

# RESOLUTE™ ETR (Extended Temperature Range) absolute optical encoder system



**RESOLUTE™ ETR is a true-absolute fine-pitch optical rotary (angle) encoder system, with guaranteed operation down to  $-40\text{ }^{\circ}\text{C}$  ( $-40\text{ }^{\circ}\text{F}$ ).**

The RESOLUTE encoder system combines 18, 26 or 32 bit resolution with exceptionally high speeds of up to 18 000 rev/min (50 metres /second) and high accuracy stainless steel ring scales.

RESOLUTE encoder systems use a single optical absolute track with a nominal pitch of  $30\text{ }\mu\text{m}$ , combined with sophisticated optics. This ensures wide set-up tolerances, very low sub-divisional error and ultra-low noise (jitter), resulting in better velocity control performance and rock solid positional stability.

Operation down to  $-40\text{ }^{\circ}\text{C}$  ( $-40\text{ }^{\circ}\text{F}$ ) in non-condensing environments is guaranteed, making this product suitable for use in applications such as telescopes, scientific research, military and aerospace. The encoder is also tough enough to survive the physical punishment of harsh environments, with high vibration resistance and solid stainless steel ring scales.

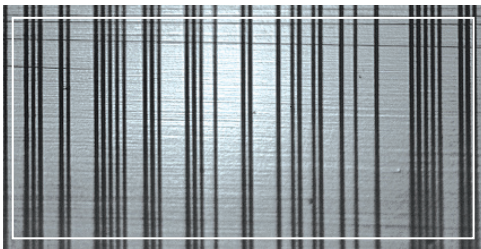
The RESOLUTE encoder system ensures reliability with excellent dirt immunity and a built-in separate position-checking algorithm, which actively checks every reading.

- True-absolute non-contact optical encoder system: no batteries required
- Operates down to  $-40\text{ }^{\circ}\text{C}$  ( $-40\text{ }^{\circ}\text{F}$ ) and up to  $+80\text{ }^{\circ}\text{C}$  ( $+176\text{ }^{\circ}\text{F}$ )
- Wide set-up tolerances for quick and easy installation
- High immunity to dirt, scratches and light oils
- Resolutions to 32 bit rotary
- 50 m/s maximum speed for all resolutions (up to 18 000 rev/min)
- $\pm 40\text{ nm}$  sub-divisional error for smooth velocity control
- Less than 10 nm RMS jitter for improved positional stability
- Built-in separate position-checking algorithm provides inherent safety
- High shock and vibration resistance
- IP64 sealed readhead for high reliability in harsh environments
- Integral set-up LED enables easy installation and provides diagnostics at a glance
- Integral over-temperature alarm
- BiSS® serial communications for high RFI immunity
- Optional Advanced Diagnostic Tool ADTa-100

## System features

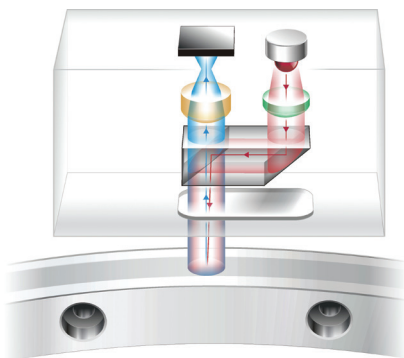
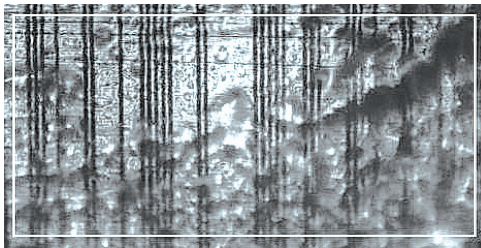
### Unique single-track absolute optical scale

- Absolute position is determined immediately upon switch-on
- No battery back-up
- No yaw de-phasing unlike multiple-track systems
- Fine pitch (30 µm nominal period) optical scale for superior motion control compared to inductive, magnetic or other non-contact optical absolute encoders
- High-accuracy graduations marked directly onto tough engineering materials for outstanding metrology and reliability



### High dirt immunity

- Advanced optics and embedded surplus code means the RESOLUTE encoder system even reads dirty scale
- Absolute position can be determined in all three cases shown here; clean scale (left), grease contamination (below-left), particle contamination (below)



