LD5 (C Variant)

Operations Manual

VERIPOS

Table of Contents

1 Introduction

1.1 General

For installation guidance please see the *LD5 Installation Manual*.

An *LD5 Quick Guide* is also available, which provides basic information regarding LD5 menus, data outputs etc.

The latest copies of all LD5 related manuals can be downloaded from the VERIPOS Online Support System (VOSS).

Throughout this manual, references will be made to the VERIPOS Helpdesk. The Helpdesk is provided by VERIPOS as the first point of contact for technical enquiries and assistance. It is manned 24 hours per day, 365 days per year.

Details can be found in the Contact Information chapter.

1.2 Scope

This **LD5 (C Variant) Operations Manual** provides information on setting up the unit, beam selection and enabling, as well as configuring the COM and IP ports.

This should not be confused with the **LD5 (A Variant or B Variant) Operations Manual**, as the operation and capabilities of each differs.

1.2.1 Contents

Chapter	Contents
1. Introduction	Discusses the purpose and target group for the manual. It also contains a list of used abbreviations and a specification of the document conventions.
2. Operation	Describes the interfaces in detail, the initial start-up, the status indicators and possible corrective actions and how to shut the system down.
3. Compatible Software	Describes the VERIPOS visualisation software which is compatible with the LD5-C.
4. Troubleshooting	Describes basic fault tracing and a detailed description on how to report problems or operating queries to the VERIPOS Helpdesk.
5. Reference information	Additional information such as additional configuration, station ID listings.
6. Contact information	Contains contact information details about the VERIPOS Helpdesk and VERIPOS offices worldwide.

1.3 Terms and abbreviations

APEX	A VERIPOS PPP service using GPS
APEX²	A VERIPOS PPP service using GPS and GLONASS
APEX⁵	A VERIPOS PPP service using GPS, GLONASS, Galileo and QZSS
DGPS	Differential GPS
DGNSS	Differential GNSS
DOP	Dilution of Precision
DQI	Differential Quality Indicator
Galileo	European GNSS constellation
Ghz	Gigahertz
GLONASS	Global Navigation Satellite System – Russian equivalent to GPS
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
HDOP	Horizontal Dilution of Precision
Hz	Hertz
IMU	Integrated Mobile Unit
L-Band	Radio frequency band, 1GHz to 2GHz, as used for VERIPOS correction data transmitted from communication satellites
LAN	Local Area Network
Lat	Latitude
LD5	Type of VERIPOS IMU
Lon	Longitude
MF	Medium Frequency radio band, 300kHz to 3MHz, as used to transmit IALA / Beacon correction data from land stations
MHz	Megahertz
MMI	Man Machine Interface
MSL	Mean Sea Level
NMEA	National Marine Electronics Association
N/A	Not applicable
PDOP	Position Dilution of Precision
PPP	Precise Point Positioning
PPS	Pulse per Second
PRN	Pseudo Random Noise
Quantum	New VERIPOS visualisation software
QZSS	Quasi-Zenith Satellite System (Japanese GNSS constellation)
RoHS	Restrictions of Hazardous Substances
RTCM	Radio Technical Commission for Maritime Services
SAL	Service Access License
SBAS	Satellite Based Augmentation System (for example WAAS/USA. EGNOS/Europe and MSAS/Asia)
SNR	Signal to Noise Ratio
Standard / Std	VERIPOS Single Frequency DGPS System using GPS
Std²	VERIPOS Single Frequency DGPS System using GPS and GLONASS
SV	Space Vehicle
Ultra	VERIPOS PPP DGNSS service using GPS
Ultra²	VERIPOS PPP DGNSS service using GPS and GLONASS
USB	Universal Serial Bus
UTC	Coordinated Universal Time
VDOP	Vertical Dilution of Precision
VERIPOS	Global DGPS service provider
VOSS	VERIPOS Online Support System
WAAS	Wide Area Augmentation System (SBAS implementation in USA)
WEEE	Waste Electrical and Electronic Equipment

1.4 Document conventions

1.4.1 Typographical conventions

Italic or **bold** text is used to emphasize certain parts of the information. *Italic* is also used in cross-references to other parts of the document.

Bold text is also used for indicators and touch screen “push-button” commands.

“Text within quotes” is used when display screens are mentioned in text.

`Monospace` text is used for input/output strings to/from the device.

1.4.2 Special notices

WARNING

A warning indicates the risk of bodily harm or serious damage to the hardware.

CAUTION

A caution indicates the risk of damaging the hardware.

NOTE

A note shows important information that helps you make better use of the system.

1.5 VERIPOS Helpdesk

For initial assistance with troubleshooting see the Troubleshooting section in this manual. If the troubleshooting section does not resolve the issue, contact the VERIPOS Helpdesk for further assistance.

VERIPOS encourage all users to promptly report problems or operating queries to the Helpdesk so that they may receive assistance with fault reports and technical enquiries.

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

The Helpdesk are trained to provide direct assistance with most queries and problems and can escalate complex issues to other operational teams where required.

1.6 VERIPOS Online Support System (VOSS)

VERIPOS have an online customer support system known as VOSS, which provides a system for raising tickets which are automatically routed to the VERIPOS Helpdesk.

Additionally, VOSS provides technical documentation, VERIPOS software and an FAQ knowledge base.

1.7 Enabling the equipment for use

VERIPOS correction signals are provided as a chargeable service.

In order for equipment to decode corrections and output positions, it must be **enabled**.

The enable/disable procedure is detailed in section Enabling Process.

When VERIPOS services are not required some contracts may allow for disabling the service to avoid charges.

NOTE

To use VERIPOS correction signals a contract between the user's company and the VERIPOS Operations department (known as Service Access License, or SAL) **must** be in place.

To avoid delays, users should record the SAL number associated with the VERIPOS equipment.

The Helpdesk is not authorised to issue a code unless an active SAL exists.

1.8 Waste electrical and electronic equipment

The Waste Electrical and Electronic Equipment Directive (hereinafter referred to as the "WEEE directive") places an obligation on EU-based manufacturers, distributors, retailers and importers to take back electronic 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 requirements contained in the WEEE Directive.

Instructions for disposal of WEEE by users in the European Union

Products which have the undernoted symbol located on either the product itself or its packaging indicates that the product must not be disposed of with other waste. Instead, it is the user's responsibility to dispose of the product by handing it over to a designated collection point for the recycling of WEEE.

The separate collection and recycling of your WEEE 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.
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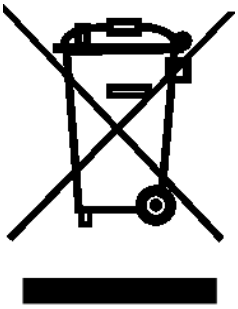

1.9 Disclaimer

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VERIPOS reserves the right at its sole discretion, but without any obligation, to make amendments or improvements to, or withdraw or correct any error(s) or omission(s) in any portion of the Manual without notice. Although VERIPOS makes a reasonable effort to include accurate and up to date information, VERIPOS does not warrant or represent that this Manual and its contents are current, complete, accurate and/or free from errors. VERIPOS does not accept any responsibility or liability for the accuracy, content, completeness, legality or reliability of this Manual and the content provided herein.

If you have any questions or comments about this Manual or our Privacy Policy, please contact us at: support@veripos.com.

The LD5 hardware and associated software is subject to VERIPOS Terms and Conditions Relating to the Provision of VERIPOS Services.

The software described in this document is furnished under a licence agreement and/or non-disclosure agreement. The software may be used or copied only in accordance with the terms of such agreement. It is against the law to copy the software on any medium except as specifically provided for in the license or non-disclosure agreement.

2 LD5 Operation

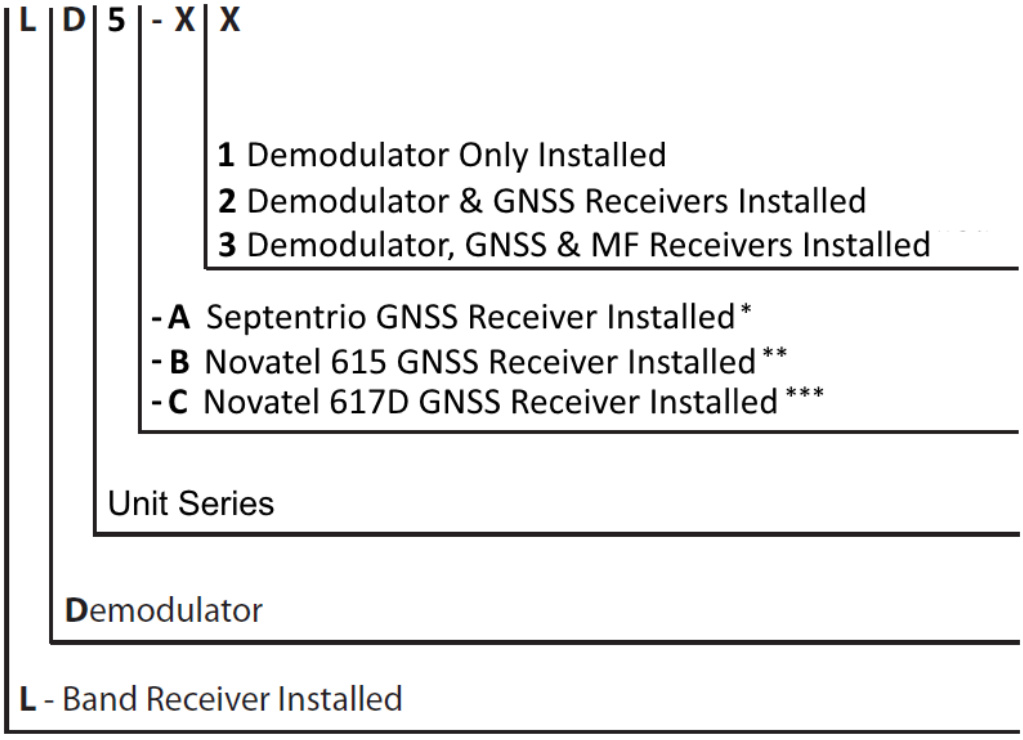
The controls for working with the LD5 are all available on the front panel. The LD5 control panel is used to configure the unit using the main screen display.

2.1 LD5 Variants

2.1.1 Available LD5 Variants

There are various LD5 IMU variants available. The variants depict the hardware installed in the unit. In addition to the common variants, there are also Mod variants which allow the use of different antenna configurations.

The 'C' variants are fitted with NovAtel GNSS receiver cards.



* Will have either GPS or GPS+Glonass tracking capabilities, depending on permissions installed

** Will have GPS+Glonass tracking capabilities

*** Will have GPS+Glonass+QZSS tracking capabilities

NOTE

The GNSS constellations which can be used in the VERIPOS solutions calculated by your LD5 will depend on the LD5 variant **and** the VERIPOS service which the LD5 is enabled for.

The table below shows the various LD5-C options which are available, depending on the user's requirements:

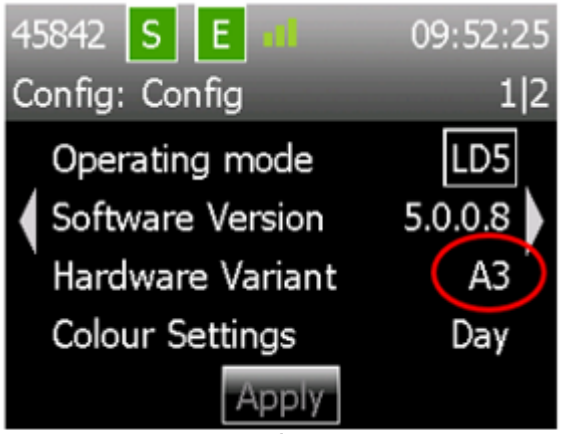
Hardware Designation	Product Name	OEM card content	Antenna Connection	Dedicated	Combined
C2	LD5	L-Band Demodulator, Novatel OEM 617D GNSS Receiver	• L-Band		ANT
			• GNSS		
			• GNSS Heading	AUX	
C2-Mod1	LD5 Mod1	L-Band Demodulator, Novatel OEM 617D GNSS Receiver	• L-Band	ANT	
			• GNSS	BEACON	
			• GNSS Heading	AUX	
C3	LD5 with MF option	L-Band Demodulator, Novatel OEM 617D GNSS Receiver, MF Receiver	• L-Band		ANT
			• GNSS		
			• GNSS Heading	AUX	
			• MF	BEACON	
C3-Mod1	LD5 with MF option Mod1	L-Band Demodulator, Novatel OEM 617D GNSS Receiver, MF Receiver	• L-Band		ANT
			• MF		
			• GNSS	BEACON	
			• GNSS Heading	AUX	
C3-Mod2	LD5 with MF option Mod2	L-Band Demodulator, Novatel OEM 617D GNSS Receiver, MF Receiver	• L-Band	ANT	
			• MF		BEACON
			• GNSS		
			• GNSS Heading	AUX	

*C and C HDT variants have the same hardware and antenna connections. C variants can have the GNSS heading option enabled by applying a heading license, thus making them C3 HDT's. With applying the license, it then enables the AUX connector for use with an antenna to compute Heading on the GNSS receiver.

