MSL600

Ultrasonic continuous sludge blanket monitor

Model Covered:
MSL600/Z0 with MSL603 transducer

CONTENTS

FOR QUICK START, SEE SECTION 5 ON PAGE 20

THIS MANUAL COVERS MSL600 FROM SOFTWARE VERSION 3.00 AND ABOVE

Figures and tables

(i) Safety precautions

BEFORE OPERATING THIS DEVICE THE MANUAL SHOULD BE READ FULLY

The following safety precautions should be observed before using this product or working on the attached cables.

- This MSL600 product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.
- The types of product users are:

  Responsible body: This is the individual or group responsible for the use and maintenance of equipment, and for ensuring that operators are adequately trained. Operators use the product for its intended function. They should not be allowed access to the electrical connections within the control box, and would normally only operate the external keypad and monitor the display.

  Maintenance personnel perform routine procedures on the product to keep it operating, for example, checking the line voltage or checking electrical connections, replacing mains fuses etc. Otherwise, only service personnel should perform them.

  Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures. There are no user serviceable parts on the main PCB section of the MSL600 product.
- Users of this product must be protected from electric shock at all times. The responsible body must ensure that users are prevented access and/or insulated from every connection point. Product users must be trained to protect themselves from the risk of electric shock.
- Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables for possible wear, cracks, or breaks before each use. When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.
- Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.
- Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. If you are unsure about the applicability of a replacement component, call a MOBREY office for information. Only use the MSL600 with the sensor supplied or Mobrey agreed replacement. The unit will not necessarily work with apparently equivalent sensor units.
- To clean the instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the inside of the instrument or allow liquids to enter or spill on the instrument.
- WARNING - If this equipment is used in a manner not specified by Mobrey, the protection provided may be impaired. The MSL600 is regarded as permanently installed equipment and as such a switch or circuit breaker must be included in the installation. This should be in close proximity to the equipment, it should be marked as the disconnecting device, and it should disconnect both current carrying conductors.
- A protective earth should be used for all applications.
- The normal application of the MSL600 requires it to be mounted on a water handling plant. The installation point and power cables associated with the MSL600 must be such that tank overflow, local flooding or pump failure do not cause these to be submerged or subject to flows of water. Sensor and sensor cabling can be submerged without hazard to equipment operators when correctly connected as described in this manual.

Explanation of symbols: The IEC Protective Earth Symbol is: 

CHECK THAT THE POWER SUPPLY IS SUITABLE BEFORE SWITCHING POWER ON.

Internal adjustments can select mains 115 Volts AC power, which makes the equipment unsuitable for 230V AC supplies. Check the 2 voltage selection switches compared with the available power supply.

1. Introduction

Before operating this device the manual should be read carefully paying particular attention to the safety precautions laid out in section (i).

This instruction manual provides comprehensive information specific to the Mobrey Measurement continuous suspended solids blanket level monitor, the MSL600.

1.1 About the MSL600

The basic MSL600 system contains an ultrasonic transducer and a bridge-mounted control unit.

The control unit is microprocessor-based and is given the designation MSL600. It is intended to be mounted on a bridge using a specially designed and easy-to-install mounting bracket that is supplied with the system.

The system is specially adapted for use with clarifiers and thickeners containing municipal and industrial wastewater treatment sludge. The MSL600 provides a means of sensing the presence of the sludge blanket and measuring its depth in the clarifier. It also provides a range of current and relay outputs to the user for control and alarm purposes.

The MSL600 uses the sonar principle, with an ultrasonic pulse transmitted under water from a partially submerged, IP68-rated transducer (MSL603). The pulse of ultrasound is transmitted vertically down into the clarifier tank, and then reflects from the surface of the sludge blanket. The system captures the ultrasonic echoes received from the sludge blanket interface and determines the time-of-flight of the echo from the transducer to the sludge blanket.

Knowing the speed of sound in the supernatant (the system has automatic temperature compensation), the control unit calculates the distance to the blanket interface. This distance is then subtracted from the programmed depth of the tank to give the sludge blanket depth or interface level. This is the system's fundamental process variable.

1.2 About this Manual

This section introduces the user to the MSL600 system, its components and key features. The system's mode of operation is explained in this section.

In section 2, the manual discusses application planning where installation is primarily intended to be on municipal and industrial wastewater clarifiers.

In section 3, the manual discusses the actual physical process of mechanical and electrical installation of the system. This section provides a step by step procedure for easy installation of the MSL600 system on site.

In section 4, the manual introduces the basics of programming the system. This section introduces the human machine interface (HMI), keypad and display

In section 5, the manual discusses the minimum programming steps needed for commissioning the system so that a meaningful measurement can be made. This quick start setup section is intended to cater for the needs of most users.

In section 6, the manual discusses in more detail the human machine interface and how the system is programmed.

In section 7, all of the system's parameters are discussed and their function detailed. Sections 6.0 and 7.0 are primarily intended for the more advanced user who needs to tune the system to meet an unusual application.

In section 8, the manual discusses in detail the mode of operation of some of the key system elements. This section is intended for the most advanced user.

Finally, sections 9 to 13 cover maintenance, troubleshooting, programming chart, technical specifications and dimension drawings relevant to using the MSL600 system.

1.3 Important MSL600 features

The MSL600 system incorporates several unique design features which are intended to promote trouble free operation, give a degree of installation flexibility, and allow ease of installation.

1.3.1 Human Machine Interface

In common with other Mobrey Measurement control units, the MSL600 makes use of the Mobrey Measurement Human Machine Interface (HMI). The HMI reflects comments and suggestions received about the need to be easy and intuitive to use. The intention is that you should be able to program and interrogate the system using the integral membrane keypad and Liquid Crystal Display (LCD) without the need for regular reference to this manual. For the more experienced user, the HMI also facilitates rapid navigation of the menu structure to system parameters.

1.3.2 Self-cleaning

One of the most important features of the MSL600 is its transducer self-cleaning facility.

In the application for which the system is designed, the transducer is normally mounted in a relatively hostile environment. In this environment, the likelihood of the transducer becoming coated or otherwise fouled is relatively high. A fouled transducer is far less efficient at transmitting sonar pulses into the supernatant. Without the ability to automatically clean itself, the transducer maintenance cycle would need to be more regular, and thus increase the life cost of the system.

Experience suggests that any moving mechanical cleaning devices are themselves prone to fouling. It is for this reason that the MSL600 uses an **air purge cleaning function**. Extensive experimental results show that this method is extremely effective in keeping the face of the transducer free from any coating growth or build-up of floating debris.

The cleaning cycle is optimised for maximum efficiency. However, you can manually initiate a cleaning cycle or override this feature by turning it off.

1.3.3 Mounting bracket

Most clarifier tanks have railings on the walkway, rotating or moving bridge or walkway. It is recommended that the MSL600 be mounted on these railings. The MSL600 system is supplied with a purpose designed mounting bracket. This bracket design has been optimised to fit most designs of railing. This is intended to provide alignment and a stable platform for the transducer and control unit.

The transducer and mounting bracket, collectively known as an MSL603, are intended to be fitted to the clarifier before the MSL600 control unit is attached to them. This allows mechanical adjustment and fitting without the need to worry about the electronics in the enclosure.

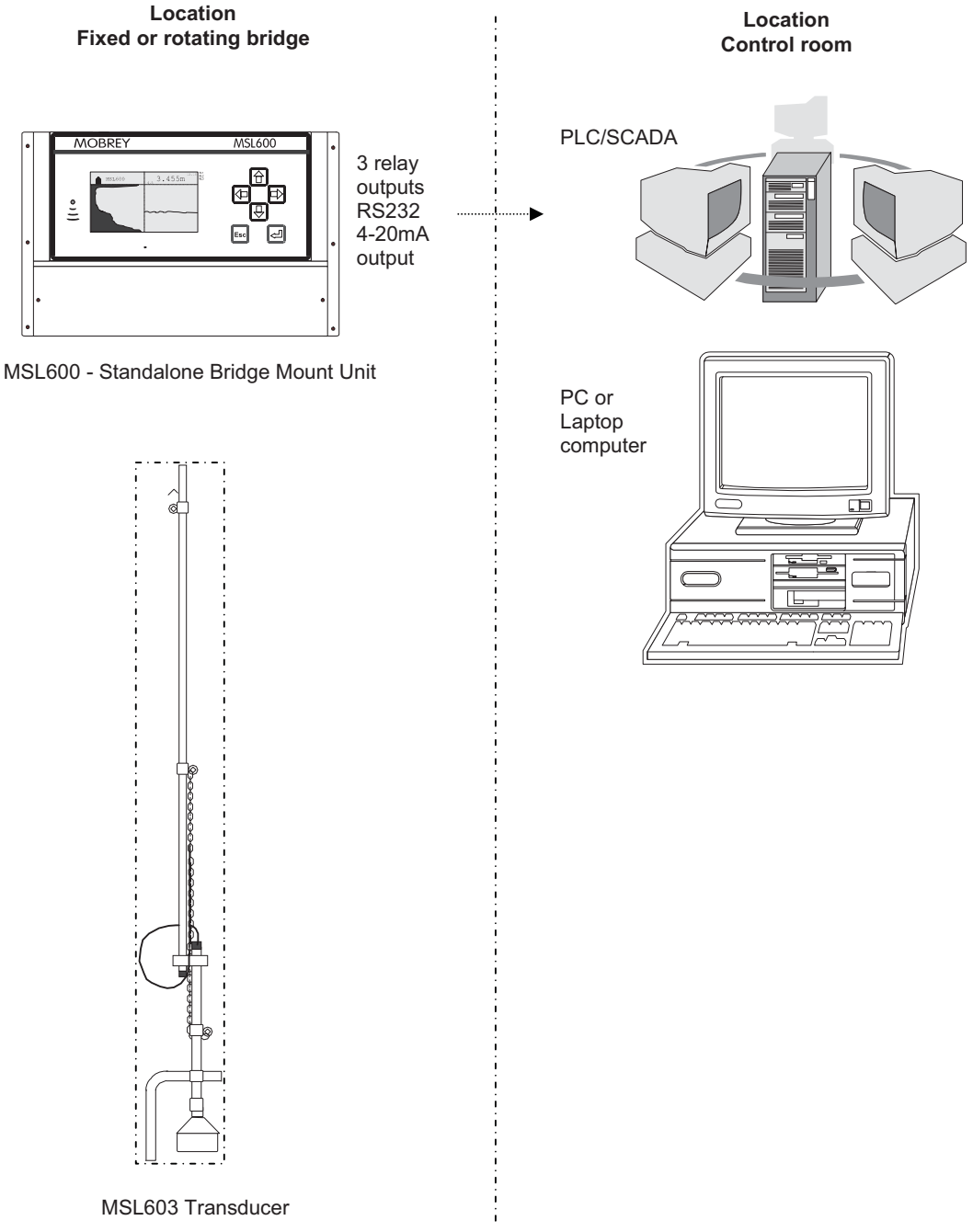
The transducer mounting arrangement is hinged so that the transducer can be lifted out of the water, using the chain provided, for ease of maintenance (in most cases this will not be necessary because the transducer is self-cleaning). When installed, the transducer front face should be continually immersed in water to a depth of approximately 75mm (3 inches). The MSL600 mounting bracket should allow sufficient adjustment for this in most cases. Extensions and extra tubes are readily available from a number of sources to allow the mounting to be modified – contact Mobrey Measurement Sales for assistance (see section 3.3.3 for other sources).

Note:
The MSL603 transducer can also be supplied without mounting hardware and is supplied complete with 10 metres (33 feet) of connecting cable and air hose for the self-cleaning system. This allows the installer to provide their own mounting arrangements using suitable 25mm (1 inch) pipe or conduit. This arrangement is normally supplied for fixed bridges or enclosed tanks where a pivoting sensor is not required.

1.4 As a system

Figure (1) shows the architecture of the complete MSL600 system and where each component is intended to be used. Install the MSL603 transducer and mounting bracket on the rotating bridge or fixed walkway over the clarifier tank. Install the MSL600 control unit on the mounting bracket.

Figure (1): MSL600 system architecture



2. Application planning

The following section discusses a few practical considerations when planning an installation.

2.1 Circular clarifiers

Circular clarifiers are very common and can come with rotating or static bridges over them.

2.1.1 Rotating bridge

If the transducer is mounted on a rotating bridge then it should be positioned on the leading edge of the bridge, see Figure (2). This places it ahead of any bow wave in the sludge blanket which may be created by trailing sub surface scrappers that would otherwise give rise to a false indication of the blanket level.

Ideally the transducer should be mounted between 1/3 and 2/3 of the way along from the outer (wall) edge of the settlement tank (i.e. 1/3 to 2/3 of the radius from the inside of the tank wall).

