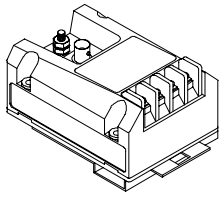
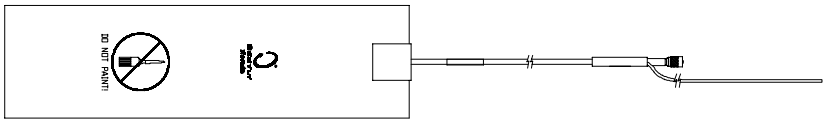
Part Number 167684-01
Revision A, October 2004

Air Gap Transducer System
Manual





BENTLY
Nevada

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Clickloc™ is a mark of the General Electric Company.

Teflon® is a registered trademark of DuPont.

The following ways of contacting Bently Nevada are provided for those times when you cannot contact your local Bently Nevada representative:

Mailing Address	1631 Bently Parkway South Minden, NV 89423 USA
Telephone	1 775 782 3611 1 800 227 5514
Fax	1 775 215 2876
Internet	www.bently.com

Related Documents

The following documents contain additional information that you may find helpful when you install the transducer.

Transducer Installation Accessories

3300 XL Proximitor® Housing Data Sheet (141195-01)

Reference

Performance Specifications for the 4000 Series Air Gap Sensor System (167545).

Bently Nevada Glossary (133055-01).

3500/46M Hydro Monitor Module Operation and Maintenance Manual (144403-01)

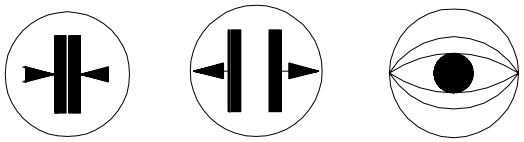
3300 XL Proximitor® Housing Data Sheet (141195-01)

Disposal Statement

Customers and third parties who are in control of the product at the end of its life or at the end of its use are solely responsible for proper disposal of the product. No person, firm, corporation, association or agency that is in control of product shall dispose of it in a manner that is in violation of United States state laws, United States federal laws, or any applicable international law. Bently Nevada, LLC is not responsible for the disposal of the product at the end of its life or at the end of its use.

Symbols

Procedures in this manual use the following symbols:



Connect Disconnect Observe

European CE mark for the Bently Nevada 4000 Series Air Gap Sensor System

CE

In this Document

Is a list of the 4000 Series Air Gap Sensor Assemblies that have the CE mark, applicable standards used for certification, and installation instructions required for compliance.

TCF through TUV Rheinland of North America

A Technical Construction File has been prepared through TUV Rheinland of North America (TUV Rheinland File Number: 30461397.001). The Certificate of Compliance is for Directive 89/336/EEC (EMC Directive). The applicable Generic Norms are: EN61000-6-2 and EN61000-6-4.

Installation Instructions

These instructions are an addition to the Installation Instructions in Section 2.

The 4000 Series Air Gap Sensor System due to its inherent sensitivity, is susceptible to EMI at levels EN61000-6-2. Special EMC (Electromagnetic Compatibility) protection measures may be necessary to achieve reliable measurements. Each unique installation must be considered.

Capacitive Probes All probes must be mounted in an EMI shielded environment (i.e. typically a machine casing ⑥). All probe cables ② and extension cables, running from the point exiting the machine to the EMI shielded enclosure, must be inside metal conduit ⑤ (or equivalent) with the conduit grounded at the machine and the enclosure.

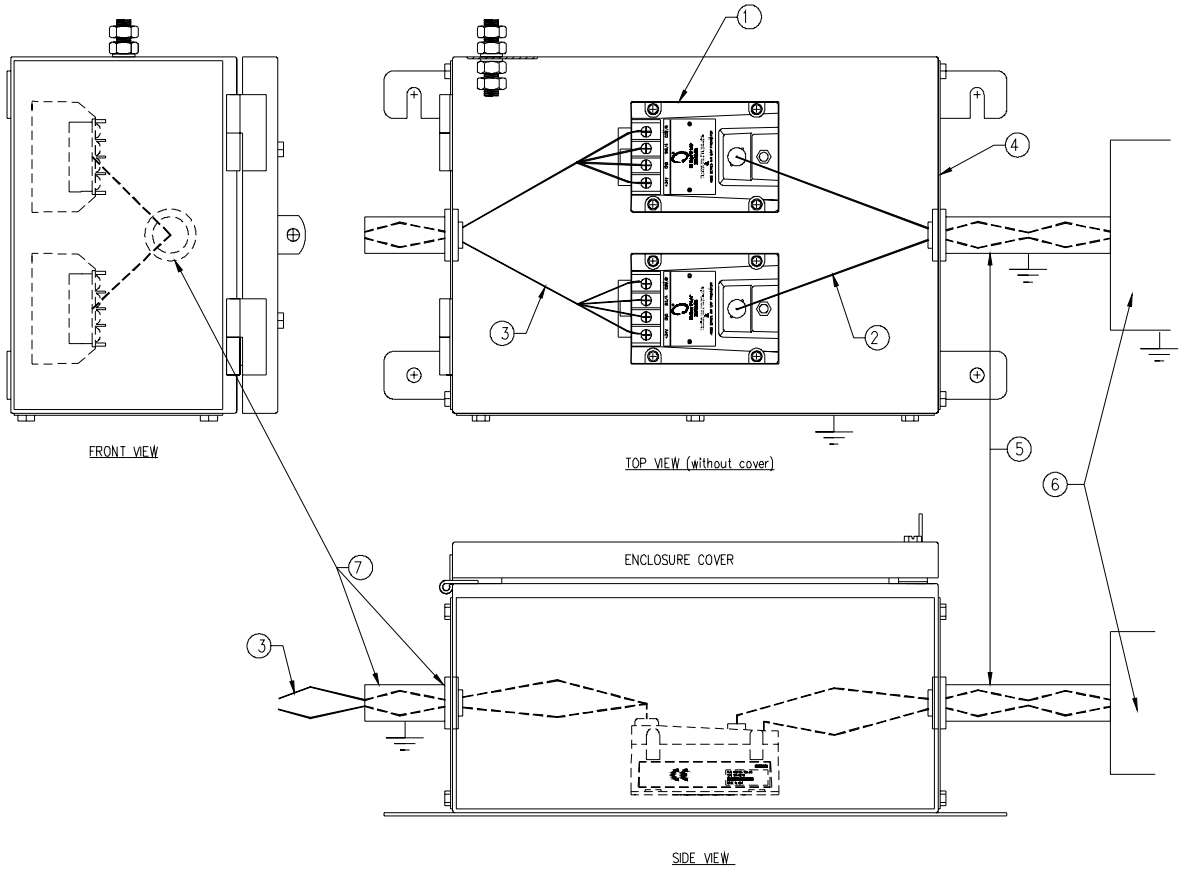
Field Wiring All field wiring ③, from the Proximitor® Sensor enclosure ④ to a receiving unit (i.e. monitor), must be shielded from EMI energy. Acceptable EMI shielding includes solid metal conduit or multi-conductor cable with both a foil and braid shield.

EMI Shielded Enclosures and EMI Shield Grounding Enclosures made of metal typically provide EMI shielding. Covers should be electrically connected to the enclosure or have overlap with the sides of the enclosure, both are preferable. Bently Nevada Proximitor® Sensor Housings and Probe Housings, which are made of metal, provide adequate EMI shielding.

Grounding EMI shields ⑦ at the point of entrance to the Proximitor® Sensor enclosure ④ and any subsequent junction enclosure is required. The shield must be maintained around the wiring as it is grounded to the enclosure.

Exposure of the systems when the EMI shielding is removed (i.e. enclosure cover) will increase EMI susceptibility.

Figure 1



Compliant Systems and Component Part Numbers

#	Model	Model Numbers
1	4000	400100, 400102

Includes all options

Testing and Test Levels

Title	EN 55011 Emission	IEC 61000-4-2 ESD	IEC 61000-4-3 Rad. RFI	EN 61000-4-4 EFT	IEC 61000-4-5 Surge	IEC 61000-4-6 Cond. RFI
Test Levels	Emission Class A	±4kV; ±8kV①	10V/m②	±2kV③	±0.5kV③	10V④
Criteria †	N/A	B	A	B	B	B⑤

These notes listed below apply only to the table "Testing and Test Levels"

① Discharge method: Contact; Air

② 80-1000 MHz sweep with 80% 1 kHz sine wave amplitude modulation

③ Lines tested: I/O

④ 150 kHz-80 MHz sweep with 80% 1 kHz sine wave amplitude modulation

⑤ Based on the high sensitivity of the signal ports, it has to be assumed that the application of immunity test signal temporarily causes incorrect readings. These do not indicate a failure of the system by itself but a possible reason for misinterpretations. For Conducted RF immunity testing, criterion B is therefore used.

† For the purposes of the 4000 Series Air Gap Sensor System CE certification, the following criteria are defined as follows:

- Criteria A: Sensor system will output less than one third of a 2000 mil meter scale and will return to steady state after test completion.
- Criteria B: Sensor system may react in any manner during test, but must self recover after test completion.
- Criteria C: N/A

Contents

Section 1 – System Description

Sensor System

The 4000 Series Air Gap Sensor System consists of:

- a 4000 Air Gap Probe
- a 4000 extension cable
- a 4000 Proximitor® Sensor

Bently Nevada's Air Gap monitoring system provides monitoring and diagnostic capability for all new and existing hydro generators and motor/generators. Air gap monitoring is fully integrated with the 3500/System 1™ platform and utilizes the 46M Hydro Monitor.

Air gap is a measure of the distance between rotor and stator in the hydro generator. Monitoring of air gap is critically important because both the stator and the rotor on large hydro machines can be quite flexible and their shape and location are affected by operating centrifugal, thermal, and magnetic forces. Off-center or out-of-round conditions will at least reduce operating efficiency and, in more severe cases, can lead to damage from magnetically induced heating or a rotor to stator rub.

Air gap monitoring utilizes multiple specially designed capacitive proximity probes that are mounted on the inner bore of the generator stator in one or more planes. Measurements are made from the stator bore to each rotor pole as the rotor turns. Minimum air gap dimension and location along with rotor shape are directly measured during unit operation. Stator shape is calculated utilizing the multiple air gap probes. The air gap monitoring system provides operations and maintenance personnel with early warning of impending problems with shape and concentricity of the generator rotor and stator.

Proximitor® Sensor

The 4000 series Air Gap Proximitor® Sensor is based upon our best selling 3300 XL Proximitor® Sensor technology. The Proximitor® Sensor uses a DIN rail connection to ease installation and to minimize the number of cumbersome screws required when working around the hydro generator. The grounding stud on the Proximitor® Sensor features a safety thread in order to ensure the locking nut does not inadvertently fall off during the installation of the ground wire on the extension cable.

Probe and Extension Cable

The 4000 series Air Gap probe is designed for maximum survivability in the harshest hydro generator environment. It can continually operate and maintain its accuracy in temperatures up to +125 ºC (257 ºF). The probe can also continually operate and maintain its accuracy in the 1.5 Tesla magnetic field often experienced between the rotor pole and the stator. ClickLoc™ connectors come standard on both the probe and extension cable.

Receiving, Inspecting, and Handling the System

The probe, extension cable, and Proximitor® Sensor are shipped as separate units and must be interconnected at the installation site by the user. Carefully remove all equipment from the shipping containers and inspect the equipment for shipping damage. If shipping damage is apparent, file a claim with the carrier and submit a copy to the nearest Bently Nevada office. Include the part numbers and serial numbers on all correspondence. If no damage is apparent and the equipment is not going to be used immediately, return the equipment to the shipping containers and reseal until ready for use.

Store the equipment in an environment free from potentially damaging conditions such as high temperature or a corrosive atmosphere. See Environmental Limits section for environmental specifications.

Customer Service

Bently Nevada maintains numerous Sales and Service offices worldwide. To locate the office nearest you, visit our website at www.bently.com. Here, you can also find specifications on all standard product offerings.

Support for products and services should be directed to one of these departments:

For product quotations, product applications, product ordering, scheduling onsite Services, and questions regarding existing orders, please contact your nearby Bently Nevada Sales and Service Office.

For general product pricing, delivery, or other ordering information, contact your local Bently Nevada office or contact Customer Service Department, Minden, Nevada, USA Phone: 1-775-215-1011 Fax: 1-775-215-2873

For technical questions or problems regarding installed Bently Nevada products, contact our Technical Support Staff at:

techsupport@bently.com

or at the following locations:

Technical Support (North America)

Phone: 1-775-782-1818 Fax: 1-775-215-2890

Technical Support (UK)

Phone: (44) 1925 818504 Fax: (44) 1925 817819

Section 2 — Installation

Sensor Installation

Introduction

Anywhere from 4 to 16 sensors will be attached to the stator laminations at evenly spaced intervals on the same plane. The stator wall shall be well prepared, as described below prior to attaching the sensor.

