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Probing systems for CNC machine tools

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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 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 multi-tasking machines
- 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.

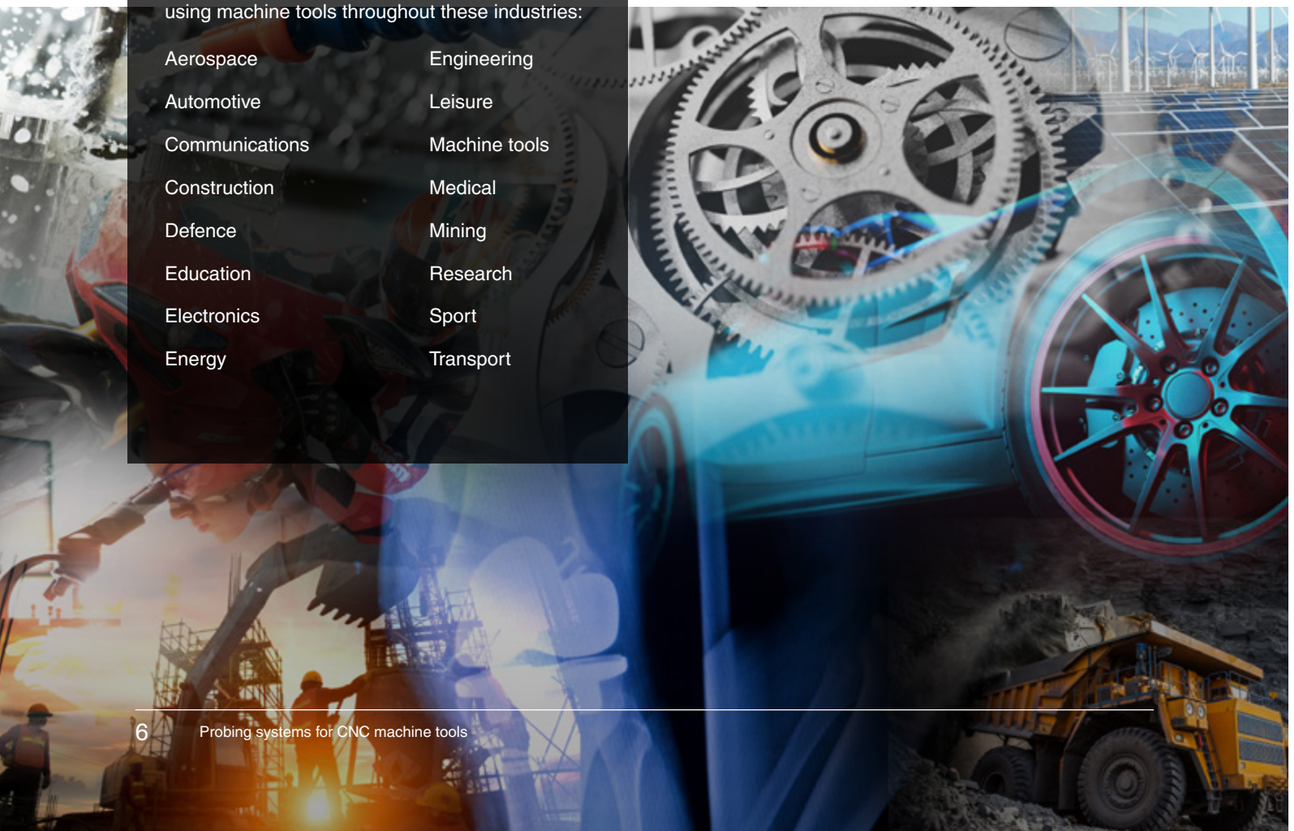
The widest range, unmatched expertise and support make compelling reasons for a productive partnership with Renishaw– the industry's premier choice.

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 controllers 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



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 consistently 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 upfront and ongoing cost to your business. Are you tied to inflexible, outdated metrology equipment with high running costs?

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

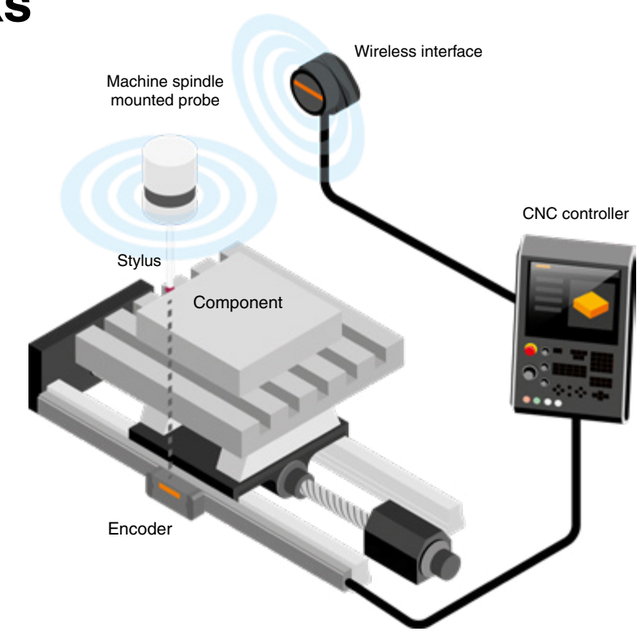
- buy fewer, more productive machines
- eliminate expensive, inflexible custom gauges
- reduce calibration and maintenance costs

How a probe works

Touch-trigger probes

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.

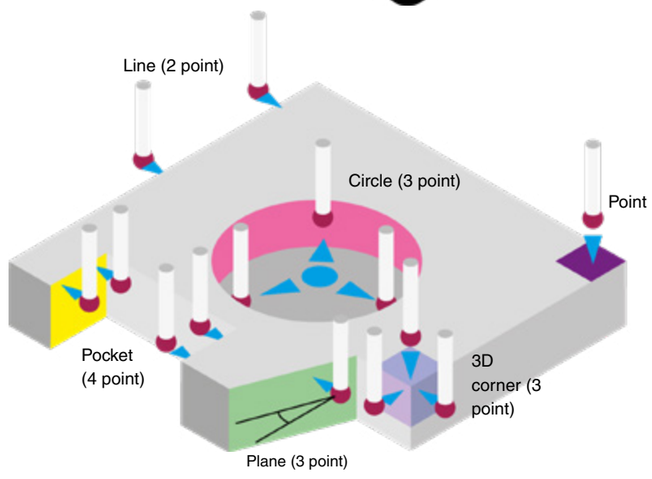
When triggered, the probe signals the machine tool controller via an interface (almost simultaneously). The machine tool controller automatically captures the machine tool position via its encoders (feedback system).



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 right) 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.



Scanning probes

Scanning probes provide high-speed, high-accuracy and high-density measurement data in XYZ on a variety of machine tools. They can be used for many traditional probing applications such as fast part set-up and in-process control. When combined with Renishaw analysis software or third-party tools they offer significant benefits over touch-trigger probing in terms of cycle time savings, collecting detailed part form information and can open up new in-process opportunities such as adaptive machining. Scanning probes can also be used for touch-trigger operations.

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.

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

Non-contact tool setters use a laser system to perform the same function. The tool passing through the laser beam acts as the trigger.

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Machine tool applications and Renishaw products

Cutting machine tools fall into the following broad categories:

- Manually operated
- Programmable – 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
- Cutting tool production

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.

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.

4

Informative

After

Post-process monitoring

After metal cutting, Renishaw's post-process monitoring solutions log process routes and verify the process and part.

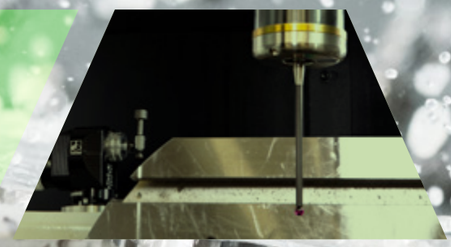
3

Active

During

In-process control

During metal cutting, Renishaw's in-process solutions enable machines to respond to inherent variation and actual conditions 'on the day'.



2

Predictive

Just before

Process setting

Just before metal cutting, Renishaw's process setting solutions establish the location and size of machining system elements.

1

Preventative

In advance

Process foundation

In advance of metal cutting, Renishaw's process foundation solutions maximise the stability of the process, environment and machine.

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 specific 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.
- Machine and process design – enhanced machine feedback and control is a firm foundation on which process feedback can be built. A systematic approach to sequencing the manufacturing process provides the best opportunities to use feedback to promote stability and automation at critical process 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:

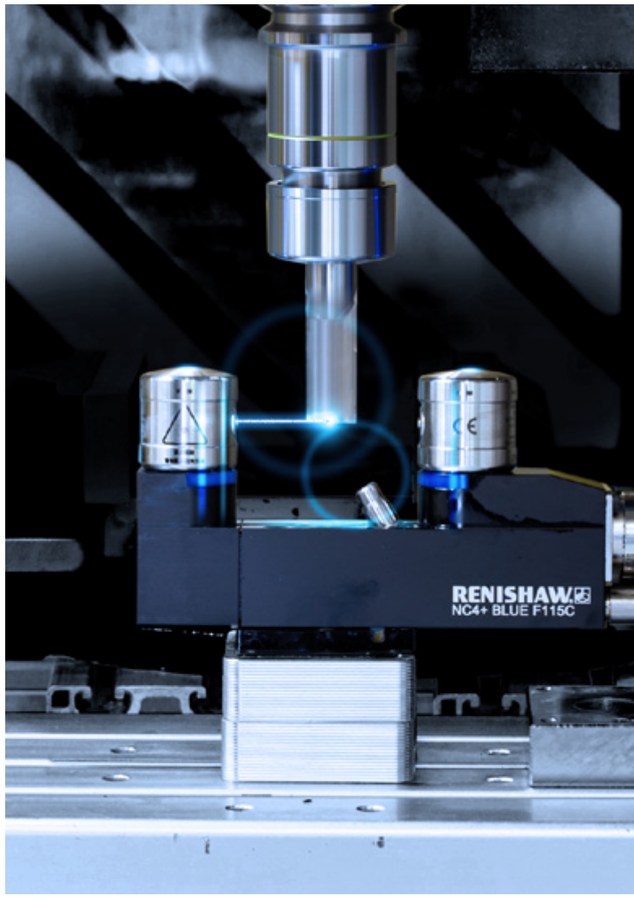
- distance from the spindle gauge-line to establish a length offset, and to check that it is within the specified tolerance
- diameter when spinning to establish a tool size offset

Part setting establishes:

- component identification to select the correct NC program
- position of a datum feature to establish a work coordinate 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

Live data streaming monitors:

- real-time processes and outputting of data
- pass, fail or warning status of each measurement
- trends, thermal effects and to schedule preventative maintenance tasks

Renishaw is a member of the MTConnect® Standards Committee

Post-process monitoring

Informative solutions

The top layer of the Pyramid involves 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
- capturing and sharing of on-machine measurement data

Productive Process Patterns™

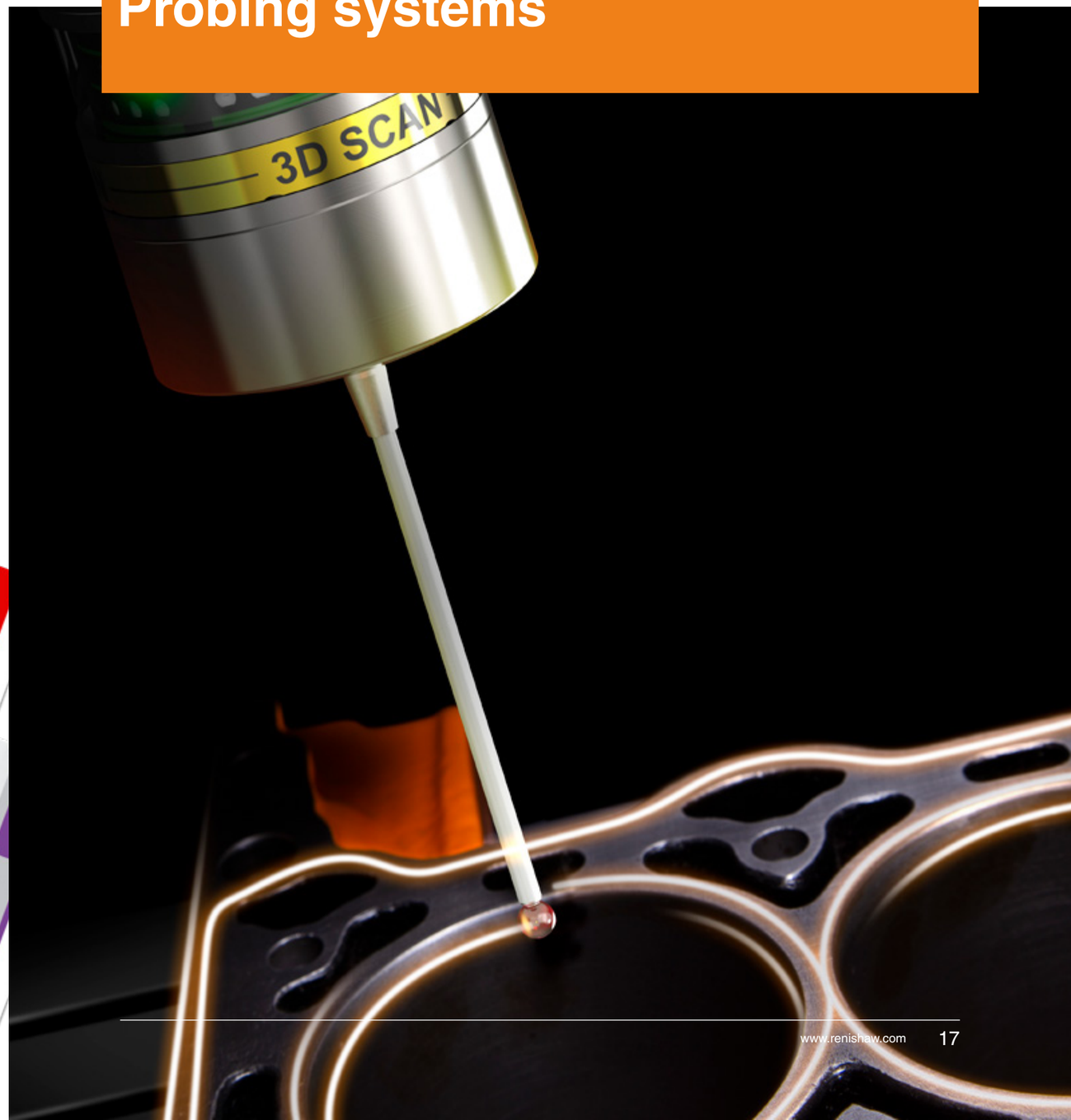
Renishaw has published solutions to many common manufacturing problems. These are explained in a clear ‘problem-solution-example’ format for convenient reference, and they are part of an expanding collection of Productive Process Patterns™.

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 toolpaths, enable machine tools to identify components and automatically select machining programs, and more.

For further information and to view and download the complete collection of Productive Process Patterns visit **www.renishaw.com/processpatterns**

Probing systems



Probing technology comparison chart

Product naming conventions

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

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

Nomenclature

Transmission type		Application		Product		Body diameter		Type	
R	Radio	M	Machine centre/ generic machine	P	Probe	25	25 mm	Blank	Kinematic or scanning
O	Optical	L	Lathe or turning centre			40	40 mm	0	Strain gauge
Blank	Hardwired	S	Scanning technology			60	63 mm	M	Modular

Comparison chart

	Transmission type			Repeatability (2σ)	3D lobing *	Maximum recommended styli length	Switch-on method				Battery type	Page
	Optical	Radio	Hard-wired				M-code	Auto	Spin	Shank switch		
Standard accuracy probes												
OMP40-2	●			1.00 µm		150 mm	●	△			½ AA	34
OLP40	●			1.00 µm		150 mm	●	△			½ AA	36
OMP60	●			1.00 µm		150 mm	●	△	●	●	AA	38
RMP40		●		1.00 µm		150 mm	●		●		½ AA	40
RLP40		●		1.00 µm		150 mm	●		●		½ AA	46
RMP60		●		1.00 µm		150 mm	●		●	●	AA	48
LP2			●	1.00 µm		100 mm	N/A				N/A	52
LP2H			●	2.00 µm		150 mm						
MP11			●	1.00 µm		100 mm						56
RP3			●	1.00 µm		48.75 mm (1.92 in)						134
High-accuracy probes												
RMP24 micro		●		0.35 µm		30 mm	●				CR1632	62
OMP400	●			0.25 µm	±1.00 µm	200 mm	●	△			½ AA	64
OMP600	●			0.25 µm	±1.00 µm	200 mm	●	△			AA	66
RMP400		●		0.25 µm	±1.00 µm	200 mm	●		●		½ AA	68
RMP600		●		0.25 µm	±1.00 µm	200 mm	●		●	●	AA	70
MP250			●	0.25 µm	±1.00 µm	100 mm	N/A				N/A	72
Scanning probes												
OSP60	●					150 mm	N/A				CR123	78
Other												
JCP			◊	1.00 µm		42.75 mm	N/A				LR	58

△ Function of receiver/interface

◊ JCP1 – Visual indication of trigger, hard-wired

* For more information, 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 touch-trigger 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.

Scanning technology

Containing a unique 3D sensor and dual planar spring design, Renishaw scanning probes containing SPRINT™ technology provide exceptionally high-accuracy measurement at unprecedented feedrates.

These probes are incredibly responsive to surface variation, making them ideal for fast and accurate measurement of complex free-form and prismatic surfaces.

Also able to operate as a touch-trigger probe, the OSP60 probe with SPRINT technology is currently in use by world leaders in industries such as automotive, aerospace, oil and gas, and machine tool manufacturing.

Application	Kinematic	Strain gauge	Scanning
Process setting	●	●	●
In-process control	●	●	●
On-machine verification	●	●	●
Multi-axis calibration		●	●
Combined spindle probe / tool setter kit option	●	●	●
3D free form measurement		●	●

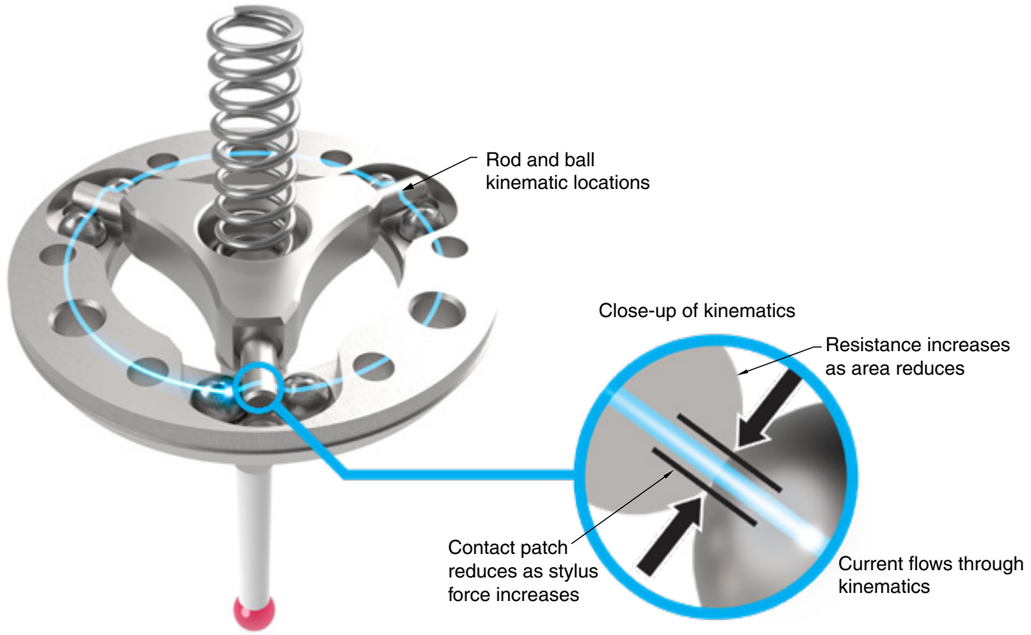
Considerations			
Repeatability	1.0 µm 2σ	±0.25 µm 2σ	
Trigger characteristic	Lobing	Low-lobing	
Maximum styli length	Typically ~ 100 mm	Typically ~ 200 mm	Typically ~ 150 mm

Kinematic resistive probe design

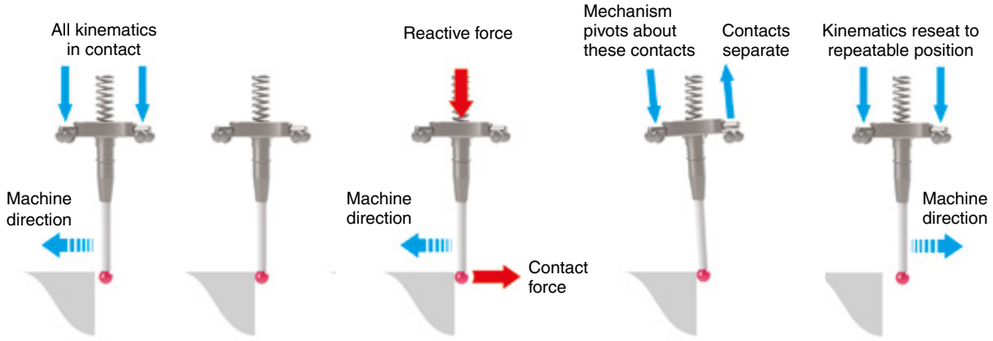
Three equally spaced rods rest on six tungsten carbide balls providing six points of contact in a kinematic location. An electrical circuit is formed through these contacts. The mechanism is spring loaded which allows deflection when the probe stylus makes contact with the part and also allows the probe 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.



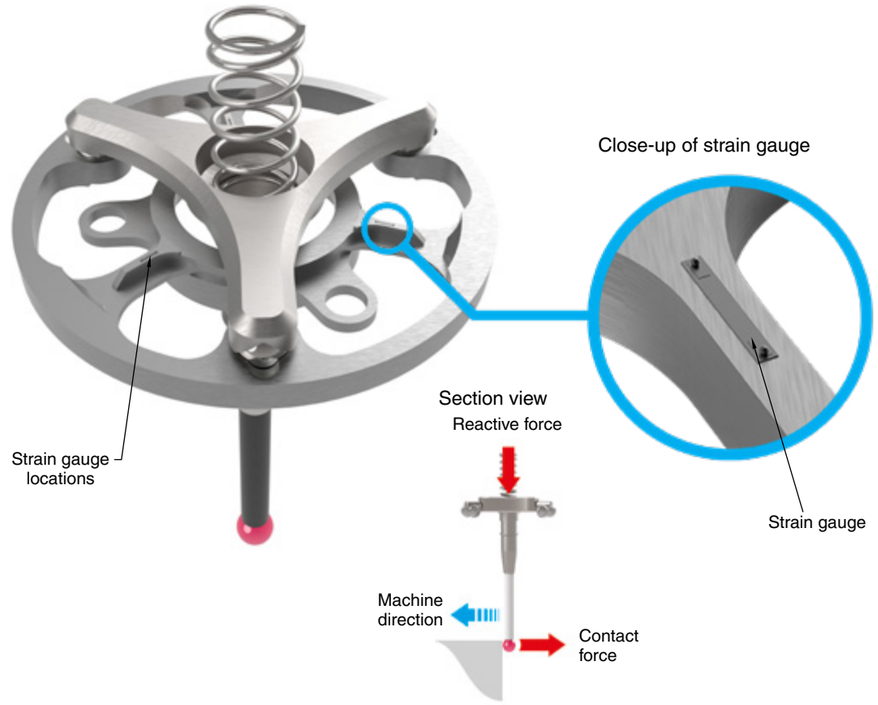
Strain gauge probe design

Innovatively engineered over years and patented by Renishaw, RENGAGE™ technology 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, OMP600, RMP400 and RMP600 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.

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. Probes with RENGAGE technology still utilise Renishaw's kinematic mechanism to retain the position. This system guarantees the repeatable reseat performance fundamental to accurate metrology.

Sensing is completely independent of the probe kinematic mechanism. Probes with RENGAGE technology 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, visit **www.renishaw.com/rengage**

Scanning probe design

Incorporating a unique 3D sensor design, the OSP60 probe with SPRINT™ technology provides an exceptional, high-speed, high-accuracy scanning and touch probing system for CNC machine tools.

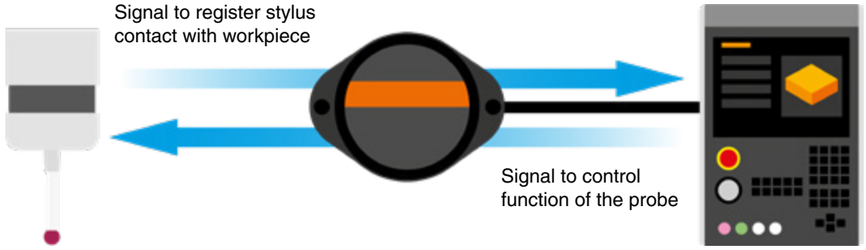
The OSP60 is based on a dual planar spring design that measures both deflection magnitude and direction. This allows the probe to be responsive to surface variation, enabling accurate high-speed measurement of complex free-form and prismatic surfaces.

Two concentric rings are mounted within the probe assembly: one fixed to the probe body; the other fixed to the stylus mount, which then moves with the stylus. Circuits on these rings are monitored and capacitance measurements between them allow the probe stylus tip deflections to be recorded accurately.

Engineered to provide 1,000 true 3D XYZ data points per second, the OSP60 works with SupaScan and Productivity+™ Scanning Suite software.

The OSP60 can also operate as a touch-trigger probe when used in conjunction with the Inspection Plus for OSP60 software package.

Transmission systems explained



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

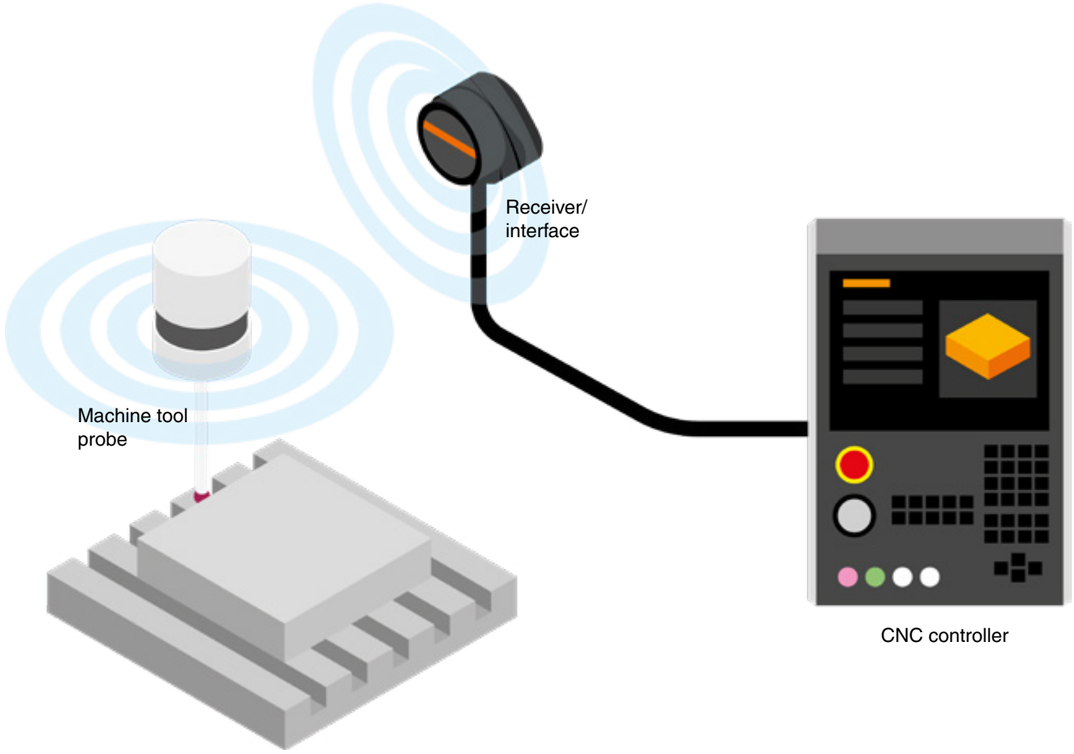
Renishaw probes use three main types of transmission systems: optical and radio (both of which are wireless), and hard-wired (connected directly to the machine tool controller via a cable).

Compatibility chart

		Receivers/interfaces							
Transmission type		Optical		Radio	Hard-wired			Optical module systems	
Products	Page	OMI-2 and variants	OMM-2C	RMI-QE	MI 8-4	HSI	HSi-C	OSI with OMM-2	OSI-S with OMM-S
Standard accuracy probes									
OMP40-2/M	40	●	●					●	
OLP40	36	●	●					●	
OMP60/M	40	●	●					●	
RMP40/M	50			●					
RLP40	46			●					
RMP60/M	50			●					
LP2 and variants (compatible with HPGA)	54	△	△	◊	●	●	●	△	
MP11	56	Integrated to the machine tool controller via a cable.							
High-accuracy probes									
RMP24-micro	62			●					
OMP400	64	●	●					●	
RMP400	68			●					
OMP600	66	●	●					●	
RMP600	70			●					
MP250 (compatible with HPGA)	72					●	●		
Scanning probes (SPRINT™ technology)									
OSP60	78								●
Other									
JCP	58	Not required, JCP wires directly into a digital readout touch sensor input.							

