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Probing systems for CNC machine tools

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Introduction

Introduction

Renishaw invented the touch-trigger probe in 1973, revolutionising the capabilities of co-ordinate measuring machines (CMMs) and enabling them to become the industry standard for offline 3D component inspection.

Machine tool users have benefitted from the use of probes since the mid 1970s. Automated probing for set-up and in-cycle inspection became possible in the 1980s when Renishaw introduced the first probes designed specifically for metal cutting applications.

Renishaw's first touch-trigger probe

How and where probes are used

Today, probing is an established best practice for maximising efficiency, quality, capability and accuracy on machine tools. Standard routines built into modern CNC controls simplify the integration of probing cycles into machining operations and offline tools. These routines combined with a CAD interface make the simulation of measurement functions easy.

Renishaw probes deliver significant cost savings and improvements in quality for all applications using machine tools throughout these industries:

- Aerospace
- Automotive
- Communications
- Construction
- Defence
- Education
- Electronics
- Energy
- Engineering
- Leisure
- Machine tools
- Medical
- Mining
- Research
- Sport
- Transport

Renishaw probing systems are available as original equipment from every major machine tool manufacturer and are increasingly retrofitted to machines already in use.

All sizes and configurations of machine tool can benefit from probing, including:

- CNC machining centres – vertical, horizontal and gantry
- CNC lathes and mill/turn centres
- CNC grinders
- PCB drilling and routing machines, and even manual machines

Whatever your machine, application or problem, there is a Renishaw probing system that will transform your manufacturing process and increase your profitability.

The widest range, unmatched expertise and support make compelling reasons for a productive partnership with Renishaw – the industry's premier choice.

Why probe?

Time is money, and unnecessary time spent manually setting workpiece positions and inspecting finished products will impact on your manufacturing performance and profitability. Renishaw probing systems eliminate costly machine down-time and the scrapping of components associated with manual setting and inspection.

Increase throughput from your existing assets

If your machines are overloaded then you could face a sizeable capital investment to make up the shortfall, or a large sub-contract bill. Or worse still, you might find yourself turning away profitable work.

But what if you could extract more throughput from the machinery you already have? You could:

- defer capital expenditure
- reduce your sub-contract and overtime bills
- pursue additional business

Increase automation and reduce human intervention

Are you reliant on skilled operators to keep your machines running, leading to high labour costs and a substantial overtime bill? Or perhaps your engineers are tied up with shop support rather than working on new processes?

What impact would lower direct labour and shop support costs have on your competitiveness? You could:

- automate manual setting and measurement processes
- reduce direct labour costs
- redeploy staff into proactive engineering roles

Reduce rework, concessions and scrap

Scrapping parts is always painful – it's a waste of time, effort and materials. Similarly, rework and concessions lead to late deliveries, fire-fighting and overtime.

If you could largely eliminate such quality costs, how would this help your responsiveness and profitability? You could:

- improve conformance and consistency
- lower unit costs
- have shorter lead times

Enhance your capability and take on more work

Customers are demanding ever more complex work whilst regulations are driving greater traceability throughout the manufacturing process. Are your capabilities keeping pace with the needs of your market?

Do you need a cost-effective way to boost the capability of your machining and inspection processes? You could:

- offer your customers state-of-the-art capabilities
- take on more complex work
- meet customer demands for traceability

Reduce your total cost of ownership

Buying and maintaining your manufacturing equipment presents an up-front and ongoing cost to your business. Are you tied to inflexible, out-dated metrology equipment with high running costs?

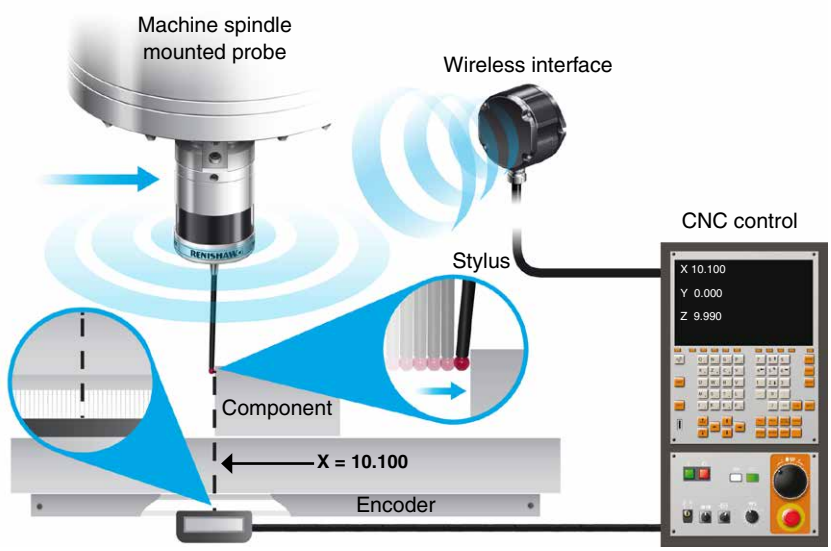
What impact would reduced total cost of ownership have on your bottom line? You could:

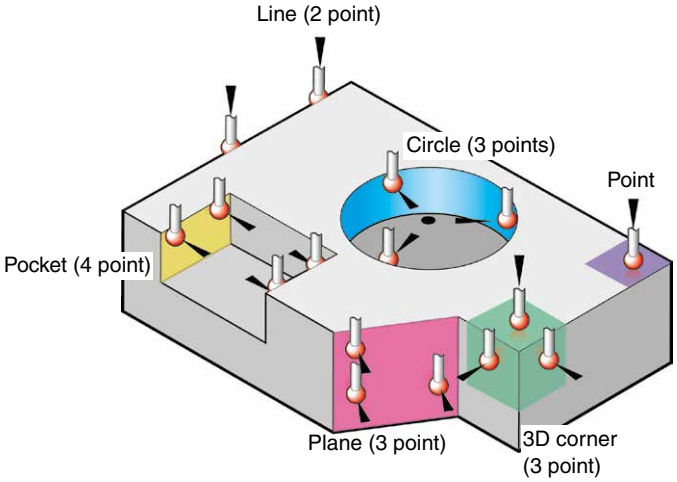
- buy fewer, more productive machines
- eliminate expensive, inflexible custom gauges
- reduce calibration and maintenance costs

How a probe works

Machine mounted probes are often referred to as touch-trigger probes because they use switches that are triggered upon contact between the probe's stylus and the component being measured or set. Switching is highly repeatable.

When triggered, the probe signals the control via an interface and the control (almost simultaneously) automatically captures the machine tool position via its encoders (feedback system).





With a co-ordinate point captured, the probe moves on to trigger at a different location. When multiple points are found, shapes and features take form. The minimum number of points needed to measure each type of feature (shown left) is based on each feature's known degrees of freedom.

Measurement is taken by substituting a feature on the component with its theoretical equivalent, for example, a circle or 3D corner. The comparison between the actual and the expected dimension, measures deviation and enables accurate, detailed inspection.

The resultant feedback is at the foundation of the preventative, predictive, active and informative controls that are essential to effective process control.

Tool setting probes

Probes used for tool setting are normally attached to the machine table or frame. Commonly referred to as tool setters, these devices use either contact or non-contact methods to trigger a signal.

Contact tool setters use a stylus to detect, measure and automatically set cutting tools using the touch-trigger principle.

Non-contact tool setters perform the same function, using a laser system where the tool passing through the laser beam acts as the trigger.

Renishaw probes are used across the broadest spectrum of machine tool applications.

Machine tool applications and Renishaw products

Cutting machine tools fall into the following broad categories:

- Manually operated
- Controlled – computer numerical control (CNC)

Most machine tools used in the production environment today are CNC machines and these can be further categorised into:

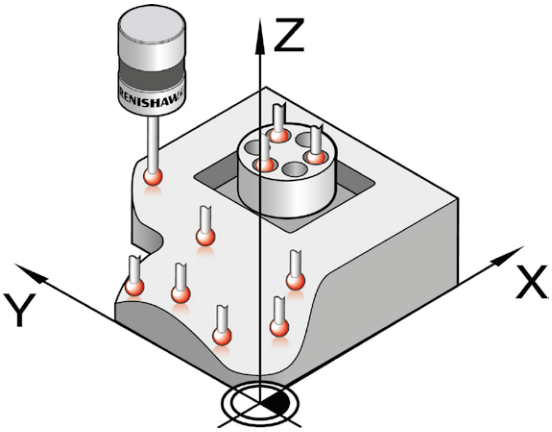
- Machining centres for milling, drilling and tapping prismatic parts
- Lathes for turning round parts
- Multi-tasking (mill–turn) machines that combine processes
- Grinding machines for fine finishing
- Drilling and routing machines for PCBs

Diverse application

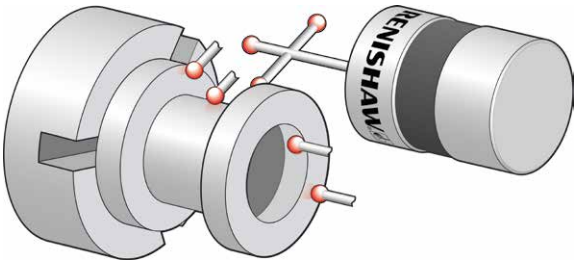
Machine tool variety is significant with options for vertical spindles, horizontal spindles, multiple spindles, automatic tool changers and so on. Machine sizes, speeds, accuracy and overall performance also vary greatly.

Arguably the most diverse, the Renishaw range of hardware and software products, can be integrated within virtually all known machine tool applications and processes.

Spindle and turret probes

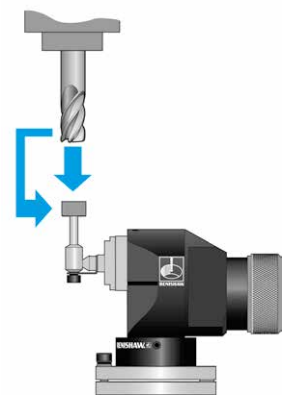


In-process gauging of a prismatic part on a vertical machining centre (VMC)

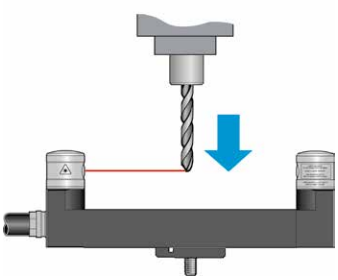


In-process gauging of a turned part on a turning centre

Tool setting and broken tool detection



Contact tool setting

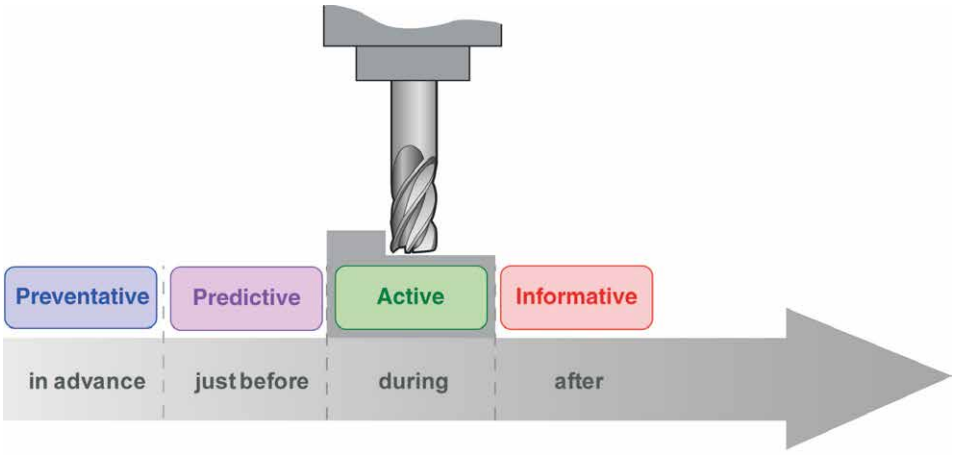


Laser-based non-contact tool setting

The Productive Process Pyramid™

Building on its own experiences developing robust manufacturing processes, Renishaw has developed a simple framework to explain how metrology solutions can deliver *successful* processes through the application of process control.

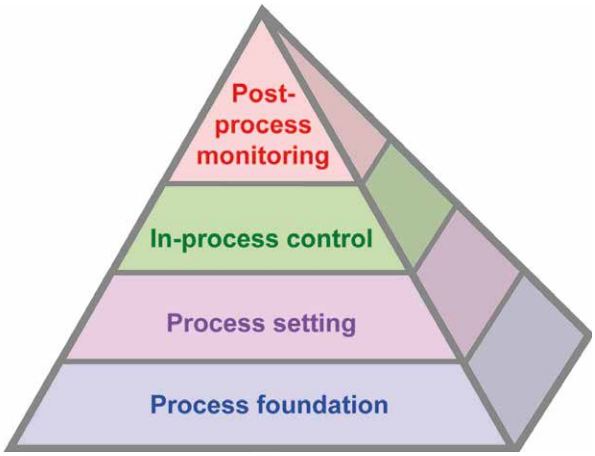
Renishaw's solutions improve machining performance and increase manufacturing capability. Placed on a timeline, Renishaw's process control solutions can be applied in advance of, just before, during and after metal cutting.



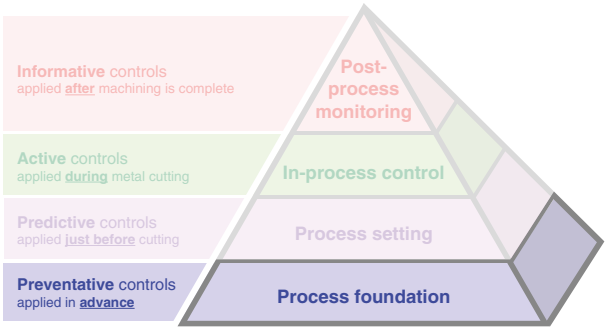
- In advance of metal cutting, Renishaw's **process foundation** solutions maximise the stability of the process, environment and machine.
- Just before metal cutting, Renishaw's **process setting** solutions establish the location and size of machining system elements.
- During metal cutting, Renishaw's **in-process** solutions enable machines to respond to inherent variation and actual conditions 'on the day'.
- After metal cutting, Renishaw's **post-process monitoring** solutions log process routes and verify the process and part.

Renishaw uses process controls identified by the manufacturing timeline to build its Productive Process Pyramid.

The Productive Process Pyramid shows how layers of control can be used systematically to remove variation from the machining process, helping to maximise productive metal cutting.



Process foundation

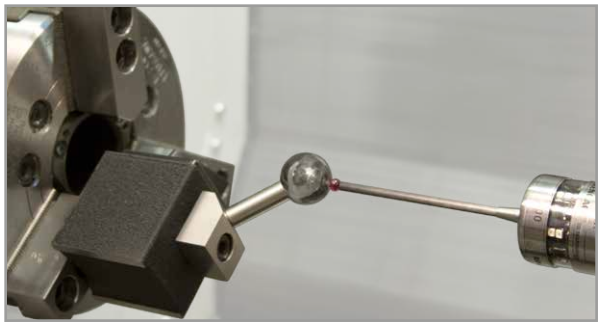


PREVENTATIVE
solutions

Controls in the base layer of the Pyramid are targeted at maximising the stability of the environment in which the process is to be performed. These preventative controls stop special causes of variation having an impact on the machining process.

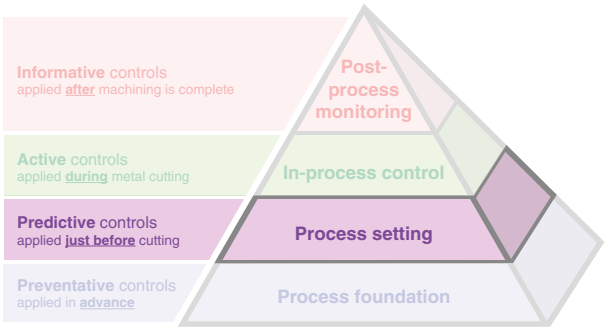
Controls in the process foundation layer include:

- **Design for manufacture** – approaches to product and process design based on a thorough understanding of current capability and a drive towards best practice rather than 'reinvention of the wheel'.
- **Control of process inputs** – involves the use of FMEA and similar techniques to understand and control all the upstream factors that can affect machining process outcomes.
- **Environmental stability** – addresses those external sources of non-conformance that cannot be eliminated in advance, but which are inherent to the operating environment.
- **Process design** – requires a systematic approach to sequencing the manufacturing process to give the best opportunity for process stability and automation. This includes integrating process feedback into the process at critical stages.
- **Machine condition optimisation** – is an essential element of the process foundation, as an inaccurate machine cannot make consistently accurate parts. A rigorous process of performance assessment, calibration and (where required) refurbishment can bring the machine's performance in line with the process requirements.



Process setting

PREDICTIVE
solutions



Process-setting controls are on-machine activities, required just before metal cutting, which predict whether the process will be successful.

Tool setting establishes:

- length from the spindle gauge-line to establish a height offset, and to check that length is within the specified tolerance
- diameter when spinning to establish a tool size offset

Part setting establishes:

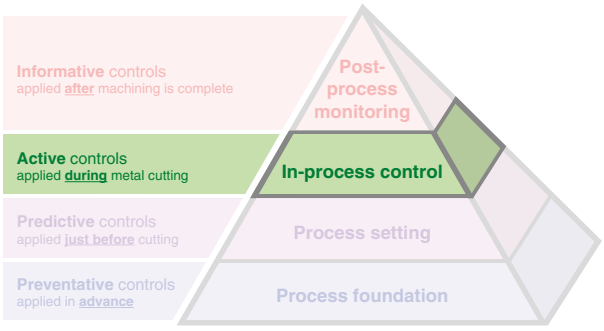
- component identification to select the correct NC program
- position of a datum feature to establish a work co-ordinate system (WCS)
- billet/component size to determine stock condition and roughing cut sequence
- orientation of a component (relative to machine axes) to establish the co-ordinate rotation

Machine setting establishes:

- alignment of a rotary axis, indexer or fixturing elements required to position and hold components
- position of an indexer's centre of rotation and/or reference points on fixture elements

In-process control

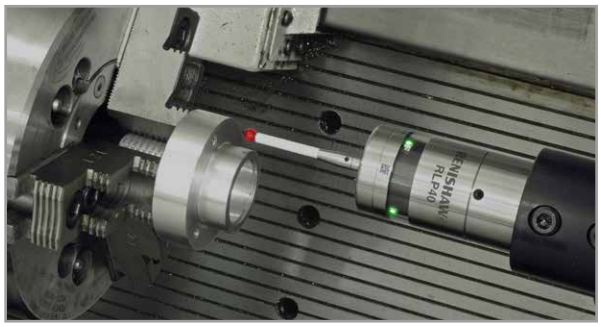
ACTIVE
solutions



Controls in this Pyramid layer include actions embedded within the metal cutting process that automatically respond to material conditions, inherent process variations and unplanned events, giving the best chance of a successful process.

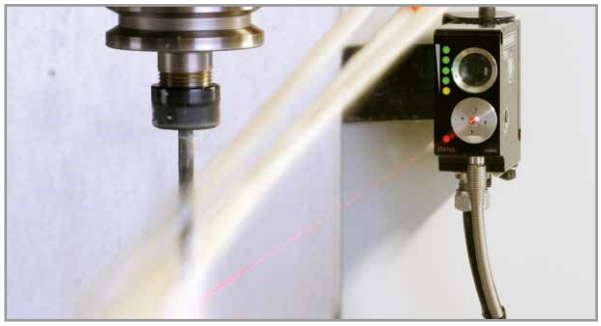
In-cycle gauging allows:

- metal cutting to adapt to variations in the machining process such as part distortion, tool deflection and thermal effects
- updating of co-ordinate systems, parameters, offsets and logical program flow depending on actual material conditions



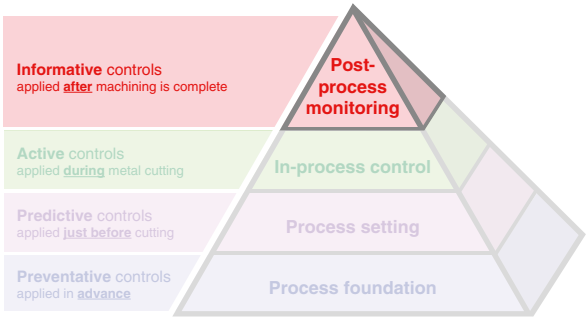
Broken tool detection recognises:

- presence of a tool
- tool position – to ensure pull-out has not occurred
- broken and/or chipped tool edges



Post-process monitoring

INFORMATIVE
solutions



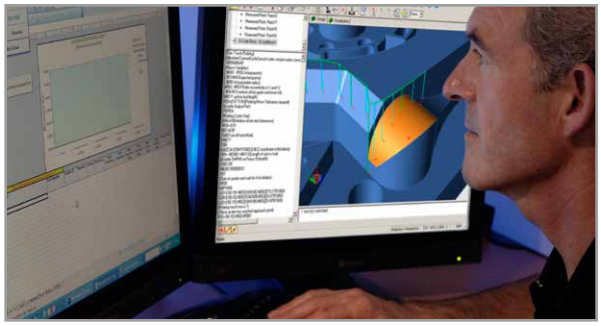
The top layer of the Pyramid involves monitoring and reporting activities that provide information about the outcome of completed processes which can then be used to influence subsequent activities.

Process logging records:

- events that happen during the machining process such as manual or automated changes to process parameters, offsets or co-ordinate systems
- interventions to the process which may have influenced the outcome

On-machine verification enables:

- inspection of critical features in the same environmental conditions as the metal-cutting process
- confidence in the stability of the machining process



Post-process reporting allows:

- documented records of component conformance
- historical tracking of critical feature dimensions for machine condition monitoring and scheduled maintenance purposes

Productive Process Patterns™

Renishaw has published solutions to many common manufacturing problems. These are explained in a clear 'problem-solution-example' format for convenient reference, and they are part of an expanding collection of Productive Process Patterns.

The Patterns provide practical examples of how solutions from all layers of Renishaw's process control framework (the Productive Process Pyramid) can be applied to improve manufacturing performance. They make use of workpiece inspection probes, tool setters, tool recognition systems software and machine diagnostic equipment.

Patterns include details of how to: control critical features using in-process measurement, generate adaptive tool paths, enable machine tools to identify components and automatically select machining programs, and more.

Visit **www.renishaw.com/processcontrol** to view and download the complete collection of Productive Process Patterns.


EMERGENCY
STOP
RENISHAW

Probing systems

Probing technology comparison chart

Renishaw's comprehensive range of workpiece measurement probes are simply named for identification. The naming conventions are explained below to help with understanding and product selection.

Probes belong to distinct technology groups or product families and can be identified using the following classification:

Denotation		**Product name**				
		R	M	P	60	0
Transmission type	R = Radio O = Optical Blank = Hard-wired					
Application	M = Machining centre or generic machine L = Lathe or turning centre					
Product	P = Probe					
Body diameter	25 = 25 mm 40 = 40 mm 60 = 63 mm					
Type	Blank = Kinematic 0 = Strain gauge M = Modular					

For example:

RMP40 denotes a radio machine probe with a 40 mm diameter body using kinematic technology.

OLP40 denotes an optical machine probe with a 40 mm diameter body using kinematic technology, suitable for a lathe application.

MP250 denotes a hard-wired probe with a 25 mm diameter body and using strain gauge technology.

Products			Transmission type			Repeatability (2σ)	3D lobing *	Maximum recommended styli length	Switch-on method				Battery type
			Optical	Radio	Hard-wired				M-code	Auto	Spin	Shank switch	
		Page	2-7	2-8	2-9								
Kinematic probes	OMP40-2	2-4	●			1.00 µm	N/A	150 mm	●	△			½ AA
	OLP40		●			1.00 µm		150 mm	●	△			½ AA
	OMP60		●			1.00 µm		150 mm	●	△	●	●	AA
	RMP40			●		1.00 µm		150 mm	●		●		½ AA
	RLP40			●		1.00 µm		150 mm	●		●		½ AA
	RMP60			●		1.00 µm		150 mm	●		●	●	AA
	LP2				●	1.00 µm		100 mm	N/A				N/A
	LP2H				●	2.00 µm		150 mm					
	MP11				●	1.00 µm		100 mm					
Strain gauge probes	OMP400	2-5	●			0.25 µm	±1.00 µm	200 mm	●	△			½ AA
	MP700		●			0.25 µm	±1.00 µm	200 mm	●	△			MN1604
	RMP600			●		0.25 µm	±1.00 µm	200 mm	●		●	●	AA
	MP250				●	0.25 µm	±1.00 µm	100 mm	N/A				N/A
Other	JCP	2-34			◊	1.00 µm		42.75 mm					LR

△ Function of receiver/interface

◊ JCP1 – Visual indication of trigger, JCP30C – Hard-wired

* For more information, please see page 2-5.

Probing technologies explained

It's all about having the right tools for the job. Our demands on manufacturing are so varied, process requirements and the tools required to carry them out also vary significantly.

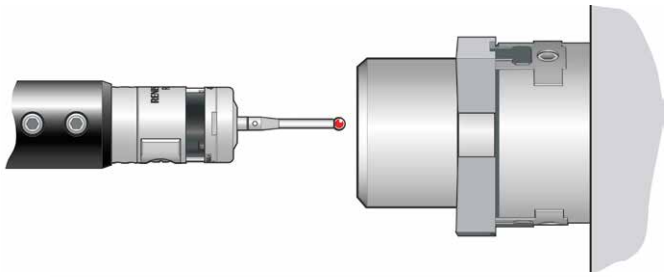
From the simple prismatic, through to sub-micron and complex form metrology, there is an application-specific Renishaw product designed, developed and proven for the job. Product differentiation is illustrated below.

Kinematic resistive

Proven over four decades, this design has been the main choice for the majority of machine builders and end users to ensure accuracy and reliability.

The ability of the probe mechanism to reseat after triggering to within 1 µm is fundamental for repeatability and good metrology.

From simple edge detection through to part alignment and on-machine gauging, this technology is available in all of Renishaw's miniature, ultra compact and compact designs.

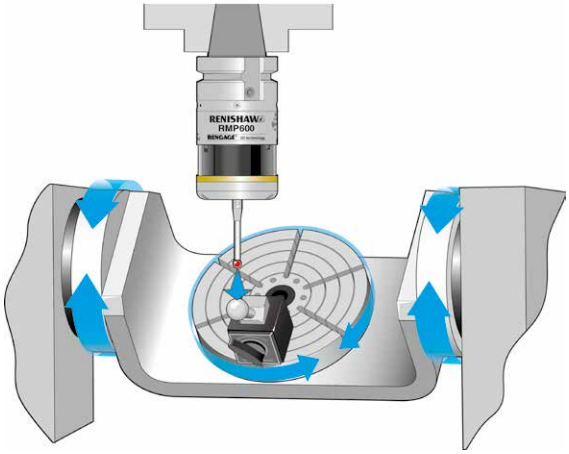


Strain gauge

Having the same kinematic mechanism but with strain gauges that "sense", this patented technology is only used in Renishaw probes that feature the RENGAGE™ trademark.

Unparalleled accuracy and repeatability make this technology the best choice for complex multi-axis work and machine calibration.

Strain gauge probes can draw even greater benefits from high specification multi-axis machines and it is for this reason that their use is now widely adopted.



Recommended technology

Application	Kinematic	Strain gauge
Process setting	●	●
In-process control	●	●
On-machine verification	●	●
Multi-axis calibration		●
Combined spindle probe / toolsetter kit option	●	●

Considerations		
Repeatability	1.0 µm 2σ	0.25 µm 2σ
Trigger characteristic	Lobing	Non-lobing
Trigger life	Typically > 1,000,000	Typically > 10,000,000
Maximum styli length	Typically ~ 100 mm	Typically ~ 200 mm

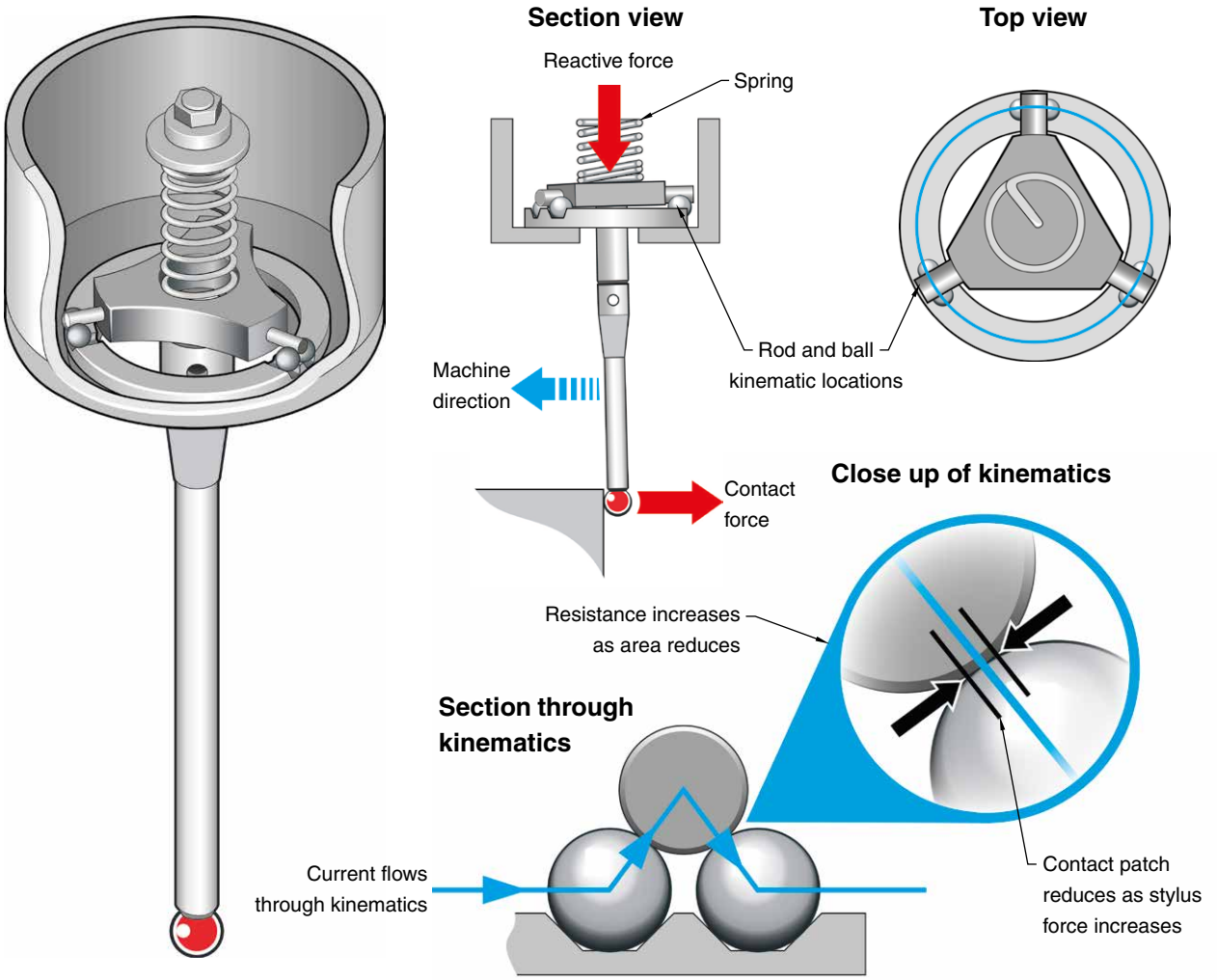
The following pages cover the design and operating principles of these technologies.

Kinematic resistive probe design

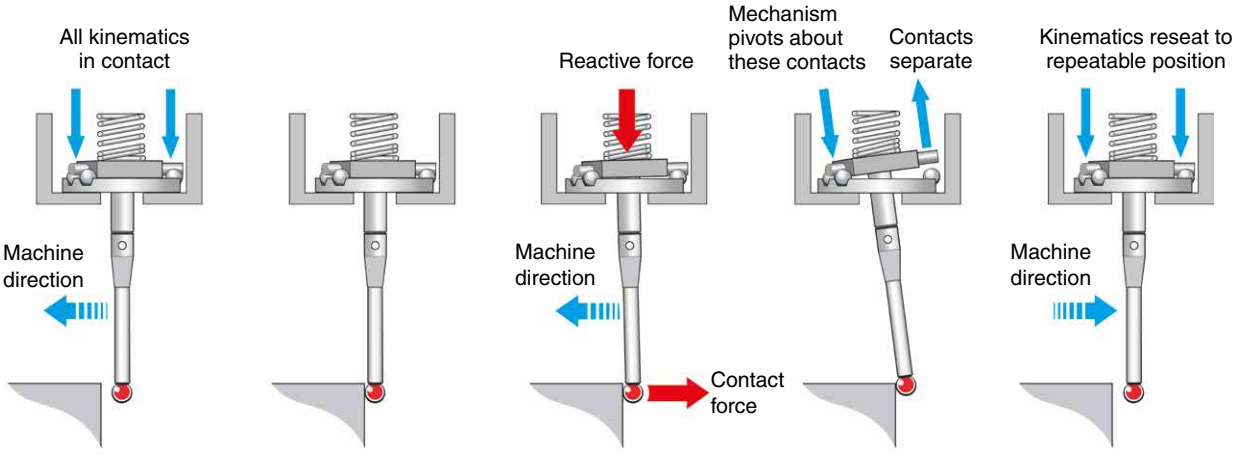
Three equally spaced rods rest on six tungsten carbide balls providing six points of contact in a kinematic location. An electrical circuit is formed through these contacts. The mechanism is spring loaded which allows deflection when the probe stylus makes contact with the part and also allows the probe to reseat in the same position within 1 µm when in free space (not in contact).

Under load of the spring, contact patches are created through which the current can flow. Reactive forces in the probe mechanism cause some contact patches to reduce which increases resistance of those elements.

On making contact with the workpiece (touch), the variable force on the contact patch is measured as a change in electrical resistance. When a defined threshold is reached, a probe output is triggered.



Based on the above kinematic principle, the stages in trigger generation are shown below. Repeatable reseating of the mechanism is critical to this process and fundamental to reliable metrology.



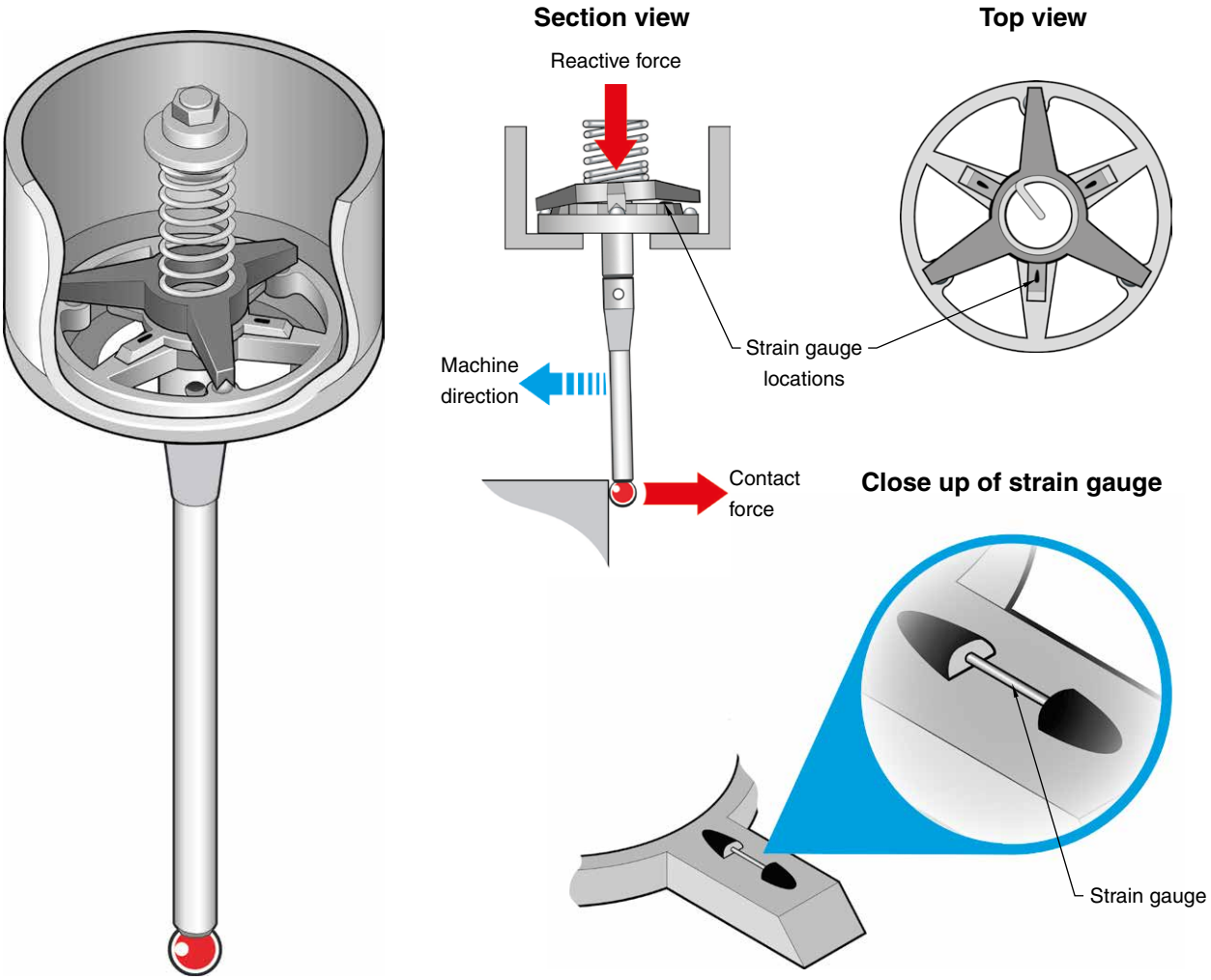
Strain gauge probe design

Innovatively engineered over years and patented by Renishaw, **RENGAGE**™ probe design combines proven silicon strain gauge technology and ultra compact electronics to achieve unparalleled performance and capabilities. Suitable for a wide range of machine tool applications and able to address the 3D performance limitations of many alternative probe designs, Renishaw's MP250, OMP400 and RMP600 are the very latest products to include this technology.

Strain gauges are positioned on carefully designed webs, mounted in the probe structure yet separate from the kinematic mechanism. The strain gauges are arranged to sense all stylus forces, which are summed together.

On reaching a threshold in any direction, a trigger signal is generated at forces that are much lower than those required to trigger a conventional probe. Rengage probes still utilise Renishaw's kinematic mechanism to retain the stylus. This system, proven over 40 years, guarantees the repeatable reseat performance fundamental to accurate metrology.

Sensing is completely independent of the probe kinematic mechanism. Rengage probes feature low force, highly repeatable, and consistent trigger characteristics that are not typically achievable with conventional probe design.



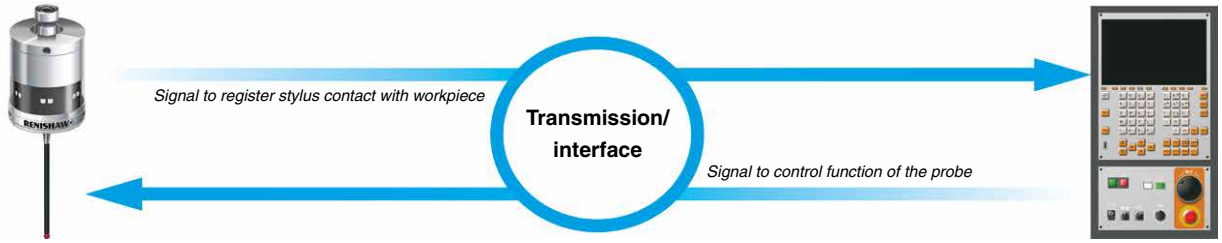
By using this technology, it is possible to eliminate up to 90% of errors due to lobing*, which for 2-axis applications can eliminate the need for significant calibration, whilst for 3-axis applications and complex geometry, performance is unequalled.

* Lobing, a characteristic of all probes, is caused by bending of the stylus and movement of the probe mechanism before the probe registers contact with a surface.

For more information regarding the many advantages of this unique probing technology please visit **www.renishaw.com/rengage**

Transmission systems explained

Probes and CNC controls communicate bidirectionally.



The passage of these signals is handled by a transmission system, the choice of which depends on the probe and machine type and application.

Renishaw probes use three main types of transmission systems: optical and radio – both of which are wireless, and hard-wired – which are connected directly to the machine control via a cable.

Transmission type		Receivers/interfaces							Optical module systems	
		Optical			Radio		Hard-wired			
	Page	2-7			2-8		2-9		2-7	
Products		OMI-2 and variants	OMI-2C	OMI	RMI	RMI-Q	MI 8-4	HSI	OSI with OMM-2	MI 12 / MI 12-B with OMM
Kinematic probes	OMP40-2	●	●	●					●	●
	OMP40M	●	●	●					●	●
	OLP40	●	●	●					●	●
	OMP60	●	●	●					●	●
	OMP60M	●	●	●					●	●
	RMP40				●	●				
	RMP40M				●	●				
	RLP40				●	●				
	RMP60				●	●				
	RMP60M				●	●				
	LP2 and variants	△	△	△	◊	◊	●	●	△	△
	MP11	Integrated to the CNC machine tool control via a cable.								
Strain gauge probes	OMP400	●	●	●					●	●
	MP700			●						●
	RMP600				●	●				
	MP250							●		
Other	JCP	Not required, JCP30C version wires directly into a digital readout touch sensor input.								

△ If used with an OMP40M or OMP60M

◊ If used with an RMP40M or RMP60M

The following pages show typical examples of each of these systems.

Optical transmission systems

A Renishaw optical transmission system uses infrared technology for communication between the probe and the CNC control and comprises the following:

Probe

The probe receives machine control signals and transmits status signals. There are two active modes, “standby” and “operating”. In standby mode, the probe is periodically transmitting and receiving, waiting for a signal to switch to operating mode. In operating mode, it transmits probe information, including battery status, to the receiver.

Receiver/interface

Renishaw provides a variety of application-specific interface models. The very latest generation uses modulated optical transmission to reject light interference from other sources and ensure reliable communications.

Systems can be optimised for the needs of smaller machine tools and up to three probes can be used with a single interface.

Renishaw optical interfaces provide visual and/or audible indicators that clearly and simply inform the operator of probe status, system power, battery status and error diagnostics.

Radio transmission systems

A Renishaw radio transmission system provides communication between the probe and the machine's control and comprises the following:

Probe

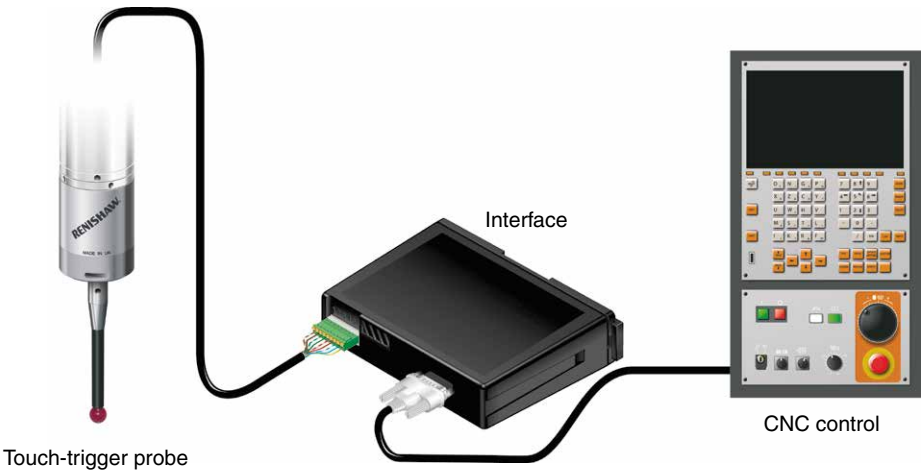
The probe receives machine control signals and transmits status signals. There are two active modes, "standby" and "operating". In standby mode, the probe is periodically transmitting and receiving, waiting for a signal to switch to operating mode. In operating mode, it transmits probe information, including battery status, to the receiver.

Receiver/interface

The combined interface and antenna convert probe signal information into a form which is compatible with the machine tool control. This technology is particularly suited to large machines and/or applications where line-of-sight between probe and interface is not possible. Frequency hopping spread spectrum (FHSS) technology enables the system to hop between channels providing reliable communication resistant to other radio device interference.

Renishaw radio interfaces provide visual and/or audible indicators that clearly and simply inform the operator of probe status, system power, battery status and error diagnostics.

Hard-wired transmission systems



A hard-wired probe system has the simplest form of transmission system and typically comprises the following elements:

Probe

A signal cable connects the probe to a machine interface unit, carrying power and probe signals.

Interface

The interface unit converts inspection probe signals into voltage-free solid-state relay (SSR) outputs for transmission to the machine tool control.

Hard-wired transmission systems are ideally suited to milling machines where the probe is manually placed in the machine spindle.

Multiple probe transmission systems

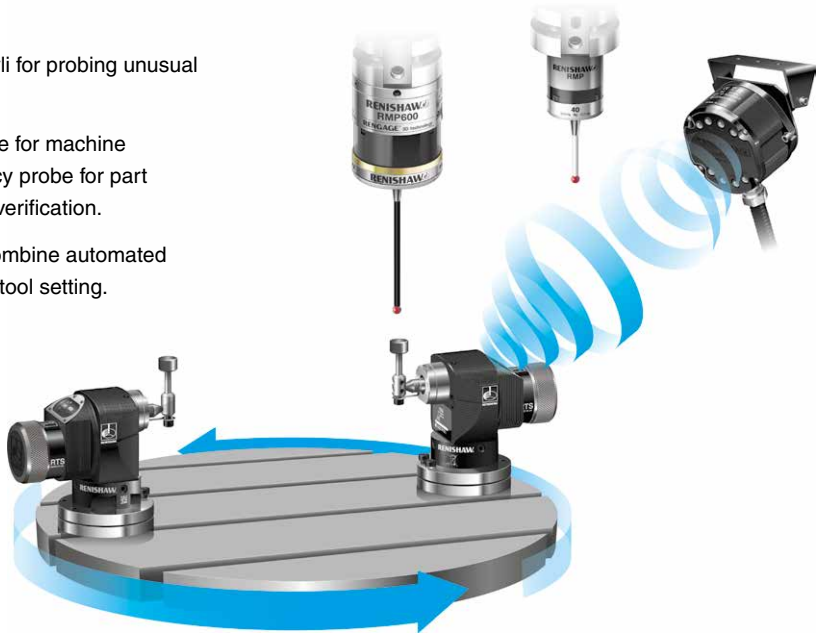
The diversity and capability of Renishaw transmission systems enables innovative multiple probe and tool setter applications and system combinations. The chart below provides some of the typical examples with various transmission types. Further variations of these are possible.

Multiple probe system	Total maximum probes	Interface	Probe type *
Twin optical probes	2	OMI-2T	OMP40-2, OMP40M OLP40
Multi optical probes	3	OSI with OMM-2	OMP60, OMP60M OMP400 OTS
Multi radio probes	4	RMI-Q ‡	RMP40, RMP40M RLP40 RMP60, RMP60M RMP600 RTS

* Any combination
‡ A maximum of one first generation radio inspection probe or tool setter can be used per RMI-Q. Additional probes and/or tool setters should be second generation. For more details, please refer to the *RMI-Q installation guide* (Renishaw part no. H-5687-8504)

Practical examples of multiple Renishaw probing applications might include:

1. Two or more probes with different styli for probing unusual features during in-process gauging.
2. One high accuracy **RENGAGE™** probe for machine calibration and one standard accuracy probe for part set-up, in-process gauging and part verification.
3. Multiple probes and tool setters to combine automated part setting, in-process gauging and tool setting.



Combination examples showing application flexibility with Renishaw radio probes.


RENISHAW
OMP
40-2
SERIAL No 7R9778
RENISHAW
OTS
MADE IN UK
RENISHAW

Probe selector

This selector will help you identify which probes are most suited to your application.

Machine types			Vertical CNC machining centres 			Horizontal CNC machining centres 			Gantry CNC machining centres 	Manual machines 
Products		Machine size / Page	Small *	Medium *	Large *	Small *	Medium *	Large *	All	All
Kinematic probes	OMP40-2	2-14	●	●		●	●			
	OMP40M	2-20	●	●		●	●			
	OLP40	2-16								
	OMP60	2-18		●	●		●	●		
	OMP60M	2-20		●	●		●	●		
	RMP40	2-24	●	●		●	●			
	RMP40M	2-30	●	●		●	●			
	RLP40	2-26								
	RMP60	2-28		●	●		●	●	●	
	RMP60M	2-30		●	●		●	●	●	
	LP2 and variants	2-34	●	●	●	●	●	●		
	MP11	2-36								●
Strain gauge probes	OMP400	2-40	●	●		●	●			
	MP700	2-42		●	●		●	●		
	RMP600	2-44		●	●		●	●	●	
	MP250	2-46								
Other	JCP	2-38								●
* Table sizes			Small			Medium			Large	
			Table size <700 mm × 600 mm			Table size <1200 mm × 600 mm			Table size >1200 mm × 600 mm	

Further machine types are continued on the next page.

Probe selector (continued)

Machine types			CNC lathes			CNC multi-tasking machines			CNC grinders
									
Products		Machine size / Page	Small §	Medium §	Large §	Small ‡	Medium ‡	Large ‡	All
Kinematic probes	OMP40-2	2-14				●			
	OMP40M	2-20	●	●		●			
	OLP40	2-16	●	●		●			
	OMP60	2-18				●	●		
	OMP60M	2-20				●	●		
	RMP40	2-24				●	●		
	RMP40M	2-30	●	●	●	●	●		
	RLP40	2-26	●	●	●	●	●		
	RMP60	2-28					●	●	
	RMP60M	2-30					●	●	
	LP2 and variants	2-34	●	●	●	●	●	●	●
	MP11	2-36							
Strain gauge probes	OMP400	2-40				●			
	MP700	2-42				●	●		
	RMP600	2-44				●	●	●	
	MP250	2-46							●
Other	JCP	2-38							

Machine types/sizes	Small	Medium	Large
§ CNC lathes	Chuck size 6 in to 8 in or smaller	Chuck size 10 in to 15 in	Chuck size 18 in to 24 in
‡ CNC multi-tasking machines	Working range <1500 mm	Working range <3500 mm	Working range >3500 mm

OMP40-2

Ultra compact 3D touch-trigger probe with optical signal transmission. Used for workpiece set-up inspection on small and medium machining centres and the growing number of high speed machines fitted with small HSK and spindle tapers.

Compatibility with all Renishaw optical receivers enables users to easily upgrade existing installations.

Key features and benefits:

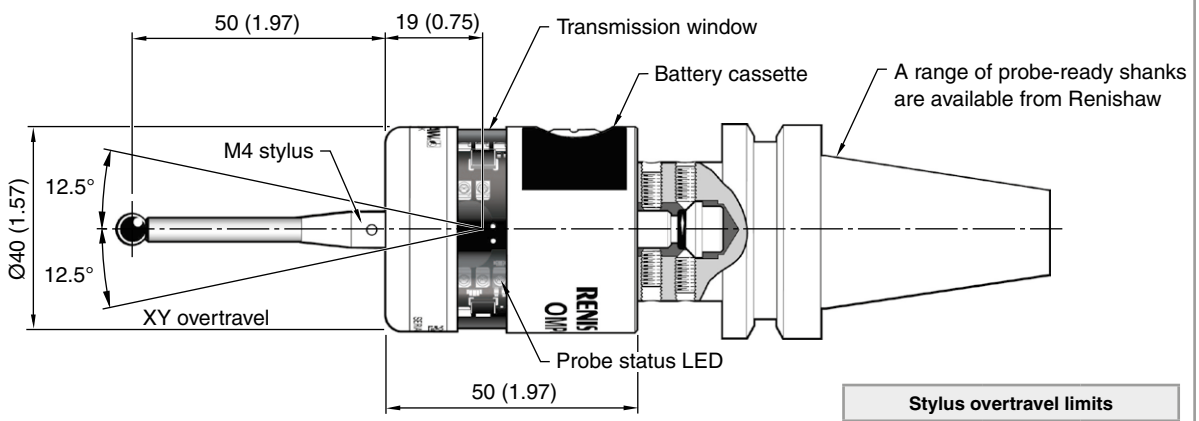
- Proven kinematic design
- Exceptional resistance to light interference with modulated transmission
- 360° transmission envelope
- Ultra compact design
- 1.00 µm 2σ repeatability

"Previously it could take 1.5 hours to set a job that took 4.5 hours of machining; that was totally unacceptable. Now we can do the same set-up in 10 minutes, immediately freeing up 1 hour 20 minutes to cut more metal, which we make money on."

