

ECHOTEL[®]

Model 961/962

Installation and Operating Manual



Model 961



Model 962

*Ultrasonic
Single and
Dual Point
Level Switches*

Read this Manual Before Installing

This manual provides information on the Echotel® Models 961 and 962 Ultrasonic Liquid Level Switches. It is important that all instructions are read carefully and followed in sequence. Detailed instructions are included in the Installation section of this manual.

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

Echotel Models 961 & 962 are designed for use in Category II, Pollution Degree 2 installations. 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.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

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 Category II installations. If equipment is used in a manner not specified by manufacturer, protection provided by equipment may be impaired.

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All Magnetrol/STI electronic level and flow products are warranted free of defects in materials or workmanship for one full year 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/STI will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

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Echotel Model 961 & 962 Ultrasonic Single and Dual Point Liquid Level Switches

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1.0 Introduction

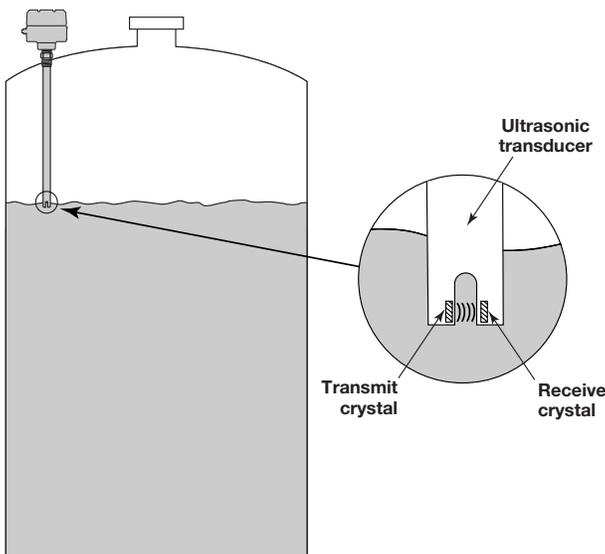
Echotel Model 961 and 962 ultrasonic level switches utilize pulsed signal technology to detect high, low, or dual point level in a broad range of liquid media applications.

Model 961 is a single point level switch. Model 962 is a dual point switch used as a level controller or to control pumps in an auto-fill or auto-empty mode.

1.1 Principle of Operation

Model 961/962 switches utilize ultrasonic energy to detect the presence or absence of liquid in a single or dual point transducer. Ultrasonic contact level technology uses high-frequency sound waves that are easily transmitted across a transducer gap (see Figure 1) in the presence of a liquid media, but are attenuated when the gap is dry. Model 961/962 switches use an ultrasonic frequency of 2 MHz to perform this liquid level measurement in a wide variety of process media and application conditions.

The transducer uses a pair of piezoelectric crystals that are encapsulated in epoxy at the tip of the transducer. The crystals are made of a ceramic material that vibrates at a given frequency when subjected to an applied voltage. The transmit crystal converts the applied voltage from the electronics into an ultrasonic signal. When liquid is present in the gap, the receive crystal senses the ultrasonic signal from the transmit crystal and converts it back to an electrical signal. This signal is sent to the electronics to indicate the presence of liquid in the transducer gap. When there is no liquid present, the ultrasonic signal is attenuated and is not detected by the receive crystal.



Ultrasonic signal transmission
across transducer gap

Figure 1

2.0 Installation

2.1 Unpacking

Unpack the instrument carefully. Inspect all units for damage. Report any concealed damage to carrier within 24 hours. Check the contents of the packing slip and purchase order. Check and record the serial number for future reference when ordering parts.

serial number

2.2 Electrostatic Discharge (ESD) Handling Procedure



Magnetrol's electronic instruments are manufactured to the highest quality standards. These instruments use electronic components that 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.
- Make sure that all electrical connections are completely made and none are partial or floating. Ground all equipment to a good, earth ground.

2.3 Mounting

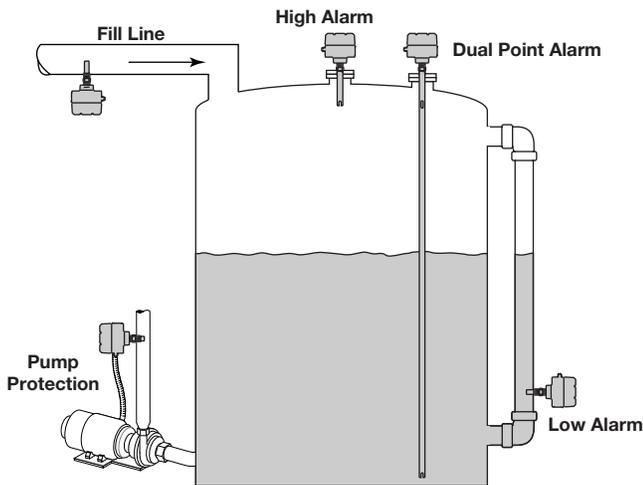


Figure 2
Typical Mounting Orientations

The Model 961 level switch may be mounted in a variety of positions as shown in Figures 2 through 5. Model 962 is always mounted vertically.

Proper orientation of the transducer gap will facilitate maximum performance in difficult applications. When the Model 961 is mounted horizontally, the transducer gap must be turned vertical to allow proper drainage of liquid out of the gap. The wrench flats on the mounting nut are aligned with the transducer gap; therefore, proper transducer mounting can be achieved by aligning the mounting nut flats in a vertical orientation. See Figure 4.

When installing a Model 961 switch in a nozzle or pipe, the transducer gap must extend into the tank at least one inch beyond the inside tank wall. Refer to Figure 5.

Screw transducer into the opening using a wrench on the transducer mounting nut flats. If flanged, bolt unit to mating flange with proper gasket. Use thread tape or suitable pipe compound on the threads. Do not over-tighten.

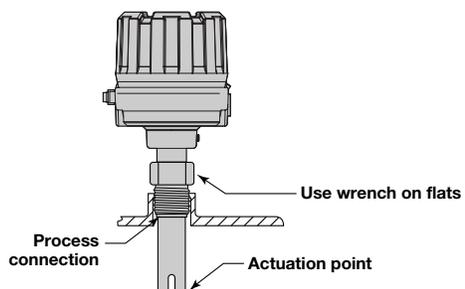


Figure 3
Vertical Mounting

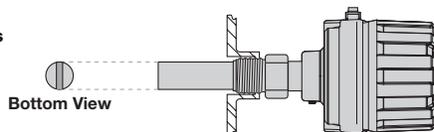


Figure 4
Horizontal Mounting

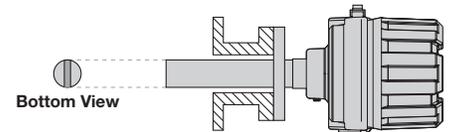


Figure 5
Nozzle Mounting

2.4 Wiring

Wiring for Model 961/962 level switches is different for all four versions. These switches are available as 4-wire, line-powered units with a relay, or as 2-wire loop-powered units with mA current shift output. Determine which version you have from the table below and proceed to the proper wiring section.

Model	Input	Output	Wiring Information
961	Line-powered	5 amp relays	<i>Proceed to section 2.4.1</i>
961	Loop-powered	Current shift	<i>Proceed to section 2.4.2</i>
962	Line-powered	5 amp relays	<i>Proceed to section 2.4.3</i>
962	Loop-powered	Current shift	<i>Proceed to section 2.4.4</i>

2.4.1 Model 961 Line-powered Wiring

Power and relay wiring connections are suitable for 12–24 AWG wire.

Caution: OBSERVE ALL APPLICABLE ELECTRICAL CODES AND PROPER WIRING PROCEDURES.

1. Make sure the power source is turned off.
2. Unscrew and remove housing cover.
3. Pull power supply and relay wires through the conduit connection.
4. Refer to Figure 6. Connect power leads to proper terminals. Model 961 is available for AC power (102 to 265 VAC) or for DC power (18–32 VDC)
 - a. AC Power – Connect “hot” wire to terminal marked L1 and the “neutral” wire to the terminal marked L2. The green head screw should be used for grounding.
 - b. DC Power – Connect wires to terminals (+) and (-) on the terminal block. The green head screw should be used for grounding.
5. Connect desired relay wiring as shown in Figure 6.
6. Prevent moisture seepage into housing by installing an approved seal drain fitting in the conduit run leading to the unit.
7. Wiring is complete. Replace housing cover.

