

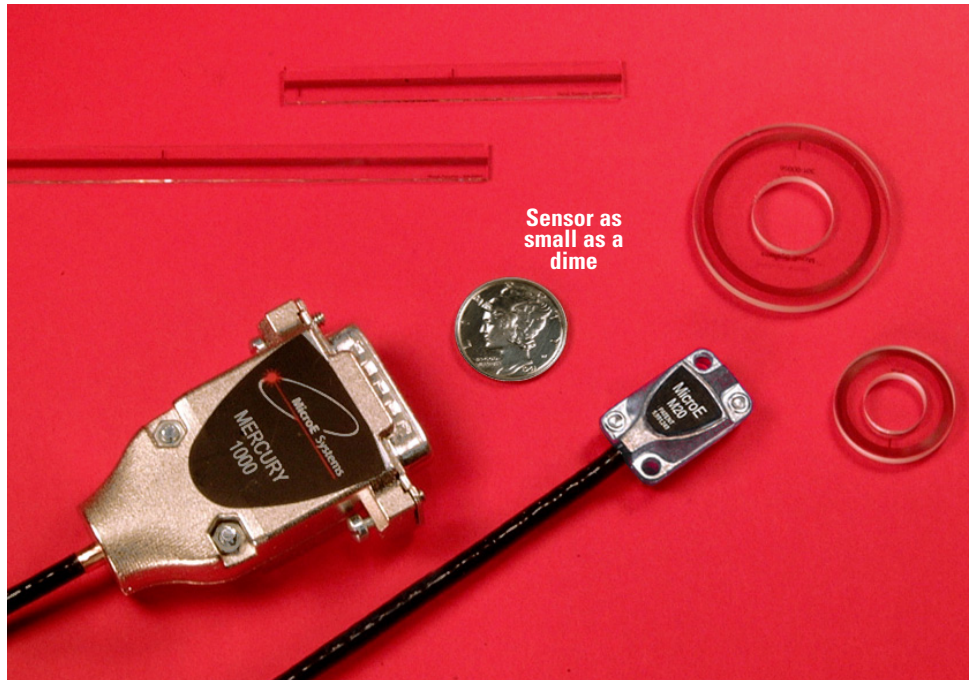
목록

Data_Sheet_Mercury_1000__1_ .....	1
Encoder overview .....	1
System configuration .....	2
Alignment & mechanical advantages .....	3
System specifications .....	4
Short & long linear scale dimensions .....	5
Rotary Scales & ordering info .....	6
Installation_Manual-Mercury_1000 .....	7
Cover .....	7
Intro & Precautions .....	8
Table of contents .....	9
Linear encoder system diagram .....	10
Linear encoder system diagram .....	11
Linear encoder installation .....	12
Linear encoder alignment .....	13
Rotary encoder installation .....	14
Rotary encoder alignment .....	15
Reference: Installing linear scales .....	16
Reference: Grounding instructions .....	17
Reference: Interface Termination; Customer interface cabling .....	18
Troubleshooting, cleaning scales .....	19
Contacting MicroE Systems .....	20
Interface_Drawing-Mercury_1000 .....	21
M1000 encoder with short linear scales .....	21
M1000 encoder with long linear scales .....	22
M1000 encoder with rotary scale and hub .....	23

# Mercury™ 1000 Analog Output Encoder Systems

## For Customer Interpolation- Resolution to 0.078µm

Reflective Linear and Rotary Encoders



### Resolution

Determined by Customer Electronics

Linear: 20µm to 0.078µm  
Rotary: 2,500 to 4.2M CPR

### Accuracy

Linear: ± 1µm available  
± 3µm to ± 5µm standard  
Rotary: Up to ± 2.1 arc-sec

### Output

Analog Sine/Cosine and Digital Index Window

The Mercury 1000 encoder system includes the sensor, double shielded cable, connector, and either a linear or rotary glass scale. Mercury's space-saving, integrated configuration gives OEM system designers a breakthrough in performance.

### Imagine what you can do with this!

Reduce the cost and size of your system, and increase its performance all at once. MicroE Systems' Mercury 1000 kit encoders are smaller, higher performance, faster to install, and easier to use than any other encoder. Advanced features include SmartPrecision™ automatic offset and gain adjustments during set up to optimize accuracy. No manual adjustments are needed. The tiny sensor fits into very tight spaces, has broad alignment tolerances for fast and easy setup and works in both linear and rotary applications. The entire Mercury 1000 encoder system is EMI shielded for use in the toughest environments. With standard analog sine/cosine output, use your interpolation electronics to achieve the resolution required by your application.

### Standard features

- Small sensor with ultra-low Z height; flush screw mounting
- Sensor is 8.4mm (H) x 12.7mm (W) x 20.6mm (L) and weighs 1.6g
- SmartPrecision automatic offset and gain set up
- Analog Sine/Cosine output and Index window
- Fundamental resolution: Linear 20µm; Rotary 2,500 - 16,384 CPR  
Interpolated resolution determined by customer electronics:  
Linear: 20µm - 0.078µm; rotary: 2,500 to 4.2M CPR
- Entire system is EMI shielded
- Bi-directional index signal
- Index mark at the center or end of the glass scale (linear)
- Alignment Tool enables fast set up (Required, see pg 2)

### Table of Contents

<b>System &amp; Sensor</b>	<b>pg 4</b>
<b>Scales</b>	<b>pg 5-6</b>
<b>Ordering Information</b>	<b>pg 6</b>

### Required accessories

- SmartPrecision Alignment Tool



### Optional features

- Glass scale length or diameter:  
Linear lengths from 5mm to 2m  
Rotary diameters from 12mm to 108mm



- Cable length of 0.5m, 1m, 2m or custom
- SmartPrecision Software for set up



# System Configurations

## Standard and Optional Equipment



**Encoder Sensor**  
Same for linear and rotary scales.

**Controller Interface Cable**  
15 pin standard D-sub connector with SmartPrecision™ automatic gain and offset adjustments.

### SmartPrecision™ Alignment Tool - SSAT 1000

Required for set up, the built-in LED indicators make alignment fast and easy, eliminating the need for an oscilloscope. In addition, The Alignment Tool automatically optimizes the M1000's gain and offset for increased accuracy with the push of a button.

The RS232 Interface Adapter provides power to the encoder and connections to a PC. This is included with the Alignment Tool.

## M1000 Encoder System Standard Equipment

### Optional Software

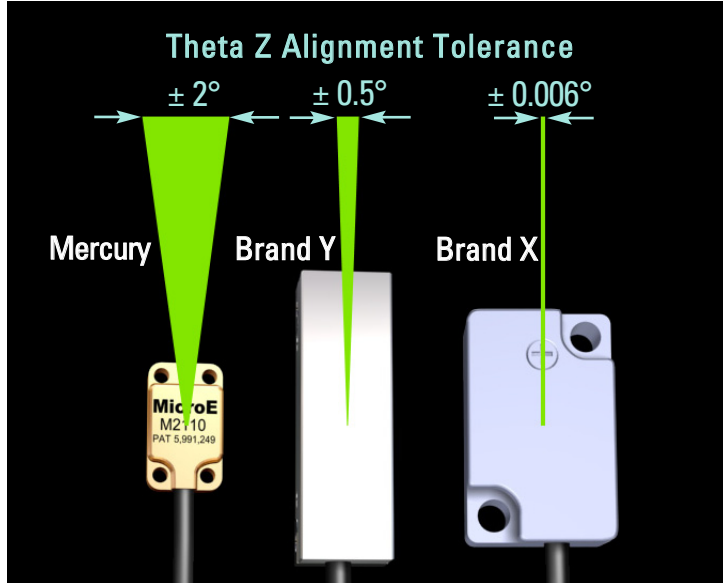
#### SmartPrecision™ Software



Optional software lets you view signal strength, Lissajous plots, position data and diagnostics.

# Broader Alignment Tolerances, Increased Standoff Clearance, Smallest Sensor and More

Why Mercury Encoders Make It Easier To Design High Performance Into Your Equipment



## Eliminate the Frustration of Touchy Encoder Alignment

### Mercury Solves this Problem for Good

Fussy alignment is no longer a concern. With Mercury's patented PurePrecision™ optics, advanced SmartPrecision™ electronics and LED alignment indicators, you can push the sensor against your reference surface, tighten the screws and you're finished. Try that with brand X or Y.

This performance is possible thanks to relaxed alignment tolerances, particularly in the theta Z axis. Mercury offers a ± 2° sweet spot— that's a 300% improvement over the best competitive encoder. And that will result in dramatic savings in manufacturing costs.

No other commercially available encoder is easier to align, easier to use, or easier to integrate into your designs.

## Alignment Tolerance Comparison\*\*

	Mercury*	Brand X	Brand Y	Mercury vs. Best Competitor
Z Standoff	± 0.15mm	± 0.1mm	± 0.1mm	Mercury is 50% better
Y	± 0.20mm for linear ± 0.10mm for rotary ≥19mm dia.	± 0.1mm	unspecified	Mercury is 100% better
theta X	± 1.0°	unspecified	± 1.0°	
theta Y	± 2.0°	± 0.1°	± 1.0°	Mercury is 100% better
theta Z	± 2.0°	± 0.006°	± 0.5°	Mercury is 300% better

\*Measured at a constant temperature for one axis at a time with all other axes at their ideal positions.

\*\*Based on published specifications

## Mercury Can Reduce System Size and Cost

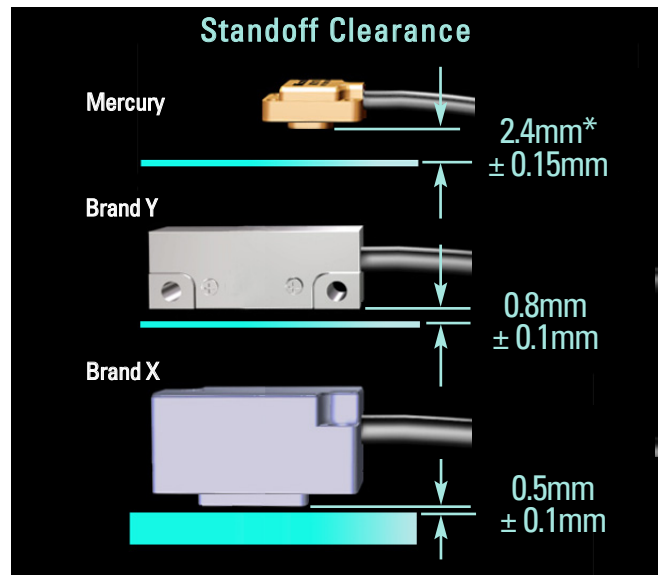
Mercury's sensor height is 44% shorter than competitive encoders, making it easy to fit into your design. This reduction can also cut total system weight and cost by allowing the use of smaller motors and stages. Safe system operation is also enhanced thanks to Mercury's generous standoff clearance— 200% greater than other encoders. And its standoff tolerance is 50% greater than the best alternative.

This significantly relaxes mechanical system tolerances, while reducing system costs.

## Mechanical Dimension Comparison\*\*

	Mercury	Brand X	Brand Y	Mercury vs. Best Competitor
Sensor Z height	8.4mm	23mm	15mm	44% better
Standoff clearance	2.4mm	0.5mm	0.8mm	200% better
Standoff tolerance	± 0.15mm	± 0.1mm	± 0.1mm	50% better
System height	11.7mm	28.5mm	15.8mm	26% better

\*\*Based on published specifications



\* Dimensions shown illustrate encoder system standoff clearance; see Mercury Encoder Interface Drawings for correct design reference surfaces.

# System Specifications

## System

Grating Period	20µm
Signal Period	20µm
System Resolution	Fundamental resolution: Linear 20µm; Rotary 2500 - 16,384 CPR Interpolated resolution determined by customer electronics: Linear: 20µm - 0.078µm; rotary: 2,500 to 4.2M CPR

Linear Accuracy\* Better than ±1µm available; contact MicroE  
Better than ±3µm up to 130mm, ±5µm from 155mm to 1m, ±5µm per meter from 1m to 2m

\*Maximum peak to peak error over the specified movement when compared to a NIST-traceable laser interferometer standard, used at room temperature and with MicroE interpolation electronics.

