Level Plus

Magnetostrictive Liquid Level Transmitters
with Temposonics® Technology
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2. Terms and definitions

6A Heavy Oils
‘Generalized Crude Oils’, Correction of Volume to 60 °F against API Gravity.

6B Light Oils
‘Generalized Products’, Correction of Volume to 60 °F against API Gravity.

6C Chemical
‘Volume Correction Factors (VCF)’ for individual and special applications, volume correction to 60 °F against thermal expansion coefficients.

6C Mod
An adjustable temperature reference for defining VCF.

API Gravity
The measure of how heavy or light a petroleum liquid is compared to water. Allowable values are 0 to 100 degrees API for (6A) and 0 to 85 degrees API for (6B).

DDA
‘Direct Digital Access’ – The proprietary digital protocol developed by MTS for use in intrinsically safe areas.

Density
Mass divided by the volume of an object at a specific temperature. The density value should be entered as lb / cu. ft..

Explosionproof
Type of protection based on enclosure in which the parts which can ignite an explosive gas atmosphere are placed within, and which can withstand the pressure developed during an internal explosion of an explosive mixture, and which prevents the transmission of the explosion to the explosive gas atmosphere surrounding the enclosure.

Flameproof
Type of protection based on enclosure in which the parts which can ignite an explosive gas atmosphere are placed within and which can withstand the pressure developed during an internal explosion of an explosive mixture, and which prevents the transmission of the explosion to the explosive gas atmosphere surrounding the enclosure.

FOUNDATION™ fieldbus
An all digital, serial, two-way communications system that serves as the base-level network in a plant or factory automation environment. Developed and administered by the fieldbus FOUNDATION™.

GOVI
‘Gross Observed Volume of the Interface’ – The total volume of the tank occupied by the interface liquid. The GOVI is only given when measuring two liquids and is calculated by subtracting the volume of the product from the total volume of liquid in the tank (GOVT – GOVP).

GOVP
‘Gross Observed Volume of the Product’ – The total volume of the tank occupied by the product liquid. When measuring only one liquid, it is also the total volume of liquid in the tank (GOVT). When measuring two liquids it is the total volume of liquid in the tank minus the volume of the interface liquid (GOVT – GOVI).

GOVT
‘Total Gross Observed Volume’ – The total volume of liquid in the tank. When measuring only one liquid it is equal to the volume of the product (GOVP). When measuring two liquids it is equal to the volume of the product and interface liquids (GOVP + GOVI).

GOVU
‘Gross Observed Volume Ullage’ – the difference in volume between the working capacity of a tank and the total volume in the tank (Working Capacity – GOVT).

HART®
A Bidirectional communication protocol that provides data access between intelligent field instruments and host systems.

Interface
Noun: The measurement of the level of one liquid when that liquid is below another liquid.

Interface
Adj.: The Software Graphical User Interface (GUI) that allows the user to access software protocols (HART, DDA, MODBUS).

Intrinsic safety
‘Intrinsically safe’ - Type of protection based on the restriction of electrical energy within apparatus of interconnecting wiring exposed to potentially explosive atmosphere to a level below that which can cause ignition by either sparking or heating effects.
**Mass**
The property of a body that causes it to have weight in a gravitational field, calculated by density at the reference temperature multiplied by the volume correction factor \((Density \times VCF)\).

**MODBUS**
A serial communications protocol published by Modicon in 1979 for use with its programmable logic controllers (PLCs). It has become a de facto standard communications protocol in industry, and is now the most commonly available means of connecting industrial electronic devices.

**NEMA Type 4X**
A product Enclosure intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, and hose-directed water; and to be undamaged by the formation of ice on the enclosure. They are not intended to provide protection against conditions such as internal condensation or internal icing.

**NPT**
U.S. standard defining tapered pipe threads used to join pipes and fittings.

**NSVP**
‘Net Standard Volume of the Product’ – The temperature corrected volume for the product liquid in the tank, requires the transmitter to be ordered with temperature measurement capabilities. The NSVP is calculated by multiplying the volume of the product liquid by a volume correction factor based on temperature \((GOVP \times VCF)\).

**Reference Temperature**
The temperature at which the density measurement is given, the allowable values are 32 °F to 150 °F (10 °C to 66 °C).

**Specific Gravity**
The density ratio of a liquid to the density of water at the same conditions.

**Sphere Radius**
The internal radius of the sphere that contains the liquid, the value is used to calculate the volume along with the Sphere Offset.

**Sphere Offset**
An offset value that accounts for additional volume in a sphere from non-uniform sphere geometry, the value is used to calculate the volume along with the Sphere Radius.

**Strap Table**
A table of measurement correlating the height of a vessel to the volume that is contained at that height. The transmitter can contain up to 100 points.

**TEC**
‘Thermal Expansion Coefficient’ - a value correlating the change in temperature for an object with the change in its volume. Allowable values are 270.0 to 930.0. TEC units are in 10 E-6/Deg F.

**Temperature Correction Method**
One of five product correction methods used to correct the product volume in the tank due to changes in temperature from 60 °F including (6A, 6B, 6C, 6C Mod, and Custom Table).

**Volume Calculation Mode**
One of two methods use to calculate volume measurements from level measurements, including Sphere and Strap Table.

