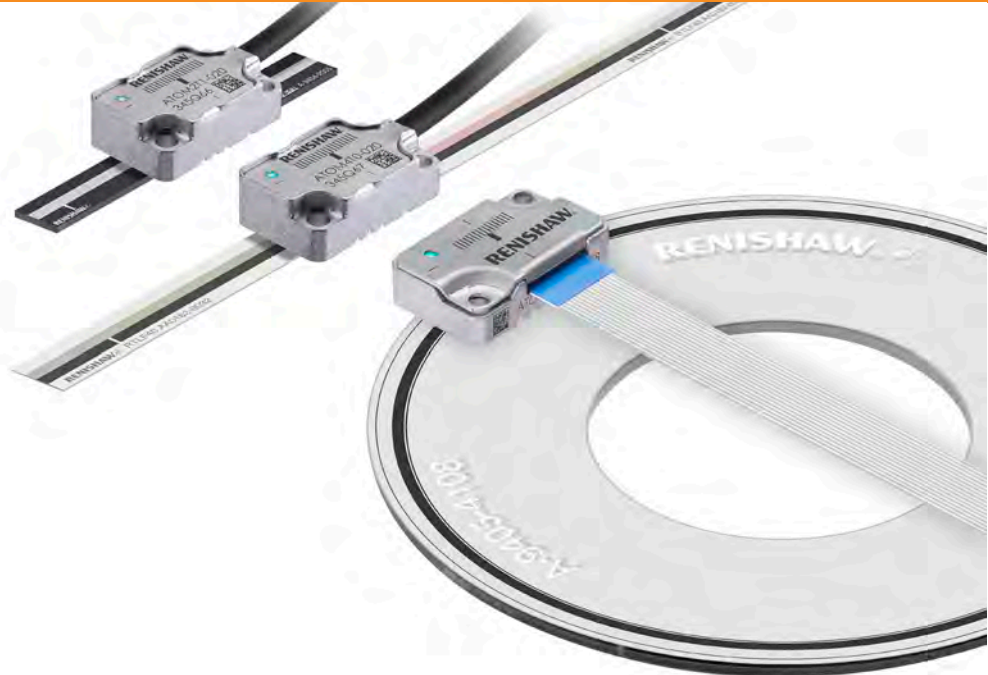


ATOM™ miniature encoder system



ATOM™ is the world's first miniature encoder with filtering optics, providing improvements in dirt immunity, signal stability and reliability for linear, partial arc and rotary applications.

ATOM features a number of other advances that help maintain signal stability, including integral Auto Gain Control and Auto Offset Control, along with a highly reliable IRED light source, making the product suitable for use in applications demanding quality and dependability.

The miniature readhead is available in 2 formats: hi-flex cable output or flexible-printed circuit (FPC) output. The FPC version helps reduce overall package size, with a reduced Z-height and easy cable routing.

ATOM is available with a range of high-accuracy optical linear, partial arc and rotary scales, including conventional glass spars, 'unbreakable' stainless steel tape scales and glass discs. Installation has been simplified by an intuitive set-up LED on the readhead that indicates signal level. Optical reference mark phasing and incremental signal optimisation can be achieved with the simple press of a button.

ATOM is suitable for use in a variety of applications that require compact size, including laser scanners, CMM arms, semiconductor manufacturing, compact linear motors/motion stages, small DDR torque motors, galvanometers and microscope stages.

ATOM – miniaturisation without compromise.

- **Miniature package: 8.35 mm × 12.7 mm × 20.5 mm (7.3 mm × 12.7 mm × 20.5 mm for FPC version)**
- **Highest signal stability and dirt immunity in its class due to filtering optics**
- **Long-term stability provided by integral Auto Gain Control (AGC) and Auto Offset Control (AOC)**
- **Low sub-divisional error (SDE) and jitter**
- **Easy installation and diagnostics using the set-up LED on the readhead**
- **Fast, simple calibration at the push of a button**
- **Auto-phase optical reference mark**
- **Available in 20 µm and 40 µm scale pitch versions**
- **Analogue output direct from the readhead**
- **Multiple interpolation options, with resolutions to 1 nm**
- **Range of high accuracy rotary, partial arc and linear scales**

www.renishaw.com/atomdownloads

 #renishaw

System features

High performance

- **Need higher speed?**

ATOM is the fastest encoder in its class, with maximum speeds up to 20 m/s and a range of high-speed interpolation options for digital versions.

- **Need higher accuracy?**

ATOM offers linear tape scales with specified overall accuracy to $\pm 5 \mu\text{m/m}$ at 20 °C, without the need for 2-point compensation that competitor encoders require.

- **Need improved positional stability and repeatability?**

ATOM has low noise (jitter), allowing users to increase servo-loop gain without instability, whilst reaping other dynamic performance benefits such as faster settling times and higher acceleration.

- **Need smoother velocity control?**

Reduce velocity ripple, improve scanning performance, reduce blur on vision systems and image capturing – all thanks to ATOM's superior optical scheme and integral AOC.

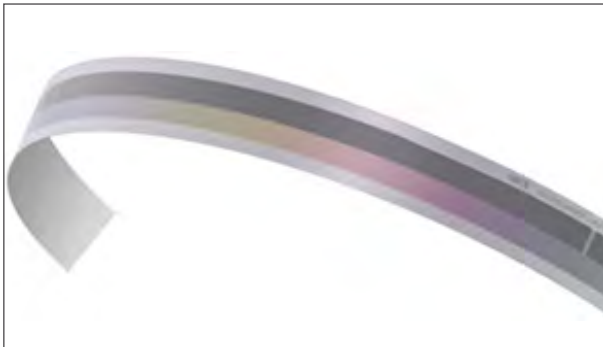
Lissajous stability

ATOM features a miniaturized version of Renishaw's unique filtering optics that are used in the TONiC™ encoder range. This optical scheme is tuned to a specific spatial frequency, so it rejects other harmonics, including those caused by dirt or other contaminants. The result is a Lissajous with high purity, that retains its fidelity even when the scale is exposed to contamination: ideal for applications where reliability is critical.

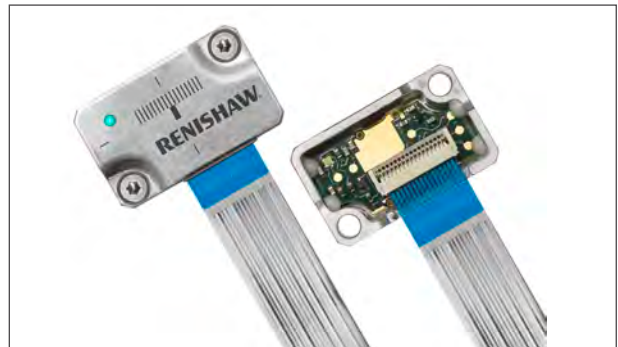
Product range

- **20 µm and 40 µm readheads with high-flex cable:**
For general purpose applications. Superior quality cable tested to 20 million flex cycles.
- **20 µm and 40 µm readheads with FPC cable:**
Side exit FPC cable allows the smallest overall package size.
- **Stainless steel tape scale (RKLF):**
Linear scale that can be wrapped around drums, arcs or shafts with radii down to 26 mm.
- **Stainless steel tape scale (RTLF):**
High-accuracy linear scale with graduations directly marked onto the steel tape surface. Available on reels for cut-to-suit flexibility.
- **Glass linear spars (RCLC):**
Conventional glass spars, available in lengths up to 130 mm.
- **Glass discs (RCDM):**
High-accuracy rotary scales with outer diameters down to 17 mm.

Stainless steel tape scale (RKLF)



20 µm and 40 µm readheads with FPC cable



Stainless steel tape scale (RTLF)



Glass discs (RCDM)



ATOM interface options

ATOM readheads are available in three versions all giving industry standard analogue output:

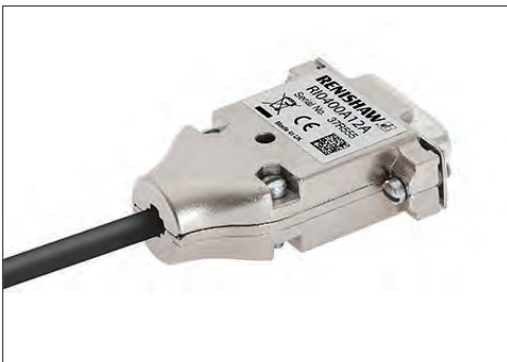
- High flex cable terminated with a 15-way D-type connector for high-volume users requiring analogue outputs.

NOTE: A CAL button is not included on this option. Refer to the installation guide for details on how to calibrate.

- High-flex cable terminated with a T-type interboard connector for use with ACi/Ri/Ti interfaces.
- FPC connector for use with ACi interface or direct connection to user electronics.



ACi interfaces are a range of high performance, miniature, open interpolator subsystems. They bring unparalleled price-performance benefits to today's motion systems that need fine resolution coupled to high speed performance in an ultra compact, open format, small footprint solution and have provision for calibrating the system. Digital interpolation down to 10 nm at up to 40 MHz clocked output is available. FPC or cable input versions available.



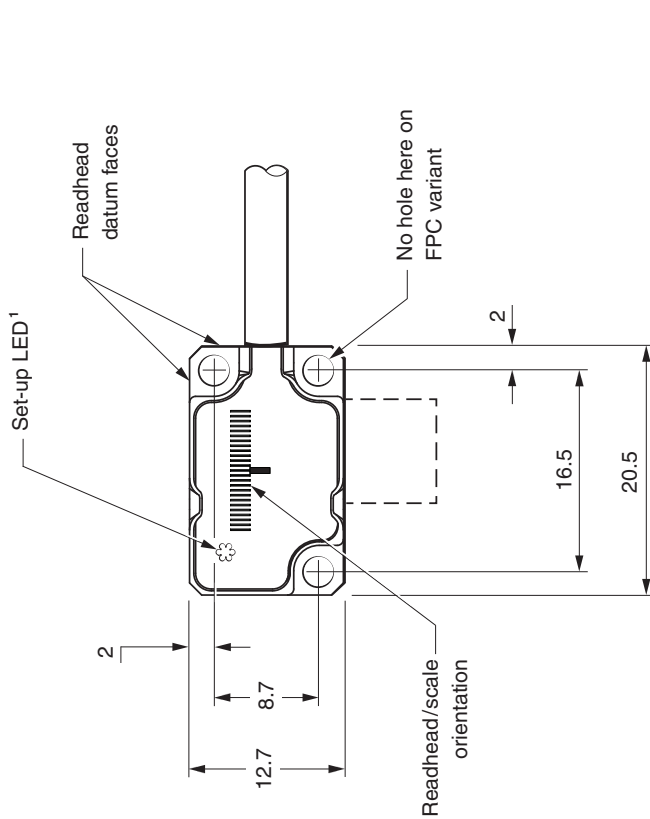
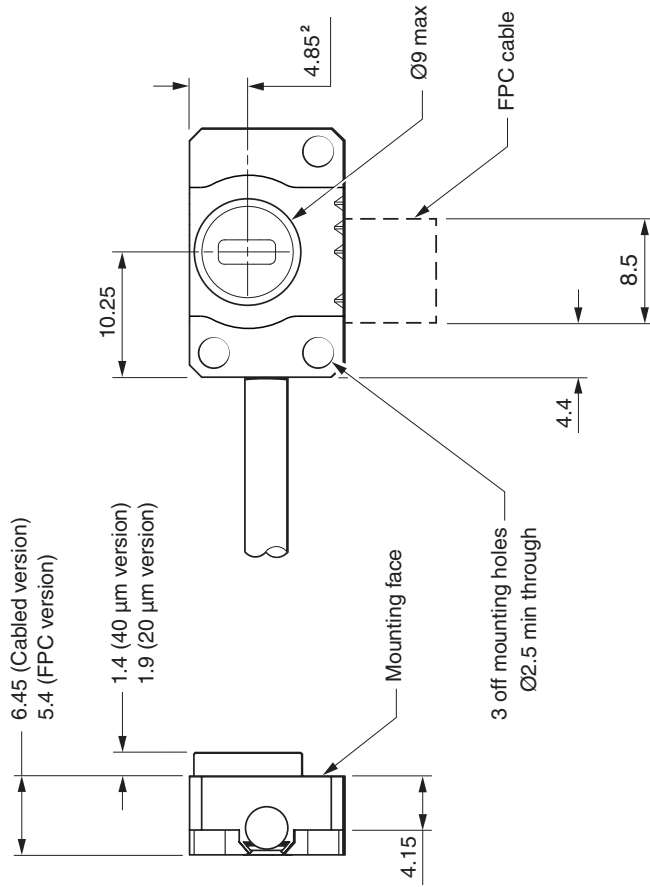
Ri interfaces are contained within an industry standard 15-way D-type connector shell, including CAL button. They offer digital interpolation down to 50 nm (clocked) and 0.5 μm (non-clocked). Analogue variants are also available.



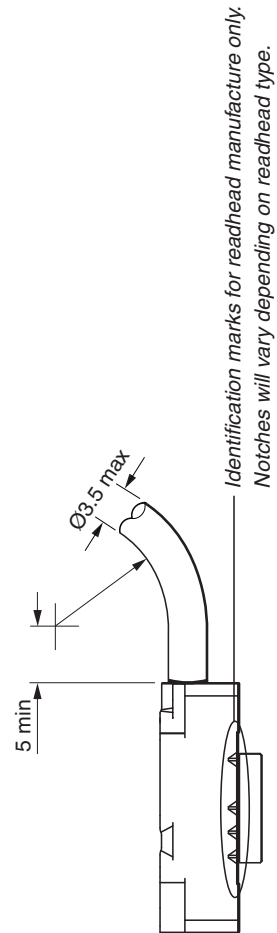
Ti interfaces are designed for applications that require higher speed, lower SDE, digital interpolation down to 1 nm resolution and include a CAL button. Clocked outputs have been optimised for speed and performance at all resolutions for industry-standard controllers. Analogue variants are also available.

