TELEDYNE TSS
Everywhereyoulook™

HydroPACT 660/660E

Pipe and Cable Survey System

User Manual

B934859 - HydroPACT 660 110V a.c.
B934803 - HydroPACT 660 24V d.c.
B935030 - HydroPACT 660E 24V d.c.

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Revision History

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1.1	September 2017	UXO warning added
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Glossary

Item	Definition as used throughout this Manual
ALT	Coil altitude above the seabed. This could be measured by a subsea altimeter connected either directly to the SEP or through the umbilical to the topside computer. 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. DeepView 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 660 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	Subsea power supply pod. The depth rated unit that accepts an electrical supply from the ROV and produces the conditioned and stabilised d.c. supplies used by the SEP.
ROV	Remotely operated vehicle. Any form of subsea or surface vehicle supporting the 660 system during survey operations.
SDC	Surface display computer. One of the configuration, control and display computer options supplied by Teledyne TSS to operate the 660 system.
SEP	Subsea electronics pod. The depth rated unit that performs the measurement operation on the target.
VRT	Vertical range to target. The distance measured by the 660 system along a line perpendicular to the coil surface, between the coil array and the closest point of the conductive target.

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1 Introduction

The HydroPACT 660 and 660E systems are turnkey solutions for performing submarine surveys on conductive targets such as cables or pipelines. Based on Teledyne TSS's market-leading pulse induction technology, these systems operate in real time and provide measurements at a rate that allows deployment on board faster ROVs. The measurement technology used by the systems also allow them to operate out of water with no degradation in performance, range or accuracy. You may therefore use the 660 and 660E systems for land-based or amphibious survey applications.

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

1.1 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.

1.2 System Description

NOTE

Except where explicitly stated, references to the 660 throughout this manual also apply to the 660E system.

Teledyne TSS has designed the 660 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.

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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

Refer to Appendix B.1 for more information on options and how to order.

NOTE

Both topside computers have their own dedicated user manuals and these should be referred for specific information on installation, operation and maintenance.

During survey operations, the subsea 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 660 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 DeepView to generate survey data.

1.2.1 660 system

Figure 1-1 shows a typical configuration for the 660 system that has the topside computer installed on a surface vessel and the subsea components mounted on an ROV. Table 1-1 identifies the individual components of the installation.

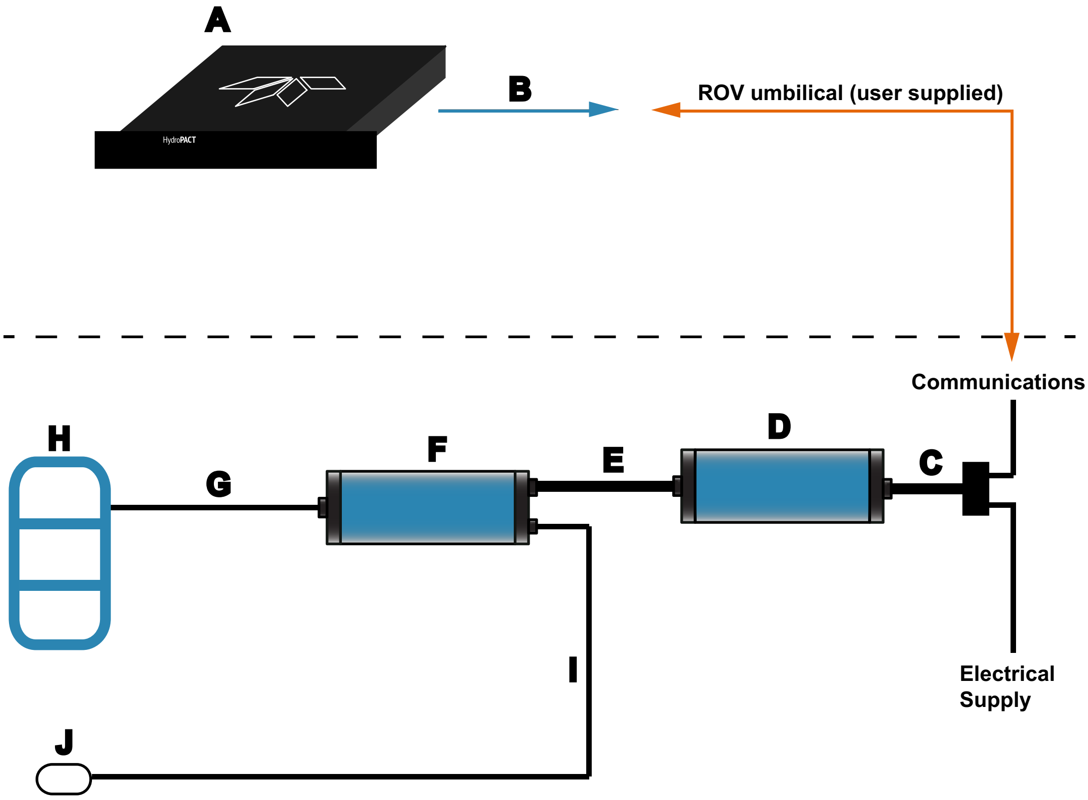

Figure 1-1: Components of the 660 system

Table 1-1: Components of the 660 system

Item	Description
A	Topside computer with DeepView installed
B	Data cable for connection between the topside computer 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	Subsea power supply unit (PSU)
E	Power and data cable that connects the PSU to the SEP
F	Subsea electronics pod (SEP)
G	Coil array cable
H	Coil array
I	Power and data cable that connects the altimeter to the SEP
J	Subsea altimeter

1.2.2 660E system

Figure 1-1 shows a typical configuration for the 660E system that has the topside computer installed on a surface vessel and the subsea components mounted on an ROV. Table 1-1 identifies the individual components of the installation.

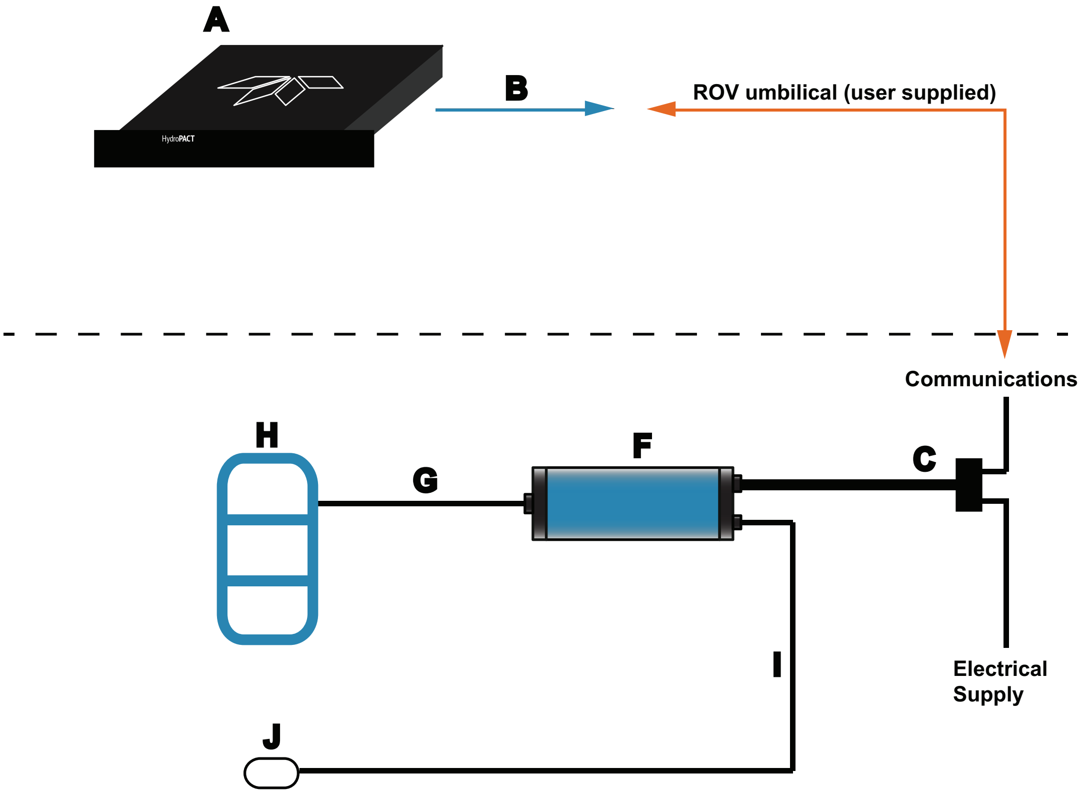

Figure 1-2: Components of the 660E system

Table 1-2: Components of the 660E system

Item	Description
A	Topside computer with DeepView installed
B	Data cable for connection between the topside computer and the ROV umbilical
C	Power and data cable (or 'ROV Tail') that connects the SEP to the ROV umbilical and power distribution system
F	Subsea electronics pod (SEP)
G	Coil array cable
H	Coil array
I	Power and data cable that connects the altimeter to the SEP
J	Subsea altimeter

1.3 Principle of Operation

The 660 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 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.

2. Terrestrial magnetism has no effect upon the system operation.

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.

WARNING

Unexploded ordnance (UXO) may take many forms including but not limited to unexploded bombs, shells, rockets and missiles, grenades, land mines, naval mines, and cluster munitions that did not explode when they were employed and still pose a risk of detonation. The unknown state of these items may mean that they become unstable with the passage of time and may be sensitive to transient electrical energies. Teledyne Technologies Incorporated and its subsidiaries, including Teledyne Limited, accept no responsibility whatsoever for the premature triggering or firing of UXO whilst employing this apparatus to detect the presence of such devices.

WARNING

The search-coils generate a strong, intermittent, electromagnetic field while operating. The principal risk from the electromagnetic field is to personnel with active implanted medical devices such as:

- Cardiac pacemakers
- Implantable cardiac defibrillators
- Cochlea implants
- Brainstem implants
- Inner ear prostheses
- Neurostimulators
- Retinal encoders
- Implanted drug infusion pumps

Teledyne Limited recommends that all personnel maintain a minimum distance of 1.5 metres from the coil surface when they are energised.

This restriction applies only to the search-coils, and only when they are under power.

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NOTE

- ❐ Note that the special characteristics of 316 stainless steel do not allow the 660 system to detect it reliably.
- ❐ Do not use the 660 system to survey targets buried beneath iron ore, which will mask signals from the target.

1.4 Warranty

Please refer to your sales agreement with Teledyne Limited for information about the terms and duration of the warranty for this product.

NOTE

Retain the original packaging to use when shipping this product between installation sites or when returning it to Teledyne Limited or an authorised distributor for repair. The use of improper packaging for shipping any part of this equipment may invalidate the warranty. For information about the proper return location and procedure, contact Teledyne Limited or an authorised distributor.

1.5 Product Support

For questions about installing your product or any other product operating enquiry contact our technical support. See our website at **www.teledynemarine.com/tss** for more information.

2 Installation

To gain the best performance out of the HydroPACT 660 system you must take care when you install and connect it. This section includes the necessary information to help you identify suitable locations for the various components of the system, and install and prepare the systems for use.

There are many different types and size of survey vessel and ROV, therefore the instructions in this chapter represent a set of general guidelines and recommendations that experience has proved effective.

2.1 Unpacking and Inspection

NOTE

Retain the original transit cases so that you may use them if you must transport the 660 systemfor any reason. You will invalidate the warranty if you use improper packing during transportation.

Upon receipt of the 660 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 Limited 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 Limited. The title page of this manual lists the contact details for Teledyne Limited. Teledyne Limited also operates a 24-hour emergency telephone support line managed by trained and experienced technicians.

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 section 7 for all sub-assemblies.

2.1.1 Scope of Supply

2.1.1.1 660 system

Case 1: 660 Pod Case

- 1 x 660 SEP
- 1 x 660 PSU pod
- 1 x PSU to ROV cable (3m)
- 1 x PSU to SEP cable (2.5m)
- 1 x ALT-250 altimeter (optional)
- 1 x ALT-250 cable (3m) (optional)
- 1 x 6 pin dummy plug
- Nylon frame fixing kit

- 1 x Universal detection support kit
- 2 x USB drive (one containing user manuals and declaration of conformity, one containing DeepView software)

Cases 2 & 3: 660 Coil Transit Case (2 off)

- 1 x 660 coil array with 2m flying lead

Case 4: SDC10 (optional) - see separate manual for scope of supply

Loose:

- 440 coil mounting bars

2.1.1.2 660E system

Case 1: 660E Pod Case

- 1 x 660E SEP
- 1 x PSU to ROV cable (3m)
- 1 x ALT-250 altimeter (optional)
- 1 x ALT-250 cable (3m) (optional)
- 1 x 6 pin dummy plug
- Nylon frame fixing kit
- 1 x Universal detection support kit
- 2 x USB drive (one containing user manuals and declaration of conformity, one containing DeepView software)

Cases 2 & 3: 660 Coil Transit Case (2 off)

- 1 x 660 coil array with 2m flying lead

Case 4: SDC10 (optional) - see separate manual for scope of supply

Loose:

440 coil mounting bars

2.2 Physical Installation

NOTE

For information on installing the topside computer refer to its dedicated user manual.

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2.2.1 SEP and PSU

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

Do not attempt to secure the housings directly to the ROV framework without using the mounting blocks. Omitting the mounting blocks may cause damage to the surface of the housings leading to corrosion.

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 2-1).

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 660 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 subsea 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.

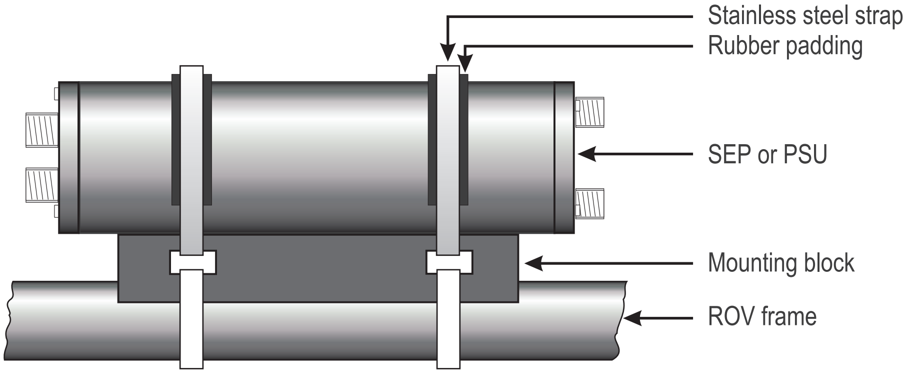

Figure 2-1: SEP and PSU mounting arrangement

2.2.2 Coil Array

The 660 system has a single, integrated array comprising port, centre and starboard search coils.

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NOTE

You should read this section before you attempt to install the coil array. These details are critical to the successful operation and performance of the 660 system. and the avoidance of with other equipment on board the ROV.

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

2.2.2.1 Positioning the coil array

2.2.2.1.1 Coil array separation distance

This is the shortest distance between the edge of the coil array and the region of the ROV where significant conductive material begins (see Figure 2-2). 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 array 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 array separation distance will allow you to deploy, manoeuvre and recover the ROV more easily.

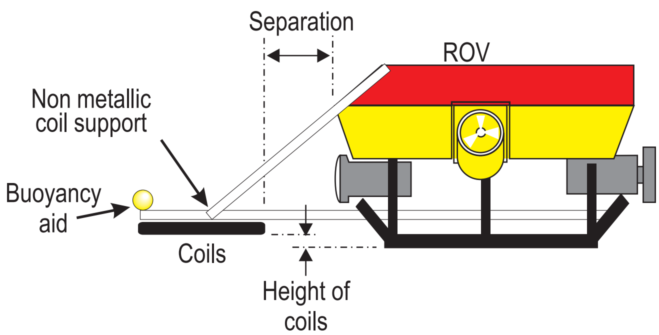

Figure 2-2: Coil array separation distance

Small ROVs will tend to generate a comparatively weak background signal. This allows you to mount the coil array 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 coil array further 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 array mounting position.

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Table 2-1 lists the maximum measured signals with the two pods mounted laterally, one behind the other, on the same horizontal plane. The values decrease as vertical separation from the coil increases. Consider these factors as you plan the installation.

Table 2-1: Measured signal response with pods mounted laterally

Separation (mm)	Signal (µV)
200	1050
300	500
400	250
500	120
600	70
700	40
800	20
900	15
1000	10

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 4.3.2 for a description of background compensation.

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.

2.2.2.1.2 Coil array mounting position

- **Front Mounting**

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 Run Window. It will also reduce the risk of an umbilical snag. With the coil array 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 660 system. Any free movement in the manipulators might cause unexpected changes in the background signal that could affect or invalidate survey data.

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If you have to use the manipulators during a survey, you must check the back-ground 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 coil array 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.

2.2.2.1.3 Height of coil array

Ideally, you should mount the coil array so that it is no lower than 0.1m above the lowest point on the ROV. This position is a compromise between the need to mount it low down to extend its operating range, and the need to protect it 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 coil array so that it is 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 coil array is not horizontal. Be particularly careful if your system uses rams to lower and deploy the coil array after you have launched the ROV.

2.2.2.2 Coil Assembly and Installation

You must use the non-conductive mounting components supplied with the 660 system to fix the coil array to the ROV frame. These mounting components include four pre-drilled cast nylon beams and nylon threaded stud, nuts and washers. When assembled, the nylon components should support the coil array rigidly in position.

NOTE

Apart from relevant components of the 660 subsea 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 660 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 two pairs of pre-drilled nylon beams to support the coils on the ROV. Figure 2-3 shows each type of nylon supporting beam:

- Two outriggers
- Two tie-bars

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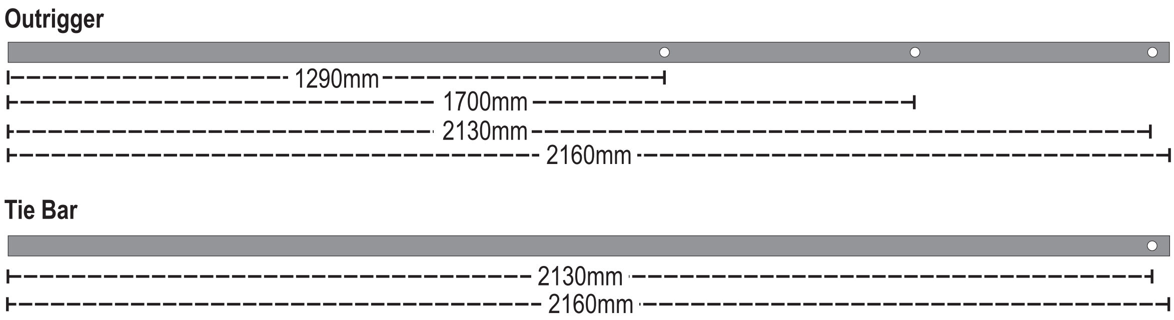

Figure 2-3: Components of the coil frame

To mount the coil array to the ROV you will need the following facilities, components and items:

- All the components and fixings of the supplied coil frame.
- 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.

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

1. Place the coil array near the ROV with the potting compound on the top and the connector facing the ROV.

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.

2. 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.

3. 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.

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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.

4. Use four lengths of nylon stud and attach the coil array to the two outrigger bars. Ensure that the fixing studs do not project too far below the bottom M16 nut. 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.

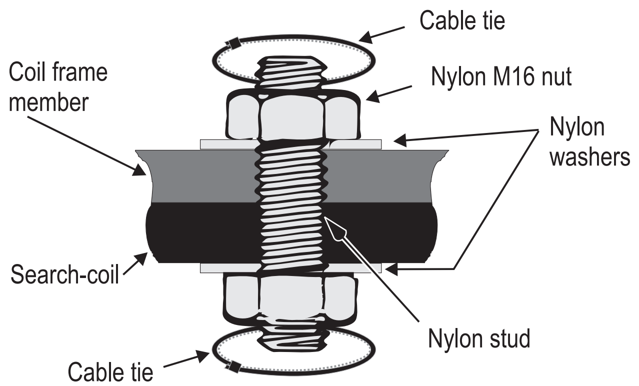

Figure 2-4: Fixing arrangement

5. Use nylon stud inserted through the lateral holes to attach the ends of the tie-bars to the outriggers. If no suitable 16.5mm diameter holes exist in the outriggers, drill them.

6. Use stainless-steel bolts or U-bolts to secure the free ends of the tie-bars to the ROV frame. 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 assembly.

