CD/L

MiniRLG

TECHNICAL MANUAL

MiniRLG Firmware   V2.B

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All information contained within this manual is subject to change without notice and does not represent a commitment on the part of CDL

1.   INTRODUCTION

1.1   General description

The CDL MiniRLG is a solid state gyrocompass system based around the Kearfott T16-B monolithic ring laser gyro and a triad of MOD VIIA accelerometers.

Depth output can be provided by either a Druck strain gauge or Paroscientific Digiquartz depth sensor.

The monolithic triaxial design of the ring laser gives a significant size advantage over a triad of traditional uniaxial ring lasers with the same level of performance. This, combined with CDL's compact electronics, allows an overall package size of just 30cm x 18cm diameter.

An auto-switching power supply has been used for easy operation on either side of the Atlantic; alternatively the unit can be powered from an external 24Vdc. The sub sea pod has data available in current loop and RS232 formats for easy integration to ROV multiplexer systems.
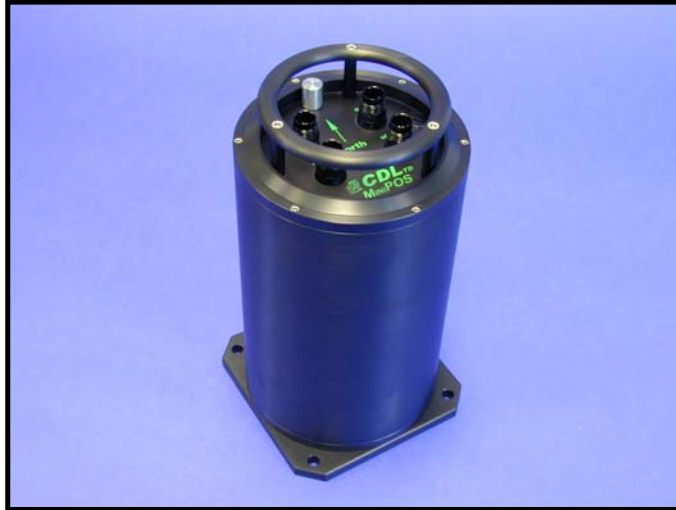
At the topside, the MiniRLG is controlled by a custom software package

1.2   Use of CDL Data Display Unit (DDU)

CDLtd Data Display Units (DDU's) are a ruggedised topside display system with extensive data transmission/reception facilities. Their touchscreen displays and built-in computer system allow the control and display of an enormous variety of equipment.

In addition, DDU's can be reconfigured as a client requirement if special data displays or telegrams are required.

The DDU uses a battery backed SRAM system to retain program memory and system settings. The battery pack within the DDU is charged any time the DDU is switched on and is kept at an optimum charge level by an intelligent charge controller. The battery pack needs 16 hours of use in order to recharge fully and a full charge will retain all software and internal settings for a minimum of 4 months.

IT IS STRONGLY RECOMMENDED THAT THE DDU BE CHARGED FOR A PERIOD OF NO LESS THAN 16 HOURS IN EVERY THREE MONTHS.

1.3   System contents

The CDL MiniRLG system comprises the following items:

> **MiniRLG subsea unit (3000m rated)**
> **Data Display Unit (DDU)**
> **20m deck cable**
> **Instruction manual**
> **Transit case**

1.4   Options

The CDL MiniRLG has a number of optional items:

> **Strain gauge depth sensor (Druck)**
> **Quartz depth sensor (DigiQuartz)**

1.5   Warranty

CDLtd UK warrants 'MiniRLG' 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.   INSTALLATION

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.

It is recommended that the original packing case be used for each subsequent transportation of the equipment.

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.

2.2   Physical installation

The CDL MiniRLG should be installed in a manner to give the unit maximum physical protection. The position read from the unit is referenced to a non-central point therefore a reference point is supplied to allow all readings to be referenced correctly to the base of the unit.

2.3   Electrical installation

The CDL MiniRLG has 4 Impulse Connectors allowing a variety of electrical connection possibilities. The surface unit has 2xRS232 outputs and a single 7 way Binder 723 series for umbilical connection.

Power can be applied to the MiniRLG by a variety of methods. The system contains a universal AC supply that can accept any voltage between 85Vac and 265Vac. Alternatively, a DC voltage between 18Vdc and 30Vdc may be applied. Power consumption is less than 30W.

