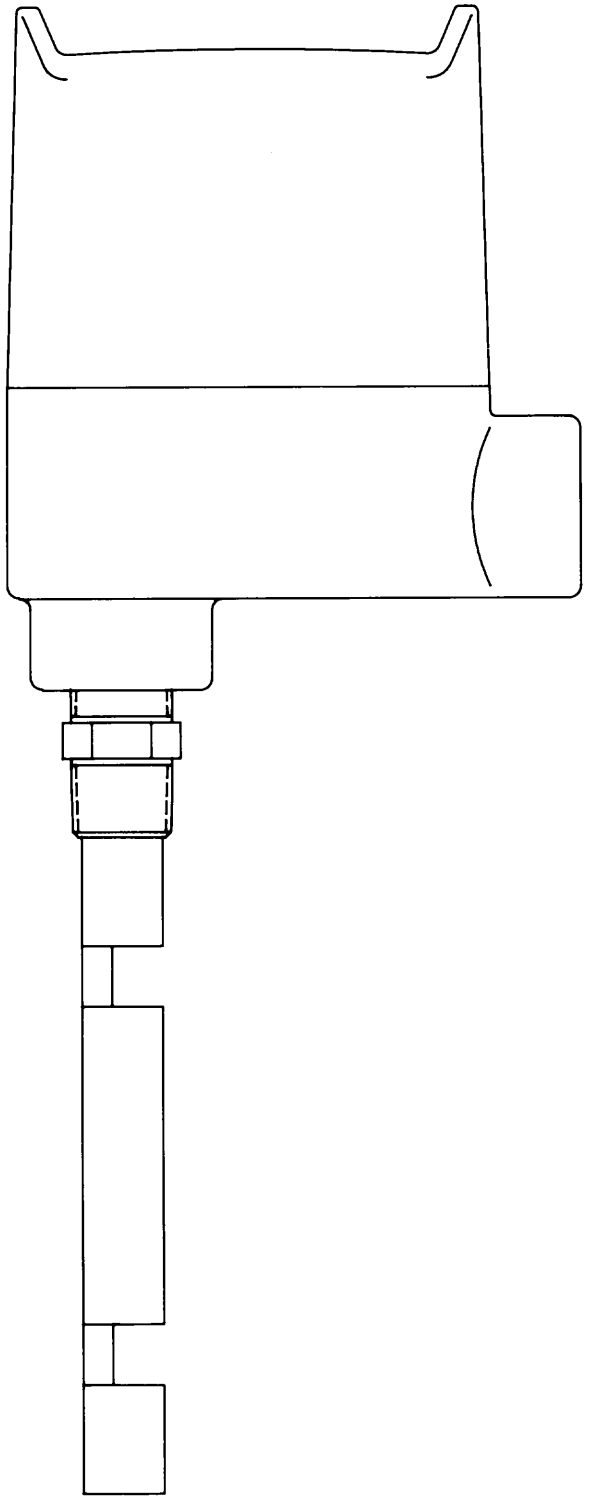
Section: L1000
Instal. Instr.: L1964
Issued: 9/92
Replaces: NEW

PENBERTHY

LEVELMARK™



MODEL 626 ULTRASONIC GAP SWITCH

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

PENBERTHY

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Fax (815) 537-5764

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PRODUCT WARRANTY

Penberthy Inc. warrants its LEVELMARK™ products to be free of defects in manufacture, labeling, packaging, or shipping. If notice of defect is received by Penberthy Inc. within **two years** from date of shipment, the defective product will be replaced, put in good operating condition, or the purchase price refunded, at the option of Penberthy Inc., free of charge, except transportation. The cost of replacement, repair, or refund of purchase price, shall be the exclusive remedy for any breach of warranty. Penberthy Inc. shall not be liable to any person, or other legal entity, for consequential damages, injury, or commercial loss from any breach of warranty. Some states do not allow the limitation or exclusion of liability for incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Penberthy Inc. ***makes no warranty of fitness for a particular application, unless approved in writing by Penberthy Inc.***, and makes no other warranty, expressed or implied, including implied warranty arising from course of dealing, or usage of trade. This warranty shall not apply if the product has been tampered with, repaired or altered outside the Penberthy factory, or if it has been subjected to misuse, neglect or accident. This warranty gives you specific legal rights, and you also may have other rights that vary from state to state.

Prior to submitting any claim for warranty service, the owner must submit proof of purchase to Penberthy Inc. and obtain a Return Authorization number to return the product. Thereafter, the product shall be returned to Penberthy Inc. at its factory in Prophetstown, Illinois, with freight prepaid.

This document and the warranty contained herein may not be modified, unless done in writing and signed by the President of Penberthy, Inc.

1.0 Introduction

The instructions in this manual pertain to the Penberthy LEVELMARK™ Model 626 Ultrasonic Gap Switch.

The Model 626 liquid level switch is designed for sensing the presence of liquids and slurries only. Do not attempt to measure highly aerated liquids, solids, or granular materials with this switch.

This switch is always integral-mounted with the sensing element. It consists of an Electronic Control Unit in a watertight (NEMA 4), explosion-proof (NEMA 7) housing, and a dual- point, or two (2) single-point Sensing Elements. See Figure #1.

