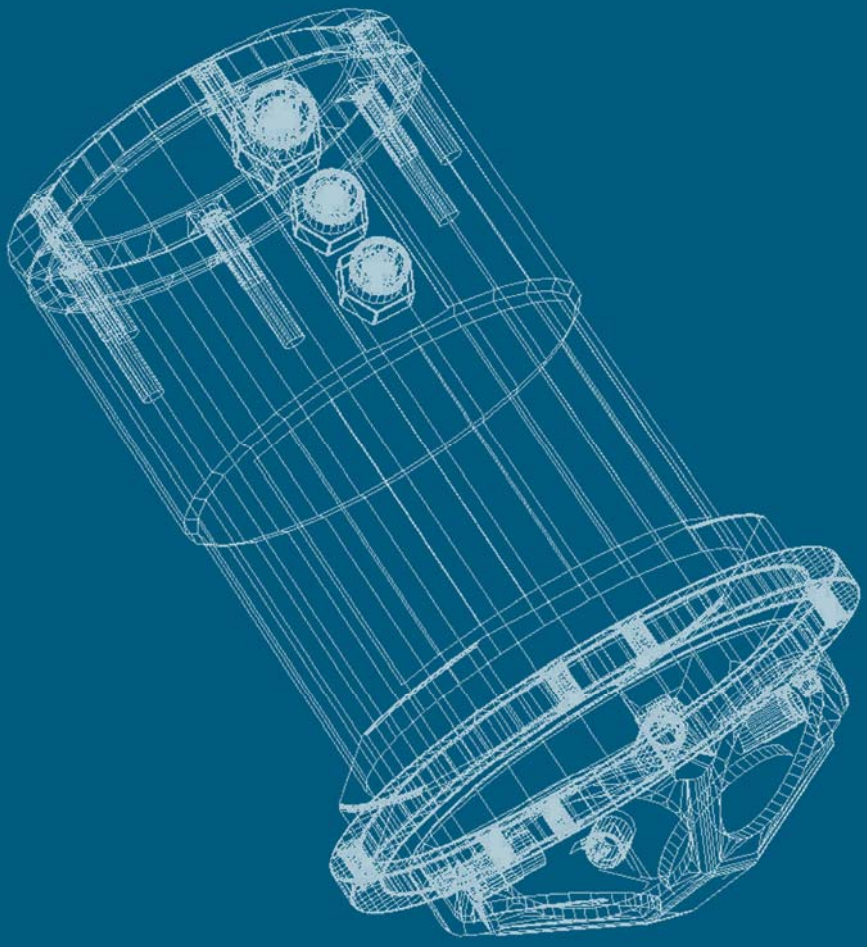
MiniPOS/NAV

Technical Manual



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Document Rev A

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INTRODUCTION

1.0. WARNINGS AND NOTES

Throughout the manual the following symbols are used:

Indicates a warning. Failure to follow these instructions will result in serious injury, damage to equipment or incorrect operation of equipment.

Indicates a note. This indicates important information that should be followed to ensure correct operation of the unit.

1.1. GENERAL DESCRIPTION

1.1.1. System Overview

The CDL MiniPOSNAV is a solid state gyro compass based around the Kearfott T16-B Monolithic Ring Laser Gyrocompass (MRLG) combined with a RDI Workhorse DVL

The MiniPOSNAV contains an Inertial Sensor Assembly (ISA) comprised of a three axis MRLG and three single-axis accelerometers. This assembly, together with the navigation processor, provides the MiniPOS 2 a full self contained Attitude Heading Reference Unit. Figure 1.1 shows the MiniPOS2 in its standard 3000m housing.

Figure 1.1: The MiniPOS 2

The MiniPOSNAV has its alignment time set to 30 minutes! The unit will not have a usable heading until this time has elapsed and it has entered the aided navigation mode (See section 3.1 for mode codes)

1.1.2. Interface Overview

The MiniPOSNAV has two user interface ports available through the umbilical connector on the pod. Both ports allow access to user selectable data strings and to the control interface. Port 1 should be used in preference to Port 2 for the control interface as it has a higher interrupt priority. There are a further two interfaces available through the AUX1/DVL and AUX2/GPS connectors.

The interfaces on the umbilical port can be configured to a number of different user selectable outputs and if required the outputs selected on either of these ports can be duplicated on either or both of the AUX connectors. Furthermore,

the high speed HAIN data can be output from either AUX port independently of the outputs selected on Port 1 or Port 2.

It is also possible to aid the MiniPOSNAV system using a GPS input. The GPS data can be either differential or non-differential but must have minimal filtering applied to the position and velocity information.

The GPS data must include the following strings: NMEA GGA, VTG and GSA. If these strings are not available in the GPS input the MiniPOS 2 will not process the data.

1.2. THEORY OF OPERATION

1.2.1. General overview

The MiniPOSNAV contains an Inertial Sensor Assembly; this assembly along with the navigation processor provide the heart of the attitude and heading reference unit.

Instantaneous linear accelerations are measured by an array of solid-state accelerometers. Rotational accelerations are measured using a three-axis monolithic ring laser gyrocompass. These readings are fed into an inertial algorithm that computes the unit's attitude relative to true vertical and heading relative to true north.

1.2.2. Reference frames

The MiniPOSNAV works by using very accurate, sensitive sensors to compare the motion of the unit relative to the Earth and fixed inertial space. The Universal reference frame is related to the 'fixed' stars. This is the only frame where no translation or rotation movements will be detected by navigation quality sensors. This frame has its origin at the centre of the Earth and has axes which are non-rotating with respect to the fixed stars. The Z-axis is co-incident with the Earth's polar axis

The Earth reference frame (e.g. WGS84) is like the Universal reference frame, except for the Earth's rotation about the polar axis at 15 degrees per hour and the Earth's rotation around the Sun at approximately 0.04 degrees per hour, giving a total of 15.04 degrees per hour. The origin is also at the Earth's centre but the axes are fixed with respect to the Earth.

The Geographic reference frame (e.g. UTM) is a local approximation to cartesian co-ordinates. The origin is at the location of the system, with axes aligned to North and Down. This is the frame that we want our measurements to be relative to.

The Vehicle reference frame has axes aligned with the roll, pitch and yaw axes of the vehicle in which the system is installed. The sensors measure motions with respect to this frame directly, i.e. forward motion will produce a response on the X accelerometer only.

The ring laser gyros within the MiniPOSNAV are sensitive enough to be able to detect and measure the rotation of the Earth with respect to the Universal reference frame, and the linear accelerometers are sensitive enough to very accurately measure the Earth's gravity vector.

1.2.3. Computing attitude

As the linear accelerometers can easily and accurately detect the direction of the Earth's gravity, it is quite simple to provide the vehicle's pitch and roll,

which are defined by the difference between the vehicle reference frame Z-axis and the Geographic reference frame Z-axis.

Given the local latitude, the ability to determine the direction of the Earth's gravity vector and the ability to detect the rotation of the Earth about its axis, it is possible to determine the orientation of the Earth's polar axis relative to the Vehicle reference frame and therefore the heading of the vehicle can be computed.

1.2.4. How the linear accelerometers work

The linear accelerometers in the unit are of the single-axis pendulous force-rebalance type. They consist of a small proof mass suspended on a flexible joint. Acceleration causes displacement of the mass which is detected by a coil. A feedback loop is used to drive the mass back to its null point and as the force required to do this is proportional to the acceleration experienced by the sensor, it is possible to measure the force and therefore measure the acceleration.

1.2.5. How the ring laser gyros work

The ring laser gyros work by generating a laser beam, splitting it into two and sending each beam in a different direction around the same closed path, figure 1.2 shows the lasing RLG block.

Figure 1.2: Lasing RLG Block

This path takes the form of a square 'loop'. If this loop is rotating about the axis orthogonal to the plane of the loop, the light which has gone one way round will have to travel very slightly further to get back to the start, whilst the light travelling the other way will have to travel a very slightly shorter path. This difference in path lengths leads to a measurable phase difference

between the two beams which is proportional to the rate of rotation of the sensor.

1.3. WARRANTY

CDLtd UK warrants 'MiniPOSNAV' products to be free from defects in materials or workmanship for one year beginning on the date when the equipment was shipped from the CDL base or from their authorised distributor.

Units must be packaged with care when returning to the CDLtd base. CDLtd recommends that the original packing material is retained for this purpose.

The responsibility of CDLtd in respect of this warranty is limited solely to product replacement or repair at an authorised location only. Determination of replacement or repair will be made by CDLtd personnel or by personnel expressly authorised by CDLtd for this purpose.

This warranty will not extend to damage or failure resulting from misuse, neglect, accident, alteration, improper installation, non-approved cables or accessories, or operation in an environment other than intended.

In no event will CDLtd be liable for any indirect, incidental or consequential damages whether through tort, contract or otherwise. This warranty is expressly in lieu of all other warranties, expressed or implied, including without limitation the implied warranties of merchantability or fitness for a particular purpose. The foregoing states the entire liability of CDLtd with respect to the products described herein.

2.0. SYSTEM CONTENTS

Figure 2.1: System Contents

When the system is received is should comprise of the following items:

1. MiniPOSNAV sub sea unit
2. Transit Case
3. 1.2 m tail for connection to the umbilical connector
4. Instruction Manual
5. Calibration Certificate
6. Connector Blanks

2.1. UNPACKING AND INSPECTION

The system was shipped from CDL in a specially designed transit case that contains cavities that exactly fit each system component. This transit case should ensure that the equipment reaches its destination in perfect working order.

