



# Mercury II™ 6000 Series

**High Performance Encoders with Digital Output**  
 High Resolution and Accuracy 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 6000 Encoder Series represents a breakthrough in performance, offering class-leading resolution and accuracy; digital output; the smallest sensor size; unmatched versatility, robustness, smart programmable features; and easy installation.

## Mercury II: The Next Generation

### High-Resolution Digital Output

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.

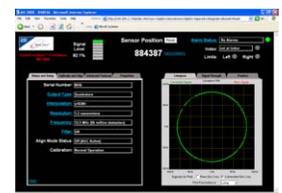
### System Features at a Glance

- High-resolution interpolated digital output; resolution from 5µm to 1.2nm
- Extremely low cyclical error - only ± 20nm - provides smooth velocity control
- Small sensor - 8.2mm tall sensor fits tight spaces
- Faster - up to 5m/s at 0.1µm resolution
- Smarter - programmable resolution in integer steps
- Cut-to-length laser tape scale comes on dispensers up to 30m
- Linear glass scales for high accuracy
- Stick-on optical index and left / right limits
- Bi-directional optical index is repeatable to 1LSB

- Low power consumption; low heat generation at the sensor
- High tolerance to scale contamination
- Broadest alignment tolerances
- Status LED's in the connector show encoder status at a glance.
- Software for setup, programmable features, monitoring and diagnostics
- RoHS and CE compliant

### Optional Features

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



### Table of Contents

System & Sensor .....Pg. 1-6  
 Sensor Electronics .....Pg. 7-8  
 SmartPrecision II Software .....Pg. 9-10

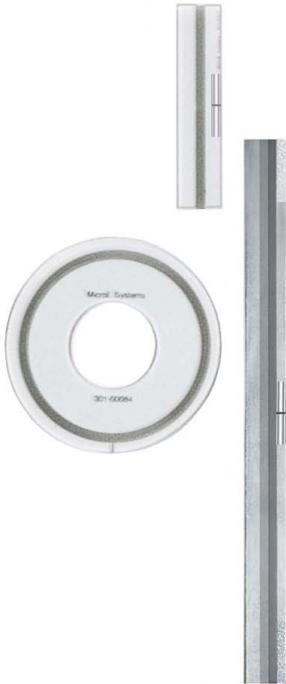
Scales .....Pg. 11-15  
 Ordering Information .....Pg. 16-18

# System Configurations

## Standard and Optional Equipment

### Mercury II™ 6000 Series Smart Encoder Systems

Standard Equipment



**Encoder Sensor**  
Same sensor for linear tape, linear glass, or rotary glass scales.



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



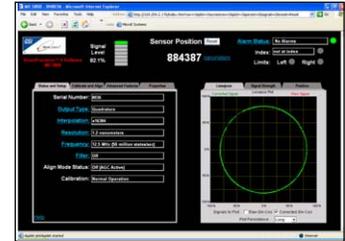
**Connector**  
RS-422 compliant 15 pin standard D-sub connector  
  
Built-in status LED's show the encoder's operational status at a glance, at all times.



**SmartPrecision™ Alignment Tool for Setup – ATMII5000**  
Provides fast and easy sensor set up. Includes setup and limit indicator LEDs, pushbutton index and limits setup, built-in SmartPrecision II Software (use is optional – not required for setup), Ethernet interface, and AC/DC power supply (not shown). The Alignment Tool is not for use while in servo control.

### Mercury II 6000 Series

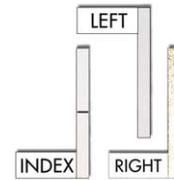
Optional Equipment



**SmartPrecision II Software**  
The software performs setup, monitoring and diagnostics, includes displays for encoder output, multiple data plots, and is used for programmable functions. It is built into the ATMII5000 Alignment Tool; use is optional. See Page 9 for details. Requires Ethernet cable.

