

Mercury II™ 4000 Series

The Next Generation of High Performance Encoders

High Performance with Tape or Glass, Linear or Rotary Scales



Resolution

Linear: 5µm to 1.22nm
Rotary: 20k to 268M CPR

Accuracy

Tape Scale: ± 5µm/m
Glass Scales:
Linear: ± 1µm available
± 1.5µm to ± 5µm standard
Rotary: Up to ± 2.1 arc-sec

Outputs

A-quad-B, Index Pulse,
Dual Limits, and Alarm

Scales

Same Sensor for Tape or Glass,
Linear or Rotary

The new Mercury II 4000 Encoder Series represents a breakthrough in performance, offering class-leading resolution and accuracy, the smallest sensor size, unmatched versatility, robustness, smart programmable features, and easy installation.

Mercury II: The Next Generation

A Breakthrough in High Performance Encoder Technology

MicroE Systems revolutionized encoder technology with the original Mercury encoder family. Smaller, faster, and smarter than anything before, it set the standard for innovation. Now Mercury II, MicroE System's newest family of reflective incremental encoders, takes another giant step forward by giving you "best-in-class" performance, unparalleled versatility, superior robustness, and unmatched ease of use. You get all of this from a single encoder system.

System Features at a Glance

- Small sensor - 8.7mm tall sensor fits tight spaces
- Faster - up to 4m/s at 0.1µm resolution
- Smarter - programmable resolution in integer steps
- Versatile - same sensor for tape, glass, linear or rotary scales
- Cut-to-length laser tape scale comes on dispensers up to 30m
- Stick-on optical index and limits
- Bi-directional optical index is repeatable to 1LSB
- Fail-safe, dedicated left and right limits

- High tolerance to scale contamination
- Broadest alignment tolerances and pushbutton setup with LEDs for signal strength and limits
- Differential outputs for high reliability in high EMI environments
- Included software with Ethernet connectivity can be used for encoder setup, programmable features, monitoring and diagnostics
- RoHS compliant

Optional Features

- Tape scale length - up to 30m per dispenser
- Glass scale length or diameter:
Linear lengths from 10mm to 2m
Rotary diameters from 44mm to 121mm
- Sensor cable length of 0.5m, 1m, 3m, 5m, or custom
- Accessory Kits for scale installations
- SmartPrecision™ II Software

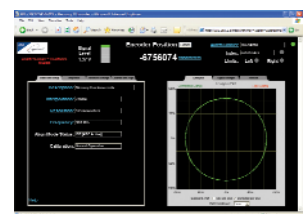


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System Configurations

Standard and Optional Equipment

Mercury II™ 4000 Series Smart Encoder Systems

Standard Equipment



SmartPrecision™ II Electronics Module

Includes setup and limit indicator LEDs, pushbutton index and limits setup, SmartPrecision II Software (use is optional - not required for setup), and Ethernet interface. A 15 pin male high density D-sub connector mates to the customer controller. Differential outputs include A-quad-B, Index, independent Left and Right Limits and an Alarm.

Sensor Cable

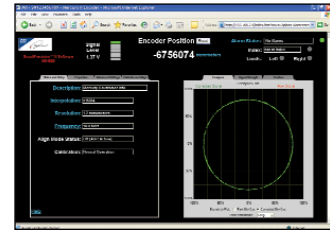
The standard high flex life cable is double shielded and available in lengths of 0.5m, 1m, 3m, 5m, or custom.

Encoder Sensor

Same sensor for linear tape, linear glass, or rotary glass scales.

Mercury II 4000 Series

Optional Equipment

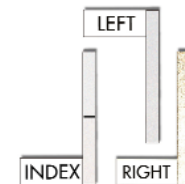


SmartPrecision II Software

The software enables all programmable and diagnostic features, setup, monitoring, and it displays encoder output and signal strength. It is included with every encoder but its use is optional. See Page 9 for details. (Requires Ethernet cable.)

Mercury II 4000 Series

Installation Accessories



Index and Limit Marker Set



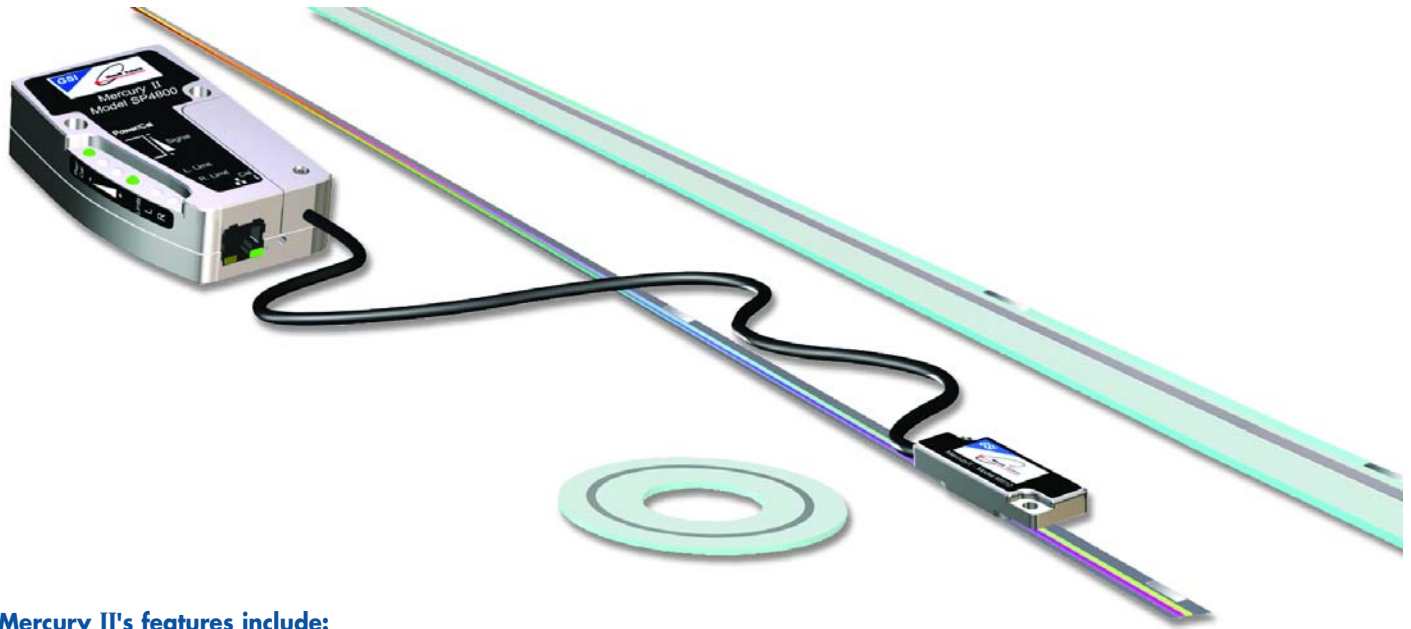
Tape Scale Applicator Tool



Tape Scale Shears

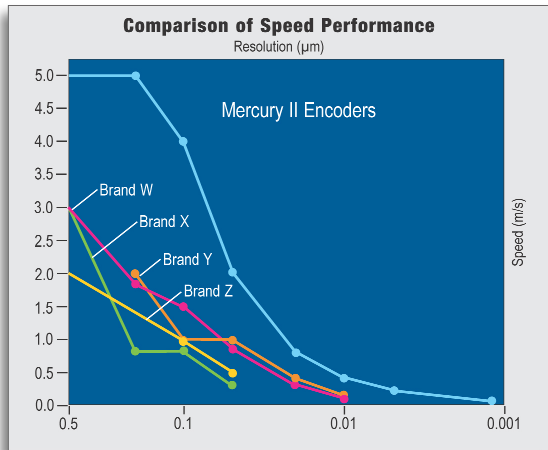
System Features at a Glance

The Mercury II™ 4000 Series is built on the field-proven Mercury I™ technology platform. Known for being smaller, smarter and faster, Mercury II builds on the original Mercury™ series and adds increased performance, versatility, robustness, and ease-of-use.