Retain the original transit case so that this may be used to transport the system when necessary. Improper packing whilst the unit is being transported will invalidate the warranty of the unit.

On receipt of the equipment, the contents of the packing case should be carefully unpacked and checked against the items on the shipping documents for any errors or omissions. If the equipment or transit case has been fitted with a CDL MicroShock device (or similar) then the device should be checked in case the system has suffered any damage during transit. It is recommended that the original packing case be used for subsequent transportation of the equipment.

2.2. PHYSICAL INSTALLATION

The CDL MiniPOSNAV should be installed on a level flat surface in a manner to give the unit maximum physical protection from accidental damage.

The MiniPOSNAV weighs 9.8Kg so a location must be chosen that will support this load whilst giving convenient access to the unit and sub connectors.

The location of the unit must not be near any sources of extreme mechanical noise.

As standard the MiniPOSNAV is shipped in a 3000M housing, however there are 4000M and 6000M options. Under no circumstances should the unit be subjected to forces greater than that stated on the unit.

The depth rating of the MiniPOSNAV housing is stated clearly on the side label. Should you wish to use a MiniPOSNAV beyond its stated rating please contact CDL for assistance BEFORE using the unit.

2.2.1. System Orientation

In order to gain an accurate heading reference the unit's heading axis should be aligned accurately with the vehicle's fore-aft axis. The unit can be mounted in different orientations, refer to Section 2.2.2.

The position read from the unit is referenced to a non-central point. Sections 7.0 and 7.1 give offsets for the reference point to allow all readings to be referenced correctly to the base of the unit.

The reference frame of the unit is defined as follows-
The unit's X-axis is the roll axis and should be aligned with the fore-aft axis of the vehicle. The unit's Y-axis is the pitch axis and should be aligned with the port-starboard axis of the vehicle. The unit's Z-axis is the yaw axis and should be aligned with the azimuth if the vehicle is level. These definitions are illustrated in Figure 2.2

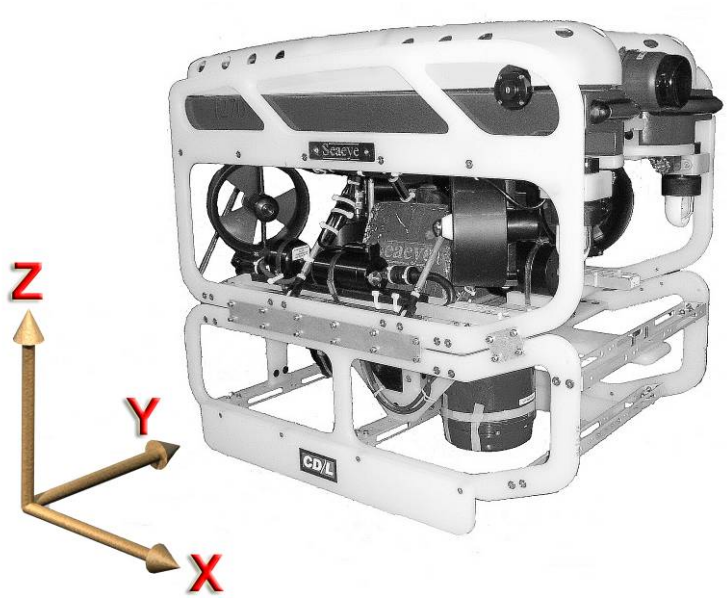


Figure 2.2 Vehicle reference frame
Image used courtesy of Seaview Systems and Seaeye Marine

Heading is defined as the angle between true north and the projection of the vehicle X-axis onto the horizontal plane.

Pitch is defined as the angle between the vehicle X-axis and the horizontal plane.

Roll is defined as the angle between the vehicle Y-axis and the horizontal plane.

Lever arm offsets for both DVL and GPS are shown in figure 2.3. The offsets are positive if the DVL/GPS is in front of, to port, and above the MiniPOSNAV.

The DVL should be mounted with the alignment notch towards the PORT side of the vehicle (Beams 2 and 3 should face forwards).

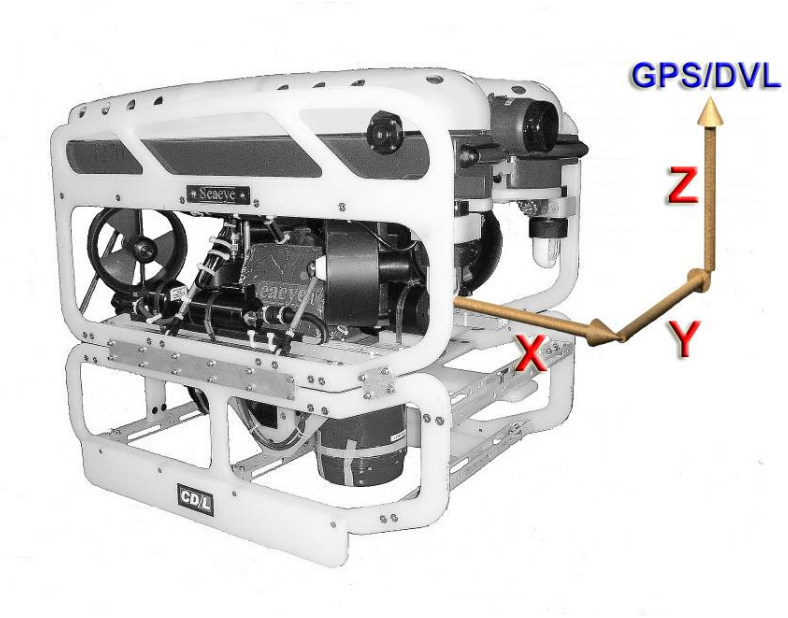


Figure 2.3 MiniPOSNAV to DVL/GPS lever arm offsets
*In this example, X, Y and Z are all **positive***
Image used courtesy of Seaview Systems and Seaeye Marine

2.2.2. System Mounting

The MiniPOSNAV can be mounted in a choice of orientations. The standard orientation is with the connectors at the top, and heading reference in the direction of the "heading" arrow on the lid. This is how CDL delivers the MiniPOSNAV unless otherwise requested.

Alternatively, it can be mounted on its side. In this orientation, there are four further horizontal alignment options, in 90 degree steps i.e. connector end of housing points: bow, starboard, stern, or port. If your MiniPOSNAV is set to one of these four alignments, the mounting rotation is as given in Table 2.1.

Note that the three columns to the right give the offsets to apply in the firmware for each orientation. These are presently preset by CDL but may be applied by the user in future firmware versions.

Orientation	Direction of "heading" arrow	Azimuth bore sight	Pitch bore sight	Roll bore sight
Connectors to bow (front)	Points vertically down	0	-90	0
Connectors to starboard (right)	Points to bow (front)	0	0	+90

Connectors to stern (back)	Points vertically up	0	+90	0
Connectors to port (left)	Points to bow (front)	0	0	-90

Table 2.1: Mounting Orientation Offsets

This configuration setup is made in the MiniPOSNAV firmware. At the time of writing it has to be done by CDL. In future firmware revisions, we do intend to allow the user to reconfigure this through the user interface.

Note that the MiniPOSNAV has to be recalibrated each time the orientation is changed, so it should not be done unless absolutely necessary.

Please contact CDL to find out about firmware versions if you want this configuration changed for your MiniPOSNAV.

2.3. ELECTRICAL INSTALLATION

The MiniPOSNAV has three connectors, one Burton 20-13 for power and data and two Burton 15-08s for GPS, DVL and auxiliary communication functions.

If any of these connectors are not in use they MUST be fitted with blanking plugs.

Interface with the unit can be by RS232 or RS422 serial communications at standard baud rates in the range 9600 – 115200 bps.

2.3.1. Umbilical Connector

The umbilical connector is a Burton 20-13 connector. This connector supplies power to the unit and has 2 serial ports. These provide the primary and secondary ports to the device. The pin out for this connector is given in Table 2.2 and the pin orientation is shown in Figure 2.4.

Pin	Name	Function	RS 232	RS 422
1	AC Live	Live		
2	Port 2 TxA	Secondary Port	Tx	Tx +
3	AC Earth	Earth		
4	+24v Rtn	Power Ground		
5	Port 1 TxA	Primary Port	Tx	Tx +
6	Port 1 TxB	Primary Port	N/C	Tx -
7	Port 1 RxA	Primary Port	Rx	Rx +
8	Port 1 RxB	Primary Port	Ground	Rx -
9	+24v DC	+24v DC		
10	AC Neutral	Neutral		
11	Port 2 TxB	Secondary Port	N/C	Tx -
12	Port 2 RxA	Secondary Port	Rx	Rx +
13	Port 2 RxB	Secondary Port	Ground	Rx -

Table 2.2: Umbilical Connector

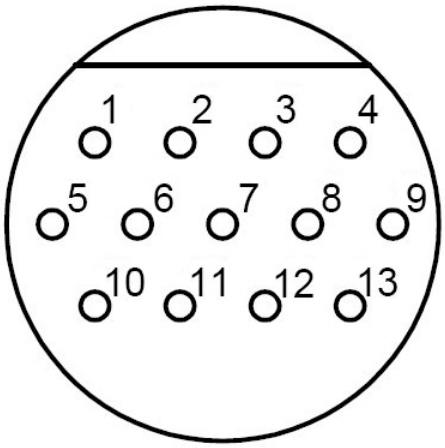


Figure 2.4: Burton 20-13 Female face view

2.3.2. AUX1/DVL connector

The auxiliary 1/DVL connector is a Burton 15-08 connector. This allows a DVL input to be supplied to the unit to aid navigation. In addition the Aux1 port can also output a fast raw binary string used in the Hydro-Acoustic Inertial Navigation (HAIN) system, or a duplication of either of the data strings on Ports 1 or 2. Table 2.3 shows the pin outs for this connector. Figure 2.5 shows the pin orientation on the connector.

