Questtec SOLUTIONS

*The New Standard of Level*

Glass-Trac Level-Trac
Steam-Trac Magne-Trac

# Magnetostrictive Level Transmitters
# Series MTLT-6000

FM APPROVED

HART® FIELD COMMUNICATIONS PROTOCOL

CSA

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## 1.0.0 Introduction

### 1.1.0 Forward

The Questtec MTLT-6000 series transmitter represents the latest in magnetostrictive level transmitter technology. Suitable for most liquid level applications, the MTLT transmitter provides a very accurate and reliable output for remote level control with zero maintenance. With greater ease of communication and programmability, the MTLT series contains the latest state-of-the-art electronics and sensor technology. All transmitters are factory calibrated to the specifications required with each order and installation.

**The MTLT-6000 series transmitter is designed exclusively for magnetic level indicators.** The waveguide probe is installed externally on the outside of the magnetic level gage chamber and is not exposed to process conditions. Based on the level gage specifications, top, bottom or remote mounted transmitter head locations are available.

### 1.2.0 Theory of Operation

Magnetostrictive level transmitters operate in conjunction with a magnetic field that originates from a liquid level float designed for the process media. A two wire waveguide probe of variable length is connected to the transmitter sensor and electronic assembly. The two wire waveguide is housed within a sealed ¼ inch (OD) sensor probe and receives a short current pulse at timed intervals. Disruption of the waveguide is caused by torsion generated by the float's lateral magnetic field at any elevation. This torsion or deflection of the waveguide is detected by the transmitter sensor, which produces a very accurate signal proportionate to the level elevation.

## 2.0.0 Preparation

### 2.1.0 Introduction

Questtec MTLT series level transmitters are built and designed to exact customer specifications as defined in each model number. Wiring terminations are required and need to follow proper procedures.

### 2.2.0 Unpacking Freight

Upon receipt, all packages containing Questtec products are to be opened carefully and inspected for freight damages. If damage to the product has occurred due to freight, a claim needs to be made at the point of product receipt and initial inspection within 24 hours. **Questtec does not insure freight or make freight claims on behalf of the owner.** Do not discard the shipping container until all components are accounted and inspected for.

### 2.3.0 Storage

If the transmitter requires storage for prolonged periods, care must be given to ensure product protection from physical and ambient conditions. Seal the entire device completely from condensation and store it with the shipping materials provided. Do not leave any auxiliary conduit connection open. Recommended storage temperatures are -10 to +130° F.

### 2.4.0 Electronic Static Discharge

Questtec level transmitters are manufactured from the highest quality electronic components of which can be damaged by static electricity. Care must be taken to eliminate static discharges surrounding the transmitter upon installation. All equipment proximal to the transmitter must be grounded to a secure source. Grounding terminals are provided both inside and outside of the instrument enclosure.

### 2.5.0 Equipment and Recommended Tools

To attach the MTLT series transmitter to an existing piping or vessel connection, the operator will need the following tools:

- Nut drivers for MTLT attachment to piping clamps
- Phillips and flat head screwdrivers
- Digital volt meter to verify and troubleshoot voltage

### 2.6.0 Temperature Ratings

The maximum ambient temperature rating of the MTLT series electronics is -40 to + 160° F. The ambient temperature range of the LED readout is -10 to +160° F. Ambient temperatures above and below that rating may cause the LED readout to malfunction. The transmitter head may require protection from prolonged direct sunlight exposure. Low temperature cryogenic or high temperature insulation blankets should be installed during extreme process operating temperatures.

The maximum process temperature rating of the MTLT series transmitter is -40°F to +235° F and applies to the waveguide probe.

### 2.7.0 Pressure Ratings

The MTLT-6000 is an externally mounted transmitter and is not subject to process pressure.