Communications with the unit can be either by current loop or RS232 formats.

The diagram below shows all pin outs:

2.3.1   Surface connection

Connection to the converter is by way of an IEC connector for mains input and a Binder 723 series connector for umbilical connection. The pin-outs are detailed below.

DDU umbilical connector	Function
1	AC Earth
2	C/L Hi input
3	C/L Hi output
4	C/L Low To Pod
5	C/L Low From Pod
6	AC Neutral
7	AC Live

This connector allows connection to the subsea pod by dedicated umbilical cable or can be used to pass these lines through an ROV cable. Please note that the current loop format used by CDLtd is based on the HPCL4100, CNY17-1X current loop system. This gives greater distance performance and noise immunity then standard current loop but means that the data stream cannot be read by a standard opto-isolator as the pod driver is passive. If it is required to read the data stream without using the surface converter unit, please contact CDLtd for details of the circuit required.

Note that this system has another advantage which is that the bi-directional data system is optically isolated at the top end **only.** This means that in the event of a comms problem, a repair can normally be made without opening the subsea pod.

The connector required at the converter is as follows:

Binder 723 series 7-way male (RS part no. 261-5957)

RS-232 connector	Function
1	N/C
2	Data In
3	Data Out
4	N/C
5	Ground

Note: A Null Modem Cable is required to connect the converter to a PC

2.3.2   Subsea connection

Connection to the MiniRLG pod is by way of the *Impulse* range of connectors.   Four connections are available on the subsea pod housing. The connectors and pin-outs are explained below.

2.3.3   Umbilical connector

Pod umbilical connector	Function
1	AC Live
2	N/C
3	Earth
4	N/C
5	C/L Lo To Pod
6	RS232 To Pod
7	RS232 From Pod
8	C/L Hi To Pod
9	N/C
10	AC Neutral
11	N/C
12	N/C
13	C/L Lo From Pod
14	Data Ground
15	C/L Hi From Pod
16	N/C

The AC voltage connection is universal input in the range 100-240Vac. The current loop system sends a full data string to the surface at a speed of 9600 baud. This baud rate gives the best ratio of update rate and useable cable length. The RS232 system operates at 9600 baud, 8 data bits, 1 stop bit, no parity, no flow control.

The connector required is as follows:

Impulse MSAJ-CCP-16

2.3.4   Auxiliary connector

AUX. connector	Function
1	N/C
2	N/C
3	N/C
4	Power Ground
5	C/L Lo To Pod
6	RS232 To Pod
7	RS232 From Pod
8	C/L Hi To Pod
9	+24V DC
10	N/C
11	N/C
12	N/C
13	C/L Lo From Pod
14	Data Ground
15	C/L Hi From Pod
16	N/C

The Auxiliary connector duplicates all data connections and allows power to be supplied from an external DC supply (18-30Vdc). This power source can be taken from an ROV or from subsea batteries.   The battery connection is wired through power diodes to prevent overcharging of the battery and current leakage (and corrosion) into the seawater environment.

The connector required is as follows:

Impulse MSAJ-CCP-16
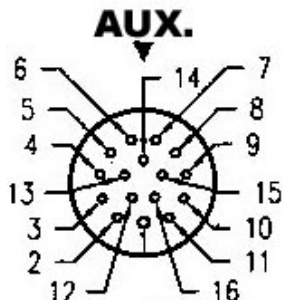
2.3.7   Pod connections: male face view
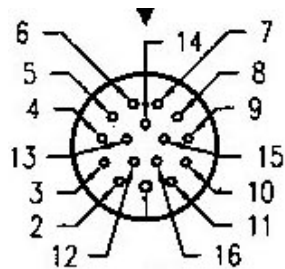
UMBILICAL

DVL

AUX.

GPS

The above diagram shows the bulkhead connectors on the face of the gyro pod (see picture below). The pin numbers can be related to function in the tables 2.3.3 - 2.3.6.

2.3.8   Deck cable connection

The deck cable provided with the MiniRLG is connected as follows.

