

ECHOTEL[®]

Model 960

Installation and Operating Manual



Model 960
(With Cast Aluminum
Housing)



Model 960
(With Stainless Steel
Housing)

Actuator-
Sensor-Interface
(AS-Interface[®])
Ultrasonic
Level Switch

Read this Manual Before Installing

This manual provides information on the Echotel® Model 960 Ultrasonic Liquid Level Switch. 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 Model 960 is 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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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 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 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.

Magnetrol's 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.





Echotel Model 960 Ultrasonic Single Point Liquid Level Switch

Table of Contents

1.0 Introduction	4
1.1 Principle of Operation	4
2.0 Installation	4
2.1 Unpacking	4
2.2 ESD Handling Procedure	5
2.3 Mounting	5
2.4 Wiring	6
2.5 Configuration	7
2.5.1 Model 960 AS-i Bus Address	7
2.5.2 Model 960 Unit Configuration	7
2.5.2.1 Time Delay Potentiometer	7
2.5.2.2 Level Test Pushbutton	8
2.5.2.3 Malfunction Test Pushbutton	8
2.5.3 LED Status Indications	8
3.0 Reference Information	9
3.1 Electronics Specifications	9
3.2 Environmental Specifications	9
3.3 Transducer Specifications	9
3.4 Performance Specifications	10
3.5 Physical Specifications	10
3.6 Dimensional Specifications	10
3.7 Agency Approvals	11
3.8 Troubleshooting	11
3.9 Replacement Parts	13
3.10 Model Number	14
3.10.1 Electronics	14
3.10.2 Transducer	15

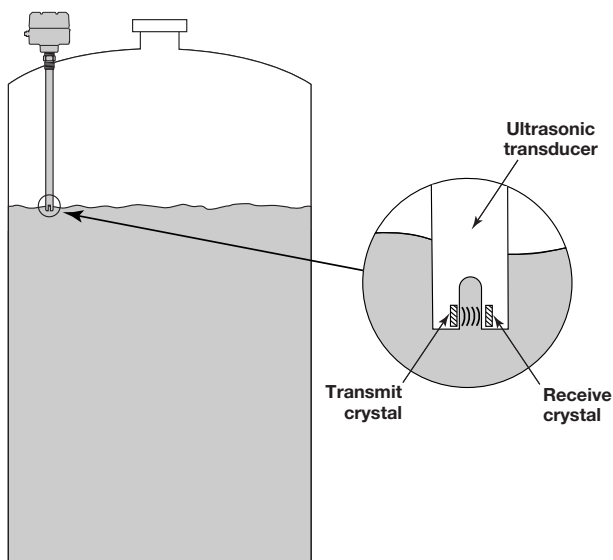
1.0 Introduction

Echotel Model 960 ultrasonic level switches utilize pulsed signal technology to detect high or low point level in a broad range of liquid media applications.

1.1 Principle of Operation

Model 960 switches utilize ultrasonic energy to detect the presence or absence of liquid in single point level applications. 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 960 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

The Model 960 level switch may be mounted in a variety of positions as shown in Figures 2 through 5.

Proper orientation of the transducer gap will facilitate maximum performance in difficult applications. When the Model 960 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 960 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.

