Level Plus®

Magnetostrictive Liquid-Level Sensors
with Temposonics® Technology

MTS SENSORS

M-Series Model MG
Transmitter with Digital Output

Data Sheet

Document Part Number
550784 Revision L

FEATURES

- Modbus and FOUNDATION™ fieldbus Output
- 3-in-1 Measurement
  - Product
  - Interface
  - Temperature
- 100 point Strap Table
- No Scheduled Maintenance or Recalibration
- API Temperature Corrected Volumes
- Inherent Accuracy ±1mm
- Explosion-proof and/or Intrinsically Safe

APPLICATIONS

- Custody Transfer
- Inventory Control
- Bulk Storage
- Sanitary Process Control

MARKETS

- Petroleum and Petrochemical
- LPG Terminals
- Biotech and Pharmaceuticals
- Food and Beverage
- Water and Wastewater

Model MG Sanitary Transmitter
NEMA Type 4X Enclosure

Model MG Rigid Transmitter
Single-Cavity Housing

Model MG Flexible Transmitter
Dual-Cavity Housing

Product overview

The Level Plus® M-Series Model MG level transmitter satisfies the demand for a digital communication interface that offers the liquid-level marketplace unsurpassed flexibility to meet most process application conditions. The Level Plus Model MG 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 MG transmitters are modular in design, offering you a selection of electronic housing styles, transmitter pipe styles and wetted materials. The Level Plus Model MG transmitter features a removable sensing element and can also incorporate 1, 5, or 12 temperature measurement points depending on the output. Subject to local electrical codes, the sensing element and electronics housing can be removed from the transmitter pipe without disrupting the operation of your process saving you time and money.

Outputs for the Level Plus Model MG transmitter include Modbus, FOUNDATION™ fieldbus, and DDA (a proprietary ASCII protocol). Modbus and DDA outputs are communicated via a 4-wire multi-drop power and data bus (EIA 485), whereas FOUNDATION™ fieldbus has a specified 3-wire bus. Utilizing the bus network eliminates the requirements for individual cable runs from each tank and these three data formats provide a direct interface to most types of computers and digital communication equipment. Both Modbus and FOUNDATION™ fieldbus outputs also allow a user to measure volume from a 100 point strap table with the option for temperature correction.

Product specifications

Parameters	Specifications
LEVEL OUTPUT	
Measured variable:	Product level and interface level
Output signal / Protocol:	Modbus RTU, DDA or FOUNDATION™ fieldbus
Order length:	**Flexible hose:** (ATEX EEx ia IIB): 3048 mm (120 in.) to 13500 mm (531.5 in.)Δ § (All else): 3048 mm (120 in.) to 22000 mm (866 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.
Inherent accuracy:	±1mm (0.039 in.)
Hysteresis:	0.002% F.S. or 0.397 mm (1/64 in.)* (any direction) * Whichever is greater
Resolution:	0.025 mm (0.001 in.)
Calculated variables:	GOVP GOVI GOVT GOVU NSVP
TEMPERATURE OUTPUT	
Measured variable:	Average and multi-point temperatures Up to 12 Modbus ∞ Up to 5, DDA and FOUNDATION™ fieldbus ∞ Minimum length of 2032 mm (80 in.) for 12 temperature positions.
Temperature accuracy:	±0.28 °C (±0.5 °F)
ELECTRONICS	
Input voltage:	**Modbus and DDA:** 10.5 to 30.1 Vdc 28 Vdc maximum for I.S. ATEX approval **FOUNDATION™ fieldbus:** 9 to 32 Vdc bus powered
Fail safe:	High, full scale
Reverse polarity protection:	Series diode

