Reference Manual
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Jan 2023

Mobrey MSM400
Sludge Density Monitor

With a Standard Range 1 MHz / 3.3 MHz Ultrasonic Sensor

delta-mobrey

Mobrey MSM400
Sludge Density Monitor

With a standard range 1 MHz / 3.3 MHz ultrasonic sensor

⚠ WARNING

Read this manual before working with the product.

For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

For the latest customer support information, visit the Mobrey brand pages at www.delta-mobrey.com, and click on the Mobrey Service or Product Support quick links.

⚠ CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on nuclear-qualified products, contact an Delta Mobrey Sales Representative.

⚠ WARNING

Replacement equipment or spare parts not approved by Delta Mobrey for use as spare parts could reduce the capabilities of the Mobrey MSM400, and may render the instrument dangerous.

- Use spare parts supplied or sold by Delta Mobrey

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Section 1 Introduction

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1.1 Safety messages

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a caution symbol (⚠). The external hot surface symbol (⚠) is used when a surface is hot and care must be taken to avoid possible burns. If there is a risk of an electrical shock the (⚠) symbol is used. Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- The Mobrey MSM400 Sludge Density Monitor must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment

Explosions could result in death or serious injury:

- Please review the approvals section of this reference manual for any restrictions associated with an installation

Electrical shock could cause death or serious injury:

- If the control unit is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the control unit is off while making connections

1.2 Manual overview

This manual provides installation, configuration and maintenance information for the Mobrey MSM400 with a standard range 1 MHz / 3.3 MHz ultrasonic sensor.

Section 2: Overview

Section 3: Installation

Section 4: Getting Started

Section 5: Service and Health Checks

Section A: Reference Data

Section B: Product Certifications

Section C: Menu Maps and Parameters

Section D: Additional Features

1.3 Customer support

For the latest customer support information, visit the Mobrey brand pages at www.delta-mobrey.com, and click on the Mobrey Service or Product Support quick links.

⚠ CAUTION

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of, and understand, the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.

1.4 Product recycling/disposal

Recycling of equipment and packaging should be taken into consideration. The product and packaging should be disposed of in accordance with local and national legislation.

Section 2 Overview

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2.1 Safety messages

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- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the control unit is off while making connections

2.2 The Mobrey MSM400 Sludge Density Monitor

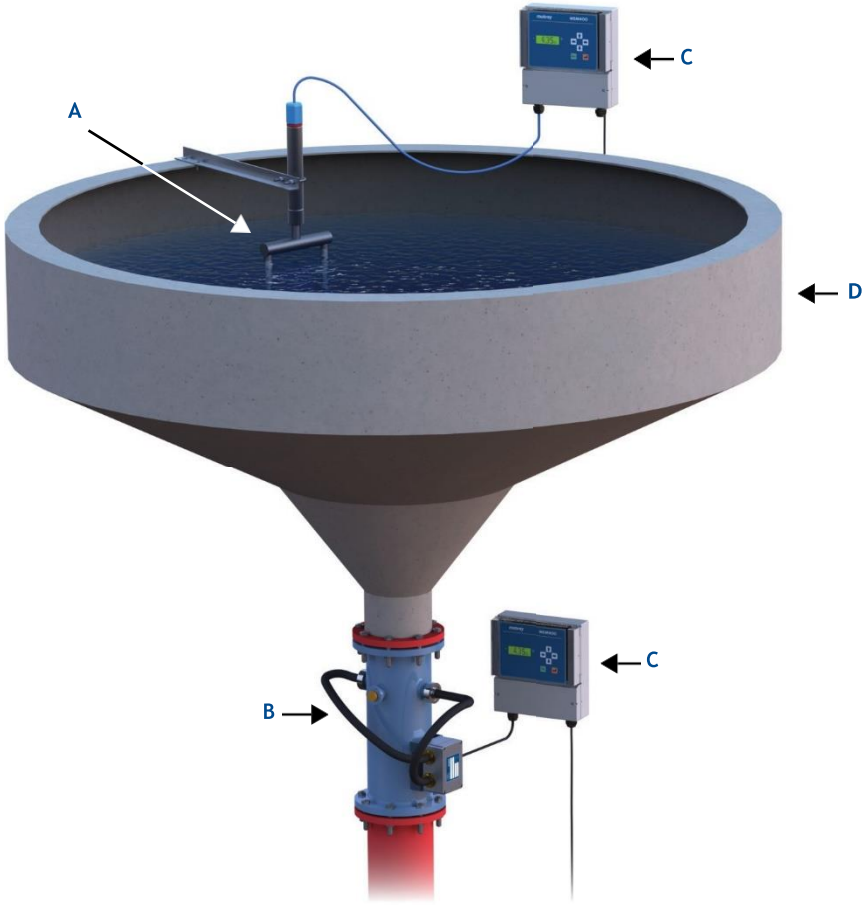
The Mobrey MSM400 is a wall-mounted control unit with a remote ultrasonic gap sensor, and are used together as a versatile sludge monitoring system (Figure 2-1 on page 4).

The MSM400 operates with a Mobrey 448 gap sensor, that comes as a complete **pipe section**, or a Mobrey 433 gap sensor suspended in an **open tank**. The sensors measure the suspended solids concentration in the liquid (gap) between two opposite sensor faces.

The **percentage-by-weight of dry suspended solids** in the liquid is calculated by the control unit, typically in the range 0.5 to 15%, and outputs a 4-20 mA or digital HART signal for a plant control system to operate the sludge process.

Typical applications are to de-sludge a sewage settlement tank, or mineral processing to maintain the percent solids of Kaolin (china clay) or similar, before the remaining process media is moved on to further refiners.

Figure 2-1. Mobrey MSM400 Sludge Density Monitors with sensors



A. Mobrey 433 Tank Mounted Sensor
B. Mobrey 448 Pipe Section Sensor
C. Mobrey MSM400 Control Unit
D. Settlement Tank

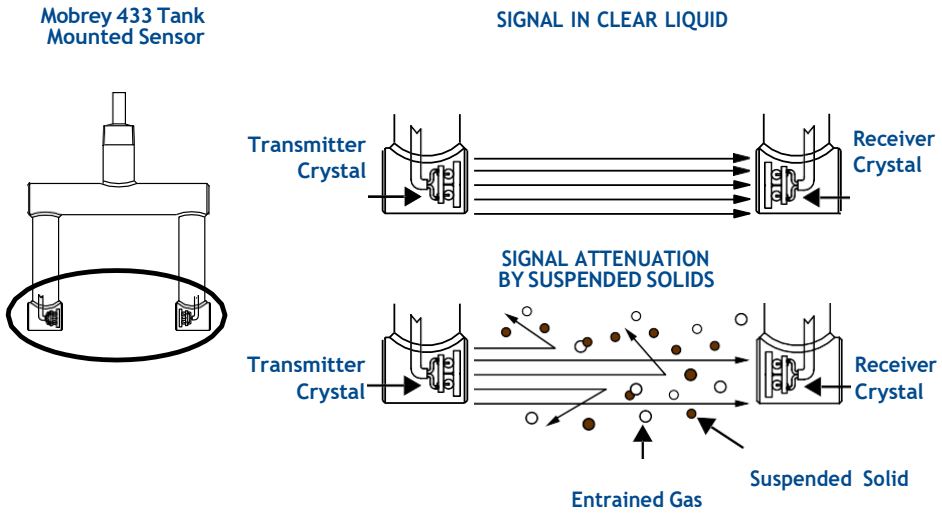
2.2.1 Measurement principle

The technique used to measure suspended solids is **ultrasonic attenuation**.

When suspended solids pass between the **gap** in the opposing sensor faces, they scatter the ultrasound (Figure 2-2). The signal loss is proportional to the percentage-by-weight of suspended solids (%Solids).

To allow measurement over a wide range of %Solids, the attenuation can be measured at one of two different frequencies.

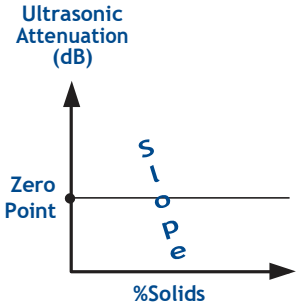
Figure 2-2. Ultrasonic attenuation



2.2.2 Sludge characteristics

The relationship between the **ultrasonic attenuation** measurement and the **percentage of solids** in a particular sludge type is dependent on the sludge *particle density* and their *average size distribution*. This is known from experience of most sludge types, and expressed as the ultrasonic attenuation in deciBels (dB) per mm gap between sensor faces, per one percent suspended solids.

Figure 2-3. Ultrasonic attenuation versus suspended solids



The relationship between *ultrasonic attenuation* and *suspended solids* is shown graphically in Figure 2-3. It is important to calibrate the unit's **zero point** by setting up the sensors in clean liquid (supernatant), and then setting the **slope** of the straight line graph using either past data or on-site samples.

In the Mobrey MSM400 control unit's memory, there is information about various sludge types to enable a basic set-up. Adjustments to the set-up can be made after on-site samples have been taken.

2.2.3 Control unit features

The MSM400 has a range of built-in display, control, and alarm functions. The menu-driven programming is simple to use and allows full configuration of the unit using the integrated membrane keypad. Sensor and electrical connections are in a separated terminal housing.

Features summary

- Tough weatherproof wall mount enclosure for internal/external mounting
- Intrinsically Safe for connection to certified ultrasonic gap sensors
- Three-line LCD display with back light (for text and graphics).
  Clear local display of the calculated value
- Two voltage-free SPDT (Single-Pole-Double-Throw) relay outputs
- Keypad and intuitive menu system for local programming
- Digital trigger input IN1
- Isolated Current Output for the digital HART signal

Note

- A full specification for the control unit is in Appendix A: Reference Data

2.2.4 Controller input

The MSM400 uses ultrasonic gap sensors to measure the ultrasonic attenuation, and calculate the percentage of solids in the liquid.

Note

- The Mobrey MSM400 is designed for **non-hazardous (safe) area** installation, but can be connected to a certified sensor installed in a hazardous area. See Appendix B: Product Certifications for the product certifications.

2.2.5 Control functionality

Control functionality is provided by two single-pole-change-over (SPCO) voltage-free contact relays in the control unit. The two relay outputs are fully field adjustable to perform a wide variety of control, fault indication, or alarm duties.

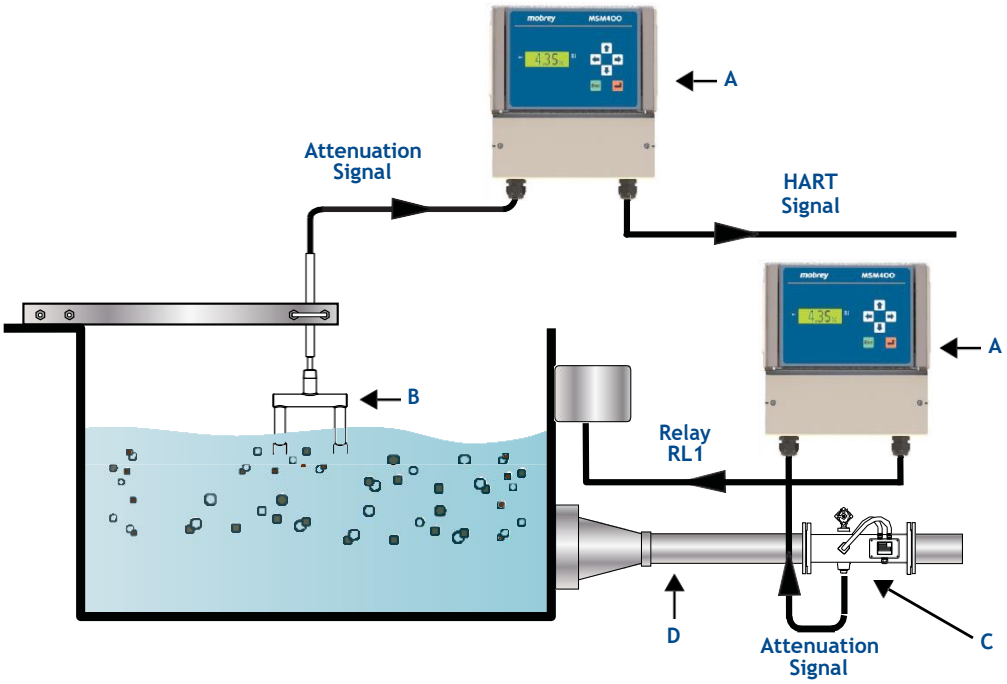
For applications where the control unit functionality is linked to other external events, there is a digital trigger input for accepting contact closure signals.

The Isolated Current Output provides a digital HART signal and is driven by the calculated the **Primary Variable (PV)**, which is typically the calculated percentage-by-weight of suspended solids (% Solids) in the liquid.

A typical application (Figure 2-4 on page 7) would include the 448 pipe-section sensor mounted in a discharge pipeline from a refiner or settlement tank, and optionally a 433 tank-mounted sensor suspended in the sludge blanket.

The relay output in the MSM400 can be used to stop the de-sludge cycle when the liquid runs clear, switching at typically a few percent suspended solids.

Figure 2-4. Typical application



A. Mobrey MSM400 Control Unit
B. Mobrey 433 Tank Mounted Sensor
C. Mobrey 448 Pipe Section Sensor
D. Discharge Pipeline

2.3 Control unit functions

Note

- For a full guide to programming the MSM400, see Section 4: Getting Started.

2.3.1 Standard functions

When connected to either Mobrey 433 ultrasonic gap sensor (tank-mounted), or a Mobrey 448 ultrasonic gap sensor (pipe-mounted):

- Calculation and display of percentage by weight of suspended solids
  – this can be re-scaled to other density measurement units.
- Output a 0/4–20 mA and HART signal
  – The Current Output is usually proportional to the Primary Variable (PV), and is displayed in bargraph form (indicating 0 to 100% of output current).
- Relay control functions
  – Relay RL1 operates at chosen values in density units.
  – Relay RL2 is a fault relay by default, which may be assigned to control duty if required.
- The MSM400 can be set-up to perform standard, water-industry de-sludging control.
- Voltage-free (digital) contact close input IN1
  – this may be used to enhance the de-sludging function.

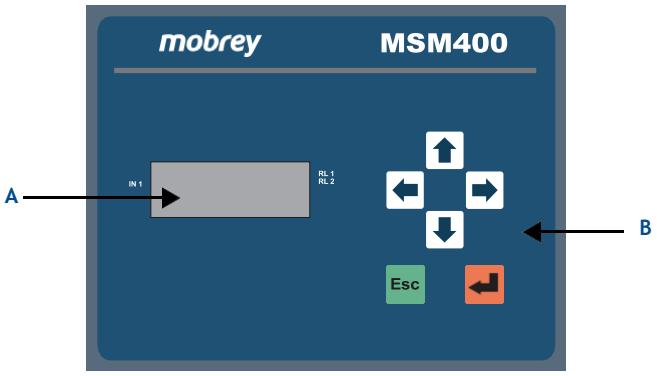
2.4 Control unit front panel

This section describes the front panel fascia, which has an integral keypad and display.

Note

- A full specification for the control unit is in Appendix A: Reference Data.

Figure 2-5. Front panel fascia



A. Three-line Back-lit LCD Display
B. Keypad

2.4.1 Keypad

The membrane keypad has six function buttons. They are used for navigating a menu system, and for viewing / editing application parameters. Table 2-1 summarizes each button function.

Table 2-1. Keypad function buttons

Button	What the button will do
	When the Full Primary Display (PV, bargraph, etc.) is shown, press the **red (ENTER)** button to access the Menu System. At other times, this button is for selecting a menu option and for confirming a changed parameter setting.
	When navigating the menu system, the **UP-ARROW** button is for moving upwards one line. At other times, this button is for scrolling up through a list of alphanumeric characters or a multiple-choice list of options.
	When navigating the menu system, the **DOWN-ARROW** button is for moving downwards one line. At other times, this button is for scrolling down through a list of alphanumeric characters or a multiple-choice list of options.
	The **LEFT-ARROW** button is for moving left e.g. to another character when changing a parameter value.
	The **RIGHT-ARROW** button is for moving right e.g. to another character when changing a parameter value.
	When navigating the menu system, use the **Esc (Escape)** button to return to a previous menu level and the Primary Display. At other times, e.g. while changing a parameter setting, the button is for restoring a parameter setting before the editing was started.

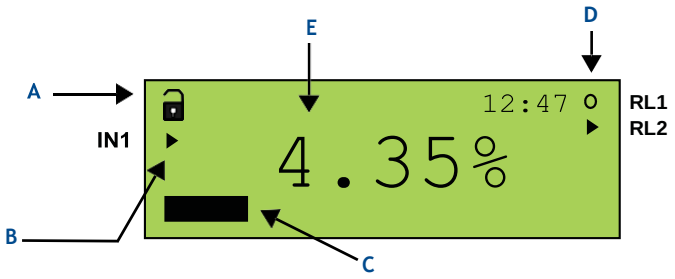
2.4.2 Display

Full Primary Display

The LCD display shows text and graphics. After the power-up and self-checks are completed, the **Full Primary Display** is presented.

The default Full Primary Display features a digital clock, Primary Value (% Solids) with display units, bargraph representation of output current, and status icons.

Figure 2-6. Typical Display Of The MSM400



A. Off-line/On-line Status (Locked Padlock = On-line)
B. Digital Input Status: o = De-energized, ▸ = Energized
C. Bargraph Of 4-20 mA Output
D. Relay (RL) Status: o = De-energized; ▸ = Energized
A = Alarm mode and Energized
E. Primary Value (PV) (% Solids)

Large PV Display

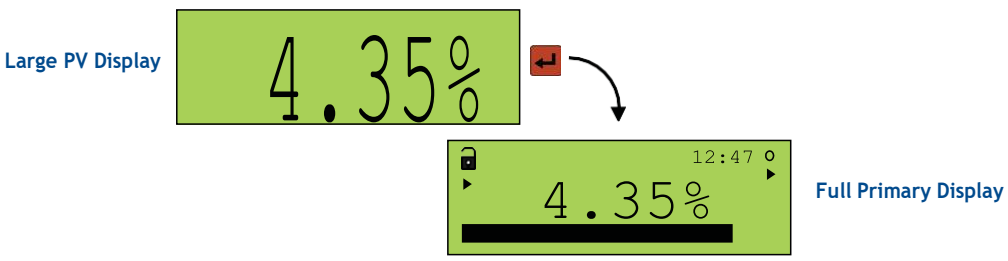
After a period of keypad inactivity within the menu system, the display automatically changes to the **Large PV Display**. This shows only the Primary Value (PV) and Display units, but in a larger character size to facilitate easier viewing.

To restore the **Full Primary Display**, press any button.

Note

- The Large PV Display feature can be switched off using parameter P574. See "Display" on page 58.
- The bargraph flashes when the Primary Value (PV) is zero.

Figure 2-7. Large PV Display and Full Primary Display



Section 3 Installation

Safety messages ..... page 11
Before you install ..... page 12
Mounting the Mobrey MSM400 control unit ..... page 13
Electrical installation ..... page 17

3.1 Safety messages

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a caution symbol (⚠). The external hot surface symbol (⚠) is used when a surface is hot and care must be taken to avoid possible burns. If there is a risk of an electrical shock the (⚠) symbol is used. Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- The Mobrey MSM400 Sludge Density Monitor must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment

Explosions could result in death or serious injury:

- Please review the approvals section of this reference manual for any restrictions associated with an installation

Electrical shock could cause death or serious injury:

- If the control unit is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the control unit is off while making connections

3.2 Before you install

Note

- The Mobrey MSM400 is designed for non-hazardous (safe) area installation, but can be connected to a certified sensor installed in a hazardous area.
- See Appendix B: Product Certifications for the product certifications.

3.2.1 Preliminary checks

The Mobrey MSM400 Sludge Density Monitor is normally supplied in two packages: one for the control unit; and one for the pipe section or tank-mounted gap sensor.

Take care in handling the heavy pipe section. In particular, do not damage the cable or the hose protection for the cable where it enters the sensors

Before installation, check that there has been no damage in transit, particularly to the sensor cables. Check that the equipment is as specified, and that the pipe section length and flanges are compatible with plant pipework.

3.2.2 General considerations

Safety guidelines

- Do not mount the control unit on a structure that is subject to vibration, or in a position where damage may be caused by impact, thermal stress, or liquid ingress.
- The fuse must only be replaced with the type specified.
- If the equipment is likely to come into contact with aggressive substances, it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

  Aggressive Substances - e.g. acidic liquids or gases that may attack metals or solvents that may affect polymeric materials.

  Suitable Precautions - e.g. regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals.
- The user should not repair this equipment.
- The Mobrey MSM400 control unit must not be connected to a supply exceeding 250 V r.m.s. or dc, or to apparatus containing a source of voltage exceeding 250 V r.m.s. or dc.
- The control unit may be connected to certified equipment used in a hazardous area. Refer to Appendix B: Product Certifications for details of relevant certifications and the safety instructions for hazardous area installations.
- Refer to the technical data in Appendix A: Reference Data.

