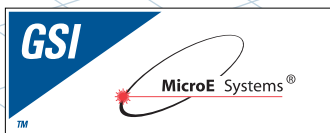
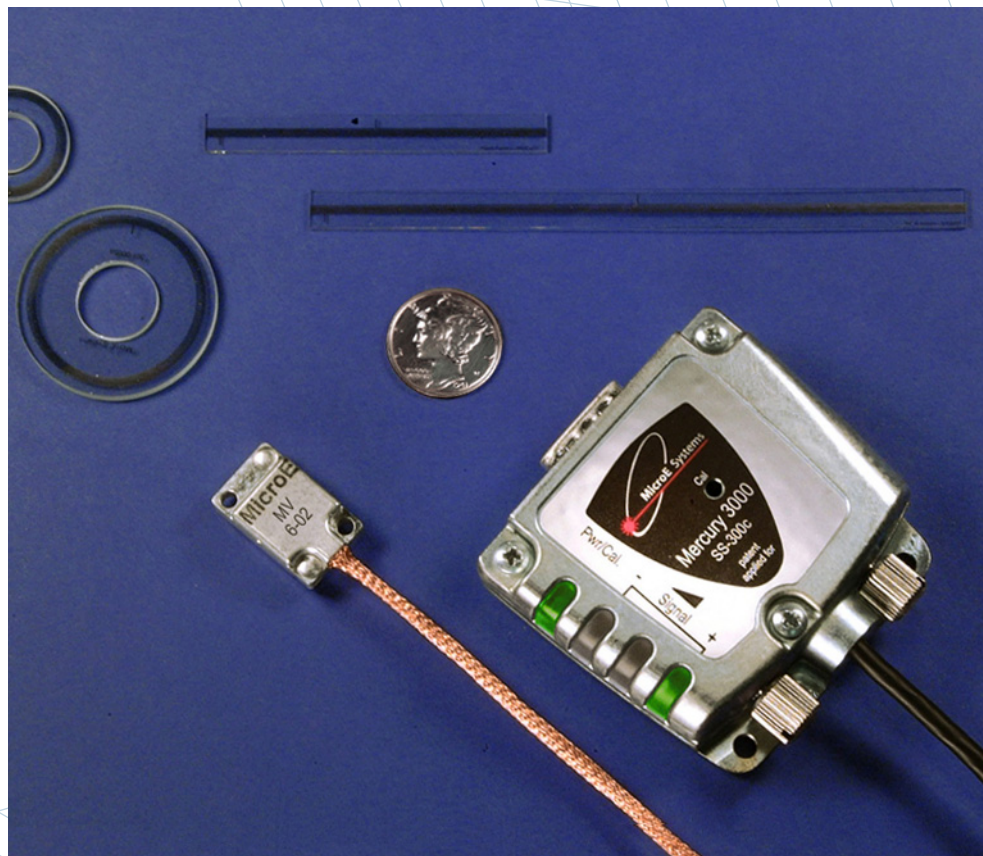


# Mercury™ 2000V & 3000V- Vacuum Rated

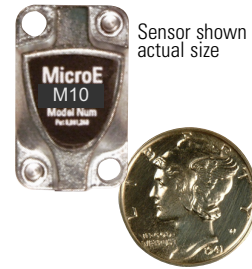
Smart Programmable Encoder Systems

*Installation Manual  
and Reference Guide*



# Introduction

MicroE Systems was founded to advance encoder technology to a level never before achieved. Our objective was to design encoder systems that would be small enough to fit into densely packed OEM equipment designs, affordable enough for cost-sensitive applications and easy enough to enable installation, setup and alignment by assemblers with little training. We are pleased to say that all of these goals have been realized with the introduction of the Mercury family of encoders.



## Precautions



- 1 Follow standard ESD precautions. Turn power off before connecting the sensor. Do not touch the electrical pins without static protection such as a grounded wrist strap.
- 2 Do not touch the glass scale unless you are wearing talc-free gloves or finger cots. Please read this installation manual for full instructions.

### **LASER SAFETY INFORMATION: Mercury & ChipEncoder**

This product is sold solely for use as a component (or replacement) in an electronic product; therefore it is not required to, and does not comply with, 21 CFR 1040.10 and 1040.11 which pertain to complete laser products. The manufacturer of the complete system-level electronic product is responsible for complying with 21 CFR 1040.10 and 1040.11 and for providing the user with all necessary safety warnings and information.

MicroE encoders contain an infrared laser diode or diodes. Emitted invisible laser radiation levels have been measured to be within the CDRH Class 1 range, which is not considered hazardous; however, to minimize exposure to the diverging beam, the encoder sensor should be installed in its operational configuration in close proximity to the encoder scale before power is applied.



- Invisible laser radiation; wavelength: 850 nm
- Max power 2.4 mW CW (4.8 mW CW for Mercury II™)
- CAUTION – The use of optical instruments with this product will increase eye hazard. DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS (MICROSCOPES, EYE LOUPES OR MAGNIFIERS).
- All maintenance procedures such as cleaning must be performed with the MicroE encoder turned off.
- Do not insert any reflective surface into the beam path when the encoder is powered.
- Do not attempt to service the MicroE encoder.