Pin	Name	Function	RS 232	RS 422
1	+24v DC out	+24v DC		
2	+24vRtn	DC Ground		
3	DVL TxA	DVL	Tx	Tx +
4	DVL TxB	DVL	N/C	Tx -
5	DVL RxA	DVL	Rx	Rx +
6	DVL RxB	DVL	Ground	Rx -
7	N/A			
8	N/A			

Table 2.3: AUX1/DVL connector

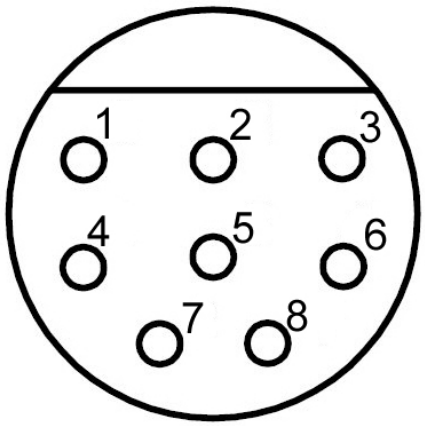


Figure 2.5: Burton 15-08 Female Face View

2.3.3. AUX2/GPS connector

The auxiliary 2/GPS connector is Burton 15-08 connector. This allows a GPS input to be supplied to the unit to aid navigation. In addition the Aux2 port can also output a fast raw binary string used in the Hydro-Acoustic Inertial Navigation (HAIN) system, or a duplication of either of the data strings on Ports 1 or 2. Table 2.4 shows the pin outs for this connector. Figure 2.6 shows the pin orientation on the connector.

Pin	Name	Function	RS 232	RS 422
1	+24v DC out	+24v DC		
2	+24vRtn	DC Ground		
3	GPS TxA	GPS	Tx	Tx +
4	GPS TxB	GPS	N/C	Tx -
5	GPS RxA	GPS	Rx	Rx +
6	GPS RxB	GPS	Ground	Rx -
7	1PPS Rtn	1 PPS Ground		
8	1PPS	1 PPS Signal		

Table 2.4: AUX1/DVL connector

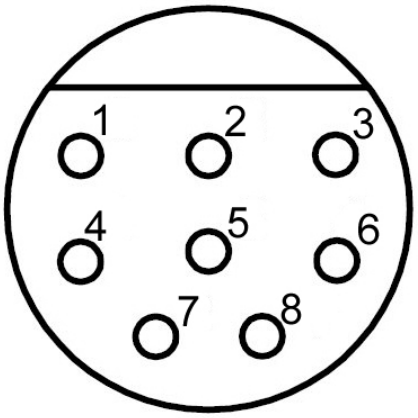


Figure 2.6: Burton 15-08 Female Face View

2.3.4. Summary

As a minimum to use and configure the MiniPOSNAV the power source and either port 1 or port 2 need to be connected.

When using a 24v DC power source care must be taken to avoid reverse polarisation of the connection. The positive supply should be connected to pin 9 and the 0v connection should be connected to pin 4 on the umbilical connector.

When using an AC power source for the unit care must be taken to ensure the correct pins are used for the umbilical connection. AC live MUST be connected to Pin 1, AC neutral must be connected to pin 10 and AC earth must be connected to pin 3 on the umbilical connector.

Failure to connect AC power supply to the correct pin on the umbilical connector will result in permanent damage to the unit

3.0. INITIAL POWER-ON

The MiniPOSNAV unit runs automatically on power up. The system has been set for a 30 minute run-up period but will generally be within 1 degree of accuracy after 3 minutes.

Please note that severe motion during the run-up period will cause the settling period to increase slightly.

After initial power on the system executes a short self test procedure which lasts approximately 10 seconds. Once this is completed the embedded control software is initialised and the four communication ports are configured with the last known settings. The system always operates with 8 bit data, no parity and one stop bit.

Port 1 and Port 2 can be configured to output data and to access the Main Menu. Aux 1 can be configured for DVL I/O, raw binary data (HAIN) or duplicate ports 1 or 2. Aux 2 can be configured for GPS I/O, raw binary data (HAIN) or duplicate ports 1 or 2.

All Ports are initially configured with 9600 baud, 8 bit data, no parity and one stop bit.

If any connectors are not in use they MUST be fitted with blanking plugs.

3.1. EMBEDDED SOFTWARE MAIN MENU

Customisation of the MiniPOSNAV's operation is allowed through embedded firmware. The various configuration options allowed in the embedded firmware have been compiled into a logical hierarchical menu structure and are accessible on either Port 1 or Port 2. The menu is accessed through any PC terminal program by pressing the Escape key, this then stops data output and displays the Main Menu.

The Terminal programme must be configured to the correct baud rate to operate correctly. The Factory default the MiniPOS is set to 9600bps 8N1.

The Main Menu provides control of the MiniPOSNAV and allows configuration of the communication ports. Configuration instructions for Ports 1 and 2 are detailed in Section 3.2 and Aux 1 and Aux 2 in Sections 3.6 and 3.7

respectively. The Main Menu also provides options to configure the RLG, to restart the MiniPOSNAV, to set latitude and to use quick modes.
At the top of every menu the POS mode is shown. This allows the user to know what the current state of the unit is:

```
“ CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 “
```

Table 3.1 shows what the mode numbering means.

Mode Number	System State
00	Idle
01	Coarse Stationary Align
02	Fine Stationary Align – Not Complete
03	Fine Stationary Align – Complete
04	Coarse GPS Align
05	Fine GPS Align – Not Complete
06	Fine GPS Align – Complete
07	Doppler Align – Not Complete
08	Doppler Align – Complete
09	Aided Navigation
0A	INS Failure

Table 3.1: Mode Number Information

To retain configuration during power off the “X” command must be executed to write settings to EEPROM. This process will take several seconds during which power must be maintained. If changes do not need to be saved wait for approximately 20 seconds until data reappears, or press q.

During Menu operations the output to data port 2 is disabled.

The Main Menu for the embedded control software is shown in Figure 3.1. Note that in the menu the figure shown to the right of option 4 is the current Latitude setting. This convention is used throughout the sub-menus to allow current settings to be quickly checked.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Menu
============
1       Config Port 1
2       Config Port 2
3       Config Gyro
4       (Re)start Alignment
5       Set Latitude ... +57.19100002
6       Set Longitude ... -2.08230994
7       Config Aux 1
8       Config Aux 2
9       Quick Modes
a       Reset factory defaults
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
```

Figure 3.1: Main Menu

3.2. CONFIGURE PRIMARY PORTS (PORT 1 AND PORT 2)

Options 1 and 2 from the main menu provide access to the configuration menus for Ports 1 and 2 respectively.

The sub-menu for Port 1 is shown in Figure 3.2. Current settings for the Output Format, Baud Rate, Output Rate and serial mode are shown to the right of the corresponding options.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Port 1 Menu
===================
1       Config Output Format ... MiniRLG1
2       Set Baud Rate ... 9600 baud
3       Set Output Rate ... 10 Hz
4       Set RS232/RS422 ... RS232
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
```

Figure 3.2: Config Port 1 Menu

3.2.1. Configuration of Output Format (Port 1 and Port 2)

Option 1 on the Port 1 Menu allows configuration of the output string format. Figure 3.3 shows the output strings that are currently supported on Port 1.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Output Format Port 1 Menu
=================================
1       CDL1
2       CDL2
3       MDL
4       MiniRLG1
5       MiniRLG2
6       MiniPOS1
7       MiniPOS2
8       Tokimec1
9       Tokimec2
a       EM3000
b       SGB
c       DLOG
d       SKR
e       NMEA
f       MRU
g       Kearfott raw binary (HAIN)
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
```

Figure 3.3: Output Format Port 1 Menu

If a new Output Format is selected a confirmation message will be displayed and confirmation of the change is required.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Change RS232 /RS422 on Port 1 - Confirm =
Y(es) Cancel = N(o)
================================================================
```

Figure 3.4: Change Output Format Confirmation

3.2.2. Set Baud Rate (Port 1 and Port 2)

Option 2 on the Port 1 Menu allows configuration of the output Baud Rate. Figure 3.5 shows the Baud Rates supported by Ports 1 and 2. As with the change of Output Format option changes in Baud Rate must be confirmed.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Baud Rate Port 2 Menu
=============================
1          9600 baud
2         19200 baud
3         38400 baud
4         57600 baud
5        115200 baud
BkSp     Up one menu level
Esc      Main Menu
X        Exit Menu and Save
Q        Quit Without Saving
```

Figure 3.5: Output Format Port 1 Menu

3.2.3. Set Output Rate (Port 1 and Port 2)

Option 3 on the Port 1 Menu allows configuration of the Output Rate. Figure 3.6 shows the Output Rates supported by Port 1. Changes in Baud Rate must be confirmed.

Maximum frequency for the data output may be limited when large data strings and/or low baud rates are selected. Exceeding these limits on Port 1 will result in incorrect operation.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Output Rate Port 1 Menu
===============================
1       50 Hz
2       25 Hz
3       10 Hz
4        5 Hz
5        2 Hz
6        1 Hz
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
```

Figure 3.6: Output Rate Port 1 Menu

3.2.4. Set Output Rate (Port 2)

Option 3 on the Port 2 Menu allows configuration of the Output Rate. Figure 3.7 shows the Output Rates supported by Port 2. Changes in Baud Rate must be confirmed.

