process measurement solutions

Magne-Sonic

MS400RH Series
Level Transmitter

Software Version 2.11

WE'VE GOT HART ABILITY

FM APPROVED

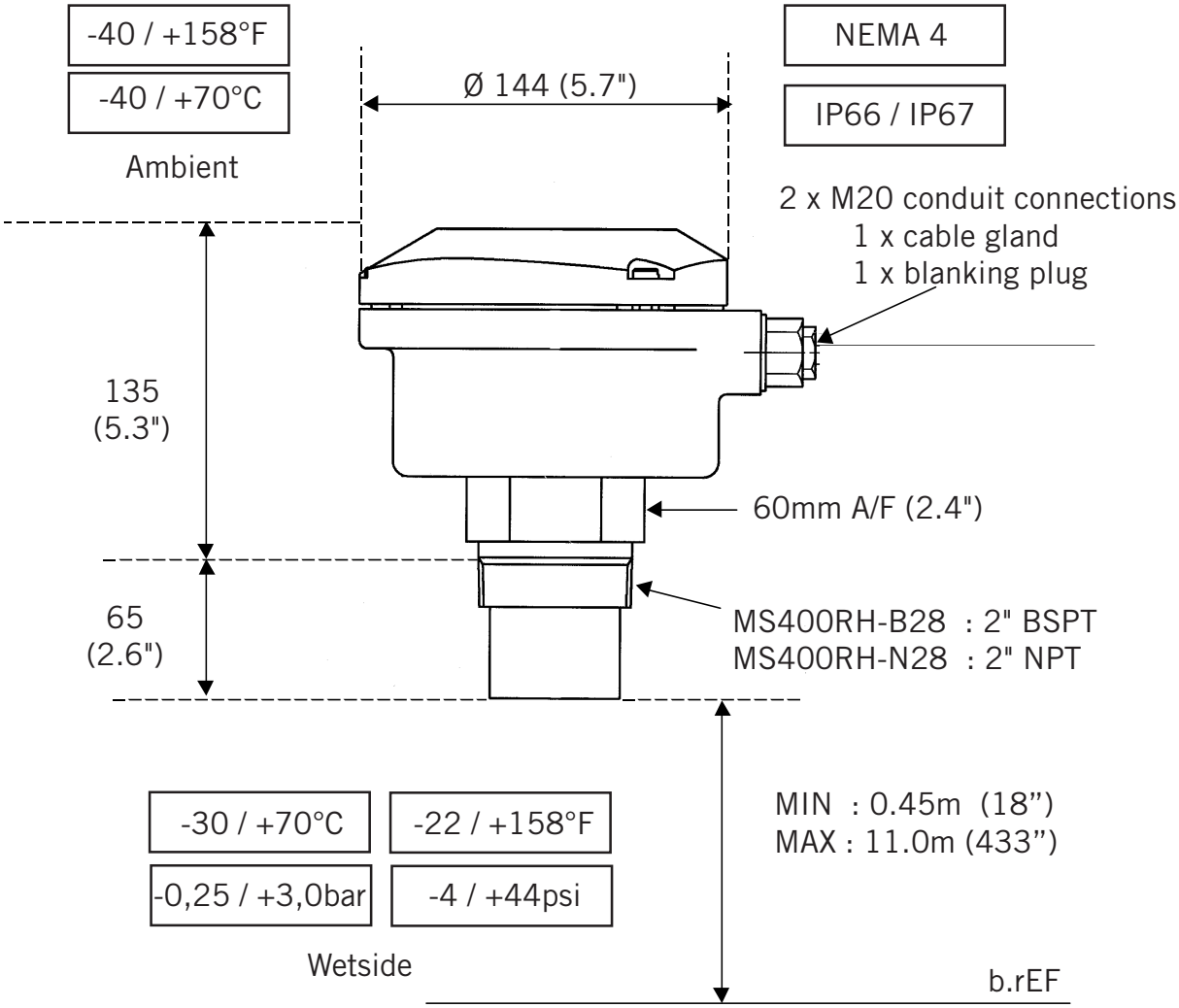
CE

CONTENTS

The MS400 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 MS400 SMART Communications.
HART is a registered trademark of the HART Communications Foundation and is a mnemonic For Highway Addressable Remote Transducer.


-40 / +158°F
-40 / +70°C
Ambient
Ø 144 (5.7")
NEMA 4
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")
MS400RH-B28 : 2" BSPT
MS400RH-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

3.1.3 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.

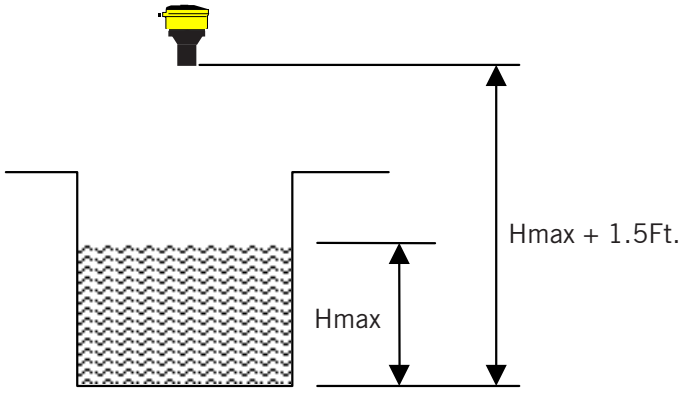
- Avoid mounting the transmitter directly above any pumps as the transmitter will detect the pump casing as the liquid falls away. If this is not possible, fine tuning on site may be required to ignore echoes from the pump casings.

