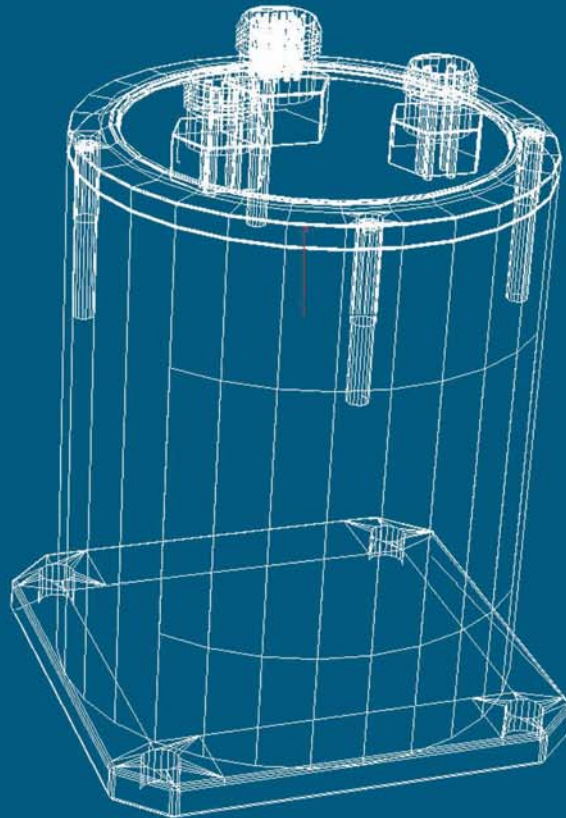




TOGS

Technical Manual



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1 Table of Contents

| | | |
|----------|-------------------------------------|----------|
| 1 | TABLE OF CONTENTS | 2 |
| 2 | INTRODUCTION | 4 |
| 2.1 | WARNINGS AND NOTES..... | 4 |
| 2.2 | GENERAL DESCRIPTION..... | 4 |
| 2.2.1 | SYSTEM OVERVIEW | 4 |
| 2.2.2 | WARRANTY | 5 |
| 3 | INSTALLATION | 6 |
| 3.1 | SYSTEM CONTENTS..... | 6 |
| 3.2 | UNPACKING AND INSPECTION..... | 6 |
| 3.3 | PHYSICAL INSTALLATION | 6 |
| 3.4 | SYSTEM ORIENTATION | 7 |
| 3.5 | ELECTRICAL INSTALLATION..... | 8 |
| 3.5.1 | UMBILICAL CONNECTOR | 8 |
| 3.6 | SUMMARY | 8 |
| 4 | OPERATING INSTRUCTIONS | 9 |
| 4.1 | INITIAL POWER-ON | 9 |
| 4.2 | EMBEDDED SOFTWARE MAIN MENU | 10 |
| 4.2.1 | MAIN MENU | 10 |
| 4.2.2 | PORTS & STRINGS MENU | 10 |
| 4.2.3 | PORT MENU | 11 |
| 4.2.4 | OUTPUT STRINGS MENU | 11 |
| 4.2.5 | STRING MENU | 12 |
| 4.2.6 | ADVANCED MENU | 12 |
| 4.2.7 | ALIGNMENT MENU | 12 |
| 4.2.8 | TOGS SETTINGS MENU..... | 12 |



4.2.9 CUSTOM STRING MENU..... 13

4.2.10 TOGS SETTINGS MENU..... 13

5 DATA OUTPUT..... 14

5.1 DATA FORMATS 14

5.2 STATUS FLAG..... 14

5.3 DATA STRING LIST..... 15

5.3.1 TOGS FORMAT 15

5.3.2 MINIRLG1 FORMAT 15

5.3.3 MINIRLG2 FORMAT 16

5.3.4 NMEA HEHDT FORMAT..... 16

5.3.5 MDL FORMAT 16

6 MAINTENANCE AND TEST 17

6.1 MAINTENANCE OF EQUIPMENT 17

6.2 CHECKOUT PROCEDURE 17

6.3 ANNUAL CALIBRATION..... 17

7 OUTPUT STRING GENERATOR 18

7.1 SPECIAL VALUES 19

7.2 EXAMPLES..... 19

8 SPECIFICATIONS 20

9 TECHNICAL DRAWINGS..... 21

10 CONTACTING CDL 22

11 DOCUMENT REVISION HISTORY 23

2 Introduction

2.1 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.