Parameters	Specifications
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
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 123 mm (4.85 in.) 121 mm (4.75 in.) O.D. **Dual cavity:** 127 mm (5 in.) by 177 mm (6.95 in.) 121 mm (4.75 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 and Tri-Clamp® Mounts **Flexible hose:** 1 in. Adjustable MNPT fitting, Flange mount
Wiring:	**Modbus and DDA:** 4-wire connections plus earth ground. Daniel Woodhead 6-pin male connector. Integral cable with pigtails. **FOUNDATION™ fieldbus:** Type A fieldbus cable
ELECTRICAL CONNECTIONS	
Single and Dual Cavity:	¾ in. FNPT conduit opening, M20 for ATEX version
NEMA Type 4X:	½ in. FNPT conduit opening

Agency approvals

Modbus and DDA
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 •• Explosion-proof housing required
Flameproof	
IEC 60079-1:2007	IECEx FMG 13.0019 X Ex d IIB T4 Ga/Gb IP66
EN 60079-1:2007	FM13ATEX0050X Ex II 1/2 G Ex d IIB T4 Ga/Gb IP66
GB 3836.2	Ex d IIB Gb IP66 GYJ13.1037X
No. 2013-54	Ex d IIB T4 Ga/Gb IP66
ABNT NBR **IEC 60069-1:2009e**	TUV 14.0935 Ex d IIB T4 Ga/Gb IP66
Intrinsically Safe	
FM 3610 **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, T4 Type 4X
EN 50020	PTB 04 ATEX 2028 X Ex II 1/2 G bzw. II 2 G EEx ia IIA T4 bzw. EEx ia IIB T4
GB 3836.4	Ex ia IIC T4 GYJ101282

FOUNDATION™ fieldbus
Explosion proof

FM 3615 **C22.2 No. 30**	Class I, Division 1, Groups B, C and D Δ Class II, Division 1, Groups E, F and G Δ Division 1, NEMA Type 4X Δ Explosion-proof housing required
Flameproof	
IEC 60079-1:2007	IECEx FMG 13.0019 X Ex d IIB T4 Ga/Gb IP66
EN 60079-1:2007	FM13ATEX0050X Ex II 1/2 G Ex d IIB T4 Ga/Gb IP66
GB 3836.2	Ex d IIB T4 Gb IP66 GYJ13.1037X
No. 2013-54	Ex d IIB T4 Ga/Gb IP66
ABNT NBR **IEC 60069-1:2009e**	TUV 14.0935 Ex d IIB T4 Ga/Gb IP66

MTS digital setup software interface

Modbus and DDA programming

MTS has developed the MTS Setup Software to help customers program and customize their Modbus and DDA transmitters.

Both Modbus and DDA Setup Software allow the user to change addresses, calibrate current tank levels, and create a backup/restore file of current settings. In addition, the Modbus Setup Software allows the user to program alarms, change the units of the output, and setup the temperature correction method and volume calculation method.

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***

FOUNDATION® fieldbus programming

Please note that the MTS Setup Software does not include any software installation program for setting up the Level Plus Model MG transmitter for FOUNDATION™ fieldbus output. All programming for FOUNDATION™ fieldbus output must be performed using a host or handheld device such as the *Rosemount® 375 or 475*.

