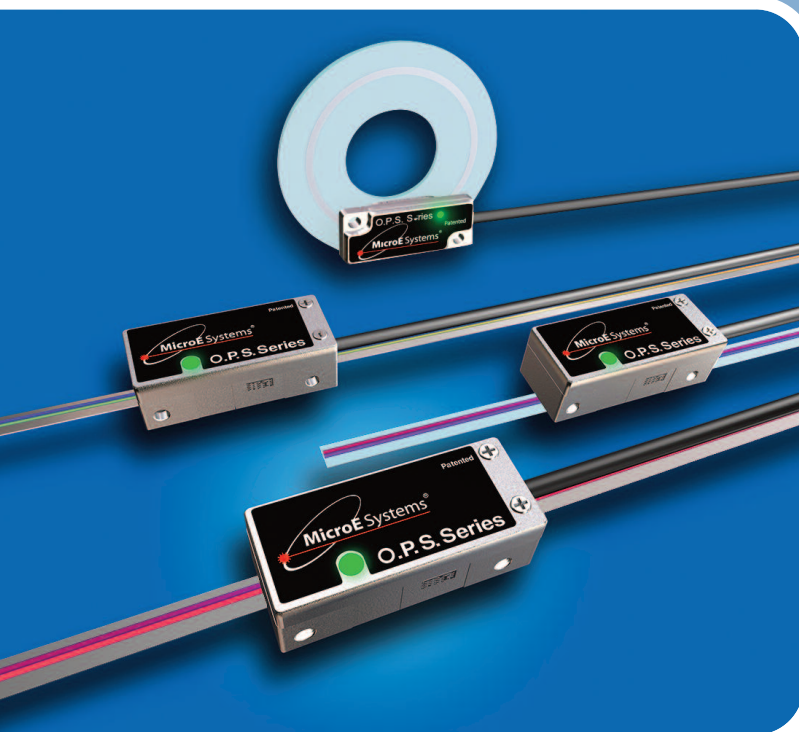




OPS™ Series Encoders

Performance and Value Optical Encoder System



RoHS
 CE

Specifications

Resolution	Linear: 1µm, 0.5µm, 0.1µm, or 50nm Rotary: 163k to 3.27M CPR
Linearity	Tape Scale: ≤ ±5µm over 1m
Accuracy	Linear Glass Scale: ≤ ±3µm over 1m Rotary Glass Scale: 3.9 arc-sec with 64mm OD scale
Cyclical Error (over any 20µm movement)	Tape Scale: ±40nm typical Glass Scale: ±25nm typical
Outputs	A-quad-B, LSB Index Pulse, Dual Limits
Scale Pitch	20µm

Benefits

- **Easy Installation**
 Wide alignment tolerances
 100% optical index and limits reduces cabling and footprint
 Flexible mounting configurations
 Same sensor for tape and glass scales
 Intuitive tools
- **High Performance**
 Built-in interpolation and AGC
 High resolution and accuracy
 Low cyclical error and low jitter
 Low power consumption
- **Dual-Purpose LED in the Sensor**
 Indicates alignment and system health

The Optical Positioning Sensor (OPS) encoder system delivers high performance and advanced positioning system features. The OPS sensor is equipped with MicroE's patented optical design and features built-in interpolation and AGC ensuring optimal performance and reliability. OPS can be configured with optical limits to reduce cabling and works with MicroE's cut-to-length linear tape and linear and rotary glass scales, minimizing total cost of ownership. Several mounting options are available.

A dual-purpose LED in the sensor simplifies installation and provides real time indication of system health. Intuitive tools make installation and commissioning fast and simple.

Model	Resolution	Output	Maximum Speed
OPS-SM-400	50nm	Digital	1.5m/s
OPS-SM-200	0.1µm	Digital	3m/s
OPS-SM-40	0.5µm	Digital	4.5m/s
OPS-SM-20	1µm	Digital	4.5m/s

Note: Above table also applies for top mount models, see page 10 to order.



Built-in dual-purpose LED indicates alignment during installation and shows encoder system health in real time during operation.

OPS™ Series Encoders

Performance and Value Optical Encoder System



RoHS
CE

Specifications

System

- OPS sensors are compatible with:
- PurePrecision™ Marker Tape II and Laser Tape II
 - Linear and rotary glass scales

Scale Pitch	20µm
Signal Period	20µm
System Resolution	1µm, 0.5µm, 0.1µm or 50nm (specify at time of ordering)

Accuracy

Linear Tape Scale	Typical slope error: 100ppm - Linearity: $\pm 5\mu\text{m}/\text{m}^1$ - Cyclical (interpolation) error: $\pm 40\text{nm}^2$
Linear Glass Scale	$\pm 3\mu\text{m}/\text{m}$ total - Cyclical (interpolation) error: $\pm 25\text{nm}^2$
Rotary Glass Scale	3.9 arc-sec with 64mm OD scale ³ - Cyclical (interpolation) error: ± 0.2 arc-sec ²

¹ Achievable after two-point correction in the customer's controller.

