ABZAR SANJESH ARIA

Instruction & maintenance leaflet
IP2046IM, Rev. AA
November 2006

Mobrey

MSP400RH Series
Level Transmitter

mobrey
www.mobrey.com

EMERSON
Process Management

CONTENTS

		Page
1.	**Introduction**	3
2.	**The MSP400RH ultrasonic level transmitter**	3
2.1	Type numbering system	3
2.2	Pressure Equipment Directive	4
2.3	Specifications	4
3.	**Installation**	6
3.1	Location of the MSP400RH transmitter	6
3.1.1	General considerations	6
3.1.2	Liquid surface conditions	7
3.1.3	In-tank / well effects	8
3.1.4	Open Channel Flow installations	8
3.2	Mounting the transmitter above the liquid surface	10
3.3	Wiring	11
3.4	Additional components in the 2 wire loop	12
4.	**Commissioning / Programming**	13
4.1	Display & push buttons	13
4.2	Power up	14
4.3	Programming - important notes	14
4.4	Setting up for the chosen application	15
4.5	Diagnostic data	27
4.6	Loop Test	28
4.7	Engineering Set-up menu	29
5.	**Maintenance**	35

Appendices

Appendix A1	Main Menu - Programming	36
Appendix A2	Diagnostic Menu	38
Appendix A3	Commissioning / Loop test menu	39
Appendix A4	Engineering menu	40
Appendix B	Default menu listing	41
Appendix C	Listing of non-linear profiles in the MSP400	43
Appendix D	Hart Communications with the MSP400	44

The MSP400 transmitter is a measuring instrument and should be handled with due care and attention at all times

Footnote :-
In this manual the following terms are used which refer to trademarks from other manufacturers:

HART: is the protocol adopted for the MSP400 SMART Communications.
HART is a registered trademark of the HART Communications Foundation and is a mnemonic For Highway Addressable Remote Transducer.

1.0 Introduction

The MSP400 ultrasonic level transmitter is designed to be mounted above a liquid and will measure the distance to the liquid surface.
When programmed with details of the vessel, sump or open channel, the MSP400 will compute level, contents or flow and give a 4-20mA signal proportional to the chosen variable. 2 relays are provided for control functions. Programming is achieved using integral push buttons or by remote communication using HART protocol.

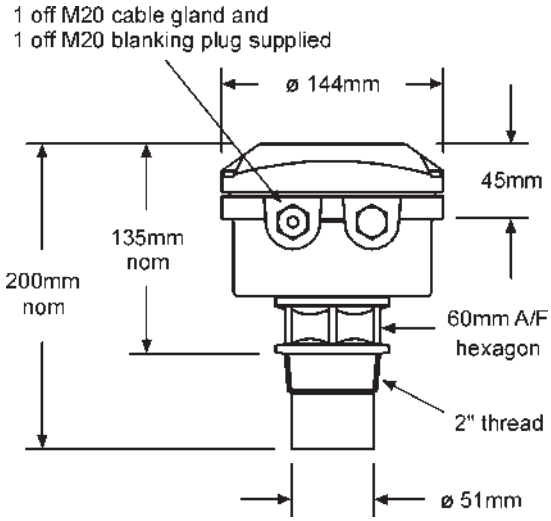
MSP400 is a two wire 24V dc loop powered transmitter and may be connected to any suitable dc power source using 2 core shielded cable. The Mobrey MCU900 range of Control Units is designed to be used with the MSP400 transmitter in this way.

The MSP400 transmitter must not be mounted in a hazardous area, even if supplied from a protected power supply.

2.0 The MSP400RH ultrasonic level transmitter.

The transmitter operates over a range of 0.45m to 11m. When powered up the transmitter will give a 4-20mA signal on the two wire power cable over the factory default range :

4mA at 11m; 20mA at 0.45m. This range may be adjusted during commissioning. See section 4.0



Models covered in this manual :

MSP400RH - B28
MSP400RH - N28

The transmitter is mounted using the 2" thread provided. An optional mounting bracket kit is available on request. MSP-BRK2 (2" BSPT) or MSP-BRK3 (2" NPT).

2.1 Type numbering system

MSP Mobrey ultrasonic level transmitter

400R 11m operating range, 2 relay outputs

H HART communications

-B28 2" BSPT mounting, PVDF wetside
-N28 2" NPT mounting, PVDF wetside

2.2 Pressure Equipment Directive

The MSP400RH transmitter does not fall within the PED definition as enclosing a pressurised fluid, so is therefore outside the scope of the Directive.

Accordingly, the Declaration of Conformity does not list the Pressure Equipment Directive.

2.3 Specifications

Materials of construction:

Transducer material	PVDF
Body & cover Material	Glass filled nylon
Cable gland	Nylon with Nitrile cable seal
Cover seal	Silicone rubber
Cover screws	316 Stainless Steel
Transducer bodyseal	EPDM

Electrical

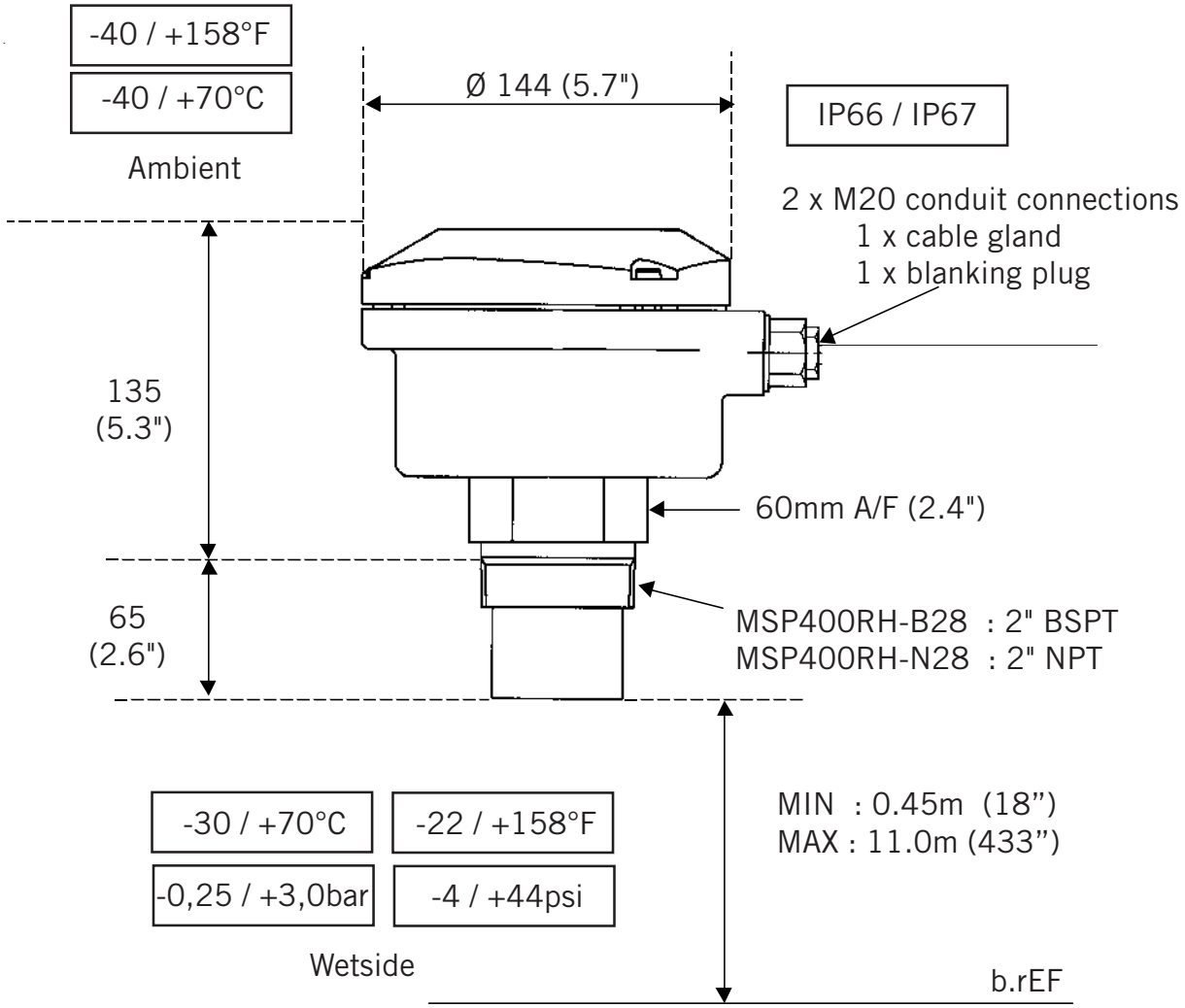
Supply voltage	12-40V dc
Output	4-20mA (3.8 - 20.5mA linear) Relays (2) : SPST rated 1A at 24Vdc
Communications	HART Digital communications (Rev. 5)
Earthing	None required
Recommended Cable	Two core each 0.22 mm^2 min, shielded
Max. cable length	3000m
Cable resistance	0.1 Ohm per metre length max.
Cable gland	Suitable for cable sizes 4mm - 8mm diameter

Operating

Range	0.45 to 11m
Temperature	
Ambient	-40°C to +70°C
Wetside	-30°C to +70°C
Pressure	-0.25 bar to 3.0 bar
Weatherproofing	IP66/IP67

Certification

The MSP400 range of products are Factory Mutual (Fm) certified as Process Control Equipment meeting basic electrical, mechanical and fire protection requirements (IP66/IP67).


-40 / +158°F
-40 / +70°C
Ambient
Ø 144 (5.7")
IP66 / IP67
2 x M20 conduit connections
1 x cable gland
1 x blanking plug
135
(5.3")
60mm A/F (2.4")
65
(2.6")
MSP400RH-B28 : 2" BSPT
MSP400RH-N28 : 2" NPT
MIN : 0.45m (18")
MAX : 11.0m (433")
-30 / +70°C
-22 / +158°F
-0,25 / +3,0bar
-4 / +44psi
Wetside
b.rEF

3.0 Installation

Important safety notice : The MSP400 is designed for safe area use only, and **must not** be installed in a hazardous area, even if the power is supplied through a barrier device.

General

a. Installation **must** be carried out by suitably trained personnel in accordance with the applicable code of practice.

b. 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.

c. The equipment should only be cleaned with a damp cloth, do not use solvents.

d. The equipment is **not** intended to be repaired by the user and is to be replaced by an equivalent certified unit. Repairs should only be carried out by the manufacturer or approved repairer.

3.1 Location of the MSP400RH transmitter

Correct location of the transmitter is essential for the reliable operation of any ultrasonic level measurement system.
Whilst the transmitter may be site tuned to deal with most application conditions, it is strongly recommended that the following guidelines should be adopted wherever relevant.

3.1.1 General considerations

- The MSP400RH transmitter complies with the European Directive for Electro Magnetic Compatibility (EMC) Class B.
  It is not advisable to mount the transmitter in close proximity to a source of electrical noise such as a variable speed drive or other high powered electrical device.

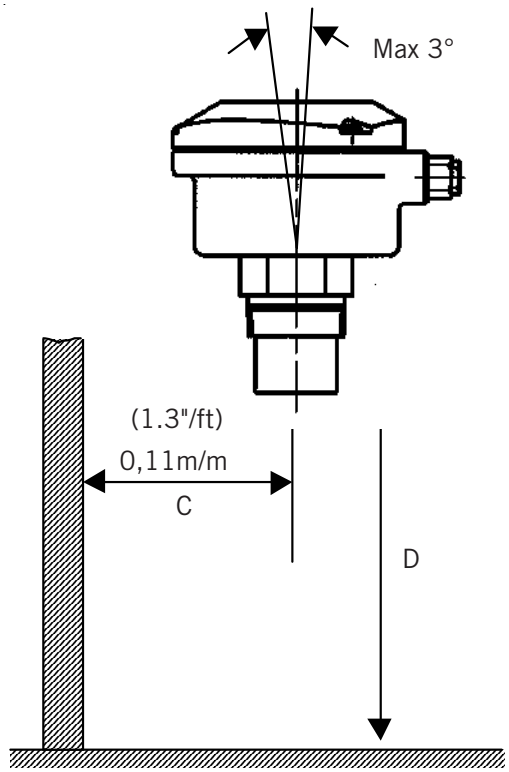
- The MSP400 should be mounted above the liquid surface using the "2" thread provided. To facilitate mounting, a bracket kit is available. See Section 3.2.

  Note : The MSP400 is designed to be mounted in a non-metallic fitting or flange. The use of metallic fittings or flanges is not recommended.

- The transmitter should be mounted as near vertical as possible to ensure a good echo from the liquid surface and maximum echo size received.
  The beam angle (to the half power point) of the transmitter is 12 degrees inclusive.

  Obstructions in the tank or well may generate echoes which can be confused with the real liquid surface echo. Obstructions within the beam angle generate strong "false-echoes"; wherever possible, the transmitter should be positioned such that false echoes are avoided.
  To avoid detecting unwanted objects in the tank or well, it is advisable to maintain a distance of at least 0.11m from the centre line of the transmitter for every metre range to the obstruction.

- If the transmitter is located near the side of the tank or well, there will be no false echo generated provided the wall is smooth and free of protrusions. However, there will still be a reduction in the echo size. To avoid large echo size loss, it is recommended that the transmitter never be mounted closer than 0.3m to the wall.
  Fatty, dirty or viscous liquids can cause a "scum line" to build-up on the tank or well wall. Avoid false echoes from this by enabling "scum line prevention" software in the MCU control unit.



i.e. D Min = 0.45m (18")
D Max = 11m (433")
C = 0.3m (12") min to 0.88m (36")

- If the transmitter is mounted in an enclosed tank, avoid mounting the transmitter in the centre of the tank roof as this could act as a parabolic reflector and create unwanted echoes. Avoid applications where heavy condensation could form on the transducer face.

- If the transmitter is mounted in a stand-off or nozzle, it is always preferable that the transmitter face be at least 5mm proud of the stand-off such that it protrudes beyond the stand-off and into the tank. If this is not possible, see section 3.2.

- If the transmitter is used in environments where direct sunlight can cause very high surface temperatures on exposed instruments, it is recommended that the installer should construct a suitable sun-shade to protect against this.

- Remember that the minimum operating range of the transmitter is 0.45m. The transmitter will not detect any liquid surface closer than 0.45m to the transmitter face.

