Data sheet
L-9517-9530-05-B

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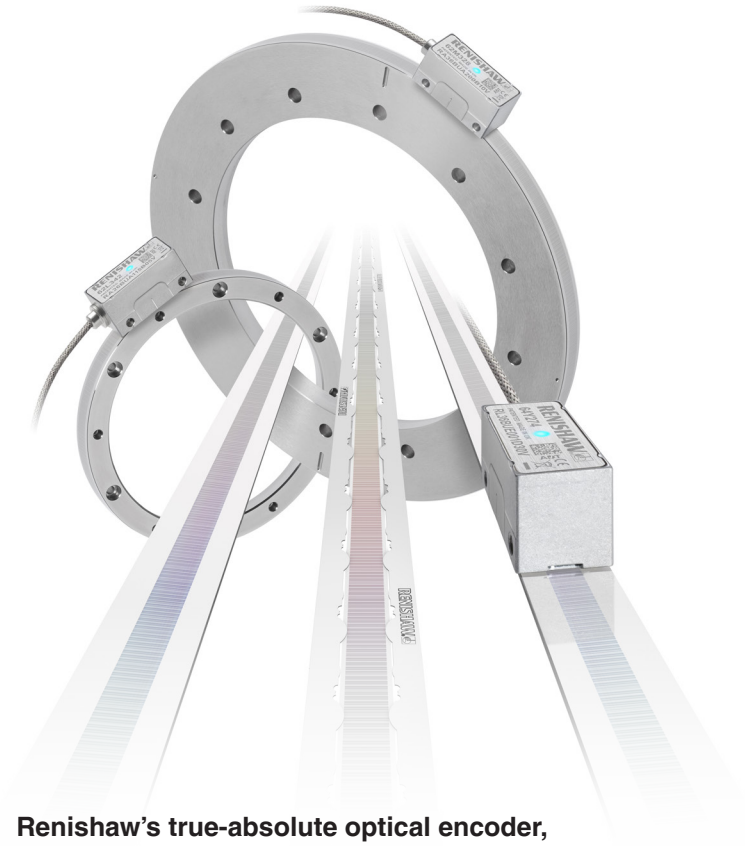
RESOLUTE™ UHV absolute optical encoder system



Renishaw's true-absolute optical encoder, RESOLUTE™, offers Ultra-High Vacuum compatibility in both linear and rotary (angle) encoder formats.

The RESOLUTE encoder determines position immediately upon switch-on, without the need for any movement or battery back-up. This means complete control of axes can be achieved immediately, thus eliminating risks of unchecked movements or collisions, a critical advantage in applications such as wafer handling where safe extraction of high-value products is essential after loss of power.

RESOLUTE encoders have inherently very low sub-divisional error (SDE), so the fidelity of feedback is improved. This has several benefits, including minimising velocity ripple, reducing vibration, increasing scanning performance and cutting the amount of heat generated in motors. The RESOLUTE system also has low positional noise (jitter) of less than 10 nm RMS, so positional stability is significantly improved. Resolutions are available to 1 nm (linear) or 32 bit (rotary), with a maximum speed up to 100 m/s.

RESOLUTE UHV encoders are available with a range of serial protocols for excellent noise immunity, including BiSS® C, Panasonic, and Siemens DRIVE-CLiQ.

- **Clean residual gas analysis (RGA)**
- **Low outgassing rate**
- **Bake-out temperature of 120 °C**
- **True-absolute non-contact optical encoder system: no batteries required**
- **Wide set-up tolerances for quick and easy installation**
- **Resolutions to 1 nm linear or 32 bit rotary**
- **Up to 100 m/s maximum speed (36 000 rev/min)**
- **±40 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**
- **Integral set-up LED enables easy installation and provides diagnostics at a glance**
- **Operates up to 75 °C**
- **Integral over-temperature alarm**
- **Compatible with a wide range of linear and rotary scales**
- **Optional Advanced Diagnostic Tool ADTa-100**