Rotary Accuracy*	Scale O.D.	Microradians	Arc-Seconds
	12.00mm	±100	±21
	19.05mm	±63	±13
	31.75mm	±38	±7.8
	57.15mm	±19	±3.9
	107.95mm	±10	±2.1

\*Based on ideal scale mounting concentricity

## Sensor Size

W:	12.70mm	0.500"
L:	20.57mm	0.810"
H:	8.38mm	0.330"

## Operating and Electrical Specifications

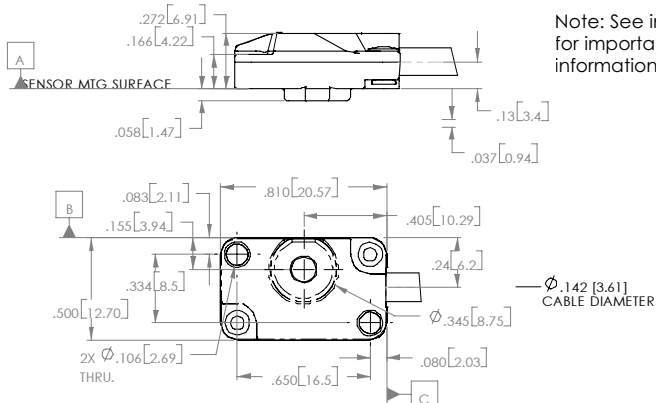
Power Supply	5VDC ±5% @ 60mA
Temperature	
Operating:	0 to 70°C
Storage:	-20 to 70°C
Humidity:	10 - 90% RH non-condensing
EMI:	Entire system is EMI/RFI protected
Shock:	1500G 0.5ms half sine (Sensor)
Sensor Weight:	2.7g (Sensor without cable)
Cable:	Double Shield. Diameter: 3.6mm (0.142") Flex Life: 20 x 10 <sup>8</sup> cycles @ 20mm bending radius

## Maximum Speed

	Scale Length/Diameter	Maximum Speed*
Linear	All Lengths	7200mm/s
Rotary	0.75"	8640 RPM
	1.25"	5272 RPM
	2.25"	2637 RPM
	4.25"	1318 RPM

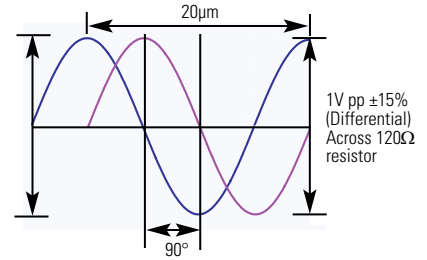
\*Assumes customer electronics have adequate bandwidth

## Mechanical Information - Sensor and Connector



Note: See interface drawing for important sensor mounting information.

## Analog Output Pins 7,8,14 and 15

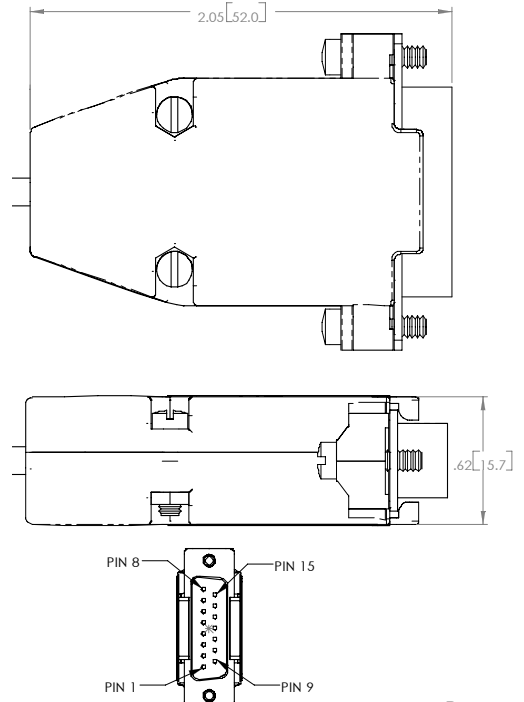
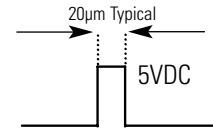


## Mercury 1000 Outputs

15-pin Standard Male D-sub connector

PIN	FUNCTION
1	Index Window-
2	Index Window+
3	Reserved - do not connect
4	Reserved - do not connect
5	Reserved - do not connect
6	Reserved - do not connect
7	Cosine+
8	Sine+
9	Reserved - do not connect
10	Reserved - do not connect
11	Reserved - do not connect
12	+5VDC
13	Ground
14	Cosine-
15	Sine -

## Index Window Pin 2



# Scale Specifications

## Standard and Customized Scales

MicroE Systems offers a wide array of chrome on glass scales for the highest accuracy and best thermal stability. Easy to install, standard linear and rotary scales meet most application requirements. Customized linear, rotary, and rotary segment scales are available where needed. All scales include an optical index. Mercury's glass scales save time by eliminating motion system calibrations or linearity corrections required by other encoders, and provide better thermal stability than metal tape scales.

### Options include:

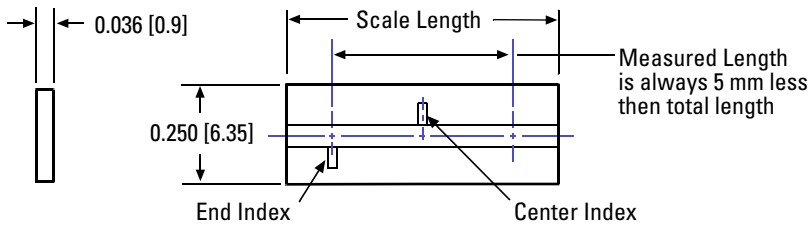
- *Standard linear*: 18mm - 2m
- *Standard rotary*: 12mm - 107.95mm diameter, with or without hubs
- *Custom linear\**: special lengths, widths, thickness, index mark locations and special low CTE materials
- *Custom rotary\**: special ID's, OD's (up to 304.8mm), index mark outside the main track and special low CTE materials
- *Mounting of hubs for rotary scales*: MicroE Systems can mount and align standard, custom, or customer-supplied hubs
- *Rotary segments\**: any angle range; wide range of radius values

\*Custom scales or rotary segments are available in OEM quantities. Contact your local MicroE Systems sales office.

## Standard Short Linear Scales

### 130mm and Shorter

Key: inches[mm]



### Specifications

Accuracy	±3µm standard ±1µm available
Material	Soda lime glass
Typical CTE	8ppm/°C
Index	Center or End

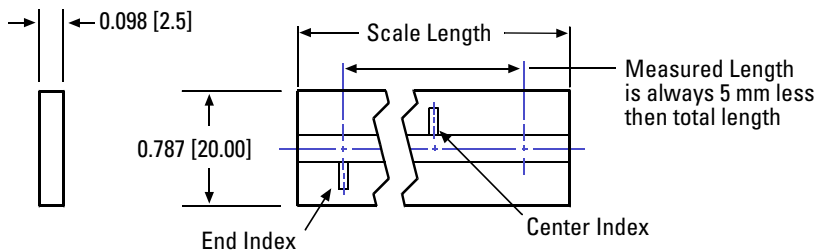
Model	L18	L30	L55	L80	L105	L130
Scale Length	0.709 [18]	1.181 [30]	2.165 [55]	3.150 [80]	4.134 [105]	5.118 [130]
Measured Length	0.512 [13]	0.984 [25]	1.969 [50]	2.953 [75]	3.937 [100]	4.921 [125]

Custom scales available

## Standard Long Linear Scales

### 155mm and Longer

Key: inches[mm]



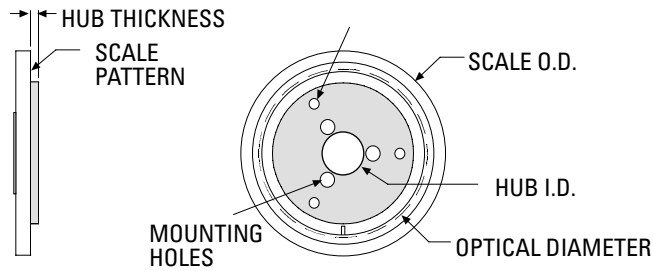
### Specifications

Accuracy	±5 µm <1m ±5 µm/m >1m
Material	Soda lime glass
Typical CTE	8ppm/°C
Index	Center or End

Model	L155	L225	L325	L425	L525	L1025	L2025
Scale length	6.102 [155]	8.858 [225]	12.795 [325]	16.732 [425]	20.669 [525]	40.354 [1025]	79.724 [2025]
Measured length	5.906 [150]	8.661 [220]	12.598 [320]	16.535 [420]	20.472 [520]	40.157 [1020]	79.528 [2020]

Custom scales available

# Standard Rotary Scales



## Specifications

Material	Soda lime glass
Typical CTE	8ppm/°C

Key: inches[mm]

Model No.	Scale Outer Diameter	Scale Inner Diameter	Optical Diameter	Hub Inner Diameter +0.0005/-0.0000	Hub Thickness	Fundamental CPR
R1206	0.472 [12.00]	0.250 [6.35]	0.413 [10.50]	0.1253 [3.18]	0.040 [1.02]	1650
R1910	0.750 [19.05]	0.375 [9.52]	0.627 [15.92]	0.1253 [3.183]	0.040 [1.02]	2500
R3213	1.250 [31.75]	0.500 [12.70]	1.027 [26.08]	0.2503 [6.358]	0.050 [1.27]	4096
R5725	2.250 [57.15]	1.000 [25.40]	2.053 [52.15]	0.5003 [12.708]	0.060 [1.52]	8192
R10851	4.250 [107.95]	2.000 [50.80]	4.106 [104.30]	1.0003 [25.408]	0.080 [2.03]	16384

Custom scales available

# How to Order Mercury 1000 Encoder Systems

To specify your Mercury encoder with the desired scale, cable length and software, consult the chart below to create the correct part number for your order. Call MicroE Systems' Rapid Customer Response team for more information [508] 903-5000.

Example (Linear Encoder): M1000-M05-L55-C1

Example (Rotary Encoder): M1000-M10-R1910-HA

<u>M1000</u>	-	<u>Cable Length</u>	-	<u>Scale Model</u>	-	<u>Scale Mounting</u>
		M05 = 0.5 m		Lxxx or Rxxxx		For linear scales:
		M10 = 1.0 m				T = Tape mounting
		M20 = 2.0 m				C1 = 3 scale clamps*
						C2 = 10 scale clamps**
						Hubs for Rotary Scales:
						NH = Without Hub
						HE = for R1206
						HA = for R1910
						HB = for R3213
						HC = for R5725
						HD = for R10851

\* 3 clamps for linear scales up to 130mm  
\*\* 10 clamps for linear scales 155mm or longer

## How to Order SmartPrecision Alignment

Required for M1000 setup

Example: Alignment Tool for Mercury 1000 encoder, 120 VAC = SSAT1000-120

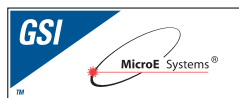
<u>SSAT1000</u>	-	<u>Voltage</u>
		120 = 120 VAC, 60Hz US Std. 2-prong plug
		220 = 220 VAC, 50Hz European Std. 2-prong plug