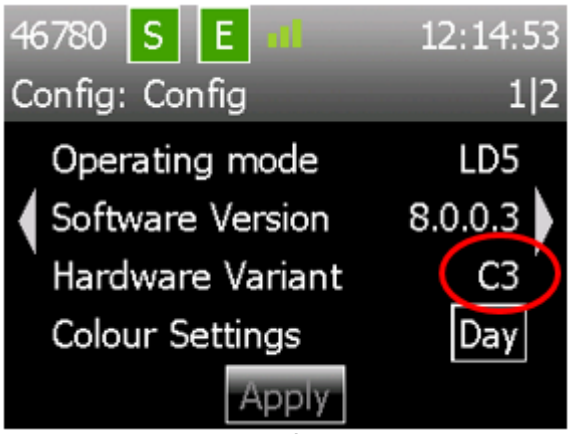
An on-screen icon for each optional receiver module (GNSS or MF Beacon) will only be shown when the module is fitted. For example, an LD5-C2 will not have an MF receiver card installed, therefore no MF related options shall be displayed within the LD5 menus.

2.1.2 Identifying LD5 Hardware Variant

The variant can be checked via the **Config > Config** menu:



A3 Variant



C3 Variant

2.2 Satellite constellations

LD5-C's are fitted with GNSS cards which are capable of tracking multiple GNSS constellations, allowing users to utilize the VERIPOS **Apex[5]** service.

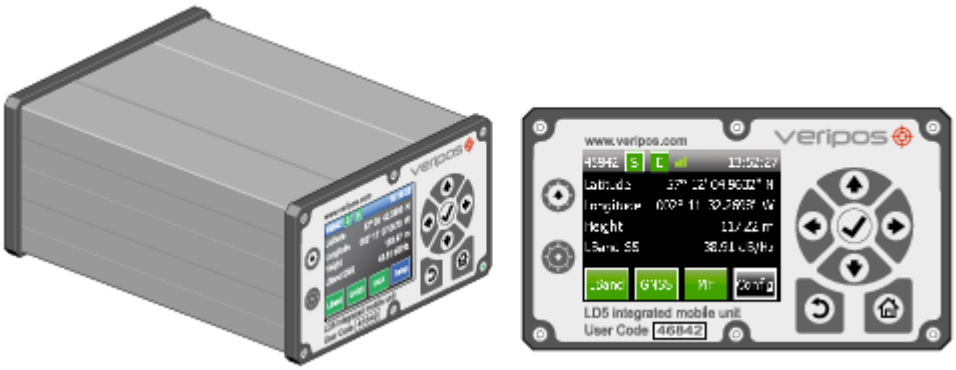
The constellations which can be used in the LD5-C variant are:

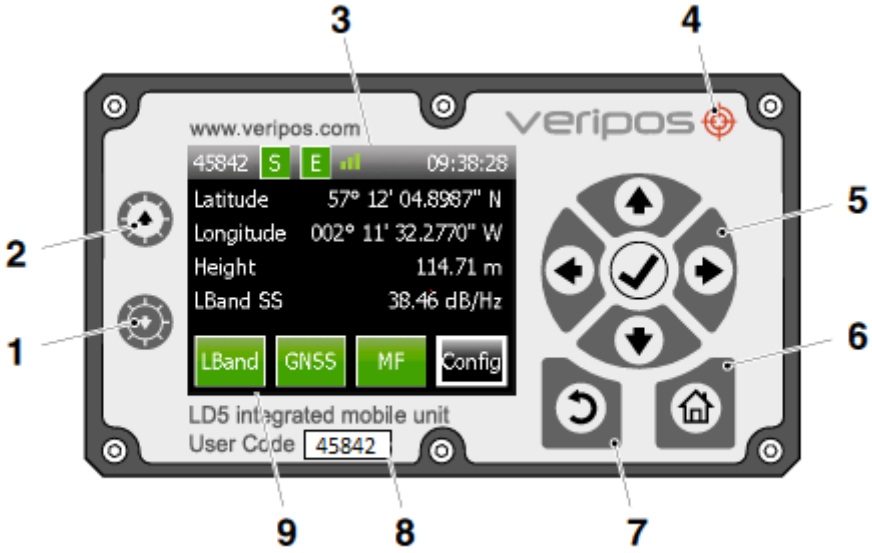
- GPS (American GNSS System)
- GLONASS (Russian GNSS System)
- Galileo (European GNSS System)
- QZSS (Japanese GNSS System)

NOTE

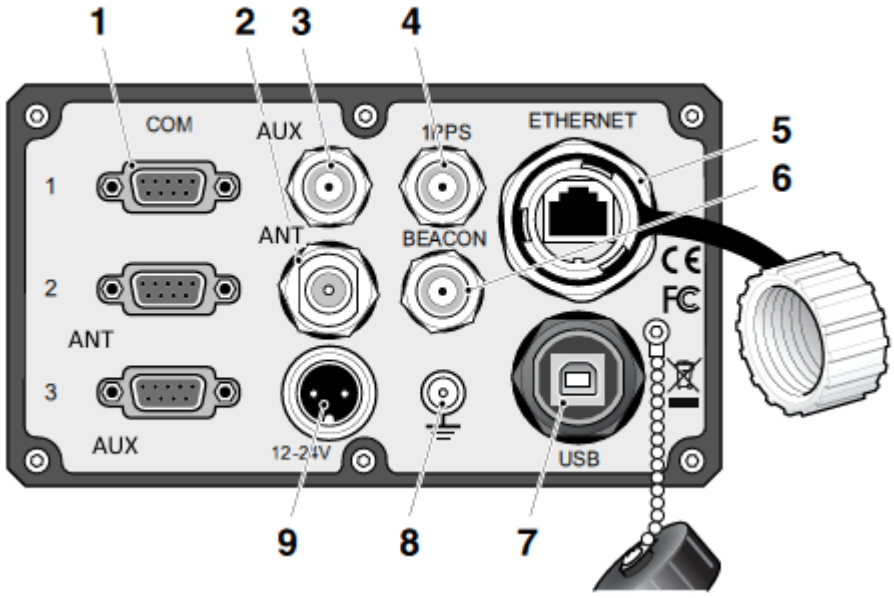
To utilize the above **Apex[5]** service, the LD5 must be subscribed to this service.

2.3 Views and controls





1 Adjust screen darker
2 Adjust screen brighter
3 L-Band Signal Strength Indicator
4 Power indicator
5 Navigation panel. Arrow keys are used to move through menu items and tick key (✓) is used to accept an item.
6 Home
7 Return
8 User code (5 digits)
9 Receiver card icons (3 max.)



LD5 Rear Panel Connectors

1 COM ports 1 to 3, RS232 or 422, 9-pin D type female connector
2 *'ANT' N-type antenna connector (Main GNSS & L-Band input)
3 'AUX' input TNC connector (Auxillary GNSS for Heading which is available when licensed)
4 '1PPS' output BNC connector
5 Ethernet RJ45 connector **
6 *'BEACON' TNC antenna connector (MF correction input)
7 USB type B connector **
8 Grounding point
9 DC power connector (12–24 VDC)

NOTE

*Standard (non-mod) LD5. Function of connector will differ on Mod LD5's.

CAUTION

** ***Do not connect devices to LD5 without first performing a virus scan!***

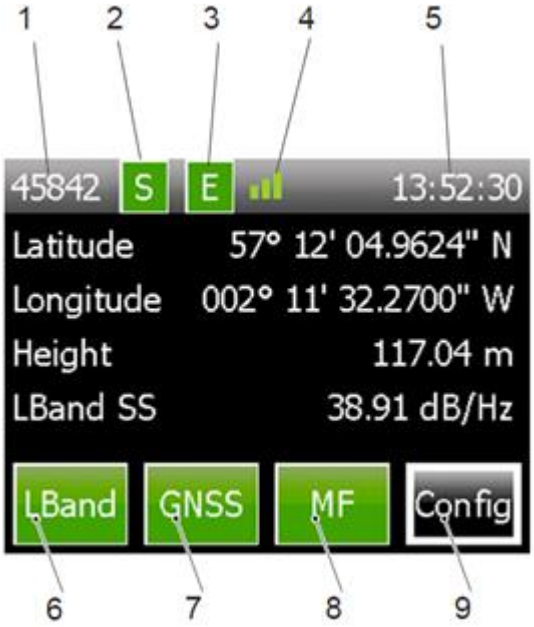
2.4 LD5 Start up

Where required, refer to the *LD5 Installation Manual* and the *Antenna & Coaxial cable Installation Guide*.

Plug in power to the rear of the unit. Wait a few minutes while a self-test is performed. Following successful test you will see the Home screen, as shown below. The LD5 may be disabled when first powered up. If the unit is disabled the L-Band, GNSS and Enabled indicator icons will be red.

To receive correction data, connection to a VERIPOS L-Band beam is required. Once a suitable beam has been selected and signal synchronisation achieved, the unit can be enabled by the 6.1 VERIPOS Helpdesk.

If there is a problem, refer to the Troubleshooting chapter in this manual.



1. Unit user code (5 digits)
2. L-Band Sync indicator
3. Unit Enabled indicator
4. L-Band signal strength indicator
5. LD5 time display (UTC)
6. Indicator and access to L-Band card controls
7. Indicator and access to GNSS card controls
8. Indicator and access to MF card controls **(C3 variants only)**
9. Access to configuration controls

The Home screen of the LD5 screen displays the Unit user code number (1), 'Sync' (2) and 'Enabled' (3) indicators (Green = OK, Red = No sync / Disabled respectively).

The L-Band signal strength indicator (4), has three states:

No. of Signal Strength Bars	Signal Strength (dB/Hz)
0	0 (No sync)
1	<32.5
2	32.5 – 36.5
3	>36.5

Time (5) shown is in universal time coordinated format (UTC).

The receiver card icons, L-Band (6), GNSS (7) and MF (8), give access to card status information and configuration controls. The icon colour will change between red or green, depending on the status of the service. Some LD5 units may not have all cards fitted and only when a receiver card is present will it appear on the Home screen.

Configuration of each installed receiver card is achieved using the arrows, return, Home and tick buttons. These are located on the control pad found on the right-hand side of the LD5 front panel.

2.5 L-Band receiver

This menu provides access to Beam Selection, Access Code, RTCM Station selection, antenna voltage and L-Band Status information.

2.5.1 L-Band > Status > Module Info

This page displays the following information regarding the L-Band card:

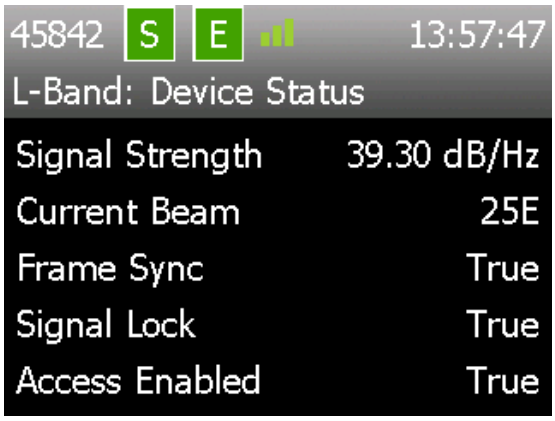
- Firmware version
- Decoder version
- Bootloader version

VERIPOS may request these details during support queries.

2.5.2 L-Band > Status > Device Status

This view allows the user to review the status of SNR, Beam, Frame Sync, Signal Lock and whether the LD5 is enabled or not

To view the L-Band signal status, from the Home screen select **L-Band > Status > Device Status**.



2.5.3 L-Band > Config > RTCM Stations

To enable or disable reference stations, from the Home screen select **L-Band > Config > RTCM Stations** and select from **RTCMa** or **RTCMb**.

Use the right/left navigation arrows to view more stations. To enable or disable stations, move the cursor to the appropriate box using the arrow keys. Then use the tick (✓) key to toggle stations between enabled (green) and disabled (red).

NOTE

Reference stations on RTCMa are used internally and are also available for output to other devices. VERIPOS recommend in most cases that are stations are enabled. The LD5 will automatically use the closest six stations in internal position computations.

