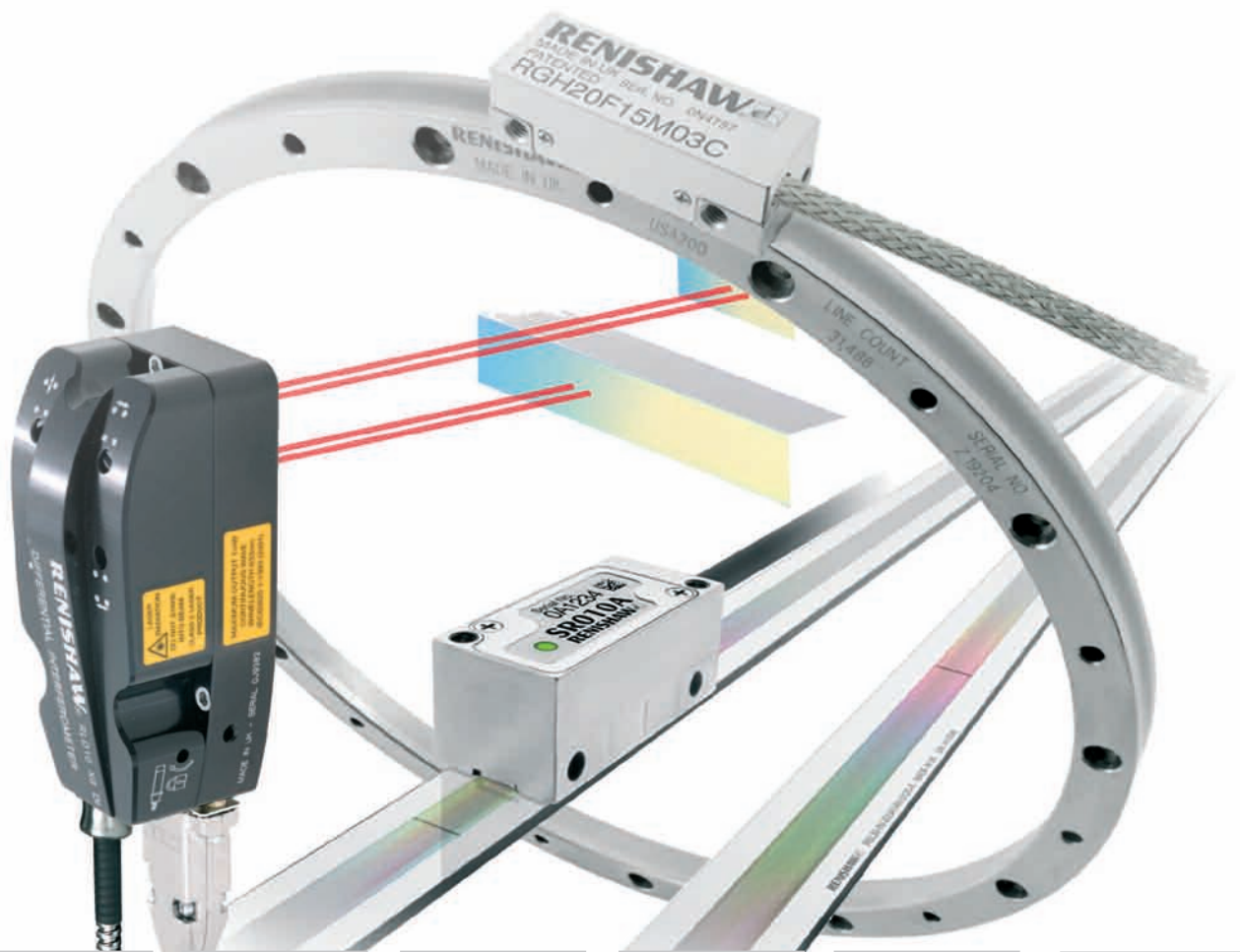


Reaction

News for the semiconductor, electronics and motion control industries.

www.renishaw.com

Total encoder solutions



RG2/RG4

The market leading RG range of linear encoders has been enhanced to offer higher speed, higher resolution and increased reliability.



SIGNUM™

New intelligent encoder range with advanced features, including the IN-TRAC™ auto-phase optical reference mark.



