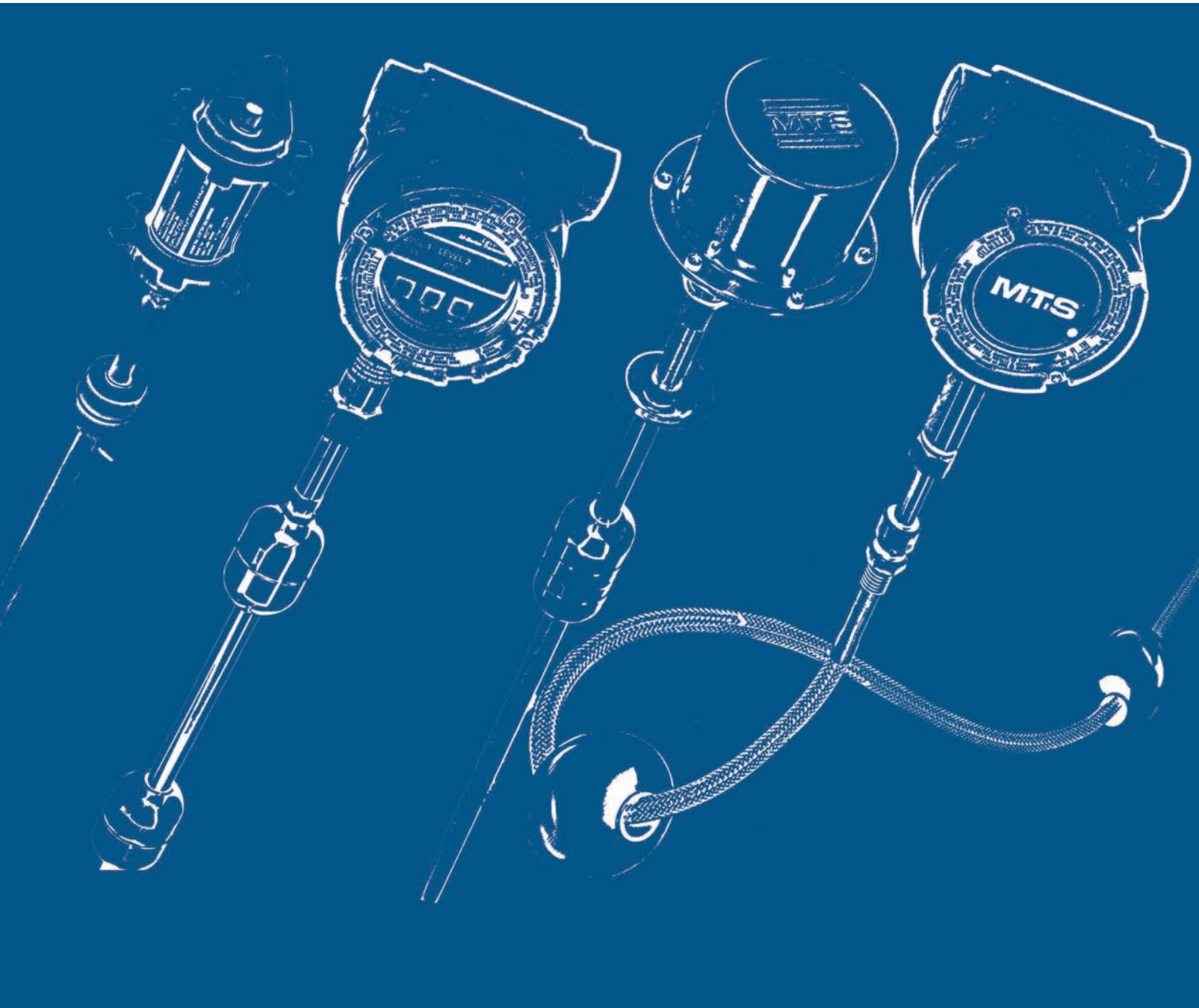
Level Plus®

Magnetostrictive Liquid-Level Sensors
with Temposonics® Technology

MTS® SENSORS

Document Part Number
551050 Revision E

Liquid-Level Product Catalog



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The parties expressly agree that the purchase and use of Material and/or Services from MTS Sensors Division are subject to MTS' Terms and Conditions, in effect as of the date of this document, which are located at **http://www.mtssensors.com/fileadmin/media/pdfs/Terms_and_Conditions.pdf** and are incorporated by reference into this and any ensuing contract. Printed Terms and Conditions can be provided upon request by emailing **sensorsinfo@mts.com** or if you prefer, go to **http://www.mtssensors.com/index** and click the Quote/Contract Terms and Conditions link at the bottom of the page to download the PDF.

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Markets We Serve

M-Series Model MC420

M-Series Model MR

M-Series Model MG

M-Series Model USTD II

Product Accessories

Table of Contents

MTS Sensors Introduction

Accuracy
Repeatability
Reliability
Value

These are the qualities we've instilled in our transmitter designs and products since we first opened our doors in 1975. At MTS Sensors, we pride ourselves on being the leader in magnetostrictive technology and the inventor of magnetostrictive linear-position and liquid-level measurement, one of the most accurate and dependable forms of measurement available.

With more than 20 current patents and annual transmitter shipments of hundreds of thousands, our manufacturing and engineering facilities (located in Cary, North Carolina; Ludenscheid, Germany; and Tokyo, Japan) provide cost effective measurement solutions for a diverse group of applications. We're backed by the resources of our Minneapolis-based parent company, MTS Systems Corporation, a leading worldwide producer of testing and automation systems.

Temposonics® Technology

Superior Performance, Preferred Results

Magnetostriction is one of the most accurate and repeatable measurement technologies available today. When the waveguide within the sensing element is stimulated by a current pulse, a magnetic field is created. External floats containing a permanent magnet interact with this magnetic field and create a “torsional strain pulse” or “waveguide twist”, which moves up and down the waveguide at an extremely high speed. Product and interface levels are then accurately determined by measuring the difference in time between the initial current pulse and the return torsional pulse.

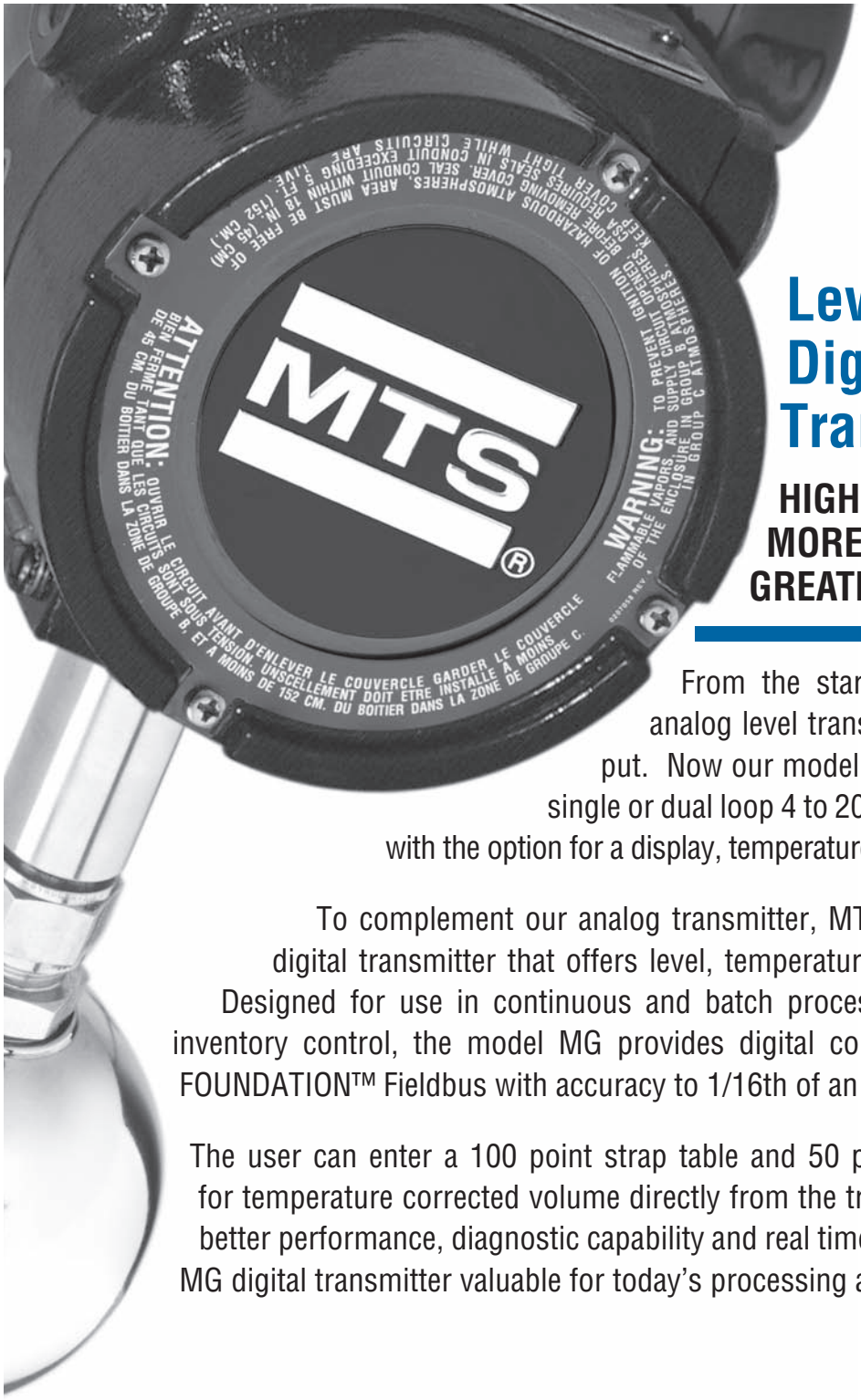
Due to stringent in-house waveguide manufacturing processes and because our transmitters have no moving parts, the result is higher accuracy, superior repeatability and the best resolution of any transmitter technology.

Level Plus® Flexible & Rigid Transmitters

MORE OPTIONS, INCREASED EFFICIENCY, LOWER INSTALLATION COSTS

As the performance leader in magnetostrictive level sensing, MTS Sensors was the first to produce a flexible magnetostrictive transmitter. Our flexible transmitter is made from a custom engineered hose woven from 316L stainless steel that is robust enough for almost any environment. By using a flexible transmitter the end user has lower shipping and installation costs along with the ability to install in applications with limited overhead clearance. Flexible transmitters are available from 3048 mm (120 in.) to 22000 mm (866 in.)

MTS also offers rigid transmitters with both industrial and sanitary finishes. Our standard industrial rigid transmitter was our first liquid level transmitter and continues to be our most popular style. Due to demand from the Pharmaceutical and Food and Beverage industries, MTS added the option for a sanitary finish that includes Ra 25 and Ra 15. Both the industrial and sanitary rigid transmitters are available from 508 mm (20 in.) to 7620 mm (300 in.).



Level Plus® Digital and Analog Transmitters

HIGHER PERFORMANCE, MORE INFORMATION, GREATER VALUE

From the start MTS Sensors has offered analog level transmitters with 4 to 20 mA output. Now our model MR analog transmitters offer single or dual loop 4 to 20 mA outputs with HART along with the option for a display, temperature measurement and more.

To complement our analog transmitter, MTS introduced our model MG digital transmitter that offers level, temperature, and volume measurement. Designed for use in continuous and batch process control, bulk storage and inventory control, the model MG provides digital communication via Modbus or FOUNDATION™ Fieldbus with accuracy to 1/16th of an inch.

The user can enter a 100 point strap table and 50 point volume correction table for temperature corrected volume directly from the transmitter. Higher resolution, better performance, diagnostic capability and real time information make the model MG digital transmitter valuable for today's processing applications.

Magnetostrictive Technology

BENEFITING MORE APPLICATIONS

Whether you need to determine if there is sufficient inventory to produce the next batch of "high-value" medication or there is leakage from an underground storage tank, our line of Level Plus liquid-level transmitters will provide the precise data you need. Our transmitters are designed to deliver accurate and reliable measurements of product levels, interface levels and temperatures in almost any application or environment.

MTS LIQUID-LEVEL TRANSMITTERS ARE THE PREFERRED TECHNOLOGY FOR USE IN TANK GAUGING AND PROCESS APPLICATIONS

Why are MTS Liquid-Level Transmitters Preferred? Because they …

- Are not affected by changes in dielectric constant
- Are not affected by changes in atmospheric conditions
- Detect liquid level rather than foam level
- Maintain linearity regardless of temperature changes
- Can measure product level, interface level and temperature through one opening
- Do not require recalibration
- Deliver the highest accuracy and provide high repeatability

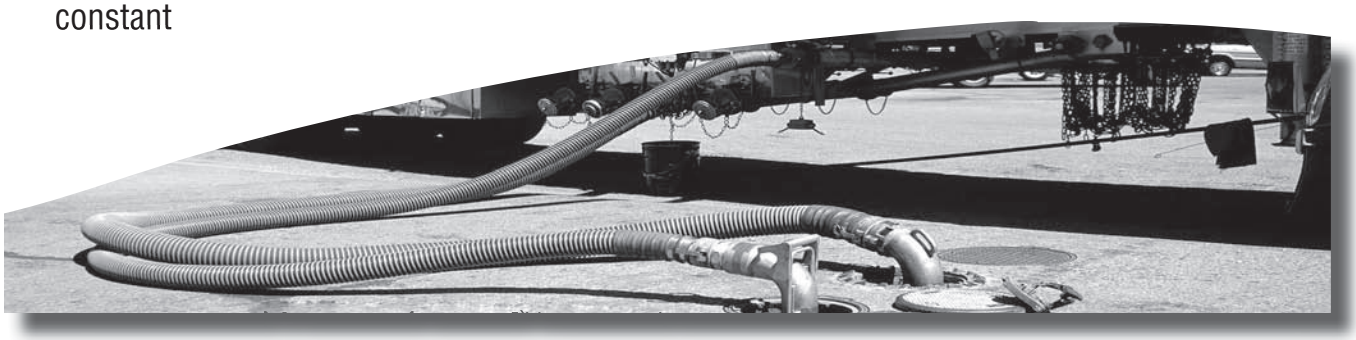
Oil & Gas/ Petroleum

WHETHER IT'S ABOVEGROUND OR BELOW GROUND…

—FOR THE BEST INVENTORY CONTROL AND SUPERIOR LEAK DETECTION PERFORMANCE, INSTALL MTS

MTS Sensors' complete level monitoring solutions for Aboveground Storage Tank (AST) and Underground Storage Tank (UST) applications deliver accurate, reliable, trouble-free and error-free measurements and feature …

- Monitoring panels display real time tank data, including level, interface and temperature, gross volume, net volume and diagnostic data, such as high/low indicators and data all from one transmitter and one opening
- Accurate regardless of temperature changes in the tank
- Lower installed cost vs. radar
- Lowest cost of ownership vs. Mechanical gauges
- A flexible transmitter drastically reduces installation costs
- Not affected by changing or low dielectric constant
- All MTS liquid-level transmitters use magnetostrictive technology. Only one moving part, the float. No scheduled maintenance, requiring no recalibration for the life of the transmitter
- Not affected by vapor, foam or condensation build up on the inside of the tank
- Explosion-proof and intrinsically safe approvals
- Monitoring system displays information from multiple tanks and provides data to other devices



Liquid Petroleum Gas

RELIABLE MEASUREMENT FROM TOP TO BOTTOM …

From bulk petroleum storage to refined fuels to propane gas, Level Plus liquid-level transmitters provide the most accurate level measurements in the industry. They are easy to install in vessels of all shapes and sizes and are capable of measuring product level, interface and temperature variances throughout the entire vessel.