² Repeating error over any 20µm movement and does not accumulate.

³ Assumes perfect alignment of scale pattern to axis of rotation.

Note: Accuracy is the maximum error over the specified movement when compared to a NIST-traceable laser interferometer standard used at 20°C.

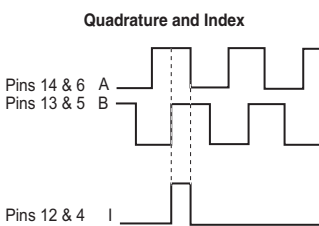
Sensor Size & Weight (side mount sensor)

Height	Width	Length
0.46 [11.67mm]	0.56 [14.30mm]	1.35 [34.25mm]
Weight	8g (without cable)	

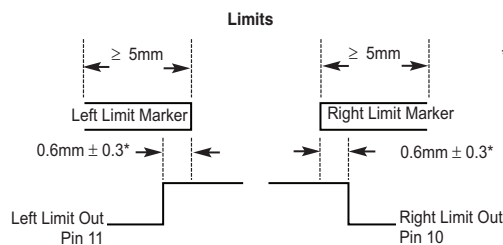
Reliability Information

5 Year Expected Reliability >99.8% under normal operating conditions

Digital Output Signals



Inverse signals are not shown for clarity.



Active low limit configuration is shown.

* With reference to the sensor's optical centerline (see interface drawings).

Operating and Electrical Specifications

Power Supply	5VDC $\pm 5\%$ @ 120mA when used with recommended termination, 80mA unterminated
Temperature	
Operating	0 to 70°C
Storage	-20 to 85°C
Humidity	10 to 90% RH non-condensing
Agency Standards Conformance:	In accordance with Electro-magnetic Compatibility Directive 2004/108/EC: EN 55011:2007 EN 61000-4-2, -3, -4, -6
Shock	300G 0.5 ms half sine
Vibration	30G at 17Hz
Sensor Cable	Double Shield (contact MicroE Systems for applications >5m) Diameter 3.6mm (0.142") Flex Life 20×10^6 cycles @ 20mm bending radius Standard 15 pin D-sub connector

Outputs

Digital A-quadr-B, 1LSB index pulse, left and right limits. A, B and I signals are differential. Limits are single ended. Index is gated to AB high.

Signal Level

A/B/I (differential): RS-422 compatible

Limits: 3.3VDC max., LVTTTL compatible (High > 2.4VDC, Low < 0.4VDC), maximum current output (source and sink): 14mA

Limits programmable as active high, active low or disabled
Alarm: Tri-state of A, B and I outputs, latched for minimum 30ms

Output Frequency (at maximum speed)