△ If used with an OMP40M or OMP60M
◊ If used with an RMP40M or RMP60M

Radio transmission systems



A Renishaw radio transmission system provides communication between the probe and the machine tool controller and comprises the following:

Probe

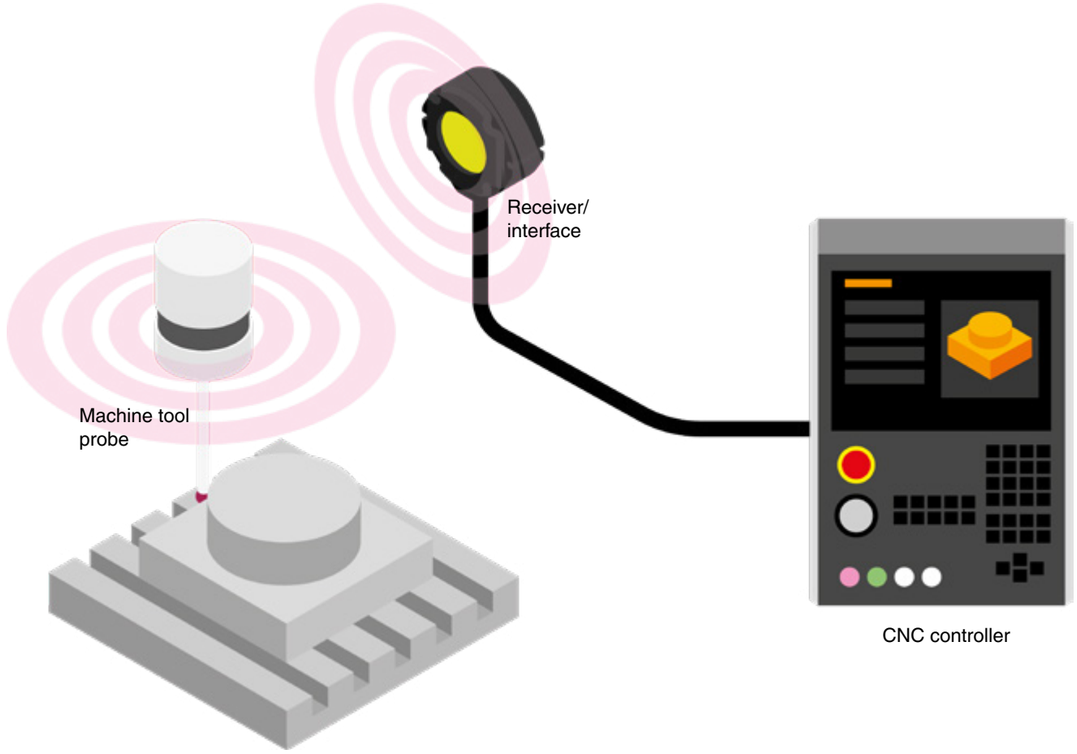
The probe receives machine tool controller signals and transmits status signals. There are two active modes, “standby” and “operating”. In standby mode, the probe is periodically transmitting and receiving, waiting for a signal to switch to operating mode. In operating mode, it transmits probe information,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

Optical transmission systems



A Renishaw optical transmission system uses infrared technology for communication between the probe and the machine tool controller and comprises the following:

Probe

The probe receives machine tool controller 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.

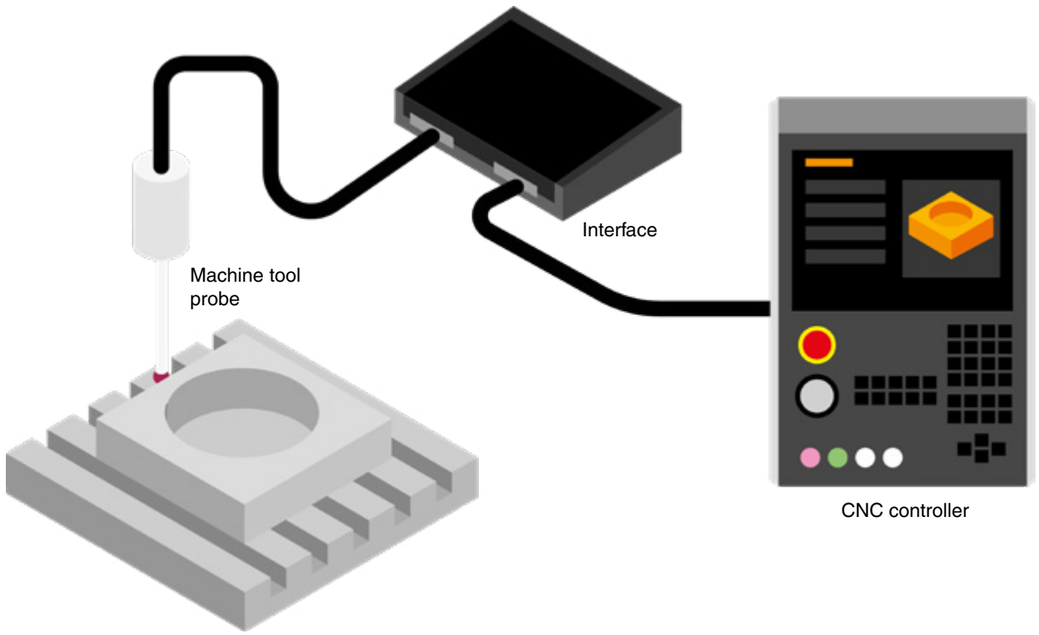
Receiver/interface

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.

Hard-wired transmission systems



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

Probe

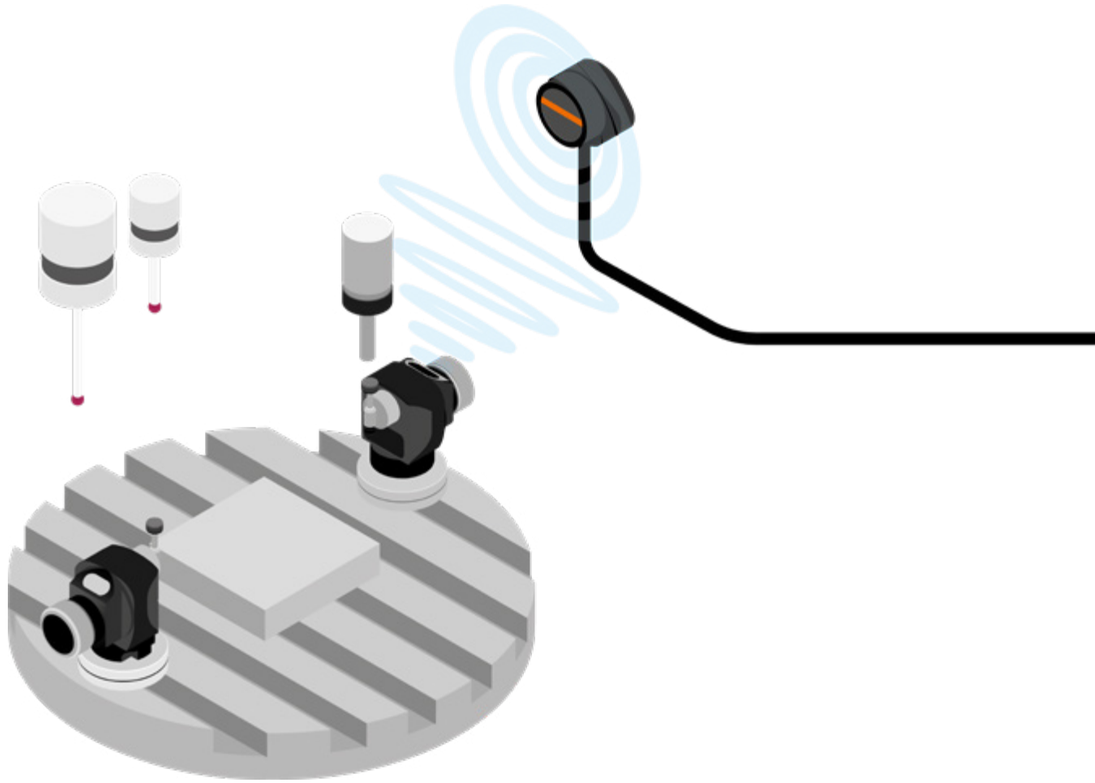
A signal cable connects the probe to a machine interface unit, carrying power and probe signals.

Receiver/interface

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

Hard-wired transmission systems are ideally suited to milling machines where the probe is permanently mounted.

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	OMP60/M, OMP600, OMP40-2/M, OMP400, OLP40
Multi optical probes	3	OSI with OMM-2 or OMM-2C	OMP60/M, OMP600, OMP40-2/M, OMP400, OLP40, OTS
Multi radio probes	4	RMI-QE	RMP40/M, RMP400, RLP40, RMP60/M, RMP600, RMP24-micro, RTS
* Any combination			

Practical examples of multiple Renishaw probing applications might include:

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

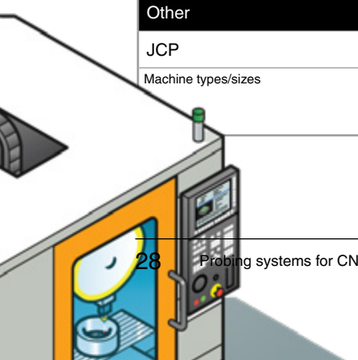
What probe?

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

Probe selector

Machine types		Vertical CNC machining centres			Horizontal CNC machining centres			Gantry CNC machining centres	Manual machines
Products	Page	Machine size			Machine size			All	All
		S	M	L	S	M	L		
Standard accuracy probes									
OMP40-2	34	●	●		●	●			
OMP40M	40	●	●		●	●			
OLP40	36								
OMP60	38		●	●		●	●		
OMP60M	40		●	●		●	●		
RMP40	44	●	●		●	●			
RMP40M	50	●	●		●	●			
RLP40	46								
RMP60	48		●	●		●	●	●	
RMP60M	50		●	●		●	●	●	
LP2 and variants	54	●	●	●	●	●	●		
MP11	56								●
High-accuracy probes									
RMP24-micro	62	●			●				
OMP400	64	●	●		●	●			
OMP600	66		●	●		●	●		
RMP400	68	●	●		●	●			
RMP600	70		●	●		●	●	●	
MP250	72								
Scanning probes									
OSP60	78	●	●	●	●	●	●	●	
Other									
JCP	58								●

Machine types/sizes	Small	Medium	Large
	Table size < 700 mm × 600 mm	Table size < 1200 mm × 600 mm	Table size > 1200 mm × 600 mm



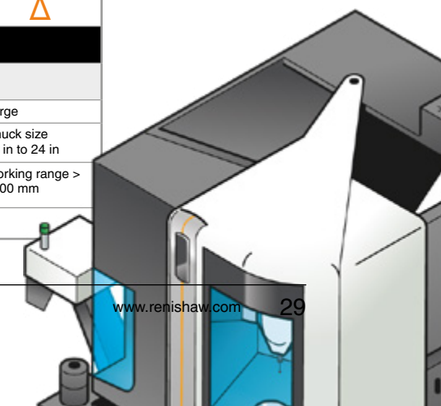
What probe? (continued)

Probe selector

Machine types		CNC lathes			CNC multi-tasking machines			CNC grinders
Products	Page	Machine size			Machine size			All
		S	M	L	S	M	L	
Standard accuracy probes								
OMP40-2	34				●			
OMP40M	40	●	●		●			
OLP40	36	●	●		●			
OMP60	38				●	●		
OMP60M	40				●	●		
RMP40	44				●	●		
RMP40M	50	●	●	●	●	●		
RLP40	46	●	●	●	●	●		
RMP60	48					●	●	
RMP60M	50					●	●	
LP2 and variants	54	●	●	●	●	●	●	●
MP11	56							
High-accuracy probes								
RMP24-micro	62				●			
OMP400	64				●			
OMP600	66				●	●	●	
RMP400	68				●			
RMP600	70				●	●	●	
MP250	72							●
Scanning probes								
OSP60	78	△	△	△	●	●	●	△
Other								
JCP	58							

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

△ Requires XYZ axes for calibration



ACS-1

Spindle probes for CNC machine tools can be highly repeatable, but their performance relies on accurate calibration. Many users rely on manual calibration processes. Even skilled operators may introduce variability, which will affect the accuracy of subsequent measurements.

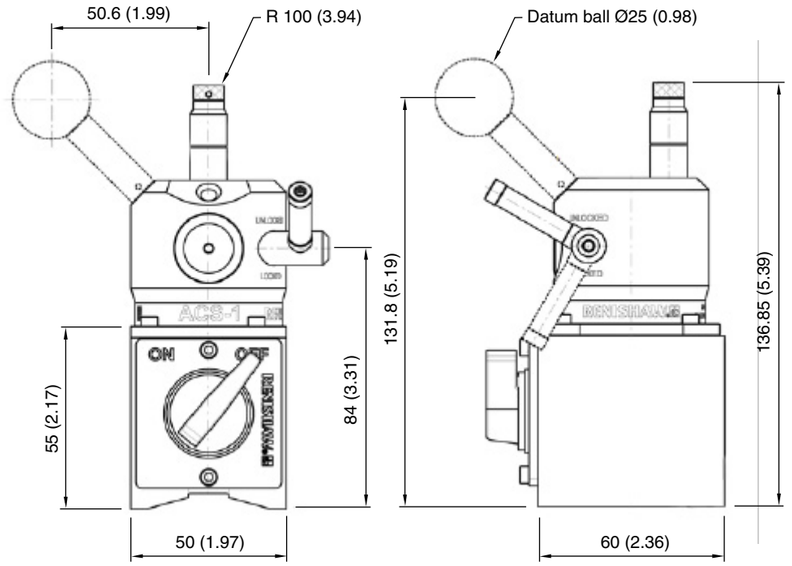
ACS-1 helps you to achieve maximum measurement accuracy on your machine tools by removing manual calibration steps.

The lockable mechanism on ACS-1 overcomes the need for manual use of precision gauge blocks or slips, ensuring consistency and reliability.

Key features and benefits:

- Accurate results – Removing operator interference ensures highly accurate probe calibration
- Excellent repeatability of calibration – No need for slip gauges
- Fast calibration – Probe length and ball diameter can be accurately determined within minutes
- Easy to use – The magnetic base makes mounting the ACS onto the machine table or chuck effortless
- Vertical or horizontal mount – Suitable for various types of machine tools
- No batteries required – Fully mechanical design
- Rugged design – A hard-wearing mechanical structure ensures longevity
- Cost effective – A simple and affordable solution for removing human error from the probe calibration process

Dimensions



Dimensions given in mm (in)

Specification

Principal application		The lockable calibration disk provides a datum surface for accurate probe length calibration. The datum sphere is used to accurately calibrate the probe's stylus ball diameter.
Maximum travel		10 mm (0.39 in)
Movement when locking		The datum surface will move by no more than 1 µm (39 µin) typically 3 µm (118 µin) maximum) when the locking mechanism is engaged.
Maximum load on the plunger (when locked)		15 N, 1529 gf (53.95 ozf). **CAUTION:** Do not apply a load of greater than 15 N, 1529 gf (53.95 ozf) to the datum surface when it is locked.
Maximum life expectancy		10,000 operations
Weight		1832 g (64.62 oz) typical
Switch-on/switch-off options		Optical on → Optical off Optical on → Timer off
Mounting		Horizontal or vertical surface of the magnetic base.
Environment	**Storage condition**	Not to be stored inside the machine.
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)

For further information and the best possible application and performance support, contact Renishaw or visit **www.renishaw.com/acs-1**

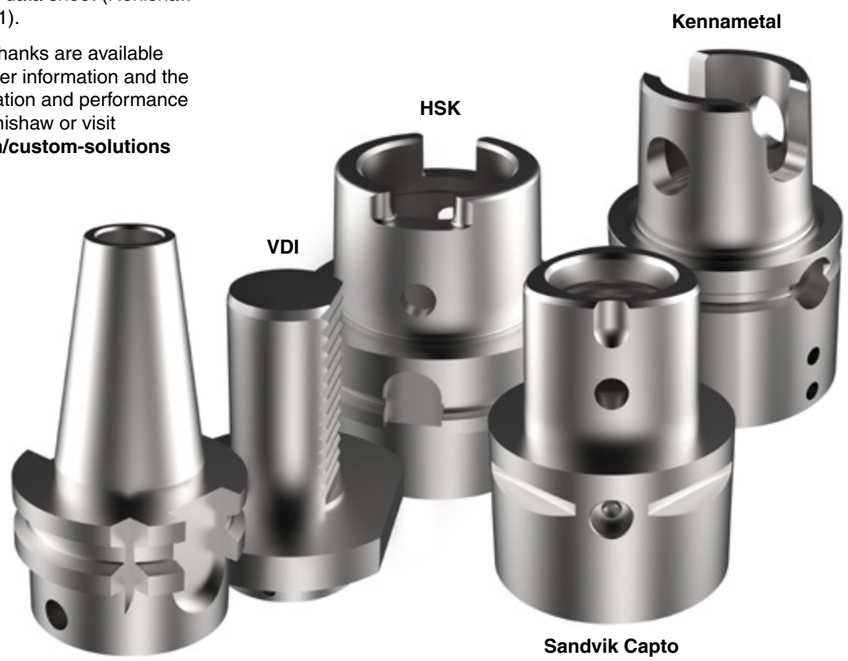
Shanks for machine tool probes

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

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



Standard accuracy probes

OMP40-2

Ultra-compact 3D touch-trigger probe with optical signal transmission. Used for workpiece set-up and 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.

> **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 (UK)

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

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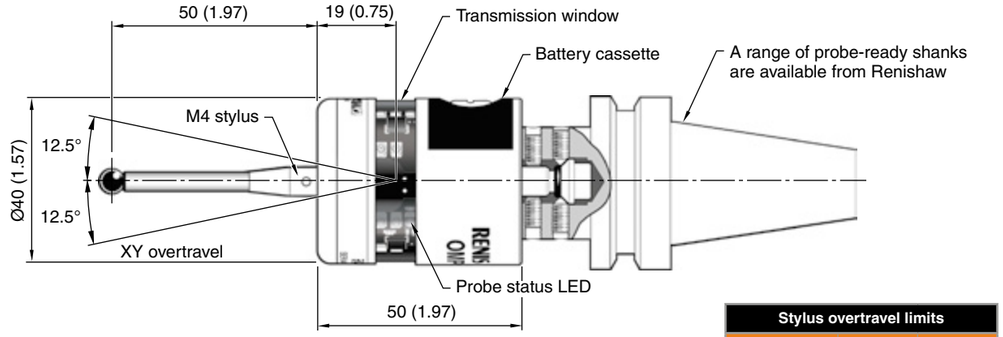
Dimensions



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)

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 OMM-2 / OMM-2C with OSI	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	1500 days maximum, dependent on optical power option	
	Continuous life	1350 hours maximum, dependent on optical power option	
Sense directions		±X, ±Y, +Z	
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(note 1)*	
Stylus trigger force (notes 2 and 3)	XY low force	0.50 N, 51 gf (1.80 ozf)	
	XY high force	0.90 N, 92 gf (3.24 ozf)	
	+Z direction	5.85 N, 597 gf (21.04 ozf)	
Environment	IP rating	IPX8 (EN/IEC 60529)	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	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, contact Renishaw or visit **www.renishaw.com/omp40-2**

OLP40

Ultra-compact 3D touch-trigger probe with optical signal transmission for workpiece set-up and inspection. Specifically designed to be additionally robust with a toughened glass window for the harsh environment in lathes and grinding machines.

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

> **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 (UK)

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

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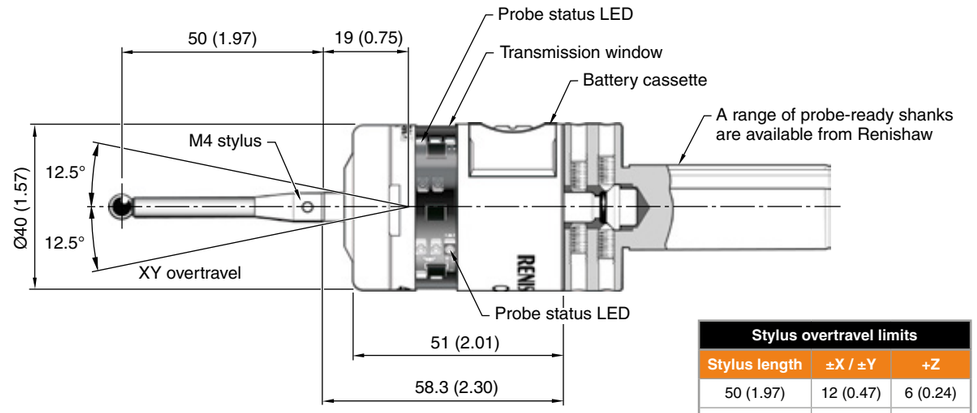
Dimensions



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)

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 OMM-2 / OMM-2C with OSI	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	1500 days maximum, dependent on optical power option	
	Continuous life	1350 hours maximum, dependent on optical power option	
Sense directions		±X, ±Y, +Z	
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(note 1)*	
Stylus trigger force (notes 2 and 3)	XY low force	0.50 N, 51 gf (1.80 ozf)	
	XY high force	0.90 N, 92 gf (3.24 ozf)	
	+Z direction	5.85 N, 597 gf (21.04 ozf)	
Environment	IP rating	IPX8 (EN/IEC 60529)	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	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, refer to the *OLP40* installation guide (Renishaw part no. H-5625-8504).

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

OMP60

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

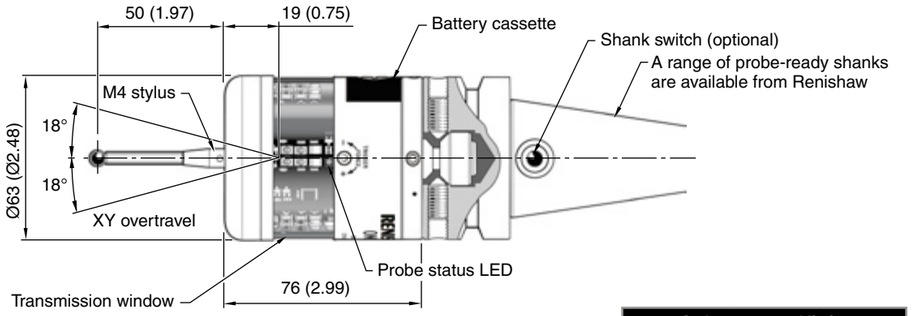
Compatibility with all Renishaw optical receivers enables users to easily upgrade existing installations.

> **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 (UK)

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

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)

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 OMM-2 / OMM-2C with OSI	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 optical power option	
	Continuous life	690 hours maximum, dependent on optical power option	
Sense directions		±X, ±Y, +Z	
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(note 1)*	
Stylus trigger force (notes 2 and 3)	XY low force	0.75 N, 76 gf (2.70 ozf)	
	XY high force	1.40 N, 143 gf (5.04 ozf)	
	+Z direction	5.30 N, 540 gf (19.06 ozf)	
Environment	IP rating	IPX8 (EN/IEC 60529)	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	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, refer to the *OMP60* installation guide (Renishaw part no. H-4038-8505).

For further information and the best possible application and performance support, 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 when using 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)

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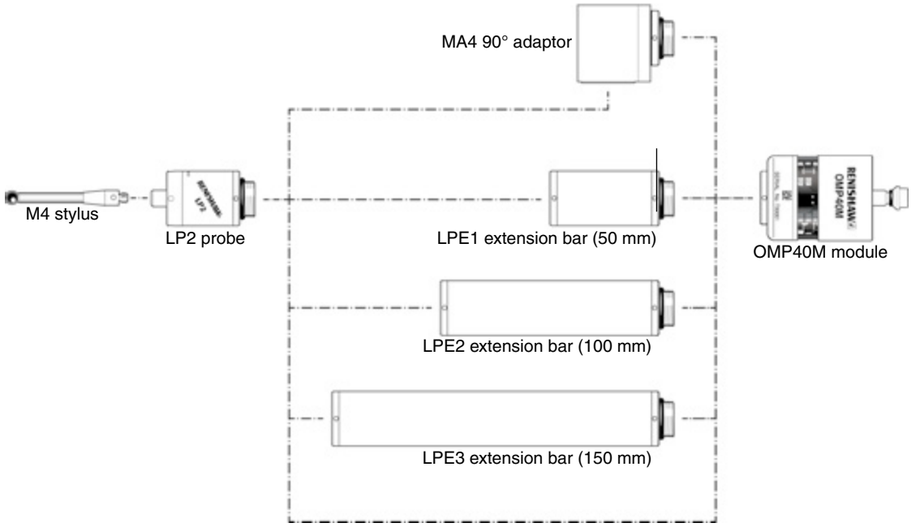
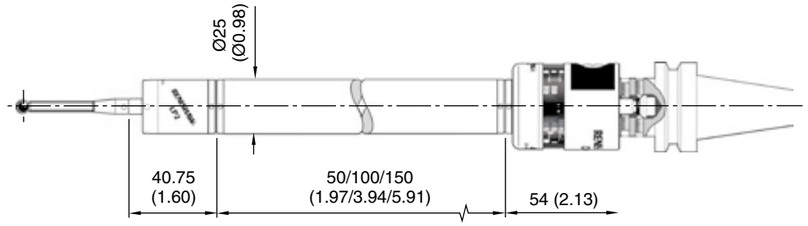
Modular system

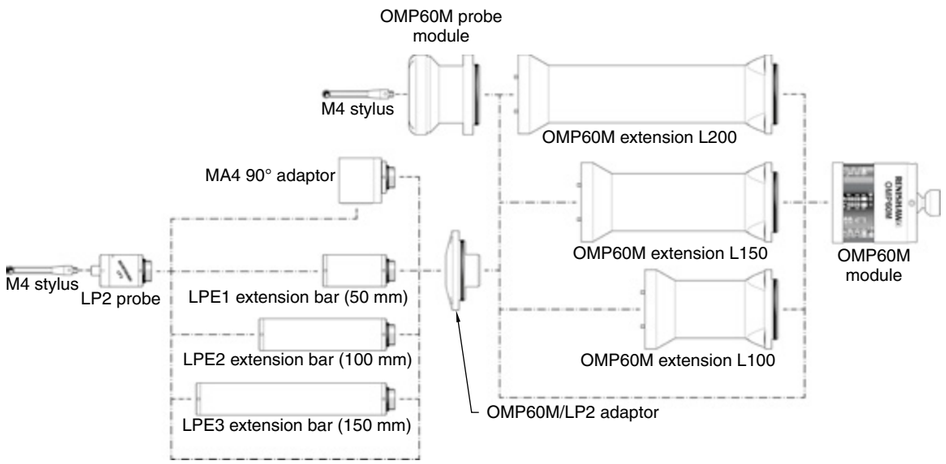


Dimensions

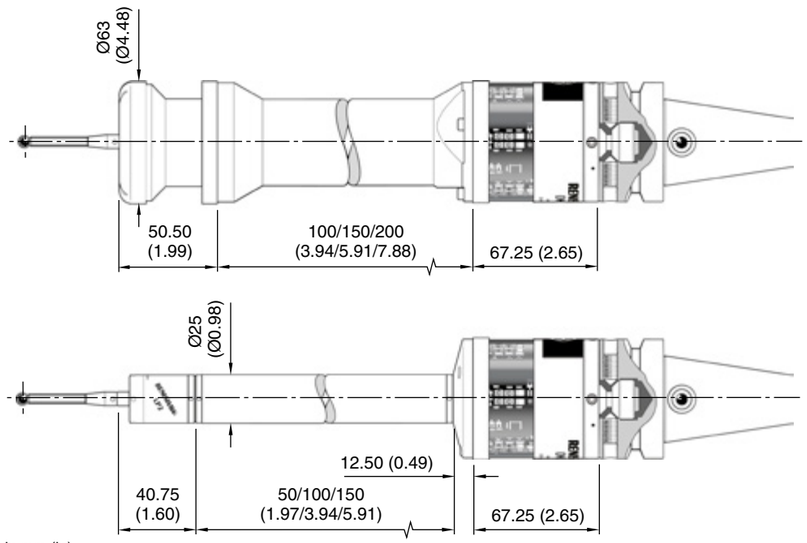


Dimensions given in mm (in)

Modular system



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 OMM-2 / OMM-2C with OSI	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	1500 days maximum, dependent on optical power option	
	Continuous life	1350 hours maximum, dependent on optical power option	
Sense directions		±X, ±Y, +Z	
Environment	IP rating	IPX8 (EN/IEC 60529)	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)	

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, OMM-2C (2 positions)	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 optical power option	
	Continuous life	690 hours maximum, dependent on optical power option	
Sense directions		±X, ±Y, +Z	
Environment	IP rating	IPX8 (EN/IEC 60529)	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)	

For further information and the best possible application and performance support, contact Renishaw or visit www.renishaw.com/**omp60** or **www.renishaw.com/omp40-2**

RMP40 (QE)

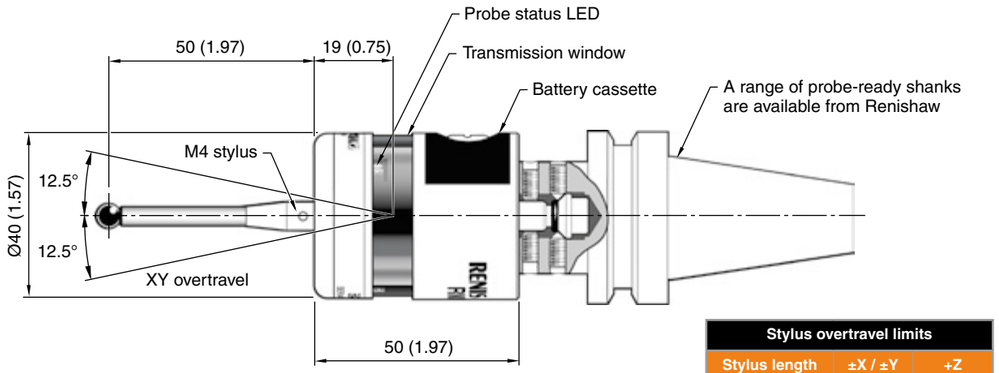
The RMP40 is a ultra-compact frequency-hopping radio spindle probe. Operating within the globally recognised 2.4 GHz ISM band, the RMP40 is suited for operation on all sizes of machine.