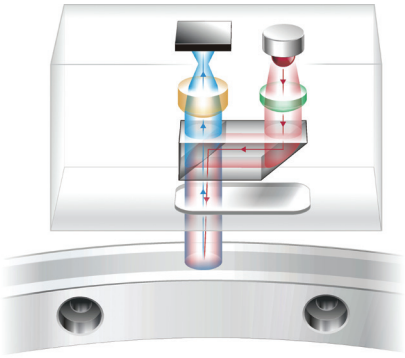
www.renishaw.com/resolutedownloads

#renishaw

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



Unique detection method

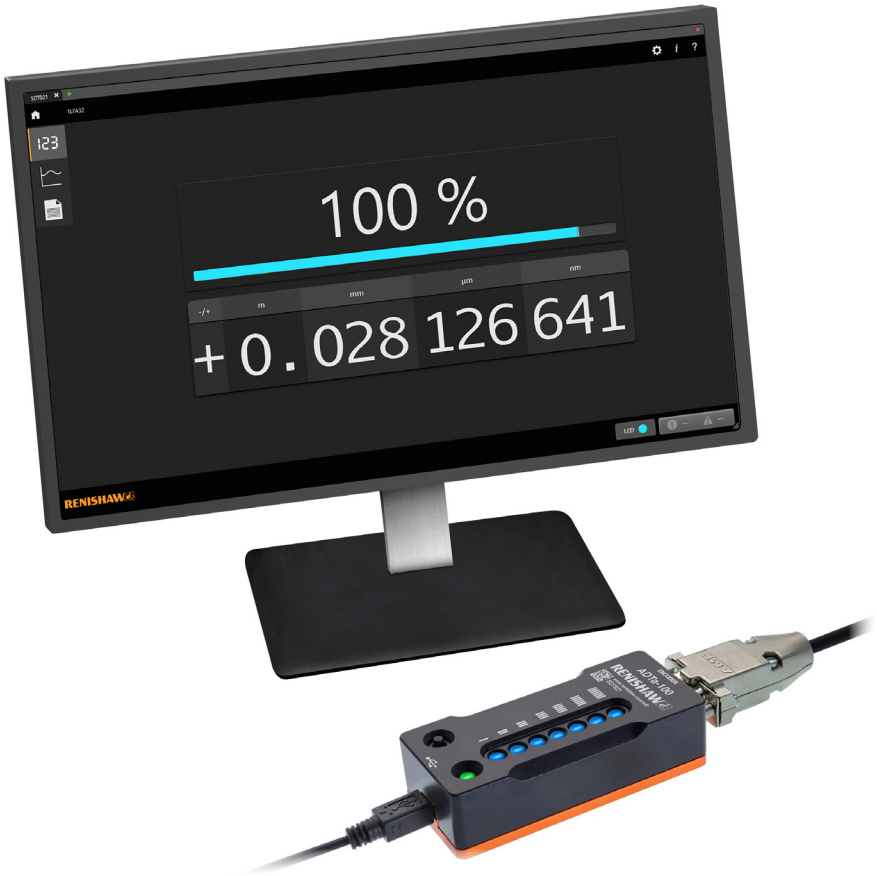
- Readhead acts like an ultra-fast miniature digital camera, taking photos of a coded scale
- Photos are analysed by a high-speed digital signal processor (DSP) to determine absolute position
- Built-in position-check algorithm constantly monitors calculations for ultimate safety and reliability
- Advanced 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 [1] 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:

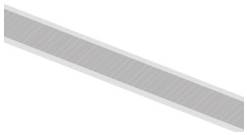
- Digital readout of encoder position and signal strength
- Graph of signal strength over the entire axis travel
- Ability to set a new zero position for the encoder system
- System configuration information



[1] ADTa-100 compatible readheads are marked with the symbol ADT

Compatible linear scales

	RTLA30-S [1]	RTLA30 (with FASTRACK™ carrier)
	Self-adhesive mounted stainless steel tape scale	Stainless steel tape scale and self-adhesive mounted carrier
		
Form (height × width)	0.4 mm × 8 mm including adhesive	RTLA30 scale: 0.2 mm × 8 mm FASTRACK carrier: 0.4 mm × 18 mm including adhesive
Accuracy (at 20 °C)	±5 µm/m	±5 µm/m
Maximum length [2]	21 m	RTLA30 lengths up to 21 m FASTRACK carrier lengths up to 25 m
Coefficient of thermal expansion (at 20 °C)	10.1 ±0.2 µm/m/°C	10.1 ±0.2 µm/m/°C

	RKLA30-S
	Self-adhesive mounted stainless steel tape scale
	
Form (height × width)	0.15 mm × 6 mm including adhesive
Accuracy (at 20 °C)	±5 µm/m
Maximum length [2]	21 m
Coefficient of thermal expansion (at 20 °C)	Matches that of substrate material when the scale ends are rigidly fixed [3]

	RELA30	RSLA30
	Self-adhesive or clip/clamp mounted low-expansion ZeroMet™ spar scale	Self-adhesive or clip/clamp mounted stainless steel spar scale
		
Form (height × width)	1.5 mm × 14.9 mm	1.6 mm × 14.9 mm
Accuracy (at 20 °C)	Up to 1 m : ±1 µm 1 m to 1.7 m : ±1 µm/m	Up to 1 m : ±1.5 µm 1 m to 2 m : ±2.25 µm 2 m to 3 m: ±3 µm 3 m to 5 m : ±4 µm
Maximum length [2]	1.7 m	5 m
Coefficient of thermal expansion (at 20 °C)	0.75 ±0.35 µm/m/°C	10.1 ±0.2 µm/m/°C

1 For RTLA30-S axis lengths > 2 m, the FASTRACK carrier with RTLA30 is recommended.

2 The maximum scale length may be limited for some serial interfaces and resolutions; refer to 'Resolution and scale lengths' on page 6 for details.

3 Scale mastering is not guaranteed after system bakeout.

For more information about the linear scales refer to the relevant absolute scale data sheet which can be downloaded from **www.renishaw.com/resolutedownloads**.

Compatible rotary scales

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

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

2 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**.

Linear encoder system

Resolution and scale lengths

The maximum scale length depends upon the serial interface, readhead resolution and the number of position bits.