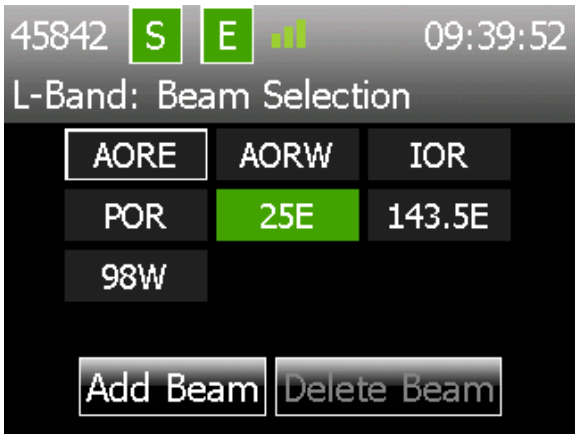
2.5.4 L-Band > Config > Beam selection

This step describes how to select a satellite beam to receive VERIPOS correction data.

If you are unsure of which VERIPOS beam(s) cover the area of operations, a chart showing beam names and coverage footprints is available in the Reference Information chapter. Up to date beam coverage charts are also available on VOSS.

Additionally the free software VeriChart is also available. It allows VERIPOS users to generate more refined charts based on vessel position and includes the relative azimuths and elevations of available beams.

From the Home screen use the navigation panel keys to select **L-Band > Config > Beam Selection**



Use the arrow keys to navigate to a beam appropriate for your region and select using the tick button. Select (using tick again) a second time to switch to the beam.

The ‘S’ (Sync) icon will turn from red to green when a usable beam has been selected and beam synchronisation has been successful.

2.5.5 L-Band > Config > Antenna Bias

The antenna bias menu allows the antenna voltage to be turned **On** or **Off**, out from the **ANT** connection at the rear of the LD5. When using a VERIPOS supplied antenna, the antenna voltage should normally be **On**, as the antenna requires power to operate. However, when the LD5 is connected to a vessel tracking dish such as a Fleet system, the voltage may be turned **Off**.

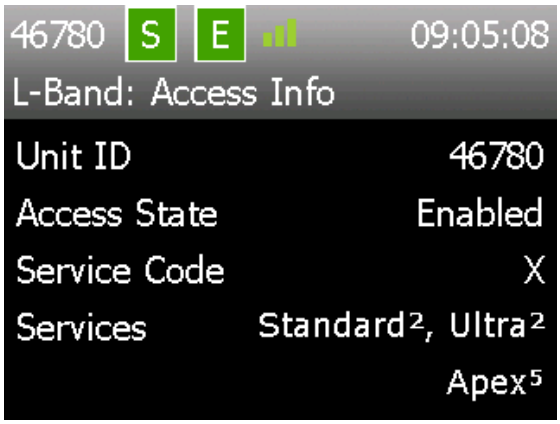
NOTE

The function of the **ANT** antenna connection will vary depending on the LD5 variant. For example, on an LD5-C3, the **ANT** connector is used for L-Band and GNSS. On an LD5-C3 Mod 2, the **ANT** connector is only used for L-Band.

Please refer to **Section 2.1** for further information regarding LD5 variants and Mods.

2.5.6 L-Band > Access Info

If the LD5 has beam sync and is enabled the Home screen “E” symbol will appear as green. If the unit has sync but the unit is disabled, navigate to **Home > L-Band > Access Info** to view your LD5 Access Information:



The unit “Enabled” (or) “Disabled” **Access State** will be highlighted here. If the unit is disabled contact the VERIPOS Helpdesk with Unit ID, Vessel Name, Client Name and SAL Number to enable.

2.5.7 L-Band > Help

This screen shows VERIPOS website details, where product support and manuals are available.

2.6 GNSS Receiver

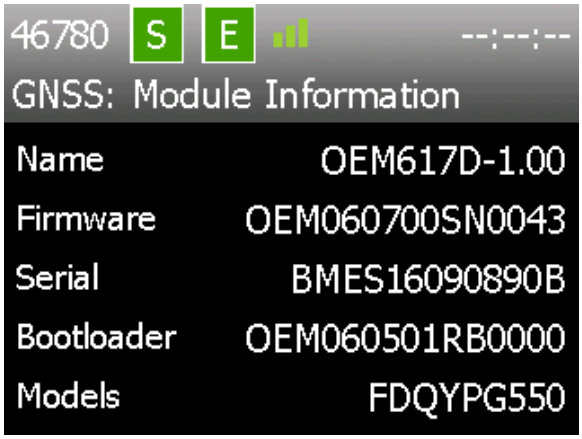
The LD5 GNSS card, status information and configuration settings are accessed from the Home screen.

2.6.1 GNSS > Status > Module Info

This screen shows the firmware installed on the GNSS receiver. From the Home screen select **GNSS > Status > Module Info**.

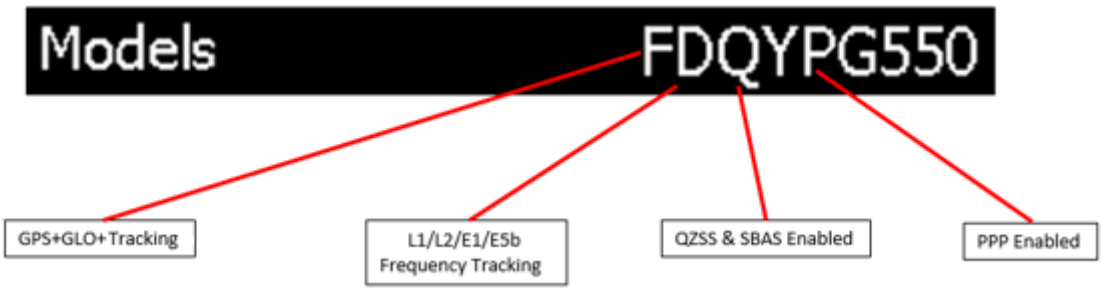
The **Module Info** page displays the following information:

- **Name** Model of NovAtel GNSS card fitted
- **Firmware** GNSS firmware version number
- **Serial** Serial number of GNSS card
- **Bootloader** GNSS card bootloader version
- **Models** Indicates GNSS card permissions.



LD5-C Model Number Details

The model numbering can be broken down as follows:



2.6.2 GNSS > Status > SV Info

This screen shows the number of satellites tracked by the LD5. From the Home screen select **GNSS > Status > SV Info**.

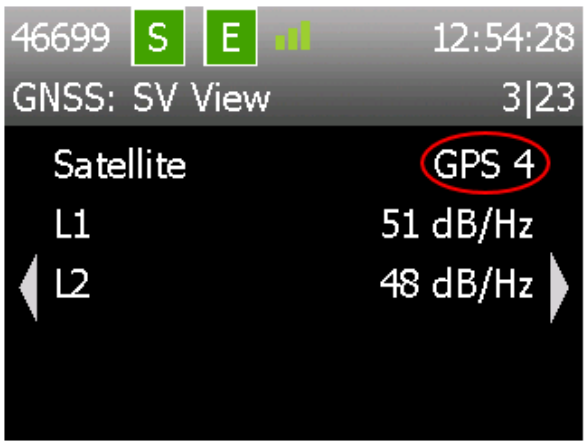
NOTE

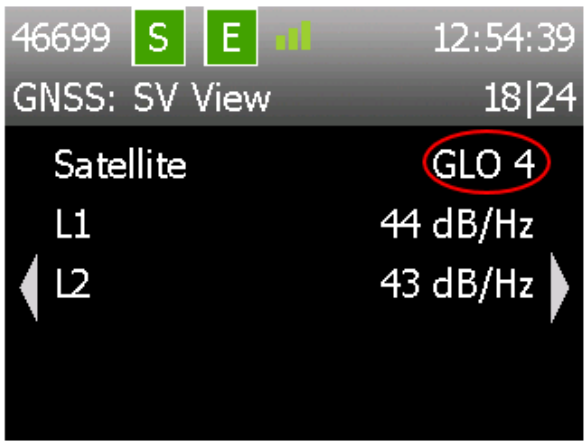
The number of satellites *tracked* should not be confused with the number of satellites *used*. The solution being calculated by the LD5 will typically use less than the amount shown, as some satellites will be below the solution elevation mask.

Also, the LD5 may not be enabled to receive GLONASS corrections and would therefore utilise only GPS satellites for calculating a position.

To view individual SV information such as SV number and SNR's, select **View**.

This page will display which GNSS constellation a particular satellite is from.

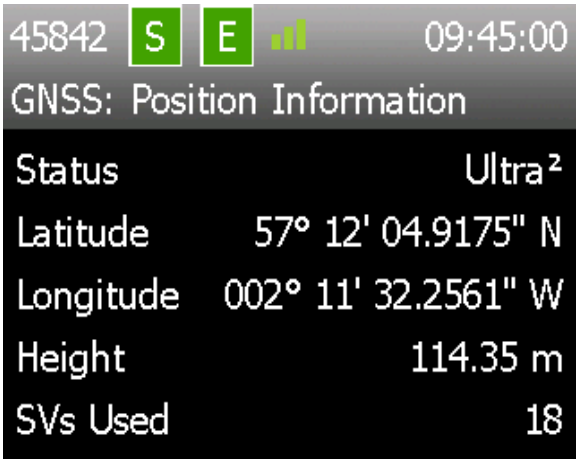




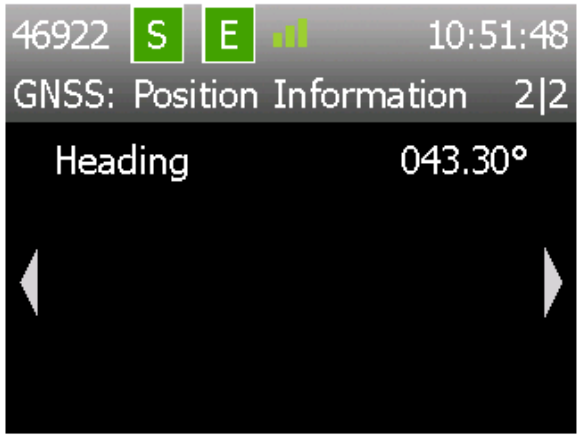
2.6.3 GNSS > Status > Position Info

Using this menu, you can view current position and solution type e.g. Apex, Ultra or Standard and number of SVs used.

From the Home screen select **GNSS > Status > Position Info**.



Units with GNSS heading capability will also display the GNSS heading solution on the 2nd **Position Information** page. The arrows marked below show that further information is available to display. Push the left or right arrow button to display the GNSS heading.



NOTE

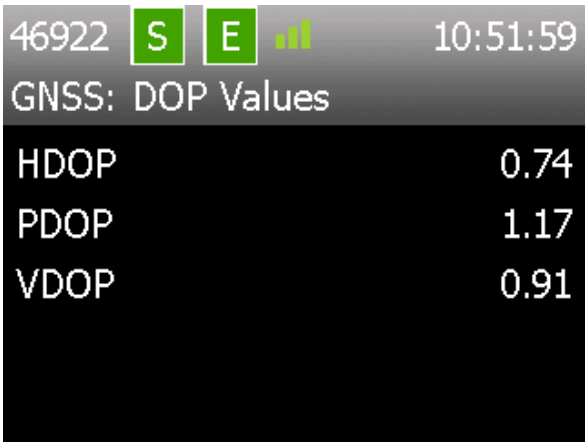
The Height displayed is WGS84 ellipsoidal height, not the antenna height above MSL.

The GNSS heading displayed here will include any correction value which has been entered via **GNSS > Config > Heading C-O**.

2.6.4 GNSS > Status > DOP Values

This screen shows DOP values of the GNSS solution. HDOP, PDOP, and VDOP are displayed.

From the Home screen select **GNSS > Status > DOP Values**.

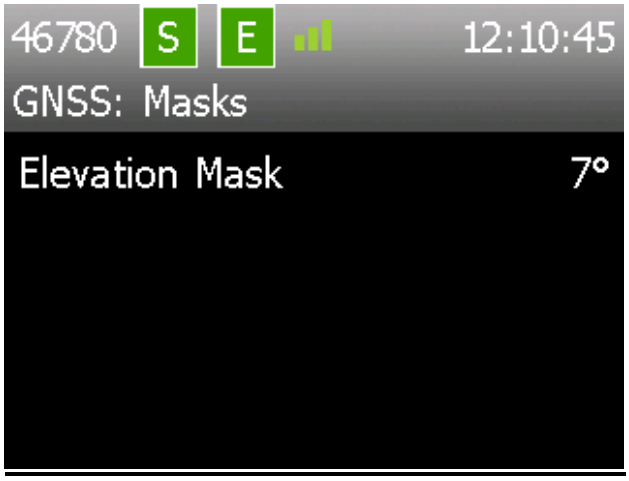


DOP is a measure of the strength of the satellite geometry at the receiver.