### 2.8.0 Voltage

**The MTLT transmitter is designed to operate at 24 Volts DC, nominal.** Please ensure that the power supply to the transmitter is the same 24 VDC voltage required. Although the voltage range of the MTLT transmitter is +12 to +30 VDC, it is highly recommended that the service voltage is established at a stable and continuous 24 VDC. Higher voltages will damage the transmitter. ***Do not connect to AC current since this will damage the transmitter and violate the transmitter warranty.***

## 3.0.0. Mounting

### 3.1.0 Introduction

Determine if the installation requires a top, bottom or remote mounted location. Consideration should be given to electrical conduit connections before the transmitter is installed. It is important to verify chemical compatibility with all wetted components.

### 3.2.0 MTLT – Magnetic Level Indicators

- The second bend in the waveguide should be placed at the same elevation of the centerline of the upper or lower process connection, depending upon the preferred transmitter head location.
- The transmitter head contains a special pipe clamp groove for chamber attachment first.
- Insolating **L** brackets are supplied for the waveguide. These maintain an even distance of the waveguide away from the magnetic level gage chamber.
- Corresponding pipe clamps are provided for each **L** bracket position, which should be spaced evenly apart throughout the waveguide.
- Secure the **L** brackets by tightening each pipe clamp accordingly after the transmitter head is secured.

## 4.0.0 Wiring

Connection to the MTLT-6000 transmitter requires an electrical conduit connection of ¾ inch NPT. The enclosure contains two conduit connection ports (Photograph No. 1). Wiring between the power supply and the MTLT-6000 transmitter should be made with 18 – 22 AWG shielded twisted pair instrument cable.

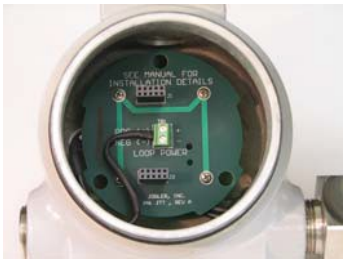
### 4.1.0 Connections

Once the electrical conduit is properly connected, the terminal block needs to be accessible for wiring connections. The terminal block is located on the termination board which is attached to the enclosure beneath the sealed transmitter puck. (Photograph No. 2) The transmitter puck plugs into the termination board. The puck will require removal (unplugging) from the termination board in order to gain access to the terminal block. Simply pull the transmitter puck out vertically and carefully. There are three guide pins located on the bottom of the transmitter puck housing. These pins realign the puck perfectly into the termination board upon reinstallation. (Photograph Nos. 3 and 4)

**Wiring to the terminal block is as follows**:

| | | | |
|---|---|---|---|
| Terminal Block: | POS (+) | Positive 24 VDC | **Red Wire** |
| Terminal Block: | NEG (-) | Negative | **Black Wire** |
| Ground Screw: | 8-32 NC | Inside Enclosure Back | **Green Wire** |

**Photograph No. 1**
Enclosure – Front



**Photograph No. 2**
Termination Board

**Photograph No. 3**
Transmitter Puck – Front

**Photograph No. 4**
Transmitter Puck – Rear

***Warning: Electrical connections may induce an explosion hazard. Do not connect or disconnect equipment unless power has been turned off and the installation area has been rendered non-hazardous. Determine the correct polarity before connecting.***

The MTLT-6000 is designed for Class 1, Division 1, Groups B, C and D hazardous locations. Explosion proof installations could have flammable vapors and liquids present. If disconnecting, instrument covers must remain tight until power is turned off. Make sure that power is off in any junction box if exposed to hazardous atmospheres. Power to the instrument can only be turned on after the installation is complete, instrument covers are tight and secure, the area is non-hazardous and the installation has been checked by the appropriate electrical engineers.

## 5.0.0 Transmitter Configuration

### 5.1.0 Introduction

The MTLT-6000 transmitter is factory configured to probe length, float density and positioning. The internal parameters that are important to the basic configuration of the transmitter are protected by a factory password and cannot be changed by the end user. The operator is provided with a user password that will be necessary to change some of the basic transmitter settings that are fundamental to transmitter performance.