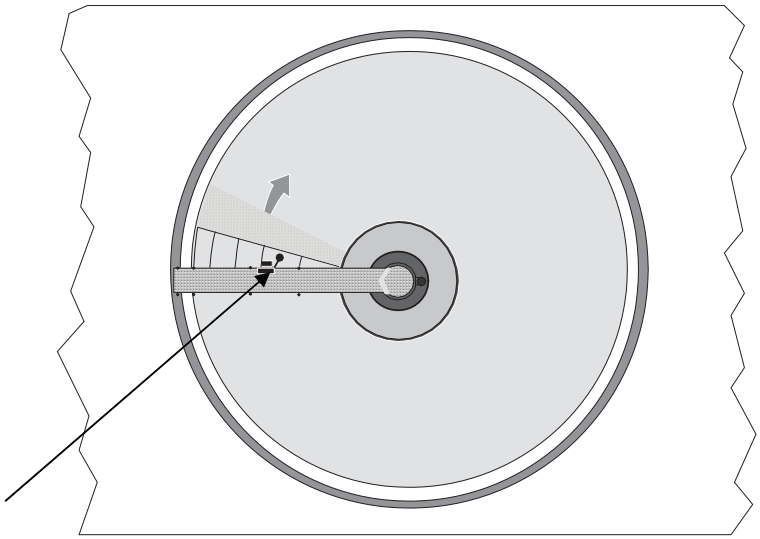
Care should be taken to ensure that the transducer is mounted over an undisturbed section of the tank, i.e. not too close to the tank inlet or tank wall, and away from columns of rising gas bubbles. All of these factors can result in false sonar echoes being received. It is recommended that the transducer be mounted at least 1m (3.3 feet) from any such structures.

If a scum removing skimmer is present then the transducer should be mounted behind this.

When locating the transducer the user must ensure that there are no permanent underwater obstructions below the transducer, as these will give false sonar echoes and disrupt the signal. It is recommended that the transducer be mounted at least 1m (3.3 feet) from any such structures.

Ensure that the transducer does not come into contact or collide with any scum boards, weirs or other surface obstructions as the bridge rotates.

Figure (2): Circular clarifiers – Rotating bridge



2.1.2 Static bridge

The transducer mounting arrangement is designed to lift out of the water if it is mounted on a fixed bridge when a moving scraper passes underneath (e.g. on a picket fence thickener). Ideally, the transducer should be mounted 1/3 to 2/3 of the way along from the outer (wall) edge of the settlement tank (i.e. 1/3 to 2/3 of the radius from the inside of the tank wall).

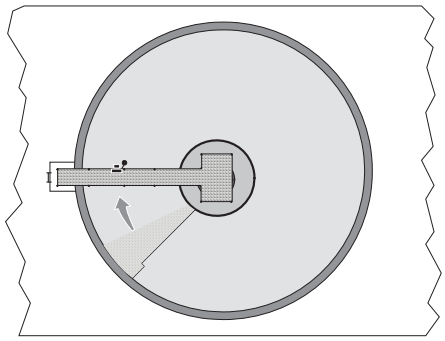
If the transducer is mounted on a static bridge then it should be positioned on the trailing edge of the bridge, see Figure (3). This gives the hinge mechanism maximum clearance from the bridge structure.

Ensure the transducer guard is facing towards the moving sweeper. The guard and hinge mechanism can be angled slightly to meet the rotating parts at a normal incidence. This avoids the transducer guard sliding sideways along the rotating part as it is lifted.

Always check that the parts sliding over each other will not become entangled or locked together. The rotating mechanism on most bridges is strong enough to bend the mounting bracket if this should happen.

It is strongly recommended that a few uneventful rotations be observed before installation is completed.

Figure (3): Circular clarifiers - Static bridge

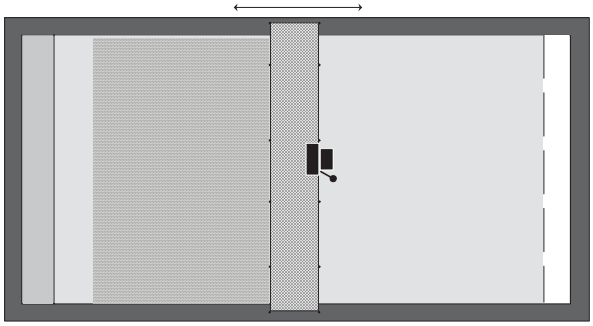


2.2 Rectangular clarifiers

As with a rotating bridge and a circular tank, the transducer should be mounted from the leading edge of the bridge to avoid false level readings from the disturbed bow wave in the sludge blanket as the bridge scrapes sludge into the hopper at the end of the clarifier.

The considerations detailed in section 2.1 for rotating clarifiers should all be considered as appropriate for a rectangular clarifier.

Figure (4): Rectangular clarifiers



3. Installation

The following section discusses installation considerations in more detail.

3.1 Preliminary checks

Carefully unpack the MSL600 control unit, transducer, and mounting bracket arrangement from their packaging.

Check that there is no visible damage to any of the packed parts, paying particular attention to the transducer and transducer cables, and the membrane keypad and display area on the MSL600.

Contained in the packaging should be the following:

Pack one

- 1 x MSL600 bridge mounted unit, with compressor housing containing the air compressor for self-cleaning on a metal mounting plate (pre-assembled).
- 1 x MSL600 manual.

Pack two

- 1 x transducer assembly, and bridge mounting kit (including tool kit).
  (*Optional – MSL603 transducer only with 10 metres of cable and air hose*)

3.2 Location

Determine the optimum location for installation of the MSL600 following the hints and tips given in section 2, Application planning.

3.3 Mounting bracket attachment

The mounting bracket is specifically designed for mounting on the centre rail of the safety railing on the bridge of any settling tank, see Figure (5). The rail can be any diameter up to 52mm (2 inches).

The bracket is also clamped to the bridge kicking board or similar supporting frame.

Adjustments can be made for different bridge heights, and the bracket can be angled to miss obstructions.
An extension arm can be added to the main support tube to extend the adjustment of the bracket further, if required.
Most adjustments are made by hexagon key and spanner, included in the supplied bridge mounting kit.
The transducer arm hangs vertically from a pivot and can be swung out of the water for cleaning and inspection.

WARNING!
The transducer is a sensitive instrument and care must be taken to prevent unnecessary impact or strain on it during installation.

3.3.1 Bridge preparation

The bracket should be prepared and initial adjustments made off the bridge. If any obstructions are present in the installation area, the unit should be set up accordingly. This will greatly simplify any adjustments required during mounting of the unit on the bridge. The cable and hose from the transducer should be handled with care to prevent any sharp bending, especially in the area where they exit the transducer arm.

Check there is sufficient room between the top rail, centre rail, and any other structure for the control box to be fitted. The space required is 430mm (17 inches) high and 360mm (14 inches) wide [see Figure (5)].

Measure the distance from the water surface to the centre rail of the safety railing (dimension A).

Measure the distance from the centre rail to the kicking board (dimension B) or similar structure.

With the bracket on the ground adjust the pivot tube up or down the main support tube until the distance between the angle bracket and midpoint of the transducer is dimension A. Adjust the clamping bracket up or down the main support tube to dimension B so it will be just clear of the final clamping position.

If the clamp is higher than the pivot tube this will need to be removed and reassembled in reverse order (view X). If dimension A is too large and cannot be achieved, remove the pivot tube assembly, screw on the extension tube and refit the pivot tube (view Y). If the pivot arm is to be set at an angle or set to the opposite hand, this should be done at this stage.

Adjust the transducer guard so that it is at 90° to the pivot arm, projecting under the pivot arm and approximately 25mm (1 inch) below the bottom of the transducer.

If necessary move the chain attachment clamps to positions convenient for swinging the transducer out of the water. Adjust the chain so that it is slightly slack with the unit fully extended and any excess chain is hanging on the main support tube and not the transducer arm.

The cable and air hose can now be attached to the bottom of the main support tube with the cable ties provided. The cable and hose must make a 360° loop between transducer tube and main support tube to allow for flexing when the arm is lifted. Move the transducer arm up and down and check that the cable and hose move freely without excessive strain.

Before installing the unit on the bridge check that all the fittings associated with pivot tube are securely tightened, including those which have not been adjusted, as these are often difficult to reach later.

3.3.2 Installing the bracket on the bridge

Before carrying the unit on to the bridge, swing the transducer arm into the up position and attach it to the main support tube with the chain. This makes the unit more compact and easier to manage. Lift the unit over the handrail and hook it on to the horizontal centre tube of the rail. Release the rail clamp and push it up firmly under the rail. **While pushing on the barrel of the rail clamp (not the lug) retighten the clamping screw**. This will ensure a tight fit against the rail.

Loosen the clamping bracket assembly, attach it to the kicking board or similar structure and retighten. The studding allows the main support tube to be adjusted approximately to the vertical position. In some instances one or both nuts between the clamps will need to be removed. Tighten all fixings.

Lower the transducer arm carefully into the water and check the water surface is approximately in line with the top of the parallel portion of the transducer and it is clear of obstructions. Adjust the pivot arm height and angle as necessary. It is recommended the unit be removed from the bridge to make these fine adjustments. Ensure the cable and air hose still move freely without excessive strain when the transducer is raised and lowered.

Check that the transducer arm is hanging vertically. The transducer guard also functions as a balance arm. To adjust, swing the arm up and loosen the transducer guard. Move the guard backwards or forwards as appropriate and retighten. Repeat until the arm hangs vertically.

When the unit is installed and functioning correctly check all fittings are securely tightened, including those which have not been adjusted.

3.3.3 Attaching the MSL600

The MSL600 and compressor box come attached to a back plate complete with mounting lug. Check the clamping screw of the mounting lug is clear of the inside face and slide the complete unit onto the top of the main support tube. Orientate the unit to the correct position and tighten the clamping screw.

Run the cable and hose up to the control unit avoiding sharp bends and flattening of the hose. Plug the air hose onto the air connector on the bottom of the compressor box. The unit is now ready for wiring.

Additional fittings for MSL bracket (UK only) can be obtained from:

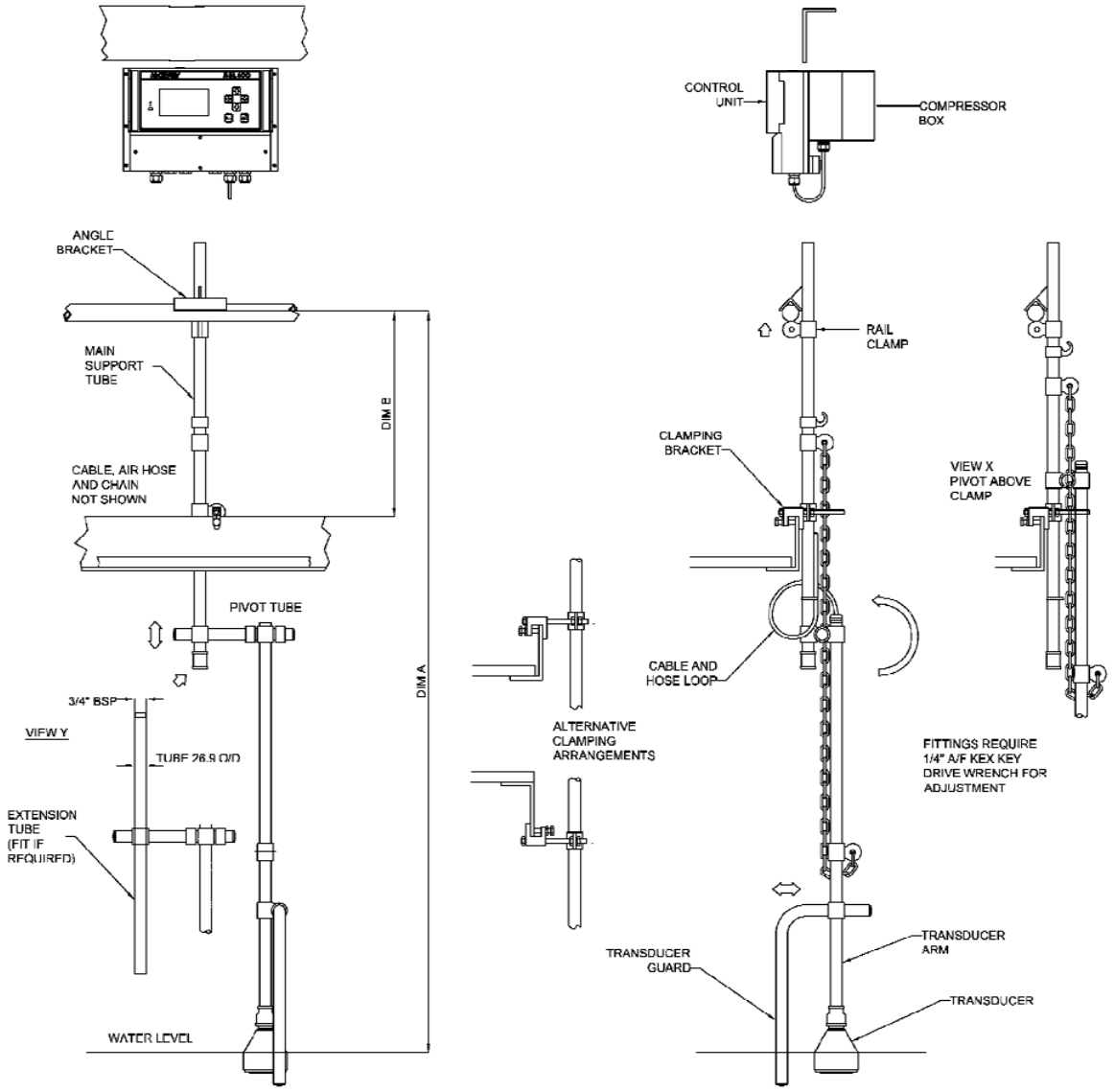
Alvin Products Limited, Knight Works, 10-12 Hampton Street, London, SE1 6SN

Tel. 020 7708 2004, **Fax**. 020 7708 3044, **Web site:** www.alvin.net

Fittings are ALVIN ‘KEY’ CLAMPS (Size 5 - 26.9mm dia.) Similar fittings are also available from other manufacturers.