## How to Order SmartPrecision Software

Optional for SSAT1000 Alignment Tool

SmartPrecision Software

SSWA-AT = SmartPrecision software on CD

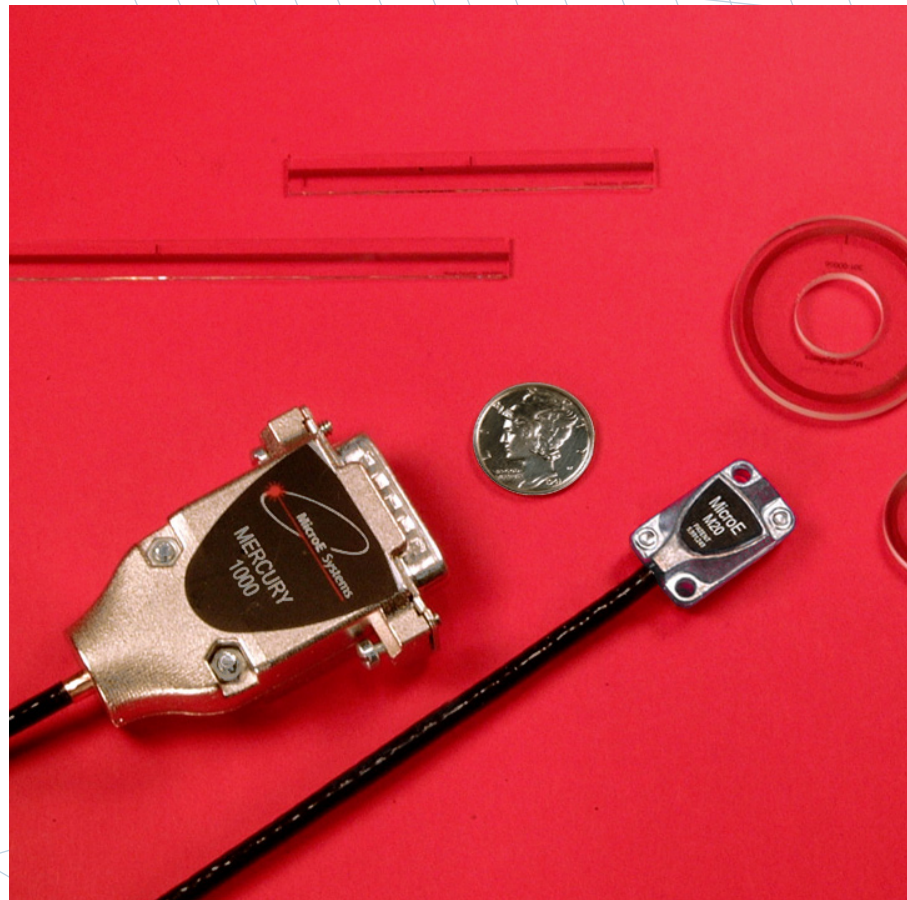


All Specifications are subject to change. All data is accurate to the best of our knowledge. MicroE Systems is not responsible for errors.

# Mercury™ 1000

Analog Output Encoder System

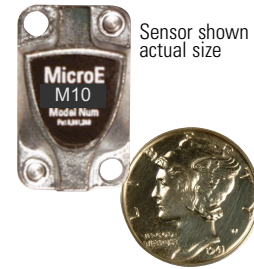
## *Installation Manual and Reference Guide*





# 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.

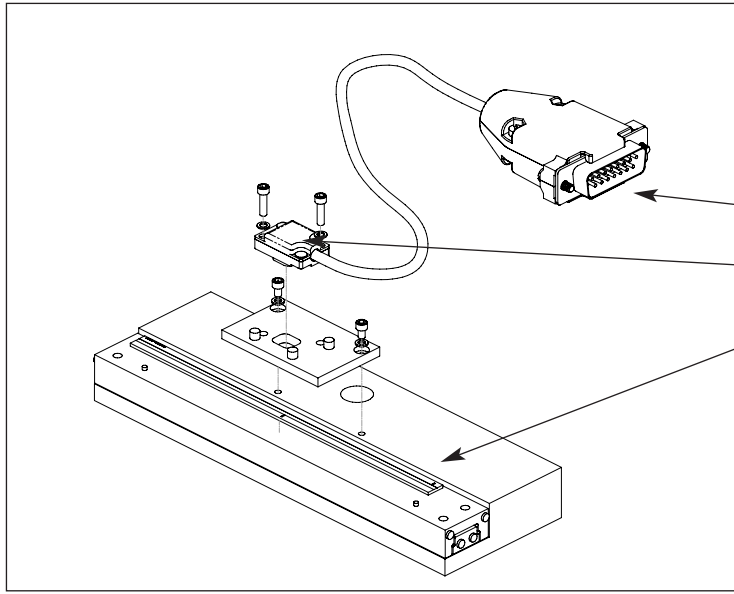
# Patents

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.

# Table Of Contents

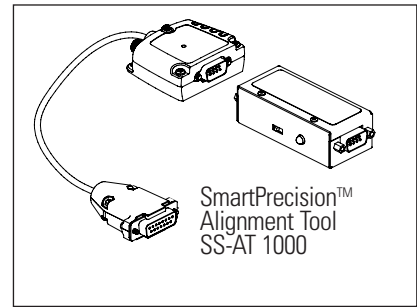
<b>SYSTEM ILLUSTRATION</b>	<b>PAGE</b>
Encoder with Linear scale	2
Encoder with Rotary scale	3
<b>INSTALLATION INSTRUCTIONS</b>	
Encoder System Mounting - Linear	4
Encoder System Alignment - Linear	5
Establishing an Index - Linear	5
Centering the Index & Calibration - Linear	5
Encoder System Mounting - Rotary	6
Encoder System Alignment - Rotary	7
Establishing an Index - Rotary	7
Centering the Index & Calibration - Rotary	7
<b>REFERENCE SECTION</b>	
Installation of Linear Scales	8
Grounding Instructions	9
Recommendations for Power	9
Recommended Interface Termination	10
Customer Interface Cable Requirements	10
<b>ENCODER TROUBLESHOOTING</b>	
Selected Topics	11
Cleaning Scales	11
Contact MicroE Systems	Back Cover

# Mercury 1000 Analog Encoder System with Linear scale

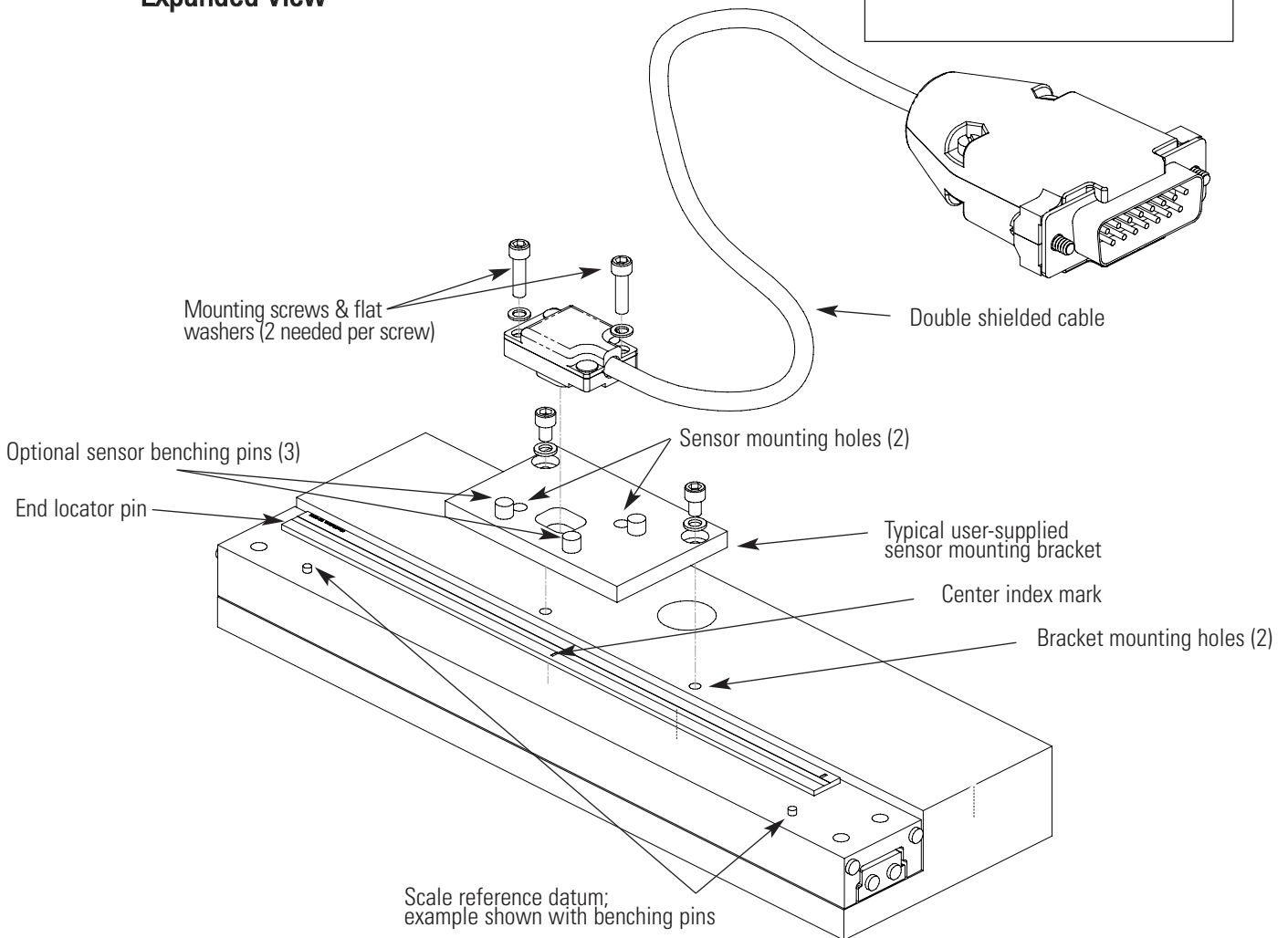


## System View Shown with linear scale

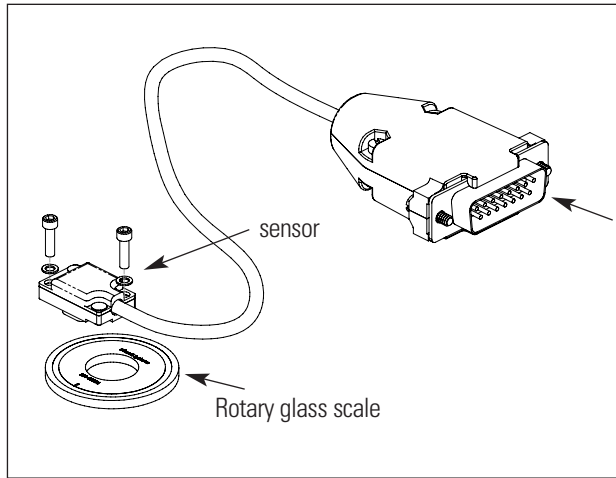
- 15 pin standard D-sub connector
- Sensor
- Linear glass scale  
(shown mounted on a linear slide)



