

UM-8084-101

Lodestar Hardware Manual

Head Office

Sonardyne International Limited
Blackbushe Business Park
Yateley, Hampshire
GU46 6GD United Kingdom

T. +44 (0) 1252 872288
F. +44 (0) 1252 876100
E. support@sonardyne.com
www.sonardyne.com

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Blackbushe Business Park
Yateley, Hampshire GU46 6GD
United Kingdom

Tel: +44 (0)1252 872288

Fax: +44 (0)1252 876100

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2 About This Manual

2.1 Purpose

This Lodestar Manual is part of a series of manuals produced by Sonardyne International Limited to support their Lodestar unit. It describes the Lodestar hardware and explains how to install, align and connect the system.

On-line manuals

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2.2 How this manual is arranged

This manual is arranged in a series of chapters, each of which includes a number of sections.

Chapter 1 "About the Lodestar Manuals" beginning on page 6

An introduction to this manual. It includes information about what the manual contains, who should read it, and how to use it.

Chapter 2 "About Lodestar" beginning on page 8

An introduction to the Lodestar, giving a description of the equipment

Chapter 3 "Technical Specifications" beginning on page 17

Technical specifications for the Lodestar, giving dimensions, electrical requirements and environmental limitations. Chapter 3 also lists the performance specifications for the Lodestar.

Chapter 4 "Installation" beginning on page 25

Instructions to identify and prepare the installation site and to install and connect the Lodestar to the controlling PC and other equipment. The alignment requirements are important between the Lodestar and the vessel to deliver the specified performance and these requirements are explained.

Chapter 5 "Troubleshooting" beginning on page 31

Instructions to identify and resolve any issues with the operation of the Lodestar.

Chapter 6 "Maintenance" beginning on page 36

Guidance and explanations of how to undertake maintenance of the Lodestar such as upgrading the firmware.

Who should read this manual

This Hardware Manual contains information for use by anyone involved with installing, using or maintaining the Lodestar hardware. It includes technical and user information to help deliver the best performance from the Lodestar.

Anyone who uses the Lodestar should make sure they read the relevant parts of this manual. If the computer that holds this electronic manual is connected to a printer, any part of it can be printed.

Operation manuals

Operation manuals are supplied separately describing how to configure and use the Lodestar for specific uses, e.g. Lodestar AHRS Operation Manual UM-8084-107.

Updates to the manual

If necessary, contact Sonardyne International Limited to check whether you have the latest revision of this manual or to request printed copies.

3 About Lodestar

3.1 Introduction

Sonardyne International Limited has applied its comprehensive experience in producing advanced and dependable marine solutions to the development of the Lodestar Attitude and Heading Reference System (AHRS) / Inertial Navigation System (INS).

The Lodestar is a solid-state AHRS/INS that includes three Ring Laser Gyroscopes (RLGs) and three linear accelerometers. These inertial-grade components provide raw data to the Sonardyne-developed gyrocompass algorithm, which uses them to produce a full range of accurate real-time motion and attitude measurements in all sea states.

Developed originally to provide accurate heading and attitude measurements for Sonardyne's family of acoustic positioning systems, Lodestar is equally suited to a variety of other applications where the accuracy of heading and attitude measurements is of critical importance. Lodestar can operate either as a stand-alone AHRS or as part of an integrated system.

Lodestar is available in surface and subsea versions, where Sonardyne's experience with underwater acoustic navigation systems has been applied to overcome the problems associated with conventional sensor platforms, such as temperature shock.

Lodestar provides the following as standard:

- industry-standard output telegrams
- battery backup to maintain uninterrupted operation in the event of brief power failure
- Battery operation will last up to two hours when using a battery from a fully-charged condition.
- 8 GB of internal memory.
- Upgrade capability to a full Inertial Navigation System (INS) that provides additional outputs of position, velocity, orientation and angular velocity at high update rates.
- 0.03° secant-latitude heading accuracy.
- 0.01° roll and pitch measurement accuracy.
- Fast follow-up speed of 500° per second.
- Single-box solution for motion sensor and gyrocompass.
- No dedicated GPS receiver necessary.
- A settling time of less than five minutes.
- Support for all industry-standard telegrams.
- Ethernet interface as standard.
- Mean Time Before Failure (MTBF) for the IMU in excess of 100,000 hours.
- Low life-cycle cost.
- Flexible mounting arrangements.
- Low current draw on start-up.
- Choice of three subsea unit depth ratings – 1000, 3000 or 5000 metres.
- Heave measurement accuracy the greater of 5 cm or 5% of measured heave.
- Robust heave algorithm.
- Data output through RS232 or RS485 serial or Ethernet interfaces.

The Lodestar has undergone independent and exhaustive testing against an industry-recognised reference and has proved capable of delivering accurate measurements in highly dynamic marine environments. Lodestar benefits from Sonardyne’s world-class manufacturing, support and training organization, which has a well-established record for providing trusted solutions.

3.2 Front panel features of the Surface Lodestar

Sonardyne has designed the Lodestar AHRS to be as simple as possible to install, connect, configure, and operate. To support this design principle, the front panel of the Surface Lodestar has only a single operator control, a series of LED status indicators, and eight ports to connect Lodestar with external equipment and supplies. The Surface Lodestar is shown in Figure 1.

Figure 1 – Surface Lodestar – Front Panel

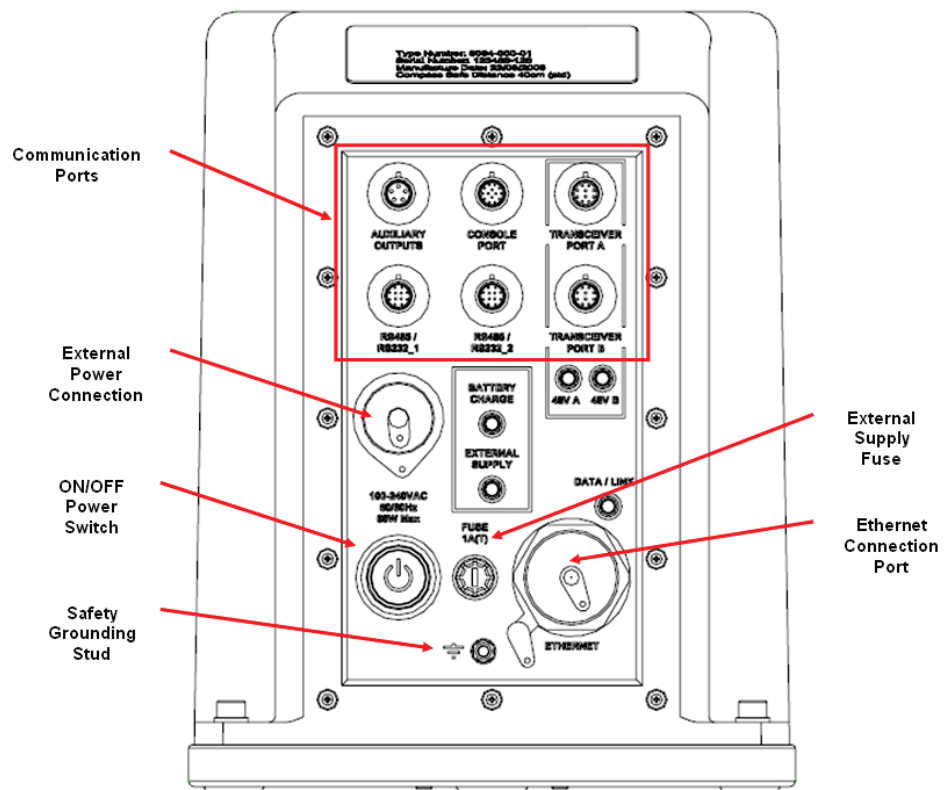


Table 1 lists and describes the connection ports on the front panel of the Surface Lodestar.

Table 1 – Connection ports on the Surface Lodestar front panel

Port Name	Description	Cable P/N	See Page
Auxiliary Outputs	<p>A 5-way female Lemo port that provides selectable analogue outputs for each pin.</p> <ul style="list-style-type: none"> • Range ± 10 V • Resolution 12 bit • Minimum load 10 kΩ / 30 nF 	8084-047	48

Console Port	A 14-way female Lemo port that allows connection of a PC to communicate with the Lodestar for configuration or data logging purposes. DC power for the unit may be connected here (24 / 8 V nominal).	8084-133	43, 44
<p>IMPORTANT: The console port connection uses a channel select line to specify RS232 (default) or RS485.</p> <ul style="list-style-type: none"> – Connect Channel select to ground if you are using RS232. – Leave Channel select disconnected if you are using RS485 			
RS485/ RS232_1	Two 12-way female Lemo ports that allow serial data connection between the Lodestar and external equipment. These ports are both available to: <ul style="list-style-type: none"> • transmit measurements from the Lodestar to receiving equipment • receive aiding information from external sources, for example a GPS receiver • send or receive a trigger signal 	8084-134	45
RS485/ RS232_2 ^a			
Transceiver Ports	A 10-way female Lemo port that allows direct serial connection between Lodestar and Sonardyne acoustic transceivers or other external instruments. These ports are also both available to: <ul style="list-style-type: none"> • transmit measurements from Lodestar to receiving equipment • receive aiding information from external sources, for example a GPS receiver. • send or receive a trigger signal 	8084-135	46,47
Power In	A 3-way male inlet port that accepts electrical power from an external mains electrical source. This port accepts 110 / 230 V AC at 50 / 60 Hz. Lodestar draws a maximum 20watts from the external power. There is a 500mA(T) fuse in line with the external electrical supply. The fuse is accessible without disassembling the unit.	8084-054	49
Ethernet	A 100BaseT Ethernet port.		

^a When using Lodestar to supply NMEA outputs to multiple listening devices, use a two-wire shielded twisted pair. See section 5.7 beginning on page 31 for information. The RS485 differential line consists of two pins – ‘A’ and ‘B’ as defined in the NMEA standard:

‘A’ (TxD– / RxD-), or the inverting pin, is negative (compared to B) when the line is idle (data is 1)
‘B’ (TxD+ / RxD+), or the non-inverting pin, is positive (compared to A) when the line is idle (data is 1)

ON/OFF power switch The ON/OFF power switch is a push button switch. Press and release to start the Lodestar. Press and hold for at least 4 seconds to close down the Lodestar.

CAUTION The ON/OFF power switch controls all power to operate the Lodestar Attitude and Heading Reference System, including power from the backup battery. If you operate the switch to power-off the Lodestar, ALL Lodestar functions will stop after a short delay.

When you operate the switch to power-on the Lodestar, you must wait for the settling time before the unit's heading measurements conform to the published accuracy specification. See Lodestar AHRS Operation Manual UM-8084-107.

External supply fuse The single panel-mounted fuse holder carries a 20mm time-delay fuse rated at 500 mA(T). This fuse protects the external power connection. Fuse failure does NOT disconnect the internal backup battery, which will maintain the Lodestar operation for up to three hours from a fully-charged condition. An LED on the front panel indicates when the Lodestar is operating on the internal battery.

Indicator LEDs Five LEDs indicate the status of power and communications for the surface Lodestar.

BATTERY AND CHARGE STATUS LEDs

There are two LEDs to show the status of Battery Charge and of the External Supply. Table 2 explains how these status LEDs operate¹.

Table 2 – Battery and charge status LEDs

External power	Battery status	Lodestar status	Battery charge	External supply
Supplied	Charging	Off	Flash green	Solid orange
	Fully charged	Off	Solid green	Solid orange
	Charging	On	Flash green	Solid green
	Fully charged	On	Solid green	Solid green
Not supplied	Discharging	On	Solid red	Off
	Low	On	Flash red	Off
	Flat	On	Off	Off

1. In normal operation the External Supply LED and Battery Charge LED should both be green. If the Battery Charge LED shows red, then the external supply has been lost and the Lodestar is running on the internal battery, which will provide up to 3 hours of operation from a fully-charged condition. Switching off will also show red because the switch-off sequence is controlled by the software.

TRANSCEIVER PORT AND DATA/LINK LEDS

The remaining LEDs show the status of the transceiver ports and the data port, as explained in Table 3.

Table 3 – Transceiver and data LEDs

LED	Colour	Description
Data/Link	Green	Illuminates when the Ethernet link is active and is passing data.
	Orange	Illuminates to show the Ethernet link is available.

Safety grounding stud The surface version has a safety grounding stud fixed to the front panel. It is necessary to connect this to a good grounding point on the vessel. This connection is in addition to the ground connection made through the cable.

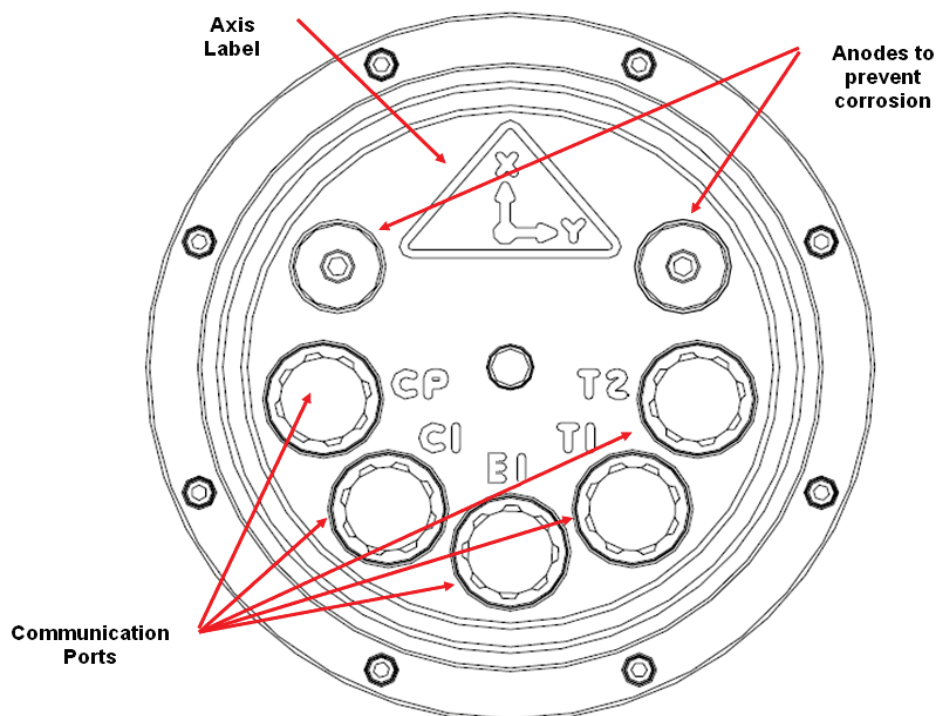
CAUTION The Surface Lodestar must be permanently bonded to a suitable grounding point on the vessel using the grounding stud. 16 AWG cable (or better) should be used for this.

3.3 Connectors of the Subsea Lodestar

The subsea version of the Lodestar AHRS does not include any operator controls or indicators. The unit's housing is cylindrical with two end-caps to provide watertight seals of the appropriate depth rating.

One end-cap is flat to support mounting against a flat surface. The other end-cap includes ports for connection between Lodestar and external equipment and supplies. The Subsea Lodestar is shown in Figure 2.

Figure 2 – Subsea Lodestar – End-cap Connections



Port Name	Description	Cable P/N	See Page
Console Port	An 8-way male port allows connection of a PC to communicate with the Lodestar for configuration or data logging purposes. This port also receives DC power from an external source. IMPORTANT: DO NOT connect AC power to the Subsea Lodestar. See section 4.3 beginning on page 23 for details about Lodestar's electrical requirements.	8084-136	50, 51
C1 Port	An 8-way female port allows serial data connection between the Lodestar and external equipment. This port can: <ul style="list-style-type: none"> transmit measurements from the Lodestar to receiving equipment receive aiding information from external sources, for example a GPS receiver. send or receive a trigger signal 	8084-137	52, 53
E1 Port (Labelled C2 on old units)	An 8-way female port allows Ethernet data connection between Lodestar and external equipment. This port can: <ul style="list-style-type: none"> transmit measurements from Lodestar to receiving equipment receive aiding information from external sources, for example a GPS receiver send or receive a trigger signal 	8084-138	54, 55
T1 Port T2 Port	Two 6-way female ports allow direct serial connections between the Lodestar and Sonardyne acoustic transceivers or other external instruments. These ports are also both available to: <ul style="list-style-type: none"> transmit measurements from the Lodestar to receiving equipment receive aiding information from external sources, for example a GPS receiver or Doppler velocity log. send or receive a trigger signal 	8084-139	56,57

CAUTION The unit's depth rating requires all ports to have either the correct connector or the correct dummy plugs securely fitted when the unit is in water. The connectors are open-faced without their dummy plugs fitted and are not waterproof in this state.