ATOM readhead dimensions

Dimensions and tolerances in mm



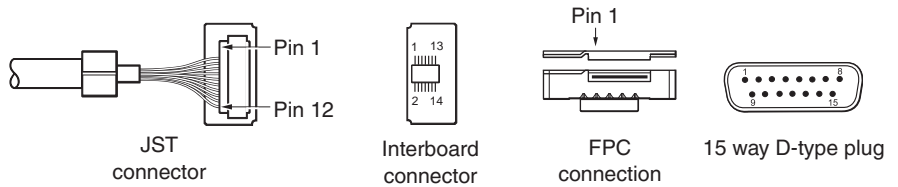
R > 20 Dynamic bend radius
R > 10 Static bend radius



¹ On FPC variants the set-up LED cut-out is circular.
² Not optical centreline.

Readhead output signals

Function	Signal	Colour	JST ² (on interboard)	Interboard connector (T)	FPC (F)	15-way D-type (D)		
			Pin	Pin	Pin	Pin		
Power ¹	5 V	Brown	11	4	9, 10	4, 5		
	0 V	White	5	13	3, 6, 11, 14	12, 13		
Incremental	Cosine	V ₁	+	Red	4	9	9	
			-	Blue	3	5	4	1
	Sine	V ₂	+	Yellow	7	12	2	10
			-	Green	6	14	1	2
Reference mark	V ₀	+	Violet	10	2	13	3	
		-	Grey	9	8	12	11	
Set-up	V _x	Clear	12	6	16	6		
Remote CAL	CAL	Orange	8	10	15	14		
Shield	-	Screen	Cable ferrule	Cable ferrule	Readhead body	Case		
Do not connect	-	-	1, 2	1, 3, 7, 11	7, 8	7, 8, 15		



Maximum speed

40 µm readhead - 20 m/s (-3dB)

20 µm readhead - 10 m/s (-3dB)

¹ All power connections can be used either to minimise voltage drop down the cable or incorporate voltage sensing.

² Only available on interboard connector.

RKLF technical specifications

Material	Hardened and tempered martensitic stainless steel fitted with a self-adhesive backing tape	
Form (H × W)	0.15 mm × 6 mm (including adhesive)	
Scale pitch	20 µm and 40 µm ¹	
Reference mark	Auto-phase optical reference mark repeatable to unit of resolution throughout specified speed and temperature range. Customer de-selectable reference marks at 50 mm spacing. ² Reference mark in the centre of scale for lengths < 100 mm.	
Accuracy (at 20 °C)	RKLF20-S / RKLF40H-S RKLF40-S	±5 µm/m ±15 µm/m
Linearity (at 20 °C)	RKLF20-S / RKLF40H-S RKLF40-S	±2.5 µm/m achievable with two point error correction ±3 µm/m achievable with two point error correction
Installation temperature	+10 °C to +35 °C ³	
Coefficient of thermal expansion (at 20 °C)	Matches that of substrate material when scale ends fixed by epoxy mounted end clamp.	
Length	20 mm to 1 m in 10 mm increments 1 m to 10 m in 1 m increments ⁴ Overall length = measuring length + 70 mm Scale length = measuring length + 40 mm	
Mass	4.6 g/m	
End fixing	Epoxy mounted end clamps (A-9523-4015) Approved epoxy adhesive (A-9531-0342) Scale end movement typically < 1 µm ⁵	

¹ 20 µm not suitable for partial arc applications.

² Only selected reference mark is bi-directionally repeatable.

³ Ensure that the scale and end clamps are installed following the installation process described in the *ATOM™ linear encoder system* installation guide (Renishaw part no. M-9696-9723).

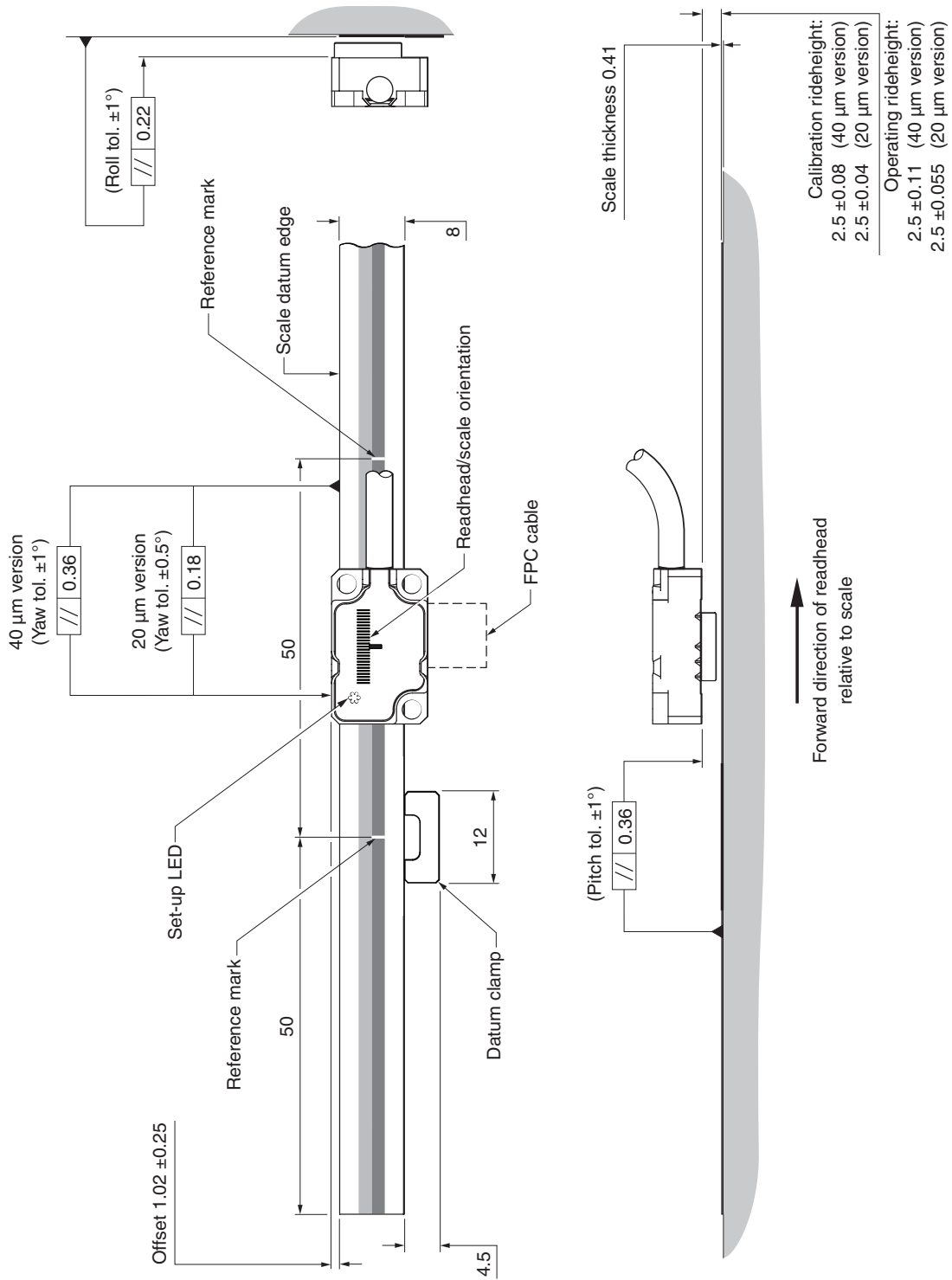
⁴ Maximum recommended axis length 1 m for 20 µm systems.

⁵ To limit maximum tension in the scale $(CTE_{\text{substrate}} - CTE_{\text{scale}}) \times (T_{\text{use extreme}} - T_{\text{install}}) \leq 550 \mu\text{m/m}$ where $CTE_{\text{scale}} = \sim 10.1 \mu\text{m/m}^\circ\text{C}$.

RTLF tape scale installation drawing



Dimensions and tolerances in mm



For detailed installation drawings refer to www.renishaw.com/atomdownloads.

RTLF technical specifications

Material	Hardened and tempered martensitic stainless steel fitted with a self-adhesive backing tape
Form (H × W)	0.41 mm × 8 mm (including adhesive)
Scale pitch	20 µm and 40 µm
Datum fixing	Adhesive datum clamp A-9585-0028 secured with Loctite® 435
Reference mark	Auto-phase optical reference mark repeatable to unit of resolution throughout specified speed and temperature range. Customer deselectable reference marks at 50 mm spacing. ¹ Reference mark in the centre of scale for lengths < 100 mm.
Accuracy (at 20 °C)	RTLF20-S / RTLF40H-S ±5 µm/m RTLF40-S ±15 µm/m
Coefficient of thermal expansion (at 20 °C)	10.1 ±0.2 µm/m/°C ²
Length	20 mm to 1 m in 10 mm increments 1 m to 10 m in 1 m increments ³ Scale length = measuring length + 6 mm (without optional end covers)
Mass	12.2 g/m

¹ Only selected reference mark is bi-directionally repeatable.

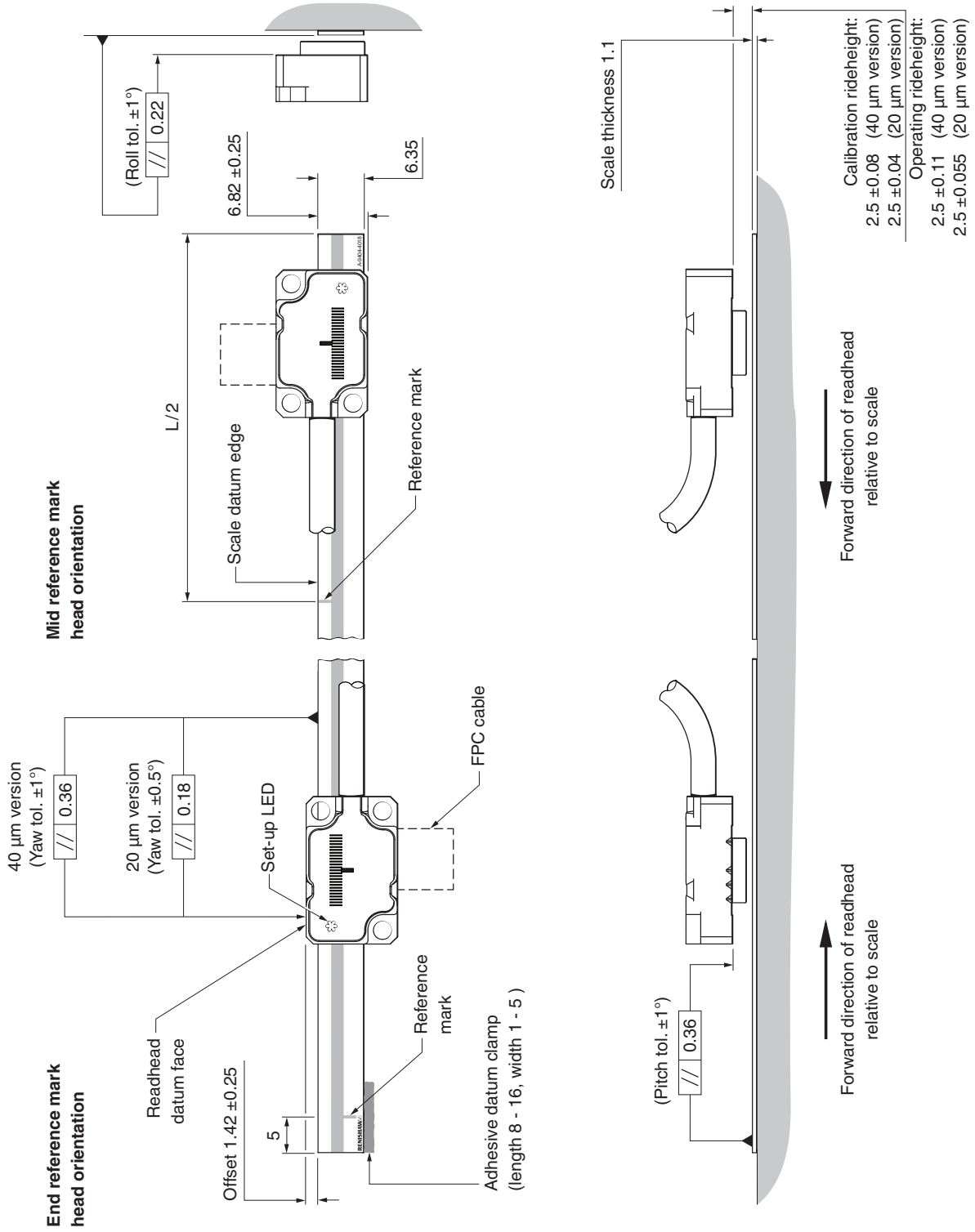
² Substrate coefficient of thermal expansion does not need to match that of the scale.

³ Maximum recommended axis length 1 m for 20 µm systems.