UHV

New range of ultra high vacuum (UHV) compatible optical encoders, with low outgassing rates and clean residual gas analysis (RGA).



Magnetic encoders

Reliable, low cost, high-speed, non-contact rotary encoders with up to 12-bit (4096 count) resolution.



Differential interferometer

RLE laser interferometer system now includes a differential interferometer enabling precise control of stage position relative to the process tool.



Parallel interface

Receives differential analogue input signals and interpolates by 4096. Provides parallel format output signals with resolutions to 40 picometres.

RG2 (20 µm) and RG4 (40 µm) encoders now offer more speed, more resolution, more features, and increased reliability.

Renishaw's encoder products are famous for their innovative filtering optics, high accuracy and high speed, and have become the established choice for many industrial applications.

With each new design, customers and designers push performance and specifications to the limit. To support this progress, Renishaw's encoder products continuously evolve and improve. In the latest phase, Renishaw's market leading RG2 (20 µm) and RG4 (40 µm) non-contact optical encoders offer more speed, more resolution, more features and increased reliability.

Key improvements include:

- Typically 20 – 30% faster than previous models
- Increased speeds now obtainable from slower controller inputs
- Lower SDE (sub divisional error)
- 50 nm resolution achieved directly from the readhead (RGH20, RGH22, RGH24 and RGH40)

- A wider choice of clocked outputs provides compatibility with a broad range of controllers
- In addition to the set-up LED and low signal alarm, the high resolution versions now include an over-speed alarm for added safety
- A host of electronics upgrades guarantee a more robust signal and greater reliability

- RGE and RGB high resolution interfaces are now reduced in size
- Significant reduction in current consumption on high resolution options

To mark these improvements, the new readheads feature a revised finish and new labelling.



MYDATA takes a different approach to the design of large-board SMT machines

The electronics industry experiences extremely rapid advances in technology, placing constantly increasing demands on production machinery. MYDATA machines must be capable of placing components with a very high level of accuracy, to cope with an ever increasing variety and complexity of components.

Renishaw encoders have been key to design changes on the Y-axis of certain MYDATA machines where,

instead of the ball-screw and rotary encoder drive system, linear motors and linear feedback have now been employed.

Olle Tullstedt, MYDATA R&D manager, explains "The linear motor and Renishaw encoder give us a big advantage, particularly when handling large boards, a capability unique to MYDATA." While the machine's acceleration and top speed are comparable to the ball-screw/rotary encoder drive, the stiffness is much

greater, meaning that the time taken to stabilise position after a move is much shorter and overall speed of operation is greater.



sigNUM™ - intelligent encoders for optimum performance

Renishaw's new **SiGNUM™** encoder range offers high speed, reliable, non-contact performance combined with advanced features, including the **IN-TRAC™** auto-phase optical reference mark.

The RESM optical angle encoder comprises the RESM ring, SR readhead and Si interface. The RESM is a one-piece stainless steel ring with 20 µm graduations marked directly on the periphery. It features the **IN-TRAC™** optical reference mark, which is repeatable in both directions at operational speeds over 3,600 rev/min (Ø52 mm) and up to 85 °C.

The RESM angle encoder boasts impressive performance. With accuracy to ±0.5 arc second, and resolution and repeatability to 0.02 arc second, it satisfies the most demanding precision applications. The low profile ring is available in a wide range of sizes (Ø52 mm to Ø413 mm) and line counts, all of which feature a large internal diameter for flexible integration.

In addition, Renishaw's patented taper mount provides active adjustment to minimise installation errors and simplify integration. Consequently, the RESM's low mass, low inertia design will not compromise system accuracy.

Like all **SiGNUM™** encoders, the RESM encoder benefits from **SiGNUM™** intelligent signal processing to ensure excellent reliability and ultra low cyclic error (±40 nm). In addition, comprehensive **SiGNUM™** software enables optimum set-up and real-time system diagnostics via a PC's USB port.