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)

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		UK, EU, EFTA, Japan and USA (China exempt). For details about other regions, contact Renishaw
Compatible interfaces		RMI-QE combined interface and receiver unit
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 (8.82 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	82 months maximum, dependent on switch-on / switch-off option.
	Continuous life	2560 hours maximum, dependent on switch-on / switch-off option.
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(note 1)*
Stylus trigger force (notes 2 and 3)	XY low force	0.50 N, 51 gf (1.80 ozf)
	XY high force	0.90 N, 92 gf (3.24 ozf)
	+Z direction	5.85 N, 597 gf (21.04 ozf)
Environment	IP rating	IPX8, BS EN 60529:1992+A2:2013 (IEC 60529:1989+A1:1999+A2:2013)
	IK rating (RMP40)	IK01 (EN/IEC 62262: 2002) [for glass window]
	IK rating (RMP40M)	IK02 (EN/IEC 62262: 2002) [for glass window]
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)
	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, contact Renishaw or visit **www.renishaw.com/rmp40**

RLP40 (QE)

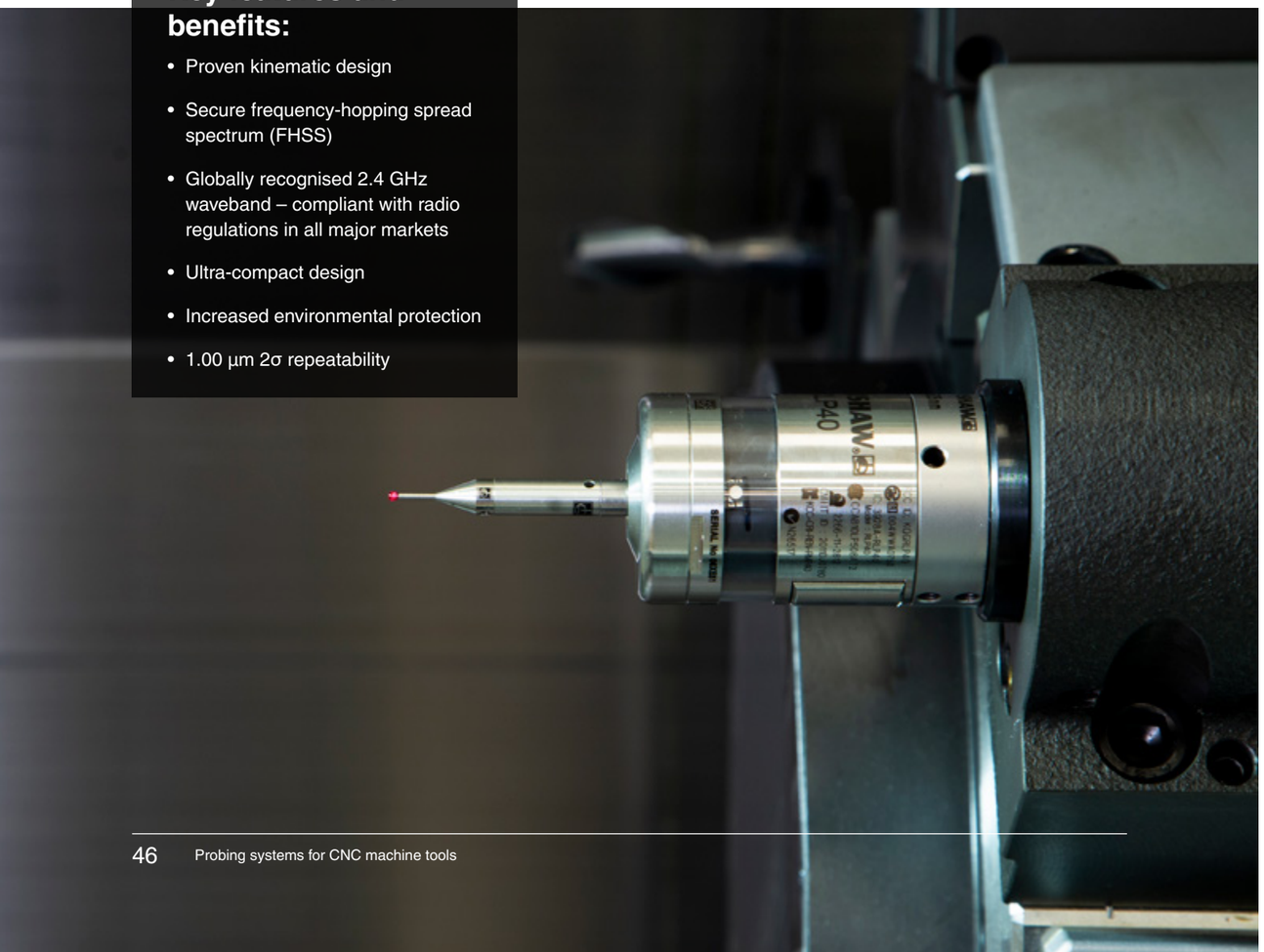
The small-bodied RLP40 is a radio frequency probe designed to be turret mounted for part setting and inspection on turning centres.

Ultra-compact and specifically designed to be additionally robust with a toughened glass window for the harsh environment in lathes and grinding machines. Secure frequency-hopping spread spectrum (FHSS) communications make the RLP40 well suited to these demanding environments. Available with a variety of activation methods, adjustable trigger force and trigger options.

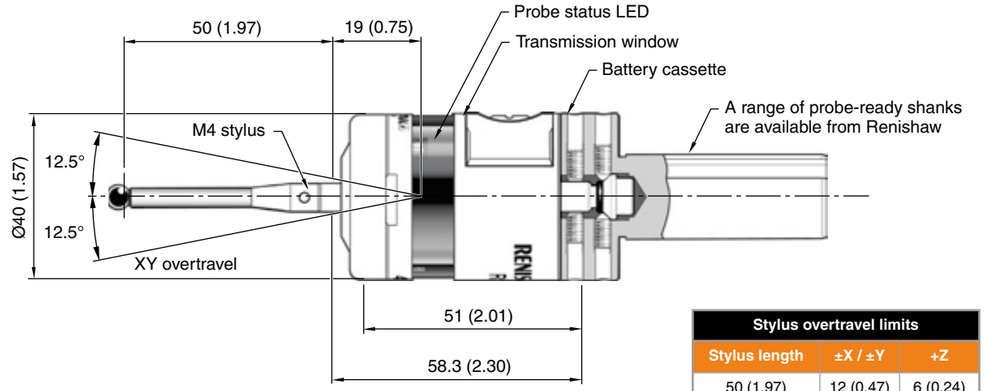
> **It gives us consistency and takes out the chance of human error. Scrap reduction is not even an issue we have to consider.**
>
> Mekall (UK)

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



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)

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		UK, EU, EFTA, Japan and USA (China exempt). For details about other regions, contact Renishaw
Compatible interfaces		RMI-QE
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**	82 months maximum, dependent on switch-on / switch-off option
	Continuous use	2560 hours maximum, dependent on switch-on / switch-off option.
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(note 1)*
Stylus trigger force (notes 2 and 3) XY low force XY high force +Z direction		 0.60 N, 61 gf (2.15 ozf) 0.97 N, 99 gf (3.49 ozf) 6.23 N, 635 gf (22.41 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, refer to the *RLP40* installation guide (Renishaw part no. H-5627-8504).

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

RMP60 (QE)

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.

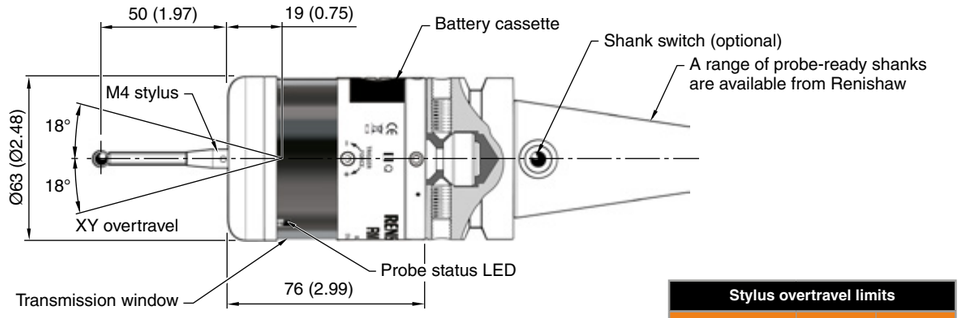
> **During the planning stage of the project it occurred to us that the new machine would be located close to the welding area and that there was a very real possibility of signal interference, so we needed a system that could cope with the conditions. The Renishaw RMP60 is the first inspection probe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

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

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

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)

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		UK, EU, EFTA, Japan and USA (China exempt). For details about other regions, contact Renishaw.
Compatible interfaces		RMI-Q and RMI-QE
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)		876 g (30.90 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**	101 months maximum, dependent on switch-on / switch-off option.
	Continuous use	4870 hours maximum, dependent on switch-on / switch-off option.
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(note 1)*
Stylus trigger force (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, refer to the *OMP60* installation guide (Renishaw part no. H-4038-8505).

RMP40M and RMP60M radio modular systems (QE)

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.

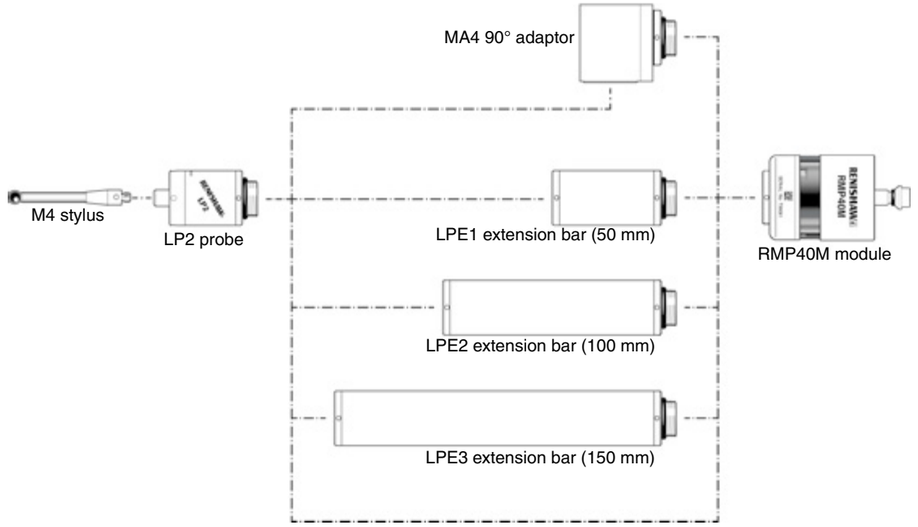
Renishaw has a comprehensive range of adaptors, extensions, and stylus configurations to overcome the most demanding of probing applications.

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

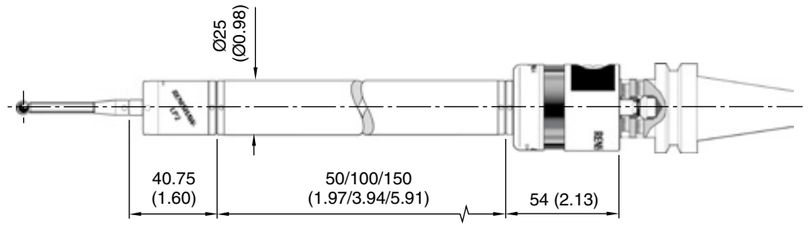
Key features and benefits:

- 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)

Modular system

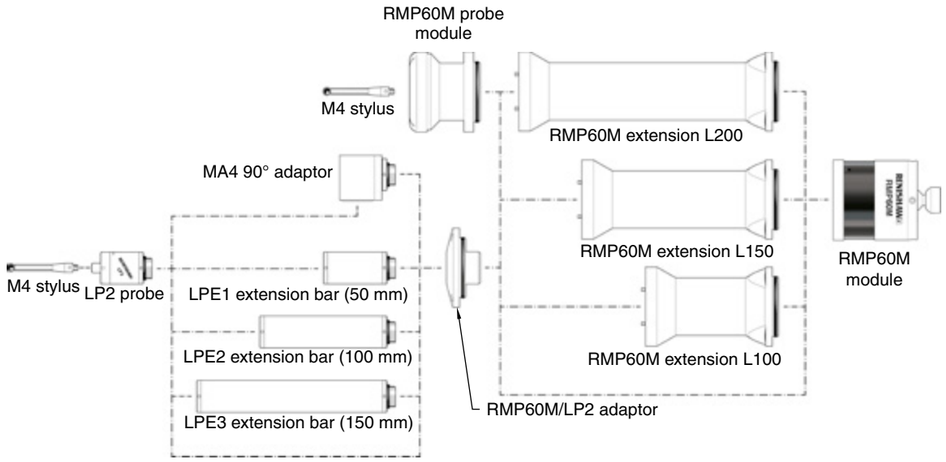


Dimensions

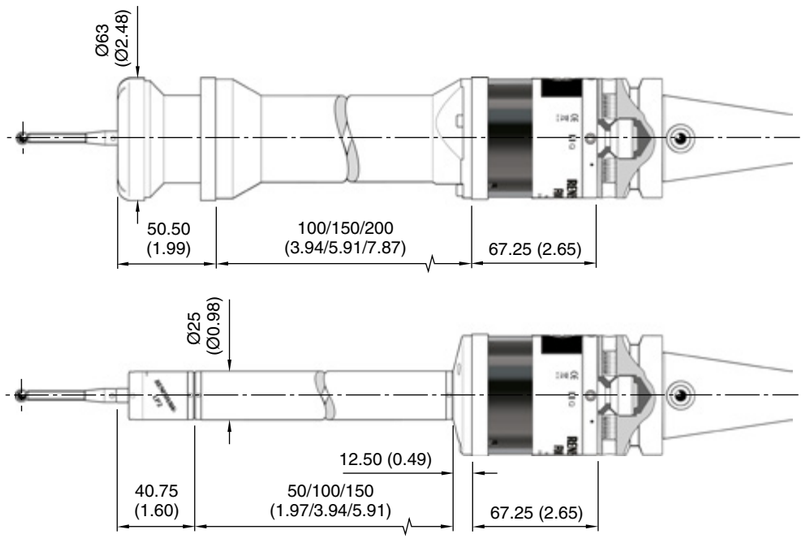


Dimensions given in mm (in)

Modular system



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		UK, EU, EFTA, Japan and USA (China exempt). For details about other regions, contact Renishaw.
Compatible probes		LP2 and variants
Compatible interfaces		RMI-QE
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)

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		UK, EU, EFTA, Japan and USA (China exempt). For details about other regions, contact Renishaw.
Compatible probes		LP2 and variants, and the OMP60M probe module
Compatible interfaces		RMI-QE
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, contact Renishaw or visit **www.renishaw.com/rmp40** or **www.renishaw.com/rmp60**

LP2

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 and mounted to an HPGA to move the probe out of the machine working envelope when not in use.. They can also be hard-wired for grinder inspection applications.

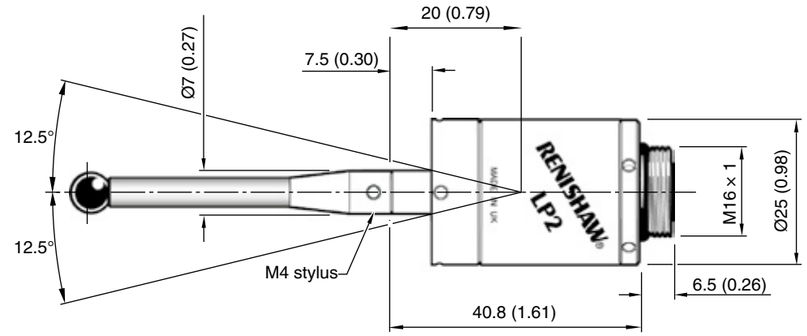
> **Old machines have been given a new lease of life because they now have intelligence via the probe and can therefore react to issues as they arise. New machines won't get through the door now without probes. So far, as value for money goes, they are easily the best bit of kit we've got on the camshaft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

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 version)

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

Dimensions



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

Dimensions given in mm (in)

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 (only when mounted to OMP60/40M)			
	Radio	RMI-Q or RMI-QE (only when mounted to RMP60/40M)			
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 *(note 1)*		2.00 µm (80 µin) 2σ *(note 1)*	
Stylus trigger force (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		+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.

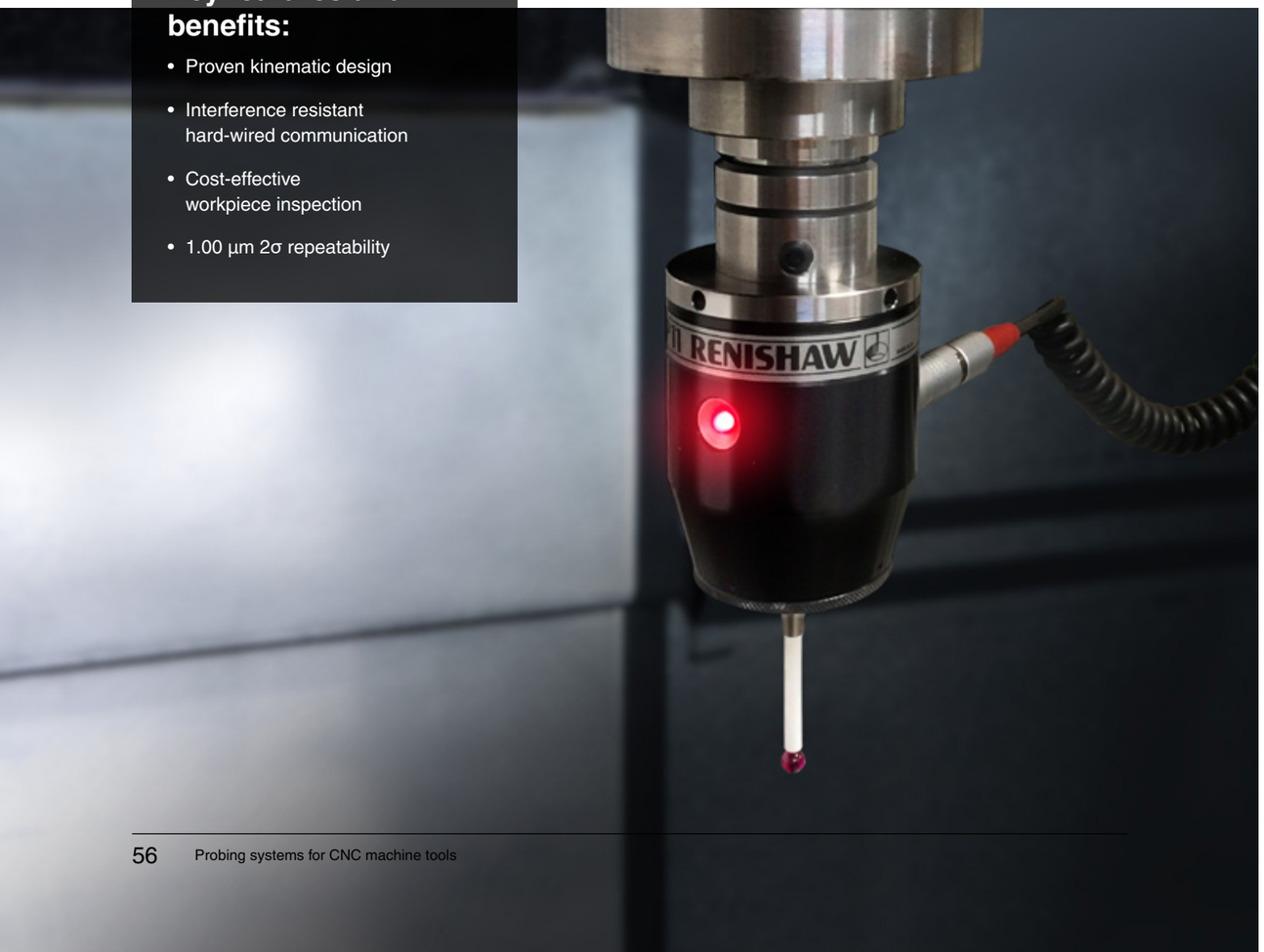
Note 3 These are the factory settings; manual adjustment of the LP2/LP2DD is possible, but the LP2H/LP2HDD is NOT adjustable. For more details, refer to the *LP2* installation and user's guide (Renishaw part no. H-2000-5021).

MP11

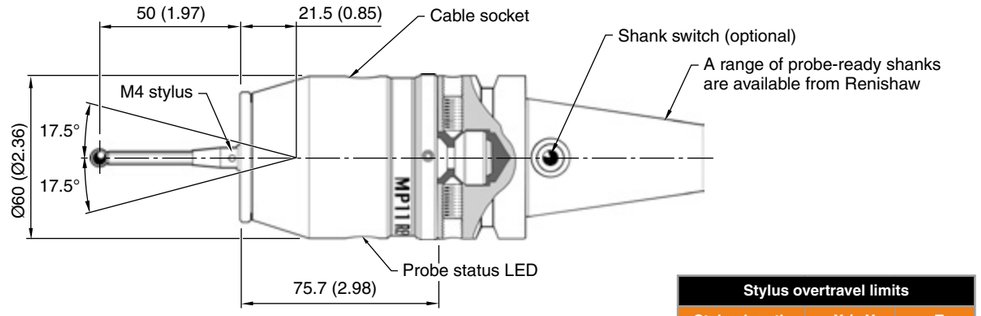
Designed for use in CNC milling machines with manual tool change, providing simple and quick insertion of the probe and cable connection. The integrated interface and curly cable hard-wired connection provide a straightforward installation and reliable communication method resistant to interference.

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)

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) 2s (note 1)
Stylus trigger force (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 +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, 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, contact Renishaw or visit **www.renishaw.com/mp11**

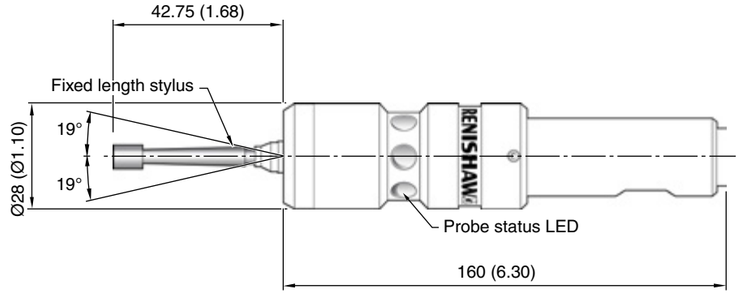
JCP

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.

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)

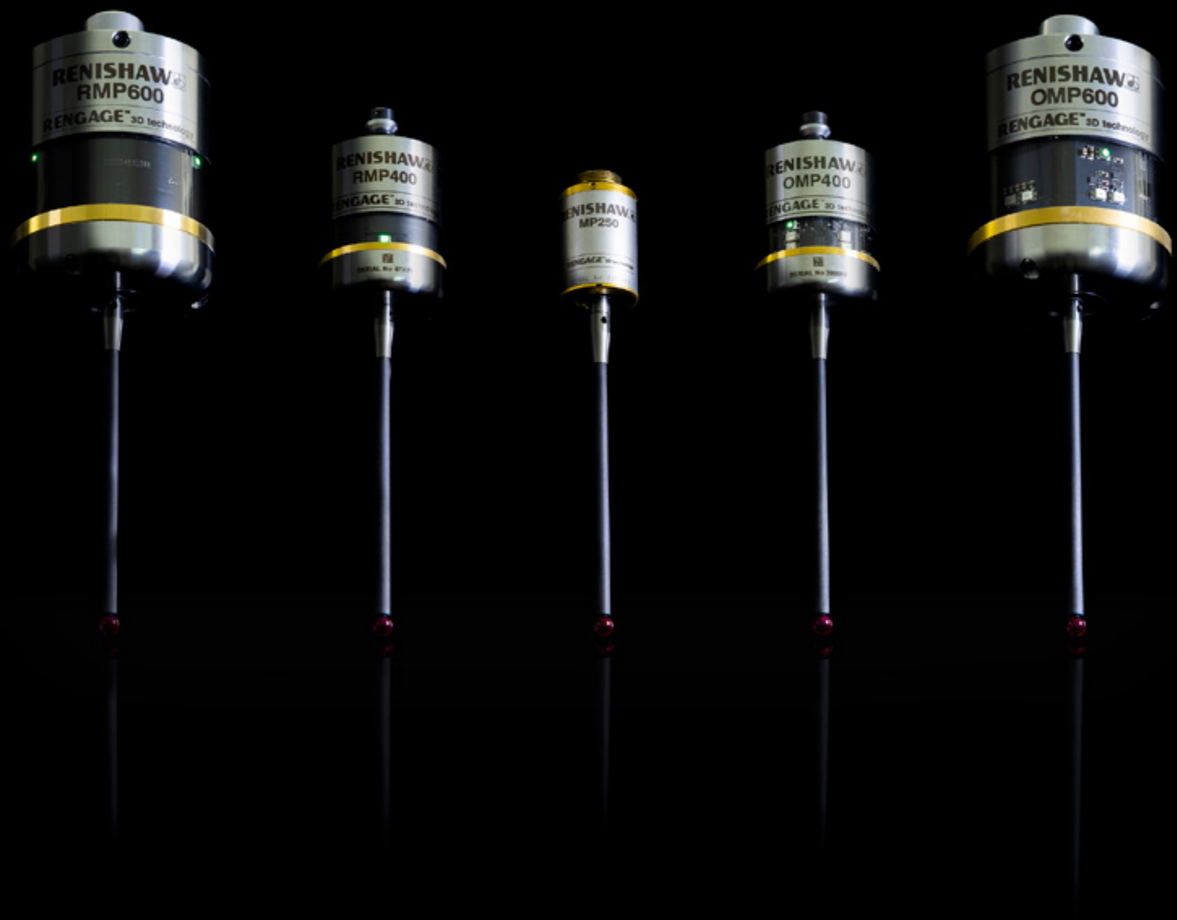
Specification

Variants		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)		30 hours	
Sense directions		±X, ±Y, +Z	
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(note 1)*	
Sealing		IP66 (EN/IEC 60529)	
Shanks		Ø20 mm (0.79 in)	Ø19.05 mm (0.75 in)
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

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

High-accuracy probes



RMP24-micro

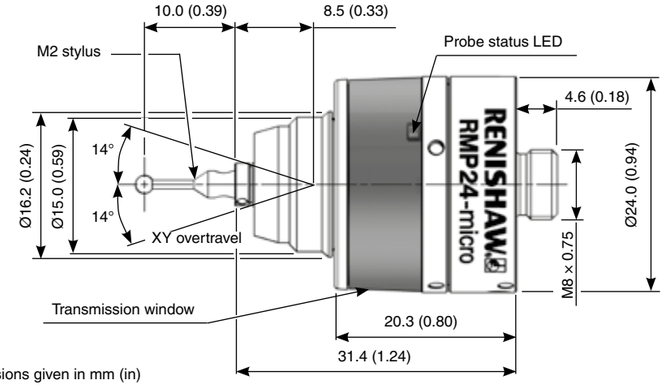
Renishaw's miniature radio probe, measuring just 24 mm in diameter and 31 mm in length, provides fast, accurate and reliable part set-up and verification in a package that fits in the palm of your hand.

RMP24-micro is our latest QE series probing system and communicates with the machine controller via the ultra-compact RMI-QE radio interface. It uses an updated version of our industry-proven frequency-hopping spread spectrum (FHSS) transmission technology and operates within the globally recognised 2.4 GHz frequency band. This agile protocol provides robust and reliable communication in busy radio environments and is compliant with radio regulations in all major markets.

