

E3 Modulelevel®

Installation and Operating Manual



*Digital E3 Modulelevel® with
HART® and PACTware™
Communications Liquid
Level Displacer Transmitter*

Read this Manual Before Installing

This manual provides information on the E3 Modulelevel® Electronic Transmitters. It is important that all instructions are read carefully and followed in sequence. Detailed installation, wiring and calibration instructions are included in this manual.

If this equipment is used in a manner not specified by this manufacturer, the protection provided by the equipment may be impaired.

Conventions Used in this Manual

Certain conventions are used in this manual to convey specific types of information. General technical material, support data, and safety information are presented in narrative form. The following styles are used for notes, cautions, and warnings.

Notes

Notes contain information that augments or clarifies an operating step. Notes do not normally contain actions. They follow the procedural steps to which they refer.

Cautions

Cautions alert the technician to special conditions that could injure personnel, damage equipment, or reduce a component's mechanical integrity. Cautions are also used to alert the technician to unsafe practices or the need for special protective equipment or specific materials. In this manual, a caution box indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Warnings

Warnings identify potentially dangerous situations or serious hazards. In this manual, a warning indicates an imminently hazardous situation which, if not avoided, could result in serious injury or death.

Safety Messages

Follow all standard industry procedures for servicing electrical and computer equipment when working with or around high voltage. Always shut off the power supply before touching any components.

Electrical components are sensitive to electrostatic discharge. To prevent equipment damage, observe safety procedures when working with electrostatic sensitive components.

WARNING! Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Low Voltage Directive

For use in Installation Category I, Pollution Degree 2. If equipment is used in a manner not specified by manufacturer, protection provided by equipment may be impaired.

Notice of Trademark, Copyright and Limitations

Magnetrol® & Magnetrol® logotype and Modulelevel® are registered trademarks of Magnetrol® International, Incorporated.

Copyright © 2017 Magnetrol® International, Incorporated. All rights reserved.

Performance specifications are effective with date of issue and are subject to change without notice. Magnetrol® reserves the right to make changes to the product described in this manual at any time without notice. MAGNETROL makes no warranty with respect to the accuracy of the information in this manual.

Warranty

All MAGNETROL electronic level and flow controls are warranted free of defects in materials or workmanship for eighteen months from the date of original factory shipment.

If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, MAGNETROL will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

MAGNETROL shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some MAGNETROL products.

Quality Assurance

The quality assurance system in place at MAGNETROL guarantees the highest level of quality throughout the company. MAGNETROL is committed to providing full customer satisfaction both in quality products and quality service.

The MAGNETROL quality assurance system is registered to ISO 9001 affirming its commitment to known international quality standards providing the strongest assurance of product/service quality available.





Magnetrol[®]

E3 Modulelevel[®]

Displacer Level Transmitter

Installation, Operation and Maintenance Manual

Table of Contents

1.0 QuickStart Installation		3.0 Reference Information	
1.1 Getting Started.....	4	3.1 Description	27
1.1.1 Equipment and Tools	4	3.2 Theory of Operation.....	27
1.1.2 Configuration Information.....	4	3.2.1 Displacer/Range Spring	27
1.2 QuickStart Mounting.....	4	3.2.2 LVDT	27
1.2.1 Tank Top.....	4	3.2.3 Interface	28
1.2.2 External Chamber	5	3.2.4 Density.....	28
1.3 QuickStart Wiring	5	3.3 Troubleshooting	28
1.4 QuickStart Configuration	6	3.3.1 Troubleshooting System Problems.....	29
2.0 Complete Installation		3.3.2 Status Messages	30
2.1 Unpacking	7	3.3.3 Checking the LVDT Winding Resistance.....	30
2.2 Electrostatic Discharge (ESD) Handling Procedure.....	7	3.3.4 Status Message Descriptions	31
2.3 Before You Start	8	3.4 Agency Approvals.....	32
2.3.1 Site Preparation	8	3.4.1 FM (Factory Mutual)	32
2.3.2 Equipment and Tools	8	3.4.2 CSA (Canadian Standards Association)	32
2.3.3 Operational Considerations.....	8	3.4.3 ATEX (European Standard for Explosion Protection)	33
2.4 Mounting.....	9	3.4.4 Agency Drawings	34
2.4.1 Tank Top Installation (E3A & E3B).....	9	3.5 Parts.....	35
2.4.2 External Chamber Installation (E3C, E3D, E3E, E3F)	10	3.5.1 Replacement Transmitter Head Parts.....	35
2.5 Wiring	11	3.5.2 User Calibration Procedure	36
2.5.1 General Purpose or Non-Incendive (Cl. I, Div. 2)	12	3.5.3 Mechanical Replacement Parts	36
2.5.2 Intrinsically Safe	13	3.5.4 Recommended Spare Parts	37
2.5.3 Explosion Proof.....	13	3.6 Specifications	38
2.6 Configuring the Transmitter.....	15	3.6.1 Functional	38
2.6.1 Operating Parameters.....	15	3.6.2 Performance – Level	39
2.6.2 Transmitter Display and Keypad	15	3.6.3 Performance – Interface Level & Density.....	39
2.6.3 Password Protection (Default = 0).....	16	3.6.4 Physical	40
2.6.4 Calibration Defaults	16	3.7 Model Numbers.....	42
2.6.5 Menu: Step-By-Step Procedure.....	16	3.7.1 E3x for Non-Steam Service	42
2.6.5.1 Measurement Type: Level.....	17	3.7.2 E3x for Steam Service.....	44
2.6.5.2 Measurement Type: Interface Level	20	Glossary	46
2.6.5.3 Measurement Type: Density.....	22		
2.7 Configuration Using HART	25		
2.7.1 Connections.....	25		
2.7.2 HART Display Menu.....	25		
2.7.3 HART Revision Table	25		
2.7.4 HART Menu.....	26		

1.0 QuickStart Installation

1.1 Getting Started

1.1.1 Equipment and Tools

No special equipment or tools are required to install E3 Modulelevel®. The following items are recommended:

- Wrenches, flange gaskets and flange bolting appropriate for process connection(s)
- Flat-blade screwdriver
- Level
- 1/8" Allen wrench
- Power supply
- Digital multimeter
- 250 to 450 ohm resistor for HART communication

1.1.2 Configuration Information

Some key information is needed to configure the E3 MODULELEVEL transmitter. Complete the following operating parameters table before beginning configuration.

Display	Question	Answer
LvlUnits	What units of measurement will be used?	
Lvl Ofst	What is the desired level reading when the level is at the calibrated zero reference (typically bottom of the displacer)?	
Proc SG	What is the actual SG of the process liquid at operating temperature?	
OperTemp	What is the actual operating temperature?	
Set 4mA	What should the level reading be at the 4 mA set point?	
Set 20mA	What should the level reading be at the 20 mA set point?	

1.2 QuickStart Mounting

NOTE: Confirm the style and process connection size/type of the E3 MODULELEVEL transmitter. Ensure it matches the requirements of the installation before continuing with the QuickStart installation.

1.2.1 Tank Top

1. If applicable, adjust and trim the adjustable hanger cable assembly to the required length and mount it between the stem and displacer.

- Using a level, verify that the vessel mounting flange is level in all directions within 3°.
- Position the head flange gasket on the vessel flange and gently lower the displacer into the vessel. To prevent damage to the stem/spring assembly, avoid tipping the unit or, in any way, putting lateral forces on the stem.
- Align the flanges and ensure that the gasket is seated properly.
- Install the flange bolts and nuts and tighten alternating nuts in a star pattern. Flange bolting torque specifications are listed on page 9.

1.2.2 External Chamber

- Remove the shipping strap and wire assembly which secures the displacer in the chamber during shipment. This assembly must be removed through the bottom connection or drain.
- Using a level, verify that the vessel mounting flanges are level in all directions within 3°.
- Align the MODULELEVEL process connections with those on the vessel and attach accordingly, based upon the connection type. Appropriate gaskets and bolting will be required for flanged connections. Install the flange bolts and nuts and tighten alternating nuts in a star pattern. Flange bolting torque specifications are listed on page 9.

1.3 QuickStart Wiring

WARNING: Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

NOTE: Ensure that the electrical wiring to the E3 transmitter is complete and in compliance with all regulations and codes.

- Remove the cover of the upper wiring compartment of the transmitter.
- Attach a conduit fitting and mount the conduit plug in the spare opening. Pull the power supply wire through the conduit fitting.
- Connect an earth ground to the nearest green ground screw. See Figure 1. Use a minimum 18 AWG rated up to 85 °C.
- Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal. For Explosion Proof Installations, see Wiring, Section 2.5.3.
- Replace the cover and tighten.

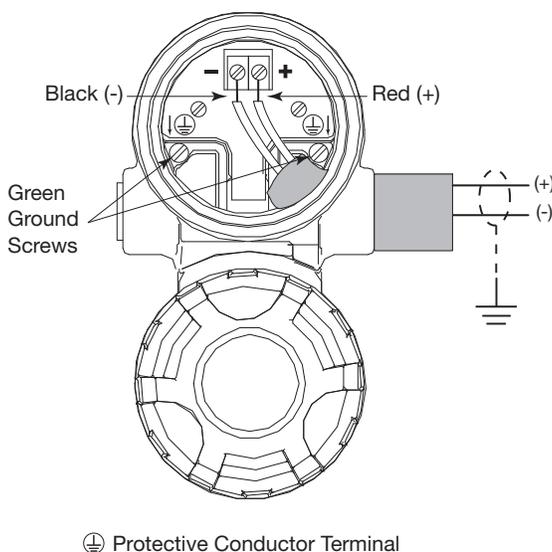


Figure 1
Integral Transmitter Wiring

1.4 QuickStart Configuration

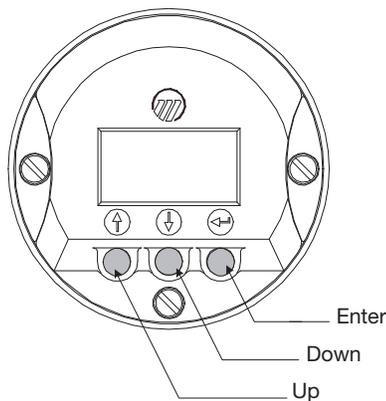


Figure 2
Transmitter Keypad & Display

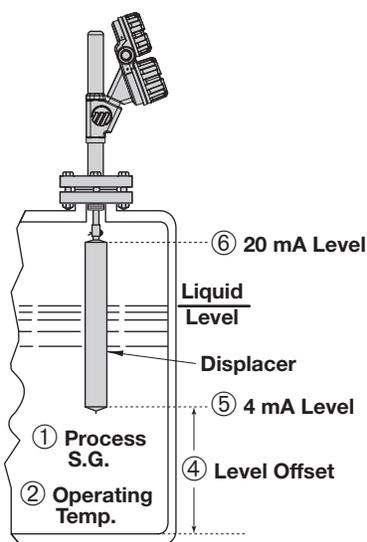


Figure 3
Tank Top Mounted
Installation

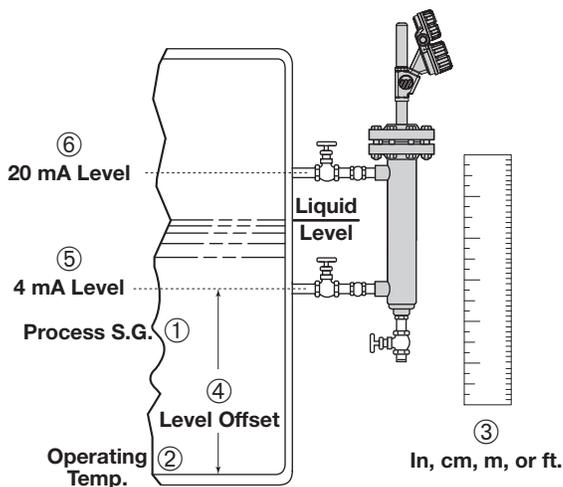


Figure 4
Chamber Type Installation
Side-Side Process Connections

The E3 MODULELEVEL transmitter comes configured with default values from the factory but can be reconfigured in the shop. The minimum configuration instructions required in the field follow. Use the information from the operating parameters table in Section 1.1.2 before beginning configuration.

1. Power up the transmitter.
The display changes every 5 seconds to show one of four values: Status, Level (or IfcLevel or SpecGrav), %Output, and Loop current.
2. Remove the cover of the lower electronic compartment.
3. Use the \uparrow and \downarrow keys to move from one step of the configuration program to the next step, see Figure 2.
4. Press the \leftarrow key. The last character in the first line of the display changes to an exclamation point (!).

LvlUnits!
xxx
5. Use the \uparrow and \downarrow keys to increase or decrease the value in the display or to scroll through the choices.
6. Press the \leftarrow key to accept a value and move to the next step of the configuration program (the default password is 0).
7. After entering the last value, allow 10 seconds before removing power from the transmitter.

The following two configuration entries are the minimum required for configuration (the default password is 0 from the LCD/keypad).

①

Proc SG
(xxx)

 Enter the actual specific gravity of the process liquid at operating temperature (N/A for Interface or Density).

②

OperTemp
xxx

 Enter the actual operating temperature of the process

The following four parameters must be entered if the default values are not satisfactory.

③

LvlUnit
(select)

 Select the desired level units of measure (inches, cm, m, feet). (Default is inches).

④

Lvl Ofst
(xxx)

 Enter the desired level reading when level is at the calibrated zero reference (typically bottom of the displacer). (Default is Zero).

⑤

Set 4mA
xxx.x

 Enter the level value (0%-point) for the 4 mA point. (Default is 0 for level and interface).

⑥

Set 20mA
xxx.x

 Enter the level value (100%-point) for the 20 mA point. (Default is full level range).

2.0 Complete Installation

2.1 Unpacking

Unpack the instrument carefully. Take care not to bend the displacer stem or enclosing tube. Ensure all components have been removed from the packing material. Check all the contents against the packing slip and report any discrepancies to the factory.

Before proceeding with the installation, do the following:

- Inspect all components for damage. Report any damage to the carrier within 24 hours.
- On chambered units, remove the shipping strap and wire assembly holding the displacer in place. This assembly must be removed through the bottom chamber connection before start-up.

Caution: If reshipping to another location, the displacer must again be secured using the same strap and wire assembly.

- Check that the model number on the nameplate matches the packing slip and purchase order.
- Record the model and serial numbers for future reference when ordering parts.

Model Number

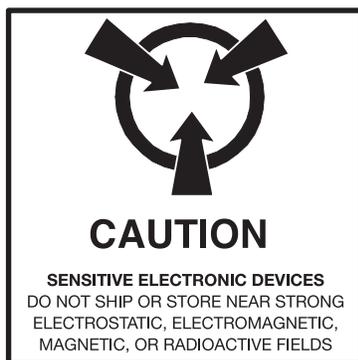
Serial Number

2.2 Electrostatic Discharge (ESD) Handling Procedure

Magnetrol® electronic instruments are manufactured to the highest quality standards. These instruments use electronic components which may be damaged by static electricity present in most work environments.

The following steps are recommended to reduce the risk of component failure due to electrostatic discharge.

- Ship and store circuit boards in anti-static bags. If an anti-static bag is not available, wrap the board in aluminum foil. Do not place boards on foam packing materials.
- Use a grounding wrist strap when installing and removing circuit boards. A grounded workstation is recommended.
- Handle circuit boards only by the edges. Do not touch components or connector pins.
- Ensure that all electrical connections are completely made and that none are partial or floating. Ground all equipment to a good, earth ground.



2.3 Before You Begin

2.3.1 Site Preparation

Each E3 MODULEVEL transmitter is built to match the physical specifications of the required installation. Ensure that the process connection(s) on the vessel matches the MODULEVEL process connection(s).

See *Mounting, Section 2.4*.

Ensure that the wiring between the power supply and MODULEVEL transmitter are complete and correct for the type of installation.

See *Wiring, Section 2.5*.

When installing the MODULEVEL transmitter in a general purpose or hazardous area, local, state and federal regulations and guidelines must be observed. See *Wiring, Section 2.5*.

2.3.2 Equipment and Tools

No special equipment or tools are required to install the Electronic MODULEVEL. The following items are recommended:

- Wrenches, flange gaskets and flange bolting appropriate for process connection(s)
- Flat-blade screwdriver
- Level
- ⅝" Allen wrench
- Power supply
- Multimeter
- 250 to 450 ohm resistor for transmitters with HART communication

2.3.3 Operational Considerations

The MODULEVEL transmitter should be located for easy access for service, configuration, and monitoring. There should be sufficient headroom to allow installation and removal of the transmitter head and, in cases of tank top configuration, the displacer. Special precautions should be made to prevent exposure to corrosive atmosphere, excessive vibration, shock, or physical damage.

The operating temperature range for the transmitter electronics is -40 to +176 °F (-40 to +80 °C). The operating temperature range for the digital display is -5 to +160 °F (-20 to +70 °C).

Caution: Operation of all buoyancy type level devices should be done in such a way as to minimize the action of dynamic forces on the float or displacer sensing element. Good practice for reducing the likelihood of damage to the control is to equalize pressure across the device very slowly.

2.4 Mounting

The E3 MODULEVEL transmitter can be mounted to a tank using a variety of configurations and process connections. Generally, either a threaded, welded or flanged connection is used with an external cage. A flanged connection is always used on a tank top model. For information about the sizes and types of connections available, see *Model Numbers, Section 3.7*.

Ensure all mounting connections are in place on the tank and properly sized for the specific unit being installed. Compare the model on the nameplate with the product information to ensure the MODULEVEL transmitter is correct for the intended installation.