3.3 Mounting the Mobrey MSM400 control unit

Guidelines

- This housing is IP65-rated. It is suitable for mounting outside, but a protective weather shield is recommended. The wall-mounting should be above any flood level, away from any overflow path, and away from direct sunlight.
- Do not mount the control unit on a structure that is subject to vibration, or in a position where damage may be caused by impact, thermal stress, or liquid ingress.
- The mass of the control unit is 1.9 kg. To conform with safety requirements, the wall on which the unit is mounted should be capable of supporting four times this weight.
- It is not necessary, or advisable, to remove the upper part of the unit housing that contains the LCD and keypad. There are no user serviceable parts inside. The unit must not be modified in any way.

Procedure

1. Mount the control unit on a suitable wall or structure using the mounting bracket kit supplied, as shown in Figure A-1 in Appendix A: Reference Data.
2. For electrical connections, see “Control unit electrical connections” on page 17.

3.4 Installing the gap sensors

The ultrasonic gap sensors come in two basic formats: tank-mounted or pipe-section.

Although the cabling arrangements are the same, they are used in different environments. Never modify the sensors.

3.4.1 Installation: Mobrey 433 tank mounted gap sensor

The 433 sensor is available in various sizes with the gap between opposing sensor faces ranging from 4 in. up to 18 in. (100 mm up to 450 mm). The larger gaps give a higher sensitivity for lower percentage solids.

These sensors are mounted directly into the settlement tank, at pre-selected levels above the tank discharge outlet. Mounting can be vertically down on a piece of stainless or galvanized steel conduit or tubing (Figure 3-1).

Figure 3-1. Mobrey 433 Tank Mounted Gap Sensor

The 433 sensor should be kept away from a wall to avoid any non-moving slurry or “dead” settlement areas. It is advisable to have an arrangement that allows removal of the sensor for periodic cleaning and ragging removal.

Guidelines

- Never hang the sensor using the sensor’s cable
- Ensure there is enough cable to allow sensor removal for cleaning
- Avoid moving objects (e.g. scrapers, bridges) catching the sensor cable
- Do not mount the sensor to close to the tank side
- Be wary of aeration ditches, activated sludge, flocculating agents, and sludge free-falling into collection sumps
- Do not install the sensor in digested sludge
- Ragging blocks the ultrasonic signal. Therefore, do not install the sensor where there is no screening

Note

- The 433 sensor is certified for use in hazardous areas. Appropriate additional precautions must be taken when working in this environment.

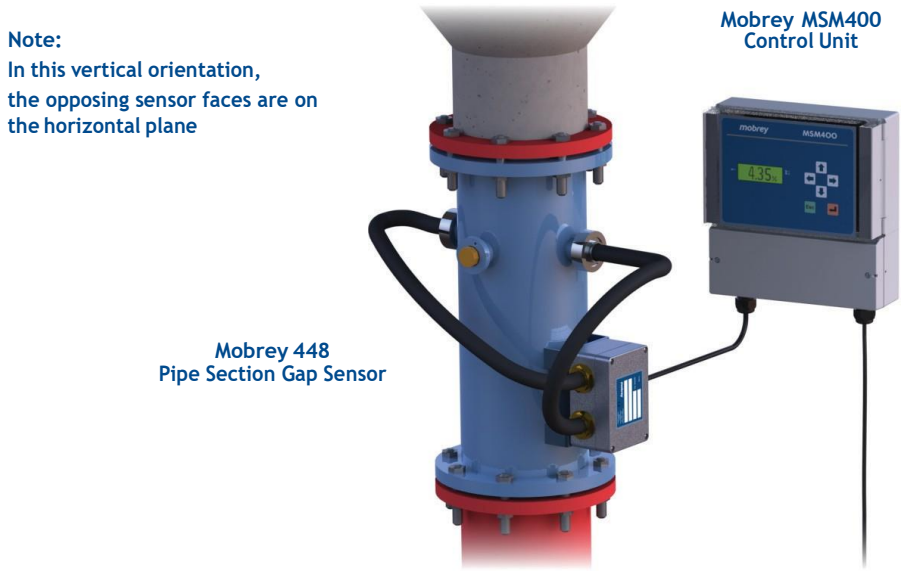
3.4.2 Installation: Mobrey 448 pipe-section gap sensor

The Mobrey 448 pipe-section should be same size as surrounding pipe work. Install it in a straight section of pipe line with the two opposing sensor faces in a *horizontal plane*. This avoids the sensors being covered with debris at the bottom of the pipe, and being in an air gap at the top of the pipe.

Note

- The pipe section gap sensor is often mounted below ground-level or in confined spaces. Appropriate additional precautions must be taken when working in this environment.

Figure 3-2. Mobrey 448 pipe-section gap sensor (vertical orientation)



Guidelines

- Avoid mounting close to valves or changes in cross-section
- Be wary of aeration ditches, activated sludge, flocculating agents, and sludge free-falling into collection sumps
- Be aware of pumps:

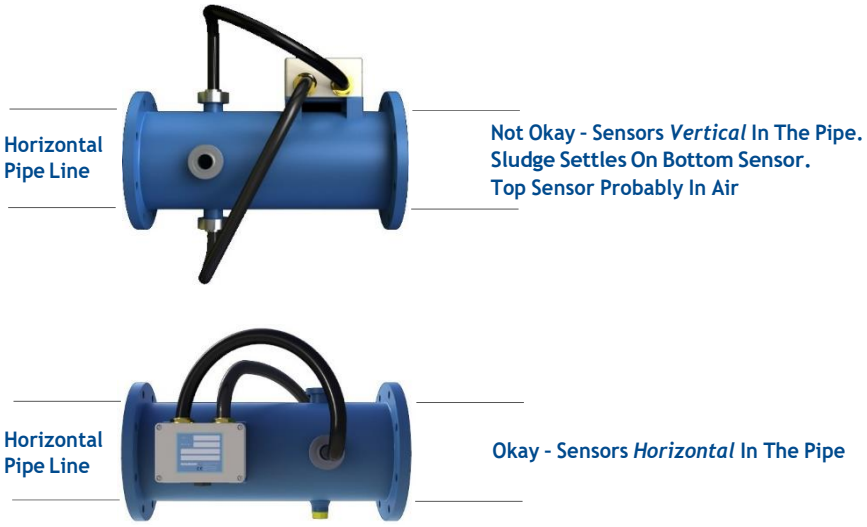
  If mounted *after* a pump, ensure the pump is not drawing air into the system or causing excessive turbulence

  If mounted *before* a pump, ensure there is sufficient head to prevent pressure loss causing outgassing

Pipe-section orientation

Particular attention must be paid to the positioning of the pipe section in relation to pressure reduction or agitation of the sludge to be monitored.

Figure 3-3. Sensor orientation for horizontal pipe line



⚠ WARNING

Air or gas that comes out of suspension in a sludge can give a false high solids reading due to high ultrasonic attenuation. The installation must maintain the full hydrostatic pressure in the sludge up to the pipe measurement section. Any unnecessary pressure reductions should be avoided. This means avoid:

- Free fall of the sludge into a sump
- Pumps and partly open valves
- Abrupt changes of pipeline diameter upstream of the sensor pipe-section

If possible position the sensors directly at the outlet of the tank, low down, so that the full hydrostatic head is maintained on the monitored liquid. However, it may be necessary to remove the sensors for face cleaning later. Isolation valves are desirable.

The pipe section sensor is supplied with a flushing spray nozzle, which directs a supply of water at the sensor faces. This is a useful cleaning procedure, avoiding the need to remove the sensors from the pipe. A water supply is required, connected to the purge nozzle on the top of the sensor pipe section.

3.5 Electrical installation

3.5.1 Control unit electrical connections

All field wiring connections are accessible on the control unit by removing the lower terminal cover.

Never remove or modify the mechanical barriers separating the terminal area from the main enclosure, and separating the transmitter input terminals from other terminals.

Figure 3-4 on page 18 shows the layout of the terminals for external connections. All terminal blocks are suitable for wires 14 to 26 AWG (0,5 to 1,5 mm^2), except the mains terminals which are suitable for wires 10 AWG (2,5 mm^2). Strip the insulation back $^1/_4$ in. (7 mm). The six cable-entry positions are pre-drilled to accept M16 and M20 cable glands.

Note

- For field wiring, use 167 °F (75 °C) copper conductors only

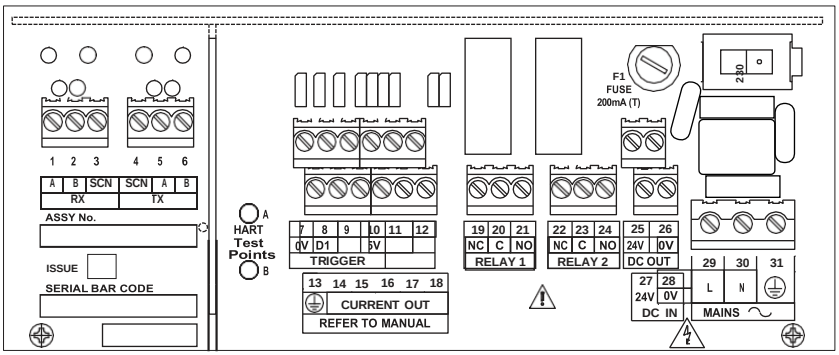
Note

It is the responsibility of the installer to:

- Refer to safety data and electrical specifications in Appendix A: Control unit specifications
- Refer to Product Certifications and Control Drawings in Appendix B: Product Certifications
- Check and obtain any hazardous area work permits required before applying power
- Observe all local regulations and approval requirements
- Ensure the wiring is suitable for the load current
- Ensure the wiring insulation is suitable for the voltage, temperature, and environment of the installation

Connection terminals

Figure 3-4. Connection terminals layout



Note

- Not all of the labelled terminals are functional in this version of the control unit. The functions available are listed in Table 3-1.

Table 3-1. Connection descriptions

Terminal	Label On PCB	Function
1	Rx A	Core of Sensor Cable 1
2	Rx B	Core of Sensor Cable 1
3	Rx SCN	Cable Screen for Cable 1
4	Tx SCN	Cable Screen for Cable 2
5	Tx A	Core of Sensor Cable 2
6	Tx B	Core of Sensor Cable 2
7	TRIGGER 0V	Ground reference for Trigger inputs
8	TRIGGER D1	Digital Trigger Input (IN1)
10	TRIGGER 5V	5 Vdc output
16 17 18	CURRENT OUT	See “Current output and HART connections” on page 23
19 to 21	RELAY 1	NC-C-NO Relay output terminals for Relay RL1
22 to 24	RELAY 2	NC-C-NO Relay output terminals for Relay RL2
25	DC out 24V	24 Vdc positive (+ve) supply to external devices
26	DC out 0V	Reference terminal for dc supply output
27	DC in 24V	24 Vdc positive (+ve) supply to the unit - i.e. dc power input
28	DC in 0V	Reference terminal for dc supply input
29	Mains L	Live terminal for mains (ac) power input
30	Mains N	Neutral terminal for mains (ac) power input
31	Mains E	Protective Earth (PE) terminal

Cable glands and blanking plugs

Three M20 glands, rated IP68 and suitable for cable with outside diameter $^{1}/_{4}$ to $^{1}/_{2}$ in. (6 to 12 mm), are supplied.

Two M16 glands, rated IP68 and suitable for cable with outside diameter $^{1}/_{5}$ to $^{2}/_{5}$ in. (5 to 10 mm), are supplied.

One M16 and two M20 blanking plugs are supplied.

Glands and blanking plugs are supplied in a plastic bag. The installer must fit these, or suitable equivalents, in place of the transit red-caps, to ensure weatherproofing of the control unit.

The sensor is supplied with an M16, IP68-rated cable gland.

It is the responsibility of the user to ensure suitable cable glands or conduit connections are used when wiring to the control unit to maintain enclosure integrity.

Note

- The sealing washers supplied with the blanking plugs must be fitted on the outside of the enclosure under the gland/blanking plug.

Figure 3-5. Supplied cable glands and blanking plugs

3.5.2 Gap sensor connections and cabling

Connection of a gap sensor to the MSM400 control unit does not confer intrinsic safety on the sensor. It is the responsibility of the installer to ensure any sensor installed in a hazardous area is suitable for use and certified accordingly. The installation should be in accordance with a recognised code of practice.

Check the electrical parameters of the installed system of control unit, sensor, and interconnecting cable, to ensure compliance with the technical data (Appendix A: Reference Data) and product certifications (Appendix B: Product Certifications). The total capacitance and inductance limits stated in Appendix B must not be exceeded.

Note

- There should not be any other devices connected between the gap sensor and the control unit.

Cable joins are allowable in cabling the sensor, provided that the joint is made within an IP20/NEMA 3 (minimum) enclosure suitable for the environment, and that wiring withstands a test voltage of 500 V r.m.s. to ground (earth).

The maximum cable length allowed between the sensor and control unit is determined by limits imposed by the Intrinsic Safety certifications and Control Drawings.

It is the responsibility of the installer to ensure that the sensor is installed in accordance with the manufacturer's instructions supplied with the sensor. Cable between the control unit and the sensor should be shielded (screened), twisted-pair with the shield (screen) connected to

terminals 3 and 4 (see Figure 3-6). Cable runs should be separate from any high voltage or mains cables to avoid crosstalk or interference.

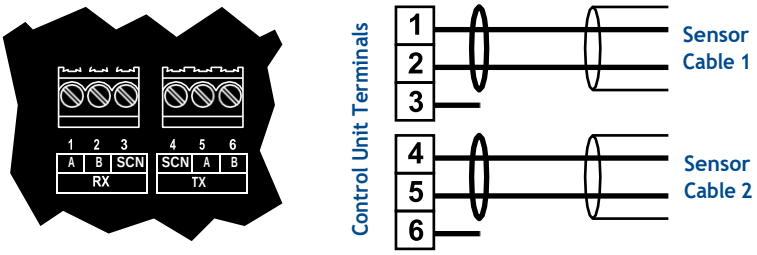
Mobrey 433 and Mobrey 448 sensors are fitted with two screened, twisted-pair cables for connection to the Mobrey MSM400 control unit.

Gap sensor connections are on the left side of the terminals enclosure. The sensors are symmetrical, meaning either of the two cable pairs can be chosen as “Tx” or “Rx”.

The sensor cable colors are:

- Cores: black and white (*connect to terminals 'A' and 'B', either way round*)
- Screens: green (*connect to terminals identified as 'SCN'*)

Figure 3-6. Sensor connections to the Mobrey MSM400 control unit



3.5.3 Power connections

The MSM400 control unit can be powered either by 24 Vdc or by 115/230 Vac mains alternating current (AC) power. When the control unit is mains powered (Figure 3-7 on page 21), use the voltage-selector slide switch to select 115 or 230 Vac as appropriate for the installation location.

When the control unit is direct current (DC) powered, ensure the supply is adequate (15 to 30 Vdc). Do not exceed 30 Vdc.

Both supplies may be connected simultaneously if required, for example, where a battery back-up is required. In this case, the unit selects the supply producing the highest internal 24 V power rail.

A switch or circuit breaker should be installed in close proximity to the MSM400 control unit, and be labelled appropriately.

Note

- In Intrinsically Safe systems, devices connected to a Mobrey MSM400 control unit must not be supplied from a voltage greater than 250 V r.m.s. or 250V ac.

Figure 3-7. Mains alternating current (ac) power connections

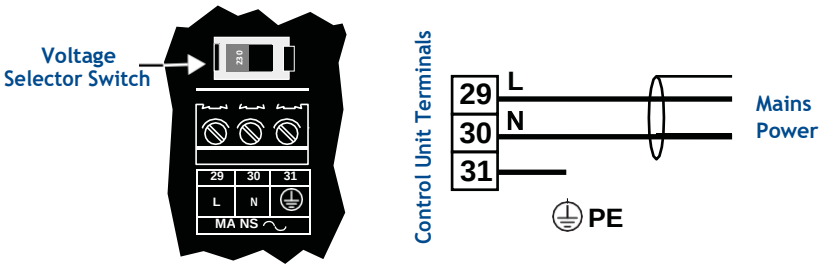
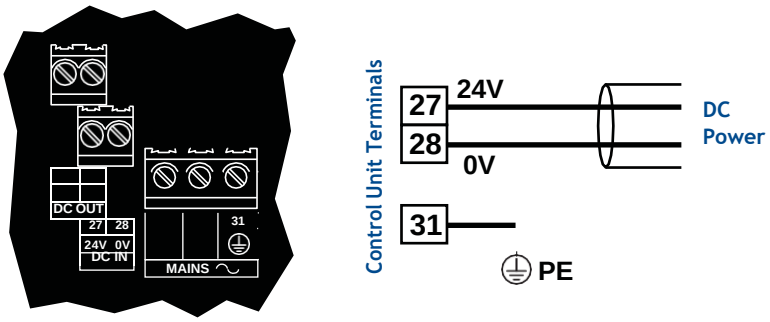


Figure 3-8. direct current (dc) power connections



Note: Only Terminals 27, 28, and 31 are required.

Note

- It is recommended that lightning suppressors are fitted if local conditions make this advisable.

3.5.4 Earthing connections

The MSM400 *must* be earthed (grounded) using terminal 31 (Protective Earth).

Terminals 3 and 4 are used for connecting the cable shields (screens) of the two, twisted-pair, sensor cables (see Figure 3-6 on page 20). This shield should be left unconnected at the sensor end *unless* there is a terminal for this purpose.

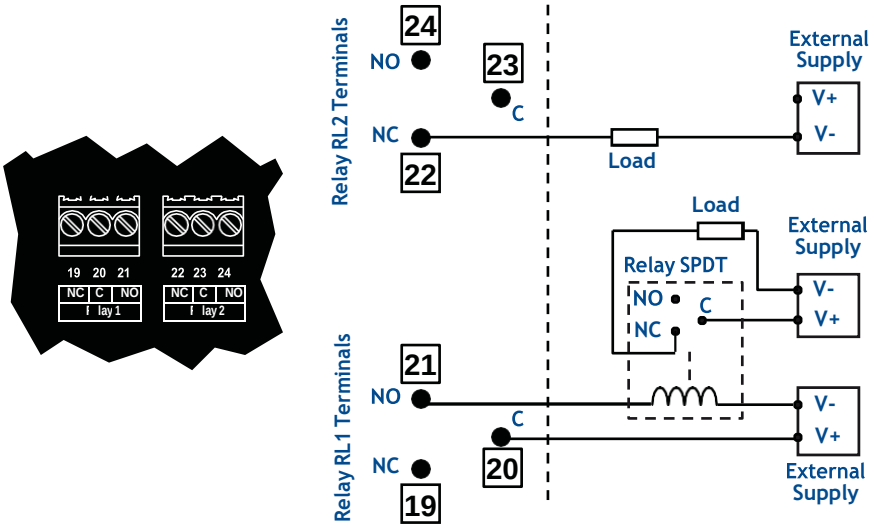
3.5.5 Relay connections

There are two voltage-free contact relays. Connections for relays RL1 and RL2 are shown in Figure 3-9 on page 22. By default, each relay is in a de-energized (*Normally Open*) state.

The present relay statuses are shown on the right-hand side of the Full Primary Display. An “o” indicates a de-energized state, and a ▸ (solid arrow head) is an energized state.

Control unit parameter D820 (on page 68) also shows the RL1 and RL2 statuses, where a “0” (*zero*) indicates a de-energized (*Normally Open*) state, and a “1” (*one*) is an energized (*Normally Closed*) state

Figure 3-9. Relay output connections (NO-C-NC)



Whilst each relay is individually double-insulated, their arrangement is such that the insulation between the relays is standard (basic) insulation. It is allowed to use these relays to control circuits with both mains and dc, or low voltage circuits. Care must be taken in order to avoid the risk of electric shock.

3.5.6 Digital trigger input connections

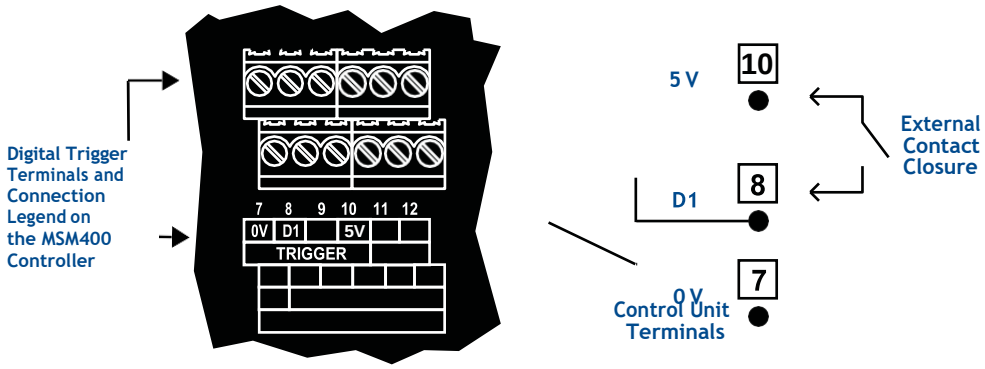
The digital trigger input, IN1, is a voltage-free contact input, and can be used to control de-sludge and other functions (see Section 4: Getting Started).