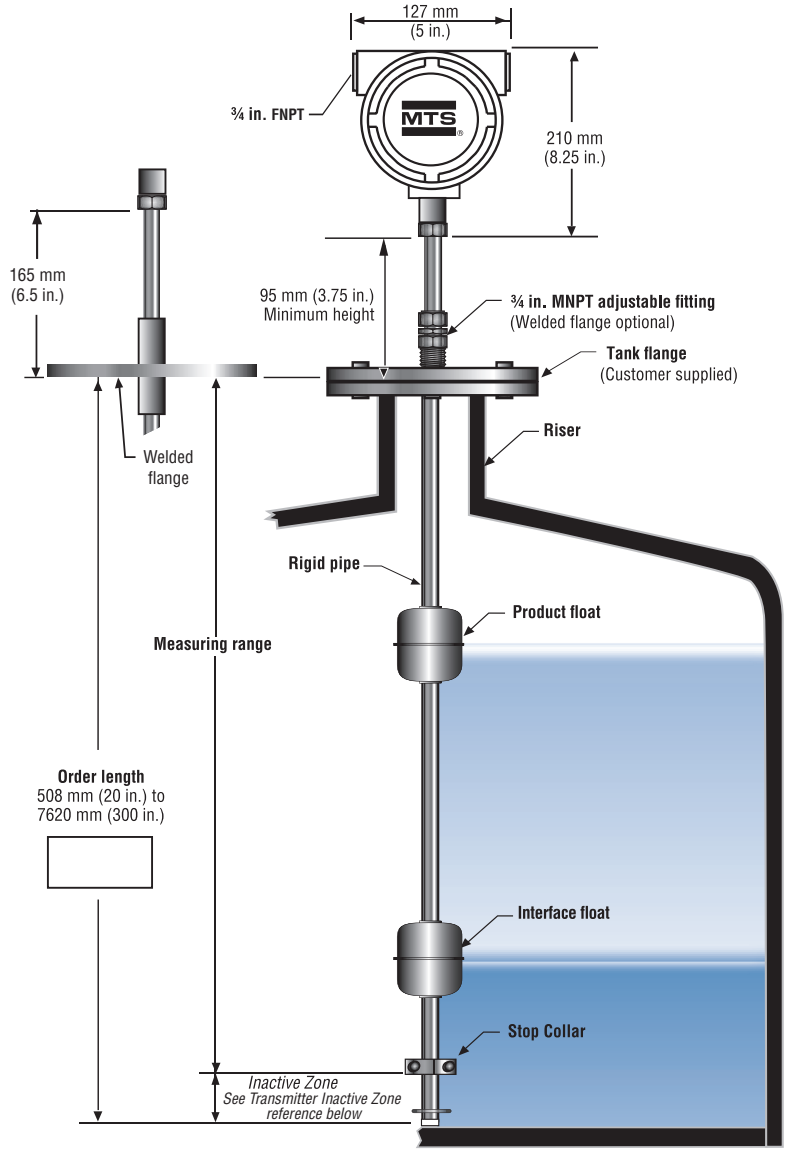
MTS has developed a DD file for the *Rosemount® 375 or 475* which includes all of the required programming capabilities.

Installation guideline, rigid pipe

MTS offers the Level Plus Model MG 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 MG transmitter 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 Model MG transmitter is equal to the '*Order length'* minus the '*Inactive zone'* (refer to the Transmitter Inactive Zone Reference Table below). 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	114 mm (4.5 in.).	132 mm (5.2 in.)

