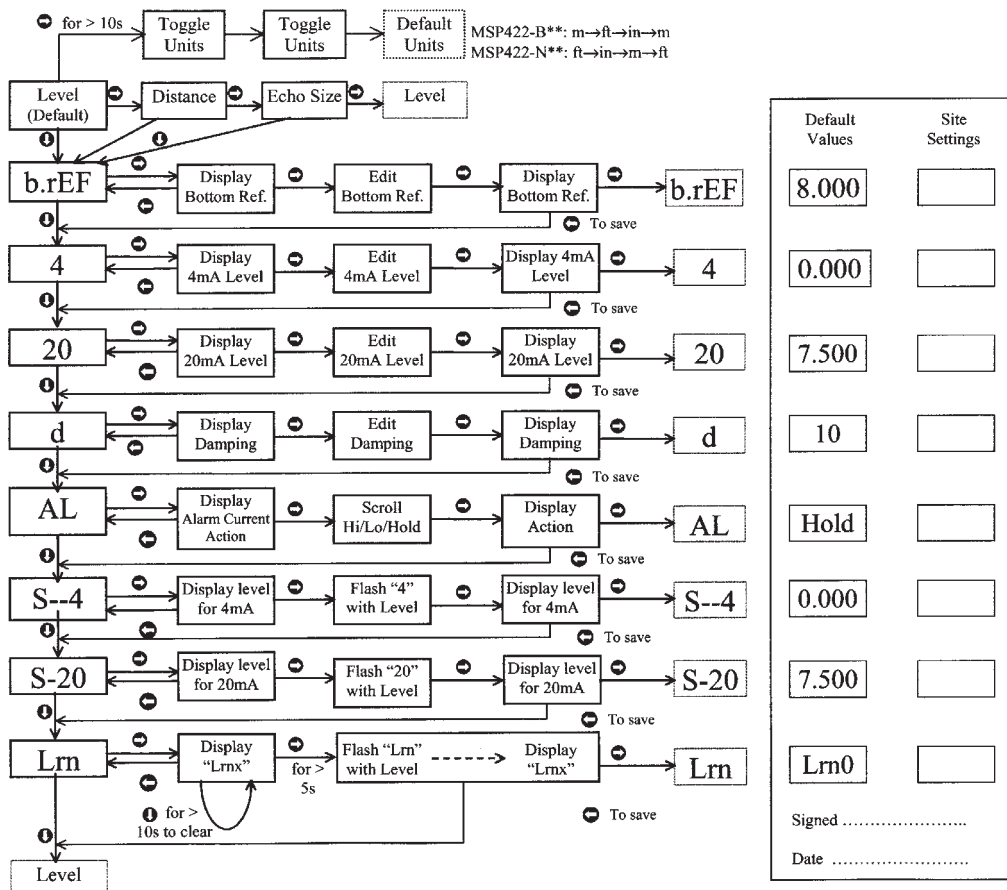


# Magne-Sonic

## MS422 Analogue Liquid Level Transmitter

Installation, operation & maintenance instructions

### MS422 Programming Menu



# IMPORTANT SAFETY NOTICE

The MS422 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.