Sewtec Automation

For the full case study please contact Renishaw or visit **www.renishaw.com/sewtec-automation**

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**+Z**
50 (1.97)	12 (0.47)	6 (0.24)
100 (3.94)	22 (0.87)	6 (0.24)

Dimensions given in mm (in)

OMP40-2 specification

Optical setting		**Modulated**	**Legacy**
Principal application		Workpiece inspection and job set-up on small to medium machining centres and small multi-tasking machines.	
Transmission type		360° infrared optical transmission (modulated or legacy)	
Compatible interfaces		OMI-2, OMI-2T, OMI-2H, OMI-2C or OSI / OMM-2	OMI or OMM / MI 12
Operating range		Up to 5 m (16.4 ft)	
Recommended styli		Ceramic, lengths 50 mm (1.97 in) to 150 mm (5.91 in)	
Weight without shank (including batteries)		250 g (8.82 oz)	
Switch-on/switch-off options		Optical on → Optical off Optical on → Timer off	
Battery life (2 × ½ AA 3.6 V Lithium-thionyl chloride)	**Standby life**	250 days maximum, dependent on switch-on/switch-off option.	
	Continuous use	230 hours maximum, dependent on switch-on/switch-off option.	270 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z	
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*	
Stylus trigger force *(see notes 2 and 3)* XY low force XY high force +Z direction		 0.50 N, 51 gf (1.80 ozf) 0.90 N, 92 gf (3.24 ozf) 5.85 N, 597 gf (21.04 ozf)	
Sealing		IPX8 (EN/IEC 60529)	
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)	

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 50 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment is not possible.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/omp40-2**

OLP40

Ultra compact 3D touch-trigger probe with optical signal transmission. Specifically designed for workpiece set-up inspection on lathes and grinding machines.

Compatibility with all Renishaw optical receivers enables users to easily upgrade existing installations.

Key features and benefits:

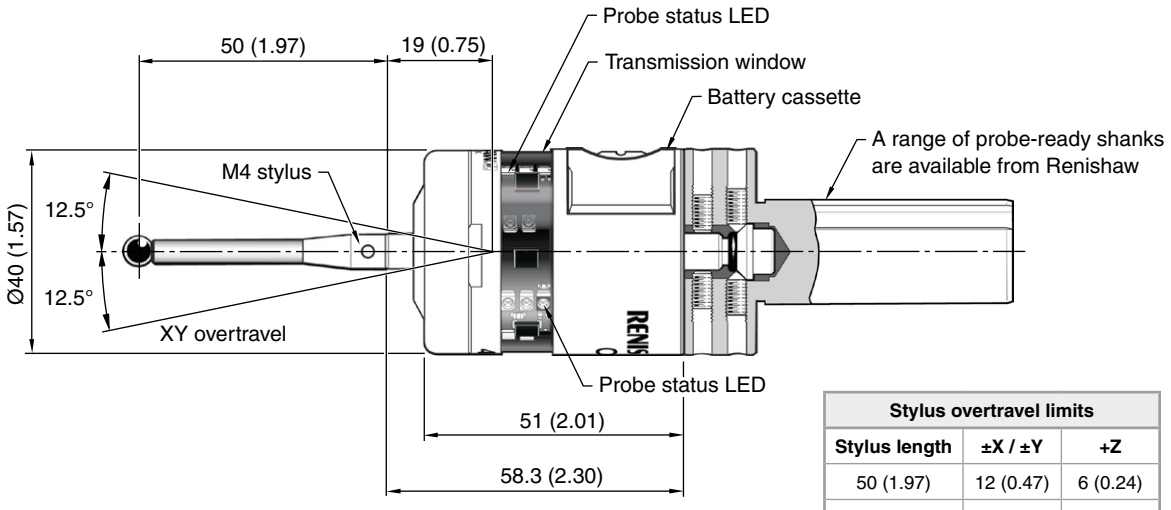
- Proven kinematic design
- Exceptional resistance to light interference with modulated transmission
- 360° transmission envelope
- Ultra compact design
- Increased environmental protection
- 1.00 µm 2σ repeatability

"On one component we used to spend 35 minutes on in-process inspection – this had to be improved. We replaced this with a probe cycle, reducing the inspection cycle to about 6 minutes."

Castle Precision

For the full case study please contact Renishaw or visit **www.renishaw.com/castle-precision**

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**+Z**
50 (1.97)	12 (0.47)	6 (0.24)
100 (3.94)	22 (0.87)	6 (0.24)

Dimensions given in mm (in)

OLP40 specification

Optical setting		**Modulated**	**Legacy**
Principal application		Workpiece inspection and job set-up on all sizes of lathes and small multi-tasking machines.	
Transmission type		360° infrared optical transmission (modulated or legacy)	
Compatible interfaces		OMI-2, OMI-2T, OMI-2H, OMI-2C or OSI / OMM-2	OMI or OMM / MI 12
Operating range		Up to 5 m (16.4 ft)	
Recommended styli		Ceramic, lengths 50 mm (1.97 in) to 150 mm (5.91 in)	
Weight without shank (including batteries)		277 g (9.77 oz)	
Switch-on/switch-off options		Optical on → Optical off Optical on → Timer off	
Battery life (2 × ½ AA 3.6 V Lithium-thionyl chloride)	**Standby life**	250 days maximum, dependent on switch-on/switch-off option.	
	Continuous use	230 hours maximum, dependent on switch-on/switch-off option.	270 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z	
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*	
Stylus trigger force *(see notes 2 and 3)* XY low force XY high force +Z direction		 0.40 N, 41 gf (1.44 ozf) 0.80 N, 82 gf (2.88 ozf) 5.30 N, 540 gf (19.06 ozf)	
Sealing		IPX8 (EN/IEC 60529)	
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)	

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 50 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment is possible. For more details, please refer to the *OLP40 installation guide* (Renishaw part no. H-5625-8504).

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/olp40**

OMP60

Compact 3D touch-trigger probe with optical signal transmission. Used for workpiece set-up inspection on a wide range of medium and large machining centres.

Compatibility with all Renishaw optical receivers enables users to easily upgrade existing installations.

Key features and benefits:

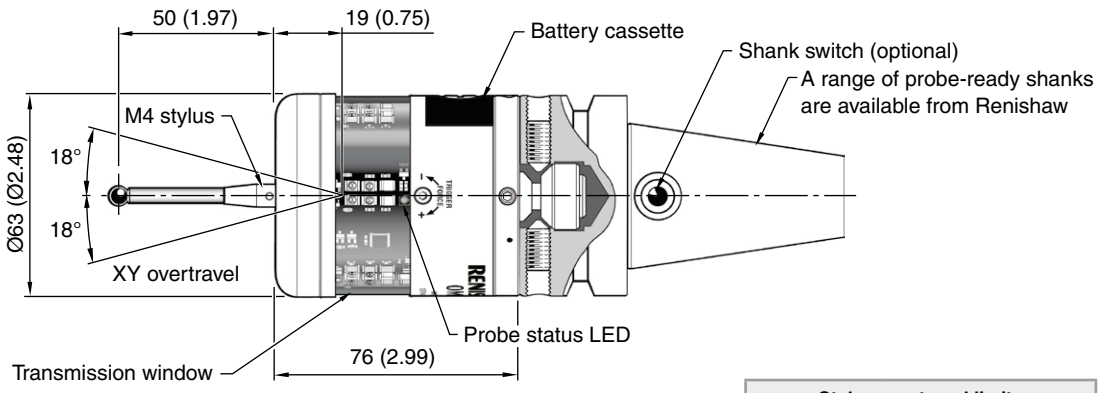
- Proven kinematic design
- Exceptional resistance to light interference with modulated transmission
- 360° transmission envelope
- Compact design
- Various activation options and adjustable trigger force
- 1.00 µm 2σ repeatability

"We have now used probing systems on this cell for over 6 years and have cut costs and times, with a step change in process control and consistency."

Dunlop Aerospace Braking Systems

For the full case study please contact Renishaw or visit **www.renishaw.com/dunlop-aerospace-braking-systems**

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**+Z**
50 (1.97)	21 (0.82)	11 (0.43)
100 (3.94)	37 (01.45)	11 (0.43)

Dimensions given in mm (in)

OMP60 specification

Optical setting		**Modulated**	**Legacy**
Principal application		Workpiece inspection and job set-up on all sizes of machining centres and small to medium multi-tasking machines.	
Transmission type		360° infrared optical transmission (modulated or legacy)	
Compatible interfaces		OMI-2, OMI-2T, OMI-2H, OMI-2C or OSI / OMM-2	OMI or OMM / MI 12
Operating range		Up to 6 m (19.7 ft)	
Recommended styli		Ceramic, lengths 50 mm (1.97 in) to 150 mm (5.91 in)	
Weight without shank (including batteries)		885 g (31.22 oz)	
Switch-on/switch-off options		Optical on → Optical off Optical on → Timer off Shank switch on → Shank switch off	
Battery life (2 × AA 3.6 V Lithium-thionyl chloride)	**Standby life**	1767 days maximum, dependent on switch-on/switch-off option.	
	Continuous use low power	690 hours maximum, dependent on switch-on/switch-off option.	880 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z	
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*	
Stylus trigger force *(see notes 2 and 3)* XY low force XY high force +Z direction		 0.75 N, 76 gf (2.70 ozf) 1.40 N, 143 gf (5.04 ozf) 5.30 N, 540 gf (19.06 ozf)	
Sealing		IPX8 (EN/IEC 60529)	
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)	

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 50 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment is possible. For more details, please refer to the *OMP60 installation guide* (Renishaw part no. H-4038-8505).

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/omp60**

OMP40M and OMP60M optical modular systems

Modular versions enable probe inspection of part features which are normally inaccessible by the standard versions.

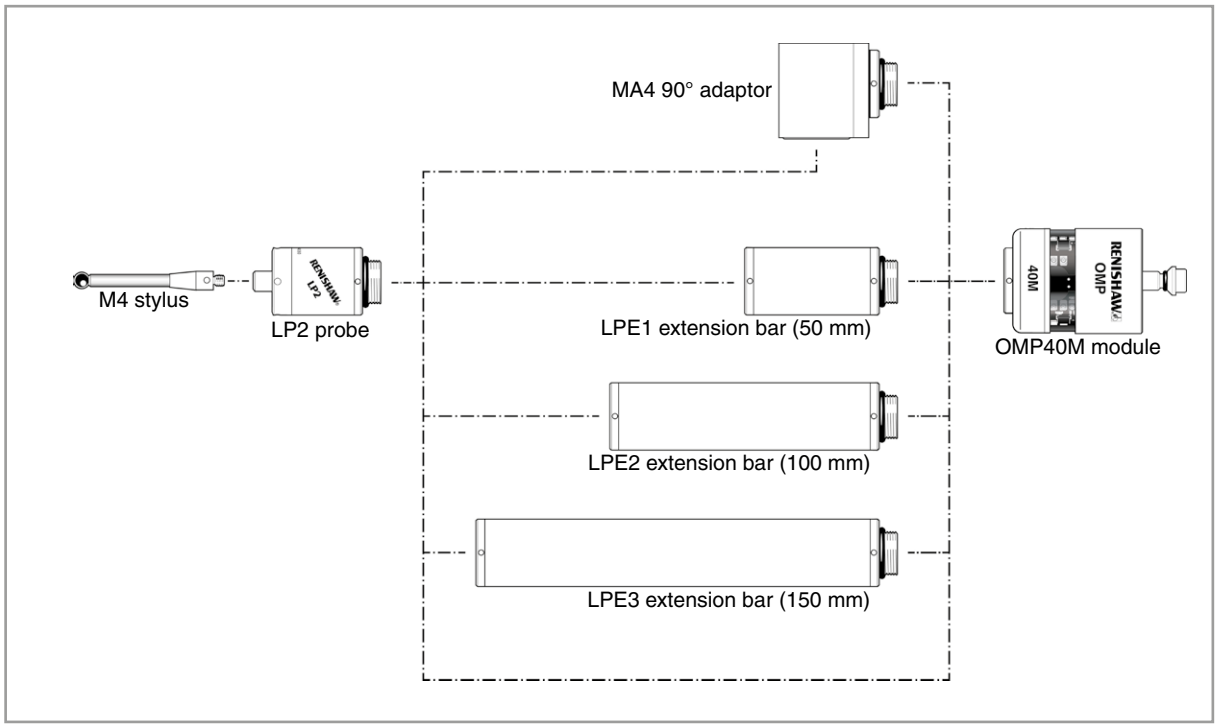
Renishaw has a comprehensive range of adaptors, extensions, and stylus configurations to overcome the most demanding of probing applications.

The OMP40M and OMP60M maintain compatibility with existing Renishaw optical receivers which enables users to smoothly upgrade existing installations. When combined with the very latest modulated transmission interface the system offers exceptional resistance to light interference. High resistance to shock and liquid immersion ensure reliable operation in the harshest of machine shop environments.

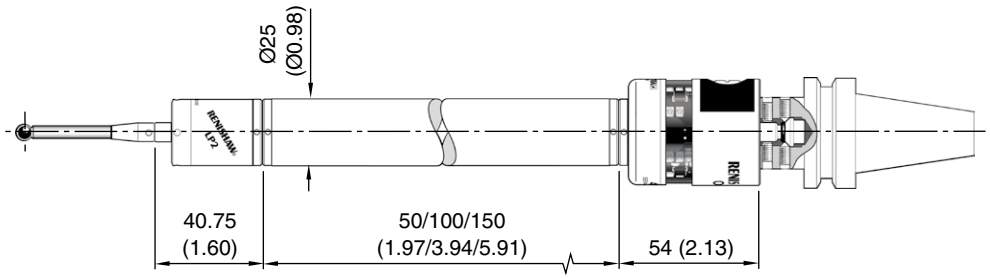
Key features and benefits:

- Proven kinematic design
- Exceptional resistance to light interference with modulated transmission
- 360° transmission envelope
- Comprehensive range of adaptors and extensions allowing access to more workpiece features
- 1.00 to 2.00 µm 2σ repeatability (dependent on probe)

OMP40M modular system

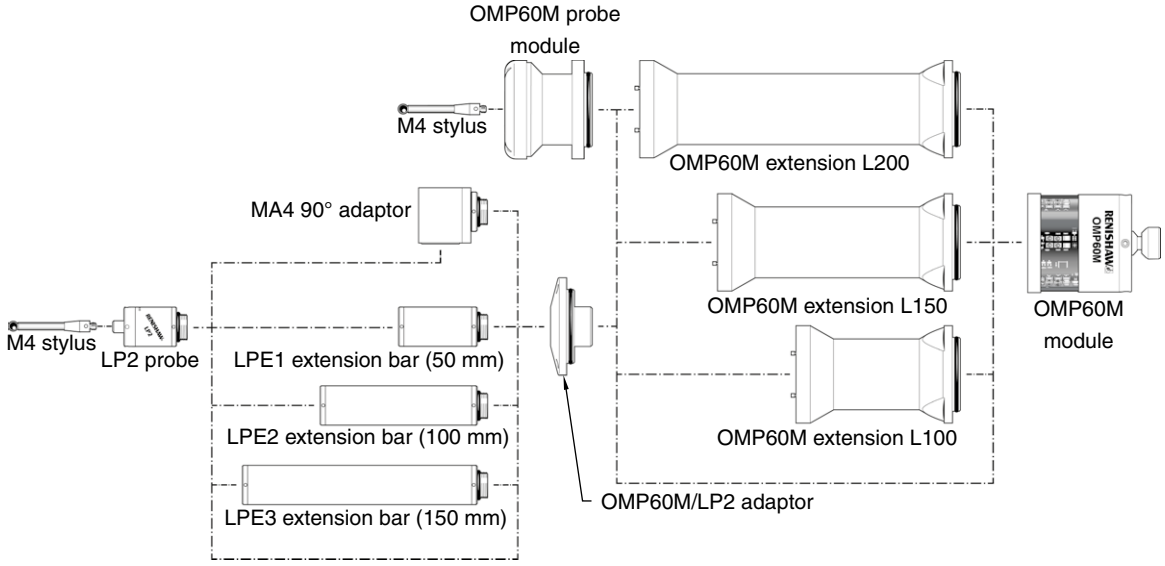


OMP40M dimensions

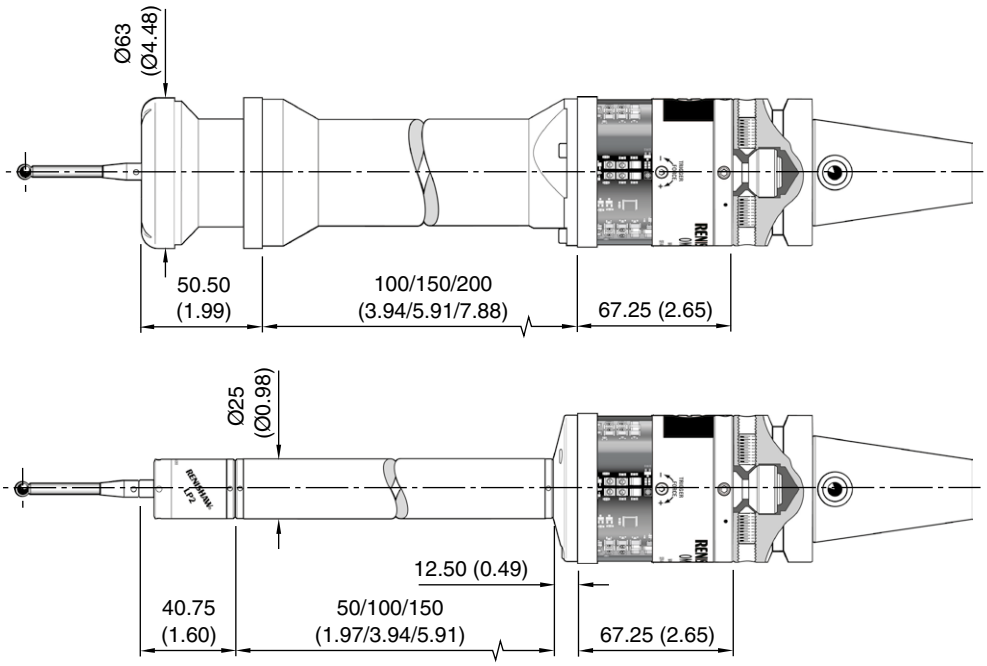


Dimensions given in mm (in)

OMP60M modular system



OMP60M dimensions



Dimensions given in mm (in)

OMP40M specification

Optical setting		**Modulated**	**Legacy**
Principal application		Workpiece inspection and job set-up on small to medium machining centres and small multi-tasking machines.	
Transmission type		360° infrared optical transmission (modulated or legacy)	
Compatible probes		LP2 and variants	
Compatible interfaces		OMI-2, OMI-2T, OMI-2H, OMI-2C or OSI / OMM-2	OMI or OMM / MI 12
Operating range		Up to 5 m (16.4 ft)	
Recommended styli		Ceramic, lengths 50 mm (1.97 in) to 150 mm (5.91 in)	
Weight without shank (including batteries)		270 g (9.52 oz)	
Switch-on/switch-off options		Optical on → Optical off Optical on → Timer off	
Battery life (2 × AA 3.6 V Lithium-thionyl chloride)	**Standby life**	250 days maximum, dependent on switch-on/switch-off option.	
	Continuous use	230 hours maximum, dependent on switch-on/switch-off option.	270 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z	
Sealing		IPX8 (EN/IEC 60529)	
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)	

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/omp40-2**

OMP60M specification

Optical setting		**Modulated**	**Legacy**
Principal application		Workpiece inspection and job set-up on all sizes of machining centres and small to medium multi-tasking machines.	
Transmission type		360° infrared optical transmission (modulated or legacy)	
Compatible probes		LP2 and variants, and the OMP60M probe module	
Compatible interfaces		OMI-2, OMI-2T, OMI-2H, OMI-2C or OSI / OMM-2	OMI or OMM / MI 12
Operating range		Up to 6 m (19.7 ft)	
Recommended styli		Ceramic, lengths 50 mm (1.97 in) to 150 mm (5.91 in)	
Weight without shank (including batteries)		892 g (31.46 oz)	
Switch-on/switch-off options		Optical on → Optical off Optical on → Timer off Shank switch on → Shank switch off	
Battery life (2 × AA 3.6 V Lithium-thionyl chloride)	**Standby life**	1767 days maximum, dependent on switch-on/switch-off option.	
	Continuous use	690 hours maximum, dependent on switch-on/switch-off option.	880 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z	
Sealing		IPX8 (EN/IEC 60529)	
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)	

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/omp60**

RMP40

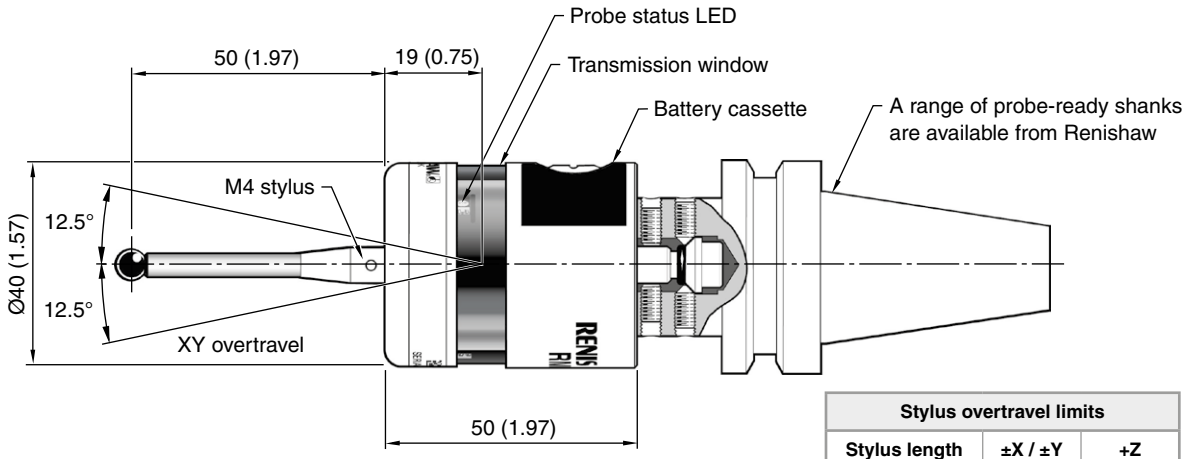
The RMP40 is the smallest frequency hopping radio spindle probe in the world. Operating within the globally recognised 2.4 GHz ISM band, the RMP40 is suited for operation on all sizes of machine.

The robust transmission protocol and small body makes the RMP40 the ideal choice for multi-tasking applications where the line-of-sight between probe and interface cannot always be maintained.

Key features and benefits:

- Proven kinematic design
- Secure frequency hopping spread spectrum (FHSS)
- Globally recognised 2.4 GHz waveband — compliant with radio regulations in all major markets
- Ultra compact design
- 1.00 µm 2σ repeatability

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**+Z**
50 (1.97)	12 (0.47)	6 (0.24)
100 (3.94)	22 (0.87)	6 (0.24)

Dimensions given in mm (in)

RMP40 specification

Principal application		Workpiece inspection and job set-up on machining centres and multi-tasking machines.
Transmission type		Frequency hopping spread spectrum (FHSS) radio Radio frequency 2400 MHz to 2483.5 MHz
Radio approval regions		China, Europe (all countries within the European Union), Japan and USA. For details about other regions, please contact Renishaw.
Compatible interfaces		RMI and RMI-Q
Operating range		Up to 15 m (49.2 ft)
Recommended styli		Ceramic, lengths 50 mm (1.97 in) to 150 mm (5.91 in)
Weight without shank (including batteries)		250 g (8.81 oz)
Switch-on/switch-off options		Radio on → Radio off or timer off Spin on → Spin off or timer off
Battery life (2 × ½ AA 3.6 V Lithium-thionyl chloride)	**Standby life**	290 days maximum, dependent on switch-on/switch-off option.
	Continuous use	450 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*
Stylus trigger force *(see notes 2 and 3)* XY low force XY high force +Z direction		 0.50 N, 51 gf (1.80 ozf) 0.90 N, 92 gf (3.24 ozf) 5.85 N, 597 gf (21.04 ozf)
Sealing		IPX8 (EN/IEC 60529)
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 50 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment is not possible.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/rmp40**

RLP40

The small-bodied RLP40 is a radio frequency probe designed to be turret mounted for part setting and inspection on turning centres.

The robust, ultra compact design and secure frequency hopping spread spectrum (FHSS) communications make the RLP40 well suited to harsh, demanding environments. Available with a variety of activation methods, adjustable trigger force and trigger options.

Key features and benefits:

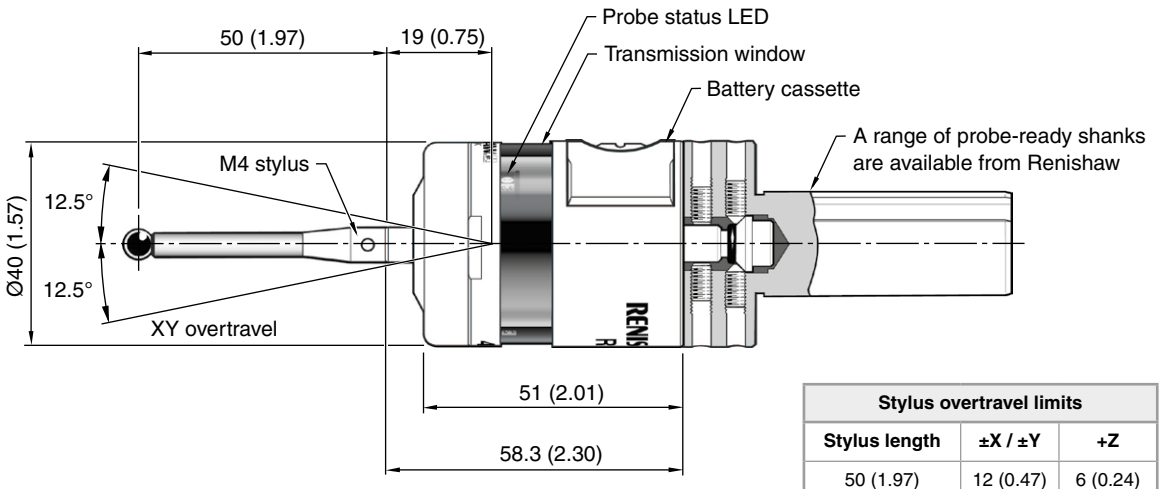
- Proven kinematic design
- Secure frequency hopping spread spectrum (FHSS)
- Globally recognised 2.4 GHz waveband – compliant with radio regulations in all major markets
- Ultra compact design
- Increased environmental protection
- 1.00 µm 2σ repeatability

"It gives us consistency and takes out the chance of human error. Scrap reduction is not even an issue we have to consider."

Mekall

For the full case study please contact Renishaw or visit **www.renishaw.com/mekall**

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**+Z**
50 (1.97)	12 (0.47)	6 (0.24)
100 (3.94)	22 (0.87)	6 (0.24)

Dimensions given in mm (in)

RLP40 specification

Principal application		Workpiece inspection and job set-up on multi-tasking machines and lathes.
Transmission type		Frequency hopping spread spectrum (FHSS) radio Radio frequency 2400 MHz to 2483.5 MHz
Radio approval regions		China, Europe (all countries within the European Union), Japan and USA. For details about other regions, please contact Renishaw.
Compatible interfaces		RMI and RMI-Q
Operating range		Up to 15 m (49.2 ft)
Recommended styli		Ceramic, lengths 50 mm (1.97 in) to 150 mm (5.91 in)
Weight without shank (including batteries)		260 g (9.17 oz)
Switch-on/switch-off options		Radio on → Radio off or timer off Spin on → Spin off or timer off
Battery life (2 × ½ AA 3.6 V Lithium-thionyl chloride)	**Standby life**	290 days maximum, dependent on switch-on/switch-off option.
	Continuous use	450 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*
Stylus trigger force *(see notes 2 and 3)* XY low force XY high force +Z direction		 0.40 N, 41 gf (1.44 ozf) 0.80 N, 82 gf (2.88 ozf) 5.30 N, 540 gf (19.06 ozf)
Sealing		IPX8 (EN/IEC 60529)
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 50 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment is possible. For more details, please refer to the *RLP40 installation guide* (Renishaw part no. H-5627-8504).

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/rlp40**

RMP60

The RMP60 is a compact spindle probe with radio signal transmission and offers automated part set-up and in-cycle gauging on machining centres including 5-axis machines.

The RMP60 combines Renishaw's traditional kinematic resistive probe mechanism with a secure and unique frequency hopping transmission protocol; ideal for the modern machine shop and harsh environments where line-of-sight between probe and interface is not always possible.

Key features and benefits:

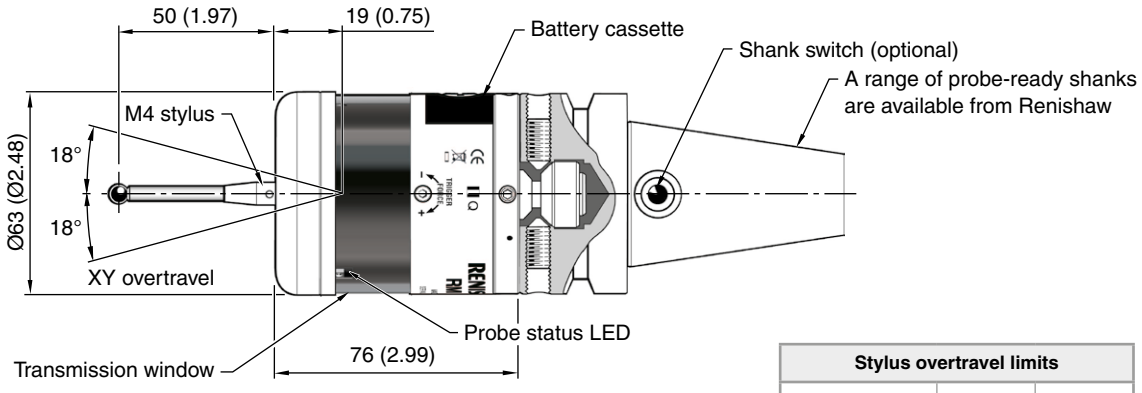
- Proven kinematic design
- Secure frequency hopping spread spectrum (FHSS)
- Globally recognised 2.4 GHz waveband – compliant with radio regulations in all major markets
- Compact design
- Various activation options and adjustable trigger force
- 1.00 µm 2σ repeatability

"During the planning stage of the project it occurred to us that the new machine would be located close to the welding area and that there was a very real possibility of signal interference, so we needed a system that could cope with the conditions. The Renishaw RMP60 is the first inspection probe to use frequency hopping spread spectrum (FHSS) data transmission."

Asquith-Butler

For the full case study please contact Renishaw or visit **www.renishaw.com/asquith-butler**

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**+Z**
50 (1.97)	21 (0.82)	11 (0.43)
100 (3.94)	37 (1.45)	11 (0.43)

Dimensions given in mm (in)

RMP60 specification

Principal application		Workpiece inspection and job set-up on multi-tasking machines, machining centres and gantry machining centres.
Transmission type		Frequency hopping spread spectrum (FHSS) radio Radio frequency 2400 MHz to 2483.5 MHz
Radio approval regions		China, Europe (all countries within the European Union), Japan and USA. For details about other regions, please contact Renishaw.
Compatible interfaces		RMI and RMI-Q
Operating range		Up to 15 m (49.2 ft)
Recommended styli		Ceramic, lengths 50 mm (1.97 in) to 150 mm (5.91 in)
Weight without shank (including batteries)		901 g (31.79 oz)
Switch-on/switch-off options		Radio on → Radio off or timer off Spin on → Spin off or timer off Shank switch on → Shank switch off
Battery life (2 × AA 3.6 V Lithium-thionyl chloride)	**Standby life**	890 days maximum, dependent on switch-on/switch-off option.
	Continuous use	1710 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*
Stylus trigger force *(see notes 2 and 3)* XY low force XY high force +Z direction		 0.75 N, 76 gf (2.70 ozf) 1.40 N, 143 gf (5.04 ozf) 5.30 N, 540 gf (19.06 ozf)
Sealing		IPX8 (EN/IEC 60529)
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 50 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment is possible. For more details, please refer to the *RMP60 installation guide* (Renishaw part no. H-4113-8504).

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/rmp60**

RMP40M and RMP60M radio modular systems

Modular versions enable the probe to access features for inspection or part setting otherwise inaccessible by the standard probe.

Both RMP40M and RMP60M combine radio frequency hopping spread spectrum (FHSS) communications with a robust design and superior battery life to deliver a flexible solution.

Renishaw has a comprehensive range of adaptors, extensions, and stylus configurations to overcome the most demanding of probing applications.

Approved radio regions: China, Europe (all countries within the European Union), Japan and USA. For details about other regions, please contact Renishaw.

Key features and benefits:

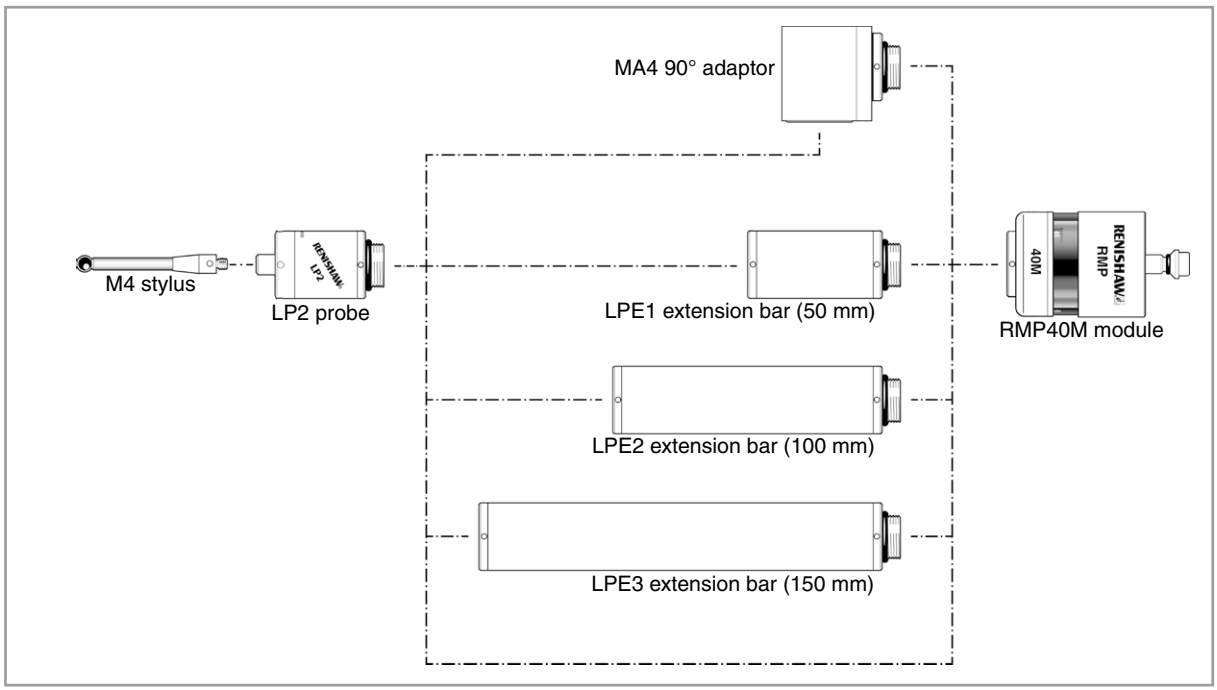
- Proven kinematic design
- Secure frequency hopping spread spectrum (FHSS)
- Globally recognised 2.4 GHz waveband – compliant with radio regulations in all major markets
- Comprehensive range of adaptors and extensions allowing access to more workpiece features
- 1.00 to 2.00 µm 2σ repeatability (dependent on probe)

"Our engineers were initially quite concerned about reaching all the areas on the chassis that we need to machine. But, because it uses radio transmission, the Renishaw probe makes part access much easier."

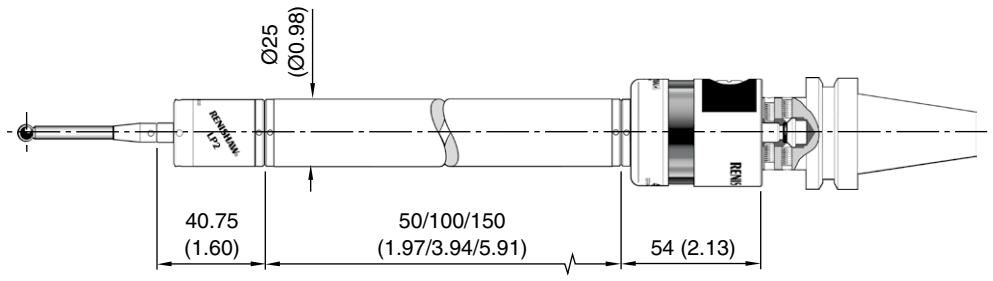
JCB

For the full case study please contact Renishaw or visit **www.renishaw.com/jcb**

RMP40M modular system

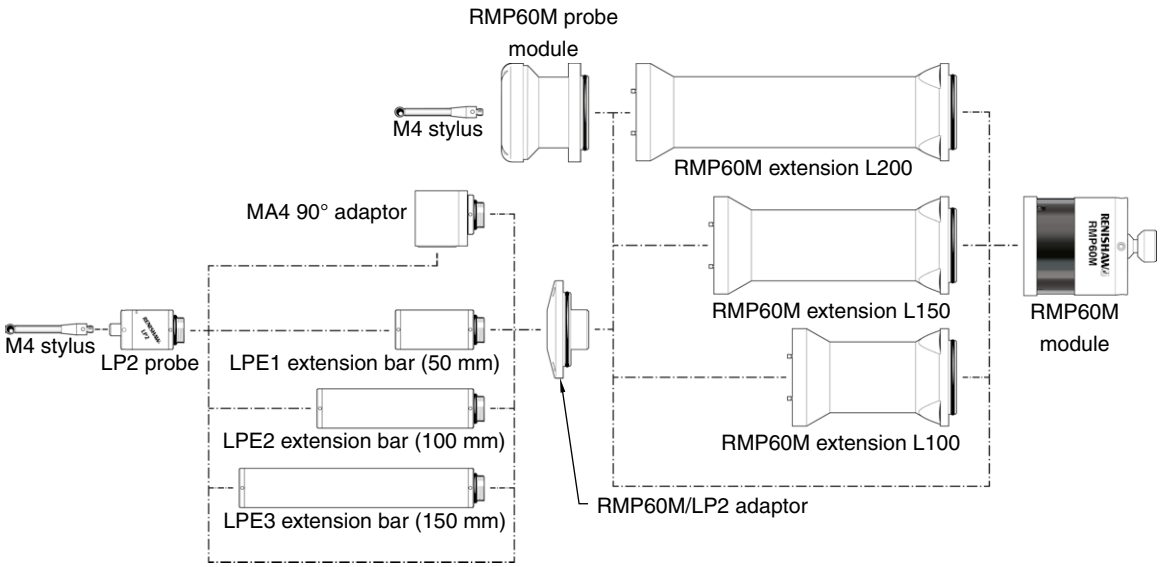


RMP40M dimensions

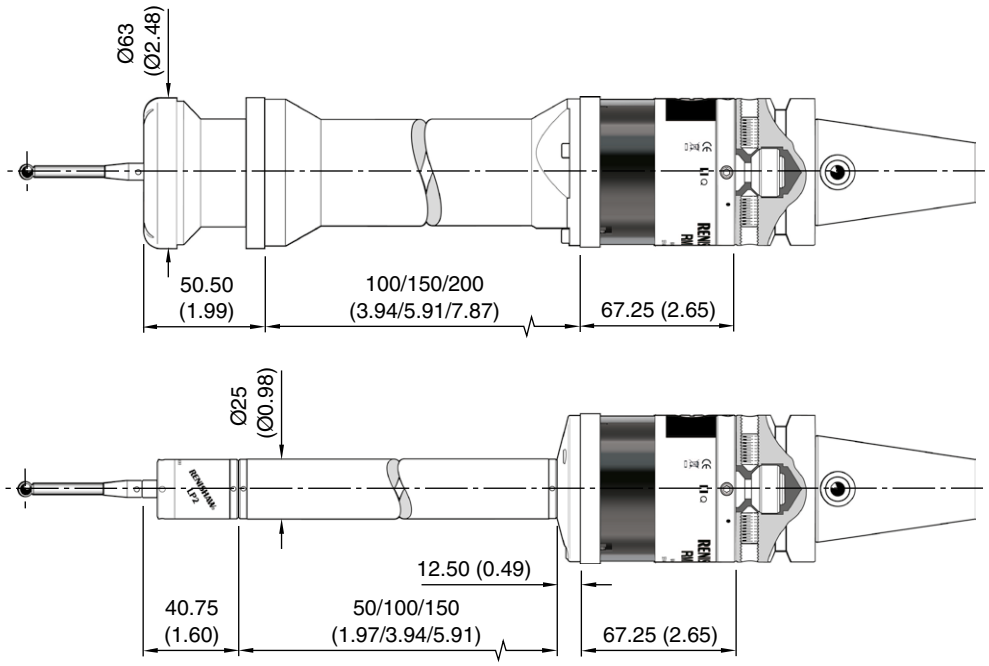


Dimensions given in mm (in)

RMP60M modular system



RMP60M dimensions



Dimensions given in mm (in)

RMP40M specification

Principal application		Workpiece inspection and job set-up on machining centres and multi-tasking machines.
Transmission type		Frequency hopping spread spectrum (FHSS) radio Radio frequency 2400 MHz to 2483.5 MHz
Radio approval regions		China, Europe (all countries within the European Union), Japan and USA. For details about other regions, please contact Renishaw.
Compatible probes		LP2 and variants
Compatible interfaces		RMI and RMI-Q
Operating range		Up to 15 m (49.2 ft)
Recommended styli		Ceramic, lengths 50 mm (1.97 in) to 150 mm (5.91 in)
Weight without shank (including batteries)		258 g (9.10 oz)
Switch-on/switch-off options		Radio on → Radio off or timer off Spin on → Spin off or timer off
Battery life (2 × ½ AA 3.6 V Lithium-thionyl chloride)	**Standby life**	290 days maximum, dependent on switch-on/switch-off option.
	Continuous use	450 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z
Sealing		IPX8 (EN/IEC 60529)
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/rmp40**

RMP60M specification

Principal application		Workpiece inspection and job set-up on multi-tasking machines, machining centres and gantry machining centres.
Transmission type		Frequency hopping spread spectrum (FHSS) radio Radio frequency 2400 MHz to 2483.5 MHz
Radio approval regions		China, Europe (all countries within the European Union), Japan and USA. For details about other regions, please contact Renishaw.
Compatible probes		LP2 and variants, and the OMP60M probe module
Compatible interfaces		RMI and RMI-Q
Operating range		Up to 15 m (49.2 ft)
Recommended styli		Ceramic, lengths 50 mm (1.97 in) to 150 mm (5.91 in)
Weight without shank (including batteries)		888 g (31.32 oz)
Switch-on/switch-off options		Radio on → Radio off or timer off Spin on → Spin off or timer off Shank switch on → Shank switch off
Battery life (2 × AA 3.6 V Lithium-thionyl chloride)	**Standby life**	890 days maximum, dependent on switch-on/switch-off option.
	Continuous use	1710 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z
Sealing		IPX8 (EN/IEC 60529)
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/rmp60**

LP2 and variants

High-performance, compact probes suitable for inspection and tool setting applications.

LP2 is the standard offering while LP2H has a higher spring force, allowing the use of longer styli. It has greater resistance to machine vibration. DD variants of both probes are available with double diaphragm sealing for use in harsh environments with particle laden coolant. All variants are suitable for use with the OMP40M and OMP60M, the radio transmission system RMP40M and RMP60M, as well as inductive transmission modules. They can also be hard-wired for grinder inspection applications.

Key features and benefits:

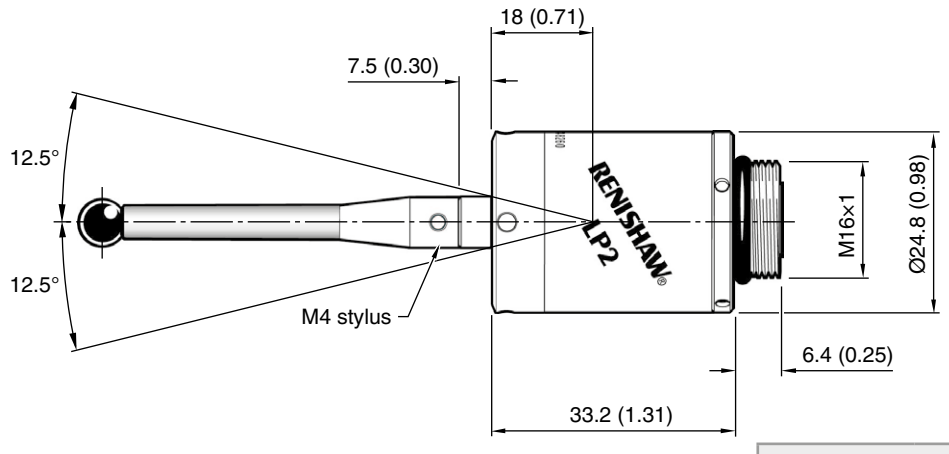
- Proven kinematic design
- Interference resistant hard-wired communication
- Miniature design
- Increased environmental protection
- 1.00 to 2.00 µm 2σ repeatability (dependent on probe)

"Old machines have been given a new lease of life because they now have intelligence via the probe and can therefore react to issues as they arise. New machines won't get through the door now without probes. So far, as value for money goes, they are easily the best bit of kit we've got on the camshaft line."

Nissan

For the full case study please contact Renishaw or visit **www.renishaw.com/nissan**

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**Z**
50 (1.97)	See table	See table

Dimensions given in mm (in)

LP2 and variants specification

Variants		LP2 / LP2DD		LP2H / LP2HDD	
Principal application		Workpiece inspection and job set-up on all sizes of lathes, machining centres and CNC grinders.			
Transmission type		Hard-wired or in conjunction with optical, or radio transceiver modules			
Compatible interfaces	**Hard-wired**	HSI, MI 8-4, FS1i or FS2i			
	Optical	OMI-2 or OSI / OMM-2			
	Radio	RMI or RMI-Q			
Recommended styli		50 mm (1.97 in) to 100 mm (3.94 in) Stylus material depends on application.		50 mm (1.97 in) to 150 mm (5.91 in) Stylus material depends on application.	
Weight		65 g (2.29 oz)			
Sense directions		±X, ±Y, +Z			
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*		2.00 µm (80 µin) 2σ *(see note 1)*	
Stylus trigger force *(see notes 2 and 3)* XY low force XY high force +Z direction		 0.50 N, 51 gf (1.80 ozf) 0.90 N, 92 gf (3.24 ozf) 5.85 N, 597 gf (21.04 ozf)		 2.00 N, 204 gf (7.19 ozf) 4.00 N, 408 gf (14.39 ozf) 30.00 N, 3059 gf (107.91 ozf)	
Stylus overtravel limits		LP2	LP2DD	LP2H	LP2HDD
±X / ±Y		14.87 mm (0.55 in) ±12.5°	19.06 mm (0.73 in) ±15°	14.87 mm (0.55 in) ±12.5°	19.06 mm (0.73 in) ±15°
Z		6.5 mm (0.26 in) 4.5 mm (0.18 in) when fitted with swarf deflector		5.0 mm (0.20 in) 4.5 mm (0.18 in) when fitted with swarf deflector	
Mounting		M16 thread, for LPE extension bars and adaptors.			
Sealing		IPX8 (EN/IEC 60529)			
Operating temperature		0 °C to +60 °C (+32 °F to +140 °F)			

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 35 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment of the LP2/LP2DD is possible, but the LP2H/LP2HDD is NOT adjustable. For more details, please refer to the *LP2 installation and user's guide* (Renishaw part no. H-2000-5021).

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/lp2**

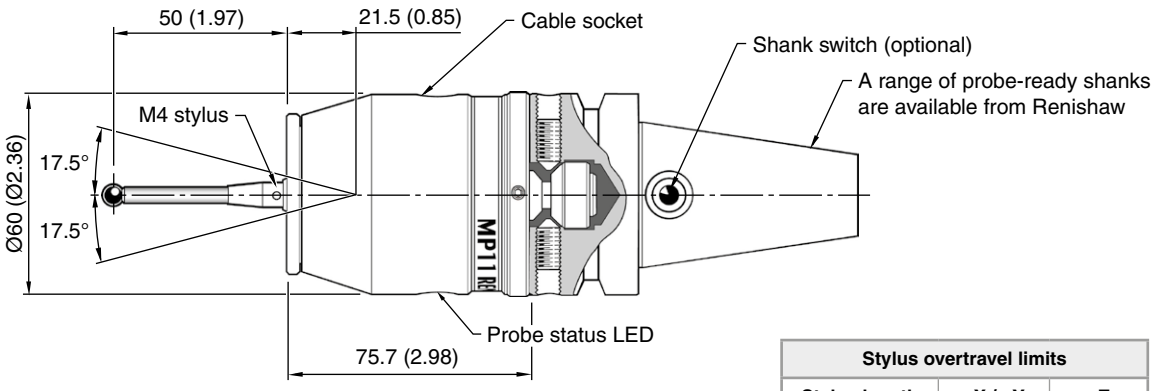
MP11

Designed for use in CNC milling machines with manual tool change, providing simple and quick insertion of the probe and cable connection. The integrated interface and curly cable hard-wired connection provide a straightforward installation and reliable communication method resistant to interference.

Key features and benefits:

- Proven kinematic design
- Interference resistant hard-wired communication
- Cost-effective workpiece inspection
- 1.00 µm 2σ repeatability

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**+Z**
50 (1.97)	21.5 (0.85)	8 (0.31)
100 (3.94)	36.5 (1.44)	8 (0.31)

Dimensions given in mm (in)

MP11 specification

Principal application	Workpiece inspection and job set-up on CNC milling machines with manual tool change.
Transmission type	Hard-wired transmission
Compatible interfaces	N/A (integrated interface)
Recommended styli	Ceramic, lengths 50 mm (1.97 in) to 100 mm (3.94 in)
Weight	540 g (19.05 oz)
Sense directions	±X, ±Y, +Z
Unidirectional repeatability	1.00 µm (40 µin) 2σ *(see note 1)*
Stylus trigger force *(see note 2 and 3)* XY low force XY high force +Z direction	 0.50 N, 51 gf (1.80 ozf) 1.50 N, 153 gf (5.40 ozf) 1.80 N to 7.00 N, 184 gf to 714 gf (6.47 ozf to 25.18 ozf)
Sealing	IP66 (EN/IEC 60529)
Operating temperature	+5 °C to +50 °C (+41 °F to +122 °F)

Note 1 Performance specification is tested at a standard test velocity of 1000 mm/min (39.37 in/min) with a 50 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment is possible. For more details, please refer to the *MP11 installation and user's guide* (Renishaw part no. H-2000-5007).

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/mp11**

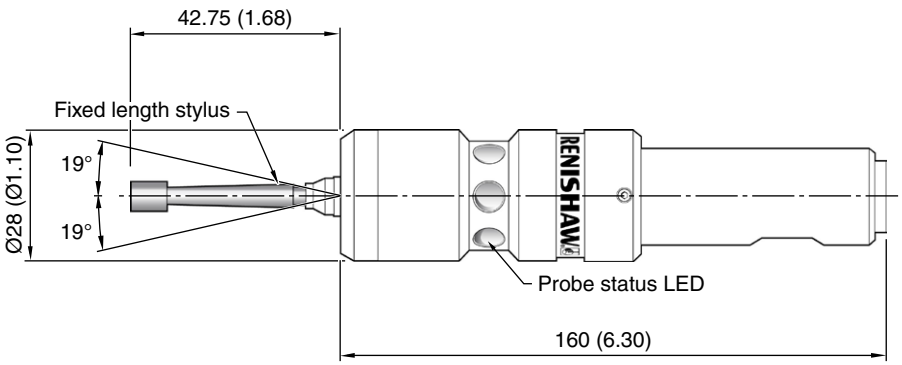
Job contact probes

An inspection probe designed specifically for use with manual machine tools that is ideal for workpiece set-up and simple inspection. Two versions are available, both using Renishaw's proven kinematic mechanism to ensure robust and repeatable reseating. The JCP1, available with metric and imperial shanks, uses electrical conductivity to sense contact with a metallic workpiece. When the stylus touches the surface an LED is illuminated. The JC30C variant provides a cable connection to digital readout counters with touch sensor inputs.

Key features and benefits:

- Proven kinematic design
- Cable-free for unrestricted machine movement and ease of installation
- Cost-effective workpiece inspection
- 1.00 µm 2σ repeatability

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**Z**
42.75 (1.68)	15 (0.59)	5 (0.20)

Dimensions given in mm (in)

Job contact probe specification

Variants		JC30C	JCP1-M	JCP1-I
Principal application		Workpiece inspection and job set-up on manual machine tools.		
Transmission type		Visual indication of trigger or hard-wired transmission		
Compatible interfaces		N/A		
Recommended styli (Integrated)	**Length**	42.75 mm		1.68 in
	Diameter	6.00 mm		0.20 in
Weight		240 g (8.47 oz)		
Battery life (2 × LR 1.5 V batteries)		30 hours		
Sense directions		±X, ±Y, +Z		
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*		
Sealing		IP66 (EN/IEC 60529)		
Shanks		Ø16 mm (0.63 in)	Ø20 mm (0.79 in)	Ø0.75 in

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 50 mm stylus. Significantly higher velocity is possible depending on application requirements.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/jcp**

OMP400

Suitable for small to medium machining centres, the OMP400 ultra compact probe features patented **RENGAGE™** strain gauge technology. It delivers unrivalled sub-micron performance when applied to complex 3D shapes and contours. Advanced capabilities include machine tool performance monitoring and on-machine verification.