3.1.2 Liquid surface conditions

- Foaming liquids can reduce the size of the returned echo as foam is a poor ultrasonic reflector. It is always preferable to mount an ultrasonic transmitter over an area of clear liquid, such as near the inlet to a tank or well. In extreme conditions, or where this is not possible, the transmitter may be mounted in a vented stilling tube provided that the inside bore of the stilling tube is at least 100 mm (4") and is smooth and free from joints or protrusions. It is also preferable that the bottom of the stilling tube does not become uncovered, thus preventing the ingress of foams.

- Beware of mounting the transmitter directly over any inlet stream.

- Liquid surface turbulence is not normally a problem unless it is excessive. In most cases, the effects of turbulence are minor, with excessive turbulence being catered for by fine tuning the transmitter on site if necessary.

3.1.3 In-tank effects

- Stirrers or agitators can cause a vortex. Always try to mount the transmitter off-centre of any vortex to maximise the return echo.
  As stirrer blades become uncovered they will create echoes as they pass through the ultrasonic beam. The transmitter can be tuned to ignore these false echoes on site.

- In non-linear tanks with rounded or conical bottoms, always mount the transmitter off-centre. In some cases, it may be desirable to install a perforated reflector plate on the tank bottom directly under the transmitter centre line to ensure a satisfactory return echo.

- Avoid mounting the transmitter directly above any pumps as the transmitter will detect the pump casing as the liquid falls away. If this is not possible, fine tuning on site may be required to ignore echoes from the pump casings.

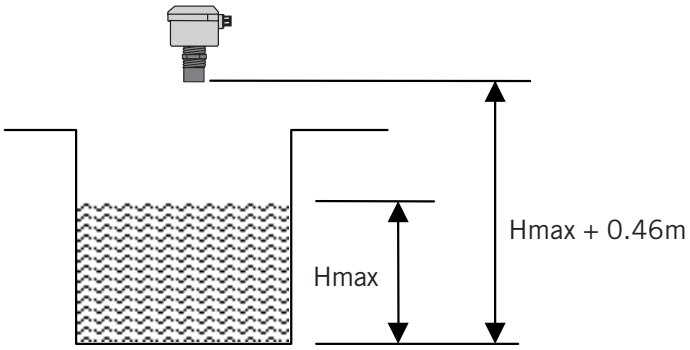
3.1.4 Open Channel Flow installations.

There are normally two distinct parts to an open channel flow measurement system; the primary element (flow structure) and the secondary element (Head measurement instrumentation).
For accurate open channel flow measurement, both parts of the system must be installed accurately.

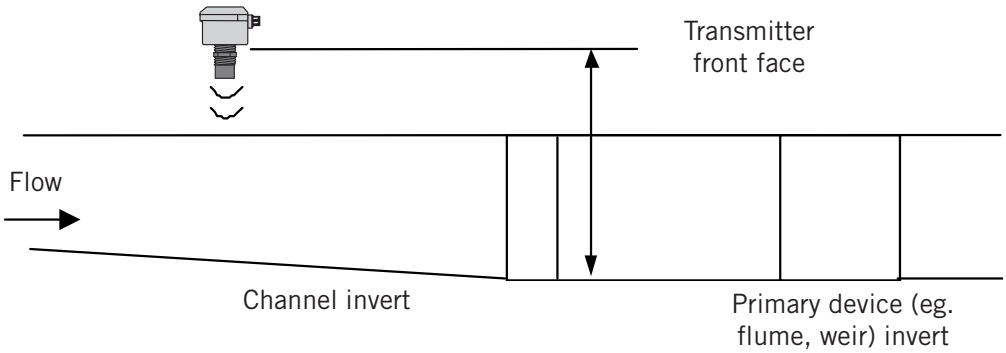
This manual explains some key aspects of the installation of the secondary element, in this case the ultrasonic transmitter.
For full details of the installation of a primary element such as a flume or weir, reference should be made to the relevant British (BS3680) or International standard.

In the United Kingdom, Mobrey Ltd offers a complete installation and commissioning service for open channel flow measurement systems. For further information contact the sales office and/or refer to Mobrey's 'The Guide'.

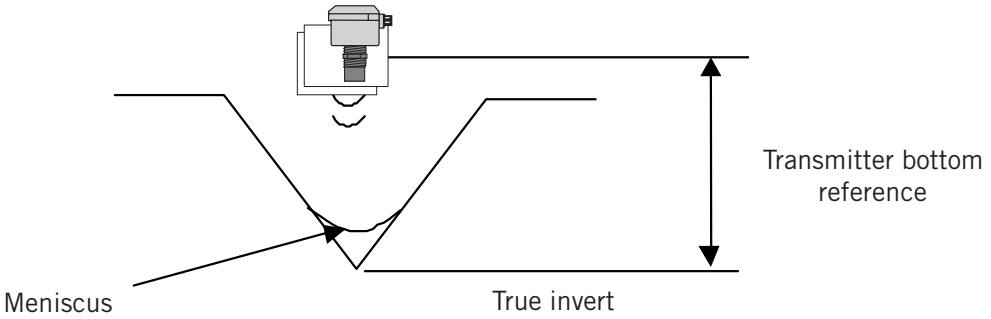
Positioning of the transmitter is critical and should be the correct distance upstream from the flow structure as stated in BS3680 e.g. a distance of 4 to 5 times Hmax for a thin plate weir or 3 to 4 times Hmax for a flume.
For optimum accuracy, the front face of the transmitter should be positioned at a height that is at least equal to the maximum flow depth plus the blanking distance of the transducer. A minimum distance of 0.46m is recommended.



It is important to note that the bottom reference of the transmitter should be related to the centre of the invert of the primary device, NOT the distance to the channel bottom directly below the transmitter.



In addition to the above, when setting the bottom reference on a 'V' notch weir it is important that the true invert of the weir is taken and not the meniscus liquid level, which may be 3 to 4mm (1/8") above the true invert.



- The liquid surface at the point of measurement must have a stable, smooth surface and uniform approach velocity. It must not be affected by baffles, foam, hydraulic jumps or any other object likely to cause flow disruption.

- The primary element should be free from any situation where it is likely to 'drown' (refer to relevant standard for further information)

- The MSP400RH transmitter has integral temperature compensation and must be protected at all times from direct sunlight and any radiated heat.
  For maximum accuracy and stability of level measurement reading the transmitter should always be shrouded to prevent the incidence of direct sunlight.
  If the flow structure permits, mount the transmitter within the flow channel or chamber.
  Alternatively, the MSP400RH transmitter can accept an input from an external temperature sensor. See section 3.3.1.

If you are in doubt about any aspect of transmitter installation, contact Mobrey (Service Division) who will be pleased to advise.

3.2 Mounting the transmitter above the liquid surface.

A 2" thread is provided to mount the transmitter.
The user should check the thread form, which will be either 2" BSPT (MSP400RH-B28) or 2" NPT (MSP400RH-N28). The thread form is clearly marked on the hexagon of the transducer body.

Note : The MSP400 is designed to be mounted in a non-metallic fitting or flange. The use of metallic fittings or flanges is not recommended.

To help installation, a bracket kit is available from Mobrey. This comprises a Stainless Steel angle bracket and PVC threaded disc which may be used to mount the MSP400 on a gantry or other support over the liquid level. Order part number MSP-BRK2 (BSP) or MSP-BRK3 (NPT). The bracket may be bolted to a suitable cross member above the liquid surface.

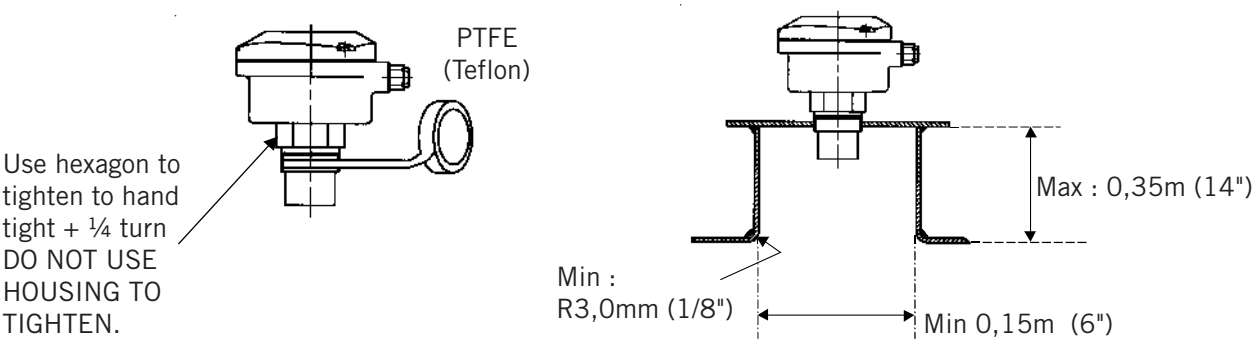
Ensure that the transmitter is perpendicular to the liquid surface to maximise the return echo size.

Check that the maximum liquid level will not encroach into the 0.45m blanking zone of the transmitter.

Note : To aid alignment, the echo size / signal strength can be displayed on the MCU900 control unit or on the MSP400RH transmitter display. Refer to section 4 for details.

Use PTFE tape on the screw thread, tighten to hand tight + ¼ turn, using the Hexagon.

When installing on a vessel which has a nozzle or stand-off, and the transducer face does not protrude into the vessel, note the dimensions in the diagram below and always ensure that the nozzle/vessel weld is smooth and free from internal weld beads or other projections.

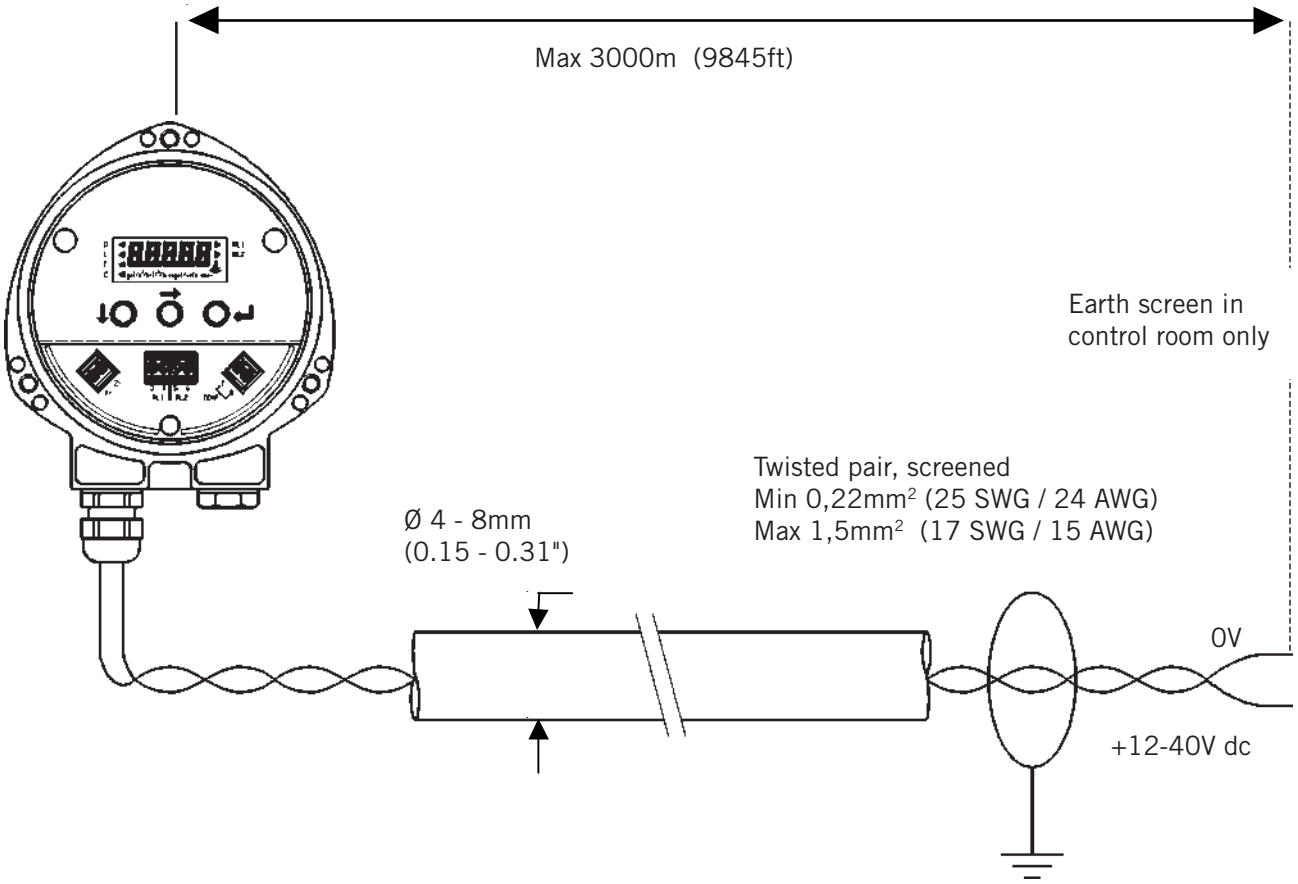


3.3 Wiring

The transmitter is supplied with cable gland suitable for cable sizes 4-8mm diameter.

Terminal	1	: +24V dc
	2	: 0v dc
	3	: RL1 (SPST)
	4	: RL1 (SPST)
	5	: RL2 (SPST)
	6	: RL2 (SPST)
	7	: MSP-RTP temperature probe (if used)
	8	: MSP-RTP temperature probe (if used)

Earth Screen : Connect to a standard earth in the control room.



3.3.1 External temperature sensor

The MSP400RH transmitter will accept an input from a Mobrey external temperature sensor.

Order part number MSP-RTP.
This is a thermistor based temperature sensor specifically designed for use with the MSP400RH transmitter.
Full installation instructions are supplied with the temperature sensor, but note that it should be mounted out of direct sunlight in a position such that it can give a representative reading of the air temperature between the liquid surface and the MSP400RH transmitter.

3.3.2 After completing the wiring

Ensure all cable glands / blanking plugs and seals are in good condition after wiring to maintain the weatherproof rating of the transmitter.

Check that the cover seal is in good condition and not twisted or misaligned in the seal location groove. When replacing the cover, tighten the 3 cover screws evenly to exert uniform pressure on the cover seal.

3.3.3 Relays

The MSP400RH transmitter has 2 integral relays which may be used for control purposes. These relays are light duty and should be used as signal relays only, with control functions being performed by external control relays.