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

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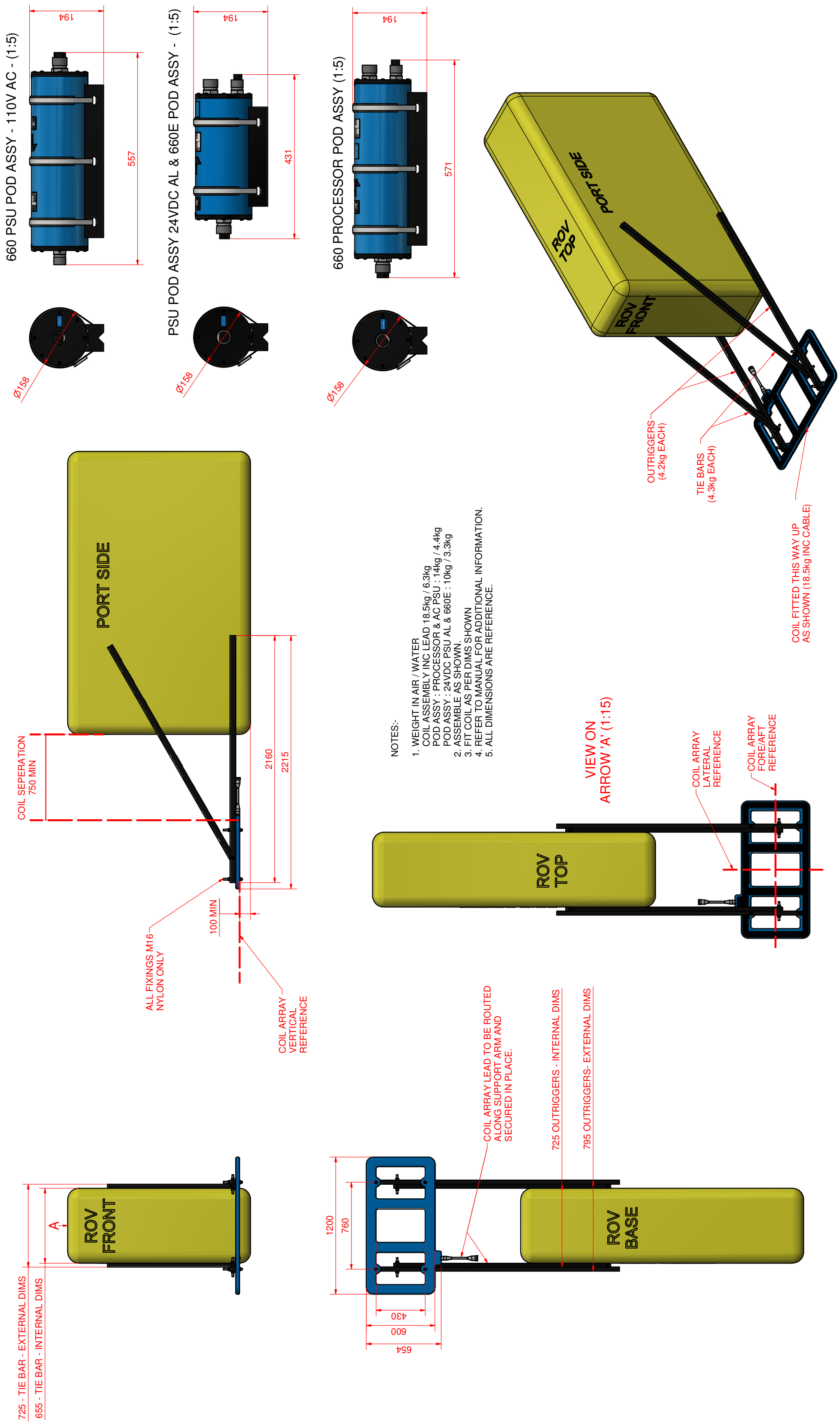

Figure 2-5: 660 installation drawing

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2.2.3 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 660 system. The example in Figure 2-6 shows how the two altimeters 'A' and 'B' will supply totally different readings at the ROV location. When used by DeepView, 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

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.

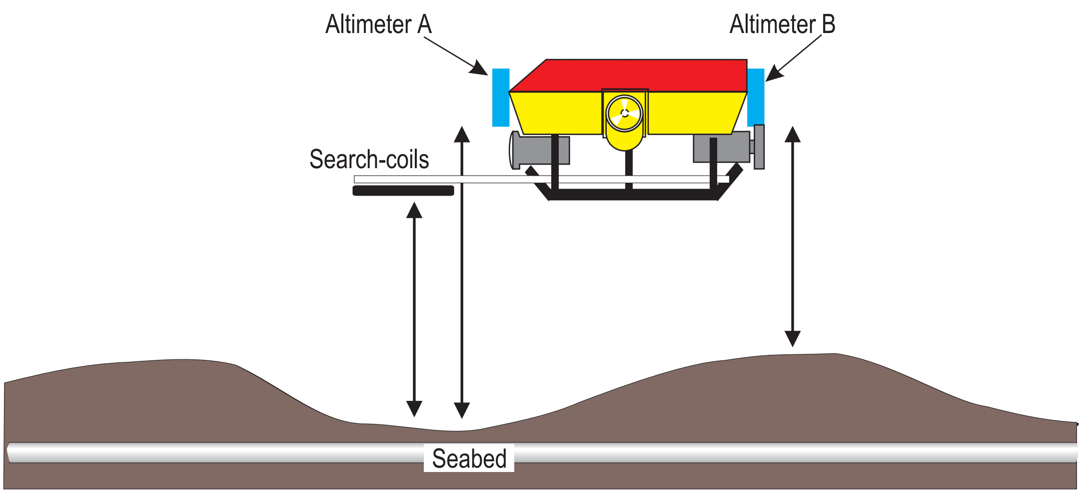

Figure 2-6: Effects of altimeter horizontal offset

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, it is strongly recommended that you use a separate profiling system to measure the seabed level.

2.2.4 Installation Checklist

- ❒ Ensure the coil array is central on the ROV and that it aligns with the fore-aft direction of travel.

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- 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.
- 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.

2.3 Electrical Installation

WARNING

There is a risk of death or serious injury by electric shock when you work on the electrical distribution system. Only a competent operator 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 660 system to the electrical distribution system. Observe all relevant local and national safety regulations while you work on the ROV and on the 660 system.

Do not reconnect the mains electrical supply to the ROV or to the 660 system until you have completed all work and you have fitted all safety covers and ground connections.

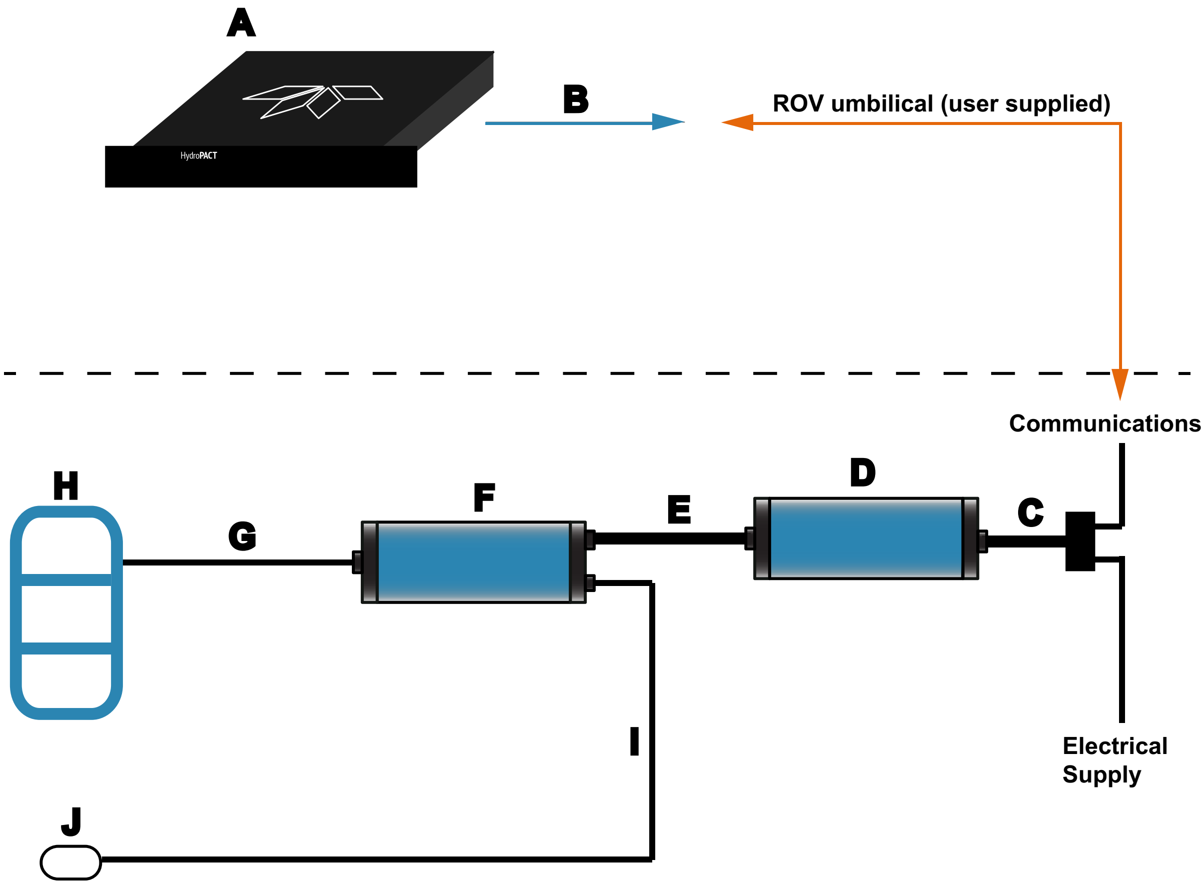

Figure 2-7: System interconnection diagram (660)

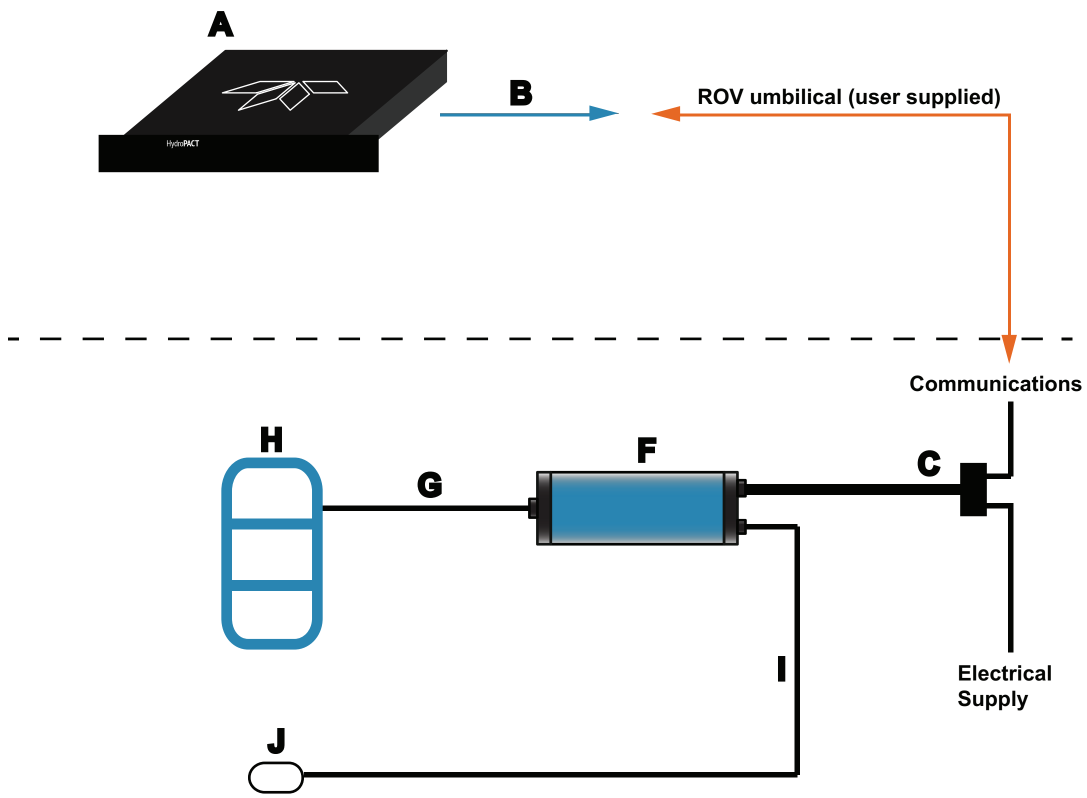

Figure 2-8: System interconnection diagram (660E)

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Table 2-2: System interconnection details

A	The topside computer accepts an electrical supply in the range 90 to 264V a.c. The power demand is a maximum of 250VA (SDC) or 300W (HydroPACT RMC10).
B	RS232 data communications from the topside computer to the ROV umbilical.
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 topside computer, and power cores that supply electrical power to operate the PSU.
D	The PSU accepts power from the ROV electrical distriction system through the ROV tail. 110V a.c. and 24V d.c. options are available. The PSU also passes communication signals from the SEP to the topside computer.
E	Connection between the PSU and the SEP is through a single cable. The SEP accepts power from the PSU and communicates with the topside computer through the PSU to SEP cable.
F	The SEP accepts power from the PSU (or ROV in the case of the 660E), drives the search coils and communicates with the altimeter and the topside computer .
G	The SEP drives the coil array through the coil cable.
H	Coil array.
I	Altimeter cable. The SEP provides power to, and communicates with, the subsea altimeter through the subsea altimeter cable.
J	Altimeter. Note that only certain types of altimeter can be connected directly to the SEP.

2.3.1 Ground Connections

If you provide the 660 system with an inadequate ground connection parts of the system will act as 'sacrificial anodes' and will slowly decay during subsea operations. This will occur whether or not you use the 660 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 660 system because there will inevitably be a potential difference between the ROV and the surface vessel.

These grounding provisions hold the 660 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.

2.3.2 Care of Subsea Connectors

Before you assemble any electrical coupling in the subsea installation, inspect the pins and receptacles of all connectors for signs of damage, contamination or corrosion. To ensure reliable operation and to extend the life of the subsea installation, take the following precautions to care for the subsea connectors used throughout the 660 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.

2.3.3 Power Supply Pod (a.c.)

CAUTION

While the subsea PSU is fused against surges and other over-current situations, it is the responsibility of the installer to provide external protection to minimise the risk of damaging the system.

The a.c. PSU operates from an electrical supply in the range 110 to 120V a.c., 45 to 65Hz. The system draws approximately 1.3A at 110V nominal supply voltage. The PSU 'Power Supply Input/Data' port accepts the a.c. electrical supply from the ROV and passes the bi-directional communications between the SEP and the topside computer. All electrical and communications connections to the subsea installation are through the power and communications cable, or 'ROV Tail'. Table 2-3 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.

Table 2-3: Power and Communications cable

Connector Pin Number (and Wire number)	Function	Core colours
1 (N)	Supply neutral line/L2	Blue
2 (E)	ROV ground	Dark Green
3 (L)	Supply 110V live/L1	Brown
4 (wire number 1)	Comms 1	Orange
5 (wire number 2)	Comms 2	White
6 (wire number 3)	Comms 3	Red

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Table 2-3: Power and Communications cable

Connector Pin Number (and Wire number)	Function	Core colours
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 'Power Supply Input/Data' port on the PSU. Tighten the knurled locking collar by hand only. **Do not overtighten this connector.**

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 660 system. You must make all connections to the ROV using waterproof connectors or splices of good quality.

2.3.4 Power Supply Pod (d.c.)

WARNING

The incoming 24V d.c. supply should be SELV, i.e. supplied from a secondary circuit which is so designed and protected that under normal and single fault conditions its voltages do not exceed a safe value.

CAUTION

While the subsea PSU is fused against surges and other over-current situations, it is the responsibility of the installer to provide external protection to minimise the risk of damaging the system.

The d.c. PSU operates from an electrical supply in the range 19 to 36V d.c. The system draws approximately 4A at 24V nominal supply voltage. The PSU 'Power Supply Input/Data' port accepts the d.c. electrical supply from the ROV and passes the bi-directional communications between the SEP and the topside computer. All electrical and communications connections to the subsea installation are through the power and communications cable, or 'ROV Tail'. Table 2-4 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.

Table 2-4: Power and Communications cable

Connector Pin Number (and Wire number)	Function	Core colours
1 (+V)	+24V	

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Table 2-4: Power and Communications cable

Connector Pin Number (and Wire number)	Function	Core colours
2 (0V)	0V	
3 (E)	Earth (ROV ground)	
4 (SCN)	Cable screen	
5 (wire number 5)	Reserved	
6 (wire number 6)	Reserved	
7 (wire number 1)	Comms 1	
8 (wire number 2)	Comms 2	
9 (wire number 3)	Comms 3	
10 (wire number 4)	Comms 4	

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 'Power Supply Input/Data' port on the PSU. Tighten the knurled locking collar by hand only. **Do not overtighten this connector.**

⚠ **CAUTION**

It is very important to provide a good ground connection on pin number 3 of the cable. A poor or a missing connection will severely degrade the performance of the 660 system. You must make all connections to the ROV using waterproof connectors or splices of good quality.

2.3.5 Subsea Electronics Pod (660)

⚠ **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 to protect any unused port on the SEP.

The SEP has three ports that allow connection to the various subsea components of the installation.

On one end cap:

- Connection port for coil array.

On the other end cap:

- Connection port for the cable from the PSU.

- Altimeter connection.

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

2.3.6 Subsea Electronics Pod (660E)

The SEP has three ports that allow connection to the various subsea components of the installation.

On one end cap:

- Connection port for coil array.

On the other end cap:

- Connection port for the ROV power and data cable.
- Altimeter connection.

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

WARNING

The incoming 24V d.c. supply should be SELV, i.e. supplied from a secondary circuit which is so designed and protected that under normal and single fault conditions its voltages do not exceed a safe value.

CAUTION

While the SEP is fused against surges and other over-current situations, it is the responsibility of the installer to provide external protection to minimise the risk of damaging the system.

The 660E SEP operates from an electrical supply in the range 19 to 36V d.c. The system draws approximately 4A at 24V nominal supply voltage. The 'Power Supply Input/Data' port accepts the d.c. electrical supply from the ROV and passes the bi-directional communications between the SEP and the topside computer. All electrical and communications connections to the subsea installation are through the power and communications cable, or 'ROV Tail'. Table 2-4 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.

Table 2-5: Power and Communications cable

Connector Pin Number (and Wire number)	Function	Core colours
1 (+V)	+24V	
2 (0V)	0V	
3 (E)	Earth (ROV ground)	
4 (SCN)	Cable screen	
5 (wire number 5)	Reserved	
6 (wire number 6)	Reserved	

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Table 2-5: Power and Communications cable

Connector Pin Number (and Wire number)	Function	Core colours
7 (wire number 1)	Comms 1	
8 (wire number 2)	Comms 2	
9 (wire number 3)	Comms 3	
10 (wire number 4)	Comms 4	

Lay the power and communications cable from the ROV electrical distribution system to the SEP. 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 'Power Supply Input/Data' port on the SEP. Tighten the knurled locking collar by hand only. **Do not overtighten this connector.**

CAUTION

It is very important to provide a good ground connection on pin number 3 of the cable. A poor or a missing connection will severely degrade the performance of the 660 system. You must make all connections to the ROV using waterproof connectors or splices of good quality.

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 to protect any unused port on the SEP.

2.3.7 Coil Array

CAUTION

The coil array is supplied pre-assembled with its cable and a protective cover over the connection. Do not remove this cover and/or disconnect the cable as part of routine operations. Disconnect the array at the SEP end of the cable.

Follow the instructions in section 4.2.2.1 to perform an electrical insulation test on the coil array, then secure the cable to the adjacent outrigger to minimise background noise due to movement of the cable.

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

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2.3.8 Subsea 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. 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.

2.3.8.1 Direct connection to the SEP

Use this method for the Teledyne TSS or Teledyne Benthos subsea 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.

Connect the cable to the ‘Altimeter’ port of the SEP. Tighten the knurled locking collar by hand only. **Do not overtighten this connector**.

2.3.8.2 Connection to the topside computer

Use this method to connect all other types of altimeter compatible for use with the 660 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 4.7 for details of these formats.

Make the following provisions if you intend to use one of the compatible alternative altimeters with the 660 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 topside computer.

- Provide a separate power supply to drive the altimeter.

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

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Connect the RS232 altimeter signals to the topside computer through the 9-way D-type male serial communication port labelled ‘COM2’. The pin designations for the 9-way D-type ports are as follows:

Table 2-6: RS232 connections for the altimeter (9-way D-type female cable)

Altimeter signal	Pin Number	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

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3 Operating Software

The topside computer has DeepView pre-installed and configured to start automatically when it is powered on.

NOTE

The DeepView software application is used with all Teledyne TSS detection systems. This chapter only covers functionality that applies to the HydroPACT 660 system.

NOTE

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

3.1 Initialisation

NOTE

It is usually better to power-on the subsea installation before you launch DeepView. This ensures the SEP data is available and will allow any configuration settings to be initialised.