Handle the sensor with care. Do not pull on the cable or connector. Never paint or attach anything to the sensor surface.

Additional Equipment List

- Isopropyl alcohol
- Disposable cloth rags
- Fine grit sandpaper (non-metallic)
- Depth Micrometer
- Electric Drill (with #7 drill bit)
- ¼-20 tap
- 18 gauge wire stripper
- Hand crimper (for ring lugs)
- Safety Wire (optional and must be non-magnetic)
- Cable tie downs (non-magnetic and ozone resistant)
- Miscellaneous conduit fittings (Consult 3300 XL Proximitor® Housing data sheet for a list of available fittings)

Important Installation Tips

- Be sure that all precautions have been taken to prevent objects from falling through the air gap to the bottom of the generator

- Be sure to review the applicable Material Safety Data Sheets for the chemicals used to assure proper personal protective equipment (PPE) is worn.

- When securing cable, conduit, or anything else inside the generator, use ONLY clamps and hardware that are non-magnetic and not affected by ozone. Ungrounded magnetic materials get very hot in the high magnetic field and can cause shorting and damage to insulation or other components. **Do not** use nylon cable ties to secure items except temporarily. Most plastics and natural rubbers become brittle and eventually are destroyed by ozone present in the generator. Panduit Corporation makes non-magnetic stainless steel hold-downs and cable ties. If a softener is needed around the cables, use a silicon rubber or fiberglass tape.

- Be sure that the extension cable is tight at the sensor end. The wire must not be allowed to become loose and get tangled in or damaged by the rotor.

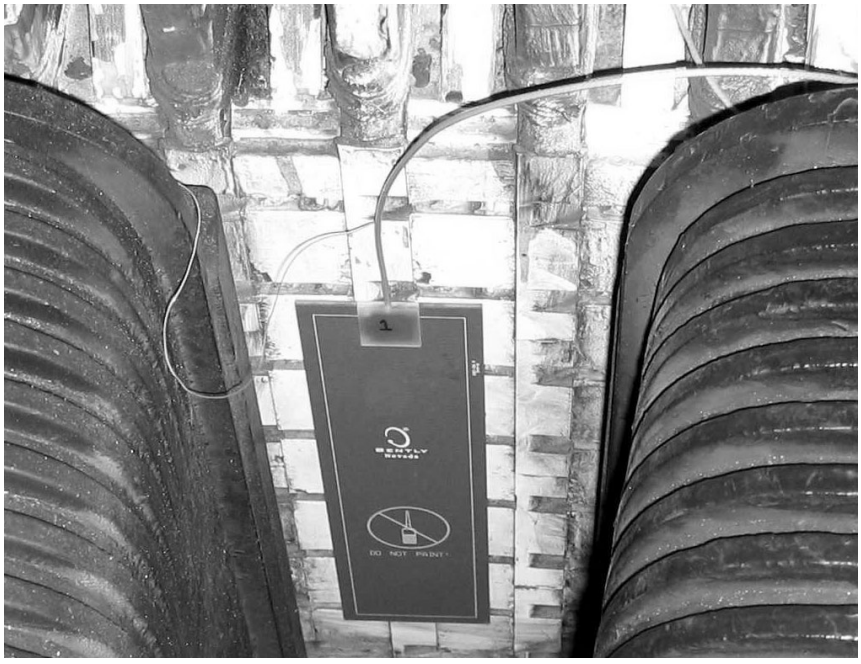
Stator Surface Preparation

The stator surface must be properly prepared in order for the sensor to be fully secured to the stator wall. Failure to do so could result in a lost sensor.

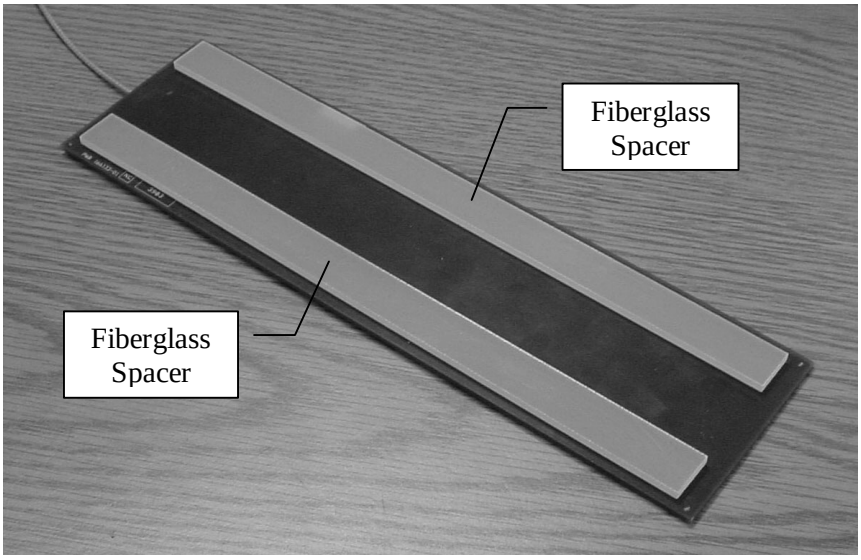
1. The sensor should be mounted such that it is centered over the stator slot wedge and located beneath the second ventilation hole. Once a suitable mounting location has been determined, moisten cloth rag with isopropyl alcohol and thoroughly wipe down gluing area on stator to remove oil and carbon deposits.
2. Using 200 grit, non-metallic sandpaper, scuff the stator wall along the stacks and verify that there are no protrusions of paint that need to be removed or sanded down. (The goal of sanding the stator is to roughen the surface for adhesion, not remove the layer of painted insulation. Please be sure to wear proper personal protective equipment, as required by the Material Safety Data Sheet, when sanding the stator due to possible dust exposure.)
3. Once sanded, wipe down again, with a cloth rag moistened with isopropyl alcohol.
4. Be sure that none of the stacks protrude out farther than the rest as the sensor must be adhered to a flat surface. If this is the case, try moving the sensor either to the left or right of the protrusion.

Attaching The Sensor

1. Prior to gluing the sensor to the stator verify that the sensor is functioning. Power up the sensor and connect the grounding wires to a grounded object. Pass your hand or an object over the face of the sensor and observe the Proximitor® Sensor output. This should result in a decrease in voltage.
2. Apply the silicone adhesive (supplied) in two strips, approximately ¼" away from the edges and approximately ¼" wide along the length of the sensor. Even after sanding, the surface is not flat and there needs to be enough adhesive to fill the gaps, but not so much that it will run out from the edges. Be sure to save the remaining adhesive for securing the sensor cable.
3. Place the sensor in position such that it faces in between the poles and that the top of the sensor is located just below the second ventilation hole, as illustrated in the figure below. Pivot the sensor slightly to spread adhesive and hold for approximately one minute onto stator wall. Avoid gluing the sensor against the surface of the wedge.



4. If the wedges protrude out farther than the surface of the stator stack, the supplied fiberglass spacers must be used in order to clear the wedges as shown in the picture below. Use the supplied silicone to adhere the wedges as shown below. After the adhesive has set (approximately 1 hour), run a ¼" wide strip of silicone down the center of each spacer and attach to the stator wall in the same fashion as mentioned above.



Determining Sensor Offset

The distance between the sensor surface and the stator surface must be measured. As shown in the picture below, the measurement, D, accounts for the thickness of the sensor, adhesive and spacers (if used). The measurement, D, is the average of six offset measurements taken at points on the sensor as shown below. The measurement, D, should be entered into the 3500 Configuration Software. Consult the 3500/46M Hydro Monitor Module Operation and Maintenance Manual for instructions on how to enter this data.

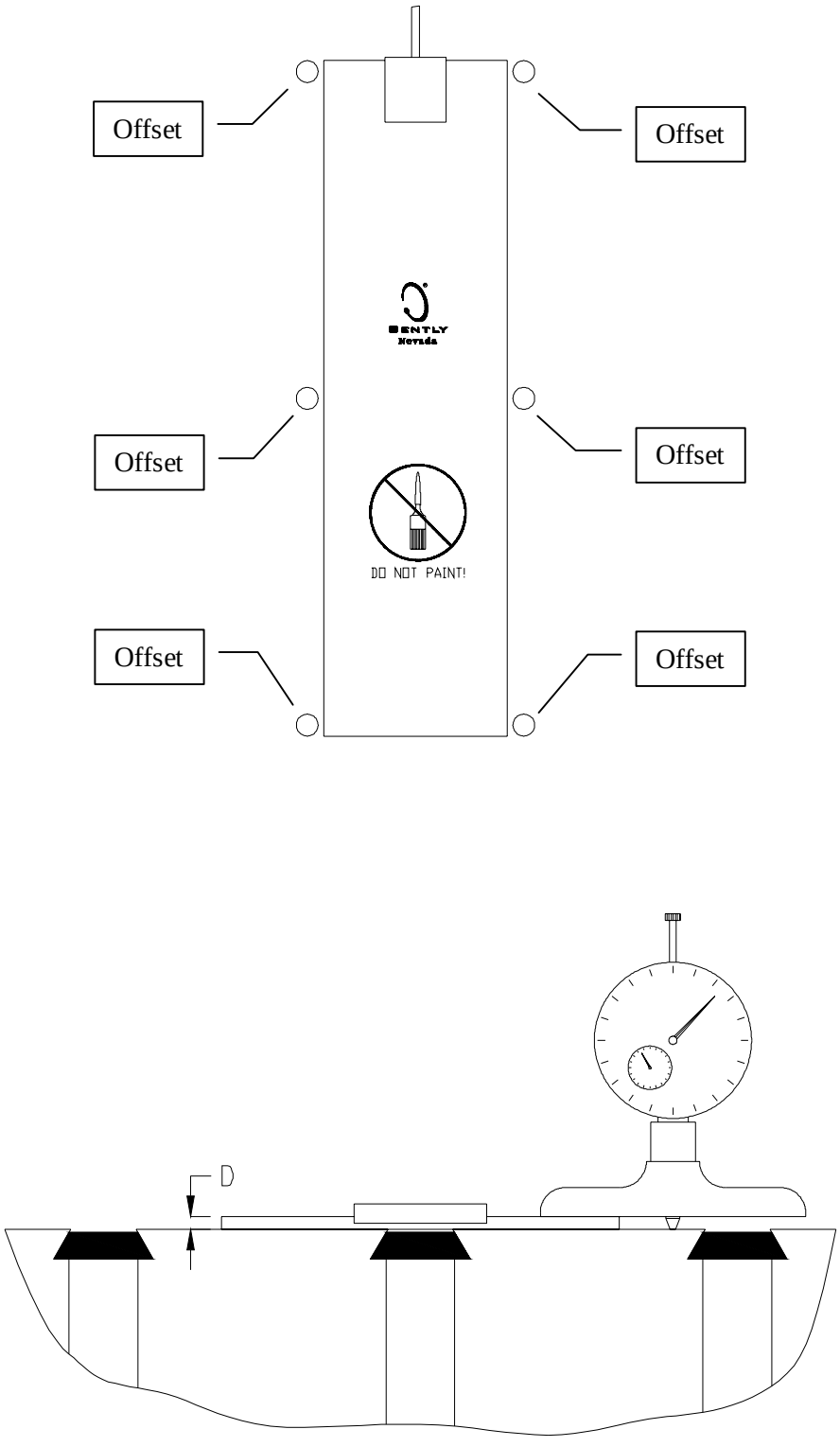


Figure 2-1 Sensor offset for installations without spacers.

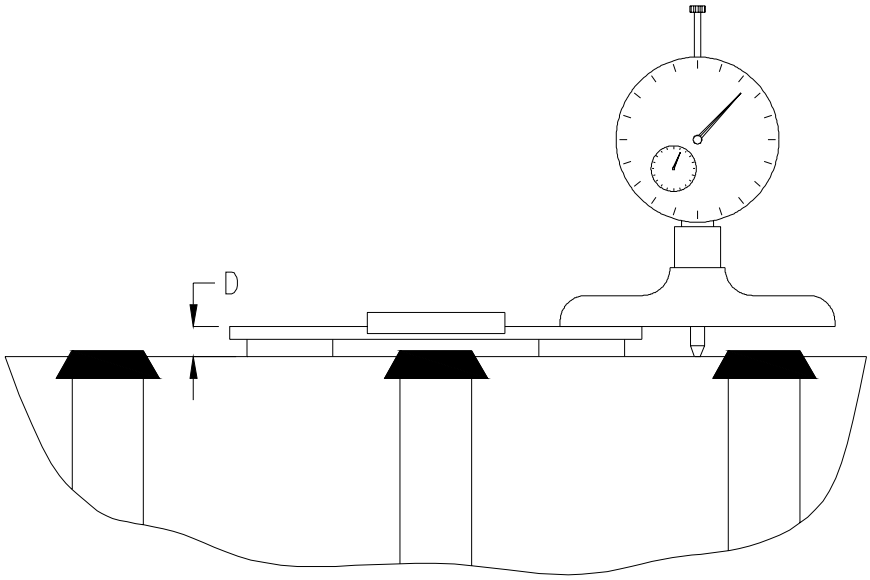


Figure 2-2 Sensor offset for installations with spacers.