**VCF**
‘Volume Correction Factor’ – A table of measurements correlating temperature points with correction factors for the liquid’s expansion/contraction. The transmitter can contain up to 50 points.

**Working Capacity**
The maximum volume of liquid that the user desires for their vessel to hold, typically 80% of the vessel’s maximum volume before overfill.
3. Introduction

3.1 Purpose and use of this manual

Before starting the operation of the equipment read this documentation thoroughly and follow the safety information.

The content of this technical documentation and of its various annexes is intended to provide information on mounting, installation and commissioning by qualified service personnel according to IEC 60079-14 or MTS trained service technicians and local regulations.

3.2 Used symbols and warnings

Warnings are intended for your personal safety and for avoidance of damage to the described product or connected devices. In this documentation, safety information and warnings to avoid dangers that might affect the life and health of personnel or cause material damage are highlighted by the preceding pictogram, which is defined below.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTICE</td>
<td>This symbol is used to point to situations that may lead to material damage and/or personal injury.</td>
</tr>
</tbody>
</table>

4. Safety instructions

4.1 Intended use

The liquid level transmitter is intended to be used to measure the level of liquid(s) contained by a structure as well as the temperature of the liquid. The product may only be used for the applications defined under item 1 to item 4 and only in conjunction with third-party devices and components recommended or approved by MTS Sensors. As a prerequisite of proper and safe operation, the product requires correct transport, storage, mounting and commissioning and must be operated with utmost care.

1. Application does not exceed product's performance specification in section 5.1.
2. Product may only be installed in hazardous areas as specified by approval certifications in section 12 following special conditions of use outlined in section 12 or in safe areas.
3. The liquid(s) being measured are compatible with the selected wetted parts of the product.
4. MTS floats should be used for proper functionality and safety approval.

4.2 Foreseeable misuse

<table>
<thead>
<tr>
<th>Foreseeable misuse</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong sensor connection</td>
<td>Possible damage to electronics. See Section 7 for Electrical Connections</td>
</tr>
<tr>
<td>Improper Installation</td>
<td>Physical damage to packaging. See Section 6 for Installation</td>
</tr>
<tr>
<td>Installation in unapproved Hazardous Area</td>
<td>Potential Spark. See Section 12 for Agency Information</td>
</tr>
</tbody>
</table>

4.3 Installation, commissioning and operation

1. Wear proper personal protection equipment such as hard hat, safety shoes, flame resistant clothing, safety glasses, gloves, and hearing protection.
2. Follow the specifications given in the technical documentation.
3. Two (2) individuals are recommended to conduct proper installation, commissioning, and repair of the level transmitter.
4. Ensure the equipment used in a hazardous environment is selected and installed in compliance with regulations governing the geographical installation and facility. Only install equipment that complies with the types of protection relevant to the applicable classes, division, zones, category, gas group, and temperature code.
5. Protect the sensor against mechanical damage during installation and operation.
6. Do not use damaged products and secure them against unintentional use. Mark damaged products as being defective.
7. Connect the sensor very carefully and pay attention to the polarity of connections. MTS recommends to not make connections while power is live.
8. Before turning on power, ensure that nobody’s safety is jeopardized by starting level transmitter and/or process.
9. Regularly follow preventative maintenance to prevent safety risks.
10. Make sure that no wire strands are loose or sticking out of the terminal block connection which could short and cause a problem.
11. Make sure that no wire strands, including shield, are in contact with the electronic module enclosure.

5. Product overview

The Level Plus® Tank Slayer® Liquid-Level transmitter is a continuous multi-functional magnetostrictive transmitter that provides product level, interface level, and temperature to the user via Modbus, or DDA. Magnetostrictive technology is one of the most accurate and
repeatable level technologies available to date. MTS is the inventor and purveyor of magnetostrictive technology and has been serving the level industry for over 35 years.

**Industries**
- Petroleum
- Liquid petroleum gas
- Pharmaceutical
- Food & beverage
- Chemical
- Mining

**Applications**
- Tank farms
- Terminals
- Bullet tanks
- Separator tanks
- Battery tanks
- Storage tanks
- Solvent extraction

**Features**
- 3-in-1 measurement
- Product level
- Interface level
- Temperature
- No scheduled maintenance or recalibration
- Field repairable
- Inherent Accuracy ±1mm
- 200 Point Strap Table
- API Temperature Corrected Volumes

### 5.1 Components
The Level Plus® Tank Slayer® liquid level transmitter consists of four main components; a housing, outer pipe, float, and electronics. Varying the components of the transmitter allows the transmitter to be customized to almost any application.

**Housings**
Level Plus® Tank Slayer® transmitters are available in three housing configurations; NEMA Type 4X 316L stainless steel, explosion-proof single and dual-cavity housings as shown below:
**Outer pipe configurations**
The outer pipe is constructed of a variety of configurations. The Tank Slayer® is available in a flexible hose. For other pipe options please consult other MTS options such as RefineMe, SoClean, and/or USTDII.

![Outer pipe configuration](image)

**Fig. 4: Outer pipe configuration**

**Floats**
Tank Slayer® transmitters offer numerous floats for different applications such as stainless steel, 3-A sanitary, hastelloy, Teflon, and Nitrophyl for both product level and interface level. To be able to accurately detect the interface level there needs to be a difference of at least 0.05 in specific gravities between the product and interface liquids. For detailed information about floats, refer to the ‘Accessories Catalog’, MTS part number 551103.