Port 2 output data is given a lower priority that Port 1 output data. This results in a slower output rate when port 1 is outputting longer data strings.

Maximum frequency for the data output may be limited when large data strings and/or low baud rates are selected in either Port 1 or Port 2. Exceeding these will result in slower output rates than anticipated on Port 2.

```
************************************************
* CDL POS2 Firmware Rev 3.01 - POS mode = 0x00 *
************************************************

MiniPOS Output Rate Port 2 Menu
===============================
1       50 Hz
2       25 Hz
3       10 Hz
4        5 Hz
5        2 Hz
6        1 Hz
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
```

Figure 3.7: Output Rate Port 2 Menu

3.2.5. Set Communication Mode

Option 4 on the Port 1 and Port 2 Menu cycles between the two communication protocols RS232 and RS422.

3.3. CONFIGURE GYRO

Option 3 on the main menu brings up the Config Gyro Menu, Figure 3.8. This menu allows the user to configure the operation mode of the MiniPOSNAV, set up DVL operation and position quality, and also input GPS and DVL lever arms. Any changes made in sub menus from here must be followed by the "update RLG" command, option 5.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Config RLG Menu
=======================
1       Config Alignment
2       Salinity/CEPOS/FORCOM
3       Config GPS Lever Arm
4       Config DVL Lever Arm
5       Update RLG
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving

Info ... when all changes have been made to
Boresight and GPS/DVL Lever Arm
select Update RLG to save the settings. The new
settings to take effect on
the next power-down/power-up cycle.
```

Figure 3.8: Config Gyro Menu

3.3.1. Config Alignment

Option 1 on the Config Gyro Menu brings up the Config Alignment Menu. The alignment mode can be set as either 1,2 or 3 and the last setting is stored during power down in memory. Text “Selected” is shown next to the current mode. Depending on current alignment mode, Options 4,5 and 6 can be chosen simultaneous but selection will return to default on restart.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Config Alignment Menu
=============================
1       Stationary Alignment ... Selected
2       Stationary Alignment with GPS ...
3       Moving base Alignment with GPS ...
4       Enable GPS aiding ...
5       Enable DVL aiding ...
6       Input Lat/Lon Valid ... True
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
```

Figure 3.9: Config Alignment Menu

3.3.2. Salinity CEPOS FORCOM Menu

The Salinity/CEPOS/FORCOM menus is shown in figure 3.10.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Salinity/CEPOS/FORCOM Menu
==================================
1       Bottom Track Mode ... Selected
2       Water Track/Bottom Track Mode ...
3       Autonomous Mode ...
4       Water Track Mode ...
5       Forced Position Fix ... True
6       Salinity ... 0.00 ppt
7       Position Quality ... 100.00 m
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
```

Figure 3.10: Salinity/CEPOS/FORCOM Menu

Options 1 to 4 are DVL tracking options. The factory default for this is “Bottom Track Mode”. More information on which mode to use and the operational use of the DVL is available in the RDI DVL manual.

Option 5, Force Position Fix command, over rides the Kalman Filter observation rejection logic and forces processing of VALID INPUT LAT and

INPUT LON as observations to the Kalman filter. This is used when the unit is stationary and at a known location.

Option 6, Salinity, is used to enter the current water salinity. This only important when the MiniPOSNAV is being used with the RDI DVL.

Option 7, position quality, indicates the quality of the input position. This must be in the range 0 – 327 m.

3.3.3. Config GPS Lever Arm Menu

Option 4 on the Config Gyro Menu initialises the Config GPS Lever Arm Menu. Through this menu the x,y and z offsets are entered in whole centimetres. Offsets should be accurate to the nearest 5cm

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Config GPS Lever Arm Menu
=================================
1       x Offset ...
2       y Offset ...
3       z Offset ...
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
```

Figure 3.11: Config GPS Lever Arm Menu

Figure 3.11 shows the offset data entry screen.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

Enter Offset - hit enter when done, hit c to
cancel
================================================
```

Figure 3.12: Offset Menu

3.3.4. Config DVL Lever Arm Menu

As with the GPS Lever Arm offsets, the DVL Lever Arm Offsets are entered in whole centimetres. Offsets should be accurate to the nearest 25cm.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Config DVL Lever Arm Menu
=================================
1       x Offset ...
2       y Offset ...
3       z Offset ...
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
```

Figure 3.13: Config DVL Lever Arm Menu

3.3.5. Update RLG Command

Option 5 sends configuration data directly to the Kearfott EPROM but will not be effective until power restart.

3.4. RESTART ALIGNMENT

The Kearfott RLG can be restarted through option 3 on the main menu. This will generate a confirmation prompt see Figure 3.13. On restart the system will again require a 10 minute run-up period but will generally be within 1 degree of accuracy after 3 minutes

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS (Re)start Alignment - Confirm = Y(es)
Cancel = N(o)
================================================
```

Figure 3.14: Confirm MiniPOS Restart

3.5. SET LATITUDE

The MiniPOSNAV System requires latitude positioning accurate to within one degree to north seek correctly. Latitudes in the northern hemisphere are entered as positive values and latitudes in the southern hemisphere are entered as negative values.

Incorrect latitude data will result in improper operation

Latitude can be inputted in three different formats.

Degrees and fractions of a degree (to 5 decimal places): 57.16671
Degrees. minutes and fractions of minutes: 57 9.23
Degrees, minutes and seconds: 57 9 15

3.6. CONFIGURE AUXILIARY PORT 1

Auxiliary Port 1 can be configured as a DVL port, to output the Raw Kearfott data or to duplicate the data output on either the primary or secondary port. Figure 3.14 shows the configuration options for Aux 1 with the system set to DVL and RS232 communication.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Config Aux 1 Menu
=========================
1       DVL ... selected
2       Raw data output
3       Duplicate primary port
4       Duplicate secondary port
5       Set RS232/RS422 ... RS232
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
============================
```

Figure 3.15: Configure Auxiliary Port 1

3.7. CONFIGURE AUXILIARY PORT 2

Auxiliary Port 2 can be configured as a GPS Port, to output the Raw Kearfott data or to duplicate the data output on either the primary or secondary port.

The GPS data must include the following strings: NMEA GGA, VTG and GSA. If these strings are not available in the GPS input the MiniPOSNAV will not process the data. A PPS signal is also required.

The GPS data can be either differential or non-differential but must have minimal filtering applied to the position and velocity information. The GPS input must be 9600 baud, 8 bit data, no parity and one stop bit.

A PPS input must be supplied to the system with the GPS data see Section 2.3.3 for connection details.

Figure 3.15 shows the configuration options for Aux 2 with the system set to GPS and RS232 communication.

```
************************************************
* CDL POS2 Firmware Rev 3.xx - POS mode = 0x00 *
************************************************

MiniPOS Config Aux 2 Menu
=========================
1       GPS ... selected
2       Raw data output
3       Duplicate primary port
4       Duplicate secondary port
5       Set RS232/RS422 ... RS232
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
```

Figure 3.16: Configure Auxiliary Port 2

3.8. QUICK MODES

```
************************************************
* CDL POS2 Firmware Rev 3.01 - POS mode = 0x00 *
************************************************

Quick Modes can only be set when alignment is
complete
Hit enter to continue
```

Figure 3.17: Alignment not Complete - Quick Modes

```
************************************************
* CDL POS2 Firmware Rev 3.01 - POS mode = 0x09 *
************************************************

MiniPOS Quick Modes Menu
========================
1       Position Fix Mode
2       Free Flight Mode
3       Zupt Mode
BkSp    Up one menu level
Esc     Main Menu
X       Exit Menu and Save
Q       Quit Without Saving
```

Figure 3.17: Alignment Complete - Quick Modes

Option 1 – Position Fix Mode
In this mode the unit must be at the location input through the Lat and Lon values and be stationary. This mode forces the unit to that position and also forces a zero velocity update. This is used in inertial navigation when returning to a known reference point set in the Lat and Long values.

Option 2 – Free Flight Mode
In this mode the unit is allowed to compute position using calculated velocities, and if connected, any aiding inputs. If there is not aiding to the unit it will start to drift after a period of time. However, if a calibrated DVL is being used as aiding then it will accurately output the unit's current position.

Option 3 – Zupt Mode
This mode is used when the unit is completely stationary, but not at the input Lat and Lon. This is used to help improve accuracy by letting the MiniPOS remove noise from its measured accelerations and velocities.

OPERATIONAL GUIDELINES

4.0. INTRODUCTION

In order to get the best performance from your MiniPOSNAV it is important to have the unit set up correctly for the task which you are performing. The operation of the unit can be split into two sections, the alignment phase and operational phase.

4.0.1. Alignment Phase

The MiniPOSNAV has its alignment time set to 30 minutes! The unit will not have a usable heading until this time has elapsed and it has entered the aided navigation mode (See section 3.1 for mode codes)

The primary consideration during the alignment phase is whether or not the unit is being aligned whilst in transit or stationary at a worksite. If the unit is stationary at a worksite, either of the following methods can be used. If the unit is in transit, GPS aided alignment should be used

Normal vessel wave motion is acceptable during a stationary alignment

To aid the alignment process, particularly at higher latitudes, one or more 90 degree rotations can be performed after the unit has reached mode 09 (aided navigation).