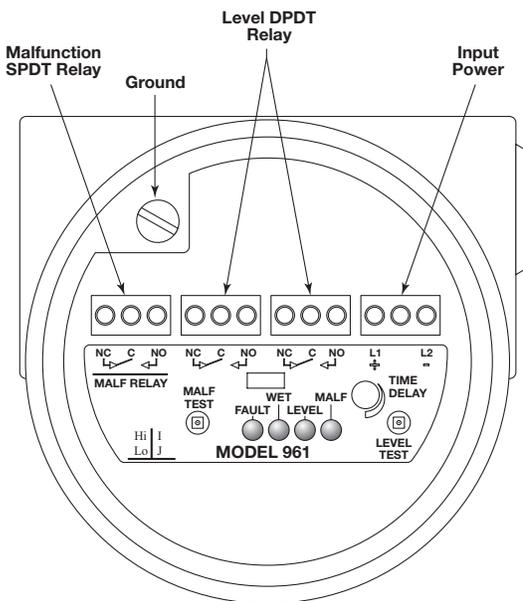


Figure 6
Model 961 Line Power Wiring

Caution: In hazardous areas, do not power the unit until the conduit is sealed and enclosure cover is screwed down securely.

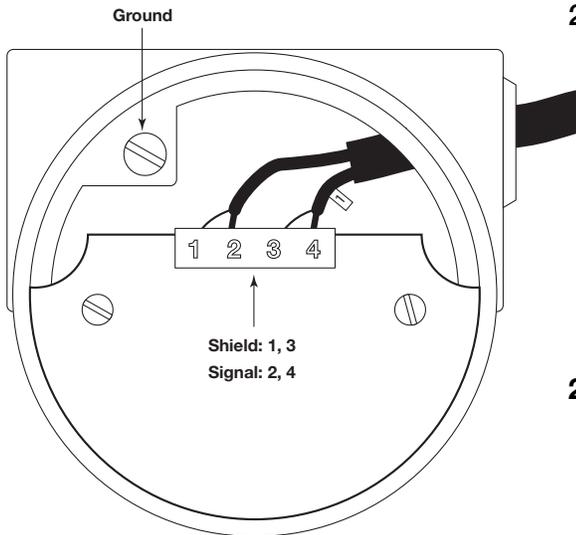


Figure 7
Model 961 Remote Transducer Wiring

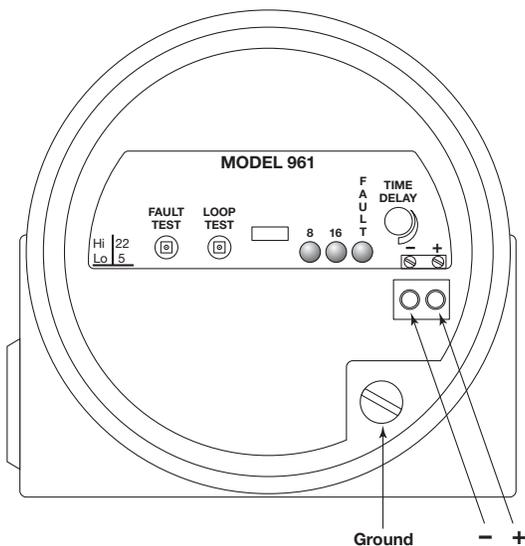


Figure 8
Model 961 Loop Power Wiring

2.4.1.1 Model 961 Remote Transducer Housing Wiring

Remote mount Model 961 units have a “1” in the 8th digit (961-XXXX-1XX) of the model number. The 037-3316-XXX cabling is pre-connected at the factory on the electronics end. The remote transducer housing has terminal blocks labeled as TB1, TB2, and TB3. Wiring from the transducer is pre-connected at TB1. Connect the 037-3316-XXX wires to TB2 and TB3 as shown in Figure 7.

2.4.2 Model 961 Loop-powered Wiring

For intrinsically safe installations, refer to the Agency Drawing in Section 3.6.1. Loop wiring connections are suitable for 12–24 AWG wire.

Caution: OBSERVE ALL APPLICABLE ELECTRICAL CODES AND PROPER WIRING PROCEDURES.

1. Make sure the power source is turned off.
2. Unscrew and remove housing cover.
3. Pull twisted pair wire through the conduit connection.
4. Refer to Figure 8. Connect wires to terminals (+) and (-) on the terminal block. Unshielded cable may be used. If shielded cable is used, attach shield to green head screw.
5. Prevent moisture seepage into housing by installing an approved seal drain fitting in the conduit run leading to the unit.
6. Wiring is complete. Replace housing cover.

Caution: In hazardous areas, do not power the unit until the conduit is sealed and enclosure cover is screwed down securely.

2.4.2.1 Model 961 Remote Transducer Housing Wiring

Remote mount Model 961 units have a “1” in the 8th digit (961-XXXX-1XX) of the model number. The 037-3316-XXX cabling is pre-connected at the factory on the electronics end. The remote transducer housing has terminal blocks labeled as TB1, TB2, and TB3. Wiring from the transducer is pre-connected at TB1. Connect the 037-3316-XXX wires to TB2 and TB3 as shown in Figure 7.

2.4.3 Model 962 Line-powered Wiring

Power and relay wiring connections are suitable for 12–24 AWG wire.

Caution: OBSERVE ALL APPLICABLE ELECTRICAL CODES AND PROPER WIRING PROCEDURES.

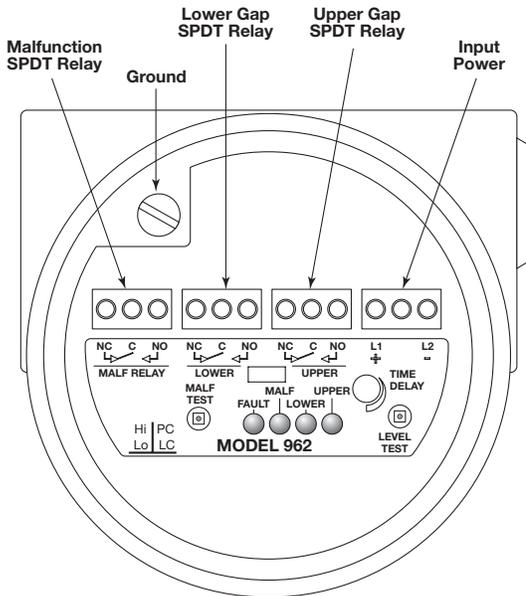


Figure 9
Model 962 Line Power Wiring

1. Make sure the power source is turned off.
2. Unscrew and remove housing cover.
3. Pull power supply and relay wires through the conduit connection.
4. Refer to Figure 9. Connect power leads to proper terminals. Model 962 is available for AC power (102 to 265 VAC) or for DC power (18–32 VDC)
 - a. AC Power – Connect “hot” wire to terminal marked L1 and the “neutral” wire to the terminal marked L2. The green head screw should be used for grounding.
 - b. DC Power – Connect wires to terminals (+) and (-) on the terminal block. The green head screw should be used for grounding.
5. Connect desired relay wiring as shown in Figure 9.
6. Prevent moisture seepage into housing by installing an approved seal drain fitting in the conduit run leading to the unit.
7. Wiring is complete. Replace housing cover.

Caution: In hazardous areas, do not power the unit until the conduit is sealed and enclosure cover is screwed down securely.

2.4.3.1 Model 962 Remote Transducer Housing Wiring

Remote mount Model 962 units have a “1” in the 8th digit (962-XXXX-1XX) of the model number. The 037-3316-XXX cabling is pre-connected at the factory on the electronics end. The remote transducer housing has terminal blocks labeled as TB1, TB2, TB3, TB4 and TB5. Wiring from the transducer is pre-connected at TB1. Connect the 037-3316-XXX wires to TB2, TB3, TB4 and TB5 as shown in Figure 10.

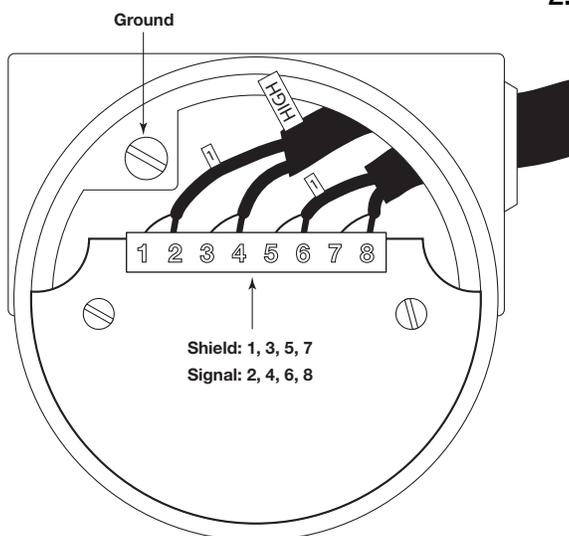


Figure 10
Model 962 Remote Transducer Wiring

2.4.4 Model 962 Loop-powered Wiring

For intrinsically safe installations, refer to the Agency Drawing in Section 3.6.1. Loop wiring connections are suitable for 12–24 AWG wire.

