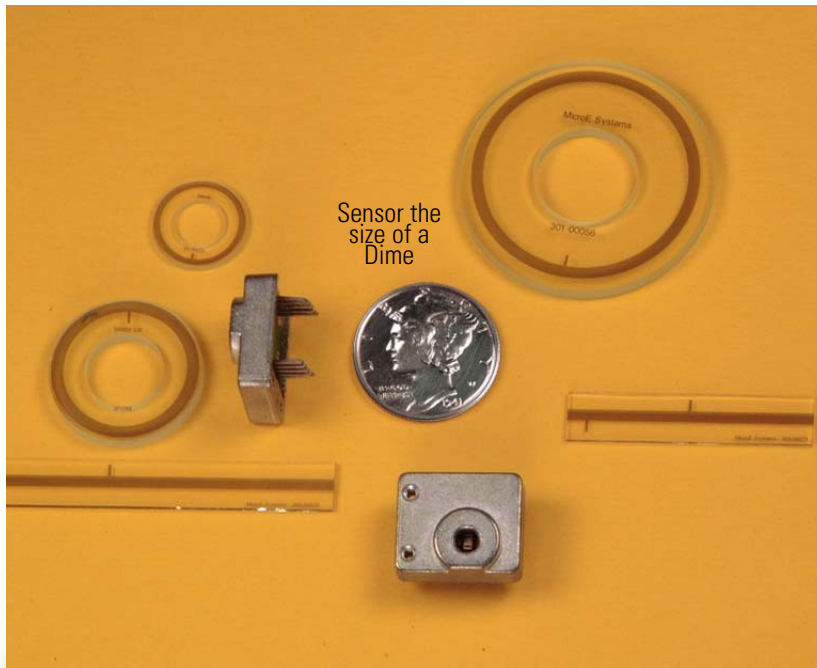**GSI** MicroE Systems®

Enabling Technology™

Mercury™ 1500P *PCB-Mount Digital Encoders*
Factory Set Resolution to 0.50µm

Reflective Linear and Rotary Encoders

Sensor the size of a Dime

Resolution
Factory Set:
 x4, x8, x20, or x40

Linear: 5µm, 2.5µm, 1.0µm, or 0.50µm

Rotary: 6,600 to 655,000 CPR

Accuracy

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

Output

A-quad-B and
Digital Index Window

The Mercury 1500P encoder is a digital output system. Designed for PC board mounting, it is available with linear or rotary scales. Mercury's space-saving, integrated configuration gives OEM system designers a breakthrough in performance.

Imagine what you can do with this!

OEMs can now use encoders for closed loop control where it was previously not possible or cost effective. Engineers can achieve dramatic improvements in system speed, throughput, and reliability, while reducing cost, size and weight. The Mercury 1500P series kit encoders make it all possible. The digital output sensors mount directly on your printed circuit board within an EMI shielded module. The low Z height of the sensor, only 5.6mm, opens up exciting design possibilities.

Table of Contents

Standard Features

- *Small PCB mount sensor*
- *Sensor is 5.6mm (H) x 12.7mm (W) x 15.2mm (L) and weighs 2.6g*
- *Resolution:*
  Linear 5, 2.5, 1.0, 0.5µm;
  Rotary 6,600 to 655,000 CPR
- *Digital Differential Outputs: A-quad-B and Index window*
- *Bi-directional Index window signal*
- *Index mark at the center or end of the glass scale (linear)*

Optional features

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

Broader Alignment Tolerances, Increased Standoff Clearance, Smallest Sensor and More
Why Mercury Encoders Make It Easier To Design High Performance Into Your Equipment

