Celera MOTION | MicroE *Encoders*

PRODUCT DATA SHEET

COMPACT

Veratus™ Series Encoders

Compact Precision Encoders for the World's Machines and Instruments

Built with the new VeraPath™ technology of MicroE encoders, the Veratus Series delivers best-in-class reliability, signal stability, and contamination tolerance in a compact package with unparalleled ease of use.

› CELERAMOTION.COM

Veratus™ Series Encoders

Compact Precision Encoders for the World's Machines and Instruments

Smart and Reliable.

Veratus is the only encoder in its class that delivers the reliability, signal stability, and contamination tolerance required in precision industrial applications with all interpolation, AGC, and signal processing performed in the sensor head. No additional PCBs, adapters, or dongles are necessary.

Built using new VeraPath™ technology from MicroE, Veratus is engineered with advanced optical filtering and state-of-the-art signal processing and electronics, ensuring low position noise (jitter) and smooth velocity control over a wide range of operating conditions. Veratus is available with resolutions up to 20 nm and offers industry standard analog and digital incremental encoder outputs, a phased LSB index, and easy-to-install magnetic limits and index select marks.

Veratus is compatible with MicroE's wide range of linear and rotary gratings and scales, enabling robust performance and easy installation.

Benefits

- Dirt immunity and reliable performance in a wide range of applications and environments; advanced optical filtering and signal processing
- Compact footprint; interpolation and signal processing in sensor head
- Automatic calibration; plug and go
- Multiple mounting configurations
- Built-in limits and flexible index selection
- Multiple linear and rotary grating/scale options
- Alignment/Status LED in sensor head

Specifications

Dimensions:	35.0 x 13.5 x 10.2 mm
Interfaces:	A-quad-B digital or 1Vpp Sin/Cos analog
Resolution: (Interpolation in Sensor Head)	5 µm – 20 nm (linear) 2,000 CPR – 75M CPR (rotary)
Accuracy Class:	+/- 1 µm (linear glass) +/- 3 µm (linear metal tape) +/- 2 arc-seconds (rotary)
Input Voltage:	5 V_{DC}
Supply Current:	220 mA with 120Ω across A, B, I 170 mA with 120Ω across Sin/Cos, IW
Max Speed:	5 m/s
Index:	IW for analog and 5 µm digital LSB for 2.5 µm digital and above
Outputs:	Sin/Cos or A-quad-B, Index, Limits (2), Alarm
Status LED:	Yes
Operating Environment:	Atmospheric
Scale Pitch:	20 µm
Repeatability: (Hysteresis)	≤ 1 LSB
Typical Sub-Divisional Error (SDE):	< 20 nm RMS
Weight:	< 15 g sensor head, < 30 g/m cable
Grating Compatibility:	Linear and Rotary

Specifications subject to change.

RoHS

Celera MOTION | MicroE Encoders
125 Middlesex Turnpike | Bedford, MA 01730-1409 USA
Tel: 781.266.5700 | celeramotion@gsig.com | www.celeramotion.com

Specifications

System

Scales

Veratus Series Encoders are compatible with Veratus Tape, Linear Glass, and Rotary Glass scales.

Scale Pitch	20 µm
System Resolution	5 µm, 2.5 µm, 1 µm, 0.5 µm, 0.2 µm, 0.1 µm, 50 nm, 20 nm. Analog 1 Vpp 2,000 CPR – 75M CPR (rotary) (specify resolution at time of ordering)

Accuracy

Tape	SDE:	<20 nm RMS[3]
	Linearity:	≤±3 µm (max/meter)
	Slope:	<±50 µm/m
Linear Glass	SDE:	<20 nm RMS[3]
	Total Accuracy:	<±2 µm/m[1]
Rotary Glass	Total Accuracy:	±2 arc-seconds[2]