Connections are shown in Figure 3-10 on page 23. A voltage greater than 2 V on terminal 8 (D1) causes trigger input IN1 to be active. This can be achieved by connecting to terminal 10 (5 V) using an external switch or relay.
The maximum voltage should not exceed 28 V.

The present digital input IN1 status is shown on the left-hand side of the Full Primary Display. An "o" indicates a de-energized state, and a ▸ (solid arrow head) is an energized state.

Control unit parameter D835 (on page 68) also shows the IN1 status, where a "0" (*zero*) indicates a de-energized state, and a "1" (*one*) is an energized state.

Figure 3-10. External trigger input connections



Note: The Current Output Legend Is Not Shown For The Purpose of Clarity

3.5.7 Current output and HART connections

The Current Output can be *internally* or *externally* powered.

To enable HART communications, the loop-resistance must be a minimum of 250 Ohms. The Current Output can drive a maximum loop-resistance of 1000 Ohms when *internally* powered.

A selectable HART resistor (270 Ohms) is inside the MSM400 control unit. The default selection setting (PL1 in the left-hand position) does not enable the internal HART resistor. If the internal HART resistor is enabled (by PL1 in the right-hand position), this reduces the maximum resistance of the external current loop.

PL1 In Left-Hand Position

Note

- The Current Output must not be routed through hazardous areas unless protected by an I.S. barrier.

Index to wiring diagrams

1. Internally-powered Current Loop (No THUM adaptor)

Option 1a:

Current Output only ..... Figure 3-11 on page 25

Option 1b:

Current Output and Wired HART Communications. . . . . Figure 3-12 on page 25

Option 1c:

Wired HART (TPA/TPB) only . . . . . Figure 3-13 on page 26

2. Internally-powered Current Loop with THUM adaptor

Option 2a:

Wireless THUM Adaptor Only
(MSM400 is a HART master only) . . . . . Figure 3-14 on page 26

Option 2b:

Current Output, and Wired and Wireless HART . . . . . Figure 3-15 on page 27

Option 2c:

Current Output, Wireless HART, and Dual Wired HART . . . . . Figure 3-16 on page 27

3. Externally-powered Current Loop (No THUM adaptor)

Option 3a:

Current Output only (No HART Communications). . . . . Figure 3-17 on page 28

Option 3b:

Current Output and Wired (TPA/TPB) HART . . . . . Figure 3-18 on page 28

4. Externally-powered Current Loop with THUM adaptor

Option 4a:

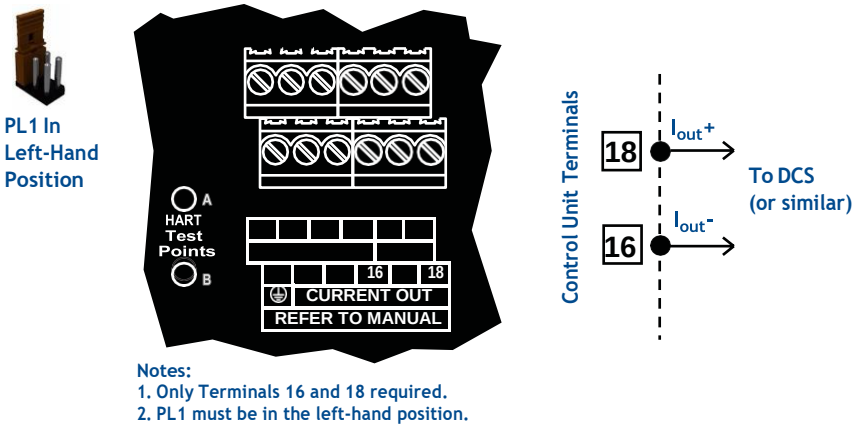
Current Output, and Wired (TPA/TPB) and Wireless HART. . . . Figure 3-19 on page 29

Option 4b:

Current Output, and Wired and Wireless HART . . . . . Figure 3-20 on page 29

Internally-powered current loop (No THUM adaptor)

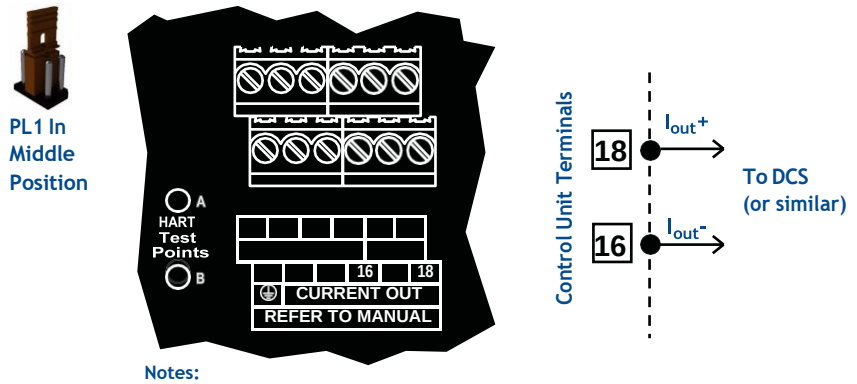
Figure 3-11. Option 1a: current output only



Notes:
1. Only Terminals 16 and 18 required.
2. PL1 must be in the left-hand position.

Figure 3-12. Option 1b: current output and wired HART communications

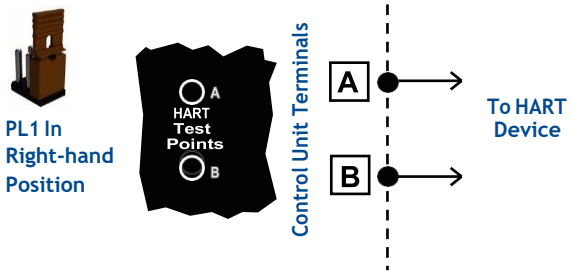
Any HART communication device (hand-held or PC-based) may be connected across HART Test Points (A and B) or a field device which has a resistance greater than 250 Ohms. The total loop-resistance must not exceed 1000 Ohms.



Notes:
1. Only Terminals 16 and 18 required.
2. PL1 must be in the middle position.

Figure 3-13. Option 1c: wired (TPA/TPB) HART only

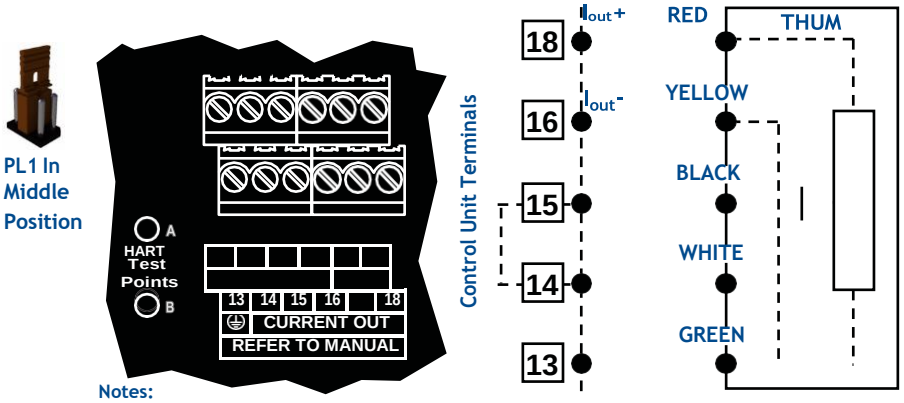
Any HART communication device (hand-held or PC-based) may be connected across HART Test Points (A and B) or a field device which has a resistance greater than 250 Ohms. The total loop-resistance must not exceed 1000 Ohms.



Notes:
1. Only HART Test Points A and B are required.
2. PL1 must be in the right-hand position.

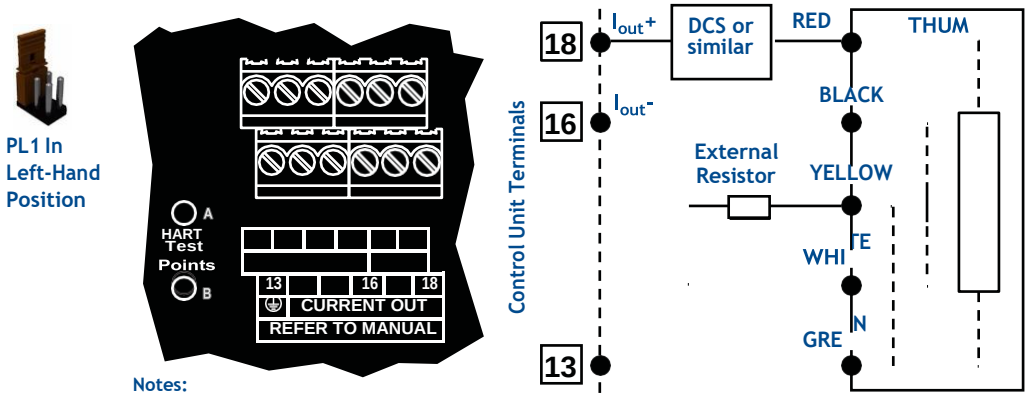
Internally-powered current loop with THUM adaptor

Figure 3-14. Option 2a: wireless THUM adaptor only (MSM400 is a HART master only)



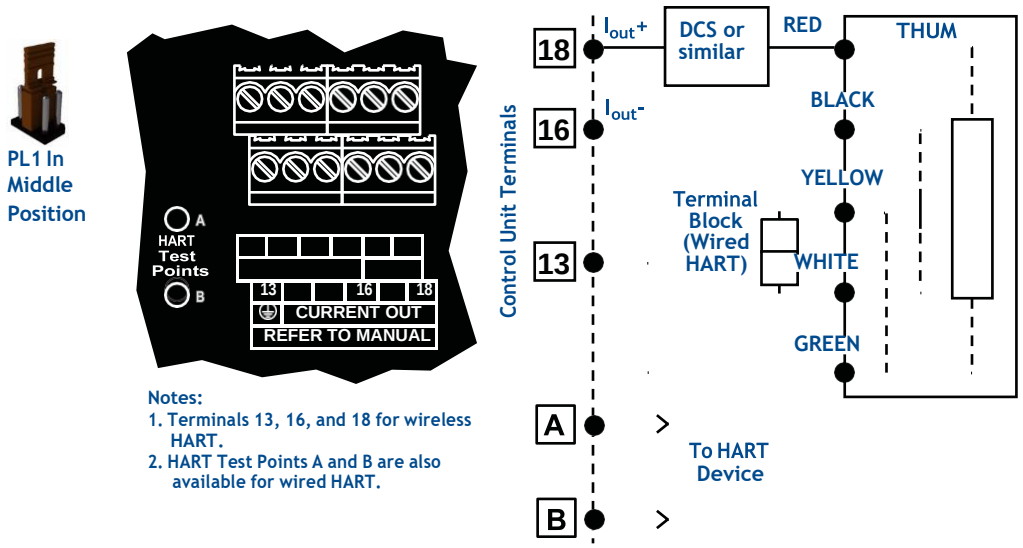
Notes:
1. Terminal 17 is not required. Terminals 14 and 15 are internally linked.
2. THUM uses MSM400 internal HART resistor to provide extra loop resistance.

Figure 3-15. Option 2b: current output, and wired and wireless HART



Notes:
1. Only terminals 13, 16, and 18 are required.
2. Connect the wired HART communication device (hand-held or PC-based) across external resistor (typically 270 Ohm) or external HART resistor.

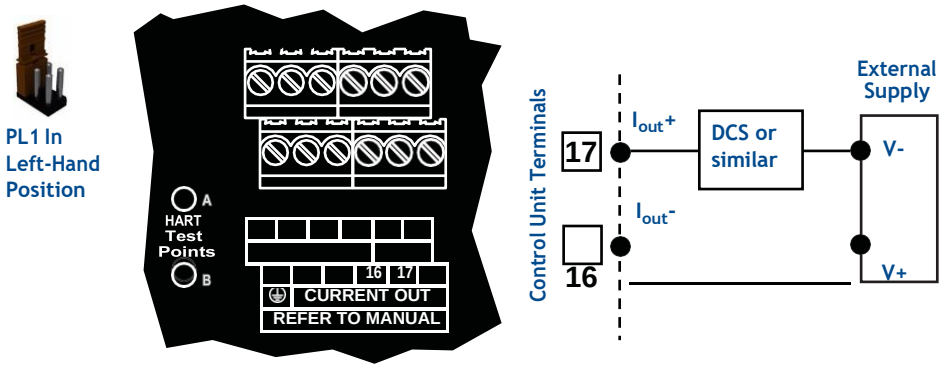
Figure 3-16. Option 2c: current output, wireless HART, and dual-wired HART



Notes:
1. Terminals 13, 16, and 18 for wireless HART.
2. HART Test Points A and B are also available for wired HART.

Externally-powered current loop (no THUM adaptor)

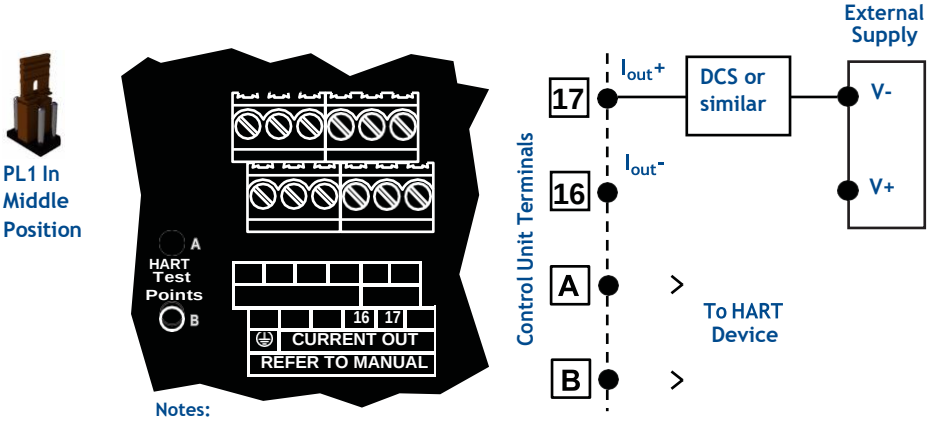
Figure 3-17. Option 3a: current output only (no HART communications)



Notes:
1. Only terminals 16 and 17 are required.
2. The maximum applied voltage is 48 Vdc.

Figure 3-18. Option 3b: current output and wired (TPA/TPB) HART communications

Any HART communication device (hand-held or PC-based) may be connected across HART Test Points (A and B) or a field device which has a resistance greater than 250 Ohms. The total loop-resistance must not exceed 1000 Ohms.



Notes:
1. Only terminals 16 and 17 are required.
2. The maximum applied voltage is 48 Vdc.

Externally-powered current loop with THUM adaptor

Figure 3-19. Option 4a: current output, and wired (TPA/TPB) and wireless HART

Notes:
1. Terminals 13, 16, and 18 are required for wireless HART and the Current Output.
2. HART Test Points A and B are for wired HART communications.
3. The maximum applied voltage is 48 Vdc.

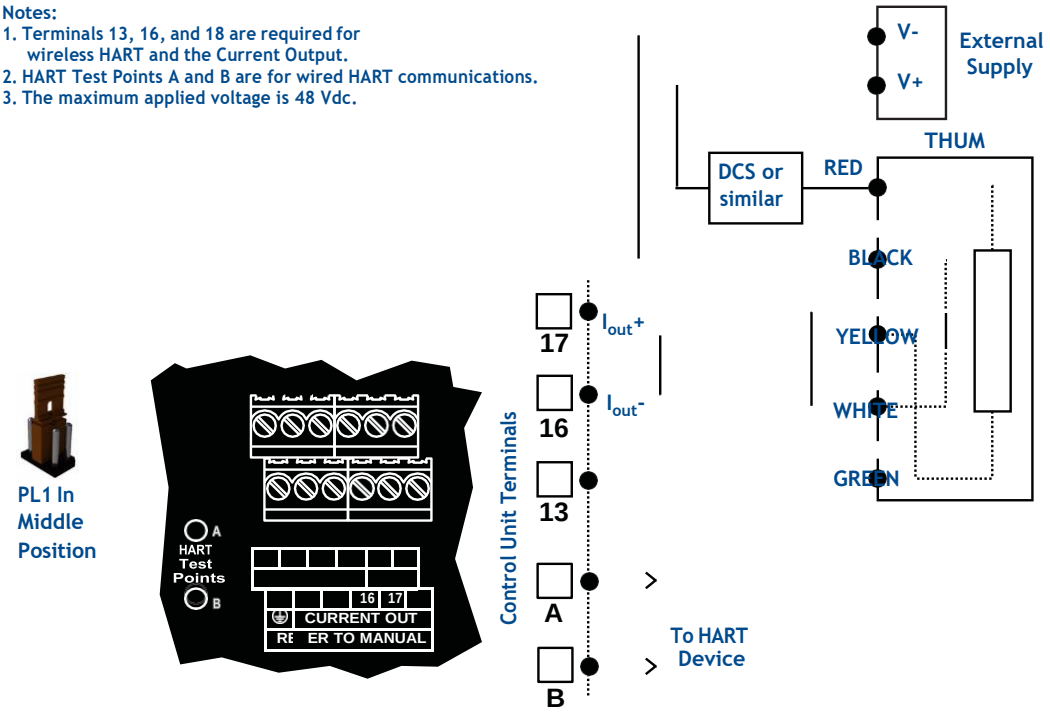
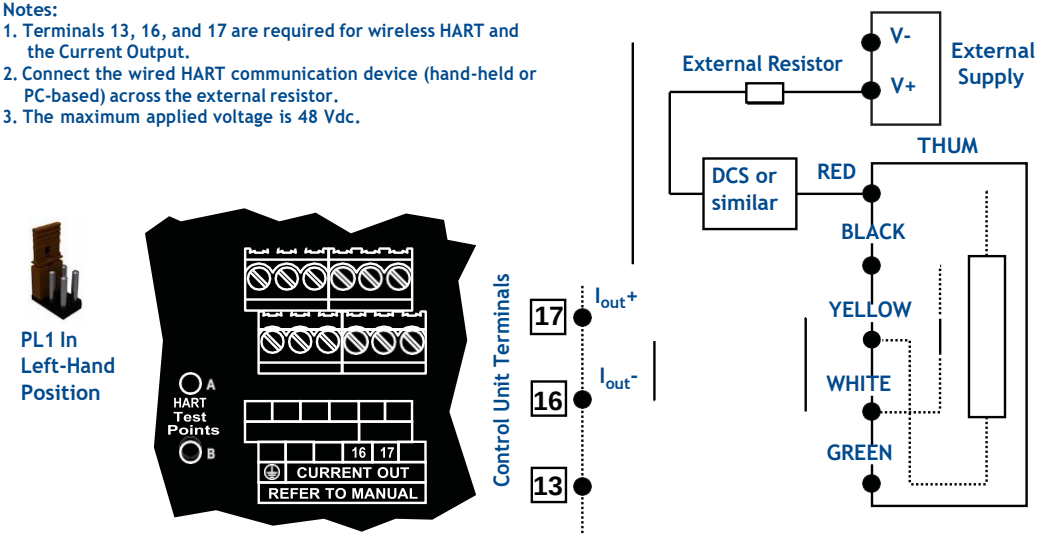


Figure 3-20. Option 4b: current output, and wired and wireless HART

Notes:
1. Terminals 13, 16, and 17 are required for wireless HART and the Current Output.
2. Connect the wired HART communication device (hand-held or PC-based) across the external resistor.
3. The maximum applied voltage is 48 Vdc.



Section 4 Getting Started

Safety messages ..... page 31
Switching on the power ..... page 32
The menu system ..... page 32
Guidance to configuring the MSM400 ..... page 38
Initial setting-up ..... page 40
Calibration ..... page 43
Setup menu ..... page 50

4.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠ WARNING

Explosions could result in death or serious injury:

Verify that the operating environment of the Mobrey MSM400 Sludge Density Monitor is consistent with the appropriate hazardous locations certifications.

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

Make sure only qualified personnel perform the installation.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any service other than those contained in this manual unless you are qualified.

4.2 Switching on the power

4.2.1 Switching on the Mobrey MSM400

After completing the installation of the control unit and sensor, apply power to the Mobrey MSM400 control unit.

The control unit briefly displays the model and software revision number, before changing to the Full Primary Display (Figure 2-6 on page 9) which indicates the Primary Variable (PV).

The default PV is the percentage-by-weight of suspended solids (%Solids). An invalid value is indicated if the sensor is not connected or in air.

The Mobrey MSM400 control unit takes the input from a Mobrey 433 or Mobrey 448 gap sensor (see Figure 2-1 on page 4).

Note

- Whenever power is lost and restored, the control unit resumes taking measurements from the sensor and the Primary Display re-appears.

4.3 The menu system

4.3.1 How to navigate the menu system

If you wish to have a quick tour of the menu system, follow the instructions in this section, otherwise feel free to explore on your own. If you get lost, use the Esc button repeatedly until the Full Primary Display re-appears.

