February 2025

Reference Manual
L231040, Rev AH

Magtech MLT-350 Series

Magnetostrictive Level Transmitter for Liquid Level Measurement

Instruction and Operations Manual

HART® COMMUNICATION PROTOCOL

EMERSON™

⚠ WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.
- Do not perform any services other than those contained in this manual unless you are qualified.

Explosions could result in death or serious injury.

- Verify the operating environment of the Magtech MLT-350 series transmitter is consistent with the appropriate hazardous locations certifications.
- Do not remove the gauge cover in explosive atmospheres when the circuit is alive.
- To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

High voltage that may be present on leads could cause electrical shock.

- Make sure the main power to the Magtech MLT-350 series transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the instrument.

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure that you thoroughly understand the contents before installing, using or maintaining this product.

For Equipment service or support needs:

Customer Central: +1-800-221-3653 (8:00 a.m. to 5:00 p.m. CST US)

TABLE OF CONTENTS

TRANSMITTER OVERVIEW

General Description

The MLT-350 is an electronic field instrument, suitable for installation in hazardous and non-hazardous industrial areas. Testing and certification has been obtained from different agencies for installation in specific areas.

This instrument is a two wire, loop powered ***smart*** transmitter, designed to measure and transmit an analog 4-20 mA signal and a digital output proportional to liquid level in a tank. The optional temperature output is configured via the HART communicator.

The Model number is MLT-350 followed by up to four letters that can describe additional features such as mounting configuration (G for Gage Mount, S for Standalone), or communications protocol (FF for fieldbus).

Optional Features of the MLT-350 include:

- Second digital output proportional to an interface level (requires a second float of different specific gravity)
- Digital temperature output gives the liquid temperature and is typically used for display and/or calculation of mass.
- Advanced diagnostics and features highly beneficial for commissioning, troubleshooting or monitoring.
- A variety of lengths and wetted materials to accommodate many different applications.

The Model MLT-351 is a Model MLT-350 that is contained in a stainless steel housing.

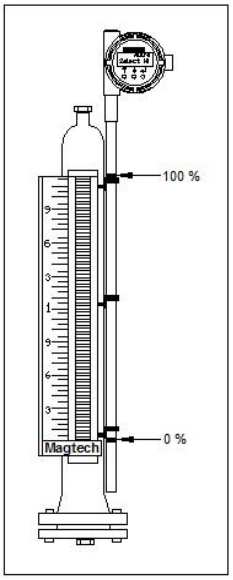
Level Transmitter

In its simplest configuration, a single-purpose float rides up and down the sensor tube, totally surrounding it. A multi-purpose float may also be used to activate the sensor, such a float being placed inside a liquid isolation pipe, (i.e. MLI) and strategically located within a certain longitudinal distance from the sensor tube. In either case, the float has a somewhat lighter specific gravity than the liquid whose level is to be measured, so that it is partially submerged at the interface of interest. As the tank level changes, the float tracks the change and continuously activates the sensor in the tube. The electronics in the housing process the changing signal and update an analog 4-20 mA output and digital HART signal. This analog output is precisely proportional to the liquid level in the tank.

MLI Mounted Transmitter

The MLT-350 may be strapped to the side of the Magtech MLI series (Magnetic Level Indicator). In such an installation, it is used as an accessory transmitter for the visual level indicator. The same float used to activate the magnetic level indicator is also used to transmit a signal to the piezoelectric sensor of the MLT-350.

In the illustration below, the transmitters may be calibrated for the same range as the visual indicator on the MLI, or for part of the range (See Section 3).

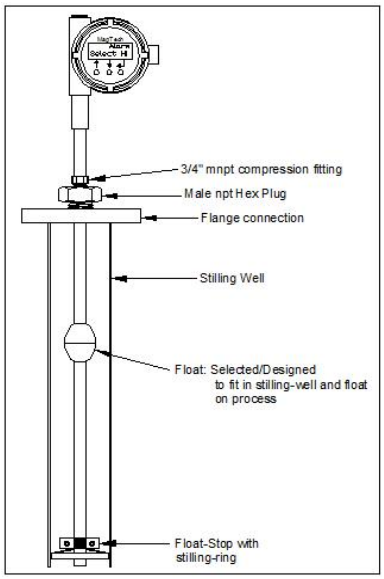


Typical MLT-350 Mounting Configuration on a MLI

Direct Insertion Transmitter

When a companion Magnetic Level Indicator is not present, the MLT-350 is inserted into the tank with its own float around the sensor tube. A stilling well may be optionally used inside the tank.

NOTE: When a stilling well is used, care should be exercised when installing the tube to center it in the chamber so that the float can freely travel the entire length of the probe. Stilling wells are required for transmitters over 10 feet.



The Calibration range of the transmitter may be field stored in non-volatile memory by using the float and push buttons. The push buttons are located on the front panel inside the condulet. See section on Calibration for more details.

INSTRUMENT DESCRIPTION

TRANSMITTER DETAIL DESCRIPTION

The MLT-350 is an assembly of two major components:

The Sensor Tube Assembly.

This 5/8" diameter stainless steel probe, sealed on one end, with the magnetostrictive waveguide in its center. In addition to the magnetostrictive waveguide, the tube also houses the optional temperature sensor and piezoelectric sensor. The tube is made to lengths 2 – 30 ft. in rigid construction.

The Electronics Housing.

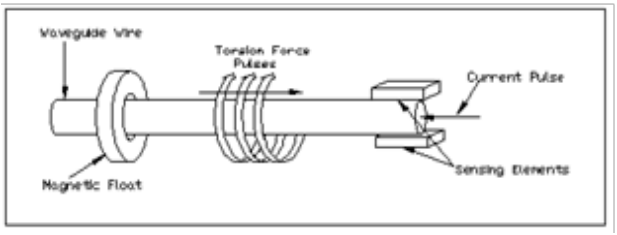
The extruded aluminum housing has two separate compartments. One side contains the microprocessor board assembly and calibration pushbuttons. The other side contains the wiring termination board. The electronics module is connected to the detector board of the sensor tube assembly via a plug-in cable.

The main board is surface mounted component construction utilizing the latest in integrated circuit technology. It contains a high-speed micro controller, D/A Converters, and HART modem.

THEORY OF OPERATION

The MLT-350 Level Transmitter is based on the principle of magnetostriction first used for digital delay lines and later for precision distance or displacement in the machine tool industry. The principle, if designed and applied properly, has potentially very high measurement resolution, typically better than 0.001 inch. In the machine tool industry such a high resolution is desirable. In the liquid level measurement application, however, a resolution of 0.03 inch is more than adequate.

In a brief description, the magnetostrictive principle consists of a wire extruded and heat treated under carefully chosen conditions to retain desired magnetic properties, which is pulsed by a circuit with a relatively high current pulse. The high current pulse produces a circular magnetic field as it travels down the wire at the speed of light. Another magnetic field generated by a permanent magnet, placed near or around the wire at some distance from the point of entry of this pulse, interferes with the magnetic field of the pulse and torsional force results at the collision point.