1.1 System Description

Electronic Control Unit -- This solid state unit decides whether the gap in the sensing element is immersed in a liquid or a vapor/gas (e.g., air), and controls the state of the 4-20 mA loop current. The unit has a built-in self-test feature. The Electronic Control Unit is contained in a watertight (NEMA 4), explosion-proof housing (NEMA 7), with a 3/4 inch NPT female connection.

Sensing Element -- The standard sensor (SU-32) is constructed of type 316 stainless steel. A piezoelectric ceramic disk is encapsulated on each side of the gaps. On the dual-point sensors the sensing gap closest to the mounting threads, or flange, is Gap #1 (Channel #1).The other gap is Gap #2 (Channel #2).A high-temperature insulated coaxial cable connects the ceramic disks to the Electronic Control Unit. The standard process connection is 3/4 inch NPT male.

2.0 Specifications

2.1 Electronic Control Unit

Control Unit Enclosure

Explosion-proof (NEMA 7) and Watertight (NEMA 4) cast aluminum housing; Buna-N O-ring.

2.1.2 Electronic Circuit Board

Power Input

12 Vdc minimum; 30 Vdc maximum.

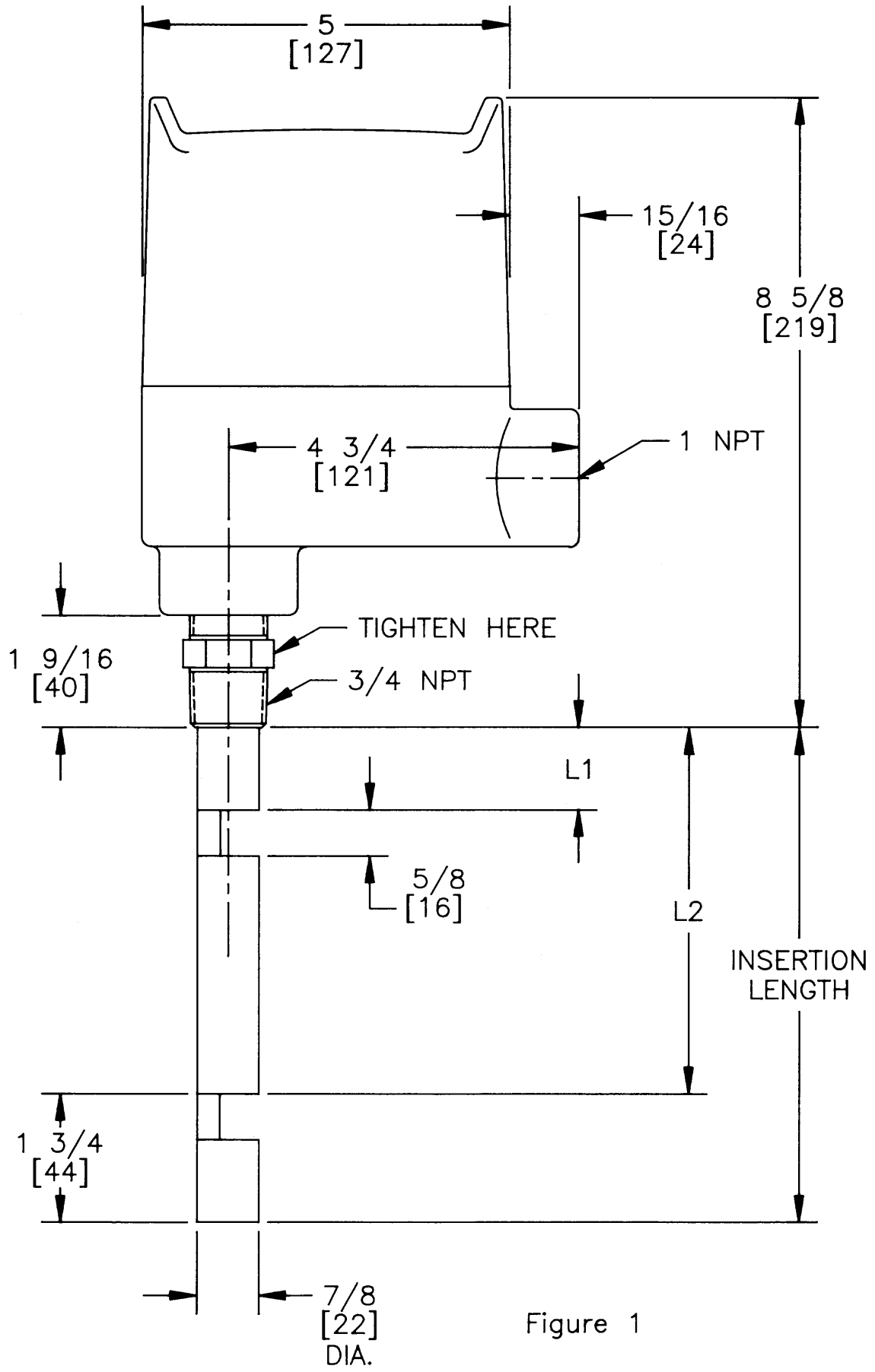

5
[127]
15/16
[24]
8 5/8
[219]
4 3/4
[121]
1 NPT
TIGHTEN HERE
1 9/16
[40]
3/4 NPT
L1
5/8
[16]
L2
INSERTION
LENGTH
1 3/4
[44]
7/8
[22]
DIA.