For assistance with selecting a specific float for your application, please contact Technical Support with the following information:
- Specific gravity of liquid(s) being measured
- Process temperature
- Process opening size
- Vessel pressure

For ATEX and IECEx approvals, Tank Slayer® transmitters should be used with a float having an offset weight and made of stainless steel or Hastelloy C. This allows the float to stay in contact with the pipe to prevent the buildup of an electrostatic charge. For detailed information about floats, refer to the ‘Accessories Catalog’, MTS part number 551103.

Non-metallic floats with a projected surface area of less than 5,000 mm² should only be used in Zone 0, Gas group IIA such as float part numbers 201643-2, 201649-2, 201650-2, 201109, 251115 and 251116. All other non-metallic floats offered by MTS such as, 251939, 251119, 251120.

**Internal electronics**
All transmitters come with two electronic components of a sensing element and a board set. Flexible sensing elements are standard on Tank Slayer®. The board set consists of up to three electronic boards and a display. The display is capable of displaying the product level, interface level, and temperature. Designed into the display are five buttons for local setup of level transmitter using the stylus.

A temperature sensing function is optional with the Tank Slayer® transmitter. The temperature sensing device is a Digital Thermometer mounted inside the transmitter’s outer pipe assembly. The Tank Slayer® can be ordered with 1, 5, 12, or 16 temperature points.

**Accessories**
MTS also offers a series of displays, housings, converters, and other accessories, please refer to the ‘Accessories Catalog’, MTS part number 551103.

**5.2 Accuracy**
For magnetostrictive transmitters inherent accuracy is measured in terms of non-linearity. Non-linearity is a measurement of any imperfections in the waveguide that are reflected in the linearity of the transmitter’s output. MTS tolerances reflect a maximum non-linearity of ± 1 mm. MTS is able to achieve such strict tolerances by manufacturing all of its own waveguide from a proprietary alloy and testing 100% of all transmitters before shipping.

**5.3 Warranty**

**Important**
Contact Technical Support or Customer Service for assistance if you suspect that the transmitter is not working correctly. Technical support can assist you with troubleshooting, part replacement, and Returned Material Authorization (RMA) information if required.

All Level Plus® transmitters come with a two year limited warranty from the factory shipment date. A Return Materials Authorization (RMA) number is required and must accompany any transmitter returns. Any unit that was used in a process must be properly cleaned in accordance with OSHA standards, before it is returned to the factory. A Material Safety Data Sheet (MSDS) must also accompany the transmitter that was used in any process.

**5.4 Storage**
If storage is required prior to installation, store indoors in a dry environment at ambient temperature range not to exceed -40°C (-40°F) to 71°C (160°F).
## 5.5 Model number identification

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p |
| a | Sensor model | L | P | T | Tank Slayer® Level Transmitter |
| b | Output | M | Modbus |
| c | Housing type | D | DDA |
| d | Electronics mounting | 1 | Standard |
| e | Sensor pipe | M | Flexible, 7/8"OD tube w/bottom fixing eye |
|   |   | N | Flexible, 7/8"OD tube w/bottom fixing weight |
|   |   | P | Flexible, 7/8"OD tube w/bottom fixing magnet |
|   |   | S | Flexible, 7/8"OD tube w/o bottom fixing hardware |
| f | Materials of construction (Wetted parts) | 1 | 316L stainless steel |
|   | Note: | Contact factory for other materials |
| g | Process connection type | 1 | NPT adjustable |
|   |   | 2 | BSPP adjustable |
|   |   | 3 | 150 lb. welded RF flange |
|   |   | 4 | 300 lb. welded RF flange |
|   |   | 5 | 600 lb. welded RF flange |
|   |   | A | PN16, DIN 2572 welded flange |
|   |   | B | PN40, DIN 2572 welded flange |
|   |   | C | PN64, DIN 2572 welded flange |
|   |   | D | PN100, DIN 2572 welded flange |
| h | Process connection size | B | 1 in. (DN25) |
|   |   | D | 2 in. (DN50) |
|   |   | E | 2 ½ in. (DN65) |
|   |   | F | 3 in. (DN80) |
|   |   | G | 4 in. (DN100) |
|   |   | H | 5 in. (DN125) |
|   |   | J | 6 in. (DN150) |
|   |   | X | None |
| i | Number of DT’s (Digital Thermometer) | 0 | None |
|   |   | 1 | One DT |
|   |   | 5 | 5 DTs |
|   |   | K | Twelve DTs |
|   |   | M | Sixteen DTs |
| j | DT Placement | F | Evenly spaced per API |
|   |   | C | Custom |
|   |   | X | None |
| k | Notified body | C | CEC (FMC) |
|   |   | E | ATEX |
|   |   | F | NEC (FM) |
|   |   | I | IEC |
|   |   | X | None |
| l | Protection method | I | IS |
|   |   | X | No approval |

(Continued on next page)
### 5.5 Model number identification (continued)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|
| L | P | T |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |
| a | b | c | d | e | f | g | h | i | j  | k  | l  | m  | n  | o  | p  |   |   |   |   |   |   |

