

# Verify DP

## Operations Manual

### VERIPOS

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## 1. INTRODUCTION

VERIPOS specialise in providing robust data broadcast services for precise positioning applications for the offshore industry.

The VERIPOS LD2 receiver may optionally be equipped with on-board QC software called Verify DP which is optimised for DP operations. This manual contains the information required to operate the Verify DP software.

Verify DP is quality control and position monitoring program that has been designed specifically for DP operators and navigation users who need to quickly and continuously assess the quality of their positioning. It provides a graphical display of essential position quality information in an easily understood format.

The software has been designed to keep operator intervention to a minimum. It generates alarms on all key positioning parameters as well as software function status. To provide flexibility, alarm thresholds are configurable.

The display has a fixed format. The information displayed includes:

- Current, past and predicted DOP values
- Satellite Polar Plot
- Satellite receiver signal to noise ratios (SNR)
- Position Information
- Position error ellipses
- Event Log
- Map showing vessel and local stations
- The age of corrections received from each VERIPOS reference station in use and/or external RTCM sources
- Vessel outline and relative location of targets

For updates to this document and to access other VERIPOS documentation referenced please see the VERIPOS online support system (VOSS):

<http://help.veripos.com>

Related documents:

<b>VERIPOS</b>	LD2 Installation Manual
<b>VERIPOS</b>	LD2 Operations Manual
<b>VERIPOS</b>	Signal Notification Form (SNF)

Users of Verify DP are recommended to refer where required to the LD2 Operations Manual for reference, fault reporting, advice and assistance when using the LD2 receiver.

## 1.1 DISPLAY, KEYBOARD AND SPEAKER

Verify DP software runs on board the VERIPOS LD2 integrated mobile unit and therefore does not require a separate computer.

The monitor connects directly to the VGA port P6 on the rear of the LD2.

A mouse and keyboard are required for system configuration and alarms management. Connect these to the PS2 type connectors on the LD2 before starting the LD2.

If the display cannot be mounted close to the LD2 an optional KVM extender may be used.

The system uses audible alarms. An external speaker may be beneficial in noisy environments or where the LD2 is located far from the operator. Attach this to the rear panel speaker output of the LD2.

## 1.2 ENABLING VERIFY DP

Verify DP as a service must first be ENABLED for the LD2 unit by Veripos Helpdesk over the air. A contract for service - Service Access Licence number (**SAL**) is required.

Verify DP is an additional VERIPOS service. When contacting the Helpdesk for an enable please specify that Verify DP is required in addition to your GNSS augmentation service. (e.g.: Verify DP and Ultra Service.)

See the LD2 Operations Manual for details on enabling VERIPOS services with your LD2.

## 1.3 SYSTEM CONFIGURATION

The keyboard and mouse are not used to control the LD2.

The Verify DP configuration menus control operation of the quality control software.

Configuration of the LD2 receiver is by use of its front panel keypad and 2-line LCD display.

The correct demodulator channel (beam) must be selected for the work area and all reference stations must be enabled on port P2.  
(With all reference stations enabled, Verify DP will automatically use the four stations nearest the work area.)

See LD2 Operations Manual for further information.

## 1.4 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. OPERATION

The following section describes how to operate Verify DP visualisation software.

### 2.1 GENERAL

With the LD2 enabled for Verify DP, the on-board Verify DP software will run automatically. This will configure the GNSS receiver in the LD2 to output all the information required. The software will then display the predetermined windows which provide information required by the DP operator.

These windows are described in detail below.

The program provides the operator with a range of configuration settings. These are accessed from the main menu and described later in this section.

*Note:*

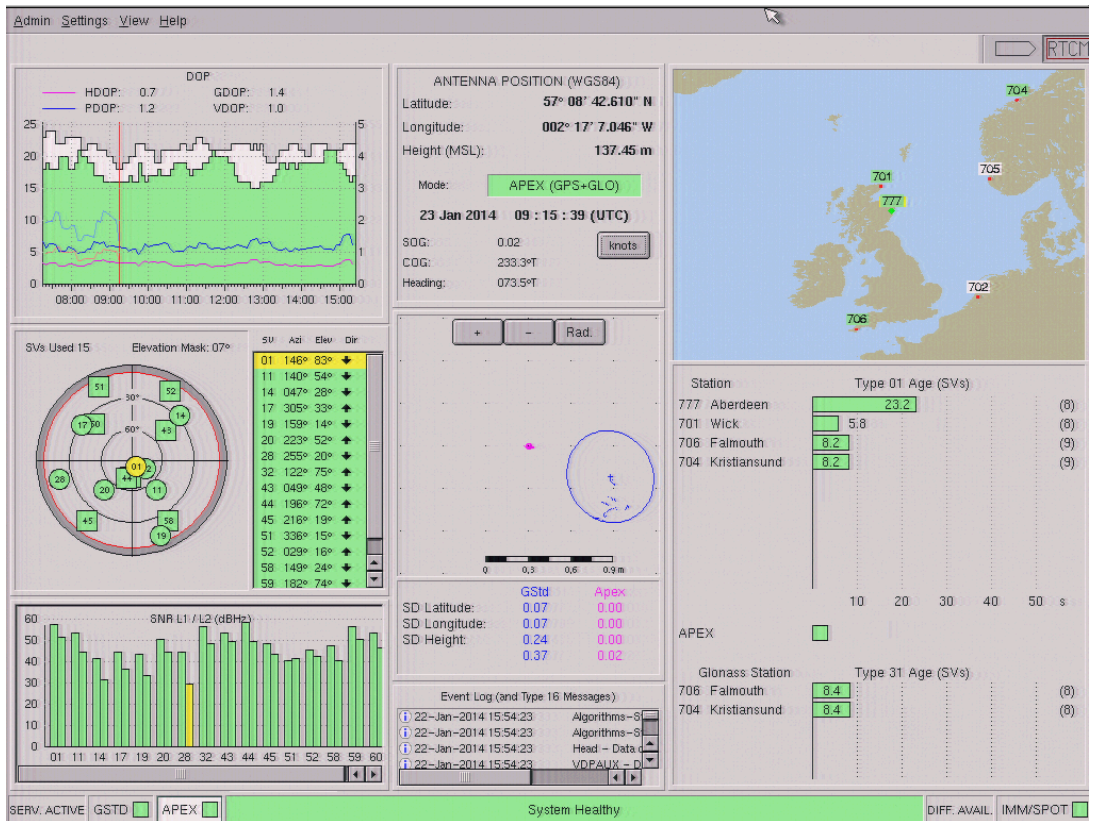
*When switching on the LD2 with Verify DP enabled, three items appear in the main menu:*

***Settings, Display and Help.***

*An additional menu item (**Admin**) may be enabled from the “Settings” menu. It then appears at the left of the menu bar.*

*A password is required to enable the “Admin” menu. It is always disabled when the unit is powered down.*

## 2.1.1 Graphical user interface



Listing from top to bottom and left to right, the windows display;

- Almanac/DOP
- Satellite Polar Plot
- Signal to Noise Ratio (SNR)
- Position Information
- DGPS Calculations
- Event Log
- Map
- VERIPOS Reference Station Information **or** Target Monitoring

Each window is described in detail in the following sections.

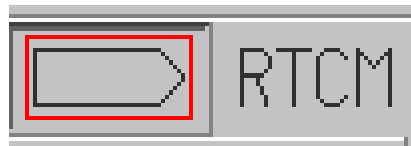
When switching on the LD2 allow time (minutes) for the GPS and L-band receivers to acquire signals.

Verify DP screen format is fixed - except for the lower right Reference Station outline window.

Station outline (RTCM) shows information about reference stations used by the on-board algorithms.

Optionally where a gyro compass is connected to the LD2 this outline window can also toggle to display a vessel outline (see Gyro section).

When Gyro use is enabled a pair of icons (used to toggle this window) are visible on the top right corner of the display:



**Vessel outline/RTCM display toggle buttons**

Clicking these buttons allows the user to switch between the vessel outline and the Reference Station information (RTCM) view.

A **Status Bar** across the bottom of the screen shows system status information (explained below).

### 2.1.2 Position Information View



## Position Information View

This view is divided into four sections:

### **1. Position**

This is the calculated position in WGS84 format displayed in degrees, minutes and seconds. Seconds are specified to three decimal points. (Centimetre level precision).

Height is computed Antenna height above mean sea level in Meters.

This is sometimes referred to as height above the Geoid and may, for DP purposes only, be height above MSL.

### **2. Mode**

“Mode” shows which VERIPOS service is currently in use as the primary system.

The software will always use the best solution available.

The box will remain green provided a valid position is being calculated.

If no VERIPOS corrections are available, the box will change colour to yellow and show “Standard”. The status indicator at the bottom of the screen will change to show “System Warning” on a yellow background.

If no GPS data is available the box will change colour to red and show “NO DATA”.

Status indicator will change to yellow and show “System Warning”.

The display screen freezes.

If no valid position is available, the box will change colour to red and the status will change to “Invalid”. Operator intervention is then required.

The mode box will display GNSS and be coloured orange when only free to air correction services or external RTCM source(s) are used.

Full QC is used when the VERIPOS Corrections are input to the Verify DP software.

### **3. Date and Time**

The date and UTC time are displayed, derived from the GPS receiver.

Where GPS signal is not received the time display freezes and the Verify DP screen display is fixed.

#### **4. Speed/Course/Heading**

Clicking the button to the side allows the user to change units: Mph, Kph, m/s, Knots.

Course over Ground is calculated from the GPS antenna position updates and represents the direction of travel for the vessel. If the vessel is stationary the position observations show only small changes in random directions.

Heading display is available when an external Gyro input is connected to the LD2.

The LD2 can accept NMEA serial gyro data in RS232 format on either port P3 or USB port (with an approved USB-Serial converter). For either input the LD2 port must be appropriately configured. See the LD2 Operations manual for details.

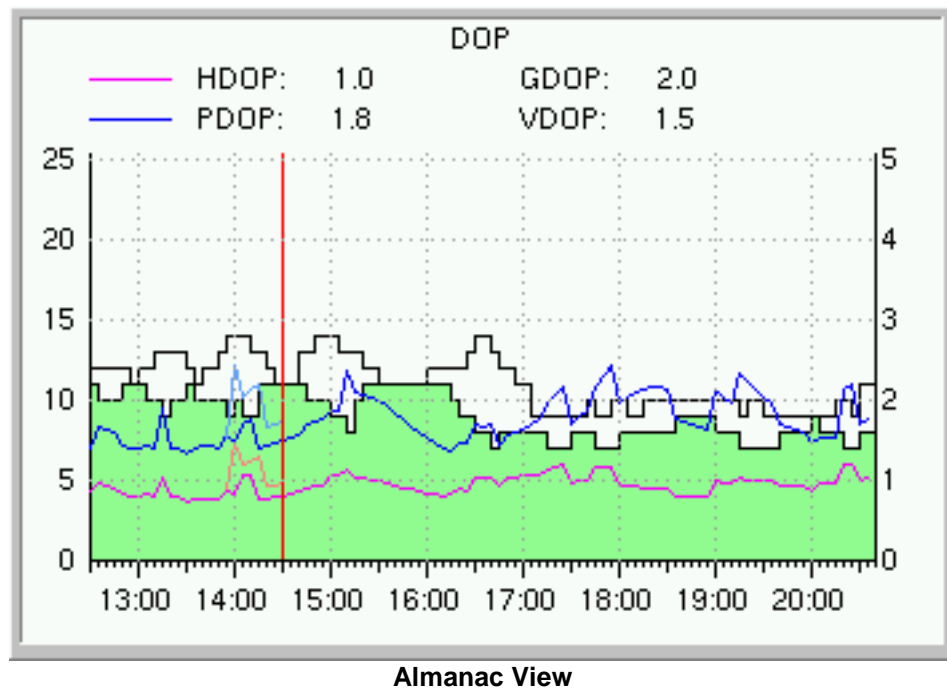
##### **2.1.3 Almanac/DOP**

The Almanac/DOP view displays data from the GNSS Almanac. It provides the user with a six hour window of predicted data that can be used for planning purposes.

In addition, a two hour history is kept showing the predicted DOP from data in the Almanac and the actual DOP values generated by the Algorithms (shown to the left of the current time). This allows the user to compare the actual and predicted DOP values.

*Note:*

*Actual figures are plotted as lighter lines, compared to the darker lines drawn by the predicted values.*



DOP (Dilution of Precision) is an indicator of the quality of the geometry of the satellite constellation. The DOP values for the current time are displayed at the top of the view as well as the last two hours of DOP data being graphically displayed.