Impulse (16 way)	Cable colour	Function	Binder (7 way)
1	Brown + Red	AC Live	7
2		N/C	-
3	Yellow	Earth	1
4		N/C	-
5	Grey	C/L Lo To Pod	4
6		N/C	-
7		N/C	-
8	White	C/L Hi To Pod	2
9		N/C	-
10	Blue + Turquoise	AC Neutral	6
11		N/C	-
12		N/C	-
13	Pink	C/L Lo From Pod	5
14		N/C	-
15	Orange	C/L Hi From Pod	3
16		N/C	-

3.   OPERATION

3.1   Initial power-on

The MiniRLG unit runs up automatically on power up. The system has been set for a 15 minute run-up period but will generally be within 1 degree of accuracy after a 3 minute period. Severe motion during the run-up period will cause the settling period to increase slightly.

3.2   Use with DDU

The primary operational mode for the MiniRLG system is using the DDU provided although the subsea unit can easily operate as a standalone unit (see section 3.3).

The DDU display software consists of 5 operational pages, which are selected, in rotation by using the 'last display' and 'next display' buttons on the touch screen. Each page performs a different function that is explained below.

3.2.1   Main display page

The MiniRLG main display page gives a visual display of all data being sent from the sub sea unit.

The heading, pitch, roll and depth displays are displayed in a larger font size for easy reading at longer distances.

Latitude and longitude displays are for indication only, this is not displaying MiniRLG settings from the subsea unit. The subsequent displays are used to make changes to these and other parameters.

The two buttons at the foot of the screen are used to navigate between displays in the software package.

Each display retains its place in the sequence and the user can move from one display to the next in either direction.
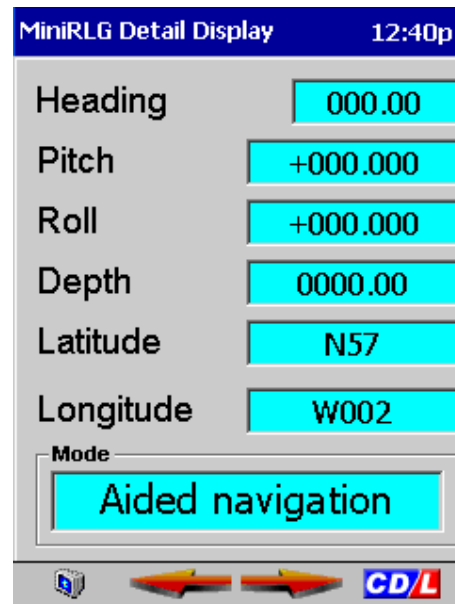
3.2.2   Latitude & Longitude setup

This page is used to give the sub sea unit latitude and longitude for its current location in the world. Positive latitude being the Northern hemisphere and positive longitude is Western hemisphere.

The sub sea unit will accept a latitude of +90 to –90 degrees and a longitude of –180 to 180 degrees. For best results during operation the MiniRLG unit must be provide with a latitude and longitude accurate to 1 degree.

The latitude and longitude are automatically sent to the MiniRLG unit when the displays are changed to the next or last display.
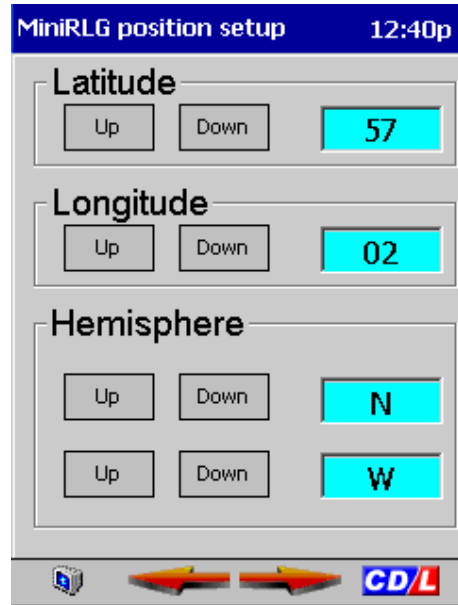
3.2.3   System setup

This display page shows the current alignment mode of the MiniRLG sub sea unit Aided Navigation is the standard running mode.

The buttons on the display are used to control the alignment of the MiniRLG unit the Start Alignment button is used if the Unit fails to Auto Align when first switched on.

The 'Restart Alignment' button is used if you require to realign the MiniRLG sub sea unit at any time.

