

RESOLUTE™ Functional Safety absolute optical encoder system



RESOLUTE™ Functional Safety (FS) is a true-absolute fine-pitch optical encoder system offering an impressive specification that is certified to Functional Safety standards.

Patented RESOLUTE encoder technology combines 1 nm resolution with exceptionally high speed, reading from a range of high-accuracy linear tape and spar scales or angle encoder rings.

RESOLUTE encoder systems use a single optical absolute track with a nominal pitch of 30 µm, 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.

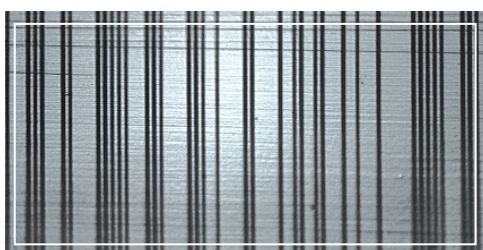
RESOLUTE FS encoders are for use in Functional Safety applications being certified to ISO 13849 Category 3 PLd, IEC 61508 SIL2 and IEC 61800-5-2 SIL2.

- True-absolute non-contact optical encoder system: no batteries required
- ISO 13849 Category 3 PLd
- IEC 61508 SIL2
- IEC 61800-5-2 SIL2
- Wide set-up tolerances for quick and easy installation
- Resolutions to 1 nm linear or 32 bit rotary
- IP64 sealed readhead for high reliability in harsh environments
- Integral set-up LED enables easy installation and provides diagnostics at a glance
- Operates up to 80 °C with an integral over-temperature alarm
- Ultra-High Vacuum (UHV) option available
- Extended Temperature Range (ETR) option available for angular systems with BiSS safety enables operation down to -40 °C
- Compatible with a wide range of linear and rotary scales
- Available with BiSS Safety and Siemens DRIVE-CLiQ serial interfaces

System features

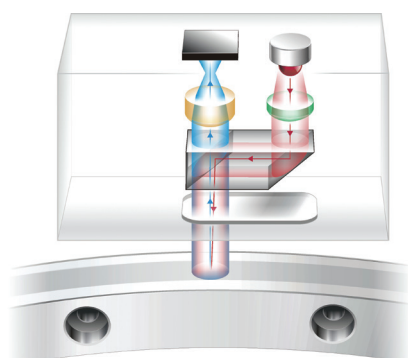
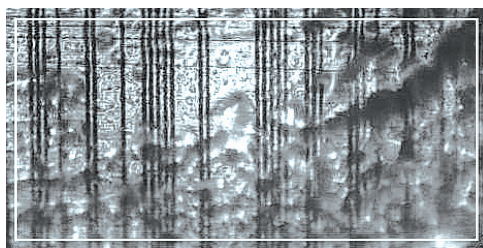
Unique single-track absolute optical scale

- 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

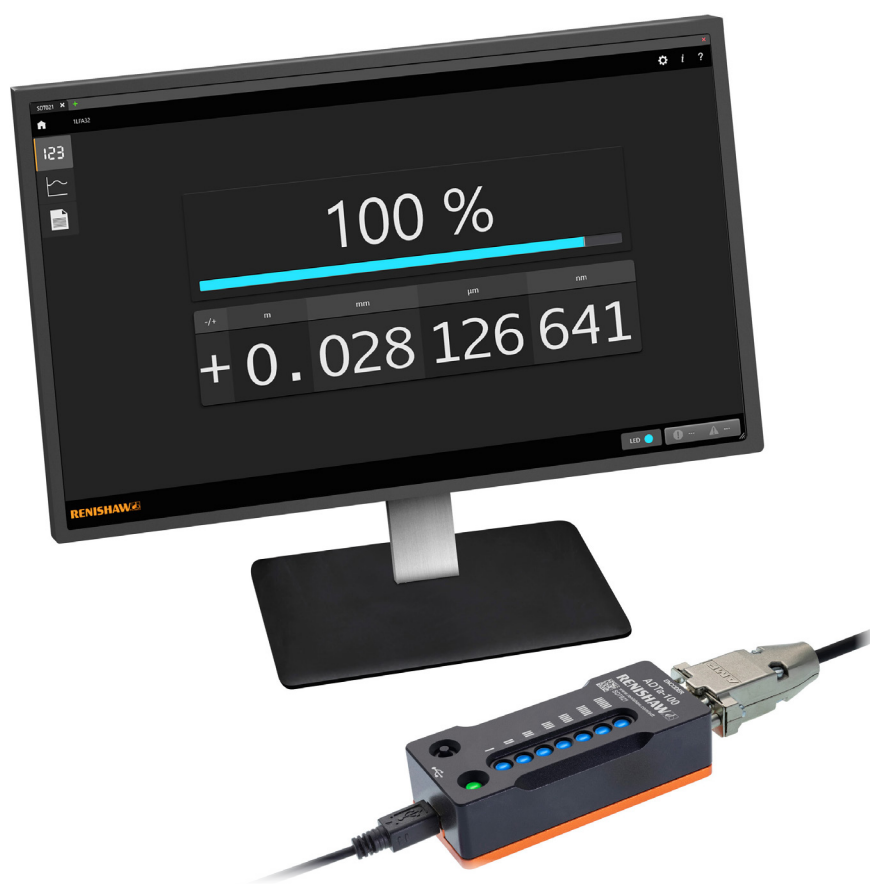
- Readhead acts like an ultra-fast miniature digital camera, taking photos of a coded scale
- Photos are analysed by a high-speed digital signal processor (DSP) to determine absolute position
- Built-in position-check algorithm constantly monitors calculations for ultimate safety and reliability
- Advanced 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-100¹ 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
- System configuration information



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

Compatible linear scales

	RTLA30-S ¹ Self-adhesive mounted stainless steel tape scale	RTLA30 (with FASTRACK™ carrier) 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

	RELA30 Self-adhesive mounted low-expansion ZeroMet™ spar scale	RSLA30 Self-adhesive mounted stainless steel spar scale
		
Form (height × width)	1.6 mm × 14.9 mm	1.5 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

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

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 'Linear encoder system' on page 6 for details.

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

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

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).

Linear encoder system

Scale lengths and speed

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

The table shows the maximum scale length and speed for each system:

Serial interfaces	Position bits	Resolution		Maximum reading speed
		1 nm	50 nm	
BiSS Safety	28 bit	-	13.42 m	100 m/s
	36 bit	21 m	-	
Siemens DRIVE-CLiQ	28 bit	-	13.42 m	100 m/s
	34 bit	17.18 m	-	

Angle encoder system

Resolution

RESOLUTE 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 Safety	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.

