

# RESOLUTE™ absolute optical encoder with *BiSS* serial communications



**RESOLUTE is a revolutionary new true absolute, fine pitch optical encoder system, with excellent dirt immunity, offering an impressive specification that breaks new ground in position feedback.**

RESOLUTE's patented technology combines 1 nm resolution with exceptionally high speed, up to 100 m/s (36 000 rev/min), reading from a range of high accuracy linear tape and spar scales or angle encoder rings.

RESOLUTE uses a unique single optical absolute track (a world first) with a nominal pitch of 30 µm, combined with sophisticated optics. This ensures wide set-up tolerances, very low sub-divisional error of ±40 nm and ultra-low noise (jitter) of less than 10 nm RMS, resulting in better velocity control performance and rock solid positional stability.

Reliability is assured by RESOLUTE's excellent dirt immunity, built-in separate position-checking algorithm and IP64 sealed readhead with wipe-clean recovery.

RESOLUTE is available with a variety of serial protocols. Please contact your local representative for the latest list.

- True absolute non-contact optical encoder system: no batteries required
- Wide set-up tolerances for quick and easy installation
- High immunity to dirt, scratches and light oils
- Resolutions to 1 nm or 32 bit rotary
- 100 m/s maximum speed for all resolutions (to 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
- IP64 sealed readhead for high reliability in harsh environments
- Integral set-up LED enables easy installation and provides diagnostics at a glance
- Readhead and linear/rotary scales are bolt-hole compatible with SIGNUM™ encoders
- Operates up to 80 °C
- Integral over-temperature alarm

#### Compatible with:

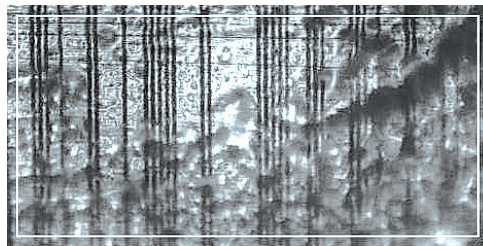
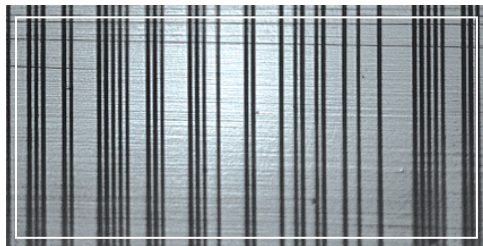
- RELA low expansion, high stability spar scales
- RSLA stainless steel spars
- RTLA with *FASTRACK*™ carrier
- RTLA-S self adhesive tape scale
- RESA angle encoders
- Ultra-high accuracy REXA angle encoders

## System features



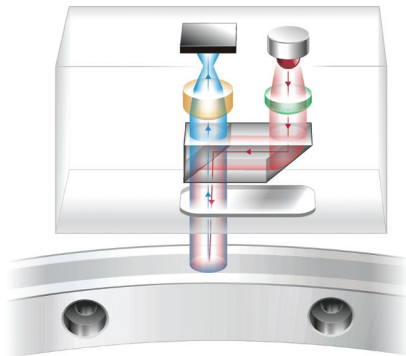
### Unique single track absolute optical scale

- ▶ 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 RESOLUTE 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 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)

### Range of rotary (angle) and linear scales

- ▶ Tough RELA low expansion nickel alloy spars with ±1 µm accuracy up to 1 metre. Available in lengths up to 1.5 metres.
- ▶ Shatter-proof RSLA stainless steel scale, offering higher accuracy than glass scales and long lengths up to 5 metres, with ±4 µm accuracy over a complete 5 metre length
- ▶ RTLA with *FASTRACK*, and RTLA-S tape scales with ±5 µm/m accuracy and easy installation
- ▶ RESA ring with unique taper mount has large through hole for easy installation
- ▶ REXA ultra-high accuracy ring with ±1 arc second total installed accuracy with dual readheads

### Range of protocols and resolutions

Protocol	Resolutions	
	Linear	Rotary
<i>BiSS</i>	50 nm	18 bit
	5 nm	26 bit
	1 nm	32 bit

Other serial protocols are available. Please contact your local Renishaw representative for information.

