Level Plus®
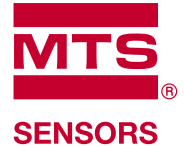
Magnetostrictive Liquid-Level Sensors with Temposonics® Technology

M-Series Model MR
Transmitter with Analog Output
Data Sheet

FEATURES

- ■ **4 to 20 mA Analog Output with HART®**
- ■ **Two Channel Output**
- ■ **3-in-1 Measurement**
  - • **Product**
  - • **Interface**
  - • **Temperature**
- ■ **No Scheduled Maintenance or Recalibration**
- ■ **High Accuracy and Repeatability**
- ■ **AMS Aware**
- ■ **Explosion-proof and/or Intrinsically Safe**

APPLICATIONS

- ■ **Inventory Control**
- ■ **Bulk Storage**
- ■ **Sanitary Process Control**

MARKETS

- ■ **Petroleum and Petrochemical**
- ■ **LPG terminals**
- ■ **Biotech and Pharmaceuticals**
- ■ **Food and Beverage**
- ■ **Water and Wastewater**

Product overview

The Level Plus® Model MR level transmitter satisfies the demand for an analog communication interface that offers the liquid-level marketplace unsurpassed flexibility to meet most process application conditions. The Level Plus Model MR transmitter provides 3-in-1 measurement using one process opening for product level, interface level, and temperature measurements. Once the transmitter is installed and calibrated there is no requirement for scheduled maintenance or recalibration. ***Set it and forget it!***

Level Plus Model MR transmitters are modular in design, offering you a selection of electronic housing styles, transmitter pipe styles and wetted materials. The Level Plus Model MR transmitter features a removable sensing element and can also incorporate an RTD for spot temperature measurement. Subject to local electrical codes, the sensing element and electronics housing can be removed from the transmitter pipe without disturbing the operation of your process saving both time and money.

Up to two 4 to 20 mA loops are available for analog indication of level, interface, and/or temperature. HART® communication allows the Model MR transmitter to indicate and display all three measurement variables simultaneously. Set-up, calibration, and diagnostics are available from any point in the loop using a standard HART hand-held communicator. An optional on-board display and keypad is also provided for local indication and programming.

**Model MR Sanitary Transmitter
NEMA Type 4X Enclosure**

**Model MR Rigid Transmitter
Single-Cavity Housing**

**Model MR Flexible Transmitter
Dual-Cavity Housing**

Product specifications

Parameters	Specifications
LEVEL OUTPUT	
Measured variable:	Product level and interface level
Output signal / Protocol:	4 to 20 mA with HART®, 1 or 2 loop
Order length:	**Flexible hose:** **(ATEX Ex ia IIB, FM IS Group C, D):** 3048 mm (120 in.) to 7620 mm (300 in.) Δ§ **(All else):** 3048 mm (120 in.) to 12200 mm (480 in.) Δ§
	Rigid pipe: 508 mm (20 in.) to 7620 mm (300 in.) Δ § **Sanitary pipe:** 508 mm (20 in.) to 7620 mm (300 in.) Δ §
	Δ Contact factory for longer lengths. § Order length equals the measurement range plus the inactive zone.
Non-linearity:	0.02% F.S. or 0.794 mm (1/32 in.)*
Repeatability:	0.01% F.S. or 0.381 mm (0.015 in.)* (any direction)
	* Whichever is greater
TEMPERATURE OUTPUT	
Measured variable:	Single-point temperatures
Type:	4 to 20 mA from 1000Ω platinum RTD at 0 °C
Repeatability:	±0.1 °C (±0.18 °F)
Temperature accuracy:	±1.5 °C (±2.7 °F)
Drift:	±0.5 °C (±0.9 °F) per year
ELECTRONICS	
Input voltage:	10.5 to 36 Vdc, 28 Vdc maximum for I.S. approval
Fail safe:	High (21.4 mA), or Low (3.8 mA)
Reverse polarity protection:	Series diode
Lightning/ Transient protection:	**Stage 1:** Line-to-ground surge suppression; IEC 61000-4-5 **Stage 2:** Line-to-line and line-to-ground transient suppressors; IEC 61000-4-4
CALIBRATION	
Zero adjust range:	Anywhere within the active length
Span adjust range:	Full scale to 152 mm (6 in.) from zero