If the MODULEVEL must be insulated, DO NOT insulate the transmitter head, e-tube or finned extensions.

Torque Specifications for Enclosing Tubes and Flange Bolting

Model	Flange Bolting	E-tube
E3A, E3B	n/a	
E3C, E3D, E3E, E3F – 150#	110–120 ft-lbs	200 – 225 ft-lbs
E3C, E3D, E3E, E3F – 300#	180–200 ft-lbs	
E3C, E3D, E3E, E3F – 600#	180–200 ft-lbs	
E3C, E3D, E3E, E3F – 900#	370–400 ft-lbs	
E3C, E3D, E3E, E3F – 1500#	400–450 ft-lbs	
E3C, E3D, E3E, E3F – 2500#	675–725 ft-lbs	

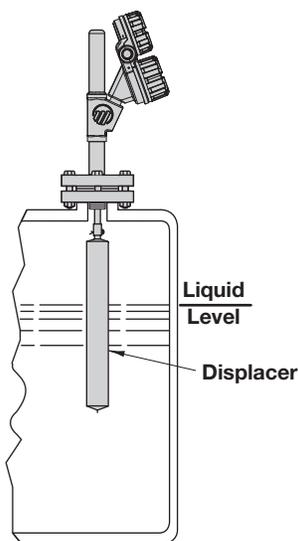


Figure 5
Tank Top Mounted
Installation

2.4.1 Tank Top Installation (E3A & E3B)

Figure 5 illustrates a typical tank top installation.

Before installing, ensure that:

- There is adequate headroom for the installation of the MODULEVEL head and displacer and that it has unobstructed entry into the vessel.
- Using a level, the mounting flange is level within 3° in all directions.
- If the adjustable hanger assembly (P/N 32-3110-001) is used, it is cut to the required length and attached to the displacer stem.

NOTE: The adjustable hanger assembly is used when the top of the displacer and, therefore, the top of the measurement range must be positioned in the vessel more than 9.31" below the mounting flange. The standard hanger cable length is 8 feet. Consult factory for longer cable.

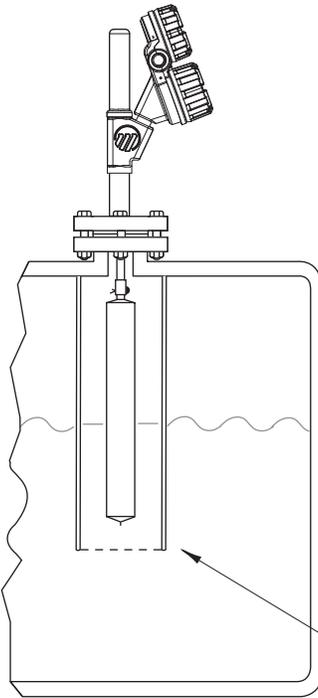


Figure 6
Tank Top Mounted
with Stilling Well

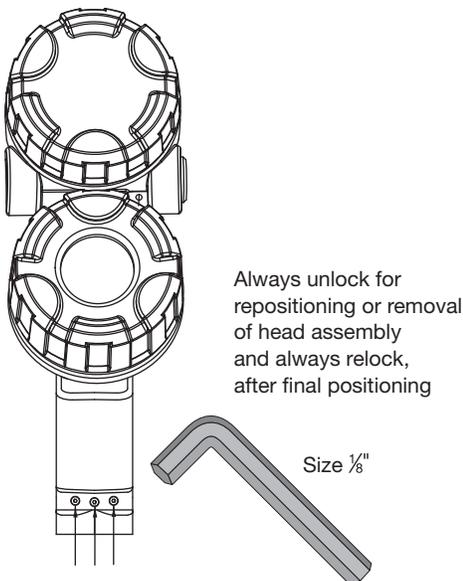


Figure 7
Transmitter Head
Lock Screws

- A stilling well is installed for applications where continuous agitation is present. The stilling well must be vertically level so as not to restrict displacer movement. See Figure 6 for a typical stilling well installation.
- The process temperature, pressure and specific gravity are within the unit's specifications for installation. See *Specifications, Section 3.6*.

To install:

1. Position the head flange gasket on the vessel flange and gently lower the displacer into the vessel. To prevent damage to the stem/spring assembly, avoid tipping the unit or, in any way, putting lateral forces on the stem.
2. Align the flanges and ensure that the gasket is seated properly.
3. Install the flange bolts and nuts and tighten alternating nuts in a star pattern. Flange bolting torque specifications are listed on page 9.

Caution: All MODULELEVEL units are shipped from the factory with the enclosing tube tightened and the transmitter head set screws locked to the enclosing tube. Failure to loosen the set screws prior to repositioning the supply and output connections may cause the enclosing tube to loosen, resulting in the possible leakage of the process liquid or vapor.

4. Loosen the transmitter head lock screws (socket type) and position conduit outlet in the desired direction. See Figure 7.
5. Retighten lock screws.

NOTE: Since the transmitter head is rotatable through 360°, it is important to make certain that the controller locking screws are tight before making electrical connections.

2.4.2 External Chamber Installation (E3C, E3D, E3E & E3F) ■

The chamber type MODULELEVEL is mounted on the side of the vessel with either a side/side or side/bottom connection, as furnished. Figure 8 on page 11 illustrates a typical chamber type installation.

Before installing, ensure that:

- There is adequate room for installation of the MODULELEVEL.
- Using a level, the vessel mounting connections are level within 3° in all directions.
- The process temperature, pressure and specific gravity are within the unit's specifications for installation. See *Specifications, Section 3.6*.
- If not already done, remove the shipping strap and wire assembly holding the displacer in place in the chamber. This assembly must be removed through the bottom chamber connection or drain before start-up.

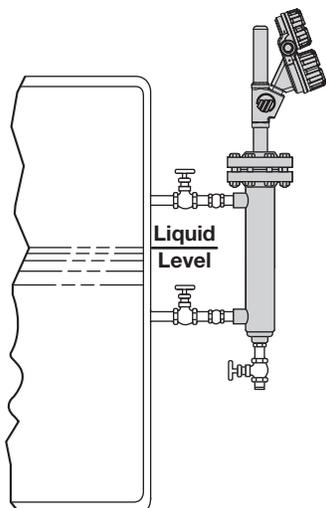


Figure 8
Chamber Type Installation
Side-Side Process Connections

To install:

1. Align the MODULELEVEL process connections with those on the vessel and attach accordingly, based upon the connection type. Appropriate gaskets and bolting will be required for flanged connections. Install the flange bolts and nuts and tighten alternating nuts in a star pattern. Flange bolting torque specifications are listed on page 9.

NOTE: It is recommended that shut-off valves be installed in each equalizing line to the chamber, along with a drain valve (refer to Figure 8). Equalizing lines should be sized at least as large as the connections provided at the chamber.

2. Make sure that the chamber is vertically level within 3° in each direction to ensure frictionless operation of the internal displacer.

Caution: All MODULELEVEL units are shipped from the factory with the enclosing tube tightened and the transmitter head set screws locked to the enclosing tube. Failure to loosen the set screws prior to repositioning the supply and output connections may cause the enclosing tube to loosen, resulting in the possible leakage of the process liquid or vapor.

3. Loosen the transmitter head lock screws (socket type) and position conduit outlet in the desired direction. See Figure 7.
4. Retighten lock screws.

NOTE: Since the transmitter head is rotatable through 360°, it is important to make certain that the controller locking screws are tight before making electrical connections.

2.5 Wiring

Caution: All versions of the E3 MODULELEVEL transmitter operate at voltages of 11–36 VDC. Higher voltage will damage the transmitter.

Wiring between the power supply and the E3 MODULELEVEL transmitter should be made using minimum of 18 AWG shielded twisted pair instrument cable. Wiring must be suitable for temperatures up to at least +85 °C. Within the transmitter enclosure, connections are made to the terminal strip and the ground connections. When installing a remote mount E3 transmitter, refer to Figures 11 & 12 on page 14 for wiring connections.

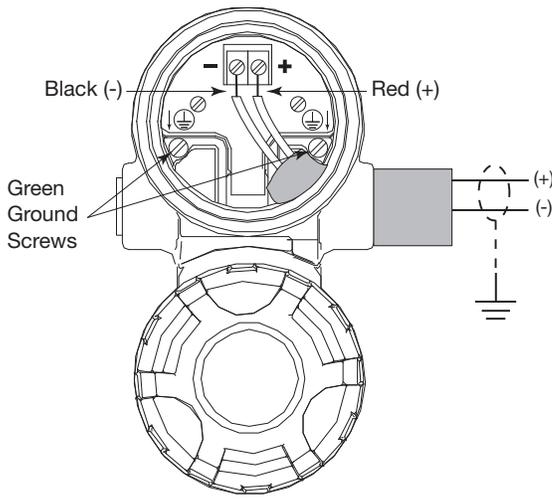
The directions for wiring the E3 transmitter depend on the application:

- General Purpose or Non-incendive (CI I, Div. 2)
- Intrinsically Safe
- Explosion Proof

WARNING! Explosion hazard. Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

2.5.1 General Purpose or Non-Incendive (CI I, Div. 2)

A general purpose installation does not have flammable media present. Areas rated non-incendive (CI I, Div. 2) have flammable media present only under abnormal conditions. No special electrical connections are required so standard installation methods may be followed.



⊕ Protective Conductor Terminal

Figure 9
Wiring Diagram

To install General Purpose or Non-Incendive wiring:

1. Remove the cover to the wiring compartment of the transmitter. Install the conduit plug in the unused opening. Use PTFE tape/sealant to ensure a liquid-tight connection.
2. Install a conduit fitting and pull the supply wires.
3. Connect shield to an earth ground at power supply.
4. Connect an earth ground wire to the nearest green ground screw. Use a minimum 18 AWG rated up to 85 °C.
5. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
6. Replace the cover to the wiring compartment of the transmitter.

To install Remote Mount wiring:

1. Install conduit from the remote mounted head to the integral conduit connection of the E3 transmitter (refer to local plant or facility procedures).
2. Remove the cover of the remote transmitter, terminal board housing and of the integral terminal board housing.
3. Connect one end of the six conductor cable (P/N 037-3226-xxx or 037-3227-xxx) to the integral terminal block and the other end to the terminal block within the remote terminal board housing. Be sure to match the six discrete numbered wires with the numbers on each terminal block. See Figures 11 & 12 on page 14.
4. Connect shield to an earth ground at the power supply.
5. Connect an earth ground wire to the nearest green ground screw per local electrical code (not shown in illustration).
6. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
7. Replace the covers to the wiring compartment of the transmitter and to both terminal board housings. Ensure that all covers are completely tightened down before applying power.

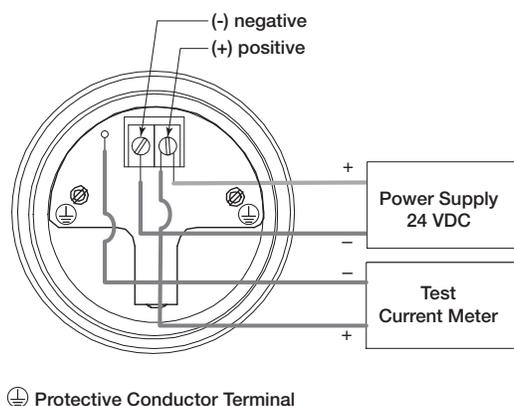


Figure 10
G.P./I.S./Explosion Proof Model

2.5.2 Intrinsically Safe

An intrinsically safe (IS) installation potentially has flammable media present. An approved IS barrier must be installed in the non-hazardous (safe) area. Consult factory for agency drawing.

To install Intrinsically Safe wiring:

1. Make sure the IS barrier is properly installed in the safe area (refer to local plant or facility procedures). Complete the wiring from the barrier to the E3 transmitter.
2. Remove the cover to the wiring compartment of the transmitter. Install the conduit plug in the unused opening. Use PTFE tape/sealant to ensure a liquid-tight connection.
3. Install a conduit fitting and pull the supply wires.
4. Connect shield to an earth ground at power supply.
5. Connect an earth ground wire to the nearest green ground screw.
6. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
7. Replace the cover to the wiring compartment of the transmitter.

2.5.3 Explosion Proof

Explosion Proof (XP) is a method of designing equipment for installation in hazardous areas. A hazardous location is an area in which flammable gases or vapors are, or may be, present in the air in quantities sufficient to produce explosive or ignitable mixtures. The wiring for the transmitter must be contained in Explosion Proof conduit extending into the safe area. See Agency Approvals, Section 3.4.

To install Explosion Proof wiring – Integral mount:

Due to the specialized design of the integral E3 transmitter, no Explosion Proof conduit fitting (EY seal) is required within 18" of the transmitter. An Explosion Proof conduit fitting (EY seal) is required between the hazardous and safe areas.

1. Install Explosion Proof conduit from the safe area to the conduit connection of the E3 transmitter (refer to local plant or facility procedures).
2. Remove the cover to the wiring compartment of the transmitter.
3. Connect shield to an earth ground at the power supply.
4. Connect an Earth ground wire to the nearest green ground screw per local electrical code. Use a minimum 18 AWG rated up to 85 °C.
5. Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
6. Replace the cover to the wiring compartment of the transmitter before applying power.

NOTE: When operated from a 24 VDC source, the maximum allowable loop resistance is 620 ohms for E3 MODULELEVEL units. When using HART, a loop resistance of 250 to 450 ohms must be placed in series with the E3 MODULELEVEL. See Figure 16 on page 39.

Caution: Instrument and conduit junction box covers must be in place and tightly sealed at all times during operation.

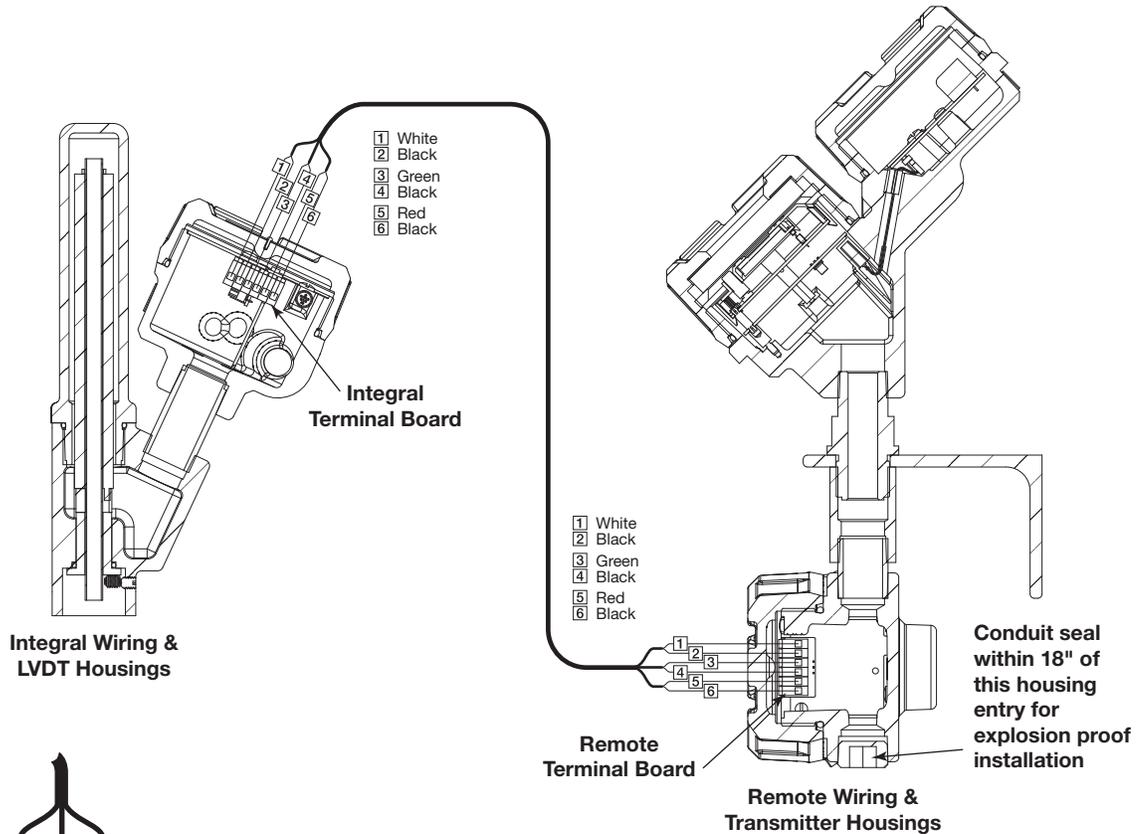


Figure 11
Remote Mount Wiring
Connections

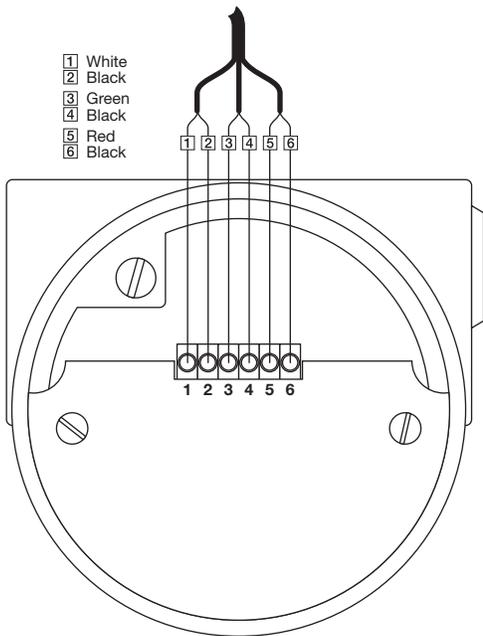


Figure 12
Integral & Remote Terminal Boards

To install Explosion Proof wiring – Remote mount:

1. Install Explosion Proof conduit from the remote mounted E3 transmitter head to the integrally mounted terminal housing at the LVDT. An Explosion Proof conduit fitting (EY seal) is required within 18" of the remote mounted transmitter head wiring housing (see figure 11). Follow steps 2 through 7 of Remote Mount wiring procedure on page 12.