### Mercury II 6000 Series

Installation Accessories



Index and Limit Marker Set



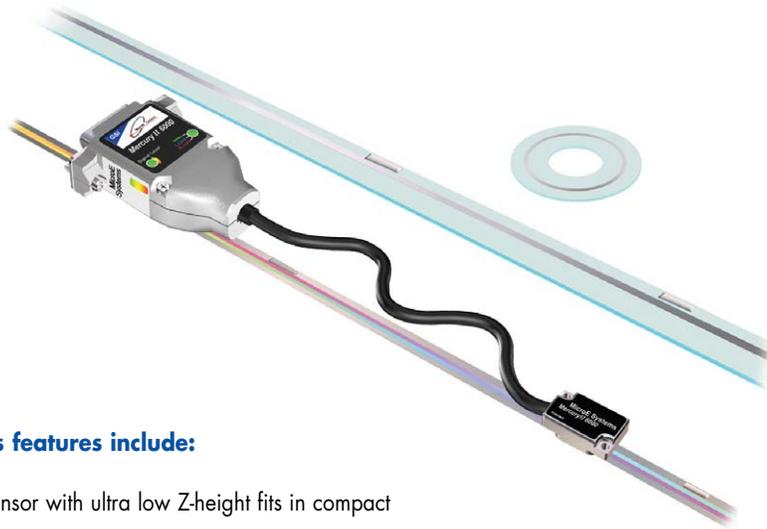
Tape Scale Applicator Tool



Tape Scale Shears

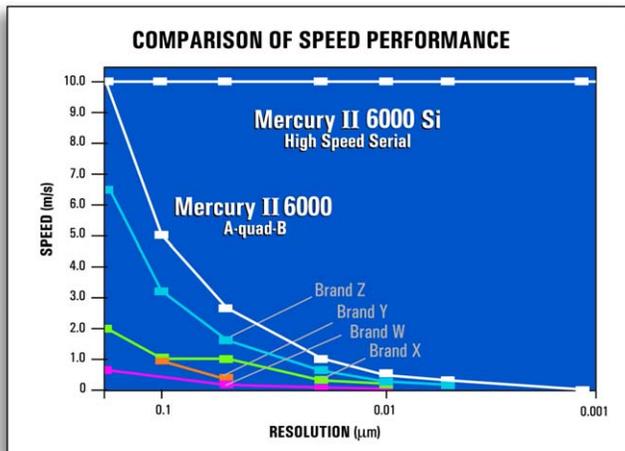
# MII 6000 System Features at a Glance

The Mercury II™ 6000 Series is built on the field-proven Mercury 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.



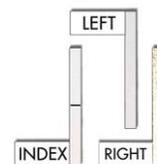
## Mercury II 6000's features include:

- 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); short-travel accuracy of  $\pm 20$ nm typical (linear glass scales); up to  $\pm 1\mu\text{m}$  (linear glass scales up to 130mm long)
- High-speed operation - up to 5m/s at 0.1 $\mu\text{m}$  resolution
- Versatility - one sensor works with laser tape or glass scales, linear or rotary

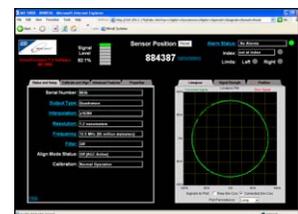


- Broad sensor alignment tolerances, and the alignment tool's built-in red/yellow/green setup LEDs and pushbutton setup, make setup fast and eliminate ancillary setup instruments
- Low sensor power consumption and heat generation – electronics in the sensor are minimized to achieve the lowest possible power consumption and associated heat generation, making the motion stage more thermally stable. Sensor power consumption is just 50mA at 5V DC.

- 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
- Low power consumption - only 50mA at the sensor, and 180mA with A, B, I, LL and RL outputs terminated for the whole encoder system
- Status LED's in the connector show encoder signal strength and limit status at a glance
- 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; Ethernet connectivity allows you to use any computer



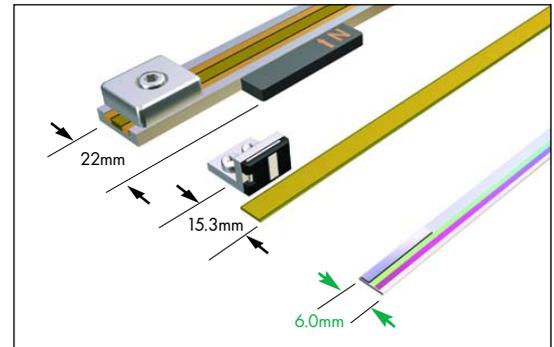
# Smallest Sensor, Lowest System Height, Smallest Tape Scale System, Broader Alignment Tolerances, and More

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

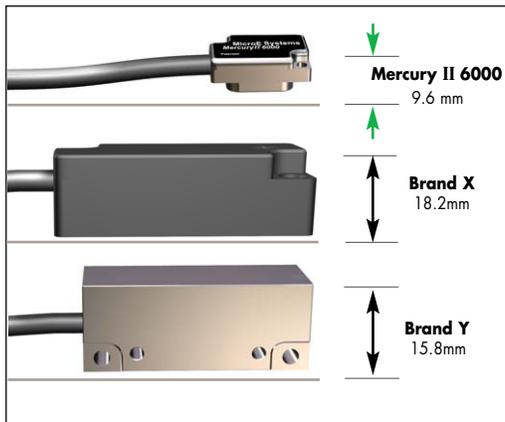
## Mercury II Can Reduce System Size and Cost

Mercury II 6000's system height with tape scale is 39% 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. Mercury II 6000'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



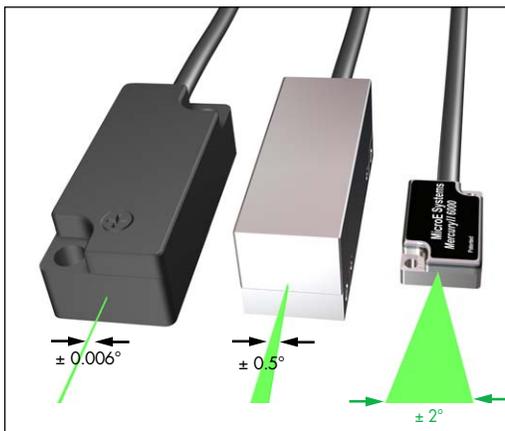
## Mechanical Dimension Comparison\*

	Mercury II 6000 with Tape Scale	Brand X	Brand Y	Mercury II vs. Best Competitor
System height	9.6mm	18.2mm	15.8mm	39% better
Sensor Z height	8.2mm	12mm	14.8mm	32% 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 for encoders with digital output

\*\*Tape scale system width including index and limits

## Theta Z Alignment Tolerance



## Eliminate the Frustration of Touchy Encoder Alignment

With Mercury's patented PurePrecision™ optics, 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.