OPS 200/400: 16.5Mhz per channel

OPS 40: 5Mhz per channel

OPS 20: 2.5Mhz per channel

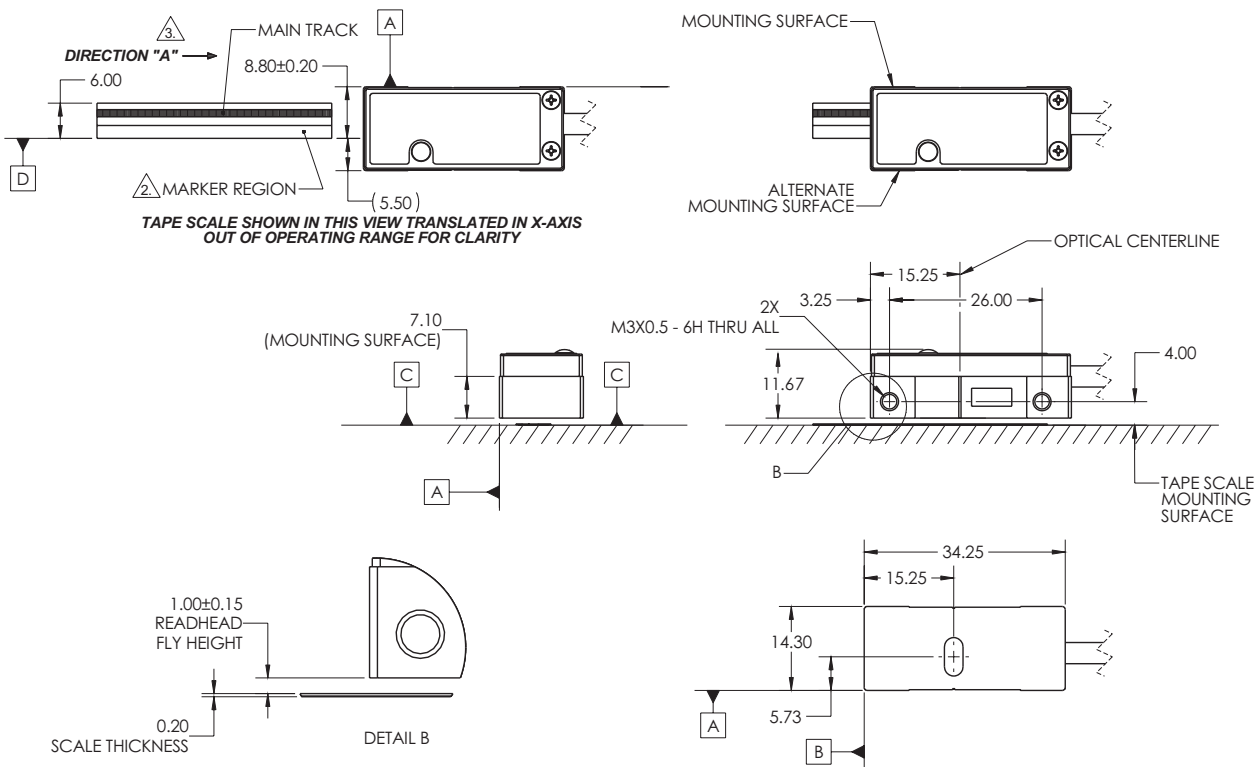
Note: Output frequency must not exceed maximum input frequency of customer electronics.

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Refer to interface drawing & installation manual for design details and recommendations.

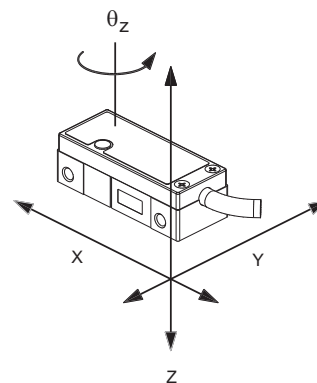
Dimensions for Side Mount Configuration



Wide Alignment Tolerances

OPS utilizes MicroE's patented optical detector design to achieve industry-leading alignment tolerances, simplifying system design and installation.

OPS Side Mount Configuration Sensor Alignment Tolerances	
Axis	Alignment Tolerance
X	Direction of Motion
Y	± 0.20mm
Z	± 0.15mm
θ_X	± 1.0°
θ_Y	± 1.0°
θ_Z	± 2.0°



Dual-Purpose LED in the Sensor



Side mount sensor shown

During installation of the system, powering up with the alignment tool plugged in disables the sensor's AGC and puts the sensor in alignment mode. The LED indicates proper system alignment when in alignment mode. Powering down, removing the alignment tool and powering up again returns the sensor to operational mode. During operation of the system, the LED indicates encoder system health.

- Green** = Optimal performance. Sensor is reading position with sufficient signal strength. Encoder system will function properly. LED will blink when passing over the index mark.
- Yellow** = Marginal performance. Sensor is reading position with marginal signal strength. Encoder system will function normally but signal strength is less than optimal.
- Red** = Improper performance. Sensor is reading position with weak signal strength or signals are saturated. Encoder system may not function properly. Alarm condition will be asserted (tri-state of A, B and I outputs, latched for minimum 30ms).

Refer to interface drawing & installation manual for design details and recommendations.

OPS™ Series Encoders

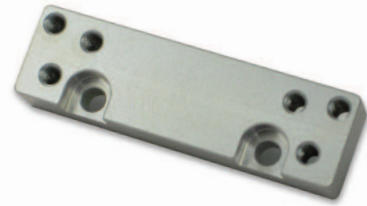
Performance and Value Optical Encoder System