GDOP is computed from the geometric relationships between the receiver position and the positions of the satellites that the receiver is using. For planning purposes GDOP is computed from the Almanac and a user position.

Predicted GDOP does not take into account obstacles that block the line-of-sight from the position to the satellites.

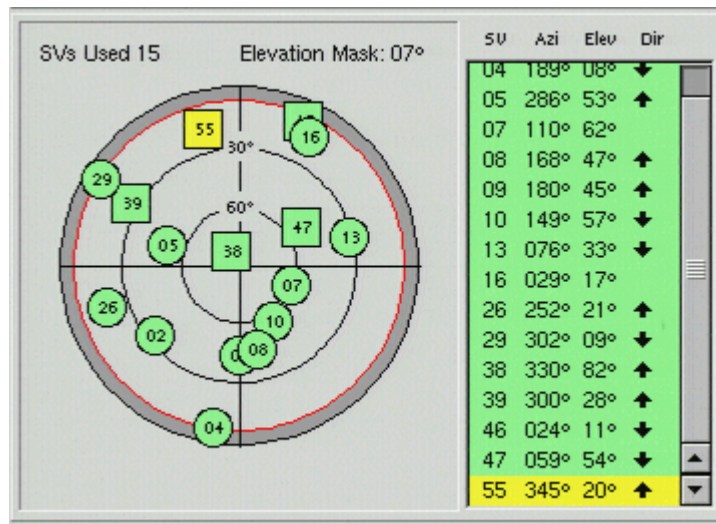
GDOP Components:

- PDOP - Position Dilution of Precision (3-D), sometimes known as the Spherical DOP.
- HDOP - Horizontal Dilution of Precision (Latitude and Longitude).
- VDOP - Vertical Dilution of Precision (Height).

The Green area displays the number of GPS and possible GLONASS (where enabled) satellites that are above elevation mask (default 7°).

The white area displays the total number of satellites above the horizon.

## 2.1.4 Satellite Polar Plot



**Satellite Polar Plot View**

The satellite polar plot displays the satellite constellations at the user's location.

Satellites are colour coded to provide information on their status with **circles** representing the satellites of the GPS constellation and **squares** representing the GLONASS constellation:

- Green – healthy satellites which are used in the computation.
- White – satellites that are in view but below the elevation mask, and therefore not used in the computation.
- Yellow – indicates missing satellites; these could be obstructed behind objects.
- Red – indicates unhealthy satellites.

The **SV** column of the view displays the unique PRN (satellite) number of the satellites in view. If the satellite is in the GLONASS constellation it will be given a PRN number greater than 32.

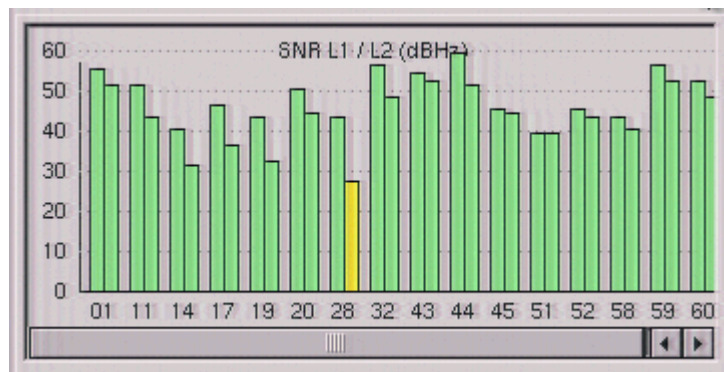
The **Azi** column is the satellites' Azimuth. The azimuth is the horizontal angle measured in degrees from the fixed point north to the direction of the satellite and is relative to the user's location.

The third column, **Elev** is the Elevation of the satellite relative to that user's position at that instant of time.

The **Dir** column provides an indicator to show if the satellite is either rising or falling.

The satellite polar plot view also shows the elevation mask height set in the unit, the number of satellites in use and the number available. A grey ring is used to indicate the elevations between zero and the mask in use. Any satellite whose elevation falls below the mask will be excluded from position computations.

### 2.1.5 Signal to Noise



**SNR View**

The strength of the signal received from each satellite available is displayed in the SNR view.

If a single frequency (L1) Multi-Reference solution is in use only a single bar will be displayed to represent the L1 SNR.

When a dual frequency solution (APEX / APEX<sup>2</sup> and Ultra / Ultra<sup>2</sup>) is enabled then both L1 and L2 measurements are plotted.

The X axis shows the PRN numbers of the satellites being received and includes satellites below the elevation mask. The Y axis shows signal strength in the range 0 to 60 dBHz, where higher values indicate stronger signals.

The bars are colour coded, with green indicating a good signal level, yellow a marginal level and red an unsatisfactory level.

*Note:*

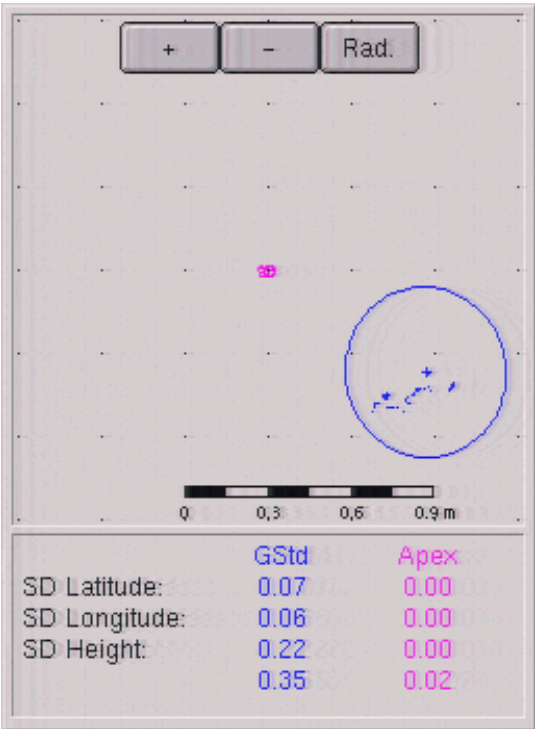
*Typical values for signal strength vary depending on the model of GPS receiver installed in the LD2. To allow for this there is provision in the “Settings” menu to change the levels at which the colour transitions occur. Threshold levels are set by the VERIPOS workshop and should only be changed under the direction of a VERIPOS engineer.*

The SNR bars will fluctuate over the period that a satellite is in view. This is a characteristic of the signal due to the changing elevation of the satellite (elevations are displayed in the Polar Plot view.)

It is normal for satellites to show low (red) SNR values when they are at low elevations. Bad SNR values at high elevations (i.e. above 40 degrees) may indicate a potential problem and should be investigated.

A problem with a single satellite usually indicates signal blockage on a particular azimuth. Problems with multiple satellites may indicate a problem with the on-board equipment. (See Troubleshooting section in this manual.)

2.1.6 DGPS Calculation



DGPS Calculation View

The DGPS calculation view displays the position error ellipses for all the calculations. Each ellipse is uniquely coloured for ease of identification.

There is a Key showing the colours associated with each position calculation. It also shows the standard deviation (SD) measurements for latitude, longitude and height components of each position solution together with its RMS. Standard deviations are a measure of the spread of the measurements (at 95% confidence) precision of the position computation. Smaller SD values indicate better accuracy.

The RMS is a statistical measure of the computed positions around a “best fit” position solution. This is shown in metres.

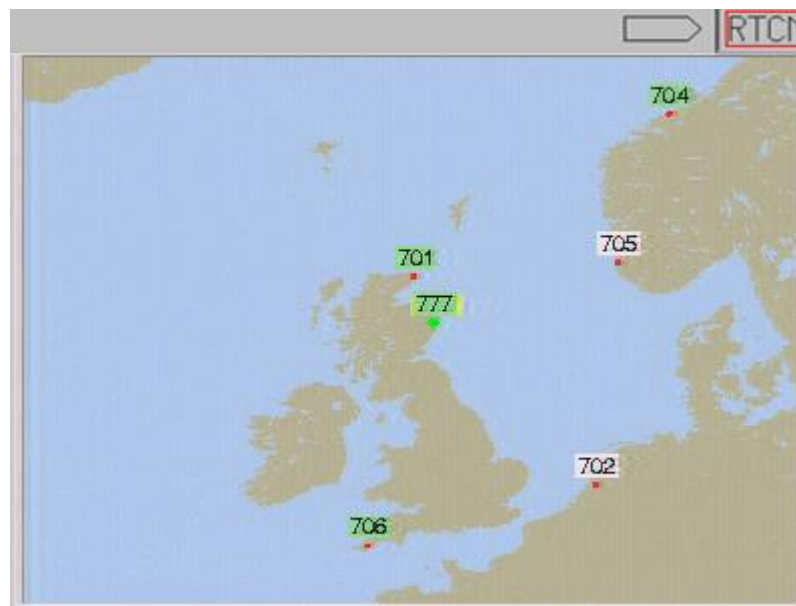
The + and – buttons on the view is available to zoom in and out, with the scale ranging from 0.05m to 5m per scale bar division.

The **RAD/GRID** button toggles between a grid and circular display.

In the grid display and the circular display the grid marks and radius are spaced two scale bar divisions apart.

The amount of position history shown on the graphical display is changeable; the default is 60 seconds. Amend using the main menu Setting / DGPS Cal settings or by right clicking on the display.

### 2.1.7 Map



Map

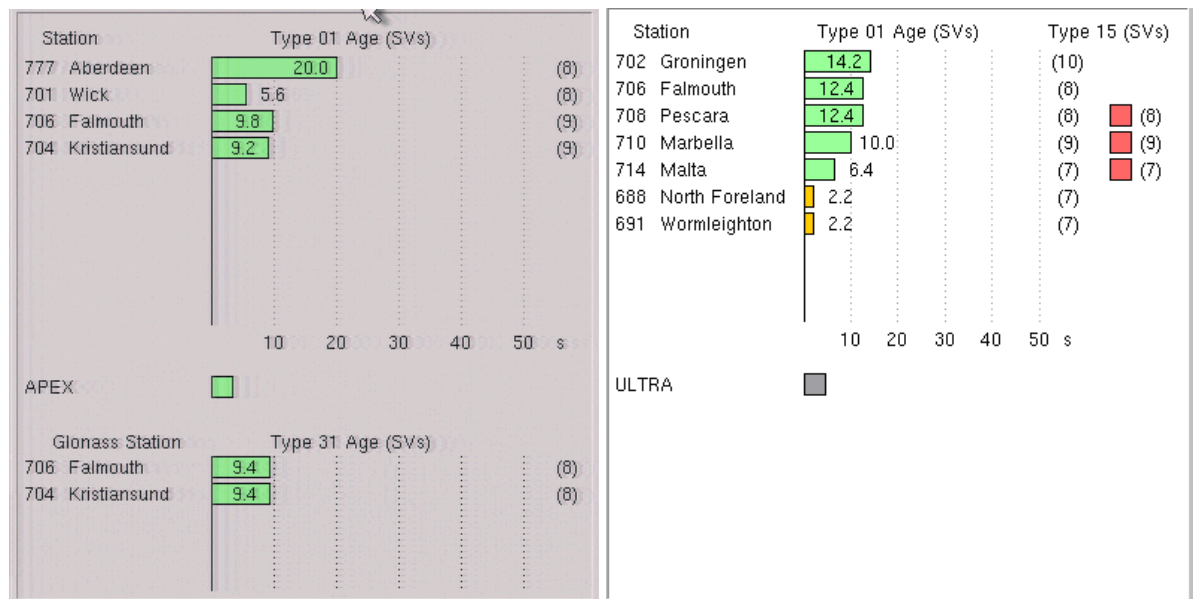
The Map View shows the user's position and the VERIPOS Reference stations that are available for the working area.

Green background indicates stations which are in use by Verify DP.

White background indicates stations which are enabled for use (using the front panel of the LD2) but are not in use by Verify DP.

*Note: The two buttons immediately above the Map window are used to select whether the lower half of the screen displays the Reference Station Information window or the Target Monitoring window. (Described below)*

## 2.1.8 Reference Station Information



Reference station Information example Views

The RTCM view displays the age of the corrections from the individual reference stations that are used in the position solution.

The reference stations are listed in the left hand column along with the VERIPOS station ID. The number of satellites for the specific reference station is indicated in brackets (located to the right of the scrolling bar) for the age of corrections.

VERIPOS RTCM Type 1 and Type 31 corrections are shown as scrolling bars which indicate the current age of the corrections. They are colour coded according to status:

- GREEN if corrections are being received at the expected intervals
  - AMBER if corrections are not being received but the old values are still valid
  - RED if corrections are not being received and the old values are no longer valid
- This may indicate a problem with the L-band link.

