

LD3

Operation Manual

VERIPOS

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CONTENTS

1.	INTRODUCTION	4
1.1	GENERAL.....	4
1.2	LD3 INTEGRATED MOBILE	4
1.3	WHAT THIS DOCUMENT COVERS	6
1.4	EQUIPMENT SUPPLIED WITH THE UNIT	6
1.5	HELPDESK	6
1.6	VOSS – VERIPOS ONLINE SUPPORT.....	7
1.7	ENABLING THE EQUIPMENT FOR USE	7
1.8	WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT.....	8
1.8.1	Replacement of Battery	8
1.9	DISCLAIMER.....	8
2.	SAFETY	10
3.	SYSTEM DESCRIPTION	10
3.1	LD3	10
3.2	LD3 OPTIONS.....	11
3.2.1	Single coax connector	12
3.2.2	Dual coax connector	12
3.3	FRONT PANEL	13
3.3.1	Battery Alarm and LED	13
3.3.2	Signal Status LEDs.....	14
3.3.3	Demodulator Status LEDs	14
3.3.4	Front panel connector	14
3.4	REAR PANEL DETAILS.....	15
3.4.1	Grounding screw.....	15
3.4.2	Power and data connector	15
3.4.3	Coaxial connectors	16
3.5	INTERFACE CABLE HARNESSSES	16
3.5.1	Configuration harness (front)	16
3.5.2	Power supply and data harness (rear)	17
4.	SOFTWARE INSTALLATION.....	17
5.	LD3 OPERATION.....	18
6.	CONFIGURATION	19
6.1	SOFTWARE VERSIONS.....	20
6.2	CONFIGURING THE LD3 FOR USE	20
6.2.1	Enable / Disable.....	21
6.2.2	Beam or downlink comms satellite selection	22
6.2.3	Reference Station selection.....	25
6.2.4	Serial Comms	26
6.2.5	View Signal and Status Information.....	28
6.2.6	Upload Firmware.....	29
6.3	LD3 AND LD3S – CHANNEL 16 MANUAL BEAM SELECTION	29
6.3.1	Example – Channel 16 manual beam entry	29
6.4	LD3S-G2.....	31
6.4.1	Introduction	31
6.4.2	Technical Information	31
6.4.3	Septentrio RXTools.....	31
6.4.4	LD3S-G2 operation.....	32
6.4.5	Receiver configuration	33
7.	TROUBLESHOOTING	40

7.1	VERIPOS HELPDESK	40
7.2	POWER FAULTS	41
7.2.1	Enable/disable faults.....	42
7.3	LBAND TROUBLESHOOTING	43
7.4	CABLE HARNESS DIAGRAMS	44
7.4.1	Front panel “control” connector for harness	44
7.4.2	Rear panel “Power + data” connector	45
7.5	TECHNICAL SPECIFICATION.....	47
7.5.1	Certification	47
7.5.2	Environmental	47
7.5.3	Mechanical.....	47
7.5.4	Electrical	47
7.5.5	Demodulator	47
7.5.6	Connectors.....	48
7.6	SERVICE ACCESS LICENCE AND SERVICE NOTIFICATION FORM	50
7.6.1	Service Access Licence	50
7.6.2	Service notification form.....	50
7.6.3	Service Access Instructions.....	51
7.7	REFERENCE STATIONS	52
7.7.1	MF Marine Beacon IALA stations	52
APPENDIX I.....	53	
CONTACT INFORMATION	53	
APPENDIX II.....	55	
ABBREVIATIONS	55	
APPENDIX III.....	58	
GLOBAL CHART	58	
APPENDIX IV.	60	
SERVICES NOTIFICATION FORM.....	60	
APPENDIX V.	63	
QUALITY STANDARDS	63	
APPENDIX VI.	68	
NMEA SENTENCES	68	

1. INTRODUCTION

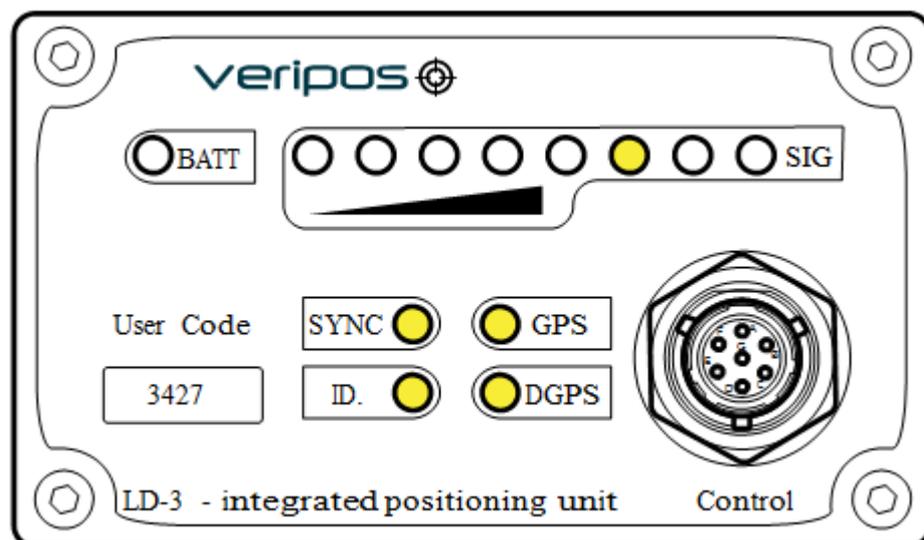
1.1 GENERAL

This document provides the information required to operate an LD3.

When consulting this document it will help the user to have the following items available:

- the 'Equipment Packing list' (included with the equipment packing sent to site)
- the LD3 Installation manual
- the VERIPOS document "Antenna and Coaxial Cable Installation" from VOSS – <http://help.veripos.com> or on the Workshop CD supplied with LD3
- interactive training modules and VERIPOS product literature on CD ROM

1.2 LD3 INTEGRATED MOBILE



LD3 Front Panel

The VERIPOS LD3 is a small, lightweight and economical unit, which is configured either as a standalone L-band satellite demodulator or as an integrated positioning mobile, complete with an internal single or dual frequency GNSS receiver.

It can receive VERIPOS L-band transmissions from high and low power satellites and output RTCM correction data for use by external GNSS equipment. When used with a dual-frequency GPS receiver and Verify QC software, the full range of VERIPOS GNSS augmentation services is available.

When fitted with the optional single frequency GPS receiver, the unit can compute DGPS position solutions using single or multiple reference stations.

Recent models are the LD3S have an option for a dual frequency GPS receiver. Units with this configuration will also be able to compute a PPP solution in addition to a DGPS position solution

Details of this type of GPS receiver can be found in section 6.4.

The position is computed within the GPS receiver and output on a serial port in NMEA format for use by the user's equipment.

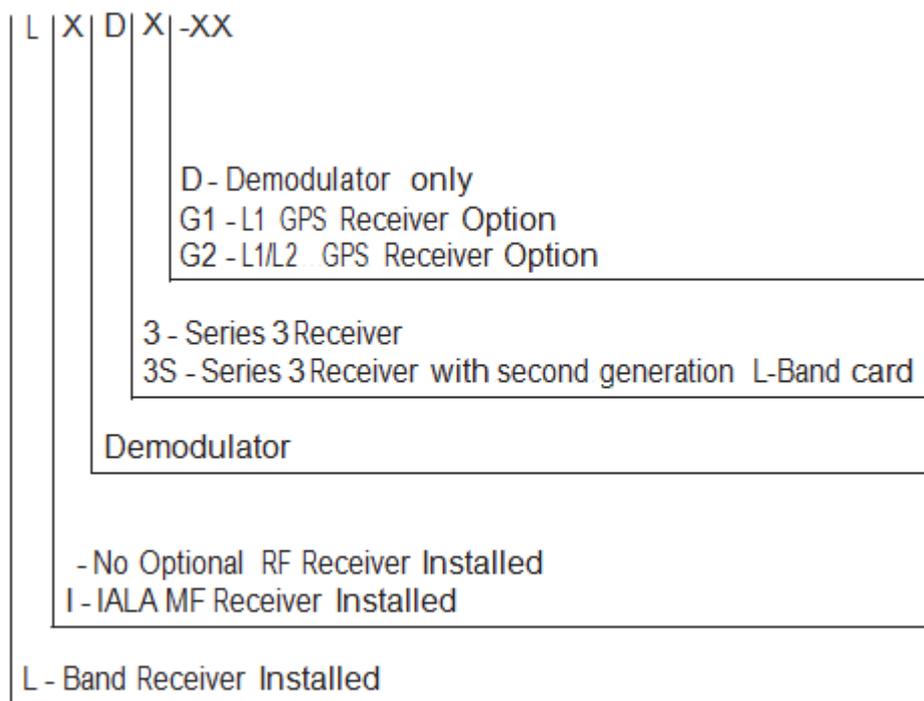
Details are in Section 6 *Configuration*

As an option, an LD3 unit with dual channel MF receiver can accept correction data from two IALA MF beacons. When available, these corrections will be used by the internal GPS receiver in the absence of LBand corrections (the corrections are not output for use by external equipment).

NOTE: This option is not available for units fitted with dual frequency GPS receivers.

The LD3 is available in various models.

The options installed are indicated by the model number as shown below:



Note:

Current LD3 units use a second generation L-band card identified with an "S" suffix in the model number (e.g. LD3S-G1 vs. LD3-G1).

The L-band Control Software can be used with both types of units. There are slight differences in the menus when configuring and operating the unit.

1.3 WHAT THIS DOCUMENT COVERS

This manual:

- Familiarises the operator with the appearance of the LD3 and the status indicators used during normal operation. This provides the operator with interconnection details and basic fault - finding procedures
- How to install and operate the LD3 using **Veripos L-Band Control 2** software on a Window PC with serial port connections and is used to enable/disable the unit and to reconfigure it for new operating regions

For installation of Equipment please see the LD3 Installation manual.

1.4 EQUIPMENT SUPPLIED WITH THE UNIT

The LD3 is supplied with:

- LD3 Operations manual
- the VERIPOS document “Antenna & Coaxial Cable Installation Guide” on CD ROM with relevant L-Band Control 2 software for enable/disable when used with VERIPOS correction services
- interface cables, coaxial cable and antenna(s) (specified when ordering)
- VERIPOS product literature and reference material on CD ROM

VERIPOS recommend the use of ‘VeriChart’ software to create local service coverage charts. This software, supplied on the Workshop CD with new units will help when selecting stations for the work area.

A free copy can be downloaded from the VERIPOS online support service (VOSS):

<http://help.veripos.com> together with an update file detailing the VERIPOS stations.

1.5 HELPDESK

VERIPOS encourage all users to promptly report problems or operating queries to the Helpdesk so that they may receive assistance.

The VERIPOS Helpdesk is the first point of contact for technical enquiries and fault reports. It is manned 24 hours per day, 365 days per year.

Helpdesk contact details are listed in Appendix 1.

For assistance with basic troubleshooting see the Troubleshooting chapter.
We recommend initial contact is made by email to the Helpdesk.
Users can also create a fault ticket on the VOSS web site.
This will ensure contact details and the description of the fault are correctly recorded.

The Veripos Helpdesk are trained to provide direct assistance with most queries and problems and can request technical staff to provide support for more complex issues.

1.6 VOSS – VERIPOS ONLINE SUPPORT

VERIPOS have an online customer support system called VOSS (VERIPOS Online Support System).

VERIPOS recommend users to frequent the web address below to view announcements made on this system.

VOSS includes a facility for raising fault tickets which are then automatically submitted to the VERIPOS Helpdesk.

The VOSS url is: <http://help.veripos.com>

VOSS has comprehensive help and assistance that provides:

- updates on VERIPOS service availability and notifications
- a knowledge base, troubleshooter and downloads
- online fault reporting

1.7 ENABLING THE EQUIPMENT FOR USE

VERIPOS correction signals are provided as a chargeable service.

To decode Veripos corrections and output positions the LD3 must be enabled.

This is achieved by the user making a request to the VERIPOS Helpdesk and quoting the LD3 User code and the Service Access License (SAL) number.

The enable/disable procedure is detailed in the Configuration chapter.

Note:

To use VERIPOS correction signals a Service Access Licence (SAL) contract, between the user's company and the VERIPOS Operations department, must be in place.
When contacting the Helpdesk please quote the SAL number associated with the VERIPOS equipment.

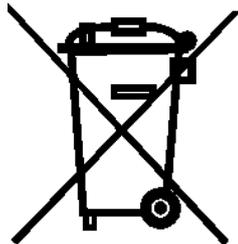
The Helpdesk is not authorised to issue a code unless an active SAL exists and its reference number can be determined.

1.8 WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT

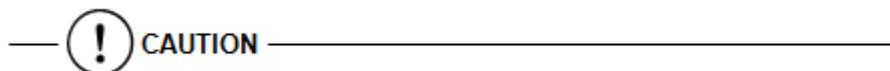
The WEEE directive places an obligation on EU-based manufacturers, distributors, retailers and importers to take-back electronics products at the end of their useful life. A sister directive, RoHS (Restriction of Hazardous Substances) complements the WEEE directive by banning the presence of specific hazardous substances in the products at the design phase. The WEEE directive covers all VERIPOS products imported into the EU as of August 13, 2005. EU-based manufacturers, distributors, retailers and importers are obliged to finance the costs of recovery from municipal collection points, reuse, and recycling of specified percentages per the WEEE requirements.

Instructions for disposal of WEEE by users in the European Union. The symbol shown below is on the product or on its packaging, which indicates that this product must not be disposed of with other waste. Instead, it is the user's responsibility to dispose of their waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment.

The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about recycling centres, please contact the local city office, the household waste disposal service or the product supplier.



1.8.1 Replacement of Battery



Where replacement of the battery unit is required, please carefully dispose as hazardous waste in line with local regulations that apply.

1.9 DISCLAIMER

VERIPOS accepts no responsibility for any damage or injury to the system, ship or personnel caused by drawings, instructions or procedures not prepared by VERIPOS.

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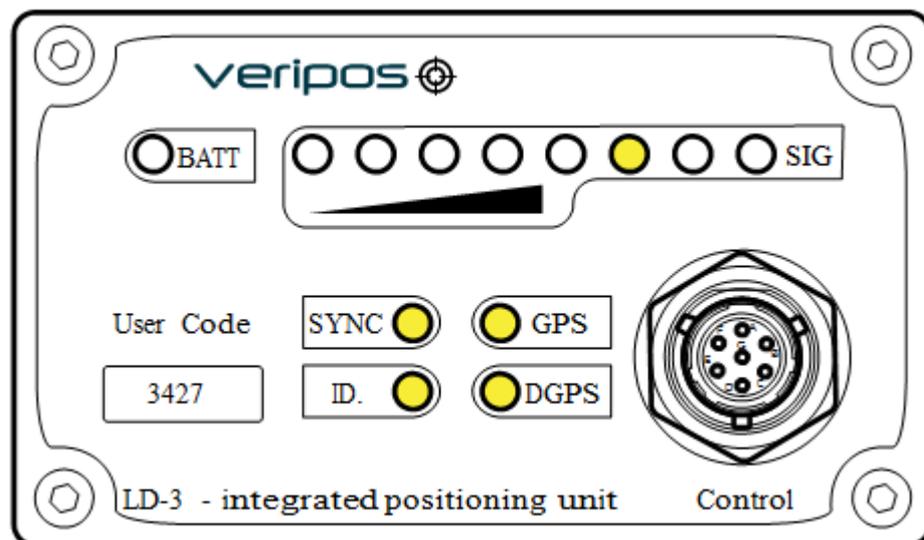
2. SAFETY

Safety is the responsibility of the individual carrying out the work and all persons involved in the operation.

