440 Pipe and Cable Survey System Manual

Related Customer Package Part No.s:

P/N 500268 440 Complete System (110V AL)
P/N 500269 440 Complete System (230V AL)
P/N 500270 440 Complete System (110V SS)
P/N 500271 440 Complete System (230V SS)

Teledyne TSS Ltd
1 Blackmoor Lane
Croxley Park
Watford
Hertfordshire
WD18 8GA
Telephone +44 (0)1923 216020
facsimile +44 (0)1923 216061
24 hr Customer Support +44 (0)7899 665603
e-mail: tsssales@teledyne.com

Document P\N: 402196
Issue 4.1

Contents

List of Figures

List of Tables

Revision History

Issue No.	Date	Details
4.1	June 2017	Section 5.2.3 - minor correction
4.0	October 2016	ECR 4438
3.8	February 2016	Minor update. SEP weights and dimensions amended
3.7	September 2015	ECR 4382
3.6	June 2014	ECR 4242
3.5	March 2014	ECR 4205, and customer support details updated
3.4	November 2013	ECR 4187
3.3	October 2013	ECR 4172
3.2	September 2013	ECR 4160
3.1	June 2013	ECR 4108, and revised formatting
3.0	October 2012	ECR 3782
2.3	June 2012	ECR 3765
2.2	September 2010	ECR 3564
2.1	May 2010	ECR 3495
2.0	January 2010	ECR 3406
1.9	July 2009	ECR 3453
1.8	December 2007	ECR 3235
1.7	October 2007	ECR 3224
1.6	February 2007	Removed references to analogue o/p. Added electrical and mechanical drawings into Drawings section.
1.5	June 2006	Changed default comms to RS232.
1.4	February 2006	New SDC9 descriptions and relative modifications.
1.3	October 2005	Updated External Output descriptions for DV4.0.3 and modified explanation of ghosting. Includes corporate rebranding.
1.2	June 2005	Included Background Noise Profile references, updated Run View display to include QC code, external o/p to include cm/mm resolution, Run View when Target Scaling is > 2000mV and video overlay displays.
1.1	Nov. 2003	Attention drawn to more stringent requirements for coil mounting and background compensation over 340 system. Clarification of centre coil mounting above port and starboard coils added. References to use of GPS to derive system time removed References to 3 coil algorithm removed Seawater compensation details added Factory defaults note added Video overlay modes clarified Note re signals data packet identifier added Note re spaces in altimeter strings added

Issue No.	Date	Details
1.0	Feb. 19 2003	First Issue

Glossary

Item	Definition as used throughout this Manual
ALT	Coil altitude above the seabed. This could be measured by a sub-sea altimeter connected either directly to the SEP or through the umbilical to the SDC. Where there is no altimeter fitted to the System, ALT could contain a fixed coil height that you specify during the configuration procedure.
COV	Target depth of cover. The SDC calculates this distance by using COV = VRT – ALT.
CV	Composite Video. This can be utilised in either NTSC or PAL formats.
LAT	Lateral offset. The horizontal distance measured by the 440 System between the top of the target and the centre line of the coil array. Positive measurements indicate a target to starboard of the centre line.
PSU	Sub-sea power supply pod. The depth rated unit that accepts an electrical supply from the ROV and produces the conditioned and stabilised DC supplies used by the SEP.
ROV	Remotely operated vehicle. Any form of sub-sea or surface vehicle supporting the 440 System during survey operations.
SDC	Surface display computer. The configuration, control and display computer supplied by Teledyne TSS to operate the 440 System.
SEP	Sub-sea electronics pod. The depth rated unit that performs the measurement operation on the target.
VRT	Vertical range to target. The distance measured by the 440 System along a line perpendicular to the coil surface, between the coil array and the closest point of the conductive target.

1 Introduction

The Teledyne TSS 440 Pipe and Cable Survey System provides a convenient and uncomplicated method for performing accurate submarine surveys on a conductive target such as a cable or pipe. The 440 System represents a considerable advance over its predecessor, the 340, in that signal processing routines are used which can discriminate between seawater and metallic targets which helps to enhance the accuracy of the information gathered during a survey.

The burial state of the target has no effect on System operation. However, you should note the following:

- The special characteristics of 316 stainless steel do not allow the 440 System to detect this material reliably.
- Do not use the 440 System to survey targets buried beneath iron ore, which will mask signals from the target.

The 440 System includes a display and control computer that you should install where you may see its screen easily while you operate the ROV. The display includes information to help you guide the ROV along the course of the target. With the introduction of the 440 Pipe and Cable Survey System, Teledyne TSS have also introduced their new DeepView for Windows software, which makes configuration and operation of the system easier under a familiar working environment. This runs on the Surface Display Computer (SDC) and makes all acquired survey data available to view or report to external data logging equipment.

The 440 System operates in real time and provides accurate measurements at a rate that allows deployment on board faster ROVs. The measurement technology used by the System also allows it to operate out of water with no degradation in performance, range or accuracy. You may therefore use the 440 System for land-based or amphibious survey applications.

This System Manual contains full installation and operating instructions and is an important part of the 440 System. You should ensure the Manual remains easily available for use by those who will install, operate and maintain the System.

Provided you follow the installation, operating and maintenance instructions included throughout this Manual, the 440 System will maintain its specified measurement accuracy.

1.1 Migration from the 340 Cable and Pipe Survey System - Summary of Benefits

The Teledyne TSS 440 system represents a considerable improvement over the previous 340 system. It operates to a greater target range than the previous system, yet is simpler to set up and operate.

The previous generation of products used a geometric algorithm to reject seawater which was based on the assumption that the undesired seawater signal is the same across the three coils. The new 440 product has an advanced compensation method which exploits the different types of signals generated by target and seawater. This allows the range to be determined from two search coils, giving up to a 50% improvement in range. Although the conductivity of seawater varies widely, the system can accommodate all situations.

Extensive testing under a variety of water conditions shows that the characteristics for the local water conditions need only be determined once per survey: the user simply inputs the approximate water temperature. An automatic method to tune the system after deployment is provided, but need only be used in exceptional circumstances.

Significant differences between 340 and 440.

- Increased range due to improved detection algorithm.
- Increased sensitivity from new search coils.
- Easier setup and survey from new Windows SDC and software.
- Raw signal data available at SDC.
- New improved video overlay facility.

Familiar advantages

- Proven, reliable PSU and electronic subsea pods.
- Standard SDC logging output format.
- Teledyne TSS support.
- Connector pin outs, voltages and protocols identical.

1.2 Conventions used

This manual uses the following conventions that signal important Warnings, Cautions and Notes:

WARNING

A **Warning** indicates the risk of death or serious injury to personnel.

CAUTION

A **Caution** indicates the risk of injury to personnel, or damage to equipment, or loss of data.

NOTE

A **Note** emphasises important information about the use of the product.

Throughout this Manual, unless stated otherwise, all measurements conform to the SI standard of units.

1.3 System Description

WARNING

The protection provided by the 440 System might be impaired if you use the equipment in a manner not specified by Teledyne TSS. For safety reasons, always follow the instructions and advice included throughout this Manual. If necessary, contact Teledyne TSS for technical advice.

Teledyne TSS has designed the 440 Pipe and Cable Survey System primarily for use in surveying operations on submarine pipes and cables. In this application the System measures, displays and records the position of the target relative to the ROV, and its depth of cover beneath the seabed.

The technology used by the System gives it the flexibility to detect any conductive target, whether the material is exposed or buried. For this reason, many other fields of operation could benefit from its capabilities.

NOTE

Teledyne TSS has optimised the standard 440 System and its software to provide the best performance for use in pipe and cable survey operations. This Manual describes the standard 440 System.

You should consult Teledyne TSS if you need to use the System within an alternative application where a non-standard configuration might be necessary.

The Teledyne TSS 440 System consists of a surface control and display computer and the depth-rated components of the sub-sea installation:

Surface Display Computer (SDC)

You should use the SDC to configure and control the 440 System. It communicates with the sub-sea installation using bi-directional signals transmitted through the ROV umbilical.

By interpreting the signals from the sub-sea installation, the SDC generates a clear graphical display that helps you to guide the ROV along the course of the target.

Simultaneously, the SDC uses one of its serial data ports to transmit the real time survey information to an external data logging system.

Sub-sea installation

The sub-sea installation includes the following components:

- A sub-sea electronics pod (SEP)
- A sub-sea power supply unit (PSU)
- Three search-coils
- A sub-sea altimeter

- Coil mounting components
- Cables you will need to interconnect the sub-sea components of the 440 System.

All sub-sea components of a new installation have a depth rating to the specifications listed in Chapter 8 "System Specifications". The main labels of the SEP and PSU also confirm the depth rating for these components. Provided you exercise all proper maintenance procedures explained in Chapter 8 "System Specifications", the sub-sea components will retain their specified depth rating throughout their working life.

Refer to section 2.3 "Sub-sea Components" on page 2-5 for descriptions of the main sub-sea components of the 440 System.

During survey operations, the sub-sea installation measures target co-ordinates. These are:

- The vertical range to the target (VRT)
- The lateral offset of the target relative to the centre of the coil array (LAT).
- The altitude (ALT) of the coil array above the seabed and the depth of target cover (COV). To make these measurements, the 440 System must receive altitude information from an altimeter. Alternatively, where the design of the ROV allows for a constant coil height, you may configure the System with this information instead.

The SEP collects the information and performs the signal processing functions necessary for the SDC and DeepView for Windows to generate accurate survey data using a powerful algorithm developed especially for this application.

1.4 Principle of Operation

The Teledyne TSS 440 Pipe and Cable Survey System relies on the principle of 'Pulse Induction' to detect the presence of a target and to measure the range of that target from each of three search coils. Using an adaptive algorithm the System can locate, using either two or three search coils, the position of the target.

Refer to Appendix A "Operating Theory" for a full description of the operating theory.

The pulse induction method of target detection provides four major advantages over other systems when used in pipe and cable survey applications:

1. It detects any type of conductive material – including non-ferrous metals such as brass, bronze, aluminium, and light alloys. *Note that the special characteristics of 316 stainless steel do not allow the 440 System to detect it reliably*.
2. Terrestrial magnetism has no effect upon the System operation or its measurement accuracy.
3. The System can measure and electronically compensate for the local conductive effects of the ROV, regardless of the ROV heading.
4. Simplified operating procedures built into the System give it a high degree of measurement stability.

1.5 Warranty

Teledyne TSS Ltd warrants the 440 Pipe and Cable Survey System to be free of defects in materials or workmanship for 12 months beginning on the date when the equipment was shipped from the Teledyne TSS Ltd factory.

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

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

In no event will Teledyne TSS Ltd be liable for any indirect, incidental, special 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 Teledyne TSS Ltd with respect to the products described herein.

Contact Teledyne TSS Ltd for information if you require further cover beyond the warranty period.

NOTE

To ship the 440 Pipe and Cable Survey System between installation sites or to return the product to Teledyne TSS Ltd or an authorised distributor for repair, package the product with care. You should retain the original transit packing case for this purpose. The use of improper packing for shipping any part of this equipment will void the warranty. For information concerning the proper return location and procedure, contact Teledyne TSS Ltd or an authorised distributor. The title page of this manual shows the contact details for Teledyne TSS Ltd.

1.6 Product Support

For questions about installing your product or any other product operating enquiry please call our 24-hour product support helpline:

+44 (0) 7899 665 603

or contact us by email:

tsscustomerservices@teledyne.com

See our website at **www.teledyne-tss.com** for more information.

2 System Overview

You should read this section of the Manual before you unpack or install the 440 System.

This section tells you about the important checks and inspections that you should make when you first receive the Teledyne TSS 440 System. It also includes a brief description of the main items supplied as standard with the System.

If you need to order replacement parts for your system please include a full description of the parts required as well as the part number and the serial number of the relevant sub-assembly.

Scope of Delivery

The 440 System includes various sub-assemblies that you must interconnect properly before the System will work.

Figure 2-1 shows a typical stand-alone configuration for the 440 System that has the SDC installed on a surface vessel and the sub-sea components mounted on the ROV. Table 2-1 identifies the individual components of the installation.

Optionally, you may use the 440 System as part of a Dualtrack installation. In this mode, a single SDC controls the operation of the 440 Pipe and Cable Survey System when its sub-sea components are connected to either a Teledyne TSS 350 or 350 Powertrack Cable Survey System. See section B.1 "Dualtrack System" on page B-1 for instructions on how to connect and configure the 440 System within a Dualtrack installation.

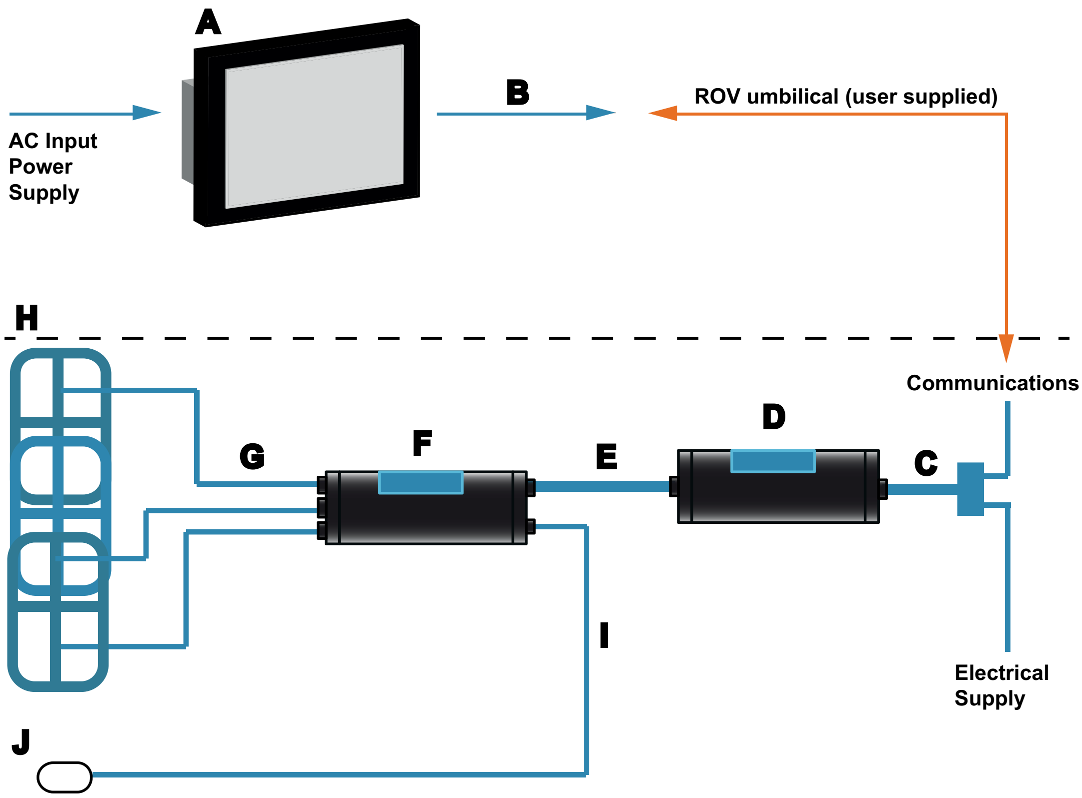


Figure 2-1: Components of the 440 System

Sections 2.2 and 2.3 below provide detailed descriptions of the surface and the sub-sea components of the 440 System.

Table 2-1: Components of the 440 Pipe and Cable Survey System

Item	Description
A	Surface display computer (SDC) provides: ❒ 19” rack-mountable Panel PC with touch-screen enabled TFT LCD (1280 x 1024 resolution). ❒ VESA-mounted comms enclosure containing Current-Loop comms, video overlay and analogue output interfaces. ❒ DeepView for Windows display and logging software pre-installed. ❒ 90-264VAC (47-63Hz) ❒ EN 60945 approved.
B	Data cable for connection between the SDC and the ROV umbilical
C	Power and data cable (or ‘ROV Tail’) that connects the PSU to the ROV umbilical and power distribution system
D	Depth rated sub-sea power supply unit (PSU)
E	Power and data cable that connects the PSU to the SEP
F	Depth rated sub-sea electronics pod (SEP)
G	Three coil connection cables * * 4m cables are supplied as standard but other lengths are available. Refer to section 3.1.3 "Coil Array" on page 3-5 for additional information.
H	Three Teledyne TSS search coils arranged as shown with connections to Channels 1 to 3 on the SEP.
I	Power and data cable that connects the altimeter to the SEP
J	Sub-sea altimeter

2.1 Unpacking and Inspection

Teledyne TSS performs a series of careful examinations and tests on the electrical function and mechanical integrity of the 440 System during manufacture and before dispatch. Special shock protecting cases safeguard the System during transit so that it should arrive without damage or defect.

NOTE

Retain the original transit cases so that you may use them if you must transport the 440 System for any reason. You will invalidate the warranty if you use improper packing during transportation.

As soon as possible after you have received the 440 System, check all items against the shipping documents. Perform a careful visual examination of all sub-assemblies and inspect them for any damage that might have occurred during transportation.

Notify Teledyne TSS immediately if there are parts or sub-assemblies missing from your shipment. If you see any damage to the System, file a claim with the insurers and inform Teledyne TSS. The title page of this Manual lists the contact details for Teledyne TSS. Teledyne TSS also operates a 24-hour emergency telephone support line managed by trained and experienced engineers.

To avoid loss or damage to any components of the System, store all sub-assemblies safely in their transit cases until you need to install them. Obey the environmental limits for storage listed in Chapter 8 "System Specifications" for all sub-assemblies.

2.2 Surface Components

2.2.1 Surface Display Computer (SDC) 10

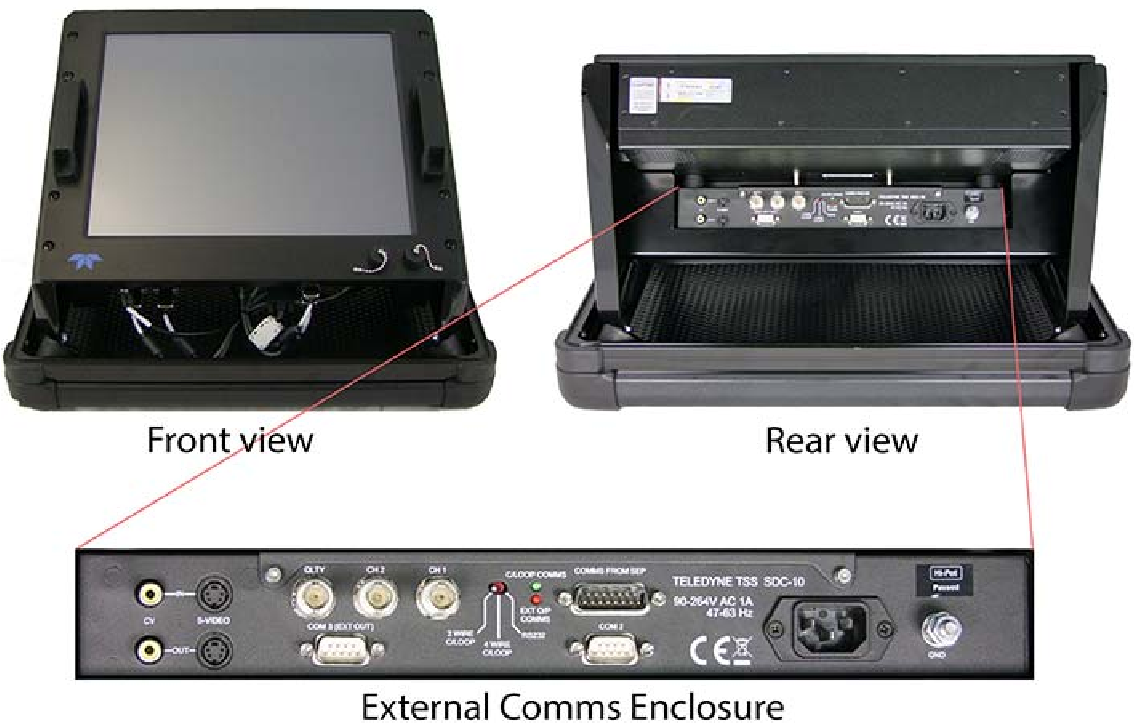


Figure 2-2: Surface Display Computer (SDC10) overview

The SDC10 comprises a ruggedised rack-mountable 19” Windows Panel PC with a VESA-mounted comms enclosure encapsulating the power, communication, video overlay and analogue output interfaces. The Panel PC provides two front-mounted USB ports to attach external equipment. All other connections are clearly labelled on the comms enclosure mounted to the rear of the Panel PC.

The Panel PC uses touch-screen technology that enables the user to configure the System without the requirement for a mouse or keyboard.

The main functions of the SDC are:

- **To communicate with the sub-sea installation.**

  Three communication methods are available: RS232, 2-wire current loop, and 4-wire current loop. You may adjust links inside the SEP and use the external comms selector switch on the SDC to select between these methods. See section 4.2.2.1 "Alternative Communication Methods" on page 4-11 for instructions to make these changes.

- **To configure and control the 440 System.**

  The SDC uses the Windows 7 operating environment. DeepView for Windows is installed on the SDC prior to delivery and is used to configure the 440 System after installation, and to operate the System during a survey. See Chapter 5 "System Configuration" and Chapter 6 "Operating software" for full instructions to use this software.

- **To display the survey measurements graphically**.

  The display on the SDC shows information that helps you to guide the ROV along the course of the target. See Chapter 6 "Operating software" for a description of the display features.

  The display information is also available on an external monitor using the video overlay which is transmitted as composite video or S-Video in either PAL or NTSC. See section 4.2.4 "Interface to Video" on page 4-16 for instructions to use this feature.

- **To send the acquired data to an external data logger.**

  The SDC allows you to log survey data externally (for use by post-processing engineers) and internally (to provide a simple record of the survey that you may replay through the SDC).

- **To provide analogue outputs.**

  The SDC provides three configurable channels (CH1, CH2 and QLTY) that can be used to automatically steer an ROV using the lateral offset survey information.

The SDC is mounted in a purpose-designed shock protecting transit case. The design of the case allows you to operate the SDC directly from it after removing the case lid. Alternatively, you may remove the SDC from the transit case and mount it in a 19-inch instrument rack if this arrangement is more appropriate. See section 3.1 "Surface Display Computer (SDC) Installation" on page 3-1 for full instructions to install the SDC.

You may also use the SDC and DeepView for Windows software to control a Dualtrack installation. See section B.1 "Dualtrack System" on page B-1 for details.

NOTE

Pay particular attention to the warning and caution notices that are included within the SDC installation instructions.

CAUTION

You may adversely and seriously affect the operating functions of the 440 System if you load unauthorised software onto the SDC hard disk, or if you attempt to use such software with the SDC. You will invalidate the warranty if you attempt to install or use unauthorised software with the SDC. Do not load any unauthorised software onto the SDC. If you are in any doubt about the SDC software, contact Teledyne TSS for advice.

CAUTION

You might destroy logged data and program files on the SDC if you allow computer viruses to infect the unit.

Computer viruses can pass from one computer to another when you transfer files in any way, for example when you connect a USB drive. To protect the SDC against this type of damage, always take the following precautions:

- Never try to use unauthorised software with the SDC.
- Never power-on or reset the SDC with a USB drive connected unless you need to reinstall all the SDC10 software (see section 6.5 "System Recovery Procedure" on page 6-33).
- Use an external PC running up-to-date anti-virus software to check digital media before you use them with the SDC. Use only virus-free digital media with the SDC. You may install appropriate and approved virus protection software on the SDC if you prefer. To maintain full effectiveness you must keep this type of protection up to date.
- Do not use any digital media with the SDC if you are unsure whether it is free from viruses.
- Do not power-on the SDC if you suspect a virus has infected it.

Teledyne TSS takes every possible precaution to prevent virus infection before shipment. If you suspect your SDC has become virus infected, contact Teledyne TSS for advice and then arrange to return the SDC to Teledyne TSS for repair.

2.3 Sub-sea Components

The sub-sea installation comprises the following component parts:

- A Sub-sea Electronics Pod (SEP).
- A Sub-sea Power Supply Unit (PSU).
- A coil array with three Teledyne TSS search-coils. See section 3.1.3.3 "Coil Assembly and Installation" on page 3-8 for instructions to install the coils.
- Frame components to mount the coils onto the ROV.
- A sub-sea altimeter.
- Cables to interconnect the sub-sea components of the 440 System and to connect them to the electrical distribution system of the ROV.

2.3.1 Power Supply Unit

The PSU accepts a single phase AC electrical supply nominally at 110V AC at 45 to 65Hz. A switched-mode circuit inside the PSU generates the conditioned DC supplies required by the SEP, with all DC supplies passing through a π-filter network to prevent noise and interference from reaching the SEP.

See section 8.1.3 "Sub-sea Power Supply Pod" on page 8-3 for full details of the PSU power requirement. There is a cartridge fuse inside the PSU to protect the System from overload conditions.

The PSU has a port for connection to the ROV electrical distribution system and umbilical. This connection uses a Power and Communications cable supplied with the System that has a multiway connector that mates to the PSU and open tails for connection to the ROV.

Connection between the SEP and the PSU is through a single cable that has a multiway connector at each end.

2.3.2 Sub-sea Electronics Pod

The SEP performs several functions:

- Timing and amplitude control for the pulsed-current drive to the search-coils.
- High-speed data acquisition and digital signal processing.
- Interpretation of data from an appropriate sub-sea altimeter connected to the SEP 'Altimeter' port.
- Communication with the SDC through the ROV umbilical using whichever communication method you have established for the System.
- Interfacing with the Teledyne TSS 350 or 350 Powertrack Cable Survey System when you use the 440 System within a Dualtrack installation.

Non-volatile memory within the SEP stores certain installation-specific parameters that the SEP needs. You may examine and change these configuration parameters remotely from the SDC. See Chapter 5 "System Configuration" and Chapter 6 "Operating software" for instructions to configure the System.

EPROM memory devices within the SEP store the software that controls all the SEP functions.

The SEP is a sealed unit with six ports:

On one end-cap:

- **Power/comms**
  This port accepts the 12-way connector from the PSU, carrying stabilised and conditioned DC supplies and the bi-directional communication signals.
- **Altimeter**
  You may connect the Teledyne TSS or Teledyne Benthos sub-sea altimeter directly to this port. The port provides DC power to operate these types of altimeter and a signal path for their RS232 communications.

On the other end-cap:

There are four electrically identical connection ports for the four active channels. The 440 System uses only channels 1 to 3 during normal operations, although you may use channel 4 as a substitute if one of the other channels fails. You must connect each coil to its correct port on the SEP. See section 4.1.5 "Search-coils" on page 4-5 for instructions to connect the coils.

CAUTION

You will damage the SEP if you leave any port exposed to seawater during deployment on the ROV, even if you are not using the 440 System.

You must fit the supplied blanking plugs to any port on the SEP that you will not be using during ROV deployment.

See section 3.1.2 "SEP and PSU" on page 3-3 for instructions to install the SEP and the PSU.

2.3.3 Search-coils

Teledyne TSS supplies three search-coils as part of a standard package. A drawing showing dimensions is available in Chapter 10 "System Drawings" and details of specification can be found in Chapter 8 "System Specifications".

See section 3.1.3 "Coil Array" on page 3-5 for full instructions to assemble the coils and mount them onto an ROV.

2.3.4 Altimeter

The main function of the 440 System is to locate and survey a target lying on or buried beneath the seabed.

If the 440 System measures the altitude of its coil array above the seabed, then it can also deliver a good estimation of the depth of target cover. A sub-sea altimeter can supply such altitude measurements to the 440 System.

The standard 440 System includes a sub-sea altimeter. You will need to install this on the ROV frame close to the centre of the coil array. See section 3.1.4 "Altimeter" on page 3-13 for instructions to install the altimeter on the ROV, and section 4.1.6 "Sub-sea Altimeter" on page 4-6 for instructions to connect it directly to the SEP.

NOTE

You should remember that an altimeter measures to a point on the seabed directly beneath its transducer face. This single-point measurement may not be the same as the local mean seabed level.

This means that an uneven seabed topography might degrade the quality and accuracy of depth of cover measurements derived using a single altimeter.

For surveys where you must measure an accurate and certifiable target burial depth, you should use an independent seabed profiling system. Log the measurements from such a system separately and then use the post-processing operation to merge them with data acquired by the 440 System.

On some types of tracked ROV, you may arrange to keep the coil array of the 440 System at a fixed height above the seabed. In these circumstances you could avoid the need for an altimeter by configuring DeepView for Windows to use a fixed coil height.

See Chapter 5 "System Configuration" for instructions to configure the altimeter after installation.

3 Physical Installation

This section of the Manual explains how to install the surface and the sub-sea components of the Teledyne TSS 440 System.

During the installation procedure you should make a written record of certain parameters and retain them with the survey log for reference during the post-processing operation. The DeepView for Windows software on the SDC allows you to examine the System parameters and to create a printed copy that you may retain with the survey records.

There are many different types and size of survey vessel and ROV and it would be impossible for this Manual to cover all installation possibilities. The instructions in this section therefore represent a set of general guidelines and recommendations that experience has proved effective.

3.1 Surface Display Computer (SDC) Installation

WARNING

You must take precautions to secure the SDC when you store and operate this unit in its transit case. Protect personnel from the hazard of falling equipment and protect the unit from damage when the survey vessel moves due to the action of waves. Install cables away from walkways and secure them so they do not present a hazard to personnel.

CAUTION

To avoid potential damage to the SDC, make certain it has sufficient ventilation to dissipate the heat that it generates during normal operation. You might damage the SDC if you allow it to overheat. To operate the SDC inside its transit case, release and remove the lid of the transit case to allow effective ventilation and heat dissipation.

If you mount the SDC in a 19-inch instrument rack you must allow a minimum 30mm clearance between the top of the SDC and any other equipment mounted directly above it in the rack. Also, allow a minimum 100mm space between the SDC rear panel and the rear of the instrument rack to allow for connectors and cable routing.

Although the SDC uses solid state electronics, the hard-disk drive and parts of the display panel are susceptible to damage through shock or sustained vibration. You must therefore exercise some care when you select a suitable location for this unit:

- Install the SDC where you have easy access to the controls. Choose a position for the SDC that allows you to see the screen easily while you operate the ROV.
- If you do not mount the SDC in an instrument rack, use the original SDC transit case to provide shock protection for the unit. Secure the transit case so that it cannot slide or fall with movements of the vessel.
- Make certain there is sufficient ventilation space above the SDC to remove the heat that it generates during normal operation. If necessary, use an electric fan to provide additional ventilation.

- Do not subject the SDC to extremes of temperature or humidity, or to severe vibration or electrical noise. Never allow the SDC to become wet.

NOTE

Obey the environmental limits listed in section 8.1.1 "Surface Display Computer" on page 8-2 when you store and operate the SDC.

Operation from transit case

Figure 3-1: SDC10 transit case - lid removal

For temporary installations, operation from the transit case is probably the most suitable method.

Follow the instructions below to correctly install the SDC10:

1. Verify the installation location SDC allows easy access to the touch-screen display and allows the user to see the screen easily while operating the ROV.
2. Open the four fixings located on the front and rear of the transit case.
3. Secure the transit case so that it cannot slide or fall with movements of the vessel.

Installing in 19" instrument rack

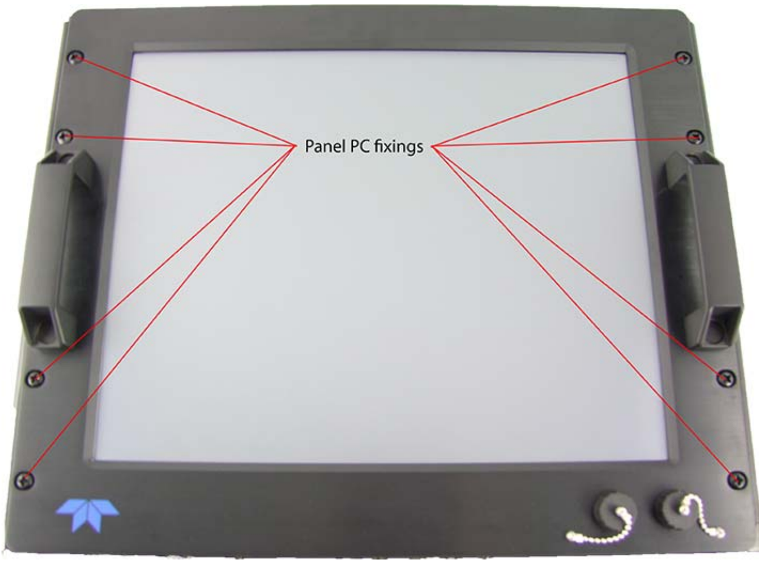


Figure 3-2: SDC10 - Panel PC fixings

1. Open the four fixings located on the front and rear of the transit case (Figure 3-1).

2. Remove the 8 x Panel PC fixing screws securing the SDC10 to the angled brackets fixed to the transit case base.

NOTE

If you intend to change the analogue output configuration used by the 440 System, make the necessary changes to the SDC *before* you install it into the instrument rack. Refer to sub-section 4.2.5.2 "Analogue Output DIP Switch Settings" beginning on page 4-17 for instructions to change the analogue output settings.

3.1.1 Sub-sea Installation

The care that you take when you install the sub-sea components of the 440 System will have a significant influence on the accuracy of survey data. Read the following instructions carefully and ensure that you have all the necessary parts and tools available before you attempt to install the System.

3.1.2 SEP and PSU

NOTE

Do not open either pod during the installation procedure unless you need to change the communication method used by the System. See section 4.2.2.1 "Alternative Communication Methods" on page 4-11 for instructions to change the communication method. You do not need to open the PSU to change the communication method.

If you need to open the SEP to set a different communication method, do this *before* you install the SEP on board the ROV. To preserve the seals, always follow the instructions carefully to disassemble and reassemble the housings. You will find these instructions in sub-section 9.2.2 "Sub-sea Installation" beginning on page 9-6.

There is a nylon mounting block attached to each of the housings. These blocks provide a safe and secure method to mount the housings to the ROV frame.

CAUTION

You might damage the anodised surface of the housings if you attempt to secure them to the ROV without using their proper mounting blocks. Corrosion will occur rapidly if you damage the protective anodising of the housings.

Do not remove the mounting blocks from the housings. Do not attempt to secure the housings directly to the ROV framework without using the mounting blocks.

The mounting blocks each have machined slots that allow you to strap the complete housing and block assembly firmly to the ROV frame. Stainless steel strapping is ideal for this purpose (see Figure 3-3).

It is safe to mount the SEP and the PSU in any orientation.

Mount the housings according to the following guidelines:

- Eliminate any possibility of snagging or damage to the housings by installing them at a protected position on the ROV.
- Locate the housings so that you may route the cables easily between the sub-assemblies of the 440 System.
- Do not apply sharp bends or other mechanical stresses to the cables during installation or operation. Route the cables between the components of the sub-sea installation, and use plastic clips to secure them to the ROV frame.
- On small ROVs, position the housings close to the centre of buoyancy to avoid upsetting the trim of the ROV.
- Tighten the mounting straps firmly so that the housings cannot move under the influence of ROV vibration or currents in the water.
- See section 4.1 "Sub-sea Components" on page 4-1 for instructions to make the electrical connections between the sub-sea components.

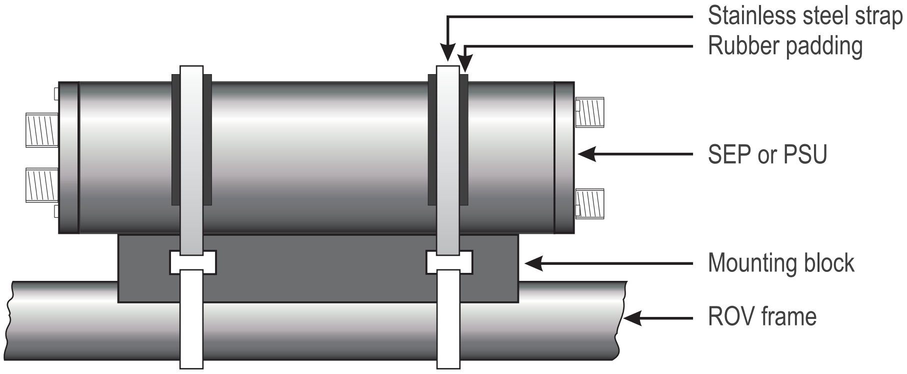


Figure 3-3: SEP and PSU mounting arrangement

3.1.3 Coil Array

NOTE

You should read this section *before* you attempt to install the array of search-coils. These details are *critical* to the successful operation and performance of the 440 System. Follow these instructions carefully to obtain the best performance from the System and to avoid interference with other equipment on board the ROV.

The Teledyne TSS 440 system has much more stringent requirements than its predecessor in terms of the coils and their mounting arrangements. The seawater signals can be almost completely excluded, therefore the performance of the system is limited mainly by the stability of the background compensation values (see section 6.2.2.3 "Background Compensation" on page 6-22).

The background compensation values must be absolutely stable and repeatable if good quality survey information is to be obtained. The coils must be mounted a sufficient distance from the ROV, and clamped tightly. Further, the metalwork of the ROV must not interfere with the compensation levels. This means that any manipulators must be tightly stowed during both survey and compensation.

NOTE

The coil cable assembly (P/N: 601004/x) can be provided in 3, 4, 6, 8 or 10m lengths. The cable length is identified by the ‘x’ suffix, i.e. 601004/4 for the 4m cable assembly. The following table outlines the cable part numbers and associated lengths.

CABLE LENGTH & IDENT TABLE		
PART No.	LENGTH 'X' (metres)	CABLE IDENT TEXT
601004/3	3	TSS 601004/3M
601004/4	4	TSS 601004/4M
601004/6	6	TSS 601004/6M
601004/8	8	TSS 601004/8M
601004/10	10	TSS 601004/10M

3.1.3.1 Search-coil Configuration

The standard 440 System uses three search-coils of dimension 1.0m × 0.94m × 0.03m. They must be mounted so that the sides without mounting holes point in a fore-aft direction.

NOTE

Versions of the 340 System used search-coils of different dimension. Do not use type 41 or other old coil types with the 440 System.

To protect the coils, mount them on the ROV with their potting compound uppermost.

Where necessary, after you have installed the coils you may restore a neutral ROV trim by firmly attaching a small non-conductive buoyancy aid to the front of the coil array.

3.1.3.2 Positioning the Search-coils

NOTE

The Search-coils must be firmly secured, so that there is no movement during the survey. A poor Search-coil mounting arrangement will reduce the performance of the system.

Consider these factors carefully when you choose a position to mount the coil array, and then read the following paragraphs for an explanation of these factors.

1. **Coil separation distance**.
   This is the distance between the coils and the body of the ROV after installation.

2. **Mounting position**.
   Consider whether you will mount the coils on the front or the rear of the ROV.

3. **Height of coils**.
   This is the vertical distance between the coils and the lowest point on the ROV. Mount the coils so they are parallel with the horizontal axis of the ROV.

1. Coil separation distance

This is the shortest distance between the edge of the search-coils and the region of the ROV where significant conductive material begins (see Figure 3-4). It is the most important consideration you must make when you plan your installation. There are conflicting requirements when you make this decision, and so you may have to make a compromise:

- **Mounting far away from the ROV**:
  A large coil separation distance will reduce the size of the background signal caused by the ROV body. This will reduce any tendency for the coils to saturate when they are over an exposed section of the target.

- **Mounting close to the ROV**:
  A small coil separation distance will allow you to deploy, manoeuvre and recover the ROV more easily.

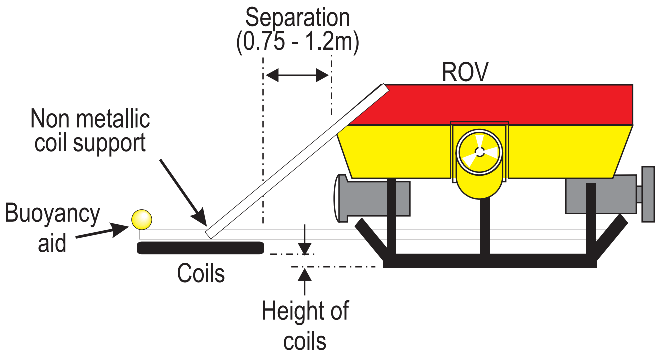


Figure 3-4: Coil separation distance

Small ROVs will tend to generate a comparatively weak background signal. This allows you to mount the coils closer to the ROV body.

Larger ROVs would generate a stronger background signal. To avoid this having too great an effect on System operation, you should mount the coils farther from the body of a large ROV. This requirement should not present a problem because larger ROVs usually possess greater manoeuvring power, and so will be able to overcome the additional manoeuvring resistance caused by the coil mounting position.

NOTE

The separation distance should be such that the background compensation signal for any channel does not exceed 1000µV for standard coil values and 7500µV for early coil values – see section 6.2.2.3 "Background Compensation" on page 6-22 for a description of background compensation. For most installations, a coil separation distance of between 0.75 and 1.2 metres will usually achieve this.

Loose metalwork on the ROV can cause changing eddy currents and hence changing background compensation levels as the vehicle lifts of the seabed. This is easily mistaken for a problem with the seawater rejection. It is best cured by moving the coils further away from the ROV. Fixing any loose metalwork securely and ensuring a good earth connection (at seawater potential) to the SEP may also help.

2. Coil mounting position

- **Front Mounting**

NOTE

Based upon considerable field experience, Teledyne TSS recommends a front-mounting location for the coils of the 440 System. This is both effective and practical for the majority of installations.

The preferred position to mount the coil array is on the front of the ROV. This will help the pilot to follow the most effective course along the target by using the DeepView for Windows Run Window. It will also reduce the risk of an umbilical snag. With coils mounted on the front of the ROV you must make certain that they do not obstruct or interfere with camera and lighting systems, scanning sonar systems, or other forward-looking sensors and probes.

NOTE

You must stow manipulator arms securely while you survey with the 440 System. Any free movement in the manipulators might cause unexpected changes in the background signal that could affect or invalidate survey data.

If you have to use the manipulators during a survey, you must check the background compensation immediately after you have stowed the manipulator arms.

- **Rear Mounting**
  Rear mounting of the coil array avoids interference with manipulator arms, camera and lighting installations, etc. However, in this position the coils could detect the trailing ROV umbilical and show it as a false target. If this happens, your survey results will include errors of indeterminate size.

If you must mount the coils at the rear of the ROV, arrange to monitor them with a video camera so that you may detect and correct this condition if it occurs.

3. Height of Coils

Ideally, you should mount the search-coils so that they are no lower than 0.1m above the lowest point on the ROV. This position is a compromise between the need to mount them low down to extend their operating range, and the need to protect them from damage by maintaining a safe distance from the seabed.

There is a danger that signal saturation may occur when a large target is very close to the coil array. When surveying such a target therefore, select a higher mounting position on the ROV.

Make certain you mount the coils so they are parallel with the horizontal axis of the ROV. The System measures the distance from the coil centres to the target, and these measurements would contain errors if the coils were not horizontal. Be particularly careful if your system uses rams to lower and deploy the coil array after you have launched the ROV.

3.1.3.3 Coil Assembly and Installation

You must use the correct non-conductive mounting components supplied with the 440 System to fix the search-coils to the ROV frame. These mounting components include six pre-drilled cast nylon beams and nylon threaded stud, nuts and washers.

When assembled, the nylon components should support the search-coils rigidly in position. You may degrade System performance if you have to cut or modify the mounting components to establish a successful installation.

IMPORTANT

Apart from relevant components of the 440 sub-sea installation, do not place any conductive material, however small or apparently insignificant, any closer to the search-coils than 0.75m. Note that, to the 440 System, a conductive bolt near the coils can look like a target at 1 metre range.

All fastenings, for example cable clips and screws, must be non-conductive.

The System includes three pairs of pre-drilled nylon beams to support the coils on the ROV. Figure 3-5 shows each type of nylon supporting beam:

- Two coil mounting strips
- Two outriggers
- Two tie-bars

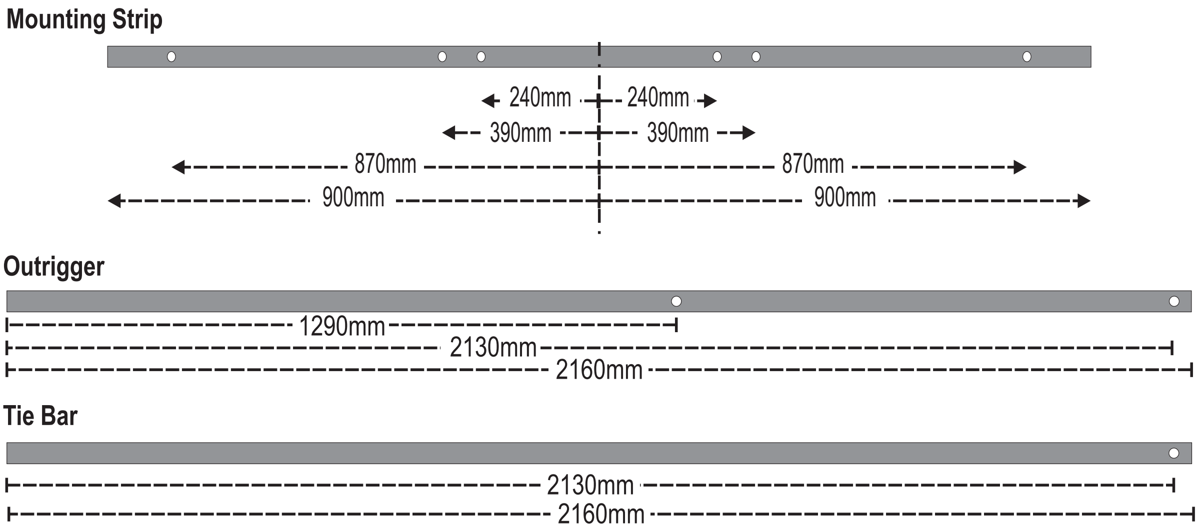


Figure 3-5: Components of the coil frame

Figure 3-6 shows how to construct the coil frame.

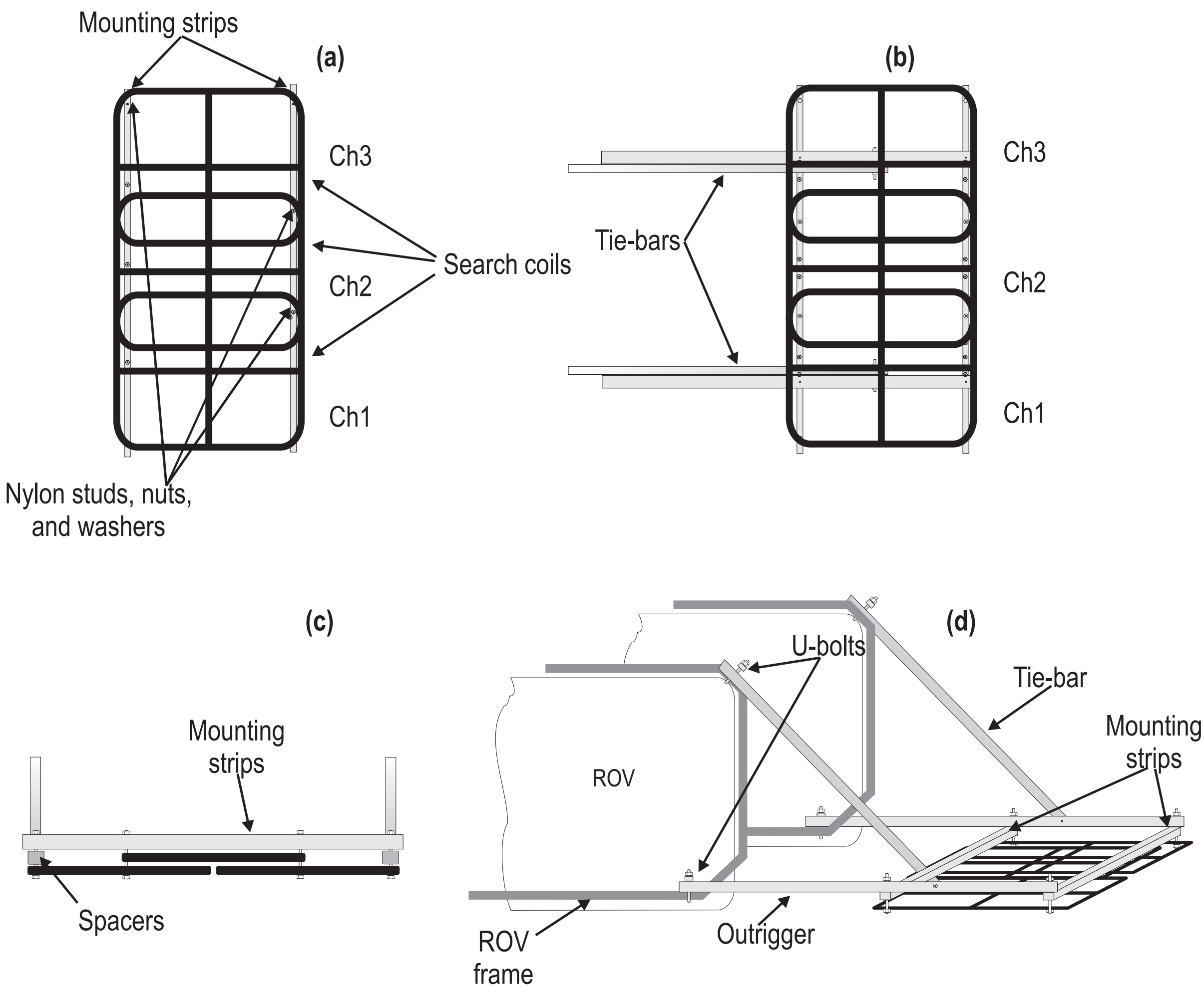


Figure 3-6: Assembly of the coil frame

NOTE

Note that the centre coil is mounted above the other two coils, making it further away from the target. The System will not function correctly if it is below the other two coils. The port and starboard coils must be mounted such that there is a gap of 5-10 mm between them as defined by the mounting holes in the coil mounting frame.

It is important for accurate readings and continued functionality that the Coils are not bent and that the mounting frame is rigid.

Attach the coil frame to the ROV

To construct the coil frame and assemble the coils to the ROV you will need the following facilities, components and items:

- All the components and fixings of the coil frame supplied by Teledyne TSS.
- Stainless steel bolts or U-bolts to fix the coil frame to the ROV.
- A drill together with 16.5mm and 5mm drill bits.

- ❒ A measuring tape.
- ❒ A spanner for M16 nuts.
- ❒ A hacksaw to cut the lengths of nylon studding.
- ❒ Plastic cable clips.

There are holes pre-drilled in the mounting strips, outriggers and tie-bars. Note however that you may have to drill additional 16.5mm holes in these components to fit the frame to your specific ROV. Try to avoid this if possible, because you may degrade the System performance.

NOTE

Do not drill holes in the search-coils.

Plan the installation carefully before you assemble the frame components and bolt them together. The following instructions assume you will be installing the coils at the front of the ROV. You may install the coils at the rear of the ROV if you take the proper precautions explained in section 3.1.3.2 "Positioning the Search-coils" on page 3-6.

Do not fully tighten the nylon fixing nuts until you have completed all the assembly work on the sub-sea installation.

1. Place the coils on the deck near the ROV. Arrange the coils so that their potting compound is on the top, and all their connectors face towards the ROV. There should be a 5-10mm gap between the port and starboard coils after the nuts have been tightened.

2. Lay the coil mounting-strips on top of the coils and bolt the assembly together using M16 nylon studding through each of the locating holes– see Figure 3-6(a). Secure the studding on each side with a nylon washer and nut.

Ensure that the fixing studs do not project too far below the bottom M16 nut (see Figure 3-7). Also, after you assemble each stud, it is a sensible precaution to drill 5mm diameter holes through the stud above and below the fixing nuts and use cable ties to lock the nuts into position.

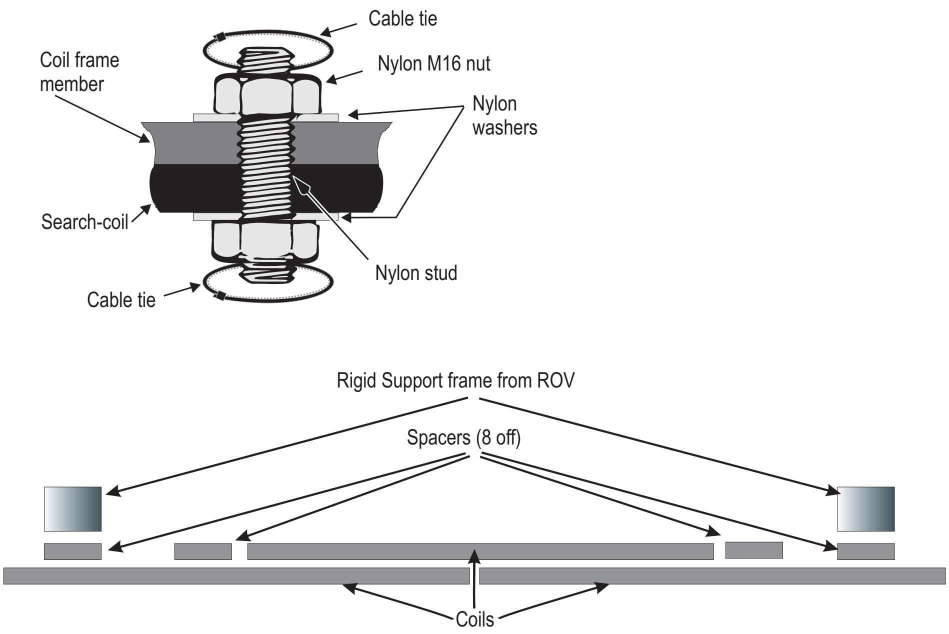


Figure 3-7: Coil fixing and use of spacers for coil arrangement

NOTE

Where there is the possibility of damage to the search-coils from contact with a rocky or abrasive seabed, you may mount the coils on top of the outrigger bars.

3. Use stainless steel bolts or U-bolts to secure the outriggers to suitable parts of the ROV frame. Ensure that the outriggers are parallel with the ROV skids. This precaution gives a small relative angle of pitch between the ROV and the search-coils. Pitch angles greater than ±15° between the coils and the target will affect measurement accuracy.

4. If necessary, you may drill new 16.5mm diameter holes in the mounting strips to help assemble the frame. When you assemble the frame, make certain you do not place excessive mechanical stress on any of the fixing studs.

CAUTION

Take care to protect the coils when you drill holes in the frame components. Do not drill holes into any part of the coils. Do not machine the coils in any way.

5. Use four lengths of nylon stud and attach the coil array to the two outrigger bars as shown in Figure 3-6(b). **Support the coils while you do this.**

6. Use nylon stud inserted through the lateral holes to attach the ends of the tie-bars to the outriggers – see Figure 3-6(c). If no suitable 16.5mm diameter holes exist in the outriggers, drill them.

Use stainless-steel bolts or U-bolts to secure the free ends of the tie-bars to the ROV frame as shown in Figure 3-6(d). You may have to shorten the tie-bars so that they do not snag the ROV umbilical.

7. Finally, ensure that all nylon studs have washers fitted. Tighten the nuts fully. Check that the outriggers and tie-bars are secure and that there is minimal free movement in the completed coil assembly.

3.1.4 Altimeter

The Altimeter needs to be mounted such that it has a free view of the seabed and avoids acoustic interference. If possible the altimeter should also be aligned with the centre of the search coil array. You should also consider its minimum range measurement specification.

Any horizontal offset between the altimeter and the coil will cause errors in depth of cover measurements made by the 440 System. The example in Figure 3-8 shows how the two altimeters ‘A’ and ‘B’ will supply totally different readings at the ROV location. When used by the SDC, these readings would show entirely different measurements for target cover. The magnitude of these errors will vary according to the seabed topography and the relative positions of the altimeter and the coil array.

Note that it is the position of the altimeter that causes these errors. Measurements of vertical range made by the 440 System will retain their accuracy under all normal conditions.

NOTE

Do not place the altimeter at the opposite end of the ROV to the coils. If you do not follow this advice, it is possible that the survey data might contain errors caused by pitch of the ROV or uneven seabed topography.

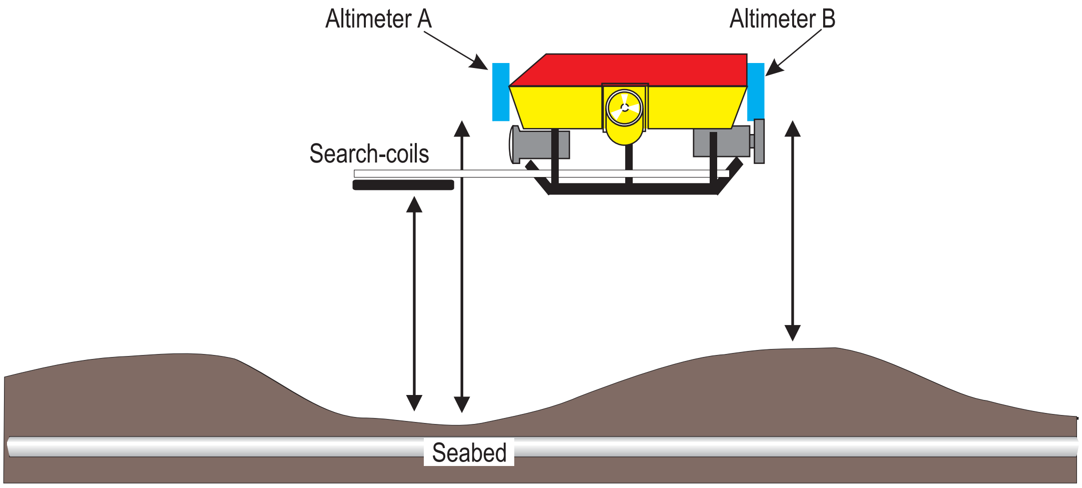


Figure 3-8: Effects of altimeter horizontal offset

When you select a position for the altimeter, make allowance for its minimum measurement range capability.

IMPORTANT

The altimeter provides information valid only for a point directly below its transducer face but parallel to its axis. When you operate the ROV over uneven seabed, or where the target is in a trench, Teledyne TSS strongly recommends that you use a separate profiling system to measure the accurate seabed level. See section 7.2.1.4 "Altimeter Positioning" on page 7-4 for further information.

3.2 Installation Check-list

- ❒ Ensure the centre coil is mounted further away from the seabed, i.e. above the port and starboard coils.
- ❒ Ensure the array is central on the ROV and that it aligns with the fore-aft direction of travel.
- ❒ Mount the coil array so that its lowest point is more than 0.1m above the lowest point on the ROV. Use a higher mounting location if coil saturation is likely during survey operations on a large target.
- ❒ Mount the coils so they are parallel with the horizontal axis of the ROV.
- ❒ Make certain there is sufficient separation between the coils and the ROV body. The background signals from the ROV should be less than 1000µV for standard coil values and 7500µV for early coil values to allow successful operation. Usually, this requires a separation distance of 0.75 to 1.2 metres between the coil array and the ROV body.
- ❒ If you intend to install the 440 System on the same ROV as a Teledyne TSS 350 or 350 Powertrack System, follow the instructions and recommendations concerning coil installation in Appendix B.
- ❒ Do not install the coil array closer than 1m to any conductive materials. Do not use any metal fixings and fastenings within the coil frame.
- ❒ Do not allow any free movement in the coil array or the cables. Poor mounting will reduce the quality of the survey information.
- ❒ Always use the nylon mounting blocks when you install the SEP and the PSU.
- ❒ When you select a location to install the altimeter, consider its minimum range measurement specification.
- ❒ Avoid installing your altimeter where there is a significant horizontal offset distance between it and the coil array.
- ❒ Record all installation-specific configuration details in the Survey Log.

4 Electrical Installation

This section of the Manual explains how to connect the SDC and the sub-sea components of the standard 440 System. You should attempt the electrical installation only after you have followed the instructions in Chapter 3 "Physical Installation" to install the sub-assemblies of the 440 System.

Also included in this section are detailed instructions that tell you how to change the communication method used between the SDC and the SEP.

NOTE

The standard 440 System uses RS232 communications. To select an alternative communication method you must change the settings of links inside the SEP and the switch on the rear of the SDC comms module. If the SDC being used is not an SDC9 or SDC10, the current loop converter card will not have an external switch. It will need to be modified by changing the internal links on the Current Loop Converter board. If you need to change the communication method you *must* make the necessary link adjustments inside the SEP *before* you mount it onto the ROV.

NOTE

The SDC provided with the 440 System is provided with Windows 7. DeepView for Windows can be installed on an additional machine, but Teledyne TSS stress that the operating system must have a minimum specification of Windows XP. The specification of the SDC provided can be found in Section 8 "System Specifications" beginning on page 8-1. This should be used as a guideline if you are planning to use DeepView for Windows on an alternative PC.

4.1 Sub-sea Components

WARNING

There is a risk of death or serious injury by electric shock when you work on the electrical distribution system. Only a competent engineer who has the relevant training and experience should make the connection to the ROV electrical distribution system.

Power-off the ROV and isolate the mains supply voltages before you connect the 440 System to the electrical distribution system. Observe all relevant local and national safety regulations while you work on the ROV and on the 440 System.

Do not reconnect the mains electrical supply to the ROV or to the 440 System until you have completed all work and you have fitted all safety covers and ground connections.

This sub-section explains how to complete the electrical installation of the sub-sea components.

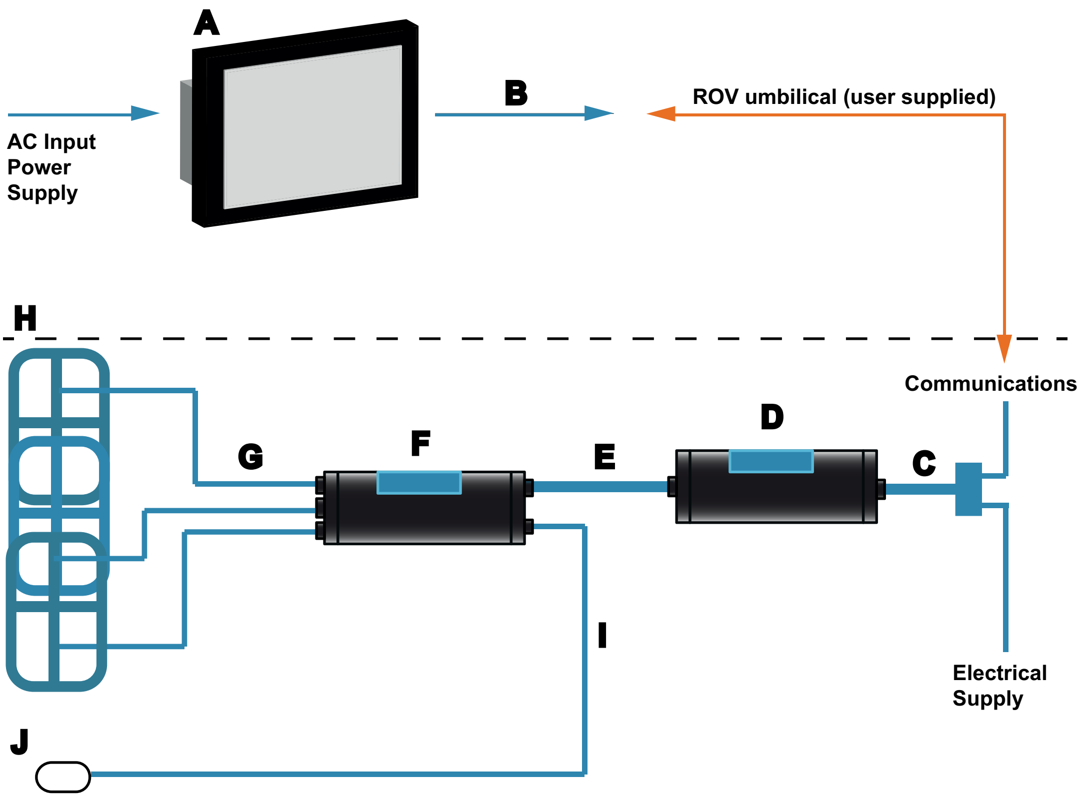


Figure 4-1: System interconnection diagram

Table 4-1: System interconnection details

A	The SDC accepts an AC electrical supply in the range 90 to 264VAC. The power demand is a maximum of 250VA.
B	Data communications from the SDC to the ROV umbilical. These can be 2-wire or 4-wire 20mA digital current loop, or RS232. The default configuration is RS232 communication.
C	Power and communications cable (or 'ROV Tail') from the ROV to the PSU. This cable has cores to carry the communication signals that pass between the SEP and the SDC, and power cores that supply mains electrical power to operate the PSU. Refer to Table 4-2 "Power and Communications cable" beginning on page 4-4 for details of the cable.
D	The PSU accepts AC power from the ROV electrical distribution system through the ROV tail. The maximum current drawn from the supply is approximately 2.8A (at 100V to 120V). As an option, Teledyne TSS can supply a PSU that accepts AC power at 230V instead.
E	Connection between the PSU and the SEP is through a single cable. The cable has a 12-way connector that connects to the SEP.
F	The SEP accepts power from the PSU and communicates with the SDC through the PSU to SEP cable. The SEP provides power to, and communicates with the sub-sea altimeter through the sub-sea altimeter cable. The SEP drives the search coils through the coil search cables.
G	Three coil connection cables
H	Three Teledyne TSS search coils arranged as shown with connections to Channels 1 to 3 on the SEP.
I	Power and data cable that connects the altimeter to the SEP
J	Sub-sea altimeter

4.1.1 Ground Connections

If you provide the 440 System with an inadequate ground connection, parts of the System will act as 'sacrificial anodes' and will slowly decay during sub-sea operations. This will occur whether or not you use the 440 System.

To prevent corrosion affecting the System in this way, you must connect pin 2 of the 8-way SEP 'Power/Comms' port locally to the ROV using a ground connection at sea water potential.

IMPORTANT

To ground the SEP use only a local grounding point on the ROV frame. Do not use a core within the umbilical to ground the 440 System because there will inevitably be a potential difference between the ROV and the surface vessel.

These grounding provisions hold the 440 System at the same electrical potential as the sea water. This prevents the occurrence of electro-chemical action between the System and sea water and minimises galvanic corrosion.

4.1.2 Care of Sub-sea Connectors

To ensure reliable operation and to extend the life of the sub-sea installation, take the following precautions to care for the sub-sea connectors used throughout the 440 System:

1. Keep both the connector and socket free from debris and salt build up.
2. Use warm soapy water to wash the connectors, and then rinse them with clean fresh water. Do not use any solvents on the connectors. Allow the connectors to dry thoroughly in air before you reassemble them.
3. Lubricate the mating face of the connectors with a very light spray of **3M Silicone Oil** or **Dow Corning #111** valve lubricant or equivalent. **Do not use grease.**

CAUTION

Some silicone lubricants will crystallise when you subject them to sea water under pressure. When this happens, the seals of the connector will degrade and allow water to penetrate.

To avoid damage to the connectors, use only the lubricant oils mentioned above, or equivalent oils that the manufacturer approves specifically for use on deep-sea connectors and seals. When you apply the lubricant oil, use a very thin coating only.