Teflon® Conduit Installation

Introduction

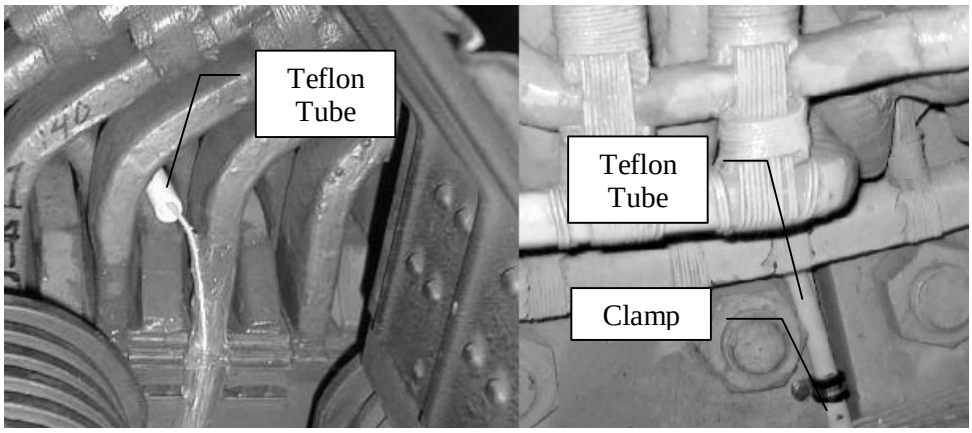
The Teflon® conduit tubing protects the sensor cable, extension cable, and connection from the stator windings. The tube is fed through the windings as close as possible to the top of the sensor and anchored down with the supplied loop strap and ¼-20 bolt.

The following materials will be required for this installation:

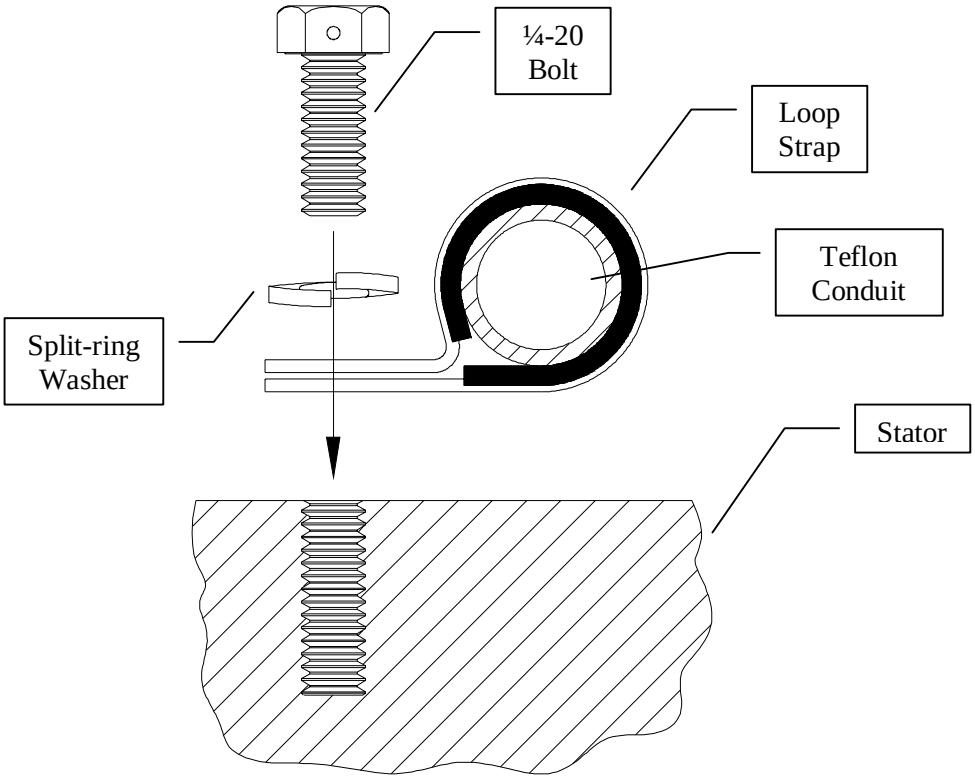
- Installation kit (included with sensor)
- Electric drill (with #7 drill bit)
- ¼-20 tap

Tube Preparation

1. An eighteen-inch tube is provided for the installation. This length should be more than long enough, but some applications will require that this tube be cut to length. Measure the distance through the windings from a point just above the probe (and slightly recessed within the windings) to a point several inches behind the stator windings. See the figure below for clarification.



2. Once the tube is in place, slide the clamp over the tube and place in the approximate mounting positions. Mark its location and drill and tap the stator (approximately ¾" deep) for a ¼-20 bolt.
3. For added security, safety wire the bolt to the tube and clamp by threading the safety wire through each bolt.



Triaxial Extension Cable Installation

Introduction

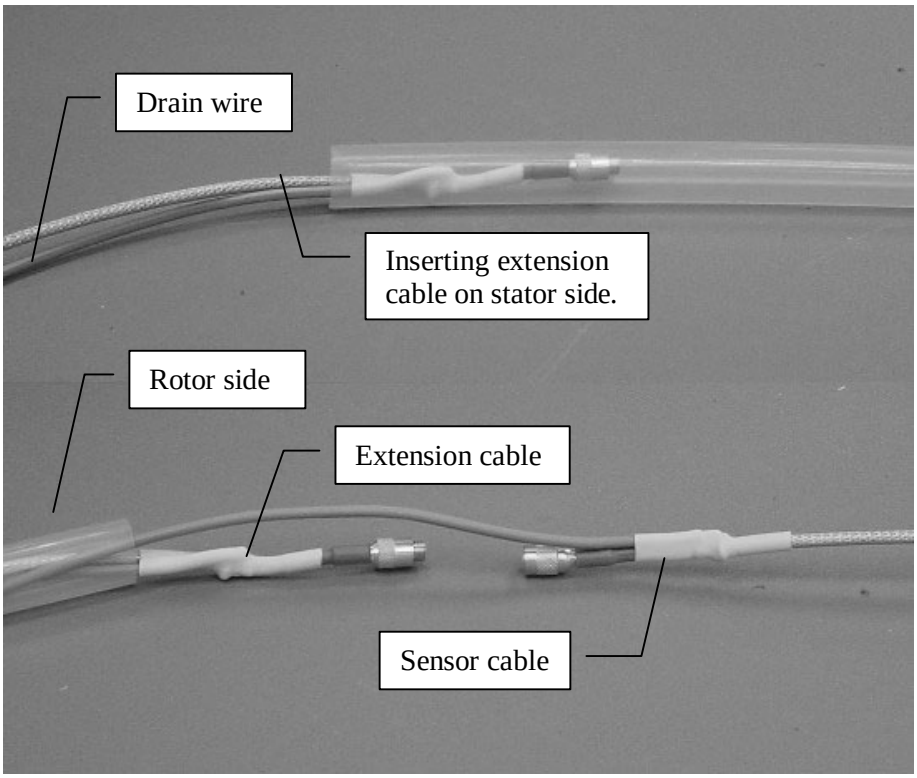
The triaxial extension cable is used to connect the Air Gap Sensor to the Proximitor® Sensor. This 10-meter cable has a female coaxial connector on one end, and a BNC connector on the other end, each with a drain wire.

The following materials will be required for this installation:

- Installation kit (included with sensor)
- 18 gauge wire stripper
- Hand crimper (for ring lugs)

Installation

1. Carefully slide the green drain wire and female coaxial end of the extension cable through the Teflon® conduit tube (near the clamp, behind stator windings) until the connector protrudes out the other end (toward the rotor) by about 2 inches.
2. Attach the male connector from the sensor to the female connector (finger tight) from the extension cable. The Clickloc™ design will prevent these from disconnecting.
3. Feed sensor cable drain wire through the Teflon® conduit tube as far as it can go. Carefully pull the extension cable, until slightly taut, through the Teflon® conduit tube. The connection will lie somewhere within the Teflon® conduit tube. Be sure that drain wire from sensor protrudes out the other side. See figure below for clarification.



4. Once the extension cable is attached to the sensor cable and the excess slack is taken up, the exposed cable between the sensor and the Teflon® conduit tube needs to be secured. Make sure the path of the cable is cleaned with isopropyl alcohol before proceeding. Liberally cover the cable with the silicone adhesive, securing it to the stator stacks. Do not paint, put silicone on, or in any way cover the surface of the sensor.

5. Allow the sensor to dry in place for a minimum of an hour and preferably overnight before proceeding.
6. The drain wire from the sensor and extension cable may need to be trimmed to reduce excess slack. Once trimmed (if necessary), strip wire and attach a ring lug to both leads using the hand crimper. Attach both grounds to the ¼-20 bolt securing the Teflon® conduit tube in place.
7. Using the supplied adhesive, seal the Teflon® conduit tube opening near the clamp to prevent the cable from sliding.

Installation of Wiring Inside Generator Housing

- **IMPORTANT!** When securing cable, Teflon® conduit tube, or anything else inside the generator, use ONLY clamps and hardware that are non-magnetic and not affected by ozone. Ungrounded magnetic materials get very hot in the high magnetic field and can cause shorting and damage to insulation or other components. **Do not** use nylon cable ties to secure items except temporarily. Most plastics and natural rubbers become brittle and eventually are destroyed by ozone present in the generator. Panduit Corporation makes non-magnetic stainless steel hold-downs and cable ties. If a softener is needed around the cables, use a silicon rubber or fiberglass tape.

- Teflon® conduit tube and cable inside of the generator housing should be attached securely every 12-18 inches.

- IMPORTANT! Be sure that the extension cable is tight at the sensor end. The wire must not be allowed to become loose and get tangled in or damaged by the rotor.

Enclosure, Power Supply & Proximitor® Sensor Installation

Introduction

The 3300 XL Proximitor® Housing, P/N 330181-01-00-01-00, allows you to protect Proximitor® Sensors and electrical terminal blocks in areas that would otherwise be subjected to possible damage from moisture or other adverse environmental conditions.

The housing is designed to accommodate a maximum of four Air Gap Proximitor® Sensors and a +24 Vdc (BN P/N 02200627) power supply in a DIN style configuration. For a hydro turbine with four sensors installed, we recommend two Proximitor® Sensors and one power supply per housing, for a total of two housings.

Prior to installing the enclosure, keep in mind the following requirements:

- Position the enclosure such that the 10-meter extension cable will reach the Proximitor® Sensor.
- Access to sufficient ground.

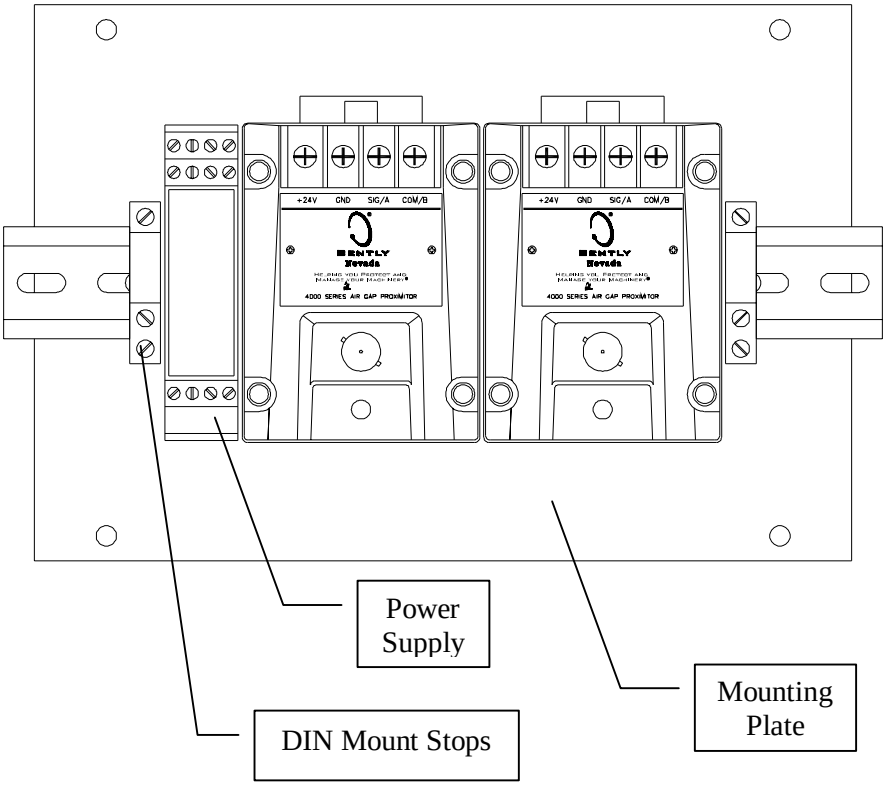
- Access to proper input power for external +24 Vdc power supply.