### 5.2.0 Operation

Each MTLT-6000 can be programmed by the three push buttons (keypad) located on the transmitter head. They are the Up and Down arrow keys and the Select key which are used to navigate the displays and to calibrate the transmitter. The Up and Down arrow keys move forward and backward in the menu structure when in the *scroll* mode and increase and decrease the value displayed when in the *set* mode. The Select key selects the *set* mode when on a menu screen where it is available. The Select key also accepts a value and moves to the next step when in the *set* mode.

The *scroll* or *set* mode is indicated by the lack or presence of the set mode symbol in the upper right hand corner of the screen. Screen scrolling is in ascending order of screen number when the down arrow is depressed and descending order when the up arrow is depressed.

The MTLT-6000 has an LCD display that shows two lines of eight characters each. All transmitter menu screens are shown on the LCD display. The display defaults to the scrolling measurement screen that shows the level height (inches or metric), percentage and milliamp outputs. The scrolling default display can be changed to any of the individual three output values at the operator's choice.

### 5.3.0 Screen Menus

5.3.1 Screen 1: <u>Default Display</u>
Category: Display
Description: Displays one of the following: Level in units, Level in percent, Loop Output in milliamps, Error Messages. The Default Display is denoted by the "*" symbol.
Notes: In the event of a transmitter error, the corresponding error message will be displayed in place of the output. Any of the output types may be displayed or they can be selected to scroll. This selection is made from Screen No. 5.

5.3.2 Screen 2: <u>Level</u>
Category: Display
Description: Displays the absolute measurement in level units (inches or cm)
Notes: In the event of a transmitter alarm condition, ALARM will be displayed in place of the level value.

**5.3.0 Screen Menus (Continued)**

5.3.3 Screen 3: Level %
Category: Display
Description: Displays the value of the primary variable in percent of span. The range is 0.00% to 100.00%
Notes: In the event of a transmitter alarm condition, ALARM will be displayed in place of the level value.

5.3.4 Screen 4: Loop
Category: Display
Description: Displays the value of the 4-20 mA current loop in milliamps.
Notes: In the event of a transmitter alarm condition, ALARM will be displayed in place of the level value

5.3.5 Screen 5: Dft Display
Category: User Setting
Input: Scroll, Level, Level%, Loop (scroll selectable)
Description: Selects the default screen display as either: Scroll, Level, Level % or Loop
Notes: None

5.3.6 Screen 6: Quick Cal
Category: User Setting
Input: Select 4 mA and 20 mA points based on float position.
Description: Allows the setting of the 0% and 100% points based on the current float position. The 0% and 100% points may be configured at either end of the probe (i.e. provides for direct OR reverse action). If the 4.00 mA button is pressed, then the current float position is set as the 4 mA elevation. If the 20 mA button is pressed, the current float position is set as the 20 mA elevation. The 0 measured value of the PV is then equated to the 0% level point by setting the value of the offset.
Notes: This function takes into account the mounting type and also checks for reverse action settings when computing the offset value.

5.3.7 Screen 7: Units
Category: User Setting
Input: Inches, Centimeters (scroll selectable)
Description: Selects the level units in cm or inches.

## 5.3.0 Screen Menus (Continued)

5.3.8 Screen 8: 4 Ma Set
Category: User Setting
Input: Position of the 4 milliamp (0%) point in inches or cm.

5.3.9 Screen 9: 20 Ma Set
Category: User Setting
Input: Position of the 20 milliamp (100%) point in inches or cm.

5.3.10 Screen 10: Offset
Category: User Setting
Input: PV measurement offset in inches or cm.
Description: A positive or negative adjustment to the PV zero reference mark.

5.3.11 Screen 11: Damping
Category: User Setting
Input: Value of the damping time constant in seconds.
Description: Sets value of the damping time constant. Input range is 0-15 seconds in 0.10 second intervals up to 1.0 second followed by 1.0 second intervals.