- HDOP - Horizontal component (2D-coordinates)
- PDOP - Position component (3D-coordinates)
- VDOP - Vertical component (height)

2.6.5 GNSS > Status > Masks

This screen shows the Mask value set on the GNSS receiver. The Mask value is setup automatically by the LD5 unit and cannot be set by the end user. From the Home screen select **GNSS > Status > Masks**.

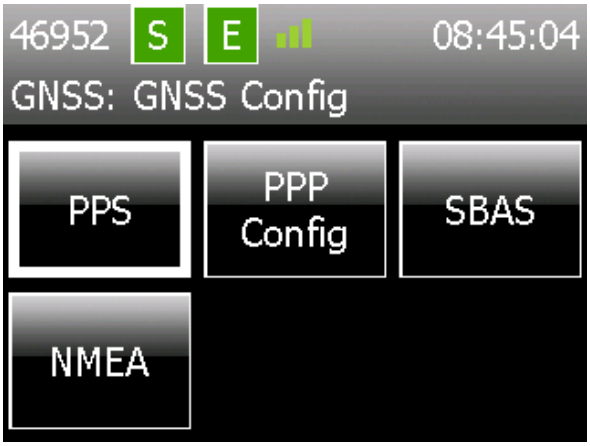


Elevation Mask – Satellites located below this value will not be used in the LD5 position calculations but will still be tracked.

2.6.6 GNSS > Config

This screen allows the user access to the GNSS Configuration menus.

From the Home screen select **GNSS > Config**.

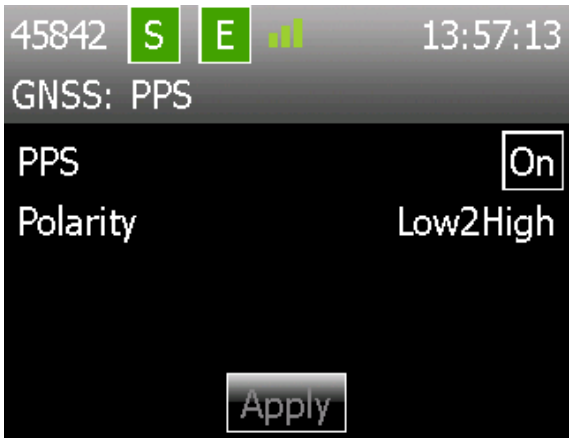


2.6.7 GNSS > Config > PPS

This menu allows the user to configure the Pulse Per Second (PPS) options. The PPS can be turned **On** or **Off** and the polarity can be amended (**Low2High**, **High2Low**).

From the Home screen select **GNSS > Config > PPS**.

Move the cursor to the appropriate box using the arrow keys. Select (✓) to amend, then navigate to **Apply** to select the different options.



2.6.8 GNSS > Config > PPP Config

The **PPP Config** setting is used to determine which PPP solution the LD5 will produce.

NOTE

Changing the PPP Config settings will re-initialise a new PPP calculation, which will take

time to settle and a PPP position output to be available.

Ensure that the solution output selected matches with VERIPOS service(s) you have enabled on the LD5.

Select (✓) to display the options (**APEX** or **ULTRA**) and use the Up / Down arrows to highlight the service required.

Select (✓) to amend then navigate to **Apply** and select (✓) to switch to this PPP service.

2.6.9 GNSS > Config > SBAS

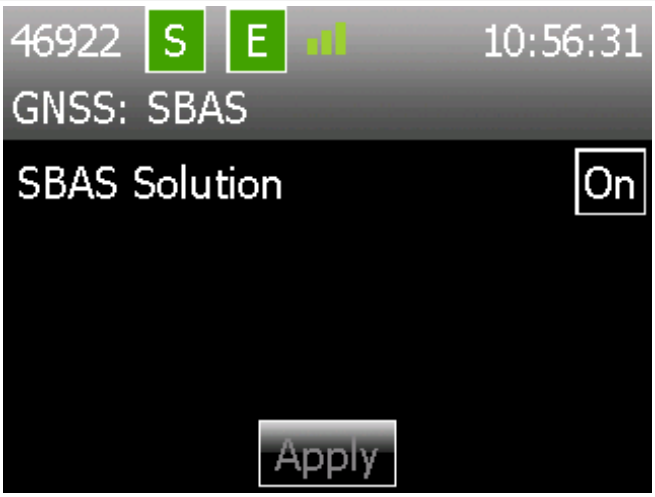
This menu allows the user to configure the SBAS option. SBAS can be turned **On** or **Off** (default is **Off**). If SBAS is **On**, an SBAS DGNSS solution will be available as a backup solution and will output should the VERIPOS solution fail.

NOTE

For LD5-C3 variants, an MF solution will be output (if enabled) in the event of loss of the VERIPOS solution. An SBAS solution will therefore only be used if both VERIPOS and MF solutions are unavailable.

From the Home screen select **GNSS > Config > SBAS**.

Select (✓) to select between **On** and **Off** then navigate to **Apply** to confirm the change.



Once selected, click **Apply**.

2.6.10 GNSS > Config > NMEA > NMEAa (or) NMEAb

This menu allows the user to switch the NMEA messages required to be output from the rear serial port(s) or via LAN **On** or **Off**.

Note there are three pages; use the right/left arrows to switch between them to view all the available message types.

To enable or disable NMEA messages, move the cursor to the appropriate box using the arrow keys. Then use the tick (✓) key to toggle stations between **On** and **Off**.

Available NMEA message types:

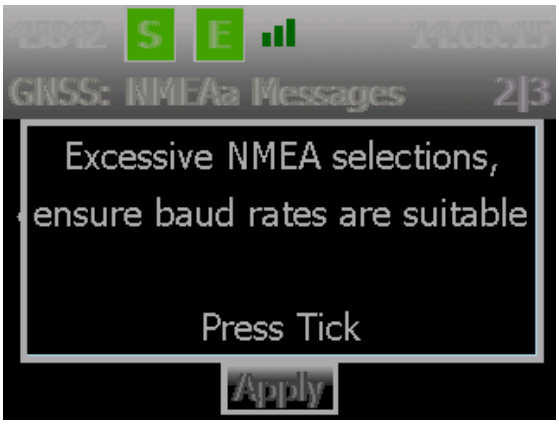
GGA *	GSV
GLL	GRS
VTG	RMC
ZDA	UKOOA **
GST	HDT***
GSA	

***** Select from 5 to 8 digit Lat / Long precision at **GNSS > Config > NMEA Config**.

** UKOOA can only be selected if all other NMEA messages are set to ***Off***.

*** Available on LD5 *HDT* licensed hardware.

If more than four NMEA message types are enabled, a warning message will appear. This is to prompt the user to ensure that a suitable baud rate is selected, if outputting an excessive number of messages via COM ports:



2.6.11 GNSS > Config > NMEA > Config

This menu allows the user to configure the number of decimal places used in the Lat and Lon fields and the Differential Quality Indicator (DQI) used in the GGA message.

From the Home screen select **GNSS > Config > PPP Config**.

Precision

Select and choose the number of digits required (5 to 8) after the decimal point in the latitude and longitude fields, used in the GGA message.

PPP DQI

This option applies only to Apex/Ultra (PPP) outputs and allows the user to define what Differential Quality Indicator will be output in the GGA message. The selectable options are **2** or **5**.

If **2** is selected, then all corrected solutions will be designated a DQI of 2.

If **5** is selected, then PPP (Ultra and Apex) corrected solutions will be designated a DQI of 5. All Differential Solutions will then be designated a DQI of 2.

2.6.12 GNSS > Config > Heading C-O

This menu is only displayed on LD5's which have the GNSS heading feature enabled. For information on how to enable an LD5-C for GNSS heading, please refer section LD5 GNSS Heading.

This menu allows a heading offset (C-O) to be applied to the GNSS heading solution which is available for output.

Use the arrow keys to enter the required correction value, followed by **Apply** to confirm changes.

NOTE

Caution should be taken to ensure that any heading offset is entered within one system only. If a heading offset has been entered in the receiving system (e.g. vessel DP), do not *also* enter an offset within the LD5.

2.6.13 GNSS > Help

This screen shows VERIPOS website details, where product support and manuals are available.

2.7 MF Beacon (IALA) Receiver

The LD5 MF card, status information and configuration settings are accessed from the Home screen.

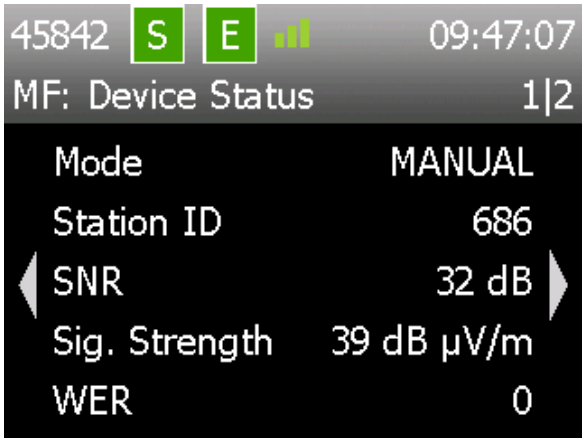
2.7.1 MF > Status > Module Info

This menu displays details of the MF receiver card fitted, such as model and firmware version.

2.7.2 MF > Status > Device Status

This page displays the current station settings and status.

From the Home screen select **MF > Status > Device Status**.



Page 1	
Mode	As selected from MF setup
Station ID	The unique numerical identifier for the station used
SNR	The current signal to noise ratio in dB/Hz
Sig. Strength	The signal received in dB µV/m
WER	The word error rate
Page 2	
Frequency	Frequency the received station is transmitting on
Baud Rate	Data rate of the received transmission
Station	Station Name (If known)

2.7.3 MF > Config > Mode

This menu allows the user to select the mode that the MF receiver will operate in.

From the Home screen select **MF > Config > Mode**.

Press (✓) to display the options (**Automatic**, **Autodist** or **Manual**) and use the Up / Down arrows to highlight the Mode required.

Press (✓) to amend then navigate to **Apply** and press (✓) to switch to this mode.

Automatic This setting uses the station with the strongest signal received.

Autodist This setting uses the closest MF beacon station to the receiver's location. This function uses a station database stored in the LD5 unit.

Manual This setting requires the user to enter a frequency and data rate from Manual Tune Menu or select a station from the Station Tune Menu.

VERIPOS recommend use of **Automatic**. Highlight the mode (press tick and then up / down arrows) then navigate to **Apply** and **Select** (✓).

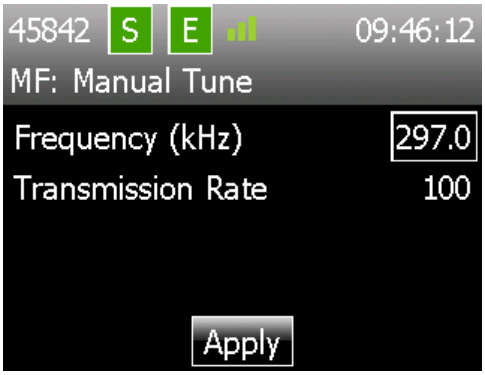
NOTE

If positioning becomes unstable, it is recommended to manual tune the receiver to the closest MF station, or select Autodist mode if the frequency is unknown.

2.7.4 MF > Config > Manual Tune

Where the user has selected Manual tuning mode, the **Manual Tune** button will be available.

From the Home screen select **MF > Config > Manual Tune**

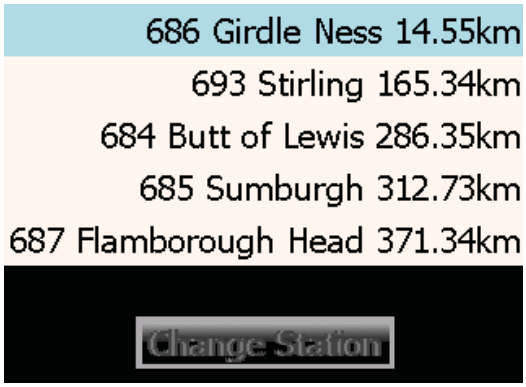


The user enters the Frequency and Data Rate of the MF Beacon Station.

2.7.5 MF > Config > Station Tune

Where the user has selected Manual tuning mode, the **Station Tune** button will be available. In this menu the user selects from the onboard station list. The list is arranged by range in km from the antenna location.

From the Home screen select **MF > Config > Station Tune**



Select Change Station and use the Up / Down arrow keys to highlight the required station. Use Select (✓) to amend the selected station.