4.1.3 Power Supply Pod

The PSU 'Power/Comms' port accepts the AC electrical supply from the ROV and passes the bi-directional communications between the SEP and the SDC. All electrical and communications connections to the sub-sea installation are through the Power and Communications cable, or 'ROV Tail'. Table 4-2 lists the pins of the connector on the Power and Communications cable, together with the relevant core colours. Refer to this table as you make the connection to the ROV electrical distribution system. All cores in the cable are 1.25mm² cross-section. See section 4.2.2 "Communication Link SEP to SDC" on page 4-8 and the cable drawing number B930473 in Chapter 10 "System Drawings" for further details.

Table 4-2: Power and Communications cable

Connector Pin Number (and Wire number)	Function	Core colours
1 (N)	Supply neutral line/L2	Blue
2 (E)	ROV ground (refer to sub-section 4.1.1 "Ground Connections" beginning on page 4-3)	Dark Green
3 (L)	Supply 110V live/L1 (or +140 to +170V DC)	Brown
Pin 4 (wire number 1)	Comms 1	Orange
Pin 5 (wire number 2)	Comms 2	White
Pin 6 (wire number 3)	Comms 3	Red
Pin 7 (wire number 4)	Comms 4	Yellow
8 (no connection)	Linked internally to the cable screen	Screen

Lay the Power and Communications cable from the ROV electrical distribution system to the PSU. Route the cable along fixed ROV frame members and use cable clips to secure it at regular intervals. Avoid applying any sharp bends or other points of mechanical stress along the cable.

Connect the Power and Communications cable to the 8-way male 'Power/Comms' port on the PSU. Tighten the knurled locking collar by hand only. **Do not overtighten this connector.**

Before you assemble any electrical coupling in the sub-sea installation, inspect the pins and receptacles of all connectors for signs of damage, contamination or corrosion. Follow the instructions in section 4.1.2 "Care of Sub-sea Connectors" on page 4-3 to clean and care for the connectors.

CAUTION

It is very important to provide a good ground connection on pin number 2 of the cable. A poor or a missing connection will severely degrade the performance of the 440 System. You must make all connections to the ROV using waterproof connectors or splices of good quality.

4.1.3.1 Power Requirement

The standard PSU operates from an AC electrical supply in the range 100 to 120V AC, 45 to 65Hz. The System draws approximately 2.8A at 110V nominal supply voltage. The same PSU can operate from a DC supply in the range 140 to 170V with no further adjustments necessary.

See Table 4-2 and make the correct power connections from the ROV electrical distribution system to your PSU.

4.1.4 Sub-sea Electronics Pod

CAUTION

Water could enter the SEP through any port that does not have a connector fitted. To avoid damage from water ingress, you must fit the correct blanking plug supplied by Teledyne TSS to protect any unused port on the SEP.

The SEP has six ports that allow connection to the various sub-sea components of the installation.

On one end cap:

- Connection ports for coil channels 1 to 4. A label identifies the four coil channels. The 440 System uses only three channels during a survey. You *must* ensure the unused port has a blanking plug fitted to protect it during sub-sea operations.

On the other end cap:

- Connection port for the 12-core cable from the PSU
- Altimeter connection

Before you assemble any electrical couplings in the sub-sea installation, inspect the pins and receptacles of all connectors for signs of damage, contamination or corrosion. Follow the instructions in section 4.1.2 "Care of Sub-sea Connectors" on page 4-3 to clean and care for the connectors.

Tighten the connector locking collars by hand only – **do not overtighten these connectors**.

4.1.5 Search-coils

CAUTION

You must fit a blanking plug to the unused channel on the SEP. The System includes four of these plugs and further can be obtained if required (Teledyne TSS P/N 202207).

If you do not fit this blanking plug, rapid corrosion of the port will occur and the port will fail. Sea water will then enter the SEP through the corroded port to cause total failure of the SEP.

You must use one of the cables supplied with the System to connect each search-coil to its correct channel on the SEP. The cables have a waterproof connector fitted to each end.

NOTE

Route the cables from the coils to the SEP by securing them along the ROV body using plastic cable clips. Avoid introducing any sharp bends or other points of stress, and ensure the cables are safe from potential damage from manipulators, thrusters or other equipment on the ROV.

Before you assemble any electrical coupling in the sub-sea installation, inspect the pins and receptacles of all connectors for signs of damage, contamination or corrosion. Follow the instructions in section 4.1.2 "Care of Sub-sea Connectors" on page 4-3 to clean and care for the connectors, and in section 6.3.2.1 "Coil Insulation Test" on page 6-13 to perform an electrical insulation test on the coils.

Tighten the connector locking collars by hand only – **do not overtighten these connectors**.

For the System to operate correctly, you must connect the search-coils to their correct input channels on the SEP. Labels identify the four SEP input channels:

- Connect the starboard coil to SEP Channel 1
- Connect the centre coil to SEP Channel 2
- Connect the port coil to SEP Channel 3
- Make certain you fit the supplied blanking plug to SEP Channel 4 to protect it from contact with sea water.

NOTE

The above coil-to-channel relationship is valid both for front and for rear mounting coil arrangements on the ROV.

4.1.6 Sub-sea Altimeter

CAUTION

If you do not use the ‘Altimeter’ port on the SEP, you must fit the correct blanking plug supplied with the System to protect it from contact with sea water. Further plugs can be obtained if required (Teledyne TSS P/N 202208).

If you do not fit this blanking plug, rapid corrosion of the port will occur and the port will fail. Sea water will enter the SEP through the corroded port to cause total failure of the SEP.

Depending on the type of altimeter used, you may connect the altimeter in one of two ways:

- Directly to the SEP (see section 4.1.6.1 "Direct Connection to the SEP" on page 4-7)
- Through the ROV umbilical to the SDC (see section 4.1.6.2 "Connection to the SDC" on page 4-7)

4.1.6.1 Direct Connection to the SEP

Use this method for the Teledyne TSS or Teledyne Benthos sub-sea altimeters. The SEP provides power to drive these altimeters.

Route the cable from the altimeter to the SEP. Secure the cable at regular intervals along fixed frame members of the ROV. Avoid introducing any sharp bends or other points of mechanical stress along the cable.

NOTE

Follow the important advice listed in section 4.1.2 "Care of Sub-sea Connectors" on page 4-3 concerning the care of connectors.

Connect the cable to the 6-way 'Altimeter' port of the SEP. Tighten the knurled locking collar by hand only. **Do not overtighten this connector**.

Use the DeepView for Windows software to configure the 440 System for use with an altimeter connected directly to the SEP. Refer to Chapter 5 "System Configuration" and Chapter 6 "Operating software" for appropriate instructions.

4.1.6.2 Connection to the SDC

Use this method to connect all other types of altimeter compatible for use with the 440 System.

These altimeters use RS232 communications. To send their signals through the umbilical, you must add them to the ROV multiplex unit and extract them at the surface. You must also provide a separate power supply for the altimeter.

Generally, these types of altimeter have different data formats. Refer to section 6.6 "Altimeter Data Format" on page 6-35 for details of these formats.

Make the following provisions if you intend to use one of the compatible alternative altimeters with the 440 System:

- Connect the altimeter to an available serial port. This will normally be the 'COM2' port. Note that, because the altimeters use RS232 communications, they cannot transmit their signals farther than approximately 15 metres. Therefore, you must add the altimeter signals to the ROV multiplexer and then extract them at the surface. You must then convert the signals to RS232 for application to the SDC.
- Provide a separate power supply to drive the altimeter.

Refer to the manual supplied by the altimeter manufacturer for relevant connection details.

Connect the RS232 altimeter signals to the SDC through the 9-way D-type male serial communication port labelled 'COM2' on the rear comms module of the SDC. The pin designations for the 9-way D-type ports are as follows:

Table 4-3: RS232 connections for the altimeter (9-way D-type female cable)

Altimeter signal	Pin Number	SDC Altimeter pin connections
RS232 data from altimeter	2	Receive
RS232 Comms to altimeter	3	Transmit. *Necessary for use only with the OSEL Bathymetric System, where communications must be bi-directional*.
RS232 common	5	Ground

Use the DeepView for Windows software to configure the 440 System for use with the appropriate type of altimeter. See Chapter 5 "System Configuration" and Chapter 6 "Operating software" for relevant instructions.

4.2 Surface Display Computer

See section 2.2 "Surface Components" on page 2-3 for a description of the SDC and Chapter 8 "System Specifications" for a minimum specification.

NOTE

All connections to the SDC are through the VESA-mounted Comms Module attached to the rear of the Panel PC. They are located on the top face of the Comms Module making them easily accessible during System installation.

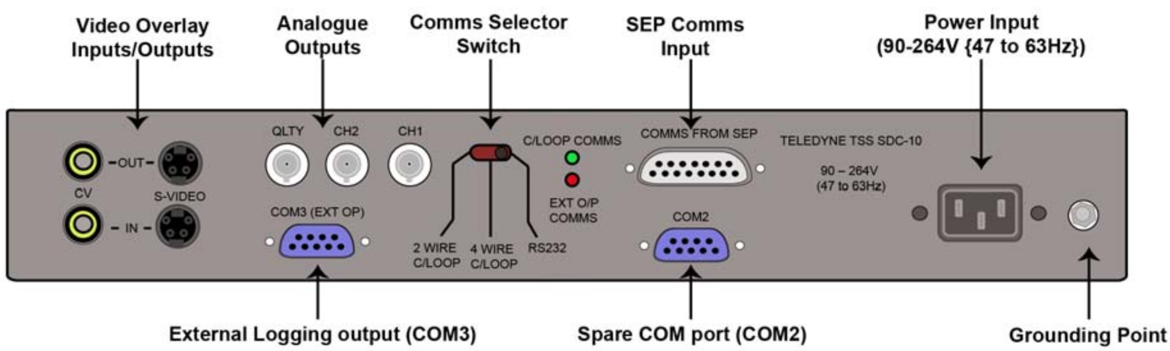


Figure 4-2: SDC Rear comms module with key to ports

4.2.1 Power Connection

Connect AC electrical power to the SDC through the 3-core electrical supply cable and standard 3-pin IEC electrical inlet. The SDC has an auto ranging power supply unit that configures itself automatically to use an electrical supply in its acceptable range 85 to 265V AC (47 to 63Hz).

4.2.2 Communication Link SEP to SDC

Use the SDC port – 'COMMS FROM SEP'

The SDC10 uses the 15-way D-Type labelled '*COMMS FROM SEP* 'to communicate with the 440 SEP. This connector is internally linked to *'COM1'* used by DeepView to establish communication with the 440 SEP. There is no requirement to make an external connection to link the SDC10 and 440 SEP comms.

The standard communication link between the SDC and the sub-sea installation of the 440 System uses RS232 communication as default. However, it is selectable between RS232, 2-wire 20 mA current loop and 4-wire 20mA current loop.

- RS232

  This is a 3-wire link suitable only for communication over distances up to 15 metres. You may use this method to transmit data to the survey control room using the ROV multiplexer and an existing data link to the survey control room.

There are two further methods that you may use to establish successful communication between the SDC and the sub-sea components of the 440 System:

- 2-wire 20mA current loop

  If the umbilical cable is of good quality, experience has shown that you may use this communication method successfully through transmission distances up to 1000 metres. To ensure reliable communications through the umbilical, select a twisted pair that has the following characteristics:

Table 4-4: Ideal twisted pair characteristics for successful communication

Twisted pair characteristic	Ideal value
Overall resistance	Less than 200Ω
Core size	0.5 to 1.0mm^2
Inter-conductor capacitance	Less than 100pF per metre

  You will need to reconfigure the SDC and the SEP to use this communication method. See section 4.2.2.1 "Alternative Communication Methods" on page 4-11 for instructions to do this.

- 4-wire 20mA digital current-loop

  You should select this method when the umbilical link to the ROV is longer than 1000 metres, or where you cannot establish reliable communication using a 2-wire current-loop.

  You will need to reconfigure the SDC and the SEP to use this communication method. See section 4.2.2.1 "Alternative Communication Methods" on page 4-11 for instructions to do this.

  After you have made the necessary changes in the SEP and the SDC, perform a simple communication check.

The Systems default parameters for communication between the SDC and the SEP are 9600 baud with 8 data bits, 2 stop bits and no parity.

NOTE

These communication settings are valid even when you use 2-wire or 4-wire current-loop communications. This is because the SDC converts between current-loop and RS232 communications through a special converter card. All communication between the SDC and the sub-sea installation passes through the relevant SDC serial port.

Communication lines between the SDC and the sub-sea components are opto-isolated at both ends.

The following tables show the connections that you must make between the SEP and the SDC for each of the three communication methods. See section 4.1.3 "Power Supply Pod" on page 4-3 and Table 4-2 for details of the connections that you must make between the SEP and the ROV electrical distribution system.

Table 4-5: Power and Communications cable – 2-wire current loop connections

SEP Power/Comms port Pin number	Function		SDC ‘COMMS FROM POD’ (15 way) pin connection
4 5	CL- CL+	⇔ ROV umbilical	3 4

Table 4-6: Power and Communications cable – 4-wire current-loop connections

SEP Power/Comms port Pin number	Function		SDC ‘COMMS FROM POD’ (15-way) Pin connection
4 5	CL+ Input CL- Input	⇔ ROV umbilical (Tx in SDC)	3 4
6 7	CL+ Output CL- Output	(Tx in SEP)	5 6

Table 4-7: Power and Communications cable – RS232 connections

SEP Power/Comms port Pin number	Function		SDC ‘COMMS FROM POD’ (15-way) Pin connection*
4 5	Tx output from SEP Rx input to SEP	⇔ Data cable	3 4
6	Common		5
The 15-way D-Type labelled “COMMS TO SEP” is internally connected to the Panel PC COM1. Hence all communications protocols, including RS232, must use the 15-way D-Type.			

To use current-loop communications you must reserve either one or two conductor pairs in the ROV umbilical for the exclusive use of the 440 System. The System includes a cable that you should use to connect the ‘COMMS FROM SEP’ port on the SDC to the twisted pairs in the ROV umbilical. The cable has a 15-way D-type connector for connection to the SDC ‘COMMS FROM SEP’ port, and open tails for connection to the umbilical at a junction box.

Previous versions of the SDC required a jumper cable to be fitted between the 15-way D-Type and COM1 of the SDC. However, the SDC10 internally connects the 15-way D-Type to COM1 and removes the requirement for the jumper cable.

4.2.2.1 Alternative Communication Methods

WARNING

There is a risk of death or serious injury by electric shock when you work inside the SDC, the SEP or the PSU. Only a competent engineer who has the relevant training and experience should open any part of the 440 System. Power-off and isolate the equipment from the mains supply voltage before you open any part of the 440 System. Observe all relevant local and national safety regulations while you perform any maintenance work on the 440 System.

Re-fit all safety covers and ground connections to the 440 System before you re-connect the equipment to the mains electrical supply.

Many components within the SDC are susceptible to damage due to electrostatic discharge. You must take precautions against such damage. These precautions include the use of a grounded conductive mat and wrist-strap. Teledyne TSS will not accept responsibility for any damage caused by failure to take such precautionary measures.

NOTE

The following instructions are valid for the SDC Type 10 shipped as part of the 440 System. If required, contact Teledyne TSS for advice for instructions relating to older versions of the SDC.

The standard communication link between the SDC and the sub-sea installations of the 440 System uses RS232 communications. This method of communication is only suitable for use with umbilical cables up to 15m. To configure the 440 System to use an alternative communication method, you must change link settings inside the SEP and the position of the external switch on the SDC comms enclosure.

The alternative communication methods are:

- 4-wire 20mA digital current-loop

  Suitable for use with umbilical cables longer than 1000 metres, or where the quality of the umbilical cable prevents effective use of the standard 2-wire method.

  In practice, the 4-wire method should be suitable for use with umbilical cables up to 4000 metres long if the umbilical is of good quality.

- 2-wire 20mA digital current-loop

  If the umbilical cable is of good quality, experience has shown that you may use this communication method successfully through transmission distances up to 1000 metres.

Configure the SEP

CAUTION

Many components inside the SEP are susceptible to damage due to electrostatic discharge. You must take precautions to prevent such damage whenever you open the SEP. These precautions include the use of a grounded conductive mat and wrist-strap. Teledyne TSS will not accept responsibility for any damage caused by failure to take such measures.

NOTE

If you need to select a different communication method, change the settings of links inside the SEP *before* you install it on board the ROV.

Follow the instructions in section 9.2.2.1 "Sub-sea Electronics Pod" on page 9-6 to open the SEP and gain access to the circuit cards. The SEP card support block, shown in Figure 4-3, carries the Analogue Board, the Driver Board, and the Main Board. The Main Board is the largest of the three.

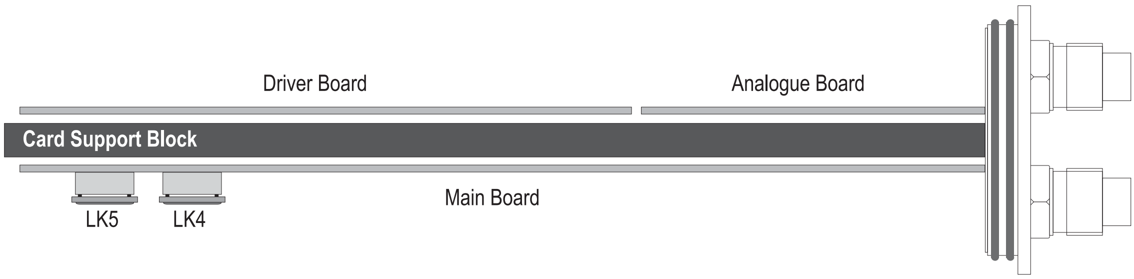


Figure 4-3: SEPcard support block

The Main Board includes two plug-in DIL 'headers', LK4 and LK5. Figure 4-4 shows the location of these links on the Main Board.

To change the communication setting used by the SEP, you must change the plug-in headers in LK4 and LK5.

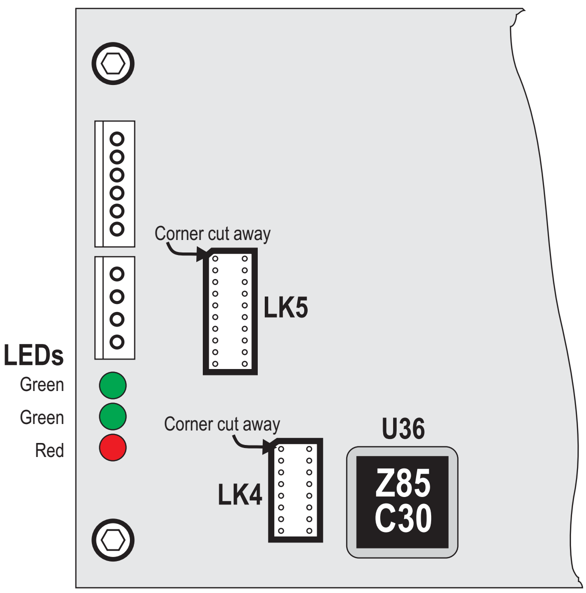


Figure 4-4: Link location on the SEP Main Board

Make certain that you have the correct link headers for your chosen communication method. Carefully remove the existing link headers from their sockets and store them safely in the field support kit.

NOTE

The header pins are thin and you might damage them if you handle the link carelessly.

Align the pins of the replacement header with the receptacles in the socket. The socket has a corner cut off to ensure that the orientation is correct as shown in Figure 4-4. Press the link header carefully into position until it seats properly in the socket. Check that none of the pins have become bent or damaged and that all are inserted fully into the socket.

Each of the headers has a different Teledyne TSS part number and establishes a different communications protocol. You may order a complete set of SEP headers from Teledyne TSS if you need to change the communication method. Table 4-8 lists the part numbers for the SEP headers.

Table 4-8: SEP link header part numbers

SEP Link	2-wire Current-loop	4-wire Current-loop	3-wire RS232 (Standard fit)
LK5	465002	465008	465005
LK4	465010	465011	465004

Once you have set both links, follow the instructions in section 9.2.2.1 "Sub-sea Electronics Pod" on page 9-6 to re-assemble the SEP.

NOTE

It is a good idea to keep the links on the spare Main Board set identically to those in the SEP. This avoids potential communication problems if you need to replace the Main Board from the field support kit during a survey.

Configure the SDC

WARNING

The SDC10 provides an external switch on the comms module to configure the communication protocol used. Do not open either the Panel PC orthe comms enclosure to change the comms protocol.

To change the communication method you will need to move the selector switch on the comms module to the required position (see Figure 4-2 above).

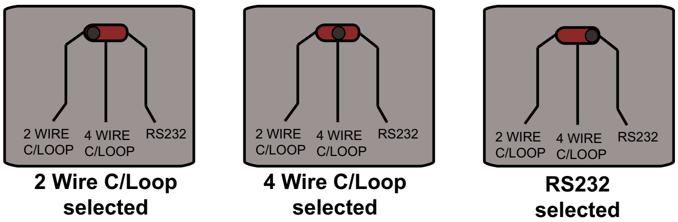


Figure 4-5: Comms selector switch positions

The available switch positions are shown in Figure 4-54-5 and described in the table below:

Comms Protocol	Switch Position
2-wire Current Loop	Left-hand position
4-wire Current Loop	Central position
RS232	Right-hand position

After you have changed the communication method, you must run the configuration wizard from DeepView for Windows to re-establish comms or comms errors will be generated.

NOTE

You must perform a communication check as part of the pre-dive tests. See section 6.3.2 "Pre-dive Checks" on page 6-12 for details of the recommended pre-dive test procedure.

4.2.3 Interface to Data Logger

Use the SDC port 'COM3 (EXT O/P)'

During normal survey operations, the 440 System acquires data at a rate of up to 1MB per hour. You should arrange to record the official survey log on a suitable data logger.

For your convenience and for test purposes, the 440 System can also create a logged record internally on the SDC hard disk. Data stored using the internal logging facility does not possess the same format as that transmitted to the external data logger, and you should not use it as the primary survey log. Internal logging allows you to record sections of the survey and then to 'replay' them subsequently using the graphical display facilities of the SDC. You cannot replay external logging files through the SDC in this way.

NOTE

The internal logging facility on the 440 System is for your convenience and for test purposes only. Do not use it as the principal survey logging tool. Unless otherwise stated, this Manual describes the external logging facility of the 440 System.

See section 6.4.1.1 "External Logging Format" on page 6-23 for a description of the format that the 440 System uses to log data.

Make a connection between the 440 System and an external data logger using the 9-way D-type 'COM3 (EXT O/P)' port on the Panel PC rear comms module. The pin designations for this port are as follows:

Table 4-9: RS232 connection to SDC 'COM3 (EXT O/P)

Signal to Data Logger	SDC 'LOG O/P' (COM3) Pin connections
RS232 input to data logger	3 (transmit)
RS232 common	5 (ground)

4.2.4 Interface to Video

Use the SDC ports 'CV IN' and 'CV OUT' or 'S-VIDEO IN' and 'S-VIDEO OUT'

1. Video input – Use appropriate input port for your format (COLOUR CV IN or S-VIDEO IN) These are clearly marked on the Panel PC Comms module.
   The standard SDC accepts video input in PAL or NTSC format from a camera mounted on the ROV. Apply the video signal to the SDC through the appropriate video input port. Teledyne TSS supplies CV cables (dual phono to phono) and a pair of BNC to phono adapters to assist video connection with the 440 System.

Note that you cannot display the video channel on the SDC screen.

The SDC mixes video images from the sub-sea camera with graphical information generated by the SEP. You may view the composite image through the appropriate video output port.

2. Video output – Use appropriate output port for your format (COLOUR CV OUT or S-VIDEO OUT)
   The format of the SDC video output signal will match that of the input video signal. That is if your input is PAL, then the output will be PAL. Similarly if your input is NTSC then the output will be NTSC. Further the video output will reflect the specific connections used i.e if the video input is monochrome CV, the output will be monochrome CV and will be provided via the 'MONO CV O/P' port (similarly colour CV input will provide via the 'COLOUR CV O/P', and S-Video output will be provided via the 'S-VIDEO O/P').

You may connect this signal to a standard video monitor using 75Ω screened cable. The output can drive a single monitor or multiple monitors if you add a suitable video drive amplifier.

4.2.5 Interface to Analogue Outputs

NOTE

The analogue output has been redesigned for the SDC10. On previous versions of the SDC, the analogue output was not included as part of the customer package. However, the SDC10 includes the analogue output as a standard component integrated into the Rear Comms Enclosure.

4.2.5.1 SDC10 Analogue Output Overview

The Analogue Output operates directly from the DeepView for Windows external output. The external output (COM3) is hard-wired to the analogue PCB input via a bespoke cable loom. This cable should not be removed or modified without contacting Teledyne TSS. If the external output is disabled via DeepView, the Analogue Output will not provide any outputs.

The Analogue Output is configurable via DIP switches located on the underside of the Comms Enclosure facing the rear of the Panel PC. These switches can only be accessed by removing the Rear Comms Enclosure. It is recommended this task is carried-out before the SDC is installed. Refer to sub-section 4.2.5.2 "Analogue Output DIP Switch Settings" for instructions to remove the Comms Enclosure and configure the DIP switches.

The analogue output interface provides three analogue outputs at the BNC connectors located on the external Comms Enclosure. Each output varies in amplitude and polarity with the lateral offset of the target. The CH1, CH2 and Quality BNC connectors represent unqualified data, qualified data and quality flag where the qualified data, (CH2), is gated by the quality flag.

The lateral offset information used to generate the outputs is provided from the DeepView external output. If the external output is disabled via DeepView, the analogue output will not provide any outputs.

4.2.5.2 Analogue Output DIP Switch Settings

The analogue output configuration can be modified using the DIP switches located on the underside of the Comms Enclosure facing the rear of the Panel PC. These switches are not accessible during normal operation. To access the DIP switches, the Comms Enclosure needs to be removed from the Panel PC.

The following steps outline how to correctly remove the Comms Enclosure:

NOTE

The external Comms Enclosure has connections from the Panel PC routed through the underside of the enclosure. Take care removing the enclosure from the Panel PC mounts ensuring these connections are not damaged.

1. Remove the transit case lid using the 4 x fixings provided.

Figure 4-6: Removing the transit case lid

2. Remove the 8 x fixings from the Panel PC attaching it to the angled bracket secured to the transit case base.

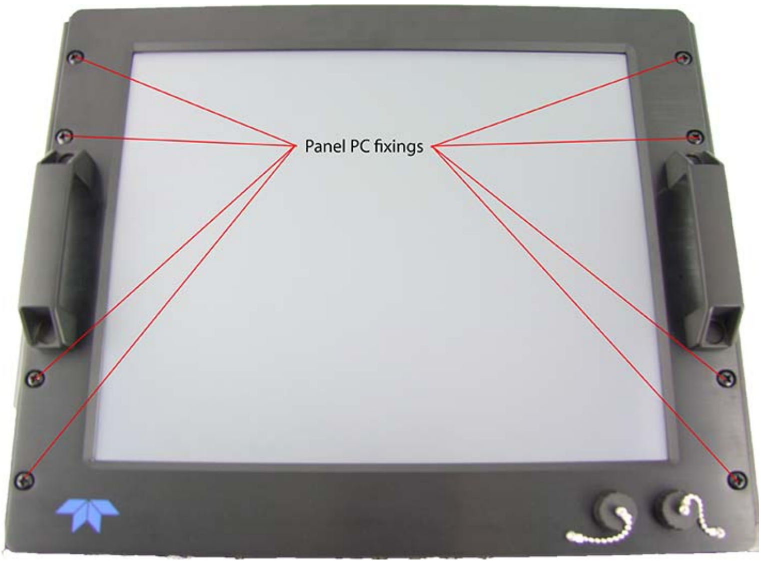


Figure 4-7: SDC10 fixings to angled bracket

3. Carefully remove the Panel PC from the angled brackets. Be careful not to damage the cables assemblies attaching the Comms Enclosure to the Panel PC. These cables should not be disconnected during this procedure.

4. Remove the 4 x fixings attaching the rear enclosure to the Panel PC.

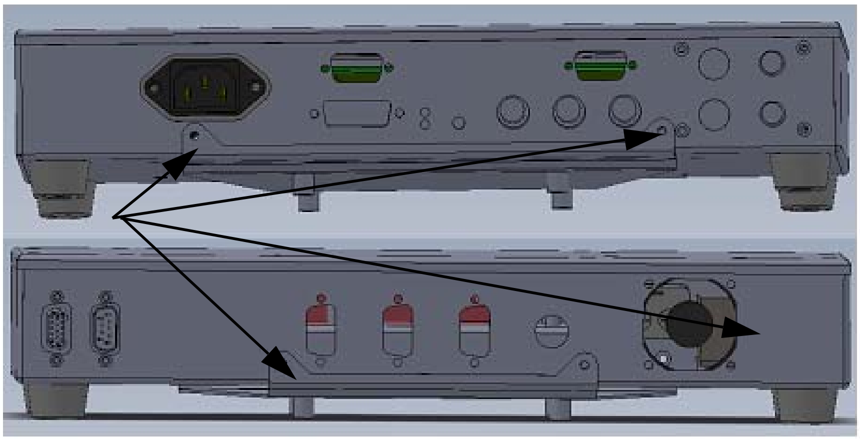


Figure 4-8: Removing the rear enclosure fixings

5. Carefully remove the comms enclosure from the fixing bracket. Ensure the cables connected to the underside of the enclosure are not damaged.

6. Table 4.10 outlines the function of each the DIP switches. Configure the switches to meet installation requirements.

Table 4.10: Analogue output DIP switch settings

Switch	Function	State	Output
SW1	CH1 gain	OFF	CH1 2V/m
		ON	CH1 1V/m

Table 4.10: Analogue output DIP switch settings

Switch	Function	State	Output
SW2	CH2 gain	OFF	CH2 2V/m
		ON	CH2 1V/m
SW3	Quality (QLTY)	OFF	12V
		ON	5V
SW4	CH1 Polarity	OFF	Reverse polarity
		ON	Normal polarity
SW1	CH2 Polarity	OFF	Reverse polarity
		ON	Normal polarity
SW2	Input Baud Rate	OFF	9600
		ON	4800

7. Position the enclosure back onto the bracket and replace the 4 x fixing screws.
8. Verify the enclosure is securely fitted to the Panel PC.
9. If operating the SDC from the transit case, fit the 8 x fixings attaching the Panel PC to the angled bracket secured to the transit case base.
10. Verify the SDC is operating as required.

5 Operating Software

NOTE

Before you power-on the SDC and the sub-sea components of the 440 System, make certain that:

- You have installed the surface and sub-sea components correctly as instructed in Chapter 3 "Physical Installation".
- You have made all electrical connections within the System using the correct cables as instructed in Chapter 4 "Electrical Installation".
- You have established an appropriate communication method between the surface and the sub-sea components.

The SDC has the required software, DeepView for Windows, pre-installed and configured to start automatically when it is powered on. This section of the Manual describes the features of the software that you must use to operate the 440 System and conduct a survey.

These instructions assume you are reasonably familiar with the Microsoft Windows operating environment. Although you may use all the commands using the Panel PC's touch-screen, you may prefer to operate the software using either a mouse or keyboard. These can be connected to the SDC using the USB ports located on the Panel PC front panel.

In these instructions, key press sequences appear in square brackets. For example, 'press [SHIFT]+[F4]' means to press the Shift key and the function key F4 together.

5.1 Power-on Procedure

NOTE

During initialisation, DeepView for Windows searches for a valid initialisation file on the SDC hard disk. If the file exists and the SDC receives compatible data packets from the SEP, DeepView for Windows will begin to operate using the configuration details stored in the initialisation file. If DeepView for Windows does not find the initialisation file or if there are no compatible data packets arriving from the SEP, it will start the System Configuration Wizard to help you establish reliable communications.

For this reason it is usually better to power-on the sub-sea installation before you power-on the SDC.

Power-on the sub-sea components of the 440 System:

All electrical power for the sub-sea components arrives through a single cable into the PSU, which generates the following stabilised and conditioned DC supplies:

- All supplies necessary to operate the SEP
- Power for a suitable sub-sea altimeter connected directly to the SEP. If you connect your altimeter to the SDC instead then you must provide a separate power supply for it.

See section 4.1 "Sub-sea Components" on page 4-1 for instructions to make the electrical connections to and between the sub-sea components of the 440 System. The System starts to operate when you provide the correct electrical supply to the PSU.

Power-on the sub-sea components of the 440 System. At the SDC, apply power to the unit and it will automatically power-on.

Power-on the SDC:

NOTE

The SDC has a power-switch located on the underside of the Panel PC. This switch is set to ON by default and should not need to be accessed by the user during normal operation. However, it is important to be aware of this switch if the Panel PC is removed from the transit case. When installed at the required location, always ensure this switch is set to ON. If this switch is set to OFF and power is applied, the Rear Comms Enclosure will receive power but the Panel PC will not power-up. This can be identified by the Rear Comms Enclosure fan being activated but the Panel PC remaining inactive.

Check that you have connected an AC electrical supply of the correct rating to the three-pin IEC mains inlet on the SDC (see section 4.2.1 "Power Connection" on page 4-8 for instructions to connect power to the SDC).

After you apply power to the SDC, it will launch Microsoft Windows and DeepView for Windows automatically after it has completed the initialisation sequence.

Provided the software launches successfully, you will see the DeepView for Windows opening splash screen. DeepView for Windows will then search for an initialisation file on the SDC that includes details of the previous operating configuration. If the software finds the initialisation file and the SDC receives data packets from the SEP that are compatible with that file, then it will begin to operate using the same configuration. Otherwise, DeepView for Windows will launch the System Configuration Wizard that allows you to define the operating parameters used by the System.

NOTE

To start the display software from Windows, select Start➡PROGRAMS➡DeepView for Windows➡DeepView for Windows.

The SDC is not provided with a keyboard or mouse as it has a touch-screen display. The SDC desktop provides a short-cut to a software keyboard that can be used to select commands and options from within DeepView for Windows. Alternatively, you may connect a keyboard or mouse using either of the two USB ports mounted on the front of the Panel PC.

5.2 Initial Configuration

Before you can use the 440 System for the first time you must configure the software. This procedure can be enabled to run every time you open DeepView for Windows or if your setup is consistent it can be disabled and accessed via “System Configuration Wizard” from the configuration menu when DeepView is operational. The options that you are able to configure are the following:

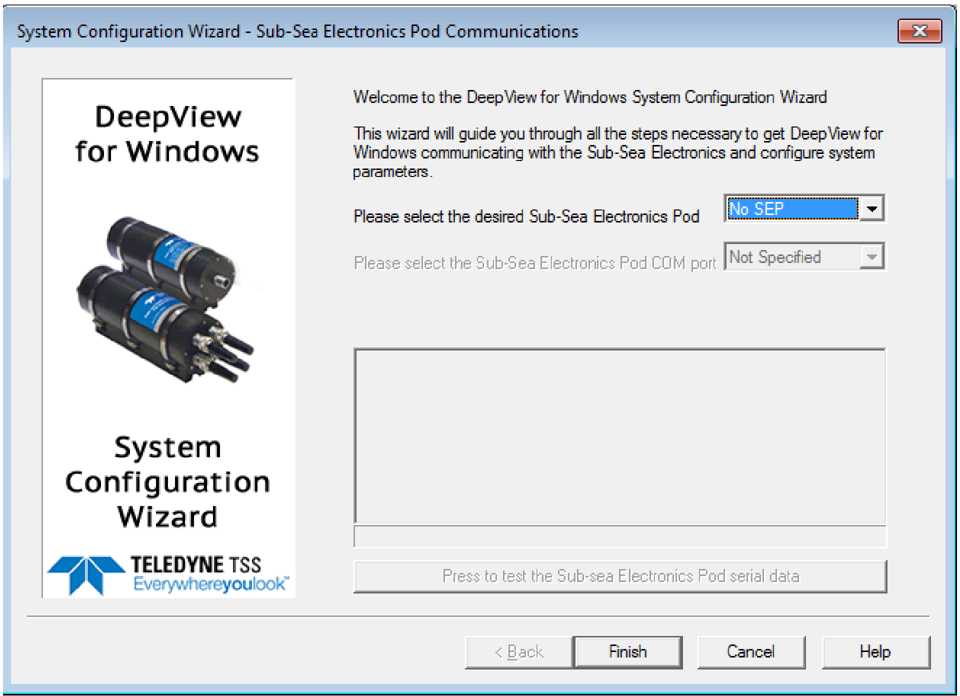


Figure 5-1: System Configuration Wizard

5.2.1 Sub-Sea Electronics Pod

Define whether there is no SEP, a 440 or whether it is part of a Dualtrack System. This setting determines the data format that DeepView for Windows expects to receive from the sub-sea installation and sets the style of Run Window that the software will use to display the System measurements.

There are three options for setting the SEP type:

- **No SEP**
  Use this option to operate DeepView for Windows with no SEP connected. This might be necessary, for example, if you wish to use DeepView for Windows to replay data on a separate PC.

- **440**
  Use this option to control a stand-alone 440 System.

- **Dualtrack**
  Use this option to control a Dualtrack System comprising an interconnected 350 / 350 Powertrack and a 440 System controlled from the same SDC. You should use this option even if you intend to use only one of the Systems during the survey.

5.2.2 Communication ports

Define the serial communication ports and their communication parameters. The SDC uses the serial communication ports to communicate with the SEP and with external devices such as the sub-sea altimeter and a data logger.

NOTE

During System Configuration the only port that you have to specify is the Communication to the SEP. Below is outlined a list of the COM Ports and their default assignments.

The SDC has four serial communication ports that it uses to communicate with external and peripheral equipment. The standard assignations for these ports are as follows. You may change these if necessary.

- COM1 is used to pass serial communications between the SEP and the SDC.
- COM2 on the rear connector panel of the SDC is used to accept serial data from any compatible altimeter that is not connected directly to the SEP. The maximum range for RS232 communications is 15 metres. Therefore, to connect an altimeter to the SDC you must add its signals to an existing multiplexed data link in the ROV umbilical and then extract them at the surface. See section 5.3.3.2 "Altimeter" on page 5-20 for instructions to configure an altimeter and set its communication parameters.
- COM3 (labelled 'LOG O/P (COM3)' on the rear connector panel of the SDC) is used to connect the SDC to a separate user-supplied data logger. You should use a data logger to record the survey measurements acquired by the 440 System. See section 5.3.3.3 "External Output" on page 5-23 for instructions to configure DeepView for data logging and to set appropriate communication parameters.
- COM5 is used by the SDC to communicate with the video overlay card. This port is not available on the Rear Comms Enclosure but is internally connected to the video overlay interface card.

DeepView for Windows allows you to set the communication parameters for each of the serial ports. Choose settings that are appropriate for the connected equipment – refer to the technical manuals of the attached equipment if necessary. Note that the standard communication parameters for COM1, the communication link between the SDC and the SEP are set to operate at 9600 baud using eight data bits, two stop bits and no parity.

NOTE

The update rate for your System will reduce if you set a lower baud rate for this communication link. You should consider reducing the baud rate for this link only if you experience persistent communication problems caused by an umbilical cable of poor quality. Ideally, in these circumstances you should swap to using an umbilical cable of good quality instead.

At this point the software will provide an analysis of the data status and will provide you with a summary screen of the findings that it has established.

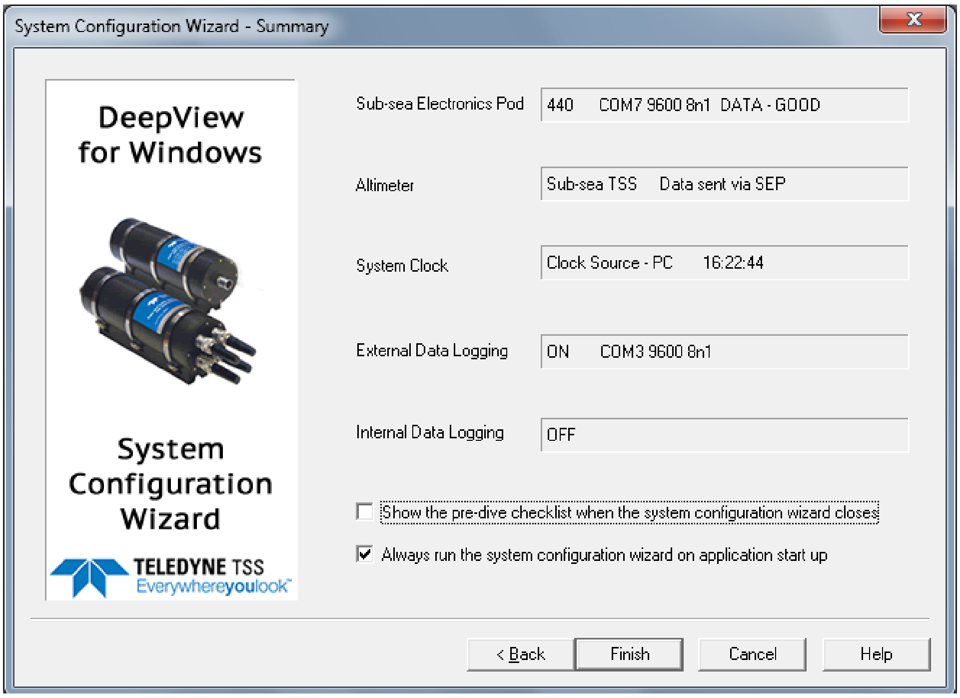


Figure 5-2: System Configuration Wizard - Summary

DeepView will now be configured to operate with the 440 System.

Before clicking on 'Finish' you have tick options to select:-

- Show the pre-dive checklist when the System Configuration Window is closed.
- Whether the System Configuration Wizard runs when DeepView for Windows starts.

NOTE

If the box is checked, the System Configuration Wizard will be run when DeepView for Windows starts. If the box is not checked and if a configuration file is available, the configuration file will be used to configure DeepView for Windows.

DeepView stores the configuration details automatically in an initialisation file when DeepView is closing down. This allows the System to establish the same configuration when you next power-on the SDC – provided it recognises the data format arriving from the SEP as being compatible with the stored configuration details. This means that you should power-on the SEP before you power-on the SDC.

5.2.3 System Parameters

The following items are key parameters that must be set prior to and during the survey. These will enable 440 to find the position of the target. To carry out an accurate survey, these parameters must be entered correctly. To edit these settings, select Configuration➡System Parameters.

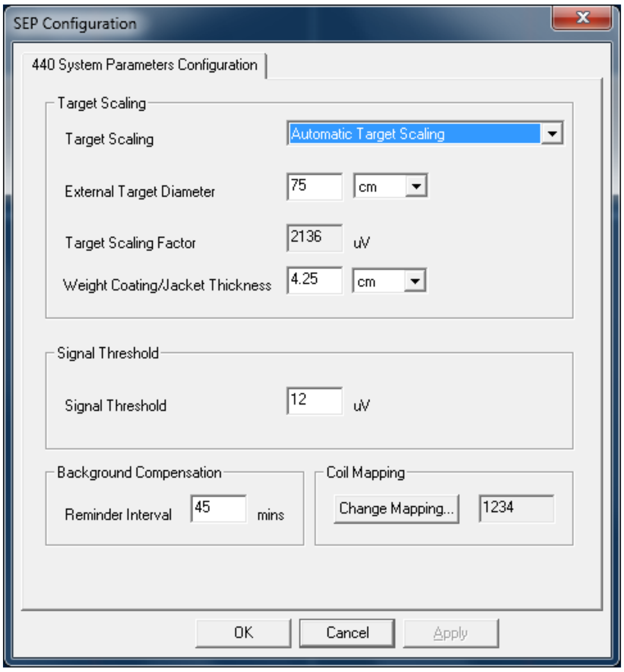


Figure 5-3: System Parameters

To follow we have listed some key parameters that will be required to be set prior to and during the survey.

5.2.3.1 Target Scaling

Configure the 440 SEP with the following target information:

- **Set the target diameter.**
  Measure the outside diameter of the conductive part of the target. Do not include any non-conductive coating in the measurement of diameter. This value, together with the target scaling is used to compute range.

- **Weight coating.**
  Enter the thickness of any non-conductive weight coating that surrounds the target. DeepView for Windows will allow for this thickness when it displays measurements of target co-ordinates.

DeepView for Windows uses a specially developed algorithm to determine an appropriate target scaling factor based on the diameter of the target. For most applications this is the correct method to use for setting a target scaling factor.

The target scaling value is designed to be as close as possible to that used for the previous 340 System. However for maximum accuracy, it is recommended that you have Teledyne TSS determine an exact target scaling factor from a sample of your target.

NOTE

When a Target Scaling value of greater than 2000uV is used, the RunView display colour scheme is modified. See section 5.3.2 "View Menu" on page 5-14 for a detailed explanation of the relevant changes.

5.2.3.2 Threshold

Set an appropriate value for threshold.

High settings will make the 440 System less sensitive to noise but will also decrease its operating range. The default setting of 15µV has proved to be suitable for the majority of survey operations. However, Teledyne TSS recommend using 25µV to minimise noise sensitivity and maximise operating range.

If the recommended threshold value of 25µV does not provide the performance requirements from the system or it is not clear what the required threshold value should be, always use the default value of 15µV.

5.2.3.3 Seawater Compensation

The 440 System uses a compensation method to distinguish signals arising from seawater and the target.

To do this, it is necessary for the software to know the conductivity of the seawater surrounding the coils and ROV during the survey. The conductivity is strongly determined by the water temperature, and for convenience this has been grouped into bands of 0-10^{o}C, 10-25^{o}C and >25^{o}C.

Select a suitable band.

This assures that salinity is between 30 and 33 psu, in areas where salinity is high (e.g. Mediterranean) or river outfalls reduce salinity (e.g. Black Sea) then manual compensation may be necessary. Refer to Appendix A "Operating Theory" for further details.

Note that surface water temperature may be considerably higher than the temperature at depth. Below 200m, the water temperature is typically 4^{o}C.

NOTE

The seawater rejection algorithm only functions correctly for ROV altitudes below approximately 4m. Above this height the target signal may ‘jump’ even if no target is present. This is not a deficiency in the system.

The seawater rejection algorithm has proven reliable, and gives only small errors (30µV at 3m altitude) if the incorrect temperature band is selected. However, in shallow or fresh water, performing a manual seawater compensation as explained in appendix A may be beneficial.

Range Determination

Once the seawater signal has been removed, the target voltage is interpreted to give the distance between the coil and the target. This voltage falls off according to an approximate sixth root law. The voltage is first divided by the target scaling value. The exact algorithm used to determine range is beyond the scope of this manual, since correcting for the exact nature of the coil response is complex.

5.2.4 Print Configuration

It is important to print details of the 440 System configuration at the start and end of a survey.

Select File➡Print Configuration to send a copy of the System Configuration to the Windows Notepad application. You may edit the details and print them from this application. An example of the print configuration via Windows notepad.


deepview.txt - Notepad

File Edit Format View Help

```
Information and Configuration Sheet        02-09-2015   16:24:44

DeepView Version            P423.2
Database Version            2.1.4

Sep Type                    440
Comms                       COM7 9600 8n1

Altimeter                   Sub-sea TSS
Comms                       Serial port not configured
Offset                      +000

External Data               Enabled - 4 per second
Comms                       COM3 9600 8n1

Video Overlay               Enabled
Comms                       COM5 9600 8n1


=============== SEP 440 Parameters ===============

Coil Drive                  Disabled
Target Diameter             75.00 cms
Target Scaling              2136 uV
Weight Coating              4.25 cms
440 Signal Threshold        12.00 uV
Coil Mapping                1234
BG Comp Reminder            45 mins
BG Comp Values              0 0 0
BG Early Comp Values        0 0 0
Seawater Rejection          Enabled
Seawater Factors (Lin)      18.00 18.00 18.00
Seawater Factors (Quad)     -0.05 -0.05 -0.05


================= Contact Details =================

Teledyne TSS Ltd
1 Blackmoor Lane, Croxley Green Business Park
Watford
WD18 8GA
United Kingdom

+44 (0)1923 216020
+44 (0)1923 216081

tsssales@teledyne.com
http://www.teledyne.com
```

Figure 5-4: Print Configuration

NOTE

The ability to print the configuration is an important feature of DeepView. It allows you to create a permanent written record of the configuration to supplement the survey logs.

Full analysis and post-processing of the raw data can be effective only if you retain a record of the 440 System configuration at the time of the survey. The Appendix reference includes a suitable form for you to record these details.

5.3 Operating DeepView for Windows

Teledyne TSS TSS designed DeepView for Windows to provide full functionality when you use a pointing device. The SDC10 utilises touch-screen technology to select commands and controls within DeepView via the touch-screen panel and software keyboard (a shortcut is locate on the SDC desktop). If preferred, a keyboard or mouse can be connected via either of the two front-mounted USB ports.

NOTE

The instructions that follow assume you to be reasonably familiar with the Microsoft Windows operating environment. If necessary, refer to a relevant Windows user guide for instructions to use Windows.

This sub-section explains how to use the software commands and tools during a survey. The instructions refer to the Run Window and to the various secondary windows described throughout this section. DeepView includes an on-line Help structure that summarises the advice and instructions included here. There is also a simple ‘Help’ panel, accessible by pressing function key [F1] from the Run Window, to list the function key short cuts that select some of the commands and tools described below. See section 5.3.5 "Function Keys" on page 5-28 for a list of the function keys available for use in the 440 and 440 modes.

Follow the advice throughout Chapter 6 "Operating Procedure" for a survey procedure using the 440 System.

5.3.1 Menu commands

Table 5-1 lists the commands available on the DeepView Menu Bar, together with their hotkey access codes and function keys where available.

Table 5-1: DeepView Menu Commands

Menu item	Sub-menu, [hot key access] and Function key	Description
File	Open /Close Replay File [F2]	Specify the name and location of an existing internally logged file that you wish to replay through DeepView for Windows. The Replay Window includes the same features and as the Run Window and operates in a similar way. A button on the DeepView for Windows toolbar performs the same function as this command. You cannot use DeepView for Windows to replay externally logged files.
	New Log File [F3]	The factory default is for internal logging to be disabled. Specify the name and location of a new file to accept the internal logging record. File names can have up to 255 characters. They can include spaces but must exclude the characters \ / : * ? " < > and |. The SDC adds a 'time' field to the start of logging and updates this at intervals of one minute. It obtains this information from the SDC system clock. You may add short comments (up to 40 characters in length) to the internal logged record by pressing the annotate button on the Run Display screen. The SDC time-tags and includes the comments in the internal log. The external logging record is unaffected by these annotations.
	Close Log File [Ctrl + F3]	If you have an internal logging file open, use this command to close it. Once you have closed the file, you cannot open it again to add more data.
	Backup Configuration	This will prompt you with a dialog box to provide a name to save the current parameters set to a file that can be accessed at a later date.
	Restore Configuration	This will provide you with a list of any previously saved configuration files that you can load.
	Print Configuration	Use this command to send a copy of the 440 System configuration to windows Notepad. You should print the configuration details from that application at the start of the survey and again at the end of the survey. Retain the hard copy prints with the survey records.
	Exit	Use this command to exit the DeepView program and return to the Windows operating environment.

Table 5-1: DeepView Menu Commands (Continued)

Menu item	Sub-menu, [hot key access] and Function key	Description
View	Run Window [Ctrl + R]	Select this command to open or close the DeepView Run Window. You may resize and move the Run Window on the SDC screen after you open it. The normal condition is for the Run Window to be closed when you start DeepView. A button on the DeepView for Windows toolbar performs the same function as this command.
	Forward Search Window [Ctrl + F]	*This command is valid only when you use DeepView for Windows to control a 350 or 350 Powertrack System. It is not available when you use the software with a 440 alone*
	Toggle Height Scale [Ctrl + H]	Use this command to modify the available selection of displayable vertical ranges. The vertical ranges vary between the 440 and the 440 systems and are as follows: 440 mode: 0m to 2m, 5m, 15m or 30m 440 mode: 0m to 2m and 0m to 5m.
	Toggle Swath Width [Ctrl + W]	*Use this command to alter the swath range for the 350 or 350 Powertrack system. This command is unavailable to the 440 system, which has a fixed swath range of 0m +/-2m. The available ranges of the 350 or 350 Powertrack system are 0m +/-2m, 0m to +/-5m and 0m to +/-15m.*
	Scope and Spectrum Analyser Window	Use this command to open or close the Scope and Spectrum Analyser Window. A button on the DeepView for Windows toolbar performs the same function as this command. You must close the Run Window (or Forward Search Window on a 350 system) before you can access this command using either the menu or the toolbar button. The normal condition is for the Scope and Spectrum Analyser Window to be closed when you start DeepView for Windows. Note that the data string transmitted from the SEP to the SDC extends significantly in length when you open the Scope and Spectrum Analyser Window. This will reduce the data update rate. You should therefore keep this window closed unless you require it.
	System Errors Window	Use this command to open or close the System Errors Window described in section 5.3.2.5 "System Errors Window" on page 5-18. A button on the DeepView for Windows toolbar performs the same function as this command. The normal condition is for the System Errors Window to be closed when you start DeepView for Windows.
	Terminal Window [TAB]	Use this command to open or close the Terminal Window described in section 5.3.2.6 "Terminal Window" on page 5-19. A button on the DeepView for Windows toolbar performs the same function as this command. The normal condition is for the Terminal Window to be closed when you start DeepView for Windows.
	Video Overlay Enable [Ctrl + V]	Use this command to select the Video Overlay function. A button on the DeepView for Windows toolbar performs the same function as this command. The video overlay feature allows the SDC to accept input from a video camera and to output the video image overlaid with the target co-ordinates and steering information.

Table 5-1: DeepView Menu Commands (Continued)

Menu item	Sub-menu, [hot key access] and Function key	Description
Config-uration	System parameters [Shift + F2]	This command displays a dialog panel that allows you to establish the type of SEP and the serial communications parameters. Refer to the following sections for relevant details and instructions.
	Altimeter [Shift + F3]	This command displays a dialog panel that allows you to establish the physical and serial communications parameters of an altimeter used with the 440 System. See section 5.3.3.2 "Altimeter" on page 5-20 for relevant details and instructions. The System Configuration Wizard also displays a similar dialog panel.
	External Output [Shift + F5]	This command displays a dialog panel that allows you to configure the SDC output to an external data logger. Set the type of data packet and its update rate, and the serial port communication parameters. Note that you must establish appropriate parameters for the external output if you wish to use the video overlay option, even if you do not intend to use the external data logging features.
	Load factory Defaults [Shift + F9]	This will prompt you with a caution box to confirm that you would like to reset the software back to the original factory defaults. This will eliminate any user parameters that have been previously configured.
	Video Overlay Setup [Shift + F10]	See section 5.3.3.5 "Video Overlay Setup" on page 5-25 for a description of the video overlay feature.
	System Configuration Wizard [Ctrl + F10]	This selection will return you to the set-up options screen that you have viewed when opening up the software. Use of this option will result in all of the parameters being reset to default.
Window	Cascade [ALT][W][C]	Use this command to arrange the various operating windows so that they overlap but with their title bars visible. This does not affect the Diagnostics Window or the Target Tracking Window.
	Tile Horizontally [ALT][W][H]	Use this command to arrange the various operating windows so that they are next to each other horizontally. This arrangement allows you to see the entire area of each window, although DeepView might resize the windows to fit the available area. This does not affect the Diagnostics Window or the Target Tracking Window.
	Tile Vertically [ALT][W][V]	Use this command to arrange the various operating windows so that they are next to each other vertically. This arrangement allows you to see the entire area of each window, although DeepView might resize the windows to fit the available area. This does not affect the Diagnostics Window or the Target Tracking Window.
Help	DeepView [ALT][H][D]	Use this command to open the on-line Help structure that explains the features of DeepView. The Help structure also includes some simple fault finding advice for the sub-sea components.
	Pre-dive Checklist [ALT][H][P]	Use this command to open the on-line Help structure that explains the checks you should make on the 440 System before you start a survey. See section 6.2 "Pre-dive Checks" on page 6-4. You may access the checklist from within the DeepView Help structure.
	About DeepView [ALT][H][A]	This command displays the version number of DeepView.

NOTE

It is recommended that you save a configuration file for each survey. You can then restore this configuration file to give the settings for the next job.

5.3.2 View Menu

5.3.2.1 Run Window

The Run Window is the most important and informative display of the 440 System. Anyone who will operate or maintain the system should therefore spend some time to make themselves familiar with the layout of the window and the information that it shows.

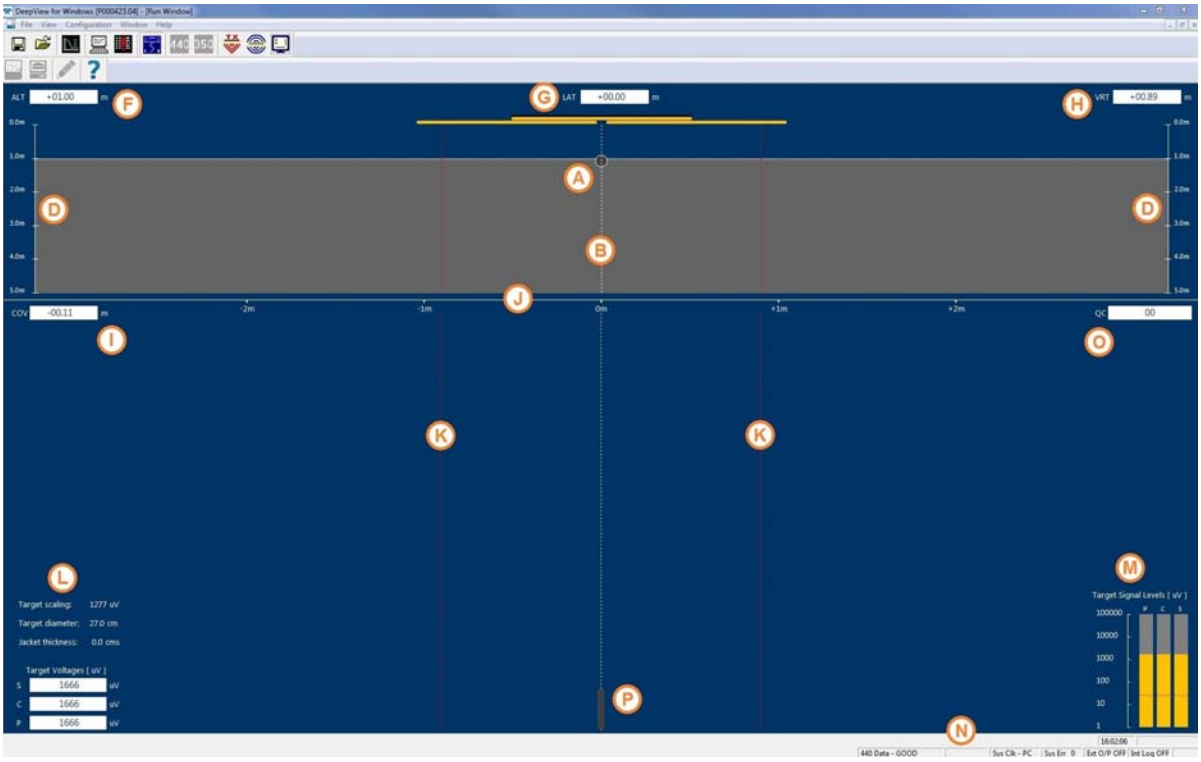


Figure 5-5: DeepView - Run Window

Controls and Features of the Run Window Controls

- The **Title Bar** shows the names of the program and of the window. The right-hand end includes the standard buttons to minimise, maximise and close the main DeepView window.
- The **Menu Bar** includes the five menu headers described under section 5.3.1 "Menu commands" on page 5-11. To access the menu and sub-menu commands, click on them or use the appropriate hot-key combination – [ALT]+[*underlined hot-key character*s]. The Menu Bar also includes buttons to minimise, maximise and close the Run Window.
- The **DeepView Toolbar** includes the buttons described in section 5.3.4 "Toolbars" on page 5-26. These tools control the functions of the DeepView for Windows program.
- The **Run Window Toolbar** includes the buttons described under ‘Run Window tools’ on page 5-14. These tools control functions within the Run Window only.

Features – Rear Elevation pane

The rear elevation pane is immediately below the Run Window Toolbar and occupies approximately 30% of the area with the window fully maximised. It shows the target **A** as a circle of fixed diameter, a vertical broken white line **B** that represents the fixed centre-line of the ROV and the two search-coil arrays.

The circle **A** moves horizontally and vertically in the pane as the relative position of the target changes. The scale **D** provides a visual reference so that you may estimate the vertical distance between the coil array and the target. CTRL H switches between 30, 15, 5 and 2 metre vertical display scales.

When the 440 System includes a properly configured altimeter, the top edge of the solid grey area shows the position of the seabed relative to the coil array. This area expands and contracts vertically with changes in ROV altitude above the seabed. If the design of the ROV allows you to configure the 440 System with a fixed coil height, the seabed indicator will remain fixed at this altitude.

The Run Window includes a series of data fields that indicate the instantaneous measurements of coil altitude (ALT) above the seabed **F**, lateral offset (LAT) of the target relative to the centre line **G**, vertical range to the target (VRT) **H** and target depth of cover (COV) **I**. The 440 System measures VRT and LAT directly, with positive measurements of LAT representing a starboard offset relative to the centre line. Measurements of ALT arrive from an altimeter, or represent the fixed coil height if this is applicable. DeepView calculates the value displayed in the COV field using COV = VRT–ALT so that positive values indicate a target that is buried. All measurement are in units of centimetres.

The solid white line **J** that separates the rear elevation pane from the 'snail trail' pane (described below) has gradations every 1m or 5m, depending on the swath width.

Two broken red lines **K** extend down the window at ±2m of lateral offset. These show the lateral limits of a quality control envelope applied by DeepView. To support efficient post-processing on data acquired by the 440 System, the software sets the quality control flag in the data output when the target is outside this envelope. Refer to sub-section 5.6 for a complete description of the quality control features.

Features – 'Snail Trail' pane

The snail trail pane is immediately below the rear elevation pane and occupies approximately 60% of the screen area with the window fully maximised. It indicates the lateral offset of the target, relative to the ROV centre line **B**, for the most recent updates.

Two data panels displays the Coil Voltages **L** and Signal Levels **M**. In Run mode, the Coil Voltages and Signal Levels are measured simultaneously on the Port Forward (PF), Starboard Forward (SF), Port Vertical (PV), Port Lateral (PL), Starboard Vertical (SV) and Starboard Lateral (SL) coils. The digital display panel uses scientific notation to display the Signal Voltages in units of microvolts (µV).

The Signal Levels bargraphs use a logarithmic scale. The use of scientific notation and log. scales allows strong and weak signals to be displayed simultaneously without the need to change scale. The red dotted line on the Signal Level chart **M**show the threshold (see section 5.2.3.2 "Threshold" on page 5-7); this is the default setting of 100µV. When the signal falls below the threshold value, the bargraph turns red.

Features – Status bar

The status bar **N**, located directly below the snail trail pane, alerts you to the operating status of DeepView and the 440 System. It includes the following information:

- **Communication status**
  This shows the DeepView operating mode (Dualtrack or 440) and the validity of serial commu-

nications between the SDC and the SEP. For successful operations in the 440 mode this should always show ‘440 Data GOOD’.

- **System time**
  The system time is derived from the SDC system clock.

- **System errors**
  The status bar shows the total number of uncleared system errors registered by DeepView. Use the System Errors Window, described in section 5.3.2.5 "System Errors Window" on page 5-18, to see details of all the system errors registered since you powered-on the SDC, up to a maximum of 600 lines.

- **External Output status**

- **Logging status**
  Two fields in the status bar indicate the ON/OFF condition of the external output (used for logging to a user-supplied data logger and to provide information for use by the optional video overlay feature) and the internal logging.

Panel **O** shows the skew of the vehicle (the heading relative to the cable).

A thick coloured line **P** indicates the target position relative to the ROV centre line. As the survey starts, this line extends upwards from the bottom of the screen until it reaches a point near the top of the snail trail pane. The top of the line then continues to move to the left and right as the lateral offset of the target changes while the remainder of the line scrolls vertically downwards in a ‘waterfall’ style of display.

Segments of the line **P** can have any of three colours:

Light grey	Good signals supplied by the coils. The target is covered.
Dark grey	Good signals supplied by the coils. The target is exposed.
Dark blue	The lateral range is outside 2m

If the System receives no altitude information, a good target signal will always appears as a light grey line.

If a target scaling value greater than 2000uV is used and the centre coil voltage is greater than both the port and starboard signals by a value larger than the signal threshold, the Snail Trail and Coverage Windows will adopt colours specific to this situation.

If the target is covered, the Snail Trail and Coverage Windows will display the target in dark green.

If the target is uncovered, the Snail Trail and Coverage Windows will display the target in light green.

5.3.2.2 Toggle Height Scale

Dependent upon specific survey requirements, the Height Scale Display g on the Run Window can be modified. For example, if a small target is being tracked a reduced height scale may be required. This feature provides the user with control over the displayed height range.

The vertical ranges for the 440 System are either 0m to 2m or 0m to 5m.

5.3.2.3 Toggle Swath Width

Availability only to the 350/350 Powertrack system, the Swath Width Display on the Run Window can be modified to meet specific survey requirements. This allows the user to alter the swath scale display dependent upon their needs.

5.3.2.4 Scope and Spectrum Analyser Window

Use the command on the View menu or the toolbar button to display the Scope and Spectrum Analyser window. You must close the Run Window (or Forward Search Window on a 350 System) before you can access this command using either the menu or the toolbar button.

DeepView for Windows can show signal data received using different styles of ‘oscilloscope’ and ‘spectrum analyser’ displays. (The spectrum analyser feature applies to the 350 System only).

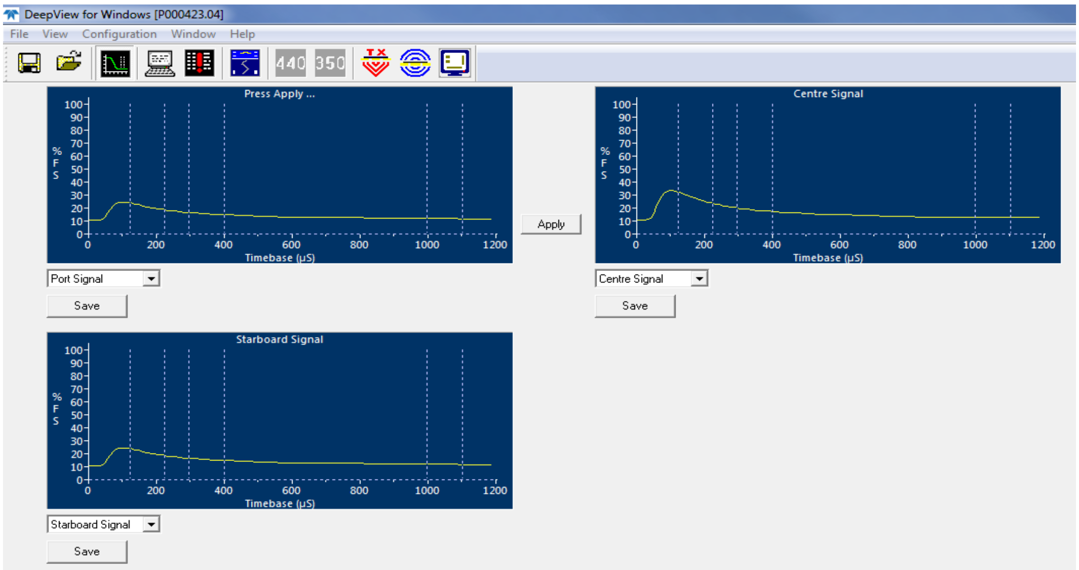


Figure 5-6: Scope Window

The above screen shows an example of the 440 Oscilloscope Window with panels for the three active channels, Port, Centre and Starboard.