- Product level, interface level, leakage detection and temperature data all from one transmitter
- Lower installed cost
- No need for multiple openings on the top of the tank
- Not affected by changes in atmospheric conditions
- Maintain linearity regardless of temperature changes in the vessel
- Intrinsically safe and explosion-proof product approvals (ATEX, FM, CSA)
- The most accurate and reliable measurements
- Fast turnaround of most shipments
- Ease of installation
- Volume and mass computations directly from transmitter

Pharmaceutical

ACCURACY IS THE BEST MEDICINE

Accuracy and repeatability are paramount in the pharmaceutical industry. Without them, costly errors can be made.

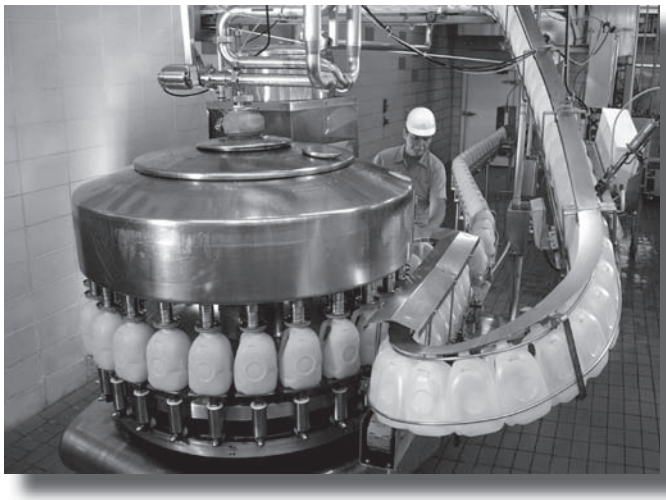
Accuracy and repeatability are paramount in the pharmaceutical industry. Without them, costly errors can be made. While other technologies are available such as load cells and radar, they are usually more difficult and costly to install. Additionally, they often lack the accuracy of magnetostrictive liquid-level transmitters. Level Plus M-Series transmitters are ideal for batch and continuous processing inherent in the pharmaceutical industry.

Here's how they help improve your control system:

- Unparalleled accuracy and repeatability
- Lower installed cost
- Faster start-up time compared to other technologies
- Digital communication interface for continuous and batch process control
- Intrinsically safe, explosion-proof product approvals (ATEX, FM & CSA)
- Not affected by changes in dielectric constant
- Temperature measurement
- Cleanable (CIP & SIP) parts
- Sanitary configurations designed to 3A standards
- Customization
- Fast turnaround on shipments
- On-site product training and excellent customer service

Food & Beverage

A PRODUCT MENU THAT WILL SATISFY EVERY NEED



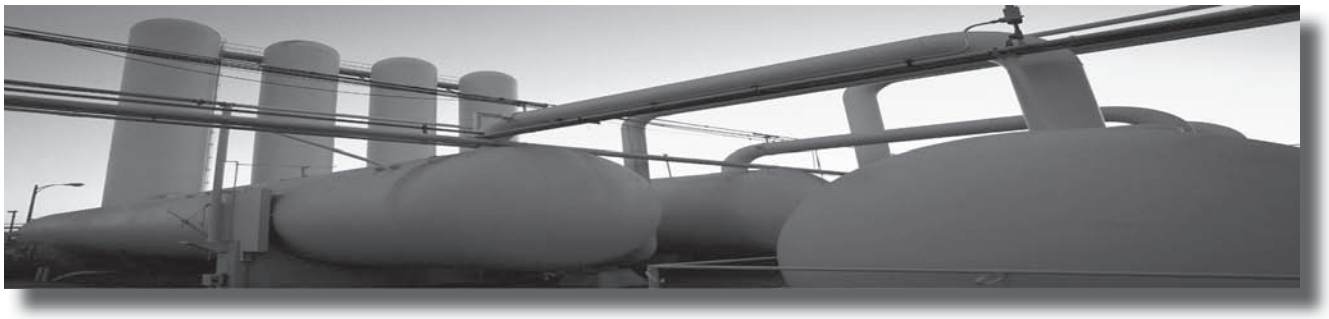
Accurate measurement must also mean accurate measurement of inventory. Because companies are often taxed on inventory levels they have in process or in stock, errors in measurement can prove to be extremely expensive.

Here's why magnetostrictive technology makes good sense for the food and beverage industry:

- The most accurate and reliable measurements
- Lower installed cost
- Faster startup time compared to other technologies
- Detects liquid level, not foam level
- Provides digital communication interface for continuous and batch process control
- Temperature measurement
- Cleanable (CIP & SIP) parts
- Sanitary configurations designed to 3A standards
- Customizations
- Fast turnaround on shipments
- On-site product training and excellent customer service

Speciality Chemical

TOUGH TRANSMITTERS FOR HARSH ENVIRONMENTS



MTS LEVEL PLUS TRANSMITTERS ARE DESIGNED FOR EASY INSTALLATION AND LOW MAINTENANCE

Whether you're dealing with extreme temperatures, foaming liquids or caustic fluids, the industry presents a challenge to transmitters that can not only withstand such environments, but can also deliver quality performance under those conditions. Keeping human contact with equipment to a bare minimum, Level Plus M-Series transmitters are designed for easy installation and low maintenance.

With more than twenty years of experience in specialty chemicals, here's how MTS Level Plus transmitters can benefit your operation:

- Product level, leakage detection and temperature data all from one transmitter
- No need for multiple openings on the top of the tank
- Lower installed cost
- Detects liquid-level, not foam level
- Requiring no calibration for life of the transmitter
- Maintains linearity regardless of temperature changes in the vessel
- The most accurate and reliable measurements
- Applications assistance
- Fast turn around of most shipments
- Intrinsically safe, and explosion-proof product approvals (ATEX, FM, & CSA)

Level Plus®

Magnetostrictive Liquid-Level Sensors
with Temposonics® Technology

M-Series Model MC420
Transmitter with Analog Output

Data Sheet

Document Reference Number
550752 Revision F

FEATURES

- 4 to 20 mA Output with HART®
- Single Channel Output
- Level Measurements
  - Product
  - Interface
- No Scheduled Maintenance or Recalibration
- High Accuracy and Repeatability
- Intrinsically Safe (I.S.)

APPLICATIONS

- General Process
- Industrial Chemicals
- Solvents
- Detergents and Soaps
- Lubricating Oils

MARKETS

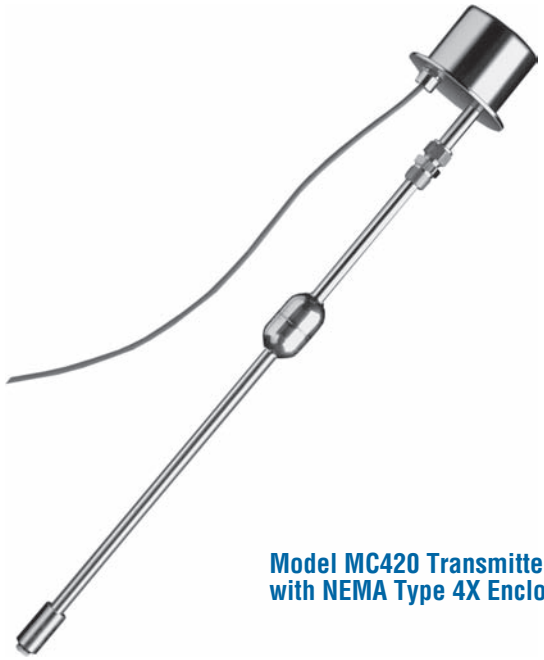
- Petrochemical
- Chemical
- Water and Wastewater

Product overview

The Level Plus® Model MC420 level transmitter satisfies the demand for an economical analog communication interface offering for hazardous area applications. The Model MC420 provides a single-channel analog 4 to 20 mA output for either a product level or an interface level measurement depending on the application and the selected float. The Model MC420 transmitter is approved by FM, CSA, and ATEX for use in Intrinsically Safe applications. Appropriate barriers are required when installing the Model MC420 transmitter in hazardous areas.

In addition to the single-channel 4 to 20 mA loop, the Model MC420 transmitter provides the HART® field communications protocol for setup and calibration. Calibration can also be accomplished using integrated reed switches and a supplied magnet without the need for expensive electronics. Once the transmitter is installed and calibrated there is no requirement for scheduled maintenance or recalibration. ***Set it and forget it!***

The Model MC420 transmitter is available in set lengths from 457 mm (18 in.) to 5486 mm (216 in.) and can be installed in applications with process temperatures between -40 °C (-40 °F) to 125 °C (257 °F). The electronics are permanently sealed in a NEMA Type 4X rated housing made of 316L stainless steel that provides protection against corrosion and resistance to harsh process conditions.



Model MC420 Transmitter with NEMA Type 4X Enclosure

Model MC420 Analog

All specifications are subject to change. Contact MTS for specifications and engineering drawings that are critical to your application. Drawings contained in this document are for reference only. Go to http://www.mtssensors.com for the latest support documentation and related media.

Product specifications

Parameters	Specifications
LEVEL OUTPUT	
Measured variable:	Product level and interface level
Output signal and Protocol:	4 to 20 mA with HART®
Order length:	**Rigid pipe:** 457 mm (18 in.) to 5486 mm (216 in.) § § Order length equals the measurement range plus the inactive zone.
Non-linearity:	0.02% F.S. or 0.794 mm (1/32 in.)* * Whichever is greater
Repeatability:	0.01% F.S. or 0.381 mm (0.015 in.)* (any direction) * Whichever is greater
ELECTRONICS	
Input voltage:	10.5 to 36 Vdc maximum 28 Vdc maximum for I.S. ATEX approved
Fail safe:	High (21.4 mA), 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, noncondensing
Operating temperatures:	**Electronics:** -34 °C (-30 °F) to 71 °C (160 °F) **Sensing element:** -40 °C (-40 °F) to 125 °C (257 °F) ◊ ◊ Contact factory for specific temperature ranges.
Vessel pressure:	Dependent on float pressure, contact factory for more information
Materials:	**Wetted parts:** 316L stainless steel **Non-wetted parts:** 316L stainless steel
FIELD INSTALLATION	
Housing dimensions:	**NEMA Type 4X:** 81 mm (3.2 in.) by 123 mm (4.85 in.) O.D.
Mounting:	**Rigid pipe:** ¾ in. Adjustable MNPT fitting
Wiring:	**Integral cable:** 4.5 m (15 ft.) 2-wire integral cable, shielded
Electrical Connections:	**NEMA Type 4X:** ½ in. FNPT conduit opening

Agency approvals

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 Division 1, NEMA Type 4X
EN 60079-11:2007	PTB 10 ATEX 2011 X Ex II 1/2 G bzw. II 2 G Ex ia IIB T4 bzw. Ex ia IIA T4

MTS Analog setup software

MTS has developed the MTS Setup Software to help customers program and customize their Level Plus Model MC420 transmitter.

The Model MC420 transmitter is programmed through a HART interface. This interface is easily connected to a PC by using a HART-to-Serial converter. The MTS Analog Setup Software allows the user to adjust *'Zero'* (4 mA) and *'Span'* (20 mA) setpoints and adjust HART parameters.

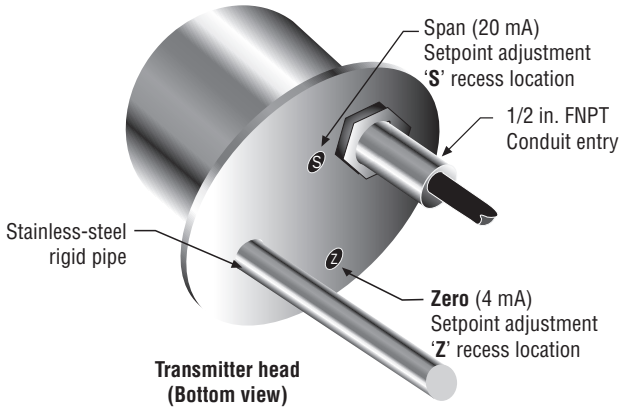
MTS setup software is shipped with each transmitter order. However, if you require an additional copy or an upgrade to your currently installed setup software, updates are available for download from the following MTS Level Products page at ***http://www.mtssensors.com***.

HART® handheld communicator programming

The Level Plus Model MC420 transmitter programming can also be performed by using a handheld HART communicator device such as the *Rosemount® 375 or 475*.