## Linear absolute encoder version

### Resolutions and scale lengths

The maximum scale length is determined by the readhead resolution and the number of position bits in the serial word. For RESOLUTE readheads with fine resolution and short word length, the maximum scale length will be limited accordingly. Conversely, coarser resolutions or longer word lengths enable the use of longer scale lengths.

RESOLUTE is available with a variety of serial protocols, but the example here shows RESOLUTE using *BiSS-C* (uni-directional) protocol with three options for the position word length; 36 bit, 32 bit and 26 bit.

The 36 bit and 32 bit position words facilitate longer lengths that can be a significant benefit, especially at fine resolutions.

Resolution	1 (nm)	5 (nm)	50 (nm)
Maximum scale length (L) with 36 bit position word	21 m	21 m	21 m
Maximum scale length (L) with 32 bit position word	4.295 m	21 m	21 m
Maximum scale length (L) with 26 bit position word	67 mm	336 mm	3.355 m
Maximum reading speed	100 m/s	100 m/s	100 m/s

Please contact your local Renishaw representative for details of other serial protocols.

### Scale specifications

For more detailed scale information please refer to relevant scale data sheet

Description	RELA	High-performance low expansion spar scale for very high accuracy applications. Lengths up to 1.5 m
	RSLA	High-performance stainless steel spar scale for very high accuracy applications with longer axis lengths. Lengths up to 5 m
	RTLA/FASTRACK	Track-mounted hardened stainless steel tape scale for high performance motion control systems requiring easier and faster scale installation and field replacement. RTLA lengths up to 21 m FASTRACK lengths up to 25 m
	RTLA-S	Self-adhesive hardened stainless steel tape scale for high performance motion control systems requiring easiest installation. Lengths up to 21 m
Accuracy	RELA	±1 µm up to 1 m @ 20 °C ±1 µm/m >1 m to 1.5 m @ 20 °C
	RSLA	±1.5 µm up to 1 m @ 20 °C ±2.25 µm up to 2 m @ 20 °C ±3 µm up to 3 m @ 20 °C ±4 µm up to 5 m @ 20 °C
	RTLA/FASTRACK	±5 µm/m @ 20 °C
	RTLA-S	±5 µm/m @ 20 °C
Thermal expansion coefficient	RELA	0.75 ±0.35 µm/m/°C @ 20 °C
	RSLA	10.1 ±0.2 µm/m/°C @ 20 °C
	RTLA/FASTRACK	10.1 ±0.2 µm/m/°C @ 20 °C
	RTLA-S	10.1 ±0.2 µm/m/°C @ 20 °C

## Angle absolute encoder version

### Resolution

RESOLUTE is available with a variety of resolutions, to meet the needs of a wide range of applications. The choice of resolutions depends on the serial protocol being used, but there are no limitations due to ring size, eg BiSS 26 bit resolution is available on all ring sizes.

RESOLUTE with BiSS serial comms is available with the following resolution options:

- 18 bit (262 144 counts per revolution,  $\approx 4.94$  arc second)
- 26 bit (67 108 864 counts per revolution,  $\approx 0.019$  arc second)
- 32 bit (4 294 967 296 counts per revolution,  $\approx 0.00030$  arc second)

Note that 32 bit resolution is below the noise floor of the RESOLUTE encoder.

For resolution options on other protocols, please contact Renishaw.