NEVER deploy the Subsea Lodestar in water unless all connectors on the end-cap have their correct plugs or dummy plugs fitted properly. Sonardyne supplies dummy plugs for this purpose.

Note: To improve the sealing performance of the connectors and dummy plugs, smear a very light coating of grease, such as Molykote 44 Medium, approved for use in deep-water seals, over the mating surfaces of the connector. Do not use oils or greases not suitable or approved for this purpose.

Before you assemble any connectors on the Subsea Lodestar, make sure both parts of the connector are in good condition and any O-rings are undamaged and fitted correctly.

3.4 Operation

The Surface Lodestar begins to operate when you connect electrical power and operate the ON/OFF switch to power-on the unit.

The Subsea Lodestar begins to operate when you connect electrical power to the unit.

Start Up Immediately following start-up, the Lodestar operates for a period of 20 seconds in its firmware loader mode, during which it completes a built-in self-test routine.

While operating in this mode, the Lodestar sends information about itself and its configuration through the Console port to a receiving PC, for example:

```
Firmware Loader Version 1.03.01.25 Feb 17 2010 09:23:33
CPU UART FPGA 3
CPU Interconnection FPGA 2
SDHC Card capacity:- 7948206080 bytes
.....
Loading firmware.....
```

Note: The communication parameters used for the Console port are initially fixed at 9600 baud, 8 data bits, 1 stop bit and no parity.

On completion of this firmware loading routine, Lodestar switches to the saved output configuration and begins to operate in accordance with the saved configuration.

See section 7.1 starting on page 36 for instruction on how to upgrade the Lodestar firmware.

Shutdown In addition to the ON/OFF switch for the Surface Lodestar described in section 3.2 the Lodestar can be turned off via the terminal interface.

To turn off the Lodestar you must enter the command mode using the following key entries:

- Hold down the CTRL and o keys together.
- Then type the following letters in sequence; SON

You will then be informed that you are in command mode with the following prompt:

```
% SAINTS Command Line
```

At this point, the Lodestar can be shutdown by typing in the shutdown command **SYS SHUTDOWN 1** three times, as shown in the example below.

```
SYS SHUTDOWN 1
SYS SHUTDOWN 1 (Shutdown No. 1)
ok
SYS SHUTDOWN 1
SYS SHUTDOWN 1 (Shutdown No. 2)
ok
SYS SHUTDOWN 1
SYS SHUTDOWN 1 (Shutdown No. 3)
INFO: Shutting down...
```

The Lodestar will then shutdown.

Note that in firmware V2.03 onwards the Lodestar will shutdown with a single command instead of 3.

Configuration Software supplied by Sonardyne allows the user to configure and operate the Lodestar (for AHRS operation, see manual UM-8084-107 for guidance on configuration). The Lodestar stores the configuration requirements in non-volatile memory, and uses the stored details to restore the same operating condition when you power-on the unit subsequently.

After you have made all connections between the Lodestar and external systems, and you have configured Lodestar fully, the configuration PC can be disconnected and allow the Lodestar to operate as a stand-alone motion reference unit. In this mode, the Lodestar will continue to operate in the same configuration until you connect the PC and change the unit's configuration.

3.5 Warranty

The Lodestar AHRS/INS is warranted against defects discovered in materials and workmanship during a period of twelve (12) months from the date of shipment from Sonardyne International Limited unless otherwise stated. This warranty is limited to the replacement or, at Sonardyne's option, repair free of cost, F.O.B. Sonardyne's loading bay in Yateley, UK, provided the equipment was not abused or operated other than in accordance with the instructions in this User Manual.

All warranty repair claims must be returned to Sonardyne with a letter stating the problem and probable cause together with a date and time of failure, with proper documentation and with freight, handling and customs duties (if any) prepaid. Return freight must also be prepaid unless otherwise arranged. Defective goods returned to Sonardyne must be satisfactorily packed and they remain at the Purchaser's risk.

This warranty shall not extend to ex-demonstration units or any item of equipment not manufactured by Sonardyne International Limited. If the supplied goods were not manufactured by Sonardyne, then Sonardyne shall attempt to assist the Purchaser to obtain from the manufacturer thereof the benefit of any warranty or guarantee relating to them given by such manufacturer to Sonardyne.

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- All product names referenced in this document are trademarks of their respective companies. Use of a term in this document should not be regarded as affecting the validity of any trademark or service name.
- Sonardyne International Limited reserves the right to modify or make changes to the Lodestar AHRS/INS, and the information contained within this document is subject to change without notice. Any changes will be notified to the holder of this document at the discretion of Sonardyne.
- Product Support** For a list of contact details for Sonardyne's offices and agents, please refer to section 8.2 "Sonardyne Offices and Agents" beginning on page 41.

4 Technical Specifications

4.1 Introduction

Sonardyne International Limited exercises a policy of continual product development and improvement. The technical specifications included in this chapter are subject to change without notice. If necessary, contact Sonardyne International Limited for details of the current specification.

Product Versions Table 5 lists the versions of the Lodestar currently available.

Table 5 – Lodestar Versions

Part Number	Description
8084-000-0000	IP67-rated surface version
8084-000-1110	1000 m depth rated version
8084-000-3110	3000 m depth rated version
8084-000-5310	5000 m depth rated version

4.2 Physical

Surface version The physical specification of the Surface Lodestar are shown in Figure 3 and Figure 4.

Figure 3 – Physical specifications – Surface Lodestar

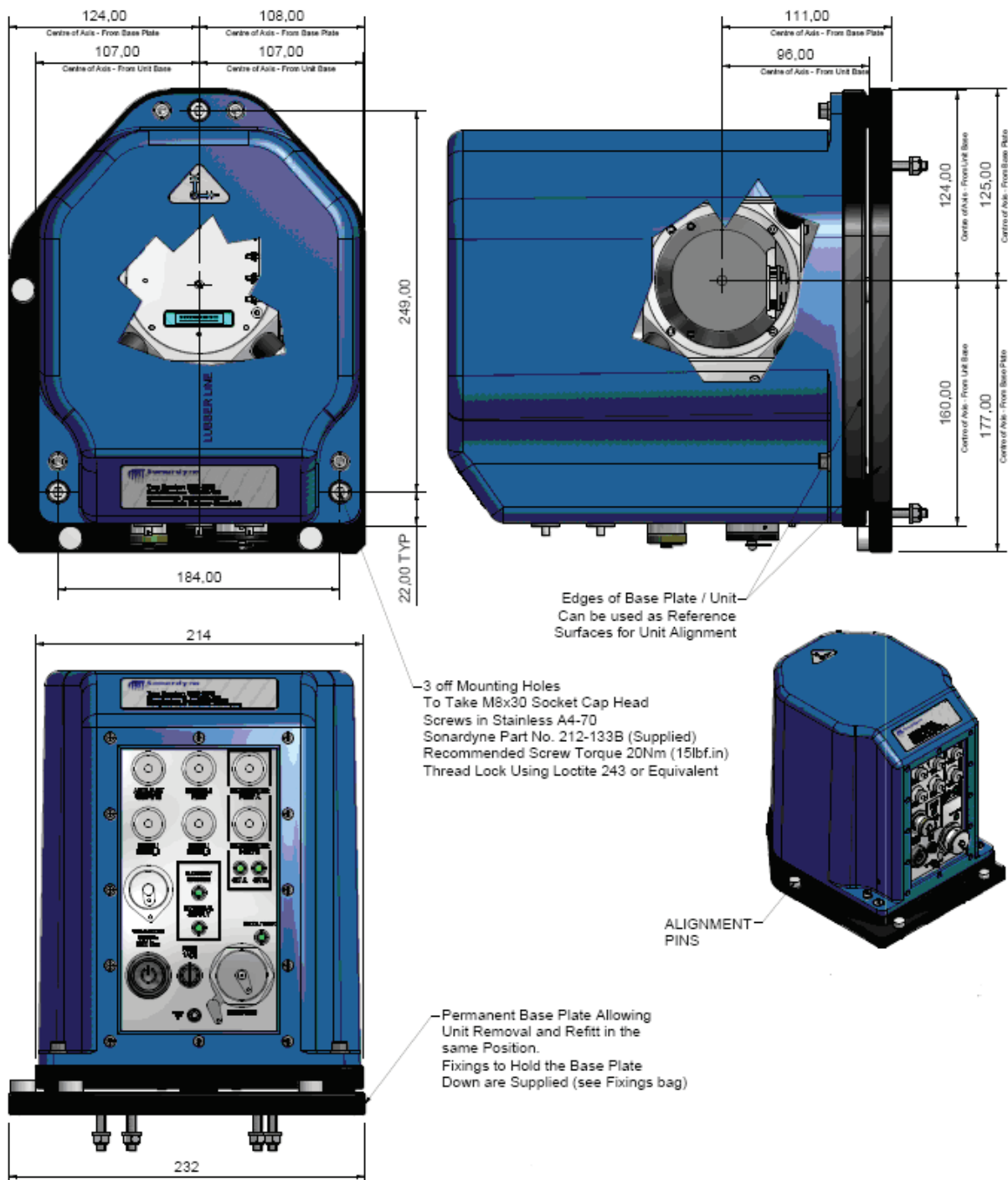
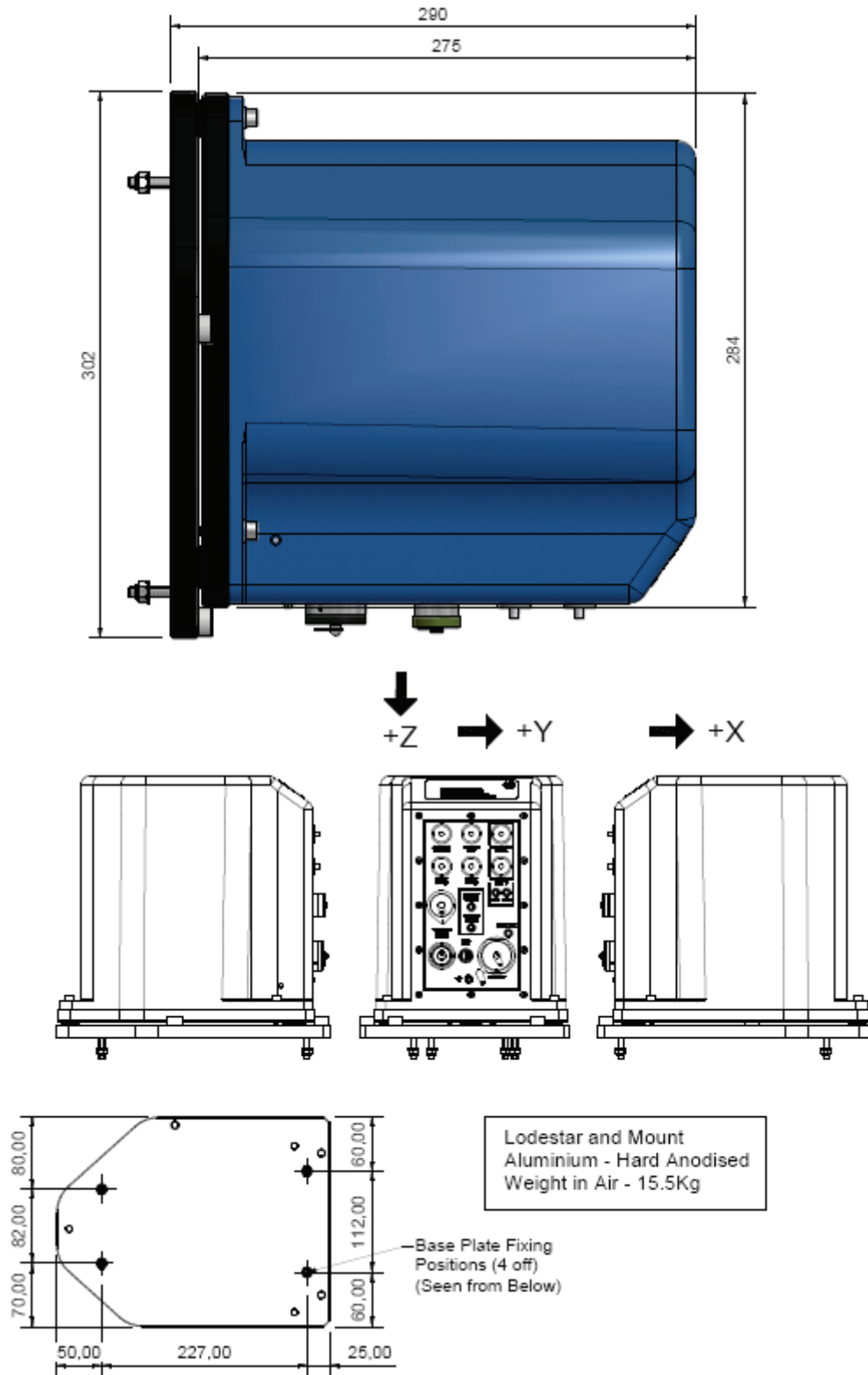


Figure 4 – Physical specifications – Surface Lodestar (continued)



Subsea versions The physical specifications of the Subsea Lodestars are shown in Figure 5, Figure 6 and Figure 7.