## Patents

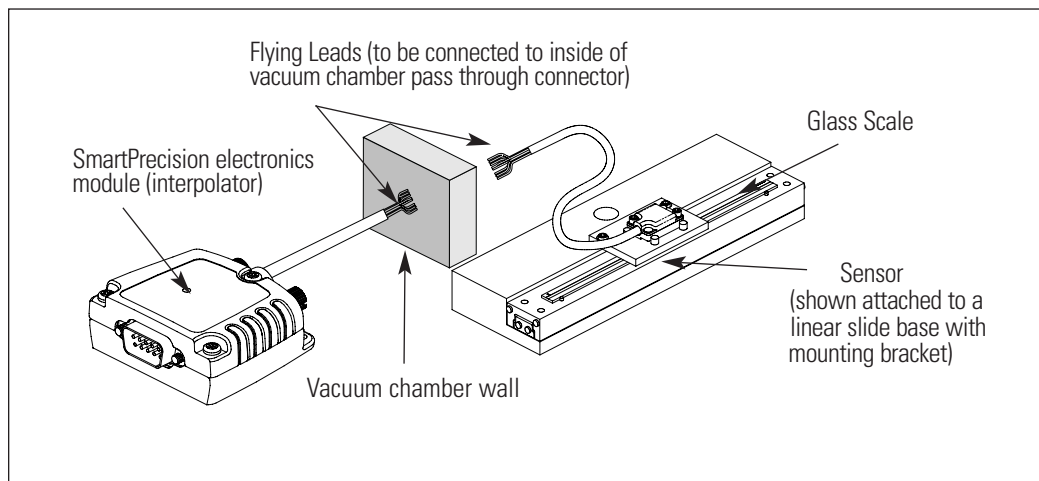
Covered by the following patents: US 5,991,249; EP 895,239; JP 3,025,237; US 6,897,435; and EP 1,451,933. Additional patents and patents pending may apply.

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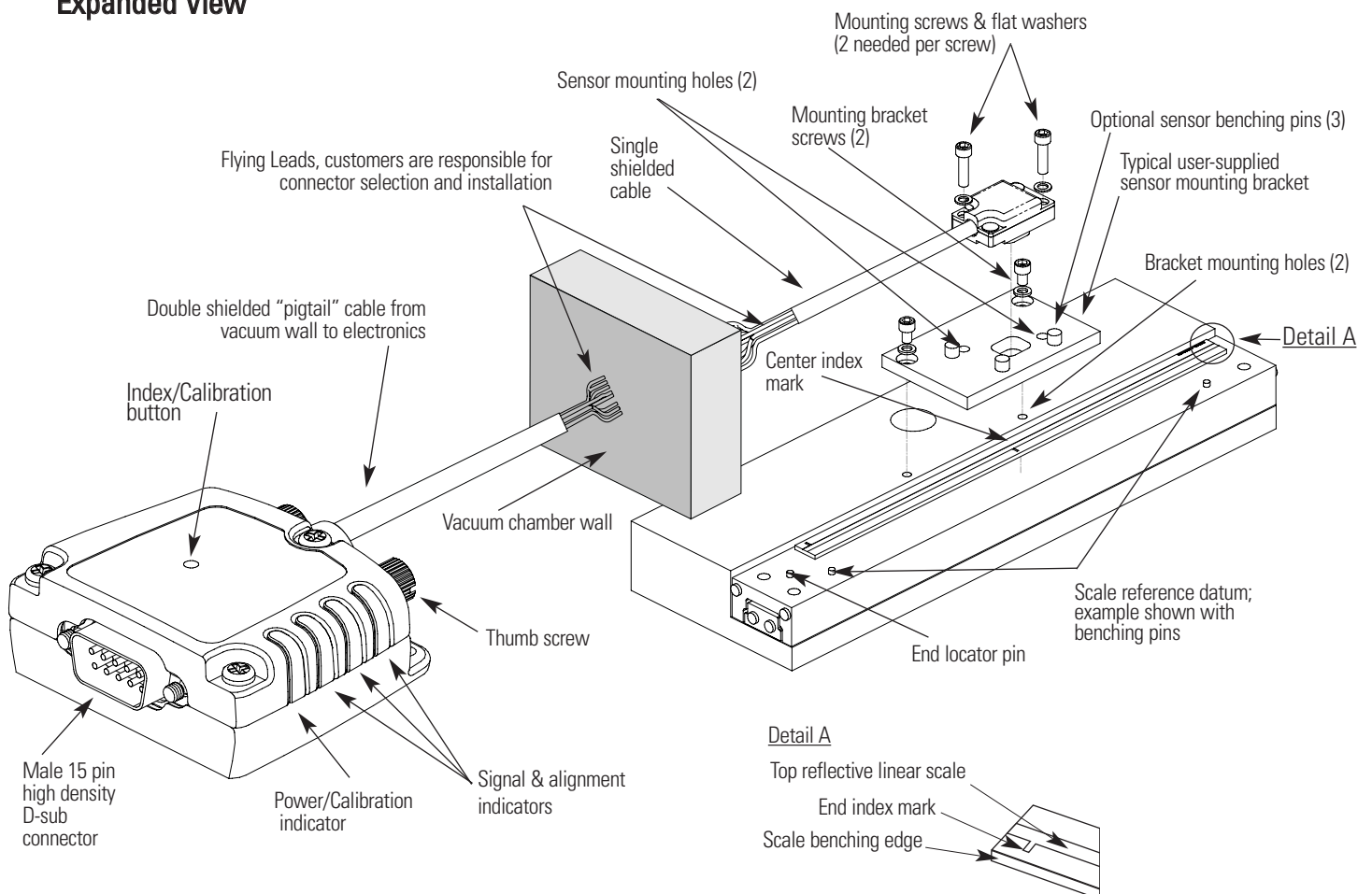
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# Mercury 2000V & 3000V Encoder System with Linear scale