### Speed and accuracy


RESA diameter (mm)	Maximum reading speed (rev/min)	System accuracy (arc second)
52	36 000	$\pm 5.49$
57	33 000	$\pm 4.89$
75	25 000	$\pm 3.82$
100	19 000	$\pm 2.86$
103	18 500	$\pm 2.72$
104	18 000	$\pm 2.69$
115	16 500	$\pm 2.44$
150	12 000	$\pm 1.91$
200	9 500	$\pm 1.43$
206	9 200	$\pm 1.42$
209	9 000	$\pm 1.4$
229	8 300	$\pm 1.27$
255	7 400	$\pm 1.11$
300	6 300	$\pm 0.95$
350	5 400	$\pm 0.82$
413	4 600	$\pm 0.69$
417	4 500	$\pm 0.68$
489	3 900	$\pm 0.59$
550	3 400	$\pm 0.52$

**System accuracy** is graduation accuracy plus SDE. Effects such as eccentricity influence installed accuracy; for application advice, please contact your local representative.

**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, please contact Renishaw for further advice.

For REXA speed and accuracy figures refer to REXA datasheet.

### General specifications (angle and linear)

<b>Power supply</b>	5 V $\pm 10\%$	1.25 W maximum (250 mA @ 5 V)
	Ripple	200 mVpp maximum @ frequency up to 500 kHz maximum
<b>Temperature</b>	Storage	-20 °C to +80 °C
	Operating	0 °C to +80 °C
		For extended temperature range see L-9517-9420 RESOLUTE ETR Data sheet
<b>Humidity</b>		95% relative humidity (non-condensing) to EN 60068-2-78
<b>Sealing</b>		IP64
<b>Acceleration</b> (readhead)	Operating	500 m/s <sup>2</sup> , 3 axes
<b>Shock</b> (readhead)	Non-operating	1000 m/s <sup>2</sup> , 6 ms, ½ sine, 3 axes
<b>Maximum acceleration of scale with respect to readhead</b>		<b>BiSS</b> - 2000 m/s <sup>2</sup>
		<b>NOTE:</b> This is the worst case figure that is correct for the slowest communications request rates. For faster request rates, the maximum acceleration of scale with respect to the readhead can be higher. For more details, please contact your local representative.
<b>Vibration</b>	Operating	300 m/s <sup>2</sup> max @ 55 Hz to 2000 Hz, 3 axes
<b>Mass</b>		Readhead 18 g Cable 32 g/m
<b>Cable</b>		Double-shielded, outside diameter 4.7 $\pm 0.2$ mm
		Flex life >20 x 10 <sup>6</sup> cycles at 20 mm bend radius
		UL recognised component 
<b>Communication format</b>		RS485/RS422 differential line-driven signal

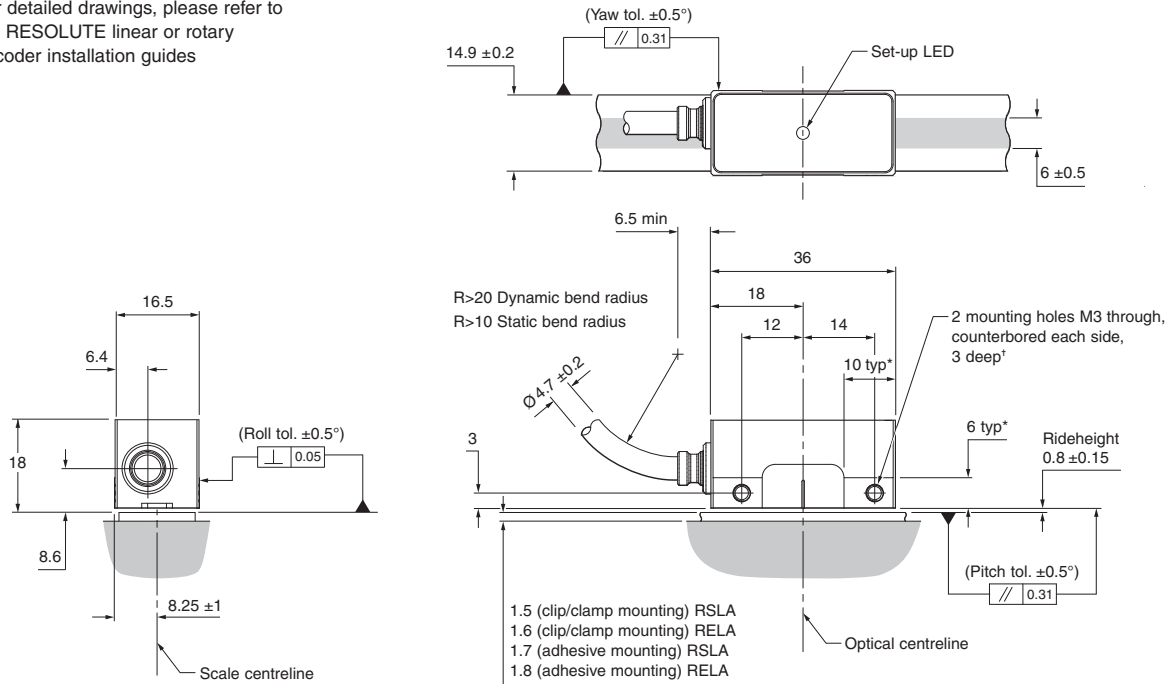
**NOTE:** For vacuum and ETR specifications refer to relevant data sheets