During operation each of these display panels shows the signal voltage measured on their respective channels against a horizontal time scale and a vertical scale of percentage of full scale.

Each of the scope panels shows the three measurement windows, defined in vertical broken white lines. These are from left to right:

- The early signal window, which is used in the seawater compensation algorithm
- The standard window, and
- The zero window.

As explained in this manual, the 440 System uses the difference between the average values measured during the standard window and the zero window as the channel signal voltage. Based on the signal voltages on the measurement channels and the target scaling factor supplied in the System Parameters window, the system then calculates the target range from each of the coils and, from that, determines the relative position of the target.

System errors

The System Errors window, shown in Figure 6-5, displays a list of all errors and events reported by the 440 System. The list includes cleared and uncleared errors. The window can include up to 600 lines of text, with a scroll bar that allows you to search through the list. When the list includes 600 lines of text, DeepView for Windows will delete the oldest message in the list to provide space for any new ones.

5.3.2.5 System Errors Window

The System Errors window, shown in Figure 5-7, displays a list of all errors and events reported by the 440 System. The list includes cleared and uncleared errors. The window can include up to 600 lines of text, with a scroll bar that allows you to search through the list. When the list includes 600 lines of text, DeepView for Windows will delete the oldest message in the list to provide room for any new ones.

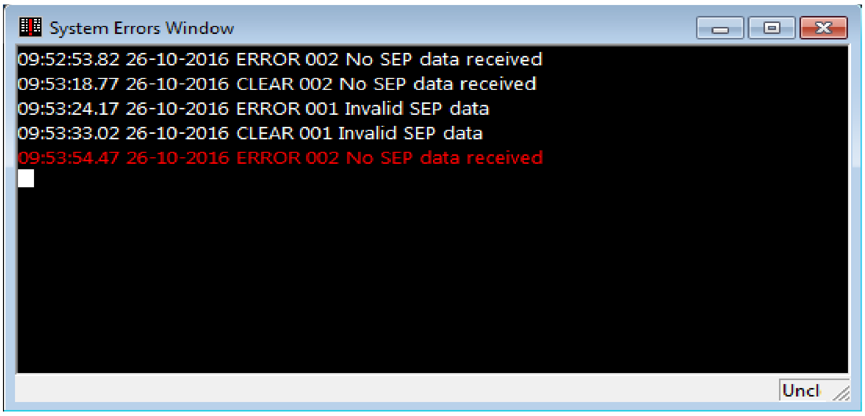
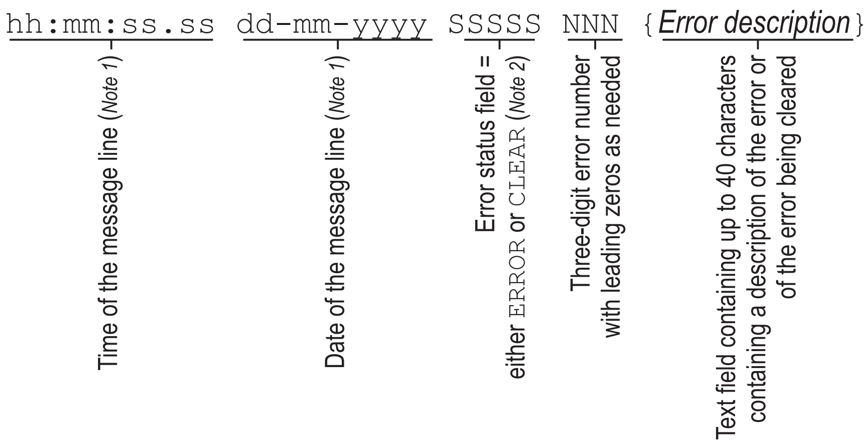


Figure 5-7: System Errors window

The lines of text always have the format described in Table 5-2.

Table 5-2: System errors format



Notes:

1. Time and date information in the message line comes from the SDC system clock.
2. The five character Error Status field can contain ERROR, CLEAR or EVENT.
3. The message line can have any of four colours against the black background:

- White indicates a cleared error.

- Red indicates an uncleared error.
- Yellow indicates an event.
- Green indicates an information message.

The System Errors window includes a status line that has two data fields. These show the total number of cleared and uncleared errors since you started DeepView for Windows.

5.3.2.6 Terminal Window

The Terminal Window, shown in Figure 5-8, allows you to send and view data to and from the SEP and the altimeter. It has a toolbar, a client area that displays black text against a white background, and a status bar.

The figure shows the Terminal Window displaying data packets from the 440 SEP in the client area. If you select the altimeter as the active serial device, the client area will show data packets from this device instead.

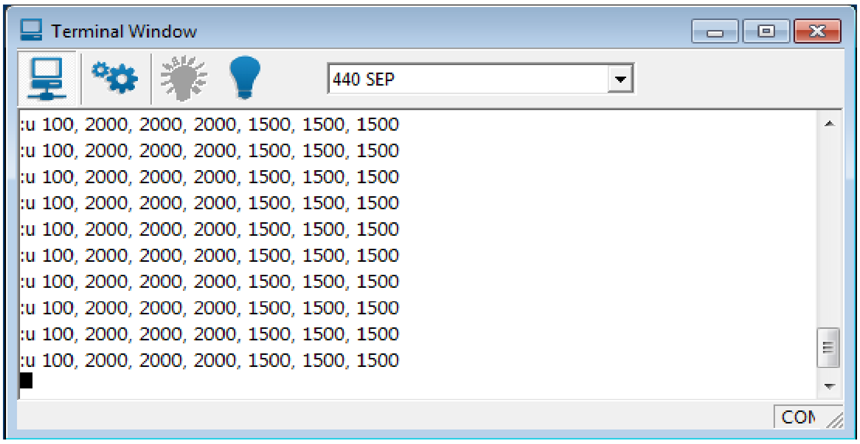


Figure 5-8: Terminal window

Table 5-3: Terminal Window toolbar

Button	Function	Explanation
	Enable/Disable SEP polling	This button has a toggle action that pauses and resumes SEP polling with alternate presses. With this button deselected, DeepView does not send the necessary characters that request data packets from the SEP.
	Terminal properties [ALT][T]	Use this button to set the serial communication parameters for the active serial device.
	Connect	This button allows you to connect the terminal to the active serial device.
	Hang Up	This button allows you to disconnect the terminal from the active serial device.

There is also a drop-down box that allows you to select the active serial device from among those available. This box includes the option to use the Terminal Window as a ‘dumb terminal’ if necessary (also accessible by pressing [ALT][Down arrow] then release [ALT]).

The status line shows the communication port settings for the active serial device.

5.3.2.7 Video Overlay Enable

Enabling Video Overlay is covered in section 5.3.3.5 "Video Overlay Setup" on page 5-25 along with details of the configuration options available.

5.3.3 Configuration Menu

5.3.3.1 System parameters

See section 5.2.3 "System Parameters" on page 5-6.

5.3.3.2 Altimeter

The Altimeter option allows you to change the altimeter configuration for specific installations and to view data transmitted by an altimeter connected directly to the SEP. To edit these settings, select Configuration➥Altimeter.

To view data transmitted by an altimeter connected to an SDC serial communication port, use the Terminal Window described in sub-section section 5.3.2.6 "Terminal Window" on page 5-19.

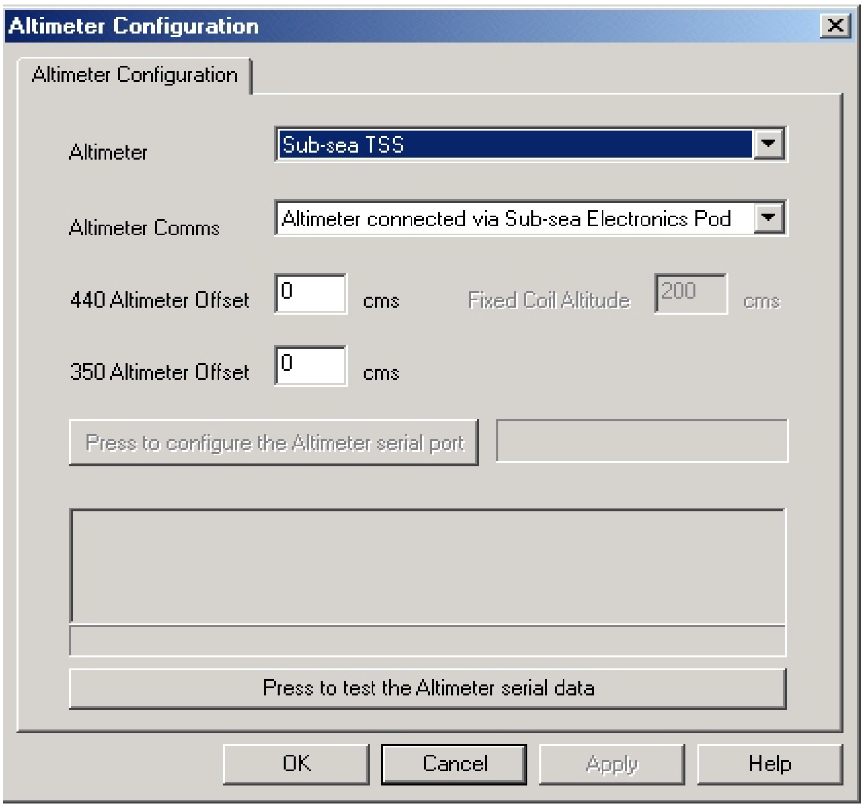


Figure 5-9: Altimeter Configuration

Use the Altimeter Configuration Window to set appropriate parameters for your altimeter:

Table 5-4: Altimeter configuration parameters

Parameter	Options
Altimeter	❒ Disabled ❒ Fixed height ❒ Sub-sea TSS* ❒ PSA 900** ❒ PSA 900 + depth** ❒ PSA 9000** ❒ PSA 916* ❒ Ulvertech Bathy ❒ Simrad UK90 ❒ OSEL Bathy ❒ SeaKing Bathy 704 ❒ Hyspec 305
Altimeter Comms	❒ Altimeter connected via Sub-sea Electronics Pod (for altimeters marked * and ** above) ❒ Altimeter connected direct to a COM port (for altimeters marked ** and all other altimeters above)
Fixed coil altitude	If there is no altimeter fitted and the design of the ROV allows the coils to remain at a fixed altitude above the seabed, enter this altitude in centimetres.
Altimeter offset	Enter the height difference, in centimetres, between the reference line of the 440 coil array and the transducer face of the altimeter. **Use a positive value if the altimeter is above the coils.**

The Altimeter Configuration Window allows you to select an SDC serial communication port that you will use to accept data from the altimeter and to set its communication parameters. Note that the 440 and 440 systems can have different offsets. Although a single altimeter is present, its height above the 440 and 440 coils will be different.

The altimeter test allows you to see the serial data transmitted by an altimeter connected to the SDC. The values shown will not have any meaning until the altimeter is immersed in water.

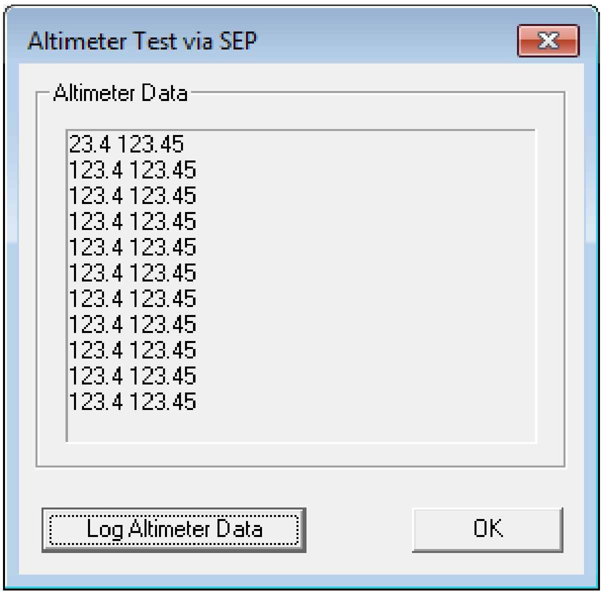


Figure 5-10: Altimeter Test

5.3.3.3 External Output

DeepView for Windows allows you to record the survey data acquired by the 440 System.
To edit these settings, select Configuration➡External Output. Note external logging is defaulted to on.

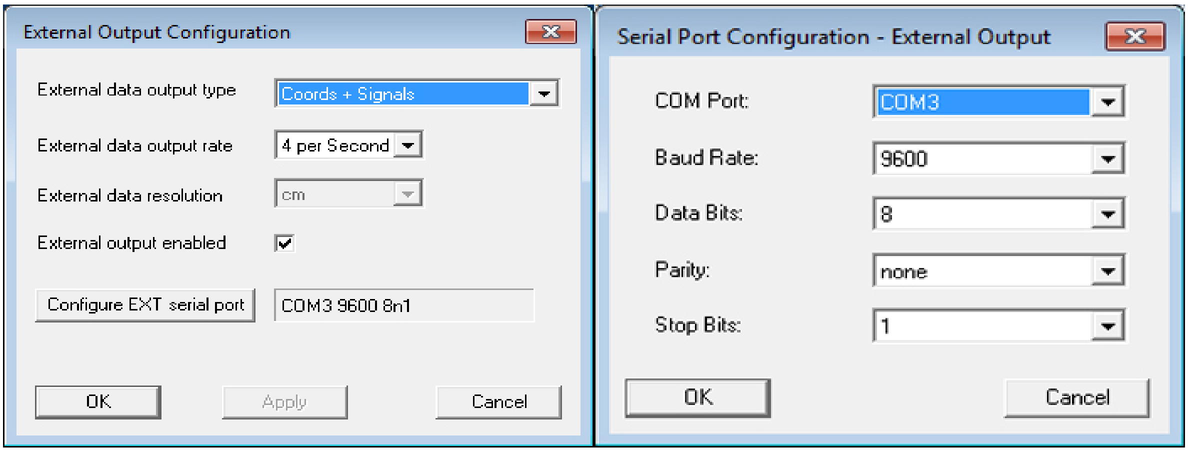


Figure 5-11: External Output Configuration and Serial Port menu

Table 5-5: External Output Configuration

External Output Configuration	
External Data Output Type:	In 440 mode, the system always outputs a sentence which combines the signal and coordinate information. See section 6.3.7 "Data Logging" on page 6-19 for a description of these data formats.
External Data Output Rate:	The SDC can transmit data to the data logger at either four records or one record per second. The default setting is four records per second. You should consider the available storage space and the desired linear track resolution for the survey before you decide between these alternatives.
External Output Enabled	This box must be checked to enable the external output. If it is enabled, then a tick will appear against the "external output" item in the "configuration" menu.
Configure EXT Serial Port	Options to configure, COM Port, Baud Rate, Data Bits, Parity and Stop Bits. See Figure 5-11.

5.3.3.4 Load Factory Defaults

To edit these settings, select Configuration➡Load Factory Default Settings. Selecting this option will present a dialog box and acceptance will result in the SEP settings being returned to their factory defaults. Certain parameters within DeepView will also be returned to their default states (see Table 5-6).

Table 5-6: Factory System Defaults

Parameter	Default Value
Target Scaling	1277uV
Target Weight Coating	1cm
Target Diameter	27cm
Weight Coating	0cm
Pipe Coefficient	1
Background compensation interval	30 mins
Video Overlay Parameters	COM5, 9600, 8, n, 2
External Output Comms Parameters	COM3, 9600, 8, n, 2
External Output Packet	Coords + signal, 4/second
Altimeter Comms Parameters	COM port not specified, 9600, 8, n, 2
Altimeter Type	Disabled
Altimeter Offset	0cm
Seawater Rejection	Enabled, 10-25C
Target Scaling	1277uV
Target Weight Coating	1cm

5.3.3.5 Video Overlay Setup

To edit these settings, select Configuration➡Video Overlay Setup.

The video overlay operates in the similar way as the previous overlay by receiving a video signal arriving from a user supplied subsea camera and overlaying it with the DeepView for Windows information specified by the user via the Video Overlay Configuration. The Video Overlay Setup menu is available via the Configuration options and provides the options illustrated below in Figure 5-12.

The video overlay has two possible modes. The first mode is where a copy of the SDC screen (the Runview) is overlaid on the video output. This is selected with the “Duplicate Runview” checkbox. The other mode is where selected information, for example the VRT and target position, are overlaid. The positions and colours of each of these elements can be fully controlled by the user.

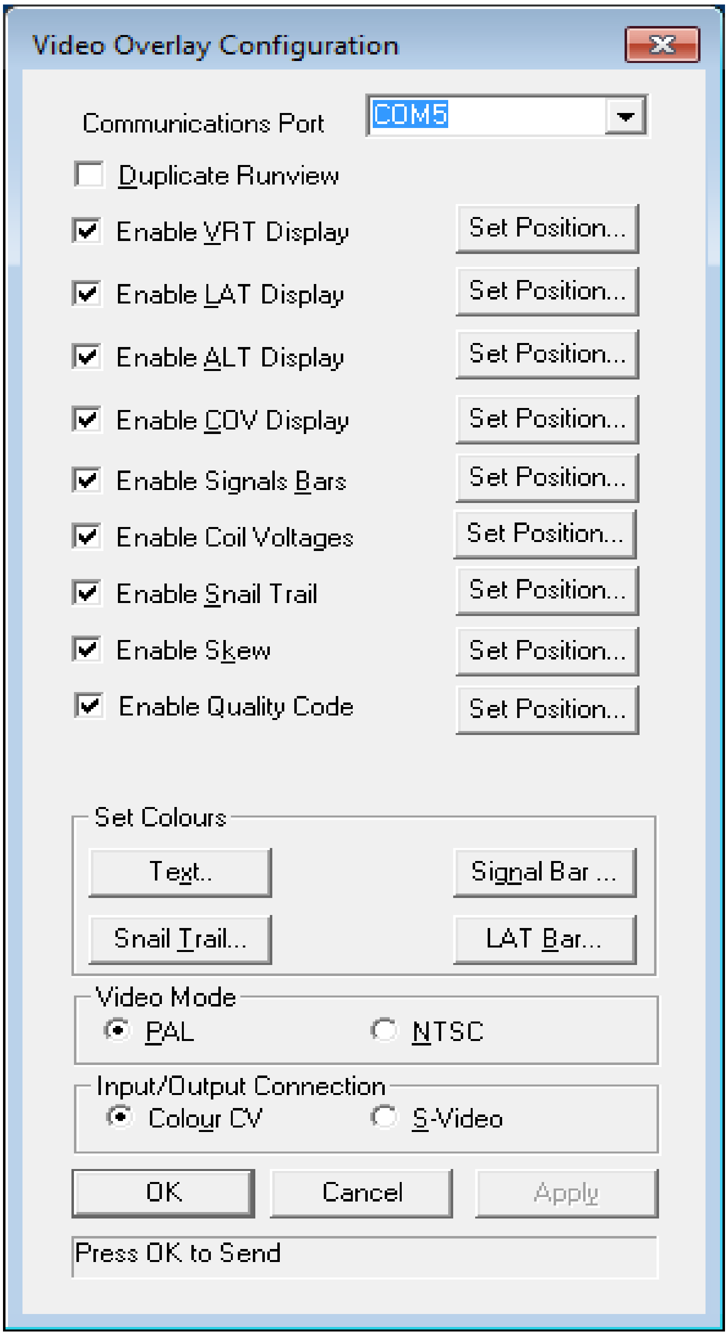


Figure 5-12: Video Overlay Setup

Dependent upon the user's requirements they can enable/disable specific information.

As shown, they are also able to set the colours of Text, Signal Bars, Signal Trail and LAT Bar, modify video mode and input/output connection.

These additional options provide the user with more control over the display to improve ease of use.

The display overlaid on the external monitor from the DeepView software is shown in Figure 5-13. The video signal will be displayed behind this survey information where the black background is currently shown.

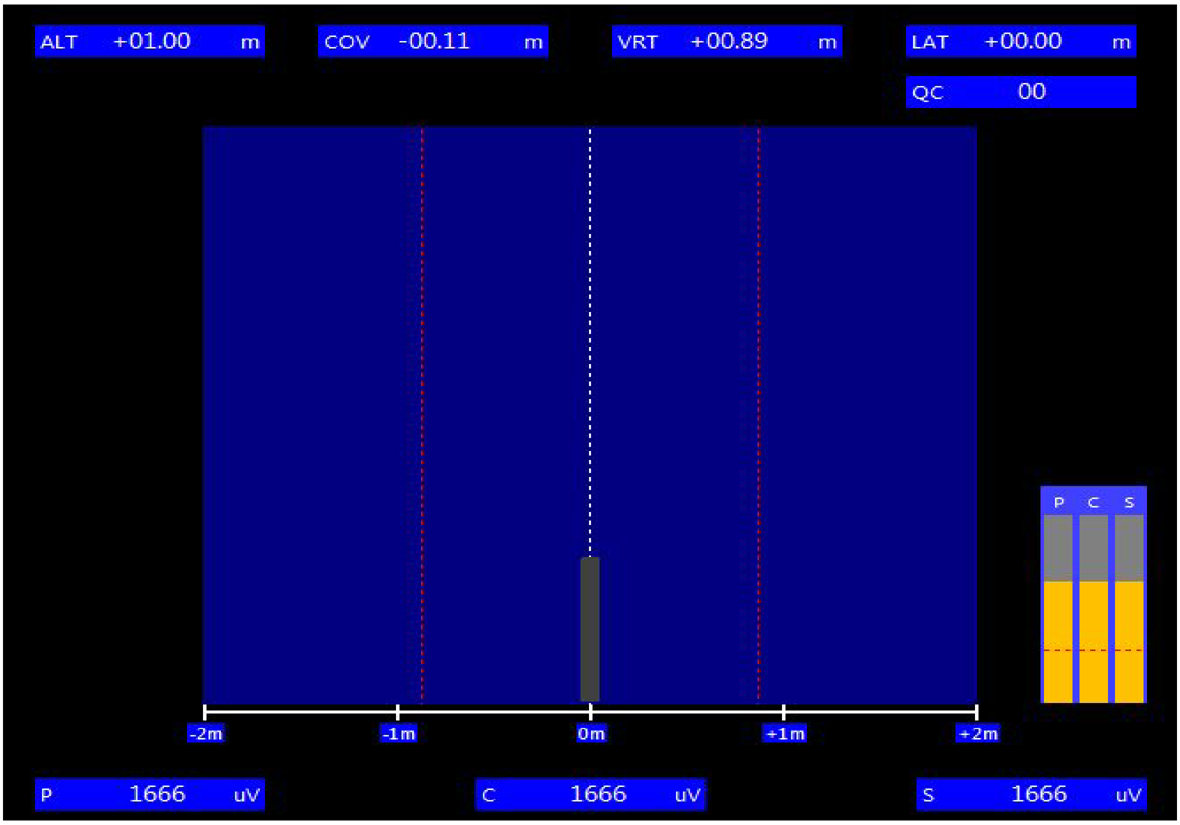


Figure 5-13: Video Overlay Signal

The Overlay feature can be enabled/disabled either from the View options or by using the icon on the toolbar.

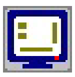
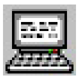
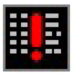
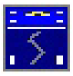
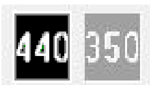
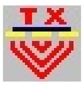
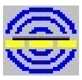
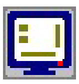


Figure 5-14: Video Overlay Enable/Disable button

5.3.4 Toolbars

Table 5-7 shows and explains the command buttons on the DeepView for Windows toolbar. You may access these command buttons by clicking on them using the touch screen or an external pointing device. A tooltip appears to remind you of the button functions if you hover the pointer over a button, with the same information also appearing in the status bar. You may also access some of the button functions by pressing the appropriate function key from the Run Window. See section 5.3.5 "Function Keys" on page 5-28 for a list of all the available function keys that you may use in the 440 mode.

Table 5-7: DeepView Toolbar

Button	Function and Function key	Explanation
	Terminal Window	This button performs the same function as the View➡Terminal Window command described above. The button has a toggle action so that the window will open and close with alternate presses. The normal condition is for the Terminal Window to be closed when you start to use DeepView. See section 5.3.2.6 "Terminal Window" on page 5-19 for a full description.
	System Errors Window	This button performs the same function as the View➡System Errors Window command described above. The button has a toggle action so that the window will open and close with alternate presses. The normal condition is for the System Errors Window to be closed when you start to use DeepView. See section 5.3.2.5 "System Errors Window" on page 5-18 for a full description.
	Run Window	This button performs the same function as the View➡Run Window command described above. The button has a toggle action so that the window will open and close with alternate presses. The normal condition is for the Run Window to be closed when you start to use DeepView.
	Dualtrack using 440 SEP data	This button is only visible when in Dualtrack mode and the 440 SEP has been enabled. Pressing the 350 icon enables the 350 or 350 Powertrack SEP and disables the 400 SEP. Refer to appendix B.1 for a description of Dualtrack.
	Dualtrack using 350 or 350 Powertrack SEP data	This button is only visible when in Dualtrack mode and the 350 or 350 Powertrack SEP has been enabled. Pressing the 440 icon enables the 440 SEP and disables the 350 or 350 Powertrack SEP. Refer to appendix B.1 for a description of Dualtrack.
	440 coil drive Function key [F5]	This button will be available if you are operating the 440 as part of a Dualtrack installation.
	Background compensation	This button will be available if you are operating the 440 as part of a Dualtrack installation: refer to the 350 Powertrack System Manual for further details.
	Video overlay Function key [F3]	This button has a toggle action that enables and disables the video overlay with alternate presses. See section 5.3.3.5 "Video Overlay Setup" on page 5-25 for details of the video overlay option.

Run Window tools

Table 5-8 shows and explains the command buttons on the Run Window toolbar. You may also access some of the button functions by pressing the appropriate function key from the Run Window. See section 5.3.5 "Function Keys" on page 5-28 for a list of all the available function keys that you may use in the 440 mode.

Table 5-8: Run Window Toolbar

Button	Function	Explanation
	Annotations	This button opens the text annotation feature available when you are creating an internal logging file. You may use the feature to add text comments, of up to 40 characters in length, to the file. The comments will appear in the status bar during replay of the file. The feature will not be available unless you have configured DeepView to generate an internal logging file.
	Help	This button has a toggle action that opens and closes the DeepView function help panel described in section 5.3.5 "Function Keys" on page 5-28.

5.3.5 Function Keys

The section 5.3.1 "Menu commands" on page 5-11 explains the menu commands and toolbar buttons available from within DeepView for Windows. You may access some of these commands and tools directly by pressing the appropriate function key on the SDC. As a simple memory aid, press the function key [F1] to see the help dialog panel shown in Figure 5-15. Note that this dialog panel is NOT part of the DeepView for Windows on-line Help support.

Press any key to close the help dialog panel.

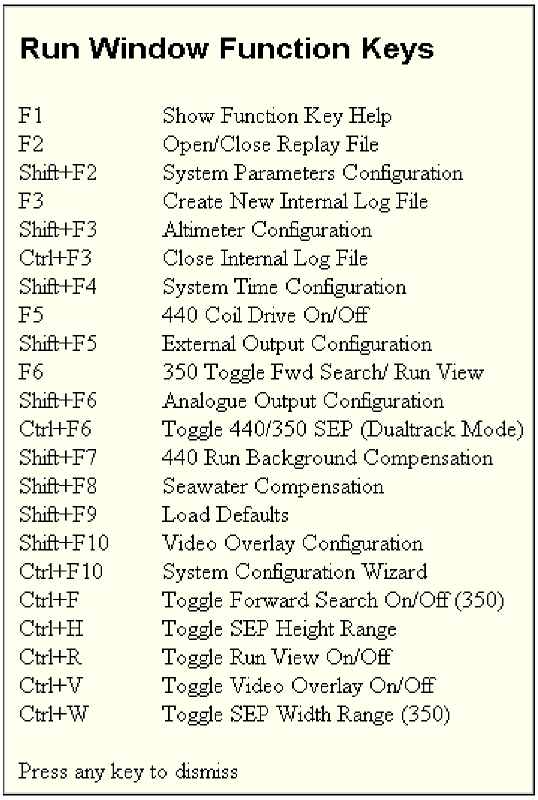


Figure 5-15: DeepView function keys

NOTE

Function key combinations [CTRL]-[F6], [CTRL]-[F7] and [F5] are valid only when you use the 440 System in a Dualtrack installation.

5.4 After the Dive

Perform the following tasks after you complete a survey using the 440 System:

1. **Print the configuration**.
   Select File➨Print Configuration to send a copy of the 440 System configuration details to Window Notepad. Use this separate application to print the details so that you may retain them with the survey records.

2. **Close the logging files**.
   Select File➨Close Log File to close the internal log file (if you have made one during the survey). Command the external data logger to stop logging data from the 440 System.

3. **Exit DeepView for Windows**.
   Select File➨Exit to exit the program. If necessary, use Windows Explorer to copy the internally logged file to a separate disk to accompany the survey records. You might need to compress the file using a separate program before you can transfer it to a diskette.

4. **Exit Windows and power-off the SDC**.
   Select Start➨Shut Down..., then choose 'Shut down' and press OK to close the Windows operating environment. Wait while Windows closes and then power-off the SDC when the screen tells you that it is safe to do so.

CAUTION

DO NOT power-off the SDC until it is safe to do so otherwise Windows™ will log the fact that it was incorrectly closed. This will cause the SDC to enter a diagnostic check automatically when you next operate it, extending the time that it takes for the 440 System to become operational after power-on.

If you power-off the SDC before Windows has closed properly, you might corrupt some of the data logging files from the survey.

5. **Power-off the sub-sea installation**.
   If you power-off the sub-sea installation before you close DeepView for Windows, the program will register a communications failure.

6. **Check the 440 System**.
   After you recover the ROV, perform all the post-survey checks and make any necessary repairs to the 440 System before you store it. This helps to ensure the System will be ready for immediate deployment when needed again. Use a fresh water hose to wash deposits of salt and debris off the System.

Refer to Section 6 for a suggested survey procedure using the 440 System.

5.5 Replaying a Log File

When you start to replay a log file an additional tool bar appears at the top of the run window.

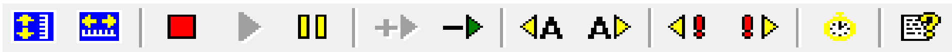
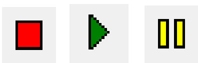
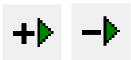
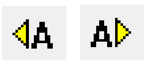
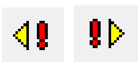


Figure 5-16: Replay toolbar keys

Table 5-9: Replay toolbar function keys

Button	Function
	Toggle height scale Function key
	Toggle swath width Function key
	Stop / Play / Pause Function keys
	Increase / Slow down replay speed Function keys
	Jump to previous / next annotation Function keys
	Jump to previous / next event Function keys
	Goto time Function key
	Help button

5.6 Quality Control

The Quality Control function of the 440 System defines an envelope within which the measurements meet the specifications for accuracy listed in Chapter 8 "System Specifications".

Whenever the co-ordinates of the target fall outside the limits of the Quality Control envelope, the following occurs:

- The target shown on the Run Display screen changes colour.
- A message appears on the screen to identify the reason for quality control failure.

- The output strings to an external data logger include the quality control indicator and identification number. The two-digit identification number allows post-processing engineers to identify the quality control failure. See section 6.3.1.3 "External Logging Format" on page 6-11 for details of the QC check code.

The extremities of the Quality Control envelope are as follows:

A) Lateral extremities:

If the target falls outside a swath range of ±2.0m from the centre of the coil array, then the Quality Control flag will be set. These extremities appear on the Run Display screen as two vertical broken red lines.

B) Vertical extremity:

If the signal strength on either of the lateral sensing coils falls to below 50µV, then the Quality Control flag will be set.

NOTE

The quality control flag does NOT mean that the measurements contain errors. It merely indicates to the post-processing team that the vertical range to target or the lateral offset has exceeded pre-defined limits. The post-processing engineers can use this flag to help them analyse the acquired data more easily.

5.7 System Recovery Procedure

If the SDC10 fails to operate correctly try the following methods to resolve the problem.

- Close the DeepView for Windows software application and restart it.
- If closing and restarting DeepView for Windows does not resolve the problem, close down the SDC10 and restart it by disconnecting and then reconnecting power, or by pressing the power reset On-Off button.
- If closing and restarting the SDC10 does not resolve the problem, reinstall the Teledyne TSS DeepView for Windows software (see section 5.8 "Reinstall DeepView for Windows Procedure" on page 5-37).
- If reinstalling DeepView for Windows does not resolve the problem, you may consider using the System Recovery Procedure to perform a factory reinstall of the Microsoft Windows 7 operating system, followed by reinstalling Teledyne TSS DeepView for Windows software.

CAUTION

- The System Recovery Procedure deletes all existing software from the SDC10 and reinstalls the Windows 7 operating system only. You will need to reinstall DeepView for Windows and any other software you have installed on the SDC10.

- The System Recovery Procedure deletes all existing data files, such as log files, from the SDC10, and these files cannot be recovered. Back up your data files to external media before you carry out this procedure.

5.7.1 Required equipment

To perform the System Recovery Procedure you need:

- The Teledyne TSS SDC10 recovery USB pen drive (memory stick). This is in addition to the USB pen drive for software installation (see section 5.9 "PC Software Installation" on page 5-37).
- A USB Keyboard (not supplied).

5.7.2 Recovery procedure steps

Make sure you have backed up all your data files to external media before you carry out this procedure.

1. Close down the SDC10 by disconnecting the power cable.
2. Remove the USB port dust cover caps on the front of the Panel PC and attach the Teledyne TSS SDC10 recovery USB pen drive and a USB keyboard.
3. Hold down the F11 key on the keyboard and reconnect power to the SDC10. If the Unit does not restart automatically press the Power On-Off button located on the underside of the base of the Panel PC (Figure 5-17).

NOTE

The Power On-Off button is not easily accessible when the Panel PC is being operated from its transit case.

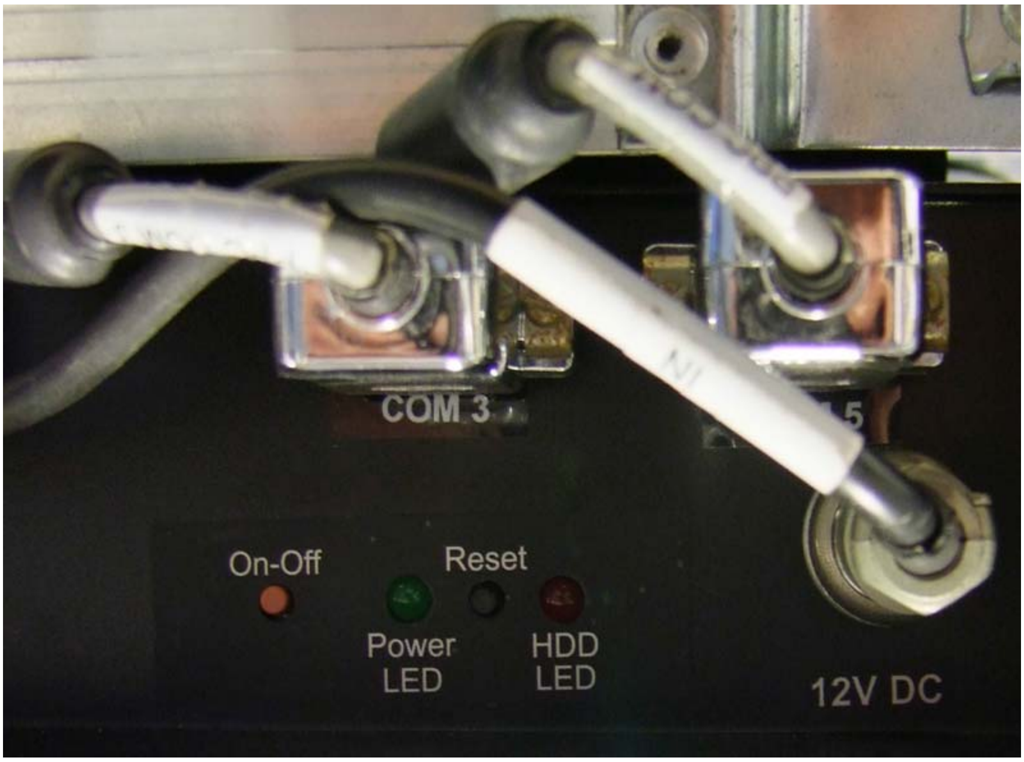


Figure 5-17: Power reset button

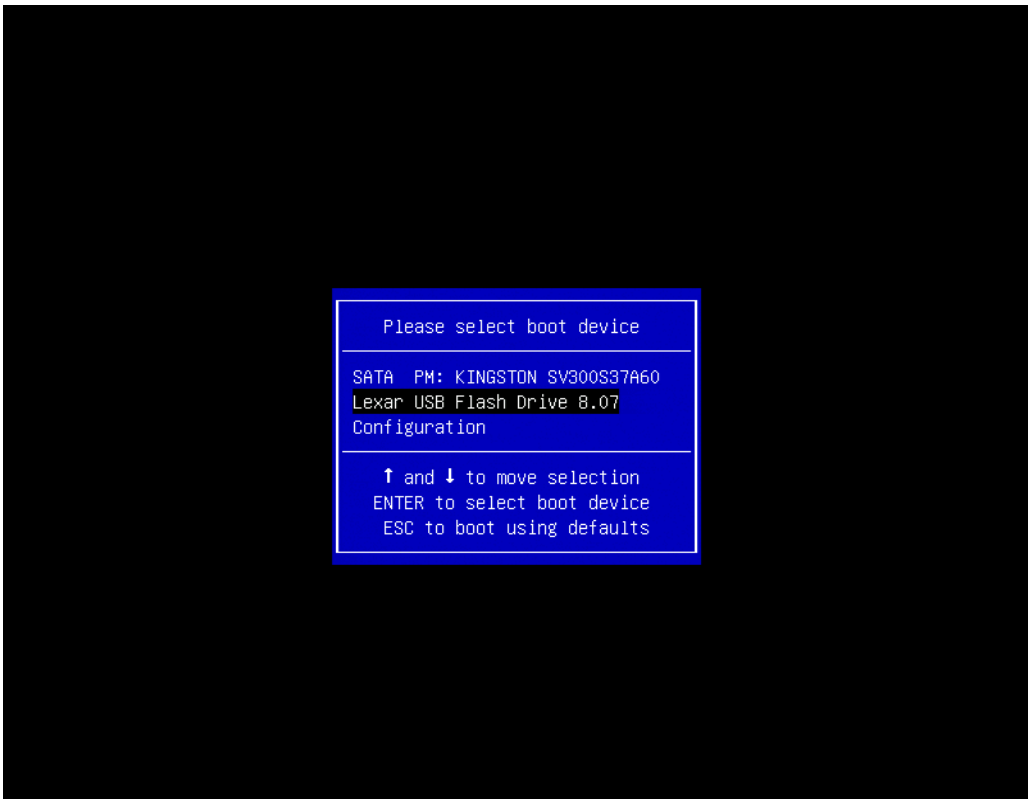


Figure 5-18: Boot Menu

4. Use the arrow keys to select the USB drive. The name of the drive may be different from the one shown in Figure 5-18. Press the Enter key on your keyboard to continue. You will see a blank screen.

5. Immediately press the Enter key for a second time.

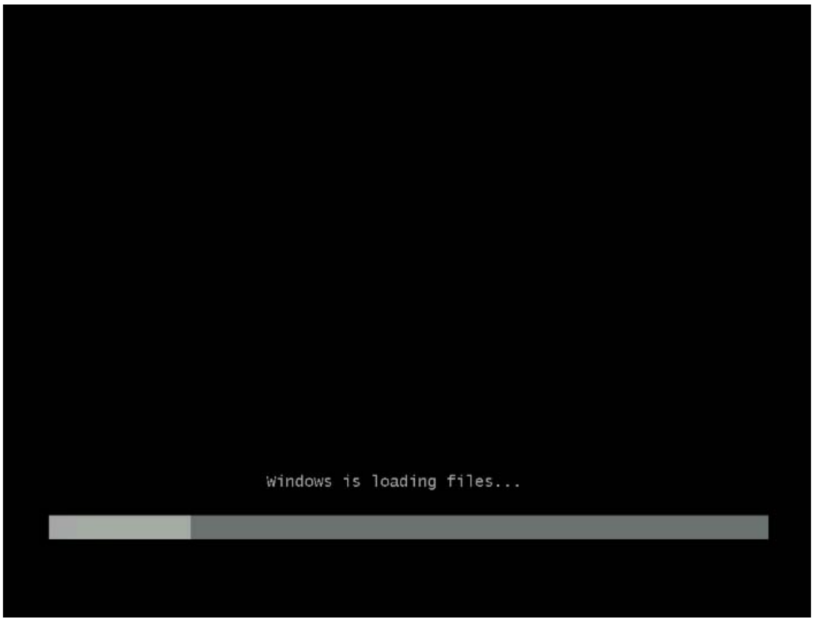


Figure 5-19: Windows Setup in progress

6. The Windows Setup programme displays a progress bar (Figure 5-19).

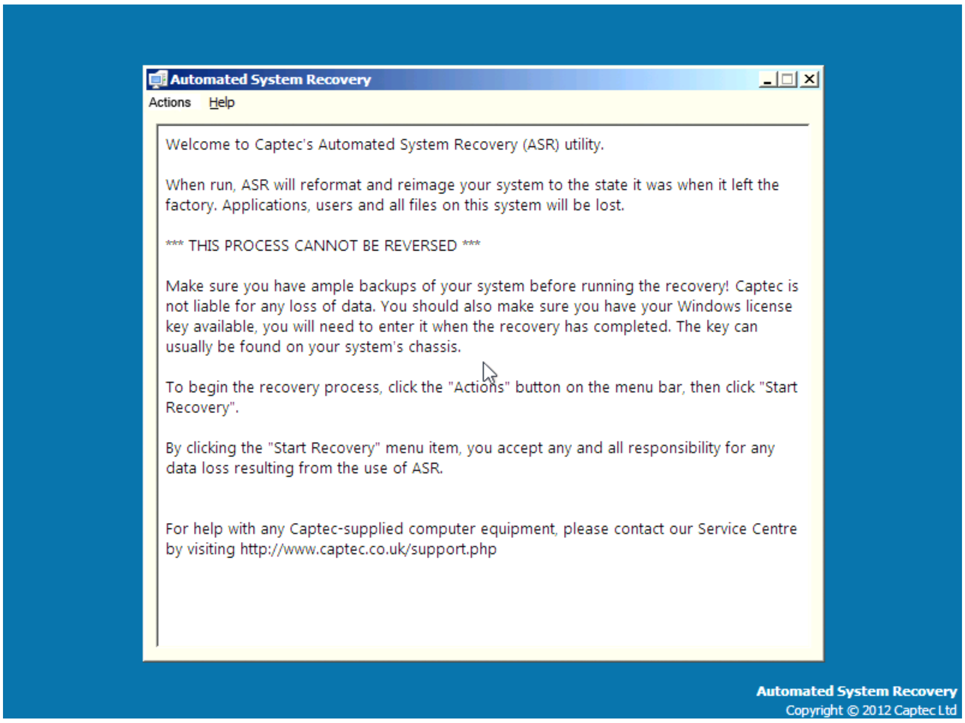


Figure 5-20: Automated recovery screen

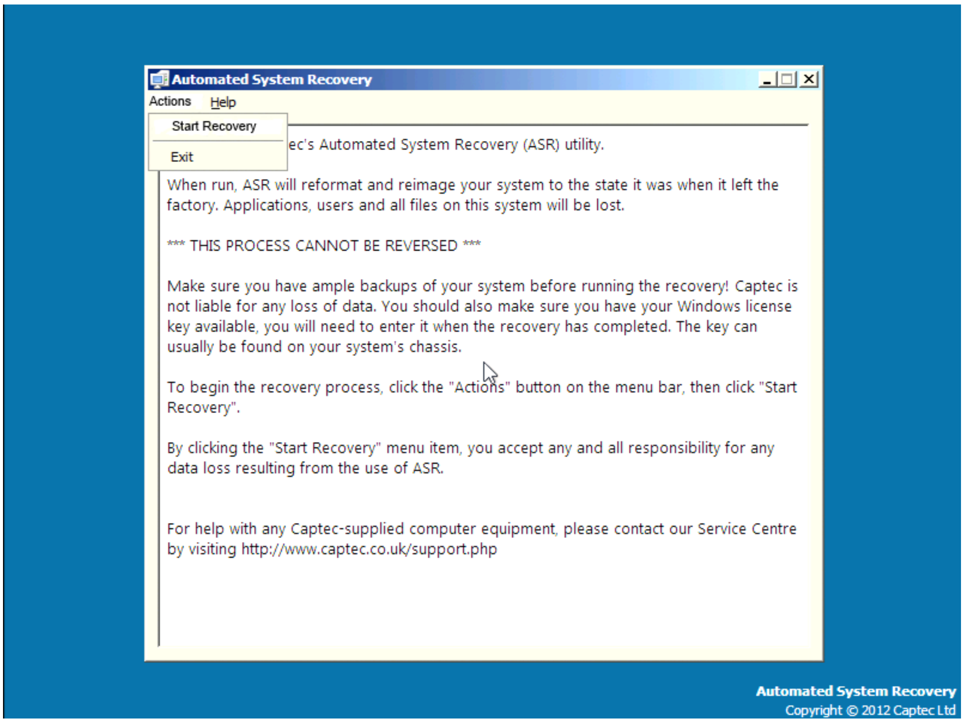


Figure 5-21: Select Start Recovery command

7. After a few moments the Automated System Recovery screen appears. Use ALT +A on your keyboard to select Actions from the top left-hand corner (Figure 5-20). Use the arrow keys on your keyboard to select Start Recovery if it is not already highlighted and press Enter (Figure 5-21).

NOTE

If you have any difficulties with the system recovery procedure please do not use the contact details on the Automated System Recovery screen and instead contact Teledyne TSS.

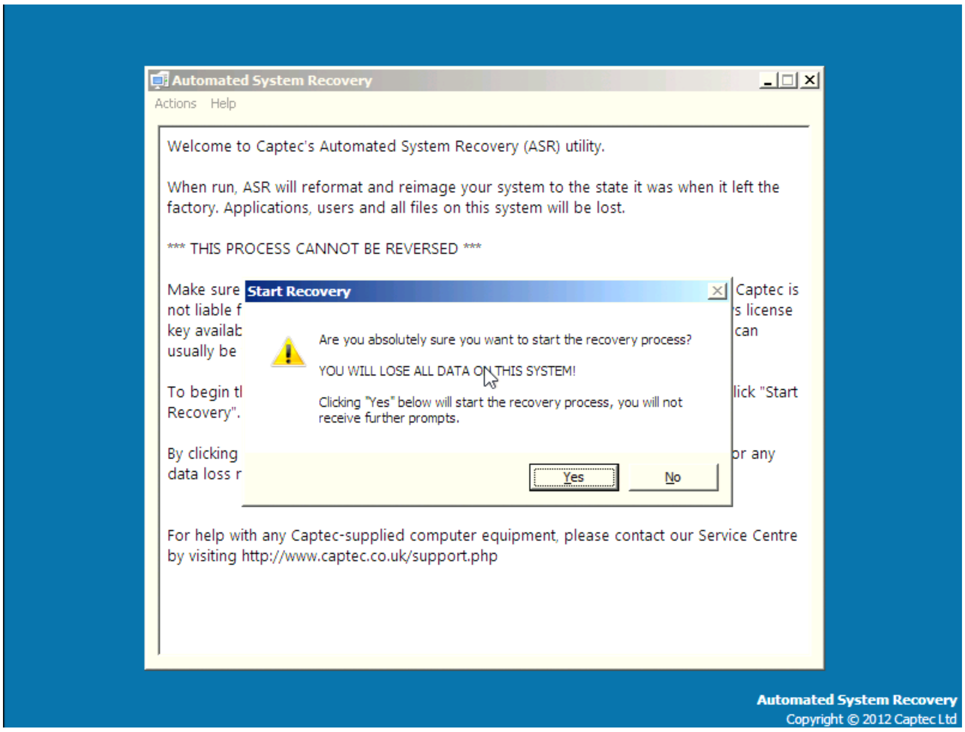


Figure 5-22: Confirm recovery

8. On the confirmation dialog use the arrow keys on your keyboard to select Yes and press Enter (Figure 5-22). While the Reinstall Procedure is running the system displays a progress bar (Figure 5-23).

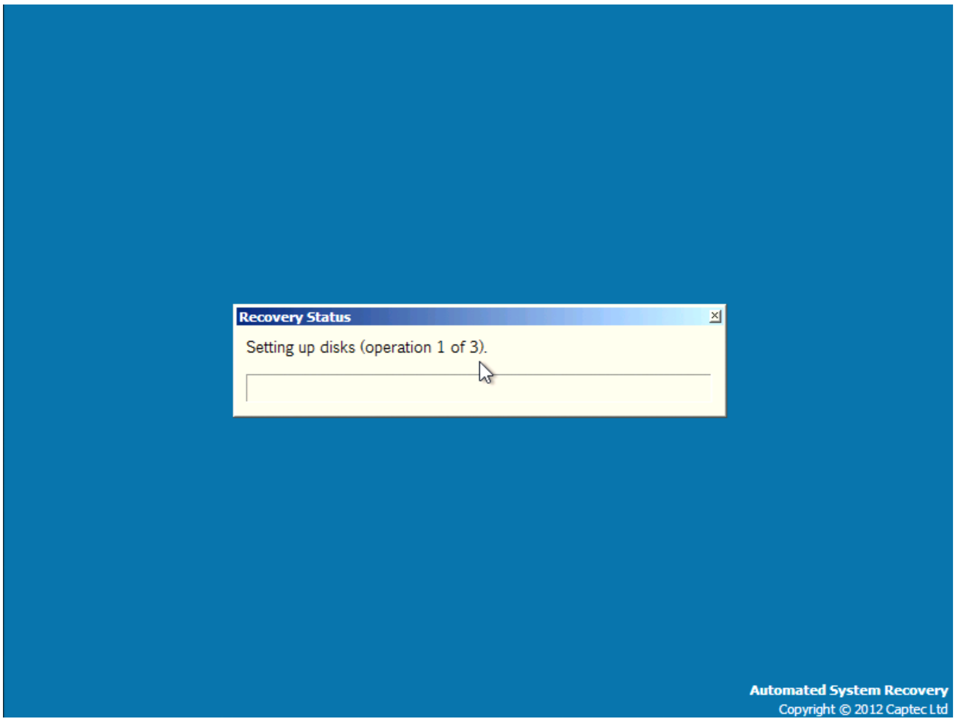


Figure 5-23: Recovery in progress

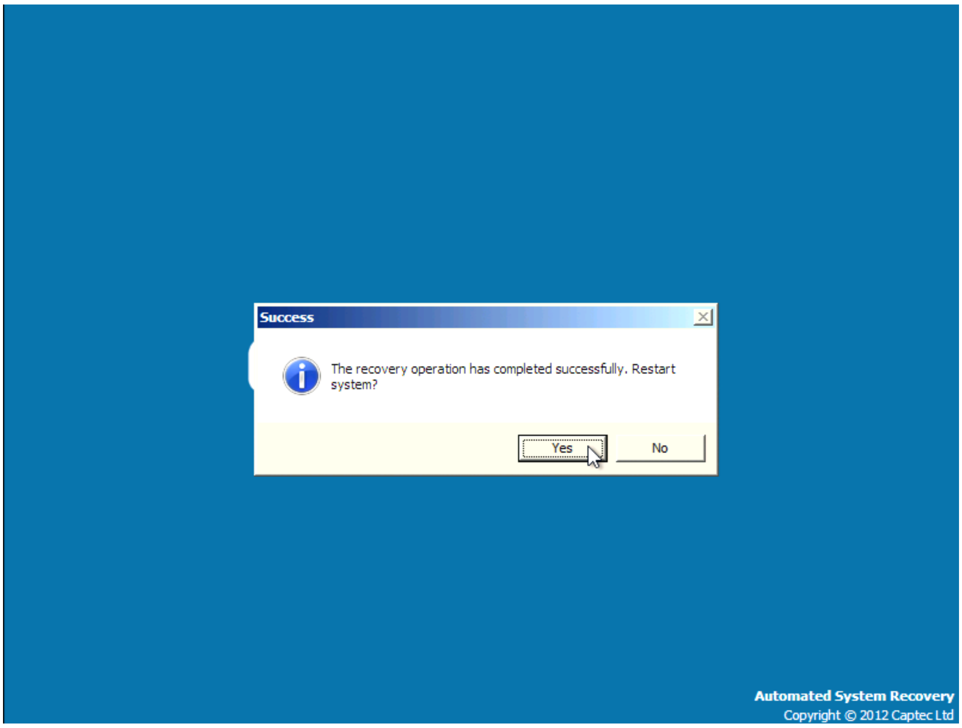


Figure 5-24: Recovery complete before reboot

9. When the Reinstall procedure is complete remove the Recovery USB from the SDC10 and Press Enter to restart the SDC (Figure 5-24).

10. After the system restarts reinstall DeepView for Windows.

5.8 Reinstall DeepView for Windows Procedure

Follow these steps to reinstall the DeepView for Windows software:

1. Select the Windows Start menu, and then select Control Panel, and Programs and features

2. Select the DeepView for Widows entry in the list of installed programs, and select Uninstall. If there is more than one DeepView entry in this list you must uninstall them all.

3. In the Windows File Manager, select the folder C:\Program Files\TSS, and delete the subfolder DeepView for Windows.

4. Insert the software USB, and run the installer file DeepView_Install.exe (the exact name of this file may vary.

5.9 PC Software Installation

Teledyne TSS TSS supplies a USB pen drive (memory stick) containing the DeepView for Windows software with the 440 System. This is in addition to the USB pen drive for system recovery (see section 5.7 "System Recovery Procedure" on page 5-31). You may install this software, under licence, on a separate PC to support the main installation on the SDC or to replay an internally logged data file. The following instructions explain how to install the software on a separate PC.

NOTE

If you do not need to install the software on a PC or on the SDC, go directly to section 5.1 "Power-on Procedure" on page 5-1 for instructions to begin using the 440 System and DeepView for Windows.

Before you install the software it is recommended that you read the readme.txt file on the USB pen drive which describes any enhancements or issues to be aware of prior to installing the software:

1. Insert the USB pen drive into a suitable USB port on your PC.
2. The software should start automatically. If it does not, within the Windows environment select 'My Computer' and the respective drive for your USB port. Within the contents of the USB pen drive you will find the setup program which automatically installs the software.
3. To use DeepView for Windows, double click on the Teledyne TSS icon that the installation programme places on your Windows 7 desktop.

NOTE

Take the following precautionary measures to maintain the SDC and your PC in optimal condition:

- Check all the drives on your PC for viruses using current versions of an approved anti-virus program.
- Perform a Windows disk check and a defragmentation session regularly.
- Follow the correct procedures to close down Windows and power-off the SDC and your PC.
- NEVER install unauthorised software on the SDC.
- NEVER make any alterations to the Windows registry unless you are entirely certain that you know what you are doing, and have backed up the registry files 'system.dat' and 'user.dat'. Inappropriate modifications to the Windows registry can prevent the SDC from operating.

6 Operating Procedure

In common with other items of precision equipment, you may rely on the quality of data gathered by the 440 System only if you follow the correct operating procedures when you use it.

This section of the Manual considers the role that the 440 System plays within an overall survey operation. It includes several checklists together with the related explanations to assist with each of the major stages of any survey that uses the System.

NOTE

This is an important section of the 440 Manual. On request, Teledyne TSS can supply additional copies to the survey planning team to provide guidance during the early stages of Project Management.

NOTE

To allow for meaningful analysis of the acquired data, the 440 System allows you to keep a record of the System configuration during a survey. When DeepView for Windows is configured a file is created that can be accessed by File, and 'Print Configuration' option. this presents a text file on screen in WordPad format that can then be printed out via the normal windows process to a connected printer.

Variables included in the configuration file are of great value during data analysis, and Teledyne TSS recommend you should always keep a written record of their settings with the survey log.

6.1 Pre-Survey Preparation

At an early stage during the planning procedure, the survey planning team should decide whether to use a 440 System. By making this decision early in the planning procedure, they can assign the correct equipment and personnel to the operation.

Contact Teledyne TSS for advice if you are unsure whether the 440 System is suitable for use in a particular survey application.

Pre-Survey Check List

Training and availability

1. Check the availability of a 440 System and a Teledyne TSS-trained operator for the period of the survey.

Target scaling

2. Determine the diameter, and weight-coating or jacket thickness of the intended survey target.
3. Will an automatically generated target scaling rate give sufficient accuracy?

4. Establish the scope of survey data acquisition, for example the maximum vertical range, required accuracy of data, etc. You may be able to use the examples in Chapter 8 "System Specifications" or you may test a sample of the target on dry land.

5. Determine the maximum tolerance limits of roll, pitch and skew between the ROV and the target during the survey.

Data Collection

6. Define the type of data you will need to collect during the survey.

System Installation Requirements

7. Determine whether the ROV will be suitable for all the survey requirements.

8. Decide which communications method to use from among 2-wire current-loop, 4-wire current-loop, or RS232.

9. Decide whether to use an altimeter or a rapid update profiler. Determine which type of altimeter you will use and where you will install it. Contact Teledyne TSS for advice if necessary.

10. Determine what facilities will be available for logging the survey data.

11. Provide a printer for connection to the SDC.

12. Determine the requirements for maintaining a video record of the survey.

6.1.1 Training and Availability

When used properly, the Teledyne TSS 440 System is a precision survey tool that provides valuable and detailed survey data to describe the track of a conductive target through the survey area.

NOTE

It is in the interest of the Survey Planners to ensure that appropriate personnel attend one of the Teledyne TSS Training Courses.

See Appendix B.2 "Training" for a description of the training available for the Teledyne TSS 440 Pipe and Cable Survey System.

Ensure that a 440 System in good working order will be available at the time of the survey operation.

6.1.2 Target Scaling

The 440 System features a simple and quick method to set the target scaling factor automatically for a particular target type and size. To achieve this, the System includes a comprehensive database of information acquired for a very wide range of target type and size.

Use the auto-scaling procedure to select the target diameter. After you have done this, the System refers to its database of target characteristics and selects a value appropriate for the survey.

The range and accuracy of measurements available from the 440 System varies with the type of target and its size. This Manual cannot therefore include precise specifications to cover all possible targets. However, Chapter 8 "System Specifications" includes a series of tables that show the degree of measurement accuracy that you may expect from the System *if you follow the correct operating procedures*. These tables provide guidance on the vertical range and measurement accuracy that you may expect for the targets listed. DO NOT use the tables as correction tables to refine survey results after you have completed the survey.

Where the information contained in Chapter 8 "System Specifications" does not provide sufficient coverage, you may make a series of manual measurements using a sample of the target on dry land to derive a table that is valid for a specific target. By prior arrangement, Teledyne TSS can perform this service before the survey using a suitable 5-metre sample length of target.

The ideal condition during the survey is for the ROV to be located centrally over the target with no roll, pitch or skew present. Where this is impossible to achieve, you may simulate the roll, pitch and skew conditions during tests on land and assess their effects on measurement accuracy.

6.1.3 Data Collection

During the early stages, the survey planning team will need to define the type of data required from the survey:

The System can complete a quick and simple check on the track and depth of cover of a target by making a series of widely spaced measurements.

Alternatively, to work to the highest achievable accuracy (for example to perform an out-of-straightness survey), you may need to stop the ROV at closely spaced intervals to perform accurate measurements on the target and to measure the mean seabed level with a separate profiling system.

6.1.4 System Installation Requirements

Before starting a survey the survey planning team should define the installation requirements of the 440 System. They should consider:

- The type of ROV to be used and where the SEP, the PSU and the coils will be mounted. The 440 System is suitable for use on most types of ROV, including towed sleds. Teledyne TSS can offer further advice if necessary.
- Which communication method to use between the SEP and the SDC. This will depend upon the characteristics of the umbilical cable. See Section 4 "Electrical Installation" beginning on page 4-1 for guidance.
- Whether to use an altimeter or a rapid update profiler, and their location on the ROV.
- The type and capacity of data logger, and its connection and communication requirements.
- Whether to use an external printer with the 440 System. Teledyne TSS recommends that you should generate a written or printed copy of the System configuration before and after the survey. This will be useful source of reference during the data analysis phase of the survey.
- The on board facilities for creating, displaying and recording video images from a sub-sea camera mounted on the ROV. Consider using the video facilities to record the installation procedure of the 440 System.

The standard 440 System includes a field support kit (FSK) for use with the sub-sea installation. Only engineers who have attended Part 2 of the relevant Teledyne TSS training course should use the FSK.

6.2 Pre-dive Checks

NOTE

DeepView for Windows has a comprehensive Help structure written specially for it. The Help structure includes a set of pre-dive checks that you should perform before you deploy the 440 System underwater. You may configure DeepView for Windows to display a summary of these checks automatically after you complete the System Configuration Wizard.

The pre-dive procedure requires you to check the mechanical installation, the electrical and communications connections throughout the System, and its configuration. You should perform these simple and sensible checks on the System as a routine part of every survey deployment. They should not take long to complete and will help to prevent expensive mistakes.

6.2.1 Mechanical

6.2.1.1 Depth rating

Note that the depth rating of sub-sea components will be impaired if the housings suffer from damage or corrosion, or if they have been disassembled and reassembled carelessly.

To maintain the depth rating of your 440 System:

- Wash the sub-sea installation with clean fresh water and inspect the sub-sea housings for damage after each survey operation. Make any necessary repairs as soon as possible. Never deploy the System on a survey if any of the sub-sea housings show signs of damage.
- Install the housings where there is no danger of damage from snagging on debris or contact with other equipment on the ROV. Secure the housings so that they cannot move or vibrate against the ROV frame.
- Follow the instructions in section 4.1.1 "Ground Connections" on page 4-3 concerning the electrical grounding of the 440 System.
- Do not open the sub-sea housings without good reason. Follow the instructions in section 9.2.2 "Sub-sea Installation" on page 9-6 to disassemble and reassemble the sub-sea housings. Check the condition of the O-ring seals and apply a very thin coating of the same silicone oil that you use to maintain the connectors – see section 4.1.2 "Care of Sub-sea Connectors" on page 4-3.

NOTE

When opening the sub-sea housing Teledyne TSS recommend that you use screws inserted into the drilled holes to jack the endcap off. Under no circumstances should a screwdriver (or similar) be used to lever the endcap off as this will result in damage to the o-ring seal and the casing.

WARNING

There have been reports of pressure building up within the Sub-sea unit if water has been able to seep into the housing. Take great care when opening the SEP unit.

6.2.1.2 Coil Installation

- **Electrical characteristics**.
  Check the coil continuity and insulation resistance. Do not use coils that fail the insulation test. See section 6.3.2.1 "Coil Insulation Test" on page 6-13.

- **Coil configuration**.
  Install the coils so that there is a 5-10mm gap between the port and starboard coils and the centre coil lies flat on top (see section Figure 3-6: "Assembly of the coil frame" on page 3-10 and Figure 3-6). Align the coils so that their connectors all face towards the ROV.

- **Coil separation distance**.
  Allow sufficient distance between the coil array and the vehicle body so that the background signal (with no target) is less than 1000µV for standard coil values and below 7500µV for early coil values. Usually this requires a coil separation distance of between 0.75m and 1.0m, depending on the size of the ROV.

- **Coil mounting**.
  Make certain the coils are mounted rigidly on the ROV. If the ROV uses a system that lowers the coil array to its normal operating position after deployment, make certain this locks into the correct position before you start the first background compensation procedure. See section 6.2.2.3 "Background Compensation" on page 6-22 for a description of background compensation.

CAUTION

Never drill holes in the coils. It will result in the coils be unusable.

You may install the coils either at the front or the rear of the ROV. If you use a rear mounting position, arrange a subsea camera to check that the umbilical does not drag near the coils and create a false target.

- **Coil height**.
  For a small target – Install the coils low on the ROV to extend the detection range as deeply as possible into the seabed. Operate the ROV carefully to avoid collisions between the coils and debris on the seabed.

For a large target – Install the coils higher on the ROV to reduce the likelihood of coil saturation. This position also provides better protection for the coils.

- **Cables**.
  Use plastic cable ties to secure the cables to the ROV frame. Make certain the cables cannot move providing a false target during survey operations.

- **ROV body**.
  Do not operate manipulators or other movable items near to the coils during survey operations. If you must use the manipulators during a survey, stow them securely and perform a full background compensation procedure before you resume the survey.

- **Conductive material**.
  Do not place conductive metal fixings, straps or other items near the coils during operation. Use only the supplied nylon fixings and frame components to secure the coil array to the ROV.

- **Altimeter**.
  Do not attach any altimeter to the coil array.

Measure the vertical offset distance between the coils and the transducer face of the altimeter. Use this distance to configure the 440 SEP.

6.2.2 Electrical

6.2.2.1 Power

Check the operating voltage for your sub-sea installation:

- The standard sub-sea PSU operates from a nominal 110V AC electrical supply. See section 8.1.3 "Sub-sea Power Supply Pod" on page 8-3 for full details of the PSU power requirements.

Check the power supply rating for your PSU, which should be marked on the PSU label.

NOTE

For Dualtrack installations, both sub-sea installations MUST operate from the same electrical supply. If necessary, obtain a new 440 PSU or 350 / 350 Power-track SEP so that you may establish this very important condition. Refer to Appendix B.1 for a description of Dualtrack.

6.2.2.2 Cables, Connectors and Coils

Cables and connectors

- Check that you have installed the cables correctly. See section 4.1 "Sub-sea Components" on page 4-1 for instructions to make connections within the sub-sea installation.
- Check the coil and cable continuity and insulation resistance as instructed in section 6.3.2.1 "Coil Insulation Test" on page 6-13.
- Inspect the cables and connectors visually for signs of damage, contamination or degradation. Make any repairs necessary before you use the cables. If necessary, fit new cables.
- Secure all cables to the ROV frame so that they cannot move or snag during survey operations. Do not apply sharp bends to the cables or expose them to other mechanical stresses.
- Follow the advice in section 4.1.2 "Care of Sub-sea Connectors" on page 4-3 about caring for connectors.
- Connect the coils to their correct channels on the SEP.
- Fit proper blanking plugs to any SEP port that will not be used during system deployment.
- Hand tighten the connectors when you reassemble them. Do not use additional leverage or apply excessive force to the connectors.