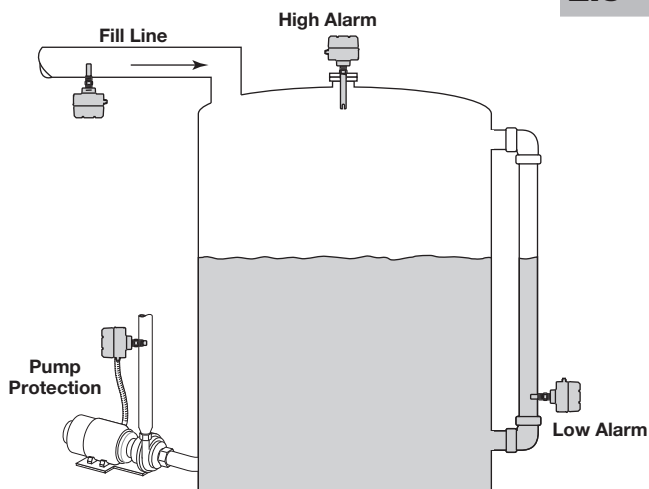


Figure 2
Typical Mounting Orientations

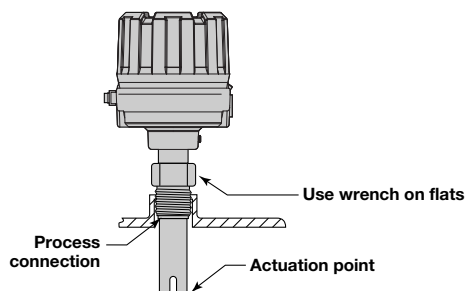


Figure 3
Vertical Mounting

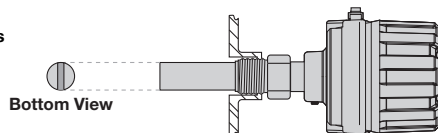


Figure 4
Horizontal Mounting

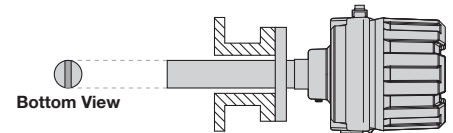


Figure 5
Nozzle Mounting

2.4 Wiring

Model 960 units can be supplied with or without a M12x1 AS-i bus quick disconnect male connector installed in one of the cable entries. If the M12x1 connector has been ordered, then complete the wiring by threading on the female M12x1 quick disconnect connector. If the M12x1 connector was not ordered then refer to the figure below for wiring instructions.

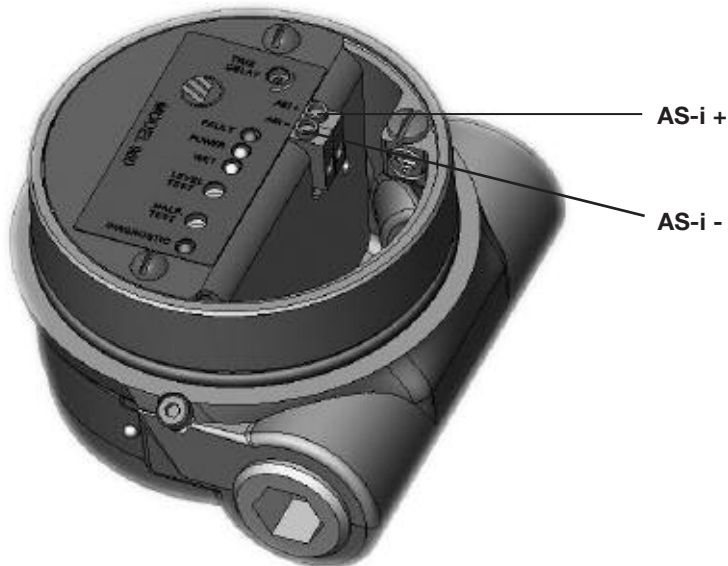


Figure 6
Model 960 Wiring

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 AS-i cabling through the conduit connection.
4. Refer to Figure 6. Connect wires to terminals (+) and (-) on the terminal block.
5. Prevent moisture seepage into housing by installing an approval 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.

2.5 Configuration

2.5.1 Model 960 AS-i Bus Address

Model 960 electronics use Actuator Sensor Interface (AS-i) bus digital communications for high or low liquid level indication. AS-i is a versatile, low cost cabling solution that is a digital replacement for traditional parallel wiring.

The AS-i bus system provides a digital serial interface with a single unshielded two-wire cable to connect up to 31 slaves (62 slaves in the extended addressing mode) on one network. In order for data exchange to occur, each slave connected to the AS-i network must be programmed with a unique address, numbered between 1 and 31. In extended addressing mode, the A or B channel select must be programmed as well. Model 960 units are factory configured as unassigned slaves with the address defaulted to 0. The address must be changed by the end user via programming at the PLC or with special handheld addressing devices.

2.5.2 Model 960 Unit Configuration

Model 960 units have the following configuration options:

- TIME DELAY potentiometer for 0.5 to 45-second signal averaging.
- LEVEL TEST push button for testing of the process level signal.
- MALF TEST push button for testing of the malfunction signal.