Mercury II's features include:

- Small, low-mass sensor with ultra low Z-height fits in compact motion systems
- Superior resolution and accuracy - resolutions up to 1.22nm (linear), 268M CPR (rotary); interpolation accuracy of ≤ 30 nm mean, std. dev. 4nm (linear glass scales); up to $\pm 1\mu\text{m}$ (linear glass scales up to 130mm long)
- High-speed operation - up to 4m/s at 0.1 μm resolution

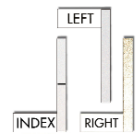


- Versatility - one sensor works with laser tape or glass scales, linear or rotary
- Broad sensor alignment tolerances, built-in red/yellow/green setup LEDs, and pushbutton setup make sensor, index and limit setup fast and eliminate ancillary setup instruments

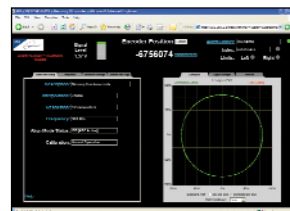
- Adhesive-mount laser tape scale supplied in continuous lengths for cut-to-length convenience and inventory savings; mounts on virtually any surface - metals, granite, glass, composites, or ceramics



- Stick-on optical index and limit markers can be placed anywhere they are required, are easy to apply, and require no adjustment; markers work on both laser tape and linear glass scales



- Convenient tape scale applicator tool insures consistency and speeds installation
- Robustness features include all differential digital outputs, all digital signals from the sensor, and double-shielded cabling for superior EMI/RFI immunity; scale contamination resistance insures encoder operation even with fingerprints, oil, dust and other forms of contamination
- Fail-safe dual optical limits have differential outputs and reduce motion system cabling; limit markers fit right on the 6mm wide laser tape scale for maximum space savings



- Included software makes setup, motoring and diagnostics easy, and new Ethernet connectivity makes remote monitoring and support convenient

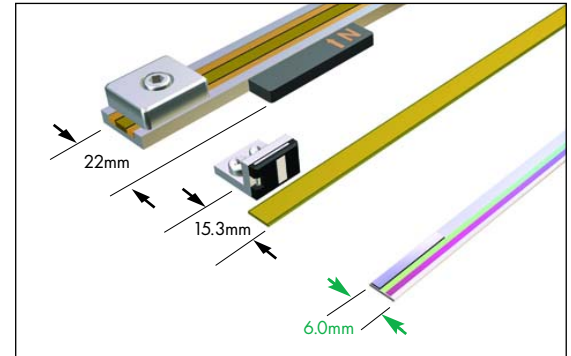
Smallest Sensor, Lowest System Height, Smallest Tape Scale System, Broader Alignment Tolerances, and More

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

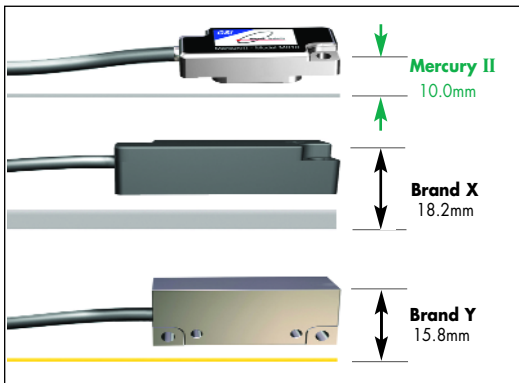
Mercury II Can Reduce System Size and Cost

Mercury II's system height with tape scale is 34% shorter than competitive encoders, making it easier to fit into your design. This reduction can also cut motion system weight and cost by allowing the use of smaller motors and stages. This significantly relaxes mechanical system tolerances, while reducing system costs. Mercury II's optical index and limit markers are placed within the 6mm width of the tape scale, saving even more space by eliminating external index and limit magnets.

Smallest Tape Scale System



Lowest System Height



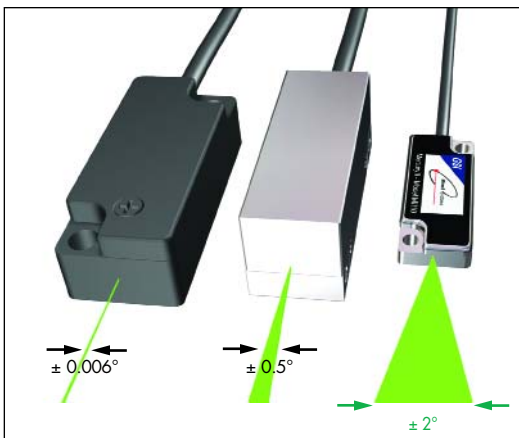
Mechanical Dimension Comparison*

	Mercury II with Tape Scale	Brand X	Brand Y	Mercury II vs. Best Competitor
System height	10.0mm	18.2mm	15.8mm	58% better
Sensor Z height	8.7mm	12mm	14.8mm	38% better
Standoff tolerance	± 0.15mm	± 0.1mm	± 0.1mm	50% better
Tape scale width**	6.0mm	22.0mm	15.3mm	155% better

*Based on published specifications

**Tape scale system width including index and limits

Theta Z Alignment Tolerance



Eliminate the Frustration of Touchy Encoder Alignment

Mercury II Solves this Problem for Good

Fussy alignment is no longer a concern. With Mercury's patented PurePrecision™ optics, advanced SmartPrecision II™ 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 II 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 II***	Brand X	Brand Y	Mercury II vs. Best Competitor
theta Z	± 2.0°	± 0.006°	± 0.5	Mercury is 300% better
theta Y	± 2.0°	unspecified	± 1.0°	Mercury is 100% better
theta X	± 1.0°	± 0.1°	± 1.0°	

*Based on published specifications

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

System Specifications

Resolution and Maximum Speed Tables

Mercury II™ 4000 Series systems have programmable interpolation from x4 to x16384 in integer steps. Below is a table of sample values.

Linear - 20µm grating pitch

Maximum Interpolation	Resolution	Maximum Speed*	Model			
			4800	4600	4500	4400
x4	5.000µm/count	5000mm/sec				
x10	2.000µm/count	5000mm/sec				
x20	1.000µm/count	5000mm/sec				
x40	0.500µm/count	5000mm/sec				
x80	0.250µm/count	5000mm/sec				
x100	0.200µm/count	5000mm/sec				
x200	0.100µm/count	4000mm/sec				
x400	0.050µm/count	2000mm/sec				
x1000	20.0nm/count	800mm/sec				
x2000	10.0nm/count	400mm/sec				
x4000	5.00nm/count	200mm/sec				
x8000	2.50nm/count	100mm/sec				
x16384	1.22nm/count†	48.8mm/sec				

† Value rounded for readability; use the formula $[20\mu\text{m}/\text{interpolation multiplier}]$ to calculate the exact resolution in units of µm/count.