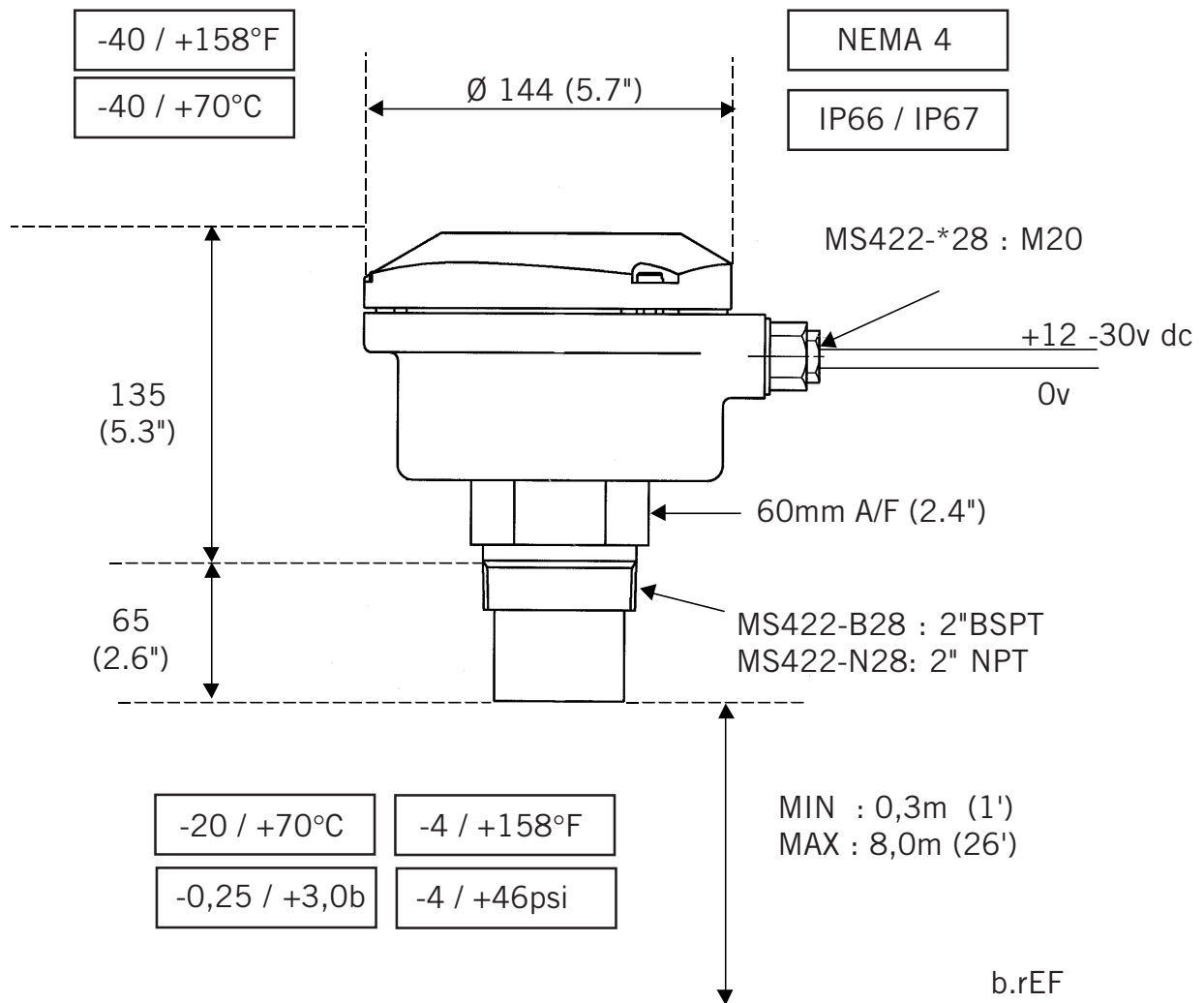
## HANDLE WITH CARE

The MS422 is a measuring instrument and should be handled with due care and attention at all times.

	<b>INDEX</b>	<b>PAGE</b>
<b>1.0</b>	<b>Specification</b>	3
<b>2.0</b>	<b>Installation</b>	4
<b>3.0</b>	<b>Wiring</b>	7
<b>4.0</b>	<b>Commissioning &amp; Operation</b>	8
4.1	Power up	8
4.2	Calibration	8
4.2.1.	Display units	8
4.2.2.	First measurements	9
4.2.3.	Setting the correct bottom reference (b.rEF)	9
4.2.4.	Setting the 4 and 20mA levels	10
4.2.5.	Setting the damping applied to the output (d)	11
4.2.6.	Selecting the output current action on alarm condition	11
4.2.7.	Setting the 4 and 20mA levels using actual liquid levels in tank	12
4.2.8.	Blocking unwanted echoes from false targets	12
4.2.9.	Changing operation to distance mode	13
4.3	Power failure	13
4.4.	Final checks	13
<b>5.0.</b>	<b>Fault Finding &amp; Error Messages</b>	14
5.1.	No display	14
5.2	No level reading	14
5.3	Error messages	14
<b>6.0.</b>	<b>Maintenance</b>	15
<b>7.0.</b>	<b>Parameter default values</b>	15
<b>8.0.</b>	<b>Programming menu</b>	16

**The MS422 is a measuring instrument and should be handled with due care and attention at all times.**

## 1.0 SPECIFICATION



Housing & Cover Material	:	Glass filled Nylon
Wetside Material	:	P.V.D.F.
Electrical output	:	4-20mA (3.8 - 20.5mA linear)

### Pressure Equipment Directive

The MS422 transmitter does not fall within the PED definition as enclosing a pressurised fluid, so is therefore outside the scope of the Directive

## 2.0 INSTALLATION

Important safety notice : The MS422 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. Contact Magne-Sonic for details of transmitters certified for use in Hazardous areas.