## Expanded View

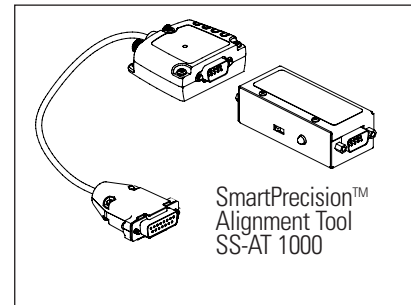


# Mercury 1000 Analog Encoder System with Rotary scale

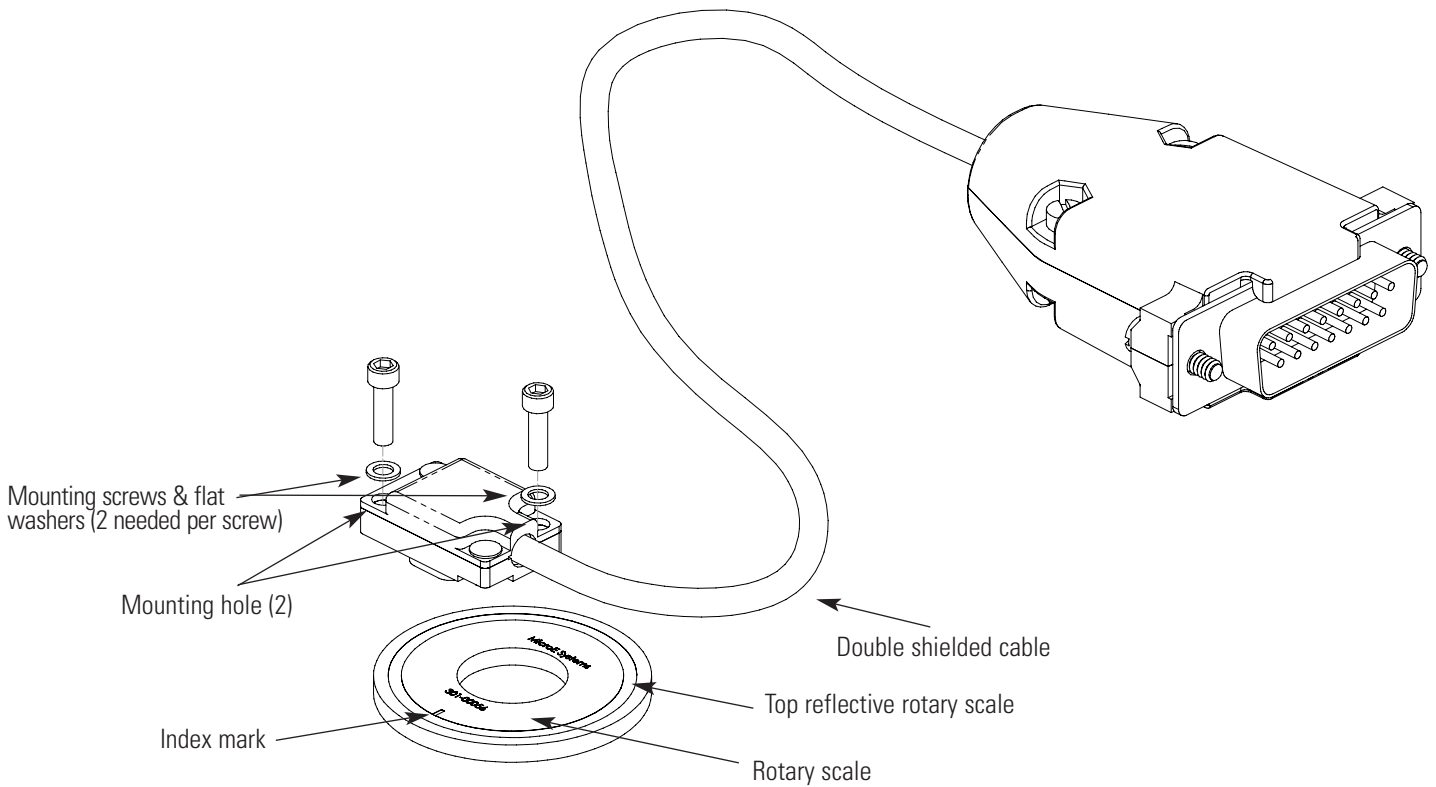


**System View**  
Shown with rotary scale

15 pin standard D-sub connector



**Expanded View**



# Installation Instructions

## Linear Encoders

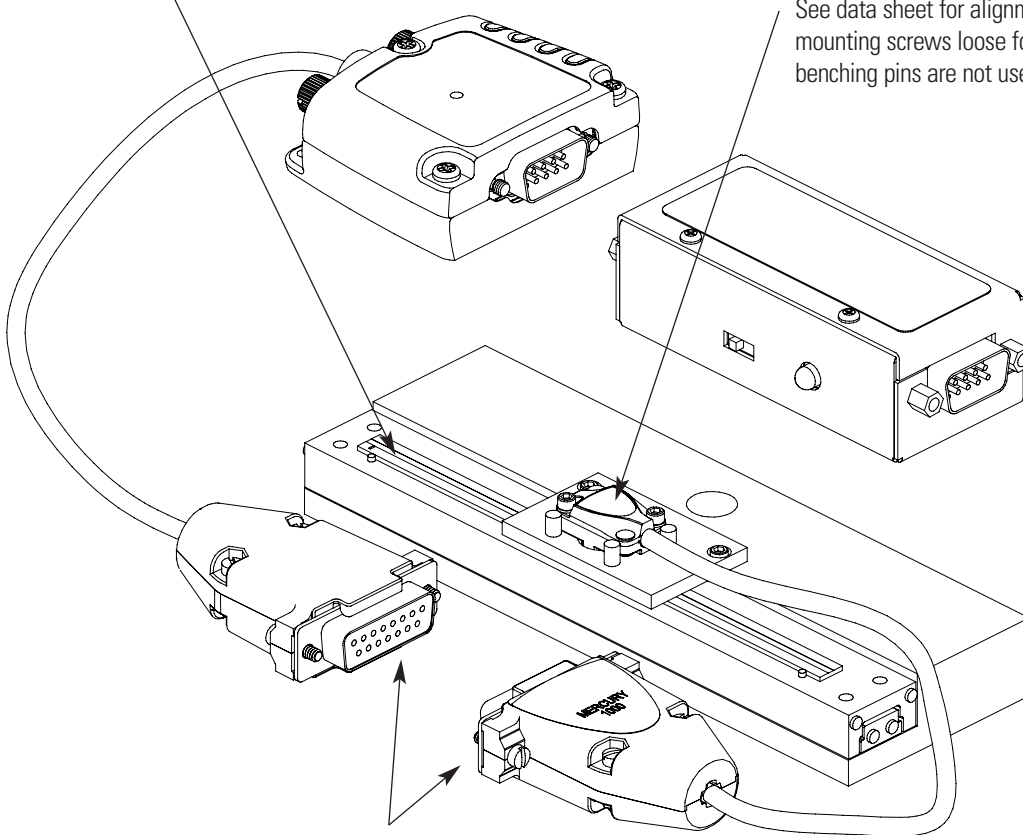
**1** Attach the scale to the base slide. Reference the preferred datum on the interface drawing for either end or center index orientation.

Depending on the mounting method, attach the scale to the slide with adhesive. 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.



**3** Be sure the source power is off before connecting the SmartPrecision™ Alignment Tool.  
Connect the M1000 to the SmartPrecision™ Alignment Tool

**4** Connect the Alignment Tool to the Computer Interface Adapter.



# Installation Instructions

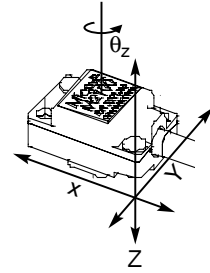
## Linear Encoders

# 5

Proper sensor alignment may require minor adjustments to the sensor position with respect to the scale. This can be performed easily using the SmartPrecision™ Alignment Tool as illustrated below.

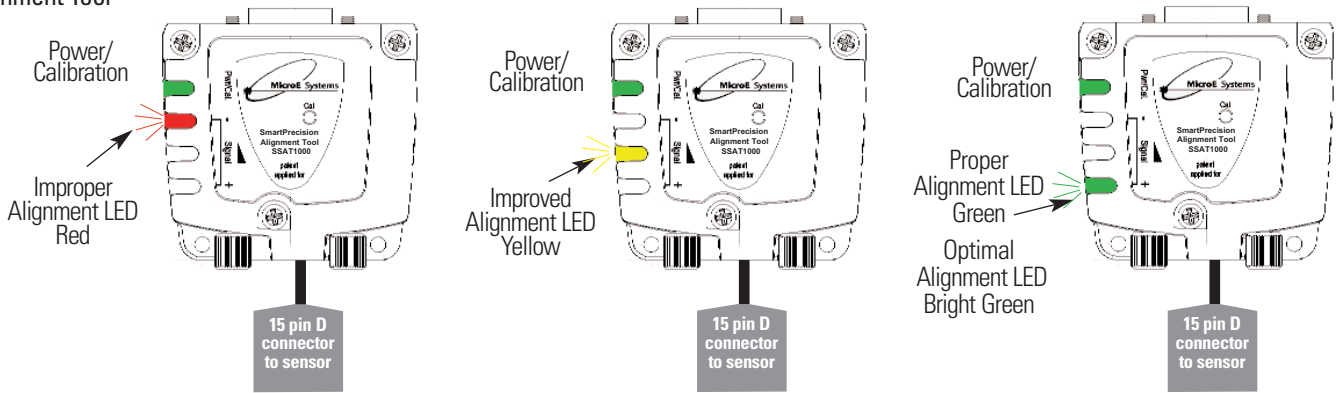
The red, yellow, or green LED will light depending on sensor alignment. Slowly move the sensor by allowing it to slide on the mounting surface until the green LED, is illuminated. Optimal alignment will be displayed as a “Bright Green” LED.

**IMPORTANT:** Confirm that the green 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.



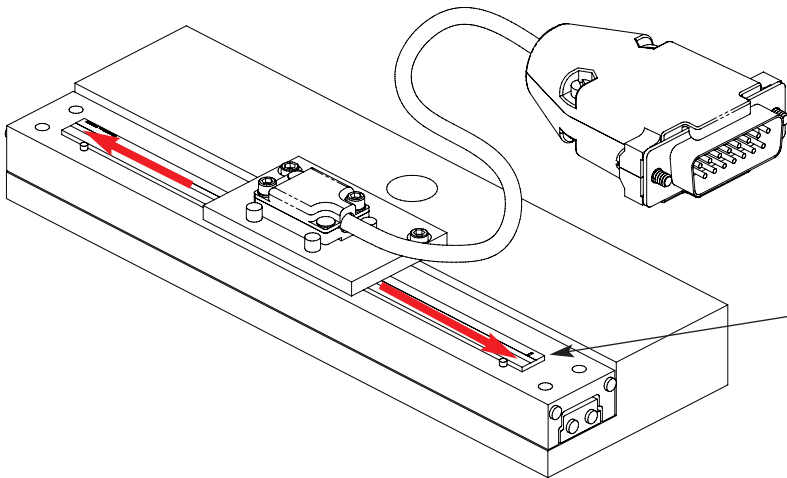
To align the sensor, move it in the Y or  $\theta_z$  directions.

### SmartPrecision™ Alignment Tool



# 6

Confirm green over the full range of motion by sliding the scale past the sensor. The “green” 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

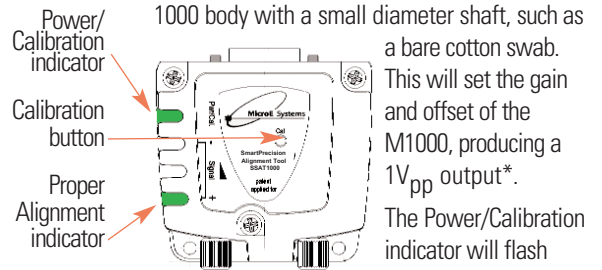
## IMPORTANT OUTPUT CALIBRATION PROCEDURE

*This procedure must be completed for proper system operation each time the sensor is aligned.*

Push the Calibration button inside the SS-AT 1000 body with a small diameter shaft, such as a bare cotton swab. This will set the gain and offset of the M1000, producing a 1V<sub>pp</sub> output\*. The Power/Calibration indicator will flash continuously. Move the

scale past the sensor over a distance of at least 7mm (1/4"). Do not run off the end of the scale. When the calibration procedure is complete, the Power/Calibration LED stops flashing.