RCLC glass spar installation drawing



Dimensions and tolerances in mm



RCLC technical specifications

Material	Soda-lime glass spar fitted with a self-adhesive backing tape
Form (H × W)	1.1 mm × 6.35 mm (including adhesive)
Scale pitch	20 µm and 40 µm
Datum fixing	Fillet of adhesive (A-9531-0342) on one side of the scale
Reference mark	Auto-phase optical reference mark repeatable to unit of resolution throughout specified speed and temperature range. Either mid or one end of travel, determined by orientation of the readhead.
Accuracy (at 20 °C)	±3 µm
Coefficient of thermal expansion	~8 µm/m/°C
Mass	13.9 g/m

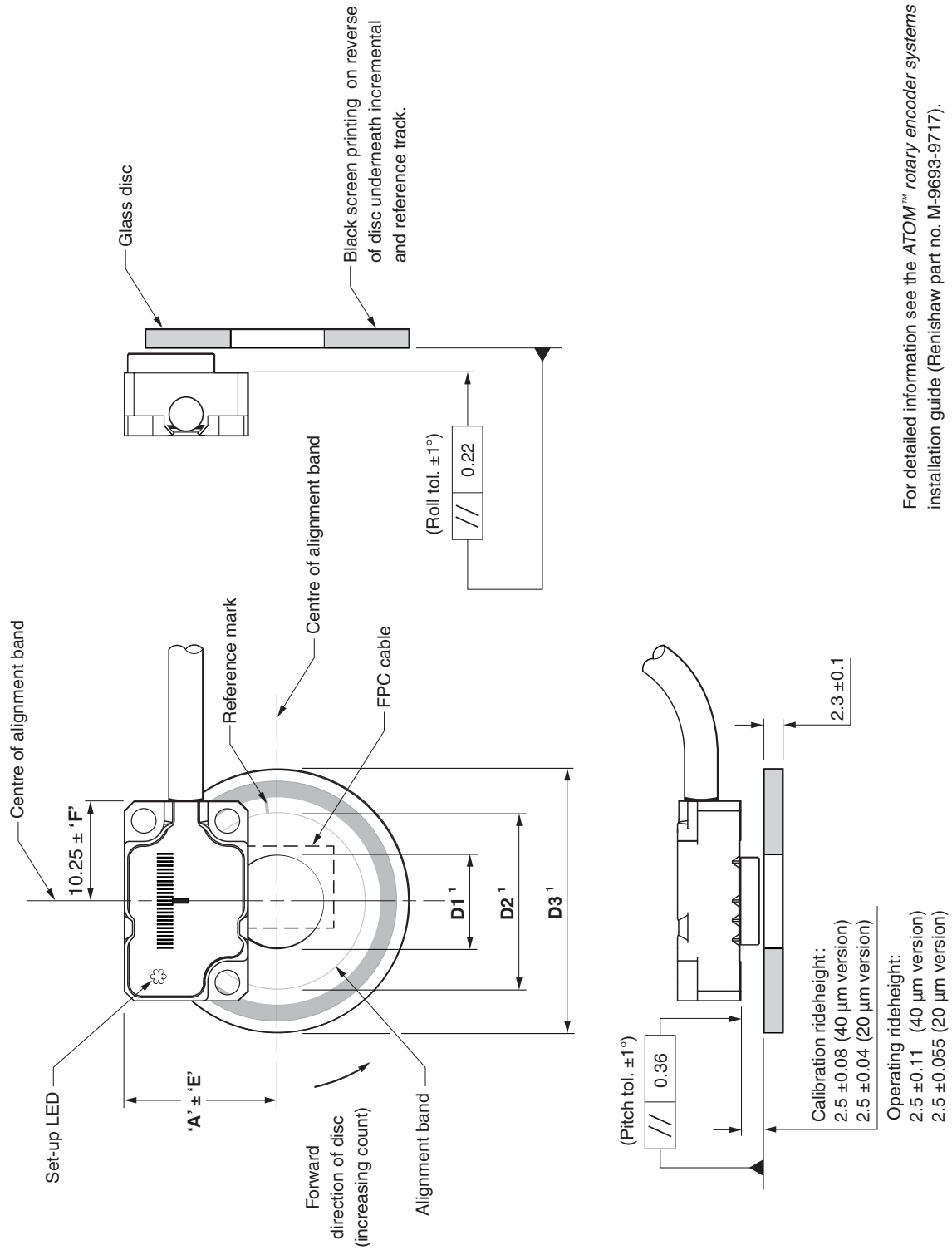
RCLC scale length

Overall length (mm)	10	18	30	55	80	100	105	130
Measuring length (mm)	7	15	27	52	77	97	102	127

RCDM rotary disc installation drawing



Dimensions and tolerances in mm



For detailed information see the *ATOM™ rotary encoder systems* installation guide (Renishaw part no. M-9693-9717).

¹ The dimensions D1, D2 and D3 are listed on the following page.

Dimensions

Disc size ¹ (mm)	Line count		D1 (mm)	D2 (mm)	D3 (mm)	Optical diameter (mm)	A (mm)	Radial tolerance E (mm)		Longitudinal tolerance F (mm)	
	20 µm version	40 µm version						20 µm version	40 µm version	20 µm version	40 µm version
17	-	1 024	3.275	8.1	16.9	13.04	10.63	-	0.1	-	0.1
20	-	1 250	3.275	11	19.9	15.92	12.07	-	0.1	-	0.1
25	-	1 650	6.46	16.1	24.9	21.01	14.62	-	0.125	-	0.075
27	-	1 800	9.625	18	26.9	22.92	15.57	-	0.125	-	0.075
30	4 096	2 048	12.8	21.15	29.9	26.08	17.15	0.1	0.125	0.075	0.125
36	5 000	2 500	12.8	26.9	35.9	31.83	20.03	0.125	0.175	0.075	0.2
50	7 200	3 600	25.5	40.9	49.9	45.84	27.03	0.125	0.2	0.075	0.2
56	8 192	4 096	25.5	47.25	55.9	52.15	30.19	0.125	0.2	0.1	0.2
68	10 000	5 000	25.5	58.55	67.9	63.66	35.94	0.15	0.2	0.125	0.3
108	16 384	8 192	50.9	99.2	107.9	104.3	56.26	0.2	0.2	0.225	0.3

¹ Special disc sizes available on request.

RCDM technical specifications

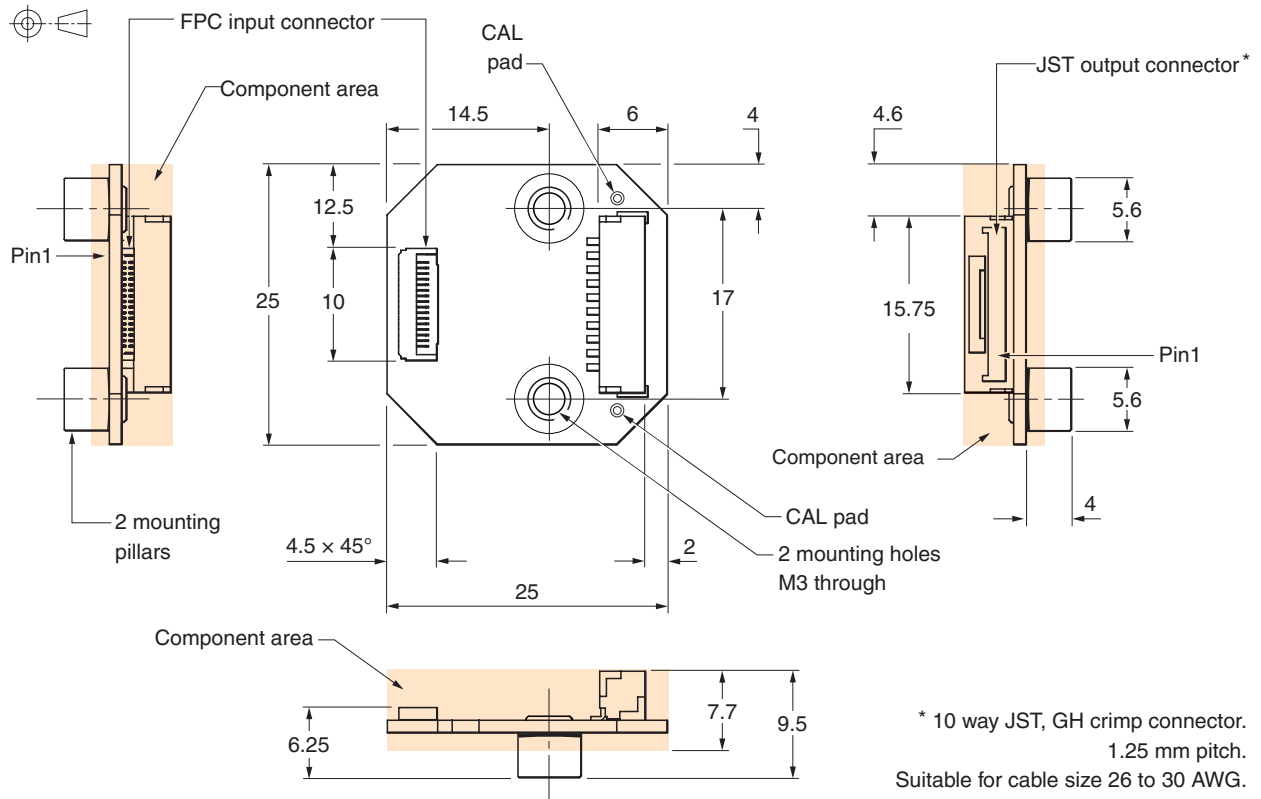
Material	Soda-lime glass	
Form	2.3 mm thick	
Reference mark	Single reference mark	
Coefficient of thermal expansion	~8 µm/m/°C	
Nominal outer diameter (mm)	40 µm	17, 20, 25, 27, 30, 36, 50, 56, 68, 108
	20 µm	30, 36, 50, 56, 68, 108

Graduation accuracy

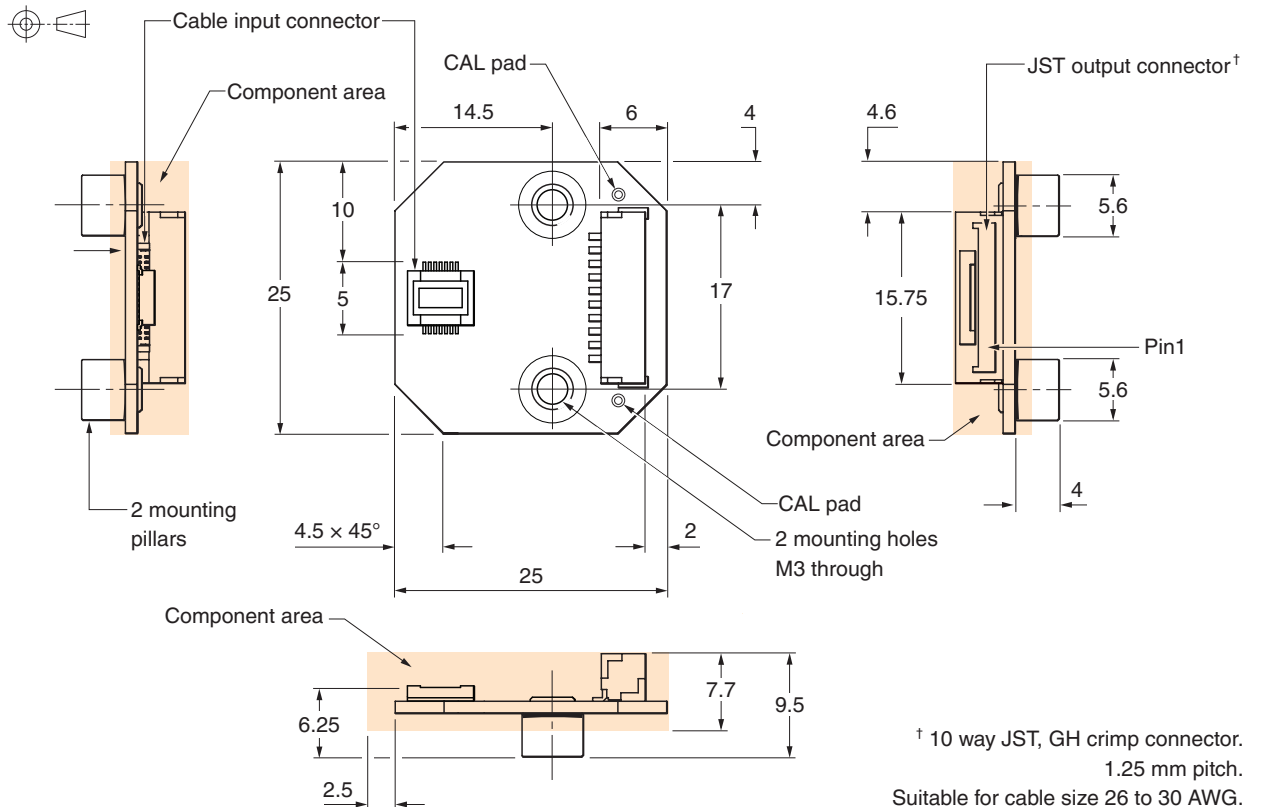
Disc size (mm)	17	20	25	27	30	36	50	56	68	108
Graduation accuracy (arc seconds)	15.81	12.95	9.82	9	7.91	6.49	4.5	3.95	3.24	2.78

ACi interface

FPC variant dimension drawing

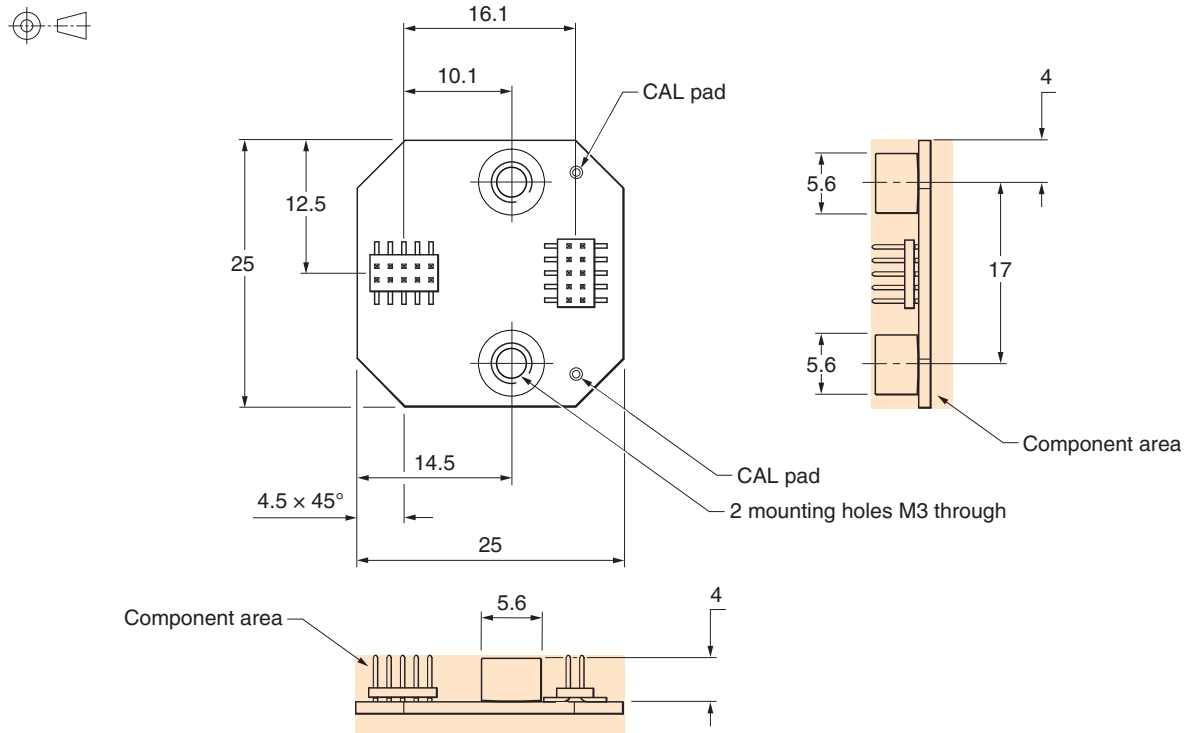


Cable variant dimension drawing



PCB mounting variant dimension drawing

Dimensions and tolerances in mm



ACi speed

20 μm system

Maximum speed (m/s)								Lowest recommended counter input frequency (MHz)
0020 (1 μm)	0040 (0.5 μm)	0080 (0.25 μm)	0100 (0.2 μm)	0200 (0.1 μm)	0400 (50 nm)	1000 (20 nm)	2000 (10 nm)	
6.5	6.5	6.5	5.8	3	-	-	-	40
6.5	6.5	4	3.2	1.6	-	-	-	20
-	-	-	-	-	0.35	0.13	0.06	12
6.5	4	2	1.6	0.8	-	-	-	10
-	-	-	-	-	0.18	0.06	0.03	6
4	2	1	0.8	0.4	-	-	-	5
-	-	-	-	-	0.12	0.04	0.02	4