2.7.6 MF > Config > Antenna Bias

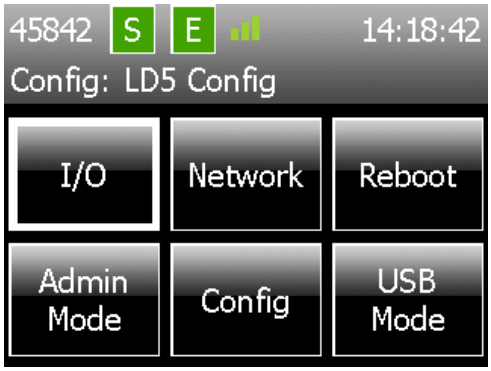
This menu allows the user to turn on or turn off the Antenna Voltage on the MF antenna connector on the rear of the LD5 unit.

2.7.7 MF > Help

This screen shows VERIPOS website details, where product support and manuals are available.

2.8 LD5 Config

This menu allows access to the configuration of the LD5 unit. Configuration of serial ports and network settings are available in this menu. Access from **Home > Config**.



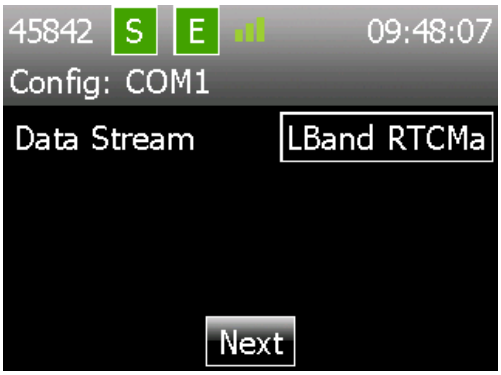
2.8.1 Config > I/O

This page allows the user to select the pages required to configure the data outputs and inputs.

2.8.2 Config > I/O > COM1 (or) COM2 / COM3

These pages allow the user to set the data streams that are output or input on the serial ports of the LD5 unit.

From the Home screen select **Config > I/O > COM1** (or) **COM2 / COM3**

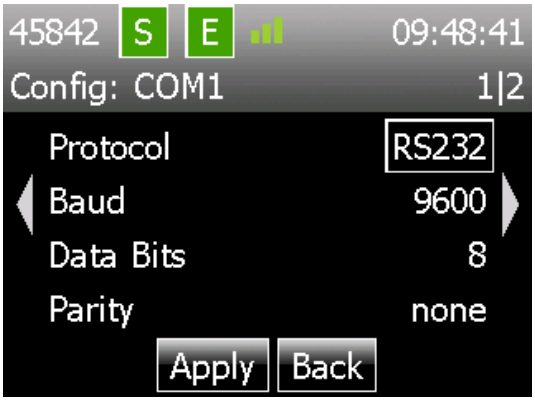


The current configured data stream is shown, or if no data stream is configured, **None** will be displayed

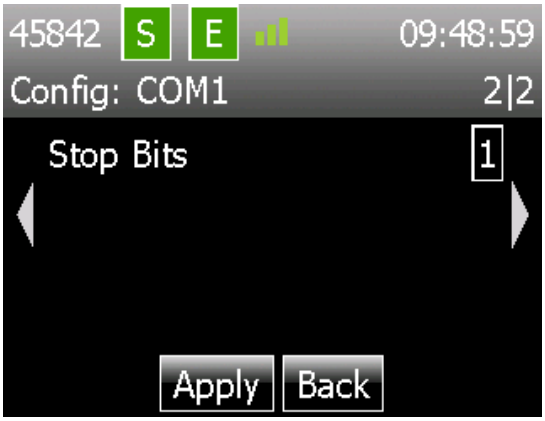
Press (✓) to display the Data Streams available and use the Up / Down arrows to highlight the data required.

Press (✓) to amend then navigate to **Next** and select (✓) to move onto the next configuration page.

Configure the Protocol, Baud Rate, Data Bits, Parity and Stop Bits:



Use Left / Right arrow buttons to move between the 2 pages.

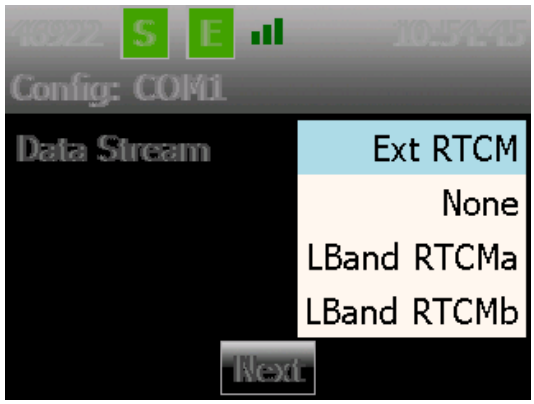


Then navigate to **Apply** and select (✓) to finish the configuration.

2.8.3 Config > I/O > COM X > Ext RTCM

Ext RTCM is used when VERIPOS External RTCM corrections from another source are used as a backup to the VERIPOS L-Band Corrections in the internal position solution.

From the Home screen select **Config > I/O > COM X** and select **Ext RTCM**. Select **Next** and then configure the COM port protocol, baud rate etc to match that of the RTCM data which is being input.



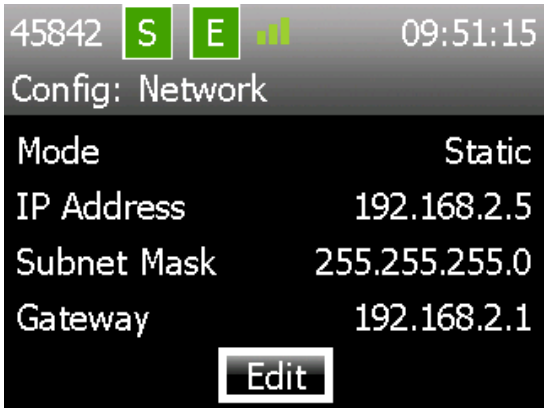
NOTE

Only VERIPOS RTCM corrections can be used for Ext RTCM inputs. No 3rd Party (non-VERIPOS) RTCM corrections can be input via Ext RTCM.

2.8.4 Config > I/O > Network

This menu allows the user to view or configure the Ethernet settings of the LD5 unit.

From the Home screen select **Config > Network**



To change the network settings select (✓)

Select from **DHCP** or **Static** mode and if required amend the IP address, subnet mask and gateway using the control panel, then select **Apply**.

2.8.5 Config > Reboot

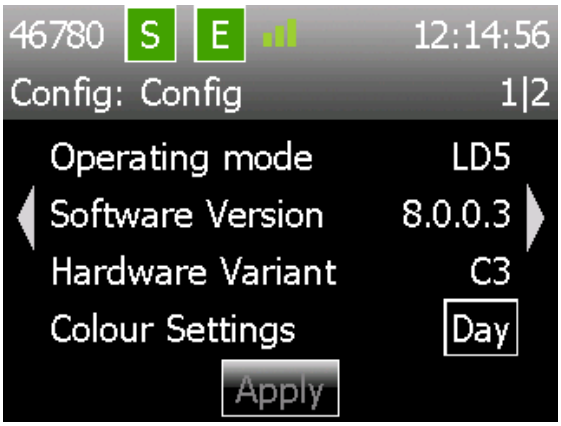
Use this to reboot the LD5 – as an alternative to power cycle.

2.8.6 Config > Admin

Only use admin mode under direction of VERIPOS.

2.8.7 Config > Config

This menu allows the user to view the Operating Mode of the LD5, change day / night screen settings and view the LD5 software version number and LD5 unit variant.
The second page allows for adjusting the screen dimmer delay period (mins).



Operating Mode
Only one Operating Mode (LD5) is available on LD5-C variants.

Software Version
This shows the software version running on the LD5 unit.

Hardware Variant
This shows the hardware variant version and if applicable, the Mod of the LD5 unit.

Colour Settings
This toggles the display between Night and Day modes. The screen dims and changes colour palettes.

Dimmer Delay (on Page 2)
This shows the time after there has been no button presses that the display will dim. Any button press takes the display out of dimmed mode.

2.8.8 Config > USB Mode

USB mode is used to perform software updates and to retrieve logged data. Only use USB mode under direction of VERIPOS.

2.9 LD5 GNSS Heading

LD5-C variants are fitted with dual antenna input GNSS cards, which can be used to provide a GNSS heading solution.

NOTE

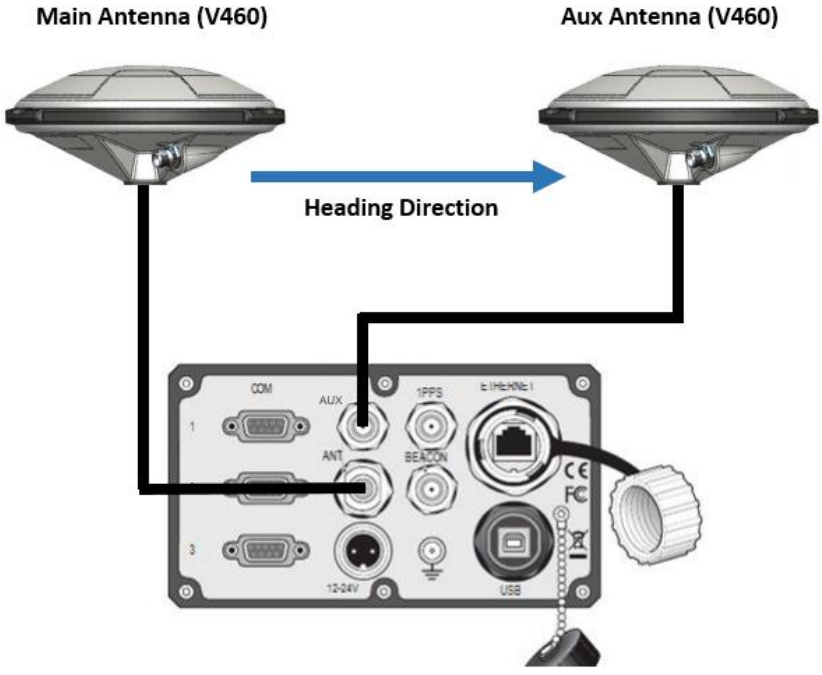
The GNSS heading function must be enabled before it can be used. Refer to Section Enabling the GNSS Heading Feature for guidance on enabling.

The heading solution accuracy is dependent upon the baseline between the **Main** and **Auxiliary** antennas.

The longer the baseline, the better the heading solution accuracy will be. For example:

Antenna Baseline	Accuracy
0.5m	0.40°
1.0m	0.20°
2.0m	0.10°
5.0m	0.04°
10.0m	0.02°

After equipment installation it is recommended that an offset calibration survey is conducted to compute any required heading C-O and establish precise offsets for the **Main** GNSS antenna.



Further guidance regarding antenna installation can be found in the *LD5 Installation Manual*.

2.9.1 Enabling the GNSS Heading Feature

Unless requested at time of purchase, the GNSS heading feature is disabled by default. If you would like to use the GNSS heading feature, you will need to contact the VERIPOS Helpdesk to obtain a licence code. This licence code can be entered within the **Admin Mode**. The Helpdesk will provide the procedure required to apply the licence code.

Once enabled, the heading options will be displayed in the relevant menus e.g. **GNSS > Config**. Additionally, the **HDT** NMEA message will be available to select as an output.

NOTE

To use GNSS heading on the LD5, two GNSS antennas are required. If additional hardware is required, contact VERIPOS.

3 VERIPOS Software Compatibility

The LD5-C can be used with the VERIPOS visualisation software **Quantum.**

Quantum is suitable for both DP and Survey applications.

The LD5-C is **NOT** compatible with legacy software such as Orion and Verify QC.

For further information regarding the new Quantum visualisation software, please visit VOSS at https://help.veripos.com and refer to the *Quantum User Manual*.

4 Troubleshooting

4.1 Overview of troubleshooting

The LD5 uses a colour screen and navigation panel to access an embedded Windows CE

The system contains no user-serviceable parts.

The cover should not be removed except under the guidance of a VERIPOS engineer, first ensuring that **the unit is isolated from all AC and DC power supplies**.

Most problems indicated by the LD5 system relate to signal reception issues and system or configuration errors, relating to the GNSS positioning card.

4.1.1 Hardware

Hardware fault finding should be limited to checking the security of connectors and checking supply voltage.

It is **strongly recommended** before detailed investigation is undertaken to first check coaxial cable integrity and correct location of antennas.

This manual provides some guidance for troubleshooting the LD5.