5.3.12 Screen 12: Fault
Category: User Setting
Input: Low, High, Latch (scroll selectable)
Description: Determines the value of the current loop output during a fault condition. Loop current can be set to 3.60 mA, 22.0 mA or latched to the value of the current loop just before fault condition occurred.
Notes: If HART communication is detected, the Low value of the current loop will be set to 3.70 mA instead of 3.60 mA to ensure reliability of communication.

5.3.13 Screen 13: Poll Adr
Category: User Setting
Input: Integer number in the range 0 – 15.
Description: Sets poll address of the transmitter for use in HART multi-drop mode.

## 5.3.0 Screen Menus (Continued)

5.3.14 Screen 14: Trim 4
Category: User Setting
Input: Integer number in the range of 0 – 4095.
Description: Trims the 4 mA output of the 4 – 20 mA loop.
Notes: Performs a trim of the Digital to Analog Converter (DAC).

5.3.15 Screen 15: Trim 20
Category: User Setting
Input: Integer number in the range of 0 – 4095.
Description: Trims the 20 mA output of the 4 – 20 mA loop.
Notes: Performs a trim of the DAC.

5.3.16 Screen 16: Loop Tst
Category: User Setting
Input: Current output in tenths of a mA.
Description: Trims the 20 mA output of the 4 – 20 mA loop.
Notes: Performs a trim of the DAC.

5.3.17 Screen 17: Mnt Pos
Category: User Setting
Input: Tom, Bottom (scroll selectable)
Description: Defines type of mounting as either top or bottom mounted.

5.3.18 Screen 18: DeadZone
Category: Factory Setting
Input: Distance in inches or cm
Description: This is an ignored region (dead zone) measured from the sensing element. Any signal generated by a magnetic field in this region will not be detected, and will not affect signals in the valid range of the detection.

5.3.19 Screen 19: Dis Fact
Category: Factory Setting
Input: Yes, No (Scroll Selectable)
Description: This makes the following hidden factory settings visible.

5.3.20 Screen 20: DeviceID
Category: Factory Setting
Input: Yes, No (scroll selectable)
Description: If Yes is selected, the Device ID will be set equal to the Final Assembly Serial Number and stored in non-volatile memory. This creates a unique transmitter ID for use in HART communication.

## 5.3.0 Screen Menus (Continued)

5.3.21 Screen 21: MeasType
Category: Factory Setting (Hidden)
Input: Single, Dual (scroll selectable)
Description: Sets the unit up for a single level measurement or a dual level measurement.

5.3.22 Screen 22: Probe Ln
Category: User Setting (Hidden)
Input: Length of sensor probe in inches or cm.
Description: Defines the length of the sensor probe. This is the valid range of detection of a magnetic field along the length of the sensor probe. The length is defined as increasing from the center point of the sensor element.
Notes: If a signal is detected beyond the set probe length, it will be ignored.

5.3.23 Screen 23: Gradient
Category: Factory Setting (Hidden)
Input: Hundredths of a microsecond per inch.
Description: This is the conversion factor for the time of flight measurement in microseconds per inch.

5.3.24 Screen 24: Threshld
Category: Factory Setting (Hidden)
Input: Integer number in the range 0 – 255.
Description: Adjusts the threshold voltage level. This is the level of voltage that the return signal must exceed in order to be detected. The range 0-255 represents a linear range of voltage from 80 mV to 1.55 V for the positive threshold and -80 mV to -1.55 V for the negative threshold.

5.3.25 Screen 25: Polarity
Category: User Setting (Hidden)
Input: Negative, Positive (scroll selectable)
Description: Sets the polarity of the threshold detector.

5.3.26 Screen 26: Senstvty
Category: Factory Setting (Hidden)
Input: Integer from 0-15 representing the sensitivity of the sensing element.
Description: Gain setting for signals received from the sensing element.
Notes: The level of signal gain should be kept at a minimum needed level due to the amplification of any noise present in the level signal.

5.3.27 Screen 27: Puls Amp
Category: Factory Setting (Hidden)
Input: Integer from 0-255 representing the amplitude of the sensor wire current pulse.
Description: Gain setting for sensor wire current pulse.