## RESOLUTE installation drawing (on RSLA/RELA scale)

Dimensions and tolerances in mm



For detailed drawings, please refer to the RESOLUTE linear or rotary encoder installation guides



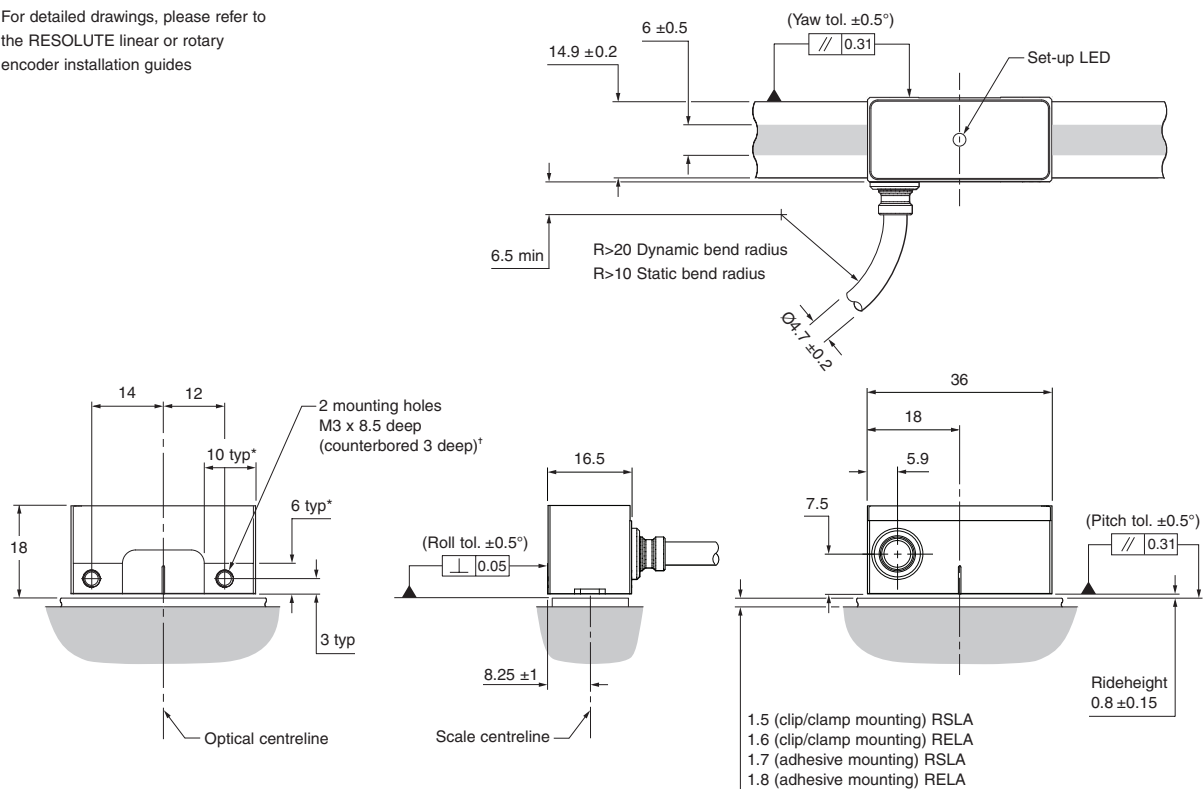
\*Extent of mounting faces. \*Thread depth from mounting face. Recommended thread engagement 5 mm (8 including counterbore). Recommended tightening torque 0.5 to 1 Nm.