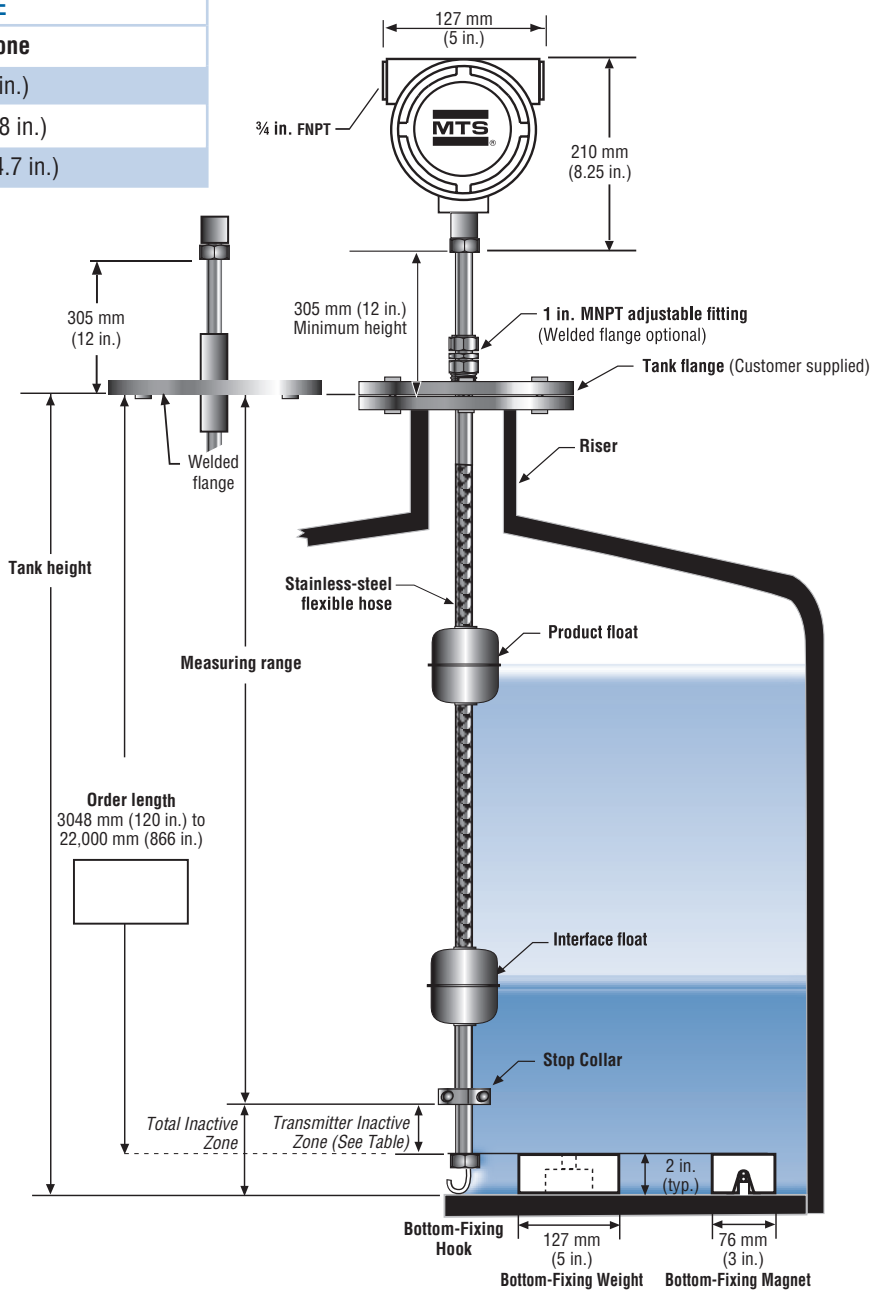
Installation guideline, flexible hose

MTS offers the Level Plus Model MG 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 22,000 mm (866 in.). The Level Plus Model MG transmitter for flexible hose applications is typically ordered with a 1 in. adjustable MNPT fitting. This fitting allows the transmitter to be adjusted (within a few inches) if the order length is not exact.

The Model MG 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 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 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.