### Unique detection method

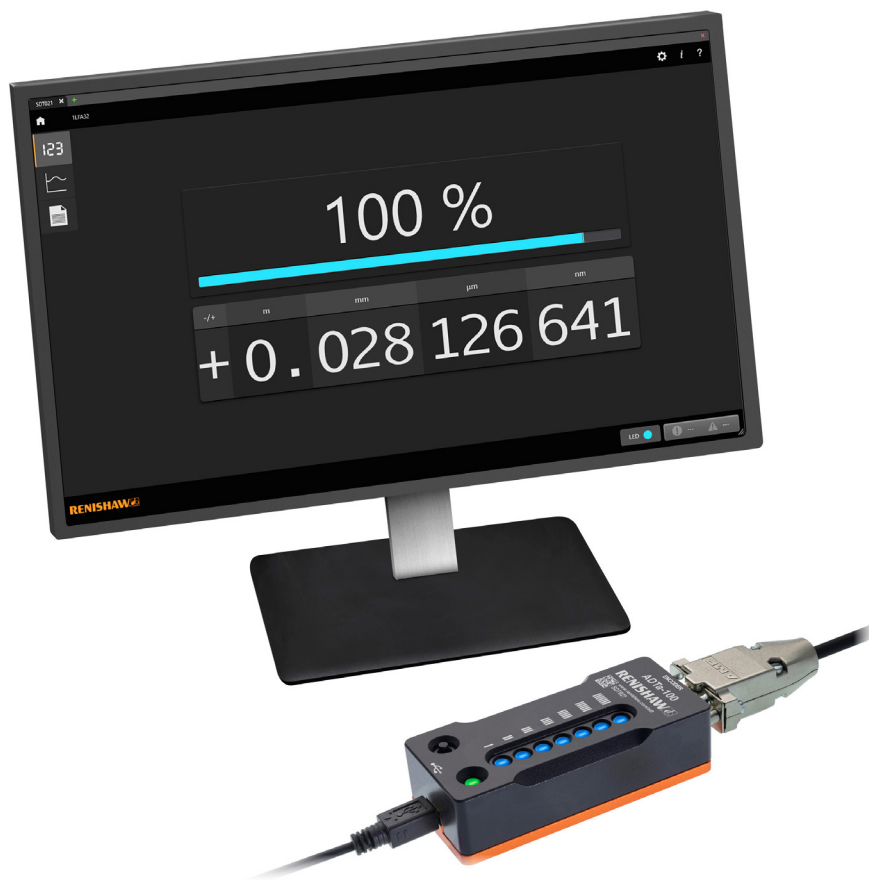
- Readhead acts like an ultra-fast miniature digital camera, taking photos of a coded scale
- Photos are analysed by a high-speed digital signal processor (DSP) to determine absolute position
- Built-in position-check algorithm constantly monitors calculations for ultimate safety and reliability
- Advanced optics and position determination algorithms are designed to provide low noise (jitter < 10 nm RMS) and low sub-divisional error (SDE ±40 nm)

## Optional Advanced Diagnostic Tool

The RESOLUTE encoder system is compatible with the Advanced Diagnostic Tool ADTa-100<sup>1</sup> and ADT View software, which acquire detailed real-time data from the readhead to allow easy set-up, optimisation and in-field fault finding.



The intuitive software interface provides:

- Digital readout of encoder position and signal strength
- Graph of signal strength over the entire axis travel
- Ability to set a new zero position for the encoder system
- System configuration information



<sup>1</sup> ADTa-100 compatible readheads are marked with the symbol **ADT**

## Compatible rotary scales

	<b>RESA30</b>	<b>REXA30</b>
	<b>303/304 stainless steel ring</b>	<b>Ultra-high accuracy 303/304 stainless steel ring</b>
		
<b>Accuracy (at 20 °C)</b>	±1.9 arc second (Typical installed accuracy for a 550 mm diameter ring) <sup>1</sup>	±1 arc second <sup>2</sup> (Total installed accuracy for ring diameters ≥ 100 mm)
<b>Ring diameters</b>	52 mm to 550 mm	52 mm to 417 mm
<b>Coefficient of thermal expansion (at 20 °C)</b>	15.5 ±0.5 µm/m/°C	15.5 ±0.5 µm/m/°C

<sup>1</sup> 'Typical' installations are a result of graduation and installation errors combining and, to some magnitude, cancelling.