- On arrival at the worksite contact the designated contact or bridge for a site specific safety induction
- Follow all relevant site safety rules and regulations that apply at the work site
- Obtain all permits relevant to the job prior to any work commencing

3. SYSTEM DESCRIPTION

3.1 LD3



LD3 Front Panel

The LD3 is the simplest receiver manufactured by VERIPOS. The range offers benefits to the user in terms of economy, small size, ease of operation and low power dissipation.

Power input to the unit is 11–36 VDC. An external PSU is required. VERIPOS normally supply a suitable AC power supply. The unit incorporates front panel LED indicators for status monitoring but it has no integral keyboard or alphanumeric display. All configuration is performed using an external PC running OEM software supplied by VERIPOS. A technical specification for the LD3 is in the Reference information chapter.

3.2 LD3 OPTIONS

Note that earlier models do not have an “S” in the name on the front panel.

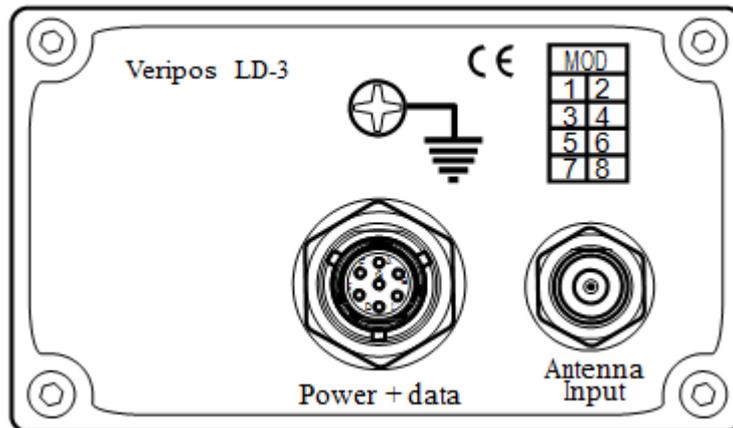
<p>LD3S-D Standalone L-band Satellite Demodulator</p>	<p>L- band card is installed and only one coaxial connector is fitted.</p> <p>The unit outputs DGPS corrections for use by external GNSS equipment.</p>
<p>LD3S-G1 Integrated Positioning Mobile</p>	<p>L-band card is installed together with a single channel GPS receiver. One coaxial connector is fitted as standard, a second may be fitted if</p> <p>A DGPS position is computed internally and output in NMEA format. DGPS corrections are output for use by external GNSS equipment.</p> <p>Raw GPS data may be output for use by external processing equipment.</p> <p>Requires two coaxial connectors in order to receive L-band signals using the vessel's Inmarsat system.</p>
<p>LID3S-G1 Integrated Positioning Mobile with IALA Beacon Receiver</p>	<p>L-band card and single channel GPS receiver.</p> <p>The GPS receiver incorporates an integrated two- channel IALA beacon receiver.</p> <p>Two coaxial connectors are fitted.</p> <p>The unit has all the features of the LD3-G1. In addition it can receive DGPS correction data from two IALA beacons. These corrections are used by the internal GPS receiver if it loses L-band corrections.</p>
<p>LD3S-G2</p>	<p>L-band card and dual frequency GNSS receiver.</p> <p>Two coaxial connectors are fitted (single coaxial configuration can be fitted if requested).</p> <p>DGPS and PPP positions are computed internally and output in NMEA format. Corrections are output for use by external GNSS equipment.</p> <p>Raw GNSS data may be output for external processing.</p>

Notes:

- The LD3 cannot receive VERIPOS HF reference stations.

- The LD3 position solution is computed within the GPS receiver. MF IALA Beacon corrections cannot be output to external equipment.
- Optionally users can incorporate a suitable PC running Verify QC software. The full range of VERIPOS services is then available for use.
- The LD3 may be fitted with one or two coaxial input connectors.

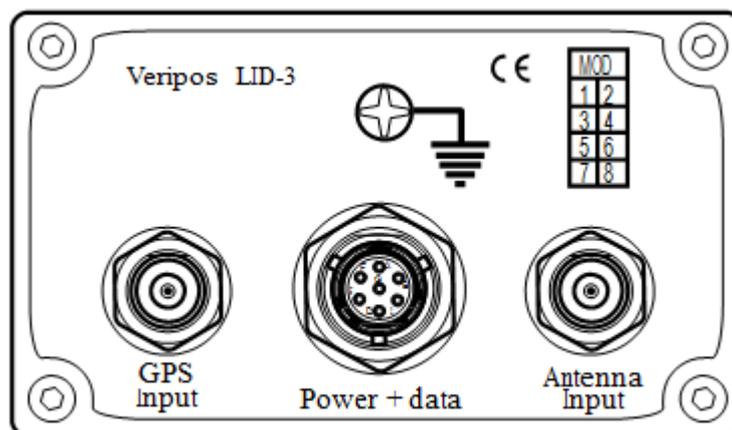
3.2.1 Single coax connector



LD3 rear panel single coaxial connector

- For LD3-D units correction signals may be received from either a high or low power satellites. High power signals can be received using a small omni-directional (SPOT) antenna. Low power signals require the use of a narrow-beam steerable dish antenna (ship's Inmarsat antenna is normally used). When interfacing an LD3S to an Inmarsat system it is recommended to insert a DC block in the L-band cable. See the LD3S Installation manual.
- For LD3-G1 and LD3S-G2 units, correction signals may only be received from high power satellites. A dual (or tri)-band omni-directional antenna must be used which receives signals from both the geo-stationary communications satellite and the GNSS satellites.

3.2.2 Dual coax connector

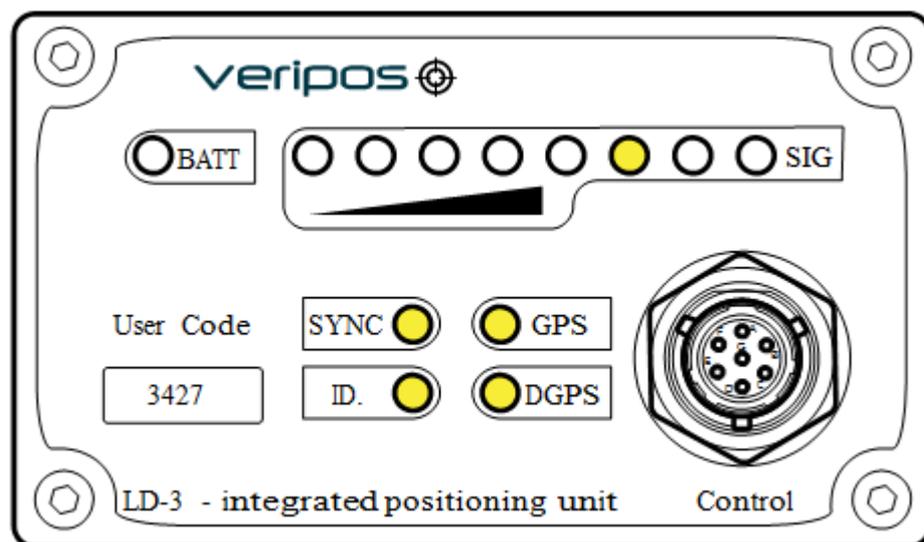


LD3 rear with dual coax connector

One connector is used for the L-band receiver and one for the GPS receiver. Depending on antenna choice the L-band input may receive corrections from high or low power transmissions.

- LD3-G1 units - the GPS input may be used with a standard GNSS antenna to receive GPS signals.
- LID3-G1 units - the GPS input may be used with a dual or tri-band antenna to receive both GNSS signal and correction signals from VERIPOS and the IALA/MF Beacons.

3.3 FRONT PANEL



LD3 front panel

The front panel of the LD3 contains 8 x LEDs for signal status, 4 x LEDs for receiver status, 1 x LED for power status and 1 x Amphenol 7-pin female data connector.

Note:

On LD3S-G2 units the GNSS input must be connected to a dual frequency GNSS antenna to receive both L1/L2 GPS and GLONASS signals.

3.3.1 Battery Alarm and LED



Battery LED

The 'BATT' LED illuminates and an audible alarm is activated when the DC input voltage drops below 11 VDC. In normal operation the LED is off.

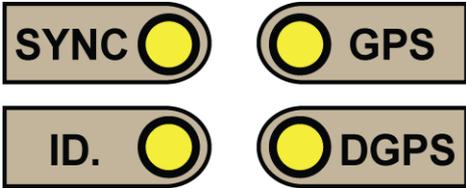
3.3.2 Signal Status LEDs

The signal status LED bar graph consists of eight LEDs. From left to right, the LED colours are: 1 x Red, 3 x Amber and 4 x Green.



Where the green indicators are illuminated the signal strength is adequate for normal operation.

3.3.3 Demodulator Status LEDs



SYNC LED	Illuminated when LD3 is locked onto the downlink beam.
ID LED	Illuminated when LD3 is enabled for service, flashes when LD3 is disabled.
GPS LED	Lit when the GNSS receiver is outputting a GGA position telegram. Flashes indicate the number of satellites used in the position computation.
DGPS LED	Lit when the GNSS receiver is outputting a differentially corrected GGA position telegram.

3.3.4 Front panel connector



LD3 Front panel connector

The “Control” connector is a 7-pin Amphenol circular female connector. It provides two bi-directional RS-232 interfaces for:

- demodulator configuration
- GPS receiver configuration

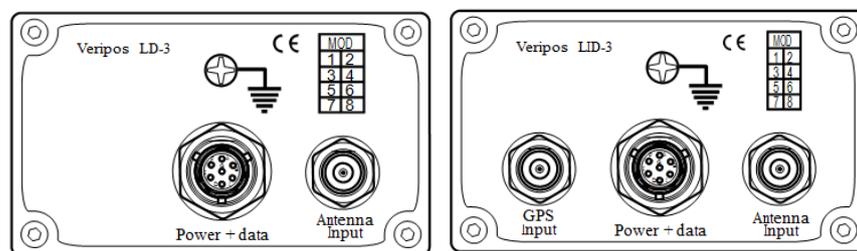
LD3 Configuration is carried out using an external Windows PC with serial port supplied by the user. Typically VERIPOS supply the required software applications and cable harness terminated in separate D9 connectors, to simplify interfacing.

Note:

A 1pps output is also available from this front panel connector.

See the Reference information chapter for details of connector pin-out and wiring diagram.

3.4 REAR PANEL DETAILS



LD3 rear panel single or dual coax conn

3.4.1 Grounding screw

The LD3 chassis must be connected to ships ground using the screw on the rear panel.

3.4.2 Power and data connector

This is an Amphenol 7-pin male connector.

It is used for power input and also for multiple RS-232 interfaces:

- DC power in
- NMEA out
- RTCM out

A cable harness is normally supplied with the LD3 which separates the multiple functions of the “Power + data” connector into single function cables, terminated in standard DB9 connectors.

See the Reference information chapter for details of the connector pin-out and a wiring diagram for the cable harness.

See the LD3 Installation manual for interfacing instructions.

3.4.3 Coaxial connectors

The rear panel may be fitted with either one or two TNC female coaxial connector (see illustrations above).

Their functions are as follows:

LD3 with **single** coaxial connector

- Antenna input – TNC female: L-band in
GPS in (when using a dual purpose L-band / GNSS antenna)

LD3 with **two** coaxial connectors

- GPS– TNC female: GPS in
MF IALA Beacon in (when using a dual purpose GNSS / MF antenna)
- L-band input) – TNC female: L-band in

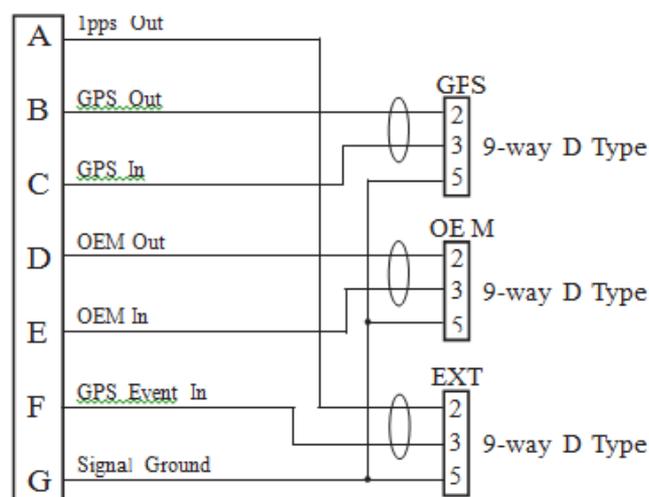
See the LD3 Installation manual for full details of the antenna and cabling options.

3.5 INTERFACE CABLE HARNESSES

These harnesses are for the LD3 and LD3S models only

3.5.1 Configuration harness (front)

7 way Amphenol

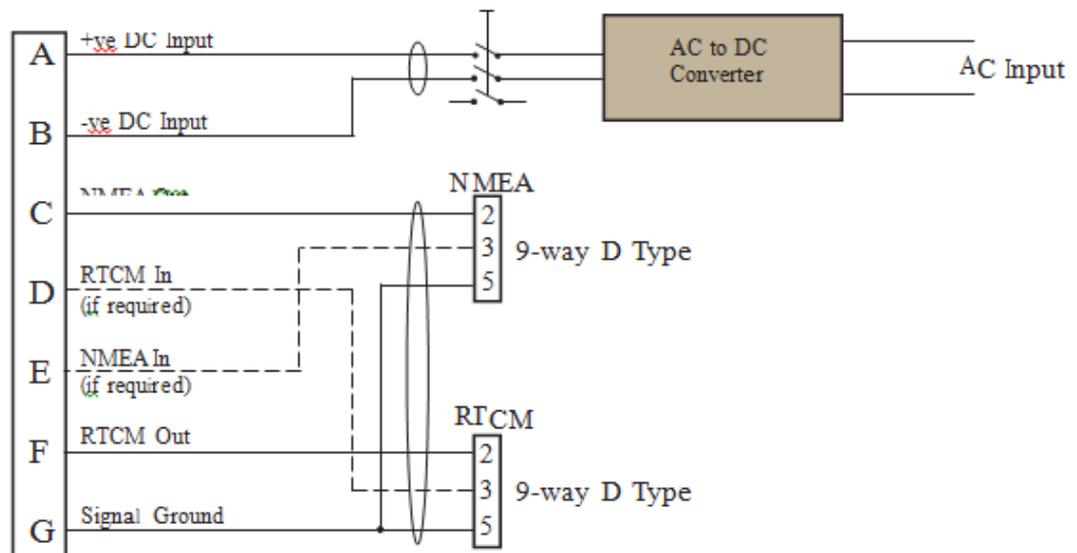


LD3 front panel config harness

The configuration cable is split between the demodulator (OEM) and GNSS receiver (GPS). These are labelled and can be connected to a DB9 standard serial port on a laptop or PC.