The effect of this torsion force is to twist the wire at this point producing a torsion wave traveling towards both ends of the wire. The propagation time of this wave is measured precisely and, if the wire properties remain stable, it is very repeatable at about 5-10 microseconds per inch, which is approximately the speed of sound in that medium. By measuring the exact number of microseconds it took the torsion wave to reach a designated termination point of the wire, the distance to the magnet from this termination point can be easily calculated.

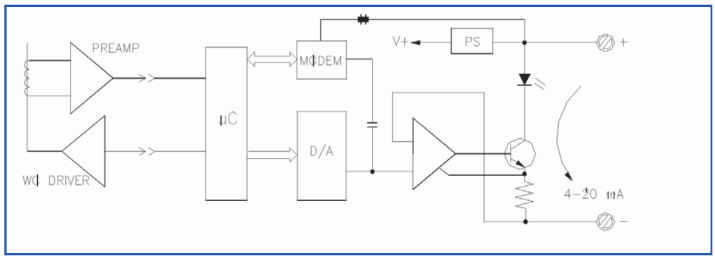
A high-speed micro controller is utilized in the design to process and calculate the elapsed time measurement. Accurate crystals are used for the time base to resolve sub-microsecond timing increments. The binary number, equivalent to the microseconds of the echo travel time, is

written to an output D/A Converter and subsequently converted to a 4-20 mA signal proportional to the item measured. The larger the number of microseconds there are, the greater the distance of the float from the head of the transmitter.

Calibration routines are included in the software to the 0% and 100% points for any distance desired. Even reverse calibration is a simple task using the software routines. Reverse calibration is desirable if ullage instead of level is required, or when the probe is installed with bottom mount electronics.

Level Transmitter. This transmitter computes the distance between the float and the detector from the elapsed time measurement. A specific time window becomes active only for a short time after the interrogation pulse is applied to the waveguide. Any feedback signal, received before and after this window, is rejected as noise. Even signals received during the active window are evaluated and filtered so that only high integrity data is accepted.

The conditioned signal is converted to a percent of full-scale number and written to the D/A Converter. The scale is defined by the calibration procedure and it corresponds to the output span (0%-100%).



Basic Level Transmitter Simplified Block Diagram

NOTE: Configuration options must be chosen at quoting stage.

The MLT-350 transmitter has four output configurations.

1. Primary Level: The most basic version of this transmitter is that it computes the distance between the float and the detector from the elapsed time measurement. A specific interrogation pulse is applied to the waveguide. Any feedback signal received before and after this window is rejected as noise. Even signals received during the active window are evaluated and filtered so that only high integrity data is accepted. The conditioned signal is converted to a percent of full-scale number and a number representing the distance and output as an analog and digital HART signal.
2. Primary Level and Interface Level: A second float may be added below the first, and the second output will be calibrated automatically. The second time interval is timed in the same manner as the first one to derive the position of the heavier float. The two floats require a separation of approximately three inches. The float size, geometry, and magnetic strength all play a factor in how close the two floats can be without interfering with each other. (Only via HART Protocol)
3. Primary Level and Temperature: An optional temperature sensor is embedded inside the bottom tip of the probe, and it is configured to be the third digital output of the transmitter, and comes factory calibrated for the operating range of -50 °C to 149 °C (-58 °F to 300 °F). (Only via HART Protocol)
4. Primary Level, Interface Level, and Temperature: This option is called a 'full- blown" unit and offers all three possible outputs. (Only via HART Protocol)

A deadband of approximately three inches, next to the detector, is fixed in the software and the float is not permitted to enter this area. If this happens output readings maybe erratic or go to fail mode.

INSTALLATION AND WIRING

MLI Mount Transmitter Installation

⚠ WARNING

If the instrument is used as an explosion proof (exp) device then exp conduit must be sealed within 18 inches of the termination point – at the instrument.

Under rated conditions, the branching point at the entry point may reach 85.6 °C, therefore, when choosing cables and cable glands this shall be taken into account.

CAUTION

During Installation, do not attempt to twist or turn the head of the transmitter. Damage to the detector assembly can occur if the head is rotated. If head is loose, contact factory immediately.

The MLT-350 can be mounted to the side of a Magtech MLI series level indicator using a special mounting bracket and stainless steel hose clamps. When mounting the transmitter to a MLI the active sensor region of the probe should fall within the centerline of the process connections on the MLI.

If the transmitter deadband region is inside the centerline of the process connections the transmitter will not output an accurate measurement because the active region of the probe is too short. When placing an order for a transmitter to accompany an existing MLI it is important to indicate the style of the MLI, the temperature and the center-to-center dimensions. Calibration of the probe will be factory set along the active region of the probe; however, a field calibration may have to be performed to match the probe to the desired control room specifications.

If a transmitter is being purchased for an interface MLI, the calibration for the probe should be done in the field to ensure a proper control room reading. For long transmitters it may be desirable for the operator to have the electronics housing mounted at the bottom of the MLI for easy access.

NOTICE: This must be specified at time of purchase.

Direct Insertion Transmitter Installation

The MLT-350 stand-alone transmitter comes equipped with a 3/4” compression fitting, mounted approximately 3.00” to 6.00” below the electronics housing. The fitting is placed in this area to ensure the transmitter is calibrated in the sensor tubes active region. Refer to the stand-alone drawings for a visual description of the transmitter features. Optional mounting configurations are available upon request.

The magnetic float used in the stand-alone unit is designed

to travel up the sensor tube with the change in fluid level. If build-up of process or contaminates should restrict the movement of the float, the transmitter sensor tube will have to be cleaned or the float may have to be replaced with one that has a wider inside diameter. The floats are designed to match the pressure and specific gravity for the process being measured and come in various materials ranging from stainless steel to PVDF (kynar).

The magnetic float can be changed out at any time to accommodate the processes being measured. The float stop, located at the bottom of the transmitter, can be removed to allow the float to slide off the sensor tube.

NOTICE: If using a Transmitter configured for interface measurements, remember to slide the float with the lightest gravity range first.

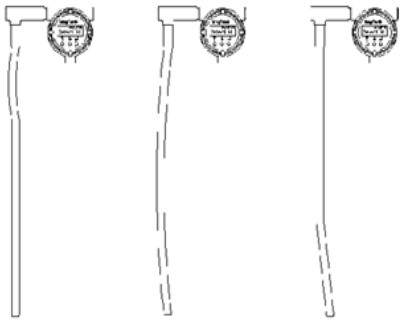
General Installation Guidelines

The basic steps to installing the MLTs are:

Inspection of equipment

Inspect the parts that are listed on the packing slip. Make sure nothing appears to be damaged such as a broken glass from the MLI (flags), damaged float, or a damaged transmitter. Please file a claim with the shipping company immediately if it is believed the shipment has arrived damaged and be prepared to provide pictures.

The following is a depiction of damaged probes:



⚠ WARNING

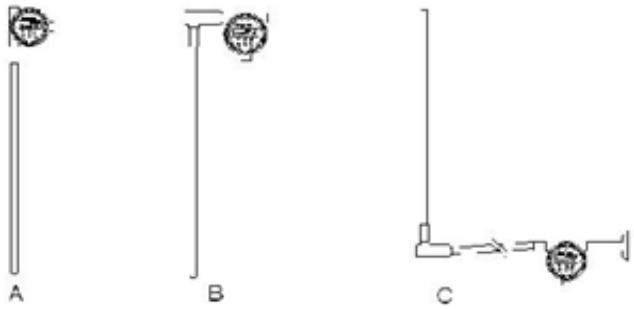
The sensor probe of the transmitter SHOULD NOT BE BENT, BOWED, OR KINKED in any way or the transmitter will not work (will most likely go into fail mode).