Note: Socket head screws require 1/4” A/F Hex key clamp bracket screws require 17mm A/F spanner.

Figure (5): MSL600 mounting



3.4 Transducer connections

The MSL600 is housed in an ABS enclosure rated to IP66. The lower section of the housing is for cable connections and the upper part has the LCD and keypad controls.

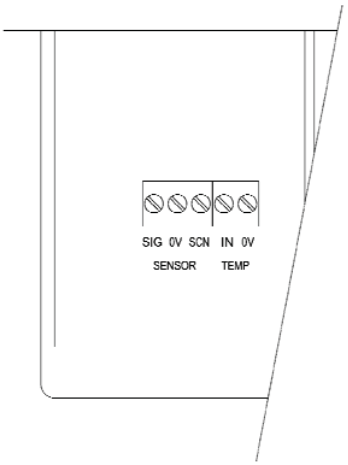
It is not necessary, or advisable, to remove the lid of the upper part of the enclosure. There are no user serviceable parts inside.

All field wiring connections are accessible by removing the lower lid, which is secured by four screws. Inside the terminal area, all connections are made using screw terminals. All terminal blocks are suitable for wires 0.5mm^2 to 2.5mm^2 (26 to 12 AWG). Insulation should be stripped back 7.0mm (0.25 inches).

The transducer cable comprises of five wires, see Figure (6), the connections for which are as follows:

- White wire - Transducer signal wire. This should be connected to the terminal block marked ‘SENSOR’ and ‘SIG’.
- Black wire - Transducer 0V wire. This should be connected to the terminal block marked ‘SENSOR’ and ‘0V’.
- Yellow wire - Transducer screen wire. This should be connected to the terminal block marked ‘SENSOR’ and ‘SCN’.
- Red wire - Temperature compensation positive wire. This should be connected to the terminal block marked ‘TEMP’ and ‘IN’
- Brown wire - Temperature compensation 0V wire. This should be connected to the terminal block marked ‘TEMP’ and ‘0V’.

Figure (6): Transducer cable wiring



All connections to the transducer are intended to be made via the first M20 cable gland (fitted) on the left-hand side, at the bottom of the MSL600 enclosure.

3.5 Power and other electrical connections

(See also section (i), safety precautions)

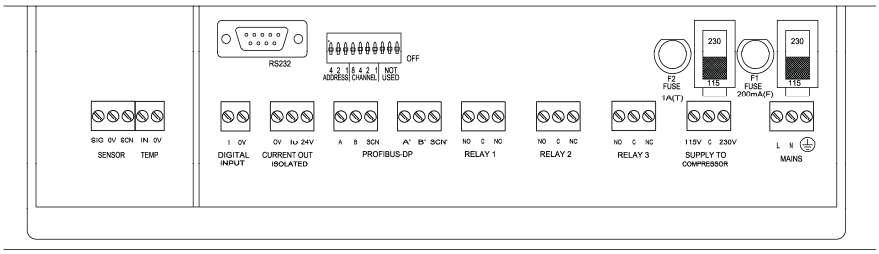
It is the responsibility of the installer to observe all local regulations and approval requirements, and to use cable to suit the environmental requirements of the particular application.
Prior to applying power to the unit ensure that the two voltage selection switches are set to the appropriate voltage for the installation.

In the event of a fuse needing replacement the user must ensure that the mains input fuse (F1) has a rating of 200mA (F) and the cleaning compressor (F2) has a rating of 1A(T).

The diagram below, Figure (7) shows the layout of external connection terminals of the MSL600 with the lower terminal housing cover removed. Table (A) gives a description of each.

Note:
When wiring of the unit is finished, ensure that the terminal housing cover is replaced the correct way up, i.e. with the bevelled edge uppermost otherwise the IP rating of the enclosure may be compromised.

Figure (7): External connection terminals



SENSOR TEMP (see note 1)	
SIG	Transducer sonar signal (white)
0V	Transducer zero volts (black)
SCN	Transducer screen (yellow)
IN	Temperature compensation signal (red)
0V	Temperature zero volts (brown)
DIGITAL INPUT (see note 2)	
1	Digital input signal
0V	Digital input zero volts
CURRENT OUT ISOLATED	
0V	Current output zero
Io	Current out
24V	24V source for current output (Not normally used)
RELAY 1 (de-energised state)	
NO	Normally open
C	Common
NC	Normally closed
RELAY 2 (de-energised state)	
NO	Normally open
C	Common
NC	Normally closed
RELAY 3 (de-energised state)	
NO	Normally open
C	Common
NC	Normally closed
COMPRESSOR (Factory wired)	
115V (White)	115V supply for the cleaning compressor
C (Purple)	Common for the cleaning compressor
230V (Orange)	230V supply for the cleaning compressor
MAINS	
L	Live terminal for mains supply
N	Neutral terminal for mains supply
E	Earth terminal for mains supply

Table (A): Connection descriptions reading from left to right (all via M20 cable glands)

3.6 Cable extension

The transducer is connected using ALPHA XTRA-GUARD4 P/N45272. The standard cable length is 10 metres. This cable comprises of two twisted pairs with an overall screen and drain. The brown and red wires from the transducer should be connected to one twisted pair. The black and white wire from the transducer should be connected to the other twisted pair. The yellow from the transducer should be connected to the drain wire which must be terminated at the screen (SCN) terminal on the PCB.

Fitting instructions for extending the MSL603 transducer cable are in section 14.

Note 1:
The standard 10 metres of cable should be sufficient for most installations. The maximum recommended additional extension is 20m. Use only cable conforming to the specification given above and ensure any connections are made using high grade screened connectors. For suitable specification connectors refer to Mobrey Measurement customer support. It is the responsibility of the installer to ensure that any extension to the cable must be suitable for its working environment.

Note 2:
The digital input, if used must be connected to switch relay contacts which are insulated to IEC6010 category III (4kV impulse) with no exposed live parts.

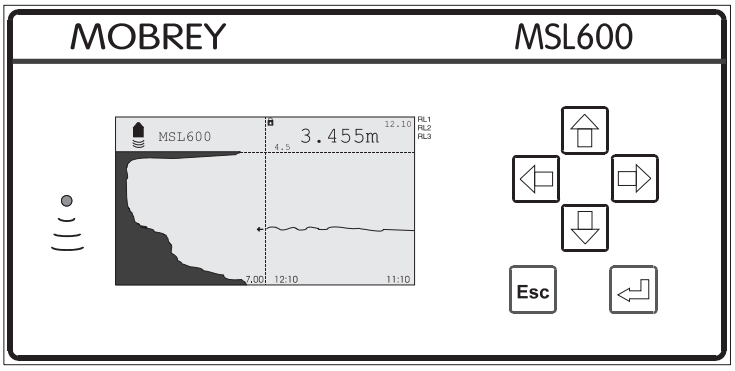
4. Programming

The following sections introduce the main display and use of the keypad (MSL600 only) for programming the MSL600. Password protection to prevent unauthorized access is also discussed.

4.1 Display

The display is a 240 x 128 dot matrix LCD module with full graphics capability and LED back light. The LCD is split into four parts, see Figure (8).

Figure (8): The LCD display layout



- Upper left – In the upper left of the display is an icon representing the transducer and the unit tag number. The tag number is user programmable via the HMI.
- Upper right – The HMI information is displayed in the upper right of the display. The HMI uses 4 lines x 20 characters with each character 7 x 5 dots. In normal operation, the actual blanket level is displayed here.
- Lower left – The lower left of the display shows the sonar echo profile from which the blanket position is determined.
- Lower right – The lower right of the display shows the blanket level trend at minute intervals over the last hour.

When the display is in the normal mode, trending is active and the ← and → keys enable the user to view the last 12 hours of data, an hour at a time backwards and forwards respectively. The views are labelled with their start and finish times. The sonar echo profile recorded at the corresponding start time is also displayed.

After reaching the oldest data the → key is inoperative. Where no data has been recorded there is a gap in the trend line. A zero value is represented by a line a single-pixel thick. Pressing Esc returns to the real time normal display.

Note: Do not confuse this trending with data logging which is discussed in more detail later.

The LCD has a back light for operator convenience. This has one of 3 modes selectable using the HMI:

- On permanently unless internal temperature too high, in which case automatically off.
- Off permanently unless internal temperature is too low, in which case automatically on.
- Auto - i.e. off until keypad is actuated, in which case on and stay on for, typically, 5 minutes - on for only 10 seconds if internal temperature too high.

The LCD on the MSL600 is supplemented by a single red LED which indicates the health of the unit. The LED flashes every 2 seconds (½Hz) to indicate normal operation, whilst a steady illumination or no illumination indicates a problem.

4.2 Contrast (viewing angle) control

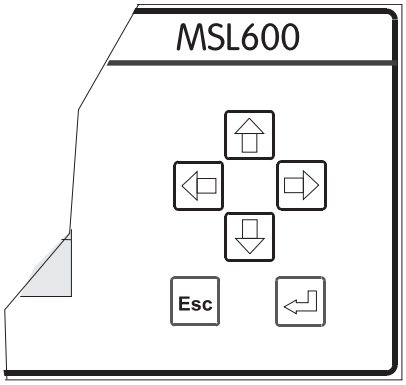
When the system is making measurements in normal mode the screen contrast or viewing angle can be adjusted. Whilst holding down the Esc key press either the ↑ or ↓ key

Esc and - increases (darkens) the contrast and Esc and ↓ decreases (lightens) the contrast.

4.3 Keypad and Menu Navigation

Data entry and interrogation is normally achieved using the integral membrane keypad on the MSL600 front panel, see Figure (9).

Figure (9): Keypad layout



The keypad comprises 6 keys:

- Cursor keys (↑,↓,←,→)
- Enter key (↵)
- Escape key (Esc)

The four arrow keys allow navigation around the HMI menu structure and the Esc and ↵ keys allow movement from one menu level to the next. Each time a key is pressed an audible “beep” is heard. This “beep” can be turned off via the HMI if required.

To access the main menu (from the normal display, see section 4.1) press ↵.

To access a menu option, highlight the option using the ↑,↓ keys and press ↵.

To change a parameter the padlock in the on line/off line menu must be open. This is done by highlighting “Go off Line” in the main menu and pressing ↵. Press ↵ again and the padlock will open. Press ↵ again and the padlock will close.

By pressing Esc repeatedly, the screen will always return to the normal display. Alternatively, pressing and holding Esc for a few seconds will result in jumping straight back to the Main Menu screen.

If any key other than Esc is held pressed for more than 1 second then it auto repeats. This is particularly useful for fast scrolling through parameters. Although the display does not show every parameter whilst fast scrolling (it is only refreshed every 500ms), the key beep (if enabled) is actuated for each parameter.

Movement through the menu structure using the arrows is shown by the titles being highlighted and flashing, i.e. reversed to showing clear letters on a black background and vice versa. Pressing ↵ with the title highlighted enters that part of the menu.

4.4 Security

The HMI includes a password system which may be used to protect parameters from unauthorised changes and also to prevent the system from being switched between On and Off-line mode.

The password is in the form of a 4-digit code (or PIN). When the user has entered the correct PIN then the password is said to be open (else closed). The PIN is a 4-digit code, value 0000 to 9999.

Once the password is open then all parameters may be edited.

A PIN of 0000 means that the password is disabled, i.e. no password is required to edit parameters.

Examining the PIN locally shows "- - - -" unless set to 0000.

When prompting for entering of PIN, the display shows "- - - -".

A PIN is set or entered by scrolling each of the 4 digits using the ← and → arrows to select the digit and ↑ and ↓ arrows to select the value for each digit.

No PIN is required to navigate the menus or to simply examine parameter values.

Attempting to change a parameter value prompts for the entering of the PIN (if it is not already open). If the parameter affects outputs, and if On-line, then after entering the PIN the user is offered go Off-line.

If the password is open then the main menu offers the option "Cancel Password" as the default (highest priority) option. Closing the password does not affect the On line/Off-line status.

The password is automatically closed after 5 minutes without any key press; this does not affect the On line/Off-line status.

4.5 On-line/Off-line

This feature allows the MSL600 outputs, i.e. its relays and current output to be frozen. Also, when On-line, the editing of all parameters which may affect these outputs is inhibited.

Off-line inhibits relays and current output.

On-line inhibits the editing of all parameters that may affect the outputs. These include relay, current output and alarm parameters.

The On line/Off-line state is shown by the padlock symbol at the top left-hand corner of the HMI display (padlock closed represents On-line).

Go On line/Off-line by selecting the appropriate item in the main menu. As the mode is toggled, a large image of the Padlock symbol opens and closes. Attempting to edit any parameter can only be performed with the unit Off-line.

If the system password is closed then the system will prompt for a password, once correctly entered then it changes as requested.

NOTE: There is no time-out on On-line or Off-line.