The 'Disconnect battery' button is used to disable the internal battery pack that is built into every MiniRLG unit. A fully charged internal battery should provide approximately 30 minutes of operation from the MiniRLG in the event of an external power interruption to the sub sea unit.
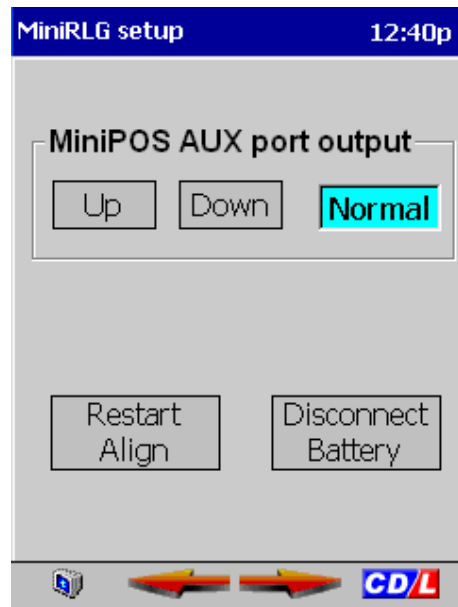
3.2.4   Data output setup

This display allows the User to select the current output format and baud rate from RS-232 ports on the front of the DDU, an example of the selected format is displayed in the window under the data format buttons. The currently selected baud rate is also displayed, most common baud rates can be selected from the DDU.

Using the up and down buttons cycles between all selectable data outputs and baud rates.
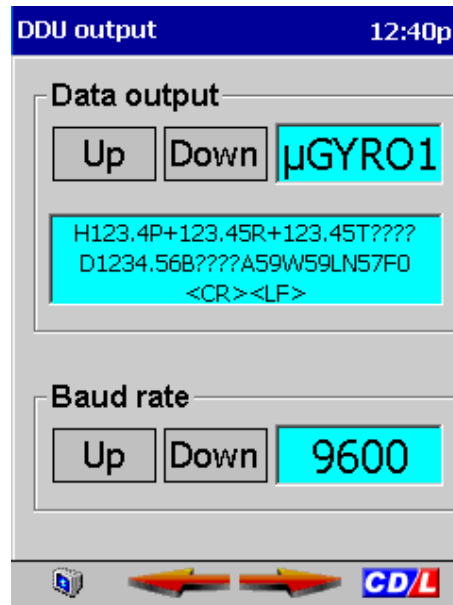
3.3   Use without DDU

The MiniRLG unit can perform a limited set of functions by using an RS232 link.

By sending the '>' character – the MiniRLG is placed into setup mode where it will accept the following commands:

L   after receipt of the 'L' the unit responds with '*enter Lat whole degrees eg. N02*'
N   after receipt of the 'N' the unit responds with '*enter Lon whole degrees eg. E001*'
U   disconnects the internal battery pack
D   download current settings
T0   Standard MiniRLG1 Output on the RS-232 Port
T1   NMEA Output on the RS-232 Port
T2   C100 Output on the RS-232 Port
T3   SKR80 Output on the RS-232 Port
T4   MDL Output on the RS-232 Port (pitch sign convention reversed)
T5   SGB Output on the RS-232 port
T6   Digilog Output   on the RS-232 port
w   This sets the unit into Alignment Mode
y   This command restarts the alignment

Note: all the above commands are case sensitive

The Data Outputs are as follows

T0:   MiniPOS1
H123.45P+12.345R+123.456M1FFC0A0W1234.56U12.3 cr lf

T1:   NMEA
$HEHDT,123.4,T cr lf

T2:   C100
$123.4,D,OK*CC cr

T3:   SKR80
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

T4:   MDL
H1234P+1234R+1234 cr lf

T5:   SGB
1234 cr lf

T6   Digilog
H1234P+1234R+1234E cr lf

3.4   Checking lat/lon Settings

To find out what the Latitude and Longitude is set to on your MiniRLG unit connect it to a PC running a terminal program.