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 single-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.

The WET LED is not influenced by the time delay pot. As an example, turning the pot clockwise will put a time delay into the 960 switch. Immersing the tip of the transducer in water will produce the following results:

- WET LED will immediately come on.
- After the time delay period the AS-i output will indicate a wet gap condition.

When removing the tip of the transducer from the water, the WET LED will immediately turn off. After the time delay period, the AS-i output will indicate a dry gap condition.

2.5.2.2 Level Test Push button

The level test push button is used to manually test the liquid level measurement operation of the Model 960 unit. Pressing this push button will reverse AS-i output. If the transducer gap is dry, pressing this pushbutton causes the unit to report a wet gap condition. If the gap is wet, pressing this pushbutton causes the unit to report a dry gap condition. The time delay pot does not affect the operation of the level test pushbutton.

2.5.2.3 Malfunction Test Push button

The malfunction test pushbutton is used to manually perform a complete diagnostics check of the 960 unit. Pressing the malfunction test push button stops all pulses between the electronics and the transmit piezoelectric crystal in the transducer. This simulates a failure of the 960 unit which is reported as follows.

- AS-i output indicates a malfunction.
- The diagnostic LED comes on to indicate that there is a fault condition.
- AS-i output indicates a wet gap condition and the WET LED comes on.

2.5.3 LED Status Indications

Model 960 units have four status indicating LEDs:

- Green POWER LED is on when power is applied to the unit.
- Yellow WET LED is on when liquid fills the bottom ¼" of the transducer gap.
- Red DIAGNOSTIC LED is on continuously when the Model 960 diagnostics detects any unit failures. This LED may also be used to diagnose what type of failure has occurred (see troubleshooting section).
- Red FAULT LED is on continuously to indicate AS-i communications fault. This LED also flashes when a unit failure occurs as indicated when the diagnostic LED is on continuously.

3.0 Reference Information

3.1 Electronics Specifications

Supply Voltage	21 to 31 VDC
AS-i Version	V 3.0
AS-i Slave Type	A/B (Maximum of 62 nodes)
AS-i Slave Profile	S-0.A.E
AS-i Data Bits	Gap Condition: D2 = 1 with a wet gap D2 = 0 with a dry gap
	Malfunction Status: D3 = 1 during malfunction D3 = 0 in normal state
Connectable Load	EN50295 and IEC 62026-2
Power Consumption	Less than 1 watt

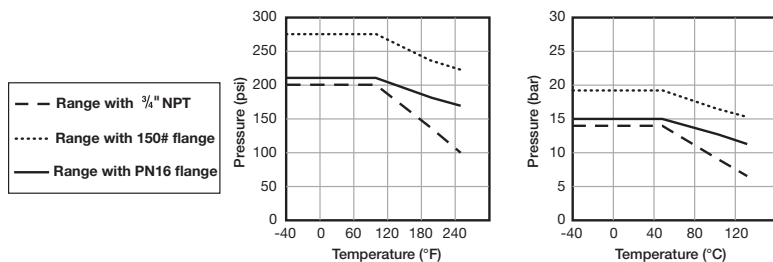
3.2 Environmental Specifications

Ambient Temperature	Electronics:	-13° to +160° F (-25° to +71° C)
Storage Temperature	Electronics:	-40° to +160° F (-40° to +71° C)
Process Temperature	Transducer:	-40° to +325° F (-40° to +163° C)
Humidity		0-99%, Non-condensing

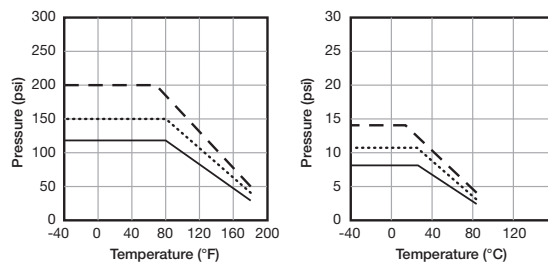
3.3 Transducer Specifications

Transducer Material	Material Code (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)