Key features and benefits:

- Miniature design - ideally suited to compact machines manufacturing high-value, high-precision parts found in medical, watchmaking and micro-mechanics industries
- Highly repeatable - high-precision components with tight tolerances can be measured with exceptional repeatability
- Ultra-low trigger force - helps eliminate surface and form damage when inspecting soft metal components

Dimensions



Dimensions given in mm (in)

Stylus overtravel limits		
Stylus length	**±X / ±Y**	**+Z**
10 (0.39)	4.5 (0.18)	4 (0.16)
30 (1.18)	9.3 (0.37)	4 (0.16)

Specification

Principal application		Workpiece inspection and job set-up on small machining centres and multi-tasking machines
Transmission type		Frequency-hopping spread spectrum (FHSS) radio
Radio approval regions		UK, EU, EFTA, Japan and USA (China exempt). For details about other regions, contact Renishaw.
Compatible interfaces		RMI-QE combined antenna, interface and receiver unit
Operating range		Up to 5 m (16.4 ft)
Recommended styli		Steel, lengths 10 mm (0.39 in) to 30 mm (1.18 in)
Weight without shank (including batteries)		36.5 g (1.28 oz)
Switch-on/switch-off options		Radio on → Radio off
Battery life 2 × CR1632 lithium manganese dioxide (Li/MnO2)	**Standby life**	5.0 months
	Continuous use	228 hours
Sense directions		Omni-directional ±X, ±Y, +Z
Unidirectional repeatability		0.35 µm (14 µin) 2σ *(note 1)*
Stylus trigger force (notes 2 and 3) XY low force XY high force Z		 0.08 N, 8.2 gf (0.29 ozf) 0.14 N, 14.3 gf (0.50 ozf) 0.75 N, 76.5 gf (2.70 ozf)
Stylus overtravel force *(note 4)* XY plane (typical minimum) +Z direction (typical minimum)		 ±14° 4 mm (0.16in)
Spindle speed (maximum)		1000 r/min
Environment *(note 5)*	**Sealing**	IPX8, BS EN 60529:1992+A2:2013 (IEC 60529:1989+A1:1999+A2:2013)
	Storage temperature	-25 °C to +70 °C (-13 °F to +158 °F)
	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 (18.89 in/min) with a 10 mm stylus. For best performance probing feedrates of up to 100 mm/min (3.94 in/min) and back-off feed of greater than 1000 mm/min (39.34 in/min) are recommended.

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, machine deceleration and system latency.

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

Note 4 Stylus overtravel is designed to protect the probe and stylus from a collision. We do not recommend utilising the extent of travel in normal probing mode.

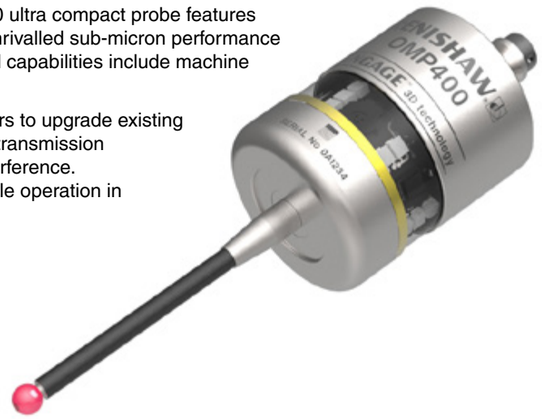
Note 5 With the battery cap removed the sealing rating is not applicable.

For further information and the best possible application and performance support, contact Renishaw or visit **www.renishaw.com/rmp24micro**

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 machine shop environments.



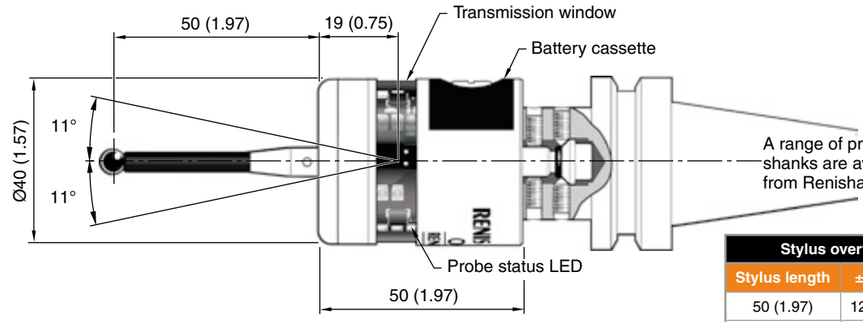
> **Meeting current and future performance requirements for our products demands manufacture of ever smaller and more intricate parts that are consistently accurate to within 1 µm. Reliable set-up and measurements are therefore critical to this process and form the basis of our decision to use RENGAGE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

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

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

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)

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 OMM-2 / OMM-2C with OSI	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.	
Battery life (2 × ½ AA 3.6 V Lithium-thionyl chloride) — **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 *(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 *(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 *(note 1)* ±1.75 µm (70 µin) – 100 mm (3.94 in) stylus length	
Stylus trigger force (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) *(note 3)* 5.50 N, 561 gf (19.78 ozf) *(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 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 the 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).

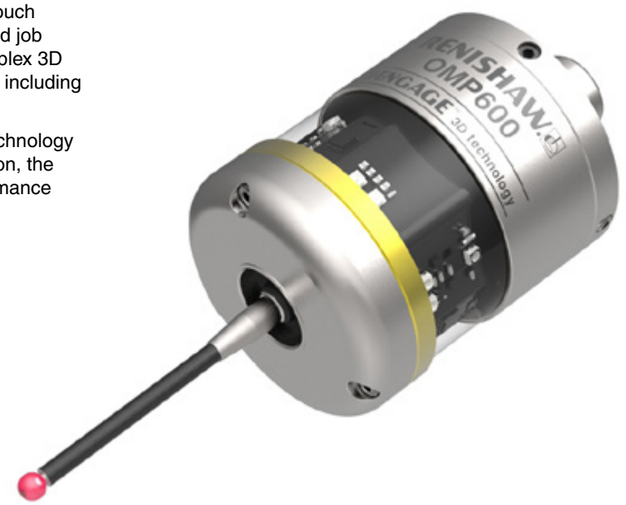
Note 4 Stylus overtravel force in the +Z direction occurs 10 µm to 11 µm after the trigger point and rises by 1.2 N/mm, 122 gf/mm (109.6 oz/in) until the machine tool stops.

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

OMP600

The OMP600 is a compact, high-accuracy touch probe that offers all the benefits of automated job set-up as well as the ability to measure complex 3D part geometries on CNC machining centres, including multi-tasking machines.

With patented RENGAGE™ strain gauge technology and interference-resistant optical transmission, the OMP600 provides the same superior performance found in all Renishaw high-accuracy probes.



Key features and benefits:

- Unbeatable 3D accuracy and repeatability enables reliable on-machine gauging/measurement
- Improved accuracy with long styli means difficult parts can be probed more easily
- Ultra-low trigger force for delicate work helps eliminate possible surface and form damage
- Compact design enables better access in restricted spaces and small machines
- Robust, even in the harshest environments, means reliable measurement and long service life

For further information and the best possible application and performance support, contact Renishaw or visit **www.renishaw.com/omp600**

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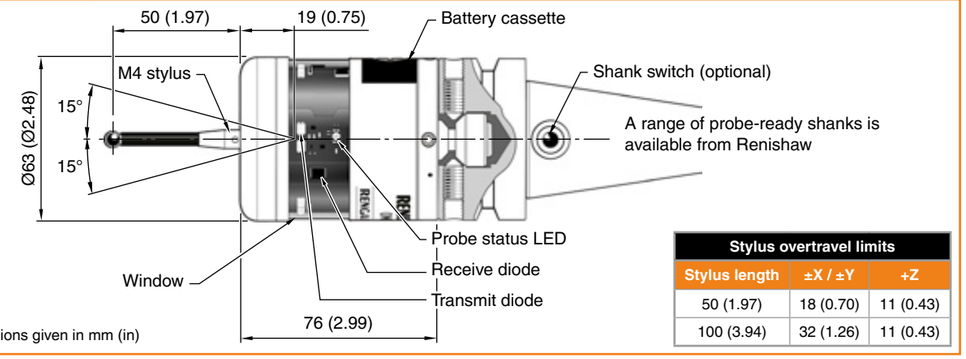
Dimensions



Dimensions given in mm (in)

Stylus overtravel limits		
Stylus length	±X / ±Y	+Z
50 (1.97)	18 (0.70)	11 (0.43)
100 (3.94)	32 (1.26)	11 (0.43)

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 OMM-2 / OMM-2C with OSI	OMI, OMM with MI 12
Operating range	Up to 6 m (19.7 ft)	
Recommended styli	High modulus carbon fibre, lengths 50 mm (1.97 in) to 200 mm (7.88 in)	
Weight without shank (including batteries)	1029 g (36.30 oz)	
Switch-on/switch-off options	Optical on →	Optical 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**	800 days maximum, dependent on switch-on/switch-off option.	
Battery life (2 × AA 3.6 V Lithium-thionyl chloride) — **Continuous use low power**	380 hours maximum, dependent on switch-on / switch-off option.	410 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 *(note 1)* 0.35 µm (14 µin) 2σ – 100 mm (3.94 in) stylus length	
X, Y (2D) form measurement deviation	±0.25 µm (10 µin) – 50 mm (1.97 in) stylus length *(note 1)* ±0.25 µm (10 µin) – 100 mm (3.94 in) stylus length	
X, Y, Z (3D) form measurement deviation	±1.00 µm (40 µin) – 50 mm (1.97 in) stylus length *(note 1)* ±1.75 µm (70 µin) – 100 mm (3.94 in) stylus length	
Stylus trigger force (notes 2 and 5) XY plane (typical minimum) +Z direction (typical minimum)	 0.15 N, 15 gf (0.54 ozf) 1.75 N, 178 gf (6.03 ozf)	
Stylus overtravel force XY plane (typical minimum) +Z direction (typical minimum)	 3.05 N, 311 gf (10.98 ozf) *(note 3)* 10.69 N, 1090 gf (38.51 ozf) *(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 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 the XY plane typically occurs 126 µm after the trigger point and rises by 0.32 N/mm, 33 gf/mm (29.3 ozf/in) until the machine tool stops (in the high force direction and using a carbon fibre stylus).

Note 4 Stylus overtravel force in the +Z direction typically occurs 50 µm after the trigger point and rises by 2.95 N/mm, 301 gf/mm (270 ozf/in) until the machine tool stops.

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

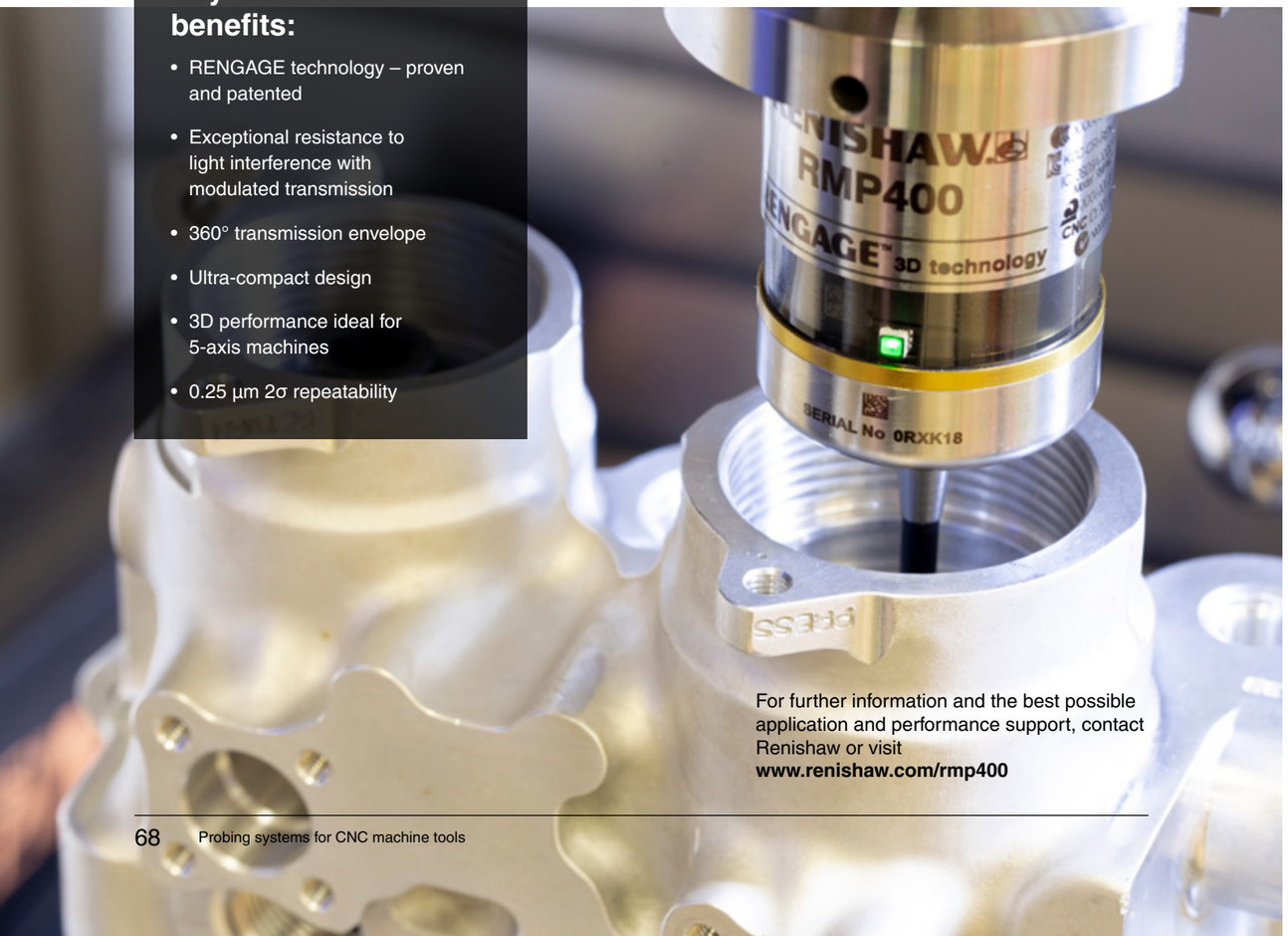
RMP400 (QE)

The RMP400 offers an unrivalled combination of size, accuracy, reliability and robustness, and allows high-accuracy probing on small to medium machining centres or other machines where line-of-sight problems affect optical signal transmission.

Successfully combining patented RENGAGE™ strain gauge technology with the patented frequency-hopping radio transmission system of the RMP40, the RMP400 provides existing probe users with a simple upgrade to solid-state strain gauge technology.

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



For further information and the best possible application and performance support, contact Renishaw or visit **www.renishaw.com/rmp400**

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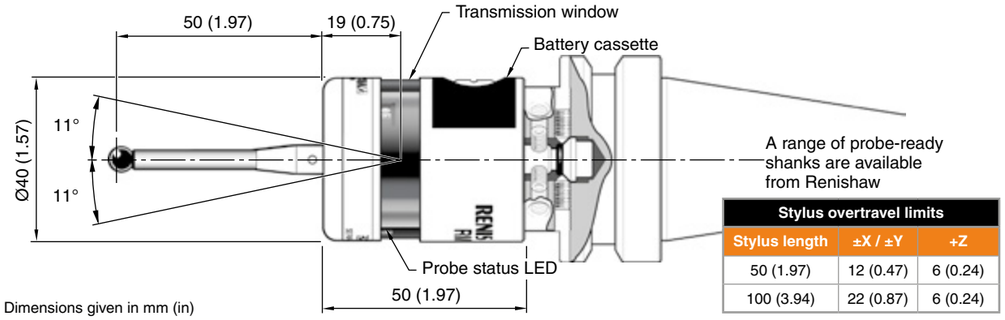
Dimensions



Dimensions given in mm (in)

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)

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		UK, EU, EFTA, Japan and USA (China exempt). For details about other regions, contact Renishaw.
Compatible interfaces		RMI-QE
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)		262 g (9.24 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**	37 months 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) 2s – 50 mm (1.97 in) stylus length (note 1) 0.35 µm (14 µin) 2s – 100 mm (3.94 in) stylus length
2D lobing in X, Y		±0.25 µm (10 µin) – 50 mm (1.97 in) stylus length (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 (note 1) ±1.75 µm (70 µin) – 100 mm (3.94 in) stylus length
Stylus trigger force (notes 2 and 5) XY plane (typical minimum) +Z direction (typical minimum)		 0.07 N, 7 gf (0.25 ozf). Trigger filter (Level 2) 1.02 N, 104 gf (3.67 ozf). Trigger filter (Level 3)
Stylus overtravel force XY plane (typical minimum) +Z direction (typical minimum)		 2.8 N, 285 gf (10.07 ozf) typical minimum (note 3) 9.8 N, 999 gf (35.25 ozf) typical minimum (note 4)
Minimum probing speed		3 mm/min (0.12 in/min)
Sealing		IPX8, BS EN 60529:1992+A2:2013 (IEC 60529:1989+A1:1999+A2:2013)
Storage temperature		-25 °C to +70 °C (-13 °F to +158 °F)
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °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 the 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 the +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.

RMP600 (QE)

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.

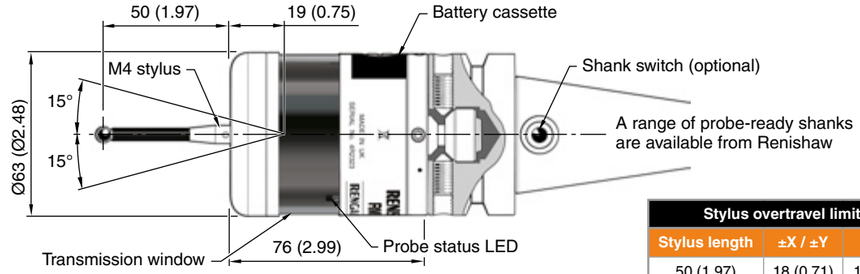
> **We are very happy with the accuracy of RMP600 and, in particular, the consequent reduction in scrap parts further down the production line. These are large, expensive components and we can use the probe to identify and avoid errors.**
>
> Tods Composite Solutions Ltd (UK)

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

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

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)

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		UK, EU, EFTA, Japan and USA (China exempt). For details about other regions, contact Renishaw.
Compatible interfaces		RMI-QE
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**	116 months maximum, dependent on switch-on / switch-off option.
	Continuous use	540 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 *(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 *(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 *(note 1)* ±1.75 µm (70 µin) – 100 mm (3.94 in) stylus length
Stylus trigger force (notes 2 and 5) XY plane (typical minimum) +Z direction (typical minimum)		 0.10 N, 10 gf (0.36 ozf). Trigger filter (Level 2) 1.22 N, 124 gf (4.39 ozf). Trigger filter (Level 3)
Stylus overtravel force XY plane (typical minimum) +Z direction (typical minimum)		 2.8 N, 285 gf (10.07 ozf) typical minimum *(note 3)* 9.8 N, 999 gf (35.25 ozf) typical minimum *(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 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 the 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 the +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.

MP250

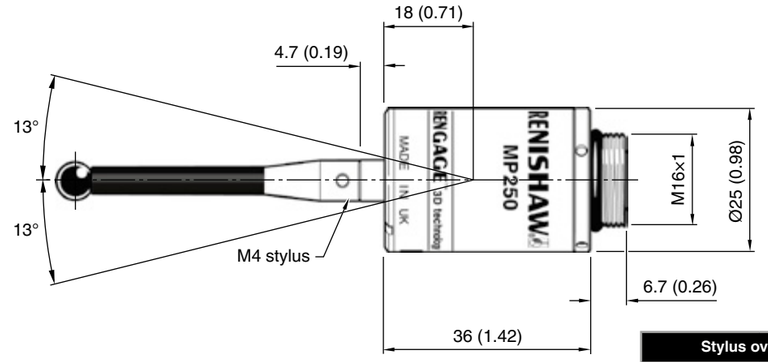
The miniature MP250 is the world's first strain gauge inspection probe for grinding machines, using Renishaw's patented RENGAGE™ technology. Suitable for use in harsh environments with double diaphragm sealing as standard. It sets new standards for the precision measurement of 3D part geometries, whilst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

MP250 can also be hard-wired for grinder inspection applications.

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)

Specification

Principal application	Workpiece inspection and job set-up on CNC grinders.
Transmission type	Hard-wired transmission
Compatible interfaces	HSI and HSI-C
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 *(note 1)*
2D lobing in X, Y	±0.25 µm (10 µin) *(note 1)*
3D lobing in X, Y, Z	±1.00 µm (40 µin) *(note 1)*
Stylus trigger force *(notes 2 and 5)*	
XY plane (typical minimum)	0.08 N, 8 gf (0.29 ozf)
+Z direction (typical minimum)	2.60 N, 265 gf (9.35 ozf)
Stylus overtravel force	
XY plane (typical minimum)	0.70 N, 71 gf (2.52 ozf) *(note 3)*
+Z direction (typical minimum)	5.00 N, 510 gf (17.98 ozf) *(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, 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.

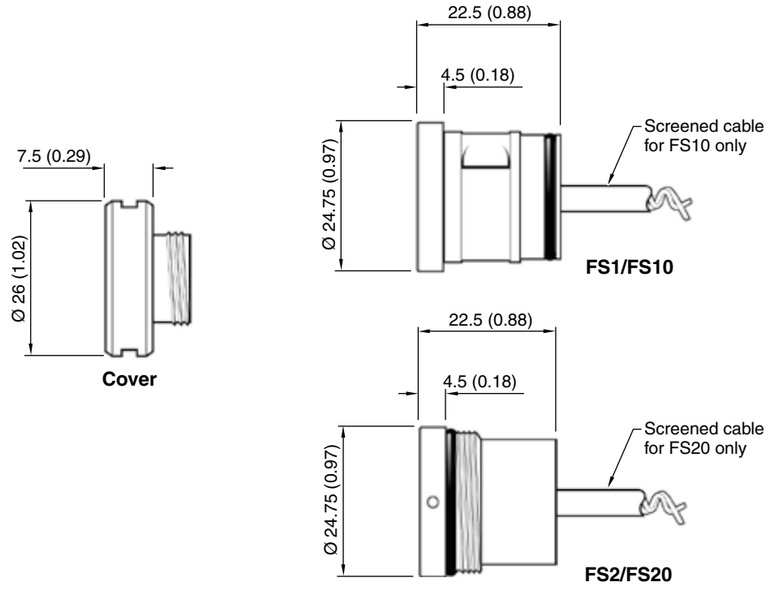
FS1/FS10 can be radially adjusted by ±4° for aligning the square stylus tip on the probe to the machine axes, whereas the FS2/FS20 are used in fixed applications that do not require adjustment.

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)

Specification

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, HSI-C 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		+5 °C to +55 °C (+41 °F to +131 °F)	

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

Scanning probes (SPRINT™ technology)

OSP60

The OSP60 probe with SPRINT™ technology is a compact spindle probe with optical signal transmission for performing both scanning and touch 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
- 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

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

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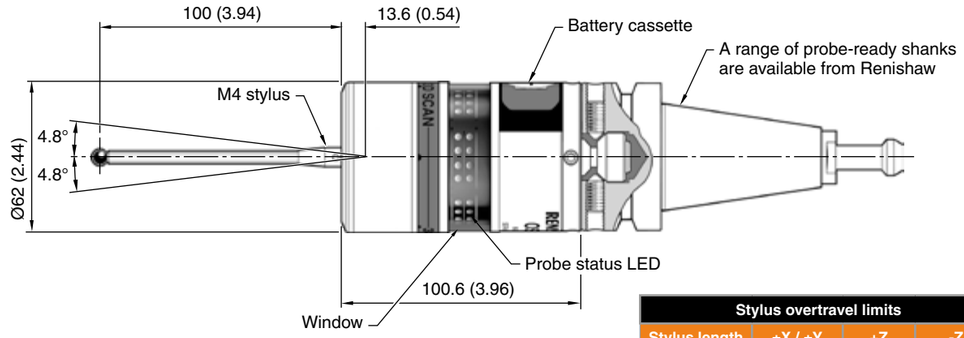
Dimensions



Stylus overtravel limits			
Stylus length	±X / ±Y	+Z	-Z
75 (1.97)	7 (0.28)	6 (0.24)	2.2 (0.09)
100 (3.94)	9 (0.35)	6 (0.24)	2.2 (0.09)
150 (5.91)	13.5 (0.53)	6 (0.24)	2.2 (0.09)

Dimensions given in mm (in)

Specification

Principal application		High-speed scanning system for on-machine process control.			
OSP60		Analogue scanning probe for machine tools, capable of both 3D scanning and 3D discrete point measurements.			
Transmission type		Infrared optical transmission: up to 1000 3D points per second			
Compatible interfaces		OSI-S (interface), OMM-S (receiver)			
Operating range		360°. Up to 4.5 m (14.7 ft) with one receiver, or up to 9 m (29.5 ft) with two receivers.			
Probe turn on time		Less than 0.5 seconds			
Recommended styli		Straight styli only. OSP60-specific styli recommended. For further information, see the information leaflet *Styli recommendations for OSP60 scanning probes* (Renishaw part no. H-5465-8102).			
Stylus length range		75 mm to 150 mm (2.95 in to 5.91 in) recommended.			
Stylus ball diameter range		2 mm to 8 mm (0.078 in to 0.31 in) typical.			
Weight without shank (including batteries)		1080 g (38.1 oz)			
Battery type (3 x CR123 3 V Lithium-manganese dioxide)	**Standby life**	Full power	121 days	Low power	121 days
	5% usage		320 hours *(note 1)*		620 hours *(note 1)*
	Continuous use		16 hours		31 hours
Scanning measurement range *(note 2)*		±X, ±Y, ±Z 0.50 mm (0.020 in)			
Sensor type		Full 3D (simultaneous XYZ data output)			
Sense directions		Omnidirectional ±X, ±Y, ±Z.			
Sensor resolution (µm/digit) *(note 3)*		XY 0.025 µm (0.9843 µin)			
3D lobing in X, Y, Z *(notes 3 and 5)*		±1.00 µm (40 µin)			
Repeatability *(notes 3 and 4)*		±0.25 µm (10 µin) 2 σ			
Maximum scanning speed *(note 6)*		Up to rapid (G0) feedrate dependent on machine tool performance and application.			
Stylus overtravel force XY plane (typical minimum) +Z direction (typical minimum)		**Spring rate** *(note 3)* 0.8 N/mm (4.57 lb/in) 1.5 N/mm (8.57 lb/in)		**Measuring force** *(notes 3 and 7)* 0.1 N 10 gf (0.4 ozf) 0.2 N 20 gf (0.7 ozf)	
Sealing		IPX8 (EN/IEC 60529)			
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)			

Note 1 Calculated value.
Note 2 Maximum allowed distance between the nominal scan line and the actual scan line. Full 3D performance on a vertical machining centre with a 75 mm stylus. In some applications, this range can be extended. Contact your local Renishaw representative for more information.
Note 3 Typical for a 100 mm stylus.
Note 4 Productivity+ discrete point measurement on a DMG Mori DMU40.
Note 5 Productivity+ 100 point 3D sphere discrete point measurement on a DMG Mori DMU40.
Note 6 Maximum feedrate for over deflection protection is F40000 in Z and F60000 in XY.
Note 7 Force at which the status signal changes for touch trigger. Assumes a trigger threshold of 0.125 mm (0.0049 in)

OSP60 styli

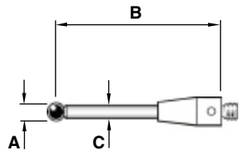
To further enhance the operational benefits provided by the OSP60 probe, a range of premium styli are available offering enhanced metrology performance.

OSP60 styli use grade 5 stylus balls that are UKAS certified, and come in standard or individually calibrated versions. They are available in a range of lengths from 80 mm to 150 mm, with either ruby or silicon nitride ball material. The OSP60 can also be used with standard Renishaw styli.

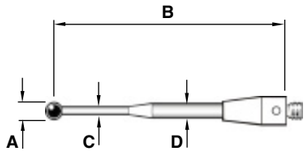
Key features and benefits:

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

Dimensions



		Ball material			
		Ruby	Silicon nitride	Ruby	Silicon nitride
Part Number	Standard	A-5004-4472	A-5004-6470	A-5004-4474	A-5004-6471
	Calibrated	A-5465-8576	A-5465-5008	A-5465-8577	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)	



		Ball material					
		Ruby	Silicon nitride	Ruby	Silicon nitride	Ruby	Silicon nitride
Part Number	Standard	A-5004-6463	A-5004-6467	A-5004-6464	A-5004-6468	A-5004-6465	A-5004-6469
	Calibrated	A-5465-5001	A-5465-5005	A-5465-5002	A-5465-5006	A-5465-5003	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		3.80 (0.15)		3.80 (0.15)		3.80 (0.15)	

Dimensions given in mm (in)

*EWSL is the effective working scanning length during scanning and is dependent on nominal deflection.
For more information, refer to *Styli recommendations for OSP60 scanning probes (Renishaw part no. H-5465-8102).*

Tool setting systems

Tool setting technology comparison chart

Comparison chart

	Page	Transmission type: Optical	Transmission type: Radio	Transmission type: Hard-wired	Function: Tool setting	Function: Broken tool detection	Minimum tool detection	Repeatability (2σ)	Stylus trigger force	Laser classification	Battery type
Contact											
OTS	100	●			●	●	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	102		●		●	●	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	104			●	●	●	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	106			●	●	●	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
LTS	108			●	●	●	Ø0.1 mm	0.75 µm	3 N / 306 gf (10.79 ozf) Z direction		N/A
APC	110			●	●	●	Ø1.0 mm	1.50 µm	0.50 N to 5.85 N / 51 gf to 597 gf (1.80 ozf to 21.04 ozf)		N/A
Non-contact											
NC4 systems	114			●	●	●	Ø0.03 mm (tool setting) Ø0.03 mm (breakage)	±1 µm *	N/A	Class 2	N/A
NCPCB ¥	118			●	●	●	Ø0.10 mm (tool setting) Ø0.08 mm (breakage)	0.50 µm		N/A	
TRS2	120			●		●	Ø0.2 mm (breakage) §	N/A	N/A	Class 2	N/A

* 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

	Page	Transmission type: Optical	Transmission type: Radio	Transmission type: Hard-wired	Function: Tool setting	Function: Broken tool detection	Function: Workpiece inspection	Operation	Repeatability for the complete system including probe (2σ)	Probe
Tool setting arms										
HPRA	124			●	●			Manual - Removable	5.00 µm (6 in – 15 in arms) 8.00 µm (18 in arms +)*	RP3
HPPA	126			●	●			Manual - Pull-down		
HPMA	128			●	●	●		Automated - Motorised		
HPMA-X	130			●	●	●		Automated - Motorised		
HPGA	132			●	●	●	●	Automated - Motorised	3.00 µm	RP3, LP2 or MP250

* For more information, please refer to H*PMA-X and TSI 3-X motorised arm and interface* datasheet (Part no.: H-6671-8200-01)

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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 rework
- reduces scrap
- reduces cost

Recommended technology

Application	Contact	Non-contact
Tool setting	●	●
Tool setting small tools < Ø0.1 mm		●
Broken tool detection	●	●
Profile checking		●
Missing insert detection		●
Wireless operation	●	

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 controller. Renishaw products cover a multitude of applications, from simple, quick, tool setting to the complex digitising of ground tools.