2.6 Configuring the Transmitter

The E3 MODULELEVEL transmitter comes calibrated from the factory.

Information on configuring the transmitter using a HART communicator is given in *Configuration Using HART, Section 2.7*.

2.6.1 Operating Parameters

Some key information is needed to configure the E3 transmitter. Complete the configuration information table. See *Configuration Information, Section 1.1.2*.

2.6.2 Transmitter Display and Keypad

The E3 transmitter has a liquid-crystal display (LCD) capable of showing two lines of 8 characters each. Transmitter measurements and configuration menu screens are shown on the LCD.

The transmitter default display is the measurement screen. It cycles every 5 seconds to display STATUS, LEVEL, %OUTPUT, and LOOP information. The transmitter defaults to this display after 5 minutes of keypad inactivity.

The keypad has three buttons used to scroll through the displays and to calibrate the transmitter – the  and  keys and the  key.

Arrows	Function in Display Mode	Function in Configuration Mode
Up and Down  	Moves forward and backward in the configuration program from one display to another.	Increases or decreases the value displayed or moves to another choice. <i>NOTE: Hold arrow key for rapid scrolling.</i>
Enter 	Enters the configuration mode (noted by an exclamation point as the last character in the top display line).	Accepts a value and returns to the display mode.

2.6.3 Password Protection (Default = 0)

The E3 transmitter is password protected to restrict access to certain portions of the menu structure that affect the operation of the system. When the proper password is entered, an exclamation point (!) appears as the last character of the first line of the display. The password can be changed to any numerical value up to 255. The password is required whenever configuration values are changed.

The default password installed in the transmitter at the factory is 0 (password disabled). The last step in the configuration menu provides the option to enter a new password. If 0 is entered as a password, the transmitter is no longer password protected and any value in the menu can be altered (except factory diagnostic values) without entering a confirming password.

NOTE: If the password is not known, the menu item New Password displays an encrypted value representing the present password. Call the factory with this encrypted value to determine the actual password.

2.6.4 Calibration Defaults

The E3 MODULELEVEL transmitter comes from the factory already calibrated. The default configuration is set up such that the level range is the length of the displacer with the 4 mA set point at the bottom of the range and the 20 mA point at the top. Field calibration is not required, but each unit must be configured for the process operating conditions. Level measurement applications require that the operating temperature and operating specific gravity be entered via the keypad and LCD display. For Interface and Density measurement applications, only the operating temperature must be entered.

While not necessary nor recommended, the E3 MODULELEVEL can be calibrated in the actual process. This is accomplished by selecting the User Calibration rather than the Factory Calibration. Once in the User Calibration, liquid level can be moved to the low and high calibration points and the sensor values for the low and high calibration points can be captured. See procedure on page 36.

2.6.5 Menu: Step-By-Step Procedure

The following table provides a complete explanation of the software menus displayed by the E3 transmitter. Use this table as a step-by-step guide to configure the transmitter.

The second column presents the menus shown on the transmitter display. The displays are in the order they would appear if the arrow keys were used to scroll through the menu.

The numbers are not shown on the display. They are provided as a reference.

The third column provides the actions to take when configuring the transmitter. Additional information or an explanation of an action is given in the fourth column.

Configuration tips:

If “Calselct” is Factory, Factory Cal Menu is available for viewing only. Only calibration parameters in User Cal Menu can be changed by the user.

To capture the current sensor value, press .

PV = Primary Variable = Level or Interface Level or Density (depending on Measurement Type).

2.6.5.1 Measurement Type: Level

	Display	Action	Comment
1	*Status* *Level * *% Out * * Loop *	Transmitter Display	
2	Level xx.xx lu	Transmitter Display	(Alternate Home Menu)
3	% Output xx.x %	Transmitter Display	(Alternate Home Menu)
4	Loop xx.xx mA	Transmitter Display	(Alternate Home Menu)
5	LvlUnits (select)	Select the level units of measure	Select cm, inches, feet, meters
6	Proc SG x.xxx sg	Enter the specific gravity of the process liquid at operating temp.	Adjusts factory calibration for actual specific gravity (limited by SG range of spring)
7	OperTemp xxx F	Enter the Process Operating Temperature	Adjusts factory calibration for actual temperature (limited by maximum temperature rating of model)
8	Set 4mA xx.xx lu	Enter the level value for 4 mA set point	Specify level at 4 mA
9	Set 20mA xx.xx lu	Enter the level value for 20 mA set point	Specify level at 20 mA
10	Lvl Ofst xx.xx lu	Enter desired output when level is at the calibrated zero reference	Minimum offset = -(displacer length) Zero reference is typically bottom of displacer or centerline of bottom-side process connection.
11	Damping xx s	Enter time constant of desired damping	0 to 45 sec
12	Fault (select)	Select loop current value in presence of a fault	Select from 3.6 mA, 22 mA or Hold
13	Poll Adr xx	Enter HART polling address number	If multidrop is not in use, poll address must = 0
14	Loop Mode (select)	Enable/Disable Loop Current Mode	If enabled, loop current follows the PV; If disabled, loop current is fixed (i.e., multidrop mode).

2.6.5.1 Measurement Type: Level Only (cont.)

	Display	Action	Comment
15	Trim Lvl xx.xx lu	Enter value to adjust Level reading	Fine tune level reading
16	Trim 4 xxxx	Fine tune 4 mA point	Adjust setting (0 – Trim 20 value) to output exactly 4.0 mA
17	Trim 20 xxxx	Fine tune 20 mA point	Adjust setting (Trim 4 value – 4095) to output exactly 20.0 mA
18	Loop Tst xx.x mA	Enter a mA output value to test loop	
19	Capture 4.00 mA	Pressing  in Data Entry Mode captures current level output as 4.00 mA Set Point	Raise liquid level to desired 4 mA point on the displacer. Press  button to “capture” this liquid level as your 4 mA point.
20	Capture 20.00 mA	In Data Entry Mode, can adjust loop value to correspond to current level output for setting 20.00 mA Set Point	Use  and  to adjust the current value to capture. Raise liquid level to a second level point on the displacer. Press  button to “capture” this liquid level as your upper loop value between 8.00 and 20.00 mA.
21	New Pass xxx	Enter new password (0 – 255)	Displays encrypted value of present password Default value = 0
22	Language (select)	Select from English, Spanish, French, German	Language choice for LCD display
23	E3 ModHT Ver 1.0	Transmitter Display	Product identification Firmware version
24	DispFact (select)	Select ‘Yes’ to display factory parameter menu as below	Selecting “No” takes you back to beginning of menu
25	History (current status)	Diagnostic Display to view present status and recent exceptions	Press  to view recent exceptions, up to ten events
26	Run Time xxxx.x h	Diagnostic Display showing elapsed time since power on or History Reset	
27	History Reset	Factory only	
28	MeasType (select)	Factory set	Level, lfcLevel, or Density
29	Model (select)	Factory set	E3A, E3B, E3C, E3D, E3E, E3F
30	SpringSG (select)	Factory set	Model specific—range of SGs for which unit is suitable
31	SprgRate x.x	Factory set	Model specific
32	SprgMat1	Factory set	Model specific
33	TempLimt xxx F	Factory set	Model specific—maximum process temperature for which unit is suitable
34	Length xx.xx lu	Factory set	Model specific—length of measuring range
35	Diameter x.xxx in	Factory set	Model specific—outside diameter of displacer
36	Weight xx.x oz	Factory set	Model specific—weight of displacer and stem assembly
37	CalSelct (select)	Select Factory or User Calibration	Selects Calibration Parameters used to calculate the measured PV.

2.6.5.1 Measurement Type: Level Only (cont.)

	Display	Action	Comment
38a	Factory Cal Menu	Press  to display the Factory Calibration sub-menu	CalSelct = Factory Submenu on page 19
38b	User Cal Menu	Press  to display the User Calibration sub-menu	CalSelct = User Submenu below
39	AdjSnrLo	Diagnostic Display	
40	AdjSnrHi	Diagnostic Display	
41	Conv Fct xxxx	Diagnostic Display	
42	Scl Ofst xxx	Diagnostic Display	
43	LVDT% xx.xx %	Diagnostic Display	
44	Chan 0	Diagnostic Display	
45	Chan 1	Diagnostic Display	
46	NSP Value	Diagnostic Display	
47	ElecTemp xxx F	Diagnostic Display	Present temperature in electronics compartment
48	Max Temp xxx F	Diagnostic Display	Maximum electronics temperature recorded
49	Min Temp xxx F	Diagnostic Display	Minimum electronics temperature recorded

2.6.5.1 Measurement Type: Level Only: Factory (display only) or User Calibration sub-menu

	Display	Action	Comment
1	LVDT% xx.xx %	Diagnostic display	
2	Calib SG x.xxx sg	Factory set	Factory calibration menu only
3	DrySensr xx.xx %	Enter or capture sensor output for Dry Sensor	Press  to capture current sensor output
4	SnrCalLo xx.xx %	Enter or capture sensor output for Low Cal Point	Press  to capture current sensor output
5	LvlCalLo xx.xx lu	Enter Level value corresponding to SnrCalLo	
6	Set 4mA xx.xx lu	Enter the level value for 4 mA set point	Specify level at 4 mA (User Cal menu only)
7	SnrCalHi xx.xx %	Enter or capture sensor output for High Cal Point	Press  to capture current sensor output
8	LvlCalHi xx.xx lu	Enter Level value corresponding to SnrCalHI	
9	Set 20mA xx.xx lu	Enter the level value for 20 mA set point	Specify level at 20 mA (User Cal menu only)
10	Escape	Press  to exit Calibration sub-menu; Returns to Factory Menu	

2.6.5.2 Measurement Type: Interface Level

	Display	Action	Comment
1	*Status* *IfcLvl* *% Out * * Loop *	Transmitter Display	
2	IfcLevel xx.xx lu	Transmitter Display	(Alternate Home Menu)
3	% Output xx.x %	Transmitter Display	(Alternate Home Menu)
4	Loop xx.xx mA	Transmitter Display	(Alternate Home Menu)
5	LvlUnits (select)	Select the level units of measure	Select cm, inches, feet, meters
6	Oper Temp xxx F	Enter the Process Operating Temperature	Adjusts factory calibration for actual temperature (limited by maximum temperature rating of model)
7	Set 4mA xx.xx lu	Enter the IfcLevel value for 4 mA set point	Assigns Level value to 4 mA loop value
8	Set 20mA xx.xx lu	Enter the IfcLevel value for 20 mA set point	Assigns Level value to 20 mA loop value
9	Lvl Ofst xxx.xx lu	Enter desired output when level is at the calibrated zero reference	Minimum offset = -(displacer length) Zero reference is typically bottom of displacer or centerline of bottom-side process connection.
10	Damping xx s	Enter time constant of desired damping	0 to 45 sec
11	Fault (select)	Select loop current value in presence of a fault	Select from 3.6 mA, 22 mA or Hold
12	Poll Adr xx	Enter HART polling address number	If multidrop is not in use, poll address must = 0
13	Loop Mode (select)	Enable/Disable Loop Current Mode	If enabled, loop current follows the PV; If disabled, loop current is fixed (i.e., multidrop mode).
14	Trim Lvl xx.xx lu	Enter value to adjust Level reading	Fine tune IfcLevel reading
15	Trim 4 xxxx	Fine tune 4 mA point	Adjust setting (0 – Trim 20 value) to output exactly 4.0 mA
16	Trim 20 xxxx	Fine tune 20 mA point	Adjust setting (Trim 4 value – 4095) to output exactly 20.0 mA
17	Loop Tst xx.x mA	Enter a mA output value to test loop	
18	Capture 4.00 mA	Pressing  in Data Entry Mode captures current level output as 4.00 mA Set Point	Raise interface level to desired 4 mA point on the displacer. Press  to “capture” this liquid level as your 4 mA point.
19	Capture 20.00 mA	In Data Entry Mode, can adjust loop value to correspond to current level output for setting 20.00 mA Set Point	Use  and  to adjust the current value to capture. Raise interface level to a second level point on the displacer. Press  to “capture” this interface level as your upper loop value between 8.00 and 20.00 mA.
20	New Pass xxx	Enter new password (0 – 255)	Displays encrypted value of present password Default value = 0
21	Language (select)	Select from English, Spanish, French, German	Language choice for LCD display
22	E3 ModHT Ver 1.0	Transmitter Display	Product identification Firmware version
23	DispFact (select)	Select “Yes” to display factory parameter menu as below	Selecting “No” takes you back to beginning of menu

2.6.5.2 Measurement Type: Interface Level (cont.)

	Display	Action	Comment
24	History (current status)	Diagnostic Display to view present status and recent exceptions	Press  to view recent exceptions, up to ten events
25	Run Time xxxx.x h	Diagnostic Display showing elapsed time since power on or History Reset	
26	History Reset	Factory only	
27	MeasType (select)	Factory set	Level, IfcLevel, or Density
28	Model (select)	Factory set	E3A, E3B, E3C, E3D, E3E, E3F
29	SpringSG (select)	Factory set	Model specific
30	SprgRate x.x	Factory set	Model specific
31	SprgMatl	Factory set	Model specific
32	TempLimt xxx F	Factory set	Model specific—maximum process temperature for which unit is suitable
33	Length xx.xx lu	Factory set	Model specific—length of measuring range
34	Diameter x.xxx in	Factory set	Model specific—outside diameter of displacer
35	Weight xx.x oz	Factory set	Model specific—weight of displacer and stem assembly
36	Lower SG x.xx	Factory set	
37	Upper SG x.xx	Factory set	
38	CalSelct (select)	Select Factory or User Calibration	Selects Calibration Parameters used to calculate the measured PV
39a	Factory Cal Menu	Press  to display the Factory Calibration sub-menu	CalSelct = Factory Submenu on page 22
39b	User Cal Menu	Press  to display the User Calibration sub-menu	CalSelct = User Submenu on page 22
40	AdjSnrLo	Diagnostic Display	
41	AdjSnrHi	Diagnostic Display	
42	Conv Fct xxxx	Diagnostic Display	
43	Scl Ofst xxx	Diagnostic Display	
44	LVDt% xx.xx %	Diagnostic Display	
45	Chan 0	Diagnostic Display	
46	Chan 1	Diagnostic Display	
47	NSP Value	Diagnostic Display	
48	ElecTemp xxx F	Diagnostic Display	Present temperature in electronics compartment
49	Max Temp xxx F	Diagnostic Display	Maximum electronics temperature recorded
50	Min Temp xxx F	Diagnostic Display	Minimum electronics temperature recorded

2.6.5.2 Measurement Type: Interface Level (cont.): Factory (display only) or User Calibration sub-menu

	Display	Action	Comment
1	LVDt% xx.xx %	Diagnostic display	
2	DrySensr xx.xx %	Enter or capture sensor output for Dry Sensor	Press \leftarrow to capture current sensor output
3	SnrCalLo xx.xx %	Enter or capture sensor output for Low Cal Point	Press \leftarrow to capture current sensor output
4	LvlCalLo xx.xx lu	Enter lfcLevel value corresponding to SnrCalLo	
5	Set 4mA xx.xx lu	Enter the lfcLevel value for 4 mA set point	Assigns Level value to 4 mA loop value (User Cal menu only)
6	SnrCalHi xx.xx %	Enter or capture sensor output for High Cal Point	Press \leftarrow to capture current sensor output
7	LvlCalHi xx.xx lu	Enter lfcLevel value corresponding to SnrCalHI	
8	Set 20 mA xx.xx lu	Enter the lfcLevel value for 20 mA set point	Assigns Level value to 20 mA loop value (User Cal menu only)
9	Escape	Press \leftarrow to exit Calibration sub-menu; Returns to Factory Menu	

2.6.5.3 Measurement Type: Density

	Display	Action	Comment
1	*Status* *SG * *% Out * * Loop *	Transmitter Display	
2	SpecGrav x.xx sg	Transmitter Display	(Alternate Home Menu)
3	% Output xx.x %	Transmitter Display	(Alternate Home Menu)
4	Loop xx.xx mA	Transmitter Display	(Alternate Home Menu)
5	OperTemp xxx F	Enter the Process Operating Temperature	Adjusts factory calibration for actual temperature (limited by maximum temperature rating of model)
6	Set 4mA xx.xx sg	Enter the SpecGrav value for 4 mA set point	Assigns specific gravity value to 4 mA loop value
7	Set 20mA xx.xx sg	Enter the SpecGrav value for 20 mA set point	Assigns specific gravity value to 20 mA loop value
8	Damping xx s	Enter time constant of desired damping	0 to 45 sec
9	Fault (select)	Select loop current value in presence of a fault	Select from 3.6 mA, 22 mA or Hold
10	Poll Adr xx	Enter HART polling address number	If multidrop is not in use, poll address must = 0
11	Loop Mode (select)	Enable/Disable Loop Current Mode	If enabled, loop current follows the PV; If disabled, loop current is fixed (i.e., multidrop mode).
12	Trim SG x.xx sg	Enter value to adjust SG reading	Fine tune SpecGrav reading
13	Trim 4 xxxx	Fine tune 4 mA point	Adjust setting (0 – Trim 20 value) to output exactly 4.0 mA