Rotary - 20µm grating pitch

Rotary Glass Scale Diameter	Fundamental Resolution	Interpolation							
		x4	x20	x40	x400	x1000	x4000	x16384	
Note: The range of available values is x4 to x16384 in integer steps; example values below.									
44.45mm	5000 CPR								
	interpolated resolution (CPR)	20000	100000	200000	2000000	5000000	20000000	81920000	
	interpolated resolution (arc-sec/count)**	64.8	12.96	6.48	0.648	0.259	0.0648	0.01582	
	interpolated resolution (µrad/count)**	314	62.8	31.4	3.14	1.257	0.314	0.0767	
	maximum speed* (RPM)	3000	3000	3000	1200	480	120	29.3	
63.50mm	8192 CPR								
	interpolated resolution (CPR)	32768	163840	327680	3276800	8192000	32768000	134217728	
	interpolated resolution (arc-sec/count)**	39.6	7.91	3.96	0.396	0.1582	0.0396	0.00966	
	interpolated resolution (µrad/count)**	191.7	38.3	19.17	1.917	0.767	0.1917	0.0468	
	maximum speed* (RPM)	1830	1830	1830	732	293	73.2	17.88	
120.65mm	16384 CPR								
	interpolated resolution (CPR)	65536	327680	655360	6553600	16384000	65536000	268435456	
	interpolated resolution (arc-sec/count)**	19.78	3.96	1.978	0.1978	0.0791	0.01978	0.00483	
	interpolated resolution (µrad/count)**	95.9	19.17	9.59	0.959	0.383	0.0959	0.0234	
	maximum speed* (RPM)	915	915	915	366	146.5	36.6	8.94	

* Maximum speed produces an encoder quadrature output of 40 million states per second (10MHz). See p. 8 for additional output frequencies. Maximum speeds shown above will be reduced if a lower quadrature output frequency is selected.

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

To calculate desired rotary interpolation multiplier, use the following equation:
 Interpolation Multiplier = Desired Resolution (CPR)/Fundamental Scale Resolution (CPR).

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

System Specifications

System

Scales:

- Cut-to-length PurePrecision™ laser tape scale - available in continuous lengths up to 30m
- Linear glass scales for high accuracy
- Rotary glass scales for rotary applications

Grating Period	20µm
Signal Period	20µm
System Resolution	5µm - 0.00122µm* in integer interpolation steps (factory set or user programmed using included SmartPrecision™ II Software)

*Value rounded for readability; use the formula $[20\mu\text{m}/\text{interpolation multiplier}]$ to calculate the exact resolution in units of $\mu\text{m}/\text{count}$.

Linear accuracy**

	Laser Tape Scale	Glass Scales
Short-travel Accuracy	± 60nm mean, std. dev. 6nm over any 20µm movement	± 30nm mean, std. dev. 4nm over any 20µm movement
Long-travel Accuracy	± 5µm/m after two-point linearization in the customer's controller	High accuracy grade: ≤ ±1µm for scales up to 130mm ≤ ±2µm for scales from 130mm to 1m Standard accuracy grade: ≤ ±1.5µm for scales up to 130mm ≤ ±5µm for scales from 130mm to 1m

**Maximum error over the specified movement when compared to a NIST-traceable laser interferometer standard, used at room temperature.

Rotary Accuracy*	Scale O.D.	Microradians	Arc-Seconds
	44.45mm	± 38	± 7.8
	63.50mm	± 19	± 3.9
	120.65mm	± 10	± 2.1

*Based on ideal scale mounting concentricity

Index: stick-on optical marker can be placed anywhere; bi-directional, full speed

Limits: separate left and right limits with stick-on markers

Sensor Size

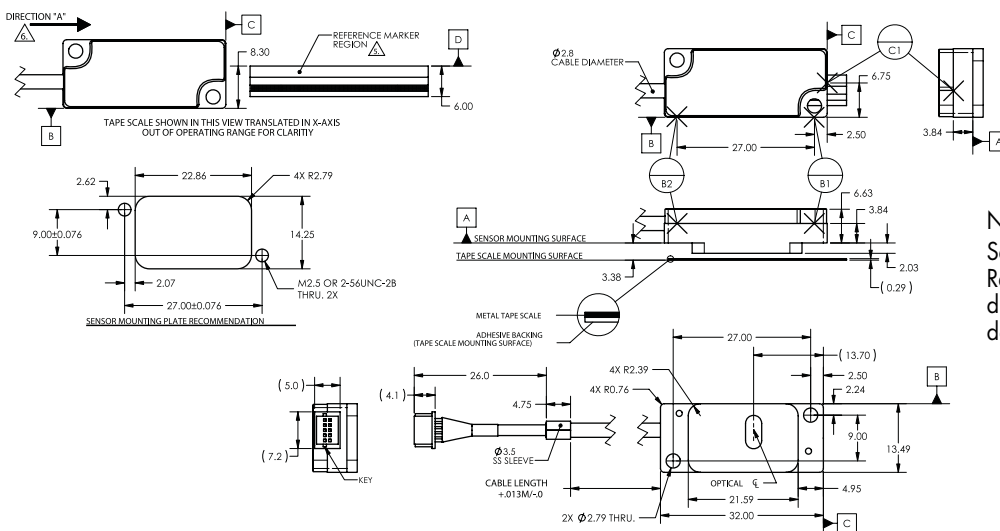
W:	13.49mm	0.531"
L:	32.00mm	1.260"
H:	8.66mm	0.341"

Operating and Electrical Specifications

Power Supply:	5VDC ±5% @ 425mA
Temperature	
Operating:	0 to 70°C
Storage:	-20 to 85°C
Humidity:	10 - 90% RH non-condensing
EMI:	CE Compliant
Shock:	300G 0.5 ms half sine (Sensor)
Sensor Weight:	6g (Sensor without cable)
Cable:	Double Shield Maximum length: 5m Diameter: 2.8mm Flex life: 20 x 10 ⁶ cycles @ 20mm bending radius

Reliability Information

5 year Expected Reliability: >99.6% under normal operating conditions.



NOTE:
Sensor shown with tape scale at left. Refer to the Mercury II™ interface drawings for additional dimensional details and important notes.