Kynar Transducer Ratings



CPVC Transducer Ratings



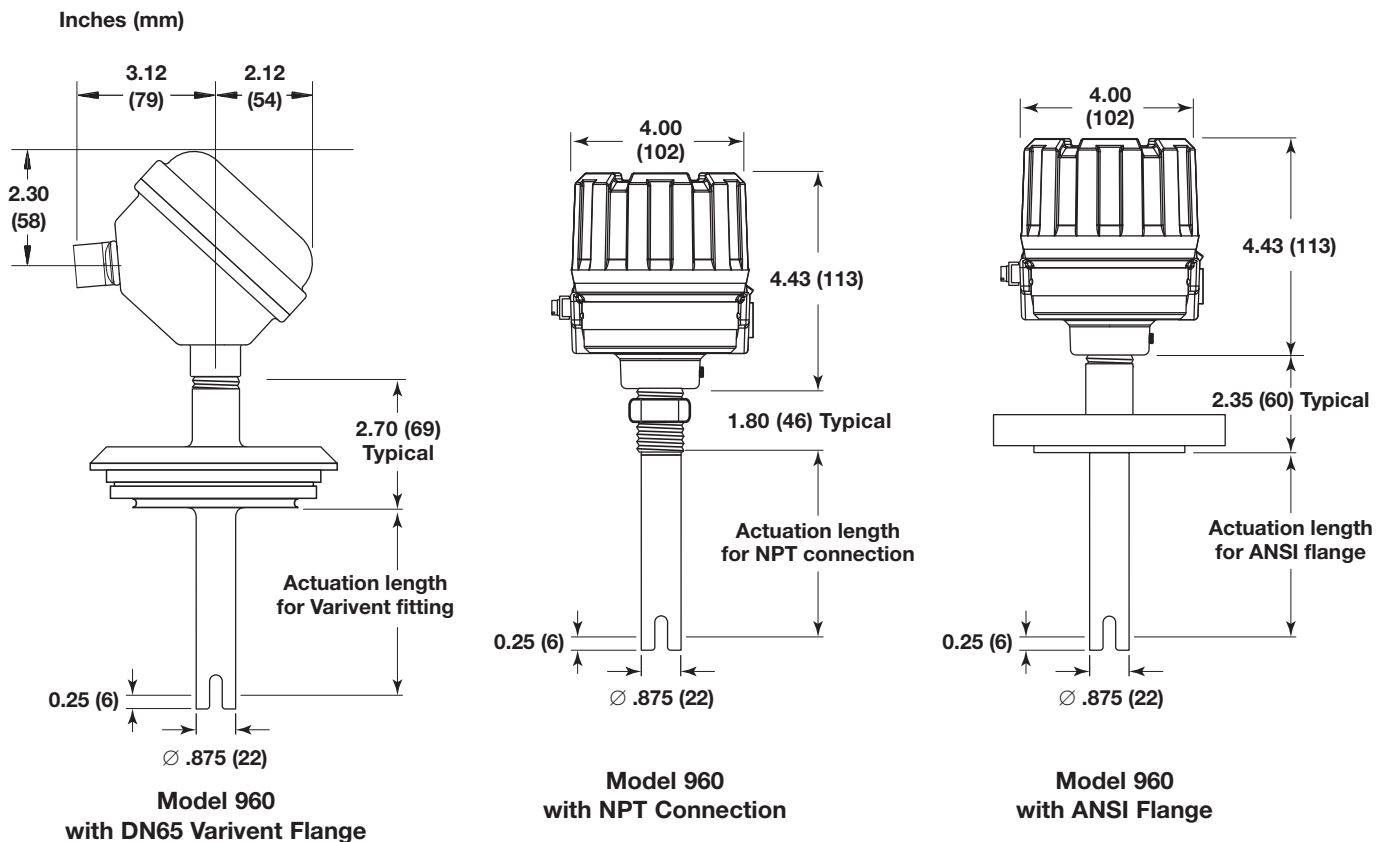
3.4 Performance Specifications

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:	Push button verifies operation of electronics, transducer, and piezoelectric crystals
Shock Class	ANSI/ISA-S71.03 Class SA1	
Vibration Class	ANSI/ISA-S71.03 Class VC2	
Electromagnetic Compatibility	Meets CE requirements EN 61326	