Menu system quick tour

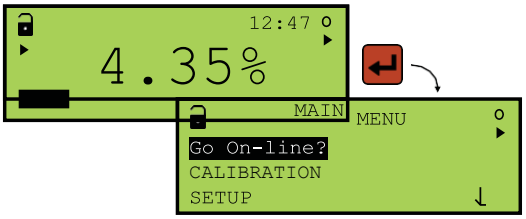
1. Ensure that the Full Primary Display is visible.

   If the menu system is visible, press the Esc button repeatedly until the Full Primary Display appears.

   If the Large PV Display is visible, press any button once.

2. Press the red (ENTER) button *once* to display the MAIN MENU (see Figure 4-1). This the top level of the menu system.

Figure 4-1. How to enter the menu system



3. Navigation of the menu system is achieved by using the ARROW buttons, the red (ENTER) button, and the Esc button.

   The Esc button returns you to the previous menu level, or to the Full Primary Display if you are at the MAIN MENU on the top level.

   If the Esc button is held down for two seconds, you will jump straight back to the MAIN MENU from within the menu system.

4. The highlighted text (e.g. Go on-line?) indicates what menu option will be selected if the red (ENTER) button was pressed now.

5. The on-screen ↓ indicates there are further menu options available, accessible by using the DOWN-ARROW button.

   An on-screen ↑ indicates there are further menu options available, accessible by using the UP-ARROW button.

6. Try using the DOWN-ARROW (↓) to highlight DIRECT (Figure 4-2), and then use the UP-ARROW (↑) button to highlight Go on-line?.

7. Press the red (ENTER) button once to select Go on-line?.

8. Use the red (ENTER) button to switch between a *closed-padlock* and *opened-padlock* (Figure 4-3 on page 34).

   An opened-padlock allows settings to be changed, and a closed-padlock prevents changes.

9. With the screen indicating an *opened-padlock*, press the Esc button once to exit back to the MAIN MENU. *Programming is now enabled, allowing settings to be changed.*

10. The MAIN MENU sits above a series of sub-menus, which lead to further levels of sub-menus that lead to parameter screens (see Figure 4-4 on page 34).

11. Within the menus, there are also parameter screens for programming (setting-up for an application, adjusting settings, etc.) and screens for displaying read-only information.

Figure 4-2. How to navigate the menu system

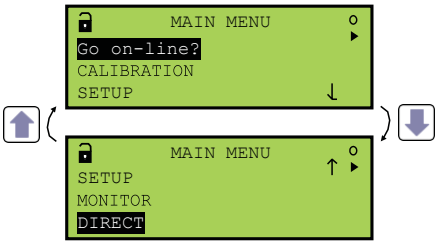


Figure 4-3. Switching between opened and closed padlocks

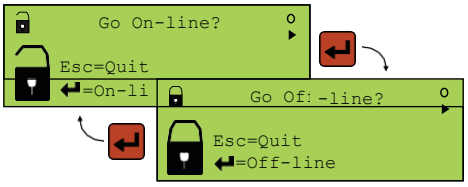
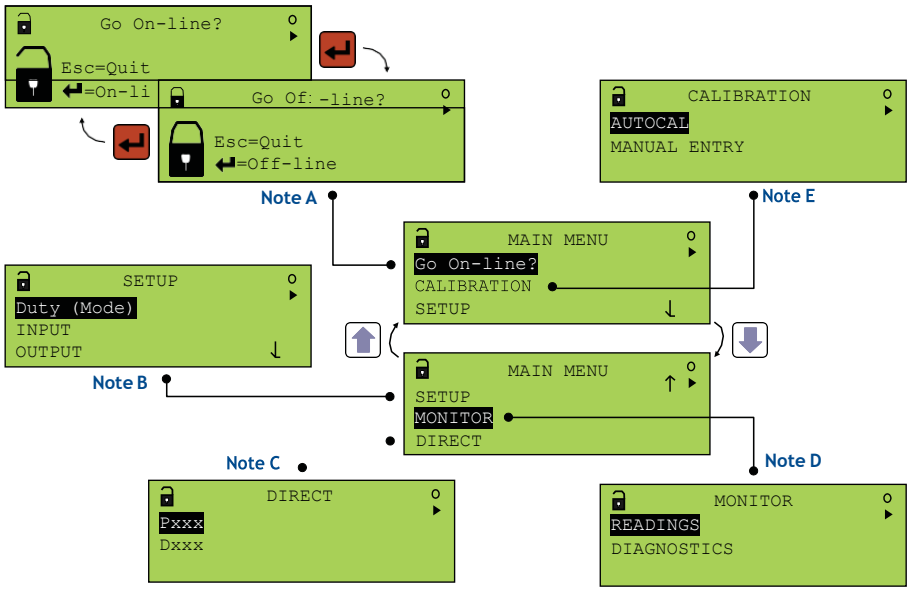


Figure 4-4. MAIN MENU overview



A. Pressing the red (ENTER) button switches the operating mode of the MSM400. An opened-padlock indicates that the unit's settings can be changed.
B. Selecting this will bring up the menu for configuring the MSM400.
C. Direct parameter access menu for quickly bringing-up parameter screens. See Appendix D for a guide to this feature.
D. Selecting this allows monitoring of live readings and diagnostic information for the MSM400.
E. For a guide to this required task, see "Calibration" on page 43.

4.3.2 How to change settings on parameter screens

To understand how to change parameter settings, such as entering the sensor gap dimension or choosing the sensor type from an option list, follow the two examples in this section.

Example 1: Entering the sensor gap dimension (value)

1. Navigate to the Sensor Gap menu option (Figure 4-5) and then press the red (ENTER) button.

2. After entering this parameter screen, it is in View Mode (Figure 4-6 on page 36).

   Guidance for what to do now is on display line 4. In View Mode, the Esc button returns you to the menu.

3. Press the red (ENTER) button to enter Edit Mode.

   The single zero ("0") changes to four zeros ("0000"), and the first digit is highlighted to show this can now be edited (Figure 4-7 on page 36). Also, on display line four, "Edit" has changed to be "Save". You can use the Esc button at any time to quit editing and restore the original setting.

4. Press the RIGHT-ARROW button *once* to highlight the next digit.

   If you go too far to the right, use the LEFT-ARROW button to move back.

5. Press the UP-ARROW button once to change the "0" to a "1".

   The UP-ARROW and DOWN-ARROW buttons scroll through the numbers (and a decimal point, where applicable).

6. Repeat Step 4 and Step 5 until the value is correct for your installation e.g. 0150 for a 150 mm gap sensor.

7. Press the red (ENTER) button to save the new sensor gap and return to View ode (see Figure 4-8 on page 36).

   On display line four, "Save" has changed back to "Edit".

8. Press the Esc button to return to the SENSOR menu.

Figure 4-5. Navigation to the sensor gap menu option

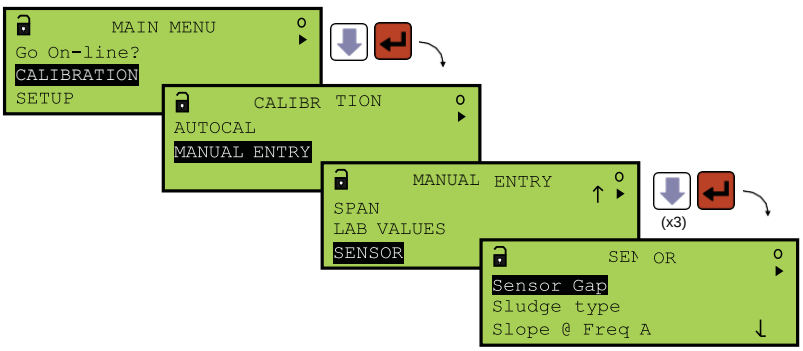


Figure 4-6. Sensor gap parameter screen (View Mode)

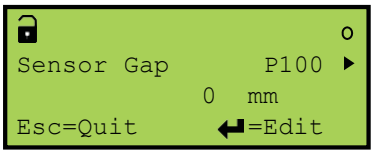


Figure 4-7. Sensor gap parameter screen (Edit Mode)

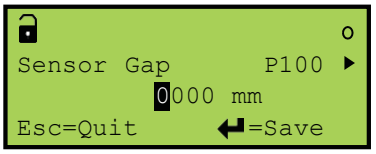
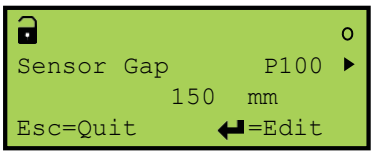


Figure 4-8. New sensor gap saved



Example 2: Choosing the gap sensor type from a list

1. Navigate to the Sensor Type parameter (as shown in Figure 4-9) and then press the **red (ENTER)** button.

2. After entering this parameter screen, it is in View Mode (see Figure 4-10).

   In View Mode, the Esc button returns you to the menu.

3. Press the **red (ENTER)** button to enter Edit Mode.

   In Edit Mode, the setting "Unknown" is highlighted to show this can now be edited (see Figure 4-11 on page 38). On display line four, "Edit" has changed to "Save". You can use the Esc button to quit editing and restore the original setting.

4. Press the **UP-ARROW** button twice to change the "Unknown" to "433".

   The UP-ARROW and DOWN-ARROW buttons scroll through the list of options e.g. "433" (Mobrey 433) and "448" (Mobrey 448).

5. Press the **red (ENTER)** button to save the new setting and return to View Mode (see Figure 4-12 on page 38).

   On display line four, "Save" has changed back to "Edit".

Figure 4-9. Navigation to the sensor type menu option

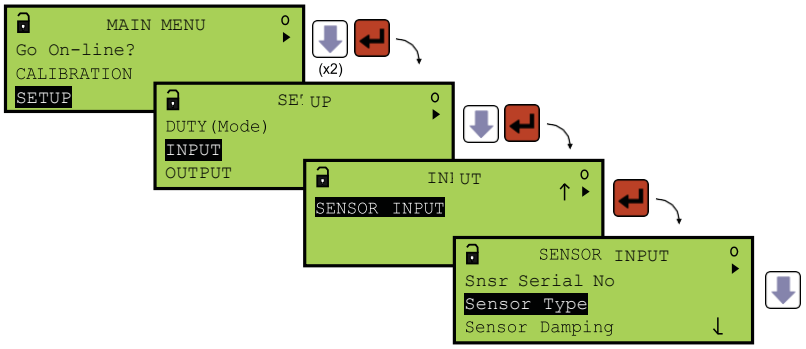


Figure 4-10. Sensor type parameter screen (View Mode)

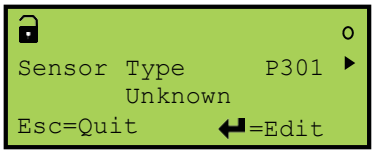


Figure 4-11. Sensor type parameter screen (Edit Mode)

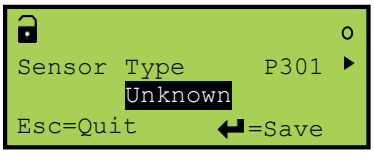
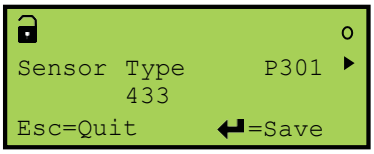


Figure 4-12. Sensor type setting saved



4.4 Guidance to configuring the MSM400

Note

- Careful preparation will help the configuration work to progress smoothly.

4.4.1 Before starting to configure

Configuring for an application is achieved from the front panel of the MSM400, or using a PC running AMS Device Manager or a Field Communicator with the Mobrey MSM400 Device Descriptor (DD) added.

Refer to "Electrical installation" on page 17 for wiring connections that can be made to the control unit.

Parameters

The control unit has menu-based parameters for configuring (setting-up for an application, adjusting settings, etc.) and for viewing information.

Parameters are populated throughout the menu system. They are grouped in sub-menus, which are organised by association with a specific function or application. Each parameter has a unique three-digit identification number, prefixed by a 'P' (if programmable) or a 'D' (if for display purposes only). Full menu maps are provided in Appendix C: Menu Maps and Parameters.

With some experience, it becomes easy to locate parameters. Alternatively, parameters can be accessed directly by knowing their unique 3-digit identification number.
See Appendix D: Additional Features for a guide to this feature.

Menu navigation

In this chapter, a simple notation has been used to guide you to a particular menu screen or parameter screen. This avoids the need for lengthy navigation instructions.

Consider the navigation instructions to be followed before arriving at the PV Units parameter screen. For this example, the starting point is the Primary Display.

In the notation form this is simply:

1. Navigate to SETUP / Duty(Mode) / PV Units.

Without the notation, this translates into these instructions:

1. Press the red (ENTER) button to display the MAIN MENU.
2. Press the DOWN-ARROW button repeatedly until SETUP is highlighted.
3. Press the red (ENTER) button *three times*.

How to configure the Mobrey MSM400 Sludge Density Monitor

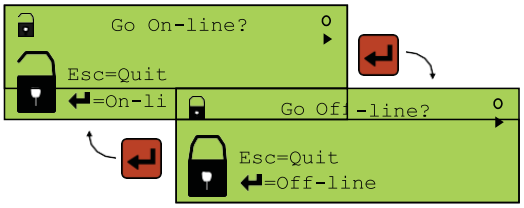
1. Put the control unit 'off-line' by opening the padlock icon (see page 40).
2. Change the system settings, which includes switching off the keyboard sound, setting the date and time, and changing on-screen language (see page 41).
3. Select the type of sensor connected to the control unit (page 42).
4. Calibrate the MSM400 for the type of sludge (page 43).
5. Set-up the duty application, which includes alternative Primary Variable (PV) units, and optional free-form text parameters e.g. a tag.
6. Set-up the outputs, which includes the Current Output (page 52) and Relays (page 54).
7. Set-up optional alarm (page 56) and fault (page 57) indication, display options (page 58), and PIN security (page 40).
8. Put the MSM400 back on-line by closing the padlock (page 40).
9. For checks (e.g. simulation), diagnostics, and faultfinding, see Section 5: Service and Health Checks.

4.5 Initial setting-up

4.5.1 Operating modes

There are two operating modes: on-line and off-line.

Figure 4-13. How to switch between On-line and Off-line



An opened padlock icon indicates the MSM400 is operating in the 'off-line' mode.
The configuration settings can be changed, but the Isolated Current Output and Relays (RL1 and RL2) are *frozen*. Fault relays are de-energized.

A closed padlock icon indicates that the MSM400 is operating in the 'on-line' mode. Most of the unit configuration settings cannot be changed. However, it prompts to go 'off-line' (and enter a security PIN if set) when attempting to change a setting. The Isolated Current Output and Relays (RL1 and RL2) are *not frozen*.

Unit security

By default, security restrictions are switched off and the user has access to all configuration parameters. After the configuration is complete, a PIN security code can be used to prevent unauthorized access. See "PIN Security" on page 40 for further information.

Note

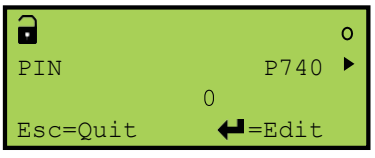
- There is trouble-shooting information in Section 5. Alternatively, the MSM400 can be re-set to the factory defaults (see "Restoring the factory defaults" on page 64).

4.5.2 PIN Security

Menu: SETUP / SYSTEM / SETTINGS / PIN

PIN

P740 PIN



Personal Identification Number (PIN) security prevents unauthorized people from configuring the MSM400. Typically, this is set-up when all the other programming has been completed. As with bankcards, there is one PIN number.

The factory default is for PIN security to be *inactive*. To activate, navigate the menu system to the PIN screen and edit a 4-digit personal identification number (PIN) that you want. The PIN is

edited with the arrow keys and confirmed with the red (ENTER) button; the 4-digit PIN will then be replaced by "-----" to indicate that PIN security is *active*. (By default, the PIN is "0" if inactive).

After PIN security is activated, a prompt for the PIN appears when needed for authorization. If correctly entered, no further PIN requests are made unless there is a period of keypad inactivity, or the Cancel Password option is selected from the MAIN MENU screen.

The Cancel Password menu option appears only after correctly entering the PIN. It disappears when selected, and makes the MSM400 secure and prompt for the PIN when needed.

Note

- If the PIN number has been forgotten, contact us for assistance.
  Please ensure that you have the serial number of the MSM400 Control Unit available.
  It is located in the menu system at: SETUP / SYSTEM / FIXED / Serial Number

4.5.3 System settings

It is advisable to check the settings of these parameters and, if necessary, make changes. This includes setting the time and date, switching off the keypad sound, and changing the on-screen language.

Menu: SETUP / SYSTEM / SETTINGS

Setting the real-time clock

P730 Date

The date format is determined by parameter P734.

P731 Time

The 24-hour clock format is supported.

P734 Date format (Default setting is "dd/mm/yy")

Choose between "dd/mm/yy", "yy/mm/dd", and "mm/dd/yy".

Keypad sound

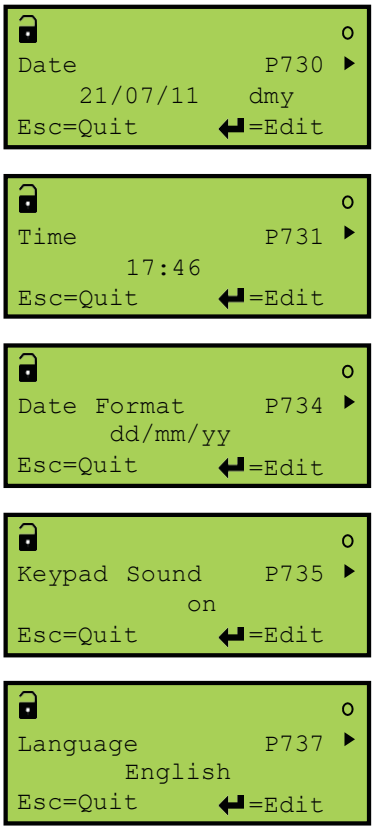
P735 Keypad Sound (Default setting is "On")

If you want the keypad sound switched off, select "Off" from the list of options.

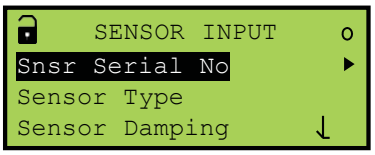
Language

P737 Language (Default setting is "English")

If you want to change the language used on-screen, there is a choice of five languages - English, Francais (French), Deutsch (German), Svensk (Swedish), and Polski (Polish).



4.5.4 Sensor input



The MSM400 control unit is used *exclusively* with ultrasonic gap sensors. These take the form of either a Mobrey 433 tank mounted sensor or a Mobrey 448 pipe section sensor.

Menu: SETUP / INPUT / SENSOR INPUT

Note

- Parameter Snsr Serial No. (P300) is set by the factory and cannot be edited.

P301 Sensor Type (Default: “Unknown”)

This selects the gap sensor type being used with the control unit.
Options include: Unknown (*default*), None, <Blank>, 433, and 448.

P302 Sensor Damping (Default: 5.00 s; Range: 0.00 to 99.9 s)

This is damping applied to the raw input signal from the gap sensor, and reduces the effects of erratic flow. Damping is specified in seconds.

P303 Sensor Delay (Default: 0.00; Range: 0.00 to 999.59)

This introduces a delay before the control unit reacts to the Primary Variable (PV) crossing a set threshold value. The setting 0:00 (m:s) is for no delay.

Example Settings:

Sensor Delay (P303) = 0:10

Relay 1 Mode (P410) = Set Point

RL 1 On Point (P411) = 15%

RL1 Off Point (P411) = 10%

The result is that Relay 1 (RL1) energizes *10 seconds* after the PV rises above *15%*.
Relay 1 de-energizes *10 seconds* after the PV falls below *10%*.

4.6 Calibration

Calibration results in the MSM400 operating at either Frequency A (1 MHz) or Frequency B (3.3 MHz). It is essential, and must be performed.

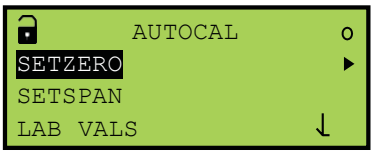
There are two calibration methods:

- Auto Calibration (Autocal) - *see below*
- Manual Entry - *see* *"Manual entry control unit calibration" on page 47*

4.6.1 AUTOCAL control unit calibration

Autocal is the preferred method and consists of four stages:

1. Setting Zero in clean mother liquor (usually water).
2. Setting the Span.
3. Entering Laboratory Values.
4. Entering the Maximum %Solids required to be measured.



Note

- It is recommended to calibrate the control unit against a known sample.

AUTOCAL: zero setting (*Mobrey 433 tank mounted sensor*)

1. Ensure the Mobrey MSM400 control unit is *off-line* (opened padlock).
2. Immerse the gap sensor in a container of clean mother liquor.

   Ensure there are no gas (air) bubbles on the sensor faces.

Mobrey 433 Tank Mounted Sensor

3. Navigate to the SETZERO parameter (CALIBRATION / AUTOCAL / SETZERO)
4. Follow the on-screen instructions.
5. Observe the two displayed values, confirming they are reasonably stable.
6. Press the **red (ENTER)** button to save when satisfied with the values, or quit using the Esc button.

