process measurement solutions

Magne-Sonic

MST900SH Series
Level Transmitter

Instruction leaflet

Software Version 1.1

Installation and maintenance instructions

CE Ex

CONTENTS

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

HART: is the protocol adopted for the MST900 SMART Communications.
HART is a registered trademark of the HART Communications Foundation and is a mnemonic For Highway Addressable Remote Transducer.

Safety Instructions specific to hazardous area installations :

Model numbers covered: MST9XXSH-AXX ("X" indicates options in construction, function and materials).
The following instructions apply to equipment covered by certificate number **BAS01ATEX1061X**:

1. 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 **must** only be cleaned with a damp cloth.

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. Technical Data

Coding (ATEX): II (1) G

Coding (CENELEC): EEx ia IIC T4 -40°C ≤ Ta ≤ 60°C
EEx ia IIC T6 -40°C ≤ Ta ≤ 55°C

a. Safety Parameters

Ui = 30V, Ii = 120mA, Pi = 0.82W, Li = 27µH, Ci = 5nF

b. Materials of construction: UPVC moulded body and front face.
PVC sheathed 2 core shielded cable.
Glass filled nylon lock nut.
316SS hanging bracket.
Epoxy adhesive sealant.

3. Special conditions for safe use

a. Do **not** mount the MST900SH on a structure that is subject to vibration, or in a position where damage may be caused by impact or thermal stress.

b. The equipment is **not** intended to be used in areas exposed to dust.

c. The equipment must **not** be installed directly in any process where the enclosure might be charged by the rapid flow of non-conductive material.

1.0 Introduction

The MST900 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 MST900 will compute level, contents or flow and give a 4-20mA signal proportional to the chosen variable. Full programming details are given in the Operating Manual.

MST900 is a two wire 24V dc loop powered transmitter and may be connected to any suitable dc power source using the factory fitted cable. The Magne-Sonic MSC900 range of Control Units is designed to be used with the MST900 Transmitter in this way.

The MST900 transmitter may be mounted in a hazardous area provided that it is supplied from a protected power supply.
When using the MST900 transmitter with an MSC900 Control Unit, no external Intrinsically Safe Barriers are required as all protection is built-in to the MSC900 Control Unit.
When using any other power supply, it is the responsibility of the user to ensure suitable Intrinsically Safe Barriers are installed. Full details are given in section 3.4.1

2.0 The MST900SH ultrasonic level transmitter.

The transmitter is a factory sealed unit with an operating range of 1 Ft. to 39 Ft.. When powered up the transmitter will give a 4-20mA signal on the two wire power cable over the factory default range : 4mA at 39 Ft.; 20mA at 1 Ft.. This range may be adjusted using a HART programmer. See section 5.0
(Note: full programming instructions are given in the Operating Manual)

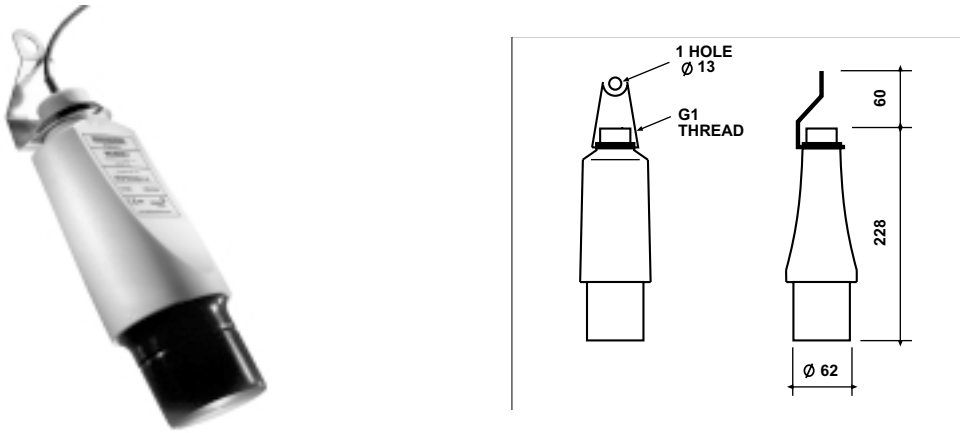


Fig (i)

A Stainless Steel mounting bracket and G1" (1" BSPP) Nylon locknut are supplied with the transmitter to facilitate mounting.