SmartPrecision™ II Electronics

The Mercury II™ 4000 Series encoder system includes a SmartPrecision II electronics module. This compact, fully-featured signal processing system performs the following functions:

- Programmable interpolation level and output bandwidth
- Accuracy optimization - sensor signals are automatically optimized to improve system accuracy and maximize repeatability
- Status and setup LEDs: red / yellow / green signal strength LEDs assist during setup and provide diagnostics at a glance; status LEDs for both limits; power-indicating LED
- Index centering - centers (gates) the bi-directional index output pulse for repeatability of 1LSB
- Programmable alarms for Low Signal and Over Speed; alarm for Over Signal (not programmable)
- All settings and setup parameters are stored in non-volatile memory
- Ethernet computer interface - for programming, encoder setup, status monitoring, and data acquisition using SmartPrecision II Software, your own software scripts, or your controller. Data rates up to 1000 position values/sec. are possible. (Note: the Ethernet interface is not recommended for use as a feedback channel in closed loop control)
- Superior EMI / RFI immunity - all outputs are differential; CE compliant
- Mounting options - all electronics are within the EMI-shielded housing and can be screwed directly into a mating connector that is bulkhead mounted, or the module may be mounted to the frame of your motion system and connected using an extension cable. Frame mounting options are screw-mount, DIN rail, or customer-supplied permanent adhesive tape

Programmable Interpolation

The electronics module has programmable interpolation that is selectable over the range x4 to x16,384 in integer steps (depending on model), providing output resolutions that can be matched to your application requirements. This feature allows customers to reduce inventory and field spare parts costs since one electronics module can be programmed for many different resolution requirements and different motion axes. Motion system development engineers also benefit from the flexibility of programmable interpolation by allowing them to vary the encoder's resolution during motion system loop tuning and optimization. Linear resolutions can range from 5µm to 1.2nm in convenient increments and rotary resolutions from 20k CPR to 268 million CPR. Specify the interpolation value at the time of ordering or select the interpolation at your site using included SmartPrecision II Software.

Programmable Maximum Output Frequency

For encoder applications combining high resolution and high speed, the SmartPrecision electronics module supports up to 40 million quadrature state changes per second*. By specifying the maximum output frequency to match your controller's capability - ranging from 625,000 to 40 million quadrature state changes per

second - the Mercury II encoder system will never produce encoder counts faster than your controller can read them. Specify the encoder's maximum output frequency at the time of ordering or select the setting at your site using MicroE's SmartPrecision II Software.

Dual limits

Mercury II includes optically and electrically fail-safe independent left and right limits with differential TTL outputs. The limit outputs are momentary. Optically, full reflectivity on the optical limit track is the normal operating condition; loss of signal on the optical limit track triggers a limit output, making them optically fail-safe. The TTL output for limits is active-low, making them electrically fail-safe. Limit outputs can be configured for active-low or active-high at the time of ordering, or by the customer using SmartPrecision II Software, to match your controller's requirement.

*"Quadrature state changes per second" is the reciprocal of "dwell time" or "edge separation". For example, 40 million states per second = 0.025µsec dwell time.



SmartPrecision II Electronics

Mercury II 4000 Series Outputs:

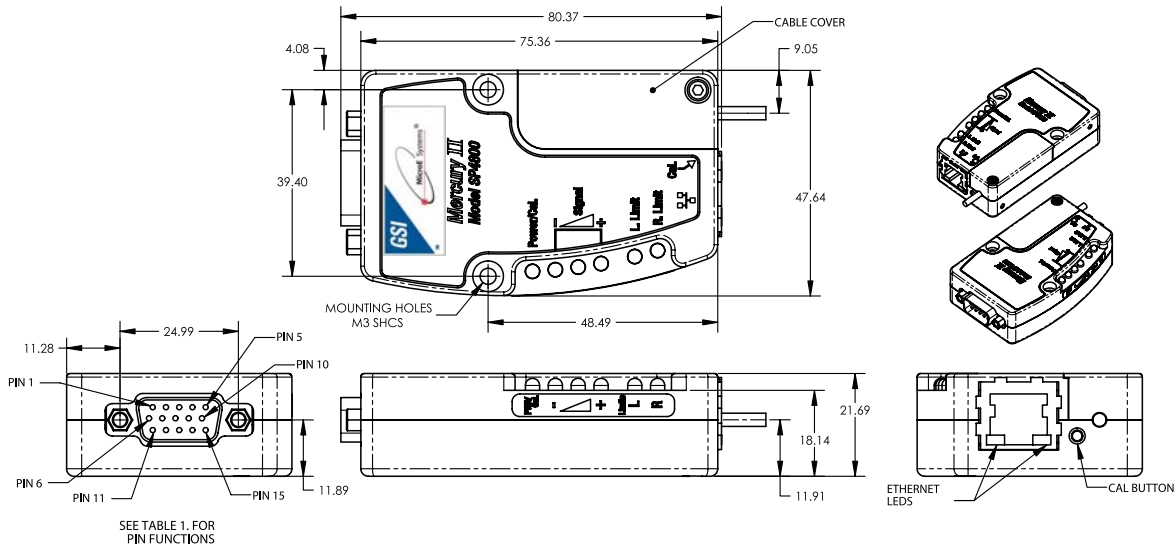
15-pin high density Male D-sub connector

PIN	Function
1	A+
2	B+
3	Left Limit Out- *
4	Alarm+ *
5	Left Limit Out+ *
6	Right Limit Out- *
7	Index+
8	Index-
9	A-
10	B-
11	GND
12	+5VDC Power In
13	Right Limit Out+ *
14	Reserved - Do not connect
15	Reserved - Do not connect

*Limit and Alarm outputs are not latching.

SmartPrecision™ II Electronics

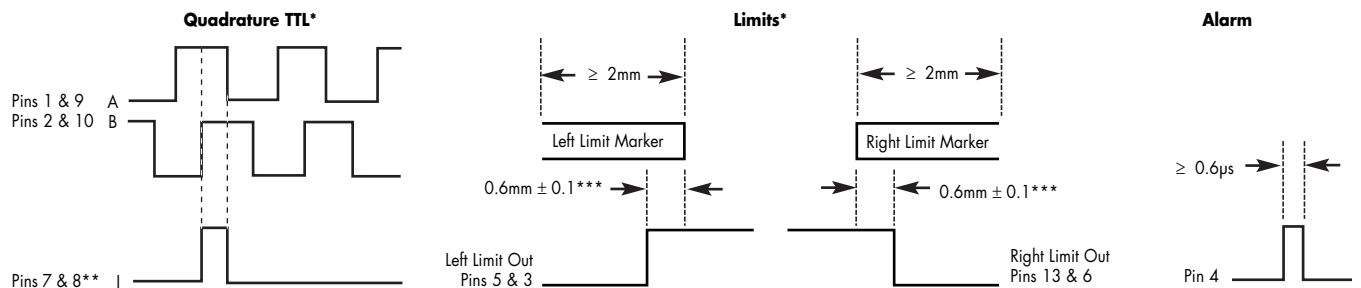
Mechanical Information - Electronics Module



Maximum Quadrature Output Frequency

Output Frequency (MHz)	A-Quad-B Output Rate (millions of states/sec)	Dwell Time (or edge separation) (µsec)
10.0	40.0	0.025
5.0	20.0	0.050
2.5	10.0	0.10
1.25	5.0	0.20
0.625	2.5	0.40
0.3125	1.25	0.80
0.15625	0.625	1.60

Output Signals

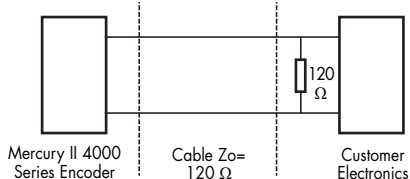


*Output signals are differential. Inverse signals are not shown for clarity.