If corrections from a station are not available for an extended period that station will not appear on the display.

When HF stations are selected they are shown with blue scrolling bars

When MF stations are selected then they will be displayed with orange scrolling bars.

*Note: HF/MF stations will only be available if the relevant option is installed and configured in the LD2. Please refer to LD2 manuals for details. When this service is used the stations will automatically be used within the calculation, depending on the distance from the stations.*

Type 15 messages (Standard Plus service) are shown as an indicator box, with the number of the satellites available from the station shown in brackets. The box remains green while corrections are received but if none are received after 6 minutes the box will change to amber and then red after 9 minutes.

Type 15 messages remain valid longer than the Type 1 messages.

VERIPOS Ultra or APEX corrections are shown by an on-screen box.

This is green when valid corrections are received.

This box will change to amber (corrections still valid) after 2 minutes where corrections are not received.

The Ultra box will change to red after 6 minutes showing that the Ultra corrections are no longer valid.

The system will switch to the next available service (e.g. VERIPOS Standard Service or MF corrections). If no corrections are available it will revert to stand-alone GPS.

*Note:*

*The threshold values are set by the VERIPOS workshop and should not be changed by the user except under the guidance of a VERIPOS engineer.*

The reference stations used in the calculation are the four closest stations to the user's location. They are selected from the stations which are enabled on **port P2** of the LD2.

*Note:*

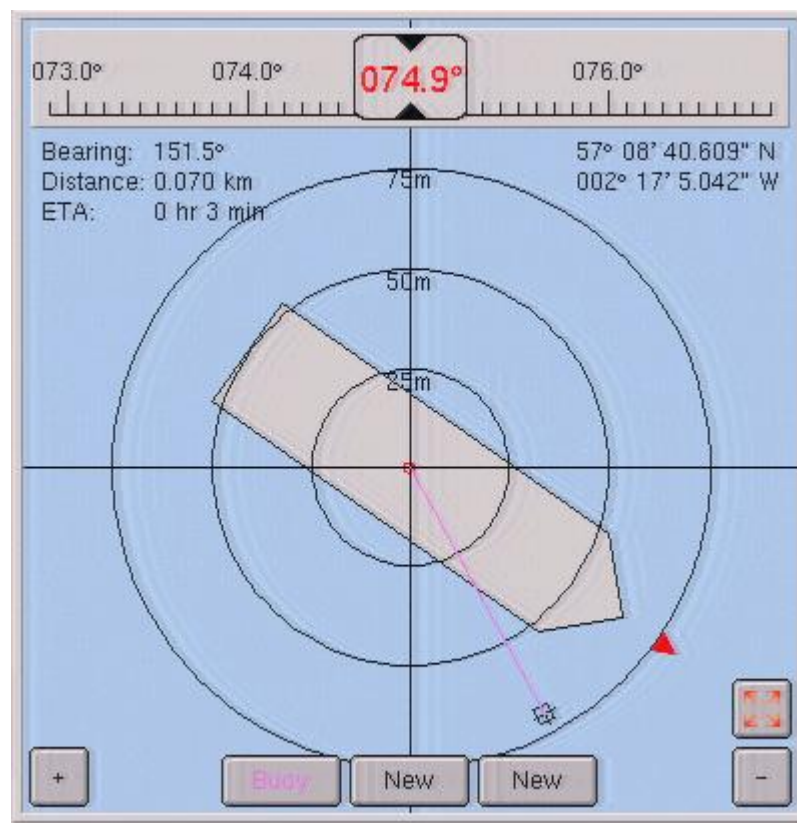
*All the reference station data received from the selected L-Band channel is available for output on port P2. When using Verify DP we recommend that all stations are enabled. During port configuration the user can enable or disable each individual station.*

The user may wish to manually select which stations are used. To do this, disable the remaining stations on port P2. Note that a maximum of four stations may be used and these stations must be within the maximum range limit (1500 Km).

### 2.1.9 Target Monitoring

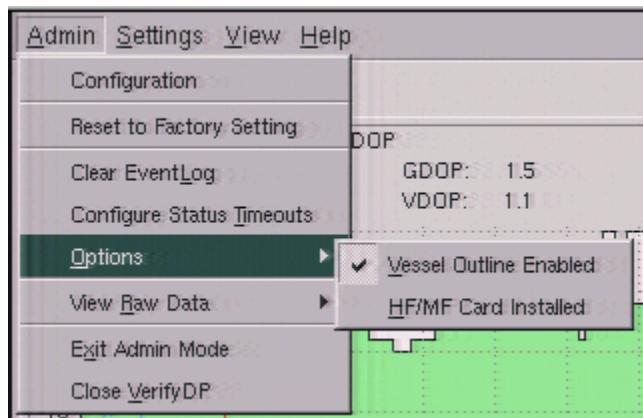
The target monitoring window displays the vessel's outline and heading.

This screen only works when a heading source from a gyro is input into the LD2 through port 3 or using the USB port.

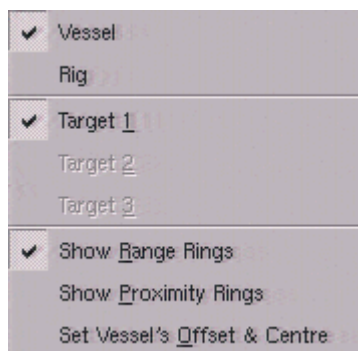


**Vessel Outline view**

Before use the vessel outline facility needs to be enabled in the software Admin Settings



The vessel outline can be chosen by right clicking the mouse on the background of the view, selecting the required outline from the list of standard and user defined vessel outlines.



#### Target monitor right click menu

User defined vessel outline can be generated using the VERIPOS Vessel Shape Editor Excel Macro which can be downloaded <http://downloads.veripos.com> located in Utilities folder. Instructions are given with in the sheet on how to upload the file to the LD2. This is typically undertaken during commissioning. Contact VERIPOS for guidance.

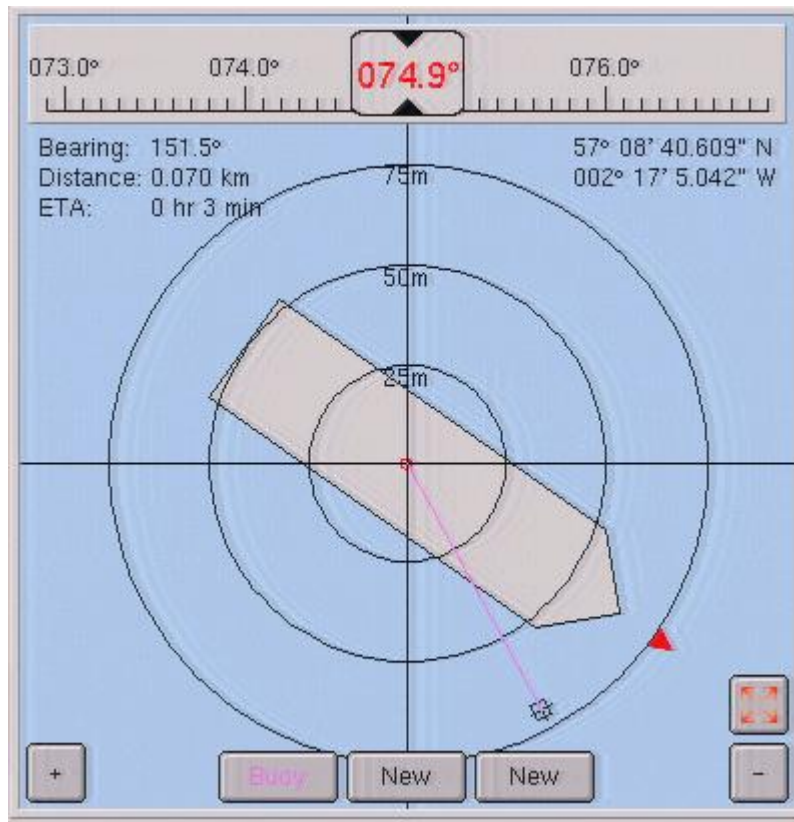
### Selecting Target

Up to three individual targets can be input to the system.

Range and bearing can be displayed to any target at any time.

It is possible to switch targets to display the range and bearing using the Target Monitor right click menu, above.

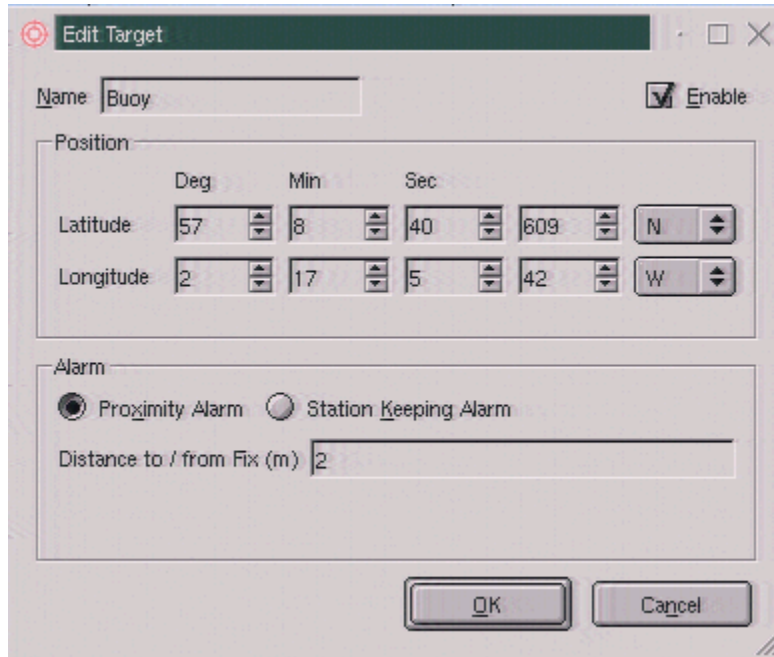
Procedure  
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**Target Monitoring View**

To enter a target position, select one of the Target buttons at the bottom of the Target monitoring view. This opens the 'Edit Target' dialogue box.

Use this dialogue box to set parameters for a vessel's proximity or a station keeping alarm.



To enable the target check the enable box.

The Target name can be edited by the user and is displayed in the target button and Target monitoring menu.

The position displayed is the vessel's position, frozen at the instant the button was pressed.

The displayed position can be kept or manually edited.

Entry must be Latitude and longitude in WGS84.

If the target is within range at the current view scale it will be displayed by a target symbol.

A red line will also be drawn from the Centre of Rotation (CoR) to the target position.

The target latitude and longitude are displayed in the top right hand side of the display.

On the top left of the screen are displayed:

- The bearing to the target from the centre of rotation
- The distance to the target from the centre of rotation
- The Estimated Time of Arrival at the target

Use this dialog box to set parameters for a vessel's proximity or a station keeping alarm.

#### Proximity Alarm

When set to Proximity the system will alarm when the distance from the target to the vessels centre of rotation is less that the user defined distance.