### 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.

### 2.1 Location of the MS422 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.

#### 2.1.1 General considerations

- The MS422 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 MS422 should be mounted above the liquid surface using the “2” thread provided. To facilitate mounting, a bracket kit is available. See Section 2.2.

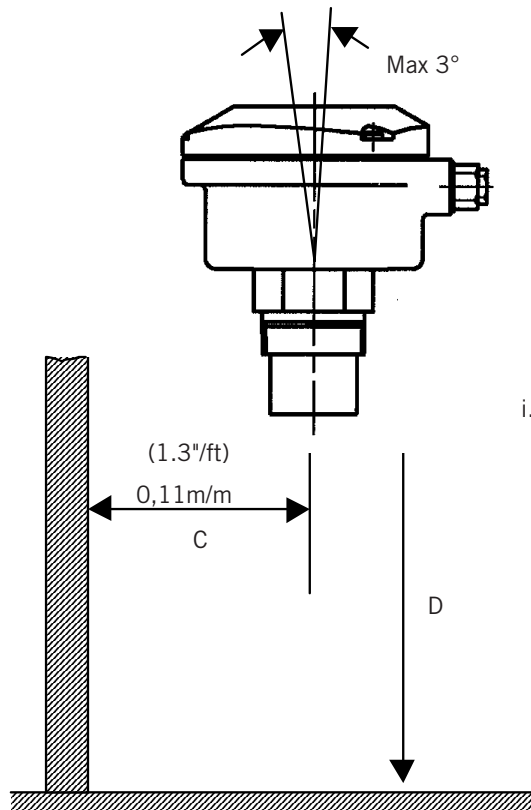
Note : The MS422 is designed to be mounted in a non-metallic fitting or flange. The use of metallic fittings or flanges is not recommended.

- 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.



i.e.

D Min	=	0.30m	(12")
D Max	=	8m	(26ft)
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 2.2.
- 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 12". The transmitter will not detect any liquid surface closer than 12" to the transmitter face.

#### 2.1.2 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.

### 2.1.3 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.

### 2.2 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 (MS422-B28) or 2" NPT (MS422-N28). The thread form is clearly marked on the hexagon of the transducer body.

Note : The MS422 is designed to be mounted in a non-metallic fitting or flange. The use of metallic fittings or flanges is not recommended.

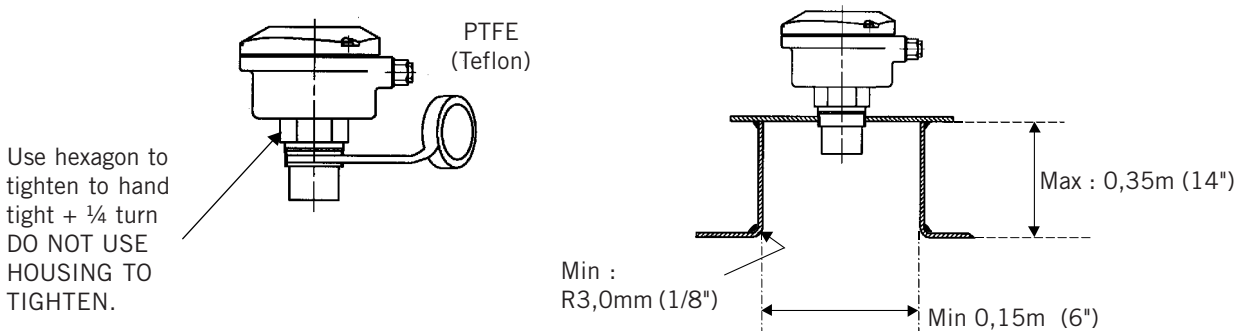
To help installation, a bracket kit is available from Magne-Sonic. This comprises a Stainless Steel angle bracket and PVC threaded disc which may be used to mount the MS422 on a gantry or other support over the liquid level. Order part number MS-BRK2 (BSP) or MS-BRK3 (NPT). The bracket may be bolted 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.