Figure 5 – Physical specifications – 1000 m Subsea Lodestar

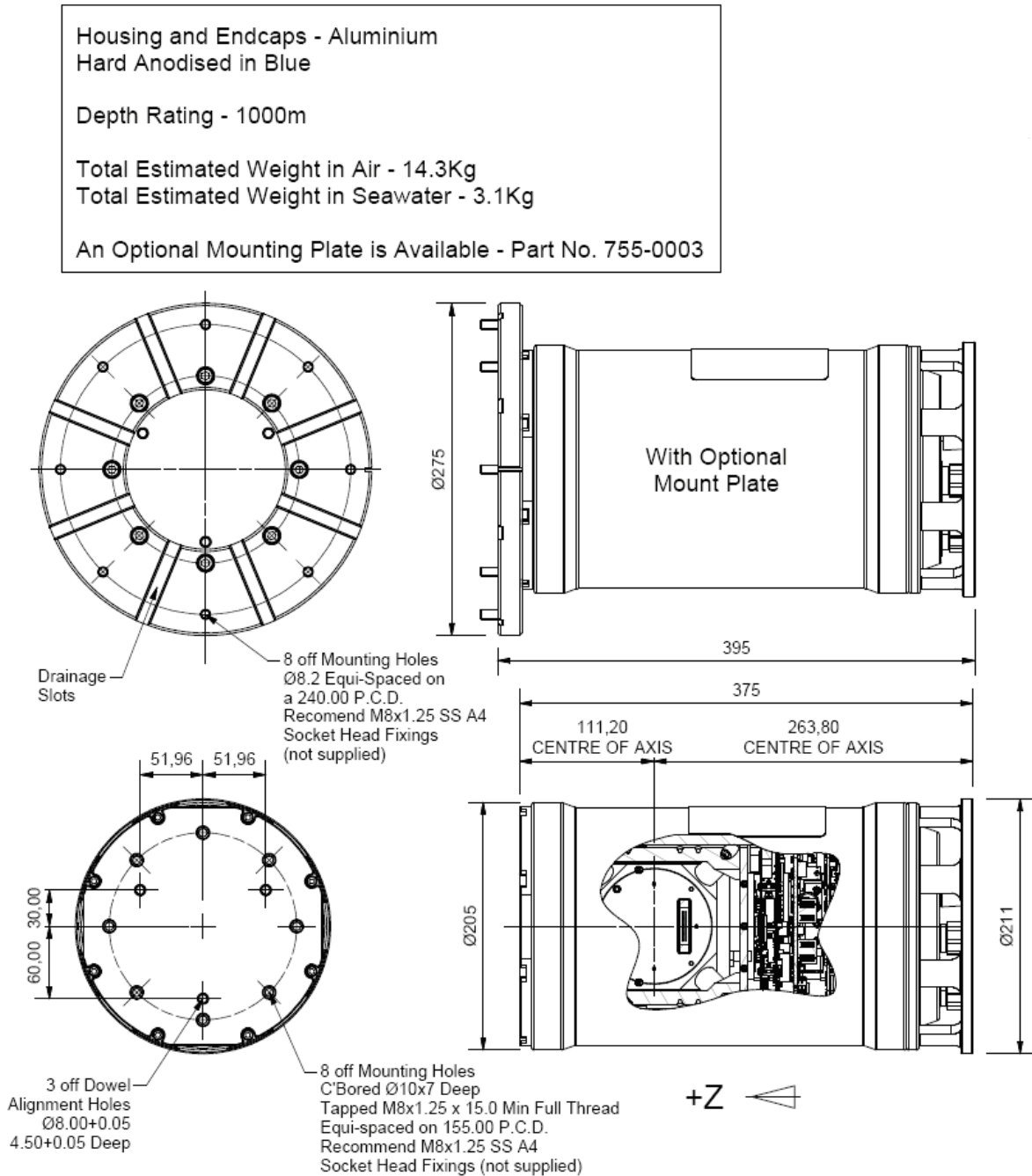


Figure 6 – Physical specifications – 3000 m Subsea Lodestar

Housing and Endcaps - Aluminium Hard Anodised in Blue
Guard - Acetal Black

Depth Rating - 3000m

Total Estimated Weight in Air -21.5Kg
Total Estimated Weight in Seawater - 8Kg

An Optional Mounting Plate is Available - Part No. 755-0003

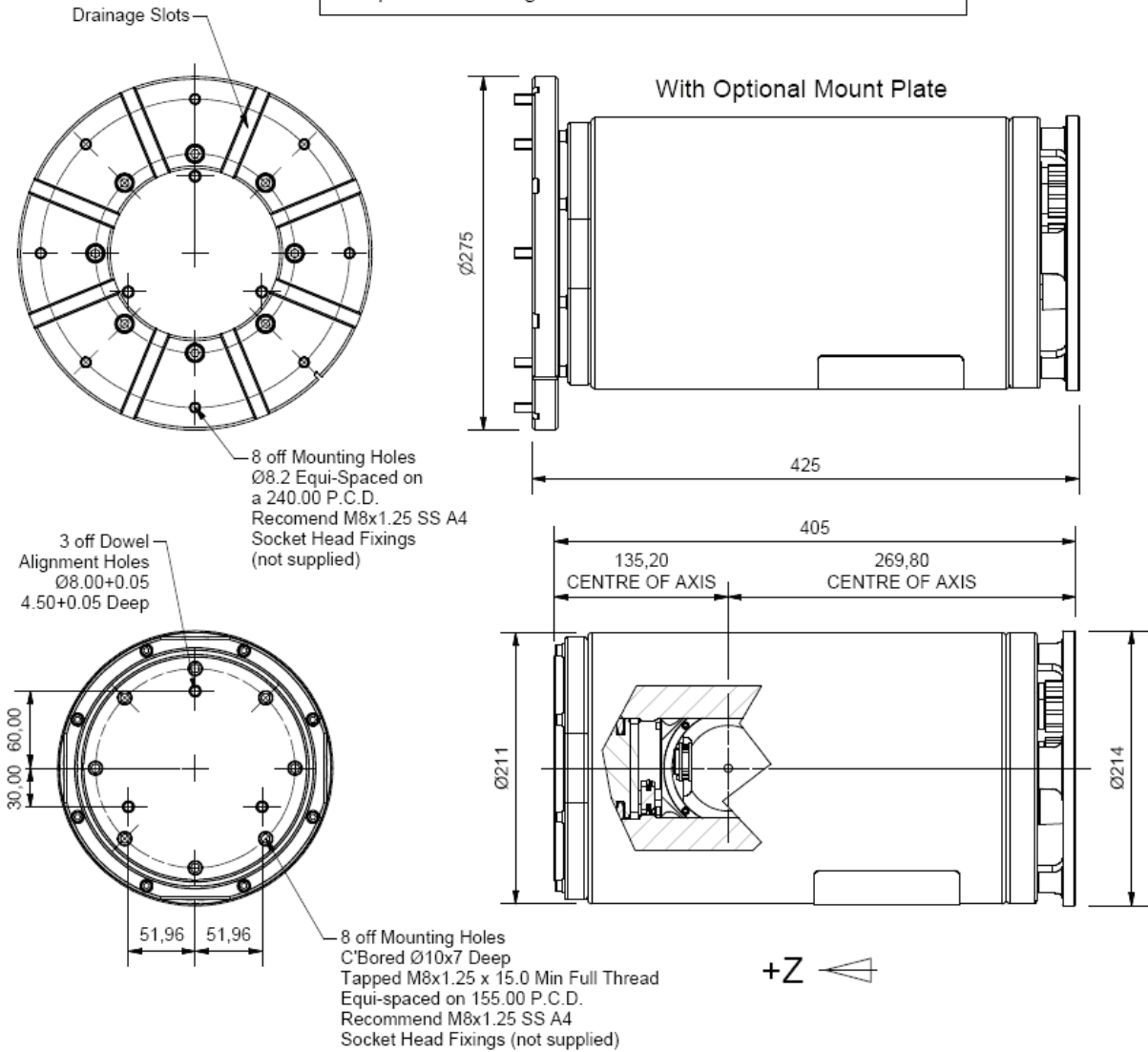
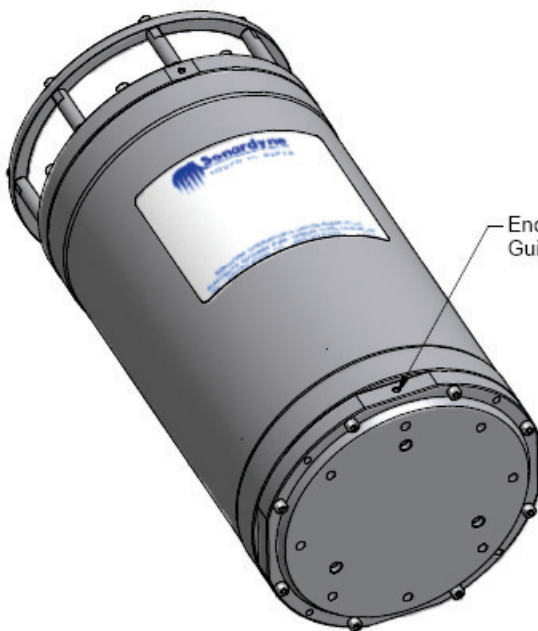
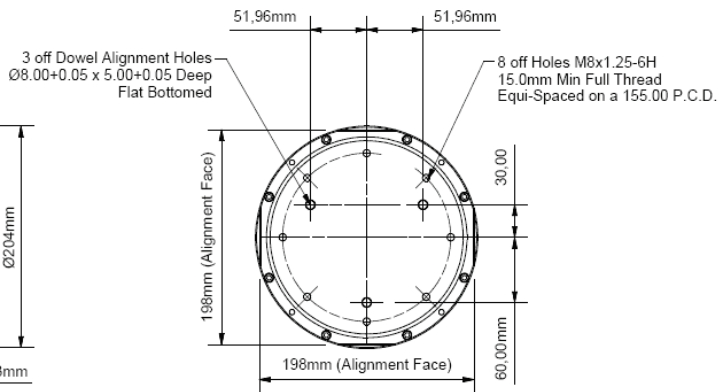
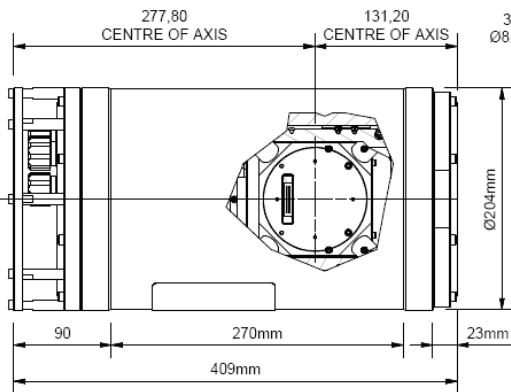
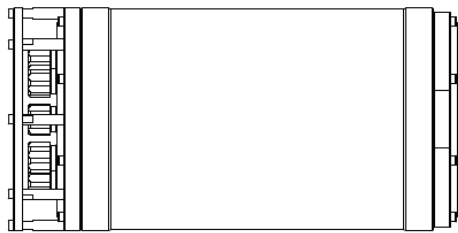


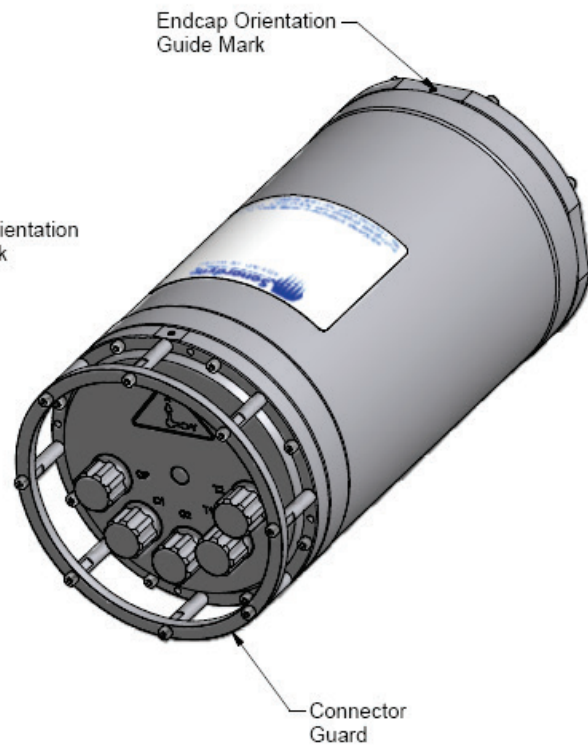
Figure 7 – Physical specifications – 5000 m Subsea Lodestar

Housing and Endcaps - Super Duplex Stainless steel
Depth Rating - 5000m

Total Estimated Weight in Air - 39Kg
Total Estimated Weight in Seawater - 28Kg



Endcap Orientation Guide Mark



Endcap Orientation Guide Mark

Connector Guard

4.3 Electrical

Electrical power requirement 110 / 240 VAC 50 / 60 Hz (for use with the surface version of Lodestar *only*), or

24 or 48 VDC (for use with the surface or the subsea versions of Lodestar)

Power demand 15 watts nominal, 20 watts maximum

Backup battery type Lithium-ion rechargeable

Backup battery support Up to 2 hours from a fully-charged condition

Data Interface Data storage 8 GB on-board RAM
Number of digital ports 4

Protocol RS232 OR RS485

Ethernet Single 100BaseT Ethernet port

Analogue Output Range ± 10 V
Resolution 12 bit
Minimum load 10 k Ω / 30 nF

4.4 Environmental

Mechanical: Surface Aluminium casing (powder coated)
Subsea Anodised aluminium (1000 & 3000 m)
Super Duplex Stainless Steel (5000 m)

Ingress: Surface IP66
Subsea 1000, 3000 or 5000 metres depth rated

Operating temperature -10°C to $+55^{\circ}\text{C}$ (14°F to 131°F)

Humidity Surface Version 0-90% RH non-condensing

Shock rating (operational) 22g, 11 ms half-sine

4.5 Performance

Heading Range 0.00° to 359.99°
Accuracy 0.04° secant latitude rms
Settling time Better than 5 minutes when stationary
Follow-up speed 500° per second
Resolution 0.01°

Roll and Pitch	Range	±90° (no physical limit)
	Accuracy	0.01°
	Resolution	0.01°
Heave	Range	±99 metres
	Accuracy (real time)	The greater of 5 cm or 5% of measured heave
	Bandwidth	User selectable
	Resolution	0.01 metres

Note: The power demand listed above is correct for the Lodestar when used as a standalone instrument.

5 Installation

5.1 Introduction

The performance specification listed in section 4.5 for the Lodestar Attitude and Heading Reference System is valid for the Lodestar's body frame. For Lodestar's measurements to be valid for the vessel on which it is mounted, it is very important to install Lodestar correctly as detailed in this chapter.

CAUTION Any misalignment between the Lodestar's IMU body frame and the vessel's body frame will mean that angles of heading, roll and pitch reported by Lodestar will be accurate for the Lodestar, but will NOT be accurate for the vessel.

This chapter explains how to install the Lodestar correctly so that its measurements are valid for the vessel. It explains all the electrical and data connections required, and provides information to help use Lodestar with multiple data receiving units.

5.2 Unpacking and inspection

Handling The Lodestar AHRS includes a number of delicate and sensitive electronic components. In particular, the accelerometers and Ring Laser Gyroscopes (RLGs) that form the Inertial Measurement Unit (IMU) are sensitive to shock and vibration. If damaged, these components cannot be replaced in the field, and the complete Lodestar unit must be returned to the factory for repair and recalibration.

CAUTION Always handle the Lodestar with care. Store the unit in the shipping container until it is ready to be installed in the prepared location.

Inspection Inspect the Lodestar and all the supplied parts on receipt, and check the shipment includes all the items listed on the shipping documents. Inform Sonardyne immediately if there are any parts missing, or if any of the supplied parts show signs of damage.

5.3 Installation location

The Lodestar can be installed at any convenient location on the vessel, from where it will deliver accurate measurements. However, to gain optimal performance from the system, identify a location to install the Lodestar that conforms as closely as possible to the following criteria:

- If possible, the location should be close to the vessel's centre of rotation under normal operating conditions.
- The location must not be subject to excessive vibration or impulse shock.
- The location must not be subject to strong magnetic or alternating electrical fields.
- The location must not exceed the environmental limits for temperature defined in section 4.4 on page 23. Do not subject Lodestar to regular and rapid changes in temperature.
- The location must provide a mounting surface that is level with respect to the vessel's body frame and of sufficient strength to support the Lodestar's weight safely and without flexing.
- The location must provide access for power and communication connections.
- There must be sufficient space to allow easy access to install the Lodestar, and to connect a PC for configuration purposes.
- Do not store tools, equipment or chemicals where they can damage the Lodestar or the connection cables.
- Make sure the Lodestar and its connection cables do not cause an obstruction to personnel operating in the area. Do not use a location where the connection cables are likely to suffer damage from mechanical stresses or chemical attack.

5.4 Site preparation

You can install the Lodestar AHRS with any convenient orientation with respect to the vessel's body frame. You can compensate for any misalignment between the Lodestar and the vessel by carefully measuring the mounting angles and entering them in software.

The site preparations you make before you install the Lodestar are important. The alignment of the Lodestar to the vehicle is discussed in section 5.5 and in depth in the Lodestar AHRS Operation Manual UM 8084-107.

Figure 8 and Figure 9 show the mounting arrangement for the surface and the subsea version of the Lodestar.

The surface version uses three M8 stainless steel socket cap head bolts and washers to secure the Lodestar to the mounting location. Sonardyne does not supply these fixing bolts.

You can use a similar mounting plate to secure the subsea version of the Lodestar, or you can use strong stainless steel straps and protective rubber strips to secure the Lodestar to a convenient location on the ROV frame. Sonardyne does not supply the fixings for these methods.

Whichever mounting method you use, prepare the location carefully to achieve coarse alignment between the Lodestar and the vehicle. See "Coarse alignment" on page 29 for information. Make sure the mounting holes are clear of swarf.