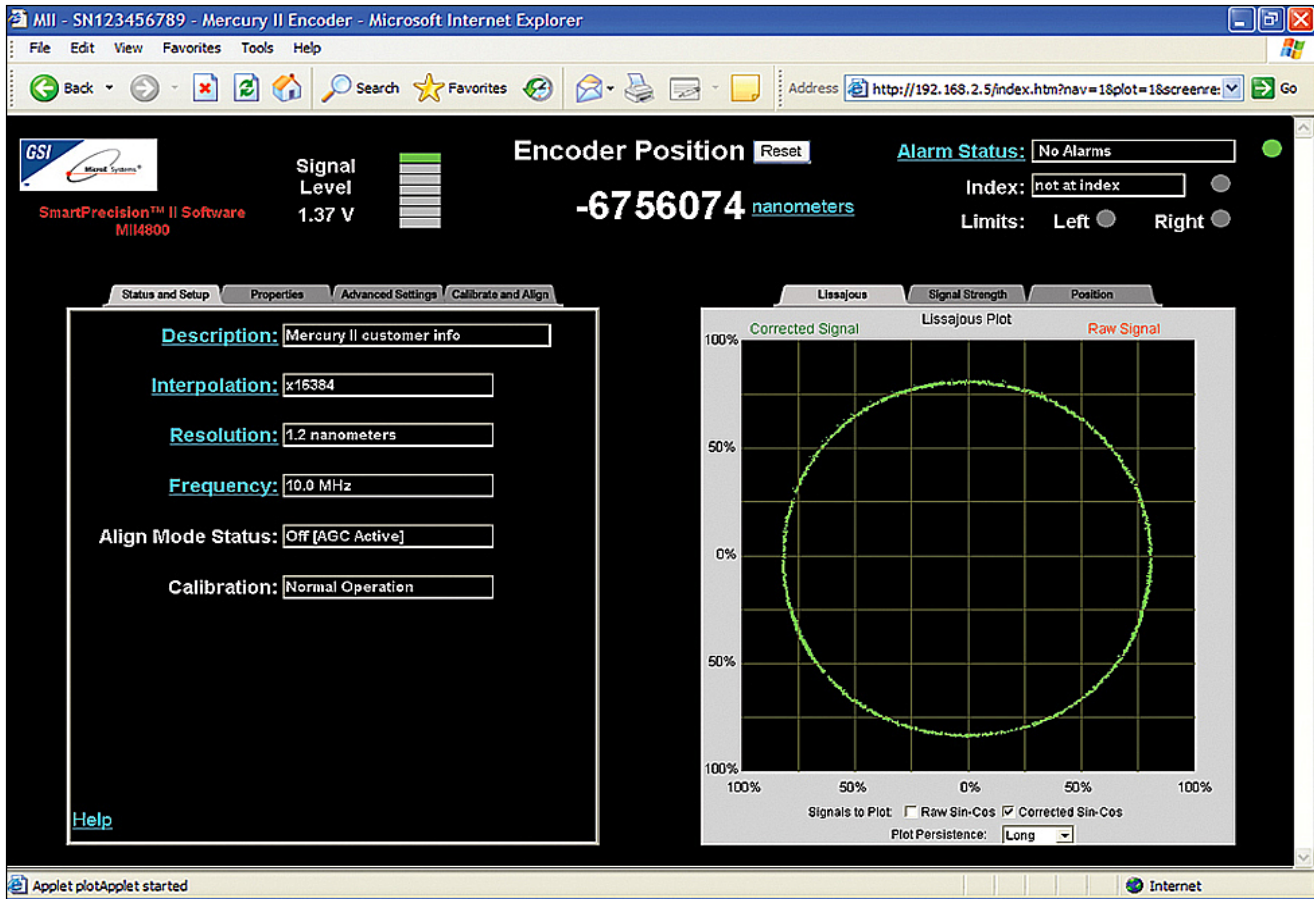
**Note: At some interpolation values the index pulse may be aligned with other states of A or B than the ones shown.

***Above are with reference to the sensor's optical centerline (see interface drawings).

Signal Termination for A-Quad-B and Index



SmartPrecision II™ Software



Why use software with an encoder?

Mercury II™ encoders include built-in SmartPrecision II Software. Mercury II's pushbutton setup process does not require use of the software, however SmartPrecision II Software adds unique functionality:

- Monitor system operation using digital readouts and data plots such as Lissajous
- Monitor motion system operation remotely from your office during system development and alpha testing
- Perform remote system support and diagnostics - engineering can support customers when the engineers are not in the same building or in the same country as the customer's motion system, and engineering can support manufacturing when engineering and manufacturing staffs are not in the same building
- Get support from trained MicroE Systems' support personnel for diagnosing customer equipment, no matter where the equipment is located throughout the world
- Use Mercury II's programmable features for more rapid integration and motion system optimization

Included with every Mercury II encoder, SmartPrecision II Software can perform real-time setup, monitoring, and diagnostic functions locally or remotely across a LAN or WAN. It operates from the encoder using simple Java commands and thus does not require any software to be installed on the computer other than a standard web browser (such as Internet Explorer). Compatible with numerous web browsers and operating systems, its features include simultaneous displays of:

- Position in engineering units
- Lissajous plot
- Encoder signal level
- Status of alarms, index and limits
- Status of programmable encoder settings
- Encoder serial numbers

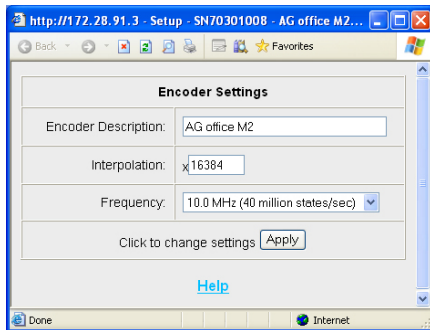
SmartPrecision™ II Software

Functions include:

- Setting of programmable features, including interpolation in integer steps and quadrature output frequency
- Encoder Calibration
- View the Alarm History Log

Program Mercury II™ Encoder Electronics

- Set interpolation in integer steps from x4 to x16,384 (Mercury II 4000 Series)
- Set maximum output frequency to match your controller
- Set limit logic when necessary to match your controller's requirements

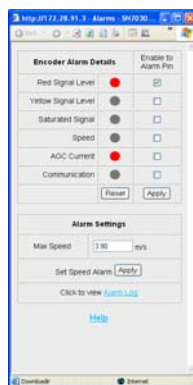


Install Mercury II Encoder System

- Align sensor using Signal Level display and Encoder Signal data plot
- Locate index and see when sensor is over the scale's index mark
- Verify sensor output over length of scale using the Signal Strength plot

Monitor Mercury II Encoder Operation

- Read encoder position in engineering units of your choice
- Read the encoder's hour meter to monitor system usage
- Capture alarms while system operates unattended



Diagnose Mercury II Encoder Performance

- Capture signal data and email it to MicroE for rapid diagnostic support
- Monitor alarms, view the alarm history log

Ethernet connectivity features:

The software resides in the Mercury II encoder electronics as a 'web server' and is accessed using an Ethernet connection. The computer does not need any special software to be installed, so virtually any computer can connect instantly to a Mercury II encoder. Ethernet connectivity advantages include:

- Use SmartPrecision II Software even while the motion system is operating
- High speed, network data connection supports many configurations:
 - one encoder with one computer
 - many encoders with one computer
 - several computers and one encoder
 - multiple encoders and multiple computers
 - one-to-one (no network), LAN, WAN, or router
- Securely connect to the encoder remotely for monitoring and field support through your company's Virtual Private Network
- The software's web server architecture can
 - respond to a variety of requests (html pages, data requests, java plots, etc.)
 - take requests from most operating systems
 - take requests from a variety of sources (user with web browser, user-software, scripts, controller, etc.)
- Program your controller to communicate with the encoder using simple HTML web commands for 'observer' position data feedback or encoder status, including calibration, alarms, and limits
- Computer operating system independence and flexibility of interfacing to your own software without needing any dlls, drivers or any specific hardware or software configuration

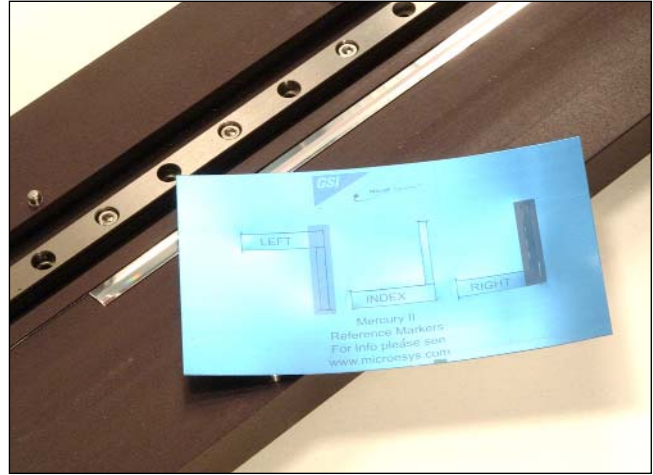
Computer requirements:

- Any computer with a web browser (such as Internet Explorer) and Java 2.0 installed and enabled
- Ethernet connection to a computer, LAN, WAN or router

How To Order

SmartPrecision II Software is included with all Mercury II encoders and does not require any installation - just access it using your computer's web browser.

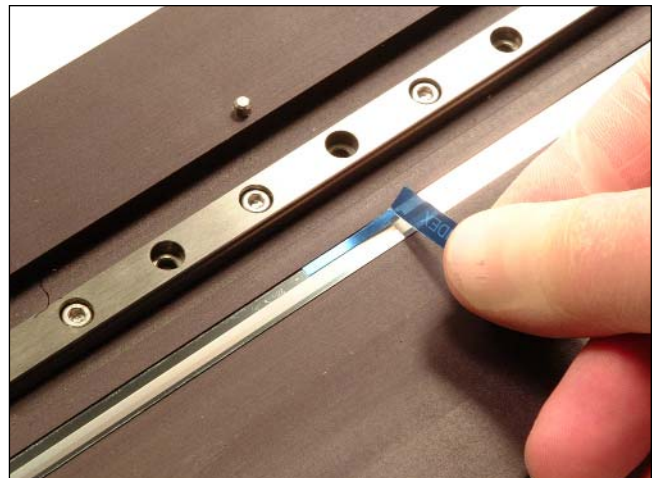
PurePrecision™ Laser Tape Scale with Stick-On Index and Limits



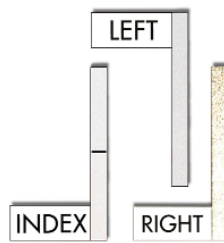
Mercury II™'s PurePrecision laser tape scale is fast and easy to install, provides excellent accuracy and takes less space than any encoder in its class. It mounts using a permanent pressure-sensitive adhesive. Thermal expansion of the substrate is matched by anchoring the ends of the tape scale using epoxy and end caps.



Tape is supplied in a dispenser in lengths up to 30m so that you can cut any length required for your application, minimizing inventory costs, or it may be ordered pre-cut to any length you specify for high-volume OEM applications.



Installation for a wide range of lengths is fast and easy using MicroE Systems' tape applicator tool, or without a tool by hand. When using the installation tool, release paper is automatically removed from the tape. The tape's location on the mounting surface is set by a reference edge that is either machined into the substrate or is put in place temporarily.



The stick-on (adhesive-mount) optical index and limit markers are mounted on the tape in seconds usually using the same reference edge as for the tape scale. This space-saving design keeps the index and limit markers within the 6mm width of the tape, ideal for space-constrained motion

systems. The index is bi-directional, operates at all encoder speeds, and is repeatable to 1LSB. View the Tape Scale Installation video at www.microsys.com/MercuryII for a demonstration.

Mercury II PurePrecision tape scale may also be installed using scale applicator tools for 6mm-wide tape from other manufacturers.

PurePrecision™ Laser Tape Scale with Stick-On Index and Limits

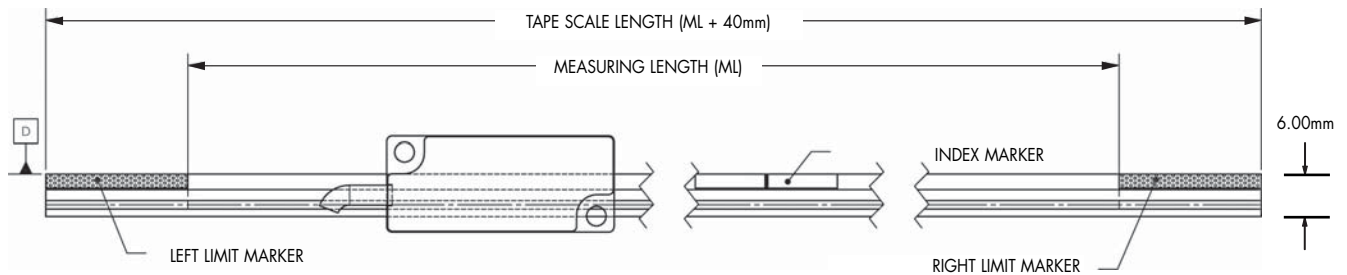
The laser scale length that you specify for your application must be calculated as follows. This calculation applies whether your application requires end limits or not. 20mm at each end of the tape scale are not to be used for encoder feedback.

Tape Scale Length = Measuring Length + 40mm*

Example: Measuring Length of 800mm is required, and limits will be used at the end of the tape scale. The Tape Scale Length = 800mm + 40mm = 840mm.

*When the end limits are at the ends of the tape scale as shown below. The Tape Scale Length must be increased further if the limit markers are applied at a distance from the ends of the tape scale.

Index and Limit Marker Locations When End Caps Are Not Used



D = Mounting Surface Reference Edge

Specifications

Accuracy	±5µm/m after two-point linearization in the customer's controller
Material	Inconel 625
Typical CTE	13ppm/°C; thermal behavior of the tape scale is typically matched to the substrate using epoxy at the ends of the tape scale

Available Lengths:

Order as much tape scale as you will require for your production and cut it to length for each job, or order pre-cut lengths to match your application requirements. Note that the Measuring Length for each axis in your equipment will be 40mm less than the Tape Scale Length when end caps are not used. PurePrecision laser tape scale is shipped in tubes for lengths from 40mm - 500mm and in dispensers for lengths greater than 500mm.