See the *Reference information* chapter for port pin-outs.

3.5.2 Power supply and data harness (rear)



LD3 Power and data rear harness

The power supply and data cable can be modified such that the LD3 outputs both NMEA position messages and RTCM.

See the *Reference information* chapter for details.

4. SOFTWARE INSTALLATION

This manual covers the use of the L-band controller software. It can be installed on any computer running the Microsoft Windows operating system with an available RS-232 serial port. If no RS-232 port is available the user must obtain and install a suitable USB-to-serial converter.

The software is supplied with new units on a CD ROM which will autorun when inserted in the computer, opening a browser window which displays the VERIPOS logo and a list of contents. Optionally navigate and select "index.html".

Select and run "VERIPOS L-band Control 2".

Install the software in the usual manner, selecting options to suit your requirements and launch the software on completion.

5. LD3 OPERATION

The LD3 is designed to function with minimal user intervention during normal operations. Monitor the unit status using the front panel indicators described in chapter 3 System description.

VERIPOS recommend that the user specifies the required data output rates and format when the unit is ordered. Ports can be configured for use by the VERIPOS workshop.

For normal operation, the indicators should be as follows:

- Batt – OFF
- Sync – ON
- ID – ON (not flashing)
- GPS – Flashing (see note below) DGPS – ON (see note below)
- Signal level bar graph (row of 8 LEDs) – At least one of the green LEDs should be ON

Note:

GPS and DGPS LEDs' check the status of the NMEA position output message. They will normally be as shown above, but may be extinguished if the user has configured a non-standard output format.

In order to make changes to the unit configuration the user must attach an external PC to the front panel connector of the LD3 (using the front cable harness supplied) and run the configuration software.

Configuration changes are required when:

1 During initial commissioning or when interfacing to new equipment:

The unit must be configured for the vessel operating region.
In addition, the NMEA Position and RTCM output ports may require configuration.

Note:

Wherever possible, use the default baud rate of **9600bps** for both NMEA and RTCM ports

The **NMEA output port** must be configured to output the telegram(s) and baud rate required by the external equipment.

The **RTCM output port** must be set to a baud rate compatible with the external equipment.

Contact Veripos Helpdesk where:

Change is required to the configuration of the NMEA position output. These changes require reconfiguration of the GPS Receiver using other utility software. The use of this software is not covered in this manual. Care is needed as the utility software allows many receiver parameters to be modified. Unauthorised configuration changes may degrade performance or render the unit inoperable.

For **LD3S-G2** users - details on reconfiguration of the GPS receiver can be found in section 6.4 of this Manual.

2 Enabling or disabling the unit

The unit will not output positions or corrections if it is disabled (ID LED flashing). This is the most common procedure. LD3 enable/disable is covered in the *Configuration* chapter in this manual.

Use the Veripos L-band control 2 software to enable / disable the LD3 in conjunction with the front panel cable harness and serial port connection.

3 When moving to a new operating area

Use the Veripos L-band control 2 software to enable / disable and change beam or reference stations used. Connect to the LD3 with the front panel cable harness and serial port connection.

Note 1:

The Downlink beam and Reference stations must be selected according to the operating region.

Use a work location chart generated in Verichart to identify beam and reference stations for the work location.

Note 2:

For the **LD3S** model, the internal RTCM baud rate (used by the GNSS receiver) can be set to a different baud rate to the externally presented RTCM serial port output.

6. CONFIGURATION

Commissioning will normally be performed by a Veripos GNSS Technician. Configuration changes may be carried out following installation or when replacing an LD3/LD3S receiver.

Configuration changes are easily made and include:

- 1 Enabling/disabling the LD3/LD3S and making changes to the services in use
- 2 Selecting the beam or communications satellite appropriate to the operating region
- 3 Selecting reference stations appropriate to the work area
- 4 Change alarm thresholds related to the GPS system. (Optimised during commissioning - only change these after consulting VERIPOS)
- 5 Archiving logged data (e.g. troubleshooting)
- 6 Entering a new license code (e.g. when replacing hardware)

The first three procedures are conducted on a regular basis and described in detail below.

Four to six are infrequent and are included for reference in the *Reference information* chapter.

6.1 SOFTWARE VERSIONS

Configuration of the LD3 is done using the L-Band control 2 software.

Latest versions are available online from VOSS at <http://help.veripos.com> users are advised to regularly check this site for updates and useful reference material when using the LD3.

6.2 CONFIGURING THE LD3 FOR USE

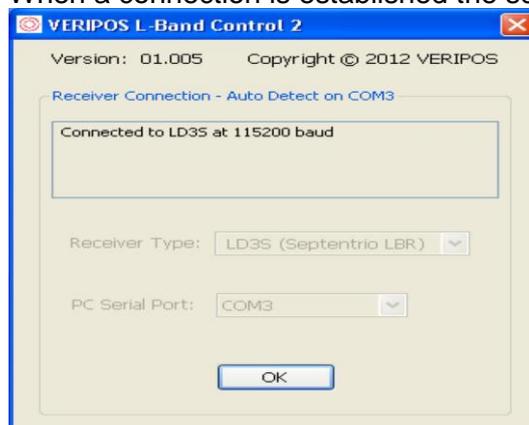
With the L-band control 2 software installed on the PC with a suitable serial port, connect the VERIPOS configuration cable harness to the “Control” connector on the LD3 front panel with the unit connected to power and the L-Band antenna connected.

Connect the D9 “**OEM**” connector to a vacant RS-232 serial port on the PC.

Run the L-band Control 2 software - select the “Veripos L- band Control 2” shortcut (Programs\Veripos folder in the “Start” menu).

The software will search for the correct serial port and when found communicate with the LD3.

When a connection is established the screen will be similar to the one below:



This page displays the unit type and baud rate used.

Click OK.

The Main Menu screen will be displayed:



Configuration sub-menus are accessed from the *Main Menu* by selecting the appropriate button. Selecting *Close* terminates the program.

6.2.1 Enable / Disable

Enable the LD3 for the chosen VERIPOS service.
This will allow output of RTCM corrections and position output.

Enable the LD3

Using a Service Notification Form (*Appendix*), email this to the Veripos Helpdesk to request enable or disable. Email address for Helpdesk is helpdesk@veripos.com

You must include the Vessel name, SAL number and User (unit) Code for the LD3.

The User Code is displayed on the LD3 front panel and on the *Unit Registration* page of the L-Band control 2 software, when connected.



Example LD3 Unit Registration Page (LD3 enabled)

6.2.2 Beam or downlink comms satellite selection

VERIPOS correction data are broadcast from geostationary satellite beams (listed in table below).

The LD3 uses corrections broadcast from one of these satellites. The choice of satellite is determined by the location of the work area and is referred to as “Beam selection” or “Channel selection”.

The beam footprint chosen for use must cover the work area. A chart showing VERIPOS beam coverage is in the *Reference information* chapter.

A vessel may have more than one LD3 system installed and in these situations it is usual that more than one Veripos beam with acceptable elevation, will be available for the vessel work area.

For system redundancy different LD3 systems on the same vessel are normally be configured on to different beams.

VERIPOS correction data are broadcast from geostationary satellite beams (see table below).

The LD3 uses corrections broadcast from one of these satellites. Choice of satellite is determined by the location of the work area and is referred to as “Beam selection” or “Channel selection”.

The beam footprint chosen for use must cover the work area. A chart showing VERIPOS beam coverage is given in the Reference information chapter.

Vessels may have more than one LD3 system installed and it is likely that more than one Veripos beam with acceptable elevation, will be available in the work area. For system redundancy different LD3 systems on the same vessel should normally be configured on different beams.

VERIPOS correction data are currently broadcast on the following beams:

Beam (Satellite)	Longitude	Data Rate (bps)
98W	98W	1200
AORW	54W	1200
25E	25E	1200
AORE	15.5W	1200
IOR	64E	1200
143.5E	143.5E	1200
POR	178E	1200

The frequency for beams may change. For current information visit VOSS at:

<http://help.veripos.com>

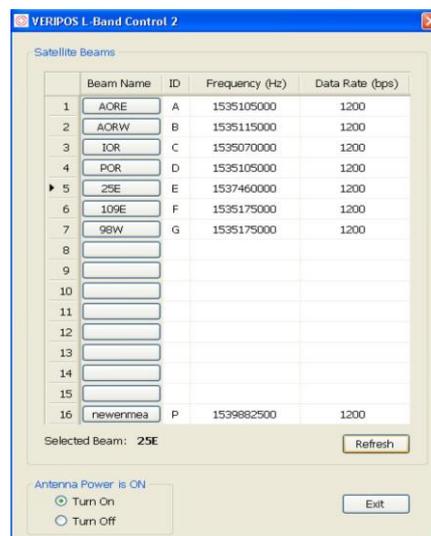
Note that the type of antenna attached to the LD3 will determine the beams which can be used.

- Omni-directional L-Band antenna - any of the high power beams can be used.
- Interfaced to the vessel's Inmarsat communications system - choice is limited to those satellites which are supported by this system.
 See VOSS for further information.

Note: If the unit is only fitted with a single TNC antenna connector it must use a combined GPS/ L-Band capable antenna.

6.2.2.1 Selecting Beam

From the main menu, select *Satellite Beams* to view the channel selection window:



From the main menu, select *Satellite Beams* to view the channel selection window:

The Beam Name with the indicator arrow is the one currently in use.
 On the example screen this is 25East (channel 5).

To change beam/channel left click on the one required then click on *Refresh*.

Note 1:

There are radio buttons on the screen to turn on or off power to the L-Band antenna voltage. Turn off the antenna power if it is connected to a directional antenna system e.g. Fleet 77.

Note 2:

The VERIPOS Helpdesk can only issue enable codes if a SAL (service access license) exists and the license number can be determined. Licenses must be pre-arranged between the user's company and the VERIPOS Operations department.
 VERIPOS correction signals are provided as a chargeable service. Users may wish to disable the equipment during periods of prolonged inactivity. Where the unit has been disabled the user must re-enable it for the required Veripos services before resuming operations.

Enabling LD3 model variants

LD3

All **LD3** units can only be enabled or disabled when receiving L-band signals from a geo-stationary satellite. Ensure the 'Sync' indicator is illuminated before attempting to enter enable or disable codes.

The 'ID' indicator on the LD3S will be extinguished when it is first switched on.

It will not be illuminated until the unit has locked to the L-band signal ('Sync' indicator illuminated).

Once a request is successful for enable / disable the Unit Registration page will show details similar to the screen below:



Select *Exit* to return to the main menu.

After changing beam / channel it is recommended to briefly disconnect power from the LD3 to reboot the demodulator card and ensure the new channel is correctly initialised. Check the 'Sync' and 'Signal strength' LEDs on the front panel of the LD3 to confirm signals are being received.

6.2.2.2 Check LD3 status

The current unit status can be determined from the 'ID' LED on the front panel.

ID LED is on	LD3/LID3 is enabled
ID LED is off	LD3/LiD3 is disabled

As noted above the indicator may be blank if the unit has no L-band signal and has been restarted.

6.2.3 Reference Station selection

The list of reference stations available for selection is determined by the satellite beam selected in the above beam/channel selection procedure.

Note: After changing the channel or enabling the unit it may take up to 2 hours for the station table to become populated.

A listing of VERIPOS reference stations shows the IDs and indicates which satellites broadcast each station corrections. This list can be downloaded from the VOSS.

Corrections from the stations selected in this procedure are sent to the internal GPS receiver (where fitted) and also to the RTCM output port

- Where an LD3-G1 (or LID3-G1) is fitted with a Magellan DG14 GNSS receiver, it will automatically select the closest stations from those enabled by the user. However VERIPOS recommend restricting the number of reference stations selected to the closest 6 or 8. This can be achieved by deselecting additional stations in the Reference Station List.
- For LD3S-G2 fitted with a Septentrio AsteRx2e GNSS receiver, it will automatically select up to 10 closest stations within 1500 km when computing a Multibase solution. Additional stations will be ignored
- When an RTCM output from the LD3 is interfaced to a computer running VERIPOS Verify QC, VERIPOS recommend all stations are enabled
- When the RTCM output is interfaced to third party equipment, the user should consult the equipment documentation to determine the optimum number of reference stations

Reference stations closest to the work area will normally provide the greatest accuracy. To achieve the specified system accuracies a **range limit (maximum baseline) of 1500 km** should be observed.

When using an LD3 to provide correction output to a PC running Verify QC it is typical to select all the reference stations for output. Further control can be done in Verify QC.

VERIPOS supply the “VeriChart” utility program to assist the user in selecting stations. It is supplied on CD with all new LD3 units and is available (with the latest reference station database updates) as a download from the VERIPOS Online support site (VOSS).

6.2.3.1 Using Veripos APEX /Ultra PPP

These services can only be used on the **LD3S-G2** or where the LD3 is connected to an external computer which is running Verify QC software interfaced to an external, dual frequency GPS receiver.

VERIPOS Ultra/Apex services have no range limitations and may be used at any location.

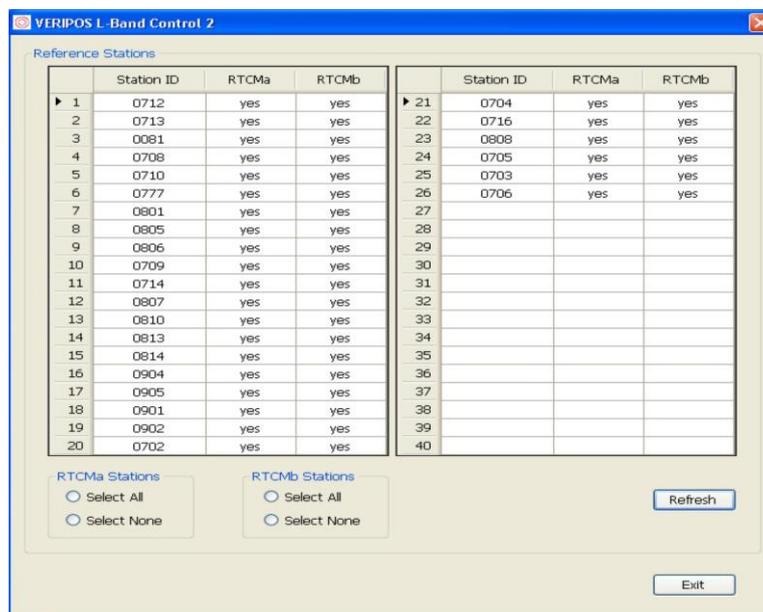
When using these services, the Ultra/Apex ID must be enabled in the station list.

Service	Station ID	NMEA Station ID
Ultra	68	0068
Ultra ²	68 + 75	0268
APEX	81	0081
APEX ²	81 + 81	0281

Note: The Station IDs are displayed on the Veripos Unit user interface. The NMEA Station IDs appear on the output NMEA message. Currently Ultra² is only available with Verify-QC.

To select reference stations:

From the main menu, select *Reference Stations* to open the station selection dialog:



To select/deselect station RTCM a and/or RTCMb output left click on Yes / No to toggle the setting for each desired station.

When finished click on *Refresh*.

The *Reference Stations* table may be blank if the unit is disabled or where beam/channel selection has been recently changed (awaiting refresh).