Parameters	Specifications
ENVIRONMENTAL	
Enclosure rating:	NEMA Type 4X
Humidity:	0 to 100% relative humidity, non-condensing
Operating temperatures:	**Electronics:** -40 °C (-40 °F) to 71 °C (160 °F) **Sensing element:** -40 °C (-40 °F) to 125 °C (257 °F) ◊ **Temperature element:** -40 °C (-40 °F) to 105 °C (221 °F) ◊ Contact factory for specific temperature ranges.
Vessel pressure:	**Industrial rigid pipe:** 1000 psi (69 bar) **Sanitary pipe:** 435 psi (30 bar) **Teflon pipe:** 100 psi (7 bar) **Flexible Hose:** 260 psi (18 bar)
Materials:	**Wetted parts:** 316L stainless steel † **Non-wetted parts:** 316L stainless steel, Epoxy coated aluminum † Contact factory for alternative materials.
FIELD INSTALLATION	
Housing dimensions:	**Single cavity:** 127 mm (5 in.) by 133 mm (5.25 in.) 123 mm (4.84 in.) O.D. **Dual cavity:** 127 mm (5 in.) by 177 mm (6.95 in.) 123 mm (4.84 in.) O.D. **NEMA Type 4X:** 81 mm (3.2 in.) by 123 mm (4.85 in.) O.D.
MOUNTING	
Rigid pipe:	¾ in. Adjustable MNPT fitting Flange or Tri-Clamp® Mount
Flexible hose:	1 in. Adjustable MNPT fitting Flange mount
WIRING	
Connections:	2-wire shielded cable or twisted pair, Daniel Woodhead 6-pin male connector, 4570 mm (180 in.) integral cable with pigtail
ELECTRICAL CONNECTIONS	
Single and Dual Cavity:	¾ in. FNPT conduit opening, M20 for ATEX/IECEx version
NEMA Type 4X:	½ in. FNPT conduit opening
DISPLAY	
Measured variables:	Product level, interface level and temperature
Size:	13 mm (0.5 in.)
Number of digits:	16

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
Agency approvals

Explosion proof

FM 3615 **C22.2 No. 30**	Class I, Division 1, Groups B, C and D •• Class II, Division 1, Groups E, F and G •• Class III, Type 4X, T4 •• Explosion-proof housing required

Flame proof

IECEx 60079-1:2007	IECEx FMG 13.0019X Ex d IIB T4 Ga/Gb IP66
EN 60079-1:2007	FM13ATEX0050X ⟨Ex⟩ II 1/2 G Ex d IIB T4 Ga/Gb IP66
No. 2013-54	Ex d IIB T4 Ga/Gb
ABNT NBR **IEC 60069-1:2009e**	TUV 14.0935 Ex d IIB T4 Ga/Gb IP66

Intrinsically safe

C22.2 No. 157	Class I, Division 1, Groups A, B, C and D Class II, Division 1, Groups E, F and G Class III, Type 4X, T4
EN 60079-11:2007	PTB 10 ATEX 2011 X ⟨Ex⟩ II 1/2 G bzw. II 2 G Ex ia IIA T4 bzw. Ex ia IIB T4 ** ** Contact factory for model numbers
FM 3610	Class I, Division 1, Groups C and D order length < 300 inches Class I, Division 1, Group D order length > 300 inches Class II, Division 1, Groups E, F, and G Class III, Type 4X, T4
GB3836.4	Ex ia IIB T4 Ga/Gb GYJ14.1051X

MTS Analog Setup software

MTS has developed the MTS Setup Software to help customers program and customize their Level Plus Model MR transmitter.