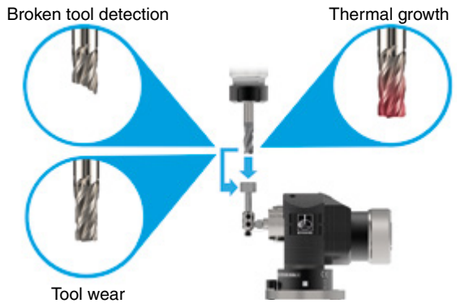
Kinematic tool setters

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.

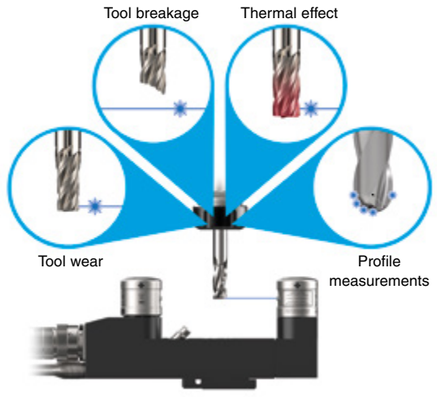
From simple length and radius checking to broken tool detection, this technology is available in all Renishaw’s contact tool setters.



High-accuracy laser tool setting systems

Renishaw’s range of NC4 non-contact tool setters provides high-precision, high-speed tool measurement and broken tool detection, allowing process control on all sizes and types of machine tools.

Measurements are fast and accurate, allowing users to increase their productivity and machine utilisation while simultaneously reducing scrap and rework.



Single-sided laser-based broken tool detection

The ground-breaking 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.

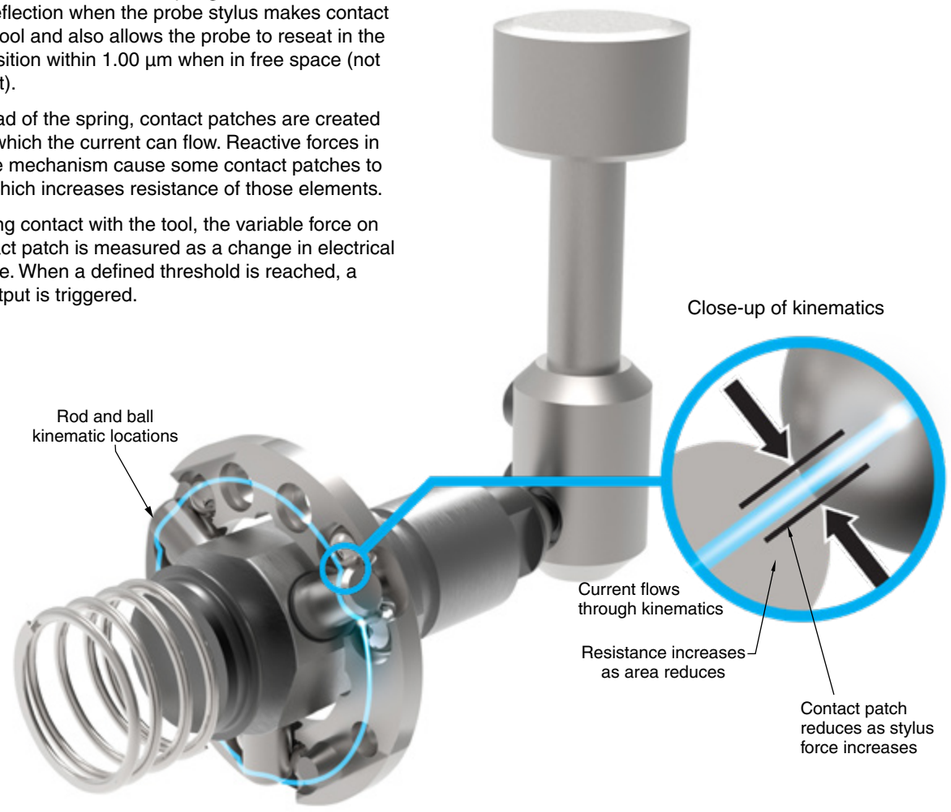
Laser-based broken tool detection can provide great benefits in reducing scrap and costs with a minimal addition to cycle time.

Kinematic contact tool setter design

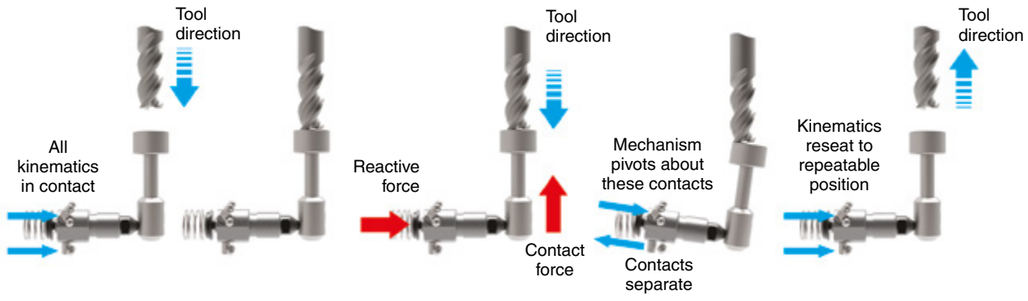
Three equally spaced rods rest on six tungsten carbide balls providing six points of contact in a kinematic location. An electrical circuit is formed through these contacts. The mechanism is spring loaded which allows deflection when the probe stylus makes contact with the tool and also allows the probe 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 tool, 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.



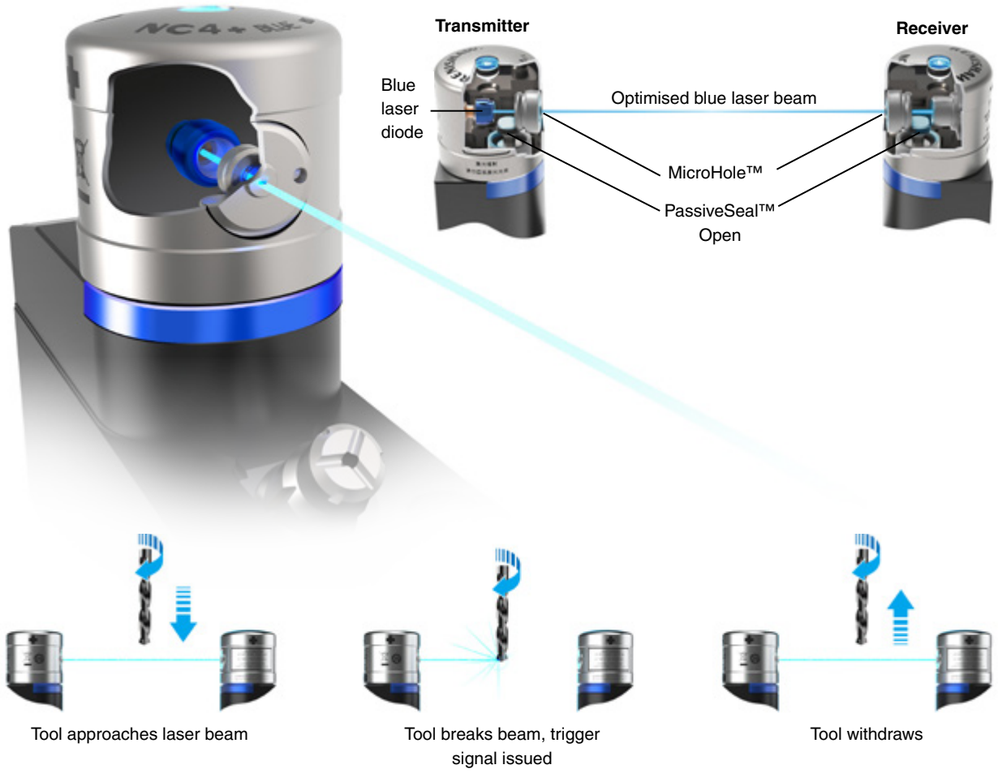
Based on the above kinematic principle, the stages in trigger generation are shown below. Repeatable reseating of the mechanism is critical to this process and fundamental to reliable metrology.



Non-contact laser-based tool setter design

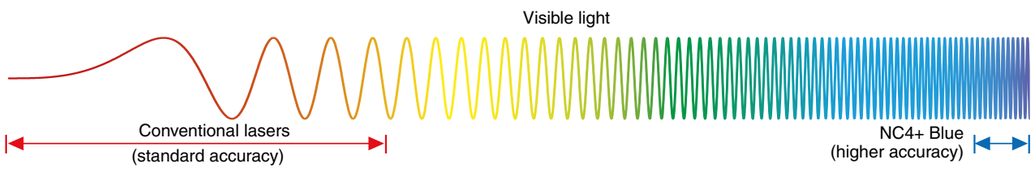
Non-contact laser tool setting systems use a beam of laser light, passing between a transmitter and a receiver, positioned within the machine tool so the cutting tools can be passed through the beam.

The passage of a tool into the beam causes a reduction in the amount of laser light being acquired by the receiver, and a trigger signal is generated. This records 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.



Blue laser technology

While conventional laser tool setting systems feature a red laser beam, NC4+ Blue is the industry's first blue laser tool setter. Blue lasers have a shorter wavelength, optimising laser geometry. As a result, NC4+ Blue delivers a step change in tool measurement accuracy:



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™ system. 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 IPX6 protection at all times.

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:

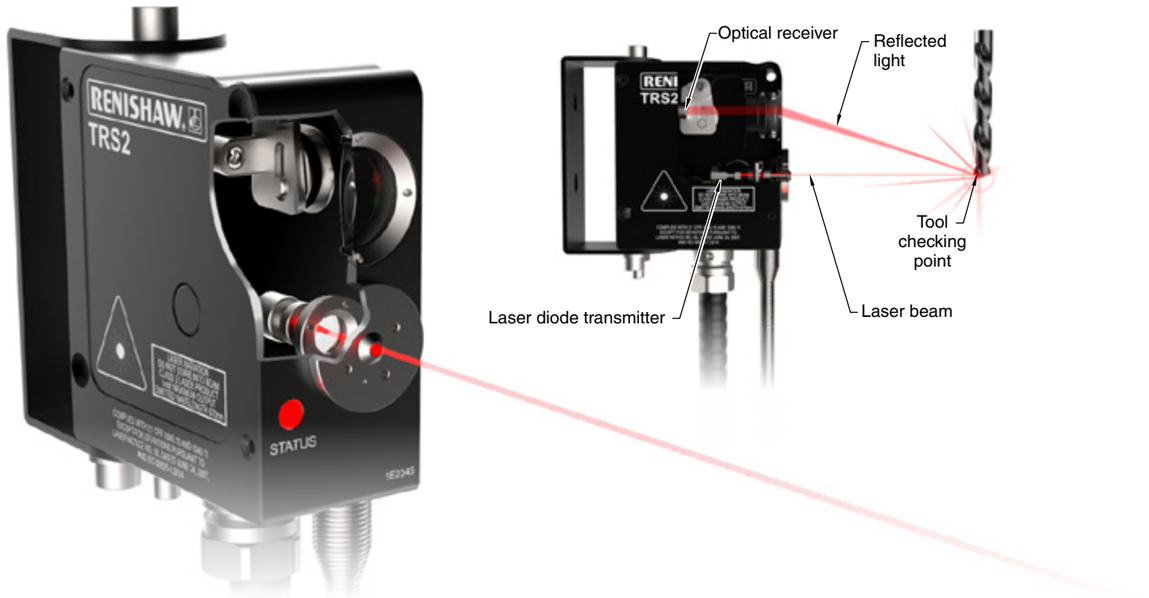
- Fail-safe environmental protection
- Robust and reliable operation
- Provides IPX6 protection of system optics at all times
- Reduces system maintenance and downtime
- No control system or M-codes required
- Compact design minimises space required within the machine tool
- Simple system requires only 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 tool setting arms are used to present a 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.

The robust rotational kinematic design used in HPPA, HPMA, HPGA and HPMA-X ensures repeatability. When the arm is actuated into the arm ready position 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 load, providing a torque to hold the hub in position.

The kinematic locations for HPRA follow the same 'six points of contact' principle as our probes, resulting in consistent fitment of the arm.

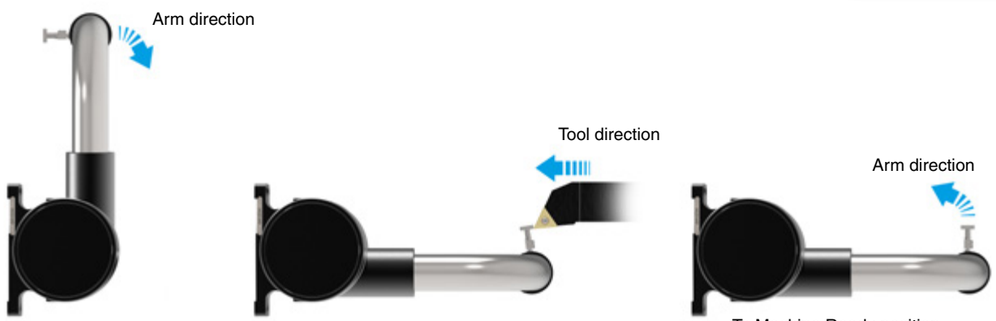
Whether manual or automatic, all Renishaw tool setting arms provide highly repeatable positioning of the probe. (Please refer to the *comparison chart* **page 85**)

Manual arms

- **HPRA** High-precision removable arm for use on multiple different machines for great flexibility
- **HPPA** High-precision pull-down arm for use on demand for quick and accurate tool setting

Motorised arms

- **HPMA** High-precision motorised arm for automating tool setting and breakage detection, enabling high-volume and productive machining
- **HPMA-X** High-precision motorised arm for extra-large machines, supporting multiple probes for multi-tool setting and breakage detection operations
- **HPGA** High-precision generic arm for ultra-high repeatability in extremely harsh environments, with part inspection capability

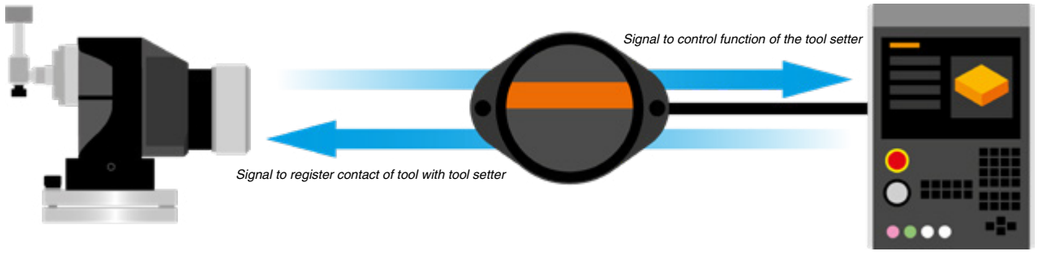


To Arm Ready position

Tool setting

To Machine Ready position

Transmission systems explained



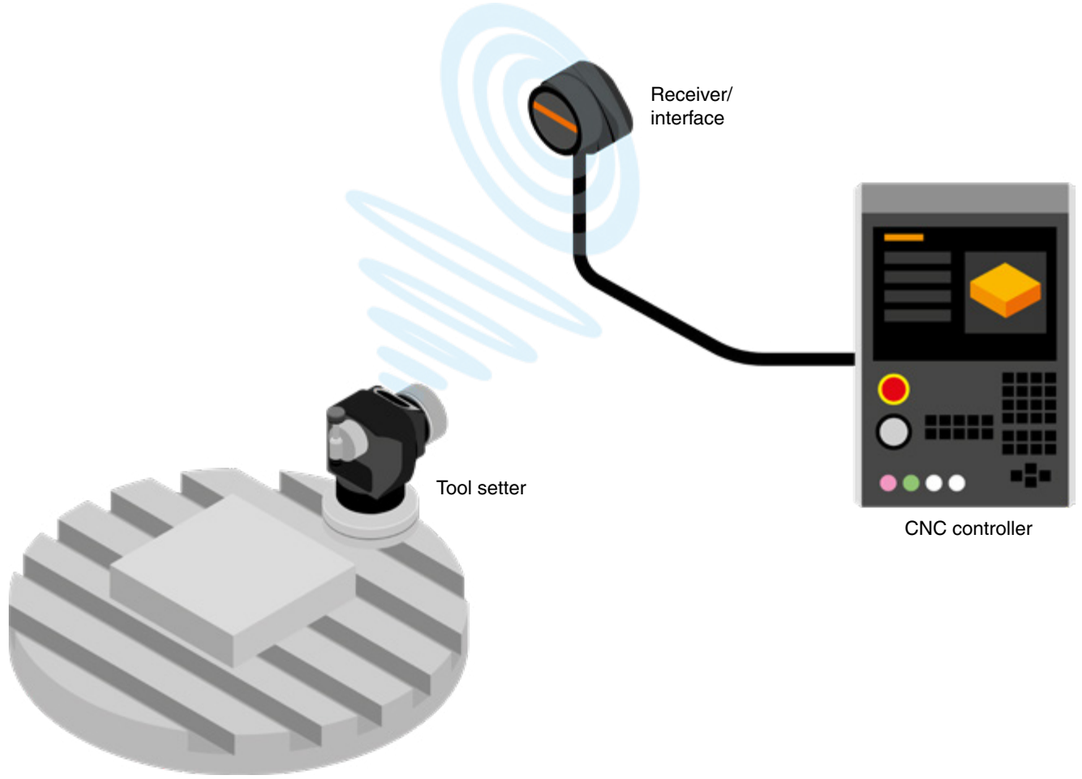
The passage of these signals is handled by a transmission system. The choice of transmission system depends on the type of probe and the type of machine tool to which it is fitted.

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

Compatibility chart

		Interfaces										
		Optical		Radio	Hard-wired							Optical module system
	Page	OMI-2 and variants	OMM-2C	RMI-QE	MI 8-4	HSI	HSI-C	NCi-6	TSI 2 and TSI 2-C	TSI 3 and TSI 3-C	TSI 3-X	OSI with OMM-2
Contact tool setters												
OTS	100	●	●									●
RTS	102			●								
TS27R	104				●	●	●					
TS34	106				●	●	●					
LTS	108	Integrated interface										
APC	110					●	●					
Non-contact tool setters												
NC4 systems	114							●				
NCPCB	118	Designed to work with SIEB and MEYER 44.20.020, 44.20.020A, and 44.20.0120 laser cards										
TRS2	120	Integrated interface										
Arms												
HPRA	124								●			
HPPA	126								●			
HPMA	128									●		
HPMA-X	130										●	
HPGA	132					●	●			●		

Radio transmission systems



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

Tool setter

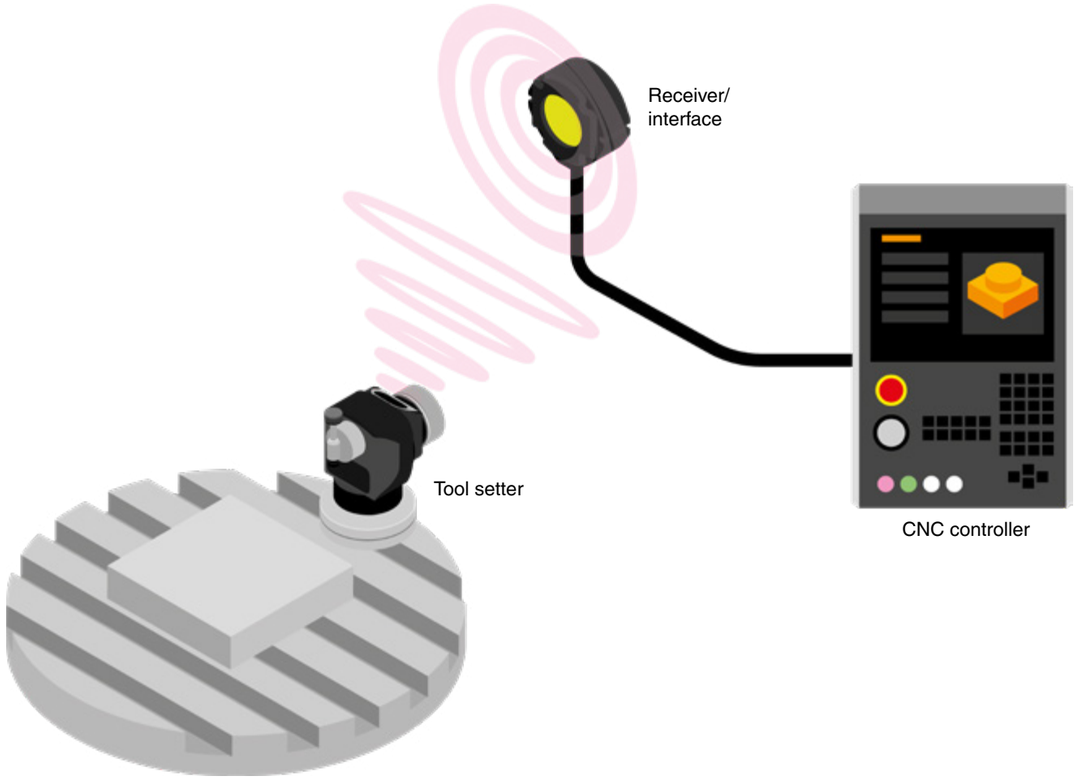
The tool setter receives machine controller signals and transmits status signals. There are two active modes, “standby” and “operating”. In standby mode, the tool setter is periodically transmitting and receiving, waiting for a signal to switch to operating mode. In operating mode it transmits probe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

Optical transmission systems



A Renishaw optical transmission system uses infrared technology for communication between the tool setter and the CNC controller 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.

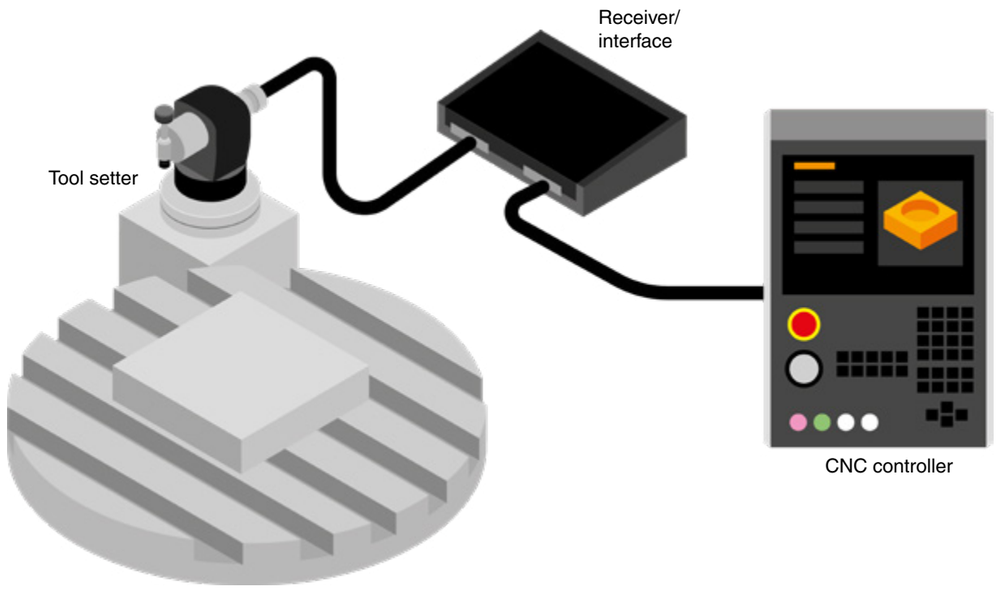
Receiver/interface

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.

Hard-wired transmission systems



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

Tool setter

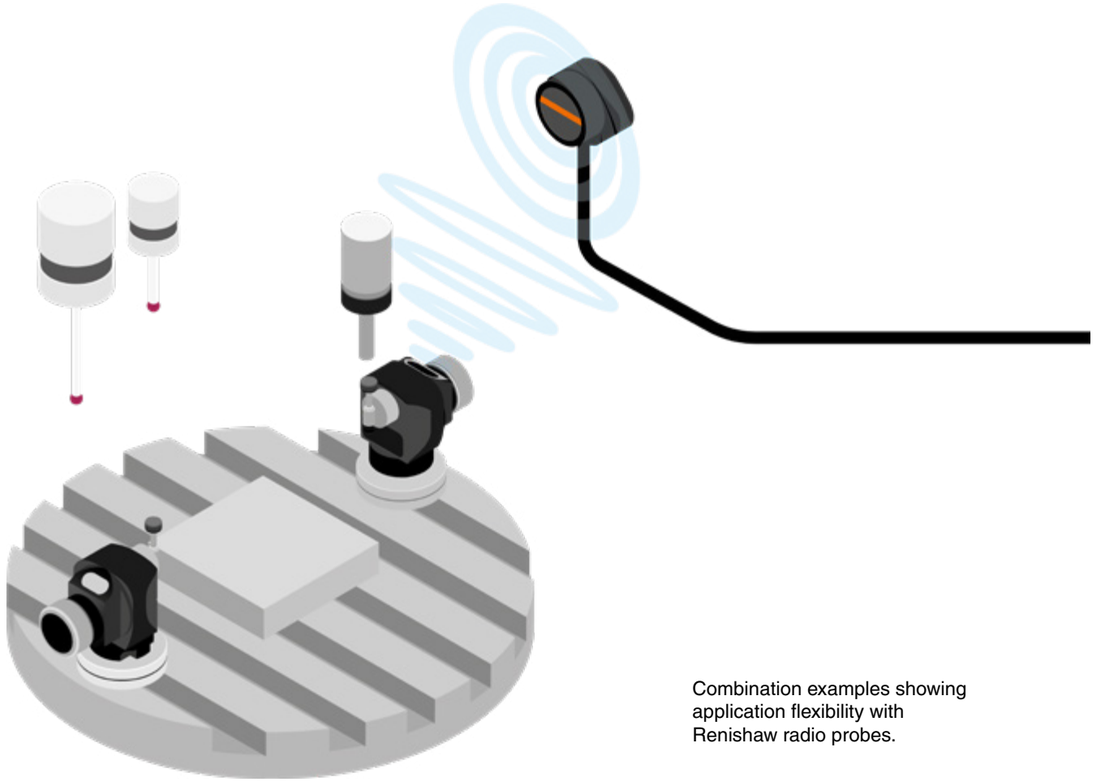
A signal cable connects the tool setter to a machine interface unit, carrying power and tool setter signals.

Receiver/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 probe transmission systems



Combination examples showing application flexibility with Renishaw radio probes.

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	OMP60/M, OMP600, OMP40-2/M, OMP400, OLP40
Multi optical probes	3	OSI with OMM-2 or OMM-2C	OMP60/M, OMP600, OMP40-2/M, OMP400, OLP40, OTS
Multi radio probes	4	RMI-QE	RMP40/M, RMP400, RLP40, RMP24-micro, RMP60/M, RMP600, RTS
* Any combination			

Practical examples of multiple Renishaw tool setter applications might include:

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

What tool setter?

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

Tool setter selector

Machine types		Vertical CNC machining centres			Horizontal CNC machining centres			Gantry CNC machining centres
Products	Page	Machine size			Machine size			All
		S *	M *	L *	S *	M *	L *	
Contact tool setters								
OTS	100	●	●		●	●		
RTS	102		●	●		●	●	●
TS27R	104	●	●	●	●	●	●	●
TS34	106	●	●	●	●	●	●	
LTS	108	●	●	●	●	●	●	
APC	110							
Non-contact tool setters								
NC4 systems	114	●	●	●	●	●	●	●
NCPCB	118							
TRS2	120	●	●	●	●	●	●	
Arms								
HPRA	124							
HPPA	126							
HPMA	128							
HPMA-X	130							
HPGA	132							
Machine types/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	Page	Machine size			Machine size			All	All
		S *	M *	L *	S *	M *	L *		
Contact tool setters									
OTS	100								
RTS	102								
TS27R	104								
TS34	106								
LTS	108								
APC	110	●	●	●	●	●	●		
Non-contact tool setters									
NC4 systems	114				●	●	●	●	
NCPCB	118								●
TRS2	120				●	●	●		
Arms									
HPRA	124	●	●	●	●	●	●		
HPPA	126	●	●	●	●	●	●		
HPMA	128	●	●	●	●	●	●		
HPMA-X*	130	●	●	●	●	●	●		
HPGA	132	●	●	●	●	●	●	●	
Machine types/sizes		Small		Medium			Large		*Extra large
		Table size < 700 mm × 600 mm		Table size < 1200 mm × 600 mm			Table size > 1200 mm × 600 mm		
§ 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		Chuck size 24 in plus
‡ CNC multi-tasking machines		Working range < 1500 mm		Working range < 3500 mm			Working range > 3500 mm		

Contact tool setters

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.