Relay 2 is defaulted as a 'fault' relay, normally energised, but may be reconfigured on site as a set point relay if required.

3.4 Additional components in the two wire loop.

3.4.1 Lightning / surge protection and other loop devices

It is allowable to fit loop powered or separately powered devices in the two wire loop provided that the transmitter receives a minimum voltage of 12V dc at 21 mA loop current.

If the area is prone to lightning strikes or voltage surges, fitting of a suppressor device is desirable between the transmitter and the control unit.

3.5 Wiring to allow HART communication

If it is intended to use HART digital communications with the MSP400RH transmitter, a 250 Ohm 0.25W load resistor must be installed in the loop.

When used with the Mobrey MCU900 family of Control Units, there is no need to install an external load resistor in the loop as there is a suitable resistor built in to the Control Unit.

If the transmitter is being supplied through a safety barrier, ensure the type chosen will pass HART/ SMART information.

Once installed, a HART communicator can be connected across the load resistor, or across the loop at any point downstream of the load resistor.

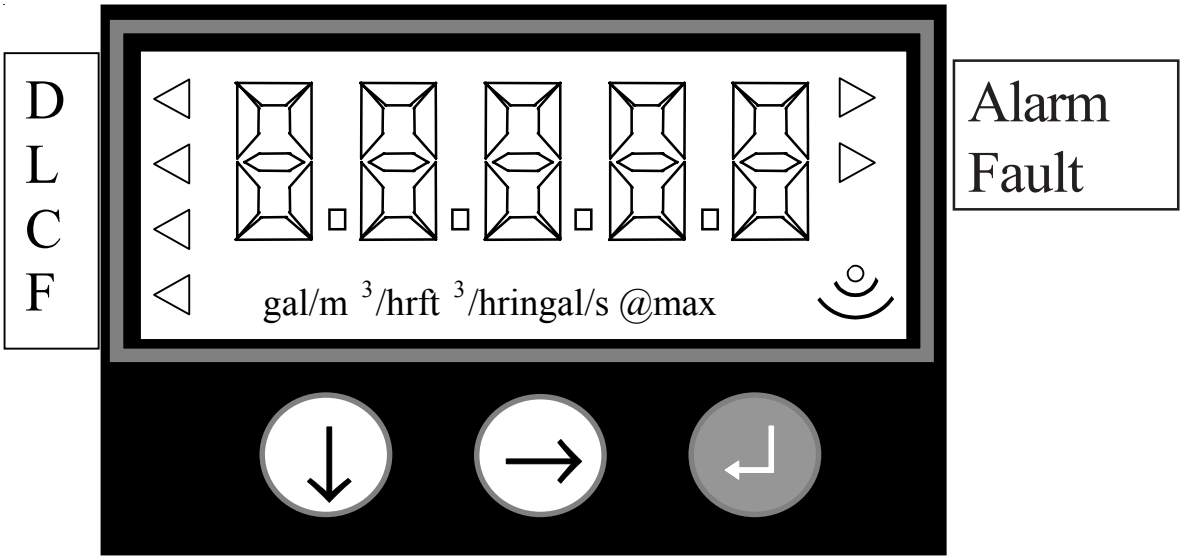
4.0 Commissioning, programming and operation

The MSP400 operates from a menu of parameters, each held in a specific memory location within the instrument. The memory locations may be pictured as a matrix, and the user navigates to each parameter to programme the instrument using ↓ and → steps.
Refer now to the Main Menu structure shown in Appendix A

The MSP400 leaves the factory pre-programmed with a value in each parameter location such that , when the power is first applied, the instrument will give a sensible reading. A list of default values is given in the parameter listing in Appendix B.

The MSP400 is HART enabled, allowing remote communications with the instrument.
The instrument can therefore be either programmed using a suitable HART compatible master, or may be programmed locally using the push buttons provided inside the instrument. For details of local programming, continue reading this section. For details of HART communications, refer to Appendix D.

4.1 Display and push buttons.



Button Colour : Green Blue Red

The main display allows display of up to 5 characters, which in the normal run mode will be the measurement, termed the Primary Variable (PV) of the instrument, or in the programming mode will be data to assist in programming.

To the left of the main display are 4 arrow icons, only one of which will be illuminated at any one time to indicate the duty chosen by the user.

To the right of the main display are 2 arrow icons which indicate the status of the transmitter relays. When illuminated, they indicate that the relay contact is closed.

Under the main display is a text string which allows display of the units of measurement. The instrument will illuminate only those characters applicable to the units of measurement chosen.

To the right of the text string is an echo received icon made up of 3 arc segments which continuously indicate the strength of the echo received (minimum, average and good)

4.2 Power up

On power up, the MSP400 will take a few seconds to initialise. The display will run through a set-up routine, first illuminating all display characters then showing the software revision number. Once checks are complete, the display will show the Primary Variable (PV) determined based upon the factory default values in the memory.

On a new instrument aimed at a good target, this will be what the MSP400 calculates as a level reading based upon the default value for the bottom reference.
The duty icon against the letter L on the top plate and the RL2 icon will be illuminated.
It is possible that the RL1 icon may be illuminated depending upon the level calculated by the MSP400 at this time.

The MSP400 is now ready for use, and the next step is to programme the unit with details of the application.

The MSP400 may be programmed either in-situ or prior to installation. All programmed data is retained in the MSP400 memory after power off.

4.3 Programming- Important notes to help you programme the MSP400

- Do not allow rain or water to enter the MSP400 whilst programming or damage to the circuit boards will occur.

- Use the push buttons as instructed below to navigate through the programming menu and select or enter application data.
  It is recommended that use of the push buttons is firm but not overly so to prevent damage to the circuit boards below, and that the user should not press buttons too fast to avoid incorrect data entry. Simply holding down the green button ↓ will automatically scroll through any option list without the need for repeated pressing of the button.

- Pressing the red button ↵ at any time will step the user back to the previous level in the menu.
  Note, if the red button ↵ is pressed after a menu option selection has been made or new data has been entered, this option selection or new data will automatically be saved.

- Whilst programming should be simple and intuitive, it may be that the user wishes to start again or may wish to clear the memory of site entered data from a previous application. The MSP400 has a “re-set default values” routine which allows the user to reload the MSP400 memory with the factory default values as shown on the menu structure. Refer to section 4.7.10.

4.4 Setting up for the chosen application - the Main Menu.

Refer now to the main menu structure chart in Appendix A.

It is important to note that MSP400 programming is most easily accomplished by first selecting the duty the transmitter is to perform.
Once a duty is selected (see section 4.4.1), a "mini-wizard" programming assistant is invoked and the user is thereafter only asked for information relevant to the duty chosen. As the user is guided through the menu, data input allows the mini-wizard to populate relevant parameters with application specific data in the background, and then select the next step required to configure the transmitter for the chosen application.

The user is strongly advised to enter the duty menu whenever programming the MSP400, thus invoking the mini-wizard which will assist programming.

Once programmed, it is possible to review the data entered into or calculated by the MSP400 by stepping through the main menu using the green button ↓.

Note however that this will be a manual navigation of the MSP400 menu, and that ***all*** menu items will be shown in this procedure, regardless of the duty chosen; the mini-wizard is only invoked if the user enters and scrolls through or selects/refreshes a duty choice.
In a manual navigation down the main menu, simply ignore those menu items shown that do not relate to your application.

4.4.1 Selecting the duty:

Screen display: dutY
Factory default setting: Level

The MSP400 may be programmed to perform one of 4 duties:

- Distance measurement
- Level measurement (factory default setting)
- Flow measurement
- Contents measurement

To change the duty:

a) Press the green button ↓ to display the "dutY" menu entry screen.

b) To confirm or change the duty from Level to one of the other duties, thus invoking the mini-wizard, press the blue button → to enter the "dutY" menu. Press the blue button → again to allow change of the duty. The current duty will now be flashing, indicating it may be confirmed or changed.

c) Press the green button ↓ to scroll through the list of available duty options, or press the red button ↵ if the duty displayed is correct

d) Once the desired duty is shown (flashing) on the display, press the blue button → to select this duty. It will now stop flashing.

e) If the chosen duty is incorrect, the edit sequence for the duty can be re-started by pressing the blue button → again.

   If the chosen duty is correct, press the red button ↵ to save the duty to memory and automatically scroll on to the next main menu option: units.

Note that the arrow icon to the left of the display will now show the duty chosen and saved.

4.4.2 Selecting the units of measurement

Screen display: unitS
Factory default setting:
MSP400RH-B28 m
MSP400RH-N28 ft

i) Note that the factory default units of measurement are dictated by the model type, which may be Imperial (ft) or Metric (m).
The user can reconfigure a Metric unit to be an Imperial or vice-versa by changing the base units (b.unit) of the MSP400 - refer to section 4.7.11

ii) Note that changing the base units will cause the MSP400 to re-start with factory default values in all other parameters.

Changing base units after programming the MSP400 will cause all programmed data to be overwritten with factory default values.

The MSP400 is pre-programmed with selected units of measurement for each of the duties available :

- Distance and Level measurement
  m , ft, in, none

- Flow measurement
  l/s, l/m, m^3/hr, gal/s, gal/m, ft^3/m (cfm), ft^3/hr, none

- Contents measurement
  l, m^3, gal, ft^3

To change the units of measurement:

a) Press the green button ↓ to display the "unitS" menu entry screen. If metres are the chosen units of measurement, as indicated by the small ""m" below the word "unitS" press the green button ↓ to continue commissioning.

b) To change the units of measurement from metres to one of the other options, press the blue button → to enter the "unitS" menu. Press the blue button → again to allow change of the units of measurement. The current unit of measurement will now be flashing, indicating it may be changed.

c) Press the green button ↓ to scroll through the list of available duty options.

Notes.
i) The MSP400 will offer a selection of units of measurement relevant to the chosen duty as shown in the option table above.
The final option in each set is "none", which appears as a blank screen. This option is available to the user who requires to display in units other than those available in the standard option table. In this case, the user will need to scale the PV according to a suitable scaling factor - refer to section 4.4.6
It is strongly recommended that the user make a note of the scale factor and the resultant units of measurement and retain this on a label within the instrument at all times to avoid later confusion.

ii) When using the green button ↓ to scroll through the units of measurement options, allow 2-3 seconds after each button press for the MSP400 to check and display the selection. Pressing the green button ↓ continuously simply continues scrolling around the units of measurement option loop.

d) Once the desired unit of measurement is shown (flashing) on the display, press the blue button → to select this option. It will now stop flashing.

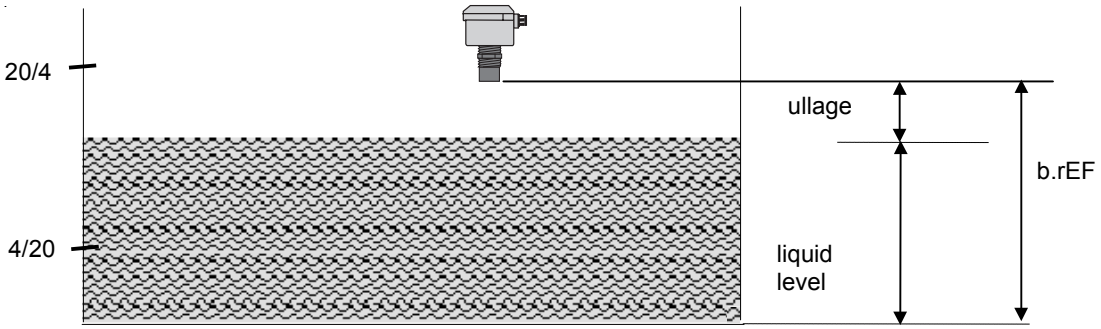
e) If the chosen units of measurement are incorrect, the edit sequence for the units of measurement can be re-started by pressing the blue button → again.

If the chosen units of measurement are correct, press the red button ↵ to save the units of measurement to memory and automatically scroll on to the next main menu option: b.rEF.

4.4.3 Setting the correct bottom reference

Screen display: b.rEF
Factory default value:
MSP400RH-B28 11
MSP400RH-N28 36

The MSP400 leaves the factory with the bottom reference pre-programmed to the maximum range of the instrument, either 11m or 36ft.



To change the bottom reference:

a) Press the green button ↓ to display the current "b.rEF" menu entry screen.

b) Press the blue button → to enter the "b.rEF" menu and to display the current bottom reference in use. It is quite unlikely that the factory default value for bottom reference will suit your application. To edit the bottom reference, press the blue button → to enter the editing mode. The leading digit of the current bottom reference will now be flashing, indicating it may be changed.

c) Use the green button ↓ to edit the value of the leading digit. Be careful not to enter a value greater than the maximum range of the MSP400: 11m or 36ft.

The value of the leading digit should therefore be 1 or 3 as a maximum, depending upon the units of measurement chosen earlier.

Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all 5 digits are correct.

d) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

e) If the new bottom reference value is incorrect, the edit sequence for the bottom reference can be re-started by pressing the blue button → again.

If the new bottom reference is correct, press the red button ↵ to save the new value to memory and automatically scroll on to the next main menu option:

Note:
If the user has chosen a duty of Flow or Contents, the next menu option offered will be "ProF". Refer now to sections 4.4.4 to 4.4.9.

If the user has chosen a duty of Level or Distance, the next menu option offered will be "4". Skip sections 4.4.4 to 4.4.9 and refer now to section 4.4.10.

TIP: a feature of the MSP400 useful at this stage is that it can be used as an electronic tape measure. With an empty tank or vessel, select Distance as the duty and the MSP400 will read the distance to the bottom of the tank. This can be noted and used when setting b.rEF

4.4.4 Selecting the correct Profile algorithm. Screen display: ProF
Factory default value: Linear

This selection is offered only if the user has chosen a duty of Flow or Contents, or is shown when manually navigating the main menu - ignore if duty chosen is Level or Distance.

The MSP400 is pre-programmed with a selection of popular profiles which are mathematical formulae to convert a linear level reading to a flow or volumetric PV.
Once converted, the 4-20mA and the display of the unit will operate according to the flow or volumetric PV.