Sensor Size and Weight

	Length	Width	Height
Dimensions (mm)	35.0	13.5	10.2
Weight	<15 g sensor head <30 g/m cable		
Sensor Cable	8 twisted pairs double-shielded, length up to 5 m		

Notes:

1. 130 mm or less
2. 125 mm diameter, excludes eccentricity
3. Primarily first and second harmonic

Operating and Electrical Specifications

Power Supply Current

AquadB, 5 V_{DC} ±5%:	<220 mA with 120Ω across A, B, I <160 mA with no load
Analog, 5 V_{DC} ±5%:	<170 mA with 120Ω across Sin/Cos, IW <140 mA with no load
Ready Time:	<0.5 s once power >4.5 V

Temperature	
Operating	-20°C to 70°C
Storage	-20°C to 85°C
Humidity	
Operating	10% to 90% RH, non-condensing
Storage	Up to 85% RH, non-condensing
Vibration	10 g, 55 Hz to 2 KHz; EN60068-2-6
Acceleration	50 g; EN 60068-2-7

Outputs

Analog: Sine/Cosine differential
Digital: A-quad-B differential
Index: Index Window (analog and 5 µm digital only),1 LSB (digital 2.5 µm and above)
Right and Left Limits single-ended, open collector 24 V compliant
Alarm is single-ended open collector

Signal Levels

A/B/I (differential): RS-422 compatible
A/B/I (single-ended, no termination): High>4.2 V_{DC}, Low <0.2 V_{DC}
Sine/Cosine: 1 Vpp across 120 ohm termination, 2 Vpp no termination, Common mode voltage 2.0 V_{DC}
Alarm: Pull up to encoder supply voltage maximum
Limits: Pull up to 24 V maximum

Maximum Velocity (Digital)

Maximum Velocity (before Overspeed Buffer Protection[4]) vs. Interpolation Depth

Controller Recommended AqB Maximum State Rate (MegaStates/Sec)	Actual Encoder AqB Maximum State Rate (MegaStates/Sec)	5000	2500	1000	500	200	100	50	20	Resolution (nm)
		4	8	20	40	100	200	400	1000	Interpolation Depth
20	17.50	5000	5000	5000	5000	3500	1750	875	350	Maximum Velocity (mm/s)
10	8.75	5000	5000	5000	4375	1750	875	437	175	
5	4.38	5000	5000	4375	2187	875	437	218	87	
2	1.75	5000	4375	1750	875	350	175	87	35	
1	0.88	4375	2187	875	437	175	87	43	17	