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

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

NOTE

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

3.2 Initial Configuration

Before you can use the 660 system for the first time you must configure the software. This procedure can be enabled to run every time you open DeepView or if your setup is consistent it can be disabled and accessed via “System Configuration Wizard” from the configuration menu. The options that you are able to configure are the following:

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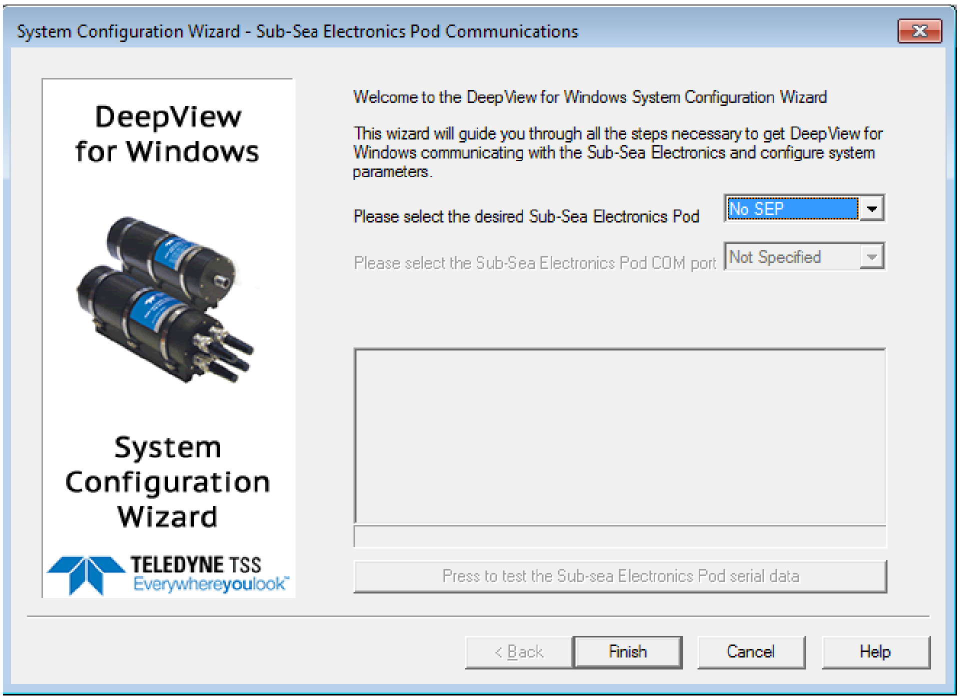

Figure 3-1: System Configuration Wizard

3.2.1 Subsea Electronics Pod

Define whether there is a 660 SEP or none. This setting determines the data format that DeepView expects to receive from the subsea installation and sets the style of Run Window that the software will use to display the system measurements.

There are two applicable options for setting the SEP type:

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

- **660**
  Use this option to control the 660 or 660E system.

3.2.2 Communication ports

NOTE

During system configuration the only port that you have to specify is the communication to the SEP.

The topside computer 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 topside computer.
- COM2 is used to accept serial data from any compatible altimeter that is not connected directly to the SEP. See section 3.3.3.2 for instructions to configure an altimeter and set its communication parameters.
- COM3 is used to connect the topside computer to a separate user-supplied data logger. You should use a data logger to record the survey measurements acquired by the 660 system. See section 3.3.3.3 for instructions to configure DeepView for data logging and to set appropriate communication parameters.
- COM5 is used by the topside computer to communicate with the video overlay card.

DeepView 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 topside computer 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 the topside computer to SEP 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.

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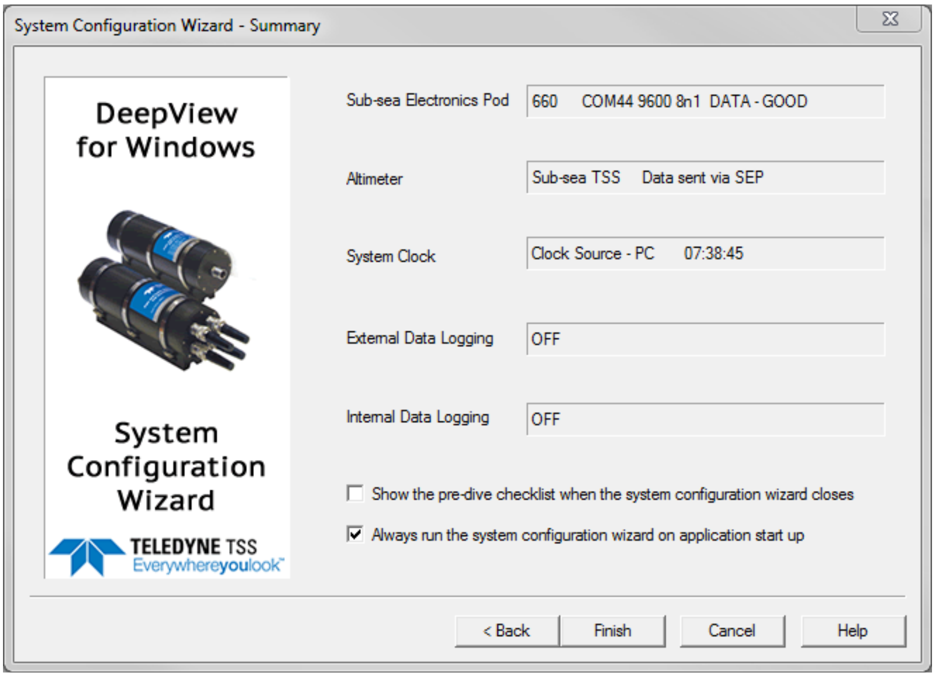

Figure 3-2: System Configuration Wizard - Summary

DeepView will now be configured to operate with the 660 system.

Before clicking on 'Finish' you have check boxes to select:

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

NOTE

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

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 topside computer, 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 launch DeepView.

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3.2.3 System Parameters

The following key parameters must be set prior to and during the survey. To edit these settings, select Configuration➡System Parameters.

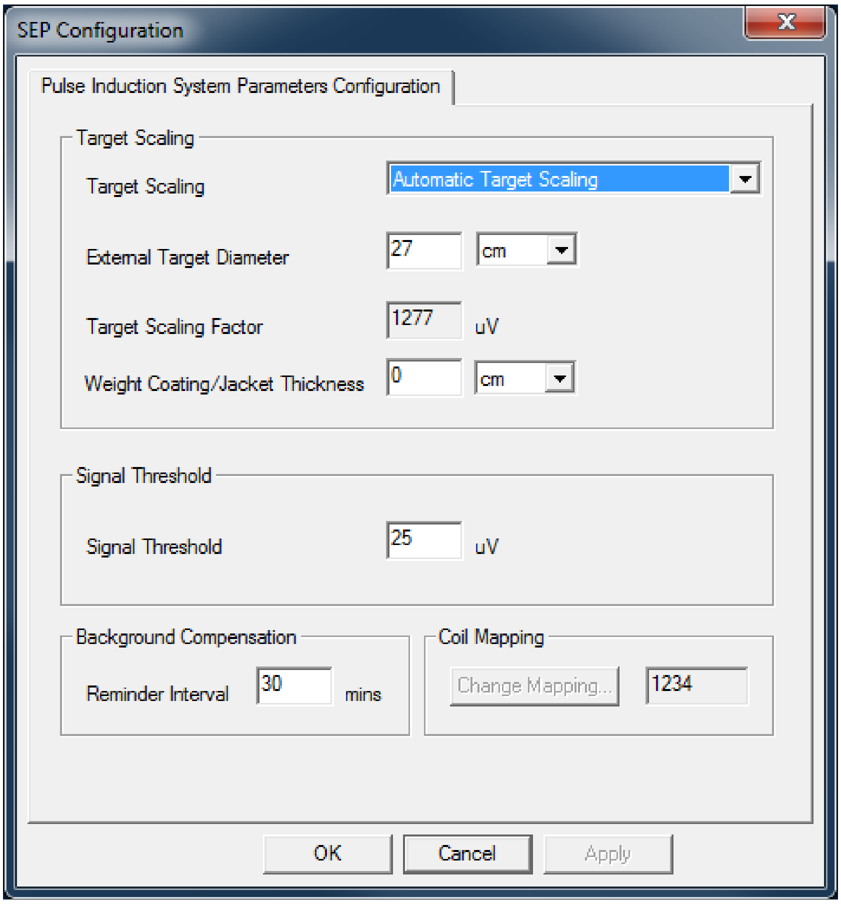

Figure 3-3: System Parameters

3.2.3.1 Target Scaling

Configure the 660 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 will allow for this thickness when it displays measurements of target co-ordinates.

DeepView 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.

For maximum accuracy it is recommended that you have Teledyne Limited determine an exact target scaling factor from a sample of your target.

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NOTE

When a target scaling value of greater than 2000uV is used, the Run Window colour scheme is modified. See section 3.3.2 for a detailed explanation of the relevant changes.

3.2.3.2 Threshold

Set an appropriate value for threshold.

High settings will make the 660 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, a value of 25µV is recommend 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.

3.2.3.3 Seawater Compensation

The 660 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°C, 10-25°C and >25°C.

Select a suitable band.

This assumes 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 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°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 may be beneficial.

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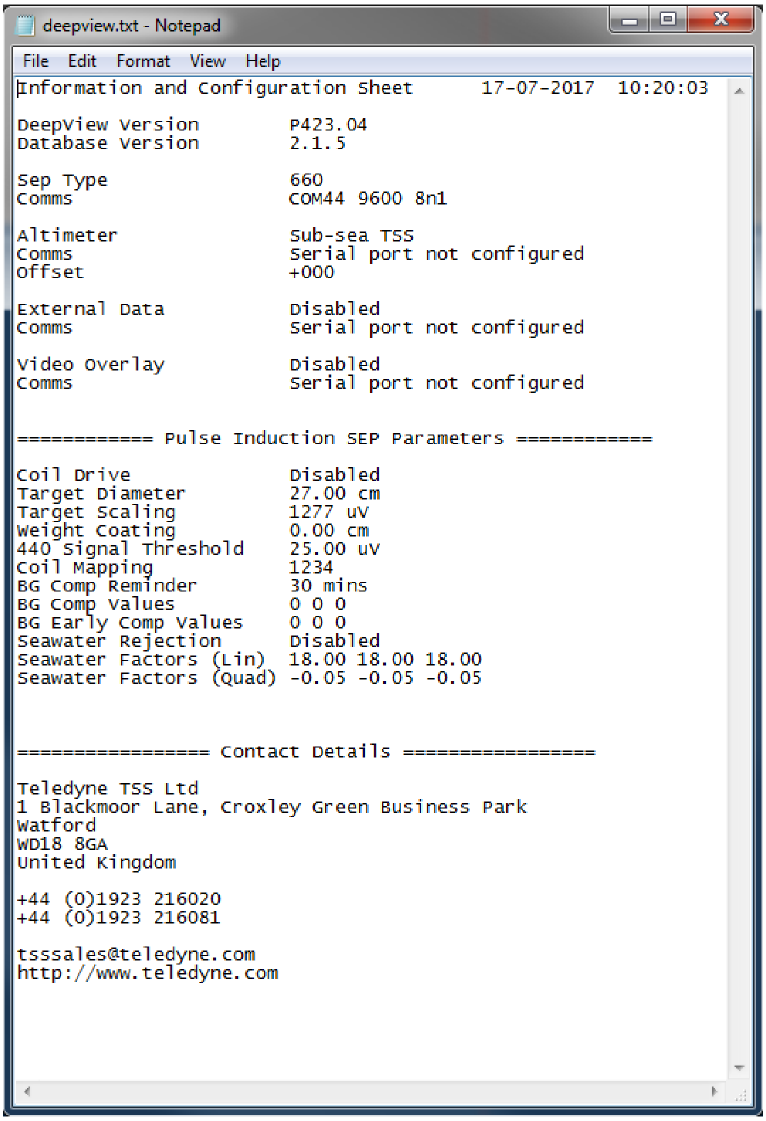
Range Determination

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.