The table below shows the maximum scale length for each system:

		Resolution			
Serial interfaces	**Position bits**	**1 nm**	**5 nm**	**50 nm**	**100 nm**
BiSS C (unidirectional)	26 bit	67 mm	336 mm	3.355 m	-
	32 bit	4.295 m	21 m	21 m	-
	36 bit	21 m	21 m	21 m	-
Panasonic	48 bit	21 m	-	21 m	21 m
Siemens DRIVE-CLiQ	28 bit	-	-	13.42 m	-
	34 bit	17.18 m	-	-	-

Speed

The table below shows the maximum speed for each system:

		Resolution			
Serial interfaces	**Position bits**	**1 nm**	**5 nm**	**50 nm**	**100 nm**
BiSS C (unidirectional)	26 bit	100 m/s	100 m/s	100 m/s	-
	32 bit	100 m/s	100 m/s	100 m/s	-
	36 bit	100 m/s	100 m/s	100 m/s	-
Panasonic	48 bit (when used with A5 series)	0.4 m/s	-	20 m/s	40 m/s
	48 bit (when used with A6 series)	4 m/s	-	100 m/s	100 m/s
Siemens DRIVE-CLiQ	28 bit	-	-	100 m/s	-
	34 bit	100 m/s	-	-	-

Angle encoder system

Resolution

RESOLUTE angle encoders are available with a variety of resolutions, dependent upon the serial interface being used.

All ring sizes are available for all serial interfaces and resolutions

Serial interfaces	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
Panasonic	23 bit	8 388 608	≈ 0.15
	32 bit	4 294 967 296	≈ 0.0003
Siemens DRIVE-CLiQ	26 bit	67 108 864	≈ 0.019
	29 bit	536 870 912	≈ 0.0024

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

Angle absolute encoder

Speed and accuracy

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

RESA30 diameter (mm)	Maximum reading speed (rev/min)		Typical installed accuracy [1] (arc second)
	BiSS C (unidirectional) and Siemens DRIVE-CLiQ	Panasonic	
52	36 000	7 200 [2]	±12.7
57	33 000	7 200 [2]	±11.8
75	25 000	7 200 [2]	±9.5
100	19 000	7 200 [2]	±7.5
101	19 000	7 200 [2]	±7.5
103	18 500	7 200 [2]	±7.4
104	18 000	7 200 [2]	±7.3
115	16 500	6 600	±6.8
124	15 000)	6 100	±6.3
150	12 000	5 000	±5.5
165	11 500	4 600	±7.0
172	11 000	4 400	±5.0
183	10 400	4 200	±4.7
200	9 500	3 800	±4.3
206	9 200	3 700	±4.2
209	9 000	3 600	±4.2
229	8 300	3 300	±3.9
255	7 400	2 900	±3.6
280	6 800	2 700	±3.4
300	6 300	2 500	±3.1
330	5 700	2 300	±2.9
350	5 400	2 100	±2.8
413	4 600	1 840	±2.4
417	4 500	1 800	±2.4
489	3 900	1 500	±2.1
550	3 400	1 300	±1.9

CAUTION: Very high speed motion axes require additional design consideration. For applications that will exceed 50% of the rated maximum reading speed of the ring, contact your local Renishaw representative.

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

[1] 'Typical' installations are a result of graduation and installation errors combining and, to some magnitude, cancelling.

[2] The maximum speed depends on the driver, motor and mechanical components. Contact Renishaw or Panasonic regarding the maximum speed.

General specifications - BiSS C (unidirectional) and Panasonic

		BiSS C (unidirectional) and Panasonic
Power supply	5 V ±10%	1.25 W maximum (250 mA @ 5 V) [1]
	Ripple	200 mVpp maximum @ frequency up to 500 kHz maximum
Temperature	Storage	0 °C to +80 °C
	Operating	0 °C to +75 °C
	Bake-out (non-operating)	+120 °C
Humidity		95% relative humidity (non-condensing) to IEC 60068-2-78
Sealing		IP30
Acceleration	Operating	500 m/s², 3 axes
Maximum acceleration of scale with respect to readhead [2]		2000 m/s²
Vibration	Operating	Sinusoidal 100 m/s², 55 Hz to 2000 Hz, 3 axes
Shock	Non-operating	1000 m/s², 6 ms, ½ sine, 3 axes
Mass	Readhead	19 g
	Readhead cable	19 g/m
EMC compliance (system)		IEC 61800-5-2 Annex E
Readhead cable	Mechanical option 'U'	Silver-coated copper braided single screen. FEP core insulation, over tin-plated copper wire.
	Mechanical option 'F'	Stainless steel cable braid.
Communication format - BiSS		RS485/RS422 differential line-driven signal
Compatible drivers - Panasonic		A5 family drivers (only compatible with RESOLUTE linear): A5, A5II, A5L, A5N, A5NL, A5BL. A6 family drivers (RESOLUTE rotary will be available for all A6 family drivers): A6SM, A6SL, A6NM, A6NL.

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.

[1] 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.

[2] 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.

General specifications - Siemens DRIVE-CLiQ

		Siemens DRIVE-CLiQ [1]
Power supply	5 V ±10%	Single readhead system: 3.05 W maximum (readhead: 1.25 W + single input interface: 1.8 W). Dual readhead system: 4.3 W maximum (2 × readheads: 1.25 W each + dual input interface: 1.8 W). 24 V power is provided by the DRIVE-CLiQ network.
	Ripple	200 mVpp maximum @ frequency up to 500 kHz maximum
Temperature	Storage	0 °C to +70 °C
	Operating	0 °C to +75 °C (readhead) 0 °C to +55 °C (interface)
	Bake-out (non-operating)	+120 °C [2]
Humidity		95% relative humidity (non-condensing) to IEC 60068-2-78
Sealing	Readhead	IP30
	Interface	IP67
Acceleration	Operating	500 m/s², 3 axes
Maximum acceleration of scale with respect to readhead [3]		2000 m/s²
Vibration	Operating	Sinusoidal 100 m/s², 55 Hz to 2000 Hz, 3 axes
Shock	Non-operating	1000 m/s², 6 ms, ½ sine, 3 axes
Mass	Readhead	19 g
	Readhead cable	19 g/m
	Interface	218 g
EMC compliance (system)		IEC 61800-5-2 Annex E
Readhead cable	Mechanical option 'U'	Silver-coated copper braided single screen. FEP core insulation, over tin-plated copper wire.
	Mechanical option 'F'	Stainless steel cable braid.