Transmitter calibration

Calibration can also be accomplished without the use of any electronic equipment. MTS supplies a custom setpoint magnet with each MC420 level transmitter. The magnet is used to set the *'Zero'* (4 mA) and *'Span'* (20 mA) setpoints. Setpoint adjustment locations *(as shown below)* are found at the bottom of the transmitter housing *(as shown below)*. Both Zero and Span setting locations are identified with ***'Z'*** (for Zero) and ***'S'*** (for Span). To set the Zero (4 mA) setpoint, adjust the float to the appropriate level and insert the magnet into the circular ***'Z'*** recess. To set the Span (20 mA) setpoint adjust the float to the appropriate level insert the magnet into the circular ***'S'*** recess.

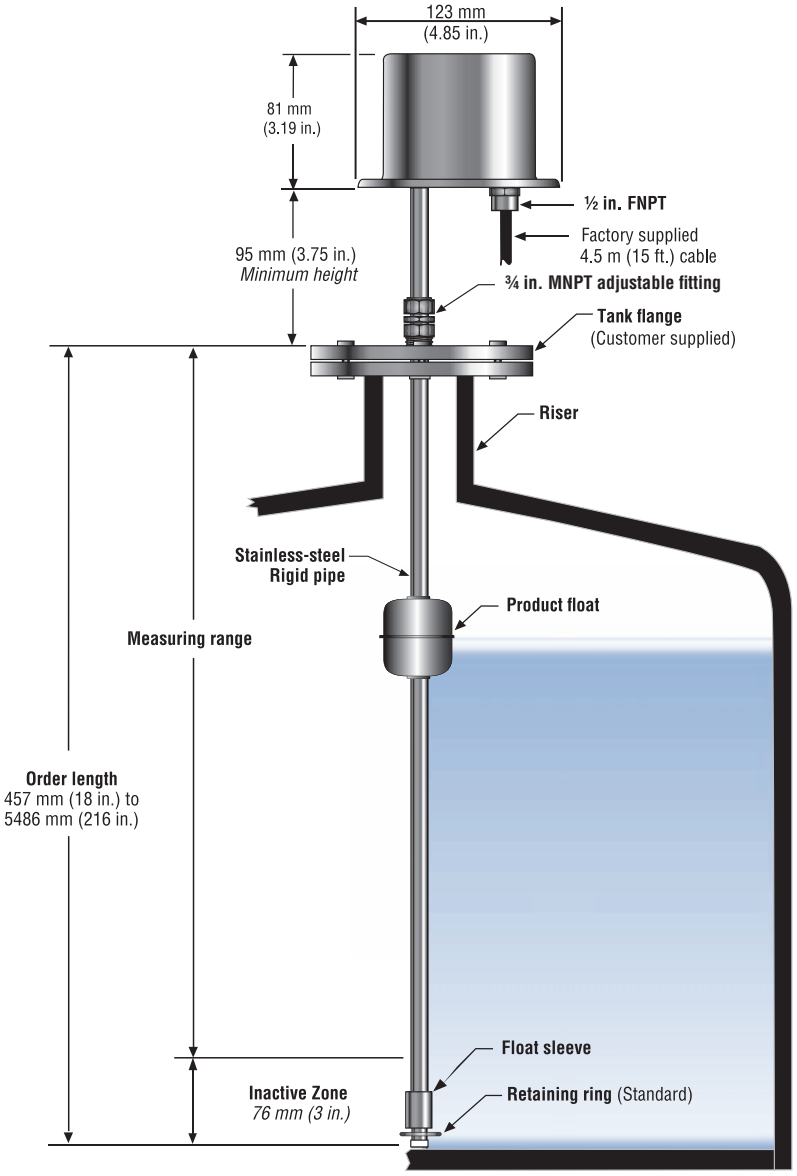


Installation guideline

MTS offers the Level Plus Model MC420 transmitter configured with a rigid pipe constructed of 316L stainless steel *(see illustration below)*. The rigid pipe configuration can be ordered in lengths from 457 mm (18 in.) to 5486 mm (216 in.). The Model MC420 comes standard with a ¾ in. MNPT Adjustable fitting as its process connection, 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 MC420 transmitter is equal to the '*Order length'* minus the '*Inactive zone'* of 76 mm (3.0 in.). The transmitter can be ordered with a single standard product float *(part number 251981-1)*, or can include an optional non-standard float *(Refer to the Level Plus Accessories Catalog, document no. 551103 for optional float selections)*.

The '*stop collar'* option must be ordered separately if you choose a non-standard float. This option 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.



Ordering information

TRANSMITTER MODEL = M C 4 2 0 (1 - 5)

M-Series Model MC420 liquid-level transmitter
Comes with one standard product level float *(part number 251981-X, see Standard float section below).*

TRANSMITTER ORDER LENGTHS¤ = ( ) ( ) ( ) (6 - 8)

Length	Code	Length	Code	Length	Code
457 mm (18 in.)	= 018	1829 mm (72 in.)	= 072	3658 mm (144 in.)	= 144
508 mm (20 in.)	= 020	2134 mm (84 in.)	= 084	3962 mm (156 in.)	= 156
610 mm (24 in.)	= 024	2438 mm (96 in.)	= 096	4267 mm (168 in.)	= 168
914 mm (36 in.)	= 036	2743 mm (108 in.)	= 108	4572 mm (180 in.)	= 180
1219 mm (48 in.)	= 048	3048 mm (120 in.)	= 120	4877 mm (192 in.)	= 192
1524 mm (60 in.)	= 060	3353 mm (132 in.)	= 132	5182 mm (204 in.)	= 204
				5486 mm (216 in.)	= 216

¤ Standard Range/lengths 457 mm (18 in.) to 5486 mm (216 in.)

OPTIONAL ACCESSORIES = ( ) ( ) (9 - 10)

FM / CSA Approved

00 = Standard float (part no.: 251981-1)
F0 = Non-Standard float ¥‡
T0 = Standard float with Stainless-steel tag
FT = Non-standard float with Stainless-steel tag ¥‡

ATEX Approved

0P = Standard float (part no.: 251981-2) with blue cable
FP = Non-standard float with blue cable ¥‡

No Approval

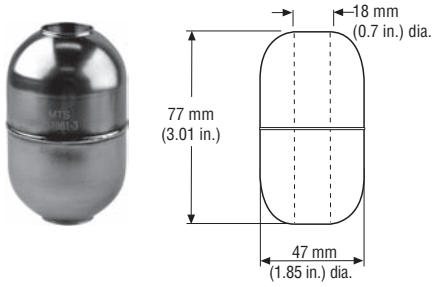
0N = Standard float (part no.: 251981-2) with gray cable
FN = Non-standard float with gray cable ¥‡

¥ Non-standard floats must be ordered separately.
‡ Requires a stop collar, part no.: 560369-1 (Which must be ordered separately)

Standard product float and optional hardware

Listed below is the standard float 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 Product Accessories'* section of this catalog or *'Level Plus Accessories Catalog, document No. 551103'* available in PDF format at ***http://mtssensors.com***.

STANDARD PRODUCT FLOAT (INCLUDED) AND OPTIONAL HARDWARE

Standard product float (included)	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
						Yes	251981-2

Optional hardware		Part number
	**Stainless-steel tag** (I.D. tag)	250857
	Stainless-steel stop collar (Required when ordering non-standard float options ***'F0'***, ***'FT'***, ***'FP'*** or ***'FN'***)	560369-1

Model MC420 Analog

Level Plus®

Magnetostrictive Liquid-Level Sensors
with Temposonics® Technology

M-Series Model MR
Transmitter with Analog Output

Data Sheet

Document Reference Number
550677 Revision J

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

All specifications are subject to change. Contact MTS for specifications and engineering drawings that are critical to your application. Drawings contained in this document are for reference only. Go to http://www.mtssensors.com for the latest support documentation and related media.

Model MR Analog

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 (FM, CSA, ATEX IIA):** 3048 mm (120 in.) to 12200 mm (480 in.) Δ§ **(ATEX IIB):** 3048 mm (120 in.) to 7600 mm (300 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.)* * Whichever is greater
Repeatability:	0.01% F.S. or 0.381 mm (0.015 in.)* (any direction) † Contact factory for alternative materials.
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, maximum for I.S. ATEX 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:	Dependent on float pressure, contact factory for more information
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.)
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 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

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 •• Division 1, NEMA Type 4X •• Explosion-proof housing required

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 Division 1, NEMA Type 4X
EN 60079-11:2007	PTB 10 ATEX 2011 X Ex II 1/2 G bzw. II 2 G Ex ia IIB T4 bzw. Ex ia IIA T4 ** ** Contact factory for model numbers

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

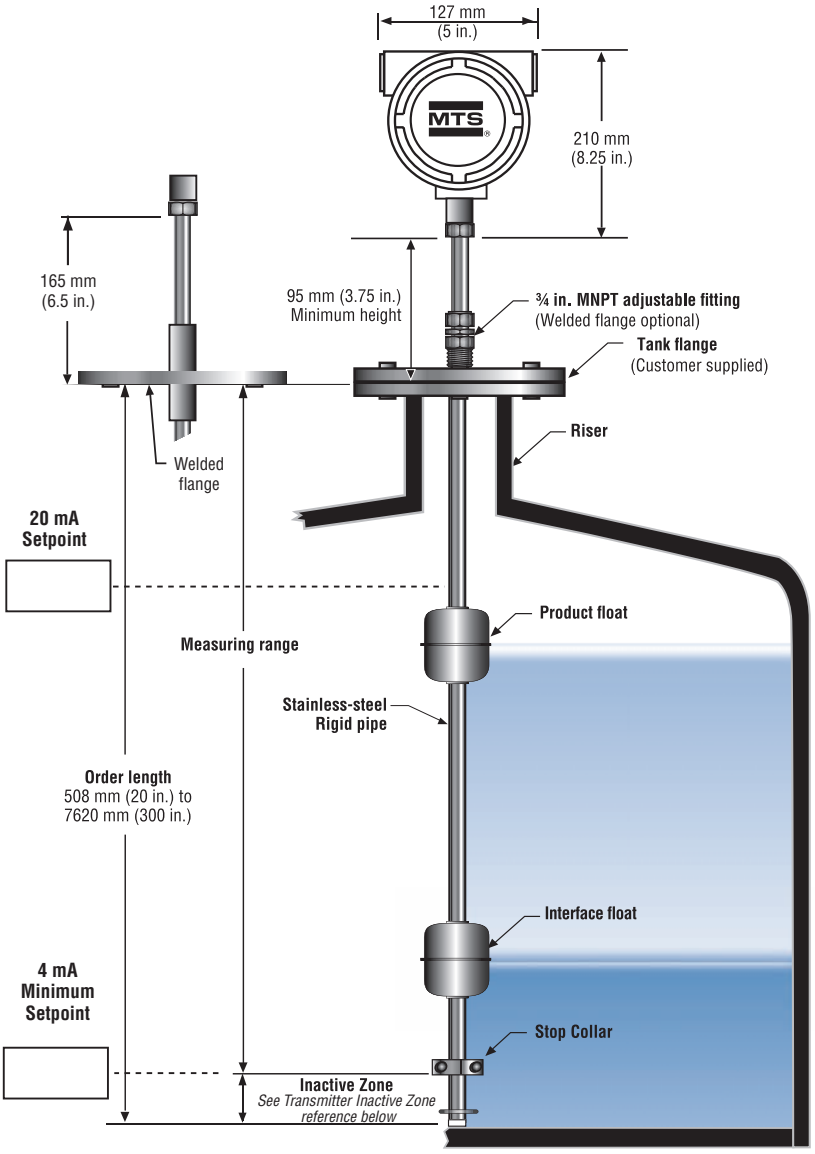
Any Level Plus Model MR transmitter that is purchased with a display has the ability to adjust the 4 and 20 mA setpoints by pressing the appropriate button located at the bottom of the display.

Installation guideline, rigid pipe

MTS offers the Level Plus Model MR transmitter configured with a rigid pipe constructed of 316L 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.). The transmitter can be ordered with a single product float or can include the optional interface float *(Refer to the Level Plus Accesories 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.)

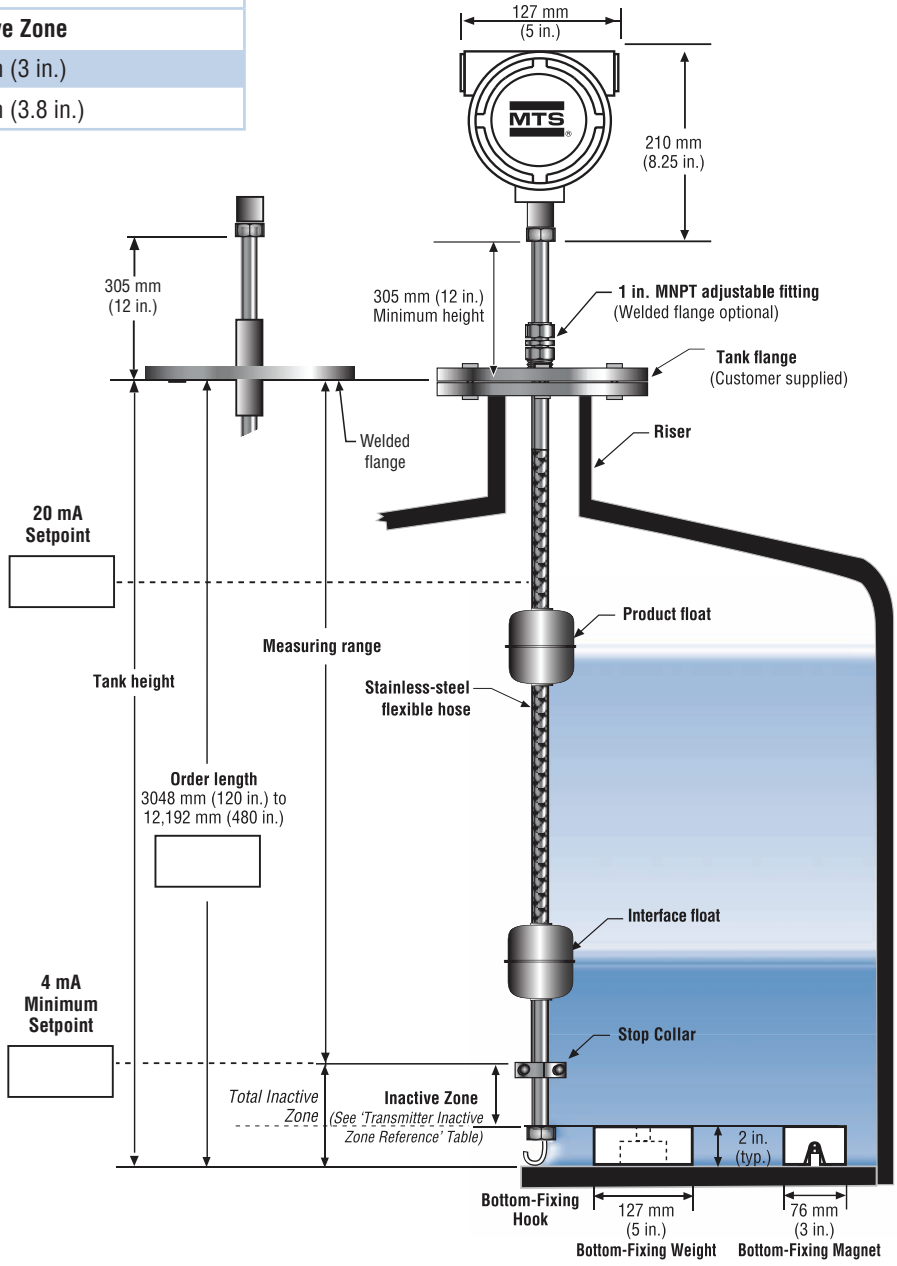
Installation guideline, flexible hose

MTS offers the Level Plus Model MR transmitter configured with a Flexible hose constructed of 316L 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.)