⚠ WARNING

Flameproof joints are not intended to be repaired.

Identify Proper Orientation of Transmitter

There are a few possible orientations of the MLT Series transmitters:



Transmitter A is a standard top mount configuration.

Transmitter B is a top mount with elbow, usually utilized when there are temperature or head room issues. There is also a bottom mount with elbow configuration which is not depicted.

Transmitter C is a bottom mount transmitter with remote electronics. This configuration is utilized in more extreme temperatures or for accessibility. There is also top mount with remote electronics which is not depicted.

Mounting the Transmitter.

Align the 4/20 mA (or 0 and 100%) markings with the center of the top and bottom process connection. Mount the transmitter along the level gage and use a nut driver to tighten the clamps so the sensor probe of the transmitter is held securely (will not slip up and down). Keep the transmitter supported while the clamps are being tightened (this can require more than one person).

⚠ WARNING

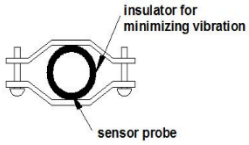
Do not overtighten the clamps because they will bend and distort. (will go into fail mode).

A: Is the correct way to have clamps tightened. The clamps do not have to meet.

B: Is incorrect because the clamp is flipped around and will not grip the sensor probe.

C: Is incorrect because the clamp has been tightened too much and the probe may be damaged/distorted.

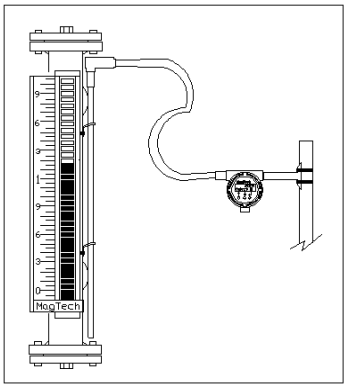
NOTE: Effects of high vibration can be minimized early on by notifying the factory at time of order. The electronics can be remote mounted and special insulators can be installed. Please see the depiction below.



Remote Mount Electronics Option

Due to process temperature, vibration or accessibility the housing/electronics of the MLT transmitter can be remote mounted as far as 25 ft. The housing/electronics are supplied with a pipe- mount bracket that can be mounted most nearby posts or pipes with hose clamps.

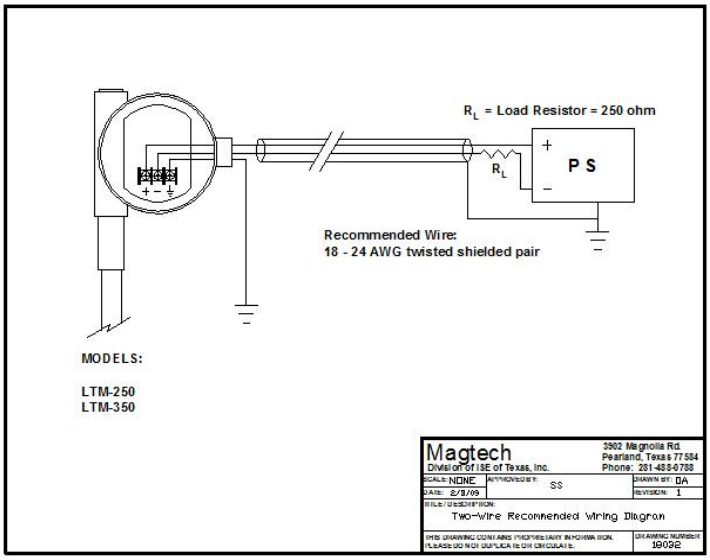
The drawing below depicts a gage mounted transmitter in the top mount remote electronics configuration.



A typical Remote Mount Electronics Option

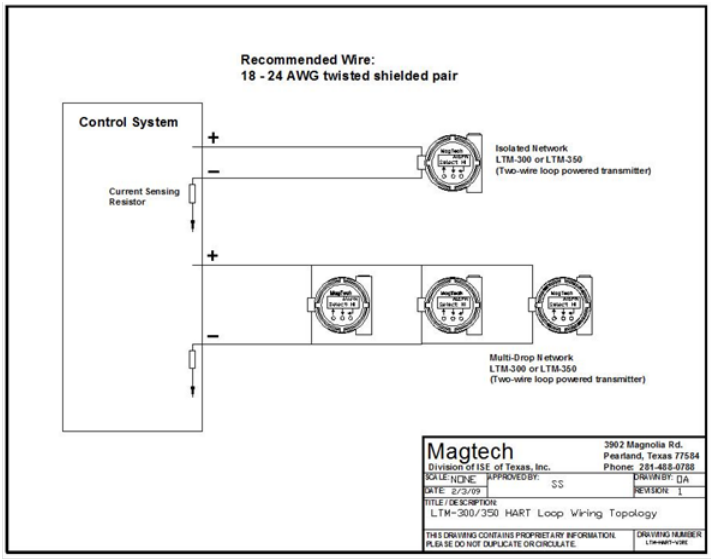
In REMOTE MOUNT electronic options please support the sensor probe at the elbow/condulet and then every 3 feet (depending on length of cable). Support at every 2 feet may be required if explosion proof conduit is utilized by the end user.

RECOMMENDED WIRING



Recommended Loop Wiring

The following below is the Hart Topology.



NOTE: Please visit www.hartcomm2.org to learn more about HART Protocol.

SPECIFICATIONS

TRANSMITTER ELECTRICAL SPECIFICATIONS

Supply Voltage:	16 to 35 VDC
Resolution:	0.039 in (1mm)
Repeatability:	.005% of full scale or .010" whichever is greater
Non-Linearity:	.01% of full scale or .030", whichever is greater
Level Sensor Accuracy:	.01% of full scale or .020", whichever is greater
Analog Output Resolution:	.025% of full scale, (1) 4/20 mA Primary level
Output:	One 4-20 mA output
Calibration:	Zero and span field adjustable with pushbuttons
Dampening:	1 to 26 seconds (field adjustable) via push-buttons
Operating Temperature: (Electronics)	-58 to 185 °F (-50 to 85 °C)
Housing:	Explosion Proof, Dual Compartment, 1/2" npt, Epoxy Coated Aluminum (Standard)
	Explosion Proof, Dual Compartment, 1/2" npt, Stainless Steel (Model MLT-351 only)

Hazardous Location Approvals:	CSA– Class I, Division 1 or Division 2, Groups B, C, D Class II, Division 1 or Division 2, Groups E, F, G Class III IECEx– Ex db IIC T5 Gb Ta = -40°C to 85°C Ex tb III C T100°C Db IP66
Humidity Limits:	SAMA PMC 31.1-5.2
Vibration Limits:	SAMA PMC 31.1-5.3
RFI Limits:	SAMA PMC 31.1-20 to 1000 MHz up to 30V/m

TRANSMITTER SENSOR TUBE

Material:	316ss standard, optional Hastelloy, Monel, Kynar-coated
Operating Temperature:	-50 to 302 °F (-50 to 150 °C)
Maximum Pressure:	2000 psig @ 300 °F
Range:	16 inches up to 30 feet