5. Quick start parameters

The system leaves the factory with default values in all the parameters. These values, after installation, allow immediate operation without any further programming. However, it is recommended for best operation that the following parameters should be programmed.

In order to get meaningful measurements from the MSL600 in the minimum time only the following parameters need to be adjusted.

5.1 Tank depth - Bottom reference

An accurate knowledge of the tank depth is a key parameter for the system.

The tank depth is the distance from the front face of the transducer to the bottom of the tank directly under the transducer [see Figure (10)]. Where the tank bottom slopes, as is often the case, the sludge blanket level, Xm indicated by the system is therefore relative to this zero reference level.

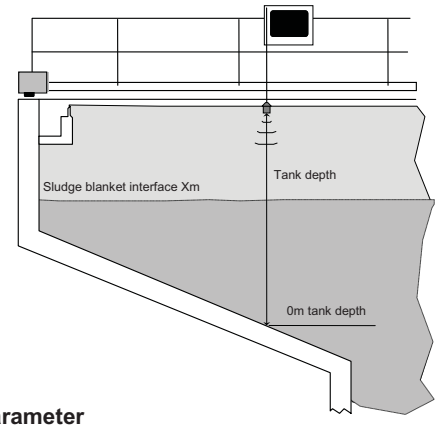


Figure (10): Tank depth parameter

The maximum tank depth that the system will measure is 7.000m (23.00 feet), the minimum is 1.000m (3.3 feet), do not confuse this with the transducer blanking distance which is discussed elsewhere and is 0.3m (1 foot) by default.

The tank depth value is stored in the system and used in subsequent calculations. The factory default is 7.000m (23.00 feet), corresponding to the maximum depth of tank for which the system is specified.

When the unit is powered on for the first time the system makes measurements using this default. It will be obvious that until the user enters a measured value certain functions, such as current output and displayed blanket level will not be correct for the installation.

5.2 Determination of tank depth

The ultimate blanket level measurement accuracy depends upon the accuracy of the value entered for the tank depth. It is always recommended that this be determined for every installation by the user using a measuring rod or similar. Alternatively, the user can obtain a workable estimate of the tank depth by adjusting the tank depth value Off line using the HMI and positioning the bottom echo at the bottom of the profile display.

This only works if a bottom echo is visible and the user must be sure that the echo he is positioning does actually correspond to the tank bottom. To do this, follow the procedure below:

1. From the normal display, press ↵.
2. The main menu will appear on the upper right of the display.
3. Highlight the Go Off line menu option and press ↵. The padlock will open.
4. Press Esc to return to the main menu.
5. Use the ↑ and ↓ keys highlight the INSTALLATION menu option and press ↵.
6. Highlight the Tank depth option and press ↵.
7. To edit the depth press ↵.
8. Use the ↑ and ↓ keys to increment and decrement the highlighted digit.
9. Use the ← and → keys to move from one digit to the next.
10. When editing has finished press ↵ to save the value.
11. The large echo (in most cases this represents the bottom of the tank that the transducer is positioned over) on the lower left display will move.
12. Repeat steps 7 to 11 as necessary.
13. When this echo appears at the bottom of the display the tank depth is set.
14. ESC to return to main menu.

Please note that to avoid confusing echoes this procedure should be carried out when there is no significant sludge blanket in the tank.

5.3 Transducer self-cleaning

The transducer self-cleaning is pre-programmed for optimal performance. However, the cleaning cycle can be changed by following the procedure set out below.

In order to access the transducer cleaning parameters follow the following programming sequence:

1. Press ↵ to access the main menu.
2. The main menu will appear on the upper right of the display.
3. Highlight the Go Off line menu option and press ↵. The padlock will open.
4. Press Esc to return to the main menu.
5. Use the ↑ and ↓ keys to highlight the SETUP menu option and press ↵.
6. Highlight the DUTY (mode) menu option and press ↵.
7. Highlight the CLEANING menu option and press ↵.
8. Highlight the Start On menu option and press ↵.
9. Use the ↑ and ↓ keys to highlight the required option and press ↵.

Three options are available;

- Auto Clean - This is the default option and means that the MSL600 will automatically carry out a cleaning cycle for 10 seconds on the hour every hour.
- Manual 5s - This allows the user to manually activate a 5 second cleaning cycle at any time after which the cycle returns to its previous setting (note, the unit must be on line to carry out this process).
- Off - The unit will not perform any cleaning cycles.

5.4 mA current output parameters

The operation of the current output is programmed by four parameters and is always controlled by the sludge blanket level.

The current output parameters are found in SETUP – OUTPUT – CURRENT OUTPUT.

The parameters are as follows:

- Low range val (Lower range value)

  This parameter allows the user to reference the programmed minimum current output (0 or 4mA) to any point in the programmed blanket level measurement range.
  The default condition is that the programmed minimum current corresponds to 0m (0 feet), the tank bottom.

- Up range val (Upper range value)

  This parameter allows the user to reference the maximum 20mA current output to any point in the programmed blanket level measurement range.

  The default condition is that 20mA corresponds automatically to the programmed tank depth parameter less the top blanking distance. This level is programmed by the tank depth parameter which by default is set to be 7.000m (23.00 feet). The 20mA level for default settings therefore corresponds to a sludge blanket level of 6.7m (22.1 feet)

- Alarm action

  This parameter is selectable from a list and determines the action to be taken by the current output under alarm conditions.

  The allowed actions are:
  - Go to 3.6mA
  - Go to 21mA
  - Hold last reading

- 0/4-20mA (0-20mA or 4-20mA setting)

  This parameter sets the current output range from a list to be either 0-20 or 4-20mA.

5.5 Current output adjust

The current output is calibrated in the factory and should not require any adjustment.

However, if required, it is possible to adjust the 4mA and 20mA points using a calibrated meter. This is done by following the procedure detailed below:

1. Connect a milliammeter to the terminal block marked CURRENT OUT ISOLATED between the 0V and the I_O connections.
2. Put the system off line so that the ‘Go Off line?’ padlock is open.
3. Access the SETUP – SYSTEM – TEST – CURRENT OUTPUT menu.
4. Select either the “4mA out adjust” or the “20mA out adjust” and press ↵.
5. Read the actual current on the calibrated meter.
6. Enter this value in the chosen parameter and press ↵.
7. Check that the actual current is now exactly 4mA or 20mA.

For diagnostic purposes the current output can be driven to any value between 4mA and 20mA by accessing SETUP – SYSTEM – TEST – CURRENT OUTPUT – Set current.

With a suitable meter connected to the current output terminals a value can programmed on the control unit and the same value will appear on the meter.

This programmed current will remain until the ‘Go On line?’ padlock is closed.

5.6 Relay parameters

The MSL600 offers various options for operating its relays. There are 2 relays that are programmable to different modes, these modes are:

- Alarm
- Set point operation
- De-sludge
- On
- Off
- None
- Fault
- Slg Lev Limits (Sludge Level Limits)

The mode of operation is selected through the SETUP – OUTPUT – RELAY – Relay Mode menu.

The default mode for Relay 1 is set point operation and for Relay 2 default mode is alarm. Relay 3 is permanently assigned to fault mode (see section 7.6 for further details).

5.7 Alarm

There are six different alarm conditions in the SETUP - OUTPUT - ALARM menu. Each alarm condition can be set to operate a relay, or drive the current output, or both, or neither to the following states:

- Current output – 3.6mA, 21mA or Hold as defined in “Alarm action” in the CURRENT OUTPUT menu.
- Relay outputs – The relays energise in the alarm condition if they are programmed in Alarm mode.

The relays or current output must be set up for alarm action for this function to operate. The available alarm actions are shown in the list below:

- Out of limits
- Current saturated
- Memory filling
- Digital Input
- Max Retries
- Xdr tilted
- Dirty supernatant
- Noise Alarm

5.8 Transducer out-of-water time

Certain installations make use of a picket fence thickener or a variety of rotating scrappers and scum boards. These rotating arms at the surface of the liquid will periodically lift the articulated transducer out of the liquid as they sweep by.

The transducer includes a (non-mercury) mechanical tilt switch. This is used to indicate when the transducer is being tilted and lifted out of the water. The MSL600 uses this information to determine whether valid sonar echo profile data is being received. If not then measurement will pause and outputs will be held until the arm is vertical again.

When the transducer is tilted a timer is started. The time for which the transducer has been tilted is compared to a maximum allowed value, programmed by the user. If this time is exceeded then an alarm condition can be flagged. It is possible to program an alarm relay to respond to this flag. This is intended to detect problems if the fence should stop under the transducer, etc. The time for which the transducer has been tilted is available as a Monitor readings parameter (D833).

When the arm returns to the vertical the timer is re-set to zero and if allocated the alarm cancelled.

If the transducer has been out of water for greater than the time allowed then its temperature may be significantly different to that of the supernatant.

The transducer may take up to 1 hour to reach thermal equilibrium. Therefore, it may take some time to restore accurate blanket level readings. When the arm tilts out of the supernatant the MSL600 holds the last supernatant temperature reading from the transducer. When the transducer falls back into the supernatant the MSL600 starts to make measurements again.

When the MSL600 measures the supernatant temperature at the transducer, as long as the temperature is within the programmed normal limits for a supernatant then the system uses this measured temperature for speed of sound compensation.

If the measured temperature is outside of these limits then the MSL600 uses the last held temperature reading. This state will continue until a valid temperature reading is again obtained from the transducer in the supernatant.

The upper and lower temperature points are programmable as HMI Engineering parameters. The default values are -5 to +40°C (23 to 104 deg F). The lower temperature should always be less than the upper and valid entries should be limited to temperatures between -40°C and +85°C (-40 to 185 deg F).

Because the tilt switch is sensitive to vibration as well as angle it is de-bounced in software. An engineering parameter exists in the HMI to allow this function to be turned on and off, in the case of for example a particularly vibration prone bridge.

5.9 Digital input

Parameter P340 is used to assign the status of the digital input to an alarm relay if desired. This allows the user to stop measurement whilst the blanket is known to be disturbed and meaningful results would not be obtained. E.g. during high in-flow or when top water level falls below the transducer face and normal measurements can't be performed.

When the digital input is active all measurements continue as normal and the LED still flashes. The sonar pulse echo display continues to update with live data. However, the blanket level is held at its last value. The trend graph continues to update, relays and current output remain active, and logging continues using the held blanket level.

Digital input active means either a short across the terminals, i.e. from a contact closure or a PLC driving low, i.e. going to '0'.

6. Detailed operation

The following sections go into programming the system in more detail.

6.1 The menu structure

From the normal display, pressing the ↵ key will enter the menu system, see Figure (11). A full menu structure is shown in section 11.

Main menu item

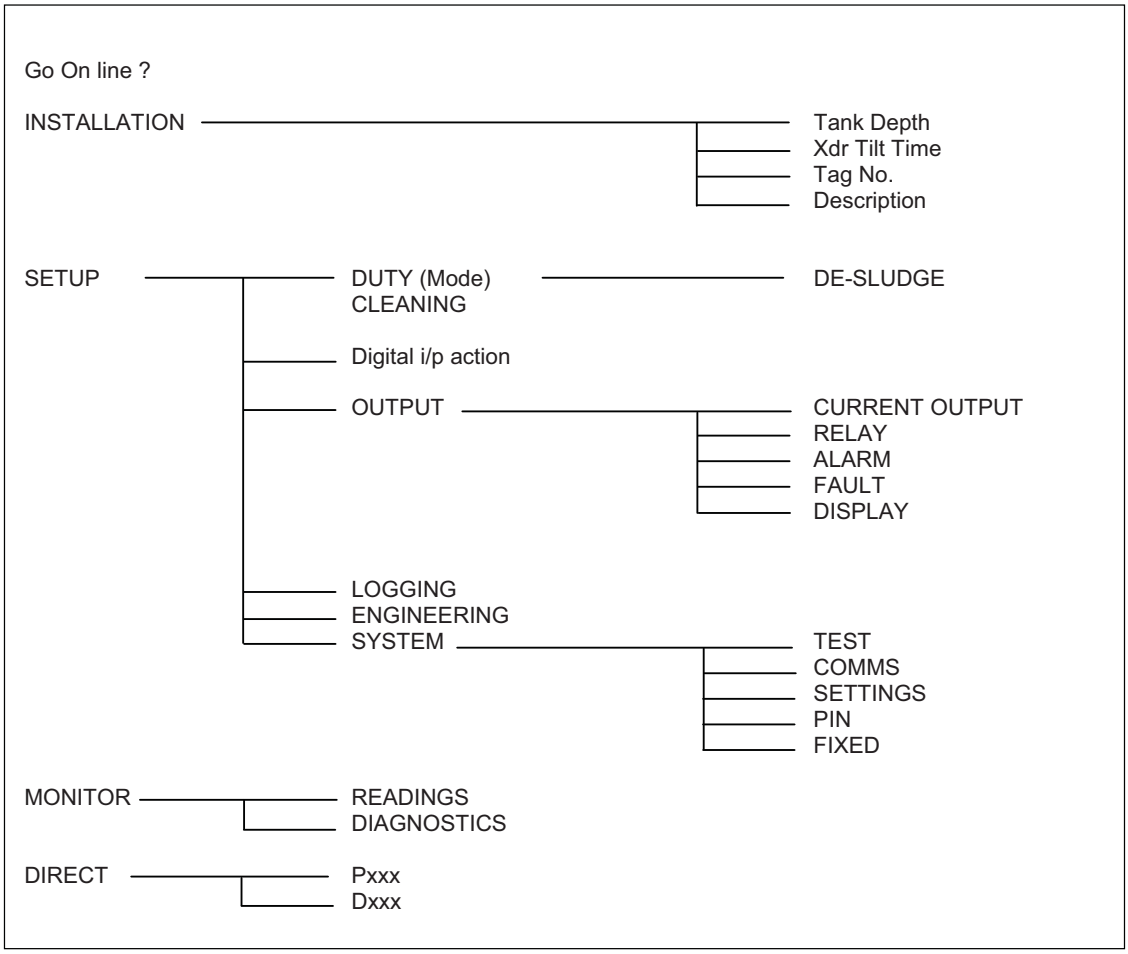


Figure (11): Menu structure

The top-level menu contains the list of available menu items:

Menu Item	Description
Go On-line *(Go off-line)*	Allows programming when off line
INSTALLATION	Installation parameters
SETUP	Setup parameters
MONITOR	Diagnostic and performance type parameters
DIRECT	Allows direct access to parameters

To move up and down the list, use the ↑ and ↓ arrows until the required menu item is highlighted, then use the ↵ key to enter that menu option.