## Station keeping Alarm

When set to station keeping the system will alarm when the distance between the target position and the vessels centre of rotation exceeds the user defined value

## Zooming

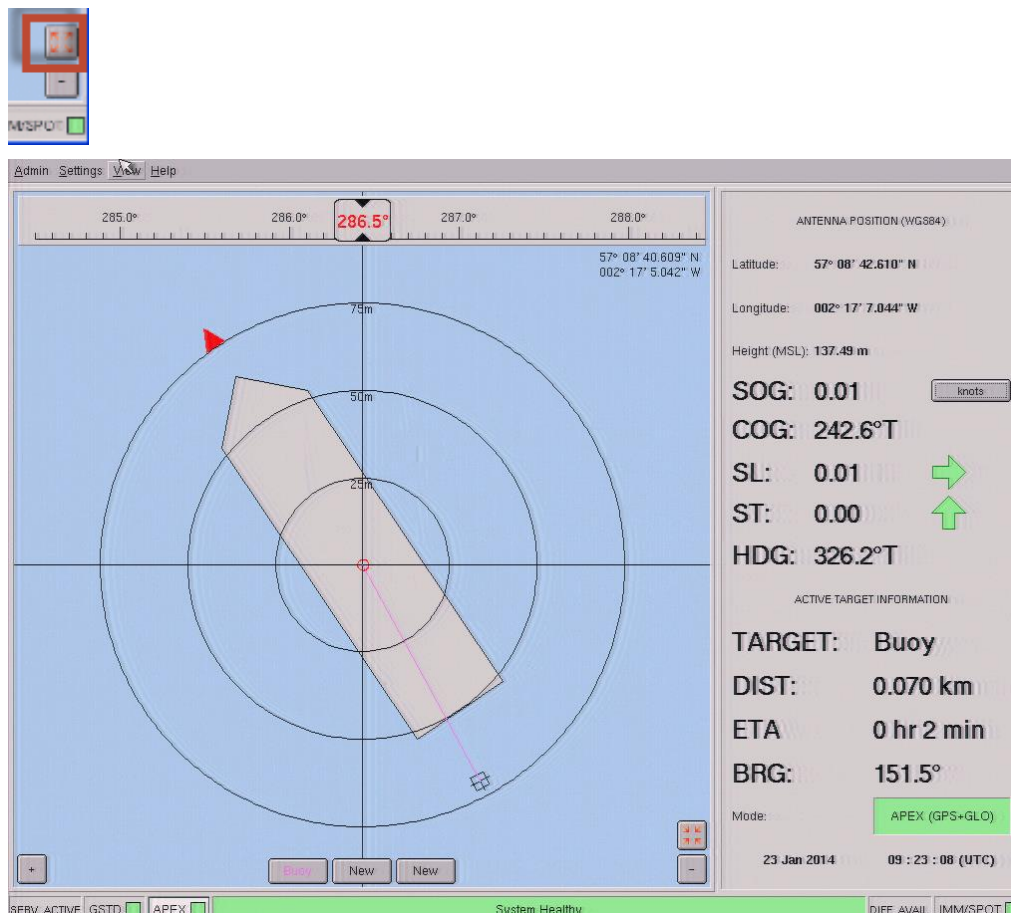
Using the [ + ] and [ – ] buttons at the bottom of the screen it is possible zoom in.

When zooming out the view exceeds the set scale, the symbol will change to an arrow pointing in the direction of the heading of vessel.

## Maximise view

The vessel outline and target view may be maximised.

Click on the expand button to toggle between views;



**Target view (maximised)**

The maximised view provided more information regarding Speed and course, heading and information on the proximity / distance to the selected target.

Variables displayed are:

- Antenna Position – latitude, longitude and height of the antenna position in WGS84
- SOG – speed over ground
- COG – course over ground
- HDG – vessel heading
- SL – speed lateral (speed of the vessel in port/starboard direction in knots only)
- ST – speed traverse (speed of the vessel in forward/aft direction in knots only)
- Active Target Information – range, bearing and ETA to the active target
- Mode – VERIPOS service currently in use as the primary system

To exit the full screen mode, either toggle the Expand button or the Escape key on the keyboard

### Range Rings

Range rings may be switched off. Right click the mouse over the Target monitoring view. In the menu left click the Show Range Rings. When ticked range rings will be displayed. Repeat to remove the range rings.

### Vessel Offsets

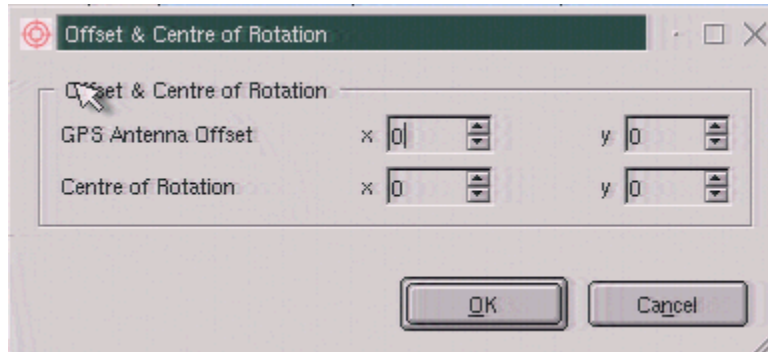
Two offset positions relative to the vessel's CRP (Central Reference Point) can be defined: the GPS Antenna offset and the vessel's CoR (Centre of Rotation) offset.

To enter values, right click the mouse over the Target monitoring view.

Select from the popup options "Set Vessel Offset & Centre". This will display the "Offset & Centre of Rotation" dialog box, below. Enter offset values for the GPS antenna and Centre of rotation relative to the vessel's CRP. Use measurements in metres (m).

Sign conventions:

Positive X = Starboard,      negative X = Port  
 Positive Y = Forward,      negative Y = Aft



**Offset and Centre of Rotation dialog box**

### 2.1.10 Event Log View

This view presents a continuous 24 hour log of the events that have occurred while the Verify DP has been running.

The view provides more detailed information where signals for the GPS and RTCM are lost and these are displayed in red.

Each message has its own date and time stamp.

### 2.1.11 Status Bar

The Status Bar runs across the bottom of the screen.

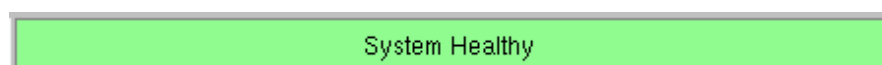
It displays data concerning system status. It is divided into sections as detailed below.

This information bar is used to show the status of the software.

The bar will be green indicating the system is healthy and operating as expected.

The bar will be yellow if a warning is displayed.

When red the system is critical and requires immediate operator attention.

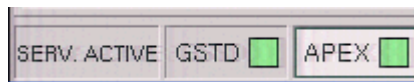


**System Status**

## System mode

The figure below presents the system mode view (this is displayed along the bottom of the Verify-DP display).

The system mode indicates which position calculations are available and whether they have been enabled.



**System Mode**

A green box denotes that the solution is available. Where the text box is highlighted this is the position solution being used. Where a service is not enabled the text box for the service is greyed out.

Where the service is enabled but not available the box will be red. This may indicate a problem with that solution.

As well as system mode indicators there are also indicators for the RTCM data input sources. In normal mode of operation the RTCM boxes are green when valid corrections are available. These turn yellow after 30 seconds, then red if corrections are not available.



**Differential Availability**

The example above shows the external RTCM feed is from a LAN network connection.

It is possible to have multiple sources of RTCM feeding the algorithms:

- On-board L-band card (IMM/SPOT) [Inmarsat or SPOT antennas]
- On-board HF/MF card HF/IALA) [HF corrections or IALA MF Beacons]
- External sources of RTCM (xRTCM)

External RTCM can be fed in to the algorithms through multiple input ports.

A letter is displayed onscreen to indicate which port is in use:

- U = USB

- S = Serial
- L = LAN (network)

## 2.2 MAIN MENU

The user has the ability to perform limited configuration from the main menu structure.

By default three main menu items are shown:

By default three main menu items are shown: “Settings”, “View” and “Help”.

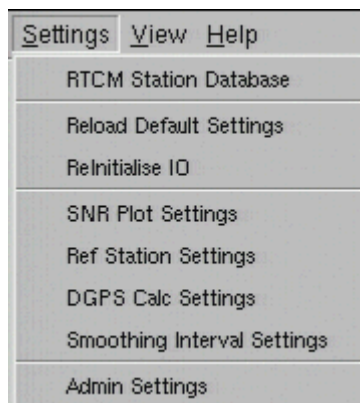
An additional menu item (**Admin**) may be enabled from the “Settings” menu which will be on the left of the menu bar.

The admin menu is intended for use by VERIPOS engineers performing system administration tasks and not normally accessed by the user.  
Details of its functions are included in the Appendix

The Admin menu is password enabled and is always disabled when the unit is powered down.

### 2.2.1 Settings

The settings menu allows for some basic configuration of the Verify DP software.



***Verify DP Settings Menu***

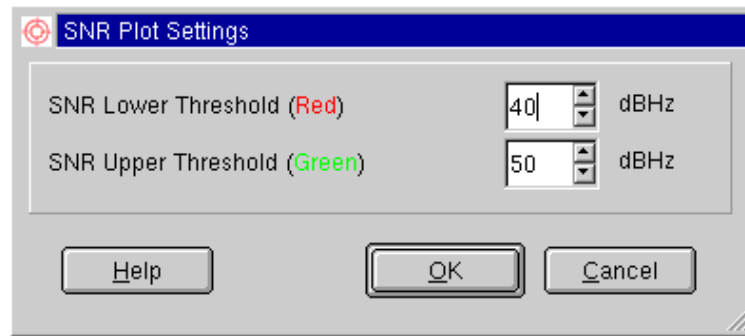
Four of the menu options (described below) may be modified by the user.

- **SNR Plot**
- **Ref Station Settings**
- **DGPS Calc Settings**

- **Smoothing Interval Settings**

Remaining menu options should only be used under the direct guidance of a VERIPOS engineer and are described in the Appendix.

### SNR Plots settings

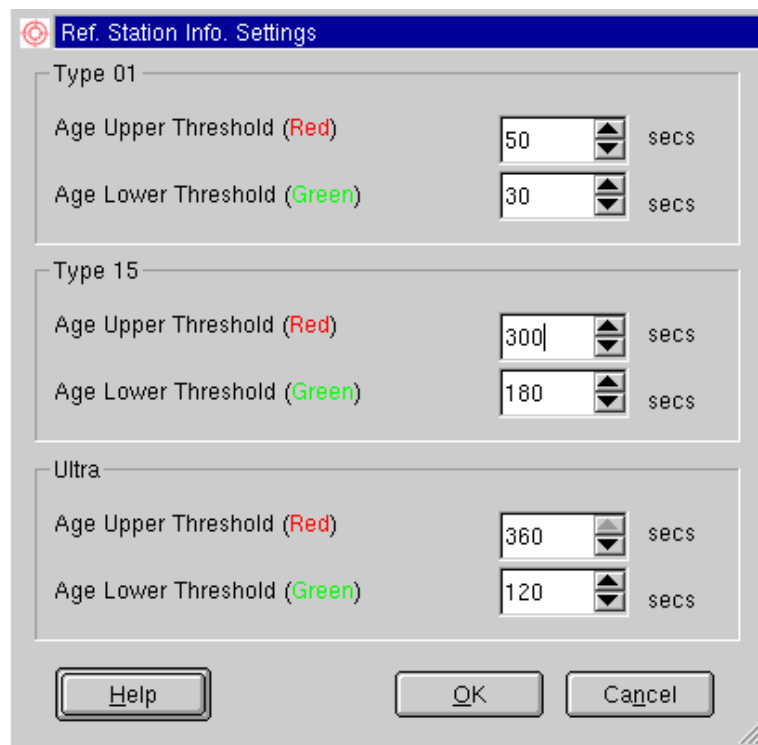


**SNR Plot Settings**

This dialogue allows the thresholds for the SNR to be set. This will determine the signal levels for display colours to change. To adjust the settings, press the up or down arrow on the appropriate threshold until the required value is displayed. The dialog can also be opened by right-clicking on the Signal to Noise window.

On initial use these will have been entered in the VERIPOS workshop to match the model of GPS receiver installed and should only be amended after consulting a VERIPOS engineer. Before making any changes the user should record the initial values

### Ref. Station Info Settings



The dialog box titled "Ref. Station Info. Settings" contains three sections for configuring age thresholds for different message types:

- Type 01**
  - Age Upper Threshold (Red): 50 secs
  - Age Lower Threshold (Green): 30 secs
- Type 15**
  - Age Upper Threshold (Red): 300 secs
  - Age Lower Threshold (Green): 180 secs
- Ultra**
  - Age Upper Threshold (Red): 360 secs
  - Age Lower Threshold (Green): 120 secs

At the bottom of the dialog are three buttons: "Help", "OK", and "Cancel".

**Reference Station Info Settings**

The Reference Station dialogue indicates the age thresholds of the RTCM corrections for each message type (Type 1, Type 15 and Ultra). This dialog can also be opened by right-clicking on the Reference Station Information window. VERIPOS recommend that the default settings are not changed.

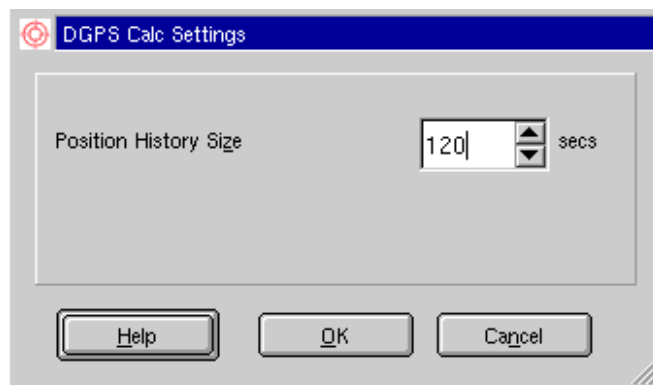
The thresholds control the age at which the display bars change colour.

The Age Upper Threshold also determines the age at which the station is excluded from the calculations.