New Pass

5.3.28 Screen 28: User Setting
Category: Integer Value 0-255
Input: Sets the password for menu items in the user setting category.
Description: Default value is zero.
Notes:

Lvl Cnts

5.3.29 Screen 29: Display
Category: Displays a count that is directly proportional to the distance between the sensing element and the detected level signal.
Description: The count displayed is taken at the output of the damping filter. Therefore the count will be damped in the same manner at the primary variable.
Notes:

5.3.30 Screen 30:

Version

Category: Display
Description: Displays the current transmitter type and version.

# 6.0.0 Troubleshooting

## 6.1.0 Troubleshooting Matrix

(NOTE: Password is 5)

| Problem | Symptom(s) | Required Actions | Resolution |
|---|---|---|---|
| Does not power up | Blank Display; No Output | Disconnect loop wires and power locally with 24VDC power supply | Check loop wiring for loose connection or loss of power transmission |
| | | Measure resistance across fuse **"F1"** on back of Termination Board (JTT) to determine if blown (must scrape off conformal coating to get a good measurement) | Contact factory for a replacement Termination Board (JTT) |
| Powers up with blank display | Blank Display; Good output | Check enclosure for evidence of water damage (ex: mineral deposits) | Contact factory for a replacement Electronics Module or Display Board (JTD) |
| Bad Signal | Alarm output; "No Level Signal" | Hold magnet up to the probe just past the bend | If alarm output, check 2 and 3 pin connectors on back of Termination Board (JTT). If loose, re-secure. If broken, contact factory for a replacement Termination Board (JTT)<br><br>If unit gives output, move to next Required Action |
| | | Verify unit is mounted securely to the side of the float chamber. If chamber has guide rods, roll the transmitter around the chamber and mount as close to the indicator as possible | If alarm output, move to next Required Action |
| | | Change the setting **"DIS FACT"** to **"YES"** to unhide factory settings; Increase **SENSITIVITY** by 1 unit | If alarm output, contact factory for additional troubleshooting |
| Bad signal toward end of probe | Alarm output at probe end farthest from the enclosure | Change the setting **"DIS FACT"** to **"YES"** to unhide factory settings; Increase Pulse Amplitude **"PulsAmp"** by 25 units | If it reads further but not all the way to the probe end, repeat the Required Action |
| Intermittent alarm | Signal reads properly, but intermittently alarms | Change the setting **"DIS FACT"** to **"YES"** to unhide factory settings; Increase Pulse Amplitude **"PulsAmp"** by 25 units | If it improves but still needs adjustment, repeat the Required Action |
| Slighly bouncy signal | Signal bounces a small amount around true output | Change the setting **"DIS FACT"** to **"YES"** to unhide factory settings; Increase Pulse Amplitude **"PulsAmp"** by 25 units | If no improvement, return Pulse Amplitude **"PulsAmp"** to original value and move to next Required Action |
| | | Increase **"Threshold"** by 25 units | If no improvement, contact factory for additional troubleshooting |
| Extremely bouncy signal | Signal wildly bounces the entire span or nearly the entire span of the unit | Disconnect loop wires and power locally with 24VDC power supply | If the transmitter operates properly, check loop wires for loose connection or noise from an external source<br><br>If no improvement, contact factory for additional troubleshooting |

### 6.2.0 Recalibration

To change the transmitter span or to reset the 4 and 20mA setpoint, first get the float at the desired 4mA location. Go to the setting called “Quick Cal” and hit the enter button. An & symbol at the top-right of the LCD shows that the setting is available to change. Hit the button under the 4 to set the 4mA point. (This sets the value in the setting call “4mA Set”) Now move the float to the desired 20mA location and Quick Cal the 20. Verify the output has been adjusted and properly tracks float movement.

### 6.3.0 Swap a mount position (Top to Bottom / Bottom to Top)

If the transmitter has been mounted upside down or swapped in the field, 3 settings need to be changed: Mount Position, 4mA Set, 20mA Set.