3.1.4 Open Channel Flow installations.

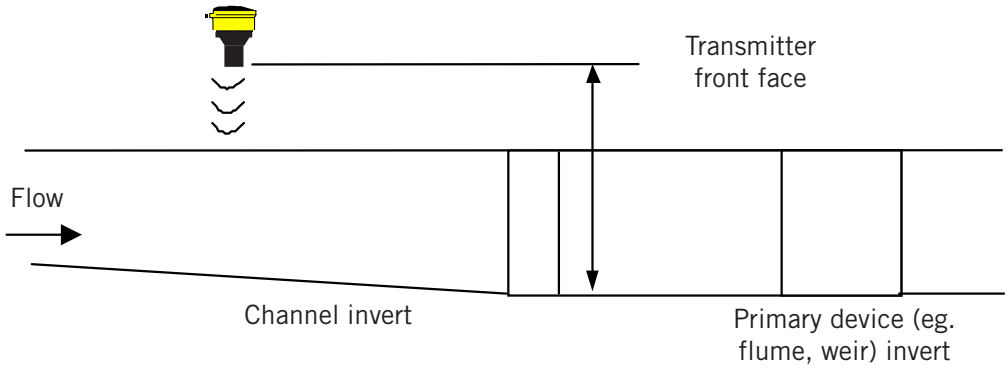
There are normally two distinct parts to an open channel flow measurement system; the primary element (flow structure) and the secondary element (Head measurement instrumentation).
For accurate open channel flow measurement, both parts of the system must be installed accurately.

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.

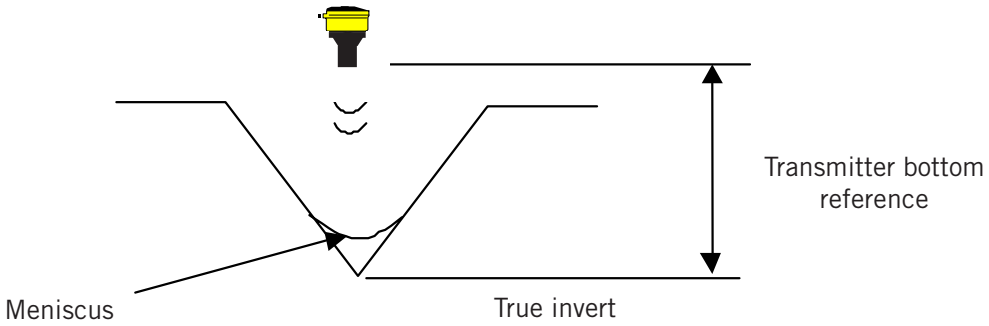
Positioning of the transmitter is critical and should be the correct distance upstream from the flow structure as stated in BS3680 e.g. a distance of 4 to 5 times Hmax for a thin plate weir or 3 to 4 times Hmax for a flume.
For optimum accuracy, the front face of the transmitter should be positioned 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 MS400RH 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 MS400RH 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 The Magne-Sonic (Service Division) who will be pleased to advise.

3.3.3 Relays

The MS400RH 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 MS400RH transmitter, a 250 Ohm 0.25W load resistor must be installed in the loop.

When used with the Magne-Sonic MSC900 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.

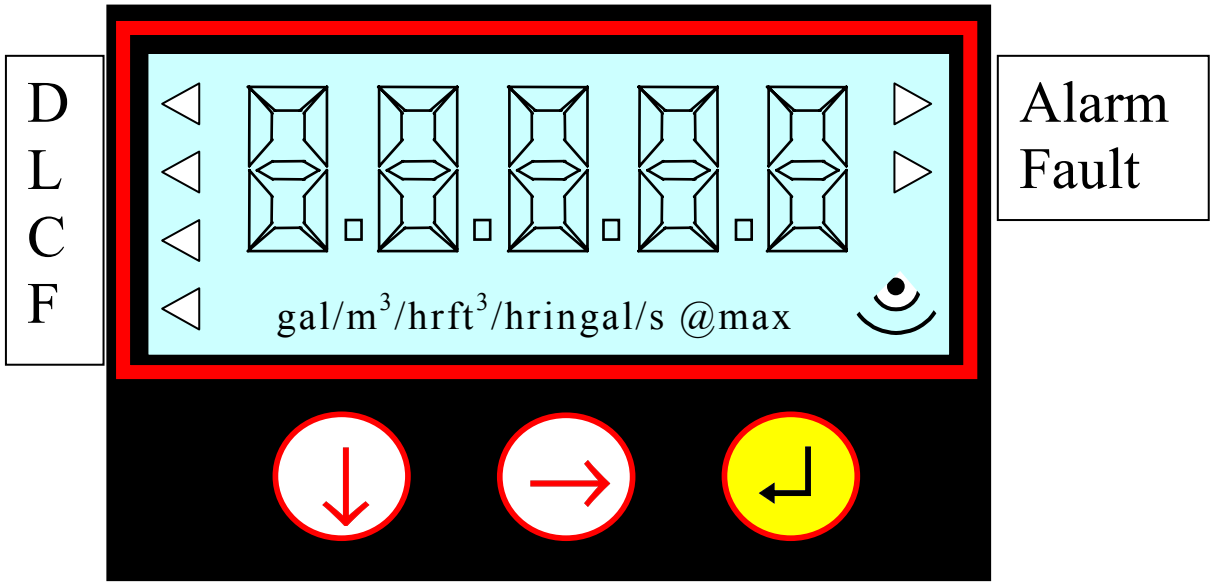
4.0 Commissioning, programming and operation

The MS400 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 D and > steps.
Refer now to the Main Menu structure shown in Appendix A

The MS400 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 MS400 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)

4.4 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 MS400 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 MS400, thus invoking the mini-wizard which will assist programming.