Compatibility with all Renishaw optical receivers enables users to upgrade existing installations. When combined with the very latest modulated transmission interface the system offers exceptional resistance to light interference. High resistance to shock and liquid immersion ensures reliable operation in the harshest machine shop environments.

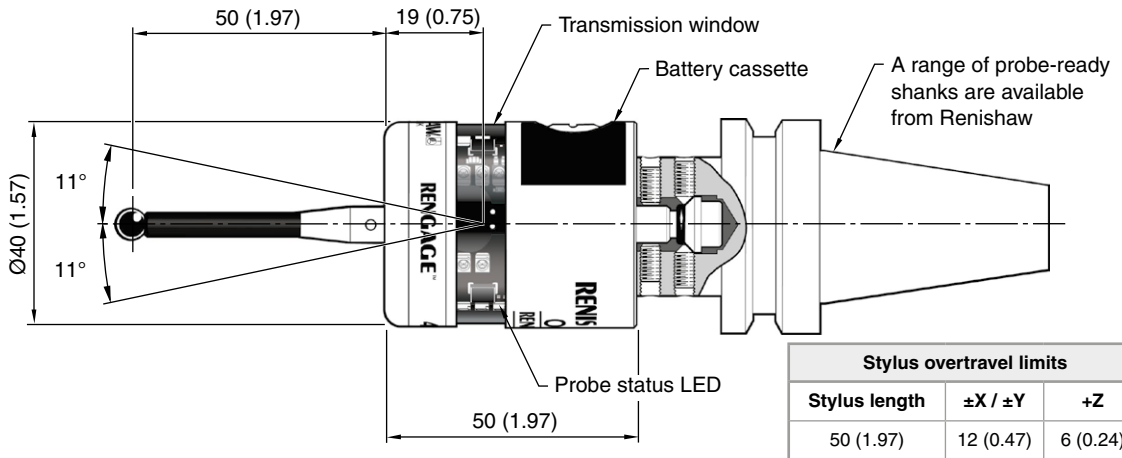
Key features and benefits:

- Rengage technology – proven and patented
- Exceptional resistance to light interference with modulated transmission
- 360° transmission envelope
- Ultra compact design
- 3D performance ideal for 5-axis machines
- 0.25 µm 2σ repeatability

"Meeting current and future performance requirements for our products demands manufacture of ever smaller and more intricate parts that are consistently accurate to within 1 µm. Reliable set-up and measurements are therefore critical to this process and form the basis of our decision to use Rengage technology. The Renishaw OMP400 is the only product capable of reliably meeting our needs."

Flann Microwave

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**+Z**
50 (1.97)	12 (0.47)	6 (0.24)
100 (3.94)	22 (0.87)	6 (0.24)

Dimensions given in mm (in)

OMP400 specification

Optical setting		**Modulated**	**Legacy**
Principal application		Workpiece inspection and job set-up on small to medium machining centres and small multi-tasking machines.	
Transmission type		360° infrared optical transmission (modulated or legacy)	
Compatible interfaces		OMI-2, OMI-2T, OMI-2C, OSI / OMM-2 and OMI-2H	OMI or OMM / MI 12
Operating range		Up to 5 m (16.4 ft)	
Recommended styli		High modulus carbon fibre, lengths 50 mm (1.97 in) to 200 mm (7.88 in)	
Weight without shank (including batteries)		256 g (9.03 oz)	
Switch-on/switch-off options		Optical on → Optical off Optical on → Timer off	
Battery life (2 × ½ AA 3.6 V Lithium-thionyl chloride)	**Standby life**	One year maximum, dependent on switch-on/switch-off option.	
	Continuous use	105 hours maximum, dependent on switch-on/switch-off option.	110 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z	
Unidirectional repeatability		0.25 µm (10 µin) 2σ – 50 mm (1.97 in) stylus length *(see note 1)* 0.35 µm (14 µin) 2σ – 100 mm (3.94 in) stylus length	
2D lobing in X, Y		±0.25 µm (10 µin) – 50 mm (1.97 in) stylus length *(see note 1)* ±0.25 µm (10 µin) – 100 mm (3.94 in) stylus length	
3D lobing in X, Y, Z		±1.00 µm (40 µin) – 50 mm (1.97 in) stylus length *(see note 1)* ±1.75 µm (70 µin) – 100 mm (3.94 in) stylus length	
Stylus trigger force *(see notes 2 and 5)* XY plane (typical minimum) +Z direction (typical minimum)		 0.06 N, 6 gf (0.22 ozf) 2.55 N, 260 gf (9.17 ozf)	
Stylus overtravel force XY plane (typical minimum) +Z direction (typical minimum)		 1.04 N, 106 gf (3.74 ozf) *(see note 3)* 5.50 N, 561 gf (19.78 ozf) *(see note 4)*	
Minimum probing speed		3 mm/min (0.12 in/min) with auto-reset	
Sealing		IPX8 (EN/IEC 60529)	
Operating temperature		+5 °C to +50 °C (+41 °F to +122 °F)	

Note 1 Performance specification is tested at a standard test velocity of 240 mm/min (9.45 in/min). Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration. **RENGAGE™** equipped probes offer ultra low trigger forces.

Note 3 Stylus overtravel force in XY plane occurs 70 µm after the trigger point and rises by 0.1 N/mm, 10 gf/mm (9.1 oz/in) until the machine tool stops (in the high force direction and using a carbon fibre stylus).

Note 4 Stylus overtravel force in +Z direction occurs 10 µm to 11 µm after the trigger point and rises by 1.2 N/mm, 122 gf/mm (109.6 oz/in) until the machine tool stops.

Note 5 These are the factory settings, manual adjustment is not possible.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/omp400**

MP700

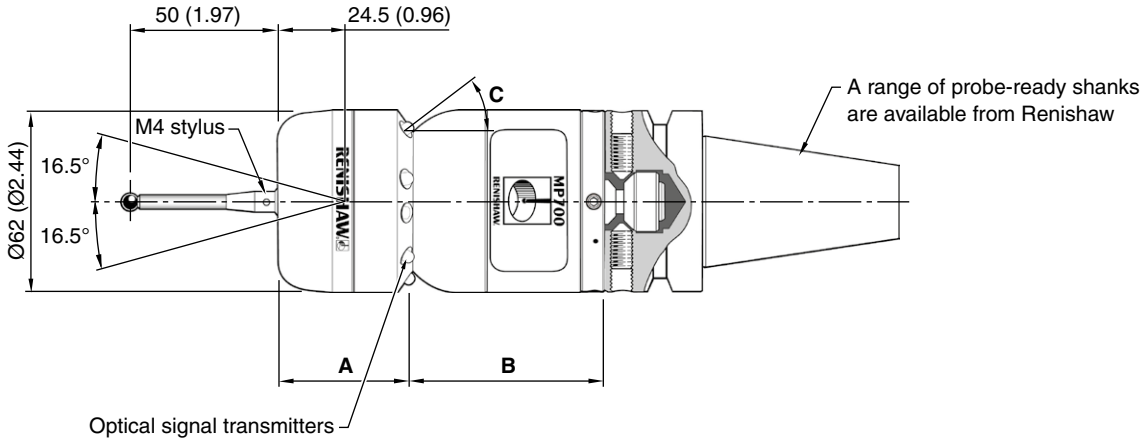
A compact high accuracy 3D touch-trigger probe with optical transmission used for workpiece set-up and inspection, plus optimisation of machine tool performance and post-process monitoring on a wide range of medium to large machining centres.

Two versions are available with an optical output of 35° or 70° to the probe's axis to suit a variety of installations.

Key features and benefits:

- Proven strain gauge sensing technology
- Establishes legacy optical transmission system
- 360° transmission envelope
- 3D performance ideal for 5-axis machines
- 0.25 µm 2σ repeatability

Dimensions



Optical output	A	B	C
35°	47.9 (1.89)	67.8 (2.67)	35°
70°	45.6 (1.80)	69.8 (2.75)	70°

Stylus overtravel limits		
Stylus length	±X / ±Y	+Z
50 (1.97)	21.5 (0.85)	11 (0.43)
100 (3.94)	36.0 (1.42)	11 (0.43)

Dimensions given in mm (in)

MP700 specification

Principal application		Workpiece inspection and job set-up on all sizes of machining centres and small to medium multi-tasking machines.
Transmission type		360° infrared optical transmission (legacy)
Compatible interfaces		OMI, OMM / MI 12
Operating range		Up to 6 m (19.7 ft)
Recommended styli		Hollow carbon fibre, lengths 50 mm (1.97 in) to 200 mm (7.88 in)
Weight without shank (including batteries)		730 g (25.75 oz)
Switch-on/switch-off options		Optical on → Optical off Optical on → Timer off
Battery life (1 × 9 V Alkaline MN1604 type battery)	**Standby life**	381 days maximum, dependent on switch-on/switch-off option.
	Continuous use	43 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		0.25 µm (10 µin) 2σ – 50 mm (1.97 in) stylus length *(see note 1)* 0.35 µm (14 µin) 2σ – 100 mm (3.94 in) stylus length
2D lobing in X, Y		±0.25 µm (10 µin) – 50 mm (1.97 in) stylus length *(see note 1)* ±0.25 µm (10 µin) – 100 mm (3.94 in) stylus length
3D lobing in X, Y, Z		±1.00 µm (40 µin) – 50 mm (1.97 in) stylus length *(see note 1)* ±1.75 µm (70 µin) – 100 mm (3.94 in) stylus length
Stylus trigger force *(see notes 2, 3 and 4)* XY plane +Z direction		 0.19 N, 19 gf (0.68 ozf) 3.25 N, 331 gf (11.69 ozf)
Stylus overtravel force XY plane (typical maximum) +Z direction (typical maximum)		 1.80 N, 184 gf (6.47 ozf) 14.00 N, 1428 gf (50.36 ozf)
Minimum probing speed		15 mm/min (0.59 in/min)
Sealing		IPX8 (EN/IEC 60529)
Operating temperature		0 °C to +60 °C (+32 °F to +140 °F)

Note 1 The specification applies to a test rig gauging speed of 240 mm/min (9.45 in/min) with zero time delay.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration. **RENGAGE™** equipped probes offer ultra low trigger forces.

Note 3 Performance specification is for a test velocity of 30 mm/min (1.18 in/min) with a 50 mm stylus and the trigger delay set to 8 ms.

Note 4 These are the factory settings, manual adjustment is not possible.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/mp700**

RMP600

The RMP600 is a compact, high accuracy touch probe with radio signal transmission, offering all the benefits of automated job set-up, plus the ability to measure complex 3D part geometries on all sizes of machining centres including multi-tasking machines.

The RMP600 successfully combines patented **RENGAGE™** strain gauge technology with the unique frequency hopping radio transmission system of the RMP60.

Key features and benefits:

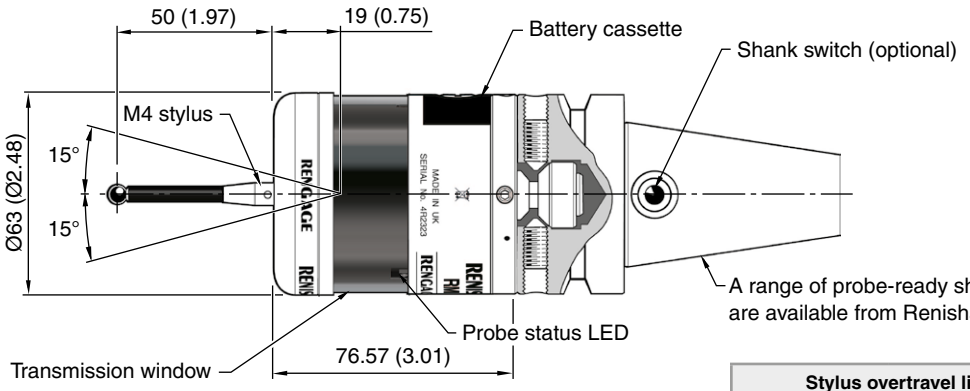
- Rengage technology – proven and patented
- Secure frequency hopping spread spectrum (FHSS)
- Globally recognised 2.4 GHz waveband – compliant with radio regulations in all major markets
- Compact design
- 3D performance ideal for 5-axis machines
- 0.25 µm 2σ repeatability

"We are very happy with the accuracy of RMP600 and, in particular, the consequent reduction in scrap parts further down the production line. These are large, expensive components and we can use the probe to identify and avoid errors."

Tods Composite Solutions Ltd

For the full case study please contact Renishaw or visit **www.renishaw.com/tods-composite-solutions**

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**+Z**
50 (1.97)	18 (0.71)	11 (0.43)
100 (3.94)	31 (1.22)	11 (0.43)

Dimensions given in mm (in)

RMP600 specification

Principal application		Workpiece inspection and job set-up on multi-tasking machines, machining centres and gantry machining centres.
Transmission type		Frequency hopping spread spectrum (FHSS) radio Radio frequency 2400 MHz to 2483.5 MHz.
Radio approval regions		China, Europe (all countries within the European Union), Japan and USA. For details about other regions, please contact Renishaw.
Compatible interfaces		RMI and RMI-Q
Operating range		Up to 15 m (49.2 ft)
Recommended styli		High modulus carbon fibre, lengths 50 mm (1.97 in) to 200 mm (7.88 in)
Weight without shank (including batteries)		1010 g (35.63 oz)
Switch-on/switch-off options		Radio on → Radio off or timer off Spin on → Spin off or timer off Shank switch on → Shank switch off
Battery life (2 × AA 3.6 V Lithium-thionyl chloride)	**Standby life**	1300 days maximum, dependent on switch-on/switch-off option.
	Continuous use	230 hours maximum, dependent on switch-on/switch-off option.
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		0.25 µm (10 µin) 2σ – 50 mm (1.97 in) stylus length *(see note 1)* 0.35 µm (14 µin) 2σ – 100 mm (3.94 in) stylus length
2D lobing in X, Y		±0.25 µm (10 µin) – 50 mm (1.97 in) stylus length *(see note 1)* ±0.25 µm (10 µin) – 100 mm (3.94 in) stylus length
3D lobing in X, Y, Z		±1.00 µm (40 µin) – 50 mm (1.97 in) stylus length *(see note 1)* ±1.75 µm (70 µin) – 100 mm (3.94 in) stylus length
Stylus trigger force *(see notes 2 and 5)* XY plane (typical minimum) +Z direction (typical minimum)		 0.20 N, 20 gf (0.72 ozf) 1.90 N, 194 gf (6.83 ozf)
Stylus overtravel force XY plane (typical minimum) +Z direction (typical minimum)		 2.80 N, 286 gf (10.07 ozf) *(see note 3)* 9.80 N, 999 gf (35.25 ozf) *(see note 4)*
Minimum probing speed		3 mm/min (0.12 in/min) with auto-reset
Sealing		IPX8 (EN/IEC 60529)
Operating temperature		+5 °C to +50 °C (+41 °F to +122 °F)

Note 1 Performance specification is tested at a standard test velocity of 240 mm/min (9.45 in/min). Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration. RENGAGE™ equipped probes offer ultra low trigger forces.

Note 3 Stylus overtravel force in XY plane occurs 80 µm after the trigger point and rises by 0.35 N/mm, 36 gf/mm (32 ozf/in) until the machine tool stops (in the high force direction and using a carbon fibre stylus).

Note 4 Stylus overtravel force in +Z direction occurs 7 µm to 8 µm after the trigger point and rises by 1.5 N/mm, 153 gf/mm (137 ozf/in) until the machine tool stops.

Note 5 These are the factory settings, manual adjustment is not possible.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/rmp600**

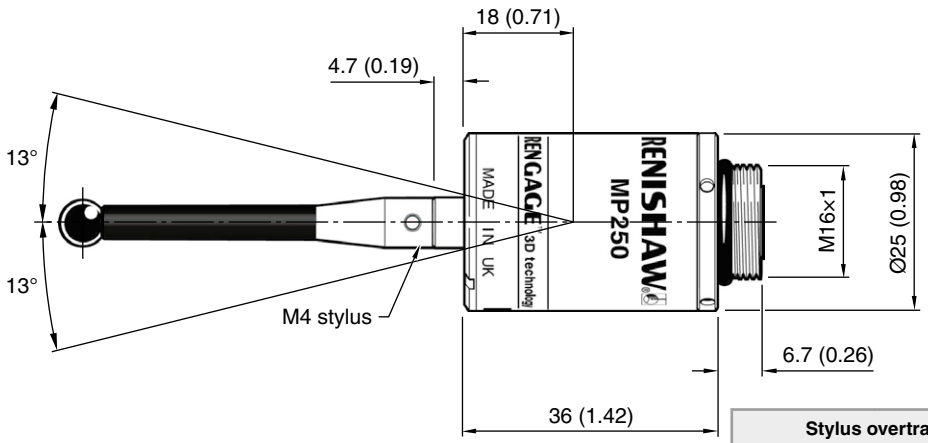
MP250

The miniature MP250 is the world's first strain gauge inspection probe for grinding machines, using Renishaw's patented RENGAGE™ technology. Suitable for use in harsh environments with double diaphragm sealing as standard. It sets new standards for the precision measurement of 3D part geometries, whilst offering all the standard probing benefits of reduced set-up times, reduced scrap and improved process control.

Key features and benefits:

- Rengage technology – proven and patented
- Interference resistant hard-wired communication
- Miniature design
- 3D performance ideal for 5-axis machines
- 0.25 µm 2σ repeatability

Dimensions



Stylus overtravel limits		
Stylus length	**±X / ±Y**	**+Z**
50 (1.97)	15 (0.59)	6.5 (0.26)
100 (3.94)	26 (1.02)	6.5 (0.26)

Dimensions given in mm (in)

MP250 specification

Principal application	Workpiece inspection and job set-up on CNC grinders.
Transmission type	Hard-wired transmission
Compatible interfaces	HSI
Recommended styli	High modulus carbon fibre, lengths 50 mm (1.97 in) to 100 mm (3.94 in)
Weight	64 g (2.26 oz)
Sense directions	±X, ±Y, +Z
Unidirectional repeatability	0.25 µm (10 µin) 2σ *(see note 1)*
2D lobing in X, Y	±0.25 µm (10 µin) *(see note 1)*
3D lobing in X, Y, Z	±1.00 µm (40 µin) *(see note 1)*
Stylus trigger force *(see notes 2 and 5)* XY plane (typical minimum) +Z direction (typical minimum)	 0.08 N, 8 gf (0.29 ozf) 2.60 N, 265 gf (9.35 ozf)
Stylus overtravel force XY plane (typical minimum) +Z direction (typical minimum)	 0.70 N, 71 gf (2.52 ozf) *(see note 3)* 5.00 N, 510 gf (17.98 ozf) *(see note 4)*
Minimum probing speed	3 mm/min (0.12 in/min)
Sealing	IPX8 (EN/IEC 60529)
Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 35 mm stylus.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration. **RENGAGE™** equipped probes offer ultra low trigger forces.

Note 3 Stylus overtravel force in the XY plane occurs 50 µm after the trigger point and rises by 0.12 N/mm, 12 gf/mm (11 ozf/in) until the machine tool stops (in the high force direction).

Note 4 Stylus overtravel force in the +Z direction occurs 11 µm after the trigger point and rises by 1.2 N/mm, 122 gf/mm (109 ozf/in) until the machine tool stops.

Note 5 These are the factory settings, manual adjustment is not possible.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/mp250**

FS1/FS2 and FS10/FS20

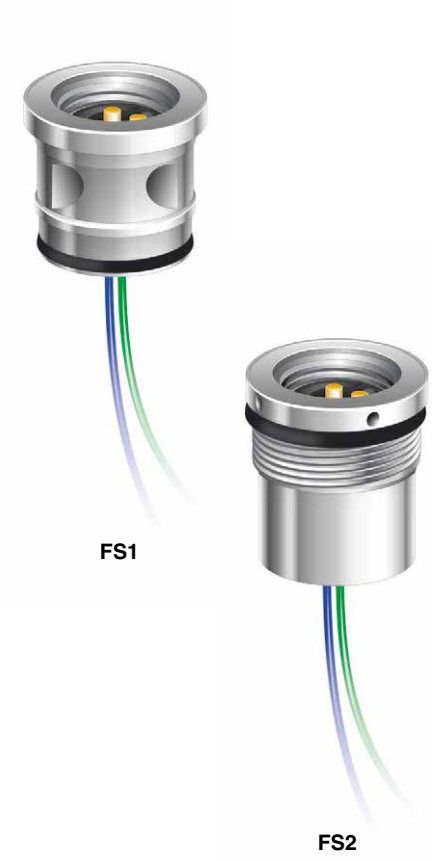
FS sockets are used to mount the LP2 or MP250 to CNC lathes and machining centres. FS1 and FS2 are compatible with the LP2 only. FS10 and FS20 are compatible with both the LP2 and MP250.

FS1/FS10 can be radially adjusted by ±4° for aligning the square stylus tip on the probe to the machine axes, whereas the FS2/FS20 are used in fixed applications that do not require adjustment.

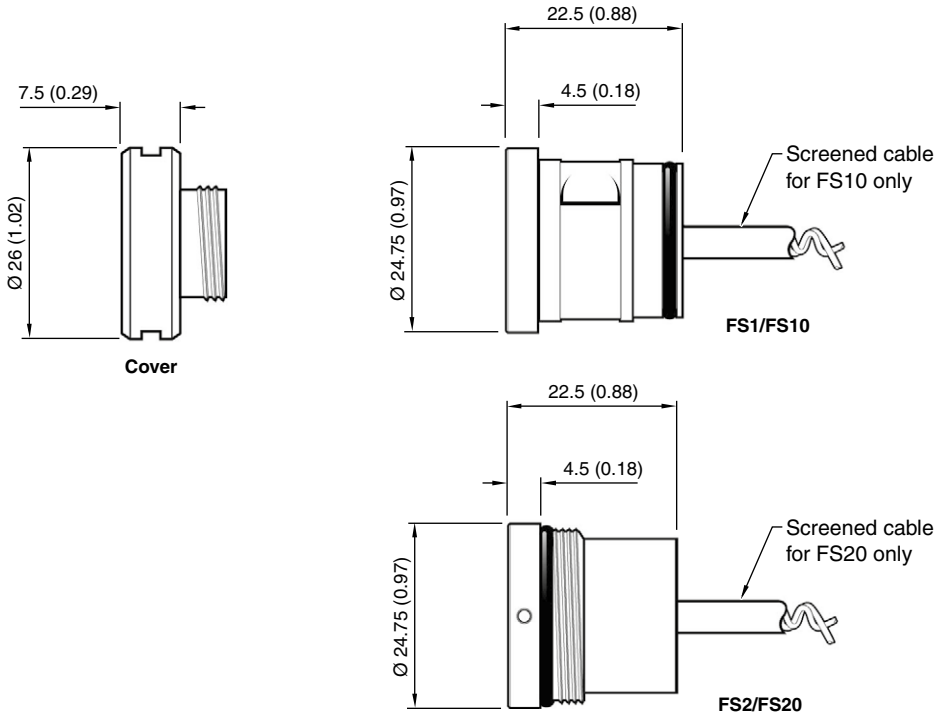
LPE extension bars can be used with these sockets to allow access to restricted features and are available in a range of lengths.

Key features and benefits:

- Simple installation
- Use in conjunction with LPE extension bars to provide access to restricted features
- Can be customised to meet the customer's individual requirements



Dimensions



Dimensions given in mm (in)

FS1/FS2 and FS10/FS20 specifiation

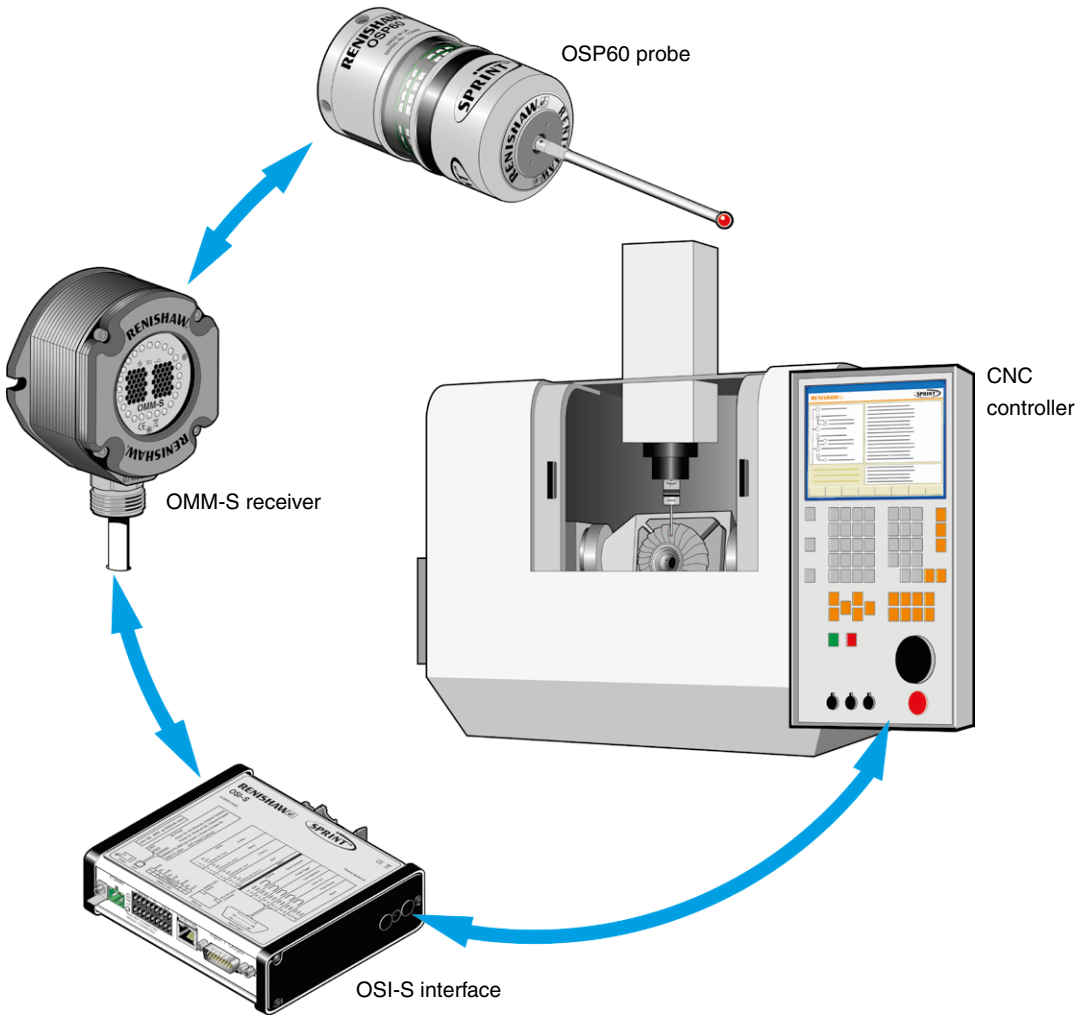
Variant		FS1/FS2	FS10/FS20
Principal application		Probe holder for lathes, grinding machines and machine tool applications.	
Transmission type		Hard-wired transmission	
Compatible probes		LP2, LP2H, LP2DD and LP2HDD	LP2, LP2H, LP2DD, LP2HDD and MP250
Compatible interface		HSI and MI 8-4	
Cable	**Specification**	Ø0.4 mm (0.02 in), single core 1 × 0.4 mm	Ø4.0 mm (0.16 in), 2-core screened cable, each core 19 × 0.15 mm
	Length	0.5 m (1.6 ft)	10 m (32.8 ft)
Operating temperature		+10 °C to +40 °C (+50 °F to +104 °F)	

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/lp2** or **www.renishaw.com/mp250**


RENISHAW
OSP60
MADE IN UK
SERIAL No. 7C0082
SPRINT™

SPRINT™ contact scanning system

The SPRINT system incorporates a new generation of on-machine scanning technology that delivers a step-change in the benefits of process control, enabling fast and accurate form and profile data capture from both prismatic and complex 3D components.



Drawing on Renishaw's partnerships with market leaders in key industrial sectors, the SPRINT machine tool scanning system is designed to provide game-changing capability for high value CNC manufacturing processes.

Incorporating multiple patented technologies, the SPRINT system comprises the OSP60 optical scanning probe, OMM-S receiver, OSI-S optical interface and a premium range of styli designed to enhance metrology performance.

SPRINT applications are enabled and supported by a range of software toolkit packages, each dedicated to a specific industrial task. These toolkits include on-machine data analysis tools which run automatically in-cycle and provide measurement feedback to the CNC machining process.

Enabling a wide range of measurement and process control methods, reducing scrap and rework while increasing machine capacity by reducing measurement cycle times, the SPRINT system is a ground-breaking high-speed, high-accuracy tool with an exceptional range of potential applications.

OSP60

The OSP60 **SPRINT™** probe is a compact spindle probe with optical signal transmission for performing both scanning and discrete point measurement on CNC machine tools.

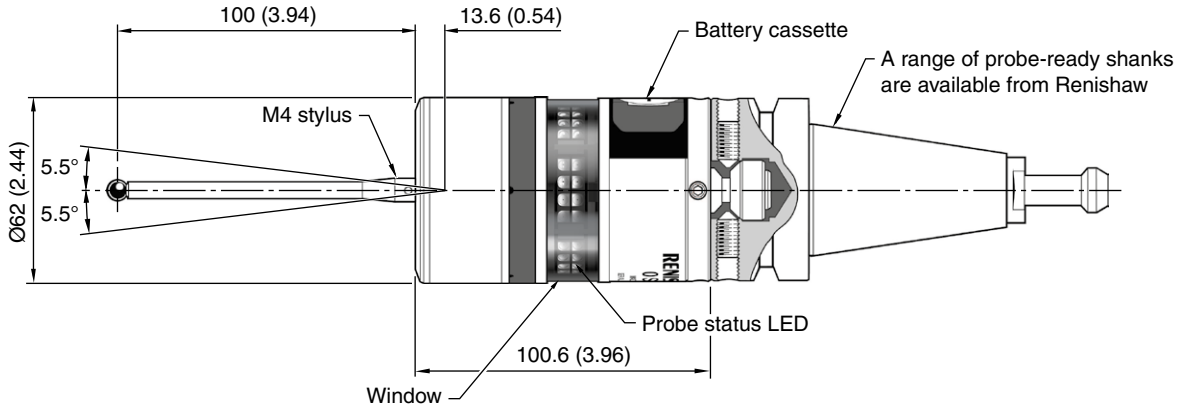
Containing an analogue sensor with 0.1 µm resolution in three dimensions, the probe provides exceptional accuracy and gives the greatest possible understanding of workpiece form.

Constructed from the highest grade material, the probe is robust and reliable in even the harshest machine tool environment, withstanding shock, vibration, temperature extremes and liquid immersion.

Key features and benefits:

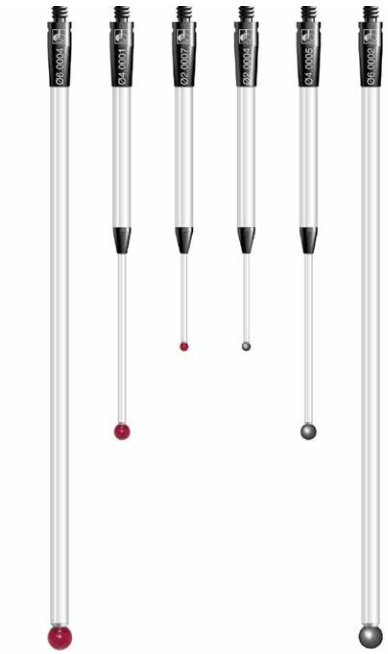
- Unique sensor mechanism for high-speed, high-resolution scanning
- Continuous measurement of 1,000 true 3D data points per second at up to 15,000 mm/min
- Excellent resistance to shock, vibration, impact, extreme temperatures and coolant flooding
- Compatible with a range of premium quality styli for optimal metrology performance
- 1 µm 2σ repeatability

Dimensions



Dimensions given in mm (in)

SPRINT™ styli



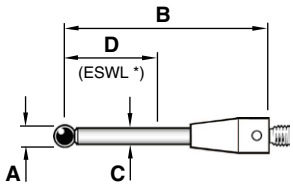
To further enhance the operational benefits provided by the OSP60 SPRINT probe, a range of premium styli is available offering enhanced metrology performance.

Easily identifiable by their black stylus holder, SPRINT styli use grade 5 stylus balls that are UKAS certified. These styli are available in a range of lengths from 80 mm to 150 mm, diameters of 1 mm, 2 mm, 3 mm, 4 mm and 6 mm, with either ruby or silicon nitride ball material.

The OSP60 can also be used with standard Renishaw styli.

Key features and benefits:

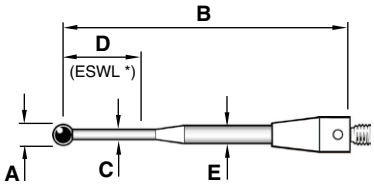
- Tightened tolerances for improved metrology performance
- Exact ball diameter engraved on the stylus holder
- All configurations include a break stem
- Choice of ball material to best suit component composition



Ball material: Ruby		
Part Number	**A-5465-8576**	**A-5465-8577**
A	6.0 (0.24)	6.0 (0.24)
B	100.0 (3.94)	150.0 (5.91)
C	3.8 (0.15)	3.8 (0.15)
D	62.9 (2.48)	71.5 (2.81)

Ball material: Silicon nitride		
Part Number	**A-5465-5008**	**A-5465-5009**
A	6.0 (0.24)	6.0 (0.24)
B	100.0 (3.94)	150.0 (5.91)
C	3.8 (0.15)	3.8 (0.15)
D	62.9 (2.48)	71.5 (2.81)

Dimensions given in mm (in)



Ball material: Ruby			
Part Number	**A-5465-5001**	**A-5465-5002**	**A-5465-5003**
A	2 (0.08)	3 (0.12)	4 (0.16)
B	80 (3.15)	100 (3.94)	100 (3.94)
C	1.50 (0.06)	2 (0.08)	2 (0.08)
D	10.70 (0.42)	27 (1.06)	42.60 (1.68)
E	3.80 (0.15)	3.80 (0.15)	3.80 (0.15)

Ball material: Silicon nitride			
Part Number	**A-5465-5005**	**A-5465-5006**	**A-5465-5007**
A	2 (0.08)	3 (0.12)	4 (0.16)
B	80 (3.15)	100 (3.94)	100 (3.94)
C	1.50 (0.06)	2 (0.08)	2 (0.08)
D	10.70 (0.42)	27 (1.06)	42.60 (1.68)
E	3.80 (0.15)	3.80 (0.15)	3.80 (0.15)

Dimensions given in mm (in)

* ESWL = Effective Scanning Working Length, measured from the centre of the ball to the point at which the stem will foul against a vertical face when at the maximum scanning deflection.

OSI-S and OMM-S

Interface and receiver system designed for use on machine tools in conjunction with the OSP60 SPRINT probe.

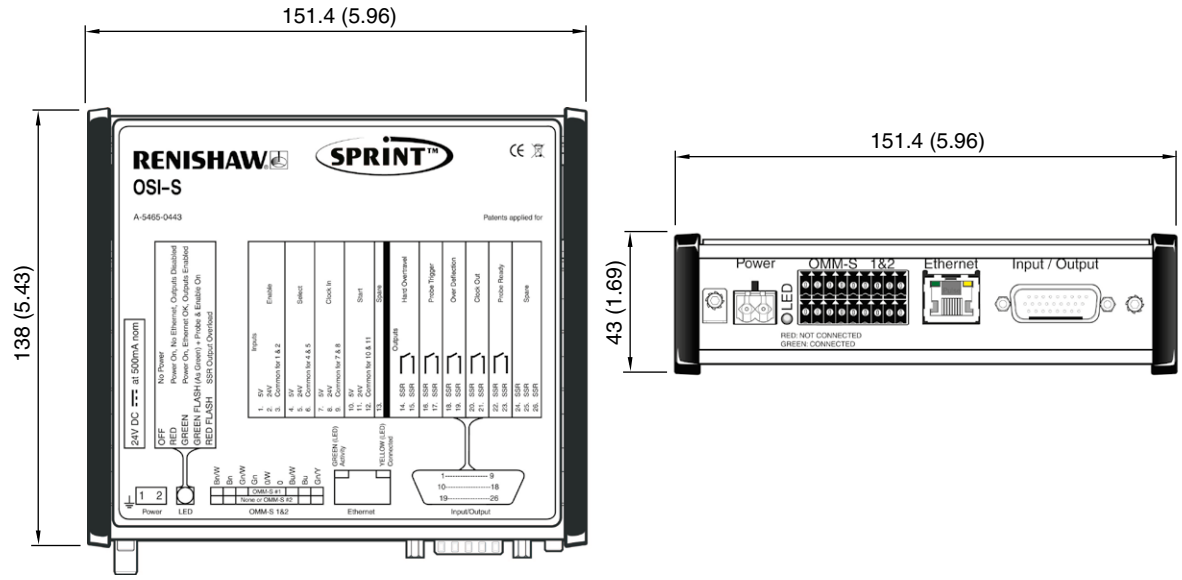
Incorporating a unique high-speed transmission system with a robust, bidirectional optical link which is particularly resistant to noise in the infrared spectrum, reliable data transmission is assured even over long distances.

Two OMM-S receivers can be used in tandem to extend transmission range: particularly useful in large and multi-axis machine tools.

Key features and benefits:

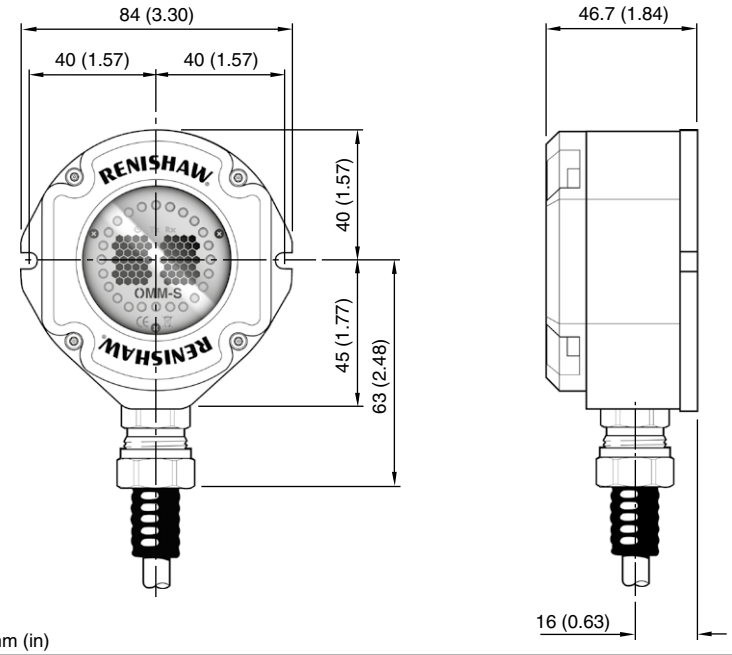
- OSI-S acts as the interface between the OSP60 and system software
- Synchronises SPRINT system hardware with the machine tool
- OMM-S provides a high-speed optical link to the OSP60 probe
- Utilises a unique communication protocol for reliable, robust data transmission
- Tandem OMM-S receivers can be connected for use with large machine tools

Dimensions



Dimensions given in mm (in)

Dimensions



Dimensions given in mm (in)

Productivity+™ CNC plug-in software

This on-machine software controls the OSP60 scanning probe, the machine tool and PC-based data tools, enabling significantly enhanced data processing in comparison to traditional methods.

The Productivity+ CNC plug-in provides exceptional ease-of-use for machine operators and programmers, with its online editor allowing the measurement program to be updated on the machine.

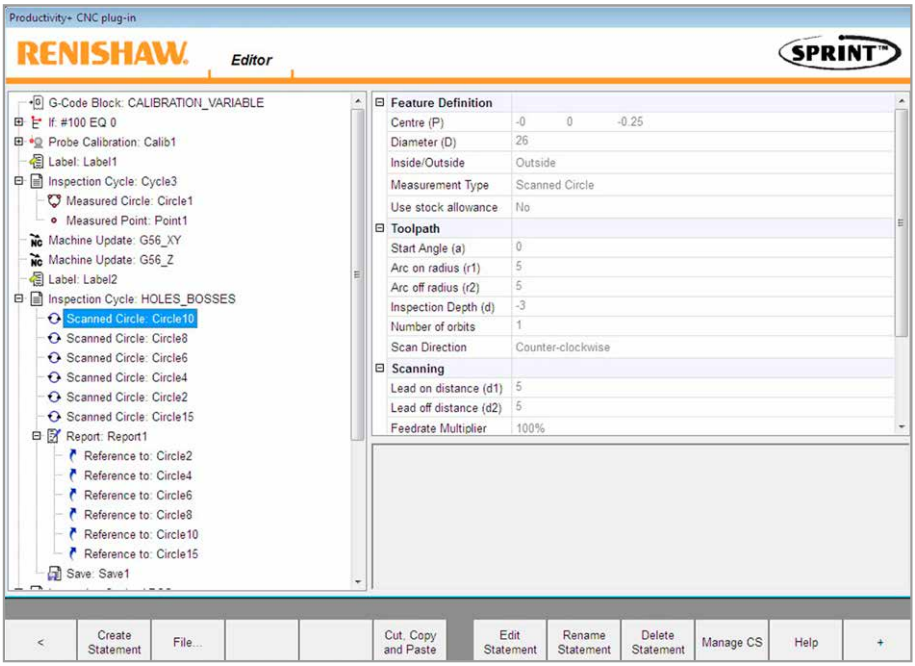
The close integration of controller and CNC plug-in is designed for automatic closed-loop process control to reduce operator intervention.

Optionally, programs can be created off-line using Productivity+™ Active Editor Pro. This PC-based application allows programs to be generated directly from the component solid model within an intuitive, icon driven, 'point-and-click' programming environment

SPRINT toolkits

The SPRINT system is offered in conjunction with a variety of software toolkit packages for data processing, each focused on an individual task or industry sector.

These industry specific software applications provide solutions for high-speed measurement of blade sections, extremely accurate diameter measurement and a sub 60 second health-check to determine machine capability.



Key features and benefits:

Productivity+ CNC plug-in software

- Real time machine data processing during measurement and cutting
- Significantly enhanced data handling capacity and analytical capacity
- Closed-loop process control for reduced operator intervention
- On-machine program generation and editing
- Foundation for SPRINT toolkits which are designed for key, industry specific applications

SPRINT toolkits

- Developed in conjunction with market leaders
- Software solutions engineered specifically for specific applications
- On-machine data analysis tools providing feedback directly to the CNC machining process

SPRINT system specification

System principal application	High-speed scanning system for on-machine process control.		
OSP60 (probe)	Analogue scanning probe for machine tools, capable of both scanning and discrete point measurements.		
OMM-S (receiver)	Optical receiver specific to the SPRINT system.		
OSI-S (interface)	An interface that processes data from the OMM-S and provides input/output communication with the machine tool.		
Productivity+™ CNC plug-in	Software performing data capture and analysis.		
Transmission type	Half duplex infrared 950 nm – 1000 3D points per second.		
Probe transmission range	Up to 4.5 m (14.7 ft) with a single receiver or up to 9 m (29.5 ft) with dual receivers – four power settings available.		
Probe weight (without shank) with batteries	1080 g (38.1 oz)		
Battery type	3 x CR123 lithium		
Battery life typical at 20 °C	**Standby**	**5% usage**	**Continuous life**
Full power	68 days	182 hrs	11 hrs
Low power (1/8)	68 days	348 hrs[1]	21 hrs
Scanning measurement range[2]	±XY 0.3 mm (0.012 in), ±Z 0.15 mm (0.006 in)		
Maximum scanning deflection (typical)[3]	±XY 0.80 mm (0.031 in), +Z 0.61 mm (0.024 in)		
Sensor resolution[4]	0.1 µm (4 µin)		
Maximum scanning speed	15 m/min (49 ft/min), dependent on machine tool performance.		
Sense directions	Omnidirectional ±X, ±Y, +Z.		
Stylus length range	75 mm to 150 mm (2.95 in to 5.90 in) recommended.		
Stylus ball diameter range	2 mm to 8 mm (0.078 in to 0.31 in) typical.		
Stylus type	Straight styli only. SPRINT styli recommended. For further information, see the *SPRINT recommended styli guide* (Renishaw part no. H-5465-8102).		
Stylus force	**Scanning**	**Discrete point measurement**	
XY (typical)[4]	0.6 N, 61 gf (2.1 ozf)	2 N, 204 gf (7.2 ozf)	
Z (typical)	1.0 N, 102 gf (3.6 ozf)	9 N, 919 gf (32.4 ozf)	
Environment	**IP rating**	**Operating temperature**	
OSP60 (probe)	IPX8 (EN/IEC60529)	+5 °C to +55 °C (+41 °F to +131 °F)	
OMM-S (receiver)	IPX8 (EN/IEC60529)	+5 °C to +55 °C (+41 °F to +131 °F)	
OSI-S (interface)	IP20 (EN/IEC60529)	+5 °C to +55 °C (+41 °F to +131 °F)	
OMM-S cable	The OMM-S is supplied with either 8 m (26 ft) or 15 m (49 ft) of cable. Cable specification: Ø6.1 mm, 8-core, twisted pair, screened cable, each core 7 x 0.146 mm. Maximum cable length 30 m (98 ft).		
Mounting **OMM-S (receiver)** **OSI-S (interface)**	A mounting bracket is available allowing directional setting. DIN rail or alternative mounting screws.		
OSI-S supply	18 Vdc to 30 Vdc 500 mA @ 24 V nominal 4 A peak. Supply must conform to EN/IEC60950-1.		
OSI-S output signal	Voltage free solid-state relay (SSR) output, configurable normally open or normally closed. 'On' resistance = 50 Ω max. Load voltage = 50 V max. Load current = 60 mA max.		
OSI-S input/output protection	Power input is protected by a 1.8 A resettable fuse. Turning on the power supply will reset the OSI-S.		
Controller compatibility	Please contact Renishaw for system compatibility requirements.		

1 Calculated value.

2 Maximum allowed distance between the nominal scan line and the actual scan line.

3 Maximum deflection that can be applied to the probe stylus tip during a scanning measurement.

4 For a 100 mm stylus.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/sprint**

Shanks for machine tool probes

To be installed into a machine tool, Renishaw probes must be used in conjunction with a shank.

Renishaw offers a comprehensive range, incorporating taper and HSK shanks, including DIN, BT and ANSI types, plus brand models such as Sandvik Capto and Kennemetal.

For full details, please refer to the *Taper shanks for machine tool probes data sheet* (Renishaw part no. H-2000-2011).

HSK

DIN

VDI

Sandvik Capto

Kennametal

A range of custom shanks are available on request. For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/custom-solutions**


RENISHAW
RENISHAW
RMP600
ENGAGE 3D technology


RENISHAW
RTS
MADE IN UK
RENISHAW

Tool setting systems

Tool setting technology comparison chart

Products			Transmission type			Function		Minimum tool detection	Repeatability (2σ)	Stylus trigger force	Laser classification	Battery type
			Optical	Radio	Hard-wired	Tool setting	Broken tool detection					
		Page	3-11	3-12	3-13							
Contact tool setters	OTS	3-5	●			●	●	Ø1.0 mm	1.00 µm	1.30 N to 2.40 N / 133 gf to 245 gf (4.68 ozf to 8.63 ozf) ‡	N/A	1/2 AA or AA
	RTS			●		●	●	Ø1.0 mm	1.00 µm	1.30 N to 2.40 N / 133 gf to 245 gf (4.68 ozf to 8.63 ozf) ‡		AA or AA
	TS27R				●	●	●	Ø1.0 mm	1.00 µm	1.30 N to 2.40 N / 133 gf to 245 gf (4.68 ozf to 8.63 ozf) ‡		N/A
	TS34				●	●	●	Ø1.0 mm	1.00 µm	0.65 N to 5.50 N / 66 gf to 561 gf (2.34 ozf to 19.78 ozf) ‡		N/A
Non-contact tool setters	NC4	3-6			●	●	●	Ø0.03 mm (tool setting) Ø0.03 mm (breakage)	0.10 µm *		Class 2	
	NCPCB ¥				●	●	●	Ø0.10 mm (tool setting) Ø0.08 mm (breakage)	0.50 µm		N/A	
Broken tool detection	TRS2	3-8			●		●	Ø0.2 mm (breakage)§	N/A		Class 2	

* Dependent on system, separation and mounting
§ Depending on the range, tool surface finish, machine environment and installation
‡ Dependent on sense direction
¥ Typically used on PCB drilling and routing machines

Products			Transmission type			Function		Operation	Repeatability (2σ)	Probe
			Optical	Radio	Hard-wired	Tool setting	Workpiece inspection			
		Page	3-11	3-12	3-13					
Tool setting arms	HPRA	3-9			●	●		Removable	5.00 µm (6 in – 15 in arms) 8.00 µm (18 in – 24 in arms)	RP3 (1 µm 2σ repeatability)
	HPPA				●	●		Manual		
	HPMA				●	●		Automatic		
	HPGA				●		●	Automatic	3.00 µm Δ	LP2 or MP250

Δ Maximum 2σ value in any direction

Benefits of tool setting and broken tool detection

Tool setting is the process of determining geometric information – length, radius and/or diameter – of a cutting tool using a tool setting device. Some tool setting technologies are also capable of determining information such as radial and linear profile and cutting edge condition. Broken tool detection can be performed by tool setting systems and dedicated broken tool detection devices. Both tool setting and broken tool detection enable unmanned operation of machine tools.

The benefits of tool setting

Determining geometric information and the current condition of a cutting tool can help to improve the manufacturing process, including checking that the correct tool for the scheduled machining program has been loaded, correcting for tool wear, and automation of tool offset updating.

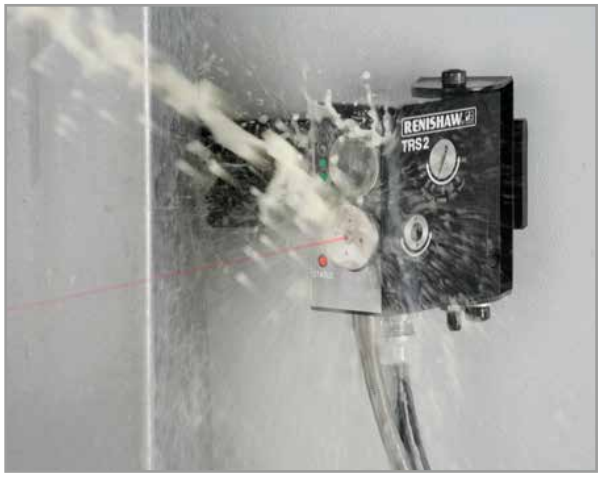
The benefits of tool setting are clear. Ensuring a tool is capable of performing the required task:

- improves accuracy
- reduces scrap
- reduces the level of operator intervention
- reduces cost

The benefits of broken tool detection

It is worth performing frequent broken tool detection cycles since tools, especially small diameter ones, can easily become broken during a machining cycle. Detection of a broken tool is a good indicator that previously machined components will have been incorrect. Machining cycles can be programmed to sound an alarm, call an operator or change to a sister tool when a broken tool is detected. Tool breakage detection:

- saves cycle time
- reduces re-work
- reduces scrap
- reduces cost



Recommended technology

Application	Contact	Non-contact
Tool setting	●	●
Tool setting small tools <0.5 mm		●
Broken tool detection	●	●
High speed broken tool detection		●
Profile checking		●
Missing insert detection		●
Wireless operation	●	

Considerations		
Maintenance	Very low	Periodic cleaning
Installation complexity	Very low	Hard-wired system only and requires air supply
Tool-to-tool accuracy	Excellent	NC4+ F145

Tool setting and broken tool detection technologies explained

Tool setting products are referred to as ‘contact’ or ‘non-contact’, depending on the technology they employ. The two technologies – kinematic touch probe or optical (laser) based – both use an interface to communicate with the machine tool control. Renishaw products cover a multitude of applications, from simple, quick, tool setting to the complex digitising of ground tools. The technologies are introduced below.

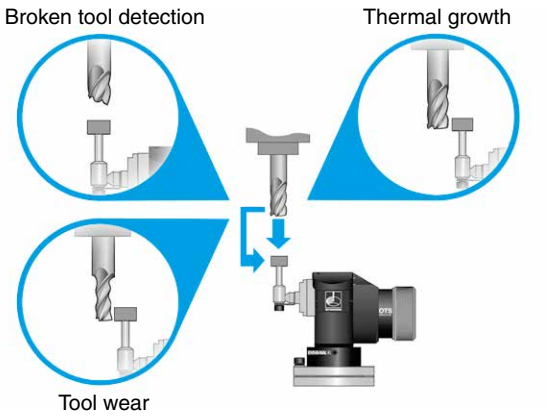
Kinematic tool setters

Renishaw contact tool setters use the same kinematic technology as workpiece inspection probes.