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.

1 RESOLUTE Siemens DRIVE-CLiQ readheads require the Siemens DRIVE-CLiQ interface to function correctly.

2 Excluding interface (not UHV compatible).

3 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.

RGA results

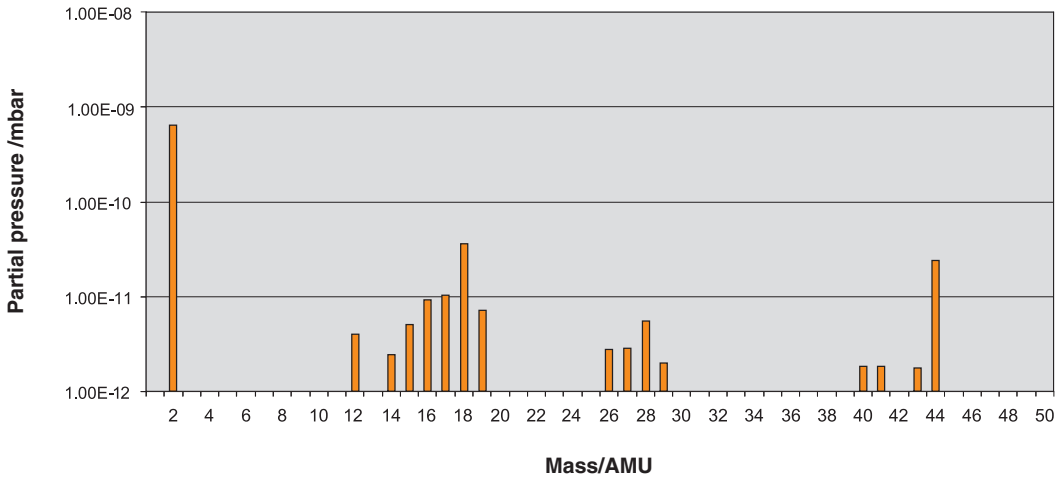
Test schedule

A quadrupole mass spectrometer (AccuQuad 200 RGA) was used to collect RGA data. Chamber pressure was measured with an Ion Gauge (G8130). After initial conditioning of the system, a background spectrum was recorded together with the total pressure in the test chamber.

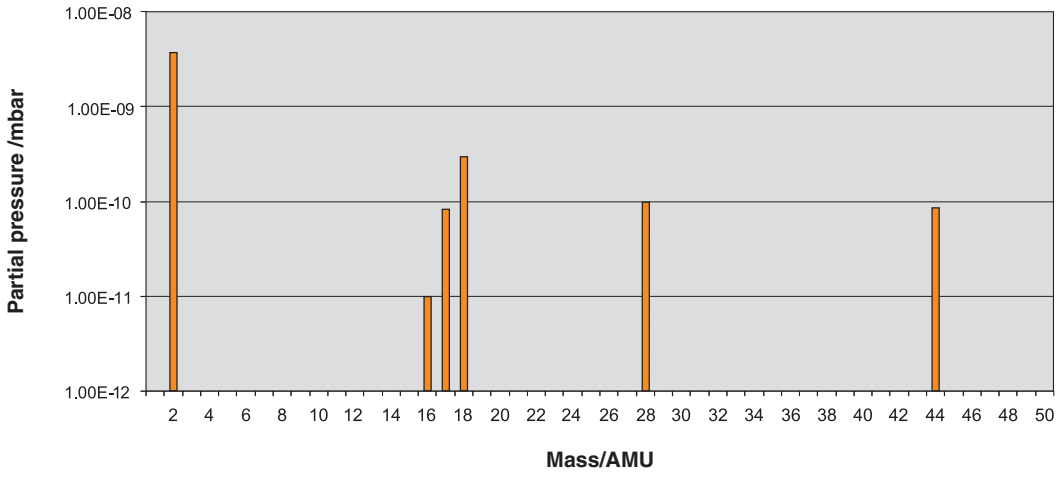
The component was placed in the vacuum system (0.0035 m^3) which was then pumped using an KJL Lion 802 (800/s) diode ion pump and a Divac diaphragm pump at ambient temperature for 24 hours, after which a background scan and the total pressure in the test chamber were recorded again. If the system pressure was better than 5×10^{-9} mbar, the test specimen was baked at 120 °C for 48 hours. The system was then allowed to cool to ambient temperature before a final mass spectrum and total pressure measurement were taken. The final RGA scans are shown below.

NOTE: Exact reproduction of these results should not be expected, as RGA data depends on the condition, specification and performance of the vacuum system. However, the RGA results shows no significant contamination attributable to RESOLUTE UHV encoders and that UHV conditions can be achieved in the presence of this product.