CAUTION Take care to protect the Lodestar's surface finish against scratches or damage. If you damage the surface finish on the Lodestar's outer casing, corrosion can occur.

Figure 8 – Mounting arrangement – Surface Lodestar

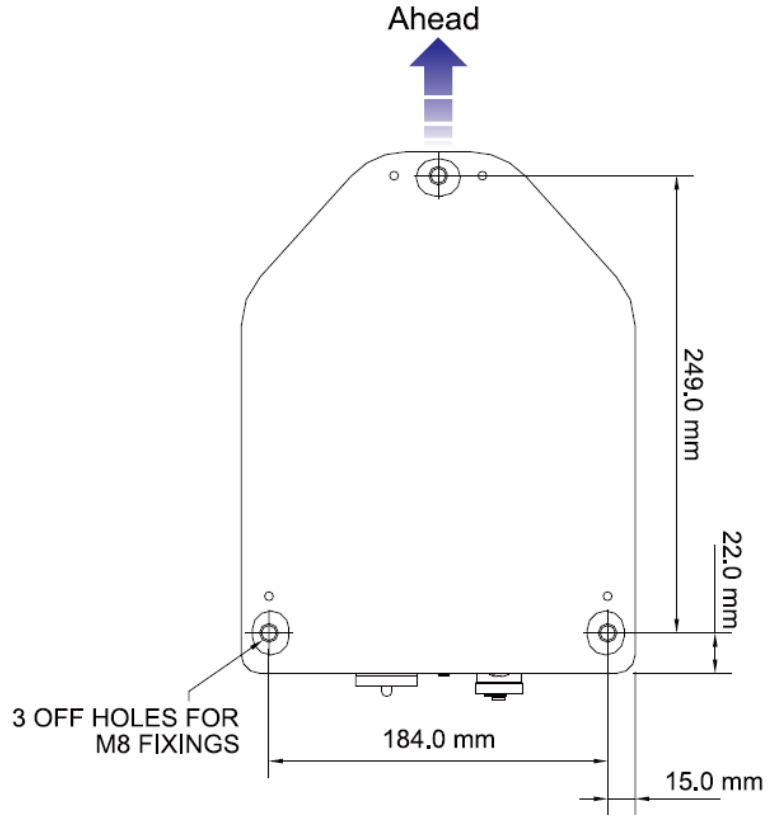
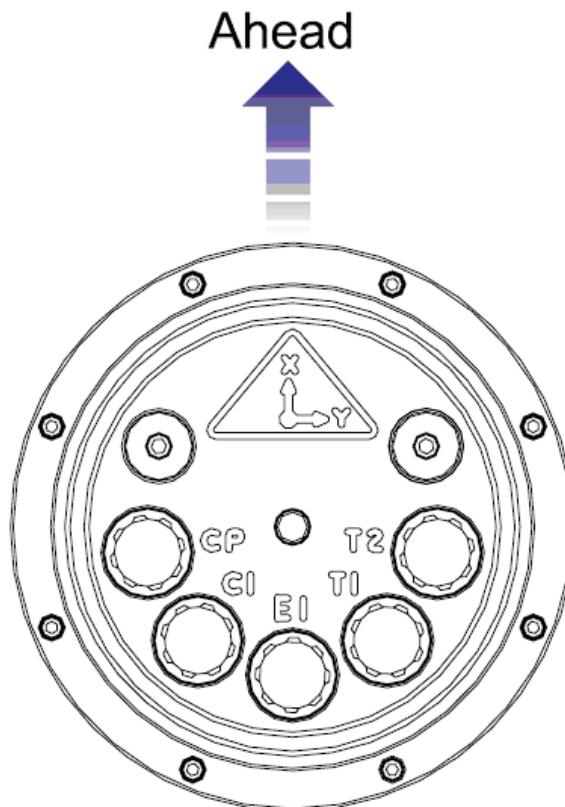


Figure 9 – Mounting arrangements – Subsea Lodestar



5.5 Alignment

Course alignment When you install the Lodestar you should attempt to align to within $\pm 2^\circ$ of the vehicle's axes, see Figure 30 on page 58 for an explanation of the Lodestar reference frame.

Alignment Marks The base plate of the Surface Lodestar has three reference edges which you can use to align Lodestar with the vessel's lubber line or with another reference baseline. It also has three supporting feet that allow the base plate to rest on a reference plane without rocking.

The Subsea Lodestar has four flats machined into the base plate that serve as alignment references.

Mounting Angles If it is not possible to mount the Lodestar within the limits described above for course alignment or if you wish to mount the Lodestar at other angles with respect to the reference axes on the vessel, ROV or platform, the mounting angles will need to be measured and configured on the Lodestar.

The Lodestar can be configured for any mounting angle that may be required.

An in-depth description of the theory and process for measuring and configuring mounting angles can be found in the Lodestar AHRS Operation Manual UM 8084-107. Also within this manual is an explanation for the effects of misalignments between the vehicle and the Lodestar.

5.6 Connections

The connections necessary depend on the application.

Sonardyne supplies cables for connection to the Lodestar. The supplied cables all have appropriate connectors at one end, and open tails at the other for direct connection into external equipment or into a junction box on the vessel or vehicle. The cables are all nominally 4 metres long as standard. Other cable lengths are available on request.

Cables (including pin outs) are described in Appendix B.

See section 5.7 "NMEA Connections to Listening Equipment" below for information concerning the connection requirements at the external receiving equipment when supplying NMEA output sentences.

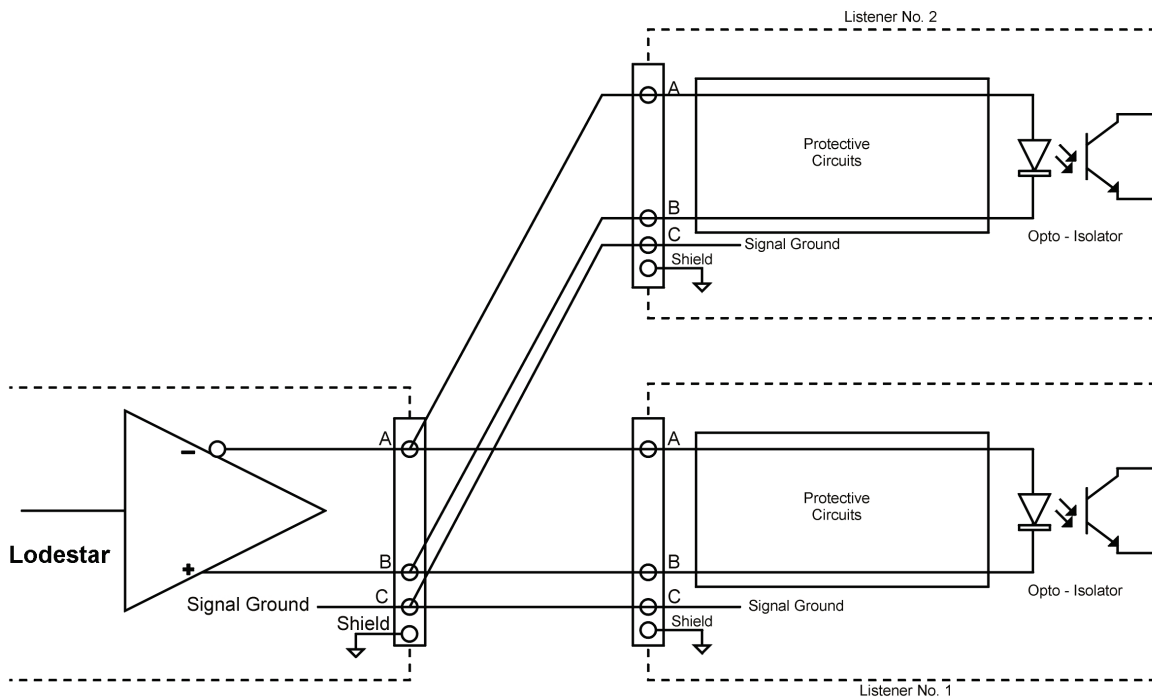
5.7 NMEA Connections to Listening Equipment

It is possible to connect a single Lodestar to more than one listening unit so that, with Lodestar transmitting multiple NMEA sentences, each listener selects the sentences they require and ignores all others.

Connection arrangements

When used in this way, interconnections are through a two-conductor, shielded twisted pair as shown in Figure 10.

Figure 10 – Listener receiving circuit



Receive circuits Multiple listeners can be connected to a single transmitting Lodestar. The listener receive circuit must include an opto-isolator and protective circuits that limit current, and protect against reverse bias and power dissipation at the opto-diode as shown above.

The receive circuit must be designed for operation with a minimum differential input voltage of 2.0 V and must not take more than 2 mA current from the line at that voltage.

In the arrangement shown in Figure 17, all signal line A connections must be connected to the listener device A connections, and signal B connections connected to listener B connections. The shields of all listener cables should be connected only to the Lodestar chassis—NOT to the listening device.

Within each listener there must be no direct electrical connection between signal line A, the return line B, the shield, and the vessel's ground or power lines.

Signal state definitions

The idle, marking, logical 1, OFF or stop bit states are defined by a negative voltage on line A with respect to line B.

The active, spacing, logical 0, ON or start bit states are defined by a positive voltage on line A with respect to line B.

6 Troubleshooting

6.1 Introduction

This chapter provides guidance to fault identification in the Lodestar.

Before calling on technical support from Sonardyne International Limited, preliminary checks should be made on the Lodestar first, as explained in this chapter, so that you can supply a full description and other details relating to the problem.

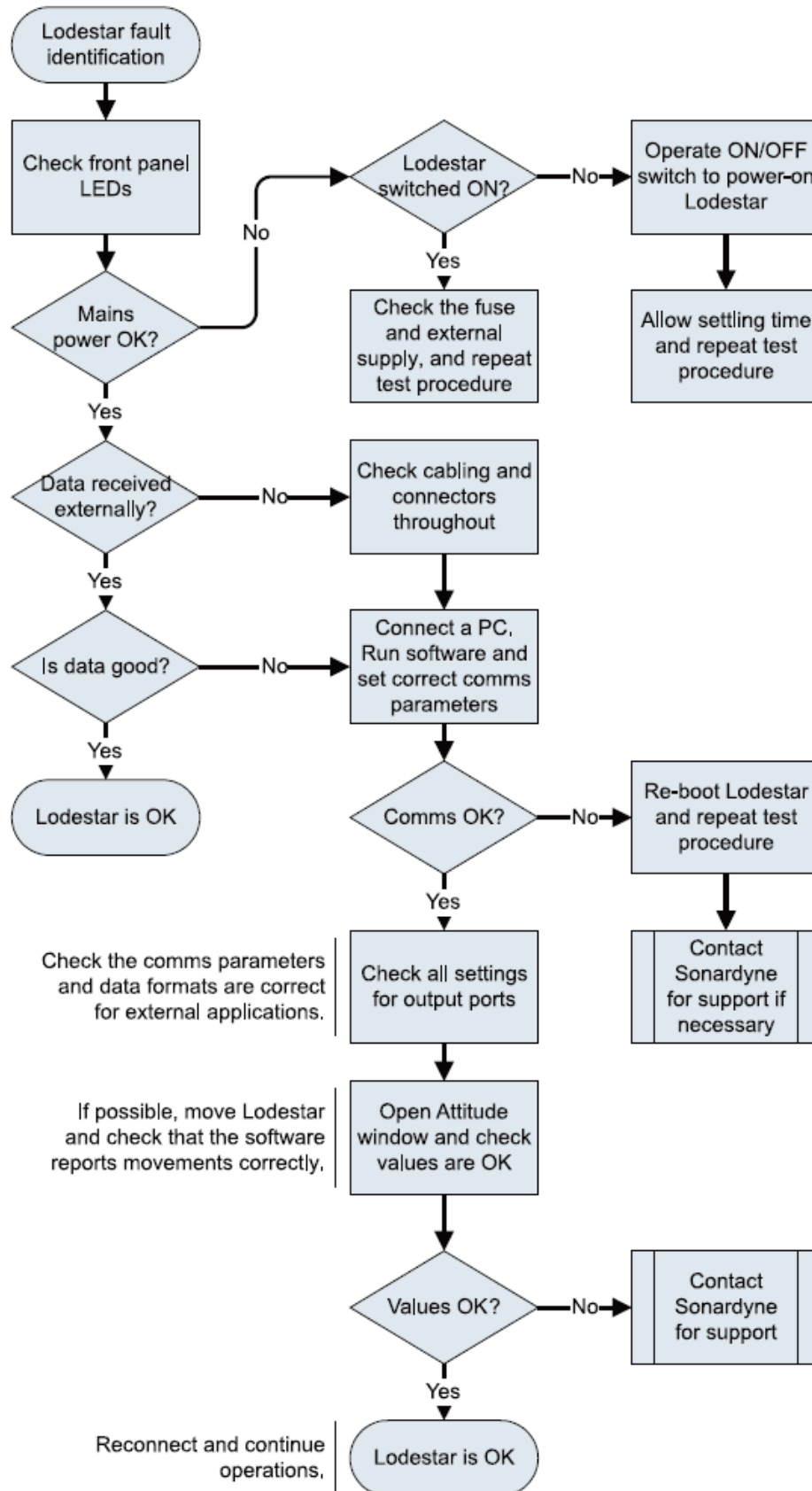
If technical support from Sonardyne is required, provide information about the Lodestar configuration in use at the time when the problem occurred. You can do this by supplying a copy of the relevant configuration file saved automatically by the Lodestar, see Lodestar AHRS Operation Manual UM-8084-107 for instructions. Specific Lodestar logged output may be requested.

6.2 Test Procedure

Figure 11 shows the recommended test procedure to follow if it is suspected that Lodestar has developed a fault. You can use this test procedure after installation to check the system operates correctly, and you can use it if you suspect a fault during normal operation.

CAUTION There are no user-serviceable parts inside Lodestar. DO NOT open the housing for any reason. This will invalidate the warranty.

Figure 11 – Lodestar test procedure



6.3 Check List

The following lists, separated into information needed and actions to take should be followed when trying to identify the problem in detail. Make a note of the answers to each bullet point, referring to the relevant sub-section for more details.

Information needed

The following bullet points all relate to general information about Lodestar.

Refer to the detailed explanations for each bullet point in the list.

- General description of problem.
- Events leading up to the problem.
- Is the problem repeatable?
- Does the problem occur at regular intervals?
- What version of software is being used?

Action to take

6.4 General information and action to take

- General description of problem.

The more information supplied about the nature of the problem, the easier it will be to provide fast and effective support.

- Events leading up to the problem

What actions were taken immediately prior to the problem?

Provide details about the steps taken before the problem was observed.

The more details provided the more likely it will be that the fault can be reproduced or to isolate one particular part of the application for analysis.

- Is the problem repeatable?

A repeatable problem allows for quick isolation down to a particular part of the software. A problem which can be reproduced can be investigated; it is more difficult to investigate an issue that cannot be reproduced.

- Does the problem occur at regular intervals?

If the problem seems to occur at a regular interval, what is the interval?

Knowledge of the interval between repetitive problems dictates the approach taken to isolate the problem.

- What version of software is being used?

6.5 Recovery Procedures

There are procedures that can be followed to recover the Lodestar to a known state in the event of a problem. These procedures are explained below.

Resetting Lodestar

6.5.1 Lodestar Reset

The Lodestar can be commanded to perform a hardware reset if shutting down the unit via the configuration software, command line or external switch (surface unit only) is not possible.

To perform hardware reset the user must be connected to the Lodestar serially via the console port using a terminal package such as HyperTerminal. Make sure the connection to the Lodestar is 9600 baud and RS232 protocol. If these conditions are met, the Lodestar can be restarted by typing **UNLK**, and then return in the terminal window (note the use of uppercase letters). You may need to enter **UNLK** and press return several times.

Restoring Factory Settings

6.5.2 Restore Lodestar Factory Settings

Lodestar can be commanded to restore its factory default settings.