3.2.4 Print Configuration

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.




```
Information and Configuration Sheet      17-07-2017  10:20:03

DeepView Version          P423.04
Database Version          2.1.5

Sep Type                  660
Comms                     COM44 9600 8n1

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

External Data             Disabled
Comms                     Serial port not configured

Video Overlay             Disabled
Comms                     Serial port not configured

============ Pulse Induction SEP Parameters ============

Coil Drive                Disabled
Target Diameter           27.00 cm
Target Scaling            1277 uV
Weight Coating            0.00 cm
440 Signal Threshold      25.00 uV
Coil Mapping              1234
BG Comp Reminder          30 mins
BG Comp Values            0 0 0
BG Early Comp Values      0 0 0
Seawater Rejection        Disabled
Seawater Factors (Lin)    18.00 18.00 18.00
Seawater Factors (Quad)   -0.05 -0.05 -0.05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```

Figure 3-4: Print Configuration

NOTE

Full analysis and post-processing of the raw data can be effective only if you retain a record of the 660 system configuration at the time of the survey. Configuration data is also critical for support requests to Teledyne Limited. Appendix D includes suitable forms for recording these details.

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3.3 Operating DeepView

This 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 3.3.5 for a list of the function keys.

3.3.1 Menu commands

Table 3-1 lists the commands available on the DeepView Menu Bar, together with their hotkey access codes and function keys where available.

Table 3-1: 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. The Replay Window includes the same features and as the Run Window and operates in a similar way. A button on the DeepView toolbar performs the same function as this command. You cannot use DeepView 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 |. DeepView adds a ‘time’ field to the start of logging and updates this at intervals of one minute. It obtains this information from the topside computer 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 Window. DeepView 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 660 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.

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Table 3-1: 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 after you open it. The normal condition is for the Run Window to be closed when you start DeepView. A button on theDeepView toolbar performs the same function as this command.
	Toggle Height Scale [Ctrl + H]	Use this command to select the desired height scale. Options are 0m to 2m and 0m to 5m.
	Scope Window	Use this command to open or close the Scope and Spectrum Analyser Window. A button on the DeepView toolbar performs the same function as this command. You must close the Run Window 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. **Note that the data string transmitted from the SEP to the topside computer 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 3.3.2.4. A button on the DeepView toolbar performs the same function as this command. The normal condition is for the System Errors Window to be closed when you start DeepView.
	Terminal Window [TAB]	Use this command to open or close the Terminal Window described in section 3.3.2.5. A button on the DeepView toolbar performs the same function as this command. The normal condition is for the Terminal Window to be closed when you start DeepView.
	Video Overlay Enable [Ctrl + V]	Use this command to select the Video Overlay function. A button on the DeepView toolbar performs the same function as this command. The video overlay feature allows the topside computer to accept input from a video camera and to output the video image overlaid with the target co-ordinates and steering information.

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Table 3-1: 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 660 system. See section 3.3.3.2 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 topside computer 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 3.3.3.5 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.

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Table 3-1: DeepView Menu Commands (Continued)

Menu item	Sub-menu, [hot key access] and Function key	Description
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 subsea 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 660 system before you start a survey. See section 4.2. 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.

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3.3.2 View Menu

3.3.2.1 Run Window

The Run Window is the most important and informative display of the 660 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.

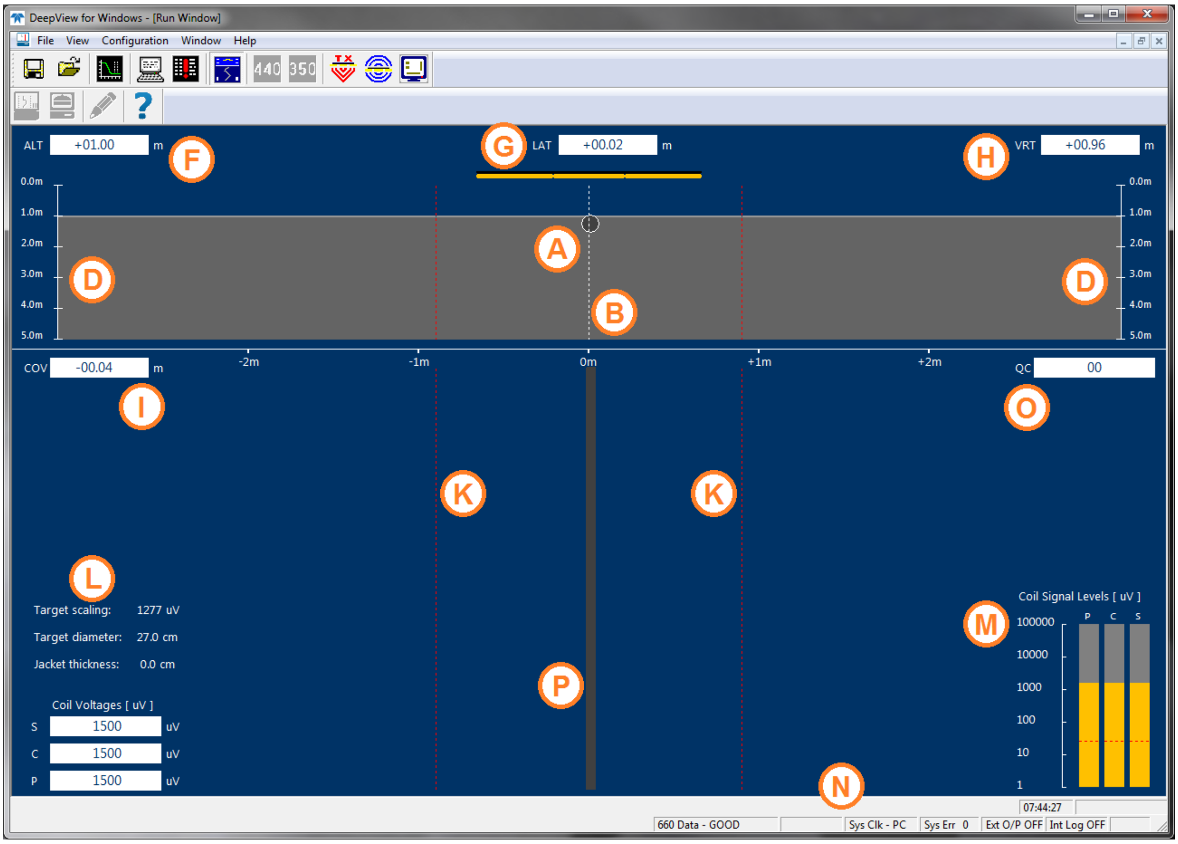

Figure 3-5: DeepView - Run Window

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 in section 3.3.1. 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 3.3.4. These tools control the functions of the DeepView program.
- The **Run Window Toolbar** includes the buttons described in section 3.3.4. These tools control functions within the Run Window only.

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 5 and 2 metre vertical display scales.

When the 660 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 660 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 660 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 660 system, the software sets the quality control flag in the data output when the target is outside this envelope. Refer to section 3.5 for a complete description of the quality control 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 (P), Centre (C) and Starboard (S) 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 3.2.3.2); this is the default setting of 25µV. When the signal falls below the threshold value, the bargraph turns red.

Status bar

The status bar **N**, located directly below the snail trail pane, alerts you to the operating status of DeepView and the 660 system. It includes the following information:

- **Communication status**
  This shows the DeepView operating mode and the validity of serial communications between the topside computer and the SEP. For successful operations in the 660 mode this should always show '660 Data GOOD'.

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- **System time**
  The system time is derived from the topside computer 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 3.3.2.4, to see details of all the system errors registered since you powered-on the topside computer, 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.

3.3.2.2 Toggle Height Scale

Dependent upon specific survey requirements, the Height Scale Display **D** 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 660 system are either 0m to 2m or 0m to 5m.

3.3.2.3 Scope Window

Use the command on the View menu or the toolbar button to display the scope r window. You must close the Run Window before you can access this command using either the menu or the toolbar button.

DeepView can show signal data received using different styles of 'oscilloscope' displays.

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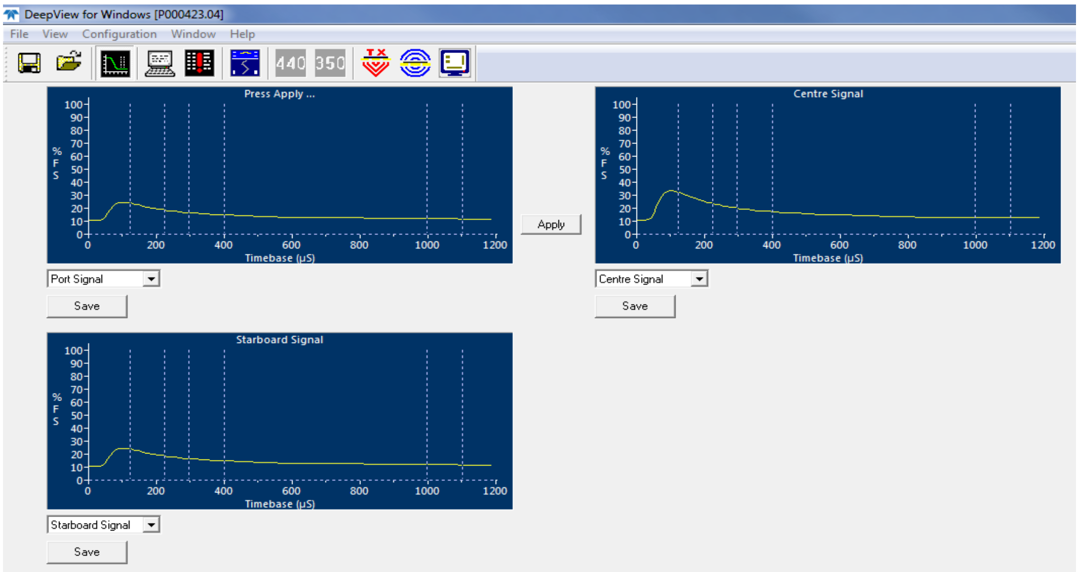

Figure 3-6: Scope Window

The above screen shows an example of the 660 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 660 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.

3.3.2.4 System Errors Window

The System Errors window, shown in Figure 3-7, displays a list of all errors and events reported by the 660 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 will delete the oldest message in the list to provide room for any new ones.

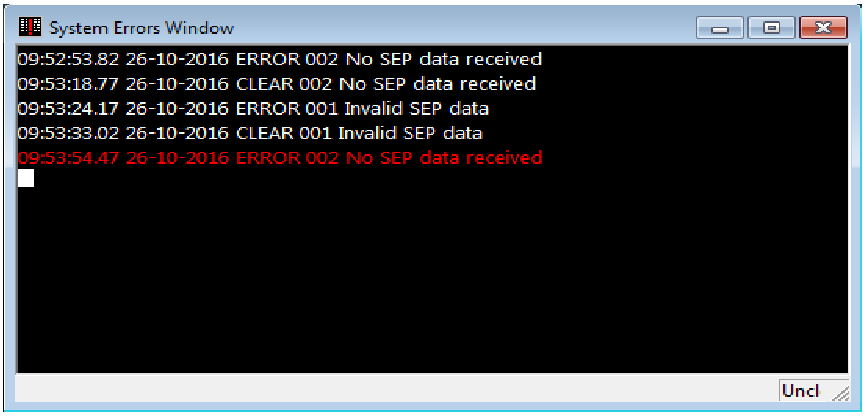

Figure 3-7: System Errors window

The lines of text always have the format described in Table 3-2.

Table 3-2: System errors format

hh:mm:ss.ss	dd-mm-yyyy	SSSSS	NNN	{*Error description*}
Time of the message line (*Note 1*)	Date of the message line (*Note 1*)	Error status field = either ERROR or CLEAR (*Note 2*)	Three-digit error number with leading zeros as needed	Text field containing up to 40 characters containing a description of the error or of the error being cleared

Notes:

1. Time and date information in the message line comes from the topside computer 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.

3.3.2.5 Terminal Window

The Terminal Window, shown in Figure 3-8, 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 660 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.

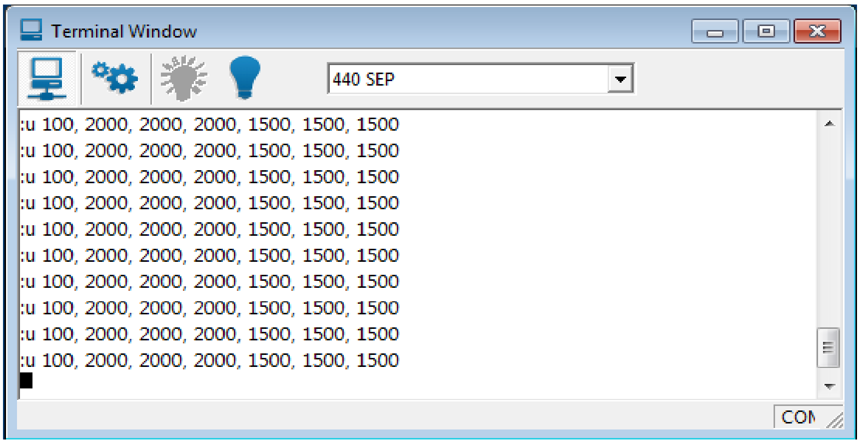

Figure 3-8: Terminal window

Table 3-3: 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.

3.3.2.6 Video Overlay Enable

Enabling Video Overlay is covered in section 3.3.3.5 along with details of the configuration options available.

3.3.3 Configuration Menu

3.3.3.1 System parameters

See section 3.2.3.

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3.3.3.2 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 a serial communication port, use the Terminal Window described in section 3.3.2.5.

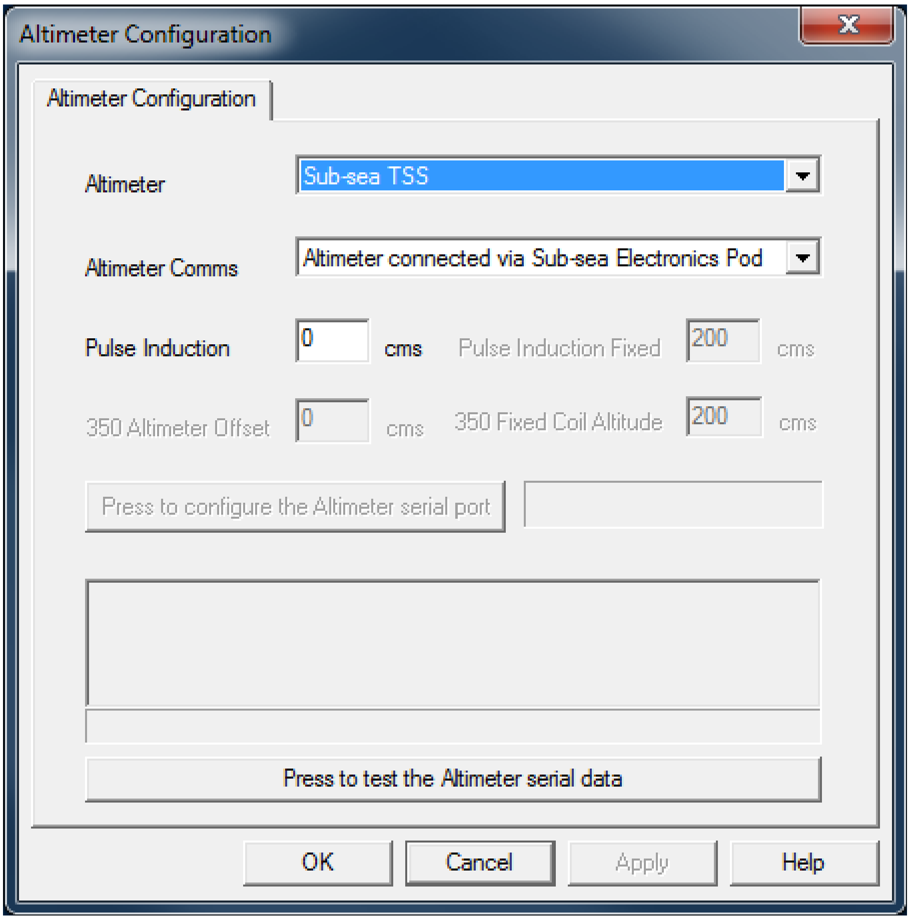

Figure 3-9: Altimeter Configuration

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

Table 3-4: 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 Subsea 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 660 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 a serial communication port that you will use to accept data from the altimeter and to set its communication parameters.

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

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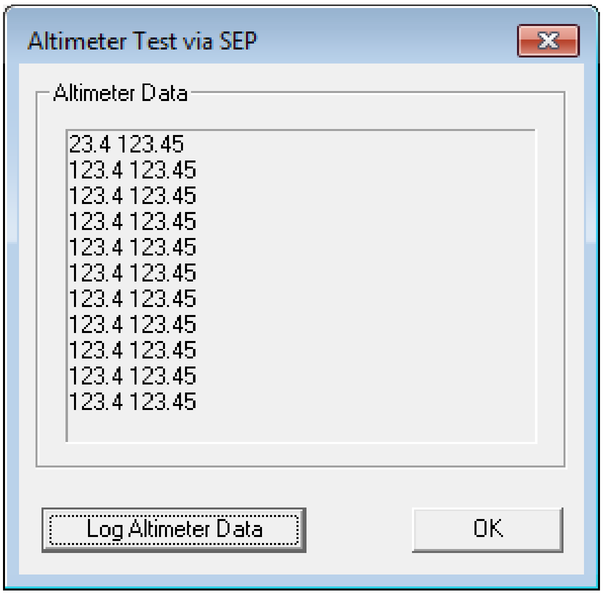

Figure 3-10: Altimeter Test

3.3.3.3 External Output

DeepView allows you to record the survey data acquired by the 660 system. To edit these settings, select Configuration➨External Output. Note external logging is defaulted to on.

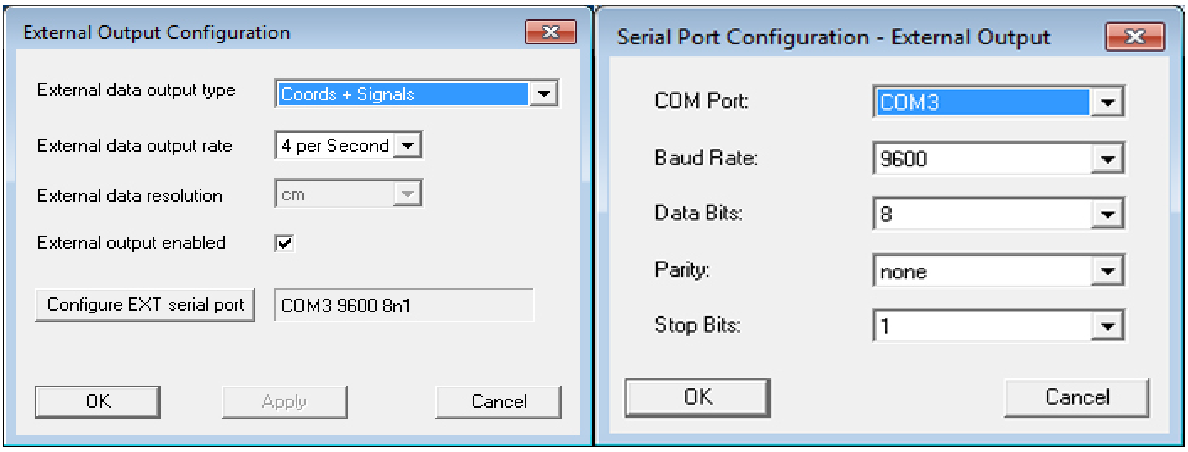

Figure 3-11: External Output Configuration and Serial Port menu

Table 3-5: External Output Configuration

External Output Configuration	
External Data Output Type:	In 660 mode the system always outputs a sentence which combines the signal and coordinate information. See section 4.4.2 for a description of these data formats.
External Data Output Rate:	The topside computer 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.

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External Output Configuration	
Configure EXT Serial Port	Options to configure, COM Port, Baud Rate, Data Bits, Parity and Stop Bits. See Figure 3-11.

3.3.3.4 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 3-6).

Table 3-6: 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

3.3.3.5 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 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 3-12.

The video overlay has two possible modes. The first mode is where a copy of 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.

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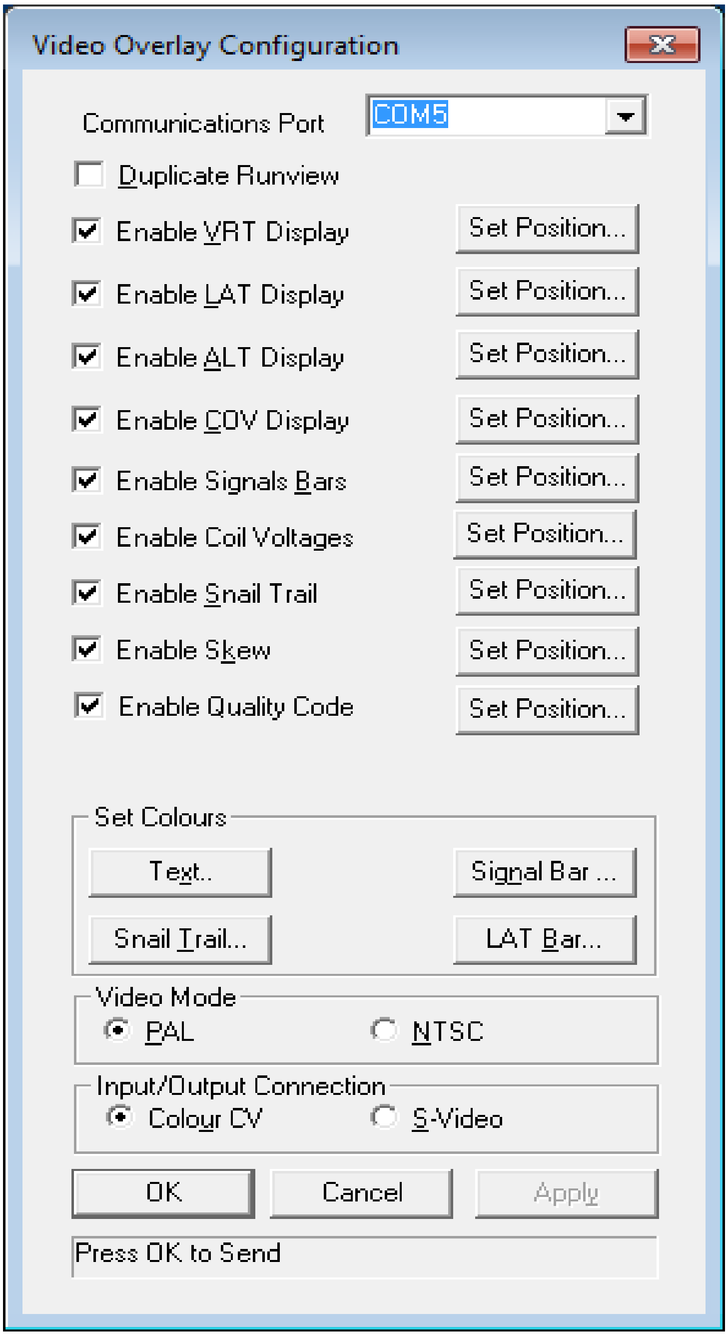


Figure 3-12: Video Overlay Setup

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 DeepView is shown in Figure 3-13. The video signal will be displayed behind this survey information where the black background is currently shown.

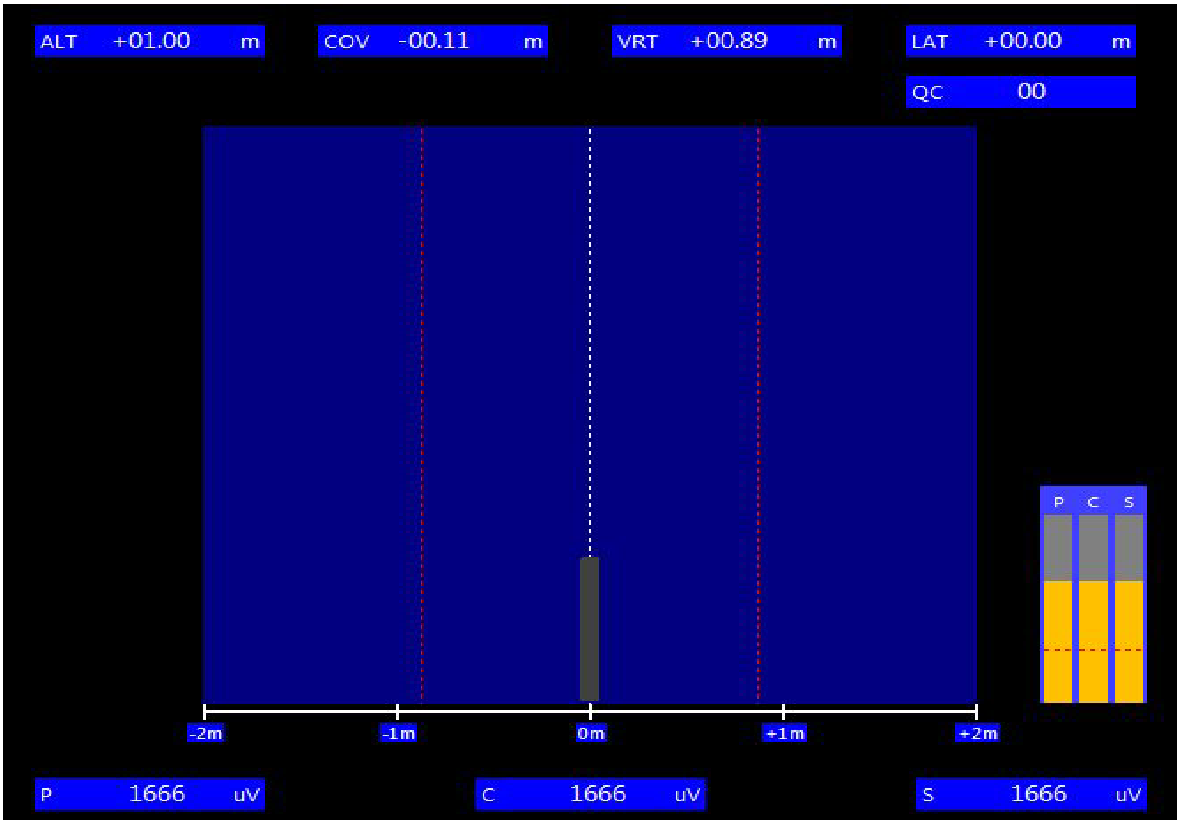


Figure 3-13: Video Overlay Signal

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

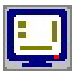


Figure 3-14: Video Overlay Enable/Disable button

3.3.4 Toolbars

Table 3-7 shows and explains the command buttons on the DeepView 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 3.3.5 for a list of all the available function keys that you may use in the 660 mode.

Table 3-7: DeepView Toolbar

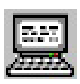
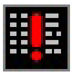
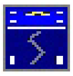
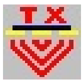
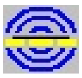
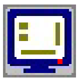
Button	Function and Function key	Explanation
	Terminal Window	This button performs the same function as the View➡Terminal Window command described above. The button has a toggle action so that the window will open and close with alternate presses. The normal condition is for the Terminal Window to be closed when you start to use DeepView. See section 3.3.2.5 for a full description.

Table 3-7: DeepView Toolbar (Continued)

Button	Function and Function key	Explanation
	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 3.3.2.4 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.
	Coil drive Function key [F5]	Toggles coil drive on/off.
	Background compensation	Runs a background compensation.
	Video overlay Function key [F3]	This button has a toggle action that enables and disables the video overlay with alternate presses. See section 3.3.3.5 for details of the video overlay option.

Run Window tools

Table 3-8 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 3.3.5 for a list of all the available function keys that you may use in the 660 mode.

Table 3-8: 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 3.3.5.

3.3.5 Function Keys

The section 3.3.1 explains the menu commands and toolbar buttons available from within DeepView. You may access some of these commands and tools directly by pressing the appropriate function key on the topside computer. As a simple memory aid, press the function key [F1] to see the help dialog panel shown in Figure 3-15. Note that this dialog panel is NOT part of the DeepView on-line Help support.

Press any key to close the help dialog panel.

Run Window Function Keys

F1	Show Function Key Help
F2	Open/Close Replay File
Shift+F2	System Parameters Configuration
F3	Create New Internal Log File
Shift+F3	Altimeter Configuration
Ctrl+F3	Close Internal Log File
Shift+F4	System Time Configuration
F5	440 Coil Drive On/Off
Shift+F5	External Output Configuration
F6	350 Toggle Fwd Search/ Run View
Shift+F6	Analogue Output Configuration
Ctrl+F6	Toggle 440/350 SEP (Dualtrack Mode)
Shift+F7	440 Run Background Compensation
Shift+F8	Seawater Compensation
Shift+F9	Load Defaults
Shift+F10	Video Overlay Configuration
Ctrl+F10	System Configuration Wizard
Ctrl+F	Toggle Forward Search On/Off (350)
Ctrl+H	Toggle SEP Height Range
Ctrl+R	Toggle Run View On/Off
Ctrl+V	Toggle Video Overlay On/Off