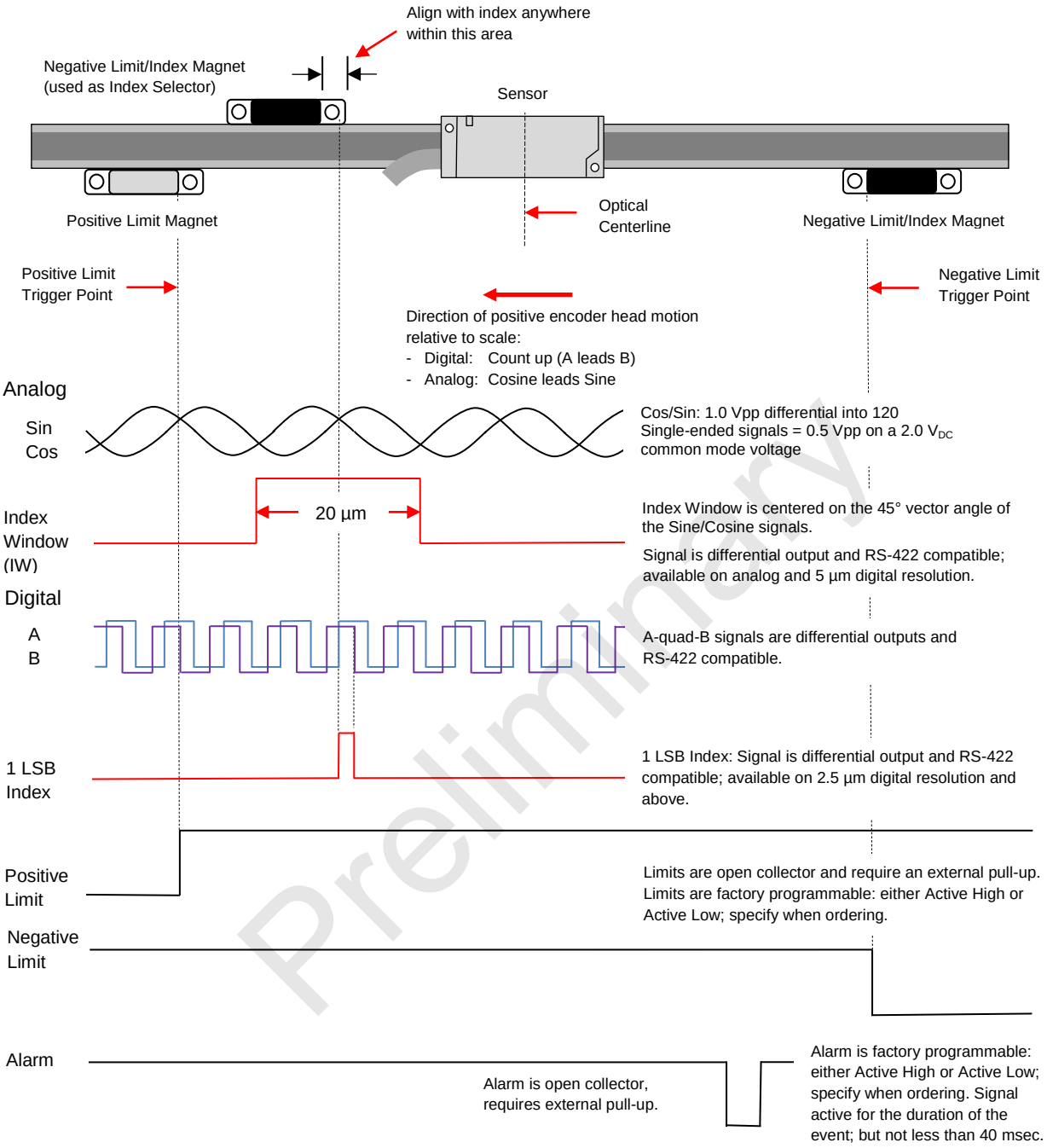
Notes[4]:

1. Veratus implements Overspeed Buffer Protection (OBP). No AqB counts are lost for velocities below 5830 mm/s even if the maximum specified state rate is exceeded.
2. The ALARM bit sets TRUE at 5.83 m/s, however, Veratus will continue to produce valid AqB outputs up to 7 m/s although accuracy specifications are no longer guaranteed.

Maximum Velocity (Analog)

Sine/Cosine Vector Magnitude: > 0.5 Vpp at 5 m/s

Output Signals



Contamination Resistance

With the new VeraPath™ technology, Celera Motion is able to offer the dirt immunity, reliability, and accuracy with metal tape scales required in advanced industrial applications where the encoder is operating in exposed environments. VeraPath filters out signal disturbances caused by scratches on scales and by typical variations of metal scale flatness and achieves high levels of accuracy with both metal scales and glass scales. This is especially beneficial when motion control systems require a precision optical encoder on a long linear stage or actuator where metal tape scales are the preferred solution.

For more details, see ***Tech Note TN-102 VeraPath™ Optical Encoder Technology***.