The presence of additional menu items off the screen is indicated by up and down arrows on the right hand side of the display.

The next level of the menu is then displayed and the required option can again be selected as above.

6.2 Parameter editing

Once the required parameter is displayed, select it and press the ↵ key (note that menu groups are in upper case letters, parameters are in upper and lower case).

Note also that there are two parameter types:

- Read/Write - these parameters are normally preceded by a “P” - e.g. P200. They may be modified by the user.
- Read Only - these parameters are normally preceded by a “D” - e.g. D800. They are either fixed within the MSL600 or produced by data processing and thus may not be modified by the user. Examples are Software Revision and Serial Number.

The desired parameter may now be modified. Numeric values are edited one digit at a time, the ← and → keys select each digit by highlighting them and the ↑ and ↓ keys increment and decrement each digit.

Alternatively, some parameters are in the form of a list. These are edited in a similar way, selecting with the ↵ key and using the ↑ and ↓ keys to scroll through the list.

When the displayed value is correct, press the ↵ key to store the value.

6.3 Scrolling

When a parameter is displayed but no digit is highlighted, the ↑ and ↓ keys will scroll to the next parameter in numeric order. This provides an alternative method of accessing parameters without using the menu facility.

6.4 Direct access

It is possible to access the parameters directly from the main menu if the parameter number is known.

From the normal display press the ↵ key to display the main menu on the top right hand side of the display.

Use the arrow keys to scroll down until the menu option DIRECT is highlighted and press the ↵ key.

Highlight either Pxxx or Dxxx
(Pxxx are user configurable parameters and Dxxx are non-configurable diagnostic parameters).

Enter the parameter number to be edited and press ↵.

If an invalid number is entered then the next lowest parameter is displayed.

7. Application parameters

The following section details each parameter.

7.1 Main menu parameters

The following functions are available at the top level of the menu structure.

Note: A full menu structure is shown in section 11.

7.1.1 Cancel password

This is a dynamic parameter; it only appears when password has been opened. This parameter allows the user to cancel the need for password entry before access to parameter editing is allowed.

7.1.2 Go Online/Offline

This is a dynamic parameter; it changes according to whether the system is online or offline. The padlock icon will be displayed in a corresponding open or closed state.

7.2 Installation parameters

The following parameters are intended primarily for use during system installation.

7.2.1 Tank Depth – P101

The tank depth is the distance from the front face of the transducer to the bottom of the tank directly under the transducer and is the user programmable range for zero blanket level.

Parameter values (Metric)			**Parameter values (Imperial)**		
Default	**Min**	**Max**	**Default**	**Min**	**Max**
7.000m	1.000m	7.000m	23.00 ft	3.30 ft	23.00 ft

7.2.2 Xdr Tilt Time – P103

This is the maximum time for which transducer can be out of the water before the system registers a fault.
The parameter is either disabled by entering a value of zero or programmed with a value in minutes.
The default is a value of 0 minutes, disabled.

Parameter values:

Default	**Min**	**Max**
0 (Disabled)	1	15

7.2.3 Tag No. – P242

This is a user defined alpha-numeric parameter. Any string up to 8 characters long may be entered using the keypad. This will usually correspond to the instrument's asset number or some other such identifier on the user's schedule.

The following characters are allowed:

!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_

Parameter values:

Default	**Min**	**Max**
MSL600	-	-

7.2.4 Description – P240

This is a user defined alpha-numeric parameter. Any string up to 12 characters long may be entered using the keypad. This will usually be a description of the application.

The following characters are allowed:

!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_

Parameter values:

Default	Min	Max
CLARIFIER1	-	-

7.3 De-sludge parameters

The following parameters relate to the de-sludge function and are found in the setup menu.

Note that minimum and maximum parameters relating to time are 00:00 and 23:59 respectively. Minimum and maximum parameters relating to sludge level are 0.000 to 7.000m (0.00 to 23.00 feet)

Note: A full menu structure is shown in section 11.

7.3.1 Start On - P250

Use this parameter to select how the de-sludge cycle starts.

The selectable options are:

- None
- Time
- Sludge Level

The parameter defaults to "None" which means it is not used.

Parameter values:

Default	Min	Max
None	-	-

7.3.2 Stop On - P251

Use this parameter to select how the de-sludge cycle stops.

The selectable options are:

- None
- Time
- Sludge Level

The parameter defaults to "None" which means it is not used.

Parameter values:

Default	Min	Max
None	-	-

7.3.3 Stop If - P252

Use this parameter to select if it is necessary to override the “Stop on” condition.

The selectable options are:

- Not used
- Sludge Level

The parameter defaults to none which means it is not used.

Parameter values:

Default	Min	Max
None	-	-

7.3.4 Start Time - P253

This is the time of the day at which the first de-sludge operation starts. The time is programmed in hours and minutes. This parameter is set up in conjunction with the de-sludge Interval P254.

Parameter values:

Default	Min	Max
07:00	-	-

7.3.5 Interval - P254

The parameter is the interval between de-sludge events.

After a start time has been programmed, the interval between each de-sludge needs to be programmed.
For example, if it is required that the de-sludge cycle starts at 7:00am each morning then 07:00 is entered in P253.
If it is then required that a de-sludge cycle is carried out every hour thereafter, 01:00 is entered in P254.

Parameter values:

Default	Min	Max
01:00	-	-

7.3.6 Max Retries - P257

This parameter is the maximum number of retries allowed following an unsuccessful de-sludge cycle. If the maximum retries is exceeded, and a relay is programmed, and allocated in alarm mode, it can be used to signal this fact.

A retry occurs if the start condition is still present when the stop condition occurs **or** if a relay maximum run time is exceeded and the stop condition has not been reached.

To prevent a relay from remaining on, the relay minimum off time must be programmed (see P415).

Parameter values:

Default	Min	Max
10	0	250

7.4 Cleaning parameters

The following parameter relates to the cleaning function.

Note: A full menu structure is shown in section 11.

7.4.1 Start On - P260

Use this parameter to select how the cleaning cycle starts.

The selectable options are:

- AutoClean
- Manual 5s
- Off

The default is “AutoClean”.

7.4.2 Interval - P264

Use this parameter to programme the interval between cleaning cycles (see also P444 - cleaning duration). This parameter is programmed in hours and minutes.

Default	Min	Max
1:00	0:10	1:39

7.4.3 Cleaning Time - P444

The duration of the cleaning cycle can be programmed in seconds

Default	Min	Max
0:10	0:10	0:20

7.5 mA output parameters

The following parameters are used to program the mA current output.

7.5.1 Lower Range Val - P400

This is the sludge blanket level in metres (or feet if Imperial version) for the minimum mA output, either 0 or 4mA as programmed using P403.

Parameter values (Metric)			Parameter values (Imperial)		
Default	**Min**	**Max**	**Default**	**Min**	**Max**
0.000m	0.000m	7.000m	0.00 ft	0.00 ft	23.00 ft

7.5.2 Upper Range Val - P401

This is the sludge blanket level in metres (or feet if Imperial version) for the maximum mA output. This value is by default set to "Auto".

Parameter values (Metric)			Parameter values (Imperial)		
Default	**Min**	**Max**	**Default**	**Min**	**Max**
Auto	0.000m	7.000m	Auto	0.00 ft	23.00 ft

Note: In the case of the default setting the upper limit is defined as being at the programmed transducer blanking distance P623 from the front of the transducer face.

7.5.3 Alarm Action - P402

This parameter is used to select the desired action which is taken by the mA output when the system is in an alarm condition.

The allowed options are:

- Go to 3.6mA
- Go to 21mA
- Hold (last reading)

The default action is to go to 3.6mA.

7.5.4 0/4-20mA - P403

This parameter is used to select the desired range of the mA output from a list.

The allowed options are:

- 0-20mA
- 4-20mA

The default is 4-20mA.

7.6 Relay parameters

The following parameters are used to program the 2 available relays RL1 and RL2, which are controlled by the sludge blanket level. The mode of relay RL3 is fixed to fault indication.

Note: A full menu structure is shown in section 11.

P	RL1	RL2
Mode	410	420
On Point	411	421
Off Point	412	422
Min ON	413	423
Max ON	414	424
Min OFF	415	425

Table (B): Relay Parameter numbers

7.6.1 Relay RL1 mode (P410) and RL2 mode (P420)

The mode of operation, or function, of the relay can be selected from a list:

7.6.1.1 Alarm mode (relay RL1 and RL2 parameters P540 to 552)

There are several alarms which can be assigned to a relay. When an alarm condition occurs it may be signalled by relay, current, both relay and current, or not at all. Alarm conditions are listed below:

- Out of Limits - P540

  The sludge blanket level is outside the limits set in the relay on and off point parameters

- mA o/p Sat. (Current Saturated) - P541

  The current output is outside the limits set in the current output parameters.

- Memory Filling - P542

  The logging memory is filling. This alarm condition is activated when the remaining memory is less than the percentage programmed by the user in ‘Low Mem Alarm’ P593.

- Digital Input - P543

  If the digital input is active then the relay indicates alarms.

- Max Retries - P544

  If at the end of a de-sludge operation the start condition is still present for a programmed number of retries then the relay alarms.

- Xdr Tilted - P550

  An alarm can be activated after the transducer has been out of water for a user-programmed length of time.

- Dirty S-nat - P551

  If the supernatant gives a high degree of returned echo (indicating a significant number of suspended particles) then an alarm can be activated.

- Noise Alarm - P552

  An alarm is activated if the background noise exceeds the pre-set limit set in parameter P622.

7.6.1.2 Fault mode (relay RL1 and RL2 parameters P560 to P570)

There are several fault conditions which can be assigned to a relay. Fault conditions may be selected to be signalled by relay, current, both relay and current, or not at all.

Messages describing active faults are automatically written to the lower HMI display.

When a fault condition occurs, a relay configured in fault mode will de-energise. Fault conditions are listed below:

- Memory Fault - P560

  A memory fault occurs if system memory has been corrupted. On occasion the control unit may indicate a memory fault when first powered up. This is normal because the unit is automatically loading default settings in to the memory. After the first power up this fault message should not occur again. All control units are first powered up prior to leaving the factory. If the memory fault message appears after the unit has been switched on and off at least once then consult the factory.

- CU Temp Fault - P561

  A fault is indicated if the temperature within the control unit exceeds pre-set limits.

- Xdr Temp Fault - P563

  A fault is indicated if the temperature within the transducer unit exceeds pre-set limits.

7.6.1.3 Set point mode (relay RL1 and RL2)

The relays can be operated in set point mode. See also section 7.6.2.

For example:
If it is required to turn a pump on using relay 1 when the sludge blanket reaches a depth of 3.5m (11.5 ft), then 3.5 (11.5) is programmed in to P411 (RL1 on point).

Note:
It is advisable that the "On" and "Off" points are always set to different values, nominally 50mm (2 in/0.16ft) apart.

7.6.1.4 De-sludge mode (relay RL1 and RL2)

The relay can be programmed to operate in de-sludge mode. The de-sludge parameters are described in section 7.3 of the manual.

7.6.1.5 On mode (relay RL1 and RL2)

The relays can be switched permanently on if required.

7.6.1.6 Off mode (relay RL1 and RL2)

The relays can be switched permanently off if required.

7.6.1.7 None mode (relay RL1 and RL2)

If the relay mode is set to "None" then the relay remains in its last valid state i.e. if the relay is "On" and the mode is changed to "None", the relay remains "On".

7.6.1.8 Sludge Level Limits mode (relay RL1 and RL2)

If the relay mode is set to Slg Lev Limits, the relay is energised above the Relay On point. It is also energised below the Relay Off point. However, the relay is de-energised in between the "On" and "Off" points.

7.6.1.9 Temperature Over Limits mode (relay RL1 and RL2)

If the relay mode is set to Temp OL, the relay is energised above the minimum and maximum control unit operating temperatures. The relay is de-energised while temperatures are within the normal operating range.