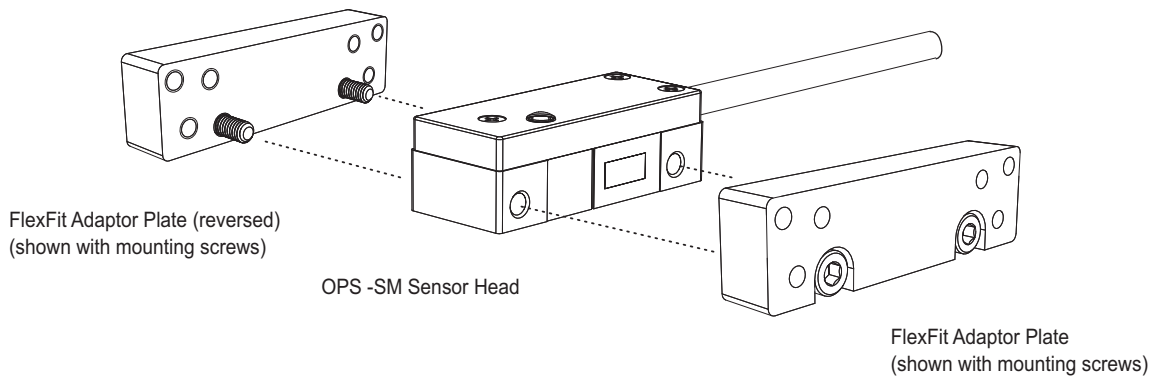
RoHS
CE

FlexFit™ Adaptor (optional)

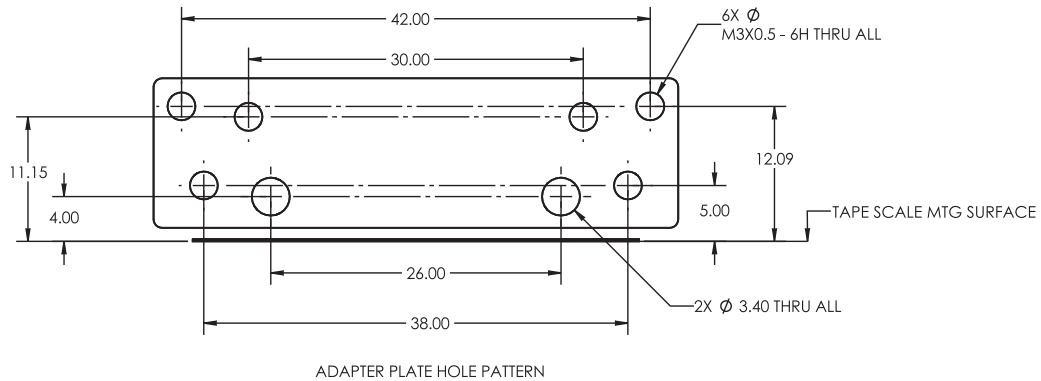
The FlexFit adaptor for the OPS Side Mount sensor enables flexible mounting configurations and is compatible with many industry-standard mounting hole patterns. OPS can be installed without re-designing your system hardware.



OPS with FlexFit Adaptor - Configuration Options



FlexFit Adaptor with mounting hole dimensions (dimensions in millimeters)



Reference drawing available. Contact MicroE Systems Application Engineering.

FlexFit Adaptor Size and Weight

Length	Width	Height
1.85 [47.0mm]	0.32 [8.0mm]	0.53 [13.4mm]
Weight	8g (sensor without cable) 20g (sensor with FlexFit Adaptor and mounting hardware)	

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Refer to interface drawing & installation manual for design details and recommendations.

OEM Flexibility – Top Mount Configuration, High Accuracy & Multiple Scale Options

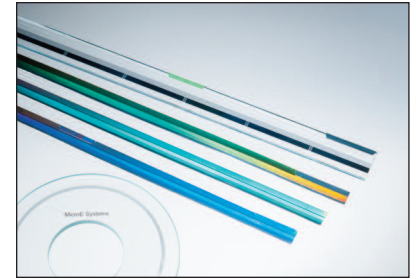


For OEMs that need to install OPS in extremely tight spaces or for low profile rotary axes, MicroE also offers the OPS in a top mount configuration.