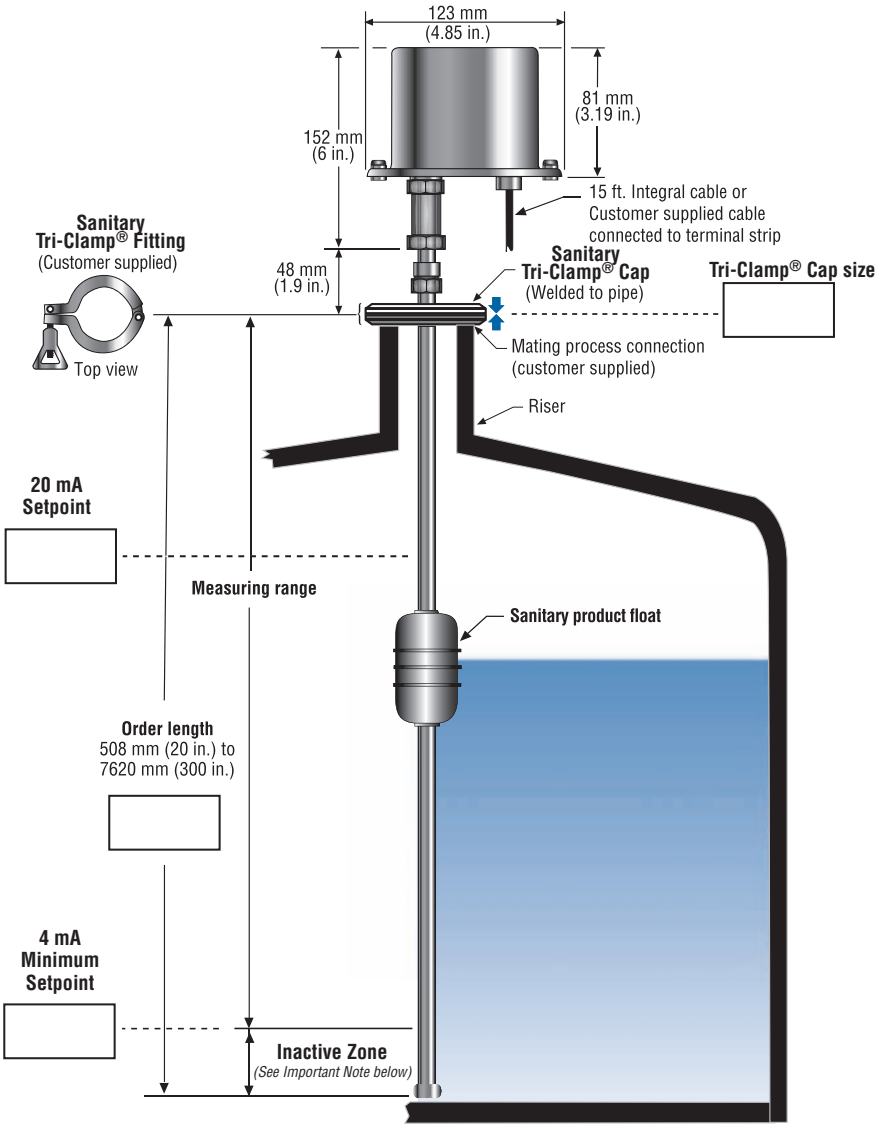


Model MR Analog

Installation guideline, sanitary pipe

MTS offers the Level Plus Model MR transmitter configured with a Sanitary pipe constructed of 316L 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 µm (0.625 µm) finish, however an electropolish option is also available with a Ra 15 µm (0.375 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 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.

Model MR Analog

Ordering information for FM-CSA approvals

TRANSMITTER MODEL = M 1

M = Magnetostrictive transmitter

TYPE = R 2

R = Analog output liquid-level transmitter

INPUT POWER = A 3

A = 24 Vdc, 2-wire loop

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)

B = Single cavity (explosion-proof and intrinsically safe)

C = Dual cavity (explosion-proof and intrinsically safe)

D = Single cavity with display (explosion-proof and intrinsically safe)

E = Dual cavity with display (explosion-proof and intrinsically safe)

L = NEMA Type 4X, 316L SS w/6-pin male connector (intrinsically safe only)

3 = NEMA Type 4X, 316L SS with internal terminal blocks (intrinsically safe only)

ELECTRONICS MOUNTING = 6

1 = Integral electronics

TRANSMITTER PIPE = 7

B = 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

H = Flexible w/bottom fixing hook (stainless steel only)

J = Flexible w/bottom fixing weight (stainless steel only)

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

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

6 = 150 lb. welded RF flange

7 = 300 lb. welded RF flange

8 = 600 lb. 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 = 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 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)

Model MR Analog

Ordering information for ATEX approval

TRANSMITTER MODEL = **M** 1

M = Magnetostrictive transmitter

TYPE = **R** 2

R = Analog output level transmitter

INPUT POWER = **A** 3

A = 24 Vdc

OUTPUT = ☐ 4

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

HOUSING TYPE = ☐ 5

F = NEMA Type 4X, 316L stainless steel with blue cable (ATEX IIA)
G = SIngle cavity (ATEX IIA)
H = Dual cavity (ATEX IIA)
J = Single cavity with display (ATEX IIA)
K = Dual cavity with display (ATEX IIA)
L = NEMA Type 4X, 316L stainless steel with 6-pin male connector
N = NEMA Type 4X, 316L stainless steel with gray cable
P = NEMA Type 4X, 316L stainless steel with blue cable (ATEX IIB)
R = SIngle cavity (ATEX IIB)
S = Dual cavity (ATEX IIB)
T = Single cavity with display (ATEX IIB)
U = Dual cavity with display (ATEX IIB)

ELECTRONICS MOUNTING = ☐ 6

1 = Integral electronics

TRANSMITTER PIPE/HOSE = ☐ 7

B = 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
H = Flexible w/bottom fixing hook (stainless steel only)
J = Flexible w/bottom fixing weight (stainless steel only)
K = 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
5 = Stainless steel, 1.4404 ◊
6 = Stainless steel, 1.4404 electropolished (3A approved, Ra 15 finish)◊
7 = Hastelloy C ◊
A = Teflon / FEP
B = Teflon / FEP with plastic floats for Zones 1, IIA and IIB
◊ Stainless-steel floats for Zone 0 IIB or plastic floats for Zone 0 IIA

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
9 = DIN flange welded according to specification

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 = ☐ 11

0 = None
2 = One RTD, customer defined position ǂ
1 = One RTD, fixed position 76 mm (3 in.) from the end of pipe
Note: ǂ*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.)

Model MR Analog

Ordering information for ATEX 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 IIB max. length 7620 mm (300 in.)

SPECIAL = ☐ 18

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

Model MR Analog

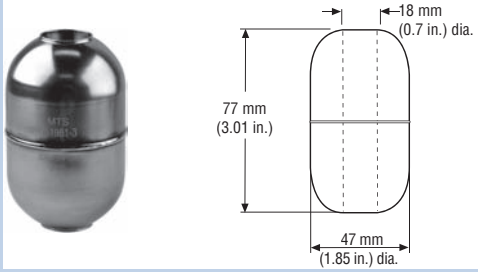
Sandard product floats

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***

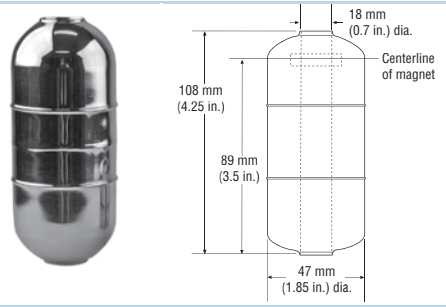
General Notes (for all applications):

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.

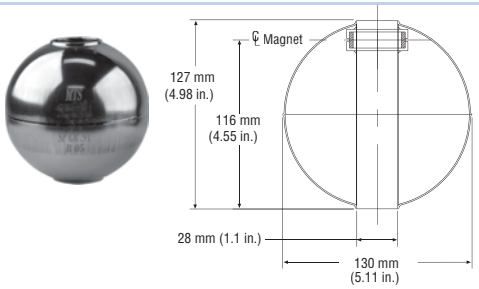
STANDARD PRODUCT FLOAT

Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
	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*

Model MR Analog

Level Plus®

Magnetostrictive Liquid-Level Sensors
with Temposonics® Technology

M-Series Model MG
Transmitter with Digital Output

Data Sheet

Document Reference Number
550784 Revision I

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**
- **Non-linearity 0.008% F.S.**
- **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.

All specifications are subject to change. Contact MTS for specifications and engineering drawings that are critical to your application. Drawings contained in this document are for reference only. Go to http://www.mtssensors.com for the latest support documentation and related media.

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:** (FM, CSA, ATEX IIA): 3048 mm (120 in.) to 22000 mm (866 in.) Δ § (ATEX IIB): 3048 mm (120 in.) to 13500 mm (531.5 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:	0.008% F.S. or 0.794 mm (1/32 in.)* * Whichever is greater
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:	Dependent on float pressure, contact factory for more information
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. FNTP conduit opening, M20 for ATEX version
NEMA Type 4X:	½ in. FNTP 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 •• Division 1, NEMA Type 4X •• Explosion-proof housing required

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 Division 1, NEMA Type 4X
EN 50020	PTB 04 ATEX 2028 X Ex II 1/2 G bzw. II 2 G EEx ia IIB T4 bzw. EEx ia IIA T4

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

Intrinsically Safe

FM 3610 **C22.2 No. 157** **CSA E60079-11** **EN 60079-11**	PENDING

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*.

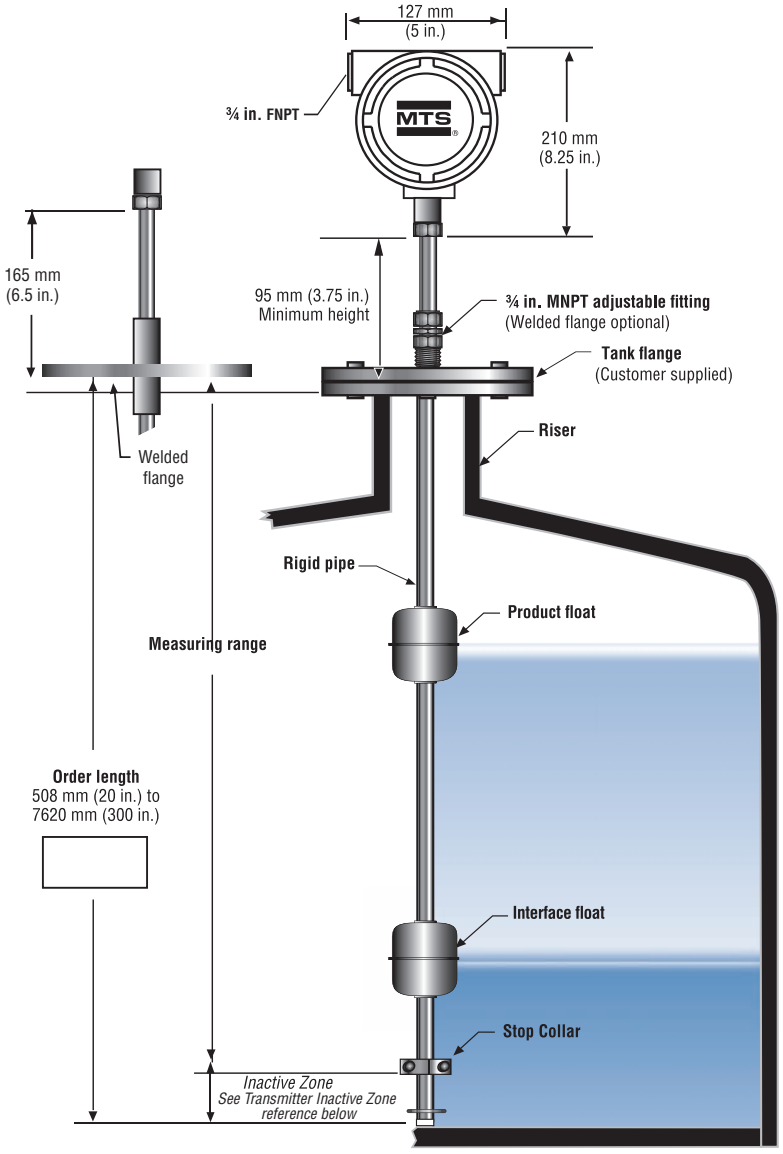
MTS has developed a DD file for the *Rosemount® 375 or 475* which includes all of the required programming capabilities.

Installation guideline, rigid pipe

MTS offers the Level Plus Model MG transmitter configured with a rigid pipe constructed of 316L 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'* of 74 mm (2.9 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 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.)