Caution: OBSERVE ALL APPLICABLE ELECTRICAL CODES AND PROPER WIRING PROCEDURES.

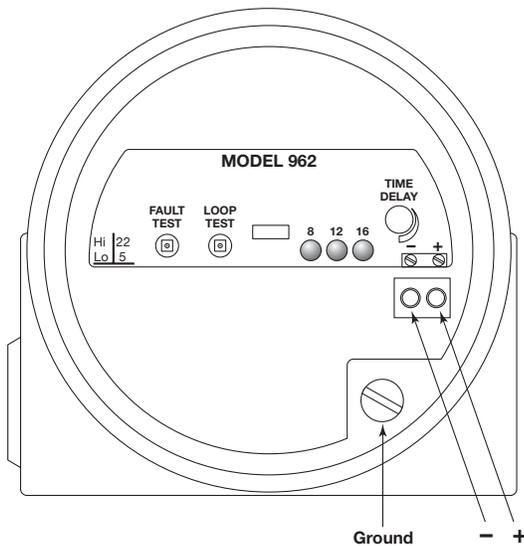


Figure 11
Model 962 Loop Power Wiring

1. Make sure the power source is turned off.
2. Unscrew and remove housing cover.
3. Pull twisted pair wire through the conduit connection.
4. Refer to Figure 11. Connect wires to terminals (+) and (-) on the terminal block. Unshielded cable may be used. If shielded cable is used, attach shield to green head screw.
5. Prevent moisture seepage into housing by installing an approved seal drain fitting in the conduit run leading to the unit.
6. Wiring is complete. Replace housing cover.

Caution: In hazardous areas, do not power the unit until the conduit is sealed and enclosure cover is screwed down securely.

2.4.4.1 Model 962 Remote Transducer Housing Wiring

Remote mount Model 962 units have a “1” in the 8th digit (962-XXXX-1XX) of the model number. The 037-3316-XXX cabling is pre-connected at the factory on the electronics end. The remote transducer housing has terminal blocks labeled as TB1, TB2, TB3, TB4 and TB5. Wiring from the transducer is pre-connected at TB1. Connect the 037-3316-XXX wires to TB2, TB3, TB4 and TB5 as shown in Figure 10.

2.5 Configuration

2.5.1 Model 961 Line-powered Configuration

Model 961 line-powered units have the following configuration options:

- TIME DELAY potentiometer for 0.5 to 45 second signal averaging
- LEVEL TEST pushbutton for testing of the DPDT process level alarm
- MALF TEST pushbutton for testing of the SPDT malfunction alarm
- Hi/Lo DIP switch for fail-safe high or low level selection
- I/J DIP switch for independent or joint operation of the relays

2.5.1.1 Time Delay Potentiometer

The time delay potentiometer is typically used in applications where turbulence or splashing may cause false level alarms. This is a 25-turn pot with a factory default setting of 0.5 seconds. If desired, this pot may be turned clockwise to increase the response time from the standard 0.5 seconds to a maximum of 45 seconds. Turning the pot counter-clockwise decreases the time delay.

The WET LED is not influenced by the time delay pot. As an example, turning the pot clockwise several turns will put a time delay into the 961. Immersing the tip of the transducer in water with the Hi/Lo switch in the Hi position, will produce the following results:

- WET LED will immediately be lit
- After the time delay the LEVEL LED will go dark and the DPDT process level relay will de-energize

When removing the tip of the transducer from the water the WET LED will immediately go dark. After the time delay the LEVEL LED will light and DPDT process level relay will energize.

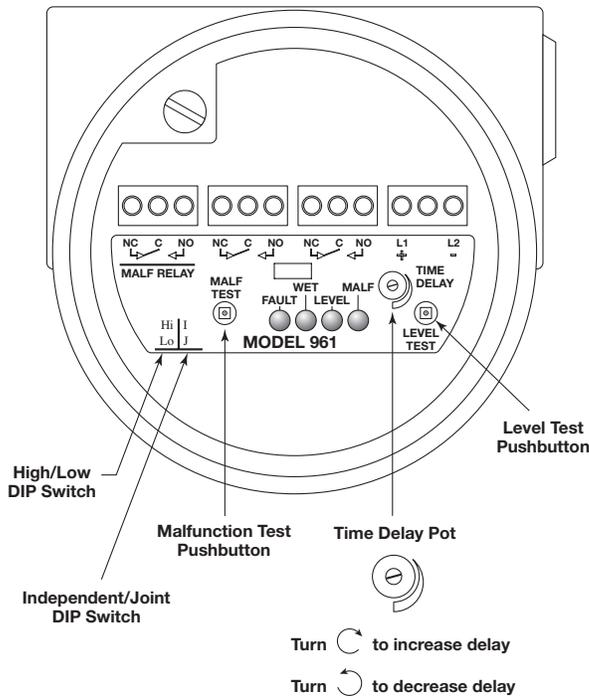


Figure 12

Model 961 Line Power Configuration

2.5.1.2 Level Test Pushbutton

The level test pushbutton is used to manually test the DPDT process level relay. Pressing this pushbutton reverses the state of the DPDT relay, from energized to de-energized or vice-versa. This can be used to manually test the relay, and whatever is connected to this relay. The time delay pot does not affect the operation of the level test pushbutton.

2.5.1.3 Malfunction Test Pushbutton

The malfunction test pushbutton is used to manually test the SPDT malfunction relay. Pressing and holding this pushbutton for 2 seconds will cause the SPDT relay to de-energize indicating a fault condition. This can be used to manually test the relay, and whatever is connected to this relay. The time delay pot does not affect the operation of the malfunction pushbutton.

NOTE: Under normal operating conditions the red fault LED is dark and the green malfunction LED is lit, indicating that the malfunction relay is energized. Should a fault condition occur, the red fault LED is lit and the green malfunction LED is dark, indicating that the malfunction relay is de-energized.

2.5.1.4 High/Low DIP Switch

The Hi/Lo DIP switch selects whether the 961 will be used as high level fail-safe switch or low level fail-safe switch. The table assists in configuring the Hi/Lo DIP switch.

Fault and Malfunction LED Indication

Operating Condition	Red Fault LED	Green Malfunction LED
Normal	Dark	Lit
Fault	Lit	Dark

High/Low DIP Switch Configuration

(Model 961 Line-powered)

Hi/Lo DIP	Gap Condition	WET LED	LEVEL LED
Hi	Dry	Dark	Lit
Hi	Wet	Lit	Dark
Lo	Dry	Dark	Dark
Lo	Wet	Lit	Lit

2.5.1.5 Independent/Joint DIP Switch

The I/J DIP switch is used to configure whether the SPDT malfunction relay acts independently or jointly with the DPDT process level relay. The factory default is for this switch to be in the “I” position, where the relays act totally independent of each other. If this DIP switch is in the “J” position, both the SPDT malfunction relay and the DPDT process relay will de-energize when a fault is detected.

2.5.2 Model 961 Loop-powered Configuration

Model 961 loop-powered units have the following configuration options:

- TIME DELAY potentiometer for 0.5 to 45 second signal averaging
- LOOP TEST pushbutton for testing the 8/16 mA loop output
- FAULT TEST pushbutton for testing the 5 or 22 mA fault output
- Hi/Lo DIP switch for fail-safe high or low level selection
- 22/5 DIP switch to select the fault mA current output

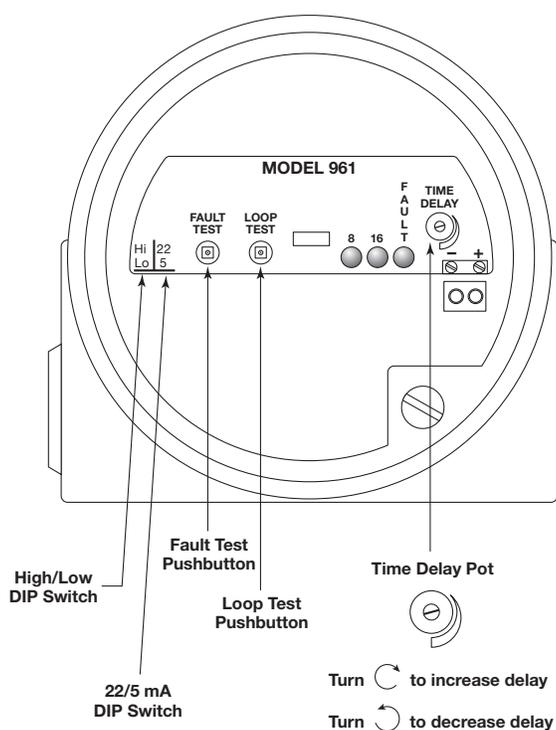


Figure 13
Model 961 Loop Power Configuration

2.5.2.1 Time Delay Potentiometer

The time delay potentiometer is typically used in applications where turbulence or splashing may cause false level alarms. This is a 25-turn pot with a factory default setting of 0.5 seconds. If desired, this pot may be turned clockwise to increase the response time from the standard 0.5 seconds to a maximum of 45 seconds. Turning the pot counter-clockwise decreases the time delay.