Mounting The Enclosure

This housing contains removable gland plates, making it easy to drill or punch holes to install conduit fittings. There are also four mounting tabs on the unit allowing simple attachment to any flat surface. The final mounting and conduit configuration is to be determined by the end user.

Power Supply And Proximitor® Sensor Layout

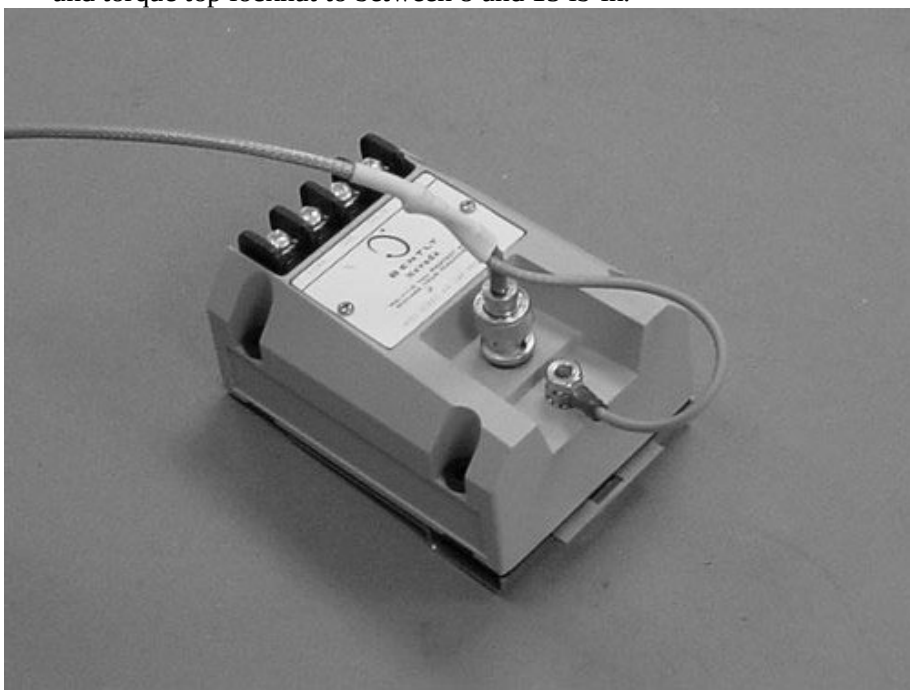
The figure below depicts the ideal layout for two Proximitor® Sensors and a power supply (housing not shown).



Sensor Connection

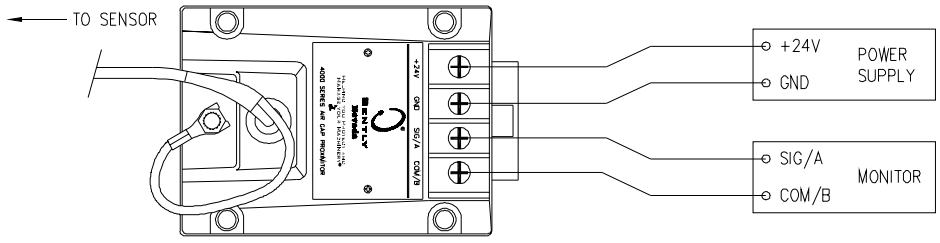
See figure below for the following connections:

- Attach male BNC connector from extension cable to the female BNC on Proximitor® Sensor.
- Loosen top locknut until it stops. Place spade lug from drain wire onto stud and torque top locknut to between 8 and 15 lb-in.



Electrical Connection

The Proximitor® Sensor requires +24±3% Vdc. BN P/N 02200627 or a similar +24 Vdc power supply is recommended to meet voltage requirement. Please see schematic below for proper connection.



Note: Once the Proximitor® Sensors are powered and put into service they should remain powered at all times except when being serviced. To protect the Proximitor® Sensors from an unwanted Electrostatic Discharge (ESD), power should be removed from the Proximitor® Sensors prior to having any work done inside the Proximitor® Housing. Do not attach power to the Proximitor® Sensors if the temperature is below 0 ºC (+32 ºF).

Application Note: When connecting the Proximitor® Sensor to the 3500 Prox/Velom I/O Module the A and B connections should be followed. The Air Gap Proximitor® Sensor is a positive output device and the Signal (SIG) and Common (COM) outputs must be reversed when connecting to the Prox/Velom I/O Module. The A output of the Proximitor® Sensor should be connected to the A input of the I/O Module and the B output of the Proximitor® Sensor should be connected to the B input of the I/O Module.

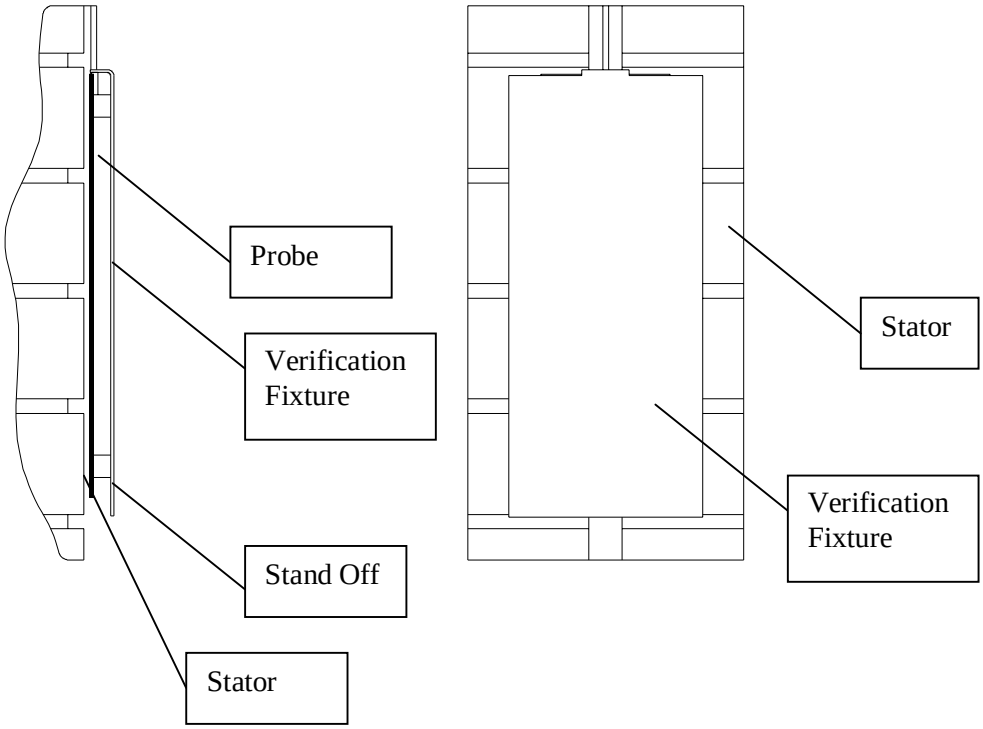
Verification

All sensors should be verified for proper operation prior to the commissioning of the generator. Bently Nevada accessory P/N 168448-01 can be used to verify that each sensor's output correlates to a known gap voltage.

The verification plate is designed to provide an air gap of 388 ± 32 mils when installed over the face of the sensor after it has been glued to the stator.

See figure below for installation orientation.

- Place target on sensor, such that notched lip hooks on the top of the sensor without disrupting cable.
- Make sure the magnetic standoffs are on the sensor face and not resting on any part of the stator.
- Connect target to stator using supplied drain wire.
- Verify output of the Proximitor® Sensor. This can be accomplished in two ways:
    - Measure the voltage between the SIG and COM outputs of the Proximitor® Sensor. The voltage should be 1.94 ± 0.16 Vdc.
    - Use the 3500 Configuration Software to verify the correct output of the air gap sensor system and adjust if desired. The measurement will be displayed in mils and should lie between the measurement for the air gap listed above. Consult the 3500/46M Hydro Monitor Module Operation and Maintenance Manual for instructions on how to verify sensor readings and adjust readings if desired.
- Remove the verification fixture from the sensor after verifying the output voltage and gap prior to the starting of the generator.



Section 3 — Maintenance and Troubleshooting

This section shows how to verify that the system is operating properly and identify parts of the system that are not working properly.

The 4000 Series Air Gap Sensor System (probe, cable and Proximitor® Sensor), when correctly installed and verified, does not need calibration or verification at regular intervals. If the monitor OK light (green) indicates a NOT OK condition (light is **not** illuminated), either a fault has occurred in the field wiring, transducer system, or power source.

Bently Nevada recommends the following practices to assure continued satisfactory operation. Verify operation by using Bently Nevada accessory P/N 168448-01 and the verification method described in Section 2 if:

- Any of the system components (probe, cable or Proximitor® Sensor) are replaced.
- Any of the components are removed and reinstalled or moved and remounted.
- Any of the components appear to be damaged.
- Whenever the machine being monitored is over-hauled.

Please note that a step change in the output of the transducer system, or other output that is not consistent with the associated machinery's trended data is, in most instances, not a transducer problem but a machinery problem. Verification of the transducer system under these conditions can be done at the user's discretion.

Some users may prefer to verify all transducers at a regular interval. As noted above, this is not required with the 4000 Series Air Gap Sensor System. Users who wish to verify the system on a regular interval should use an interval consistent with their own practices and procedures, which may or may not be based upon ISO 10012-1 "Quality Assurance Requirements for Measuring Equipment" (section 4.11).

Troubleshooting

This section shows how to interpret a fault indication and isolate faults in an installed transducer system. Before beginning this procedure, be sure the system has been installed correctly and all connectors have been secured properly in the correct locations.

When a malfunction occurs, locate the appropriate fault, check the probable causes for the fault indication and follow the procedure to isolate and correct the fault. Use a digital voltmeter to measure voltage. If you find faulty transducers, contact your local Bently Nevada office for assistance.

The troubleshooting procedures use measured voltages as shown in the following figure and tables:

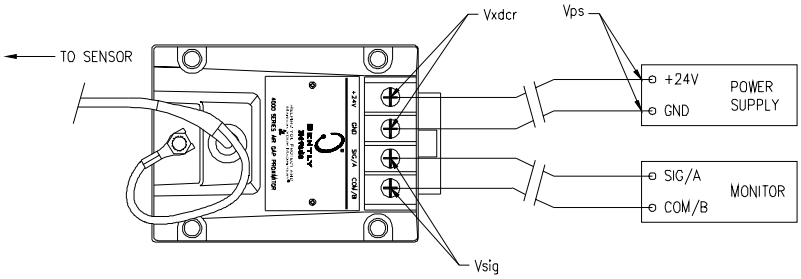
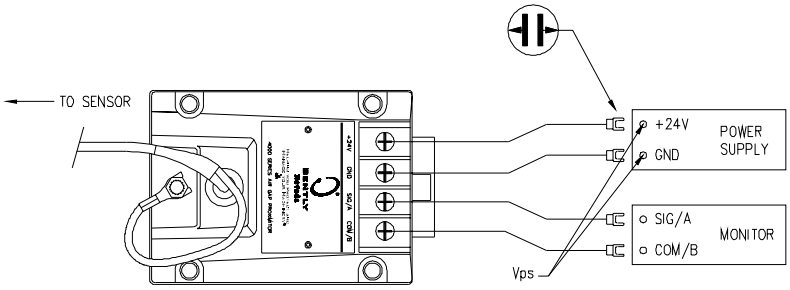


Table 3-1 Symbols for Measured Voltages

Symbol	Meaning	Voltage measured between...
V_{SIG}	Signal voltage from the transducer	SIG/A and COM/B
V_{PS}	Power supply voltage	Power Supply and Ground
V_{XDCR}	Supply voltage at transducer	+24V and GND

Note: V_{SIG}, V_{PS}, and V_{XDCR} are all positive voltage values.