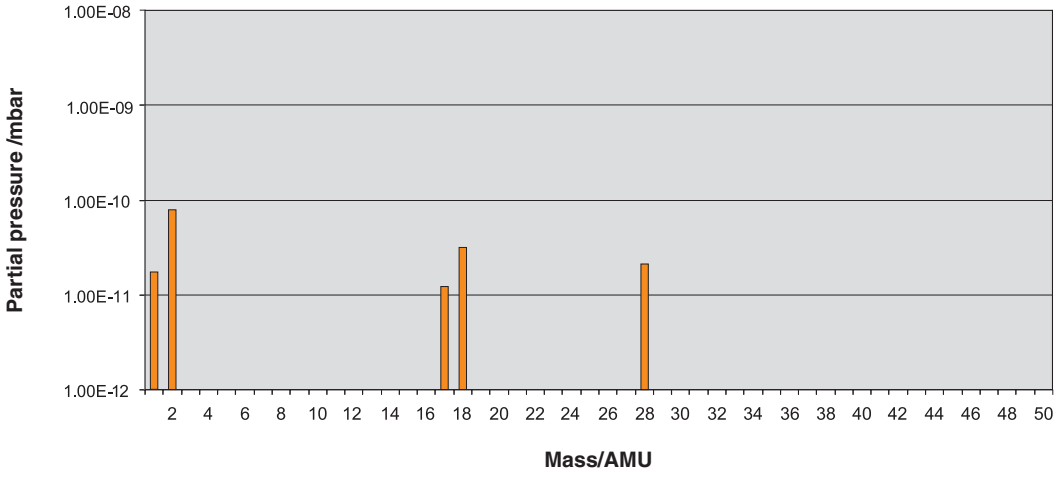
RESOLUTE UHV readhead with 1.0 m cable after bake-out (total pressure = 8×10^{-10} mbar)



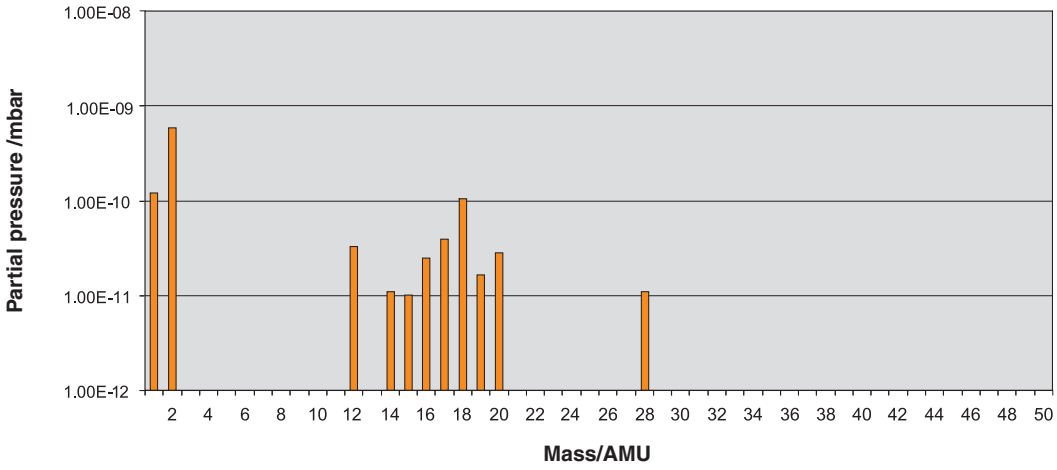
RSLA30 linear scale (180 mm length) with 2 clips and 1 clamp after bake-out (total pressure = 3.0×10^{-10} mbar)



RTLA30-S linear scale (300 mm length) after bake-out (total pressure = 1.69 × 10^{-10} mbar)