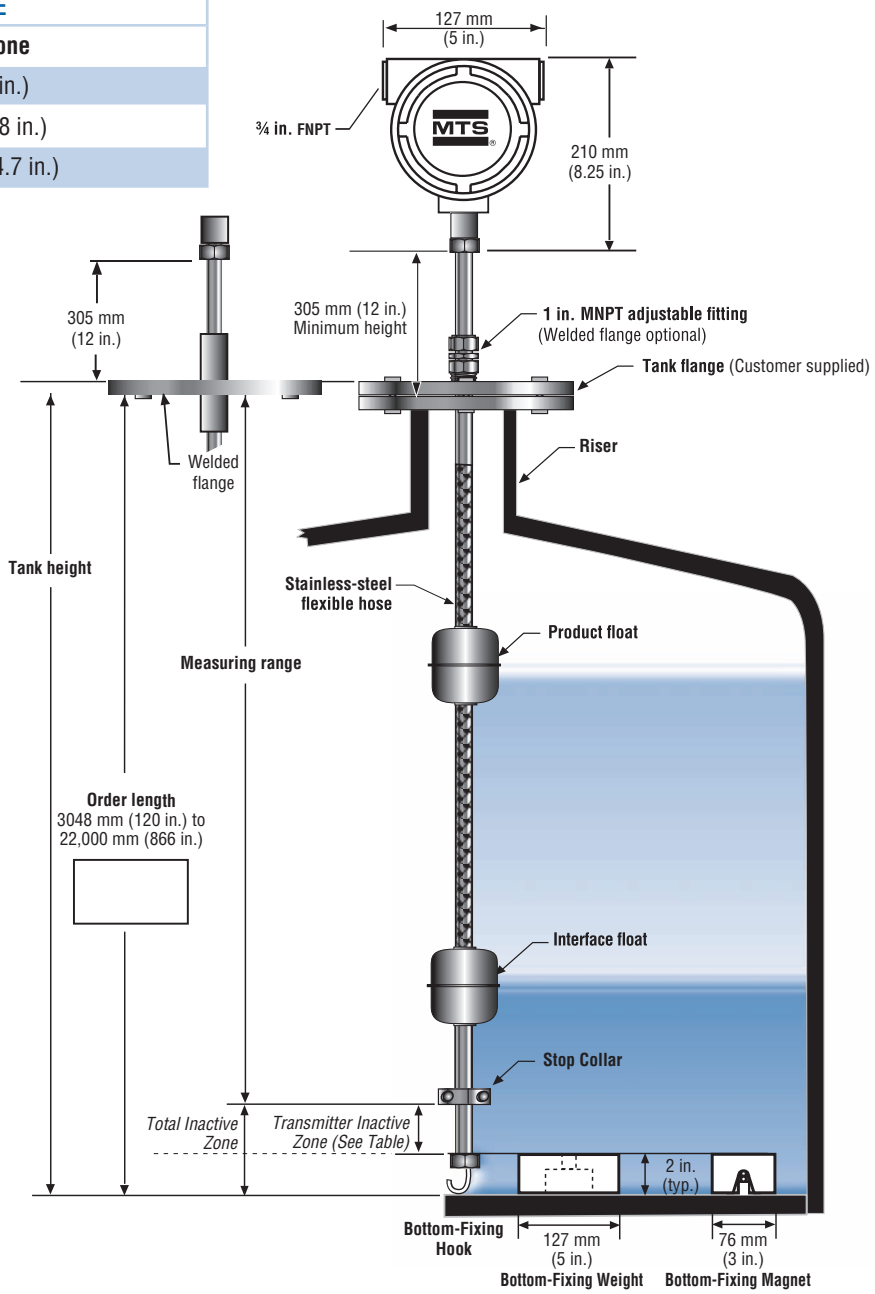
Installation guideline, flexible hose

MTS offers the Level Plus Model MG transmitter configured with a Flexible hose constructed of 316L 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.

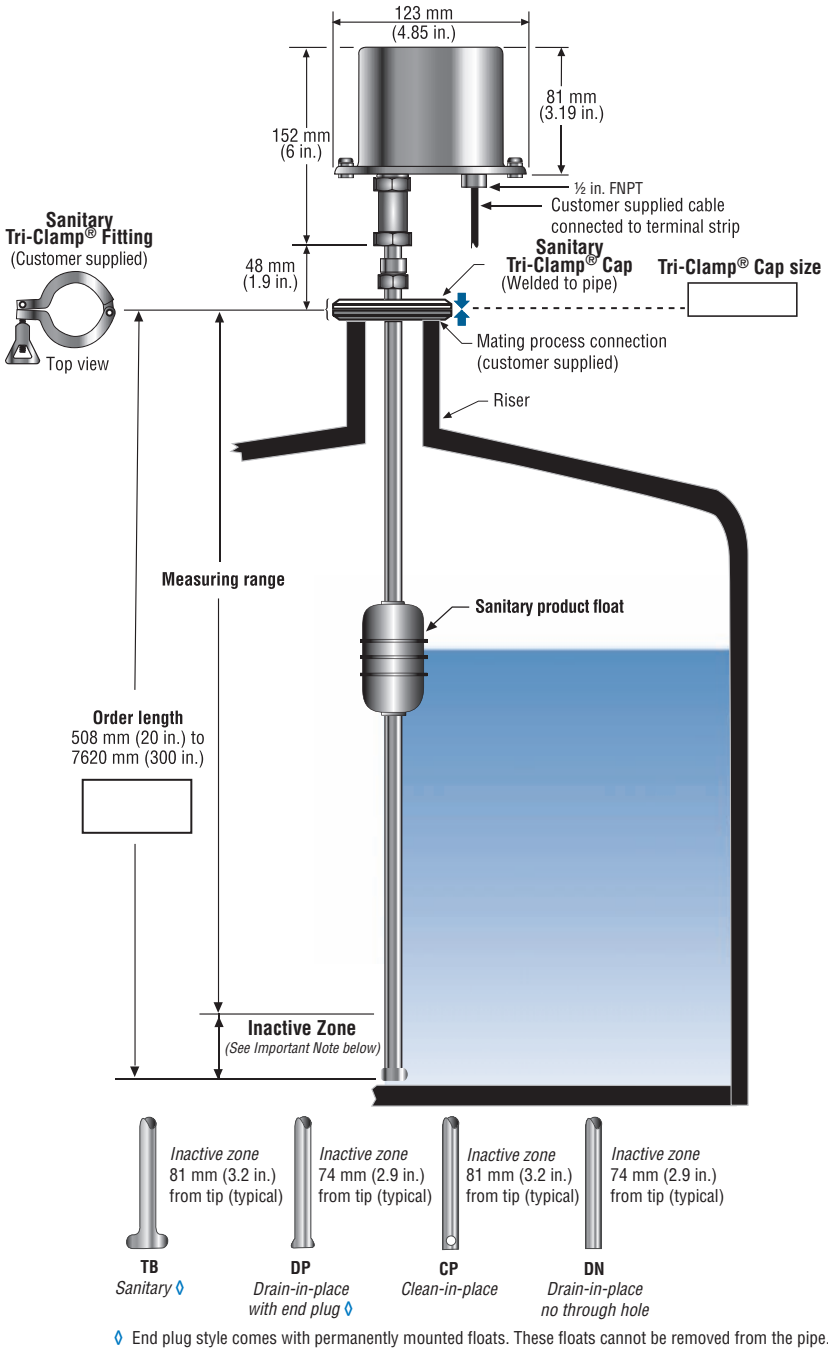
TRANSMITTER INACTIVE ZONE REFERENCE	
Length	**Inactive Zone**
< 7.6 m (25 ft.)	76 mm (3 in.)
< 12.2 m (40 ft.)	97 mm (3.8 in.)
< 22 m (72.2 ft.)	120 mm (4.7 in.)



Installation guideline, sanitary pipe

MTS offers the Level Plus Model MG transmitter configured with a Sanitary pipe constructed of 316L 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 µm (0.625 µm) finish, however an electropolish option is also available with a Ra 15 µm (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)*. 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 = Digital output level transmitter

INPUT POWER = **A** 3

A = 24 Vdc

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 = 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 approval

TRANSMITTER MODEL — = M 1

M = Magnetostrictive transmitter

TYPE — = G 2

G = Digital output level transmitter

INPUT POWER — = A 3

A = 24 Vdc

OUTPUT — = ☐ 4

M = Modbus RTU data format
D = MTS DDA
F = FOUNDATION™ fieldbus (Not approved)

HOUSING TYPE — = ☐ 5

F = NEMA Type 4X, 316L stainless steel with blue cable (ATEX IIA)
G = Single cavity (ATEX IIA)
H = Dual cavity (ATEX IIA)
P = NEMA Type 4X, 316L stainless steel with blue cable (ATEX IIB)
R = Single cavity (ATEX IIB)
S = Dual cavity (ATEX IIB)
4 = NEMA Type 4X, 316L stainless steel with internal terminal block (ATEX IIA)
5 = NEMA Type 4X, 316L stainless steel with internal terminal block (ATEX IIB)

ELECTRONICS MOUNTING — = ☐ 6

1 = Integral electronics

TRANSMITTER PIPE/HOSE — = ☐ 7

B = 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
5 = Stainless steel, 1,4404 ◊
6 = Stainless steel, 1,4404 electropolished (3A approved, Ra 15 finish) ◊
7 = Hastelloy C ◊
A = Teflon / FEP
B = Teflon / FEP with plastic floats for zone 1, IIA and IIB
◊ Stainless steel floats for Zone 0 IIB or plastic floats for Zone 0 IIA

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. (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.

Ordering information continued

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

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.*

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.)
= Teflon: 508 mm (20 in.) to 6096 mm (240 in.)
= Flexible transmitter: 3048 mm (120 in.) to 22,000 mm (866 in.) except ATEX IIB max. length 13500 mm (531 in.)

SPECIAL = ☐ 18

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

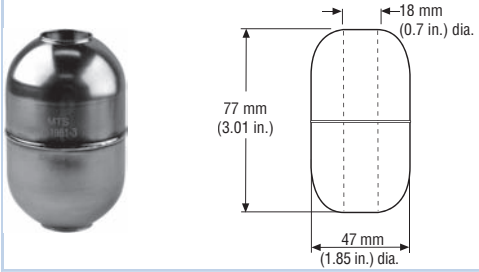
Sandard product floats

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***

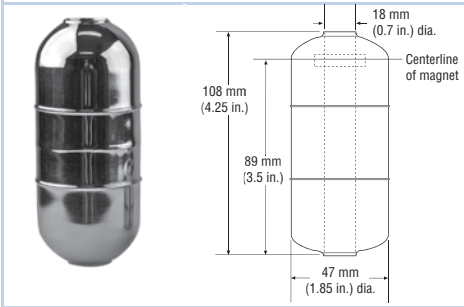
General Notes (for all applications):

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.

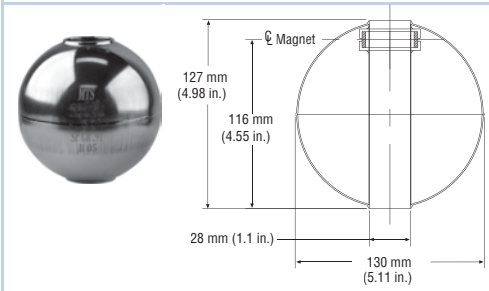
STANDARD PRODUCT FLOAT

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*

Model MG Digital

Level Plus®

Magnetostrictive Liquid-Level Sensors
with Temposonics® Technology

M-Series Model USTD II

Underground Storage Tank Level Sensing
for Leak Detection and Inventory Monitoring

Data Sheet

MTS SENSORS

Model USTD II

Document Reference Number
550949 Revision F

FEATURES

- **DDA Output**
- **3-in-1 Measurement**
  - **Product**
  - **Interface**
  - **Temperature**
- **No Scheduled Maintenance or Recalibration**
- **Non-linearity 0.025% F.S.**
- **Intrinsically Safe (I.S.)**

APPLICATIONS

- **Underground Storage Tanks**
- **Fuels and Solvents**
- **Sumps**

MARKETS

- **Petroleum and Petrochemical**
- **Biotech and Pharmaceuticals**
- **Water and Wastewater**

Level Plus Model USTD II
Liquid-Level Transmitter

Product overview

The Level Plus® Model USTD II level transmitter is designed for use in Underground Storage Tanks (UST). The most common UST application is containing automotive fuels at gas stations. The Model USTD II 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!***

The Model USTD II transmitter uses a proprietary ASCII based protocol referred to as Direct Digital Access (DDA) for communication. The DDA output utilizes a 4-wire, multi-drop power and data bus RS-485 network. Utilizing the data bus network eliminates requirements for individual cable runs to and from each tank. The RS-485 network also allows for longer cable runs for more tanks and greater distances.