Proven over four decades, this design has been the main choice for the majority of machine builders and end users to ensure accuracy and reliability.

The ability of the probe mechanism to reseat after triggering to within 1.00 µm is fundamental for repeatability and good metrology.

From simple length and radius checking to broken tool detection, this technology is available in all Renishaw’s contact tool setters.

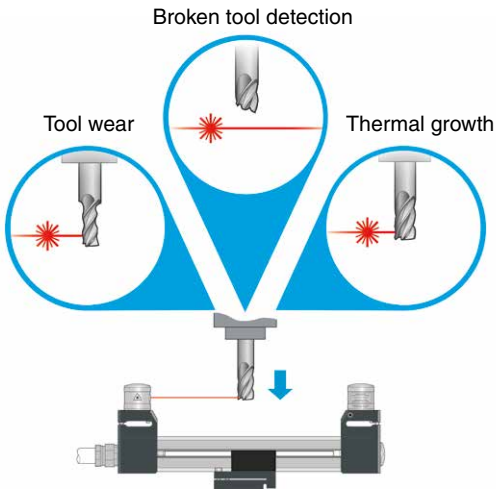


Non-contact laser-based tool setting

Non-contact systems employ laser technology to capture tool geometric information.

Being capable of radial and linear profile checking as well as cutting edge condition monitoring, this technology provides fast cycle times and advanced functionality.

Non-contact tool setting can facilitate even greater benefits from most types of machine tool.

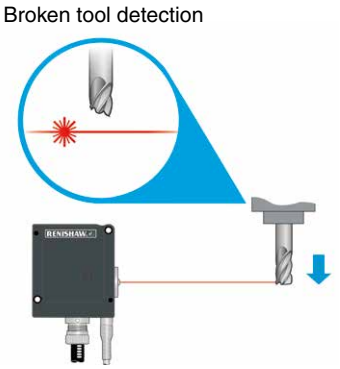


Single-sided laser-based broken tool detection

The groundbreaking TRS2 technology employs a single-sided laser-based design to allow swift and reliable detection of broken tools.

The patented Toolwise™ electronics analyse the reflected laser light and allow detection at a range of spindle speeds.

Laser-based broken tool detection can provide great benefits in reducing scrap and costs with a minimal addition to cycle time.



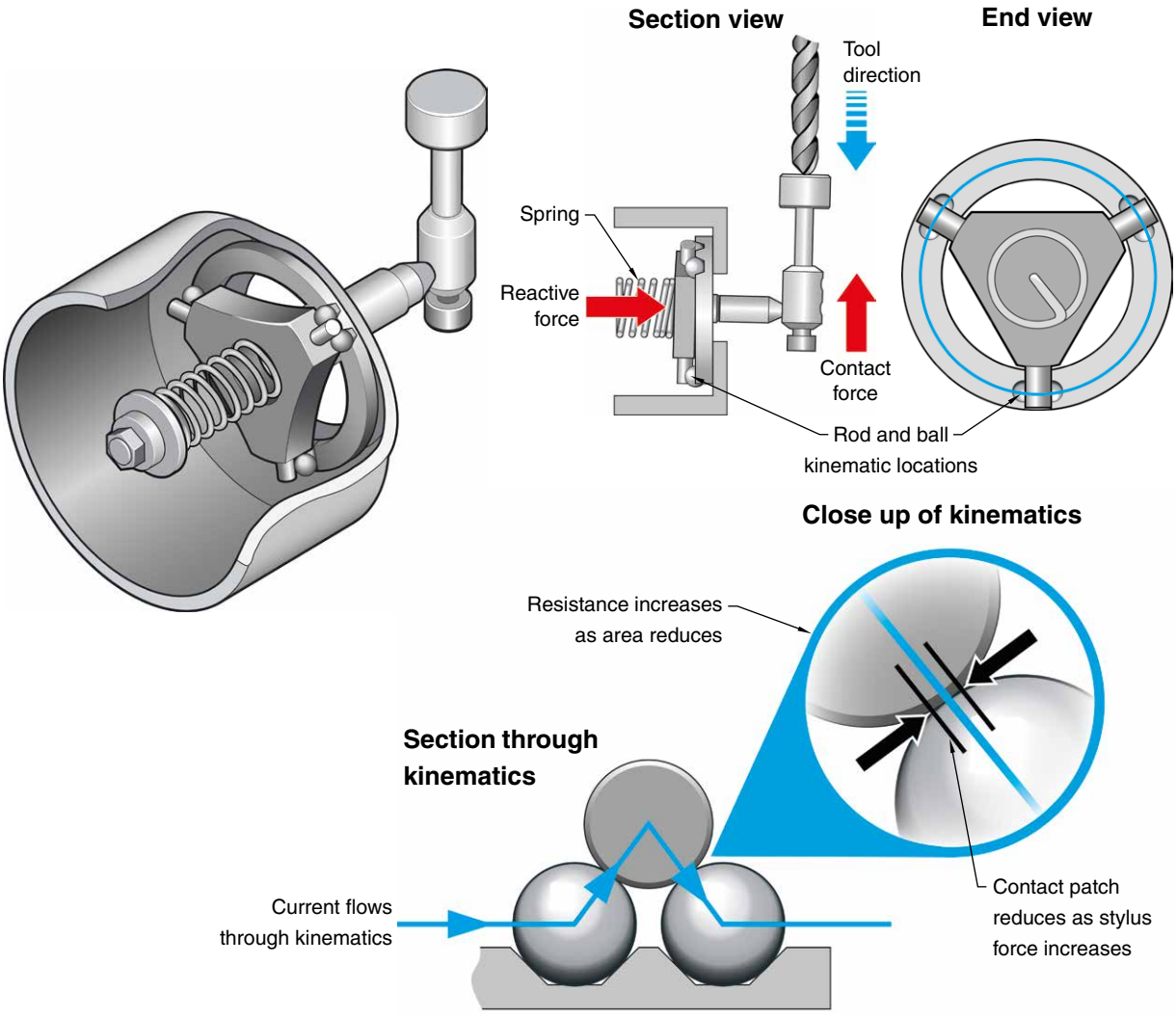
The following pages cover the design and operating principle of these technologies.

Kinematic contact tool setter design

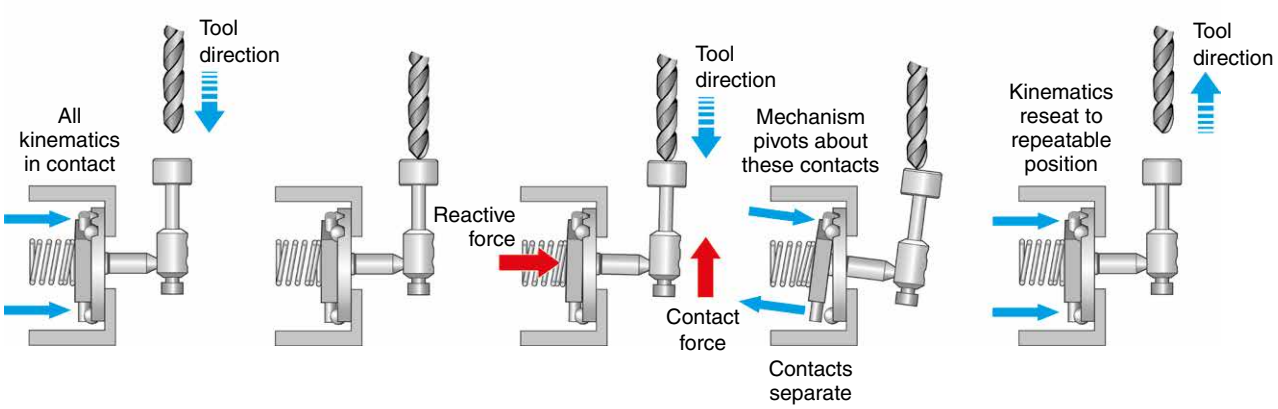
Three equally spaced rods rest on six tungsten carbide balls providing six points of contact in a kinematic location. An electrical circuit is formed through these contacts. The mechanism is spring loaded which allows deflection when the probe stylus makes contact with the part and also allows the probe to reseat in the same position within 1.00 µm when in free space (not in contact).

Under load of the spring, contact patches are created through which the current can flow. Reactive forces in the probe mechanism cause some contact patches to reduce which increases resistance of those elements.

On making contact with the workpiece (touch), the variable force on the contact patch is measured as a change in electrical resistance. When a defined threshold is reached, a probe output is triggered.



Based on the above kinematic principle, the stages in trigger generation are shown below. Repeatable reseating of the mechanism is critical to this process and fundamental to reliable metrology.

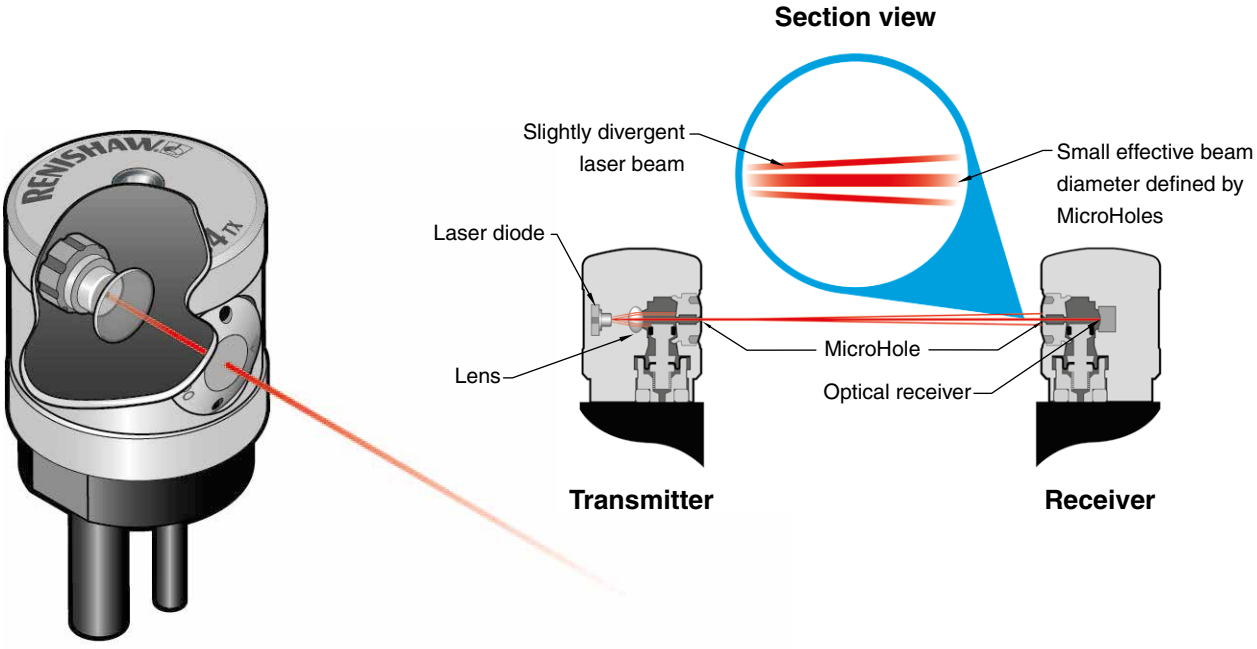


Non-contact laser-based tool setter design

Non-contact laser tool setting systems use a beam of laser light, passing between a transmitter and a receiver, positioned within the machine tool so the cutting tools can be passed through the beam.

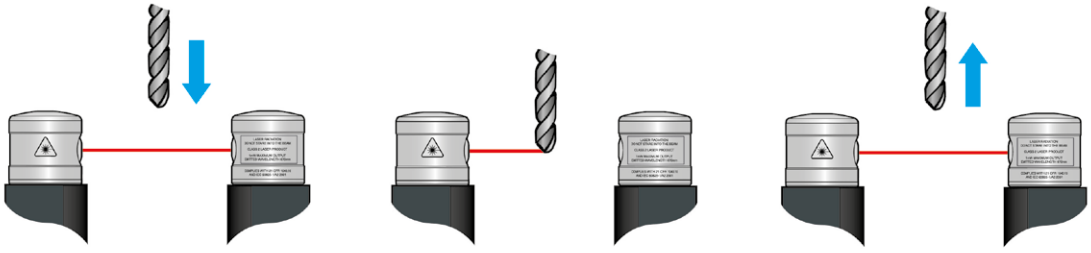
The passage of a tool into the beam causes a reduction in laser light seen at the receiver, from which a trigger signal is generated. This latches the machine position at that instant, providing the information to determine a tool's dimension. With approaches from several directions, tool geometry can also be accurately determined. These systems can also be used to detect broken tools, by rapidly moving the tool into a position where it should intersect the laser beam, if light reaches the receiver, the tool tip must be missing.

Renishaw's laser tool setters feature a small, effectively parallel beam, produced by passing the laser light through a lens and two small apertures. The MicroHole™ on the transmitter defines the shape and size of the emergent beam, which is slightly divergent along its length. A second MicroHole and, in some models, a pinhole inside the receiver, governs the light that reaches the optical detector, this effectively collimates the beam. It is this narrow beam of light – a small subset of the overall emitted laser beam – that is the effective measuring beam.



The receiver measures the light levels: when a reduction of 50% is seen, a trigger is generated.

Whilst some laser tool setting systems are repeatable only at their focal point, Renishaw's systems provide repeatable measurement at any point along the laser beam. By optimising the point of measurement to suit the machining process, users can save valuable cycle time on systems with large separations between the transmitter and receiver.



Tool approaches laser beam

Tool breaks beam, trigger signal issued

Tool withdraws

The following page explains MicroHole technology in more detail.

MicroHole™ and PassiveSeal™ technologies

Superior environmental protection for robust low maintenance operation

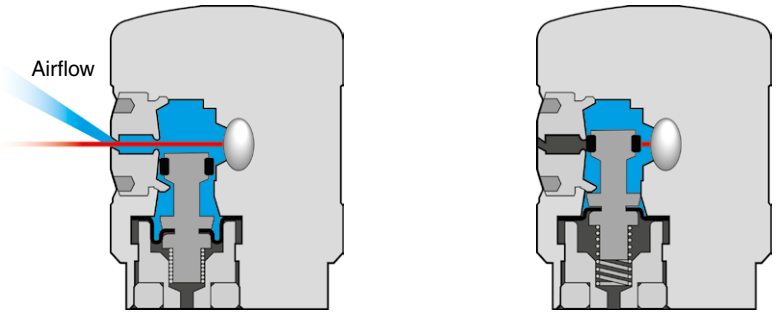
Coolant and swarf contamination can negatively affect performance on all types of non-contact systems. Renishaw's non-contact systems are protected by innovative technology and contain precision optics to achieve superb levels of performance, even in the harshest of machine tool environments.

MicroHole

All Renishaw non-contact systems for machine tools use MicroHole technology as their primary protection against coolant and swarf. The innovative design uses a constant, high velocity stream of air to protect the optics while minimising air consumption. Unlike shutter designs, Renishaw's protection systems do not require complicated control systems or M-codes, providing much simpler system installation. In addition, where shutter systems provide no protection during measurement moves, Renishaw optics remain protected at all times.

PassiveSeal

Renishaw's NC4 non-contact tool setting system combines MicroHole technology with an additional fail-safe sealing device, PassiveSeal. This device provides an additional layer of protection, preventing contamination of the optics if the air supply fails. The combination of MicroHole and PassiveSeal gives NC4 IPX8 protection at all times.



PassiveSeal open **PassiveSeal closed**

The PassiveSeal system, designed for the NC4 transmitter and receiver heads, is activated by air pressure. When the air supply is switched onto the NC4 head, the PassiveSeal lowers allowing the laser beam to exit through the MicroHole. In the event of air supply failure, or if the supply is switched off, the PassiveSeal automatically rises to cover the MicroHole, excluding coolant and preventing contamination.

Features and advantages:

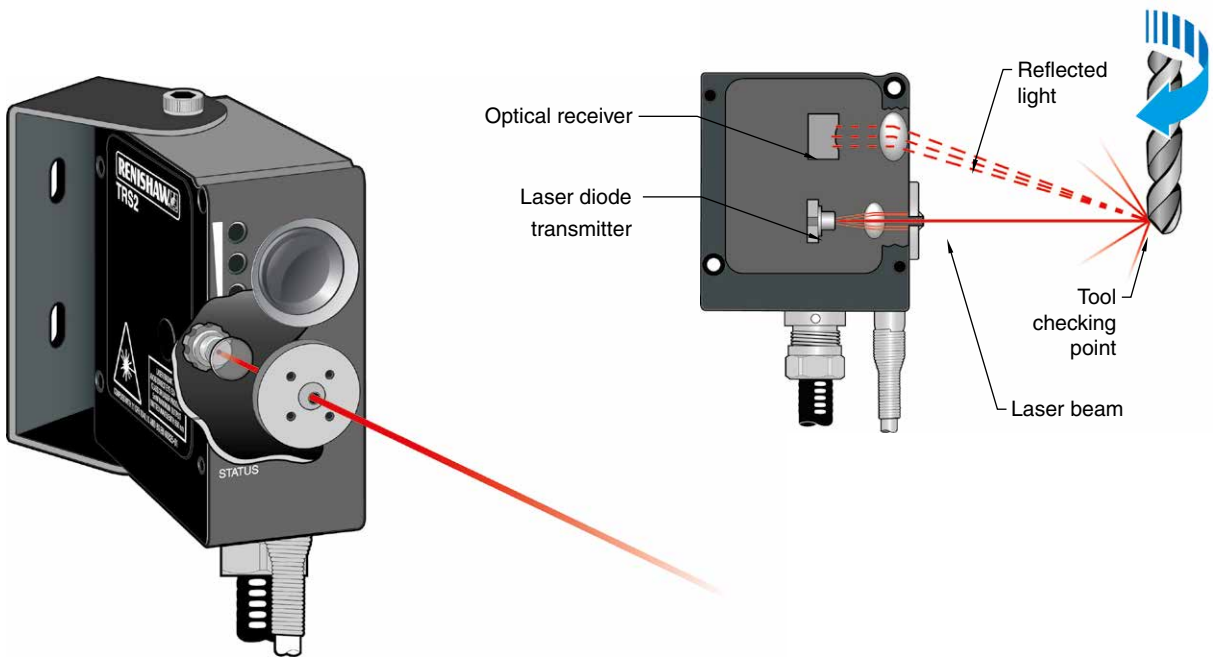
- Fail-safe environmental protection
- Robust and reliable operation
- Provides IPX8 protection of system optics
- Reduces system maintenance and downtime
- No control system or M-codes required
- Compact design minimises space required within the machine tool
- Simple system requires only one air supply pipe

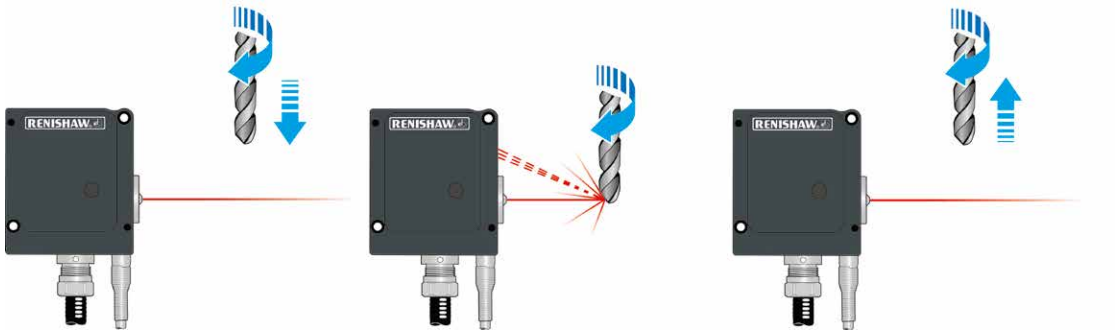
Single-sided laser-based broken tool detection system

Non-contact broken tool detection uses a similar technology to non-contact tool setting but it is distinguished by the differences in use and configuration.

Renishaw's TRS2 is an innovative single-sided system dedicated to broken tool detection.

TRS2 utilises a laser transmitter and receiver incorporated in the same unit and detects the presence of a tool via the reflection of the laser beam off the tool. In operating mode, a laser beam is emitted from the unit and reflected off a rotating tool – typically 3 mm above the tool tip – back to the receiver. The reflected levels of light vary due to the tool's rotation, resulting in a repeating pattern. This pattern is analysed by the unique ToolWise™ tool recognition electronics within the TRS2, resulting in rapid indication of a good tool and allowing the machining cycle to continue. If no tool is detected during the user-defined time period, a 'broken tool' alarm is issued, allowing a sister tool to be called.





Tool enters laser beam

Reflected lights is analysed by ToolWise™ electronics

Tool ok signal issued and tool withdraws

Tool setting arm design

Commonly used on lathes and grinding machines, the arms are used to present a tool setting probe in front of the turret in a repeatable position. When not in use, the arms can either be removed from the machine or retracted away from the working environment. They consist of a mounting attached to the bulkhead of the machine; the arm, which can be manually operated or motorised; and a probe mounted on the end of the arm.

Tool setting arms use a mounting similar to the Kinematic resistive probe mechanism to ensure repeatability. When the arm is actuated into the Arm Ready position, the interface detects an output and the three kinematic stops in the hub and base ensure the arm is locked in this repeatable position. A set of spring plates fixed to the hub provide both axial and radial load, providing a torque to hold the hub in position.

Whether manual or automatic, all Renishaw tool setting arms provide a highly repeatable location for the probe.

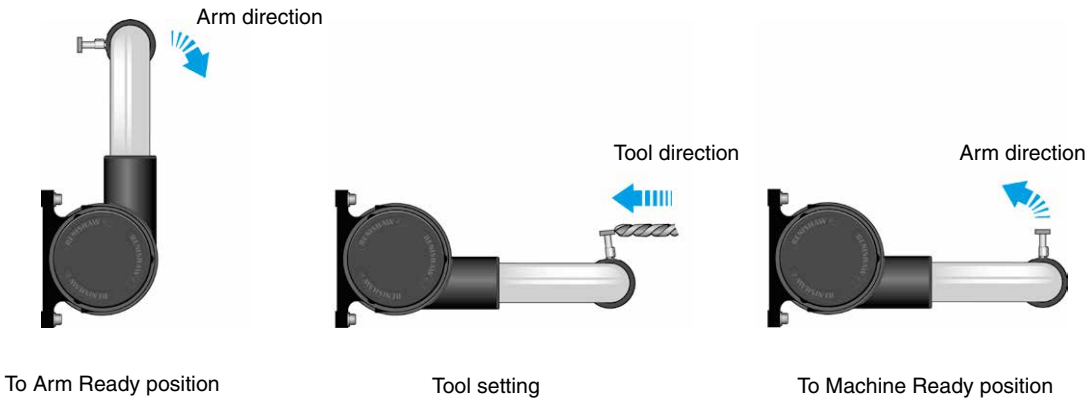
Manual arms

Two manual arms are available from Renishaw, with typical system repeatability of 5.00 µm *: the high precision removable arm (HPRA), used where space in the machine is at a premium, and the high precision pull-down arm (HPPA) which is stored in the machine and manually pulled into position when required.

Motorised arms

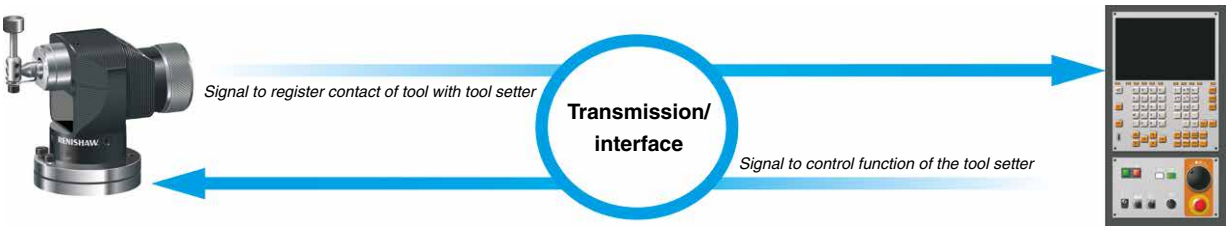
Renishaw offers two types of motorised arm: the high precision motorised arm (HPMA), which is a motorised version of the HPPA with typical system repeatability of 5.00 µm *, and for applications requiring improved repeatability, for example on grinding machines, the high precision generic arm (HPGA) arm with repeatability of 3.00 µm in all three axes.

* Dependent on arm size. For more details, please refer to the HPRA product page 3-32, HPPA product page 3-34 or the HPMA product page 3-36.



Transmission systems explained

Tool setters and CNC controls communicate bidirectionally.



The passage of these signals is handled by a transmission system. The choice of transmission system depends on the type of probe and the type of machine tool to which it is fitted.

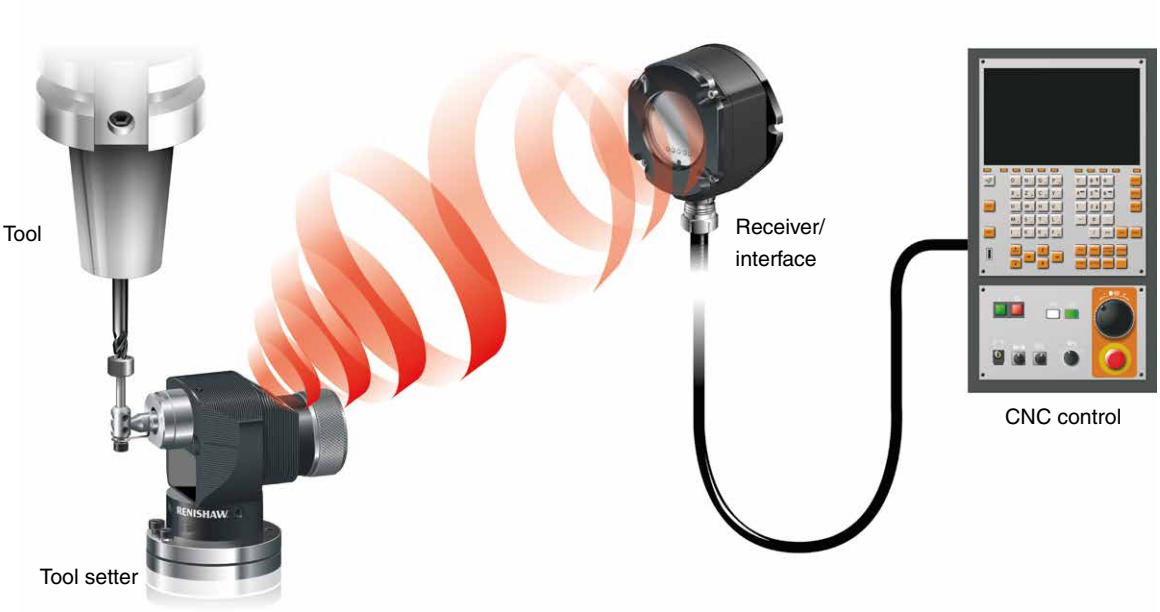
Renishaw probes use three main types of transmission systems: optical and radio, which are wireless, and hard-wired, which is connected directly to the machine control via an interface.

Transmission type		Interfaces								Optical module system
		Optical		Radio	Hard-wired					
	Page	3-11		3-12	3-13					3-11
Products		OMI-2 and variants	OMI-2C	RMI-Q	MI 8-4	HSI	NCi-5	TSI 2 and TSI 2-C	TSI 3 and TSI 3-C	OSI with OMM-2
Contact tool setters	OTS	●	●							●
	RTS			●						
	TS27R				●	●				
	TS34				●	●				
Non-contact tool setters	NC4						●			
	NCPCB	Designed to work with SIEB and MEYER 44.20.020, 44.20.020A, and 44.20.0120 laser cards								
	TRS2	Interface not required								
Arms	HPRA							●		
	HPPA							●		
	HPMA								●	
	HPGA *					●			●	

* Both interfaces required for operation

The following pages show typical examples of each of these systems.

Optical transmission systems



A Renishaw optical transmission system uses infrared technology for communication between the tool setter and the CNC control and comprises the following:

Tool setter

The tool setter receives machine control signals and transmits status signals. There are two active modes, “standby” and “operating”. In standby mode, the tool setter is periodically transmitting and receiving, waiting for a signal to switch to operating mode. In operating mode it transmits tool setter information including battery status to the receiver.

Receiver/interface

Renishaw provides a variety of application-specific interface models. The very latest generation uses modulated optical transmission to reject light interference from other light sources, and ensures reliable communications.

Systems can be optimised for the needs of smaller machine tools and multiple tool setters can be used with a single interface.

Renishaw optical interfaces provide visual and/or audible indicators that clearly and simply inform the operator about tool setter status, system power, battery status and error diagnostics.

Radio transmission systems

A Renishaw radio transmission system provides communication between the tool setter and the machine control and comprises the following:

Tool setter

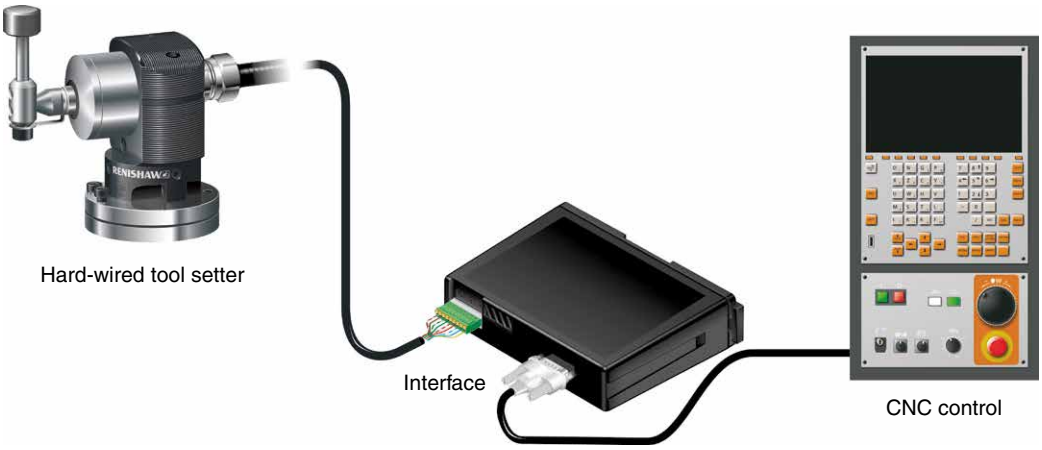
The tool setter receives machine control signals and transmits status signals. There are two active modes, “standby” and “operating”. In standby mode, the tool setter is periodically transmitting and receiving, waiting for a signal to switch to operating mode. In operating mode it transmits probe information, including battery status, to the receiver.

Receiver/interface

The combined interface and antenna convert tool setter signal information into a form which is compatible with the machine tool control. This technology is particularly suited to large machines and/or applications where line-of-sight between tool setter and interface is not possible. Frequency hopping spread spectrum (FHSS) technology enables the system to hop between channels providing reliable communication resistant to other radio device interference.

Renishaw radio interfaces provide visual and/or audible indicators that clearly and simply inform the operator of tool setter status, system power, battery status and error diagnostics.

Hard-wired transmission systems



A hard-wired probe system has the simplest form of transmission system and, typically, comprises the following elements:

Tool setter

A signal cable connects the tool setter to a machine interface unit, carrying power and tool setter signals.

Interface

The interface unit converts inspection tool setter signals into voltage-free solid-state relay (SSR) outputs for transmission to the machine tool control.

Hard-wired transmission systems are ideally suited to tool setting on machining centres and lathes where the probe remains in a fixed location.

Multiple tool setting transmission systems

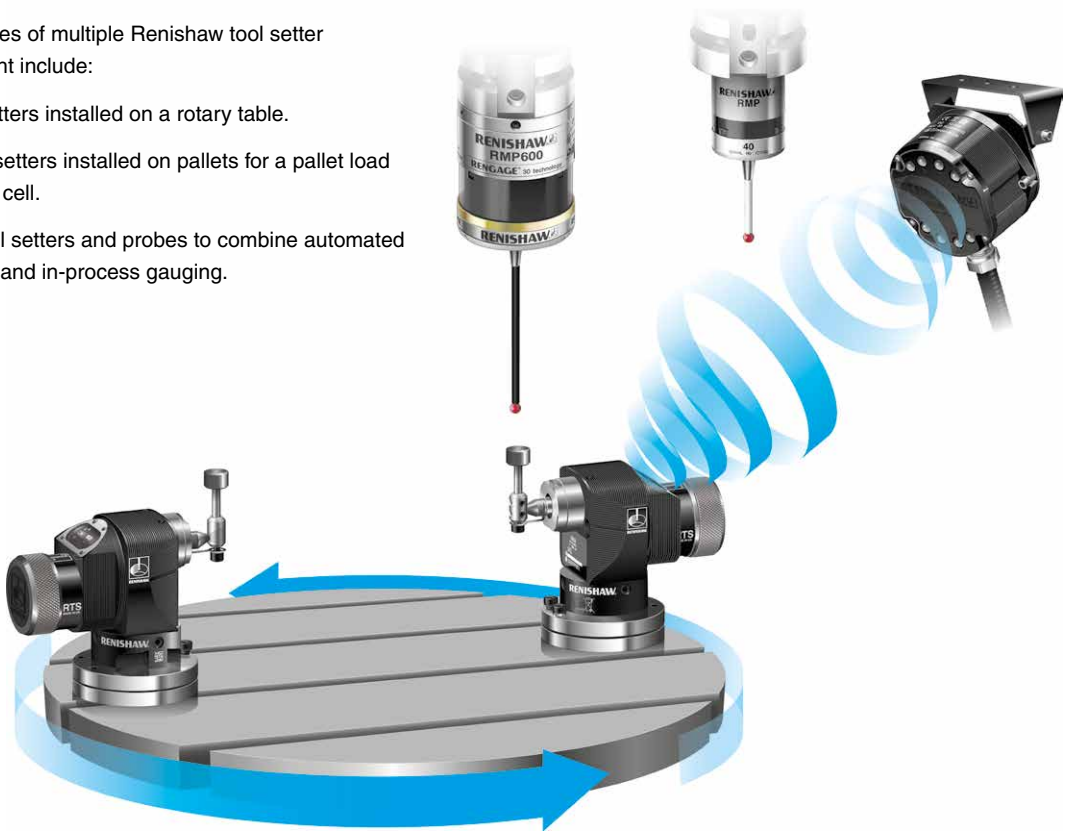
The diversity and capability of Renishaw transmission systems enable innovative multiple probe and tool setter applications and system combinations. The chart below provides some of the typical examples with various transmission types. Further variations of these are possible.

Multiple probe system	Total maximum probes	Interface	Probe type *
Twin optical probes	2	OMI-2T	OTS OMP40-2, OMP40M OLP40
Multi optical probes	3	OSI with OMM-2	OMP60, OMP60M OMP400
Multi radio probes	4	RMI-Q ◊	RTS RMP40, RMP40M RLP40 RMP60, RMP60M RMP600

* Any combination
◊ A maximum of one first generation radio inspection probe or tool setter can be used per RMI-Q. Additional probes and/or tool setters should be second generation. For more details, please refer to the *RMI-Q installation guide* (Renishaw part no. H-5687-8504).

Practical examples of multiple Renishaw tool setter applications might include:

1. Two tool setters installed on a rotary table.
2. Three tool setters installed on pallets for a pallet load machine or cell.
3. Multiple tool setters and probes to combine automated tool setting and in-process gauging.

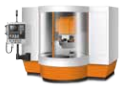


Combination examples showing application flexibility with Renishaw radio probes.

Tool setting product selector

This selector will help you identify which tool setters are most suited to your application.

Machine types			Vertical CNC machining centres 			Horizontal CNC machining centres 			Gantry CNC machining centres 
Products		Machine size / Page	Small *	Medium *	Large *	Small *	Medium *	Large *	All
Contact tool setters	OTS	3-16	●	●		●	●		
	RTS	3-18		●	●		●	●	●
	TS27R	3-20	●	●	●	●	●	●	●
	TS34	3-22	●	●	●	●	●	●	
Non-contact tool setters	NC4	3-24	●	●	●	●	●	●	●
	NCPCB	3-28							
	TRS2	3-30	●	●	●	●	●	●	●
Arms	HPRA	3-32							
	HPPA	3-34							
	HPMA	3-36							
	HPGA	3-38							
* Table sizes			Small		Medium			Large	
			Table size <700 mm × 600 mm		Table size <1200 mm × 600 mm			Table size >1200 mm × 600 mm	

Machine types			CNC lathes 			CNC multi-tasking machines 			CNC grinders 	PCB drilling and routing machines 
Products		Machine size / Page	Small §	Medium §	Large §	Small ‡	Medium ‡	Large ‡	All	All
Contact tool setters	OTS	3-16								
	RTS	3-18								
	TS27R	3-20								
	TS34	3-22								
Non-contact tool setters	NC4	3-24				●	●	●		
	NCPCB	3-28								●
	TRS2	3-30				●	●	●		
Arms	HPRA	3-32	●	●	●	●	●	●		
	HPPA	3-34	●	●	●	●	●	●		
	HPMA	3-36	●	●	●	●	●	●		
	HPGA	3-38	●	●	●	●	●	●	●	
Machine types/sizes			Small		Medium			Large		
§ CNC lathes			Chuck size 6 in to 8 in or smaller		Chuck size 10 in to 15 in			Chuck size 18 in to 24 in		
‡ CNC multi-tasking machines			Working range <1500 mm		Working range <3500 mm			Working range >3500 mm		

OTS

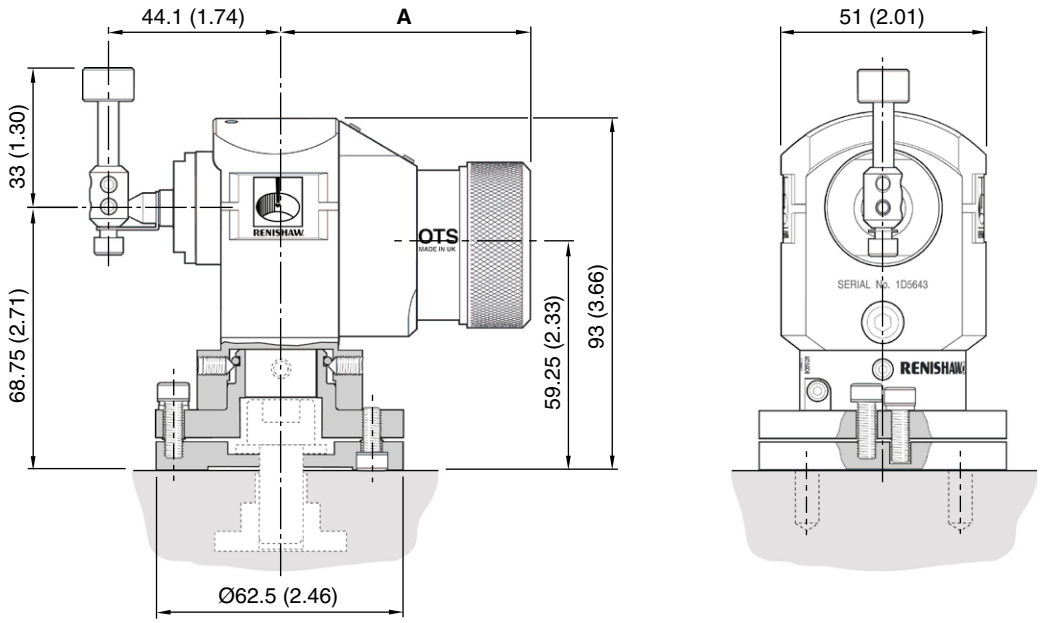
Compact 3D touch-trigger tool setter with optical signal transmission used for broken tool detection and rapid measurement of tool length and diameter on a wide range of tools.

Compatible with Renishaw optical modulated receivers.

Key features and benefits:

- Proven kinematic design
- Exceptional resistance to light interference with modulated transmission
- Direction adjustable infra-red optical module
- Cable-free for unrestricted machine movement and ease of installation
- 1.00 µm 2σ repeatability

Dimensions



Stylus overtravel limits	
XY	+Z
±3.5 (0.14)	6 (0.24)

Battery type	A
½ AA	67.8 (2.67)
AA	92.5 (3.64)

Dimensions given in mm (in)

OTS specification

Variant		½ AA OTS	AA OTS
Principal application		Tool measuring and broken tool detection on small to medium machining centres.	
Transmission type		Infrared optical transmission (modulated)	
Compatible interfaces		OMI-2, OMI-2T, OMI-2H, OMI-2C and OSI / OMM-2	
Operating range		Up to 5 m (16.4 ft)	
Recommended styli		Disc stylus (tungsten carbide, 75 Rockwell C) or Square tip stylus (ceramic tip, 75 Rockwell C)	
Weight with disc stylus (including batteries)		870 g (30.69 oz)	950 g (33.51 oz)
Switch-on/switch-off options		Optical on →	Optical off
		Optical on →	Timer off
Battery life (2 × ½ AA or AA 3.6 V Lithium-thionyl chloride)	**Standby life**	310 days	730 days
	Continuous use	400 hours	800 hours
Sense directions		±X, ±Y, +Z	
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*	
Stylus trigger force *(see notes 2 and 3)*		1.30 N to 2.40 N, 133 gf to 245 gf (4.68 ozf to 8.63 ozf) depending on sense direction	
Sealing		IPX8 (EN/IEC 60529)	
Mounting		M12 (1/2 in) T bolt (not supplied) Optional Spirol pins to allow accurate remounting (supplied)	
Operating temperature		+5 °C to +50 °C (+41 °F to +122 °F)	

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 35 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment is not possible.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/ots**

RTS

Tool setter with radio transmission suitable for use on machining centres of all sizes, or in applications where line-of-sight between the tool setter and receiver is difficult to achieve.

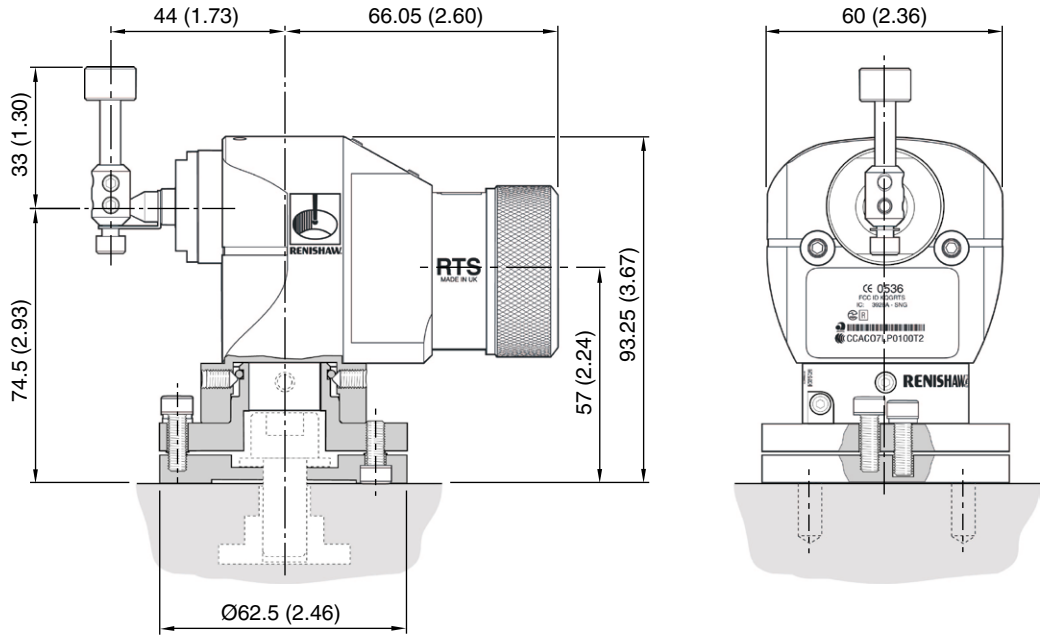
The RTS offers users broken tool detection and rapid measurement of tool length and diameter on a wide range of tools.

The RTS forms part of Renishaw's family of new generation radio transmission probes. The cable-free design enables the RTS to be used as a standalone or as part of a multi-probe system allowing use in a wide range of applications.

Key features and benefits:

- Proven kinematic design
- Secure frequency hopping spread spectrum (FHSS)
- Globally recognised 2.4 GHz waveband — compliant with radio regulations in all major markets
- Cable-free for unrestricted machine movement and ease of installation
- 1.00 µm 2σ repeatability

Dimensions



Stylus overtravel limits	
XY	+Z
±3.5 (0.14)	6 (0.24)

Dimensions given in mm (in)

RTS specification

Principal application		Tool measuring and broken tool detection on vertical and horizontal machining centres and gantry machining centres.
Transmission type		Frequency hopping spread spectrum (FHSS) radio Radio frequency 2400 MHz to 2483.5 MHz
Radio approval regions		China, Europe (all countries within the European Union), Japan and USA. For details about other regions, please contact Renishaw.
Compatible interfaces		RMI-Q
Operating range		Up to 15 m (49.2 ft)
Recommended styli		Disc stylus (tungsten carbide, 75 Rockwell C) or Square tip stylus (ceramic tip, 75 Rockwell C)
Weight with disc stylus (including batteries)		870 g (30.69 oz)
Switch-on/switch-off options		Radio on → Radio off
Battery life (2 × AA 3.6 V Lithium-thionyl chloride)	**Standby life**	600 days maximum
	Continuous use	1600 hours maximum
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*
Stylus trigger force *(see notes 2 and 3)*		1.30 N to 2.40 N, 133 gf to 245 gf (4.68 ozf to 8.63 ozf) depending on sense direction
Sealing		IPX8 (EN/IEC 60529)
Mounting		M12 (1/2 in) T bolt (not supplied) Optional Spirol pins to allow accurate remounting
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 35 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment is not possible.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/rts**

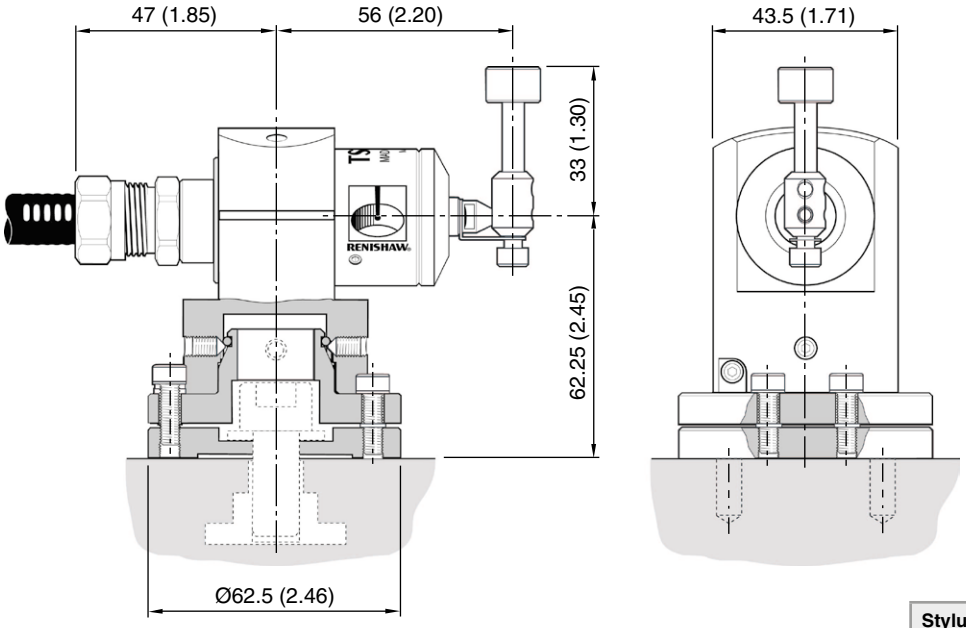
TS27R

Compact 3D touch-trigger tool setter with hard-wired signal transmission used for broken tool detection and rapid measurement of tool length and diameter on a wide range of tools.

Key features and benefits:

- Proven kinematic design
- Interference resistant hard-wired communication
- Cost effective tool setting for all types of machining centres
- 1.00 µm 2σ repeatability

Dimensions



Stylus overtravel limits	
XY	+Z
±3.5 (0.14)	6 (0.24)

Dimensions given in mm (in)

TS27R specification

Principal application		Tool measuring and broken tool detection on all sizes of vertical and horizontal machining centres and all gantry machining centres.
Transmission type		Hard-wired transmission
Compatible interfaces		MI 8-4 or HSI
Recommended styli		Disc stylus (tungsten carbide, 75 Rockwell C) or Square tip stylus (ceramic tip, 75 Rockwell C)
Weight with disc stylus		1055 g (37.21 oz)
Cable (to interface)	**Specification**	Ø4.35 mm (0.17 in), 4-core screened cable, each core 7 x 0.2 mm
	Length	10 m (32.8 ft)
	Electrical Connection	Cable on the end of unit
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*
Stylus trigger force *(see notes 2 and 3)*		1.30 N to 2.40 N, 133 gf to 245 gf (4.68 ozf to 8.63 ozf) depending on sense direction
Sealing		IPX8 (EN/IEC 60529)
Mounting		M12 (1/2 in) T bolt (not supplied) Optional Spirol pins to allow accurate remounting
Operating temperature		+5 °C to +60 °C (+41 °F to 140 °F)

Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 35 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment is not possible.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/ts27r**

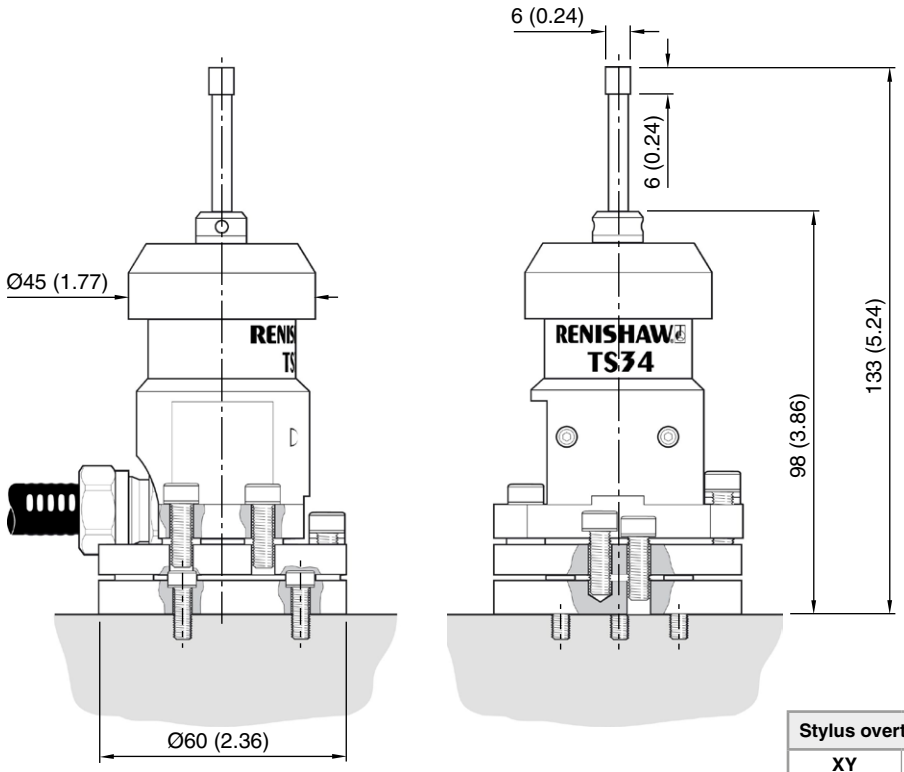
TS34

Compact 3D touch-trigger tool setter with hard-wired signal transmission used for broken tool detection and rapid measurement of tool length and diameter on a wide range of tools. Available as a rear or side exit version.

Key features and benefits:

- Proven kinematic design
- Interference resistant hard-wired communication
- Compact footprint takes up minimal space on the table
- 1.00 µm 2σ repeatability

Dimensions



Stylus overtravel limits	
XY	+Z
±3.5 (0.14)	6 (0.24)

Dimensions given in mm (in)

TS34 specification

Principal application		Tool measuring and broken tool detection on all sizes of vertical and horizontal machining centres.
Transmission type		Hard-wired transmission
Compatible interfaces		MI 8-4 or HSI
Recommended styli		Square tip stylus (tungsten carbide, 75 Rockwell C)
Weight with disc stylus		660 g (23.28 oz)
Cable (to interface)	**Specification**	Ø5.2 mm (0.2 in), 2-core screened cable, each core 72 x 0.08 mm
	Length	5 m (16.4 ft)
	Electrical connection	Cable on the side of unit
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(see note 1)*
Stylus trigger force *(see notes 2 and 3)*		
XY low force		0.65 N, 66 gf (2.34 ozf)
XY high force		1.42 N, 145 gf (5.11 ozf)
Z direction		5.50 N, 561 gf (19.78 ozf)
Sealing		IPX8 (EN/IEC 60529)
Mounting		M4 bolts (3 off)
Operating temperature		+5 °C to +60 °C (+41 °F to 140 °F)

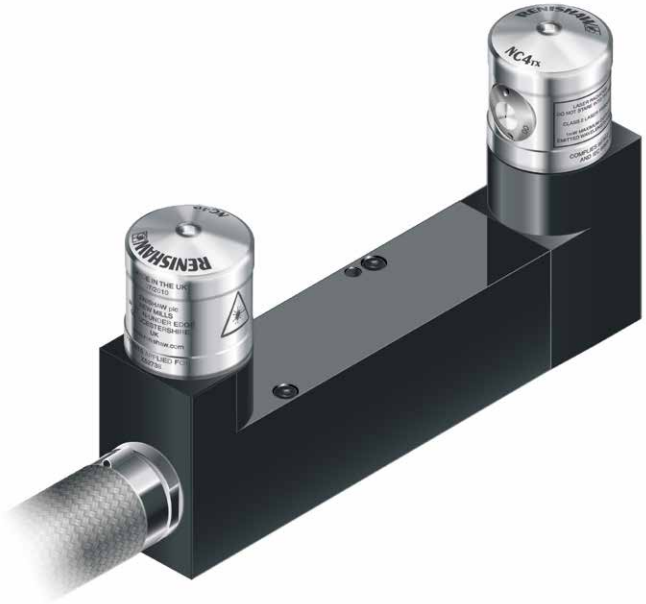
Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 35 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 3 These are the factory settings, manual adjustment is not possible.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/ts34**

NC4



Allows fast, non-contact tool setting and tool breakage detection on a variety of machining centres. Available as fixed system and separate system variants, the NC4 incorporates the unique MicroHole™ protection system and the innovative fail-safe PassiveSeal™, maintaining IPX8 environmental protection.