Ctrl+W	Toggle SEP Width Range (350)

Press any key to dismiss

Figure 3-15: DeepView function keys

3.4 Replaying a Log File

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

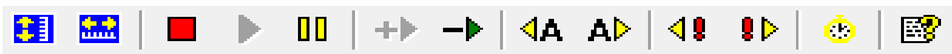
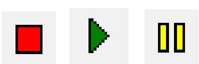


Figure 3-16: Replay toolbar keys

Table 3-9: Replay toolbar function keys

Button	Function
	Toggle height scale Function key
	Toggle swath width Function key
	Stop / Play / Pause Function keys

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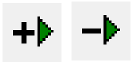
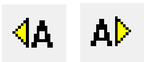
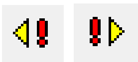
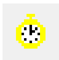
Button	Function
	Increase / Slow down replay speed Function keys
	Jump to previous / next annotation Function keys
	Jump to previous / next event Function keys
	Goto time Function key
	Help button

3.5 Quality Control

The Quality Control function of the 660 system defines an envelope within which the measurements meet the specifications listed in Chapter 7.

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 Window 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 4.6.1.1 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 Window 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

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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.

3.6 Reinstall DeepView Procedure

Follow these steps to reinstall the DeepView software:

1. Select the Windows Start menu, and then select Control Panel, and Programs and features
2. Select the DeepView for Windows entry in the list of installed programs, and select uninstall. If there is more than one DeepView for Windows 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).

3.7 PC Software Installation

AcUSB drive containing the DeepView software is supplied with the 660 system. You may install this software, under licence, on a separate PC to support the main installation on the topside computer or to replay an internally logged data file. The following instructions explain how to install the software on a separate PC.

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, double click on the Teledyne logo icon that the installation programme places on your Windows 7 desktop.

NOTE

Take the following precautionary measures to maintain the topside computer 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 topside computer and your PC.
- NEVER install unauthorised software on the topside computer.
- 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 topside computer from operating.

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4 Operating Procedure

In common with other items of precision equipment, you may rely on the quality of data gathered by the 660 system only if you follow the correct operating procedures when you use it.

This section of the manual considers the role that the 660 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.

CAUTION

The 660E system is intentional radiator equipment incorporating a transmitting antenna (the coil array). The system is intended for submerged operation. Consequentially, care should be taken if the system is operated on a ship's deck, for example, pre-deployment.

Operation of the equipment in close proximity to ship's receiving antennas and equipment capable of interfering with safe navigation of the ship and with radiocommunications equipment should be avoided.

NOTE

To allow for meaningful analysis of the acquired data, the 660 system allows you to keep a record of the system configuration during a survey. When DeepView 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 it is recommended that you always keep a written record of their settings with the survey log.

4.1 Pre-Survey Preparation

At an early stage during the planning procedure, the survey planning team should decide whether to use a 660 system. By making this decision early in the planning procedure, they can assign the correct equipment and personnel to the operation.

Contact Teledyne Limited for advice if you are unsure whether the 660 system is suitable for use in a particular survey application.

4.1.1 Training

When used properly, the 660 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. It is in the interest of the survey planners to ensure that appropriate personnel attend one of the training courses. See Appendix B.2 for a description of the training available for the 660 system.

4.1.2 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 measurements on the target and to measure the mean seabed level with a separate profiling system.

4.1.3 Target Scaling

The 660 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 660 system varies with the type of target and its size. This manual cannot therefore include precise specifications to cover all possible targets. However, Chapter 7 includes a table that shows the degree of measurement accuracy that may be achieved if you follow the correct operating procedures. This table provides guidance on the vertical range and measurement accuracy that you may expect for the targets listed. DO NOT use the table as a correction table to refine survey results after you have completed the survey.

Where the information contained in Chapter 7 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 Limited 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.

4.1.4 System Installation Requirements

Before starting a survey the survey planning team should define the installation requirements of the 660 system. They should consider:

- The type of ROV to be used and where the SEP, the PSU and the coils will be mounted. The 660 system is suitable for use on most types of ROV, including towed sleds. Teledyne Limited can offer further advice if necessary.
- 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 660 system. It is recommended that you 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 subsea camera mounted on the ROV. Consider using the video facilities to record the installation procedure of the 660 system.

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4.2 Pre-dive Checks

NOTE

DeepView 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 660 system underwater. You may configure DeepView 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 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.

4.2.1 Depth rating

Note that the depth rating of subsea 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 660 system:

- ❐ Wash the subsea installation with clean fresh water and inspect the subsea 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 subsea 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 2.3.1 concerning the electrical grounding of the 660 system.
- ❐ Do not open the subsea housings.

4.2.2 Coil Installation

4.2.2.1 Coil insulation test

Damage can occur to the coil array from collisions with debris on the seabed or from other causes. Usually, damage to the coil array appears as a degraded coil insulation resistance rather than a short circuit. Under these circumstances, the 660 system may continue to work, but there will be some loss of performance in survey measurements delivered by the system.

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To reduce the possibility of damage to the electronics or reduced performance due to a partial insulation breakdown, check the coil array and cable before you connect it to the SEP.

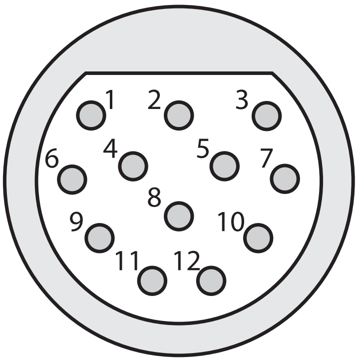

Figure 4-1: Coil cable pinout

Perform the insulation test as described in Table 4-1 on the coil array.

Table 4-1: Insulation test parameters

Equipment	Measurement point 1	Measurement point 2	Resistance
Digital meter	Pin 2	Pin 7	5.50 +/- 0.5Ω
	Pin 3	Pin 5	
	Pin 8	Pin 9	
	Pin 10	Pin 11	0.25 +/- 0.1Ω
500V digital insulation tester	Pin 2	Shell	200MΩ
	Pin 3		
	Pin 5		
	Pin 7		
	Pin 8		
	Pin 9		
	Pin 10		
	Pin 11		

Replace the assembly if it shows high resistance, short-circuited windings or an insulation breakdown.

4.2.2.2 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.

4.2.2.3 Coil mounting

Make certain the coil array is 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.

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You may install the coil array 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 coil array and create a false target.

4.2.2.4 Coil height

For a small target – Install the coil array 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 coil array and debris on the seabed.

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

4.2.2.5 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.

4.2.2.6 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.

4.2.2.7 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.

4.2.2.8 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 660 SEP.

4.2.3 Power

Check the operating voltage for your subsea installation. Depending on the installation, the subsea PSU will operate from a nominal 110V a.c. or 24V d.c. electrical supply.

4.2.4 Cables and Connectors

- ❐ 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.
- ❐ 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.

4.2.5 Communication

- ❐ Check that you have established the correct communication method in the SEP and in the top-side computer.

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- ❒ In DeepView, 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.
- ❒ Set the RS232 parameters of ‘COM2’ and ‘LOG O/P’ (COM3) ports to match any equipment connected to them.

4.2.6 Configuration

4.2.6.1 Time and Date

Set the internal clock of the topside computer to the correct date and time.

4.2.6.2 Target Scaling

Target scaling is the method used by the 660 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. DeepView 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. For maximum accuracy it is recommended Teledyne Limited determine an exact target scaling factor from a sample of your target.

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See section 4.8 for the full procedure to measure the scaling factor of a target.

4.2.6.3 Threshold

High settings will make the 660 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.

4.2.6.4 External Logging Format

The 660 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 4.6.1.1). You should not need to alter this setting.

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

4.2.6.5 Serial Port Parameters

An overview of the default port configurations and use can be found in section 3.2.2.

4.2.6.6 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, DeepView 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. Disabling the reminder interval is not recommended.

4.2.6.7 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 660 system, select the appropriate model.

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 660 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.

4.2.6.8 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 topside computer, 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.

4.2.7 Functional Checks

You should perform these important functional checks on the 660 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.

4.2.7.1 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 660 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.

In DeepView, perform a background compensation routine by pressing [Shift +F7] from the Configuration Menu. Wait ten seconds until DeepView 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 Window and then place a metallic test target (for example, a spanner) on the port side of the coil array. Switch on coil drive by pressing [F5] from the Run Window and check that the display shows a strong signal on the relevant channel. Repeat this test in the centre and starboard side of the coil array, switching off coil drive while you move the test target from one location to the next.

4.2.7.2 Oscilloscope Test

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

Repeat this test when the ROV is in the water.

4.2.7.3 Altimeter Test

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

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4.3 Deployment

With the ROV in the water there are a number of further tests and operations required before survey operations can begin.

4.3.1 Oscilloscope and altimeter tests

Check again for correct waveforms from the SEP using the DeepView oscilloscope function (section 4.2.7.2), and for correct data strings from the altimeter (section 4.2.7.3).

4.3.2 Background Compensation and Monitoring

To ensure that information acquired by the 660 system is valid, 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

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 4.3.4). Any problems must be rectified before the survey is performed.

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

4.3.2.1 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 660 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 6.1.1 for details.

4.3.2.2 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 topside computer, 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. Check that all the measurements appear in black – red figures on any channel indicate signal saturation.

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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 660 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 6.1.1 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. Reposition the coil array further 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 Window. 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.

4.3.2.3 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 DeepView 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.

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4.3.3 Seawater Compensation

The 660 system uses 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.

To 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 660 system or its configuration.

A manual compensation routine is available (see Appendix A). 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. The use of the pre-programmed bands is recommended 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 Limited for advice on this point.

4.3.4 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.

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.

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.

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4.4 The Survey Operation