#### (m) Gas group
- A Group A
- B Group B
- C Group C
- D Group D
- 1 IIA
- 2 IIB
- 3 IIC
- X None

#### (n) Unit of measure
- M Metric - Millimeters
- U US customary - Inches

#### (o) Length (no decimal spaces)
- Flexible sensor pipe: 62 to 866 in. (code as 06200 to 86600)
- Flexible sensor pipe: 1575 to 22000 mm (code as 01575 to 22000)

#### (p) Special
- S Standard Product

### ORDERING NOTE

Accessories such as floats, cables, and displays have to be ordered separately. All accessories are shown in the Accessories Catalog (551103).
### 5.6 Specifications (Technical data)

#### Level Output

<table>
<thead>
<tr>
<th>Measured variable</th>
<th>Product level and interface level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output signal /Protocol</td>
<td>Modbus RTU, DDA</td>
</tr>
</tbody>
</table>
| Order length            | **Flexible hose:** 1575 mm (62 in.) to 22000 mm (866 in.)  
§ Order length equals the measurement range plus the inactive zone. |
| Inherent Accuracy       | ±1 mm (0.039 in.)                  |
| Repeatability           | 0.001% F.S. or 0.381 mm (0.015 in.)  
* (any direction) |

#### Temperature Output

<table>
<thead>
<tr>
<th>Measured variable</th>
<th>Average and multipoint temperatures</th>
</tr>
</thead>
</table>
| Temperature accuracy    | ±0.2 °C (0.4 °F) range -40 °C (-40 °F) to -20 °C (-4 °F)*,  
±0.1 °C (0.2 °F) range -20 °C (-4 °F) to 70 °C (158 °F)*,  
±0.15 °C (0.3 °F) range 70 °C (158 °F) to 100 °C (212 °F)*,  
±0.5 °C (0.9 °F) range 100 °C (212 °F) to 105 °C (221 °F)  
* Whichever is greater |

#### Electronics

| Input voltage           | 10.5 to 28 Vdc                |
| Fail safe               | High, Full scale for digital  |
| Reverse polarity protection | Series diode                |
| EMC Standards           | IEC 61326-3-2, IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4  
IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8 |

#### Environmental

| Enclosure rating        | NEMA Type 4X, IP65               |
| 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         | Flexible Hose: 260 psi (18 bar) |
| Materials               | Wetted parts: 316L stainless steel †  
Non-wetted parts: 316L stainless steel, Epoxy coated aluminum  
† Contact factory for alternative materials. |

#### Field Installation

| Housing dimensions      | Single cavity: 145 mm (5.7 in.) W x by 127 mm (5 in.) D x by 109 mm (4.3 in.) H  
Dual cavity: 117 mm (4.6 in.) W x by 127 mm (5 in.) D x by 206 mm (8.1 in.) H  
Stainless steel single cavity: 178 mm (7.1 in.) W x by 135 mm (5.3 in.) D x by 153 mm (6 in.) H  
NEMA Type 4X: 87 mm (3.4 in.) H x by 124 mm (4.9 in.) Ø (Diameter)  
§ Contact factory for longer lengths. |
| Mounting                | Flexible hose 1 in. Adjustable MNPT or BSPP fitting, Flange mount |
| Wiring                  | 4-wire shielded cable or twisted pair, Daniel Woodhead 6-pin male connector,  
4570 mm (180 in.) integral cable with pigtail |

#### Electrical Connections

| Single and Dual Cavity   | ¾ in. FNPT conduit opening, M20 for ATEX/IECEx version |
| NEMA Type 4X             | ½ in. FNPT conduit opening |

#### Display

| Measured variables       | Product level, interface level and temperature |

* Whichever is greater  
Δ Contact factory for longer lengths.  
◊ Contact factory for specific temperature ranges.  
† Contact factory for alternative materials.  
§ Order length equals the measurement range plus the inactive zone.
6. Installation and mounting

6.1 Training

Installation should only be conducted by qualified service personnel according to IEC 60079-14 and local regulations and/or MTS trained service technicians and local regulations. MTS offers web based and in person training for installation, commissioning, maintenance, and repair. MTS also offers factory direct services for these same functions. Contact MTS to discuss training or factory direct services before starting.

6.2 Stilling wells and guide poles

Level Plus® transmitters can be mounted in slotted or unslotted stilling wells but a slotted stilling well is always preferred. Using an unslotted stilling well will negatively affect performance of any level device as the level in the stilling well can differ from the level in the tank. The Level Plus® transmitter can also be installed to one side of the stilling well to also allow for sampling and manual gauging from the same opening as the automatic tank gauging. Contact Technical Support for details.

Level Plus® transmitters do not require a stilling well for installation. Our transmitters are installed in numerous tanks without stilling wells with no loss in performance due to our patented flexible waveguide and hose. A stilling well is highly recommended for agitated, turbulent, and/or fast filling tanks.

6.3 Tools

- 9/16" Socket and ratchet
- Channel Lock pliers
- 3/16" Hex Key (Allen wrench)
- 1" Open End wrench
- Common head screwdriver

6.4 Installation steps

**Caution**

When assembling and installing the Tank Slayer® transmitter, be careful not to allow the flexible hose to kink or be coiled in less than 16 in. (406.5 mm) diameter. It is recommended that assembly and mounting of this transmitter should not be done alone. To ensure proper and safe assembly of the Tank Slayer® transmitter, a minimum of two (2) individuals are recommended. Gloves are also recommended. PPE is required for work areas such as safety shoes, safety glasses, hard hat, and fire resistant clothing.