40 μm system

Maximum speed (m/s)								Lowest recommended counter input frequency (MHz)
0020 (2 μm)	0040 (1 μm)	0080 (0.5 μm)	0100 (0.4 μm)	0200 (0.2 μm)	0400 (0.1 μm)	1000 (40 nm)	2000 (20 nm)	
13	13	13	11.6	6	-	-	-	40
13	13	8	6.4	3.2	-	-	-	20
-	-	-	-	-	0.7	0.26	0.12	12
13	8	4	3.2	1.6	-	-	-	10
-	-	-	-	-	0.36	0.12	0.06	6
8	4	2	1.6	0.8	-	-	-	5
-	-	-	-	-	0.24	0.08	0.04	4

Angular speed

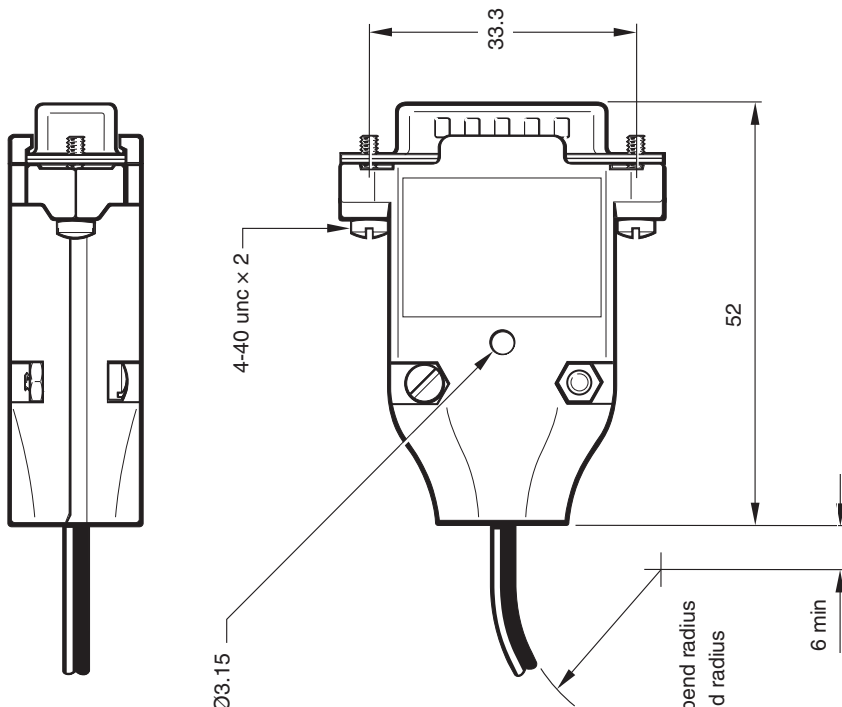
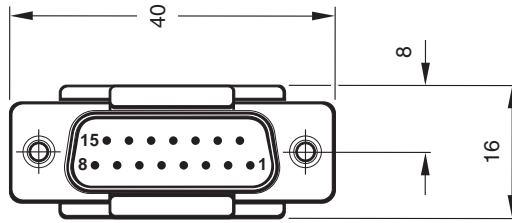
Angular speed depends on disc optical diameter – use the following equation to convert to rev/min:

$$\text{Angular speed (rev/min)} = \frac{V \times 1000 \times 60}{\pi D} \quad \text{where } V = \text{maximum linear speed (m/s)} \text{ and } D = \text{optical diameter (mm)}$$

Ri interface

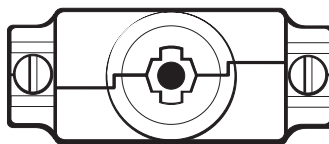
Dimension drawing

Dimensions and tolerances in mm



CAL/AGC push button switch access hole Ø3.15

R > 20 Dynamic bend radius
R > 10 Static bend radius



Ri speed

Clocked outputs

Ri0100, Ri0200 and Ri0400 interfaces have clocked outputs.

Customers must ensure they comply with the lowest recommended counter input frequency.

Maximum speed (m/s)						Lowest recommended counter input frequency (MHz)
20 µm system			40 µm system			
0100 (0.2 µm)	0200 (0.1 µm)	0400 (50 nm)	0100 (0.4 µm)	0200 (0.2 µm)	0400 (0.1 µm)	
-	0.8	0.4	-	1.6	0.8	12
-	0.5	0.25	-	1	0.5	10
0.8	0.4	0.2	1.6	0.8	0.4	6
0.5	0.25	0.12	1	0.5	0.24	4

Non-clocked outputs

Ri0004, Ri0008, Ri0020 and Ri0040 interfaces have non-clocked outputs.

20 µm system		40 µm system		Lowest recommended counter input frequency (MHz)
Interface type	Maximum speed (m/s)	Interface type	Maximum speed (m/s)	
0004 (5 µm)	10	0004 (10 µm)	20	$\left(\frac{\text{Encoder velocity (m/s)}}{\text{Resolution (µm)}} \right) \times 4 \text{ safety factor}$
0008 (2.5 µm)	10	0008 (5 µm)	20	
0020 (1 µm)	10	0020 (2 µm)	20	
0040 (0.5 µm)	10	0040 (1 µm)	20	

Analogue outputs

40 µm system - 20 m/s (-3dB)

20 µm system - 10 m/s (-3dB)

Angular speed

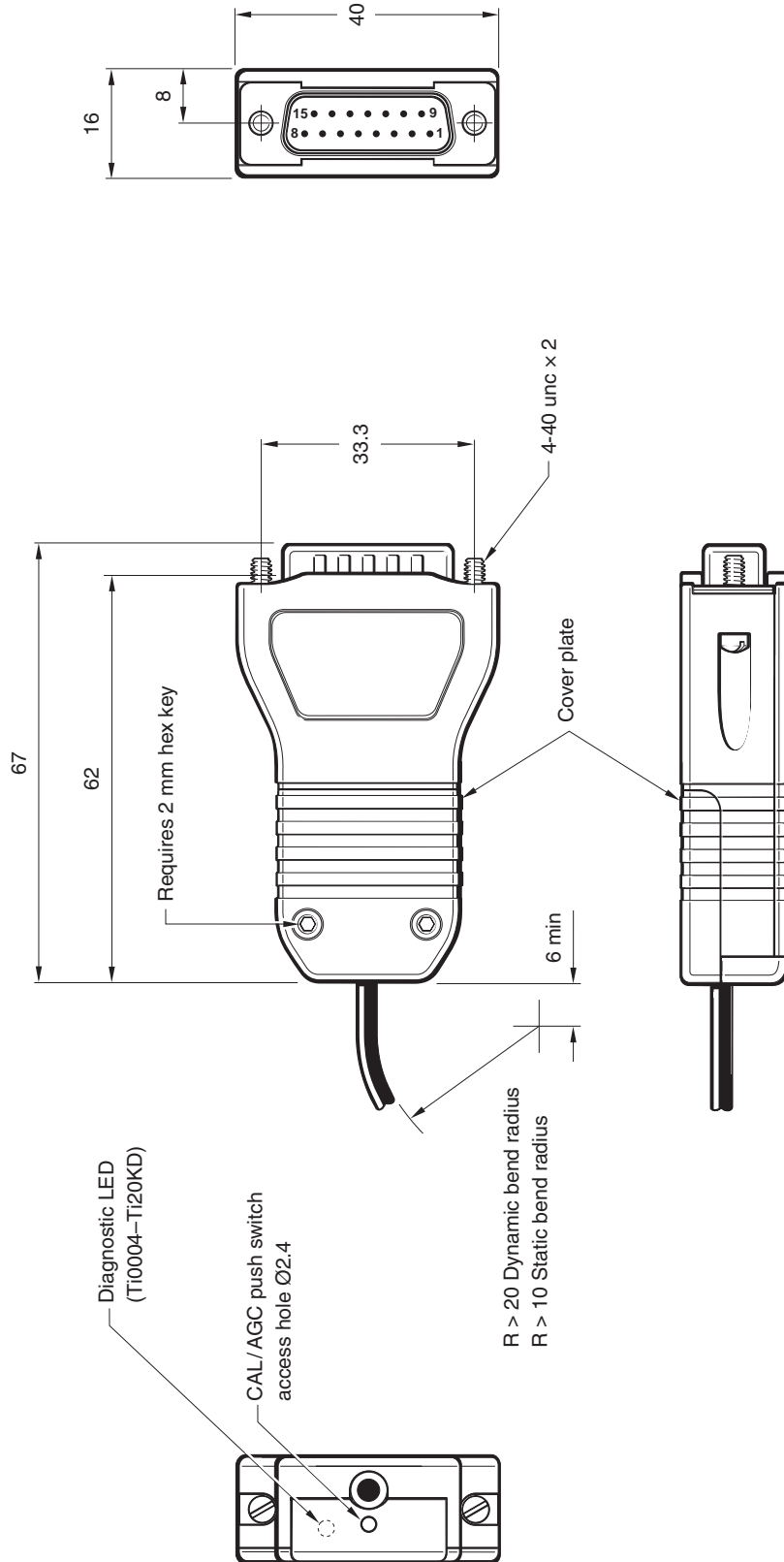
Angular speed depends on disc optical diameter – use the following equation to convert to rev/min:

$$\text{Angular speed (rev/min)} = \frac{V \times 1000 \times 60}{\pi D} \text{ where } V = \text{maximum linear speed (m/s) and } D = \text{optical diameter (mm)}$$

Ti interface

Dimension drawing

Dimensions and tolerances in mm



Ti speed

20 µm system

Maximum speed (m/s)											Lowest recommended counter input frequency (MHz)
Ti0004 5 µm	Ti0020 1 µm	Ti0040 0.5 µm	Ti0100 0.2 µm	Ti0200 0.1 µm	Ti0400 50 nm	Ti1000 20 nm	Ti2000 10 nm	Ti4000 5 nm	Ti10KD 2 nm	Ti20KD 1 nm	
10	10	10	6.48	3.24	1.62	0.648	0.324	0.162	0.0654	0.032	50
10	10	10	5.4	2.7	1.35	0.54	0.27	0.135	0.054	0.027	40
10	10	8.1	3.24	1.62	0.81	0.324	0.162	0.081	0.032	0.016	25
10	10	6.75	2.7	1.35	0.675	0.27	0.135	0.068	0.027	0.013	20
10	9	4.5	1.8	0.9	0.45	0.18	0.09	0.045	0.018	0.009	12
10	8.1	4.05	1.62	0.81	0.405	0.162	0.081	0.041	0.016	0.0081	10
10	6.48	3.24	1.29	0.648	0.324	0.13	0.065	0.032	0.013	0.0065	8
10	4.5	2.25	0.9	0.45	0.225	0.09	0.045	0.023	0.009	0.0045	6
10	3.37	1.68	0.67	0.338	0.169	0.068	0.034	0.017	0.0068	0.0034	4
4.2	0.84	0.42	0.16	0.084	0.042	0.017	0.008	0.004	0.0017	0.0008	1

40 µm system

Maximum speed (m/s)											Lowest recommended counter input frequency (MHz)
Ti0004 10 µm	Ti0020 2 µm	Ti0040 1 µm	Ti0100 0.4 µm	Ti0200 0.2 µm	Ti0400 0.1 µm	Ti1000 40 nm	Ti2000 20 nm	Ti4000 10 nm	Ti10KD 4 nm	Ti20KD 2 nm	
20	20	20	12.96	6.48	3.25	1.296	0.648	0.324	0.013	0.064	50
20	20	20	10.8	5.4	2.7	1.08	0.54	0.27	0.108	0.054	40
20	20	16.2	6.48	3.24	1.62	0.648	0.324	0.162	0.064	0.032	25
20	20	13.5	5.4	2.7	1.34	0.54	0.27	0.136	0.054	0.026	20
20	18	9	3.6	1.8	0.9	0.36	0.18	0.09	0.036	0.018	12
20	16.2	8	3.24	1.62	0.8	0.324	0.162	0.082	0.032	0.0162	10
20	12.96	6.48	2.58	1.296	0.648	0.26	0.13	0.064	0.026	0.013	8
20	9	4.5	1.8	0.9	0.45	0.18	0.09	0.046	0.018	0.009	6
20	6.74	3.36	1.34	0.676	0.338	0.136	0.068	0.034	0.0136	0.0068	4
8.4	1.68	0.84	0.32	0.168	0.084	0.034	0.016	0.008	0.0034	0.0016	1

Analogue speed

40 µm system - 20 m/s (-3dB)

20 µm system - 10 m/s (-3dB)

Angular speed

Angular speed depends on disc optical diameter – use the following equation to convert to rev/min:

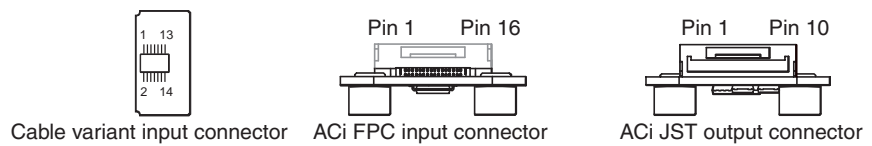
$$\text{Angular speed (rev/min)} = \frac{V \times 1000 \times 60}{\pi D} \quad \text{where } V = \text{maximum linear speed (m/s)} \text{ and } D = \text{optical diameter (mm)}$$

Interface signals

ACi FPC and cable variant interface (digital output only)

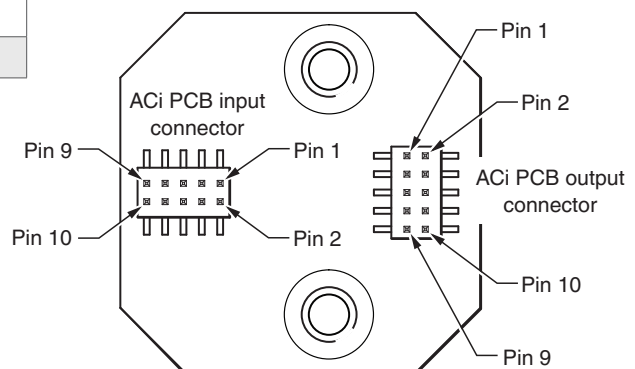
Function	Input				Output		
	Signal	Cable		FPC	JST		
		Colour	Pin	Pin	Signal	Pin	
Power ¹	5 V	Brown	4	7, 8	5 V	9	
	0 V	White	13	3, 6, 11, 14	0 V	10	
Incremental	V ₁	+	Red	9	A	+	1
		-	Blue	5		-	2
	V ₂	+	Yellow	12	B	+	3
		-	Green	14		-	4
Reference mark	V ₀	+	Violet	2	Z	+	5
		-	Grey	8		-	6
Set-up	V _x	Clear	6	1	X	7	
Remote CAL	CAL	Orange	10	2	CAL	8	
Shield	-	Screen	Cable ferrule	-	-	-	
Do not connect	-	-	1, 3, 7, 11	9, 10	-	-	

¹ All power connections can be used either to minimise voltage drop down the cable or incorporate voltage sensing.