7.6.2 Relay On and Off Points

Relay On Point for RL1 (P411) and RL2 (P421)

This is the sludge blanket level at which the Set Point mode relay turns on i.e. between 0.000 and 7.000m (0.00 to 23.00 ft). See also section 7.6.1.3 for related information.

Relay OFF Point for RL1 (P412) and RL2 (P422)

This is the sludge blanket level at which the Set Point mode relay turns off i.e. between 0.000 and 7.000m (0.00 to 23.00 ft). See also section 7.6.1.3 for related information.

7.6.3 Relay overrides (Min ON, Max ON, and Min OFF)

Relay minimum on time (Min ON) for RL1 (P413) and RL2 (P423)

This is the minimum time for which the relay will remain on in non-alarm or fault modes. This takes priority over the maximum on time. It is important to note that this function only operates when the minimum off time is set to a non-zero value. This parameter can be set between 00:00 and 99.59 in mm:ss.

Relay maximum on time Max ON for RL1 (P414) and RL2 (P424)

This is the maximum time for which the relay will remain on in non-alarm or fault modes. It is important to note that this function only operates when the minimum off time is set to a non-zero value. This parameter can be set between 00:00 and 99.59 in mm:ss.

Relay minimum off time Min OFF for RL1 (P415) and RL2 (P425)

Once the relay has turned off this is the minimum time before the relay will turn on again. If both minimum and maximum on times are set to zero (default) then they are not used. This parameter can be set between 00:00 and 99.59 in mm:ss.

7.7 Display parameters (HMI)

7.7.1 HMI upper, middle, and lower display options

The top right hand section of the main display, the HMI, can be adjusted to suit your requirements.
The HMI display is split into three regions:

1. Display Upper - P570 (Default – Time)
2. Display Middle - P571 (Default – Sludge level)
3. Display Lower - P572 (default – Date)

What is displayed in these sections is selected from a list as follows:

- Time
- Rad msg count
- None
- Sludge Level
- Range
- % mA Output
- mA Output
- RL1 run-time
- RL2 run-time
- Clean run-time
- Internal Temp
- Xducer Temp
- Noise level
- % Free Lg Mem
- Description
- Tag
- Date

Note: The current output and relays are always controlled by sludge level regardless of display selection.

7.7.2 Backlight On/Off - P575

The default for the display back light is "Auto". It can be switched to "Off" or "On". If set to Auto it is on when a key is pressed. The back light will automatically turn off after 5 minutes or if the internal temperature is too high and exceeds its programmed limits. It will turn on if the internal controller temperature is too low and is less than the programmed limit.

7.7.3 Clear Trend

The lower right of the display shows a trend of the sludge blanket position over the last 12 hours. Pressing ↵ when in the Clear Trend menu will clear this trend information. When the data is cleared the unit indicates this by displaying 'Done'. This does NOT clear logged data.

7.7.4 Clear Profile

The lower left of the display shows a profile of the sludge blanket. Pressing ↵ when in the Clear Profile menu will clear this information. When the data is cleared the unit indicates this by displaying 'Done'

7.8 Logging parameters

Logged data can be downloaded and analysed via the RS232 port and Mobrey Measurement Log View Software (via a PC). For copies of this software, please contact Mobrey Measurement Sales.

Note: A full menu structure is shown in section 11.

7.8.1 Log Interval - P590

The MSL600 can log the value (not the units) of the parameter that is shown on the middle of the HMI Display. The MSL600 can store up to 4800 records. The interval between each record being stored is programmed in minutes in P590, the Logging interval. The unit takes a reading every 5 seconds and averages the readings over the programmed logging interval.
The unit automatically stores the maximum recorded value that occurred in the previous 24-hour period (from 12 midnight to 12 midnight).

Parameter values:

Default	Min	Max
5	0	99

7.8.2 Fast log - P591

The control unit will automatically override the logging interval and log at a rate of one record per minute when the sludge blanket level is above the level in metres (Feet – Imperial) set in the fast Log parameter. If the parameter is set to zero then fast log is not used.

Parameter values (Metric)

Default	Min	Max
0.000	0.000	7.000

Parameter values (Imperial)

Default	Min	Max
0.000	0.000	23.00

7.8.3 Data Overwrite - P592

If this parameter is set to "On" then old data will be over written when the memory is full. If it is set to "Off" then old data is not over written and the unit stops logging when the memory is full.

Parameter values:

Default	Min	Max
On	Off	-

7.8.4 Low Mem Alarm - P593

An alarm can be activated if the memory reaches this level when set as a % of full memory.

Parameter Values:

Default	Min	Max
0	0	99

7.9 Engineering parameters

The MSL600 blanket echo processing algorithm has been optimised for use on various types of municipal and industrial sludge. The user can select from either of two municipal sludge types depending on the application.

The following parameters have been extensively tested and, once **MUNICIPAL 1** or **MUNICIPAL 2** sludge types have been chosen, the user should not need to adjust them. However, different sludge types have widely varying ultrasonic properties and settling characteristics, therefore the following parameters are adjustable in order that the MSL600 can be set up for different types of sludge.

Note:
It is strongly recommended that if the default parameters do not give reliable operation, or if use on industrial sludge is required, then advice is sought from Mobrey Measurement Customer Support.

7.9.1 Alg. Select – P620

Use this parameter to select an algorithm which is optimised for municipal or industrial sludge.
The allowed options are:

- **Municipal 1** (This covers most Municipal Wastewater applications e.g. Primary and Secondary settlement tanks, Picket fence thickeners)
- **Municipal 2** (This covers Industrial applications such as Industrial effluent final settlement, clarifiers, slurry settlement etc.)

The default is Municipal 1. After selecting the algorithm to use, there are a number of common algorithm parameters which can be adjusted using the HMI.

7.9.2 Common algorithm parameters P621 to P629

Common algorithm parameters affect the way in which both **Municipal 1** and **Municipal 2** algorithms work.

7.9.2.1 Ave. Cyc Count – P621

The number of cycles, in powers of 2 over which the unit will average raw sonar echo profiles to remove any spurious reflections from such things as air bubbles and floating solids.

Since a complete measurement cycle takes 2 seconds then the averaging cycle count can effectively damp the noise over a period between 4 seconds and 2048 seconds(or 34 minutes, which is a substantial proportion of a rotation of most bridges).

The default value is 128 cycles. The minimum is 2 and the maximum is 1024.

Parameter values:

Default	Min	Max
128	2	1024

7.9.2.2 Noise Alrm Lev – P622

The unit automatically monitors the background electronic noise floor as a % of display width, see parameter D834. If this level exceeds the Noise Alarm Lev value, programmed as a % of display width then an alarm can be indicated by allocating an output in P552, Noise Alarm.

The default value is 25%.

Parameter values:

Default	Min	Max
25	0	100

7.9.2.3 Top Blanking – P623

This is the minimum operating range for the transducer in metres (feet – imperial). This parameter allows the user to program a region in front of the transducer which is not used by the system.

This is useful if there are any fixed obstructions in front of the transducer which cannot be moved or otherwise avoided.

This parameter is also useful when programming the industrial algorithm for avoiding floating or settling debris in front of the transducer.

The default value is 0.3 metres / 1 foot.

Parameter values (metric)

Default	Min	Max
0.300	0.100	7.000

Parameter values (imperial)

Default	Min	Max
1.00	0.33	23.00

7.9.2.4 Damping – P624

It is unlikely that the blanket level will change by a large amount on a short time scale. The settling process is typically fairly slow. If the system should want to respond to noise or stray echoes from bubbles or debris this parameter, which is programmed as a time measured in seconds damps out rapid fluctuations in the measured sludge blanket level.

The default value is 60 seconds.

Parameter values:

Default	Min	Max
60	0	9999

7.9.2.5 Upr S-nat Temp – P625

This is the value used for temperature compensation if the measured supernatant temperature should exceed this value. Valid entries are between –35 and +85°C (-30 to 185 deg F).

The default is +40°C (105 deg F)

Parameter values (metric)

Default	Min	Max
40	-35	+85

Parameter values (imperial)

Default	Min	Max
105	-30	185

7.9.2.6 Lwr S-nat Temp – P626

This value is used for temperature compensation if the measured supernatant temperature is below this value. **The lower temperature (P626) must always be less than the upper (P625).**
Valid entries are between –40 and +85°C (-40 to 185 deg F).

The default is -5°C (25 deg F)

Parameter values (metric)			Parameter values (imperial)		
Default	**Min**	**Max**	**Default**	**Min**	**Max**
-5	-40	+85	25	-40	185

7.9.2.7 SoS constant - P627

The speed of sound at 0^{O}C (32 deg F) for a particular supernatant can be programmed in m/s (ft/s imperial).

Default (metric m/s)	Default (imperial ft/s)
1402.0	4599.7

7.9.2.8 Bottom Blanking – P628

This parameter allows the user to program a region close to the bottom of the tank which is not used by the system for normal blanket level measurement.

This is useful if there are any fixed obstructions in front of the transducer close to the bottom of the tank which cannot be moved or otherwise avoided.

The default value is 0.0 metres / 0 foot

Parameter values (metric)			Parameter values (imperial)		
Default	**Min**	**Max**	**Default**	**Min**	**Max**
0.000	0.000	9.999	0.00	0.00	33.00

7.9.2.9 Level Offset – P629

This parameter is used to provide an offset to the normal displayed sludge blanket level (D800). The value may be entered as a positive or negative value to provide the required offset to the normal displayed sludge blanket level.

Default is 0.0.

Parameter values (metric)			Parameter values (imperial)		
Default	**Min**	**Max**	**Default**	**Min**	**Max**
0.0	-0.99	0.99	0.0	-3.0	3.0

7.9.3 Municipal 1 parameters P630 to P637

When the Municipal 1 algorithm is selected using parameter P620 (page 37), only the following specific parameters need to be adjusted.

7.9.3.1 Significance – P630

This parameter is used to select which echo in the echo profile that the Municipal 1 algorithm chooses as the most likely to correspond to the real sludge blanket level.

The algorithm scans the echo profile for echoes. It calculates the mean and standard deviation of amplitudes for these echoes. Depending on the P630 setting, the algorithm can be programmed to select the first significant echo it comes to, measured from the surface of the supernatant **or** the most significant echo it detects in the entire profile.

The allowed options are:
- First
- Most (default)

7.9.3.2 Sharp Echo Reject – P631

Electrical noise and other types of false echo are characteristically shorter in duration than the real echo from a sludge blanket. This parameter allows fine tuning of the value which the municipal algorithm uses as a window width to separate out these echoes.

Note:
This is a key system parameter and should not be adjusted without asking for advice from Mobrey Measurement.

Parameter values:

Default	Min	Max
8	5	30

7.9.3.3 Lost Echo Rnge - P633

The lost echo range is the distance, split equally above and below, that the device will still look for an echo before going to hold last reading as set in lost echo delay (P637).

The parameter P633 is set in number of samples. However, each sample equates to approximately 25mm (1”). Therefore when set with the default value of 24, the device will look for a valid echo in a window 300mm (12”) above and 300mm (12”) below its last valid value. If no valid echo is present, it will hold its last reading for the programmed amount as set in P637.

Parameter values:

Default	Min	Max
24	1	410

7.9.3.4 Threshold – P634

The Municipal 1 algorithm scans the echo profile for echoes. It calculates the mean and standard deviation of amplitudes for these echoes. In order to be significant, the echoes must exceed a threshold value determined in terms of the standard deviation of the echo amplitudes.

The default value is 0.5 standard deviations.

Parameter values:

Default	Min	Max
0.5	0.00	9.99

7.9.3.5 Noise SD Mult – P635

The Municipal 1 algorithm scans the echo profile for echoes. Prior to sending pulses to the transducer, the noise floor is measured. It calculates the mean and standard deviation of fluctuations in the noise floor.

In order to be significant, the echo from a blanket must not only exceed a threshold value determined in terms of the standard deviation of the echo amplitudes (P634) but it must also exceed a threshold value determined in terms of the standard deviation of the noise floor (P635).

The default value is 2.75 standard deviations.

Parameter values:

Default	Min	Max
2.75	0.00	9.99

7.9.3.6 Dirty Mult – P636

It is often the case that the supernatant becomes dirty. In this case, large echoes can be seen directly in front of the transducer that should not necessarily be ignored or blanked out. If the amplitude of these signals is typically above 50% of the screen width, it is likely the supernatant was dirty and an alarm would be helpful in this situation. This can be achieved by programming a relay to operate in alarm mode and setting the alarm condition to Dirty S-nat.

Parameter P636 is used to linearly scale the default threshold of 50%. The default value is a multiplier of 0.5, which represents 50% of the maximum displayable amplitude.

Parameter values:

Default	Min	Max
0.5	0.00	2.00

7.9.3.7 Lost Echo Time - P637

The Municipal 1 algorithm has a facility such that if the echo is lost from a set range (see P633) then the last reading is held for the programmed time. This allows the unit to accommodate any false echoes from targets other than the sludge blanket. In other words, the device is able to recognise that the sludge level does not change rapidly.

The parameter can be set between 1 to 255 minutes

Parameter values:

Default	Min	Max
30	1	255

7.9.4 Municipal 2 parameter P640

Only one specific parameter, P640, needs to be adjusted when the Municipal 2 algorithm is selected.