Features of VeraPath

Veratus Series Encoders utilize the following features of VeraPath to minimize the impact of scale contamination:

- LED light source
- Advanced filtering optics
- Large detector area
- State-of-the-art signal processing

Causes of Contamination

VeraPath minimizes optical scanning errors caused by contamination such as:

- Oil film
- Dust
- Water
- Fingerprints

Advanced Signal Processing

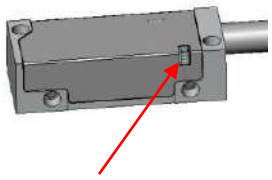
Sensor optics and internal control loops make a robust position detector capable of high contamination resistance. Veratus internal control loops generate corrections:

- Automatic Vector Magnitude Control (AVMC): adjusts Lissajous diameter to a constant 1 Vpp through debris and over time
- Automatic Offset Control (AOffC): adjusts Lissajous origin to 0.0 volts to minimize SDE error
- Automatic Gain Tracking Control (AGainTC): balances the amplitude of Sine/Cosine so that the Lissajous is round minimizing SDE error
- Automatic Common Mode Output Voltage Control (ACMOV): adjusts the common mode output voltage of Sine/Cosine to 2.0 V_{DC} independent of encoder alignment

Veratus Sensor

System Status LED

Veratus Series Encoders have a built-in Status LED that displays alignment quality, index/limits detection, and alarms.



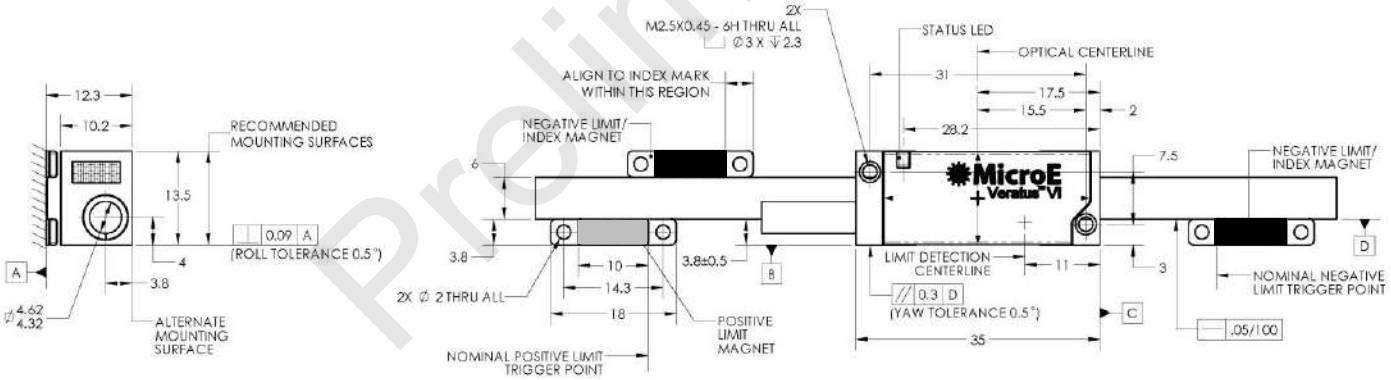
Status LED

LED Color	System Status
Green	Optimal alignment: Optimal position signal with minimum power consumption Encoder system meets specification.
Greenish -Yellow	Good alignment: Optimal position signal at specified power consumption Encoder system meets specification.
Orange	Alignment could be improved but fully operational: Sensor is reading position with marginal signal strength. Encoder system functions but vector magnitude may not be 1 Vpp and SDE may exceed specification.
Red	Sensor fault: Sensor is reading position with weak signal strength, or Power supply is less than 4.2 V, or Power supply is greater than 5.5 V, or Sensor moving faster than 5.8 m/s. Encoder system may not function properly. Alarm signal will be asserted.