1. Consult Section 4.3 before starting.
2. Perform Commissioning Steps 1-9 in Section 8.4.
3. Remove the stop collar. With assistance, feed the flexible hose through the hole of the removed tank flange until the flange is positioned at the rigid section of pipe near the top of the transmitter. Insert the threaded portion of the adjustable fitting into the customer supplied flange and tighten (apply pipe thread sealant if required). Be careful not to drop flange on the flexible hose as damage may result.
4. Slide the product float onto the flexible pipe. Slide the interface float (optional) onto the flexible pipe. Install stop collar 3 inches from the bottom of rigid section (see ‘Note’ below). Do not drop float(s) or allow them to free fall along the flexible pipe as damage may result.

**Notes**

The stop collar can be removed or adjusted based on the float selected for the application. Please consult the factory for more information.

5. Mount the hook, weight, or the magnet to the welded end-plug section of the pipe (this is the bottom rigid section of the pipe) using the supplied nut, spacer and washer, tighten securely as shown in Figure 5. For the magnet, remove washer before installing in tank.

6. Slide float(s) back down to the stop collar to prevent them from free falling during installation into the tank. Insert the flex pipe and floats through the tank riser pipe and lower the transmitter/float assembly into the tank until it rests on the bottom. If you are using a bottom-fixing hook, fasten the hook to the appropriate customer-supplied mating hardware at the tank bottom.

7. Secure the flange onto the tank riser pipe.

8. Pull the transmitter upward to straighten the flexible pipe until the resistance of the weight, magnet, or hook is felt without raising the weight or magnet off the floor of the tank. Tighten the adjustable fitting to hold the transmitter in place.

9. Terminate the field wire cables noting proper wire orientation.

6.5 Mounting

The method of mounting the transmitter is dependent on the vessel or tank in which it is being used, and what type of transmitter is being mounted. There are two typical methods for mounting; threaded flange mounting and welded flange mounting.
7. Electrical connections

7.1 Basic information
A typical intrinsically safe connection for the Level Plus® Tank Slayer® transmitter includes protective safety barriers, a power supply and a reading or monitoring device. Refer to Agency information in Section 12.

7.2 Safety recommendations
Be sure to:
1. Always follow applicable local and national electrical codes and observe polarity when making electrical connections.
2. Never make electrical connections to the Tank Slayer® transmitter with power turned on.
3. Make sure that no wire strands are loose or sticking out of the terminal block connection which could short and cause a problem.
4. Make sure that no wire strands, including shield, are in contact with the electronic module enclosure.

7.3 Industrial topologies
There are four topologies described and illustrated below. However, the daisy chain topology is not recommended by MTS.

Point-to-point
The point-to-point topology consists of having only one device on the loop as shown in Figure 8. This topology is not usually used with a bus network since it does not take advantage of placing multiple devices on a loop.
7.4 Cable recommendations

Refer to 'Table 1' below for general requirements of cable types for the Level Plus® Tank Slayer® analog transmitter.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum cable size</td>
<td>24 AWG or heavier (0.51 mm diameter)</td>
</tr>
<tr>
<td>Cable type</td>
<td>Single pair shielded or multiple pair with overall shield; minimum 0.010 in. (0.25 mm) insulation thickness</td>
</tr>
<tr>
<td>Capacitance</td>
<td>Less than 30 pF/Ft</td>
</tr>
</tbody>
</table>

Table 2: Cable specification and parameters

7.5 Electrical conduit

Notes
1. Tighten housing cover (both front and back covers if dual cavity) to full stop against the O-ring.
2. Do not over-tighten compression fittings.
3. Use side conduit entry only.
4. In high humidity areas, use a breather drain type conduit sealing fitting to minimize moisture intrusion.
7.6 Grounding

**Note**

Grounding the transmitter through a threaded conduit connection does not provide sufficient ground.

There are two methods to provide an earth ground to the earth ground of the electronics. Either method must result in a resistance of less than 1 Ohm. Refer to ‘Table 3’ for safety barrier references.

- Run an earth ground through the conduit and connect directly to the earth ground lug inside the housing.
- Run an earth ground directly to the ground lug on the outside of the housing.

7.7 Safety barriers

Refer to Table 3 for entity parameters and Table 4 for example safety barriers.

### Entity parameters

<table>
<thead>
<tr>
<th></th>
<th>Digital supply</th>
<th>Digital communication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ui</strong></td>
<td>28 Vdc</td>
<td>8.6 Vdc</td>
</tr>
<tr>
<td><strong>Ii</strong></td>
<td>100 mA</td>
<td>10 mA</td>
</tr>
<tr>
<td><strong>Ci</strong></td>
<td>0.0 µF</td>
<td>0 µF</td>
</tr>
<tr>
<td><strong>Li</strong></td>
<td>0 Digital mH</td>
<td>0.0 mH</td>
</tr>
<tr>
<td><strong>Pi</strong></td>
<td>700 mW</td>
<td>21.5 mW</td>
</tr>
</tbody>
</table>

**Table 2: Safety barrier entity parameter references**

### 8. Commissioning

#### 8.1 Training

Commissioning should only be conducted by qualified service personnel according to IEC 60079-14 or MTS trained service technicians and local regulations. MTS offers web based and in person training for installation, commissioning, maintenance, and repair. MTS also offers factory direct services for these same functions. Contact MTS to discuss training or factory direct services before starting.