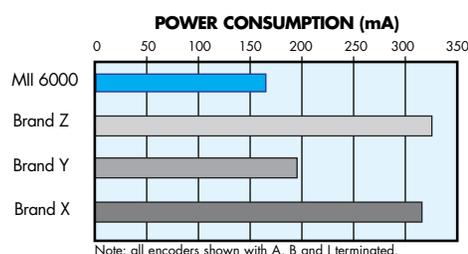
## Alignment Tolerance Comparison\*

	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	± 1.0°	unspecified	± 1.0°	
theta X	± 1.0°	± 0.1°	± 1.0°	

\*Based on published specifications for encoders with digital output

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

## Lowest Power Consumption



MII 6000 uses advanced electronics, giving MII 6000 the lowest power consumption of any high-performance digital-output encoder:

- Lowest heat generation / dissipation
- Cost and size savings in the controls / drives
- More system design flexibility

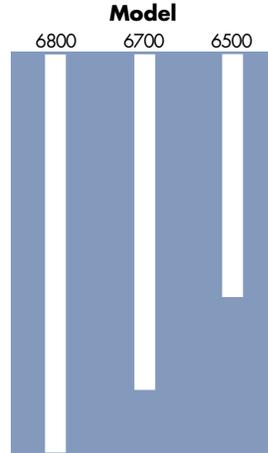
# MII 6000 System Specifications

## Resolution and Maximum Speed Tables

Mercury II™ 6000 Series systems have programmable interpolation from x4 to x16384 in integer steps. Below is a table of sample values. For applications requiring up to 10m/s at full resolution, use the MII6800Si with high speed serial interface.

### Linear - 20µm grating pitch

Maximum Interpolation	Resolution	Maximum Speed*
x 4	5.000µm/count	10000mm/sec
x 10	2.000µm/count	10000mm/sec
x 20	1.000µm/count	10000mm/sec
x 40	0.500µm/count	10000mm/sec
x 80	0.250µm/count	10000mm/sec
x 100	0.200µm/count	10000mm/sec
x 200	0.100µm/count	5000mm/sec
x 400	0.050µm/count	2500mm/sec
x 1000	20.0nm/count	1000mm/sec
x 2000	10.0nm/count	500mm/sec
x 4000	5.00nm/count	250mm/sec
x 8000	2.50nm/count	125mm/sec
x 16384	1.22nm/count*	61mm/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						
		Note: The range of available values is x4 to x16384 in integer steps; example values below.						
		x4	x20	x40	x400	x1000	x4000	x16384
<b>44.45mm</b>	<b>5000 CPR</b>							
	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)	6000	6000	6000	1500	600	150	36.6
<b>63.50mm</b>	<b>8192 CPR</b>							
	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)	3660	3660	3660	915	366	91.5	22.3
<b>120.65mm</b>	<b>16384 CPR</b>							
	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)	1830	1830	1830	457	183.1	45.7	11.17

\* Maximum speed produces an encoder quadrature output of 50 million states per second (12.5MHz). 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.

# MII 6000 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 µm/count.

Linear accuracy\*\*

	Laser Tape Scale	Glass Scales
Short-travel Accuracy	± 30nm typical over any 20µm movement	± 20nm typical 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. Note: after power up, the index mark must be passed once at ≤ 1 m/s for proper operation.