Table 3-2 Definitions



Symbol	Definition	Example
A > B	"A" value is more positive than "B"	23 > 21
A < B	"A" value is more negative than "B"	5 < 10
A = B	"A" same value (or very close) to "B"	3.40 = 3.41

Fault Type 1: V_{XDCR} < 23.2 Vdc or V_{XDCR} > 24.8 Vdc

Possible causes:

- Faulty power source
- Faulty field wiring
- Faulty Proximitor® Sensor

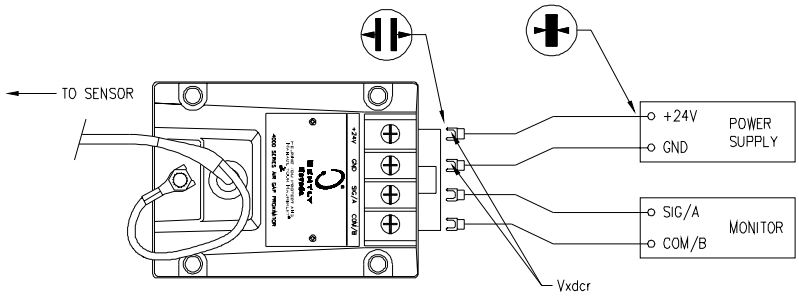
Measure V_{PS}: Is V_{PS} < 23.2 Vdc or V_{PS} > 24.8 Vdc?

Yes: Faulty power supply.
No: Go to next step.

Measure V_{XDCR}: Is V_{XDCR} < 23.2 Vdc or V_{XDCR} > 24.8 Vdc?

Yes: Faulty Field wiring.
No: Faulty Proximitor® Sensor.

Fault Type 2: V_{SIG} = 0 Vdc

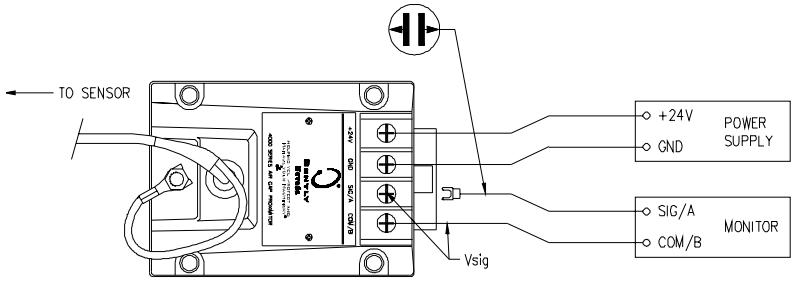


Possible causes:

- Incorrect power source voltage
- Short circuit in field wiring
- Short circuit at Proximitor® Sensor terminal connection
- Faulty Proximitor® Sensor

Does fault condition type 1 exist?

Yes: Use the procedure for fault type 1
No: Go to the next step



Measure V_{SIG}: Is V_{SIG} = 0 Vdc?

No: Incorrect power source voltage or short in field wiring or short at Proximitor® Sensor terminal connection.
Yes: Faulty Proximitor® Sensor.

Fault Type 3: 0 Vdc < V_{SIG} < 0.01 Vdc

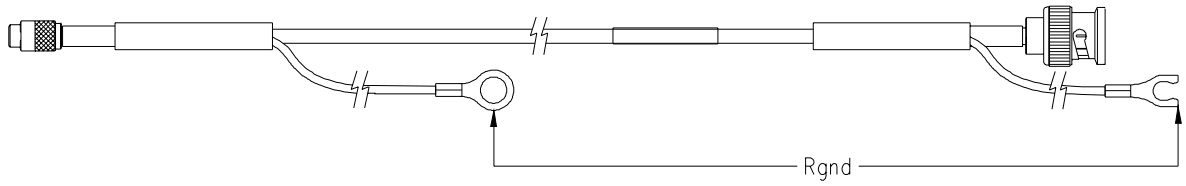
Possible causes:

- Incorrect power source voltage
- Faulty Proximitor® Sensor
- Short or open circuit in a connector (dirty or wet) or loose connectors
- Short or open circuit in the probe
- Short or open circuit in extension cable

Does fault condition type 1 exist?

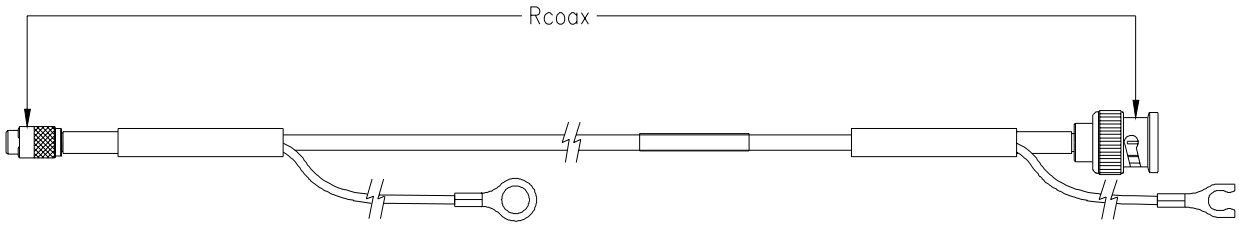
Yes: Use the procedure for fault type 1
No: Go to the next step

Measure continuity at the following points on the extension cable:



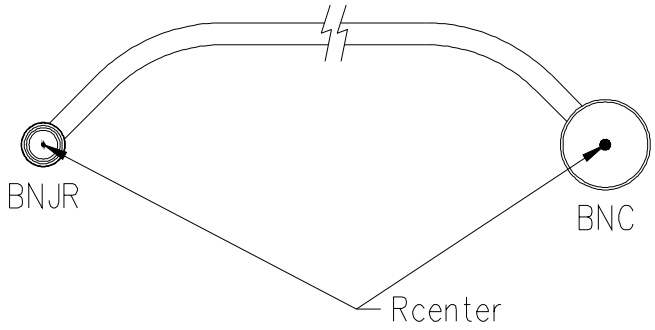
Is 0.1 Ω < R_{GND} < 1.0 Ω ?

Yes: Go to next step
No: Faulty extension cable



Is 0.1 Ω < R_{COAX} < 1.0 Ω ?

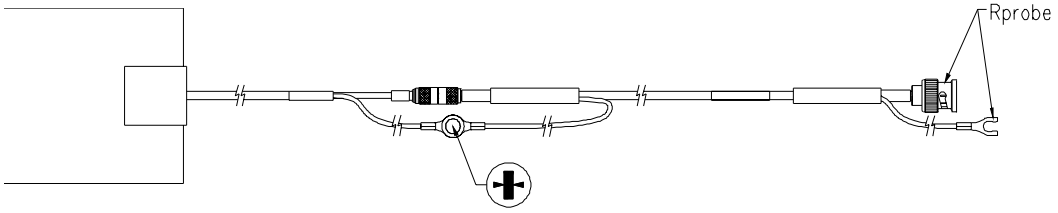
Yes: Go to next step
No: Faulty extension cable



Is 7 Ω < RCENTER < 8 Ω ?

Yes: Go to next step
No: Faulty extension cable

Disconnect the BNC connector and the grounding wire from the Proximitor® Sensor. Measure the resistance between the grounding wire and the outer conductor of the BNC connector with the probe connected to the extension cable and the probe grounding wire connected to the probe side extension cable grounding wire;



Is 200.8 kΩ < R_{PROBE} < 201.2 kΩ ?

No: Faulty probe

Fault Type 4: V_{SIG} > 14 Vdc with verification fixture on the face of the probe

Reconnect the BNC connector and the grounding wire to the Proximitor® Sensor. Power up the system and install the Air Gap verification fixture over the face of the probe. Make sure both the surface the probe is resting on and the Air Gap verification fixture are grounded. Measure V_{SIG}.

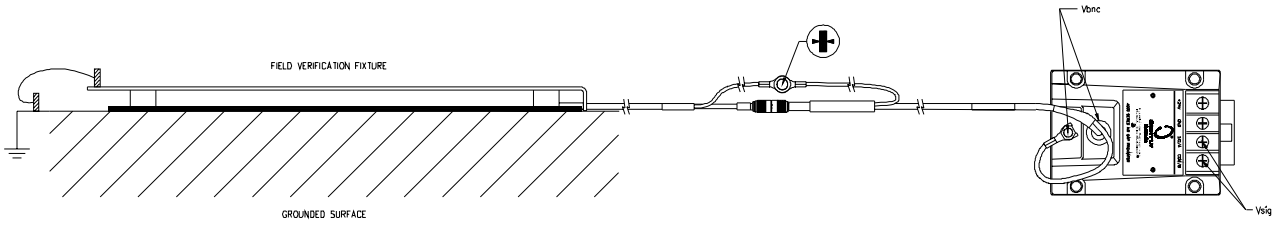
Is V_{SIG} > 14 Vdc?

Yes: Faulty probe, Proximitor® Sensor or cable
No: Go to next step

At this point, set up a known good system and verify that V_{SIG} of the Proximitor® Sensor is in the following range with the Air Gap verification fixture properly placed on the probe face:

1.85 Vdc < V_{SIG} < 2.10 Vdc

With the verification fixture in place, begin swapping the questionable individual components in to the known good system to determine which component is faulty. Whichever component causes V_{SIG} to fall outside of the above voltage range is defective.



Section 4 — 3300 XL Proximity Housing Description

The 3300 XL Proximitor® Housing allows you to protect Proximitor® Sensors, interface modules and electrical terminal blocks in areas that would otherwise be subjected to possible damage from moisture or other adverse environmental conditions.

Mounting Options

The 3300 XL Proximitor® Housing is designed to accommodate both DIN-rail and panel mounted Proximitor® Sensors although the 4000 Series Air Gap Proximitor® Sensors only come with DIN mount option. The housing holds up to **four** 4000 Series Air Gap Proximitor® Sensors and **one** power supply.

Environmental Certifications

The 3300 XL Proximitor® Housing has been tested and certified to meet stringent **IP66** and **Type 4X** environmental ratings for protecting enclosed electronic equipment in harsh conditions. The 304L stainless steel construction resists moisture, corrosion, and impacts in virtually all installations. The housing may be hosed down for cleaning when necessary. The 3300 XL Proximitor® Housing can be used for North American Division 1 and 2 and European Zone 0, 1, and 2 hazardous area applications when used with approved fittings. However, it is **not** an explosion-proof housing.

Removable Gland Plates

The 3300 XL Proximitor® Housing is our only housing with removable gland plates. This feature makes it easy to remove the side plates or bottom gland plate for drilling or punching conduit holes. In addition, the door can be easily unlatched and removed due to its stainless steel slip hinge.

The gland plates have four thickness options to suit various conduit installation requirements. If you want a threaded conduit hole, a gland plate thickness of 3.05 mm (0.120 in) or greater is required in order to properly drill and tap the holes.

The conduit fittings come with a lock nut and O-ring to firmly tighten and seal the conduit fitting into both tapped and untapped holes. Fittings are available in stainless steel, brass, aluminum or chrome-plated zinc.