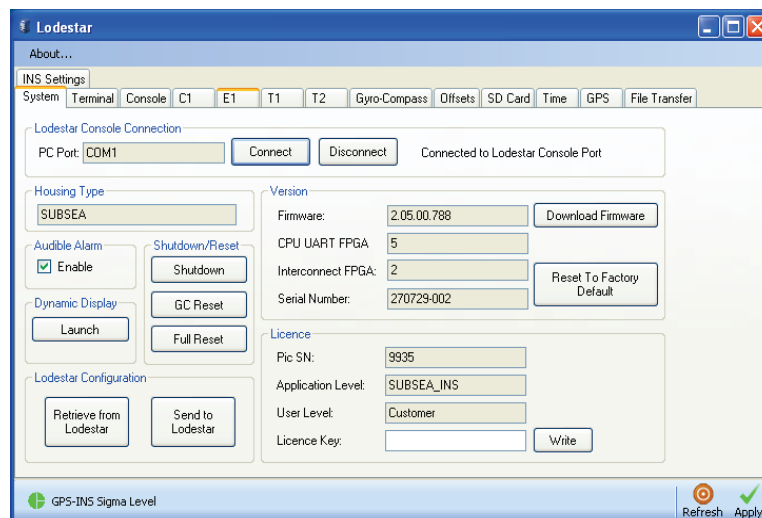
CAUTION If factory settings are restored the all previous user defined settings in Lodestar will be lost. It is recommended a careful note is taken of any required settings before restoring factory settings. See [AHRS Operation Manual UM-8084-107 for instructions](#)

The Lodestar PC Utility can be used to restore Lodestar to its default state. This procedure will succeed even if the current baud rate of Lodestar isn't known.

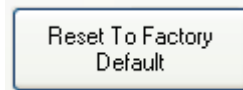
Connect the Lodestar directly to the PC using Lodestars Console port. If using a test cable then check that the blue connectors are joined to put Lodestar into an RS232 mode. Apply power to the Lodestar and wait 2 minutes for it to start up.

Open the Lodestar PC Utility and attempt to Connect to Lodestar.

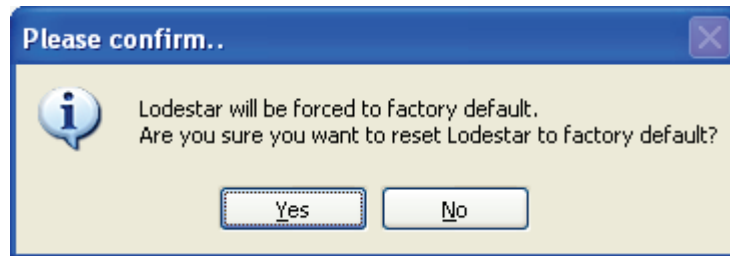
Figure 12 – PC Utility Connection



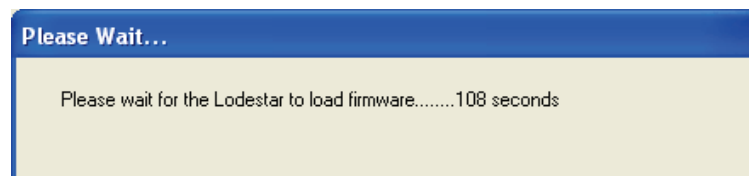
Press the Reset to Default button.



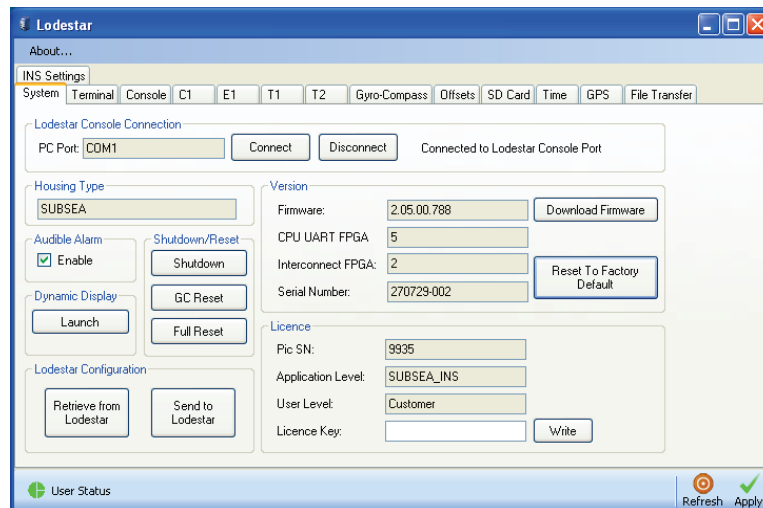
Press Yes to confirm that you want to reset Lodestar to default.



The PC Utility will reboot Lodestar and reset it to factory default state. It will then wait for Lodestar to re-boot.



After the boot process has completed the PC Utility will attempt to connect to Lodestar using factory default settings. If successful then information concerning the lodestar will be displayed.



7 Maintenance

The Lodestar can accept firmware updates through the Console port. See sections 3.2 and 3.3 for further information about the port locations.

Where it is possible to communicate with the Lodestars Console port, the firmware upgrade should be performed using the procedure in section 7.1

7.1 Firmware Upgrade using the PC Utility

The Lodestar can be upgraded in the field by customers by loading new versions of the firmware on the unit. Customers will be informed of any required firmware upgrades by Sonardyne support. The process for upgrading firmware is explained below.

Before upgrading the firmware, ensure you have the following available:

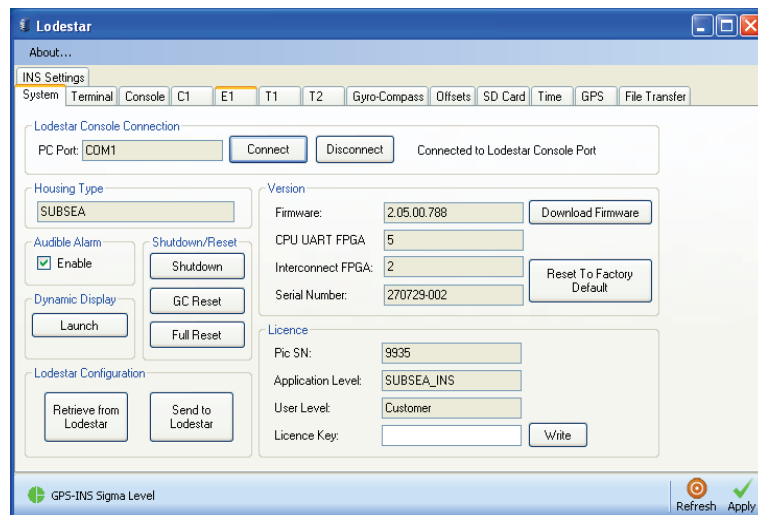
- The new firmware file (IMU.hex)
- A serial connection to the Lodestar on the console port.

Connect to Lodestar

Connect the Lodestar Console port to the PC either directly via RS232 or through an NSH. If using a test cable then check that the blue connectors are joined to put Lodestar into an RS232 mode. If not using an NSH then power to the Lodestar and wait 2 minutes for it to start up.

Open the Lodestar PC Utility and attempt to Connect to Lodestar.

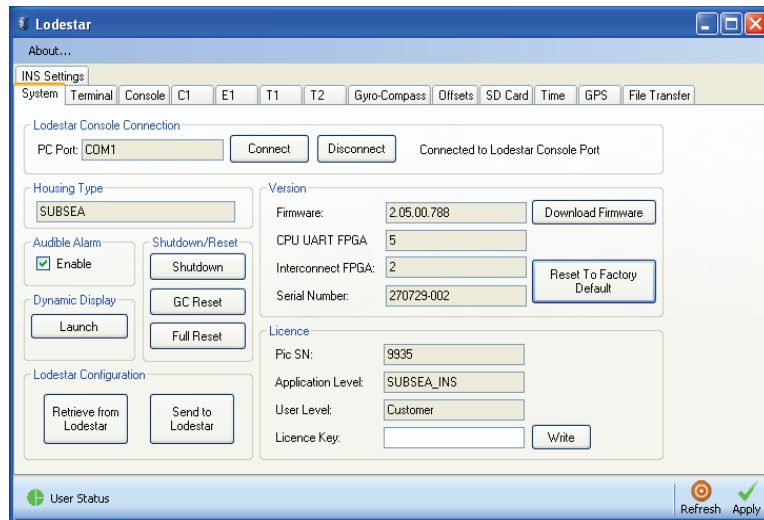
Figure 13 – PC Utility Connection



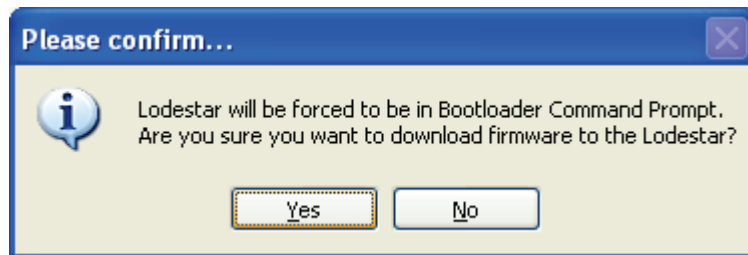
Store the Lodestars Configuration

Once connected use the 'Retrieve from Lodestar' button to store the configuration of the Lodestar as a text file. This shouldn't be needed but a backup is always recommended.

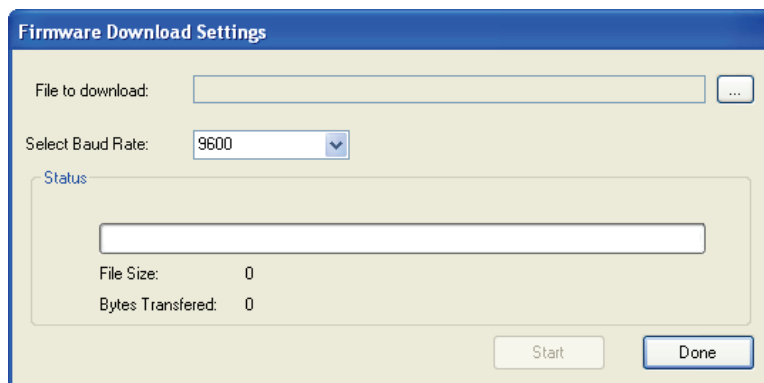
Start the Firmware Upgrade Press the Download Firmware button...



Confirm that you wish to upgrade firmware by pressing Yes...



The following dialog box will be displayed.

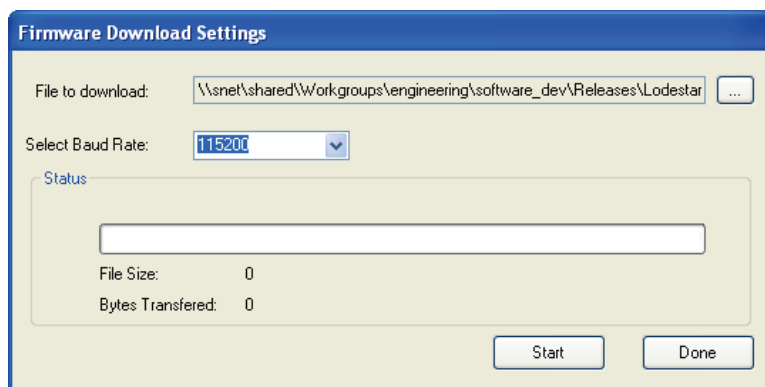


First select the file to download by browsing to the folder containing the new IMU.HEX file supplied by Sonardyne.

When a file is selected a warning will be displayed asking if the file is definitely a Lodestar firmware file. Press YES to continue.

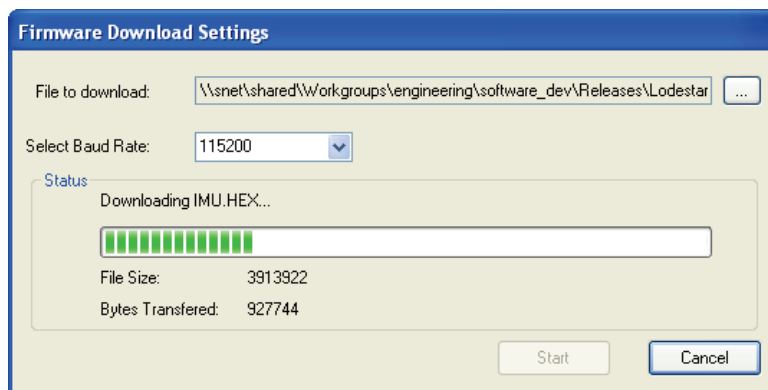


Next select a baud rate for the download. Sonardyne recommends 115200 baud for all firmware downloads.

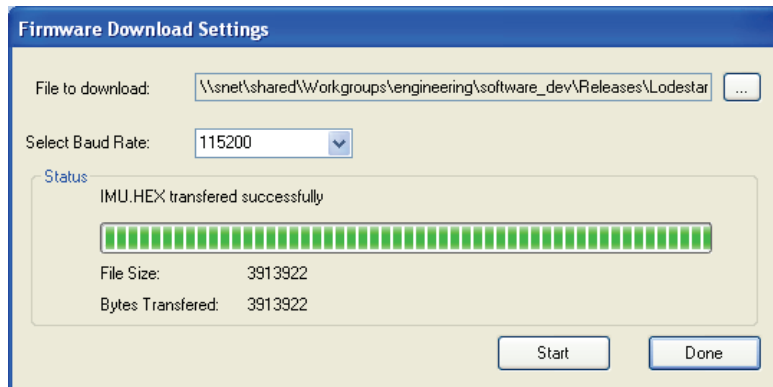


Finally press Start to commence the download. At this point the progress bar will begin to increment and the bytes transferred will increase.

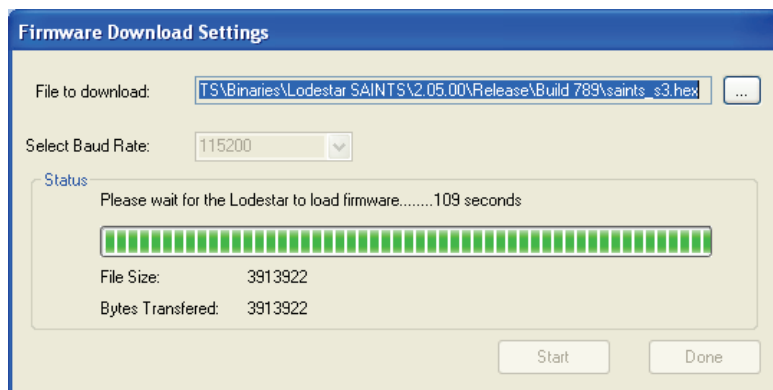
Download time at 115200 is less than 5 minutes. Do not interact with the PC while the download is in progress.



Once the download is complete press the Done button.



At this point the utility will re-boot the Lodestar.



Once complete the PC Utility will re-program Lodestar to give it the same configuration that it had before the upgrade began. Therefore it should now be ready for use.

8 Technical Support

8.1 Getting technical support

8.1.1 Sonardyne 24-hour Emergency Helpline

Tel: + 44 (0) 1252 877600

Sonardyne's 24-hour Emergency Helpline is answered at Blackbushe during normal office hours, which are 08:30 to 17:30 UK time.

Outside these hours, the call is automatically transferred to a local agency that will log the details of your emergency and alert the appropriate Sonardyne personnel.

Sonardyne's aim is to make sure that emergency requests are dealt with immediately during office hours and are responded to within 30 minutes at all other times.

Please note the helpline is for **emergency use only**. Do not use it for general enquiries. General enquiries should be directed to local Sonardyne offices. Alternatively, use one of the dedicated e-mail groups. Please note that e-mails are answered only during normal office hours, which are 08:30 to 17:30 UK time.

Product Family	Support e-mail Address
Lodestar	support@sonardyne.com
All other Sonardyne products	support@sonardyne.com

A more effective response will be obtained when requesting technical support via e-mail if the appropriate system and configuration files are attached to assist in solving the problem.

8.2 Sonardyne Offices and Agents

Sonardyne offices are shown as blue bullets in Figure 14.