Thresholds can be changed by the operator with the limits by pressing the up or down arrow until the required threshold value is reached.

This option should be used with caution after consulting a VERIPOS engineer and should only be amended after consulting a VERIPOS engineer. Before making any changes the user should record the initial values

## DGPS Calc Settings



**DGPS Calculation Settings**

The DGPS Calculation view is used to set the amount of position history that will be displayed. The longer the time set in seconds the more position points will be displayed on the plot. This dialog can also be opened by right-clicking on the DGPS Calculation window.

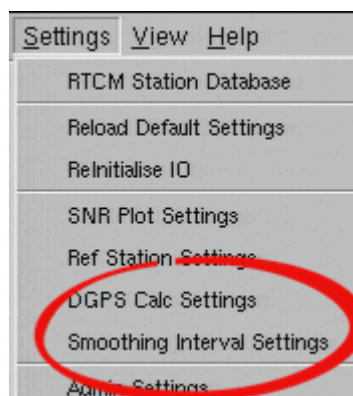
### Smoothing Interval Settings

With Verify DP software version 2.0.9.5 (and above) has a new feature which enables the smoothing of the Vessel Outline and Target display to be adjusted between zero to 30 seconds.

#### Note:

The default setting is for an interval of 10 seconds.

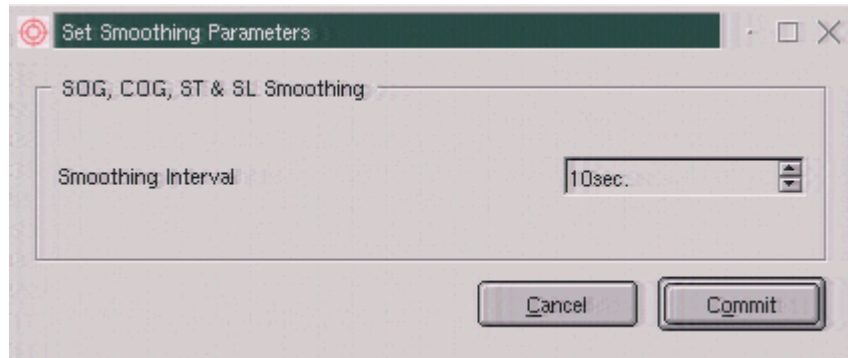
Select on the **Settings** menu the **Smoothing Interval Settings** entry;



**Verify DP v2.0.9.5 Smoothing Interval**

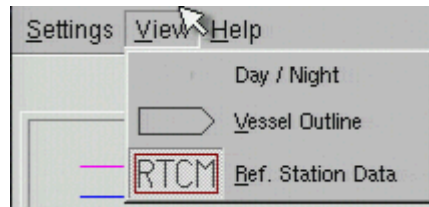
In the dialog box, if required amend the **Set Smoothing Parameters** to the required value in seconds (range zero to 30 seconds) using the arrows then click on **Commit** to apply.

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**Verify DP v2.0.9.5 Set Smoothing**

## 2.2.2 View



**View Menu**

### 2.2.2.1 Day / Night

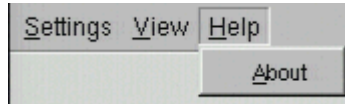
This allows night dimming of the Verify DP screen when on a ship bridge darkened at night.

#### Vessel Outline / Ref. Station Data

This menu is available when the system is enabled to display the vessel outline from the Admin menu. It allows users to switch between the Vessel outline or Reference Station and related information views.

This function can also be done by clicking on the icons on the top right of the DP display.

### 2.2.3 Help



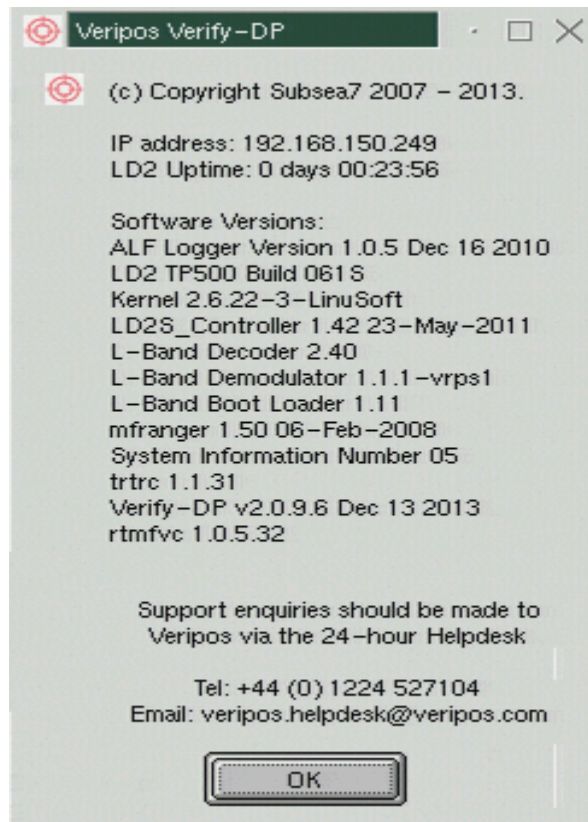
#### Help Menu

The Help menu enables the user to access information about Veripos DP.

About

About opens information about the system including:

IP address, the LD2 uptime and Software Versions.



#### About Dialog

### 3. TROUBLESHOOTING

This section is to assist users for the most frequently encountered areas.

PROBLEM:	SOLUTION:
<i>The vessel is in port. The Verify DP monitor is displaying a full screen of data. LD2 is powered down (e.g. generator change). When the unit is powered back up the screen is blank.</i>	Check the "ID" indicator on LD2. If the indicator is flashing, the unit is disabled. Enable the LD2 using normal procedures – the display will be restored.
<i>An enable code is entered into the LD2. The "ID" indicator stops flashing and is steadily illuminated but the monitor remains blank.</i>	Turn off the power to the LD2 (switch on rear panel). Wait ca. one minute then turn the power back on. The unit should always be rebooted after enabling.
<i>The unit is an LD2S. The user enters an Enable (or Disable) code is supplied by the Helpdesk but the unit status does not change. If the LD2S is rebooted the Access Code display may be blank.</i>	Check the "Sync" indicator on the LD2S. It cannot be enabled or disabled unless they are receiving signal on the L-Band input. If the "Sync" indicator is extinguished there is a problem with L-band input which must be corrected before the unit can be enabled. (Refer to the LD2 Operations Manual).
<i>The user cannot access the Target Monitoring (Vessel Outline) screen.</i>	<p>This screen is optionally displayed on the bottom right of the display in place of the Station Data window.</p> <p>From the main menu, click on the "View" menu and select "Vessel Outline".</p> <p>If "View" is not listed in the main menu, then the screen is disabled in the Admin menu. See menu documentation in this manual.</p>
<i>The "Mode" indicator on the Position window turns red and displays "NO DATA". The "Time" display freezes and the remainder of the screen ceases updating. The alarm sounds.</i>	This indicates a total positioning failure caused by a loss of GPS input. Refer to the LD2 Operations manual for troubleshooting procedures.
<i>In the Station Data window the "Age" bars turn amber, then red. The alarm sounds. In the status bar (at the bottom of the screen) the "IMM/SPOT" (on the right hand side) is red.</i>	<p>May indicate a loss of correction data from the L-Band input. Unless external or HF corrections are available the position shown will be uncorrected GPS. (Mode will indicate "STANDARD" with an amber background.)</p> <p>Check the "Sync" indicator on the LD2. This</p>

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	<p>will probably be extinguished, confirming a failure of L-Band reception.</p> <p>Refer to LD2 Operations Manual for further troubleshooting information.</p>
--	--

## 4. ADDITIONAL MENU FUNCTIONS

The Software offers additional capabilities that in normal use will not require to be used. This section describes their use.

### 4.1 ADMIN

Selecting this option will open a password dialog box. Upon correct entry of the password, an additional item “Admin” will be added to the left hand end of the main menu. The functions of this menu are described below.

**NOTE:**

*This menu is normally reserved for administration functions by VERIPOS engineers. The user should only use the functions under guidance from VERIPOS. The password must be obtained from the VERIPOS Helpdesk. See **Contact information**.*

#### 4.1.1 Admin menu

An optional, additional menu item (“Admin”) may be enabled from the “Settings” menu. It then appears on the left of the menu bar. This menu is for use by VERIPOS engineers performing system administration tasks and should not normally be accessed by the user.

A password is required to enable the “Admin” menu and is disabled when the unit is powered down.

Password available from the VERIPOS Helpdesk (**Appendix 1, Contact Information**).

The Helpdesk can also provide guidance concerning the correct use of the Verify DP functions.

The Additional function menu options are detailed in **Appendix 2**.

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## APPENDIX 1

### CONTACT INFORMATION

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## 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 Operations Project Management+ 44 (0) 1224 965800

VERIPOS Helpdesk E-mail: [helpdesk@veripos.com](mailto: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](http://www.veripos.com)

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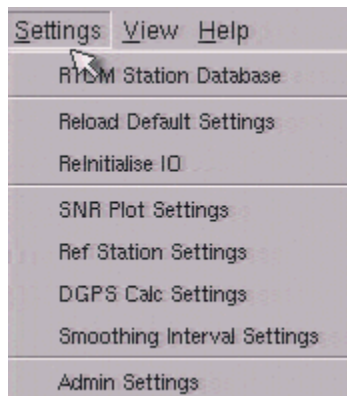
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## APPENDIX 2

### ADDITIONAL MAIN MENU FUNCTIONS

## SETTINGS MENU

The Settings menu allows for some basic configuration of the Verify DP software.



**Verify DP Settings Menu**

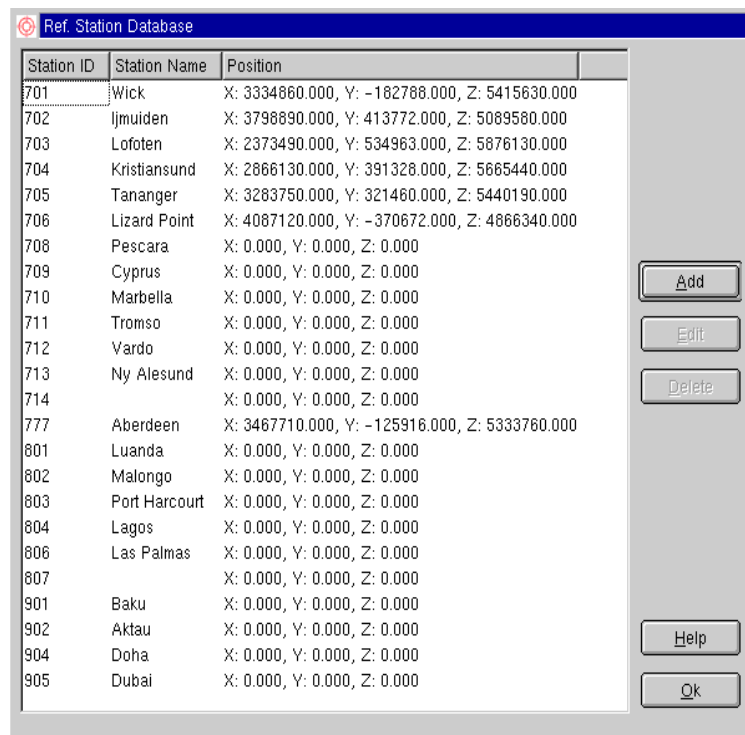
Only three of the menu options should routinely be modified by the user. These are:

- **SNR Plot Settings**
- **Ref Station Settings**
- **DGPS Calc Settings**

These are described in Section 2 in the main body of the manual.