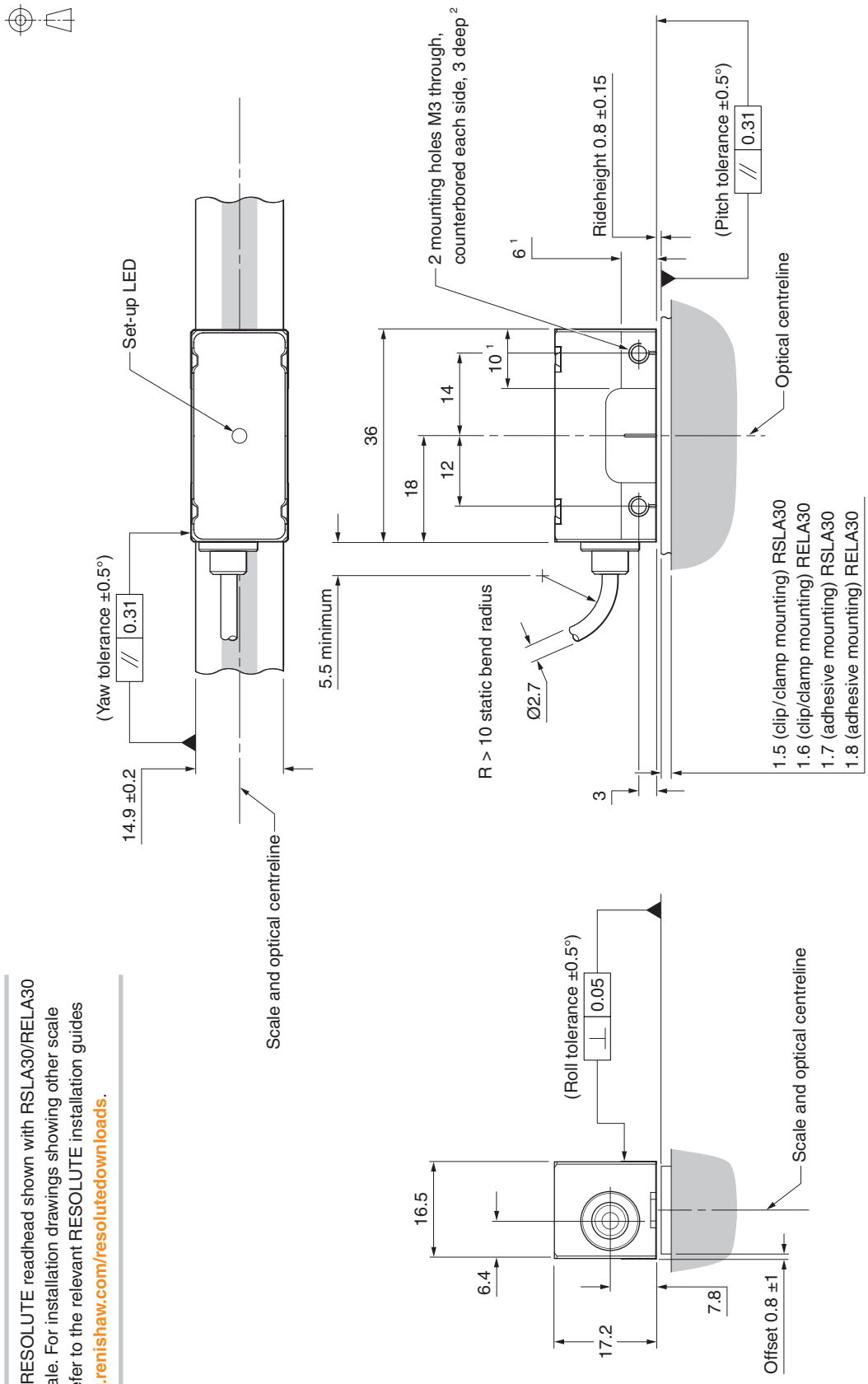


RESA30 (Ø115 mm) after bake-out (total pressure = 7.76 × 10^{-10} mbar)



RESOLUTE UHV readhead installation drawing

Dimensions and tolerances in mm



NOTE: RESOLUTE readhead shown with RSLA30/RELA30 spar scale. For installation drawings showing other scale types refer to the relevant RESOLUTE installation guides at www.renishaw.com/resolutedownloads.

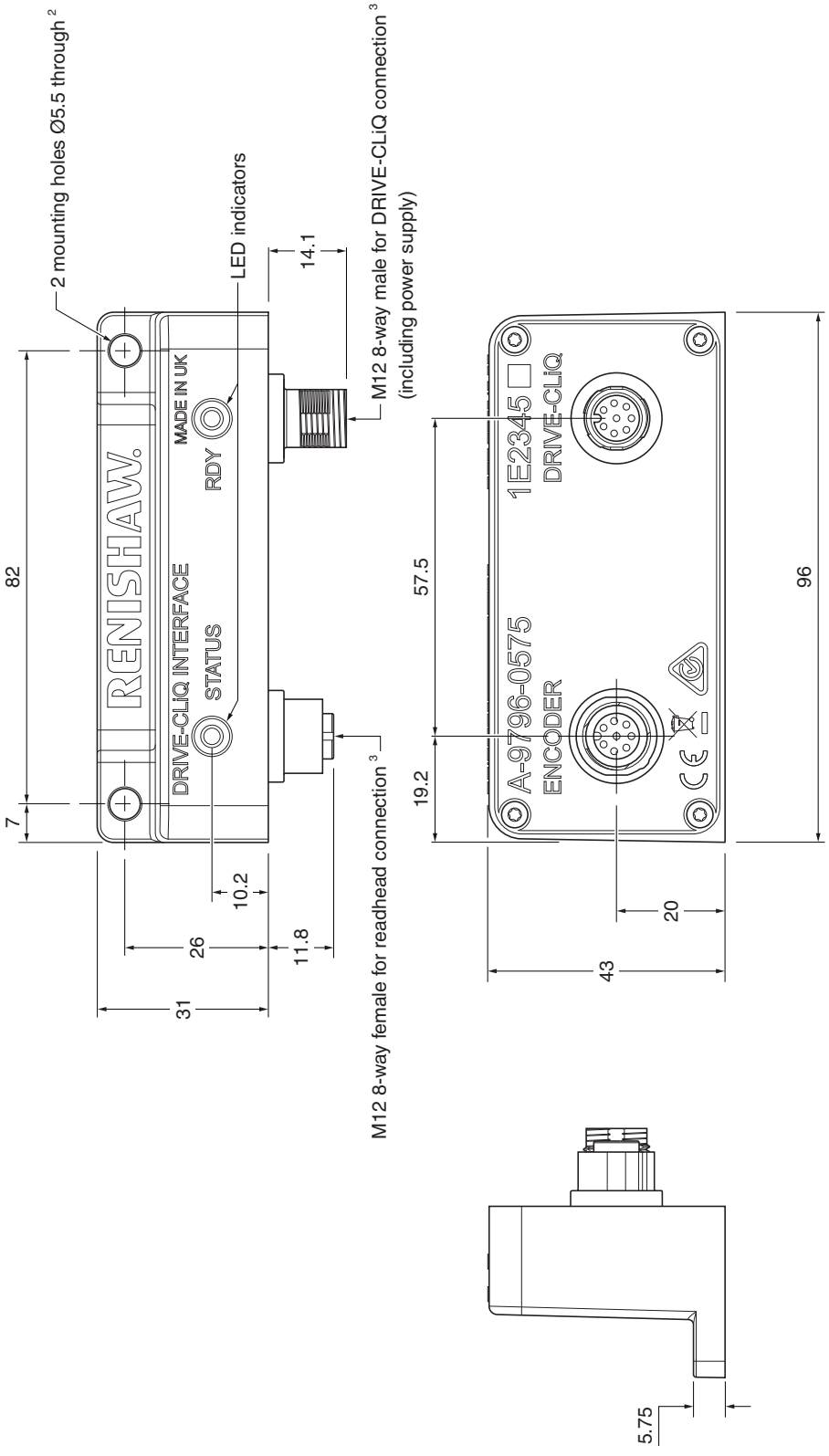
[1] Extent of mounting faces.