## System View

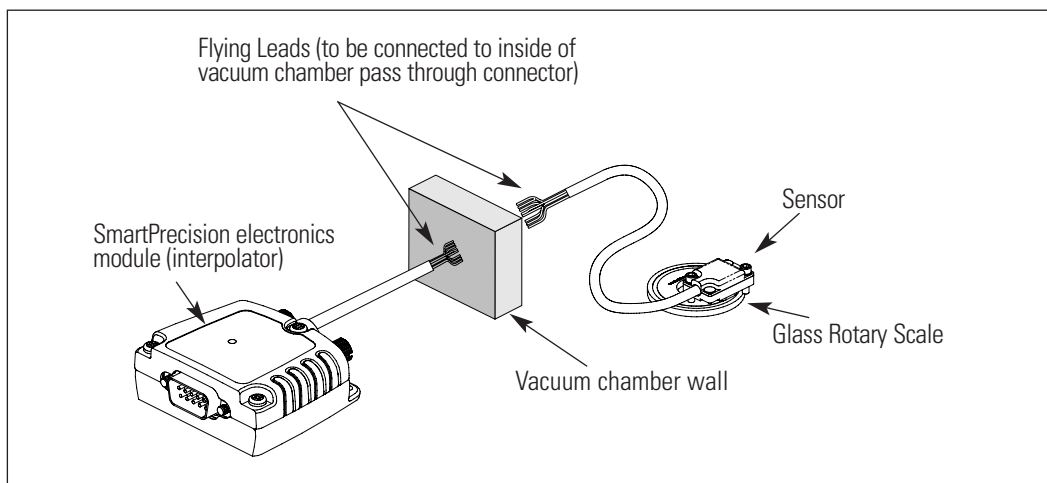


## Expanded View

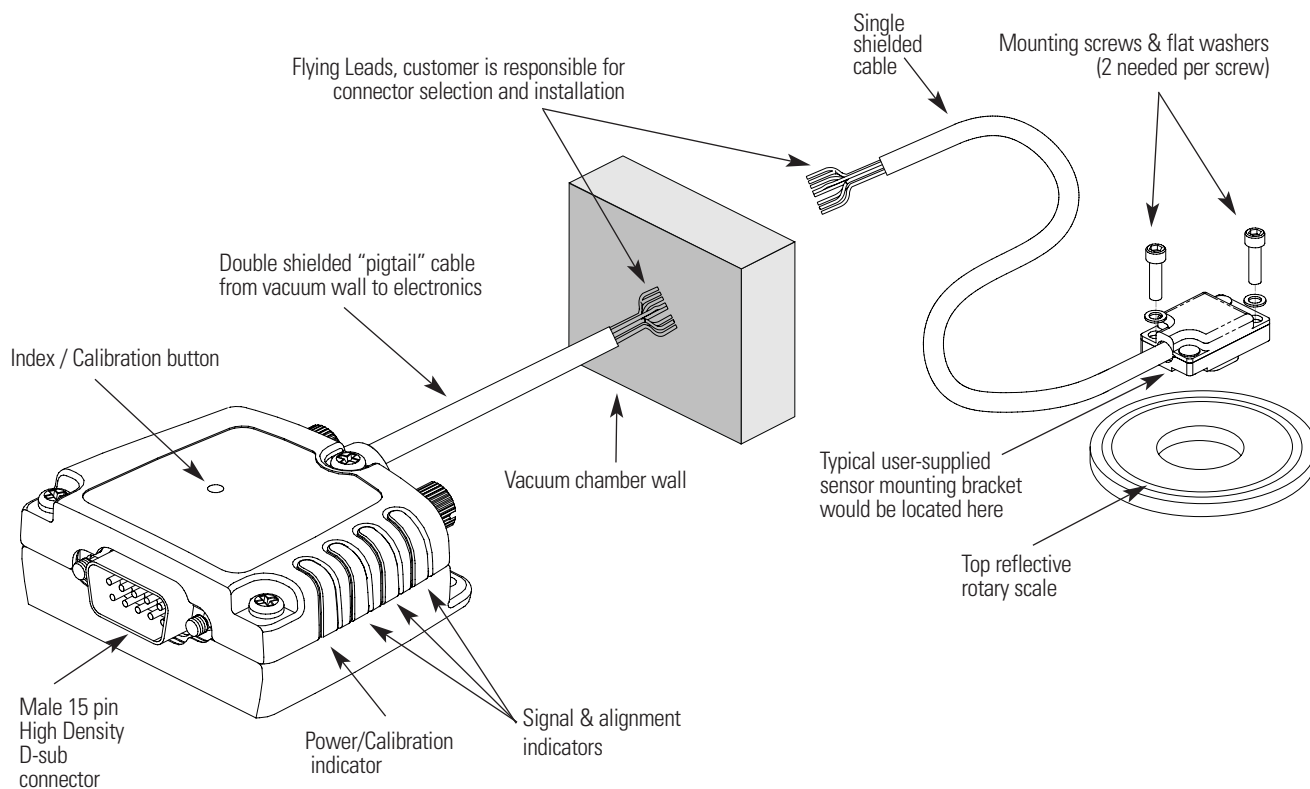


# Mercury 2000V & 3000V Encoder System with Rotary scale

## System View Shown with Rotary scale



## Expanded View



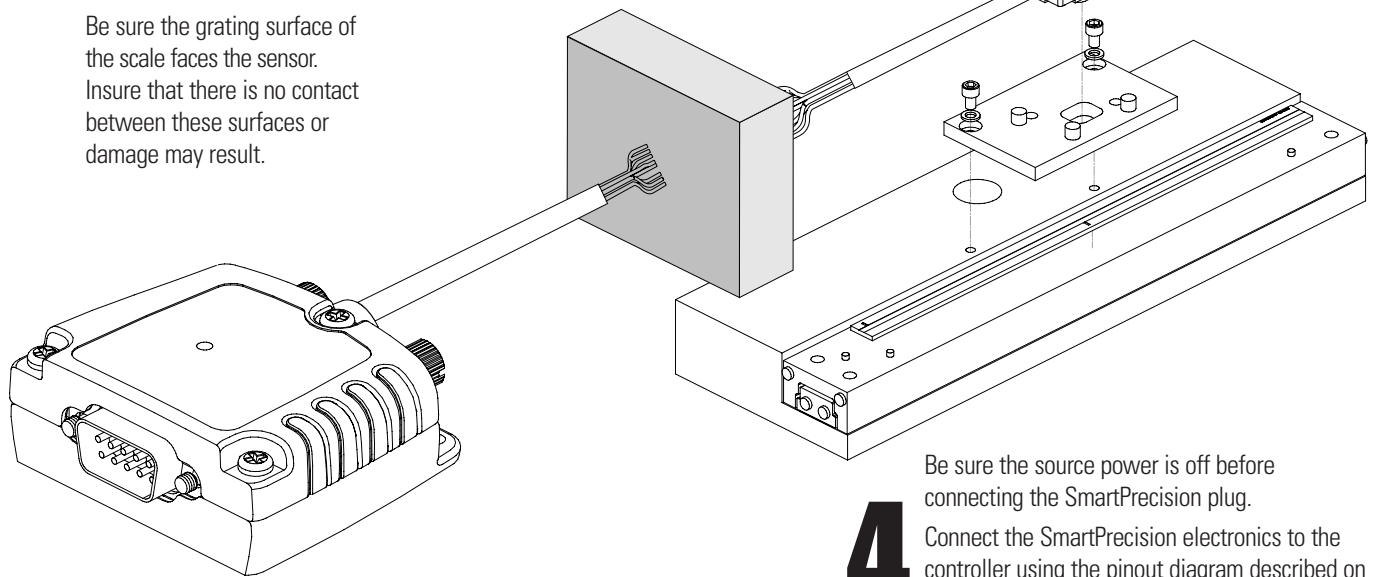
# Installation Instructions

## Linear Encoders

**1** Attach the scale to the base slide. Reference the preferred datum on the interface drawing for either end or center index orientation.

Attach the scale to the slide.  
Refer to pg. 8 for details.

Be sure the grating surface of the scale faces the sensor.  
Insure that there is no contact between these surfaces or damage may result.



**2** Install the sensor on your mounting surface referencing the appropriate datum surface as shown on the interface drawing. Use 2 washers per mounting screw.

Benching pins may be used to locate the sensor if the system mechanical tolerances are adequate. See data sheet for alignment tolerances, or keep mounting screws loose for sensor alignment if benching pins are not used.

Connect the vacuum cable to the feed-through in the vacuum wall. Wires of the same color must be connected through the vacuum chamber wall (see Interface Drawing for color assignments). Vacuum cables are shipped with "flying" leads". Customers are responsible for connector selection and installation.

**3** CAUTION: observe precautions for handling electrostatic sensitive devices.

Install the double shielded "pigtail" cable from vacuum wall to electronics into the SmartPrecision electronics module. This cable is shipped with "flying" leads. Customers are responsible for connector selection and installation.

- A) Remove the three cover screws and the top half of the connector housing. Do not pull on the 15-pin D-sub connector or the circuit board under the insulation layer.
- B) Attach the sensor's 5 X 2 connector to the mating 5 X 2 connector on the circuit board.