The options available are described in the following sections:

4.4.4.1 Flow measurement

3/2	Flume 3/2 flow law
5/2	V-Notch 5/2 flow law
mann	Manning formula
PAr 1	1 ft Parshall flume
PAr 2	2 ft Parshall flume
PAr 3	3 ft Parshall flume
PAr 4	4 ft Parshall flume
PAr 5	5 ft Parshall flume
PAr 6	6 ft Parshall flume
PAr 7	7 ft Parshall flume
PAr 8	8 ft Parshall flume
FF01	Flume Flat 1
:	
:	
:	
FP07	Flume Parabolic 7

The last 30 options for flow FF01 - FP07 comprise a selection of pre-defined standard flow structures which may be of use if none of the other profiles suit. Refer to Appendix D for details.

Note, when scrolling around the profile option loop, all flow and contents profiles are shown.

There are two other profiles which are available but which are not visible when programming the MSP400 using the push buttons.

SPEC. P Special plotted : only used if the MSP400 has been configured by a HART master such as the Mobrey MCU900 series controller or Mobrey H-Conf401 software

SPEC.C Special calculated : used when a standard profile is not available from the MSP400 library. Allows the user to enter a Power law and a K factor, for example for a small Parshall flume or to modify the K factor or power to allow for imperfections in standard flow structures.

To change the flow profile:

a) Press the green button ↓ to display the “ProF” menu entry screen.

b) Press the blue button → to display the current selection. If this selection is correct, press the red button ↵ to return to the main menu.

c) To change the profile to one of the other options, press the blue button → to enter the “ProF” menu. The current selection will now be flashing, indicating it may be changed.

d) Press the green button ↓ to scroll through the list of available profile options, as given in the table above.

Note: The complete range of options is displayed, regardless of the duty selected earlier.

e) Once the desired profile is shown (flashing) on the display, press the blue button → to select this option. It will now stop flashing.

f) If the chosen profile is incorrect, the edit sequence for the profile selection can be re-started by pressing the blue button → again.

If the profile is correct, press the red button ↵ to save the profile to memory and automatically scroll on to the next main menu option.

Note:
The next menu item presented will depend upon the flow profile chosen :-

i) 3/2 5/2 : the next menu item will be "SCALE"
The MSP400 will automatically calculate the Power factor and only requies the K factor to be entered.
Refer to section 4.4.6

ii) Manning : the next menu item will be "LEUEL @ max".
Refer to section 4.4.7.

iii) Parshall, FF or FP : the next menu item will be "d". The MSP400 will automatically calculate the appropriate Power factor and K factor, and will set the 4mA point at zero flow and the 20mA point at maximum flow.
Refer to section 4.4.12.

4.4.4.2 Contents measurement

Lin	Linear (factory default setting)
H.CYL.F	Horizontal cylinder on it's side with flat ends
SPH.	Spherical vessel
H.CYL.D	Horizontal cylinder on it's side with dished ends

To change the contents profile:

a) Press the green button ↓ to display the "ProF" menu entry screen.

b) Press the blue button → to display the current selection. If this selection is correct, press the red button ↵ to return to the main menu.

c) To change the profile to one of the other options, press the blue button → to enter the "ProF" menu. The current selection will now be flashing, indicating it may be changed.

d) Press the green button ↓ to scroll through the list of available profile options, as given in the table above.

Note: The complete range of options is displayed, regardless of the duty selected earlier.

e) Once the desired profile is shown (flashing) on the display, press the blue button → to select this option. It will now stop flashing.

f) If the chosen profile is incorrect, the edit sequence for the profile selection can be re-started by pressing the blue button → again.

If the profile chosen is "Lin", press the red button ↵ to save the profile to memory and automatically scroll on to the next main menu option "SCALE".
Refer to section 4.4.6.

If the profile chosen is any other contents profile, press the red button ↵ to save the profile to memory and automatically scroll on to the next main menu option "Cont @ max", Refer to Section 4.4.9.

4.4.5 Power factor for the chosen flow law.

Screen display: P.FACt
Factory default value: 1.000

This selection is offered only if the user has chosen a duty of Flow which requires the manual entry of a power factor in a formula of the type

Flow Q = kh* (where * = the power factor)

or is shown when manually navigating the main menu - ignore if duty chosen is Level, Distance or Contents.

The MSP400 is pre-programmed with the appropriate power factor for many of the flow profile options available, or it may be edited to suit the user's specific flow structure.

Refer to Appendix C for a table of pre-programmed values.

To edit the power factor

a) Press the blue button → to enter the "P.FACt" menu and to display the current power factor in use. If this is correct, press the green button ↓ return to the main menu.
If the power factor is to be edited, press the blue button → again to allow editing

The leading digit of the current power factor will now be flashing, indicating it may be changed.

b) Use the green button ↓ to edit the value of the leading digit.

c) Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all 5 digits are correct.

d) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

If the new power factor value is incorrect, the edit sequence for the power factor can be re-started by pressing the blue button → again.

If the new power factor is correct, press the red button ↵ to save the new value to memory and automatically scroll on to the next main menu option: "SCALE"

4.4.6 K Factor for the chosen flow law

Screen display SCALE
Factory default value 1.000

Note:
The display will read "SCALE". If a flow duty has been chose, the value entered into this parameter is in effect the K factor in a flow law of the form Flow Q = kh*.

If a Distance, Level or Contents duty has been chosen, the value entered into this parameter is a factor by which the measured distance, level or contents is scaled.

For a Level or Distance duty the scaling factor is normally left at the value calculated by the MSP400 depended upon previously entered data and the duty chosen, or the default value of 1.000, unless the user wishes to convert the measurement to units other than those offered as standard, for example, yards.

For a linear Contents duty, the user must enter a scaling factor to convert the level measurement to a contents measurement. If the units of measurements are "m", then enter the volume contained in 1m of liquid height in the tank. If the units of measurements are "ft", then enter the volume contained in 1ft of liquid height in the tank.

To edit the scale factor

a) Press the blue button → to enter the "SCALE" menu and to display the current scale factor in use. If this is correct, press the red button ↵ return to the main menu.
If the scale factor is to be edited, press the blue button → again to allow editing

The leading digit of the current scale factor will now be flashing, indicating it may be changed.

b) Use the green button ↓ to edit the value of the leading digit.

c) Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all 5 digits are correct.

d) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

If the new scale factor value is incorrect, the edit sequence for the scale factor can be re-started by pressing the blue button → again.

If the new scale factor is correct, press the red button ↵ to save the new value to memory and automatically scroll on to the next main menu option: "4"

However, if the data already entered allows the MSP400 to calculate the maximum flow, the 4mA and 20mA points are automatically set to 4mA at zero flow and 20mA at maximum flow.
The next menu item offered in this case is "d".
Refer to section 4.4.11

4.4.7 Maximum level entry	Screen display	LEUEL@ max
	Factory default value	1.000

This selection is offered only if the user has chosen a duty of Flow which requires entry of the level at which the maximum flow occurs, or is shown when manually navigating the main menu - ignore if duty chosen is Level, Distance or Contents.

To enter the value for the level at which the maximum flow occurs:

a) Press the blue button → to enter the "LEUEL" @ max" menu and press the blue button → again to allow editing.

The leading digit of the level value will now be flashing, indicating it may be changed.

b) Use the green button ↓ to edit the value of the leading digit.
Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all 5 digits are correct.

c) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

d) If the new level value is incorrect, the edit sequence for the maximum level can be re-started by pressing the blue button → again.

e) If the level value entered is correct, press the red button ↵ to save the value to memory and automatically scroll on to the next main menu option: "Flo @ max".

4.4.8 Maximum flow entry

Screen display: Flo @ max
Factory default value: 1.000

This selection is offered only if the user has chosen a duty of Flow which requires entry of the maximum flow capability of the chosen structure (not the maximum flow expected in the application), or is shown when manually navigating the main menu - ignore if duty chosen is Level, Distance or Contents.

To enter the value for maximum flow:

a) Press the blue button → to enter the "Flo @ max" menu and press the blue button → again to allow editing.

The leading digit of the maximum flow will now be flashing, indicating it may be changed.

b) Use the green button ↓ to edit the value of the leading digit.
Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all 5 digits are correct.

c) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

d) If the new maximum flow value is incorrect, the edit sequence for the maximum flow can be re-started by pressing the blue button → again.

e) If the maximum flow value entered is correct, press the red button ↵ to save the value to memory and automatically scroll on to the next main menu option: "4".

However, with a duty of Flow chosen if the data already entered allows the MSP400 to calculate the maximum flow, the 4mA and 20mA points are automatically set to 4mA at 0 flow and 20mA at maximum flow.

The next menu item offered in this case is "d".
Refer to section 4.4.12.

4.4.9 Maximum contents entry

Screen display: Cont @ max
Factory default value: 1.000

This selection is offered only if the user has chosen a duty of Contents which requires entry of the maximum contents of the vessel, or is shown when manually navigating the main menu - ignore if duty chosen is Level, Distance or Flow.

To enter the value for maximum contents:

a) Press the blue button → to enter the "Cont @ max" menu and press the blue button → again to allow editing.

The leading digit of the maximum contents will now be flashing, indicating it may be changed.

b) Use the green button ↓ to edit the value of the leading digit.
Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all 5 digits are correct.

c) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

d) If the new maximum contents value is incorrect, the edit sequence for the maximum contents can be re-started by pressing the blue button → again.

e) If the maximum contents value entered is correct, press the red button ↵ to save the value to memory and automatically scroll on to the next main menu option: "4".

4.4.10 Setting the 4mA point

Screen Display: 4
Factory default value: 0.000

Enter the value of the PV which you require to be signalled by 4mA

The 4mA point may be set above or below the 20mA point to suit the monitoring or control equipment. If you wish to set the 4 and 20mA points by ranging the MSP400 to a fixed target, such as the level in the vessel at any particular time or a fixed target at a known distance away, skip these menu options now by pressing the green button D 2 times to arrive at the set damping option.

To edit the 4mA point

a) Press the blue button → to enter the 4mA menu and to display the current value in use. If this is correct, press the red button ↵ return to the main menu.
If the 4mA point is to be edited, press the blue button → again to allow editing

The leading digit of the current 4mA value will now be flashing, indicating it may be changed.

b) Use the green button D to edit the value of the leading digit.

c) Once correct, use the blue button → to select the next digit and then the green button D to edit as before, or the blue button → to move to the next digit. Continue this sequence until all 5 digits are correct.

If the new 4mA value is incorrect, the edit sequence for the 4mA point can be re-started by pressing the blue button → again.

If the 4mA value is correct, press the red button ↵ to save the new value to memory and automatically scroll on to the next main menu option: “20”

4.4.11 Setting the 20mA point

Screen Display: 20
Factory default value: 10.550

Enter the value of the PV which you require to be signalled by 20mA

The 20mA point may be set above or below the 4mA point to suit the monitoring or control equipment.

To edit the 20mA point

a) Press the blue button → to enter the 20mA menu and to display the current value in use. If this is correct, press the red button ↵ return to the main menu.
If the 20mA point is to be edited, press the blue button → again to allow editing

The leading digit of the current 20mA value will now be flashing, indicating it may be changed.

b) Use the green button D to edit the value of the leading digit.

c) Once correct, use the blue button → to select the next digit and then the green button D to edit as before, or the blue button → to move to the next digit. Continue this sequence until all 5 digits are correct.

d) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

If the new 20mA value is incorrect, the edit sequence for the 20mA point can be re-started by pressing the blue button → again.

If the 20mA value is correct, press the red button ↵ to save the new value to memory and automatically scroll on to the next main menu option: “d”

4.4.12 Setting the damping applied to the output

Screen display d
Factory default value 3

The damping value entered is actually a time constant in seconds which is applied as smoothing to the displayed PV and current output.
A new value may be entered up to a maximum value of 9999 seconds. A large value will have the effect of smoothing out rapid changes of current output and will also smooth out the effects of turbulence and ripples on the liquid surface.

Note, it would not normally be necessary to select a value greater than 30 seconds.

Alternatively, a value of zero may be entered in which case no smoothing is applied and changes in reading immediately change the current output.

Note, as the MSP400 transmits a pulse at nominally once per second, a damping time of zero will not necessarily give an immediate change in output.

To edit the damping value:

a) Press the blue button → to enter the damping menu and to display the current value in use. If this is correct, press the green button ↓ return to the main menu.
If the damping value is to be edited, press the blue button → again to allow editing

The leading digit of the current damping value will now be flashing, indicating it may be changed.

b) Use the green button ↓ to edit the value of the leading digit.

c) Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all the digits are correct.

d) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

If the new damping value is incorrect, the edit sequence for the 20mA point can be re-started by pressing the blue button → again.

If the damping value is correct, press the red button ↵ to save the new value to memory and automatically scroll on to the next main menu option: “AL”

4.4.13 Selecting the output current action on alarm condition

Screen display AL
Factory default value Hold

The MSP400 will signal an alarm condition in the event that the target echo is lost for a period of 900 seconds or more. This time of 900 seconds is factory set and is changeable in the field.
(See Section 4.7.2)

The user can select what action the current output will take in the event of a lost echo condition:

Hi The current on the two wire loop will drive up to 21mA and will remain there until a correct target echo is recovered. The display will flash “LE” and the alarm action alternately.

Hold The current will freeze at the value it was last reading and will remain there until a correct target echo is recovered. The display will flash “LE” and the last valid reading alternately.

Lo The current on the two wire loop will drive down to 3.6mA and will remain there until a correct target echo is recovered. The display will flash “LE” and the alarm action alternately.

To change the output current action on alarm condition:

a) Press the blue button → to enter the alarm action menu and to display the current selection. If this is correct, press the green button ↓ return to the main menu.

b) If the action is to be changed, press the blue button → again to allow editing

c) Press the green button ↓ to scroll through the list of available profile options, as given in the table above.

d) Once the desired action is shown (flashing) on the display, press the blue button → to select this option. It will now stop flashing.

e) If the chosen action is incorrect, the edit sequence for the profile selection can be re-started by pressing the blue button → again.

If the action is correct, press the red button ↵ to save the action to memory and automatically scroll on to the next main menu option.

4.4.14 Setting the relay on and off points

The MSP400 has two integral signal relays, each SPST format.

RL1 is a control relay by default. It may be set to energise at any value of PV and de-energise at any other value of PV. Setting the on and off points to a common PV will turn the relay off. The on value may be greater or smaller than the off value, and vice-versa.

RL2 is a fault relay by default. In this mode, it will de-energise under Lost Echo or system fault conditions. This relay will also de-energise in the event the power fails.

The mode of RL2 may be changed to control mode by entering on and off values. In control mode, RL2 ceases to be a fault relay.