Accuracy

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

RESA30 diameter (mm)	Typical installed accuracy ¹ (arc second)	RESA30 diameter (mm)	Typical installed accuracy ¹ (arc second)
52	±12.7	200	±4.3
57	±11.8	206	±4.2
75	±9.5	209	±4.2
100	±7.5	229	±3.9
101	±7.5	255	±3.6
103	±7.4	280	±3.4
104	±7.3	300	±3.1
115	±6.8	330	±2.9
124	±6.3	350	±2.8
150	±5.5	413	±2.4
165	±7.0	417	±2.4
172	±5.0	489	±2.1
183	±4.7	550	±1.9

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

Speed

The maximum speed of the RESOLUTE FS encoder system depends on the mounting method and the scale type.

For further information, refer to the *RESOLUTE™ Functional Safety installation guide and safety manual BiSS Safety encoder system* (Renishaw part no. M-9755-9109) or the *RESOLUTE™ Functional Safety installation guide and safety manual Siemens DRIVE-CLiQ encoder system* (Renishaw part no. M-9796-9134). These documents are available at www.renishaw.com/fsencoders.

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

General specifications - standard FS readheads

		BiSS Safety	Siemens DRIVE-CLiQ ¹
Power supply		5 V ±10% 1.25 W maximum (250 mA @ 5 V) ² Ripple: 200 mVpp maximum @ frequency up to 500 kHz maximum	Voltage and current 4.3 W maximum 24 V power is provided by the DRIVE-CLiQ network
Readhead over voltage protection		–12 V to +20 V	–12 V to +20 V
Interface over voltage protection		N/A	–36 V to +36 V
Temperature	Storage (system)	–20 °C to +80 °C	–20 °C to +70 °C
	Installation (system)	+20 °C ±5 °C	+20 °C ±5 °C
	Operating (readhead)	0 °C to +80 °C	0 °C to +80 °C
	Operating (interface)	N/A	0 °C to +55 °C
Humidity		95% relative humidity (non-condensing) to IEC 60068-2-78	
Sealing	Readhead	IP64	IP64
	Interface	N/A	IP67 ³
Environmental protection		Protection class III Pollution degree II Altitude 2000 m	
Acceleration	Operating (readhead)	500 m/s ² , 3 axes	
Maximum acceleration of scale with respect to readhead ⁴		2000 m/s ²	
Vibration	Operating (readhead)	Sinusoidal 300 m/s ² , 55 Hz to 2000 Hz, 3 axes	Sinusoidal 300 m/s ² , 55 Hz to 2000 Hz, 3 axes
	Operating (interface)	N/A	Sinusoidal 100 m/s ² , 55 Hz to 2000 Hz, 3 axes
Shock	Non-operating	1000 m/s ² , 6 ms, ½ sine, 3 axes	
Mass	Readhead	18 g	18 g
	Readhead cable	32 g/m	32 g/m
	Interface	N/A	218 g
EMC compliance		IEC 61800-5-2 Annex E	
Readhead cable		7 core, tinned and annealed copper, 28 AWG Single-shielded, outside diameter 4.7 ±0.2 mm Flex life > 40 × 10 ⁶ cycles at 20 mm bend radius UL recognised component 	
Maximum readhead cable length		10 m	10 m (to controller or interface) (refer to manufacturer specifications for maximum cable length from interface to controller)

CAUTION: The RESOLUTE encoder system has been designed to meet the requirements of IEC 61800-5-2: Annex E second environment, 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 Current consumption figures refer to a terminated RESOLUTE BiSS Safety system. BiSS Safety encoder systems must be powered from a 5 Vdc supply complying with the requirements for PELV of standard IEC 60950-1.

³ If the original termination is altered by the user or an extension cable is used, it is the responsibility of the system manufacturer to ensure the IP rating of the interface connection meets their requirements.

⁴ 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 - FS UHV readheads

		BiSS Safety	Siemens DRIVE-CLiQ ¹
Power supply		5 V $\pm$ 10% 1.25 W maximum (250 mA @ 5 V) ² Ripple: 200 mVpp maximum @ frequency up to 500 kHz maximum	Voltage and current 4.3 W maximum 24 V power is provided by the DRIVE-CLiQ network
Readhead over voltage protection		-12 V to +20 V	-12 V to +20 V
Interface over voltage protection		N/A	-36 V to +36 V
Temperature			
Storage (system)		0 °C to +80 °C	0 °C to +70 °C
Installation (system)		+20 °C $\pm$ 5 °C	+20 °C $\pm$ 5 °C
Operating (readhead)		0 °C to +75 °C	0 °C to +75 °C
Operating (interface)		N/A	0 °C to +55 °C
Bake-out (non-operating)		+120 °C	+120 °C ³
Humidity		95% relative humidity (non-condensing) to IEC 60068-2-78	
Sealing	Readhead	IP30	IP30
	Interface	N/A	IP67 ⁴
Environmental protection		Protection class III Pollution degree II Altitude 2000 m	
Acceleration	Operating (readhead)	500 m/s ² , 3 axes	
Maximum acceleration of scale with respect to readhead ⁵		2000 m/s ²	
Vibration	Operating (readhead)	Sinusoidal 100 m/s ² , 55 Hz to 2000 Hz, 3 axes	Sinusoidal 100 m/s ² , 55 Hz to 2000 Hz, 3 axes
	Operating (interface)	N/A	Sinusoidal 100 m/s ² , 55 Hz to 2000 Hz, 3 axes
Shock	Non-operating	1000 m/s ² , 6 ms, ½ sine, 3 axes	
Mass	Readhead	19 g	19 g
	Readhead cable	19 g/m	19 g/m
	Interface	N/A	218 g
EMC compliance		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	
Maximum readhead cable length		10 m	10 m (to controller or interface) (refer to manufacturer specifications for maximum cable length from interface to controller)

CAUTION: The RESOLUTE encoder system has been designed to meet the requirements of IEC 61800-5-2: Annex E second environment, but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is essential.

NOTE: The Siemens DRIVE-CLiQ interface is not UHV compatible and needs to be installed outside of the vacuum chamber.

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

² Current consumption figures refer to a terminated RESOLUTE BiSS Safety system. BiSS Safety encoder systems must be powered from a 5 Vdc supply complying with the requirements for PELV of standard IEC 60950-1.

³ Excluding interface (not UHV compatible).

⁴ If the original termination is altered by the user or an extension cable is used, it is the responsibility of the system manufacturer to ensure the IP rating of the interface connection meets their requirements.