Order the required Tape Scale Length using model number TS-xxxxx (where xxxxx = Tape Scale Length in mm [40mm - 30000mm]). Example (9000mm Tape Scale): TS-09000. Contact MicroE Systems for lengths greater than 30m.

Linear and Rotary Glass Scales

MicroE Systems offers a wide array of chrome on glass scales. Easy to install, choose from standard linear and rotary scales, or customized linear, rotary, and rotary segment scales where needed. Use linear glass scales when you need the highest accuracy.

Glass Scale Options

- Standard linear: 10mm - 1m (consult MicroE for longer lengths)
- Standard rotary: 44mm - 121mm diameter, with or without hubs
- Custom linear*: special lengths, widths, thickness, index mark locations, pre-printed index and limits, and special low CTE materials
- Custom rotary*: special ID's, OD's (up to 304.8mm), index mark inside 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.

Mercury II linear glass scales 130mm or shorter are only 6mm wide, enabling drop-in replacement of existing 6mm wide tape scale encoders for dramatic improvements in motion system resolution and accuracy.

Standard Short Linear Scales

130mm and Shorter

Dimensions in mm.

Specifications

Accuracy	±1.5µm standard accuracy grade ±1µm available (high accuracy grade)
Material	Soda lime glass
Typical CTE	8ppm/°C

Linear Glass Scales

The stick-on (adhesive-mount) optical index and limit markers are mounted on the scale in seconds usually using the same reference edge as for the scale or a metal block. This space-saving design keeps the index and limit markers within the 6mm width of the scale, ideal for space-constrained motion systems. The index is bi-directional, operates at all encoder speeds, and is repeatable to 1LSB.

The scale length that you specify for your application must be calculated as follows.

When your application requires end limits:

$$\text{Glass Scale Length} = \text{Measuring Length} + 40\text{mm}^*$$

Example: A Measuring Length of 90mm is required, and limits will be used. Scale Length = 90mm + 40mm = 130mm.

*When the end limits are at the ends of the tape scale

When your application does not require end limits:

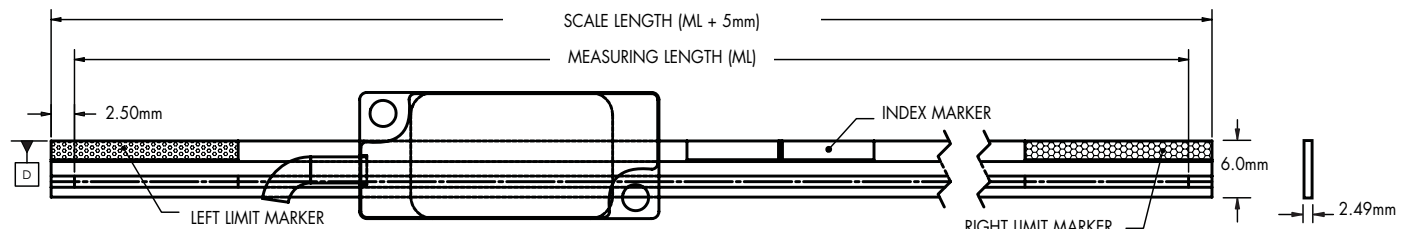
$$\text{Glass Scale Length} = \text{Measuring Length} + 5\text{mm}$$

Example: A Measuring Length of 25mm is required, and limits will not be used. Scale Length = 25mm + 5mm = 30mm.

Factory cut-to-length flexibility:

Mercury II's stick-on index and limit markers make factory cut-to-length glass scales possible, enabling rapid turnaround for any scale length and helping you exactly match your application requirements. For OEM applications, linear glass scales can be ordered with pre-printed index and limit markers that are optimized for your needs, speeding installation and maximizing motion system performance.

Order the required Scale Length using model number MIIlxxxx where xxxx = Scale length in mm (10mm - 1000mm). Example: (30mm Linear Glass Scale): MIIl30.



D = Mounting Surface Reference Edge

Note: The following are only examples; you can order any size.

Model	MIIl18	MIIl30	MIIl55	MIIl80	MIIl105	MIIl130
Scale Length	18mm	30mm	55mm	80mm	105mm	130mm
Measuring Length - Without Limits	13mm	25mm	50mm	75mm	100mm	125mm
Measuring Length - With Limits	N/A	N/A	15mm	40mm	65mm	90mm

Custom scales available, including scales with pre-printed index and limits

Linear Glass Scales with Stick-on Index and Limits

Standard Long Linear Scales

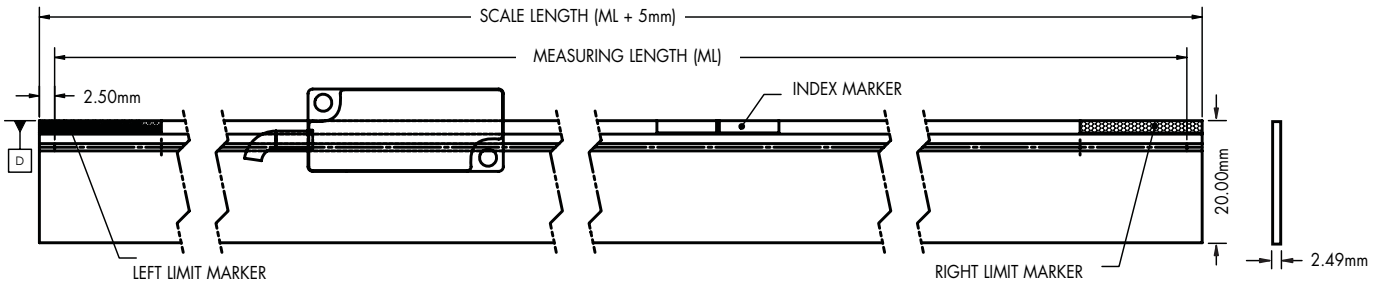
131mm and Longer

Dimensions in mm.

Specifications

Accuracy	±5µm standard accuracy grade ±2µm available (high accuracy grade)
Material	Soda lime glass
Typical CTE	8ppm/°C

Order the required Scale Length using model number MIILxxxx where xxxx = Scale length in mm (10mm - 1000mm). Example: (225mm Linear Glass Scale): MIIL225. Contact MicroE Systems for lengths greater than 1m.



D = Mounting Surface Reference Edge

Note: The following are only examples; you can order any size.