All relay set point values must be entered in the units chosen for the PV.

To set the on and off points for the relays:

a) Press the blue button → to enter the "r1 on" menu and to display the on PV value in use. If this is correct, press the red button ↵ return to the main menu.
If the on PV value is to be edited, press the blue button → again to allow editing

The leading digit of the current on value will now be flashing, indicating it may be changed.

b) Use the green button ↓ to edit the value of the leading digit.

c) Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all 5 digits are correct.

d) Press the blue button → a final time to confirm the new PV value. None of the digits should now be flashing.

If the new PV on value is incorrect, the edit sequence for the PV on value can be re-started by pressing the blue button → again.

If the new PV on value is correct, press the red button ↵ to save the new PV on value to memory and automatically scroll on to the next main menu option: "r1 OFF"

Repeat the sequence to edit the values for R1 off and R2 on and off values, or skip as appropriate.

Once correct, the next menu option offered will be "SEt 4"

4.4.15 Setting the 4 and 20mA levels using actual liquid levels in the tank

Screen display (SEt 4 & SEt 20)
Factory default value Hold

If you have already programmed the 4 and 20mA levels as above, you do not need to enter this menu. All the programming is now complete and you should press the red button ↵ to exit the programming menu and return to the main PV display.

If, however, you wish to set the 4 or 20mA level by ranging the instrument to a known target – perhaps the level in the vessel at this time – then press the blue button → to enter this menu.

To set the 4mA level

a) With the MSP400 aimed at a target a distance away equivalent to the 4mA level, press the blue → button to display the value for the 4mA setting. Press the blue button → to allow setting, and the display will alternately flash "4" with the current level reading.

b) Press blue button → to confirm the correct value for the 4mA level then press red button ↵ to save the new value for the 4mA setting.

c) With the MSP400 aimed at a target a distance away equivalent to the 20mA level, press the blue → button to display the value for the 20mA setting. Press the blue button → to allow setting, and the display will alternately flash "20" with the current level reading.

d) Press blue button → to confirm the correct value for the 4mA level then press red button ↵ to save the new value for the 20mA setting.

Programing of the MSP400 is now complete.

Check the main display to ensure the duty, units and PV are correct, and that relays are on or off according to the set points programmed.

The cover may now be replaced, refer back to section 3.3.2

4.5 Diagnostic data. See also Appendix A2.

The MSP400 can display useful diagnostic data which can aid setting up and fault finding.

To aid interpretation of the data presented, the data will alternate with suitable text to remind the user what data is being displayed.
The user is not able to change or edit any of the data shown in the diagnostic section of the menu.

To enter the diagnostic menu, the user should press the blue button → from the main display screen to display the text "diAg". The following information is available:

4.5.1 Press the green button ↓ to display the distance to target in the chosen base units (m, ft, in) which the MSP400 is measuring regardless of the duty chosen for the instrument.

Note:
Pressing the red button ↵ at any time will return the user to the top level "diAg" screen; pressing it again will return the user to the main display screen

4.5.2 Press the green button ↓ to scroll down to the next diagnostic data "LEUEL".

This is the level in base units, which the MSP400 has calculated based upon the bottom reference and the distance measured, regardless of the duty chosen for the instrument.

4.5.3 Press the green button ↓ to scroll down to the next diagnostic data "Echo. S".
This is the echo size being received on a scale of 0 to 100.

The user should aim to achieve a value of greater than 10, although the MSP400 will operate at values below this.

4.5.4 Press the green button ↓ to scroll down to the next diagnostic data "Echo. n".
This is the number of echoes being received and can be useful indicator of the data being processed by the MSP400.
A thorough understanding of ultrasonic level systems is required to interpret this data.

4.5.5 Press the green button ↓ to scroll down to the next diagnostic data "F".
This is the frequency in kHz at which the transducer is operating, and should read between 49 & 58.

4.5.6 Press the green button ↓ to scroll down to the next diagnostic data "t".
This is the temperature which is being recorded by the integral temperature sensor and which is being used by the transmitter in calculating distance to target, unless an external temperature probe connected in which case it is the temperature being measured by the external probe.

4.5.7 Pressing the green button ↓ again will return the user to the start of the diagnostic menu.
The user may now press the red button ↵ to return the instrument to the normal operating mode with the display showing the PV, or may press and hold the blue button → for at least 2 seconds to move to the Loop Test menu.

4.6 Loop Test : See also Appendix A3 "tESt"

The MSP400 has the facility to cycle through it's programmed operating range without any change in the liquid level, causing the current output and relays to cycle through their normal operation.
Also, the MSP400 can be programmed to fix the loop current at any desired value between 4 and 20mA to allow testing of any other loop or control instruments.

To enter the loop test menu from the normal operating mode, press the blue button → to display "diAg" then press and hold the blue button → for at least two seconds to display "tESt".

4.6.1 Cycle function "CyCLE"

a) Press the green button ↓ to scroll down to the "CyCLE" menu.

b) Press the blue button → to enter the cycle menu . The display will zero and show "0.0000 m".

c) Press the blue button → to initiate the cycle, and the MSP400 will cycle from the 4mA value to the max PV value and back to the 4mA value again over about 100 seconds.
Pressing the green button ↓ at any time during the cycle will stop the cycle at that point. Press the green button ↓ again to continue the cycle.

d) Press the blue button → to return to the loop test menu and display ""CyCLE".

4.6.2 Loop Current fixing "LOOP"

a) From the Loop test display "tESt" or the cycle display "CyCLE", press the green button ↓ to scroll to the "LOOP" menu.

b) Press the blue button → to enter the LOOP menu, and the display will zero to show "0.000".

c) Press the blue button → to start an edit sequence which allows the user to enter a value for the desired fixed loop current. Use the green button ↓ to change the digits in the normal manner.

d) Once the desired value is entered, press the blue button → to fix and display the loop current.

e) To change the fixed current value to a new value, press the blue button → to return to the LOOP menu

Pressing the green button ↓ again will return the user to the start of the Loop test menu.
The user may now press the red button ↵ to return the instrument to the normal operating mode with the display showing the PV, or may press and hold both the blue → and the red ↵ buttons ***together*** for at least 2 seconds to move to the Engineering set-up menu.

4.7 Engineering Set-up menu : See also Appendix A4 "Eng"

The proficient user is able to fine tune operation of the MSP400 if site or application conditions are unusual.

Users are recommended to leave all operational fine tuning parameters at the factory default settings unless they have a good understanding of the function and capability of the parameters.

The "reload factory defaults" function may be found within this menu, and should be used if the transmitter has been configured incorrectly or if the user wishes to reset all parameter values back to factory default values.

To display the Engineering set-up menu "Eng", navigate from the normal PV display using the blue button → and the red button ↵. Note the requirement to hold the button or hold two buttons together as shown on the main menu in Appendix A.

To enter the "Eng" menu, press the green button ↓ to display the first menu item "t.HoLd"

4.7.1 Setting the Threshold

Screen display	"t.HoLd"
Factory default value	Auto

The threshold value is actually a limit below which false echoes are rejected.

Auto shows that the MSP400 will automatically set the threshold level for optimum performance based on echo sizes being received.

A new value may be entered up to a maximum value of 99. A large value will have the effect of eliminating false echo processing.

Note that the value shown is in the same units as echo size; if the wrong echo is being processed then raising the threshold level above that of the false echo size (see 4.5.3) will allow the MSP400 to ignore any echoes below this size, including the false echo itself.

To edit the threshold value:

a) Press the blue button → to enter the threshold menu and to display the current value in use. If this is correct, press the red button ↵ return to the main menu.
If the threshold is to be edited, press the blue button → again to allow editing

The leading digit of the 3 digit threshold value will now be flashing, indicating it may be changed.

b) Use the green button D to edit the value of the leading digit.

c) Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all 3 digits are correct.

d) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

If the new threshold is incorrect, the edit sequence can be re-started by pressing the blue button → again.

If the threshold is correct, press the red button ↵ to save the new value to memory and automatically scroll on to the next main menu option: "LE"

4.7.2 Setting the Lost Echo Time

Screen display	"LE"
Factory default value	900

The lost echo time is the time in seconds which the MSP400 will wait before taking the lost echo action as described in 4.4.13.

A new value may be entered in the range 0 to 9999. It is recommended that the lost echo time be left at 900 seconds to avoid false trips and alarms due to temporary loss of echo due to transient poor surface conditions. A shorter lost echo time should only be programmed if it is imperative that action be taken in a shorter timeframe.

To edit the lost echo time:

a) Press the blue button → to enter the lost echo time menu and to display the current value in use. If this is correct, press the red button ↵ return to the main menu.
If the lost echo time is to be edited, press the blue button → again to allow editing

The leading digit of the lost echo time value will now be flashing, indicating it may be changed.

b) Use the green button ↓ to edit the value of the leading digit.

c) Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all 4 digits are correct.

d) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

If the new lost echo time is incorrect, the edit sequence can be re-started by pressing the blue button → again.

If the lost echo time is correct, press the red button ↵ to save the new value to memory and automatically scroll on to the next main menu option: "dEAd"

4.7.3 Setting the Dead Band

Screen display	"dEAd"
Factory default value:	
MSP400RH-B28	0.45 (m)
MSP400RH-N28	1.5 (ft)
or	18 (in)

The dead band is the region below the MSP400 transmit face in which no measurements can be made. This is also sometimes known as the Blanking or Blocking zone, and is a feature of all Ultrasonic level transmitters, with a value dependant upon certain intrinsic properties of the transmitter itself.

The user should never reduce the dead band below the factory default minimum value unless advised to do so by the manufacturer.

A larger value may be entered to elimate echo processing of echoes from false targets.

Note however, that any real echos in the dead band will also now be ignored.

To edit the dead band:

a) Press the blue button → to enter the dead band menu and to display the current value in use. If this is correct, press the red button ↵ return to the main menu.
If the dead band is to be edited, press the blue button → again to allow editing

The leading digit of the dead band value will now be flashing, indicating it may be changed.

b) Use the green button ↓ to edit the value of the leading digit.

c) Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all digits are correct.

d) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

If the new dead band is incorrect, the edit sequence can be re-started by pressing the blue button → again.

If the dead band is correct, press the red button ↵ to save the new value to memory and automatically scroll on to the next main menu option: "F"

4.7.4 Setting the Frequency

Screen display "F"
Factory default value: Auto

The frequency at which the MSP400 operates is automatically chosen by the microprocressor to ensure optimum signal size and performance.

Auto shows that the MSP400 will automatically set the frequency to obtain the best echo size and optimum performance. The actual frequency being used by the MSP400 can be viewed in diagnostics. See 4.5.5

The limits of operating frequency are a function of the intrinsic properties of the transmitter itself. The MSP400 may be set to operate at any frequency between 49 and 58 kHz

The transmit frequency directly affects the quality of the echo being received, which may be useful to either improve a poor echo or reduce the quality of a false echo.

To change the frequency:

a) Press the blue button → to enter the frequency menu and to display the current value in use. If this is correct, press the red button ↵ return to the main menu.
If the frequency is to be changed, press the blue button → again to allow editing

The frequency value currently in use will now be shown flashing on the display.

b) Use the green button ↓ to scroll through the options available (49 to 58 kHz).

c) Use the blue button → to select the chosen frequency.

If the new frequency is incorrect, the edit sequence can be re-started by pressing the blue button → again.

If the frequency is correct, press the red button ↵ to save the new frequency to memory and automatically scroll on to the next main menu option: "Prf"

4.7.5 Setting the Pulse repetition frequency

Screen display "Prf"
Factory default value: 1.0

The rate of pulses transmitted by the MSP400 is set at a factory default value of once per second.

The MSP400 may be set to transmit faster or more slowly at selected repetition rates between 0.5 and 2.0 times per second.

The pulse repetition frequency may be changed to overcome cross talk problems if more than one ultrasonic transmitter is mounted in the same tank.

To change the pulse repetition frequency:

a) Press the blue button → to enter the pulse repetition frequency menu and to display the current value in use. If this is correct, press the red button ↵ return to the main menu.
If the pulse repetition frequency is to be changed, press the blue button → again to allow editing

The pulse repetition frequency value currently in use will now be shown flashing on the display.

b) Use the green button ↓ to scroll through the options available (0.5 to 2.0).

c) Use the blue button → to select the chosen pulse repetition frequency.

If the new pulse repetition frequency is incorrect, the edit sequence can be re-started by pressing the blue button → again.

If the pulse repetition frequency is correct, press the red button ↵ to save the new pulse repetition frequency to memory and automatically scroll on to the next main menu option: "Stir"

4.7.6 Setting a valid echo count

Screen display "Stir"
Factory default value: 4

This parameter is normally used in vessels with a stirrer or agitator, particularly if it is slow moving, it is possible for the MSP400 to detect uncovered blades and treat them as a valid echo, thus calculating an incorrect level reading.

The MSP400 may be set to one of a list of pre-selected times in the range 1 to 100

Lowering = faster response

To change the valid echo count :

a) Press the blue button → to enter the stirrer menu and to display the current value in use. If this is correct, press the red button ↵ return to the main menu.
If the valid echo count is to be changed, press the blue button → again to allow editing

The valid echo count currently in use will now be shown flashing on the display.

b) Use the green button ↓ to scroll through the options available (1 to 100).

c) Use the blue button → to select the chosen valid echo count.

If the valid echo count is incorrect, the edit sequence can be re-started by pressing the blue button → again.

If the valid echo count is correct, press the red button ↵ to save the valid echo count to memory and automatically scroll on to the next main menu option: "SPi"

4.7.7 Setting the Spike rejection

Screen display "SPi"
Factory default value: 0 (disabled)

In applications with high levels of acoustic or electrical noise, a spike could incorrectly trigger the echo detection system. In such cases, the value of SPi can be increased (in the range 0-100) which has the effect of rejecting such spikes. The user may have to try several different values to determine the best option.

To change the spike rejection:

a) Press the blue button → to enter the spike rejection menu and to display the current value in use. If this is correct, press the red button ↵ return to the main menu.
If the spike rejection is to be changed, press the blue button → again to allow editing

The spike rejection currently in use will now be shown flashing on the display.

b) Use the green button ↓ to scroll through the options available (1 - 100 in pre programmed steps)

c) Use the blue button → to select the chosen spike rejection.

If the new spike rejection is incorrect, the edit sequence can be re-started by pressing the blue button → again.