6.2.4 Serial Comms

The “Serial Comms” option allows LD3 demodulator ports to be configured.

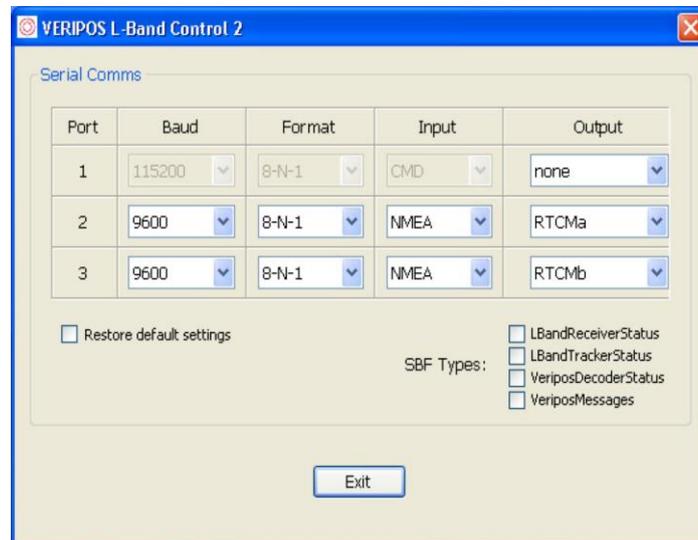
Only amend the default settings where changes are necessary.

Where reconfiguration of output ports is considered, contact the VERIPOS Helpdesk for assistance.

NOTE: description depending on LD3 model varies – see options BELOW.

A: LD3 setup for serial comms

From the main menu, select *Serial Comms* to view the demodulator port settings:



This dialog is used to configure Port 1 on the demodulator card (Port 2 is not used) and to restore default settings.

Port 1 outputs RTCM data to both external equipment and to the internal GPS receiver. VERIPOS recommend default baud rate of 9600.

Port 1 receives NMEA position telegrams from the GPS receiver.

If the receiver is configured to output NMEA GGA output strings the demodulator will read the data and set the status of the front panel GPS and DGPS indicators.

Note: Use this dialog with care. Incorrect settings may prevent correct system operation. Match any changes using this screen to those on the the GPS receiver using Ashtech Evaluate software (not covered in this manual) or the RxControl software (refer to section 6.5 LD3S-G2).

The default baud rate is 9600.

Any changes to the rate on the NMEA output of the GPS card the Port 1 Rx rate should be set to match.

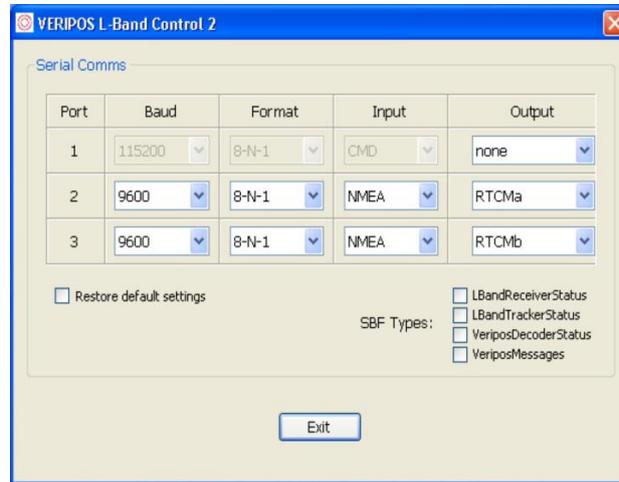
If the NMEA output does not contain the correct string, or the baud rates do not match, the LD3 front panel indicators will be extinguished.

Caution:

To suit requirements of external equipment, any baud rate changes of Port 1 must be matched with the same setting for RTCM input baud rate on the GPS receiver.

B: LD3S setup for serial comms

From the main menu, select *Serial Comms* to view the demodulator port settings:



Note:

Port 1 - only used for configuring the L-Band receiver. The only change possible is to set the output to SBF for use with Verify DPx or Verify QC (Demodulator Status).

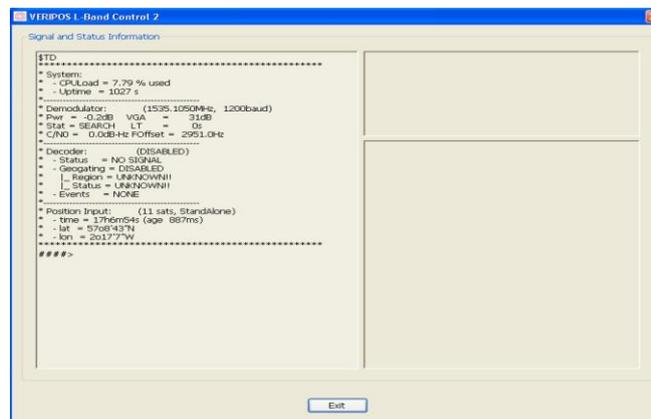
Port 2 - provides the RTCM output to external equipment from the connector on the rear panel of the LD3S.

Port 3 - provides the RTCM output to the GPS receiver and receives NMEA position telegrams from the GPS receiver. If the receiver is configured to output NMEA GGA or GGAX output strings the demodulator will read the data and set the status of the front panel GPS and DGPS indicators accordingly.

Changes to Port 3 should not be made without first contacting the VERIPOS Helpdesk.

Note that if the NMEA output does not contain the correct string or the baud rates do not match the front panel indicators will not be lit.

6.2.5 View Signal and Status Information



This window displays additional data on the status of the demodulator.

The 'Sync' indicator should be sufficient during normal operation.

A Veripos technician may request values from this screen during fault finding.

6.2.6 Upload Firmware

Only use this area under guidance from a Veripos technician or the Helpdesk.

The main menu includes an option for upgrading the unit firmware.

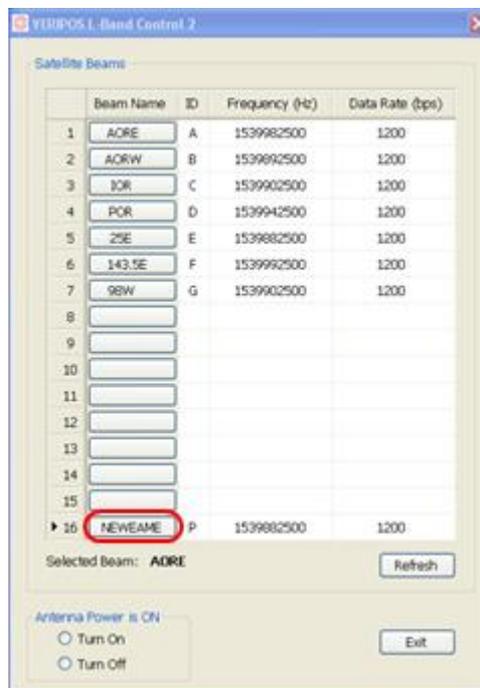
6.3 LD3 AND LD3S – CHANNEL 16 MANUAL BEAM SELECTION

6.3.1 Example – Channel 16 manual beam entry

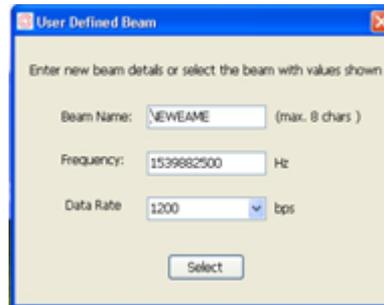
Only use when recommended by a Veripos technician or the Helpdesk.

This option allows for entry and use of a new frequency channel from the communications satellite.

In the *Satellite Beams* menu, click on Channel number 16 "BEAMNAME" entry box.



A *User Defined Beam* dialogue box opens.



Type a unique desired beam name, the frequency in Hz and the Data Rate (1200bps).

When completed click *Select* and *Refresh* to enter and use this Beam.

After the new beam has been selected the station list is updated automatically.
This can take up to 2 Hours.

To view and amend stations used go to the Reference Stations page and select all / amend stations used, as described earlier in this section.

6.4 LD3S-G2

6.4.1 Introduction

The second generation of the LD3 units, known as the LD3S can be fitted with a Septentrio AsteRx2e dual frequency GNSS receiver, to receive L1/L2 GPS and GLONASS signals.

LD3S units with this configuration functions just like a normal LD3S unit but is capable of outputting raw L1/L2 GPS and GLONASS data, RTCM data and at the same time, compute DGPS and PPP solutions, equivalent to the VERIPOS Standard multiple reference station and VERIPOS Ultra PPP solutions.

The Septentrio AsteRx2e receiver requires an application called RxControl for configuration and the receiver card has built in algorithms to compute differentially corrected positions.

A copy of RxControl software can be downloaded from the VERIPOS Online support site (VOSS). URL is in the *Contact information* chapter.

6.4.2 Technical Information

The AsteRx2e receiver is a 126 channel GNSS receiver capable of data output up to 25 Hz from each of the 3 ports. It is also capable of receiving dual frequency GLONASS signals.

This option will be available for purchase if required by the user. Please contact the VERIPOS Helpdesk for details.

The AsteRx2e GNSS receiver is preloaded with the latest released firmware available. This firmware will determine the receiver's capability. As and when new VERIPOS Services are launched may The AsteRx2e receiver is a 126 channel GNSS receiver, capable of output- ting data at a rate of up to 25 Hz from each of the 3 ports. It is also capable of receiving dual frequency GLONASS signals. This option will be available for purchase if required by the user. Please contact the VERIPOS Helpdesk for details.

The AsteRx2e GNSS receiver is preloaded with the latest released firmware available. This firmware will determine the receiver's capability. Contact Veripos Helpdesk for further information.

6.4.3 Septentrio RXTools

The RxTools Software is made up of modules.

Details of each module are in the table below.

Utility	Details
Rx Control	Used to configure the GPS receiver for various operations.
DataLink	Enables various communication types and data flow control.
Rx Logger	Used to log Raw SBF data for playback and analysis.
Rx Upgrade	Upgrade of AsteRx2e firmware and bootloader.
SBF Analyzer	Analysis of GPS /Glonass characteristics, from the logged SBF data
SBF Converter	Conversion of Raw SBF data into Rinx or other formats.

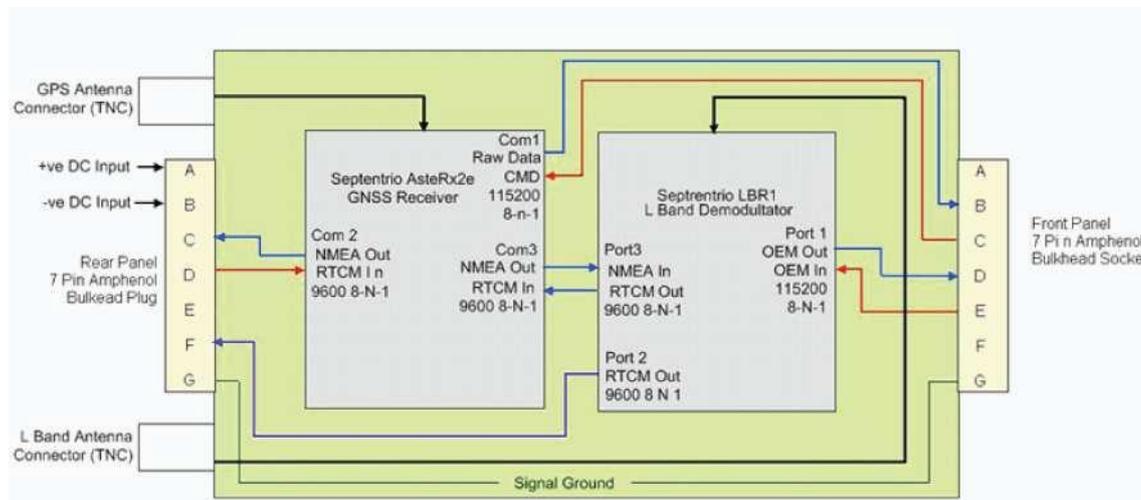
The RxTools utility software can be installed on any computer running Windows XP® Operating system with an available RS-232 serial port.

Install the software in the usual way.

Assuming that the defaults were accepted a folder named 'Septentrio' will be created in the Programs section of the Start menu. Shortcuts for all the utility modules will be created on the Desktop.

6.4.4 LD3S-G2 operation

6.4.4.1 Schematic



There are three internal communications ports on the GPS receiver for the following purposes:

COM 1 Reserved for RAW data output to the LD3 front connector and for connecting to the RX Control application for configuration.

COM 2 Used to output NMEA position output messages from the rear connector of the LD3 unit.

May also be used to inject RTCM into the GPS receiver to be used for computation by the receiver's internal algorithms.

COM 3

Injects NMEA position messages into Port 3 of the L-band demodulator and receives corrections from the internal L-band demodulator. This will determine the status of the GPS and DGPS indicators.

6.4.4.2 Standard Config

Various NMEA position output messages are available for configuration using the RxControl utility.

Users will need to select them individually on Com2 using the utility program and the data will be available on the rear connector on the LD3 unit.

Rates of output messages can be set from 0.1 Hz to 25 Hz.

Veripos recommend to only enable the GGA message on **Com 3**, as this port injects the data into the Septentrio L-band receiver.

RAW GPS data is available on the front connector of the LD3.

This data can be used together with the Verify QC software for a full range of VERIPOS GNSS augmentation services. When used this way the RTCM messages can be output via the rear connector of the LD3 unit.

6.4.5 Receiver configuration

The AsteRx2e receiver needs to be configured prior to use. Once configured the user can choose to save the configuration file and reload it at a later time or to another LD3S-G2 unit where the same configuration settings are required.

This section details the steps required when configuring the GPS receiver using the RxControl software.

Connect the D9 GPS connector to an unused RS-232 serial port on the PC.

Run the RxControl utility by clicking on the shortcut located on the Windows Desktop.

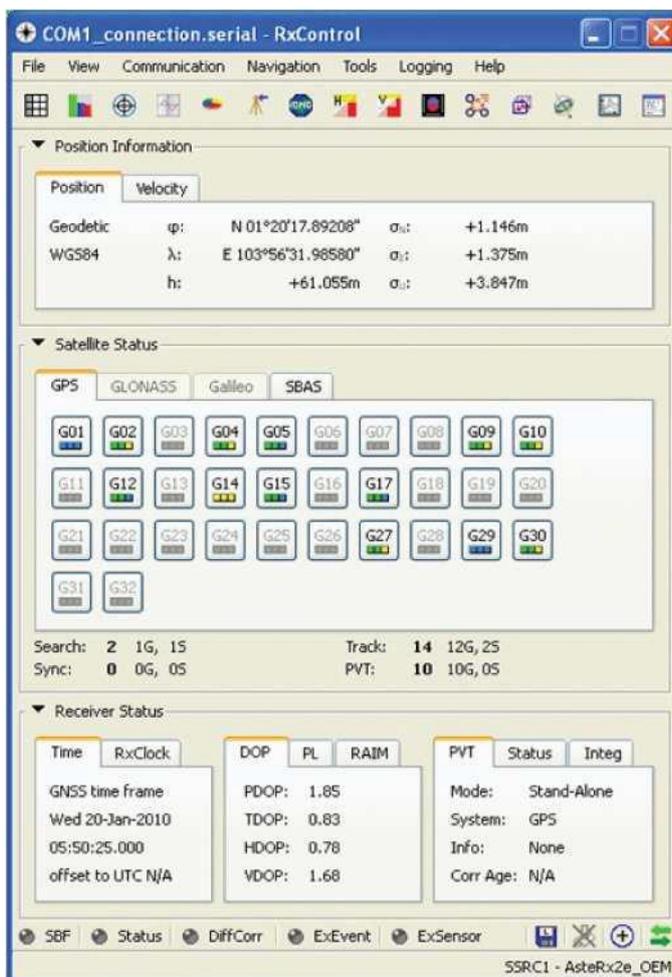
The software will attempt to connect to the receiver using the last used serial port.