[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.

Siemens DRIVE-CLiQ interface drawing

Dimensions and tolerances in mm

Single readhead input (A-9796-0575) [1]



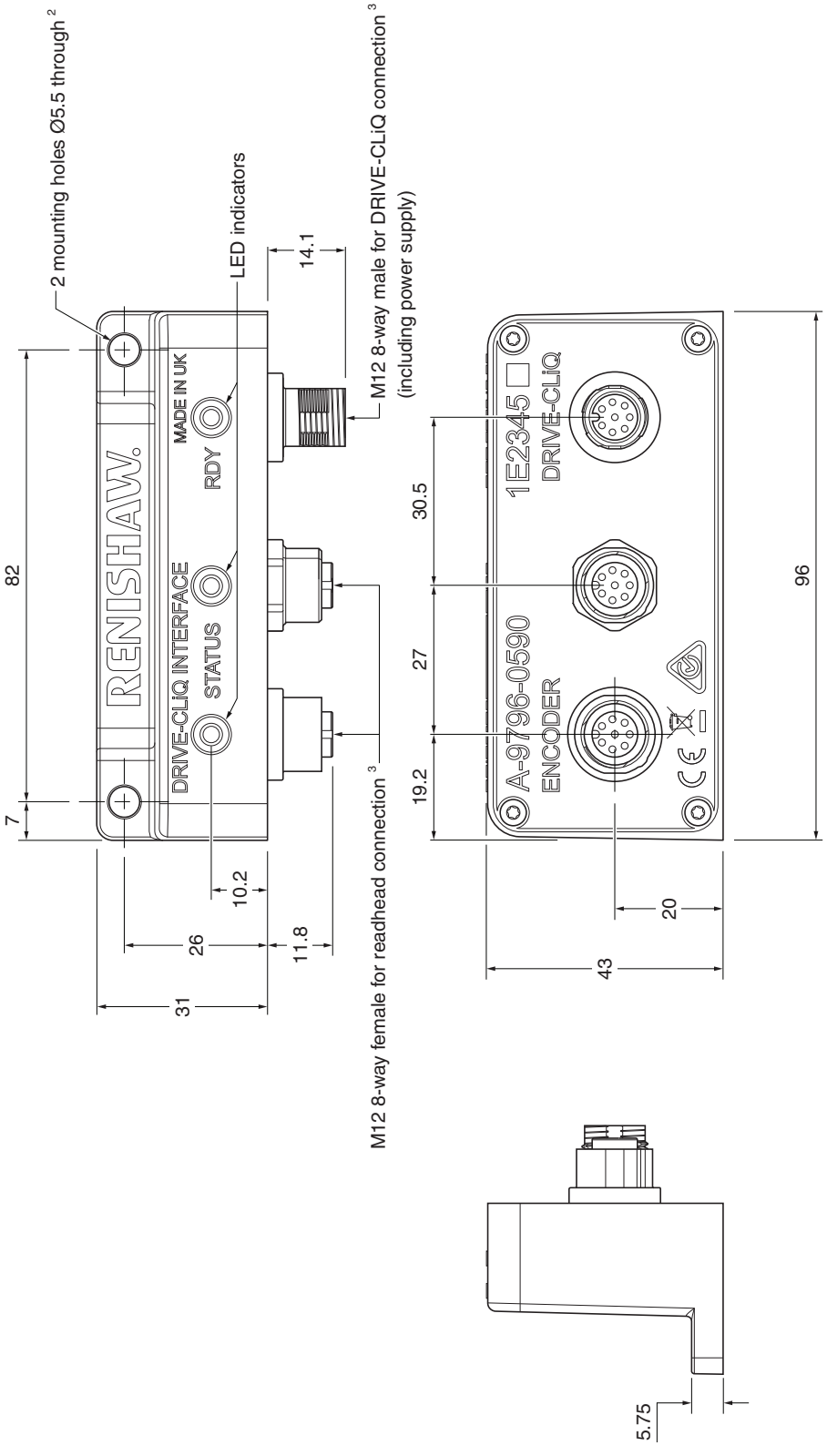
NOTE: RESOLUTE Siemens DRIVE-CLiQ readheads require the Siemens DRIVE-CLiQ interface to function correctly.

1 Siemens DRIVE-CLiQ interface is not UHV compatible.
2 Screw grade: ISO 4762-M5. Maximum tightening torque 4 Nm. Recommended thread engagement ≥ 5 mm.
3 Maximum tightening torque 4 Nm.