Normally, survey operations conducted using the 660 system will require only the Run Window and other selections from the Operation Menu.

The following paragraphs describe how you should use the facilities of the 660 system during a survey. They assume that you have completed the full target scaling and background compensation procedures successfully.

4.4.1 Interpreting the Run Window

The Run Window is the most informative screen available from the 660 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 Window show the signal strength received from each of the coils in the array. 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 coils will increase. Signals on the other coils will then increase in strength until all three 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 Window.

Target Track

The main region of the Run Window 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 4.6.1.1 for more information on quality control.

If you have connected an altimeter to the system, DeepView 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 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 Window will appear as a solid red line.

Left/Right Tracking occurs when the 660 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 Window 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 Window 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 DeepView 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 coil array above the seabed (ALT).
- Vertical range to the target (VRT).
- Depth of target cover (COV).

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- 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 Window, 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 Window, you may select the oscilloscope from within this screen by selecting 'Scope 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. 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.

- The second, called the 'Standard region', lies between 300µs and 400µs on the timebase scale.

- The third, called the 'Zero region', lies between 1000µs and 1100µs on the timebase scale.

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).

4.4.2 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

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- The video recording of the 660 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
- All survey data including the regular background compensation, seawater compensation checks and Background Noise Profile check
- Any other information requested by the survey planning team

4.4.3 Replay Logged Data

NOTE

You cannot use DeepView 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. 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.

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 660 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 4.6.1.1 for a description of the external logging format.

Internally logged files are of variable length and include all data transmitted to the topside computer 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 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.

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4.5 After the Dive

Perform the following tasks after you complete a survey using the 660 system:

1. **Print the configuration**
   Select File➥Print Configuration to send a copy of the 660 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 660 system.

3. **Exit DeepView**
   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 topside computer**
   Select Start➥Shut Down..., then choose 'Shut down' and press OK to close the Windows operating environment.

CAUTION

DO NOT power-off the topside computer until it is safe to do so otherwise Windows will log the fact that it was incorrectly closed. This will cause the topside computer to enter a diagnostic check automatically when you next operate it, extending the time that it takes for the 660 system to become operational after power-on.

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

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

6. **Check the 660 system**
   After you recover the ROV, perform all the post-survey checks and make any necessary repairs to the 660 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.

4.6 Data Quality

4.6.1 Profile

During post-processing you may use the data acquired by the 660 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 4-2.

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

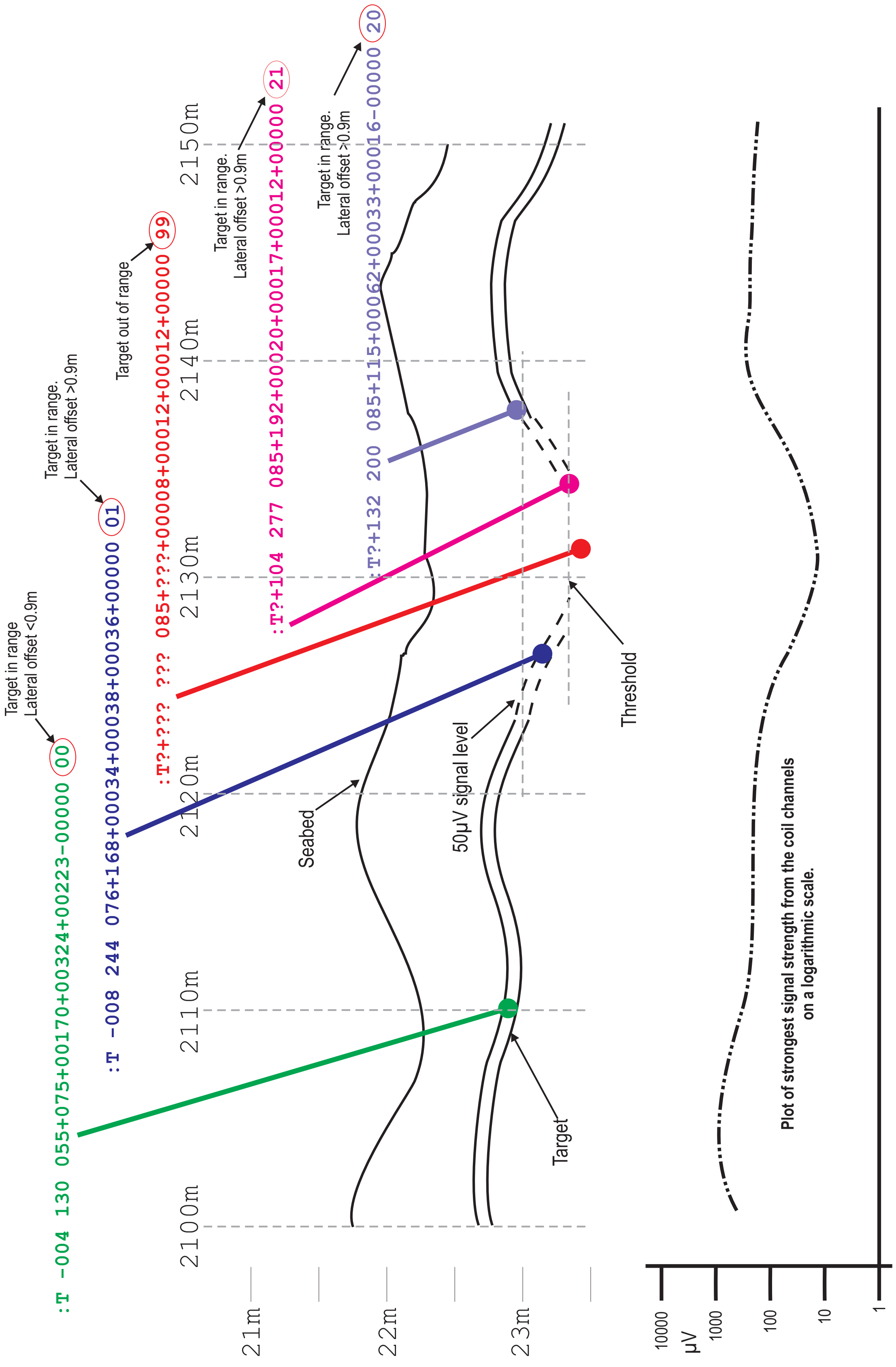


Figure 4-2: Example of a target profile modified using quality control information

4.6.1.1 External Logging Format

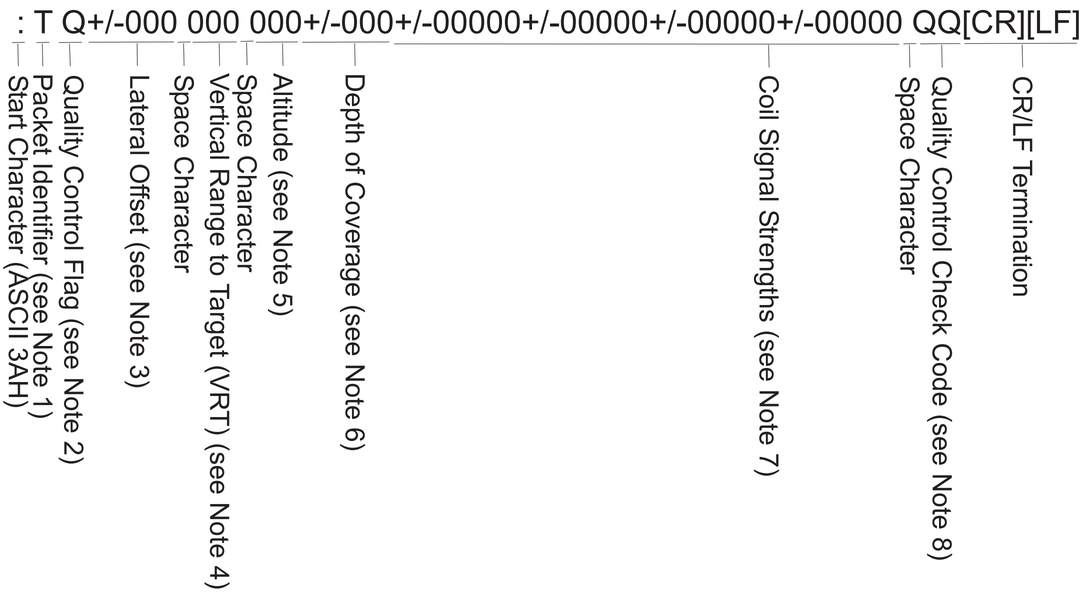
4.6.1.1.1 Co-ordinates and Signals Format

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.

DeepView 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 Window.

Table 4-2: External Co-ordinates and signals format - cm resolution



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

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- The 660 system cannot compute a 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 660 system always measures to the top of the conductive part of the target. DeepView compensates for the thickness of any weight coating and outputs the corrected value. See Figure 4-4 and Figure 4-5.

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. DeepView 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 660 system cannot compute a position for the target
- Coil saturation has occurred
- There is no fixed coil height or information available to DeepView 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 4-4. 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.

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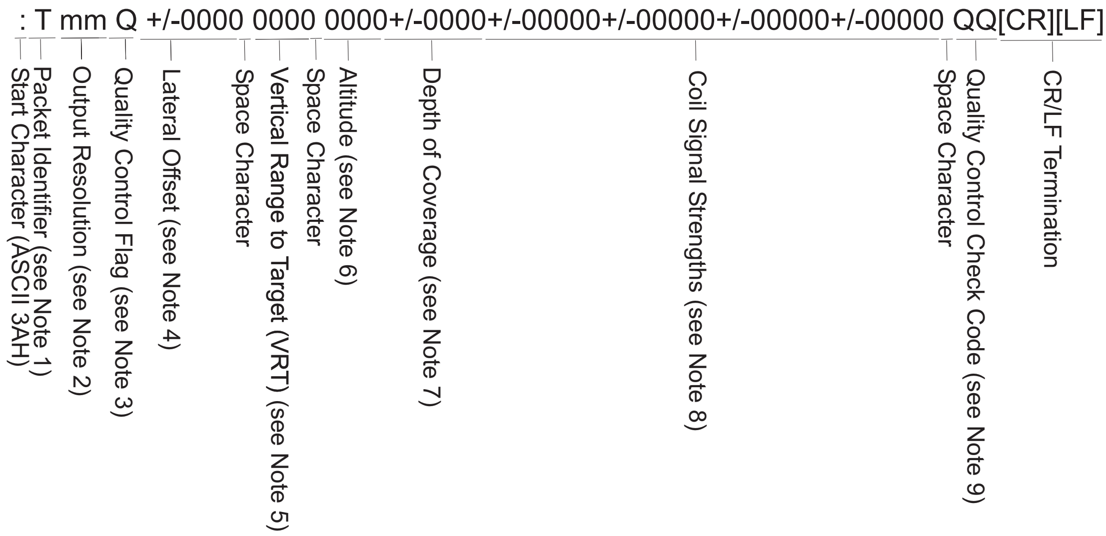
Table 4-3: External Co-ordinates and signals format - mm resolution



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 660 system cannot compute a 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 660 system always measures to the top of the conductive

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part of the target. DeepView compensates for the thickness of any weight coating and outputs the corrected value. See Figures 4-4 and 4-5.

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. DeepView 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 660 system cannot compute a position for the target
- Coil saturation has occurred
- There is no fixed coil height or information available to DeepView from an altimeter

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

9. 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 4-4. 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 4-4: QC check code meaning - External logging format

QC check code	VRT	LAT	Coils used for LAT calculation	QC flag	Notes
00	Value	Value (<±0.9m)	Port, centre, starboard	-	-
00	H.HH	?.??	-	Set	Overheating
01	Value	Value (<±0.9m)	Port, starboard	-	-
02	Value	Value (<±0.9m)	Port, centre	-	-
03	Value	Value (<±0.9m)	Centre, starboard	-	-
20	Value	Value (>±0.9m)	Port, centre, starboard	Set	-
21	Value	Value (>±0.9m)	Port, starboard	Set	-
22	Value	Value (>±0.9m)	Port, centre	Set	-

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QC check code	VRT	LAT	Coils used for LAT calculation	QC flag	Notes
23	Value	Value (>±0.9m)	Centre, starboard	Set	-
30	S.SS	?.??	-	Set	Saturation of 1 or more coils.
99	?.??	?.??	-	Set	Target out of range.
99	?.??	Value	Port or starboard	Set	Left/right tracking.

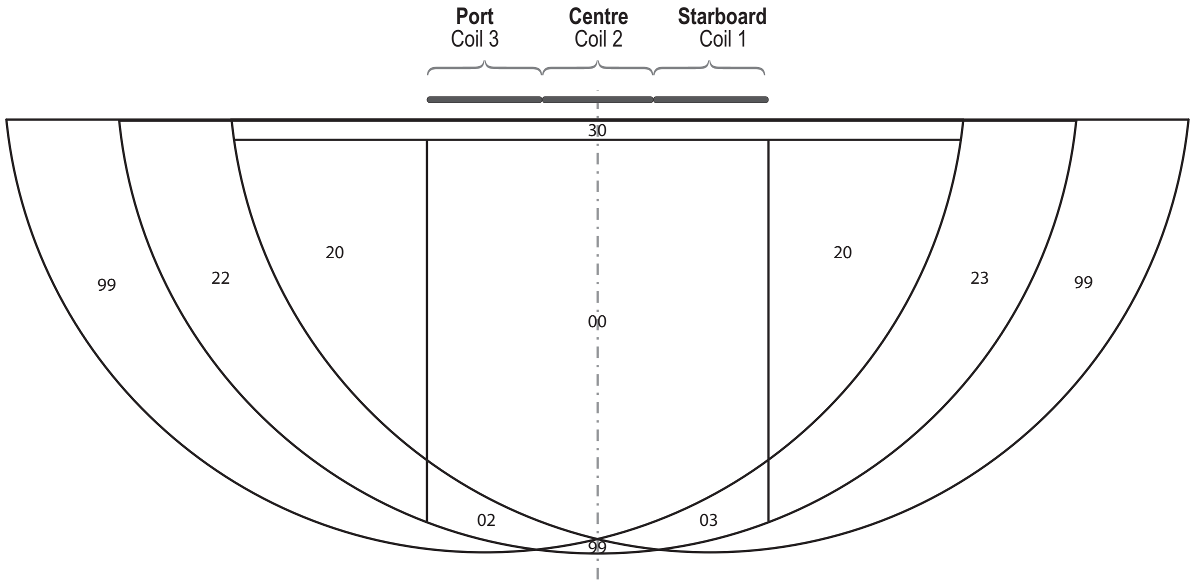


Figure 4-3: Quality Code Areas

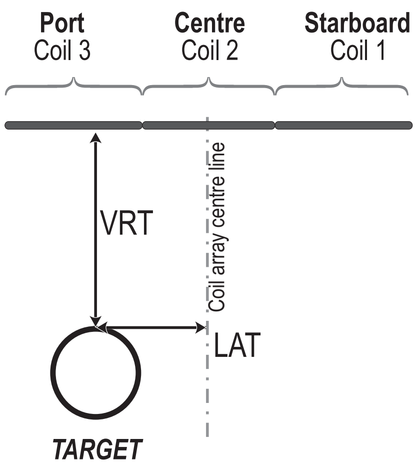


Figure 4-4: Vertical range and offset distances

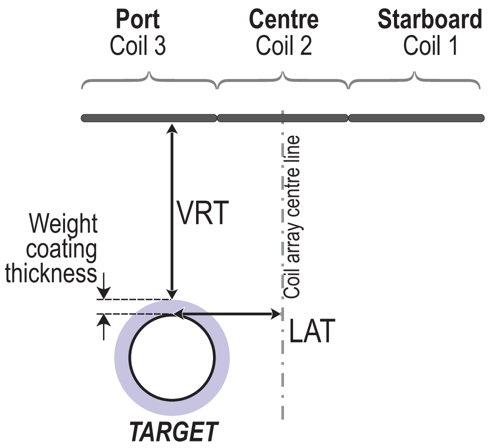
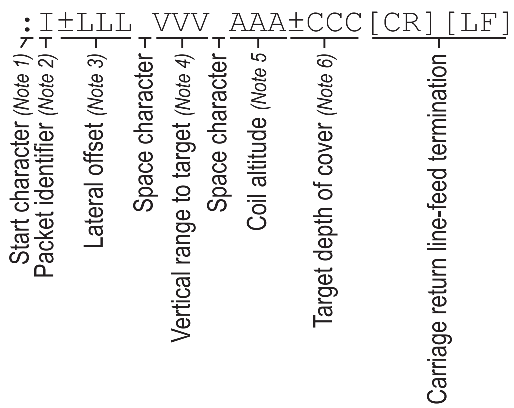


Figure 4-5: Vertical range with weight coating thickness

4.6.1.1.2 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 Window. The individual field definitions are as follows.

Table 4-5: External Co-ordinates format



Notes:

1. The Start character is a colon – ASCII 3Ah.
2. ‘I’ (ASCII 49h) identifies a co-ordinates data packet.
3. 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.
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. 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 charac-

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ter 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 660 system cannot compute a 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 660 system always measures to the top of the conductive part of the target. DeepView compensates for the thickness of any weight coating and outputs the corrected value. See Figure 4-4 and Figure 4-5.

5. 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.
6. DeepView 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 660 system cannot compute a position for the target
- Coil saturation has occurred
- There is no fixed coil height or information available to DeepView from an altimeter

4.6.1.1.3 Timestamped Coordinates Format

The timestamped coordinates data contains the standard coordinates data format. 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 4-6

Table 4-6: Timestamped Coordinates format

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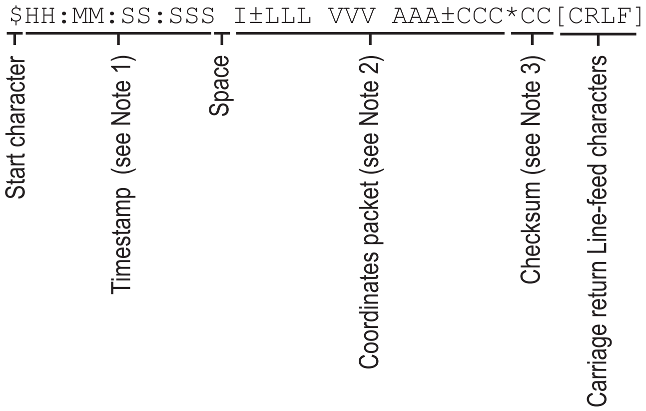


Notes:

1. The timestamp is always formatted as HH:MM:SS:SSS. Additional, zeros will be used to ensure field length remains fixed.

2. See Table 4-5 for the coordinates packet description.

3. 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.

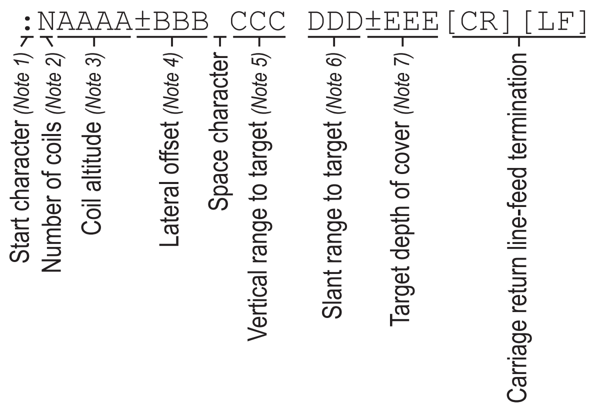
4.6.1.2 Internal Logging Format

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.

4.6.1.2.1 Co-ordinates Data Packet

The string is 24 characters long with individual fields definitions as follows. DeepView 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 Window.

Table 4-7: Internal Co-ordinates format



Notes:

1. The Start character is a colon – ASCII 3Ah.

2. The number of coils fitted to the 660 system is always 3.

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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.

4. 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.

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. The field will contain question marks if the target is out of range.

6. 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:

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

7. 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.

4.6.1.2.2 Signals Data Packet

The individual fields definitions for the Signals Data Packet are as follows. DeepView 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 Window.

Table 4-8: 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 strengh 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:

1. The Start character is a colon – ASCII 3Ah.

2. 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.

3. 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.

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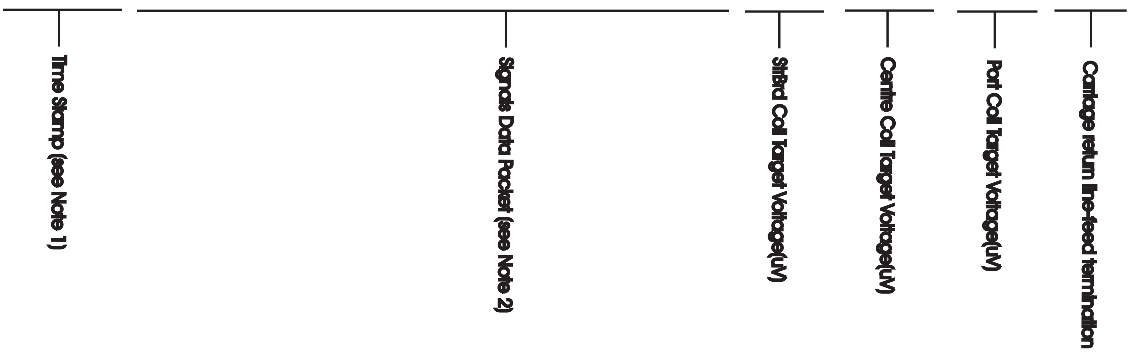
4. The signal strengths, in micro volts (µV) measured +99999 to -9999. Always padded with zeros to fill at least four spaces. The sequence of values is Starboard coil (early), Centre coil (early), Port coil (early) Starboard coil (standard), Centre coil (standard), Port coil (standard).

4.6.1.3 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 4-9: Background Noise Logging format

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



Notes:

1. Timestamp formatted as HH:MM:SS obtained from the controlling PC system clock.

2. The Signals Data packet is in the standard internal signals format (see Table 4-8) except for the start character (ASCII 3Ah) and Event Identification character are comma separated from the following fields.

4.7 Altimeter Data Format

You may use certain types of altimeter manufactured by Teledyne TSS, Teledyne Benthos, Datasonics, Ulvertech, Simrad and OSEL with the 660 system.

See section 2.3.8.2 for instructions to connect one of these alternative types of altimeter to the topside computer. You may connect a TSS, Benthos or Datasonics unit either to the topside computer 'COM2' port or directly to the SEP 'Altimeter' port.

You must configure the display software to use your altimeter type. See section 3.3.3.2 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 660 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 topside computer.

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4.7.1 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 4-10: Altimeter output format – Benthos PSA 916

`Ryy.yy[CR][LF]`

Ryy.yy	Altitude (metres) above the seabed
[CR][LF]	Carriage return line-feed termination

4.7.2 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 4-11: Altimeter output format – Teledyne TSS and Datasonics

`Txx.x Ryy.yy[CR][LF]`

Txx.x	Altimeter temperature °C
(space)	Space character
Ryy.yy	Altitude (metres) above the seabed
[CR][LF]	Carriage return line-feed termination

If the Datasonics PSA 900 includes the optional pressure transducer, the data string becomes:

Table 4-12: Altimeter output format – Datasonics with pressure transducer

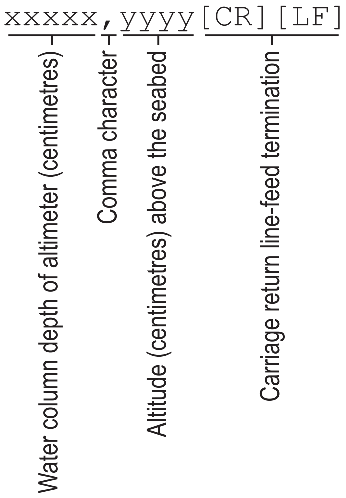
`Dnn.n Txx.x Ryy.yy[CR][LF]`

Dnn.n	Altimeter depth (metres)
(space)	Space character
Txx.x	Altimeter temperature °C
(space)	Space character
Ryy.yy	Altitude (metres) above the seabed
[CR][LF]	Carriage return line-feed termination

4.7.3 Ulvertech Bathymetric System

The Ulvertech Bathymetric system transmits data at 9600 baud using 8 data bits, 1 stop bit and no parity.

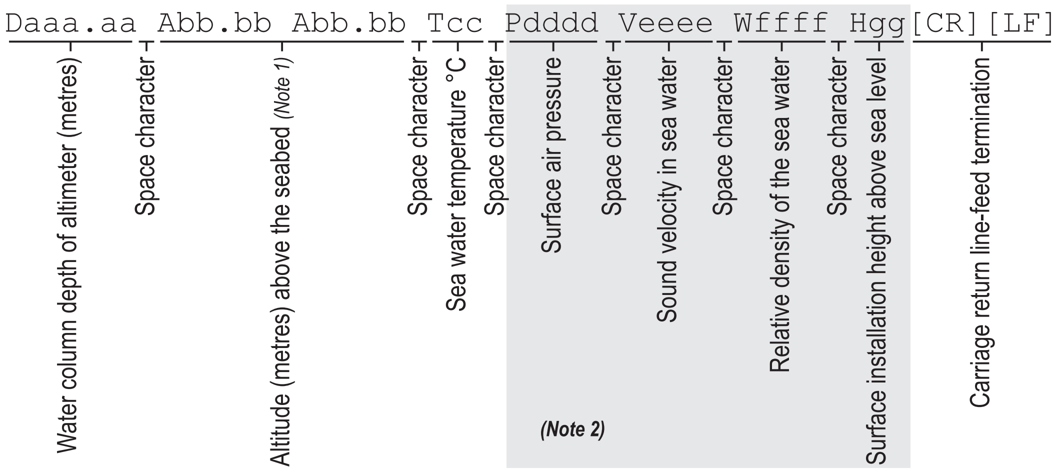
Table 4-13: Altimeter output format – Ulvertech Bathymetric system



4.7.4 Simrad UK90

The Simrad UK90 transmits data at 4800 baud using 8 data bits, 2 stop bits and no parity.

Table 4-14: Altimeter output format – Simrad UK90



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 660 system.

4.7.5 OSEL Bathymetric System

The OSEL Bathymetric system transmits data at 9600 baud using 8 data bits, 1 stop bit and no parity.

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Table 4-15: 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 DeepView before it transmits each data string. The communication link between the OSEL altimeter and the topside computer must therefore be bi-directional. DeepView transmits the interrogating character automatically when configured to use the OSEL altimeter.

4.7.6 Tritech SeaKing Bathy 704

The SeaKing Bathy system transmits data continuously using RS232 communications at 9600 baud.

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Table 4-16: Tritech SeaKing Bathy format