3.5 Physical Specifications

Housing Material	Cast aluminum A356-T6, or deep drawn 304 stainless steel	
Cable Entry	Cast Aluminum:	Dual ¼" NPT, or M20
	304 Stainless Steel:	Dual ½" NPT, or M20


3.6 Dimensional Specifications



3.7 Agency Approvals

AGENCY	APPROVED MODELS	PROTECTION METHOD	AREA CLASSIFICATION
FM 	960-58AX-030 or 960-58AX-031 with transducers 9X1-XXXX-XXX	Explosion Proof	Class I, Div. 1, Groups B, C & D Class II, Div. 1, Groups E, F & G Class III, Type 4X, IP 66, T6
	960-58AX-07X or 960-58AX-03X with transducers 9X1-XXXX-XXX	Non-Incendive	Class I, Div. 2, Groups A, B, C & D Class II, Div. 2, Groups F & G Class III, Type 4X, IP 66, T4 IP67 for 304 Stainless Steel Housing
CSA 	960-58AX-030 or 960-58AX-031 with transducers 9X1-XXXX-XXX	Explosion Proof	Class I, Div. 1, Groups B, C, & D Class II, Div. 1, Groups E, F & G Class III, Type 4X, IP 66, T6
PENDING FEBRUARY 2007	960-58AX-030 or 960-58AX-031 with transducers 9X1-XXXX-XXX	Non-Incendive	Class I, Div. 2, Groups A, B, C & D Class II, Div. 2, Groups E, F & G Class III, Type 4X, IP 66, T4 IP67 for 304 Stainless Steel Housing
ATEX 	960-58AX-0C0 or 960-58AX-0C1 with all metallic transducers*	Flame Proof	 II 1/2 G, EEx d IIC T6
	960-58AX-0EX with all metallic transducers*	Non-Sparking	 II 3 G, EEx n II T6
AS-i 	These units have been tested to AS-Interface Specification EN50295 and IEC 62026-2 , and have met the demands of the AS-Interface Test Requirements. AS-Interface certificate #76401		

*Consult factory for model numbers

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

3.8 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 960 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. The LEVEL TEST pushbutton and DIAGNOSTIC LED are used to assist in troubleshooting the switch:

When a fault occurs, as indicated by the DIAGNOSTIC LED being on continuously, press the LEVEL TEST pushbutton and observe the DIAGNOSTIC LED.

3.8 Troubleshooting (cont.)

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

If the DIAGNOSTIC LED flashes once when the LEVEL TEST push button 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 14 and 15 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 3.9 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 960 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 960 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 or excessive aeration. Relocate or isolate switch.

3.9 Replacement Parts

Cast Aluminum Housing

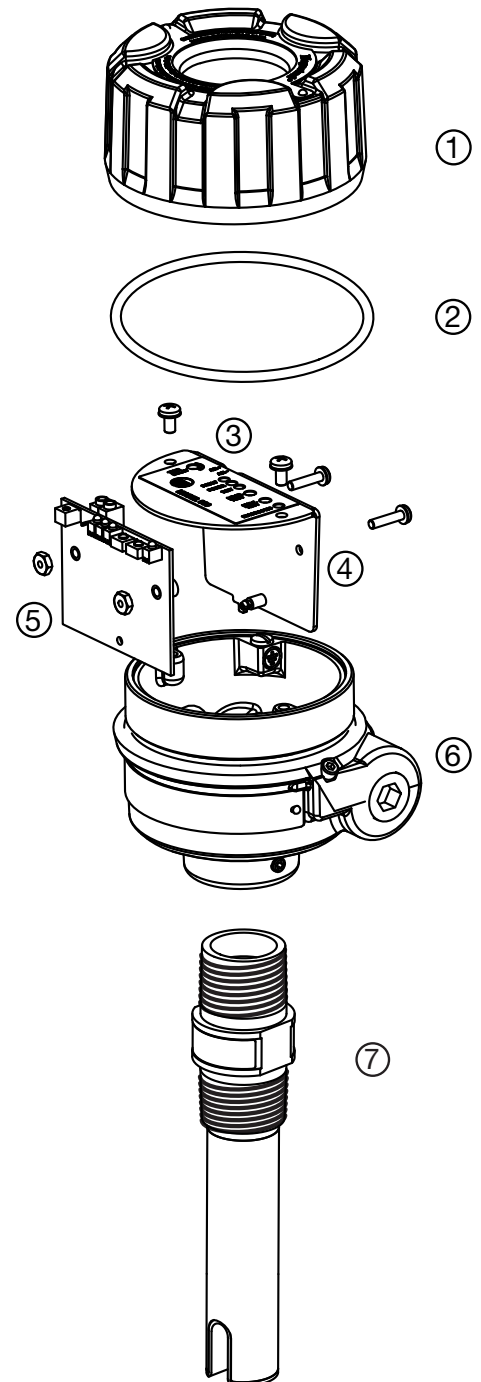
Item	Description	Part Number
1	Housing cover without window	004-9193-002
1	Housing cover with window	036-4410-005
2	O-Ring	012-2201-237
4	Board mounting bracket	005-6690-003
6	FM/CSA housing base with 3/4" NPT	004-9212-002
6	FM/CSA housing base with M20	004-9212-005
6	ATEX housing base with 3/4" NPT	004-9212-003
6	ATEX housing base with M20	004-9212-004