⁵ 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 - FS ETR readheads

		BiSS Safety
Power supply		5 V $\pm$ 10% 1.25 W maximum (250 mA @ 5 V) ¹ Ripple: 200 mVpp maximum @ frequency up to 500 kHz maximum
	Readhead over voltage protection	-12 V to +20 V
Temperature	Storage	-40 °C to +80 °C
	Installation	+20 °C $\pm$ 5 °C
	Operating	-40 °C to +80 °C
Humidity		95% relative humidity (non-condensing) to IEC 60068-2-78
Sealing		IP64
Environmental protection		Protection class III Pollution degree II Altitude 2000 m
Acceleration	Operating (-40 °C to 0 °C)	300 m/s ² , 3 axes
	Operating (0 °C to +80 °C)	500 m/s ² , 3 axes
Maximum acceleration of scale with respect to readhead ³		2000 m/s ²
Vibration	Operating	Sinusoidal 300 m/s ² , 55 Hz to 2000 Hz, 3 axes
Shock	Non-operating	1000 m/s ² , 6 ms, ½ sine, 3 axes
Mass	Readhead	18 g
	Readhead cable	32 g/m
EMC compliance		IEC 61800-5-2 Annex E
Readhead cable		7 core, tinned and annealed copper, 28 AWG Single-shielded, outside diameter 4.7 $\pm$ 0.2 mm Flex life > 40 $\times$ 10 ⁶ cycles at 20 mm bend radius ³ UL recognised component 
Maximum readhead cable length		10 m

CAUTION: The RESOLUTE encoder system has been designed to meet the requirements of IEC 61800-5-2: Annex E second environment, but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is essential.

NOTE (For ETR applications only): If using RESA30 rings, the hub should be made of a material with a CTE of between 14 and 18 μ m/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.

¹ Current consumption figures refer to a terminated RESOLUTE BiSS Safety system. BiSS Safety encoder systems must be powered from a 5 Vdc supply complying with the requirements for PELV 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.

³ The readhead cable must be held static for operation below 0 °C.

RGA results

Test schedule

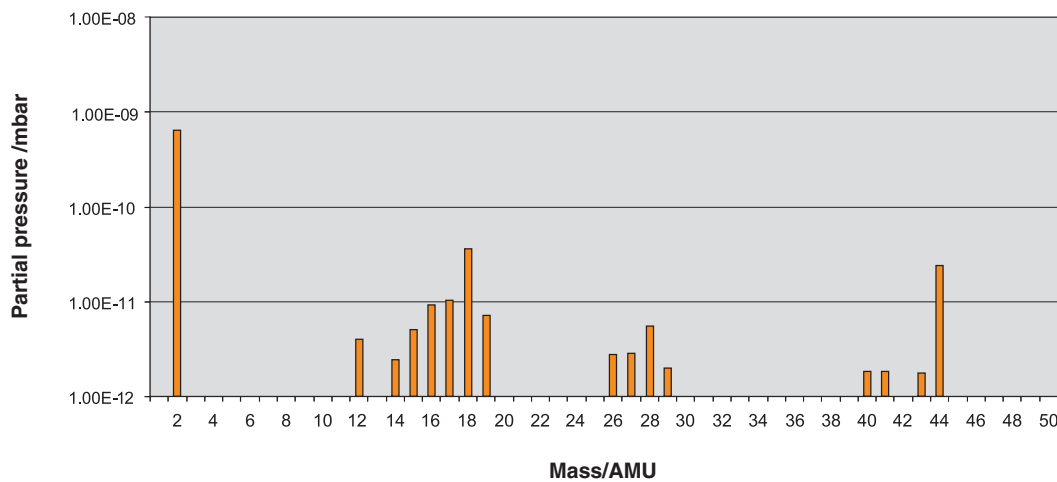
A quadrupole mass spectrometer (AccuQuad 200 RGA) was used to collect RGA data. Chamber pressure was measured with an Ion Gauge (G8130). After initial conditioning of the system, a background spectrum was recorded together with the total pressure in the test chamber.

The component was placed in the vacuum system (0.0035 m³) 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.

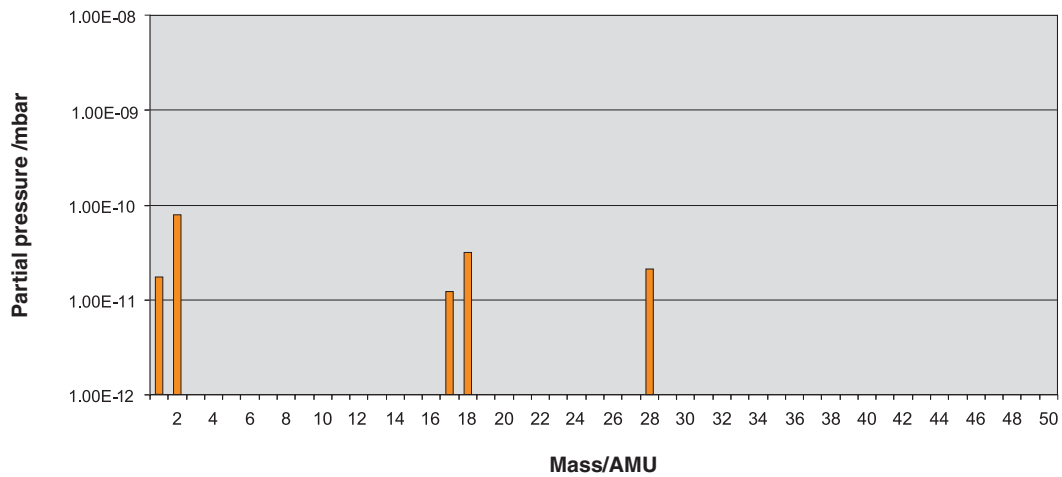
NOTES:

- 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.
- The Siemens DRIVE-CLiQ interface is not UHV compatible and needs to be installed outside of the vacuum chamber.

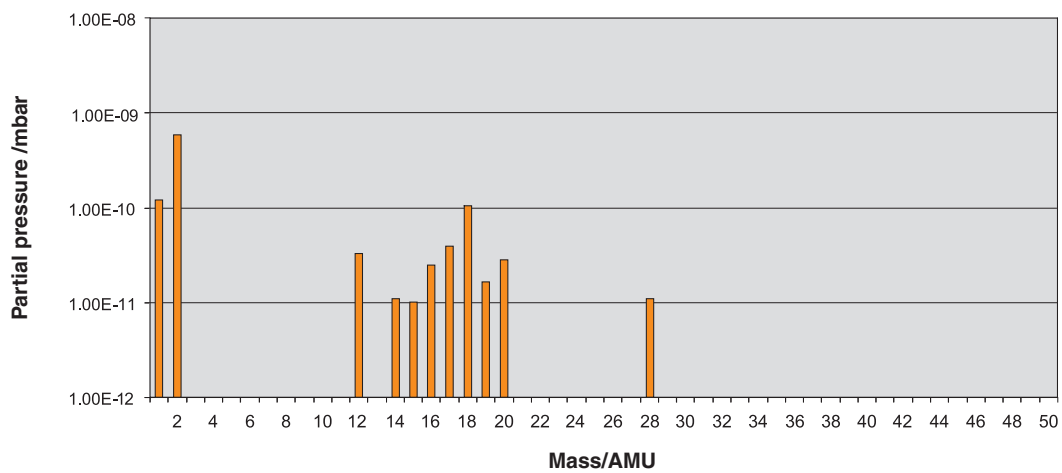
RESOLUTE UHV readhead with 1.0 m cable after bake-out (total pressure = 8×10^{-10} mbar)