The Model MR transmitter is programmed through the HART interface. This interface is easily connected to a PC by using the HART-to-Serial converter. The MTS Analog Setup Software allow the user to adjust both *'Zero'* (4 mA) and *'Span'* (20 mA) setpoints, adjust HART parameters, and customize the optional built-in display. MTS setup software is shipped with each transmitter order. However, if you require an additional copy or an upgrade to your currently installed setup software, software is available for download from the MTS Level Products page at ***http://www.mtssensors.com***

HART® handheld communicator programming

The Level Plus Model MR transmitter programming can also be performed by using handheld HART communicator device such as the *Rosemount® 375 or 475*.

Setpoint programming using the display

Any Level Plus Model MR transmitter that is purchased with a display has the ability to adjust the 4 and 20 mA setpoints by pressing the appropriate button located at the bottom of the display.

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Installation guideline, rigid pipe

MTS offers the Level Plus Model MR transmitter configured with a rigid pipe constructed of 316L (1.4404) stainless steel *(see illustration below)*. The rigid pipe configuration can be ordered in lengths from 508 mm (20 in.) to 7620 mm (300 in.). The Model MR is typically ordered with a ¾ in. MNPT adjustable fitting which allows the transmitter order length to be adjusted (within a few inches) if the tank height and order length are not exactly equal.

The '*Measuring range*' of the M-Series transmitter is equal to the '*Order length*' minus the '*Inactive zone*' of 74 mm (2.9 in.), *(refer to table Transmitter Inactive Zone Reference)*. The transmitter can be ordered with a single product float or can include the optional interface float *(Refer to the Level Plus Accessories Catalog, document no. 551103 for optional float selections)*. If required, temperature measurement is also an option.

A '*Stop collar*' is included which is designed to keep the float out of the *inactive zone*. The placement of the *stop collar* is dependent on the float and placement of the magnet. If your application requires measuring to the bottom of your vessel, ask MTS about our *low liftoff* float option which can measure less than 25 mm (1 in.) of liquid.
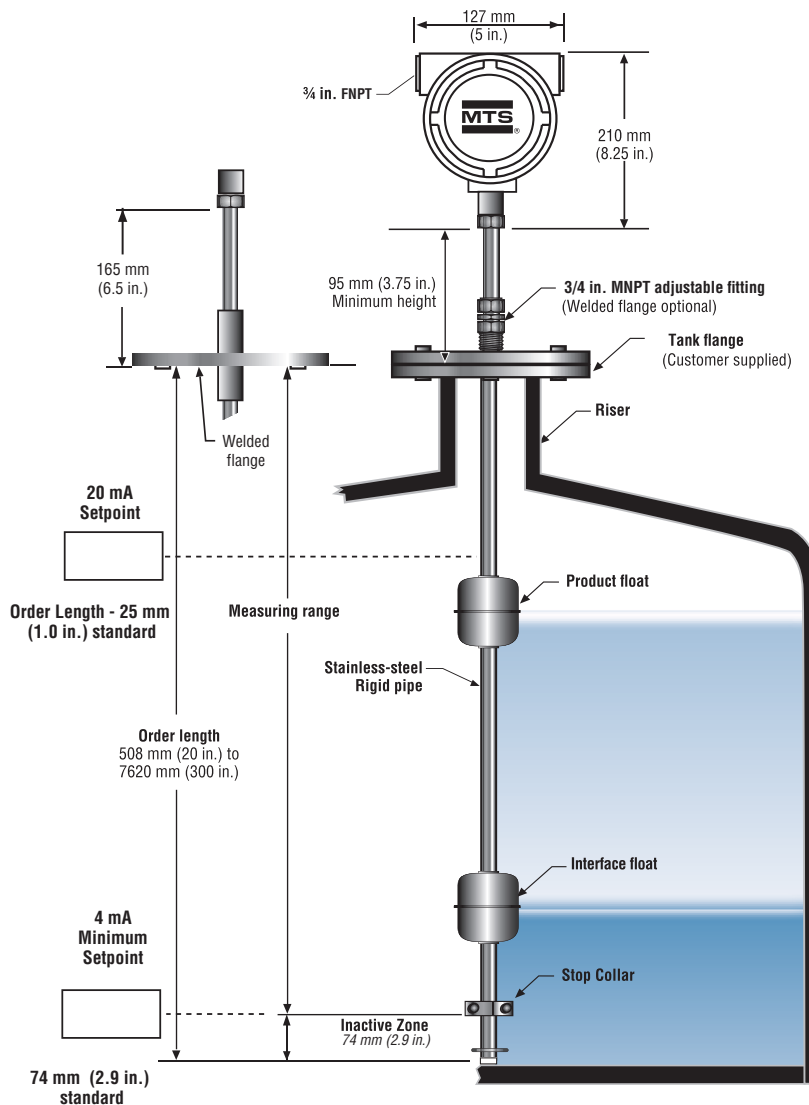
| TRANSMITTER INACTIVE ZONE REFERENCE		
Material	**Order Length 1219 mm (< 48 in.)**	**Order Length 1220 mm (> 48 in.)**
316L SS, Hastelloy C	74 mm (2.9 in.)	74 mm (2.9 in.)
Teflon	115 mm (4.5 in.)	132 mm (5.2 in.)