Go to the setting “Mnt Pos”. Change this setting from Top to Bottom or Bottom to Top depending on where the electronics are located. Now go to 4mA Set and 20mA set and swap these numbers. Verify the output in mA and In/cm has been correctly swapped. If the display is upside down remove the electronics module, unscrew the termination board, turn to the desired orientation and reassemble.

# 7.0.0 References

## 7.1.0 Warranty

Questtec electronic level controls are warranted from defects, both parts and complete assemblies, for 365 days from the date of factory direct shipment to the operator / owner. The warranty does not commence at the time of process system start up.

In the event of product return during the warranty period, all components are first inspected for abnormal physical and electronic defects. If the subject item is determined covered under the standard warranty, Questtec will replace or repair the device at no cost to the owner.

Questtec is not liable for warranty claims on any level control that has been misapplied, mishandled, or installed improperly based on the parameters outlined in this manual. This also applies to products damaged by freight without claims filed in a timely manner.

## 7.2.0 Quality Control

Questtec's quality control program is based on ISO-9001 domestic and international standards. All MTLT series transmitters and component parts are fabricated and in compliance with international and domestic ISO guidelines. Questtec is committed to full customer satisfaction both in products and in service.

## 7.3.0 Model Numbers

| Model | Description |
|---|---|
| MTLT-6000 | Magnetic level gage, externally mounted, *waveguide probe is non-intrusive.* |

## 7.4.0 Specifications

### 7.4.1 Performance

| | |
|---|---|
| Accuracy | +/- 0.015 inches |
| Repeatability | 0.001% of full span |
| Linearity | 0.020% of full span |
| Rate of Change (Max) | 6 inches per second |
| Refresh Rate | 10 times per second |
| Initiation | 0.00 seconds |
| Damping | 0.00 to 1.00 @ 0.01 second increments<br>1.00 to 25.0 @ 1.00 second increments |
| Unusable Region | 1.00 inch (at end of probe) |
| Dead Zone | 0.00 inch (user specify) |
| Humidity | 0.00 – 99.0% (non-condensing) |

### 7.4.2 Electrical

| | |
|---|---|
| Input | 12-30 VDC (24 VDC Nominal) |
| Output | 4-20 mA |
| Resistance | 600 Ohms (max) @ 24 VDC |
| Power Consumption | 0.66 Watt (30 VDC x 0.022 ohms = 0.66 W) |
| Error Signal | 3.60 or 22 mA |
| Interface | 3 button keypad, HART, or PACT software |
| Display | 2 line 8 character LCD |
| Values | Inches or centimeters, percent of level, mA |

### 7.4.3 Ratings

| | | |
|---|---|---|
| Ambient Temperature | -40° to +160° F (-40° to +70° C) | Electronics |
| | -10° to +160° F (-40° to +70° C) | LCD Readout |
| Process Temperature | | |
| Standard | -40° to +235° F (-40° to +114° C) | All Models |
| HT Version | -40° to +400° F (-40° to +214° C) | MTLT |

### 7.4.4 Enclosure

| | |
|---|---|
| Type | Single Compartment |
| Material | Cast Aluminum (optional 316 SS) |
| Finish | Polyester Powder Coat |
| Rating | FM (Canada & US) , Type Nema 4X |

### 7.4.5 Sensor

| | |
|---|---|
| Material | 316 SS, (optional CPVC, Hastelloy, Alloy 20) |
| Length | 6.00 to 300 inches |

### 7.5.0 Industry Approvals

| Agency | Model | Protection | Area Classification |
|---|---|---|---|
| FM (Canada & US) | MTLT-6000 | Intrinsically Safe | Class I, Division 1: Groups A, B, C, & D<br>Class II, Division 1: Groups E, F, G<br>Class III,<br>Nema Type 4X |
| | MTLT-6000 | Explosion Proof | Class I, Division 1: Groups B, C, & D<br>Class II, Division 1: Groups E, F, G<br>Nema Type 4X |