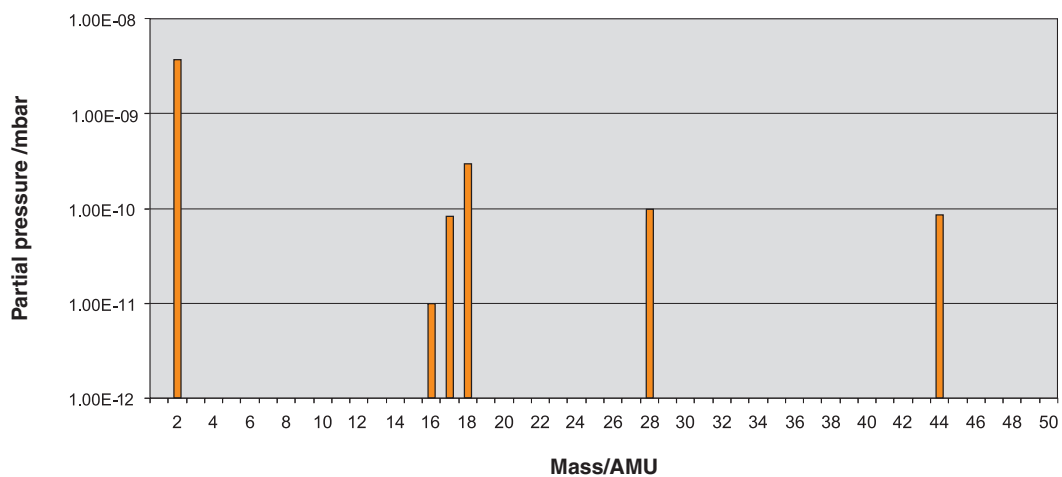
RTLA30-S linear scale (300 mm length) after bake-out (total pressure = 1.69×10^{-10} mbar)



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



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



Safety sub-functions

The RESOLUTE Functional Safety BiSS Safety encoder and Siemens DRIVE-CLiQ encoder systems provide safe position data that supports the following safety sub-functions defined by IEC 61800-5-2:2016:

- Safe stop 1 (SS1) and Safe stop 2 (SS2)
- Safe operating stop (SOS)
- Safe limited acceleration (SLA) $\leq 500 \text{ m/s}^2$
- Safe acceleration range (SAR) $\leq 500 \text{ m/s}^2$
- Safe limited speed (SLS) ¹ $\leq 100 \text{ m/s}$ ($\leq 50 \text{ m/s}$ for ETR variant)
- Safe speed range (SSR) ¹ $\leq 100 \text{ m/s}$ ($\leq 50 \text{ m/s}$ for ETR variant)
- Safely limited position (SLP)
- Safely limited increment (SLI)
- Safe direction (SDI)
- Safe speed monitor (SSM) ¹ $\leq 100 \text{ m/s}$ ($\leq 50 \text{ m/s}$ for ETR variant)

The system must be installed and operated in accordance with the instructions defined by the installation guide. Failure to follow the correct use instructions and failure to heed the limitations may result in PLd and / or SIL2 not being achieved and will invalidate the functional safety certification.

NOTE: For the maximum permitted speeds for the range of ring diameters refer to the installation guides. These are available at www.renishaw.com/fsencoders.

¹ For further details see the *RESOLUTE™ Functional Safety installation guide and safety manual BiSS Safety encoder system* (Renishaw part no. M-9755-9109) or the *RESOLUTE™ Functional Safety installation guide and safety manual Siemens DRIVE-CLiQ encoder system* (Renishaw part no. L-9796-9134). These documents are available at www.renishaw.com/fsencoders.

Functional Safety data declaration

IEC 61508 safety data

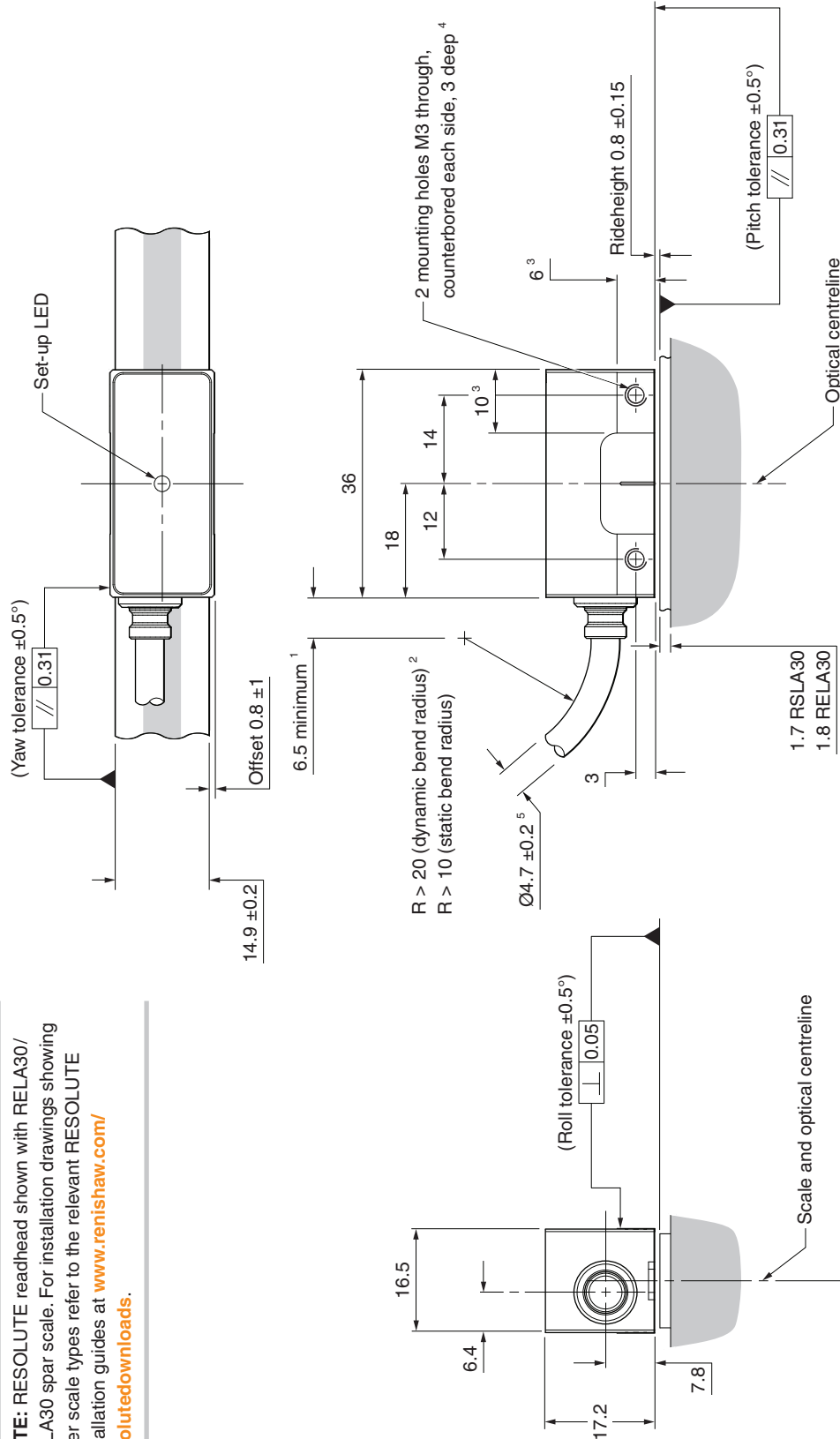
	RESOLUTE™ Functional Safety with BiSS® Safety encoder system	RESOLUTE™ Functional Safety Siemens DRIVE-CLiQ encoder system	
		Single readhead systems	Dual readhead systems
Safety Integrity Level	2		
Random Hardware Failures (per hour)	$\lambda_s = 5.94 \times 10^{-7}$ $\lambda_D = 8.80 \times 10^{-7}$ $\lambda_{DD} = 7.92 \times 10^{-7}$ $\lambda_{DU} = 8.80 \times 10^{-8}$	$\lambda_s = 6.86 \times 10^{-7}$ $\lambda_D = 1.07 \times 10^{-6}$ $\lambda_{DD} = 9.64 \times 10^{-7}$ $\lambda_{DU} = 1.07 \times 10^{-7}$	$\lambda_s = 1.26 \times 10^{-6}$ $\lambda_D = 1.95 \times 10^{-6}$ $\lambda_{DD} = 1.76 \times 10^{-6}$ $\lambda_{DU} = 1.96 \times 10^{-7}$
PFD _{avg}	Not applicable due to continuous demand mode		
PFH (per hour)	$\lambda_{DU} = 8.80 \times 10^{-8}$	$\lambda_{DU} = 1.07 \times 10^{-7}$	$\lambda_{DU} = 1.95 \times 10^{-7}$
Architectural Constraints	Type B HFT = 0 SFF = 94%		
Hardware safety integrity compliance	Route 1H		
Systematic safety integrity compliance	Route 1S		
Systematic capability	SC2		
Demand mode	Continuous		
Proof test interval	Not required for continuous demand mode		