Then send it the following commands

>

D

MUST BE A CAPITAL D NOT LOWER CASE

The RLG will now output its internal settings similar to below

>DL28DB8000N016F0000P7FFFS0000C01T0VC0MA0GFE

The Characters between L and N are the latitude in hex and between N and P is the Longitude in hex

So the latitude is 28DB8000 and the Longitude is 016F0000

To convert these hex numbers to an actual heading

1. Convert to hex number to decimal
2. Divide the answer by 2 to the power of 31
3. Multiply the answer by 180

For the above example

Latitude

    1.   28DB8000 = 685473792 (Decimal)
    2.   685473792 divided by 2^31 = 0.319198608
    3.   0.319198608 x 180 = 57.46 degrees

    North is positive, therefore Lat = N57.46

Longitude

    1.   016F0000 = 24051712 (decimal)
    2.   24051712 divided by 2^31 = 0.011199951
    3.   0.011199951 x 180 = 2.02 degrees

    West is positive, therefore Lon = W2.02

3.5   Heading, pitch and roll conventions
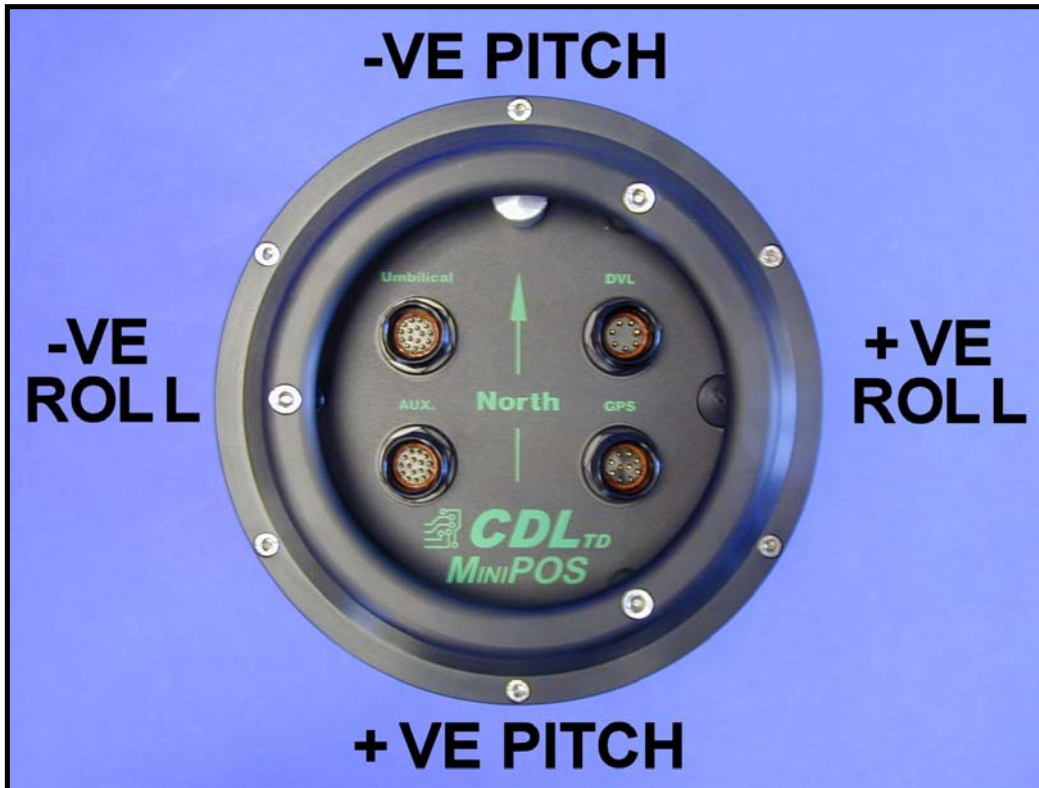
The diagram above shows the conventions for heading, pitch and roll as read from the MiniRLG. The pitch and roll labels refer to a DOWNWARDS movement of the relevant edge. Ie bow down is -ve pitch.

4.   DATA OUTPUTS

4.1   Data telegrams available from DDU

MiniRLG1
H123.45P+12.345R+123.456M123W1234.56U12.3<CR><LF>

MiniRLG2
H12345P+12345R123456M123W123456U123<CR><LF>

MDL
H1234P+1234R+1234<CR><LF>

SGB
1234<CR><LF>   (heading)

Legend:

H	Heading
P	Pitch
R	Roll
M	Mode 1st digit 0 = Idle
	1 = Coarse stationary align
	2 = Fine stationary align not complete
	3 = Fine stationary align complete
	9 = Aided navigation
	A = System failure
	Mode last byte is the navigation monitor byte in hex
W	Depth
U	Battery voltage