2.5.2.2 Loop Test Pushbutton

The loop test pushbutton is used to manually test the loop current output. Pressing the LOOP TEST pushbutton reverses the output from 8 mA to 16 mA or from 16 mA to 8 mA. This can be used to manually test the loop output and whatever is connected to the 961. The time delay pot does not affect the operation of the loop test pushbutton.

2.5.2.3 Fault Test Pushbutton

The FAULT TEST pushbutton is used to manually force the 961 to the mA value that is selected at the 22/5 DIP switch. Pressing this pushbutton for 2 seconds will simulate a circuit test failure. This causes the output to go to the selected fault current of either 22 or 5 mA, and the red FAULT LED will light. The time delay pot does not affect the operation of the malfunction pushbutton.

NOTE: Fault current will be greater than 21 mA, or less than 3.6 mA.

High/Low DIP Switch Configuration (Model 961 Loop-powered)

Hi/Lo DIP	Gap Condition	8 mA LED	16 mA LED	Fault LED
Hi	Dry	Lit	Dark	Dark
Hi	Wet	Dark	Lit	Dark
Lo	Dry	Dark	Lit	Dark
Lo	Wet	Lit	Dark	Dark

2.5.2.4 High/Low DIP Switch

The Hi/Lo DIP switch is used to select whether the 961 will be used as high level fail-safe switch or low level fail-safe switch. Normal process level operation produces an 8 mA value, and 16 mA is produced when the unit is in a level alarm state. The table can be used to assist in configuring the Hi/Lo DIP switch.

2.5.2.5 22/5 DIP Switch

The 22/5 DIP switch is used to select whether the 961 will produce a 22 mA or a 5 mA output when the unit detects a fault condition.

NOTE: Fault current will be greater than 21 mA, or less than 3.6 mA.

2.5.3 Model 962 Line-powered Configuration

Model 962 line-powered units have the following configuration options:

- TIME DELAY potentiometer for 0.5 to 45 second signal averaging
- LEVEL TEST pushbutton for testing of the SPDT process level relays
- MALF TEST pushbutton for testing of the SPDT malfunction relay
- Hi/Lo DIP switch for fail-safe high or low level selection
- PC/LC DIP switch for level control or pump control operation

2.5.3.1 Time Delay Potentiometer

The time delay potentiometer is typically used in applications where turbulence or splashing may cause false level alarms. This is a 25-turn pot with a factory default setting of 0.5 seconds. If desired, this pot may be turned clockwise to increase the response time from the standard 0.5 seconds to a maximum of 45 seconds. Turning the pot counterclockwise decreases the time delay.

2.5.3.2 Level Test Pushbutton

The level test pushbutton is used to manually test both of the SPDT process level relays. Pressing this pushbutton reverses the state of both SPDT process level relays, from energized to de-energized or vice-versa. This can be used to manually test these relays, and whatever is connected to them. The time delay pot does not affect the operation of the level test pushbutton.

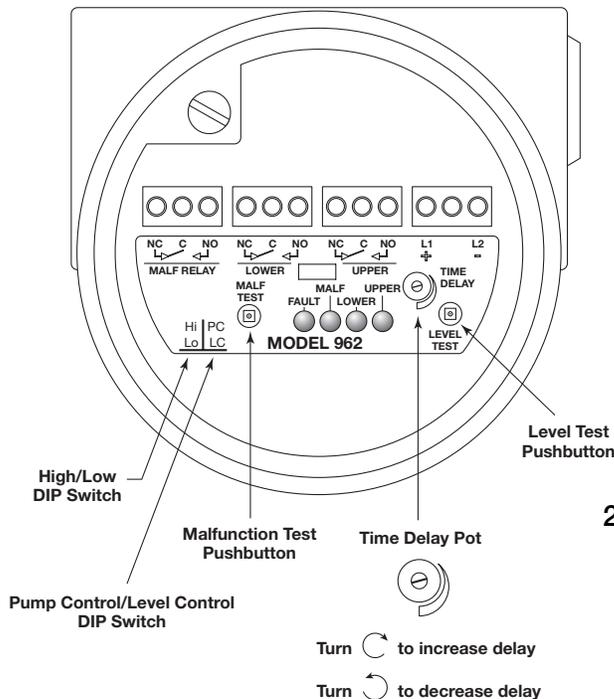


Figure 14

Model 962 Line Power Configuration

2.5.3.3 Malfunction Test Pushbutton

Fault and Malfunction LED Indication

Operating Condition	Red Fault LED	Green Malfunction LED
Normal	Dark	Lit
Fault	Lit	Dark

The malfunction test pushbutton is used to manually test the SPDT malfunction relay. Pressing and holding this pushbutton for 2 seconds will cause the SPDT relay to de-energize, indicating a fault condition. This can be used to manually test the relay, and whatever is connected to this relay. The time delay pot does not affect the operation of the malfunction pushbutton.

NOTE: Under normal operating conditions the red fault LED is dark and the green malfunction LED is lit, indicating that the malfunction relay is energized. Should a fault condition occur, the red fault LED is lit and the green malfunction LED is dark, indicating that the malfunction relay is de-energized.

2.5.3.4 High/Low DIP Switch

The Hi/Lo DIP switch is used to select whether the 962 will be used as high level fail-safe switch or low level fail-safe switch. The setting of the Hi/Lo DIP also affects how the PC/LC DIP switch configures the unit. Read Section 2.5.3.5 below and then proceed to the table in Section 2.5.3.6 for proper setting of these two DIP switches.

2.5.3.5 PC/LC DIP Switch

The PC/LC DIP switch is used to select whether the 962 will operate in a pump control or a level control mode. Select LC to use the 962 as a level controller where the relays operate independently of each other. Select PC to operate the 962 as a pump controller where the relays latch to enable an auto fill or auto empty mode.

The configuration tables on page 11 (Section 2.5.3.6) are used for proper setting of the Hi/Lo and PC/LC DIP switches, and also indicates the status of the yellow LOWER and UPPER LEDs. The green MALF (malfunction) LED and the red FAULT LEDs are purposely not included in this table.

2.5.3.6 PC/LC and Hi/Lo DIP Switch Configuration Tables

Fail-safe High Level Control Configuration

DIP Switches		Gap Condition		Lower Gap		Upper Gap	
PC/LC	Hi / Lo	Lower	Upper	Relay	LED	Relay	LED
LC	Hi	Dry	Dry	energized	On	energized	On
LC	Hi	Wet	Dry	de-energized	Off	energized	On
LC	Hi	Wet	Wet	de-energized	Off	de-energized	Off

Fail-safe Low Level Control Configuration

DIP Switches		Gap Condition		Lower Gap		Upper Gap	
PC/LC	Hi / Lo	Lower	Upper	Relay	LED	Relay	LED
LC	Lo	Dry	Dry	de-energized	Off	de-energized	Off
LC	Lo	Wet	Dry	energized	On	de-energized	Off
LC	Lo	Wet	Wet	energized	On	energized	On

Fail-safe High Pump Control Configuration (typical operating sequence)

DIP Switches		Gap Condition		Lower Gap		Upper Gap	
PC/LC	Hi / Lo	Lower	Upper	Relay	LED	Relay	LED
PC	Hi	Dry	Dry	energized	On	energized	On
PC	Hi	Wet	Dry	energized	On	energized	On
PC	Hi	Wet	Wet	de-energized	Off	de-energized	Off
PC	Hi	Wet	Dry	de-energized	Off	de-energized	Off
PC	Hi	Dry	Dry	energized	On	energized	On

Fail-safe Low Pump Control Configuration (typical operating sequence)

DIP Switches		Gap Condition		Lower Gap		Upper Gap	
PC/LC	Hi / Lo	Lower	Upper	Relay	LED	Relay	LED
PC	Lo	Dry	Dry	de-energized	Off	de-energized	Off
PC	Lo	Wet	Dry	de-energized	Off	de-energized	Off
PC	Lo	Wet	Wet	energized	On	energized	On
PC	Lo	Wet	Dry	energized	On	energized	On
PC	Lo	Dry	Dry	de-energized	Off	de-energized	Off