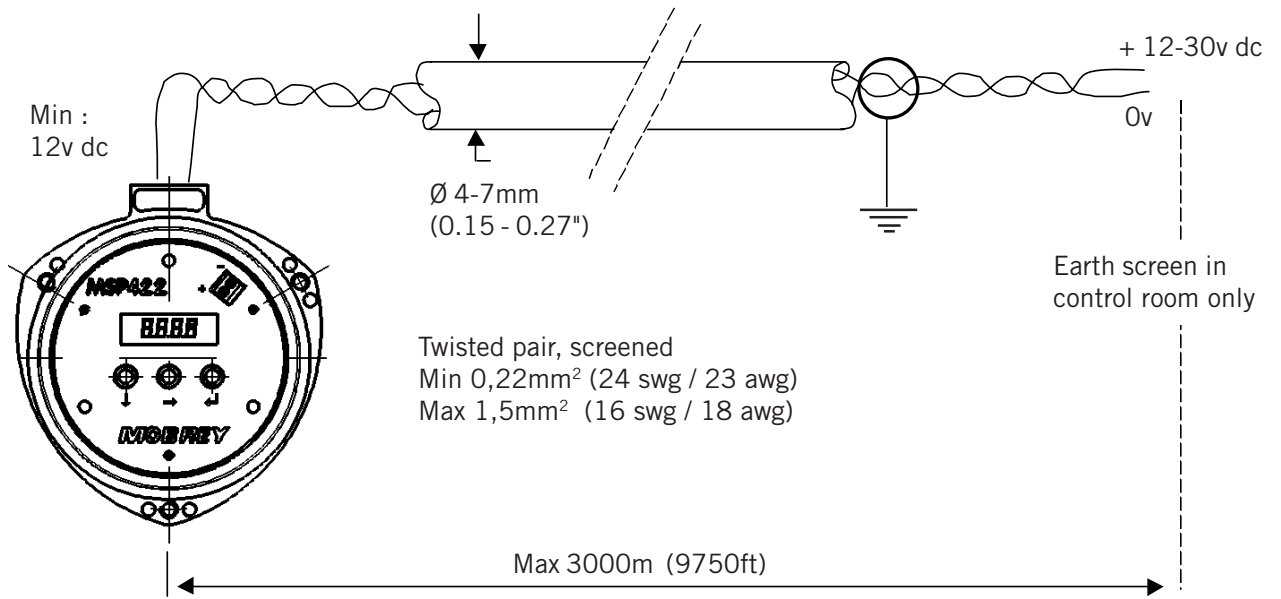
Check that the maximum liquid level will not encroach into the 12" blanking zone of the transmitter.

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.



### 3.0 WIRING



Multicore cable may be used, but it is recommended that each pair used to connect to an MS422 should be individually shielded.

## 4.0 COMMISSIONING AND OPERATION

Refer to Programming card inside MS422 or menu in this manual.

MS422 operates from a menu of parameters held in memory. The instrument leaves the factory pre-programmed with a value in each parameter location such that, when power is first applied, the instrument will give a sensible reading.

A list of default values is given in the menu layout.

### 4.1 Power up

On power up, the MS422 will take a few seconds to initialise, then the display will run through a set-up routine, showing a full set of figure eight's, then the software revision and finally a full set of zeros whilst the microprocessor identifies the correct return echo and confirms this repeats enough to be acceptable. The instrument is now ready for use, and is set-up using the 3 coloured push buttons.



Refer now to the Programme menu which is shown on the front of this manual and also in the instrument itself on a card tucked between the electronics housing and the body.

### 4.2 Calibration

#### 4.2.1 Display units

Default values are as follows :-



MS422-B28	Metres
MS422-N28	Feet

The display units can be changed using the blue button . Simply hold the blue button  down for 10 seconds and the units will change to the next option in the following sequence :

Metres to Feet to Inches and back to Metres again.