This procedure has saved the sensor insertion loss (in dB) to the control unit's memory. Now, proceed to "AUTOCAL span setting (Mobrey 433 tank mounted sensor)" on page 44.

AUTOCAL: zero setting (*Mobrey 448 pipe section sensor*)

Mobrey 448 Pipe Section Sensor

1. Ensure the Mobrey MSM400 control unit is *off-line* (opened padlock).
2. Flood the pipe section with clean mother liquor.

   Ensure there are no gas (air) bubbles on the sensor faces. This may be difficult to confirm, but there are two options:

   a. De-mount the pipe section, stand it on a rubber mat, flood the pipe section with clean mother liquor. Occasionally wipe the sensor faces to prevent gas (air) bubbles depositing on the sensor faces.
   b. With the pipe section in-situ, flush through with a continuous stream of mother liquor. This supply must not have a significant drop in pressure to ensure gas (air) has not come out of solution.
3. Navigate to SETZERO parameter (CALIBRATION / AUTOCAL / SETZERO)
4. Follow the on-screen instructions.
5. Observe the two displayed values, confirming they are reasonably stable.
6. Press the **red (ENTER)** button to save when satisfied with the values, or quit using the Esc button.

This procedure has saved the sensor insertion loss (in dB) to the control unit's memory. Now, proceed to AUTOCAL span setting (Mobrey 448 pipe section sensor) below.

Note

- The stored value can be viewed (and edited) at Zero ref@FreqA (P120), etc. See the "Manual Entry" sections on later pages.

AUTOCAL span setting (*Mobrey 433 tank mounted sensor*)

It is essential to carry out the Span Setting with the sensor in a sludge blanket in the tank. If a sample is drawn from the bottom of the tank, dissolved gas (air) may come out of solution and affect the calibration.

Mobrey 433 Tank Mounted Sensor

It is necessary to take a sludge sample at the same time as the SETSPAN routine is performed and it may require the assistance of a second person. Take appropriate safety precautions.

Note

- The calibration is carried in terms of %solids. If it is required to operate in other measurement units (e.g. g/l), that adjustment must be made after calibration (including Lab Val and Max %Solids) is complete.

1. Lower the gap sensor into the sludge blanket, ensuring a reasonably steady indication.
2. Navigate to CALIBRATION / AUTOCAL / SETSPAN

3. Follow the on-screen instructions.

4. Observe the two displayed values, confirming they are reasonably stable.

5. Press the red (ENTER) button to save when satisfied with the values, or quit using the Esc button.

Sludge Samples Are Required

The control unit prompts to perform another SETSPAN operation. This may result in a better overall accuracy and repeatability.

6. If the values are saved, take actual samples (at the same time as Step 5) and send them to a laboratory to confirm the %Solids.

This procedure has saved the additional signal loss due to the sludge to the control unit's memory.

Note

- These values can be viewed (and edited) at Span 1 @ FreqA (P130), etc. See the “Manual Entry” sections on later pages.

AUTOCAL span setting (*Mobrey 448 pipe section sensor*)

It is necessary to take a sludge sample from close to the senor at the same time as the SETSPAN routine is performed and it may require the assistance of a second person.

Take appropriate safety precautions.

Mobrey 448 Pipe Section Sensor

Note

- The calibration is carried in terms of %solids. If it is required to operate in other measurement units (e.g. g/l), that adjustment must be made after calibration (including Lab Val and Max %Solids) is complete.

1. Allow the sludge flow to stabilize, ensuring the two opposing sensor faces are fully covered.

2. Navigate to CALIBRATION / AUTOCAL / SETSPAN.

3. Follow the on-screen instructions.

Sludge Samples Are Required

4. Observe the two displayed values, confirming they are reasonably stable.

5. Press the red (ENTER) button to save when satisfied with the values, or quit using the Esc button.

The control unit prompts to perform another SETSPAN operation. This may result in better overall accuracy and repeatability.

6. If the values are saved, take actual samples (at the same time as Step 5) and send them to a laboratory to confirm the %Solids.

This has saved the additional signal loss (due to sludge) to the control unit's memory. Proceed to AUTOCAL lab values (both sensor types) below.

Note

- These values can be viewed (and edited) at Span 1 @ FreqA (P130), etc. See "Manual entry control unit calibration" on page 47 for instructions.

AUTOCAL lab values (both sensor types)

1. Navigate to the parameter Lab Value 1 (P150) (CALIBRATION / AUTOCAL / LAB VALS / LAB VALS / Lab Value 1)
2. Edit Lab Value 1 (P150) to be the same value as given by the laboratory, and save the setting.
3. Scroll to, edit, and save Lab Value 2 (P152) and Lab Value 3 (P153) as appropriate. Otherwise, press Esc.

Mobrey 433 Tank Mounted Sensor

Mobrey 448 Pipe Section Sensor

Now, proceed to edit the maximum %Solids required to be measured.

AUTOCAL max %solids (both sensor types)

1. Navigate to the parameter Max %Solids (P160) (CALIBRATION / AUTOCAL / Max % Solids)
2. Edit Max %Solids (P160) to be the maximum, desired percentage-by-weight of suspended solids, and then save the setting.

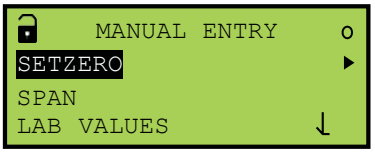
This final action, together with the Span and Lab Values information results in the control unit operating at either Frequency A (1 MHz) or Frequency B (3.3 MHz).

Mobrey 433 Tank Mounted Sensor

Mobrey 448 Pipe Section Sensor

4.6.2 Manual entry control unit calibration

Manual entry consists of three stages:



1. Setting Zero in clean mother liquor (*usually water*).
2. Setting the Span (*three alternative methods*).
3. Entering the Maximum %Solids required to measure.

Note

- It may require the use of laboratory sample values (see later).

Manual Entry: Zero Setting (Both Sensor Types)

The easiest way to set the zero is to follow the AUTOCAL / SETZERO routine as previously explained (see page 43). If this is not possible and values have been provided, then follow this procedure:

1. Ensure the Mobrey MSM400 control unit is *off-line* (opened padlock).
2. Navigate to Zero ref@FreqA (P120) (CALIBRATION / MANUAL ENTRY / ZERO REF / Zero ref@FreqA)
3. Edit the value, and save the setting.
4. Scroll to the parameter Zero ref@FreqB (P121).
5. Edit the value, and save the setting.

Mobrey 433 Tank Mounted Sensor

Mobrey 448 Pipe Section Sensor

This has saved the sensor insertion loss (in dB) to the control unit's memory. Now, proceed to Manual entry: span setting (both sensor types) .

Manual entry: span setting (both sensor types)

Setting the span can be achieved using three alternative methods:

- Span Method - *see below*

  Edit and save signal loss due to sludge as sludge sample is taken. Then edit Lab Values when available, and set Max %Solids.

  This is a manual version of the AUTOCAL / SETSPAN routine as previously described (page 44).

- Sensor Gap/Sludge Type method - *see page 48*
- Slope Factor method - *see page 49*

  With the Slope factor method, these figures may have been derived from a previous calibration. This is the least preferred method.

Mobrey 433 Tank Mounted Sensor

Mobrey 448 Pipe Section Sensor

Sludge Samples Are Required

Span method: step (a) entering span settings

The easiest way to set the span is to follow the AUTOCAL/SETSPAN routine as previously explained (on page 44). If this is not possible and figures have been provided from some source, then proceed as below:

1. Navigate to Span 1 @ FreqA (P130).
   (CALIBRATION/MANUAL ENTRY/SPAN/Span 1 @ FreqA)
2. Edit the value and save it, ensuring a sample is taken at the same time.
3. Scroll to Span 1 @ Freq B (P131).
4. Edit the value and then save it, ensuring a sample is taken at the same time.
5. Repeat for Span 2 (@ Frequencies A and B) and Span 3 (if required)
6. Enter the laboratory results (see below).

Span method: step (b) entering lab values

1. Navigate to LAB VALS
   (CALIBRATION / MANUAL ENTRY / LAB VALS / Lab Value 1)
2. Edit the value, and then save it.
3. Scroll to Lab Value 2 and Lab Value 3 (if appropriate).
4. Enter Max %Solids (P160) (see below).

Span method: step (c) entering Max %Solids (P160)

1. Navigate to Max % Solids (P160)
   (CALIBRATION / Max % Solids)
2. Edit the value, and then save it.

This final action, together with the Span and Lab Values information results in the control unit operating at either Frequency A (1 MHz) or Frequency B (3.3 MHz).

Sensor gap and sludge type method

1. Navigate to Sensor Gap (P100)
   (CALIBRATION / MANUAL ENTRY / SENSOR / Sensor Gap)
2. Edit the value to be the sensor gap size (in mm), and then save it.
3. Scroll to Sludge Type (P101)
4. In edit mode, select the sludge type which is closest to your sludge.

Options include: None (inactive), Primary (Municipal sludge), Secondary (Municipal sludge), China Clay (Kaolin), Bauxite, Metal Hydrox(ides), Water (treatment) Alum, Potable (water) sludge, Lime Slurry, Copper Tails (tailings).

Each sludge type has a signal loss (attenuation) expressed as dB per %Solids per mm sensor gap. By selecting a Sludge Type and entering the Sensor Gap results in the control unit knows the signal loss (attenuation) for 1% suspended solids. These attenuation factors are based on many years of experience but will vary from source to source.

5. Then enter Max %Solids (P160) (see below)

Manual entry of Max %Solids (P160)

6. Navigate to Max % Solids (P160)
(CALIBRATION / Max % Solids)

7. Edit the value, then save it.

This final action, together with the Span and Lab Values information results in the control unit operating at either Frequency A (1 MHz) or Frequency B (3.3 MHz).

Sensor slope factor method

This is the least preferred method. It relies on known signal loss data. If this method is to be used, follow this procedure:

1. Navigate to dB Fact 1 (P102)
(CALIBRATION / MANUAL ENTRY / SENSOR / Slope @ Freq A)

2. Edit the value (in dB/% solids), and then save it.

3. Scroll to Slope @ Freq B (P103).

4. Edit the value (in dB/% solids), and then save it.

5. Enter Max %Solids (P160) (see below).

Manual entry of Max %Solids (P160)

6. Navigate to Max % Solids (P160)
(CALIBRATION / Max % Solids)

7. Edit the value, and then save it.

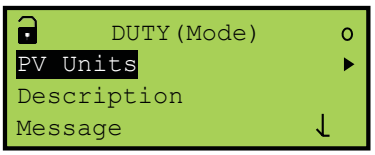
This final action, together with the Span and Lab Values information results in the control unit operating at either Frequency A (1 MHz) or Frequency B (3.3 MHz).

4.7 Setup menu

4.7.1 Primary Variable units

Menu: SETUP / DUTY (Mode) / PV UNITS

P200 PV Units



The Primary Variable (PV) is typically the *percentage-by-weight of suspended solids* (%Solids), and drives the Isolated Current Output and relays.

The PV units can be changed with P200 and this will apply a scaling factor to automatically re-scale the PV value into the correct units. Valid PV Units are % (*default*), kg/m^3, lb/gal, lb/ft^3, g/l, mg/l, mg/cc, oz/ft^3, oz/gal, lb/yd^3, none.

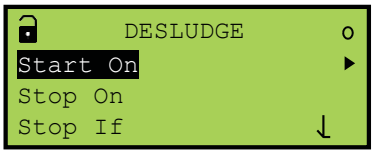
Note

- This is a simple fixed scaling factor which may not correct for density variations (usually quite small) of the dry solids or the mother liquor.

4.7.2 De-sludge function

Menu: SETUP / DUTY (Mode) / DESLUDGE

The de-sludge menu allows the Mobrey MSM400 control unit to perform simple de-sludging functions using a relay.



De-sludging can be based on time, Primary Variable (PV) comparison with a relay On/Off Point, or the digital trigger input IN1. There are two separate de-sludging periods e.g. for day-time and night-time.

A relay must be allocated to de-sludge duty using Relay 1 Mode (P410) or Relay 2 Mode (P420) parameters (see “Relays” on page 54).

P250 Start On

This specifies what function *starts* a de-sludge operation, which then uses a de-sludge duty relay. Options include:

- “None” (*default*)
- “Time” - *see Start Time 1 (P253) and Start Time 2 (P255)*
- “PV > level” - *Primary Value rises above the relay On Point level*
- “Ext Trig” - *see page 26 for digital trigger input connections*

P251 Stop On

This specifies what function *ends* the de-sludge operation.
Options include:

- "None" (*default*)
- "Time" - *see Interval 1 (P254) and Interval 2 (P256)*
- "PV < level" - *Primary Value falls below the relay Off Point level*
- "Ext Trig" - *see page 26 for digital trigger input connections*

P252 Stop If

This fail-safe allows the Stop On (P251) function to be overridden.
Options include:

- "Not Used" (*default*)
- "PV < level" - *Primary Value falls below the relay Off Point level*
- "Ext Trig" with selectable delay in seconds
  (0s, 1s, 2s, 5s, 10s, 15s, 20s, 30s, 60s, 90s, 120s, 180s, or 240s)
  - *see page 26 for digital trigger input connections*

P253 Start Time 1 (Default: 7:00 h:m)

This is the time of day at which a de-sludge operation would start.
The default start time is 07:00 am. in the 24-hour clock format.

P254 Interval 1 (Default: 1:00 h:m)

This selects how frequently a de-sludge operation should be performed.
The default interval between operations is 1 hour.

P255 Start Time 2 (Default: 0:00 h:m)

This is the time of day at which a *second* de-sludge operation would start.
Use the 24-hour clock format to enter the required time. The default time of 0:00 inhibits this *second* de-sludge operation.

P256 Interval 2 (Default: 0:00 h:m)

This selects how frequently a *second* de-sludge operation should be performed. The default setting of 0:00 is for *no interval* between operations.

P257 Max Retries (Default: 0)

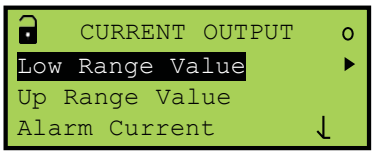
This defines the *maximum number of attempts* to perform a relay operation before it becomes an alarm condition.

The situation can occur if the control unit is *off-line* (open padlock), preventing all relay operations from running. It can also occur when a *maximum on time* relay safeguard prevents the completion of a relay operation. See page 55 for all relay safeguard parameters.

Note

- For alarm indication options, see "Alarms" on page 56.

4.7.3 Current Output



Menu:
SETUP / OUTPUT / CURRENT OUTPUT

Note

- The output current is *frozen* while the MSM400 control unit is in the *off-line* (opened padlock) operating mode. See "Operating modes" on page 40.

P400 Low Range Value (Default: 0.00)

This is the Primary Variable (PV) value represented by a *4 mA output*, or a *0 mA output* if Current Span (P403) is set to 0-20 mA. Units are set by parameter PV Units (P200) (page 50).

P401 Up Range Value (Default: 40.00)

This is the Primary Variable (PV) value represented by a 20 mA output.
Units are set by the parameter PV Units (P200) (see page 50).

P403 Current Span

This is the minimum current over which the current output is linear.
Options include:

- 0-20 mA (*HART communication is not available below 4 mA*)
- 4-20 mA (*default*)

P402 Alarm Current (Default: High)

This parameter specifies the *fixed output current* to be applied while an alarm or fault condition is active. Options include:

- LOW - Fixes the output current to a low current (Table 4-1) to indicate an alarm.
- HOLD - Freezes the output current at the present Primary Variable (PV) value.
- HIGH (*default*) - Fixes the output current to a high current (Table 4-1) to indicate alarm.

Note

- See "Control unit specifications" on page 71 for technical information about the Current Output.

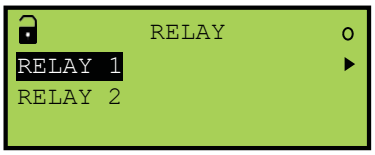
Table 4-1. Current Saturation and Alarm Levels

Current Output Linear Limit		Alarm LOW (mA)	Alarm HIGH (mA)	P402 Options (Output Current)	Factory Default Setting for P402
Minimum (mA)	Maximum (mA)				
3.8	20.5	3.6	21.0	High (21.0 mA)	High (21.0 mA)
				Hold	
				Low (3.6 mA)	

Note

- It is an alarm condition when the output current has reached the linear limit i.e. saturated. The saturation levels limits are ≤ 3.9 mA and ≥ 20.8 mA.

4.7.4 Relays



Menu: SETUP / OUTPUT / RELAY

There are two Single Pole, Double Throw (SPDT) relays.

Note

- Relay states are *frozen* while the MSM400 control unit is in the *off-line* (opened padlock) operating mode. See "Operating modes" on page 40.

Relay 1

The Relay 1 (RL1) output is normally configured as a Set Point relay. It can be used to start and stop pumps, or open and close valves, at different Primary Variable (PV) threshold set values. The relay energizes at one level and de-energizes at a different level.

For further details, see Relay 1 Mode (P410) below, and "Set Point Control" on page 55.

Relay 2

The Relay 2 (RL1) output is normally configured as a Fault relay.
Fault conditions are defined in the FAULT menu (see page 57).

Both relays can be changed to perform other actions such as the de-sludge function, alarm control (see ALARM menu on page 56), PV out-of-limit alarm, be always energized, or be always de-energized.

Relay 1 can be changed to a Fault relay by editing the parameter Relay 1 Mode (P410) setting.

Relay (RL) status

The relay status icons on the Full Primary Display have these meanings:

▸ = energized: Relay is presently energized.

0 = de-energized: Relay is presently de-energized.

A = Alarm: Relay allocated to alarm duty (see page 56 about alarms).

Relay duty selection

P410 Relay 1 Mode (Default: "Set Point")

The relay modes are:

- "Set Point" duty

  The relay energizes at the On Point (P411) setting, and de-energizes at the Off point (P412) setting. See "Set Point Control" on page 55 for setting these threshold parameters.

- "Desludge" duty

  A typical application for the relay is to control the de-sludging of a tank. This involves the pumping out of sludge from the tank. See "De-sludge function" on page 50 for setting the *start* and *stop* conditions.

- "Alarm" duty

  While an alarm condition exists (see page 56), it can be indicated by a relay *energizing* and the Isolated Current Output *forced* to a mA level specified by the parameter Alarm Current (P402). See "Alarms" on page 56 for configuring how specific alarm conditions are indicated.

- "Fault" duty

  While a fault condition exists (see page 57), it can be indicated by the relay *de-energizing* and the Isolated Current Output *forced* to a mA level specified by the parameter Alarm Current (P402). See "Faults" on page 57 for configuring how specific fault conditions are indicated.

- "On" duty - *The relay is always energized.*
- "None" - *The relay is inactive.*
- "Off" duty - *The relay is always de-energized.*

P420 Relay 2 Mode (Default: "Fault")

As Relay 1 Mode (P410). See above for options, but use RL2 parameters.

"Set Point" control

P411 RL1 On Point(Default: 0.00; Units are PV Units)

This is the level at which the relay RL1 energizes when the Set Point duty is selected by parameter Relay 1 Mode (P410).

P412 RL1 Off Point (Default: 0.00; Units are PV Units)

This is the level at which the relay RL1 de-energizes when the Set Point duty is selected by parameter Relay 1 Mode (P410).

P421 RL2 On Point (Default: 0.00; Units are PV Units)

As RL1 On Point (P411), but specific to Relay 2 (RL2).

P422 RL2 Off Point (Default: 0.00; Units are PV Units)

As RL1 Off Point (P412), but specific to Relay 2 (RL2).

Relay safeguard options

P413 RL1 Min ON (Default: 0:00 m:s)

After relay RL1 is energized, it stays energized until the *minimum on time* (in minutes and seconds) has elapsed *or* until the specified condition (PV > Off Setpoint, Fault, Alarm, etc.) has passed, whichever is the later.

This optional override (safeguard) allows sufficient time for connected equipment to respond.

P414 RL1 Max ON (Default: 0:00 m:s)

After relay RL1 is energized, it is de-energized when the *maximum on time* (in minutes and seconds) has elapsed time regardless of other specified conditions from relay duty selection (page 54).

This optional override (safeguard) prevents overuse of connected equipment.

P415 RL1 Min OFF(Default: 0:00 m:s)

When relay RL1 has de-energized, it does not energize again until the *minimum off time* has elapsed, regardless of specified conditions from relay duty selection (page 54).

This optional override (safeguard) avoids overuse of connected equipment.

P423 RL2 Min ON(Default: 0:00 m:s)

As RL1 Min On (P413), but specific to Relay 2 (RL2).

P424 RL2 Max ON (Default: 0:00 m:s)

As RL1 Max On (**P414**), but specific to Relay 2 (RL2).

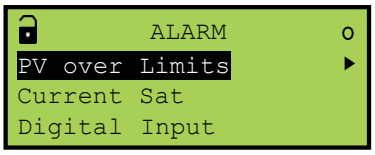
P425 RL2 Min OFF(Default: 0:00 m:s)

As RL1 Min On (**P415**), but specific to Relay 2 (RL2).