Once programmed, it is possible to review the data entered into or calculated by the MS400 by stepping through the main menu using the green button D.

Note however that this will be a manual navigation of the MS400 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 MS400 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 D 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 D 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:
MS400RH-B28 m
MS400RH-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 MS400 - refer to section 4.7.11

ii) Note that changing the base units will cause the MS400 to re-start with factory default values in all other parameters.

Changing base units after programming the MS400 will cause all programmed data to be overwritten with factory default values.

The MS400 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 D 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 D 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 D to scroll through the list of available duty options.

Notes.
i) The MS400 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 D to scroll through the units of measurement options, allow 2-3 seconds after each button press for the MS400 to check and display the selection. Pressing the green button D 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.

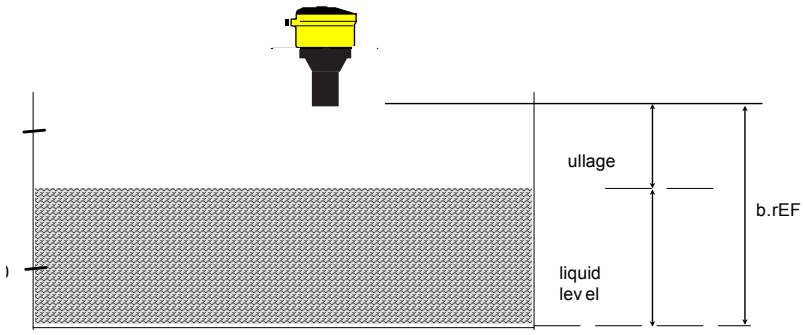
e) If the chosen units of measurement are incorrect, the edit sequence for the units of measurement can be re-started by pressing the blue button > again.

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:
MS400RH-B28 11
MS400RH-N28 36

The MS400 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 D 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 D to edit the value of the leading digit. Be careful not to enter a value greater than the maximum range of the MS400: 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 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.

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 MS400 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 MS400 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 MS400 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 MS400 using the push buttons.

SPEC. P Special plotted : only used if the MS400 has been configured by a HART master such as the Magne-Sonic MSC900 series controller or Magne-Sonic H-Conf401 software

SPEC.C Special calculated : used when a standard profile is not available from the MS400 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 D 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 D 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 MS400 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 MS400 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 D 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 D 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 “4”.
Refer to section 4.4.10.

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 MS400 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 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 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.

The scaling factor is normally left at the value calculated by the MS400 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.

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 green 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 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 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 MS400 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 D to edit the value of the leading digit.
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.

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 D to edit the value of the leading digit.
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.

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, if the data already entered allows the MS400 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 D to edit the value of the leading digit.
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.

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 MS400 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 MS400 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 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 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 MS400 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 D 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 MS400 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 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 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 MS400 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 MS400 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 MS400 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 MS400 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 D to display the distance to target in the chosen base units (m, ft, in) which the MS400 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 D to scroll down to the next diagnostic data “LEUEL”.

This is the level in base units, which the MS400 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 D 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 MS400 will operate at values below this.

4.5.4 Press the green button D 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 MS400.
A thorough understanding of ultrasonic level systems is required to interpret this data.

4.5.5 Press the green button D 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 D 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 D 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.

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

The proficient user is able to fine tune operation of the MS400 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, an 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 D 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 MS400 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 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 D 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 MS400 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 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 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:	
MS400RH-B28	0.45 (m)
MS400RH-N28	1.5 (ft)
or	18 (in)

The dead band is the region below the MS400 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 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 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 MS400 operates is automatically chosen by the microprocressor to ensure optimum signal size and performance.

Auto shows that the MS400 will automatically set the frequency to obtain the best echo size and optimum performance. The actual frequency being used by the MS400 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 MS400 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 D 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 MS400 is set at a factory default value of once per second.

The MS400 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 D 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 MS400 to detect uncovered blades and treat them as a valid echo, thus calculating an incorrect level reading.

The MS400 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 D 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 D 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 MS400 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 MS400 is fitted with an integral temperature sensor which continuously monitors the air temperature around the transducer.