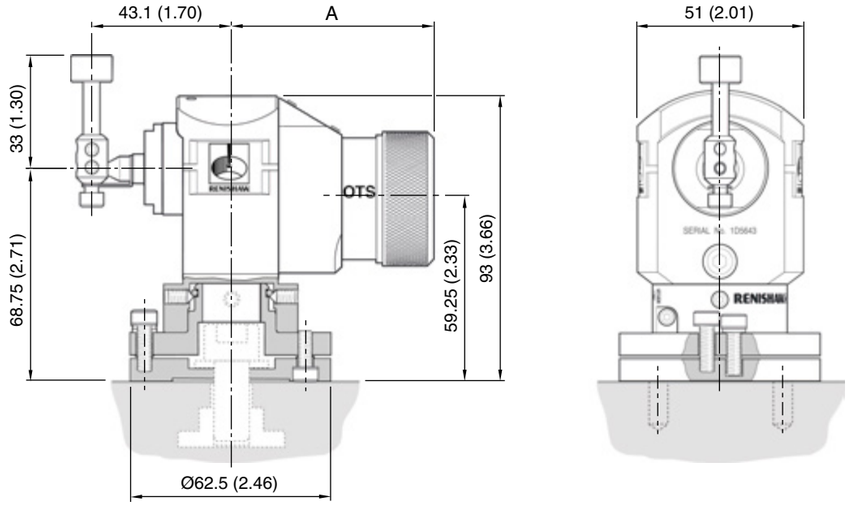
½ AA OTS

Key features and benefits:

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

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

Dimensions



Stylus overtravel limits	
±X / ±Y	+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)

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 or OMM-2 / OMM-2C with OSI	
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 *(note 1)*	
Stylus trigger force *(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 +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.

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.

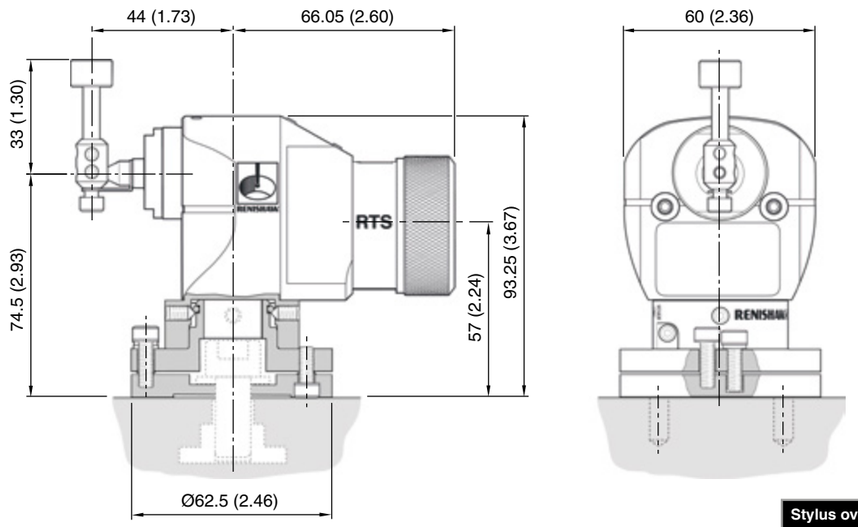
The RTS forms part of Renishaw's family of radio transmission probes. The cable-free design enables the RTS to be used as a standalone or as part of a multi-probe system allowing use in a wide range of applications.

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

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

Dimensions



Stylus overtravel limits	
±X / ±Y	+Z
±3.5 (0.14)	6 (0.24)

Dimensions given in mm (in)

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		UK, EU, EFTA, Japan and USA (China exempt). For details about other regions, contact Renishaw.
Compatible interfaces		RMI-QE
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**	99 months maximum
	Continuous use	4860 hours maximum
Sense directions		±X, ±Y, +Z
Unidirectional repeatability		1.00 µm (40 µin) 2σ *(note 1)*
Stylus trigger force *(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)

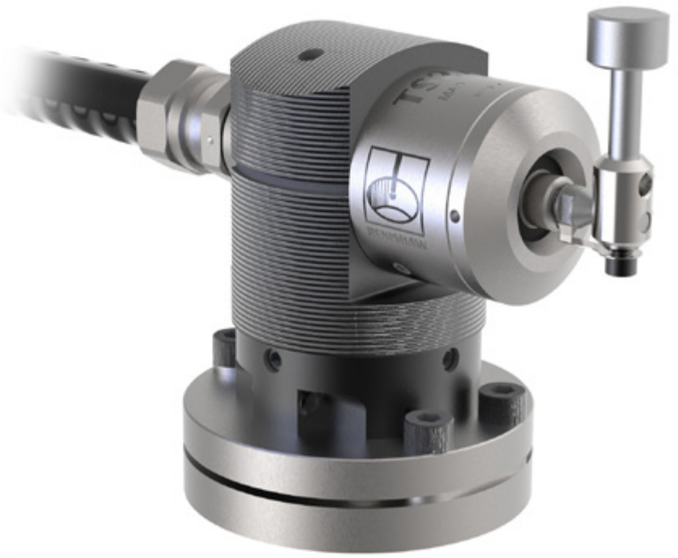
Note 1 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 35 mm stylus. Significantly higher velocity is possible depending on application requirements.

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.

TS27R

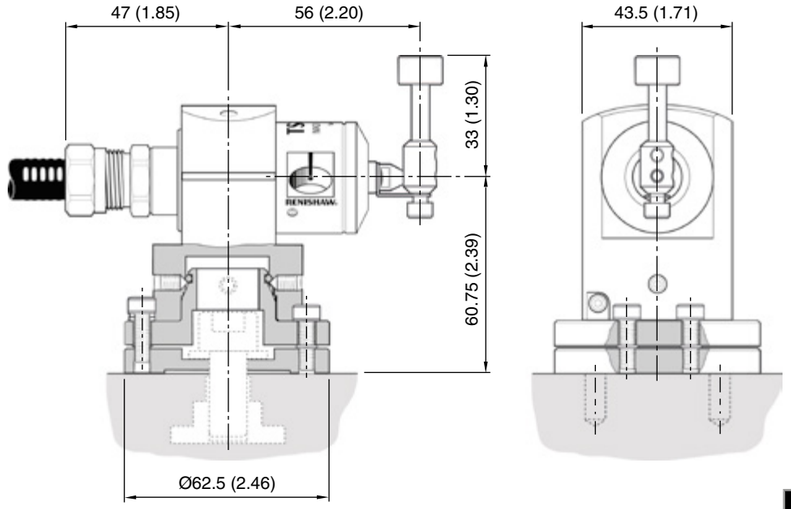
Compact 3D touch-trigger tool setter with hard-wired signal transmission used for broken tool detection and rapid measurement of tool length and diameter on a wide range of tools.



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



Dimensions given in mm (in)

Stylus overtravel limits	
±X / ±Y	**+Z**
±3.5 (0.14)	6 (0.24)

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, HSI or HSI-C
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 *(note 1)*
Stylus trigger force *(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, contact Renishaw or visit **www.renishaw.com/ts27r**

TS34

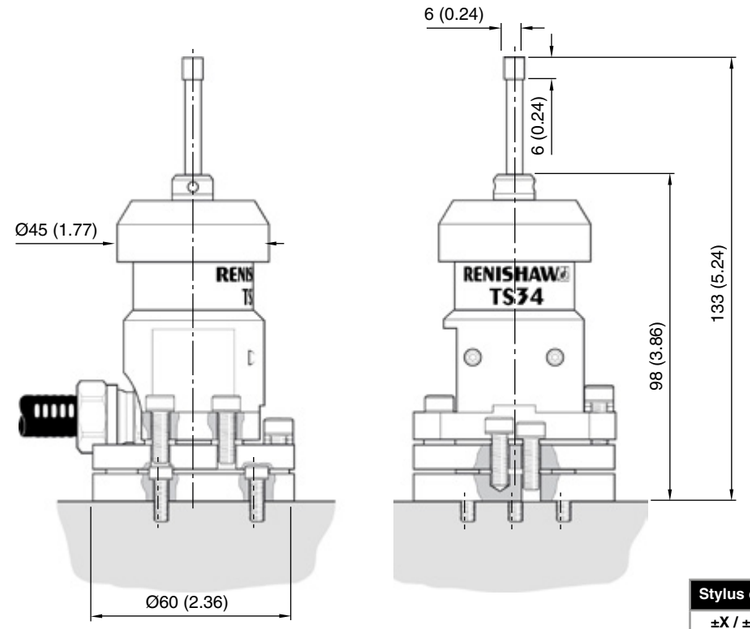
Compact 3D touch-trigger tool setter with hard-wired signal transmission used for broken tool detection and rapid measurement of tool length and diameter on a wide range of tools. Available as a rear or side exit version.

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

RENISHAW apply innovation™

Dimensions



Stylus overtravel limits	
±X / ±Y	+Z
±3.5 (0.14)	6 (0.24)

Dimensions given in mm (in)

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, HSI or HSI-C
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 × 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 (note 1)
Stylus trigger force *(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 (x 3)
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, contact Renishaw or visit **www.renishaw.com/ts34**

LTS

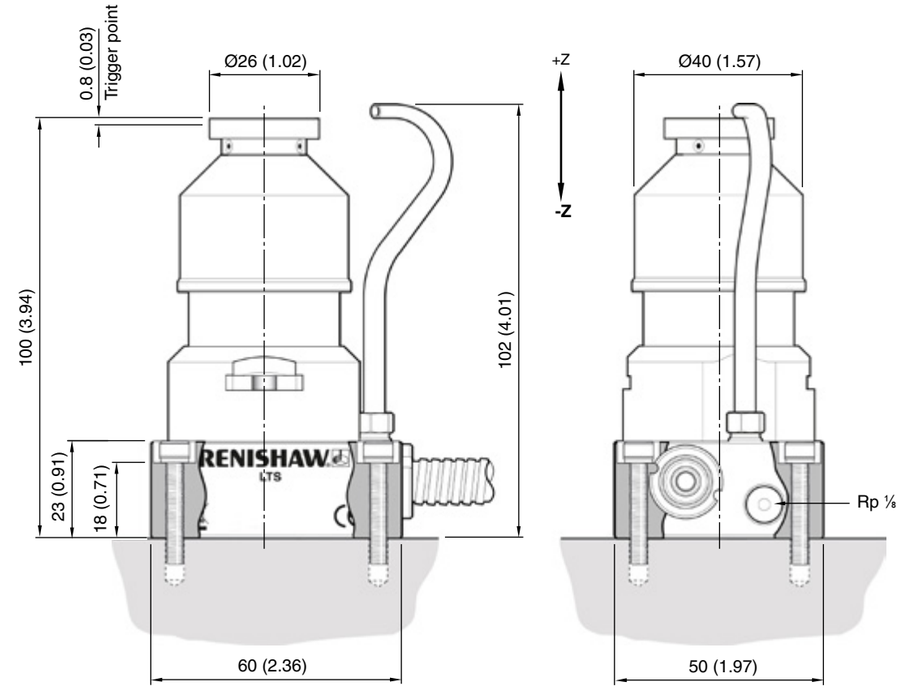
The LTS is a single-axis tool setter which is triggered when a tool touches the contact pad. A trigger signal is sent to the machine tool controller via the hard-wired cable and the tool length is automatically calculated.

The LTS is designed to operate within the machining environment, so it is resistant to swarf or coolant ingress and prevents false triggers due to shocks or vibration.

Key features and benefits:

- Reduce the time taken to set tools by up to 90% compared with manual methods
- Automatically update tool offsets
- Remove manual errors and variation in setting tools
- Reduce scrap and rework of materials
- Identify broken tools so that corrective action can be taken
- Track thermal changes in the machine and tools

Dimensions



Dimensions given in mm (in)

Specification

Principal application		Tool length setting, broken tool detection and thermal compensation on all sizes of CNC machines.
Transmission type		Hard-wired transmission
Compatible interfaces		Integrated interface 12 to 30 Vdc capable of supplying 50 mA minimum.
Weight with raised air blast		835 g (29.45 oz)
Cable	**Specification**	Ø5 mm (0.2 in), 7-core screened cable, each core 7 × 0.1 mm
	Length	8 m (26.24 ft)
	Electrical connection	Cable on the end of unit
Sense directions		+Z axis
Repeatability		0.75 µm (30 µin) 2σ
Contact pad trigger force		3 N / 306 gf (10.79 ozf) Z direction
Sealing		IPX6, IPX8 (EN/IEC 60529)
Mounting		M5 × 25 mm cap head screws (× 4) – 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, contact Renishaw or visit **www.renishaw.com/lts**

APC

The APC range is available as the APCA-45 and the APCS-45.

The APCA-45 features dual air actuation for extend and retract control and the APCS-45 features air actuation to extend with automatic spring return for retract.

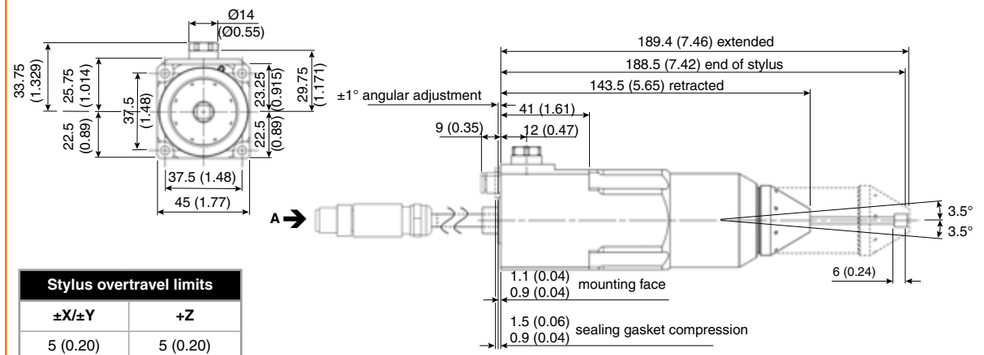
Both are compact and robust tool setting probes, specifically engineered for the harshest environments found in lathes and multi-tasking machines. A range of innovative design features ensures accurate and reliable tool measurement, delivering reduced scrap, improved quality and increased throughput.

Key features and benefits:

- Rapid measurement of turning, parting, grooving, threading and boring tools
- Pneumatic, dual air cover ensures the stylus is fully protected when not in use
- Reduced human error and scrap through increased measurement automation
- Increased throughput and reduced downtime through rapid in-process control (measurement can take place with the part still in the chuck). 1.50 µm 2σ repeatability (dependent on probe version)
- Improved product quality through the compensation of tool wear and thermal effects

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

Dimensions



Stylus overtravel limits	
±X/±Y	+Z
5 (0.20)	5 (0.20)

Dimensions given in mm (in)

Specification

Variant	APCA-45	Air extension and air retraction
	APCS-45	Air extension and sprung retraction
Principal application	Tool setting probe with automatic protection cover for lathes and multi-tasking machines. Contamination management available with air bleed.	
Transmission type	Hard-wired transmission	
Compatible interfaces	HSI or HSI-C	
Weight	1200 g (42.33 oz) with 0.5 m (1.64 ft) cable and connector.	
Cable	0.5 m (1.6 ft) minimum, M12 connector IEC 61076-2-101. A-standard female *(note 1)*.	
Sense directions	±X, ±Y, +Z	
Unidirectional repeatability	1.50 µm (59 µin) 2σ *(note 2)*	
Stylus trigger force *(note 3)*	XY plane (low force) XY plane (high force) +Z direction	0.49 N, 50.25 gf (1.77 ozf) 0.90 N, 92.21 gf (3.25 ozf) 6.79 N, 692.88 gf (24.44 ozf)
Supply voltage	12 Vdc to 30 Vdc	
Supply current	HSI HSI-C	40 mA @ 12 Vdc, 23 mA @ 24 Vdc 110 mA @ 12 Vdc, 80 mA @ 24 Vdc
Pneumatic supply	Supply must conform to BS ISO 8573-1: Class 4.6.3. Maximum operating pressure 6.5 bar (94.27 psi), minimum operating pressure 4.5 bar (65.27 psi).	
Input pneumatic connections	Three push fit fittings for Ø4 mm (0.16 in) tubing (ISO/TS 11619:2014). Extend, Retract and Air blast stalk *(note 4)*.	
Output connection	Blanked DIN EN ISO 228–G 1/8 outlet for customer configurable “air blast stalk”.	
Mounting	M4 × 50 mm (1.97 in) long (ISO 4762 grade 12.9) or equivalent × 4	
Retract confirm sensor	Operating voltage 12 Vdc to 30 Vdc, no load current 3 mA, rated operating current 150 mA, output resistance open collector, switching output PNP normally open (NO). When the cover is extended, the output is LOW. When the cover is retracted it is HIGH. (12 Vdc to 30 Vdc).	
Sealing	IPX6 and IPX8, BS EN 60529:1992+A2:2013 (IEC 60529:1989+A1:1999+A2:2013) Connector sealed to IP67 when mated	
Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)	

Note 1 When wiring the APC to the machine tool controller the installer should ensure the screen is connected.

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

Note 3 Using a 60 mm stylus.

Note 4 Can be configured by customer to provide air blast functionality.

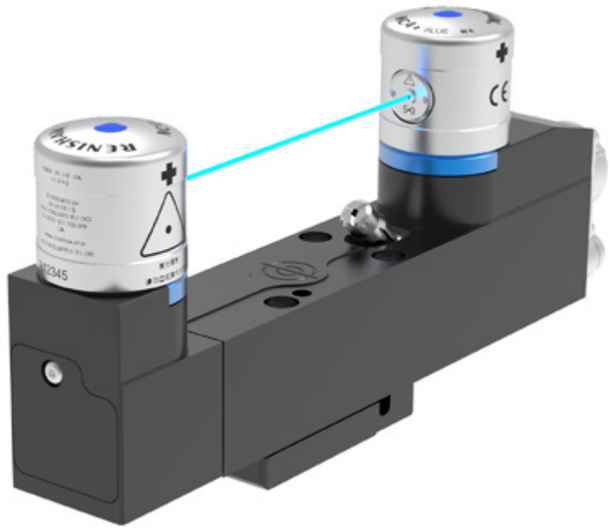
Non-contact tool setters

NC4 systems

The NC4 is an advanced laser tool setter that sets cutting tools and checks for tool breakage inside a CNC machine. Using a laser means that not only can you set tool length and diameter, but you can also check tool edges for chips, or even monitor tool run-out, all without the risk of damaging the tool during measurement.

All NC4 laser tool setters deliver exceptional metrology performance. With variants in many shapes, sizes and configurations, the NC4 is suitable for a variety of machine types and applications.

Using industry-first blue laser technology, NC4+ Blue systems deliver the best metrology performance in the range. With the short wavelength laser, tools and features as small as 30 microns can be measured with unrivalled tool-to-tool accuracy. Due to its optimised air caps, an impressive tool measurement repeatability of ±0.5 µm 2σ can be achieved using the NC4+ Blue.

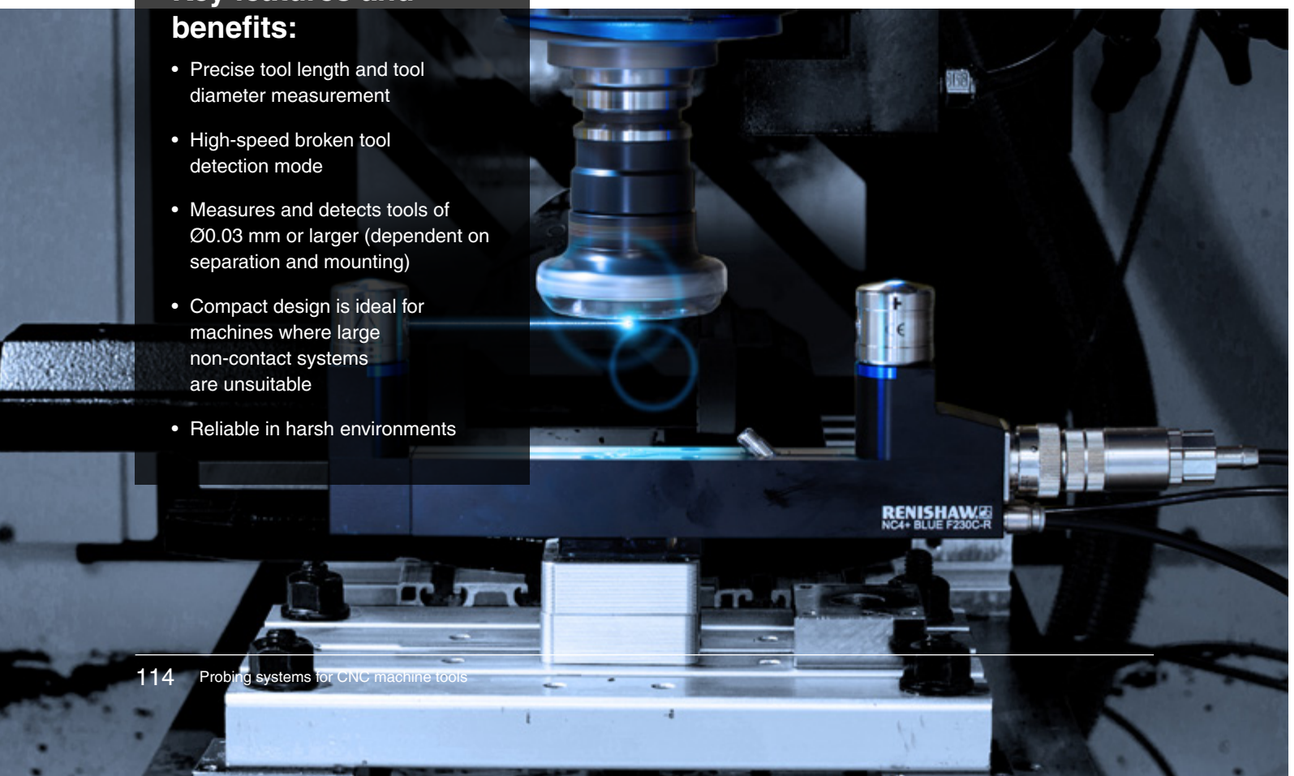


“If it wasn’t for the Renishaw system, the machine could, for example, operate with a broken cutting tip, with disastrous results. Furthermore, since tools are checked for breakage automatically, one operator can easily manage both machines: all he needs to do is load the pieces and ensure that everything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

Ducati (Italy) ”

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 harsh environments



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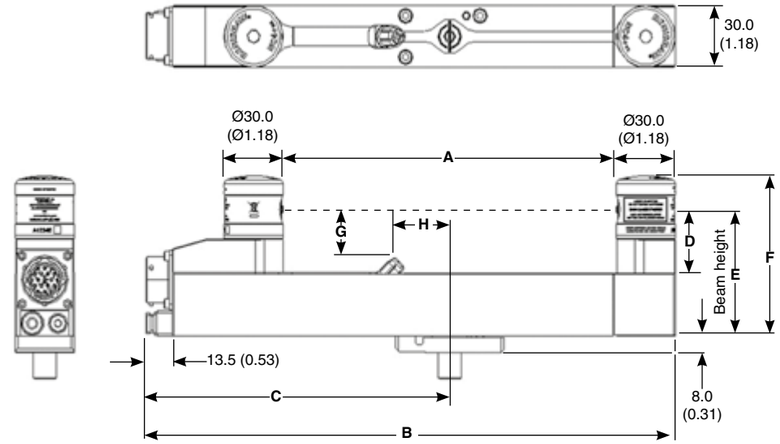
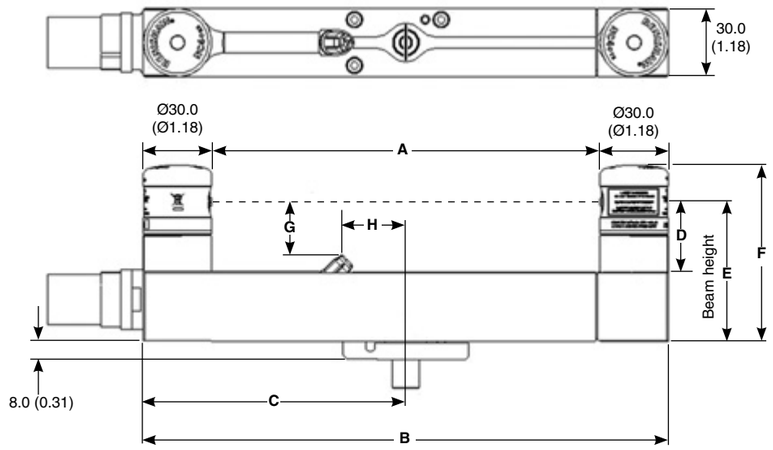
System with connector (blue and red laser) dimensions



Model	Blue laser	Red laser	Dimensions							
			A	B	C	D	E	F	G	H
F115C	●	●	55.0 (2.17)	155.0 (6.10)	97.3 (3.83)	31.0 (1.22)	61.0 (2.40)	77.0 (3.03)	18.1 (0.71)	13.8 (0.54)
F115C (raised)	●	●	55.0 (2.17)	155.0 (6.10)	97.3 (3.83)	50.0 (1.97)	80.0 (3.15)	96.0 (3.78)	35.1 (1.38)	12.3 (0.48)
F145C	●	●	85.0 (3.35)	185.0 (7.28)	112.3 (4.42)	31.0 (1.22)	61.0 (2.40)	77.0 (3.03)	21.3 (0.84)	25.3 (1.00)
F145C (raised)	●	●	85.0 (3.35)	185.0 (7.28)	112.3 (4.42)	50.0 (1.97)	80.0 (3.15)	96.0 (3.78)	37.1 (1.46)	24.7 (0.97)
F230C	●	●	170.0 (6.69)	270.0 (10.63)	155.0 (6.10)	31.0 (1.22)	61.0 (2.40)	77.0 (3.03)	21.3 (0.84)	25.3 (1.00)
F230C (raised)	●	●	170.0 (6.69)	270.0 (10.63)	155.0 (6.10)	50.0 (1.97)	80.0 (3.15)	96.0 (3.78)	40.3 (1.59)	44.3 (1.74)
F300C	●	●	240.0 (9.45)	340.0 (13.39)	190.0 (7.48)	31.0 (1.22)	61.0 (2.40)	77.0 (3.03)	21.3 (0.84)	25.3 (1.00)
F300C (raised)	●	●	240.0 (9.45)	340.0 (13.39)	190.0 (7.48)	50.0 (1.97)	80.0 (3.15)	96.0 (3.78)	40.3 (1.59)	44.3 (1.74)

Dimensions given in mm (in)

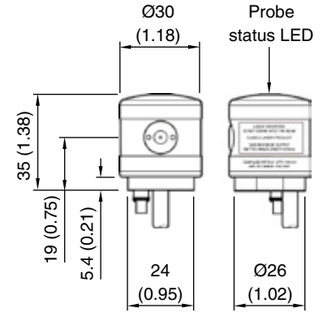
Hard-wired system dimensions

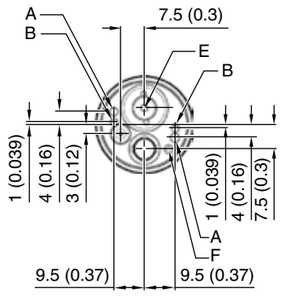


Model	Blue laser	Red laser	Dimensions							
			A	B	C	D	E	F	G	H
F115		●	55.0 (2.17)	115.0 (4.53)	57.5 (2.26)	31.0 (1.22)	61.0 (2.40)	77.0 (3.03)	18.0 (0.71)	13.7 (0.54)
F115 (raised)		●	55.0 (2.17)	115.0 (4.53)	57.5 (2.26)	50.0 (1.97)	80.0 (3.15)	96.0 (3.78)	35.6 (1.40)	12.6 (0.50)
F145	●	●	85.0 (3.35)	145.0 (5.71)	72.5 (2.85)	31.0 (1.22)	61.0 (2.40)	77.0 (3.03)	20.4 (0.80)	24.5 (0.96)
F145 (raised)	●	●	85.0 (3.35)	145.0 (5.71)	72.5 (2.85)	50.0 (1.97)	80.0 (3.15)	96.0 (3.78)	37.5 (1.48)	25.0 (0.98)
F230	●	●	170.0 (6.69)	230.0 (9.06)	115.0 (4.53)	31.0 (1.22)	61.0 (2.40)	77.0 (3.03)	21.3 (0.84)	25.3 (1.00)
F230 (raised)	●	●	170.0 (6.69)	230.0 (9.06)	115.0 (4.53)	50.0 (1.97)	80.0 (3.15)	96.0 (3.78)	40.3 (1.59)	44.3 (1.74)
F300		●	240.0 (9.45)	300.0 (11.81)	150.0 (5.91)	31.0 (1.22)	61.0 (2.40)	77.0 (3.03)	21.4 (0.84)	25.4 (1.00)
F300 (raised)		●	240.0 (9.45)	300.0 (11.81)	150.0 (5.91)	50.0 (1.97)	80.0 (3.15)	96.0 (3.78)	40.4 (1.59)	44.4 (1.75)