ACi PCB mounting variant interface (digital output only)

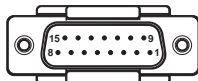
Function	Input		Output			
	Signal	Pin	Signal	Pin		
Power	5 V	9	5 V	6		
	0 V	2	0 V	5		
Incremental	V ₁	+	4	A	+	8
		-	6		-	10
	V ₂	+	3	B	+	7
		-	1		-	9
Reference mark	V ₀	+	8	Z	+	3
		-	10		-	1
Remote CAL	V _x	7	X	4		
Shield	CAL	5	CAL	2		



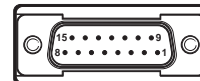
Interface signals

Ri and Ti interfaces

Function	Digital		Analogue			
	Signal	Pin	Signal	Pin		
Power ¹	5 V	7, 8	5 V	4, 5		
	0 V	2, 9	0 V	12, 13		
Incremental signals	A	+	14	V ₁	+	9
		-	6		-	1
	B	+	13	V ₂	+	10
		-	5		-	2
Reference mark	Z	+	12	V ₀	+	3
		-	4		-	11
Alarm ²	E	+	11	-	-	-
		-	3			
Set-up	X	1	V _x	6		
Remote CAL	-	-	CAL	14		
Shield	-	Case	-	Case		
Do not connect	-	10, 15	-	7, 8, 15		



Ri connector




Ti connector

¹ All power connections should be used either to minimise voltage drop down the cable or incorporate voltage sensing.

² The alarm signal can be output as a line driven signal or 3-state. Select the preferred option at time of ordering.

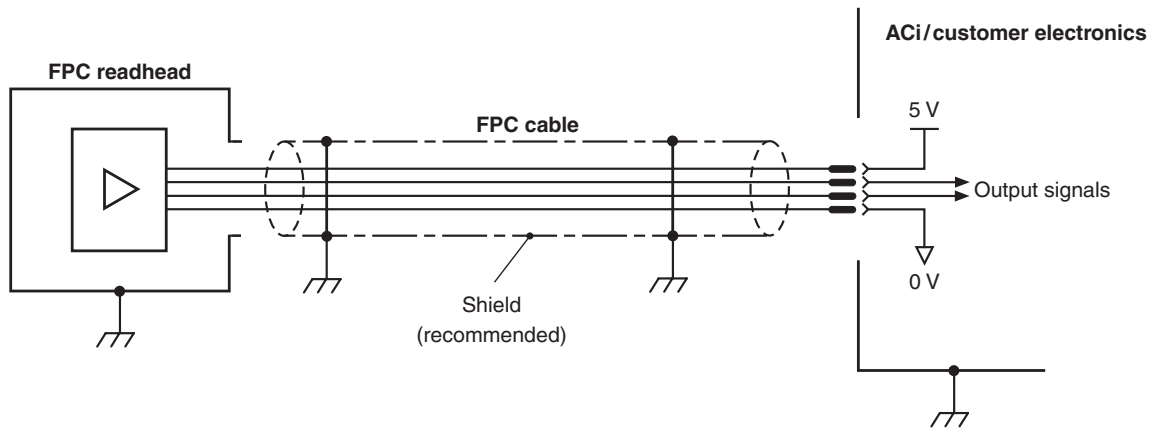
General specifications

Power supply ¹	5 V ±10%	<p>ATOM readhead typically < 50 mA</p> <p>ATOM with ACi typically < 100 mA</p> <p>ATOM with Ri typically < 100 mA</p> <p>ATOM with Ti typically < 200 mA</p> <p>For analogue outputs a further 10 mA in total will be drawn when terminated with 120R.</p> <p>For digital outputs a further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120R.</p> <p>Power from a 5 Vdc supply complying with the requirements for SELV of standard IEC 60950-1.</p>
	Ripple	200 mVpp maximum@frequency up to 500 kHz
Temperature	Storage	-20 °C to +70 °C
	Operating	0 °C to +70 °C
Humidity		95% relative humidity (non-condensing) to IEC 60068-2-78
Sealing	Cable variant	IP40
	FPC variant	IP20 (with lid fitted)
	Ri interface	IP20
	Ti interface	IP20
Acceleration (system)	Operating	400 m/s ² , 3 axes
Shock (system)	Operating	1000 m/s ² , 6 ms, ½ sine, 3 axes
Vibration	Operating	100 m/s ² max @ 55 Hz to 2000 Hz, 3 axes
Mass	Cable readhead	4 g
	FPC readhead	2.3 g
	Cable	18 g/m
	Ti interface	100 g
	Ri interface	70 g
	ACi interface	4 g
Readhead cable		<p>10 core, high flex, EMI screened cable, outside diameter 3.5 mm maximum</p> <p>Flex life > 20 × 10⁶ cycles at 20 mm bend radius, maximum length 5 m.</p> <p>(Extension cable up to 25 m when using Renishaw approved extension cable)</p> <p>UL recognised component </p>
FPC cable		16 core, 0.5 mm pitch, maximum exposed conductor length 2.5 mm, maximum length 1 m
Connector options	Cable variants	Interboard connector compatible with the Ri, Ti and ACi (cable variant) interfaces
	FPC	15-way, D-type connector
		16 core, 0.5 mm pitch, compatible with ACi (FPC variant)
Typical SDE (analogue)	20 µm version	< ±75 nm
	40 µm version	< ±120 nm

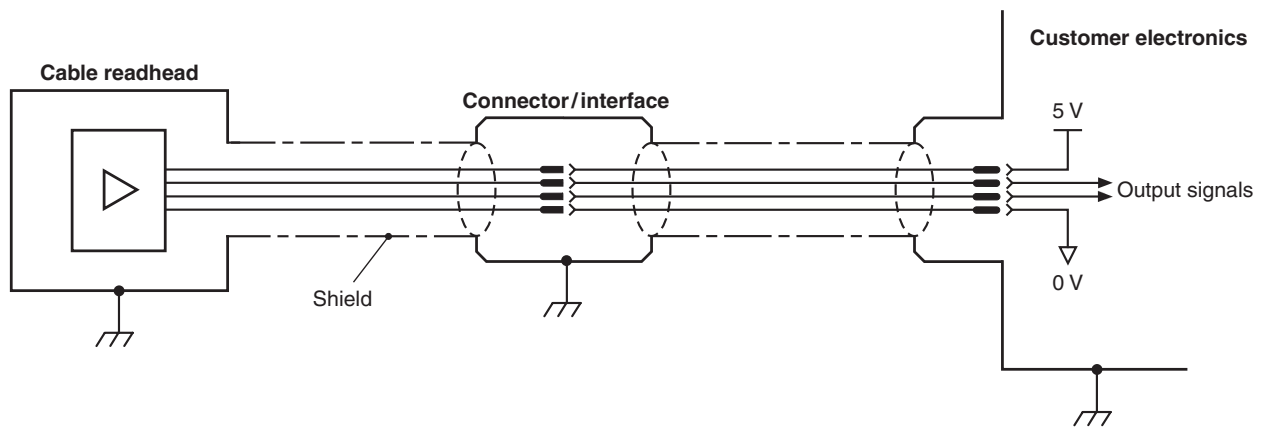
¹ Current consumption figures refer to unterminated systems.

Electrical connections

Grounding and shielding



For more information on FPC refer to the installation guide.

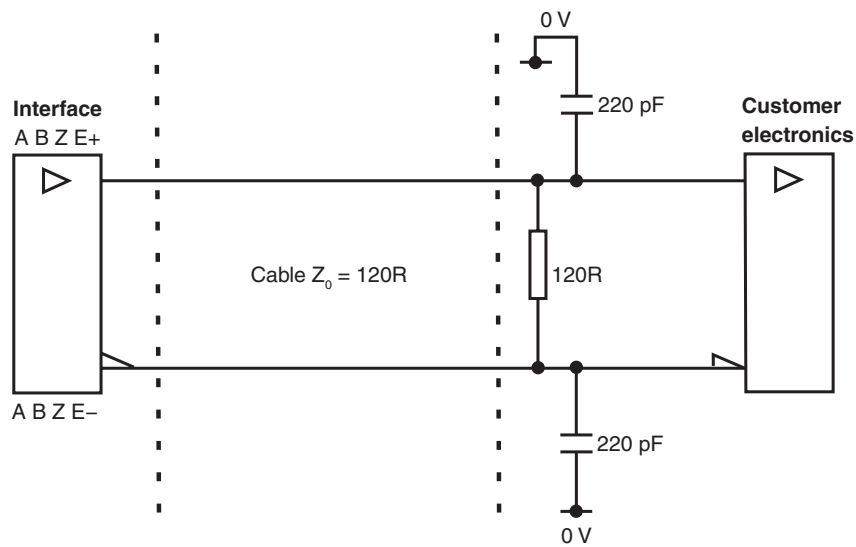


IMPORTANT: The shield should be connected to the machine earth (Field Ground).

NOTE: Maximum cable length between interface and customer electronics is 25 m for ACi and Ri and 50 m for Ti depending on clocked output.

Recommended signal termination

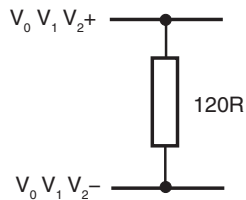
Digital outputs



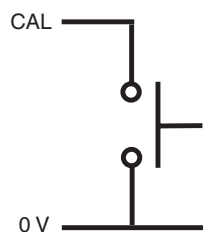
Standard RS422A line receiver circuitry.

Capacitors recommended for improved noise immunity.

Analogue outputs



Remote CAL operation



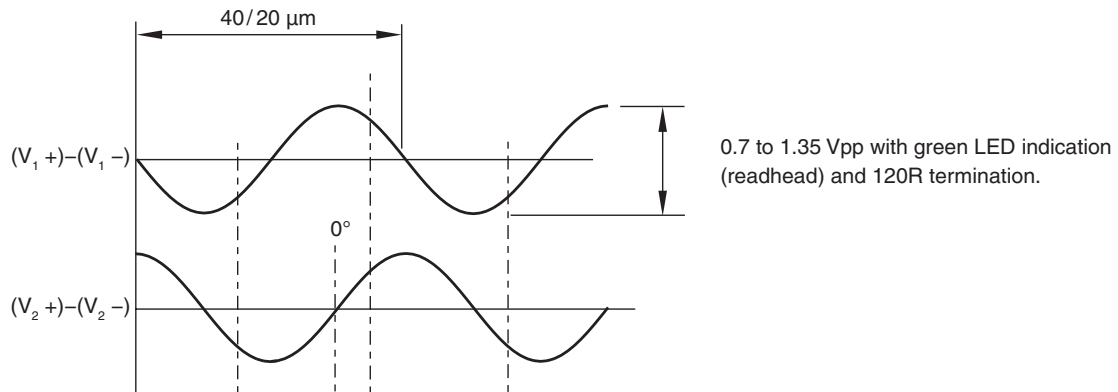
Remote operation of the CAL is possible via the CAL pin. For applications where no interface is used, remote CAL operation is essential.

Output specifications

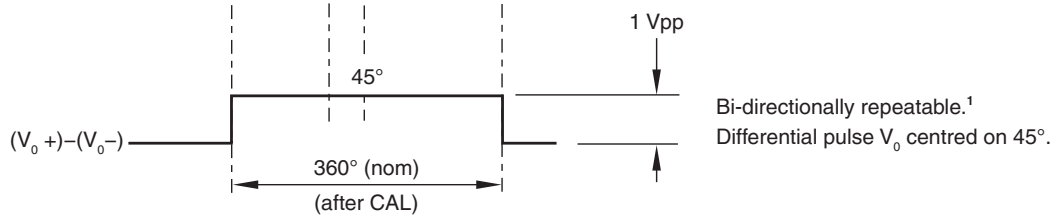
Analogue output signals

All ATOM readheads and Ri and Ti analogue interfaces

Incremental 2 channels V_1 and V_2 differential sinusoids in quadrature, centred ~ 1.65 V (90° phase shifted)



Reference

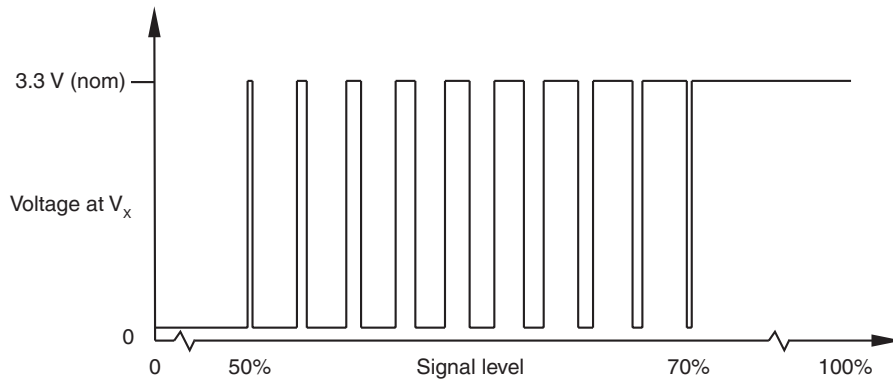


Differential signals V_{0+} and V_{0-} centred on ~ 1.65 V.