2.2 General Description

2.2.1 System Overview

The CDL TOGS is a solid state gyrocompass based around a Fibre Optic Gyro (FOG).

The TOGS contains an Inertial Sensor Assembly (ISA). This assembly, together with the navigation processor, provides the TOGS a full self contained Attitude Heading Reference system.

2.2.2 Warranty

CDLtd UK warrants 'TOGS' 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.

3 Installation

3.1 System Contents

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

1. TOGS subsea unit
2. Transit case (if ordered)
3. 1.2 m tail for connection to the umbilical connector
4. Instruction Manual
5. Calibration Certificate
6. Connector Blanks

3.2 Unpacking and Inspection

If a transit case has been ordered, the system will be 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. It is recommended that the original packing case be used for subsequent transportation of the equipment.

3.3 Physical Installation

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

The TOGS weighs 10.5kg 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 noises or extreme magnetic field sources.

As standard the TOGS will be supplied in a 3000 metre housing, however there are 4000M and 6000M options available if requested. Under no circumstances should the unit be subject to forces greater than that stated on the unit.



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

3.4 System Orientation

The default settings of the TOGS assume that the unit's heading axis (X-axis) is aligned with the fore-aft axis of the vehicle and the unit's pitch axis (Y-axis) is aligned with the port-starboard axis of the vehicle. This is illustrated in Figure 1.

If the system is installed in a different manner, this can be compensated for by entering the corresponding angle offsets into the system boresight menu.

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 1.

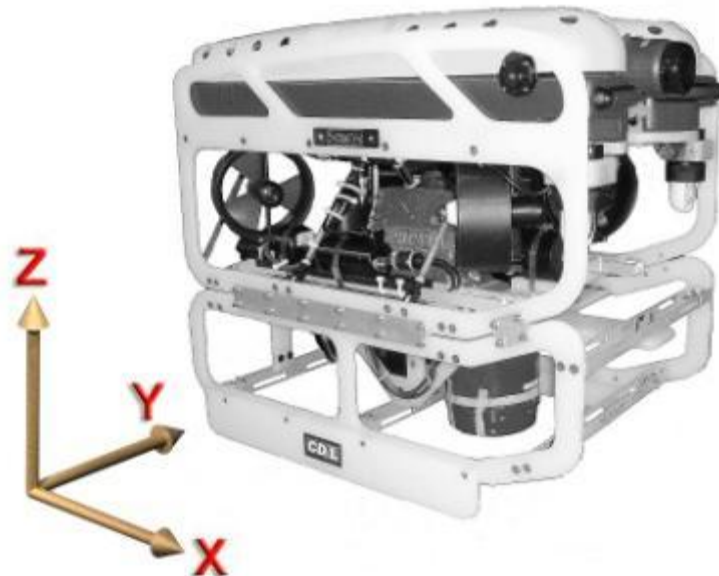


Figure 1: Vehicle Reference Frame

Image courtesy of Seaview Systems and Seaview 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.