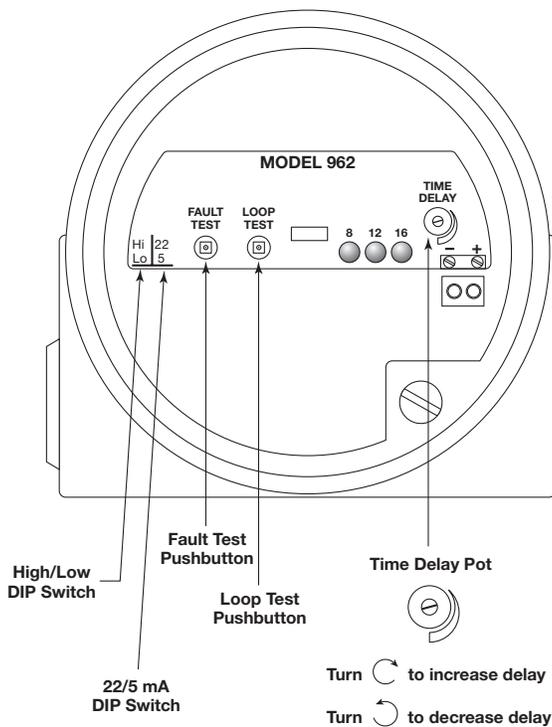


Figure 15
Model 962 Loop Power Configuration

2.5.4 Model 962 Loop-powered Configuration

Model 962 loop-powered units have the following configuration options:

- TIME DELAY potentiometer for 0.5 to 45 second signal averaging
- LOOP TEST pushbutton for testing the 8/12/16 mA loop output
- FAULT TEST pushbutton for testing the 5 or 22 mA fault output
- Hi/Lo DIP switch for fail-safe high or low level selection
- 22/5 DIP switch to select the fault mA current output

2.5.4.1 Time Delay Potentiometer

The time delay potentiometer is typically used in applications where turbulence or splashing may cause false level alarms. This is a 25-turn pot with a factory default setting of 0.5 seconds. If desired, this pot may be turned clockwise to increase the response time from the standard 0.5 seconds to a maximum of 45 seconds. Turning the pot counterclockwise decreases the time delay.

2.5.4.2 Loop Test Pushbutton

The loop test pushbutton is used to manually test the loop current output. Pressing the LOOP TEST pushbutton will force the output from 8 mA to 12 mA, 12 mA to 16 mA, or 16 mA to 8 mA. This can be used to manually test the loop output and whatever is connected to the 962. The time delay pot does not affect the operation of the loop test pushbutton.

2.5.4.3 Fault Test Pushbutton

The FAULT TEST pushbutton is used to manually force the 962 to the mA value that is selected at the 22/5 DIP switch. Pressing this pushbutton for 2 seconds will simulate a circuit test failure. This causes the output to go to the selected fault current of either 22 or 5 mA, and all 3 LEDs will go dark. The time delay pot does not affect the operation of the malfunction pushbutton.

NOTE: Fault current will be greater than 21 mA, or less than 3.6 mA.

2.5.4.4 High/Low DIP Switch

The Hi/Lo DIP switch is used to select whether the 962 will be used as high level fail-safe switch or low level fail-safe switch. Normal process level operation produces an 8 mA value, and 16 mA is produced when the unit is in a level alarm state. The table below can be used to assist in configuring the Hi/Lo DIP switch:

High/Low DIP Switch Configuration
(Model 962 Loop-powered)

Hi/Lo DIP	Lower Gap	Upper Gap	8 mA LED	12 mA LED	16 mA LED
Hi	Dry	Dry	Lit	Dark	Dark
Hi	Wet	Dry	Dark	Lit	Dark
Hi	Wet	Wet	Dark	Dark	Lit
Lo	Dry	Dry	Dark	Dark	Lit
Lo	Wet	Dry	Dark	Lit	Dark
Lo	Wet	Wet	Lit	Dark	Dark

2.5.4.5 22/5 DIP Switch

The 22/5 DIP switch is used to select whether the 962 will produce a 22 mA or a 5 mA output when the unit detects a fault condition.

NOTE: Fault current will be greater than 21 mA or less than 3.6 mA.

3.0 Reference Information

3.1 Electronics Specifications

3.1.1 Model 961/962 with Relay Output

Supply Voltage		102 to 265 VAC, or 18 to 32 VDC
Relay Outputs	961:	One DPDT level relay and one SPDT malfunction relay
	962:	Two SPDT level relays and one SPDT malfunction relay
Relay Ratings	DPDT:	5 amps @ 120 VAC, 250 VAC, and 30 VDC, 0.15 amp @ 125 VDC
	SPDT:	5 amps @ 120 VAC, 250 VAC, and 30 VDC, 0.15 amp @ 125 VDC
Fail-safe		Selectable for high or low level
Power Consumption	961/962:	Less than 3 watts
Ambient Temperature		-40° to +160° F (-40° to +71° C)

3.1.2 Model 961/962 with Current Shift Output

Supply Voltage		11 to 35 VDC
Current Shift Output	Normal Operation:	8 mA
	Level Alarm Condition:	16 mA
	Malfunction:	3.6 mA or 22 mA selectable
Loop Resistance		104 ohms with 11 VDC input, 1100 ohms with 35 VDC input
Fail-safe		Selectable for high or low level
Power Consumption	961/962	Less than 1 watt
Ambient Temperature		-40° to +160° F (-40° to +71° C)

3.2 Transducer Specifications

3.2.1 Model 9A1/9M1 Single Point

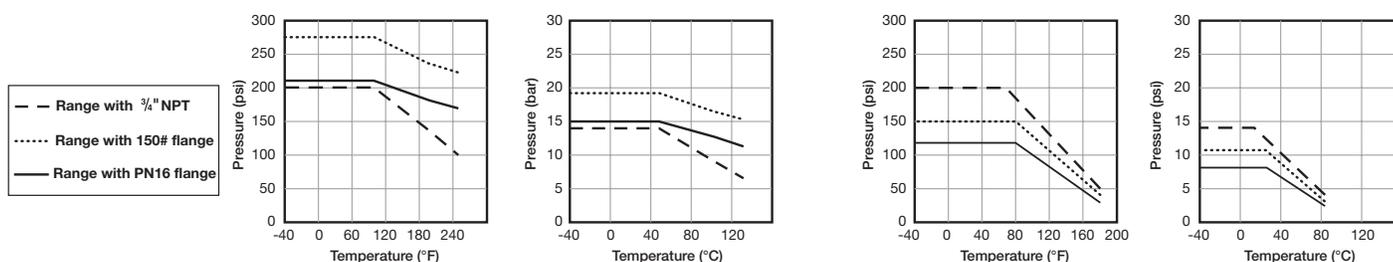
Transducer Material	Material Code (see page 23)	Operating Temperature Range	Maximum Pressure	Actuation Length
316 Stainless Steel	A, S, N, K	-40° to +325° F (-40° to +163° C)	2000 psi (138 bar)	1" and 2" (3 and 5 cm)
316 Stainless Steel	A, S, N, K	-40° to +325° F (-40° to +163° C)	1500 psi (103 bar)	3" to 130" (6 to 330 cm)
Hastelloy C-276	B	-40° to +325° F (-40° to +163° C)	2000 psi (138 bar)	1" and 2" (3 and 5 cm)
Hastelloy C-276	B	-40° to +325° F (-40° to +163° C)	1500 psi (103 bar)	3" to 130" (6 to 330 cm)
Monel	C	-40° to +325° F (-40° to +163° C)	1200 psi (83 bar)	1" to 130" (3 to 330 cm)
Kynar®	R	-40° to +250° F (-40° to +121° C)	see graphs below	2" to 130" (5 to 330 cm)
CPVC	P	-40° to +180° F (-40° to +82° C)	see graphs below	2" to 130" (5 to 330 cm)

3.2.2 Model 9A2/9M2 Dual Point

Transducer Material	Material Code (see page 24)	Operating Temperature Range	Maximum Pressure	Actuation Length
316 Stainless Steel	A, K	-40° to +325° F (-40° to +163° C)	1500 psi (103 bar)	5" to 130" (13 to 330 cm)
CPVC	P	-40° to +180° F (-40° to +82° C)	see graphs below	5" to 130" (13 to 330 cm)