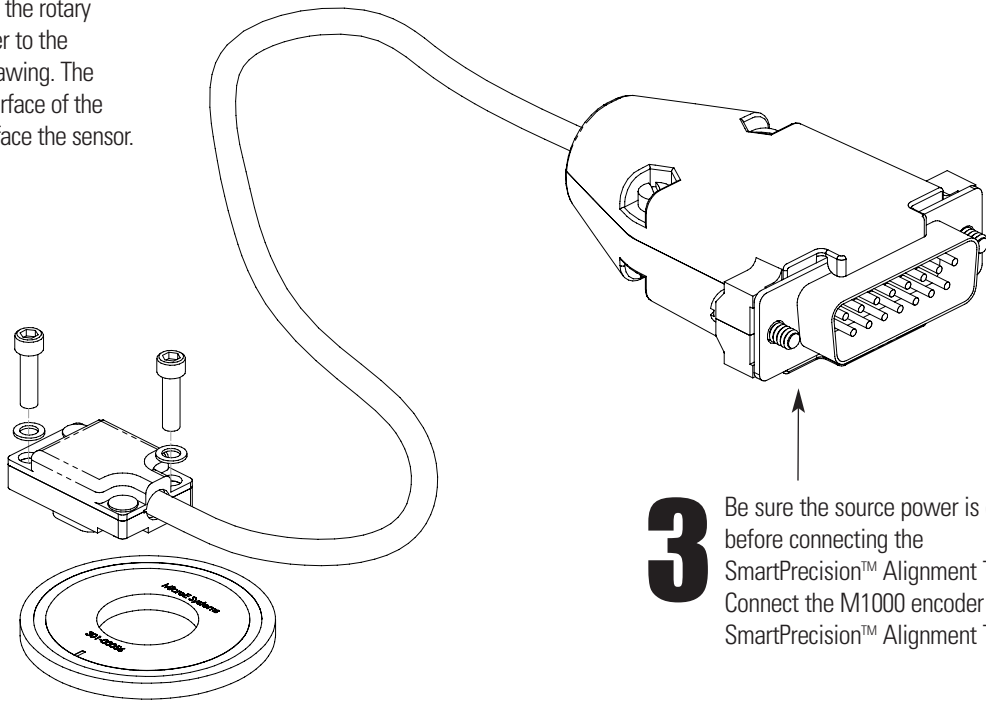
\* ±15% (Differential) across 120Ω resistor



# 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.



**3** Be sure the source power is off before connecting the SmartPrecision™ Alignment Tool. Connect the M1000 encoder to the SmartPrecision™ Alignment Tool.

**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.

**4** Connect the Alignment Tool to the Computer Interface Adapter.



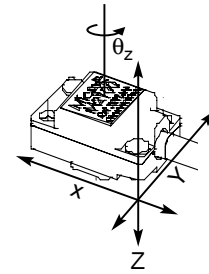
# Installation Instructions Rotary Encoders

Proper sensor alignment may require minor adjustments to the sensor position with respect to the scale. This can be performed easily using the SmartPrecision™ Alignment Tool as illustrated below.

## 5

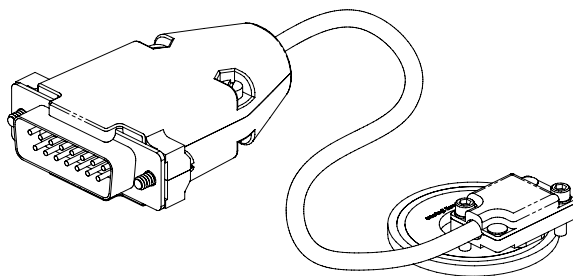
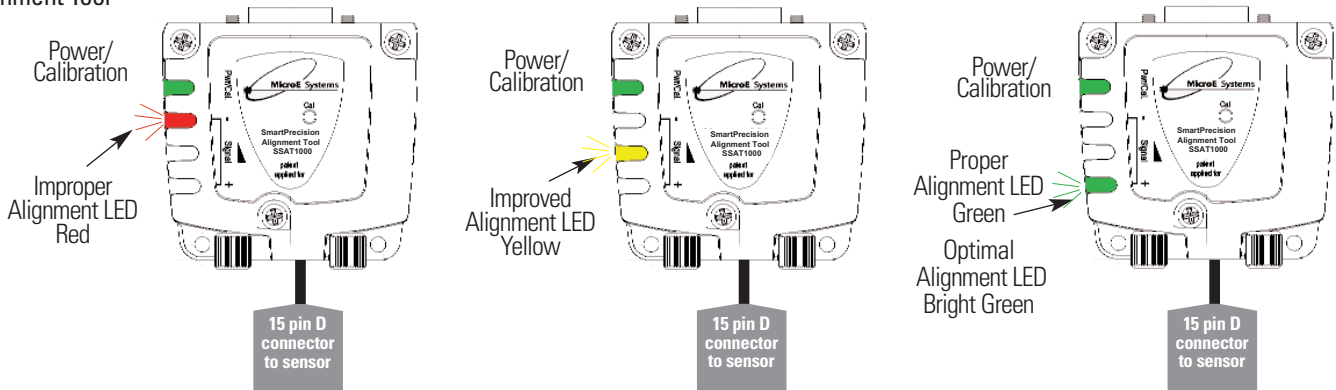
The red, yellow, or green LED will light depending on sensor alignment. Slowly move the sensor by allowing it to slide on the mounting surface until the green LED, is illuminated. Optimal alignment will be displayed as a “Bright Green” LED.

**IMPORTANT:** Confirm that the green 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.

### SmartPrecision Alignment Tool



## 6

Confirm green over the full range of motion by sliding the scale past the sensor. The “green” 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.

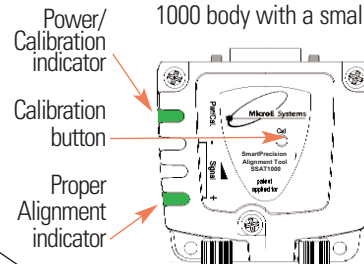
Push the Calibration button inside the SS-AT 1000 body with a small diameter shaft, such as a bare cotton swab.

This will set the gain and offset of the M1000, producing a 1V<sub>pp</sub> output\*.

The Power/Calibration indicator will flash

continuously. Move the scale past the sensor over a distance of at least 7mm (1/4”). Do not run off the end of the scale when using a segment scale. When the calibration procedure is complete, the Power/Calibration LED stops flashing.

\* ±15% (Differential) across 120Ω resistor





# Installation Reference Guide

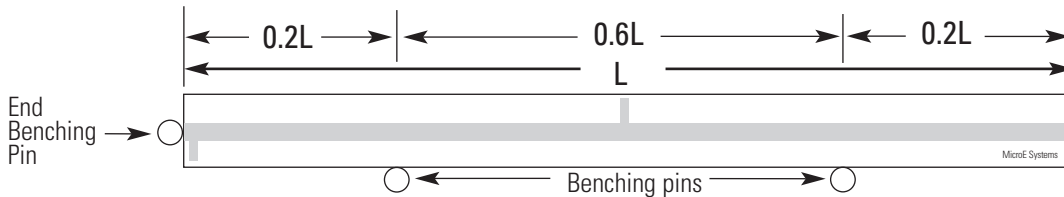
## Positioning the Scale

Note: Before beginning mounting procedure, use talc-free gloves or finger cots to handle the scales.

"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.



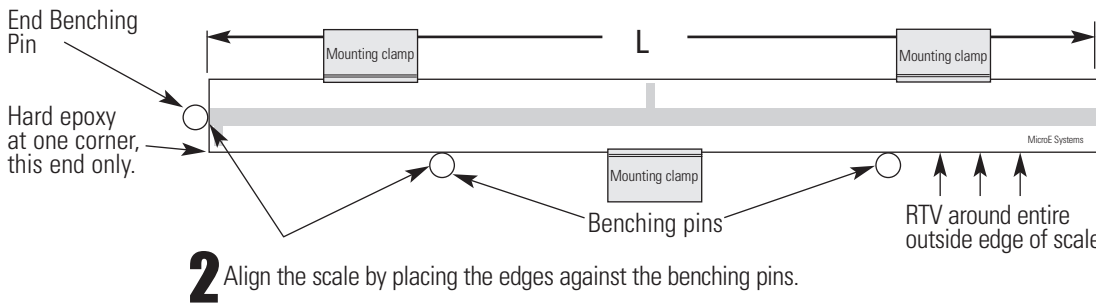
## Mounting the Scale

MicroE Systems' linear scales should be affixed to the mounting surface. Two different approaches are described below:

### Epoxy and RTV Mounting (Recommended for best accuracy)

**1** Make sure the mounting surface is clean and dry.

**3** Optionally, scale clamps may be used to secure the scale while the adhesive cures. Avoid damage to the top surface.



Scale clamp with adhesive  
Side view showing optional scale clamps and scale. Space clamps every 75mm on scales over 150 mm in length.

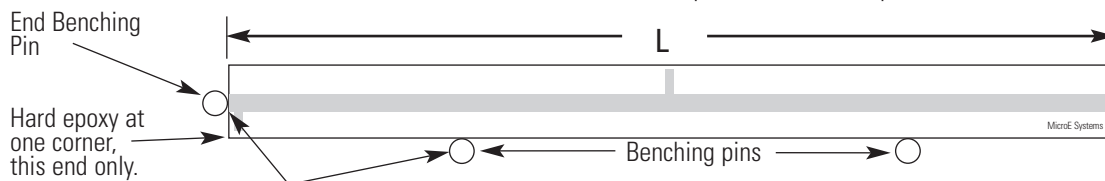
**2** Align the scale by placing the edges against the benching pins.

**4** Apply a hard epoxy, such as Tra-Con's Tra-Bond 2116, to the end of the scale at the end benching pin. Apply 100% Silicone RTV adhesive around the edges of the scale. This method allows thermal expansion from the benched end of the scale. After adhesive curing, remove the scale mounting clamps or, if permanently installing clamps, make sure they do not interfere with the sensor or sensor mount.

### Two Sided Adhesive Tape Mounting

**1** Make sure the mounting surface is clean and dry. Peel the cover paper off and place the scale above the final location.

**3** Gently place the scale on the mounting surface. Positioning adjustments can be made until the scale is firmly pressed down. After final positioning, push down on the top of the scale to secure it.



**2** Align the scale by placing the edges against the benching pins.

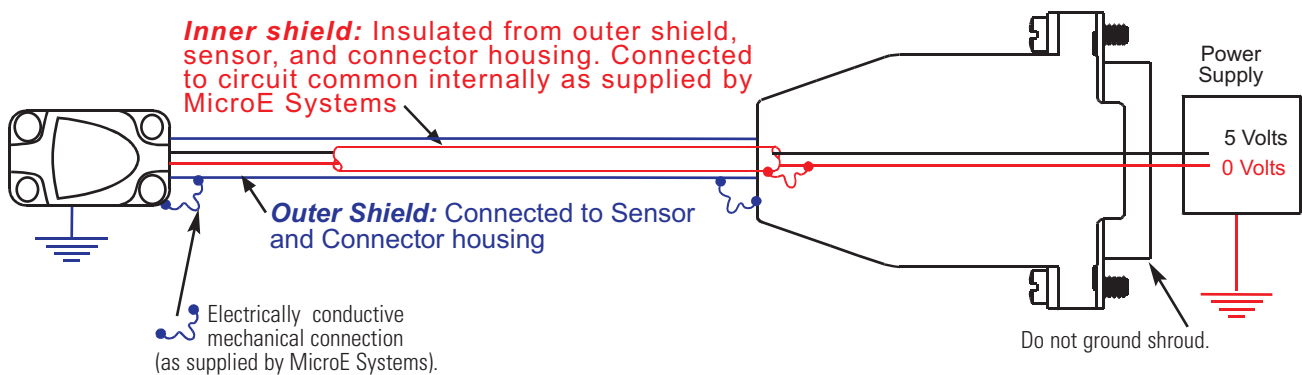
## Grounding Instructions for Mercury 1000 Encoder System

For Mercury 1000 encoder systems to operate reliably, it is essential that the sensor and cable shield are grounded properly according to the following instructions. The diagrams below show how to make the connections when the encoder's connector is plugged into the customer's controller chassis. If a customer-supplied extension cable is used, it should be a double shielded cable with conductive connector shells and must provide complete shielding over the conductors contained within it over its entire length. Furthermore, the shields should be grounded at the connection to the controller chassis the same way as the encoder connectors in the diagrams below.

Note: For best performance, isolate the encoder outer shield from motor cable shields and separate the encoder cable as far as possible from motor cables.