2.6.5.3 Measurement Type: Density (cont.)

	Display	Action	Comment
14	Trim 20 xxxx	Fine tune 20 mA point	Adjust setting (Trim 4 value – 4095) to output exactly 20.0 mA
15	Loop Tst xx.x mA	Enter a mA output value to test loop	
16	Capture 4.00 mA	Pressing \leftarrow in Data Entry Mode captures current sg output as 4.00 mA Set Point	Current SpecGrav set as 4 mA point. Submerge displacer in lowest SG liquid. Press \leftarrow to “capture” this SG as your 4 mA density.
17	Capture 20.00 mA	In Data Entry Mode, can adjust loop value to correspond to current sg output for setting 20.00 mA Set Point	(8.00 ≤ loop value ≤ 20.00 mA) Use \uparrow and \downarrow to adjust the current value to capture. Submerge displacer in higher SG liquid. Press \leftarrow button to “capture” this SG as your upper loop value between 8.00 and 20.00 mA.
18	New Pass xxx	Enter new password (0 – 255)	Displays encrypted value of present password Default value = 0
19	Language (select)	Select from English, Spanish, French, German	Language choice for LCD display
20	E3 ModHT Ver 1.0	Transmitter Display	Product identification Firmware version
21	DispFact (select)	Select “Yes” to display factory parameter menu as below	Selecting “No” takes you back to beginning of menu
22	History (current status)	Diagnostic Display to view present status and recent exceptions	Press \leftarrow to view recent exceptions, up to ten events
23	Run Time xxxx.x h	Diagnostic Display showing elapsed time since power on or History Reset	
24	History Reset	Factory only	
25	MeasType (select)	Factory set	Level, lfcLevel, or Density
26	Model (select)	Factory set	E3A, E3B, E3C, E3D, E3E, E3F
27	SpringSG (select)	Factory set	Model specific
28	SprgRate x.x	Factory set	Model specific
29	SprgMatl	Factory set	Model specific
30	TempLimt xxx F	Factory set	Model specific—maximum process temperature for which unit is suitable
31	Length xx.xx lu	Factory set	Model specific—length of measuring range
32	Diameter x.xxx in	Factory set	Model specific—outside diameter of displacer
33	Weight x.xx oz	Factory set	Model specific—weight of displacer and stem assembly
34	CalSelct (select)	Select Factory or User Calibration	Selects Calibration Parameters used to calculate the measured PV
35a	Factory Cal Menu	Press \leftarrow to display the Factory Calibration sub-menu	CalSelct = Factory Submenu on page 24

2.6.5.3 Measurement Type: Density (cont.)

	Display	Action	Comment
35b	User Cal Menu	Press  to display the User Calibration sub-menu	CalSelct = User Submenu below
36	AdjSnrLo	Diagnostic Display	
37	AdjSnrHi	Diagnostic Display	
38	Conv Fct xxxx	Diagnostic Display	
39	Scl Ofst xxx	Diagnostic Display	
40	LVDT% xx.xx %	Diagnostic Display	
41	Chan 0	Diagnostic Display	
42	Chan 1	Diagnostic Display	
43	NSP Value	Diagnostic Display	
44	ElecTemp xxx F	Diagnostic Display	Present temperature in electronics compartment
45	Max Temp xxx F	Diagnostic Display	Maximum electronics temperature recorded
46	Min Temp xxx F	diagnostic Display	Minimum electronics temperature recorded

2.6.5.3 Measurement Type: Density: Factory (display only) or User Calibration sub-menu

	Display	Action	Comment
1	LVDT% xx.xx %	Diagnostic display	
2	DrySensr xx.xx %	Enter or capture sensor output for Dry Sensor	Press  to capture current sensor output
3	SnrCalLo xx.xx %	Enter or capture sensor output for Low Cal Point	Press  to capture current sensor output
4	SGCalLo xx.xx sg	Enter SpecGrav value corresponding to SnrCalLo	
5	Set 4mA xx.xx sg	Enter the PV value for 4 mA set point	Specify SG at 4 mA (User Cal menu only)
6	SnrCalHi xx.xx %	Enter or capture sensor output for High Cal Point	Press  to capture current sensor output
7	SGCalHi xx.xx sg	Enter SpecGrav value corresponding to SnrCalHi	
8	Set 20mA xx.xx sg	Enter the PV value for 20 mA set point	Specify SG at 20 mA (User Cal menu only)
9	Escape	Press  to exit Calibration sub-menu; Returns to Factory Menu	

2.7 Configuration Using HART

Since E3 transmitter supports the HART (Highway Addressable Remote Transducer) communication protocol, configuration tools, such as a HART 375/475 handheld communicator, can be used to provide a communication link to the E3 transmitter. When connected to the control loop, the same system measurement readings shown on the transmitter are shown on the communicator. In addition, the communicator can be used to configure the transmitter.

The HART communicator may need to be updated to include the E3 software (Device Description). Contact your local HART Service Center for additional information.

2.7.1 Connections

A HART communicator can be operated from a remote location by connecting to a remote junction or by connecting directly to the terminal block in the electronics housing of the E3 MODULELEVEL transmitter.

HART uses the Bell 202 frequency shift key technique of high-frequency digital signals. It operates on the 4–20 mA loop and requires a minimum of 250 Ω load resistance. A typical connection between a communicator and the E3 MODULELEVEL transmitter is illustrated.

2.7.2 HART Display Menu

For detailed operating information for the 375/475 Field Communicator, refer to the instruction manual provided with it.

The E3 transmitter online menu tree is shown in the following illustration. Open the menu by pressing the alphanumeric key 0, Device Setup, to display the second-level menu.

2.7.3 HART Revision Table

HART Version	HCF Release Date	Compatible with E3 Software
Dev V1, DD V1	December 2007	Version 1.0A through 1.0D
Dev V2, DD V1	September 2011	Version 1.1A and later

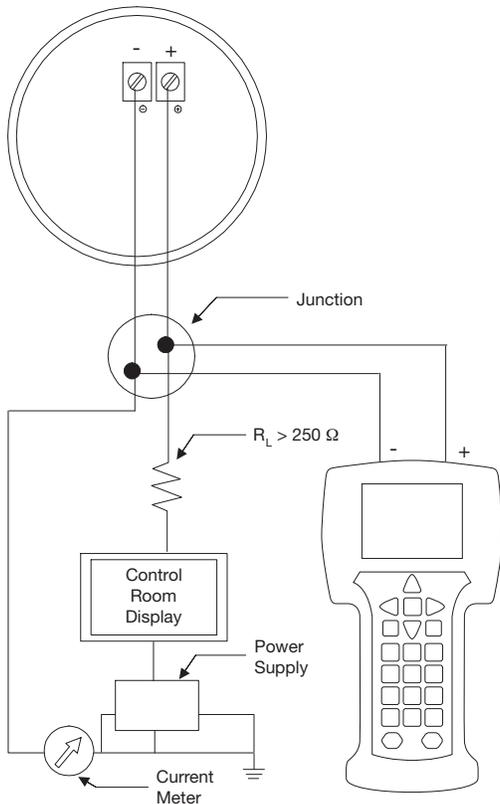
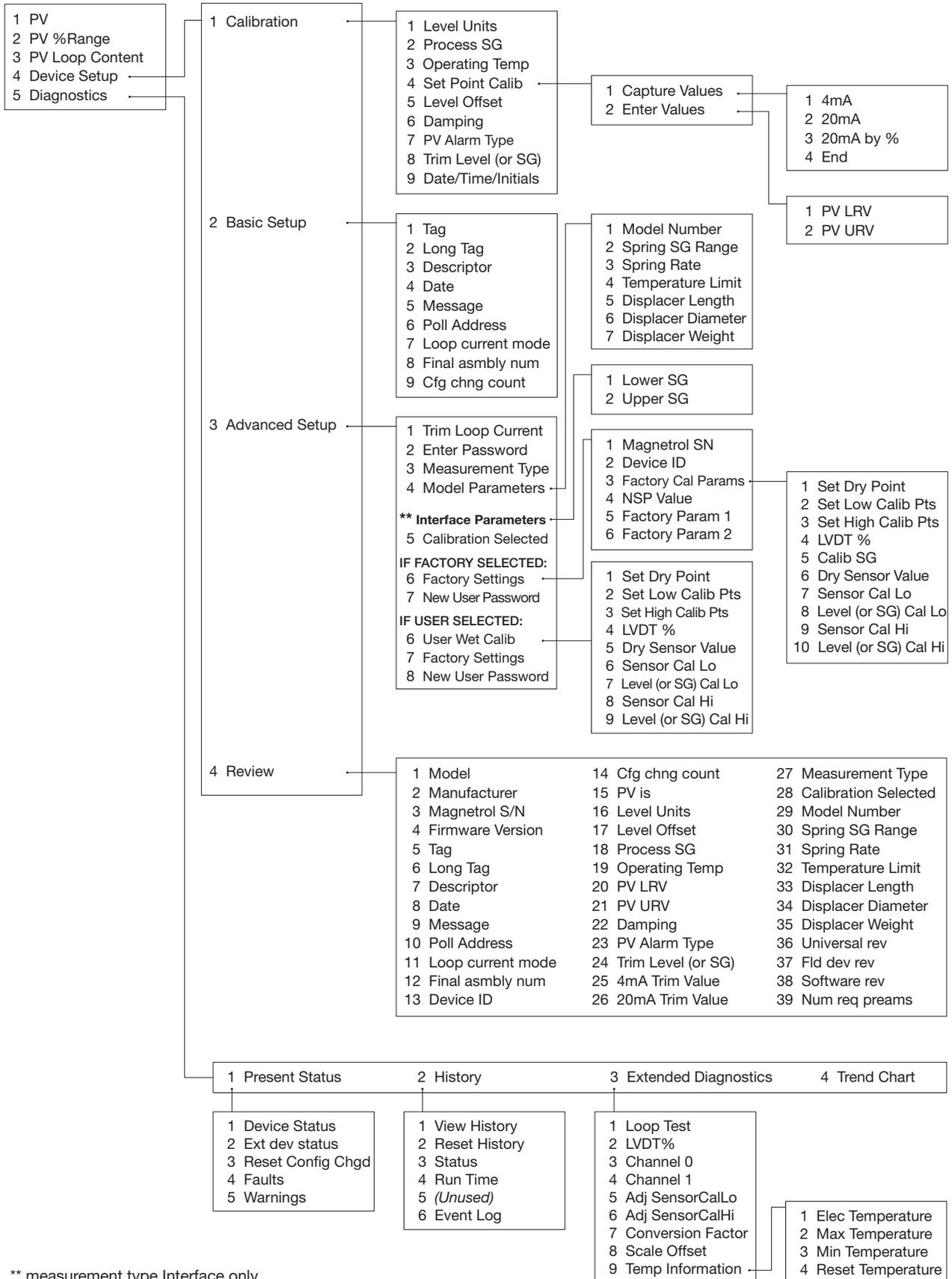


Figure 13
Typical HART Connection

2.7.4 HART Menu (E3 Modulelevel®)



3.0 Reference Information

This section presents an overview of the operation of the E3 Electronic MODULELEVEL Displacer Level Transmitter, information on troubleshooting common problems, listings of agency approvals, lists of replacement and recommended spare parts, and detailed physical, functional, and performance specifications.

3.1 Description

The E3 MODULELEVEL is a loop-powered, two-wire, 24 VDC level transmitter which utilizes simple buoyancy principles in combination with a precision range spring and a highly accurate LVDT (linear variable differential transformer) to detect and convert liquid level movement into a stable 4–20 mA output signal. The electronics are housed in an ergonomic, dual-compartment enclosure which is angled for ease of wiring and calibration.

3.2 Theory of Operation

The Electronic MODULELEVEL Displacer Level Transmitter relies on the principles of buoyancy to convert mechanical movement to an electronic output. See Figure 14.

3.2.1 Displacer/Range Spring

According to Archimedes principle, the buoyancy force acting on an object immersed in liquid is equal to the mass of the liquid displaced. As the level changes, the volume of displacer submerged in the liquid changes, thus varying the buoyancy force acting on the displacer. This change is detected by the precision range spring from which the displacer hangs, causing it to elongate or compress. The change in spring length causes movement of a special LVDT core which is mounted on a rigid stem attached to the spring.

3.2.2 LVDT

E3 MODULELEVEL utilizes highly precise LVDT technology to convert the movement of the LVDT core within the LVDT to a stable 4–20 mA output signal. The position of the core with respect to a primary and two secondary windings within the LVDT, induces a voltage in each winding. The comparison of the induced voltages within the micro-processor of the E3 results in very accurate level output.

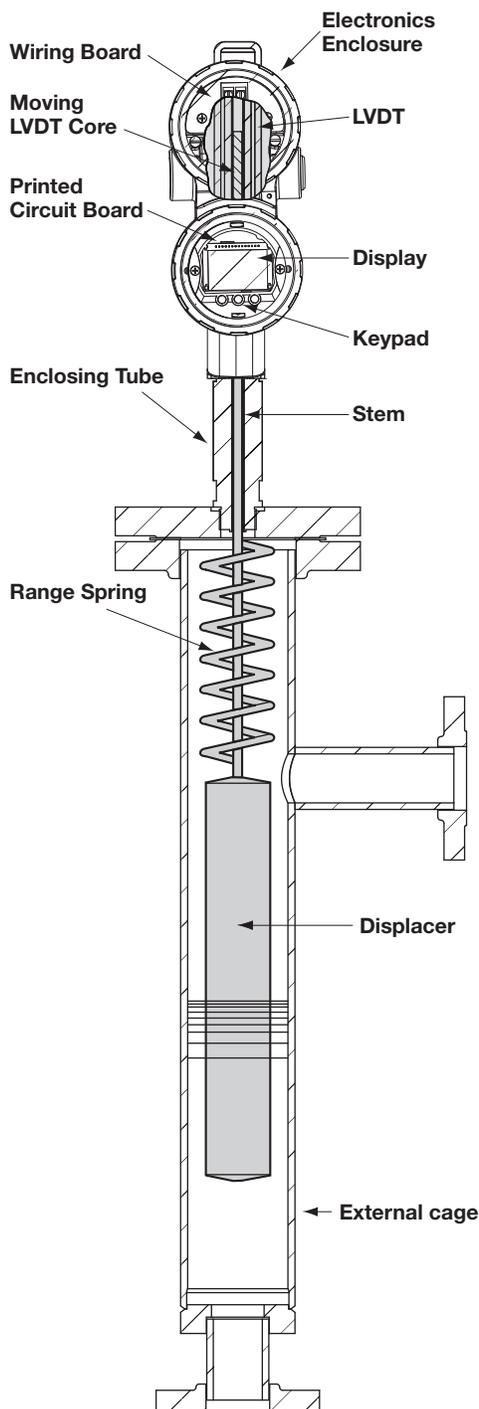


Figure 14
Electronic Modulelevel®
Components

3.2.3 Interface

E3 MODULELEVEL is capable of tracking the interface level of two immiscible liquids with different densities. Each unit is custom-made with a displacer specially designed for the user's application. This allows it to detect the position of a clean interface or an emulsion layer and convert it into a stable 4–20 mA signal. Contact the factory for assistance in specifying an E3 for interface service. Note that for proper interface detection, the entire displacer must always be immersed in liquid.

3.2.4 Density

Yet another capability of E3 MODULELEVEL is to track the changing density of a liquid over a known density range and convert that into a stable 4–20 mA output signal. As the density of the liquid changes, so does the mass of the liquid displaced by the specially designed displacer. The resulting change in buoyancy force on the displacer causes the movement of the LVDT core necessary to convert the density change to the 4–20 mA signal.

3.3 Troubleshooting

The E3 MODULELEVEL displacer transmitter is designed, engineered and constructed for trouble-free operation over a wide range of operating and application conditions. Below, common transmitter problems are discussed in terms of their symptoms and corrective actions.

WARNING! Explosion hazard. Do not remove covers unless power has been switched off or the area is known to be non-hazardous.

Use of the included PACTware™ PC program is highly recommended and invaluable for troubleshooting and advanced calibration. A HART RS232 or USB modem (purchased separately) is required. See MAGNETROL PACTware™ bulletin 59-101.

WARNING! Other than operation of the push-buttons to enter parameter data, live maintenance is not permitted.