- C) Route the double shielded "pigtail" cable through its channel in the center of the connector body and place the cable's hex sleeve in the matching recess. Attach the top half of the connector housing to the bottom half using the three cover screws. The longest screw is used in the hole adjacent to the cable exit.
- D) Connect the customer supplied connector to the feed-through in the vacuum wall.

**4** Be sure the source power is off before connecting the SmartPrecision plug.

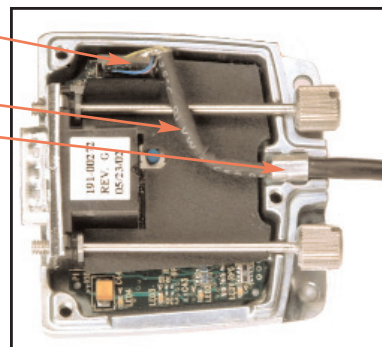
Connect the SmartPrecision electronics to the controller using the pinout diagram described on the interface drawing.

Pin 1 must not be connected under any circumstances, including connection to wires within extension cables and floating wires. Any connection to Pin 1 could damage or disable the encoder system.

Insure proper system grounding. Refer to the procedure on pg 9.

Tighten the thumb screws.

Power up the system. The Power/Calibration indicator will illuminate.





# Installation Instructions

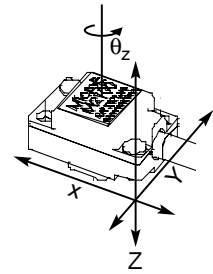
## Linear Encoders

5

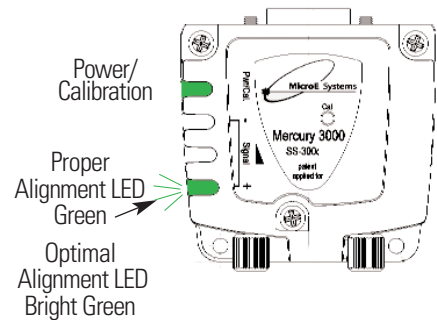
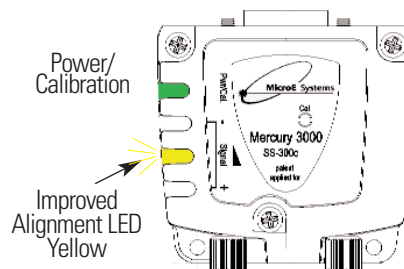
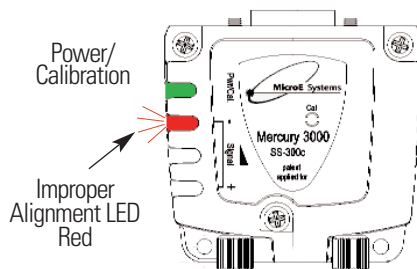
If benching dimensions cannot be provided, proper sensor alignment may require minor adjustments to the sensor position with respect to the scale. This can be performed easily using the LED alignment indicators, as illustrated below.

The red, yellow, or green LED will light depending on sensor alignment. Slowly move the sensor by allowing it to slide on the mounting surface until the green or Proper Alignment LED, is illuminated. Optimal alignment will be displayed as a "Bright Green" LED.

**IMPORTANT:** Confirm that the Proper Alignment LED blinks when passing over the index. If not, readjust the sensor in the Y direction and repeat the above procedure. When alignment is completed, tighten the sensor mounting screws.