Auto indicates that the MS400 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

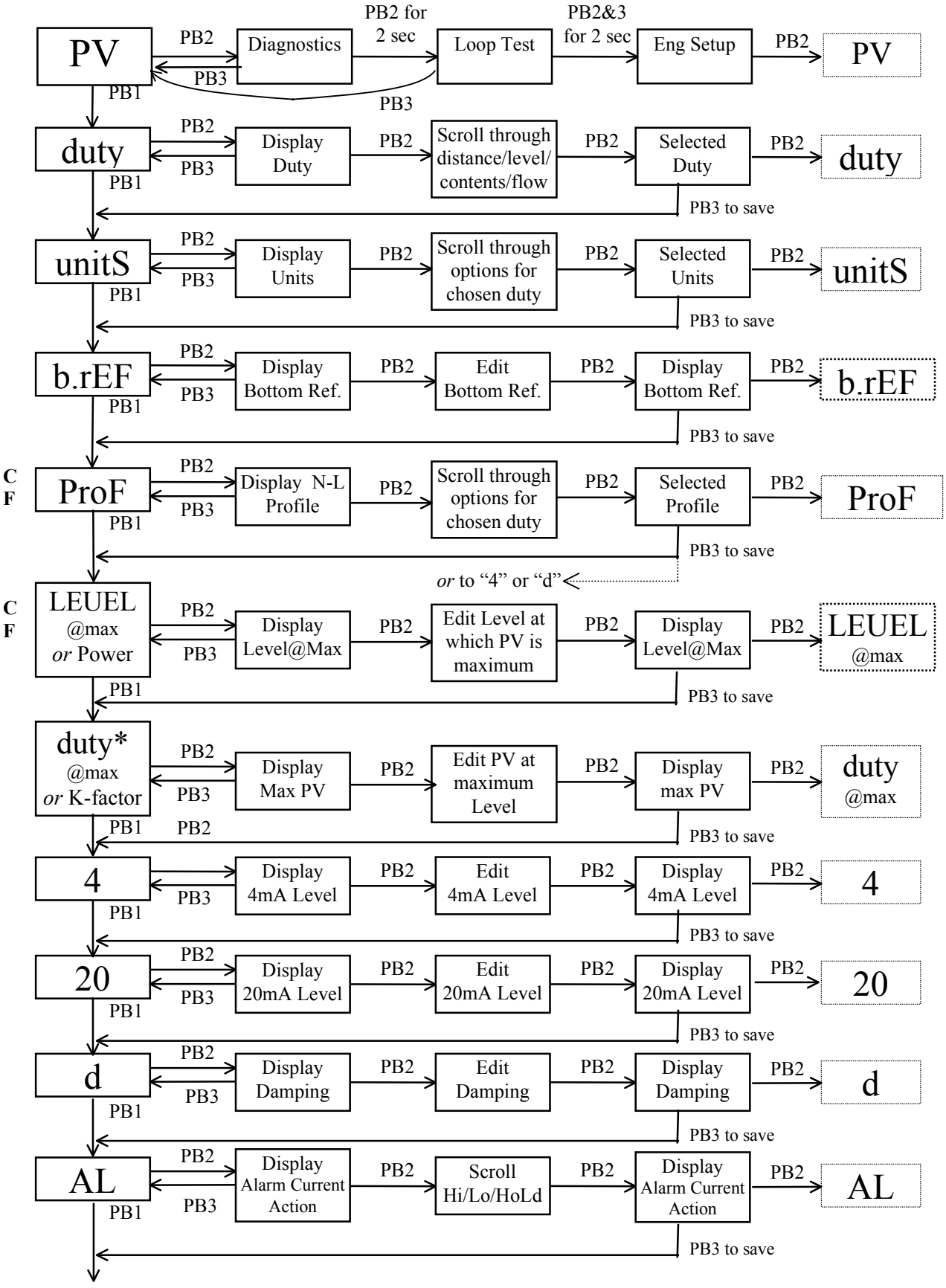
The leading digit of the temperature will now be flashing, indicating it may be changed.