3.3.1 Troubleshooting System Problems

Symptom	Problem	Solution
No loop current.	Power supply not turned on.	Turn on power.
	Insufficient source voltage.	E3 requires a minimum of 11 VDC at the wiring board. Verify supply voltage.
	Improperly wired or damaged wiring.	Check wiring and connections.
	Defective electronics.	Replace PC board assembly or wiring board as required.
LEVEL, % OUTPUT and LOOP values are all inaccurate.	Basic configuration data is questionable.	Verify Level Offset values. If using factory calibration, verify that Process SG and Operating Temperature values are accurate. Verify/confirm that Model Parameters are accurate. Confirm set points are as expected.
Transmitter does not track level.	Model incompatible with process liquid	Verify model in use is appropriate for process liquid SG.
	Possible damage to unit.	Check displacer, spring, stem and enclosing tube for damage. Replace all damaged parts.
	Possible material buildup	Check displacer, spring, stem, enclosing tube and displacer for buildup of process material. Clean any fouled parts.
	Displacer, spring or stem dragging on inside of chamber, e-tube.	Verify proper and level installation (within 3 degrees of plumb in all directions).
Level reading on display is correct, but loop value is stuck at 4 mA.	Invalid poll address.	Set poll address to 0 if not using multi-drop.
LEVEL, % OUTPUT and LOOP values fluctuate.	Liquid turbulence.	Increase damping until output stabilizes or install stilling well.
	Power supply unstable.	Repair or replace power supply.
	Electrical interference (RFI).	Consult factory for assistance.
HART device only: Handheld will only read Universal Commands	Most current Device Descriptors are not installed in handheld.	Contact local HART service center for the latest DDs.
Cannot set high level to 20 mA	Incorrect power supply.	Check power supply.
	Excessive loop resistance	Increase power supply voltage or decrease loop resistance (max 620 ohms @ 24 VDC).
Loop current less than 4 mA	Liquid level less than 0%.	No action required.
	Supply voltage out of limits at transmitter.	Adjust power supply or reduce loop resistance.
4 mA output does not match display	4 mA may need to be trimmed.	Use Trim 4 mA to adjust output to match display.
Loop current exceeds 20 mA	Liquid level greater than 100%.	No action required.
	Supply voltage out of limits at transmitter.	Adjust power supply or reduce loop resistance.
	Wired incorrectly.	Check power supply (+) and (-) for reverse wiring.
20 mA output does not match display	20 mA may need to be trimmed.	Use Trim 20 mA to adjust output to match display.
Output jumps quickly over wide range	Bent stem impeding smooth core movement	Review Status History for Surge event. Inspect stem and replace if damaged.
Non-linear output.	Excessive loop resistance.	Increase power supply voltage or decrease loop resistance.
	Displacer hanging up.	Verify proper and level installation (within 3 degrees of plumb in all directions.)
	Bent stem.	Check stem. Replace if damaged.
	Possible material buildup	Check displacer, spring, stem, enclosing tube and displacer for buildup of process material. Clean any fouled parts.

3.3.2 Status Messages

The E3 MODULELEVEL transmitter utilizes a 3-section hierarchy for reporting diagnostic conditions: FAULTS, WARNINGS, and INFORMATION. This information can be reviewed at the STATUS screen in the user menu. This screen captures only current conditions. Historical information can be viewed at the HISTORY screen in the Factory menu.

FAULT: The highest level in the hierarchy of diagnostics annunciating a defect or failure in circuitry or software that precludes reliable measurement. In the presence of a fault, the current (mA) value is 3.6, 22, or HOLD depending on the “Fault” loop current value selected. A message is also displayed on the rotating screen. Further error information can be obtained by viewing the Status History in the Factory Menu.

WARNING (MESSAGE): The second level in the hierarchy of Diagnostics annunciating conditions that are not fatal but may affect measurement. A message will occur on the main (rotating) screen when a Warning is detected but will not affect output current. Further error information can be obtained by viewing the Status History in the Factory Menu.

INFORMATION (MESSAGE): The lowest level in the hierarchy of diagnostic conditions providing operational factors that are not critical to measurement. Further error information can be obtained by viewing the Status History in the Factory Menu.

EFFECTS OF EACH DIAGNOSTIC MESSAGE

	Loop Output	Status Message	Status History
Fault	3.6/22/HOLD	Yes	Yes
Warning	No Effect	Yes	Yes
Information	No Effect	No	Yes

3.3.3 Checking the LVDT Winding Resistance

WARNING: To prevent ignition of explosive atmospheres, disconnect power before servicing.

Refer to Figure 15 during this procedure.

1. Remove power from the unit.
2. Remove the electronics housing cover and the electronics bezel assembly.
3. Disconnect the six-pin connector J1 from the back of the PC board assembly.
4. Using a multimeter, check the primary winding by verifying that pins 1 and 4 of the six-pin connector have approximately 75 to 105 ohms resistance.
5. Check the secondary winding by verifying that pins 2 and 5 or pins 3 and 6 of the six-pin connector have approximately 70 to 100 ohms resistance.
6. If the winding resistance is out of range, replace LVDT.

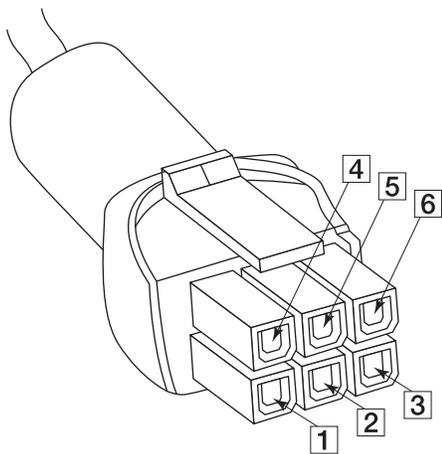


Figure 15
LVDT Six-Pin Connector

3.3.4 Status Message Descriptions

Display Message	Type	Description	Solution
OK	Information	Absence of any warning or fault	No action required.
System Warning	Information	Unexpected system events	No action required unless warning persists
Surge	Information	A/D readings from the LVDT secondary windings are changing more rapidly than expected.	Rate of level change is greater than expected. Check for possible process surge or bent stem.
Initial	Warning	Initializing, PV held at 4 mA set point while unit powers up. Should be transient.	No action required.
Cal Span	Warning	Span between Sensor Calibration Hi and Lo values is less than minimum span.	Recalibrate or reconfigure unit with longer span
Lo Temp	Warning	Present temperature measured in electronics compartment is below -40 °C.	<ol style="list-style-type: none"> 1. Transmitter may need to be moved to ensure ambient temperature is within specification 2. Change to remote mount transmitter 3. Controlled external heat may be required to ensure that temperature inside housing is within specification
Hi Temp	Warning	Present temperature measured in electronics compartment is above +80 °C.	<ol style="list-style-type: none"> 1. Transmitter may need to be moved to ensure ambient temperature is within specification 2. Change to remote mount transmitter 3. Controlled external cooling may be required to ensure that temperature inside housing is within specification
TrimReqd	Warning	Loop trim values are defaults; loop output may be inaccurate.	Perform Loop Trim operation.
Cal Reqd	Warning	Default calibration parameters in use, level reading inaccurate.	Consult factory.
SecFltHi	Fault	<ul style="list-style-type: none"> • A/D readings from LVDT secondary windings are above expected range. • Bad LVDT wiring connection. 	<ul style="list-style-type: none"> • Check for missing displacer. • Check LVDT winding resistance.
SecFltLo*	Fault	<ul style="list-style-type: none"> • A/D readings from LVDT secondary windings are below expected range. • Bad LVDT wiring connection. 	<ul style="list-style-type: none"> • Check for broken spring or leaking displacer. • Check LVDT winding resistance.
CoreDrop	Fault	<ul style="list-style-type: none"> • Core too far out. • Bad LVDT wiring connection. 	<ul style="list-style-type: none"> • Check for lost or damaged LVDT core. • Check LVDT winding resistance.
PriFault	Fault	LVDT Primary circuit open condition.	Check LVDT winding resistance. Replace LVDT if values are out of range
LoopFail	Fault	Loop current differs from commanded value by more than 1.00 mA.	Insufficient power. Supply must be 11–36 VDC.
DfltParm	Fault	Non-volatile parameters have been defaulted.	Consult factory.

*Can occur when unit is designed for interface and no liquid is on the displacer.

PACTware PC program E3 Modulelevel® offers the ability to monitor output and LVDT position using the PACTware DTM. Refer to bulletins 59-101 and 59-601 for more information.

3.4 Agency Approvals

3.4.1 FM (Factory Mutual)

Agency	Model	Transmitter Codes Digits 8, 9 and 10	Approval
	EXX-XXXX	x11, x12, x13, x14 x21, x22, x23, x24 x31, x32, x33, x34 x41, x42, x43, x44 x51, x52, x53, x54 x61, x62, x63, x64 x81, x82, x83, x84	Explosion Proof ① Class I, Div. 1; Groups B, C, D Type 4X, IP66
	EXX-XXXX	x15, x16, x17, x18 x25, x26, x27, x28 x35, x36, x37, x38 x45, x46, x47, x48 x55, x56, x57, x58 x65, x66, x67, x68 x85, x86, x87, x88	Intrinsically Safe ② Class I, Div. 1; Groups A, B, C, D Class II, Div. 1; Groups E, F, G Class III, T4 Entity Type 4X, IP66
	EXX-XXXX	x11, x12, x13, x14 x21, x22, x23, x24 x31, x32, x33, x34 x41, x42, x43, x44 x51, x52, x53, x54 x61, x62, x63, x64 x81, x82, x83, x84	Non-Incendive Class I, Div. 2; Groups A, B, C, D Class II, Div. 2; Groups E, F, G Class III, Div. 2; T4 Type 4X, IP66
	EXX-XXXX	x11, x12, x13, x14 x21, x22, x23, x24 x31, x32, x33, x34 x41, x42, x43, x44 x51, x52, x53, x54 x61, x62, x63, x64 x81, x82, x83, x84	Dust Ignition Proof Class II, Div. 1; Groups E, F, G Class III, T5 Type 4X, IP66

3.4.2 CSA (Canadian Standards Association)

Agency	Model	Transmitter Codes Digits 8, 9 and 10	Approval
	EXX-XXXX	x11, x13, x21, x23 x31, x33, x41, x43 x51, x53, x61, x63 x81, x83	Explosion Proof ① Class I, Div. 1; Groups B, C, D Class II, Div. 1; Groups E, F, G Class III, T4 Type 4X, IP66 & IP67
	EXX-XXXX	x15, x17, x25, x27 x35, x37, x45, x47 x55, x57, x65, x67 x85, x87	Intrinsically Safe ② Class I, Div. 1; Groups A, B, C, D Class II, Div. 1; Groups E, F, G Class III, T4 Entity Type 4X, IP66
	EXX-XXXX	x11, x13, x21, x23 x31, x33, x41, x43 x51, x53, x61, x63 x81, x83	Non Incendive Class I, Div. 2; Groups A, B, C, D Class II, Div. 2; Groups E, F, G Class III, T4 Type 4X, IP66

Agency	Model	Transmitter Codes Digits 8, 9 and 10	Approval/Standards
ATEX 	EXX-XXXX	x1E, x1F, x1G, x1H x2E, x2F, x2G, x2H x3E, x3F, x3G, x3H x4E, x4F, x4G, x4H x5E, x5F, x5G, x5H x6E, x6F, x6G, x6H x8E, x8F, x8G, x8H	Flameproof ATEX Ex II 1/2 G Ex d IIC T6 EN 60079-0, EN 60079-1, EN 60079-26 94/9/EC
	EXX-XXXX	x1A, x1B, x1C, x1D x2A, x2B, x2C, x2D x3A, x3B, x3C, x3D x4A, x4B, x4C, x4D x5A, x5B, x5C, x5D x6A, x6B, x6C, x6D x8A, x8B, x8C, x8D	Intrinsically Safe ② ATEX Ex II 1 G Ex ia IIC T4 EN 60079-0, EN 60079-11, EN 60079-26, EN 60079-27 94/9/EC
	EXX-XXXX	x1A, x1B, x1C, x1D x2A, x2B, x2C, x2D x3A, x3B, x3C, x3D x4A, x4B, x4C, x4D x5A, x5B, x5C, x5D x6A, x6B, x6C, x6D x8A, x8B, x8C, x8D	Non-Sparking ATEX Ex II 3 G Ex ic II T6 EN 60079-0 EN 60079-11 94/9/EC
IEC	EXX-XXXX	x1E, x1F, x1G, x1H x2E, x2F, x2G, x2H x3E, x3F, x3G, x3H	Flameproof IECEx Ex d IIC T6 Ga/Gb IEC 60079-0 IEC 60079-1 IEC 60079-26
	EXX-XXXX	x1A, x1B, x1C, x1D x2A, x2B, x2C, x2D x3A, x3B, x3C, x3D	Intrinsically Safe ② IECEx Ex ia IIC T4 Ga IEC 60079-0 IEC 60079-11 IEC 60079-26 IEC 60079-27

① On remote electronics housing only, seal is required within 18 inches.

② Entity parameters for intrinsically safe installation:

FM/CSA

$V_{\max} = 28.6 \text{ V}$ $P_{\max} = 1 \text{ W}$ $L_i = 9.4 \mu\text{H}$
 $I_{\max} = 140 \text{ mA}$ $C_i = 5.5 \text{ nF}$

ATEX

$V_{\max} = 28.4 \text{ V}$ $P_{\max} = 0.67 \text{ W}$ $L_i = 3 \mu\text{H}$
 $I_{\max} = 94 \text{ mA}$ $C_i = 2.2 \text{ nF}$



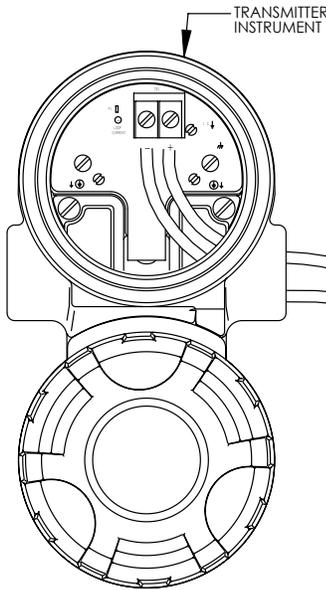
These units have been tested to EN 61326 and are in compliance with the EMC Directive 2004/108/EC.

3.4.4 Agency Drawings

HAZARDOUS LOCATION
 MODULELEVEL TRANSMITTER
 INTRINSICALLY SAFE FOR:
 CLS I, DIV. I GROUPS A, B, C & D
 CLS II, DIV. I GROUPS E, F & G
 CLS III

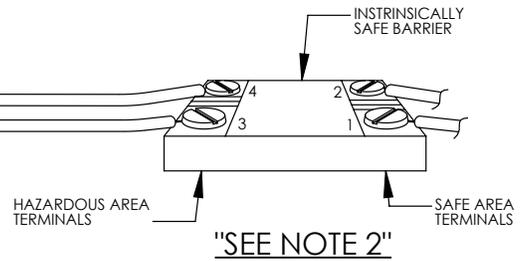
ENTITY
 $V_{max} = 28.6\text{ V}$
 $I_{max} = 140\text{ mA}$
 $P_{max} = 1\text{ W}$
 $C_i = 5.5\text{ nF}$
 $L_i = 9.4\text{ }\mu\text{H}$

**MODULELEVEL
 MODEL E3X-XXXX-HX5**
 N 6
 3 7
 8



NON-HAZARDOUS LOCATION
LIMITING VALUES
 $V_{oc} \leq 28.6\text{ V}$ $C_a \geq 5.5\text{ nF}$
 $I_{sc} \leq 140\text{ mA}$ $L_a \geq 9.4\text{ }\mu\text{H}$

THE VOLTAGE (V_{max}) AND CURRENT (I_{max}) WHICH THE TRANSMITTER CAN RECEIVE MUST BE EQUAL TO OR GREATER THAN THE MAXIMUM OPEN CIRCUIT VOLTAGE (V_{oc} OR V_{+}) AND THE MAXIMUM SHORT CIRCUIT CURRENT (I_{sc} OR I_E), WHICH CAN BE DELIVERED BY THE SOURCE DEVICE. IN ADDITION, THE MAXIMUM CAPACITANCE (C_i) AND INDUCTANCE (L_i) OF THE LOAD AND THE CAPACITANCE AND INDUCTANCE OF THE INTERCONNECTING WIRING, MUST BE EQUAL TO LESS THAN THE CAPACITANCE (C_a) OR THE INDUCTANCE (L_a), WHICH CAN BE DRIVEN BY THE SOURCE DEVICE.