6.3 Survey Operations

This sub-section is of special interest to personnel who will operate the 440 System during a survey. It explains how to use the System correctly.

Before you start a survey that uses the 440 System:

- Check that you have established the correct communication method in the SEP and in the SDC. See section 4.2.2 "Communication Link SEP to SDC" on page 4-8.

- ❒ Check that you have connected the coil cables in the correct sequence (Starboard to Channel 1, etc.).
- ❒ At the SDC ensure that you have attached all necessary connections from the SEP/PSU, the data logger, the altimeter, the video system and the printer as required.
- ❒ Check that you have installed and secured the SDC safely so that it will not move or fall with movements of the survey vessel.
- ❒ Check and connect a noise-free power supply of the correct voltage to the SDC.
- ❒ Check the power supply connection from the ROV to the PSU. The standard PSU accepts AC electrical power at a nominal supply voltage 110V.
- ❒ Set the correct format for external data logging.
- ❒ Set the RS232 parameters of the SDC 'COM2' and 'LOG O/P' (COM3) ports to match any equipment connected to them.
- ❒ If you are using a current-loop communication method, check on the SDC to see whether the 'C/LOOP' LED shows green when you power-on the sub-sea installation. Select the Run Display screen and check that it updates correctly. Use the SDC oscilloscope display to check for correct waveforms on all channels.

Operations Check List

Installation

1. Check that you have installed the 440 System correctly.
2. Set the internal clock of the SDC to the correct date and time.

Establishing the Start-of-Survey Configuration

3. Set the target scaling factor to the correct value.
4. Set the correct altimeter parameters, including any vertical offset measurements.
5. Set the threshold according to requirements.
6. Check that coil mapping correctly matches the specific installation.
7. Set the background compensation reminder interval.
8. Upon completion of 3 – 8 above, backup the configuration to the SDC hard disk.
9. Print the configuration and retain a copy with the survey records.

Pre-dive Checks

10. Power-on the 440 System thirty minutes before you deploy the ROV. If practical, perform a target detection test.
11. Use the SDC oscilloscope display and check for correct waveforms on all channels.
12. If your System has an altimeter fitted, perform an Altimeter Test and check that the System receives data strings from the altimeter.

13. With the ROV in the water, check again for correct waveforms from the SEP using the SDC oscilloscope function, and for correct data strings from the altimeter.

Background and Seawater (Active) Compensation Monitoring

14. Perform a background compensation procedure at the start of the dive with the ROV on the seabed. It is common for the background characteristics of the ROV to change during the first 20 minutes of deployment, possibly due to thermal effects. Survey measurements made during this period may include errors caused by such changes in ROV characteristics. Repeat the background compensation procedure 30 minutes after you deploy the ROV. Create a hard copy of the results and attach it to the survey records.

15. Perform regular background and seawater compensation checks during the survey to ensure that no changes or shifts have occurred. Use the internal logging facility to record these checks.

16. Perform a Background Noise Profile check. To perform a Noise Profile of the surveying vicinity, steer the ROV away from the target to a distance of approximately 10 metres. At this position check that all the signal voltages fall to zero ±5µV. If any signal voltage is greater than 5µV at a distance of 10 metres from the target, repeat the full background compensation procedure. Use the Noise Profile logging facility to record the signals present during the test. If all signals are close to zero, return to the target and continue the survey.

17. Check the Seawater compensation. Lift the vehicle to 3m off the seabed. The target voltages should be less than 10µV. If they vary, check the water temperature is set correctly. If good rejection cannot be obtained then consider using Manual Compensation.

NOTE

A “Flick” in the target voltages occurs at approx. 4m above the seabed, this is not a fault in the 440 System or its configuration.

Data Logging

18. Log all survey data including the regular background compensation, seawater compensation checks and Background Noise Profile check.

19. Maintain a written record of any events that occur during the survey (for example a collision between the ROV and debris, etc.). Describe any corrective actions taken.

20. To assist post-survey analysis a Background Noise Profile should be carried out after a Background Compensation. This facility allows a log to be generated of background noise in the surveying vicinity that could affect the quality of the survey data obtained. See section 7.3.5 Background Noise Profile.

End of Survey

21. Print another copy of the System configuration and retain it with the survey records.

22. Wash the sub-sea installation carefully using a fresh-water hose to remove all deposits of salt and debris. Check the sub-sea installation visually for signs of damage or corrosion. Repair any damage to the equipment before you stow the ROV.

6.3.1 Establishing the Survey Configuration

6.3.1.1 Target Scaling

Target scaling is the method used by the 440 System to determine the relationship between the coil signal strength and the range to the target. It allows the System to know whether a specific signal level comes from a small target close to the coils or a larger one farther away.

The value you use for the target scaling factor depends upon the nature of the target itself – particularly its diameter and its physical characteristics. You may establish this using one of two methods that you may access by 'System parameters' Menu:

1. Auto Scaling

2. Entry of a known value for the Target Scaling factor.

Use of the correct value will allow accurate measurements on the target. However, due to the influence of a sixth-root term in the calculation, absolute accuracy is not necessary when you enter a target scaling factor. Trials have shown that, when using a target scaling factor that is 100% too high, errors in the measured range to target will not exceed 20%.

Auto Scaling

This is the preferred method for setting a target scaling factor. It uses the stored database of target characteristics to determine a suitable value for the target scaling factor for use in the range calculation formula.

Before the System can determine the correct Target Scaling factor, you must supply the following information about the target:

Target Diameter	Enter the external diameter of the conductive part of the target. Note: If you select Flexible Pipeline as the target type, you must set the *internal* diameter.
Weight Coating / Jacket Thickness	Enter a value between zero and 20cm for the thickness of any non-conductive coating on the target.

Upon completion, press OK to determine the correct value for target scaling factor. The SDC will display this value and allow you to accept or reject it. Press [OK] to use the displayed value.

This completes the Auto Scaling process.

Known Target Scaling factor

This menu option allows you to enter a target scaling factor that you have determined by performing a separate series of tests for a specific or unusual target.

The target scaling value is designed to be as close as possible to that used for the previous 340 system. However, for maximum accuracy it is recommended Teledyne TSS determine an exact target scaling factor from a sample of your target.

See section 6.5 "Target Scaling" on page 6-33 for the full procedure to measure the scaling factor of a target.

6.3.1.2 Threshold

High settings will make the 440 System less sensitive to noise but will also decrease its operating range. The default setting of 25µV has proved to be suitable for the majority of survey operations.

Check the threshold setting by opening the system parameters window [Shift+F2] from the Configuration options. If necessary, the number can be modified from this menu.

6.3.1.3 External Logging Format

The 440 System provides three alternative formats for logging data externally. The default conditions is to log the co-ordinates, signals and quality check-code information simultaneously (see section 6.2.2.2 "External Data Logging" on page 6-20). You should not need to alter this setting.

Select the external logging format using the External Output option from the Configuration options.

6.3.1.4 Serial Port Parameters

An overview of the default port configurations and use can be found in section 5.3.2 "Communication ports" on page 5-5. Any changes in configuration to any of the ports used with the SDC is covered in the respective subsections related to the operation and connections required.

6.3.1.5 Background Compensation Reminder

During normal operation, you should perform a background compensation check at regular intervals to detect and compensate for any variations in the background signal from the ROV.

The background compensation reminder allows you to set a pre-determined interval of between 1 and 360 minutes. After the completion of the pre-set interval, the SDC will display a message banner as a reminder to perform this important check. You may clear this panel by pressing [ENTER] after making the check, or by performing a background compensation.

You may adjust the interval from within the System Parameter Window [Shift+F2] from the Configuration options. The default setting is 30 minutes. It is possible to disable this reminder feature by setting the interval to zero. Teledyne TSS does NOT recommend that you disable the reminder interval.

6.3.1.6 Altimeter Parameters

You may gain access to the altimeter parameters by selecting the Altimeter Window[Shift+F3] from the Configuration options.

If you have connected an altimeter to the 440 System, select the appropriate model in the first field by selecting the available options.

Enter the vertical distance between the bottom face of the search-coils and the transducer face of the altimeter. Enter a positive value if the altimeter is higher on the ROV than the search-coils.

If you have no altimeter fitted to the 440 System and your ROV allows you to set the coils at a fixed altitude above the seabed, enter the fixed altitude value.

NOTE

You must still enable the altimeter for the System to use the value for fixed altitude.

6.3.1.7 Coil Mapping

For normal operations, you should leave coil mapping set to its default configuration '1234'. However, if you change the connections between the coils and the SEP channels, you will have to change the coil mapping configuration accordingly. To do this, enter the System Parameters Window [Shift+F2] from the Configuration options.

6.3.1.8 Save and Print the Configuration

After the display software completes its initialisation sequence, it will search for a file that contains the initial System configuration. You may modify this file by saving a new start-up configuration that is more appropriate to the requirements of your survey.

After you have established the correct survey configuration for the System, select 'Print Configuration' from the 'File' Menu. If you do not have a printer connected to the SDC, you may use this screen and then write the details onto a suitable form.

Whether you create a hard copy of the configuration by hand or whether you print the details, you should keep a record of the System configuration with the survey log.

6.3.2 Pre-dive Checks

You should perform these important functional checks on the 440 System *before* you deploy the ROV. Note that you may display a list of the recommended pre-dive checks by pressing [F8] from the Operation Menu.

1. Coil insulation test
2. Target detection test
3. Oscilloscope test (in air and in water)
4. Altimeter test

WARNING

Draft proposals have been issued by the National Radiological Protection Board (NRPB) that restrict personal exposure to Electric and Magnetic fields. Users of the Teledyne TSS 440 System should therefore note the following:

Although the search-coils generate intermittent strong magnetic fields while operating, beyond a distance of 1.5 metres from the coil surface the field strength is below the maximum level recommended within the NRPB guidelines.

1. Do not handle the search-coils when they are powered-on.

2. When power is applied to the search-coils, all persons must be at least 1.5 metres from the coil surface.

These restrictions apply only to the search-coils, and only when they are under power.

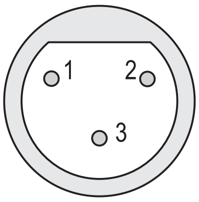
Teledyne TSS recommends that you press [F5] from the Run Display screen to switch off coil drive while working close to the coils.

6.3.2.1 Coil Insulation Test

Damage can occur to the search-coils from collisions with debris on the seabed or from other causes. Usually, damage to the coils appears as a degraded coil insulation resistance rather than a short circuit. Under these circumstances, the 440 System may continue to work without damage to the SEP Driver Board, but there will be some loss of accuracy in survey measurements delivered by the System.

To reduce the possibility of damage to the Driver Board or a loss of survey accuracy due to a partial insulation breakdown, check each coil before you connect it to the SEP.

Use a sensitive digital meter to measure the DC continuity of each coil between pins 1 and 2 of the coil connector. This resistance should be 0.30 +/- 0.05Ω.



Use a 500V digital insulation tester to measure the insulation resistance of the coil. Each coil should show an insulation resistance greater than 200MΩ between the shell, pin 1 and pin 2 of the coil connector.

Renew any coils that show high resistance, short-circuited windings or an insulation breakdown.

6.3.2.2 Target Detection Test

NOTE

Perform this test only if there is a convenient and safe method for lifting and suspending the ROV off the deck.

Power-on the 440 System and allow a period of about five minutes for the System to settle.

If the ROV is resting on the deck of the survey vessel, the proximity of the deck and other metal fittings will cause the search-coils to saturate. Therefore, use whatever safe means are available to lift the ROV off the deck and suspend it in the air so that the coils are at least two metres from any metallic object.

At the SDC, perform a background compensation routine by pressing [Shift +F7] from the Configuration Menu. Wait ten seconds until the SDC displays a single line of measurements and then press any key to stop the routine.

Switch off coil drive by pressing [F5] from the Run Display screen and then place a metallic test target (for example, a spanner) on one of the search-coils. Switch on coil drive by pressing [F5] from the Run Display screen and check that the display shows a strong signal on the relevant channel. Repeat this test for all three search-coils, switching off coil drive while you move the test target from one coil to the next.

6.3.2.3 Oscilloscope Test

Use the SDC oscilloscope display function and check that waveforms are being displayed correctly.

Repeat this test when the ROV is in the water.

6.3.2.4 Altimeter Test

Perform an altimeter test and check that the SEP or the SDC is receiving data packets correctly from the altimeter.

6.3.3 Background Compensation and Monitoring

To ensure that information acquired by the 440 System is accurate, you must perform the full background compensation 20 minutes after you immerse the System in water and turn on the for the dive. Do not use the measurements made by the System until you have performed the background compensation.

NOTE

The 440 system has much more stringent requirements than its predecessor, the 340, in terms of background compensation stability. If good quality survey information is to be obtained, then the background compensation levels must be absolutely stable and repeatable. Variation in the compensation levels indicates that the system is not performing correctly. This can be monitored and logged using the Background Noise Profile facility (see section 6.2.2.5 "Background Noise Profile" on page 6-25). Any problems must be rectified before the survey is performed.

The full background compensation procedure is different from the background compensation check described in section 6.3.3 "Background Compensation and Monitoring" on page 6-14. You must perform the background compensation check at regular intervals throughout the survey operation.

These procedures and checks should not introduce significant delays into the survey operation, yet will allow greater confidence in the accuracy of survey measurements.

You should consider them an important part of the survey operation.

What Is Background Compensation?

The ‘Background Compensation’ process starts and proceeds after you enter the ‘Background Compensation’ Menu and click on ‘start’ from the Configuration Menu. It allows the 440 System to measure any constant signal level caused by the proximity of the ROV, and by the conductive effects of sea water.

The System measures the background signal on each channel and calculates the average value during a 10 second period. The average values derived for each channel then represent a ‘zero reference’ against which signals supplied by the search-coils will be compared. The System considers any received signals that are greater than this reference as originating from a target.

A sudden and significant change in the results of a background compensation check affecting one channel could indicate a partial failure of coil insulation. See section 9.3.1 "Fault on Single Channel Only" on page 9-11 for details.

Background Compensation Procedure

Place the ROV on the seabed so that the search-coils are at least 10 metres from the target and are located in an area that is clear of conductive debris.

The ‘Background Compensation’ process starts and proceeds after you enter the ‘Background Compensation’ Menu and click on ‘start’ from the Configuration Menu.If a printer is on-line and connected to the SDC, it will print a header that includes the date and time.

Wait approximately one minute until the System has completed at least five measurement cycles. The results will appear on the SDC screen. Check that all the measurements appear in black – red figures on any channel indicate signal saturation.

As the System completes each measurement cycle, the background compensation measurements appear on the screen and on a printer if one is connected.

Press any key to stop the background compensation process. There will be a delay of about ten seconds while the System completes its final set of measurements. The background compensation results used by the 440 System are those included in the last line on the display.

Examine the columns of figures that appear under each of the three channels. Within each of the used channels, the column of figures should all be the same within ±5µV. If they are not, then there may be a fault on the System. See section 9.3.1 "Fault on Single Channel Only" on page 9-11 for fault identification procedures.

It does not matter if the figures in one channel are different from those in another.

Ideally, the figures for channels 1–3 should all be below 1000µV for standard coil values and below 7500uV for early coil values. If any channel shows a background compensation figure significantly above this level, do the following:

1. Move the ROV to another area of clear ground and repeat the background compensation process. If the values fall to below 0µV this means that the original site had some hidden conductive debris near the coils.

2. See section 3.1.3.2 "Positioning the Search-coils" on page 3-6 and reposition the search-coils farther from the ROV body.

Upon successful completion of the background compensation procedure, include a written or printed copy of the compensation values with the survey log and return to the Run Display screen. Examine the coil voltage displayed for each channel and note that they should all show values close to zero. The display should also show a large red 'Target Out of Range' banner to indicate that there is no target within the detection range of the search-coils.

Move the ROV by two metres and confirm that the displayed signal strength values *do not go negative*. If they do, this indicates that you conducted the background compensation procedure in the presence of conductive debris on the seabed. In this event, move the ROV to another clear area and repeat the background compensation procedure.

Background Compensation Check

NOTE

The background compensation check is a different procedure from the full background compensation. You must perform the check at regular intervals (at least once every hour), and after every deployment of the manipulator arms. You may configure the SDC to show a message banner that reminds you to perform this operation at pre-set intervals.

At regular intervals, move the ROV approximately 10 metres away from the target. Confirm that the signals on each channel fall to within ±5µV of zero. You may resume the survey if the signals fall to an acceptable value. The Background Noise Profile facility allows for these signals to be monitored and logged fro post-survey analysis.

If the signal strength on any channel exceeds 5µV, perform another background compensation procedure as described in section "Background Compensation Procedure" on page 6-14 and then continue the survey.

6.3.4 Seawater Compensation

The 440 system is based on being able to separate the different signals arising from seawater and target. This allows the range to the target to be determined from two coils.

This is achieved by means of a signal processing routine, which differentiates the target signal from the unwanted seawater signal on the basis of its slower decay rate. This process requires the provision of two calibration parameters by the user. For convenience, they are pre-programmed into DeepView and are selected on the basis of the approximate water temperature.

The seawater algorithm can reject the signals arising from the seawater to levels of approximately 5µV. If the incorrect temperature band is selected, then this rejection worsens to perhaps 20µV. This error voltage is still small in relation to target voltages at all but the most extreme ranges, so the impact of selecting the incorrect band is not great. Further, the seawater error voltage increases as the ROV is lifted off the sea floor. Generally, when tracking a target which is deeply buried the vehicle will be close to the seabed, reducing the error voltage still further.

Select a band based on the approximate water temperature at the survey depth. Although surface water temperature varies widely, below 200m the temperature is usually 4°C.

A manual compensation routine is available (see section 6.2.2.4 "Seawater ‘Active’ Compensation" on page 6-24 and Appendix A "Operating Theory"). This may be used if there is reason to suspect that the pre-programmed parameters are not giving sufficient performance. This may occur in regions of atypical salinity (such as the Black Sea) or in the presence of fresh water outfalls or vents. Teledyne TSS recommends the use of the pre-programmed bands for the majority of surveys.

The parameters can also be affected slightly by the total water column depth. In situations where the water depth is shallow and changing, manual compensation may be required. Please contact Teledyne TSS for advice on this point.

6.3.5 Background Noise Profile

The Background Noise Profile allows the surveyor to measure spurious signals in the surveying vicinity and identify if they will have an effect on the quality of the survey data. It also allows for identification of areas that could be problematic during the survey.

This data can be logged to assist post-survey data processing and identification of any anomalies in the survey data gathered. It also allows for the logged data to be replayed to highlight any problems that occurred during a survey.

6.3.6 The Survey Operation

Normally, survey operations conducted using the 440 System will require only the Run Display screen and other selections from the Operation Menu.

The following paragraphs describe how you should use the facilities of the 440 System during a survey. They assume that you have completed the full target scaling and background compensation procedures successfully.

6.3.6.1 Interpreting the Run Display Screen

The Run Display screen is the most informative screen available from the 440 System and would normally be on permanent view during a survey operation.

It is important that you should possess a full understanding of the information presented on this screen so that you may interpret its displayed information correctly.

Signal Strength

The two information boxes in the bottom left and right-hand corners of the Run Display screen show the signal strength received from each of the search-coils. Digital information appears in the left-hand box, while vertical bar graphs show the same information in the right-hand panel.

Once you have completed the background compensation correctly, both panels should indicate a value of zero ±5µV when there is no target near the coils. This can be verified by using the Background Noise Profile facility allowing for a permanent log to be made of spurious signals in the area. This data can also be replayed to assist survey/ post survey analysis.

As the ROV moves towards the target, the signal strength measured by one of the outer search-coils will increase. Signals on the other coils will then increase in strength until all three search-coils return a signal.

As the signal strength from each channel increases and the signal differences exceed the threshold setting, the red bars will change to yellow and the 'Target Out of Range' warning will be switched off.

The logarithmic scale used for the vertical bar graphs reacts clearly to weak signals while simultaneously displaying strong signals. An experienced operator will be able to detect the presence of a target and guide the ROV towards it using this graphical display, even when there is no target visible on the main region of the Run Display screen.

Target Track

The main region of the Run Display screen shows the track of the target relative to the centre of the coil array. This clear and simple graphical display style helps you to manoeuvre the ROV over and along the target.

On the bottom region of the screen, a thick line represents the track of the target relative to the centre-line of the coil array. The top of this line moves from side to side and scrolls downward to create a 'waterfall' display showing the relative position of the target over the previous 200 updates.The colour of the target line changes according to the nature of the received signal:

Light grey Good signals supplied by the coils. The target is covered.

Dark grey Good signals supplied by the coils. The target is exposed.

If the System receives no altitude information, a good target signal will *always* appears as a light grey line.

Blue The quality control flag is set. The display will not show VRT, COV or LAT measurements in these circumstances. This could be for any of the following reasons:

- The System is receiving signals from one coil only.
- The lateral offset is greater than ±0.9m. See section 6.4.1.1 "External Logging Format" on page 6-23 for more information on quality control.

If you have connected an altimeter to the System, the SDC determines the state of target burial by performing the simple calculation:

COV = VRT – ALT

A positive value for COV indicates that the target is covered.

Signal saturation may occur if the target is too close to the coil array. Whenever this happens, an automatic gain facility immediately reduces the voltage gain of the System by a factor of 10.

If the target is very close to the search-coils, it is likely that saturation will continue even if the surveyor reduces the System voltage gain. Under these circumstances saturation will persist until the target moves farther from the search-coil array, and the target track shown on the Run Display screen will appear as a solid red line.

Left/Right Tracking occurs when the 440 system is able to calculate a valid lateral offset but unable to calculate a valid vertical offset. This condition will set the Quality Code to ‘99’ and the Quality Flag will be SET.

The top region of the Run Display screen represents a cross-sectional rear view of the coil array, the target and the seabed. The coil array appears at the top edge of the screen and a vertical broken white line extends down from its centre.

A hollow white circle represents the target. This circle moves to the left and right, and up and down as the position of the target moves relative to the coil array. Note that the *diameter* of this circle does not change with different target sizes.

Whenever the System cannot measure the vertical range to target, for example during signal saturation or when the target falls within the range of one coil only, the circle that represents the target will disappear from the screen.

The seabed appears on the Run Display screen as a horizontal white line. This line moves up and down in response to measurements made by the altimeter if you have one connected to the System.

If your System has no altimeter, the position of the seabed line will show the fixed coil height. You should configure the SDC with a fixed coil height if your System does not use an altimeter.

The seabed line will disappear from the screen whenever the altitude exceeds 5m.

Near the right-hand edge of the top region, there is a scale of vertical range. You may estimate the vertical range to the target and the coil altitude against this scale. Press [CTRL]+[H] or use the ‘Toggle Height Scale’ from the ‘View’ to toggle between the 5 metre and the 2 metre scale range.

There are other data fields presented on the screen. These provide a digital indication of:

- Altitude of the search-coils above the seabed (ALT).
- Vertical range to the target (VRT).
- Depth of target cover (COV).
- Lateral offset between the target and the centre-line of the coil array (LAT). A positive value indicates that the target is to starboard of the centre-line.
- Quality Code (QC).

There is also a scale of lateral offset distance displayed between the top and the bottom regions of the Run Display screen, with gradations at zero, ±1.0 and ±2.0 metres. You cannot change the range of this scale.

The Quality Code is also displayed in the right side of the Snail Trail Window displaying system status relative to coils in use/ signal stengths obtained.

All measurements of distance are in units of metres to two decimal places.

Oscilloscope Display

Although not part of the Run Display screen, you may select the oscilloscope from within this screen by selecting 'Scope and Spectrum Analyser Window' from the View option. Correct interpretation of the oscilloscope can assist in the understanding and operation of the System.

The oscilloscope display includes three 'panels'. These panels represent the signals on starboard, centre and port coils. The oscilloscope displays the coil signals as green traces. It updates the traces using average values taken over eight consecutive sample cycles. This process removes most noise, although any significant noise levels will remain visible. Provided the noise does not encroach on either of the sample regions, as shown in example (h) of the fold-out drawing, the measurement process should not be affected. You should investigate and remove any severe causes of noise pick-up.

For each of the oscilloscope panels, the left-hand edge corresponds to a time immediately after the end of the voltage drive pulse and pre-sample period (see Appendix A "Operating Theory" for a full description of the measurement cycle timing). The width of each panel represents a timebase period of either 1200µs or 600µs from the start of the trace, as indicated by scale gradations on the x-axis of each panel.

There are three critical regions on the oscilloscope display, with their boundaries marked by vertical broken white lines. Example (a) in the fold-out drawing shows these:

- The first, called the 'Early region', lies between 130µs and 230µs on the timebase scale. During this period, the System makes 25 measurements of the signal and calculates an average value for these.
- The second, called the 'Standard region', lies between 300µs and 400µs on the timebase scale. During this period, the System makes 25 measurements of the signal and calculates an average value for these.
- The second, called the 'Zero region', lies between 1000µs and 1100µs on the timebase scale. The System averages the 25 measurements that it makes during this period and uses the result as the zero reference against which the System compares the measurement made during the both the 'Standard region' and 'Early region' periods.

The two differences between these three averages is the derived signal strength is used to determine the target voltages for the channels on the Run Display screen.

The y-axis has gradations from zero to 100%, with the absolute signal voltage represented by 100% on this axis appearing at the bottom centre of the oscilloscope screen. Saturation occurs when the signal voltage exceeds 100% on this scale. Provided the saturation does not extend into the 'Sample region', the measurement will not be affected. The fold-out drawing shows examples of slight saturation (f) and full saturation (g).

6.3.7 Data Logging

To provide the post-processing engineers with a detailed account of the survey it is important to maintain a full log of events as they occur during a survey.

The survey log should therefore include:

- The data logged to an external logger
- The video recording of the 440 System installation and configuration procedures (if one has been made)
- The video recordings from cameras on board the ROV

- ❐ Details of any events, such as ROV collisions, that may have occurred during the survey, and the effect that they may have had upon the survey. You should also record any corrective action taken.
- ❐ Printed or hand-written sheets containing the System configuration details that were taken at the start and at the end of the survey
- ❐ Background Noise Profile logged data
- ❐ Any other information requested by the survey planning team

6.3.8 Replay Logged Data

NOTE

You cannot use the display software on the SDC to replay externally logged files.

To replay a previously logged data file you have to select Open/Close Replay file [F2] from the file option from within DeepView for Windows. This will provide you with the following dialog box to select the file you require. The location of these files by default is a Logs folder within the DeepView for Windows directory, but this can be changed by the user to another directory, or to a floppy disk in drive A of the SDC.

❐Externally logged data files include data packets of fixed length that supply all the information required for a full analysis of the survey. The file includes target co-ordinates, signal values and important quality control information generated by the 440 System during the survey. You should use this logging method to generate the primary survey recording.

Externally logged files will usually be stored on a separate data logger along with files generated by other items of survey equipment. See section 6.4.1.1 "External Logging Format" on page 6-23 for a description of the external logging format.

❐Internally logged files are of variable length and include all data transmitted to the SDC by the SEP (target co-ordinates, signal values and, possibly, information needed by the Scope and Spectrum Analyser window). The data packets also include comment lines that describe the SEP type and other System information, a time stamp and any text annotations supplied by the user.

NOTE

The internal logging format does NOT include the quality control information.

See section 6.4.1.2 "Internal Logging Format" on page 6-30 for a description of the internal logging format.

NOTE

The internal logging facility is for test purposes and for the convenience of operators only. You should not use it to record the main survey log.

External logging and internal logging use different data formats that are not compatible with each other. You cannot use the SDC to 'replay' an externally logged file.

DeepView for Windows allows you to configure an SDC serial port for communication with the external data logger. This option is covered in section 6.2.2.2 "External Data Logging" on page 6-20. Refer to the technical manual of your data logger for the correct communication parameters.

6.4 Data Quality

6.4.1 Profile

During post-processing you may use the data acquired by the 440 System to plot additional information onto the target profile. Similarly, you may use the additional quality control information contained in the data packets to modify the way that the profile of the target appears on the chart:

- The data packets include, by default, the co-ordinates of the target, the raw signals data, and a quality control check-code. An example profile appears in Figure 6-1.

Also in this example, the profile disappears completely whenever the target is out of range.

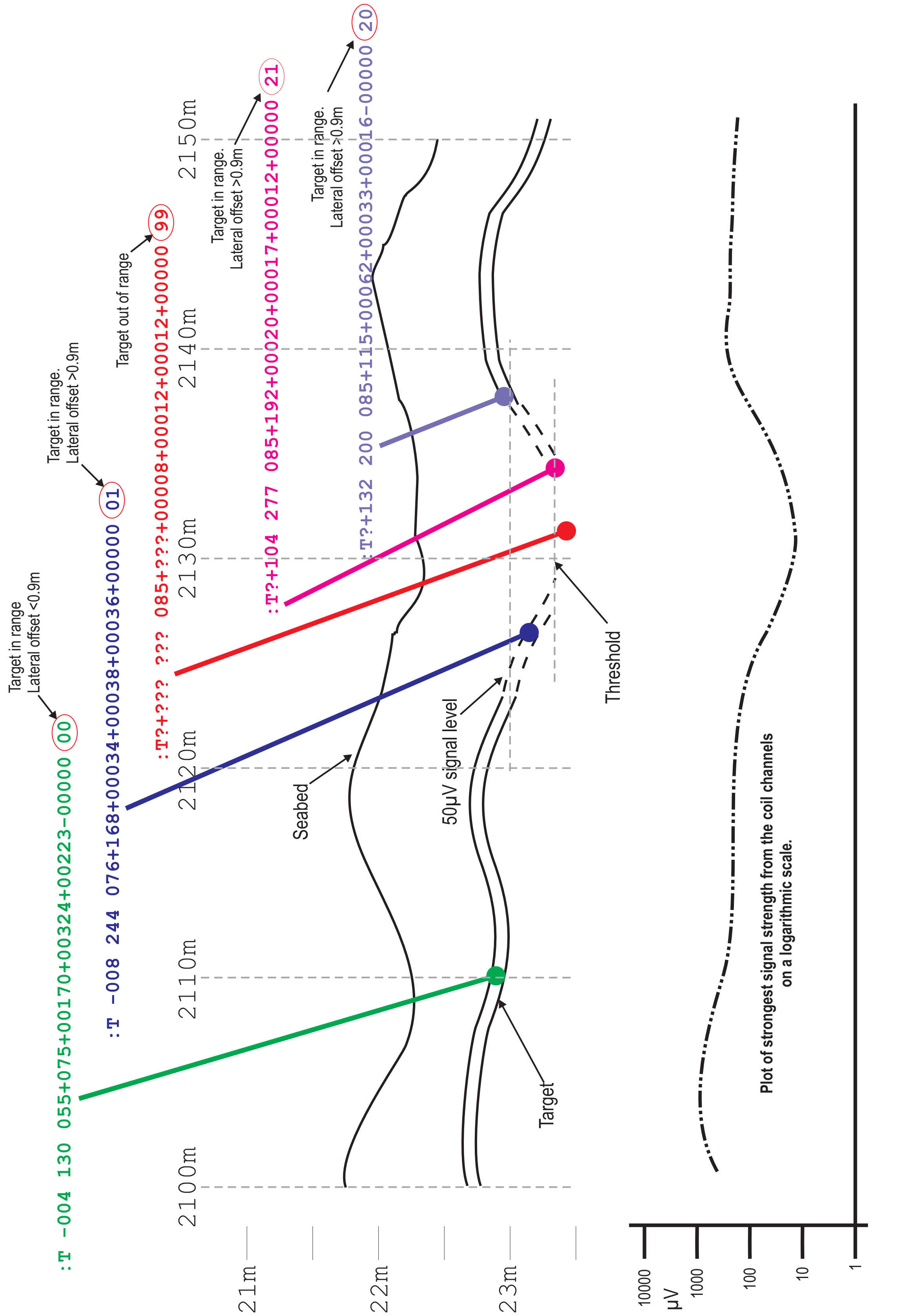


Figure 6-1: Example of a target profile modified using quality control information

6.4.1.1 External Logging Format

A) Co-ordinates and Signals Format

NOTE

The external output can be configured to output in centimetres or millimetres. When configuring external equipment, be aware that the resolution used has an effect on the formatting and length of the external output string.

The SDC logs all distances in units of centimetres or millimetres dependent upon output resolution and signal voltages in units of microvolts. The values in the packet are rounded and it is possible that they will not precisely match those on the Run Display screen.

Table 6-1: External Co-ordinates and signals format - cm resolution

: T Q+/-000 000 000+/-000+/-00000+/-00000+/-00000+/-00000 QQ[CR][LF]

- Start Character (ASCII 3AH)
- Packet Identifier (see Note 1)
- Quality Control Flag (see Note 2)
- Lateral Offset (see Note 3)
- Space Character
- Vertical Range to Target (VRT) (see Note 4)
- Space Character
- Altitude (see Note 5)
- Depth of Coverage (see Note 6)
- Coil Signal Strengths (see Note 7)
- Space Character
- Quality Control Check Code (see Note 8)
- CR/LF Termination

Notes:

1. 'T' (ASCII 54h) identifies a signals and co-ordinates data packet. 'I' (ASCII 49h) identifies co-ordinates only packet.

2. The Quality Control (QC) flag will be a space character (ASCII 20h) when RESET or a question mark (ASCII 3Fh) if the target is out of range or in saturation or > 90cm lateral offset. See also the QC check code later in this packet.

3. The lateral offset (LAT) is measured from the centre of the coil array in centimetres. Positive values indicate a target to starboard of the centre line. The field will contain '???' if the target is out of range or saturation or >90 cm LAT.

4. The vertical range to target (VRT) is the distance between the bottom face of the coil array and the top of the conductive part of the target in centimetres. If you have entered a weight coating thickness using the 'Target Scaling' feature of the software, VRT measurements will be to the top of the weight coating. There are several conditions that will cause the field to contain '???':

- The target is out of range

- The 440 System cannot compute an accurate position for the target
- Coil saturation has occurred

NOTE

Although the VRT measurements displayed and logged will be valid to the top of the weight coating, the 440 System always measures to the top of the conductive part of the target. The SDC compensates for the thickness of any weight coating and outputs the corrected value. See Figure 6-3 and Figure 6-4.

5. When used, coil altitude (ALT) information comes from an altimeter and is output in centimetres. Otherwise, the information in this field will be the fixed coil height if available. The field will contain '???' if there is no fixed height or altimeter information available.

6. The SDC calculates the target depth of cover (COV) using COV = VRT – ALT in centimetres. A positive value indicates the target is covered. Zero or negative values indicate an exposed target. There are several conditions that will cause the field to contain '???':

- The target is out of range
- The 440 System cannot compute an accurate position for the target
- Coil saturation has occurred
- There is no fixed coil height or information available to the SDC from an altimeter

7. The signal strengths, in microvolts (µV) measured on Starboard coil, Centre coil, Port coil.

8. The QC check code provides additional status information that explains any occurrence of the QC flag being set. The code consists of a two-digit number with the meaning defined in Table 6-3. Where possible, the third coil is used to assist the lateral offset calculation. This makes the LAT more stable and can make the VRT more accurate. For this reason, the most accurate survey information is available when all three coils are in range. This is indicated by codes 00 and 20.

Table 6-2: External Co-ordinates and signals format - mm resolution

```
: T mm Q +/-0000 0000 0000+/-0000+/-00000+/-00000+/-00000+/-00000 QQ[CR][LF]
```

- Start Character (ASCII 3AH)
- Packet Identifier (see Note 1)
- Output Resolution (see Note 2)
- Quality Control Flag (see Note 3)
- Lateral Offset (see Note 4)
- Space Character
- Vertical Range to Target (VRT) (see Note 5)
- Space Character
- Altitude (see Note 6)
- Depth of Coverage (see Note 7)
- Coil Signal Strengths (see Note 8)
- Space Character
- Quality Control Check Code (see Note 9)
- CR/LF Termination

Notes:

1. 'T' (ASCII 54h) identifies a signals and co-ordinates data packet. 'I' (ASCII 49h) identifies co-ordinates only packet.

2. When using mm resolution, this field will always show 'mm'.

3. The Quality Control (QC) flag will be a space character (ASCII 20h) when RESET or a question mark (ASCII 3Fh) if the target is out of range or in saturation or > 90cm lateral offset. See also the QC check code later in this packet.

4. The lateral offset (LAT) is measured from the centre of the coil array in millimetres. Positive values indicate a target to starboard of the centre line. The field will contain '????' if the target is out of range or saturation or >90 cm LAT.

5. The vertical range to target (VRT) is the distance between the bottom face of the coil array and the top of the conductive part of the target in millimetres. If you have entered a weight coating thickness using the 'Target Scaling' feature of the software, VRT measurements will be to the top of the weight coating. There are several conditions that will cause the field to contain '????':

- The target is out of range
- The 440 System cannot compute an accurate position for the target
- Coil saturation has occurred

NOTE

Although the VRT measurements displayed and logged will be valid to the top of the weight coating, the 440 System always measures to the top of the conductive part of the target. The SDC compensates for the thickness of any weight coating and outputs the corrected value. See Figures 6-3 and 6-4.

6. When used, coil altitude (ALT) information comes from an altimeter and is output in millimetres. Otherwise, the information in this field will be the fixed coil height if available. The field will contain '????' if there is no fixed height or altimeter information available.

7. The SDC calculates the target depth of cover (COV) using COV = VRT – ALT in millimetres. A positive value indicates the target is covered. Zero or negative values indicate an exposed target. There are several conditions that will cause the field to contain '????':

- The target is out of range
- The 440 System cannot compute an accurate position for the target
- Coil saturation has occurred
- There is no fixed coil height or information available to the SDC from an altimeter

8. The signal strengths, in microvolts (µV) measured on Starboard coil, Centre coil, Port coil)

9. This fixed data of '+00000' represents the redundant channel.

10. The QC check code provides additional status information that explains any occurrence of the QC flag being set. The code consists of a two-digit number with the meaning defined in Table 6-3. Where possible, the third coil is used to assist the lateral offset calculation. This makes the LAT more stable and can make the VRT more accurate. For this reason, the most accurate survey information is available when all three coils are in range. This is indicated by codes 00 and 20.

Table 6-3: QC check code meaning - External logging format

QC Check Code	Meaning
00	Lateral offset of target is <±0.9m using port, centre and starboard coils for calculation.
01	Lateral offset of target is <±0.9m using port and starboard coils for calculation.
02	Lateral offset of target is <±0.9m using port and centre coils for calculation.
03	Lateral offset of target is <±0.9m using starboard and centre coils for calculation.
20	Lateral offset of target is >±0.9m using port, centre and starboard coils for calculation. Quality flag is SET.
21	Lateral offset of target is >±0.9m using port and starboard coils for calculation. Quality flag is SET.
22	Lateral offset of target is >±0.9m using centre and port coils for calculation. Quality flag is SET.
23	Lateral offset of target is >±0.9m using centre and starboard coils for calculation. Quality flag is SET.
30	Saturation of 1 or more coils. Quality flag is SET.
99	Target out of range or Left/Right Tracking. Quality flag is SET.

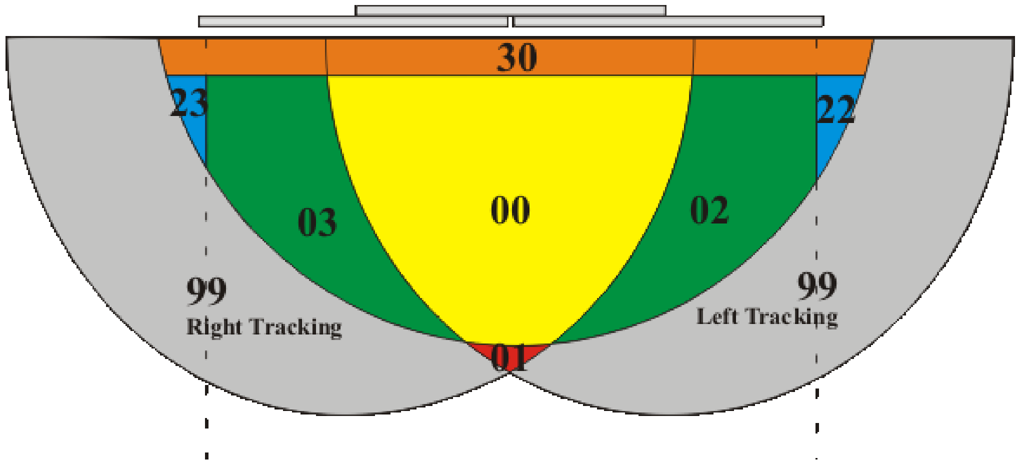


Figure 6-2: Quality Code Areas

NOTE

When Left/Right Tracking, the Quality Code will be set to '99'.

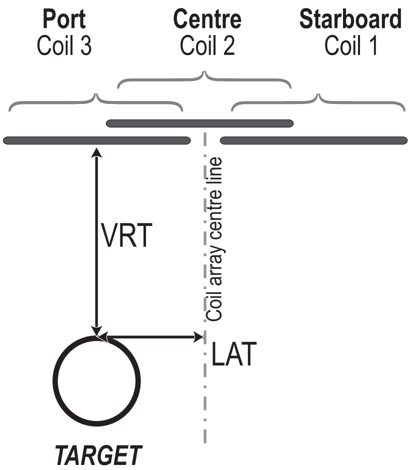


Figure 6-3: Vertical range and offset distances

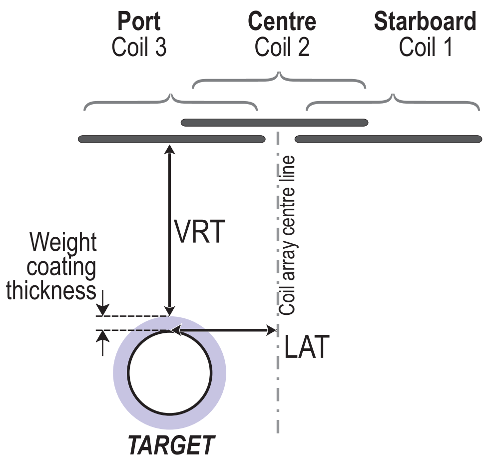
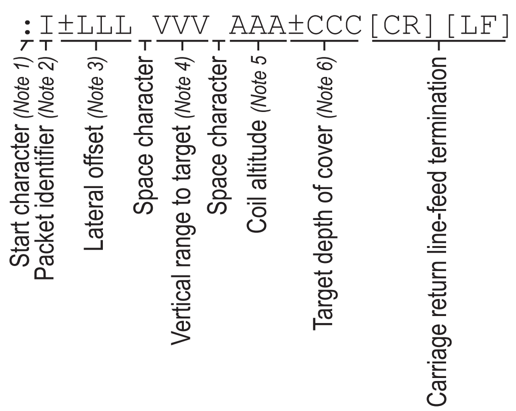


Figure 6-4: Vertical range with weight coating thickness

B) Co-ordinates Format

The string length is dependent upon the output resolution selected via the external output configuration dialog box. If centimetre resolution is selected, the string will be 20 characters in length. To accommodate for the additional resolution, when using millimetre resolution the string will be 24 characters in length. The values in the packet are rounded and it is possible that they will not precisely match those on the Run Display screen. The individual field definitions are as follows.

Table 6-4: External Co-ordinates format



NOTES

- The Start character is a colon – ASCII 3Ah.
- 'I' (ASCII 49h) identifies a co-ordinates data packet.
- The lateral offset (LAT) is measured from the centre of the coil array. Positive values indicate a target to starboard of the centre line. The field will contain question marks if the target is out of range. If millimetre resolution is used the field length will be increased by one character to accommodate the additional resolution.
- The vertical range to target (VRT) is the distance between the bottom face of the coil array and the top of the conductive part of the target. If you have entered a weight coating thickness using the 'Target Scaling' feature of the software, VRT measurements will be to the top of the weight coating. If millimetre resolution is used the field length will be increased by one character to

accommodate the additional resolution. There are several conditions that will cause the field to contain question marks:

- The target is out of range
- The 440 System cannot compute an accurate position for the target
- Coil saturation has occurred

NOTE

Although the VRT measurements displayed and logged will be valid to the top of the weight coating, the 440 System always measures to the top of the conductive part of the target. The SDC compensates for the thickness of any weight coating and outputs the corrected value. See Figure 6-3 and Figure 6-4.

11. Coil altitude (ALT) information comes from an altimeter if the System includes one. Otherwise, the information in this field will be the fixed coil height if available. The field will contain question marks if there is no fixed height or altimeter information available. If millimetre resolution is used the field length will be increased by one character to accommodate the additional resolution.

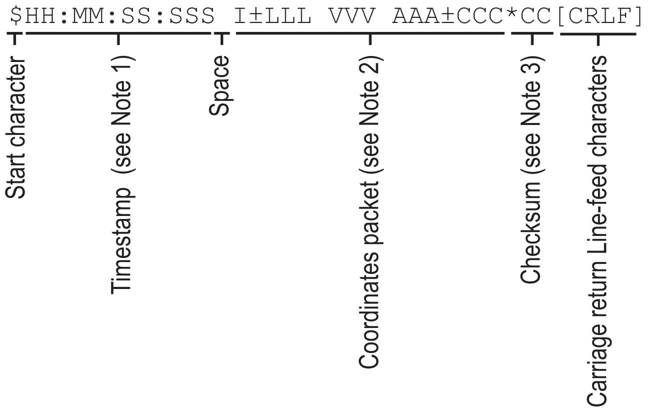
12. The SDC calculates the target depth of cover (COV) using COV = VRT – ALT. A positive value indicates the target is covered. Zero or negative values indicate an exposed target. If millimetre resolution is used the field length will be increased by one character to accommodate the additional resolution. There are several conditions that will cause the field to contain question marks:

- The target is out of range
- The 440 System cannot compute an accurate position for the target
- Coil saturation has occurred
- There is no fixed coil height or information available to the SDC from an altimeter

C) Timestamped Coordinates Format

The timestamped coordinates data contains the standard coordinates data format as outlined in Table 6-4. In addition, the packet contains a timestamp to identify when new data has been received and a checksum to verify the packet integrity. The data format is described in Table 6-5

Table 6-5: Timestamped Coordinates format



NOTE

- The timestamp is always formatted as HH:MM:SS:SSS. Additional, zeros will be used to ensure field length remains fixed.
- See section 6.4.1.1 "External Logging Format" on page 6-23 for the coordinates packet description.
- Checksum is calculated by XORing all characters before the asterisk, excluding the '$' start character. The resultant hexadecimal value is ASCII-encoded and appended to the packet before the CR/LF packet termination characters.

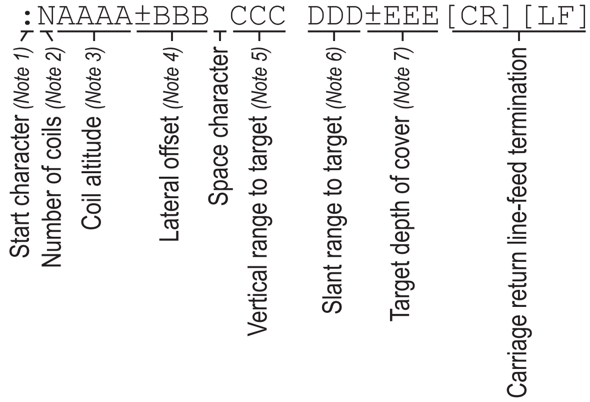
6.4.1.2 Internal Logging Format

The format used for internal logging is identical to that used by the SEP to transmit data packets. These data packets fall into two categories – 'Co-ordinates' and 'Signals'. The SEP transmits them alternately.

A) 'Co-ordinates' Data Packet

The string is 24 characters long with individual fields definitions as follows. The SDC logs all distances in units of centimetres. The values in the packet are rounded and it is possible that they will not precisely match those on the Run Display screen.

Table 6-6: Internal Co-ordinates format



NOTES

- The Start character is a colon – ASCII 3Ah.
- The number of coils fitted to the 440 System is always 3.
- Coil altitude (ALT) information comes from an altimeter if the System includes one. Otherwise this field will contain three space characters and a zero.
- The lateral offset (LAT) is measured from the centre of the coil array. Positive values indicate a target to starboard of the centre line. The field will contain question marks if the target is out of range.
- The vertical range to target (VRT) is the distance between the bottom face of the coil array and the top of the conductive part of the target. The field will contain question marks if the target is out of range.
- The slant range is the straight-line distance between the centre of the coil array to the top of the conductive part of the target:

$$ddd = \sqrt{((bbb^2) + (ccc^2))}$$

- The target depth of cover COV = VRT – ALT. A positive value indicates the target is covered. Zero or negative values indicate an exposed target. The field will contain question marks if the target is out of range.

B) Signals Data Packet

The individual fields definitions for the Signals Data Packet are as follows. The SDC logs all signals in units of microvolts. The values in the packet are rounded and it is possible that they will not precisely match those on the Run Display screen.

Table 6-7: Internal signals format

```
:S0000,1111,2222,3333,1111,2222,3333[CR][LF]
```

- :S — Event identification (Note 2)
- 0000 — Altimeter height above seabed (Note 3)
- 1111 — Signal strength of Starboard coil (early) (Note 4)
- 2222 — Signal strengh of centre coil (early) (Note 4)
- 3333 — Signal strengh of port coil (early) (Note 4)
- 1111 — Signal strengh of Starboard coil (standard) (Note 4)
- 2222 — Signal strengh of Centre coil (standard) (Note 4)
- 3333 — Signal strengh of Port coil (standard) (Note4)
- [CR] [LF] — Carriage return line-feed termination

NOTES

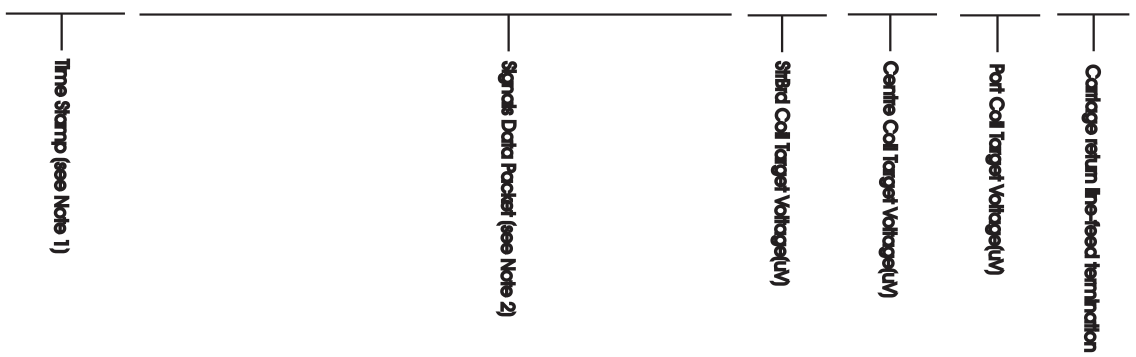
- The Start character is a colon – ASCII 3Ah.
- The identifier character can be either upper or lower case. The two have exactly the same meaning except that a lower case character indicates that the coil drive is switched off. The letters are “H”: overheating, “O”: coil saturation/overrange, “U”: under threshold and “S”: normal operation.
- Altimeter height in cm above the seabed. Note that ‘0’ indicates that altimeter is not connected. When altimeter is running, reading is padded with zeros to fill the 4 spaces.
- The signal strengths, in micro volts (µV) measured +99999 to -9999. Always padded with zeros to fill at least four spaces. The sequence of values is Starboard coil (early), Centre coil (early), Port coil (early) Starboard coil (standard), Centre coil (standard), Port coil (standard).

6.4.1.3 Background Noise Profile Logging Format

The format of the Background Noise Profile log is specific to this facility. It can only be replayed via the Background Noise Profile dialog box. Table 7.6 shows the logging format.

Table 6-8: Background Noise Logging format

HH:MM:SS ,:,a,111,22222,33333,44444,55555,66666,77777,111111,222222,333333,[CR][LF]



NOTES

- Timestamp formatted as HH:MM:SS obtained from the controlling PC system clock.
- The Signals Data packet is in the standard internal signals format (see Table 7-5) except for the start character (ASCII 3Ah) and Event Identification character are comma separated from the following fields.

6.5 Target Scaling

NOTE

The preferred method for determining a target scaling factor is to use the Auto Scaling feature of the 440 System described in section 6.3.1.1 "Target Scaling" on page 6-10.

You should perform the following procedure whenever dry-land testing is necessary on a specific target. This might be, for example, when the target does not fall easily into one of the four standard categories.

For most applications, it will be sufficient to determine the target scaling factor only. However, if you must define the complete performance envelope of the System for a specific target, you may need to extend the procedure to include a full assessment of the vertical range accuracy, based upon a large number of measurements. Chapter 8 "System Specifications" includes some typical charts of this type.

6.5.1 Target Scaling Procedure

System configuration

Establish the 440 System on dry land so that, while keeping the coil array level, you may move it easily to various heights above the sample target. A suitable arrangement could include two adjustable vertical props holding a wooden support frame on which you mount the coils.

The sample of target must be no shorter than 5 metres.

Power-on the 440 System and allow a period of 15 to 20 minutes for the System to stabilise. Then, with the target removed from the immediate test area, perform a background compensation with the coils supported 1 metre above ground level.

Position the coil array so that, when you move it through a range of heights, the background level does not change by more than 5µV – use the Run Display screen to observe the signals from the three channels.

Estimate the Target Scaling factor

Use the Auto-scaling feature and choose a target type, diameter, and weight-coating that matches the specific target as closely as possible. Record the values on Form D1 in section D.1 "Target Scaling Procedure" on page D-3.

Make a note of the value suggested by the 440 System for the target scaling factor and use this as the *first* estimate in the scaling process.

Determining the nominal Target Scaling factor

Position the target under the centre of the search-coils, and ensure that the target and the coil array are mutually at right angles.

Using the first estimate of the target scaling factor, record the true vertical range to target against that shown on the Run Display screen of the 440 System for a number of different vertical ranges. Also, record the signal strengths measured by each of the search-coils.

Use Form D2 in section D.2 "Target Scaling Results" on page D-5 to record the test results.

If the vertical ranges shown by the 440 System are greater than the actual vertical range, reduce the value for target scaling factor, and vice versa. Repeat the tests using the new value for target scaling factor – enter the new value using the option ‘Key in known Target Scaling Factor’ in the target scaling menu.

Continue repeating the measurements and adjusting the value for target scaling factor until you obtain a satisfactory set of results.

At each stage, complete the Target Scaling Results form (Form D2).

Defining the performance envelope of the System

If you require a full assessment of the vertical and lateral range performance, follow the procedure detailed below using the nominal value for target scaling factor determined previously. Note that you must check the background compensation before you continue.

With the target placed under the centre of the coil array, establish the System with a vertical range measured to be 0.2m above the target. Record the results on the 440 Accuracy Results form (Form D3 in Appendix D "Reference").

Move the target to a lateral offset of 0.2m and record the vertical range. Note that you may make measurements on the target to either port or to starboard of the centre-line since experiments have confirmed that the performance of the 440 System is symmetrical.

Repeat the measurement, increasing the lateral offset in 0.2m increments until a ‘Target Out of Range’ warning occurs. Record each measurement.

Return the target to the centre of the coil array and increase the vertical range by 0.2m. If practicable, perform a background compensation.

Repeat the measurements of vertical range moving the target laterally every 0.2m. Record each measurement.

Increase the vertical height by 0.2m and, if practicable, perform a background compensation.

Repeat the above procedure until ‘Target Out of Range’ occurs with the target placed centrally under the coil array.

The effects of roll, pitch, and skew

Generally, where roll, pitch and skew are less than 15°, the measurements of vertical range delivered by the 440 System will not degrade by more than ±50mm.

Under some conditions, it may be possible to perform a survey only with some angle of skew between the target and the ROV. If this is a possibility, repeat the target scaling process described above with an equivalent skew applied to the coil-array. You may then measure any deviation in accuracy and make appropriate allowance at a later stage.

You may calculate the effects of roll on measurement accuracy:

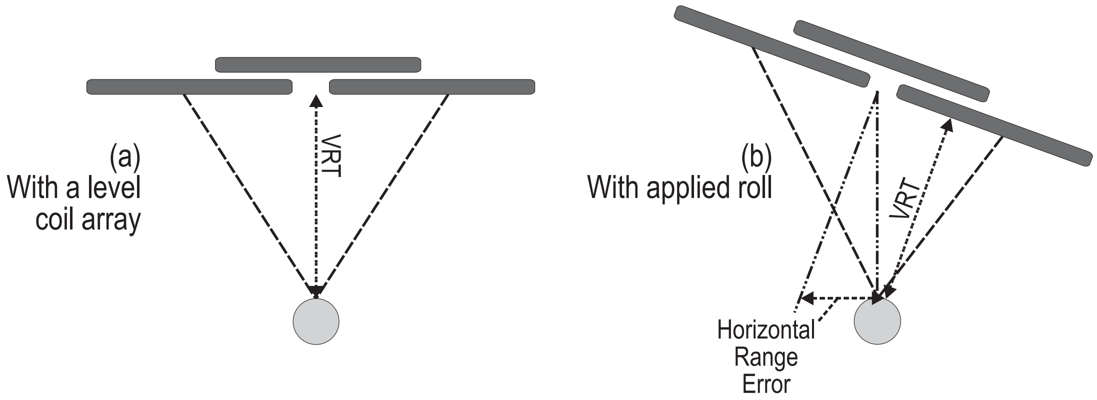


Figure 6-5: The effects of roll on measurement accuracy

For a target located centrally under the coil array as shown, the displayed value for lateral offset will contain an error as follows:

$$\text{Error} = Z\sin(\text{Roll angle})$$

Where Z = the vertical distance between the centre of the coil array and the top of the target.

For example, measurements on a target located 1.0m below the centre of the coil array will include a lateral offset error of 0.17m with 10° of roll applied to the ROV.

Vertical measurements made by the 440 System are relatively unaffected by small angles of roll. Under the conditions described in the above example, the vertical measurement will contain an error of only 15mm.

6.6 Altimeter Data Format

You may use certain types of altimeter manufactured by Datasonics, Ulvertech, Simrad and OSEL with the 440 System.

See section 4.1.6.2 "Connection to the SDC" on page 4-7 for instructions to connect one of these alternative types of altimeter to the SDC. You may connect the Datasonics unit either to the SDC ‘COM2’ port or directly to the SEP ‘Altimeter’ port.

You must configure the display software to use your altimeter type. See section 6.2.2.1 "Altimeter" on page 6-19 for instructions to do this.

The descriptions below include the individual data formats and the RS232 parameters for each type of altimeter that you may use with the 440 System. Except for the OSEL altimeter, transmission starts immediately after power-on.

Note that DeepView removes all spaces present in the altimeter string before interpretation. This is because the UK90 format sometimes includes extra spaces which are not defined in its specification. This removal of spaces applies to all types of altimeters which are connected directly to the SDC.

6.6.1 Benthos PSA 916

The PSA 916 transmits data at 9600 baud using 8 data bits, 1 stop bit and no parity by default. For alternative configurations see its separate user manual.

Table 6-9: Altimeter output format – Benthos PSA 916

Ryy.yy	[CR][LF]
Altitude (metres) above the seabed	Carriage return line-feed termination

6.6.2 Datasonics PSA 900 and PSA 9000

The transmission formats for the Teledyne TSS altimeter, and the Datasonics PSA 900 and PSA 9000 are identical. They transmit data at 2400 baud using 7 data bits, 1 start bit, 1 mark bit and 1 stop bit.

Table 6-10: Altimeter output format – Teledyne TSS and Datasonics

Txx.x	(space)	Ryy.yy	[CR][LF]
Altimeter temperature °C	Space character	Altitude (metres) above the seabed	Carriage return line-feed termination

If the Datasonics PSA 900 includes the optional pressure transducer, the data string becomes:

Table 6-11: Altimeter output format – Datasonics with pressure transducer

Dnn.n	(space)	Txx.x	(space)	Ryy.yy	[CR][LF]
Altimeter depth (metres)	Space character	Altimeter temperature °C	Space character	Altitude (metres) above the seabed	Carriage return line-feed termination

6.6.3 Ulvertech Bathymetric System

The Ulvertech Bathymetric system transmits data at 9600 baud using 8 data bits, 1 stop bit and no parity.

Table 6-12: Altimeter output format – Ulvertech Bathymetric system

```
xxxxx,yyyy[CR][LF]
```

xxxxx	Water column depth of altimeter (centimetres)
,	Comma character
yyyy	Altitude (centimetres) above the seabed
[CR][LF]	Carriage return line-feed termination

6.6.4 Simrad UK90

The Simrad UK90 transmits data at 4800 baud using 8 data bits, 2 stop bits and no parity.

Table 6-13: Altimeter output format – Simrad UK90

```
Daaa.aa Abb.bb Abb.bb Tcc Pdddd Veeee Wffff Hgg[CR][LF]
```

Daaa.aa	Water column depth of altimeter (metres)
(space)	Space character
Abb.bb Abb.bb	Altitude (metres) above the seabed *(Note 1)*
(space)	Space character
Tcc	Sea water temperature °C
(space)	Space character
Pdddd	Surface air pressure *(Note 2)*
(space)	Space character *(Note 2)*
Veeee	Sound velocity in sea water *(Note 2)*
(space)	Space character *(Note 2)*
Wffff	Relative density of the sea water *(Note 2)*
(space)	Space character *(Note 2)*
Hgg	Surface installation height above sea level *(Note 2)*
[CR][LF]	Carriage return line-feed termination

Notes:

1. The Simrad UK90 altimeter measures altitude at twice the rate that it measures depth. It therefore includes the altitude field twice in each data packet, separated by a space character. Both altitude fields will contain similar values because it is unlikely the altitude will change significantly during the short interval between the two measurements.

2. The contents of these output data fields are set externally and have no effect on operation of the 440 System.

6.6.5 OSEL Bathymetric System

The OSEL Bathymetric system transmits data at 9600 baud using 8 data bits, 1 stop bit and no parity.

Table 6-14: Altimeter output format – OSEL bathymetric system

```
xxxxxx,yyy[CR][LF]
```

- xxxxxx — Water column depth of altimeter (centimetres)
- , — Comma character
- yyy — Altitude (centimetres) above the seabed
- [CR][LF] — Carriage return line-feed termination

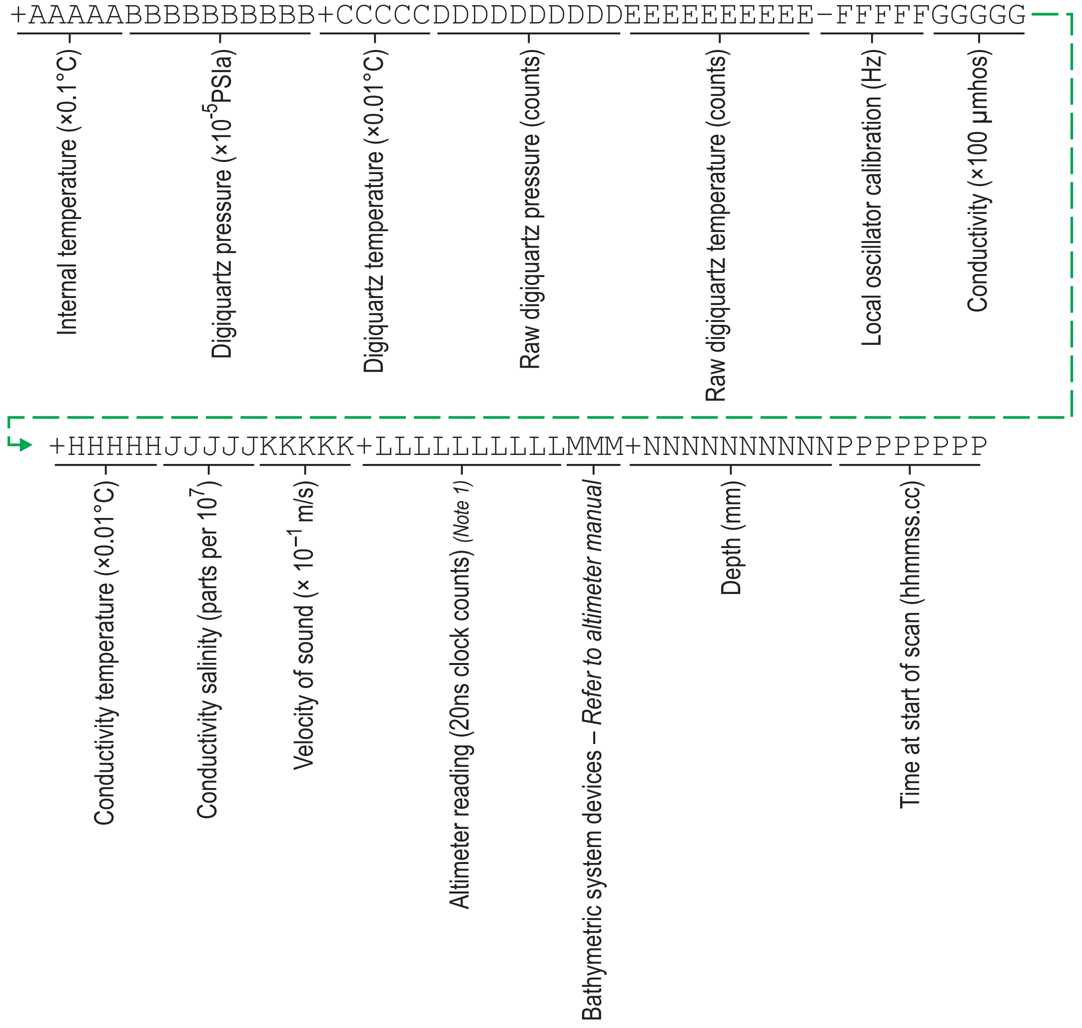
NOTE

The OSEL altimeter must receive the interrogating character upper case 'D' from the SDC before it transmits each data string. The communication link between the OSEL altimeter and the SDC must therefore be bi-directional. The SDC transmits the interrogating character automatically when configured to use the OSEL altimeter.

6.6.6 Tritech SeaKing Bathy 704

The SeaKing Bathy system transmits data continuously using RS232 communications at 9600 baud.

Table 6-15: Tritech SeaKing Bathy format



Notes:

1. The SDC performs the following calculation to calculate the altitude above the seabed:

Altitude = ((Altimeter reading × 200ns) × velocity of sound) ÷ 2

For example, if the count were 162712, then:

Altitude = ((162712 × 200ns) × 1475) ÷ 2 = **24.000 metres**

This is the true distance from the transducer face of the altimeter to the seabed.

7 Operational Considerations

There are some operating circumstances when the performance and accuracy of the 440 System may degrade. This section of the Manual describes some of the major causes of performance degradation so that you may avoid them or compensate for their effects.

7.1 Operating Performance

Together with the skilful operation of the 440 System, two major factors influence the response and the performance of the System during survey operations:

1. Target size and conductivity

The System detects any conductive target close to the coil array. Targets that have a larger conductive mass will return a stronger signal than smaller targets. It follows therefore that the System can detect large targets at a considerably greater range than small ones.