2.1 Type numbering system

MST Magne-Sonic Ultrasonic level transmitter

900 UPVC construction, 39 Ft. operating range

SH Factory sealed transmitter, HART communications

-A ATEX Certified Intrinsically Safe for Zone 0

/10 Fitted with 10 Ft. two core shielded cable
/65 Fitted with 65 Ft. two core shielded cable
/164 Fitted with 164 Ft. two core shielded cable

2.2 Safety Data

Type numbers	See above
Certificate number	BAS01ATEX1061X
ATEX Coding (EU Directive 94/9/EC)	II I G
Cenelec Coding	EEx ia IIC T4 (-40DegC≤Ta≤60DegC) EEx ia IIC T6 (-40 DegC≤Ta≤55DegC)
Safety parameters	
	*U*i 30 V
	*I*i 120mA
	*P*i 0.82W
	*L*i 27µH
	*C*i 5nF

2.3 Pressure Equipment Directive

The MST900SH transmitter has been assessed in accordance with the Pressure Equipment Directive 97/23/EC and is classified as "Sound Engineering Practice" (SEP)

The Directive states that equipment classified as SEP meets all of the requirements of the Directive but that CE marking of the product may not be used to signify this. Accordingly, the Declaration of Conformity as Appendix 2 of this manual does not list the Pressure Equipment Directive.

2.4 Specifications

Materials of construction:		
	Body Material	UPVC (stabilised)
	Cable sealant	Epoxy adhesive
	Locknut	Nylon
	Bracket	316 Stainless Steel
	Cable	PVC sheathed two core shielded cable
Electrical		
	Supply voltage	
		Transmitter in Non Hazardous area: 12-40V dc
		Transmitter in Hazardous area: 12-30V dc
	Output	4-20mA
	Communications	HART Digital communications (Rev. 5)
	Earthing	None required
	Cable size	Overall diameter 4mm, two cores each 0.22 mm^2
	Cable length	10 Ft., 65 Ft. or 164 Ft..
	Cable resistance	0.1 Ohm per metre length.
Operating		
	Range	1 to 39 Ft.
	Temperature	
	Ambient	-40F to +140F
	Wetside	-40F to +140F
	Pressure	0 psi to 43 psi

3.0 Installation

 The MST900SH may be mounted in a hazardous area provided it is supplied through or from a suitably protected power supply (such as the Magne-Sonic MSC900 Series).
Refer to the safety parameters given in section 2.2.

3.1 Location of the MST900SH 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 MST900SH 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 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 4 In. 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 11 In. 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 MSC control unit.

- 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.

- 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.

- Remember that the minimum operating range of the transmitter is 300mm. The transmitter will not detect any liquid surface closer than 300mm 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 4 In. 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 / well 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 in the well 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.

- If the well is subject to flooding, it is advisable to fit the transmitter with a submersion shield. Whilst the transmitter will of course stop working whilst covered with liquid, the transmit face will be protected from contamination by an air lock inside the shield.

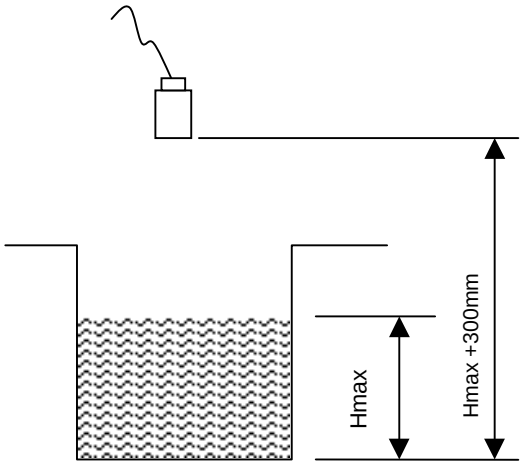
3.1.4 Open Channel Flow installations.

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.