ISO 9001 CERTIFIED

FM APPROVED

CE Ex

Product specifications

Parameters	Specifications
LEVEL OUTPUT	
Measured variable:	Product level and interface level
Output signal / Protocol:	DDA
Order length:	**Rigid pipe:** 737 mm (29 in.) to 3785 mm (149 in.) §Δ § Order length equals the distance from the bottom of the housing to the tip of the pipe, (including the inactive zone). Δ Contact factory for longer lengths.
Non-linearity:	0.025% F.S. or 0.794 mm (1/32 in.)◊
Repeatability:	0.001% F.S. or 0.381 mm (0.015 in.)◊ ◊ Whichever is greater.
TEMPERATURE OUTPUT	
Measured variable:	Average and multipoint temperatures Up to 5
Accuracy:	± 0.28 °C (± 0.5 °F)
ELECTRONICS	
Input voltage:	10.5 to 30.1 Vdc 28 Vdc maximum for I.S. ATEX approval
Fail safe:	High, Full scale
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:	IP 68
Humidity:	0 to 100% relative humidity, noncondensing
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)
Vessel pressure:	4 bar (60 psi)
Materials:	**Wetted parts:** 316L stainless steel **Non wetted parts:** 316L stainless steel
FIELD INSTALLATION	
Housing dimensions:	51 mm (2 in.) dia. by 132 mm (5.2 in.) height
Mounting:	¾ in. Adjustable NPT fitting (ATEX, FM) or Fill tube hanger (FM only)
Wiring:	4-wire, plus earth ground
Electrical Connections:	5-pin M12 connector

Agency approvals

Intrinsically Safe

FM 3610	Class I, Division 1, Groups A, B, C and D T4 Division 1, NEMA Type 4X
EN 50020	PTB 04 ATEX 2107 X Ex II 1/2 G bzw. II 2 G EEx ia IIB T4 bzw. EEx ia IIA T4 **

(Fill tube hanger mount is not ATEX approved)

MTS DDA setup software

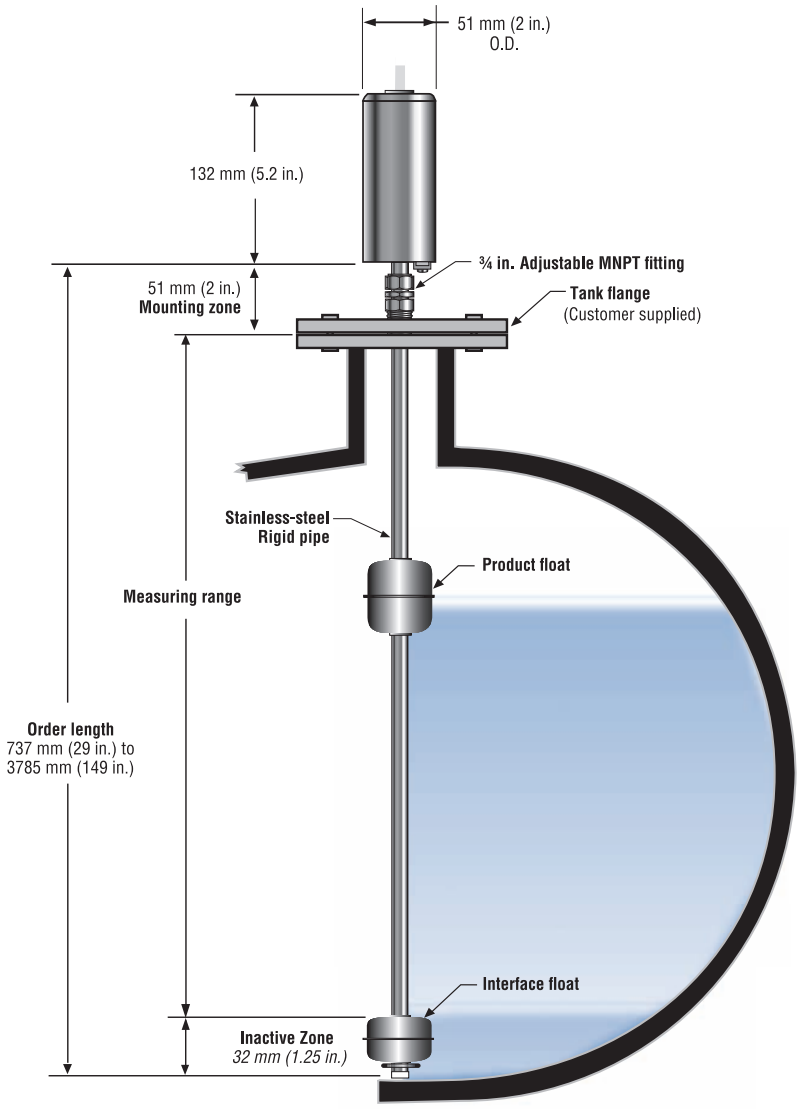
MTS developed the DDA Setup software to help customers program and customize their installed Model USTD II transmitter. The DDA Setup software allows the user to change addresses, calibrate current tank levels, and create a backup and restore file of current settings. The backup and restore file allows the customer to replace the electronics or transmitter and restore all previously defined settings.

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, updates are available for download from our public website at ***http://www.mtssensors.com***.

Installation guideline, external mount

MTS offers the Level Plus Model USTD II transmitter configured with a rigid pipe constructed of 316L stainless steel. The rigid pipe configuration can be ordered in lengths from 737 mm (29 in.) to 3785 mm (149 in.). The Model USTD II can be installed using a flange mount *(see illustration below)*. The flange mount allows the transmitter to be installed external to the tank through a flange with a ¾ in. MNPT Adjustable fitting which is FM and ATEX approved. The NPT fitting allows the transmitter mount to be adjusted (within an inch) if the tank height and order length are not exactly equal.

The '*Measuring range*' of the Model USTD II transmitter is equal to the '*Order length'* minus the '*Mounting zone'* at 51 mm (2.0 in.) and the '*Inactive zone'* of 32 mm (1.25 in.). The Model USTD II transmitter can be ordered with a single product float or can include the optional interface float *(Refer to page 33 for float specifications)*. Average and individual temperature measurement from five positions are included.

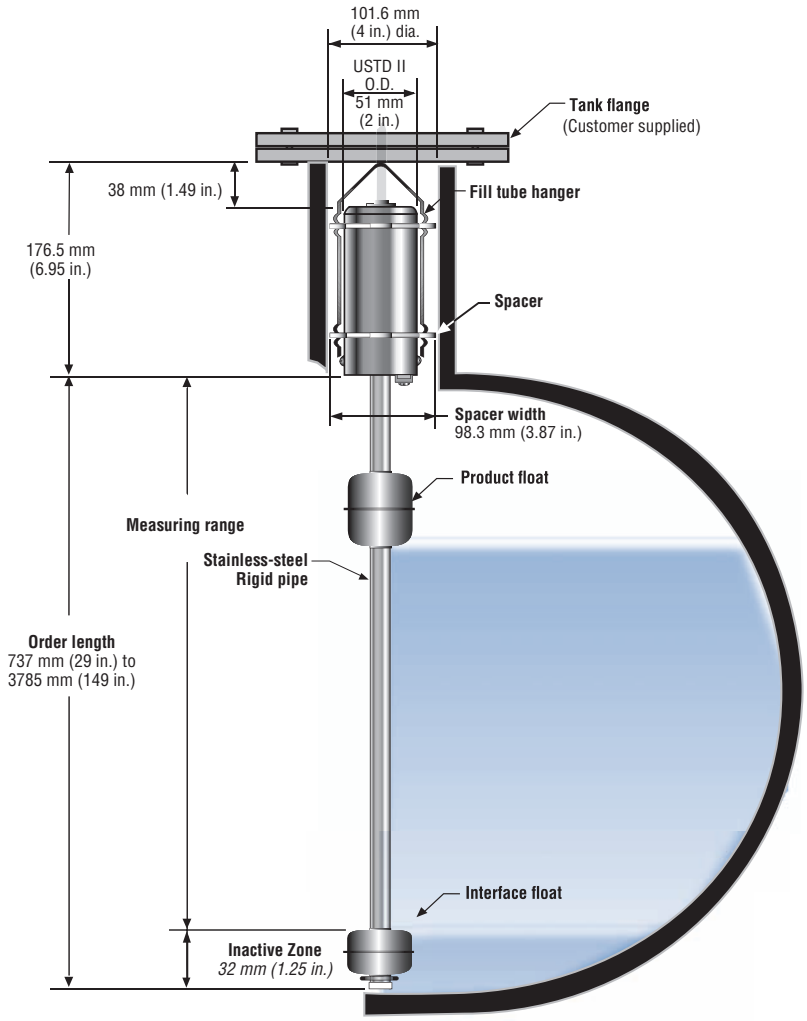


Installation guideline, internal mount

MTS offers the Level Plus Model USTD II transmitter configured with a rigid pipe constructed of 316L stainless steel. The rigid pipe configuration can be ordered in lengths from 737 mm (29 in.) to 3785 mm (149 in.). The Model USTD II can be installed using a *Fill Tube Hanger* mount *(see illustration below)*. The fill tube hanger mount allows the transmitter to be installed in the fill tube or riser pipe within the tank and is FM approved.

The '*Measuring range*' of the Model USTD II transmitter is equal to the '*Order length'* minus the '*Inactive zone'* of 32 mm (1.25 in.). The overall length of the transmitter in the tank is equal to the '*Order length'* plus the height of the housing and bracket at 176.5 mm (6.95 in.) The Model USTD II transmitter can be ordered with a single product float, or can include the optional interface float *(Refer to page 33 for float specifications)*. Average and individual temperature measurement from five positions are included.

***** The fill tube hanger mount is not available with ATEX approval***



Ordering information

TRANSMITTER MODEL = U S T D I I (1 - 6)

M-Series Model USTD II liquid-level transmitter

UNIT OF MEASURE = [ ] (7)

M = Metric (millimeters)
U = US Customary (inches)

TRANSMITTER ORDER LENGTH = [ ][ ][ ][ ] (8 - 11)

Length	Code
Millimeters	= XXXX (737 mm to 3785 mm)
Inches	= 0XXX (29 in. to 149 in.)

MOUNTING AND CATEGORY OF APPARATUS = [ ] (12)

H = Fill tube mounting (hanger with centering spacers) FM Approved
A = Flange mounting (¾ in. MNPT adjustable fitting) FM Approved
6 = Flange mounting (¾ in. MNPT adjustable fitting) ATEX Approved

MOUNTING TYPE = [ ] (13)

S = Standard product without cable (FM Approved)
9 = Standard product without cable (ATEX Approved)
7 = Cable gland and integral blue cable (ATEX Approved)

STANDARD FEATURES

Five DT's, evenly spaced
Data output format (USTD type)

USTD II CABLE ASSEMBLY OPTION

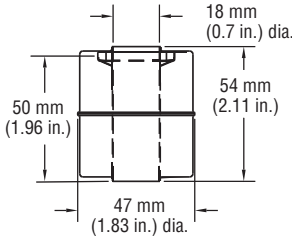
Description	Part number
5 m straight connector cable (ATEX)	402486
2 m straight connector cable (FM)	530049
2 m 90° connector cable (FM)	370481

Standard product and interface float selection

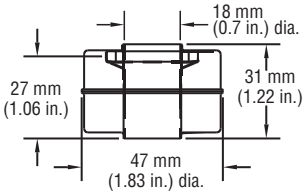
The table below lists standard product and interface float selections. Consult the factory for help in selecting the correct float for your application. For detailed information about all liquid-level product accessories, refer to the *'Level Plus Accessories Catalog, document Number 551103'* from a link on the following MTS Level Product Support page:

http://www.mtssensors.com*/products/liquid-level-sensors/accessories/index.html*

PRODUCT FLOAT

Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
 	4 bar (60 psi)	149 °C (300 °F)	Yes	0.6	SS	Yes	201605-2

INTERFACE FLOAT

Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
 	4 bar (60 psi)	149 °C (300 °F)	Yes	0.85 - 0.9	SS	Yes	201606-2

Level Plus®

Magnetostrictive Liquid-Level Sensors
with Temposonics® Technology

Product Accessories

Floats, Weights, Meters, Enclosures, Indicators,
Interface Terminals and Programming

MTS SENSORS

Accessories

Document Reference Number
551103 Revision D

FEATURES

- **Variety of Styles and Sizes to Fit Most Applications**
- **Available in 316L Stainless Steel, Aluminum, Teflon®, Hastelloy® C and Nitrophyl®**
- **Custom Weighting Available**

APPLICATIONS

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

MARKETS

- **Petroleum and Petrochemical**
- **LPG Terminals**
- **Biotech and Pharmaceutical**
- **Food and Beverage**
- **Waste and Wastewater**

MTS Offers a Variety of M-Series Liquid-Level Product Accessories to Choose From

Accessories overview

MTS Sensors offers a variety of floats to meet your application needs. Our floats come in a variety of sizes from less than 38 mm (1.5 in.) up to 178 mm (7 in.) in diameter. Float materials are available in stainless steel, Teflon®, Aluminum, Hastelloy® C and Nitrophyl®.

Offset weighted floats are also available for applications requiring ATEX approval. Product viscosity, specific gravity, and temperature can vary widely in a process or tank gauging application. Because of these variables and others, such as tank pressure and corrosiveness, no one float can meet all requirements. Therefore, a variety of float styles are available and we will assist you in choosing the one that best meets your requirements.

When choosing a float for your application, MTS recommends you choose one that has a specific gravity of at least 0.05 less than that of the measured liquid. For interface measurement, a minimum of 0.05 specific gravity differential is recommended between upper and lower liquids.

MTS Sensors also offers a variety of meters, housings, and calibration equipment as accessories to our transmitter range. Meters are available for analog, DDA, and Modbus outputs.

For more information, please contact the MTS Sensors' applications department or go to www.mtssensors.com for more information.