<sup>2</sup> Accuracy when using two RESOLUTE readheads. For the accuracy value of ring diameters < 100 mm, see *REXA30 ultra-high accuracy absolute angle encoder* data sheet (Renishaw part no. L-9517-9405).

For more information about the rotary scales refer to the relevant absolute scale data sheet which can be downloaded from [www.renishaw.com/resolutedownloads](http://www.renishaw.com/resolutedownloads).

## Resolution

RESOLUTE ETR angle encoders are available with a variety of resolutions, to meet the needs of a wide range of applications.

All ring sizes are available for all resolutions.

Serial interface	Resolution	Counts per revolution	Arc second
BiSS-C (unidirectional)	18 bit	262 144	≈ 4.94
	26 bit	67 108 864	≈ 0.019
	32 bit	4 294 967 296	≈ 0.0003

**NOTE:** 32 bit resolution is below the noise floor of the RESOLUTE encoder.

## Speed and accuracy


The table below shows the maximum speed and typical installed accuracy for RESOLUTE ETR readheads with standard diameter RESA30 rings.

RESA30 diameter (mm)	Maximum reading speed (rev/min)	Typical installed accuracy <sup>1</sup> (arc second)
52	18 000	±12.7
57	18 000	±11.8
75	12 500	±9.5
100	9 500	±7.5
101	9 500	±7.5
103	9 250	±7.4
104	9 000	±7.3
115	8 250	±6.8
124	7 500	±6.3
150	6 000	±5.5
165	5 750	±7.0
172	5 500	±5.0
183	5 200	±4.7
200	4 750	±4.3
206	4 600	±4.2
209	4 500	±4.2
229	4 150	±3.9
255	3 700	±3.6
280	3 400	±3.4
300	3 150	±3.1
330	2 850	±2.9
350	2 700	±2.8
413	2 300	±2.4
417	2 250	±2.4
489	1 950	±2.1
550	1 700	±1.9

For REXA30 speed and accuracy figures, refer to the *REXA30 ultra-high accuracy absolute angle encoder* data sheet (Renishaw part no. L-9517-9405).

<sup>1</sup> 'Typical' installations are a result of graduation and installation errors combining and, to some magnitude, cancelling.

## General specifications

<b>Power supply</b>	5 V ±10% Ripple	1.25 W maximum (250 mA @ 5 V) <sup>1</sup> 200 mVpp maximum @ frequency up to 500 kHz maximum
<b>Temperature</b>	Storage Operating	-40 °C to +80 °C -40 °C to +80 °C
<b>Humidity</b>		95% relative humidity (non-condensing) to IEC 60068-2-78
<b>Sealing</b>		IP64
<b>Acceleration</b>	Operating (-40 °C to 0 °C) Operating (0 °C to +80 °C)	300 m/s <sup>2</sup> , 3 axes 500 m/s <sup>2</sup> , 3 axes
<b>Maximum acceleration of scale with respect to readhead</b> <sup>2</sup>		2000 m/s <sup>2</sup>
<b>Vibration</b>	Operating	Sinusoidal 300 m/s <sup>2</sup> , 55 Hz to 2000 Hz, 3 axes Random vibration 0.175 g <sup>2</sup> /Hz ASD 20 -1000 Hz, -6dB roll off 1-2 kHz, 3 axes
<b>Shock</b>	Non-operating	1000 m/s <sup>2</sup> , 6 ms, ½ sine, 3 axes
<b>Mass</b>	Readhead Readhead cable	18 g 32 g/m
<b>EMC compliance</b>		IEC 61800-5-2 Annex E
<b>Readhead cable</b> <sup>3</sup>		7 core, tinned and annealed copper, 28 AWG Single-shielded, outside diameter 4.7 ±0.2 mm Flex life > 40 × 10 <sup>6</sup> cycles at 20 mm bend radius UL recognised component 
<b>Maximum readhead cable length</b>		10 m
<b>Communication format</b>		RS485/RS422 differential line-driven signal

**CAUTION:** The RESOLUTE encoder system has been designed to the relevant EMC standards, but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is essential.

**NOTE:** If using RESA30 rings, the hub should be made of a material with a CTE of between 14 and 18 µm/m/°C. If using REXA30 rings, contact your local Renishaw representative. Further environmental testing has been carried out. Contact Renishaw if you have specific requirements.