Installation guideline, flexible hose

MTS offers the Level Plus Model MR transmitter configured with a flexible hose constructed of 316L (1.4404) stainless steel *(see illustration below)*. The flexible hose configuration can be ordered in lengths from 3048 mm (120 in.) to 12,192 mm (480 in.). The Level Plus Model MR transmitter for flexible hose applications is typically ordered with a 1 in. MNPT adjustable fitting. This fitting allows the transmitter to be adjusted (within a few inches) if the order length is not exact.

The Model MR transmitter *'Measuring range'* is equal to the *'Order length'* minus the *'Inactive zone'* (refer to the transmitter inactive zone reference table below). The *'Order length'* should equal the *'Tank height'* minus 51 mm (2.0 in.). The transmitter may be ordered with a single product float or can include the optional interface float *(Refer to the Level Plus Accessories Catalog, document no. 551103 for optional float selections)*. If required, temperature measurement is also an option.

A *'Stop collar'* is also included which is designed to keep the float out of the *inactive zone*. The placement of the *stop collar* is dependent on the float and placement of the magnet. If your application requires measuring to the bottom of your vessel, ask MTS about our *low liftoff* float option which can measure less than 25 mm (1 in.) of liquid.

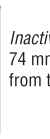| TRANSMITTER INACTIVE ZONE REFERENCE	
Length	**Inactive Zone**
< 7.6 m (25 ft.)	76 mm (3 in.)
7.6 m to 12.2 m (25 to 40 ft).	97 mm (3.8 in.)