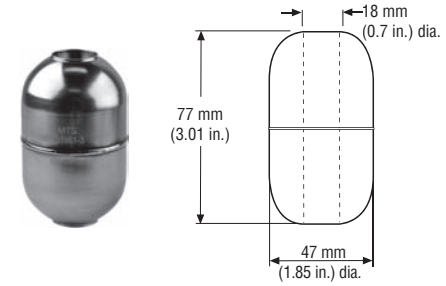
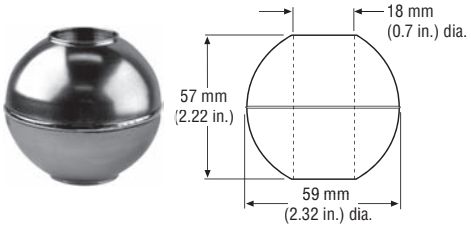
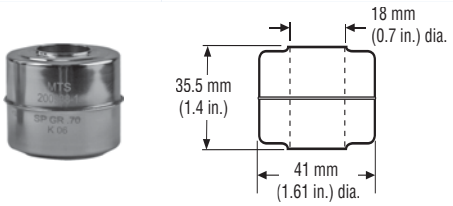
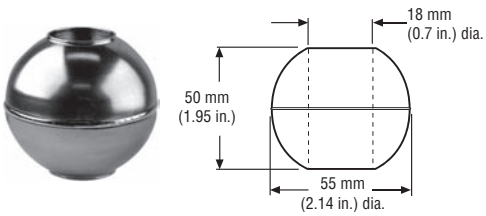
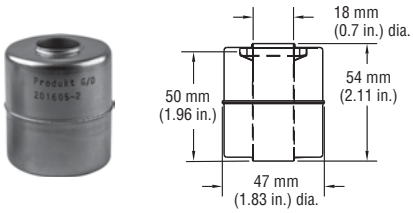
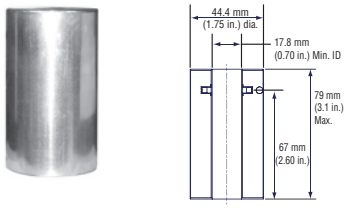
FM APPROVED

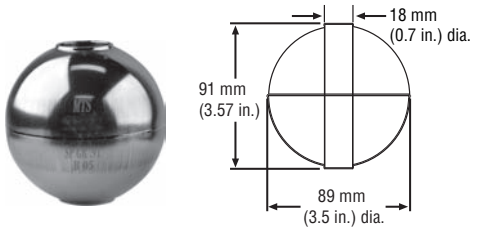
ISO 9001 CERTIFIED

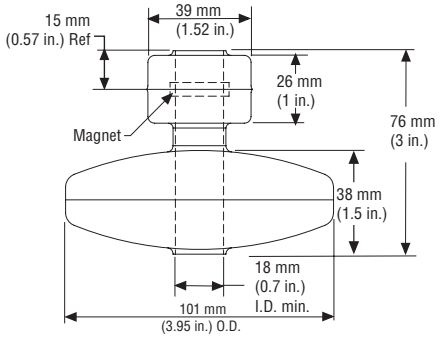
Standard Float Options

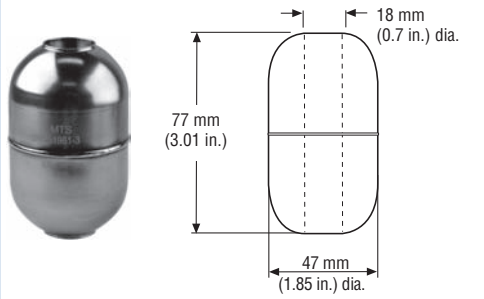
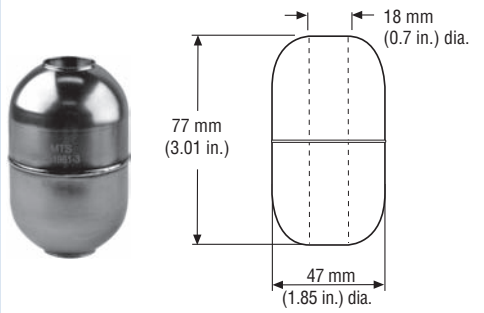
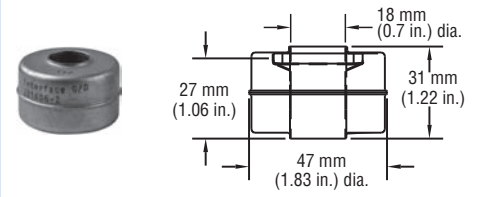
General Notes:

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. When the magnet is not shown, the magnet is positioned at the center line of float.
4. 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.
5. Drawings contained in this document are for reference only. Contact the factory for engineering drawings.
6. *Call for specific lead times. Typical lead time exceeds lead time of the transmitter.

STANDARD PRODUCT FLOATS **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*
	22.4 bar (325 psi)	149 °C (300 °F)	No	0.48	SS	No	251387-1
				0.48	SS	Yes	251387-2*
	8.6 bar (125 psi)	149 °C (300 °F)	No	0.74	SS	No	200938-1
				0.74	SS	Yes	200938-2*
	51.7 bar (750 psi)	149 °C (300 °F)	No	0.74	SS	No	252354*
	4 bar (60 psi)	149 °C (300 °F)	Yes	0.6	SS	Yes	201605-2
	29.3 bar (425 psi)	149 °C (300 °F)	Yes	0.45	Aluminum	No	201693-1
				0.45	Aluminum	Yes	201693-2

STANDARD PRODUCT FLOATS 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	0.43	SS	No	251469-1
				0.45	SS	Yes	251469-2*

LOW-LIFTOFF FLOAT Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
	8.6 bar (125 psi)	149 °C (300 °F)	Yes	0.65	SS	No	252228-3*

STANDARD INTERFACE FLOATS 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	0.90 - 0.96	SS	No	251982-1
						Yes	251982-2*
					Hastelloy C	No	251982-3
						Yes	251982-4*
	29.3 bar (425 psi)	149 °C (300 °F)	No	1.03 - 1.10	SS	No	251983-1
						Yes	251983-2*
					Hastelloy C	No	251983-3*
						Yes	251983-4*
	4 bar (60 psi)	149 °C (300 °F)	Yes	0.85 - 0.9	SS	Yes	201606-2

Sanitary Float Options

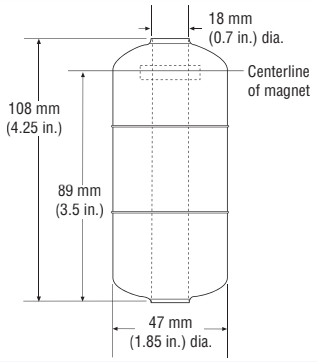
General Notes (for sanitary applications):

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.

Notes:

1. Float meets 3A Sanitary specifications.
2. Use this float with all Sanitary transmitter wells as other floats may enter the inactive zone when the tank is emptied.

SANITARY FLOATS
Float and dimension reference

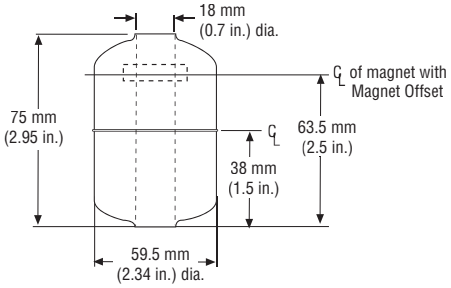


Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
10.3 bar (150 psi)	149 °C (300 °F)	Yes	0.66	SS 200 Grit/ Ra 25 µm (0.625 µm)	No	401513-1
					Yes	401513-2*
				SS 240 Grit/ Ra 15 µm (0.375 µm)	No	401513-3*
					Yes	401513-4*

Notes:

1. Float meets 3A Sanitary specifications.
2. Float may enter the inactive zone when used with 3A Sanitary transmitter wells.

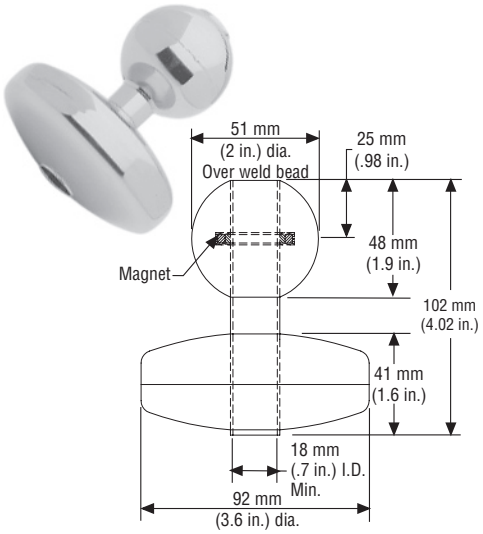
Float and dimension reference



Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
22.4 bar (325 psi)	149 °C (300 °F)	No	0.63	SS 200 Grit/ Ra 25 µm (0.625 µm)	No	200931-1*
					Yes	200931-2*
				SS 240 Grit/ Ra 15 µm (0.375 µm)	No	200931-3*
					Yes	200931-4*
22.4 bar (325 psi)	149 °C (300 °F)	Yes	0.63	SS 200 Grit/ Ra 25 µm (0.625 µm)	No	200931-5*
					Yes	200931-6*
				SS 240 Grit/ Ra 15	No	200931-7*
					Yes	200931-8*

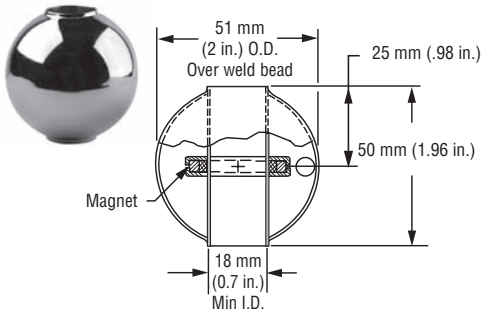
Note:

Use this float with all Sanitary transmitter wells as other floats may enter the inactive zone when the tank is emptied.

SANITARY FLOATS CONTINUED Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
	8.6 bar (125 psi)	149 °C (300 °F)	Yes	048	SS 240 Grit/ Ra 15 µm (0.375 µm)	No	252228-1*

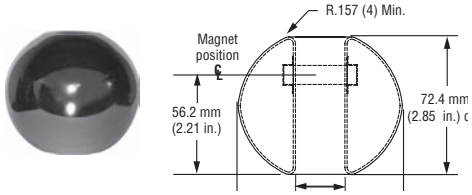
Notes:

1. Float meets clean-in-place and drain-in-place applications.
2. Float may enter the inactive zone. Consult factory about viability of usage.

Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
	22.4 bar (325 psi)	149 °C (300 °F)	No	0.74	SS 240 Grit/ Ra 25 µm (0.625 µm)	No	251234-1*
						Yes	251234-2*

Notes:

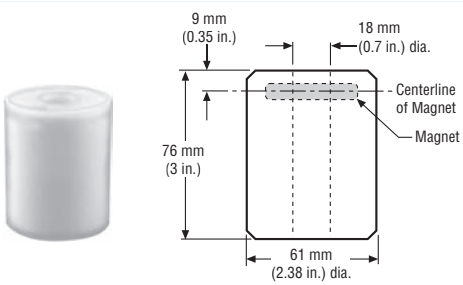
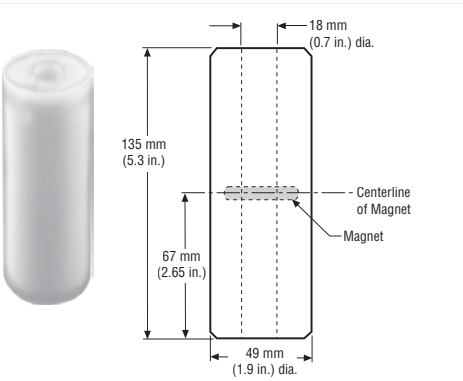
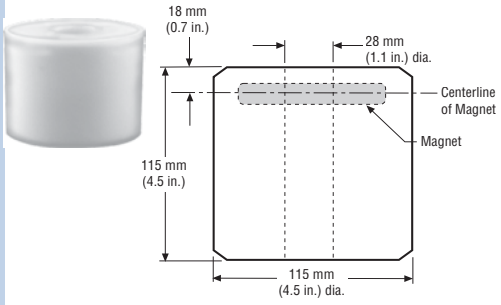
1. Float meets 3A Sanitary specifications.
2. Float meets clean-in-place and drain-in-place applications.
3. Float may enter the inactive zone. Consult factory about viability of usage.

Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
	8.6 bar (125 psi)	149 °C (300 °F)	Yes	0.83 - 0.86	SS 240 Grit/ Ra 15 µm (0.375 µm)	Yes	560564-2*

Teflon Float Options

General Notes:

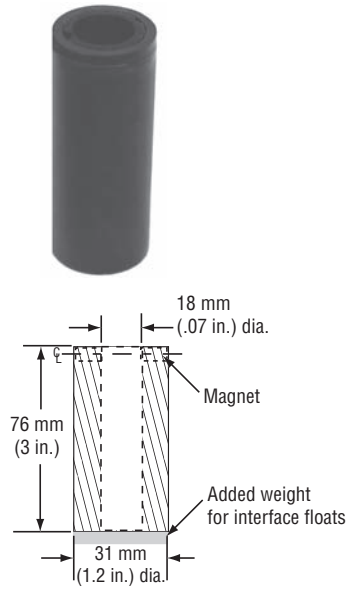
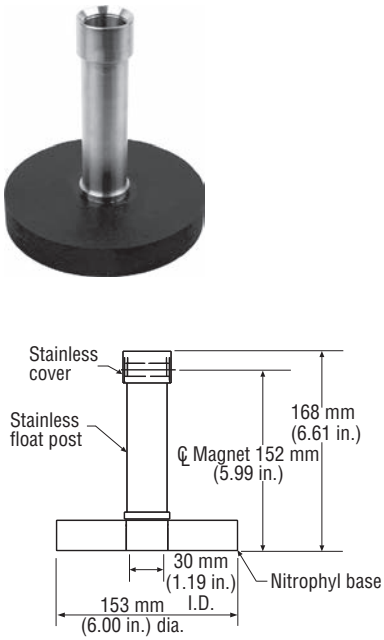
1. Be sure that the float specific gravity is at least 0.05 less than that of the measured liquid as a safety margin at ambient temperature.
2. For interface measurement: A minimum of 0.05 specific gravity differential is required between the upper and lower liquids.
3. When the magnet is not shown, the magnet is positioned at the center line of float.
4. 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.
5. Drawings contained in this document are for reference only. Contact the factory for engineering drawings.
6. *Call for specific lead times. Typical lead time exceeds lead time of the transmitter.

TEFLON FLOATS **Float and dimension reference**	**Pressure**	**Temp.**	**Magnet offset**	**Specific gravity**	**Material**	**Weight offset**	**Part number**
	1.7 bar (25 psi)	38 °C (100 °F)	Yes	0.86	Teflon	No	201109*
				0.90 - 0.95	Teflon	No	251115*
				1.04 - 1.11	Teflon	No	251116*
	1.7 bar (25 psi)	38 °C (100 °F)	No	0.86	Teflon	No	251939*
	1.7 bar (25 psi)	38 °C (100 °F)	Yes	0.9 - 0.95	Teflon	No	251119*
				1.04 - 1.11	Teflon	No	251120*

Teflon Floats

General Notes:

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. When the magnet is not shown, the magnet is positioned at the center line of float.
4. 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.
5. Drawings contained in this document are for reference only. Contact the factory for engineering drawings.
6. *Call for specific lead times. Typical lead time exceeds lead time of the transmitter.