¹ Only calibrated reference mark is bi-directionally repeatable.

Set-up

During normal operation

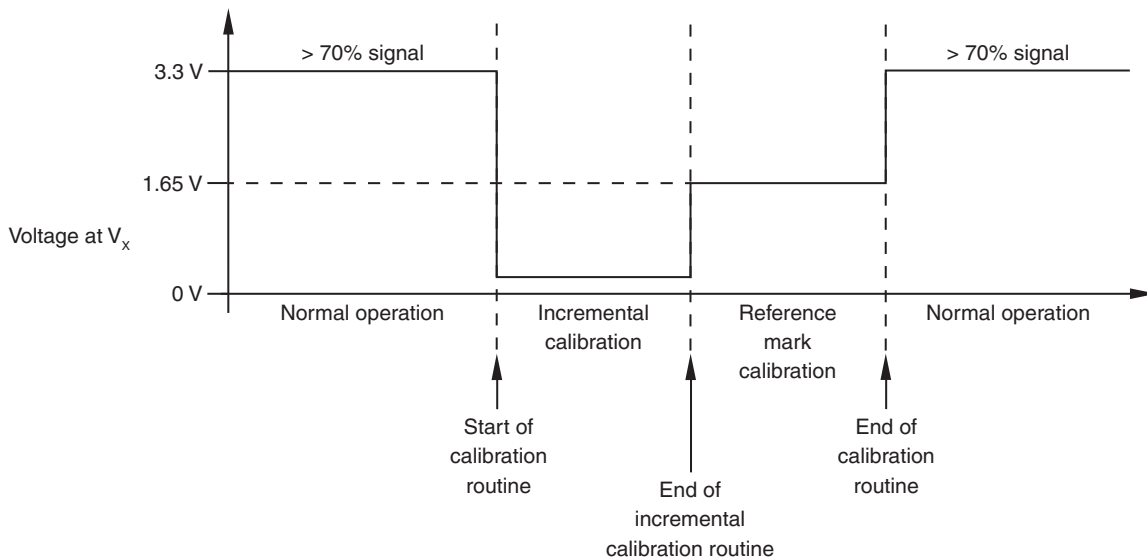


Between 50% and 70% signal level, V_x is a duty cycle.

Time spent at 3.3 V increases with incremental signal level.

At > 70% signal level V_x is nominal 3.3 V.

During CAL routine

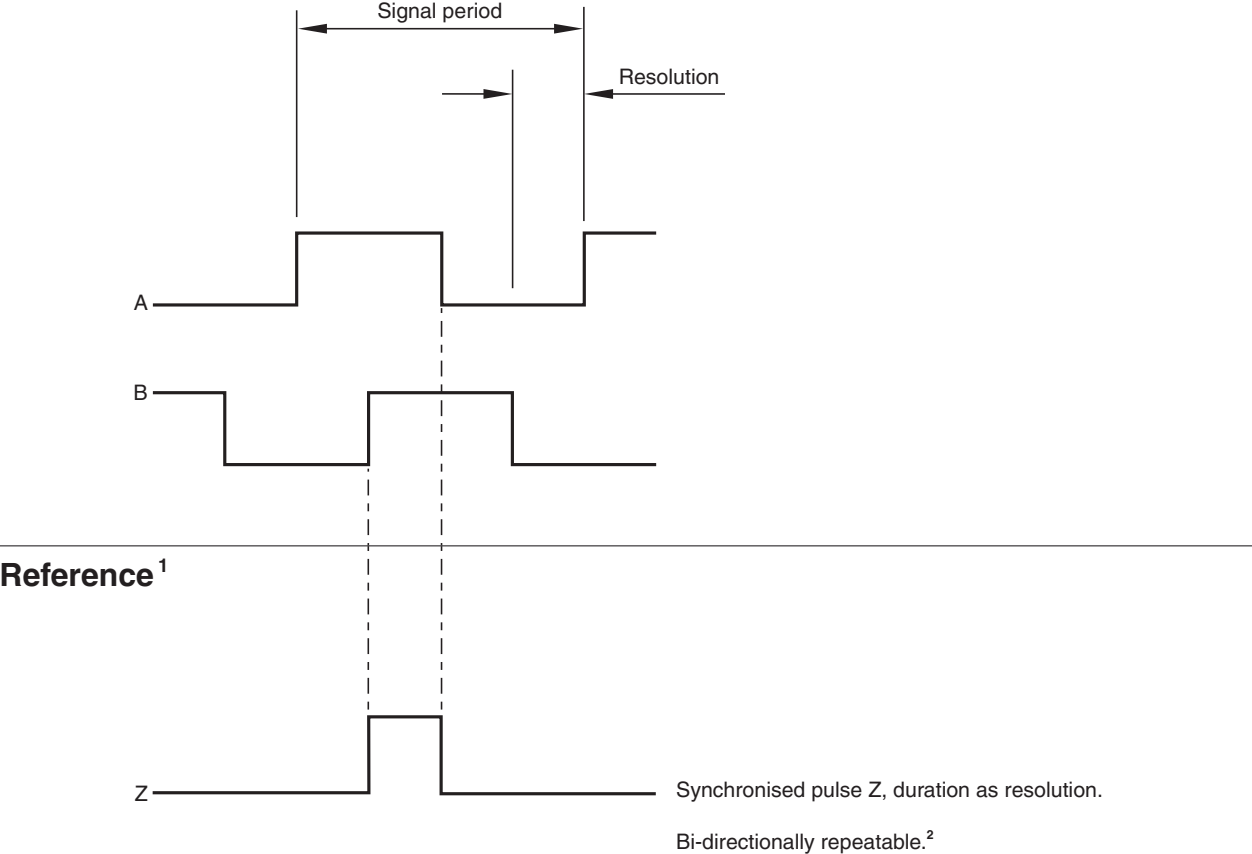


Digital output signals

Form - Square wave differential line driver to EIA RS422A

All ACi interfaces, Ri digital interfaces, and Ti digital interfaces

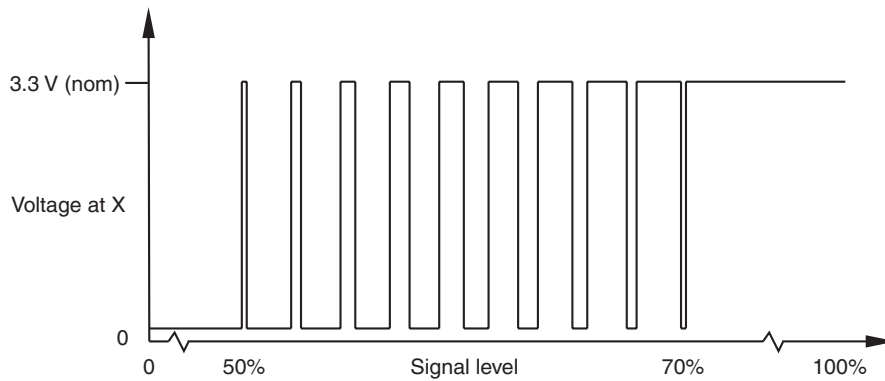
Incremental¹ 2 channels A and B in quadrature (90° phase shifted)



¹ Inverse signals not shown for clarity.

² Only calibrated reference mark is bi-directionally repeatable.

Set-up (ACi interfaces and Ri digital interfaces)

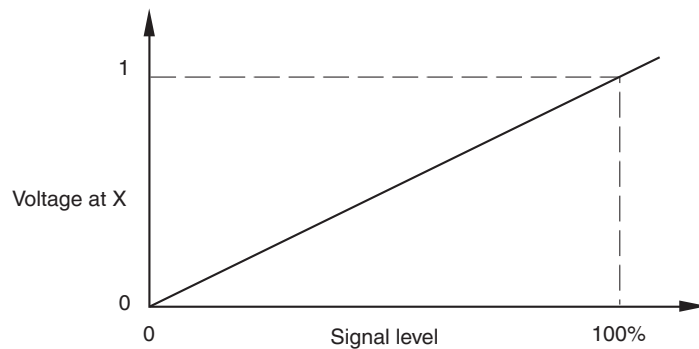


Between 50% and 70% signal level, X is a duty cycle.

Time spent at 3.3 V increases with incremental signal level.

At > 70% signal level X is nominal 3.3 V.

Set-up¹ (Ti digital interfaces only)

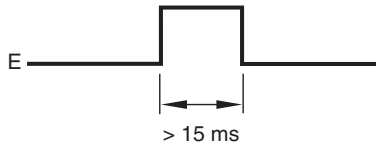


Set-up signal voltage proportional to incremental signal amplitude.

¹ Set-up signal as shown is not present during calibration routine.

Alarm¹

Differential line driven alarm output (Ri digital interfaces and Ti digital interfaces)



Interface model	Alarm asserted when
Ri0004	<ul style="list-style-type: none"> < 40% signal Overspeed
Ri0008	
Ri0020	
Ri0040	
Ri0100	<ul style="list-style-type: none"> < 20% signal > 130% signal
Ri0200	
Ri0400	

Interface model	Alarm asserted when
Ti	<ul style="list-style-type: none"> < 20% signal > 135% signal Overspeed

3-state alarm output (ACi interfaces, Ri digital interfaces, and Ti digital interfaces)

Differentially transmitted signals forced open circuit for > 15 ms when alarm conditions valid.

¹ Inverse signals not shown for clarity.

ATOM readhead

ATOM 4 F 0 - 000

Scale period

- 2 - 20 μm
- 4 - 40 μm

Head type

- F - FPC: for use with FPC variant ACi or customer PCB
- T - Cabled: interboard connector (for use with cable variant ACi, customer PCB, Ri or Ti interfaces)
- D - Cabled: D-type connector

Cable length

- 000 - FPC
- 020 - 200 mm
- 030 - 300 mm
- 050 - 500 mm
- 080 - 800 mm
- 100 - 1000 mm
- 150 - 1500 mm
- 200 - 2000 mm
- 300 - 3000 mm
- 500 - 5000 mm

Head gain setting

Head gain setting	RTL/ RKL ¹ (tape scale)	RCLC (glass spar)	40 μm rotary discs (mm)				20 μm rotary discs (mm)			
			< 20	20	25, 27, 30	> 30	30	36	50, 56, 68	108
0	✓									
1		✓				✓				✓
2					✓				✓	
3				✓				✓		
4			✓				✓			

¹ RKL¹ linear and RKL40 partial arc.

RTLF tape scale

Scale type	Scale pitch	Length	Increments	Part number (where xxxx is the length in cm) ¹	Head gain setting
RTLF20-S	20 µm	20 mm to 1 m	10 mm	A-9406-xxxx	0
		1 m to 10 m ²	1 m		
RTLF40H-S	40 µm (high accuracy)	20 mm to 1 m	10 mm	A-9408-xxxx	0
		1 m to 10 m ²	1 m		
RTLF40	40 µm	20 mm to 1 m	10 mm	A-9407-xxxx	0
		1 m to 10 m ²	1 m		

¹ Ordering A-9408-0070 for example will result in a length of 70 cm.

² Lengths greater than 10 m available on request.

RKLF mastered tape scales

Scale type	Scale pitch	Length	Increments	Part number (where xxxx is the length in cm) ³	Head gain setting
RKLF20-S	20 µm ⁴	20 mm to 1 m	10 mm	A-6767-xxxx	0
		1 m to 10 m	1 m		
RKLF40H-S	40 µm (high accuracy) ⁴	20 mm to 1 m	10 mm	A-6771-xxxx	0
		1 m to 10 m	1 m		
RKLF40	40 µm	20 mm to 1 m	10 mm	A-6769-xxxx	0
		1 m to 10 m	1 m		

³ Ordering A-6767-0070 for example will result in a length of 70 cm.

⁴ Not recommended for partial arc applications.