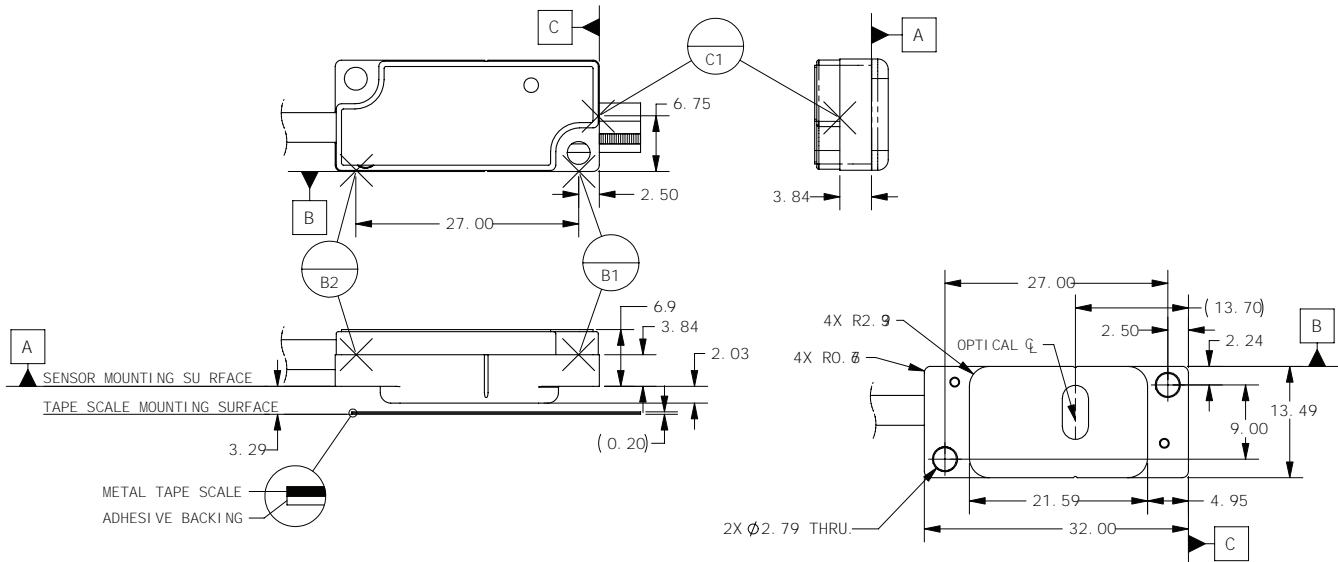
OPS can also be configured for applications that require high accuracy and works with a range of rotary and linear glass scales. Contact MicroE Applications engineering to explore OEM solutions.

OPS Series available with:

- Top mount sensor
- High accuracy linear glass scales
- Range of rotary glass scales

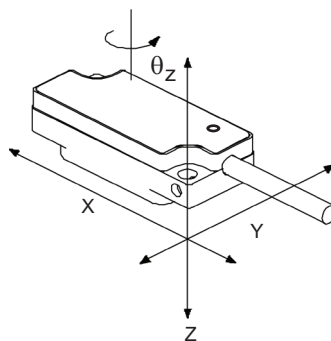


Dimensions for Top Mount Configuration



Wide Alignment Tolerances

OPS Top Mount Configuration Sensor Alignment Tolerances	
Axis	Alignment Tolerance
X	Direction of Motion
Y	± 0.20mm
Z	± 0.15mm
θ _X	± 1.0°
θ _Y	± 1.0°
θ _Z	± 2.0°



Sensor Size & Weight (top mount sensor)

Height	Width	Length
0.35 [8.93mm]	0.53 [13.49mm]	1.26 [32.00mm]
Weight	6g (without cable)	

Refer to interface drawing & installation manual for design details and recommendations.

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Alignment Tool and Software

Alignment Tool

Proper installation of the OPS encoder system requires confirmation of sensor alignment and calibration of the optical index and limit signals. Alignment and calibration is performed using MicroE's intuitive alignment tool and is completed in a few simple steps.

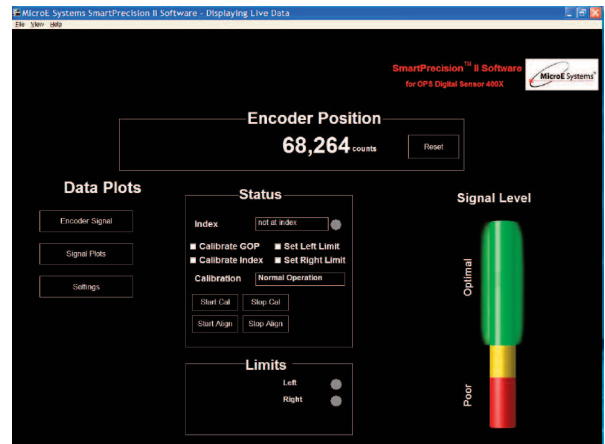
During installation of the system, powering up with the alignment tool plugged in disables the sensor's AGC and puts the sensor in alignment mode. The LED indicates proper system alignment when in alignment mode. Powering down, removing the alignment tool and powering up again returns the sensor to operational mode. During operation of the system, the LED indicates encoder system health.



OPS Alignment Tool.

Software

Further diagnostic capabilities are possible by using MicroE's SmartPrecisionII™ Software. SmartPrecisionII™ Software also provides the ability to configure the OPS encoder system in the field to meet the needs of multiple applications.