#### 8.2 Tools

- 9/16” Socket and ratchet
- Channel Lock pliers
- 3/16” Hex Key (Allen wrench)
- 1” Open End wrench
- RS485 to USB Converter (MTS Part # 380114)
- PC
- Linear Regulated Power Supply
- MTS Setup Software

#### 8.3 Setup software

MTS offers Setup Software that is shipped with the level transmitter and is also available for download from www.mtssensors.com. The Setup Software is to be used for installation, commissioning, and troubleshooting. For further details on how to use the setup software consult the Interface Manual Modbus (MTS Part# 551700) and the Interface Manual DDA (MTS Part# 551701).

#### 8.4 Commissioning steps

**Note**

For Additional details consult the protocol specific Interface Manual Modbus (MTS Part #551700) and Interface Manual DDA (MTS Part #551701).

1. Consult Section 4.3 before starting
2. Remove level transmitter from shipping container.
3. Remove bottom fixing nut, washer, spacer, and stop collar.
4. Insert flexible hose into float(s) making sure float(s) are in the active range.
5. Connect power, RS485 to USB converter, and PC.
6. Open MTS Setup Software.
7. Establish Communication.
9. For Modbus Interface – Set Address, Enter Strap Table, Setup Volume Correction Method. Default address 247.
10. Disconnect Power and Communication. Remove floats. Prepare flexible level transmitter for transport to the top of the tank.
12. Have qualified technician perform hand measurement. Enter hand measurement into MTS Setup Software and calibrate.
13. Store all settings as backup file according to site name and tank number.

<table>
<thead>
<tr>
<th>Supplier</th>
<th>STAHL</th>
<th>STAHL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>9001/01-280-100-101</td>
<td>9001/01-086-010-101</td>
</tr>
<tr>
<td>Maximum voltage</td>
<td>28 Vdc</td>
<td>8.6 Vdc</td>
</tr>
<tr>
<td>Maximum current (each channel)</td>
<td>100 mA</td>
<td>10 mA</td>
</tr>
<tr>
<td>Maximum power (each channel)</td>
<td>700 mW</td>
<td>21.5 mW</td>
</tr>
<tr>
<td>Number of channels</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Interface</td>
<td>Modbus/DDA</td>
<td>Modbus/DDA</td>
</tr>
</tbody>
</table>

**Table 4: Safety barrier entity parameter references**
9. Maintenance

9.1 Training
Maintenance should only be conducted by qualified service personnel according to IEC 60079-14 and local regulations and/or MTS trained service technicians. MTS offers web based and in person training for installation, commissioning, maintenance, and repair. MTS also offers factory direct services for these same functions. Contact MTS to discuss training or factory direct services before starting.

9.2 Tools
- 9/16" Socket and ratchet
- Channel Lock pliers
- 3/16" Hex Key (Allen wrench)
- 1" Open End wrench
- RS485 to USB Converter (MTS Part # 380114)
- PC
- Linear Regulated Power Supply
- MTS Setup Software

9.3 Inspection
Below are some standard items that should be inspected on a regular basis to make sure that the level transmitter and surrounding environment are in operating condition.

- Hazardous Area Label is present and legible
- Hazardous Area approval is correct for installation
- There are no visible unauthorized modifications
- Electrical connections are tight
- Condition of enclosure gasket is satisfactory
- No water ingress (white powder)
- No obvious damage to cable
- Sealing of conduit or cable gland is satisfactory
- Earth ground is satisfactory
- Single or Dual Cavity Enclosure threads are not damaged
- Housing and sensing element piston o-ring is not damaged or cracked
- No corrosion on visible parts
- Printed circuit boards are clean and undamaged

9.4 Preventative maintenance
Level Plus® level transmitters do not typically require preventative maintenance but may require preventative maintenance dependent on the application. For general purpose applications where there is no potential for buildup on the flexible hose and/or float there is no need for preventative maintenance but routine inspection is still suggested. For severe service applications where there is potential for buildup on the flexible hose and/or float then preventative maintenance is required.

9.4.1 General purpose applications

9.4.1.1 Perform Inspection suggested in section 9.3

9.4.2 Severe Service Applications

9.4.2.1 Perform Inspection suggested in section 9.3

9.4.2.2 Disconnect Power.

9.4.2.3 Disconnect process connection from tank. Remove flexible hose from tank.

Note
It is best to clean the hose as it is removed from the tank to minimize the amount of product that is removed from the tank. The user should take caution and abide by all regulations so that product is not spilled and the environment is not contaminated.

9.4.2.4 When the bottom of the hose is reached inspect the floats.

9.4.2.4.1 If the floats are highly contaminated then remove the assembly from the tank and remove the floats from the hose.