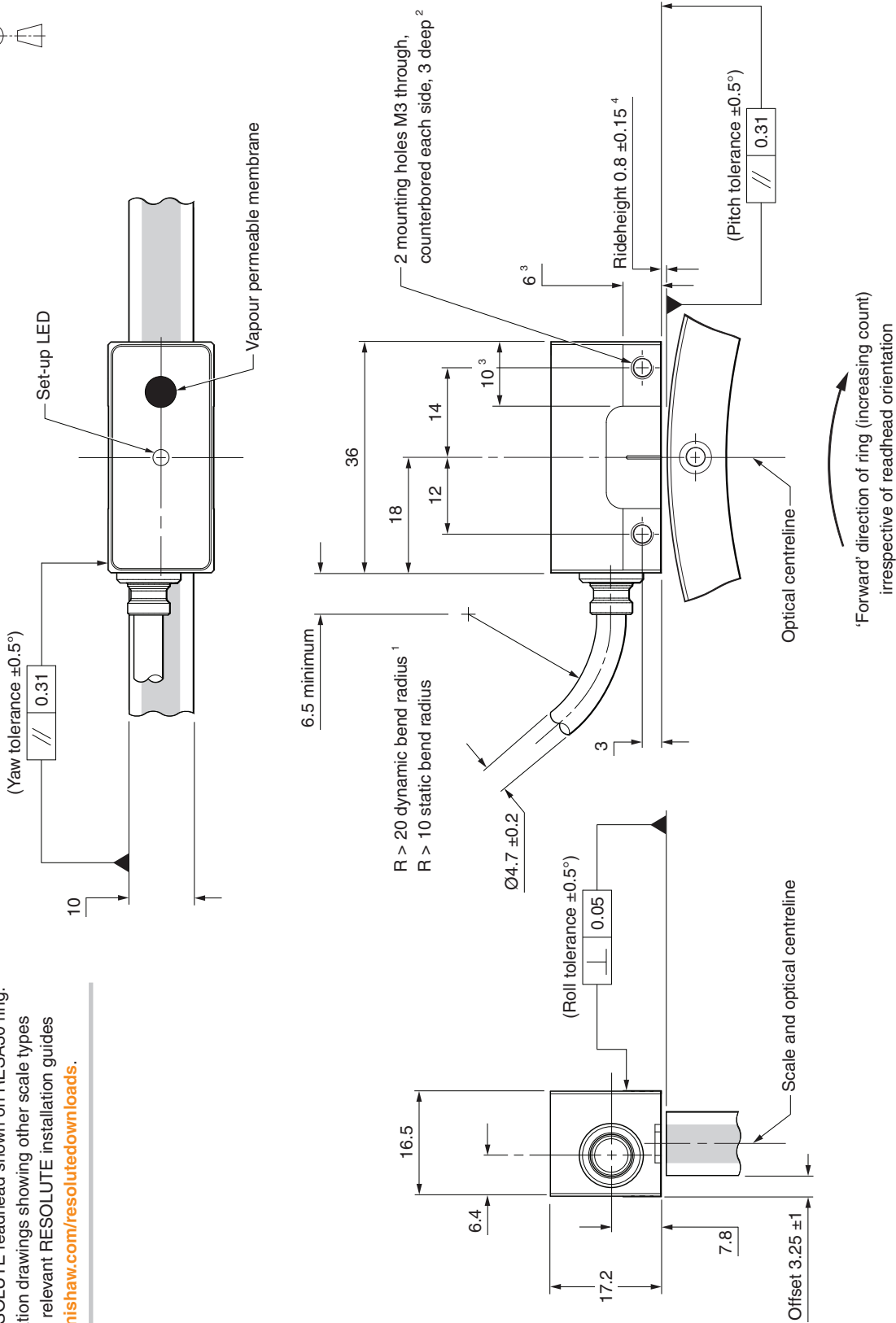
<sup>1</sup> Current consumption figures refer to terminated RESOLUTE systems. Renishaw encoder systems must be powered from a 5 Vdc supply complying with the requirements for SELV of standard IEC 60950-1.

<sup>2</sup> This is the worst case figure that is correct for the slowest communications clock rates. For faster clock rates, the maximum acceleration of scale with respect to the readhead can be higher. For more details, contact your local Renishaw representative.

<sup>3</sup> The readhead cable must be held static for operation below 0 °C.