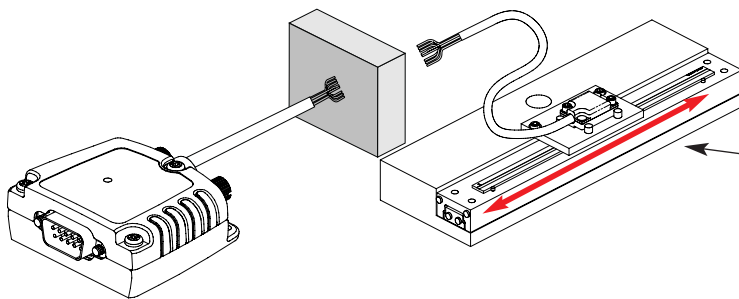


To align the sensor, move it in the Y or  $\theta_z$  directions.



6

Confirm proper alignment over the full range of motion. The "Proper Alignment" LED must remain on over the entire range. If not aligned over the entire range of motion, loosen the sensor mounting screws and repeat step 5.



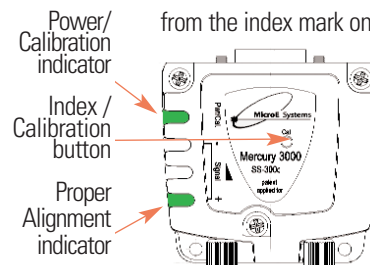
7

### IMPORTANT

#### OUTPUT CALIBRATION PROCEDURE

This procedure must be completed for proper system operation each time the sensor is aligned or if the SmartPrecision electronics module is replaced.

Position the sensor at least 7mm (1/4") away from the index mark on the scale. Next, push the Index/Calibration button inside the module with a small diameter shaft, such as a bare cotton swab.



The Power/Calibration indicator will flash continuously.

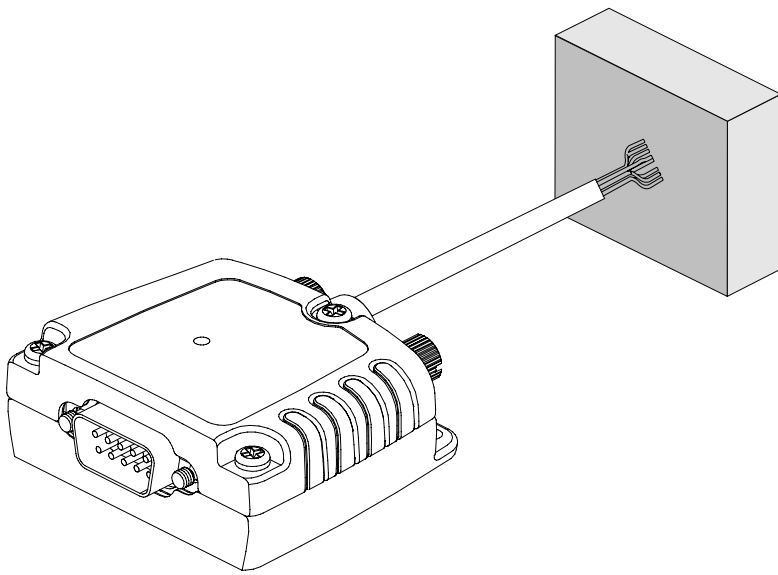
Move the scale past the sensor in both directions so that the index mark passes under the sensor. Do not run off the end of the scale. When the calibration procedure is complete, the Power/Calibration indicator stops flashing.

# Installation Instructions

## Rotary Encoders

**1** Attach your hub/scale assembly to the rotary device. Refer to the interface drawing. The reflective surface of the scale must face the sensor.

Be sure the grating surface of the scale faces the sensor. Insure that there is no contact between these surfaces or damage may result.



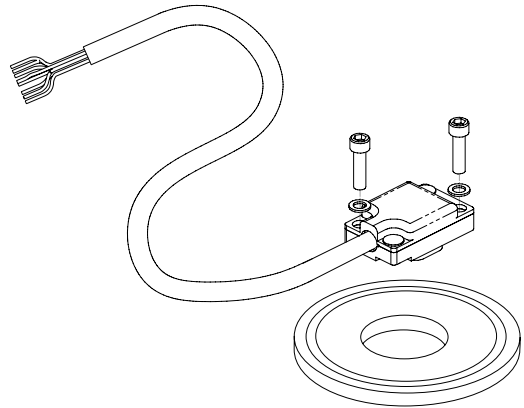
**3** CAUTION: observe precautions for handling electrostatic sensitive devices. Install the double shielded "pigtail" cable from vacuum wall to electronics into the SmartPrecision electronics module. This cable is shipped with "flying" leads. Customers are responsible for connector selection and installation.

- Remove the three cover screws and the top half of the connector housing. Do not pull on the 15-pin D-sub connector or the circuit board under the insulation layer.
- Attach the sensor's 5 X 2 connector to the mating 5 X 2 connector on the circuit board.
- Route the double shielded "pigtail" cable through its channel in the center of the connector body and place the cable's hex sleeve in the matching recess. Attach the top half of the connector housing to the bottom half using the three cover screws. The longest screw is used in the hole adjacent to the cable exit.
- Connect the customer supplied connector to the feed-through in the vacuum wall.

**2** Install the sensor on your mounting surface referencing the appropriate datum surface as shown on the interface drawing. Use 2 washers per mounting screw.

Benching pins may be used to locate the sensor if the system mechanical tolerances are adequate. See data sheet for alignment tolerances, or keep mounting screws loose for sensor alignment if benching pins are not used.

Connect the vacuum cable to the feed-through in the vacuum wall. Wires of the same color must be connected through the vacuum chamber wall (see Interface Drawing for color assignments). Vacuum cables are shipped with "flying" leads". Customers are responsible for connector selection and installation.



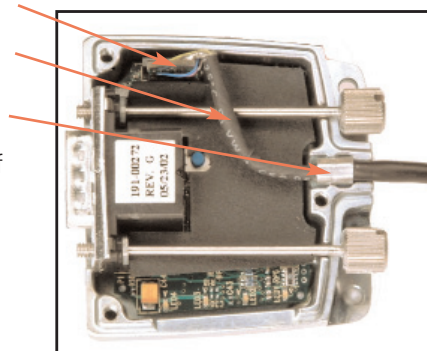
**4** Be sure the source power is off before connecting the SmartPrecision plug. Connect the SmartPrecision electronics to the controller using the pinout diagram described on the interface drawing.