## RESOLUTE side exit cable installation drawing (on RSLA/RELA scale)

Dimensions and tolerances in mm



For detailed drawings, please refer to the RESOLUTE linear or rotary encoder installation guides



\*Extent of mounting faces. \*Thread depth from mounting face. Recommended thread engagement 5 mm (8 including counterbore). Recommended tightening torque 0.5 to 1 Nm.

## RESOLUTE angle nomenclature

	RA	26B	AA	052B	30	A
<b>Series</b>						
R = RESOLUTE						
<b>Scale form</b>						
A = Angular						
<b>Protocol</b>						
18B = <i>BiSS</i> 18 bit						
26B = <i>BiSS</i> 26 bit						
32B = <i>BiSS</i> 32 bit						
<b>Mechanical option</b>						
A = Standard IP64						
E = Extended Temperature Range* (standard cable outlet)						
V = Vacuum†						
S = Side cable outlet						
D = Extended Temperature Range* (side cable outlet)						
<b>Gain option</b>						
A = Standard						
<b>Ring diameter</b>						
052 = 52 mm ring						
057						
075						
100						
103						
104						
115						
150						
183 (REXA only)						
200						
206						
209						
229						
255						
300						
350						
413 (RESA only)						
417						
489 (RESA only)						
550 (RESA only)						
<b>Scale code option</b>						
B = Standard scale code						
<b>Cable length</b>						
05 = 0.5 m						
10 = 1 m						
15 = 1.5 m						
30 = 3 m						
50 = 5 m						
99 = 10 m						
<b>Termination</b>						
A = 9 way D-type connector						
F = flying lead (unterminated)						
V = vacuum flying lead (unterminated)†						