MENU STRUCTURE AND FEATURES

PUSHBUTTON OPERATION

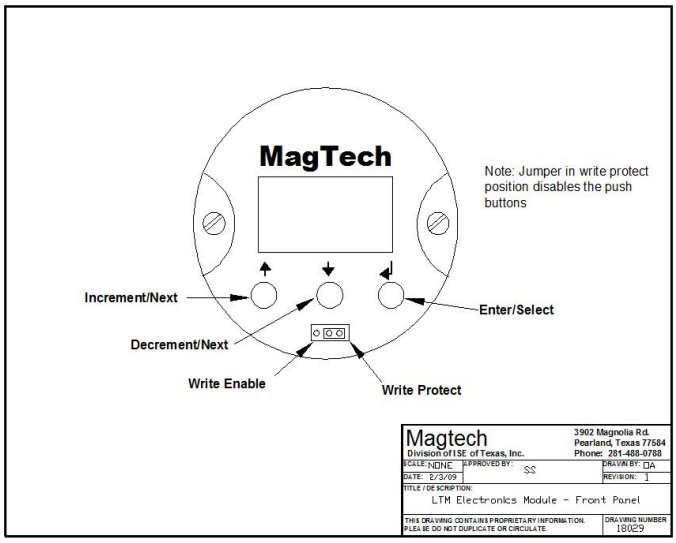
The menu structure and pushbutton operation of the MLT series transmitters is simple and user-friendly. The electronics module has 3 pushbuttons (from left to right):

↑ This button is used to increment values and change "Yes" to "No" and "No" to "Yes".

↓ This button is used to decrement values and change "Yes" to "No" and "No" to "Yes".

← This is the enter button used to execute functions and enter/exit into or out of submenus.

NOTICE: The pushbuttons are timed not pressurized. It does not matter how hard/firm you press them. The buttons depend on the length of time they are pressed. The longer you hold the button the faster it will increment/decrement values. Hold the enter button down for 2 seconds to enter the configuration menus and 1 second for all subsequent menus.



MENU STRUCTURE

The menu structure has been designed so the end user can make parameter changes relatively fast and easy. Below is a detailed description of these menus.

The MLT-350 LCD is a 2 x 8 character screen. The main screen scrolls between the following parameters:

1. Level (in selected engineering units, i.e. 60.00 in or 1524 mm)
2. Interface (when option is provided – in selected engineering units)
3. Temperature (when option is provided – in selected engineering units)
4. The analog current corresponding to level (in mA, i.e. 20.00 mA)
5. Percent of range corresponding to level (in %, i.e. 100.00 %)

If the user desires to enter into the configuration menus simply press/hold the enter button for 2 seconds.

NOTICE: Make sure that the electronics are not in write – protect mode. The menu order can change and new menus can be introduced based on transmitter output options and hardware or software revisions.

The following is the MLT-350 LCD Menu Flowchart

SW Rev	1.00.00
HW Rev	1.00.00
Display?	Scroll→Level→Intrface*→Temp**→mA Out→% Range

SelLngth	30.00in		
Lvl Unit	in → ft → mm → cm → m		
Temp Unit**	C → F → R → K		
Sel PV*	Level → Interface		
Sel Alrm	FailHigh → FailLow → HoldOut		
ChgRnge? →	**Sel LRV** →	**Sel URV**	
Yes → No (yes)	0.00in	24.00in	
SelDamp	1 sec		
ROC Fltr	10.0in/s		
TrmSnsr?	→TrimZero → TrimZero →TrimSpan → TrimSpan → Span		
Yes→No (yes)	- Busy -	24.00in	- Busy - Error (if incorrect)
Offset	0.00in		
TrimDAC? →	Trim 4mA →	Trim 20mA →	
Yes → No (yes)	120	3860	
TstLoop? →	LoopTest		
Yes → No (yes)	4.00mA		
Exit?	Yes → No		

* Only Applies when an Interface Float is included

** Only Applies when an Temperature Sensor is included

Configuration Screens (Up/ Down arrows choose options)

Press Select to Enter

Scrolling Option: Allows the user to stop the main menu from scrolling and choose 1 of 4 possible parameters: Engineering Units (level and interface), Current (mA), or Percentage. Select the desired parameter and then press enter. "Scroll" is the default parameter this option keep the main menu scrolling. See section "5.2 Features" for more details.	Display? Scroll
Select Length: THIS IS NOT THE MEASURING RANGE. This parameter should only reflect the overall sensor length. It can be adjusted by incrementing and decrementing the value and then pressing enter.	SelLngth 30.00in
Level Units:	LvlUnits
This menu can be used to change the level engineering units. It can be changed by incrementing/decrementing to one of the following units: in, ft, mm, cm, m and then pressing enter.	in
Select PV: This menu allows the user to select the measurement that controls the transmitter's current output (mA).	Sel PV Level

NOTE: This menu only appears if the interface (2 floats) option is provided.

Select Alarm: The following alarm settings can be chosen: "FailHigh" = 21.00mA or greater "FailLow" = 3.50mA	Sel Alarm Fail High
Change Range: This menu allows the user to change the measuring range or span. Enter the menu by changing the "No" to a "Yes" and press enter.	ChgRnge? No
Select Lower Range Value (LRV): This is the 4.00mA (0.00%) point on the senor. This value should only be incremented. For example if the value is changed from "0.00in" to "3.00in" the 4.00mA point will shift 3.00 inches higher than the original point. It is recommended to leave this at 0.00 most of the time unless a special circumstance arises. Press enter to go the next screen.	Sel LRV 0.00 in
Select Upper Range Value (URV): This is the 20.00mA (100.00%) point on the sensor. This value should only be decremented. Changing this parameter will change the measuring range or span of the transmitter.	Sel URV 0.00 in
Select Damping: This parameter is used to slow down the reaction of the instrument in order to ignore or average out any agitation on the process surface that may be causing an unsteady output. The units are fixed in seconds and values can be from 1 to 26 seconds.	Sel Damp 1s
Rate of Change (RoC) Filter:	RoC Fltr

This parameter helps ignore erroneous readings from the transmitter's surroundings. If the user knows how fast the level can change in the vessel (i.e. inches per second) then this parameter should be set at a rate that the level in the vessel cannot suddenly jump to. See section "5.2 Features" for more details.

10.0in/s

Trim Sensor:

This menu can be used to recalibrate the transmitter

TrmSnsr?
No

NOTE: There is no need to recalibrate the instrument simply use the "Change Range" menu and change the LRV and URV as desired. If the need arises to use this menu then level simulation will be required at 0 and 100 percent.

Offset (digital only):

This parameter simply adds a digital value to the measuring range or span it does NOT shift or move the measuring range. See section "5.2 Features" for more details.

Offset
0.00 in

NOTE: The offset will not change the 4/20mA output from its original calibrated points. It only adds a digital scale to the engineering units output. The offset will also be added to the interface level when available.

Trim Digital-Analog-Converter (DAC):

These are factory set parameters used to provide an accurate 4.000mA and 0.000mA. This parameter should not be changed as Magtech uses NIST traceable equipment to calibrate our transmitters and only accredited laboratories for the annual calibration of our equipment. This menu will allow the user to change the accuracy of the transmitter output.