This is indicated by the position of the decimal point in the displayed value :

Units	Display
m	8.000
ft.	26.24
in.	314.9

Once the units have changed from default to the next option, the blue button  can be released, in which case the new units selected are confirmed, or the blue button  can continue to be held down, in which case the next units option is given after a further three seconds.

When the display units have been programmed, please note that you must use the same units when programming in the bottom reference, 4 and 20mA points.

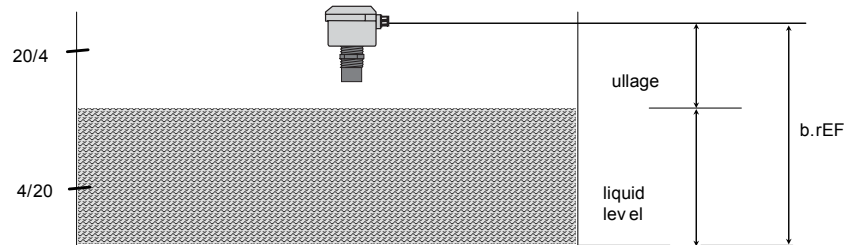
The 4-20mA output may be set to operate over all or just a part of the total measuring range. There is no theoretical limit on the minimum span of the current output, although in practice a span below 100mm is not recommended. With small spans, be aware that a high value of damping will greatly affect the performance of MS422.

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

**Footnote :** The MS422 measures and calculates at all times in metres. The units of display are derived as a last operation using a pre-programmed conversion factor.



**4.2.2 First measurements.** With the MS422 installed and display units selected, the display will now be showing what the instrument thinks is the liquid level. This is a value calculated by the microprocessor, being the difference between the distance to target being measured and the default value for the datum or bottom reference (b.rEF).



Before changing any of the default values, use blue button **▶** to scroll along to the next piece of information, which is the distance to target as measured by the MS422 from the front (transmit) face. This value is shown alternately with the text “diSt” to remind the user the MS422 display is in distance mode. You can now quickly check correct operation against a manual measurement if required.

**TIP :** A feature of the MS422 useful at this stage is that it can be used as an electronic tape measure. With an empty tank or vessel, the MS422 will read the distance to the bottom of the tank. This can be noted and used when setting b.rEF later.

Press blue button **▶** again to scroll the display to show the echo size on a scale of 0-100. (It is possible to record a value greater than 100, but do not worry about this!). With the display in this mode, the central “:” cursor will flash once for every echo received, which under normal circumstances will be approximately once per second.

**TIP :** It is useful at this point to check that the maximum echo size available is being received. Adjust the position of the instrument until the highest echo size is shown continually. In most applications, the signal strength will vary over a wide range :  
20 – 80.

Press blue button **▶** now to return to the original level reading and to start the calibration routine.

Note that the output of the MS422 will vary during programming as the various default values are changed. The display will automatically revert to the level or distance reading from any other display after a period of 4 minutes.


### 4.2.3 Setting the correct bottom reference (b.rEF).


- Press green button **▼** and the display will scroll from the level reading to “b.rEF”.
- Press blue button **▶** to enter the editing menu for b.rEF. The display will show the present value of the b.rEF parameter.
- If this value is correct, press red button **◀**, then green button **▼** to scroll on to the next menu option. (4.2.4 below).

Or

To change the value, press blue button **▶** to edit :-


The first digit of the display will flash and may be changed using green button **▼**. Once correct, press blue button **▶** to select the next digit and then green button **▼** to edit, or the blue button **▶** again to move to the next digit. Continue this sequence until all 4 digits are correct, then press the blue button **▶** a final time to confirm the new b.rEF value ( none of the digits should now be flashing)




If the new value is incorrect, the edit sequence for b.rEF can be started again by pressing the blue button  .

If the new value is correct, press the red button  to save the b.rEF programmed in and the display will automatically scroll on to the 4mA (4) setting menu.

#### 4.2.4 Setting the 4 and 20mA levels. (4 & 20)






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


If you wish to set the 4 and 20mA levels by ranging the MS422 to a fixed target, such as the level in the tank at any particular time, skip these menu options by pressing the green button  2 times to arrive at the set damping option.