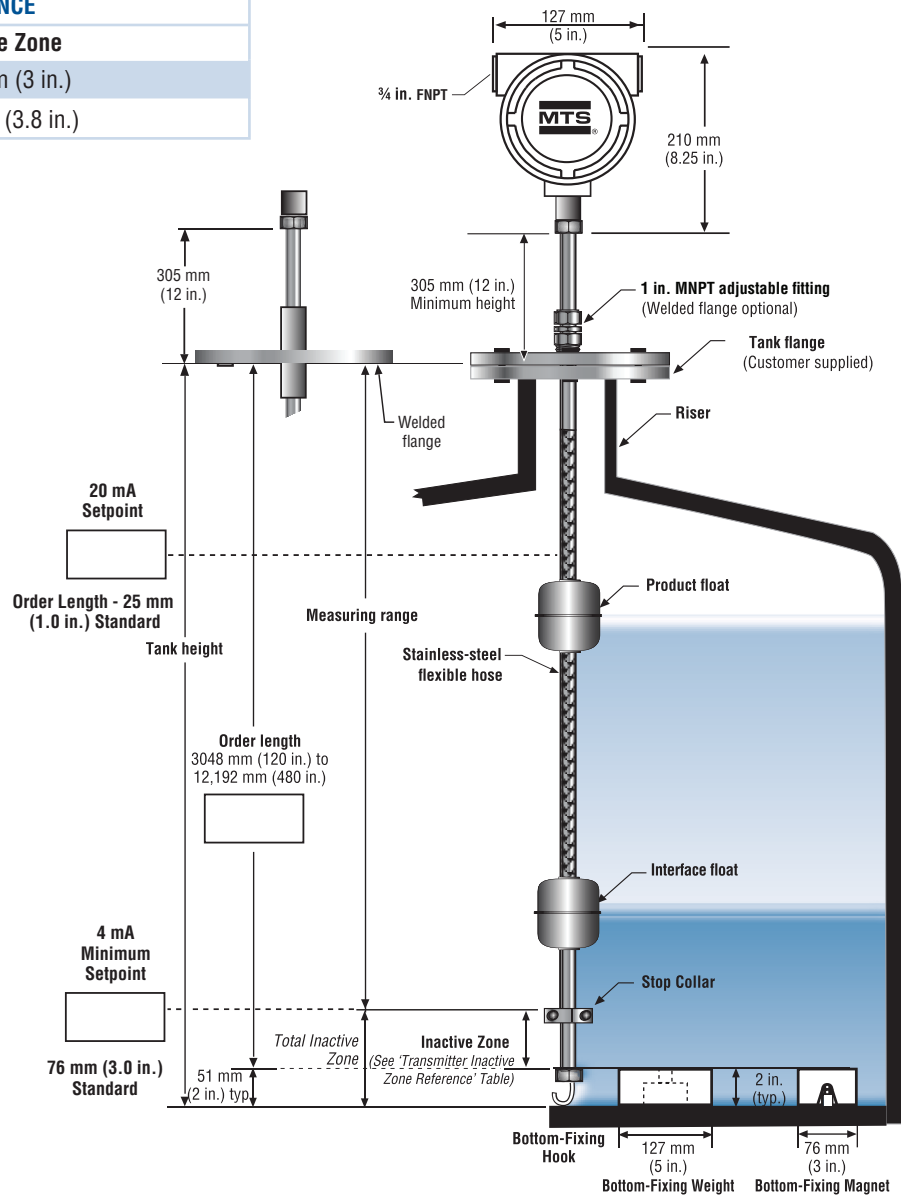
Level Plus® Model MR Installation Guideline
Sanitary Pipe Applications

Installation guideline, sanitary pipe

MTS offers the Level Plus Model MR transmitter configured with a sanitary pipe constructed of 316L (1.4404) stainless steel *(see illustration below)*. The sanitary pipe configuration can be ordered in lengths from 508 mm (20 in.) to 7620 mm (300 in.). The 316L sanitary pipe comes standard with a Ra 25 µ in (0.625 µm) finish, however an electropolish option is also available with a Ra 15 µ in (0.381 µm) finish. The standard process fitting is a welded Tri-Clamp®. Because the Tri-Clamp is welded, it is imperative that the correct order length is provided. The order length should be equal to the height from the bottom of the tank to the top of the process connection on the tank.

The Model MR transmitter '*Measuring range*' is equal to the '*Order length*' minus the '*Inactive zone*'. The inactive zone measurement is dependent on the end plug style chosen *(shown in the table below)*. The order length should be equal to the height from the bottom of the tank to the top of the process connection on the tank. The standard sanitary float magnet is offset to ensure the magnet does not enter the inactive zone despite the end plug. The transmitter can be ordered with a single product float or can include the optional interface float *(Refer to the Level Plus Accessories Catalog, document no. 551103 for optional float selections)*. If required, temperature measurement is also an option.