```
+AAAAABBBBBBBBBB+CCCCCDDDDDDDDDDEEEEEEEEEE−FFFFFGGGGG
+HHHHHJJJJJKKKKK+LLLLLLLLLLMMM+NNNNNNNNNNPPPPPPPP
```

AAAAA	Internal temperature (×0.1°C)
BBBBBBBBBB	Digiquartz pressure ($\times10^{-5}$PSIa)
CCCCC	Digiquartz temperature (×0.01°C)
DDDDDDDDDD	Raw digiquartz pressure (counts)
EEEEEEEEEE	Raw digiquartz temperature (counts)
FFFFF	Local oscillator calibration (Hz)
GGGGG	Conductivity (×100 µmhos)
HHHHH	Conductivity temperature (×0.01°C)
JJJJJ	Conductivity salinity (parts per 10^7)
KKKKK	Velocity of sound ($\times 10^{-1}$ m/s)
LLLLLLLLLL	Altimeter reading (20ns clock counts) *(Note 1)*
MMM	Bathymetric system devices – *Refer to altimeter manual*
NNNNNNNNNN	Depth (mm)
PPPPPPPP	Time at start of scan (hhmmss.cc)

Notes:

1. DeepView 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.

4.8 Target Scaling

NOTE

The preferred method for determining a target scaling factor is to use the auto scaling feature of the 660 system. You should perform the following procedure whenever dry-land testing is necessary on a specific target. This might be, for

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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.

4.8.1 Target Scaling Procedure

4.8.1.1 System configuration

Establish the 660 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 660 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 Window to observe the signals from the three channels.

4.8.1.2 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 Appendix C.1.

Make a note of the value suggested by the 660 system for the target scaling factor and use this as the first estimate in the scaling process.

4.8.1.3 Determining the nominal Target Scaling factor

Position the target under the centre of the coil array 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 Window of the 660 system for a number of different vertical ranges. Also, record the signal strengths measured by each of the search-coils.

Use Form D2 in Appendix C.2 to record the test results.

If the vertical ranges shown by the 660 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).

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4.8.1.4 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 660 Performance Envelope Results form (Form D3 in Appendix C.3).

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 660 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.

4.8.1.5 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 660 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:

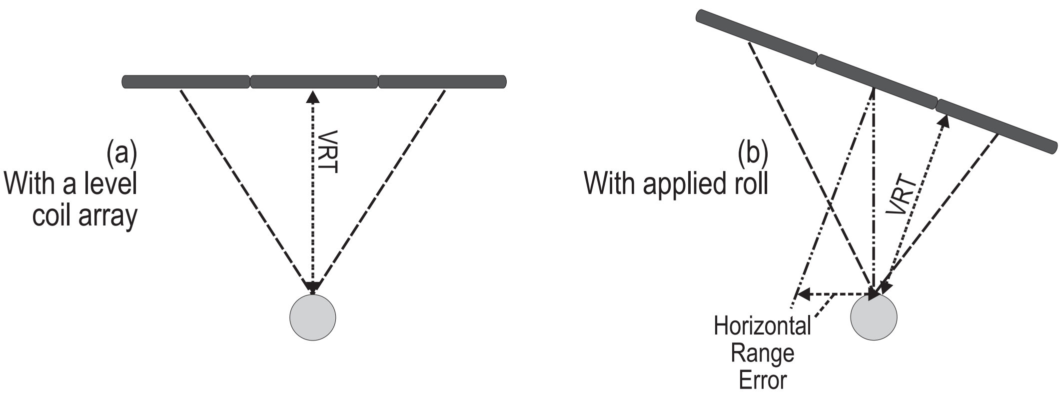

Figure 4-6: The effects of roll on measurement accuracy

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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 660 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.

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5 Operational Considerations

There are some operating circumstances when the performance of the 660 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.

5.1 Operating Performance

Together with the skilful operation of the 660 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 array mounting arrangement on the ROV

The performance of the 660 system depends heavily on the mounting arrangement of the coil array. The two principal considerations are the coil array separation from the ROV (section 2.2.2.1.1), which affects the amount of background compensation necessary and hence the sensitivity of the system, and the height of the coil array. (section 2.2.2.1.2). 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:

You may use all the information and facilities available from the 660 system to identify any drop in system performance so that you may take effective and appropriate corrective action. The logged data packets include a Quality Control flag to identify data that might show degraded performance.

5.2 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

5.2.1 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.

5.2.1.1 ROV Position over the Target

Figure 5-1 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.

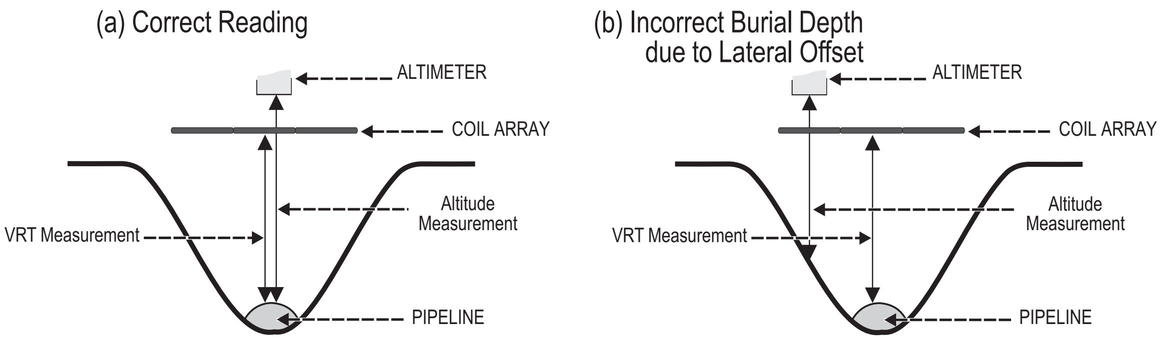

Figure 5-1: Altimeter errors during trench surveys

Flying with no lateral offset
Figure 5-1(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.

Flying with Lateral Offset
In Figure 5-1(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 valid 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 2.2.3.
- 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 660 system during the survey analysis operation.

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5.2.1.2 Trim

In severe cases of roll such as shown in Figure 5-2, errors might appear in the vertical range and lateral offset measurements on the target.

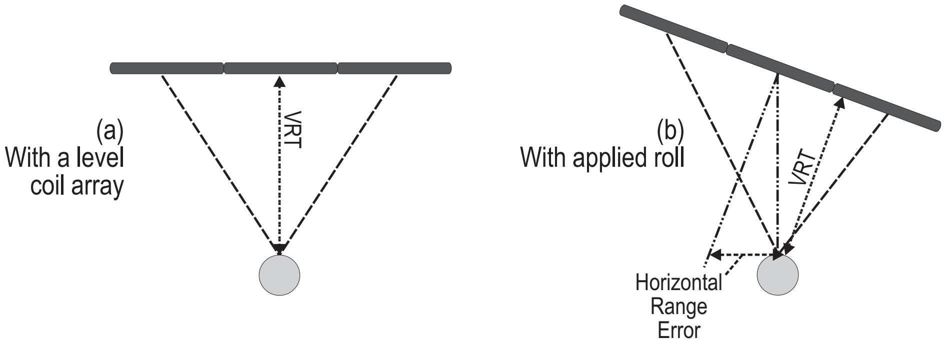

Figure 5-2: ROV roll errors

Figure 5-2(a) shows the ideal condition where the ROV is level over the target. In these conditions, the measurements for VRT and LAT will be valid.

Figure 5-2(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 660 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

5.2.1.3 Skew

Figure 5-3(a) shows the ideal aspect between the coil array and the target.

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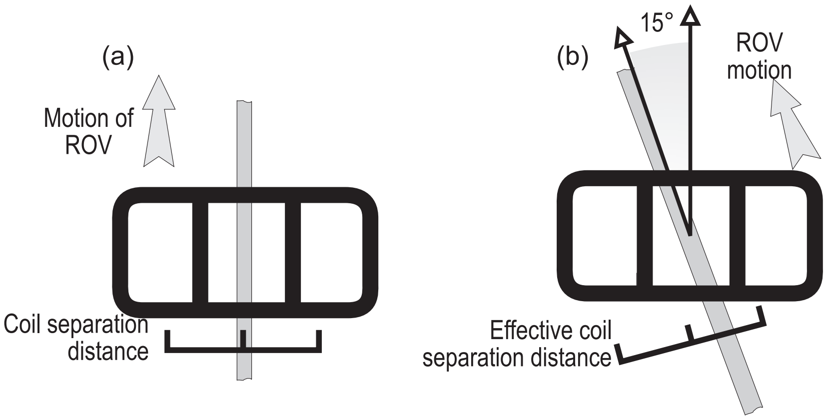

Figure 5-3: ROV skew errors

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 5-3(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 4.8 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 system performance.

5.2.1.4 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 5-4 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.

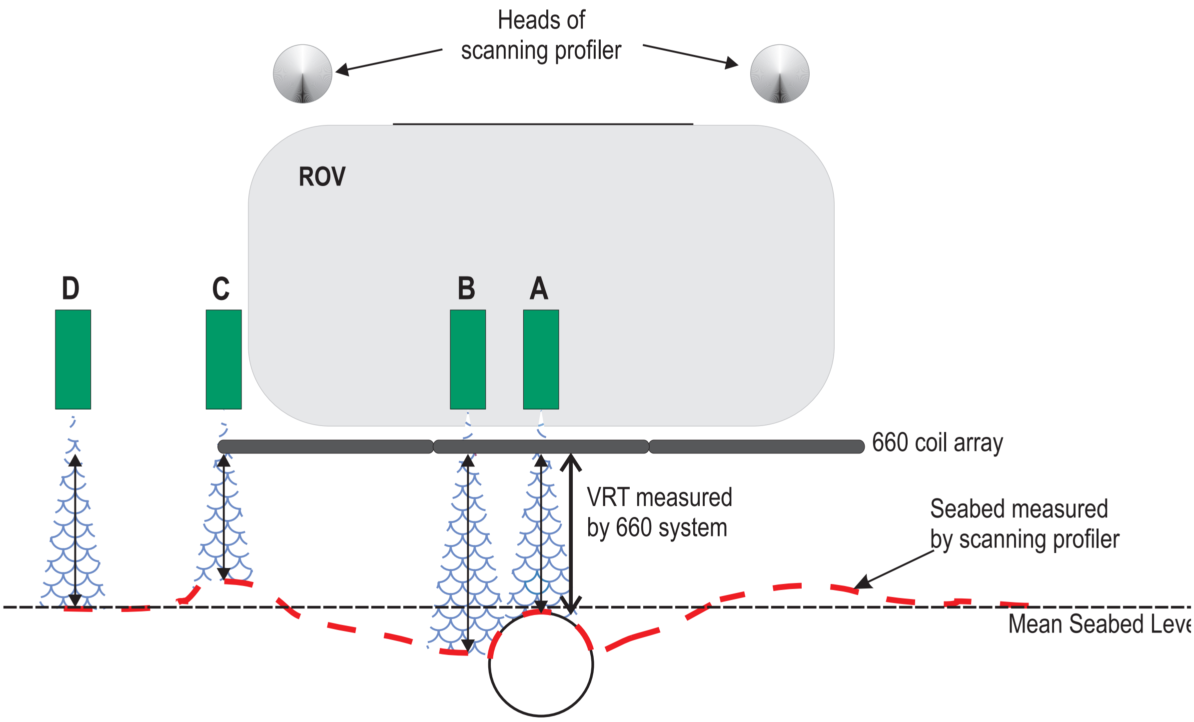

Figure 5-4: Effects of altimeter mounting position

In Figure 5-4 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 660 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 660 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 660 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 660 display would show the target covered by a few centimetres.

The 660 system supplies measurements of the vertical distance between the coil array and the top of the conductive part of the target. The system calculates depth of target cover using this vertical range information and measurements supplied by the altimeter.

The example in Figure 5-4 illustrates that the altimeter position can affect the depth of cover information supplied by the 660 system.

Summary:

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1. Where depth of cover measurements are critical to the requirements of the survey, it is recommended that you use an independent scanning profiler system to determine the mean seabed level. Subsequent post-processing will then allow you to plot a target profile using merged data from the 660 system and from the profiler.

5.2.2 Electrical Interference

The 660 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 section describes the sources of interference that might affect the 660 system.

5.2.2.1 ROV Body

The 660 system uses the principle of Pulse Induction to detect and locate any conductive material within range of the coil array. Normally, the conductive material will be a valid target and the 660 system will supply data concerning its location and depth of cover with no loss of system performance.

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 4.3.2 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.

5.2.2.2 Power-carrying Cables

If you use the 660 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 DeepView 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.

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5.2.2.3 Impressed-current Cathodic Protection

The 660 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 DeepView 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 660 system in this way.

Summary:

1. Use the DeepView 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.

5.3 ROVs

You may use the 660 system with most types and sizes of ROV, and you may operate it at depths down to its specified depth rating listed in Chapter 7. The standard installation described in this manual provides a high degree of repeatability and a useful measurement range, together with ease of deployment.

The system will supply valid survey data only if you install it in accordance with the instructions in Chapter 2.

NOTE

Remember that the 660 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.

5.3.1 Speed of Operation

The 660 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.

5.3.2 Altitude above the Seabed

The vertical detection range of the 660 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.

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5.3.3 Manipulators and Probes

Any manipulators or probes deployed on the ROV during a survey will present moving targets that the 660 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.

5.3.4 Tracked ROV

You may install the 660 system on tracked ROVs. This type of ROV should allow you to set a fixed coil height.

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6 Maintenance

CAUTION

Teledyne Limited accepts no liability for field repairs. The warranty of spare parts may be affected if incorrectly fitted. If in doubt, contact Teledyne Limited.

6.1 Fault Identification

NOTE

If your system fails, perform the following checks before you calling our technical support engineers for assistance.

1. Check that you have installed the 660 system correctly according to the instructions in Chapter 2.
2. Check that the configuration of the 660 system is correct. Refer to Chapter 3 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 topside computer 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 6.1.1.
- Altimeter failure – see section 6.1.2.
- Unexpected signal variation during normal operation – see section 6.1.3.

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6.1.1 Fault on Single Channel Only

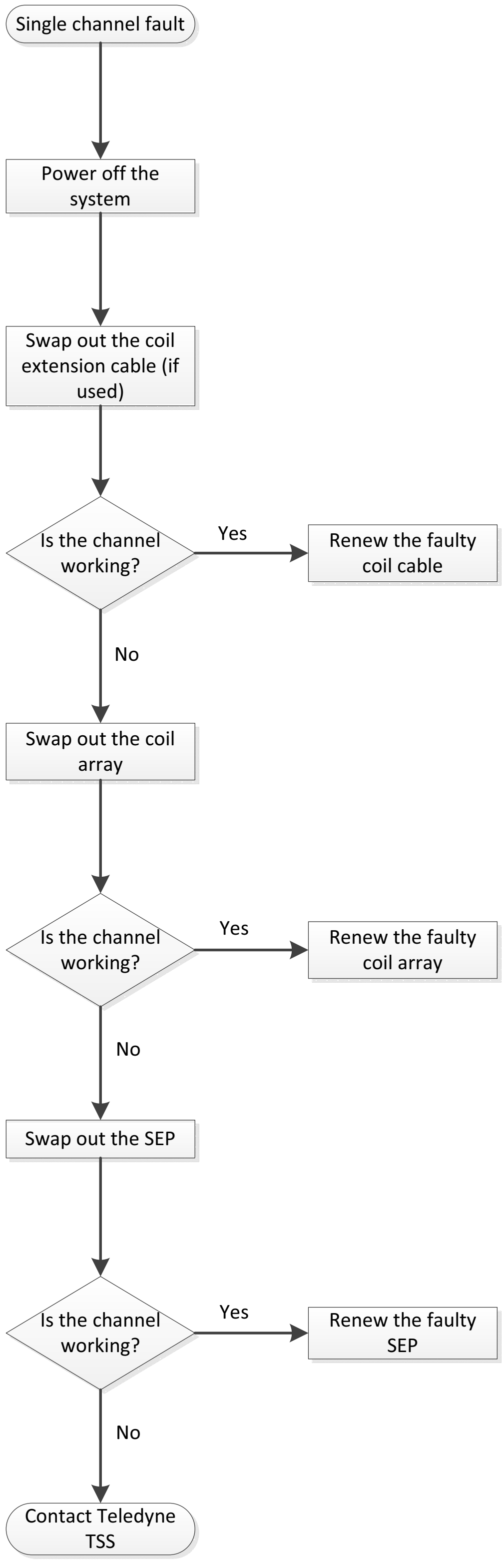

Figure 6-5: Single channel failure

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6.1.2 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 COM2, select COM2 from the terminal mode and check the data strings against those listed in section 4.7. See section 3.3.2.5 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.

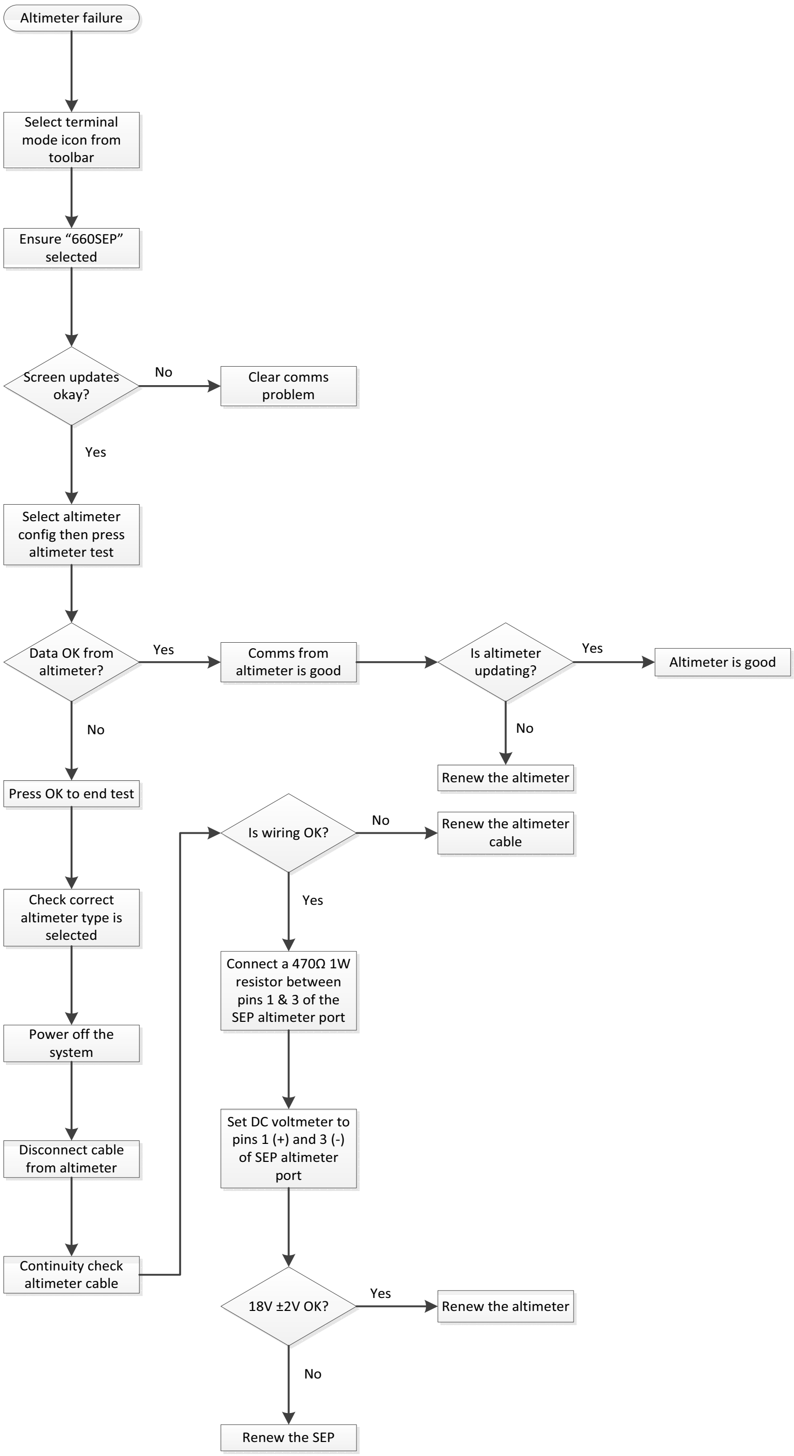

Figure 6-6: Altimeter failure

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6.1.3 Unexpected Signal Variation During Normal Operation

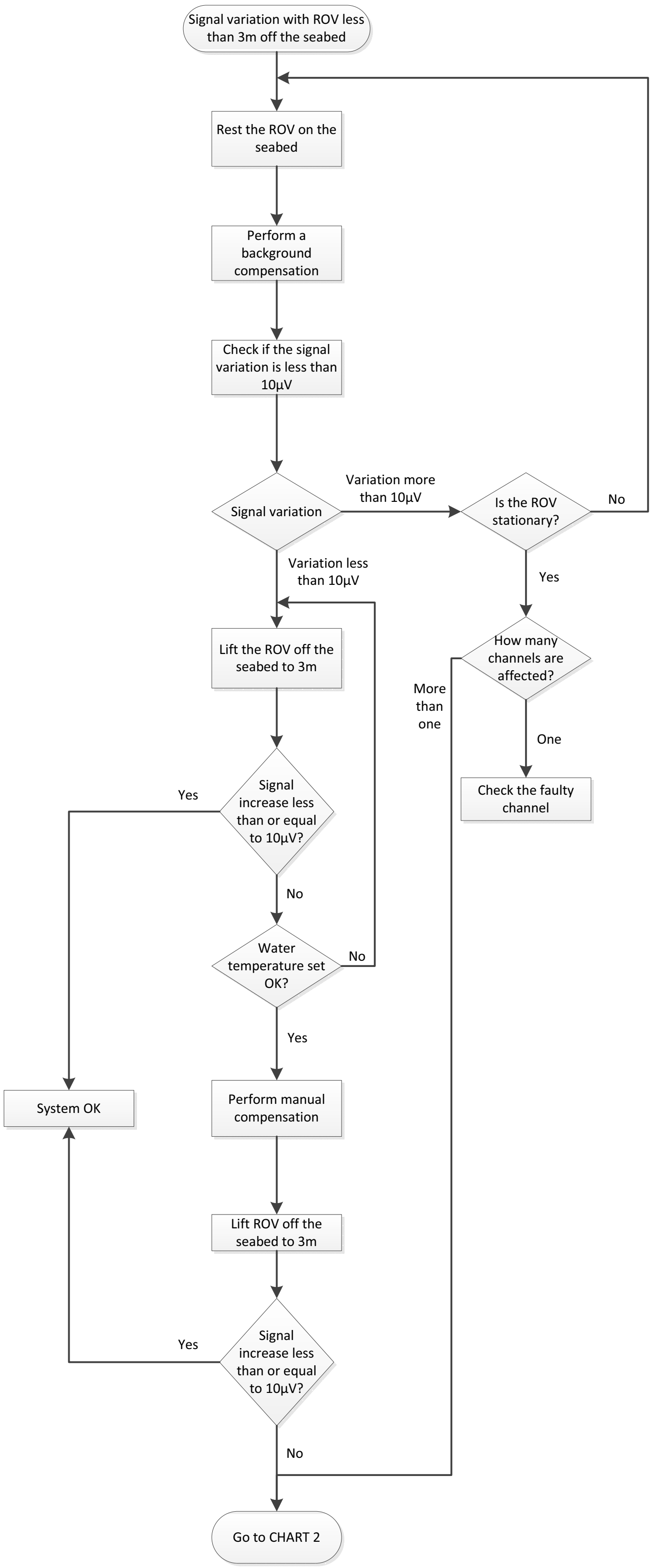

Figure 6-7: Signal shifts – CHART 1

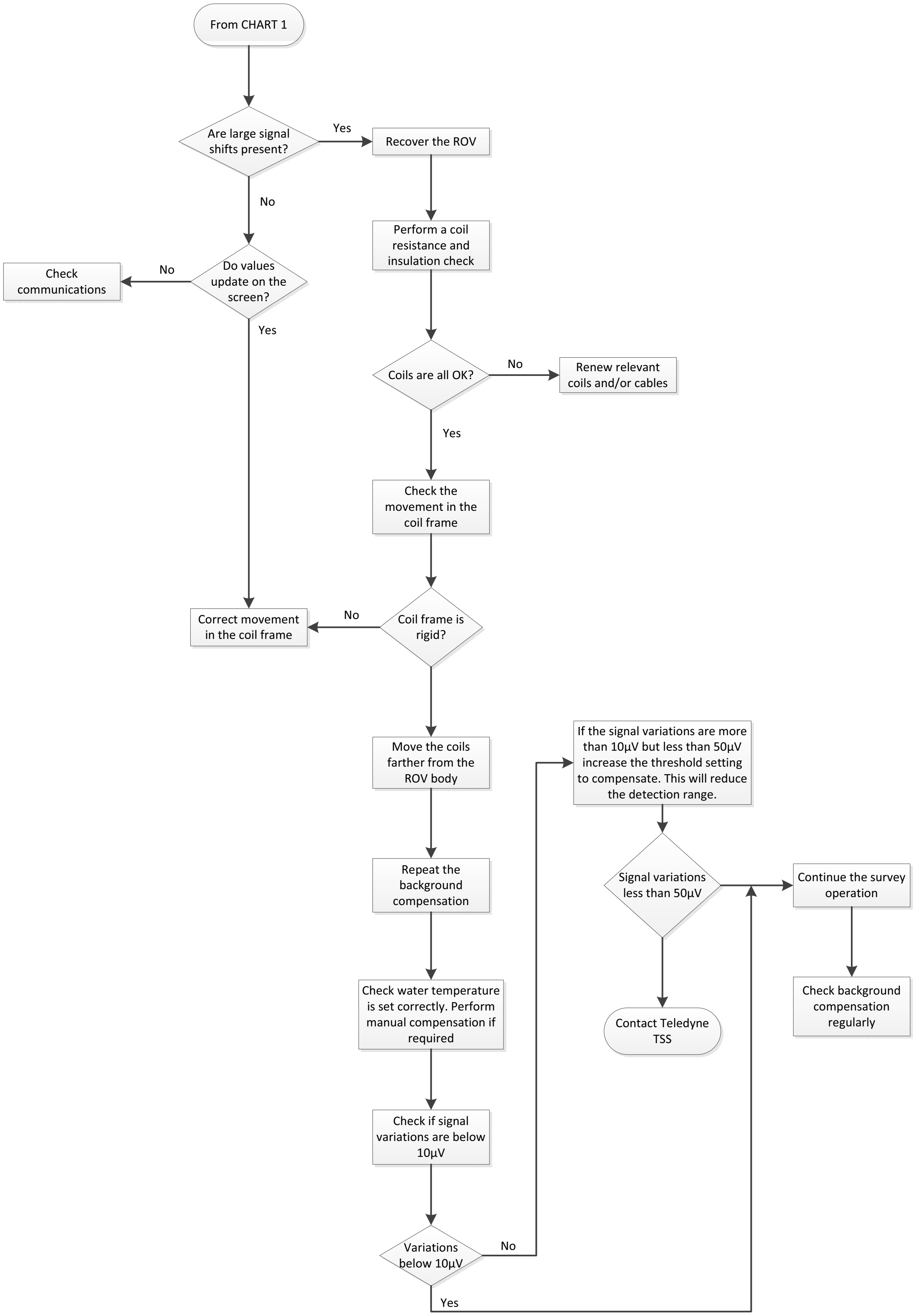

Figure 6-8: Signal shifts – CHART 2

6.2 Spares

6.2.1 Coils

TSS Part Number	Description
B934891	660 coil

6.2.2 Subsea pods

TSS Part Number	Description
B934862/S	660 SEP, 3,000m rated
B935029/S	660E SEP, 3,000m rated
B934861/S	660 PSU pod, 110V a.c., 3,000m rated
B934989/S	HydroPACT PSU pod, 24V d.c., 3,000m rated

6.2.3 Housings

TSS Part Number	Description
B935017/S	660 SEP housing assembly, 3,000m rated
B935134/S	660E SEP housing assembly, 3,000m rated
B935022/S	660 PSU 110V a.c. housing assembly, 3,000m rated
B935006/S	HydroPACT PSU 24V d.c. housing assembly, 3,000m rated

6.2.4 End caps

TSS Part Number	Description
B935018/S	660 SEP (to coil) end cap assembly, 3,000m rated
B935023/S	660 SEP (to PSU) end cap assembly, 3,000m rated
B935135/S	660E SEP (to coil) end cap assembly, 3,000m rated
B935032/S	660E SEP (to ROV) end cap assembly, 3,000m rated
B935024/S	660 PSU a.c. (to ROV) end cap assembly, 3,000m rated
B935035/S	660 PSU a.c. (to SEP) end cap assembly, 3,000m rated
B935008/S	HydroPACT PSU d.c. (to ROV) end cap assembly, 3,000m rated
B935015/S	HydroPACT PSU d.c. (to SEP) end cap assembly, 3,000m rated

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6.2.5 Electronics