Precision optics are supplied as standard. These enable the compact series to achieve unsurpassed performance in a unit particularly suited to small machines and machines where space is at a premium, while separate systems allow simple installation on large machine tools with a range of up to 5 metres.

For applications using small diameter tools, the NC4+ is available, providing excellent performance with small tools and superb tool-to-tool accuracy.

Key features and benefits:

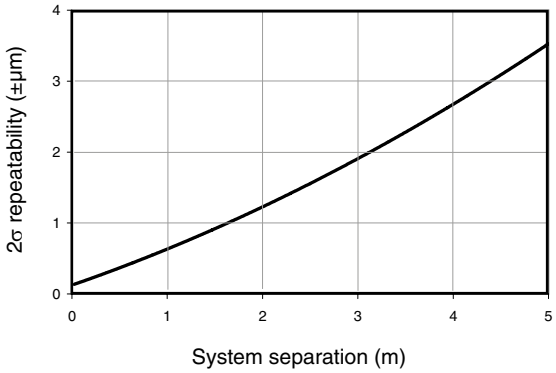
- Precise tool length and tool diameter measurement
- High-speed broken tool detection mode
- Measures and detects tools of Ø0.03 mm or larger (dependent on separation and mounting)
- Compact design is ideal for machines where large non-contact systems are unsuitable
- Reliable in the harshest of environments
- ±0.10 µm 2σ repeatability

"If it wasn't for the Renishaw system, the machine could, for example, operate with a broken cutting tip, with disastrous results. Furthermore, since tools are checked for breakage automatically, one operator can easily manage both machines: all he needs to do is load the pieces and ensure that everything is running smoothly."

Ducati Motor

For the full case study please contact Renishaw or visit **www.renishaw.com/ducati**

Repeatability and functional data

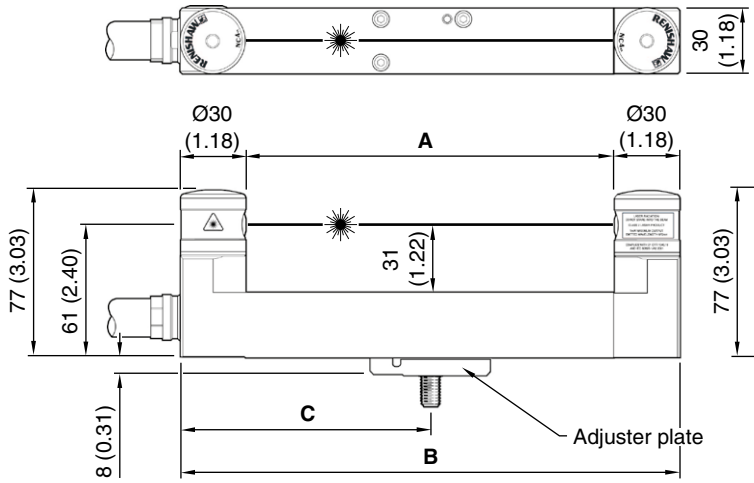


NOTE: The trend line is calculated from the average 2σ repeatability values for 20 NC4 systems

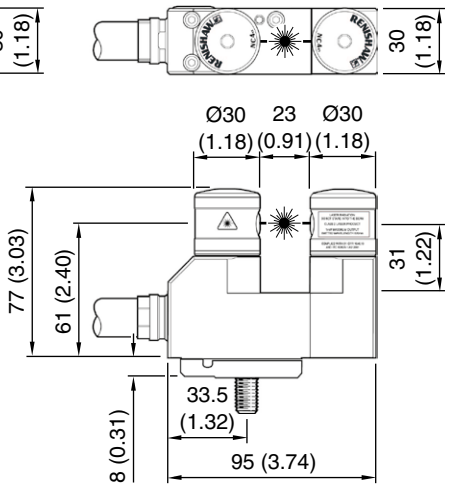
Transmitter/receiver separation (m)			Minimum tool diameter (mm) when …	
			… measured	… detected
Compact fixed system	F95	0.023	0.03	0.03
	F115	0.055	0.07	0.04
	F145	0.085	0.08	0.05
	NC4+ F145	0.085	0.03	0.03
	F230	0.170	0.20	0.07
	F300	0.240	0.20	0.10
Modular fixed system	F300	0.225	0.20	0.10
Separate system		0.500	0.30	0.10
		1.000	0.40	0.20
		2.000	0.50	0.20
		3.000	0.60	0.30
		4.000	1.00	0.30
		5.000	1.00	0.30

NC4 dimensions

Compact fixed system
F115, F145, F230 and F300 models



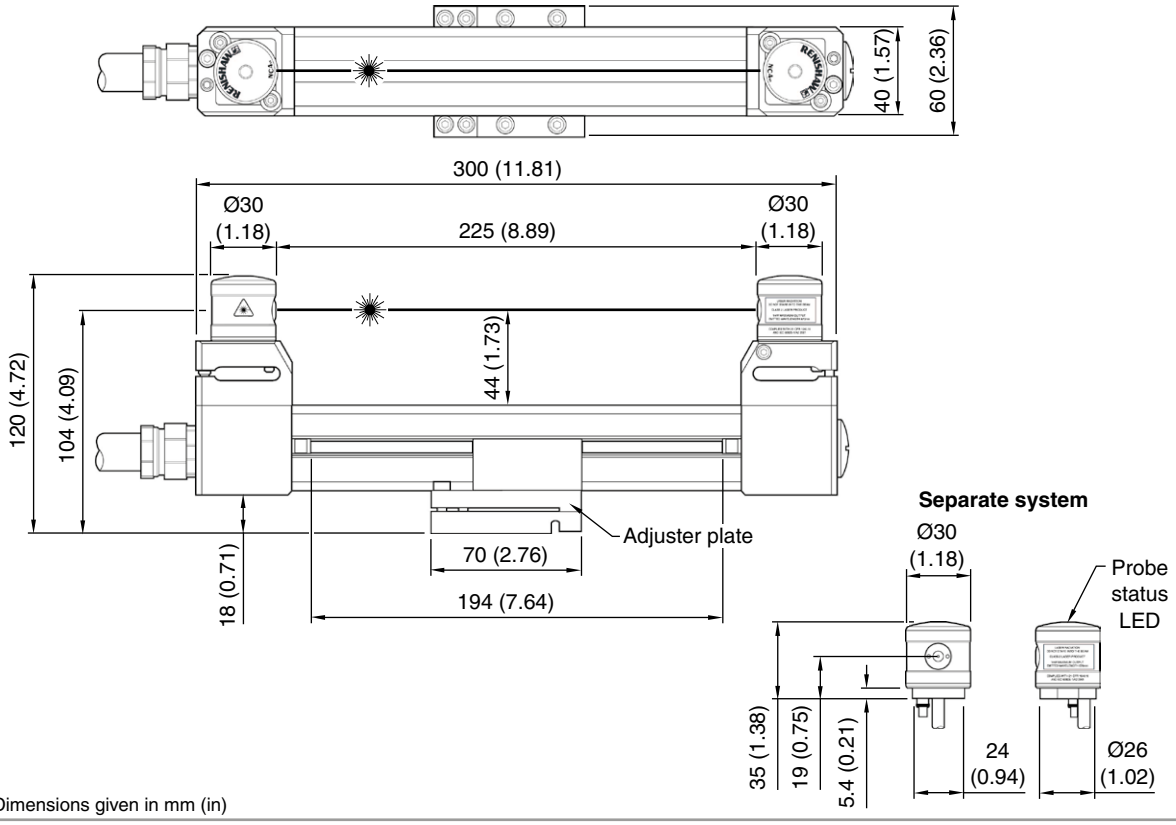
Compact fixed system
F95 model



Model	F115	NC4/NC4+ F145	F230	F300
Dimension A	55 (2.17)	85 (3.35)	170 (6.69)	240 (9.45)
Dimension B	115 (4.53)	145 (5.71)	230 (9.06)	300 (11.81)
Dimension C	57.5 (2.26)	72.5 (2.85)	115 (4.53)	150 (5.91)

Dimensions given in mm (in)

Modular fixed system

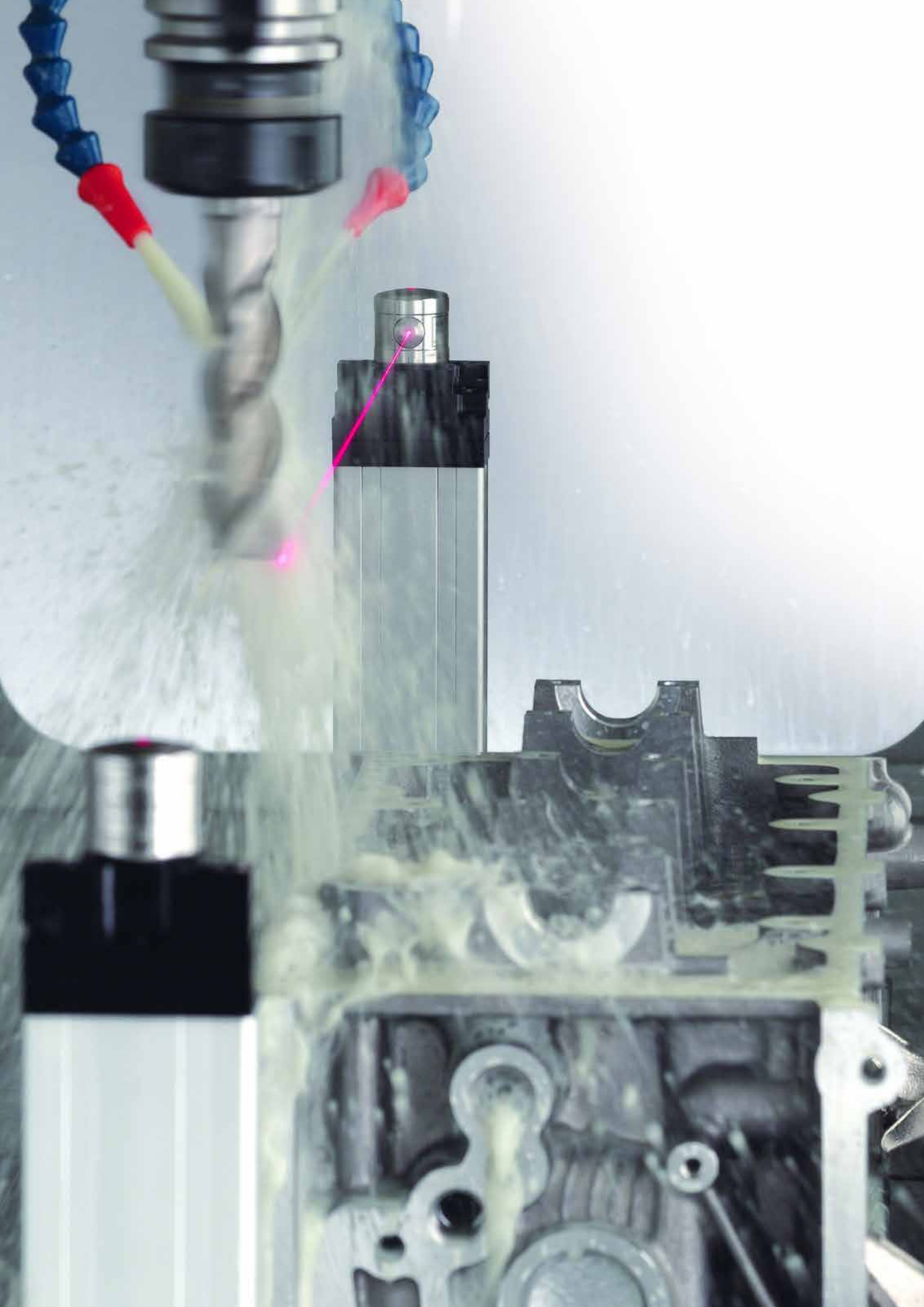


Dimensions given in mm (in)

NC4 specification

Principal application		High-precision, high-speed, non-contact tool measuring and broken tool detection on all sizes of vertical and horizontal machining centres, multi-tasking machines and all gantry machining centres.
Transmission type		Hard-wired transmission
Compatible interface		NCi-5
Repeatability	**Typical**	±0.10 µm (4 µin) 2σ
	Specified	NC4 ±1.00 µm (39 µin) 2σ at 1 m (3.28 ft) separation NC4+ F145 ±1.00 µm (39 µin) 2σ at 85 mm (3.35 in) separation
Tool setting		Ø0.03 mm (0.0012 in) or larger depending on the separation and set-up
Tool breakage detection		Ø0.03 mm (0.0012 in) or larger depending on the separation and set-up
Detection range		N/A
Output signal (from interface unit)		Two voltage-free, solid-state relays (SSR). Each can be either normally open or normally closed (selectable via a switch). Current (max.) 50 mA, voltage (max.) ±50 V. The interface contains an auxiliary relay which can be used for switching the output between the NC4 and a spindle probe. This relay could also be used to control an air blast kit (not supplied).
Supply voltage (to interface)		11 Vdc to 30 Vdc
Supply current (to interface)		120 mA @ 12 V, 70 mA @ 24 Vdc
Supply protection		Resettable fuses in interface. Reset by removing power and cause of fault.
Electrical connection arrangement (Other configurations are available on request.)	**Separate systems**	Cable on the underside of the unit.
	Fixed systems	Cable on the end of the unit.
Cable (to interface)	**Specification**	Ø5.8 mm (0.24 in), two twisted pairs, two individual cores plus screen, each core 18 × 0.1 mm insulated
	Length	12.5 m (41.0 ft)
	Electrical connection	Separate system: cable on the underside of the unit. Fixed systems: cable on the end of the unit. Other configurations are available on request.
Pneumatic supply		Ø3 mm (0.12 in) air pipe, 3 bar (43.5 psi) min., 6 bar (87.0 psi) max. The air supply to the NC4 must conform to ISO 8573-1: Class 1.7.2.
Laser type		Class 2 laser product
Laser beam alignment	**Separate systems**	Various optional adjuster packs are available.
	Fixed systems	The unit is supplied with an adjustable mounting plate on the underside.
Weight		500 g (1.1 lb) (single transmitter or receiver unit with cable)
Sealing		IPX8 (EN/IEC 60529) with air on or air off
Mounting (Alternative fixing arrangements are available.)	**Separate systems**	M3 bolts (3 off) plus Ø2 mm (0.079 in) dowel holes (2 off) (not supplied)
	Fixed systems	M4 (3 off), M10 (3/8 in) or M12 (1/2 in) bolts for mounting via adjuster plate (not supplied)
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/nc4**



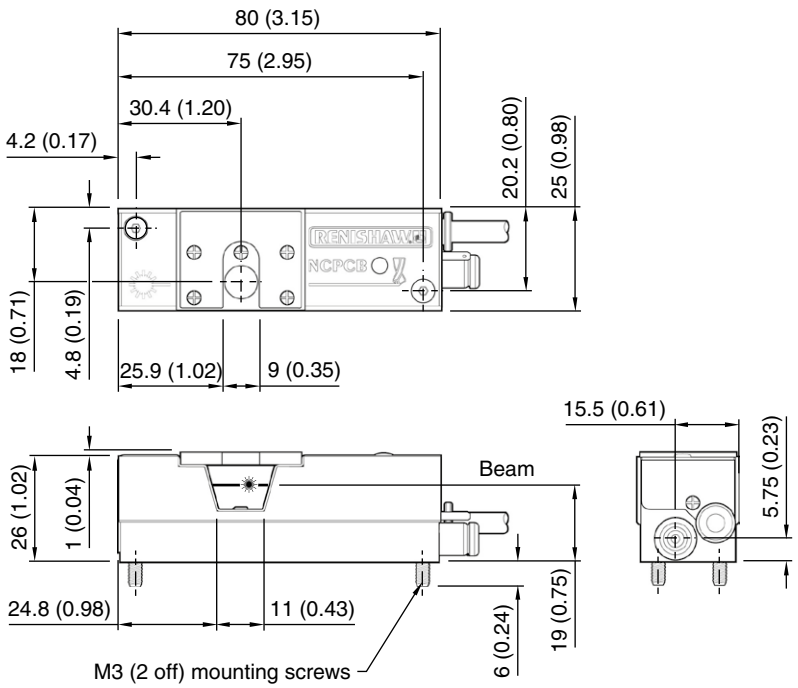
NCPCB

Non-contact tool setter for PCB drilling machines used for run-out checking, tool setting and tool breakage detection in one simple compact unit.

Key features and benefits:

- Compact; it measures just 80 mm (long) × 25 mm (wide) × 27 mm (tall)
- Integral in-built air blast capability for optics/tool cleaning
- Allows diameter measurement of tools as small as 0.1 mm
- Use on multiple spindle machines capable of 250,000 rpm
- 0.50 µm 2σ repeatability

Dimensions



Dimensions given in mm (in)

NCPCB specification

Principal application		High-precision tool measuring and broken tool detection on PCB drilling and routing machines.
Transmission type		Hard-wired transmission
Compatible interface		Sieb & Meyer 44-52
Repeatability		0.50 µm (20 µin) 2σ
Tool setting		Ø0.10 mm (0.004 in)
Tool breakage detection		Ø0.08 mm (0.003 in)
Detection range		N/A
Supply voltage		5 Vdc ±0.1 V
Supply current		60 mA @ 5 Vdc
Output signal (from interface unit)		Signal (output). HCMOS 5 V, 12 mA output. Beam broken: 0 V, not broken: 5 V
Input/output protection		N/A
Electrical connection arrangement		Cable on the end of the unit.
Cable (to machine control)	**Specification**	Ø4.85 mm (0.19 in), 5-core screened cable, each core 18 × 0.1 mm
	Length	0.8 m (2.62 ft)
	Electrical connection	Cable on the end of the unit.
Pneumatic supply		Via a Ø4 mm push-fit connector, 0.5 bar (7.3 psi) min., 3 bar (43.5 psi) max. The air supply to the NCPCB must conform to ISO8573-1: Class 1.7.2.
Laser type		N/A
Laser beam alignment		N/A
Weight		130 g (4.59 oz)
Sealing		IP50 (EN/IEC 60529)
Mounting		M3 bolts (2 off)
Operating temperature		+10 °C to +40 °C (+50 °F to +104 °F)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/ncpcb**

TRS2

Tool recognition system used for non-contact broken tool detection of solid centred cutting tools on a variety of machine tools. The unique ToolWise™ tool recognition electronics determine whether a tool is present by analysing the reflective light pattern from the rotating tool. Random light patterns created by coolant and swarf are ignored, eliminating the chance of failing to detect a broken tool due to coolant obscuring the beam. The single unit can be mounted outside the working environment, saving valuable space on the table.

Key features and benefits:

- Cost-effective, fast and reliable
- The latest ToolWise tool recognition technology
- Ultra-quick detection: typically the tool spends approximately 1 second in the laser beam
- Simple installation and set-up

"Each component needs at least 34 tool checks, so with the TRS2 check taking less than 7 seconds, the cycle time for every part has been reduced by an average of 7.5 minutes – some 6% of cycle time."

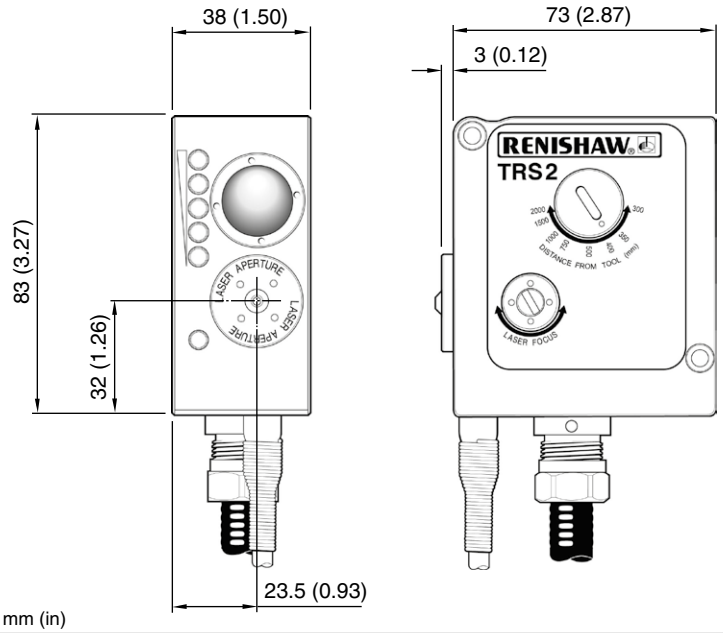
"After a detailed analysis, based on the cost to run machines, we know this equates to a saving of more than €150K in the first year. This is because most of the non-productive machine time taken to check tools has now been released to machine components. We have paid back the initial investment in the TRS2s in a matter of just 5 months."

"When we started we had several options for improving machining productivity, but this was by far the best, the others would have taken much longer to pay back."

SAME DEUTZ-FAHR and Lamborghini tractors

For the full case study please contact Renishaw or visit **www.renishaw.com/same-deutz-fahr**

Dimensions



Dimensions given in mm (in)

TRS2 specification

Principal application		High-speed non-contact tool breakage detection of solid tools on all sizes of vertical and horizontal machining centres, all gantry machining centres and multi-tasking machines.
Transmission type		Hard-wired transmission
Compatible interface		N/A (integrated interface)
Repeatability		N/A
Tool setting		N/A
Tool breakage detection		Ø0.2 mm (0.008 in) *(see notes 1 and 2)*
Detection range		TRS2 adjustable between 300 mm (11.8 in) and 2 m (78.7 in). Factory set to 350mm (13.8 in). TRS2-S fixed at 350 mm (13.8 in).
Supply voltage		11 Vdc to 30 Vdc
Supply current		65 mA @ 12 Vdc, 42 mA @ 24 Vdc
Output signal (from interface unit)		Status Output. Voltage-free solid-state relay (SSR) output, configurable normally open or normally closed.
Input/output protection		Supply/output protected by resettable fuses
Electrical connection arrangement		Cable on the underside of the unit
Cable (to machine control)	**Specification**	Ø4.85 mm (0.19 in), 5-core screened cable, each core 18 × 0.1 mm
	Length	0.8 m (2.62 ft)
	Electrical Connection	Cable on the end of the unit.
Pneumatic supply		Ø4 mm (0.16 in) air pipe The air supply to the TRS2 must conform to ISO 8573-1: Class 1.7.2.
Laser type		Class 2 laser product
Laser beam alignment		The unit is supplied with an adjustable mounting bracket.
Weight		750 g (1.65 lb), including 10 m (32.8 ft) of cable
Sealing		IPX8 (EN/IEC 60529) with air on
Mounting		Mounting bracket provided, with M6 (2 off) clearance slots. Alternative fixing arrangements are available.
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

Note 1 Each TRS2 unit is tested with a Ø0.5 mm (0.02 in), blue finish, HSS jobber drill (Farnell part no. 203778) at a range of 350 mm (13.8 in). Test conditions: dry tool, spinning at 5000 r/min, which must be detected by the TRS2 within 1 second.

Note 2 Depending on range, tool surface finish, machine environment and installation.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/trs2**

HPRA

A high precision ‘plug-in’ arm which is manually located inside the machine for tool setting, and then removed once the process is complete.

The arm is locked into a repeatable kinematic location on a mounting base during operation. When not in use, the HPRA is stored on a stand located on or near the machine.

Key features and benefits:

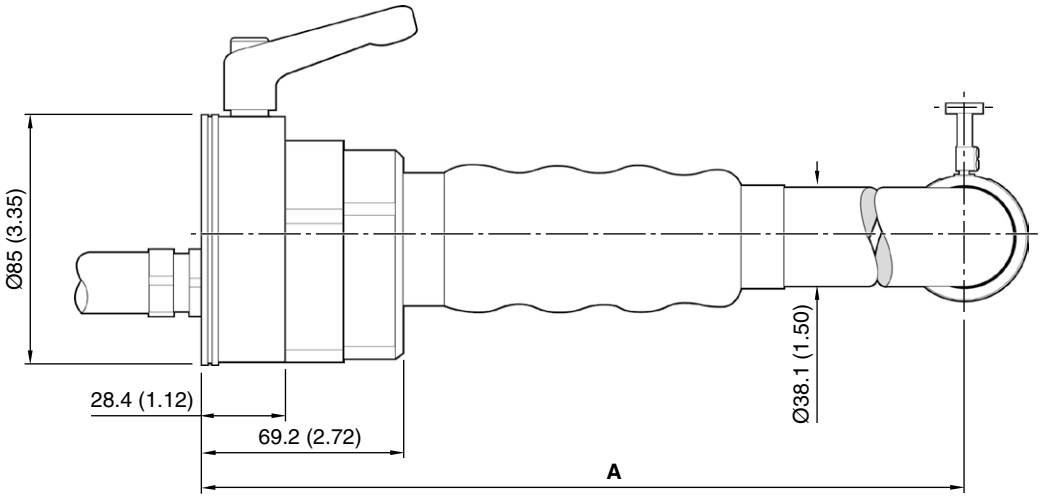
- The arm is removed from the machine for storage and uses minimal space
- Bi-colour LED for continuous feedback on system status
- Tool setting times up to 90% faster compared to traditional manual methods
- Retrofittable
- Stylus ‘break stem’ protects the probe if stylus overtravel limits are exceeded
- Stylus configurations to suit 16 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm tooling

“We were generating too much scrap using optical presetters to measure our KM units. Also, following this form of measurement, a bank of data of some 150 characters had to be typed into the CNC control by the operator. One human error could result in crashing a £200k machine tool. We could have opted for direct feedback from the presetters, but the Renishaw option was more cost-effective. Today, the repeatability is guaranteed, operator error is minimised, and scrap rates eliminated.”

Geo. W. King Ltd.

For the full case study please contact Renishaw or visit **www.renishaw.com/geo-king**

Dimensions

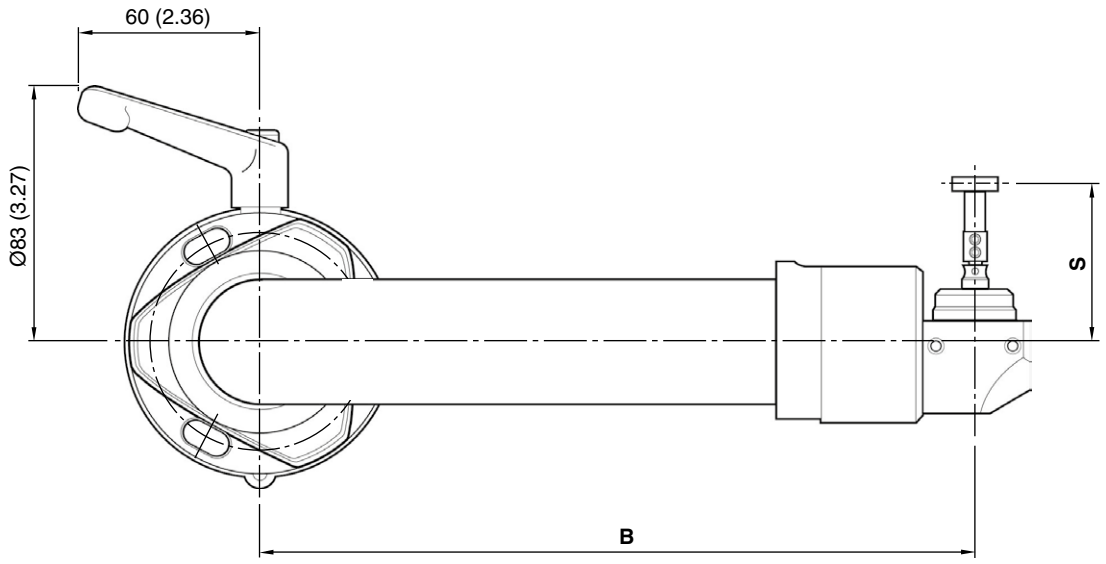


Arm dimensions	
Dimension	**A***
Maximum	580 (22.83)
Minimum	250 (9.84)

Dimensions given in mm (in)

*A variety of standard length arms are available on request

HPRA dimensions (front view)



Arm dimensions			
Dimension	**B***	**S**	**Tool size**
Maximum	450 (17.72)	71 (2.80)	50 (1.97)
Minimum	211 (8.31)	36 (1.42)	16 (0.63)

Dimensions given in mm (in)

*A variety of standard length arms are available on request

HPRA specification

Variant		**Standard rear exit**	**Standard side exit**
Principal application		Tool measuring and broken tool detection on 2-axis and 3-axis CNC lathes.	
Transmission type		Hard-wired transmission	
Probe		RP3 *(see note 1)*	
Compatible interfaces		TSI 2 or TSI 2-C	
Cable (to interface)	**Specification**	Ø4.0 mm (0.16 in), 2-core screened cable, each core 7 × 0.2 mm	
	Length	3 m (9.8 ft), 5.5 m (18.0 ft), 10 m (32.8 ft), 12 m (39.4 ft)	3 m (9.8 ft)
Sense directions		±X, ±Y, +Z	
Typical positional repeatability *(see note 2)*		5.00 µm (197 µin) 2σ X/Z (arms for machines with 6 in to 15 in chucks) 8.00 µm (315 µin) 2σ X/Z (arms for machines with 18 in to 24 in chucks)	
Stylus trigger force		See note 1	
Sealing		IPX8 (EN/IEC 60529)	
Mounting		M6 bolts (3 off)	
Operating temperature		+5 °C to +60 °C (+41 °F to +140 °F)	

Note 1 For more details, please refer to the RP3 product page 3-40.

Note 2 Test conditions: Stylus length: 22 mm (0.87 in)
Stylus velocity: 36 mm/min (1.42 in/min)
Stylus force: factory settings

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/hpra**

HPPA

A simple, manually operated ‘pull-down, push-up’ system, which is permanently located within the turning centre and readily available for high-precision tool setting operations.

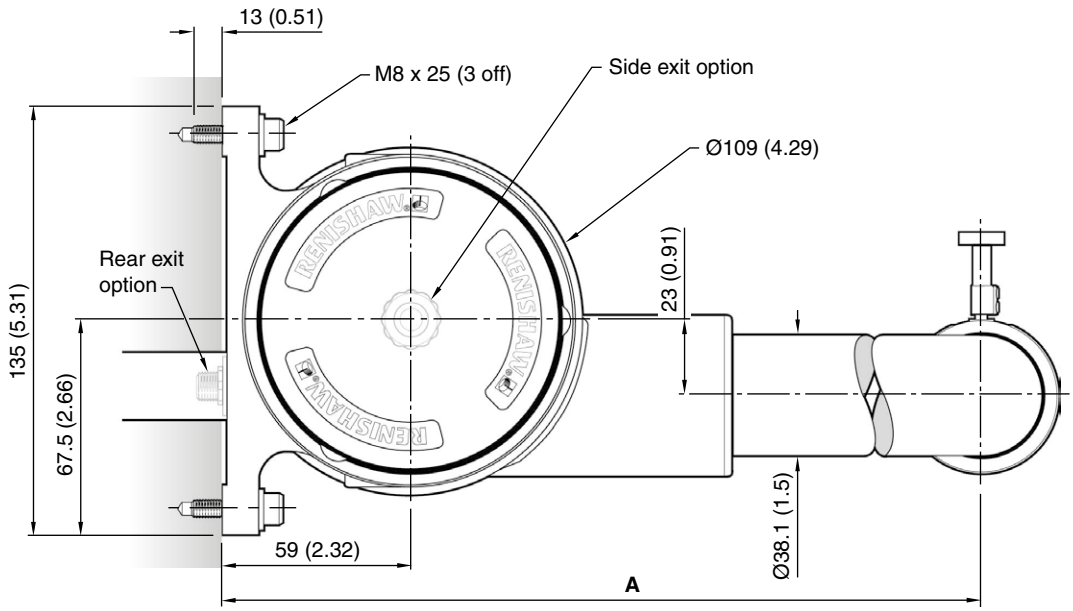
An innovative patented rotary device automatically locks the arm into a repeatable kinematic location. No additional adjustment or locking device is required.

In addition to high levels of performance offered by the HPPA, the compact system design minimises space required within the machine tool.

Key features and benefits:

- Long-life rotary device durability
- Low thermal growth steel arm
- Uses minimal machine space when stored
- Bi-colour LED for continuous feedback on system status
- Tool setting times up to 90% faster than traditional manual methods
- Stylus ‘break stem’ protects the probe if stylus overtravel limits are exceeded
- Stylus configurations to suit 16 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm tooling

Dimensions (side view)

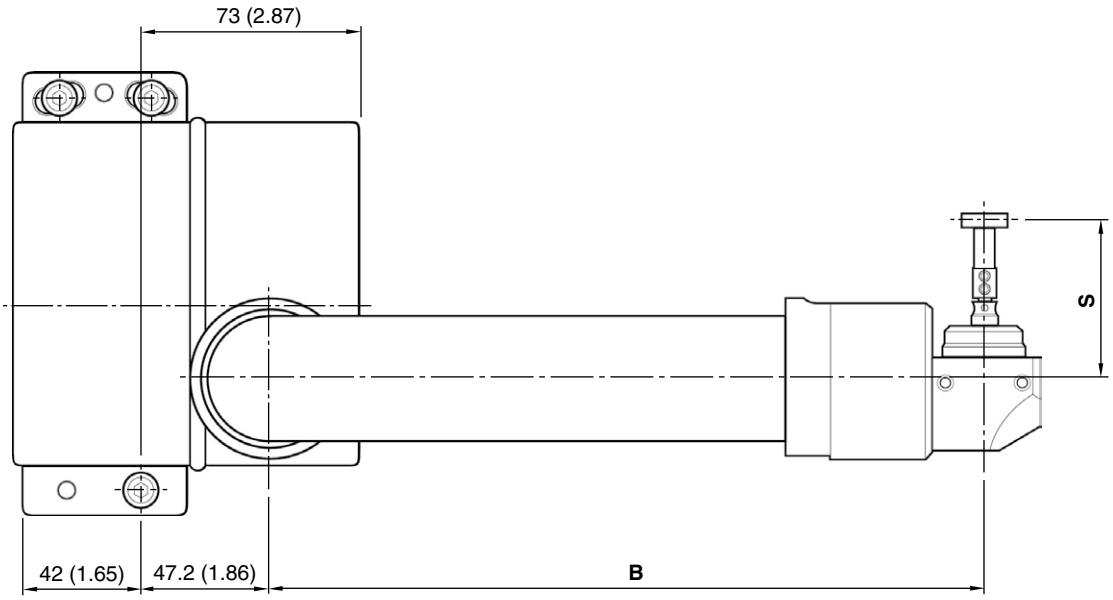


Arm dimensions	
Dimension	**A***
Maximum	555 (21.85)
Minimum	250 (9.84)

Dimensions given in mm (in)

*A variety of standard length, rear and side exit arms are available on request

Dimensions (front view)



Arm dimensions			
Dimension	**B***	**S**	**Tool size**
Maximum	458.2 (18.04)	71 (2.80)	50 (1.97)
Minimum	219.2 (8.63)	35.7 (1.41)	16 (0.63)

Dimensions given in mm (in)

*A variety of standard length arms are available on request

HPPA specification

Variant		**Standard rear exit**	**Standard side exit**
Principal application		Tool measuring and broken tool detection on 2-axis and 3-axis CNC lathes.	
Transmission type		Hard-wired transmission	
Probe		RP3 *(see note 1)*	
Compatible interfaces		TSI 2 or TSI 2-C	
Cable (to interface)	**Specification**	Ø5.9 mm (0.23 in), 5-core screened cable, each core 42 × 0.1 mm	Ø4.0 mm (0.16 in), 2-core screened cable, each core 7 × 0.2 mm
	Length	2 m (6.5 ft), 5 m (16.4 ft), 10 m (32.8 ft)	7 m (22.9 ft)
Sense directions		±X, ±Y	
Typical positional repeatability *(see note 2)*		5.00 µm (197 µin) 2σ X/Z (arms for machines with 6 in to 15 in chucks) 8.00 µm (315 µin) 2σ X/Z (arms for machines with 18 in to 24 in chucks)	
Stylus trigger force		See note 1	
Arm sweep angle		90°/91° (if Renishaw probe enclosure is not used, note maximum arm sweep angle of 91°.)	
Sealing		IPX8 (EN/IEC 60529)	
Mounting		M8 bolts (3 off)	
Operating temperature		+5 °C to +60 °C (+41 °F to +140 °F)	

Note 1 For more details, please refer to the RP3 product page 3-40.

Note 2 Test conditions: Stylus length: 22 mm (0.87 in)
Stylus velocity: 36 mm/min (1.42 in/min)
Stylus force: factory settings

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/hppa**

HPMA

An electrically powered arm allowing high-precision automated tool setting on CNC lathes and turning centres.

Rapid actuation allows in-process tool setting and broken tool detection without the need for operator intervention: machine commands activate the arm and lock it into position within 2 seconds.

After the tools have been set, a further command returns the arm to a safe position away from the machining operations.

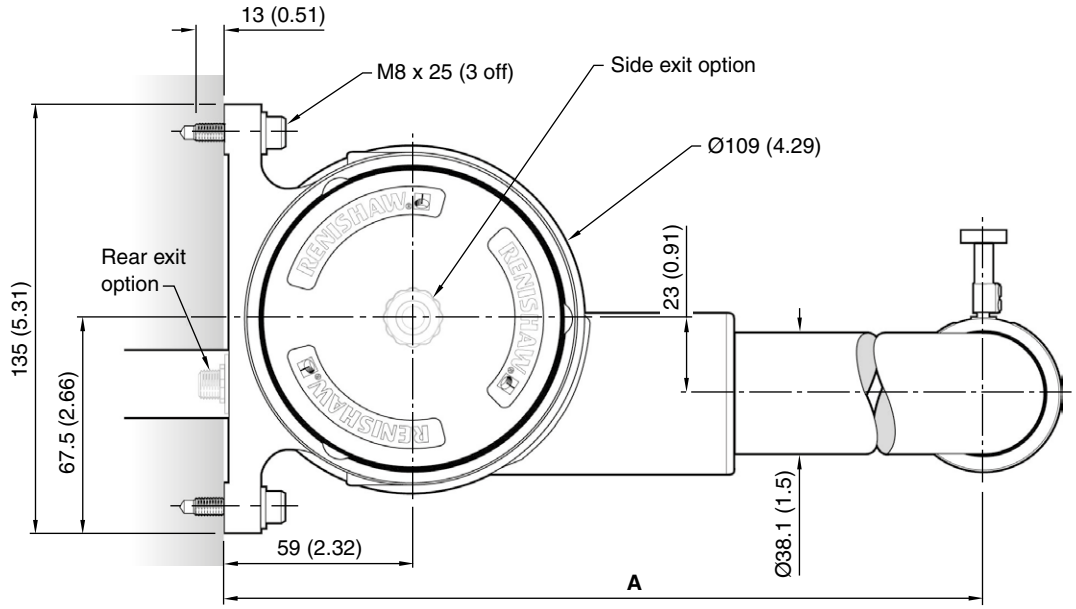
An innovative patented rotary device automatically locks the arm into a repeatable kinematic location. No additional adjustment or locking device is required.

In addition to the high levels of performance offered by the HPMA, the system's compact design minimises the amount of space required within the machine tool.

Key features and benefits:

- Rapid actuation
- Full program control of tool setting and broken tool detection
- Bi-colour LED for continuous feedback on system status
- Tool setting times up to 90% faster than traditional manual methods
- Stylus 'break stem' protects the probe if stylus overtravel limits are exceeded
- Stylus configurations to suit 16 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm tooling

Dimensions (side view)

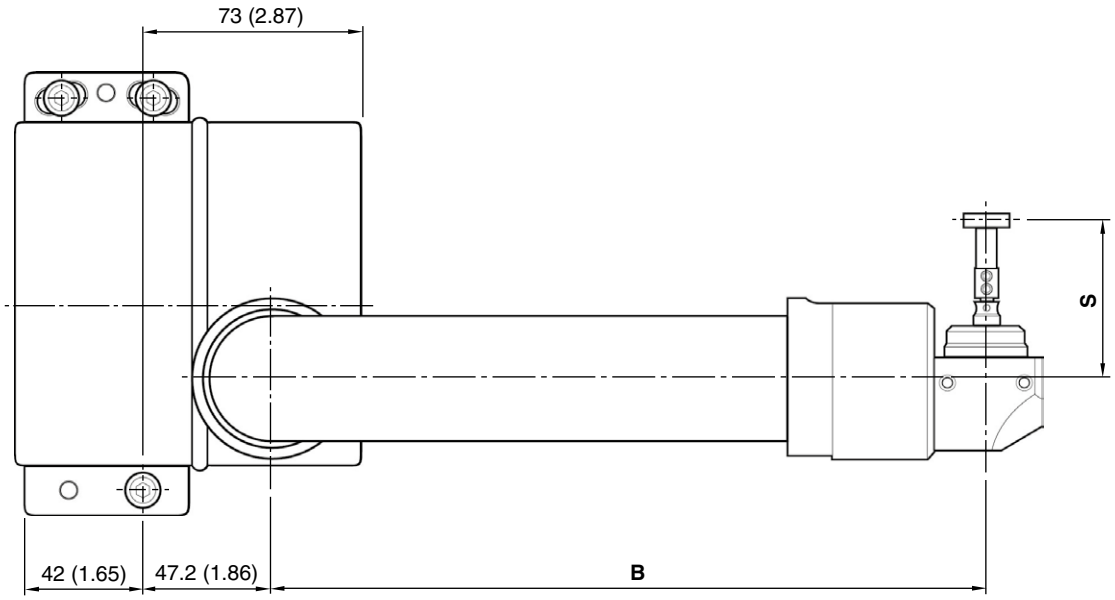


Arm dimensions	
Dimension	**A***
Maximum	555 (21.85)
Minimum	250 (9.84)

Dimensions given in mm (in)

*A variety of standard length, rear and side exit arms are available on request

Dimensions (front view)



Arm dimensions			
Dimension	**B***	**S**	**Tool size**
Maximum	458.2 (18.04)	71 (2.80)	50 (1.97)
Minimum	219.2 (8.63)	35.7 (1.41)	16 (0.63)

Dimensions given in mm (in)

*A variety of standard length arms are available on request

HPMA specification

Variant		**Standard rear exit**	**Standard side exit**
Principal application		Tool measuring and broken tool detection on 2-axis and 3-axis CNC lathes.	
Transmission type		Hard-wired transmission	
Probe		RP3 *(see note 1)*	
Compatible interfaces		TSI 3 or TSI 3-C	
Cable (to interface)	**Specification**	Ø6.0 mm (0.23 in), 5-core screened cable, each core 42 × 0.1 mm	Ø4.35 mm (0.17 in), 4-core screened cable, each core 7 × 0.2 mm
	Length	2 m (6.5 ft), 5 m (16.4 ft), 10 m (32.8 ft)	7 m (22.9 ft)
Sense directions		±X, ±Y	
Typical positional repeatability *(see note 2)*		5.00 µm (197 µin) 2σ X/Z (arms for machines with 6 in to 15 in chucks) 8.00 µm (315 µin) 2σ X/Z (arms for machines with 18 in to 24 in chucks)	
Stylus trigger force		See note 1	
Arm sweep angle		90°/91° (If Renishaw probe enclosure is not used, note maximum arm sweep angle of 91°.)	
Sealing		IPX8 (EN/IEC 60529)	
Mounting		M8 bolts (3 off)	
Operating temperature		+5 °C to +60 °C (+41 °F to +140 °F)	

Note 1 For more details, please refer to the RP3 product page 3-40.

Note 2 Test conditions: Stylus length: 22 mm (0.87 in)
Stylus velocity: 36 mm/min (1.42 in/min)
Stylus force: factory settings

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/hpma**

HPGA

A high-precision motorised tool setting arm for use on both CNC lathes and grinding machines.

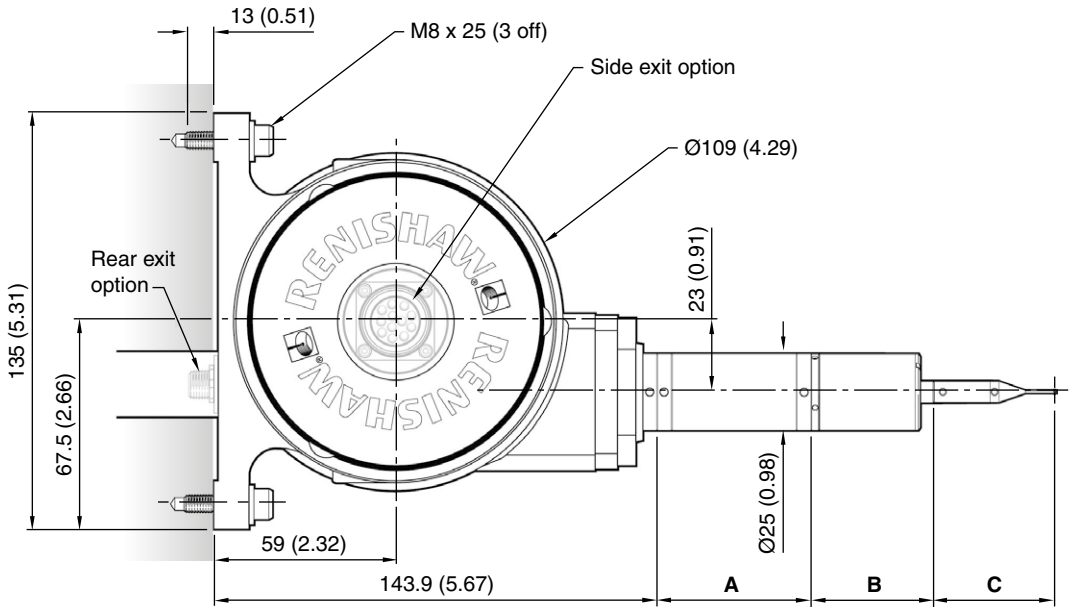
The patented rotary kinematic design ensures highly repeatable stylus positioning each time the arm is rotated into its 'Arm Ready' position.

The HPGA provides excellent repeatability in all three major machine axes, especially when used with the Rengage™ high accuracy strain gauge MP250 probe. With the innovative new SwarfStop™ seal design, it can withstand the harshest of environments.

Key features and benefits:

- Also suitable for workpiece inspection
- Compatible with Renishaw's LP2 probe as well as the RENGAGE™ MP250 probe for improved repeatability and multi-axis directional performance
- Tool setting times up to 90% faster than traditional manual methods
- Reliable in the harshest machine environments
- Interchangeable arms and cable
- 3.00 µm 2σ repeatability in all three machine axes

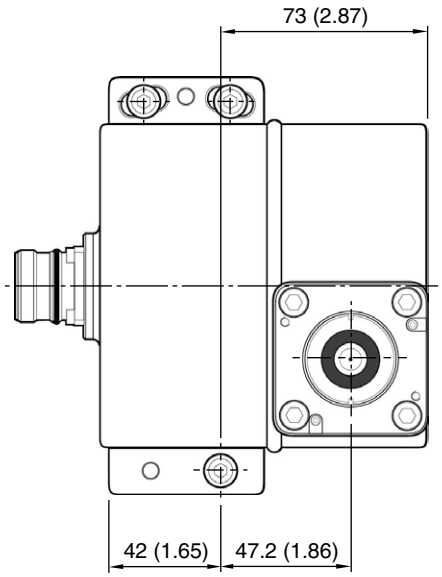
Dimensions (side view)



Model	LPE1	LPE2	LPE3	LP2	MP250
Dimension A	50 (1.97)	100 (3.94)	150 (5.91)	N/A	N/A
Dimension B	N/A	N/A	N/A	40.8 (1.61)	40.7 (1.60)
Dimension C	For a full range of styli please contact Renishaw plc.				

Dimensions given in mm (in)

Dimensions (side exit, front view)



Dimensions given in mm (in)

HPGA specification

Variant		Standard rear exit	Standard side exit
Principal application		Workpiece inspection, tool measuring and broken tool detection on CNC lathes and CNC grinders.	
Transmission type		Hard-wired transmission	
Probe		LP2 or MP250 *(see note 1)*	
Compatible interfaces		TSI 3 (or TSI 3-C) and HSI	
Cable (to interface)	**Specification**	Ø5.9 mm (0.23 in), 8-core screened cable, each core 32 × 0.1 mm	Ø5.8 mm (0.23 in), two twisted pairs, two individual cores plus screen, each core 18 × 0.1 insulated
	Length	1.5 m (4.92 ft), 3 m (9.8 ft), 5 m (16.4 ft), 10 m (32.8 ft)	2 m (6.5 ft), 5 m (16.4 ft), 10 m (32.8 ft)
Sense directions		±X, ±Y, +Z	
Typical positional repeatability *(see note 2)*		3.00 µm (118 µin) 2σ	
Stylus trigger force		See note 1	
Arm sweep angle		90° (typical)	
Sealing		IPX8 (EN/IEC 60529)	
Mounting		M8 bolts (3 off)	
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)	

Note 1 For more details, please refer to the LP2 product page 2-34 or the MP250 product page 2-46.

Note 2 Maximum 2σ value in any direction. Performance specification is for 10 points at 48 mm/min trigger speed using an LP2 probe with a 20 mm long stylus and a 15 mm square tip.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/hpga**

RP3

Tool setting kinematic probe for lathes and turning centres that can also be used for workpiece set-up.

Suitable for OEM installation into purpose-built holders. It utilises a universal M4 stylus mounting, allowing the full range of Renishaw styli to be used.

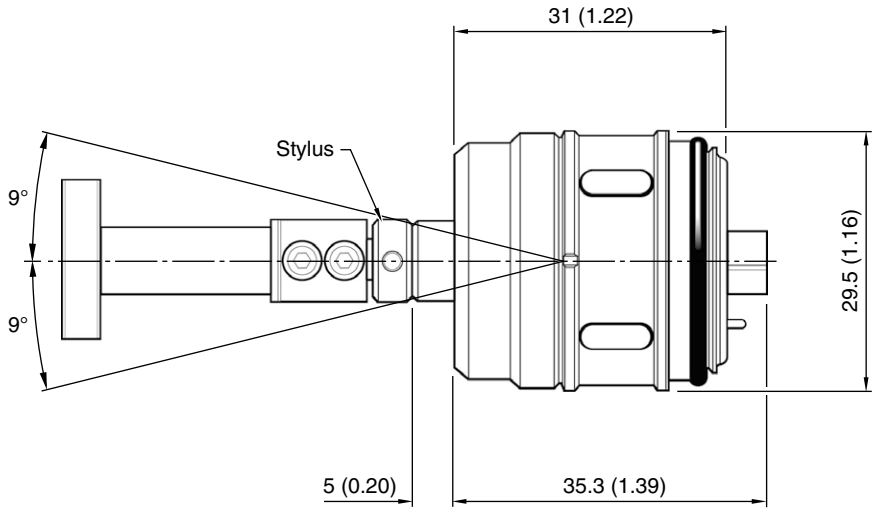
Connection from the probe terminals to the interface cable is made easy with the availability of an OEM kit.

The short body provides significant advantages in tool setting applications and the high performance of traditional Renishaw touch-trigger probes.