4.7.5 Alarms

Menu: SETUP / OUTPUT / ALARM

The Mobrey MSM400 control unit can detect the following alarm conditions:



- Current Output Saturated (*see P541 below*):

  This alarm happens if the PV is such that the output current wants to drive beyond the saturation level values (see Table 4-1 on page 4-53)

- Digital Input Activated (*see P543 below*):

  This alarm happens while Digital Trigger Input (IN1) is activated.

For each alarm listed above, there is a dedicated parameter in the ALARM menu for selecting the method of indication for that alarm.

P541 Current Sat (Default: “None”)

Options for indicating this alarm condition are “None” (*inhibited alarm*) and “Relay” (*see “Relays” on page 54*).

P542 Digital Input (Default: “None”)

The digital input is active and has been assigned to an Alarm function.
Review the configuration of related parameters.

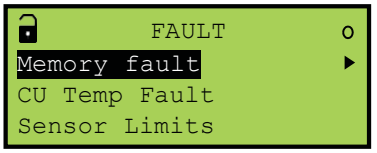
Options for indicating this alarm condition are “None” (*inhibited alarm*), “Relay” (*see “Relays” on page 54*), “Current” (*see “Current Output” on page 52*), or “Both” (*relay and current output*)

Note

- The default settings for P541 and P543 are for these alarms to be not indicated by a relay or Current Output. However, alarms are always shown on the primary display and in the alarm report parameter D830.

4.7.6 Faults

Menu: SETUP / OUTPUT / FAULT



The Mobrey MSM400 control unit can detect the following fault conditions:

- Control Unit Memory Fault (*see P560 below*):

  When this fault happens, Fault relays de-energize and the output current is forced to the Alarm Current (P402) specified. This is the default setting.

- Control Unit Temperature Out-of-limits (*see P561 below*):

  The control unit’s internal temperature (D844) is operating outside the ambient temperature specification limits (see Appendix A: Reference Data).

- Sensor Out-of-limits (*see P562 below*):

  The total attenuation (D852) has exceeded either of these two limits:

  Menu: SETUP / ENGINEERING / SENSOR LIMITS /

  Min dB (P640) (Default: 16.0 dB)

  Max dB (P641) (Default: 90.0 dB)

- Attenuation is less than the Zero Reference

  The measured attenuation value is less than the value stored for the clear supernatant. See “Calibration” on page 43 for how to re-calibrate the zero reference.

- Clock error

  The internal real-time clock is not advancing.

- Retries Out-of-limits

  The control unit is configured to perform a de-sludging or cleaning operation. However, it has failed to achieve the required Stop On (P251) condition despite a number of retries (Max Retries parameter P257).

  Check that the system is functioning correctly, including the valves and pumps which are implementing the de-sludging or cleaning operation. Also, check that the sensor assembly is not dirty. Review the configuration of alarm parameters (see “Alarms” on page 56).

P560 Memory Fault(Default: “Both”)

Memory faults include ROM checksum error, EEPROM signature error, EEPROM checksum error, and RAM test failure.

Options for indicating this fault condition are “None” (*not indicated*), “Relay” (see *“Relays” on page 54*), “Current” (*see “Current Output” on page 52*), or “Both” (*relay and current output*).

P561 CU Temp Fault (Default: “None”)

Options for indicating this fault condition are “None” (*not indicated*), “Relay” (*see “Relays” on page 54*), “Current” (*see “Current Output” on page 52*), or “Both” (*relay and current output*).

P562 Sensor Limits (Default: “None”)

Options for indicating this fault condition are “None” (*not indicated*), “Relay” (*see “Relays” on page 54*), “Current” (*see “Current Output” on page 52*), or “Both” (*relay and current output*).

Note

- The default settings for P561 and P562 are for these specific faults to be not indicated by a relay or Current Output. However, faults are always shown on the primary display and in the fault report parameter D831.

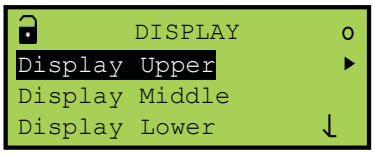
4.7.7 Display

Menu: SETUP / OUTPUT / DISPLAY

The factory default configuration of the Full Primary Display can be changed to show different graphic and text information.

Three areas of the Full Primary Display can be re-configured:

- Upper display
- Middle display
- Lower display



In addition, the Large PV Display and backlight operations can be adjusted.

P570 Display Upper (Default: “P731-Time”)

Select from a multiple-choice list of parameters (see Table 4-2 on page 4-59).

P571 Display Middle (Default: “D800-PV”)

Select from a multiple-choice list of parameters (see Table 4-2 on page 4-59).

P572 Display Lower (Default: “Bargraph”)

Select from a multiple-choice list of parameters (see Table 4-2 on page 4-59).

P574 Display Size (Default: “Large”)

Use this to adjust whether the primary display shows the Large PV Display after a period of keypad inactivity, or remains showing the Full PV Display.

P575 Backlight (Default: “On”)

Select from “On” (always on), “Off” (always off) or “Auto” (goes on when using keypad; goes off after 5 minutes of inactivity).

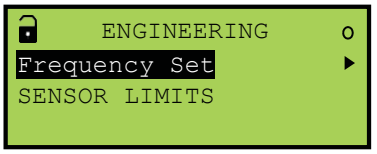
Table 4-2. Full Primary Display line selection

P570/1/2 Options	Parameters
None	(Nothing selected)
D800-PV	Primary Variable (PV) value
D801-Density	Sludge density
D802-Atten	Attenuation
D803-Total Att	Total attenuation
D805-%mA Out	Percentage of current output (0/4-20 mA span)
D806-mA Out	Actual current output
D821-RL1 time	Running time for relay RL1 if energized
D822-RL2 time	Running time for relay RL1 if energized
D844-CU Temp	Temperature of MSM400
D850-Atten@A	Measured attenuation when gap sensor is operating at 1 MHz
D851-Atten@B	Measured attenuation when gap sensor is operating at 3.3 MHz
D860- Freqncy.	Operating frequency of gap sensor
P240-Descript(1)	Free-form description
P241-Message(1)	Free-form message
P242-Tag(1)	Free-form tag name
P730-Date	Date
P731-Time	Time of day
Bargraph(2)	Bargraph of 0/4-20 mA output (for lower display only)

(1) Parameter is in the menu SETUP / Duty(Mode)
(2) The bargraph can only be selected for the lower display line.

4.8 Engineering

4.8.1 Engineering Setup



Menu: SETUP / ENGINEERING

P630 Sensor Frequency (Default: Auto)

The MSM400 control unit may operate at one of two frequencies, A or B, which are 1 MHz or 3.3 MHz respectively. Sensor Frequency is used to determine the actual operating frequency that the MSM400 will use (D860).

Section 5 Service and Health Checks

Safety messages ..... page 61
General troubleshooting ..... page 62
Servicing ..... page 63
Restoring the factory defaults ..... page 64
Tests ..... page 64

5.1 Safety messages

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a caution symbol (⚠). The external hot surface symbol (⚠) is used when a surface is hot and care must be taken to avoid possible burns. If there is a risk of an electrical shock the (⚠) symbol is used. Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- The Mobrey MSM400 Sludge Density Monitor must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment

Explosions could result in death or serious injury:

- Please review the approvals section of this reference manual for any restrictions associated with an installation

Electrical shock could cause death or serious injury:

- If the control unit is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the control unit is off while making connections

5.2 General troubleshooting

5.2.1 Troubleshooting guide

There is no display

- Check if the power supply cable insulation is preventing contact at the terminal block
- Check if the *correct* power supply is connected to the *correct* terminals (see “Power connections” on page 20)
- If the control unit is AC-powered, check the voltage selector switch is in the correct position (see Figure 3-4 on page 18).
- Check the main fuse (200 mA (T) 5 x 20mm)
- If the control unit is DC-powered, check there is a minimum of 15 Vdc at the terminals.

Solids indication changing and current fixed/relays not switching

- If the control unit is off-line (open padlock), return unit to the on-line (closed padlock) operating mode (see “Operating modes” on page 40)

Solids indication is not changing

- Check that the sensor is connected
- Check that the sensor is covered
- Check the sensor orientation is correct for the pipe-section sensor

  Ensure the line between the two halves of the pipe sensor is (nominally) horizontal
- Check that SETZERO / ZERO REF has been set correctly
- If the measurement is “out-of-range”, contact the factory

No current output

- Check PL1 is in either the left-hand or centre position

5.2.2 Error messages

- SENSOR DIRTY

  This may appear when performing a SETZERO (ZERO REF) and **min dB (P640)** is set to a non-zero value.
- CURRENT SATURATED (CS)
- TEMPERATURE LIMIT (TL)

5.2.3 Fault messages

There are microprocessor fault messages which could be shown on the LCD, indicating significant problems with the sensor microprocessor. For all these error conditions, contact the factory to discuss a solution. It maybe necessary to return the unit for repair.

These fault messages and codes are:

- ROM CHECKSUM (RC)
- EEPROM SIGNATURE (ES)
- EEPROM CHECKSUM (EC)
- RAM TEST (RT)

5.2.4 Other messages

When an unknown instrument is being interrogated, a universal set of error messages is used:

- DEVICE MALFUNCTION (DV)
- PV OUT OF LIMITS (PL)
- NON PV OUT OF LIMITS (NL)
- CURRENT SATURATED (CS)

5.3 Servicing

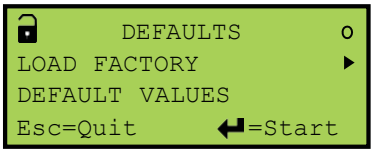
- Before servicing, disconnect power to prevent ignition of flammable or combustible atmospheres
- Substitution of components may impair intrinsic safety
- No maintenance of the control unit is required beyond occasional cleaning of the enclosure with a damp cloth. Solvents or bleaches should not be used. Do not modify or repair the unit
- There are no spare parts for the MSM400. If a problem persists, contact us for advice. The contact details are on the back page of this reference manual

5.4 Restoring the factory defaults

5.4.1 Restore factory default settings

Menu: SETUP / SYSTEM / TEST / LOAD DEFAULTS

Use the following sequence to restore the MSM400 to the factory defaults, erasing all user entered data:



- Navigate to the DEFAULTS menu
- Press the red (ENTER) button *twice* and then wait for a short beep

Note

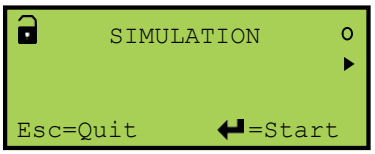
- The factory defaults may not be the same as the settings when shipped from the factory. It is advisable to keep a record of settings, if possible.

5.5 Tests

This is a guide to tests, Current Output adjustments, live readings, and diagnostic data for the MSM400. Included is a summary of the fixed (permanent) data of the MSM400 e.g. the unit's serial number.

5.5.1 Simulation (auto cycle)

Menu: SETUP / SYSTEM / TEST / SIMULATION



The Simulation function is selected by pressing the red (ENTER) button at the SIMULATION screen.

To start, press the UP-ARROW button once.

When started, the PV value to is driven up to the PV corresponding to Max dB sensor limit (P641) and then driven down to Min dB sensor limit (P640), continuously. This exercises the Current Output and relays.

A single simulation cycle takes approximately 100 seconds to complete.

Note

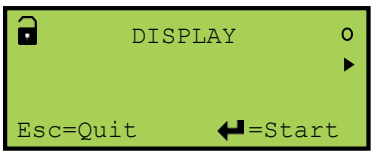
- During this simulation, the MSM400 operations continue as normal.

To pause at any time, press the UP-ARROW button. While paused, pressing the UP-ARROW button resumes the simulation cycle. You can also press the DOWN-ARROW twice to pause and then change direction of the cycle.

To quit at any time, even while paused, use the Esc button to exit immediately to the primary display. Upon exiting, the PV value immediately takes on the value based on the sensor input.

5.5.2 Display

Menu:
SETUP / SYSTEM / TEST / DISPLAY



The DISPLAY screen is for visually checking that are no dead LCD pixels.

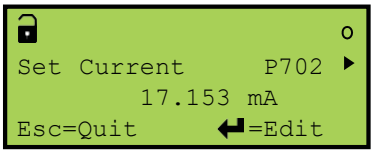
To start, press the red (ENTER) button. After completion of the visual test, the MSM400 model number and software version are displayed.

Use the Esc button to exit to the menu system.

5.5.3 Set current

Menu:
SETUP / SYSTEM / TEST / CURRENT OUTPUT

P702 Set Current



To temporarily set the Current Output to fixed output current, follow these three steps:

Step 1: Select the Set Current menu option (*from the above menu*).

Step 2: Edit a suitable mA value (*in the range 0/4-20 mA*).

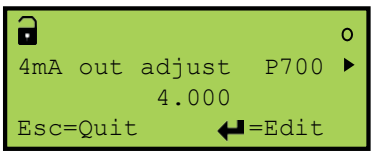
Step 3: Save the mA value to then fix the output current at that level.

Pressing the Esc button exits to the menu, and restores the output current to the level for the live PV value when back on-line (closed padlock).

5.5.4 Current output calibration

Menu:
SETUP / SYSTEM / TEST / CURRENT OUTPUT

P700 4 mA Out Adjust



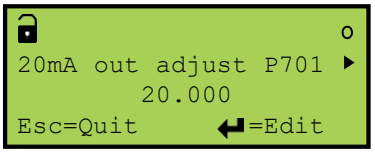
To change the 4 mA output current calibration, follow these three steps:

Step 1: Select the 4 mA Out Adjust menu option (*from the above menu*).

Step 2: Measure the output current with a calibrated milliammeter attached to terminals 18/16 (internally powered) or terminals 16/17 (externally powered).

Step 3: If the measured output current is not 4 mA, edit the P700 value to be the same as the milliammeter reading and then save it.

P701 20 mA Out Adjust



To change the 20 mA output current calibration, follow these three steps:

Step 1: Select the 20mA Out Adjust menu option (*from the above menu*).

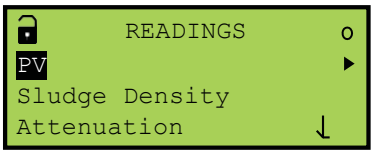
Step 2: Measure the output current with a calibrated milliammeter attached to terminals 18/16 (internally powered) or terminals 16/17 (externally powered).

Step 3: If the measured output current is not 20 mA, edit the P701 value to be the same as the milliammeter reading and then save it.

5.5.5 Readings and results

Menu: MONITOR / READINGS

Readings and results



D800 PV

This is the *continuously* calculated PV (Primary/Process Variable) value. The result is typically the percentage of suspended solids (%Solids).

The PV drives the output current (usually 4-20 mA) and relay RL1.

D801 Sludge Density

This is the *continuously* calculated SV (Secondary Variable) and always indicates the percentage of suspended solids (%Solids).

D802 Attenuation

The third variable (TV) is the attenuation due to the suspended solids.

The calculated value is the *difference* between the fourth variable (FV) and the Zero Setting (page 43) at the operating frequency.

D803 Total Atten

The fourth variable (FV) is the total attenuation.

The calculated value is the *total attenuation* due to the sensor signal loss and suspended solids. The value is mirrored in Attenuation (D852).

D805 % Current Output

This is the *continuously* calculated theoretical percentage of the 0/4-20mA current output from the Isolated Current Output of the MSM400.

The calculation is based on the PV value, and Isolated Current Output limits (set by parameters P400 and P401).

Note

- Parameter D805 is not affected by the on-line and off-line operating modes.

D806 Current Output

This is the current being output *now* from the Isolated Current Output.

Note

- The Isolated Current Output is frozen while the MSM400 is in the off-line (open padlock) operating mode.

Menu: MONITOR / READINGS / RELAY

Relay status

D820 Relay Status

This indicates when relays are energized (1) or de-energized (0).
The first digit represents Relay RL1.

D821 RL1 Run-Time(Sub-menu: RELAY RUN TIME)

This indicates the total time that relay RL1 has been energized. It is reset to zero by editing 0:00 and saving.

D822 RL2 Run-Time(Sub-menu: RELAY RUN TIME)

This indicates the total time that relay RL2 has been energized. It is reset to zero by editing 0:00 and saving.

Alarm and fault reports

D830 Alarm Report

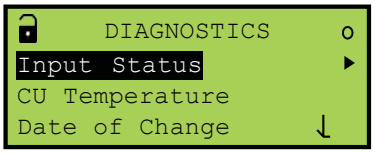
This indicates the present alarm conditions to be resolved.
See "Alarms" on page 56 for further information.

D831 Fault Report

This indicates the present fault conditions to be resolved.
See "Faults" on page 57 for further information.

5.5.6 Control unit diagnostics

Menu: MONITOR / DIAGNOSTICS



Input status

D835 Input Status

This indicates whether the digital inputs IN1 is active (1) or inactive (0).

Control unit temperature

D844 CU Temperature

This indicates the internal temperature of the MSM400.

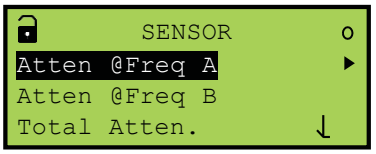
Date of change

D848 Date of Change

This shows the date on which a MSM400 parameter was last changed using the front panel keypad or remotely using HART.

5.5.7 Sensor diagnostics

Menu: MONITOR / DIAGNOSTICS / SENSOR



D850 Atten @ Freq A

This indicates the *total attenuation* (in dB) at Frequency A (usually 1 MHz). See also "Sensor input" on page 42.

If Frequency B is in use, 0.0 dB is displayed by D850.

D851 Atten @ Freq B

This indicates the *total attenuation* (in dB) at Frequency B (usually 3.3 MHz).
If Frequency A is in use, 0.0 dB is displayed by D851.

See also "Sensor input" on page 42.

D852 Attenuation

This is the *total attenuation* due to the sensor signal loss and the suspended solids in the sludge. The result is mirrored in the fourth variable parameter D803.

D853 Signal level

This indicates the present sensor signal size (in Bits). It is the basic, unprocessed signal.

D854 Span @ Freq A

This indicates the *additional* attenuation (in dB) due to the suspended solids at Frequency A (usually 1 MHz). If Frequency B is in use, 0.0 dB is displayed by D854.

D855 Span @ Freq B

This indicates the *additional* attenuation (in dB) due to the suspended solids at Frequency B (usually 3.3 MHz). If Frequency A is in use, 0.0 dB is displayed by D855.

D858 Slope A

This indicates the calculated attenuation / % suspended solids at Frequency A (usually 1 MHz) after the calibration procedure is performed.

D859 Slope B

This indicates the calculated attenuation / % suspended solids at Frequency B (usually 3.3 MHz) after the calibration procedure is performed.

D860 Frequency Used

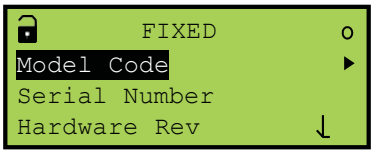
This indicates the live operating frequency.

D861 Max Measurable

This indicates the maximum measurable density, which is calculated from the zero and span calibration data. See "Calibration" on page 43 for all calibration information.

5.5.8 Fixed data

Menu: SETUP / SYSTEM / FIXED



The values of the following parameters may be requested from you if you need to contact Delta Mobrey for help with this product.

D750 Model Code

This is the partial model number of your MSM400.

D751 Serial Number

This is the unique serial number of the MSM400.

D752 Hardware Rev

This is the revision number of the particular build of the MSM400.

D753 Software Rev

This is the revision number of the software release that is running on the MSM400.

Appendix A Reference Data

Control unit specifications ..... page 71
433 sensor specification ..... page 74
448 sensor specification ..... page 75
Dimensional drawings ..... page 76

A.1 Control unit specifications

A.1.1 General

Product

- Mobrey MSM400 Sludge Density Monitor:
  Control Unit and Gap Sensor (Tank Mounted or Pipe Section)

Mounting styles

- Wall mount using supplied pair of brackets
- Total of 6 off mounting holes (5 mm diameter) on supplied brackets
- See Figure A-1 on page 76 for dimensions drawing

Power options

- Mains AC (115/230V) or low-voltage DC (24V)

A.1.2 Display

Type

- Dot matrix LCD, 32 x 122 pixels, back lit
- Integrated into enclosure

A.1.3 Electrical

AC mains power supply input

- 115V or 230V ac ±15% (switch selectable)
- Power consumption: 10 VA nominal
- Fuse (F1): 200 mA (T), 5x20 mm, 240 V

DC power supply input

- 15 to 30 Vdc, 24 Vdc nominal
- Power consumption: 6 W nominal

Gap sensor input

- Terminals for ultrasonic gap sensor (Mobrey 433 or Mobrey 448).
  Tx and Rx cables come with the sensor, each with 2 cores and screen

Trigger input

- Unit accepts a 5 Vdc trigger input signal
- 5 Vdc provided

Current output

- Signal range (nominal): 0–20 or 4–20 mA, software selectable
- Output range (linear): 3.8 to 20.5 mA
  (See Table A-1 on page 72 for current saturation and alarm indication levels)
- Load: R_{max} is 1 K Ohm at 22 mA
- Maximum applied voltage 48 Vdc
- Isolated from other terminals to 500 Vdc
- Update rate (software): 10 times every second
- See Table A-1 on page 72 for current saturation and alarm indication levels

Table A-1. Current saturation and alarm indication levels

Current		Alarm LOW	Alarm HIGH	P402 Options(1) (Output Current)	Factory Default Setting for P402
Minimum	Maximum				
3.8 mA	20.5 mA	3.6 mA	21.0 mA	High (21.0 mA) Hold Low (3.6 mA)	High (21.0 mA)

(1) See "Current Output" on page 52 for a description of this parameter, and where to find it in the integrated display menu system.