Kynar Transducer Ratings

CPVC Transducer Ratings



3.3 Performance Specifications

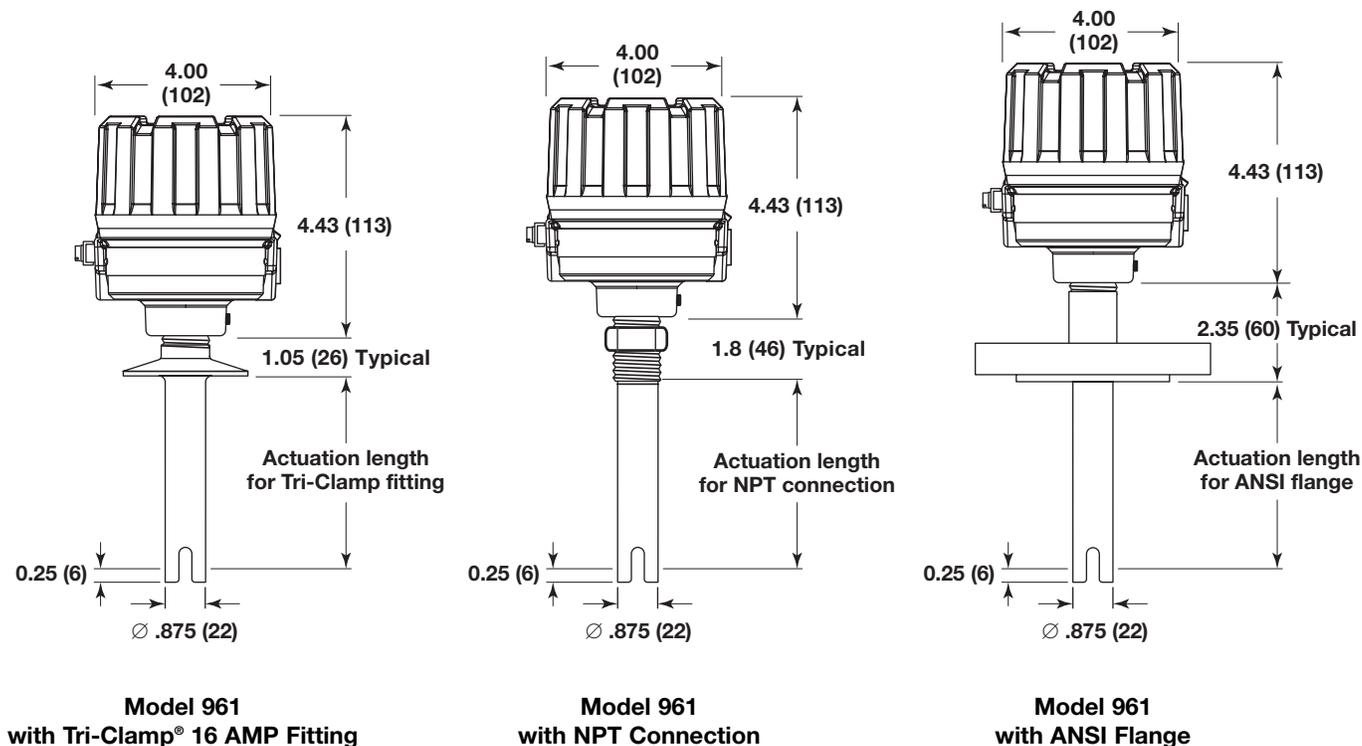
Repeatability		+/- 0.078" (2 mm)
Response Time		½ second typical
Time Delay		Variable 0.5 – 45 seconds on rising and falling levels
Self-Test	Automatic:	Continuously verifies operation of electronics, transducer, piezoelectric crystals, and electrical noise
	Manual:	Pushbutton verifies operation of electronics, transducer, and piezoelectric crystals
Shock Class		ANSI/ISA-S71.03 Class SA1
Vibration Class		ANSI/ISA-S71.03 Class VC2
Humidity		0 – 99%, non-condensing
Electromagnetic Compatibility		Meets CE requirements EN 61326

3.4 Physical Specifications

Housing Material		Cast aluminum A356-T6, or cast 316 stainless steel
Cable Entry		¾" NPT, or M20
Gross Weight	961/962 Electronics:	2.2 lbs. (1.0 kg)
	2" (5 cm) Transducer:	0.6 lbs. (0.3 kg)

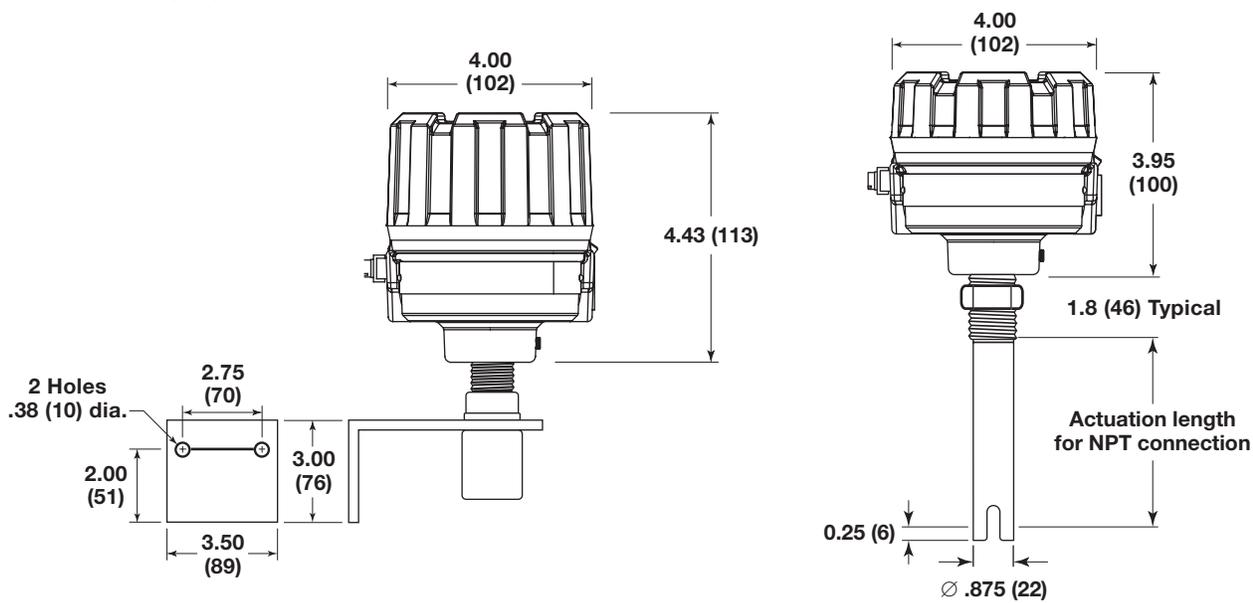
3.5 Dimensional Specifications

Inches (mm)



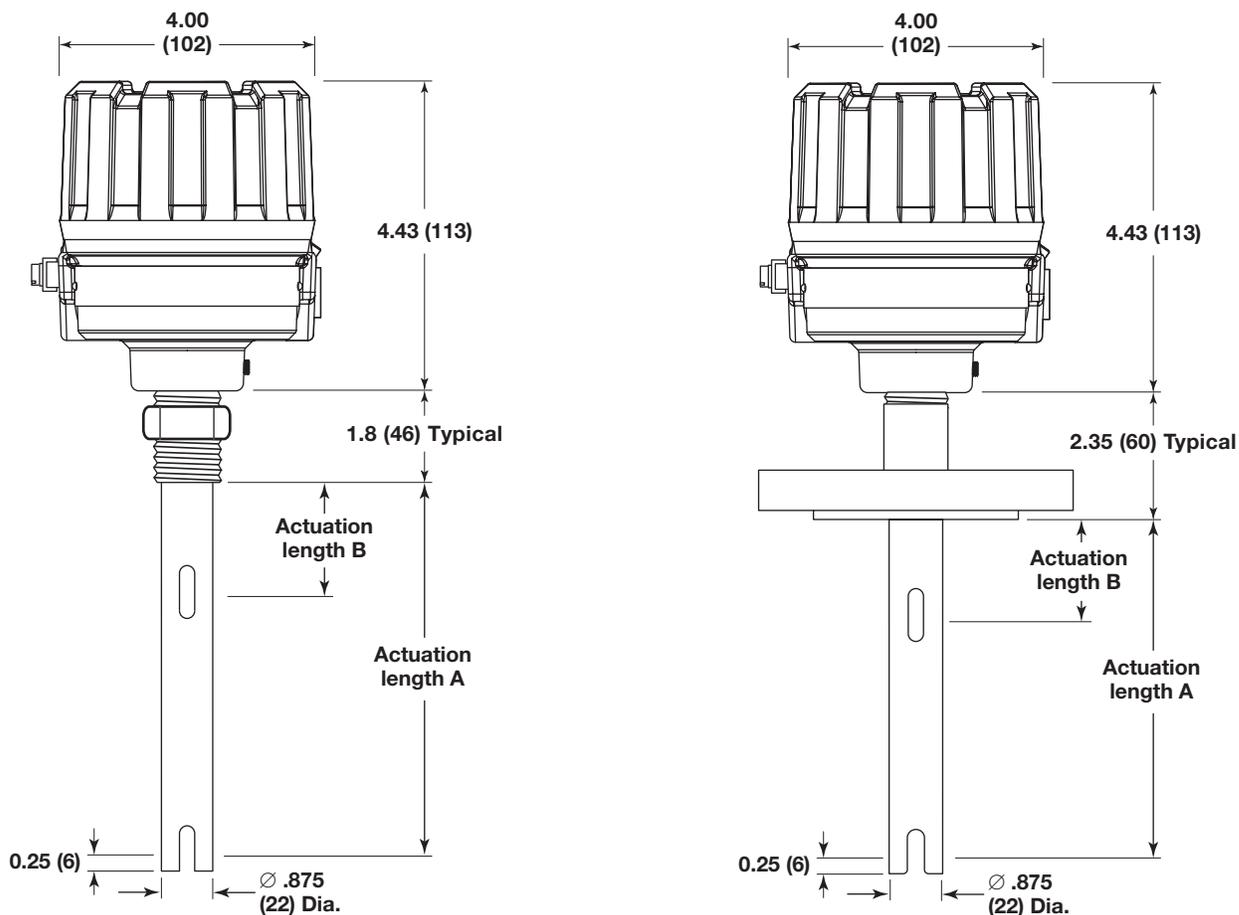
3.5 Dimensional Specifications

Inches (mm)