The remaining menu options should only be used under the direct guidance of a VERIPOS engineer. These are described below:

## RTCM Station Database



Station ID	Station Name	Position
701	Wick	X: 3334860.000, Y: -182788.000, Z: 5415630.000
702	Ijmuiden	X: 3798890.000, Y: 413772.000, Z: 5089580.000
703	Lofoten	X: 2373490.000, Y: 534963.000, Z: 5876130.000
704	Kristiansund	X: 2866130.000, Y: 391328.000, Z: 5665440.000
705	Tananger	X: 3283750.000, Y: 321460.000, Z: 5440190.000
706	Lizard Point	X: 4087120.000, Y: -370672.000, Z: 4866340.000
708	Pescara	X: 0.000, Y: 0.000, Z: 0.000
709	Cyprus	X: 0.000, Y: 0.000, Z: 0.000
710	Marbella	X: 0.000, Y: 0.000, Z: 0.000
711	Tromso	X: 0.000, Y: 0.000, Z: 0.000
712	Vardo	X: 0.000, Y: 0.000, Z: 0.000
713	Ny Alesund	X: 0.000, Y: 0.000, Z: 0.000
714		X: 0.000, Y: 0.000, Z: 0.000
777	Aberdeen	X: 3467710.000, Y: -125916.000, Z: 5333760.000
801	Luanda	X: 0.000, Y: 0.000, Z: 0.000
802	Malongo	X: 0.000, Y: 0.000, Z: 0.000
803	Port Harcourt	X: 0.000, Y: 0.000, Z: 0.000
804	Lagos	X: 0.000, Y: 0.000, Z: 0.000
806	Las Palmas	X: 0.000, Y: 0.000, Z: 0.000
807		X: 0.000, Y: 0.000, Z: 0.000
901	Baku	X: 0.000, Y: 0.000, Z: 0.000
902	Aktau	X: 0.000, Y: 0.000, Z: 0.000
904	Doha	X: 0.000, Y: 0.000, Z: 0.000
905	Dubai	X: 0.000, Y: 0.000, Z: 0.000

**RTCM Database**

This displays the reference stations in the LD2.

## Reload Default Settings

Once this has been selected all the “Factory Default” settings are loaded into the preset views of Verify-DP. This does not affect the hardware settings of the LD2.

## Re-Initialise IO

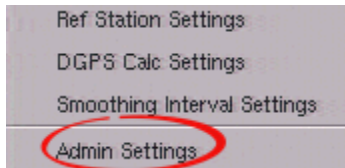
This will Re-initialise the internal sockets used for passing RTCM data to algorithms within the LD.

## Re-Initialise Decoder

The Factory settings are re-established on the decoder when this is selected.

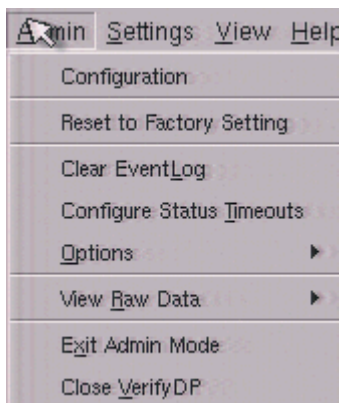
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## Admin Settings



Selecting this option will open a password dialog box. Upon correct entry of the password, an additional item “Admin” will be added to the left hand end of the main menu. The functions of this menu are described below.

Note: This menu is normally reserved for administration functions by VERIPOS engineers. The user should only use the functions under guidance from VERIPOS. The password must be obtained from the VERIPOS Helpdesk. See Contact Information section in the Appendix.



# Administration Menu

By default only three items appear in the main menu: Settings, View and Help.

An additional menu item (Admin) may be enabled from the “Settings” menu. It then appears on the left of the menu bar.

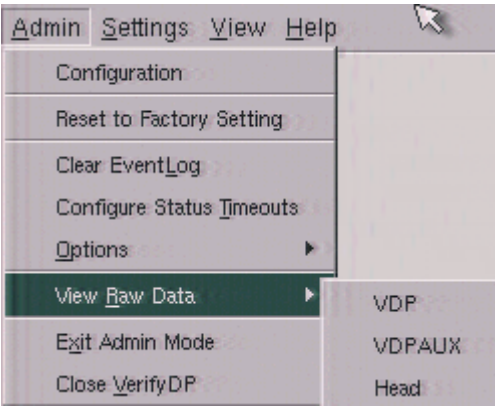
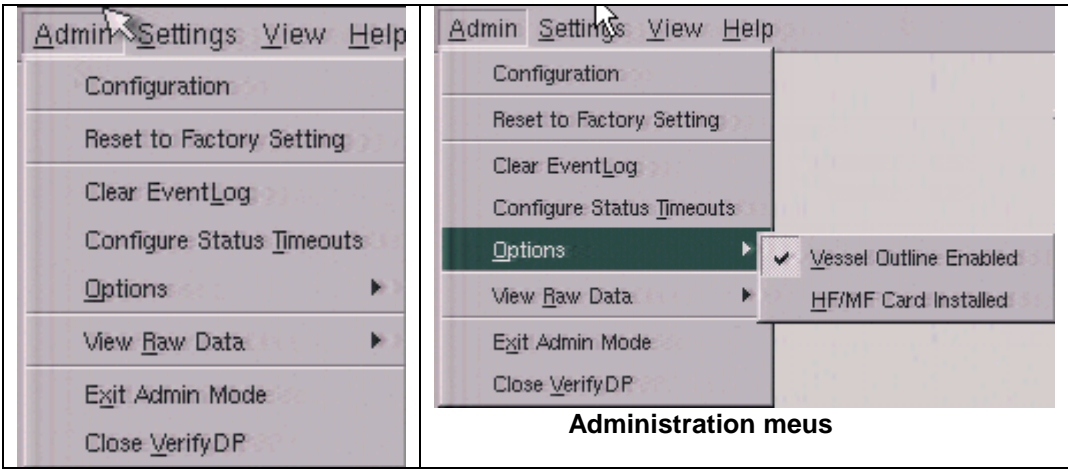
This menu is intended for use by VERIPOS engineers performing system administration tasks and should not normally be accessed by the user.

A password is required to enable the “Admin” menu and is disabled when the unit powers down.

Where required the password is obtained from the VERIPOS Helpdesk.  
(See “Contacts” section of Appendix.)

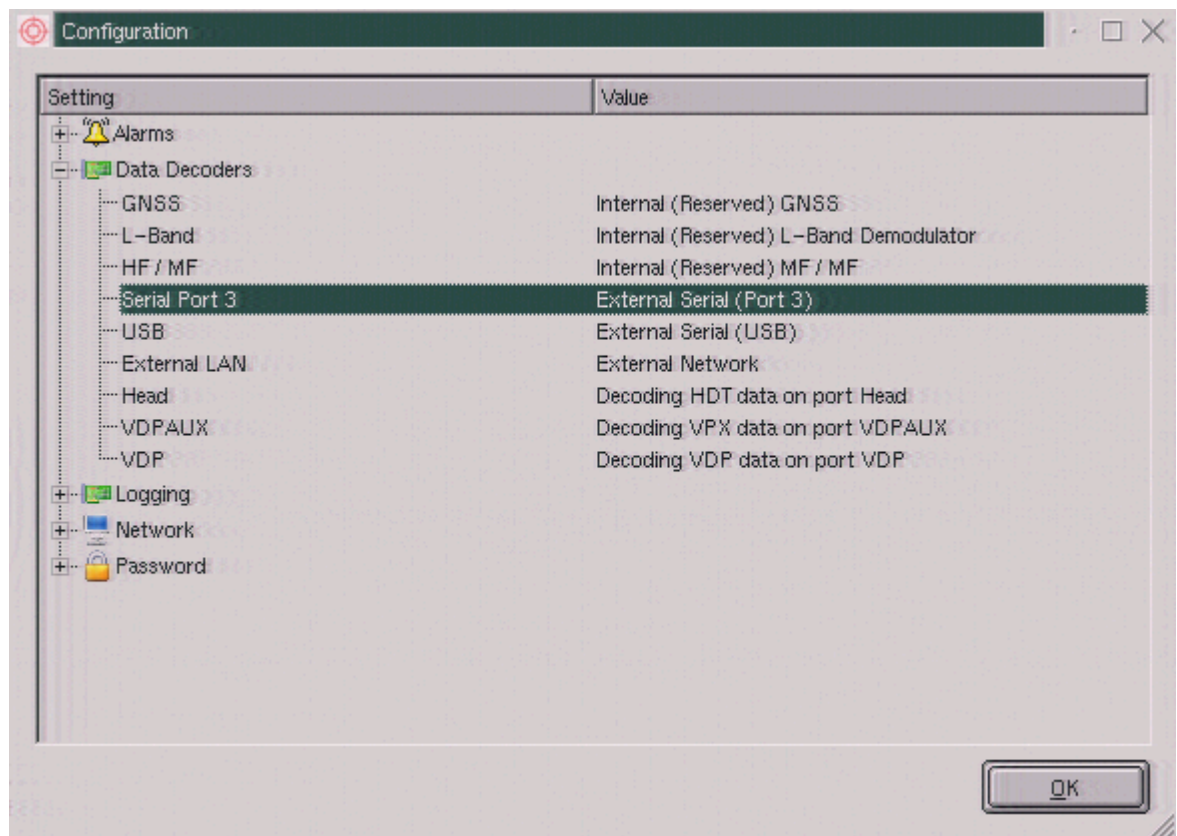
The Helpdesk can also provide guidance concerning the correct use of functions.

The menu options are shown below:



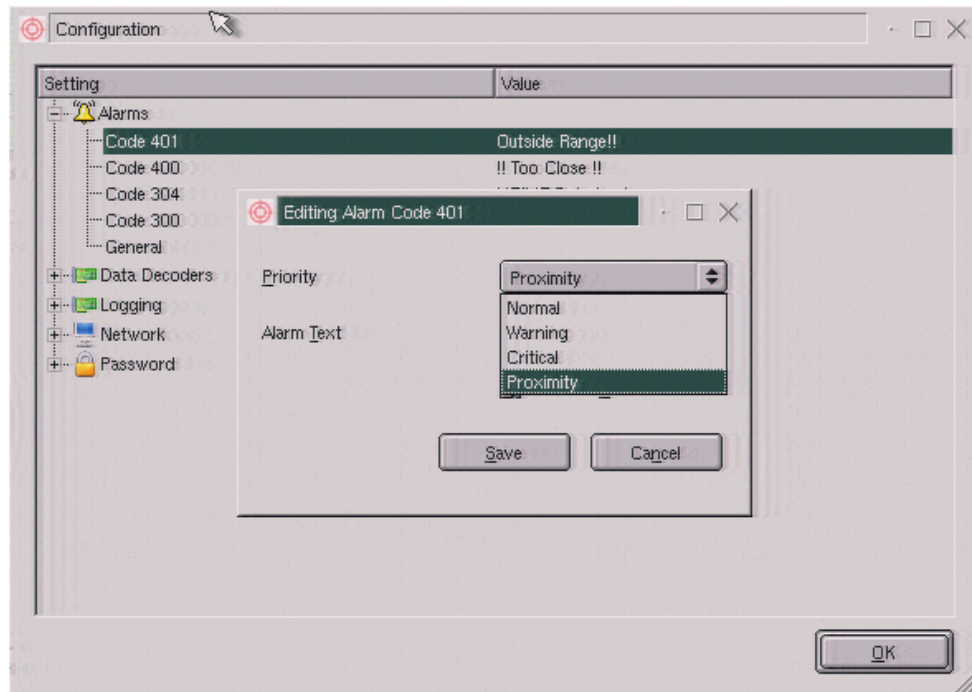
## Configuration

Opening Configuration displays the following sections:



Double clicking opens each section while a right click allows a new config to be made.

## Configure Alarms



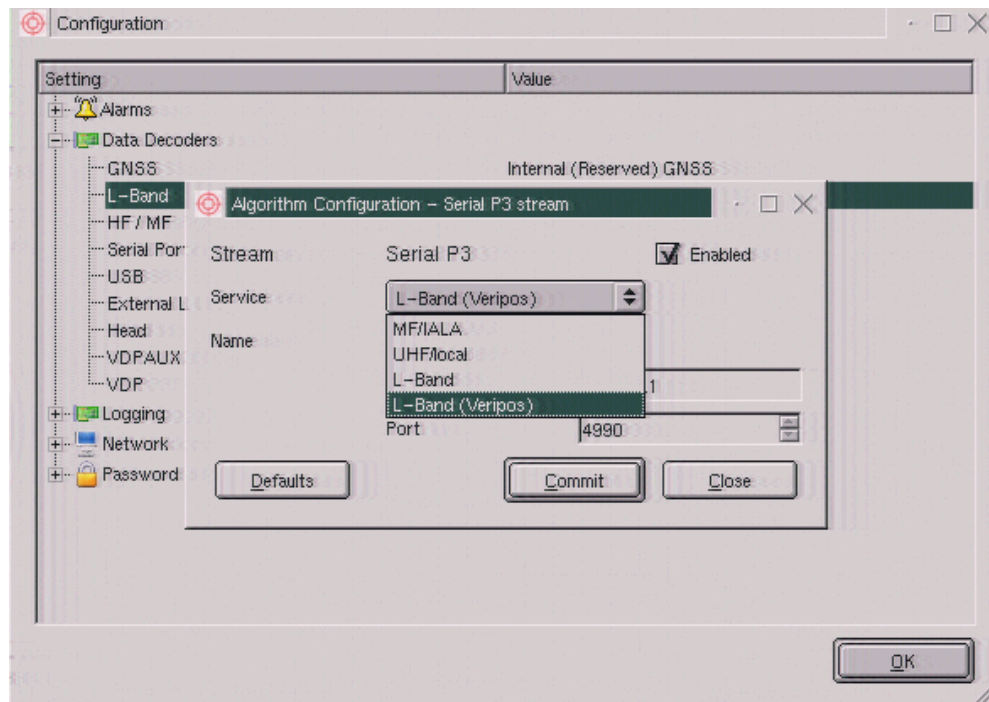
**Alarm Configuration**

The user can configure the priority of alarms these depending on the severity of the operation, i.e. is data is lost, this may be seen as critical as the system will not be operating at all. The alarm priorities are:

Normal  
 Warning  
 Critical  
 Proximity

To change the priorities on the alarm codes, select Admin / Configuration and expand Alarms. Use the drop down box to select the appropriate alarm priority for the alarm code. Finally select Save to enable.