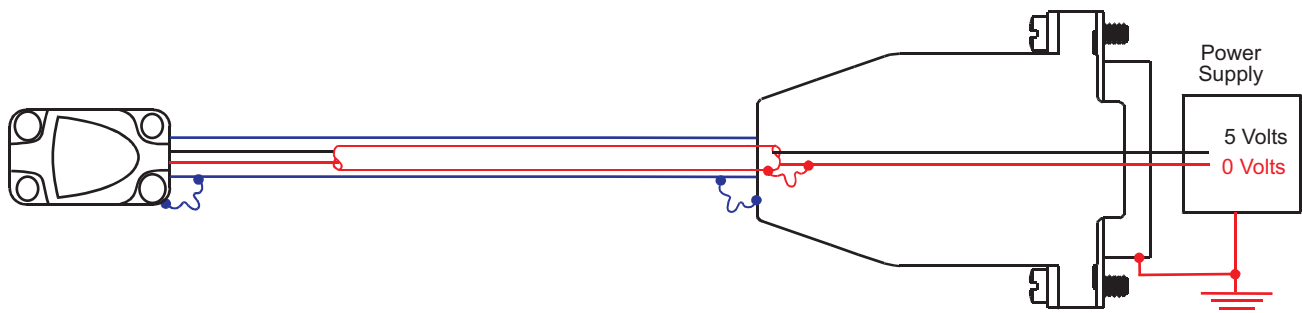
### Sensor mounted with good electrical contact to a well-grounded surface (preferred)

1. 15-pin D-sub connector grounding: the encoder's connector shell must be in intimate, electrically conductive contact with the customer-supplied mating connector, which must be isolated from the controller's ground. If a customer-supplied shielded cable connects the encoder to the controller, then the outer shield on the customer-supplied cable must be isolated from the controller's ground.
2. The sensor mounting surface must have a low impedance (DC/AC) connection to ground. The encoder sensor mounting surface may have to be masked during painting or anodizing to insure good electrical contact with the sensor.



### Sensor mounted to a surface that is grounded through bearings or a poorly-grounded surface, or mounted to a non-conducting surface

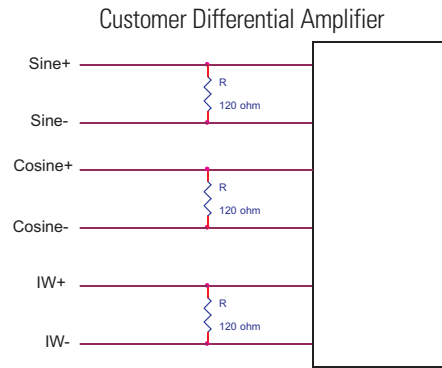
1. 15-pin D-sub connector grounding: the encoder's connector shell must be in intimate, electrically conductive contact with the customer-supplied mating connector, which must be connected to the controller's ground. If a customer-supplied shielded cable connects the encoder to the controller, then the outer shield on the customer-supplied cable must be connected to the controller's ground. The controller must be grounded to earth at the point of installation.
2. The encoder sensor must be mounted so that it is electrically isolated from ground.



## 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.

## 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.

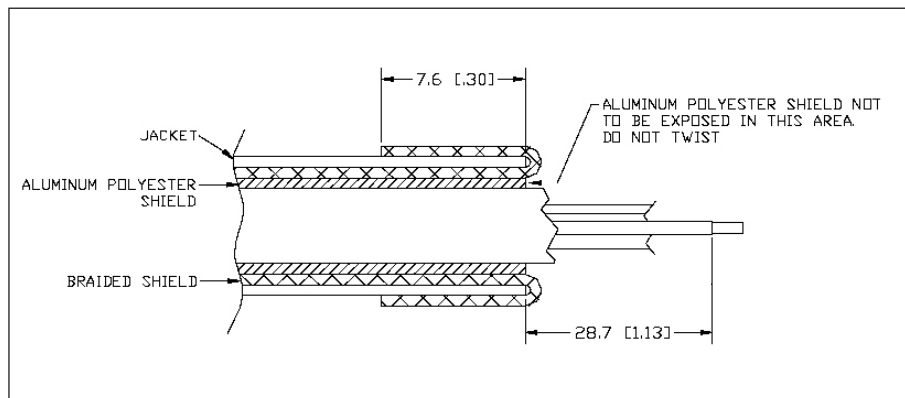
## Signal Wiring:

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

Mercury 1000	
Signal	Twisted Pair
Sine+	Pair 1
Sine-	
Cosine+	Pair 2
Cosine-	
Index+	Pair 3
Index-	
+5V	Pair 4
GND	

## 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.

# Troubleshooting

## Problem

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

## Solution

- Make sure the M1000 15-pin D connector is fully seated and connected.
- Confirm that +5 Volts DC is being applied to pin 12 on the M1000 15-pin D connector and that pin 13 is connected to ground.

## Problem

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

## Solution

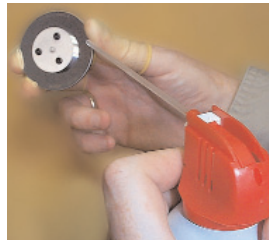
- Verify that the sensor has been aligned to the scale and that the mounting screws are tight. Check the dimensions for the mechanical mounting holes (and clamps if any) to make sure that the sensor is correctly located over the scale. Refer to appropriate the interface drawing.
- Check that the scale 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.***

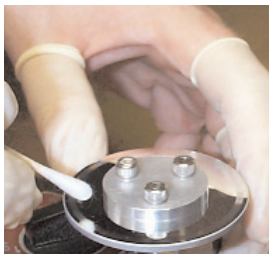
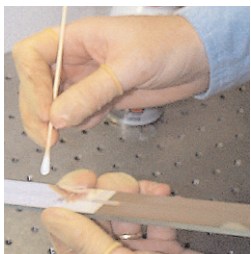
## Solution

- Part of the normal setup procedure is to activate the SmartPrecision™ Alignment Tool calibration process by pressing the recessed button on the SmartPrecision™ Alignment Tool connector body. The Power/Calibration indicator will flash until calibration is complete.



### General Particle Removal

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

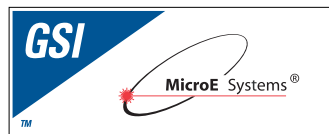


### Contamination Removal

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.

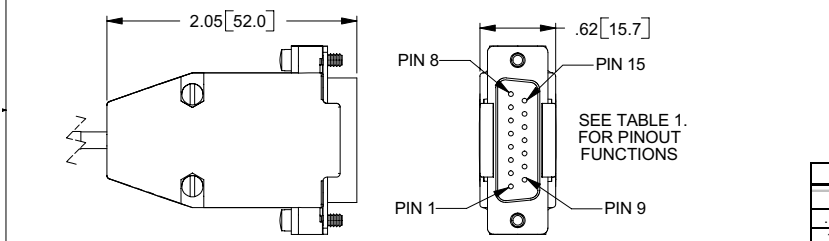
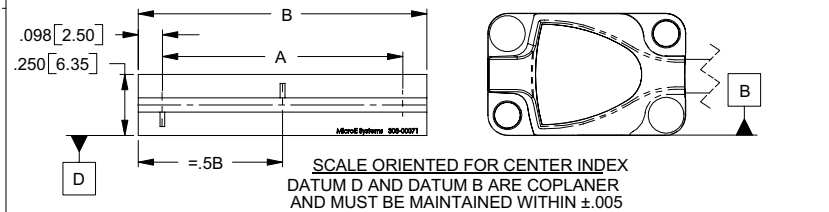
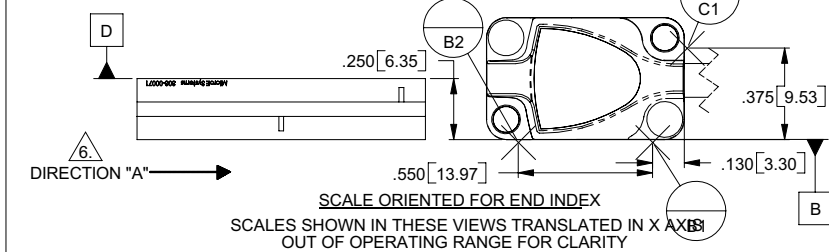
# Contacting MicroE Systems

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.



# Mercury 1000 Encoder System Interface Drawing: Short Linear Scales

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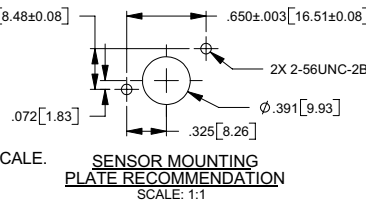
- NOTE:**
- RECOMMENDED MOUNTING HARDWARE:  
2-56 OR M2 SCREWS w/ 4 FLAT WASHERS (2 ON EACH SCREW) (OD OF WASHER NOT TO EXCEED .150 [3.81]). MAX. TORQUE: 3.3 in. lbs
  - IF BENCHING PINS ARE TO BE USED, PINS MUST BE PLACED ALONG DATUM EDGES OF BOTH THE SENSOR AND THE SCALE FOR PROPER ALIGNMENT. (REFERENCE DATUMS B1, B2 AND C1 FOR SENSOR BENCHING PINS)
  - HEIGHT OF SENSOR BENCHING PINS MUST BE A MINIMUM OF .170 [4.32] IN HEIGHT FROM DATUM A.
  - HEIGHT OF SCALE BENCHING PINS NOT TO EXCEED THE THICKNESS OF THE SCALE.
  - RECOMMENDED SENSOR MOUNTING PLATE THICKNESS:  
MINIMUM- 4 SCREW THREADS  
MAXIMUM- ALLOW CLEARANCE TO SCALE AND SCALE MOUNTING HARDWARE (BENCHING SURFACES, CLAMPS, HUBS, ETC.)
  - WHEN SCALE MOVES IN DIRECTION "A" WITH RESPECT TO A STATIONARY READHEAD OUTPUT SIGNAL COS+/B+ (PIN 7/PIN 10) LEADS OUTPUT SIGNAL SIN+/A+ (PIN 8/PIN 5).
  - DO NOT CONNECT TO "RESERVED" PINS. SEE TABLE 1. FOR RESERVED PINS.
  - FOR SCALES ATTACHED WITH ADHESIVE TAPE (LXX-T), THE SCALE MOUNTING SURFACE MUST BE .006" FURTHER AWAY FROM SENSOR MOUNTING SURFACE FOR NOMINAL Z HEIGHT. DIM = .193[4.90]

**TABLE 1.**  
**15 Pin Interface**  
**Plug Pinouts**

Pin	Function (M1000)	Function (M1500S)
1	IW-	N/C
2	IW+	N/C
3	RESERVED	N/C
4	RESERVED	A-
5	RESERVED	A+
6	RESERVED	N/C
7	COS+	SIN+
8	SIN+	COS+
9	N/C	B-
10	N/C	B+
11	N/C	N/C
12	+5V	+5V
13	GND	GND
14	COS-	IW+
15	SIN-	IW-

**TABLE 2.**  
**Cable Length**

(1000)	(1500S)
.5 Meter	1 Meter
1 Meter	2 Meter
2 Meter	5 Meter



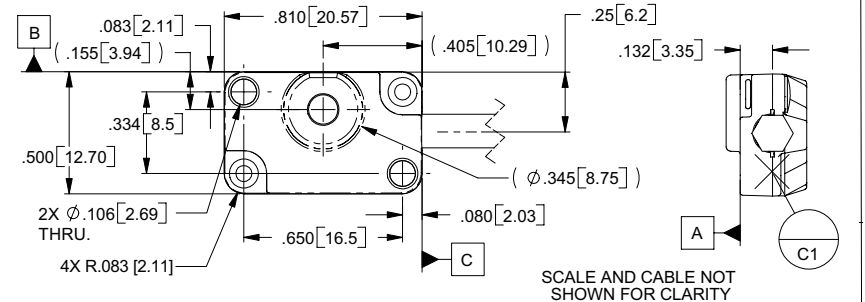
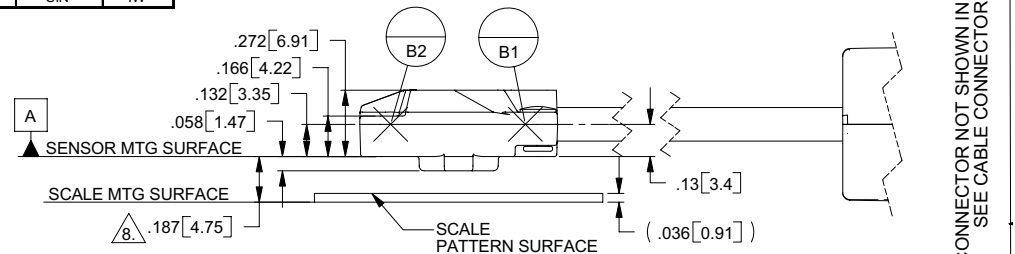
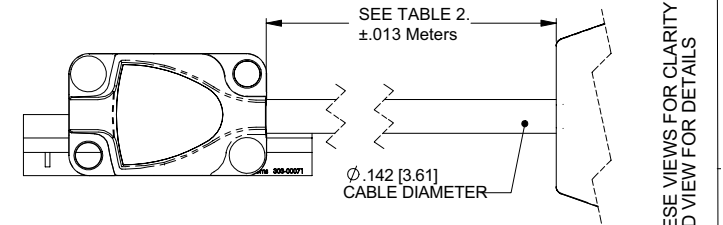
**SCALE IDENTIFICATION AND SIZE**