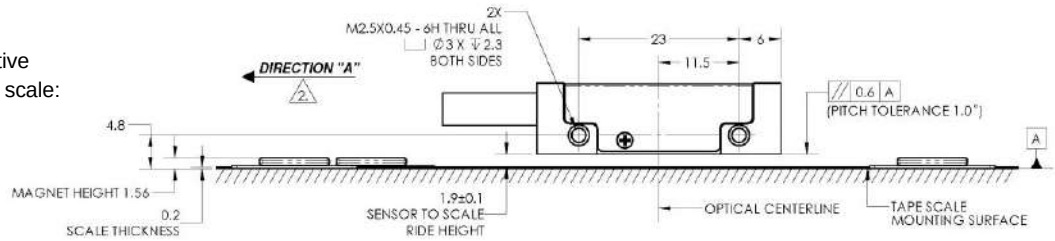
Indications for Index/Limits Detection

- Index: very bright at the index
- Positive Limit: flashes between normal and very bright at 4 Hz when passing over positive limit
- Negative Limit: flashes between normal and very bright at 2 Hz when passing over negative limit

Interface Drawing



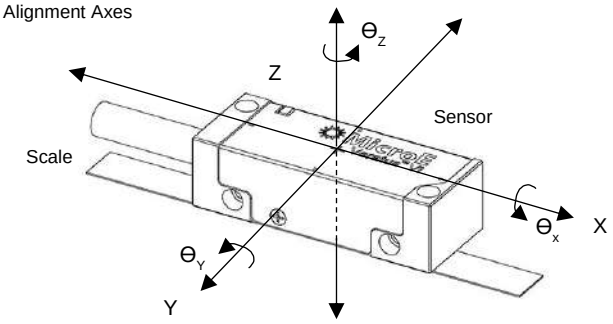
Direction "A": Direction of positive encoder head motion relative to scale:
- Digital: Count up (A leads B)
- Analog: Cosine leads Sine



Wide Alignment Tolerances

Veratus Series Encoders Sensor Alignment Tolerances	
Axis	**Alignment Tolerance**
X	Direction of Motion
Y	± 0.5 mm
Z	± 0.1 mm
θX	± 0.5°
θY	± 1.0°
θZ	± 0.5°

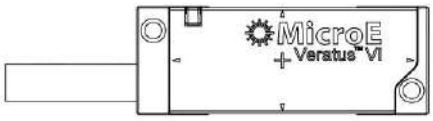
Alignment Axes



Sensor Mounting Options

There are two options for mounting the Veratus sensor:

- Top Mount



- Side Mount

Recommended Customer Required Parts

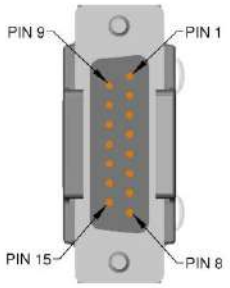
Use the following parts or equivalents to mount the Veratus sensor:

Item	Mounting Scheme
Mounting Screws (2)	Two tapped M2.5 holes on the side and two tapped M2.5 holes on top
Magnets	Two 0-80 or M1.6 pan head screws or adhesive backing (epoxy recommended for adhesive mounting)
Z-Height Shim Spacer	Disposable shim for installing sensor (included with sensor)
Applicator Tool	For tape scale installation; side mount

Z-Height Shim Spacer

Applicator Tool

Sensor Connector

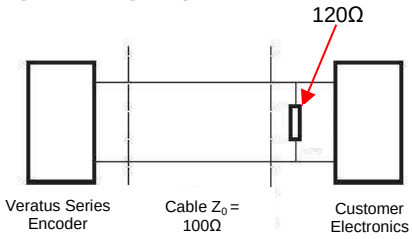


Pin Numbers	Signals	
	Digital	Analog
1	NC	Cos-
2	Com	Sin-
3	Alarm	Index+
4	Index-	5V
5	B-	5V_Sense
6	A-	Alarm
7	5V	Positive Limit
8	5V_Sense	Negative Limit
9	Com_Sense	Cos+
10	Negative Limit	Sin+
11	Positive Limit	Index-
12	Index+	Com
13	B+	Com_Sense
14	A+	NC
15	NC	NC

NC – No Connect

Recommended Signal Termination

Digital/Analog Outputs

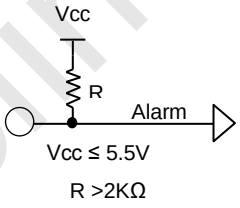


Note: Maximum cable length is 5 m; contact MicroE Applications Engineering if longer lengths are required.