Figure 14 – Sonardyne Office Locations



8.2.1 Sonardyne Office locations

Sonardyne International Limited has offices in the following locations:

8.2.1.1 UK—Headquarters

Sonardyne International Ltd
Blackbushe Business Park
Yateley, Hampshire
GU46 6GD United Kingdom
T. +44 (0)1252 872288
F. +44 (0)1252 876100
E. sales@sonardyne.com

8.2.1.2 UK—Aberdeen

Sonardyne International Ltd
Units 12-14, The Technology Centre
Claymore Drive, Bridge of Don
Aberdeen AB23 8GD
United Kingdom
T. +44 (0)1224 707875
F. +44 (0)1224 707876
E. sales@sonardyne.com

8.2.1.3 USA—Houston

Sonardyne Inc
8280 Willow Place Drive North
Suite 130, Houston
Texas 77070
USA
T. +1 281 890 2120
F. +1 281 890 7047
E. usa.sales@sonardyne.com

8.2.1.4 Singapore

Sonardyne Asia Pte. Ltd.
34 Loyang Crescent
Block B
Singapore 508993
Tel: +65 6542 1911
Fax: +65 6542 6937
e-mail: asia.sales@sonardyne.com

8.2.1.5 Brasil (Rio das Ostras)

Sonardyne Brasil Ltda
Av. Zen lotes 05 e 06
Quadra D
Zen, Rio das Ostras – RJ
CEP 28.890-000, Brasil
T. +55 22 2123 4950
F. +55 22 2123 4951
E. brasil.sales@sonardyne.com

Appendix A – Cable Drawings

Figure 15 – Lodestar Surface Console Cable Tail – CPN 820-0054

NOTE: TWISTED PAIRS MUST BE KEPT TOGETHER

Item 1 Pin No.	Colour	Function	Twisted Pair
1	Orange	RX_TX+	Twisted Pair
2	Black	TX_TX-	
3	Brown	OVI	Twisted Pair
4	Black		
5	Red	DC_IN	Twisted Pair
8	Black		
6	Yellow	DC_RTN	Twisted Pair
7	Black		
9	Black	RX-	Twisted Pair
10	Blue	RX+	
11	Green	Not Used	Twisted Pair
12	Black		
13	White	SEL_485232	Twisted Pair
14	Black	OVI	

Join 13 and 14 for RS232 Comms
Do not join for RS485 Comms

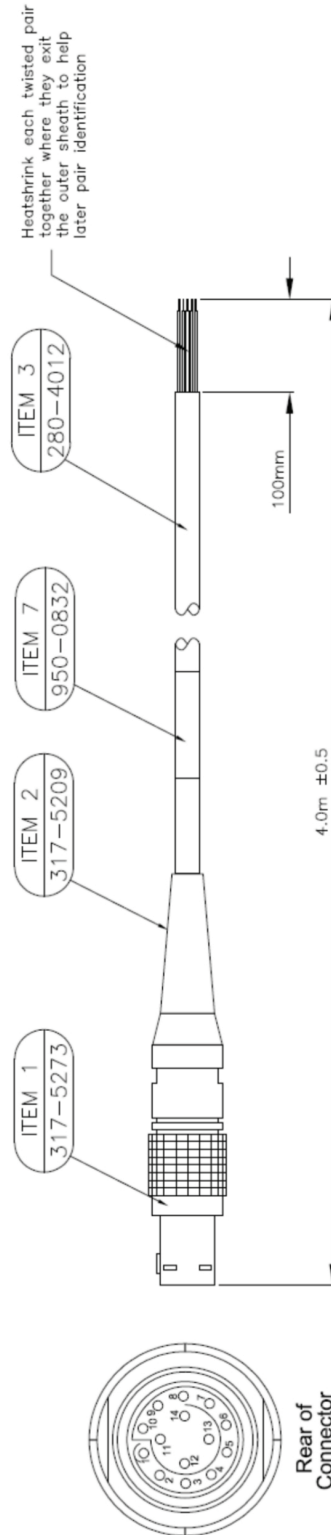
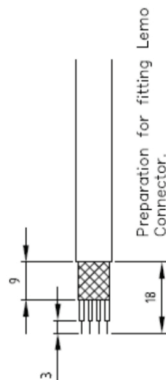