When the MiniPOSNAV is being used to give position it is advised the after half an hour of sitting stationary the unit it rotated 90 degrees then allowed to sit stationary for a further 30 minutes.

4.0.1.1. Stationary alignment

This is the factory default. The unit uses the user-supplied latitude stored in EEPROM and assumes that the unit is stationary. Note that normal vessel wave motion is acceptable. If a GPS input is available, it can be used by selecting option 2, ‘Stationary alignment with GPS’ in the ‘Config alignment’ menu. See section 3.3.1

4.0.1.2. Stationary alignment with GPS

When doing an alignment with GPS it is necessary for the MiniPOSNAV to “see” some motion in the GPS data to allow it to align properly. In situations where the vessel is near stationary a stationary alignment with GPS will need to be done rather than a Moving Base Alignment.

The correct GPS offsets must be added as described in section 3.3.2

4.0.1.3. Moving base alignment

If the unit is to be aligned whilst moving, i.e. on board a steaming vessel, the 'Moving base alignment with GPS' option should be selected. Again, this can be found in the 'Config alignment' menu. See section 3.3.1

The correct GPS offsets must be added as described in section 3.3.2

4.0.2. Operational Phase

Once the unit has finished the alignment phase, the type of task being performed and the availability of GPS or DVL aiding will determine which settings should be used.

Flag settings set in the 'Config Alignment Menu' (figure 3.9, items 4,5 and 6) are not saved to EEPROM and so are not remembered after a power cycle.

4.0.2.1. Operations in a restricted area

If the unit is to be used within a small restricted area, for example on an ROV deployed from a vessel on DP, or from a rig or platform, the choice of settings is less important. Ideally, the unit will have DVL aiding available, the 'Enable DVL aiding' flag should be set to 'True', and the Enable GPS aiding' and 'Input lat/lon valid' flags should be cleared.

If a DVL is not available, then either GPS aiding should be supplied, the 'Enable GPS aiding' flag set to 'True' and the 'Input lat/lon valid' flag cleared, or the unit should be supplied with a latitude correct to within ±1º and the 'Input lat/lon valid' flag should be set to 'True'.

4.0.2.2. Operations over a wide area

If the unit is to be used over a wide area, for example on an ROV performing long survey lines or performing a pipeline survey, the following settings should be used. Ideally, the unit will have DVL aiding available, the 'Enable DVL aiding' flag should be se to 'True', and the 'Enable GPS aiding' and 'Input lat/lon valid' flags should be cleared.

If a DVL is not available, the 'Input lat/lon valid' flag should be cleared and the 'Enable GPS aiding' flag should be cleared. In periods when the ROV is at a fixed location the latitude should be updated and the 'Input lat/lon valid' flag should be set to true. Before the ROV moves off the 'Input lat/lon valid' flag should be cleared again.

4.0.2.3. Surface vessel use

If the unit is mounted on a moving surface vessel, ideally GPS aiding will be available and the 'Enable GPS aiding' flag should be set and the 'Input lat/lon valid' flag should be cleared.

If GPS is not available then the ‘Input lat/lon valid’ flag should be set to ‘False’. In periods when the vessel is at a fixed location the latitude should be updated and the ‘Input lat/lon valid’ flag should be set to ‘True’. The correct GPS offsets must be added as described in section 3.3.2

DVL aiding can be used, especially if GPS aiding is not available. The correct DVL offsets must be added as described in section 3.3.3 and the ‘Enable DVL aiding’ flag should be set to ‘True’. Again, in periods when the vessel is at a fixed location the latitude should be updated and the ‘Input lat/lon valid’ flag should be set to ‘True’.

5.0. DATA FORMATS

The MiniPOSNAV is able to output a range of industry standard ASCII and binary strings to enable it to be interfaced to other systems.

These string outputs are listed below and are changed via the menu system, see Section 3.2.1.

Figures 4.1 shows the sign convention for the MiniRLG 1, MiniRLG2, MiniPOS 1 and MiniPOS 2 strings. Figure 4.2 shows the sign convention for the CDL 1, CDL 2, MDL, Digilog, Tokimec, EM3000 strings.

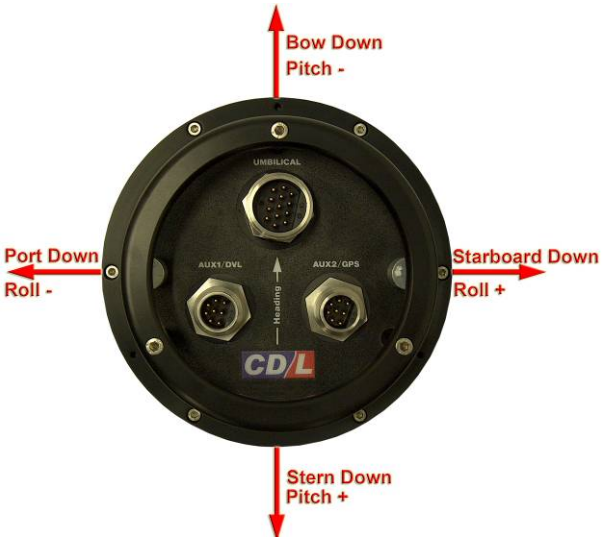


Figure 5.1: Pitch and roll convention (MiniRLG)

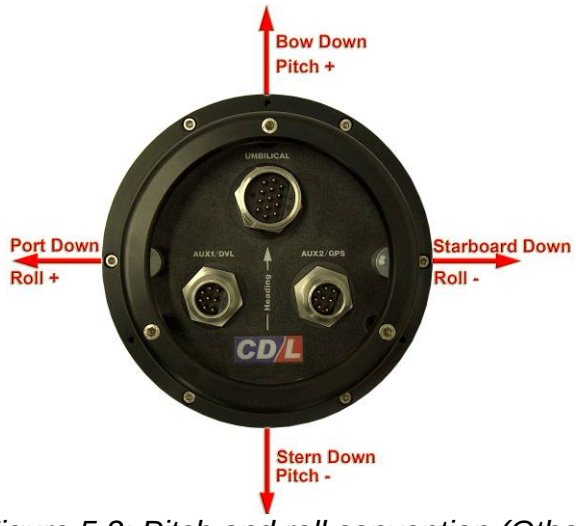


Figure 5.2: Pitch and roll convention (Other)

Where <CR><LF> is shown this refers to ASCII characters 0Dh and 0Ah respectively.

5.0.1. CDL1 Format

Haaa.a**P**bccc.cc**R**deee.ee**T**ff.f**D**gggg.gg**B**hh.h**A**ii**W**jj**LN**kk**Fl<CR><LF>**

Where:

aaa.a	is Heading in degrees aaa(deg).a(decimal)
bccc.cc	is Pitch in degrees ccc(deg).cc(decimal) b [+] bow down / [-] stern down see figure 5.2
deee.ee	is Roll in degrees eee(deg).ee(decimal) d [+] port down / [-] starboard down see figure 5.2
ff.f	Not used
gggg.gg	Only available in POS units
hh.h	Not used
ii	Not used
jj	Not used
kk	Latitude
l	Fault flag

Number of characters in the string (including carriage return line feed): 54

5.0.2. CDL 2 Format

Haaaa**P**bccccc**R**deeeee**T**fff**D**ggggggg**B**hhh**A**ii**W**jj**LN**kk**Fl<CR><LF>**

Where:

aaaa	is Heading in degrees aaa(deg).a(decimal)
bccccc	is Pitch in degrees ccc(deg).cc(decimal) b [+] bow down / [-] stern down see figure 5.2
deeeee	is Roll in degrees eee(deg).ee(decimal) d [+] port down / [-] starboard down see figure 5.2
fff	Not used
ggggggg	Only available in POS units
hhh	Not used
ii	Not used
jj	Not used
kk	Latitude
l	Fault flag

Number of characters in the string (including carriage return line feed): 48

5.0.3. MDL Format

Haaaa**P**bcccc**R**deeee**<CR><LF>**

Where:

aaaa	is Heading in degrees aaa(deg).a(decimal)
bcccc	is Pitch in degrees cc(deg).cc(decimal) b [+] bow down / [-] stern down see figure 5.2
deeee	is Roll in degrees ee(deg).ee(decimal) d [+] port down / [-] starboard down see figure 5.2

Number of characters in the string (including carriage return line feed): 19

5.0.4. MiniRLG1

Haaa.aa**P**bcc.ccc**R**deee.eee**M**fGGHHII**W**jjjj.jj**U**kk.k**<CR><LF>**

Where:

aaa.aa	is Heading in degrees aaa(deg).aa(decimal)
bcc.ccc	is Pitch in degrees cc(deg).ccc(decimal) b [-] bow down / [+] stern down see figure 5.1
deee.eee	is Roll in degrees eee(deg).eee(decimal) d [-] port down / [+] starboard down see figure 5.1
f	is status digit see section 4.1 for details
GG	is the navigation monitor in ASCII hex
HH	is the validity byte in ASCII hex
II	is the mode byte in ASCII hex
jjjj.jj	Only available in POS units
kk.k	Not used