TrimDAC?
No

NOTE: A current meter should be used to monitor the 4/20mA when this function is selected.

Test Loop:

This function allows for direct control of the Transmitter's current output (mA) capability. Simply enter into this menu and change the current (mA) output as desired. This option is excellent for plant startup verification.

TstLoop?
No

Exit:

This signifies the last menu before the main screen. If the user desires go back through the configuration menus then change the "Yes" to "No" and review the configuration again else press enter while the screen shows "Yes" and return to the main screen.

Exit?
Yes

Exit to Displays

Features Description

Scrolling Option:

When choosing not to scroll the main menu the following options can be chosen by pressing the up and down push buttons.

Display ?	Display ?	Display ?	Display ?	Display ?	Display ?
Scroll (or)	**Level** (or)	**Intrface** (or)	**Temp** (or)	**mA Out** (or)	**% Range**

NOTE: The "Scroll" option will vary depending on how many outputs are configured.

Rate of Change (RoC) Filter:

The RoC filter is a continuous monitor of how fast (the rate) the level is rising and falling. It is also an excellent tool to help eliminate any temporary spontaneous noise that may be present in-field. For example, if the level in a tank cannot rise or fall faster than 12.0 in/s then the setting for the RoC filter should be set to 12.0 in/s or less to help filter/ignore erroneous readings.

NOTE: The engineering units will change according to units selected (i.e. cm/s).

Offset:

The offset is a digital number that gets added to both the LRV and URV to account for any distance below the sensor probes measuring distance. For example if the offset is changed from "0.00in" to "2.00in" the 'Level' on the main screen will show "2.00in" at 4.00mA and the 20.00mA value will simply have 2.00 inches added to it.

NOTE: The span will not change and the 4/20mA will not shift from its original calibrated points. This offset value will also add to the interface level when available.

Advance Menus

There is an "advance" menu incorporated into the MLT-350 model. To access this menu press and hold the increment (↑) button first then while holding the increment button press and hold the enter button for 3 seconds. A new menu will appear on the LCD screen.

The following is a flow chart of the "advanced" menus

ComPort? → Serial

Yes → No (Yes) Active

↓

Default? → **Default?** →

Yes → No (Yes) Load → Save (Load)

↓

For Load **Select** → Defaults

Factory→ Sensor1 → Sensor2 → Sensor3 Loaded

↓

For Save **Select** → Defaults

Sensor1 → Sensor2 → Sensor3 Saved

↓

Deadzone

1.50in

↓

1pt Cal? → SelLngth → Sel LRV→ Sel URV→ Energy→

Yes → No (Yes) 30.00in 0.00in 24.00in 22%

↓

DCOffset→ HoldTime→ CrntLvl?→ CrntLvl?→

1.50V 4µs 0.00in -Busy-

↓

LvlAdjst? → CrntLvl?→ CrntLvl?

Yes → No (Yes) 0.00in -Busy-

↓

FlipPrb? → Config?→ Rerange?→

Yes → No (Yes) Bottom → Top Yes → No (Yes)

↓

For Yes Sel LRV→ Sel URV→ CrntLvl?→ CrntLvl

0.00in 24.00in 0.00in -Busy-

↓

For No CrntLvl?→ CrntLvl

0.00in -Busy-

↓

ChgSgnl? → Energy→ DCOffset→ HoldTime→

Yes → No (Yes) 22% 1.50V 4µs

↓

PW Filter → **PW Min** → **PW Max**

On → Off (On) 40 tics 100 tics

↓

*** 4mA Sat** →

Off→ On (On)

↓

For On Unit will saturate to 3.80 mA below the calibrated 4.00mA point.

↓

For Off Unit will hold 4.00 mA as long as the float is detected below the calibrated 4.00mA point.

Exit? →

Yes → No

* Avg PW and 4mA Sat menus/options are available in software revisions 1.02.00 or higher.

ComPort:

This menu is currently only utilized at the factory and will not assist in any troubleshooting. When the menu first appears the "No" option is defaulted, simply press enter to bypass this option. If "Yes" is selected and this menu is accidently entered into then the push buttons will be locked out. Simply cycle the power to the instrument to clear the effect of entering into this option.

Default:

The next menu is the "Default Configurations" menu. This option allows the user to "load" the original factory settings or load settings saved in slots labeled "Sensor 1", "Sensor 2" or "Sensor 3" (if utilized by end user). If desired one electronics module can save settings for 3 other sensor probes by calibrating the electronics module to a particular sensor probe then saving those settings into slots labeled sensor 1, 2, or 3. Change the menu screen from "load" to "save". Then the user can save current setting into slots labeled sensor 1, 2 or 3 and load from these slots as desired. If the output is still erratic, try disconnecting the power momentarily by unplugging and re-plugging-in the terminals. If a glitch was stored in RAM memory, this will generally clear it.

Loading Factory Defaults:

Enter into the "Defaults" menu by changing the "no" to a "yes". Then the option to "Load" will appear. Press enter and the "Factory" option will appear then press enter on more time to execute the load from defaults (settings can also be loaded from Sensor 1, 2, or 3 by using the up or down arrows on the "Factory" screen if the user has utilized the other slots).

Saving Settings:

Enter into the "Defaults" menu by changing the "no" to a "yes". Then the option to "Load" will appear. Use the up or down arrow to change the "Load" to "Save" option. Press enter and the next menu will appear with "Sensor 1". By pressing enter the current settings of the transmitter will be saved. At the "Sensor 1" menu screen if the up or down arrow is pressed the user has the option to save the transmitter settings into "Sensor 2" or "Sensor 3" slots. Note: One electronics module can potentially hold up to 3 other transmitter settings.

NOTE: The factory settings can never be overwritten (or saved to), only loaded from.

Deadzone:

This menu is mainly utilized at the factory to achieve optimal linearity near the deadband close to the electronics. This feature was released just in case in-field adjustments are necessary.

NOTE: This option/feature only appears in software revisions 1.01.15 or higher.

1-point Calibration Procedure (1pt Cal):

The following menu is the 1 –point Calibration procedure. This procedure was designed to help the user get up and running in an emergency. If electronics have to be shared in an emergency the following procedure guides the user through a "quick" calibration procedure that does not require level simulation but instead works with the current level (1 point) in the vessel/tank.

NOTICE: Please consult factory before attempting this procedure. Document transmitter's serial number for better assistance.

1. Enter into the "1pt Cal" menu by changing the "no" to a "yes" and pressing enter.
2. The first menu is "SelLngth" or select length. This is not the measuring range but the overall probe length. This information can be found on the label of the instrument housing. (See Section 2.1 Product Identification). Enter the value in using the up or down arrows and press enter.
3. The second menu is "Sel LRV" or select lower range value. Most of the time this value is at 0.00in. It is recommended to leave this value at zero and press enter.
4. The next menu is "Sel URV" or select upper range value. Enter in the desired measuring range and press enter.
5. The "Energy" menu is next. This parameter controls the amount of energy being sent down the sensor probe. Longer sensor probes require more energy shorter sensor probes require less energy. Please contact the factory for guidance with this parameter.
6. The "DCOffset" menu is the DC voltage that the signal is offset by. It is useful for eliminating some noise. Please contact the factory for guidance with this parameter.
7. The "HoldTime" menu is the amount of time the energy being sent down the probe is sustained. Note: a longer hold time can increase the deadband near the electronics. Please contact the factory for guidance with this parameter.
8. The last menu is the "CrntLvl" or current level menu. Enter the known current level in the vessel/tank (in engineering units) and press enter. The calibration should take place and the transmitter should be operational. If the next menu appears then the operation was successful. If the menu reverts back to the beginning of the "1pt Cal" menu then the operation was unsuccessful. Further troubleshooting may be necessary if the operation is unsuccessful. See Section 6 for troubleshooting guide.