Figure 1

Output Current

22 mA maximum; Nominally:

≤11 mA = both gaps dry.
14 mA (± 1.5 mA) = Gap #1 dry, Gap #2 wet.
17 mA (± 1.5 mA) = Gap #1 wet, Gap #2 dry.
20 mA (± 1.5 mA) = both gaps wet.

Output current independent of the supply voltage over the 12 - 30 Vdc power input range.

Repeatability

Better than 1/16 inch.

Gain Adjustment

DC differential amplifier gain control for noise reduction. Factory preset for most applications.

Response Time

Minimum ½ second.

Operating Temperature

-40°C to 70°C (-40°F to 160°F).

NOTE: For integrally mounted units the temperature range above applies when the sensing element temperature is less than 70°C (160°F).For higher sensing element temperatures, de-rate the maximum ambient temperature of the control unit by 1° for each 5° the sensing element operating temperature exceeds 70°C (160°F).

2.2 Sensing Element

Construction

Type 316 stainless steel (standard)
Hastelloy-C, Monel, and Alloy-20 (optional)
Kynar and CPVC (optional; not FM or CSA approved)

All welded construction with shielded RCA phono plug connectors.

Operating Temperature

-40°C to 121°C (-40°F to 250°F).

Operating Pressure

1,500 psig over operating temperature range (metal sensing elements only). Contact factory for ratings of other sensors.

Cable

Standard cable (RG-178 B/U) used for temperatures -70°C to 200°C (-94°F to 392°F); 4 inches maximum length.

2.3 Approvals

FM Approved
Explosion-proof for:
Division 1;
Class I; Groups B, C, D;
Class II; Groups E, F, G;
Class III
When installed in accordance with Penberthy Drawing # 18805-009 (Figure #6)

CSA Certified (Integral Mounting Only)
Explosion-proof for:
Division I;
Class I; Groups B, C, D;
Class II; Groups E, F, G;
Class III; Encl. 4

FM Approved
Intrinsically Safe for:
Division 1;
Class I; Groups A, B, C, D;
Class II; Groups E, F, G;
Class III
When installed in accordance with Penberthy Drawing #18806-009. (Figure #5)

3.0 Theory of Operation

3.1 Electronic Control Unit

While reading the theory of operation for the electronic control unit, refer to Figure #2 for a block diagram. On each channel the Amplifier is a high gain bandpass amplifier. The input is connected to the Receive Transducer and the output is connected to the Transmit Transducer. These transducers are located in the sensing element (see section 3.2).This forms a feedback system for the amplifier that will oscillate when the feedback is of sufficient amplitude. This can occur only when the gap in the sensing element is filled with a liquid or slurry. The Detector senses this oscillation, and causes the loop current to change.

3.2 Sensing Element

The sensing element has a piezoelectric ceramic disk on each side of a sensing gap. One ceramic disk, the Transmit Transducer, is used to convert an electrical signal into an ultrasonic signal, which is then transmitted across the sensing gap. The other ceramic disk, the Receive Transducer, receives the ultrasonic signal and converts it into an electrical signal. This system is more efficient when a liquid (slurry) fills the sensing gap because liquids are much better conductors of sound than gases (air). This difference in efficiency (feedback) enables the Electronic Control Unit to sense the presence or absence of liquid.