Number of characters in the string (including carriage return line feed): 47

5.0.5. MiniRLG2

Haaaaa**P**bccccc**R**deeeeee**M**fGGHHII**W**jjjjjj**U**kkk**<CR><LF>**

Where:

aaaaa	is Heading in degrees aaa(deg).aa(decimal)
bccccc	is Pitch in degrees cc(deg).ccc(decimal) b [-] bow down / [+] stern down see figure 5.1
deeeeee	is Roll in degrees eee(deg).eee(decimal) d [-] port down / [+] starboard down see figure 5.1
f	is status digit see section 4.1 for details
GG	is the navigation monitor in ASCII hex
HH	is the validity byte in ASCII hex
II	is the mode byte in ASCII hex
jjjj.jj	Only available in POS units
kk.k	Not used

Number of characters in the string (including carriage return line feed): 42

5.0.6. Tokimec 1 Format

$PTVF,abbbbP,cddddR,eee.eT,fgg.gPR,hii.iRR,jkk.kAR,lmm.mN,yyyMD,zzzz
AL<CR><LF>
Where:

abbbb	is Pitch in degrees bb(deg).bb(min) a[-] bow up / [space] bow down
cdddd	is Roll in degrees dd(deg).dd(min) c[-] port up / [space] port down
eee.e	is Heading in degrees
fgg.g	is the rate of pitch in degrees/sec f[-] bow up / [space] bow down
hii.i	is the rate of roll in degrees/sec h[-] port up / [space] port down
jkk.k	is the rate of turn in degrees/sec j[-] CCW / [space] CW
lmm.m	is the vessel speed in Knots l[-] is astern / [space] ahead
yyy	not used
zzzz	status

Number of characters in the string (including carriage return line feed): 72

5.0.7. Tokimec 2 Format

$PTVF,abbbbP,cddddR,eee.eT,fgg.gPR,hii.iRR,jkk.kAR,lmm.mN,yyyMD,zzzz
AL*nn<CR><LF>
Where:

abbbb	is Pitch in degrees bb(deg).bb(min) a[-] bow up / [space] bow down
cdddd	is Roll in degrees dd(deg).dd(min) c[-] port up / [space] port down
eee.e	is Heading in degrees
fgg.g	is the rate of pitch in degrees/sec f[-] bow up / [space] bow down
hii.i	is the rate of roll in degrees/sec h[-] port up / [space] port down
jkk.k	is the rate of turn in degrees/sec j[-] CCW / [space] CW
lmm.m	is the vessel speed in Knots l[-] is astern / [space] ahead
yyy	not used
zzzz	status
hh	checksum of all in string but $ and * characters

Number of characters in the string (including carriage return line feed): 75

5.0.8. EM3000 Format

The Simrad EM3000 format consists of a fixed length message using single byte unsigned, 2-byte unsigned and 2-byte twos-complement integer data elements. For the 2-byte elements, the least significant byte is transmitted first.

Status	**Header**	**Roll**		**Pitch**		**Not Used**		**Heading**	
A0	90	LSB	MSB	LSB	MSB	00	00	LSB	MSB

Where:

Element	Scaling	Format	Size	Value
Status		Unsigned	1 Byte	90h,91h,A0h
Header		Unsigned	1 Byte	90h
Roll	0.01 degrees	2's compliment	2 Bytes	-999 to 999
Pitch	0.01 degrees	2's compliment	2 Bytes	-999 to 999
Heading	0.01 degrees	Unsigned	2 Bytes	0 to 35999

Table 5.1: EM3000 Fields

Roll is positive with port side up. Pitch is positive with bow up. Status Byte indicates the following:

Value	Status
90h	Normal
91h	Reduced Performance
A0h	Invalid Data

Number of bytes in the string: 5

5.0.9. SGB Format

aaaa**<CR><LF>**

where:

aaaa	is Heading in Degrees aaa(deg).a(decimal)

Number of characters in the string (including carriage return line feed): 6

5.0.10. DLOG Format

Haaaa**P**bcccc**R**deeeef**<CR><LF>**

Where:

aaaa	is Heading in degrees
bcccc	is Pitch in degrees b [+] bow down / [-] stern down see figure 5.2
deeee	is Roll in degrees d [+] port down / [-] starboard down see figure 5.2
f	final flag: E Exact heading available S Gyro settling

Number of characters in the string (including carriage return line feed): 20

5.0.11. SKR Format

4 characters (most significant first)

UART encoded with address encoding in bits 4 and 5 and BCD digit in bits 0-3

Bits 6 and 7 always zero

00110011=Hundreds digit 3

00100101=Tens digit 5

00010111=Units digit 7

00000010=Tenths digit 2

Heading 357.2 degrees

Number of characters in the string (including carriage return line feed): 4

5.0.12. NMEA HEHDT Format

$HEHDT,aaa.a,**T<CR><LF>**

Where:

aaa.a is Heading in degrees
aaa(deg).a(decimal)

Number of characters in the string (including carriage return line feed): 16

5.0.13. MiniPos1 Format

*AAAAAAAA**%**BBBBBBBB**;**CCCCCCCC**:**DDDD**H**eee.ee**P**fgg.ggg**R**hiii.iii**M**jKK
LLMM**W**nnnn.nn**U**oo.o**<CR><LF>**

Where:

AAAAAAAA	is System Latitude in degrees $\pm 180/2^{-31}$ degrees in ASCII Hex, 4 Bytes
BBBBBBBB	is System Longitude in degrees $\pm 180/2^{-31}$ degrees in ASCII Hex, 4 Bytes
CCCCCCCC	System depth in meters $\pm 2^{-31}$ 0.1m in ASCII Hex, 4 Bytes
DDDD	DVL Altitude in meters $0\text{-}2^{16}$ 0.1m in ASCII Hex, 2 Bytes
eee.ee	is Heading in degrees eee(deg).ee(decimal)
fgg.ggg	is Pitch in degrees gg(deg).ggg(decimal) f [-] bow down / [+] stern down see figure 5.1
hiii.iii	is Roll in degrees iii(deg).iii(decimal) h [-] port down / [+] starboard down see figure 5.1
j	is status digit see section 4.1 for details
KK	is the navigation monitor in ASCII hex
LL	is the validity byte in ASCII hex
MM	is the mode control logicals byte in ASCII hex
nnnn.nn	Pressure Depth Only available where a depth sensor is fitted
oo.o	Not used

Number of characters in the string (including carriage return line feed): 79

5.0.14. MiniPos2 Format

*****abb.bbbbbbb**%**cddd.ddddddd**;**effff.f**:**ggg.gg**H**hhh.hh**P**ijj.jjj**R**klll.lll**M**mNNOOPP
Wqqqq.qq**U**rr.r**<CR><LF>**

Where:

abb.bbbbbbb	is System Latitude in degrees a [-] is the southern hemisphere / [+] is the northern hemisphere
cddd.ddddddd	is System Longitude in degrees c [-] is the western hemisphere / [+] is the eastern hemisphere
effff.f	System depth in meters e [+] is below actual sea level / [-] is above sea level
gggg.gg	DVL Altitude in meters
hhh.hh	is Heading in degrees eee(deg).ee(decimal)
ijj.jjj	is Pitch in degrees gg(deg).ggg(decimal) f [-] bow down / [+] stern down see figure 5.1
klll.lll	is Roll in degrees iii(deg).iii(decimal) h [-] port down / [+] starboard down see figure 5.1
m	is status digit see section 4.1 for details
NN	is the navigation monitor in ASCII hex
OO	is the validity byte in ASCII hex
PP	is the mode control logicals byte in ASCII hex
qqqq.qq	Pressure Depth Only available where a depth sensor is fitted
rr.r	Not used

Number of characters in the string (including carriage return line feed): 87

5.1. STATUS FLAG

The MiniPOS 2 outputs a status flag in some of the strings. This flag has the following meanings.

Status Flag	Meaning
0	Idle
1	Coarse stationary align
2	Fine stationary align – not complete
3	Fine stationary align – complete
4	Coarse GPS align
5	Fine GPS align – not complete
6	Fine GPS align – complete
9	Aided navigation
A	System failure

Table 5.2: Status flag

5.2. LATENCY

The latency between movement of the RLG2 and that movement being displayed in the raw output from the inertial sensor is 5ms.

The Latency between a movement of the RLG2 and outputting heading on Port 1 is 9.8ms

6.0. MAINTENANCE OF EQUIPMENT

The CDL MiniPOSNAV is a self contained system which requires no regular maintenance other than a yearly calibration check (see Section 5.3).

All casings should be checked regularly for signs of damage.

All connections on the surface and subsea units should be checked regularly for fouling, bent pins or signs of damage.

6.1. CHECKOUT PROCEDURE

1. Connect the MiniPOSNAV to the RS232 port on a PC
2. Connect a suitable power supply to the MiniPOSNAV.
3. Examine the connections and ensure they are secure
4. Power up the MiniPOSNAV.
5. The MiniPOSNAV unit should now begin to dither (a high pitched humming sound can be heard).
6. Heading should appear within 2 minutes when coarse stationary alignment is complete.

6.2. ANNUAL CALIBRATION

This equipment requires an annual calibration to be carried out at the CDL base (or approved authorised distributor). The equipment will be calibrated and fully function checked to ensure continued reliable operation. When returned, the equipment will carry both function test and calibration check certificates. Contact CDL for current calibration charges for this equipment. The turn-around time for this service is normally 1-2 days.