ISO 13849 safety data

	RESOLUTE™ Functional Safety with BiSS® Safety encoder system	RESOLUTE™ Functional Safety Siemens DRIVE-CLiQ encoder system	
		Single readhead systems	Dual readhead systems
MTTF _D (years)	130	106	58
Diagnostic coverage	Medium (90%)		
Category	3		
Performance level	d		
Lifetime/Replacement limits	20 years		

RESOLUTE FS readhead installation drawing

Dimensions and tolerances in mm

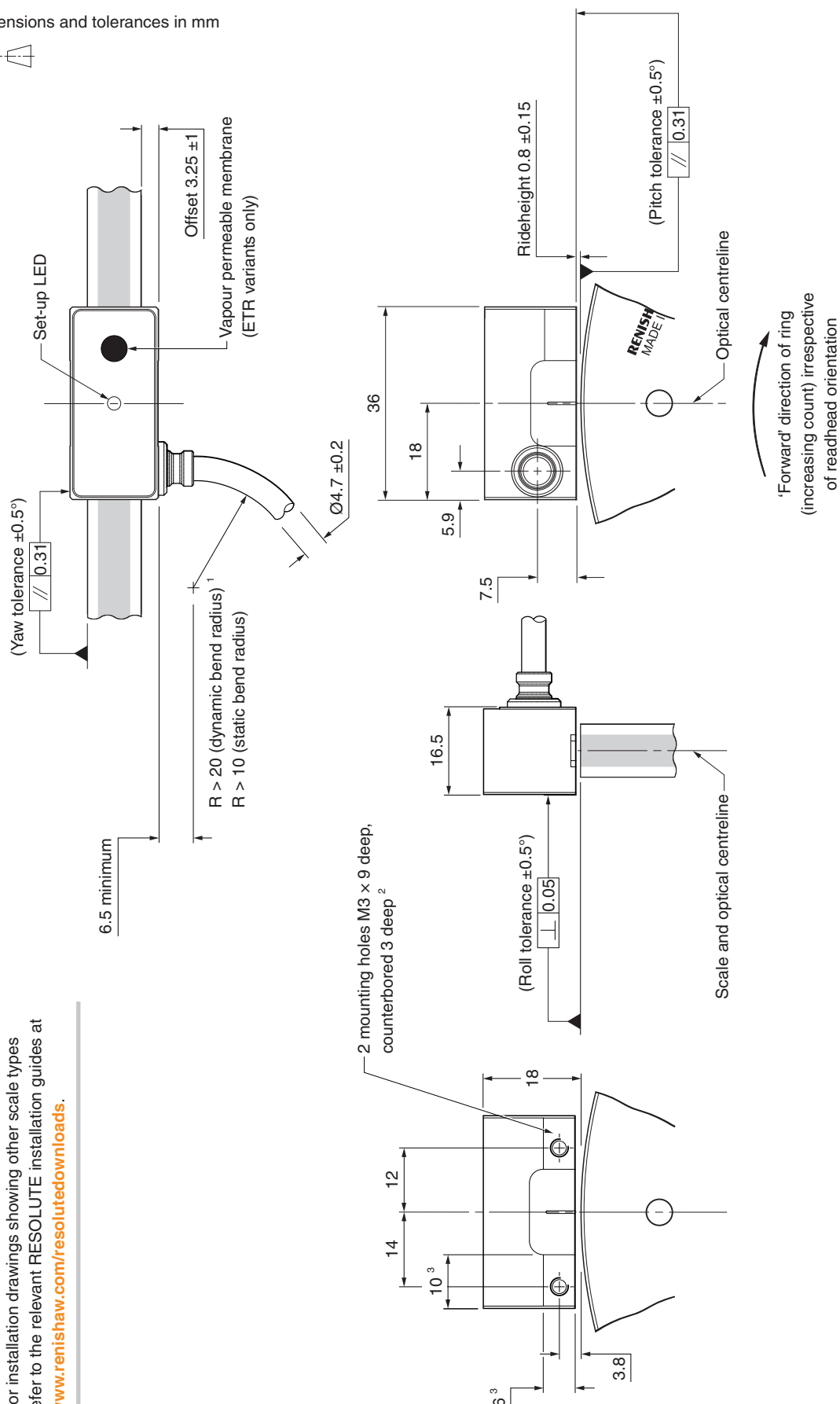


NOTE: RESOLUTE readhead shown with RELA30/ RSLA30 spar scale. For installation drawings showing other scale types refer to the relevant RESOLUTE installation guides at www.renishaw.com/resolutedownloads.