3.5 Electrical Installation

3.5.1 Umbilical Connector

The umbilical connector is a Burton 20-13 connector. This connector supplies power to the unit and has 2 isolated serial ports. The pin out for this connector is given in and the pin orientation is shown in Figure 2

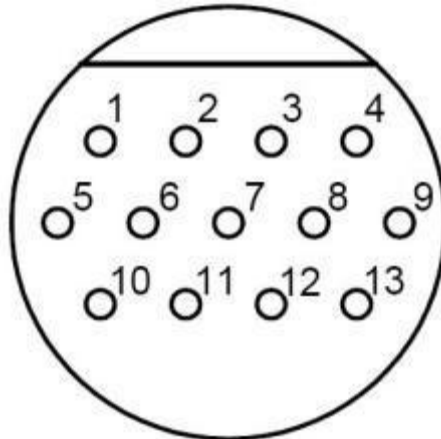


Figure 2: Burton 20-13 connector pinout

| Pin | Name | Function | RS232 | RS422 |
|-----|------------|----------------|--------|-------|
| 1 | N/C | | | |
| 2 | Port 2 TxA | Secondary Port | Tx | Tx+ |
| 3 | N/C | | | |
| 4 | +24V Rtn | Power Ground | | |
| 5 | Port 1 TxA | Primary Port | Tx | Tx+ |
| 6 | Port 1 TxB | Primary Port | N/C | Tx- |
| 7 | Port1 RxA | Primary Port | Rx | Rx+ |
| 8 | Port1 RxB | Primary Port | Ground | Rx- |
| 9 | +24V DC | Power +24V | | |
| 10 | N/C | | | |
| 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 1: Umbilical Connector

3.6 Summary

To use and configure the TOGS, as a minimum, the power source and port 1 need to be connected.

4 Operating Instructions

4.1 Initial power-on

The TOGS unit runs automatically on power up. The system has been set for a 10 minute initial alignment period but will generally be within 1 degree of accuracy after 3 minutes.

Excessive motion during the initial alignment period will decrease the accuracy of the TOGS.

All Ports are initially configured as RS232 with 9600 baud, 8 bit data, no parity and one stop bit.

4.2 Embedded software Main Menu

Customisation of the TOGS's operation is allowed through embedded firmware. Various configuration options allowed in the embedded firmware have been compiled into a logical hierarchical menu structure and are accessible on Port 1. The menu can be accessed through any PC terminal program by entering "menu" [ENTER]. This will stop data output and display the Main Menu.

The Main Menu provides options for control of the TOGS and allows configuration of the communication ports, output strings and various navigation settings. The Main Menu also provides options to restart the TOGS and to set latitude and longitude. Navigating the menu is done by entering the menu ID and pressing [ENTER]. Pressing "0" [ENTER] will always go back to the previous menu.



To retain configuration during power off, the settings must be saved to FLASH using the main menu. This process will take about a second during which power must be maintained.

4.2.1 Main menu

The main menu has the following entries

```
TOGS v1.2.2 - Main - Fri 19 Mar 2010 14:16:52
 1. Set initial latitude [57.1910000 deg]
 2. Ports & strings
 3. Advanced
 4. Configuration dump
 0. Back
```

[1] allows you to set the initial latitude. The value are entered as decimal degrees. Negative latitude is on the southern hemisphere.

[2] allows you to change port and string settings.

[3] allows you to change advanced options.

[4] Dumps all the settings as text.

[0] will quit the menu, asking you if you want to save your changes if you have made any.



Entering incorrect latitude will decrease the accuracy of the TOGS. The entered latitude should be within 1 degree of the actual latitude where the system is used to ensure proper operation of the system.

4.2.2 Ports & strings menu

```
TOGS v1.2.2 - Ports & strings - Fri 19 Mar 2010 14:17:04
 1. Port 1
 2. Port 2
 0. Back
```

[1] Enters the port 1 menu

[2] Enters the port 2 menu

If you have made any changes to the port settings without saving, an asterisk [*] will be displayed next to the port name.

4.2.3 Port menu

```
TOGS v1.2.2 - Port 1 - Fri 19 Mar 2010 14:17:12
1. Output strings [TOGS (2.50 Hz)]
2. Baud rate      [9600]
3. Mode          [RS232]
4. Parity        [None]
5. Stopbits      [1]
0. Back
```

[1] Enters the output strings menu. The currently selected strings are displayed in brackets.