If the spike rejection is correct, press the red button ↵ to save the new spike rejection to memory and automatically scroll on to the next main menu option: "t"

4.7.8 Setting the Temperature

Screen display "t"
Factory default value: Auto

The MSP400 has to know the temperature of the air space through which it is sending pulses so that the speed of sound can be correctly computed.
The distance to target is then calculated using the formula

Distance to target = Speed of Sound in air space x (Time taken for echo to return / 2)

The MSP400 is fitted with an integral temperature sensor which continuously monitors the air temperature around the transducer.

Auto indicates that the MSP400 is set to continuously measure the temperature using the integral temperature sensor.

It may occasionally be necessary to over-ride this automatic monitoring and fix the temperature to be used in SoS computations, for example if the air temperature is not uniform and the temperature being recorded is not representative of the true air temperature.

To edit and fix the temperature :

a) Press the blue button → to enter the temperature menu and to display the current value in use. If this is correct, press the red button ↵ return to the main menu.
If the temperature is to be edited, press the blue button → again to allow editing

The leading digit of the temperature will now be flashing, indicating it may be changed.

b) Use the green button ↓ to edit the value of the leading digit.

c) Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all digits are correct.

d) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

If the new temperature is incorrect, the edit sequence can be re-started by pressing the blue button → again.

If the temperature is correct, press the red button ↵ to save the new value to memory and automatically scroll on to the next main menu option:
The next option will be “t.CAL” if the MSP400 is using the Mobrey remote temperature probe MSP-RTP to monitor the air temperature.

If no external temperature probe is connected the next menu option will be “Ld.dEF”.
Refer now to Section 4.7.10.

4.7.9 Temperature calibration — Screen display “t.CAL”

This menu option is only displayed if the MSP400 is using the Mobrey remote temperature probe MSP-RTP to monitor the air temperature.
Remote air temperature measurement is only possible with the Mobrey MSP-RTP. This is a negative temperature co-efficient (NTC) thermistor design.
Due to the effects of cable length and electronic component tolerances the MSP-RTP air temperature measurement could be up to +/- 0.5°C in error.
This menu option allows the user to trim the recorded temperature to match the users own reading.

To edit and fix the temperature :

a) Press the blue button → to enter the temperature calibration menu and to display the current value in use. If this is correct, press the red button ↵ return to the main menu.
If the temperature is to be calibrated, press the blue button → again to allow calibration.

The leading digit of the temperature will now be flashing, indicating it may be changed.

b) Use the green button ↓ to edit the value of the leading digit.

c) Once correct, use the blue button → to select the next digit and then the green button ↓ to edit as before, or the blue button → to move to the next digit. Continue this sequence until all digits are correct.

d) Press the blue button → a final time to confirm the new value. None of the digits should now be flashing.

If the new temperature is incorrect, the edit sequence can be re-started by pressing the blue button → again.

If the temperature is correct, press the red button ↵ to save the new value to memory and automatically scroll on to the next main menu option:

4.7.10 Loading factory default values — Screen display “Ld.dEF”

It may occasionally be necessary to re-set the MSP400 parameters to factory default values, particularly if the user is unsure of data already changed and held in the transmitter.

Note : Re-loading factory defaults will overwrite all parameters and all site entered data will be lost.

To ensure that this operation is not initiated by accident, a specific push button sequence is necessary to load factory defaults.

To load factory default values:

a) Press the blue button → to enter the load defaults menu and display “Ld.dEF”

b) Press the blue button → for at least two seconds to flash the screen message “SurE”.

c) Press the blue button → again to acknowledge the message and stop the message flashing.

The user can now abort by pressing the blue button → again to return to the start of the menu, allowing moving on to “b.unit” (refer to section 4.7.11) or may continue on and load factory defaults.

d) To load factory defaults, press and hold both the blue button → and the red button ↵ together for at least 2 seconds.

The screen will now flash the message “b.units” and will reload all factory default values.
The MSP400 will now automatically re-start as if it were a new instrument on first power-up.

4.7.11 Changing the base units

Screen display	“b.unit”
Factory default:	
MSP400RH-B28	metric (m)
MSP400RH-N28	imperial (ft)

The MSP400 may be reconfigured to operate in a choice of base units:

Metres
Feet
Inches

Note: If the base units are changed, the MSP400 will automatically re-start as if it were a new instrument on first power-up, but will default to the chosen base units and will load factory default values into all other parameters.

To change the base units :

a) Press the blue button → to enter the base units menu and to display the current units in use. If these are correct, press the red button ↵ return to the main menu.
If the base units are to be changed, press the blue button → again to allow editing

The base units currently in use will now be shown flashing on the display.

b) Use the green button ↓ to scroll through the 3 options available .

c) Use the blue button → to select the chosen base units.

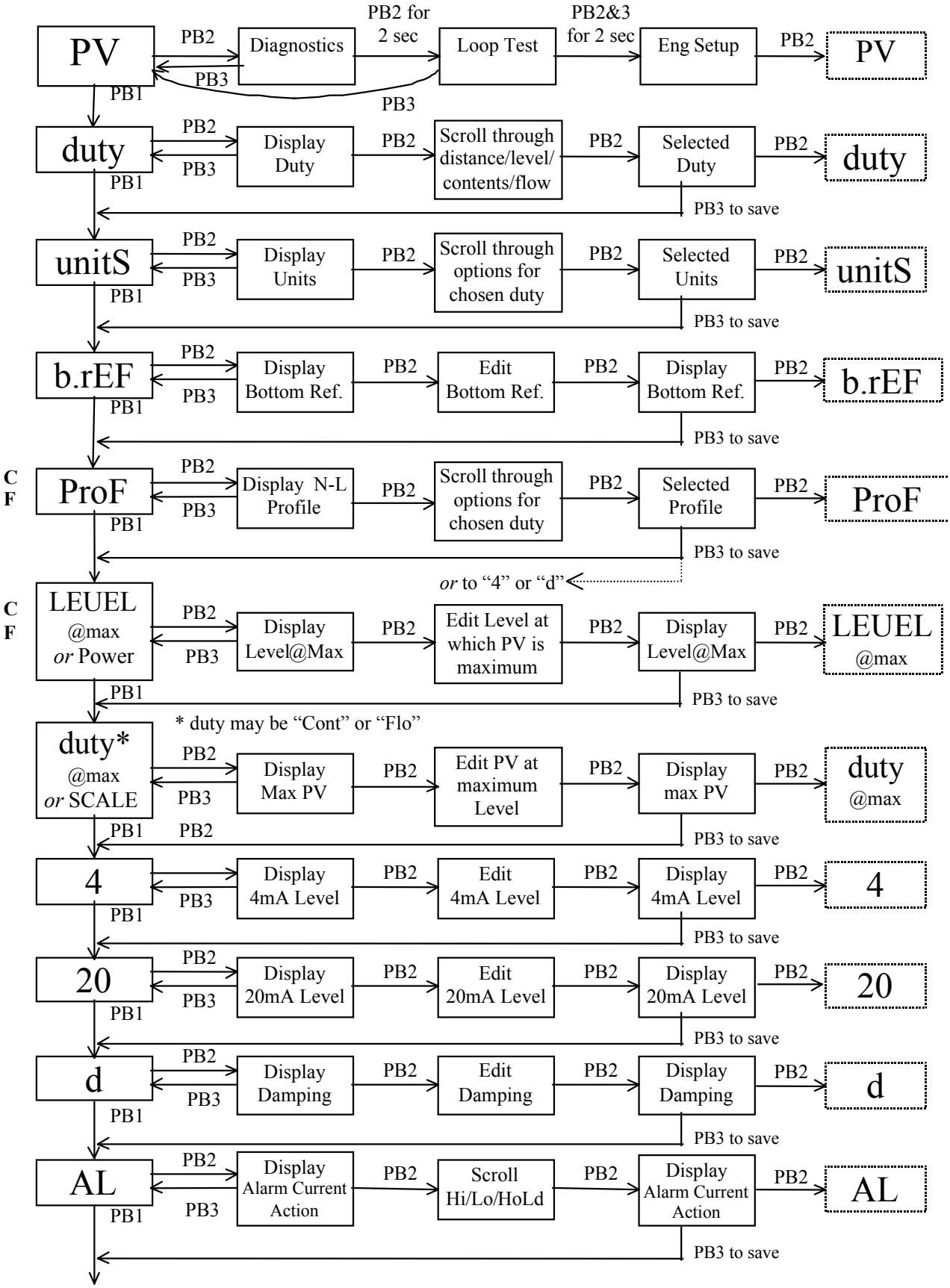
If the base units are incorrect, the edit sequence can be re-started by pressing the blue button → again.

If the base units are correct, press the red button ↵ to save the new base units and automatically re-start the MSP400.

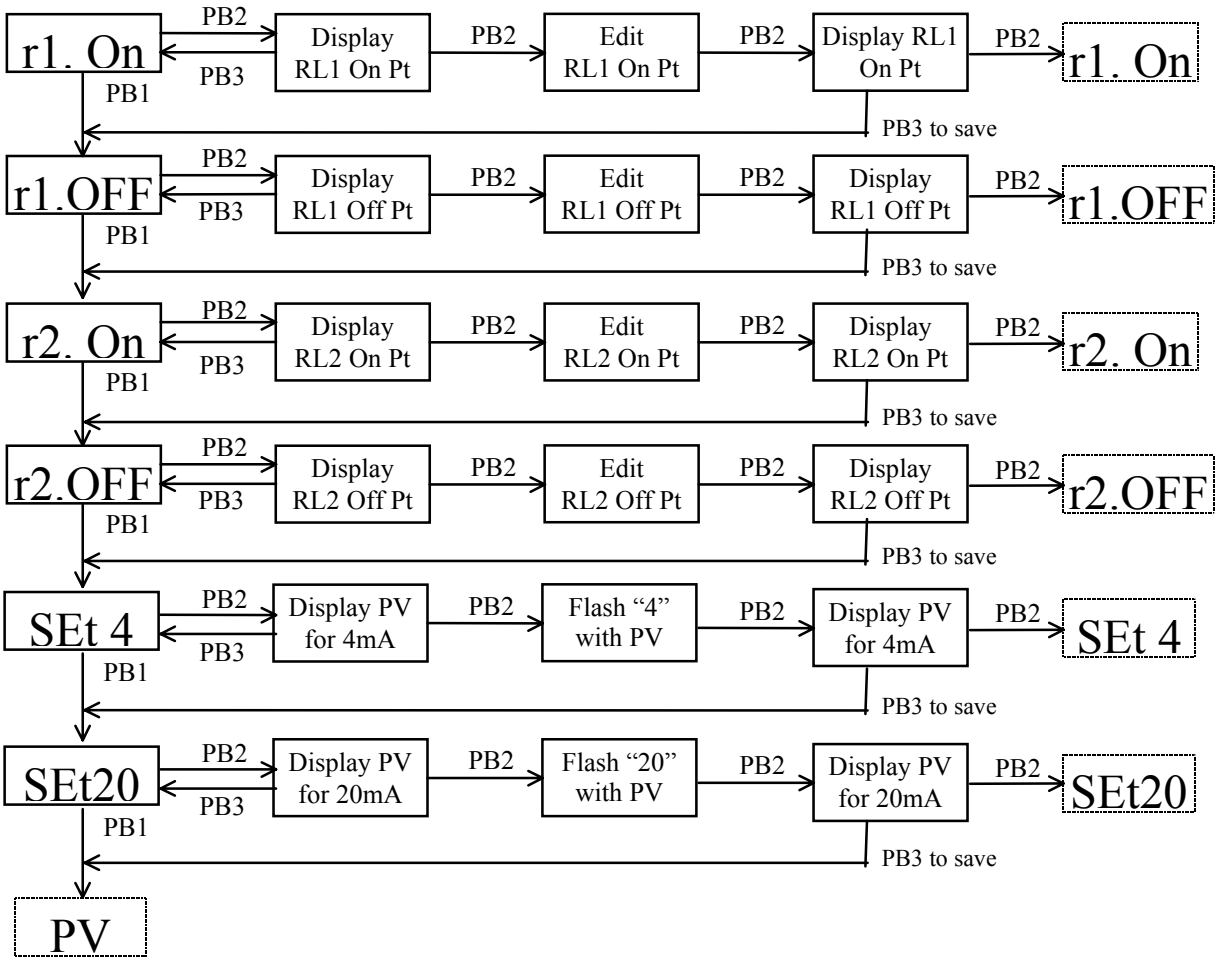
5.0 Maintenance

There is no routine maintenance required for the MSP400RH other than an occasional check to ensure that the front face of the transmitter is clean and that the cover seal and all wiring / cable glands are in good condition.