Scale	Dim A.	Dim B.
Identification #	Measured Length	Scale Length
LXX	XXmm-5mm	XXmm
FACE L30	30mm-5mm = 25mm	30mm
(max) L130	130mm-5mm = 125mm	130mm

THESE ARE EXAMPLES

**REVISIONS**

LTR	ECO	DESCRIPTION	DATE	APPROVED
A	---	RELEASE TO PRODUCTION	5/7/02	MF
B	879	ADDED M1000 TO DESC., UPDATED TABLE 1. SEE ECO	6/6/02	MF
C	900	UPDATED CABLE LENGTHS, ADD TABLE 2.	6/27/02	MF
D	907	UPDATED SIGNALS ON TABLE 1. SEE ECO	7/07/02	MF
E	946	UPDATED NOTE 1., ADDED MAX. TORQUE NOTE	8/14/02	MF
F	980	SNOUT DIMS TO REF. THK SCALE CORRECTED, REF.	9/24/02	MF
G	973	UPDATED TABLE 1. PIN 8 (COS+) WAS N/C. SEE ECO	11/19/02	MF
H	1428	UPDATED MODEL WITH SHRUNKEN HYBRID, ADDED NOTE 8.	5/31/05	SB



UNLESS OTHERWISE SPECIFIED, APPROVALS DATE

APPROVALS	DATE
DRAWN: S.BUTURLIA	5/1/02
CHECKED:	
ENGRG: DON GRIMES	5/6/02
TRF/CHK: MIKE SKWIRA	5/6/02
QA: JACK FARNAM	5/6/02

ALL DIMENSIONS ARE IN INCHES (millimeters)  
DIM. APPLY AFTER PROCESSING  
INTERPRET ALL GEOMETRIC TOLS. PER ANSI Y14.5M-1994

TOLERANCES ARE:  
DECIMALS: .XX [X]±.01 [25]  
ANGULAR: XXX [XX]±.005 [13] ±30 MIN.

DESCRIPTION:  
**INTERFACE, ENCODER, 20um SHORT LINEAR, MERCURY 1000/1500S SENSOR**

SIZE: B DWG. NO.: ID-00231 REV. H  
SCALE: 2:1 CAD FILE: SHEET 1 OF 1

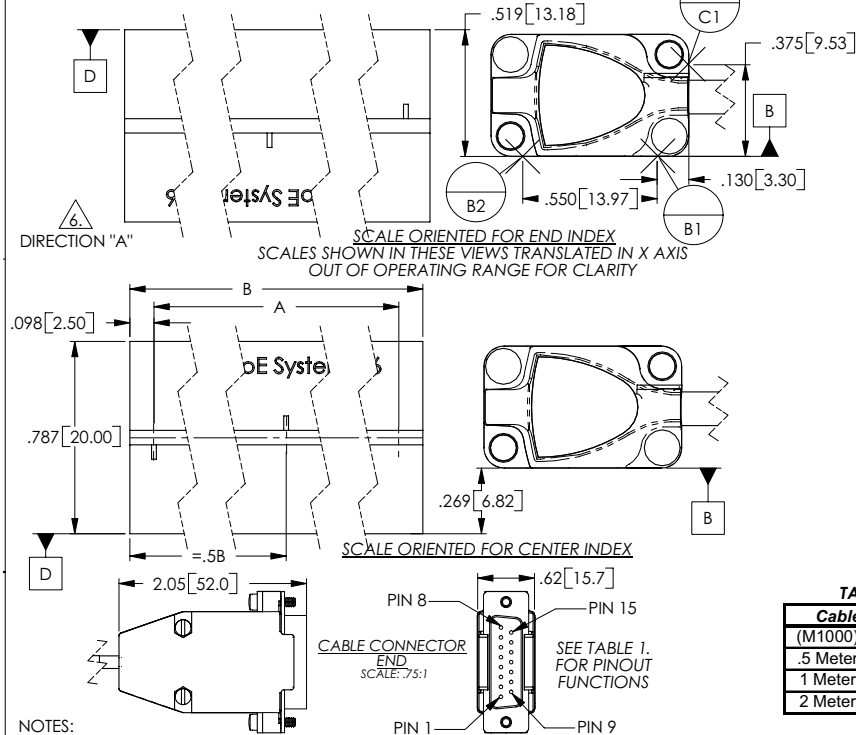
CONNECTOR NOT SHOWN IN THESE VIEWS FOR CLARITY  
SEE CABLE CONNECTOR END VIEW FOR DETAILS

UNITS: .in [mm]



# Mercury 1000 Encoder System Interface Drawing: Long Linear Scales

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- NOTES:
- RECOMMENDED MOUNTING HARDWARE:  
2-56 OR M2 SCREWS w/ 4 FLAT WASHERS (2 ON EACH SCREW)  
(OD OF WASHER NOT TO EXCEED .150 [3.81])  
MAX TORQUE: 3.3 in. lbs
  - IF BENCHING PINS ARE TO BE USED, PINS MUST BE PLACED ALONG DATUM EDGES OF BOTH THE SENSOR AND THE SCALE FOR PROPER ALIGNMENT. (REFERENCE DATUMS B1, B2 AND C1 FOR SENSOR BENCHING PINS)
  - HEIGHT OF SENSOR BENCHING PINS MUST BE A MINIMUM OF .170 [4.32] IN HEIGHT FROM DATUM A.
  - HEIGHT OF SCALE BENCHING PINS NOT TO EXCEED THE THICKNESS OF THE SCALE.
  - RECOMMENDED SENSOR MOUNTING PLATE THICKNESS:  
MINIMUM- 4 SCREW THREADS  
MAXIMUM- ALLOW CLEARANCE FOR SCALE AND SCALE MOUNTING HARDWARE (BENCHING SURFACES, CLAMPS, HUBS, ETC.)

6. WHEN SCALE MOVES IN DIRECTION "A" WITH RESPECT TO A STATIONARY READHEAD, OUTPUT SIGNAL COS+ / B+ (PIN 7 / PIN 10) LEADS OUTPUT SIGNAL SIN+ / A+ (PIN 8 / PIN 5).

7. DO NOT CONNECT TO "RESERVED" PINS. SEE TABLE 1. FOR RESERVED PINS.

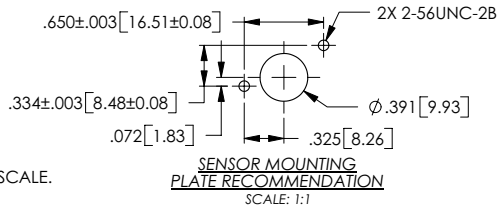
8. FOR SCALES ATTACHED WITH ADHESIVE TAPE (LXX-T), THE SCALE MOUNTING SURFACE MUST BE .006" FURTHER AWAY FROM SENSOR MOUNTING SURFACE FOR NOMINAL Z HEIGHT. DIM = .255 [6.48]

**TABLE 1.**  
**15 Pin Interface**

Plug Pinouts		
PIN	Function (M1000)	Function (M1500S)
1	IW-	N/C
2	IW+	N/C
3	RESERVED	N/C
4	RESERVED	A-
5	RESERVED	A+
6	RESERVED	N/C
7	COS+	SIN+
8	SIN+	COS+
9	N/C	B-
10	N/C	B+
11	N/C	N/C
12	*+5V	*+5V
13	GND	GND
14	COS-	IW+
15	SIN-	IW-

**TABLE 2.**  
**Cable Length**

(M1000)	(1500S)
.5 Meter	1 Meter
1 Meter	2 Meter
2 Meter	5 Meter



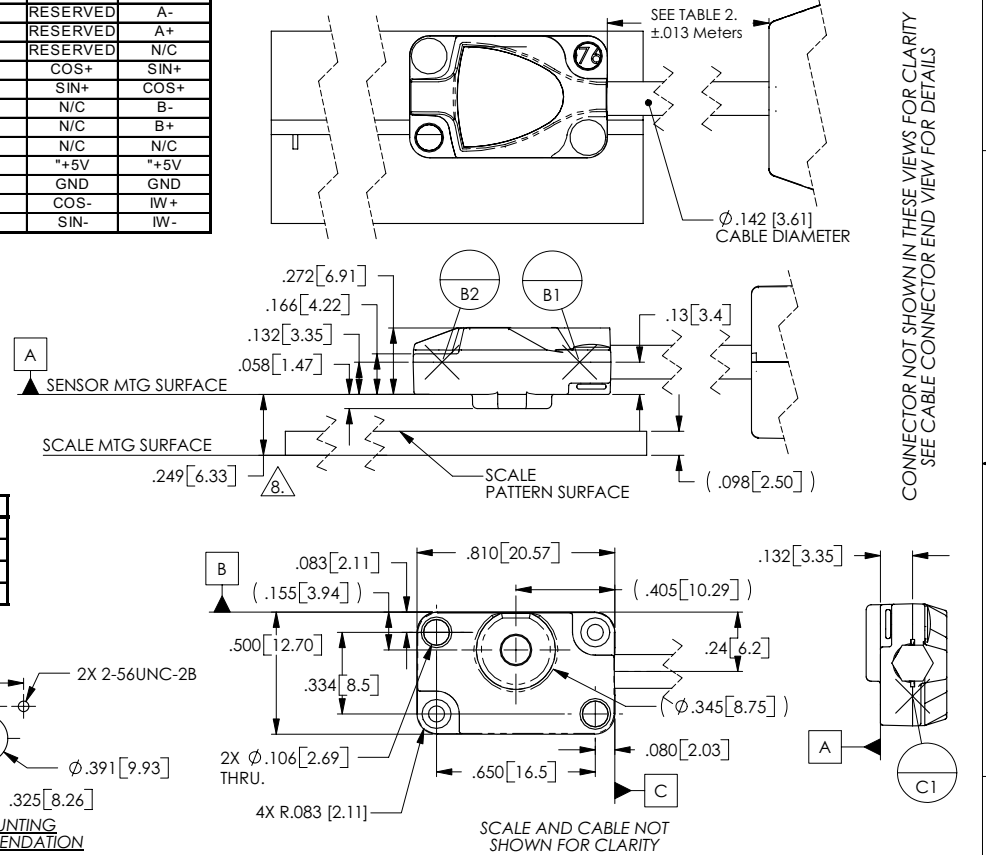
**SCALE IDENTIFICATION AND SIZE**

Scale Identification #	Dim. A Measured Length	Dim. B Scale Length
LXX	XXmm-5mm	XXmm
L155	155mm-5mm=155mm	155mm
(max)	2025mm-5mm=2020mm	2025mm

THESE ARE EXAMPLES

**REVISIONS**

LTR	ECO	DESCRIPTION	DATE	APPROVED
A	---	RELEASE TO PRODUCTION	5/7/02	MF
B	879	ADDED M1000 TO DESC. UPDATED TABLE 1. SEE ECO	6/5/02	MF
C	900	UPDATED CABLE LENGTHS. ADDED TABLE 2.	6/27/02	MF
D	907	UPDATED SIGNALS IN TABLE 1. SEE ECO	7/07/02	MF
E	946	UPDATED NOTE 1. ADDED MAX TORQUE NOTE	8/14/02	MF
F	960	SNOUT DIMS TO REF. SCALE THK TO REF.	9/24/02	MF
G	979	UPDATED TABLE 1. PIN 8 (COS+) WAS N/C. SEE ECO	11/19/02	MF
H	1428	UPDATED MODEL WITH SHRUNKEN HYBRID. ADDED NOTE 8.	5/25/05	SB
I	1498	REVERSED PINS 9 & 15 IN CABLE CONNECTOR DETAIL.	10/28/05	SB



UNLESS OTHERWISE SPECIFIED  
ALL DIMENSIONS ARE IN INCHES  
DIM. APPLY AFTER PROCESSING  
INTERPRET ALL GEOMETRIC TOLS.  
PER ANSI Y14.5M-1994

TOLERANCES ARE:  
DECIMALS: .XX ±.01  
.XXX ±.005

ANGULAR: ±30 MIN.