4.1.2 Power faults

Fault	Reason	Remedy
Screen blank Power indicator extinguished	External supply fault, dis-connected or switched off	Check power indicator (target symbol, top right on LD5) is lit. Adjust screen brightness using buttons on the left side of the LD5. Check power connections to the unit for physical and electrical integrity.
	Fault in AC/DC supply.	Disconnect the power supply. Check voltages to and from the power supply unit. The LD5 AC 110/240 VAC supplies DC power 12–24 VDC to the LD5. Reconnect power and allow LD5 to restart.
	LD5 fault.	If the PSU voltage is correct, contact the VERIPOS Helpdesk.

4.1.3 Enable/disable faults

Fault	Reason	Remedy
Enable indicator shows red. 	Unit disabled	Contact VERIPOS helpdesk and request unit to be enabled on desired Access Code.
Unable to receive over the air enable message.	Not receiving L-Band signal. 'Sync' icon is red.	Unit needs to receive a beam (L-Band frequency) for the global work region before it can be enabled / disabled. Ensure L-Band antenna is connected, has a clear view of sky to equator. Use the Quick Guide to select and confirm a valid regional satellite beam has been selected for the work area.

4.1.4 L-Band signal faults

Fault	Reason	Remedy
Sync indicator shows red. 	No sync with satellite beam. No beam being received. Unit requires a restart.	Use the 'Global coverage chart' (in Section 4) to check which beam is correct for current location. Go to **L-Band > Config > Beam Selection** to check and, if required, amend to the correct regional beam. Where L-Band signal is derived from vessel's Inmarsat. - Inmarsat system may have lost beam lock or has switched to a different geostationary satellite. Confirm the Inmarsat is tracking the correct satellite. Check the correct frequency is entered - refer to Section 4 of this manual. Contact Helpdesk.
	Vessel has moved to a new work region - beam used has not been changed.	Check which beam is selected at **L-Band > Status > Device Status**. If necessary, consult the Coverage chart at https://help.veripos.com

Fault	Reason	Remedy
Sync indicator shows red. 	Antenna blockage.	Visually check whether the path between the antenna and satellite is subject to blockage. This can occur when the vessel is in port and/or alongside a large structure. Blockage can also be caused by the vessel's own superstructure. This may be eliminated by changing the heading.
	Interference.	Investigate any source of L-Band transmissions and high-power transmissions of other frequencies. If possible shut down possible sources to eliminate them.
	Antenna disconnected or inoperative.	Visually check antenna and cable for DC power and damage. Check coaxial connections and inspect antenna for damage.

4.1.5 GNSS Signal faults

Fault	Reason	Remedy
No Position displayed on Home screen	Antenna placement.	Visually check whether there are any physical obstructions preventing the GNSS antenna from having a clear view of the sky. This can occur when the vessel is in port and/or alongside a large structure. Blockage can also be caused by the vessel's own superstructure.
	Interference.	Investigate any source signal transmissions around the same frequency as GNSS and high-power transmissions of other frequencies. If possible shut down possible sources to eliminate them.
	Antenna disconnected or inoperative.	Visually check antenna and cable for DC power and damage. Check coaxial connections and inspect antenna for damage.

4.1.6 GNSS Heading faults

Fault	Reason	Remedy
No GNSS heading available	No GNSS reception from *Aux* GNSS antenna.	Visually check antenna and cable for DC power and damage. Check coaxial connections and inspect antenna for damage. Confirm there are no potential sources of interference or physical obstructions around the *Aux* GNSS antenna.

Fault	Reason	Remedy
	No GNSS reception from *Main* GNSS antenna.	Check the LD5 Home screen to check if a valid position is being displayed. No position indicates a problem with the *Main* GNSS feed. Visually check antenna and cable for DC power and damage. Check coaxial connections and inspect antenna for damage. Confirm there are no potential sources of interference or physical obstructions around the *Main* GNSS antenna.
	GNSS heading Feature not enabled.	Check the **GNSS > Config** menu. If no "**Heading C-O**" menu is present, then GNSS heading has not been activated. Contact VERIPOS Helpdesk for a GNSS heading licence code.
GNSS heading solution value not as expected	Incorrect heading offset (C-O) entered via the LD5 MMI	Navigate to the C-O setting within the GNSS/Config menu on the LD5. Update the C-O value to align the heading solution with vessel North.
	No C-O entered	Check the orientation of the LD5 *Main & Aux* GNSS antennas. If not installed in line with vessel North (Main antenna installed furthest aft), the heading solution will need to be corrected. A heading C-O can be entered within the LD5 menus, this will allow for a corrected heading value to be output from the LD5. Alternatively, output a raw heading value from the LD5 and enter the C-O value within the receiving vessel system. **Do not enter C-0 in LD5 & vessel system!**

4.2 VERIPOS Helpdesk

For assistance with basic troubleshooting please refer to the section in this manual.

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

For general help please see the extensive library of FAQ and reference material on the VERIPOS Online support system, VOSS at:

https://help.veripos.com

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 in the *Contact information* chapter. VERIPOS recommend initial contact is made by email.

You can also create a fault ticket accessed from the VOSS. Using this system will ensure contact details, fault description etc. are correctly recorded and you can track progress without using email.

The Helpdesk is trained to provide assistance to most queries. They can request technical staff to provide support for complex issues.

To ensure a rapid response, initial communication should include 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**
- **User Code** (on front panel) and current 'Access code' of LD5, see the operation chapter for details.
- **Current status** of the LD5
- 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?
- **Description/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?

Once basic information has been received the Helpdesk raise a fault ticket. Users can access the ticket from the VERIPOS Online support site.

5 Reference information

5.1 Service access licence and enabling process

5.1.1 Service access license

VERIPOS correction signals are provided as a chargeable service.

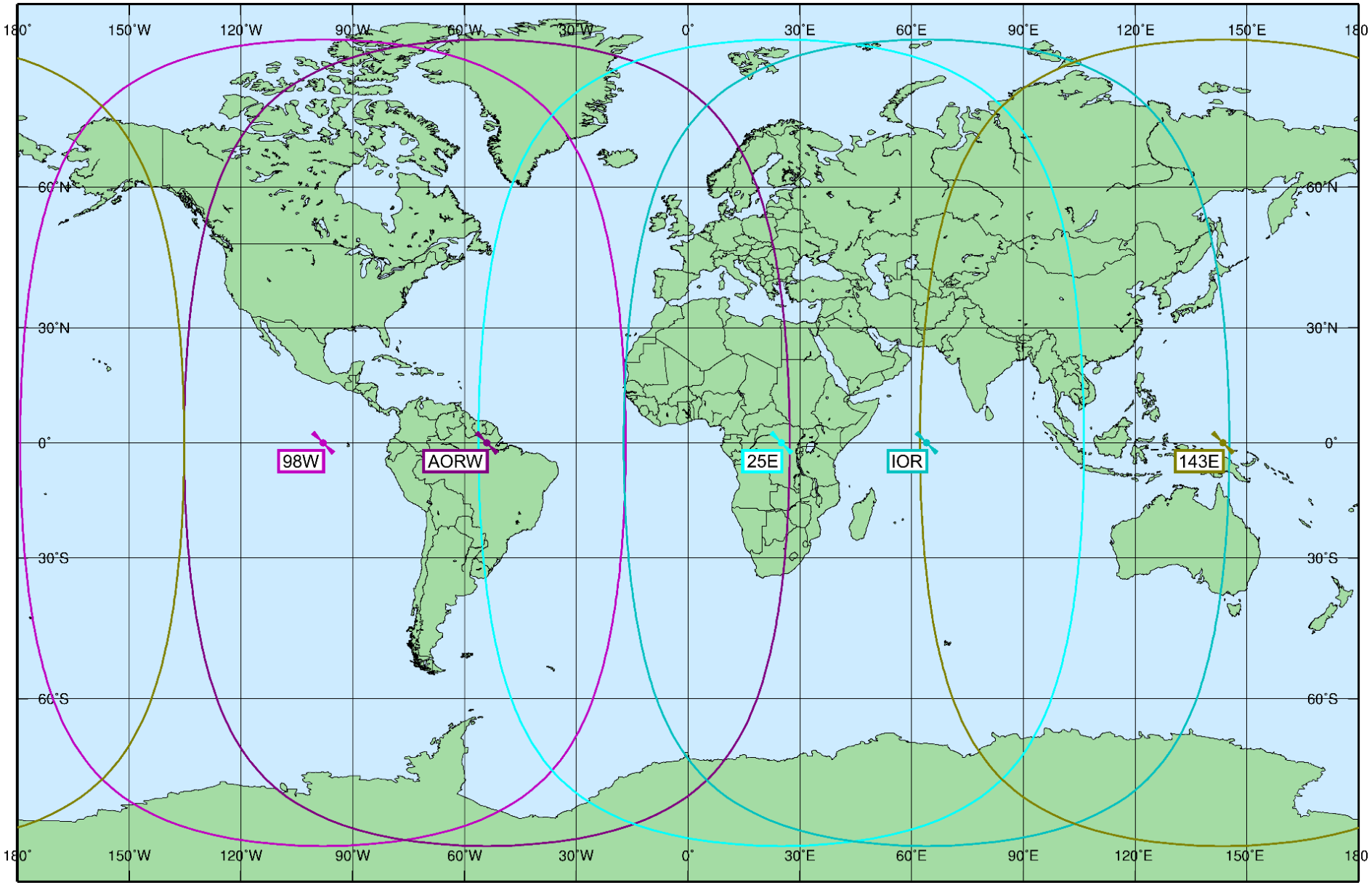
In order to receive this service, the user must first arrange a **Service Access License** (SAL). This takes the form of a contract which is agreed between the user's company and the VERIPOS Operations department.

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.

5.1.2 Enabling Process

In order to enable or disable VERIPOS equipment contact the VERIPOS Helpdesk at: **helpdesk@veripos.com** with SAL, unit user code/s, vessel name, client name and services required.

5.2 Global coverage chart



5.3 COM ports

5.3.1 LD5 COM and IP sockets

LD5 Mode – Default Data Stream Settings

Data stream	Default COM port / Assignment	Baud rate	Socket
L-Band RTCMa	COM 1	9600	9001
L-Band RTCMb	Unassigned	9600	9002
L-Band Config	Unassigned	115200	9003
GNSS NMEAa	COM 2	9600	19016
GNSS NMEAb	Unassigned	9600	19017
MF RTCM	COM 3	9600	9031*
Ext RTCM	Unassigned	9600	-
None	–	–	–

* C3 variants only

5.3.2 LD5 COM and IP sockets

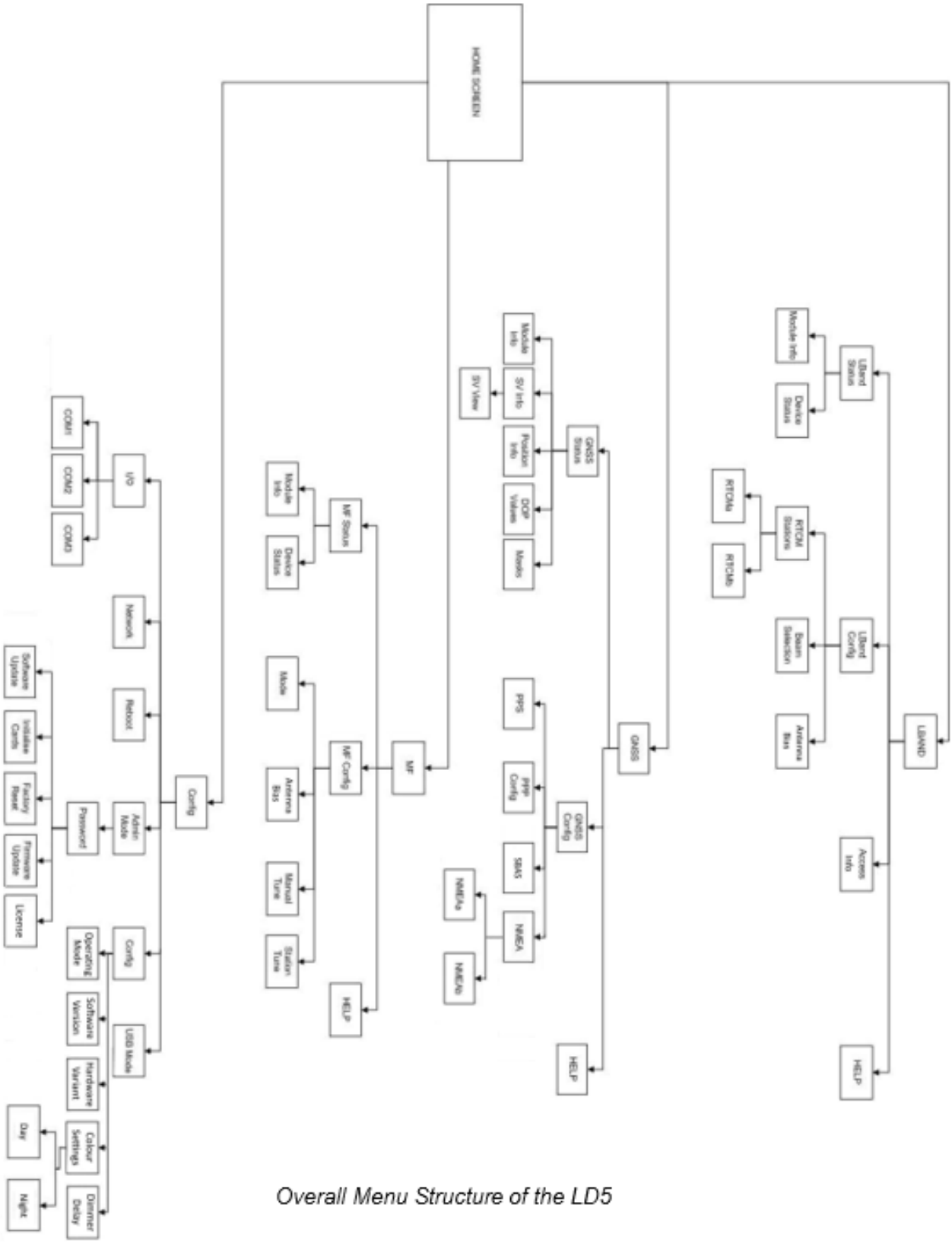
Default configuration for each COM port is:

- 8 data bits
- No parity
- 1 stop bit

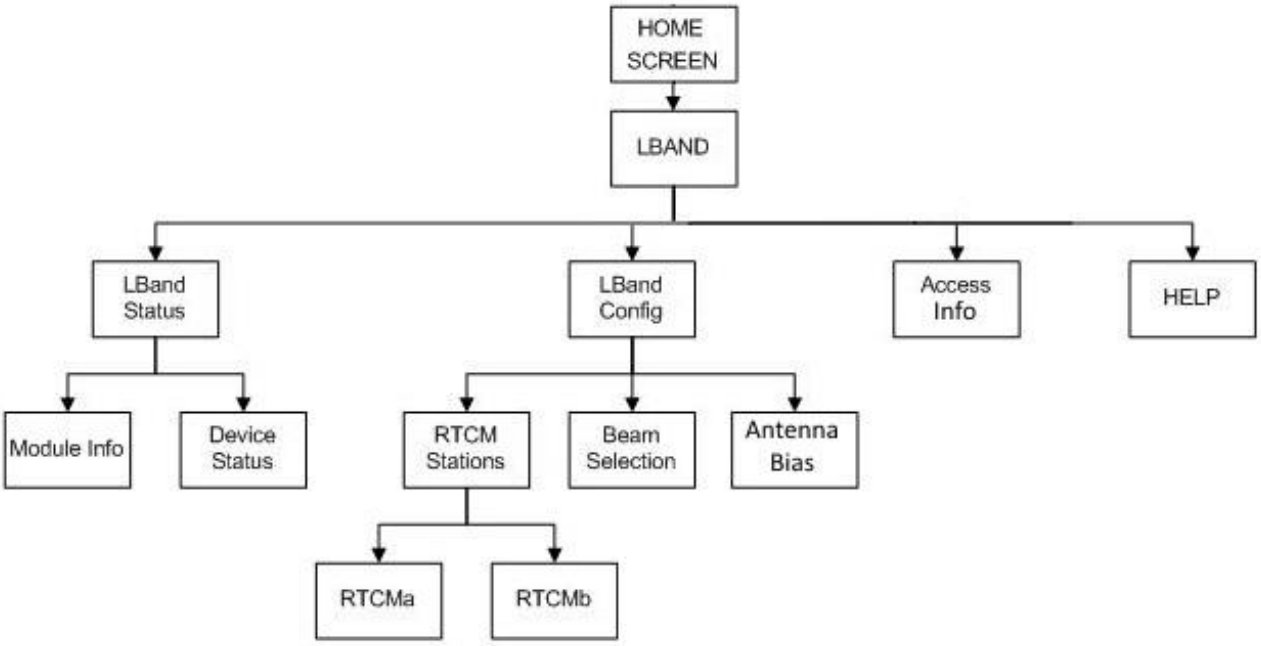
This information may be required when interfacing to ships systems using RS-232/422 standards. The LD5 is the transmitting device.

DB9 pin	Function	
	RS-232	RS-422
1	Not connected	Not connected
2	TxD	Tx(-)
3	RxD	Rx(-)
4	Not connected	Not connected
5	Signal ground	Signal ground
6	Not connected	Tx(+)
7	Not connected	Not connected
8	Not connected	Not connected
9	Not connected	Rx(+)

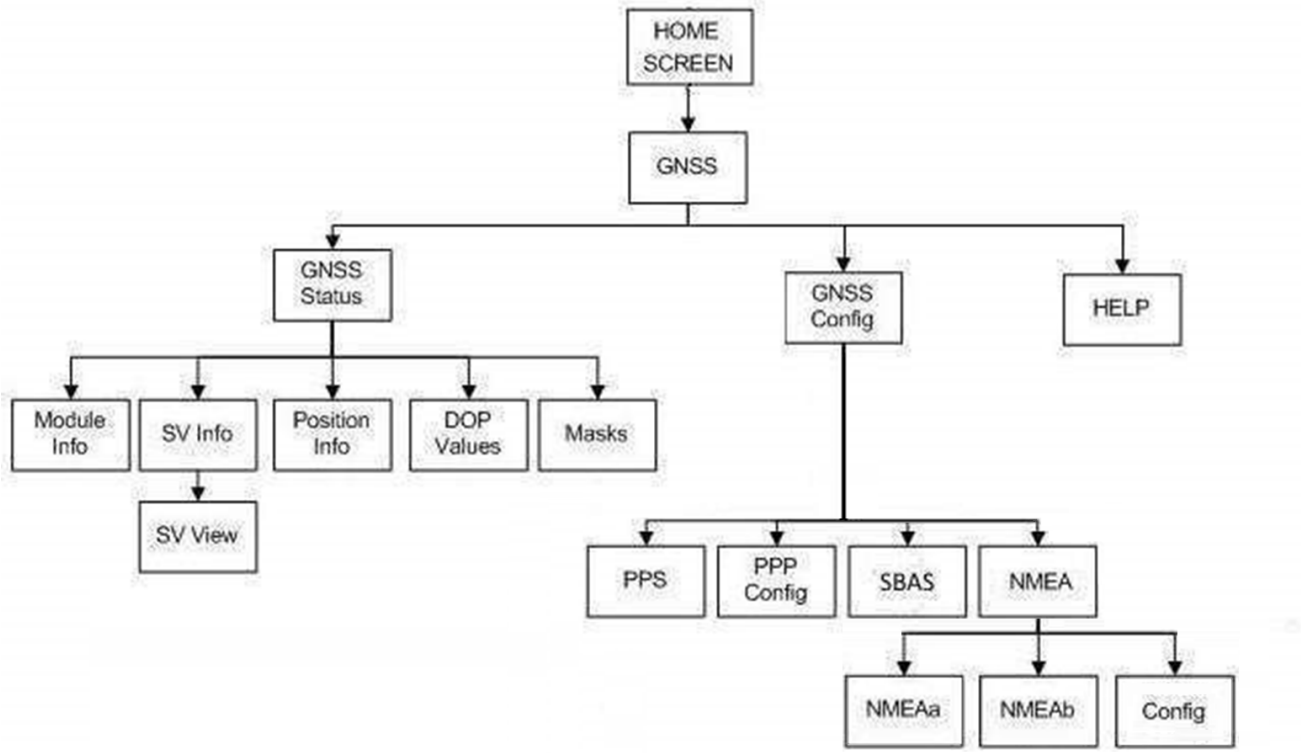
5.4 LD5 Menu structure



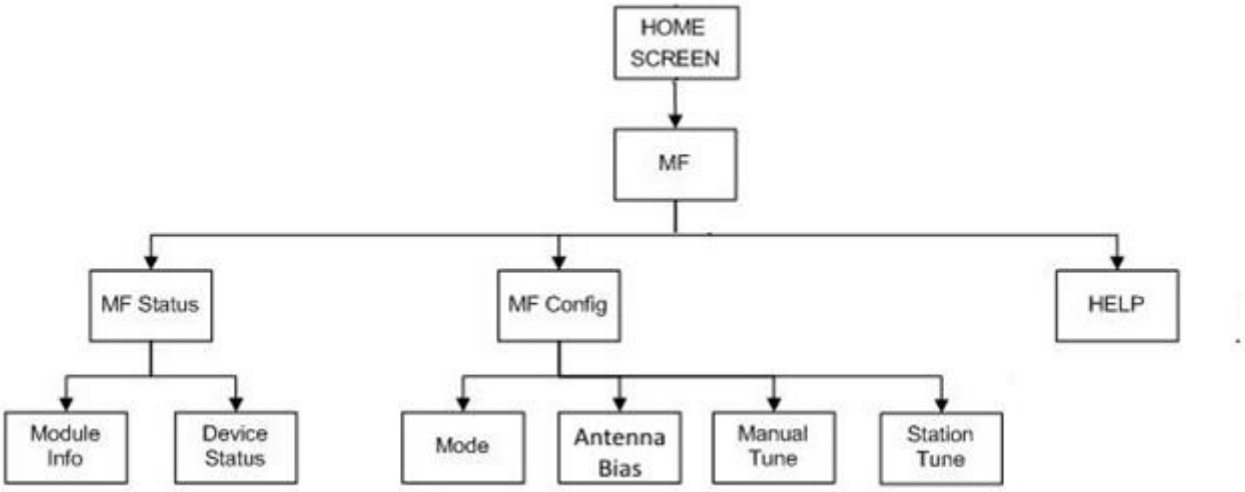
Overall Menu Structure of the LD5



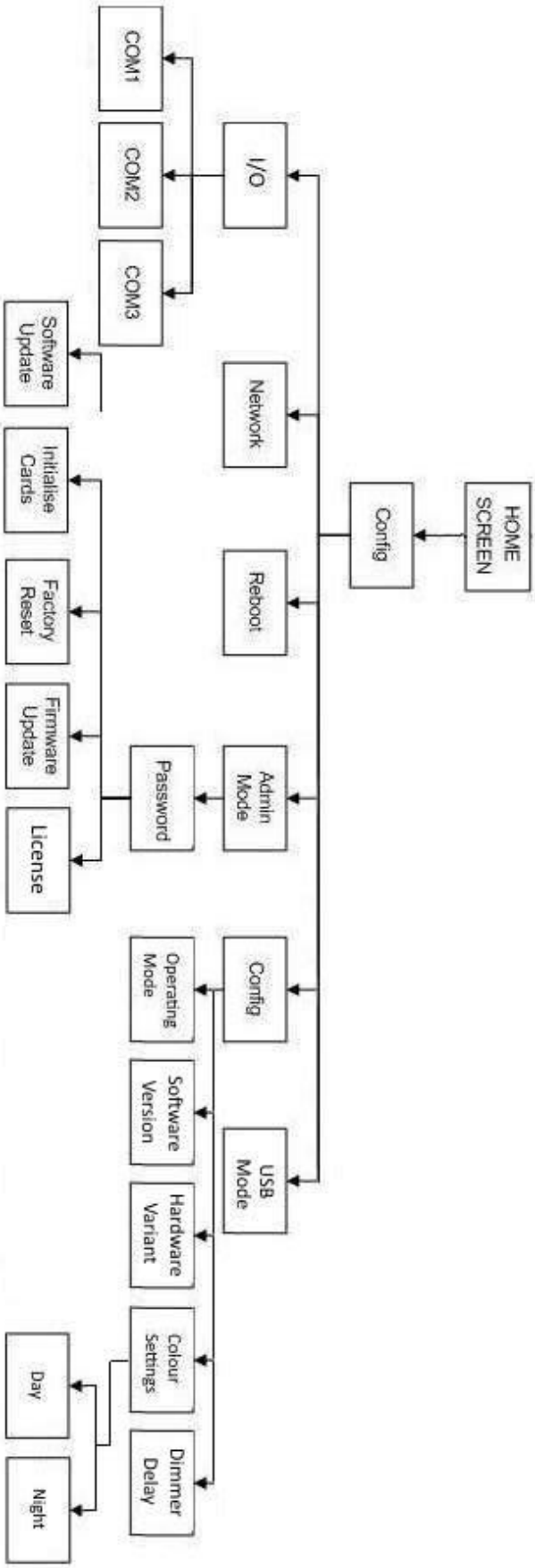
L-Band Menu Structure of the LD5



GNSS Menu Structure of the LD5



MF Menu Structure of the LD5



Config Menu Structure of the LD5

5.5 NMEA Sentences

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

GGA	GSA*
GLL*	GSV
VTG*	GRS*
ZDA	RMC*
GST*	UKOOA
HDT*	

NOTE

*Message talker ID will differ depending on which calculation is being computed. For example, a GPS only calculation such as Apex will begin *GPxxx*, whereas a calculation utilising more than one constellation such as Apex[2] will begin *GNxxx*.