When using the software for the first time the user will be prompted to configure a serial port for this connection.



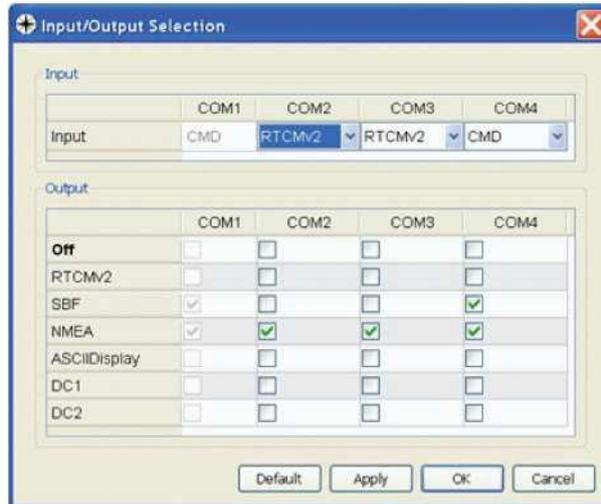
Configure the appropriate PC com port used and click Finish.

Once the connection is established, the software will display the antenna coordinates as well as the tracked satellites information:



6.4.5.1 Input/Output selection

This menu can be found in the “Communication” drop down list and allows the user to configure the different data types to be available on the various receiver ports.



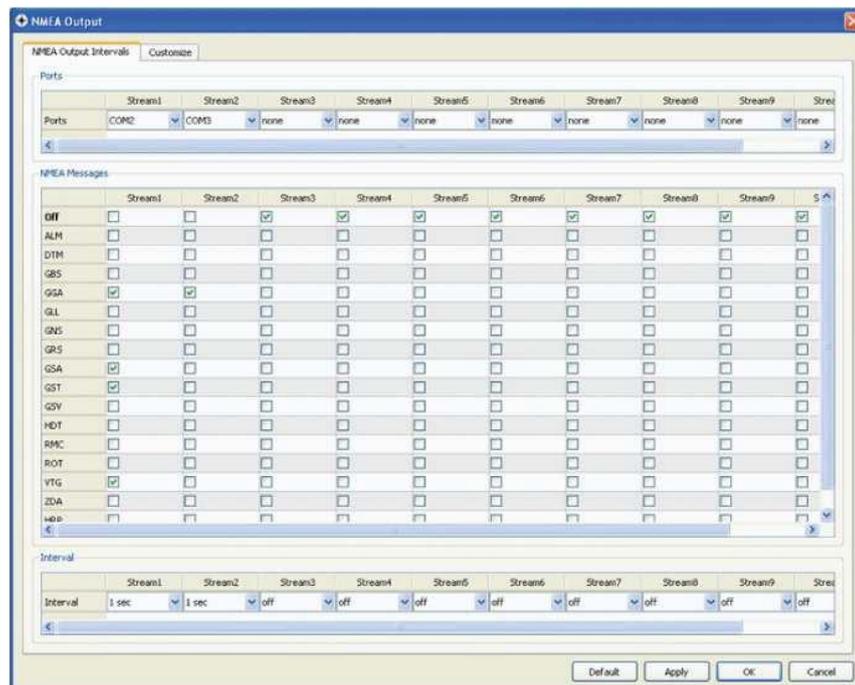
Note: For standard operations, the above settings are recommended.

6.4.5.2 NMEA output messages

The LD3S-G2 unit is capable of outputting various NMEA position messages from the rear connector.

Users are able to select all these messages and set the frequency for the message output in the NMEA Output menu.

This menu is located in the “Communication – Output Settings” drop down list.



Check on the relevant message boxes required for output on COM2.

This will determine the type of messages that will be available on the LD3S rear connector.

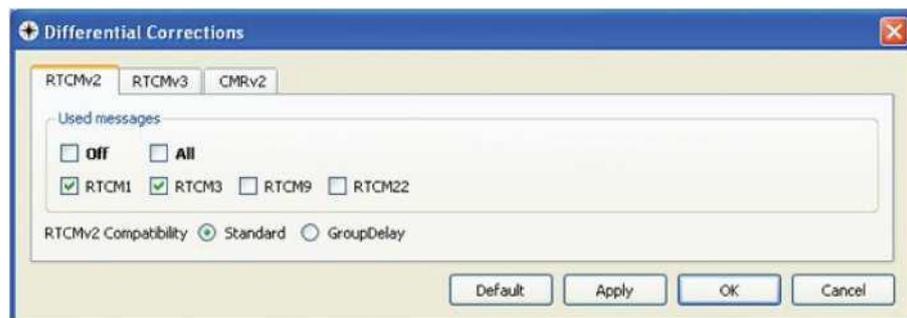
COM3 setting is usually set to GGA only.

The status of this message will be reflected on the GPS and DGPS indicators.
The user will also have to set the output interval required between 10 to 0.04 seconds
(Default is a 1 Sec interval).

6.4.5.3 Differential corrections

This menu in “*Communications – Input Settings*” configures the type of RTCM messages to be used by the AsteRx2e receiver.

Veripos recommend to configure this menu as follows:



6.4.5.4 COM port settings

Users may set the baud rates for message outputs according to preference.
Baud rates may vary from 1200 bps to 460800 bps.
The menu is in “*Communication – COM Port Settings*”.



Note:

Veripos advise to only change settings for COM2, ie. the baud rate settings for the rear connector.

Any changes to the settings for the other ports may affect the overall LD3S-G2 performance.

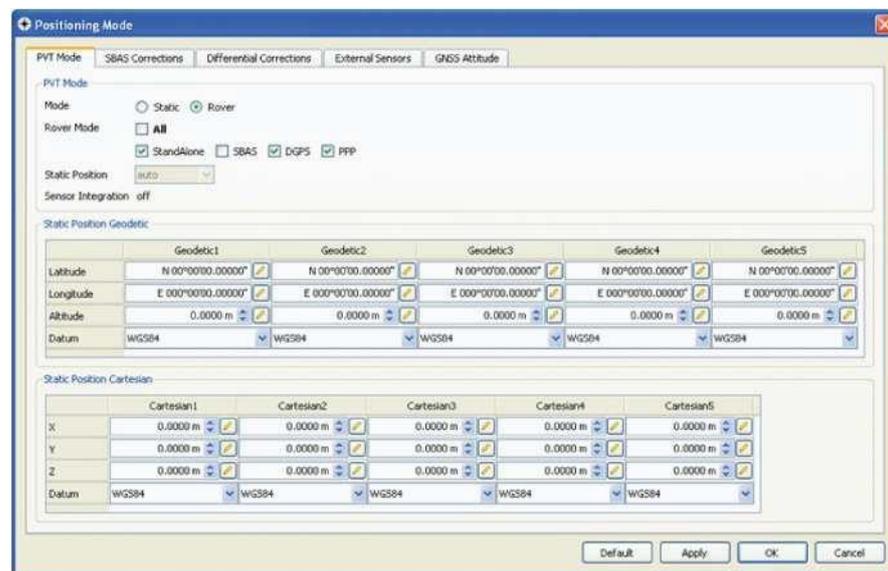
6.4.5.5 Positioning mode

This menu, found in “*Navigation – Positioning Mode*”, consist of five different tabs.

The *PVT Mode* tab allows the user to check the types of computation available using the receiver’s internal algorithm.

Options available will depend on the firmware that is loaded in the receiver.

Refer to section 6.4.2 *Technical information* for details.



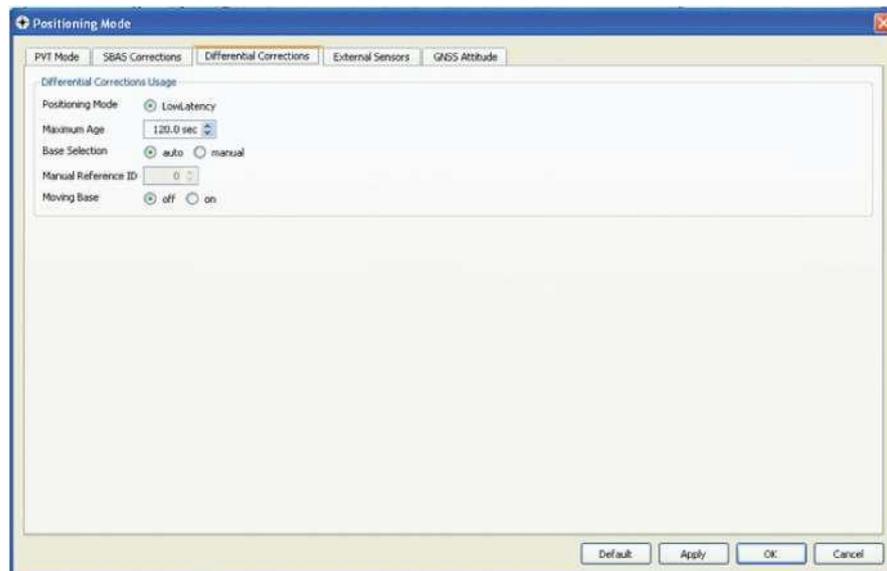
If the firmware version does not include a PPP option the PPP checkbox will not be available for selection.

The *Differential Corrections* tab sets the criteria in which the receiver uses the RTCM corrections it receives.

‘*Maximum Age*’ refers to the maximum latency of the RTCM update before the computed position falls back to standalone positions.

The receiver will attempt to use any corrections ID that it receives when the ‘*Base Selection*’ is set to *Auto*.

Setting this to manual will require the user to enter the station ID manually.



6.4.5.6 Save settings

Upon completion of the receiver setup, the configuration needs to be saved in the receiver's volatile memory so that the receiver will load its last known settings upon boot up.

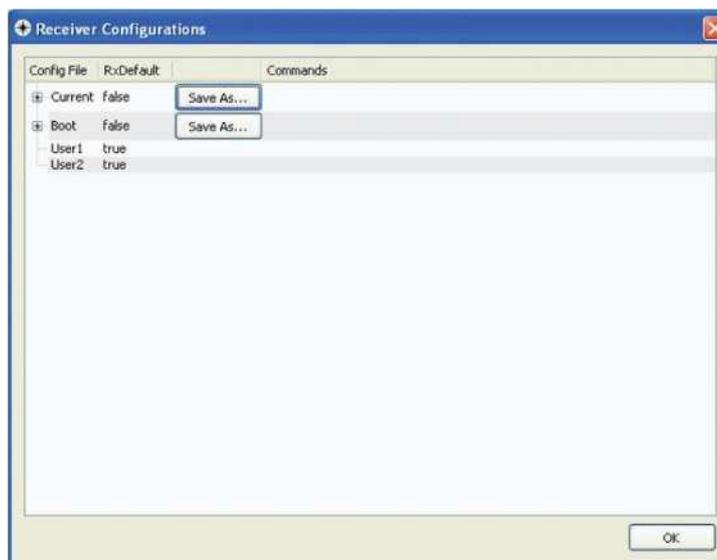
Open the 'Copy Configuration' window in the "File" drop down menu. Select 'Source' as Current and 'Target' as Boot and click *Apply*.



6.4.5.7 Creating a script file

The GPS receiver can be configured by the user and once the unit is tested the settings can be saved into a file. This file can then be used to configure other units that require the same settings.

Open the 'Show Receiver Configurations' menu in the "File" drop down tab. Click on *Save As* for the 'Current Config File' and save the file in text format (.txt).



The .txt file can be opened using the Windows Notepad application and can be manually edited by advanced users using the Septentrio commands.

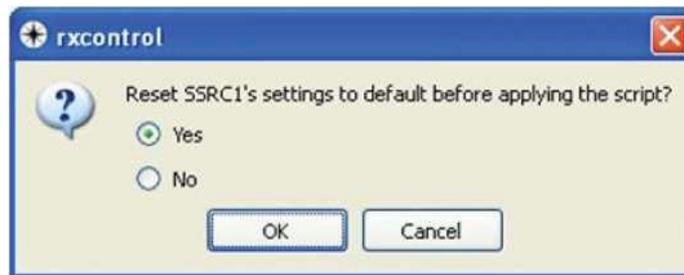


6.4.5.8 Loading a script file

The .txt file, also known as the script, can be loaded onto the AsteRx2e receiver whenever the user requires another LD3S-G2 unit to be similarly configured. This will also allow new users to send the file to VERIPOS Helpdesk for editing and rectification, before loading it back onto the receiver.

In the “File” drop down tab, select ‘Upload Script’. Choose the .txt file and click Open.

The user will be prompted to reset the receiver before applying the script. Select Yes and click OK.



The script file will then be loaded and the receiver will be configured accordingly.

7. TROUBLESHOOTING

The equipment is designed and manufactured to exacting standards. Once installed and operating it should provide prolonged trouble-free service.

7.1 VERIPOS HELPDESK

VERIPOS encourage all users to promptly report problems or queries to the VERIPOS Helpdesk.

The Helpdesk is manned 24 hours per day, 365 days per year.

Contact details are given in the Contact information chapter.

The duty operator is trained to provide direct assistance with the common queries and problems.

In addition they can call on a range of technical staff who will provide support for more complex issues.

Except in emergencies please email the Helpdesk or raise a fault ticket on the VOSS web site.

Before contacting the Helpdesk, please check the brief fault-finding in this manual. This lists common conditions and actions to take.

To ensure a rapid response initial communication with the Helpdesk should provide the following information:

- User's name
- Telephone number. If possible, choose a phone near the equipment
- Email address. Full vessel name
- Correct identification is important; VERIPOS may have installation drawings
- Name of parent company. Current Access code of LD3
- User code of LD3 (on front panel)
- Current status of the front panel indicators on the LD3

- Brief description of other VERIPOS hardware and software installed. Vessel's current operating region and Lat/Long
- Vessel's status. Is it alongside, in transit, in operation or shut down due to fault?
- History of fault including time when a problem occurred
- Is this a new installation which has not yet been fully commissioned?
- Did a problem suddenly arise with a system which was previously working?
- Did the system cease working after moving to a new region?
- Description of fault

Note: There are no user-adjustable controls or serviceable items within the LD3 receiver.