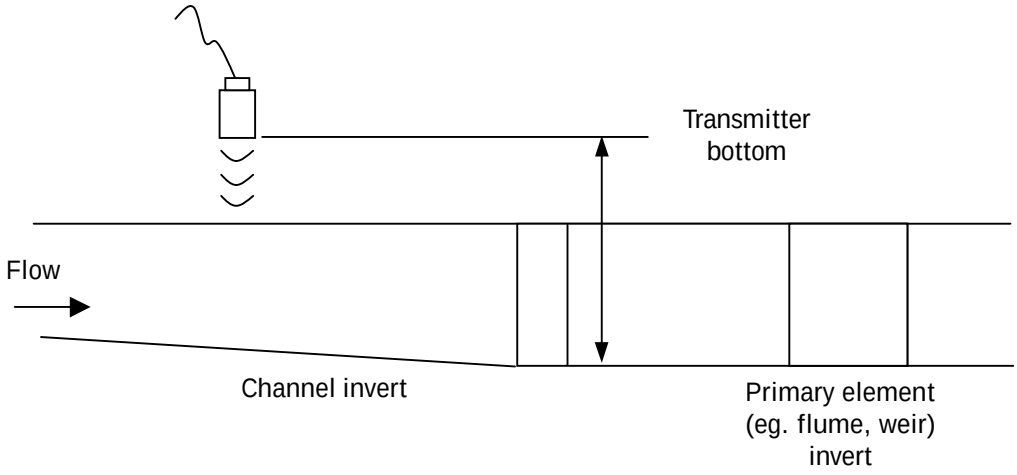
This manual explains some key aspects of the installation of the secondary element, in this case the ultrasonic transducer.
For full details of the installation of a primary element such as a flume or weir, reference should be made to the relevant British (BS3680) or International standard.

In the United Sttes Magne-Sonic offers a complete installation and commissioning service for open channel flow measurement systems. For further information contact the sales office and/or refer to Magne-Sonic ‘The Guide’.

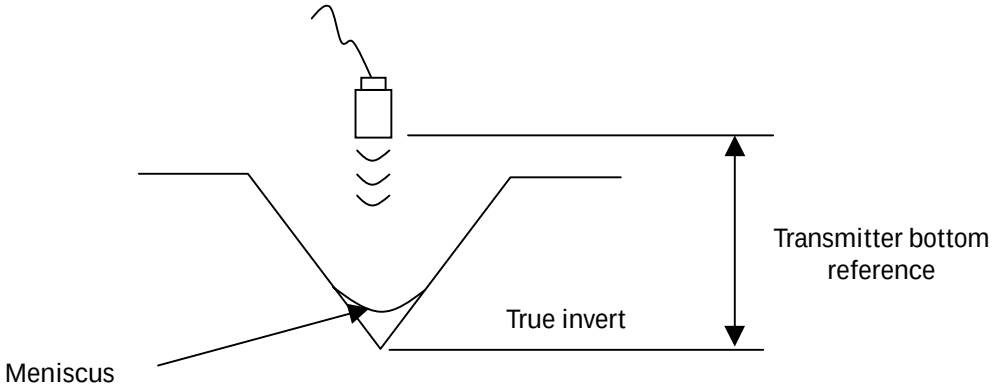
* Positioning of the transmitter is critical and should be the correct distance upstream from the flow structure as stated in BS3680 e.g. a distance of 4 to 5 times hmax for a thin plate weir or 3 to 4 times hmax for a flume.
For optimum accuracy. the front face of the sensor should be positioned at a height that is at least equal to the maximum flow depth plus the blanking distance of the transducer. A minimum distance of 12 In. 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 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 MST900SH 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.

- In many installations, the use of a calibration device is mandatory. Magne-Sonic offer the MS-HVD for this purpose, details on request.
  In order to minimise measurement uncertainties when a calibration device is installed, it is recommended that the calibrated range should be kept to a realistic minimum. i.e. max flow plus 10mm. Ensure that the target plate of the calibration device does not fall within the 11 In. blanking distance of the transmitter.

  All calibrations should be derived to suit as installed conditions.

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

3.2 Mounting the transmitter above the liquid surface

The transmitter is supplied with a purpose made 316 Stainless Steel mounting bracket which should be used to mount the transmitter over the liquid surface.
The bracket is designed to fit over the 1" threaded neck of the transmitter and is retained by a locknut.