- ¹ 5.5 minimum for FS UHV readheads.
- ² UHV: The dynamic bend radius is not applicable for UHV cables. UHV cables are for static use only.
- ³ Extent of mounting faces.
- ⁴ The recommended thread engagement is 6 mm minimum (9 mm including counterbore) and the recommended tightening torque is 0.9 Nm to 1.1 Nm (FS standard readheads only).
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 (FS UHV readheads only).
- ⁵ $\varnothing 2.7$ for FS UHV readheads.

RESOLUTE FS side exit cable readhead installation drawing

Dimensions and tolerances in mm



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

ETR: The readhead cable must be held static for operation below 0 °C.

The recommended thread engagement is 6 mm minimum (9 mm including counterbore) and the recommended tightening torque is 0.9 Nm to 1.1 Nm.

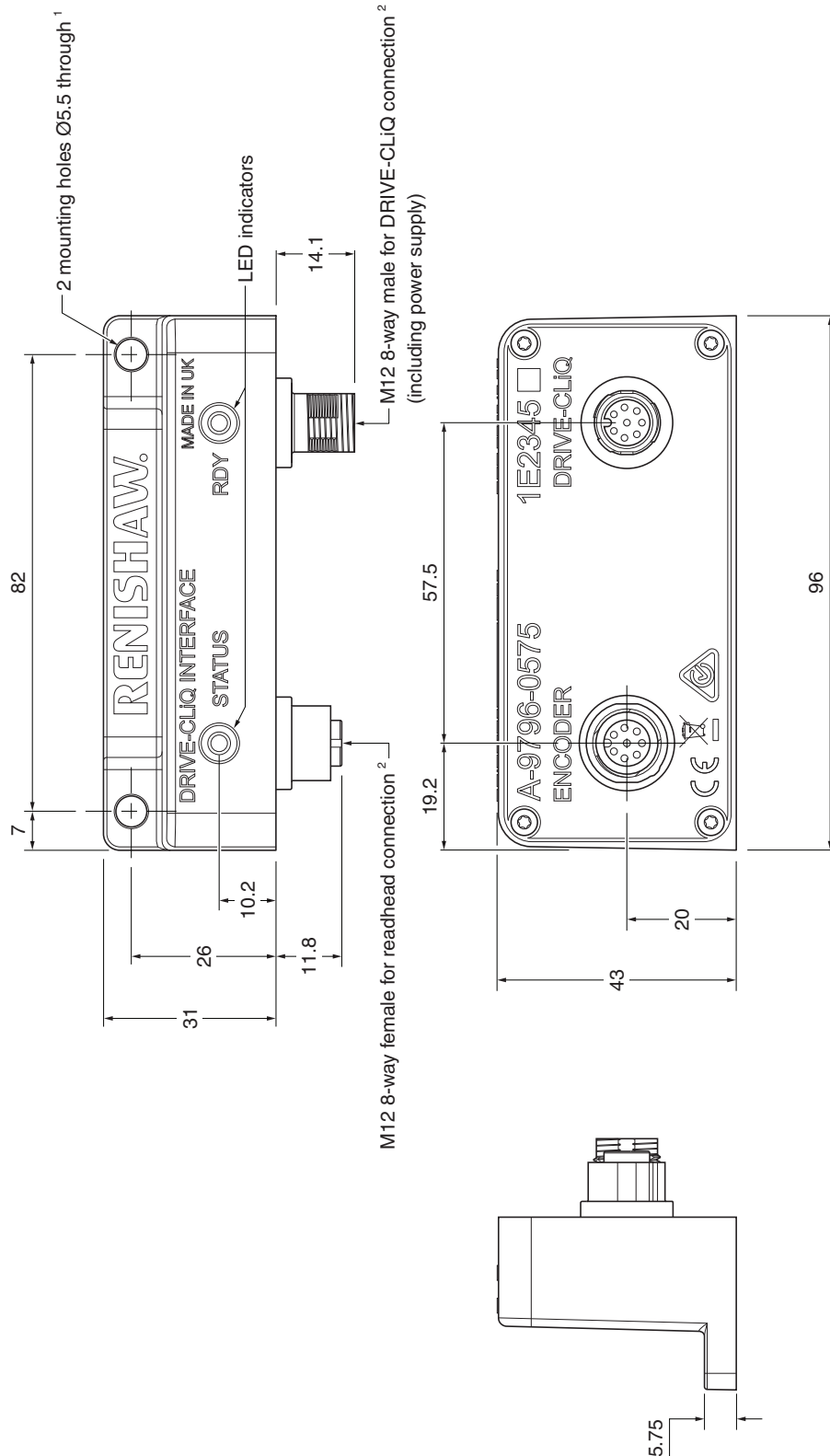
3 Extent of mounting faces.

Siemens DRIVE-CLiQ interface drawing

Dimensions and tolerances in mm



Single readhead input (A-9796-0575)



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

¹ Screw grade: ISO 4762-M5. Maximum tightening torque 4 Nm. Recommended thread engagement ≥ 5 mm.