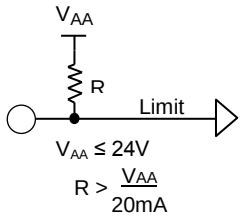
Alarm and Limit Outputs

Alarm and limit outputs are open collector circuits that are factory programmable: either active high or active low; specify when ordering. Each circuit requires an external pull-up resistor. See customer-supplied circuit examples below.

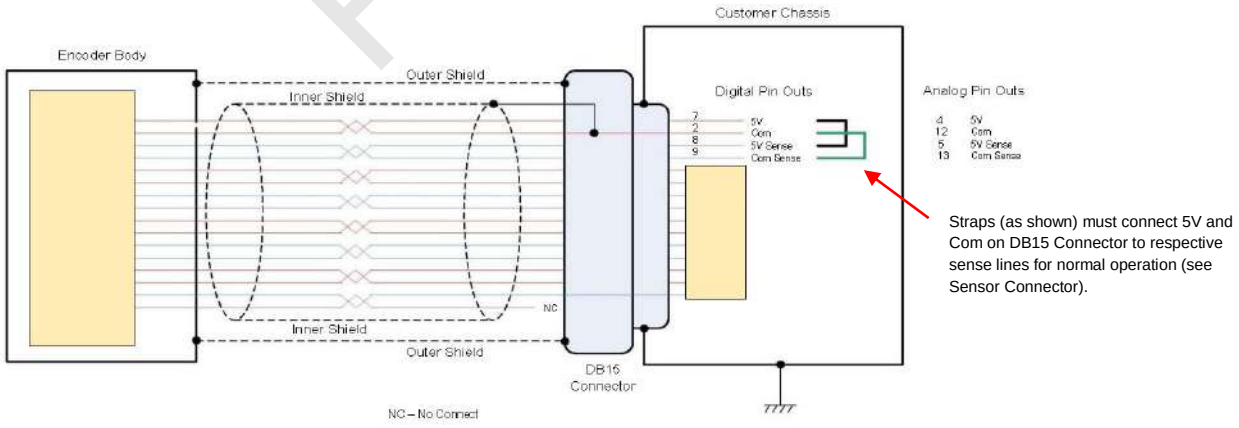
Alarm Output



Limit Output



Cable Shield Termination

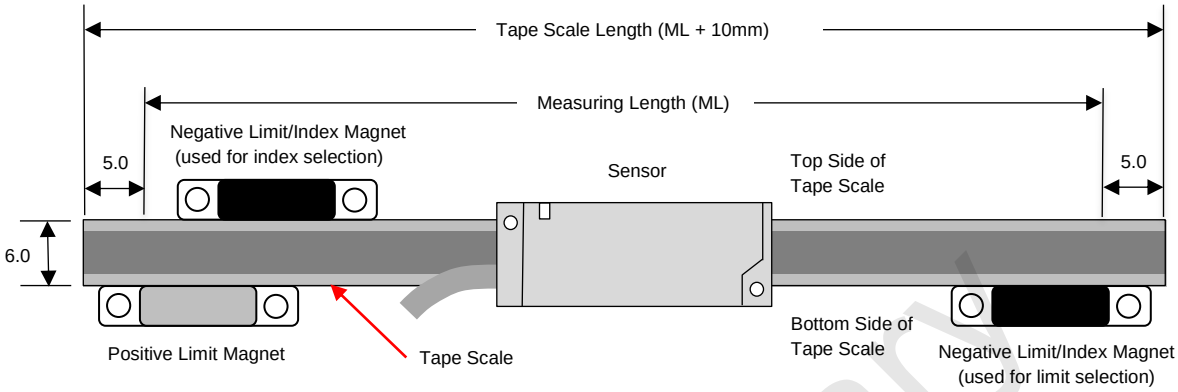


Note: For cable lengths greater than 5 m, use the 5 V sense lines to boost supply voltage to 5 V ±5% at sensor head