TB *Sanitary* ◊	**DP** *Drain-in-place with end plug* ◊	**CP** *Clean-in-place*	**DN** *Drain-in-place no through hole*
Inactive zone 81 mm (3.2 in.) from tip (typical)	Inactive zone 74 mm (2.9 in.) from tip (typical)	Inactive zone 81 mm (3.2 in.) from tip (typical)	Inactive zone 74 mm (2.9 in.) from tip (typical)

◊ End plug style comes with permanently mounted floats. These floats cannot be removed from the pipe.

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Ordering information for FM and CSA approvals

TRANSMITTER MODEL					=	**M** 1
M	=	Magnetostrictive transmitter				
TYPE					=	**R** 2
R	=	Analog output liquid-level transmitter				
AGENCY APPROVAL					=	☐ 3
F	=	FM	**C**	=	CSA	
3	=	3-A				
OUTPUT					=	☐ 4
1	=	4-20 mA Single loop with HART	**2**	=	4-20 mA Dual loops with HART	
HOUSING TYPE					=	☐ 5
A	=	NEMA Type 4X, 316L stainless steel with cable (intrinsically safe only)	**E**	=	Dual cavity with display (explosion-proof and intrinsically safe)	
B	=	Single cavity (explosion-proof and intrinsically safe)	**L**	=	NEMA Type 4X, 316L SS w/6-pin male connector (intrinsically safe only)	
C	=	Dual cavity (explosion-proof and intrinsically safe)	**3**	=	NEMA Type 4X, 316L SS with internal terminal blocks (intrinsically safe only)	
D	=	Single cavity with display (explosion-proof and intrinsically safe)				
ELECTRONICS MOUNTING					=	☐ 6
1	=	Integral electronics				
TRANSMITTER PIPE					=	☐ 7
B	=	Rigid Industrial, end-plug with stop collar	**F**	=	Sanitary, drain-in-place, no hole, DN	
C	=	Sanitary, T-bar, TB	**H**	=	Flexible w/bottom fixing hook (stainless steel only)	
D	=	Sanitary, drain-in-place, DP	**J**	=	Flexible w/bottom fixing weight (stainless steel only)	
E	=	Sanitary, clean-in-place, CP	**K**	=	Flexible w/bottom fixing magnet (stainless steel only)	
MATERIALS OF CONSTRUCTION (WETTED PARTS)					=	☐ 8
		Note: contact factory for other materials				
1	=	316L stainless steel	**A**	=	Teflon	
2	=	Electropolished 316L stainless steel Ra 15	**C**	=	CRN Approved	
3	=	Hastelloy C				
PROCESS CONNECTION TYPE					=	☐ 9
1	=	NPT adjustable fitting	**6**	=	150 lb. welded RF flange	
4	=	Sanitary, welded	**7**	=	300 lb. welded RF flange	
5	=	Sanitary, adjustable	**8**	=	600 lb. welded RF flange	
PROCESS CONNECTION SIZE					=	☐ 10
A	=	¾ in. (NPT for ⅝ in. pipe)	**F**	=	3 in.	
B	=	1 in. (NPT for ⅞ in. hose)	**G**	=	4 in.	
C	=	1½ in.	**H**	=	5 in. (except sanitary)	
D	=	2 in.	**J**	=	6 in.	
E	=	2½ in.				
TEMPERATURE					=	☐ 11
0	=	None	**2**	=	One RTD, customer defined position[‡‡]	
1	=	One RTD, fixed position 76 mm (3 in.) from the end of pipe			**Note:** [‡‡](if this option is selected, position '**18 E**' must also be selected)	
UNIT OF MEASUREMENT					=	☐ 12
M	=	Metric (millimeters) Encode length in millimeters if using metric (XXXXX mm)	**U**	=	US Customary (inches) Encode length in inches if ordering in US Customary (XXX.XX in.)	
LENGTH					= ☐☐☐☐☐	13-17
	=	Order length based on unit of measurement				
		Flexible transmitter: 3048 mm (120 in.) to 12,192 mm (480 in.)		Rigid/Sanitary transmitter: 508 mm (20 in.) to 7620 mm (300 in.)		
SPECIAL					=	☐ 18
S	=	Standard product	**E**	=	Engineering special (not affecting agency controlled parts or features)	