Pin 1 must not be connected under any circumstances, including connection to wires within extension cables and floating wires. Any connection to Pin 1 could damage or disable the encoder system.

Insure proper system grounding. Refer to the procedure on pg 9.

Tighten the thumb screws.

Power up the system. The Power/Calibration indicator will illuminate.





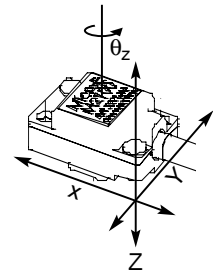
# Installation Instructions Rotary Encoders

# 5

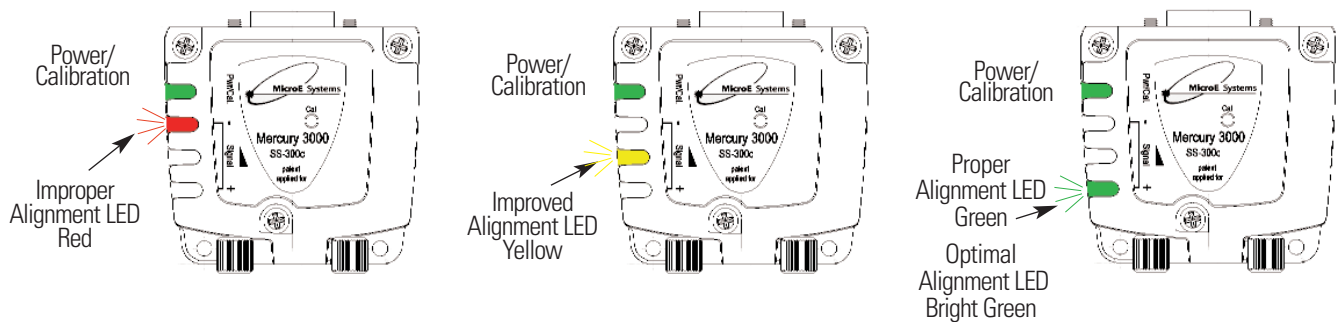
If benching dimensions cannot be provided, proper sensor alignment may require minor adjustments to the sensor position with respect to the scale. This can be performed easily using the LED alignment indicators, as illustrated below.

The red, yellow, or green LED will light depending on sensor alignment. Slowly move the sensor by allowing it to slide on the mounting surface until the green or Proper Alignment LED, is illuminated. Optimal alignment will be displayed as a "Bright Green" LED.

**IMPORTANT:** Confirm that the Proper Alignment LED blinks when passing over the index. If not, readjust the sensor in the Y direction and repeat the above procedure. When alignment is completed, tighten the sensor mounting screws.



To align the sensor, move it in the Y or  $\theta_z$  directions.



# 6

Confirm proper alignment over the full range of motion. The "Proper Alignment" LED must remain on over the entire range. If not aligned over the entire range of motion, loosen the sensor mounting screws and repeat step 5.

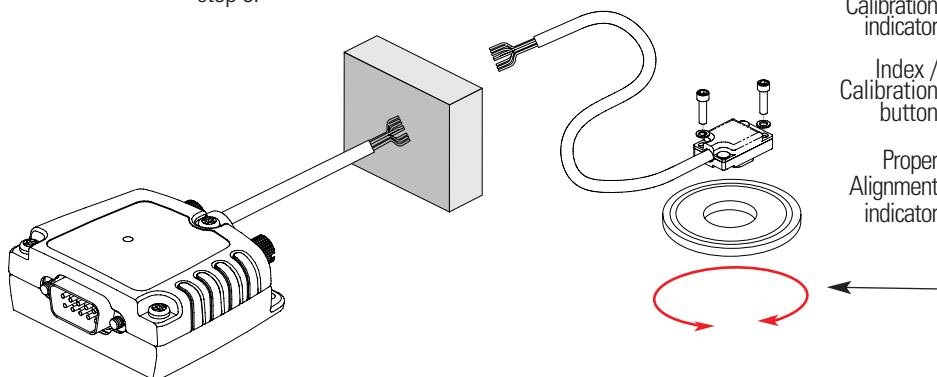
# 7

## **IMPORTANT** **OUTPUT CALIBRATION PROCEDURE**

*This procedure must be completed for proper system operation each time the sensor is aligned or if the SmartPrecision electronics module is replaced.*

Position the sensor at least 7mm (1/4") away from the index mark on the scale. Next, push the Index/Calibration button inside the module with a small diameter shaft, such as a bare cotton swab.

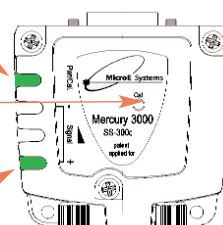
The Power/Calibration indicator will flash continuously. Move the scale past the sensor in both directions so that the index mark passes under the sensor. Do not run off the end of the scale when using a segment scale. When the calibration procedure is complete, the Power/Calibration indicator stops flashing.



Power/  
Calibration  
indicator

Index /  
Calibration  
button

Proper  
Alignment  
indicator



The Power/  
Calibration  
indicator

# Reference Section

## Installation of Linear Scales

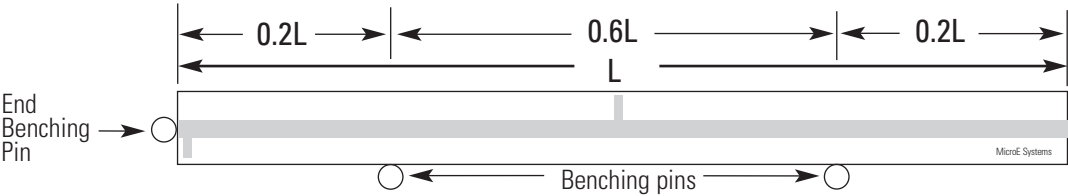
### Positioning the Scale

Note: Before beginning mounting procedure, use talc-free gloves or finger cots to handle the scales. Also use vacuum compatible handling procedures and materials . "Benching" the scale to the system means aligning the scale by means of benching pins. Pin locations are described on the appropriate interface drawing. Two benching pins are recommended on the long side of the scale and one at the end as shown . This is marked datum A on the interface drawing.