NOTES:

- MANUFACTURER'S INSTALLATION INSTRUCTIONS SUPPLIED WITH THE PROTECTIVE BARRIER AND THE CEC (FOR CSA) OR THE NEC AND ANSI/ISA RP 12.6 (FOR FMRC) MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT. BARRIER MUST BE CSA CERTIFIED FOR CANADIAN INSTALLATIONS & FM APPROVED FOR U.S. INSTALLATION.
- CONTROL EQUIPMENT CONNECTED TO PROTECTIVE BARRIERS MUST NOT USE OR GENERATE MORE THAN 250 VDC OR VRMS. RESISTANCE BETWEEN INTRINSICALLY SAFE GROUND AND EARTH GROUND MUST BE LESS THAN 1.0 OHM.
- NRTL LISTED DUST-TIGHT SEALS MUST BE USED WHEN TRANSMITTER IS INSTALLED IN CLASS II & III ENVIRONMENTS.
- NO REVISIONS TO THIS DRAWING WITHOUT CSA AND FMRC APPROVAL.
- FOR CSA: EXIA INTRINSICALLY SAFE/SECURITE INTRINSEQUE.
- WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR HAZARDOUS LOCATIONS.
- FOR SUPPLY CONNECTIONS, USE WIRE SUITABLE FOR THE OPERATING TEMPERATURE. FOR 60° C AMBIENT, USE WIRE WITH A MINIMUM TEMPERATURE RATING OF 85° C.
- THE TRANSMITTER CAN ALSO BE INSTALLED IN:
 - CLASS I, DIVISION 2, GROUPS A, B, C & D
 - CLASS II, DIVISION 2, GROUPS E, F & G
 - CLASS III, DIVISION 2, HAZARDOUS LOCATIONS AND DOES NOT REQUIRE CONNECTION TO A PROTECTIVE BARRIER WHEN INSTALLED PER THE CEC (FOR CSA) OR THE NEC (FOR FM) AND WHEN CONNECTED TO A POWER SOURCE NOT EXCEEDING 30 VDC. FIELD WIRING MUST BE INSTALLED IN CONDUIT PER THE CEC AND NEC.
- FM & CSA CERTIFIED BARRIERS WITH LINEAR OUTPUT CHARACTERISTICS **MUST BE USED**. REFER TO THE FOLLOWING TABLE FOR GUIDANCE ON SELECTION OF "LINEAR OUTPUT" BARRIERS. THE PARAMETERS LISTED ARE "TYPICAL" ASSOCIATED APPARATUS (SAFETY BARRIER), GROUP A/B GAS OUTPUT ENTITY PARAMETERS FOR LINEAR AND NON-LINEAR SUPPLIES. FOR TYPICAL OUTPUT CURRENTS AS LISTED:

BARRIER OUTPUT CURRENT (ISC)	LINEAR TYPE BARRIER OUTPUT			NON-LINEAR TYPE BARRIER OUTPUT		
	VOC	C _a	L _a MINIMUM	VOC	C _a	L _a MINIMUM
80mA	30V	0.12µF	4.0mH	14V	0.14µF	1mH
100mA	28V	0.13µF	3.0mH	15V	0.16µF	0.5mH
				12V	0.16µF	1mH
125mA	26V	0.17µF	2.3mH	13.6V	0.175µF	0.5mH
				12.5V	0.18µF	0.5mH
140mA	24V	0.21µF	1.7mH	14.7V	0.25µF	0.15mH
				11.5V	0.18µF	0.5mH
				14V	0.275µF	0.15mH

THE OUTPUT POWER OF A "LINEAR" OUTPUT BARRIER MAY BE CALCULATED AS FOLLOWS:
 $P_{om} = V_{oc} \cdot I_{sc}$ OR $P_{om} = U_o \cdot I_o$

THE OUTPUT POWER OF A "NON-LINEAR" OUTPUT BARRIER MAY BE CALCULATED AS FOLLOWS:
 $P_{om} = V_{oc} \cdot I_{sc}$ OR $P_{om} = U_o \cdot I_o$

- WARNING: TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTIBLE ATMOSPHERES DISCONNECT POWER BEFORE SERVICING.
- USE THIS DEVICE ONLY AS SPECIFIED IN THE INSTALLATION AND OPERATING MANUAL.

AGENCY LISTED DRAWING

ALL REVISIONS TO THIS DRAWING REQUIRE QA APPROVAL



099-5069-001

099-5069-F

SHEET 2 OF 3

3.5 Parts

3.5.1 Replacement Transmitter Head Parts

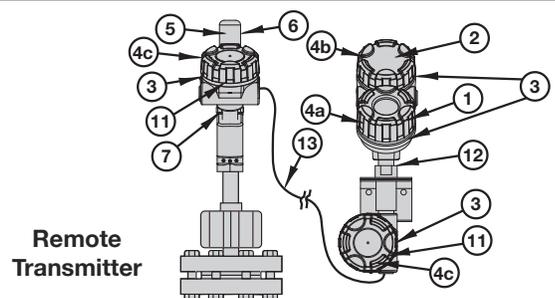
① Electronic Module HART SIL 2	Z31-2844-001*
② Wiring Board	
HART SIL 2	Z30-9151-001
③ Transmitter Housing O-rings (2 required)	012-2201-237
④ Transmitter Housing Cover Kits – Contains parts 4a and 4b	
ATEX/IEC & FM/CSA, aluminum, IS, integral	089-6606-004
ATEX/IEC & FM/CSA, stainless steel, IS, integral	089-6606-005
FM/CSA, aluminum, XP, integral	089-6606-009
FM/CSA, stainless steel, XP, integral	089-6606-010
ATEX/IEC, aluminum, XP, integral	089-6606-013
ATEX/IEC, stainless steel, XP, integral	089-6606-014
FM/CSA, aluminum, XP, remote	089-6606-015
FM/CSA, stainless steel, XP, remote	089-6606-016
FM/CSA, aluminum, IS, remote	089-6606-017
FM/CSA, stainless steel, IS, remote	089-6606-018
④c Terminal Junction Box Covers (2 required)	
FM/CSA, aluminum, XP, remote	Consult Factory
FM/CSA, stainless steel, XP, remote	Consult Factory
FM/CSA, aluminum, IS, remote	Consult Factory
FM/CSA, stainless steel, IS, remote	Consult Factory
⑤ LVDT Kit – Contains parts 5, 8, 9, and 10	
Low Temperature (9 th digit 1 or 4)	089-7827-007*
Mid Temperature (9 th digit 2 or 5)	089-7827-008*
High Temperature (9 th digit 3 or 6)	089-7827-009*
Ultra High Temperature (9 th digit 8)**	089-7827-010*
⑥ LVDT Housing Cover Kits	
Aluminum	089-7837-001
Stainless Steel	089-7837-002
Stainless Steel (For Ultra High Temp LVDT)	089-7837-003
⑦ LVDT Cover O-ring	012-2222-123
⑪ Remote Terminal Boards (2 required)	030-3609-001
⑫ Remote Transmitter Jumper Cable	037-7917-001
⑬ Remote Cable Assembly (last two digits indicate cable length in feet)	
Up to +400 °F (+204 °C)	037-3226-0xx
Up to +500 °F (+260 °C)	037-3227-0xx

* Field replacement of this part requires a user calibration of the repaired unit.

** Contains LVDT Core, Item 20.

Parts Identification

1 Electronic Module	7 LVDT Cover O-ring
2 Wiring Board	8 TFE Spacer
3 Transmitter Housing O-rings (2)	9 Grip Ring
4a Meter/Bezel Compartment Cover	10 Top LVDT Spacer
4b Wiring Compartment Housing Cover	11 Remote Terminal Boards (2)
4c Terminal Junction Box Covers (2)	12 Remote Transmitter Jumper Cable
5 LVDT Assembly	13 Remote Cable Assembly
6 LVDT Housing Cover	



3.5.2 User Calibration Procedure

The E3 MODULELEVEL is calibrated at the factory, so it normally requires only configuration by the user in the field. Should the E3 require replacement of any parts in the field, a user calibration must be performed after changing out any of the following original parts: Bezel assembly, LVDT assembly, range spring, stem assembly, or displacer. The following procedure should be followed when performing a user calibration in the field. Note: User calibration should be performed at normal operating conditions. The factory calibration parameters will not be incorporated into the level measurement.

1. Move liquid level on displacer to desired low level point. Using keypad and LCD display, scroll down to DispFact.
2. Press \leftarrow to access data entry mode, down arrow until "Yes" is displayed and Enter again. The factory menu is now accessible.
3. Scroll down to CalSelct.
4. Press \leftarrow , then \downarrow until "User" is displayed and \leftarrow again.
5. Press \downarrow to UserCalMenu then press \leftarrow to show the menu.
6. Scroll down to SnrCalLo.
7. Press \leftarrow , then \uparrow and \leftarrow simultaneously and \leftarrow again. The current liquid level has been captured as the low level point.
8. Scroll down to LvlCalLo. The default value is 0.00. If a different level value is desired at this point, press \leftarrow , use the \uparrow and \downarrow keys to choose the desired value and press \leftarrow again.
9. Move the liquid level on displacer to the desired high level point. Scroll to SnrCalHi.
10. Press \leftarrow , then \uparrow and \leftarrow simultaneously and \leftarrow again. The current liquid level has been captured as the high level point.
11. Scroll down to LvlCalHi. The default value is an arbitrary length. Press \leftarrow , use the \uparrow and \downarrow keys to choose the level value and press \leftarrow again. The user calibration is complete.

3.5.3 Mechanical Replacement Parts

Cage Pressure Rating	Temp. Config. 4th digit	Spring SG Range	E-tube Kits ⁽¹⁴⁾			Stem Kit* ⁽¹⁵⁾	Spring Kits* ⁽¹⁶⁾			
			CSA, Carbon Steel	FM, ATEX, IEC Carbon Steel	CSA, FM, ATEX, IEC, 316 SS		Inconel®	316 SS		
150#, 300# & 600# ANSI	A, B, C	0.23 – 0.54	089-5958-017	089-5958-002	089-5958-006	089-5565-004	089-5340-002	n/a		
		0.55 – 1.09				089-5565-003	089-5340-005			
		1.10 – 2.20				089-5565-003	089-5340-008			
	D, E, F	0.23 – 0.54	089-5958-019	089-5958-004	089-5958-008	089-5565-008	089-5340-003			
		0.55 – 1.09				089-5565-007	089-5340-006			
		1.10 – 2.20				089-5565-007	089-5340-009			
	J, K, L	0.23 – 0.54	089-5958-005	089-5958-001	089-5958-005	089-5565-002	089-5340-002	089-5340-001		
		0.55 – 1.09				089-5565-001	089-5340-005	089-5340-004		
		1.10 – 2.20				089-5565-001	089-5340-008	089-5340-007		
	M, N, P Temp ≤ +450°F (+230°C)	0.23 – 0.54	089-5958-018	089-5958-003	089-5958-007	089-5565-006	089-5340-002	n/a		
		0.55 – 1.09				089-5565-005	089-5340-005			
		1.10 – 2.20				089-5565-005	089-5340-008			
M, N, P Temp ≥ +500°F (+260°C)	0.23 – 0.54	089-5958-018	089-5958-003	089-5958-007	089-5565-006	089-5340-003	n/a			
	0.55 – 1.09				089-5565-005	089-5340-006				
	1.10 – 2.20				089-5565-005	089-5340-009				
900# ANSI	B	0.55 – 1.09	089-5958-020	089-5958-010	089-5958-014	089-5565-004	089-5340-010	n/a		
	E		089-5958-022	089-5958-012	089-5958-016	089-5565-008				
	K		089-5958-013	089-5958-009	089-5958-013	089-5565-002				
	N		089-5958-021	089-5958-011	089-5958-015	089-5565-006				
1500# & 2500# ANSI	B	0.55 - 1.09	089-5958-020	089-5958-010	n/a	089-5565-004			089-5340-010	n/a
	E		089-5958-022	089-5958-012		089-5565-008				
	K		089-5958-013	089-5958-009		089-5565-002				
	N		089-5958-021	089-5958-011		089-5565-006				
150# THRU #600	N	0.55 - 1.09	089-5958-027			089-5565-013**	089-5340-011			
	E		089-5958-028			089-5565-015**				
900# THRU #2500	N	0.55 - 1.09	089-5958-027			089-5565-014**	089-5340-011			
	E		089-5958-028			089-5565-016**				

For Ultra High Temperature LVDT

* Field replacement of this part requires a user calibration of the repaired unit.

** For ultra high temperature LVDT stem kits, LVDT core is not included.

Cage Pressure Rating	Head Flange Size	⑰ Head Flange Kit	
		Carbon Steel	316 SS
150# ANSI	3"	89-4242-001	89-4242-017
	4"	89-4242-005	89-4242-021
	6"	89-4242-011	89-4242-027
300# ANSI	3"	89-4242-002	89-4242-018
	4"	89-4242-006	89-4242-022
	6"	89-4242-012	89-4242-028
600# ANSI	3"	89-4242-003	89-4242-019
	4"	89-4242-007	89-4242-023
	6"	89-4242-013	89-4242-029
900# ANSI	3"	89-4242-004	89-4242-020
	4"	89-4242-008	89-4242-024
	6"	89-4242-014	89-4242-030
1500# ANSI	4"	89-4242-009	89-4242-025
	6"	89-4242-015	89-4242-031
	6"	89-4242-010	89-4242-026
2500# ANSI	6"	89-4242-016	89-4242-032

⑱ Displacer Kits*			
	150, 300, 600#		High Pressure 900, 1500, 2500#, Ultra High Temp LVDT
	S.G. Range		S.G. Range
	0.23-0.54 & 0.55-1.09	1.10 - 2.2	0.55 - 1.09
14"	89-6125-001	89-6126-001	89-6125-010
32"	89-6125-002	89-6126-002	89-6125-011
48"	89-6125-003	89-6126-003	89-6125-012
60"	89-6125-004	89-6126-004	89-6125-013
72"	89-6125-005	89-6126-005	n/a
84"	89-6125-006	89-6126-006	n/a
96"	89-6125-007	89-6126-007	n/a
108"	89-6125-008	89-6126-008	n/a
120"	89-6125-009	89-6126-009	n/a

⑲ Cotter pins	
All Units	10-5203-001

Kit Definitions

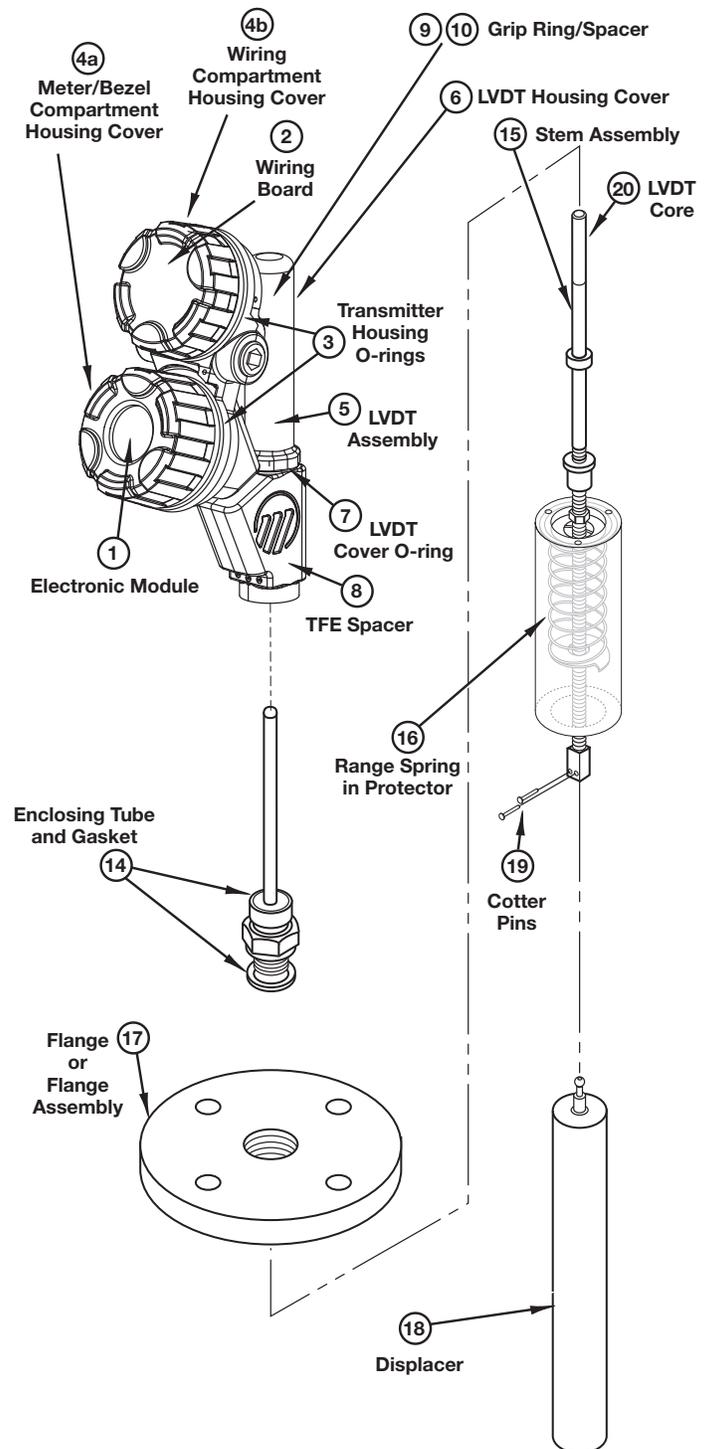
Head flange kit includes: head flange, studs, nuts and gasket (top mounting units) or head flange only (chambered unit)

E-tube kits include: E-tube, E-tube extension(s) and gasket

Stem kits include: stem assembly, stem extension, LVDT core

Spring kits include: spring assembly, screws and lockwashers

Displacer kits include: displacer and cotter pins



3.5.4 Recommended Spare Parts

① Electronic Module	
HART SIL 2	Z31-2844-001*

⑤ LVDT Assembly Kit	
Low Temperature (9 th digit 1 or 4)	89-7827-007*
Mid Temperature (9 th digit 2 or 5)	89-7827-008*
High Temperature (9 th digit 3 or 6)	89-7827-009*
Ultra High Temp (9 th digit 8)**	89-7827-010*

* Field replacement of this part requires a user calibration of the repaired unit.

** Contains LVDT Core, Item 20.

3.6 Specifications

3.6.1 Functional

System Design

Measurement Principle Buoyancy – continuous displacement utilizing a precision range spring

Input

Measured Variable Level, determined by LVDT core movement affected by buoyancy force changes on continuous displacer

Physical Range Up to 120" (300 cm) based on displacer length (C/F for longer ranges)

Output

Type	Analog:	4 to 20 mA direct or reverse with HART digital signal
Range	Analog:	3.8 to 20.5 mA useable, 22.5 mA maximum
	Digital:	0 to 100%
Resolution	Analog:	0.01 mA
	Digital:	0.1%
	Level units:	0.01 inch
Loop Resistance (maximum)	620 ohms @ 24 VDC	
Diagnostic Alarm	3.6, 22 mA or HOLD selectable (Complies with NAMUR NE 43)	
Damping	Adjustable 0-45 seconds	
Sampling Rate	Transmitter 15 times per second	

User Interface

Keypad 3-button menu-driven data entry and system security

Indication 2-line x 8-character LCD display

Digital Communication HART Version 6.x compatible

Power

Voltage (measured at instrument terminals) 11–36 VDC --- (Direct Current) This device provides only Functional Isolation

Current 22.5 mA maximum

Housing

Material Aluminum A356-T6 (<0.20% copper), optional 316 stainless steel

Cable Entry $\frac{3}{4}$ " NPT and M20

Ingress Protection TYPE 4X, IP66

Chamber

Materials Carbon steel
316/316L stainless steel

Wetted parts 304/304L and 316/316L (900# and greater) and Inconel® (spring)
316/316L (600# and less) and Inconel (spring)

Process connections Tank Top: 3", 4", 6" ANSI Flange
Chambered: 1½", 2" NPT
1½", 2" Socketweld
1½", 2" ANSI Flanges

Process Conditions

Process temperature range ① Steam applications:
-20 to +800 °F (-29 to +427 °C)
Non-steam applications:
-20 to +850 °F (-29 to +454 °C) ②

Process pressure range 5100 psig @ +100 °F
(351 bar @ +38 °C)

① Maximum process temperatures are based on ambient temperatures less than or equal to +120 °F (+49 °C). Higher ambient temperatures require reduced process temperatures.