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 height
M	units of geoidal height, meters
x.x	age of differential GPS data
nnnn	Differential reference station ID, 0000 to 1023
*hh<CR><LF>	checksum, carriage return and line feed

NOTE: The number of decimal places in the Latitude and Longitude values is configurable via the LD5 in the ***GNSS/ Config/ NMEA Config*** under ***NMEA Precision***. Between 5 and 8 decimal places are selectable.

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 (meters)	Standard deviation of semi-major axis of error ellipse
c.c (meters)	Standard deviation of semi-minor axis of error ellipse
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

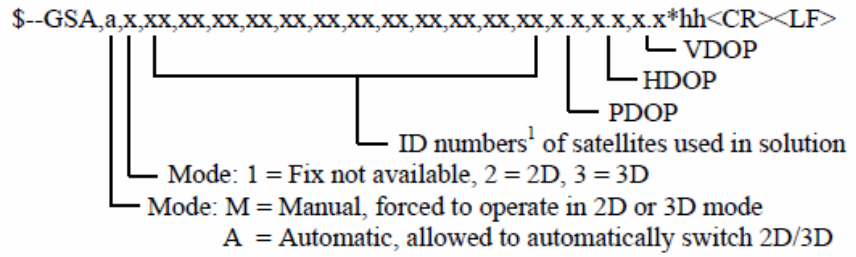
hhmmss.ss	UTC time in hours, minutes, seconds of the GPS position
dd,mm,yyy	Day,Month,Year (UTC)
xx	local zone hours (00 to +/-13 hrs)
yy	local zone minutes (00 to 59)
*hh<CR><LF>	checksum, carriage return and line feed

NMEA GSA Sentence

GSA sentence defined:

GNSS DOP and Active Satellites
GNSS receiver operating mode, satellites used in the navigation solution reported by the GGA or GNS sentence, and DOP values.

If only GPS, GLONASS, etc. is used for the reported position solution the talker ID is GP, GL, etc. and the DOP values pertain to the individual system. If GPS, GLONASS, etc. are combined to obtain the reported position solution multiple GSA sentences are produced, one with the GPS satellites, another with the GLONASS satellites, etc. Each of these GSA sentences shall have talker ID GN, to indicate that the satellites are used in a combined solution and each shall have the PDOP, HDOP and VDOP for the combined satellites used in the position.



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 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.

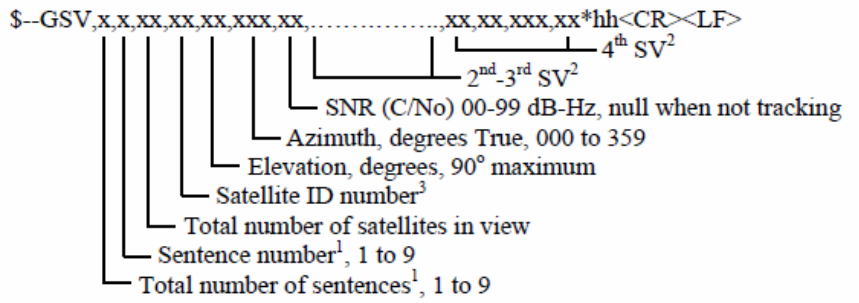
NMEA GSV Sentence

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.



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 GLL Sentence

The NMEA GGL sentence provides 2D position data.

Structure and Example:

$GPGLL,ddmm.mmmmmmm ,a, dddmm.mmmmmmm
,b,hhmmss.ss,S,I*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)
I 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 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

Note that, as of the 2.3 release of NMEA, there is a new field in the VTG sentence at the end just prior to the checksum. Receivers that don't have a magnetic deviation (variation) table built in will null out the Magnetic track made good.

NMEA GRS Sentence

GNSS Range Residuals

This sentence is used to support Receiver Autonomous Integrity Monitoring (RAIM).
Range residuals can be computed in two ways for this process. The basic measurement integration cycle of most navigation filters generates a set of residuals and uses these to update the position state of the receiver.
These residuals can be reported with GRS, but because of the fact that these were used to generate the navigation solution they should be recomputed using the new solution in order to reflect the residuals for the position solution in the GGA or GNS sentence.
The MODE field should indicate which computation method was used. An integrity process that uses these range residuals would also require GGA or GNS, GSA, and GSV sentences to be sent.
If only GPS, GLONASS, etc. is used for the reported position solution the talker ID is GP, GL, etc. and the range residuals pertain to the individual system. If GPS, GLONASS, etc. are combined to obtain the position solution multiple GRS sentences are produced, one with the GPS satellites, another with the GLONASS satellites, etc. Each of these GRS sentences shall have talker ID “GN”, to indicate that the satellites are used in a combined solution. It is important to distinguish the residuals from those that would be produced by a GPS-only, GLONASS-only, etc. position solution. In general the residuals for a combined solution will be different from the residual for a GPS-only, GLONASS-only, etc. solution.

$--GRS,hhmmss.ss,x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh<CR><LF>

Range residuals in meters for satellites used in the navigation solution1,2.
Order must match order of the satellite ID3 numbers in GSA.
When GRS is used GSA and GSV are generally required.

Mode: 0 = residuals were used to calculate the position given in the matching GGA or GNS sentence
1 = residuals were recomputed after the GGA or GNS position was computed

UTC time of the GGA or GNS fix associated with this sentence

Notes:

1) If the range residual exceeds +99.9 meters, then the decimal part is dropped, resulting in an integer (-103.7 becomes -103). The maximum value for this field is +999.

2) The sense or sign of the range residual is determined by the order of parameters used in the calculation.
The expected order is as follows: range residual = calculated range - measured range.

3) When multiple GRS sentences are being sent then their order of transmission must match the order of corresponding GSA sentences.
Listeners shall keep track of pairs of GSA and GRS sentences and discard data if pairs are incomplete.

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:
$GPRMC,123519,A,4807.038,N,01131.000,E,022.4,084.4,230394,003.1,W*6A
Where:

RMC	Recommended Minimum sentence C
123519	Fix taken at 12:35:19 UTC
A	Status A=active or V=Void.
4807.038,N	Latitude 48 deg 07.038' N
01131.000,E	Longitude 11 deg 31.000' E
022.4	Speed over the ground in knots
084.4	Track angle in degrees True
230394	Date - 23rd of March 1994
003.1,W	Magnetic Variation
*6A	The checksum data, always begins with *

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. For more information on this field.

NMEA HDT Sentence

The NMEA HDT sentence provides heading information derived from the system.

$GPHDT,xxx.xx,T*hh<CR><LF>
where:

$GPHDT – is the message name stating it is a GPS heading (true) message
xxx.xx – this is the heading
T – states the heading is true
*hh – is the check sum for the message

UKOOA Sentence

Example:

[240 6700 VERI 1 1921 432026.0 +0.1 +22.4 057 12.08202N 002 11.53784W 64.220 +50.40 1.344 0.650 1.176 7 0.192 0.360 0.02 0.008 -0.001 0.004 0.030 0.09 0.06 344.8 P 15{ 12 19 15 17 25 10 24 32 14 82 72 80 83 65 71} 1{ 268}]

VERIPOS UKOOA sentence defined:

Content	Format	Field	Unit	Comments
Start Character	A1	1	-	Open string
Length of Message	I4	2….5	-	Number of characters
Software Version	A5	6….10	-	
System Name	A6	11….16	-	
Record Identifier	I2	17…18	-	See comment 1
GPS Week Number	I5	19…23	-	Since Jan 6th 1980
GPS Time of Fix	F9.1	24…32	sec	Seconds into current GPS Week
Age of Record	F5.1	33…37	sec	See comment 2
Latency	F6.1	38…43	sec	
Latitude	F13.6	44…56	dm	^dd^mm.mmmmm (^=space)
Latitude Hemisphere Indicator (N or S)	A1	57	-	N or S
Longitude	F13.6	58…71	dm	^dd^mm.mmmmm (^=space)
Longitude Hemisphere Indicator (E or W)	A1	72	-	E or W
Altitude above MSL	F7.3	73…79	m	Antenna height above mean sea level. See comment 3
Geoid Separation	F8.2	80…87	m	See comment 4
PDOP	F7.3	88…94	-	
HDOP	F7.3	95…101	-	
VDOP	F7.3	102…108	-	
Fix Status	I2	109…110	-	See comment 5
Internal Reliability	F7.3	111…117	m	See comment 6
External Reliability (m)	F8.3	118…125	m	See comment 7
Unit Variance	F5.2	126…130	m²	See comment 8
Variance Latitude	F7.3	131…137	m²	See comment 8
Covariance Lat/Long	F8.3	138…145	m²	See comment 8
Variance Longitude	F7.3	146…152	m²	See comment 8
Variance Height	F7.3	153…159	m²	See comment 8
95% Error Ellipse Semi Major Axis	F6.2	160…165	m	See comment 9
95% Error Ellipse Semi Minor Axis	F6.2	166…171	m	See comment 9
Orientation Of Semi Major Axis of Error	F6.1	172…177	º	See comment 10
F Test (P=Pass, F=Fail)	A2	178…179	-	See comment 11
No of Satellites used in the Fix (n)	I3	180…182	-	

Satellite PRN Numbers of Satellites used in Fix	{I3*(n-1)+I2}	Variable	-	PRN numbers have format I2 and are space separated
Number of Reference Stations used for this Fix (00 – 99)	I2	Variable	-	
Ids of the Reference Stations used in the Fix	{I5*(n-1)+I4}	Variable	-	Station ID numbers have format I4 and are space separated
End of Character	A1		-	Close string
Carriage Return	¬		-	
Line Feed	^		-	

Field Formats:

Ax Alphanumeric text
Ix Integer Field
Fx.y Floating point field

Where:

x gives the total length including the decimal point and decimals
y the number of decimals

If a sign (+ or -) is included in the field, the sign must be immediately adjacent to the number it relates to with no spaces in between i.e. -3.12

Alphanumeric text fields must be left justified, and numeric fields must be right justified.

The field sizes are selected with a space between each field. This aids manual readability and protects against overflow.

Comments:

1. Record Identifier — shows the calculation used, as different calculations can be labelled: 1, 2, 3 etc.
2. Age of Record — time of the first character of the data string being output, minus the time of position.
3. Altitude Above MSL — the datum for height calculations.
4. Geoid Separation — separation between mean sea level and the WGS84 reference ellipsoid, based on a Geoid model as for example EGM96.
5. Fix Status Codes — shows the calculation used, as different calculations can be labelled: 1, 2, 3 etc.

Single Frequency	
Status Code	**Meaning**
0	No or Bad Fixes
1	Altitude Aiding (Weighted Height used in Fix)
2	Altitude hold (2D Fix)
3	3D Fix
Dual Frequency (4 is added to the above values when positioning is set-up for dual frequency calculations)	
Status Code	**Meaning**
4	No or Bad Fix
5	Altitude Aiding (Weighted Height used in Fix)
6	Altitude hold (2D Fix)
7	3D Fix

6. Internal Reliability — smallest outlier that is likely to be detected by the current solution.
7. External Reliability — maximum positional effect of an undetectable error in an observation. This quantity is related to the Power of the test (probability that the MDE would be detected) and the Significance level used.
8. (Co)-variance — The Variance and Covariance terms are elements from the variance-covariance matrix of the position fix computation (un-scaled)
9. 95% Error Ellipse — Shows 95% confidence level of the semi-major and semi-minor axis of the error ellipse
10. Orientation — Orientation of the semi major axis (degrees from true North)
11. F Test — A test applied to the Unit Variance. A “Fail” may result from large outliers in the measurements.

6 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.

6.1 VERIPOS Helpdesk

Helpdesk telephone	+44 (0)1224 965900
Helpdesk e-mail	helpdesk@veripos.com
VERIPOS Online support	https://help.veripos.com

NOTE

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

6.2 VERIPOS Office Locations

6.2.1 VERIPOS UK

VERIPOS House
1B Farburn Terrace
Dyce, Aberdeen
AB21 7DT
United Kingdom

6.2.2 Additional VERIPOS Offices

For up to date locations for other VERIPOS offices worldwide, please visit www.veripos.com .