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

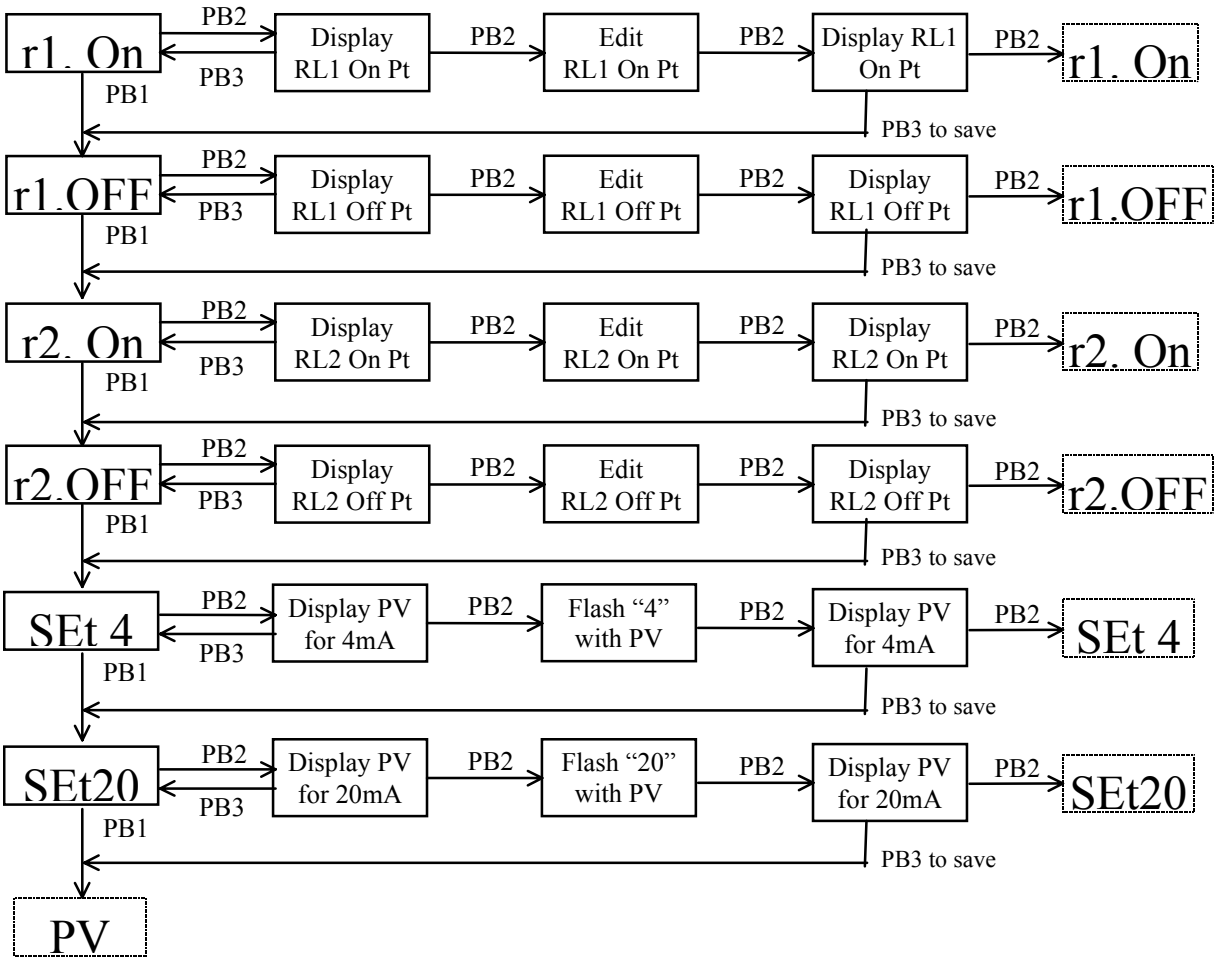
c) Once correct, use the blue button > to select the next digit and then the green button D to edit as before, or the blue button > to move to the next digit. Continue this sequence until all digits are correct.