9.4.2.4.2 If the floats are slightly contaminated then clean the floats without removing the floats from the hose.

9.4.2.5 Replace flexible hose and floats in tank.

9.4.2.6 Connect process connection to tank.

9.4.2.7 Connect Power.

9.4.2.8 The process should be carried out regularly until a consistent pattern has been established as to how long the intervals between cleanings should be.
10. Repair

10.1 RMA policy

Important
Contact Technical Support or Customer Service for assistance if you suspect that the transmitter is not working correctly. Technical support can assist you with troubleshooting, part replacement, and Returned Material Authorization (RMA) information if required.

All Level Plus® transmitters come with a two year limited warranty from the factory shipment date. A Return Materials Authorization (RMA) number is required and must accompany any transmitter returns. Any unit that was used in a process must be properly cleaned in accordance with OSHA standards, before it is returned to the factory. A Material Safety Data Sheet (MSDS) must also accompany the transmitter that was used in any process.

10.2 Training

Repair should only be conducted by qualified service personnel according to IEC 60079-14 and/or MTS trained service technicians. MTS offers web based and in person training for installation, commissioning, maintenance, and repair. MTS also offers factory direct services for these same functions. Contact MTS to discuss training or factory direct services before starting.

10.3 Tools

» 9/16" Socket and ratchet
» Channel Lock pliers
» 3/16" Hex Key (Allen wrench)
» 1” Open End wrench
» Phillips head screwdriver
» Common head screwdriver
» RS485 to USB Converter (MTS Part # 380114)
» PC
» Linear Regulated Power Supply

10.4 Troubleshooting

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No communication with transmitter</td>
<td>No power</td>
<td>Check voltage at transmitter</td>
</tr>
<tr>
<td>Wiring incorrect</td>
<td>Reference installation drawing section 12</td>
<td></td>
</tr>
<tr>
<td>Wrong address</td>
<td>DDA factory default is ‘192’ Modbus factory default is ‘247’</td>
<td></td>
</tr>
<tr>
<td>Wrong software</td>
<td>Confirm correct software</td>
<td></td>
</tr>
<tr>
<td>Wrong protocol</td>
<td>Confirm software and transmitter are same protocol</td>
<td></td>
</tr>
<tr>
<td>Missing magnet error</td>
<td>Float not recognized</td>
<td>Confirm that the float is attached</td>
</tr>
<tr>
<td></td>
<td>Float is in the dead zone</td>
<td>Raise float to see if the error stops</td>
</tr>
<tr>
<td></td>
<td>Wrong number of floats selected</td>
<td>Confirm that the number of floats on the transmitter and the number of floats the transmitter is attempting to verify are the same.</td>
</tr>
<tr>
<td>Trigger level error</td>
<td>Gain needs to be adjusted</td>
<td>Consult Factory</td>
</tr>
<tr>
<td></td>
<td>SE is damaged</td>
<td>Consult Factory</td>
</tr>
<tr>
<td></td>
<td>Min. trigger level too high</td>
<td>Consult Factory</td>
</tr>
<tr>
<td>Volume calculation error</td>
<td>No strap table entered</td>
<td>Enter strap table</td>
</tr>
<tr>
<td></td>
<td>Level outside range of strap table</td>
<td>Enter additional points in strap table</td>
</tr>
<tr>
<td></td>
<td>Strap table incorrect</td>
<td>Check value entries</td>
</tr>
<tr>
<td>VCF error</td>
<td>No VCF table entered</td>
<td>Enter VCF table</td>
</tr>
<tr>
<td></td>
<td>VCF table incorrect</td>
<td>Check VCF value entries</td>
</tr>
</tbody>
</table>

Table 5: Troubleshooting reference
10.5 Setup software
MTS offers Setup Software that is shipped with the level transmitter and is also available for download from www.mtssensors.com. The Setup Software is to be used for installation, commissioning, and troubleshooting. For further details on how to use the setup software consult the Interface Manual Modbus (MTS Part# 551700) and the Interface Manual DDA (MTS Part# 551701).

11. Interface
Tank Slayer® is available with multiple outputs including Modbus and DDA. This Operation and Installation Manual includes all of these outputs. Each output has its own specialized Interface Manual that should be consulted for additional information on the specific output.

11.1 Modbus
MTS offers Modbus RTU over a RS485 half-duplex network. For additional information consult Interface Manual Modbus, MTS Part# 551700.

11.2 DDA
MTS offers DDA (Direct Digital Access) over a RS485 half-duplex network. For additional information consult Interface Manual DDA, MTS Part# 551701.

12. Agency information

12.1 Approvals overview
The Notified Body is designated in the 13th digit of the model number and the Protection Method is designated in the 14th digit of the model number. These two digits of the model number specify the hazardous area approval that provided with the selected level transmitter.

<table>
<thead>
<tr>
<th>Notified body</th>
<th>Protection method</th>
<th>Classifications</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>E = ATEX I = Intrinsic Safety</td>
<td>Ex II 1/2 G Ex ia IIC T4 Ga/Gb Ta = -50 °C to 71 °C</td>
<td>EN 60079-0:2012 EN 60079-11:2012</td>
<td></td>
</tr>
<tr>
<td>I = IEC I = Intrinsic Safety</td>
<td>Ex ia IIC T4 Ga/Gb Ta = -50 °C to 71 °C</td>
<td>IEC 60079-0:2011 IEC 60079-11:2011</td>
<td></td>
</tr>
</tbody>
</table>

Table 6: Agency approvals

12.2 Certificates
Downloadable copies of all certificates are located at www.mtssensors.com and can be downloaded on the product specific landing page. If there is any difficulty in obtaining the certificates from the web contact MTS Technical Support and they will be sent electronically.