Theta Z Alignment Tolerance
± 2° ± 0.5° ± 0.006°

Mercury   Brand Y   Brand X

MicroE
M2110
PAT 5,991,249
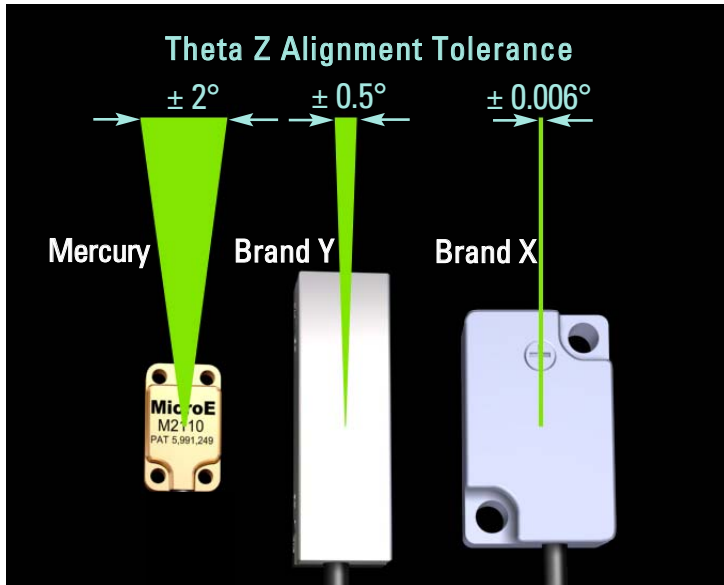
Eliminate the Frustration of Touchy Encoder Alignment

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 it's 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

Note: Mercury 1500P is even smaller at 5.6mm sensor height

Standoff Clearance

Mercury — 2.4mm* ± 0.15mm

Brand Y — 0.8mm ± 0.1mm

Brand X — 0.5mm ± 0.1mm
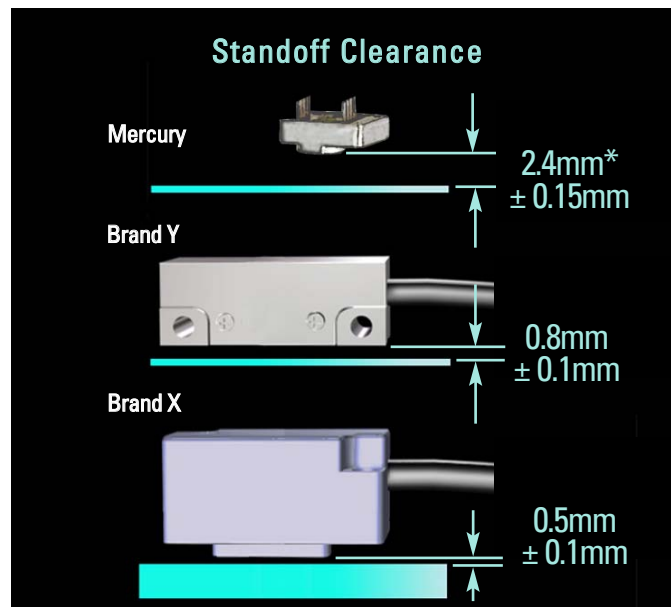
* Dimensions shown illustrate encoder system standoff clearance; see Mercury Encoder Interface Drawings for correct design reference surfaces.

System Specifications
Resolution and Maximum Speed

Mercury 1500P systems have factory set interpolation: x4, x8, x20, x40. Below is the table of available resolutions.

Linear - 20µm grating pitch

Interpolation	Resolution	Maximum Speed
x4	5.000µm/count	7200mm/s
x8	2.500µm/count	7200mm/s
x20	1.000µm/count	7200mm/s
x40	0.500µm/count	7200mm/s