2. Coil arrangement on the ROV

The performance of the 440 System depends heavily on the mounting arrangements of the coil array. The standard System is optimised for use with three search-coils having dimensions 1.0m × 0.94m × 0.03m. Considerable field experience confirms the ability of this coil arrangement to provide the best combination of accuracy, detection range and ease of deployment.

See section 6.4.1.1 "External Logging Format" on page 6-23 for a full description of the external logging format to a data logger. The SDC includes a indication of the quality of the measurement.

NOTE

The Quality Control feature eases quality control review during subsequent post-processing and data analysis.

The minimum operating range of the System depends on the tendency for the search-coils to saturate when they are too close to a conductive mass. Since the strength of signals relates to the size of the target, saturation occurs more readily for large targets and their minimum detection range is therefore greater than for small targets.

Summary:

The logged data packets include a Quality Control flag to identify data that might show degraded accuracy.

You may use all the information and facilities available from the 440 System to identify any drop in System performance so that you may take effective and appropriate corrective action.

7.2 Sources of Error

There are other error sources that might degrade System performance. You should make yourself aware of these so that you may take action to avoid them or to reduce their effect on survey results.

These error sources fall within two categories:

- ROV handling

- Electrical interference

7.2.1 ROV Handling

The following paragraphs describe the potential sources of error that might arise as a result of unskilled or inappropriate operation of the ROV.

7.2.1.1 ROV Position over the Target

Figure 7-1 illustrates how errors in the measurement of depth of cover might occur when you survey a target that is partially buried beneath an uneven seabed.

NOTE

Note that errors such as these arise from inaccuracies in measurements made by the altimeter and not to any errors in measuring the vertical range to target.

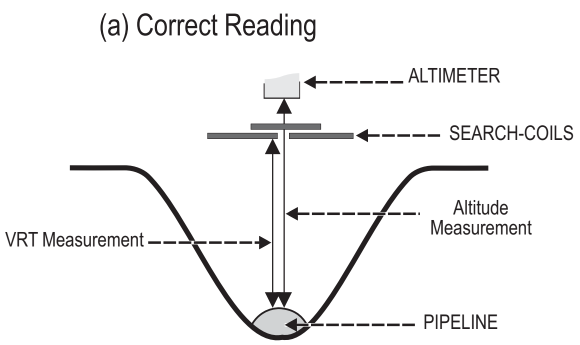


Figure 7-1: Altimeter errors during trench surveys

Flying with no lateral offset
Figure 7-1(a) shows the best condition achievable when you use a single altimeter: The ROV is level and is flying with the altimeter directly over the target.

Under these conditions the depth of cover measurements are accurate.

Flying with Lateral Offset
In Figure 7-1(b), the lateral offset of the ROV has placed the altimeter to one side of the target so that it measures its altitude above one of the trench walls. Consequently, the altimeter delivers information that will not allow accurate assessment of the depth of target cover.

It is therefore important to ensure that:

- You install the altimeter correctly according to the instructions in section 3.1.4 "Altimeter" on page 3-13.
- You locate the altimeter near the centre of the coil array.
- You operate the ROV so that, as far as possible, the target remains positioned centrally beneath the coil array.

It is important also to recognise that, under the above conditions, these errors affect only the *depth of cover* measurements.

Summary:

1. Install the altimeter correctly near the centre of the coil array.
2. Pay careful attention to the relative position of the ROV over the target.
3. Be aware of any errors that may arise from the local seabed topography.
4. For surveys where the depth-of-cover information is critical, consider using a scanning profiler to survey the seabed on either side of the target. You may then merge information from the profiler with measurements from the 440 System during the survey analysis operation.

7.2.1.2 Trim

In severe cases of roll such as shown in Figure 7-2, errors might appear in the vertical range and lateral offset measurements on the target.

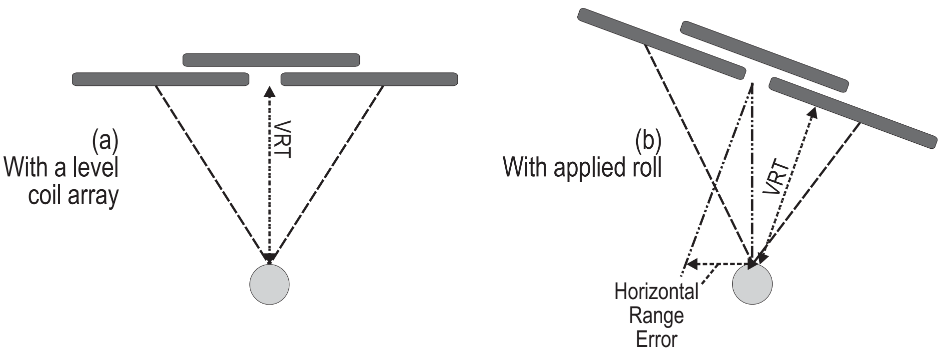


Figure 7-2: ROV roll errors

Figure 7-2(a) shows the ideal condition where the ROV is level over the target. In these conditions, the measurements for VRT and LAT will be accurate and valid.

Figure 7-2(b) shows the same situation, but with 15° roll applied to the ROV. If left uncorrected, under these conditions, errors will exist in the measurements of both the vertical range and the lateral offset.

For a target located centrally beneath the coil array as shown, the displayed value for lateral offset will contain an error as follows:

$$\text{Error} = Z\sin(\text{Roll angle})$$

Where Z is the vertical distance between the coils and the target.

For example, measurements on a target located 1.0 metre below the centre of the coil array will include a lateral offset error of 0.17 metres with 10° of roll applied to the ROV.

Measurements of VRT performed by the 440 System will remain relatively unaffected by small angles of roll. Under the conditions described in the above example, the vertical measurement will contain an error of only 15mm caused by the ROV attitude.

Summary:

1. Inaccuracies in vertical range measurements made by the System increase by no more than 3.5% for roll angles up to ±15°.
2. Where possible operate the ROV with an even trim throughout a survey

7.2.1.3 Skew

Figure 7-3(a) shows the ideal aspect between the coil array and the target.

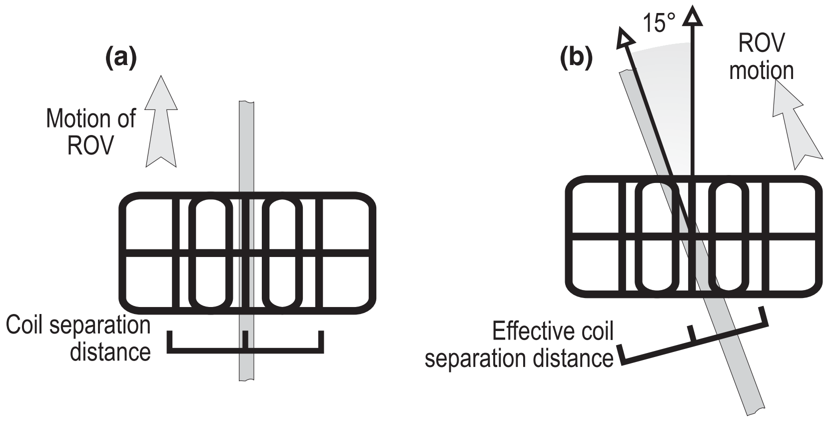


Figure 7-3: ROV skew errors

The accuracy of vertical range and lateral offset measurements may degrade if large angles of skew exist between the coil array and the target. This is because the effective coil separation distance decreases as the angle opens as shown in Figure 7-3(b).

If there is a slight crosscurrent in the survey area, it may be possible to perform the survey only with a small angle of skew present.

Under these circumstances, the System will continue to supply valid data with skew angles up to ±15°. If you know that this condition will prevail in the survey area, assess the degree of error by conducting dry-land test measurements on a sample of the target with applied skew. See section 6.5 "Target Scaling" on page 6-33 for instructions.

Summary:

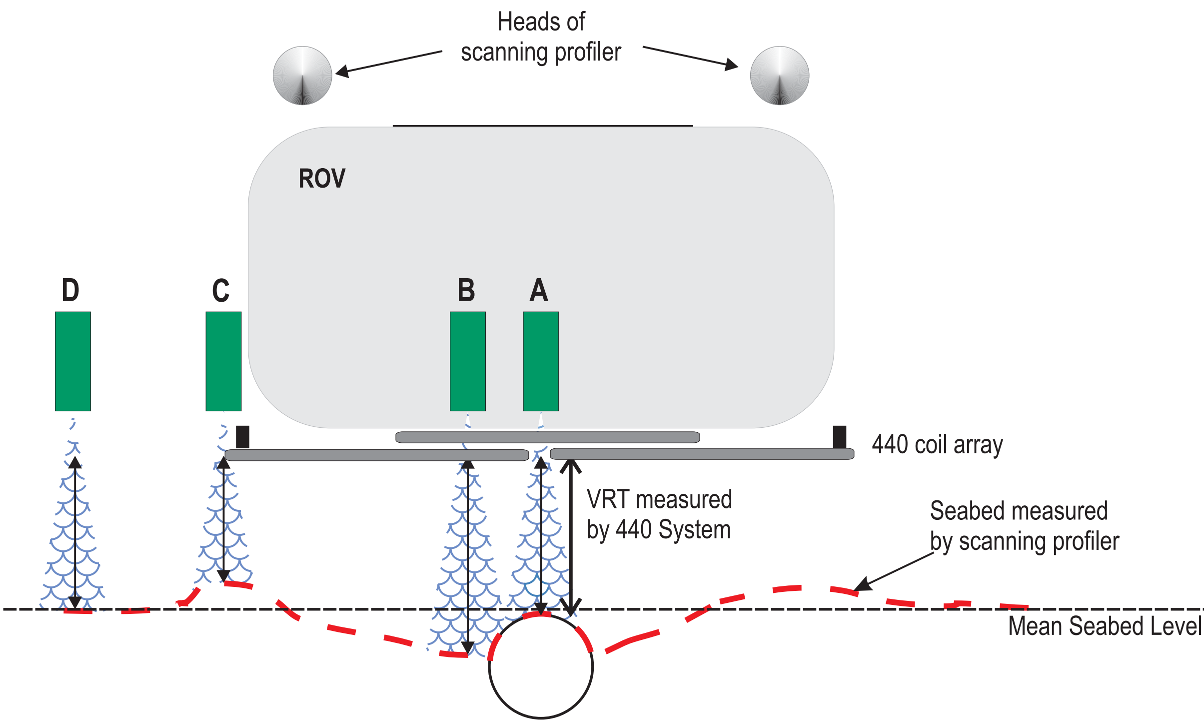
1. Avoid operating the ROV with angles of skew greater than ±15°.

2. Sometimes you may conduct a survey only with an angle of skew present (for example, because of crosscurrents in the survey area). If this is the case, perform a series of dry-land tests to determine the effect that the predicted angle of skew will have on measurement accuracy.

7.2.1.4 Altimeter Positioning

A simple altimeter measures the ROV altitude above a single point on the seabed. Unless the local seabed topography is essentially flat, this measurement may not be precisely the same as the true altitude of the ROV above the mean seabed level.

Figure 7-4 shows an ROV with four altimeters mounted at various points on its body. In this example, the ROV is surveying a partially covered pipe at the bottom of a shallow trench. Low spoil heaps created by the action of a trenching plough mark the two sides of the trench.



Altimeter A	Depth of Cover to the top of the target
Altimeter B	Depth of Cover to the bottom of the trench
Altimeter C	Depth of Cover to top of spoil heap
Altimeter D	Depth of Cover to mean seabed

Figure 7-4: Effects of altimeter mounting position

In Figure 7-4 the measurements made by the four altimeters are all different:

Altimeter A:	is located vertically above the centre of the coil array. With the ROV positioned as shown directly over the target, the narrow beamwidth of the altimeter (10°) measures to the top of the target. The depth of cover information supplied by the 440 System would show the target to be slightly exposed.
Altimeter B:	is located slightly to one side of the coil-array centre line. The measurements of altitude delivered by this unit are valid for the seabed immediately to one side of the target. The 440 display would show the target exposed by several centimetres.
Altimeter C:	is located at one end of the coil array and, in the example shown, measures the altitude above the top of the spoil heap. Because this heap is higher than the surrounding seabed, the 440 display would indicate the target to be covered by several centimetres.
Altimeter D:	is located on a boom and is measuring to an area of the seabed that has not been disturbed by the trenching process. The 440 display would show the target covered by a few centimetres.

The 440 System supplies measurements of the vertical distance between the search-coils and the top of the conductive part of the target. The System calculates depth of target cover using this accurate vertical range information and measurements supplied by the altimeter.

The example in Figure 7-4 illustrates that the altimeter position can affect the depth of cover information supplied by the 440 System.

Summary:

1. Where depth of cover measurements are critical to the requirements of the survey, Teledyne TSS recommends that you use an independent scanning profiler system to determine the mean seabed level. Subsequent post-processing will then allow you to plot an accurate target profile using merged data from the 440 System and from the profiler.

7.2.2 Electrical Interference

The 440 System is **unaffected** by the following factors:

- Changes of ROV heading
- Any local static magnetic field
- Acoustic noise
- The presence of platforms, rigs, or other vessels in the vicinity, provided they are further than 6m from the coil array

This sub-section describes the sources of interference that might affect the 440 System.

7.2.2.1 ROV Body

Appendix A describes the principle of Pulse Induction used by the 440 System. This method detects and locates any conductive material within range of the coil array. Normally, the conductive material will be a valid target and the 440 System will supply data concerning its location and depth of cover with no loss of accuracy.

The System will also detect manipulators and other conductive parts of the ROV body that lie within range of the search-coils. However, provided these objects remain stationary relative to the coils during the survey, the System can measure and then compensate for their effects using the Background Compensation facility.

Summary:

1. Perform the Background Compensation procedure described in section 6.3.3 "Background Compensation and Monitoring" on page 6-14 before the survey commences and then at intervals of 30 minutes.

2. Avoid using manipulators and probes during a survey, and ensure that those parts of the ROV close to the coil array cannot move.

7.2.2.2 Power-carrying Cables

If you use the 440 System to survey power cables that are carrying high currents, the coils might experience some interference. If this occurs, random errors may appear in measurements supplied by the System.

The most effective way to cure this problem is to remove power from the target cable.

Summary:

1. Perform regular checks on signal quality by using the SDC oscilloscope function. Determine whether any electrical noise is present on the received signal. If the noise does not enter either of the sampling regions shown on the oscilloscope display you may ignore its effects.

2. If noise is present on the oscilloscope display and it is affecting measurements, arrange to remove power from the cable before you continue the survey.

7.2.2.3 Impressed-current Cathodic Protection

The 440 System may suffer from noise pick-up if you use it to survey pipes that use single-phase impressed-current cathodic protection. This will generate random errors in the range and offset data.

Use the SDC oscilloscope function to check whether there is noise on the signal from this source.

Three-phase impressed current protection and pipes protected by sacrificial anodes do not affect the 440 System in this way.

Summary:

1. Use the SDC oscilloscope function to make regular checks on signal quality.

2. If necessary, arrange to switch off the impressed-current protection. The interference will disappear immediately but the protection afforded by the current will remain for several days.

7.3 ROVs

You may use the 440 System with most types and size of ROV, and you may operate it at depths down to its specified depth rating listed in Chapter 8 "System Specifications". The standard installation described in this Manual provides a high degree of accuracy and a useful measurement range, together with ease of deployment.

It is important to install the 440 System properly by following the instructions included in Chapter 3 "Physical Installation" and Chapter 4 "Electrical Installation" of this Manual. The System will supply valid survey data only if you follow the installation and operating instructions in this Manual. Provided you follow these instructions, you may install the System on most types of ROV.

NOTE

Remember that the 440 System detects the presence of *any* conductive material nearby. When you install the System on an ROV therefore, avoid the presence of any conductive material within range of the search-coils.

During a survey, you must avoid using any manipulator arms, probes, or other items that can move while you are operating the 440 System. To guarantee the accuracy of your data throughout the survey, you must perform regular checks on background compensation.

7.3.1 Speed of Operation

The 440 System delivers measurements to a data logger continuously at a rate that allows deployment on faster ROVs. This is sufficient to maintain a high track resolution under all normal operating conditions.

7.3.2 Altitude above the Seabed

The vertical detection range of the 440 System is limited by the characteristics of the target, in particular its size.

The low signal strength that the System receives from a small target will reduce its detection range. If you use the System to survey a small target you should therefore operate the ROV as near as possible to the seabed, while avoiding damage. If your ROV has an automatic facility for maintaining altitude, you may use it.

Larger targets will cause stronger signals in the search-coils so that you may operate the ROV at a greater altitude above the seabed.

7.3.3 Manipulators and Probes

Any manipulators or probes deployed on the ROV during a survey will present moving targets that the 440 System will detect. These movements might therefore introduce errors to the survey measurements.

You should avoid using such tools during a survey unless circumstances demand their deployment.

NOTE

After you have used any such tools during a survey, stow and secure them properly. You *must* then perform a background compensation procedure before you continue the survey.

7.3.4 Tracked ROV

You may install the 440 System on tracked ROVs. This type of ROV should allow you to set a fixed coil height.

8 System Specifications

Along with a detailed specification of the 440 System and its major assemblies, this section of the Manual also includes examples to show the measurement performance that the System can deliver under ideal operating conditions.

NOTE

While revising this 440 System Manual, Teledyne TSS has made every effort to ensure that the specifications included are correct. However, in line with the Teledyne TSS policy of continual product development and improvement, Teledyne TSS reserves the right to change equipment specifications without notice. Refer to Teledyne TSS for advice if necessary.

8.1 Specifications

Where included, UK Imperial measurements are accurate to two decimal places only.

8.1.1 Surface Display Computer

SDC-Type:	10
Processor:	Built-in Intel fan-less N270 Atom 1.6GHz CPU
Operating System:	Windows 7
RAM size:	2 GB
Hard disk size:	32GB
Panel PC Interfaces:	2 x front-mounted USB ports
Comms Enclosure Interfaces:	IEC mains input (90 - 264V {47 to 63Hz})
	15-Way D-Type (Comms from SEP)
	2 x RS232 serial ports (COM2 and COM3)
	S-Video and Composite Video In/Out (video overlay)
	3 x BNC Analogue Outputs (CH1, CH2 and QLTY)
	RS232, 2-wire and 4-wire current loop selector switch
Keyboard:	On-screen touch-screen keyboard.
Monitor:	19" military grade touch-screen Panel PC
Overall size:	599.2mm(W) x 480mm(D) x 345mm (H) (inc. transit case)
Weight:	
Power input voltage:	90 - 265V (47 to 63Hz) auto-ranging
Power consumption:	250W maximum
Operating temperature range:)	0° to 50°C {*32°F to 122°F*}
Relative humidity:	10% to 95% R.H. non-condensing at 40°C
Vibration resistance:	5 to 17Hz 2.5mm double amplitude displacement. 17 to 500Hz 1.5g peak-to-peak
Ingress protection:	IP65

8.1.2 Sub-sea Electronics Pod

Size:	Ø148 × 468mm* {*Ø5.83 × 18.43 inches**}

Weight:	Aluminium	(In air)	11.9kg {*26.2 pounds*}
		(In water)	3.6kg {*7.9 pounds*}
	Stainless Steel	(In air)	22.4kg *{49.3 pounds}*
		(In water)	14.1kg *{31.0 pounds}*
Operating temperature:			0° to 30°C {*32°F to 86°F*}
Communication:			RS232
			2-wire 20mA digital current-loop.
			4-wire 20mA digital current-loop.
			{Selectable by internal links.}
Depth rating:	(Aluminium)		3000 metres {*9842 feet*}
	(Stainless steel)		6000 metres {*19684 feet*}
Finish:	(Aluminium)		Hard black anodised aluminium
	(Stainless steel)		Polished
Connections:	(Search-coils)		Three cables of length 4 metres
	(To PSU)		Single 12-way cable 2.5 metres length.

**Allow up to 300mm* {*11.81 inches} *extra for connector clearance*.

8.1.3 Sub-sea Power Supply Pod

Size:			Ø148 × 468mm* {*Ø5.83 × 18.43 inches**}
Weight:	Aluminium	In air	13.1kg {*28.8 pounds*}
		In water	4.8kg {*10.6 pounds*}
	Stainless Steel	In air	23.6kg *{51.9 pounds}*
		In water	15.3kg *{33.7 pounds}*
Input voltage:			100 to 120V AC 45 to 65Hz
			Maximum power demand 2.8A
Operating temperature			0° to 30°C {*32°F to 86°F*}
Depth rating	(aluminium)		3000 metres {*9842 feet*}
	(stainless steel)		6000 metres {*19684 feet*}
Finish	(aluminium)		Hard black anodised aluminium
	(stainless steel)		Polished

Connections:	ROV	3 metres cable length
Umbilical		One or two twisted pairs, or multiplexer.

**Allow up to 300mm* {*11.81 inches} *extra for connector clearance*.

8.1.4 Search Coil Array

Size:		1000 × 940 × 30mm {*39.37 × 37 × 1.18 inches*}
Quantity:		3
Weight:	In air	15kg {*33.07 pounds*} each
	In water	4.75kg {*10.47 pounds*} each
Depth rating:		6000 metres {*19684 feet*}
Material:		High density polyethylene (HDPE)
SEP connection cable:		4 metres (6 metre option available)

8.2 Performance

The following tables show the results of tests performed by Teledyne TSS using 5 metre lengths of sample targets. They illustrate the range and accuracy that you may achieve under ideal conditions by following the procedures described in Chapter 6 "Operating Procedure" carefully.

The charts show:

Horizontal axis the true lateral offset of the target relative to the centre-line of the coil array. *Note that the response of the coil array is symmetrical and accuracy is the same to port and starboard of the centre-line*. *The values are valid for positive and negative lateral offset*.

Vertical axis increments of increasing true vertical range to the target.

Data table the difference between the measurement of VRT shown on the 440 and the actual vertical range.

IMPORTANT NOTE:

You should not use these charts as correction tables. They provide an indication only of what you could achieve under ideal operating conditions if you follow the correct operating procedures for the 440 System.

Note also that each table applies to one type and size of target *only*.

Table 8-1: Standard pipeline diameter = 0.27m (10 inch)

Vertical Range \ True Lateral Offset (±cm)	0	10	20	30	40	50	60	70	80	90
50	-3	-2	-2	3	4	4	6	7	8	8
60	-1	-2	-2	2	2	3	4	6	6	5
70	-1	-1	-1	1	2	2	3	3	4	4
80	-2	-2	-2	-1	0	1	2	2	3	3
90	-1	-2	-1	-1	0	0	0	1	1	2
100	-1	-2	-1	-1	0	0	0	1	1	2
110	-1	-1	-1	-1	-1	-1	0	-1	0	-1
120	0	-1	-1	-2	-1	-1	-1	-1	0	-2
130	0	-1	-1	0	-1	-1	-1	-1	0	-2
140	0	-1	0	-1	0	-1	-1	-1	-1	-1
150	1	0	-1	-2	-1	-1	-1	-1	-1	-2
160	1	0	-1	-1	-1	-1	-1	-1	-2	-3
170	1	-1	-1	-1	-1	-2	-2	-3	-2	-3
180	1	0	-1	-1	-1	-2	-2	-4	-2	-3
190	2	-1	-1	-2	-2	-3	-2	-4	-4	-4
200	1	-2	-1	-2	-2	-3	-3	-7	-9	-8
210	2	-4	-1	-2	-2	-5	-5	-13	-10	-5
220	3	-4	-3	-5	-4	-8	-8	-16	-14	-13
230	-4	-3	-2	-4	-3	-10	-6	-11	-10	-14
240	-4	-8	-3	-6	-6	-11	-6	-12	-23	-16
250	-1	-11	1-3	-8	-8	-13	-13	-21	-21	-16
260	6	-7	1	-5	-5	-14	-9	-9	-17	-24
270	8	0	6	-5	-4	-11	-10	-38	-38	-56
280	11	-15	3	-2	-4	-11	-1	-42	-9	25
290	16	-5	11	-12	1	-17	-7	TOR	TOR	TOR
300	4	-12	8	-3	7	TOR	TOR	TOR	TOR	TOR

Target Scaling = 1400µV Threshold = 15µV

Table 8-2: Standard pipeline diameter = 0.11m (4 inch)

Vertical Range \ True Lateral Offset (±cm)	0	10	20	30	40	50	60	70	80	90
50	TOR	-1	4	4	5	6	7	8	7	4
60	-3	-2	1	1	2	3	4	5	4	1
70	-1	-1	-1	0	2	2	3	3	2	1
80	-1	0	0	0	1	1	1	1	1	0
90	0	-1	-1	0	0	0	0	0	0	0
100	0	0	0	2	0	1	1	1	1	1
110	1	0	0	0	0	0	0	1	0	0
120	1	-7	0	-1	0	0	0	0	0	1
130	1	-7	0	-1	0	0	-1	-1	0	1
140	1	-1	-1	-1	0	-1	-1	-1	0	0
150	3	-1	-2	-2	-1	-1	-2	-1	-1	2
160	1	-2	-3	-3	-1	-1	-2	-1	-1	-1
170	2	-1	-2	-3	0	-2	-2	-1	-1	-2
180	2	-3	-2	-3	0	-1	-4	-2	-2	-3
190	-1	-3	-4	-4	-1	5	-1	-2	-3	-2
200	-4	-3	-2	-4	1	0	-2	-3	1	3
210	-6	-7	-5	-5	6	2	3	0	1	-7
220	-5	4	-9	-7	TOR	3	-14	2	TOR	3

Target Scaling = 420µV Threshold = 15µV

Table 8-3: Cable diameter = 0.025m (1 inch)

Vertical Range	True Lateral Offset (±cm) 0	10	20	30	40	50	60	70	80	90
50	9	8	9	9	9	10	6	2	-12	-55
60	6	6	5	7	8	8	-2	0	-10	-6
70	4	3	4	4	6	6	TOR	-7	-13	2
80	2	0	2	3	4	4	TOR	-30	-18	TOR
90	2	0	2	3	4	4	TOR	TOR	TOR	TOR
100	-2	-3	1	-3	-2	-1	TOR	TOR	TOR	TOR
110	-1	-3	-4	-5	-4	-5	TOR	TOR	TOR	TOR
120	2	-11	-8	-10	-7	-5	TOR	TOR	TOR	TOR

Target Scaling = 26µV Threshold = 15µV

Table 8-4: Umbilical diameter = 0.11m (4 inch)

Vertical Range	True Lateral Offset (±cm) 0	10	20	30	40	50	60	70	80	90
50	2	4	3	3	4	5	5	3	-8	-6
60	1	1	1	2	3	4	4	1	-6	-10
70	1	2	0	0	1	2	2	-1	-70	-8
80	0	1	0	-1	0	1	0	-2	-5	-7
90	0	1	0	-1	-1	0	-1	-2	-5	-6
100	1	1	0	-1	-2	-2	-2	-3	-4	-4
110	1	1	0	-1	-1	-1	-1	-2	-3	-3
120	1	0	0	-1	-2	-1	-2	-2	-2	-3
130	1	0	-1	-1	-2	-2	-2	-2	-3	-3
140	0	0	-1	-2	-3	-3	-2	-2	-2	-3
150	0	-1	-2	-3	-4	-4	-3	-3	-2	-3
160	0	-2	-3	-4	-5	-4	-4	-2	-3	-2
170	1	4	-3	-6	-7	-6	-6	-5	-4	-5
180	-1	-2	-3	-5	-6	-6	-4	-2	-2	-4
190	-10	-4	-6	-9	-9	-8	-6	-6	-3	-3
200	-2	-7	-8	-13	-11	-10	-7	-4	-17	-11
210	1	-7	-14	-7	-8	-9	-4	-3	-7	-9
220	4	2	2	-9	-7	-4	0	-1	-2	-7

Target Scaling = 550µV Threshold = 15µV

8.3 Update Rate

You may set the rate at which the 440 System supplies measurements to an external data logger to either one or four records per second.

Update rates available from independent seabed profiling systems may be different from the update rate you have set for the 440 System. If your ROV includes both these systems, you must allow for their different update rates when you analyse the survey data.

9 Maintenance

You will find it easier to identify and clear a fault on the 440 System if you have a full understanding of the location of the individual sub-assemblies, and of the way they interact. This section helps you to maintain and service the System by describing the main internal components of the sub-sea installation.

WARNING - ELECTRICAL HAZARD

Mains power supply voltages can cause death or serious injury by electric shock.

Only a competent engineer who has received the relevant training and experience should perform maintenance work on electrical equipment.

Power-off and isolate the equipment from the electrical supply before you work on any equipment that uses a mains power supply. Arrange to discharge any power supply storage capacitors safely.

Observe all relevant local and national safety regulations while you perform any maintenance work on electrically powered equipment.

Do not connect the equipment to an electrical supply until you have refitted all safety covers and ground connections.

9.1 Circuit Description

The sub-sea installation consists of three principal parts:

- The coil array
- The Sub-sea Power Supply Pod (PSU)
- The Sub-sea Electronics Pod (SEP)

Figure 9-1 shows how these are interconnected.

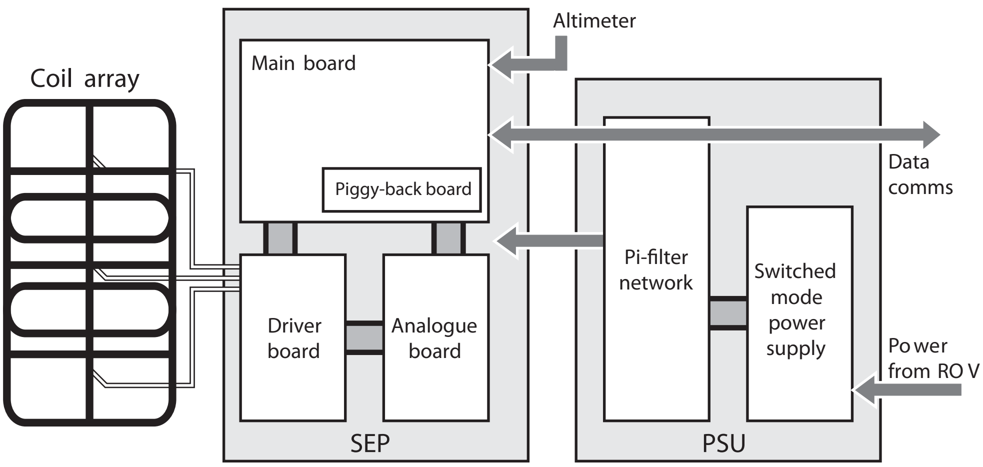


Figure 9-1: Simplified interconnection diagram

Chapter 10 "System Drawings" includes the drawings for the System.

9.1.1 Power Supply Pod

The PSU contains the Power Supply PCB assembly and the π–Filter Assembly – see Figure 9-2.

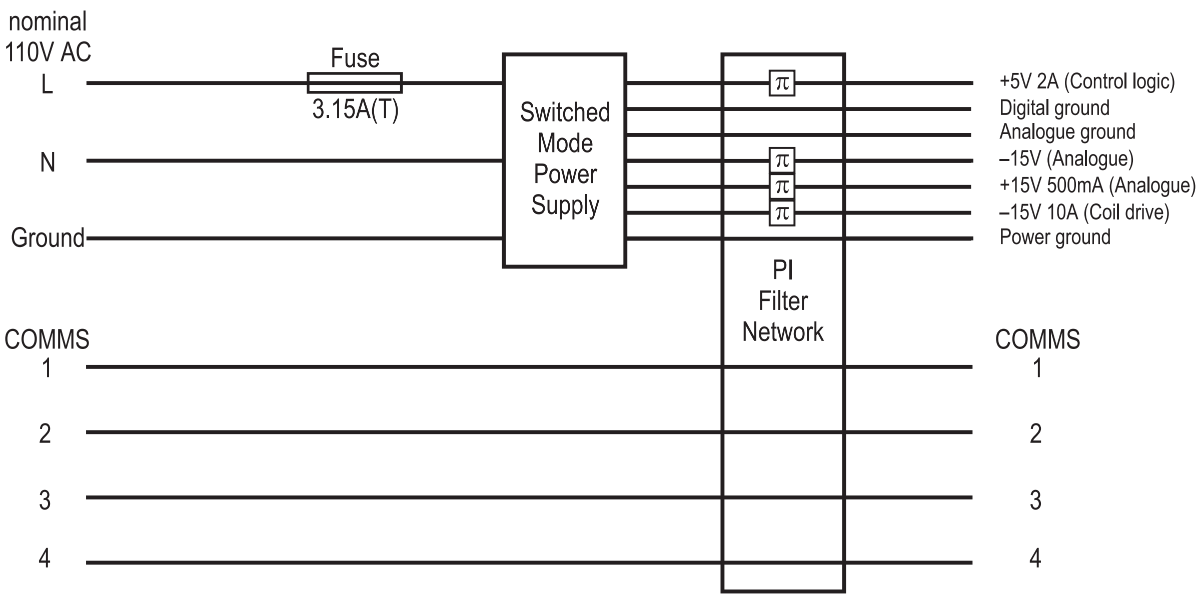


Figure 9-2: PSU interconnection diagram

9.1.1.1 Power Supply PCB

(*See drawing 490228 in* Chapter 10 "System Drawings")

Power for the sub-sea installation comes from the ROV electrical supply. Normally this will be nominal 110V single phase AC rated at 350VA. For special applications, Teledyne TSS can supply the 440 System with a PSU that accepts nominal 240V AC instead.

The PSU uses switched-mode circuitry to convert the electrical supply from the ROV into the four conditioned and stabilised DC supplies required by the SEP. These are:

- +5V (2A) for use by the control logic.
- +15V (500mA) for use by the analogue electronics.
- –15V (500mA) for use by the analogue electronics.
- –15V (10A) to drive the search-coils.

Cooling of the supply is by direct thermal conduction to the PSU housing assisted by a small fan.

WARNING

There is a danger of electric shock from electrical voltages in the PSU. Do not open the PSU with power connected.

Except for the fuse on the input, the Power Supply board is NOT repairable in the field. You must renew the board as a complete unit if you suspect it has developed a fault condition.

There have been reports of pressure building up within the Sub-sea units if water has been able to seep into the housing. Caution must be taken when opening the SEP unit.

NOTE

When opening the sub-sea housing Teledyne TSS recommend that you use screws inserted into the drilled holes to jack the endcap off. Under no circumstances should a screwdriver (or similar) be used to lever the endcap off as this will result in damage to the o-ring seal and the casing.

9.1.1.2 Filter Assembly

(*See drawing 400654 in* Chapter 10 "System Drawings")

The output from a switched-mode power supply is inherently noisy. To prevent this electrical noise from disturbing the sensitive analogue circuits within the SEP, all outputs from the PSU pass through a π-filter network. The filters are contained within a metal screening can with inputs via feed-through capacitors.

9.1.2 Sub-sea Electronics Pod

The SEP includes three circuit boards:

- Main Board
- Driver Board
- Analogue Board

9.1.2.1 Main Board

(*See drawings 401178 and B929935 in* Chapter 10 "System Drawings")

NOTE

The main board assembly (401183) comprises the main board (401178) with an integral piggy-back board (B929934). The spares part is 401183 which incorporates the integral piggy-back board.

The SEP drives the coil channels sequentially with control exercised through a Programmable Timer under the direction of a high-performance Digital Signal Processor (DSP) on the Main Board.

After amplification, the signals from each channel pass to the analogue-to-digital converter (ADC) and then to the DSP. The DSP performs the complex signal analysis necessary to determine the target position.

Finally, the Main Board sends the target co-ordinates to the SDC through an optically isolated serial communications link.

9.1.2.2 Driver Board

(*See drawing 401181 in Section* Chapter 10 "System Drawings")

Under the control of the Main Board, the Driver Board drives the coil channels using four power MOSFET switches.

A current limiter allows coil current to rise to a maximum value of 20A during each drive pulse. The action of the limiter ensures that the amplitude of the current pulse is substantially independent of any variations in the supply voltage arriving at the PSU.

At the correct moment during each measurement cycle, the Driver Board switches off coil drive current. At this moment, the current in the coil falls very rapidly towards zero causing a back e.m.f. that drives the associated MOSFET briefly into avalanche breakdown at 250V.

Refer to Appendix A for details of the operating theory and the timing for each measurement cycle.

An LC filter smoothes the current drawn from the PSU to an approximately continuous level (*not* RMS) of 7A (with three search-coils attached).

9.1.2.3 Analogue Board

(*See drawing 401071 in Section* Chapter 10 "System Drawings")

After the initial 250V spike, the signal returned from the search-coil represents the voltage induced in the target by the original current pulse.

The Analogue Board applies two stages of pre-amplification to each signal channel with an overall gain of 200. If the SEP receives a signal that is too strong, the DSP removes the second stage of amplification to reduce the overall gain to 10.

The Analogue Board removes noise using an intelligent filter that clamps the signal to zero until the end of the 250V spike.

The conditioned signal then passes to the Main Board for processing and analysis.

9.1.3 Communications Loop

When you configure the System to use the 2-wire current-loop communications method, the SEP and the SDC share a twisted pair in the umbilical. To avoid possible contention, the 440 System assigns ‘Master’ status to the SDC, and ‘Slave’ status to the SEP.

Immediately after you power-on the 440 System, the SEP transmits a short ‘banner’ message to the SDC and then waits for commands to arrive. Other than its initial banner message, the SEP will not transmit any data until it receives a carriage-return signal from the SDC.

The SEP Main Board generates current at 20mA for the communication loop. The ‘COMMS’ LED on the SDC is in series with the current-loop and therefore confirms that the communication loop is intact when it shows red. Note that the COMMS LED does NOT confirm successful communication between the SEP and SDC, but shows only that the loop is intact.

Figure 9-3 shows a simplified schematic of the current-loop, including the optically isolated I/O ports at both ends of the umbilical cable.

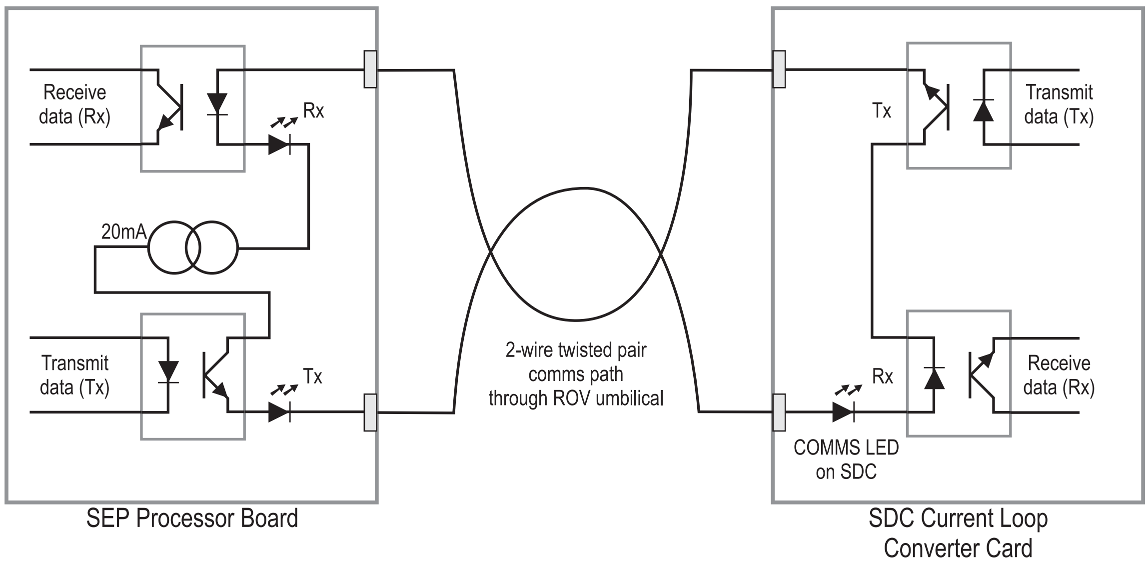


Figure 9-3: Simplified schematic of the current-loop

9.2 Disassembly and Reassembly

WARNING - ELECTRICAL HAZARD

Mains power supply voltages can cause death or serious injury by electric shock.

Only a competent engineer who has received the relevant training and experience should perform maintenance work on electrical equipment.

Power-off and isolate the equipment from the electrical supply before you work on any equipment that uses a mains power supply. Arrange to discharge any power supply storage capacitors safely.

Observe all relevant local and national safety regulations while you perform any maintenance work on electrically powered equipment.

Do not connect the equipment to an electrical supply until you have refitted all safety covers and ground connections.

9.2.1 Surface Display Computer

CAUTION

Many components within the SDC are susceptible to damage due to electrostatic discharge. You must take precautions against such damage: These precautions include the use of a grounded conductive mat and wrist-strap. Teledyne TSS will not accept responsibility for any damage caused by failure to take such precautionary measures.

9.2.2 Sub-sea Installation

CAUTION

Many components within the sub-sea pods are susceptible to damage due to electrostatic discharge. You must take precautions against such damage: These precautions include the use of a grounded conductive mat and wrist-strap. Teledyne TSS will not accept responsibility for any damage caused by failure to take such precautionary measures.

To complete the disassembly of the sub-sea pods you will need the following tools and facilities:

- A clean anti-static work area
- A 3mm hexagonal key
- A 2mm hexagonal key

9.2.2.1 Sub-sea Electronics Pod

(*See drawing 490232 in Section* Chapter 10 "System Drawings").

Remove the 'Power/Comms' end-cap:

NOTE

Note that this end-cap has two ports. Its correct orientation is for the 12-way port to align with the SEP identification label.

1. Use the 3mm hexagonal key to release and remove the four M4 × 16mm A4 stainless-steel screws that secure the end-cap to the housing.
2. Use the 2mm hexagonal key to remove the two grub-screws from the threaded holes near the edge of the end-cap.
3. Insert two of the M4 × 16mm screws into the holes vacated by the grub-screws and tighten them by hand until you feel resistance.
4. Use the 3mm hexagonal key to tighten the two M4 × 16mm screws alternately so that they lift the end-cap away from the SEP housing.
5. After you have screwed the two jacking screws home, use your fingers to ease the end-cap away from the SEP housing. Note that a partial vacuum may form inside the housing and this may make it difficult to remove the end-cap. **Do not insert any hard or sharp instruments into the gap to act as a lever because this may scratch the surface, following which corrosion will occur**.
6. Remove the two jacking screws from the end-cap.
7. Do not allow strain to develop on the internal connectors as you ease the end-cap away from the SEP housing. Disconnect the 12-way and the 6-way internal connectors by pressing their two side-clips together and pulling the plugs and sockets apart.
8. Disconnect the ground strap by pulling the spade connector and receptacle apart.

Remove the coil connector end-cap:

NOTE

Note that this end-cap has four ports. Its correct orientation is for channels 1 and 2 to be at the top of the SEP.

9. Remove the four M4 × 16mm A4 stainless-steel screws as before. Substitute two of these screws in place of the two grub screws to jack the end-cap away from the SEP housing. Remove the jacking screws from the end-cap.
10. Remove the end-cap carefully – note that it carries all the circuit board assemblies. Handle this assembly with care. Pull the end-cap carefully until the entire assembly is free of the SEP housing and place it on the clean anti-static work surface. Save the pack of desiccant that is wedged underneath the circuit-board assembly and store it in a warm dry place while you work on the circuitry.
11. The Main Board is located on one side of the central support block, and the Driver Board and the Analogue Board are located together on the other side.

To remove any of the boards:

- Note their positions and carefully disconnect all the plugs and connectors that link the board to the main assembly.
- Use the 3mm hexagonal key to remove the M4 × 16mm bolts that secure the board to the support and remove the board from the assembly.
- On completion of repair work refit the board and reconnect the cables and connectors correctly.

Reassemble the SEP:

12. Check the condition of the two rubber O-rings that seal each of the end-caps. Clean or renew them if necessary. Apply a thin smear of approved lubricant to the rings to ensure they make an efficient seal when you reassemble the SEP. For this purpose, use the same type of lubricant that you use for the sub-sea electrical connectors – see section 4.1.2 "Care of Sub-sea Connectors" on page 4-3 for these important instructions.
13. Place the desiccant pack inside so that it fits between the Main Board and the SEP housing. Make certain that there are no trapped wires or components, and push the end-cap home. This end-cap must be opposite the end of the SEP that has the ground strap attached inside.
14. Carefully align the end-cap to the SEP housing so that the four securing screws will engage properly. If necessary, turn the end-cap slightly to achieve perfect alignment. Ensure that both holes for the grub screws align with the hardened stainless steel inserts on the end of the SEP housing.
15. Insert the four M4 × 16mm A4 stainless steel screws and use the 3mm hexagonal key to tighten them evenly. Insert both grub-screws and tighten them lightly.
16. Reconnect the ground wires, the 8-way and the 6-way connectors on the ‘Power/Comms’ end-cap. Make certain both locking clips on each of the multi-way connectors engage properly.
17. Align and engage the ‘Power/Comms’ end-cap into the SEP housing. Make certain both holes for the grub screws align with the hardened stainless steel inserts in the end of the SEP housing.
18. Make certain there are no trapped wires and press the end-cap home. If necessary, twist the end-cap slightly to achieve perfect alignment of the screw holes. As you replace the end-cap, the SEP housing may become slightly pressurised which may make the cap difficult to replace. **Do not apply excessive force**.
19. Insert the four M4 × 16mm A4 stainless steel screws and use the 3mm hexagonal key to tighten them evenly. Insert both grub-screws and tighten them lightly.

9.2.2.2 Power Supply Pod

Neither of the PSU end-caps has an obvious point of reference to use for orientation when you reassemble the pod.

Remove the end-cap that has the moulded cable attached:

1. Jack the end-cap off the housing by following the same procedure described above for the SEP. Note that a partial vacuum may form inside the PSU as you remove the end-cap and this may make removal difficult. **Do not insert any hard or sharp instruments into the gap to act as a lever**.

2. Release the single 12-way internal connector by pressing its two side-clips together. Remove the end-cap.

3. Follow the same procedure to remove the other PSU end-cap.

4. Pull the end-cap forward and disconnect the single ground connection at the spade terminal.

5. Pull the end-cap carefully from the body. Save the desiccant pack.

Reassemble the PSU:

6. Check the condition of the two rubber O-rings that seal each of the end-caps. Clean or renew them if necessary. Apply a thin smear of approved lubricant to the rings to ensure they make an efficient seal when you reassemble the PSU. For this purpose, use the same type of lubricant that you use for the sub-sea electrical connectors – see section 4.1.2 "Care of Sub-sea Connectors" on page 4-3 for these important instructions.

7. Insert the end-cap that carries the circuit board first.

8. Reconnect the ground strap at the spade connector and receptacle.

9. Place the desiccant pack inside so that it fits between the card carrier and the PSU housing. Make certain that there are no trapped wires or components and push the end-cap and card carrier home. Ensure that there is nothing to obstruct the free rotation of the small board-mounted fan.

10. Carefully align the end-cap to the PSU housing so that the four securing screws will engage properly. If necessary, turn the end-cap slightly to achieve perfect alignment. Ensure that the two holes for the grub screws align with the hardened stainless steel inserts on the end of the PSU housing.

11. Reconnect the 12-way connector to the other end-cap. Make certain both locking clips engage properly on the connector.

12. Align the end-cap with the PSU housing and push it home. If necessary, twist the end-cap slightly to achieve perfect alignment of the screw holes. As you replace the end-cap, the PSU housing may become slightly pressurised which may make the cap difficult to replace. **Do not apply excessive force**.

13. Insert the four M4 × 12mm A4 stainless steel screws and use the 3mm hexagonal key to tighten them evenly. Insert both grub-screws and tighten them lightly.

9.3 Fault Identification

The remainder of this section includes advice and a series of flow charts to help you locate a fault in the sub-sea components of the 440 System. The SDC oscilloscope function is a powerful fault identification tool.

NOTE

Teledyne TSS has gathered considerable experience with the 440 System in many survey operations and under a variety of conditions and has used this experience to compose the following flow charts.

If your System fails, perform the following checks *before* you call Teledyne TSS engineers for assistance.

1. Check that you have installed the 440 System correctly according to the instructions in Chapter 3 "Physical Installation" and Chapter 4 "Electrical Installation".
2. Check that the configuration of the 440 System is correct. Refer to sub-section section 5.3 "DeepView For Windows - System Configuration" on page 5-4 for details of the System Configuration display.
3. Check that you have connected all cables correctly.
4. Check that the correct electrical supplies are available to the SDC and the PSU.
5. Identify the fault symptoms as clearly as possible, and apply the appropriate fault identification routine from the following list:

- Fault on a single channel only – see section 9.3.1 "Fault on Single Channel Only" on page 9-11.
- Communications failure – see section 9.3.2 "Current Loop Communications Failure" on page 9-13.
- Altimeter failure – see section 9.3.3 "Altimeter failure." on page 9-17.
- Unexpected signal variation during normal operation – see section 9.3.4 "Unexpected Signal Variation During Normal Operation" on page 9-20.

9.3.1 Fault on Single Channel Only

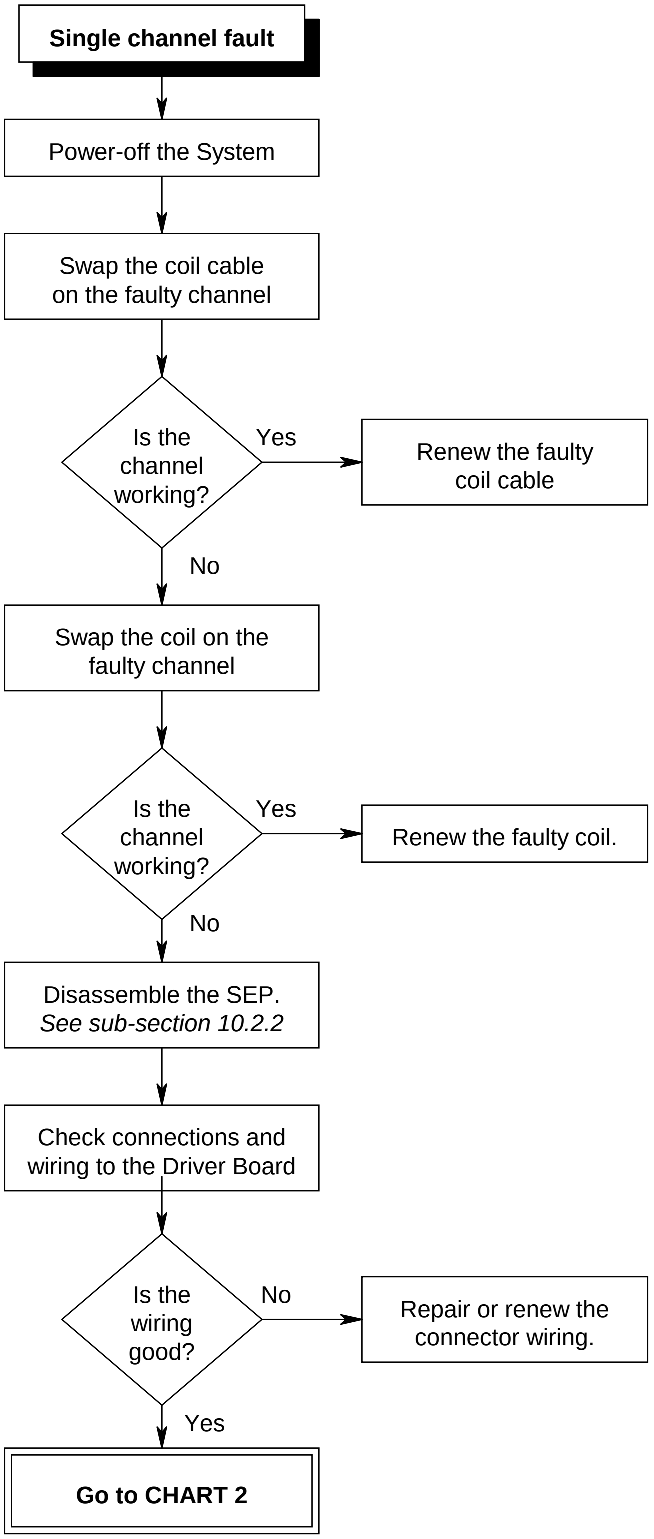
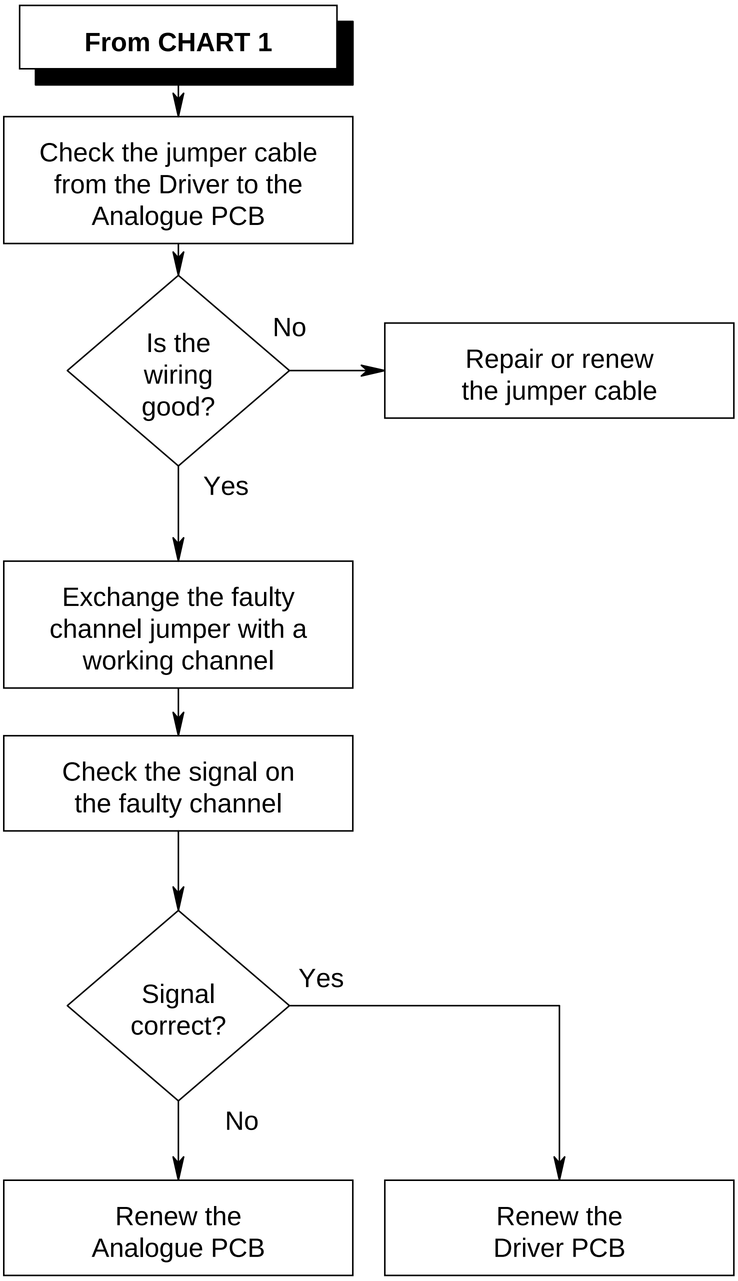


Figure 9-4: Single channel failure – CHART 1



WARNING
Dangerous voltages exist in this area of circuitry.
You must disconnect power from the System before you perform work in these areas.

Figure 9-5: Single channel failure – CHART 2

9.3.2 Current Loop Communications Failure

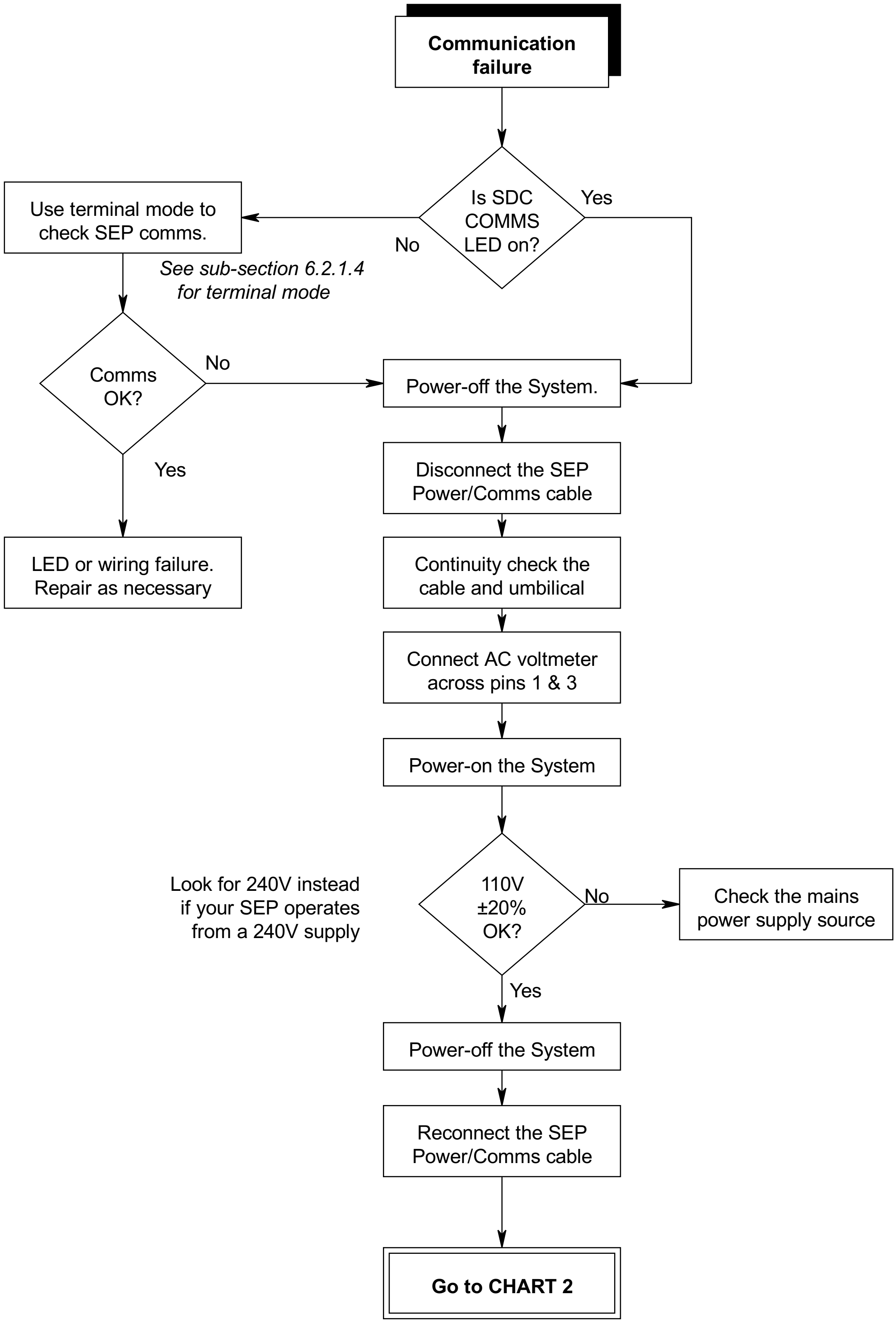


Figure 9-6: Communications failure – CHART 1

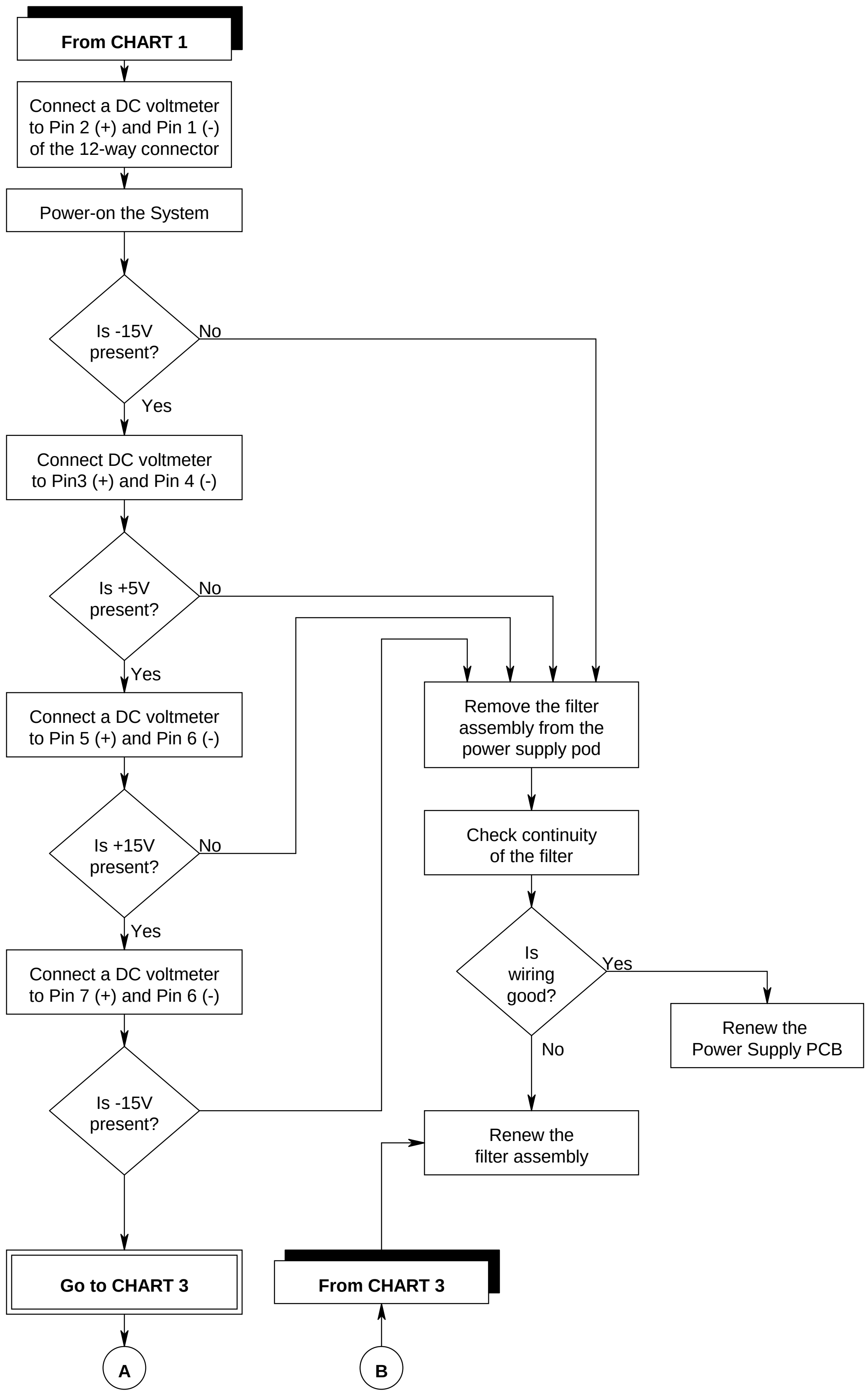


Figure 9-7: Communications failure – CHART 2

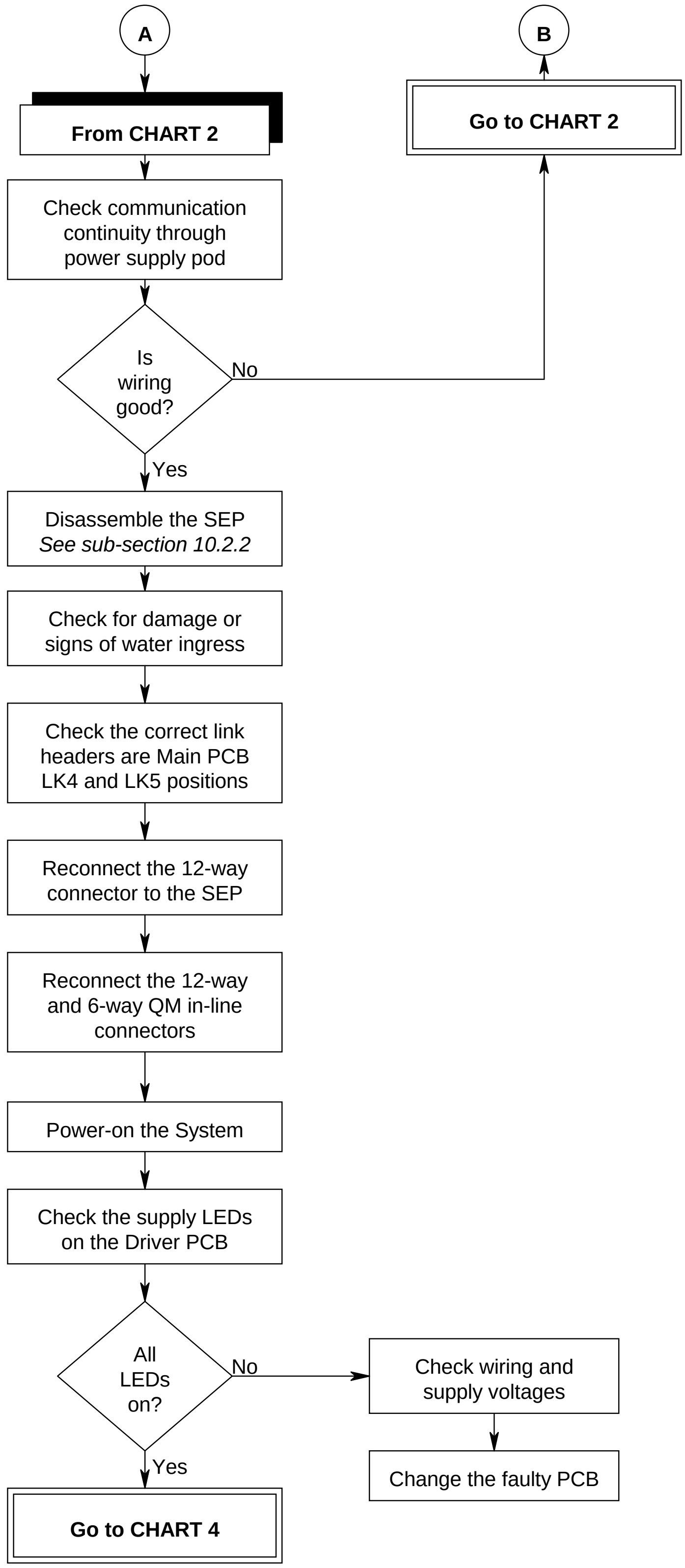


Figure 9-8: Communications failure – CHART 3

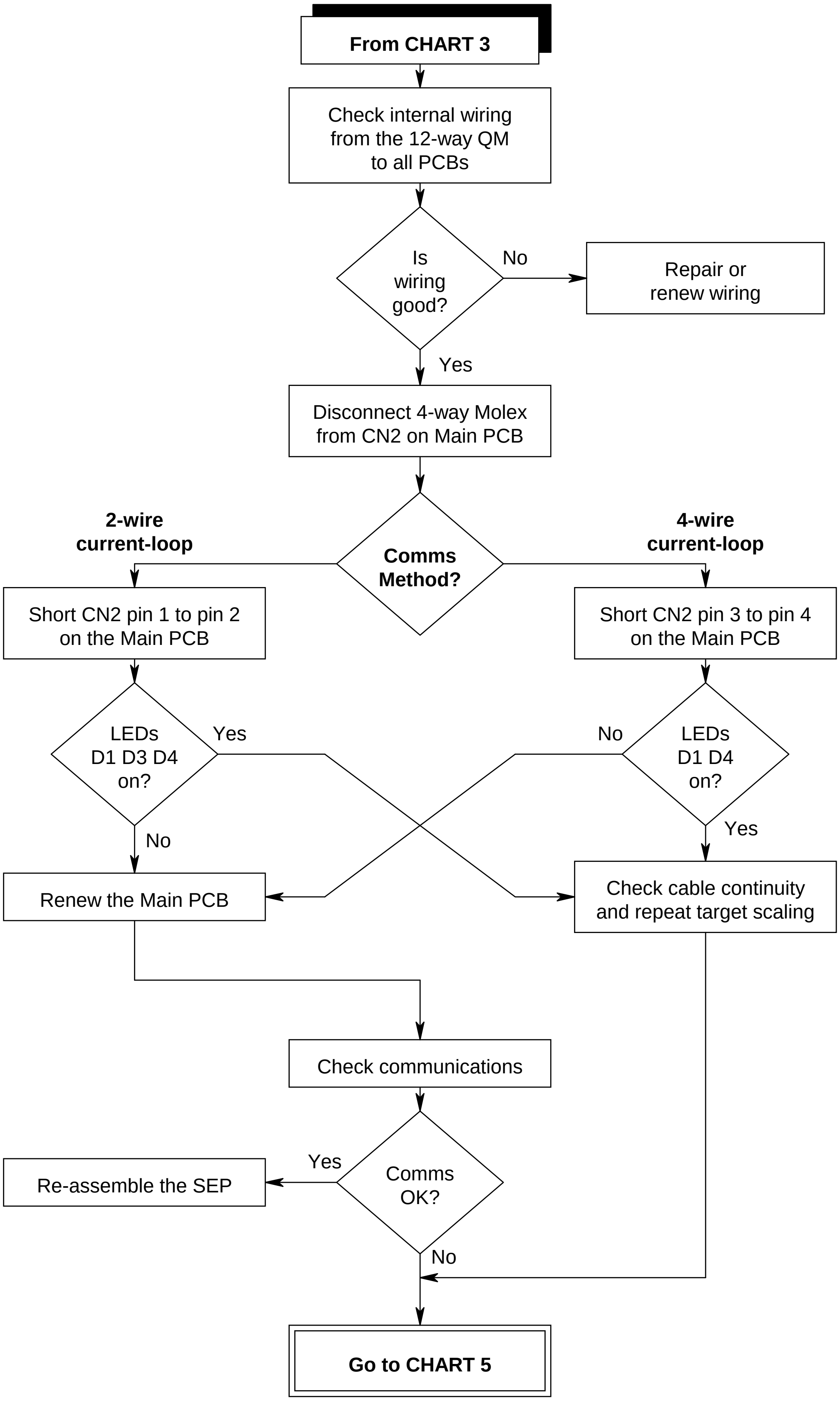


Figure 9-9: Communications failure – CHART 4

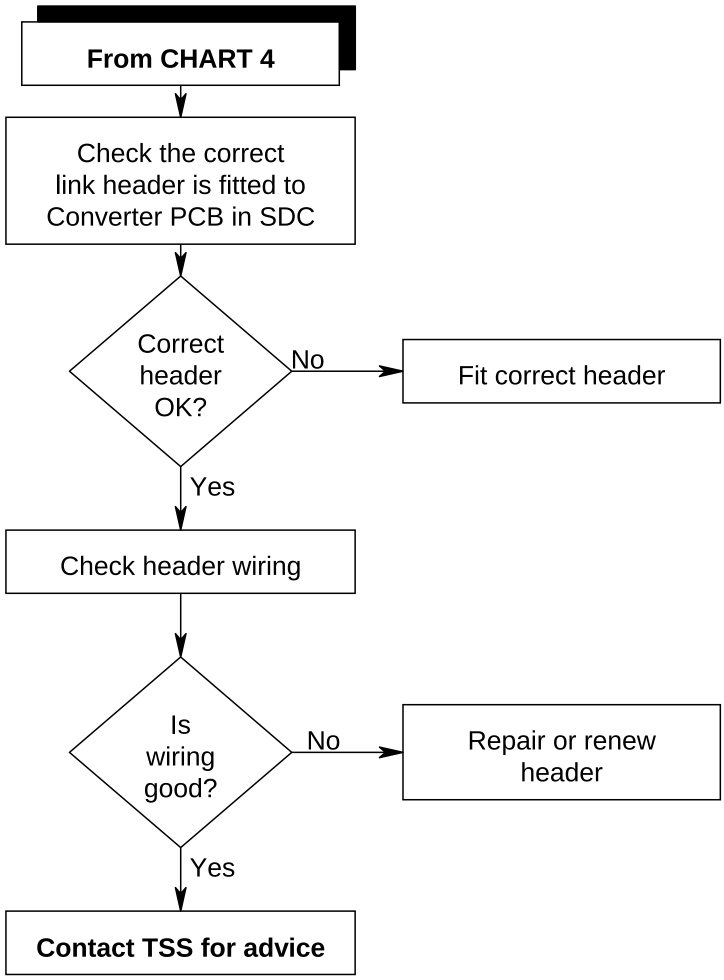


Figure 9-10: Communications failure – CHART 5

9.3.3 Altimeter failure.

These flow charts should help you to identify a fault with the Teledyne TSS ALT250 altimeter connected directly to the SEP.