Key features and benefits:

- Compatible with the full range of Renishaw M4 styli
- Standard fit HP series tool setting arm (HPRA, HPPA and HPMA)
- Flexibility – kit available for OEM installations
- Large 9° of overtravel – increases the durability of the probe
- 1.00 µm 2σ repeatability

Dimensions



Dimensions given in mm (in)

RP3 specification

Principal application	Manual and automatic tool setting arms on 2-axis and 3-axis lathes.
Transmission type	Hard-wired transmission
Compatible interfaces	MI 8-4, TSI 2, TSI2-C, TSI 3, TSI 3-C
Recommended styli	48.75 mm (1.92 in)
Probe outputs	OEM kit including connection PCB
Weight	80 g (2.82 oz)
Sense directions	5-axis ±X, ±Y, +Z *(see note 1)*
Unidirectional repeatability	1.00 µm (40 µin) 2σ *(see note 2)*
Stylus trigger force *(see notes 3 and 4)* XY low force XY high force +Z direction	 1.50 N, 153 gf (5.40 ozf) 3.50 N, 357 gf (12.59 ozf) 12.00 N, 1224 gf (43.16 ozf)
Sealing	IPX8 (EN/IEC60529)
Operating temperature	+5 °C to +60 °C (+41 °F to +140 °F)

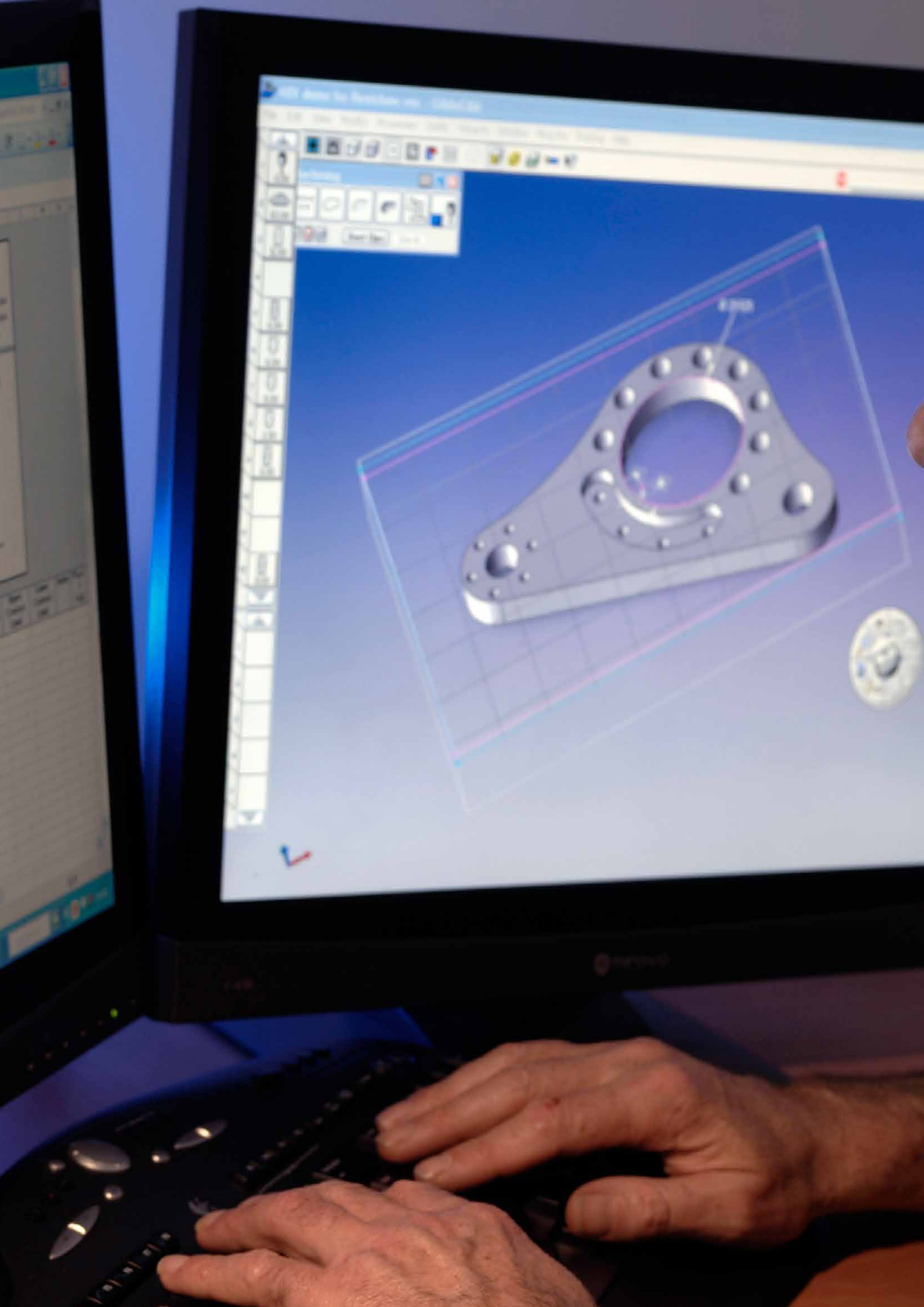
Note 1 Where the RP3 is to be used in the probe's Z-axis (the lathe Y-axis), then a five-faced stylus is available to order from Styli and Fixturing Products.

Note 2 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 35 mm stylus. Significantly higher velocity is possible depending on application requirements.

Note 3 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

Note 4 These are the factory settings, manual adjustment is not possible.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/rp3**



Measurement and inspection software

Spindle probing software functionality comparison chart

Products	Macro software		PC based software			
			Productivity+™		On-machine verification	Report formatting and analysis
	EasyProbe	Inspection Plus	Active Editor Pro	GibbsCAM® plug-in	Renishaw OMV	Renishaw CNC Reporter
Page / Functionality	4-6	4-7	4-8	4-8	4-10	4-12
On-machine process control		●	●	●		
On-machine verification with graphical reports					●	
On-machine verification with text based reporting *		●	●	●		
Programming from CAD models			●	●	●	
Programming from within CAM system		● §		●		
Running the same program on different CNC controls			●	●	●	
On-machine program editing	●	●				
Import and analysis of text-based reports						●
Level of CNC logic programming required	Medium	High	Low	Low	Low	N/A

* Subject to CNC machine tool configuration
§ Capability provided by certain CAM vendors

Software overview

Renishaw provides a selection of measurement and inspection software solutions which are designed to complement our range of measurement and process control hardware.

There are two main classifications of software:

- **Macro packages** are installed and resident on the CNC machine, and are reliant on traditional G-code programming techniques.
- **PC based packages** enable a wide variety of tasks to be performed using post processors which are configured for individual machine tools.

The comprehensive range of available packages offers solutions for tool setting, job set-up, component measurement and inspection, plus verification and reporting.

Macro software packages

EasyProbe

The EasyProbe software package provides simple and fast job set-up and component measurement routines and requires only minimal programming knowledge.

Inspection Plus

A comprehensive macro package which provides full functionality for a wide range of inspection and process control applications.

Tool setting software (contact)

This software is designed to operate with industry standard OTS, RTS and TS27R tool setting probes, and is suitable for use with the vast majority of machining centres.

Tool setting software (non-contact)

Suitable for applications using delicate and very small tools, or configurations where the probe must not obstruct the machine's working envelope.

PC based software packages

Productivity+™

Uses component solid models to generate probe inspection routines incorporating logic functionality and intelligent process control.

Renishaw OMV

Allows on-machine, CMM-style inspection of complex component geometries. Customisable reporting provides results information in tabular and graphical formats.

Renishaw CNC Reporter

Uses measurement data from Productivity+ or Inspection Plus to generate printable inspection reports. Results data is presented as a graphical control chart with feature-by-feature tabular information including tolerance check.

EasyProbe, Inspection Plus, Productivity+, Renishaw OMV (and OMV Pro) and Renishaw CNC Reporter are covered in detail on subsequent pages.

Software compatibility selector

Software / Control	CNC machining centres							CNC lathes		CNC multi-tasking machines	
	EasyProbe	Inspection Plus	Tool setting (contact)	Tool setting (non-contact)	GibbsCAM® plug-in	Active Editor Pro	Renishaw OMV	Tool setting	3-axis tool setting	Inspection Plus	Tool setting (non-contact)
Fanuc 0-18/21/ 30-32M	●	●	●	●	●	●	●				
Fanuc 0-21/30-32T								●	●		
Mazak		●	●	●	●	●	●	●		●	●
Mitsubishi Meldas	●	●	●	●	●	●	●	●			
Yasnac	●	●	●	●	●	●	●				
Fadal			●	●							
Okuma OSP/U		●	●	●	●	●	●				
HAAS	●	●	●	●	●	●	●	●			
Hurco WinMax		●	●	●	●	●					
Siemens 800 series			●					●			
Siemens 802 810D/840D/828D	●	●	●	●	●	●	●	●			
Selca			●	●			●				
GE2000			●								
Toshiba Tosnuc		●					●				
Acramatic A2100							●				
Heidenhain				●	●	●	●				
NUM		●	●				●	●	●		
Traub								●	●		
Makino		●		●	●	●	●				
Mori Seiki MAPPS		●	●	●	●	●	●				●
Andron							●				
Fidia							●				
Brother		●	●	●	●	●					
Nakamura										●	
Doosan (Fanuc)	●	●	●	●	●	●	●	●	●	●	

Development work to extend the range of supported controls is ongoing so you may be able to take advantage of the benefits offered by Renishaw software even if your existing platform is not listed.

For more details, please refer to the *Probe software for machine tools - program selection list* (Renishaw part no. H-2000-2298), *Probe software for machine tools - program features* (Renishaw part no. H-2000-2289) and *PC based software selection guide: machine tool applications* (Renishaw part no. H-2000-6597).


RENISHAW
OMP

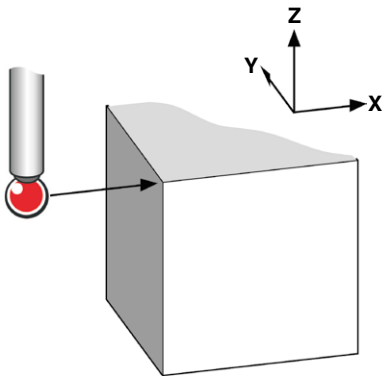
EasyProbe

The EasyProbe software package is designed to allow simple job set-up and component measurement tasks to be performed on a machine tool with minimal G-code programming knowledge.

Easily configurable using a supplied installation utility to suit compatible CNC machine tool makes and models, the application provides a wide range of measurement cycles, including four-point bore/boss and two-point web/pocket, angle find, single surface measure, probe length and stylus offset calibration.

The operator can use the handwheel to manually position the probe to a suitable start position and run the measurement cycle in MDI, or probe positioning and measurement cycles can be combined into a simple G-code program which will execute automatically.

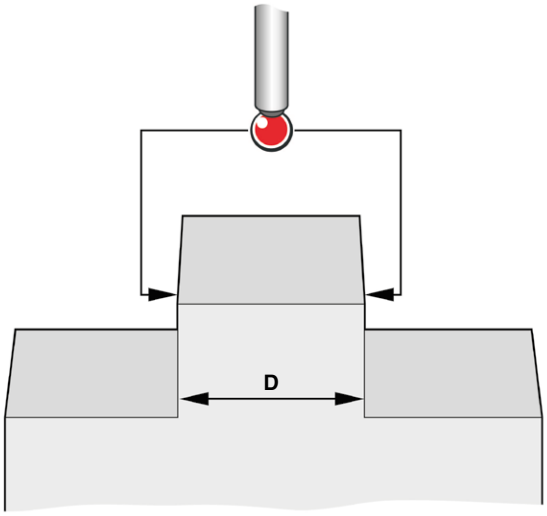
Some example program code is given below.



X surface measure cycle

Code:
G65 P9023 X10. S54.
Explanation:

G65	=	sub-macro call
P9023	=	measurement program
X10.	=	measuring move in X-axis
S54.	=	work offset number to be set (S54. indicates that G54 will be updated)



Web measure cycle

Code:
G65 P9023 D50. Y1. Z-15. S54.
Explanation:

G65	=	sub-macro call
P9023	=	measurement program
D50.	=	feature width
Y1.	=	direction indicator
Z-15.	=	inspection depth
S54.	=	work offset number to be set (S54. indicates that G54 will be updated to the centre of the web in the Y-axis)

Key features and benefits:

- Simple programming: minimal operator skill required
- Updating of work offsets for accurate component positioning
- Storing of measurement results and errors to macro variables
- Protected positioning enabled
- Can be used in MDI mode, or have cycles written to a part program for automatic operation

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/easyprobe**

Inspection Plus

Inspection Plus is the industry standard macro based component measurement package, with a global end-user installation base of tens of thousands.

Compatible with all major machine tool control platforms, this machine-resident package – when combined with Renishaw probing hardware – requires no other external peripherals and is simple to program with only basic G-code knowledge.

Available as a simple retrofit or OEM/distributor installation, the package provides users with a comprehensive range of measurement cycles, including vector and angular measurement, probe calibration and report printing capability (depending on control functionality) in a single, integrated solution.

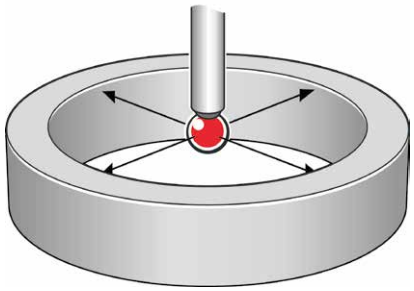
Commonly used for job set-up, component identification and defined interval inspection, the software exports measurement results data – size, position and errors – to machine variables, allowing further calculations to be performed and logic functionality applied as necessary.

Some example program code is given below.

Calibration cycle: calibrating a stylus ball radius using a ring gauge

Code:
G65 P9803 D50.005 Z50. S1.
Explanation:

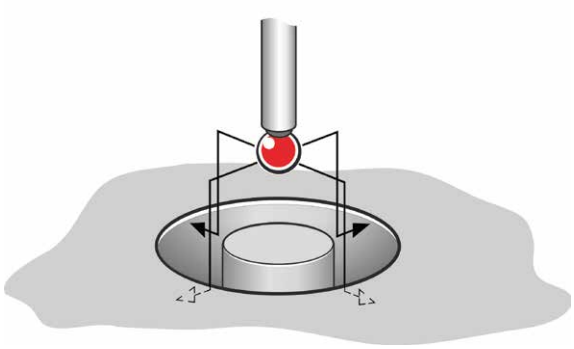
G65	=	sub-macro call
P9803	=	measurement program
D50.005	=	diameter of ring gauge
S1.	=	work offset number to be set (S1 to S6 = G54 to G59, therefore S1 = G54)



Bore/boss measurement cycle

Code:
G65 P9814 D50. Z-10. S4.
Explanation:

G65	=	sub-macro call
P9814	=	measurement program
D50.	=	circle diameter
Z-10.	=	inspection depth
S4.	=	work offset number to be set (S1 to S6 = G54 to G59, therefore S4 = G57)



Key features and benefits:

- Measurement of internal and external features to determine size and position
- Comprehensive range of standard measurement cycles, enhanced vector cycles and a range of calibration cycles
- Protected positioning to stop the machine upon probe/component collision
- One-touch and two-touch measurement functionality
- Statistical process control (SPC) feedback based on trend analysis and average results

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/inspectionplus**

Productivity+™

Productivity+ provides users with a simple-to-use environment for incorporating in-cycle measurement and inspection probe routines into machining cycles, with no requirement for G-code programming experience.

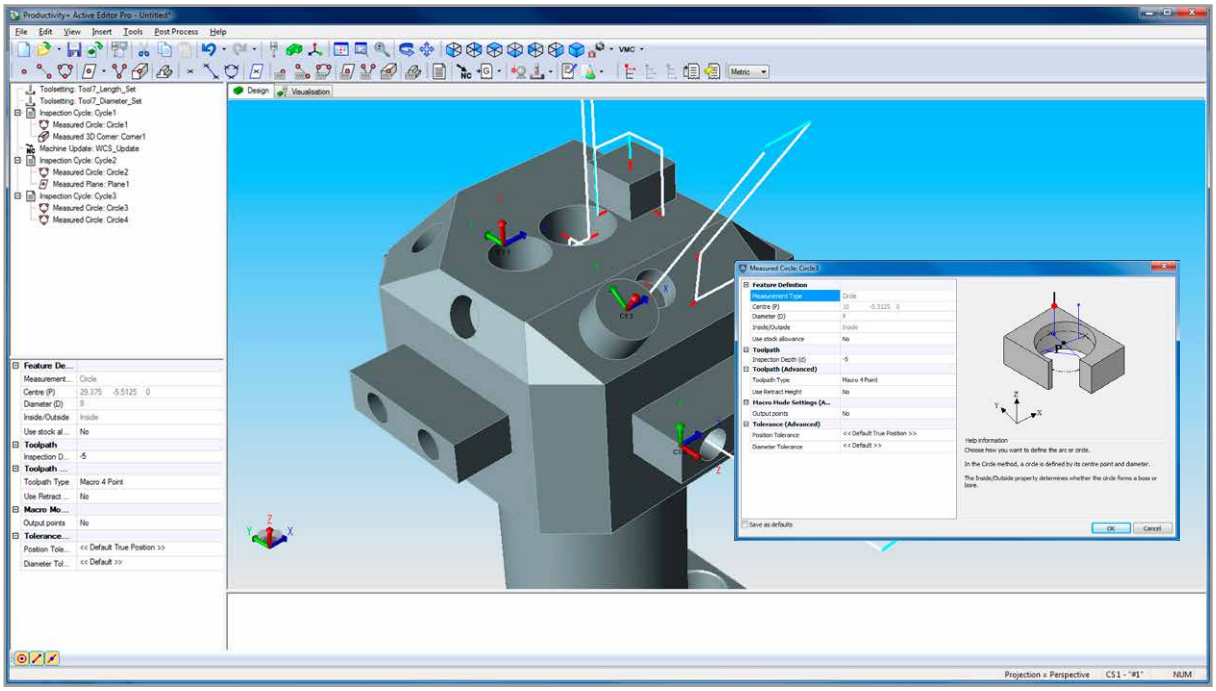
Productivity+ can assist in three core areas of a machining process:

- 'Predictive' process-setting tasks – such as job set-up, part and tool identification – implemented before machining to ensure that the process runs smoothly.
- 'Active' in-process control tasks – such as tool condition monitoring, tool dimension updates and re-machining based on measurement results – implemented during a machining process allowing adaptation to variations in real-time cutting conditions.
- 'Informative' post-process reporting tasks – providing users with information about a completed process and helping to influence decisions for subsequent operations and processes.

Calculation of measurement results, logic decisions and machine tool updates are all performed on the CNC itself, eliminating the need for external communications.

Productivity+ software is available in two application versions:

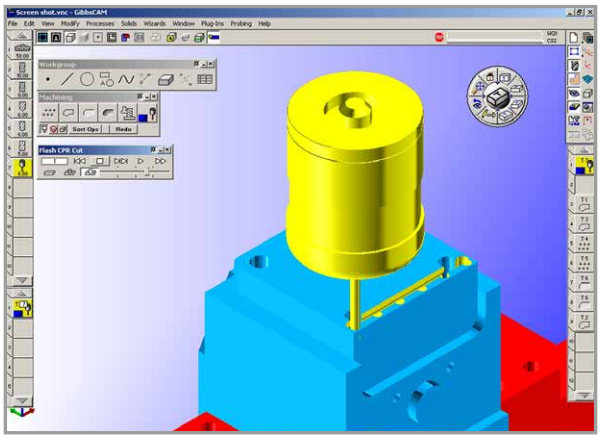
- **Active Editor Pro** is a stand-alone program generation package which uses imported solid models to provide a point-and-click programming environment. Measurements, logic and updates may be added to existing NC machining code and then post processed to provide a single comprehensive NC program containing metal cutting and component inspection operations.
- The **GibbsCAM plug-in** increases the flexibility of the CAM package to include probing capability. The probe is handled in the same way as any other tool, allowing probing operations to be programmed as the machining process is defined.



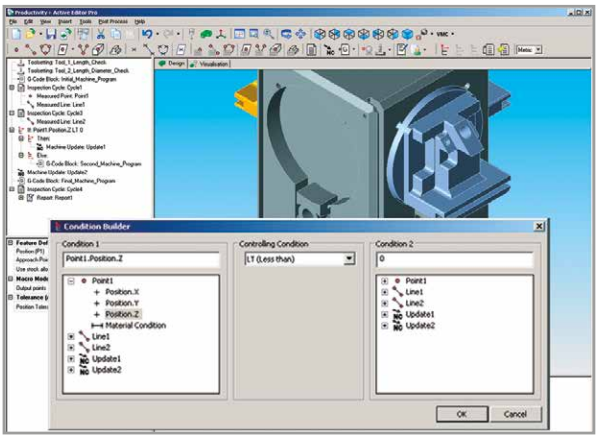
Multi-axis measurement (Active Editor Pro)

Key features and benefits:

- Automatic adaptation of cutting programs in real time based on inspection results
- Programming using component solid models (or manually where no model exists)
- Creation of constructed elements from previously inspected component geometry
- Probe cycle visualisation, including crash detection
- Multi-axis support for a wide range of machine tool control platforms



Program simulation (GibbsCAM plug-in)



Logic and condition builder (Active Editor Pro)

"We looked at the whole production cycle time and in some cases were able to reduce it by up to 50%. Productivity+ software and Renishaw part setting probes have made this possible. Productivity+ makes it much easier to prove out the process before going on the machine."

Alp Aviation

For the full case study please contact Renishaw or visit **www.renishaw.com/alp-aviation**

Productivity+ specification

Supported controls Please note that multi-axis support may not be available for all control types. Contact your local Renishaw representative for latest availability.	• Brother • Fanuc • HAAS • Heidenhain • Hitachi Seicos	• Hurco • Makino • Mazak • Mitsubishi Meldas • Mori Seiki • Okuma • Siemens • Yasnac
Supported CAD formats	• IGES • Parasolid • STEP • ACIS * • Autodesk Inventor *	• CATIA * • Creo Elements/Pro (ProE 2000i2) * • SolidWorks * • NX (Unigraphics) *
Supported languages	• English • Czech • French • German • Italian	• Japanese • Korean • Simplified Chinese • Spanish • Traditional Chinese
System requirements (recommended)	Operating system	Microsoft Windows XP, Windows Vista, Windows 7 (32-bit or 64-bit version) or Windows 8 (32-bit or 64-bit version)
	Processor	2.0 GHz Intel Core 2 Duo (or equivalent)
	Memory	2 GB RAM and 1 GB hard disk space (32-bit operating systems) 4 GB RAM and 1 GB hard disk space (64-bit operating systems)
	Graphics card §	NVIDIA GeForce 5 series (or later)
	Other	DVD drive for software installation

* available as an additional cost option
§ applicable to the Productivity+ Active Editor Pro application only

See **www.renishaw.com/aepro-graphics** for a list of alternative tested cards.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/prodplus**

Renishaw OMV and OMV Pro

On-machine component verification software

Renishaw OMV allows users to perform CMM-style, post-machining inspection and verification tasks on their machine tool, and create comprehensive reports of measurement results and part tolerance.

A range of user selectable alignment options ensure optimum CAD / machine datum alignment and orientation, reducing set-up requirements even for highly complex components.

Inspection elements can be programmed directly by selecting geometric features from a solid model, by manually entering data or using file import techniques. Free-form surfaces can also be programmed with ease. Complete programs or individual elements can be simulated on-screen to detect potential probe-component collisions and errors.

Measurement results obtained can be returned 'live' to the PC, or stored on the CNC machine tool control for access at a later date (depending on machine configuration and capability).

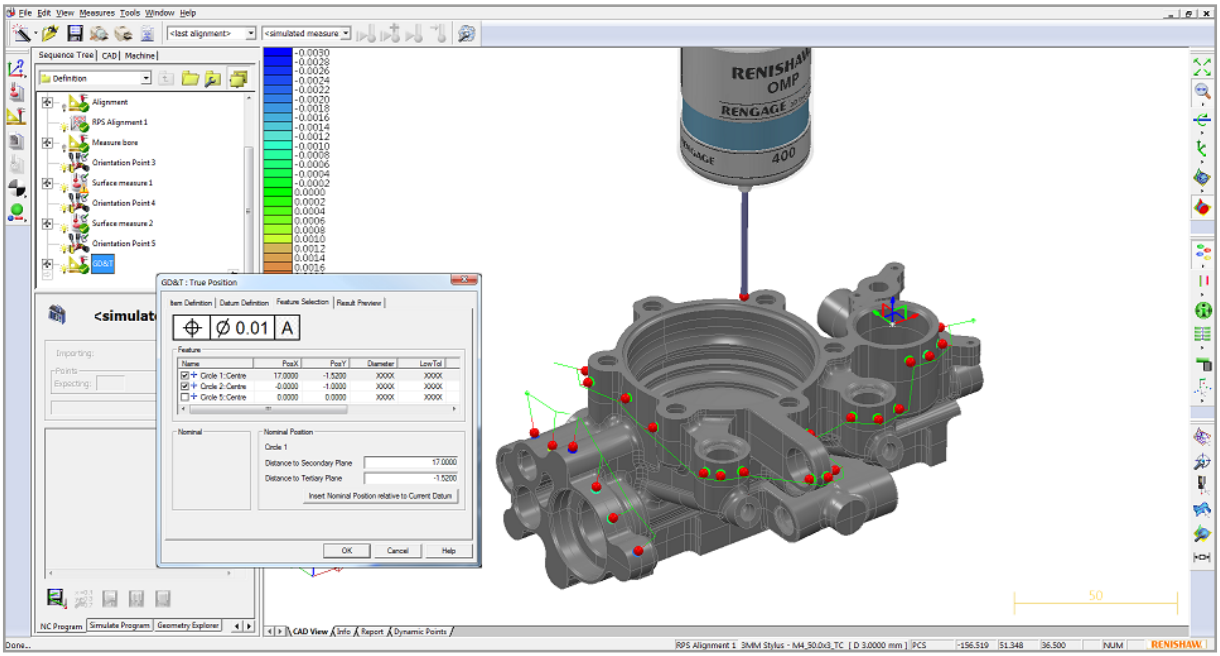
Post inspection reporting is available in a number of formats. On-screen, visual options include colour-coded confetti points (with tolerance gradient), call outs and in-place labels. Customisable tabular reports can also be generated, including feature acceptance data, tolerance information and snap shots of the component CAD model.

Renishaw OMV Pro *

Renishaw OMV Pro provides superior operational functionality in comparison to that of the standard product offering.

- **Geometric dimensioning and tolerancing (GD&T):** an integrated wizard for the creation of elements to determine relationships such as parallelism and perpendicularity between features. This functionality allows full comparison of machine measurements against manufacturing drawings before component removal.
- **Constructed features:** create additional measurements and data points using previously measured features. For example, determine the relationship between features on multiple axes of a single component. This function is particularly useful when inspecting components with a large number of prismatic features.
- **Multiple CAD model import:** import CAD models of all required components, assemblies and fixtures in a single session.
- **Machine simulation:** extend the functionality of program simulation to include a 3D machine model; invaluable assistance when using multi-axis machines and components with complex geometries.

* Renishaw OMV Pro may not be available in all geographical regions.



Component measurement and inspection, plus additional functionality such as GD&T (OMV Pro)

Key features and benefits:

- User selectable alignment options and probing strategies
- Inspect 2D and 3D geometric features and free-form surface profiles
- Program simulation including collision and error detection
- On-model graphical inspection results, including tolerance indication and customisable tabular reports

Functionality	Renishaw OMV	Renishaw OMV Pro
Free-form surface measurement	●	●
Simple geometric features (position, size etc.)	●	●
HTML and graphical reports	●	●
Programming from a CAD model	● (single model only)	● (multiple models)
Programming with no CAD model	●	●
Multi-axis machine capability	●	●
Complex geometric functions		●
ASME GD&T functionality		●

"One of the key reasons for purchasing was to align the cabin roof and then machine it. This has proven very successful and we are now producing our own CMM reports generated from the use of the Renishaw OMV software."

Tods Composite Solutions Ltd

For the full case study, please contact Renishaw, or visit **www.renishaw.com/tods-composite-solutions**

OMV and OMV Pro specification

Supported controls Most machine tool controls that support probing are compatible, including:	• Acramatic • Fanuc • Fidia • HAAS • Heidenhain • Hitachi Seicos	• Makino • Mazak • MillPlus • Mitsubishi Meldas • Mori Seiki • NUM	• Okuma • Roeders • Selca • Siemens • Tosnuc • Yasnac
Supported CAD formats	• ACIS * • AutoCAD * • Autodesk Inventor * • CATIA V5 * • Cimatron * • Creo Elements/Pro (ProE 2000i2) *	• IGES • NX (Unigraphics) * • Parasolid * • Rhino * • SDRC I-deas * • SET • Sirona *	• Solid Edge * • SolidWorks * • SpaceClaim * • STEP • VDA/FS • WildFire *
Supported languages	• English • French • German • Icelandic • Italian	• Japanese • Korean • Polish • Portuguese (Brazilian) • Russian	• Simplified Chinese • Spanish • Traditional Chinese
System requirements (recommended)	Operating system	Microsoft Windows XP (32-bit only), Windows Vista or Windows 7 (32-bit or 64-bit)	
	Processor	2.0 GHz Intel Core 2 Duo (or equivalent)	
	Memory	3 GB RAM (32-bit operating systems) 6 GB RAM (64-bit operating systems)	
	Graphics card §	NVIDIA Quadro 256 MB (or equivalent)	
	Other	USB port for licence dongle DVD drive for software installation Internet Explorer version 7 (or later) .NET framework version 3.5 Microsoft Excel (to generate Excel based reports) Adobe Acrobat (or similar, to export reports to PDF format)	

* available as an additional cost option

§ ATI graphics cards such as Radeon and FireGL are not supported

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/omv**

Renishaw CNC Reporter

Data analysis and report generation

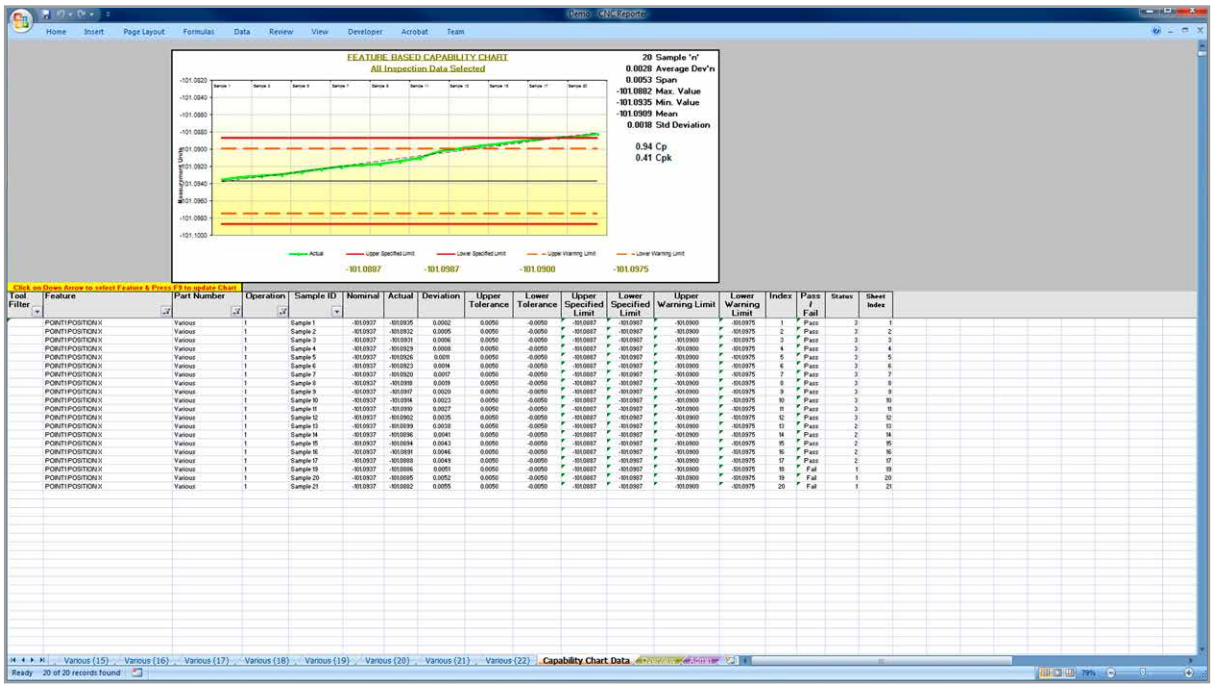
Operating within the Microsoft Excel environment, this application provides a simple tool for analysing results and generating inspection reports from measurement data collected by CNC machine tools running Renishaw's Productivity+™ and Inspection Plus software packages.

For each set of data imported, the application provides a tabulated record of: measured feature dimension(s); the deviation from nominal, tolerance limits; and a pass/fail indication. Colour-coded data cells and a summary plot with tolerance and warning limits provide a high impact, visual indication of feature compliance and adherence to tolerance.

Capability charts produced by the application provide an ideal solution for tracking the measurement results of a single or critical feature across a batch of components to determine machine wear, thermal effects and to help schedule preventative maintenance.

The familiar Excel operating environment ensures simple operation and allows individual configuration. Report templates can be customised allowing corporate identification, or simply an indication of the component concerned.

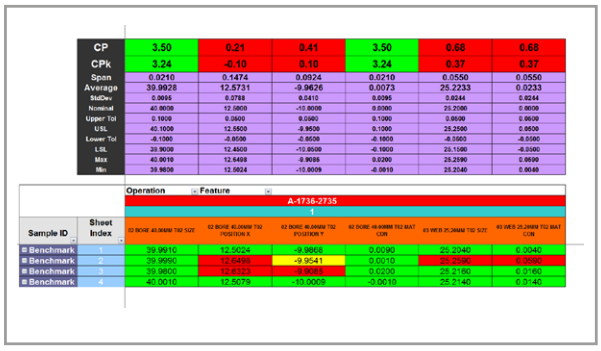
For larger data collection applications, the incorporated Data Manager application allows the analysis and comparison of reports from a large number of components.



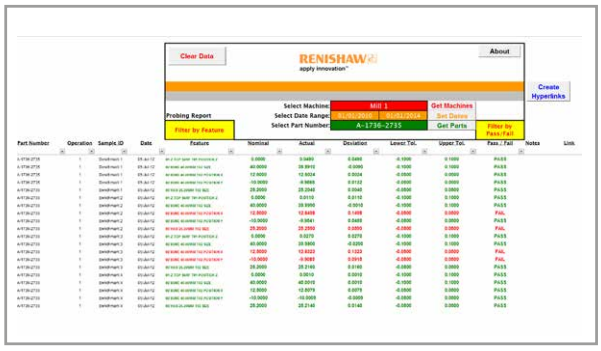
Renishaw CNC Reporter capability chart

Key features and benefits:

- Display results data generated by Productivity+ and Inspection Plus software packages in a clear and easy to understand format
- Results can be achived to a built-in integrated database and reviewed using the dedicated Data Manager tool
- Familiar Excel environment for simple user configuration
- Colour coded reports, including tolerance limits for instant Go/No go decision
- Feature tracking and control plots for process monitoring



Renishaw CNC Reporter overview



Data Manager archive query

"[Renishaw CNC Reporter is] … an instant indicator, very easy to see the trend of the process. I can keep dimensions within the control limits and easily keep a record of every measured value."

Martin Aerospace

For the full case study, please contact Renishaw, or visit **www.renishaw.com/martin-aerospace**

Renishaw CNC Reporter specification

Compatibility	Renishaw CNC Reporter is compatible with output results data from Productivity+ Active Editor Pro, Productivity+ GibbsCAM plug-in and Inspection Plus (subject to configuration by Renishaw engineers).	
Supported languages	Renishaw CNC Reporter operates in English only	
System requirements (recommended)	Operating system	Microsoft Windows XP, Windows Vista, Windows 7 (32-bit or 64-bit version) or Windows 8 (32-bit or 64-bit version, subject to .NET Framework 2 and 3.5 being installed and activated)
	Processor	2.0 GHz Intel Core 2 Duo (or equivalent)
	Memory	2 GB RAM and 1 GB hard disk space (32-bit operating systems) 4 GB RAM and 1 GB hard disk space (64-bit operating systems)
	Other	CD/DVD drive for software installation Existing installation of Microsoft Excel 2003 or later (2010 recommended)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/cncreporter**


RENISHAW
apply innovation™
The Circular Plot shows two linear axes plotted against each other.
Time
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Machine tool diagnostics

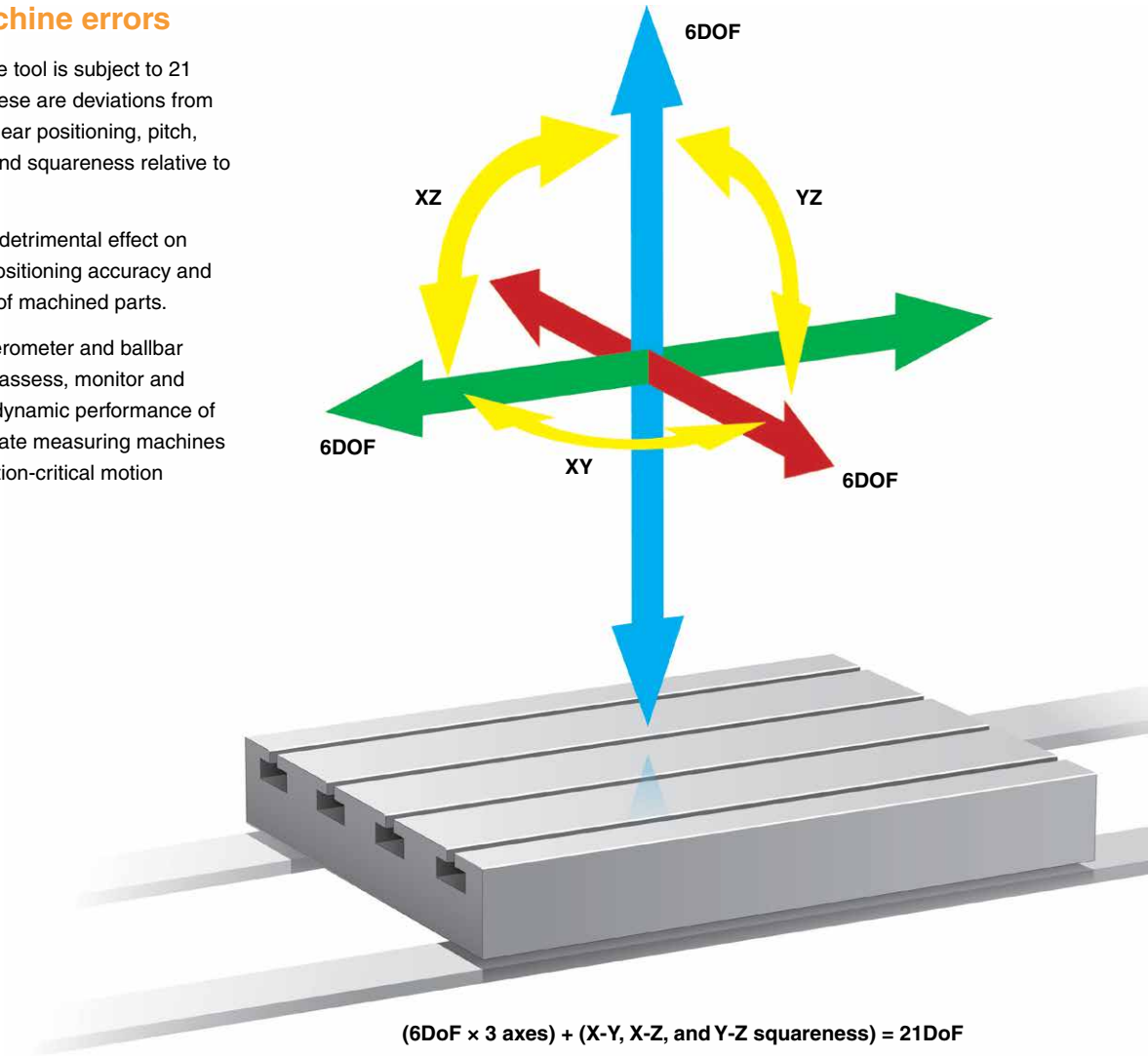
Introduction

Geometric machine errors

A typical 3-axis machine tool is subject to 21 degrees of freedom. These are deviations from the ideal and include linear positioning, pitch, yaw, straightness, roll and squareness relative to the other axes.

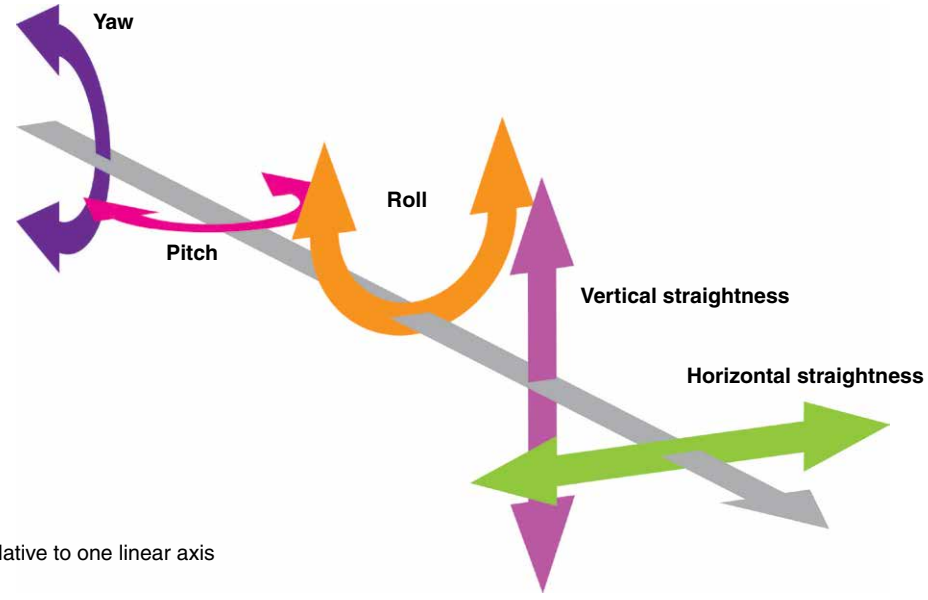
All of these can have a detrimental effect on the machine's overall positioning accuracy and therefore the accuracy of machined parts.

Renishaw's laser interferometer and ballbar measurement systems assess, monitor and improve the static and dynamic performance of machine tools, co-ordinate measuring machines (CMMs) and other position-critical motion systems.



(6DoF × 3 axes) + (X-Y, X-Z, and Y-Z squareness) = 21DoF

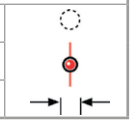
Model shown illustrates 3-axis orientation for a vertical machining centre



Degrees of freedom relative to one linear axis

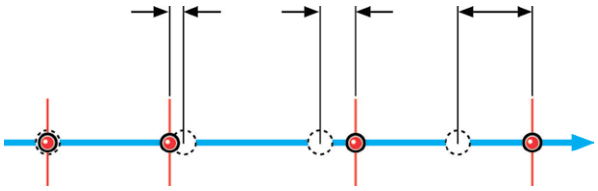
Error types explained

Errors typically occur when the actual position differs from the indicated position on the machine's controller. Often caused by (but not limited to) geometric errors, simplified versions are shown in the following diagrams.

Key	
Indicated target/position	
Actual position	
Error	

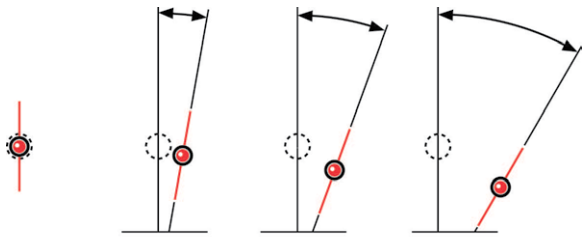
Linear

- Caused by leadscrew pitch.
- Results in backlash and scaling errors.
- Variance may be shorter or longer as shown here.



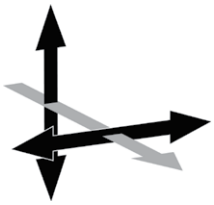
Angular

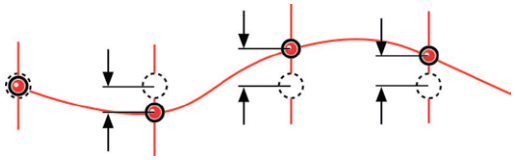
- The axis rotates as it moves through its travel. This includes roll, pitch and yaw and can result in both linear and lateral positioning errors.
- The effect of positioning errors varies relative to distance from the axis of movement.

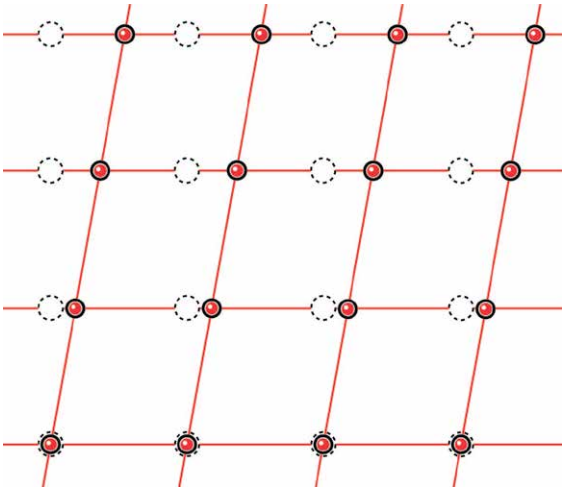


Straightness

- Sideways linear movement as axis moves through its travel.
- Caused by bent guideways or misalignment, often due to wear, damage or machine foundation problems.
- Results in poor machining accuracy.

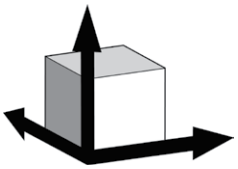






Squareness

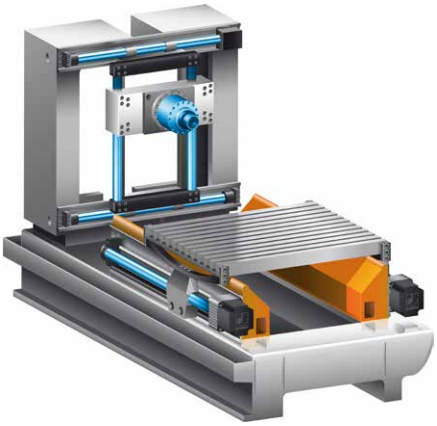
- Two orthogonal axes are not at 90° to each other.
- Often caused by bending, misalignment or wear.
- Machined faces on components will not be square.



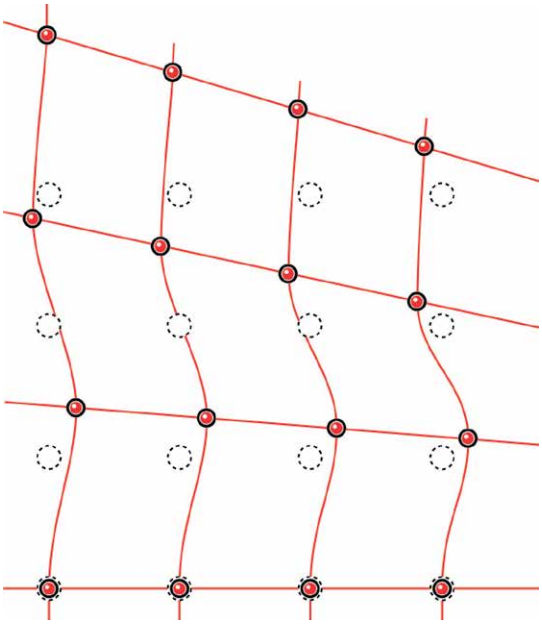
Machine tool errors

Multiple errors

- In reality any axis will be subject to angular, straightness and linear errors at the same time.



Generic 3-axis horizontal machine

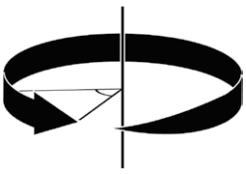


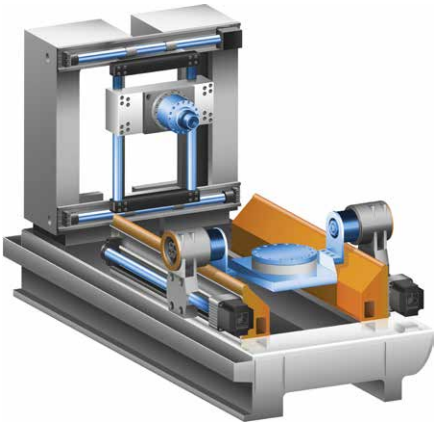
The potential for error increases significantly with the additional dynamic effects created as the machine axes interpolate.

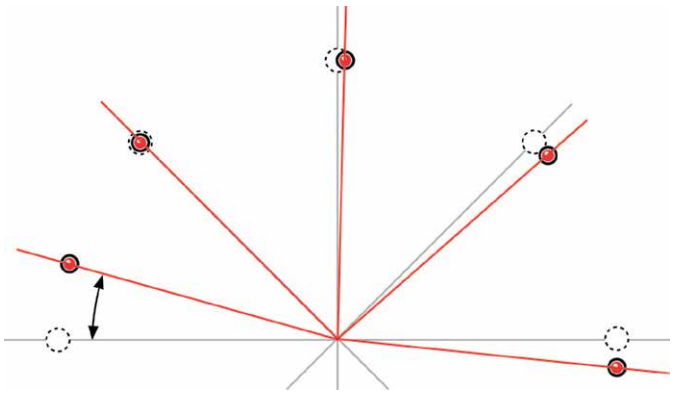
Using Renishaw's telescopic ballbar and laser calibration systems, machine users can verify and optimise machine performance to establish a known and repeatable level of process capability.

Rotary errors

- Actual rotational position is different to indicated position on the machine's controller.
- Indicates positioning system problems and causes incorrect positions of machined features.







Generic 5-axis machining centre

When two further rotary axes are added to the standard three linear axes ('metrology frame'), it becomes necessary to identify the location of the centres of rotation (pivot points) of these rotary axes. The machine's control system must know these precisely in order to position the cutting tool's tip relative to the workpiece.

AxiSet™ Check-Up is designed to identify errors in rotary axis position and performance, including making recommendations for pivot point corrections.

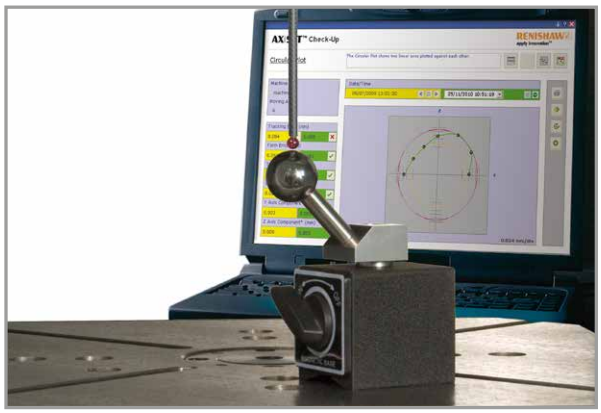
Product selector

Products		AxiSet™ Check-Up	QC20-W ballbar system	XL-80 laser system
	Page	5-6	5-8	5-10
Machine error source	Linear axis position error			●
	Linear axis repeatability			●
	Angular pitch and yaw			●
	Straightness of an axis		●	●
	Squareness between axes		●	●
	Flatness of a surface			●
	Rotary axis/table angular positioning			●
	Backlash		●	●
	Reversal spikes		●	
	Lateral play		●	
	Cyclic error		●	
	Scale error		●	
	Servo mismatch between axes		●	
	Rotary axis position error	●		
	Rotary axis alignment error	●		
	Rotary axis mechanical error	●		
	Thermal distortion	●		

AxiSet™ Check-Up

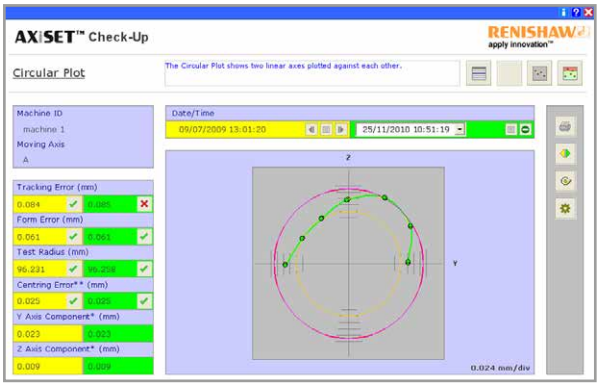
A cost-effective solution for checking the alignment and positioning performance of rotary axes. In just a few minutes, users of multi-axis machining centres and multi-tasking mill-turn machines can identify poor machine alignments and geometry that can cause extended process setting times and non-conforming parts.

By providing machine users with a fast and accurate health check of rotary axis pivot points, AxiSet Check-Up assists in the 'preventative' process foundation to maximise the stability of the environment and machine. When used alongside Renishaw's QC20-W ballbar system and laser interferometers, AxiSet Check-Up gives an unparalleled machine diagnosis solution.



Key features and benefits:

- Discrete reporting of pivot point and lathe centre-line error along linear axes (as commonly defined in CNCs)
- Measure and report critical errors quickly
- Reliably check and track machine performance trends over time
- Compatible with a wide range of multi-axis machines



AxiSet™ Check-Up system components

Macros

Written for a range of CNC controls, these probing macros are machine specific and available for a range of machines with rotary axes including 5-axis machining centres and multi-tasking machines. These macros drive the machine to collect measurement data.

PC software package

Running in Microsoft Excel, the software analyses the probe data and displays results in various easy-to-read graphical formats.