Rotary - 20µm grating pitch

Rotary Glass Scale Diameter	Fundamental Resolution		Interpolation Below is a table of the available resolutions.			
0.472" [12.00mm]	1650 CPR		x4	x8	x20	x40
		interpolated resolution (CPR)	6,600	13,200	33,000	66,000
		interpolated resolution (arc-sec/count)*	196.4	98.2	39.2	19.64
		interpolated resolution (µrad/count)*	952	476	190.3	95.2
		maximum speed (RPM)	13090	13090	13090	13090
0.750" [19.05mm]	2500 CPR		x4	x8	x20	x40
		interpolated resolution (CPR)	10,000	20,000	50,000	100,000
		interpolated resolution (arc-sec/count)*	129.6	64.8	25.9	12.96
		interpolated resolution (µrad/count)*	628	314	125.6	62.8
		maximum speed (RPM)	8640	8640	8640	8640
1.250" [31.75mm]	4096 CPR		x4	x8	x20	x40
		interpolated resolution (CPR)	16,384	32,768	81,920	163,840
		interpolated resolution (arc-sec/count)*	79.1	39.6	15.82	7.91
		interpolated resolution (µrad/count)*	383	191.7	76.6	38.3
		maximum speed (RPM)	5273	5273	5273	5273
2.250" [57.15mm]	8192 CPR		x4	x8	x20	x40
		interpolated resolution (CPR)	32,768	65,536	163,840	327,680
		interpolated resolution (arc-sec/count)*	39.6	19.78	7.92	3.96
		interpolated resolution (µrad/count)*	191.7	95.8	38.3	19.17
		maximum speed (RPM)	2637	2637	2637	2637
4.250" [107.95mm]	16384 CPR		x4	x8	x20	x40
		interpolated resolution (CPR)	65,536	131,072	327,680	655,360
		interpolated resolution (arc-sec/count)*	19.78	9.89	3.96	1.978
		interpolated resolution (µrad/count)*	95.8	47.9	19.16	9.58
		maximum speed (RPM)	1318	1318	1318	1318

* Resolution values shown are approximate. To calculate exact resolution values, convert from CPR (Counts Per Revolution) to the desired units.

Note: Specifications assume XOR function which is available in all standard controllers.

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

System Specifications

System

Grating Period	20µm
System Resolution	5µm, 2.5µm, 1.00µm, or 0.50µm (linear)
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.

**Or +/- one quadrature count, whichever error value is greater.

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

**Or +/- one quadrature count, whichever error value is greater.

Sensor Size

W:	12.70mm	0.500"
L:	15.24mm	0.600"
H:	5.59mm	0.220"

Operating and Electrical Specifications

|	
Power Supply	5VDC ±5% @ 33mA[1]
Temperature	
Operating:	0 to 70°C
Storage:	-20 to 70°C
Humidity:	10 - 90% RH non-condensing
Shock:	1500G 0.5 ms half sine (Sensor)
Sensor Weight:	2.6g

[1] Note: a voltage regulator on the customer's printed circuit board, such as Analog Devices' ADP 3334 or equivalent, is recommended at the 5V input to the encoder for maximum reliability.
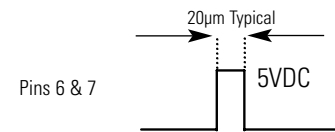
Mercury 1500P Outputs

10-pin interface

PIN	FUNCTION
1	B -
2	B +
3	Sin + *
4	Cos + *
5	+ 5 V DC
6	Index Window +
7	Index Window -
8	A +
9	A -
10	Ground

* Analog outputs are for sensor alignment only.
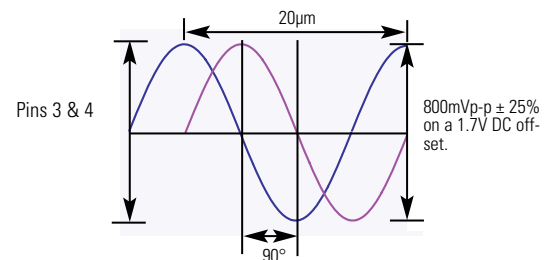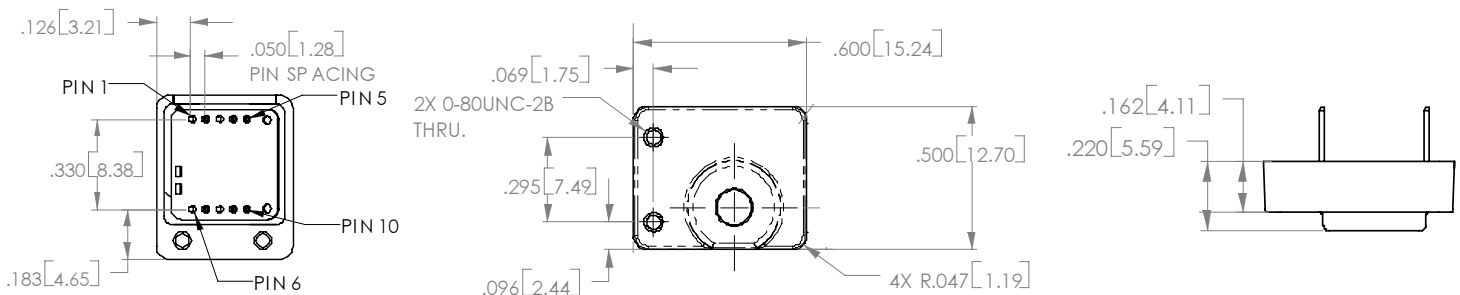
Output Signals**
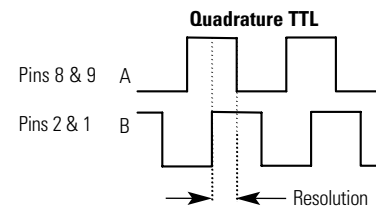
** Inverse signals not shown for clarity.