② Consult factory for low temperature applications down to -330 °F (-200 °C).

Environment

Electronics Operating Temperature	-40 to +176 °F (-40 to +80 °C)
Display Function Operating Temperature	-5 to +160 °F (-20 to +70 °C)
Storage Temperature	-50 to +185 °F (-40 to +85 °C)
Humidity	0-99%, non-condensing
Electromagnetic Compatibility	Meets CE Requirements: EN 61326
Surge Protection	Meets CE Requirements EN 61326
Shock Class	ANSI/ISA-S71.03 Class SA1 ③
Vibration Class	ANSI/ISA-S71.03 Class VC2 ③
Altitude	≤2000 m
Pollution Degree	2

3.6.2 Performance - Level

Linearity	±0.50% of full span
Repeatability	±0.20% of full span
Ambient temperature effect	Maximum zero shift is 0.017%/°F over ambient temperature range
Operating Temp. range:	-40 to +176 °F (-40 to +80 °C)
LCD Temp. Range:	-5 to +160 °F (-20 to +70 °C)
Hysteresis	±0.20% of full span
Response Time	<1 second
Warm-up Time	<5 seconds

3.6.3 Performance - Interface Level & Density ④

Linearity	±0.70% of full span
Repeatability	±0.40% of full span
Ambient temperature effect	Maximum zero shift is 0.017%/°F over ambient temperature range

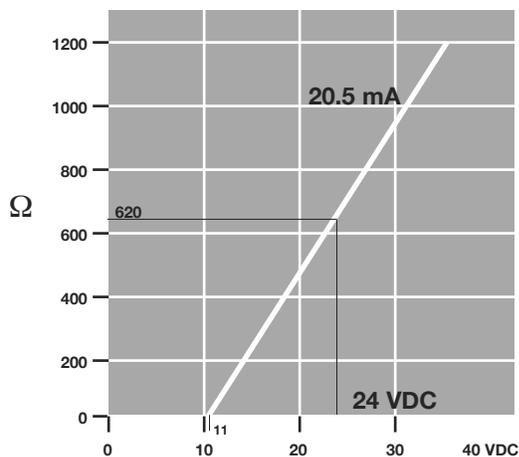


Figure 16
Allowable Loop Resistance
vs. Supply Voltage

③ With aluminum housing only. Does not apply to models with 316 SS transmitter housings.

④ The displacer must always be completely immersed in process liquid when the E3 is used in interface or density service. Top mounted models require liquid level to exceed the top of the displacer by 2" at all times to ensure optimal performance.

3.6.4 Physical – Inches (mm)

Dimensional specifications for standard pressure models E3A, E3B, E3C, E3D, E3E, E3F

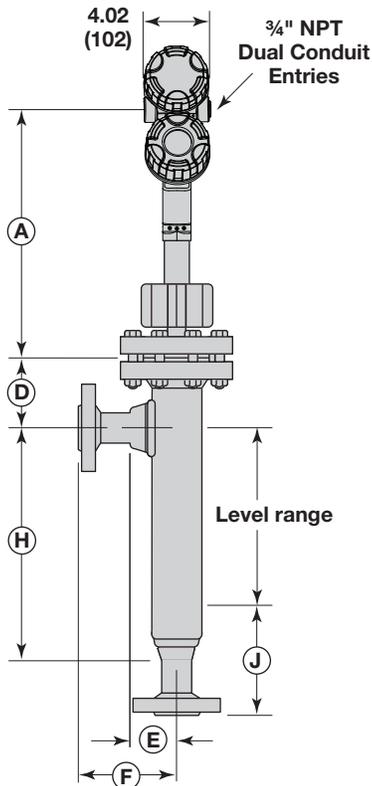


Figure 17

HT Integral Side/Bottom Mount
Fourth Digit Codes A, B, C

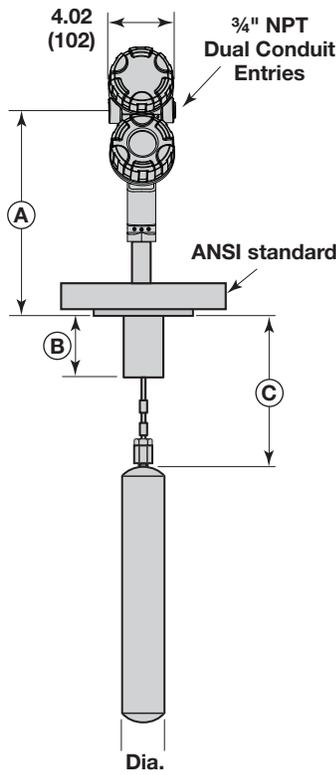


Figure 18

E3A/E3B Series with Integral Top Mounting
Fourth Digit Codes J, K, L

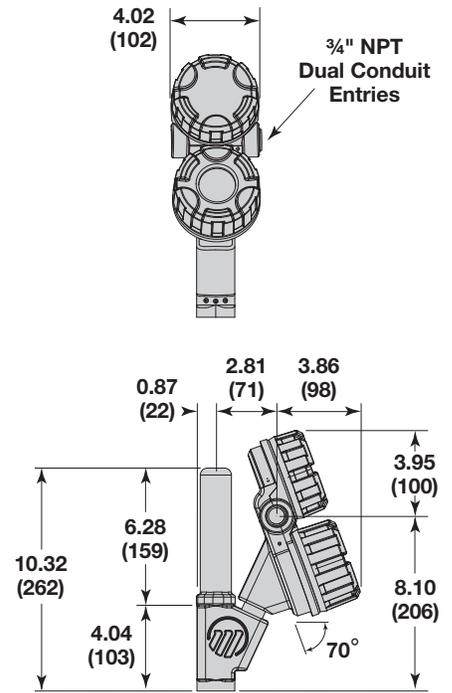


Figure 19

Integral Transmitter Head

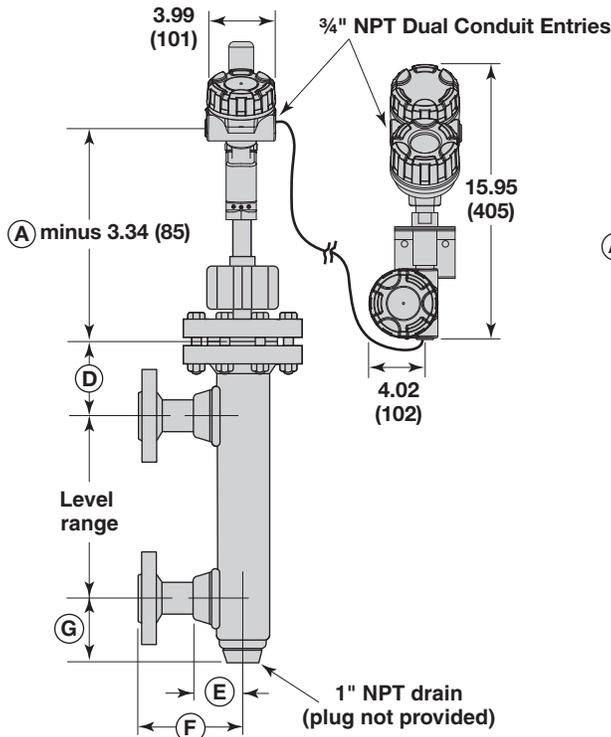


Figure 20

Remote Side/Side Mount
Fourth Digit Codes A, B, C

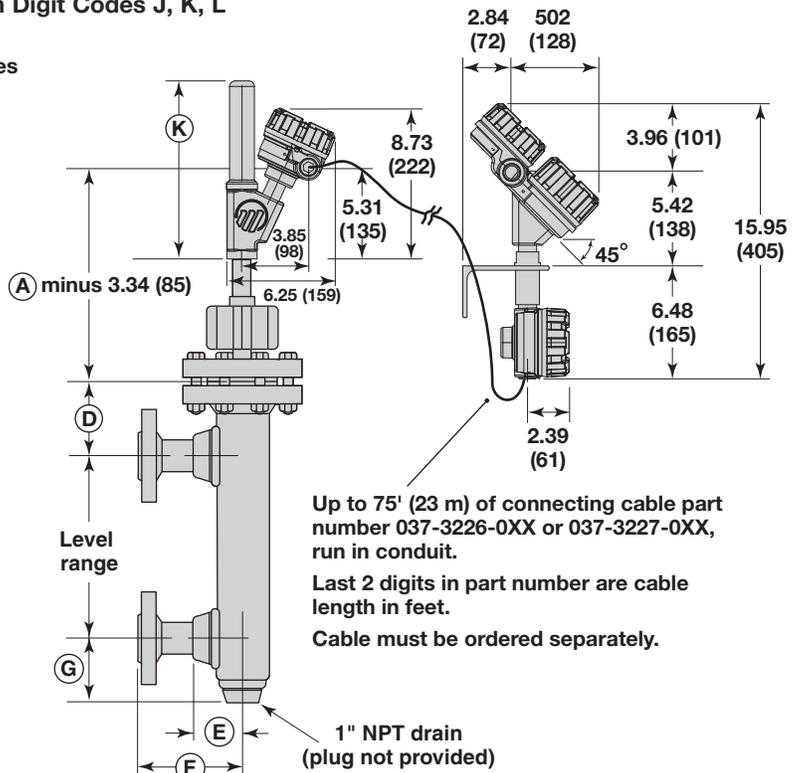


Figure 21

Remote Side/Side Mount
Fourth Digit Codes A, B, C

Up to 75' (23 m) of connecting cable part number 037-3226-0XX or 037-3227-0XX, run in conduit.
Last 2 digits in part number are cable length in feet.
Cable must be ordered separately.

Dimensional specifications – inches (mm)

9th Digit	Cage Press. Rating	Process Conn. Size	Spring S.G. Range	Dimension								
				B	C	D	E	F	G	H	J	K
1, 2, 3, 4, 5, 6	150#, 300# & 600# ANSI	1½"	0.23 – 0.54	6.75 (171)	9.31 (236)	9.31 (236)	3.19 (81)	7.00 (178)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	10.32 (262)
			0.55 – 1.09	4.75 (121)	7.31 (186)	7.31 (186)	3.19 (81)	7.00 (178)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	10.32 (262)
			1.10 – 2.20	4.75 (121)	7.31 (186)	7.31 (186)	3.19 (81)	7.00 (178)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	10.32 (262)
		2"	0.23 – 0.54	6.75 (171)	9.31 (236)	9.31 (236)	3.31 (84)	7.13 (181)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	10.32 (262)
			0.55 – 1.09	4.75 (121)	7.31 (186)	7.31 (186)	3.31 (84)	7.13 (181)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	10.32 (262)
			1.10 – 2.20	4.75 (121)	7.31 (186)	7.31 (186)	3.31 (84)	7.13 (181)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	10.32 (262)
	900# ANSI	1½"	0.55 – 1.09	6.75 (171)	9.31 (236)	9.31 (236)	3.19 (81)	7.00 (178)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	10.32 (262)
		2"	0.55 – 1.09	6.75 (171)	9.31 (236)	9.31 (236)	3.31 (84)	7.13 (181)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	10.32 (262)
	1500# ANSI	1½"	0.55 – 1.09	6.75 (171)	9.31 (236)	9.31 (236)	3.19 (81)	7.00 (178)	3.44 (87)	3.44 + range (87 + range)	6.43 (163)	10.32 (262)
		2"	0.55 – 1.09	6.75 (171)	9.31 (236)	9.31 (236)	3.31 (84)	8.13 (207)	3.44 (87)	3.44 + range (87 + range)	7.43 (189)	10.32 (262)
	2500# ANSI	1½"	0.55 – 1.09	6.75 (171)	9.31 (236)	9.31 (236)	4.00 (102)	9.00 (229)	3.44 (87)	3.44 + range (87 + range)	10.21 (259)	10.32 (262)
		2"	0.55 – 1.09	6.75 (171)	9.31 (236)	9.31 (236)	4.38 (111)	9.81 (249)	3.44 (87)	3.44 + range (87 + range)	11.08 (281)	10.32 (262)
8	150#, 300# & 600#	1½"	0.55 – 1.09	8.25 (210)	9.31 (236)	9.31 (236)	3.19 (81)	7.00 (178)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	11.60 (295)
		2"	0.55 – 1.09	8.25 (210)	9.31 (236)	9.31 (236)	3.31 (84)	7.13 (181)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	11.60 (295)
	900#	1½"	0.55 – 1.09	8.25 (210)	9.31 (236)	9.31 (236)	3.19 (81)	7.00 (178)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	11.60 (295)
		2"	0.55 – 1.09	8.25 (210)	9.31 (236)	9.31 (236)	3.31 (84)	7.13 (181)	3.00 (76)	3.00 + range (76 + range)	5.43 (138)	11.60 (295)
	1500#	1½"	0.55 – 1.09	8.25 (210)	9.31 (236)	9.31 (236)	3.19 (81)	7.00 (178)	3.44 (87)	3.44 + range (87 + range)	6.43 (163)	11.60 (295)
		2"	0.55 – 1.09	8.25 (210)	9.31 (236)	9.31 (236)	3.31 (84)	8.13 (207)	3.44 (87)	3.44 + range (87 + range)	7.43 (189)	11.60 (295)
	2500#	1½"	0.55 – 1.09	8.25 (210)	9.31 (236)	9.31 (236)	4.00 (102)	9.00 (229)	3.44 (87)	3.44 + range (87 + range)	10.21 (259)	11.60 (295)
		2"	0.55 – 1.09	8.25 (210)	9.31 (236)	9.31 (236)	4.38 (111)	9.81 (249)	3.44 (87)	3.44 + range (87 + range)	11.08 (281)	11.60 (295)

"A" Dimension		Fourth Digit of Model Number			
Cage Press. Rating	Head Flange Size	A, B, C	D, E, F	J, K, L	M, N, P
150# ANSI	3"	16.97 (431)	24.97 (634)	12.97 (329)	20.97 (533)
	4"	16.97 (431)	24.97 (634)	12.97 (329)	20.97 (533)
	6"	17.03 (433)	25.03 (636)	13.03 (331)	21.03 (534)
300# ANSI	3"	17.16 (436)	25.16 (639)	13.16 (334)	21.16 (537)
	4"	17.28 (439)	25.28 (642)	13.28 (337)	21.28 (541)
	6"	17.47 (444)	25.47 (647)	13.47 (342)	21.47 (545)
600# ANSI	3"	17.53 (445)	25.53 (648)	13.53 (344)	21.53 (547)
	4"	17.78 (452)	25.78 (655)	13.78 (350)	21.78 (553)
	6"	18.16 (461)	26.16 (664)	14.16 (360)	22.16 (563)
900# ANSI	3"	17.78 (452)	25.78 (655)	13.78 (350)	21.78 (553)
	4"	18.03 (458)	26.03 (661)	14.03 (356)	22.03 (560)
	6"	18.47 (469)	26.47 (672)	14.47 (368)	22.47 (571)
1500# ANSI	3"	18.16 (461)	26.16 (664)	14.16 (360)	22.16 (563)
	4"	18.41 (468)	26.41 (671)	14.41 (366)	22.41 (569)
	6"	19.53 (496)	27.53 (699)	15.53 (394)	23.53 (598)
2500# ANSI	4"	19.28 (490)	27.28 (693)	15.28 (388)	23.28 (591)
	6"	20.53 (521)	28.53 (725)	16.53 (420)	24.53 (623)

3.7 Model Numbers

3.7.1 E3x for Non-Steam Service

DESIGN TYPE

E 3	Standard Construction Electronic MODULELEVEL
------------	--

MOUNTING AND CHAMBER MATERIALS

Flanged top ①		Cage side/bottom		Cage side/side	
steel	316 SS	steel	316 SS ②	steel	316 SS ②
A	B	C	D	E	F

① Adjustable 8-foot hanger cable, part number 32-3110-001, required when distance from flange face to top of displacer must be greater than 7.31".

② Bolting material is alloy steel.

SPECIFIC GRAVITY AND PROCESS TEMPERATURE

Integral or Remote					Transmitter Mounting
1 & 4	1 & 4	1 & 4	1, 4 & 8 ③	3, 6 & 8 ③	Use with Mounting/Temp. codes (9th Digit)
Std.	4"	8"	12"	8"	Temperature Extension
J	A	M	D	M	0.23 – 0.54 specific gravity (up to 600 lbs)
K	B	N	E	N	0.55 – 1.09 specific gravity (all pressures)
L	C	P	F	P	1.10 – 2.20 specific gravity (up to 600 lbs)

③ 9th Digit=8 only good with 0.55–1.09 SG.