NEW SiGNUM™ RELM high accuracy linear scale



The RELM high accuracy linear scale is an exciting new addition to the **SiGNUM™** range. Currently available in Invar, which provides a low thermal expansion of 1.3 µm/m/K, the 20 µm RELM scale is offered in fixed lengths with a choice of **IN-TRAC™** reference mark positions. The robust, yet highly precise, spar offers a level of performance previously available only from more delicate fine pitch encoder systems. With accuracy to ±1 µm/m and resolution to 20 nm, RELM fulfils the most demanding precision motion requirements.

NEW range of ultra high vacuum (UHV) compatible readhead systems

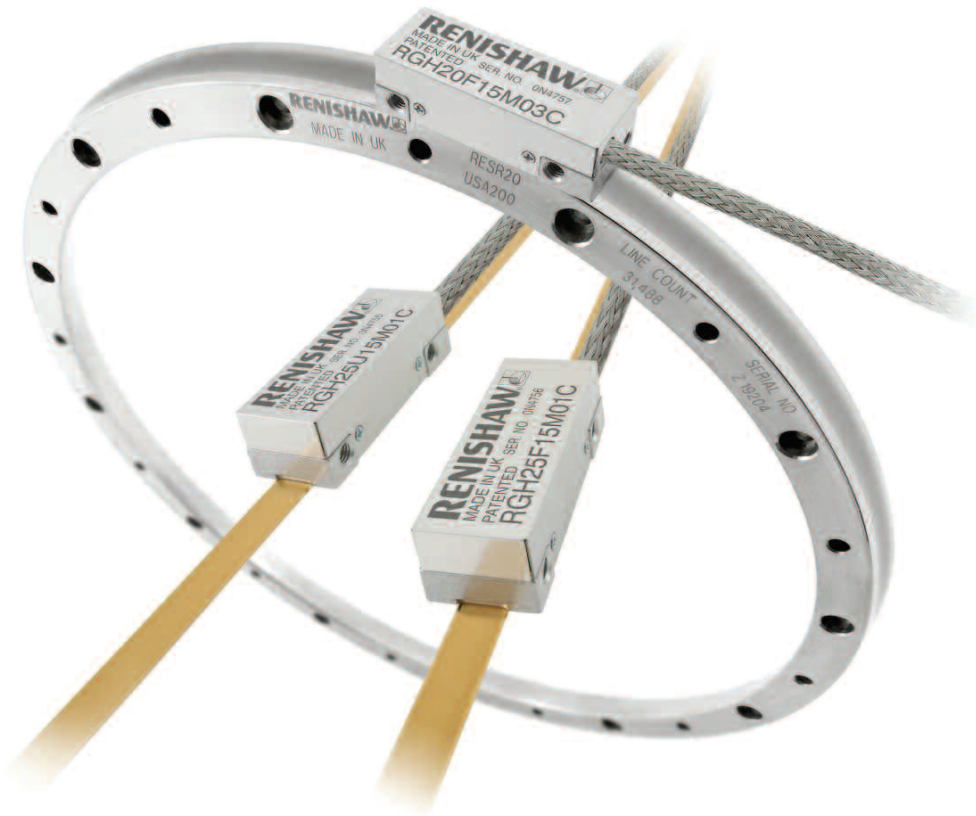
Renishaw's new range of vacuum compatible optical encoders offers all the benefits of the established RG2 linear and angle encoder systems; non-contact patented filtering optical scheme, high accuracy and high speed.

Renishaw's vacuum range has been specially constructed from clean UHV compatible materials and adhesives to give low outgassing rates and a clean residual gas analysis (RGA). The readheads are designed for use with Renishaw's RGS20-S tape scale for linear axes, or for use with Renishaw's 20 µm RESR angle encoder, to provide precision feedback for rotary motion in UHV environments.

Key features of the range include:

- Clean RGA
- Bake out temperature of 120 °C
- Low outgassing
- Low power consumption readheads (50 mA)
- Resolution to 10 nm
- Low cyclic error (< ±0.1 µm)
- Self-tuning adaptive electronics give high accuracy and long-term reliability

Suitable for a wide range of applications, including wafer handling/testing, wafer fabs, scientific instruments, spectroscopy, vacuum inspection equipment, rotary tables and many more.