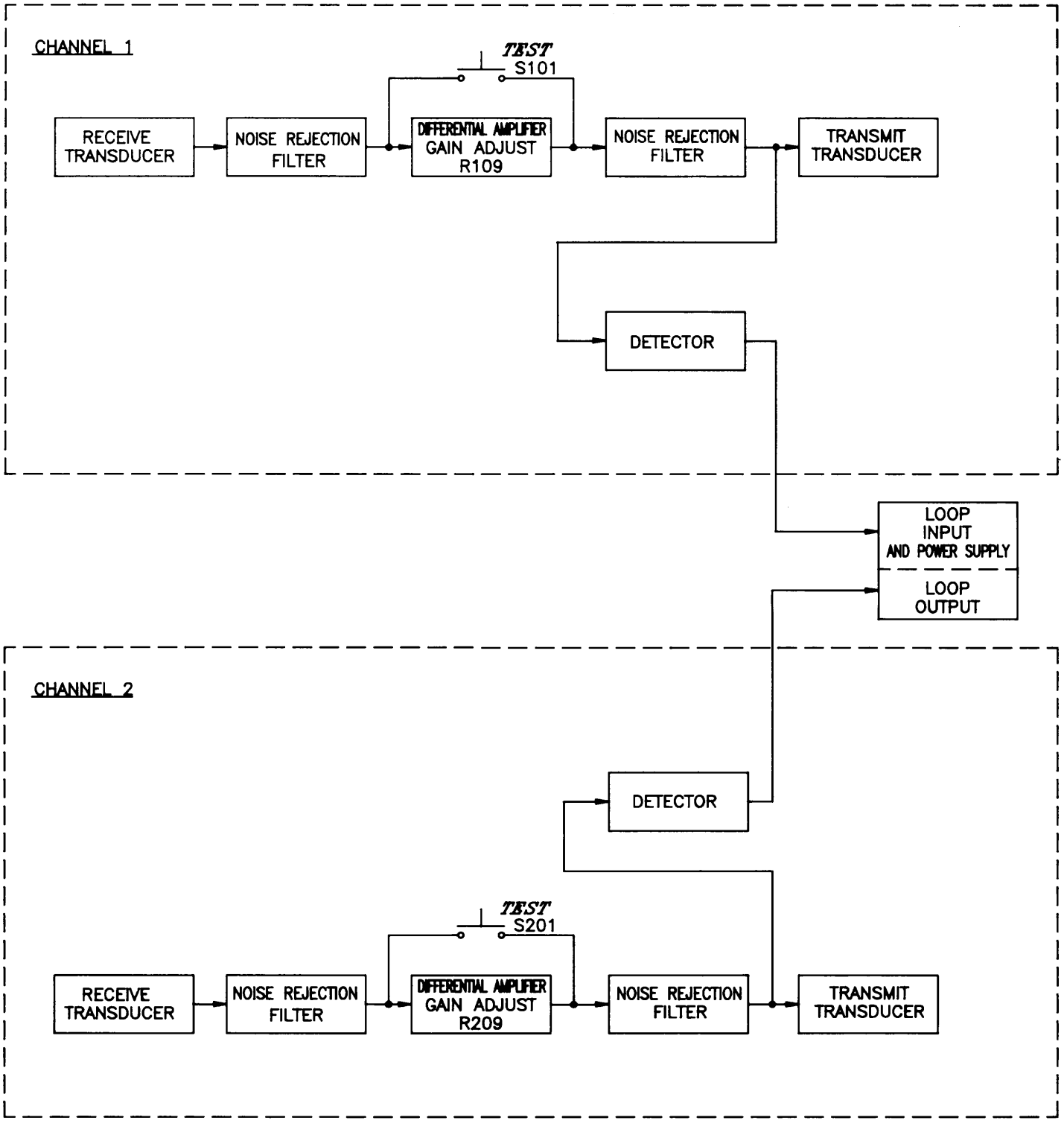

CHANNEL 1
TEST
S101
RECEIVE TRANSDUCER
NOISE REJECTION FILTER
DIFFERENTIAL AMPLIFIER GAIN ADJUST R109
NOISE REJECTION FILTER
TRANSMIT TRANSDUCER
DETECTOR
LOOP INPUT AND POWER SUPPLY
LOOP OUTPUT
CHANNEL 2
DETECTOR
TEST
S201
RECEIVE TRANSDUCER
NOISE REJECTION FILTER
DIFFERENTIAL AMPLIFIER GAIN ADJUST R209
NOISE REJECTION FILTER
TRANSMIT TRANSDUCER

Figure 2

4.0 Installation

4.1 Unpacking

Upon receiving the Model 626 ultrasonic switch, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt installation. Notify the carrier immediately and request a damage inspection. Check each item against the packing list.

4.2 Mounting the Switch

4.2.1 Selecting the mounting location.

1.) Locate the sensing element away from inlet or outlet openings to avoid excessive turbulence. This turbulence can produce cavitation that may cause false indication.

2.) Verify that there are no obstructions in the vessel along the entire length of the sensing element.

3.) Horizontal mounting of the sensing element is recommended when viscous liquids or slurries are to be measured. This will allow the liquid to drip off the flat surfaces of the sensing element gap more easily. However, horizontal mounting is not practical with a dual-point sensing element (e.g., SU-32). Applications involving clean liquids or low viscosity slurries may be measured from any position.

4.) Locate the sensing element out of the direct flow of liquid during filling or emptying to avoid false indication. If this is not possible, baffle the inlet or outlet.

5.) Do not use these switches where coating buildup or sludge/debris could cause the gap in the sensing element to become blocked. This condition can result in false indication.

4.2.2 Installation

/!\ WARNING /!

Turn off and lock out all power before beginning installation.

1.) Mount the sensor into a suitable NPT fitting or flange connection. When using the NPT fitting, use thread sealing tape or pipe joint compound around the threads of the sensor to obtain a good seal without excessive tightening. Screw the sensor into the tank using the 1-1/16" hexagonal fitting on the sensor for tightening. **DO NOT** use the enclosure for tightening.

2.) If you are using conduit for the current loop wiring use a conduit seal with a drain or a drip-loop to prevent condensate from entering the housing. Condensate can cause equipment malfunction or failure.

3.) Remove the enclosure cover. Pull the current loop wiring into the electronic control unit housing via the conduit hub. The circuit board can be removed to simplify pulling the wiring.

4.3 Wiring the Electronic Control Unit

Run the current loop wiring as shown in Figure #3.See Figure #4 to decide the correct connection of the wiring. The terminal block is suitable for 14 to 22 AWG stranded wires. See Figure #5 for proper connection to approved safety barriers.

5.0 Set Up

5.1 Initial Power Up

The following check of operation requires power to be applied to the unit with the cover removed.

/!\ WARNING /!