- a) Press the blue button  to enter the editing menu for the 4mA level. The display will show the present value of the 4mA level.
- b) If this value is correct, press the red button  , then the green button  to scroll on to the next menu option.




Or

Press the blue button  to edit this value :-

The first digit of the display will flash and may be changed using green button  . Once correct, press blue button  to select the next digit and then green button  to edit, or the blue button  again to move to the next digit. Continue this sequence until all 4 digits are correct, then press the blue button  a final time to confirm the new 4mA value ( none of the digits should now be flashing)






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


If the new value is correct, press the red button  to save the 4mA level programmed in and the display will automatically scroll on to the 20mA (20) setting menu.


- a) Press the blue button  to enter the editing menu for the 20mA level. The display will show the present value of the 20mA parameter.
- b) If this value is correct, press the red button  , then the green button  to scroll on to the next menu option.

Or,

Press the blue button  to edit this value :-

The first digit of the display will flash and may be changed using green button  . Once correct, press blue button  to select the next digit and then green button  to edit, or the blue button  again to move to the next digit. Continue this sequence until all 4 digits are correct, then press the blue button  a final time to confirm the new 20mA value ( none of the digits should now be flashing)




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

If the new value is correct, press the red button  to save the 20mA level programmed in and the display will automatically scroll on to the damping (d) setting menu.

#### 4.2.5 Setting the damping applied to the output (d).






The damping value entered is actually a time constant in seconds which is applied as smoothing to the level reading and the output current. A new value may be entered up to a value of 999 seconds. A large value will have the effect of smoothing out rapid changes of level and will also smooth out the effects of turbulence and ripples on the liquid surface. (It would be highly unusual to select a value greater than 30 seconds.)


You may choose to enter a value of zero, in which case no smoothing will be applied to the current output and changes in reading immediately change the current output. (note, as the MS422 transmits at nominally once per second, a damping time of zero will not necessarily give an immediate response).

- a) Press the blue button  to enter the editing menu for the damping time .  
The display will show the present value of damping.
- b) If this value is correct, press the red button  , then the green button  to scroll on to the next menu option.

Or

Press the blue button  to edit this value :-

The first digit of the display will flash and may be changed using green button  . Once correct, press blue button  to select the next digit and then green button  to edit, or the blue button  again to move to the next digit. Continue this sequence until all 3 digits are correct, then press the blue button  a final time to confirm the new damping value ( none of the digits should now be flashing)

If the new value is incorrect, the edit sequence for damping can be started again by pressing the blue button  .






If the new value is correct, press the red button  to save the damping value programmed in and the display will automatically scroll on to the alarm action menu. ( AL)

#### 4.2.6 Selecting the output current action on alarm condition.


The MS422 will signal an alarm condition in the event that the target echo is lost for a period of 10s or more.

The user can select what action the current output will take in this case.



- |      |  |
|------|--|
| Hi   | The current on the two wire loop will drive up to 21 mA and remain there until the correct target echo is recovered. The display will flash "LE" and the last reading.       |
| Hold | The current will freeze at the value it was last reading and will remain there until the correct target echo is recovered. The display will flash "LE" and the last reading. |
| Lo   | The current on the two wire loop will drive down to 3.6 mA and remain there until the correct target echo is recovered. The display will flash "LE" and the last reading.    |



To change the action from the default action Hold, enter the menu using, the blue  button to show the current action. Press blue button  to enter edit mode. With the display flashing use green button  to display the required action and then press blue button  to select this action and the display will stop flashing. Press red button  to save and scroll on to the menu that allows setting of the 4mA and 20mA levels against a known target.



#### 4.2.7 Setting the 4 and 20mA levels using actual liquid levels in the tank (S--4 and S-20).



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 green button  to move to the final "Lrn" option in the main menu.

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.

The first option is to set the 4mA level. Ensure the target is at the desired 4mA level and, with the display reading the new value, press the blue button . The display will show the present value for the 4mA setting. Press the blue button  again to edit the 4mA level, and the display will alternately flash "4" with the current level reading.


Press blue button  to confirm the correct value for the 4mA level then press red button  to save and exit to the 20mA setting menu.