Deep Drawn 304 Stainless Steel Housing

Item	Description	Part Number
1	Housing cover without window	036-5702-003
1	Housing cover with window	036-5702-002
2	O-Ring	012-2201-155
4	Board mounting bracket	005-6691-002
6	Housing base	036-5701-004

Common Parts

Item	Description	Part Number
3	Bezel overlay sticker	005-9734-001
5	Electronics board	030-3588-001
7	Transducer	See Model Number



3.10 Model Number

3.10.1 960 Electronics

BASIC MODEL NUMBER

960	Integral mount ultrasonic level switch
-----	--

INPUT POWER

5	24 VDC loop powered
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OUTPUT SIGNAL

8	Actuator Sensor Interface (AS-i)
---	----------------------------------

SELF-TEST

A	Automatic & manual via push button
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OPTIONS

0	None
1	Window in enclosure cover

MOUNTING

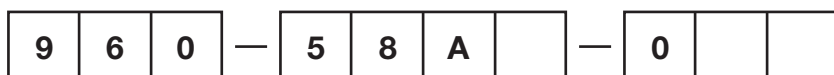
0	Integral
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AGENCY APPROVAL

3	FM/CSA Explosion proof & Non-incendive (Available with 10th digit = 0 or 1)
7	FM/CSA Non-incendive & General Purpose (Available with 10th digit = 4 or 5)
C	ATEX II 1/2 G EEx d II C T6 Flame Proof (Available with 10th digit = 0 or 1)
E	ATEX EEx n II T6, Non-sparking (Available with 10th digit = 4 or 5)

HOUSING & CONDUIT CONNECTION

0	Cast aluminum with 3/4" NPT dual conduit entries
1	Cast aluminum with M20 dual conduit entries
4	Deep drawn 304 SS w/ 1/2" NPT dual conduit entries
5	Deep drawn 304 SS w/M20 dual conduit entries



3.10.2 Model 960 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	¾" NPT
21	1" NPT
22	1" BSP (G1)

SANITARY CONNECTIONS

3T	1"/1½" Tri-Clamp® 16 AMP fitting
4T	2" Tri-Clamp® 16 AMP fitting
VV	DN65 – Varivent

ANSI RAISED FACE FLANGES

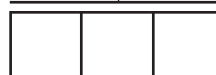
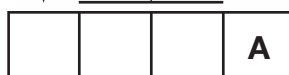
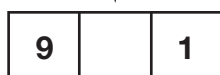
23	1" 150# ANSI RF flange
24	1" 300# ANSI RF flange
25	1" 600# ANSI RF flange
33	1½" 150# ANSI RF flange
34	1½" 300# ANSI RF flange
35	1½" 600# ANSI RF flange
43	2" 150# ANSI RF flange
44	2" 300# ANSI RF flange
45	2" 600# ANSI RF flange

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



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 5.



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BULLETIN: 51-632.0
EFFECTIVE: March 2007