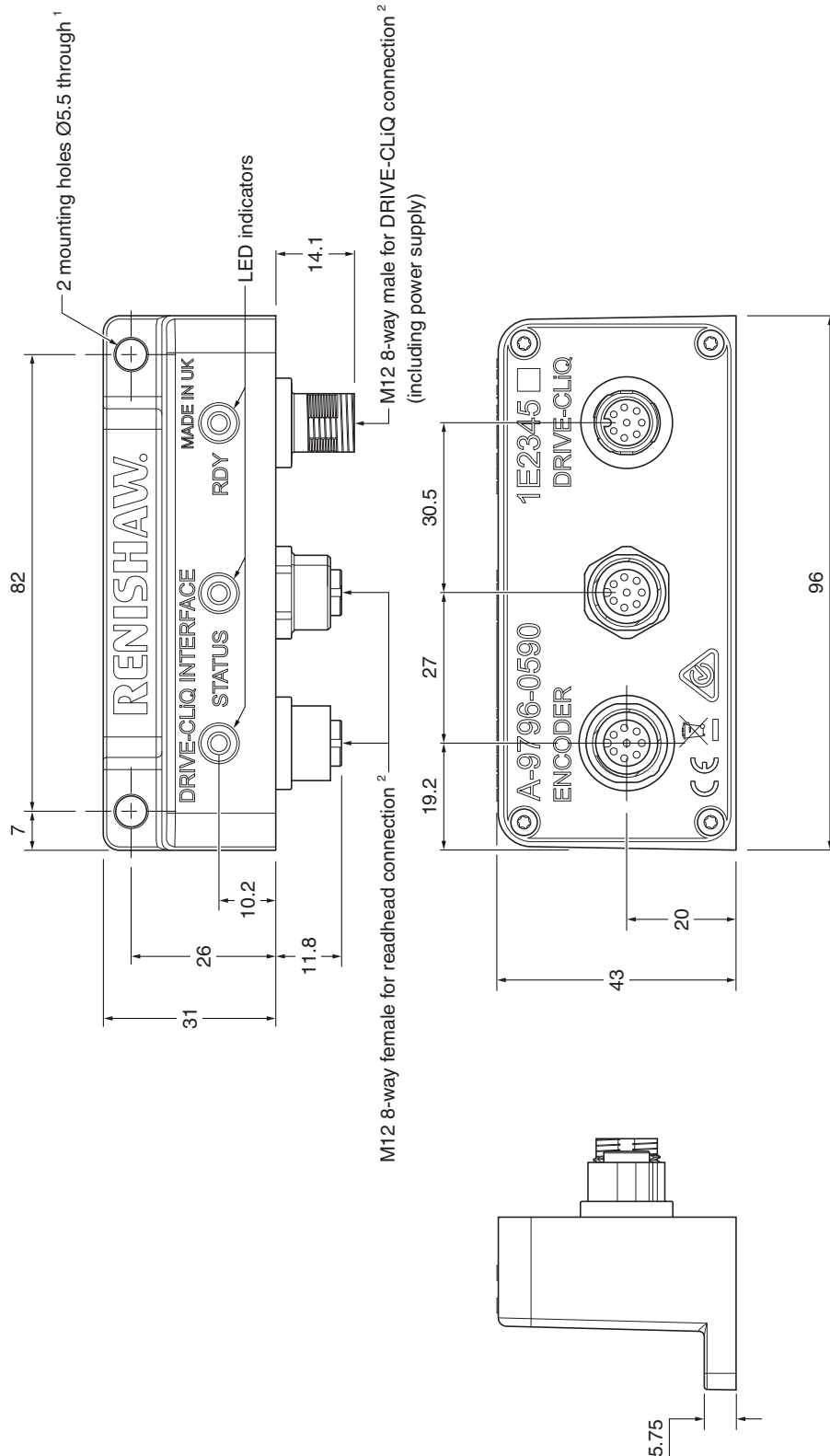
² Maximum tightening torque 4 Nm.

Siemens DRIVE-CLiQ interface drawing

Dimensions and tolerances in mm



Dual readhead input (A-9796-0590)



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

¹ Screw grade: ISO 4762-M5. Maximum tightening torque 4 Nm. Recommended thread engagement ≥ 5 mm.

² Maximum tightening torque 4 Nm.

RESOLUTE BiSS Safety readhead part numbers

Linear readheads

	S	L	36B	B	S	001	C	30	A
Series _____									
S = RESOLUTE Functional Safety									
Scale form _____									
L = Linear									
Serial interface _____									
28B = BiSS 28 bit (select 50 nm resolution) ¹									
36B = BiSS 36 bit (select 1 nm resolution) ¹									
Mechanical option _____									
B = Standard cable outlet									
R = Side cable outlet									
U = Ultra High Vacuum (silver coated copper braid cable)									
F = Ultra High Vacuum (stainless steel cable braid)									
Gain option _____									
T = RTLA30 / RTLA30-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 (select 36B serial interface) ¹									
050 = 50 nm (select 28B serial interface) ¹									
Scale code option _____									
B = RTLA30 / RTLA30-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 (> 10 m to 21 m scale length) ²									
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 _____									
A = 9-way D-type connector ('B' and 'R' mechanical options only)									
S = M12 (sealed) connector ('B' and 'R' mechanical options only)									
F = Flying lead (unterminated cable) ('B' and 'R' mechanical options only)									
V = Vacuum flying lead (unterminated cable) ('U' and 'F' mechanical options only)									

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

¹ For linear BiSS Safety variants, 'Serial interface' and 'Resolution', must be selected in certain combinations.

- 28B must be selected for 50 nm resolution systems.
- 36B must be selected for 1 nm resolution systems.

Other combinations are not valid.

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

RESOLUTE BiSS Safety readhead part numbers

Angular readheads

			S	A	32B	B	A	052	B	30	A																		
Series _____																													
S = RESOLUTE Functional Safety																													
Scale form _____																													
A = Angular																													
Serial interface _____																													
32B = BiSS 32 bit																													
Mechanical option _____																													
B = Standard cable outlet T = Extended Temperature Range (standard cable outlet) R = Side cable outlet C = Extended Temperature Range (side cable outlet) U = Ultra High Vacuum (silver coated copper braid cable) F = Ultra High Vacuum (stainless steel cable braid)																													
Gain option _____																													
A = Standard																													
Ring diameter _____																													
<table border="0"> <tbody> <tr> <td>052 = 52 mm</td> <td>150 = 150 mm</td> <td>280 = 280 mm (RESA30 only)</td> </tr> <tr> <td>057 = 57 mm</td> <td>165 = 165 mm</td> <td>300 = 300 mm</td> </tr> <tr> <td>075 = 75 mm</td> <td>172 = 172 mm</td> <td>330 = 330 mm (RESA30 only)</td> </tr> <tr> <td>100 = 100 mm</td> <td>183 = 183 mm</td> <td>350 = 350 mm</td> </tr> <tr> <td>101 = 101 mm (RESA30 only)</td> <td>200 = 200 mm</td> <td>413 = 413 mm (RESA30 only)</td> </tr> <tr> <td>103 = 103 mm</td> <td>206 = 206 mm</td> <td>417 = 417 mm</td> </tr> <tr> <td>104 = 104 mm</td> <td>209 = 209 mm</td> <td>489 = 489 mm (RESA30 only)</td> </tr> <tr> <td>115 = 115 mm</td> <td>229 = 229 mm</td> <td>550 = 550 mm (RESA30 only)</td> </tr> <tr> <td>124 = 124 mm (RESA30 only)</td> <td>255 = 255 mm</td> <td></td> </tr> </tbody> </table>												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
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B = Standard scale code																													
Cable length _____																													
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A = 9-way D-type connector ('B', 'R', 'T', and 'C' mechanical options only) S = M12 (sealed) connector ('B' and 'R' mechanical options only) F = Flying lead (unterminated cable) ('B', 'R', 'T', and 'C' mechanical options only) V = Vacuum flying lead (unterminated cable) ('U' and 'F' mechanical options only)																													