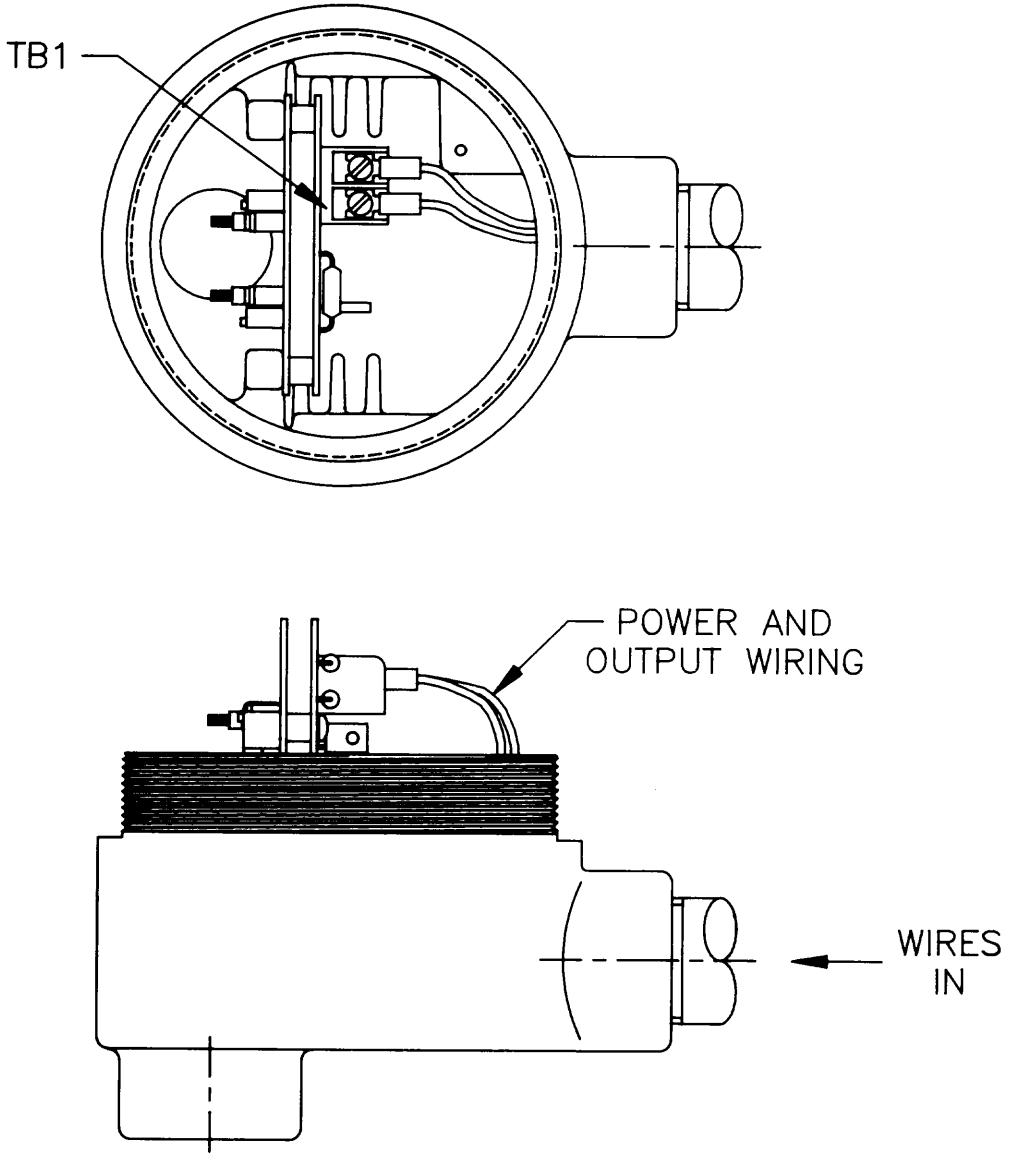
Be sure that the unit is properly grounded, and that a suitable intrinsically safe barrier has been installed between the power supply and this unit.

Follow the procedure in Section 6.2, Steps 1-5, to connect your milliammeter in the current loop. If both gaps are empty the current should be less than or equal to 11 mA. Immerse gap #2 in a liquid; the current should be 14 mA (± 1.5 mA). If possible, remove gap #2 from the liquid and immerse gap #1; the current should be 17 mA (± 1.5 mA). Immerse both gaps; the current should be 20 mA (± 1.5 mA). If these conditions are not met, go to Section 6.0. If the unit is operating correctly, disconnect your milliammeter, reconnect the positive (+) loop wire to the positive (+) terminal of TB1, and reassemble the housing.

6.0 Troubleshooting

6.1 Introduction

Your Penberthy LEVELMARK™ Ultrasonic Liquid Level Switch is designed to give you years of unattended service. However, failure of electrical equipment can occur. Sound engineering practices require periodic inspection of the instrument to insure it is in good working order. The following check of operation requires power to be applied to the unit with the cover removed.