7.2 POWER FAULTS

Fault	Reason	Remedy
<p>All indicators extinguished</p>	<p>External supply disconnected or switched off</p> <p>External Supply faulty.</p> <p>LD3 fault</p>	<p>Check connection between the "Power + Data" cable harness and the external PSU. Check the AC power to the external PSU.</p> <p>Disconnect the 7-pin connector from the rear panel of the LD3. Check the voltage between pins "A" and "B" of the cable connector, taking care not to short any pins. This should be between 11V and 36V (A +ve., B -ve.)</p> <p>If voltage between pins "A" and "B" is correct. Contact Veripos Helpdesk.</p>
<p>Batt indicator illuminated.</p>	<p>Input voltage is less than 11V.</p>	<p>PSU is faulty or has inadequate current rating. Replace PSU.</p>

7.2.1 Enable/disable faults

Fault	Reason	Remedy
<p>1. After requesting a service enable all entries remain unchanged “Service Code” Status shows previous values).</p> <p>After requesting an enable / disable, “Service Code” shows new value but other entries remain unchanged</p> <p>ID lamp on LD3S front panel is extinguished (it should normally be illuminated, either solid or flashing).</p>	<p>Access code” incorrect Unit requires a reset.</p> <p>For LD3S only: Not receiving L-band signal.</p> <p>For LD3S units only: No L-band signal has been received since the unit was</p>	<p>Report problem to Helpdesk – include a note of current status and codes where applicable.</p> <p>LD3S units cannot be enabled or disabled unless the Sync indicator is illuminated. See L-Band troubleshooting.</p> <p>For LD3S units, the ID indicator is not activated until L-band signals have been received. See L-Band troubleshooting.</p>

7.3 LBAND TROUBLESHOOTING

Fault	Reason	Remedy
<p>SYNC indicator extinguished.</p>	<p>Unit requires a reset.</p>	<p>Switch power OFF for one minute then switch back ON. Allow a few minutes for the unit to acquire synchronisation.</p>
	<p>The vessel has moved to a new region but the demodulator has not been re-configured.</p>	<p>Run the VERIPOS OEM software and check which channel (beam) is selected. Use the "Global coverage chart" (see the Reference Information chapter to confirm whether this is correct for the current location.</p>
	<p>L-band signal is derived from vessel's Inmarsat. Inmarsat has lost lock or has switched to a different satellite.</p>	<p>Run the VERIPOS OEM software and check which channel (beam) is selected. Verify that the Inmarsat is tracking the same satellite.</p>
	<p>Antenna blockage</p>	<p>Visually check whether the path between the antenna and satellite is subject to blockage. This can occur when the vessel is in port or alongside a large structure. Blockage can also be caused by the vessel's own superstructure. This can usually be eliminated by changing the heading</p>
	<p>Interference</p>	<p>Investigate any source of L-band transmissions. Also high power transmissions of other frequencies. If possible, shut down possible sources to eliminate them.</p>
	<p>Antenna power turned OFF when using a spot antenna</p>	<p>For LD3S units only. Run the VERIPOS OEM software and select "Beams".</p>
<p>Antenna disconnected or inoperative.</p>	<p>Visually check antenna and cable for possible damage. Check coaxial connections.</p>	

Reference Information

7.4 CABLE HARNESS DIAGRAMS

7.4.1 Front panel “control” connector for harness

Amphenol connector	Function
Pin A	1pps Out (LVTTL timing pulse)
Pin B	GPS config. Out (RS-232)
Pin C	GPS config. In (RS-232)
Pin D	L-band config. Out (RS-232)
Pin E	L-band config. In (RS-232)
Pin F	GPS Event In (LVTTL level transition)
Pin G	0 V (RS-232 common)

Note: 1pps Out” and “GPS Event In” are rarely used

1pps Out

This provides accurate time synchronisation for third party navigation systems or multi-beam sonar.

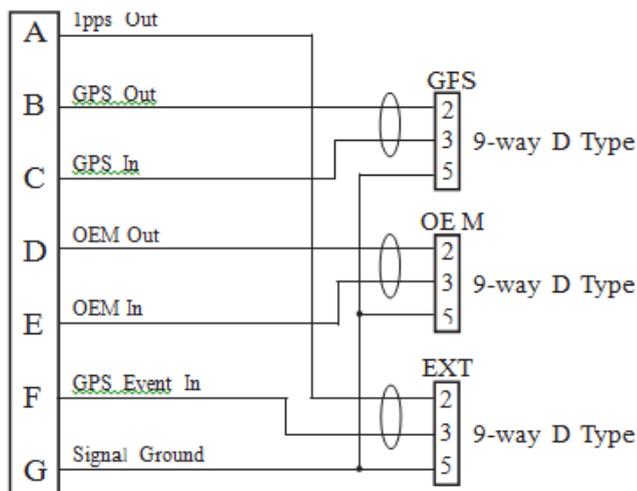
GPS Event In

This input can be used to time tag external events. Upon detection of a transition the receiver can output the time and/or the position at the instant of the event.

Users should contact the VERIPOS Helpdesk for further information before attempting to use either of these two signals.

A diagram for the front harness is shown below.

7 way Amphenol



7.4.2 Rear panel “Power + data” connector

The pictures below show the harness logic diagrams for LD3S and LD3. Physically, same cable harness is used.

Amphenol connector	Function
Pin A	+ve DC Input (11 – 36 VDC)
Pin B	-ve DC Input
Pin C	NMEA Out (RS-232 from GPS Rx)
Pin D	RTCM In (RS-232 from external source)
Pin E	NMEA In (RS-232 from external source)
Pin F	RTCM Out (RS-232 from L-band Rx)
Pin G	0 V (RS-232 common)

Note: RTCM In and NMEA In are rarely used.
 For the LD3/LID3 variant, Pin E on the Amphenol connector is designated as ‘MSG Out’ instead of ‘NMEA In’.

RTCM In

RTCM corrections from an external source may to be input to the GPS receiver.

NMEA In

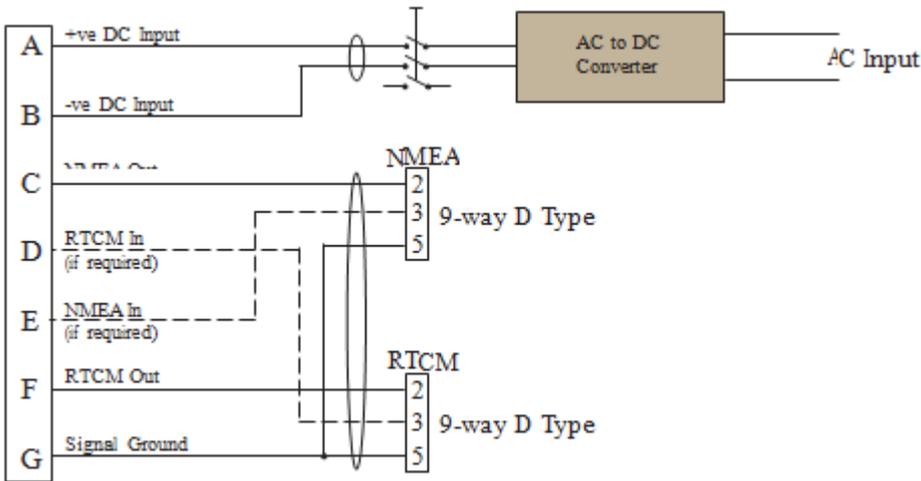
A 'GGA' position message from an external GPS receiver may be input to an LD3 which does not have an internal receiver.

This enables the operation of the GPS and DGPS indicators on the LD3 front panel.

Users should contact the VERIPOS Helpdesk for further information before attempting to use either of these two signals.

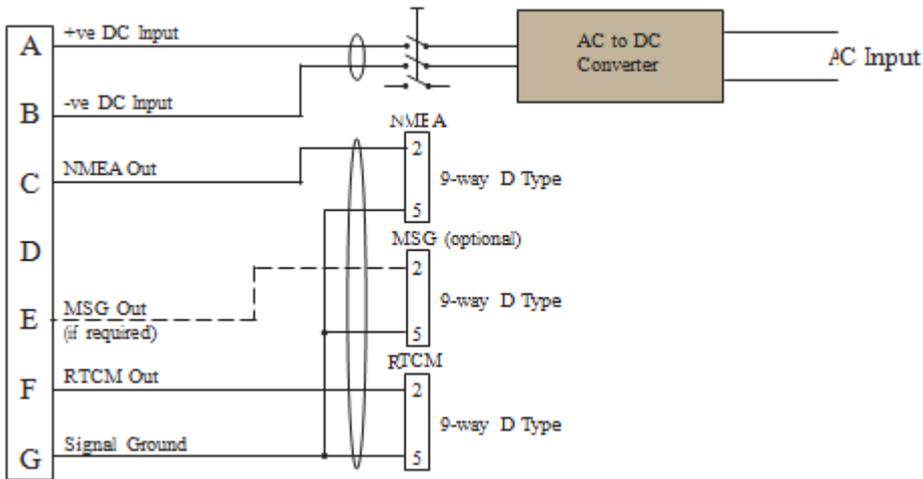
7.4.2.1 Logic wiring harness for LD3S

7 way Amphenol



7.4.2.2 Logic wiring harness for LD3

7 way Amphenol



7.5 TECHNICAL SPECIFICATION

7.5.1 Certification

IEC 60945

7.5.2 Environmental

Enclosure material	Steel
Enclosure protection	IP-53
Operating temperature range	0 to +45°C
Recommended operating temperature range	+20 °C to +25 °C
Operating humidity	Max 95% non - condensing
Storage temperature range	-20 °C to +60°C
Storage humidity	< 55%
Vibration testing	EN 60945

7.5.3 Mechanical

Size:	111 mm x 66 mm x 186 mm (These are the box dimensions. Allow additional clearance for connectors and optional mounting plate.)
Weight	1.15 kg (Exact weight varies according to options installed.)

7.5.4 Electrical

Input voltage	11 – 36 VDC
Power consumption	5W typical
External PSU Input: 100–240 VAC, 47–63 Hz	Output: 12V DC 75W

7.5.5 Demodulator

LD3/S – 1525 MHz to 1559 MHz input from L-band antenna or tapped L- band output from Inmarsat B terminals.

The following optional OEM GNSS cards can be installed in the LD3/LD3S:

Ashtech* DG14

- 12 channel L1 C/A code and carrier
- 2 SBAS channels (WAAS/EGNOS/MSAS)
- Edge and Strobe correlator multipath mitigation
- Standard NMEA-0183 V3.0 output
- Differential base and remote RTCM V2.2
- Raw data output (code and carrier)
- 1PPS (5V TTL)
- Position and raw data update rates selectable up to 20Hz
- Kalman Filter
- 2 x bi-directional RS-232 serial ports up to 115200 bps
- Operating temp: -30 °C to +70 °C
- Power Consumption: 1.2W

Septentrio AsteRx2e

- 136 channel L1/L2 C/A code and carrier tracking of GPS and GLONASS signals
- 3 SBAS channels (WAAS/EGNOS and others)
- Posteriori Multipath Estimator technique
- Standard NMEA-0183 v2.30 output format
- Differential base and remote RTCM V2.2, 2.3, 3.0 or 3.1
- Raw data output (code, carrier and navigation data)
- 1PPS (3.6V TTL)
- 2 event markers
- NMEA output data, update rates selectable up to 25 Hz
- 4 bi-directional RS-232 ports
- Operating temp: -40 °C to +70 °C
- Power Consumption: 1.5W

7.5.6 Connectors

7.5.6.1 Front Panel “Control”

7-pin female Amphenol circular chassis connector.

Pin	Function	Notes
A	1pps out	1pps time synchronisation output from GPS.
B	GPS out	Bidirectional RS-232 GPS receiver configuration port. (May also be used to interface Raw GPS to Verify QC.)
C	GPS in	
D	OEM out	Bidirectional RS-232 demodulator configuration port.
E	OEM in	
F	GPS event in	For workshop use only.
G	0 V	Signal ground.

In most installations this connector is used to interface to the external computer to configure the LD3.

Two separate ports are used; one to configure the GPS receiver and the other to configure the demodulator. These ports use a fixed format. No user setup is required.

When using the VERIPOS Verify QC system the GPS I/O port is used to provide raw GPS data to the Verify computer.

A 1pps output is available if required by the user.

This provides accurate time synchronisation for third party navigation systems or multi-beam sonar.

It is derived directly from the internal GPS receiver and is output from the LD3 on pin “A” of the front panel “Control” connector (signal ground on pin “G”). Exact specification of the signal will vary according to the model of GPS receiver installed in the LD3.

Consult the VERIPOS Operations department for advice on specific installations.

7.5.6.2 Rear panel “Power + Data”

7-pin female Amphenol circular chassis connector.

Pin	Function	Notes
A	+ve DC input	
B	-ve DC input	
C	NMEA output	RS-232 serial output.
D	RTCM input	
E	NMEA input	For workshop use only.
F	RTCM output	RS-232 serial output.
G	0 V	Signal ground.

This connector is used for power input and for data connection to external equipment.

For most installations NMEA out and RTCM out are used.

NMEA out (not available from LD3-D or LD3S-D units)

This is an RS-232 serial port providing position data in NMEA format for use by external equipment. It is derived directly from the GPS receiver and uses a default baud rate of 9600 baud.

Users specify the format required by external equipment when ordering the unit. VERIPOS will then configure the LD3 before shipment.

Any field changes (either to NMEA telegrams or to baud rate) must be made using a GPS receiver utility to directly modify the GPS receiver configuration.

RTCM out

This is an RS-232 serial port outputting RTCM corrections in standard format for use by external equipment. The default baud rate is 9600 baud.

Note:

LD3 units – the same RTCM data is fed to both the external equipment (via rear panel) and to the internal GPS receiver.

LD3S units – two separately configurable RTCM ports are provided.

One provides corrections for the external equipment and the other provides corrections for the internal GPS receiver.

LD3 units – recommended baud rate setting

When selecting stations or baud rate the user must consider the requirements of both the internal equipment and the internal receiver.

VERIPOS recommend leaving the baud rate at the default value of 9600 baud.

Where it is essential to change this (e.g. the external equipment requires a different rate) then the GPS receiver must be reconfigured to accept the new rate. Consult VERIPOS for advice in using the Ashtech Evaluate software.

7.6 SERVICE ACCESS LICENCE AND SERVICE NOTIFICATION FORM

7.6.1 Service Access Licence

VERIPOS correction signals are provided as a chargeable service.

In order to receive this service the user must first arrange a service access license (SAL). This takes the form of a contract which is agreed between the user's company and the VERIPOS Operations department.

The equipment cannot be used until an enable code is obtained from the VERIPOS Helpdesk. The Helpdesk is not authorised to issue a code unless an active SAL exists and its number can be determined.

To avoid delays the user should keep a record of the SAL number associated with his unit.

Depending upon the contract between VERIPOS and the user's company the user may wish to disable the equipment during periods of prolonged inactivity.

7.6.2 Service notification form

In order to enable or disable the equipment, codes must be obtained from the VERIPOS Helpdesk.

Requests for enable/disable codes should be made using the Service Notification Form (SNF).

This should be submitted by email to the VERIPOS Helpdesk at: helpdesk@veripos.com

A blank SNF form is shown in the Appendix. The latest version of the form can be downloaded from the VERIPOS Online support web site:

<http://help.veripos.com>

If necessary, enable requests can also be submitted by telephone to the VERIPOS Helpdesk.

See the Contact information chapter for current phone numbers.

Before calling please refer to a SNF and ensure that all the required information is available.

VERIPOS provide a range of services which are available in various combinations. When requesting an enable code, the user must specify which services are required. The full listing of services is provided on the service notification form. The choice of services affects both pricing and system accuracy.