Dimensions given in mm (in)

NC4 separate system (red laser only) dimensions





Dimensions given in mm (in)

A = Mounting holes (× 2), M3 × 0.5 P x 8 mm (0.32 in) deep

B = Dowel holes (× 2), Ø2 mm × 8 mm (0.32 in) deep

C = Pneumatic push-fit connector, Ø3 mm (Ø0.12 in) plastic pipe

D = Supply cable, 6 mm (Ø0.24 in)

E = PassiveSeal vent. Do not cover

F = Blacking screw. Do not disturb

Specification

Variant		NC4	NC4+ Blue
Principal application		High-precision, high-speed non-contact tool setting and tool breakagedetection on all sizes of vertical and horizontal machining centres, multi-tasking machines and gantry machining centres.	
Transmission type		Hard-wired transmission	
Compatible interface		NCi-6	
Repeatability	F115 and F145	±1.0 µm (39.37 µin) 2σ	±0.5 µm (19.69 µin) 2σ
	F230 and F300	±1.0 µm (39.37 µin) 2σ	±0.75 µm (29.53 µin) 2σ
Tool setting and tool breakage detection (minimum tool or feature size)	F115 systems	Ø0.03 mm (0.0012 in)	
	F145 systems	Ø0.05 mm (0.0020 in)	
	F230 systems	Ø0.1 mm (0.0039 in)	
	F300 systems	Ø0.2 mm (0.0079 in)	
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/NC4+ Blue and a spindle probe. This relay can also be used to control an air blast solenoid (optional).	
Supply voltage (to interface)		11 Vdc to 30 Vdc	
Supply current (to interface)		120 mA @ 12 Vdc, 70 mA @ 24 Vdc	
Supply protection		Resettable fuses in interface. Reset by removing power and cause of fault.	
Electrical connection arrangement		**Systems with connector:** connector socket **Hard-wired systems:** Cable on the end of the unit. Other configurations are available on request.	
Cable (to interface)	**Specification**	Ø6.0 mm (0.24 in), two twisted pairs, two individual cores plus screen, each core 18 × 0.1 mm insulated	
	Length	12.5 m (41.01 ft)	
	Electrical connection	**Systems with connector:** cable with bayonet-type cable plug, connector socket on the end of the unit. **Hard-wired systems:** cable on the end of the unit. Other configurations are available on request.	
NC4 barrier air pneumatic supply		Air supply to the NC4 must conform to BS ISO 8573-1: 2010 Class 1.4.2. 6.0 bar (87.02 psi) maximum. **Systems with connector:** Ø4.0 mm (0.16 in) × 5.0 m (16.40 ft). **Hard-wired systems:** Ø3.0 mm (0.12 in) × 5.0 m (16.40 ft).	
Air blast pneumatic supply		Air supply to the air blast must conform to BS ISO 8573-1: 2010 Class 2.9.4. Ø6.0 mm (0.24 in) air pipe × 5.0 m (16.40 ft), 6.0 bar (87.02 psi) maximum.	
Laser type		Class 2 laser product:	
		1 mW maximum output emitted wavelength 670 nm	1 mW maximum output emitted wavelength 405 nm.
		WARNING: Laser radiation. Do not stare into beam.	
Laser beam alignment		The unit is supplied with an adjustable mounting plate on the underside.	
Weight (including 12.5 m (41.01 ft) of cable).		1080 g (2.38 lb) to 2000 g (4.4 lb) depending on configuration.	
Mounting		M4 (× 3), M10 (3/8 in) or M12 (1/2 in) bolts for mounting via adjuster plate (not supplied) Other fixing arrangements are available on request.	
Environment	IP rating	IPX6 and IPX8, BS EN 60529:1992+A2:2013 (IEC 60529:1989+A1:1999+A2:2013)	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)	

For accessories, please refer to **NC4 non-contact tool setting system accessories (Renishaw part no. H-2000-2223)**

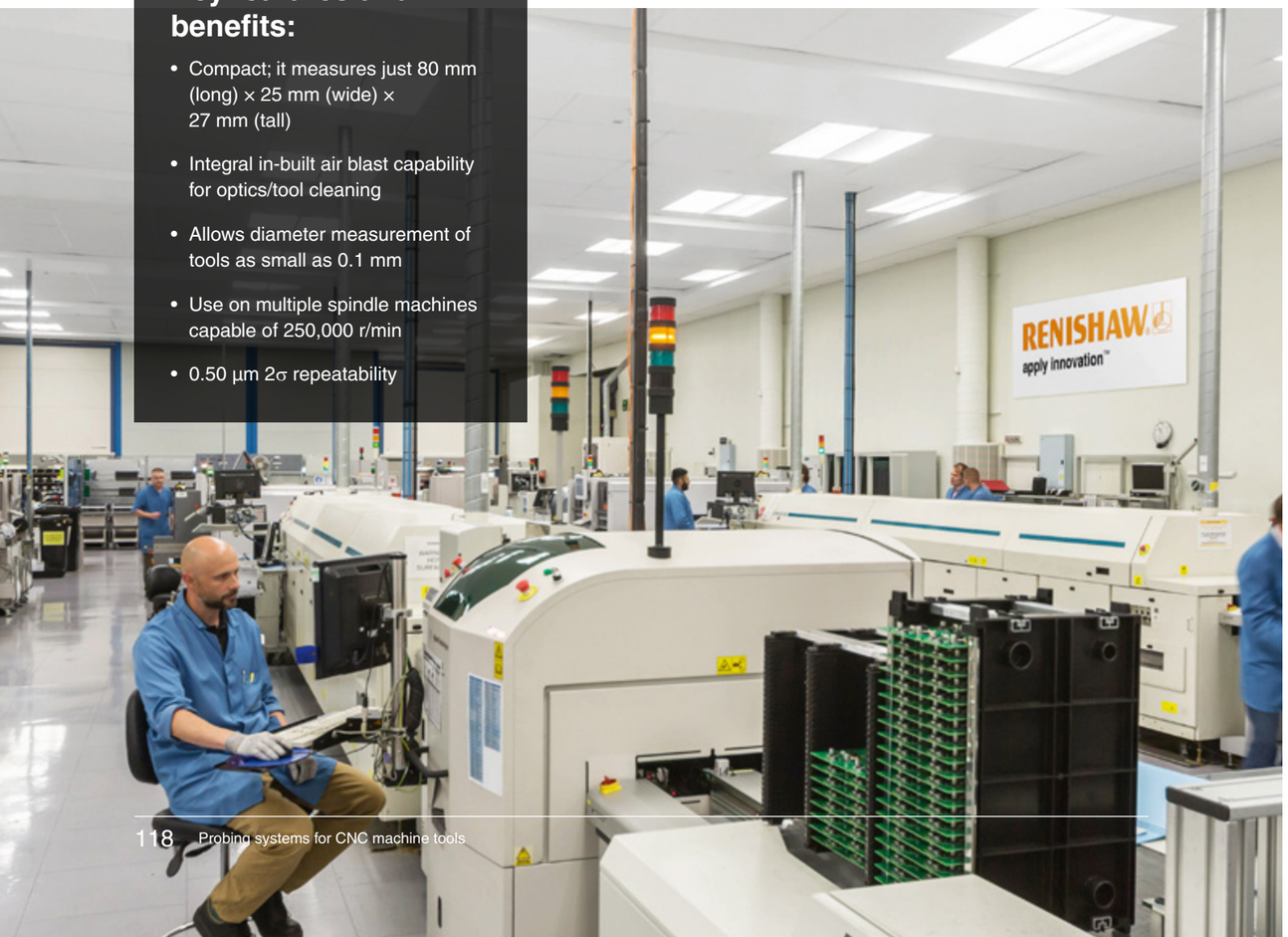
For further information and the best possible application and performance support, contact Renishaw or visit **www.renishaw.com/nc4**

NCPCB

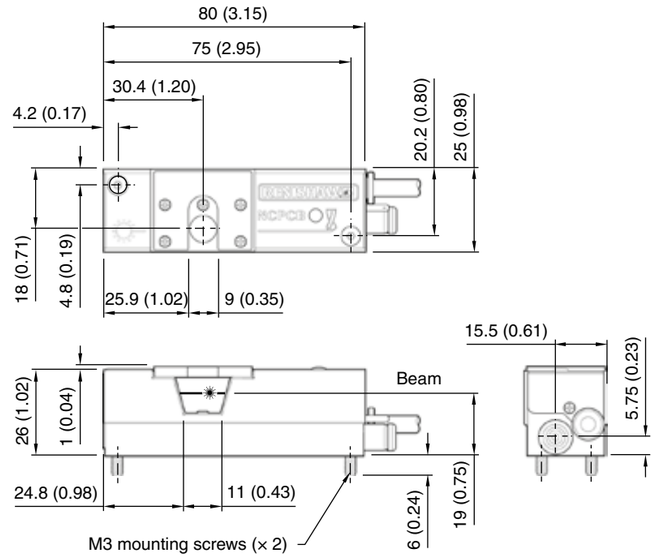
Non-contact tool setter for PCB drilling machines used for run-out checking, tool setting and tool breakage detection in one simple compact unit.

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 r/min
- 0.50 µm 2σ repeatability



Dimensions



Dimensions given in mm (in)

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)
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

For further information and the best possible application and performance support, 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.

“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.”

SAME DEUTZ-FAHR (Italy)

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

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

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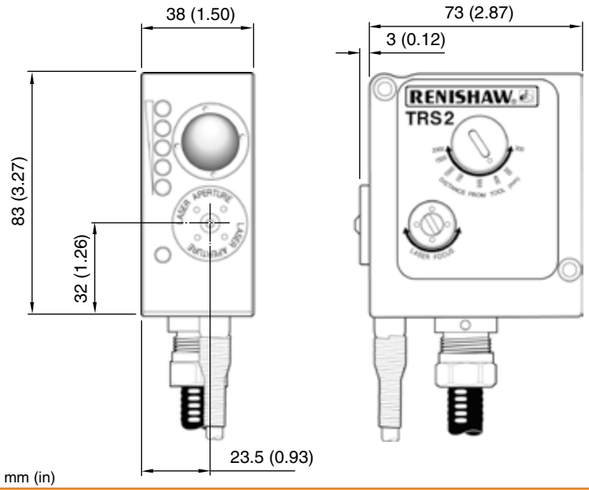
Dimensions



Dimensions given in mm (in)

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) *(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**	Ø0.5 mm (0.20 in), 5-core screened cable, each core 18/0.1 mm insulated.
	Length	5 m (16.4 ft),10 m (32.8 ft)
	Electrical Connection	Cable on the underside 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 **WARNING:** Laser radiation. Do not stare into beam.
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) 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.

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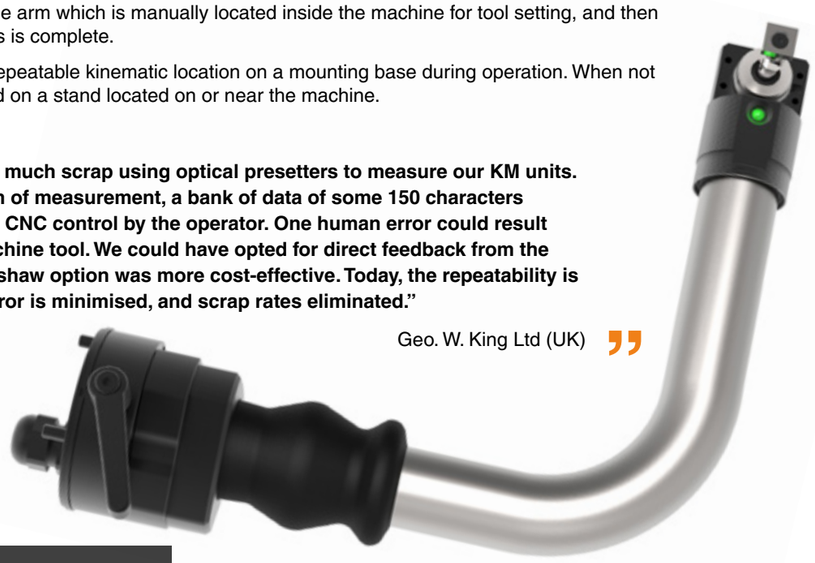
Arms

HPRA

A high-precision removable 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.



“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 (UK)

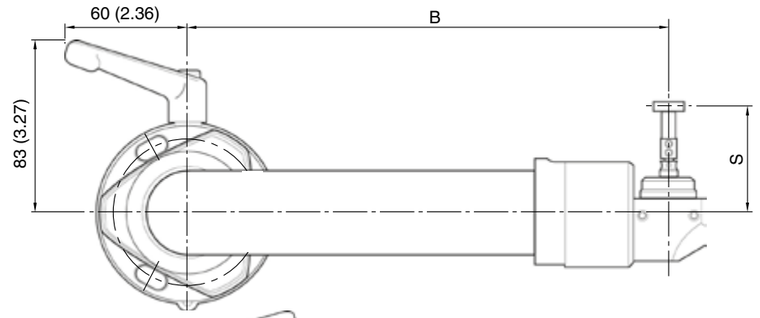
Key features and benefits:

- 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
- A single arm can be shared between multiple machines

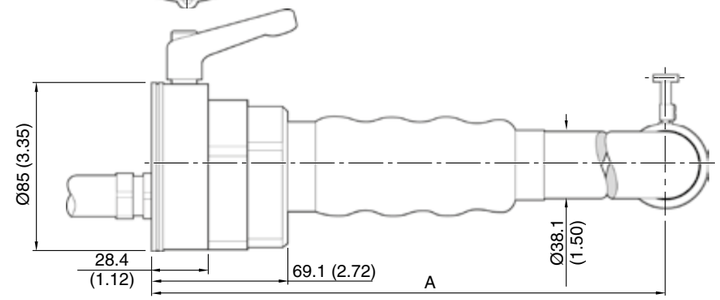
For further information and the best possible application and performance support, contact Renishaw or visit **www.renishaw.com/hpra**

Dimensions

Front view



Side view



*A range of standard sizes are available, with either a rear or side exit connection.

Arm dimensions				
Dimension	**A***	**B***	**S**	**Tool size**
Maximum	580 (22.83)	450 (17.72)	71 (2.80)	50 (1.97)
Minimum	250 (9.84)	211 (8.31)	35.7 (1.40)	16 (0.63)

Dimensions given in mm (in)

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 *(note 1)*	
Compatible interfaces		TSI 2 or TSI 2-C	
Weight		3 kg	
Cable (to interface)	**Specification**	Ø4.0 mm (0.16 in), 2-core screened cable, each core 0.34 mm²	
	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)
Typical positional repeatability *(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 *(probe axis)*	**XY low force**	1.5 N, 153 gf (5.40 ozf)	
	XY high force	3.5 N, 357 gf (12.59 ozf)	
	+Z direction	12 N, 1224 gf (43.16 ozf)	
Arm sweep	**Motion**	N/A	
	Angle	N/A	
Environment	**IP rating**	IPX6 and IPX8, BS EN 60529:1992+A2:2013	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)	
Mounting		M8 bolts for Arm mounting × 3	

Note 1 For more details, refer to the RP3 product page

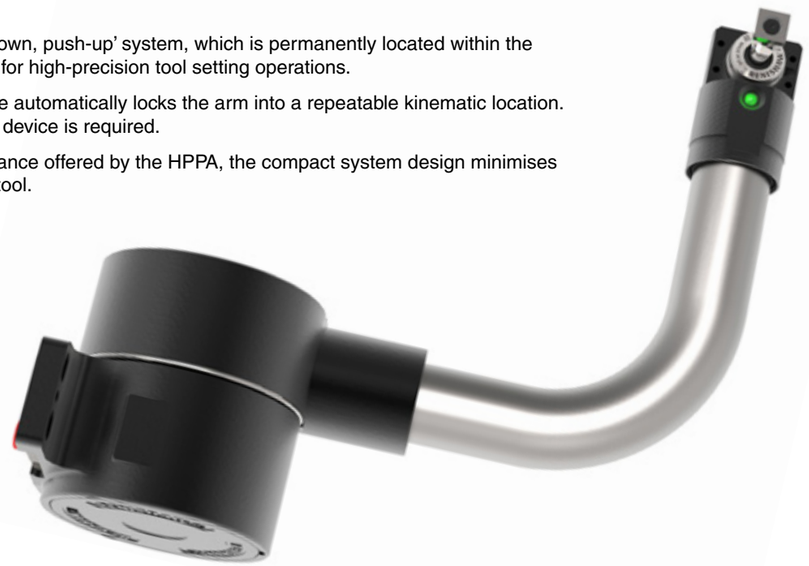
Note 2 Test conditions: Stylus length: 22 mm (0.87 in)
Stylus velocity: 36 mm/min (1.42 in/min)
Stylus force: factory settings

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.

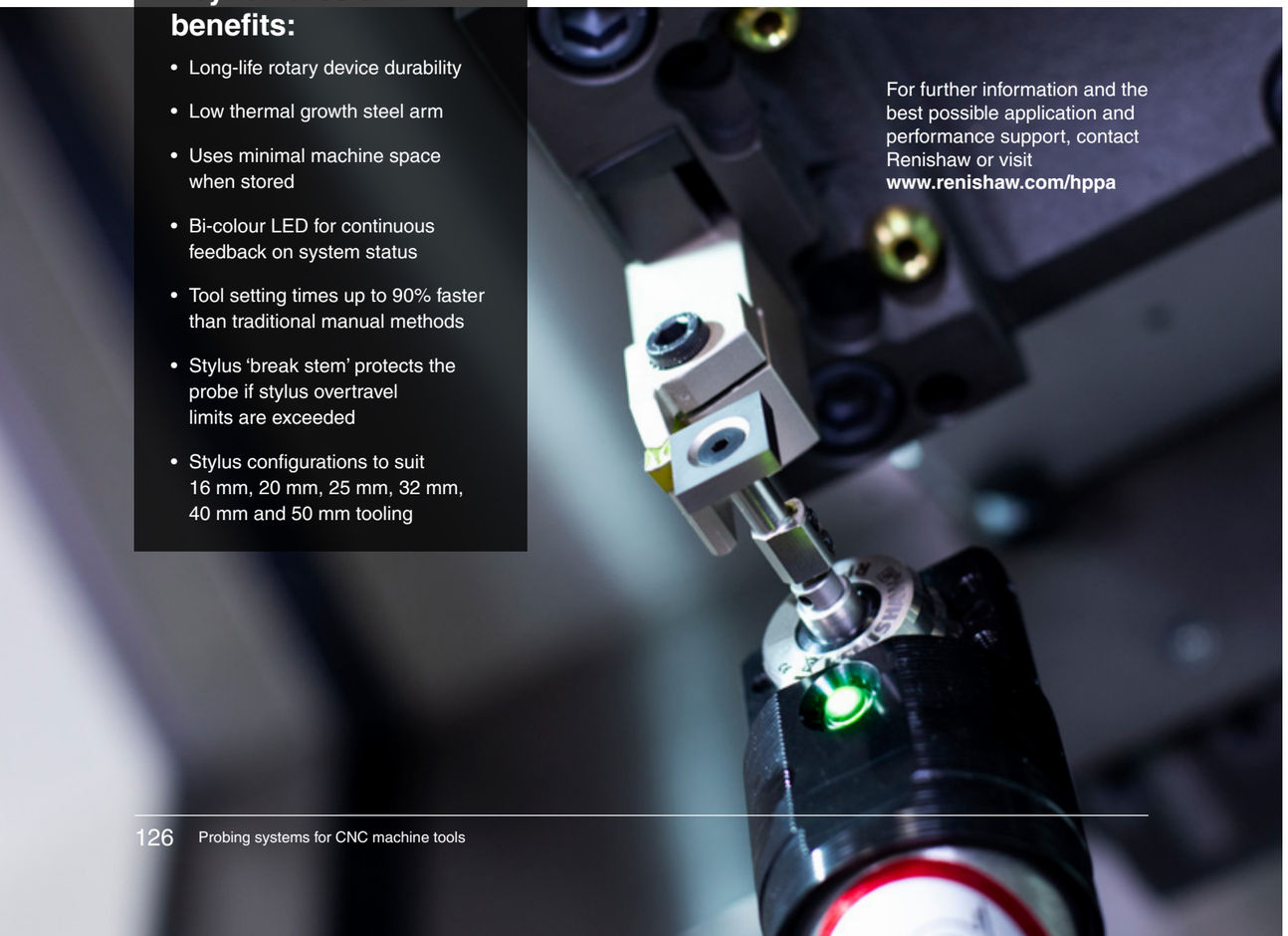
An innovative patented rotary device automatically locks the arm into a repeatable kinematic location. No additional adjustment or locking device is required.

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:

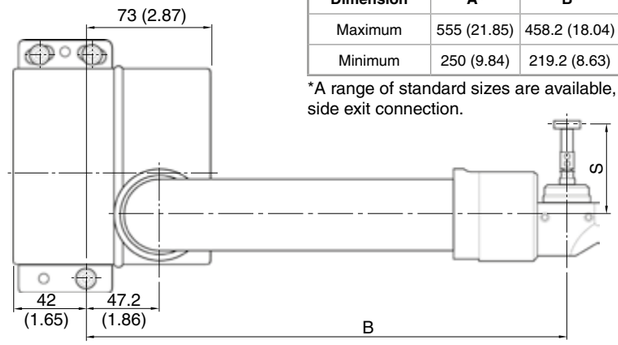
- Long-life rotary device durability
- Low thermal growth steel arm
- Uses minimal machine space when stored
- Bi-colour LED for continuous feedback on system status
- Tool setting times up to 90% faster than traditional manual methods
- Stylus ‘break stem’ protects the probe if stylus overtravel limits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



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

Dimensions

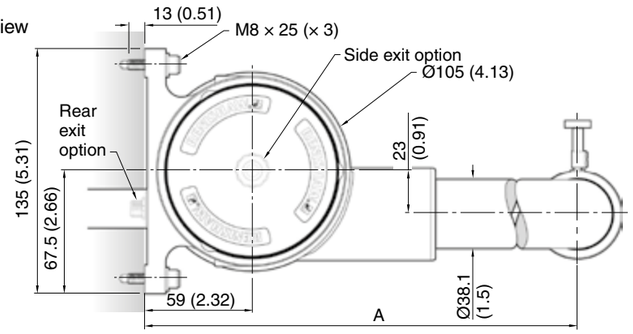
Front view



Arm dimensions				
Dimension	**A***	**B***	**S**	**Tool size**
Maximum	555 (21.85)	458.2 (18.04)	71 (2.80)	50 (1.97)
Minimum	250 (9.84)	219.2 (8.63)	35.7 (1.41)	16 (0.63)

*A range of standard sizes are available, with either a rear or side exit connection.

Side view



Dimensions given in mm (in)

Specification

Variant		Standard rear exit	Standard side exit
Principal application		Tool measuring on 2-axis CNC lathes	
Transmission type		Hard-wired transmission	
Probe		RP3 *(note 1)*	
Compatible interfaces		TSI 3 or TSI 3-C	
Weight		5 kg	
Cable (to interface)	**Specification**	Ø7.3 mm (0.29 in), 5-core screened cable, each core is 0.75 mm²	Ø4.35 mm (0.17 in), 4-core screened cable, each core is 0.22 mm²
	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, +Z	
Typical positional repeatability *(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 *(probe axis)*	**XY low force**	1.5 N, 153 gf (5.40 ozf)	
	XY high force	3.5 N, 357 gf (12.59 ozf)	
	+Z direction	12 N, 1224 gf (43.16 ozf)	
Arm sweep	**Motion**	Manual	
	Angle	90° (if not using Renishaw probe pocket, maximum arm sweep angle is 91°)	
Environment	**IP rating**	IPX6 and IPX8, BS EN 60529:1992+A2:2013	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)	
Mounting		M8 bolts for Arm mounting × 3, M6 bolts for Probe pocket mounting × 2	

Note 1 For more details, refer to the RP3 product page

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

HPMA

An electrically actuated 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

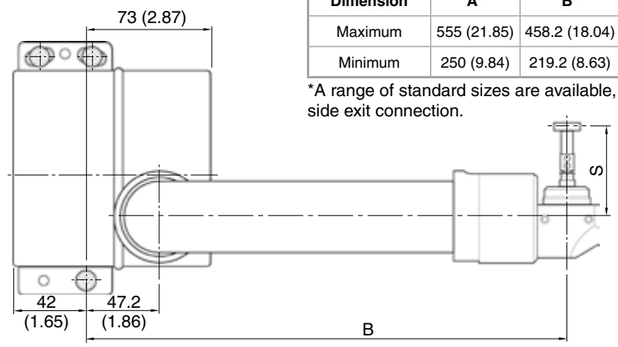
For further information and the best possible application and performance support, contact Renishaw or visit **www.renishaw.com/hpma**

Dimensions

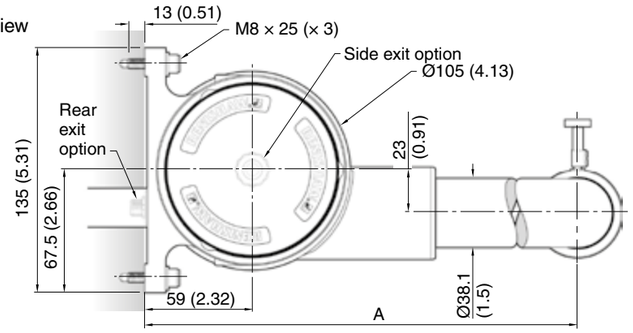
Front view

Arm dimensions				
Dimension	**A***	**B***	**S**	**Tool size**
Maximum	555 (21.85)	458.2 (18.04)	71 (2.80)	50 (1.97)
Minimum	250 (9.84)	219.2 (8.63)	35.7 (1.41)	16 (0.63)

*A range of standard sizes are available, with either a rear or side exit connection.



Side view



Dimensions given in mm (in)

Specification

Variant		Standard rear exit	Standard side exit
Principal application		Tool measuring on 2-axis CNC lathes	
Transmission type		Hard-wired transmission	
Probe		RP3 *(note 1)*	
Compatible interfaces		TSI 3 or TSI 3-C	
Weight		5 kg	
Cable (to interface)	**Specification**	Ø7.3 mm (0.29 in), 5-core screened cable, each core is 0.75 mm²	Ø4.35 mm (0.17 in), 4-core screened cable, each core is 0.22 mm²
	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, +Z	
Typical positional repeatability *(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 *(probe axis)*	**XY low force**	1.5 N, 153 gf (5.40 ozf)	
	XY high force	3.5 N, 357 gf (12.59 ozf)	
	+Z direction	12 N, 1224 gf (43.16 ozf)	
Arm sweep	**Motion**	Motorised	
	Angle	90° (if not using Renishaw probe pocket, maximum arm sweep angle is 91°)	
Environment	**IP rating**	IPX6 and IPX8, BS EN 60529:1992+A2:2013	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)	
Mounting		M8 bolts for Arm mounting × 3, M6 bolts for Probe pocket mounting × 2	

Note 1 For more details, refer to the RP3 product page 129.

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

HPMA-X

An electrically actuated arm with a high-performance motor and gearbox, allowing high-precision automated tool setting on large CNC lathes and turning centres.

Rapid actuation allows in-process tool setting and broken tool detection on complex, multiple probe installations, without the need for operator intervention: machine commands activate the arm and lock it into position within 3 seconds.

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

An innovative rotary device automatically locks the arm into a repeatable kinematic location. The high-efficiency brushless motor, three-stage planetary gearbox and built-in sensors provide the required torque, control the smooth motion, and detect any collisions.