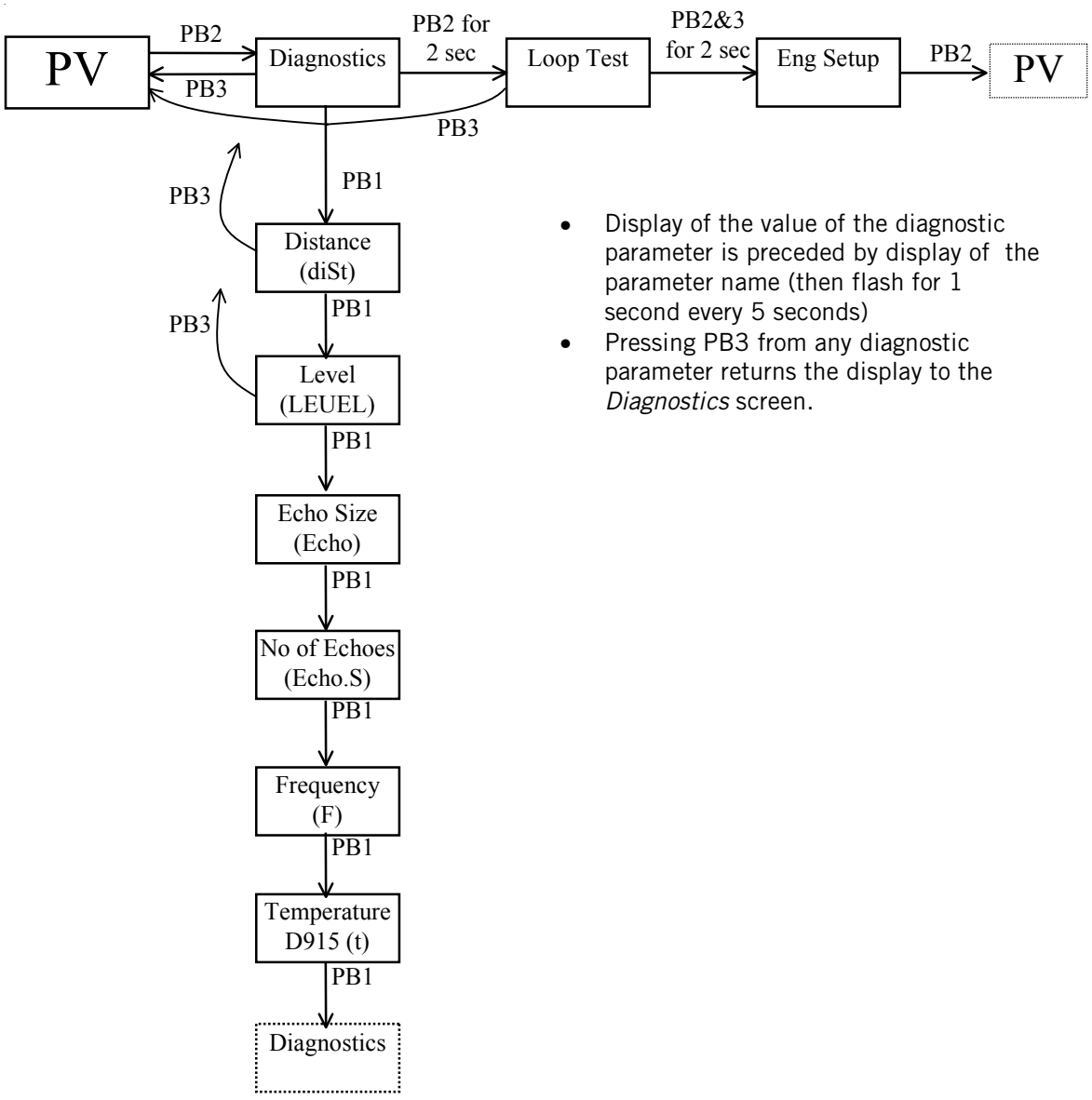
MAIN MENU : PROGRAMMING



Cont'd / ...

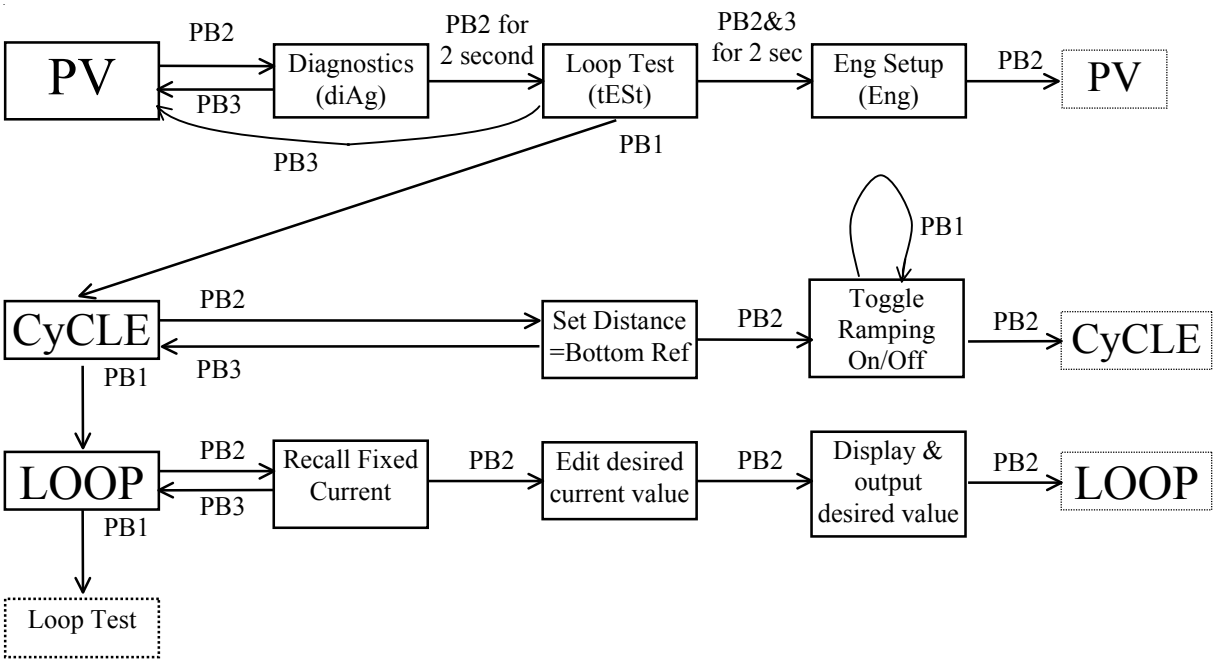

r1. On
PB2
PB3
Display RL1 On Pt
PB2
Edit RL1 On Pt
PB2
Display RL1 On Pt
PB2
r1. On
PB1
PB3 to save
r1.OFF
PB2
PB3
Display RL1 Off Pt
PB2
Edit RL1 Off Pt
PB2
Display RL1 Off Pt
PB2
r1.OFF
PB1
PB3 to save
r2. On
PB2
PB3
Display RL2 On Pt
PB2
Edit RL2 On Pt
PB2
Display RL2 On Pt
PB2
r2. On
PB1
PB3 to save
r2.OFF
PB2
PB3
Display RL2 Off Pt
PB2
Edit RL2 Off Pt
PB2
Display RL2 Off Pt
PB2
r2.OFF
PB1
PB3 to save
SEt 4
PB2
PB3
Display PV for 4mA
PB2
Flash "4" with PV
PB2
Display PV for 4mA
PB2
SEt 4
PB1
PB3 to save
SEt20
PB2
PB3
Display PV for 20mA
PB2
Flash "20" with PV
PB2
Display PV for 20mA
PB2
SEt20
PB1
PB3 to save
PV

DIAGNOSTICS MENU

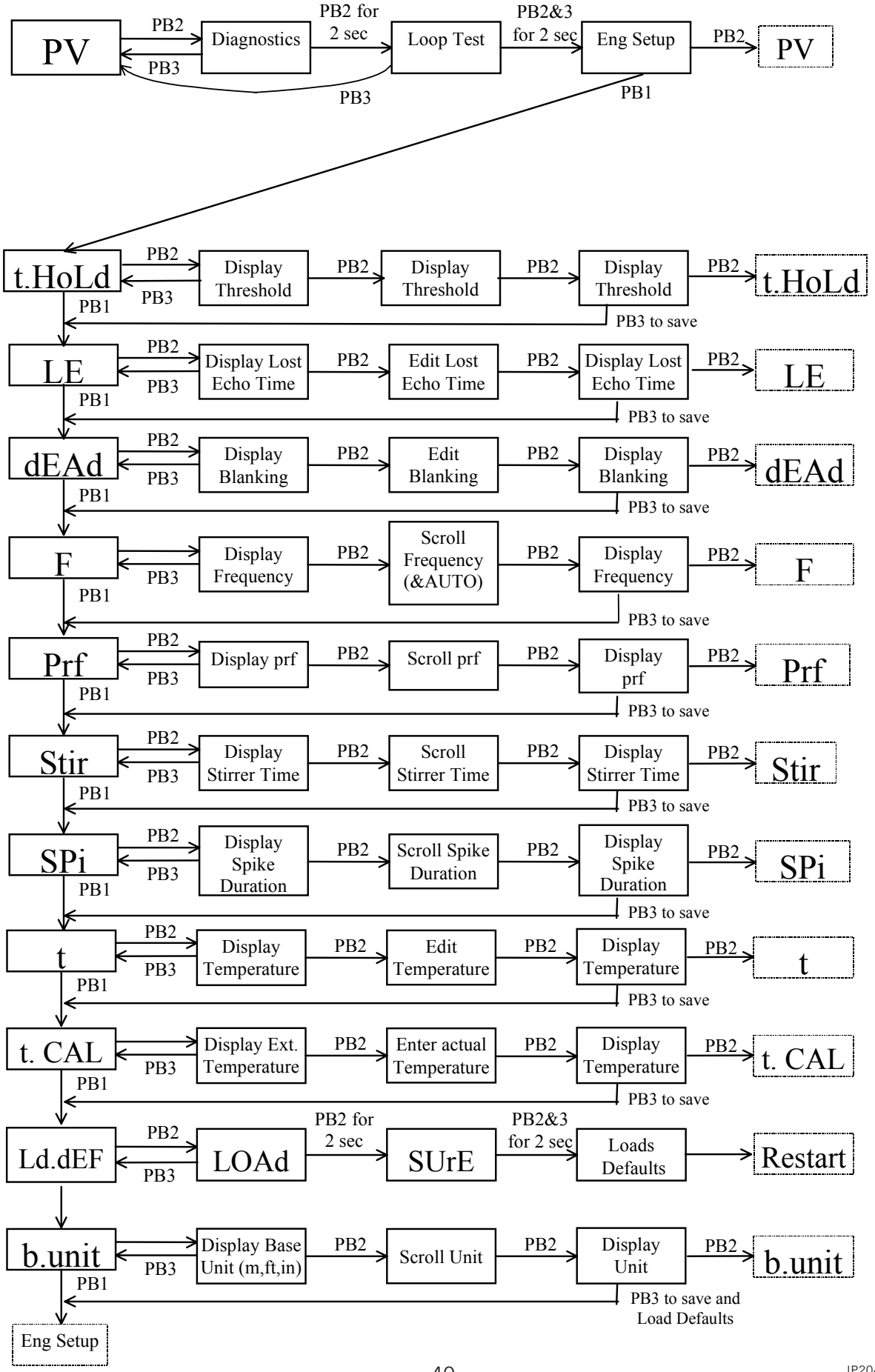


- Display of the value of the diagnostic parameter is preceded by display of the parameter name (then flash for 1 second every 5 seconds)
- Pressing PB3 from any diagnostic parameter returns the display to the *Diagnostics* screen.