If a fault develops when you use an alternative altimeter connected to SDC ‘ALTIMETER’ (COM2), select COM2 from the terminal mode and check the data strings against those listed in section 6.6 "Altimeter Data Format" on page 6-35. See section 6.2.1.2 "View Options" on page 6-9 for details of the terminal mode.

If there are no data strings from the altimeter, check the RS232 parameters and the wiring. Refer to the altimeter manual for specific servicing details.

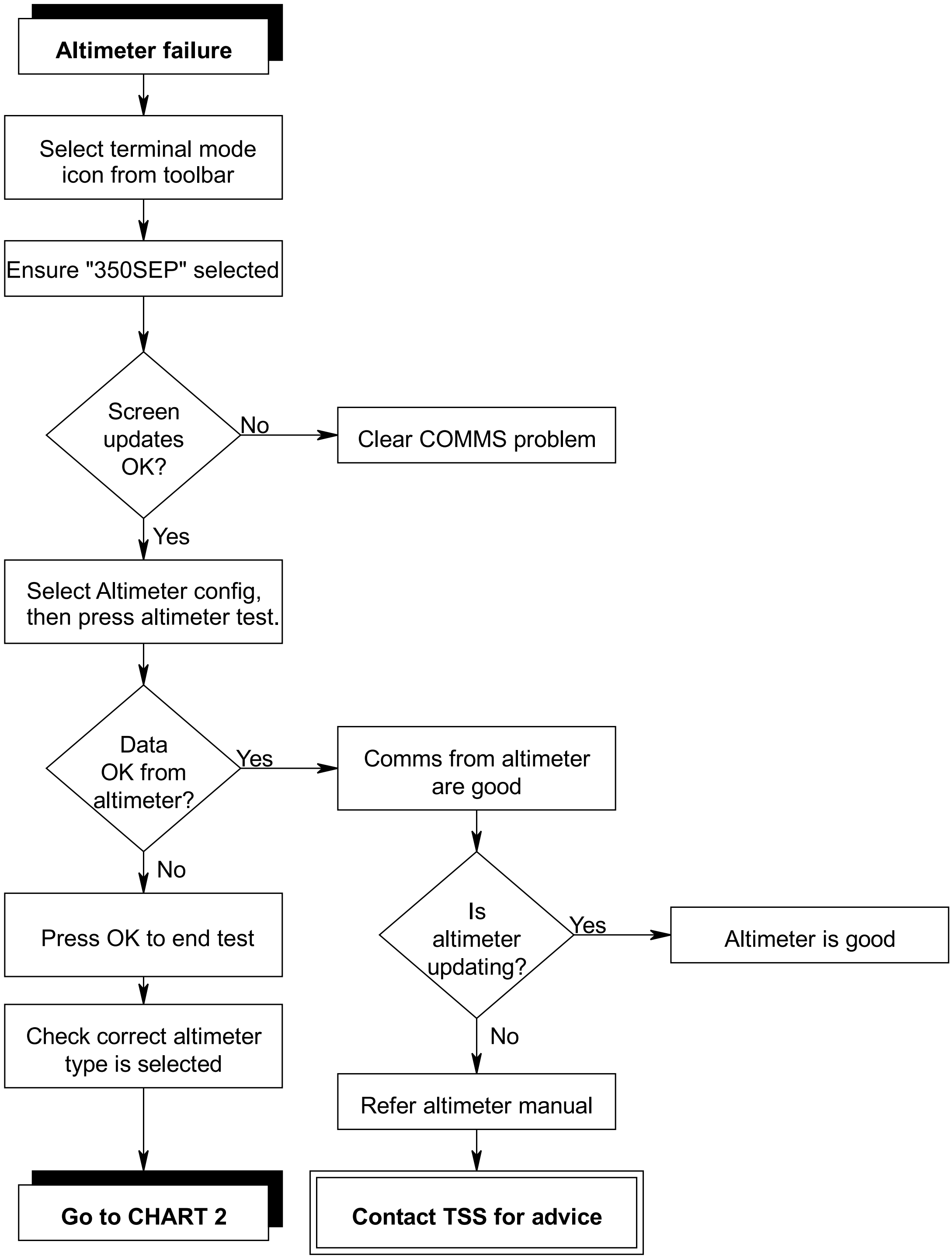


Figure 9-11: Altimeter failure – CHART 1

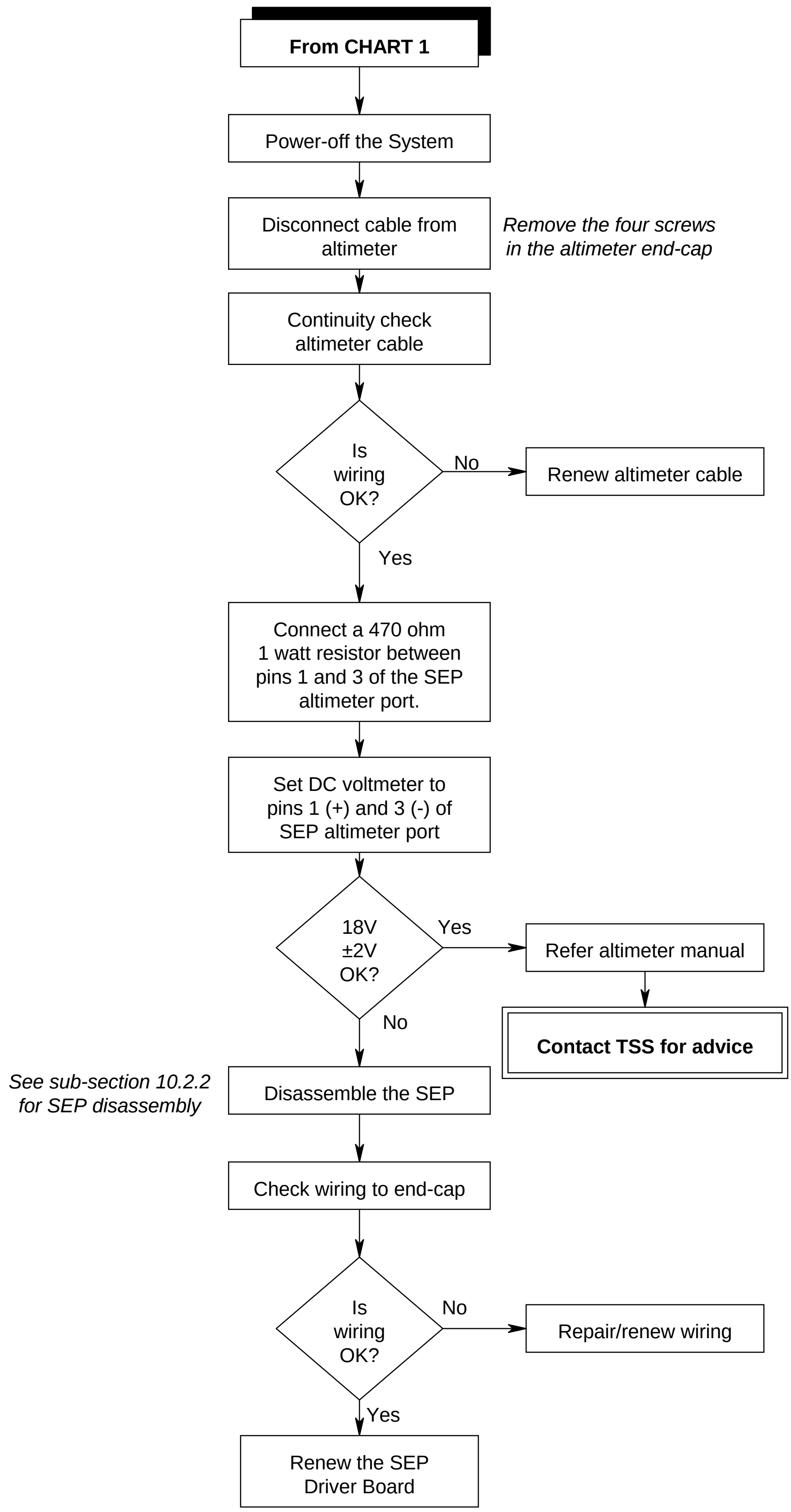


Figure 9-12: Altimeter failure – CHART 2

9.3.4 Unexpected Signal Variation During Normal Operation

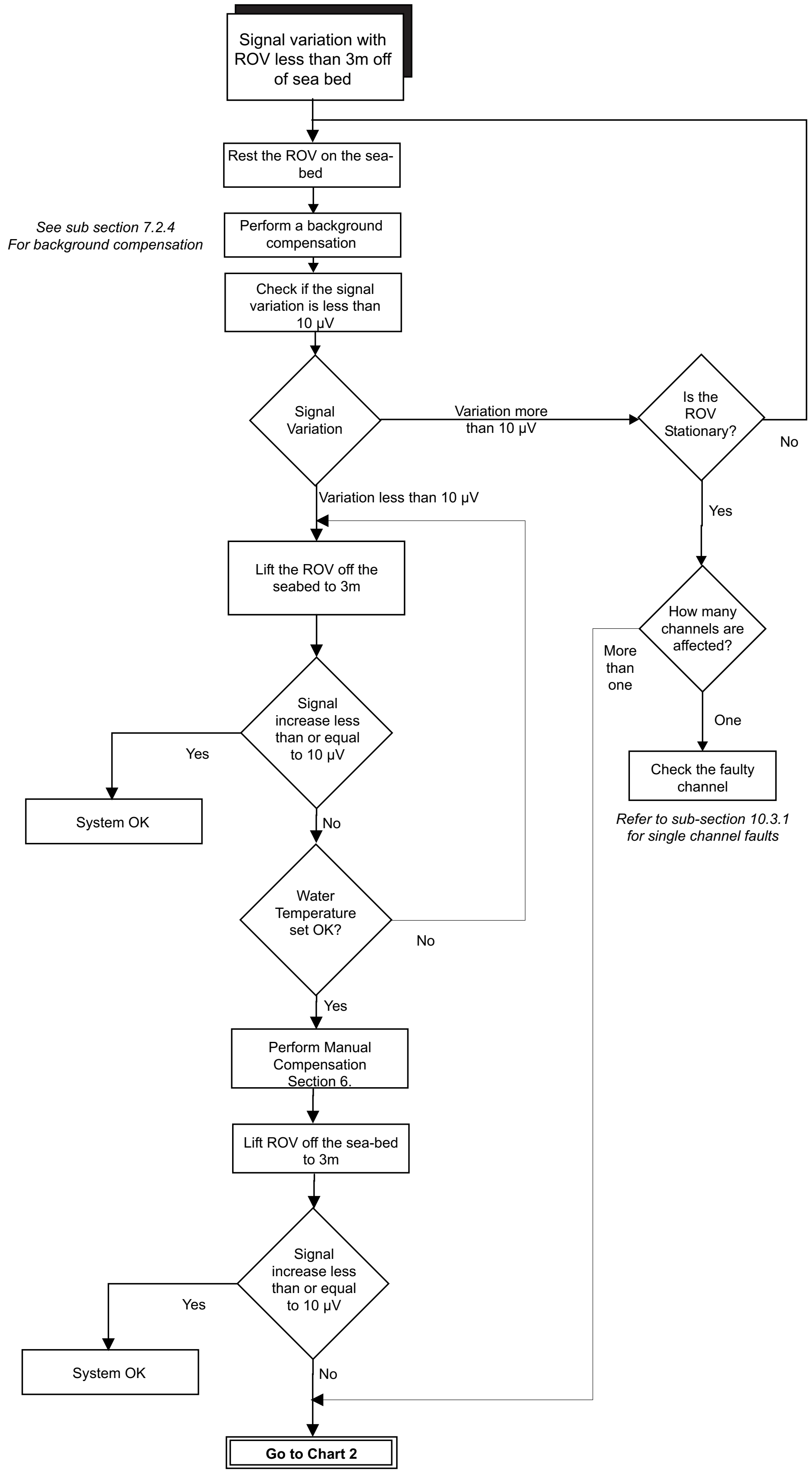


Figure 9-13: Signal shifts – CHART 1

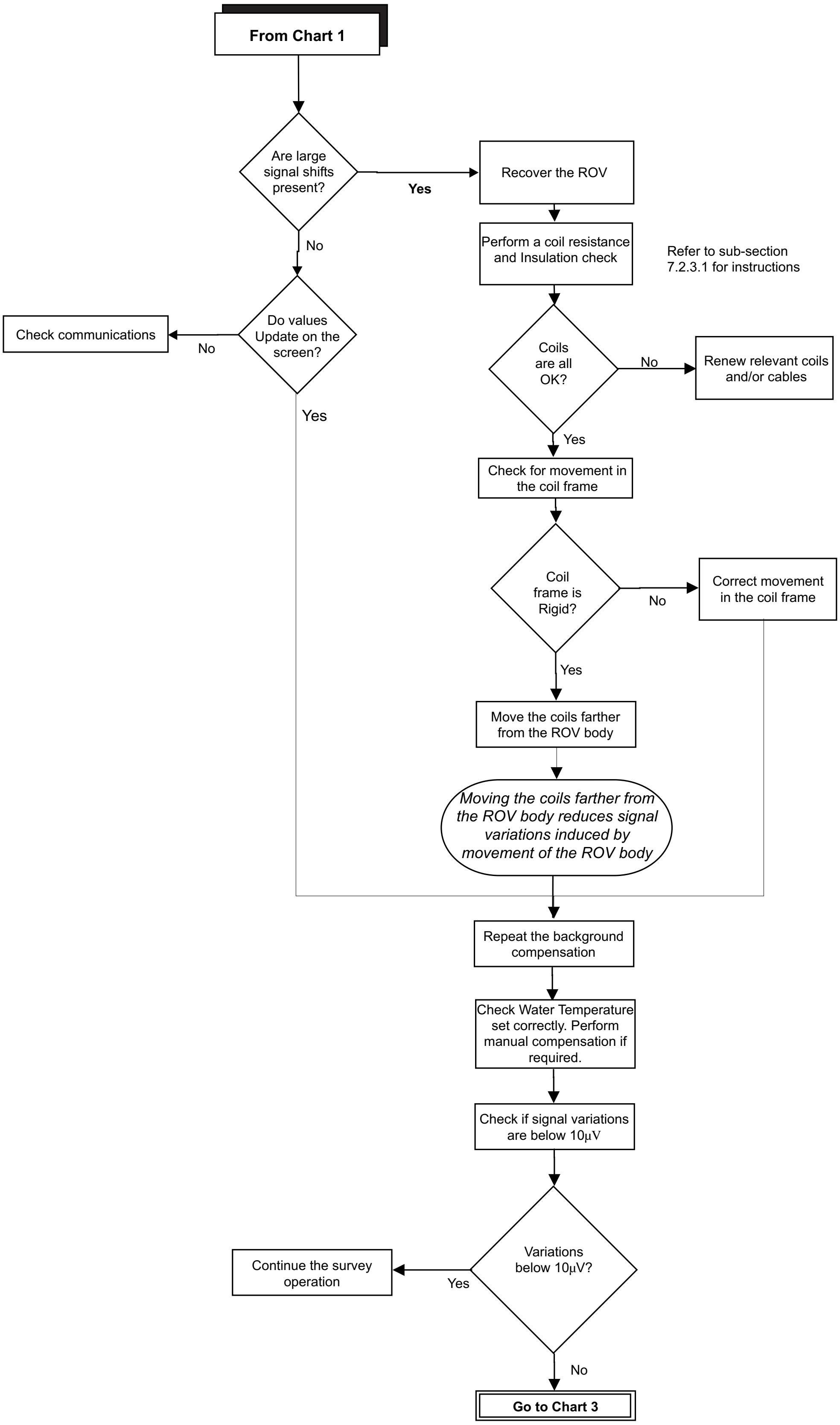


Figure 9-14: Signal shifts – CHART 2

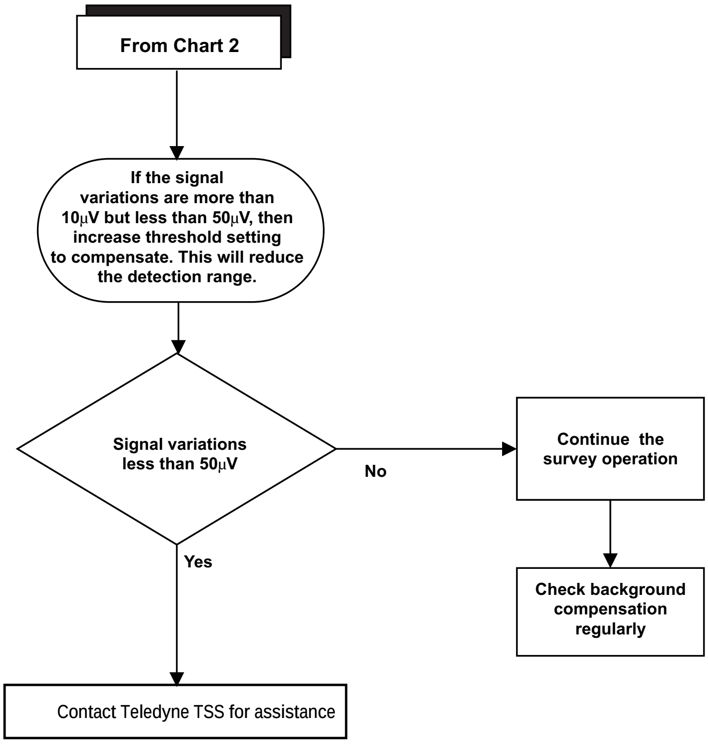


Figure 9-15: Signal shifts – CHART 3

10 System Drawings

The following sub-sections contain all the electrical and mechanical drawings relevant to the 440 Pipe and Cable Survey System.

10.1 Electrical Drawings

Table 10-1: Electrical Drawings

Drawing Number	Description
490232 – 1	Sub-sea Electronics Pod (Aluminium and Stainless Steel)
401178 – 1	Main Board
401178 – 2	Main Board – Processor
401178 – 3	Main Board – Analogue AD & DA
401178 – 4	Main Board – Timing & Comms.
B929935-1	Main Board - Piggy-back board
401181 – 1	Driver Board
401181 – 2	Driver Board – Control
401181 – 3	Driver Board – MOSFETs
401071 – 1	Analogue Board
401071 – 2	Analogue Board – Control
401071 – 3	Analogue Board – Pre–amps
401050 – 1	PSU Filter Assembly
490228 – 1	Power Supply Pod (Aluminium & Stainless Steel) - 110 Volt version