Siemens DRIVE-CLiQ interface drawing

Dimensions and tolerances in mm

Dual readhead input (A-9796-0590) [1]



NOTE: RESOLUTE Siemens DRIVE-CLiQ readheads require the Siemens DRIVE-CLiQ interface to function correctly.

1 Siemens DRIVE-CLiQ interface is not UHV compatible.
2 Screw grade: ISO 4762-M5. Maximum tightening torque 4 Nm. Recommended thread engagement ≥ 5 mm.
3 Maximum tightening torque 4 Nm.

RESOLUTE UHV linear readhead part numbers

R L 32B U S 001 C 30 V

Series

R = RESOLUTE

Scale form

L = Linear

Serial interface

26B = BiSS 26 bit (1 nm, 5 nm, or 50 nm resolution only)
32B = BiSS 32 bit (1 nm, 5 nm, or 50 nm resolution only)
36B = BiSS 36 bit (1 nm, 5 nm, or 50 nm resolution only)
48P = Panasonic 48 bit (1 nm, 50 nm, or 100 nm resolution only)
28D = Siemens DRIVE-CLiQ 28 bit (50 nm resolution only)
34D = Siemens DRIVE-CLiQ 34 bit (1 nm resolution only)

Mechanical option

U = Ultra High Vacuum (silver coated copper braid cable)
F = Ultra High Vacuum (stainless steel cable braid)

Gain option

T = RTLA30 / RTLA30-S / RKLA30-S scales (scale code option 'B' or 'E' only)
S = RSLA30 scale (scale code option 'C' only)
E = RELA30 scale (scale code option 'C' or 'D' only)

Resolution

001 = 1 nm
005 = 5 nm (BiSS only)
050 = 50 nm
100 = 100 nm (Panasonic only)

Scale code option [1]

B = RTLA30 / RTLA30-S / RKLA30-S (20 mm to 10 m scale length)
C = RSLA30 (20 mm to 5 m scale length) / RELA30 (> 1.13 m to 1.7 m scale length)
D = RELA30 (20 mm to 1.13 m scale length)
E = RTLA30 / RTLA30-S / RKLA30-S (> 10 m to 21 m scale length)

Cable length

02 = 0.2 metres
05 = 0.5 metres
10 = 1.0 metres
15 = 1.5 metres
30 = 3.0 metres
50 = 5.0 metres
90 = 9.0 metres
99 = 10.0 metres

Cable termination

V = Vacuum flying lead (unterminated cable)

Valid system configurations (readheads and scale) can be checked at **www.renishaw.com/epc**.

[1] The maximum scale length may be limited for some serial interfaces and resolutions; refer to 'Resolution and scale lengths' on page 6 for details.

RESOLUTE UHV rotary readhead part numbers

R A 32B U A 052 B 30 V

Series

R = RESOLUTE

Scale form

A = Angular

Serial interface

18B = BiSS 18 bit
26B = BiSS 26 bit
32B = BiSS 32 bit
23P = Panasonic 23 bit
32P = Panasonic 32 bit
26D = Siemens DRIVE-CLiQ 26 bit
29D = Siemens DRIVE-CLiQ 29 bit

Mechanical option

U = Ultra High Vacuum (silver coated copper braid cable)
F = Ultra High Vacuum (stainless steel cable braid)

Gain option

A = Standard

Ring diameter

052 = 52 mm
057 = 57 mm
075 = 75 mm
100 = 100 mm
101 = 101 mm (RESA30 only)
103 = 103 mm
104 = 104 mm
115 = 115 mm
124 = 124 mm (RESA30 only)
150 = 150 mm
165 = 165 mm
172 = 172 mm
183 = 183 mm
200 = 200 mm
206 = 206 mm
209 = 209 mm
229 = 229 mm
255 = 255 mm
280 = 280 mm (RESA30 only)
300 = 300 mm
330 = 330 mm (RESA30 only)
350 = 350 mm
413 = 413 mm (RESA30 only)
417 = 417 mm
489 = 489 mm (RESA30 only)
550 = 550 mm (RESA30 only)

Scale code option

B = Standard scale code

Cable length

02 = 0.2 metres
05 = 0.5 metres
10 = 1.0 metres
15 = 1.5 metres
30 = 3.0 metres
50 = 5.0 metres
90 = 9.0 metres
99 = 10.0 metres

Cable termination

V = Vacuum flying lead (unterminated cable)

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

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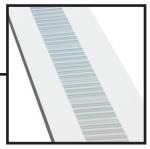
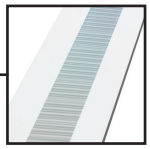
RESOLUTE series compatible products

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

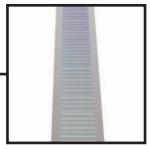
Compatible with RESOLUTE
readheads showing the ADT mark.



RELA30 self-adhesive or
clip/clamp mounted ZeroMet™
spar scale

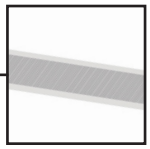


RSLA30 self-adhesive
or clip/clamp mounted
stainless steel spar scale

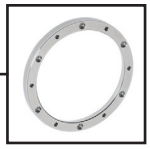


RTLA30-S self-adhesive
tape scale

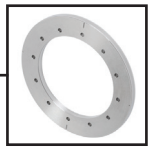
RTLA30 tape scale
and FASTRACK carrier



RKLA30-S self-adhesive
mastered tape scale



RESA30 stainless steel ring



REXA30 high-accuracy
stainless steel ring

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.

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