- 1

Position the benching pins in from either end. 20% of the overall scale length is the recommended location from the edge.
- 2

Be sure the benching pins do not extend too high in the Z direction to prevent mechanical interference with the sensor or sensor mount.



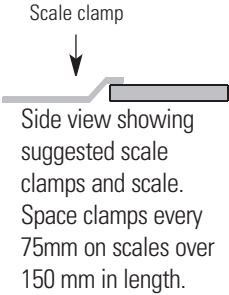
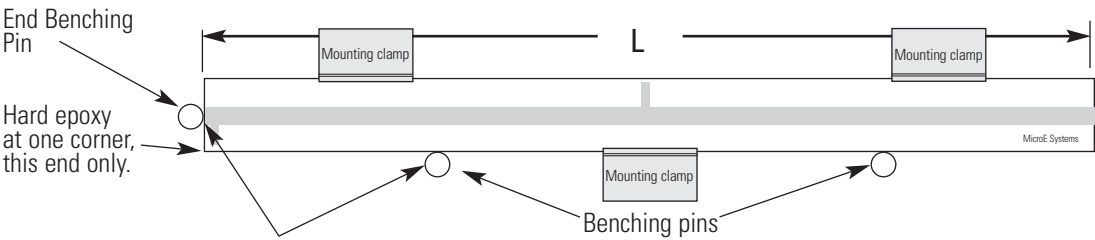
### Mounting the Scale

#### Suggested Epoxy and Clamp Mounting

- 1

Make sure the mounting surface is clean and dry.
- 3

Scale clamps (customer supplied) may be used to mechanically secure the scale. The clamps should allow for thermal expansion of the scale and mounting surface. Make sure that the clamps do not interfere with the sensor or sensor mount. Note: adhesive used on clamps supplied by MicroE is not vacuum rated.



- 2

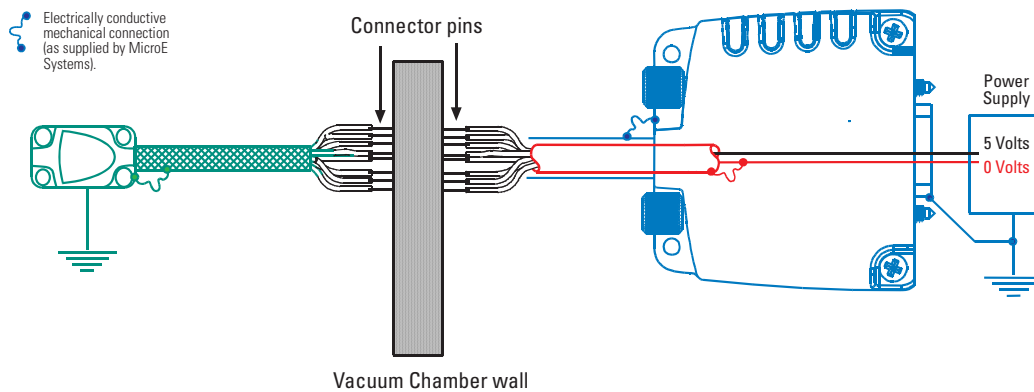
Align the scale by placing the edges against the benching pins.
- 4

Apply a hard, vacuum compatible epoxy to the end of the scale at the end benching pin.

## Grounding Instructions for Mercury 2000V and 3000V Encoder Systems

Correct grounding can be implemented in several ways depending on how the customer implements the connections through the vacuum chamber wall. The diagram below is suitable where:

- The outer cable shields are electrically isolated from each other at the vacuum chamber wall.
- The sensor is mounted with good electrical contact to a well-grounded surface. (Note that an electrical path through bearings will not result in a well-grounded sensor.)



Note: specific applications may require a different grounding scheme. Contact MicroE Systems for applications support.

### Shielding Instructions

Customer-installed connectors at the vacuum chamber wall must electrically shield the signal wires from Electro Magnetic Interference, Radio Frequency Interference and Electro Static Discharge. The connectors' shielding must completely surround the wires with no gaps, including intimate electrical contact 360 degrees around the outer cable shields at the ends of the cables supplied with flying leads. The inner shield of the cable that is attached to the SmartPrecision electronics module must be electrically isolated from the outer shield.

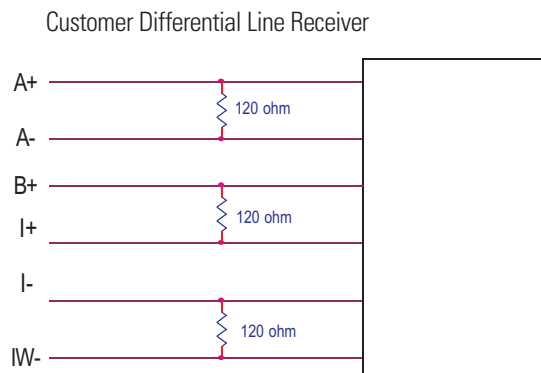
### Important Note

MicroE Systems recommends testing the motion subsystem after the Mercury 2000V and 3000V encoders are installed using your vacuum through-wall connectors. The testing should prove that the motion system has sufficient immunity to Electro Magnetic Interference, Radio Frequency Interference and Electro Static Discharge according to the application requirements.

## Recommendations for Power

Mercury encoders require a minimum of 4.75V DC continuously. When designing circuits and extension cables to use Mercury encoders, be sure to account for voltage loss over distance and tolerances from the nominal supply voltage so that at least 4.75V DC is available to the Mercury encoder under all operating conditions. The input voltage should not exceed 5.25V DC.