DLOG
H1234P+1234R+1234E<CR><LF>

Final flag character is either:
E   Exact heading available
S   Gyro settling

SKR
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

CDL1
H123.4P+123.45R+123.45T12.3D1234.56B12.3A59W59LN57F0<CR><LF>

CDL2
H1234P+12345R+12345T123D123456B123A59W59LN57F0<CR><LF>

Legend:

T	Temperature		
D	Depth		
B	Battery voltage		
A	Alignment timer		
W	Preheat timer		
L	Latitude		
F	Fault flag	0 = Gyro fully operational
		1 = Fault (non-fatal)
		2 = Fault (fatal)
		9 = Gyro in preheat

4.2   User defined data telegrams

The CDL DDU is a display system containing a Windows CE™ powered touch screen
computer. The display software used for the MiniRLG system can be modified to produce
any required data telegram. In addition, the microcontrollers inside the subsea pod contain a
program that can be modified in a similar manner. Please contact CDL for any specific
requirements.

5.   MAINTENANCE AND TEST

5.1   Maintenance of equipment

The CDL MiniRLG 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.

5.2   Checkout procedure

1.   Power up the DDU on its own.
2.   The Reset RCD page should now be displayed. Reset the RCD.
3.   The No Data page should now be displayed.
4.   Power Down the DDU.
5.   Connect the supplied 20m deck cable to the Umbilical port on the MiniRLG.
6.   Connect the other end to the DDU.
7.   Examine the connections and ensure they are secure
8.   Power up the DDU and reset the RCD.
9.   The MiniRLG unit should now begin to dither.
10.   The DDU should now be receiving data from the MiniRLG.
11.   Heading should appear within 2 minutes when coarse stationary alignment is complete.

5.3   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. Contact CDL for current calibration charges for this equipment. The turn-around time for this service is normally 1-2 days.
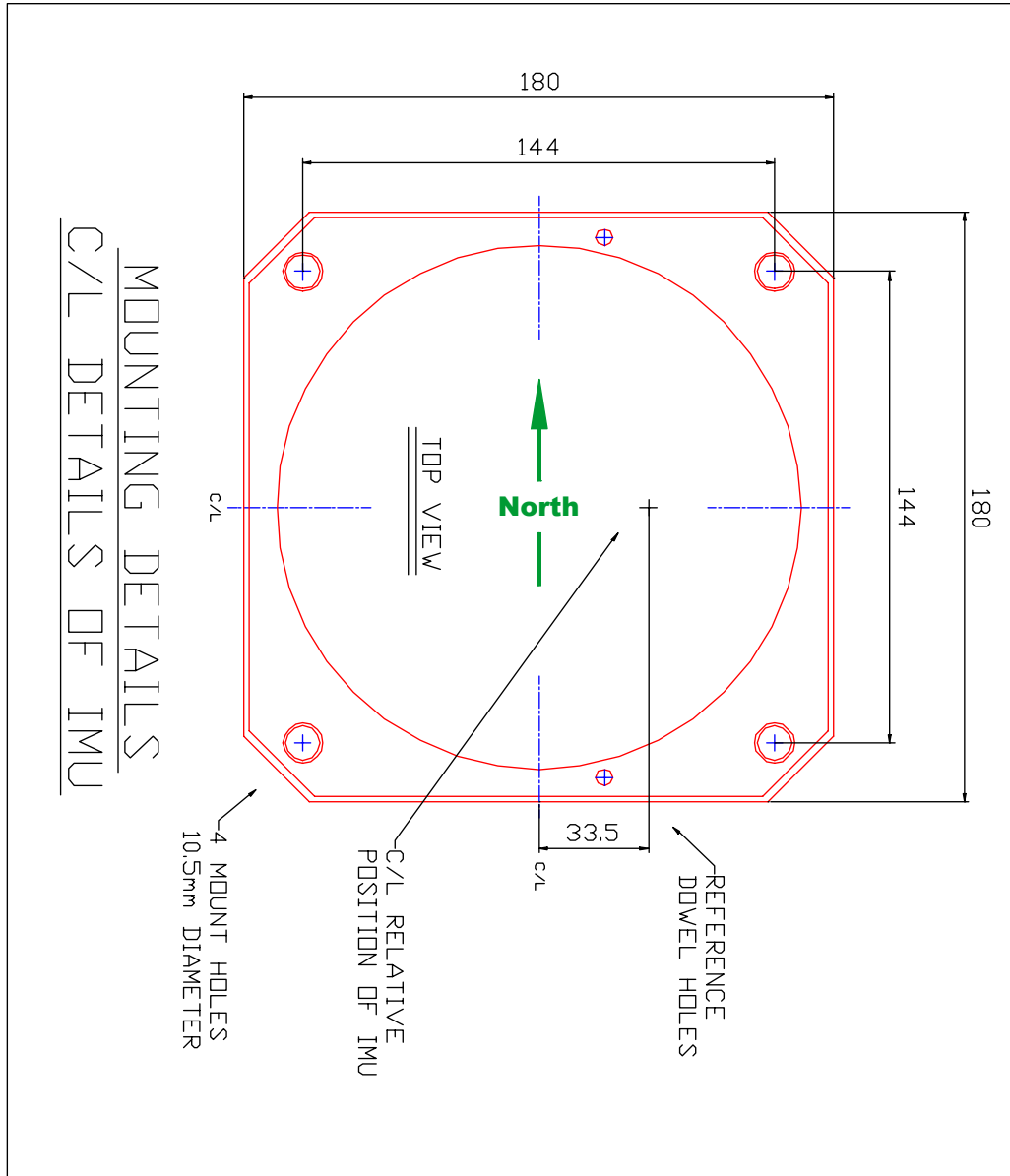
5.4   Reloading DDU software instructions