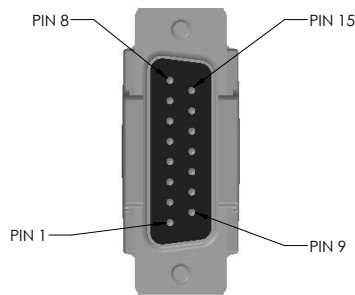
SmartPrecisionII™ Software included with Alignment Tool.

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Refer to interface drawing & installation manual for design details and recommendations.

Connector Pin Configuration

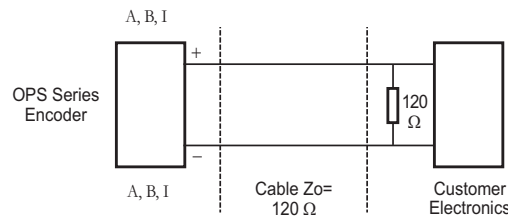


O.P.S. 15P D-SUB		
Pin#	Function	Wire Color
1	Do Not Connect	
2	GND	Black
3	Do Not Connect	
4	IW-	Brown
5	B-	Blue
6	A-	Yellow
7	+5V	Red
8	+5V	
9	GND	
10	RL	Gray
11	LL	White
12	IW+	Orange
13	B+	Violet
14	A+	Green
15	Do Not Connect	

NOTE: GND and INNER SHIELD ARE INTERNALLY CONNECTED.

Recommended Signal Termination

Digital Outputs:

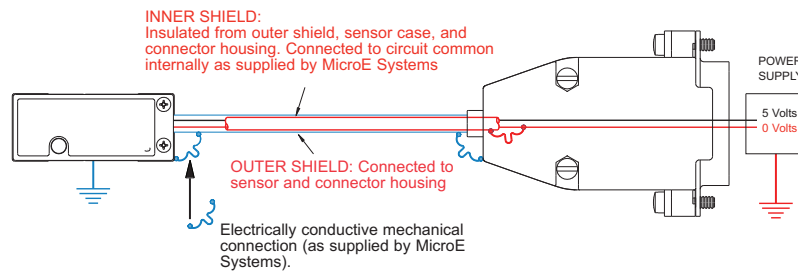


Standard RS-422 Line Receiver Circuitry

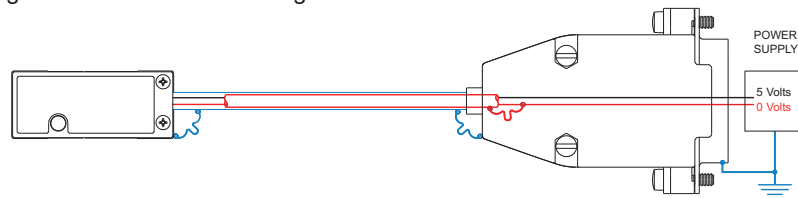
Max cable length: 5m. Contact MicroE Applications Engineering if longer length required.

Grounding Considerations

Sensor mounted with good electrical contact to well grounded surface (preferred):



Sensor mounted to poorly grounded or non-conducting surface:



Refer to interface drawing & installation manual for design details and recommendations.

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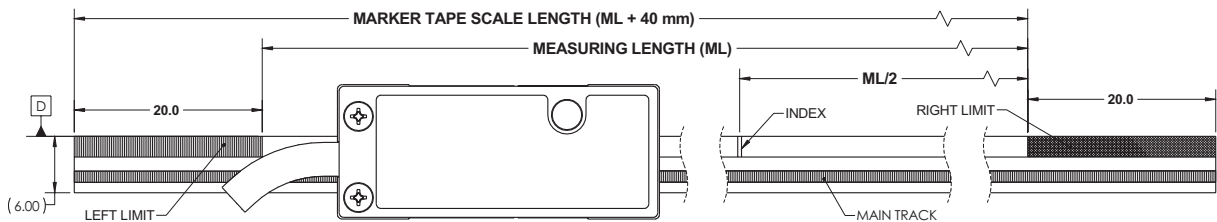
Multiple Scale Options

OPS works with MicroE's PurePrecision™ linear tape scales and a wide range of linear and rotary glass scales. PurePrecision™ linear tape scales are easily installed on virtually any surface with standard adhesive backing, can be cut-to-length in the field and achieve industry-leading price/performance. Glass scales are available for linear applications requiring higher accuracy and for rotary applications. PurePrecision™ tape provides linearity of $\pm 5\mu\text{m/m}$, is only 6mm wide, and is available in two configurations in lengths up to 30m:

Marker Tape II: Index and limits are factory-encoded in the scale and can be configured to meet any application. Marker Tape II is ideal for high volume, repeat order systems.