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

## Sensor Size

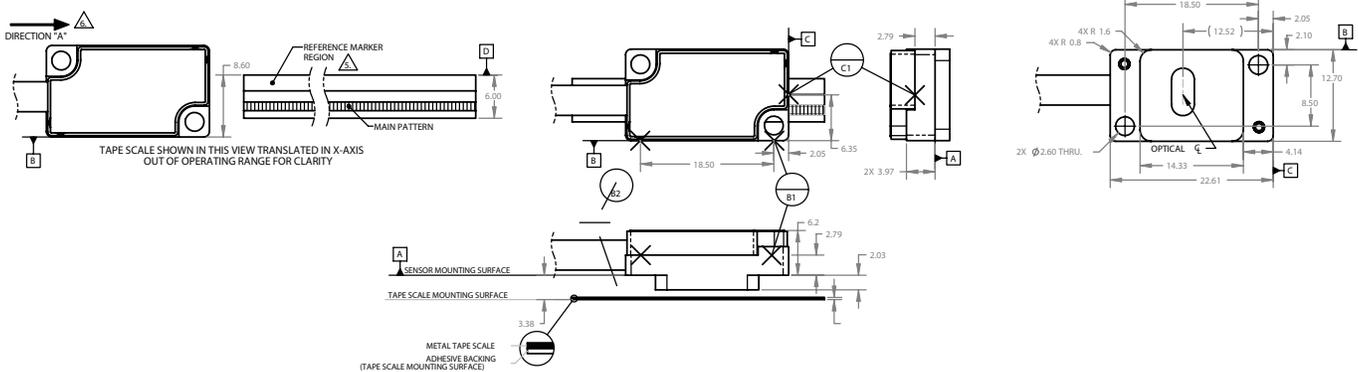
H:	8.23mm
W:	12.70mm
L:	22.61mm

## Operating and Electrical Specifications

Power Supply:	5VDC ±5% @ 140mA (No outputs terminated) @ 180mA (A, B, I, and both limits terminated); 50mA at the sensor
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)
Vibration:	30G @ 17Hz
Sensor Weight:	3g (Sensor without cable)
Cable:	Double Shield Maximum length: 10m (contact MicroE Systems for applications >5m) Diameter: 4.2mm Flex Life: 20 x 10 <sup>6</sup> cycles @ 20mm bending radius

## Reliability Information

5 year Expected Reliability: >99.8% under normal operating conditions.



NOTE:

Sensor shown with tape scale. Refer to the Mercury II™ 6000 interface drawings for additional dimensional details and important notes.

# Mercury II™ 6000 Electronics



The Mercury II™ 6000 series encoders are optimized to achieve the smallest sensor with the lowest power consumption, while delivering high resolution and accuracy. This compact, versatile system includes the following features:

- Programmable interpolation level and output bandwidth
- Accuracy optimization - sensor signals are automatically optimized to improve system accuracy and maximize repeatability
- Bi-directional index output pulse with repeatability of 1LSB
- A-Quad-B tri-state output alarm for low signal
- All settings and setup parameters are stored in non-volatile memory
- Superior EMI/RFI immunity - all outputs are differential; CE compliant
- Status LED's in the connector show the encoder's operational status at a glance

## Programmable Interpolation

The sensor 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 SmartPrecision II Software.

## Programmable Maximum Output Frequency

For encoder applications combining high resolution and high speed, the sensor supports up to 50 million quadrature state changes per second\*. By specifying the maximum output frequency to match your controller's capability - ranging from approximately 0.098 to 50 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, 50 million states per second = 0.02 µsec dwell time.

## Programmable Low Pass Filter

The Mercury II 6000 has a programmable low-pass output filter for enhanced performance in low speed applications. The filter can be disabled for full bandwidth or set from 0.01 - 100kHz in steps of 0.01kHz, where the frequency is -3dB output roll off.

## Alignment Tool



## Alignment Tool Features

- Provides fast and easy sensor alignment, index setup and limit setup
- Status and setup LED's: red / yellow / green signal strength LED's assist during setup and provide diagnostics at a glance; status LED's for both limits; power-indicating LED
- Includes AC/DC power supply
- Use pushbutton or software for setup
- Built-in SmartPrecision II Software for setup, monitoring, and diagnostics; only a web browser is needed (use of software is optional)
- Ethernet software connectivity supports remote connection to the Alignment Tool and MII6000 encoder, and multiple encoders / computers

Note: Alignment Tool and software not for use while in servo control

# Mercury II™ 6000 Outputs

## Mercury II 6000 Series Outputs:

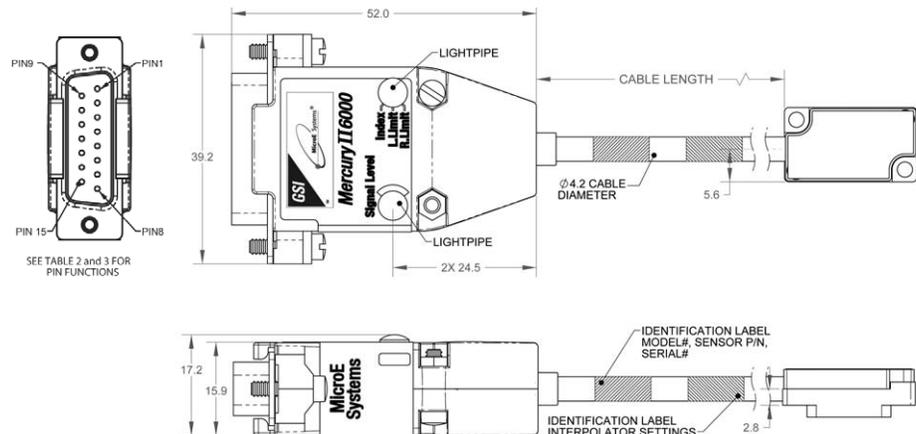
15-pin standard Male D-sub connector

PIN	Function
1	Right Limit+
2	Ground
3	Right Limit-
4	Index-
5	B-
6	A-
7	5V
8	5V
9	Ground
10	Left Limit+
11	Left Limit-
12	Index+
13	B+
14	A+
15	Alarm

NOTE:

Tri-state alarm: A and B are tri-stated if the encoder signal becomes too low for reliable operation