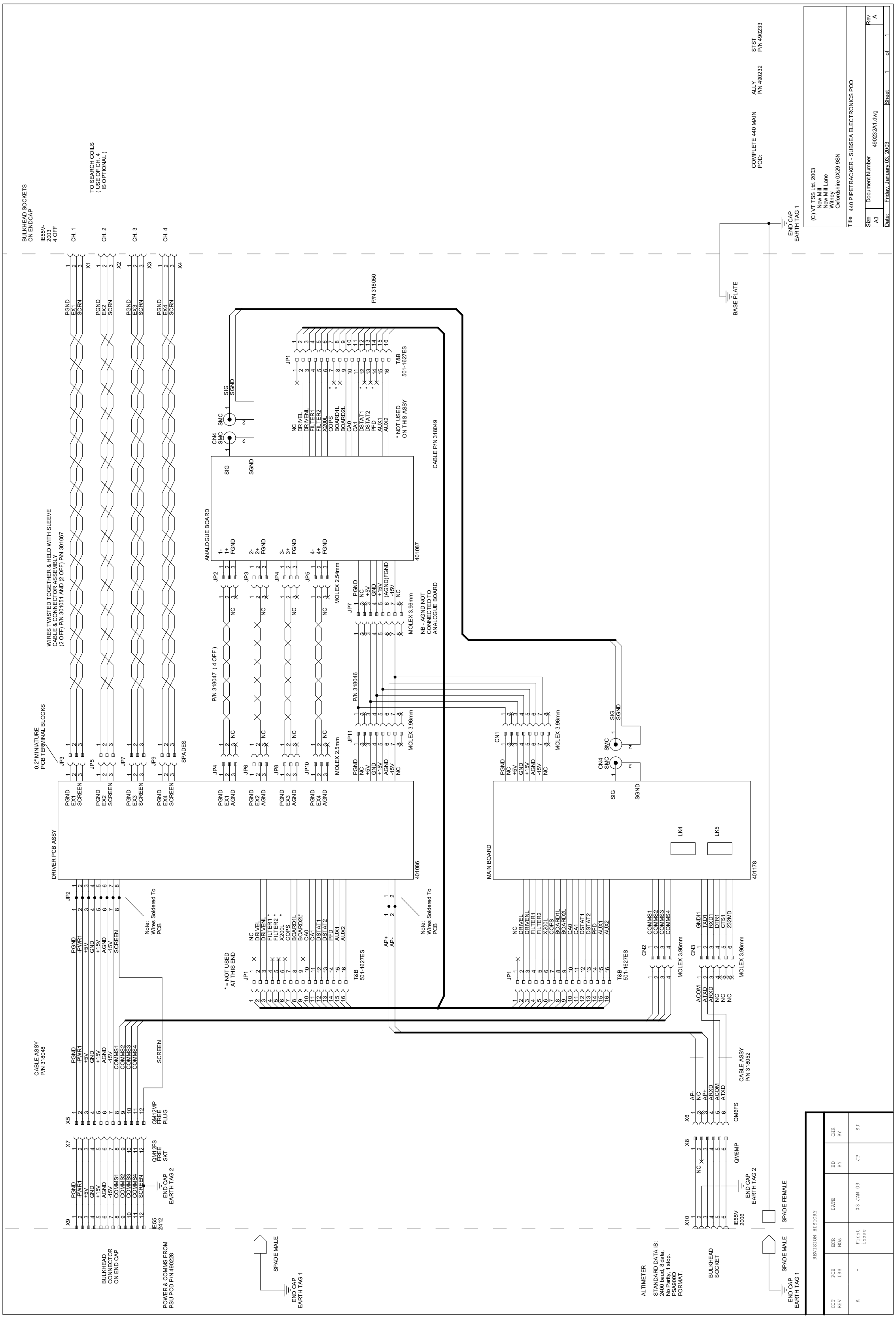


Figure 10-1: 490232-1 Sub-sea Electronics Pod

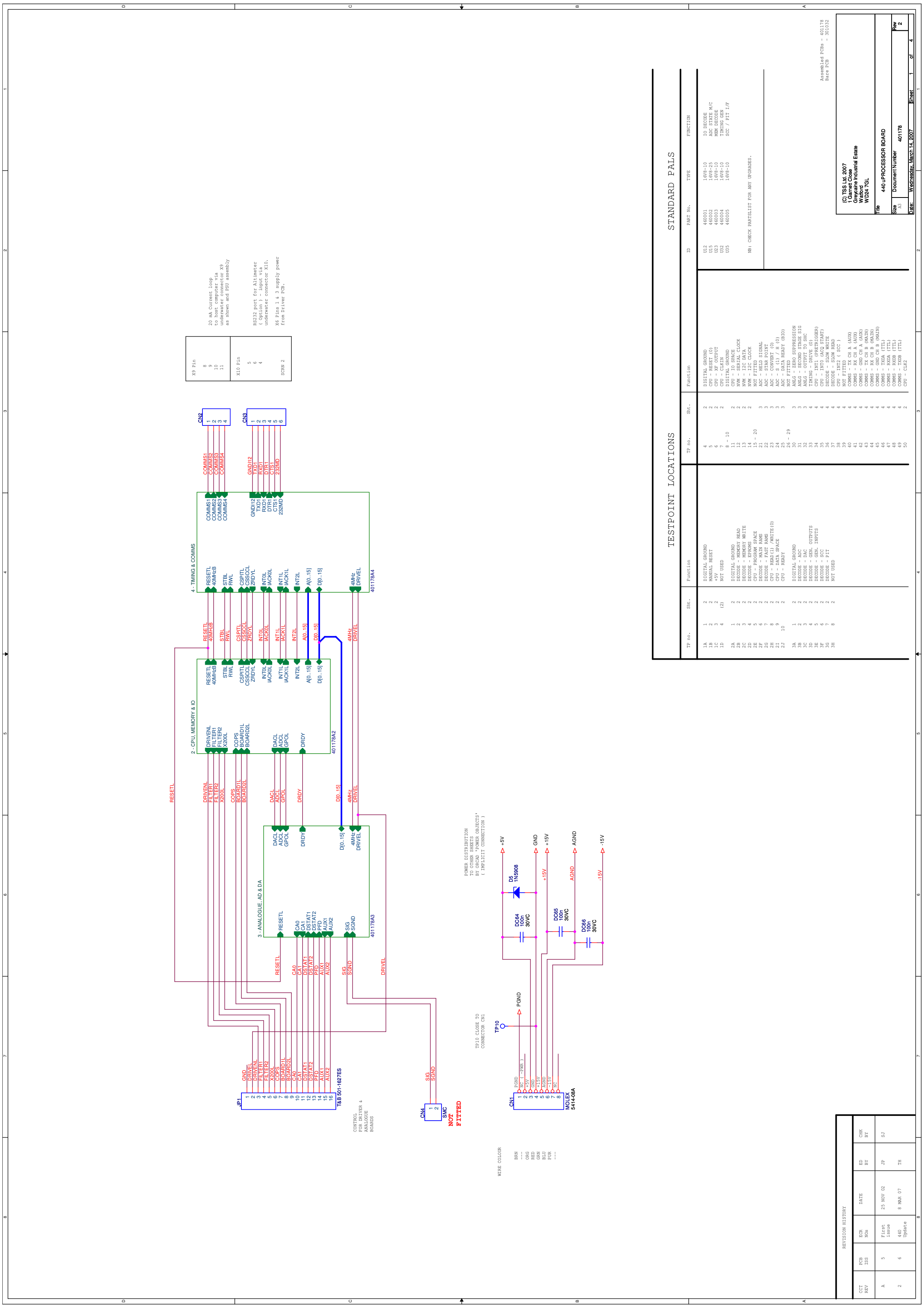


Figure 10-2: 401178-1 Main Board

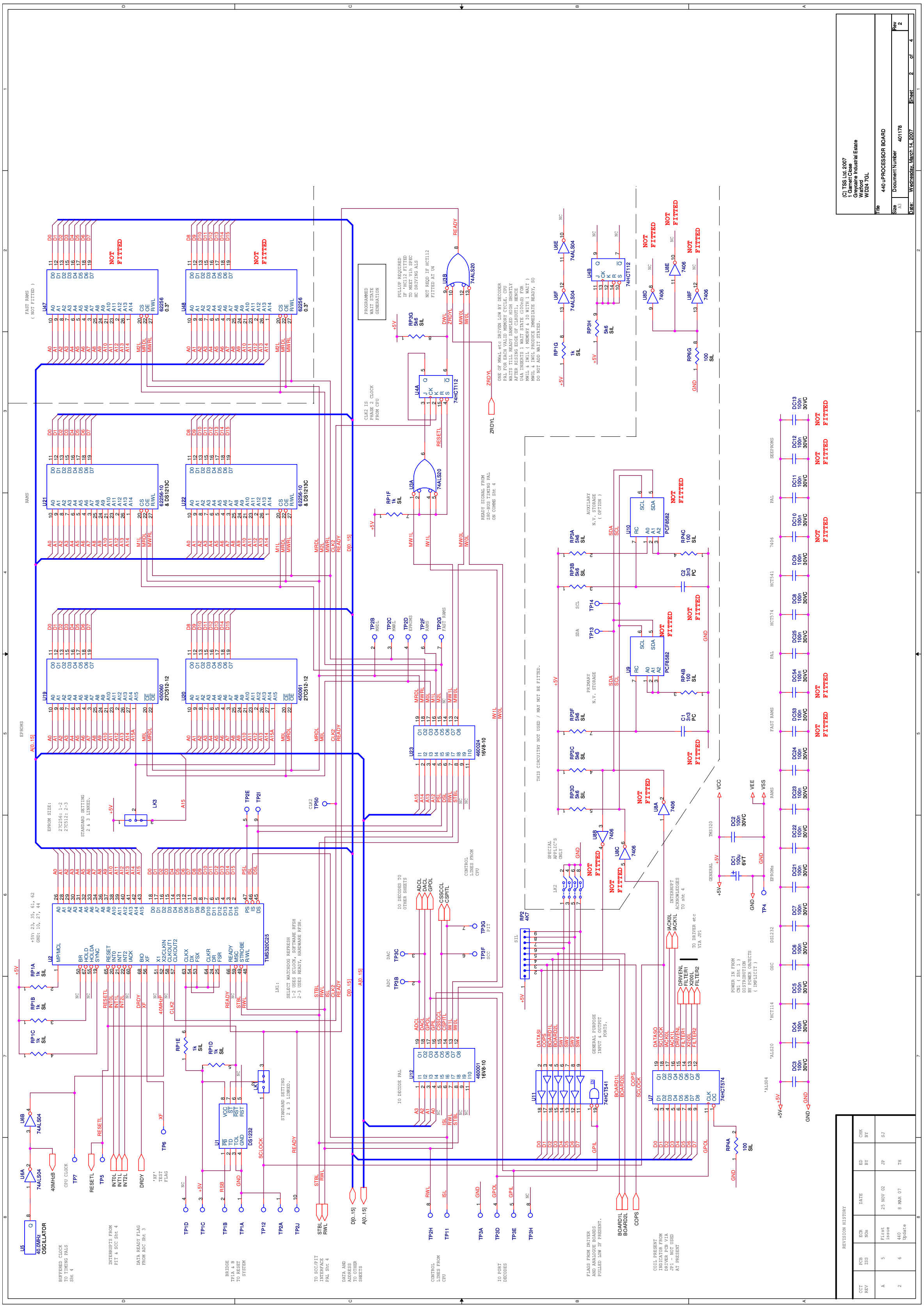


Figure 10-3: 401178-2 Main Board - Processor

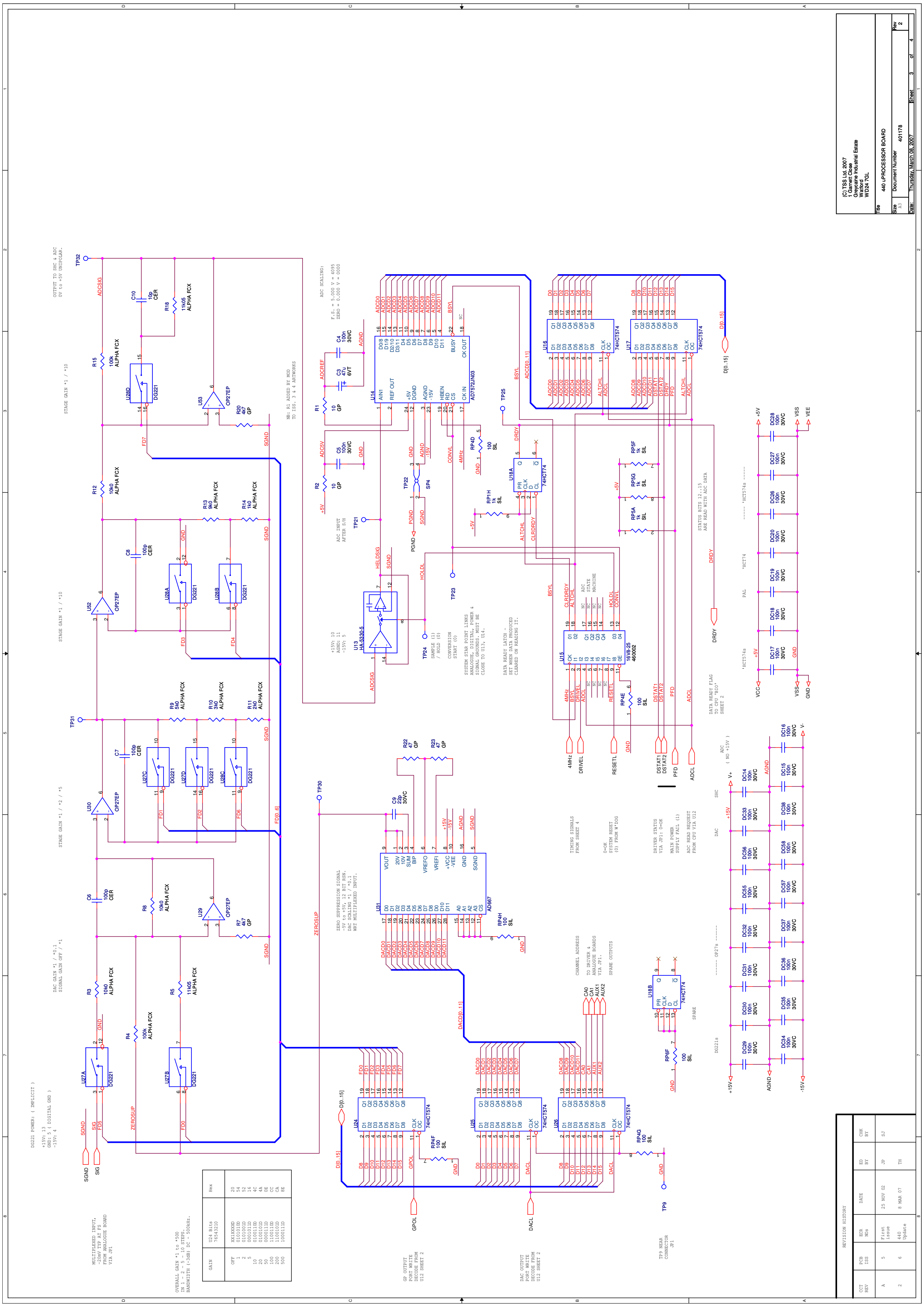


Figure 10-4: 401178-3 Main Board - Analogue AD & DA

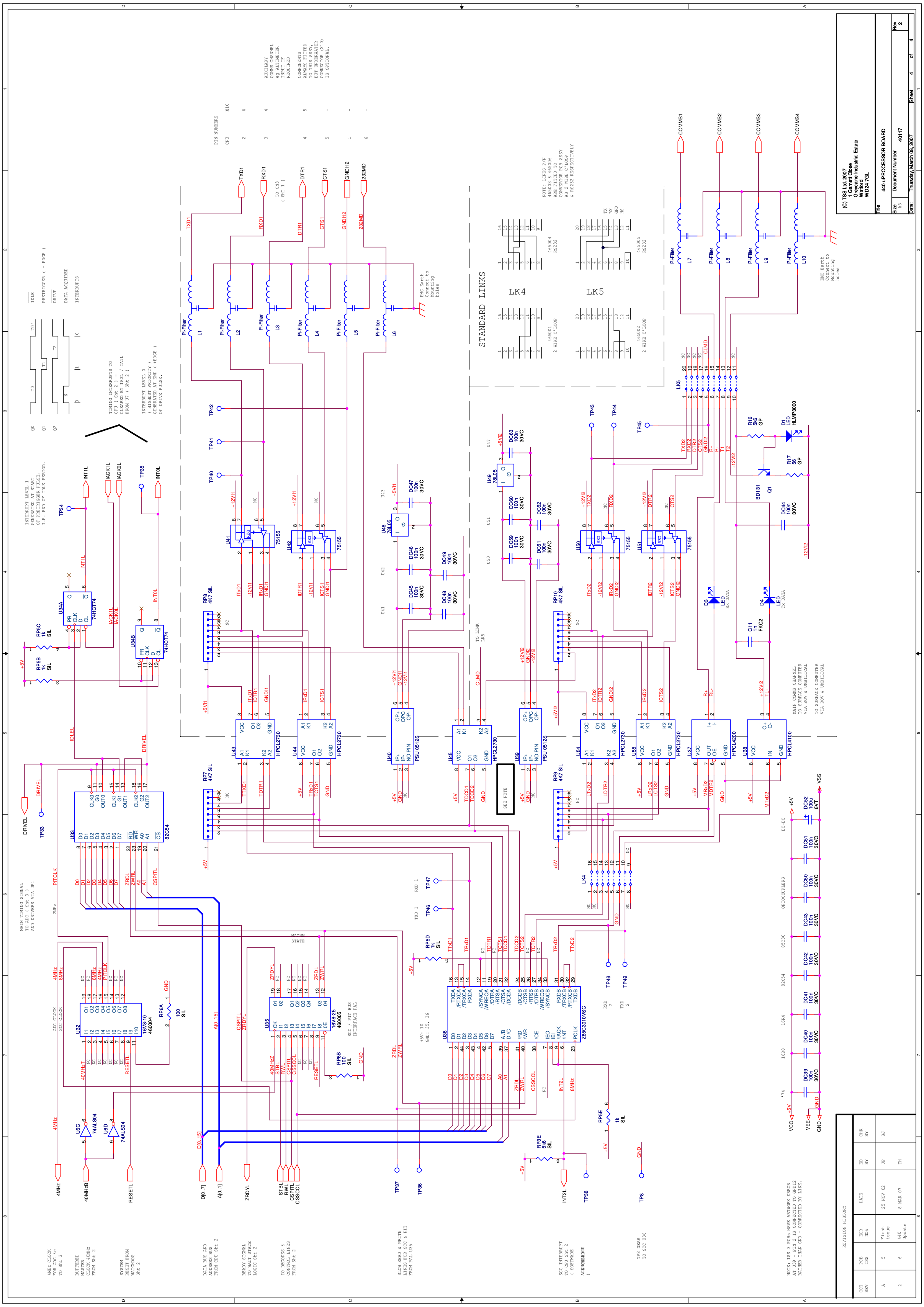


Figure 10-5: 401178-4 Main Board - Timing and Comms

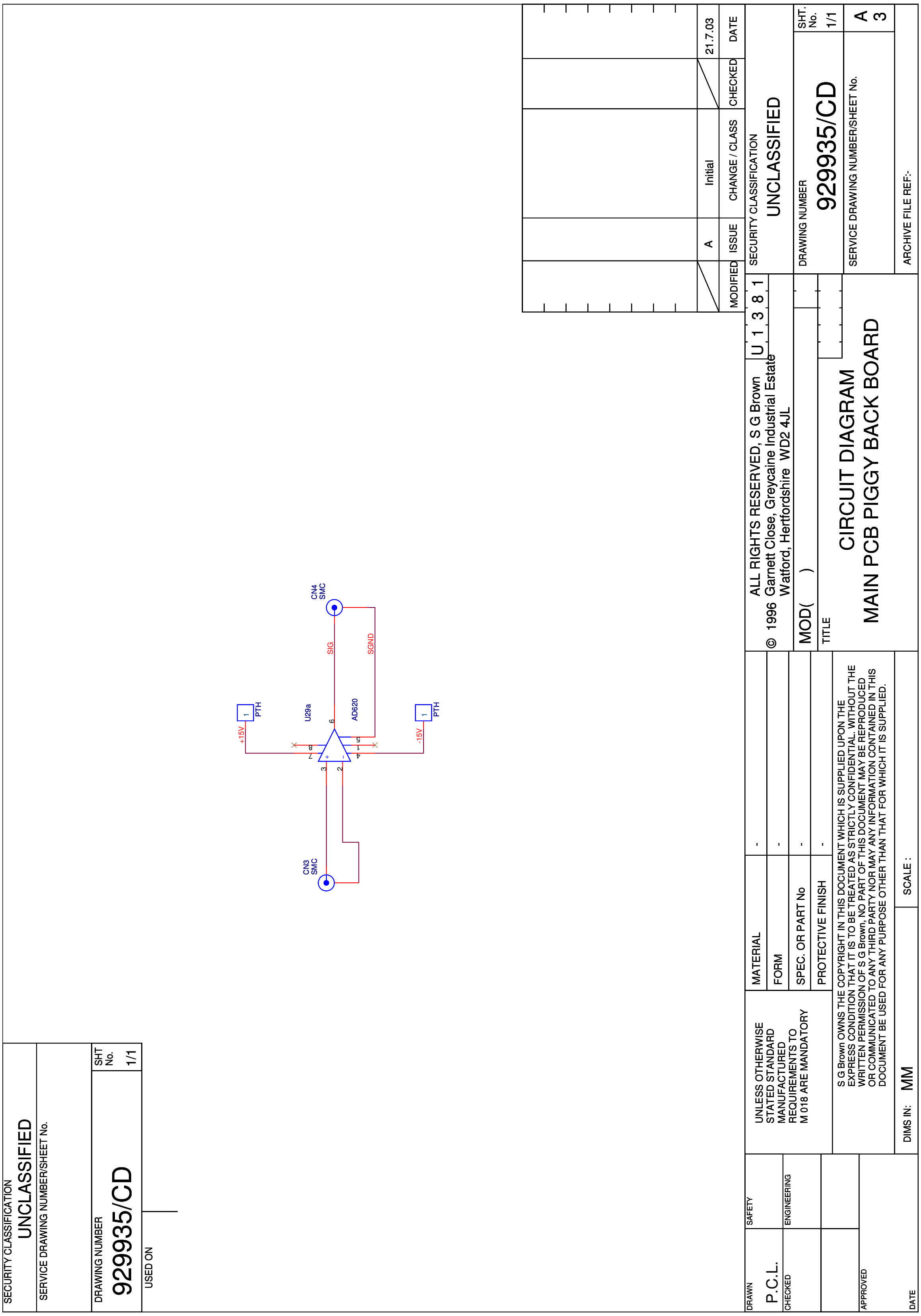


Figure 10-6: B929935-1 Main Board - Piggy-back board

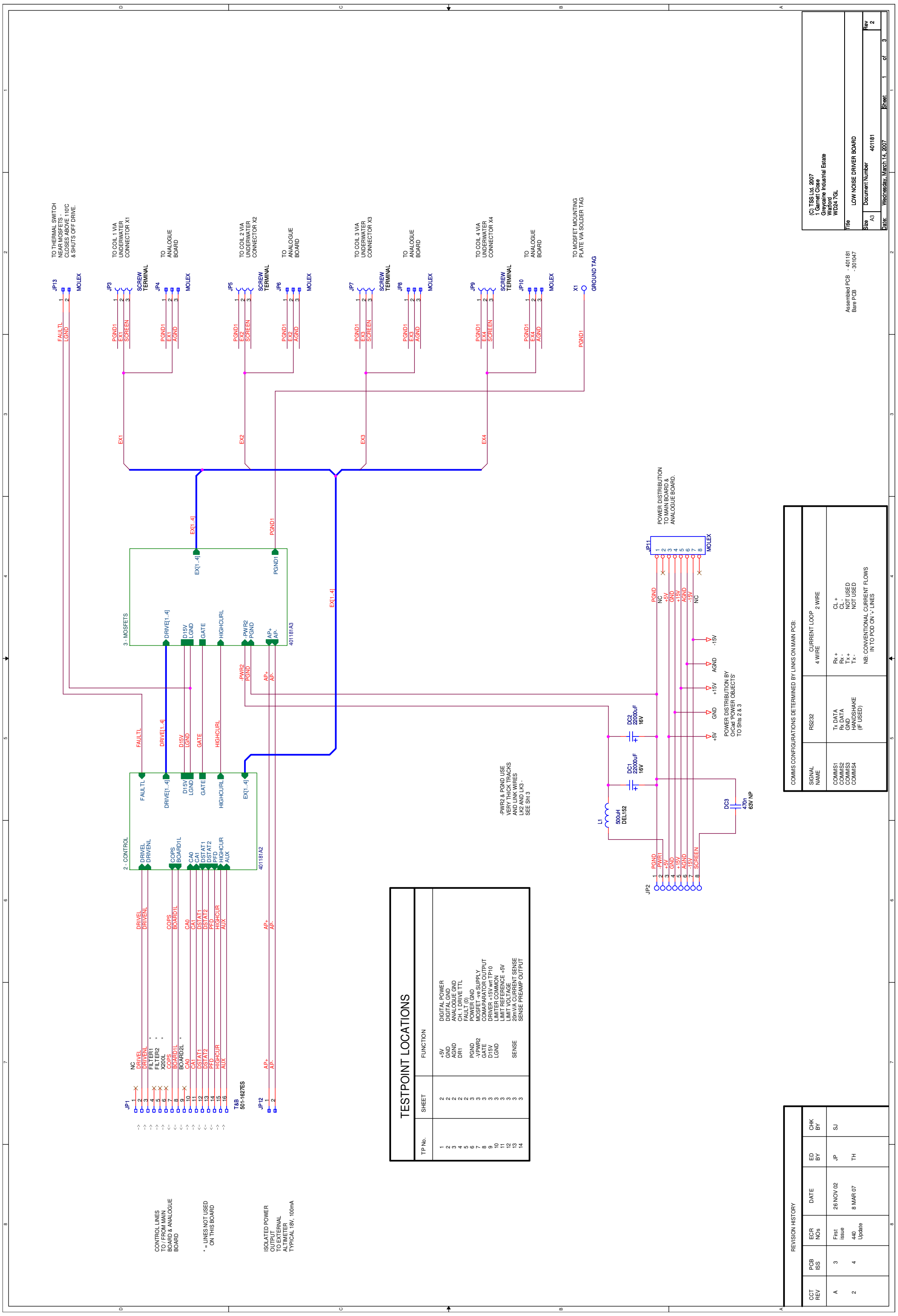


Figure 10-7: 401181-1 Driver Board

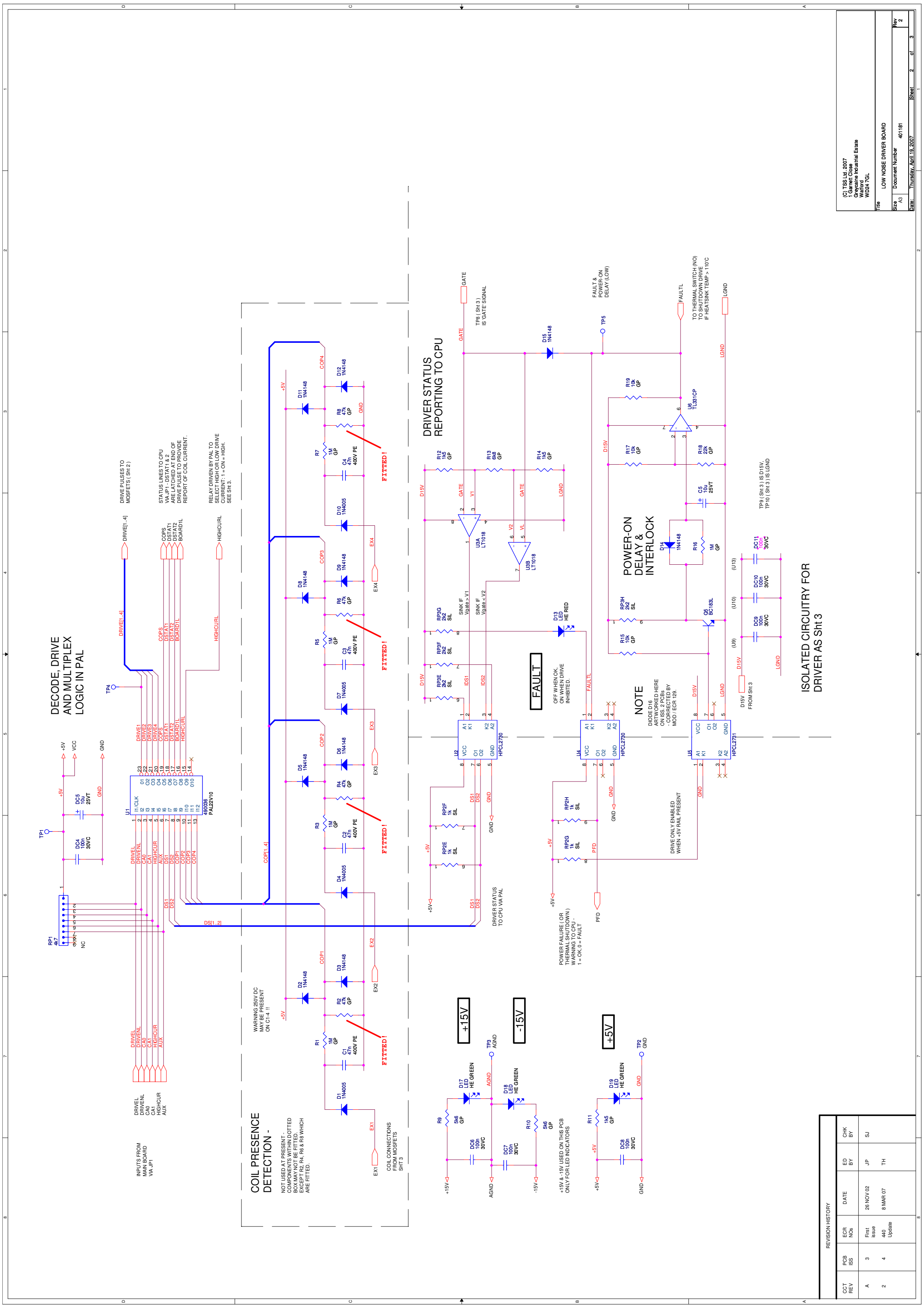


Figure 10-8: 401181-2 Driver Board - Control

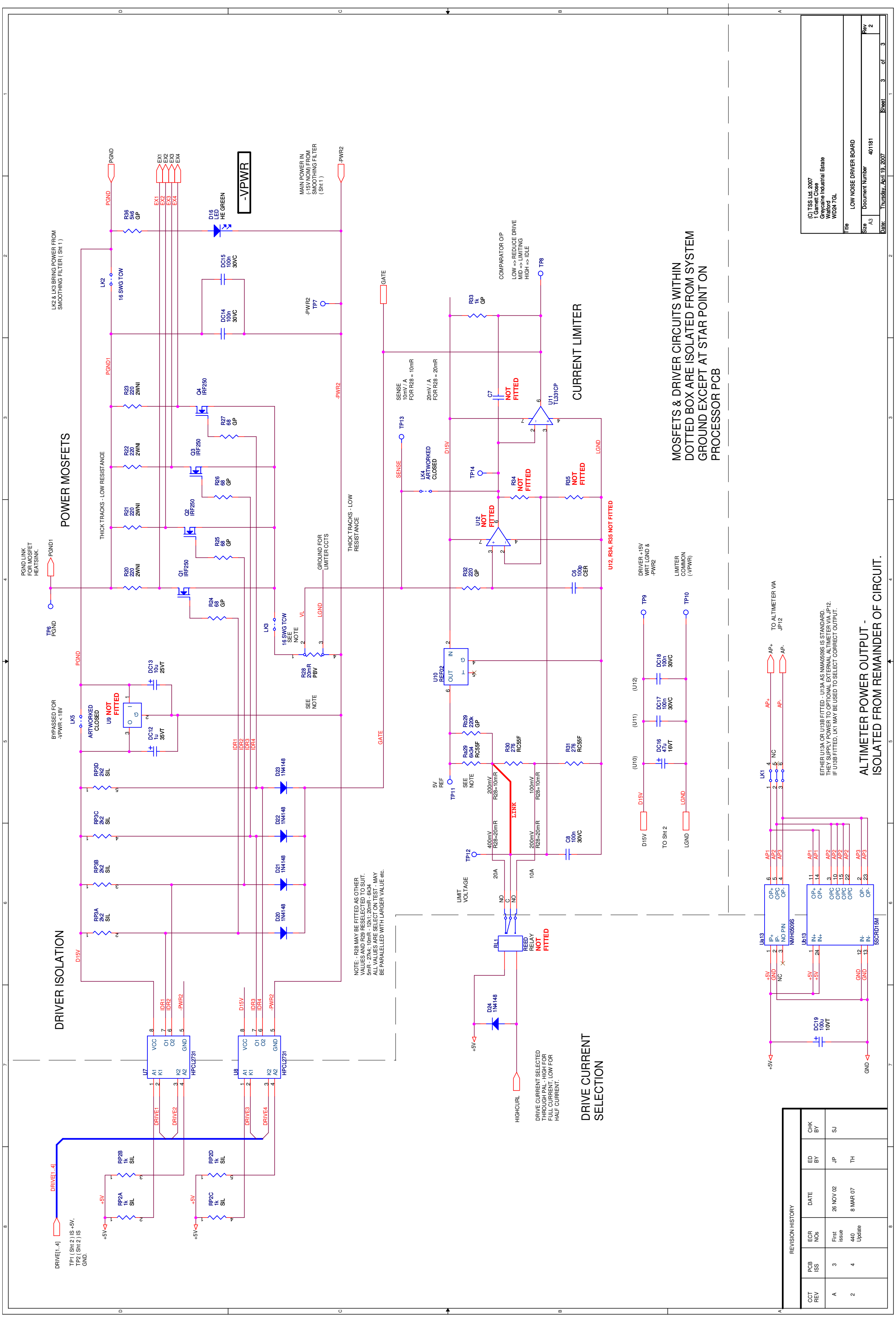


Figure 10-9: 401181-3 Driver Board - MOSFETS

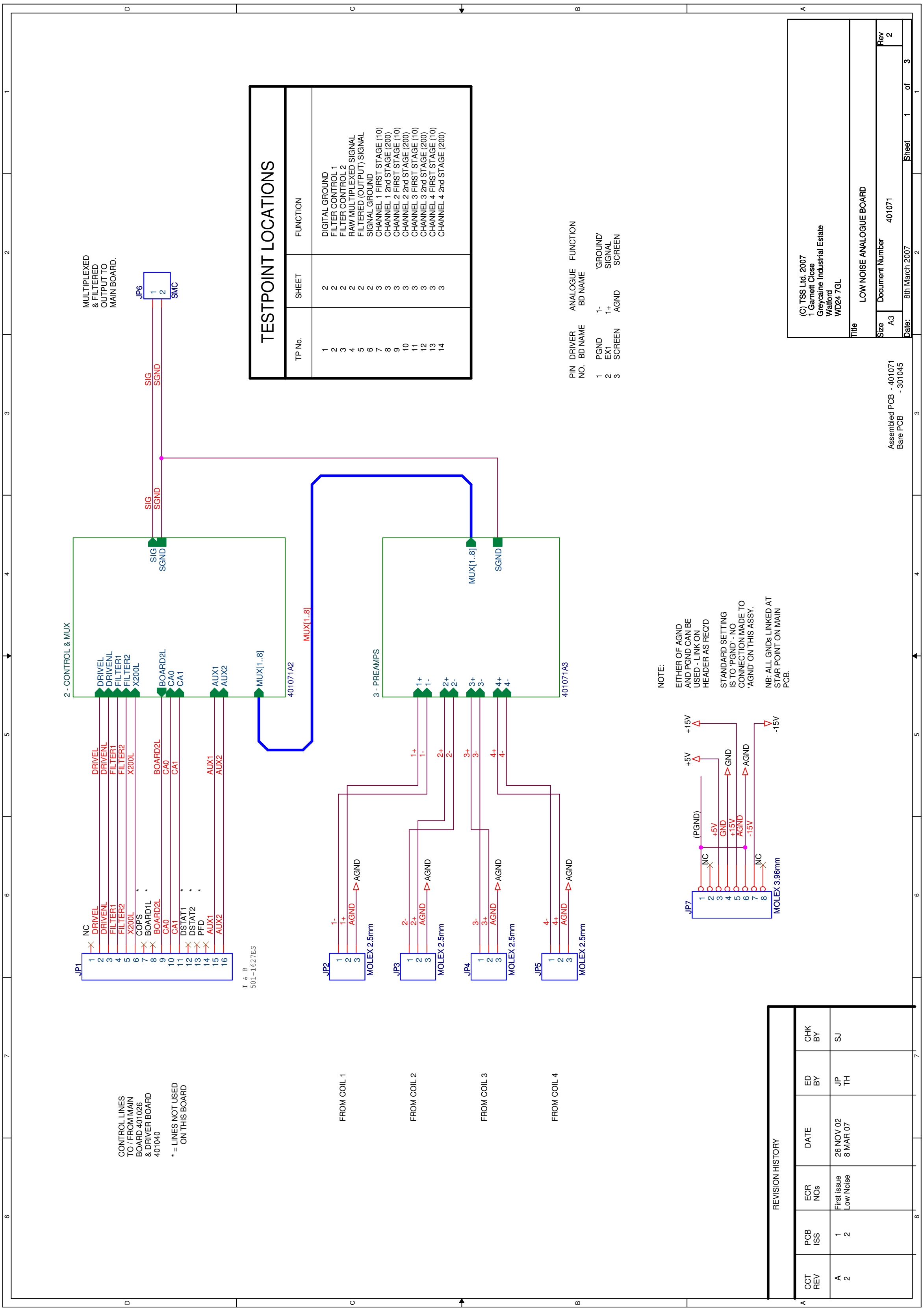


Figure 10-10: 401071-1 Analogue Board

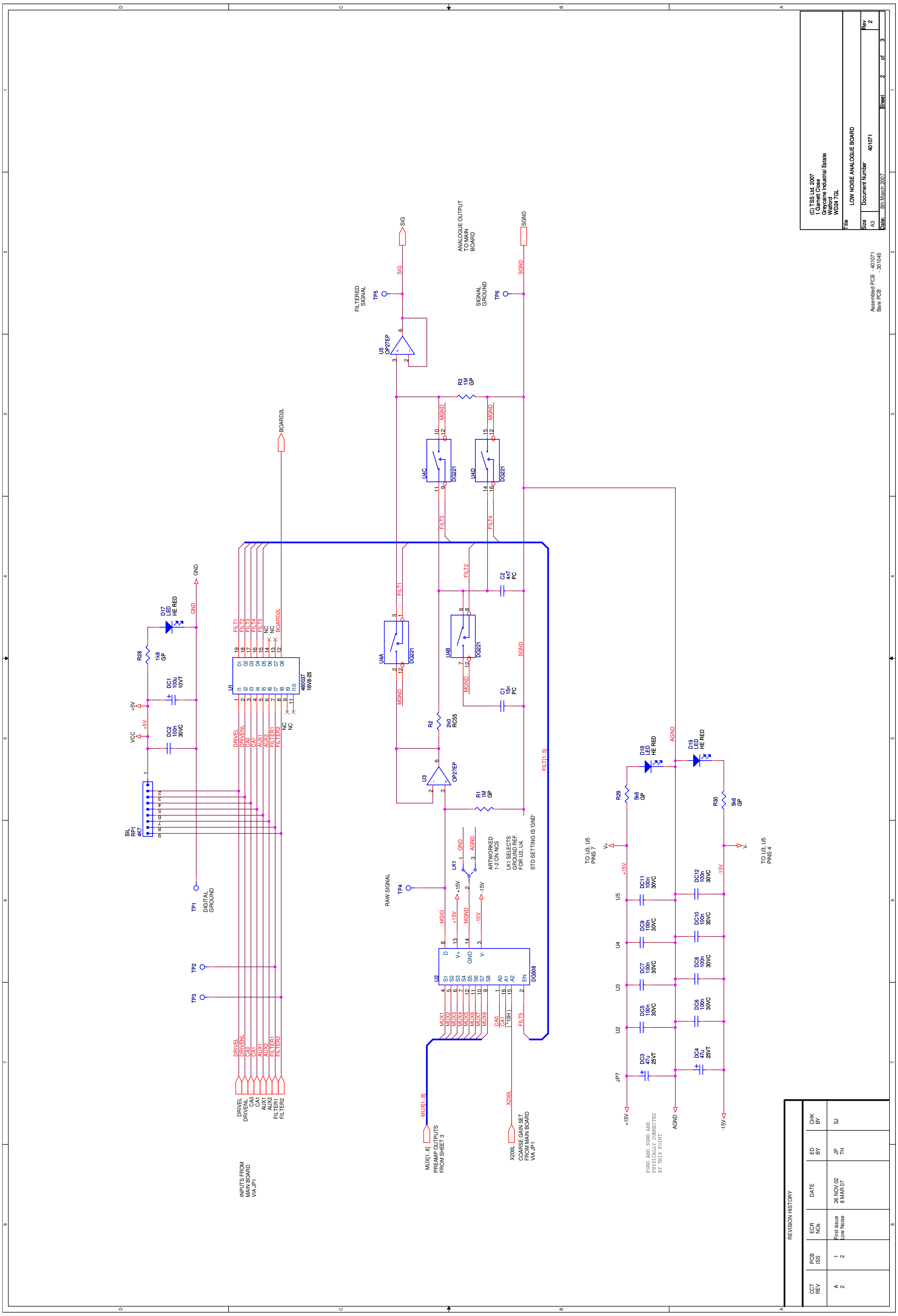


Figure 10-11: 401071-2 Analogue Board - Control

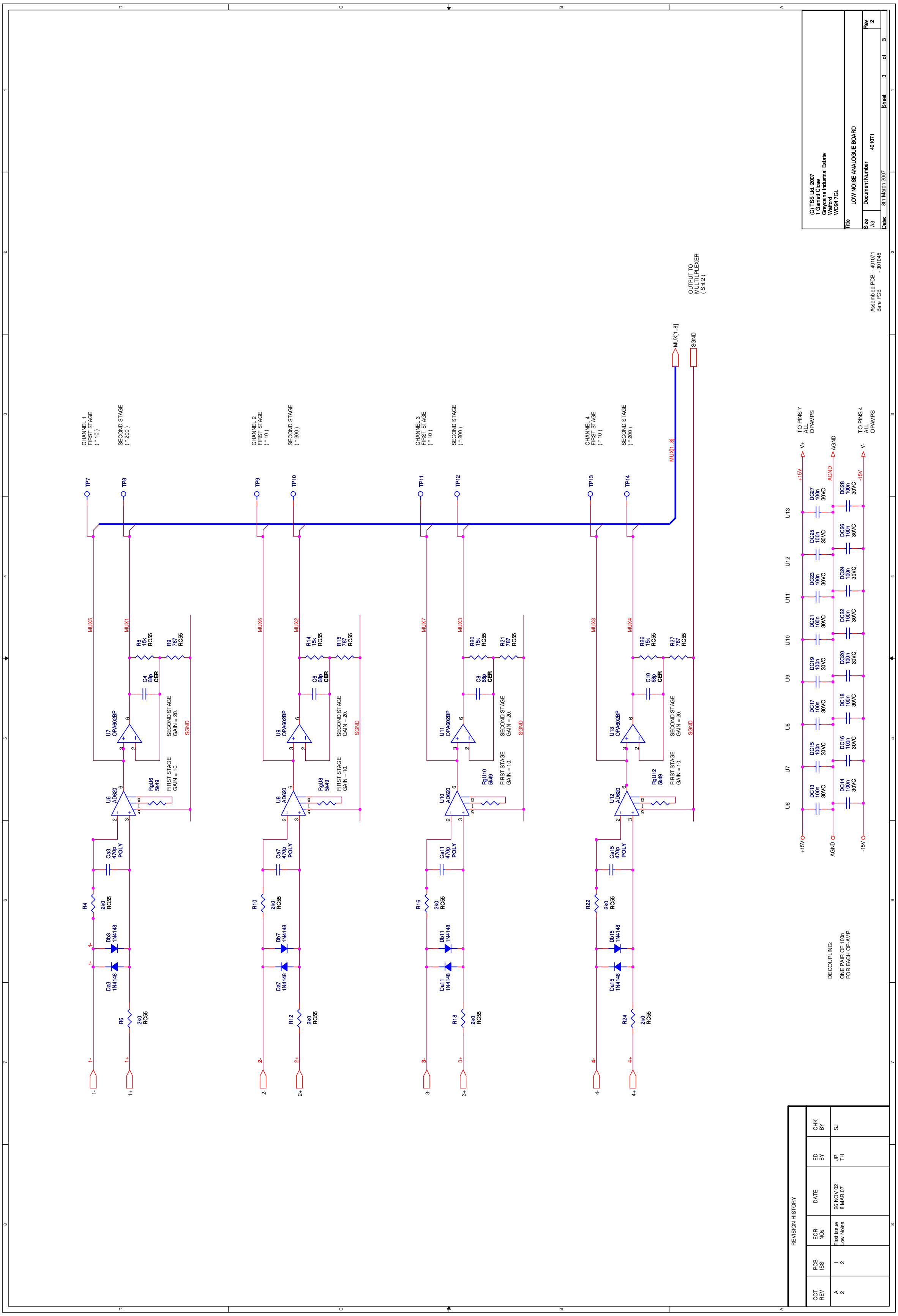


Figure 10-12: 401071-3 Analogue Board - Pre-amps

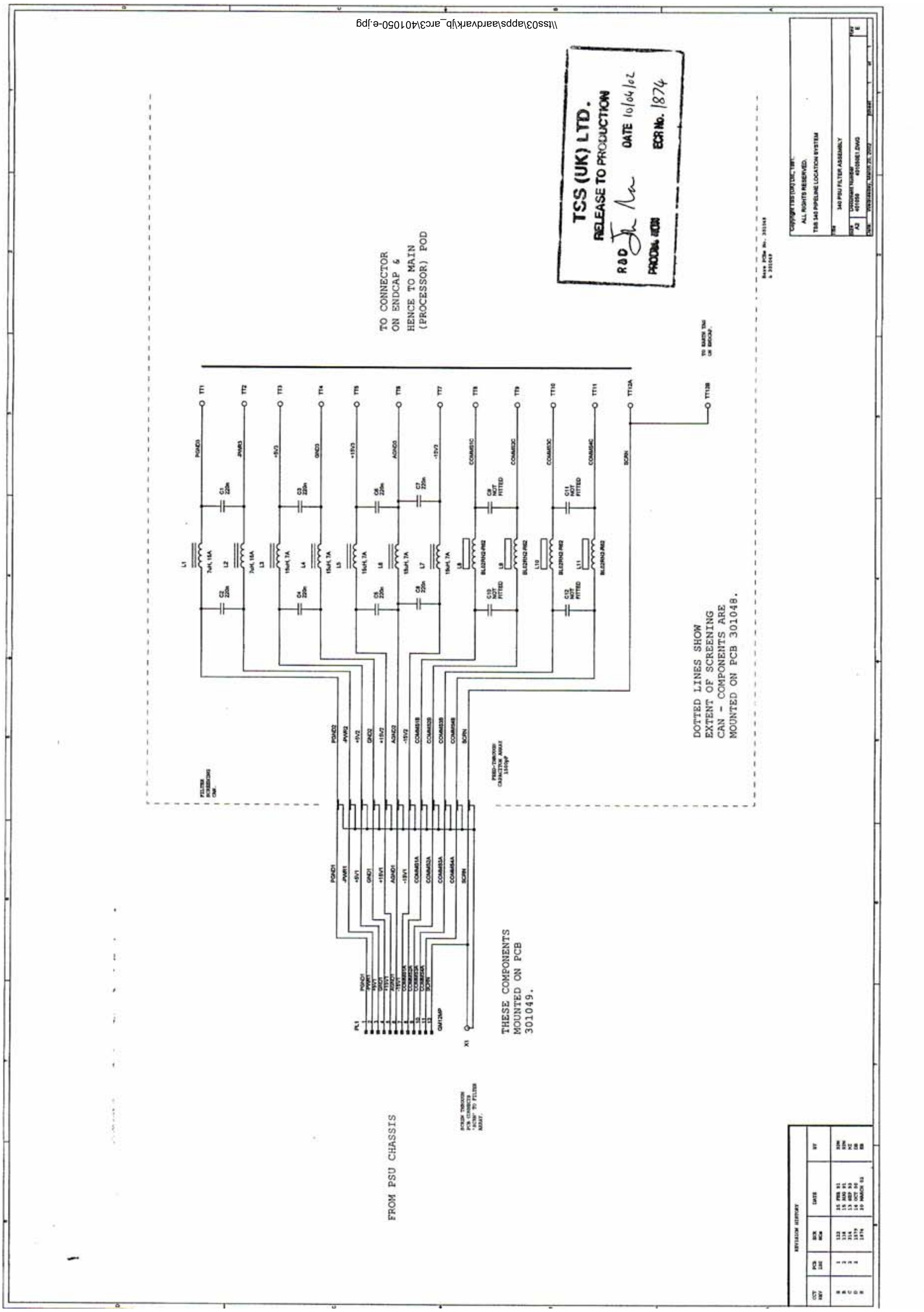


Figure 10-13: 401050-1 PSU Filter Assembly

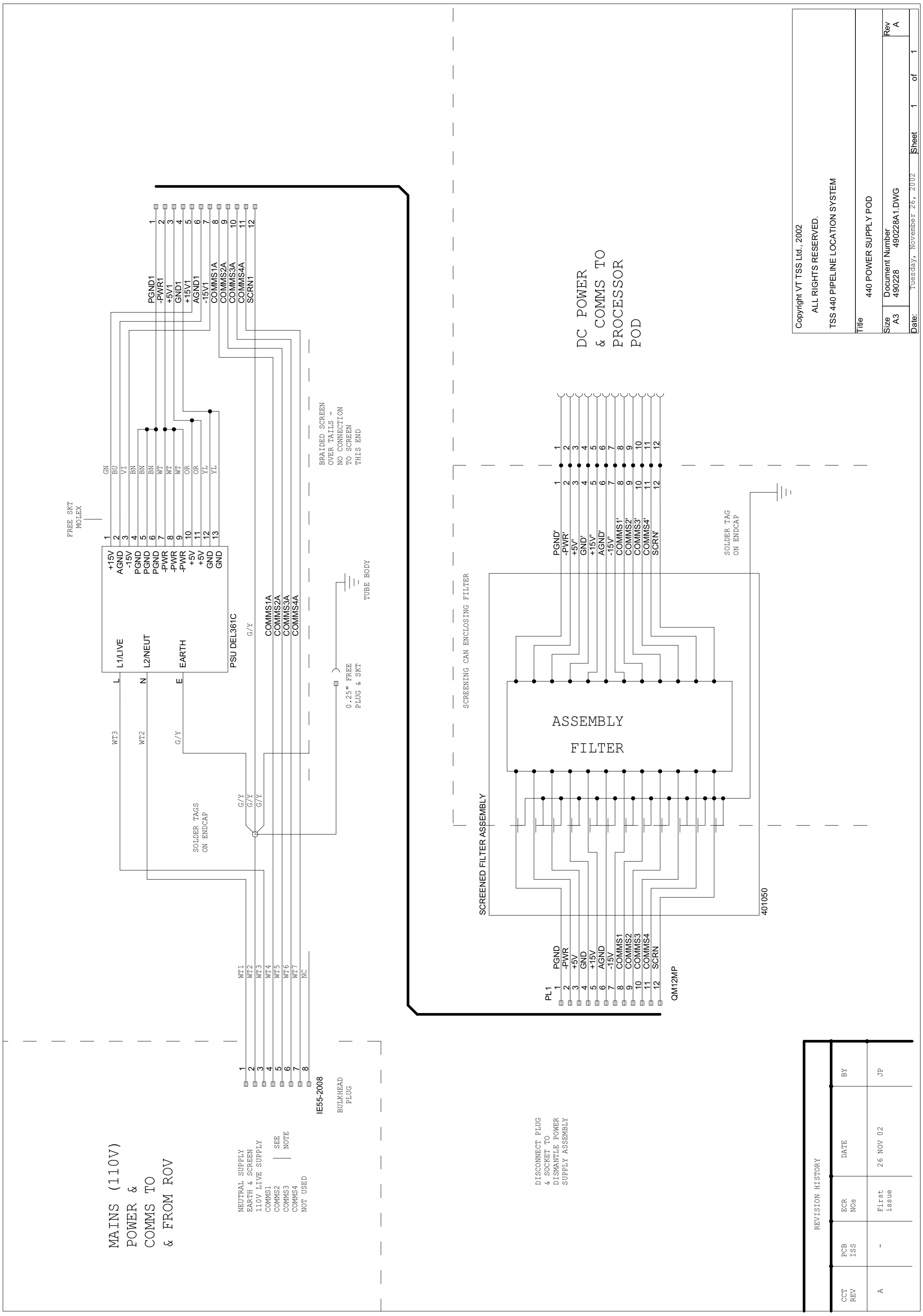


Figure 10-14: 490228-1 Power Supply Pod - 110V Version

10.2 Mechanical Drawings

Table 10-2: Mechanical drawings

Standard Product Drawing Number	Description	Stainless Steel Drawing Number*
N/A	SDC10 Dimensions	N/A
400604 – 1	Power Supply Chassis Assembly	400646 – 1
400667 – 1	Main Chassis Assembly	400668 – 1
400667 – 2	Main Chassis Assembly	400668 – 2
401181 – 1	Driver PCB Assembly	N/A
401071 – 1	Analogue PCB Assembly	N/A
400654 – 1	PSU Filter Assembly	400655
490232 – 1	Processor Pod Assembly	490233
490228 – 1	Power Supply Pod Assembly - 110 Volt version	490230
500045 – 1	Coil Mounting Frame	N/A
B930892 – 1	Coil Assembly	N/A
601004– 1**	Coil Cable Assembly	N/A
B930473 – 1	PSU to ROV (PWR/COMMS) Cable – 3.0m	N/A
601824 – 1	Teledyne TSS Altimeter 250Cable Assembly – 3.0m standard	N/A
601203 - 1	Benthos Altimeter Cable Assembly – 3.0m standard	N/A
500268 - 1	440 Pipe and Cable Survey System Complete Assembly	500270 - 1

* Stainless Steel Drawing Numbers included in this table for information only. For details and specification see the corresponding Standard Product Drawing Numbers.

** The coil cable assembly can be supplied in 3, 4, 6, 8 or 10m lengths. Drawing 601004 identifies the specific cable assemblies using the part number 601004/x, where ‘x’ reflects the specific cable length. For example, 601004/4 identifies the 4m coil cable assembly.

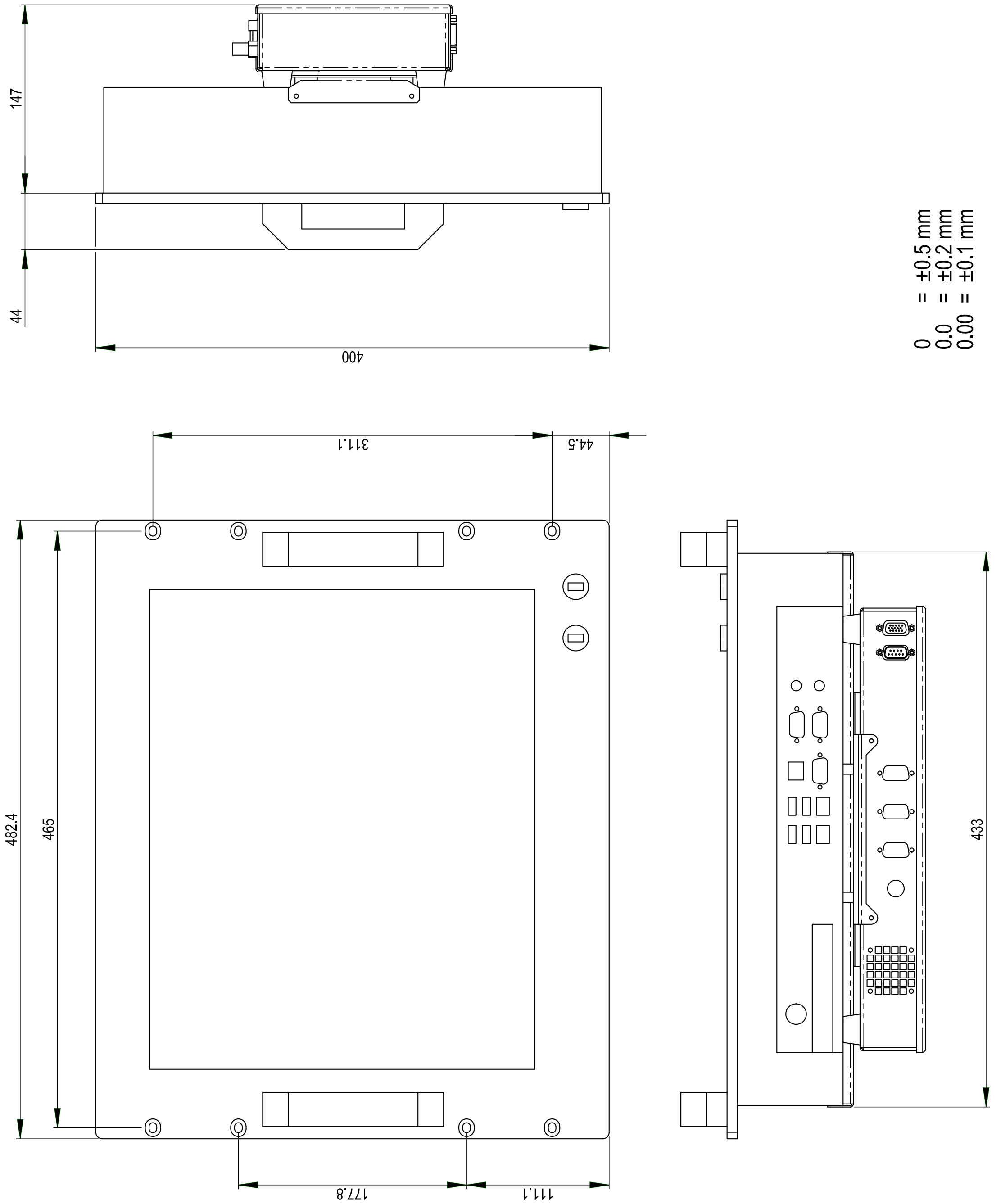


Figure 10-15: SDC10 Dimensions

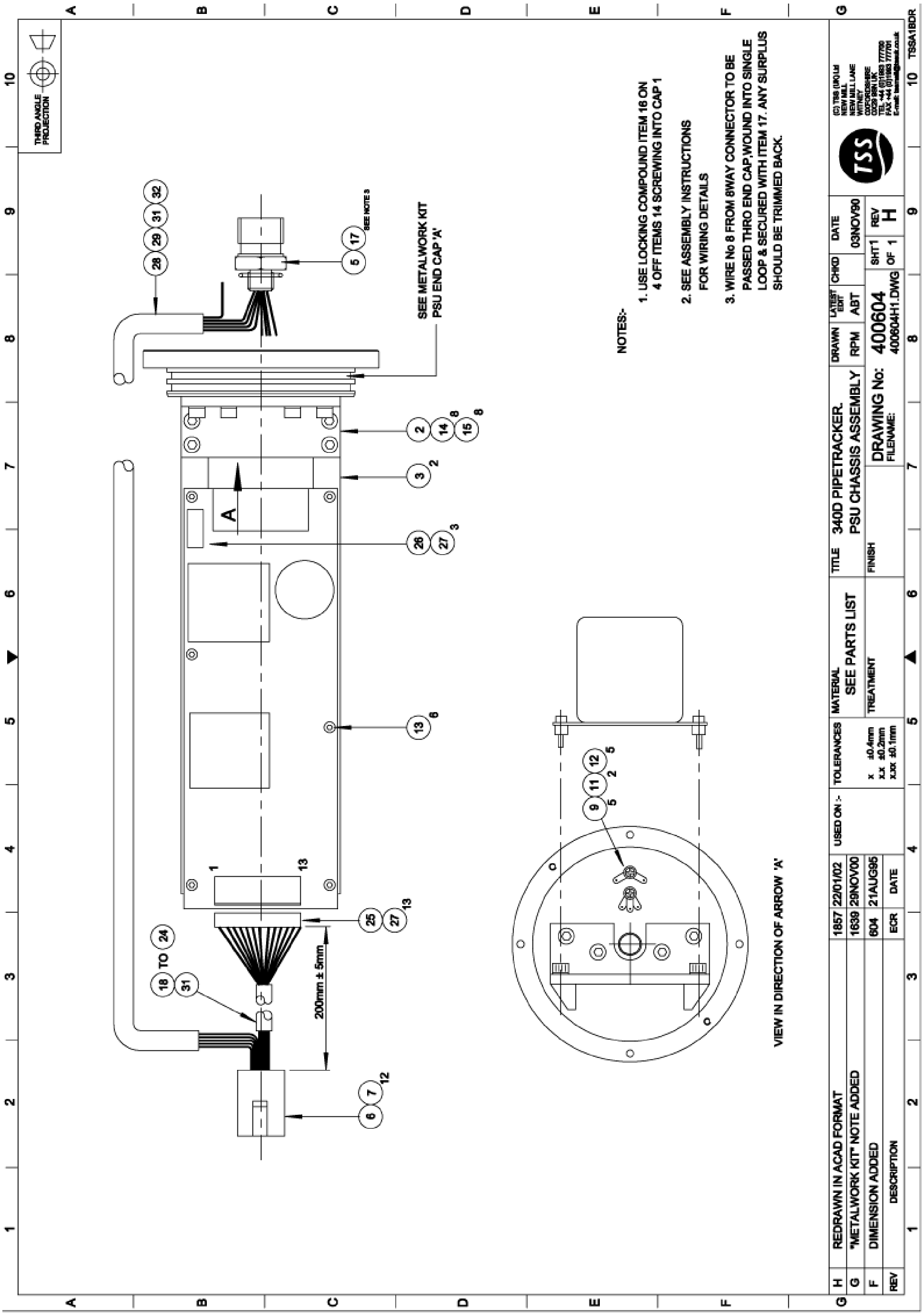


Figure 10-16: 400604-1 Power Supply Chassis Assembly

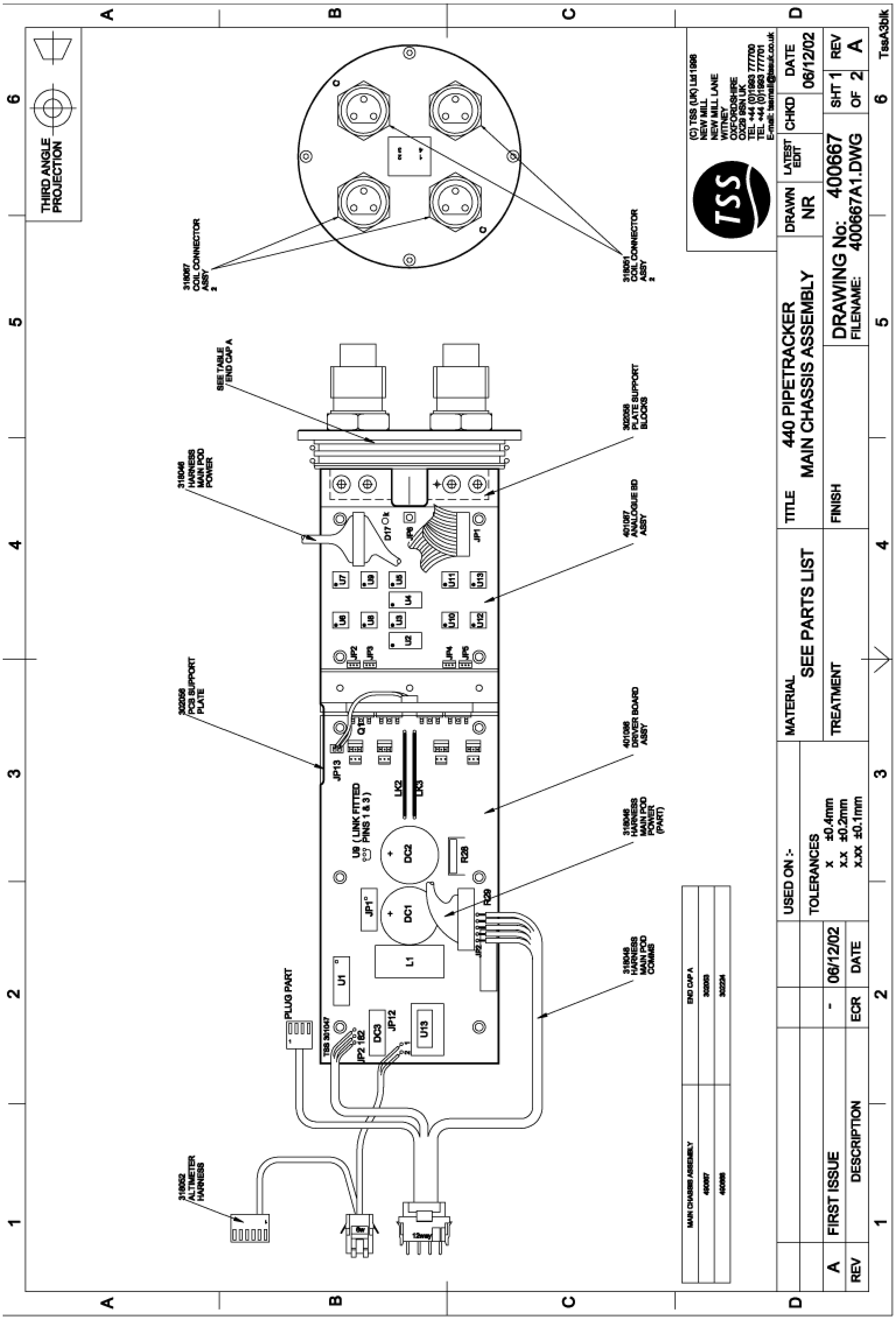


Figure 10-17: 400667-1 Main Chassis Assembly

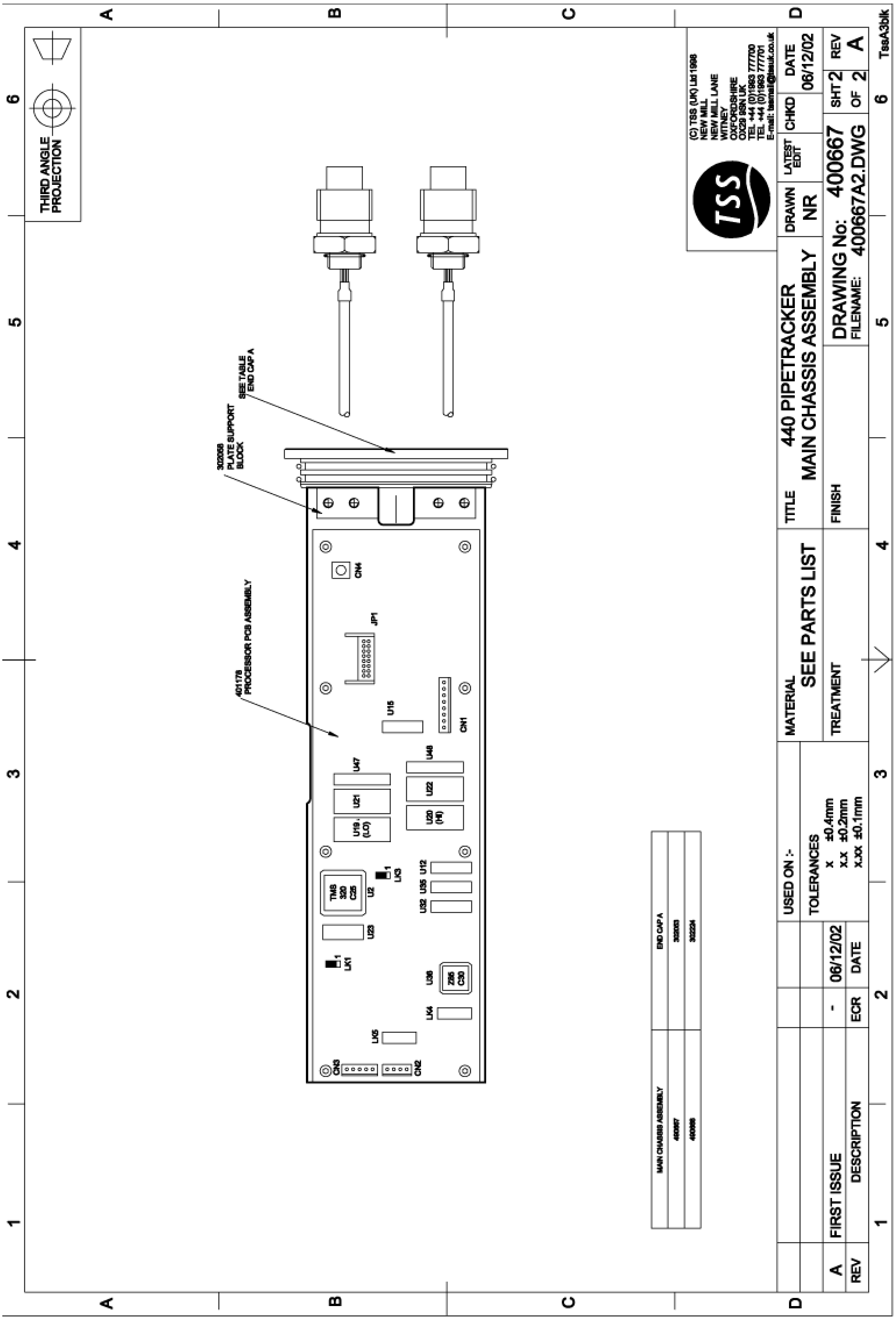


Figure 10-18: 400667-2 Main Chassis Assembly

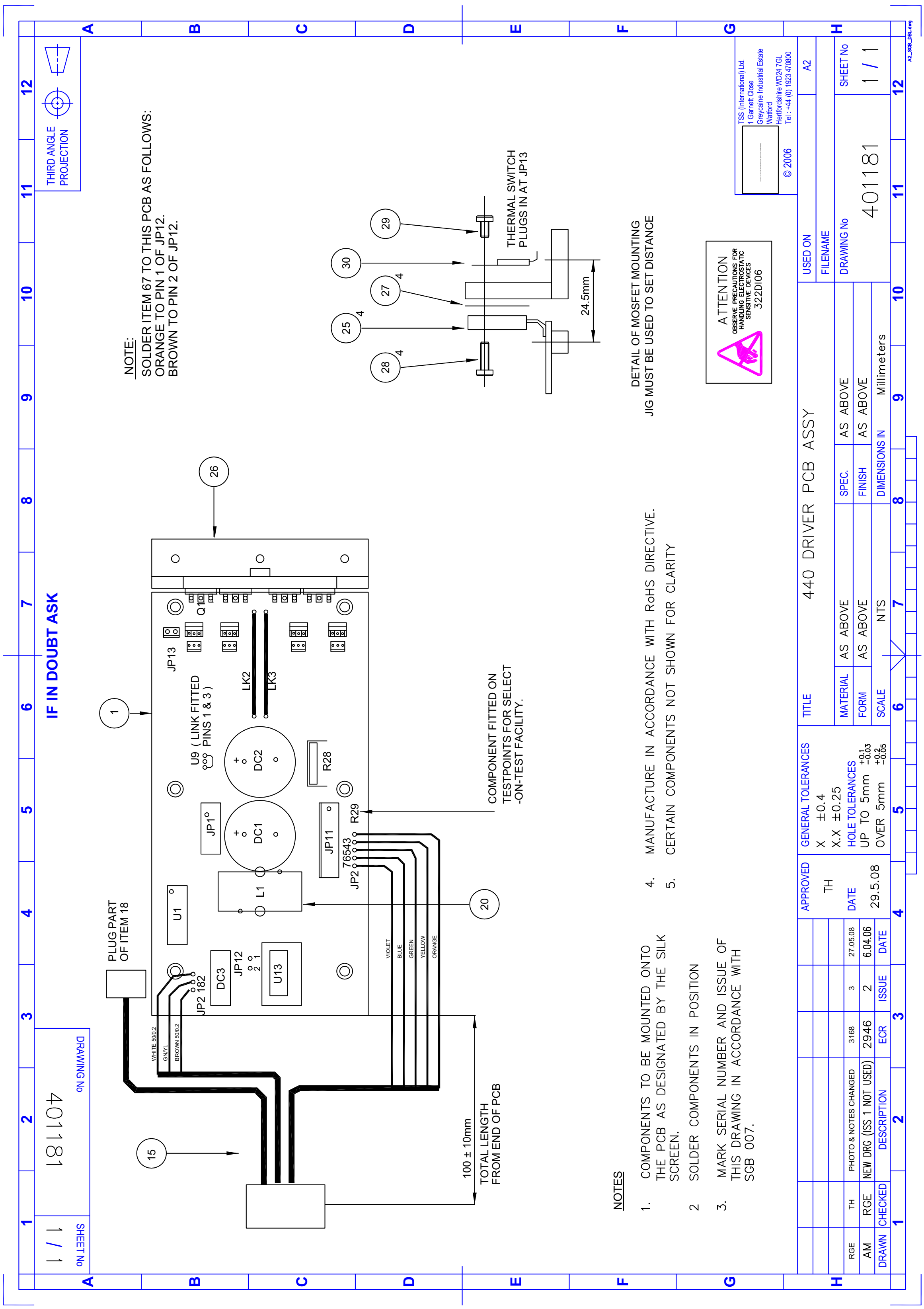


Figure 10-19: 401181-1 Driver PCB Assembly

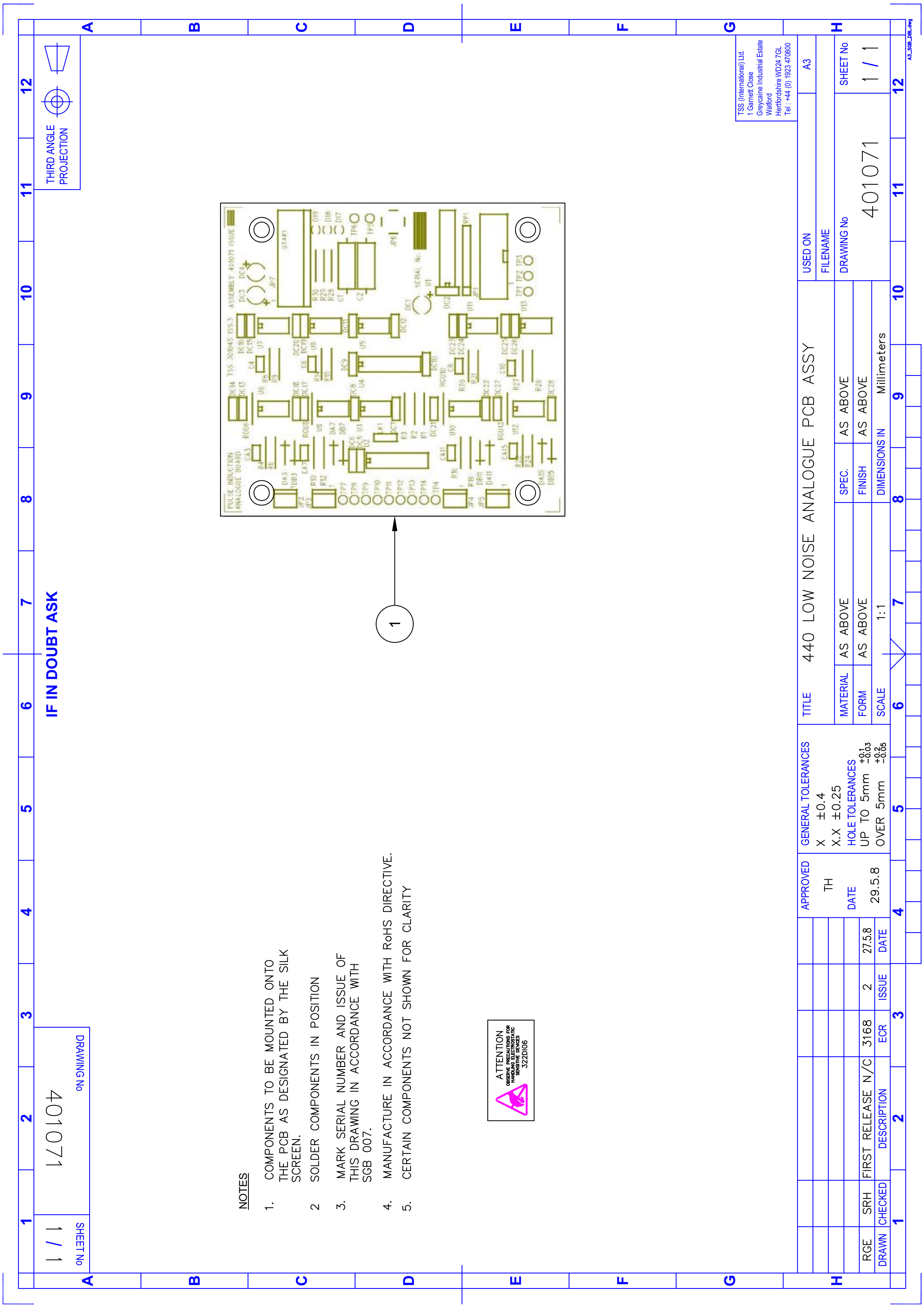


Figure 10-20: 401071-1 Analogue PCB Assembly

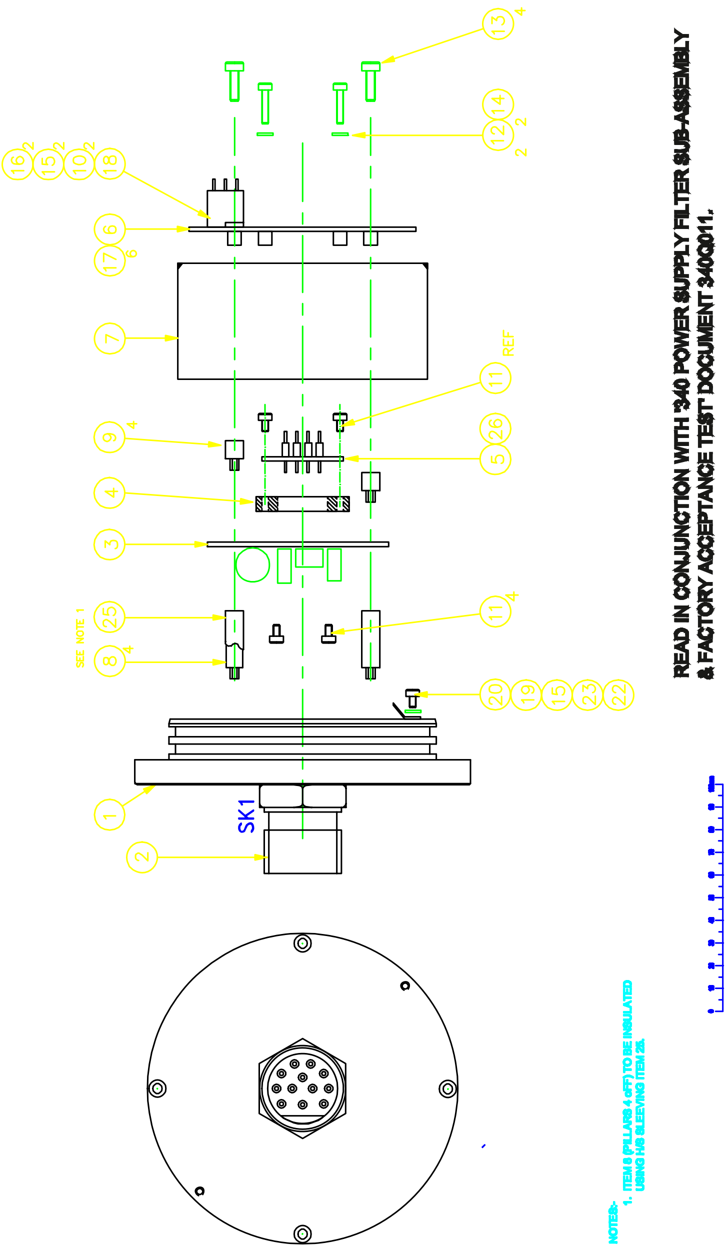


Figure 10-21: 400654-1 PSU Filter Assembly

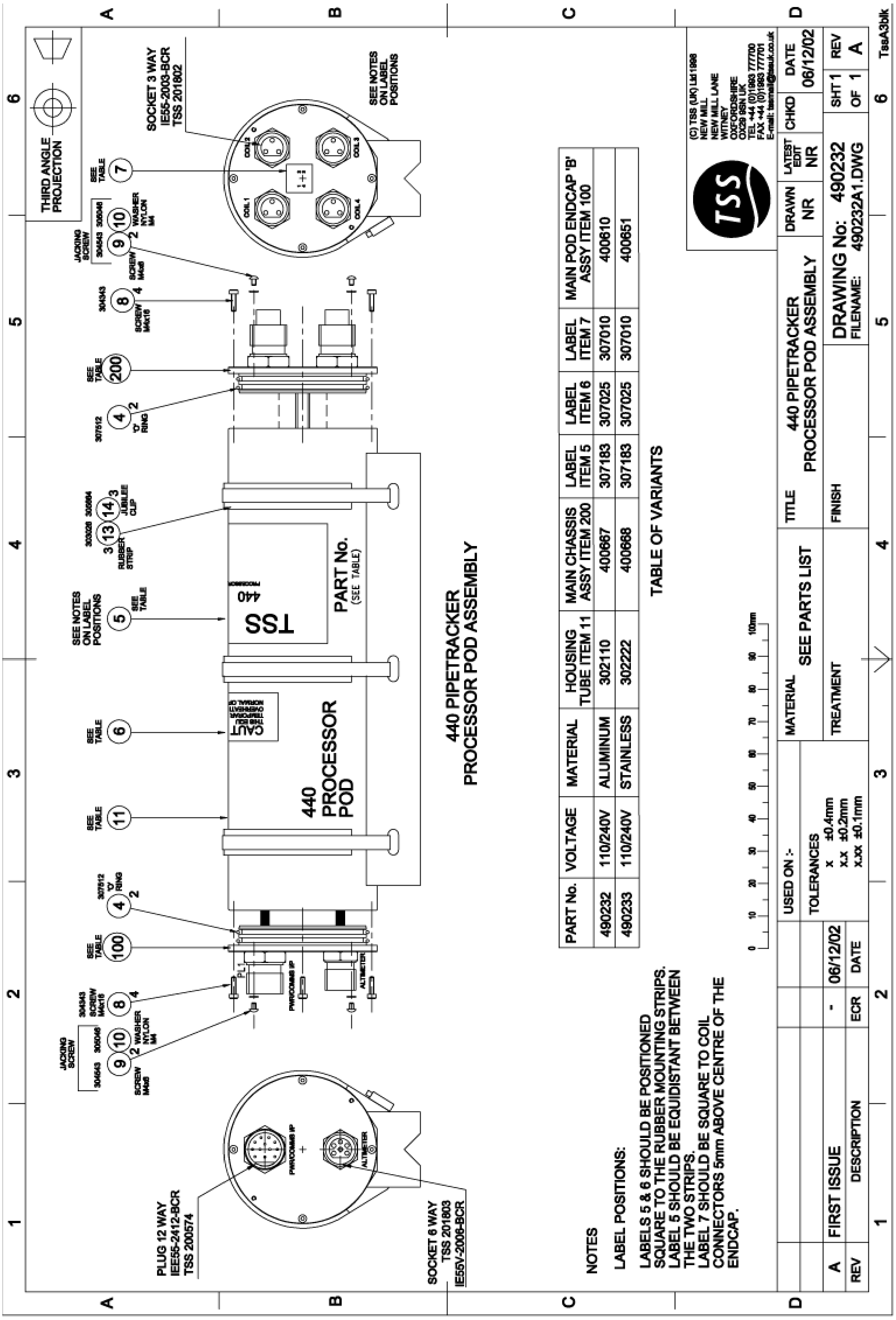


Figure 10-22: 490232-1 Processor Pod Assembly

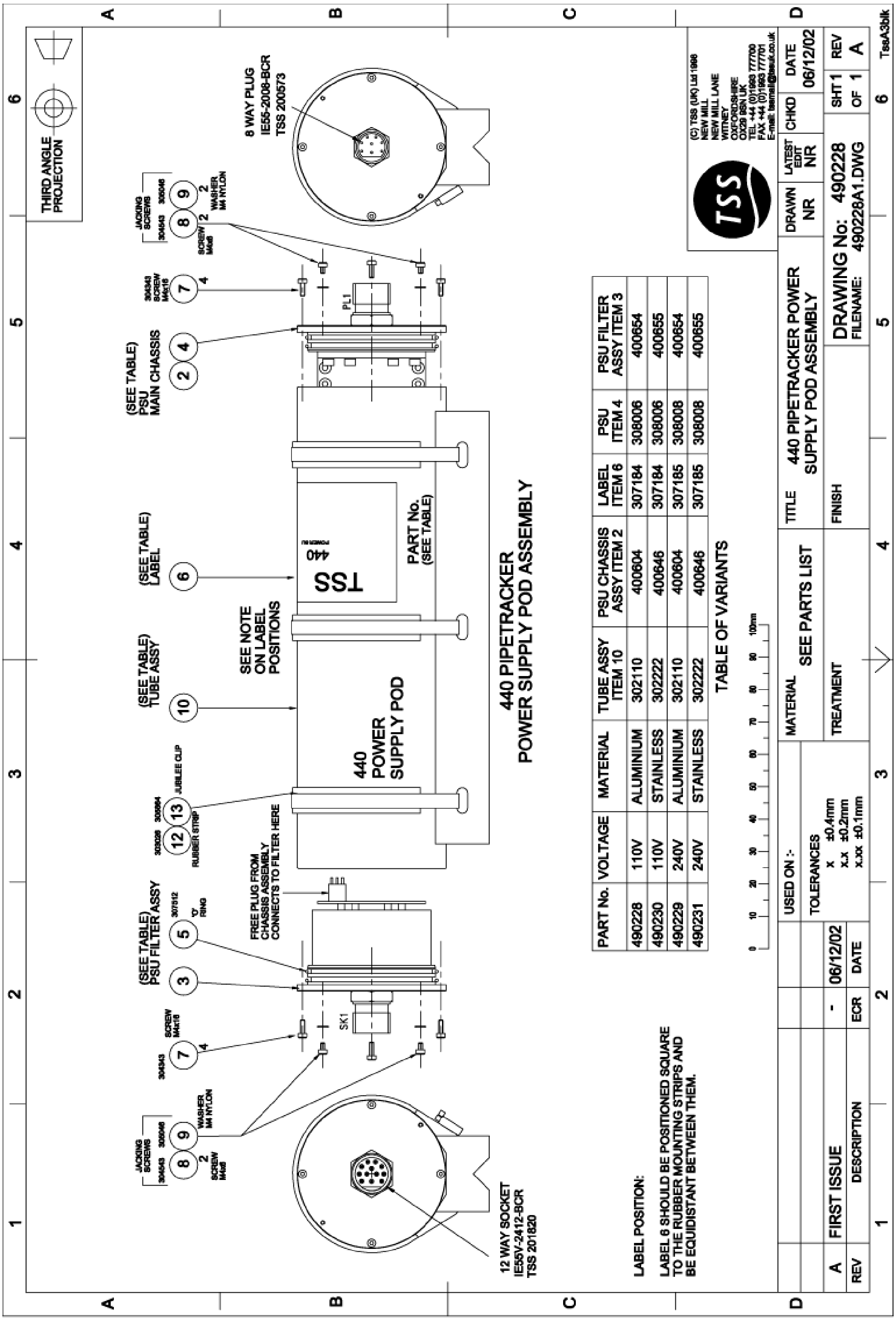


Figure 10-23: 490228-1 Power Supply Pod Assembly - 110v version

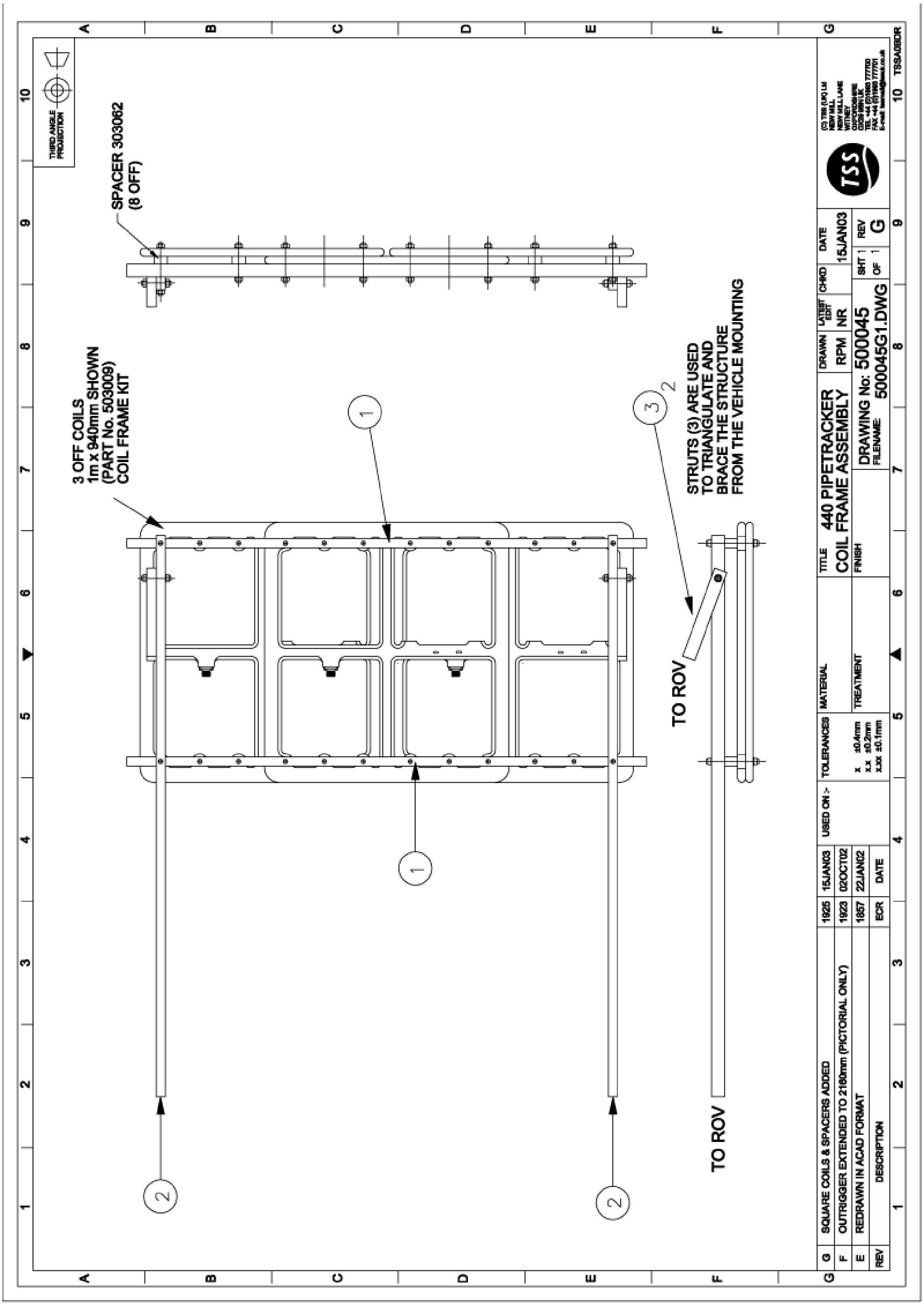


Figure 10-24: 500045-1 Coil Mounting Frame

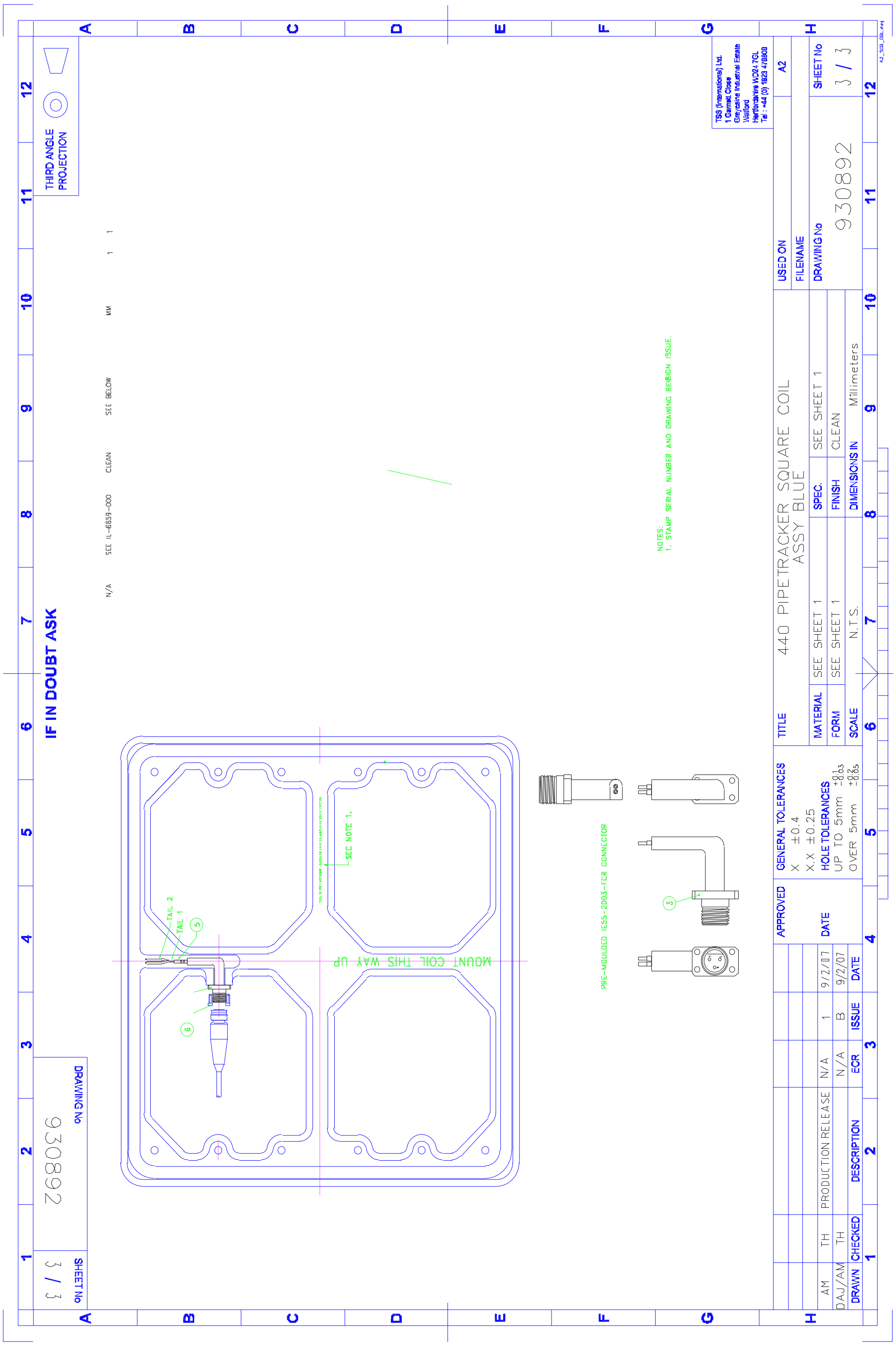


Figure 10-25: B930892-1 Coil Assembly

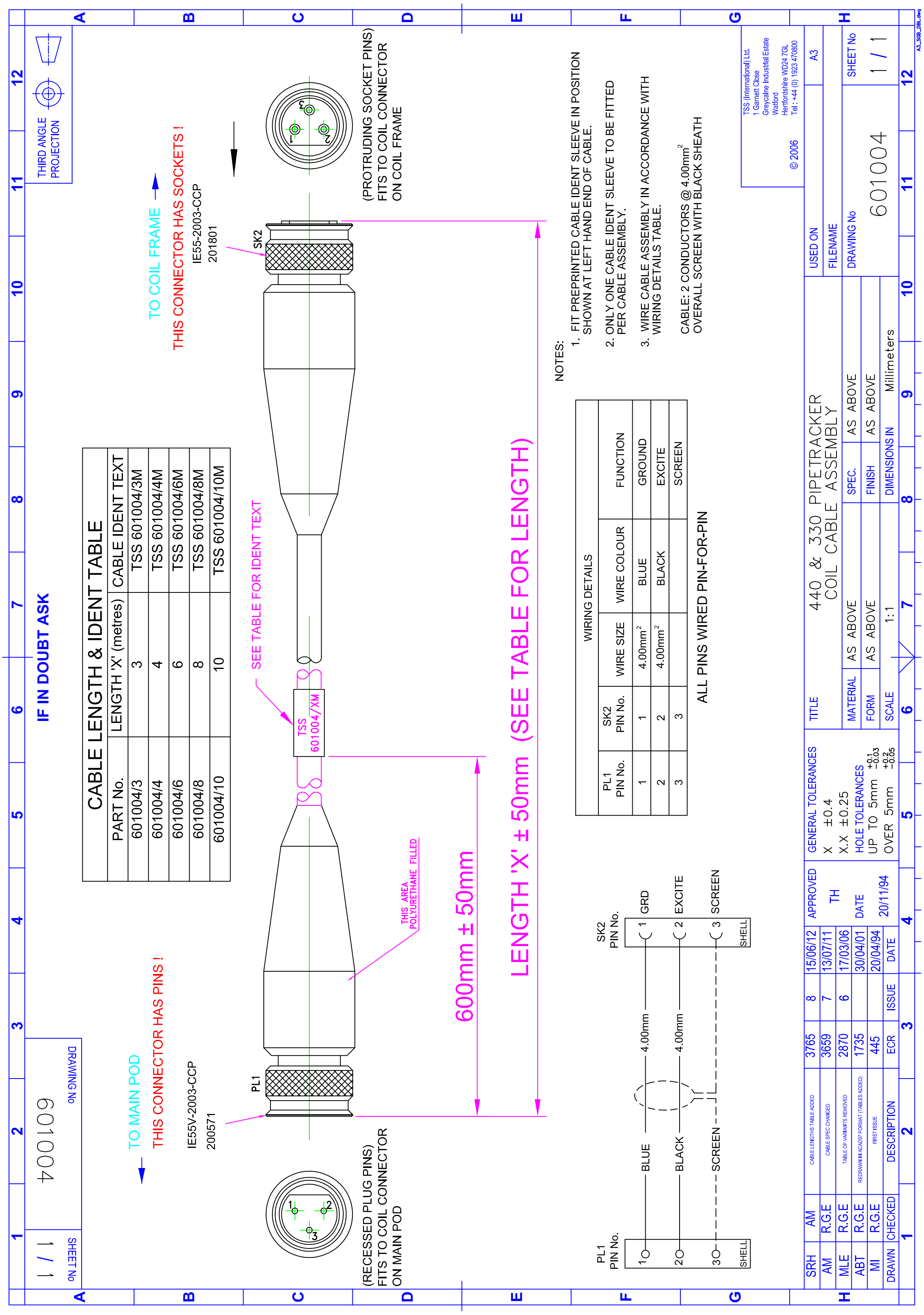


Figure 10-26: 601004-1 Coil Cable Assembly

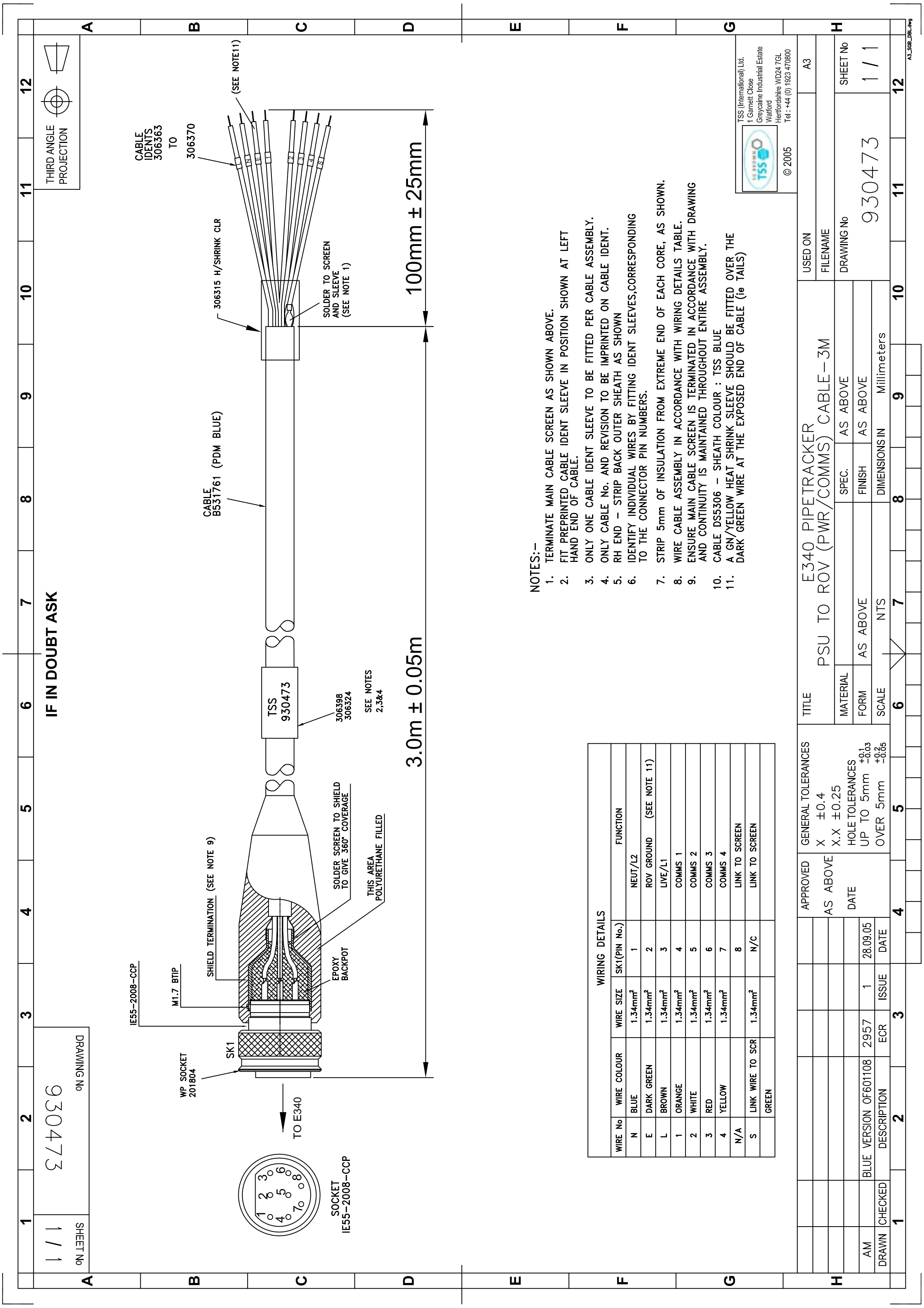


Figure 10-27: B930473-1 PSU to ROV (PWR/COMMS) Cable - 3.0m

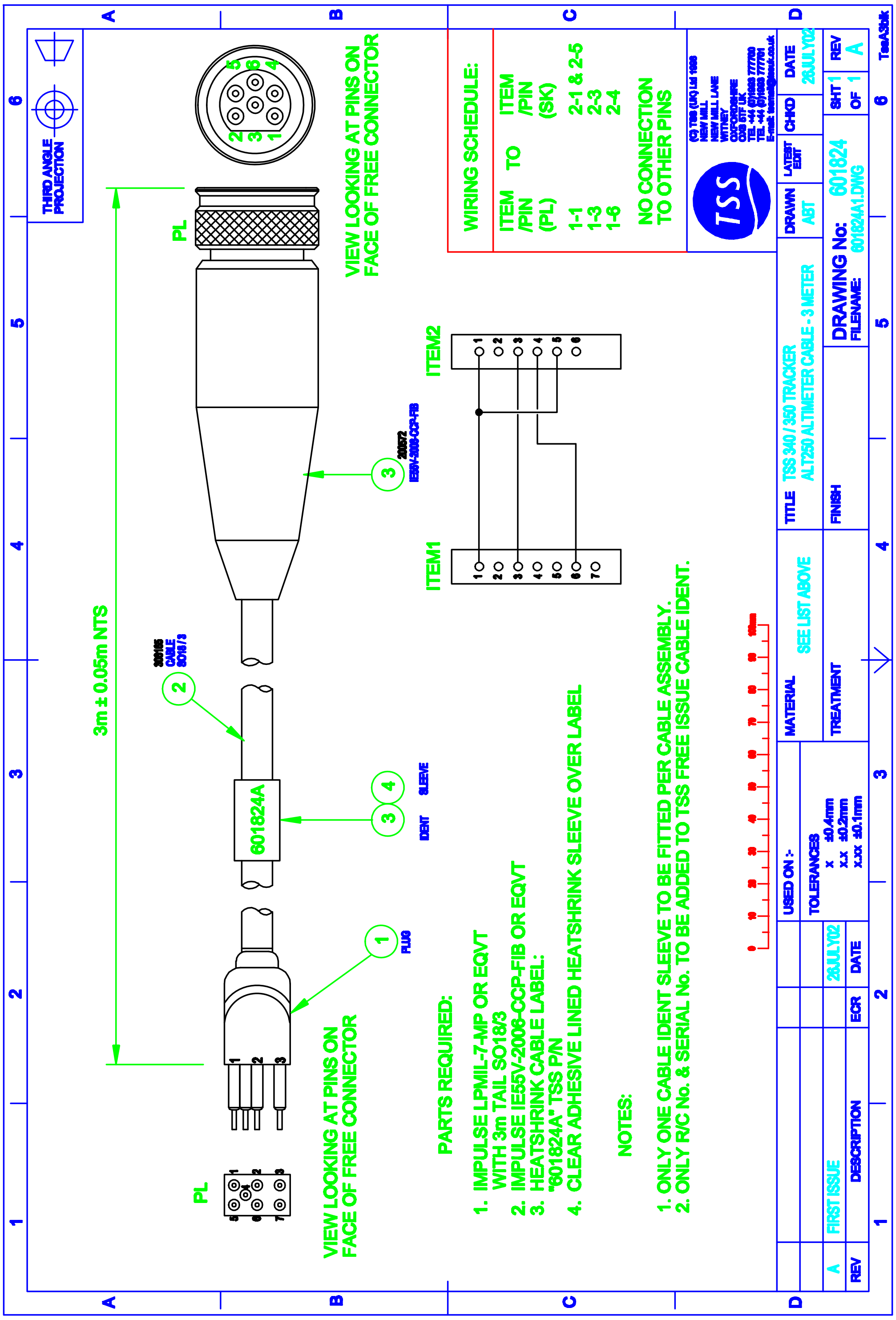


Figure 10-28: 601824-1 Teledyne TSS Altimeter 250 Cable Assembly - 3.0m standard

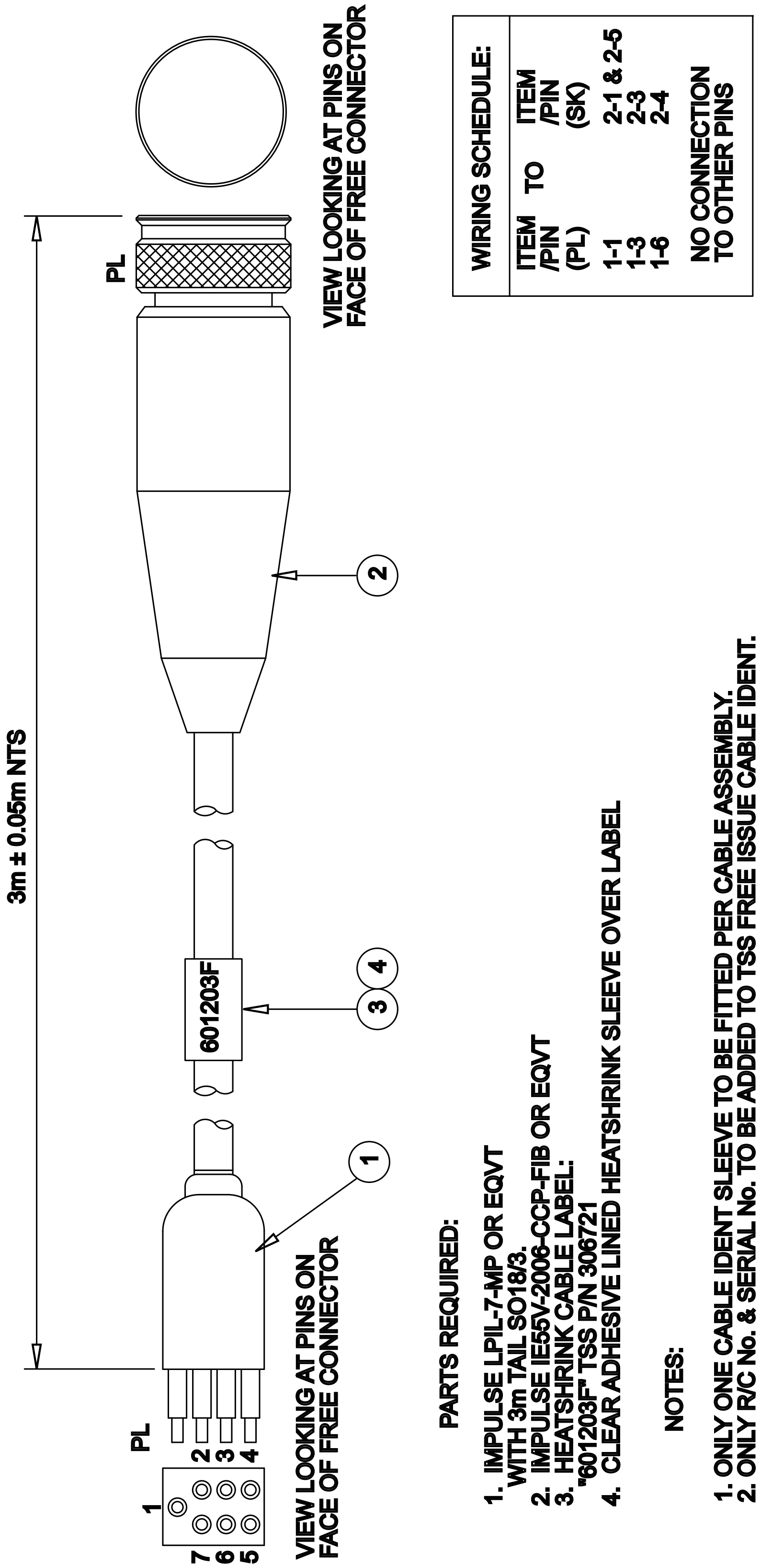


Figure 10-29: 601203-1 Benthos Altimeter Cable Assembly - 3.0m standard

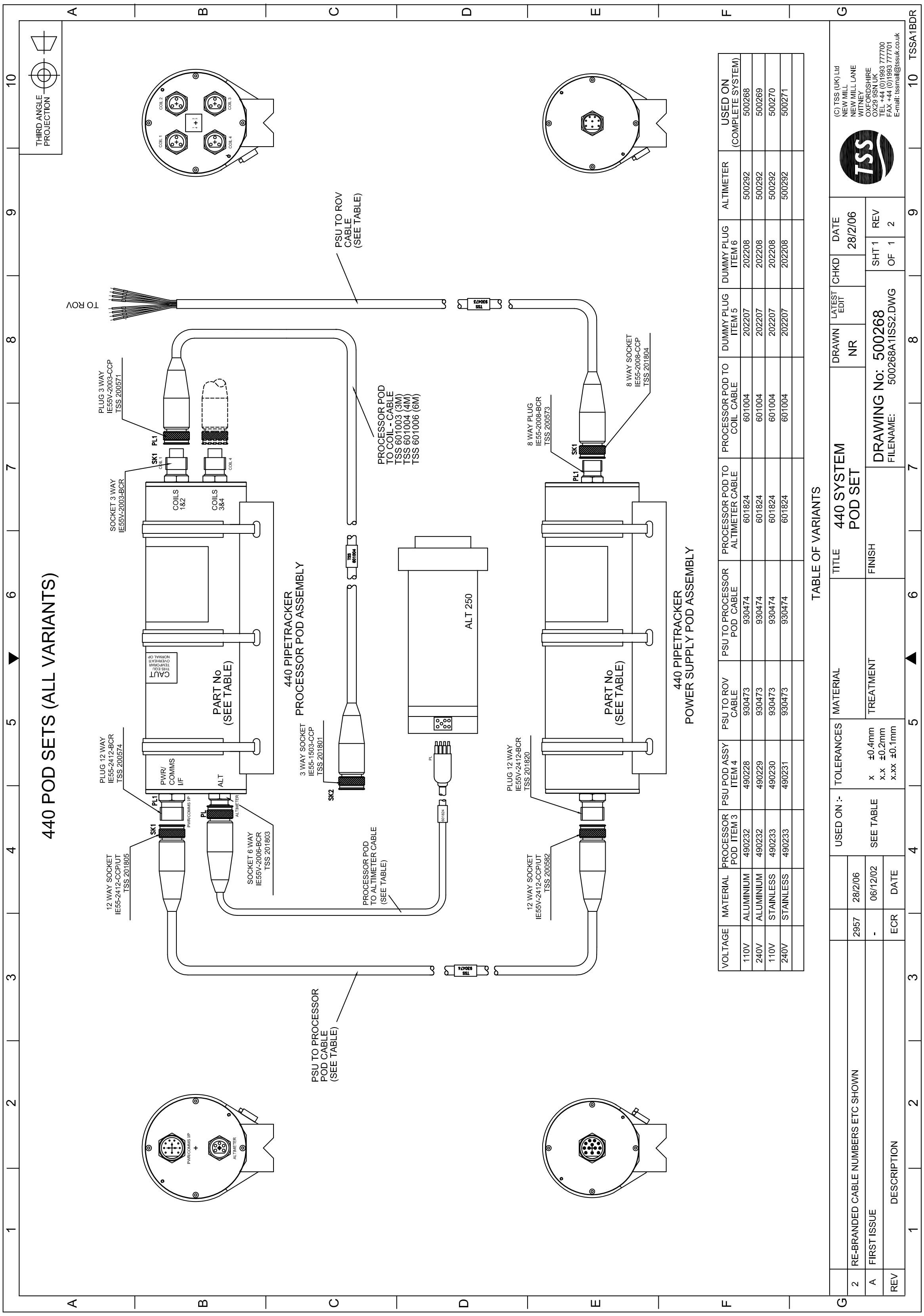


Figure 10-30: 500268-1 440 Pipe and Cable Survey System Complete Assembly

A Operating Theory

The 440 System locates a target by:

1. Inducing a pulse of current in the conductive material of the target.
2. Using three independent coils to detect the magnetic fields associated with the currents induced in the target.
3. Calculating the position of the target from the relative strengths of the signals on each channel.