Figure 17 – Lodestar Surface Comms Test Cable – CPN 820-0061

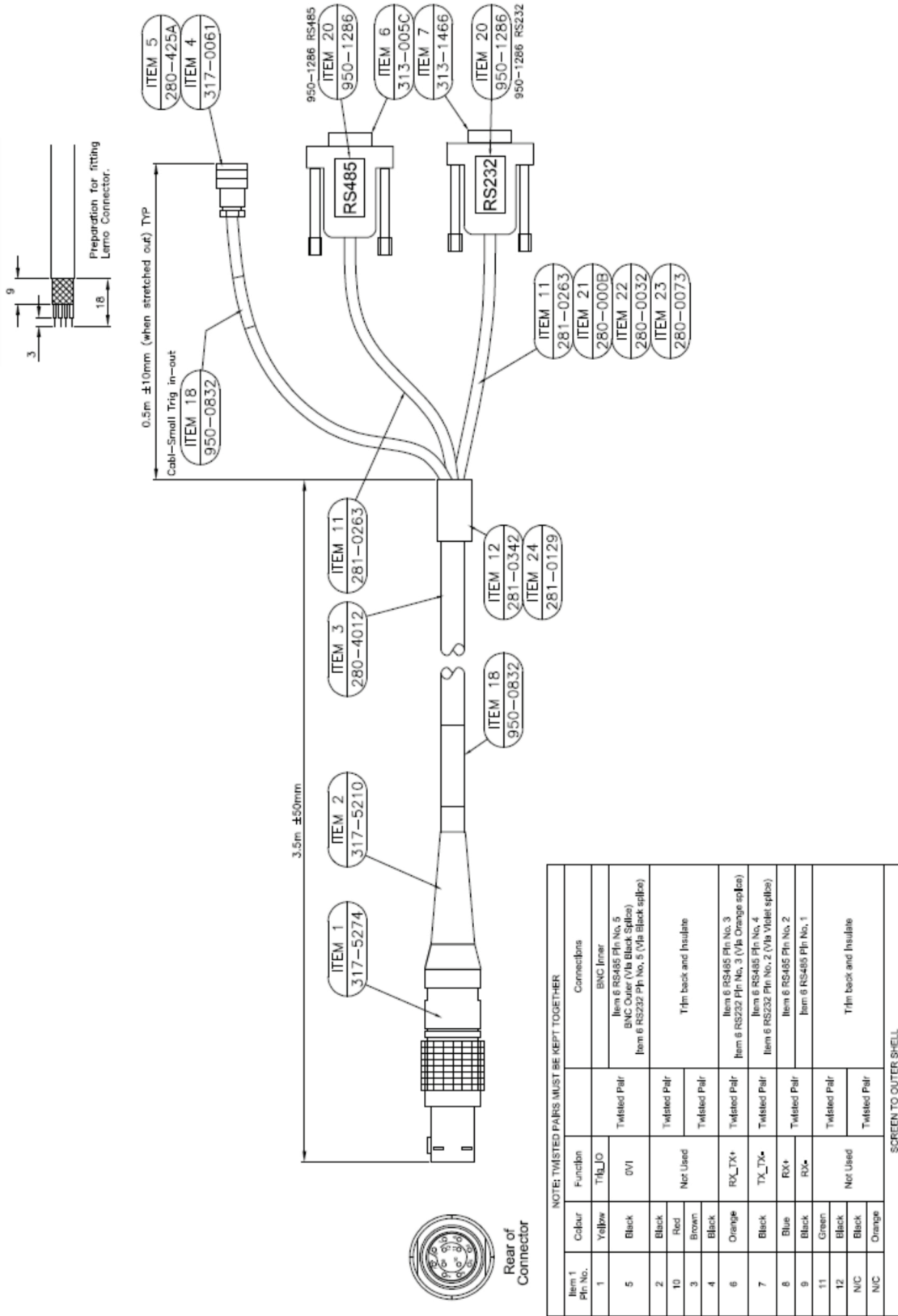


Figure 18 – Lodestar Surface Transceiver Cable Tail – CPN 820-0062

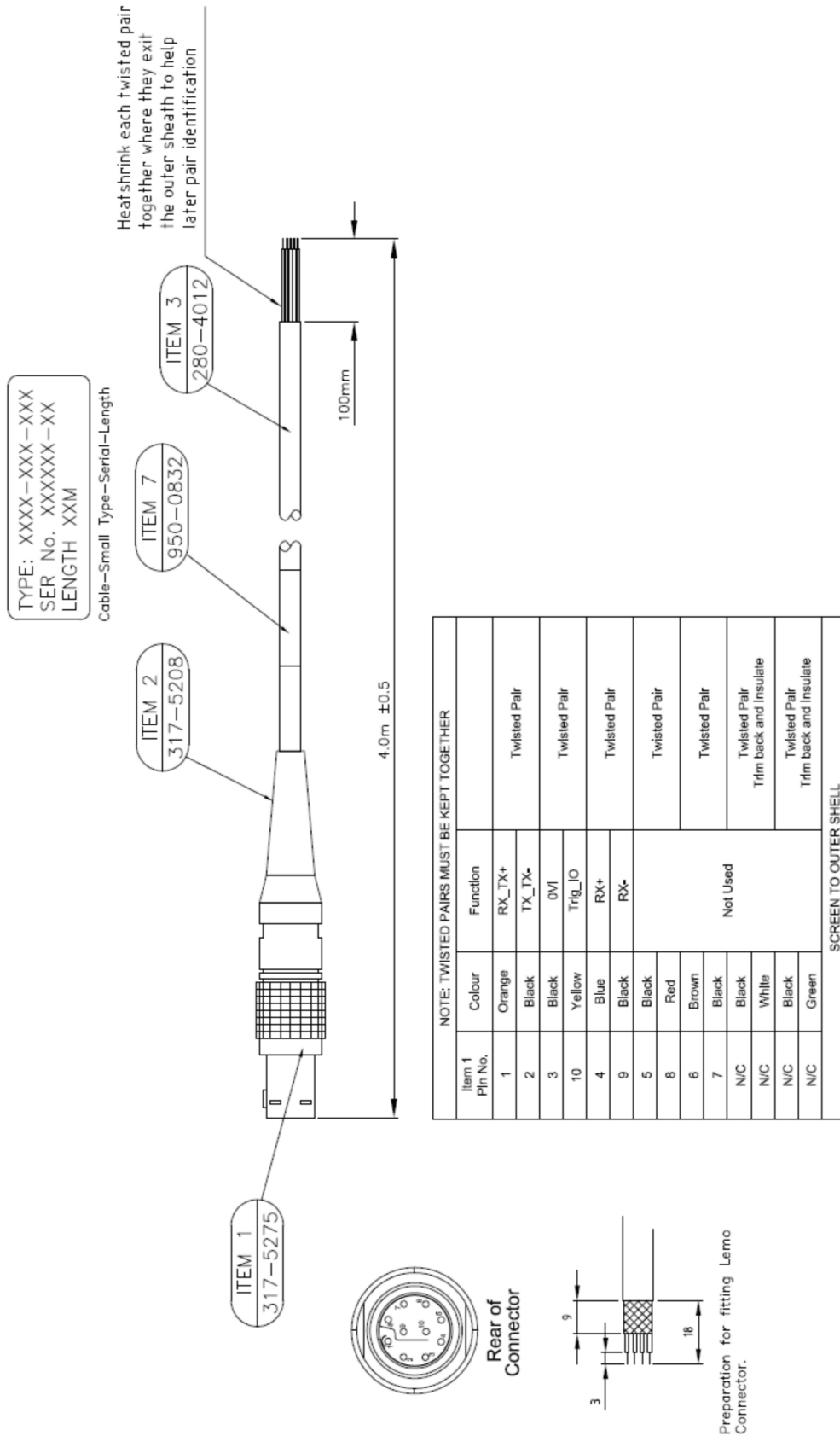


Figure 19 – Lodestar Surface Transceiver Test Cable – CPN 820-0064

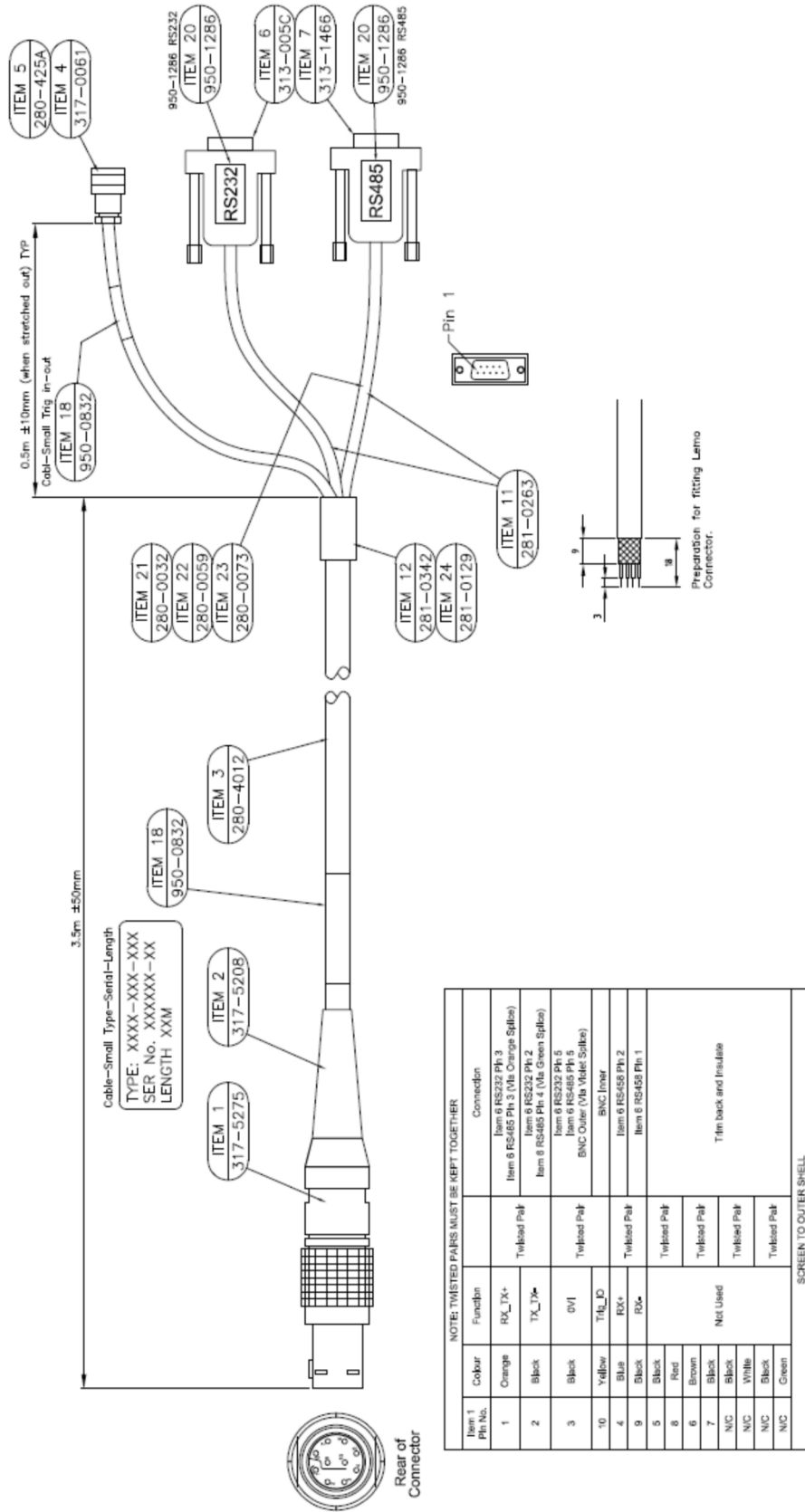


Figure 20 – Auxiliary Lemo Cable Assembly – CPN 820-6817

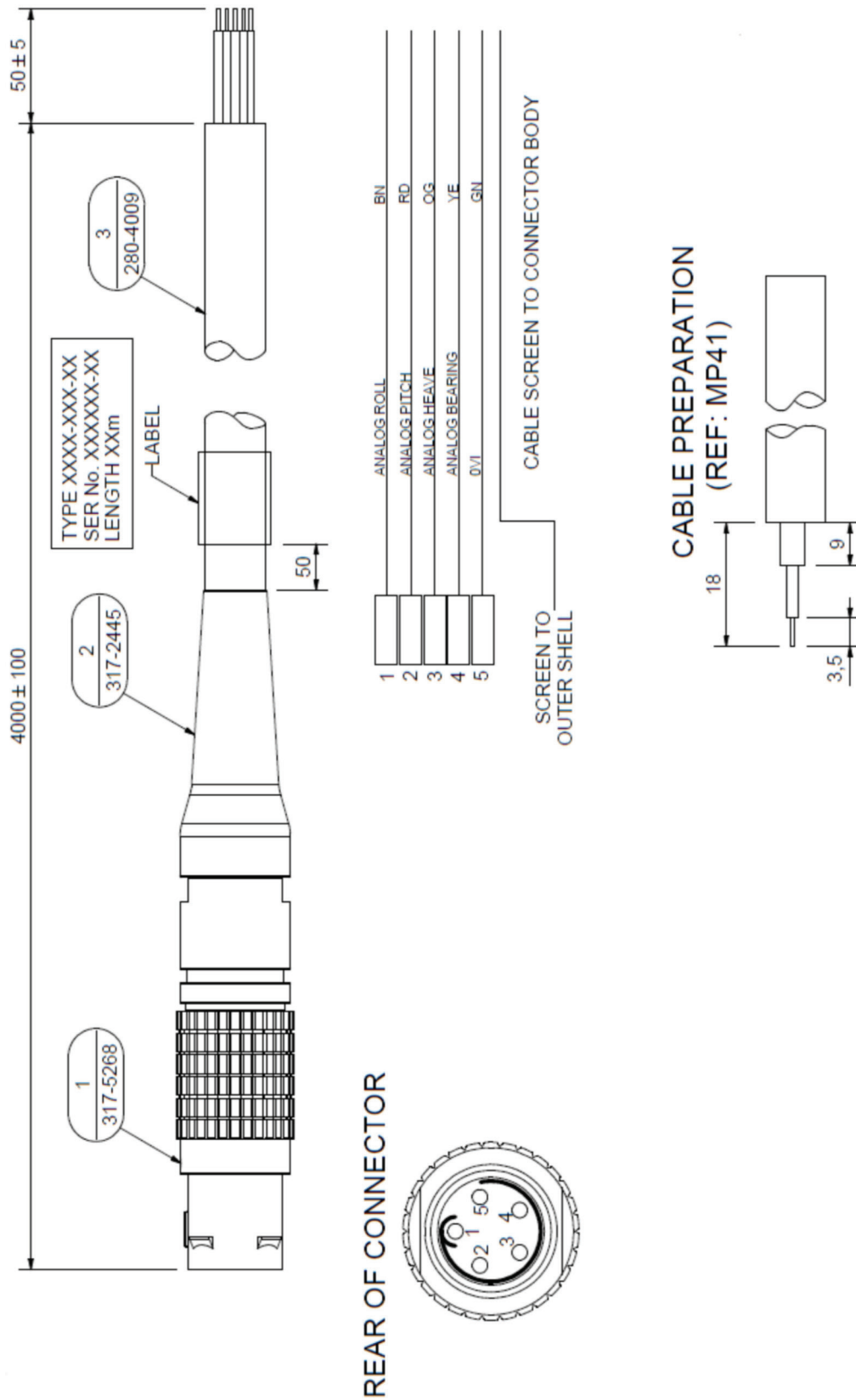


Figure 21 – Gyro Power Cable – CPN 820-6828

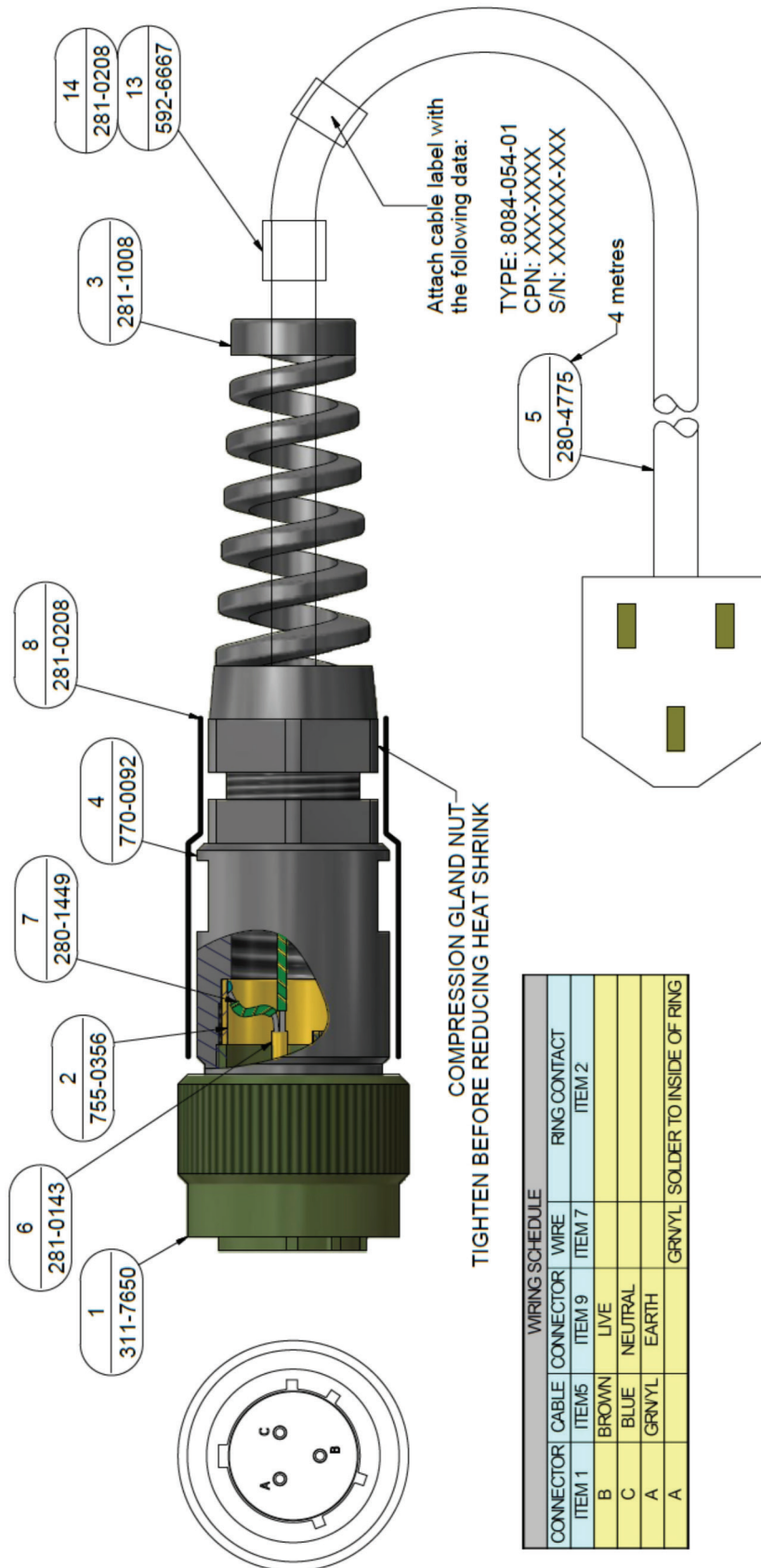


Figure 22 – Lodestar Subsea Console Cable – CPN 820-0065

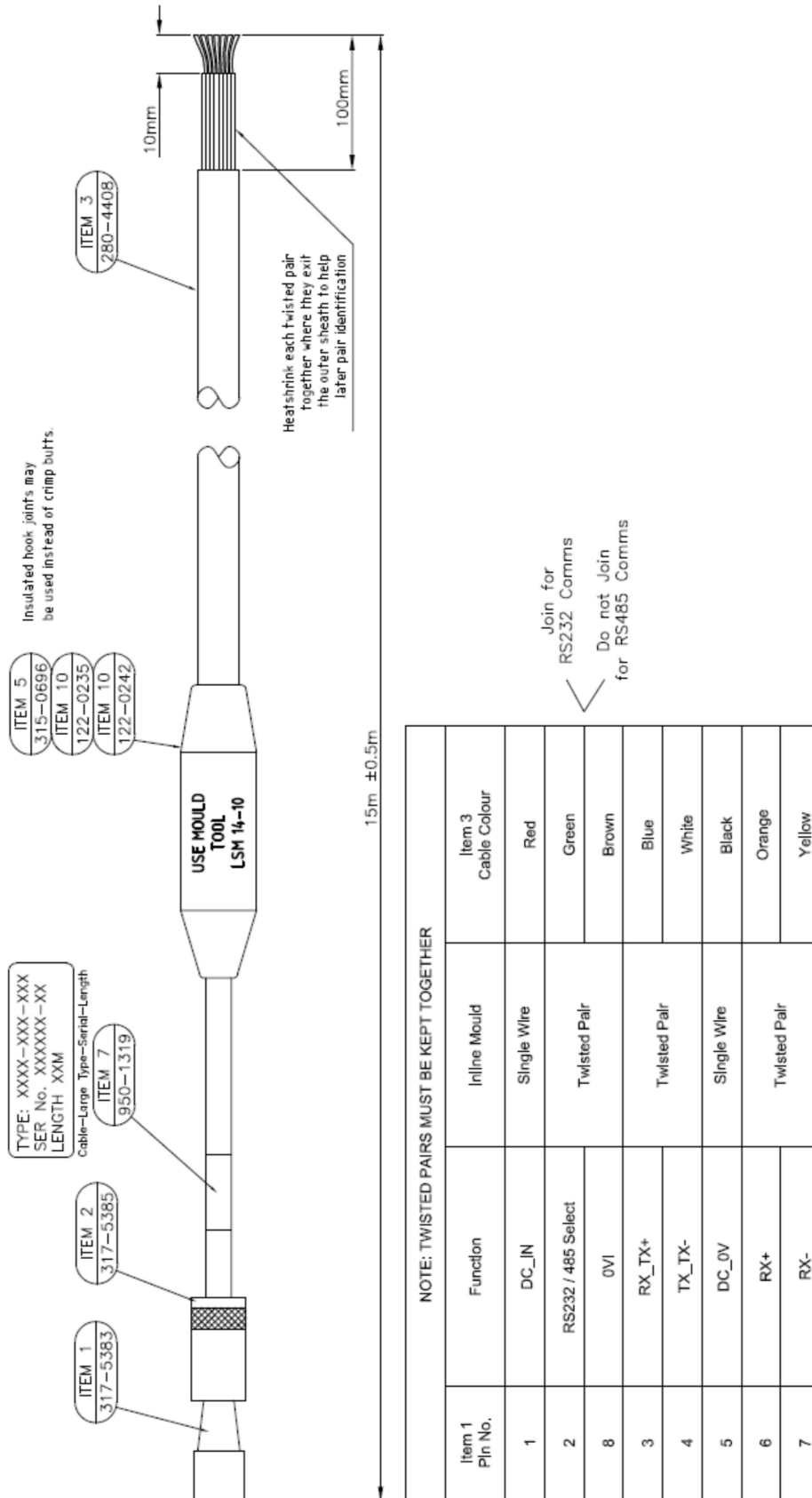
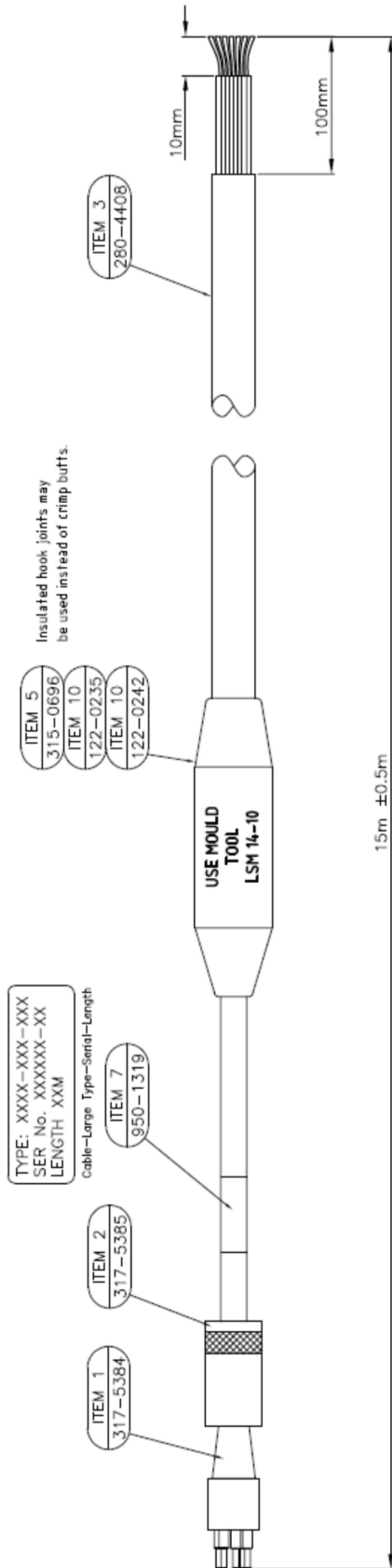


Figure 24 – Subsea Lodestar Comms C1 Cable – CPN 820-0068



Item 1 Pin No.	Function	Inline Mould	Item 3 Cable Colour
1	Not Used	Single Wire	Red
5	Not Used	Single Wire	Black
2	TRIG_IO	Twisted Pair	Green
8	0Vl	Twisted Pair	Brown
3	RX_TX+	Twisted Pair	Blue
4	TX_TX-	Twisted Pair	White
6	RX+	Twisted Pair	Orange
7	RX-	Twisted Pair	Yellow