For more information visit the VERIPOS Web site: <http://help.veripos.com>

Note: Some services are only available on units with specific hardware options installed.

7.6.3 Service Access Instructions

Each customer has to obtain sufficient Service Access Licences (SAL's) to cover the maximum number of vessels, mobile drilling units or other offshore installations simultaneously accessing Services.

SAL's are available for VERIPOS signals as listed on the Notification form (SNF).

VERIPOS services are encrypted and the receiving equipment must be programmed with the appropriate access codes in order to receive the services.

Note that where a SAL for combined services has been procured, it is not possible to split the services across different vessels.

Clients will be allocated a unique SAL number upon completion of commercial agreement. To activate the service the SAL ID number must be entered onto this Service Notification Form (SNF) together with all other required details.

To activate / deactivate services, the user must submit a completed Service Notification Form (SNF) to the VERIPOS Helpdesk.

7.7 REFERENCE STATIONS

The VERIPOS reference station ID's and beam transmission information are listed and updated regularly on VOSS at:

<http://help.veripos.com>

Also on the VOSS are latest details of Ultra and Apex ID's for the Veripos beams. Please consult the Station table for latest information.

VERPOS Ultra, Ultra², APEX and APEX² ID's

Satellite	ULTRA ID	ULTRA ² ID _s	APEX ID	APEX ² ID _s	Status
98W	68	68 + 75	81	81+ 82	Operational
AORW	68	68 + 75	81	81+ 82	Operational
25E	68	68 + 75	81	81+ 82	Operational
AORE	68	68 + 75	81	81+ 82	Operational
IOR	68	68 + 75	81	81+ 82	Operational
143.5E	68	68 + 75	81	81+ 82	Operational
POR	68	68 + 75	81	81+ 82	Operational

Updated 11 April 2013

7.7.1 MF Marine Beacon IALA stations

A listing of IALA MF stations is available from:

<http://site.ialathree.org/> (select "IALA Lists of Radionavigation Services").

VERIPOS accept no responsibility for use of correction signals provided by third parties with VERIPOS equipment.

APPENDIX I.

CONTACT INFORMATION

VERIPOS CONTACT INFORMATION

All initial contacts regarding technical or support issues should be initially addressed to the VERIPOS Helpdesk. Where appropriate, the Helpdesk will refer issues to the regional operations and engineering teams.

VERIPOS Helpdesk Telephone: +44 (0) 1224 965900

VERIPOS Helpdesk E-mail: helpdesk@veripos.com

VERIPOS Online Support Site (VOSS):<http://help.veripos.com>

If shipping equipment back to VERIPOS, please contact the Helpdesk who will provide the current shipping address, according to your area of operations.

UK Veripos office address:

	Veripos House, 1B Farburn Terrace, Dyce, Aberdeen. AB21 7DT Scotland UK
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For other sites visit www.veripos.com

APPENDIX II.

ABBREVIATIONS

Acronym	Meaning
ADE	Above Deck Equipment
BDE	Below Deck Equipment
BER	Bit Error Rate
CoG	Course over Ground
CR	Carriage Return
DGPS	Differential GPS
DOP	Dilution of Precision
DP	Dynamic Positioning
EGNOS	European Geostationary Navigation Overlay System
GDOP	Geometry Dilution of Precision
GLONASS	GLOBAL NAVIGATION Satellite System – Russian equivalent to GPS
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
HDOP	Horizontal Dilution of Precision
IMU	Integrated Mobile Unit
KPH	Kilometres per Hour
LAN	Local Area Network
LF	Line Feed
LNA	Low Noise Amplifier
L-Band	Methods of transmitting Correction data to mobile users
LCD	Liquid Crystal Display
LD6	Unit containing GPS card, demodulator and PC processor
LVTTL	Low Voltage Transistor Transistor Logic
MF	Medium Frequency Radio used to Transmit Correction Data
MPH	Miles per Hour
m/s	Metres per Second
MSAS	Multi-functional Satellite Augmentation System
NMEA	National Marine Electronics Association
PDOP	Positional Dilution of Precision
PPP	Precise Point Positioning
PPS	Pulse per Second
PRN	Pseudo Random Noise
RMS	Root Mean Square
RTCM	Radio Technical Commission for Maritime Services
SBAS	Satellite Based Augmentation System
SD	Standard Deviation
SDRAM	Synchronous Dynamic Random Access Memory
SNF	Signal Notification Form
SNR	Signal to Noise
Spotbeam	High Power L-Band Signal
Standard	VERIPOS Single frequency DGPS system
Standard+	VERIPOS Dual frequency DGPS system
SV	Space Vehicle
Ultra	VERIPOS High accuracy positioning systems
USB	Universal Serial Bus
UTC	Coordinated Universal Time
VDOP	Vertical Dilution of Precision
VGA	Video Graphic Array
VOSS	VERIPOS Online Support System
WAAS	Wide Area Augmentation System
WEEE	Waste Electrical and Electronic Equipment

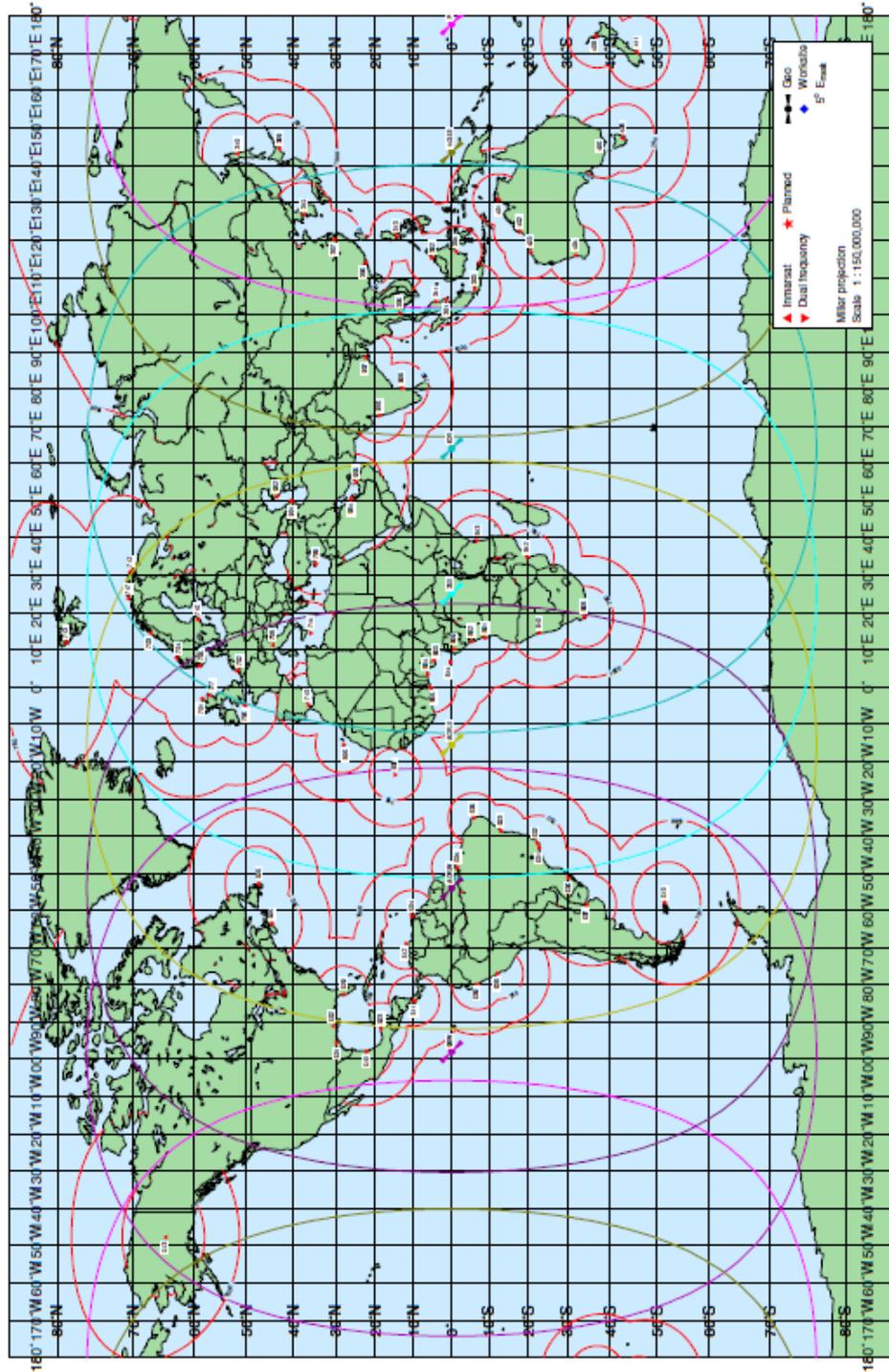
Acronym	Meaning
AC	Alternating Current
AHRS	Attitude and Heading Reference System
COG	Course Over Ground
CRP	Central Reference Point
DC	Direct Current
DGPS	Differential Global Positioning System
DHCP	Dynamic Host Configuration Protocol
DP	Dynamic Positioning
EGM	Earth Gravitational Model
GLONASS	Global'naya Navigatsionnaya Sputnikovaya Sistema
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
IP	Internet Protocol
ITRF	International Terrestrial Reference Frame
LED	Light Emitting Diodes
PPS	Pulse Per Second
PVA	Position, Velocity and Attitude.
QC	Quality Control
SD	Secure Digital
SOG	Speed Over Ground
TCP	Transmission Control Protocol
UDP	User Datagram Protocol

APPENDIX III.

GLOBAL CHART



Veripos Station and Beam Chart



Global Chart Aug 2013.vcc

Reference date: 26 August 2013
Station file: VeriposStations_22Jul13.dat [FIS2F90D2]

APPENDIX IV.

SERVICES NOTIFICATION FORM

SIGNAL ACCESS INSTRUCTIONS

- 1.0 CLIENT is to obtain sufficient SIGNAL ACCESS LICENCES (SAL's) to cover the total number of vessels, barges, mobile drilling units or other offshore installations simultaneously accessing SERVICES.
- 2.0 SAL's are available for the following VERIPOS SIGNALS either singly or in combination:
 - Standard (single or dual-beam satellite delivery)
 - Standard² (single or dual-beam satellite delivery)
 - Ultra (single or dual-beam satellite delivery)
 - Ultra² (single or dual-beam satellite delivery)
 - Apex (single or dual-beam satellite delivery)
 - Apex² (single or dual-beam satellite delivery)
 - NTRIP (internet delivery of VERIPOS SIGNAL(S))

VERIPOS SIGNALS are encrypted and receiving EQUIPMENT and HARDWARE must be programmed 'over-the-air' in order to receive the SIGNALS. Note that where a SAL for combined SIGNALS has been procured, it is not permissible to split the SIGNALS across different vessels.

CLIENT may also, subject to EQUIPMENT/HARDWARE configuration and compatibility, make use of third party services such as:

- IALA HF/MF DGPS signal
- Locally transmitted UHF augmentation signal
- External RTCM input

and should contact VERIPOS Helpdesk in such instances to ensure that the EQUIPMENT and/or HARDWARE is suitably configured.

- 3.0 Following execution of the CONTRACT the CLIENT will be allocated a unique SAL number for each vessel aboard which SERVICES are to be provided. To activate the SIGNAL, the SAL ID number must be entered onto the SERVICES Notification Form (SNF), together with all other required details.
- 4.0 To activate / deactivate SIGNAL, the user must submit a completed SNF to the VERIPOS Helpdesk.

Note. VERIPOS NTRIP – additional documentation on the use of this service will be provided upon request.
- 5.0 Upon receipt of a completed SNF, the VERIPOS Helpdesk will initiate the relevant enable or disable procedures and where appropriate, update the service over-the-air.
- 6.0 It remains the responsibility of the CLIENT to ensure that the SERVICE has been enabled or disabled. Delay in notification of SIGNAL disablement may have commercial implications.

SERVICES NOTIFICATION FORM

Email to: helpdesk@veripos.com Website: <http://www.veripos.com>
 24Hr Helpline: +44 (0)1224 527104 Fax Number: +44 (0)1224 748204

SIGNAL ACCESS LICENCE Number [see note 1, 3 & 4]	
---	--

Company / Project Name	
-------------------------------	--

Vessel Name	
--------------------	--

Vessel / Rig / Offshore Installation Details			
Geographic Location:		Telephone:	
Contact Name:		Fax:	
Authorised Person		Email:	

Service	Single or Dual Beam	Enable (dd/mm/yy)	Disable (dd/mm/yy)
STANDARD (GPS)			
STANDARD ² (GPS+Glonass)			
ULTRA (Precise Point Position)			
ULTRA ² (Precise Point Position, GPS+Glonass)			
APEX (Precise Point Position)			
APEX ² (Precise Point Position, GPS+Glonass)			
VERIFY DP DISPLAY (Software feature) [Specify correction signals separately]			
NTRIP			

Equipment Details	
Serial No. / User Code	Equip Type (e.g. LD2 G2)
1	
2	
3	
4	

NTRIP Details		
Vessel IP/IOLAN IP	Username	Password
1		
2		

NCC Use Only	
Date Received:	Processed By:
Date Confirmation Issued:	Issued By:

APPENDIX V.

QUALITY STANDARDS

QUALITY STANDARDS

A number of standards offer marine satellite navigation system users DGNSS (DGPS/DGPS+DGLONASS) quality information. The most well-known and frequently referred to standards are:

1. UKOOA
2. NMEA-0183

Each standard is explained in more detail in the following sections.

NMEA have recently introduced the NMEA-2000 interface standard. This standard falls outside the scope of this document. See www.nmea.org for further information.

References

- [1] Guidelines for the use of Differential GPS in offshore surveying, UKOOA, 1994
- [2] NMEA 0183 Standard for interfacing marine electronic devices, version 3.01, January 1, 2002
- [3] Guidelines on the use of DGPS as a positioning reference in control systems, IMCA M 141, October 1997

UKOOA STANDARD

The UK Offshore Operator Association (UKOOA) issued 'Guidelines for the use of Differential GPS in offshore surveying' in 1994. These guidelines set out what is generally regarded as good practise in the offshore industry. They are not mandatory and operators are free to adopt different guidelines or standards.

These guidelines are now dated in certain areas due to advancements in positioning technology and algorithms. However, they contain useful suggestions for quality monitoring as indicated below [see 1]: -

"To assist DGPS operators and client representatives to monitor the quality of the DGPS system in real-time the following information should be continuously available:

- *Pseudo-range residuals of all SV's and observation weight values used*
- *Unit variance*
- *Number of satellites in view and number used in solution*
- *Redundancy of least squares solution*
- *DOP values (HDOP, PDOP and VDOP)*
- *Latency of differential correction data*
- *Position comparisons derived from different reference stations*
- *Derived antenna height with respect to "known" height*
- *Monitor station information, especially position error measured at the monitor station. All data should be time tagged*
- *Maximum external reliability figure and observation carrying it"*

The UKOOA guidelines present a set of test statistics and quality measures recommended for use with DGPS. In its final recommendations [see 1] it states: -

“It is essential to assess the precision and reliability of each position in order to ensure the quality of the DGPS measurements. Thus it recommends that the following processing steps be implemented: -

- *w-test for outliers carried out for each position fix*
- *F-test for unit variance carried out for each position fix*
- *When no more outliers are identified in any fix, precision and reliability measures will be calculated:*
 - *Precision: a-posteriori error ellipse*
 - *Reliability: external reliability (positional MDE using a power of test of 80%)”*

Where accuracy and precision statistical parameters are generated these all represent a 95% (2σ) confidence region.