RCLC glass spar

Length	20 µm	40 µm	Head gain setting
10	A-9404-2010	A-9404-4010	1
18	A-9404-2018	A-9404-4018	1
30	A-9404-2030	A-9404-4030	1
55	A-9404-2055	A-9404-4055	1
80	A-9404-2080	A-9404-4080	1
100	A-9404-2100	A-9404-4100	1
105	A-9404-2105	A-9404-4105	1
130	A-9404-2130	A-9404-4130	1

RCDM rotary discs (20 µm version)

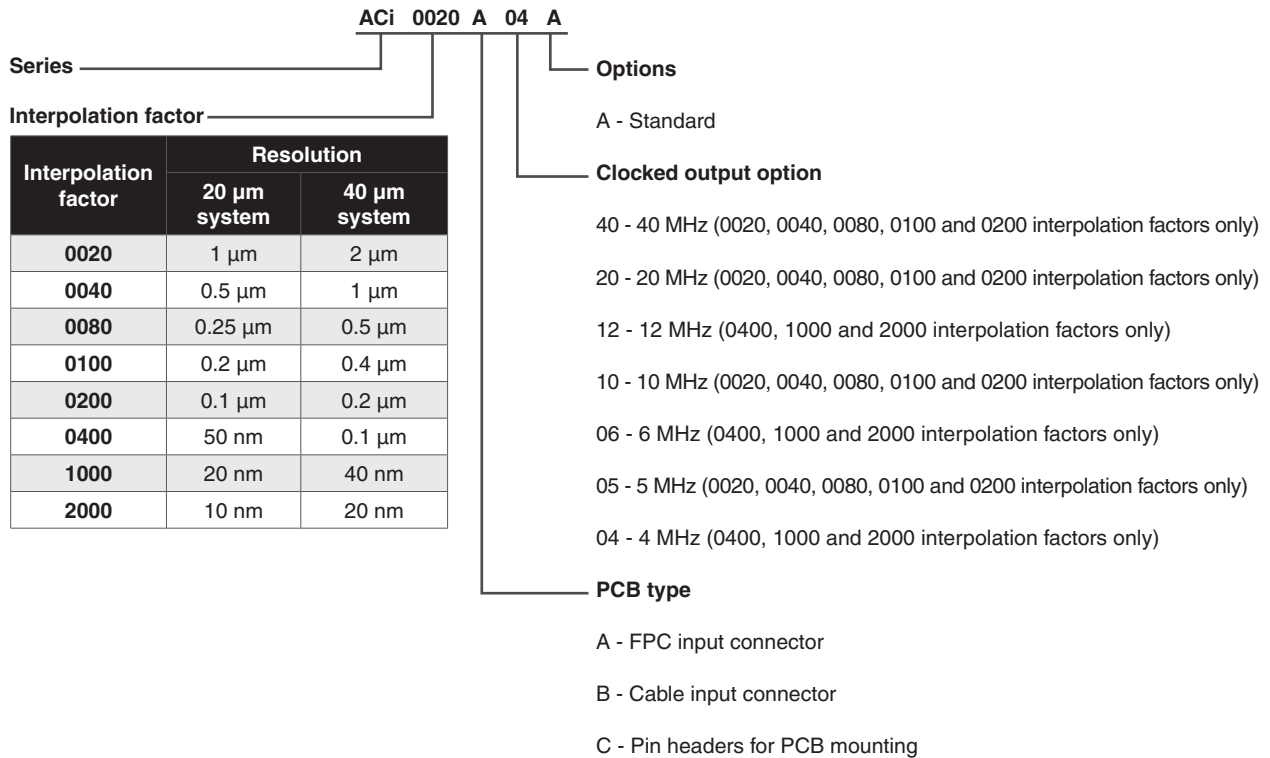
Diameter (mm)	Part number	Head gain setting
30	A-9405-2030	4
36	A-9405-2036	3
50	A-9405-2050	2
56	A-9405-2056	2
68	A-9405-2068	2
108	A-9405-2108	1

NOTE: Other disc diameters are available. Contact your local Renishaw representative for more information.

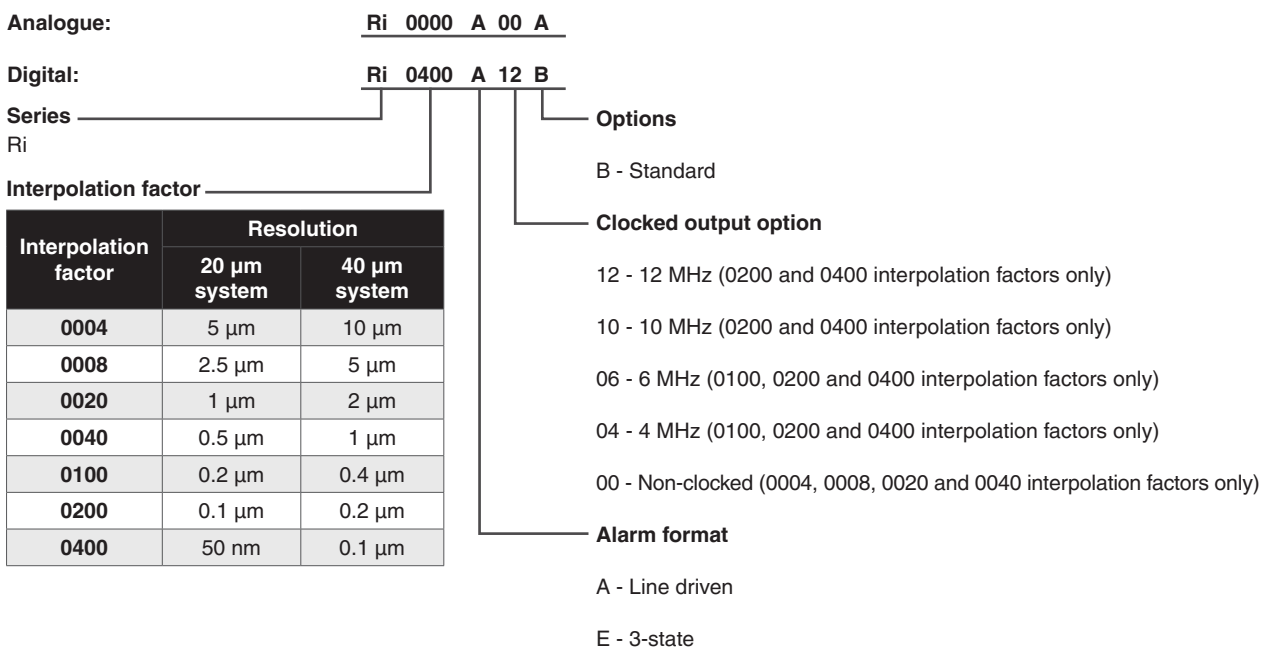
RCDM rotary discs (40 µm version)

Diameter (mm)	Part number	Head gain setting
17	A-9405-4017	4
20	A-9405-4020	3
25	A-9405-4025	2
27	A-9405-4027	2
30	A-9405-4030	2
36	A-9405-4036	1
50	A-9405-4050	1
56	A-9405-4056	1
68	A-9405-4068	1
108	A-9405-4108	1

ACi interface



Ri interface



Ti interface

Analogue: Ti 0000 A 00 A

Options _____

A - Vmid - 1.65 V

V - Vmid - 2.5 V

Digital: Ti 0200 A 20 E

Series _____

Ti

Interpolation factor _____

Options

E - Standard

Clocked output option

50, 40, 25, 20, 12, 10, 08, 06, 04, 01 (MHz)

Alarm format and conditions

A - Line driven; All alarms

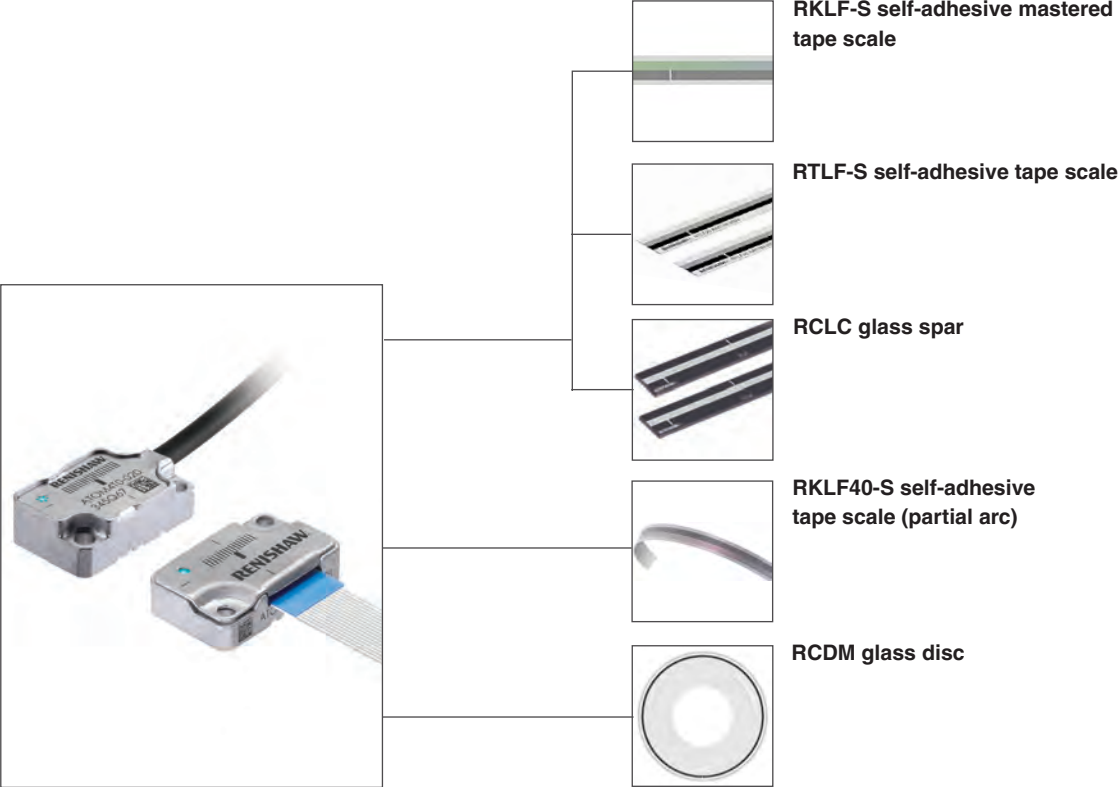
B - Line driven; low signal, high signal

E - 3-state; All alarms

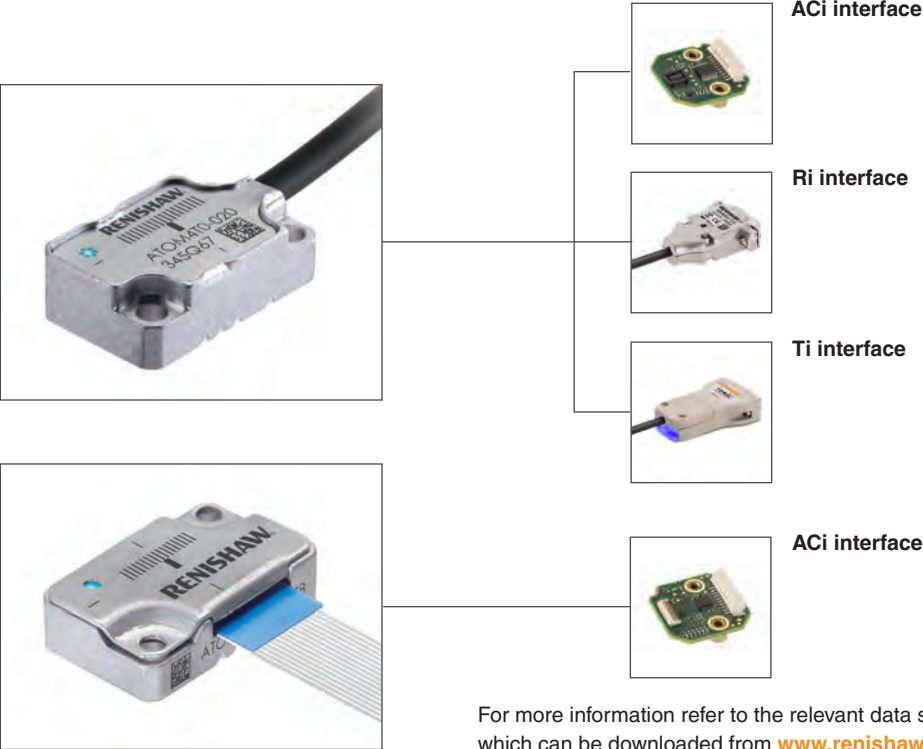
F - 3-state; low signal, high signal

Interpolation factor	Resolution	
	20 μ m system	40 μ m system
0004	5 μ m	10 μ m
0020	1 μ m	2 μ m
0040	0.5 μ m	1 μ m
0100	0.2 μ m	0.4 μ m
0200	0.1 μ m	0.2 μ m
0400	50 nm	0.1 μ m
1000	20 nm	40 nm
2000	10 nm	20 nm
4000	5 nm	10 nm
10KD	2 nm	4 nm
20KD	1 nm	2 nm

ATOM compatible scales



ATOM compatible interfaces



For more information refer to the relevant data sheets and installation guides which can be downloaded from www.renishaw.com/atomdownloads.

www.renishaw.com/contact



#renishaw



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Issued: 01.2023

RKL scale for partial arc applications



Measuring a partial arc of rotation is made easy with Renishaw's flexible RKL encoder scales. The flexible nature of the small cross-sectional area of these scales allows them to be wrapped around a drum, shaft or arc with a minimum radius of 26 mm.

RKL scale is compatible with Renishaw's QUANTIC™, VIONIC™, TONIC™, ATOM DX™, ATOM™ and RESOLUTE™ readheads providing a partial arc solution for a wide range of applications.

RKL scale is installed onto the axis substrate by a self-adhesive backing tape making this a quick, straightforward and inexpensive process. The scale ends are rigidly fixed to the axis substrate by means of epoxy or epoxy fastened end clamps, eliminating the need to drill holes.

- Small cross-sectional area making it ideal for partial arc rotation applications
- Suitable for external radii down to 26 mm
- Compatible with a wide range of Renishaw's incremental and absolute readheads
- 20 µm, 30 µm and 40 µm pitch versions available
- 'Cut-to-length' convenience
- *IN-TRAC*™ optical reference marks
- High solvent immunity

RKL partial arc scale specifications

	Incremental			Absolute
	RKLC20-S	RKLC40-S	RKLF40-S	RKLA30-S
Compatible readheads	VIONiC and TONiC	QUANTiC	ATOM and ATOM DX ¹	RESOLUTE
Form (height x width)	0.15 mm x 6 mm (including adhesive)			
Pitch	20 µm	40 µm	40 µm	30 µm
Accuracy (at 20 °C) (based on neutral axis)	±5 µm/m	±15 µm/m	±15 µm/m	±5 µm/m (including slope and linearity)
Linearity (at 20 °C) (based on neutral axis)	±2.5 µm/m	±3 µm/m	±3 µm/m	-
Supplied length	20 mm to 20 m (> 20 m available on request)		20 mm to 10 m (> 10 m available on request)	20 mm to 21 m
Material	Hardened and tempered stainless steel			
Mass	4.6 g/m			
Coefficient of thermal expansion (at 20 °C)	10.1 ±0.2 µm/m/°C			
Temperature	Storage	-20 °C to +80 °C		
	Operating ²	0 °C to +70 °C		
	Installation	+10 °C to +35 °C		
Humidity	95% relative humidity (non-condensing) to IEC 60068-2-78			
Shock	Operating	500 m/s ² , 11 ms, ½ sine, 3 axes		
Vibration	Operating	300 m/s ² maximum @ 55 to 2000 Hz, 3 axes		
Recommended end fixing	R ≥ 75 mm	Epoxy mounted end clamps (A-9523-4015)		
	R ≥ 26 mm	Approved epoxy adhesive (A-9531-0342)		
Minimum arc radius ³	30 mm	26 mm	26 mm	50 mm

Reference mark ⁴

RKLC20-S and RKLC40-S ⁵	IN-TRAC reference mark, directly embedded into incremental track. Bi-directional position repeatable to unit of resolution throughout specified speed. 50 mm spacing, first reference mark 50 mm from scale end. Reference mark at mid-point of scale length for lengths < 100 mm.
RKLF40-S	Customer de-selectable auto-phase optical reference mark. Bi-directional position repeatable to unit of resolution throughout specified speed. 50 mm spacing, first reference mark 50 mm from scale end. Reference mark at mid-point of scale length for lengths < 100 mm.
RKLA30-S	No reference mark

¹ 40 µm ATOM and ATOM DX readhead variants only.