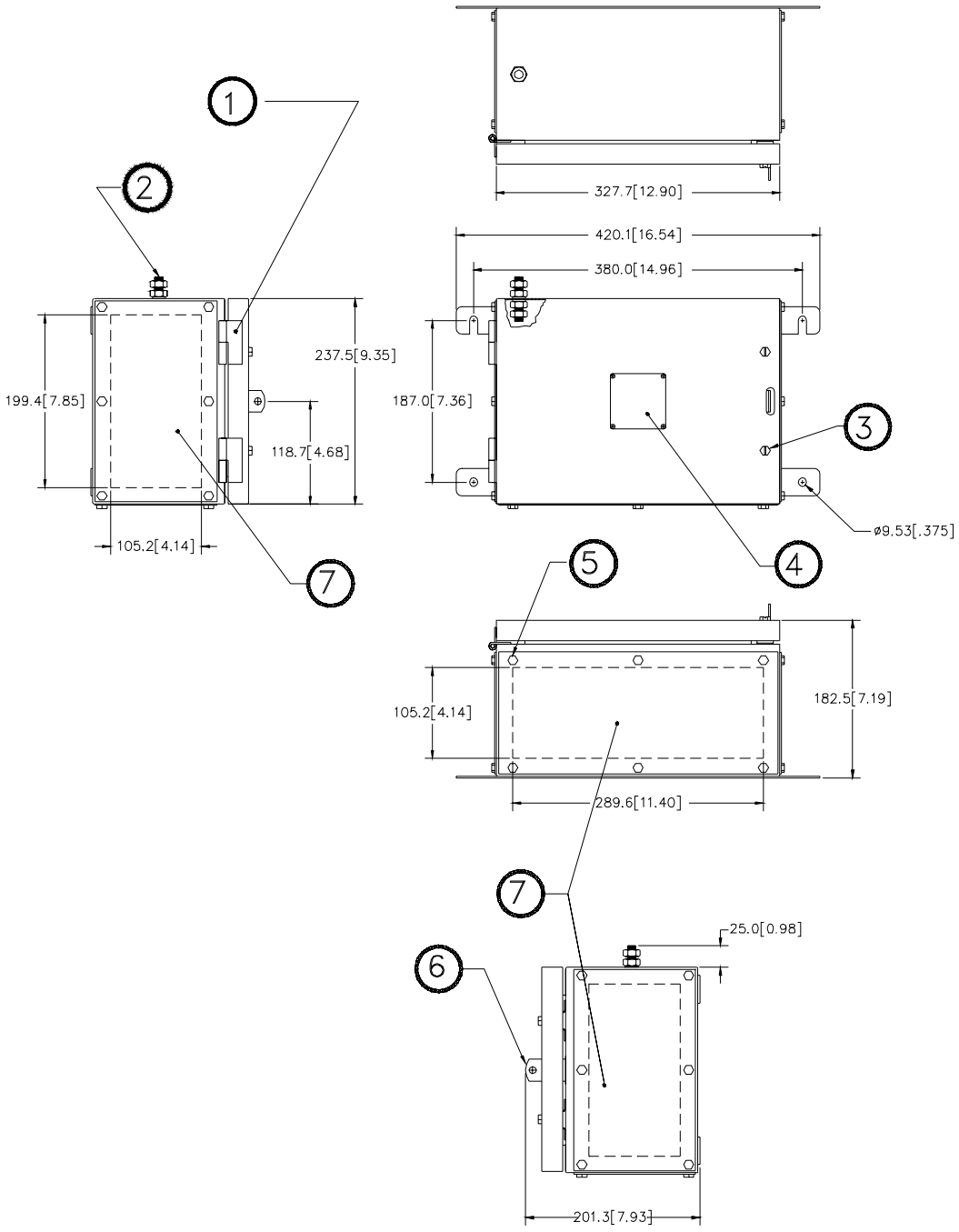
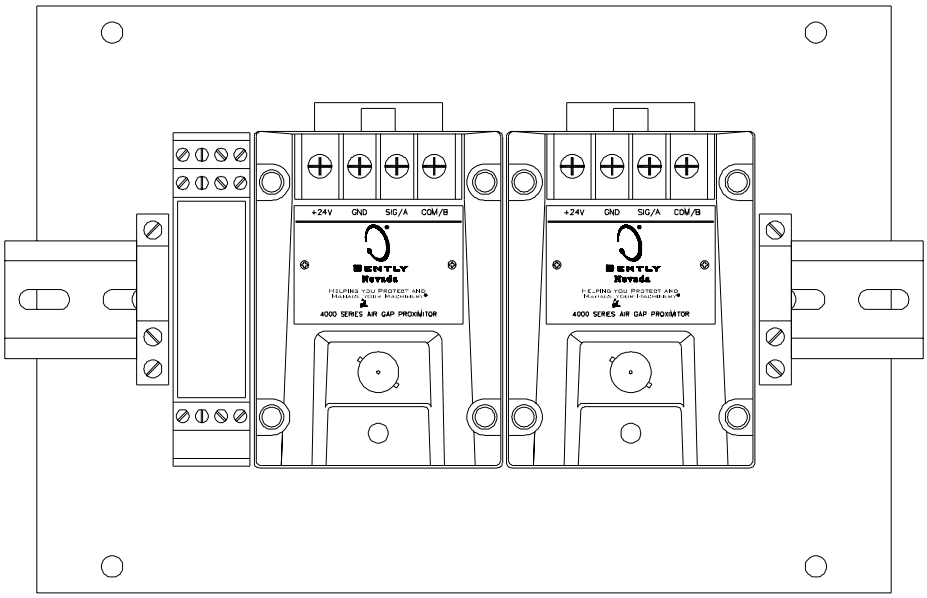


Figure 4-1 3300 XL Housing Outline Drawing

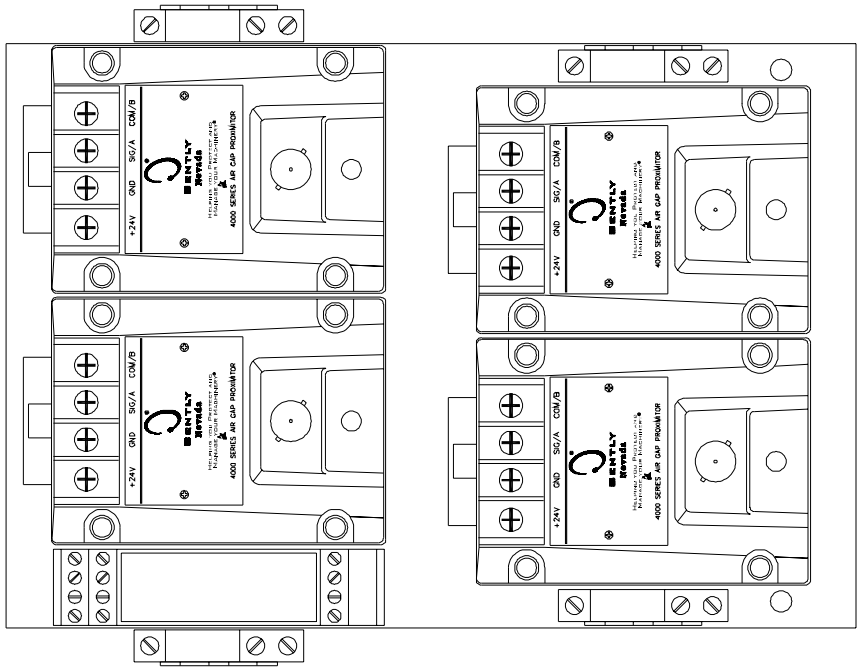
(1) Stainless steel slip hinge. Allows cover to be removed from housing
(2) M10 x 1.5 – 6 g grounding stud, stainless steel
(3) M6 slotted hex head captive fastener, stainless steel
(4) Approval/ identification label
(5) M6 x 16 mm hex head bolt, stainless steel
(6) ϕ 8.33 [0.328] padlock hasp
(7) Removable gland plate, 3 places

Din Mount Orientation

The following illustration shows the correct orientation for two DIN mounted 4000 Series Air Gap Proximitor® Sensors in the 3300 XL Proximitor® Housing:



The next illustration shows the correct orientation for four DIN mounted 4000 Series Air Gap Proximitor® Sensors in the 3300 XL Proximitor® Housing:



Section 5 — 4000 Series Air Gap Sensor System Specifications and Ordering Information

Unless otherwise noted, the following specifications are for a 4000 Series Air Gap Proximitor® Sensor, extension cable, and probe between 0ºC and +50ºC (+32ºF to +122ºF), with a +24 Vdc power supply, and a 10 kΩ load.

Electrical

Proximitor® Sensor Input

Accepts one non-contacting 4000 Series Capacitive Probe and Extension Cable

Power

Requires +23.25 Vdc to +24.75 Vdc at 75 mA maximum consumption

Supply Sensitivity

Less than 20 mV change in output voltage per volt change in input voltage

Output Resistance

50 Ω ± 5%

Extension Cable capacitance

75.5 pF/m (23.0 pF/ft) typical

Field Wiring

0.2 to 1.5 mm^2 (16 to 24 AWG)

Recommend using two-conductor shielded cable. Maximum length of 305 metres (1000 feet) between the 4000 Series Proximitor® Sensor and the monitor.

Linear Range

45.7 mm (1800 mils). Linear range begins at approximately 5.1 mm (200 mils) from the face of the probe and is from 5.1 to 50.8 mm (200 to 2000 mils) (approximately +1 to +10 Vdc).

System

Average Scale Factor (ASF)

0.20 mV/µm (5.0 mV/mil), nominal

Deviation from a straight line

Less than ±2.54 mm (±100 mils) with system between 0 ºC and +50 ºC (+32 ºF and +122 ºF).

Frequency Response

0 to 5.0 kHz: +0, -3 dB typical with up to 305 metres (1000 feet) of field wiring.

Electrical Classification

Complies with the European CE mark.

Mechanical

Probe Material

FR4 type material

Probe Cable Specifications

75 Ω triaxial, fluoroethylene propylene (FEP) cable

Extension Cable Material

75 Ω triaxial, flouroethylene propylene (FEP) cable

Proximitor® Sensor Material

Aluminum

Tensile Strength (maximum rated)

312 N (70 pounds) probe lead to probe. 89 N (20 pounds) at probe lead to extension cable connectors.

Connector Material

Gold-plated brass and gold-plated beryllium copper

Connector-to-connector torque

Recommended Torque

Finger tight

Maximum Torque

0.565 N•m (5 in•lb)

Minimum Bend Radius

25.4 mm (1.0 in)

System Mass (typical)

Probe

Approximately 140 g (0.3 lbs)

Extension Cable

Approximately 320 g (0.7 lbs)

Proximitor® Sensor

Approximately 380 g (0.8 lbs)

Environmental Limits

Probe Temperature Range

Operating Temperature

0 to +125 ºC (+32 to +257 ºF)

Storage Temperature

-35 to 125 ºC (-31 to 257 ºF)

Extension Cable Temperature Range

Operating Temperature

0 to +125 ºC (+32 to +257 ºF)

Storage Temperature
-35 to +125 ºC (-31 to +257 ºF)

Proximitor® Sensor Temperature Range

Operating Temperature
0 to +70 ºC (+32 to +158 ºF)

Storage Temperature
-35 to +85 ºC (-31 to 185 ºF)

Relative Humidity

Less than a 5% change in average scale factor when tested in 93% humidity in accordance with IEC standard 60068-2-78 for up to 56 days.

Patents Pending

Ordering Information

4000 Series Capacitive Proximity Probe

400102-01
45.7 mm (1800 mils) linear range probe

4000 Series Air Gap Proximitor® Sensor

400100-AXXX-BXX

A: System Length Option
1 0 0 10.0 metre (33 feet) system length

B: Probe Size Option
0 2 Use with 400102-01

4000 Series Extension Cable

400130-AXXX

A: Cable Length
1 0 0 10.0 metre (33 feet) cable length

Accessories

167545
Performance Specification

02200627
+24 Vdc Power Supply

330181
3300 XL Proximitor® Housing. Suggested configuration is 330181-01-00-01-00-00; a housing with DIN mount hardware, no conduit fitting, standard 2.34 mm (0.92 in) gland plate thickness, no terminal blocks, and no approvals.

02173006

Bulk Cable (specify length in feet) 1.0 mm^2 (18 AWG), 2-conductor, twisted, shielded cable used for the PROX OUT signal on the Air Gap Proximitor® Sensor terminal strip