# RESOLUTE ETR readhead installation drawing - standard cable outlet

Dimensions and tolerances in mm

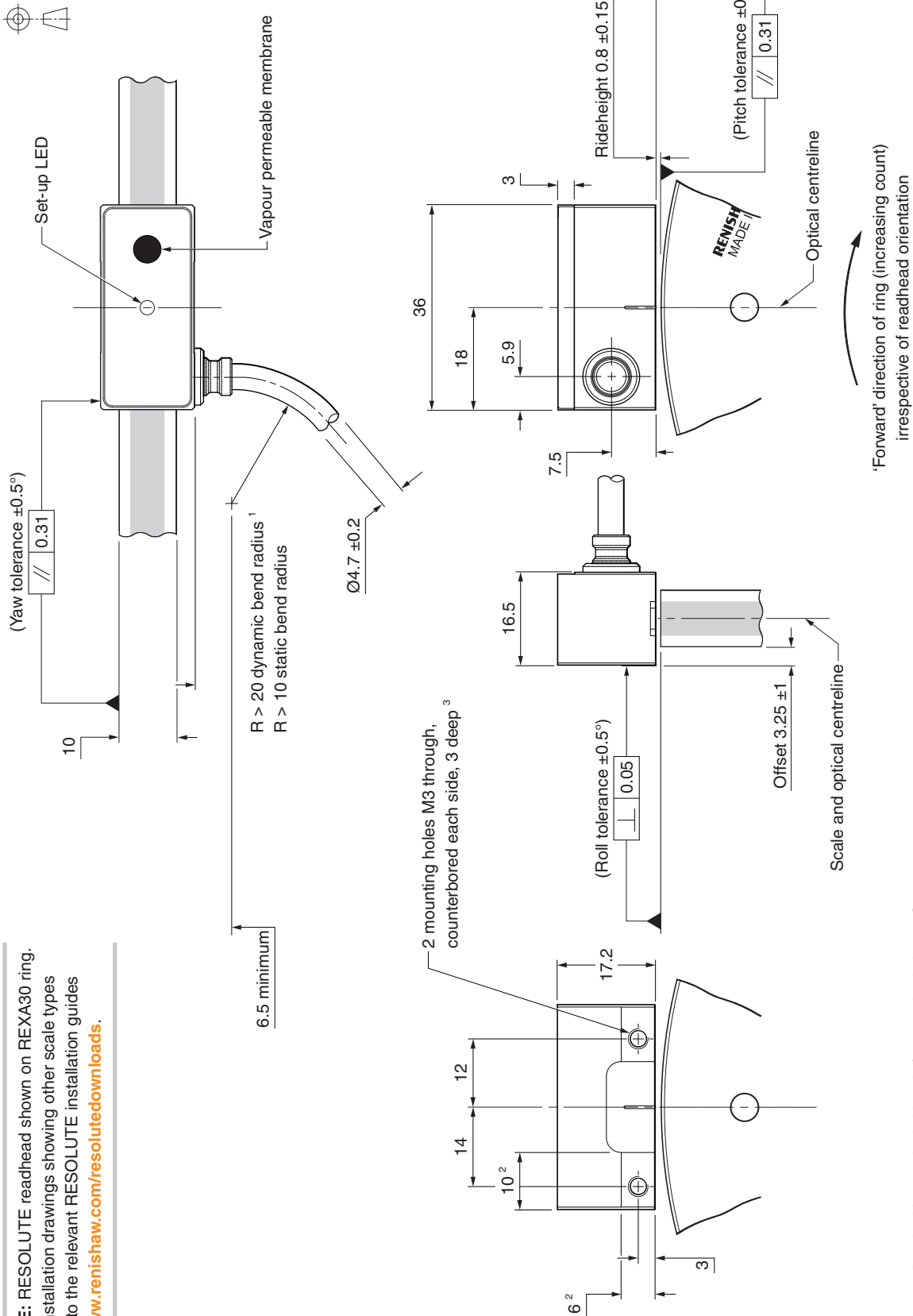


**NOTE:** RESOLUTE readhead shown on RESA30 ring. For installation drawings showing other scale types refer to the relevant RESOLUTE installation guides at [www.renishaw.com/resolutedownloads](http://www.renishaw.com/resolutedownloads).