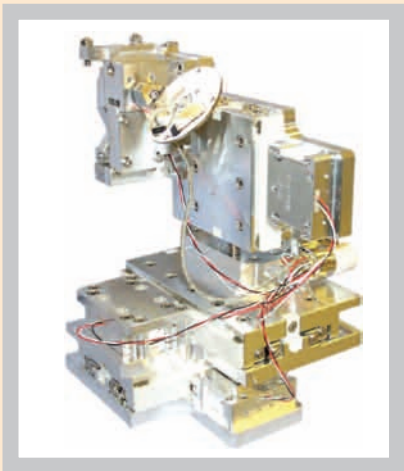


The UHV range			
	Readhead	Interface	Scale
• Linear (medium resolution)	RGH25U	RGB25	RGS20-S
• Linear (high resolution)	RGH25F	RGF	RGS20-S
• Rotary	RGH20F	RGF	RESR

Renishaw scales facilitate micro-machining research

Special equipment has recently been installed at the University of Southampton by Ionoptika Ltd., for research into one of the most demanding of applications; micro-machining. Renishaw RG2 scale and RGH25 UHV readheads provide the critical means of positioning for the nanometric movements required.

An interesting feature of the multi-axis, sub-micron accuracy sample stage is its use of piezo-ceramic 'standing motion' motors. "Matching the Renishaw encoders to these motors has proved very effective", claims Mr Barber, Ionoptika's Technical Manager. The result is continuous smooth motion combined with high resolution, zero backlash, and fine positioning accuracy.



NEW range of miniature non-contact rotary encoders

To meet the increasing demand for reliable, low cost, high-speed rotary feedback, Renishaw has introduced a range of frictionless miniature magnetic encoders with resolutions from 9-bit (512 count) to 12-bit (4096 count).

The novel non-contact design provides reliable long-term operation by eliminating the need for seals or bearings, whilst operational speeds of over 30,000 rpm can be achieved with measurement accuracy to 0.3°. For harsh environments, compact versions are available with sealing to IP68.

Further benefits provided by the range include

- Extended operational temperature range of -25 °C to 125 °C
- Excellent shock and vibration resistance
- Low cost absolute feedback
- Easy installation and set-up
- Excellent reliability with non-contact design

The new range of rotary magnetic encoders is easy to integrate, with a range of formats offered, including component, modular and packaged versions. Absolute encoders provide up to 12-bit resolution (4096 count) in parallel or serial data formats, whilst other output options include incremental (1024 ppr), analogue, linear voltage and linear current. The linear voltage or current output options can be used in applications such as panel switches where, traditionally, potentiometers have been used.

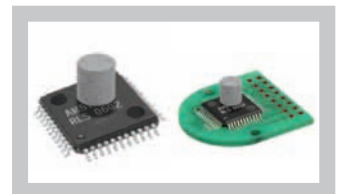
With such a flexible design, a wide range of applications will benefit from these new encoders, including mobility devices, marine instrumentation, CCTV, medical scanners, construction vehicles, valve position control, vending machines, industrial power tools and motor feedback.



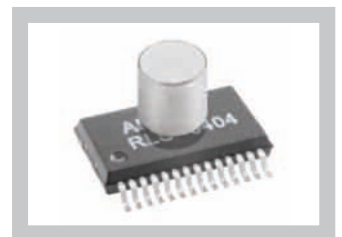
Non-contact, frictionless design (RM22) and traditional bearing/shaft version (RE22)



Non-contact, frictionless design (RM36) and traditional bearing/shaft version (RE36)



Non-contact, frictionless design encoder chip AM512 and evaluation module



Non-contact, frictionless design encoder chip AM256



Flexible laser interferometer based encoder solutions for precision motion feedback

Today's semiconductor and electronics marketplace has seen a continued drive to accommodate smaller feature sizes, increase throughput and reliability, whilst simultaneously decreasing equipment footprints and costs. For providers of position encoders, this means ongoing OEM demand for higher system resolution, velocity and accuracy, coupled with rapid installation times, low initial purchase price and low cost of ownership.

In addition to its range of optical linear and rotary encoders, Renishaw offers motion system vendors a complementary range of laser interferometer-based encoder solutions that can be effectively applied to address these issues over a broad range of applications and industrial sectors.