Relays

- 2 x SPDT, rated 5 A at 240 Vac resistive

Cable entry

- 6 positions pre-drilled (3 off16 mm, and 3 off 20 mm)
- 5 x plastic glands supplied (2 off M16x1.5, and 3 off M20x1.5)
- 3 x blanking plugs supplied (1 off M16x1.5, and 2 off M20x1.5)

Cable connection

- Cage clamp terminal blocks in separate terminal compartment
- Maximum wire size is 2.5 mm^2

A.1.4 Mechanical

Materials of construction

- ABS enclosure with polycarbonate lid
- 304SS cover fixing screws
- UV resistant Polycarbonate membrane keypad
- Nylon cable glands and blanking plugs

Dimensions

- See "Dimensional drawings" on page 76

Weight

- 1.9 kg

A.1.5 Environment

Ambient temperature

- -30 to 55 °C (-22 to 131 °F)
- See Appendix A: Product Certifications for approval temperatures ranges

Relative humidity

- 95%

Electrical safety

- EN61010-1

Ingress protection

- IP65 indoor and outdoor

Installation category

- III: Supply voltage < 132 Vac, IEC60664
- II: Supply voltage < 264 Vac, IEC60664

Pollution degree

- 2

Maximum altitude

- 2000 m

Electromagnetic compatibility

- Emissions and Immunity: EN 61326 (Class A)
- To ensure electro-magnetic compatibility in any European member state, the control unit should not be installed in a location with domestic mains power

Certifications

- See “Product Certifications” on page 77

A.2 433 sensor specification

A.2.1 General

Product

- Mobrey 433 In-tank Gap Sensor, 316 Stainless steel
- 1 MHz / 3 MHz Sensor Gap size: 4, 6, 8, 12, or 18 in (100, 150, 200, 300, or 450 mm)

A.2.2 Connections

Mounting connection

- ¾-in. BSPT thread

Sensor cable

- 23 ft. (7 m) dual screened/shielded twisted pair (*others upon request)*

A.2.3 Environment

Operating temperature

- -40 to 130 °F (-40 to 55 °C)
- 212 °F (100 °C) upon request

Operating pressure

- 1522 psi (105 bar)

Ingress protection

- IP68

A.2.4 Approvals

See “Product Certifications” on page 77.

A.3 448 sensor specification

A.3.1 General

Product

- Mobrey 448 pipe section with integral 316 stainless steel gap sensors
- Gap size 4, 6, 8, 12, or 18 in. (100, 150, 200, 300, or 450 mm) depending on pipe size/flange choice

Pipe section material

- Epoxy-coated carbon steel

Drain material

- 1-in. NPT thread

Spray nozzle/flushing valve

- 1-in. BSP thread, and 316 stainless steel wetside

A.3.2 Connections

Mounting connection

- Raised Face (RF) flanged, in-line installation
- EN1092-1 DN100 (PN 10/PN 16), DN150 (PN 10/PN 16), and DN200 (PN10) or 4 in. ASME B16.5 Class 150, 6 in. ASME B16.5 Class 150, and 8 in. ASME B16.5 Class 150

Sensor cable

- 23 ft. (7 m) from junction box, oil hose protected, dual screened twisted pair (others upon request)

Cable junction box

- IP65 aluminium alloy

A.3.3 Environment

Operating temperature

- -40 to 158 °F (-40 to 70 °C)

Operating pressure

- 145 psi (10 bar)

Ingress protection

- IP65

A.3.4 Approvals

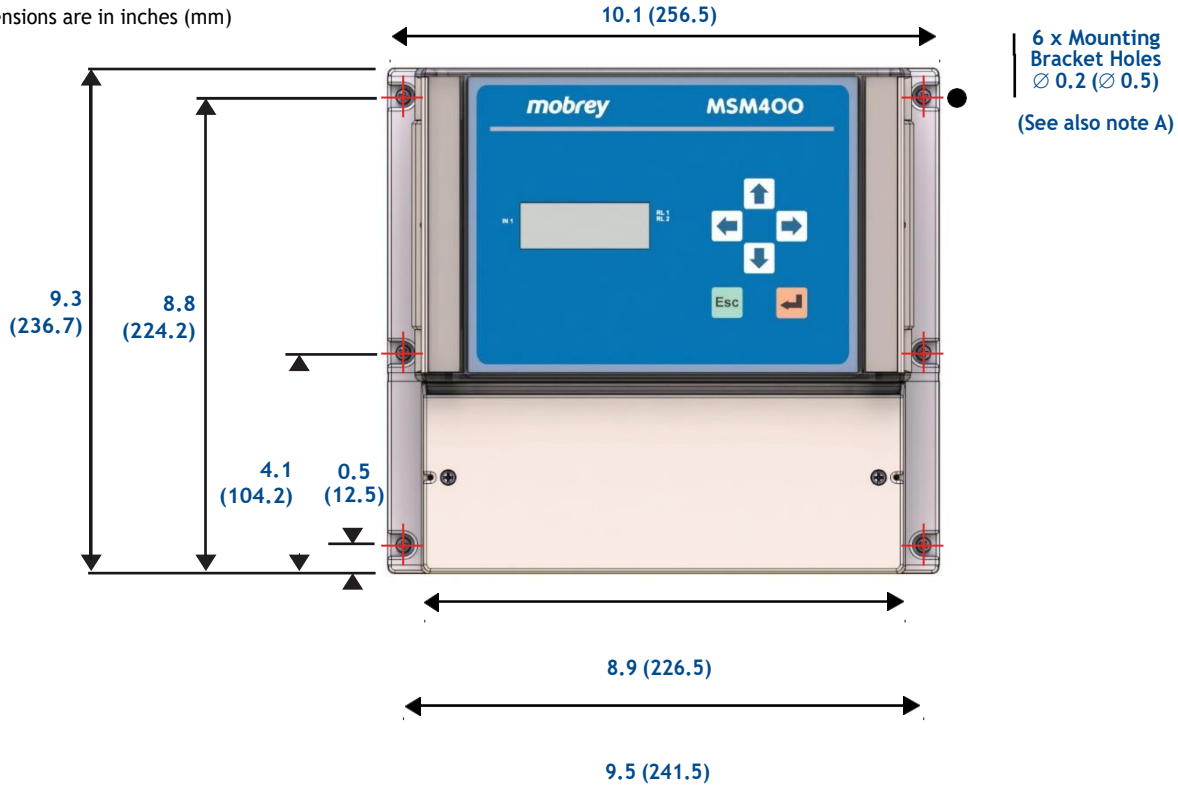
Hazardous area

- See “Product Certifications” on page 77

A.4 Dimensional drawings

Figure A-1. Control unit

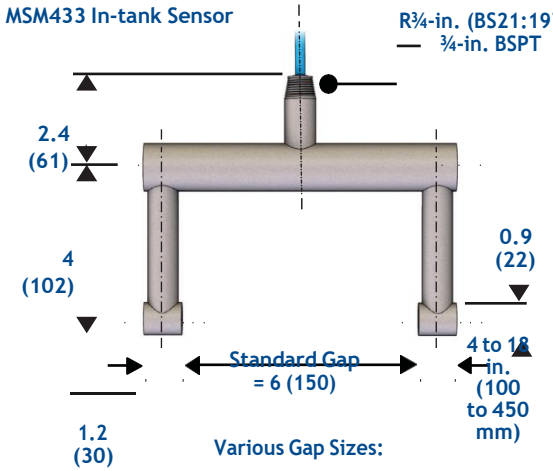
Note: Dimensions are in inches (mm)

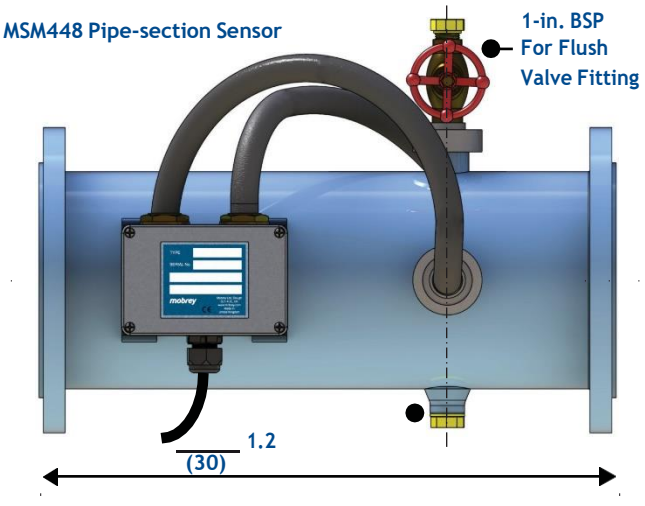


A. Mounting brackets for wall mounting are provided, and these should be attached to the rear of the housing using the self tapping screws (also provided).The brackets are then used to wall mount the MSM400 control unit using the six mounting holes available.

Figure A-2. Sensors

Note: Dimensions are in inches (mm)





Appendix B Product Certifications

Safety messages ..... page 77
Approved manufacturing location ..... page 78
European directive information ..... page 78
Hazardous locations certification ..... page 79

B.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a caution symbol (⚠). The external hot surface symbol (⚠) is used when a surface is hot and care must be taken to avoid possible burns. If there is a risk of an electrical shock the (⚠) symbol is used. Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- The Mobrey MSM400 Sludge Density Monitor must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment

Explosions could result in death or serious injury:

- Please review the approvals section of this reference manual for any restrictions associated with an installation

Electrical shock could cause death or serious injury:

- If the control unit is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the control unit is off while making connections

B.2 Approved manufacturing location

Delta Mobrey Limited, United Kingdom

B.3 European directive information

The EC declaration of conformity for all applicable European directives for this product can be obtained by contacting your local sales office.

ATEX directive (2014/34/EU)

- The control unit and gap sensors comply with EN IEC 60079-0:2018 and EN60079-11:2012

UKEx Regulation 2016 UKSI 2016:1107

- The control unit and gap sensors comply with EN IEC 60079-0:2018 and EN60079-11:2012

Low voltage directive (2014/35/EU)

- The control unit complies with EN61010-1
- The gap sensors are outside the scope of the LVD directive

Pressure equipment directive (PED) (2014/68/EU)

- The control unit and in-tank mounted gap sensor are outside the scope of the PED Directive
- The pipe-section gap sensor complies with the PED directive

Electro magnetic compatibility (EMC) Directive (2014/30/EU)

- The control unit and sensors comply with EN 61326-1

CE-mark

- The control unit and sensors comply with the applicable directives.

UKCA-mark

- The control unit and sensors comply with the applicable regulations.

B.4 Hazardous locations certification

B.4.1 Control unit approvals

ATEX intrinsically safe approval (current output only)

Certificate numbers: ITS00ATEX2002X

Intrinsically safe for II (I) G, [Ex ia Ga] IIC

Ambient temperature: -40 to +55 °C

Channel 1 (Rx) electrical parameters:

Uo = 1.2 V, Io = 42.1 mA, Po = 13 mW, Co = 0.4 nF, Lo = 0.04 mH

Channel 2 (Tx) electrical parameters:
Uo = 4.6 V, Io = 162 mA, Po = 0.2 W, Co = 0.4 nF, Lo = 0.04 mH

(See also "Instructions for hazardous area installation" on page 80)

UKEX intrinsically safe approval (current output only)

Certificate numbers: ITS21UKEX0389X

Intrinsically safe for II (I) G, [Ex ia Ga] IIC

Ambient temperature: -40 <Ta< +55 °C

Channel 1 (Rx) electrical parameters:

Uo = 1.2 V, Io = 42.1 mA, Po = 13 mW, Co = 0.4 nF, Lo = 0.04 mH

Channel 2 (Tx) electrical parameters:
Uo = 4.6 V, Io = 162 mA, Po = 0.2 W, Co = 0.4 nF, Lo = 0.04 mH

(See also "Instructions for hazardous area installation" on page 80)

IECEx intrinsically safe approval (current output only)

Certificate numbers: IECEx ITS 13.0044X

Intrinsically safe for [Ex ia Ga] IIC

Ambient temperature: -40 to +55 °C

Channel 1 (Rx) electrical parameters:

Uo = 1.2 V, Io = 42.1 mA, Po = 13 mW, Co = 0.4 nF, Lo = 0.04 mH

Channel 2 (Tx) electrical parameters:
Uo = 4.6 V, Io = 162 mA, Po = 0.2 W, Co = 0.4 nF, Lo = 0.04 mH

(See also "Instructions for hazardous area installation" on page 80)

B.4.2 Gap sensor approvals

ATEX intrinsically safe approval (gap sensors)

Certificate numbers: ITS00ATEX2003X

Intrinsically safe for II 1 G, Ex ia IIC T6...T3 Ga

Ambient temperature: -40 to +70 °C

Electrical parameters:

Ui = 4.6 V, Ii = 162 mA, Pi = 0.2 W, Ci = 14 nF, Li = 0.1 mH

(See also "Instructions for hazardous area installation" on page 80)

UKEX intrinsically safe approval (gap sensors)

Certificate numbers: ITS21UKEX0388X
Intrinsically safe for II 1 G, Ex ia IIC T6...T3 Ga
Ambient temperature: -40 <Ta < +70 °C
Electrical parameters:
Ui = 4.6 V, Ii = 162 mA, Pi = 0.2 W, Ci = 14 nF, Li = 0.1 mH
(See also "Instructions for hazardous area installation" on page 80)

IECEx intrinsically safe approval (gap sensors)

Certificate numbers: IECEx ITS 13.0044X
Intrinsically safe for Ex ia IIC T6...T3 Ga
Ambient temperature: -40 to +70 °C
Electrical parameters:
Ui = 4.6 V, Ii = 162 mA, Pi = 0.2 W, Ci = 14 nF, Li = 0.1 mH
(See also "Instructions for hazardous area installation" on page 80)

B.4.3 Instructions for hazardous area installation

General

1. Installation of this equipment shall be carried out by suitably trained personnel, in accordance with the applicable code of practice.

2. The user should not repair this equipment.

3. It is the responsibility of the user to ensure the voltage and current limits for this equipment are not exceeded.

4. If the equipment is likely to come into contact with aggressive substances, it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

   Aggressive substances: e.g. acidic liquids or gases that may attack metals or solvents that may affect polymeric materials.

   Suitable precautions: e.g. regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals.

Sensors

Model numbers covered: MSM433A*** and MSM448A***
("*" indicates options in construction, function and materials).

The following instructions apply to equipment covered by certificate numbers ITS00ATEX2003X ITS21UKEX0388X and IECEx ITS 13.0044X:

1. The equipment may be used with flammable gases and vapors with apparatus groups IIA, IIB, and IIC, and with temperature classes T1, T2, T3, T4, T5, and T6.

2. Technical data:

   a. Materials of construction: See "Control unit specifications" on page 71.

   b. Coding:

ATEX & UKEx: II 1 G
Ex ia IIC T6...T3 Ga (-40 °C < Ta < +70 °C)

IECEx: Ex ia IIC T6...T3 Ga (-40 °C < Ta < +70 °C)

T Class	Process Temperature (Tp)
T6, T5, T4, T3, T2, T1	-40 °C to +70 °C
T5, T4, T3, T2, T1	-40 °C to +85 °C
T4, T3, T2, T1	-40 °C to +120 °C
T3, T2, T1	-40 °C to +150 °C

   c. Input parameters:

   Ui = 4.6 V, Ii = 162 mA, Pi = 0.2 W, Ci = 14 nF, Li = 0.1 mH

Control unit

Model number covered: MSM400. The following instructions apply to equipment covered by certificate numbers ITS00ATEX2002X, ITS21UKEX0389X and IECEx ITS 13.0044X:

1. The MSM400 control unit ("control unit") may be connected to a transmitter located in a hazardous area. The control unit must not itself be located in a hazardous area.

2. Wiring instructions

   a. The control unit must not be connected to a supply exceeding 250 V r.m.s. or dc, or to apparatus containing a source of voltage exceeding 250 V r.m.s. or dc.

   b. The intrinsically safe outputs of the MSM400 control unit may be connected to certified equipment used in a hazardous area requiring category 1 (Ga) equipment, with flammable gases and vapors with apparatus groups IIC, IIB and IIA. No additional I.S. barrier is required.

   c. The fuse must only be replaced with the type specified in the section "Control unit specifications" on page 71.

3. Technical data:

   a. Materials of construction: See "Control unit specifications" on page 71.

   b. Coding:

   ATEX & UKEx II (I) G, [Ex ia Ga] IIC (-40 °C < Ta < +55 °C)

   IECEx (Ga) [Ex ia Ga] IIC (-40 °C < Ta < +55 °C)

   c. Gap sensor inputs:

Gap Sensor Inputs	Channel 1 (Rx)	Channel 2 (Tx)
Terminal numbers	1, 2	5, 6
Cable Screen Terminal	3	4
Parameters:	Uo=1.2 V, Io=42.1 mA, Po=13 mW, Co=0.4 nF, Lo= 0.04 mH	Uo=4.6 V, Io=162 mA, Po=0.2 W, Co=0.4 nF, Lo=0.04 mH

   d. Cables: the cable between the Control Unit and Sensors must be a separate cable or multicore cable, which must be of Type A or B as defined in IEC/EN 60079-25 and is subject to the following:

   The circuit from each channel must be individually screened when used within Type A multicore cable.

   The peak voltage with a Type B multicore must not exceed 60 V.

Group	Capacitance	Inductance or L/R max	
IIC	99.9 µF	0.7 mH	98 µH/Ω
IIB	999.9 µF	4.8 mH	673 µH/Ω
IIA	999.9 µF	8.8 mH	1253 µH/Ω

   e. Year of manufacture: printed on the product label

4. Special conditions of use:

   a. The protection (IP) rating of the enclosure must be maintained by the use of suitably rated cable glands or conduit entries. Unused cable entries are to be fitted with suitably rated blanking plug.

Appendix C Menu Maps and Parameters

Safety messages ..... page 83
Menu maps and parameters ..... page 83

C.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠ WARNING

Explosions could result in death or serious injury:

Verify that the operating environment of the Mobrey MSM400 Sludge Density Monitor is consistent with the appropriate hazardous locations certifications.

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

Make sure only qualified personnel perform the installation.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

Do not perform any service other than those contained in this manual unless you are qualified.