## Configure Data Decoders



**I/O Configuration example – P3**

The Data Decoder dialog enables the user to configure data ports in the LD2 for communications.

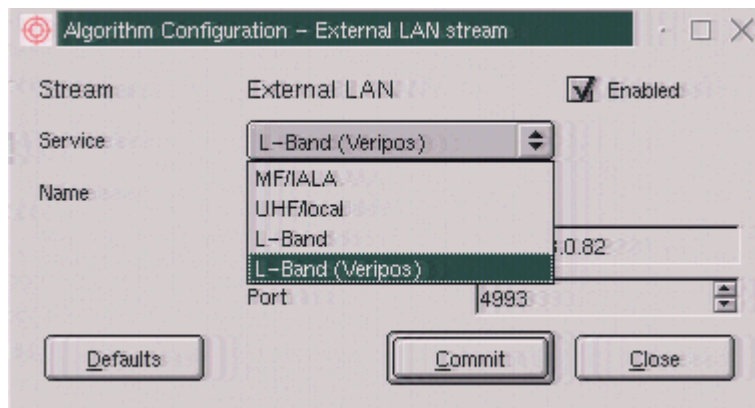
To configure an IO select which type is being used.

The following data is available on the associated port and IP address.

N. B. Gyro data is optional.

Data	Address	Port
VDP	127.0.0.1	5000
VDP Aux	127.0.0.1	8001
Gyro (HDT) serial port 3	127.0.0.1	4990
Gyro (HDT) USB	127.0.0.1	4997

## Configure Data Streams



### Configure Data Stream

The above dialog enables the user to configure the data inputs from external data sources into the algorithms. The Stream is the Source of the data input, the user should select the appropriate data source then tick the Enable box then choose the appropriate data type :

- **GNSS** GNSS data from the on-board GNSS card when enabled.
- **L-band** RTCM corrections from the on-board L-band Card when enabled.
- **HF/MF** RTCM corrections from the on-board HF/MF Card when enabled.
- **Serial P3** External data from a third party system being feed through Port 3

HF/IALA Allows for an external source of HF/MF data to be input into the on-board algorithms.

UHF Local Allows for an external source of UHF data to be input into the on-board algorithms.

L-Band (Ext 2) messages Allows for the input of non -VERIPOS RTCM messages into the on-board algorithms

L-Band (VERIPOS) Allows for VERIPOS RTCM messages from another VERIPOS demodulator to be input in to the on-board algorithms

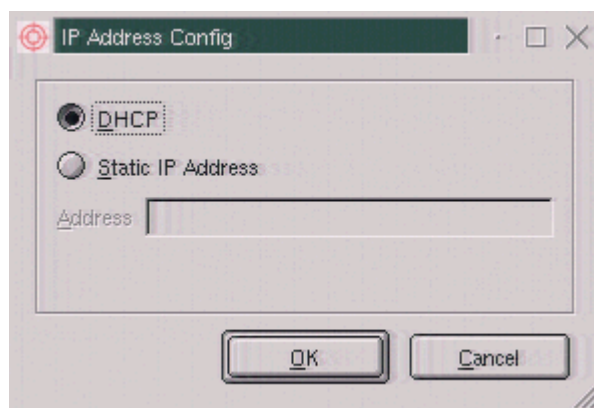
- **USB** External data from a third party system being feed through the USB port

HF/IALA	Allows for an external source of HF/MF data to be input into the on-board algorithms.
UHF Local	Allows for an external source of UHF data to be input into the on-board algorithms.
L-Band (Ext 2) messages	Allows for the input of non -VERIPOS RTCM messages into the on-board algorithms
L-Band (VERIPOS)	Allows for VERIPOS RTCM messages from another VERIPOS demodulator to be input in to the on-board algorithms
<ul style="list-style-type: none"> <li>• <b>Ext. LAN</b> External data from a third party system being feed through the LAN Port. When using the External LAN data feed, the user must enter the IP and port number of the system that is outputting the data.</li> </ul>	

HF/IALA	Allows for an external source of HF/MF data to be input into the on-board algorithms.
UHF Local	Allows for an external source of UHF data to be input into the on-board algorithms.
L-Band (Ext 2) messages	Allows for the input of non -VERIPOS RTCM messages into the on-board algorithms
L-Band (VERIPOS)	Allows for VERIPOS RTCM messages from another VERIPOS demodulator to be input in to the on-board algorithms

## Configure IP Address

The IP Address Configuration dialog allows the user to configure the way that an IP address is assigned to the LD2. The user can configure the system to obtain an address from a Network using DHCP where supported, or the user can allocate the LD2 a Static IP Address.



IP Address Configuration

## Change Password

If the password is changed, it is ***strongly recommended*** that the new password is held in a secure place on the vessel so that when it is urgently required it can be easily obtained.

## Clear Event Log

If the data is old in the Event Log then by using this facility all the data can be deleted. Not recommended whilst the vessel is in DP operation.

## Display Dimming

This facility can be used to adjust the display for the operator's night time requirements.

## Options

There are two options in the options menu:

**Vessel outline enable:** enables the View option in the top menu bar which allows the user to toggle between the vessel outline and the station information view.

**HF/MF card installed:** should be enabled when there is an HF/MF installed in the LD2. If there is no HF/MF card installed, this option should be disabled or the system will sound an alarm when it does not receive HF/MF data.

## View Raw Data

This allows the user to view the data being used to populate the Verify-DP display. This is useful to check if data is being output from the algorithms.

## Exit Admin Mode

This will take the operator back to the normal display with the Admin menu item removed from the task bar at the top of the screen.

## Close Verify DP

Selecting this will close the screen leaving it blank, but the LD2 unit will keep running. To restore Verify-DP on the screen, the LD2 **must** be cycled off/on.

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## APPENDIX 3

### ABBREVIATIONS

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## ABBREVIATIONS

ADE	Above Deck Equipment
APEX / APEX <sup>2</sup>	Veripos High Accuracy Positioning System
BDE	Below Deck Equipment
BER	Bit Error Rate
CoG	Course over Ground
CR/LF	Carriage Return/Line Feed
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
HF	High Frequency Radio used to Transmit Correction Data
KPH	Kilometres per Hour
LAN	Local Area Network
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 / Std	VERIPOS Single frequency DGPS system
SV	Space Vehicle
Ultra	VERIPOS High accuracy positioning system
USB	Universal Serial Bus
UTC	Coordinated Universal Time
V	Volt
VDOP	Vertical Dilution of Precision
VGA	Video Graphic Array
VOSS	VERIPOS Online Support System
W	Watt
WAAS	Wide Area Augmentation System

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WEEE

Waste Electrical and Electronic Equipment

## APPENDIX 4

### VERIPOS REFERENCE STATION LISTING

VERIPOS reference stations are listed below.

The listing is up to date at time of publication.

The latest VERIPOS Station listing can be found on the VERIPOS Online Support System via the following URL: <http://help.veripos.com> in FAQ's.

**VERIPOS PPP services Ultra and APEX** have no range limitations and may be used in any location.

The corrections are in a VERIPOS proprietary format and can only be decoded by VERIPOS systems.

The same Station ID's are used across all satellite beams;

Service	Station ID	NMEA Station ID
Ultra	68	0068
Ultra <sup>2</sup>	68 + 75	00268
APEX	81	0081
APEX <sup>2</sup>	81 + 82	0281

Global and regional coverage charts are available on the VERIPOS online support site (VOSS) at: <http://help.veripos.com>

VERIPOS also provide "Verichart" software which enables the user to generate a chart showing the best beams and reference stations for the exact location of the worksite. This software is provided with new systems and may also be downloaded from VOSS.

VERIPOS recommend that this software is installed during commissioning so that it is available during operations.

#### IALA BEACONS:

A listing of IALA MF stations is available from: <http://site.ialathree.org/>  
 (Select "IALA Lists of Radionavigation Services")

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## APPENDIX 5

### 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
3. IMCA

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](http://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 DP 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% ( $2\sigma$ ) 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](http://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.

## IMCA RECOMMENDATIONS

In October 1997 IMCA issued a document titled 'Guidelines on the use of DGPS as a positioning reference in DP control systems' (IMCA reference: IMCA M 141), see [3]. These guidelines highlight the specific need of DP vessels for position stability and repeatability, more so than just accuracy. It stipulates that DP systems receive unfiltered position data. DP systems using multiple position reference should perform comparisons to detect drift and instabilities. The DP system should perform quality checking and detect failures.

Two DGPS service parameters are considered as critical: correction update rate and latency. It recommends using differential services with an update rate of less than 5 seconds but it recognises that lower update rates suffice for certain applications. These recommendations are now out of date since Selective Availability was switched off on the GPS satellites in May 2000. Update rates of up to 60 seconds are now considered sufficient.

It equally recommends latencies of around 5 seconds or at least less than 15-20 seconds. Again these recommendations are out of date and latencies up to 100 second are now considered sufficient to maintain accurate and stable positioning.

The IMCA guidelines recognise that 'DPO's are not expected to have either the time or the need to interpret the plethora of information in DGPS QC monitoring'.

Section 4.2.1 of the guidelines explains the practicalities of quality indicators: -

*"Some QC parameters provide a simple measure of performance and others indicate the reason for degradation in performance. Parameters also exist that may be used to determine an imminent positioning failure or degradation and it is these that are most useful in the DP field as an imminent failure may be detected and appropriate action taken. Conversely, such parameters can also be used to re-select the DGPS. A yes/no flag for the presence of differential signal is the only DGPS quality indicator many DP control systems can look for and it does not represent an adequate indicator of DGPS quality for critical DP operations.*

*DGPS QC can and, for many activities, should be used more effectively than at present. QC indicators should be understandable, helpful and meaningful to non-specialist and should be minimised to avoid overloading DPO's with information. DGPS should reliably indicate its own performance to limit the interpretation needed by DPO's in busy vessel environments where they have other responsibilities and distractions."*

The IMCA guidelines recognise that there is an abundance of usable QC parameters available in most DGPS services. However, they recommend a simple DGPS Quality Indicator (DQI) reflecting a logical approach to: -

1. Is the DGPS operating correctly i.e. are corrections available?
2. Can reliability be determined i.e. does the data allow testing?
3. What is the precision and does it meet the user's needs?

The proposed structure of the DQI values is outline in the table below (based on table 4.2.2 in [3] : -

DQI	Status of Solution (note 1)	Precision (note 2)	Comments (note 3)
0	Failed Solution	N/A	-
1	Uncorrected	N/A	Solution obtained but no differential
2	Corrected position but no redundancy	N/A	Minimum DGPS solution
3	Corrected position; Redundancy of 1	Poor	Poor DOP / geometry
4	Corrected position; Redundancy of 1	< 10m	Adequate DOP / geometry
5	Corrected position; Redundancy of > 1	< 10m	Ability to reject outlier; Poor DOP / geometry
6	Corrected position; Redundancy of > 1	< 10m	Ability to reject outlier; Gradual improvement in geometry / DOP
7	Corrected position; Redundancy of > 1	< 4m	Ability to reject outlier; Gradual improvement in geometry / DOP
8	Corrected position; Redundancy of > 1	< 2m	Ability to reject outlier; Gradual improvement in geometry / DOP
9	Corrected position; Redundancy of > 1	< 0.5m	Ability to reject outlier; Gradual improvement in geometry / DOP

Notes: -

1. Pre-requisite is a successful solution with a valid statistical test
2. Confidence regions are 95%
3. Assumes improving DQI; if DQI value is worsening, read gradual deterioration

The thinking behind the DQI values is that DGPS systems can cascade in performance and update the DP system accordingly on a worsening or improving positioning.