## Mechanical Information - 15 pin Connector

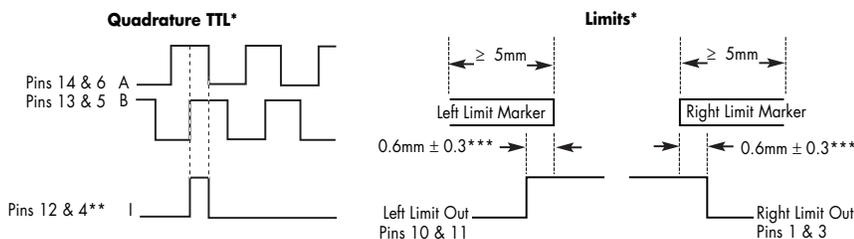


## Maximum Quadrature Output Frequency

Output Frequency (MHz)	A-Quad-B Output Rate (millions of states/sec)	Dwell Time (or edge separation) (µsec)
12.50	50.00	0.02
6.25	25.00	0.04
3.125	12.50	0.08
1.563	6.25	0.16
0.781	3.125	0.32
0.391	1.5625	0.64
0.195	0.78125	1.28
0.098	0.390625	2.56
0.049	0.1953125	5.12
0.024	0.09765625	10.24

\*Values shown are approximate. Exact values may be calculated as follows: Output Frequency = 12.5MHz / 2<sup>n</sup> where n = number of steps below 12.5MHz, or Output Rate = 50 / 2<sup>n</sup> where n = number of steps below 50 million states per second.

## Output Signals

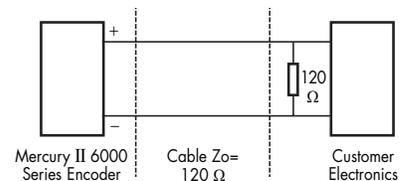


\*Output signals are differential. Inverse signals are not shown for clarity.

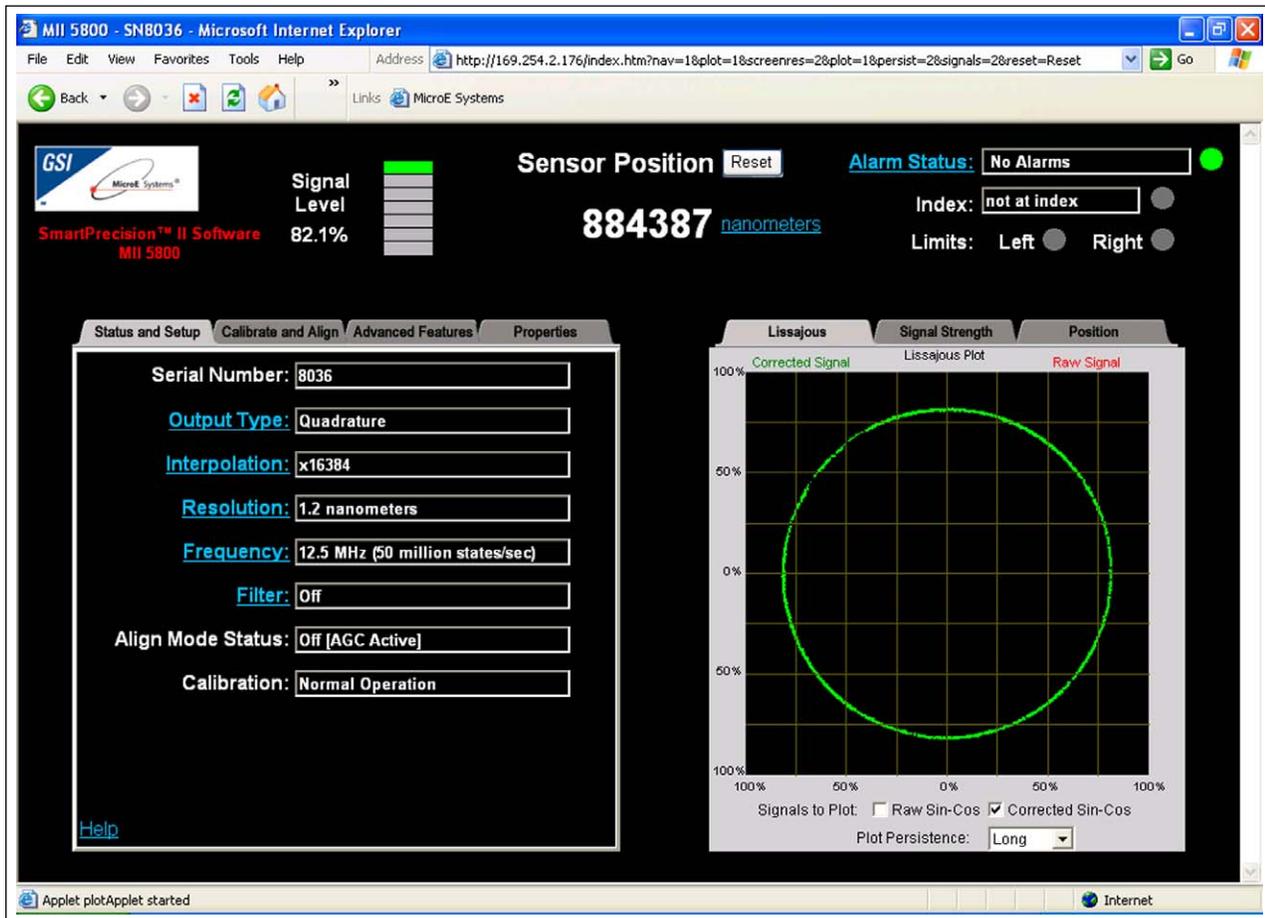
\*\*Note: At some interpolation values the index pulse may be aligned with other states of A or B than the ones shown.