Industrial blankets are typically much denser and more substantial than municipal sludge found in a conventional wastewater plant. For this reason, the echo profile from an industrial sludge typically only displays one distinct echo.

7.9.4.1 Threshld Offset – P640

The echo from the blanket will produce a signal which is visible above the electronic noise floor on the echo profile display.

The threshold offset parameter is the offset of the threshold which the user wishes to set above the noise floor. Both the noise level, D834 and the threshold offset are expressed as a % of full screen.

The noise level can be viewed as a diagnostic parameter from the monitor menu. The first point in the echo profile which exceeds the threshold level is determined by the algorithm to be at the blanket level.

Remember that;
Threshold level = Threshld Offset (P640) + Noise Level (D834)

When setting this parameter, remember that the echo amplitude can get larger or smaller over a period of time during normal operation of the system. This is because the consistency of the sludge varies with time and position in the settling tank as the bridge rotates over it.

Floating debris close to the transducer can give echoes which will exceed the threshold level. It is suggested that in this case the blanking distance, P623 be extended to include this region in the echo profile.

The default value is 30%.

Parameter values:

Default	Min	Max
30	0	100

7.10 System parameters

These parameters can be used to test the MSL600 hardware.

Note: A full menu structure is shown in section 11.

7.10.1 AUTO CYCLE function

The Auto Cycle or Self-Test function has the effect of automatically ramping up the sludge blanket level value between its minimum and maximum values so as to exercise the current output and relays without the actual blanket level changing.

With the unit On-line, this parameter is accessed via SETUP-SYSTEM-TEST-AUTOCYCLE. Once the menu item AUTOCYCLE is entered press ↵ . The on screen display prompts you to press ↑ to start the AUTOCYCLE.

AUTOCYCLE is stopped by pressing ↑. Press ESC to return to main menu.

A complete cycle is executed in about 100 seconds. It may be paused and re-started using the ↑ arrow key.

During Auto Cycle mode, the MSL600 system continues to measure the blanket level in the background.

On exiting the Auto Cycle mode the sludge blanket level immediately takes on the value based on the MSL600 sensor inputs.

7.10.2 DISPLAY test

This function allows the user to test all the pixels in the MSL600 display.

The Display Test function displays the product name, full software version number, and exercises all pixels. The MSL600 remains in Display Test mode until the Esc key is pressed. The same data, excluding the test pattern, is displayed at power-up.

7.10.3 Current Output test parameters P700 to P702

This function allows the user to test the current output on the MSL600.

7.10.3.1 4mA Out Adjust - P700

The current output is calibrated in the factory and should not require any adjustment. However, if required, it is possible to adjust the 4mA point using a calibrated meter (see section 5.5).

7.10.3.2 20mA Out adjust - P701

The current output is calibrated in the factory and should not require any adjustment. However, if required, it is possible to adjust the 20mA point using a calibrated meter (see section 5.5).

7.10.3.3 Set Current - P702

It is possible to force the current output to a value to check loop equipment. Any value between 0 and 20mA can be programmed (see section 5.5). When the unit is returned to On Line mode the current output reverts to normal.

7.10.4 LOAD DEFAULTS function

The unit can be reset to its factory-default configuration at any time by selecting the Load Defaults menu option. Pressing ↵ loads the default values when in this menu. This action does not change the language setting or the base units selected (metric or imperial).

7.10.5 COMMS parameters P710 to P716

These parameters are used for serial RS232 communications.

7.10.5.1 Address - P710

Poll Address. The default value of this parameter should not be changed. The parameter is included in the menu system for future software updates. **Default = 0**

7.10.5.2 Interface - P711

The type of serial interface. The default value of this parameter should not be changed. The parameter is included in the menu system for future software updates. **Default = log download**

7.10.5.3 Baud Rate - P712

The speed of transfer of the interface in bit/s. The default value of this parameter should not be changed. The parameter is included in the menu system for future software updates. **Default = 9600**

7.10.5.4 Start Bits - P713

The number of start bits. The default value of this parameter should not be changed. The parameter is included in the menu system for future software updates. **Default = 1**

7.10.5.5 Data Bits - P714

The number of data bits between start and parity bit. The default value of this parameter should not be changed. The parameter is included in the menu system for future software updates. **Default = 8**

7.10.5.6 Parity - P715

Whether an even or odd parity check bit has been added. The default value of this parameter should not be changed. The parameter is included in the menu system for future software updates. **Default = even**

7.10.5.7 Stop Bits - P716

The number of stop bits. The default value of this parameter should not be changed. The parameter is included in the menu system for future software updates. **Default = 1**

7.10.6 SETTINGS parameters P730 to P737 and BASE UNITS selection

7.10.6.1 Base units

The user can select either metric units (metres, deg C) or imperial units (Feet, degrees F)

7.10.6.2 Date - P730

The current date is entered here.

7.10.6.3 Time - P731

The current time is entered here.

7.10.6.4 Date format - P734

The format for the date can be chosen from a list:

- yy/mm/dd
- dd/mm/yy (Default metric)
- mm/dd/yy (Default imperial)

7.10.6.5 Keypad Sound - P735

Each time a key is pressed, a beep sounds as confirmation of the key being pressed. This audio feedback can be turned off. The default is on.

7.10.6.6 Language - P737

The HMI default language is English. The user can chose from a list of English, Francais, Deutsch, or Svenska.

7.10.7 PIN parameter P740

7.10.7.1 PIN - Personal Identification Code - P740

The unit can be protected from unauthorised use by programming a PIN. Access is via SETUP – SYSTEM – PIN – PIN. Any four digit numeric characters can be programmed as a PIN. In the PIN menu enter 0000 to remove the password.

Please ensure that the PIN is not forgotten. If the password is forgotten, the factory must be consulted. Please provide the full serial number of the unit which can normally be found on the external label.

7.10.8 FIXED parameters D750 to D753

7.10.8.1 Model Code - D750

The model code of the control unit.

7.10.8.2 Serial No. - D751

The serial number of the control unit.

7.10.8.3 H/W Revision - D752

The hardware revision of the control unit.

7.10.8.4 S/W Version - D753

The software revision. This is displayed to one decimal place. Performing the Display test function (section **Error! Reference source not found.**) will show the full software version.

7.11 Readings and diagnostics parameters

The user can not alter the value of readings or diagnostics parameters within the MONITOR menu.

Note: A full menu structure is shown in section 11.

7.11.1 Readings parameters D800 to D834

7.11.1.1 Sludge Level - D800

The main process variable, the sludge blanket level in metres (feet – imperial).

Note:
If P629 Level offset is being used, this value will be added or subtracted from the normal sludge blanket level and displayed as D800.

7.11.1.2 Target Range - D801

The actual distance from the transducer to the sludge blanket interface in metres (feet – imperial).

7.11.1.3 % Current Output - D805

Indicates % of current output

7.11.1.4 Current Output - D806

The actual current output in mA.

7.11.1.5 Relay Status - D820

This diagnostic parameter indicates the status of all the relays including relay three, the fault relay and relay four, the compressor relay.

The relay status is indicated by a **1** or a **0**. A **1** indicates the relay is energised, a **0** indicates the relay is de-energised.

The display shows the state in the following format: **0000**
Reading from left to right the first 0 is relay 1, the second 0 is relay 2, the third 0 is relay 3 and the fourth 0 is relay 4.

7.11.1.6 RL * Runtime – (RL 1-D821, RL 2-D822, Cleaning time-824)

The total length of time in hours and minutes that a relay has been energised is monitored from this parameter. Entering zero for the hours and minutes will reset the parameter.

7.11.1.7 Alarm Report - D830

When an alarm is detected then it can be viewed by accessing this parameter.

Press ↵ to highlight the first alarm report item. The user can step through the current active alarms using the ↑ and ↓ keys.

7.11.1.8 Fault Report - D831

When a fault is detected then it can be viewed by accessing this parameter. In normal operation, the highest priority active fault condition is also displayed in the lower display. Press ↵ to highlight the first fault report item. The user can scroll through the current active faults using the ↑ and ↓ keys.

7.11.1.9 Xdr Tilt Time - D833

A diagnostic parameter indicating the time for which the transducer has been out of the water in min:secs.

7.11.1.10 Noise Level - D834

A diagnostic parameter indicating the noise level in the tank as a % of full screen.

7.11.2 Diagnostics parameters D835 to D852

7.11.2.1 Input Status - D835

A diagnostic parameter indicating the status of the digital input, 1 indicating active, 0 indicating not active.

7.11.2.2 LE Count – D836

This gives an indication as to reliability of signal.

7.11.2.3 Radio Channel - D842

This parameter is not used with this version of the MSL600.

7.11.2.4 Radio Address - D843

This parameter is not used with this version of the MSL600.

7.11.2.5 CU Temperature (Temperature of Control Unit) - D844

View this parameter to see the current temperature in °C (imperial – degrees F) inside the MSL600 control unit. This temperature is used for control of the LCD back light, turning it on to generate a degree of internal heating in cold weather and off when hot to avoid overheating.

7.11.2.6 Xducer Temp (Temperature of Transducer) - D845

View this parameter to see the current temperature in °C (imperial - degrees F) of the transducer. This temperature is used in the compensation of the speed of sound in the supernatant.

7.11.2.7 Free Memory (Logging Memory Free) - D846

View this parameter to see the amount of MSL600 logging memory remaining as a % before the end of the buffer is reached and over writing at the start begins. This parameter is compatible with Mobrey Measurement Log View software.

7.11.2.8 Date of Change (Last date of Change) - D848

View this parameter to see the date of the last change to the configuration of the MSL600. This parameter can be used to detect unauthorised access.

7.11.2.9 Echo Sharpness – D849

View this parameter to estimate the size of the echo. A typical reading would be between 20 and 30.

7.11.2.10 Speed of Sound - D850

View this parameter to see the temperature compensated speed of sound in the supernatant which the MSL600 is using in its calculation of sludge blanket level in m/s (imperial – ft/s).

7.11.2.11 Max Xdr Temp - D851

View this parameter to see the maximum temperature in °C (imperial – degrees F) which has been experienced by the transducer.

This log is reset by direct entry of a nominal ambient value of 20°C (68 degrees F).

7.11.2.12 Min Xdr Temp - D852

View this parameter to see the minimum temperature in °C (imperial degrees F) that has been experienced by the transducer. This log is reset by direct entry of a nominal ambient value of 20°C (68 degrees F).

8. Technical reference

8.1 Transmit pulse and echo processing

The transducer and it's transmit and receive circuitry is optimized to work at 1.0MHz.

Some sludge blankets are indistinct.

The algorithm has been optimised to average out and ignore unwanted signals produced by particles in the supernatant, whilst detecting and measuring the wanted signals from the sludge blanket.

Although the algorithm is designed to largely ignore particles in the supernatant, the information (size and distance) is retained allowing a warning of this condition to be indicated.

9. Maintenance

The MSL600 should require no maintenance. It has no user serviceable parts inside.

Although the MSL603 transducer should keep its front face clean by self-cleaning the transducer should be inspected periodically to ensure that algae or floating debris is not collecting on its side or transducer face.

10. Troubleshooting

Refer to factory

11. Programming chart

Main Menu Option	Sub-menu Level 1	Sub-menu Level 2	Sub-menu Level 3	Parameter Title	Par No.
Cancel Password (only seen if the password is active)				-	-
Go Offline ?				-	-
INSTALLATION				Tank Depth	P101
				Xdr Tilt Time	P103
				Tag No.	P242
				Description	P240
SETUP	DUTY(Mode)	DESLUDGE		Start On	P250
				Stop On	P251
				Stop If	P252
				Start Time	P253
				Interval	P254
				Max Retries	P257
		CLEANING		Start On	P260
				Interval	P264
				Cleaning Time	P444
				Digital i/p action	P340
	OUTPUT	CURRENT OUTPUT		Low Range Val	P400
				Up Range Val	P401
				Alarm Action	P402
				0/4-20mA	P403
		RELAY	RELAY 1	Relay 1 Mode	P410
				RL1 On Point	P411
				RL1 Off Point	P412
				RL1 Min ON	P413
				RL1 Max ON	P414
				RL1 Min OFF	P415
			RELAY 2	Relay 2 Mode	P420
				RL2 On Point	P421
				RL2 Off Point	P422
				RL2 Min ON	P423
				RL2 Max ON	P424
				RL2 Min OFF	P425
			RELAY 3	Relay 3 Mode	P430
		ALARM		Out of Limits	P540
				mA o/p Sat.	P541
				Memory Filling	P542
				Digital Input	P543
				Max Retries	P544
				Xdr Tilted	P550
				Dirty S-nat	P551
				Noise Alarm	P552
		FAULT		Memory Fault	P560
				CU Temp Fault	P561
				Xdr Temp Fault	P563
		DISPLAY		Display Upper	P570
				Display Middle	P571
				Display Lower	P572
				Backlight On/Off	P575
			Clear Trend	-	-
			Clear Profile	-	-
	LOGGING			Log Interval	P590
				Fast Log	P591
				Data Overwrite	P592
				Low Mem Alarm	P593