## RESOLUTE linear nomenclature

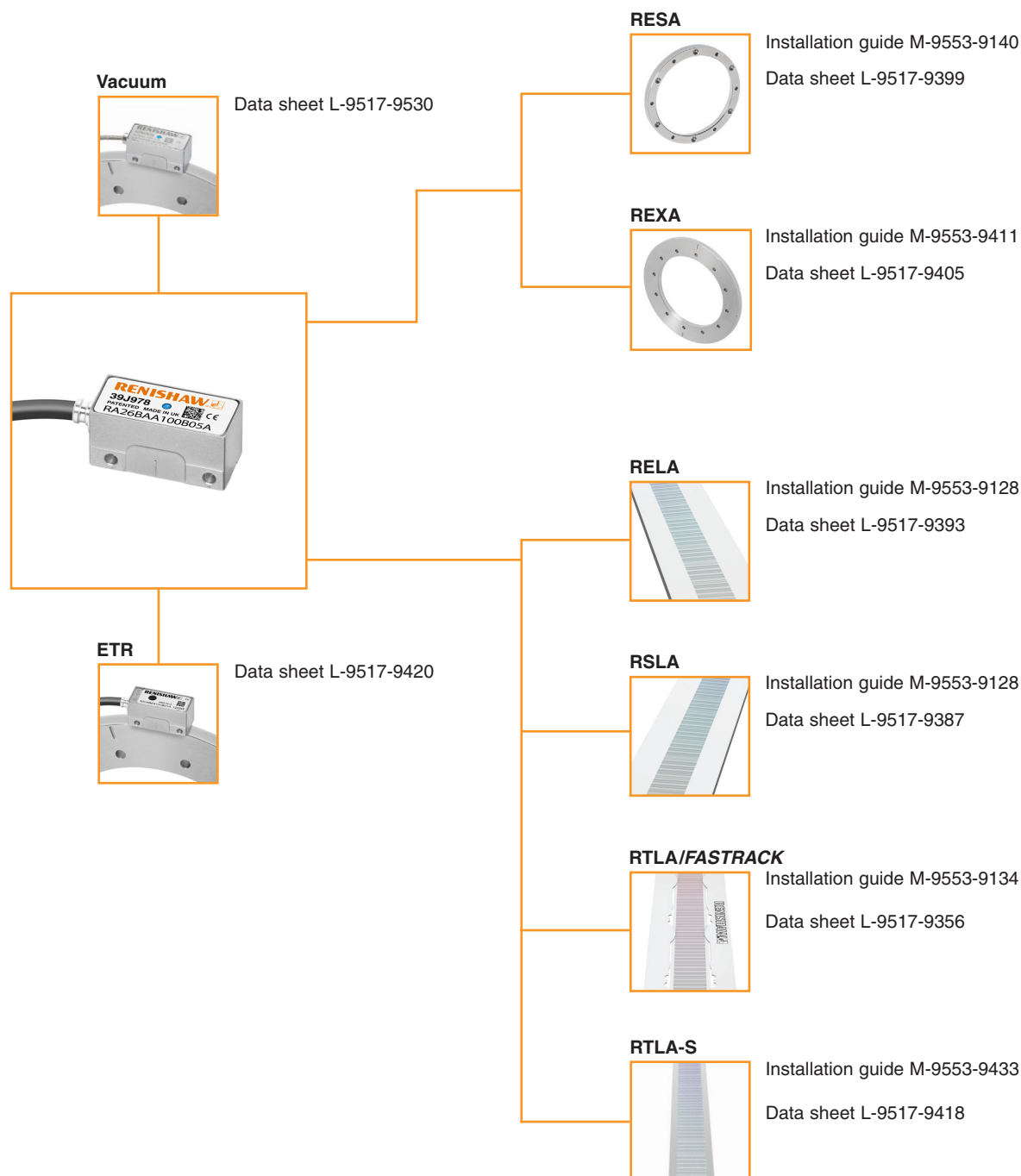
	RL	32B	AS	001C	30	A
<b>Series</b>						
R = RESOLUTE						
<b>Scale form</b>						
L = Linear						
<b>Protocol</b>						
26B = <i>BiSS</i> 26 bit						
32B = <i>BiSS</i> 32 bit						
36B = <i>BiSS</i> 36 bit						
<b>Mechanical option</b>						
A = Standard IP64						
V = Vacuum†						
S = Side cable outlet						
<b>Gain option</b>						
T = RTLA/RTLA-S						
S = RSLA						
E = RELA						
<b>Resolution</b>						
001 = 1 nm						
005 = 5 nm						
050 = 50 nm						
<b>Scale code option</b>						
B = RTLA/RTLA-S (100 mm to 10 m only)						
C = RSLA (all scale lengths)/RELA (>1130 mm)						
D = RELA (≤1130 mm)						
E = RTLA/RTLA-S (all scale lengths)						
<b>Cable length</b>						
05 = 0.5 m						
10 = 1 m						
15 = 1.5 m						
30 = 3 m						
50 = 5 m						
99 = 10 m						
<b>Termination</b>						
A = 9 way D-type connector						
F = flying lead (unterminated)						
V = vacuum flying lead (unterminated)†						

\*For additional information on Extended Temperature Range variant refer to L-9517-9420 RESOLUTE ETR Data sheet.

†For additional information on Vacuum variant refer to L-9517-9530 RESOLUTE UHV Data sheet.



## RESOLUTE Compatible products:



**For worldwide contact details, please visit our main website at [www.renishaw.com/contact](http://www.renishaw.com/contact)**

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