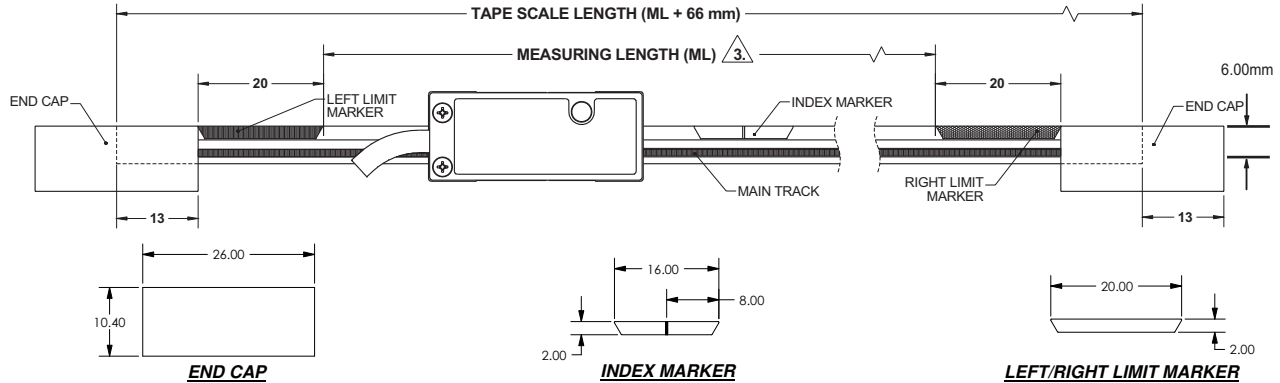
Laser Tape II: Stick-on index and limits are offered for maximum flexibility and are easy to apply. Laser Tape II is ideal for supporting multiple index and limit configurations and rapid prototyping.

PurePrecision Marker Tape II, with factory-encoded Index and Limits



Note: End caps not shown for clarity.

PurePrecision Laser Tape II, with stick-on Index and Limits



PurePrecision™ Tape Scales

Specifications

Linearity	$\leq \pm 5\mu\text{m/m}$
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

Tape Scale Applicator Tool for OPS Series

The Tape Scale Applicator Tool should be used for scale lengths greater than 300 millimeters. The Applicator Tool enables fast and accurate installation of long scale lengths which ensures optimal encoder performance.



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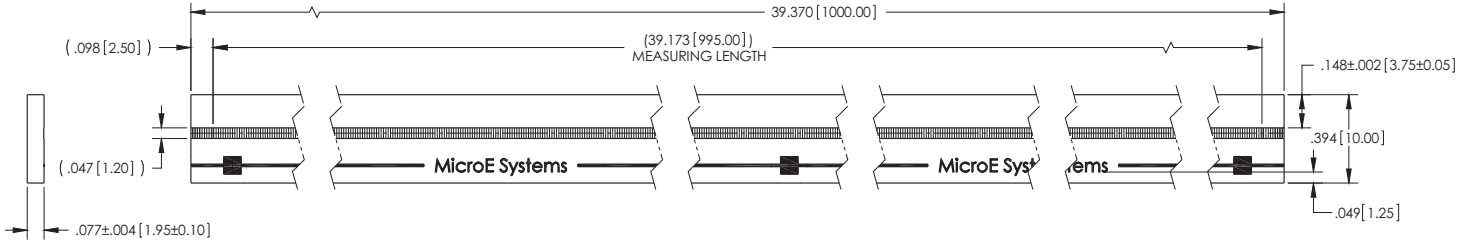
Refer to interface drawing & installation manual for design details and recommendations.



Multiple Scale Options

Performance and Value Linear Glass Scales

Performance and Value linear glass provides accuracy of $\pm 3\mu\text{m}/\text{m}$, is only 10mm wide, and is available with stick-on index and limits in lengths up to 1m. Performance and Value glass is easily installed with standard adhesive backing, can be cleaned with isopropyl alcohol or acetone, and is ideal for applications that demand the performance of glass at a value similar to tape.



Specifications

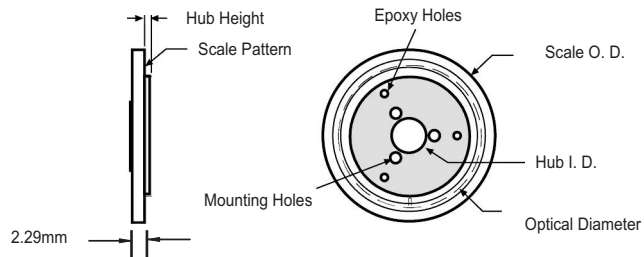
Material	Soda lime glass
Typical CTE	8ppm/°C

Rotary Glass Scales

OPS works with a wide range of rotary scales. Model R6425NR is shown below for reference. Rotary glass scales are available with or without hubs, and in arc segments. Contact MicroE Applications Engineering to discuss your requirements.