12.3 FM

12.3.1 Special Conditions of Safe Use
1. The apparatus enclosure contains aluminum and is considered to constitute a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact or friction. (When installed in a Ga Approval)
2. The maximum permitted ambient temperature of the Level Plus Digital/Analog Level Transmitter is 71 °C. To avoid the effects of process temperature and other thermal effects care shall be taken to ensure the surrounding ambient and the ambient inside the transmitter housing does not exceed 71 °C
3. Some models contain non-metallic enclosure parts, to prevent the risk of electrostatic sparking the nonmetallic surface should only be cleaned with a damp cloth.

12.3.2 Labels

Fig. 13: FM label

Fig. 14: FM label

Table of contents:
- 10.5 Setup software
- 11. Interface
- 11.1 Modbus
- 11.2 DDA
- 12. Agency information
- 12.1 Approvals overview
- 12.2 Certificates
- 12.3 FM

Page 118
12.3.3 Installation drawing (cont.)

NOTES:
1. THE CUSTOMER SHOULD CONNECT THE OUTSIDE GROUND LUG TO THE SAFETY EARTHING GROUND SYSTEM

WARNING:
CONDUIT SEALS REQUIRED WITHIN 457 MM (18") OF HOUSING.
12.4 FMC

12.4.1 Special conditions of safe use

1. The apparatus enclosure contains aluminum and is considered to constitute a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact or friction. (When installed in a Ga Approval)

2. The maximum permitted ambient temperature of the Level Plus® Digital/Analog Level Transmitter is 71 °C. To avoid the effects of process temperature and other thermal effects care shall be taken to ensure the surrounding ambient and the ambient inside the transmitter housing does not exceed 71°C

3. Some models contain non-metallic enclosure parts, to prevent the risk of electrostatic sparking the nonmetallic surface should only be cleaned with a damp cloth.

12.4.2 Labels

![Fig. 17: FMC label](image1.png)

![Fig. 18: FMC label](image2.png)
12.4.3 Installation drawing (cont.)

Fig. 20: FMC installation drawing
12.5 ATEX and IECEx

12.5.1 Special conditions of safe use

1. The apparatus enclosure contains aluminum and is considered to constitute a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact or friction. (When installed in a Ga Approval)

2. The maximum permitted ambient temperature of the Level Plus® Digital/Analog Level Transmitter is 71 °C. To avoid the effects of process temperature and other thermal effects care shall be taken to ensure the surrounding ambient and the ambient inside the transmitter housing does not exceed 71°C

3. Some models contain non-metallic enclosure parts, to prevent the risk of electrostatic sparking the nonmetallic surface should only be cleaned with a damp cloth.

12.5.2 Labels

Fig. 21: ATEX label

Fig. 22: IECEx label
1. THE CUSTOMER SHOULD CONNECT THE OUTSIDE GROUND LUG TO THE SAFETY EARTHING GROUND SYSTEM.

WARNING:

CONDUIT SEALS REQUIRED WITHIN 457 MM (18") OF HOUSING.

Fig. 24: ATEX / IECEx installation drawing
12.5.3 EC Declaration of Conformity

EC Declaration of Conformity
EG-Konformitätserklärung
Déclaration CE de Conformité

MTS Systems Corporation, Sensors Division, 3001 Sheldon Drive, Cary NC 27513, USA

declares as manufacturer in sole responsibility that the products
declare en qualité de fabricant sous sa seule responsabilité que les produits
comply with the regulations of the following European Directives:
sont conformes aux prescriptions des directives européennes suivantes:

94/9/EC  Equipment and protective systems for use in potentially explosive atmospheres
Geräte und Schutzsysteme zur Verwendung in explosionsgefährdeten Bereichen Appareils
et systèmes de protection à être utilisés en atmosphères explosives

2004/108/EC  Electromagnetic Compatibility
Elektromagnetische Verträglichkeit
Compatibilité électromagnétique

Applied harmonized standards:
Angewandte harmonisierte Normen:
Normes harmonisées appliquées:


EC type examination certificate:
EG-Baumusterprüfbescheinigung:
Certificat de l’examen CE de type :
issued by / ausgestellt durch / exposé par:

FM 14 ATEX 0068 X, 1st Supplement
FM Approvals Ltd.
Windsor, Berkshire, United Kingdom

Notified body for quality assurance control:
Benannte Stelle für Qualitätsüberwachung:
Organisme notifié pour l’assurance qualité :
Ident number / Kennnummer / Numéro d’identification :

1725

Marking / Kennzeichnung / Marquage :

II 1/2 G Ex ia IIC/ T4
Ta = -50° C to +71 °C

Lüdenscheid, 2015-07-07
MTS Sensor Technologie GmbH & Co. KG, Auf dem Schüffel 9, 58513 Lüdenscheid, Germany

Thomas Muckenhardt
Quality Management
ATEX Representative

Handelsregister: Amtsgericht Iserlohn HRA 3314  •  Geschäftsführer: John Vincent Enholz
MTS Sensor Technologie ist ein Unternehmen der MTS Systems Corporation, Minneapolis, USA