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

RESOLUTE FS Siemens DRIVE-CLiQ readhead part numbers

Linear readheads

	S	L	34D	B	S	001	C	30	S
Series _____									
S = RESOLUTE Functional Safety									
Scale form _____									
L = Linear									
Serial interface _____									
28D = Siemens DRIVE-CLiQ 28 bit (select 50 nm resolution) ¹									
34D = Siemens DRIVE-CLiQ 34 bit (select 1 nm resolution) ¹									
Mechanical option _____									
B = Standard cable outlet									
R = Side cable outlet									
U = Ultra High Vacuum (silver coated copper braid cable)									
F = Ultra High Vacuum (stainless steel cable braid)									
Gain option _____									
T = RTLA30 / RTLA30-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 (select 34D serial interface)									
050 = 50 nm (select 28D serial interface)									
Scale code option _____									
B = RTLA30 / RTLA30-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 (> 10 m to 21 m scale length) ²									
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 _____									
S = M12 (sealed) connector ('B' and 'R' mechanical options only)									
F = Flying lead (unterminated cable) ('B' and 'R' mechanical options only)									
V = Vacuum flying lead (unterminated cable) ('U' and 'F' mechanical options only)									

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

¹ For linear Siemens DRIVE-CLiQ Functional Safety variants, 'Serial interface' and 'Resolution', must be selected in certain combinations.

- 28D must be selected for 50 nm resolution systems.
- 34D must be selected for 1 nm resolution systems.

Other combinations are not valid.

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

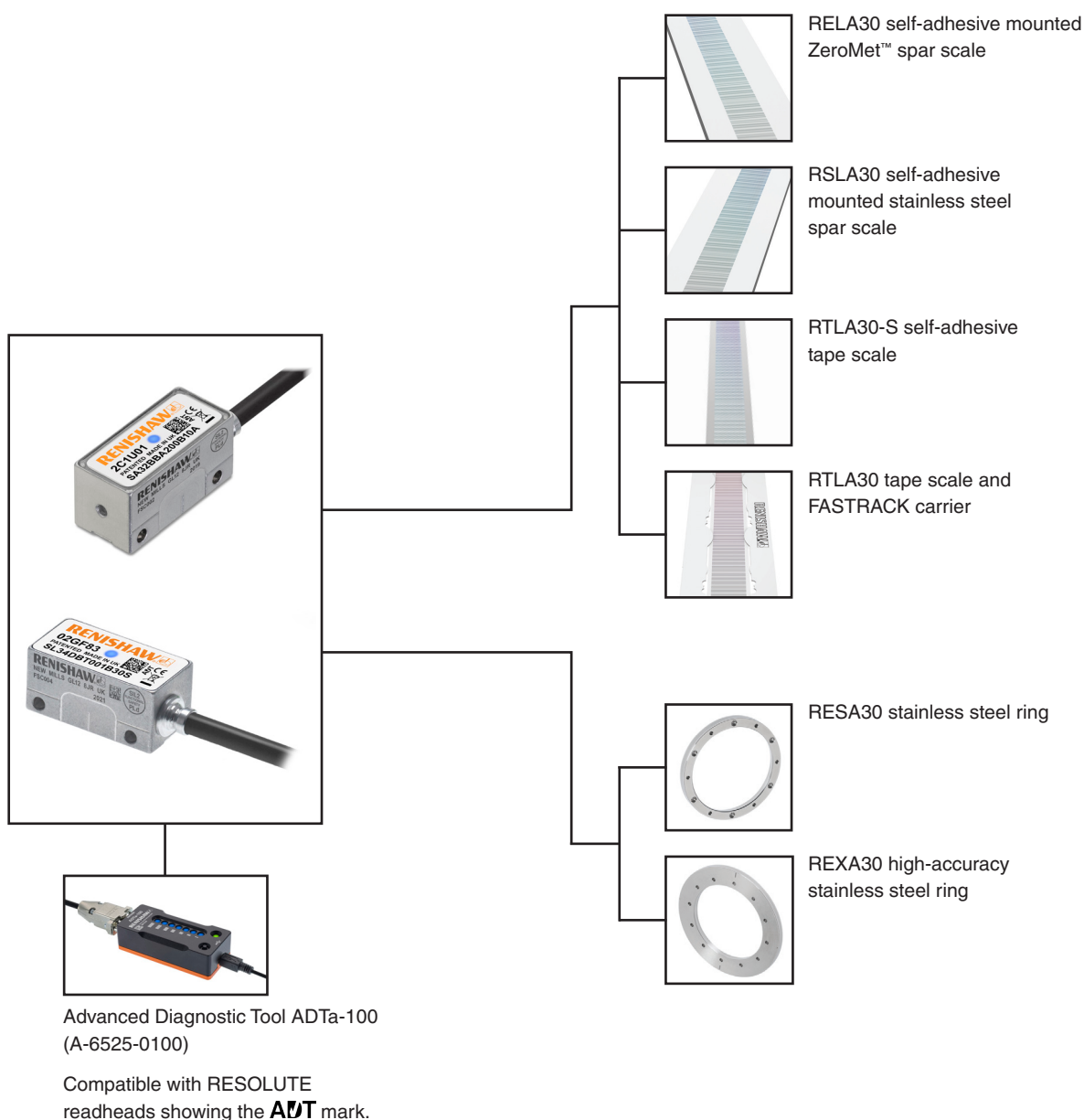
RESOLUTE FS Siemens DRIVE-CLiQ readhead part numbers

Angular readheads

		S	A	29D	B	A	052	B	30	S
Series _____										
S = RESOLUTE Functional Safety										
Scale form _____										
A = Angular										
Serial interface _____										
26D = Siemens DRIVE-CLiQ 26 bit										
29D = Siemens DRIVE-CLiQ 29 bit										
Mechanical option _____										
B = Standard cable outlet										
R = Side cable outlet										
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	150 = 150 mm	280 = 280 mm (RESA30 only)								
057 = 57 mm	165 = 165 mm	300 = 300 mm								
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Scale code option _____										
B = Standard scale code										
Cable length _____										
02 = 0.2 metres	15 = 1.5 metres	90 = 9.0 metres								
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Cable termination _____										
S = M12 (sealed) connector ('B' and 'R' mechanical options only)										
F = Flying lead (unterminated cable) ('B' and 'R' mechanical options only)										
V = Vacuum flying lead (unterminated cable) ('U' and 'F' mechanical options only)										

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

RESOLUTE FS series compatible products



Installation information can be found in the *RESOLUTE™ Functional Safety installation guide and safety manual BiSS Safety encoder system* (Renishaw part no. M-9755-9109) or the *RESOLUTE™ Functional Safety installation guide and safety manual Siemens DRIVE-CLiQ encoder system* (Renishaw part no. L-9796-9134). These documents are available at www.renishaw.com/fsencoders.

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.

www.renishaw.com/contact



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