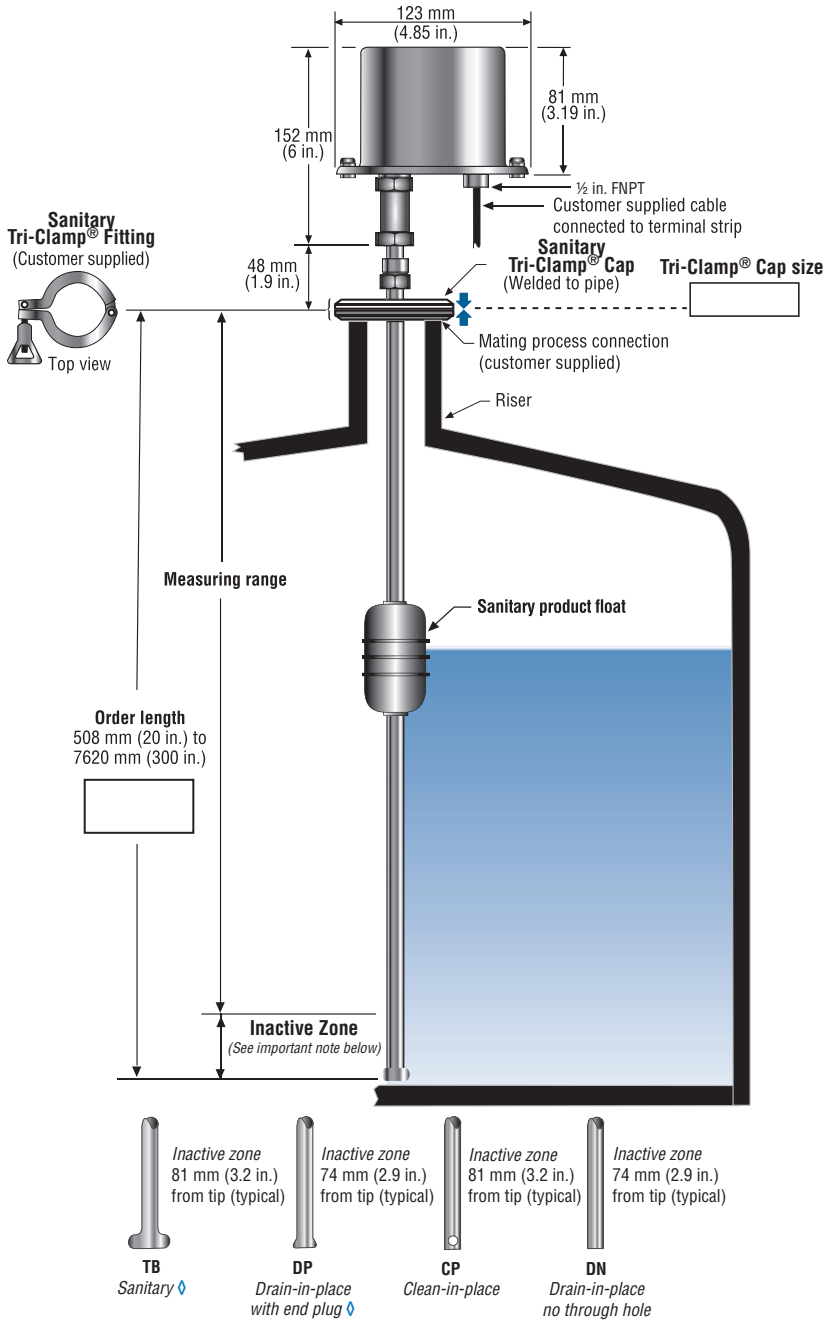
TRANSMITTER INACTIVE ZONE REFERENCE	
Length	**Inactive Zone**
< 7.6 m (25 ft.)	76 mm (3 in.)
< 12.2 m (40 ft.)	97 mm (3.8 in.)
< 22 m (72.2 ft.)	120 mm (4.7 in.)



Installation guideline, sanitary pipe

MTS offers the Level Plus Model MG 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 (0.375 µm) finish. The standard process fitting is a welded Tri-Clamp® cap. Because the Tri-Clamp cap 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 MG 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)*. For consistency, 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.



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

Ordering information for FM and CSA approvals

TRANSMITTER MODEL = M 1

M = Magnetostrictive transmitter

TYPE = G 2

G = Analog output liquid-level transmitter

AGENCY APPROVAL = ☐ 3

A = FM and CSA
3 = 3-A

OUTPUT = ☐ 4

M = Modbus RTU data format
D = MTS DDA
F = FOUNDATION™ fieldbus (XP only)

HOUSING TYPE = ☐ 5

3 = NEMA Type 4X, 316L stainless steel with NPT and internal terminal blocks (Intrinsically safe only)
B = Single cavity (explosion-proof and intrinsically safe)
C = Dual cavity (explosion-proof and intrinsically safe)
L = NEMA Type 4X, 316L with 6-pin connector (Intrinsically safe only)

ELECTRONICS MOUNTING = ☐ 6

1 = Integral electronics

TRANSMITTER PIPE/HOSE = ☐ 7

B = Rigid Industrial, end-plug with stop collar
C = Sanitary, T-bar, TB
D = Sanitary, drain-in-place, DP
E = Sanitary, clean-in-place, CP
F = Sanitary, drain-in-place, no hole, DN
M = Flexible w/bottom fixing hook (stainless steel only)
N = Flexible w/bottom fixing weight (stainless steel only)
P = Flexible w/bottom fixing magnet (stainless steel only)