Index Window

Alignment Signals

Mechanical Information - Sensor

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]
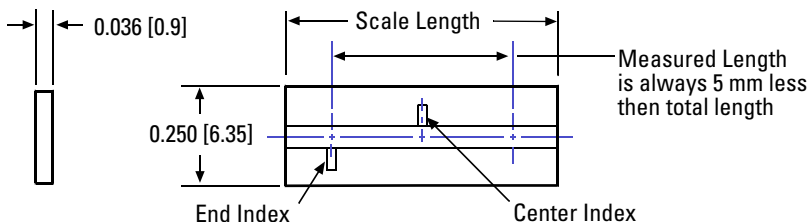
Specifications

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

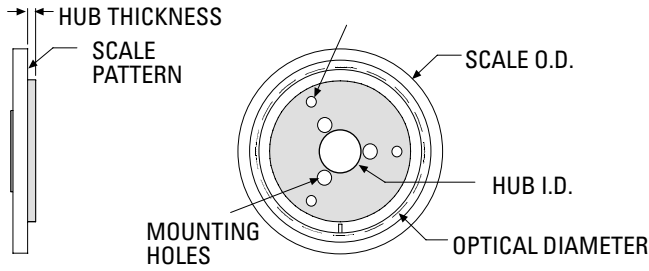## Standard Long Linear Scales
155mm and Longer

Key: inches[mm]
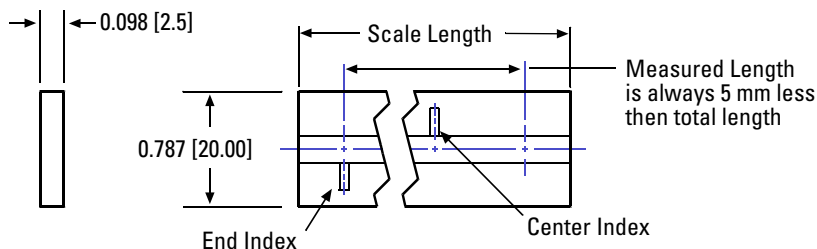
Specifications

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

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MicroE Systems is not responsible for errors.

Standard Rotary Scales

HUB THICKNESS
SCALE PATTERN
SCALE O.D.
HUB I.D.
MOUNTING HOLES
OPTICAL DIAMETER

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 +.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 1500P Encoder Systems

To specify your Mercury encoder with the desired scale, consult the chart below to create the correct part number for your order. Call MicroE Systems' Rapid Customer Response team for more information at **[781] 266-5700**.

Example (linear): M1540P-L55-C1   (rotary): M1540P-R3213-HB

M15xxP   –   Scale Model   –   Scale Mounting

M1504P = 4x interpolation
M1508P = 8x
M1520P = 20x
M1540P = 40x

Lxxx or Rxxxx

For Linear Scales:
T = Tape Mounting
C1 = 3 scale clamps*
C2 = 10 scale clamps**

Hubs for Rotary Scales:
NH = No hub
HE = for R1206
HA = for R1910
HB = for R3213
HC = for R5725
HD = for R10851

* 3 clamps come standard with linear scales up to 130mm
** 10 clamps come standard with linear scales 155mm or longer

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