To set the 20mA level, ensure that the target is at the desired 20mA level and, with the display reading the new value, press the blue button . The display will show the present value for the 20mA setting. Press the blue button  again to edit the 20mA level, and the display will alternately flash "20" with the current level reading.



Press blue button  to confirm the correct value for the 20mA level then press red button  to save and exit to the "Lrn" menu.

#### 4.2.8 Blocking unwanted echoes from false targets


The MS422 has an easy to use "Lrn" (Learn) routine which allows the user to teach the instrument up to 2 false echoes and then ignore them in future operation.


If the application is straight forward and there are no false echoes, press the green button  now to exit the programming menu and return the instrument to normal operation, showing the level reading on the display.

If, once the MS422 is in operation, an echo other than the true liquid surface echo is detected, and an incorrect level reading is displayed, the instrument can be taught to ignore this false echo. This routine may be used at any time, either during or after set-up or should a problem occur later.

Press blue button  to enter the Lrn menu. The display will show "LrnX", where X is 0,1 or 2 and is the number of false target echoes already stored. To store a new false echo, press the blue button  for greater than 5s.

Note : If there are already 2 false echoes stored (Lrn2) then the MS422 will not allow the user to store another echo until the memory is cleared. (see below)

The display will now flash the false target position alternating with "Lrn". After 4s the false target is stored and the display shows "LrnX". If for any reason this target is not to be saved then press the blue button  and the "Lrn" sequence may be repeated or aborted.



Otherwise, press the red button  to save the false target echo and return to the main menu.

To store another false target echo, navigate down the main menu to "Lrn" and repeat the sequence again.


Note :-

When a false target echo is stored, the MS422 effectively sets up a 'window' around the false target and will ignore any echo from within that windows unless the echo from the liquid surface is larger than that from the false target.

The user may therefore see no change in the MS422 output current whilst the liquid level moves through this window, which is equivalent to a distance of around 200mm.

To clear the MS422 of all false echoes stored, simply press blue button  to enter the Lrn menu then with the display showing "LrnX" press the green button  for 10s to completely clear the memory. The display will now show "Lrn0".

#### **4.2.9 Changing operation to distance mode**

If the MS422 is to be used to measure distance rather than level, the display can now be changed accordingly. With the display showing the level reading, press the  blue button, the display will now show the distance to target alternating with "Dist".

Note : The display will continue to alternate between the distance to target and "Dist" whilst in distance mode.

#### **4.3 Power failure**

All parameters are held in E<sup>2</sup>PROM memory, so in the event of a power failure or disconnection from the power supply the MS422 will remember all of its last parameter values and will resume correct operation once power is restored.

#### **4.4 Final checks**

Check the display is reading correctly.  
You may wish to check echo size again before re-fitting the enclosure lid.

Check that the cover seal is in place in the cover and is good condition. It should not be twisted or kinked in any way.

Carefully set the cover on the MS422 with the text on the cover label at right angles to the conduit entry, and tighten the three cover screws equally to seal the instrument.

Check that the cable gland is securely tightened and sealing on the cable sheath.

## **5.0 FAULT FINDING & ERROR MESSAGES**

### **5.1 No display :**

Check power supply. Ensure a minimum of 12v dc at the instrument terminals. Check cable insulation is not preventing contact at the terminal block.

### **5.2 No level reading :**

Check instrument is pulsing. You should be able to hear the transducer “ticking” about once per second. If there is no sound, the instrument should be replaced.

### **5.3 Error messages**

**5.3.1** Flashing “LE” with “0000”. This means that the MS422 is not receiving a return echo possibly because the liquid surface is poor or beyond the range (8m/26ft) of the instrument. Re-locate the instrument or contact Magne-Sonic for details of longer range instruments.

**5.3.2** Flashing “LE” with a level reading. This means that the MS422 is no longer receiving satisfactory echoes from the liquid surface. This may be because of one of a variety of reasons, for example, excessive foaming, turbulence or ullage vapours.

First, check that the instrument transmit face is free from contamination and condensation. The MS422 will operate with some condensation on the face, but excessive condensation may cause operational problems. If the vessel can not be adequately vented to prevent condensation forming, contact Magne-Sonic for alternative solutions.

Check the instrument is still vertically aligned above the liquid surface, then check the echo received size. If the echo size is small (<3), re-locate the transducer or modify the vessel so that the MS422 can operate above a more acceptable area of the liquid surface.