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

1 = 316L stainless steel
2 = Electropolished 316L stainless steel Ra 15
3 = Hastelloy C
A = Teflon
C = CRN Approved

PROCESS CONNECTION TYPE = ☐ 9

1 = NPT, adjustable fitting
4 = Sanitary, welded
5 = Sanitary, adjustable fitting
6 = 150 lbs. welded RF flange
7 = 300 lbs. welded RF flange
8 = 600 lbs. welded RF flange

PROCESS CONNECTION SIZE = ☐ 10

A = ¾ in. (NPT for ⅝ in. pipe)
B = 1 in. (NPT for ⅞ in. hose)
C = 1½ in.
D = 2 in.
E = 2½ in.
F = 3 in.
G = 4 in.
H = 5 in. (except sanitary)
J = 6 in.

TEMPERATURE (DIGITAL THERMOMETERS) = ☐ 11

0 = None
1 = One DT, fixed position
2 = One DT, customer defined position ǂ
5 = Five DTs, evenly spaced as API
6 = Five DTs, customer defined position ǂ
K = Twelve DTs, evenly spaced per API
L = Twelve DTs, customer defined position ǂ

Notes:
ǂ *If this DT option is selected, option '**18 E**' must also be selected.*
§ *One DT at 203 mm (8 in.) from end of transmitter if the order length is less than 9144 mm (360 in.). If the length greater, One DT at 914 mm (36 in.) from the end of the transmitter.*

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

= Rigid or Sanitary transmitter: 508 mm (20 in.) to 7620 mm (300 in.)
= Flexible transmitter: 3048 mm (120 in.) to 22,000 mm (866 in.)

SPECIAL = ☐ 18

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

Ordering information for ATEX and IECEx based approval

TRANSMITTER MODEL = M 1

M = Magnetostrictive transmitter

TYPE = G 2

G = Digital output level transmitter

APPROVAL AGENCY = [ ] 3

E = ATEX approved
H = IECEx approved
P = CCoE approved
K = KC approved
B = INMETRO

OUTPUT = [ ] 4

M = Modbus RTU data format
D = MTS DDA
F = FOUNDATION™ fieldbus (Flameproof Only)

HOUSING TYPE = [ ] 5

B = Single cavity (Flameproof IIB)
C = Dual cavity (Flameproof IIB)
F = NEMA Type 4X, 316L stainless steel with cable (ATEX, EEX ia IIA)
G = Single cavity (ATEX, EEx ia IIA)
H = Dual cavity (ATEX, EEx ia IIA)
P = NEMA Type 4X, 316L stainless steel with cable (ATEX, EEX ia IIB)
R = Single cavity (ATEX, EEx ia IIB)
S = Dual cavity (ATEX, EEx ia IIB)
4 = NEMA Type 4X, 316L stainless steel with terminal block (ATEX, EEx ia IIA)
5 = NEMA Type 4X, 316L stainless steel with terminal block (ATEX, EEx ia IIB)

ELECTRONICS MOUNTING = [ ] 6

1 = Integral electronics

TRANSMITTER PIPE/HOSE = [ ] 7

B = Rigid Industrial, end-plug with stop collar
C = Sanitary, T-bar, TB
D = Sanitary, drain-in-place, DP
E = Sanitary, clean-in-place, CP
F = Sanitary, drain-in-place, no hole, DN
M = Flexible w/bottom fixing hook (stainless steel only)
N = Flexible w/bottom fixing weight (stainless steel only)
P = Flexible w/bottom fixing magnet (stainless steel only)
L = Sanitary Special

MATERIALS OF CONSTRUCTION (WETTED PARTS) (Note: contact factory for other materials) = [ ] 8

1 = Stainless steel, 1,4404
2 = Stainless steel, 1,4404 electropolished (3A approved, Ra 15 finish)
3 = Hastelloy C
A = Teflon

PROCESS CONNECTION TYPE = [ ] 9

1 = NPT, adjustable fitting
4 = Sanitary, welded
5 = Sanitary, adjustable fitting
6 = 150 lb. welded RF flange
7 = 300 lb. welded RF flange
8 = 600 lb. welded RF flange
9 = DIN flange welded according to specification

PROCESS CONNECTION SIZE = [ ] 10

A = ¾ in. (MNPT for ⅝ in. pipe)
B = 1 in. (MPT for ⅞ in. hose)
C = 1½ in.
D = 2 in.
E = 2½ in.
F = 3 in.
G = 4 in.
H = 5 in. (except sanitary)
J = 6 in.