MTS Sensors

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Level Plus® M-Series Model MR Liquid-Level Transmitter - Analog Output
Product Catalog, Part No.: 551050 Revision F, EN 01/14

Ordering information for ATEX and IECEx based approval

TRANSMITTER MODEL ——— = **M** 1

M = Magnetostrictive transmitter

TYPE ——— = **R** 2

R = Analog output level transmitter

APPROVAL AGENCY —— = ☐ 3

E = ATEX Approved   **P** = CCoE Approved   **B** = INMETRO

H = IECEx Approved   **K** = KC Approved

OUTPUT ——— = ☐ 4

1 = 4-20 mA Single loop with HART   **2** = 4-20 mA Dual loops with HART

HOUSING TYPE —— = ☐ 5

B = Single cavity (Flameproof IIB)   **J** = Single cavity with display (ATEX, Ex ia IIA)

C = Dual cavity (Flameproof IIB)   **K** = Dual cavity with display (ATEX, Ex ia IIA)

D = Single cavity with display (Flameproof IIB)   **P** = NEMA Type 4X, 316L stainless steel with cable (ATEX, Ex ia IIB)

E = Dual cavity with display (Flameproof IIB)   **R** = Single cavity (ATEX, Ex ia IIB)

F = NEMA Type 4X, 316L stainless steel with cable (ATEX, Ex ia IIA)   **S** = Dual cavity (ATEX, Ex ia IIB)

G = Single cavity (ATEX, Ex ia IIA)   **T** = Single cavity with display (ATEX, Ex ia IIB)

H = Dual cavity (ATEX, Ex ia IIA)   **U** = Dual cavity with display (ATEX, Ex ia IIB)

ELECTRONICS MOUNTING ——————————————————————————————————————— = ☐ 6

1 = Integral electronics

TRANSMITTER PIPE/HOSE —————————————————————————————————————— = ☐ 7

B = Rigid Industrial, end-plug with stop collar   **H** = Flexible w/bottom fixing hook (stainless steel only)

C = Sanitary, T-bar, TB   **J** = Flexible w/bottom fixing weight (stainless steel only)

D = Sanitary, drain-in-place, DP   **K** = Flexible w/bottom fixing magnet (stainless steel only)

E = Sanitary, clean-in-place, CP   **L** = Sanitary Special

F = Sanitary, drain-in-place, no hole, DN

MATERIALS OF CONSTRUCTION (WETTED PARTS) **(Note:** contact factory for other materials) ——————— = ☐ 8

1 = Stainless steel, 1.4404   **A** = Teflon / FEP

2 = Stainless steel, 1.4404 electropolished

3 = Hastelloy C

PROCESS CONNECTION TYPE ———————————————————————————————————— = ☐ 9

1 = NPT, Adjustable fitting   **7** = 300 lbs. Welded RF flange

4 = Sanitary, welded   **8** = 600 lbs. welded RF flange

5 = Sanitary, adjustable fitting   **9** = DIN flange welded according to specification

6 = 150 lbs. welded RF flange

PROCESS CONNECTION SIZE ———————————————————————————————————— = ☐ 10

A = ¾ in. (NPT for ⅝ in. pipe)   **F** = 3 in.

B = 1 in. (NPT for ⅞ in. hose)   **G** = 4 in.

C = 1½ in.   **H** = 5 in. (except sanitary)

D = 2 in.   **J** = 6 in.

E = 2½ in.

TEMPERATURE —— = ☐ 11

0 = None   **1** = One RTD, fixed position 76 mm (3 in.) from the end of pipe

2 = One RTD, customer defined position ‖

Note: ‖If this RTD option is selected, option '**18 E** ' must also be selected

UNIT OF MEASUREMENT —— = ☐ 12

M = Metric (millimeters) Encode length in millimeters if using metric (XXXXX mm)   **U** = US Customary (inches) Encode length in inches if ordering in US Customary (XXX.XX in.)