Appendix A of the UKOOA guidelines emphasises this by listing ‘Suggested parameters to be specified by a system user for typical marine survey operations’ and states that ‘In order to carry out rigorous QC, the covariance matrix generated by the least squares computation should be used to generate test statistics and quality measures’.

It recommends the following Test Statistics:

1. w-test used to detect outliers
2. F-test used to verify the model which is being used to account for ‘errors’ in the DGPS observations

It recommends also the following Quality Measures:

1. Error Ellipse an approximate graphical representation of the positional standard deviation in two dimensions
2. External Reliability the effect of the maximum MDE (Marginally Detectable Error) on the computed position

These recommendations are particularly aimed at survey applications but could be applied equally to DP applications.

NMEA-0183 STANDARD

The National Marine Electronics Association (NMEA) has developed a specification defining the interface between various pieces of marine electronic equipment. The standard permits marine electronics to send information to computers and to other marine equipment via a serial interface. A full copy of this standard is available for purchase at their web site (www.nmea.org). The current version of the standard is 3.01.

GPS receiver communication is defined within this specification. The idea of NMEA is to send a line of data called a sentence that is totally self-contained and independent from other sentences. There are standard sentences for each device category and in addition NMEA permits hardware manufactures to define their own proprietary sentences for whatever purpose they see fit. All standard sentences have a two letter prefix defining the device using that sentence type. For GPS receivers the prefix is GP followed by a three letter sequence defining the sentence contents. All proprietary sentences begin with the letter P and are followed with 3 letters identifying the manufacturer controlling that sentence.

NMEA consists of sentences, the first word of which, called a data type, defines the interpretation of the rest of the sentence. Each data type has its own unique interpretation and is defined in the NMEA standard. Each sentence begins with a '\$' and ends with a carriage return/line feed sequence no longer than 80 characters of visible text (plus the line terminators). The data is contained within this single line with data items separated by commas. The data itself is ASCII text and may extend over multiple sentences in certain specialized instances but is normally fully contained in one variable length sentence. The data may vary in the amount of precision contained in the sentence. For example time might be indicated to decimal parts of a second or location may be shown with 3 or even 5 digits after the decimal point. Programs reading the data should only use the commas to determine the field boundaries and not depend on column positions. There is a provision for a checksum at the end of each sentence which may or may not be checked by the unit reading the data. The checksum field consists of a '*' and two hex digits representing the exclusive OR of all characters between, but not including, the '\$' and '*'. A checksum is required on some sentences.

There have been several changes to the standard but for GPS use the only ones that are likely to be encountered are 1.5 and 2.0 through 2.3. Version 2.3 added a mode indicator to several sentences used to indicate the kind of fix the receiver currently has. The value can be A=autonomous, D=differential, E=Estimated, N=not valid, S=Simulator. Sometimes there can be a null value as well. Only the A and D values correspond to an active and reliable sentence. This mode character has been added to the RMC, RMB, VTG, and GLL, sentences and optionally some others including the BWC and XTE sentences.

The hardware interface for GPS receivers is designed to meet the NMEA requirements. They are compatible also with most computer serial ports using RS232 protocols, however strictly speaking the NMEA standard is not RS232. They recommend conformance to EIA-422. The interface speed generally can be adjusted, but the NMEA standard is 4800 baud with 8 bits of data, no parity, and one stop bit. All GPS receivers supporting NMEA should support this speed. Note that at a baud rate of 4800, you can easily send enough data to more than fill a full second of time.

At 4800 baud, 480 characters per second can be sent. As an NMEA sentence can be as long as 82 characters this can be limited to less than six different sentences. The actual

limit is determined by the specific sentences used and it is easy to overrun the capabilities for rapid sentence response.

A cable is required to connect to the GPS receiver output. Data can be output also via Ethernet or wireless connection. For general NMEA use with a GPS receiver, only two wires are required in the cable, data out from the GPS receiver and ground.

APPENDIX VI.

NMEA SENTENCES

NMEA SENTENCES

This section describes the message structure of the following positioning and QC output messages: -

- GGA
- GST
- ZDA
- GSA
- GSV
- RMC
- VTG
- GLL

Other message options may be available from the unit depending on the GNSS receiver installed. If other message types are required contact VERIPOS for assistance.

NMEA GGA Sentence

The NMEA GGA sentence contains time and position fix related data for a GPS system. It includes basic quality information, which is limited to 'Fix Quality', 'Number of Satellites in Use', 'HDOP' and 'Age of Differential GPS Data'.

Structure and Example: -

```
$GPGGA,hhmmss.ss,ddmm.mmmmm,a,dddmm.mmmmm,b,q,xx,p.p,a.b,M,c.d,M,x.x,nnnn*hh<CR>
<LF>
$GPGGA,123519,4807.0378783,N,01131.0054784,E,1,08,0.9,545.4,M,46.9,M,,*47
```

GGA sentence defined: -

GGA	Global Positioning System Fix Data
hhmmss.ss	UTC of position
ddmm.mmmmm	latitude of position
a	N or S, latitude hemisphere
dddmm.mmmmm	longitude of position
b	E or W, longitude hemisphere
q	GPS Quality indicator (0 = invalid, 1 = GPS SPS, 2 = DGPS fix, 3 = GPS PPS, 4 = Fixed RTK, 5 = Float RTK, 6 = Estimated (dead reckoning), 7 = Manual Input Mode, 8 = Simulation Mode)
xx	number of satellites in use
p.p	horizontal dilution of precision
a.b	antenna altitude above mean-sea-level
M	units of antenna altitude, meters
c.d	Geoidal Separation
M	units of geoidal separation, meters
x.x	age of differential data
nnnn	Differential reference station ID, 0000 to 1023
*hh<CR><LF>	checksum, carriage return and line feed

NMEA GST Sentence

The NMEA GST sentence provides error statistics of the position fix. These statistics follow from the position calculation process.

Structure and Example:

```
$GPGST,hhmmss.ss,a.aa,b.bb,c.cc,ddd.dd,e.ee,f.ff,g.gg*hh<CR><LF>
$GPGST,024603.00,3.2,6.6,4.7,47.3,5.8,5.6,22.0*58
```

GST sentence defined:

GST	GNSS Pseudo-range Error Statistics
hhmmss.ss	UTC time in hours, minutes, seconds of the GPS position
a.aa	RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudo-ranges and differential DGNSS corrections
b.bb	Standard deviation of semi-major axis of error ellipse (meters)
c.cc	Standard deviation of semi-minor axis of error ellipse (meters)
d.dd	Orientation of semi-major axis of error ellipse (meters)
e.ee	Standard deviation of latitude error (meters)
f.ff	Standard deviation of longitude error (meters)
g.gg	Standard deviation of altitude error (meters)
*hh<CR><LF>	Checksum, carriage return and line feed

NMEA ZDA Sentence

The NMEA ZDA sentence provides time and time zone information.

Structure and Example:

```
$GPZDA,hhmmss.ss,dd,mm,yyyy,xx,yy*hh<CR><LF>
$GPZDA,201530.00,04,07,2002,00,00*6E
```

ZDA sentence defined:

ZDA	Time & Date
hhmmss.ss	UTC time in hours, minutes, seconds of the GPS position
dd,mm,yyy	Day,Month,Year (UTC)
xx	local zone hours (00 to +/-13 hrs)
yy	local zone minutes (00 to 59)
*hh<CR><LF>	checksum, carriage return and line feed

NMEA GSA Sentence

The NMEA GSA sentence contains the GNSS DOP and satellites used in the solution. If only GPS SVs are used in the calculation the talker ID will be GP. If only Glonass SVs are used in the calculation the Talker ID will be GL. If the GPS and Glonass SVs are used in a combined solution the talker ID will be GN and multiple GSA sentences are produced.

Structure and Example:

```
$--GSA,a,n,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,pp,p,hh,h,vv.v*cc<CR><LF>
```

\$GNGSA,A,3,02,04,05,07,08,10,13,16,23,29,,,1.1,0.6,0.9*21
 \$GNGSA,A,3,68,69,70,78,79,80,85,86,,,,,1.1,0.6,0.9*2F

GSA sentence defined: -

GSA	GNSS DOP and Active Satellites
a	Mode M = Manual, forced to operate in 2D or 3D mode A = Automatic, allowed to automatically switch 2D/3D
n	Mode: 1 = Fix not available, 2 = 2D, 3 = 3D
xx (x12)	ID numbers of satellites used in solution, up to the first 14 ID's
pp.p	PDOP
hh.h	HDOP
v.vv	VDOP
*cc<CR><LF>	checksum, carriage return and line feed

Notes:

1) Satellite ID numbers. To avoid possible confusion caused by repetition of satellite ID numbers when using multiple satellite systems, the following convention has been adopted:

- a) GPS satellites are identified by PRN numbers (range from 1 to 32).
- b) The numbers 33-64 are reserved for WAAS satellites. The WAAS system PRN numbers are 120-138. The offset from NMEA WAAS SV ID to WAAS PRN number is 87. A WAAS PRN number of 120 minus 87 yields the SV ID of 33. The addition of 87 to the SV ID yields the WAAS PRN number.
- c) The numbers 65-96 are reserved for GLONASS satellites. GLONASS satellites are identified by 64+satellite slot number. The slot numbers are 1 through 24 for the full GLONASS constellation of 24 satellites, this gives a range of 65 through 88. The numbers 89 through 96 are available if slot numbers above 24 are allocated to on-orbit spares.

NMEA GSV Sentence

GSV sentence defined:

GNSS Satellites In View

Number of satellites (SV) in view, satellite ID numbers, elevation, azimuth, and SNR value. Four satellites maximum per transmission. Total number of sentences being transmitted and the number of the sentence being transmitted are indicated in the first two fields.

If multiple GPS, GLONASS, etc. satellites are in view, use separate GSV sentences with talker ID GP to show the GPS satellites in view and talker GL to show the GLONASS satellites in view, etc. The GN identifier shall not be used with this sentence.

Structure and Example:

\$--GSV,n,s,t,xx,ee,aa,dd,xx,ee,aa,dd,xx,ee,aa,dd,xx,ee,aa,dd*cc<CR><LF>
 \$GPGSV,2,2,8,09,43,294,47,08,19,062,42,06,49,314,49,010,03,120,29*45

GSV sentence defined: -

GSV	GNSS satellites in view
n	Number of GSV Sentences per epoch
s	Sequence Number of current message
t	Total number of satellites in view
xx	Satellite Number ^{2,3}

ee	Satellite Elevation (up to 90°) ²
aa	Satellite Azimuth (0° to 360°) ²
dd	Signal to Noise Ratio (dBHz)
*cc<CR><LF>	checksum, carriage return and line feed

Notes:

1) Satellite information may require the transmission of multiple sentences all containing identical field formats when sending a complete message. The first field specifies the total number of sentences, minimum value 1.

The second field identifies the order of this sentence (sentence number), minimum value 1. For efficiency it is recommended that null fields be used in the additional sentences when the data is unchanged from the first sentence.

2) A variable number of "Satellite ID-Elevation-Azimuth-SNR" sets are allowed up to a maximum of four sets per sentence. Null fields are not required for unused sets when less than four sets are transmitted.

3) Satellite ID numbers. To avoid possible confusion caused by repetition of satellite ID numbers when using multiple satellite systems, the following convention has been adopted:

- a) GPS satellites are identified by their PRN numbers, which range from 1 to 32.
- b) The numbers 33-64 are reserved for WAAS satellites. The WAAS system PRN numbers are 120-138. The offset from NMEA WAAS SV ID to WAAS PRN number is 87. A WAAS PRN number of 120 minus 87 yields the SV ID of 33. The addition of 87 to the SV ID yields the WAAS PRN number.
- c) The numbers 65-96 are reserved for GLONASS satellites. GLONASS satellites are identified by 64+satellite slot number. The slot numbers are 1 through 24 for the full GLONASS constellation of 24 satellites, this gives a range of 65 through 88. The numbers 89 through 96 are available if slot numbers above 24 are allocated to on-orbit spares.

NMEA RMC Sentence

NMEA has its own version of essential gps pvt (position, velocity, time) data.

It is called RMC, the Recommended Minimum, which will look similar to:

Structure and Example:

```
$--RMC,hhmmss.ss,A,ddmm.mmm,a,dddmm.mmm,b,s.s,g.g,ddmmyy,xx,c,i*hh<CR><LF>
$GPRMC,123519,A,4807.038,N,01131.000,E,022.4,084.4,230394,003.1,W*6A
```

RMC sentence defined:

RMC	Recommended minimum
hhmmss.ss	UTC time in hours, minutes, seconds of the GPS position
A	Status: A = Active, D=Differential, V = Void.
ddmm.mmm	latitude of position
a	N or S, latitude hemisphere
dddmm.mmm	longitude of position
b	E or W, longitude hemisphere
s.s	Speed Over Ground (Knots)
g.g	Course Over Ground (Degrees True)
ddmmyy	Day,Month,Year (UTC)
xx	Magnetic Variation
c	E or W Magnetic Variation direction
i	mode indicator (A = Autonomous, D = Differential, E = Estimated, M= Manual,

	S = Simulator, N = data Not valid)
*hh<CR><LF>	checksum, carriage return and line feed

Note that as of the 2.3 release of NMEA, there is a new field in the RMC sentence at the end just prior to the checksum.

NMEA VTG Sentence

The NMEA VTG sentence provides the actual course and speed relative to the ground. Structure and Example:

```
$GPVTG,p,p,T,q,q,M,r,r,N,s,s,K,u*hh<CR><LF>
$GPVTG,054.7,T,034.4,M,005.5,N,010.2,K*33
```

VTG sentence defined:

VTG	Course over ground and ground speed
p.p	Course over ground (True)
T	degrees True
q.q	course over ground (Magnetic)
M	degrees Magnetic
r.r	speed over ground (knots)
N	knots
s.s	speed over ground (km/hr)
K	km/hr
u	mode indicator (A = Autonomous, D = Differential, E = Estimated, M= Manual, S = Simulator, N = data Not valid)
*hh<CR><LF>	checksum, carriage return and line feed

Receivers that do not have a magnetic deviation (variation) table built in will null out the 'Magnetic track made good'.

NMEA GLL Sentence

The NMEA GLL sentence provides 2D position data.

Structure and Example:

```
$GPGLL,ddmm.mmmmm ,a, dddmm.mmmmm ,b,hhmmss.ss,S,l*cc<CR><LF>
$GPGLL,5708.7104685,N,00217.1169613,W,062859.00,A,D*72
```

GLL sentence defined:

GLL	Geographic position - Latitude and Longitude
ddmm.mmmmm	latitude of position
a	N or S
dddmm.mmmmm	longitude of position
b	E or W
hhmmss.ss	UTC of position
S	status (A = data valid ; V = data not valid)
l	mode indicator (A = Autonomous, D = Differential, E = Estimated, M= Manual, S = Simulator, N = data Not valid)
*cc<CR><LF>	checksum, carriage return and line feed