SPECIFICATIONS

7.0. PERFORMANCE

Heading accuracy	±0.169	° up to 65º latitude
Pitch and Roll	0.028	°RMS
Angle random walk	0.02	°/root hour
Bias Repeatability	0.1	°/hour
Scale Factor Repeatability	75	PPM
Axis Alignment	20	Arc-Second
Settling Time	10	Minutes
Speed	0 to 90	Knots

7.1. ELECTRICAL AND DIGITAL

Operating Power	35W	Max
AC Voltage	100 – 240	VAC
DC Voltage	18-30	VDC
Digital Interface	RS232 or RS422 selectable	
Baud Rate	9600 to 115200	bps
Data Output Rate	upto 50	Hz

7.2. PHYSICAL

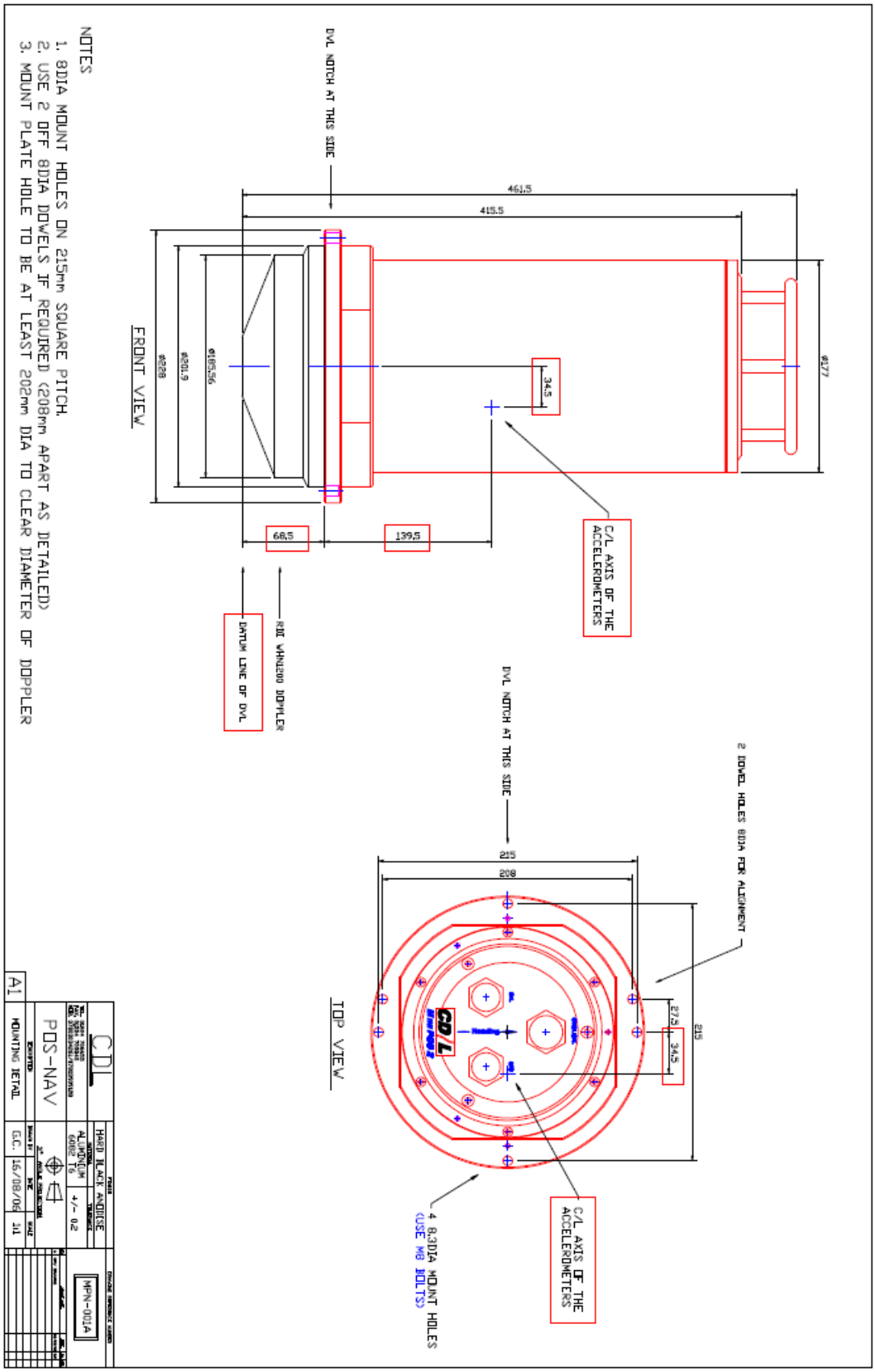
Standard Depth Rating	3000	Meters
Sub Sea Unit Dimensions	ø177 x 268	mm
In air weight (excluding cable)	9.8	Kg
In water weight (excluding cable)	2.5	Kg
Finish	Hard anodised aluminium	

7.3. ENVIRONMENTAL

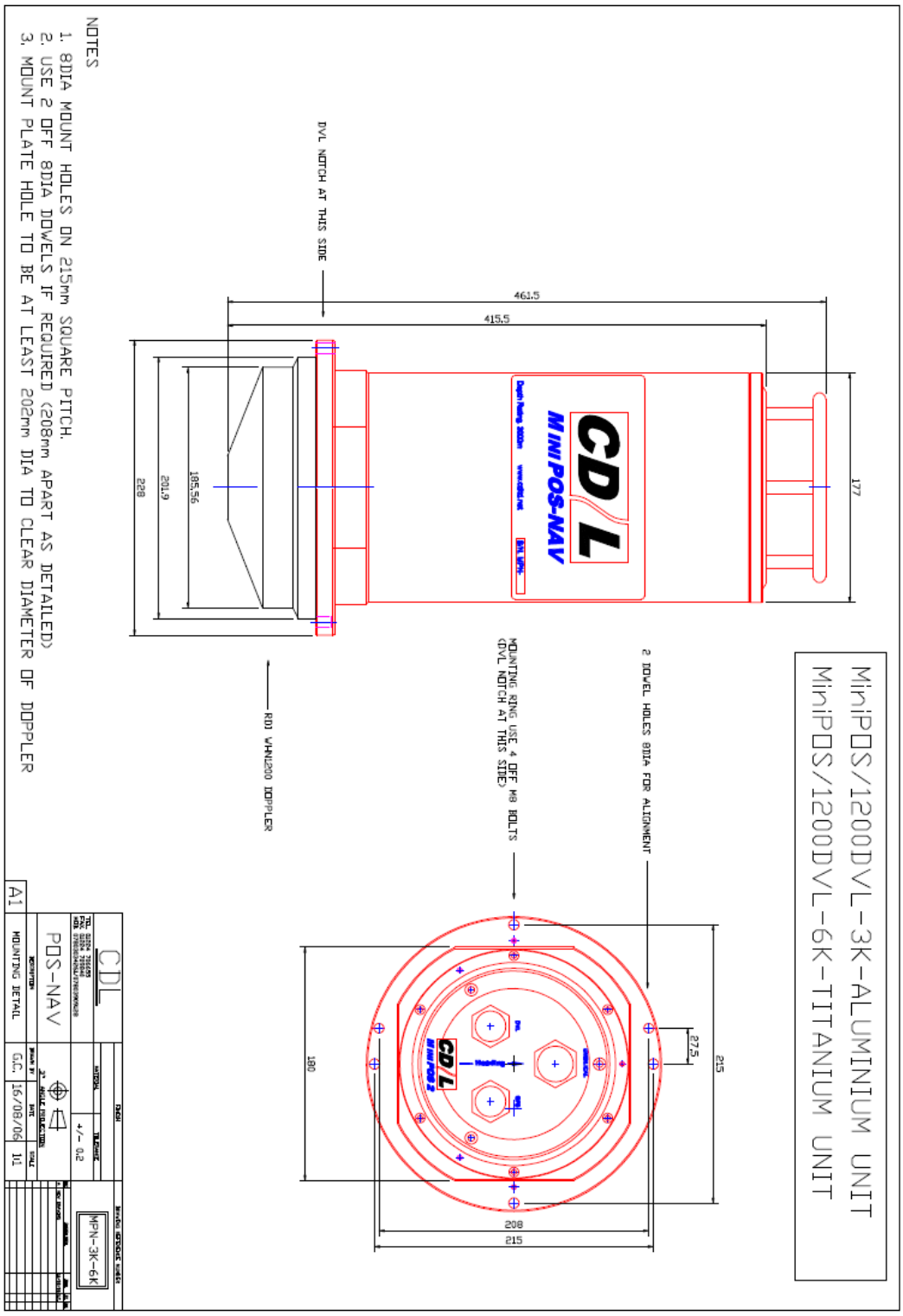
Operational Life	>19,000	hours
Random vibration	4.13	G RMS
Shock	30	G 11ms half sine pulse
Temperature	-40 to + 60	°C

TECHNICAL DRAWINGS

8.0. MINIPOSNAV TECHNICAL DRAWING



8.1. 3000M VERSION



GPS INTERFACE

9.0. INTRODUCTION

To enable the MiniPOSNAV to use GPS as an aiding input the GPS MUST have the following:

A 1pps signal
A GGA string output
A VTG string output
A GSA sting output

The GPS input to the MiniPOSNAV is currently set at 9600 bps, 8 data bits, no parity and 1 stop bit.

In addition to this to allow the unit to align the GPS input should have enough satellites/information to give a figure of merit of above 5 with a 3D solution.

The unit will NOT align if the system velocities and/or position diverge drastically from those of the GPS.