[2] Allows you to change the baud rate of the port

[3] Allows you to change between RS232, RS485 and RS422 mode

[4] Allows you to select No, Even or Odd parity

[5] Allows you to select 1 or 2 stop bits



Decreasing the baud rate of a port may cause it to have insufficient bandwidth to send all the selected data strings. The menu system will issue a warning if the bandwidth is too low.



Always test a setting by choosing “Apply settings” before saving settings to flash. Incorrect settings may make it impossible to communicate with the TOGS. Ex: Selecting RS422 on port 1 without access to an RS422 cable will make it impossible to get into the TOGS menu and change the setting back.

If you make changes to a port, an “Apply settings” option appear, which, if selected, will apply the current settings to the port.

4.2.4 Output strings menu

```
TOGS v1.2.2 - Output strings - Fri 19 Mar 2010 14:17:21
1. TOGS [2.50 Hz]
2. MiniRLG1
3. MiniRLG2
4. NMEA HEHDT
5. Tokimec 1
6. TCM2 HPR
7. HMR3000
0. Back
8. TSS2 (no status)
9. Watson/Tritech Gyro
A. MDL
B. Custom 1
C. Custom 2
D. Custom 3
E. Custom 4
```

The output menu allows you to define which output strings are selected and at what interval. Selecting a menu point will enter a menu where you can change the settings for that string.



Selecting too many strings and/or too high update rates can exceed the bandwidth of the output ports. The menu system will issue a warning if the limit has been reached.

4.2.5 String menu

```
TOGS v1.2.2 - TOGS - Fri 19 Mar 2010 14:17:31
 1. Enabled [Yes]
 2. Frequency [2.50 Hz (400 ms)]
 3. Modes [Any]
 0. Back
```

Selecting [1] toggles if the string is selected.

Selecting [2] changes the frequency at which the string is output.

Selecting [3] changes which modes the string is sent out in.

Settings that are changed in this menu are applied immediately.

4.2.6 Advanced menu

```
TOGS v1.2.2 - Advanced - Fri 19 Mar 2010 14:19:24
 1. Alignment
 2. Edit custom strings
 3. TOGS settings
 4. Status
 5. Restart alignment
 6. Save settings to FLASH
 7. Reload settings from FLASH
 0. Back
```

Selecting [1] allows you to change settings regarding the initial alignment.

Selecting [2] allows you to edit the custom strings.

Selecting [3] allows you to change TOGS interface settings.

Selecting [4] prints status information about the TOGS.

Selecting [5] resets the TOGS algorithms and restarts the alignment

Selecting [6] saves the current settings to FLASH

Selecting [7] reloads the previously saved settings from FLASH

4.2.7 Alignment menu

```
TOGS v1.2.2 - Alignment - Fri 19 Mar 2010 14:19:31
 1. Fine alignment time [10 min]
 0. Back
```

This menu allows you to set the fine alignment time.

4.2.8 Togs settings menu

```
TOGS v1.2.2 - Edit custom strings - Fri 19 Mar 2010 14:19:41
 1. Custom 1
 2. Custom 2
 3. Custom 3
 4. Custom 4
 0. Back
```

This menu allows you to edit the 6 custom strings that are on the TOGS. By selecting any of the strings, you will enter a menu where you can edit the name and format of the string.

4.2.9 Custom string menu

```
TOGS v1.2.2 - Custom 1 - Fri 19 Mar 2010 14:19:54
Name:
  Custom 1
Format:
  Custom string 1
Output:
  Custom string 1

1. Edit name
2. Edit Format string
0. Quit
```

In this menu you can change the name and format of the custom strings. You will also see an example output of what the string will look like. Refer to chapter 7 for further explanation of format strings.