² To limit the maximum tension in the scale $(CTE_{\text{substrate}} - CTE_{\text{scale}}) \times (T_{\text{use extreme}} - T_{\text{install}}) \leq 550 \mu\text{m/m}$ where $CTE_{\text{scale}} = \sim 10.1 \mu\text{m/m/}^\circ\text{C}$.




³ For smaller radii contact your local Renishaw representative.

⁴ Only the calibrated reference mark is phased.

⁵ Where a specific reference mark location is required, contact your local Renishaw representative for advice on the best method to achieve this.

Compatible readheads

	Incremental		
	VIONIC	TONiC	QUANTiC
			
Readhead size (length x width x height in mm)	35 x 13.5 x 10	35 x 13.5 x 10	35 x 13.5 x 10
Interface	-	Ti, TD or DOP	-
Scale type	RKLC20-S	RKLC20-S	RKLC40-S
Output	Digital resolutions from 5 µm to 2.5 nm direct from the readhead	Analogue 1 Vpp. Digital resolutions from 5 µm to 1 nm from an interface.	Analogue 1 Vpp. Digital resolutions from 10 µm to 50 nm direct from the readhead.
Sub-divisional error (typical)	< ±15 nm	< ±30 nm	< ±150 nm (partial arc radius > 67.5 mm) < ±80 nm ¹ (partial arc radius ≤ 67.5 mm)
Maximum speed	12 m/s	10 m/s	24 m/s ¹
Diagnostic tool	ADTi-100 and ADT View	TONiC diagnostic tool	ADTi-100 and ADT View

	Incremental		
	ATOM ²	ATOM DX ²	RESOLUTE
			
Readhead size (length x width x height in mm)	20.5 x 12.7 x 7.85 (FPC variant: 20.5 x 12.7 x 6.8)	20.5 x 12.7 x 10.85 (Top exit variant: 20.5 x 12.7 x 7.85)	36 x 16.5 x 17.2
Interface	Ri, Ti, ACi	-	DRIVE-CLiQ only
Scale type	RKLF40-S	RKLF40-S	RKLA30-S
Output	Analogue 1 Vpp. Digital resolutions from 10 µm to 2 nm from an interface.	Digital resolutions from 10 µm to 5 nm direct from the readhead.	BiSS, Siemens DRIVECLiQ, FANUC, Mitsubishi, Panasonic, Yaskawa
Sub-divisional error (typical)	< ±120 nm	< ±120 nm	±40 nm
Maximum speed	20 m/s	20 m/s	100 m/s
Diagnostic tool	ATOM diagnostic tool	ADTi-100 and ADT View	ADTa-100 and ADT View

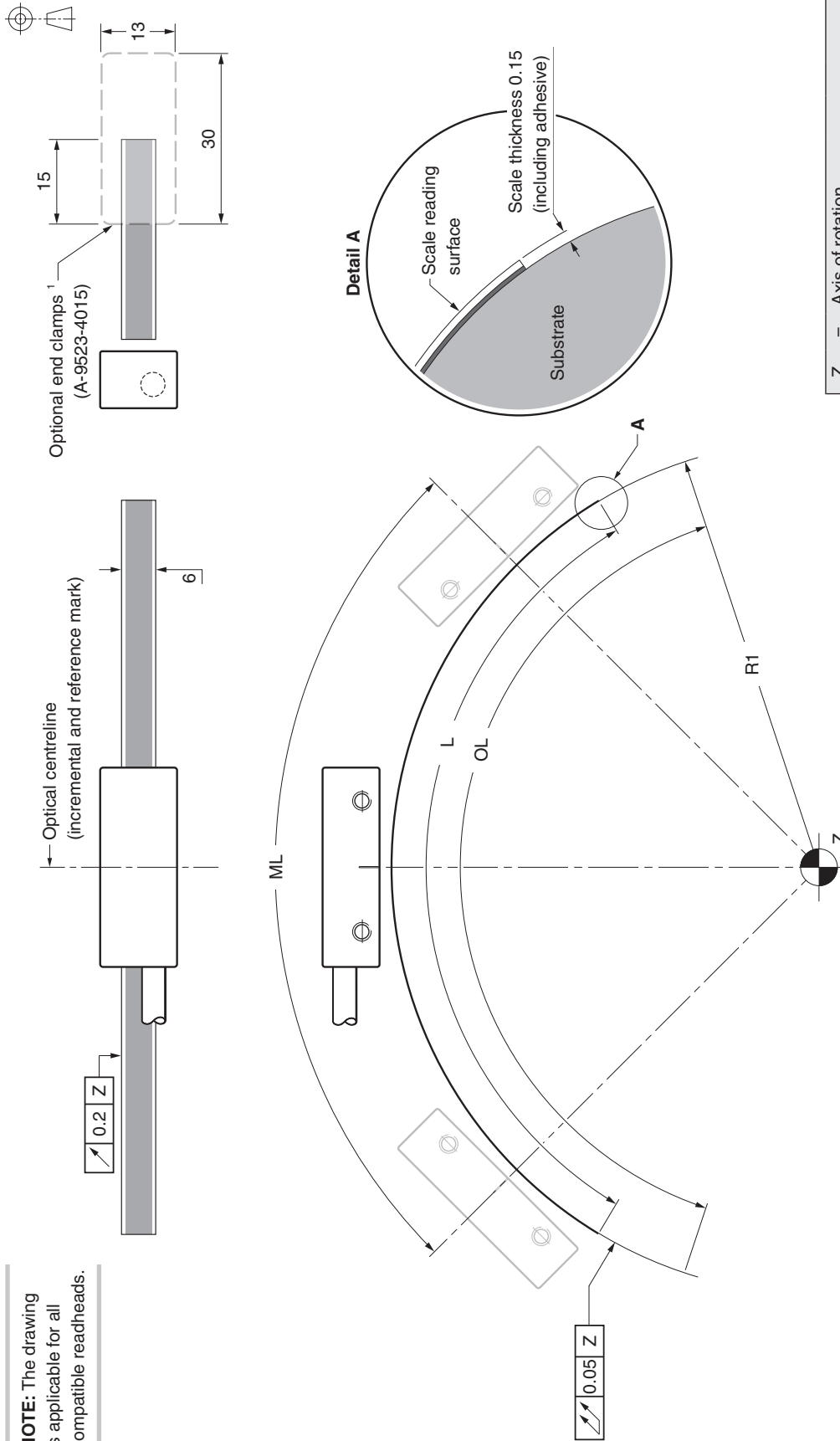
NOTE: If installing RKL scale on a partial arc for a UHV or ETR application, contact your local Renishaw representative for more information.

¹ Digital variants only.

² 40 µm ATOM and ATOM DX readhead variants only.

RKLC partial arc installation drawing

Dimensions and tolerances in mm



NOTE: The drawing is applicable for all compatible readheads.

NOTE: The surface roughness of the substrate must be better than 3.2 μm. The parallelism of the scale surface to the axis guideway (readhead ride height variation) must be within 0.05 mm.

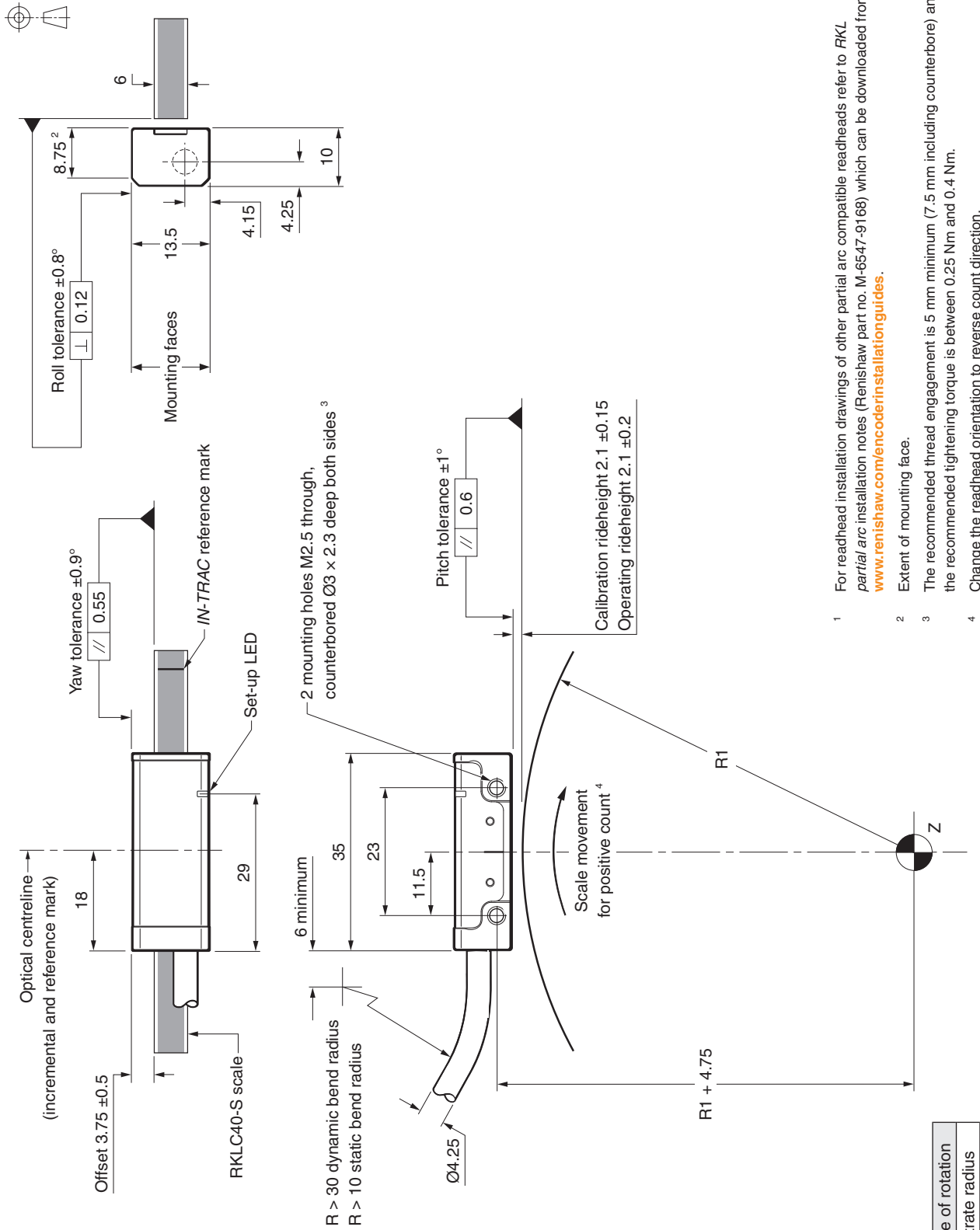
¹ When not using end clamps, the scale ends must be secured using an alternative method. For further information refer to *RKLC partial arc installation notes* (Renishaw part no. M-6547-9168) which can be downloaded from www.renishaw.com/encoderinstallationguides.

² When calculating scale length, the first reference mark is 50 mm from scale end.

³ For RESOLUTE systems: To ensure readhead does not clash with the end clamps. L = ML + 66 and OL = ML + 96.

QUANTiC readhead installation drawing ¹

Dimensions and tolerances in mm



- ¹ For readhead installation drawings of other partial arc compatible readheads refer to *RKL partial arc* installation notes (Renishaw part no. M-6547-9168) which can be downloaded from www.renishaw.com/encoder/installationguides.
- ² Extent of mounting face.
- ³ The recommended thread engagement is 5 mm minimum (7.5 mm including counterbore) and the recommended tightening torque is between 0.25 Nm and 0.4 Nm.
- ⁴ Change the readhead orientation to reverse count direction.

Scale part numbers

Scale type	Part number (where xxxx is the scale length in cm) ¹	Available lengths	Compatible readheads
RKLC40-S	A-6665-xxxx	20 mm to 20 m (> 20 m available on request)	QUANTiC
RKLC20-S	A-6663-xxxx	20 mm to 20 m (> 20 m available on request)	VIONiC and TONiC
RKLF40-S	A-6769-xxxx	20 mm to 20 m (> 20 m available on request)	ATOM and ATOM DX ²
RKLA30-S	A-6667-xxxx	20 mm to 21 m	RESOLUTE

¹ For example, ordering A-6663-0110 will result in a 110 cm length of RKLC20-S.



² 40 µm ATOM and ATOM DX readhead variants only.

Accessory part numbers

RKL scale accessories

Part description	Part number	Product image
Guillotine (for cutting RKL scale)	A-9589-0071	
Shears (for cutting RKL scale)	A-9589-0133	
RKLC-S side mount scale applicator (compatible with VIONiC, TONiC and QUANTiC side mount systems)	A-6547-1912	
RKLC-S top mount scale applicator (required for TONiC top mounted systems only)	A-6547-1915	
RKLF-S side mount applicator (compatible with ATOM and ATOM DX)	A-6547-1943	
RKLF-S top mount applicator (compatible with ATOM and ATOM DX)	A-6547-1939	
RKLF-S slim side mount applicator (compatible with ATOM and ATOM DX)	A-6547-1947	
RKLA-S scale applicator (compatible with RESOLUTE)	A-6547-1918	

End clamp accessories

Part description	Part number	Product image
RGC-F end clamp kit - epoxy mounted (the RGC-F end clamps fix the ends of the partial arc scale to the substrate material)	A-9523-4015	
RGG-2 two part epoxy (the RGG-2 epoxy is recommended for the mounting of end clamps and scale ends)	A-9531-0342	

Reference mark accessories

Part description	Part number	Product image
Reference mark de-selector stickers (pack of 20 de-selector stickers - RKLf ATOM /ATOM DX systems only)	A-9402-0049	