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

## Signal Termination for A-quad-B, Index and Limits



# SmartPrecision™ II Software



## Why use software with an encoder?

Mercury II™ 6000's Alignment Tool includes built-in SmartPrecision II Software. The Alignment Tool's pushbutton setup process does not require use of the software, however SmartPrecision II Software adds unique functionality:

- Monitor encoder operation using digital readouts and data plots such as Lissajous
- 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
- Perform encoder setup with the convenience and step-by-step prompts of a software interface

Included with every Mercury II 6000 Alignment Tool, SmartPrecision II Software can perform 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 software alarms, index and limits
- Status of programmable encoder settings
- Encoder serial number

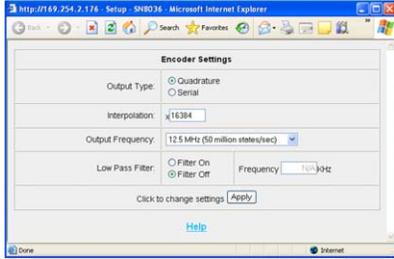
# SmartPrecision™ II Software

## Functions:

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

## Program Mercury II™ Encoder Electronics

- Set interpolation in integer steps from x4 to x16,384 (Mercury II 6800)
- Set maximum output frequency to match your controller
- Disable / enable low-pass filter and set filter roll-off frequency
- Set limit logic when necessary to match your controller's requirements



## Install Mercury II 6000 Encoders

- Align sensor using Signal Level display and Lissajous 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 6000 Encoder Operation

- Read encoder position in engineering units of your choice
- View data plots (software not for use while using Mercury II 6000 in servo control)
- Monitor software alarms and programmable settings



## Diagnose Mercury II 6000 Encoder Performance

- Capture signal data and email it to MicroE for rapid diagnostic support
- View software alarms and programmable settings

## Ethernet Connectivity Features

The software resides in the Mercury II 6000 Alignment Tool 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 6000 Alignment Tool. Ethernet connectivity advantages include:

- 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 6000 Alignment Tools 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

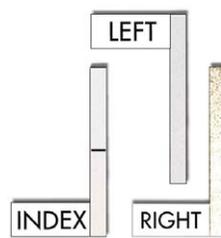
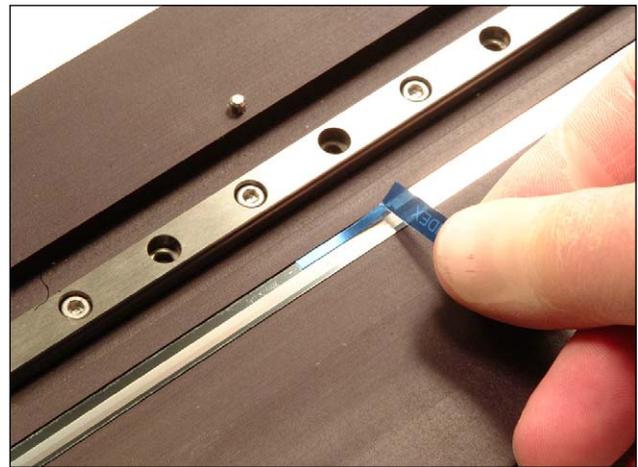
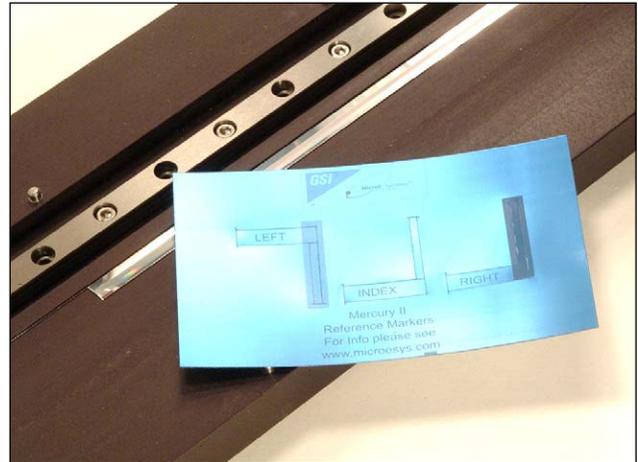


Mercury II™'s PurePrecision laser tape scale is fast and easy to install, provides excellent accuracy and takes less space than any encoder in its class. It mounts using a permanent pressure-sensitive adhesive. Thermal expansion of the substrate is matched by anchoring the ends of the tape scale using 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.microesys.com/MercuryII](http://www.microesys.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