NOTE: The 1-point calibration may not be within the published accuracy specification. Again this procedure was designed to get a critical application up and running. A recalibration (two point calibration) may be highly desirable as soon as the opportunity presents itself.

Level Adjustment (LvlAdjst):

If the level gage indicator and level transmitter reading do not match or appear to be incorrect by a few inches then the "LvlAdjst" function can be utilized. Enter into the menu and simply use the up and down push buttons to enter the current level being displayed by the level gages visual indicator and then press enter. The transmitter will adjust the calibration and output accordingly. Note: Be careful make sure this is what is desired.

Field Reversible Transmitter (FlipPrb):

An important and key feature of the MLT-350 Model is the ability to flip (rotate) the entire transmitter 180 degrees. This procedure is only for MLI mount transmitters with an elbow connection on them. If the transmitter does not have an elbow connection please contact factory for assistance. If the need arises and a bottom mount transmitter is preferred over a top mount transmitter or vice versa then following these simple steps. THIS PROCEDURE IS FOR MLI MOUNT TRANSMITTERS ONLY.

1. Physically flip (rotate) the entire transmitter (this includes the sensor probe) and mount it accordingly.

NOTICE: Be careful not to damage the sensor probe while rotating the transmitter.

2. Remove the front glass cover of the transmitter enclosure and then using needle nose pliers pull on the protruding screws (spanner screws) to pull out the electronics module. Alternate pulling on the screws in order to prevent damage to the electronics module.
3. Rotate the electronics module 180° and insert it back into the enclosure. The module should now be right side up.
4. Go into the "advanced" configuration menu by holding the increment (↑) button and the enter button together for 3 seconds. The menu should read "ComPort", release the buttons.

NOTICE: Be careful not to damage the sensor probe while rotating the transmitter.

5. Press the Enter button to bypass the menus until the "FlipPrb?" (Flip Probe) menu appears. Use the up or down buttons to select "Yes" and press Enter.
6. When "Yes" is selected the next menu is the "Config" (Configuration/Orientation) menu. This is where the "Top" or "Bottom" mount configuration is selected. This configuration/orientation is with reference to where the sensor probe "bulkhead" is located on top or bottom. Select the appropriate "Config" and press enter. If the original orientation is selection the menu will revert back to "FlipPrb?" menu.
7. The next menu is "Rerange?" (Change Range) menu. Select "Yes" if the measuring range (or span) is changing from the original span. Select "No" if the span is to able to remain the same. Selecting "Yes" will then go through change range procedure discussed in section 5.1 of this manual.
8. After the "Rerange?" menu is the "CrntLvl?" (current level) menu. Simply enter where the existing level is in the vessel and a one-point calibration will take place automatically and the next menu will appear. If the next menu appears then the operation was successful. If the menu reverts back to the beginning of the "FlipPrb" menu then the operation was unsuccessful. Further troubleshooting may be necessary if the operation is unsuccessful. See Section 6 for troubleshooting guide.

Change Signal (ChngSgnl):

The next and final menu in the special features menu is "ChngSgnl" or change signal option. The feature allows the adjustment of the signal being sent down the sensor probe. It can be utilized when one electronics module is being utilized to save settings for various different length sensor probes.

This menu has 3 parameters that can be adjusted. The first is "Energy" [%], it is increased for a longer sensor probe and decreased for a shorter sensor probe. The second parameter is "DCOffset" or DC Offset [v], this is the DC voltage that the signal is offset by. It is useful for eliminating some noise. This parameter is usually left at 2.5 V. The third (and final) parameter is the "HoldTime"

or hold time [µs], this is how long the Energy is held for. This parameter is recommended to stay within a certain range. Also see section "6.3 Changing Signal Parameters"

NOTICE: This option is also intended for mainly factory use. Changing these parameters can cause undesirable results. Please consult factory with any questions. The "factory" default configurations can be loaded if the parameters have been drastically changed.

NOTE: There is purposely not much detail on this option as it is recommended that these parameters not be changed unless the electronics module is being utilized for more than one sensor probe. It is also recommended that the user be guided by the factory if this option is being utilized.

Pulse Width Filter (PW Filtr):

The pulse width filter can be utilized for dual output (level and interface) applications if there are any erroneous readings being transmitted or displayed. This feature can be adjusted so the unique signal from the magnetic float can be concentrated on and all other false signals are ignored.

NOTE: This option/feature only appears in software revisions 1.01.15 or higher.

This option was revised in software revision 1.02.00 to show the average pulse being detected to help better set the PW filter.

4mA Saturation (4mA Sat):

When turned on this feature is designed to cause the transmitter output to go to 3.80mA saturation if the level drops below the calibrated 4.00mA point. By default this feature is turned off so the transmitter output will hold 4.00mA if the level were to slightly fall below the calibrated 4.00mA point. This is due to the design of the transmitter as it pertains to the MLI and in direct insertion applications.

NOTE: This option/feature only appears in software revisions 1.02.00 or higher.

TRANSMITTER CALIBRATION AND TROUBLESHOOTING

CALIBRATION

NOTICE: There really is no need to re-calibrate this instrument. The MLT-Series arrive calibrated to specified measuring ranges at order placement.

If the need arises and a recalibration is deemed necessary please follow these instructions carefully.

NOTE: Level simulation will be required at 0% and 100% positions.

1. Verify the "probe length" is not the same as the" measuring range" desired. If so please change accordingly. See Section 5.1.
2. Go to the "Change Range" menu and set the desired URV (measuring range).
3. Go to the "Trim Sensor" menu and enter.
4. At the "Trim Zero" screen place the level (or magnet/float) at 0% (4mA point) and then press enter.
5. At the "Trim Span" screen move the level (or magnet/float) to 100% (20mA point) and then press enter.
6. "Exit" the configuration menus and the instrument should be calibrated. If not begin to troubleshoot or consult factory for assistance.

Error Preventative Calibration:

The MLT-350 transmitters are protected from incorrect calibration so if something is done incorrectly it will display "Span Error" on the LCD for 5 seconds and then return to the beginning of the "Trim Sensor" menu.

Recommendation:

Again there is no need to recalibrate the instrument simply go to the "Change Range" menu and adjust the LRV or URV as desired.

GENERAL TROUBLESHOOTING

Magtech manufactures custom built products so each transmitter has been specifically designed to fit on a MLI or be inserted into a tank/vessel and has been approved

by the end user at some point during the ordering/purchasing process. Each transmitter has been factory calibrated to meet end user requirements so there is no need to recalibrate these transmitters unless the requirements have changed from the time of purchase/delivery to installation. If the need arises to calibrate these units to a new range please carefully read and follow the calibration procedure in the instruction and operation (I/O manual) or consult the factory. Always feel free to contact the factory if any questions or uncertainties arise. The following guide has been established to guide the end user through some troubleshooting procedures if the need arises.