Renishaw's RLE system is a unique, advanced homodyne laser interferometer system, specifically designed for position feedback applications. Each RLE system consists of either an RLU10 or RLU20 laser unit and up to two RLD10 detector heads, the model of which is selected dependent on individual application requirements.

The RLU laser unit is the heart of the RLE system containing the HeNe laser tube, the majority of system electronics and the fibre optic launch. This fibre optic launch system allows the RLU to be mounted remotely from the precision motion stage, thus eliminating a potential heat source, which could result in thermal errors.

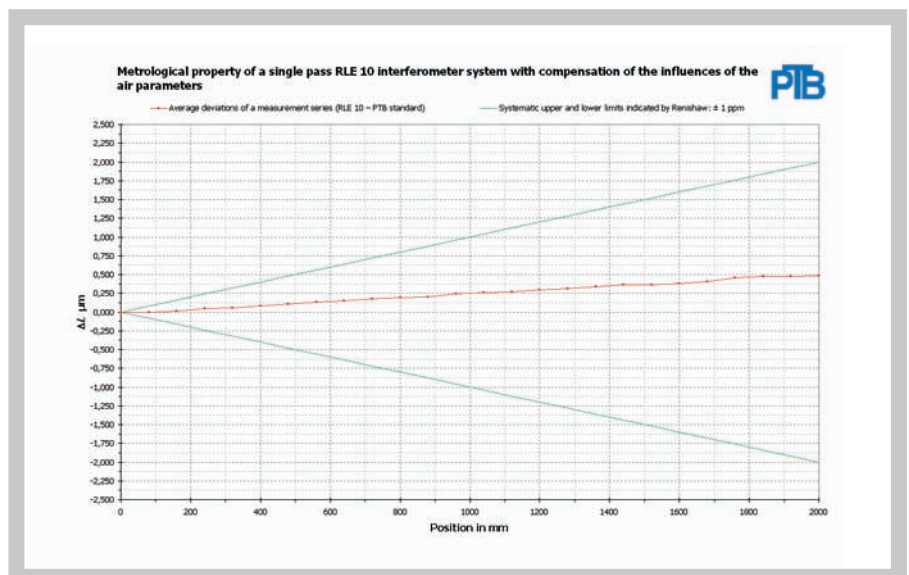
Position output signals from the RLU are directly available in differential digital RS422 format and / or 1 Vpp analogue sine / cosine formats. Digital output signals provide resolutions to 10 nm. The analogue output has a signal period of 158 nm when using a double pass plane mirror or differential interferometer and 316 nm when using a single pass retroreflector. Optionally, an RGE interpolator or RPI20 parallel interface can be incorporated into the system to provide resolutions to 0.39 nm and 40 picometres respectively (when used with a double pass or differential interferometer).

When using a laser interferometer system in non-vacuum environments, refractive index changes can occur. These changes, caused by varying environmental conditions, affect the wavelength of the laser light, and thus the positioning accuracy. This applies to all laser interferometer systems.

If it is not possible to reference the system against some known distance that is insensitive to environmental variations, some form of compensation is required to maintain system accuracy.

To counter refractive index changes, Renishaw offers the RCU10 compensation system. Taking readings from the RLE system and environmental data from its sensors, the RCU10 modifies 'raw' position feedback signals before supplying corrected data to the motion controller. The whole compensation process incurs a delay of less than 2 μ s.

Typical performance of a single pass RLE10 system, with compensation for refractive index provided by an RCU10, is shown in the graph below. The upper and lower green limit lines on the graph indicate the published specification of a compensated RLE system which is $< \pm 1$ ppm. The system tested achieved a performance accuracy of approximately 0.24 ppm.



System accuracy is quoted to the internationally recognised 95% confidence level ($k=2$).

User selectable range of fully compatible RLD10 detector heads

Renishaw offers a range of fully compatible RLD detector heads for use with the RLE system. In total six models of detector heads are available, based on four variants, most* of which contain the fringe detection scheme, interferometer optics and integrated beam steerer(s).