The Pulse Induction method of target detection, used by the Teledyne TSS 440 System, provides considerable advantages over alternative magnetometer-based systems:

- Pulse induction can detect almost any type of conductive material – not just ferrous metals.
- Terrestrial magnetism has no effect upon the measurements.
- The System can compensate electronically for the proximity of the ROV body, regardless of its magnetic heading.
- The System uses a simplified scaling procedure that allows a high degree of measurement accuracy and stability.

This appendix describes the technique of Pulse Induction, and the method used by the 440 System to derive the signal strength and the target co-ordinates.

A.1 Pulse Induction

NOTE

Because of the special characteristics of 316 stainless steel, it is very difficult to establish strong eddy currents in this material. For this reason, you would experience considerable difficulties in detecting targets made exclusively from 316 stainless steel.

A current flowing through any coil will create a surrounding magnetic field. The strength of that field at any instant in time will be proportional to the instantaneous magnitude of current. If the current in the coil changes, the strength of the magnetic field will vary in proportion to the changes in magnitude of coil current.

These variations in magnetic field strength will induce voltages in conductive targets that lie near the coil. The magnitude of eddy currents that flow in the target because of these induced voltages will depend upon two factors:

- The electrical characteristics of the target material.
- The rate at which the current in the coil changes.

Any eddy currents flowing in the target material will produce magnetic fields of their own and these ‘secondary’ fields will induce a measurable voltage in the coil as they change.

The 440 System uses this principle to detect the presence of conductive material near the search-coils. See Figure A-1, which shows a single cycle of measurement on one channel:

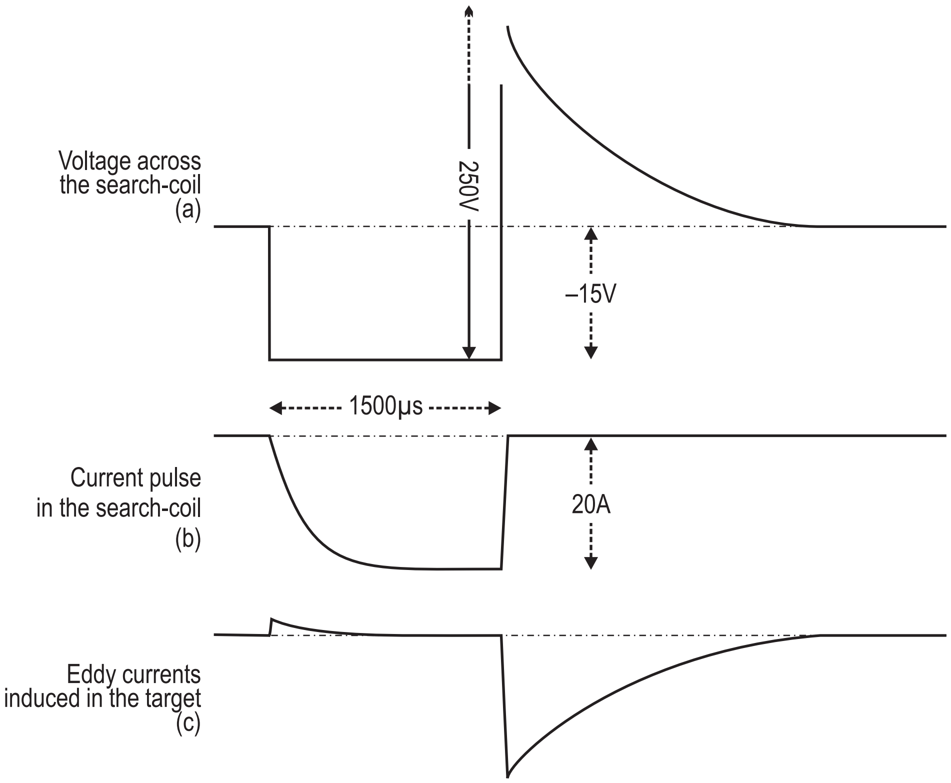


Figure A-1: Pulse induction waveforms (not to scale)

In Figure A-1(a) a voltage pulse of amplitude –15V and width 1500µs drives current into a single search-coil. The polarity is not important for the purposes of this explanation.

The current flowing in the coil rises in a logarithmic manner, as shown in Figure A-1(b). The SEP limits this current to a maximum of 20A.

At the end of the 1500µs ‘drive’ period, the SEP removes the voltage drive to the coil and the current begins to fall rapidly – though not instantaneously – towards zero as shown in Figure A-1(b).

The surrounding magnetic field collapses very quickly as the coil current falls towards zero. This rapid change of magnetic field induces eddy currents in nearby conductive targets, and the magnetic fields associated with these eddy currents induce a voltage in the coil. See Figure A-1(c).

Because the current changes at a much higher rate at the end of the drive pulse than at the start, the eddy currents are much stronger while the current decays to zero.

The initial high voltage peak (250V) that occurs in the coil immediately after the end of the drive pulse is due largely to the self inductance of the coil.

After the initial voltage peak, the shape of the decaying waveform will depend upon the nature and the proximity of any nearby conductive material. The 440 System uses this feature to determine the range between the coil and the target.

A.2 Waveform Measurement

By making measurements upon the decaying part of the voltage waveform, the 440 System measures the range between each search-coil and any conductive target nearby.

A.2.1 Timing

Timing during each cycle of measurement is an important consideration:

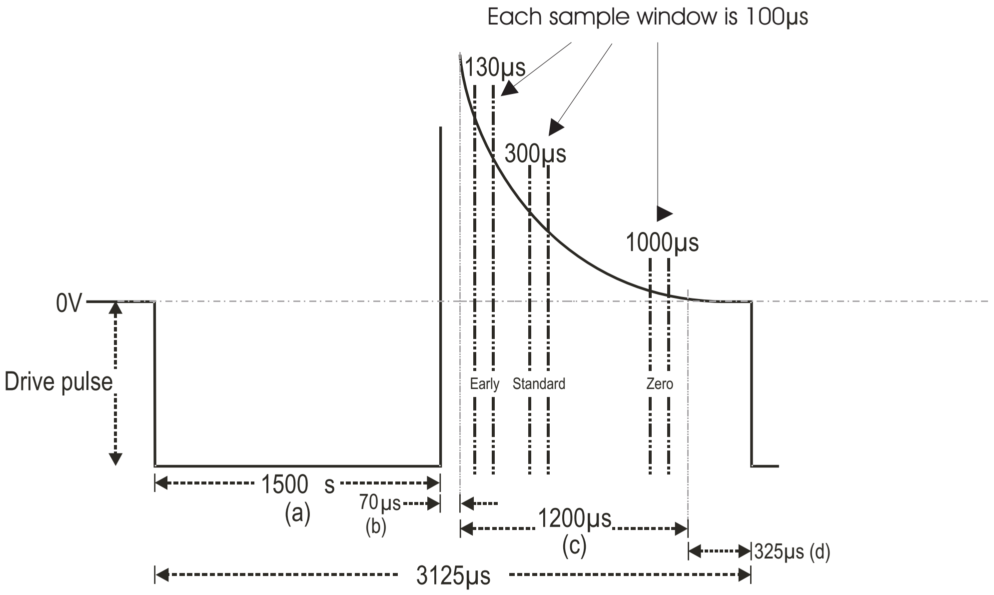


Figure A-2: Timing relationship for a single cycle of measurement

Each measurement cycle starts at the beginning of the voltage drive pulse – see Figure A-2. This pulse lasts for 1500µs while the current flowing through the coil rises as shown in Figure A-1(b).

At the end of the 1500µs pulse, the SEP removes drive voltage from the coil. As the magnetic field collapses with the current, self-inductance causes a 250V spike to appear across the coil windings with a polarity opposite from that of the original drive pulse.

The 440 System waits for a further 100µs to allow the voltage spike to decay and to allow the effects of sea water to dissipate. The System then begins a 1200µs sampling period as shown at Figure A-2(c). During this period the SEP makes 300 measurements at intervals of 4µs and digitises these to 12-bit accuracy before storing them in a buffer memory.

Within the sampling period there are three regions, each of which is 100µs wide:

- **Sample Region 1 – 'Early'**
  This region begins 130µs after the beginning of the sample period and provides the 'early' level for the channel. The SEP calculates and stores the average value of the 25 individual samples taken within this region

- **Sample Region 2 – 'Standard'**
  This region begins 300µs after the beginning of the sample period and provides the 'standard' level for the channel. The SEP calculates and stores the average value of the 25 individual samples taken within this region.

- **Sample Region 3 – 'Zero'**
  This region begins 1000µs after the beginning of the sample period and provides the 'zero reference' level. The SEP calculates and stores the average value of the 25 individual samples taken within this region.

At the end of the sampling period, there is an interval of 325µs while the SEP performs calculations on its measurements. See section A.2.2 "Derivation of Signal Voltage" on page A-4 for an explanation of how the 440 System derives the signal voltage from these measurements for use in the calculation process.

The SEP applies this measurement cycle to each channel sequentially as shown in Figure A-3.

The measurement cycle for each channel lasts a total of 3125µs. With measurements repeated on four channels, it follows that the SEP measures each channel every 12500µs, or 80 times per second.

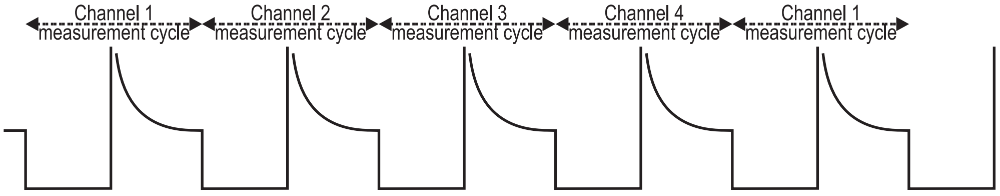


Figure A-3: Sequence of consecutive measurement cycles

A.2.2 Derivation of Signal Voltage

After the SEP has measured each channel eight times, it determines the mean value for the eight preceding occurrences of Sample Region 1 and Sample Region 2. It then subtracts the mean value for Sample Region 3 from the mean values for Sample Region 1 and 2, and this final figure represents the two signal voltages for the specific channel.

Each channel therefore has its signal strength values updated ten times per second.

A.2.3 Seawater Rejection

A.2.3.1 Introduction

The Teledyne TSS 440 system represents a considerable advance over the familiar 340 system in that signal processing routines are used which can discriminate between seawater and metallic targets. This discrimination is important, because the seawater response seen by the coils varies with the height of the vehicle above the sea bed. This variability means that it cannot be rejected by the simple background compensation routines used in the 340.

See section 6.3.4 "Seawater Compensation" on page 6-16 for an explanation on Seawater Temperature and setting it correctly.

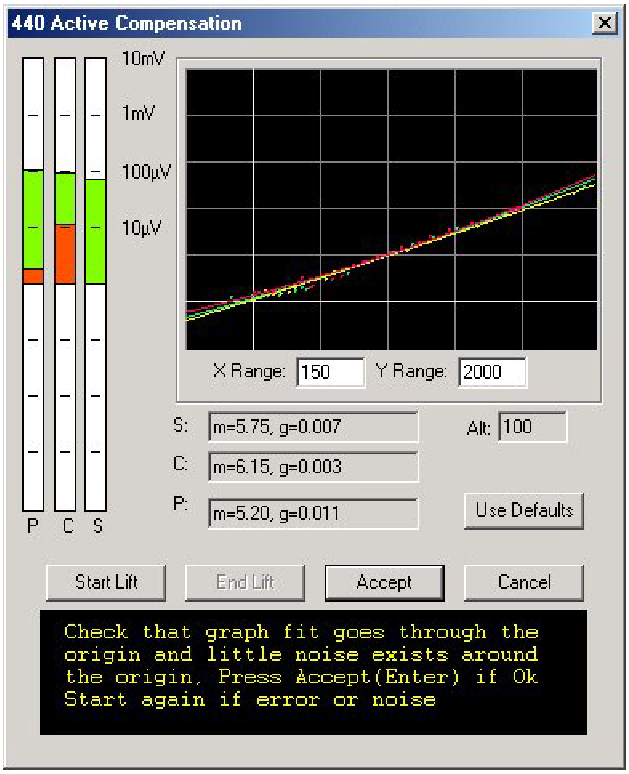


Figure A-4: Seawater signal

The seawater signal, to the 440's search coils, looks similar to a target. This means that as the vehicle is lifted off the seabed, a voltage over and above the target signal is seen. This voltage could easily be interpreted as a change in the target's position. To correctly interpret the coil signals, it is assumed that this extra seawater signal affects all three coils equally. By comparing voltages between the centre and starboard, and centre and port pairs of coils, the effect of the seawater can be minimised. The main drawback of this approach is that it limits range.

The Teledyne TSS 440 system uses an active compensation method to remove the seawater signal from the coil voltages. This allows a more flexible means of determining range to be used, which provides both increased accuracy at short ranges and up to a 40% improvement in ultimate range. Also, effects due to the three coils receiving different seawater signals are minimised.

A.2.4 Compensation: How it Works

The Teledyne TSS 440 uses two separate methods of compensation: background and seawater (active). Background compensation removes contributions to the signals which do not vary with altitude, for example the ROV and the metal in the coil connectors. These effects are accounted for by a compensation procedure with the vehicle on the sea bed. The coil voltages reported at the SDC also provide a useful check as to whether the system is operating correctly.

Technically, background compensation is the recording of the coil voltages with the vehicle stationary. These voltages are then subtracted from subsequent readings.

The system measures the coil voltage at three points. This yields two voltages, termed “early” and “standard”. The “early” voltage will be more sensitive to both target and seawater than the “standard” voltage. The “early” voltage will be approximately 20 times more sensitive to seawater than the “standard” voltage. However, it will be only three times more sensitive target signals. It is this different sensitivity is exploited to remove the seawater signals.

To remove the seawater contributions from the coil signals, two calibration constants are needed. The first of these is a linear correction (typically 17-20) which states how much more sensitive the "early" window is to seawater. A second (quadratic) correction is also needed, and has a value of perhaps -0.05.

The determination of the seawater calibration factors is known as "active compensation". It is a similar process to the ground compensation used in some metal detectors. The coil voltages are recorded as the vehicle is lifted up from the seabed and plotted on a graph. The calibration values are determined from the shape of this graph.

The system is supplied with three sets of constants suitable for most regions of the world. Since the water conductivity is determined mainly by temperature, the user need select only the approximate water temperature.

A.2.4.1 Background Compensation

The first stage after deploying the vehicle is to place it on the seabed. The area chosen should be flat and well away from any trenches, vertical rock faces. It is imperative that area chosen is completely free of any metallic debris or buried objects. Any manipulators or moveable items should be folded away from the coils, and not moved until the survey is complete.

Then, the background compensation is begun. The subsea system averages the two coil voltages and reports them to the SDC. They are then stored and automatically subtracted from the reported coil voltages.

When performing this compensation, the "standard" sample voltages should be less than 1000µV, and not vary by more than 20µV between coils. Excessive voltages, or large differences between coils can indicate that the coils are mounted close to the vehicle, the presence of metallic objects in the sea bed, or a failure of one of the detection coils. The "early" coil voltages will be typically 5 times greater due to the increased sensitivity.

Once the background compensation is completed, then the coil voltages should all be reported as zero. This indicates that the subtraction has been carried out correctly. Then, the active compensation can be performed.

A.2.4.2 Active Compensation

The SDC software provides an "Active Compensation" dialog which can perform this procedure if required. The screen has three main areas: the coil voltage indicators, the graph and the results. The coil voltage indicators show the actual signals coming from the coils in real time; both the "early" and "sample" voltages are represented as green and red respectively. These voltages are quite distinct from those presented on the run/display screen which show the remaining target voltage after the seawater signals have been removed.

At this stage, the voltage indicators should all read zero. If they do not, then the background compensation was not carried out correctly, or the vehicle has moved since the compensation was carried out.

The graph area shows the relation between the "early" (y- axis) and "standard" (x- axis). After pressing the "Start" button, the vehicle is then lifted from the sea bed to an altitude of approximately 5m. This height need not be accurately measured: if an altimeter is not available the vehicle is merely lifted until the "standard" voltage reaches 120µV in temperate regions and 250µV in the tropics. The vehicle should be lifted as smoothly as possible, and the lift should take approximately 30s to reach 5m. As the vehicle moves, points will be plotted on the graph.

The scale of the graph can be changed by the user. The routines only analyse the data which is visible within the black area of the graph. The "x scale" and "y scale" values can be decreased to zoom in on the graph, but should immediately returned to 150 and 1000µV respectively. This ensures that the complete lift curve will be analysed. In conditions of increased seawater conductivity, this scale may not be sufficient to assess the whole curve, and must be increased.

When the vehicle has reached sufficient height, the “stop” button can be pressed. Then, the graph can be assessed. It should show a smoothly rising curve which passes through the origin, as shown in Figure A-5. If the background compensation was not correctly carried out, then the graph will not meet the origin, as shown in Figure A-6 A small y- intercept (50µV) can be tolerated, since it is the gradient of the curve which is important.

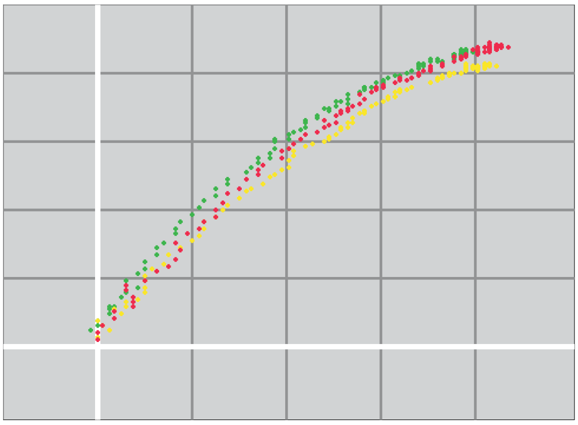


Figure A-5: Perfect lift with the results passing through the origin

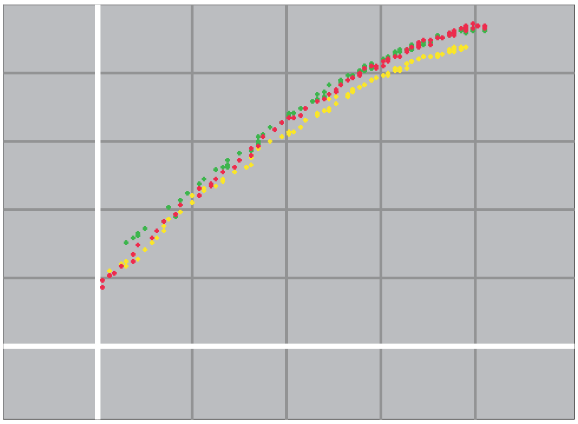


Figure A-6: Example of poor background compensation

If metal is present on the sea bed, then the graph will not move smoothly away from the origin as the vehicle is lifted. This is shown in Figure A-7. This will have a detrimental affect on the accuracy of the calibration values and could ultimately lead to incorrect survey data. More importantly, it indicates that the background calibration will not be valid, and must be repeated. Figure A-8 shows another effect due to the coils moving as the vehicle was lifted. The vehicle was not lifted smoothly, resulting in missing points in the middle of the graph.

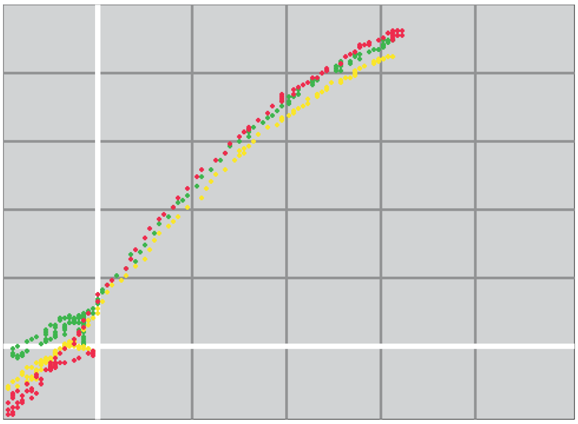


Figure A-7: Example with metal present on the seabed during compensation

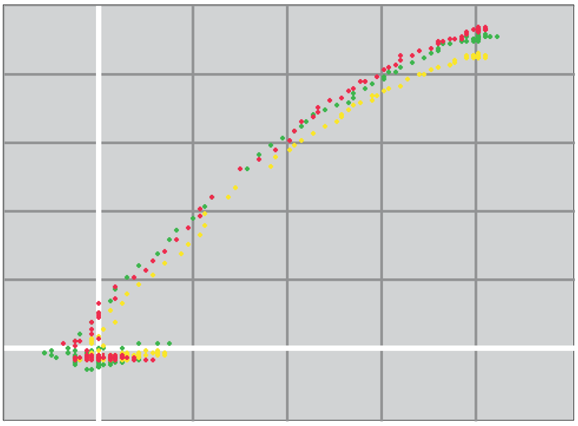


Figure A-8: Example where the vehicle was not moved smoothly

The “active compensation” window will automatically make a best fit to the vehicle data. This curve will be overlaid on the scattered points. The resulting parameters in the results section at the bottom of the screen. The linear parameter, m, should be in the region 10-20, and the quadratic parameter should be approximately -0.05. A curvature opposite to that shown in Figure A-5 or an unexpected value of m indicates that the calibration was not carried out correctly or the subsea electronics have failed in some way.

A.2.4.3 Checking the Rejection

If desired, the system's rejection of seawater can now be seen. Returning to the run/display screen, the target voltages are displayed. With the vehicle still 3m above the sea bed, these should be within a few µV of zero. If the vehicle is now slowly dropped to the seabed, then the target voltages should remain close to zero. They may deviate slightly in either a positive or negative sense, but should remain much less than the signal threshold of 15µV.

If the voltages change suddenly when the vehicle lands on the sea bed, then this may be due to either detection of a metal object, or the coils not being firmly attached to the vehicle. Significant changes will reduce the accuracy of the survey data when operating close to the ultimate range of the system. The Teledyne TSS 440 system operates at much greater survey ranges and this places stringent requirements on the background compensation and the rigidity of the coil mounting frame.

If the voltages vary when the vehicle is some way above the sea bed, then this is most likely due to an error in the active compensation procedure. It must be repeated, perhaps on a slightly different area of the seabed.

A.2.4.4 Rejection Parameters

The rejection values, once determined, should last the length of the survey. However, it is sensible to check that seawater signals are correctly rejected in the way described above once every half hour. The SDC software will generate a reminder every half hour. The background compensation must be repeated, but is sufficient merely to check that the active compensation is still correct.

The rejection values are determined by many factors, but the most important of contributions are due to the conductivity of the seawater and the overall water depth. The relations between the values and water depth is non linear, and changes more steeply at shallow water depths. For this reason, if the survey begins in deep water but moves into shallow water (e.g. when following a pipeline inshore) the calibration must be more frequent. However, at water depths of 50m or greater, the values will no longer be affected by depth.

The effect of seawater conductivity is more difficult to compensate for, since it can vary in an unpredictable way. In deep water (>100m) the conductivity (determined by salinity and temperature) will be nearly constant, and should have little effect. However, if the survey crosses the thermocline or will approach areas of different conductivity such as vents or fresh water outfalls, then the active compensation will need to be checked more frequently.

If a conductivity probe is available on the vehicle, then any changes will be apparent to the users. A change of more than a few mS/cm may necessitate recompensation. If it believed that the conductivity has changed, then the rejection can be checked as described above.

A.2.4.5 Background Noise Profile

The SDC software provides a “Background Noise Profile” dialog. This facility displays traces of the three coil voltages along with additional displays to determine spurious signals within the surveying vicinity. Figure A-9 illustrates the display during a Background Noise Profile.

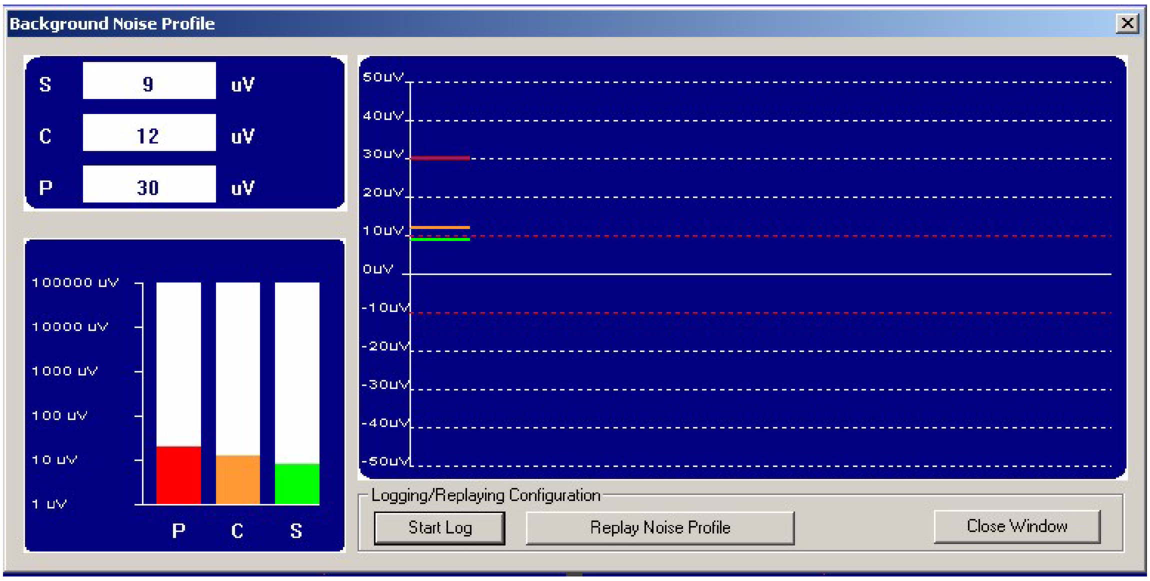


Figure A-9: Background Noise Profile Window

The Port voltage is displayed in red, the Centre voltage in amber and the Starboard voltage in green. The dotted red line displays the signal threshold currently set for the system.

The voltages displayed during the Background Noise Profile can be logged. This data is timestamped allowing for comparison with other survey data to assist post-survey analysis. The format of the Background Noise Profile log file is shown in section 6.4.1.3 "Background Noise Profile Logging Format" on page 6-32.

A.2.5 Trenching Vehicles

In the case of a crawling ROV, it may not be possible to lift the vehicle off the seabed. However, very good survey information can still be obtained merely by selecting the correct water temperature.

A.2.6 Limitations

Figure A-10 shows typical lift curves with a fixed target is present. Although this situation does not appear when surveying, it shows how the software has to separate the seawater and target components of the returned voltages. The solid curve (“No target”) shows a seawater lift curve with only seawater present. If a 10µV target signal is present, then this curve will be repeated, but shifted 10µV to the right, and 30µV upwards. At an early voltage of approximately 140µV, this curve crosses the “No target” curve.

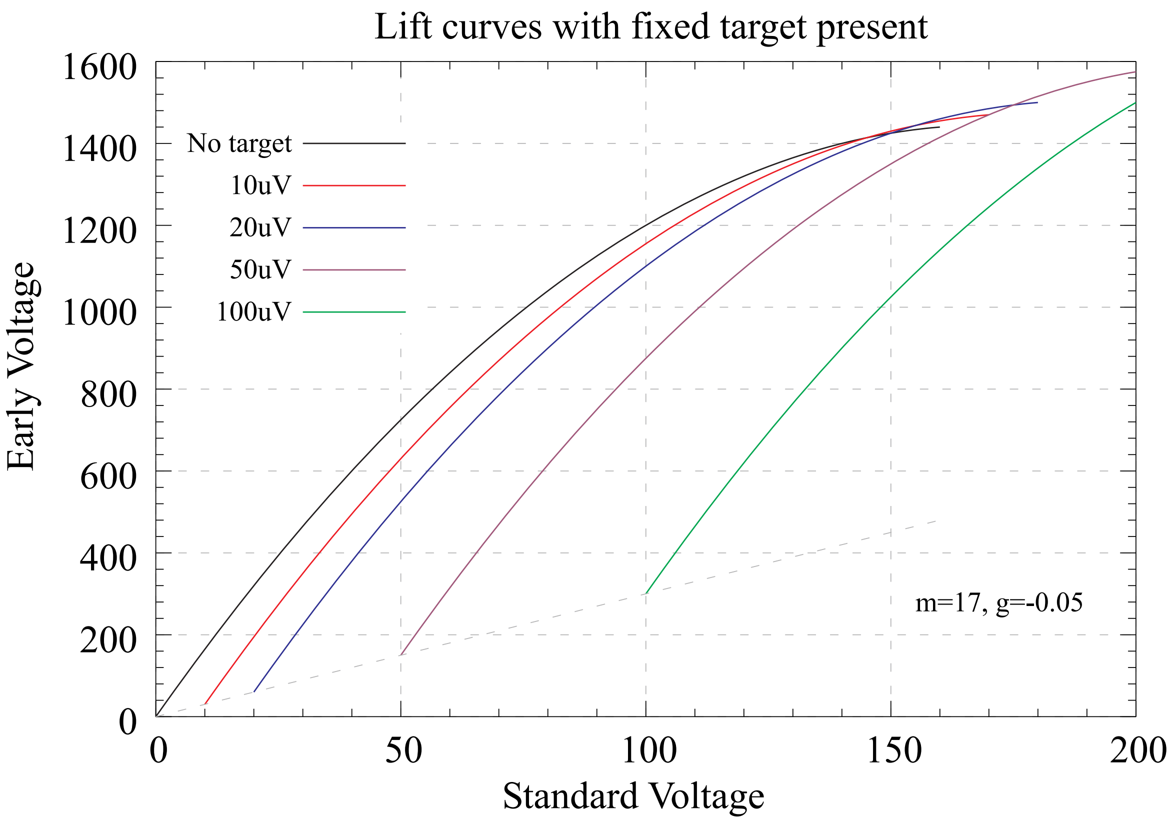


Figure A-10: Typical lift curves with a fixed target present

This means that if the seawater rejection mechanism is faced with early and standard voltages of 140 and 1450µV, it will be unable to decide if a target is present or not. This means that at 140µV of seawater, the algorithm will not work correctly and return a less accurate value for range. However, this point occurs only when the ROV is approximately 4m above the seabed, well beyond the range of a typical survey.

In more conductive water, the seawater parameters change, and the crossing point moves to perhaps 250µV. The increase in seawater signal means that the point where the algorithm begins to break down remains at roughly 4m.

A sudden jump in the target voltages when the ROV is lifted is to be expected, and is not due to a deficiency in the system or its configuration.

A.2.7 Range Determination

Once the seawater signal has been removed, the target voltage is interpreted to give the distance between the coil and the target. This voltage falls off according to an approximate sixth root law. The voltage is first divided by the target scaling value. The exact algorithm used to determine range is beyond the scope of this manual, since correcting for the exact nature of the coil response is complex.

When the target is close to the coils, all three coils are used to determine the position. The differences between the port and centre, and starboard and centre coils are taken then used to compute range. If the sum of these differences is less than the threshold, or any coil is less than the threshold, then only two coils are used to make the calculation. The two coil calculation is also able to adapt to the position of the target, using the centre and one other coil at larger lateral ranges.

B Options

The description throughout the main part of this Manual relates to the standard 440 Pipe and Cable Survey System. Such a System provides all the facilities you will need to survey a target lying on or buried beneath the seabed.

For some applications, the 440 System may be more effective if you specify it with one or more of the available options.

This appendix describes the options that Teledyne TSS can supply for use with the 440 Pipe and Cable Survey System:

- Combined ‘Dualtrack’ installation with a Teledyne TSS 350 or 350 Powertrack System
- Engineer training

B.1 Dualtrack System

CAUTION

You might cause permanent damage to the sub-sea installations of the 440, 350 350 Powertrack System if you operate them from an incorrect electrical supply voltage.

The standard sub-sea components of both Systems operate from a nominal 110V AC electrical supply. Both Systems are available with the option to operate from a nominal 240V AC electrical supply. When you interconnect the 440 and 350 or 350 Powertrack Systems within a Dualtrack installation *you must operate both from the same electrical supply*.

Throughout this sub-section, ‘the 350 Manual’ refers to the Teledyne TSS 350 Cable Survey System Manual, Teledyne TSS document P/N 402197. The ‘350 Powertrack Manual’ refers to the TSS document P/N 402233.

This part of Appendix B describes the features of a Teledyne TSS ‘Dualtrack’ System that combines the 440 and the 350 Survey Systems on board an ROV. It includes all information specific to a Dualtrack installation and provides cross references that help you locate more detailed information in the relevant product Manual.

NOTE

You must consider the Manuals for the Teledyne TSS 440 and the 350 / 350 Powertrack Systems valid in all respects except for those areas listed in sub-section B.1.2 "The Differences” beginning on page B-2 below. Teledyne TSS recommends that all personnel who will install, use and maintain the equipment should read and thoroughly understand the 440 System Manual and the 350 or 350 Powertrack Manual.

B.1.1 The Equipment

The Dualtrack equipment described in this sub-section consists of the following:

- Sub-sea components of a Teledyne TSS 440 Pipe and Cable Survey System.
- Sub-sea components of a Teledyne TSS 350 or 350 Powertrack Cable Survey Systems.
- A single SDC to provide configuration, control and communications functions for both sets of sub-sea components.
- Product Manuals, interconnection cables and mounting components for all three sub-sea electronics pods.

NOTE

The 350 requires to have the latest firmware (version 3.7 or later) EPROM. This can be confirmed in the terminal mode of DeepView for Windows, when the System is initiated a banner is displayed that will identify the version number.

Teledyne TSS supplies the System with Microsoft Windows 7 and the DeepView for Windows graphical display software already installed and configured to run automatically when you power-on the SDC. DeepView for Windows can operate in all modes necessary to use the Dualtrack System.

The sub-sea components and the SDC supplied with the Dualtrack System are exactly as described in the relevant parts of the 440 System Manual and the 350 or 350 Powertrack Manual, except for those differences listed in section B.1.2 "The Differences" on page B-2.

B.1.2 The Differences

Note the following important issues when you install the Dualtrack System:

1 Scope of Delivery

See section B.1.3 "Scope of Delivery" on page B-3 for a list of the standard items supplied with the Dualtrack System.

2 Physical installation

See section 3.1.1 "Sub-sea Installation" on page 3-3 of this Manual for instructions to install the sub-sea components of the Teledyne TSS 440 System.

See Chapter 3 "Physical Installation" of the 350 or 350 Powertrack Manuals for instructions to install the sub-sea components of the 350 System.

You must take special precautions regarding the placement of the search coils when you install the Dualtrack System on board an ROV.

See section B.1.4 "Physical Installation" on page B-5 for a description of the special precautions you must make when you install the Dualtrack System.

3 Electrical connection

To make the most efficient use of the ROV umbilical, the Dualtrack System uses only two wires for all communications between the surface and the sub-sea installations. See sub-section B.1.6 "Electrical

Connection" beginning on page B-6 for details of the special electrical connection requirements necessary to support this communication arrangement.

Where necessary, you may use 4-wire or RS232 communications instead.

Note that, in a Dualtrack System, you *must* connect the altimeter *only* to the ALTIMETER port of the 440 SEP, or to an SDC serial port. **Do not connect the altimeter to the 350 or 350 Powertrack SEP**.

4 Operation

NOTE

In a Dualtrack installation, you cannot operate the 440 and the 350 or 350 Powertrack Systems simultaneously.

DeepView for Windows allows you to switch between the 440 and the 350 / 350 Powertrack operating mode easily and quickly. The Run Window and its status bar will show the current operating mode.

5 Power requirement

See section B.1.7 "Power Supply Requirement" on page B-11 for details of the power supply requirements for the sub-sea components of the Dualtrack System.

B.1.3 Scope of Delivery

Dualtrack includes the following major sub-assemblies:

Figure B-1: Surface Display Computer (SDC10)

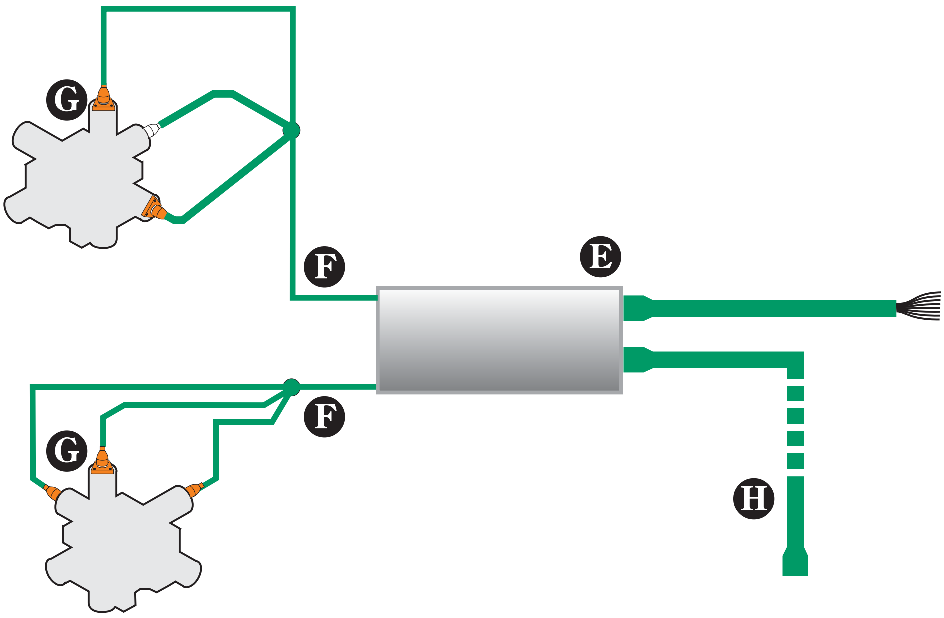


Figure B-2: Sub-sea components of the Teledyne TSS 350 or 350 Powertrack Systems

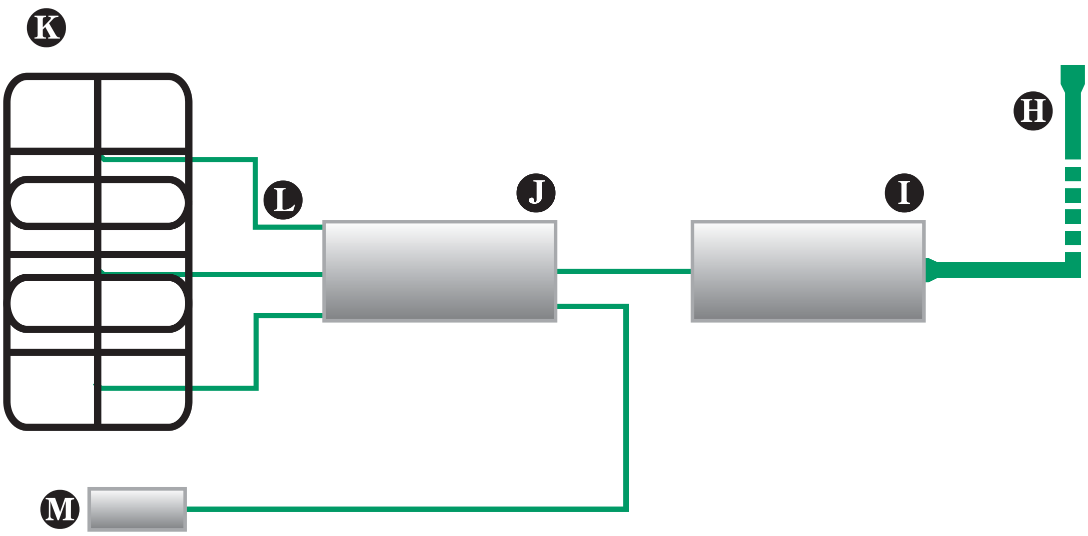


Figure B-3: Sub-sea components of the Teledyne TSS 440 System

Table B-1: Components of the Dualtrack System

Item	Description
Refer to Figure B-1: The SDC includes	
-	Surface Display Computer (SDC) pre-loaded with Microsoft Windows™ 7 and the DeepView for Windows display software.
-	Touch-screen display
-	Rear-mounted comms enclosure containing power and comms interfaces.
-	2 x front-mounted USB ports.

Table B-1: Components of the Dualtrack System (Continued)

Item	Description
Refer to Figure B-2:	
E	Sub-sea Electronics Pod for the Teledyne TSS 350 or 350 Powertrack Cable Survey Systems.
F	Two connection cables with waterproof connectors for the port and the starboard coil triads.
G	Port and starboard coil triads.
H	Teledyne TSS 440-to-350 link cable (Teledyne TSS P/N B930477). The cable is 2.5 metres long and has waterproof connectors at both ends.
Refer to Figure B-3:	
I	Sub-sea Power Supply Pod (440 PSU) for the 440 Pipe and Cable Survey System.
J	Sub-sea Electronics Pod (440 SEP) for the 440 Pipe and Cable Survey System.
K	Coil array comprising three Teledyne TSS search-coils.
L	Three connection cables with waterproof connectors for the array of search-coils.
M	Sub-sea altimeter with connection cable and waterproof connector. *This altimeter provides information for use by the entire Dualtrack System.*

Also included with the Dualtrack System but not shown are:

- The SDC and DeepView for Windows software.
- Teledyne TSS 440 Pipe and Cable Survey System Manual – *Teledyne TSS P/N 402196 current issue*.
- Teledyne TSS 350 Cable Survey System Manual – *Teledyne TSS P/N 402197 current issue* or Teledyne TSS 350 Powertrack Cable Survey System Manual – *Teledyne TSS P/N 402233 current issue*
- Mounting components for the search-coils of the 440 System (see Section 3.1.3 "Coil Array" beginning on page 3-5 of this Manual for details).
- Mounting components for the coil triads of the 350 / 350 Powertrack System (see Section 3 "Physical Installation" beginning on page 3-1 of the 350 / 350 Powertrack Manual for details).
- Mounting components for all three electronics housings of the Dualtrack System.

B.1.4 Physical Installation

B.1.4.1 Search-coils

Follow the instructions in the 350 or 350 Powertrack Manual to install the mounting bar and coil triads of the Teledyne TSS 350 or 350 Powertrack System.

Follow the instructions included in section 3.1.3 "Coil Array" on page 3-5 of this Manual to install the mounting frame and the coil array of the 440 System.

CAUTION

With drive current applied to the coils of the 440 System, large induced voltages can appear across the coils of the 350 System. Later versions of the 350 search coils (serial numbers from 570 and upwards), include diodes to protect them from damage caused by these induced voltages.

If your System includes coils that have no diode protection (serial numbers below 570), you should ensure that there is a clearance of more than 0.75 metres between the coils of the 440 System and the coils of the 350 System. Contact Teledyne TSS for advice if necessary.

B.1.5 Sub-sea Pods

The Dualtrack System includes three sub-sea pods:

- The PSU for the 440 System.
- The SEP for the 440 System.
- The SEP for the 350 or 350 Powertrack System.

Follow the instructions in sub-section 3.2.1 of the 350 / 350 Powertrack Manual to install the 350 / 350 Powertrack SEP.

Follow the instructions included in section 3.1.2 "SEP and PSU" on page 3-3 of this Manual to install the 440 SEP and the 440 PSU.

B.1.6 Electrical Connection

It is very important that you should interconnect the sub-sea components exactly as described in Figure B-4 and the instructions below.

IMPORTANT

If the Dualtrack System is an upgrade to an existing 440 System, you must open the 440 SEP and set it to use RS232 communications. See section 4.2.2.1 "Alternative Communication Methods" on page 4-11 of the 440 Manual for instructions to change the communication method used by the 440 SEP.

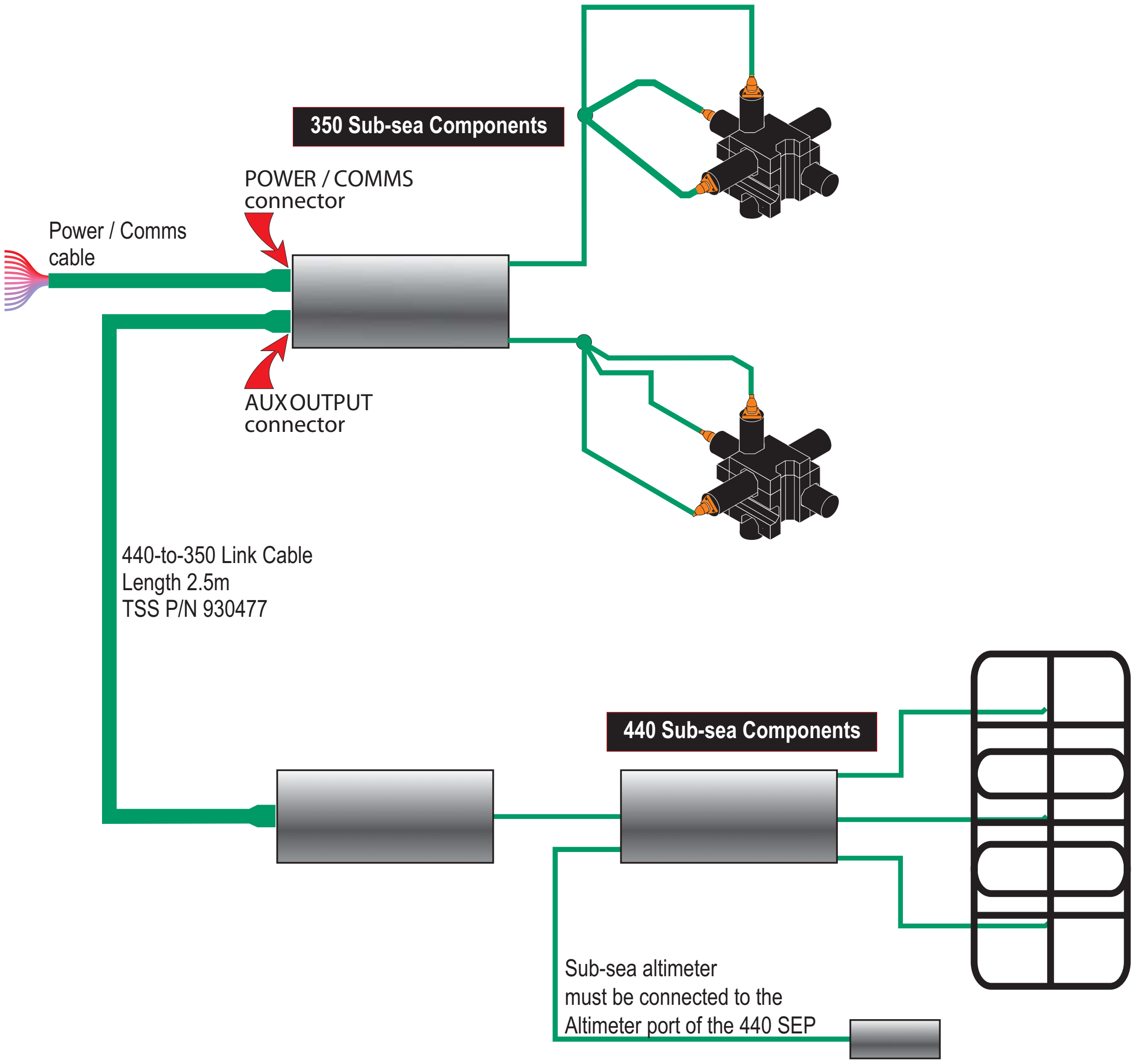


Figure B-4: Electrical interconnection of sub-sea components

CAUTION

To avoid damage to either of the SEPs, make certain that you fit the blanking plugs supplied by Teledyne TSS to any unused ports.

Failure to take this precaution might allow water to penetrate the SEP housings, following which total circuit failure will occur.

Connect the Teledyne TSS 440 sub-sea components:

1. Complete the physical installation of the 440 search-coils as described in section 3.1.3 "Coil Array" on page 3-5 of this Manual. Route the coil connection cables to the correct ports on the 440 SEP. Use plastic cable clips to secure the cables to the fixed framework of the ROV.

2. Install the altimeter near the centre of the 440 search-coil array as described in section 3.1.4 "Altimeter" on page 3-13 of this Manual. Route the cable from the altimeter to the 440 SEP and follow the instructions in section 4.1.6.1 "Direct Connection to the SEP" on page 4-7 of this Manual to connect it. Use plastic cable clips to secure the cable to the ROV frame.

IMPORTANT

The Dualtrack System uses one altimeter only. You *must* connect the altimeter to the ALTIMETER port on the 440 SEP, or to an SDC serial port.

If you connect the altimeter to the ALTIMETER port of the 350 SEP the Dualtrack System will not operate correctly.

3. Connect the 440 SEP to its PSU as described in this Manual.

Connect the Teledyne TSS 350 or 350 Powertrack sub-sea components:

4. Complete the physical installation of the coil triads as described in sub-section 3.2 of the 350 / 350 Powertrack Manual. Route the coil connection cables to the correct ports on the 350 / 350 Powertrack SEP. Use plastic cable clips to secure the cables to the ROV framework.

5. Connect the 350 / 350 Powertrack SEP to the ROV electrical supply by following the instructions in sub-section 4.1.3 of the Manual.

CAUTION

You might cause permanent damage to the sub-sea installations of the 440 or the 350 / 350 Powertrack System if you operate them from an incorrect electrical supply.

The standard sub-sea components of both Systems operate from a nominal 110V AC electrical supply. Optionally, both Systems are available for operation from a nominal 240V AC electrical supply.

When you interconnect the 350 or 350 Powertrack and the 440 Systems within a Dualtrack installation, *you must operate both Systems from the same electrical supply*.

6. Connect the communications conductors of the 350 / 350 Powertrack Power/Comms cable to the ROV umbilical. Note that the Dualtrack System would normally use 2-wire current-loop communications to the SDC to reduce the demand for twisted pairs in the umbilical. However, where necessary, you may use 4-wire or RS232 communications instead. Refer to Table 4-5, Table 4-6, or Table 4-7 in this Manual for appropriate connection details.

Connect the 440 System to the 350 System:

7. Use the 440-to-350 Link Cable (Teledyne TSS P/N B930477) to connect the 8-way ‘Power/Comms’ connector on the 440 PSU to the AUX OUTPUT port on the 350 SEP. This link uses RS232 communications at 9600 baud.

Note that the connectors at each end of the cable are of a different design. You cannot reverse the cable when you make this connection.

Refer to section 4.1.2 "Care of Sub-sea Connectors" on page 4-3 in this Manual for instructions to care for and assemble the sub-sea connectors. Make all interconnections between the sub-sea assemblies and tighten the locking collars by hand. Do not over tighten the sub-sea connectors.

Connect the SDC to the umbilical cable:

8. Refer either to section 4.2.2 "Communication Link SEP to SDC" on page 4-8 of this Manual or to the 350 / 350 Powertrack Manual for instructions to complete the connection using the selected communication method.

B.1.6.1 System Configuration

The DeepView for Windows software allows you to configure and control both Systems in a Dualtrack installation.

NOTE

If you are installing Dualtrack operation as an upgrade to an existing 440, 350 or 350 Powertrack System:

- Ensure your SDC is capable of running Microsoft Windows™ 7 and the DeepView for Windows software. Contact Teledyne TSS for advice if necessary.
- In a Dualtrack System, the 440 SEP must communicate using RS232. If your 440 SEP uses 2-wire or 4-wire communications, refer to section 4.2.2.1 "Alternative Communication Methods" on page 4-11 of this Manual and set RS232 communications *before* you install the SEP on the ROV.
- Follow the instructions in section 5.1 "Software Installation" on page 5-1 of this Manual to install the software onto your SDC.

To configure the Dualtrack System properly you must complete the following actions.

1. Use the DeepView for Windows System Configuration Wizard to configure the 440 and the 350 or 350 Powertrack Systems correctly. Select Dualtrack for the SEP type. Refer to section 5.3 "DeepView For Windows - System Configuration" on page 5-4 of this Manual for instructions to configure the 440 System. Refer to the 350 / 350 Powertrack Manual for instructions to configure that System.

IMPORTANT

You *must* select Dualtrack as the SEP type even if you intend to use only one of the Systems during the survey.

2. Take care to enter all details completely and correctly. Set appropriate altimeter offsets for the 440 and the 350 / 350 Powertrack Systems.

B.1.6.2 System Operation

When supplied as part of a complete Dualtrack System the SDC will have all the software necessary to operate already installed and tested. After power-on the SDC will perform an initialisation sequence and DeepView for Windows will then start automatically.

Contact Teledyne TSS for advice if you wish to upgrade an existing 440 or 350 / 350 Powertrack System to a Dualtrack.

1. Refer to this Manual and the 350 / 350 Powertrack Manual for instructions to use DeepView for Windows in its 440 and 350 and 350 Powertrack modes.

2. Use the selection buttons on the DeepView for Windows tool bar to select either the 440 or the 350 operating mode. These buttons are available for use only if you select Dualtrack as the SEP type in the System Configuration Wizard. The buttons are mutually exclusive – you cannot operate the installation with the 440 System and the 350 System operating simultaneously.

3. DeepView for Windows annotates the internal logging file with the operating mode so that it can replay the file correctly.

IMPORTANT

Note that the external logging file changes its format when you switch between the 440 and the 350 mode. Be aware that this might cause problems with the data logger and its software.

B.1.6.3 Forward Search Window

In addition to the DeepView for Windows information outlined in Chapter 6 "Operating software" of this manual. The Forward Search Window [Ctrl + F] (or via the View Drop down menu) is available for use with the 350 and Dualtrack options.

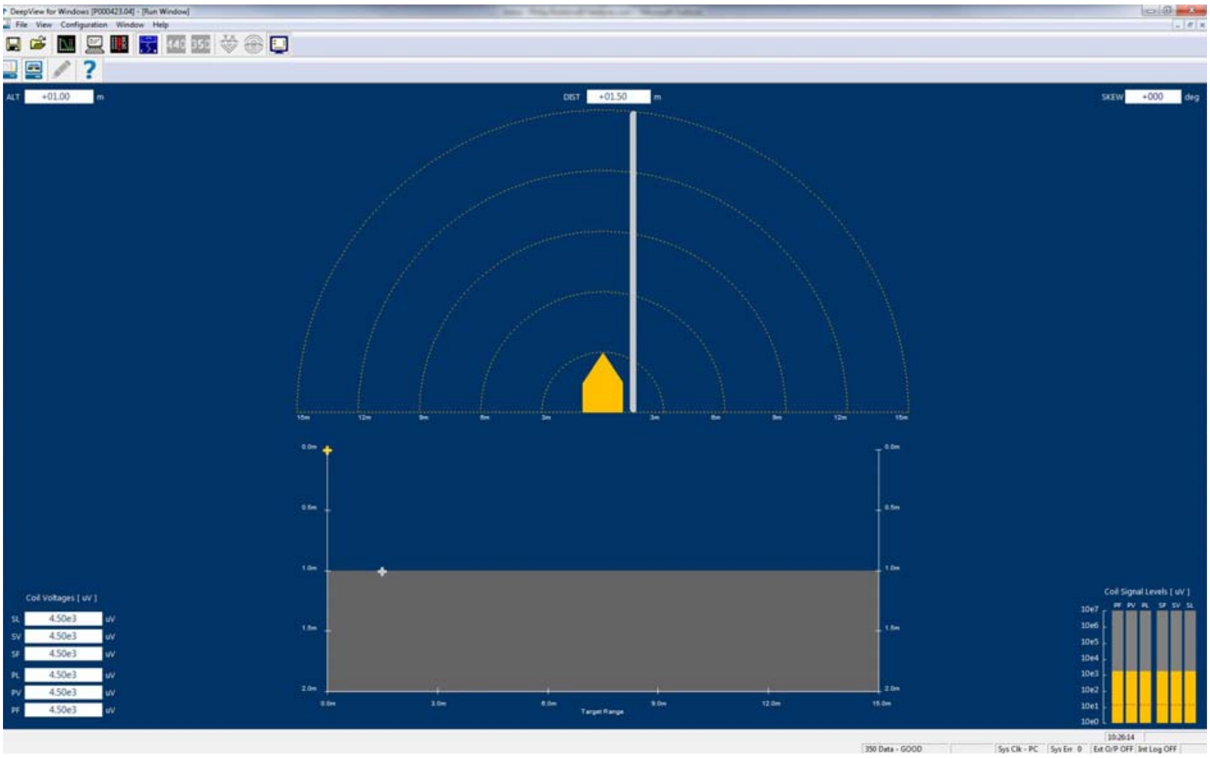


Figure B-5: DeepView for Windows: Forward Search Window

B.1.7 Power Supply Requirement

CAUTION

You might cause permanent damage to the sub-sea installations of the 440 or the 350 System if you operate them from an incorrect electrical supply.

The standard sub-sea components of both Systems operate from a nominal 110V AC electrical supply. Optionally, both Systems are available for operation from a nominal 240V AC electrical supply.

When you interconnect the 440 and the 350 Systems within a Dualtrack installation, *you must operate both Systems from the same electrical supply*.

Specifications for the Dualtrack System are as listed in Section 8.1 of the relevant Manual for the 440 and 350 Systems.

Note however that the sub-sea components of the Dualtrack System must operate from the same nominal supply voltage (either 110V or 240V AC as appropriate).

The maximum current consumption for the Dualtrack System is 3.1A at 110V AC nominal electrical supply or 1.8A at 240V AC nominal electrical supply.

B.2 Training

The Teledyne TSS 440 Pipe and Cable Survey System is a precision ‘front line’ survey tool. To exploit the full potential of the System, all personnel involved with a survey that uses the 440 System – from the initial planning stages to final data presentation – should possess a sound understanding of the performance of the System and its application.

Teledyne TSS has developed two levels of training course to provide for the needs of those who will be involved with a survey that uses the 440 System. For effective learning, the maximum number of participants in each course is limited.

Participants who successfully complete the training course, which includes a written test, receive a numbered Training Certificate

- System overview
- Principles of operation
- Initial installation
- Software overview and interfacing with other equipment
- Operational considerations and limitations
- Practical demonstration
- Use of the System as part of a Dualtrack installation

C Altimeter

Table C-1: Benthos PSA-916 part numbers

B345421	Altimeter, subsea 6000m (Benthos PSA 916 - includes B934685 cable assembly)
B934684	Altimeter and mounting kit assembly (as above, plus components from B934703)
B934685	Cable assembly, altimeter 3m (for use with Benthos PSA 916 only)
B934703	Altimeter mounting kit spares assembly

Table C-2: TSS ALT-250 part numbers

500292	Altimeter, subsea Teledyne TSS-ALT-250 - 3000m (no cable or accessories)
500294	As above, detection kit - 3000m (includes bracket 601824A)
500295	Altimeter - 3000m, including 3m pigtail 601826A
B345420	Altimeter, subsea Teledyne TSS-ALT-250 - 6000m (no cable or accessories)
B931155	As B345420, detection kit - 6000m (includes bracket 601824A)
601824A	Cable ALT-250 to Teledyne TSS 350/440 SEP (3m)
601825A	Cable ALT-250 to Teledyne TSS 350/440 SEP (7m)
601826A	Pigtail (3m)
601827A	Pigtail (7m)

D Reference

The following pages contain blank sample copies of forms that you may use to record details about the 440 System before and during a survey. You should complete these forms and include copies with the final survey results to help the post-processing engineers with their survey analyses.

These are master copies of the forms, printed on right-hand pages only for easier photocopying. Make copies of these forms as necessary.

D.1 Target Scaling Procedure

Target scaling performed by: ____________ Date: ____________

Attach a completed Configuration Log Sheet or a print-out of the configuration details.

Target details			
Standard pipeline			
Target type		External diameter (cm)	
		Internal diameter (cm)	
Target wall thickness (cm):			
Weight coating thickness (cm):			

Background Compensation			
Channels in use:		Start of scaling procedure	End of scaling procedure
Channel 1	Early	µV	µV
	Standard	µV	µV
Channel 2	Early	µV	µV
	Standard	µV	µV
Channel 3	Early	µV	µV
	Standard	µV	µV
Channel 4	Early	µV	µV
	Standard	µV	µV

Water Temperature	Hot		Medium		Cold	
Compensation	Manual		M		G	

Final target scaling	
Target scaling factor (generated by the 'Auto Scaling' facility of the System):	µV

D.2 Target Scaling Results

Automatic target scaling factor: [ ] µV

Nominal VRT (cm)	True VRT COL 1	440 VRT COL 2	Range error COL 1 – COL 2	Channel signals (µV) Starboard	Centre	Port
40						
60						
80						
100						
120						
140						
160						
180						
200						
210						
220						
230						
240						

Optimised target scaling factor: [ ] µV

Nominal VRT (cm)	True VRT COL 1	440 VRT COL 2	Range error COL 1 – COL 2	Channel signals (µV) Starboard	Centre	Port
40						
60						
80						
100						
120						
140						
160						
180						
200						
210						
220						
230						
240						

D.3 Performance Envelope Results

Target scaling factor;[ ] µV

True VRT (cm)	VRT VALUES DISPLAYED BY SDC															
	Lateral offset (cm) to port [ ] or to starboard [ ]															
	300	280	260	240	220	200	180	160	140	120	100	80	60	40	20	0
20																
40																
60																
80																
100																
120																
140																
160																
180																
200																
220																
240																
260																

D.4 Survey Details

Complete this log before every survey and file with the Survey Records

Survey Vessel:	
Date:	
Survey Vehicle:	
Site:	
Client:	
Project Number:	

D.5 System Configuration Details

SDC S/N:		Software Version:	
SEP S/N:		Firmware Version:	
PSU S/N			
Search Coils:			
Coil 1 S/N:		Coil 2 S/N:	
Coil 3 S/N:		Coil 4 S/N:	
Altimeter type:		S/N:	
Analogue option fitted?		Y/N	
Coil mapping:		Threshold setting (µV):	
Target Type			
Weight coating thickness (cm)			
Target scaling factor:			
Altimeter Source:			
Altimeter S/N:		Enabled?	Y/N
Altimeter Offset (cm):		Fixed coil altitude (cm):	
External data logger type:			
Logging rate:			
Compensation reminder interval:			
Audible alarm enabled?		Y/N	
Initial compensation values early:		Port	
		Centre	
		Starboard	
Initial compensation values standard:		Port	
		Centre	
		Starboard	
Water temperature:	Hot	Medium	Cold
Compensation:	Manual	M	G
Survey Completed by:			
Teledyne TSS 440 Training Certificate No.:			
Date of training:			

E Index