Veratus Tape Scales

Model: VILT

Veratus Linear Tape Scales are adhesive-backed metal tape scales, which are only 6mm wide and easily installed on virtually any surface with standard adhesive backing while achieving industry-leading price/performance. Veratus tape scales provide linearity of ≤ ± 3 µm (max/meter) and are easily cut to length in the field. Customer-specified lengths up to 20 m can be ordered.



Limits/Index Magnets

There are two magnet types that are used for limits and index selection:

- Negative Limit/Index Magnet
- Positive Limit Magnet

The Negative Limit/Index Magnet can serve as both the Negative Limit or as the Index Selector depending on location. For index selection, place the magnet on the **top side** of the tape scale. For assigning a negative limit, place the magnet on the **bottom side** of the tape scale. Magnet Size (mm) is 18 (l) x 3.75 (w) x 1.56 (h) with adhesive backing.

Standard index marks are located every 50mm. The index selection magnet is used to select a single index mark at the desired location. Magnets and scales have an adhesive backing for securing to surfaces and magnets can also be fastened using two mounting screws. Custom tape scales can be ordered with an optical index mark in any location.

Specifications

Linearity	≤ ± 3 µm (max/meter)
Material	Inconel 625
Typical CTE	12.8 ppm/°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 Veratus Series Encoders

- Use the Tape Scale Applicator Tool Model VILT-AT for scale lengths greater than 0.3 meters; side mount only.
- The Applicator Tool enables fast and accurate installation of long scale lengths, which ensures optimal encoder performance.

How to Order

Sensor

VIA-5000-AA1-20-05A (example)

- Cable Termination
  A=15-pin D-sub
- Cable Length
  05=0.5 m
  10=1.0 m
  15=1.5 m
  30=3.0 m
  50=5.0 m
- AquadB Output Rate
  20=20 MegaStates/second
  10=10 MegaStates
  05=5 MegaStates
  02=2 MegaStates
  01=1 MegaStates
  00=Analog 1 Vpp
- Index Selector
  1=Enabled (requires selector magnet to trigger index)
  0=Disabled (all indexes trigger signal)
- Limits
  A=Open Collector, Active High
  B=Open Collector, Active Low
- Alarm
  A=Open Collector, Active High
  B=Open Collector, Active Low
- Resolution
  5000=5 µm
  2500=2.5 µm
  1000=1 µm
  0500=0.5 µm
  0200=0.2 µm
  0100=0.1 µm
  0050=50 nm
  0020=20 nm
  0000=Analog 1 Vpp
- Sensor Type
  A=Standard
- Model
  VI = Veratus Incremental

Scales[1] - Veratus Tape Scale

VILT-05000I-A-A (example)

- Mounting
  A=Adhesive
- Index Mark
  A=Every 50 mm
  B=Center of measuring length
  C=Customer specified
  E=None
- Continuous or Individual
  C=Continuous lengths with cut marks
  I=Individual length (default selection for Index Mark types A & E)
- Measuring Length
  XXXXX=Length in mm
- Model
  VILT=Veratus Tape Scale, Standard

Accessories

VI-RM	Reference Marker Selector Magnet
VI-PL	Positive Limit Magnet
VI-NL	Negative Limit Magnet
VILT-AT	Tape Scale Applicator Tool (used for lengths >0.3 m)

Note[1]: Scales Availability: linear glass and rotary glass scales are available; contact MicroE for more details:
- Linear Glass Scales: Model VILG, lengths up to 130 mm
- Rotary Glass Scales: Model VIRG, diameters up to 130 mm