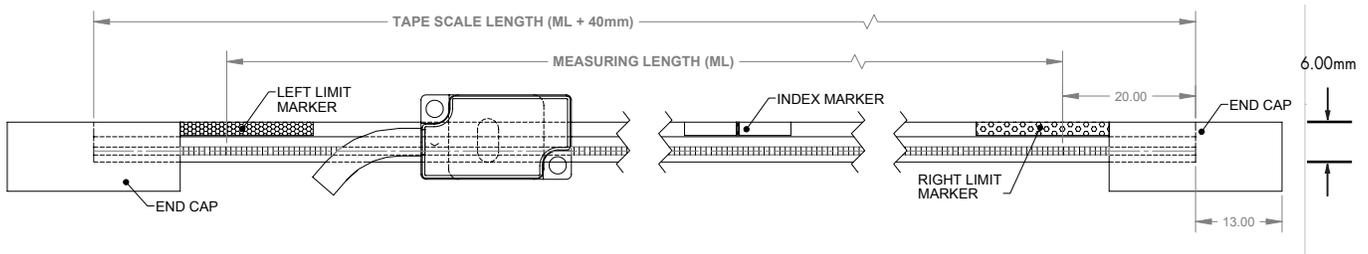
The laser scale length that you specify for your application must be calculated as follows. This calculation applies whether your application requires end limits or not. 20mm at each end of the tape scale are not to be used for encoder feedback.

**Tape Scale Length = Measuring Length + 40mm\***

Example: Measuring Length of 800mm is required, limits will be used at the end of the tape scale and end caps will not be used. The Tape Scale Length = 800mm + 40mm = 840mm.

\*When the end limits are at the ends of the tape scale and end caps are not used. 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



## 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

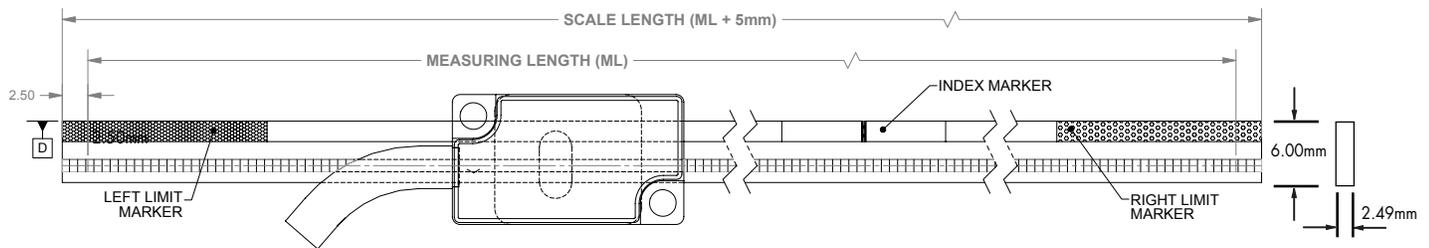
130mm and Shorter

Dimensions in mm.

### Specifications

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

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	MIIL018	MIIL030	MIIL055	MIIL080	MIIL105	MIIL130
<b>Scale Length</b>	18mm	30mm	55mm	80mm	105mm	130mm
<b>Measuring Length - Without Limits</b>	13mm	25mm	50mm	75mm	100mm	125mm
<b>Measuring Length - With Limits</b>	N/A	N/A	15mm	40mm	65mm	90mm

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

## 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.

# Linear Glass Scales with Stick-on Index and Limits

## Standard Long Linear Scales

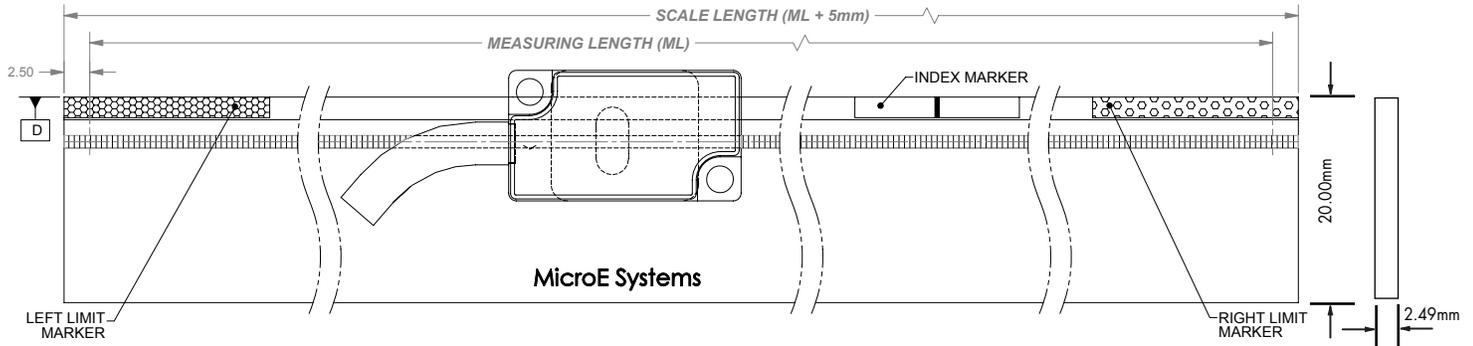
131mm and Longer (Dimensions in mm.)

### Specifications

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

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.