Model 961/962 with Remote Electronics

Remote Transducer with NPT Connection



Model 962 with NPT Connection

Model 962 with ANSI Flange

3.6 Agency Approvals

AGENCY	APPROVED MODELS	PROTECTION METHOD	AREA CLASSIFICATION
FM  APPROVED	96X-2DA0-X3X or 96X-7DA0-X3X with transducers 9AX-XXXX-XXX or 9MX-XXXX-XXX	Explosion Proof	Class I, Div. 1, Groups B,C, & D Class II, Div. 1, Groups E,F, & G Class III, NEMA 4X, IP 66, T6
	96X-XDA0-XXX or 96X-XDA0-XXX with transducers 9AX-XXXX-XXX or 9MX-XXXX-XXX	Non-Incendive	Class I, Div. 2, Groups A,B,C, & D Class II, Div. 2, Groups E,F, & G Class III, NEMA 4X, IP 66, T4
	96X-50A0-X1X with transducers 9AX-XXXX-XXX or 9MX-XXXX-XXX	Intrinsically Safe	Class I, Div. 1, Groups A,B,C, & D Class II, Div. 1, Groups E,F, & G Class III, NEMA 4X, IP 66, T6
CSA 	96X-2DA0-X3X or 96X-7DA0-X3X with transducers 9AX-XXXX-XXX or 9MX-XXXX-XXX	Explosion Proof	Class I, Div. 1, Groups B,C, & D Class II, Div. 1, Groups E,F, & G Class III, NEMA 4X, IP 66, T6
	96X-XDA0-XXX or 96X-XDA0-XXX with transducers 9AX-XXXX-XXX or 9MX-XXXX-XXX	Non-Incendive	Class I, Div. 2, Groups A,B,C, & D Class II, Div. 2, Groups E,F, & G Class III, NEMA 4X, IP 66, T4
	96X-50A0-X1X with transducers 9AX-XXXX-XXX or 9MX-XXXX-XXX	Intrinsically Safe	Class I, Div. 1, Groups A,B,C, & D Class II, Div. 1, Groups E,F, & G Class III, NEMA 4X, IP 66, T6
ATEX 	96X-XXAO-XCX with transducers 9XX-AXXA-XXX 9XX-SXXA-XXX 9XX-BXXA-XXX 9XX-CXXA-XXX 9XX-NXXA-XXX 9XX-KXXA-XXX	Explosion Proof	Ex II 1/2 G, EEx d IIC T6
	96X-50A0-XAX with transducers 9XX-AXXA-XXX 9XX-SXXA-XXX 9XX-BXXA-XXX 9XX-CXXA-XXX 9XX-NXXA-XXX 9XX-KXXA-XXX	Intrinsically Safe	Ex II 1 G, EEx ia IIC T5

 These units have been tested to EN 61326 and are in compliance with the EMC Directive 89/336/EEC.

3.7 Troubleshooting

Caution: In hazardous areas, do not remove the housing cover until power is disconnected and the atmosphere is determined to be safe.

The Model 961/962 has a unique diagnostics feature to assist in troubleshooting should a failure occur. A microprocessor in the electronics continuously monitors all self-test data. Should a fault occur, the microprocessor can determine whether the malfunction is due to the electronics, transducer, piezoelectric crystals, or the presence of environmental noise. A pushbutton and Fault LED is used to assist in troubleshooting the switch:

- One flash of the Fault LED indicates a problem with either the transducer, piezoelectric crystals, or the interconnection wiring
- Two flashes of the Fault LED indicates a problem with one of the electronics boards
- Three flashes of the Fault LED indicates excessive levels of environmental noise

The following shows the pushbuttons and LEDs used for each version of the 961/962 for diagnostic troubleshooting:

Electronics Version	Pushbutton	LED
961 with 5 amp relays	LEVEL TEST	FAULT
961 with current shift	LOOP TEST	FAULT
962 with 5 amp relays	LEVEL TEST	FAULT
962 with current shift	LOOP TEST	16 mA

If the above diagnostic LED flashes once when the pushbutton is pressed, the most common issue is the interconnection wiring between the electronics and the transducer. Check all wiring inside the housing to make sure that all wires are secure in their respective terminal blocks. Make sure that all the terminal block screws are fully tightened. If all wires are secure then contact the factory. A replacement transducer may be needed. See the Model Number section on pages 23 and 24 for proper replacement part numbers.

Two flashes of the LED indicates an issue with the electronics module. Contact the factory for a replacement electronics module. See Section 3.8 for spare electronics boards part numbers.

Environmental noise is the issue if the diagnostic LED flashes three times. Common sources of environmental noise are conducted electrical noise from a VFD (variable frequency drive), radiated electrical interference from a walkie-talkie or radio, or mechanical vibration from some nearby source. This noise could affect the 961/962 and other electrical instrumentation. Check to see if any of the above listed sources may be causing the interference and correct the issue to insure proper operation of the unit.

It is also possible that application related issues may be affecting the proper operation of the 961/962 unit. The table below assists in troubleshooting.

PROBLEM	ACTION
No signal with level change	Check wiring to make sure proper input voltage is supplied.
	Make sure liquid is filling the transducer gap.
	Check for dense foam on surface or dried product in the gap. Unit may not function properly if either condition exists.
No change in output between wet gap or dry gap	Check to see if transducer gap is plugged with solids.
	Check for dense foam in gap.
The switch is chattering	Check for proper input voltage supply.
	Check for turbulence. Relocate switch or isolate from turbulence.
	Check for excessive aeration.

3.8 Replacement Parts

Model 961/962 Common Parts

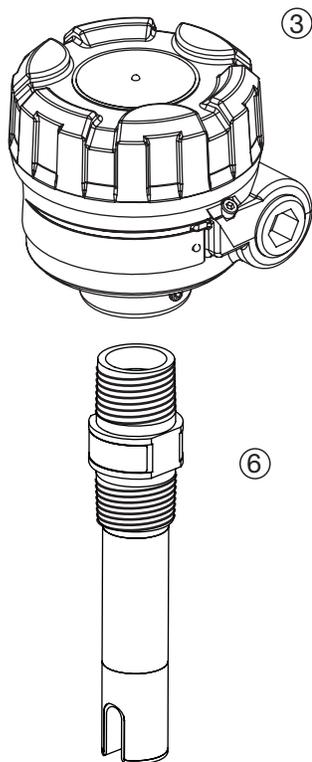
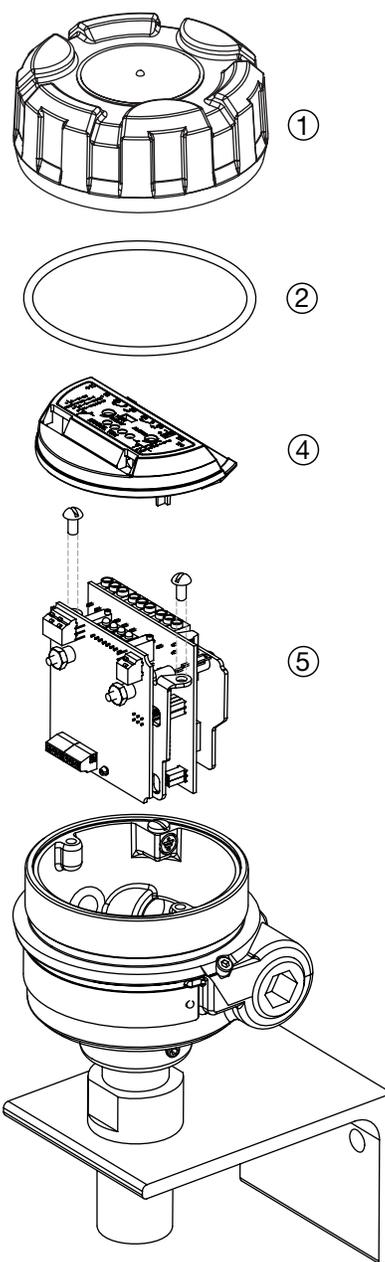
Item	Description	Part Number
1	Cast Aluminum Cover	004-9192-009
2	O-Ring	012-2201-237
3	Remote Transducer Housing Cover	004-9193-002
4	Bezel	See table below
5	Electronic Boards	See table below
6	Transducer	See Model Number