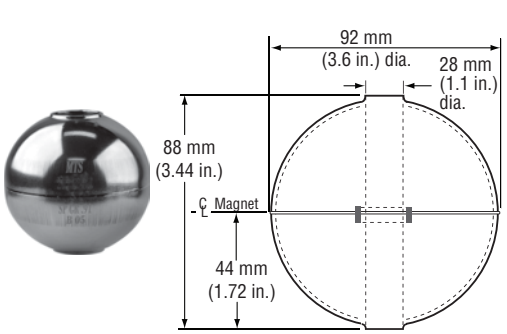
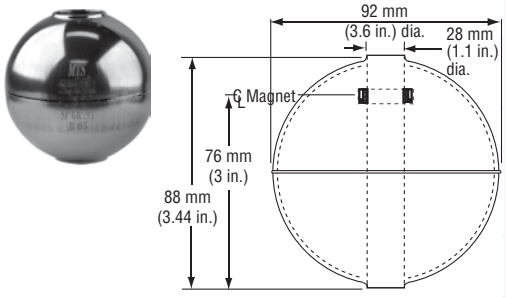
NITROPHYL FLOATS **Float and dimension reference**	**Pressure**	**Temp.**	**Magnet offset**	**Specific gravity**	**Material**	**Weight offset**	**Part number**
	17.2 bar (250 psi)	104 °C (220 °F)	Yes	0.39	Nitrophyl	No	201643-1
						Yes	201643-2
				0.80 - 0.86	Nitrophyl	No	201649-1
						Yes	201649-2
				0.91 - 0.96	Nitrophyl	No	201650-1
						Yes	201650-2
	17.2 bar (250 psi)	104 °C (220 °F)	Yes	0.90 - 0.96	Nitrophyl	No	252999*

Nitrophyl Floats

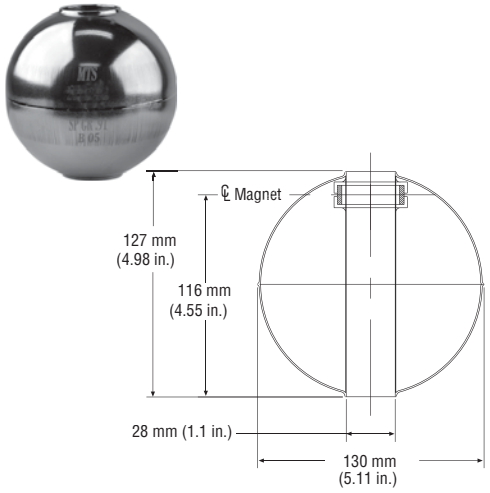
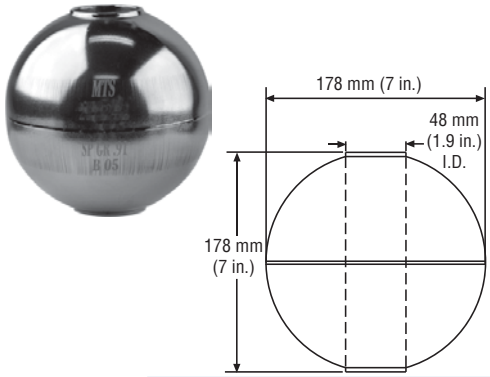
Long-gauge Float Options

General Notes:

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. When the magnet is not shown, the magnet is positioned at the center line of float.
4. 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.
5. Drawings contained in this document are for reference only. Contact the factory for engineering drawings.
6. *Call for specific lead times. Typical lead time exceeds lead time of the transmitter.

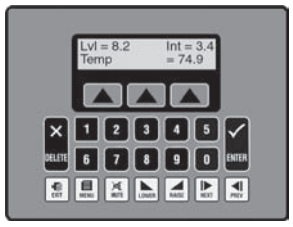
LONG-GAUGE FLOATS **Float and dimension reference**	**Pressure**	**Temp.**	**Magnet offset**	**Specific gravity**	**Material**	**Weight offset**	**Part number**
	29.3 bar (425 psi)	149 °C (300 °F)	No	0.54	SS	No	251223-1
				0.65	Hastelloy C	No	251223-3*
				0.90 - 0.96	SS	No	251224-1
					Hastelloy C	No	251224-3*
				1.03 - 1.10	SS	No	251225-1*
					Hastelloy C	No	251225-3*
	29.3 bar (425 psi)	149 °C (300 °F)	Yes	0.54	SS	No	252961-1
						Yes	252961-2*
				0.90 - 0.96	SS	No	252962-1
						Yes	252962-2*
				1.03 - 1.10	SS	No	252963-1*
						Yes	252963-2*
	37.9 bar (550 psi)	149 °C (300 °F)	No	0.44	SS	No	250709-1*
				0.52	Hastelloy C	No	250709-3*
				0.90 - 0.96	SS	No	250714-1*
					Hastelloy C	No	250714-3*
				1.03 - 1.10	SS	No	250855-1*
					Hastelloy C	No	250855-3*

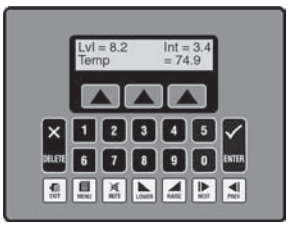
Long-Gauge Floats

LONG-GAUGE FLOATS (CONTINUED) Float and dimension reference	Pressure	Temp.	Magnet offset	Specific gravity	Material	Weight offset	Part number
	37.9 bar (550 psi)	149 °C (300 °F)	Yes	0.44	SS	No	201248-1
				0.44		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*
	17.2 bar (250 psi)	149 °C (300 °F)	No	0.44	SS	No	251426-1*
						Yes	251426-2*
				0.47	Hastelloy C-22	No	251426-3*
						Yes	251426-4*
				0.90 - 0.96	SS	No	251427-1*
						Yes	251427-2*
					Hastelloy C-22	No	251427-3*
						Yes	251427-4*
				1.03 - 1.10	SS	No	251428-1*
						Yes	251428-2*
	22.4 bar (325 psi)	149 °C (300 °F)	No	0.66	SS	No	201232-1
						Yes	201232-2*
				0.70	Hastelloy C	No	201232-3*
						Yes	201232-4*
				0.92 - 0.96	SS	No	201233-1*
						Yes	201233-2*

ANALOG PROCESS METERS		Part number
	**LED Display Universal Analog Process Meter** Precision Digital PD6000-6R0 6 Digit LED display **Input:** Analog 4-20 mA **Output:** None 110 VAC Input Power 32 point linearization Includes 24 Vdc transmitter supply **Material:** Standard 1/8 in. DIN, high impact plastic, NEMA Type 4X front panel	380071
	**LED Display Universal Analog Process Meter (2 Relays)** Precision Digital PD6000-6R2 6 Digit LED display **Input:** Analog 4-20 mA **Output:** 2 relays 110 VAC Input Power 32 point linearization Includes 24 Vdc transmitter supply **Material:** Standard 1/8 in. DIN, high impact plastic, NEMA Type 4X front panel	380072
	**LED Display Universal Analog Process Meter (4 Relays)** Precision Digital PD6000-6R4 6 Digit LED display **Input:** Analog 4-20 mA **Output:** 4 relays 110 VAC Input Power 32 point linearization Includes 24 Vdc transmitter supply **Material:** Standard 1/8 in. DIN, high impact plastic, NEMA Type 4X front panel	380073
	**LED Display Universal Analog Process Meter (2 Relays, 4-20 mA)** Precision Digital PD6000-6R5 6 Digit LED display **Input:** Analog 4-20 mA **Output:** 4-20 mA and 2 relays 110 VAC Input Power 32 point linearization Includes 24 Vdc transmitter supply **Material:** Standard 1/8 in. DIN, high impact plastic, NEMA Type 4X front panel	380095
	**XP Loop Powered Analog Meter** Loop Powered on 4-20 mA output Displays in Percentage Only Embedded in XP Housing **XP:** Class I, II, III; Division 1; Groups B-G **IS:** Class I, II, III; Division 1; Groups A-G	380062
	**Loop Powered Analog Meter** F070-A-HG-PL-X1-ZB Loop Powered on 4-20 mA output Displays loop current, engineering units, and/or value Selectable on screen engineering units IP 67 / NEMA Type 4X Intrinsically Safe, backlight	380088

ANALOG PROCESS METERS (CONTINUED)		Part number
	**Multi-Channel Consolidating Analog Process Meter** Precision Digital PD941-8K9-15 **Input:** 4 Analog 4-20 mA **Output:** 4 Analog 4-20 mA, 9 relays 110 VAC Input Power 32 point linearization	380089

MODBUS PROCESS METERS		Part number
	**Multivariable Modbus Process Meter** Display levels in feet, inches, and 16ths of an inch Scrolling Display of Product, Interface, Temperature, or combination **Input:** RS485 Modbus RTU **Output:** 2 Form A relays and 4-20 mA 110 VAC Input Power 16 point linearization Includes 24 Vdc transmitter supply **Material:** Standard 1/8 in. DIN, high impact plastic, NEMA Type 4X front panel	380086
	**Single Variable Modbus Process Meter** Precision Digital PD865-6R5-16 6 Digit Display in Decimal Format Display 1 process variable without interrupting Master/Slave communication **Input:** RS485 Modbus RTU **Output:** 2 Form A relays and 4-20 mA 110 VAC Input Power 16 point linearization Includes 24 Vdc transmitter supply **Material:** Standard 1/8 in. DIN, high impact plastic, NEMA Type 4X front panel	380094
	**Modbus Master Display** Modbus Master Display Product, Interface, and Temperature **Input:** 7 Modbus transmitters **Output:** None UL Class 1, Div. 2 approved	253023-3

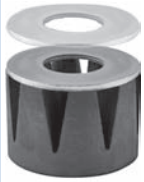
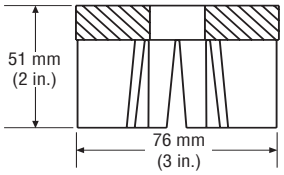
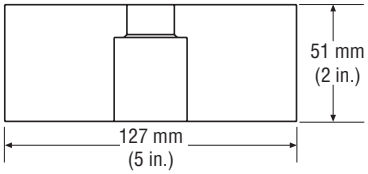
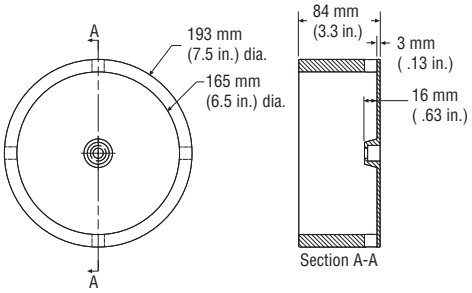
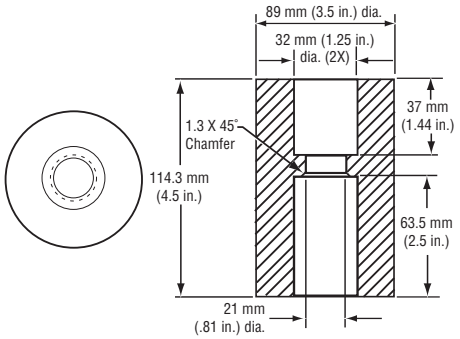
DDA PROCESS METERS		Part number
	**DDA Spy Display** DDA Slave Display Product, Interface, and Temperature **Input:** 1 DDA transmitters **Output:** None UL Class 1, Div. 2 approved	253023-2

Process Meters and Enclosure Options

PROCESS METER ENCLOSURES		Part number
	**XP Enclosures••** Display 380086 or 380094 Display 380088 •• *XP Enclosures are available for most process meters, please contact factory for more information.*	561452 561453
	**NEMA Enclosures†** **Single NEMA 4X** (PDA 2811) **Dual NEMA 4X** (PDA 2302) † *NEMA Enclosures are available for most process meters, please contact factory for more information.*	401150 401151
MODBUS TERMINALS		**Part number**
	**LCD Modbus Terminal** Displays up to 4 tanks (2 levels, temp, volume) Displays up to 8 tanks (2 levels, temp) Displays levels in ft., in, and 16ths in. **Input:** Up to 8 Modbus transmitters **Output:** Modbus Mounted in NEMA 4 box Class 1 Div. 2 Includes Power Supply Calibrate from Screen	280494-X
	**Touchscreen Modbus Terminal** Displays up to 16 tanks (2 levels, temp, volume) Displays levels in ft., in, and 16ths in. **Input:** up to 16 Modbus transmitters **Output:** Modbus Pictorial display of tanks Touchscreen Mounted in NEMA 4 box Class 1 Div. 2 Includes Power Supply Calibrate from Screen	280508

PROGRAMMING ACCESSORIES		Part number
	**HT100 Hand Held Terminal** M-Series Model MG Transmitter with DDA output Remote setup, troubleshooting, and maintenance	251259
SETUP SOFTWARE		**Part number**
	**M-Series Model MG with Modbus** PC setup software on CD Includes RS-485 to RS-232 adapter, part no. 380075	625051
	M-Series Model MG with Modbus PC setup software on CD	625052
	M-Series Model MG with DDA PC setup software on CD	625053
	M-Series Model MR PC setup software on CD Includes HART adapter, part no. 380068	252273-1
	M-Series Model MR PC setup software on CD	252273-2
HARDWARE		**Part number**
	**HART to RS-232 adapter** (SMAR H1-311)	380068
	RS-485 to RS-232 adapter converter (B & B Electronics)	380075
	**Hex Bushing** 2 in. MNPT x 3/4 in. FNPT	561440
	Hex Bushing 2 in. FNPT x 4 in. MNPT	561441
	Hex Bushing 1 in. FNPT x 2 in. MNPT	561448

Magnet and Weight Assembly Options

MAGNET AND WEIGHT ASSEMBLIES		Part number
 	**150 lb. Pull Magnet** For LDF long transmitter and M-Series transmitters. (Top ring must be removed before installation)	560604
 	**Standard 11 lb. Weight** For M-Series transmitters	401059
 	**Low Liftoff 11 lb. Weight Assembly** Use with float, part no. 252999	402364
 	**Narrow 11 lb. Weight** Use with M-Series transmitters	402647

Part Number: 551050, Revision E 02-11 EN

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