- 1 The readhead cable must be held static for operation below 0 °C.
- 2 The recommended thread engagement is 5 mm minimum (8 mm including counterbore) and the recommended tightening torque is 0.5 Nm to 0.7 Nm.
- 3 Extent of mounting faces.
- 4  $0.8 \pm 0.1$  mm on 52 mm rings

# RESOLUTE ETR readhead installation drawing - side cable outlet

Dimensions and tolerances in mm



**NOTE:** RESOLUTE readhead shown on REXA30 ring. For installation drawings showing other scale types refer to the relevant RESOLUTE installation guides at [www.renishaw.com/resolutedownloads](http://www.renishaw.com/resolutedownloads).

<sup>1</sup> The readhead cable must be held static for operation below 0 °C.

<sup>2</sup> Extent of mounting faces.

<sup>3</sup> The recommended thread engagement is 5 mm minimum (8 mm including counterbore) and the recommended tightening torque is 0.5 Nm to 0.7 Nm.

<sup>4</sup>  $0.8 \pm 0.1$  mm on 52 mm rings



## RESOLUTE ETR readhead part numbers

**R A 26B T A 052 B 30 A**

**Series**

R = RESOLUTE

**Scale form**

A = Angular

**Serial interface**

18B = BiSS 18 bit

26B = BiSS 26 bit

32B = BiSS 32 bit

**Mechanical option**

T = Extended Temperature Range (standard cable outlet)

C = Extended Temperature Range (side cable outlet)

**Gain option**

A = Standard

**Ring diameter**

052 = 52 mm

150 = 150 mm

280 = 280 mm (RESA30 only)

057 = 57 mm

165 = 165 mm

300 = 300 mm

075 = 75 mm

172 = 172 mm

330 = 330 mm (RESA30 only)

100 = 100 mm

183 = 183 mm

350 = 350 mm

101 = 101 mm (RESA30 only)

200 = 200 mm

413 = 413 mm (RESA30 only)

103 = 103 mm

206 = 206 mm

417 = 417 mm

104 = 104 mm

209 = 209 mm

489 = 489 mm (RESA30 only)

115 = 115 mm

229 = 229 mm

550 = 550 mm (RESA30 only)

124 = 124 mm (RESA30 only)

255 = 255 mm

**Scale code option**

B = Standard scale code

**Cable length**

02 = 0.2 metres

15 = 1.5 metres

90 = 9.0 metres

05 = 0.5 metres

30 = 3.0 metres

99 = 10.0 metres

10 = 1.0 metres

50 = 5.0 metres

**Cable termination**

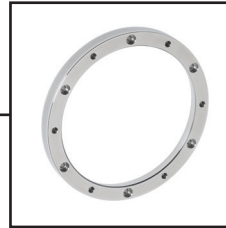
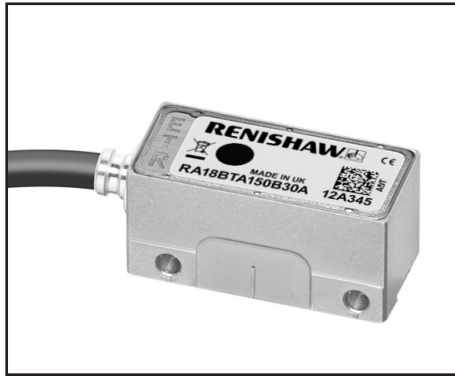
A = 9-way D-type connector

F = Flying lead (unterminated cable)

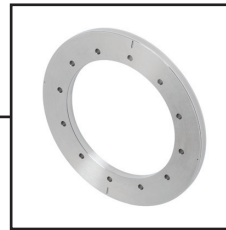
Valid system configurations (readheads and scale) can be checked at [www.renishaw.com/epc](http://www.renishaw.com/epc).

**NOTE:** Contact your local Renishaw representative if you have specific ETR requirements.

## RESOLUTE ETR series compatible products



RESA30 stainless steel ring



REXA30 high-accuracy stainless steel ring



Advanced Diagnostic Tool ADTa-100  
(A-6525-0100)

Compatible with RESOLUTE  
readheads showing the **ADT** mark.

For more information about the ADTa-100 and the scale, refer to the relevant data sheets and installation guides which can be downloaded from [www.renishaw.com/resolutedownloads](http://www.renishaw.com/resolutedownloads).

[www.renishaw.com/contact](http://www.renishaw.com/contact)



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Part no.: L-9517-9420-05-B

Issued: 04.2024