PROCESS CONNECTION SIZE & TYPE

External Cage		Top Mount			Type
1½"	2"	3"	4"	6"	
A	E	n/a	n/a	n/a	NPT
R	F	n/a	n/a	n/a	SW
P	Q	G	H	K	Flange

CHAMBER PRESSURE CLASS

ANSI Flange rating					
150# RF	300# RF	600# RF	900# RF	1500# RF ④	2500# RF ④⑤⑥
3	4	5	6	7	8

④ Pressure rating limited by enclosing tube to 5150 psi @ 100°F

⑤ For stainless steel construction on 1500# and 2500# models, consult factory

⑥ Models E3A and E3B with 2500# construction must have a mounting flange 4" or greater

LEVEL RANGE

All Pressures / 9th Digit = 8					600# or below					
14	32	48	60	72	84	96	108	120	Inches	
356	813	1219	1524	1829	2134	2438	2743	3048	mm	
A	B	C	D	E	F	G	H	I	Code	

TRANSMITTER – ELECTRONICS (see opposite page)



3.7.1 E3x for Non-Steam Service - Transmitter Electronics

SIGNAL OUTPUT

S	4-20 mA/HART, SIL 2/3 Certified
----------	---------------------------------

MOUNTING/TEMPERATURE

Integral Mount		
	Maximum Process Temperature	Use with Specific Gravity and Process Temperature codes (4th Digit):
1	+550 °F (+290 °C)	J, K, L, A, B, C, M, N, P, D, E, F
3	+551 to +600 °F (+291 to +315 °C)	M, N, P
Remote Mount ^⑦		
	Maximum Process Temperature	Use with Specific Gravity and Process Temperature codes:
4	+550 °F (+290 °C)	J, K, L, A, B, C, M, N, P, D, E, F
6	+551 to +600 °F (+291 to +315 °C)	M, N, P
8	+601 to +850 °F (+316 to +454 °C)	E, N

^⑦ Cable for remote mounting transmitter is 037-3226-xxx up to +400 °F (+204 °C) and 037-3227-xxx (Belden 88777) above +400 °F (+204 °C) where -xxx is the length in feet from 10 (-010) to 400 (-400) feet.

HOUSING MATERIAL/CONDUIT ENTRY/APPROVAL

Housing Material/Conduit Entry/Approval	9 th Digit
1 Cast aluminum, FM/CSA XP, ¼" NPT	1,3,4,6,8
2 Cast aluminum, FM XP, M20	
3 Cast stainless steel, FM/CSA XP, ¼" NPT	
4 Cast stainless steel, FM XP, M20	
5 Cast aluminum, FM/CSA IS, ¼" NPT	
6 Cast aluminum, FM IS, M20	
7 Cast stainless steel, FM/CSA IS, ¼" NPT	
8 Cast stainless steel, FM IS, M20	
A Cast aluminum, ATEX/IEC IS, ¼" NPT	1,3,4,6,8 ^⑧
B Cast aluminum, ATEX/IEC IS, M20	
C Cast stainless steel, ATEX/IEC IS, ¼" NPT	
D Cast stainless steel, ATEX/IEC IS, M20	
E Cast aluminum, ATEX/IEC XP, ¼" NPT	
F Cast aluminum, ATEX/IEC XP, M20	
G Cast stainless steel, ATEX/IEC XP, ¼" NPT	
H Cast stainless steel, ATEX/IEC XP, M20	

^⑧ 9th digit = 8 applies to ATEX only.

E3X-XXXX (see previous page)



3.7.2 E3x for Steam Service

DESIGN TYPE

E 3	Standard Construction Electronic MODULELEVEL
------------	--

MOUNTING AND CHAMBER MATERIALS

Flanged top ①		Cage side/bottom		Cage side/side	
steel	316 SS	steel	316 SS ②	steel	316 SS ②
A	B	C	D	E	F

- ① Adjustable 8-foot hanger cable, part number 32-3110-001, required when distance from flange face to top of displacer must be greater than 7.31".
 ② Bolting material is alloy steel.

SPECIFIC GRAVITY AND PROCESS TEMPERATURE

Integral or Remote	Integral	Remote	Integral or Remote	Integral or Remote	Remote	Transmitter Mounting
1 & 4	2	5	2 & 5	3 & 8	6 & 8	Use with Mounting/Temp. codes (9th Digit)
Std.	4"	Std.	8"	12"	8"	Temperature Extension
K	B	K	N	E	N	0.55 - 1.09 specific gravity (all pressures)

PROCESS CONNECTION SIZE & TYPE

External Cage		Top Mount			Type
1½"	2"	3"	4"	6"	
A	E	n/a	n/a	n/a	NPT
R	F	n/a	n/a	n/a	SW
P	Q	G	H	K	Flange

CHAMBER PRESSURE CLASS

ANSI Flange rating					
150# RF	300# RF	600# RF	900# RF	1500# RF ④	2500# RF ③④⑤
3	4	5	6	7	8

- ③ Pressure rating limited by enclosing tube to 5150 psi @ +100°F.
 ④ For stainless steel construction on 1500# and 2500# models, consult factory.
 ⑤ Models E3A and E3B with 2500# construction must have a mounting flange 4" or greater.

LEVEL RANGE

All Pressures / 9th Digit = 8				600# or below					
14	32	48	60	72	84	96	108	120	Inches
356	813	1219	1524	1829	2134	2438	2743	3048	mm
A	B	C	D	E	F	G	H	I	Code

TRANSMITTER – ELECTRONICS (see opposite page)

E	3	
----------	----------	--

--	--	--	--

--	--	--

3.7.2 E3x for Steam Service - Transmitter Electronics

SIGNAL OUTPUT

S	4-20 mA/HART, SIL 2/3 Certified
----------	---------------------------------

MOUNTING TEMPERATURE

Integral Mount		
	Maximum Process Temperature	Use with Specific Gravity and Process Temperature codes (4th Digit):
1	+300 °F (+150 °C)	K
2	+301 to +450 °F (+151 to +230 °C)	B, N
3	+451 to +500 °F (+231 to +260 °C)	E
Remote Mount ^⑥		
	Maximum Process Temperature	Use with Specific Gravity and Process Temperature codes (4th Digit):
4	+300 °F (+150 °C)	K
5	+301 to +450 °F (+151 to +230 °C)	B, K, N
6	+451 to +500 °F (+231 to +260 °C)	E, N
8	+501 to +800 °F (+261 to +427 °C)	E, N ^⑦

^⑥ Cable for remote mounting transmitter is 037-3226-xxx up to +400 °F (+204 °C) and 037-3227-xxx (Belden 88777) above +400 °F (+204 °C) where -xxx is the length in feet from 10 (-010) to 400 (-400) feet.

^⑦ 4th digit N with 9th digit 8 has a maximum temperature of +700 °F (+371 °C)

HOUSING MATERIAL/CONDUIT ENTRY/APPROVAL

Housing Material/Conduit Entry/Approval	9 th Digit
1 Cast aluminum, FM/CSA XP, 3/4" NPT	1,2,3,4,5,6,8
2 Cast aluminum, FM XP, M20	
3 Cast stainless steel, FM/CSA XP, 3/4" NPT	
4 Cast stainless steel, FM XP, M20	
5 Cast aluminum, FM/CSA IS, 3/4" NPT	
6 Cast aluminum, FM IS, M20	
7 Cast stainless steel, FM/CSA IS, 3/4" NPT	
8 Cast stainless steel, FM IS, M20	
A Cast aluminum, ATEX/IEC IS, 3/4" NPT	1,2,3,4,5,6,8 ^⑧
B Cast aluminum, ATEX/IEC IS, M20	
C Cast stainless steel, ATEX/IEC IS, 3/4" NPT	
D Cast stainless steel, ATEX/IEC IS, M20	
E Cast aluminum, ATEX/IEC XP, 3/4" NPT	
F Cast aluminum, ATEX/IEC XP, M20	
G Cast stainless steel, ATEX/IEC XP, 3/4" NPT	
H Cast stainless steel, ATEX/IEC XP, M20	

^⑧ 9th digit = 8 applies to ATEX only

E3X-XXXX (see previous page)



Glossary

Accuracy The closeness of agreement between the result of measurement and the true value of the measure (inaccuracy equals the maximum positive and negative % deviation over the total span).

ANSI *American National Standards Institute.*

ATEX *ATmospheres EXplosive* European regulations governing the use of equipment installed in hazardous locations.

CE *Conformité Européene* Standards and performance criteria for the new European Union.

CSA *Canadian Standards Association* Canadian, third party agency that qualifies the safety of electrical equipment.

Damping The imposed delay between level change and the corresponding output signal change; often used to smooth unwanted output variations.

Default Screens The initial position of the menu structure that displays the primary measurement values of Level/IfcLevel/SpecGrav, %Output, Loop and to which it returns after 5 minutes of inactivity.

Diagnostics Three levels of error messages; Fault, Warning and Information.

Displacer A sensing element that is heavier than the liquid in which it is used and provides the volume necessary to vary the buoyancy force acting on the unit.

DVM/DMM Digital Volt Meter/Digital Multimeter.

Electromagnetic Energy The radiation that travels through space as electric and magnetic fields varying with position and time. Examples in increasing frequency: radio waves, microwave, infrared light, visible light, ultraviolet light, x-rays, gamma waves, and cosmic waves.

EM See *Electromagnetic Energy.*

EMI *Electromagnetic Interference* Electrical noise caused by electromagnetic fields that may affect electrical circuits, particularly low-power electronic devices.

EN *European Normal* Committee guidelines in EC countries that take precedence over local and/or country guidelines.

Enclosing Tube Non-flexing pressure boundary component that isolates the process from the electronics.

ENV Preliminary EN guidelines, or pre-standards.

ESD Electrostatic Discharge The release of stationary electrical energy which can cause damage to electronic components.

Explosion-Proof Enclosure An enclosure designed to withstand an explosion of gas or vapor within it and prevent the explosion from spreading outside the enclosure.

Factory Sealed A third-party-approved Explosion Proof seal installed in the unit during manufacturing. This alleviates the end user from installing an external XP seal adjacent (within 18") to the device.

Fault The highest level in the hierarchy of diagnostics annunciating a defect or failure in circuitry or software that preclude reliable measurement. The current (mA) value unit defaults to 3.6, 22, or Hold and a message is displayed on the rotating screen. Further information can be obtained by viewing the Status or Diagnostic (Factory Menu) screens.

Feedthrough A small connecting cavity between the main housing compartments, carrying the cable that supplies the operating energy to the measurement circuitry and returns the output value proportional to the level.

FM *Factory Mutual* American, third party agency that qualifies the safety of electrical equipment.

Four Wire An electronic instrument design that uses one set of wires to supply power (120/240 VAC, 24 VDC) and another set to carry the process measurement signal (4–20 mA). Also called *Line Powered.*

FSK Frequency Shift Keying.

Ground An electrical connection to the Earth's potential that is used as a reference for the system and electrical safety.

Grounded A state where no electrical potential exists between the ground (green) connection on the transmitter and the Earth or system ground.

HART *Highway Addressable Remote Transducer.* Protocol that uses the Bell 202 frequency shift keying (FSK) method to superimpose low level frequencies (1200/2000 Hz) on top of the standard 4–20 mA loop to provide digital communication.

HART ID See *Poll Address.*

Hazardous Area An area where flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

IEC *International Electrotechnical Commission* Organization that sets international standards for electrical devices.

Increased Safety Designs and procedures that minimize sparks, arcs, and excessive temperatures in hazardous areas. Defined by the IEC as Zone 1 environments (Ex e).

Inductor A coil across which a voltage is induced as a result of the variation of the current through the coil.

Information (message) The lowest level in the hierarchy of diagnostic conditions providing operational factors that are not critical to measurement. Further information can be obtained by viewing the Status or Diagnostic (Factory Menu) screens.

Interface: Electrical A boundary between two related, electronic circuits.

Interface: Process A boundary between two or more immiscible liquids.

Intrinsically Safe Ground A very low resistance connecting to a ground, in accordance with the National Electrical Code (NEC, ANSI/NFPA 70 for FMRC), the Canadian Electrical Code (CEC for CSA), or the local inspector.

Intrinsic Safety A design or installation approach that limits the amount of energy that enters a hazardous area to eliminate the potential of creating an ignition source.

Level The present reading of the height of material in a vessel.

Linearity The worst case error calculated as a deviation from a perfect straight line drawn between two calibration points.

Line Powered See *Four Wire*.

Loop The present reading of the 4–20 mA current output.

Loop Powered See *Two Wire*.

Loop Resistance The total value of the resistance in a two-wire loop including equipment and wiring.

Low Voltage Directive A European Community requirement for electrical safety and related issues of devices using 50–1000 VDC or 75–1500 VAC.

LVDT *Linear Variable Differential Transformer* This is the mechanism by which the Electronic MODULELEVEL measures liquid level. This type of transformer compares the currents induced in two secondary windings to determine the position of the transformer core and, therefore, the liquid level.

Measured Value The typical measurement values used to track the level of a process: Level, % Output and Loop.

Media The liquid material being measured by the level transmitter.

Multidrop The ability to install, wire, or communicate with multiple devices over one cable. Each device is given a unique address and ID.

Non-hazardous Area An area where no volatile mixtures of vapors/gas and oxygen will be found at any time. *Also called General Purpose Area.*

Non-incendive A circuit in which any arc or thermal effect produced, under intended operating conditions of the equipment or due to opening, shorting, or grounding of field wiring, is incapable, under specific test conditions, of igniting the flammable gas, vapor, or dust-air mixture.

Password A numerical value between 0 and 255 that protects stored configuration data from unauthorized manipulation.

Percent (%) Output The present reading as a fraction of the 16mA scale (4–20mA).

Poll Address (HART ID) A number between 1 and 15 which sets an address or location of a device in a multi-drop loop. Poll address for single device configuration is 0.

Primary Winding The inductor within a transformer to which the voltage source is connected and which, as a result, produces the magnetic field.

QuickStart The essential information needed for the E3 MODULELEVEL to be installed, wired and calibrated.

Range The maximum value to which the control may sense level. In the case of the MODULELEVEL, this value is limited to the physical size of the displacer.

Repeatability The maximum error between two or more output readings of the same process condition.

RFI *Radio Frequency Interference* Electrical noise that can have an adverse affect on electrical circuits, particularly low-power devices.

Secondary Winding The inductor within a transformer in which current is induced by the magnetic field of the primary winding.

Span The whole or some portion of difference between the upper and lower limits of the range, which is chosen by the user.

Specific Gravity (SG) The ratio of the density of a material to the density of water at the same conditions.

Status The current state of the transmitter's diagnostics; screen updates every 10 seconds.

Stilling Well A device, usually a tube or pipe, which encloses the sensing element of a level control in order to protect it from and minimize the effects of turbulence in the vessel. To ensure that the level in the well is identical to that outside the well, it must have vent holes included near the top to allow escape of vapor trapped above the liquid level.

Transformer An electrical device which transfers electrical energy from a primary winding to one or more secondary windings by magnetic induction (no electrical contact)

Trim 4/Trim 20 Built-in system capability to fine tune the 4 mA and 20 mA points so the transmitter output corresponds exactly to user's meter, DCS input, etc.

Two Wire An electrical instrument design that uses one set of wires to provide both the supply power and process measurement signal. The process measurement is achieved by varying the current of the loop. Also called *Loop Powered*.

Units The engineering units used to measure the level in the system.

Warning (message) The second level in the hierarchy of Diagnostics annunciating conditions that are not fatal but may affect measurement. A message will occur on the main (rotating) screen when a Warning is detected but will not affect output current. Further information can be obtained by viewing the Status or Diagnostic screens.

Service Policy

Owners of MAGNETROL controls may request the return of a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Controls returned under our service policy must be returned by Prepaid transportation. MAGNETROL will repair or replace the control at no cost to the purchaser (or owner) other than transportation if:

1. Returned within the warranty period; and
2. The factory inspection finds the cause of the claim to be covered under the warranty.

If the trouble is the result of conditions beyond our control; or, is NOT covered by the warranty, there will be charges for labor and the parts required to rebuild or replace the equipment.

In some cases it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned will be determined on the basis of the applicability of our warranty.

No claims for misapplication, labor, direct or consequential damage will be allowed.

For Technical Support contact one of the offices listed below.

Return Material Procedure

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" (RMA) number be obtained from the factory, prior to the material's return. This is available through a MAGNETROL local representative or by contacting the factory. Please supply the following information:

1. Company Name
2. Description of Material
3. Serial Number
4. Reason for Return
5. Application

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 accompany material that was used in any media.

All shipments returned to the factory must be by prepaid transportation.

All replacements will be shipped F.O.B. factory.

NOTE: See Electrostatic Discharge Handling Procedure on page 7.

NOTE: If unit needs to be returned, the displacer must be secured to prevent damage in transit.



705 Enterprise Street • Aurora, Illinois 60504-8149 • 630-969-4000
info@magnetrol.com • www.magnetrol.com

Copyright © 2017 Magnetrol International, Incorporated

Magnetrol, Magnetrol logotype and Moduleval are registered trademarks of Magnetrol International, Incorporated.
CSA logotype is a registered trademark of Canadian Standards Association.
HART is a registered trademark of the HART Communication Foundation.
Inconel is a registered trademark of Special Metals Corporation.
Teflon is a registered trademark of DuPont.

BULLETIN: 48-635.9

EFFECTIVE: October 2017

SUPERSEDES: August 2017