A GPS receiver with minimal filtering on the outputs should be used.

To enable as many GPS receivers to be used as possible the MiniPOSNAV has a dedicated GPS processor on it. This formats the GPS strings and, if necessary, adds a checksum to the strings for input into the IMU.

Figure 9.1 and 9.2 give examples of tested GPS strings.

```
$GPGGA,130953.00,5711.45867,N,00204.92652,W,1,06,3,22.39,M,48,M,-1.0,0000
$GPVTG,148.0,T,,,0.01,N,,
$GPGSA,A,3,27,13,04,20,23,24,,,,,,,4,3,3
```

Figure 9.1: GPS strings with no checksum

```
$GPGGA,000359.0,5711.4631956,N,00205.0128725,W,1,08,1.3,19.75,M,,,,*16
$GPVTG,82.062,T,82.062,M,0.0103019,N,0.019079,K*72
$GPGSA,M,3,10,27,29,21,17,24,26,08,,,,,2.2,1.3,1.7*3A
```

Figure 9.2: GPS strings with a checksum

The following sections describe the fields in the GPS strings which are used.

9.1. GGA STRING

Name	Data Type	Units	Field	Note
UTC	CHAR	Hr-Min-Sec	1	Not Used
Latitude	CHAR	Deg-Min	2	
Latitude Direction	CHAR	n/a	3	N = +, S = -
Longitude	CHAR	Deg-Min	4	
Longitude Direction	CHAR	n/a	5	E = +, W = -
GPS Quality 0 = Invalid 1 = SPS Mode 2 = DGPS Mode 3 = PPS Mode	CHAR	n/a	6	
Number of Satellites	CHAR	n/a	7	00-12
HDOP	CHAR	n/a	8	Not Used
Altitude (Mean Sea Level)	CHAR	Meters	9	
Altitude Units	CHAR	n/a	10	Not Used
Geoid Separation	CHAR	n/a	11	Not Used
Geoid Separation Units	CHAR	n/a	12	Not Used
Data Age	CHAR	n/a	13	Not Used
Station ID	CHAR	n/a	14	Not Used

Table 9.1: GGA String

9.2. VTG STRING

Name	Data Type	Units	Field	Note
Manual/Auto Mode	CHAR	n/a	1	Not Used
Fix Mode 1 = No Fix 2 = 2D Fix 3 = 3D Fix	CHAR	n/a	2	
Satellite ID's	CHAR(12)	n/a	3-14	
PDOP	CHAR	n/a	15	Not Used
Expected Horiz DOP	CHAR	n/a	16	
Expected Vert DOP	CHAR	n/a	17	

Table 9.2: VTG String

9.3. GSA STRING

Name	Data Type	Units	Field	Note
True Course	CHAR	Deg	1	
True Course Units	CHAR	n/a	2	Not Used
Magnetic Course	CHAR	Deg	3	Not Used
Magnetic Course Units	CHAR	n/a	4	Not Used
Speed N	CHAR	Knots	5	
Speed N Units	CHAR	n/a	6	Not Used
Speed K	CHAR	Kmph	7	
Speed K Units	CHAR	n/a	8	Not Used

Table 9.3: GSA String

9.4. USEFUL INFORMATION ASSOCIATED WITH GPS

9.4.1. UTC

UTC – Coordinated Universal Time

UTC is a high-precision atomic time standard which approximately tracks Universal Time (UT). It is the basis for legal civil time all over the Earth. Time zones around the world are expressed as positive and negative offsets from UTC

As a time scale, UTC divides time up into days, and days into hours, minutes, and seconds. Days are conventionally identified using the Gregorian calendar, but Julian Day Numbers can also be used. Each day contains 24 hours and each hour contains 60 minutes, but the number of seconds in a minute is slightly variable.

Most UTC days contain exactly 86400 seconds, with exactly 60 seconds in each minute. Occasionally the last minute of a day has 59 or 61 seconds, or prior to 1972 other lengths. These irregular days have 86399 seconds, 86401 seconds, or some other number of seconds. The irregular day lengths mean that Julian Dates don't work properly with UTC. The intercalary seconds are known as "leap seconds".

Information obtained from: http://en.wikipedia.org/wiki/Coordinated_Universal_Time

9.4.2. DOP

DOP - Dilution of precision

DOP is a GPS term used in geomatics engineering to describe the geometric strength of satellite configuration. When visible satellites are close together in the sky, the geometry is said to be weak and the DOP value is high; when far apart, the geometry is strong and the DOP value is low.

Factors that affect the DOP are, besides the satellite orbits, the presence of obstructions which make it impossible to use satellites in certain sectors of the local sky. Especially in urban measurements, this may be limiting.

We speak of HDOP, VDOP, PDOP and TDOP respectively, for Horizontal, Vertical, Position (3-D) and Time Dilution of Precision. These quantities follow mathematically from the positions of the useable satellites on the local sky. GPS receivers allow the display of these positions ("skyplot") as well as the DOP values.

Information obtained from: http://en.wikipedia.org/wiki/Dilution_of_precision_(GPS)

9.4.3. Geoid Separation

Geoid separation is the distance between the geoid and ellipsoid. Where the ellipsoid is a mathematical model of Earth formed by rotating an ellipse about its minor axis. The geoid is a gravitational equipotential surface that approximates mean sea level.

Information obtained from: http://www.geoplace.com/uploads/featurearticle/0501sgi.asp

DVL INTERFACE AND SETUP

10.0. INTRODUCTION

The MiniPOSNAV has been interfaced to an RDI Workhorse Navigator DVL. The DVL provides the MiniPOSNAV IMU with additional velocity information that aids the unit, improving drift rates and increasing accuracies.

10.1. INTERFACE TO THE DVL

The MiniPOSNAV has been interfaced to an RDI Workhorse Navigator DVL. For correct operation beams 2 and 3 of the DVL face forward. Figure 10.1 shows the relation ship between the alignment notch and the beam numbers.

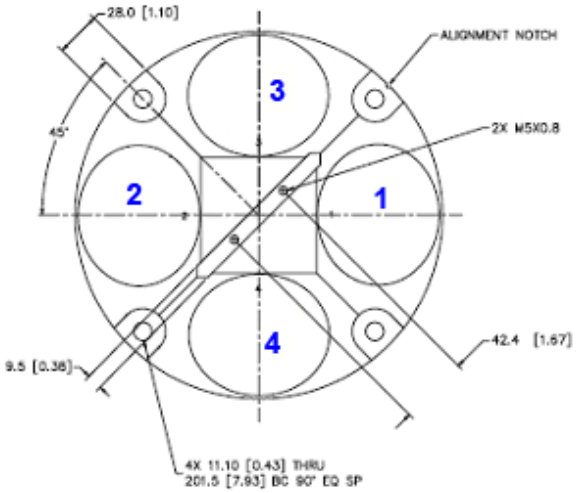


Figure 10.2: DVL Beam Numbers

The DVL can be configured, via and internal switch, to be either RS232 or RS422, usually it is supplied in RS232 mode. The MiniPOSNAV can accept DVL data in either RS232 or RS422 but this MUST be configured through the menu system, see section 3.6, before the DVL is connected to the MiniPOSNAV.

10.2. IMU DVL COMMUNICATIONS

The MiniPOSNAV initiates communications as follows:

1) Immediately following system power-up and start-up processing, the MiniPOSNAV establishes communication with the DVL via a "break" command (via a discrete that is mechanized to hold the RS-422 voltage in a logic "0" state). This is the "wake-up" command to the DVL, which puts it into an I/O mode (the DVL I/O mode suspends DVL ping and velocity data acquisition, and allows configuration and mode commands to be entered with echo verification).

2) The DVL responds to the "wake-up" with an ASCII ">" output indicating it is ready to receive input commands. When this has been received by the MiniPOSNAV it transmits a "CR0" command that restores configuration/mode settings preset in EEPROM to RAM.

3) Following the configuration command sequence, the DVL clock used to time-tag pings is initialized (synchronized) to the MiniPOSNAV internal time, including hour, minute, second. Fractional second input is not provided (ping time from DVL does include .01 sec resolution). The internal time used to time tag the received DVL data must be set to an even second at the time the DVL clock synch command is sent. The 50Hz counter for IMU Kalman timing can be reset to zero and zero sent to the DVL when re-synching. The DVL echo of the input time is verified and if a discrepancy detected, the time input is commanded again.

4) The DVL is maintained in the I/O mode (no pinging) until ‘enable DVL aiding’ has been set to ‘True’, see section 3.3.1. The DVL is then commanded into "autonomous" mode. In this mode the DVL suspends Command I/O, pings at a variable rate determined by the DVL for maximum data under current conditions, and outputs velocity data messages without request at a rate consistent with the ping rate. This mode of operation is commanded via a "CS" command (start pinging) and maintained except for occasional periodic re-synchronization of the DVL clock. The DVL is commanded out of this mode via a "break" if ‘enable DVL aiding’ is set to false. To command DVL to "Autonomous mode" requires transmitting to the DVL a "BK2" command.

5) The DVL time is re-synched to the IMU once every 30 minutes. This requires suspension of the "autonomous" mode and commanding the DVL into I/O mode via a "break" command, with the DVL response of a ">" character. When the IMU has received this response, it issues a clock reset command per the initial clock synch scenario. The DVL is commanded back to the operational "autonomous" mode immediately following the DVL re-synch echo unless a discrepancy is detected in which case a retry is performed.

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