## Recommended Interface Termination



Customer Interface Cable Requirements

Customer cables that interface to Mercury series encoders must have the following characteristics:

- Twisted pair signal wiring.
- Characteristic impedance of 100-120 ohms.
- Sufficient wire gauge to meet the minimum voltage requirement at the encoder, for example 24AWG gauge wire for a 2m length cable. Examples of acceptable cables with 24 AWG gauge wire and 4 twisted pairs are Belden 9831, 8104, and 9844 or other manufacturer's equivalents.
- Single shield cable with a minimum of 90% coverage. Note that a double shielded cable may be required in high-noise applications.

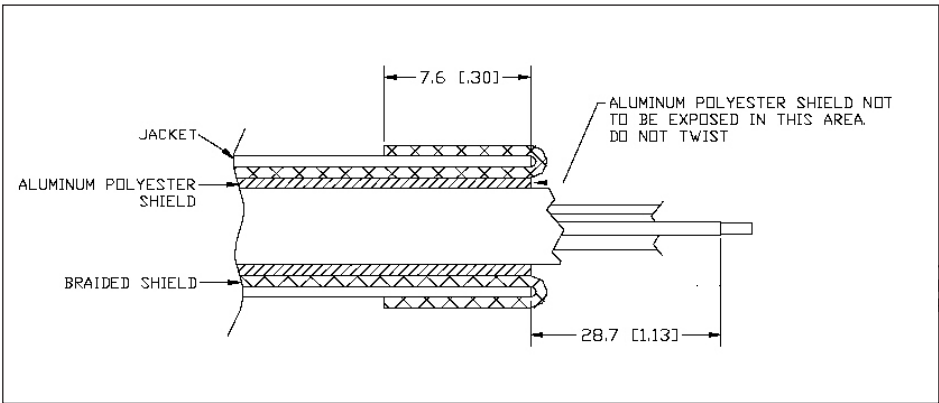
Signal Wiring:

Each differential signal should be connected to a corresponding twisted pair as follows:

Mercury 3500, 3000, 2000	
Signal	Twisted Pair
A+ A-	Pair 1
B+ B-	Pair 2
Index+ Index-	Pair 3
+5V GND	Pair 4

Shield Termination:

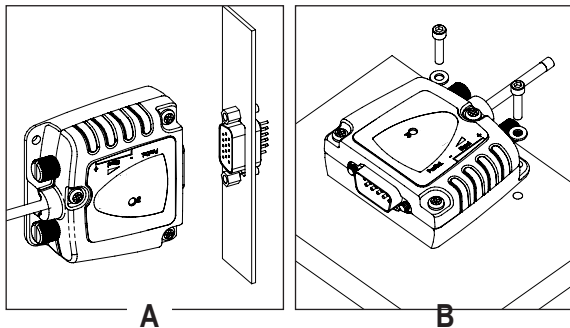
The customer's cable shield should be in 360° contact with the connector shroud and the connector shell to provide complete shielding. The connector shell should be metal with conductive surfaces. Suggested metal connector shells for use with Mercury 3500, 3000, 3000Si, and 2000 encoders: AMP 748676-1 or equivalent; for Mercury 1000 and 1500S encoders: AMP 745172-3, -2, or -1 where the dash number is dependent on the customer's outside cable diameter. The shield should be terminated as illustrated in the following diagram.



Fold braided shield back over jacket. Example shows double-shielded cable. Dimensions shown are for illustration only.

# Reference Section

## SmartPrecision Module Mounting Options



The SmartPrecision electronics module may be mounted directly to a bulkhead connector using the integral thumb screws shown in figure A.

Alternatively, the module may be used with an extension cable and mounted to a base plate using the mounting tabs as shown in figure B.

## Troubleshooting

### Problem

***The Power/Calibration indicator will not come on.***

### Solution

- Make sure that the SmartPrecision™ electronics' 15-pin D-sub connector is fully seated and connected.
- Confirm that +5 Volts DC is being applied to pin 12 on the SmartPrecision electronics' 15-pin HD connector and that pin 13 is connected to ground.

### Problem

***Can't get the SmartPrecision™ electronics' "Signal" LEDs better than red or yellow; or the green, " Proper Alignment" indicator doesn't stay illuminated over the full length of the scale.***

### Solution

- Verify that the sensor has been aligned to the scale and that the mounting screws are tight. Check the dimensions for the mechanical mounting holes (and clamps if any) to make sure that the sensor is correctly located over the scale. Refer to appropriate the interface drawing.
- Check that the scale is firmly mounted and can't jiggle or move in other than the intended direction.
- Make sure that the scale is clean over its entire length or circumference.

### Problem

***The green Power/Calibration indicator is flashing unexpectedly.***

### Solution

- Part of the normal setup procedure is to activate the SmartPrecision™ electronics' Index/Calibration process by pressing the recessed button the SmartPrecision™ electronics' connector body. The On/Index LED will begin to flash until the index mark on the scale passes under the sensor at least one time in each direction.

### Problem

***Can't Complete the Index/Calibration process - the green Power/Calibration indicator doesn't stop flashing.***

### Solution

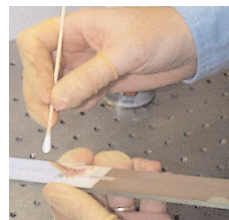
- Verify that the sensor is mounted in the correct orientation to the scale for the desired index mark. Refer to the interface drawing.
- Refer to step 5 of the installation procedure to insure proper operation.

## Cleaning scales



### General Particle Removal

Blow off the contamination with nitrogen, clean air, or a similar gas.



### Contamination Removal

Use a lint-free cleanroom wipe or cotton swab dampened with isopropyl alcohol or acetone only to wipe the surface clean. Handle the scale by the edges. Do not scrub the scale.

## Contacting MicroE Systems

Thank you for purchasing a MicroE Systems product. You should expect the highest level of quality and support from MicroE. If you want to download the Mercury Encoder Installation Manual, Data Sheet or Interface Drawing, browse [www.microesys.com](http://www.microesys.com) and click on the Mercury Encoders button.