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

MAIN MENU : PROGRAMMING

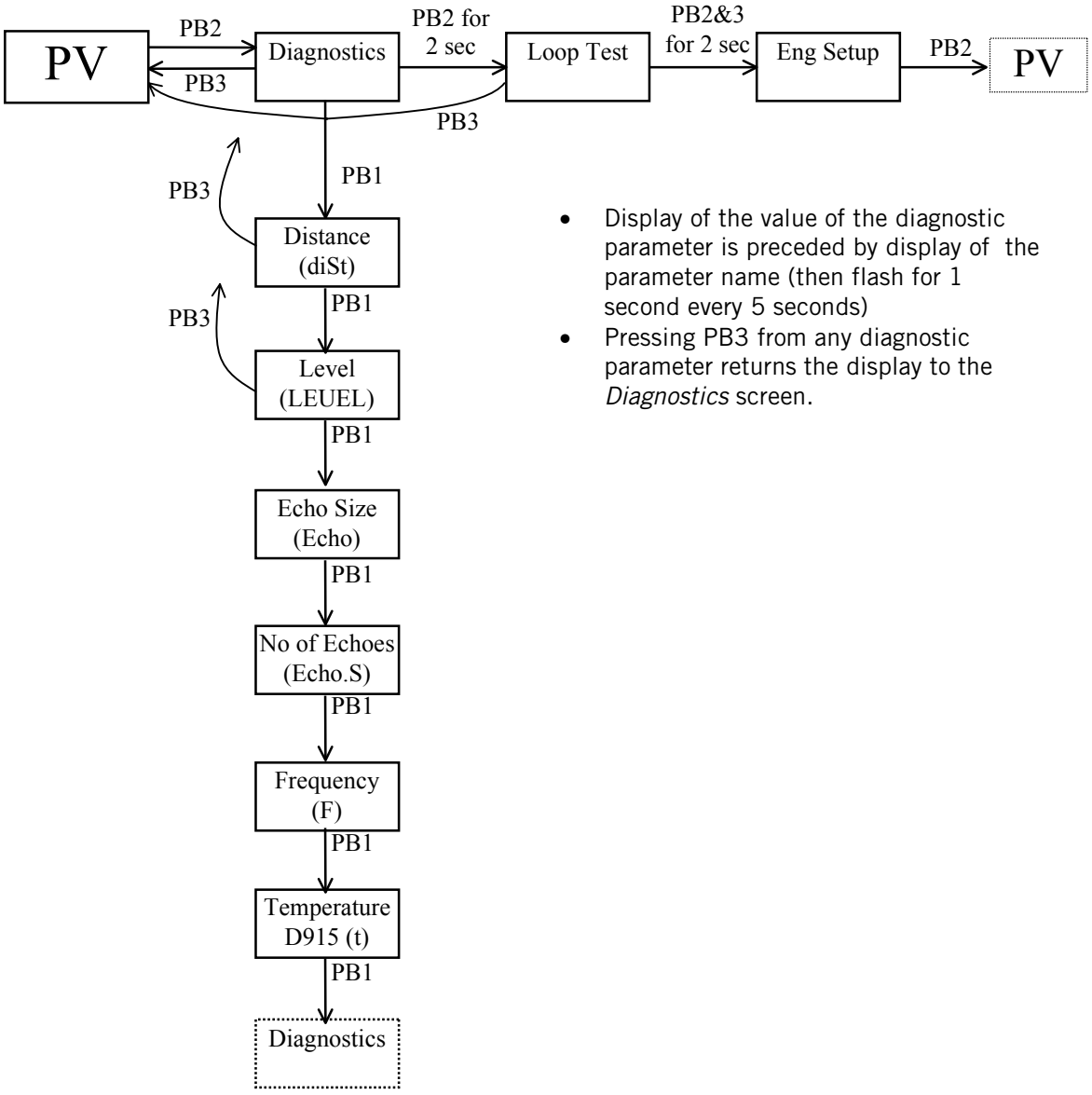


Cont'd / ...