Programming chart continued…

	ENGINEERING			Alg. Select	P620
		CONFIG ALGORITHM	COMMON	Ave. Cyc Count	P621
				Noise Alrm Lev	P622
				Top Blanking	P623
				Bottom Blanking	P628
				Damping	P624
				Upr S-nat Temp	P625
				Lwr S-nat Temp	P626
				SoS constant	P627
				Level Offset	P629
			MUNICIPAL 1	Significance	P630
				Sharp Echo Reject	P631
				Lost Echo Rnge	P633
				Threshold	P634
				Noise SD Mult	P635
				Dirty Mult	P636
				Lost Echo Time	P637
			MUNICIPAL 2	Thrshld Offset	P640
	SYSTEM	TEST	AUTO-CYCLE	-	-
			DISPLAY	-	-
			CURRENT OUTPUT	4mA Out Adjust	P700
				20mA Out Adjust	P701
				Set Current	P702
			LOAD DEFAULTS	-	-
		COMMS		Address	P710
				Interface	P711
				Baud Rate	P712
				Start Bits	P713
				Data Bits	P714
				Parity	P715
				Stop Bits	P716
			RADIO	Radio Timeout	P722
				Radio On/Off	P723
		SETTINGS		Base Units	-
				Date	P730
				Time	P731
				Date Format	P734
				Keypad Sound	P735
				Language	P737
				PIN	P740
		FIXED		Model Code	D750
				Serial No.	D751
				H/W Revision	D752
				S/W Version	D753

Programming chart continued…

MONITOR	READINGS			Sludge Level	D800
				Target Range	D801
				% Current Out	D805
				Current Output	D806
		Relay		Relay Status	D820
			Relay Run-time	RL1 Run-Time	D821
				RL2 Run-Time	D822
				Cleaning Time	D824
				Alarm Report	D830
				Fault Report	D831
				Xdr Tilt Time	D833
				Noise Level	D834
	DIAGNOSTICS			Input Status	D835
				CU Temperature	D844
				Xducer Temp	D845
				Free Memory	D846
				Date of Change	D848
				Echo Sharpness	D849
				Speed of Sound	D850
				Max Xdr Temp	D851
				Min Xdr Temp	D852
		RADIO		Radio Msg Count	D853
				Radio STX Count	D854
				Radio Channel	D842
				Radio Address	D843
DIRECT	Pxxx			-	
	Dxxx			-	

Note: The Radio parameters are not used with this version of the MSL600.

12. Specification

12.1 MSL600

Model No.	**MSL600**
Operating principle	Ultrasonic sonar
Range	7.0m (23 feet)
Dead band	0.3m (1 foot)
Accuracy	+/-35mm (+/- 1.4”)
Resolution	25mm (1”)
Temperature limits ^{O}C - Sensor	-40 to +65 (-40 to 150 degrees F)
Temperature limits ^{O}C - Control unit	-20 to +55 (-4 to 130 degrees F)
Temperature compensation	Integral
Power Supply – AC	Switch selected 115 or 230Vac
Power Supply – Hz	50/60Hz
Power rating	140VA
Outputs	
Relays	2 programmable relays 1 fault relay
Analogue	0/4-20mA
Display	LCD 240 x 128 pixels with back light
Communications	RS232
Enclosure	
IP rating	IP66
Material	ABS
Dimensions W x H x D	355 x 237 x 95mm (14 x 9.3 x 3.75 INS) Without compressor housing. See dimensional drawing for full details.
Programming	Via integral membrane keypad
Transducer cleaning method	Compressor driven air cleaning

Weight

Enclosure & compressor housing	7.0 Kg / 15.4 lbs
Transducer & mounting bracket	12.0 Kg / 26.4 lbs
Approvals	CE, LVD, EMC
Max Altitude	2000m
Max Humidity	95% RH
Pollution Degree	2-1EC664

Additional specification notes:

Programming menu using Mobrey HMI.

Sludge blanket level from bottom of the clarifier.

Icon enunciators display the relay status.

The display gives a graphical presentation of sludge profile through the clarifier.

A trend graph indicates the sludge level for the last 12 hour(s).

The MSL600 has a single red LED to indicate power on. This LED flashes on as the transducer pulses. Continuous On = fault

12.2 MSL603 transducer

IP Rating	IP68 / Type 6P
Material	Ceramic face, PTFE nozzle, UPVC body
Cable	Alpha xtra-guard 4 P/N 45272, 10 metres

13. Dimensional drawings

Figure (12): MSL600 Bridge mounted unit

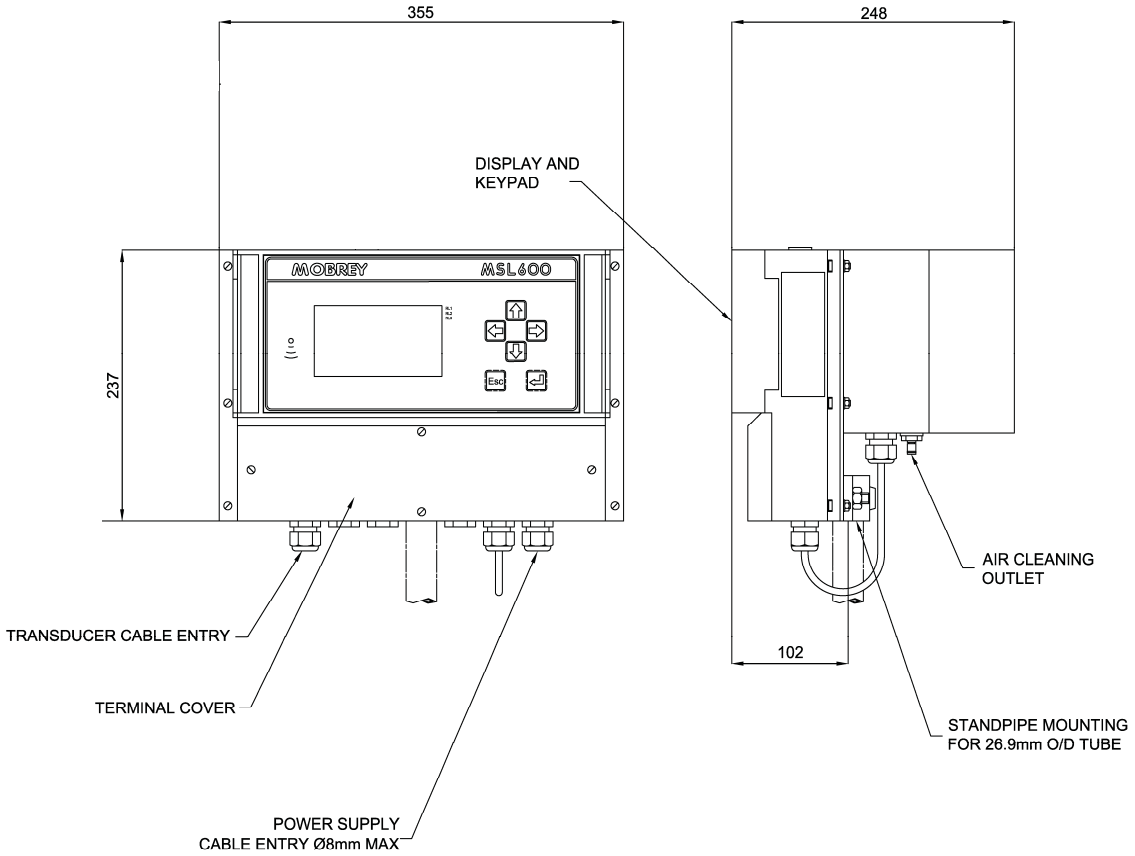
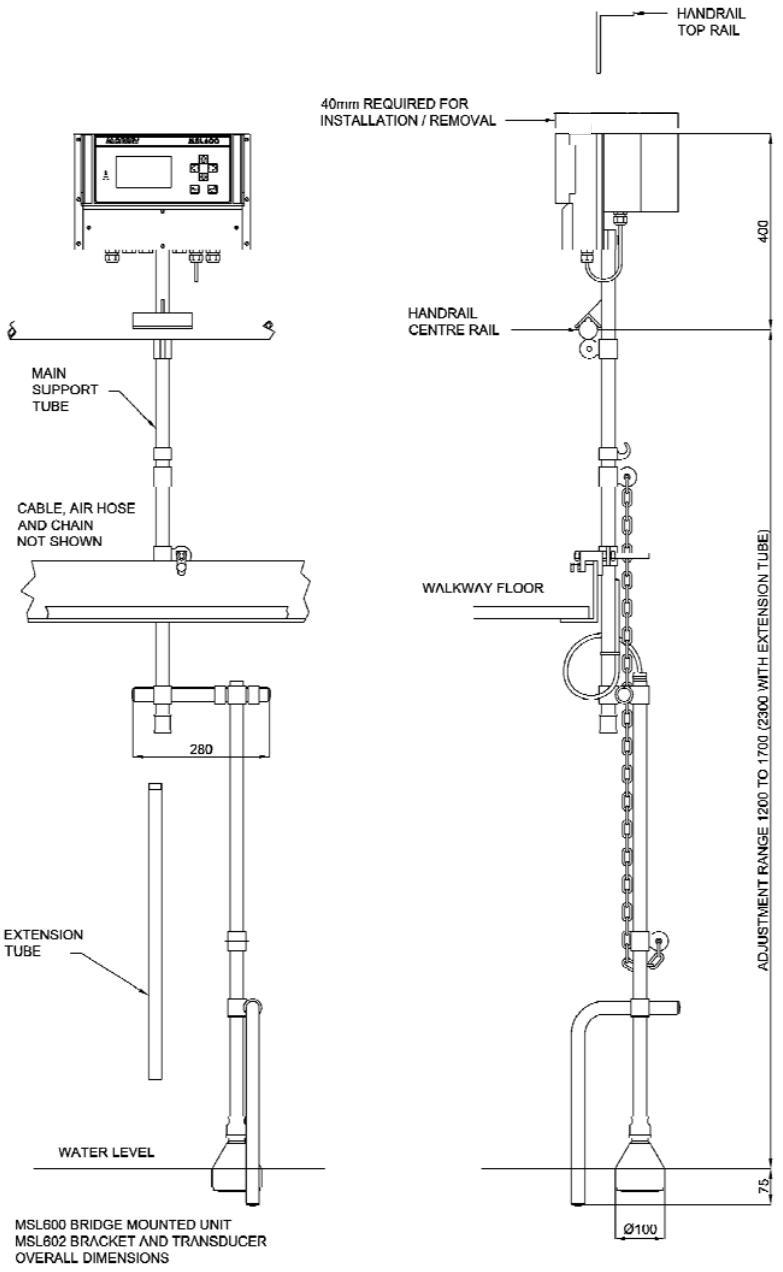


Figure (13): MSL600 and MSL603 assembly



14. MSL603 transducer cable extension

Parts required:

ITT Cannon TNM connectors (Cannon part no.) [R.S. stock no.]

1 off Reversed receptacle	(192993-0071) [265-9727]
1 off Reversed plug	(192993-0051) [265-9812]
2 off Shielded endbell	(192993-0081) [265-9777]
4 off Solder cup pin	(192900-0634) [329-8660] *to fit in the receptacle*
4 off Solder cup socket	(192900-0632) [329-8676] *to fit in the plug*

Fitting instructions:

PLEASE NOTE - THIS CABLE CARRIES LOW LEVEL SIGNALS WHICH ARE VULNERABLE TO ELECTRO-MAGNETIC INTERFERENCE. IT IS IMPORTANT FOR THE CORRECT OPERATION OF THE MSL600 THAT THE BRAIDED SCREEN, AS WELL AS THE INTERNAL CORES ARE CONNECTED AS SPECIFIED.

The cable comprises a brown and white twisted pair, and a black and white twisted pair. During the following procedure, care should be taken to ensure that the two white wires are connected correctly.

The Shielded Endbell is supplied with assembly instructions, which includes an exploded drawing. In the following description, the part references [in square brackets] refer this drawing.

- Terminate the new length of cable to look like the existing transducer cable as follows: The drain wire has a yellow sleeve, the white wire, that is twisted with the brown wire, has a red sleeve. All conductors should preferably have crimped ferrules for insertion in the terminal blocks.
- Cut off the terminations on the existing transducer cable

The following instructions refer to both plug and receptacle assemblies:

- Slide the endbell components [parts 1 to 5] on to the cable.
- Strip the outer insulation back 38mm
- Pull the exposed braid back over the outer insulation and remove the inner foils to expose the twisted cores for the full 38mm.
- Using an indelible marker, mark the white wire in the white/black twisted pair.
- Untwist the wires and strip the insulation back 4mm.
- Solder pins/sockets to wires.
- Fit the 'O' ring from the endbell kit in the groove of the connector.
- Push the support sleeve [part 6] onto the cable, and over the braid.
- Insert the pins/sockets into the back of the connector as follows: position A - marked white, B - black, C - white, D - brown. The pins/sockets must be pressed well into the housing, using a narrow implement, to snap into place.
- Pull the support sleeve [part 6] forwards towards the connector, and draw the braid over the spring elements [of part 6].
- Pull the grounding ring [part 5] forwards and snap it onto the support sleeve [part 6] trapping the braid.
- Screw together the remaining elements of the endbell. Note that ITT Cannon recommend a torque setting for the housing [part 4].

The air hose is extended using the nozzle (RS stock no. 795-348) and a hose (RS-stock no, 721-4013, 20m, black).

MSL600

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