168448-01

Air Gap Verification Kit

Graphs and Dimensional Drawings

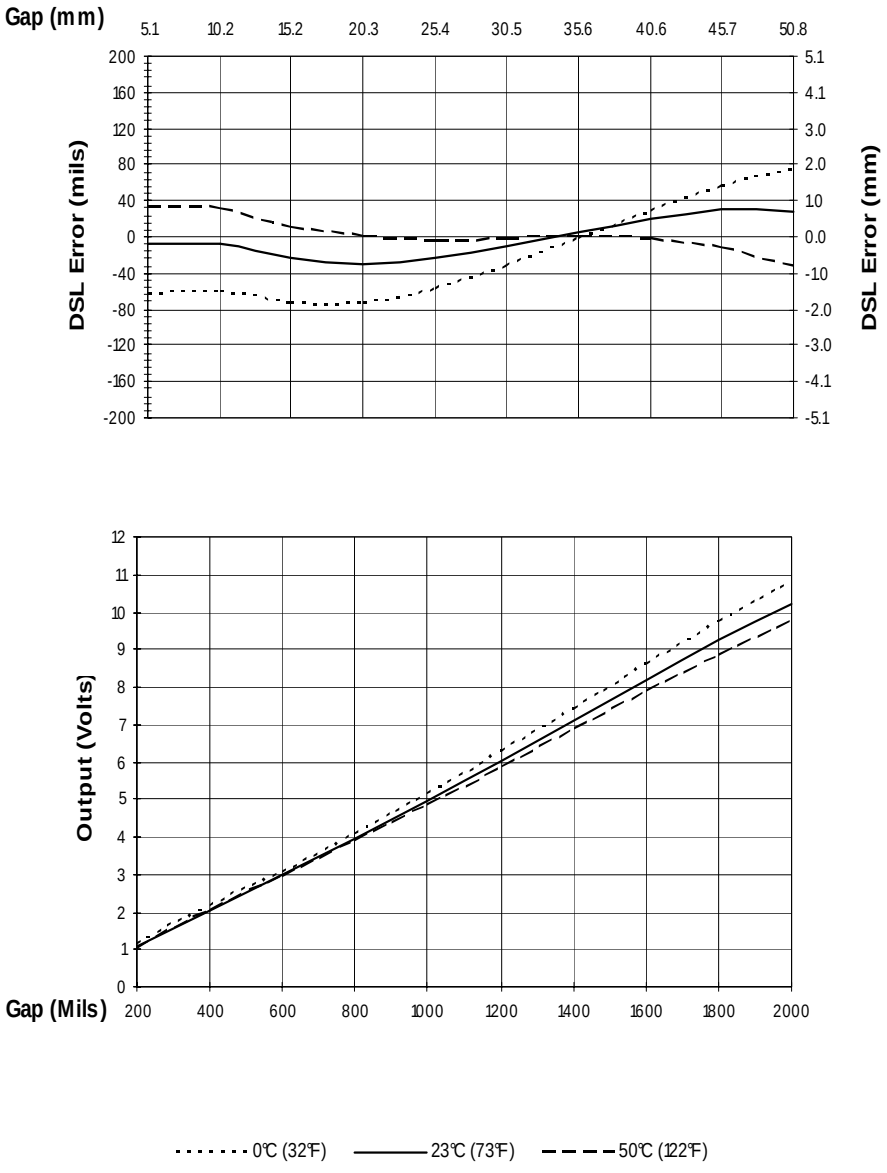


Figure 5-1 Typical Air Gap Proximitor® Sensor at Temperature

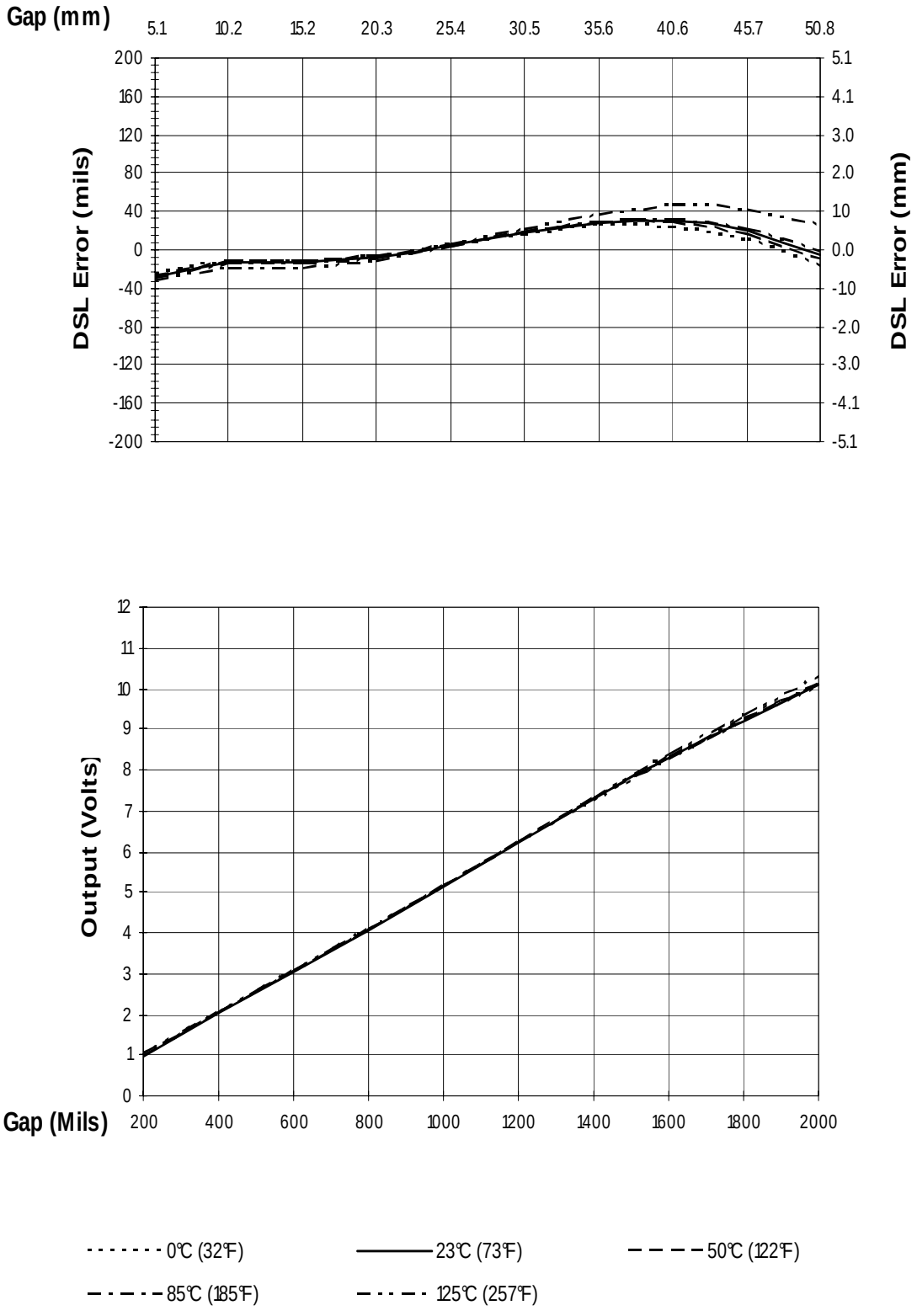


Figure 5-2 Typical Air Gap Probe at Temperature

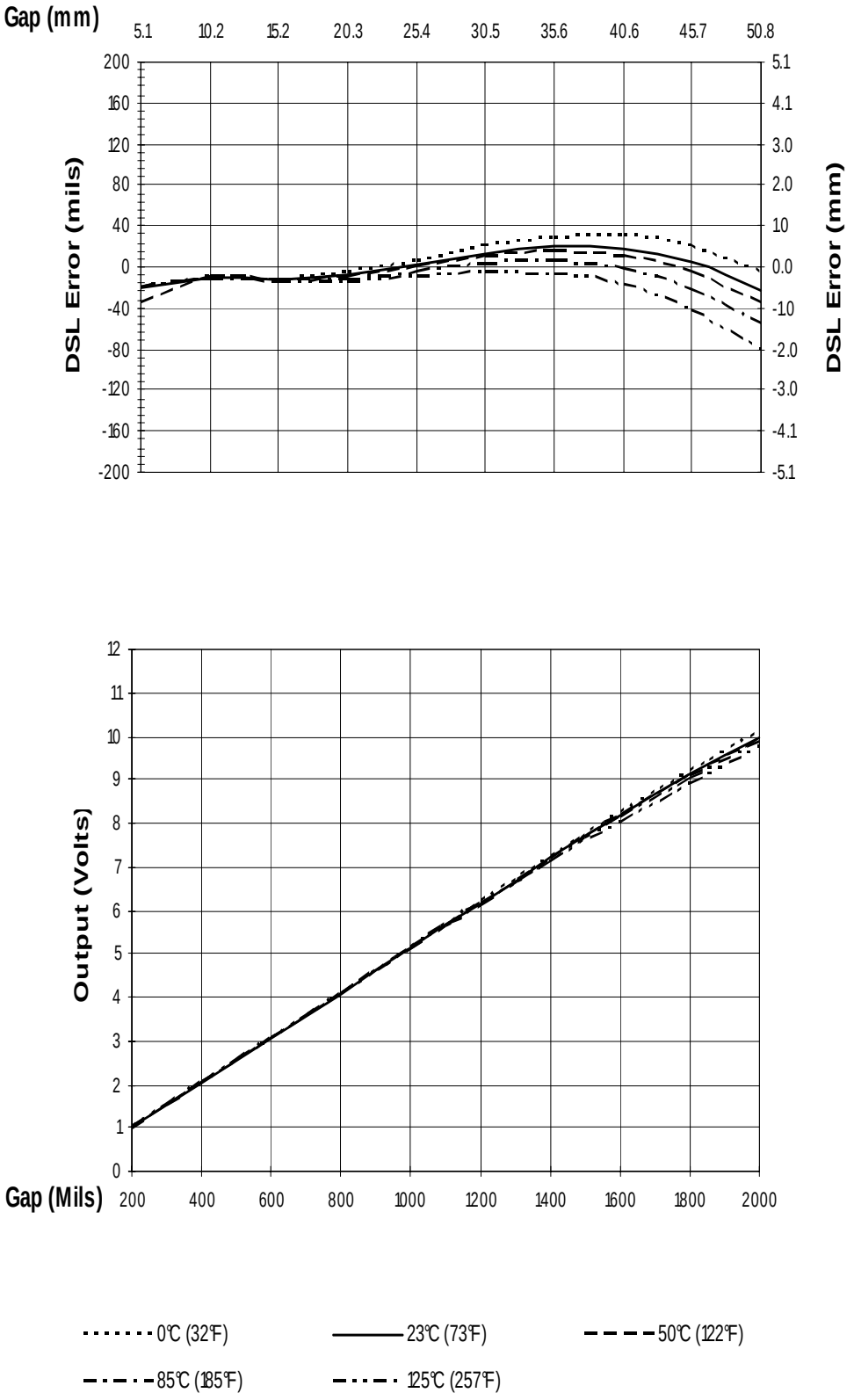


Figure 5-3 Typical Air Gap Cable at Temperature

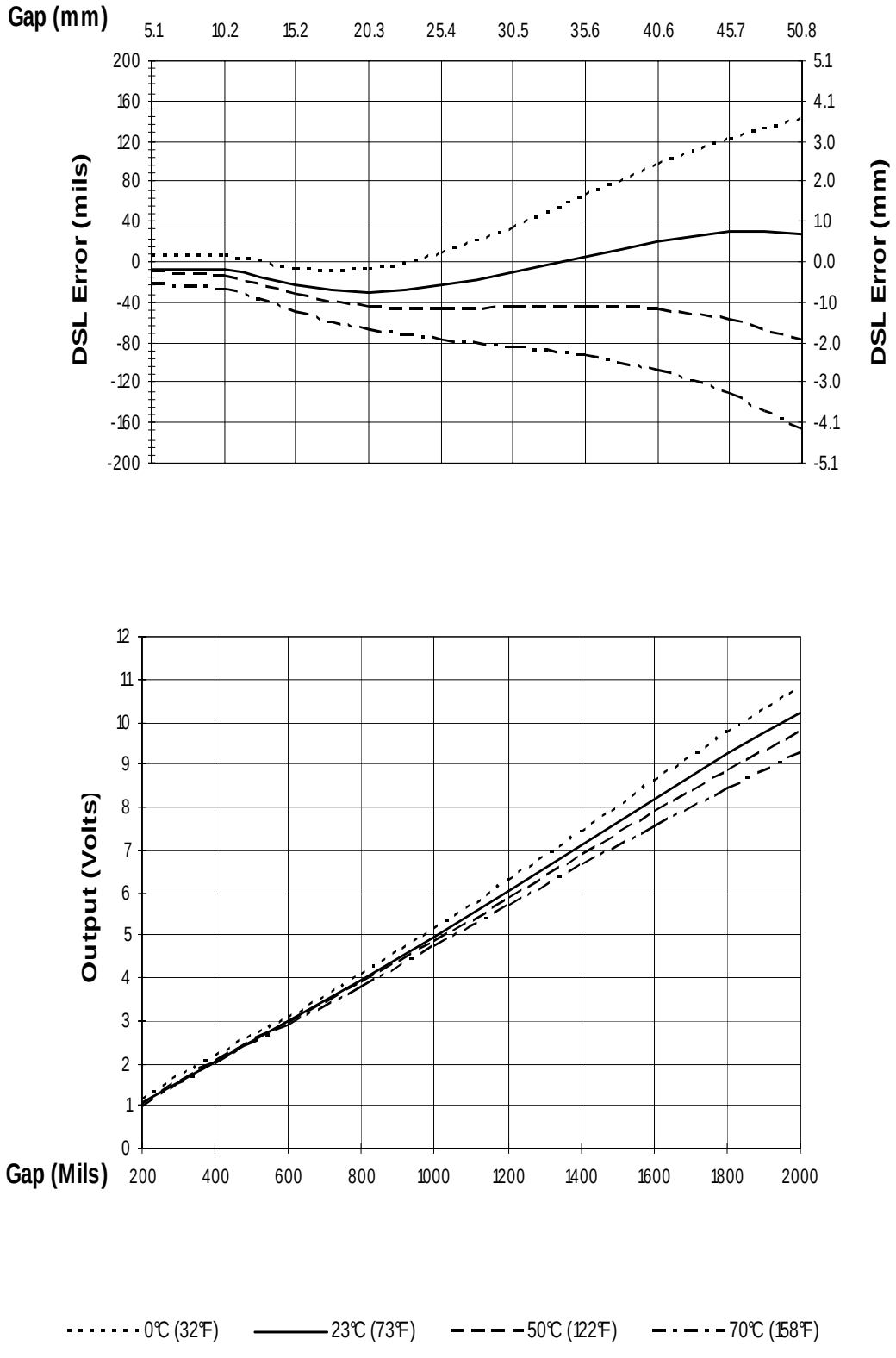
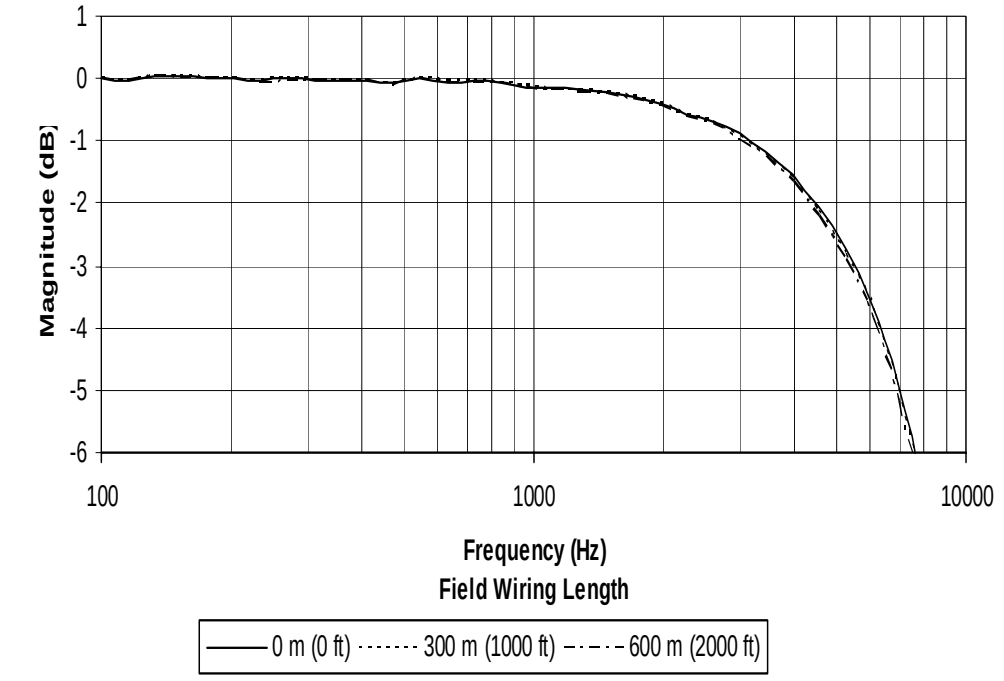