**APPROVALS**

DATE	APPROVALS
5/3/02	S.BUTURLIA
5/6/02	DON GRIMES
5/6/02	MIKE SKWIRA
5/6/02	JACK FARNAM

**GS1** MicroE Systems  
Division of GSI  
8 Erie Drive  
Natick, MA 01760

DESCRIPTION:  
INTERFACE, ENCODER,  
20um LONG LINEAR,  
MERCURY 1000/1500S SENSOR

DWG. NO. ID-00232  
SCALE: 2:1 CAD FILE: SHEET 1 OF 1

# Mercury 1000 Encoder System Interface Drawing: Rotary Scale with Hub

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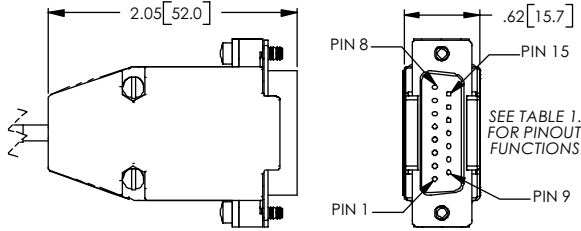
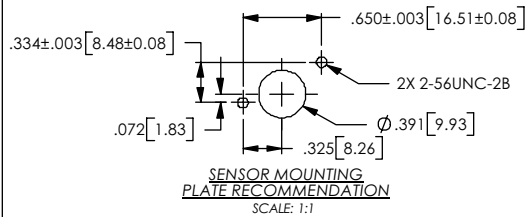


TABLE 1.

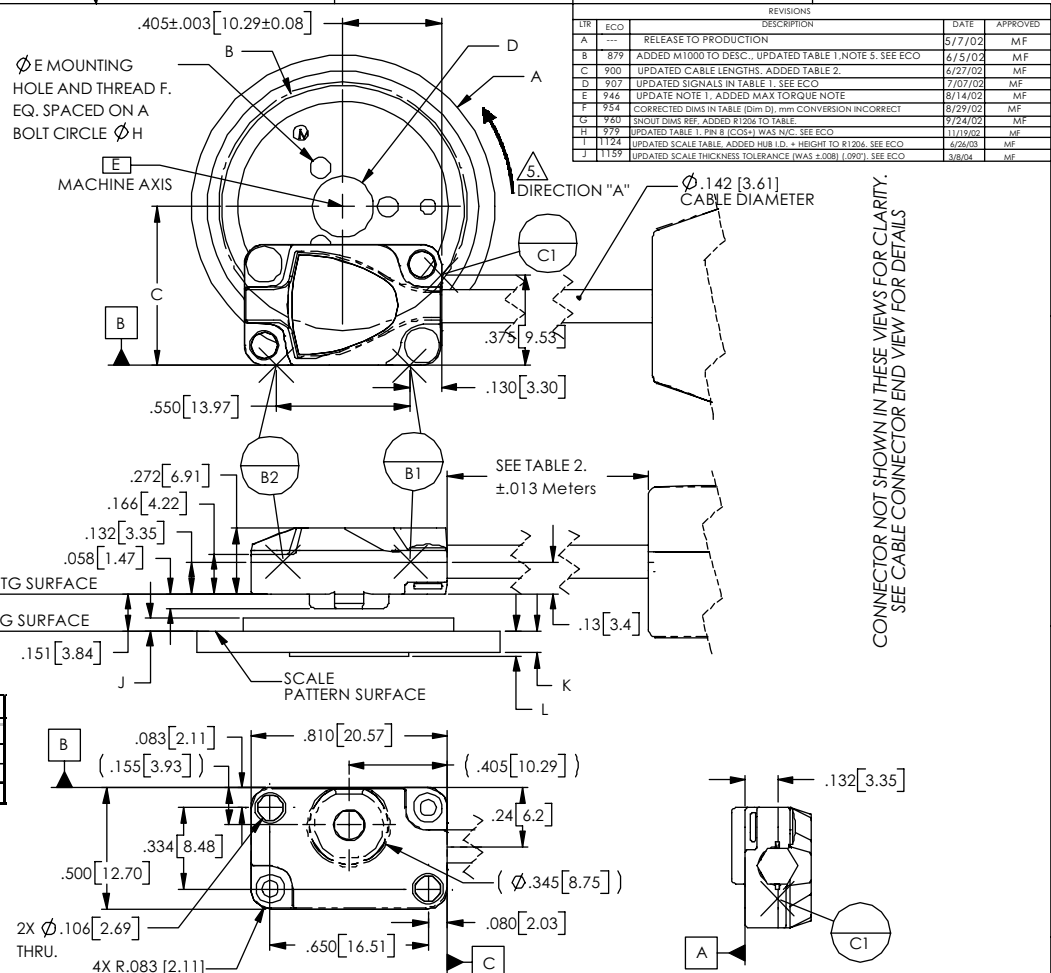
15 Pin Interface Plug Pinouts		
Pin	Function (M1000)	Function (M1500S)
1	IW-	N/C
2	IW+	N/C
3	RESERVED	N/C
4	RESERVED	A-
5	RESERVED	A+
6	RESERVED	N/C
7	COS+	SIN+
8	SIN+	COS+
9	N/C	B-
10	N/C	B+
11	N/C	N/C
12	+5V	+5V
13	GND	GND
14	COS-	IW+
15	SIN-	IW-



- NOTE:
1. RECOMMENDED MOUNTING HARDWARE:  
2-56 OR M2 SCREWS w/ 4 FLAT WASHERS (2 ON EACH SCREW)  
(OD OF WASHER NOT TO EXCEED .150 [3.81])  
MAX TORQUE: 3.3 in. lbs
  2. IF BENCHING PINS ARE TO BE USED, PINS MUST BE PLACED ALONG DATUM EDGES OF SENSOR FOR PROPER ALIGNMENT.  
(REFERENCE DATUMS B1, B2 AND C1).
  3. HEIGHT OF SENSOR BENCHING PINS MUST BE A MINIMUM OF .170 [4.32] IN HEIGHT FROM DATUM A.
  4. RECOMMENDED SENSOR MOUNTING PLATE THICKNESS:  
MINIMUM- 4 SCREW THREADS  
MAXIMUM- ALLOW CLEARANCE FOR SCALE AND SCALE MOUNTING HARDWARE  
(BENCHING SURFACES, CLAMPS, HUBS, ETC.)
  5. WHEN SCALE MOVES IN DIRECTION "A" WITH RESPECT TO A STATIONARY READHEAD, OUTPUT SIGNAL COS+/B+ (PIN 7/PIN 10) LEADS OUTPUT SIGNAL SIN+/A+ (PIN 8/PIN 5).
  6. DO NOT CONNECT TO "RESERVED" PINS. SEE TABLE 1. FOR RESERVED PINS.

TABLE 2.

Cable Length	
(1000)	(1500S)
.5 Meter	1 Meter
1 Meter	2 Meter
2 Meter	5 Meter



REVISIONS				
LIK	ECO	DESCRIPTION	DATE	APPROVED
A	---	RELEASE TO PRODUCTION	5/7/02	MF
B	879	ADDED M1000 TO DESC., UPDATED TABLE 1, NOTE 5. SEE ECO	6/5/02	MF
C	900	UPDATED CABLE LENGTHS, ADDED TABLE 2.	6/23/02	MF
D	907	UPDATED SIGNALS IN TABLE 1. SEE ECO	7/07/02	MF
E	946	UPDATE NOTE 1. ADDED MAX TORQUE NOTE	8/14/02	MF
F	954	CORRECTED DIMS IN TABLE (DIM D), mm CONVERSION INCORRECT	8/29/02	MF
G	960	SHOUT DIMS REF. ADDED R1206 TO TABLE.	9/24/02	MF
H	979	UPDATED TABLE 1. PIN 8 (COS+) WAS N/C. SEE ECO	11/19/02	MF
I	1124	UPDATED SCALE TABLE. ADDED HUB I.D. + HEIGHT TO R1206. SEE ECO	4/26/03	MF
J	1159	UPDATED SCALE THICKNESS TOLERANCE (WAS ±.008) L0901. SEE ECO	3/8/04	MF

CONNECTOR NOT SHOWN IN THESE VIEWS FOR CLARITY.  
SEE CABLE CONNECTOR END VIEW FOR DETAILS.

SCALE AND CABLE NOT SHOWN FOR CLARITY

SCALE IDENTIFICATION AND SIZE. DIMENSIONS IN INCHES [MILLIMETERS]

Scale Identification	Counts/Rev	Dim. A Scale O.D.	Scale I.D.	Dim. B Optical Dia.	Dim. C Mounting Dim.	Dim. D Hub I.D.	Dim. E Mounting Hole Dia.	Thread F	Dim. H Bolt Circle	Dim. J Hub Height	Dim. K Scale Thickness	Dim. L Hub Relief
R1206	1,650	0.472 [12.00]	.250+/-0.005 [6.35+/-0.13]	0.413 [10.50]	0.348+/-0.002 [8.84+/-0.05]	0.1253+0.0005/-0.0000 [3.182+0.013/-0.000]	N/A	N/A	N/A	0.040 [1.02]	.036+/-0.002 [0.91+/-0.05]	0.045 [1.14]
R1910	2,500	0.750 [19.05]	.375+/-0.005 [9.53+/-0.13]	0.627 [15.92]	0.454+/-0.002 [11.53+/-0.05]	0.1253+0.0005/-0.0000 [3.182+0.013/-0.000]	[1.19]	0-80	[6.35]	[1.02]	[2.29+/-0.10]	[2.67]
R3213	4,096	1.250 [31.75]	.500+/-0.005 [12.70+/-0.13]	1.027 [26.08]	0.654+/-0.002 [16.62+/-0.05]	0.2503+0.0005/-0.0000 [6.357+0.013/-0.000]	[1.78]	2-56	[9.40]	[1.27]	[2.29+/-0.10]	[2.67]
R5725	8,192	2.250 [57.15]	1.000+/-0.005 [25.40+/-0.13]	2.053 [52.15]	1.168+/-0.002 [29.66+/-0.05]	0.5003+0.0005/-0.0000 [12.707+0.013/-0.000]	[3.45]	8-32	[19.05]	[1.52]	[2.29+/-0.10]	[2.67]
R10851	16,384	4.250 [107.95]	2.000+/-0.005 [50.80+/-0.13]	4.106 [104.30]	2.194+/-0.002 [55.73+/-0.05]	1.0003+0.0005/-0.0000 [25.408+0.013/-0.000]	[3.45]	8-32	[34.93]	[2.03]	[2.29+/-0.10]	[2.67]

UNLESS OTHERWISE SPECIFIED  
ALL DIMENSIONS ARE IN INCHES (MILLIMETERS) DIM. APPLY AFTER PROCESSING PER ANS I14.5M-1994  
TOLERANCES ARE:  
DECIMALS: .XX [X]±.01 [0.25] .XXX [XX]±.005 [0.13]  
ANGULAR: ±30 MIN.

APPROVALS	DATE
DRAWN: S. BUTURLIA CHECKED:	5/6/02
ENGRG: DON GRIMES MFG ENG: MIKE SKWIRA QA: JACK FARNAM	5/6/02

UNITS: .in [mm]  
MicroE Systems  
DESCRIPTION: INTERFACE, ENCODER, 20um ROTARY w/HUB, MERCURY 1000/1500S SENSOR

SIZE B	DWG. NO. ID-00233	REV. J
SCALE: 2:1	CAD FILE:	SHEET 1 OF 1