Model 961 Single Point Electronics

Input Power	Bezel	Power Board	Logic Board
DC line	003-1230-002	030-3592-002	030-3591-001
AC line	003-1230-002	030-3592-001	030-3591-001
DC loop	003-1230-003	030-3590-001	None

Model 962 Dual Point Electronics

Input Power	Bezel	Power Board	Logic Board
DC line	003-1230-002	030-3594-002	030-3595-001
AC line	003-1230-002	030-3594-001	030-3595-001
DC loop	003-1230-003	030-3593-001	None



3.9 Model Number

3.9.1 961/962 Electronics

BASIC MODEL NUMBER

961	Single-point electronics
962	Dual-point electronics

INPUT POWER

2	18 to 32 VDC line-powered
5	11 to 35 VDC loop-powered
7	102 to 265 VAC line-powered

OUTPUT SIGNAL

0	mA current shift (available with Input Power code 5)
D	5 amp gold flash relays (available with Input Power codes 2 or 7)

MOUNTING

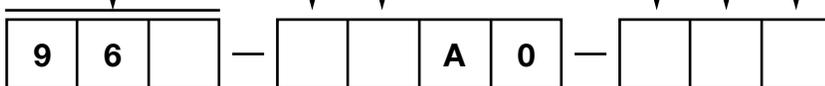
0	Integral
1	Remote (requires Connecting Cable below)

AGENCY APPROVAL

1	FM/CSA Intrinsically safe & Non-incendive (available with Output Signal code 0)
3	FM/CSA Non-incendive & Explosion proof (available with Output Signal code D)
A	ATEX II 1G EEx ia II C T5, Intrinsically safe
C	ATEX II 1/2G EEx d II C T6, Explosion proof

ELECTRONICS HOUSING

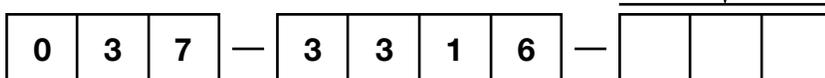
0	Cast aluminum with 3/4" NPT dual conduit entries
1	Cast aluminum with M20 dual conduit entries
2	Cast SS with 3/4" NPT dual conduit entries
3	Cast SS with M20 dual conduit entries



3.9.2 Connecting Cable

CABLE LENGTH

Length of cable from remote electronics to transducer in feet
 Maximum Length: 150 feet (45 meters)
 Example: 12 feet = **012**



3.9.3 Model 961 Single Point Transducer

TRANSDUCER UNIT OF LENGTH

A	English (length in inches)
M	Metric (length in centimeters)

MATERIALS OF CONSTRUCTION

A	316/316L stainless steel
S	316/316L with 20 Ra sanitary finish (use only with Process Connection codes 3T, 4T, or VV)
B	Hastelloy C-276
C	Monel
R	Kynar (use only with Process Connection codes 11, 23, 33, 43, BA, CA, DA)
P	CPVC (use only with Process Connection codes 11, 23, 33, 43, BA, CA, DA)
N	316/316L stainless steel, NACE construction
K	316/316L stainless steel, ASME B31.1 & B31.3 construction

PROCESS CONNECTIONS

THREADED CONNECTIONS

11	3/4" NPT
21	1" NPT
22	1" BSP (G1)

SANITARY CONNECTIONS

3T	1"/1 1/2" Tri-Clamp® 16 AMP fitting
4T	2" Tri-Clamp® 16 AMP fitting
VV	DN65 – Varivent

ANSI RAISED FACE FLANGES

23	1" 150# ANSI RF flange
24	1" 300# ANSI RF flange
25	1" 600# ANSI RF flange
33	1 1/2" 150# ANSI RF flange
34	1 1/2" 300# ANSI RF flange
35	1 1/2" 600# ANSI RF flange
43	2" 150# ANSI RF flange
44	2" 300# ANSI RF flange
45	2" 600# ANSI RF flange

EN/DIN FLANGES

BA	DN 25 PN 16 EN 1092-1 Type A
BB	DN 25 PN 25/40 EN 1092-1 Type A
BC	DN 25 PN 63/100 EN 1092-1 Type B2
CA	DN 40 PN 16 EN 1092-1 Type A
CB	DN 40 PN 25/40 EN 1092-1 Type A
CC	DN 40 PN 63/100 EN 1092-1 Type B2
DA	DN 50 PN 16 EN 1092-1 Type A
DB	DN 50 PN 25/40 EN 1092-1 Type A
DD	DN 50 PN 63 EN 1092-1 Type B2
DE	DN 50 PN 100 EN 1092-1 Type B2

ACTUATION LENGTH (unit of length specified in second digit)

1" to 130" in 1" increments 1" minimum for NPT process connections 2" minimum for BSP, sanitary, and flanged process connections Example: 4 inches = 004
3 cm to 330 cm in 1 cm increments 3 cm minimum for NPT process connections 5 cm minimum for BSP, sanitary, and flanged process connections Example: 6 centimeters = 006

9		1
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			A
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3.9.4 Model 962 Dual Point Transducer

TRANSDUCER UNIT OF LENGTH

A	English (length in inches)
M	Metric (length in centimeters)

MATERIALS OF CONSTRUCTION

A	316/316L stainless steel
P	CPVC (use only with Process Connection codes 11, 23, 33, 43, BA, CA, DA)
K	316/316L stainless steel, ASME B31.1 & B31.3 construction

PROCESS CONNECTIONS

THREADED CONNECTIONS

11	3/4" NPT
21	1" NPT
22	1" BSP (G1)

ANSI RAISED FACE FLANGES EN/DIN FLANGES

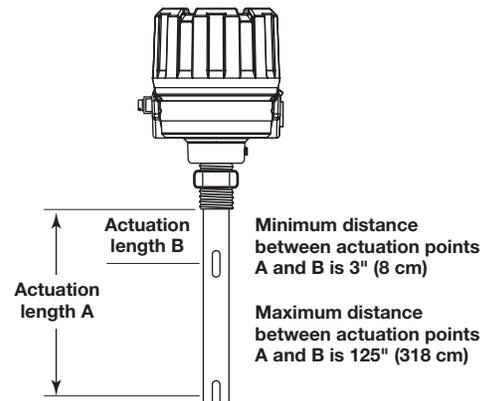
23	1" 150# ANSI RF flange	BA	DN 25 PN 16 EN 1092-1 Type A
24	1" 300# ANSI RF flange	BB	DN 25 PN 25/40 EN 1092-1 Type A
25	1" 600# ANSI RF flange	BC	DN 25 PN 63/100 EN 1092-1 Type B2
33	1 1/2" 150# ANSI RF flange	CA	DN 40 PN 16 EN 1092-1 Type A
34	1 1/2" 300# ANSI RF flange	CB	DN 40 PN 25/40 EN 1092-1 Type A
35	1 1/2" 600# ANSI RF flange	CC	DN 40 PN 63/100 EN 1092-1 Type B2
43	2" 150# ANSI RF flange	DA	DN 50 PN 16 EN 1092-1 Type A
44	2" 300# ANSI RF flange	DB	DN 50 PN 25/40 EN 1092-1 Type A
45	2" 600# ANSI RF flange	DD	DN 50 PN 63 EN 1092-1 Type B2
		DE	DN 50 PN 100 EN 1092-1 Type B2

Important:

Use the "A" dimension as the actuation length code. The "B" dimension must also be specified in quote/order.

Example:

For a 962 with an "A" dimension of 18" and a "B" dimension of 7", specify actuation length code 018.



"A" DIMENSION ACTUATION LENGTH (units specified in second digit)

5" to 130" in 1" increments
 5" minimum for NPT process connections
 6" minimum for BSP, and flanged process connections
 Example: 5 inches = 005

13 cm to 330 cm in 1 cm increments
 13 cm minimum for NPT process connections
 15 cm minimum for BSP, and flanged process connections
 Example: 13 centimeters = 013



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.

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 Magnetrol's 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 2.



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Heikensstraat 6 • B 9240 Zele, Belgium • 052 45.11.11 • Fax 052 45.09.93
Regent Business Ctr., Jubilee Rd. • Burgess Hill, Sussex RH15 9TL U.K. • 01444-871313 • Fax 01444-871317



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BULLETIN: 51-646.0
EFFECTIVE: January 2006