Model	MIIL155	MIIL225	MIIL325	MIIL425	MIIL525	MIIL1025
Scale Length	155mm	225mm	325mm	425mm	525mm	1025mm
Measuring Length - Without Limits	150mm	220mm	320mm	420mm	520mm	1020mm
Measuring Length - With Limits	115mm	185mm	285mm	385mm	485mm	985mm

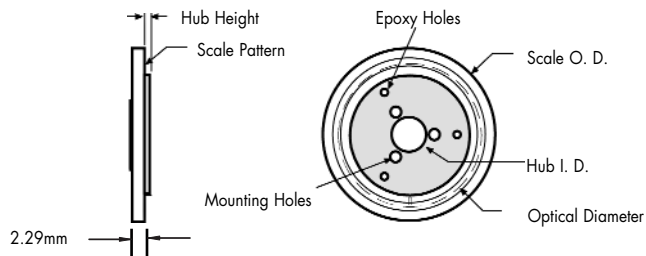
Custom scales available, including scales with pre-printed index and limits

Rotary Glass Scales with Built-in Index

Standard Rotary Scales

Specifications

Material	Soda lime glass
Typical CTE	8ppm/°C



Dimensions in mm

Model No.	Fundamental CPR	Scale Outer Diameter	Scale Inner Diameter	Optical Diameter	Hub Inner Diameter +0.013mm/-0.0000	Hub Height
MIIR4513	5000mm	44.45mm	12.70mm	31.83mm	6.358mm	1.27mm
MIIR6425	8192mm	63.50mm	25.40mm	52.15mm	12.708mm	1.52mm
MIIR12151	16384mm	120.65mm	50.80mm	104.30mm	25.408mm	2.03mm

Custom scales are available including larger diameters

Installation Accessory Kits



Compatible with all Mercury II™ encoder models, Installation Accessory Kits provide everything you need to install Mercury II encoders. Kits come in “non-consumable” and “consumable” styles. Non-consumable kits are designed for first-time buyers. They include the special tools that you only need to buy once, and add all of the consumables needed for five installations. Consumable kits are for customers to reorder after they have used up the consumable materials in the Non-consumable kits. The Consumables Kits include all materials necessary for 10 installations. All Accessory Kits include both Metric and US Customary sensor mounting screws and hex wrenches, and come packaged in a kit for convenient storage. For instructions about how to use the kits, see the installation manual for Mercury II encoders at www.microsys.com/MercuryII.

- MIIAK-1 Non-consumables for Tape Scale Installations (includes consumables for five installations)
- MIIAK-2 Consumables for Tape Scale Installations (includes consumables for 10 installations)
- MIIAK-3 Non-consumables for Linear Glass Scale Installations (includes consumables for five installations)
- MIIAK-4 Consumables for Linear Glass Scale Installations (includes consumables for 10 installations)
- MIIAK-5 Non-consumables for Rotary Glass Scale Installations (includes consumables for five installations)
- MIIAK-6 Consumables for Rotary Glass Scale Installations (includes consumables for 10 installations)

	MIIAK-1	MIIAK-2	MIIAK-3	MIIAK-4	MIIAK-5	MIIAK-6
Tape Scale Applicator Tool - for applying tape scale	1					
Tape Scale Shears - for cutting tape scale	1					
Tweezers - plastic with sharp tips	1		1			
Sensor Height Gage - for verifying sensor height	1		1		1	
Index and Limit Marker Set - for tape or linear glass scales	5	10	5	10		
Tape Scale End Caps (two required per tape scale installation)	10	20				
Two-part Epoxy - for mounting scales	5 Packages	10 Packages	5 Packages	10 Packages	5 Packages	10 Packages
Silicone Adhesive - for mounting linear glass scales			1 Tube	1 Tube		
Powder-Free Finger Cots	8	15	8	15	8	15
Scale Cleaning Tissues	8	15	8	15	8	15
Sensor Mounting Screws - M2.5x6mm	10	20	10	20	10	20
Sensor Mounting Screws - 2-56UNCx1/4inch	10	20	10	20	10	20
Hex Wrench for M2.5 Screws	1		1		1	
Hex Wrench for 2-56UNC Screws	1		1		1	

How to Order Mercury II™ Encoder Systems

To specify your Mercury II encoder with the desired encoder model, cable length, level of interpolation, maximum output frequency, and limit logic, order the required quantities for each system model number below. Order scales and additional items using their model number. Call MicroE Systems' Rapid Customer Response team for more information at 508-903-5000 (800-355-4047 in the US).

Example: MII4800-MII10-16384-2-1

<u>Model</u>	<u>Cable Length</u>	<u>Integer Interpolation</u>	<u>Maximum Output Frequency</u>	<u>Limit Logic</u>
MII4800 (interpolation range: x4 to x16384)	MII05 = 0.5m	4 = x4	1 = 10.0 MHz	1 = active low (fail safe)
MII4600 (interpolation range: x4 to x4000)	MII10 = 1m	5 = x5	2 = 5.0 MHz	2 = active high
MII4500 (interpolation range: x4 to x1000)	MII30 = 3m	↓	3 = 2.5 MHz	
MII4400 (interpolation range: x4 to x400)	MII50 = 5m		4 = 1.25 MHz	
			5 = 0.625 MHz	
			6 = 0.312 MHz	
			7 = 0.156 MHz	
		16384 = x16384		

PurePrecision™ Laser Tape Scales

Example (8000mm Tape Scale): TS-08000

TS-xxxxx Where xxxxx = Tape Scale Length in mm (40mm - 30000mm).

MS

MS = One set of index and limit markers (one index marker, one left limit marker, and one right limit marker)

EC

EC = One tape scale end cap (10 per bag; Must be ordered in multiples of 10)
(Note: two are recommended per tape scale installation)

PurePrecision Linear Glass Scales

(Standard accuracy grade)

Example (350mm Linear Glass Scale): MIIL350

MIILxxxx Where xxxx = Glass Scale Length in mm (10mm - 1000mm).

(High accuracy grade scales: consult MicroE Systems)

Note: index and limit marker sets must be ordered separately - one set per linear glass scale

PurePrecision Rotary Glass Scales

Example (44.45mm OD Rotary Glass Scale with Hub):

MIIR4513-HI

MIIRxxxx* – Hub
 MIIR4513 NH = Without Hub
 MIIR6425 HI = for R4513
 MIIR12151 HJ = for R6425
 HK = for R12151

*Custom versions are available

Note: rotary glass scales are shipped not mounted to hubs; hub mounting is available from MicroE Systems - contact us for information

How to Order Mercury II™ Encoder Systems

Installation Accessory Kits

Example (Consumables Kit for Tape Scale Installations): MIIAK-2

MIIAK - Kit Number

- 1 = Kit 1, Non-consumables for tape scale installations. Includes consumables for (5) installations.
- 2 = Kit 2, Consumables for tape scale installations. Includes consumables for (10) installations.
- 3 = Kit 3, Non-consumables for glass scale installations. Includes consumables for (5) installations.
- 4 = Kit 4, Consumables for glass scale installations. Includes consumables for (10) installations.
- 5 = Kit 5, Non-consumables for rotary glass scale installations. Includes consumables for (5) installations.
- 6 = Kit 6, Consumables for rotary glass scale installations. Includes consumables for (10) installations.

Mercury II Encoders Are Fully RoHS-Compliant

Mercury II is fully compliant with European Directive 2002/95/EC (Restriction of use of Hazardous Substances, "RoHS"). A Document of Compliance is available upon request. "Mercury™" is a brand name of MicroE Systems; Mercury and Mercury II encoders do not contain any mercury metal.

Vacuum-Rated and Small Diameter Rotary Encoders

See www.microesys.com/mercury for Mercury linear and rotary encoders that are vacuum rated up to 10^{-8} Torr, and small-diameter rotary encoders with scale outside diameters from 32mm to 12mm.

All specifications are subject to change.

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