Single-pass interferometer

- Uses an external retroreflector target optic for linear applications with axis lengths up to 4 m and is available with 0° or 90° beam launch orientation
- Directly produces a sinusoidal output with a signal period of 316 nm that enables digital quadrature resolutions of up to 20 nm to be provided
- Optionally, the RPI20 parallel interface can be used to extend resolution (LSB) to 80 picometres

Double-pass interferometer

- Requires an external plane mirror target optic for X-Y applications with axis lengths up to 1 m and is available with 0° or 90° beam launch orientation
- Directly produces a sinusoidal output with a signal period of 158 nm that enables digital quadrature resolutions of up to 10 nm to be provided
- Optionally, the RPI20 parallel interface may be used to extend resolution (LSB) to 40 picometres

No internal interferometer

- The absence of interferometer optics within this head enables the RLE system to be configured with external optics that allow linear, angle and straightness measurements to be made
- 0° beam launch orientation only

Double-pass differential interferometer (column reference)

- Requires external plane mirror targets for reference and measurement interferometer arms for X-Y applications with axis lengths up to 1 m
- The reference arm should be a fixed distance of up to 0.5 m
Produces a sinusoidal output with a signal period of 158 nm, enabling digital quadrature resolutions of up to 10 nm

- Optionally, the RPI20 parallel interface may be used to extend resolution (LSB) to 40 picometres

As the measurement and reference beam paths have an element of commonality, this detector head offers a number of benefits:

- Measures stage versus column or workpiece versus tool for a true differential measurement
- Removal of errors due to thermal translation of the interferometer mounting position
- Minimisation of the effects of laser frequency instability as the differential path length (between measurement and reference paths) is reduced
- Common mode environmental effects enable the detector head to be mounted outside the process chamber with minimal affect on positioning accuracy

** an RLD10 0° model is available with no internal optics.*



Single-pass interferometer



Double-pass interferometer



Differential interferometer

RLE system accessories

Mirrors

RLE systems which use an external retroreflector as the target optic are supplied complete with a housed retroreflector. For applications that require a plane mirror target optic, Renishaw can, if requested, supply mirrors and adjustable mirror mounts, which allow up to $\pm 2.5^\circ$ of yaw adjustment and $\pm 1^\circ$ pitch adjustment.

RPI20 parallel interface

Renishaw's RPI20 parallel interface accepts differential analogue 1 Vpp sine / cosine signals, interpolates by 4096 and provides an output in parallel format with up to 36-bits of position data being available. When used with a double pass or differential interferometer, it is possible to achieve resolutions of 40 picometres at velocities of up to 1 m/sec.

System architecture consists of a daughter board and industry standard (VME) interface specifically designed to accommodate docking of either one or two daughter boards.

For multi-axis bus based architectures, the daughter board contains switches allowing each board to be assigned a unique address, expanding capability to seven axes.

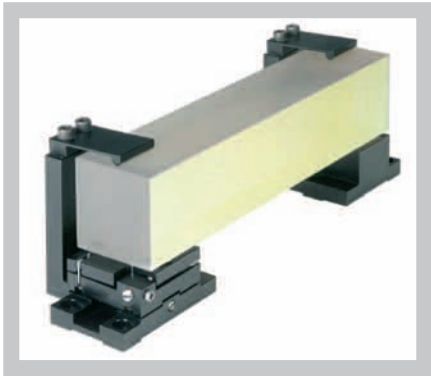
RGE interpolators

The RGE range of interpolators produce high-resolution digital quadrature signals from the analogue 1 Vpp sine and cosine data provided by the encoder system. The resolution of this digital output quadrature is a function of the distance represented by one 360° cycle of the input analogue signals and the interpolation factor.

RGE interpolators, compatible with the RLE system, are available with interpolation factors of 25, 50 and 100, and output updates rates of 10 MHz and 20 MHz.

When RGE interpolators are used with the RLE laser interferometer system, the following resolutions can be obtained:

Available RGE resolutions		
Interferometer type	Double pass (plane mirror)	Single pass (retroreflector)
Sinusoidal input resolution	158 nm	316 nm
Available output resolutions	0.39 nm, 0.79 nm, 1.58 nm	0.79 nm, 1.58 nm, 3.16 nm



Mounted mirror



RPI20 parallel interface



RGE interpolator

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