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

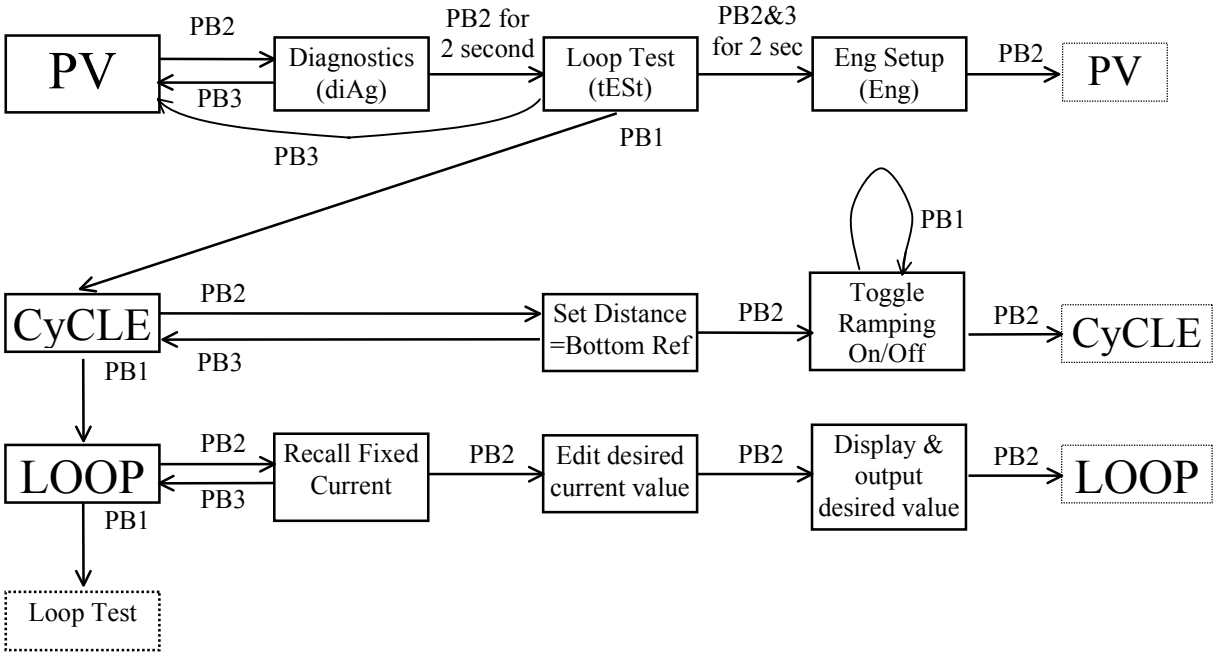
APPENDIX A2

DIAGNOSTICS MENU

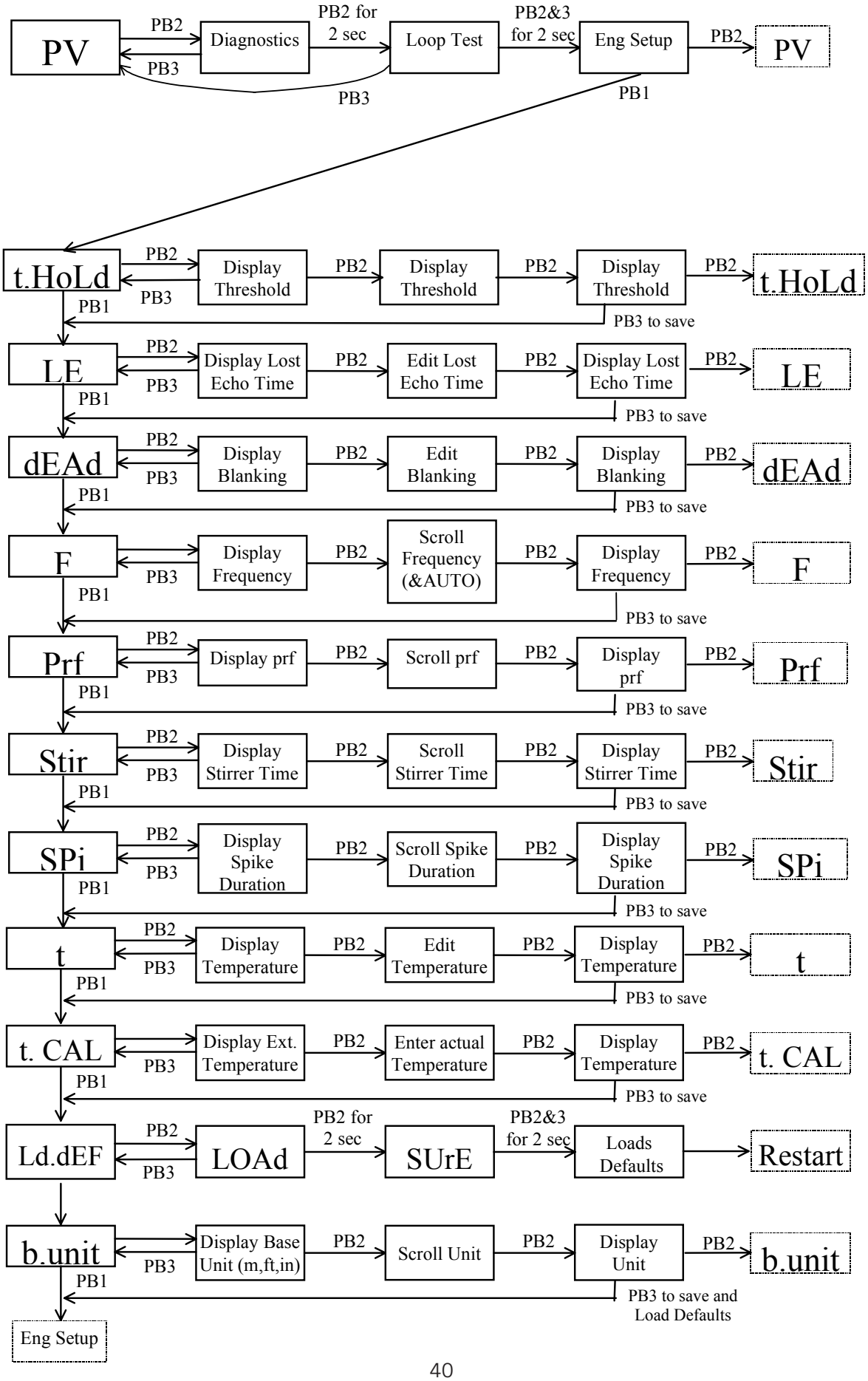


- Display of the value of the diagnostic parameter is preceded by display of the parameter name (then flash for 1 second every 5 seconds)
- Pressing PB3 from any diagnostic parameter returns the display to the *Diagnostics* screen.