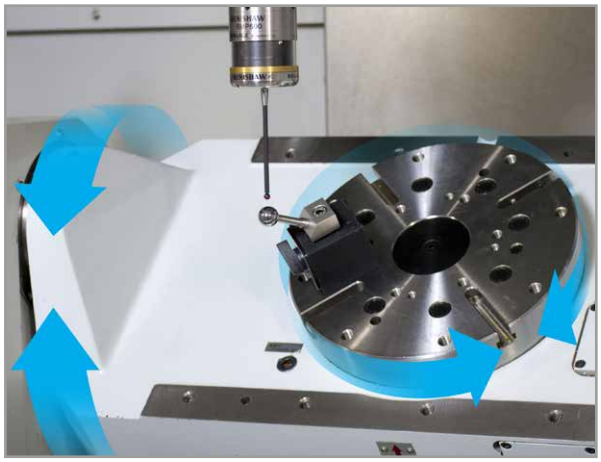
Hardware

A single calibration sphere, conveniently mounted on a magnetic base, is used as a reference feature for measurements. This simple-to-use artefact ensures that set-up time is kept to a minimum and, in most cases, does not require fixtures or parts to be removed.

Recommended for use with AxiSet Check-Up:

Strain gauge probe – for ultimate accuracy, Renishaw recommends the use of strain gauge probes. These include the latest generation of **RENGAGE™** probes as well as the widely used MP700 model.

Calibrated test bar – ensures that AxiSet measurements are traceable and comparable to the settings made by machine tool builders.



Specification

Supported controls	Most machine tool controls that support probing run this software, including: Mazak, Fanuc, Mori Seiki, Siemens, HAAS, Hurco.	
Machine compatibility	Full 5-axis machining centres Multi-tasking turn-mill machines Machines with indexers (3+2, 4+1) Other machines with rotary axes, for example, horizontal machining centres	
Supported languages	English	
System requirements (recommended)	Operating system	Microsoft Windows XP, Windows Vista or Windows 7 (32-bit or 64-bit version)
	Typical CNC memory space required	If Inspection Plus is already loaded: Check-Up folder: 11 kB Calibration folder: 3 kB Measure folder: 18 kB If Inspection Plus is not currently loaded: Check-Up folder: 11 kB
	Other	CD/DVD drive for software installation Microsoft Excel and Word 2003, 2007 or 2010

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/axiset**

QC20-W ballbar system

For optimum analysis of rotary axis performance using AxiSet™ Check-Up, it is important that the machine's linear axes and axis orthogonality are also performing within specification. This can be determined using the QC20-W ballbar and, if necessary, an XL-80 laser can be used to provide detailed correction data. Crucially, the XL-80 laser system and QC20-W ballbar are independent measuring devices, which means they make use of their own feedback system and are independent of the machine's encoders.

Together with AxiSet, these powerful performance testing products combine to ensure that the highest quality parts can be consistently produced by 5-axis machining centres and multi-tasking machines.

The QC20-W ballbar can carry out tests covering all three orthogonal planes without moving the centre pivot, carrying out a restricted arc (220°) in two of the planes, and a full 360° in the third.

Rapid diagnosis of the machine's performance is supplied from the unique and comprehensive diagnostic report generated with the Ballbar 20 software. Each error is ranked according to its significance to the overall machine performance alongside the error value.

Key features and benefits:

- Bluetooth wireless technology for flexible operation
- Indicates overall machine accuracy with contributing errors clearly displayed
- Software allows repeat testing and tracking of performance trends over time
- Increases the knowledge of your machine/ manufacturing capabilities, potentially reducing scrap and rework

"The ballbar system knocks hours off our servicing times, gives trends for quality analysis and maintenance and almost straight away a test can show what improvement we have made. In short, using the ballbar gives us confidence at every level."

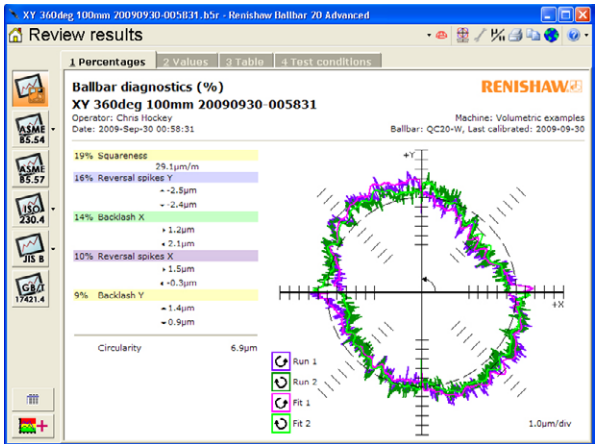
Sandvik Medical Solutions
For the full case study please contact Renishaw

QC20-W system components

Software

Ballbar 20 software has an intuitive interface providing users with step-by-step instructions for:

- Live data capture
- Analysis and display of test data in accordance with the latest international standards as well as an extensive Renishaw analysis that automatically diagnoses machine errors



Hardware

The QC20-W ballbar is supplied as a complete kit-in-a-case – all you need is a PC to start testing.

Case contents:

- QC20-W wireless ballbar (and one CR2 battery)
- Centre pivot
- Tool cup
- 50, 150, 300 mm extension bars
- System software (including manuals)
- Offset setting ball
- Zerodur calibrator
- Getting started with QC20-W ballbar DVD

Specification

Ballbar measurement accuracy		±1.00 µm (±40 µin) at +20 °C (+68 °F)
Ballbar measuring range		±1.0 mm (±0.04 in)
Sensor stroke		-1.25 mm (-0.05 in) to +1.75 mm (+0.07 in)
Maximum sample rate		1000 Hz
Data transmission range		10 m (32.8 ft) typical (Bluetooth, Class 2)
System case dimensions (L × W × H)		395 mm × 300 mm × 105 mm (15.5 in × 11.8 in × 4.1 in)
System case weight (including kit contents)		3.75 kg (8 lb 4 oz) approx.
Supported languages		• English • Czech • French • German • Italian • Japanese • Korean • Simplified Chinese • Spanish • Traditional Chinese
System requirements (recommended)	**Operating system**	Microsoft Windows XP, Windows Vista or Windows 7 (32-bit or 64-bit version)
	Processor	500 MHz Pentium (or equivalent)
	Memory	256 MB RAM, 100 MB hard disk space
	Other	CD/DVD drive for software installation Bluetooth compatibility
Operating temperature		0 °C to +40 °C (+32 °F to +104 °F)

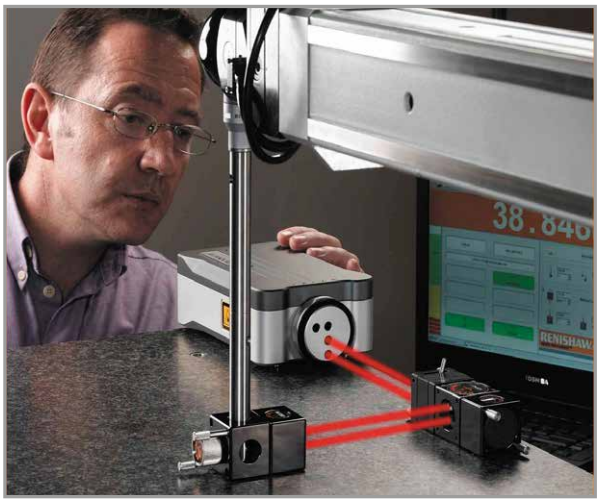
For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/qc20**

XL-80 laser measurement system

Renishaw's laser interferometer systems are used for comprehensive accuracy assessment of machine tools, coordinate measuring machines (CMMs) and other critical motion systems. The XL-80 laser produces an extremely stable laser beam with a wavelength that is traceable back to national and international standards. Laser interferometers are widely regarded as the ultimate in measurement systems.

Key features and benefits:

- 0.5 µm/m accuracy traceable to national standards
- Measures linear, angular and straightness errors on linear axes
- Combined with the XR20-W (rotary axis calibrator) it can determine angular errors on rotary axes
- Provides data for error compensation and machine correction
- Provides the ultimate verification of machine performance for machine tool builders and end users worldwide



The XL-80 laser is usually used for initial comprehensive machine calibration and correction with the QC20-W ballbar providing periodic verification back to the initial performance.

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/xl-80**

Receivers and interfaces

Transmission compatability chart

Probing systems

Transmission type		Products	Page	OMP40-2	OMP40M	OLP40	OMP60	OMP60M	RMP40	RMP40M	RLP40	RMP60	RMP60M	LP2 and variants	MP11	JCP	OMP400	MP700	RMP600	MP250
Receivers/ interfaces	Optical	OMI-2 and OMI-2T	6-4	●	●	●	●	●						△	Integrated to CNC machine's control via cable.	Not required, JCP30C version wires directly into a digital readout touch sensor input.	●			
		OMI-2C	6-6	●	●	●	●	●						△			●			
		OMI	6-8	●	●	●	●	●						△			●	●		
	Radio	RMI	6-24						●	●	●	●	●	◊					●	
		RMI-Q	6-26						●	●	●	●	●	◊					●	
	Hard-wired	MI 8-4	6-30											●						
		HSI	6-32											●						●
Optical modular systems		OSI with OMM-2	6-10	●	●	●	●	●						△			●			
		MI 12 / MI 12-B with OMM	6-12	●	●	●	●	●						△			●	●		

△ If used with an OMP40M or OMP60M

◊ If used with an RMP40M or RMP60M

Transmission compatability chart (continued)

Tool setting systems

Transmission type		Products	Page	OTS	RTS	TS27R	TS34	NC4	NCPCB	TRS2	HPRA	HPPA	HPMA	HPGA *
Receivers/ interfaces	Optical	OMI-2 and OMI-2T	6-4	●					Designed to work with SIEB and MEYER 44.20.020, 44.20.020A, and 44.20.0120 laser cards	Interface not required				
		OMI-2C	6-6	●										
	Radio	RMI-Q	6-26		●									
	Hard-wired	MI 8-4	6-30			●	●							
		HSI	6-32			●	●							●
		NCi-5	6-36					●						
		TSI 2 and TSI 2-C	6-38								●	●		
		TSI 3 and TSI 3-C	6-40										●	●
Optical modular systems		OSI with OMM-2	6-10	●										

* Both interfaces required for operation

OMI-2 and OMI-2T

Combined optical interface and receiver, designed for mounting on a wide range of machine tools within the machine's working envelope.

The interface provides users with a visual indication of probe status, start signal status, battery condition and error condition.

The OMI-2T also provides visual indication of the selected probe.

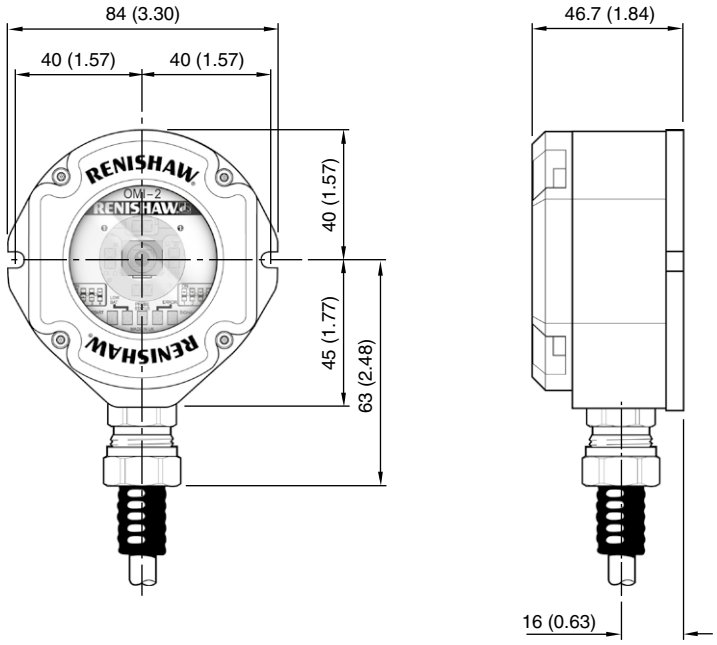
Key features and benefits:

- Modulated transmission for improved rejection of optical interference
- Suitable for single (OMI-2) or twin (OMI-2T) probe or tool setter applications
- Adjustable TX and RX range selection
- User configurable inputs and outputs
- Compatible with all Renishaw's modulated transmission probes

OMI-2 interface

OMI-2T interface

Dimensions



Dimensions given in mm (in)

OMI-2 and OMI-2T specification

Variant		OMI-2	OMI-2T
Principal application		The OMI-2 processes signals from RENGAGE™ or standard probes and converts them into machine outputs, which are then transmitted to the CNC control.	The OMI-2T processes signals from RENGAGE™ or standard probes and converts them into machine outputs, which are then transmitted to the CNC control. The system allows two probes to be used with one interface.
Transmission type		Infrared optical transmission (modulated)	
Probes per system		One	Two
Compatible probes		OMP40-2, OMP40M, OLP40, OMP60, OMP60M, OMP400 and OTS	
Operating range		For optical performance envelopes, see pages 6-16, 6-18 and 6-22.	
Weight		OMI-2 including 8 m (26.2 ft) of cable = 957 g (33.76 oz) OMI-2 including 15 m (49.2 ft) of cable = 1488 g (52.49 oz)	OMI-2T including 8 m (26.2 ft) of cable = 920 g (32.45 oz)
Supply voltage		12 Vdc to 30 Vdc	
Supply current		200 mA @ 24 V peak, 40 mA typical	
Configurable M-code input		Pulsed or level	Level
Output signal		**Probe Status 1, Low Battery, Error** Voltage-free solid-state relay (SSR) outputs, configurable normally open or normally closed. **Probe Status 2a** 5 V isolated driven output, invertible. **Probe Status 2b** Power supply voltage driven output, invertible.	**Probe Status 1, Probe Status 2, Low Battery, Error** Voltage-free solid-state relay (SSR) outputs, configurable normally open or normally closed.
Input/output protection		Supply protected by resettable fuse. Outputs protected by over current protection circuit.	
Cable (to machine control)	**Specification**	Ø7.35 mm (0.29 in), 13-core screened cable, each core 18 × 0.1 mm	
	Length	8 m (26.2 ft), 15 m (49.2 ft)	
Diagnostic LEDs		Start, low battery, probe status, error and signal condition.	Start, low battery, probe status, error, active system and signal condition.
Mounting		Flush mounting or directional mounting with optional mounting bracket (available separately).	
Sealing		IPX8 (EN/IEC 60529)	
Operating temperature		0 °C to +60 °C (+32 °F to +140 °F)	

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/omi-2** or **www.renishaw.com/omi-2t**

OMI-2C

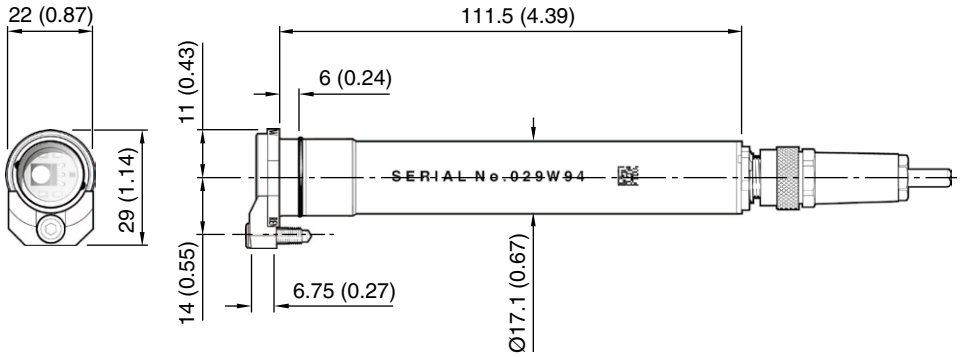
Compact combined interface and receiver, designed to be mounted in the spindle nose of a machine tool within the machine's working envelope.

The interface provides users with a visual indication of probe status, start signal status, battery condition and error condition.

Key features and benefits:

- Modulated transmission for improved rejection of optical interference
- Suitable for single probe or tool setter applications
- Compatible with all Renishaw modulated transmission probes
- Machine-specific variants available

Dimensions



Dimensions given in mm (in)

OMI-2C specification

Principal application		The OMI-2C processes signals from **RENGAGE™** or standard probes and converts them into driven outputs relative to the ground connection, which are then transmitted to the CNC control.
Transmission type		Infrared optical transmission (modulated)
Probes per system		One
Compatible probes		OMP40-2, OMP40M, OLP40, OMP60, OMP60M, OMP400 and OTS
Operating range		For optical performance envelopes, see page 6-18.
Weight		Weight of unit with retaining bracket = 73 g (2.6 oz)
Supply voltage		15 Vdc to 30 Vdc
Supply current		200 mA @ 24 V peak, 80 mA typical
Configurable M-code input		Level
Output signal		Dependent on control (see installation guide).
Input/output protection		Supply protected by resettable fuse. Outputs protected by over current protection circuit.
Diagnostic LEDs		Start, low battery, probe status, error and overcurrent.
Cable (to machine control)	**Specification**	Ø4.75 mm (0.19 in), 12-core screened cable, each core 7 × 0.1 mm
	Length	8 m (26.2 ft), 15 m (49.2 ft)
Mounting		Specifically designed for mounting in the machine spindle.
Sealing		IPX8 (EN/IEC 60529)
Operating temperature		0 °C to +60 °C (+32 °F to +140 °F)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/omi-2c**

OMI

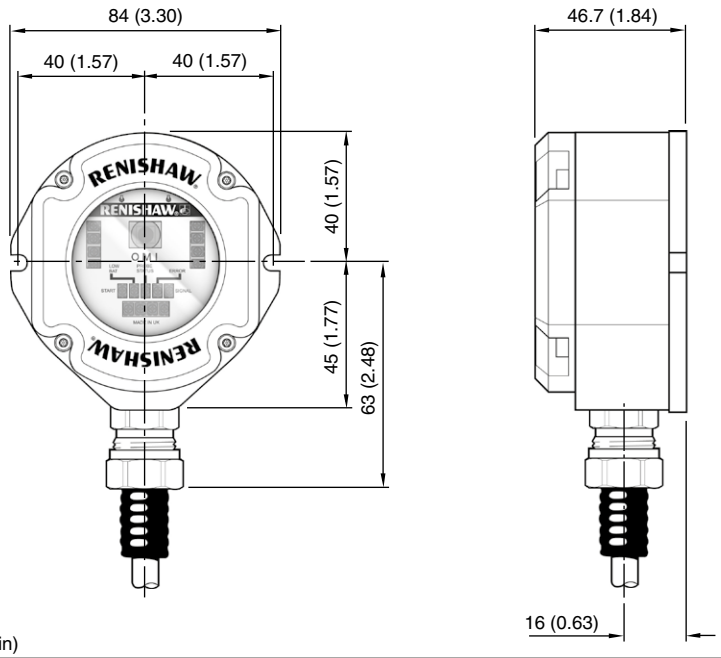
A combined optical transmitter and receiver that conveys signals between a probe system and the CNC machine's control. It is designed for mounting on a wide range of machine tools within the machine's working envelope.

The interface provides users with a visual indication of probe status, start signal status, battery condition and error condition.

Key features and benefits:

- Legacy (non-modulated) transmission for use with Renishaw's first generation and dual transmission mode probes operating in legacy mode
- Suitable for single probe applications
- Adjustable TX and RX range selection
- User configurable inputs and outputs

Dimensions



Dimensions given in mm (in)

OMI specification

Principal application		The OMI processes signals from legacy probes and converts them into 'totem-pole' outputs, which are then transmitted to the CNC control.
Transmission type		Infrared optical transmission (legacy)
Probes per system		One
Compatible probes		OMP40-2, OMP40M, OLP40, OMP60, OMP60M, OMP400 and MP700
Operating range		For optical performance envelopes, see pages 6-16, 6-18, 6-20 and 6-21.
Weight		OMI including 8 m (26.2 ft) of cable = 612 g (21.58 oz)
Supply voltage		12 Vdc to 30 Vdc
Supply current		550 mA @ 24 V peak, 100 mA typical
Configurable M-code input		Pulsed
Output signal		**Probe Status, Low Battery, Error, Pulsed Skip** Opto-coupled 'totem-pole' transistor outputs, configurable normally high or normally low.
Input/output protection		Supply/outputs protected by resettable fuses.
Diagnostic LEDs		Start, low battery, probe status, error and signal condition.
Cable (to machine control)	**Specification**	Ø4.75 mm (0.19 in), 12-core screened cable, each core 7 × 0.1 mm
	Length	8 m (26.2 ft)
Mounting		Flush mounting or directional mounting with optional mounting bracket (available separately).
Sealing		IPX8 (EN/IEC 60529)
Operating temperature		+5 °C to +60 °C (+41 °F to +140 °F)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/omi**

OSI and OMM-2

A modular receiver and interface system, designed for a wide range of machine tools utilising either one or two OMM-2 receivers mounted within the machine's working envelope. The OSI interface is mounted inside the machine cabinet.

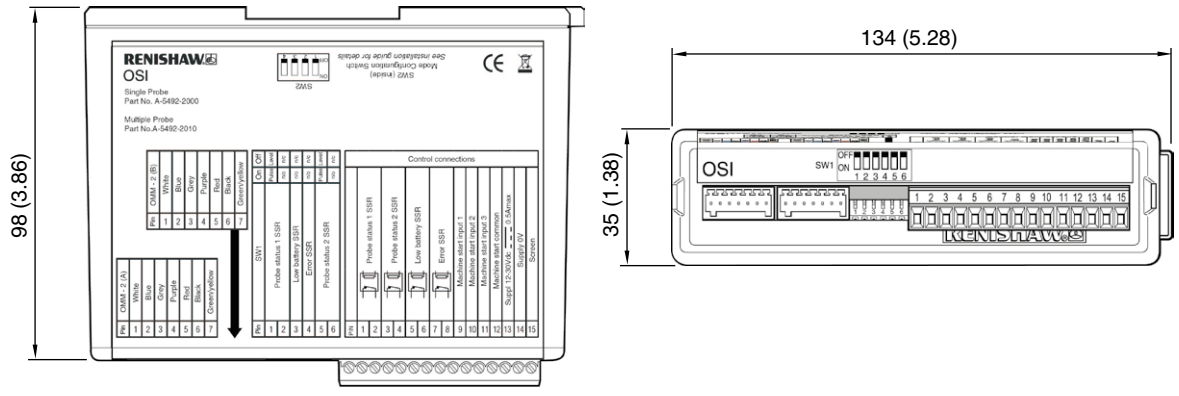
The system operates using 'modulated' optical transmission mode and is compatible with Renishaw machine probes operating in 'modulated' mode.

The receiver provides users with a visual indication of probe status, active probe, start signal status, battery condition and error condition.

Key features and benefits:

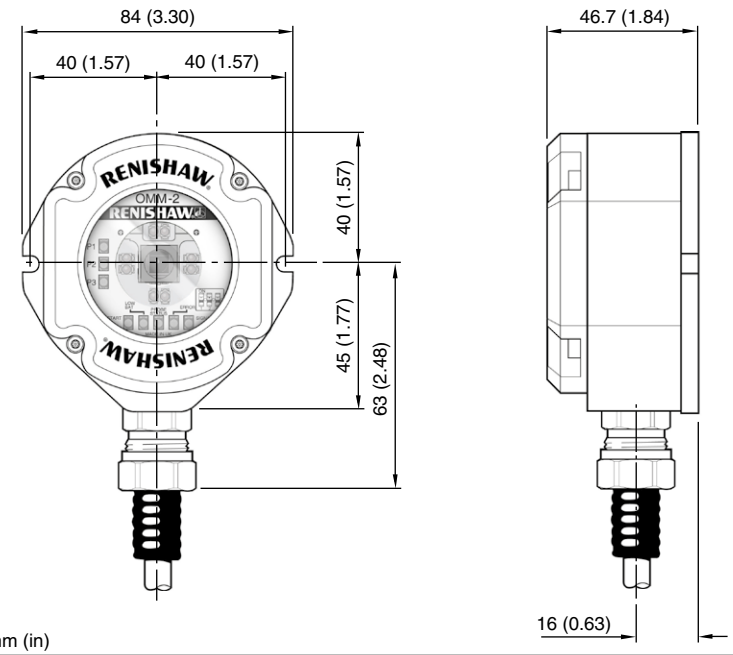
- Modular transmission for improved rejection of optical interference
- Suitable for multi-probe or tool setter applications using one, two or three probes
- Allows tandem OMM-2s to be connected for use with large or twin compartment machines
- User configurable machine inputs/outputs
- Adjustable TX and RX range selection
- Compatible with all Renishaw modulated transmission probes

OSI dimensions



Dimensions given in mm (in)

OMM-2 dimensions



Dimensions given in mm (in)

OSI and OMM-2 specification

Product		OSI	OMM-2
Principal application		The OSI processes signals from RENGAGE™ or standard probes via single or tandem OMM-2s and converts them into machine outputs, which are then transmitted to the CNC control. The system allows three probes to be used with one interface.	
Transmission type		Infrared optical trasmission (modulated)	
Probes per system		Three	
Compatible probes		OMP40-2, OMP40M, OLP40, OMP60, OMP60M, OMP400 and OTS	
Operating range		For optical performance envelopes, see pages 6-16, 6-18 and 6-22.	
Weight		N/A	Including 8 m (26 ft) of cable = 727 g (25.64 oz) Including 15 m (49 ft) of cable = 1037 g (36.58 oz) Including 25 m (82 ft) of cable = 1458 g (51.43 oz)
Supply voltage		12 Vdc to 30 Vdc	
Supply current		200 mA max @ 24 V with tandem OMM-2	
Configurable M-code input		Pulsed or level	
Output signal		**Probe Status 1, Probe Status 2, Low Battery, Error** Voltage-free solid-state relay (SSR) outputs, configurable normally open or normally closed.	
Input/output protection		Supply protected by resettable fuse. Outputs protected by over current protection circuit.	
Diagnostic LEDs		Start, low battery, probe status, error, active system and signal condition via OMM-2.	
Cable (to interface)	**Specification**	Ø5.8 mm (0.23 in), 6-core screened cable, each core 18 × 0.1 mm	
	Length	8 m (26.2 ft), 15 m (49.2 ft), 25 m (82.0 ft)	
Mounting		DIN rail. Alternative mounting using screws.	Flush mounting or directional mounting with optional mounting bracket (available separately).
Sealing		IPX8 (EN/IEC 60529)	
Operating temperature		0 °C to +60 °C (+32 °F to +140 °F)	

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/osi** or **www.renishaw.com/omm-2**

MI 12 / MI 12-B and OMM

A modular receiver and interface system, designed for a wide range of machine tools utilising either one or two OMM receivers mounted within the machine's working envelope. A free standing / panel mounted MI 12 interface or MI 12-B interface is mounted in the machine cabinet.

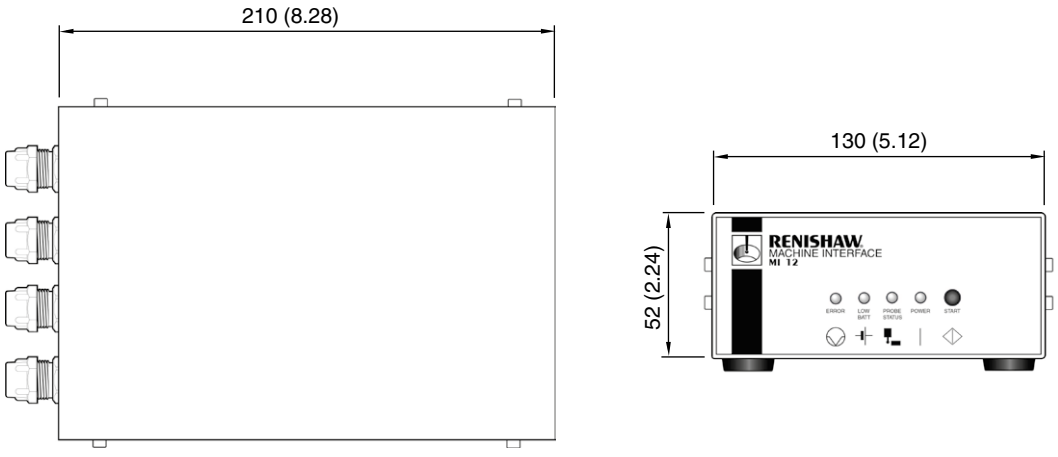
The system provides a single probe solution utilising either single or tandem OMMs on very large or twin compartment machines.

The interface provides users with a visual indication of system power and signal transmission.

Key features and benefits:

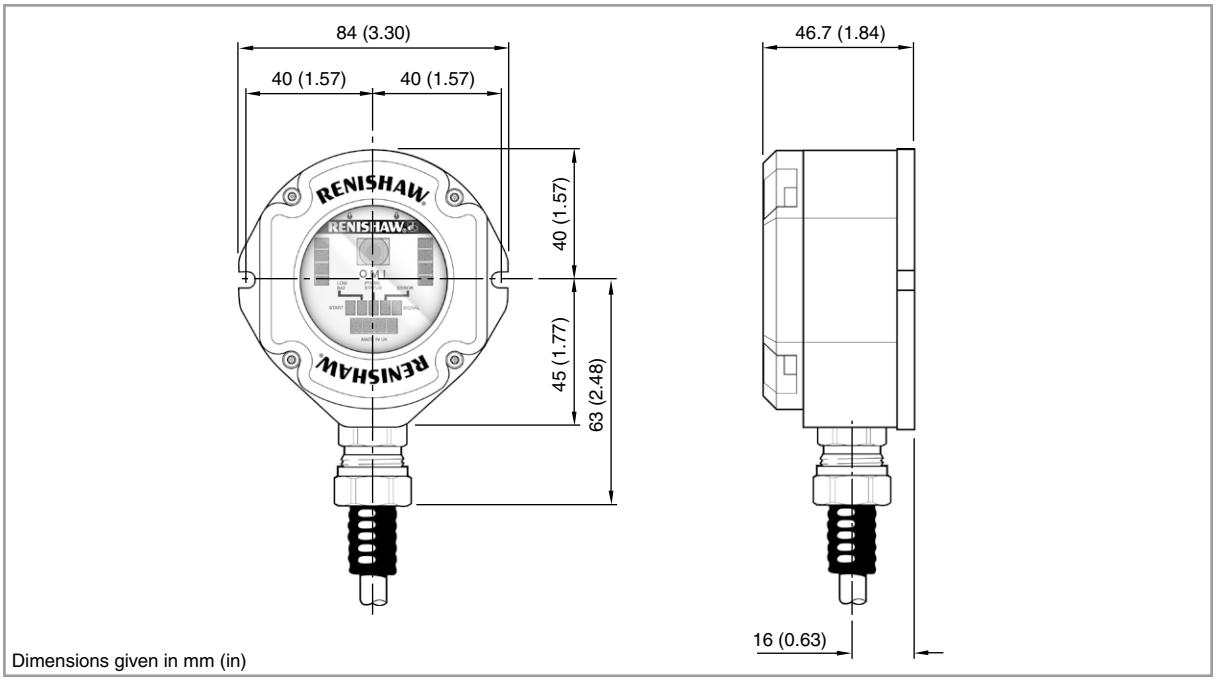
- Legacy (non-modulated) transmission for use with Renishaw's first generation and dual transmission mode probes operating in legacy mode
- Suitable for single probe applications
- Allows tandem OMMs to be connected for use with large or twin compartment machines
- User configurable machine inputs/outputs
- Remote audible indicator or lamp output
- Adjustable TX and RX range selection

Dimensions



Dimensions given in mm (in)

Dimensions



Dimensions given in mm (in)

MI 12 / MI 12-B and OMM specification

Product		MI 12	MI 12-B	OMM
Principal application		The MI 12 / MI 12-B processes signals from legacy probes via either single or tandem OMMs and converts them into voltage-free solid-state relay (SSR) outputs, which are then transmitted to the CNC control.		
Transmission type		Infrared optical trasmission (legacy)		
Probes per system		One		
Compatible probes		OMP40-2, OMP40M, OLP40, OMP60, OMP60M, OMP400 and MP700		
Operating range		For optical performance envelopes, see pages 6-17, 6-19, 6-20 and 6-21.		
Weight		OMM including 25 m (82.0 ft) of cable = 1243 g (43.85 oz)		
Supply voltage		15 Vdc to 30 Vdc		
Supply current		400 mA @ 24 V peak		
Configurable M-code input		Pulsed		
Output signal		**Error, Low battery, Probe status, Probe status (complement)** Voltage-free solid-state relay (SSR) outputs, configurable normally open or normally closed.		
Input/output protection		Supply/outputs protected by fuses.		
Diagnostic LEDs		Error, low battery, probe status and power. Connection provided for a remote device (LED or buzzer).		Power, start and signal.
Cable (to interface)	**Specification**	Ø4.85 mm (0.19 in), 5-core screened cable, each core 18 × 0.1 mm		
	Length	25 m (82.0 ft)		
Mounting		Free standing or panel mounting with optional panel mounting kit.	Board mounting within the machine cabinet using self-adhesive feet or M4 support studs.	Flush mounting or directional mounting with optional mounting bracket (available separately).
Sealing		IPX8 (EN/IEC 60529)		
Operating temperature		+5 °C to +60 °C (+41 °F to +140 °F)		

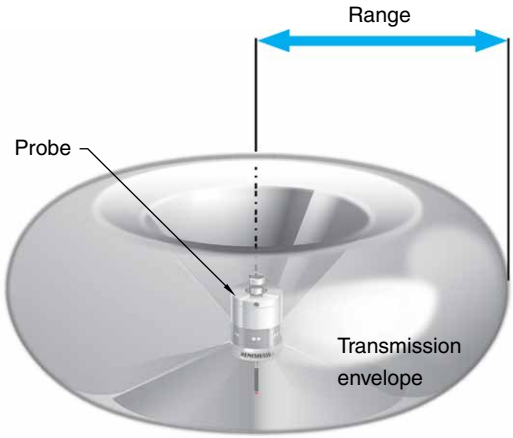
For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/mi12** or **www.renishaw.com/omm**

Optical probe, receiver and interface performance envelopes

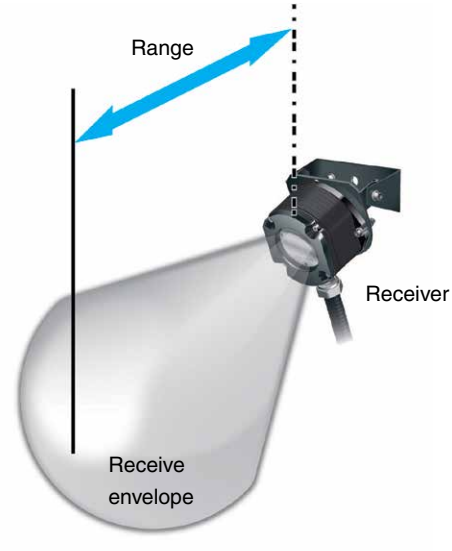
Optical probe, receiver and interface combinations are available for virtually any application. Renishaw recommends 'line of sight' installation within a tested range. A range of up to 9 meters is possible depending on the system selected.

Renishaw works closely with machine tool builders to ensure installations are optimised for all factory fitted systems, providing the end user with warranted and reliable systems that work to known standards.

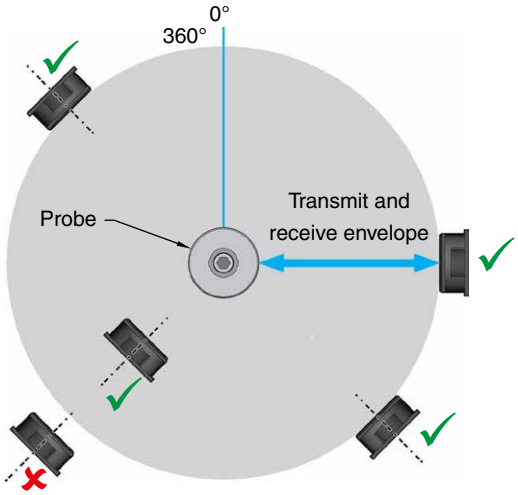
For retrofit installations, experienced Renishaw engineers ensure that the system operation is optimised according to application requirements.



Renishaw optical probes have 360 ° transmission envelopes that resemble irregular torus shapes.

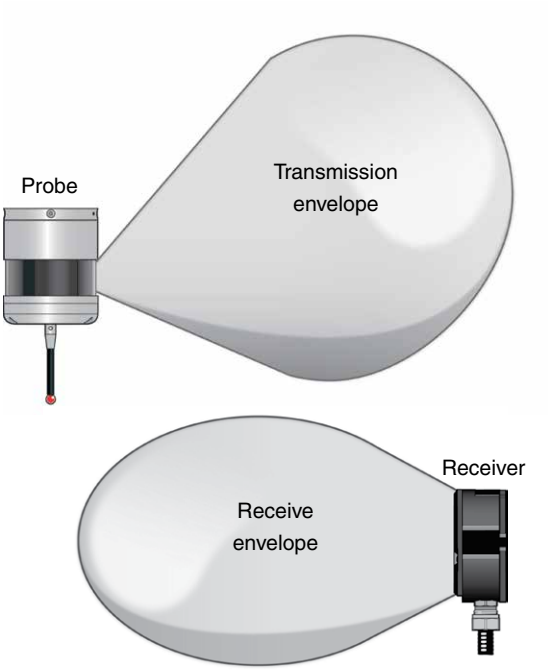


Renishaw optical receivers have receive envelopes that resemble irregular balloon shapes.

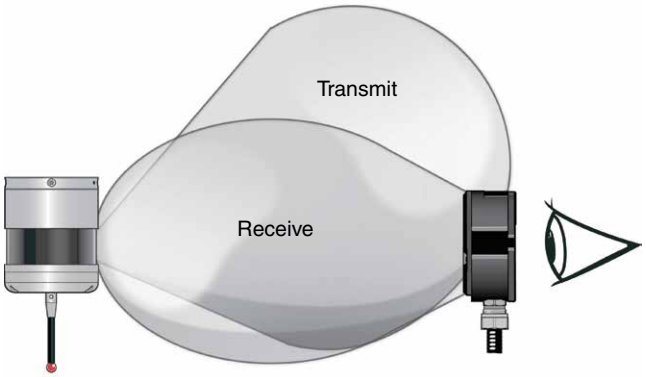


Plan view showing 360° vision envelope and example of positioning options for receivers

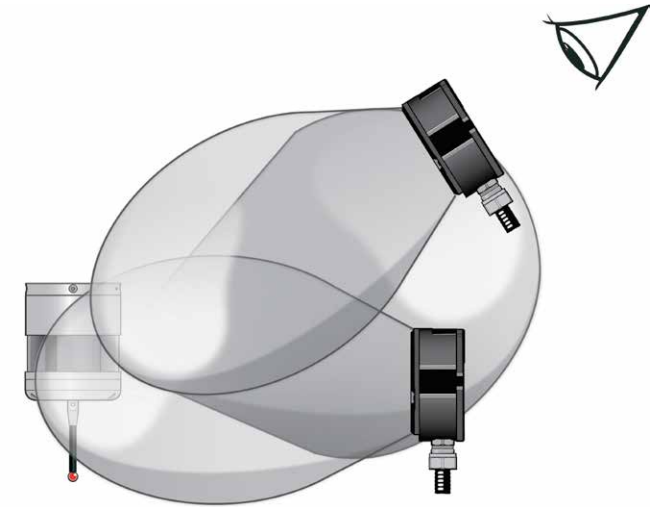
Optical systems are configured so that the probe and interface envelopes overlap.



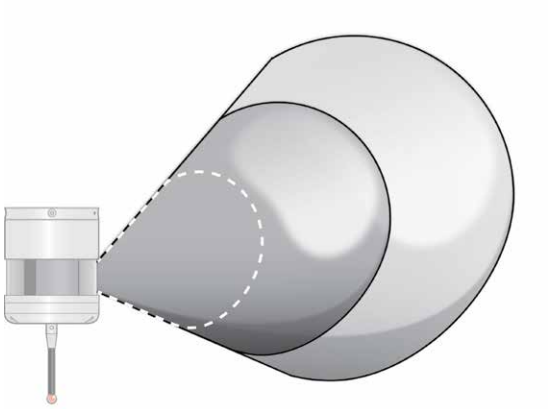
Side views showing respective ranges of the probe and receiver when used as a system.



Combined plots from probes (transmitters) and receiver shown in each other's field of view.



Two alternative positioning examples with overlapping fields of view.



There are three modes for transmitters and receivers.

Operating – standard power

Switch-on / switch-off

Operating – low power

Note: When operating under standard power mode full measuring distance can be achieved, whereas when operating under switch-on / switch-off and low power modes the probe and interface need to be in close proximity.

The following plots illustrate the performance data for every combination of Renishaw optical probe, receiver and interface.

Optical receiver and interface performance envelopes

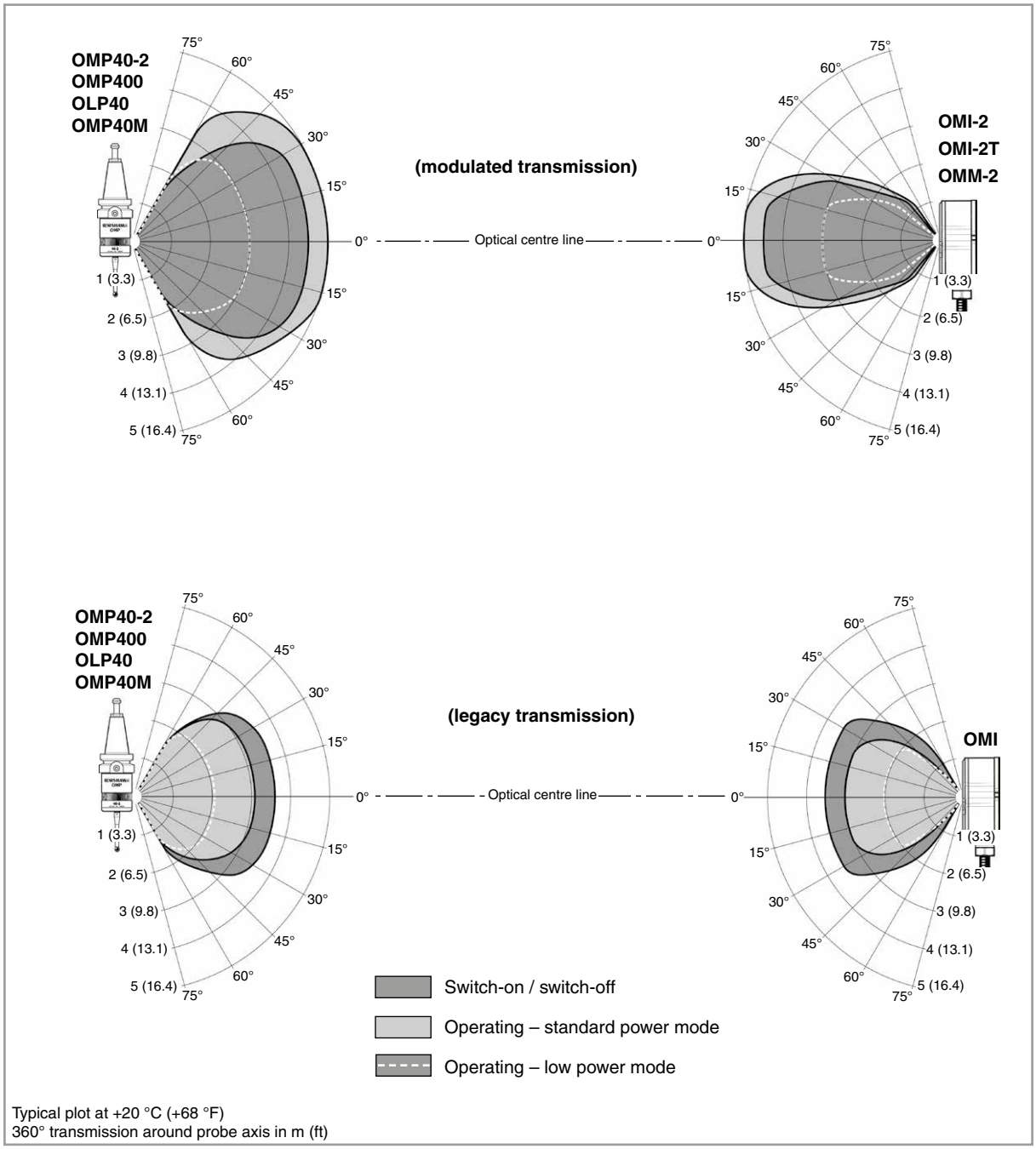
Renishaw optical probes have a 360° transmission envelope over the ranges shown below.

The probe and optical receivers may deviate from the optical centre line, provided opposing light cones always overlap, with transmitters and receivers in each other's field of view (line-of-sight).

Reflective surfaces within the machine may affect the transmission range.

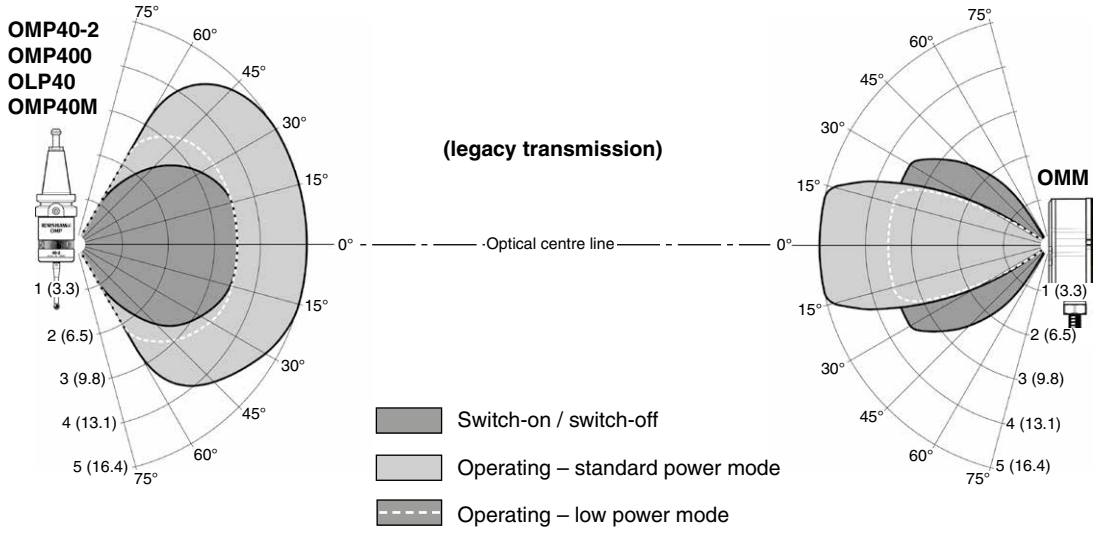
Build up of debris around the probe or receiver may have a detrimental affect on transmission performance. We recommend that debris is removed as often as necessary to maintain optimum transmission performance.