ROUTING OF POWER AND OUTPUT WIRING

Figure 3

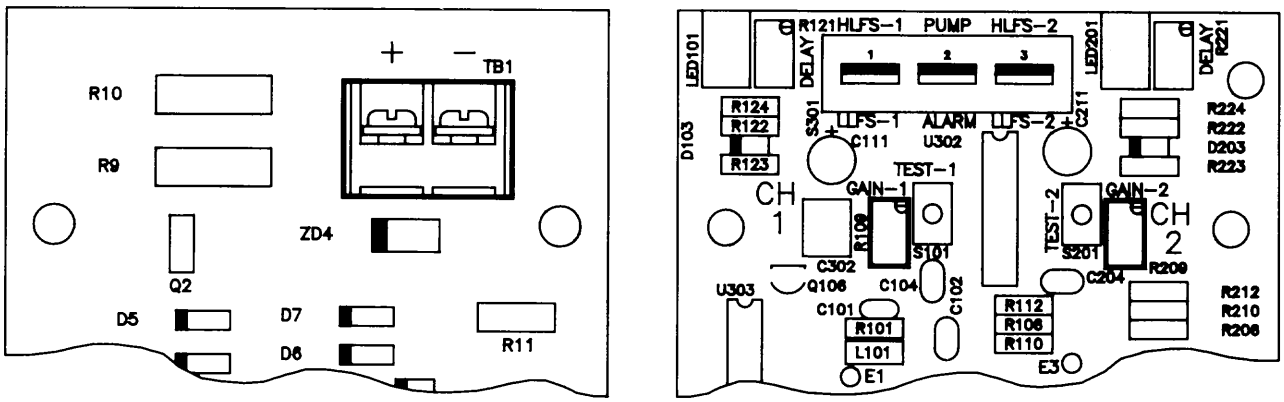
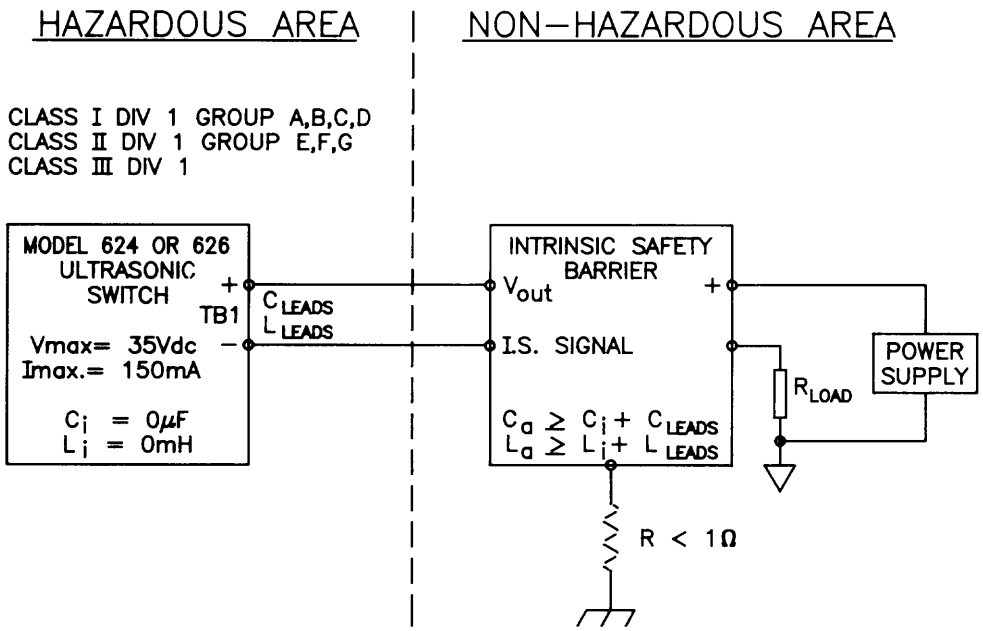

+
−
TB1
R10
R9
ZD4
Q2
D5
D7
D6
R11
R121
HLFS−1
PUMP
HLFS−2
LED101
DELAY
LED201
DELAY
R221
R124
R122
R123
S301
C111
U302
C211
R224
R222
D203
R223
D103
TEST−1
GAIN−1
CH
1
R109
S101
TEST−2
S201
GAIN−2
CH
2
R209
C302
Q106
C104
C102
C204
U303
C101
R112
R106
R110
R101
L101
E1
E3
R212
R210
R206

Figure 4

DWG. NO. 18806-009

ENTITY
CONTROL DRAWING



EQUIPMENT SUPPLYING INTRINSIC SYSTEM MUST NOT PRODUCE MORE THAN 250Vdc OR 250V rms.

NOMINAL POWER SUPPLY VOLTAGE = 25.5Vdc

USE ONLY ONE BARRIER PER SWITCH CIRCUIT.

LOOP WIRE DISTANCE NOT TO EXCEED 1,500 FT. USING C_{LEADS} = 60pF/FT.
L_{LEADS} = 0.20μH/FT.

V_{max} = MAXIMUM VOLTAGE AT SWITCH INPUT TERMINALS

I_{max} = MAXIMUM SWITCH CURRENT

C_i = MAXIMUM UNPROTECTED INTERNAL CAPACITANCE

L_i = MAXIMUM UNPROTECTED INTERNAL INDUCTANCE

V_{out} = OPEN CIRCUIT VOLTAGE AVAILABLE FROM BARRIER $V_{out} \leq V_{max}$

I_{sc} = SHORT CIRCUIT CURRENT AVAILABLE FROM BARRIER $I_{sc} \leq I_{max}$

C_a = MAXIMUM ALLOWABLE CAPACITANCE CONNECTED TO BARRIER INTRINSICALLY SAFE TERMINALS

L_a = MAXIMUM ALLOWABLE INDUCTANCE CONNECTED TO BARRIER INTRINSICALLY SAFE TERMINALS

NO CHANGES TO THIS DRAWING WITHOUT PREVIOUS APPROVAL FROM FACTORY MUTUAL.