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
R6425NR	8192	63.50mm	25.40mm	52.15mm	12.708mm	1.52mm

Hub mounting and custom scales are available, including larger diameters

Refer to interface drawing & installation manual for design details and recommendations.

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OPS™ Series Encoders

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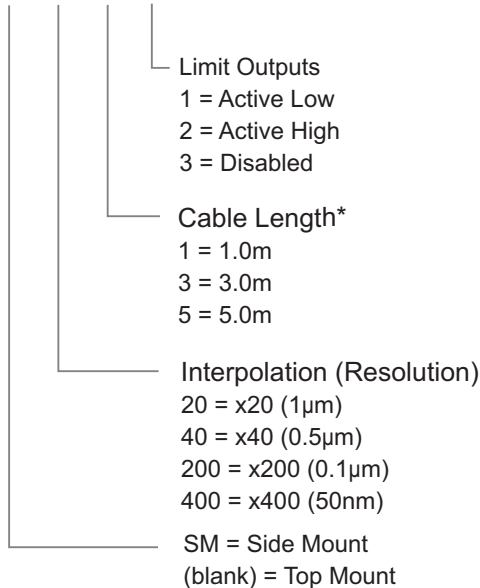


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How to Order

Sensor

OPS-SM-400 - 3 - 1



* Custom cable lengths and connectors are available. Contact MicroE Applications Engineering.

Sensor Installation Tools

- AT-OPS** Alignment Tool Kit for OPS encoders includes Alignment Tool, SmartPrecisionII™ Software, USB Cable, Power Supply (100V-240VAC, US 2-prong plug)
- ZG-PP1** Z-Height Gauge, PurePrecision™ Tape Scales, Top Mount Sensor
- ZG-GS1** Z-Height Gauge, Glass Scales, Top Mount Sensor

FlexFit™ Adaptor

- MK-FFA** FlexFit Adaptor Mounting Kit. Reference design is available upon request.

End Cap Kit, PurePrecision Tape Scales

- EC** Optional Tape Scale End Caps

Adaptor for Open Collector Limit Outputs

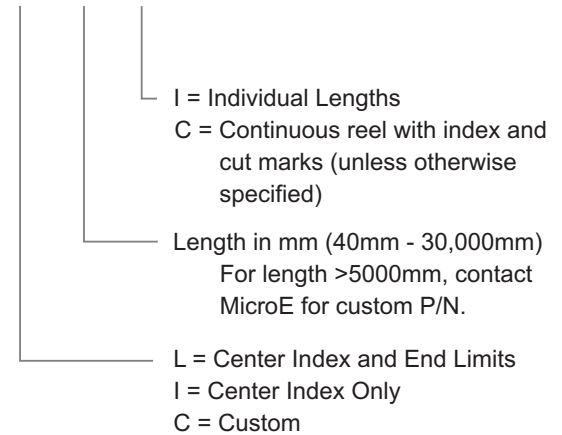
- MIIA-OCL** Small DB15 adaptor to convert 3.3V left and right limit output signals to open collector type (7407).

All specifications subject to change.

Scales

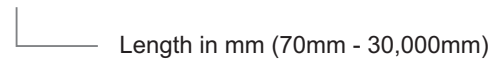
PurePrecision™ Marker Tape II

HPMT - N - A - L - 5000 - I



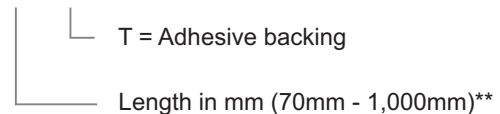
PurePrecision™ Laser Tape II

HPTS - 30000 - N



Performance and Value Linear Glass

PVGL - 1000 - T



** For lengths <70mm or >1m, contact MicroE Applications Engineering.

Stick-on Index and Limit Markers (for Laser Tape II and Performance and Value Linear Glass Scales)

- NRIMS** Qty. 8 Stick-On Index Markers
- NRLMS** Qty. 4 Stick-On Left Limit Markers and Qty. 4 Stick-On Right Limit Markers

Rotary Glass

Contact MicroE Applications Engineering to discuss your requirements.

Tape Scale Applicator Tools (use for lengths >300mm)

- TSAT-SM-PPT** Tape Applicator Tool for OPS-SM, Side Mount Sensors
- TSAT-PPT** Tape Applicator Tool for OPS, Top Mount Sensors

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