TEMPERATURE (DIGITAL THERMOMETERS) = [ ] 11

0 = None
1 = One DT, fixed position§
2 = One DT, customer defined position ǂ
5 = Five DTs, evenly spaced per API
6 = Five DTs, customer defined position ǂ
K = Twelve DTs, evenly spaced per API
L = Twelve DTs, customer defined position ǂ

Note:
ǂ *If this DT option is selected, option '**18 E** ' must also be selected*

§ *One DT at 203 mm (8 in.) from end of transmitter if the order length is less than 9144 mm (360 in.). If the length greater, One DT at 914 mm (36 in.) from the end of the transmitter.*

Ordering information continued

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

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

= Flexible transmitter: 3048 mm (120 in.) to 22,000 mm (866 in.) except ATEX Ex ia IIB max. length 13500 mm (531 in.)

= Teflon: 508 mm (20 in.) to 6096 mm (240 in.)

SPECIAL = ☐ 18

S = Standard product

E = Engineering special (not affecting agency controlled parts or features)

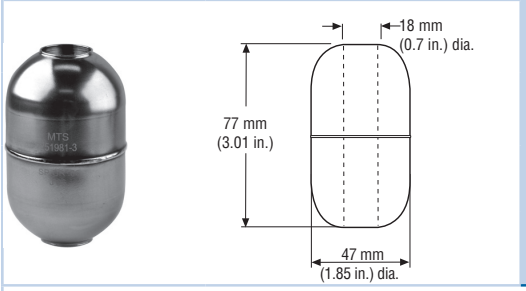
Standard product floats

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***

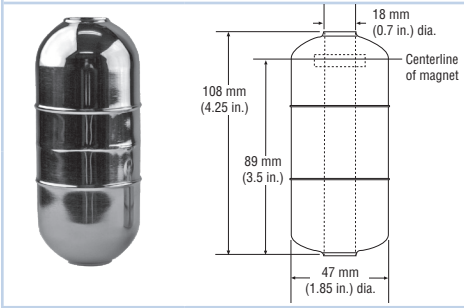
General Notes (for all applications):

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 µm (0.625 µm).
4. Electropolish is available for stainless-steel floats up to 240 Grit/Ra 15 µm (0.375 µm).
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.

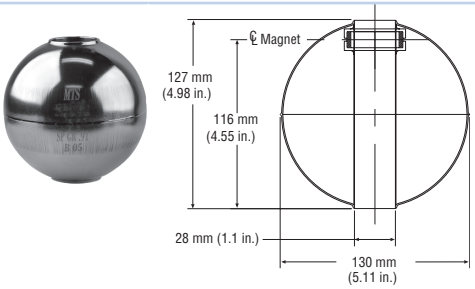
STANDARD PRODUCT FLOAT

Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
	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
	10.3 bar (150 psi)	149 °C (300 °F)	Yes	0.66	SS 200 Grit/ Ra 25 µm (0.625 µm)	No	401513-1
						Yes	401513-2*
					SS 240 Grit/ Ra 15 µm (0.375 µm)	No	401513-3*
						Yes	401513-4*

LONG-GAUGE FLOAT

Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
	37.9 bar (550 psi)	149 °C (300 °F)	No	0.44	SS	No	201248-1
						Yes	201248-2*
				0.90 - 0.96	SS	No	252959-1
						Yes	252959-2*
				1.03 - 1.10	SS	No	252960-1*
						Yes	252960-2*

MTS®

SENSORS

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LEGAL NOTICES