TSS Part Number	Description
401183/T	660 processor PCB
B934887/T	660 driver PCB
B934888/T	660 analogue PCB
308006/T	110V a.c. PSU PCB
B934874/T	24V d.c. filter PCB
B934883/T	24V d.c. converter PCB
B934002/T	660E PSU PCB
B934012/T	660E control PCB

6.2.6 Topside computer

TSS Part Number	Description
B933640	SDC10 (Surface Display Computer)
B934805	RMC10 (Rackmount Computer)

6.2.7 Altimeter

TSS Part Number	Description
500292	ALT-250, 3,000m rated

6.2.8 Cables

TSS Part Number	Description
B930473	A.C. input cable, 3m
B934984	D.C. input cable, 3m
B930474	SEP to PSU cable, 2.5m
601824	ALT-250 altimeter cable, 3m
B935021	660 SEP cable harness set
B935136	660E SEP cable harness set

6.2.9 Other

TSS Part Number	Description
B934907	660 coil mounting kit
B935028	Universal detection support kit

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7 System Specifications

NOTE

Teledyne Limited has made every effort to ensure that the specifications included are correct. However, in line with the Teledyne Limited policy of continual product development and improvement, Teledyne Limited reserves the right to change equipment specifications without notice. Refer to Teledyne Limited for advice if necessary.

7.1 Specifications

7.1.1 Subsea Electronics Pod (660)

Size		Ø148 × 468mm*
Weight	In air	14.0kg
	In water	4.4kg
Communication		RS232
Operating temperature		0-30°C
Depth rating		3,000m
Finish		Anodised aluminium with nylon coating

**Allow up to 300mm extra for connector clearance.*

7.1.2 Subsea Electronics Pod (660E)

Size		Ø148 × 328mm*
Weight	In air	10.0kg
	In water	3.3kg
Communication		RS232
Input voltage		19-36V d.c.
Maximum power demand		40W
Operating temperature		-20 to +45°C (coil drive on) -20 to +70°C (coil drive off)
Depth rating		3,000m
Finish		Anodised aluminium with nylon coating

**Allow up to 300mm extra for connector clearance.*

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7.1.3 Subsea Power Supply Pod

		110V a.c.	24V d.c.
Size		Ø148 × 468mm*	Ø148 × 328mm*
Weight	In air	13.4kg	10.0kg
	In water	3.8kg	3.3kg
Input voltage		110-120V a.c. 45-65Hz	19-36V d.c.
Maximum power demand		150VA	100W
Operating temperature		0-30°C	
Depth rating		3,000m	
Finish		Anodised aluminium	Anodised aluminium with nylon coating

**Allow up to 300mm extra for connector clearance.*

7.1.4 Coil Array

Size	Maximum	1200 × 714 × 62mm
	Nominal	1200 × 600 × 30mm
Quantity		1
Weight (incl. cable)	In air	18.5kg
	In water	6.3kg
Depth rating		6,000m
Material		HDPE/PU

7.2 Performance

The following table shows the results of tests performed using a 5 metre length of sample target. It illustrates the range and performance that you may achieve under ideal conditions by following the procedures described in Chapter 4 carefully.

The chart shows:

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 performance 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 660 and the actual vertical range.

IMPORTANT NOTE:

Such charts should not be used 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 660 system.

Note also that the table applies to one type and size of target *only*.

Table 7-1: Standard pipeline diameter = 0.10m (4 inch)

	True Lateral Offset (±cm)									
Vertical Range	0	10	20	30	40	50	60	70	80	90
50	-1	-2	-1	-1	-1	0	2	4	4	7
60	1	0	0	0	0	0	0	-3	-4	-6
70	0	0	0	0	0	1	2	3	1	2
80	0	0	-1	-1	-2	-1	0	0	-4	-4
90	-1	-1	-1	-2	-2	-2	-2	-3	1	-4
100	0	0	-1	-1	-1	0	1	2	0	0
110	2	2	0	0	-1	1	-4	-2	2	-11
120	1	2	1	0	-1	0	-2	2	2	-7
130	1	1	1	0	-3	1	5	1	-1	-12
140	-1	-1	-2	2	1	-2	3	5	-2	5
150	1	-1	-2	1	3	1	3	5	-7	-8
160	-4	-4	-3	-1	4	5	7	3	13	-21

7.3 Update Rate

You may set the rate at which the 660 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 660 system. If your ROV includes both these systems, you must allow for their different update rates when you analyse the survey data.

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A Operating Theory

The 660 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 660 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 repeatability.

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 the 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 660 system uses this principle to detect the presence of conductive material near the coil array. See Figure A-1, which shows a single cycle of measurement on one channel:

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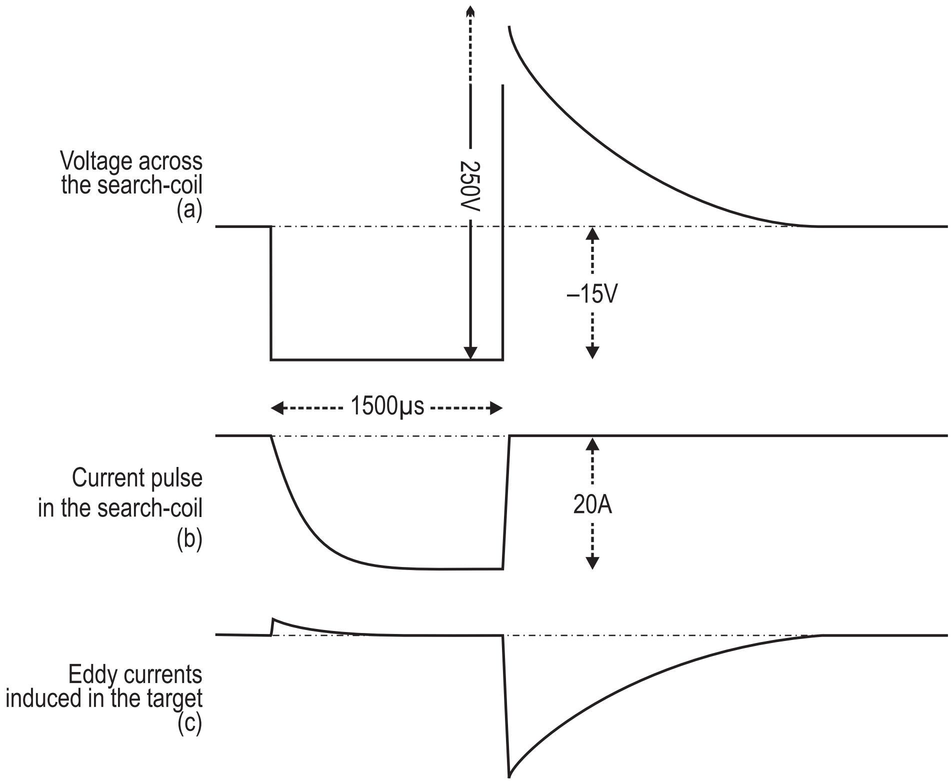

Figure A-1: Pulse induction waveforms (not to scale)

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 660 system uses this feature to determine the range between the coil and the target.

A.2 Seawater Rejection

The seawater signal, to the 660'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

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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.

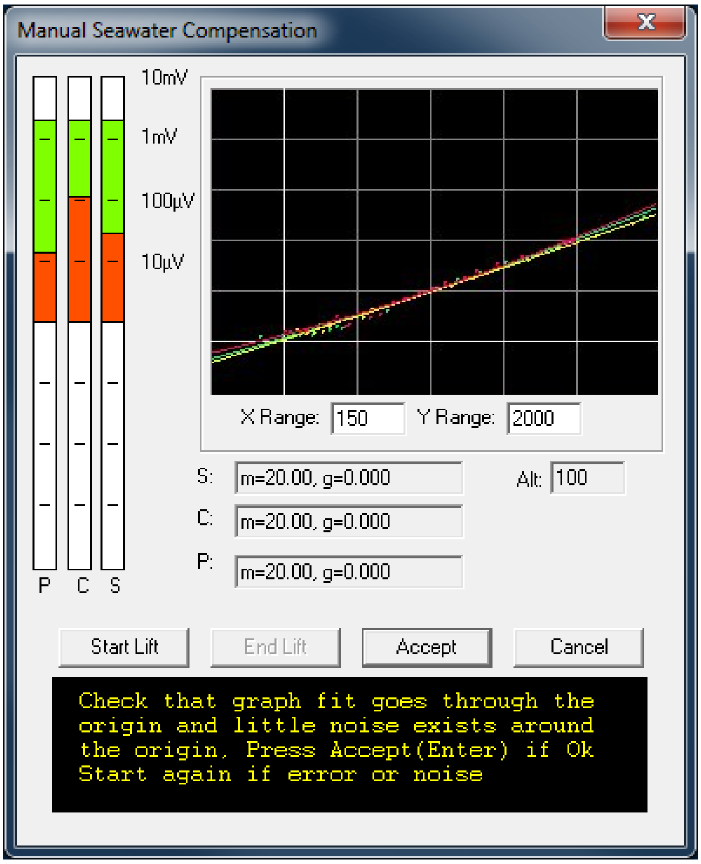

Figure A-2: Seawater signal

The 660 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.3 Compensation

The 660 system 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 by DeepView 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 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

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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.3.1 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 DeepView. 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.3.2 Active Compensation

DeepView 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-3. If the background compensation was not correctly carried out, then the graph will not meet

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the origin, as shown in Figure A-4 A small y- intercept (50µV) can be tolerated, since it is the gradient of the curve which is important.

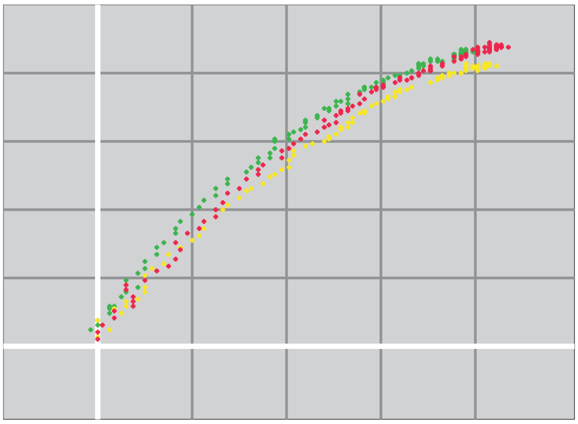

Figure A-3: Perfect lift with the results passing through the origin

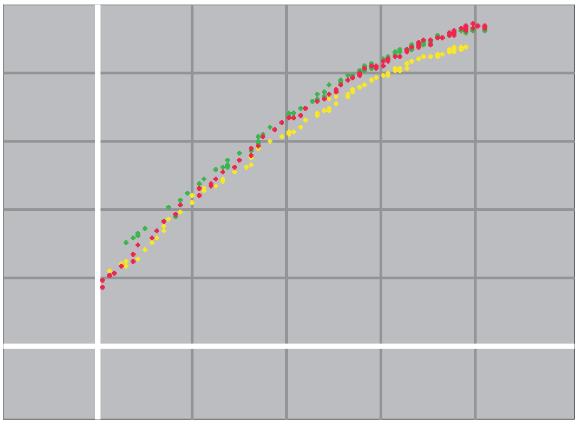

Figure A-4: Example of poor background compensation

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-5. 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-6 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.

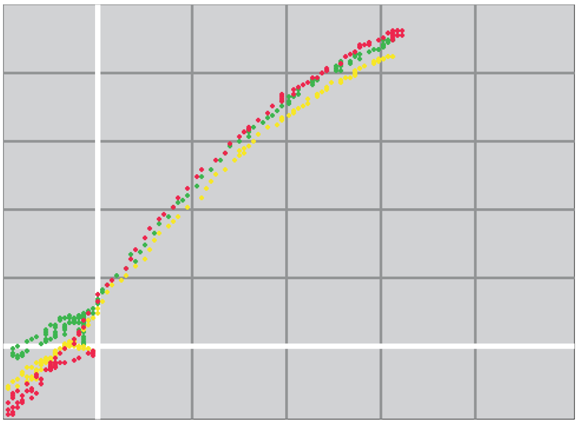

Figure A-5: Example with metal present on the seabed during compensation

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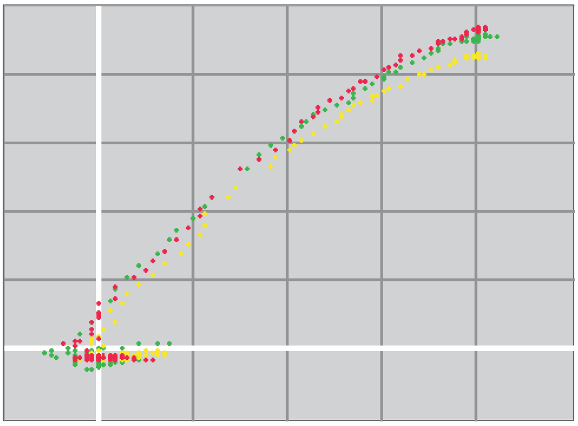

Figure A-6: Example where the vehicle was not moved smoothly

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-3 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.3.3 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 repeatability of the survey data when operating close to the ultimate range of the system. The 660 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.3.3.1 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. DeepView 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)

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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.3.4 Background Noise Profile

DeepView 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-7 illustrates the display during a Background Noise Profile.

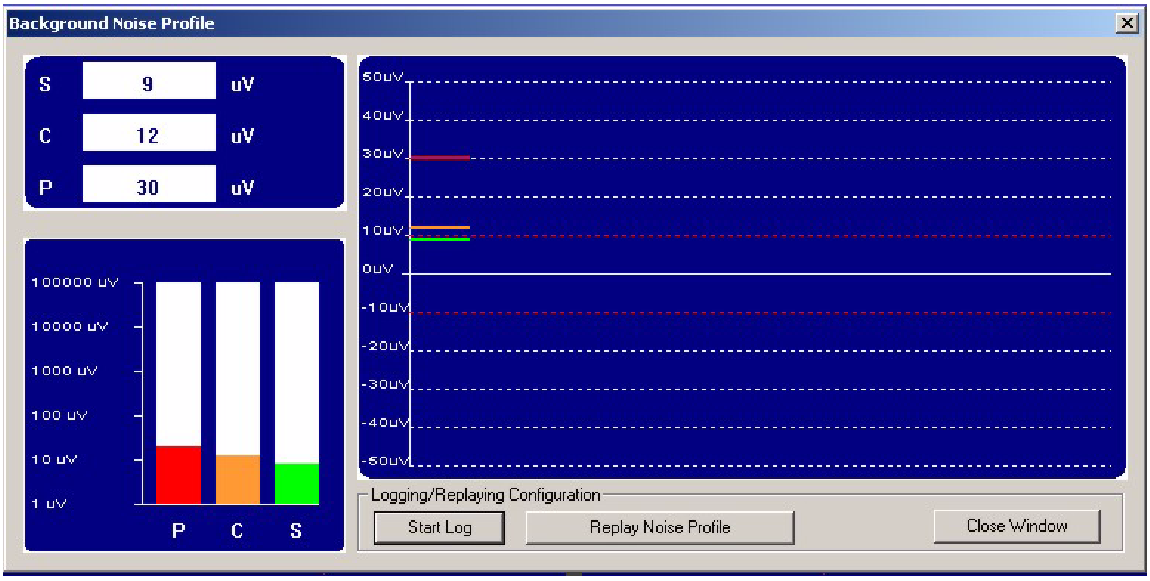

Figure A-7: Background Noise Profile Window

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 4.6.1.3.

A.3.5 Trenching Vehicles

In the case of a crawling ROV, it may not be possible to lift the vehicle off the seabed. However, very good performance can still be obtained merely by selecting the correct water temperature.

A.3.6 Limitations

Figure A-8 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.

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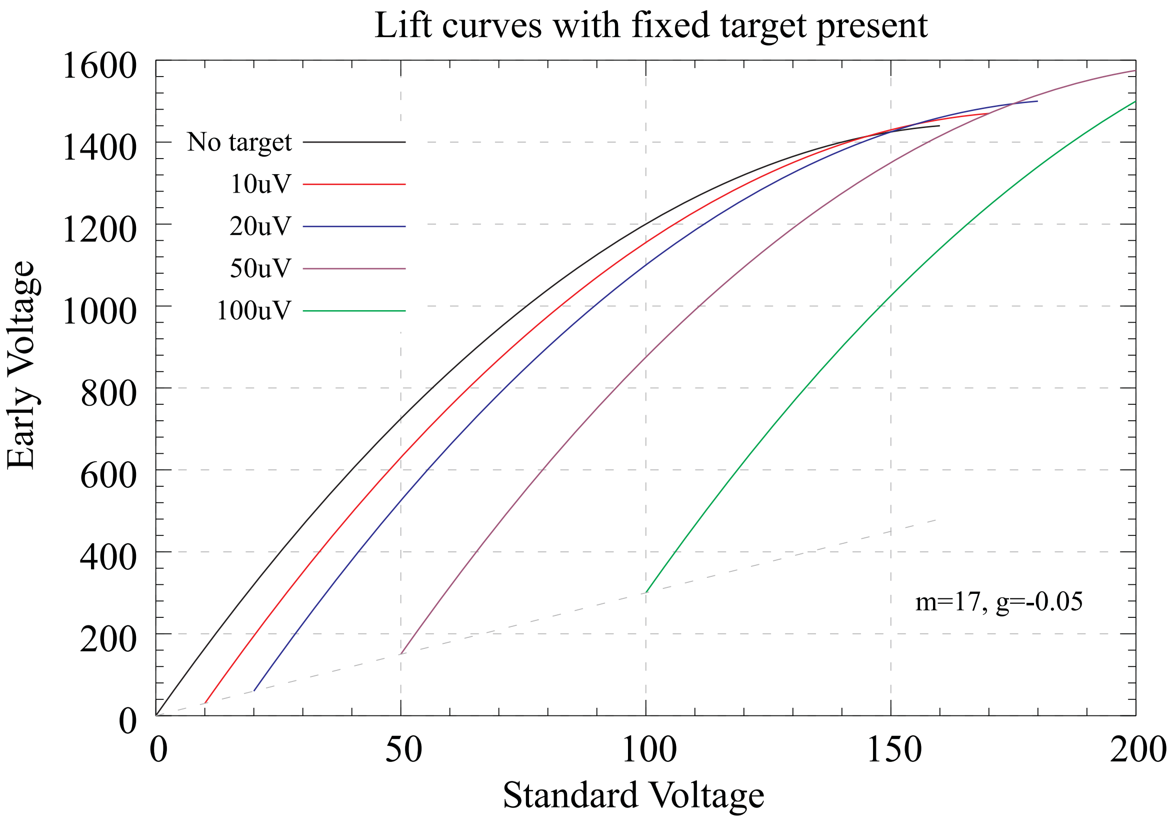

Figure A-8: Typical lift curves with a fixed target present

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.3.7 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.

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B Options

B.1 Systems

Customer Package Number	Description
B934859	660 system, 110V a.c., 3,000m rated, SDC10, altimeter
B934859/1	660 system, 110V a.c., 3,000m rated, altimeter
B934859/2	660 system, 110V a.c., 3,000m rated
B934803	660 system, 24V d.c., 3,000m rated, SDC10, altimeter
B934803/1	660 system, 24V d.c., 3,000m rated, altimeter
B934803/2	660 system, 24V d.c., 3,000m rated
B935030	660E system, 24V d.c., 3,000m rated, SDC10, altimeter
B935030/1	660E system, 24V d.c., 3,000m rated, altimeter
B935030/2	660E system, 24V d.c., 3,000m rated

B.1.1 Coils

TSS Part Number	Description
B934891	660 coil

B.1.2 Subsea pods

TSS Part Number	Description
B934862/O	660 SEP, 3,000m rated
B935029/O	660E SEP, 3,000m rated
B934861/O	660 PSU pod, 110V a.c., 3,000m rated
B934989/O	660 PSU pod, 24V d.c., 3,000m rated

B.1.3 Topside computer

TSS Part Number	Description
B933640	SDC10 (Surface Display Computer)
B934805	RMC10 (Rackmount Computer)

B.1.4 Altimeter

TSS Part Number	Description
500292	ALT-250, 3,000m rated

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B.1.5 Cables

TSS Part Number	Description
B930473	A.C. input cable, 3m
B934984	D.C. input cable, 3m
B930474	SEP to PSU cable, 2.5m
B934816/2m	Coil extension cable, 2m
B934816/4m	Coil extension cable, 4m
601824	ALT-250 altimeter cable, 3m

B.1.6 Other

TSS Part Number	Description
B934907	660 coil mounting kit

B.2 Training

The Teledyne TSS 660 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 660 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 Limited has developed two levels of training course to provide for the needs of those who will be involved with a survey that uses the 660 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. Topics covered include:

- System overview
- Principles of operation
- Initial installation
- Software overview and interfacing with other equipment
- Operational considerations and limitations
- Practical demonstration
- Regular maintenance procedures
- System test procedures

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C Reference

The following pages contain blank sample copies of forms that you may use to record details about the 660 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.

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C.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):			

Target Scaling Results

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

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C.2 Target Scaling Results

Automatic target scaling factor: [ ] µV

Nominal VRT (cm)	True VRT COL 1	660 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: [ ] µVPerformance Envelope Results

Nominal VRT (cm)	True VRT COL 1	660 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						

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C.3 Performance Envelop Results

Target scaling factor;[ ] μVSurvey Details

True VRT (cm)	VRT VALUES															
	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																

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C.4 Survey Details

Complete this log before every survey and file with the Survey Records

Survey Vessel:	
Date:	
Survey Vehicle:	
Site:	
Client:	
Project Number:	

C.5 System Configuration Details

Topside computer S/N:		Software Version:	
SEP S/N:		Firmware Version:	
PSU S/N			
Coil array 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 660 Training Certificate No.:			
Date of training:			

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D Index

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T

V

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HydroPACT 660/660E User Manual
Document Part Number: 060220
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Date: January 2019

TELEDYNE TSS
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MANAGEMENT SYSTEM CERTIFICATION
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