There are 3 basic scenarios that can potentially cause issues:

Physical damage to the sensor probe.

Accidents can happen during the installation process and if the sensor is permanently bent, bowed, or kinked it will no longer work properly. Some symptoms of damage to the sensor probe are:

a) Erratic output, unit jumping to full scale (alarm mode) randomly, usually around the damage point.
b) Unit in constant alarm condition
c) Unit going into alarm condition after a certain point.

NOTICE: NEVER bend, bow or cause a kink in the sensor probe, this will damage the instrument and void the warranty. Do not attempt to straighten the sensor probe, this will not help the instrument work. If the shipment arrives damaged please file a claim with the shipping company and contact the factory to arrange for a replacement.

Water damage

Water damage to the electronics module or sensor probe. This is potentially the most severe case the symptoms are unpredictable. If there is any suspicion that the transmitter may have incurred water damage please contact the factory to make arrangements to have the unit sent back for factory inspection.

NOTE: Physical and water damage are not covered under warranty.

Magnetic Indentation

It is possible for any magnetostrictive instrument to have residual magnetic energy stored along the length of the waveguide. These magnetic anomalies can interfere with the output response signal. If this appears to be the case a level gage float (or a bar magnet preferably) may be run along the length of the sensor tube, past the head of the transmitter, in an even motion without stopping. This will usually clear all such magnetic anomalies.

NOTICE: Never move a magnet in perpendicular motion away from the sensor tube. This will always leave a residual magnetic field in the waveguide which causes the transmitter output to be erroneous or unstable.

NOTE: The MLT-350 is HART compatible, however HART communication will not work if the unit is not powering up.

BASIC TROUBLESHOOTING

Symptom	Potential Issue/Problem	Possible Solution
Transmitter is not powering up. The LCD is not turning on and there is zero mA current draw.	Polarity Check	The transmitter is polarity protected. Check the field wiring to make sure the plus and minus connections are not reversed.
	Electronics not making proper connection to power connector.	Make sure the electronics module is seated properly. Open the front cover (where the LCD is) and firmly push on the "Magtech" text. A good way to tell if the electronics are not seated properly is by making sure the protection screws are not physically higher than the outside of the housing. Sometimes pulling

		the electronics module out and putting it back in can reseat the electronics correctly. Use cutters or needle nose pliers to grip the protection screw and lightly pull on each screw (alternate).
Output of transmitter is erratic OR in constant failure mode	Configuration settings not optimized	Change signal parameters. See section " " or contact factory for assistance.
	Electronics module failure	Replace electronics with known working electronics from a sensor of similar length and/or contact factory for replacement assistance.
	Sensor probe failure	Consult factory for assistance.
Local display showing dark black squares or blinking "please standby"	LCD did not initialize properly	Cycle power rapidly (this may have to be done a few times).
	Electronics module failure	Replace electronics with known working electronics from a sensor of similar length and/or contact factory for replacement assistance.
Cannot enter into menus local display menus using push buttons	Write protect jumper is locking buttons	Move the blue jumper from the right (2pins) to the left (2pins).
Transmitter output does not match display	If the mA output greater than 22mA then Electronics module failure (most likely due to power surge)	Consult factory for replacement assistance (non-warranty)
	If the mA output less than 22mA but slightly different	Perform DAC trim described in section 7.1.
	from display then DAC Trim	

CHANGING SIGNAL PARAMETERS

There are 3 parameters involved with “Energy Settings”. These parameters are Energy, DCOffset and HoldTime.

- Energy [%] is the amount of energy (a voltage correlated to percentage) being sent down the sensor probe.
- DCOffet [V] is the DC voltage that the signal is offset by. It is useful for eliminating some noise.
- HoldTime [µs] is how long the Energy is sent down for.

Symptom: Transmitter is erratic (i.e. output going from correct reading to failure mode).

Possible Resolution: Increase Energy Settings:

1. Unlock the pushbuttons by moving the blue jumper to the left, Hold the UP button for 1sec
2. While holding the UP button also hold ENTER button (together) for 3 secs
3. The menu should change to “ComPort” release the buttons
4. Bypass this menu by pressing enter.
5. Keep bypassing the menus until you see “ChgSgnl”,
6. Use the up or down arrows to change the “no” to a “yes” and press enter.
7. The next Menu will say “Energy” and a percentage, increase this number by 10 [%] and press enter. (i.e. 20 to 30 %)
8. The next Menu will say “DCOffset”, and a voltage, leave this value unchanged and press Enter.
9. The next menu will say “HoldTime” and a number; increase this number by 2 [µs] and press enter. (i.e. 4 to 6 µs)
10. Then simply press enter until you see the “Exit” menu and then press enter one last time.

The above procedure can also help if the output is in constant failure mode. If the procedure does not help please contact factory for further assistance. 1-800-221-3653.

MLT-350 HAS HART PROTOCOL

HART PROTOCOL: GENERAL INFORMATION

The MLT-350 is a HART registered and certified instrument. The section presents how the HART Communication Protocol has been utilized in the MLT-350. This section does not explain what HART Protocol is, please visit www.hartcomm2.org to learn about HART.

HART PROTOCOL: MENUS AND FLOWCHART

The following is a flow chart of our HART menu structure. This flow chart can be utilized to access desired parameters and operations when using a handheld communicator or a HART enabled host system.

Hart Protocol: Menus and Flowchart

Device Setup →	→	Process Variables →	→	Level			
PV Value (1)				Interface (2)			
Loop Current				Temper (3)			
LRV				% Range			
URV				Loop Current			
		Diag/Service →	→	Loop Test			
				Diagnostics →	→	Device Status	
						Operation Status	
						Calibration Status	
						Level Alarm Status	
				Calibration →	→	D/A trim	
						Full Level trim	
						Full Temp trim (3)	
						Calibration	
						Review →	→ Level Gain
							Lvl UTP Value
				Live Measurements →	→	Level Pulse	Sensor UTP Value
						Interface Pulse (4)	Lvl LTP Value
						Tic Limit	Sensor LTP Value
							Temperature Gain (3)
							Temperature Offset (3)
							RTD UTP Value (3)
							A/D UTP Value (3)
							RTD LTP Value (3)
							A/D LTP Value (3)
							DAC Zero
							DAC Full
		Basic Setup →	→	Level Setup →	→	Keypad Rerange →	→ LRV
				Orientation is:		Level Offset	URV
				PV is: (2)		Rate of Change	Unit
				LCD Output is:			LSL
				Probe Length			USL
				Level Units			
				Temper Units (3)			
				Damping			
		Detailed Set-up →		Device Profiles →	→	Factory Slot	

		Load		
		User 1 Slot		
		Load		
		Save		
		User 2 Slot		

Continued on Next Page

		Load		
		Save		
		User 3 Slot		
		Load		
		Save		
	Signal Setup →	→ Energy		
		DC Offset		
		Hold Time		
	Digital Level Alarms →	→ Alarms are:		
		(Enabled/Disabled)		
		Alarm High High		
		Alarm High		
		Alarm Low		
		Alarm Low Low		
		Level Alarm Status		
	Output Condition →	→ Analog Output →	→	Loop Current Mode
				Ao Alrm typ
				D/A trim
				Loop Test
		HART Output →	→	Poll addr
				Num req preams
	HART Information →	→ Manufacturer		
		Model Unique		
		ID serial		
		Number Date		
		Sales Order		
		Purchase Order		
		Tag		
		Long Tag		
		Message		
		Descriptor		
		Revision #→	→	Universal rev
				Fld dev rev
				Final asmbly num
				Software rev
				Hardware rev

(1) When Interf is PV, Interf is displayed
(2) Only Applies when interface float is included
(3) Only Applies when temperature sensor is included
(4) Value displays 0 if interface float/ temperature sensor is not present.