4.2.10 TOGS settings menu

```
TOGS v1.2.2 - TOGS settings - Fri 19 Mar 2010 14:20:07
1. Menu timeout          [100 sec]
2. Set Date
3. Boresight
4. Output synchronization [Time]
0. Back
```

This menu allows you to change settings for the TOGS, as well as enter boresights.

Selecting [1] will allow you to change the menu timeout

Selecting [2] will allow you to change the date

Selecting [3] will open up a menu where you can change the roll, pitch and yaw boresights.

Selecting [4] will change the output string synchronization between “Time” or “Data”.

The internal TOGS algorithms work at 51.44 Hz, so if “Data” is selected, the output rate will follow this frequency. I.e. If you select 50 Hz output rate, you will actually get 51.44 Hz. If you select “Time” synchronization, you will get the exact 50 Hz output rate, but the data will be extrapolated.

5 Data Output

5.1 Data Formats

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

The predefined string outputs are listed below and are changed via the menu system.

It is also possible to define custom strings from the menu using the output string generator.

Figure 3 shows the sign convention for the TOGS, MiniRLG 1 and MiniRLG 2 strings.



Figure 3: Sign convention for TOGS and MiniRLG strings

5.2 Status Flag

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

| Status Flag | Meaning |
|-------------|-------------------------|
| 1 | Coarse stationary align |
| 2 | Fine stationary align |
| 9 | Aided navigation |

Table 2: Status flag

5.3 Data string list

5.3.1 TOGS format

AHaaa.aa APbccc.cc ARdeee.ee Mf Eggggggg<CR><LF>

Where:

aaa.aa is Heading in degrees (0 to 360deg)
aaa(deg).aa(decimal)
bcc.ccc is Pitch in degrees (-180 to 180 deg)
cc(deg).cc(decimal)
b [-] bow down / [+] stern down
deee.eee is Roll in degrees (-180 to 180 deg)
eee(deg).ee(decimal)
d [-] port down / [+] starboard down
f is the status flag. See section 5.1 Status Flag
ggggggg is the cycle counter

5.3.2 MiniRLG1 format

Haaa.aaPbcc.cccRdeee.eeeMfgghhiiWjjj.jjUkk.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 control logicals byte in ASCII hex
jjj.jj Only available in POS units
kk.k Not used

5.3.3 MiniRLG2 format

HaaaaaPbccccRdeeeeeeMfgghhiiWjjjjjUkkk<CR><LF>

Where:

| | |
|---------|--|
| aaaaa | is Heading in degrees aaa(deg).aa(decimal) |
| bcccc | 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 control logicals byte in ASCII hex |
| jjj.jj | Only available in POS units |
| kk.k | Not used |

5.3.4 NMEA HEHDT format

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

Where:

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

5.3.5 MDL format

HaaaaPbbbbRcccc<CR><LF>

Where

| | |
|------|--|
| aaaa | is heading in degrees aaa(deg).a(decimal) |
| bbbb | is pitch in degrees bbb(deg).bb(decimal) |
| cccc | is roll in degrees ccc(deg).cc(decimal) |

6 Maintenance and Test

6.1 Maintenance of equipment

The CDL TOGS is a self-contained system which requires no regular maintenance other than a yearly calibration check.

All housings 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.

6.2 Checkout procedure

1. Connect the TOGS to the RS232 port on a PC
2. Connect a suitable power supply to the TOGS.
3. Examine the connections and ensure they are secure
4. Power up the TOGS.
5. Heading should appear within 30 seconds when coarse stationary alignment is complete.

6.3 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. Please contact CDL for current calibration charges for this equipment. The turn-around time for this service is normally 1-2 days.

7 Output string generator

The TOGS includes an output string generator, which enables the user to change the format of the output strings without having to upgrade the firmware or restart the TOGS.