Figure 25 – Subsea Lodestar Comms C1 Test Cable – CPN 820-0070

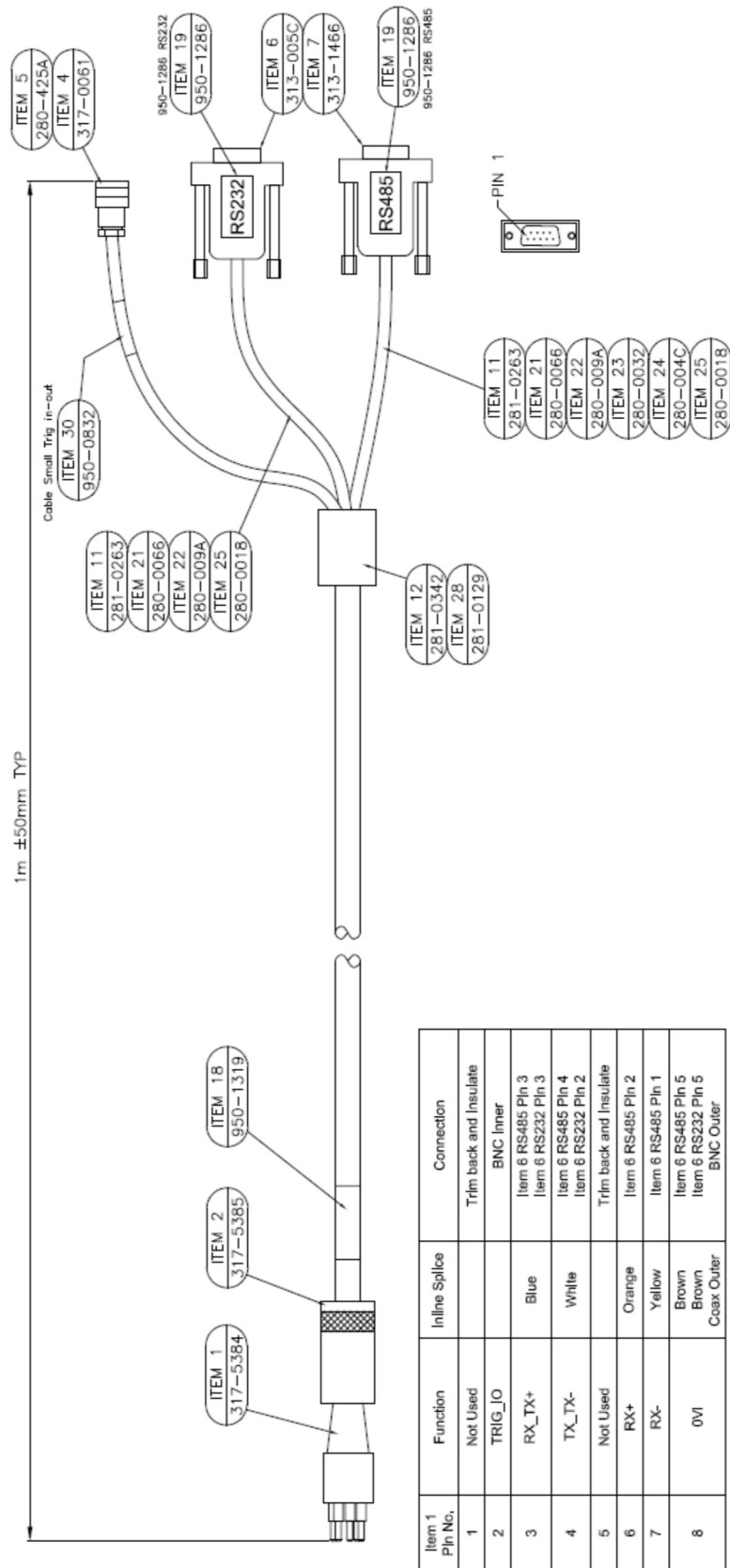
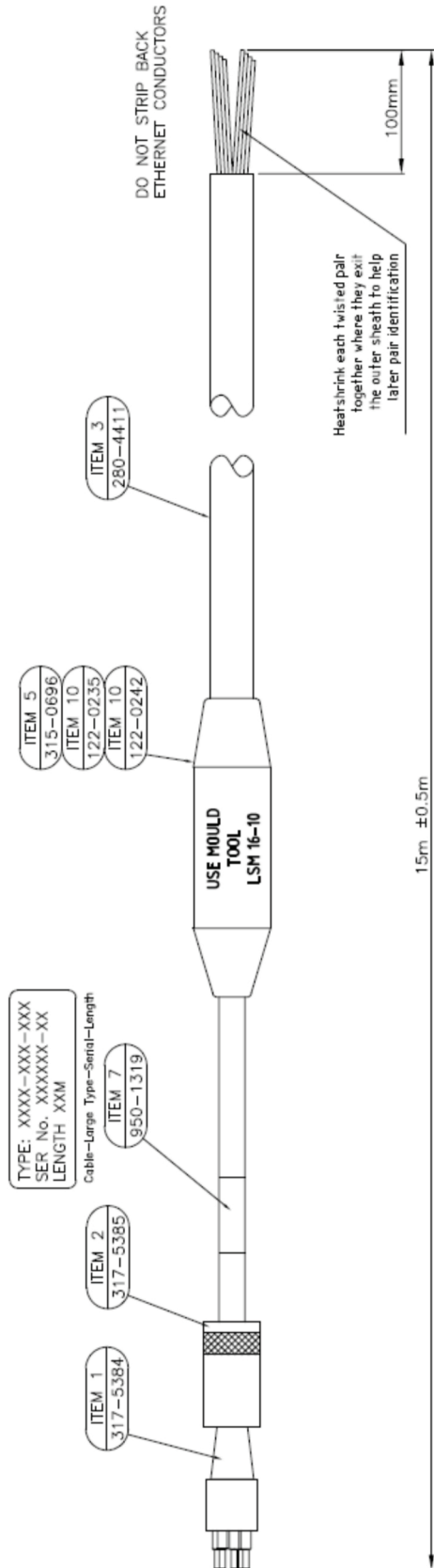
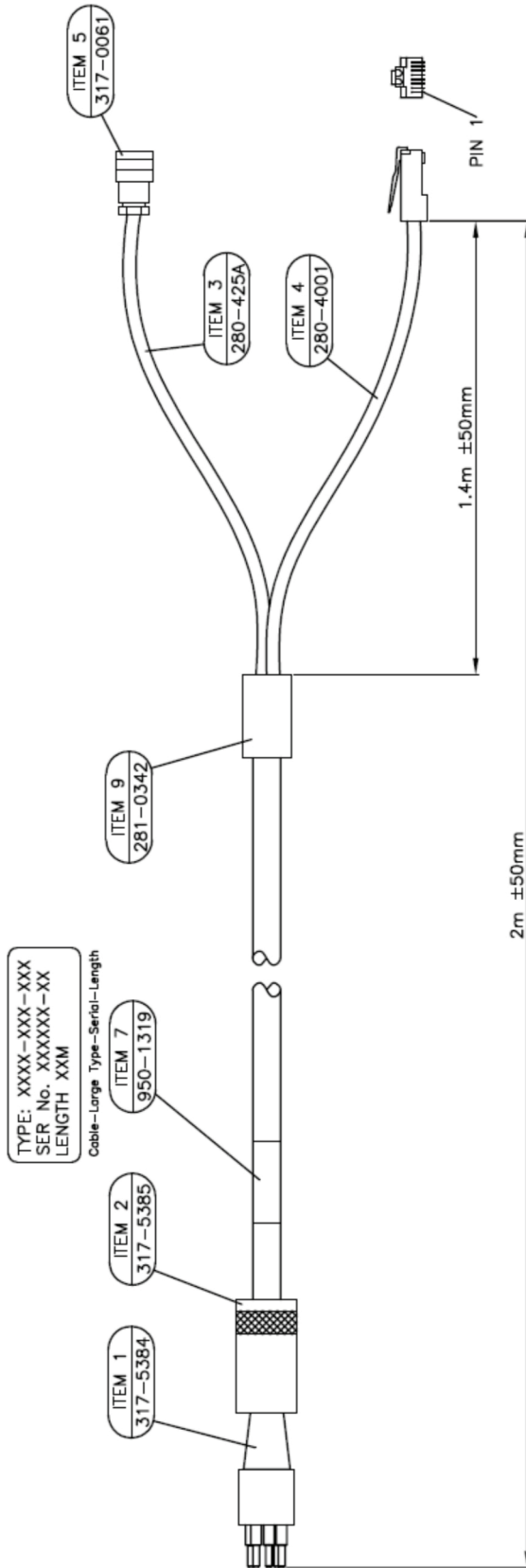


Figure 26 – Subsea Lodestar Comms Ethernet Tail Cable – CPN 820-0071



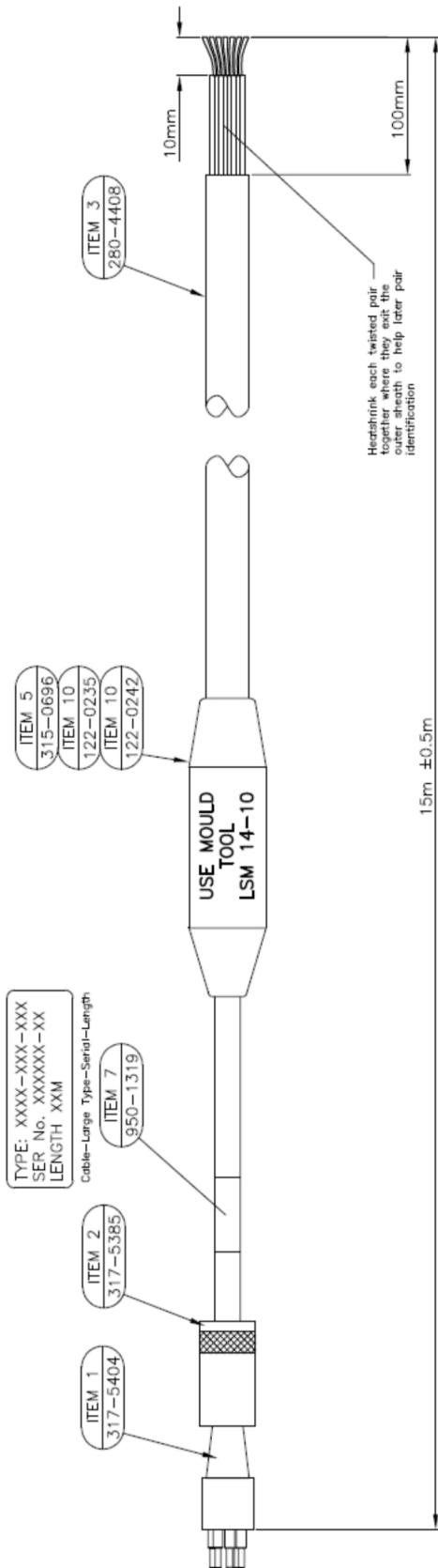
Item 1 Pin No.	Function	Inline Mould	Item 3 Cable Colour
1	Spare 1	Twisted Pair	Brown - 22 AWG
5	Spare 2		White / Brown - 22 AWG
2	TRIG_IO	Single Wire	Blue - 16 AWG
3	Ethernet TD+	Twisted Pair	White / Green - 22 AWG
4	Ethernet TD-		Green - 22 AWG
6	Ethernet RD+	Twisted Pair	White / Orange - 22 AWG
7	Ethernet RD-		Orange - 22 AWG
8	DVI	Single Wire	Black - 16 AWG
N/C	Not Used	Twisted Pair	Blue - 22 AWG
N/C		Trim back and Insulate	White / Blue - 22 AWG
N/C		Single Wires	Red - 16 AWG
N/C		Trim back and Insulate	Green - 16 AWG
N/C			Grey - 16 AWG

Figure 27 – Subsea Lodestar Comms Ethernet Cable – CPN 820-0072



Item 1 Pin No.	Function	Inline Splice	Connection
1	Not Used	N/C	Trim back and Insulate
2	TRIG_IO	Coax Inner	BNC Inner
3	Ethernet TD+	Twisted Pair	Item 4 Pin 3 - Green / White
4	Ethernet TD-		Item 4 Pin 6 - Green
5	Not Used	N/C	Trim back and Insulate
6	Ethernet RD+	Twisted Pair	Item 4 Pin 1 - Orange / White
7	Ethernet RD-		Item 4 Pin 2 - Orange
8	OVI	Coax Outer	BNC Outer
		N/C	Item 4 Pin 5 - Blue / White
			Item 4 Pin 4 - Blue
			Item 4 Pin 7 - Brown / White
			Item 4 Pin 8 - Brown
Trim back and Insulate all unused wires			

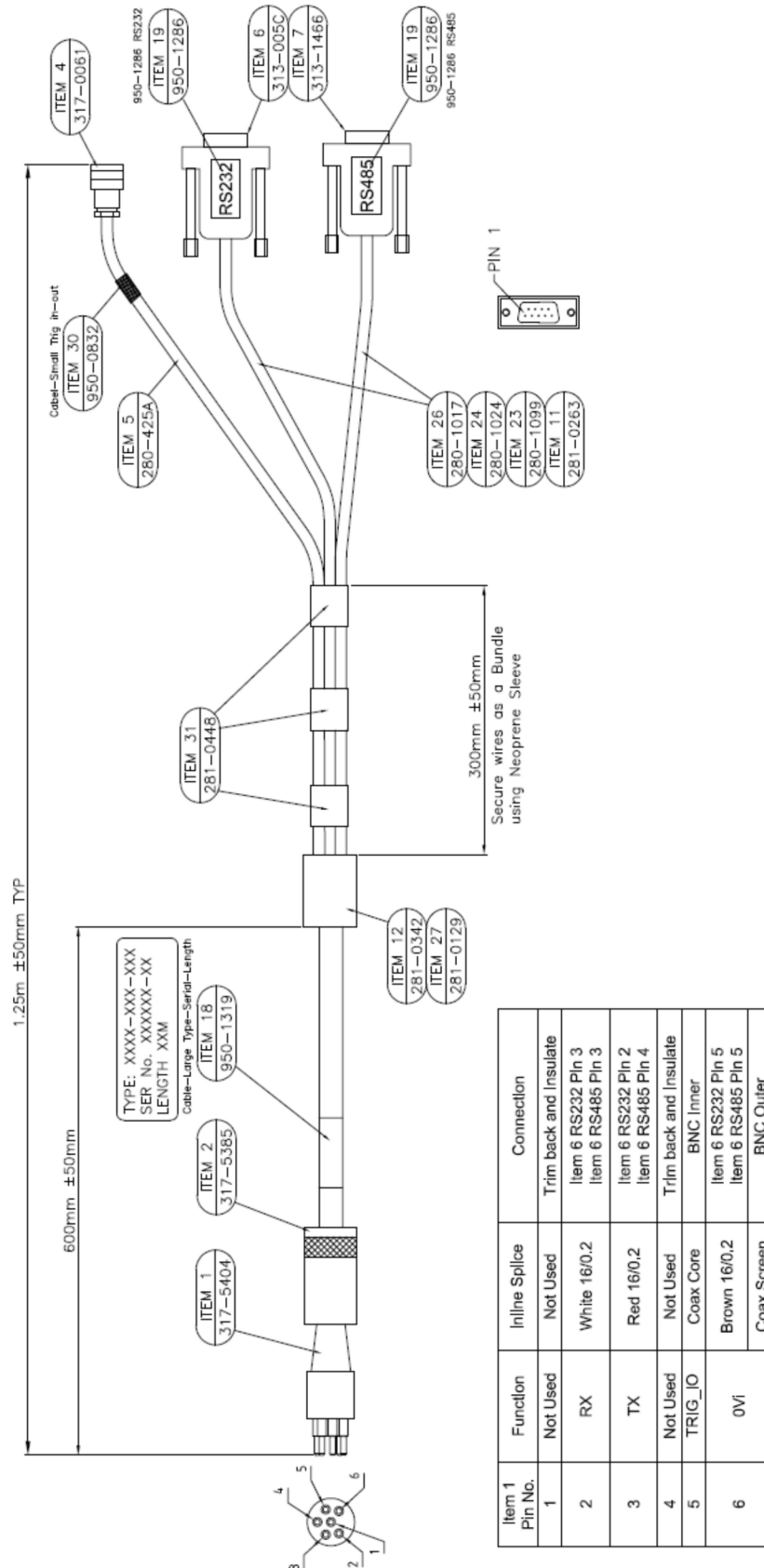
Figure 28 – Subsea Lodestar Transceiver Cable Tail – CPN 820-0073



NOTE: TWISTED PAIRS MUST BE KEPT TOGETHER

Item 1 P/in No.	Function	Inline Mould	Item 3 Cable Colour
1	Not Used	Single Wire Trim back and Insulate	Red
2	RX_485+	Twisted Pair	White
3	TX_485-		Blue
4	Not Used	Single Wire Trim back and Insulate	Black
5	TRIG_IO	Twisted Pair	Brown
6	OVI		Green
N/C	Not Used	Twisted Pair Trim back and Insulate	Orange
N/C			Yellow

Figure 29 – Subsea Lodestar Transceiver Test Cable – CPN 820-0078



Item 1 Pin No.	Function	Inline Splice	Connection
1	Not Used	Not Used	Trim back and Insulate
2	RX	White 16/0.2	Item 6 RS232 Pin 3 Item 6 RS485 Pin 3
3	TX	Red 16/0.2	Item 6 RS232 Pin 2 Item 6 RS485 Pin 4
4	Not Used	Not Used	Trim back and Insulate
5	TRIG_JO	Coax Core	BNC Inner
6	0V1	Brown 16/0.2 Coax Screen	Item 6 RS232 Pin 5 Item 6 RS485 Pin 5 BNC Outer

Appendix B – Lodestar Reference Frame

Figure 30 – Lodestar Reference Frame