UNLESS OTHERWISE SPECIFIED
TOLERANCES ON MACHINED DIMENSIONS:
.X = ±.063 Fractional dimensions: ±1/8
.XX = ±.031 Angels: ±30 minutes
.XXX = ±.015 Fillet radii: .000 thru +.063
250 R.M.S. maximum Holes: .000 thru +.005
TOLERANCES ON CAST OR FABRICATED DIMENSIONS:
Fractions: ±1/8 Angles: ±1 degree
ALL DIMENSIONS ARE IN INCHES

PENBERTHY
PROPHETSTOWN, IL. USA 61277

TITLE INTRINSIC SAFETY CONTROL DRAWING 624 & 626

DRAWING SCALE: 1=1	APVD.
COMPUTER SCALE: 1=1	REV. C
REL. 33910	SHEET 1 OF 1
DRW. JS	DATE 11/11/91
DRAWING NO. 18806-009	

/!\ WARNING /!

Be sure that the unit is properly grounded, and that a suitable intrinsically safe barrier has been installed between the power supply and this unit.

6.2 Electronic Unit Checkout

If the unit doesn't operate properly, inspect it for proper installation and wiring. If this fails to correct the problem check the loop current value at TB1 as described below.

1.) Turn off power to the unit.

2.) Disconnect the wire at the positive (+) terminal of TB1.

3.) Connect the wire from Step #2 to the positive (+) lead of the milliammeter.

4.) Connect the negative (-) lead of your milliammeter to the positive (+) terminal of TB1.

5.) Turn on the power.

6.) The current should be less than or equal to 11 mA. Immerse gap #2 in a liquid; the current should be 14 mA (± 1.5 mA). If possible, remove gap #2 from the liquid and immerse gap #1; the current should be 17 mA (± 1.5 mA). Immerse both gaps; the current should be 20 mA (± 1.5 mA). If the output of the unit is not proper go to Section 6.2.1.

7.) If the unit is operating properly, turn off the power, disconnect the milliammeter, reconnect the control loop wiring to TB1, and turn on the power.

6.2.1 Calibration Procedure

IMPORTANT: The Model 626 Liquid Level Switch comes precalibrated from the factory for most applications. However, we suggest that you check the calibration in relation to your application to insure optimum operation.

1.) To set the Gain use a trimpot tool or a small flat-tip screwdriver. Set Channel #2 first.

2.) Rotate the screw on the potentiometer (Channel #2, R209) clockwise 30 turns or until a slight detent is felt, or an audible click is heard, every revolution.

3.) If the loop current is less than or equal to 11 mA rotate the screw 3 turns counter-clockwise and go to Step #5.

4.) If the loop current is 14 mA (± 1.5 mA), then, while counting the number of turns, rotate the screw counter-clockwise until the loop current is less than or equal to 11 mA. Rotate the screw three additional turns counter-clockwise. If more than 13 turns are required, the unit may need service; Go to Section 7.1.

5.) Immerse Gap #2 (the bottom gap on dual-point sensors) in a liquid. Rotate the screw on the potentiometer (Channel #1, R109) clockwise 30 turns or until a slight detent is felt, or an audible click is heard, every revolution.

6.) If the loop current is 14 mA (± 1.5 mA), rotate the screw three turns counter-clockwise and go to Step #8.

7.) If the loop current is 20 mA (± 1.5 mA), then, while counting the number of turns, rotate the screw counter-clockwise until the loop current is 14 mA (± 1.5 mA). Rotate the screw three additional turns counter-clockwise. If more than 13 turns are required, the unit may need service; Go to Section 7.1.

8.) Immerse both gaps in a liquid; the loop current should be 20 mA (± 1.5 mA). Remove both gaps from the liquid; the loop current should be less than or equal to 11 mA. If not, go to Section 7.1.

6.3 Removing the Circuit Board

If it has been determined that the circuit board is not functioning properly, then use the following procedure to remove it from the Electronic Unit Housing.

1.) Turn off all power to the unit.

2.) Disconnect the signal wires from the circuit board.

3.) Remove the screws on each side of the board.

4.) Disconnect the circuit board from the sensing element by grasping the phono connector on opposite sides and pulling it apart. **DO NOT** pull on the cables.

5.) Lift the circuit board out of the housing. See Section 7.2 before returning it to the factory.

6.4 Problems and Causes

Problems	Possible Cause	Solution
1.) Unit output always less than 12.5 mA	A.) Improper wiring B.) Loss of power C.) Gain misadjusted D.) Sensing Element malfunction E.) Electronic Unit malfunction	A.) Sec. 4.3 B.) Sec. 6.2 C.) Sec. 6.2.1 D.) Contact factory E.) Contact factory
2.) Unit output always greater than 18.5 mA	A.) Improper wiring B.) Gain misadjusted C.) Sensing Element malfunction D.) Electronic Unit malfunction	A.) Sec. 4.3 B.) Sec. 6.2.1 C.) Contact factory D.) Contact factory
3.) Unit gives incorrect loop current	A.) Loose wiring B.) Turbulence/Aeration C.) Sensing Element malfunction D.) Electronic Unit malfunction	A.) Sec. 4.3 B.) Sec. 4.2.1 C.) Contact factory D.) Contact factory

7.0 Factory Assistance

7.1 Field Service

Trained field service engineers are available on a time-plus-expense basis to assist in start-ups, diagnosing difficult application problems, or in-plant training of personnel. Contact the Penberthy factory for further details.

Although standard electronic units are generally in factory stock Penberthy suggests that you keep a spare Electronic Control Unit on hand if the application is critical. A good benchmark is one spare unit for every ten units in service.