The output string generator produce an output according to the format as described below. The format string is a character string composed of zero or more directives: ordinary characters (not %), which are copied unchanged to the output string; and conversion specifications, each of which results in fetching one INS value, formatting it, and copying the result to the output string. Each conversion specification is enclosed by % characters. A conversion specification is comprised of a set of fields, an identifier field, one or more arithmetic fields and a formatting field. The fields are delimited by ':' characters.

Example:

An example of a conversion specification is the following: "%hea:*10:f+07.2%". This would fetch the heading, scale it by 10 and output it in a field with the length 7, prefixed by a sign, zero padded and with 2 decimals. An example output would be "+023.54" if the heading was 2.354 degrees.

The identifier is comprised of three (3) characters that select the value to be read out. Ex: "hea" is the heading, "rol" is the roll and "pit" is the pitch. Some values has special meaning which will be explained below. For a complete reference of the identifiers, refer to the table at the end of this section.

After the identifier, one can do simple arithmetic operations, such as scaling (*, /) and offsetting (+, -) by using arithmetic fields. The native angle format of the TOGS is degrees. If one would like to convert it to radians, the value needs to be divided by 57.29, so would enter /57.29 in an arithmetic field. Arithmetic fields can be put after one another to do more complex maths. A *0.017 field followed by a +2 field and a *10 field would scale the value by 0.017, then add 2 to the value and finally scale that value by 10.

A format field starts with an f. It follows the format syntax of a 'printf' statement. The format field is a string of characters which signify how the scaled number should be formatted in the output string.

The format field can change the following:

- the number of characters in the outputted number;
- if an explicit sign should be added;
- the precision after the comma;
- if the number should be padded with zeroes.

The flag characters

The format field is started by zero or more of the following flags:

“0” - The value should be zero padded

“+” - A sign should always be placed before a number produced. By default, a sign is used only for negative numbers.

The field width

Following the flag characters is an optional decimal digit string, which specifies the minimum field width. If the converted value has fewer characters than the field width, it will be padded with spaces (or 0's) on the left.

The precision

An optional precision, in the form of a period ('.') followed by an optional decimal digit string. This gives the minimum number of digits to appear after the radix character.

7.1 Special values

CRC

The CRC identifier has a special meaning, as it can be put anywhere in the format string, except within another conversion specification. If a CRC conversion specifier is found, the output string is ended with a 4-byte hexadecimal CRC value. Now, only one type is supported, namely CRC-16.

Example:

To add a CRC-16 field to the end of the output string with an initial value of

0xFFFF:

`%crc%`

7.2 Examples

To output the a string with heading in radians, with a sign, a fixed field length of 7 characters padded with 0's and 2 decimal places, the format string should be

`%hea:*0.017:f+07.2%`

which would output the string +002.35

To remove the dot, one could multiply the scaling by 100, and have no decimal places:

`%hea:*1.7:f+06.0%`

which would output the string +00235

To output the epoch, one would not need scaling or formatting, so it is simply

`%epo%`

which for example would output

5675

8 Specifications

AHRS Specification:

| | |
|-------------------|-------------------|
| Heading Accuracy: | 0.5 deg sec(lat)* |
| Pitch and Roll | 0.1 deg* |

Power Requirements:

| | |
|---------|----------|
| Voltage | 18-30Vdc |
| Power | 8 to 12W |

Telemetry Interface:

| | |
|-------------------------|--|
| Serial outputs | 4 isolated |
| Serial protocol options | RS232, 422 and 485 (software configurable) |

Weight and Dimensions:

| | |
|---------------------|-------------------|
| Subsea unit (3000m) | 175mm dia x 244mm |
| Weight in Air | 10.5kg |
| Weight in Water | 5kg |

Mounting Holes:

M8 on 141mm square pitch

*1 Sigma

10 Contacting CDL

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In case of faults or queries please contact the Development personnel in the first instance.

11 Document revision history

02/07/2010 Rev G->H

- Added information about the isolated comms lines
- Added revision history

23/08/2010 Rev H->I

- Numbered sections correctly
- Modified initial power up instructions