IMPORTANT : Never suspend the transmitter by the cable.

Use a chain or wire through the hole provided in the bracket, which is shaped to ensure that the transmitter will hang perpendicular to the liquid surface.
Check that the material of the chain or wire is corrosion resistant to the liquids and any vapours present.

Alternatively, 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 0.3m blanking zone of the transmitter.

Note: To aid alignment, the echo size / signal strength can be displayed on the MSC900 control unit or on a suitable HART compliant handheld.

3.3 Wiring

The transmitter is supplied with a factory fitted length of PVC sheathed two core shielded cable which should be neatly run back to the control unit or a suitable local NEMA4 junction box.

The transmitter cable cores are identified as follows :-

Red	24V dc
Black	0V dc
Screen	Earth : must be connected to an Intrinsically Safe Earth in the non-hazardous area if the transmitter is installed in a hazardous area. Connect to a standard earth if the transmitter is not in a hazardous area.

The cable may be cut to length on site or may be extended using an NEMA4 junction box and suitable extension cable up to a total length of 9842 Ft

Where the transmitter is installed in a hazardous area, it is the responsibility of the user to ensure that the cable parameters of the total length of cable used together with the parameters of the MST900SH are less than the safety parameters of the safety barrier (or MSC900 Control Unit if used instead) . See section 3.4 below.
Multicore cable may be used provided that each pair within the multicore has a separate shield.

As good instrumentation practice, avoid tracking the cable with other cables which carry high voltages if possible.

3.4 Additional components in the two wire loop.

3.4.1 Safety barriers – installation of the transmitter in a hazardous area.

When used with the Magne-Sonic Control Unit Series MSC900, **NO** additional safety barriers are required as the output from the control unit is Intrinsically Safe (refer to manual supplied with the control unit for full details)

If powering the transmitter from any other power supply, it is the responsibility of the user to ensure a suitable Intrinsically Safe barrier is fitted in the safe area.

The barrier must be chosen such that it's output parameters Uo, Io and Po are less than Ui, Ii and Pi of the MST900SH transmitter.
For the MST900SH transmitter, Ui = 30V, Ii = 120mA and Pi = 0.82W.

In addition, the sum of the capacitance and the inductance of the transmitter and any extra cable fitted must not exceed the maximum specified for the barrier chosen.
For the MST900SH transmitter with 50m of factory fitted cable, Ci = 5nF and Li = 27µH

Suitable barriers include the MTL products 706, 706S, 787, and 787S.

3.4.2 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.

It is the responsibility of the user to ensure any loop devices, if mounted in the hazardous area, carry the requisite hazardous area certification and do not cause the system parameters to exceed those of the safety barrier (or MSC900).

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

3.5 Wiring to allow HART communication

When used with the Magne-Sonic MSC900 Control Unit, 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 it is intended to use HART digital communications with the MST900SH transmitter, a 250Ohm 0.25W load resistor must be installed in the loop.

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.

It is the responsibility of the user to ensure that any HART communicator used in the hazardous area is suitably certified for that area.

4.0. Maintenance
There is no routine maintenance required for the MST900SH other than an occasional check to ensure that the front face of the transmitter is clean and that the wiring is in good condition.

5.0 Commissioning / Programming

This section gives a very brief overview to allow checking of the installation. For full programming details, refer to the Operating Manual.

When power is applied to the transmitter it will give a 4-20mA signal proportional to "level" based on some factory set default values for a typical tank :-

Bottom reference (depth of tank)	39 Ft from transducer face
4mA level	0 Ft.
20mA level	11.7m

Hence, for a liquid surface (or other flat target) that is 5m away, the current on the loop will represent a liquid level of (39 Ft. – 5m) = 7m with a value of 13.57mA.

The user may programme the MST900SH transmitter with the specific installation details to re-range the 4-20mA signal.

The MST900SH transmitter is usually connected to a Magne-Sonic MSC900 control unit which allows access to and changing of the transmitter operating parameters.
If being used without the MSC900 Control Unit a HART compatible programming device will be necessary (and the loop must have a load resistor installed.

The Magne-Sonic PC software "H-View" is also available, allowing a computer fitted with a HART modem to communicate with and re-programme the MST900SH transmitter. Note : A HART modem is supplied with the H-View software.