The IMCA guidelines subsequently propose a modified NMEA \$GPGLL sentence called the \$DPGLL sentence. The \$DPGLL sentence has the same structure as the \$GPGLL sentence, for ease of implementation, but the meaning of two fields have been replaced:

- The DGPS QI field in the \$GPGLL sentence has been replaced by the DQI field in the \$DPGLL
- The Differential Reference Station Identifier in the \$GPGLL sentence has been replaced by the DGPS System Identifier in the \$DPGLL sentence.

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This identifier reads DGPR for a radio-based link or DGPI for an Inmarsat-based link

## APPENDIX 6

### NMEA SENTENCES

## NMEA SENTENCES

This section describes the message structure of the following advanced positioning messages: -

- GGA
- GLL
- GST
- ZDA
- GNS
- VTG
- HDT
- ROT

### 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.mmmmmmm,a,dddmm.mmmmmmm,b,Q,s,p,p,h,h,M,g,g,M,x.x,nnnn*c<CR><LF>
$GPGGA,150207.00,5708.7100972,N,00217.1170486,W,2,10,0.9,137.44,M,50.72,M,6.4,0704*57
```

GGA sentence defined: -

GGA	Global Positioning System Fix Data
hhmmss.ss	UTC of position
ddmm.mmmmmmm	latitude of position
a	N or S, latitude hemisphere
dddmm.mmmmmmm	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)
s	number of satellites in use
p.p	horizontal dilution of precision
h.h	antenna altitude above mean-sea-level
M	units of antenna altitude, meters
g.g	Geoidal height
M	units of geoidal height, meters
x.x	age of differential GPS data
nnnn	Differential reference station ID, 0000 to 1023
*c<CR><LF>	checksum, carriage return and line feed

NMEA-0183 compatible string.

Number of SV's is limited to 12 and the sentence length is restricted to 82 characters

### **NMEA GLL Sentence**

The NMEA GLL sentence provides 2D position data.

Structure and Example:

```
$GPGLL,ddmm.mmmmmmm ,a, dddmm.mmmmmmm ,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.mmmmmmm	latitude of position
a	N or S
dddmm.mmmmmmm	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

### **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,a,b,b,c,c,d,d,e,e,f,f,g,g*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.a	RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudo-ranges and differential DGNSS corrections
b.b	Standard deviation of semi-major axis of error ellipse (meters)
c.c	Standard deviation of semi-minor axis of error ellipse (meters)
d.d	Orientation of semi-major axis of error ellipse (meters)
e.e	Standard deviation of latitude error (meters)
f.f	Standard deviation of longitude error (meters)
g.g	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,yy	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 GNS Sentence

The NMEA GNS sentence contains time and position fix related data for a single or combined satellite navigation system. Separate \$GPGNS and \$GLGNS sentences are used to report data calculated from individual systems if a combined GPS+GLONASS position is output. A single string will be output if no GLONASS data is in use.

Structure and Example:

```
$GPGNS,hhmmss.ss,ddmm.mmm,a,dddmm.mmm,b,ee,xx,p,p,a,b,c,d,l,l,nnnn*hh<CR><LF>
$GNGNS,104601.00,5707.7332018,N,00204.7778500,W,DD,12,0.71,24.743,50.284,,*45
$GPGNS,104601.00,,,,,09,,,,3.0,0001*44
$GLGNS,104601.00,,,,,03,,,,3.4,0001*56
```

GNS sentence defined:

GNS = GNSS Fix Data	
hhmmss.ss	UTC of position
ddmm.mmm	latitude of position
a	N or S, latitude hemisphere
dddmm.mmm	longitude of position
b	E or W, longitude hemisphere
ee	Mode Indicator. First character is for the GPS system, the second character for the GLONASS system. (N = No Fix, A = Autonomous, D = Differential, P = Precise, R = Real Time Kinematic, F = Float RTK, E = Estimated, M = Manual Input Mode, S = Simulation Mode)
xx	number of satellites in use
p.p	horizontal dilution of precision
a.b	antenna altitude above mean-sea-level
c.d	Geoidal height
l.l	age of differential GPS data
nnnn	Differential reference station ID, 0000 to 1023
*hh<CR><LF>	checksum, carriage return and line feed

### **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
T	degrees True
q.q	course over ground
M	degrees Magnetic
r.r	speed over ground
N	knots
s.s	speed over ground
K	km/hr
U	mode indicator (A = Autonomous, D = Differential, E = Estimated)
*hh<CR><LF>	checksum, carriage return and line feed

Verify-QC supports 2 variations of the NMEA VTG sentence. These variations are:

- VTG (Default) conforms to NMEA v3.0 standard and includes the mode indicator
- VTG (Old) conforms to previous NMEA standards and does not include the mode indicator

### **NMEA HDT Sentence**

The NMEA HDT sentence provides the actual vessel heading in degrees.

Structure and Example:

```
$GPHDT,p.p,T*hh<CR><LF>
$GPHDT,038.13,T*0C
```

HDT sentence defined:

HDT = Heading, True	
p.p	heading
T	degrees True

### **NMEA ROT Sentence**

The NMEA ROT sentence provides the rate of turn and direction of turn in degrees/minute.

Structure and Example:

```
$GPROT,q.q,A*hh<CR><LF>
$GPROT,01.88,A*33
```

ROT sentence defined:

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ROT = Rate of Turn  
 q.q rate of turn, degrees/minute  
 A status (A = data valid ; V = data not valid)

## APPENDIX 7

### GYRO INPUT CONFIGURATION

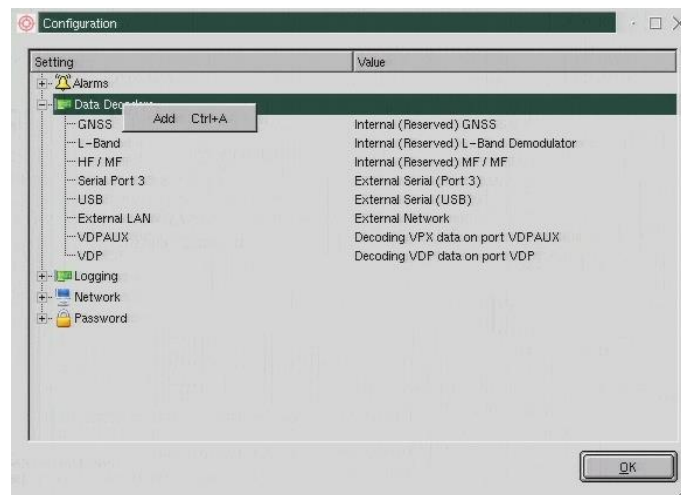
---

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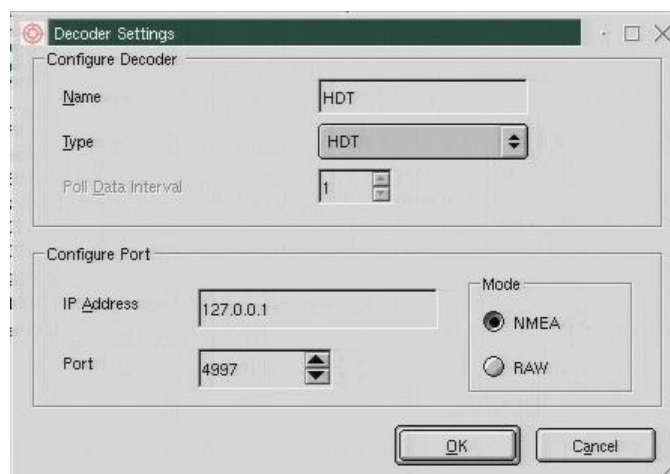
---

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1. Connect the Gyro input to P3 or USB port of the LD2. If using a USB to serial converter, once installed re-boot the LD2.
2. Configure the LD2 settings for Gyro Input on P3 or USB.
3. Select **Settings** menu from the top menu panel and then **Admin Settings** menu.
4. The password box will appear. Contact the Veripos Helpdesk to request the password. Enter the password and press OK. When correct password is entered the **Admin** menu option is added to the top menu.
5. Select the **Configuration** from the **Admin** menu. The Configuration box will appear.
6. Right Click on Data Decoders and select **Add**



7. The following box will appear. Enter Name as **HDT**. Select Type HDT and enter the correct port number (P3 = 4990, USB = 4997)



8. Click OK. Close the configuration window and close the **Admin** Menu.

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## APPENDIX 8

### VERIFY DP LOGGING

## **LD2S and Verify DP software - version 2.0.7.3 for Logging**

### Introduction

This addendum to the Verify DP manual (AB-V-MA00514) contains the information required to operate the logging option available for the VERIPOS LD2S Integrated Mobile unit, when using Verify DP version 2.0.7.3 software or above

The LD2S receiver may as an option be equipped with onboard software, called Verify DP that is optimised for DP operations.

### **Logging**

This software version has a new feature which enables the system to log the Raw GNSS and RTCM Data.

This then can allow loading and replay of this data on to a PC using a VERIPOS Verify QC software package.

Subsequent data analysis can show performance of the system as an aid to diagnose problems.

### Note:

Logging will be enabled during system commissioning where it is required.

The logging feature is disabled by default.

It may be enabled using the Admin Menu of this version of Verify DP. The menu access is password protected.

Where the Verify DP data logging capability is required after commissioning, contact the VERIPOS helpdesk for guidance.

When enabled, Verify DP version 2.0.7.3 will run a rolling data log.

This holds 333Mb of data (approximately 2-3 day of data).

It will create a new file every 30 minutes.

As the stored data reaches 333Mb in size the oldest file will be deleted to make room for a new file (overwrite).

### **Requirements**

You will need a USB memory stick in FAT32 format with minimum of 350Mb of free space.

The USB stick requires a folder with specific formatting to be prepared before use.

### **Downloading Data**

Data can be downloaded from the LD2S unit by inserting a USB Flash drive into the USB port on the rear of the LD2s.

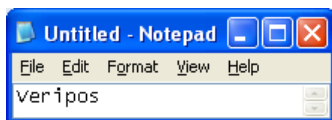
**Note:**  **CAUTION**

**This procedure should not be carried out during position critical operations.**

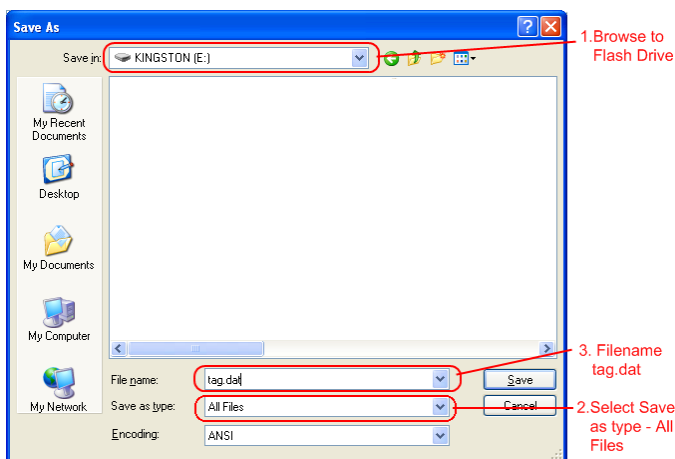
- During download of data to the USB stick, output of data from the LD2S will be intermittent.

To download data:

1. Prepare the USB Flash Drive - insert stick in to a USB port of a PC
2. Confirm you can access the stick
3. Ensure the Flash drive has at least 350Mb of free space available
4. Open Notepad on the PC
5. Type **Veripos** ('V' in Veripos should be upper case)



6. Click **File – Save As**
7. Browse to the USB stick root folder
8. Select **All files** in Save As Type
9. Enter file name **tag.dat**



10. Open USB stick in My Computer or Explorer
11. Ensure tag.dat file is saved on the root folder.
12. On USB stick create a **New- Folder** and name folder **Veripos** ('V' in Veripos should be upper case)
13. Enter folder and select **File- New- Folder** - name this folder **Logs**
14. Remove USB stick from PC and insert into USB port on the rear panel of the LD2S.

The LD2S unit will detect the flash drive with the required files and folders and will automatically download the data to the prepared folder the Flash Drive.

Note: Allow up to 10 minutes to download all data onto the USB Flash Drive

When download is finished a message will appear onscreen of Verify DP advising that the download is complete.

Remove the USB stick which is now in ready for use on a PC with Verify QC version 1.07 and above.

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### **Troubleshooting and advice**

Should you have problems or require assistance please check our FAQ's on VERIPOS Online Support Service - [VOSS](#) enter a support request there or call our helpdesk on +44 1224 965900.

Ends.