MLT-350 IN A SIS

General Safety Guidelines

The MLT-350 transmitters are designed to output a 4/20mA output signal under normal operation representing liquid level in a vessel. The 4/20mA output is considered the safety function of the transmitters.

The MLT-350 transmitters are design to operate without the need for periodic maintenance or inspection. If the MLT-350 transmitters are being used as part of a Safety Implemented System (SIS) then periodic proof testing will be required for the transmitter to detect any potential failure which is defined as Dangerous Undetectable in the transmitters' normal operation.

Proof Testing must be performed at regular interval of 1 year. The result of this testing must be documented. If the transmitter exhibits a failure mode output during normal operation then it will be necessary to perform proof testing regardless of scheduled intervals.

MLT-350 Safety Ratings

1. The Safe Failure Fraction: 92.46%
2. The average Probability of Failure on demand is: 1.19×10^{-3}
3. Executes diagnostics at a maximum interval of 1 sec.
4. Provides a diagnostic/ failure update in less than 2 seconds of the occurrence.
5. The transmitter may only be used in an SIS when:
    - Software Revision is 1.01.16 or greater
    - Hardware Revision is 1.00.02 or greater
6. It is classified as Type B equipment.
7. The transmitters must be used within the limit defined in this manual.
8. The maintenance, troubleshooting and safety inspection should be done by qualified personnel. The qualifications include but are not limited to knowledge of the products operating principles, application in which the transmitter is being utilized, the information in this instruction manual and a general knowledge/experience as an Instrumentation or Electronic Technician.

MLT-350 Proof Test

1. To avoid any false alarms take appropriate steps to notify control room that the instrument is being tested.
2. Utilize the pushbuttons and scroll through the main menus until "TestLoop" is shown.1
3. Enter into this menu and modulate the current output from 3.5 to 20.8 mA while verifying the current output with a multimeter or the control room. If this function does not work then instrument is in Failure Mode. Use troubleshooting tips to figure out why instrument is in failure mode and do not try to recalibrate.
4. Exit "TestLoop" function by pressing enter.

NOTE: The "TestLoop" function helps test for power supply problems such as not enough voltage or possible quiescent current related failures.

Safety Inspection

The MLT-350 transmitters have 3 major components the magnetic float, the electronics (analog output) and the sensor probe. The MLT-350 detects the magnetic float position from inside the MLI (MLI - mounted) or along its sensor (Direct Insertion). To work properly the float must move freely either inside the MLI or along the sensor. If the float is damaged or gets stuck in the vessel or along the probe the transmitter will continue to report the level/position of the float. This qualifies as a Dangerous undetected failure. To avert this failure the float will need to be inspected for integrity and movement. Depending on the application some MLI's can have two floats inside the chamber and some transmitters can have two floats on the sensor. In both cases the following inspection should be done for both floats.

For MLI - mounted transmitters:

1. Remove the float from the level gage chamber and visually inspect for damage such as dents or visible holes.
2. The float can be checked for leaks by submerging it in water and observing for air bubbles.
3. Install the float inside the chamber (note orientation of float) and move the float from bottom process connection (0%) to the top process connection (100%) length of the chamber

using process fluid or other media. The float should move freely from 0 to100%.

For Direct insertion transmitters:

1. Move the float up and down along the length of the sensor probe. The float should move freely from the bottom float stop to the top process connection.
2. Remove the float from sensor and visually inspect for damage such as dents or visible holes.
3. The float can be checked for leaks by submerging it in water and observing for air bubbles.

IDENTIFICATION

For an SIS application the MLT-350 must be specified at the time of order due to rigorous in house testing. A SIL rated MLT-350 can be identified with approval markings on the label of instrument.

WARRANTY

WARRANTY

All Magtech products are warranted against defects in materials and workmanship for eighteen months from the date of shipment or twelve months from the date of installation, whichever period expires first. The MLI chamber and process connections are guaranteed for the life of the tank or vessel to which it is attached. Floats are guaranteed for two years. Magtech will repair or replace at its discretion those products that fail to perform as specified, with the following exceptions:

1. Products repaired or modified by persons that are not authorized by Magtech.
2. Products subjected to misuse, negligence or accidents.
3. Products that are connected, installed, or otherwise used in such a way not in strict accordance with manufacturer's instructions.

This warranty is in lieu of any other warranty expressed or implied by any party other than Magtech. Repairs and/or replacements shall be at the sole discretion of Magtech based on the terms and conditions of this warranty. Defective products shall be returned to the factory prepaid by the buyer after obtaining a Return Authorization Number from Magtech. All warranty repairs or replacements will be performed at the factory in Pearland. Surface return freight will be paid by Magtech. Factory warranties do not include field service. Field service warranty repairs will be at the buyer's expense.

Any modifications to terms and conditions of this warranty will not be binding unless made in writing and signed by an authorized agent or official of Magtech.

NOTE: ALL MAGTECH INSTRUMENTS SHOULD BE UNPACKED AND THOROUGHLY INSPECTED UPON RECEIPT. MAGTECH INSTRUMENTS ARE SHIPPED FOB FACTORY AND ARE FULLY PROTECTED AGAINST DAMAGE OR LOSS DURING SHIPMENT. ANY CLAIMS FOR PARTS DAMAGED DURING SHIPMENT SHOULD BE SUBMITTED WITHIN 15 DAYS OF RECEIPT OF GOODS BY CUSTOMER.

Emerson Automation Solutions- Magtech
3902 Magnolia Road, Pearland, Texas, 77584-1610, USA

CHINA ROHS

MLT-350 MODEL DISCLOSURE

含有China RoHS管控物质超过最大浓度限值的部件型号列表 MLT-350/351

List of MLT-350/351 Parts with China RoHS Concentration above MCVs

部件名称 Part Name	有害物质 / Hazardous Substances					
	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr +6)	多溴联苯 Polybrominated biphenyls (PBB)	多溴联苯醚 Polybrominated diphenyl ethers (PBDE)
电子组件 Electronics Assembly	X	O	O	O	O	O

本表格系依据SJ/T11364的规定而制作.

This table is proposed in accordance with the provision of SJ/T11364.

O: 意为该部件的所有均质材料中该有害物质的含量均低于GB/T 26572所规定的限量要求.

O: Indicate that said hazardous substance in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

X: 意为在该部件所使用的所有均质材料里，至少有一类均质材料中该有害物质的含量高于GB/T 26572所规定的限量要求.

X: Indicate that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.