Should your DDU lose its memory contents, you can quickly restore the memory using a CDL flashcard.

1.   Ensure that your DDU is fully charged.

2.   Switch on the DDU and follow the on screen setup instructions.

3.   Switch off the power and open the DDU. Locate the slot on the upper edge of the display, behind the front plate. Insert the flashcard into this slot, if not previously installed.

4.   Re-apply power, but **BE CAREFUL**, **there are live components located in the power supply and RCD.**

5.   On the screen, click on the following sequence-
        Start/ Settings/ System/ HP Backup/ Restore/ Restore All Data/ MiniRLG.

6.   When the display instructs you, reset the device by inserting a thin tool, such as a screwdriver, in to the hole located in the PSU/Battery plate behind the display. Press the red button using the tool, this will restore the software. Ensure that power to the DDU is maintained during the reset, otherwise you will have to repeat the entire procedure.

7.   On screen click the following sequence-
        Start/ Programmes/ FileExplorer/ MyDocuments/ MyDevice/ MiniRLG/ MiniRLG

8.   Switch off and re-assemble the DDU.

6.   TECHNICAL DRAWINGS

SIDE VIEW

293

335.5

ø178

12

180

MOUNTING DETAILS
C/L DETAILS OF IMU

TOP VIEW

North

180

144

144

180

33.5

c/L

c/L

4 MOUNT HOLES
10.5mm DIAMETER

C/L RELATIVE
POSITION OF IMU

REFERENCE
DOWEL HOLES
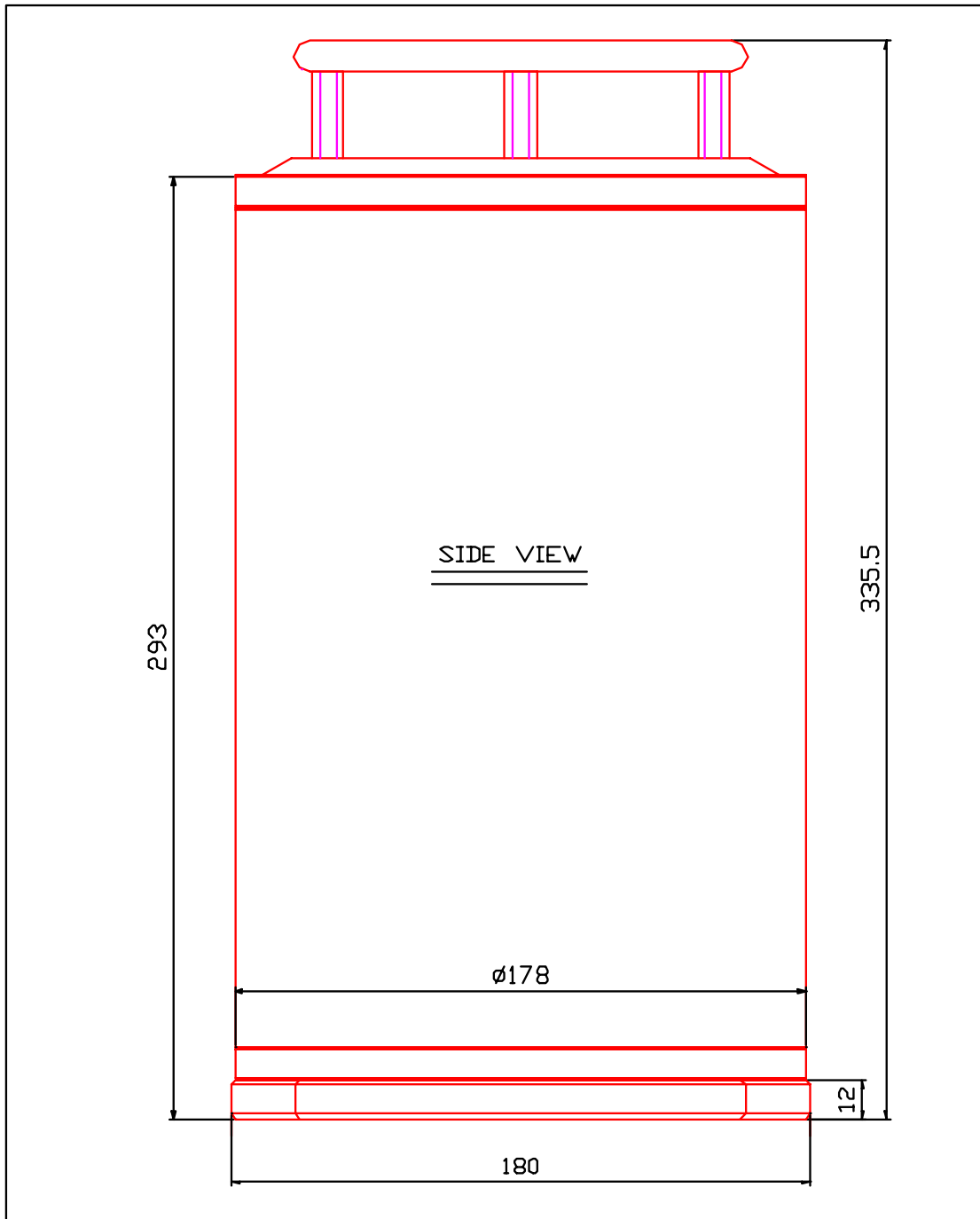