Figure 5-4 Typical Air Gap Sensor System at Ambient Temperature



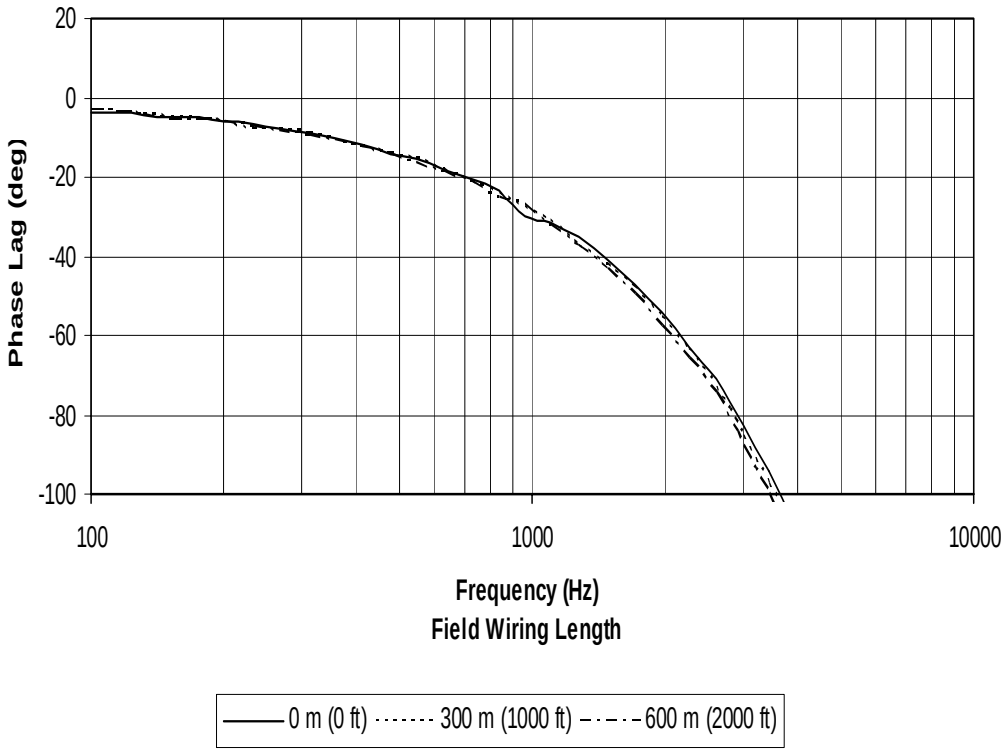


Figure 5-5 Frequency Response

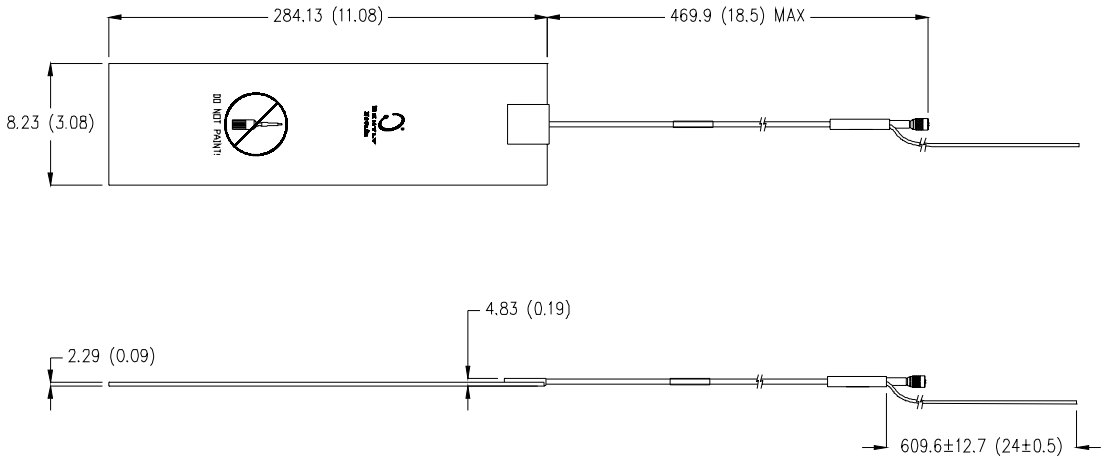


Figure 5-6 400102 Air Gap Sensor Probe

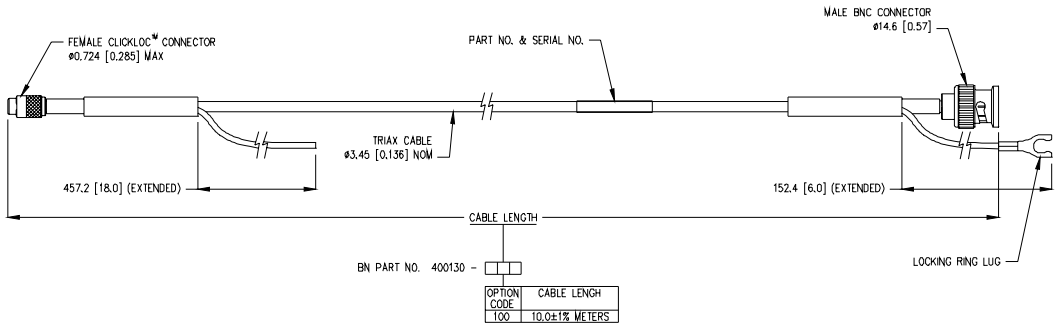


Figure 5-7 400130 Air Gap Sensor Extension Cable

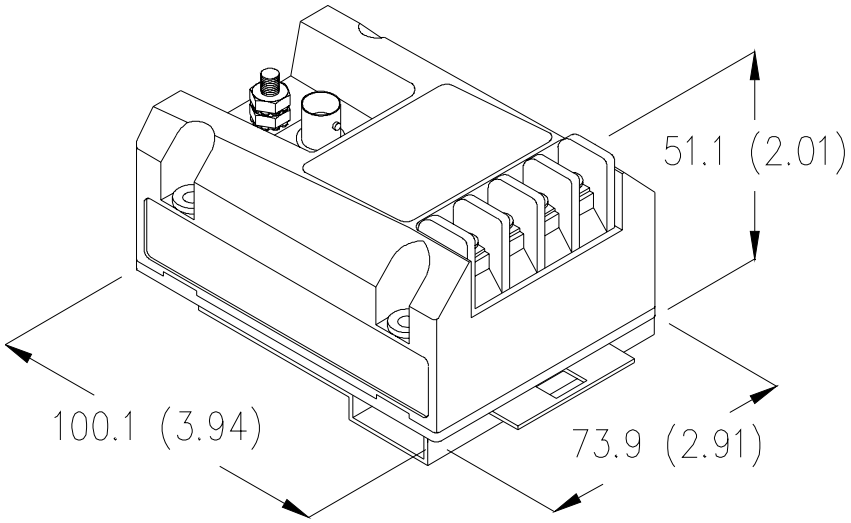


Figure 5-8 400100 Air Gap Sensor Proximitor® Sensor

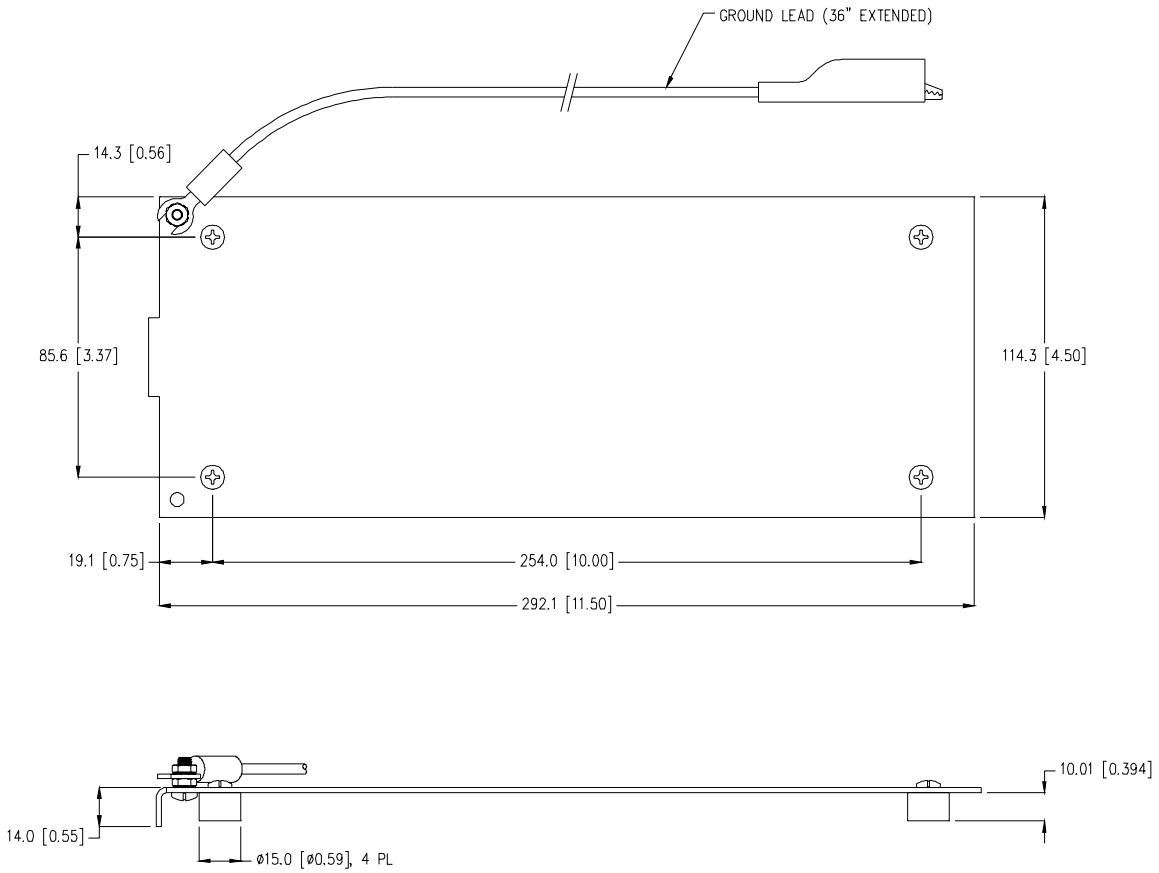


Figure 5-9 168448-01 Air Gap Verification Fixture