COMMISSIONING / LOOP TEST MENU

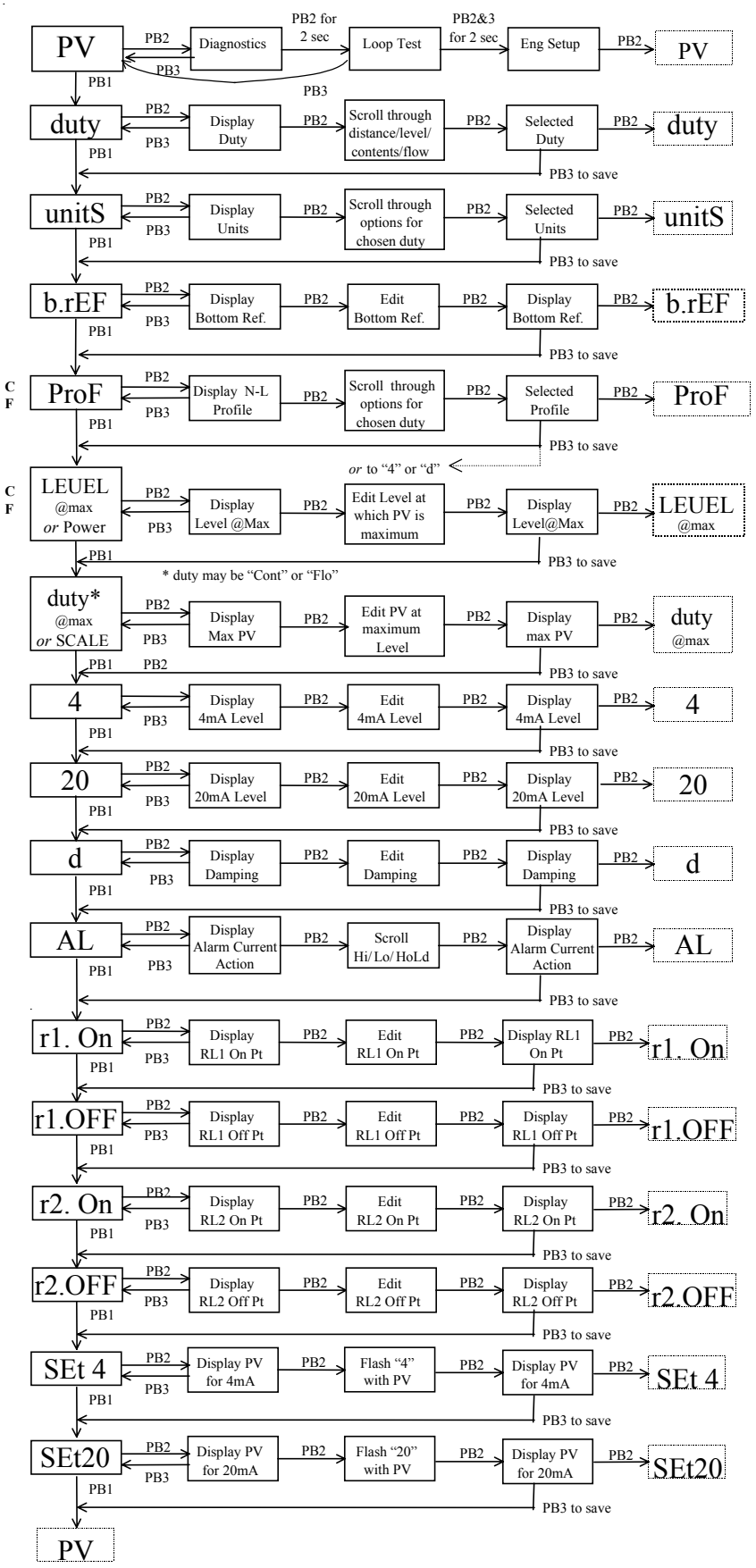


ENGINEERING MENU



DEFAULT VALUE LISTING : MAIN MENU PARAMETERS

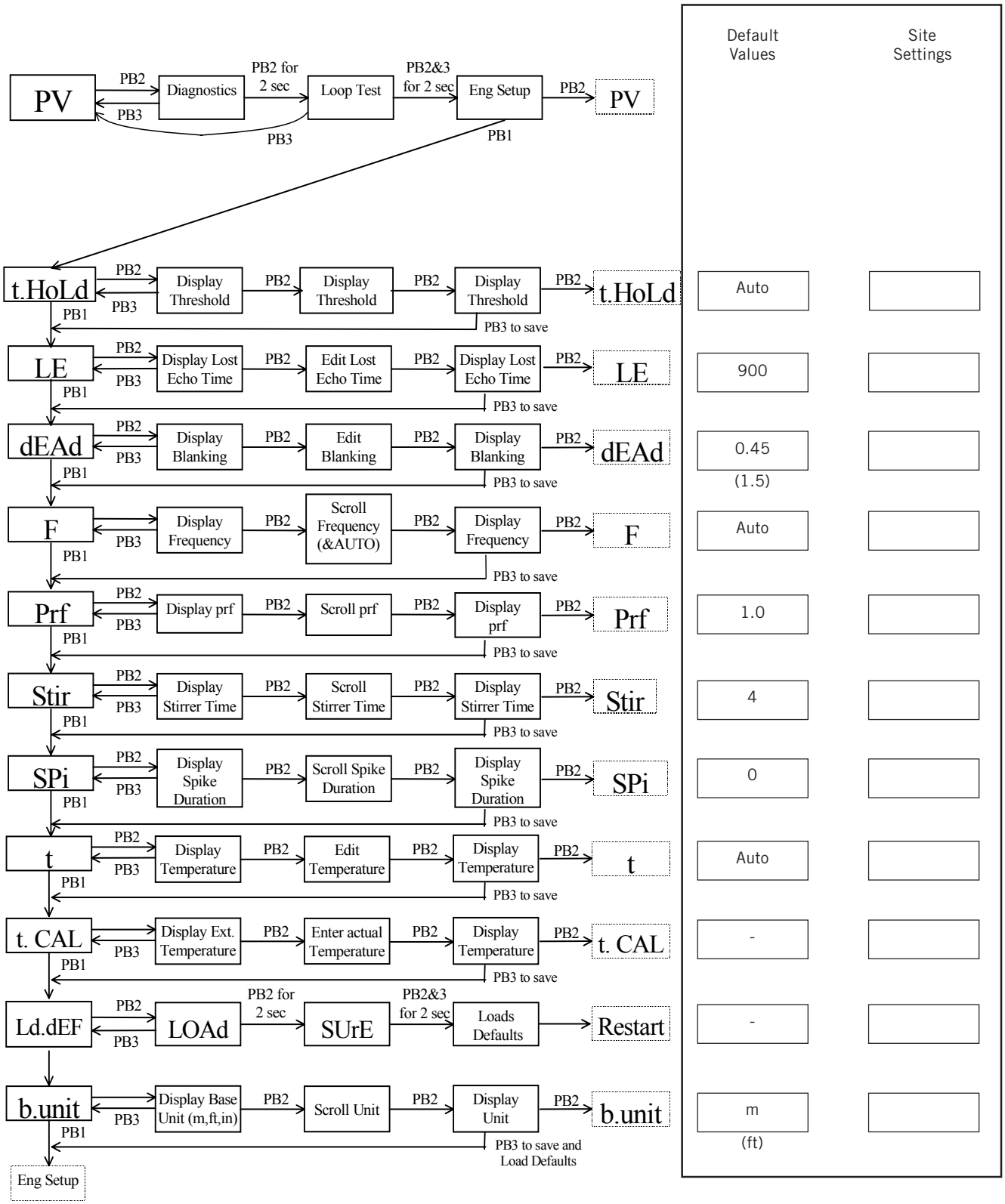
Default value shown are for the metric model MSP400RH-B28.
Where different, values for the imperial model MSP400RH-N28 are shown in brackets.



Default Values	Site Settings
LEVEL	
M (ft)	
11.00 (36.0)	
Lin	
1.0	
1.0	
0	
10.55 (34.5)	
3	
HOLD	
0	
0	
0	
0	

DEFAULT VALUE LISTING : ENGINEERING PARAMETERS

Default value shown are for the metric model MSP400RH-B28.
Where different, values for the imperial model MSP400RH-N28 are shown in brackets.



LISTING OF NON-LINEAR PROFILES IN THE MSP400

Screen Display	Description	Hmax used		K Factor * or Flo @ max.		Power Factor	20mA point if auto-set	
Lin	Linear	-		User		1.0	-	
SPEC.P	Special (plotted)	-		User		User	As P013	
H. CYL.F	Horiz. Cyl. (Flat)	-		User		User	As P013	
SPH.	Spherical	-		User		User	As P013	
H. CYL.D	Horiz. Cyl. (Dome)	-		User		User	As P013	
3/2	Flume (3/2)	-		User		1.5	User	
5/2	V-Notch (5/2)	-		User		2.5	User	
nnann[a]	Manning Formula	-		User		User	As P013	
SPEC.C	Special (calculated)	-		User		User	User	
		m	ft	Metric	Imp.		m^3/hr	gal/min
PAr 1	Parshall 1 (1')	0.75	2.5	2487	1795	1.522	1610	7240
PAr 2	Parshall 2 (2')	0.75	2.5	5143	3590	1.550	3290	14900
PAr 3	Parshall 3 (3')	0.75	2.5	7863	5386	1.566	5010	22600
PAr 4	Parshall 4 (4')	0.75	2.5	10630	7181	1.578	6750	30500
PAr 5	Parshall 5 (5')	0.75	2.5	13440	8976	1.587	8510	38400
PAr 6	Parshall 6 (6')	0.75	2.5	16280	10770	1.595	10300	46400
PAr 8	Parshall 8 (8')	0.75	2.5	22010	14360	1.607	13900	62600
FF 01	Flume Flat 1 (m)	0.102		134.7877		1.5	9	
FF 02	Flume Flat 2 (m)	0.191		178.2664		1.5	36	
FF 03	Flume Flat 3 (m)	0.267		313.4177		1.5	90	
FF 04	Flume Flat 4 (m)	0.406		541.7157		1.5	360	
FF 05	Flume Flat 5 (m)	0.635		811.1058		1.5	900	
FF 06	Flume Flat I	0.200		132.2		1.5	30	
FF 07	Flume Flat II	0.250		177.7		1.5	60	
FF 08	Flume Flat III	0.300		217.58		1.5	90	
FF 09	Flume Flat III bis	0.3333		328.35		1.5	200	
FF 10	Flume Flat III ter	0.400		272.0		1.5	200	
FF 11	Flume Flat IV	0.400		352.1726		1.5	180	
FF 12	Flume Flat V	0.500		442.932		1.5	360	
FF 13	Flume Flat V bis	0.400		400.5		1.5	320	
FF 14	Flume Flat VI	0.540		499.0569		1.5	720	
FF 15	Flume Flat VII	0.700		623.7		1.5	1080	
FF 16	Flume Flat VIII	0.600		881.16		1.5	1440	
FF 17	Flume Flat VIII bis	0.666		798.0		1.5	1500	
FF 18	Flume Flat IX	0.800		1065.186		1.5	1800	
FF 19	Flume Flat IX bis	0.733		814.8		1.5	1700	
FF 20	Flume Flat X	0.867		1322.2761		1.5	3600	
FF 21	Flume Flat X bis	1.200		1609.0		1.5	7500	
FF 22	Flume Flat X ter	0.959		1064.884		1.5	3500	
FF 23	Flume Flat XI	1.200		1650.99		1.5	7200	
FP 01	Flume Parabolic 1	0.200		15878.5		2.3	20	
FP 02	Flume Parabolic 2	0.250		17591.1		2.3	40	
FP 03	Flume Parabolic 3	0.310		11645.6		2.2	90	
FP 04	Flume Parabolic 4	0.380		13669.5		2.2	180	
FP 05	Flume Parabolic 5	0.460		9802.7		2.1	360	
FP 06	Flume Parabolic 6	0.600		11367.8		2.1	720	
FP 07	Flume Parabolic 7	0.800		12227.7		2.1	1400	

Notes :

i). SPEC.P and SPEC.C ONLY DISPLAY IF POPULATED BY EXTERNAL MASTER. Refer to Section 4.4.4.1.

ii). Where shown "User" indicates user required to input the appropriate data.

HART COMMUNICATIONS WITH THE MSP400

D 1.0 Overview

The MSP400 ultrasonic level transmitter supports HART communications, which may be used to programme or interrogate the transmitter remotely from any point on the 2 wire loop.

Any HART compatible communication device may be connected across the loop and, if loaded with the Device Description (DD) of the MSP400 transmitter, will have full access to the all of the parameters of the instrument as shown in D 3.0
If the communication device is not loaded with the MSP400 DD, then access to the Universal and some Common Practice commands is possible in accordance with HART convention.

The MSP400 may be used with the Mobrey MCU900 Series of control units. MCU900 will supply the 24V dc loop power to the MSP400 and provide control functionality using the 4-20mA signal from the transmitter.
The MCU900 control unit has HART communications capability and access to all of the parameters of the MSP400 as shown in D3.0.

The Mobrey PC software "DDConf" is also available, allowing a computer fitted with a HART modem to communicate with and re-programme the MSP400 transmitter.
Note : A HART modem is supplied with the DDConf software.

D 2.0 Wiring

Wiring for HART communications is no different to that of 4-20mA instruments, except that the loop must contain a resistance of at least 250 Ohm. This resistance may be achieved by a combination of wiring resistance and any other loop instruments, or may be achieved by the inclusion of a suitable 250 Ohm resistor, usually connected in series in the +24V dc power line at the power supply.

Note, the MSP400 requires a minimum voltage of 12V dc at the terminals for correct operation.

D 3.0 Table of MSP400 Parameters

							USER DEFAULTS		
							MSP400RH		
						base units	m	ft	in
SETUP	DUTY			P010	Bottom Reference	as base units	11.0	36.0	432.0
				P011	Tank Shape	-	Linear	Linear	Linear
				P013	PV Scale Factor	-	1.0	1.0	1.0
				P014	Profile Height	as base units	1.0	1.0	1.0
		NLP CURVE		P030	Profile Point 1	%	10	10	10
				P031	Profile Point 2	%	20	20	20
				P032	Profile Point 3	%	30	30	30
				P033	Profile Point 4	%	40	40	40
				P034	Profile Point 5	%	50	50	50
				P035	Profile Point 6	%	60	60	60
				P036	Profile Point 7	%	70	70	70
				P037	Profile Point 8	%	80	80	80
				P038	Profile Point 9	%	90	90	90
				P039	Profile Point 10	%	100	100	100
		>		P000	Message	-	MESSAGE		
		>		P001	Tag	-	MSP400		
		>		P002	Description	-	MSP400 XMTR		
	PV CALC			P012	Primary Variable Units (PV Units)	-	m	ft	in
	OUTPUT	CURRENT		P015	Upper range value	L000	10.55	34.5	414.0
				P016	Lower range value	L000	0.0	0.0	0.0
				P020	Damping	sec	3.0	3.0	3.0
				L000	Range Value Units	-			
		RELAYS	RELAY 1	P070	Relay 1 mode	-	Setpoint		
				P071	Relay 1 PV ON Point	as PV units	0.0	0.0	0.0
				P072	Relay 1 PV OFF Point	as PV units	0.0	0.0	0.0
			RELAY 2	P073	Relay 2 mode	-	Fault/Setpoint		
				P074	Relay 2 PV ON Point	as PV units	0.0	0.0	0.0
				P075	Relay 2 PV OFF Point	as PV units	0.0	0.0	0.0
	ENGINEERING			P021	LE Delay	sec	900	900	900
				P022	LE Action	-	Hold	Hold	Hold
				P023	Blanking	base units	0.45	1.5	18.0
				P024	Speed of Sound	base units/s	331.8	1088.6	13063
				P025	Temperature	C or F	Auto	Auto	Auto
				P026	Threshold	%	Auto	Auto	Auto
		ADVANCED		P041	Pulse Repetition	sec	1.0	1.0	1.0
				P042	Echoes Needed	-	4	4	4
				P043	Threshold 1 Time	ms	2.0	2.0	2.0
				P044	Target Pulses	-	Auto	Auto	Auto
				P045	Target Frequency	kHz	Auto	Auto	Auto
				P049	Spike Rejection	-	0	0	0
	SYSTEM				AUTO CYCLE	-			
					LOAD DEFAULTS	-			
				L200	Base Units	-			
		FIXED		P004	Final Assembly Number	-	as applicable		
				P005	Serial Number	-	as applicable		
				P970	Front face material	-	Kynar	Kynar	Kynar
			HART	D949	Model Code	-	53	53	53
				D950	HART Device Code	-	46	46	46
				D951	Comms Address	-	Unchanged (ex-factory = 0)		
				D952	Hardware Revision	-	as applicable		
				D953	Software Version	-	as applicable		
				D960	Manufacturer's Code	-	Mobrey		
				D961	Unique ID	-	as applicable		
				D962	Universal Cmd Rev	-	5	5	5
				D963	Transmitter Spec. Cmd Rev	-	as applicable		
				D964	Response Preamble	-	5	5	5
				D965	Transmitter Flags	-			
MONITOR	READINGS	VARIABLES		D900	Primary Variable	base units			
				D901	Level (SV)	base units			
				D902	Range (TV)	base units			
				D903	Transducer Temperature	C or F			
		CURRENT		D906	Current output	mA			
				D905	% Current Output	%			
		>		D908	Relay Status	-			
	DIAGNOSTICS			D910	Target Range / Distance to Target	base units			
				D911	Echo Size	%			
				D912	Echo Success Rate	%			
				D913	Target Echoes	-			
				D914	Speed of Sound	base units/s			
				D915	Transducer Temperature	C or F			
				D916	Transducer Frequency	kHz			
		HISTORY		P003	Date of Change	dmy	01/01/02	01/01/02	01/01/02
				P046	Maximum Temperature	°C	50	50	50
				P047	Minimum Temperature	°C	-10	-10	-10

MSP400RH

Instruction & maintenance leaflet
IP2046IM, Rev. AA
November 2006

The Emerson logo is a trade mark and service mark of Emerson Electric Co.
Rosemount is a registered trademark of Rosemount Inc.
Mobrey is a registered trademark of Mobrey Ltd.
All other marks are the property of their respective owners.
We reserve the right to modify or improve the designs or specifications of product and services at any time without notice.

International:
Emerson Process Management
Mobrey Measurement
158 Edinburgh Avenue,
Slough, Berks, SL1 4UE, UK
T +44 1753 756600
F +44 1753 823589
www.mobrey.com

Americas:
Emerson Process Management
Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN USA 55317
T (US) (800) 999-9307
T (International) (952) 906-8888
F (International) (952) 949-7001

EMERSON™
Process Management