7.2 Telephone Assistance & Equipment Return

If you are having difficulty with your LEVELMARK™ level controls, notify your local LEVELMARK™ representative, or call the factory direct at (815) 537-2311 and ask for an applications engineer.

To help us to assist you more effectively, please have as much of the following information as possible when you call:

- Instrument Model #
- Probe Model #
- Penberthy Invoice # and Date
- Process Material
- Temperature
- Pressure
- Brief description of the problem
- Checkout procedures (from the instruction manual) that failed

If attempts to solve your problem fail, you may be requested to return your instrument to the factory for intensive testing. You must obtain a Return Authorization (R. A.) number from Penberthy before returning anything. Failure to do so will result in the unit being returned to you, without being tested, freight collect. To obtain a R. A. # gather the following information besides that above:

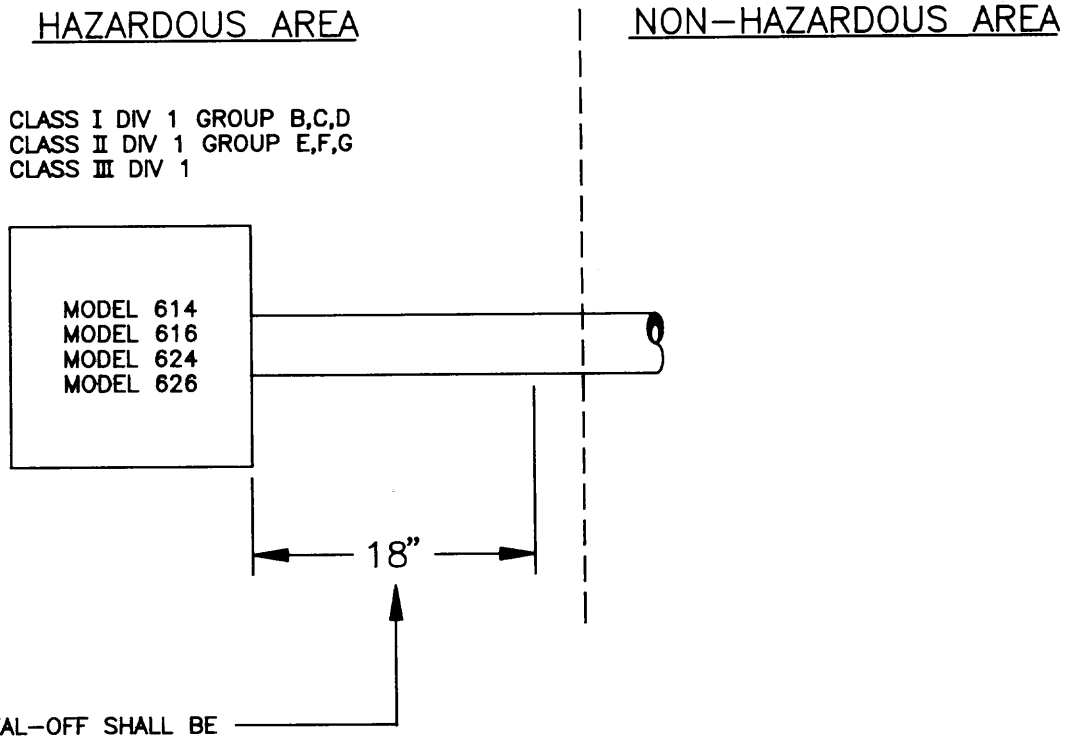
- Reason for Return
- Person to contact at your company
- "Ship-To" address

We recommend that you return the entire unit so that we can test the entire "system."

There is a minimum charge of $50.00 for evaluation of non-warranty units. You will be contacted before we repair the unit if there will be any additional charges. If you return a unit that is covered by the warranty, but is not defective, the minimum charge will apply.

DWG. NO. 18805-009

CONTROL DRAWING



A FLAME PATH SEAL-OFF SHALL BE INSTALLED WITHIN 18 IN. OF ENCLOSURE

CASE TEMPERATURE CANNOT EXCEED 100°C (212°F)

WIRING TO BE IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE (NEC) PERTINENT PARTS OF THE 500 SERIES OF ARTICLE 5 OR LOCAL CODES AS APPLICABLE.

NO CHANGES TO THIS DRAWING WITHOUT PREVIOUS APPROVAL FROM FACTORY MUTUAL.

UNLESS OTHERWISE SPECIFIED
TOLERANCES ON MACHINED DIMENSIONS:
.X = ±.063 Fractional dimensions: ±1/8
.XX = ±.031 Angels: ±30 minutes
.XXX = ±.015 Fillet radii: .000 thru +.063
250 R.M.S. maximum Holes: .000 thru +.005
TOLERANCES ON CAST OR FABRICATED DIMENSIONS:
Fractions: ±1/8 Angles: ±1 degree
ALL DIMENSIONS ARE IN INCHES

PENBERTHY
PROPHETSTOWN, IL. USA 61277

TITLE EXPLOSION PROOF CONTROL DRAWING 614, 616, 624 & 626

DRAWING SCALE: 1=1	APVD.
COMPUTER SCALE: 1=1	REV. B
REL. 33910	SHEET 1 OF 1
DRW. JS / DATE 11/11/91	DRAWING NO. 18805-009

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