7.   SPECIFICATIONS

7.1   Performance

Heading accuracy	0.169	(Degrees)
Pitch and Roll	0.028	(Degrees)
Drift rate	0.05	(Degrees/root hour)
Bias Repeatability	0.7	(Degrees/hour)
Scale Factor Repeatability	350	(PPM)
Axis Alignment	65	(Arc-Second)

7.2   Electrical

Operating Power	35W	(Max)
IP Voltage	100-240Vac	(Universal)
Or	18-30Vdc	

7.3   Physical

Standard Depth Rating	3000	(Meters)
Sub Sea Unit Dimensions	182 dia. X 300	(mm)
Sub Sea Unit Weight	9.8	(Kg)
DDU Dimensions	240 x 180 x 90	(mm)
DDU Weight	4.6	(Kg)

7.3   Environmental

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

8.   CONTACTING CDL

8.1   By phone

Tel: +44 (0) 1224 706655
Fax: +44 (0) 1224 709840
Web: www.cdltd.net

8.2   By email

Colin Crichton   cc@cdltd.net
Gary Crichton   gc@cdltd.net
Matt Blair   mb@cdltd.net
Nick Murray   nm@cdltd.net
Murray Leys   ml@cdltd.net
Richard Hallyburton   rh@cdltd.net
Nigel Money   nsm@cdltd.net
Carla Crichton   cmc@cdltd.net

8.3   Out of hours

Out of hours contact numbers

Colin Crichton	(home)	-	+44 (0) 1224 702466
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Gary Crichton	(home)	-	+44 (0) 1358 722597
(Technical Director)	(mobile)	-	+44 (0) 7803 909128
Matt Blair	(home)	-	+44 (0) 1224 744917
(Managing Director)	(mobile)	-	+44 (0) 7718 365729
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In case of faults or queries please contact the Development personnel in the first instance.