Ø40 optical performance envelopes



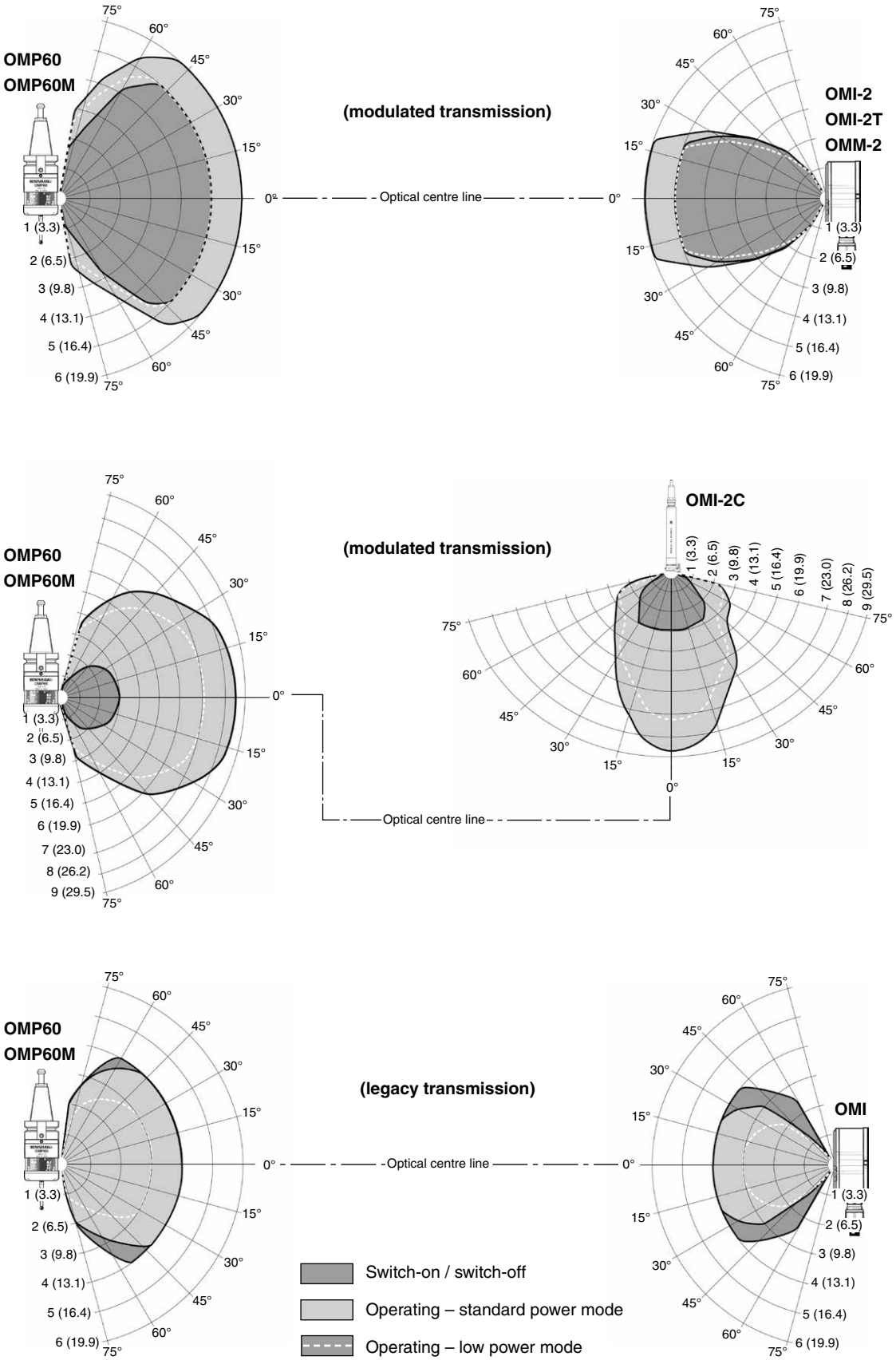
Typical plot at +20 °C (+68 °F)
360° transmission around probe axis in m (ft)

Ø40 optical performance envelopes (continued)



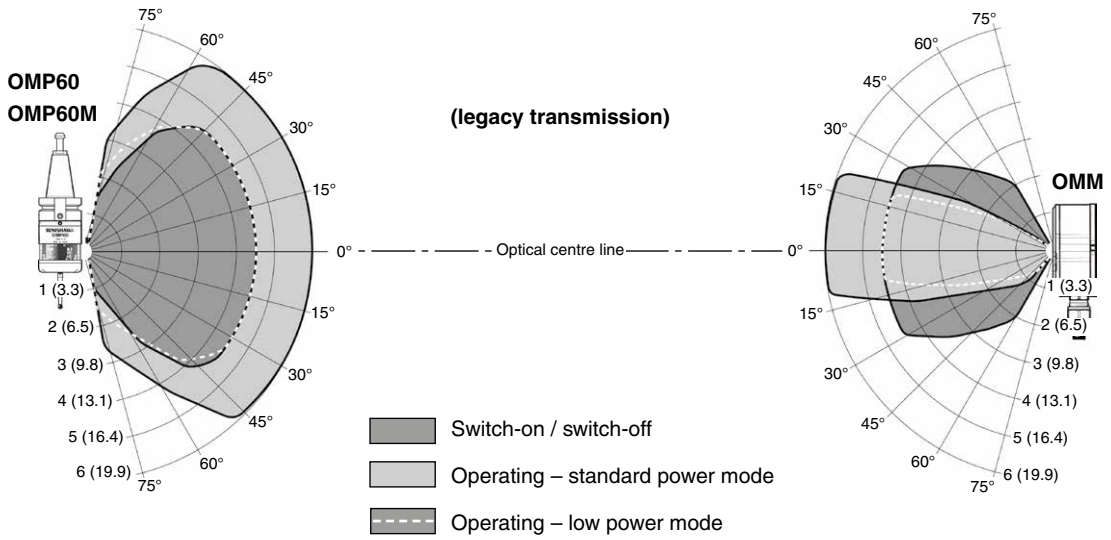
Typical plot at +20 °C (+68 °F)
360° transmission around probe axis in m (ft)

Ø60 optical performance envelopes



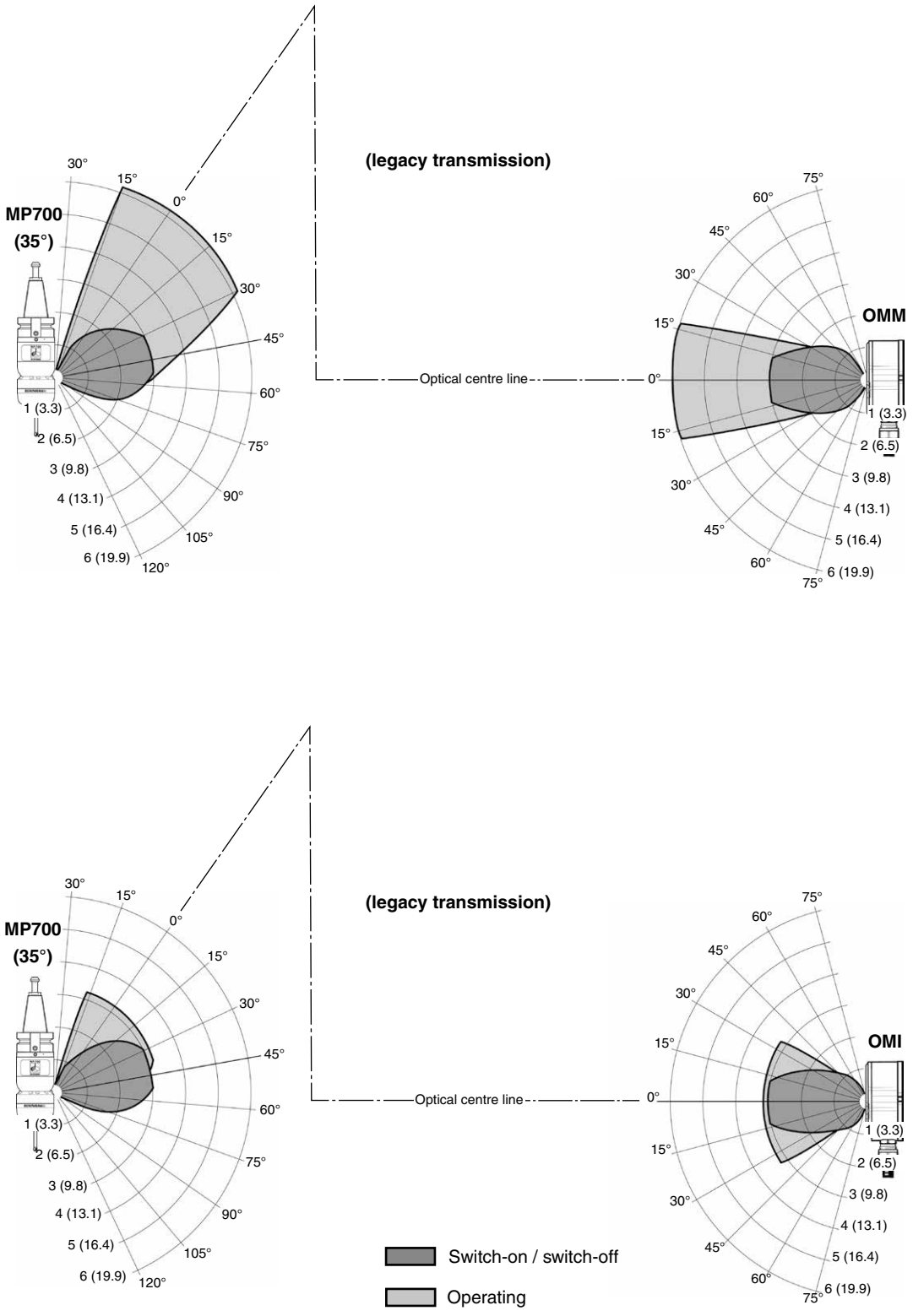
Typical plot at +20 °C (+68 °F)
360° transmission around probe axis in m (ft)

Ø60 optical performance envelopes (continued)



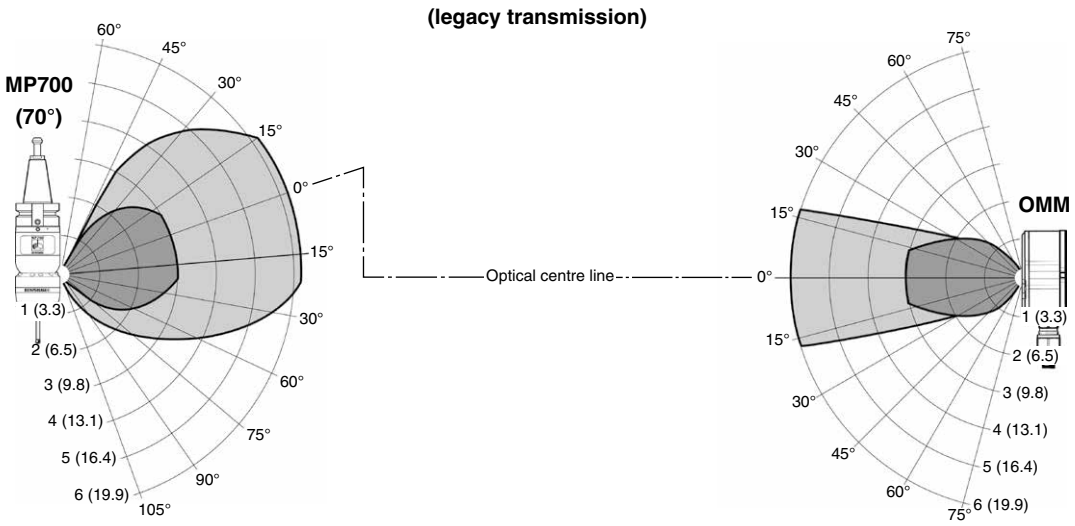
Typical plot at +20 °C (+68 °F)
360° transmission around probe axis in m (ft)

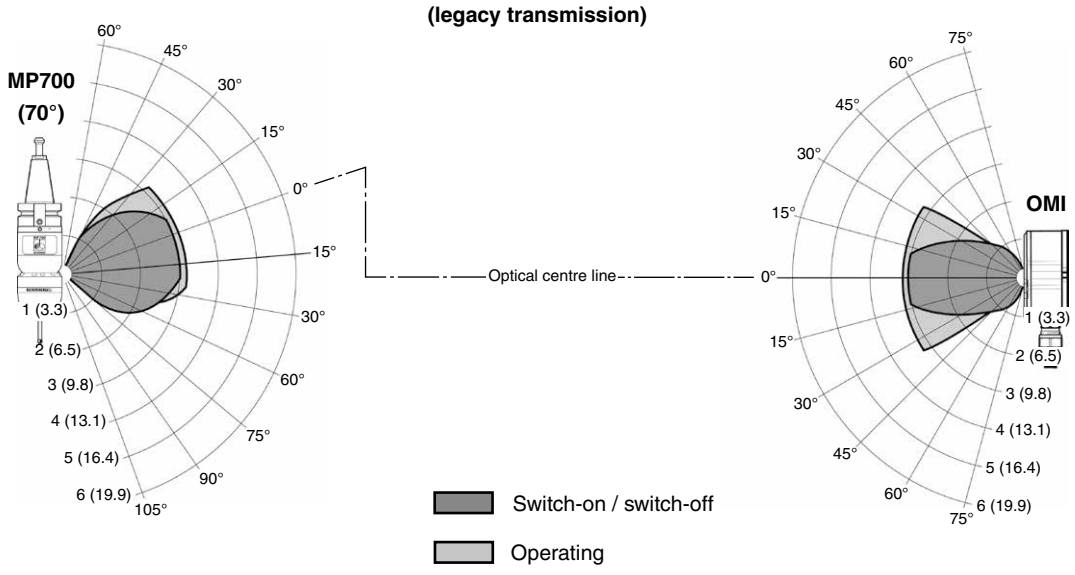
MP700 (35°) performance envelopes



Typical plot at +20 °C (+68 °F)
360° around probe axis in m (ft)

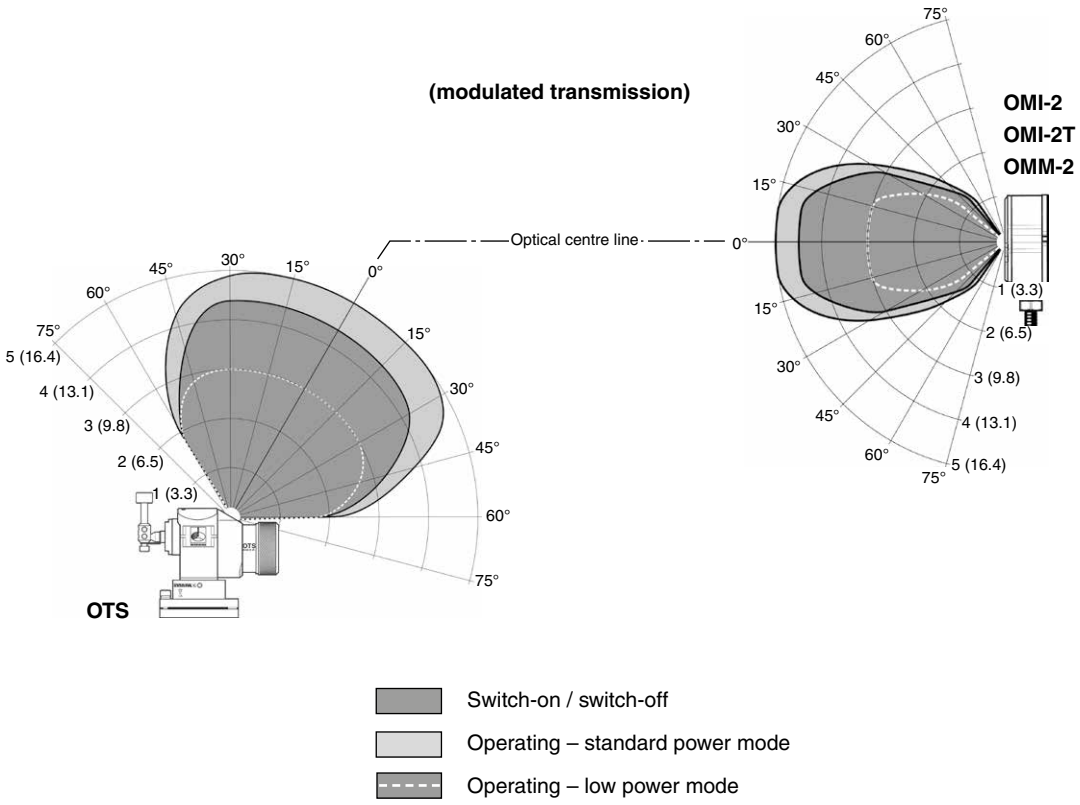
MP700 (70°) performance envelopes





Typical plot at +20 °C (+68 °F)
360° around probe axis in m (ft)

OTS performance envelope



Typical plot at +20 °C (+68 °F)
Transmission around probe axis in m (ft)


RENISHAW
OTS
RENISHAW

RMI

A combined interface and receiver unit for use with Renishaw radio probes. It is designed to be mounted within the machine's working envelope, and unlike optical transmission systems, line-of-sight between the probe and receiver is not necessary, resulting in a quick and simple installation.

Use of the RMI with a Renishaw radio probe is ideal for retrofitting to existing machines.

Key features and benefits:

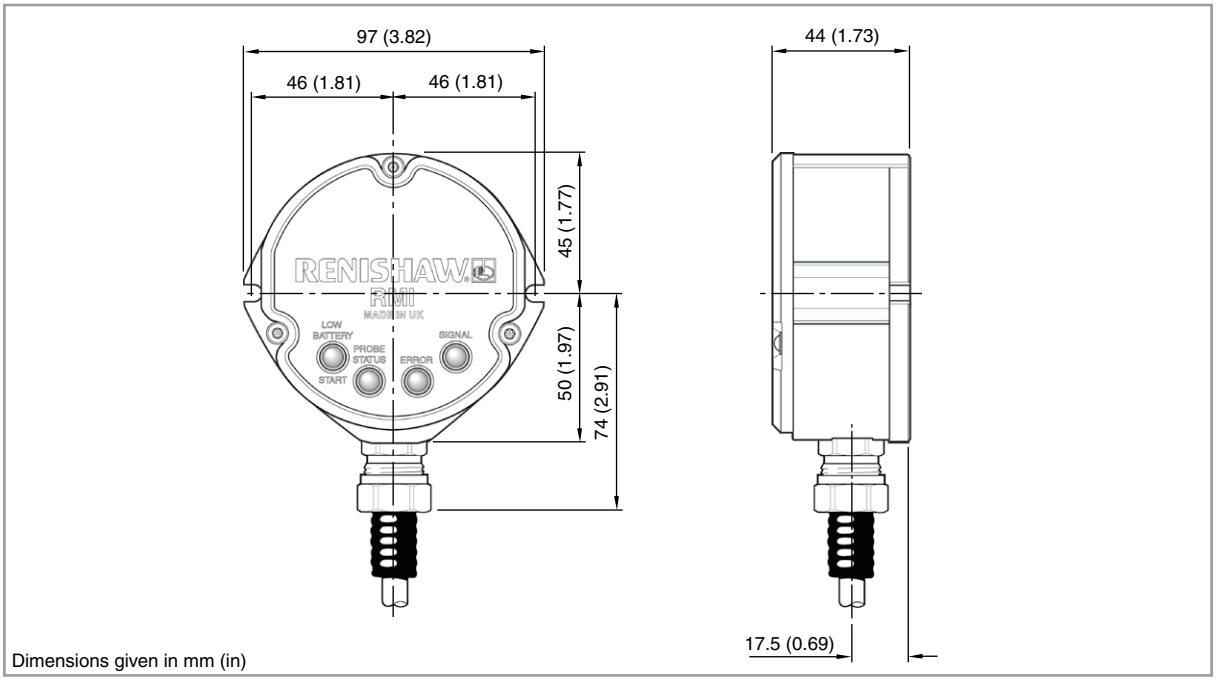
- Globally recognised 2.4 GHz waveband – compliant with radio regulations in all major markets
- Frequency hopping spread spectrum (FHSS) transmission
- Negligible interference from other radio sources means consistent and reliable performance
- Many systems can be used simultaneously without affecting each other
- Robust long range communications make the RMI ideal for larger machines

"Our engineers were initially quite concerned about reaching all the areas on the chassis that we need to machine. But, because it uses radio transmission, the Renishaw probe makes part access much easier."

JCB

For the full case study please contact Renishaw or visit **www.renishaw.com/jcb**

Dimensions



Dimensions given in mm (in)

RMI specification

Principal application		Medium to large machining centres, 5-axis twin spindle machines and vertical turret lathes.
Transmission type		Frequency hopping spread spectrum (FHSS) radio Radio frequency 2400 MHz to 2483.5 MHz
Radio approval regions		China, Europe (all countries within the European Union), Japan and USA. For details about other regions, please contact Renishaw.
Probes per system		Radio M-code on = one Spin/shank switch on = unlimited
Compatible probes		RMP40, RMP40M, RLP40, RMP60, RMP60M and RMP600
Operating range		For radio performance envelopes, see pages 6-2 and 6-3.
Weight		RMI including 15 m (49.2 ft) of cable = 1540 g (54.30 oz)
Supply voltage		12 Vdc to 30 Vdc
Supply current		250 mA @ 24 V peak, 100 mA typical
Configurable M-code input		Pulsed or level
Output signal		**Probe Status 1, Low Battery, Error** Voltage-free solid-state relay (SSR) outputs, configurable normally open or normally closed. **Probe Status 2a** 5 V isolated driven output, invertible. **Probe Status 2b** Power supply voltage driven output, invertible.
Input/output protection		Supply protected by resettable fuse. Outputs protected by over current protection circuit.
Diagnostic LEDs		Start, low battery, probe status, error and signal condition.
Cable (to machine control)	**Specification**	Ø7.35 mm (0.28 in), 13-core screened cable, each core 18 × 0.1 mm
	Length	Standard: 15 m (49.2 ft) Optional: 30 m (98.4 ft), 50 m (164.0 ft)
Mounting		Flush mounting or directional mounting with optional mounting bracket (available separately).
Sealing		IPX8 (EN/IEC 60529)
Operating temperature		+5 °C to +50 °C (+41 °F to +122 °F)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/rmi**

RMI-Q

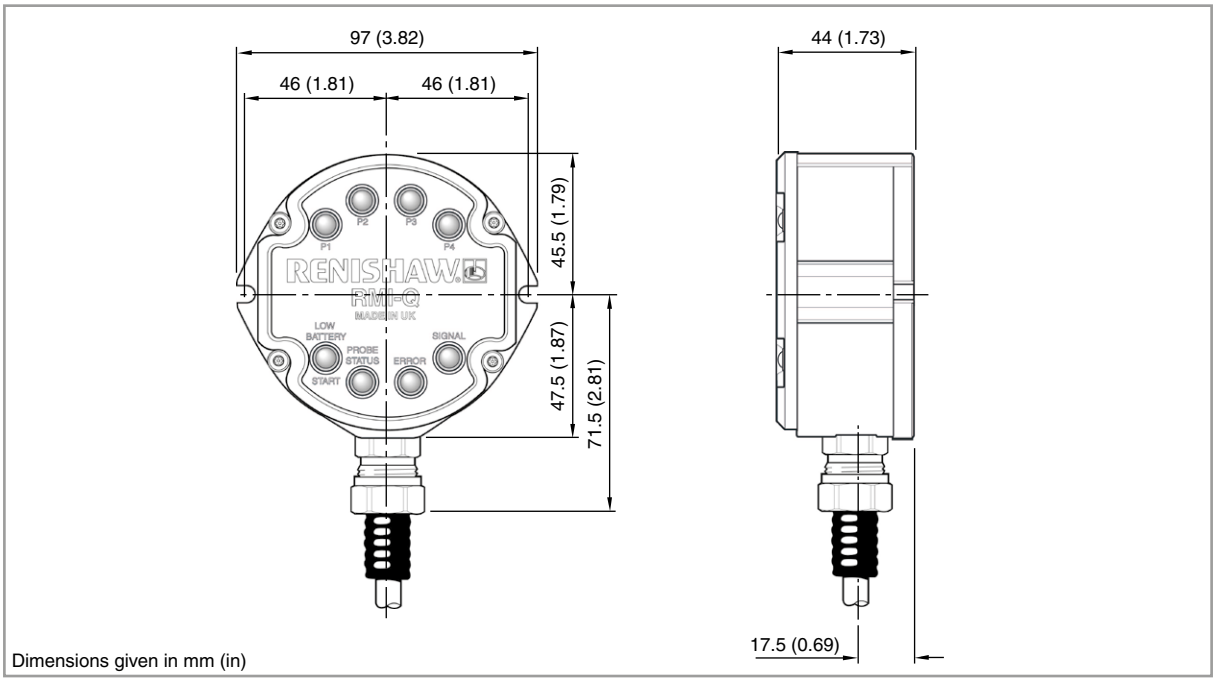
A combined transmitter, receiver and interface unit that enables individual radio turn on and operation of up to four separate Renishaw radio probes. This permits numerous combinations of radio probes and/or radio tool setters to be used on the same machine tool. It is designed to be mounted anywhere within the machine's working envelope, resulting in a quick and simple installation. Unlike the optical transmission systems, line-of-sight between the probe and receiver is not necessary.

Use of the RMI-Q with multiple Renishaw radio probes is ideal for retrofitting to existing machines.

Key features and benefits:

- Up to four probes with one interface and receiver unit
- Globally available 2.4 GHz frequency band – compliant with radio regulations in all major markets
- Frequency hopping spread spectrum (FHSS) transmission
- Negligible interference from other radio sources means consistent and reliable performance
- Multiple Renishaw radio probes will co-exist within the widest machining environment
- Robust, long range communications make RMI-Q ideal for larger machines

Dimensions



Dimensions given in mm (in)

RMI-Q specification

Principal application		All machining centres, 5-axis machines, twin spindle machines and vertical turret lathes.
Transmission type		Frequency hopping spread spectrum (FHSS) radio Radio frequency 2400 MHz to 2483.5 MHz
Radio approval regions		China, Europe (all countries within the European Union), Japan and USA. For details about other regions, please contact Renishaw.
Probes per system		Radio M-code on = up to four Spin/shank switch on = unlimited
Compatible probes		RMP40, RMP40M, RLP40, RMP60, RMP60M, RMP600 and RTS
Operating range		For radio performance envelopes, see page 6-28 and 6-29.
Weight		RMI-Q including 8 m (26 ft) of cable = 1050 g (37.04 oz) RMI-Q including 15 m (49.2 ft) of cable = 1625 g (57.32 oz)
Supply voltage		12 Vdc to 30 Vdc
Supply current		250 mA @ 24 V peak, 100 mA typical
Configurable M-code input		Pulsed or level
Output signal		**Probe Status 1, Low Battery, Error** Voltage-free solid-state relay (SSR) outputs, configurable normally open or normally closed. **Probe Status 2a** 5 V isolated driven output, invertible. **Probe Status 2b** Power supply voltage driven output, invertible.
Input/output protection		Supply protected by resettable fuse. Outputs protected by over current protection circuit.
Diagnostic LEDs		Start, low battery, probe status, error, signal condition and P1, P2, P3, P4 system status.
Cable (to machine control)	**Specification**	Ø7.6 mm (0.30 in), 16-core screened cable, each core 18 × 0.1 mm
	Length	Standard: 8 m (26.2 ft), 15 m (49.2 ft) Optional: 30 m (98.4 ft), 50 m (164.0 ft)
Mounting		Flush mounting or directional mounting with optional mounting bracket (available separately).
Sealing		IPX8 (EN/IEC 60529)
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/rmi-q**

Radio receiver and interface performance envelopes

Recommended for applications where line of sight between probe and receiver are not possible, various combinations of radio probes and receivers/interfaces are possible to suit virtually any application and are particularly suited to large machines. Tested and specified to a range of 15 metres, greater ranges may be achieved depending on mounting within the machine working environment and reflective surfaces within it.

Renishaw works closely with machine tool builders to ensure installations are optimised for all factory fitted systems, providing the end user with warranted and reliable systems that work to known standards.

Similarly for retrofit installations, experienced Renishaw engineers ensure that the system operation is optimised according to application requirements.

All Renishaw radio systems use FHSS transmission technology to ensure protection from external interference from other devices operating in the same environment.

Renishaw radio receivers have receive envelopes that resemble cylindrical shapes

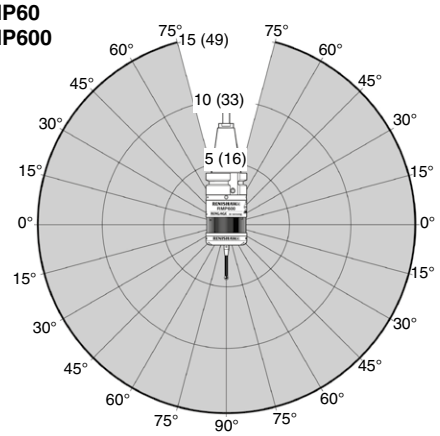
Renishaw workpiece probes have transmission envelopes that resemble spherical shapes

Radio probes and receivers are installed so that their envelopes overlap during operation.

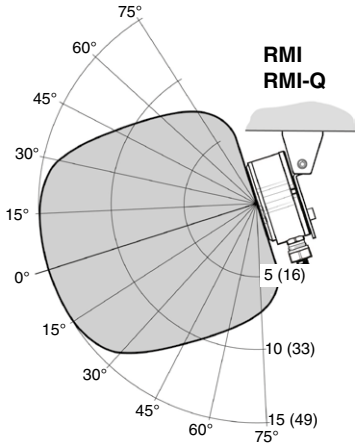
Renishaw radio probes have a 360° transmission envelope over the ranges shown below. The following plots show the different performance envelopes for workpiece inspection probes and tool setting probes.

Ø40 and Ø60 radio performance envelope

RMP40
RLP40
RMP60
RMP600



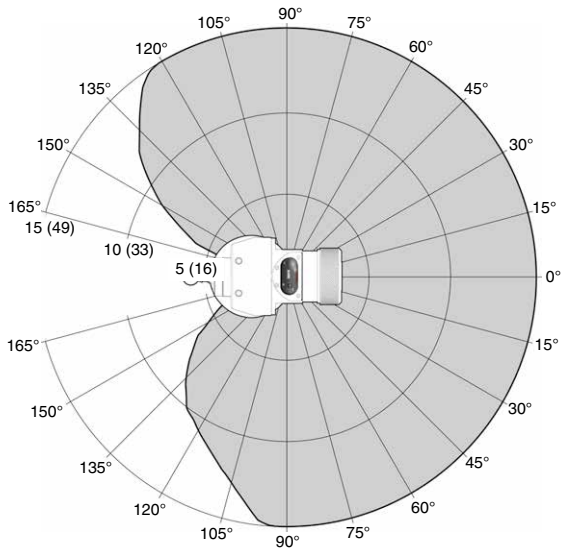
RMI
RMI-Q



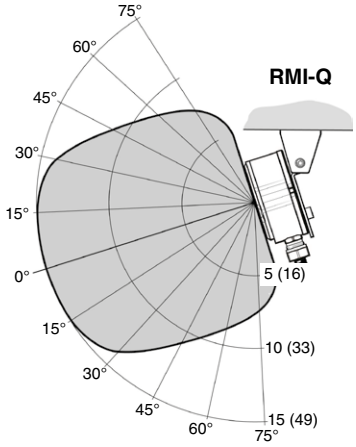
Operating and switch-on / switch-off

Typical plot at +20 °C (+68 °F)
Transmission range in m (ft)

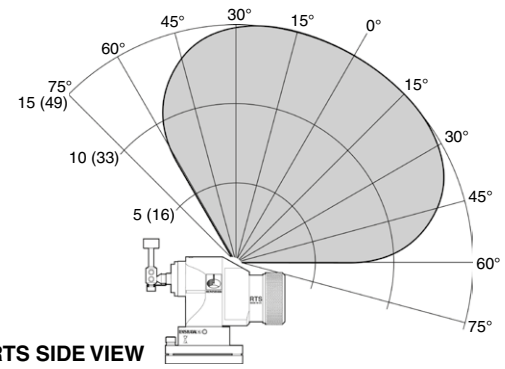
RTS radio performance envelope



RTS TOP VIEW



RMI-Q



RTS SIDE VIEW

Typical plot at +20 °C (+68 °F)
Transmission range in m (ft)

Operating and switch-on / switch-off

MI 8-4

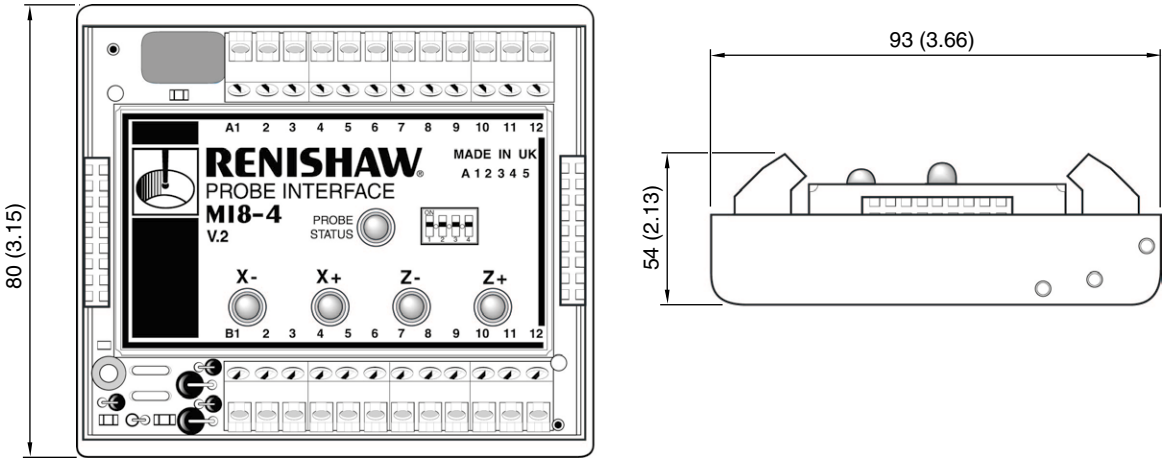
Interface for processing the probe signal from a hard-wired kinematic probe and converting it to the correct format for connection to a control's probe input.

The MI 8-4 can also be connected to the 4-wire Fanuc automatic measurement input (XAE, ZAE). Four signals are required from the control to determine which of the four outputs should generate the probe's signal.

Key features and benefits:

- M-code controlled switch between inspection probe and tool setting probe output
- Diagnostic LEDs indicate axis movement
- Proven and reliable design
- Simple, quick installation
- Compatible with standard kinematic probes

Dimensions



Dimensions given in mm (in)

MI 8-4 specification

Principal application	Transmission interface for hard-wired workpiece inspection and tool setting probes which conveys and processes signals between a probe and the CNC machine control.
Transmission type	Hard-wired
Probes per system	Two
Compatible probes	LP2 and variants, TS27R and TS34
Supply voltage	15 Vdc to 30 Vdc
Supply current	80 mA maximum (each XAE/ZAE output connection will add to the supply current)
Output signal	**Probe Status** Opto-coupled 'totem-pole' transistor output, configurable normally high or normally low. Configurable as TTL compatible. **Four Selectable Axis Outputs** 'Totem-pole' transistor outputs.
Input/output protection	Supply protected by fuse.
Diagnostic LEDs	Probe status, axis movement (X-, X+, Z-, Z+)
Mounting	DIN rail mounting or dual lock pads.
Operating temperature	0 °C to +50 °C (+32 °F to +122 °F)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/mi8-4**

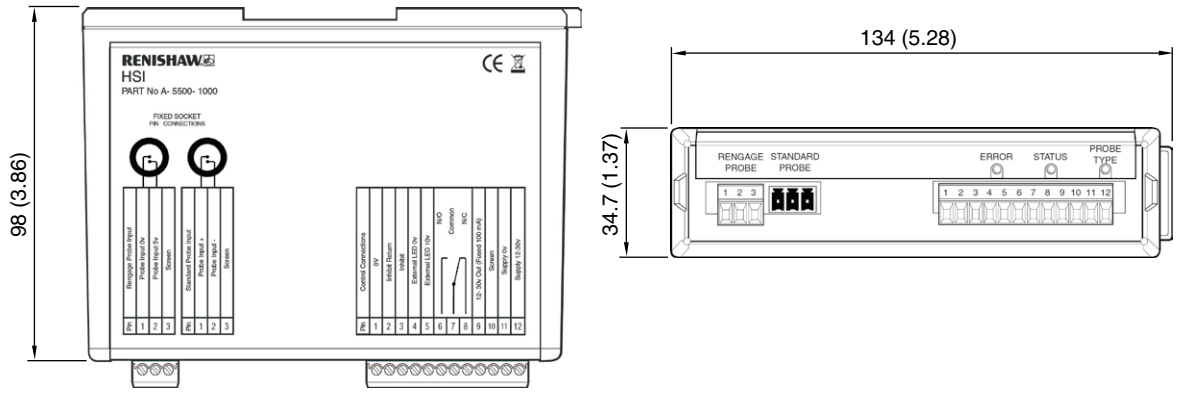
HSI

A hard-wired transmission interface, which conveys and processes signals between a probe and the CNC machine control. The HSI is compatible with Renishaw's hard-wired range of inspection and tool setting probes. Units are DIN rail mounted and feature an 'easy fit' location mechanism. The HSI features an 'inhibit' mode allowing the probe to be powered off when not in use.

Key features and benefits:

- Simple, quick installation
- Compatible with **RENGAGE™** and standard kinematic hard-wired kinematic probes
- Proven and reliable design
- Probe vibration filter reduces false triggers caused by machine vibration

Dimensions



Dimensions given in mm (in)

HSI specification

Principal application	The HSI processes signals from RENGAGE™ or standard hard-wired probes and converts them into machine outputs, which are then transmitted to the CNC control.
Transmission type	Hard-wired
Probes per system	One
Compatible probes	MP250, LP2, TS27R, TS34 and RP3
Supply voltage	11 Vdc to 30 Vdc
Supply current	40 mA @ 12 V, 23 mA @ 24 V
Output signal	**Probe Status** Voltage-free solid-state relay (SSR) output, configurable normally open or normally closed.
Input/output protection	Supply protected by resettable fuse. Outputs protected by over current protection circuit.
Diagnostic LEDs	Error, status and probe type. Connection provided for remote device (LED or buzzer).
Probe vibration filter	A trigger delay circuit (8 ms) helps to reduce false triggers caused by machine vibration
Mounting	DIN rail mounting. Alternative mounting using screws.
Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/hsi**

FS1i and FS2i

The FS1i and FS2i are female sockets, used for holding LP2 probes.

Similar to FS sockets, the FS1i can be radially adjusted by ±4° for aligning the square stylus tip on the probe to the machine axes, whereas the FS2i is used in fixed applications that do not require adjustment.

Powered from a 12 V to 30 V supply, they contain an integrated interface which converts the probe's signal into a voltage-free solid-state relay (SSR) output for transmission to the CNC machine control.

With the built-in interface and compact size, these sockets eliminate the need for a separate interface within the control cabinet, simplifying installation.

LPE extension bars can be used with these sockets to allow access to restricted features and are available in a range of lengths.

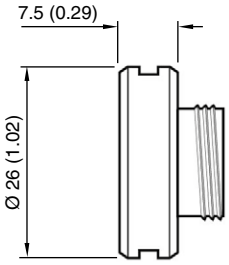
FS1i

FS2i

Key features and benefits:

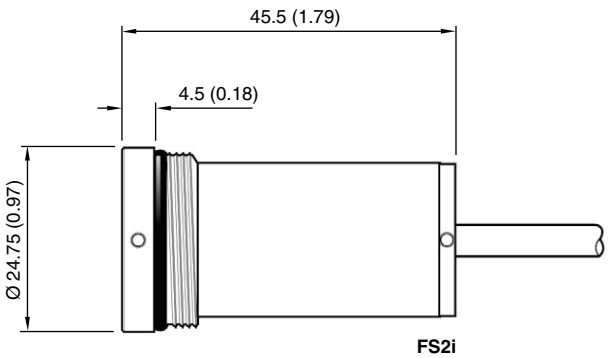
- Simple installation
- Can be used in conjunction with LPE extension bars to provide access to restricted features
- Can be customised to meet the customer's individual requirements
- Eliminate requirement for separate interface

Dimensions



Cover

FS1i



FS2i

FS1i and FS2i specification

Principal application		Socket with integral interface used to hold LP2 range of probes.
Transmission type		Hard-wired transmission
Compatible probes		LP2, LP2H, LP2DD and LP2HDD
Compatible interface		N/A (integrated interface)
Cable	**Specification**	Ø4.35 mm (0.01 in), 4-core screened cable, each core 7 × 0.2 mm
	Length	10 m (32.8 ft)
Supply voltage		12 Vdc to 30 Vdc
Supply current		18 mA nominal, 25 mA maximum
Output signal		Voltage-free solid-state relay (SSR) output.
Input/output protection		SSR output is protected by a circuit which limits the current to 60 mA. Power input is protected by a 140 mA resettable fuse.
Supply protection		Short circuit protected output. The interface must be powered from a suitably fused supply.
Operating temperature		+10 °C to +40 °C (+50 °F to +104 °F)

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/lp2**

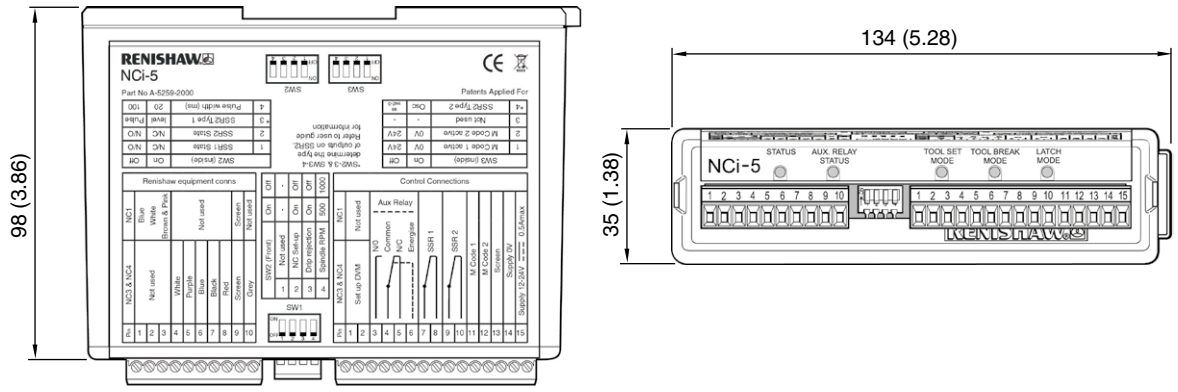
NCi-5

An interface used with the NC4 non-contact tool setting systems, which processes their signals and converts them into voltage-free solid-state relay (SSR) outputs for transmission to the CNC machine's control. The NCi-5 features a drip-rejection mode, allowing it to filter out random drops of coolant without triggering the system.

Key features and benefits:

- DIN rail mounted within the machine control cabinet
- Alternative two screw mounting arrangement
- SSR output for easy user configuration
- Diagnostic LEDs indicate system status
- Drip rejection mode eliminates false triggers

Dimensions



Dimensions given in mm (in)

NCi-5 specification

Principal application	The NCi-5 processes signals from the NC4 and converts them into a voltage-free solid-state relay (SSR) output, which is transmitted to the CNC machine control.
Transmission type	Hard-wired
Probes per system	One
Compatible probes	NC4
Supply voltage	11 Vdc to 30 Vdc
Supply current	120 mA @ 12 V, 70 mA @ 24 Vdc
Output signal	**SSR1, SSR2** Voltage-free solid-state relay (SSR) output, configurable normally open or normally closed. **Auxiliary Relay** Relay for controlling external/auxiliary equipment.
Input/output protection	Supply/output protected by resettable fuses.
Diagnostic LEDs	Beam status, latch mode, high speed tool breakage detection mode, auxiliary relay, tool setting mode.
Modes of operation	High-speed tool breakage detection mode. Normal measurement mode. Latch mode – for profile checking and cutting edge checking. Drip rejection mode – rejects random drops of coolant falling through the beam.
Mounting	DIN rail mounting. Alternative mounting using screws.
Operating temperature	+5 °C to +50 °C (+41 °F to +122 °F).

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/nci-5**

TSI 2 and TSI 2-C

The TSI 2 and TSI 2-C interfaces process signals between the HPRA and HPPA tool setting arms and the CNC machine tool control.

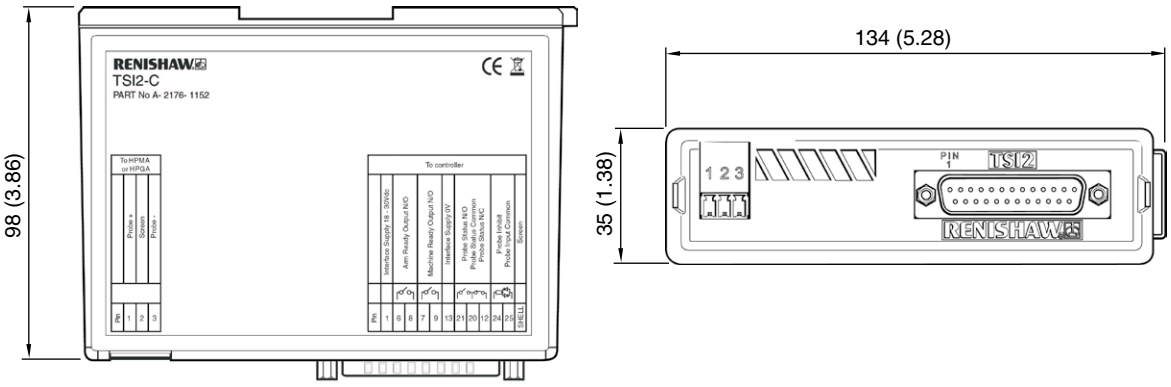
The TSI 2 interface is designed to be used with all standard +24 Vdc operated controls, for example Fanuc, Siemens etc.

For controls that do not operate from standard +24 Vdc power supplies, for example Okuma and HAAS, the TSI 2-C should be used instead. This features configurable solid-state relay (SSR) outputs that are easily integrated into all non +24 V controls.

Key features and benefits:

- DIN rail mounted within the machine control cabinet
- 'Easy fit' location mechanism
- SSR output for easy user configuration (TSI 2-C only)
- Probe vibration filter reduces false triggers caused by machine vibration

Dimensions



Dimensions given in mm (in)

TSI 2 and TSI 2-C specification

Variant	TSI 2	TSI 2-C
Principal application	The TSI 2 and TSI 2-C interfaces process signals between the HPRA and HPPA tool setting arms and the CNC machine tool control.	
Transmission type	Hard-wired	
Probes per system	One	
Compatible probes	HPRA and HPPA	
Screen	Connect free end of cable screen to machine ground star point.	
Supply voltage	18 Vdc to 30 Vdc	
Supply current	I_{max} = 50 mA (not including output loading)	I_{max} = 120 mA
Output signals	**Probe status, Machine Ready, Arm Ready** Unipolar active-high (non-configurable). Not TTL compatible.	**Probe status** Voltage-free solid-state relay (SSR) output, configurable normally open or normally closed, compatible with TTL inputs. **Machine Ready, Arm Ready** Voltage-free solid-state relay (SSR) output, compatible with TTL inputs.
Input/output protection	Supply protected by fuse.	Supply protected by resettable fuse. Outputs protected by fuses.
Input Signal	Inhibit Probe select inputs Internally pulled down (2k4) ACTIVE HIGH	Inhibit Internally pulled down (2k4) ACTIVE HIGH
Standard outputs	Probe status (no complement) Position confirm signals (Machine Ready and Arm Ready)	
Probe vibration filter	A trigger delay circuit (6.5 ms) can be activated by reversing the brown and white wire connections to the TSI 2 (PL2-1 and PL2-3)	
Mounting	DIN rail mounting.	
Operating temperature	+5 °C to +60 °C (+41 °F to +140 °F)	

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/tsi2**

TSI 3 and TSI 3-C

The TSI 3 and TSI 3-C interfaces process signals between the motorised HPMA and HPGA tool setting arms and the CNC machine tool control.

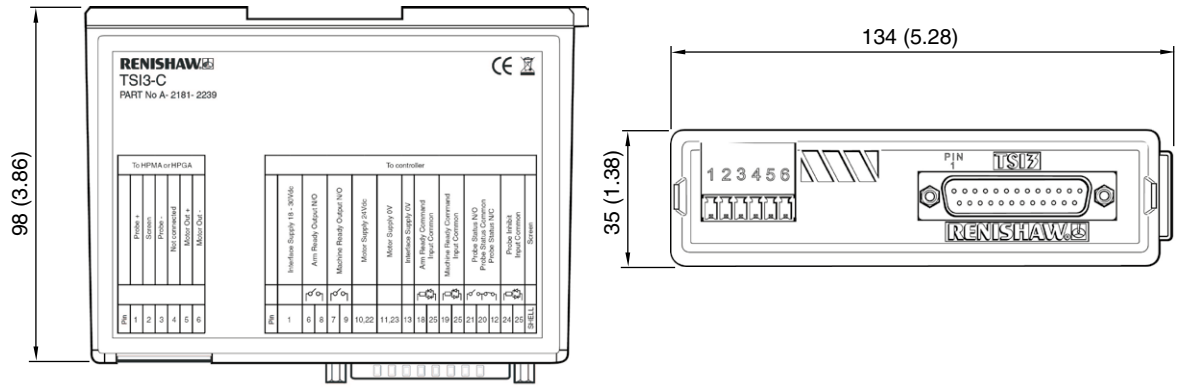
The TSI 3 interface is designed to be used with all standard +24 Vdc operated controls, for example Fanuc, Siemens etc.

For controls that do not operate from standard +24 Vdc power supplies, for example Okuma and HAAS, the TSI 3-C should be used instead. This features configurable solid-state relay (SSR) outputs that are easily integrated into all non +24 V controls.

Key features and benefits:

- DIN rail mounted within the machine control cabinet
- 'Easy fit' location mechanism
- SSR output for easy user configuration (TSI 3-C only)
- Probe vibration filter reduces false triggers caused by machine vibration

Dimensions



Dimensions given in mm (in)

TSI 3 and TSI 3-C specification

Variant		TSI 3	TSI 3-C
Principal application		The TSI 3 and TSI 3-C interfaces process signals between the motorised HPMA and HPGA tool setting arms and the CNC machine tool control.	
Transmission type		Hard-wired	
Probes per system		One	
Compatible probes		HPMA and HPGA	
Screen		Connect free end of cable screen to machine ground star point.	
Supply voltage	**Interface**	18 Vdc to 30 Vdc	
	Motor	24 Vdc + 20% -10%	
Supply current	**Interface**	I_{max} = 100 mA (not including output loading)	I_{max} = 140 mA
	Motor	I_{max} = 2.5 A for 4 s (worst case stall)	I_{max} = 2.5 A for 4 s (worst case stall)
Output signals		**Probe status, Machine Ready, Arm Ready** Unipolar active-high (non-configurable). Not TTL compatible.	**Probe status** Voltage-free solid-state relay (SSR) output, configurable normally open or normally closed, compatible with TTL inputs. **Machine Ready, Arm Ready** Voltage-free solid-state relay (SSR) output, compatible with TTL inputs.
Input/output protection		Supply protected by fuse. Motor supply protected by resettable fuse.	Supply protected by resettable fuse. Motor supply protected by resettable fuse. Outputs protected by fuses.
Input signal		Inhibit, Arm Ready command Machine Ready command Probe select inputs Internally pulled down (2k4) ACTIVE HIGH	Inhibit, Arm Ready command Machine Ready command Internally pulled down (2k4) ACTIVE HIGH
Standard outputs		Probe status (no complement) Position confirm signals (Machine Ready and Arm Ready)	
Diagnostic LEDs		N/A	Motor state LED Arm state LED
Mounting		DIN rail mounting.	
Operating temperature		+5 °C to +60 °C (+41 °F to +140 °F)	

For further information and the best possible application and performance support please contact Renishaw or visit **www.renishaw.com/tsi3**

Styli

Importance of styli

Successful measuring performance is highly dependent on the ability of the probe's stylus to access a feature and then maintain accuracy at the point of contact. At Renishaw we have used our expertise in probe and stylus design to develop a comprehensive range of machine tool styli to offer you the greatest possible precision.

Remember – the stylus is the first link with the workpiece, so it is vital that it delivers the greatest possible accuracy at the point of contact.

Guide to best practice

Metrology performance can easily be compromised if you use a stylus with poor ball roundness, poor ball location, bad thread fit or a compromised design that allows excessive bending during measurement.

Choosing the correct stylus:

- Always use styli that are as short and stable as possible.
- With long styli components, ensure that they have the required stability.
- Check that the styli you use have no defects, particularly on the thread and the seating area. This will ensure that the mount is very secure.
- Check that the probe component is firmly attached.
- Replace worn styli.
- Are your components thermally stable? Bear in mind the ambient conditions.
- When putting together stylus configurations, refer to the permitted masses as specified by the sensor manufacturer.
- Avoid too many or different thread connections.
- Use the lowest possible number of separate components.
- Do you have scanning applications? Take advantage of the benefits offered by silicon nitride balls when scanning aluminium.
- Use the largest possible balls.
- Large ball styli act as mechanical filters on the surface of the workpiece. The fine structures on the surface of the workpiece are scarcely recorded with large balls, which prevents random measurement variations.
- Styli should always be aligned at right-angles, or as close to a right angle as possible, to the planes being measured. For angled measuring planes and angled bores, angled cubes and knuckles are available to ensure that styli are accurately aligned.
- Ensure that the measuring force and dynamics suit the stylus components. With small ball styli with a slim stem, you should reduce these values when necessary.

Options and accessories

Renishaw offers the widest range of stylus types and accessories to suit virtually any of your applications. All components, including styli balls, are available in a range of materials. Grade 5 balls are used as standard, with grade 3 balls available on request. For information on ball grades, please refer to *Precision styli guide* (Renishaw part no. H-1000-3304, section 3).

Straight styli

The simplest and most frequently used type of stylus. Straight shouldered and tapered stems are available. Styli with tapered stems offer better rigidity when the workpiece is easily accessible. Stylus balls are made from ruby, silicon nitride, zirconia, ceramic or tungsten carbide. Holders and stems are available in a range of materials – titanium, tungsten carbide, stainless steel, ceramic and carbon fibre.

Main application:

For simple features with which direct contact can be made.

Star styli

Multi-tip stylus configurations with rigidly mounted styli. Balls are made from ruby, silicon nitride or zirconia. You can also configure your own star styli using stylus centres to mount up to five styli components.

Main application:

For surfaces and holes with which direct contact can be made. This configuration offers flexibility, enabling the tip to make contact with different features without changing the stylus.

Swivel styli

This is a clamping mechanism that can be used to adjust styli to the required angle.

Main application:

For angled surfaces and angled holes, this configuration gives flexibility, enabling you to make contact with different features without changing the stylus.

Disc styli

These styli are 'sections' of highly spherical balls and are available in various diameters and thicknesses. Mounted on a threaded spigot, the discs are made from steel, ceramic or ruby. Full rotational adjustment and the ability to add a centre stylus are features of the range, making them particularly flexible and easy to use.

Main application:

Used to probe undercuts and grooves within bores, which may be inaccessible to star styli. Probing with the 'spherical edge' of a simple disc is effectively the same as probing on or about the equator of a large stylus ball. However, only a small area of this ball surface is available for contact and hence thinner discs require angular alignment in order to ensure correct contact with the feature being probed.

Cylinder styli

Cylinder styli are made from tungsten carbide, ruby or ceramic.

Main application:

For measuring sheet metal, pressed components and thin workpieces when proper contact cannot be guaranteed with ball styli. In addition, various threaded features can be probed and the centres of tapped holes located. Ball-ended cylinder styli allow full datuming and probing in X, Y and Z directions, thus allowing surface inspection to be performed.

Ceramic hemispherical styli

The large effective ball diameter and minimal weight of hemispherical styli offer operational advantages over conventional styli configurations.

Main application:

For measuring deep features and bores. Suitable also for contact with rough surfaces, as the roughness is mechanically filtered out by the large diameter surface.

Accessories

Useful for adapting probe components more precisely to specific measuring tasks. Renishaw offers an extremely wide range of accessories, which are fully covered in our catalogue. For details, please refer to *Styli and accessories* (Renishaw part no. H-1000-3200).

For further information on the full range of Renishaw styli, custom design and other services we offer, please visit **www.renishaw.com/styli**

Custom solutions

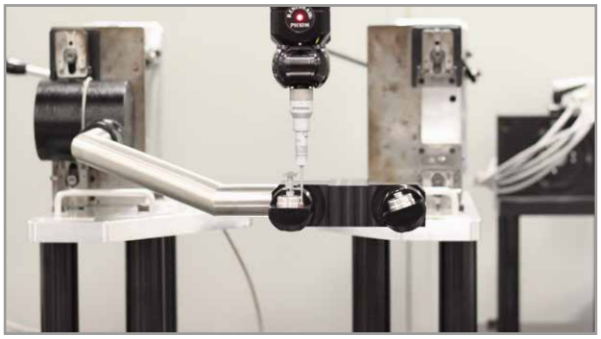
Custom solutions

The Custom Products team has been established at our UK headquarters for over 30 years and has unparalleled experience in providing custom-designed inspection products and accessories to meet your exact requirements, ranging from specialist styli to full probing systems.

We offer engineering and applications advice and design services for any product to meet your needs from concept through to one-off or low-volume production with short lead-times and full documentation and customer drawings.

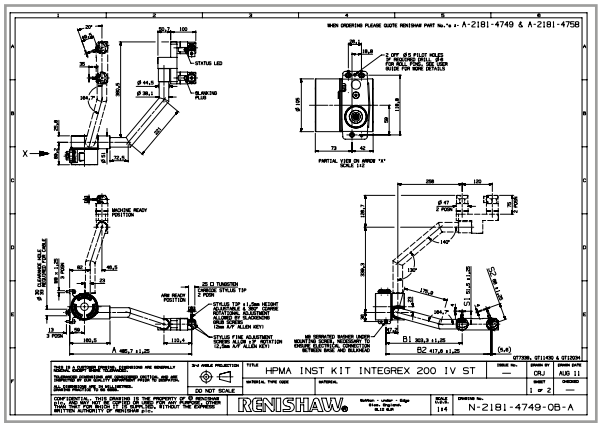
Over the last 5 years we have designed and produced more than 4,000 special styli, 500 bespoke toolsetting arms, 200 machine-specific retrofit kits, 100 shanks and adaptors, numerous specialised probing systems and many other system components, interfaces, calibration kits and accessories.

Every Renishaw custom product is hand-built to the same high levels of quality as our standard product range and is backed by our unrivalled global sales and support network.



Build and inspection

Successful installation and operation



Engineering and design

"Renishaw's expedited delivery made our customer happy enough to request a quote for two additional arms. I have lost track of how many times the product has materialised seemingly out of thin air to meet our needs. It is and always will be my pleasure to work with Renishaw."

CNC Engineering Inc.

For further information please contact Renishaw

For further information on Renishaw's custom solutions please contact Renishaw or visit **www.renishaw.com/custom-solutions**

Renishaw plc
New Mills, Wotton-under-Edge,
Gloucestershire, GL12 8JR
United Kingdom

T +44 (0)1453 524524
F +44 (0)1453 524901
E uk@renishaw.com
www.renishaw.com

RENISHAW
apply innovation™

For worldwide contact details, please visit our main website at www.renishaw.com/contact

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