Ordering information for ATEX and IECEx based approval

LENGTH (Order length based on unit of measurement) —————————————— = ☐ ☐ ☐ ☐ ☐ 13-17

= Rigid or Sanitary transmitter: 508 mm (20 in.) to 7620 mm (300 in.)   =   Teflon: 508 mm (20 in.) to 6096 mm (240 in.)

= Flexible transmitter: 3048 mm (120 in.) to 12,192 mm (480 in.) except ATEX, Ex ia IIB max. length 7620 mm (300 in.)

SPECIAL ——————————————————————————————————— = ☐ 18

S = Standard product   **E** = Engineering special (not affecting agency controlled parts or features)
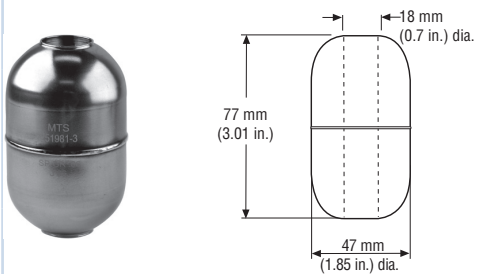
Standard product floats

Listed below are standard floats for general applications. Please consult the factory for help in selecting the correct float for your application. For detailed information about all liquid-level product accessories, refer to the *'Level Plus Accessories Catalog, document No. 551103'* available in PDF format at *http://www.mtssensors.com*
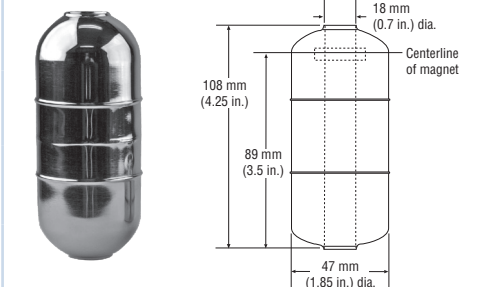
General Notes (for all applications):

1. Be sure that the float specific gravity is at least 0.05 less than that of the measured liquid as a safety margin at ambient temperature.
2. For interface measurement: A minimum of 0.05 specific gravity differential is required between the upper and lower liquids.
3. Sanitary polish is available for stainless-steel floats up to 200 Grit/Ra 25.
4. Electropolish is available for stainless-steel floats up to 240 Grit/Ra 15.
5. When the magnet is not shown, the magnet is positioned at the center line of float.
6. Offset weight option: A weight is installed in the float to bias, or tilt the float installed on the transmitter tube so that the float remains in contact with the transmitter tube at all times. The offset option is required for installations that must conform to ATEX standards.
7. Drawings contained in this document are for reference only. Contact the factory for engineering drawings.
8. *Call for specific lead times. Typical lead time exceeds lead time of the transmitter.

STANDARD PRODUCT FLOAT

Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
18 mm (0.7 in.) dia. / 77 mm (3.01 in.) / 47 mm (1.85 in.) dia.	29.3 bar (425 psi)	149 °C (300 °F)	No	0.65	SS	No	251981-1
				0.67	SS	Yes	251981-2*
				0.68	Hastelloy C	No	251981-3
				0.71	Hastelloy C	Yes	251981-4*

SANITARY FLOAT

Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
18 mm (0.7 in.) dia. / Centerline of magnet / 108 mm (4.25 in.) / 89 mm (3.5 in.) / 47 mm (1.85 in.) dia.	10.3 bar (150 psi)	149 °C (300 °F)	Yes	0.66	SS 200 Grit/ Ra 25 µin (0.625 µm)	No	401513-1
						Yes	401513-2*
					SS 240 Grit/ Ra 15 µin (0.381 µm)	No	401513-3*
						Yes	401513-4*

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MTS Sensors

SENSORS

Document Part number:
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