Lost echo (LE) will not be signalled until there has been no return echo for a 10 second period. Within the 10 seconds, the output will remain fixed. If the 10 seconds elapses and no satisfactory has been received, the output will drive to the current level selected and the display will flash the last valid level reading alternately with “LE”.

If, however, a satisfactory echo is received within the 10 seconds, a new output is established and the LE timer is re-set.

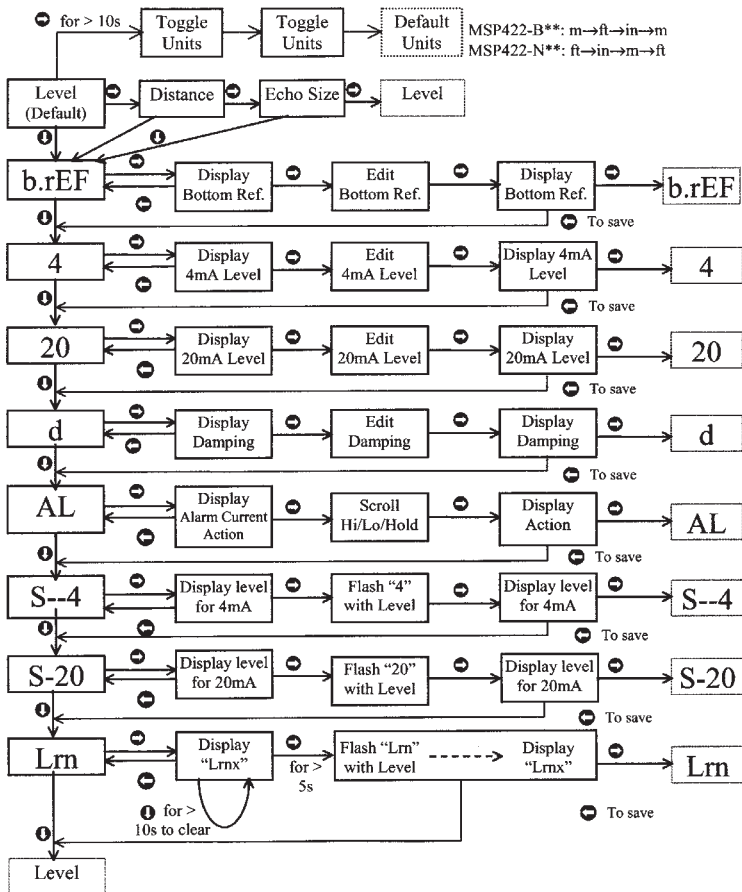
## 6.0 MAINTENANCE AND SPARE PARTS

The only maintenance required is to check the instrument transmit face occasionally to ensure it remains clean.

There are no spare parts for the MS422. If a problem persists, contact Magne-Sonic for advice or a replacement unit.

## 7.0 PARAMETER DEFAULT VALUES

<b>Parameter</b>	<b>MS422-B28 (Metric)</b>	<b>MS422-N28 (Imperial)</b>
Measuring units	metres	feet
Display reading	level	level
Bottom reference	8	26.24
4 mA level	0	0
20mA level	7.5	14.76
Damping	10s	10s



Default Values	Site Settings
8.000	<input type="text"/>
0.000	<input type="text"/>
7.500	<input type="text"/>
10	<input type="text"/>
Hold	<input type="text"/>
0.000	<input type="text"/>
7.500	<input type="text"/>
Lrn0	<input type="text"/>
Signed .....	
Date .....	



**Quality...Reliability...Service**  
**1-800-238-4027**

**MAGNE-SONICS**<sup>®</sup>

A Division of The Clark-Reliance<sup>®</sup> Corporation

9441 W. Sam Houston Pkwy. # 100  
Houston, TX 77099 U.S.A.  
Telephone: (713) 785-4400  
TOLL FREE: 1-800-238-4027  
Fax: (713) 785-1826  
E-mail: level@magnesonic.com  
www.clark-reliance.com

16633 Foltz Industrial  
Strongsville, OH 44136 U.S.A.  
Telephone: (440) 572-1500  
Fax: (440) 238-8828