C.2 Menu maps and parameters

This section contains:

- A menu system map for configuring a Mobrey MSM400 control unit using the integrated display and keypad
- A Device Descriptor (DD) map for configuring the Mobrey MSM400 control unit using a PC running AMS Device Manager or a Field Communicator with the Mobrey MSM400 Device Descriptor (DD) added

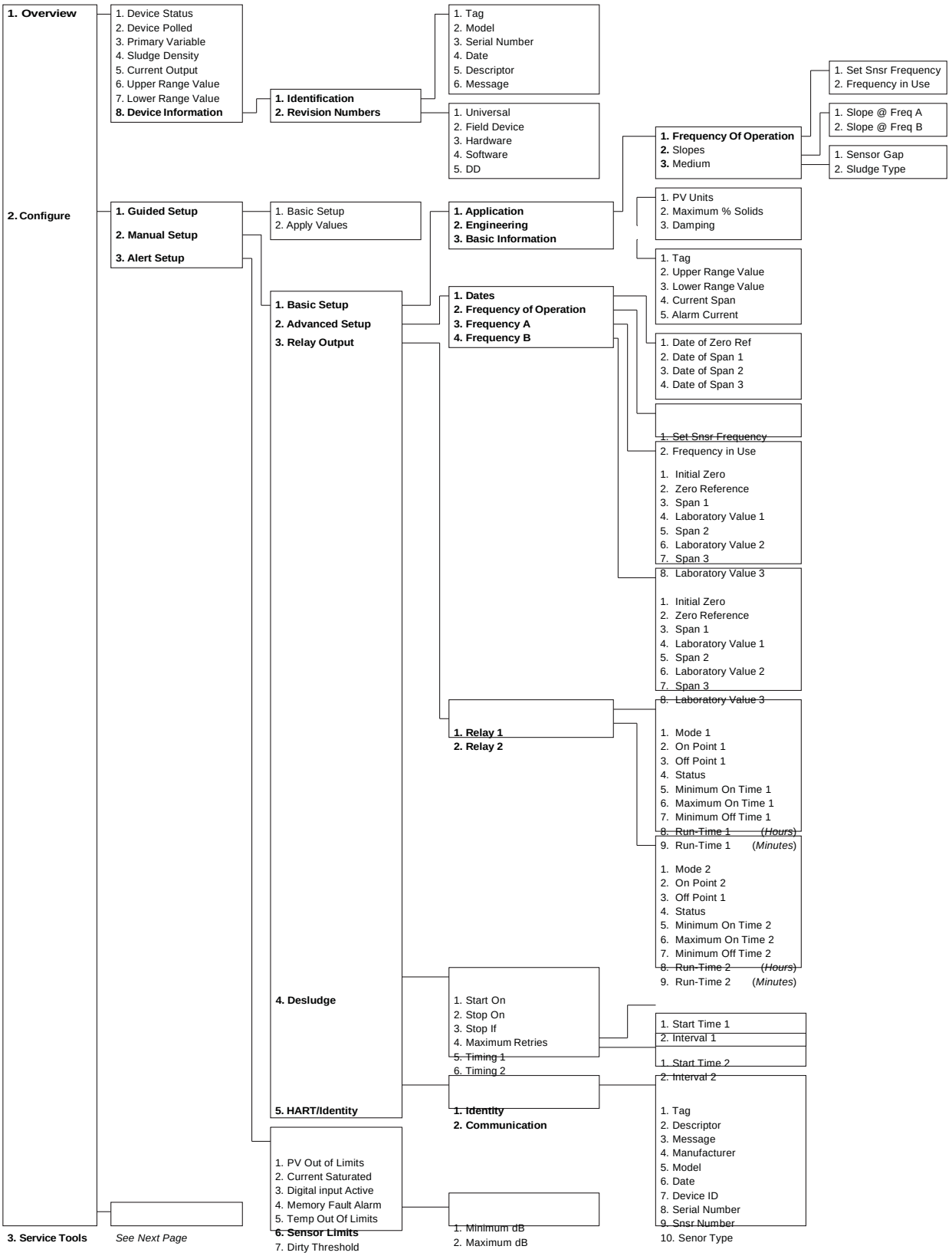
Table C-1. Mobrey MSM400 control unit Map

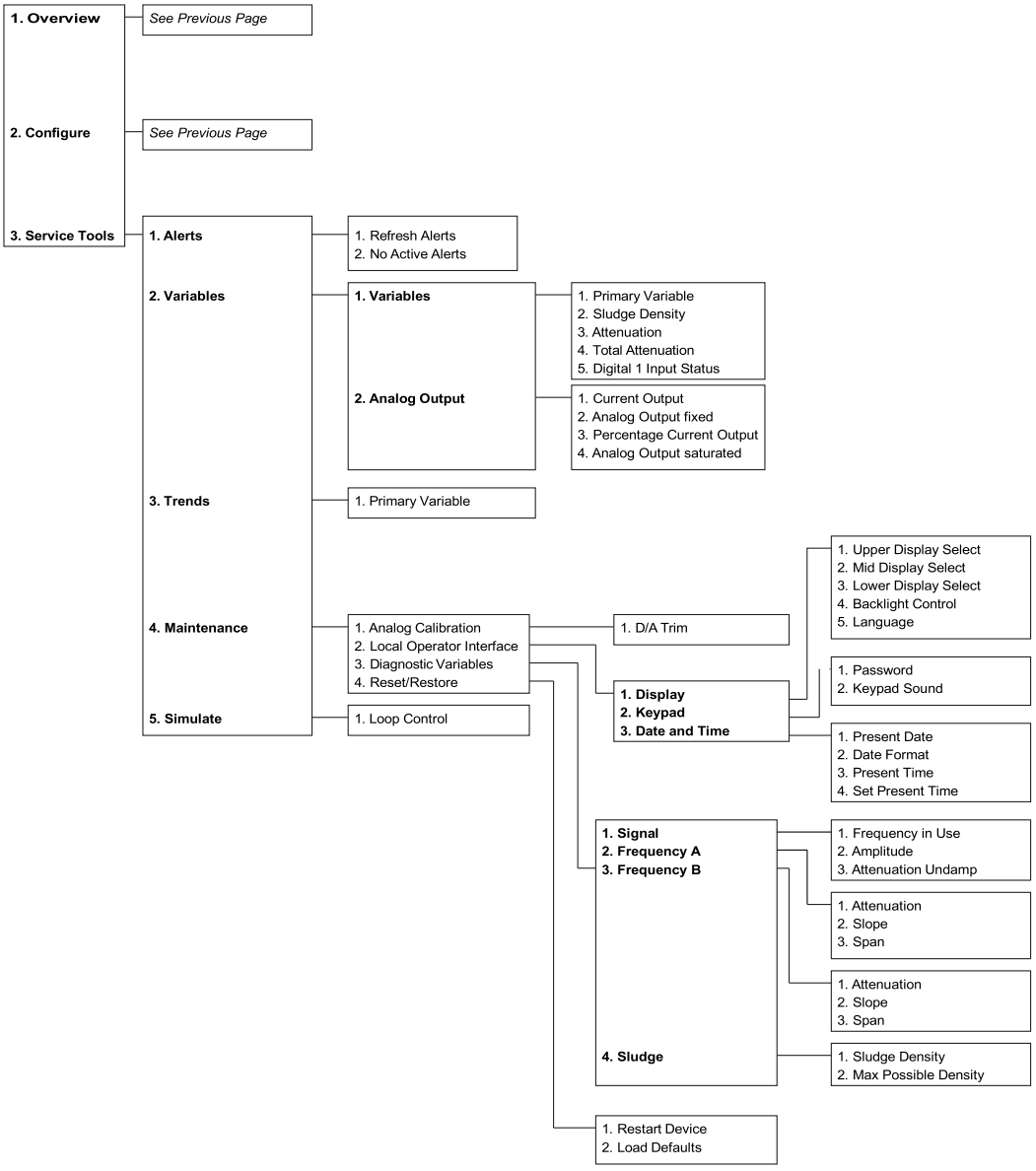
MAIN MENU	Menu Level 2	Menu Level 3	Menu Level 4	Parameter ID and Descriptor		Units	Factory Defaults	Reference Pages
Cancel password				-	Cancel password	-	-	64
Go on-line?				-	Go on-line? / Go-off line?	-	-	40
CALIBRATION	AUTOCAL	SETZERO		-	SETZERO	-	-	43
		SETSPAN		-	SETSPAN	-	-	44
		LAB VALS	Lab Value 1	P150	Lab Value 1	%	0.00	48
			Lab Value 2	P151	Lab Value 2	%	0.00	48
			Lab Value 3	P152	Lab Value 3	%	0.00	48
		Max % Solids		P160	Max % Solids	%	0.00	48
	MANUAL ENTRY	ZERO REF	Zero ref@FreqA	P120	Zero ref@FreqA	dB	0.00	47
			Zero ref@FreqB	P121	Zero ref@FreqB	dB	0.00	47
			Date zero ref	P122	Date zero ref	-	00/00/00	47
			Init Zero-FreqA	P123	Init Zero-FreqA	dB	0.0	47
			Init Zero-FreqB	P124	Init Zero-FreqB	dB	0.0	47
		SPAN	Span 1 @ FreqA	P130	Span 1 @ FreqA	dB	0.0	48
			Span 1 @ FreqB	P131	Span 1 @ FreqB	dB	0.0	48
			Span 2 @ FreqA	P132	Span 2 @ FreqA	dB	0.0	48
			Span 2 @ FreqB	P133	Span 2 @ FreqB	dB	0.0	48
			Span 3 @ FreqA	P134	Span 3 @ FreqA	dB	0.0	48
			Span 3 @ FreqB	P135	Span 3 @ FreqB	dB	0.0	48
			Span 1 Date	P140	Span Date 1		00/00/00	48
			Span 2 Date	P141	Span Date 2		00/00/00	48
			Span 3 Date	P142	Span Date 3		00/00/00	48
		LAB VALUES	Lab Value 1	P150	Lab Value 1	%	0.00	48
			Lab Value 2	P151	Lab Value 2	%	0.00	48
			Lab Value 3	P152	Lab Value 3	%	0.00	48
		SENSOR	Sensor Gap	P100	Sensor Gap	mm	0	48
			Sludge type	P101	Sludge type	-	None	48
			Slope @ Freq A	P102	Slope @ Freq A	dB/%	0.00	49
			Slope @ Freq B	P103	Slope @ Freq B	dB/%	0.00	49
		Max % Solids		P160	Max % Solids	%	0.00-	48
SETUP	DUTY (Mode)	PV UNITS		P200	PV Units	-	%	50
		Description		P240	Description	-	Description	
		Message		P241	Message	-	32 CHARS	
		Tag		P242	Tag	-	MSM400	
		DESLUDGE	Start On	P250	Start On	-	None	50
			Stop On	P251	Stop On	-	None	50
			Stop If	P252	Stop If	-	Not Used	50
			Start Time 1	P253	Start Time 1	h:m	7:00	50
			Interval 1	P254	Interval 1	h:m	1:00	50
			Start Time 2	P255	Start Time 2	h:m	0:00	50

MAIN MENU	Menu Level 2	Menu Level 3	Menu Level 4	Parameter ID and Descriptor		Units	Factory Defaults	Reference Pages
SETUP	*DUTY (Mode)*	*DESLUDGE*	Interval 2	P256	Interval 2	h:m	0:00	50
			Max Retries	P257	Max Retries		0	50
	INPUT	SENSOR INPUT	Snsr Serial No	P300	Snsr Serial No		-	42
			Sensor Type	P301	Sensor Type		Unknown	42
			Sensor Damping	P302	Sensor Damping		5.0	52
			Sensor Delay	P303	Sensor Delay	m:s	0.00	52
	OUTPUT	CURRENT OUTPUT	Low Range Value	P400	Low Range Value	%	0.00	52
			Up Range Value	P401	Up Range Value	%	40.00	52
			Alarm Current	P402	Alarm Current		3.6 mA	52
			Current Span	P403	Current Span	-	4-20 mA	52
	RELAY	RELAY 1	Relay 1 Mode	P410	Relay 1 Mode	-	None	54
			RL1 On Point	P411	RL1 On Point	%	0.00	54
			RL1 Off Point	P412	RL1 Off Point	%	0.00	54
			RL1 Min On	P413	RL1 Min On	m:s	0:00	54
			RL1 Max On	P424	RL1 Max On	m:s	0:00	54
			RL1 Min Off	P415	RL1 Min Off	m:s	0:00	54
		RELAY 2	Relay 2 Mode	P420	Relay 2 Mode	-	None	54
			RL1 On Point	P421	RL1 On Point	%	0	54
			RL1 Off Point	P422	RL1 Off Point	%	0	54
			RL1 Min On	P423	RL1 Min On	m:s	000:00	54
			RL1 Max On	P424	RL1 Max On	m:s	000:00	54
			RL1 Min Off	P425	RL1 Min Off	m:s	000:00	54
	ALARM	PV Over Limits		P540	PV Over Limits	-	None	56
		Current Sat		P541	Current Sat	-	None	56
		Digital Input		P543	Digital Input	-	None	56
	FAULT	Memory fault		P560	Memory fault	-	Both	57
		CU Temp Fault		P561	CU Temp Fault	-	None	57
		Sensor Limits		P562	Sensor Limits	-	None	57
	DISPLAY	Display Upper		P570	Display Upper	-	P731-Time	58
		Display Middle		P571	Display Middle	-	D800-PV	58
		Display Lower		P572	Display Lower	-	Bargraph	58
		Backlight		P575	Backlight	-	On	58
	ENGINEERING	Frequency Set		P630	Frequency Set		Auto	60
		SENSOR LIMITS	Min dB	P640	Min dB	dB	1.0	57
			Max dB	P641	Max dB	dB	100.0	57
			Dirty Threshold	P642	Dirty Threshold	dB	0.0	57
	SYSTEM	TEST	SIMULATION		SIMULATION	-	-	64
			DISPLAY		DISPLAY	-	-	65
			CURRENT OUTPUT	P700	4 mA out adjust	-	4.000	65
				P701	20 mA out adjust	-	20.000	65
				P702	Set Current	mA	0.000	65
		DEFAULTS			LOAD DEFAULTS	-	-	64

MAIN MENU	Menu Level 2	Menu Level 3	Menu Level 4	Parameter ID and Descriptor		Units	Factory Defaults	Reference Pages
SETUP	*SYSTEM*	COMMS	Address	P710	Address	-	0	
		SETTINGS	Date	P730	Date	dmy	(Factory set)	41
			Time	P731	Time	-	-	41
			Date format	P734	Date Format	-	dd/mm/yy	41
			Keypad Sound	P735	Keypad Sound	-	On	41
			Language	P737	Language	-	English	41
			PIN	P740	PIN	-	0	40
		FIXED	Model Code	D750	Model Code	-	(Factory set)	69
			Serial Number	D751	Serial Number	-	(Factory set)	69
			Hardware Rev	D752	Hardware Rev	-	(Factory set)	69
			Software Rev	D753	Software Rev	-	(Factory set)	69
			HART / ...	D760	Manufacturer	-	(Mobrey)	69
				D761	Device ID	-	(Factory set)	-
				D762	HART Rev	-	5	-
				D763	Field Dev Rev	-	1	-
				D764	Preamble Bytes	-	5	-
				D765	Flags	-	1	-
MONITOR	READINGS		PV	D800	PV	%	-	66
			Sludge Density	D801	Sludge Density	%	-	66
			Attenuation	D802	Attenuation	dB	-	66
			Total Atten	D803	Total Atten	dB	-	66
			% Current Out	D805	% Current Out	%	-	66
			Current Output	D806	Current Output	mA	-	67
			Alarm Report	D830	Alarm Report	-	-	67
			Fault Report	D831	Fault Report	-	-	67
		RELAY	Relay Status	D820	Relay Status	-	-	67
			RUN TIME / ...	D821	RL1 Run-Time	h:m	-	67
				D822	RL2 Run-Time	h:m	-	67
	DIAGNOSTICS		Input Status	D835	Input Status	-	-	68
			CU Temperature	D844	CU Temperature	°C	-	68
			Date of Change	D848	Date of Change		--/--/--	68
			SENSOR / ...	D850	Atten @ Freq A	dB	-	68
				D851	Atten @ Freq B	dB	-	68
				D852	Total Atten	dB	-	68
				D853	Signal level	-	-	68
				D854	Span @ Freq A	dB	-	68
				D855	Span @ Freq B	dB	-	68
				D858	Slope A	dB%	-	69
				D859	Slope B	dB%	-	69
				D860	Frequency Used		-	69
				D861	Max measurable	%	-	69
DIRECT	See "Direct parameter access" on page 91 for a full description of this menu.							

Figure C-1. Device Descriptor (DD) Map




1. Overview
See Previous Page
2. Configure
See Previous Page
3. Service Tools
1. Alerts
1. Refresh Alerts
2. No Active Alerts
2. Variables
1. Variables
1. Primary Variable
2. Sludge Density
3. Attenuation
4. Total Attenuation
5. Digital 1 Input Status
2. Analog Output
1. Current Output
2. Analog Output fixed
3. Percentage Current Output
4. Analog Output saturated
3. Trends
1. Primary Variable
4. Maintenance
1. Analog Calibration
2. Local Operator Interface
3. Diagnostic Variables
4. Reset/Restore
1. D/A Trim
1. Display
2. Keypad
3. Date and Time
1. Upper Display Select
2. Mid Display Select
3. Lower Display Select
4. Backlight Control
5. Language
1. Password
2. Keypad Sound
1. Present Date
2. Date Format
3. Present Time
4. Set Present Time
1. Signal
2. Frequency A
3. Frequency B
1. Frequency in Use
2. Amplitude
3. Attenuation Undamp
1. Attenuation
2. Slope
3. Span
1. Attenuation
2. Slope
3. Span
4. Sludge
1. Sludge Density
2. Max Possible Density
1. Restart Device
2. Load Defaults
5. Simulate
1. Loop Control

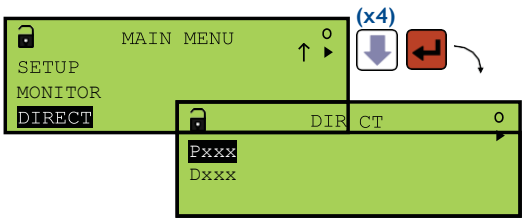
Appendix D Additional Features

D.1 Direct parameter access

The direct parameter access menu is selected from the MAIN MENU (Figure D-1). It features a method for fast access to parameter screens.

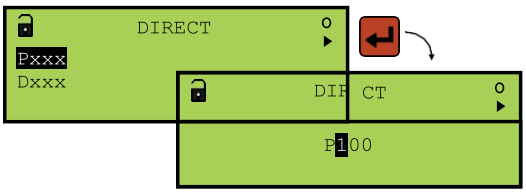
This is an ideal facility for those who want to check or change settings of parameters without traversing the menu system. All that is required is the entry of the 3-digit identification (ID) number for a parameter, as found in Appendix C: Menu Maps and Parameters.

Figure D-1. Navigating to the Direct parameter access menu



Both 'P' and 'D' prefixed parameters can be accessed, but through separate selection screens. At the DIRECT menu screen, a selection must first be made which is based on the parameter prefix (see Figure D-2).

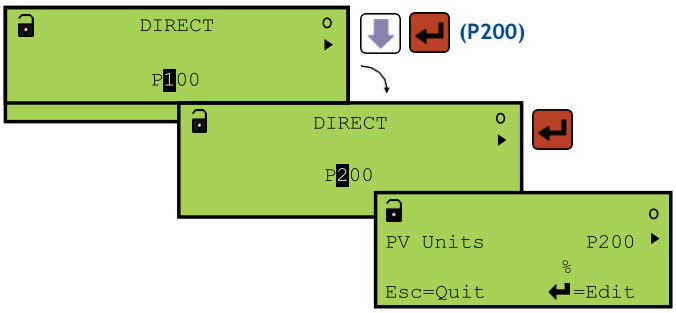
Figure D-2. Pxxx or Dxxx selection



After the **Pxxx** or **Dxxx** selection is made, the unique 3-digit identification number of the parameter is edited using the arrow buttons. Pressing the **red (ENTER)** button then makes the parameter screen appear, unless the parameter does not exist.

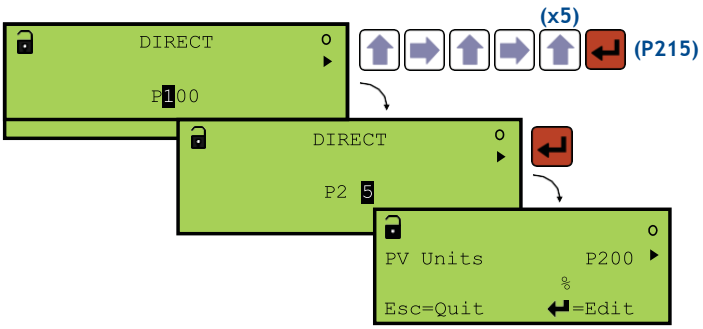
In Figure D-3 on page 92, the PV Units selection parameter (**P200**) has been accessed by entering “200” and then pressing the **red (ENTER)** button.

Figure D-3. Parameter exists



When a parameter with the input identification number does not exist, the nearest numbered parameter is displayed instead. However, pressing the **Esc** button returns you to the input screen, allowing you to re-edit the number and try for another parameter screen. This **Esc** button feature is very convenient for quickly viewing and editing more than one parameter.

Figure D-4. No such parameter



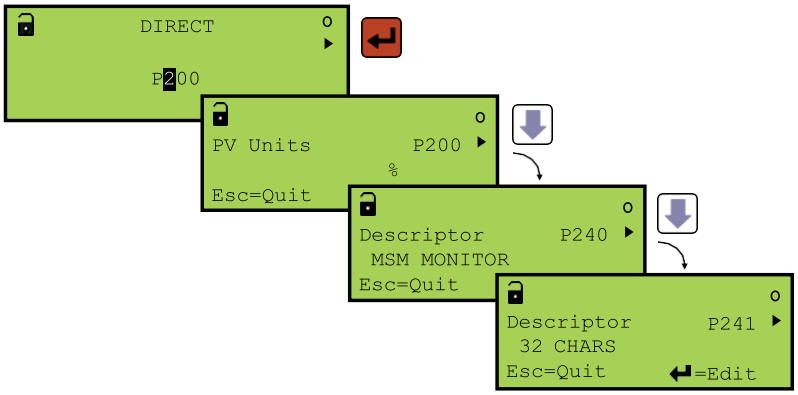
Whilst displaying a parameter screen, you may use the **UP-ARROW** or **DOWN-ARROW** buttons to scroll through adjacent parameters (Figure D-5 on page 93).

Note

- This scrolling feature is also available when a parameter has been accessed by the normal navigation of the menu system.

You can use the **Esc** button to return to the **Pxxx** or **Dxxx** input screen at any time. After finishing with the DIRECT parameter access, press the **Esc** button repeatedly until the MAIN MENU appears.

Figure D-5. Scrolling through parameters



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