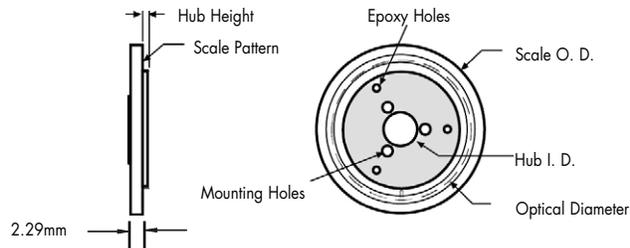
Model	MIIL155	MIIL225	MIIL325	MIIL425	MIIL525	MIIL1000
Scale Length	155mm	225mm	325mm	425mm	525mm	1000mm
Measuring Length - Without Limits	150mm	220mm	320mm	420mm	520mm	995mm
Measuring Length - With Limits	115mm	185mm	285mm	385mm	485mm	960mm

# 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	5000	44.45mm	12.70mm	31.83mm	6.358mm	1.27mm
MIIR6425	8192	63.50mm	25.40mm	52.15mm	12.708mm	1.52mm
MIIR12151	16384	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.microesys.com/MercuryII](http://www.microesys.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	

Note: MII6000 sensor height gages and sensor mounting screws are not included in the accessory kits. Contact MicroE Systems for availability.

# How to Order Mercury II™ 6000 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 781-266-5700.

## MII6800, A-quad-B Output, with Output Resolution from 5µm to 1.2nm

Example: MII6810-AB-16384-1-1-0

MII68XX	AB	Interpolation (Integer Steps)	Maximum Output Frequency	Limit Logic	Low Pass Filter Roll Off Frequency (kHz)
MII6810 = 1m cable	AB = A-quad-B output	4 = x4	1 = 12.50 MHz	1 = active low (fail safe) 2 = active high	0 = off (full bandwidth)
MII6830 = 3m cable		5 = x5	2 = 6.25 MHz		1 = 1kHz
MII6850 = 5m cable		↓	3 = 3.125 MHz		2 = 2kHz
		16384 = x16384	4 = 1.563 MHz		↓
			5 = 0.781 MHz		100 = 100kHz
			6 = 0.391 MHz		
			7 = 0.195 MHz		
			8 = 0.098 MHz		
			9 = 0.049 MHz		
			10 = 0.024 MHz		

## MII6700, A-quad-B Output, with Output Resolution from 5µm to 5nm

Example: MII6710-AB-4000-1-1-0

MII67XX	AB	Interpolation (Integer Steps)	Maximum Output Frequency	Limit Logic	Low Pass Filter Roll Off Frequency (kHz)
MII6710 = 1m cable	AB = A-quad-B output	4 = x4	1 = 12.50 MHz	1 = active low (fail safe) 2 = active high	0 = off (full bandwidth)
MII6730 = 3m cable		5 = x5	2 = 6.25 MHz		1 = 1kHz
MII6750 = 5m cable		↓	3 = 3.125 MHz		2 = 2kHz
		4000 = x4000	4 = 1.563 MHz		↓
			5 = 0.781 MHz		100 = 100kHz
			6 = 0.391 MHz		
			7 = 0.195 MHz		
			8 = 0.098 MHz		
			9 = 0.049 MHz		
			10 = 0.024 MHz		

## MII6500, A-quad-B Output, with Output Resolution from 5µm to 50nm

Example: MII6510-AB-400-1-1-0

MII65XX	AB	Interpolation (Integer Steps)	Maximum Output Frequency	Limit Logic	Low Pass Filter Roll Off Frequency (kHz)
MII6510 = 1m cable	AB = A-quad-B output	4 = x4	1 = 12.5MHz	1 = active low (fail safe) 2 = active high	0 = off (full bandwidth)
MII6530 = 3m cable		5 = x5	2 = 6.25 MHz		1 = 1kHz
MII6550 = 5m cable		↓	3 = 3.125 MHz		2 = 2kHz
		400 = x400	4 = 1.563 MHz		↓
			5 = 0.781 MHz		100 = 100kHz
			6 = 0.391 MHz		
			7 = 0.195 MHz		
			8 = 0.098 MHz		
			9 = 0.049 MHz		
			10 = 0.024 MHz		

# How to Order Mercury II™ Encoder Systems

## How to Order SmartPrecision Alignment Tool

Required for MII6000 setup. AC / DC Power Supply is included, 100-240 VAC / 50-60 Hz.

### Example (Alignment Tool for MercuryII 6000 encoders, Europlug): ATMII5000-S-EU

<u>ATMII5000</u>	—	<u>Connector</u>	—	<u>Plug Type</u>
		S =		US = Power Supply with
		15-pin Std.		US Standard 2-prong plug
		D-sub		
				EU = Power Supply with
				European Standard
				2-prong plug

## 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 bag of tape scale end caps (10 per bag)  
Note: two end caps 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

<u>MIIRxxxx*</u>	—	<u>Hub</u>
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](http://www.microesys.com/mercury) for Mercury linear and rotary encoders that are vacuum rated up to  $10^8$  torr, small-diameter rotary encoders with scale outside diameters from 32mm to 12mm and low-cost PCB mount encoders.

All specifications are subject to change.

**MicroE Systems** - World Headquarters: 125 Middlesex Turnpike, Bedford, MA USA 01730-1409

DS-Mercury II 6000 Rev. C

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