COMMISSIONING / LOOP TEST MENU

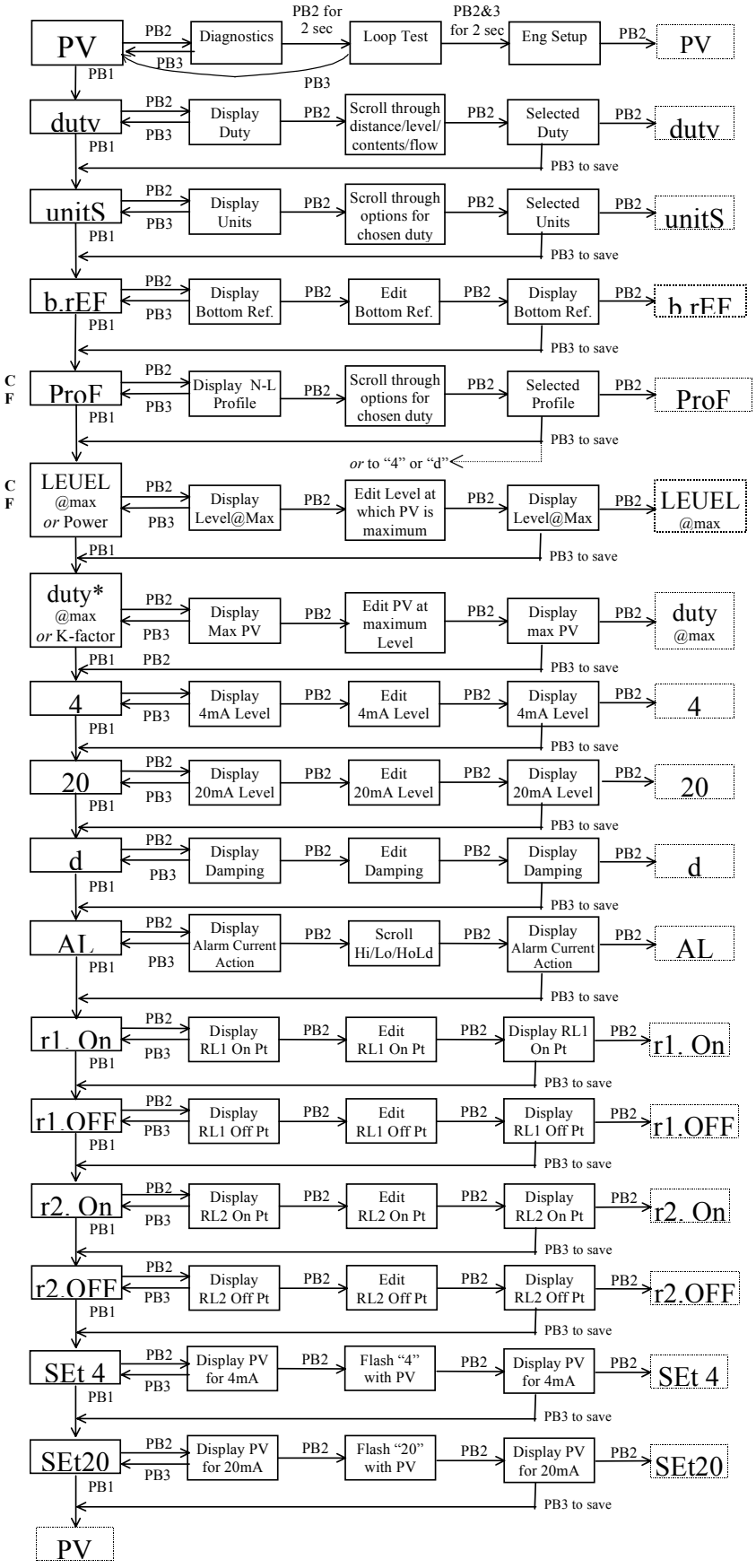


ENGINEERING MENU



DEFAULT VALUE LISTING : MAIN MENU PARAMETERS

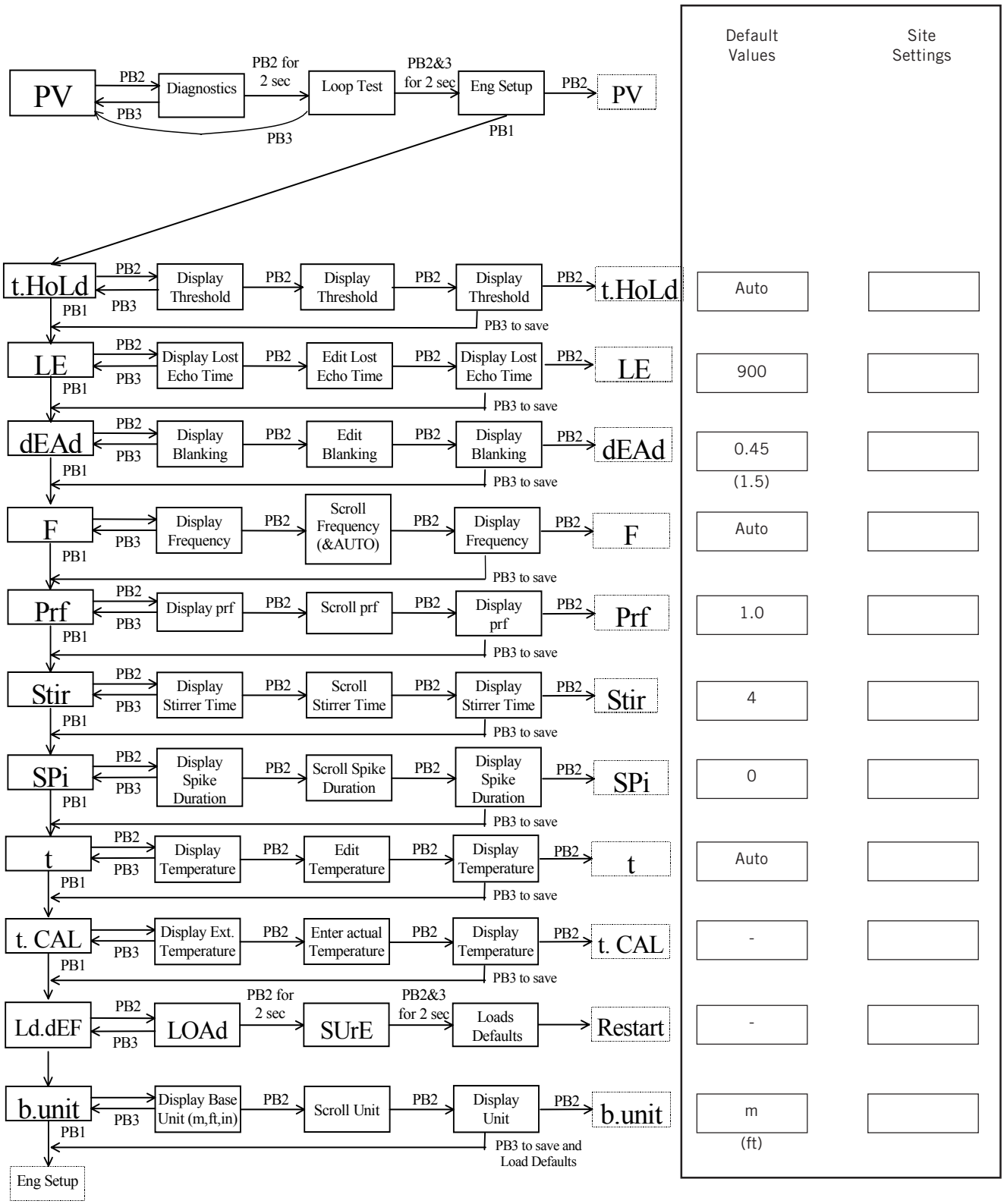
Default value shown are for the metric model MS400RH-B28.
Where different, values for the imperial model MS400RH-N28 are shown in brackets.



	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 MS400RH-B28.
Where different, values for the imperial model MS400RH-N28 are shown in brackets.



LISTING OF NON-LINEAR PROFILES IN THE MS400

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[1]	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.

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