To further assist the user who has access to a HART programming tool, Appendix 1 gives a list of the operating Parameters of the MST900SH transmitter.

6.0 Accessories

6.1. Submersion shield
The MS-SUB2 is a tubular shield which slips over the black transmitter front housing.
This is usually fitted in wet well installations where the liquid level could rise faster than the pumps can pump out. As the liquid covers the transmitter, an air-lock is created in the shield and the transmitter face remains free from contamination.

Appendix I : MST900SH programming parameters

Par No.	Parameter Name	Parameter Title as shown on HART device	Units	Default (ex-factory) value
P000	Message	Message	-	MESSAGE
P001	Tag Number - (8 characters)	Tag No.	-	MSP900
P002	Description (16 characters)	Description	-	MSP900 XMTR
P003	Date of Change	Date of Change	dmy	01/01/01
P004	Final Assembly Number	Final Assy No.	-	-
P005	Serial Number	Serial No.	-	-
P010	Bottom Reference	Bottom Ref.	m	12
P011	Tank Shape	Tank Shape	-	Linear
P012	Primary Variable Units	PV Units	-	m
P013	PV Scale Factor	PV Scale Factr	-	1
P014	Profile Height	Profile Height	-	1
P015	Upper range value	Up Range Val	P12	11.7
P016	Lower range value	Low Range Val	P12	0
P020	Damping	Damping	sec	3
P021	LE Delay	LE Delay	sec	9999
P022	LE Action	LE Action	-	Hold
P023	Blanking	Blanking	m	0.3
P024	Speed of Sound	Speed of Sound	m/s	331.8
P025	Temperature	Temperature	°C	Automatic
P026	Threshold	Threshold	%	Automatic
P030	Profile Point 1 (PV at 10% of height)	Profile Pt. 1	%	10
P031	Profile Point 2 (PV at 20% of height)	Profile Pt. 2	%	20
P032	Profile Point 3 (PV at 30% of height)	Profile Pt. 3	%	30
P033	Profile Point 4 (PV at 40% of height)	Profile Pt. 4	%	40
P034	Profile Point 5 (PV at 50% of height)	Profile Pt. 5	%	50
P035	Profile Point 6 (PV at 60% of height)	Profile Pt. 6	%	60
P036	Profile Point 7 (PV at 70% of height)	Profile Pt. 7	%	70
P037	Profile Point 8 (PV at 80% of height)	Profile Pt. 8	%	80
P038	Profile Point 9 (PV at 90% of height)	Profile Pt. 9	%	90
P039	Profile Point 10 (PV at 100% of height)	Profile Pt. 10	%	100
P041	Pulse Repitition	Pulse Repeat	-	1 Sec
P042	Echoes Needed	Echoes Needed	-	4
P043	Threshold 1 Time	Thresh 1 Time	ms	2
P044	Target Pulses	Target Pulses	-	Auto
P045	Target Frequency	Target Freq	kHz	Auto
P046	Maximum Temperature	Max Temp	°C	150
P047	Minimum Temperature	Min Temp	°C	90
P970	Front face material	TX Material	-	UPVC
	READ ONLY PARAMETERS			
D900	Primary Variable	Xmtr PV	P012	-
D901	Level (SV)	Level (SV)	m	-
D902	Range (TV)	Range (TV)	m	-
D903	Transducer Temperature	Xducer Temp	°C	-
D906	Current output	Current Output	mA	-
D905	% Current Output	% Current Out	%	-
D910	Target Range / Distance to Target	Target Range	m	-
D911	Echo Size	Echo Size	%	-
D912	Echo Success Rate	Echo Success	%	-
D913	Target Echoes	Target Echoes	-	-
D914	Speed of Sound	Speed of Sound	m/s	-
D915	Transducer Temperature	Xducer Temp	°C	-
D916	Transducer Frequency	Xducer Freq	kHz	-
D950	HART Device Code	HART Dev Code	-	MSP900
D951	Comms Address	Poll Address	-	0
D952	Hardware Revision	H/W Revision	-	-
D953	Software Version	S/W Version	-	1.1
D960	Manufacturer's Code	Manufacturer	-	Solartron Mobrey