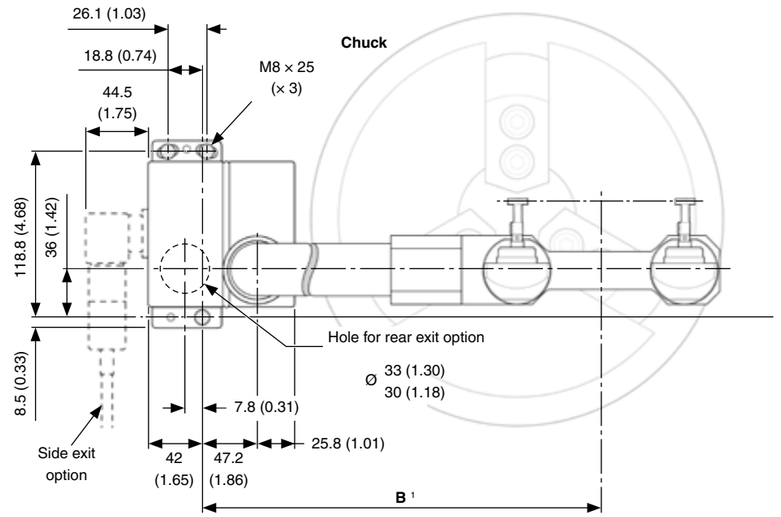
Key features and benefits:

- High torque capability for lifting large and complex arms
- High performance motor and gearbox
- Rapid actuation with controlled acceleration and deceleration
- Automated tool setting and broken tool detection
- Four status LEDs on the interface
- Built-in sensors that monitor and confirm the arm position

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

Dimensions

Arm dimensions				
Dimension	**A***	**B***	**S**	**Tool size**
Maximum	700 (27.56)	700 (27.56)	71 (2.80)	50 (1.97)
Minimum	250 (9.84)	219.2 (8.63)	35.7 (1.41)	16 (0.63)



Dimensions given in mm (in)

Specification

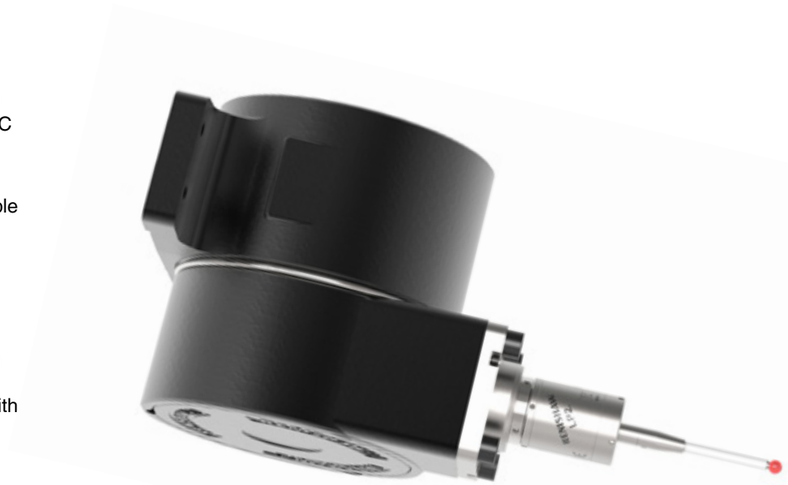
Variant		Standard rear exit	Standard side exit
Principal application		Tool measuring on 2-axis CNC lathes	
Transmission type		Hard-wired transmission	
Probes		RP3	
Compatible interfaces		TSI 3-X	
Weight		5 kg	
Cable (to interface)	**Specification**	Ø6.9 mm (0.27 in), 12-core screened cable, 0.22 mm2 per core	
	Length	30 m (98.43 ft) maximum	
Sense directions		±X, ±Y, +Z	
Typical positional repeatability		8 µm (315 µin) 2σ X/Y max at 1000mm length or 700x700 mm AxB dimensions	
Stylus trigger force *(probe axis)*	**XY low force**	1.5 N, 153 gf (5.40 ozf)	
	XY high force	3.5 N, 357 gf (12.59 ozf)	
	+Z direction	12 N, 1224 gf (43.16 ozf)	
Arm sweep	**Motion**	Motorised	
	Angle	90° (if not using Renishaw probe pocket, maximum arm sweep angle is 91°)	
Environment	**IP rating**	IPX6 and IPX8, BS EN 60529:1992+A2:2013	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)	
Mounting		M8 bolts for Arm mounting × 3, M6 bolts for Probe pocket mounting × 2	

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 MP250 – a high-accuracy strain gauge probe with RENGAGE™ technology. With the innovative new SwarfStop™ seal design, it can withstand the harshest of environments.

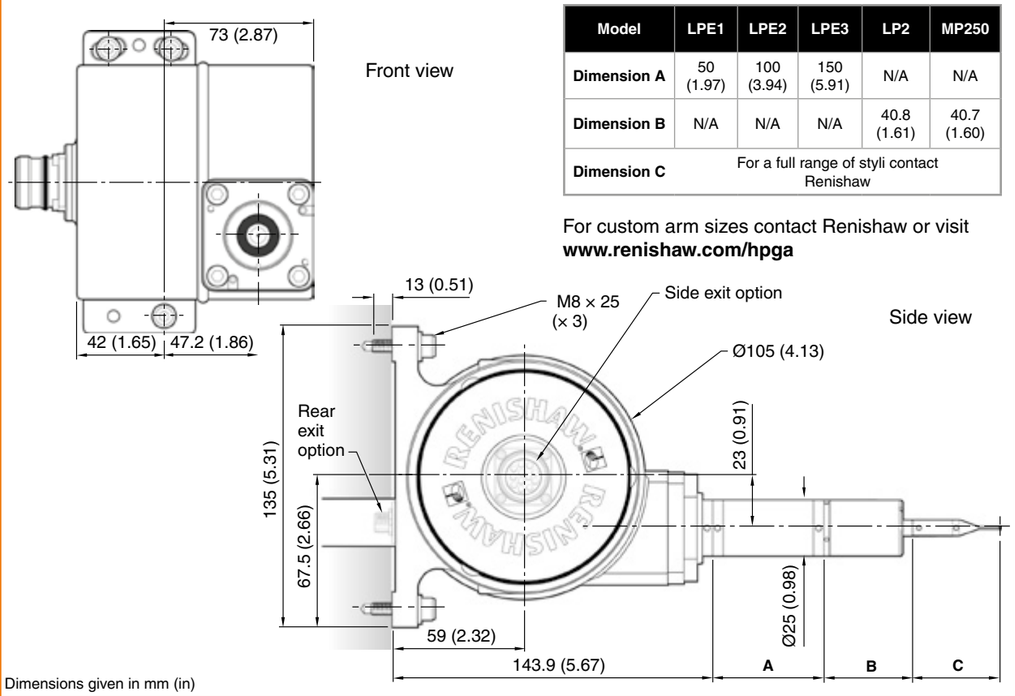


Key features and benefits:

- Suitable for tool setting, broken tool detection and workpiece inspection
- Compatible with Renishaw's LP2 probe as well as the MP250 strain gauge 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

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

Dimensions



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 contact Renishaw				

For custom arm sizes contact Renishaw or visit **www.renishaw.com/hpga**

Dimensions given in mm (in)

Specification

Variant		Standard rear exit	Standard side exit
Principal application		CNC lathes and grinding machines	
Transmission type		Hard-wired transmission	
Probe		LP2, MP250 and RP3	
Compatible interfaces		TSI 3 / C for LP2 Only TSI 3 / C and HSI for LP2 or MP250	
Weight		4 kg	
Cable (to interface)	**Specification**	Ø5.9, 8-core screened cable, each core is 0.25mm²	Ø7.6 8-core screened cable, each core is 0.25mm²
	Length	2 m (6.5 ft), 5 m (16.4 ft), 10 m (32.8 ft)	3 m (9.8 ft), 5 m (16.4 ft), 10 m (32.8 ft)
Sense directions		±X, ±Y, +Z	
Typical positional repeatability *(note 1)*		3 µm 2σ XYZ	
Stylus trigger force LP2/MP250/RP3 *(probe axis)*	**XY low force**	0.50 N, 51 gf (1.80 ozf) / 0.70 N, 71 gf (2.52 ozf) / 1.50 N, 153 gf (5.40 ozf)	
	XY high force	0.90 N, 92 gf (3.24 ozf) / N/A / 3.50 N, 357 gf (12.59 ozf)	
	+Z direction	5.85 N, 597 gf (21.04 ozf) / 2.60 N, 265 gf (9.35 ozf) / 12.00 N, 1224 gf (43.16 ozf)	
Arm sweep	**Motion**	Motorised	
	Angle	90° (if not using Renishaw probe pocket, maximum arm sweep angle is 91°)	
Environment	**IP rating**	IPX6 and IPX8, BS EN 60529:1992+A2:2013	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)	
Mounting		M8 bolts for Arm mounting × 3, M6 bolts for Probe pocket mounting × 2	

Note 1 Maximum 2 sigma 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.

RP3

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

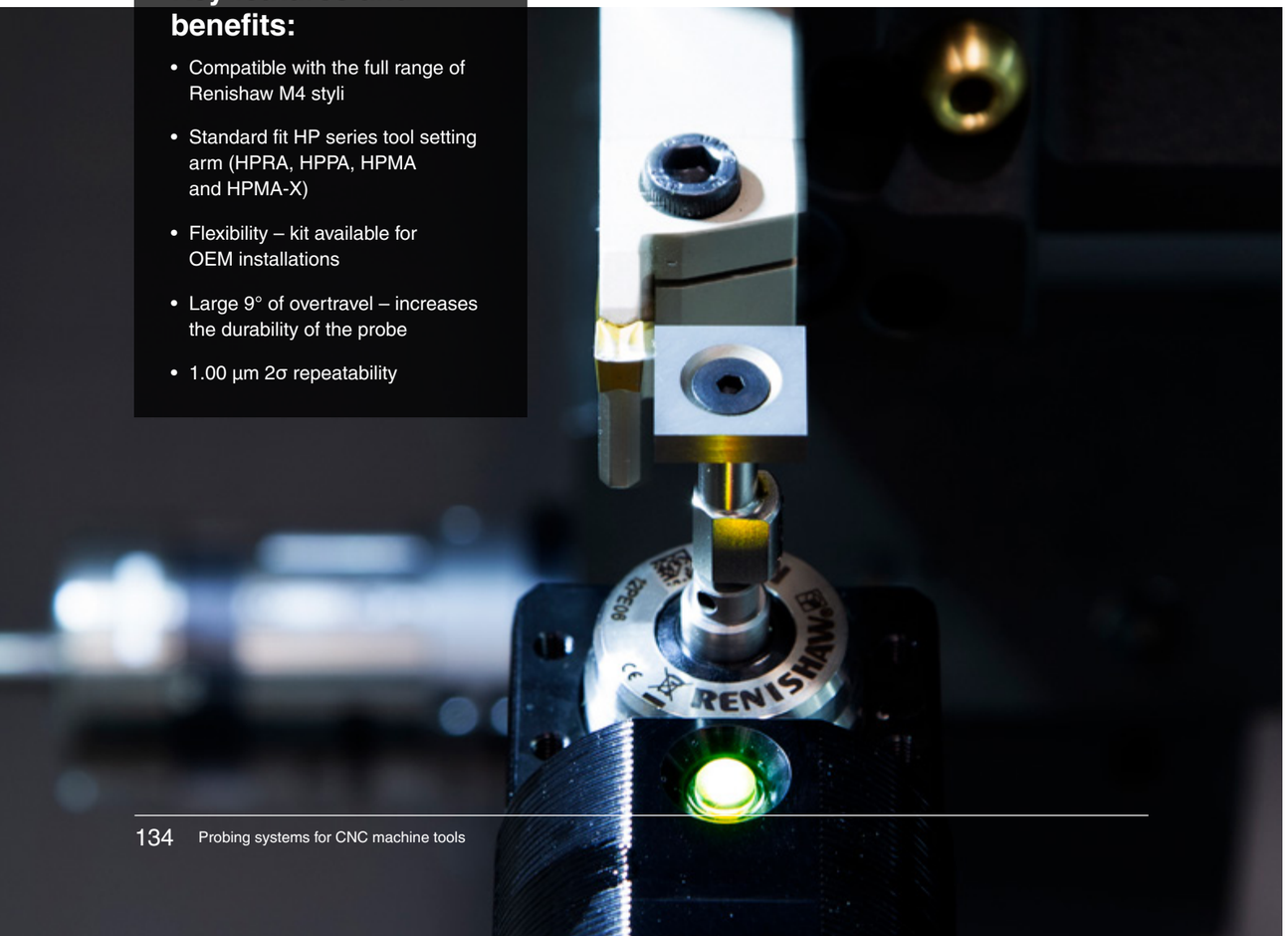
Suitable for OEM installation into purpose-built holders. It utilises a universal M4 stylus mounting, allowing the full range of Renishaw styli to be used.

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

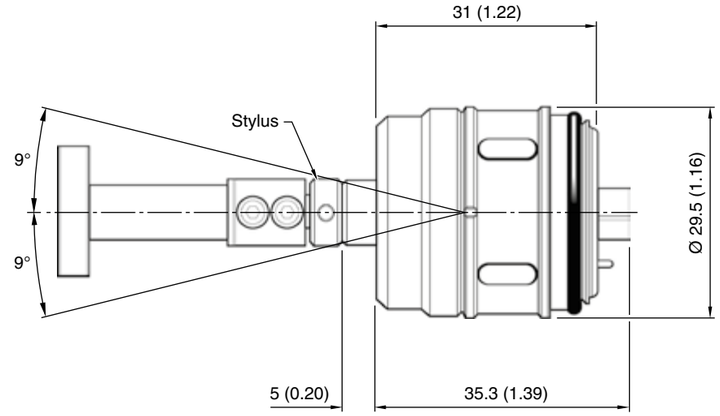
The short body provides significant advantages in tool setting applications and the high performance of traditional Renishaw touch-trigger probes.

Key features and benefits:

- Compatible with the full range of Renishaw M4 styli
- Standard fit HP series tool setting arm (HPRA, HPPA, HPMA and HPMA-X)
- 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)

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 *(note 1)*
Unidirectional repeatability	1.00 µm (40 µin) 2σ *(note 2)*
Stylus trigger force *(notes 3 and 4)*	
XY low force	1.50 N, 153 gf (5.40 ozf)
XY high force	3.50 N, 357 gf (12.59 ozf)
+Z direction	12.00 N, 1224 gf (43.16 ozf)
Sealing	IPX8 (EN/IEC60529)
Operating temperature	+5 °C to +55 °C (+41 °F to +131 °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, contact Renishaw or visit **www.renishaw.com/hparms**

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Powerful and intuitive machine tool probing software

Machine tool software functionality

Renishaw provides a range of macro, PC, and smartphone software solutions designed to complement its range of measurement and process control hardware.

Comparison chart

Software packages		Inspection Plus	Contact tool setting	Non-contact tool setting	SupaScan[1]	Productivity+™ Active Editor Pro	Productivity+™ CNC plug-in	Reporter[1]	AxiSet™ Check-Up
Functionality	Page	139	142	143	144	146	148	152	162
Spindle probing									
Part mis-load		●							
Part set-up (WCS)		●			●	●	●		
Part and feature measurement		●			●	●	●		
Support for scanning probes					●	●	●		
Machine tool calibration and qualification							●		●
Programming from CAD models						●			
Tool setting									
Tool set-up and monitoring			●	●					
General									
On-machine programming		●	●	●	●		●		●
Office-based programming						●			
In-process control		●	●	●	●	●	●		
Text based reporting of measurement results		●			●	●	●		
Graphical reporting of measurement results								●	
Add-on packages available for advanced functionality		●		●			●		

1 Requires macro software.

For more information including machine tool controller compatibility, refer to the *Probe software for machine tools - programs and features* data sheet (Renishaw part no. H-2000-2298) or visit **www.renishaw.com/machinetoolsoftware**

Inspection Plus

Inspection Plus is the industry standard macro package for machine tools, offering solutions for part setting, inspection and in-process measurement.

Compatible with all major machine tool controller platforms, this machine-resident package is simple to program.

Experienced users can create and execute cycles using traditional G-code techniques. New or less experienced users can use one of the available programming tools; for example, the GoProbe smartphone app, or a graphical user interface (GUI) such as Set and Inspect or GoProbe iHMI.

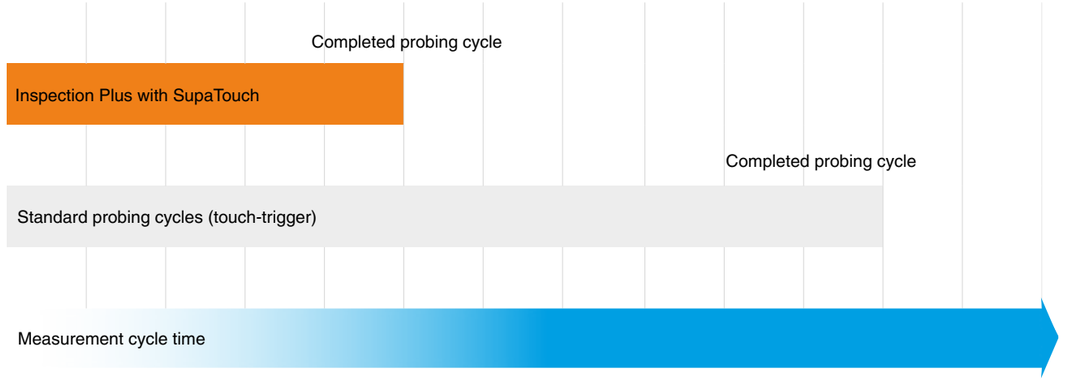
Key features and benefits:

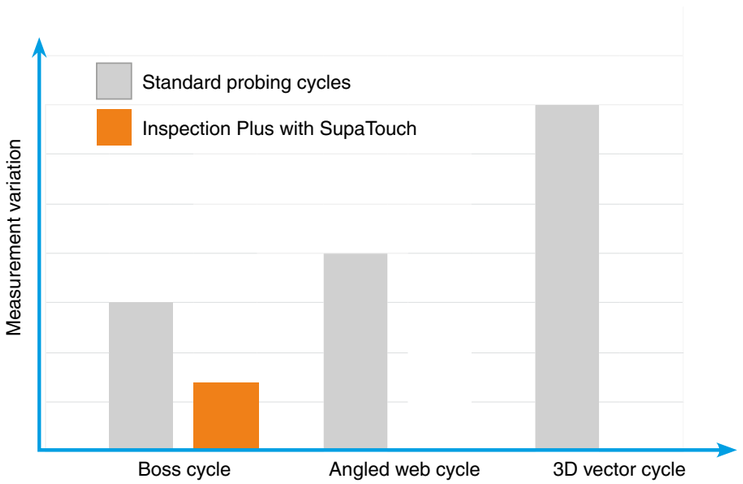
- Comprehensive range of standard measurement cycles, enhanced vector cycles and a range of calibration cycles
- A range of user-friendly programming options including GoProbe, Set and Inspect and other GUIs
- SupaTouch optimisation that reduces cycle time, improves metrology and automatically selects a one-touch or two-touch measurement strategy
- Statistical process control (SPC) feedback based on trend analysis and average results
- Offers a simple migration path from manual part setting cycles through to automated inspection cycles and then on to more complex inspection cycles
- Advanced cycles add-on package to extend functionality further

Inspection Plus - continued

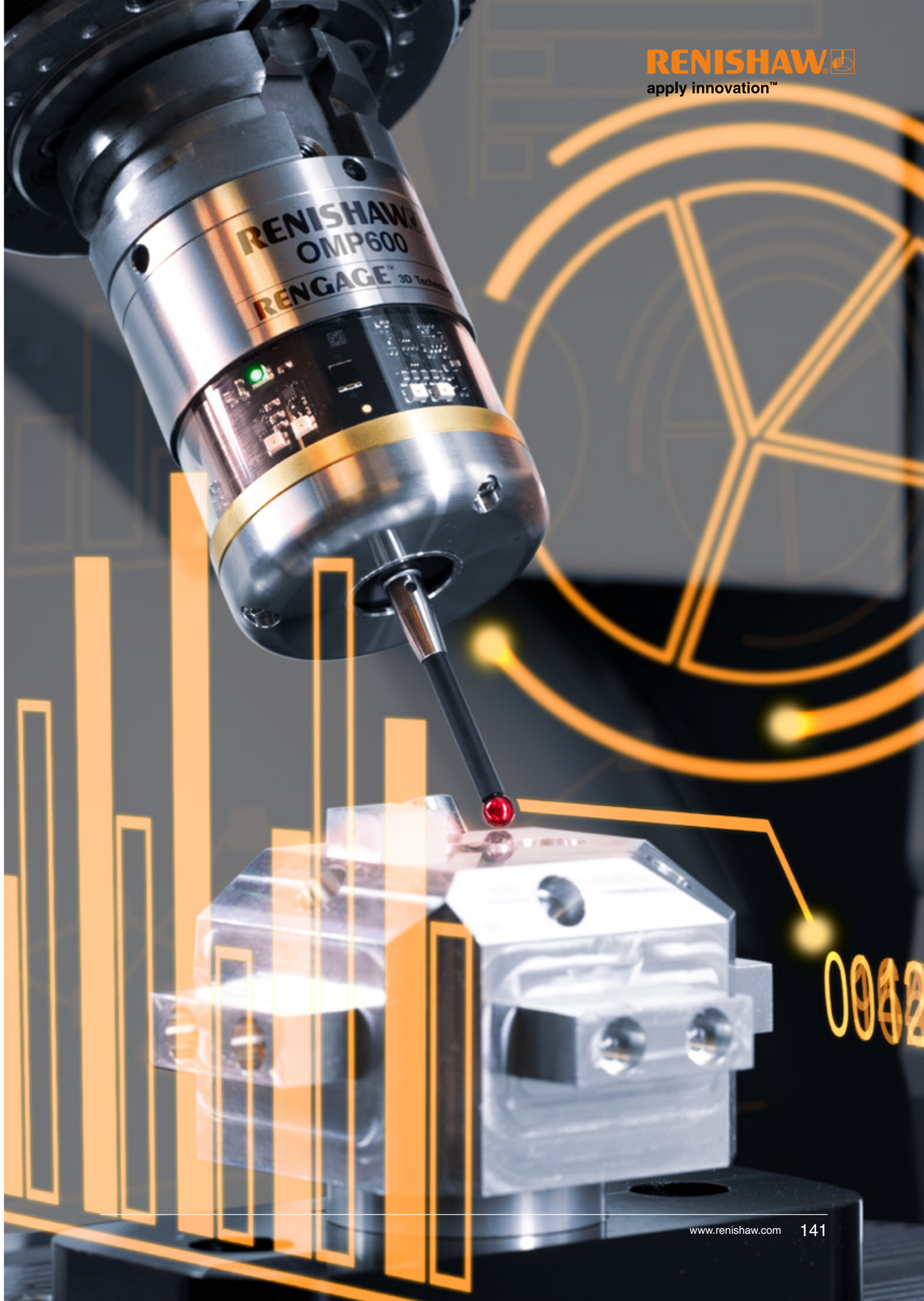
GoProbe cycles are included as standard in most Inspection Plus packages. Requiring only simple single-line commands, GoProbe eliminates the need for extensive knowledge of G-codes. The GoProbe smartphone app allows users to create this single-line command with just a few quick taps ready for input to the machine tool controller. Where required, further assistance is available in the form of animations, help images and associated text.

Inspection Plus uses SupaTouch technology to optimise the performance of each machine tool. SupaTouch intelligently minimises cycle times, increases productivity and delivers significant improvements in metrology. Inspection Plus is the foundation for many other Renishaw applications and is often a prerequisite for that application; for example Set and Inspect, Reporter and AxiSet™ Check-Up.





For more information including machine tool controller compatibility, refer to the *Probe software for machine tools - programs and features* data sheet (Renishaw part no. H-2000-2298) or visit **www.renishaw.com/inspectionplus**



Contact tool setting software

Contact tool setting macro software allows users to accurately set the length and diameter of cutting tools on CNC machining centres prior to machining and to check for broken tools and thermal drift during the machining process.

Experienced users can create and execute cycles using traditional G-code techniques. New or less experienced users can use Renishaw's range of user-friendly GUIs (including Set and Inspect) or the GoProbe smartphone app.

For more information including machine tool controller compatibility, refer to the *Probe software for machine tools - programs and features* data sheet (Renishaw part no. H-2000-2298)1 or visit **www.renishaw.com/toolsettingsoftware**

Key features and benefits:

- Significant time savings with reduced machine downtime
- Accurate tool length and diameter measurement
- Automatic tool offset calculation and correction
- Elimination of manual setting errors
- In-cycle tool breakage detection
- Reduced scrap
- Compatible with the GoProbe smartphone app, Set and Inspect and the range of GUIs

Non-contact tool setting software

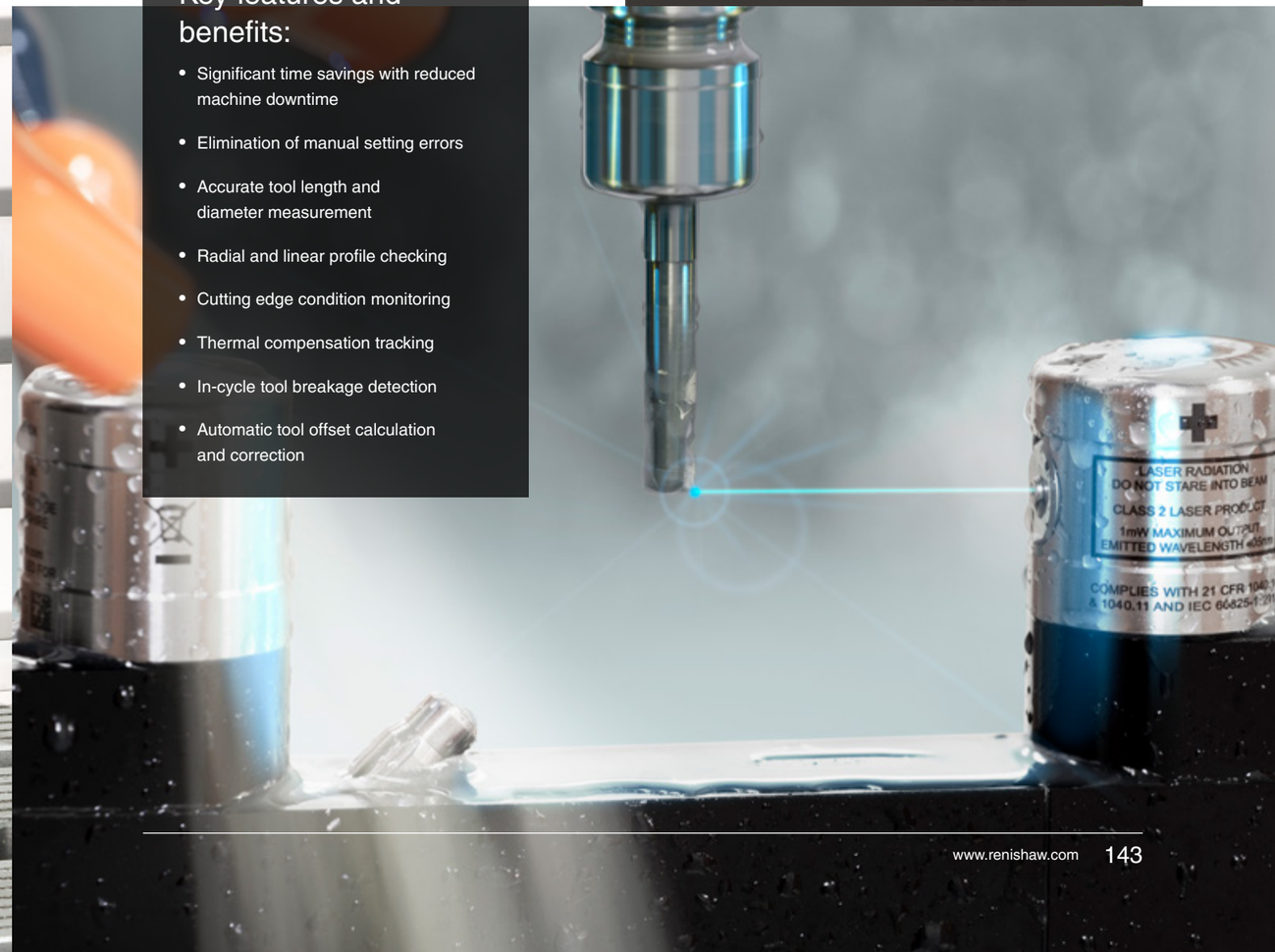
Renishaw non-contact tool setting macro software is capable of radial and linear profile checking as well as length and diameter, cutting edge condition monitoring, fast cycle times and advanced functionality. Additional cycles are available for advanced users.

Experienced users can create and execute cycles using traditional G-code techniques. Renishaw's range of user-friendly GUIs (including Set and Inspect) and the GoProbe smartphone app support new and less experienced users.

For more information including machine tool controller compatibility, refer to the *Probe software for machine tools - programs and features* data sheet (Renishaw part no. H-2000-2298) or visit **www.renishaw.com/toolsettingsoftware**

Key features and benefits:

- Significant time savings with reduced machine downtime
- Elimination of manual setting errors
- Accurate tool length and diameter measurement
- Radial and linear profile checking
- Cutting edge condition monitoring
- Thermal compensation tracking
- In-cycle tool breakage detection
- Automatic tool offset calculation and correction



SupaScan

SupaScan is an easy-to-use, on-machine probing system designed for exceptionally fast workpiece set-up using either scanning or point measurement techniques.

Utilising the OSP60 probe incorporating SPRINT™ technology, SupaScan can also be used to determine form information and to monitor surface condition. Defects including excessive waviness, surface peaks and steps can be detected, allowing corrections to be made whilst the component is still mounted in the machine tool, greatly enhancing your on-machine inspection capability.

The DPU-1 data processing unit, supplied as part of the SupaScan system, generates all the required programming and configuration macros, meaning that no separate programming interface is required.

SupaScan is also compatible with the Renishaw Inspection Plus macro suite. Inspection Plus for OSP60 can be used to program touch-trigger probe routines, and also allows existing Renishaw probe users to switch to SupaScan and achieve cycle time savings using their current, proven inspection programs. This compatibility also means that new or inexperienced programmers can take advantage of the simplified programming techniques provided by Set and Inspect or the GoProbe smartphone app.

Scan data is analysed by the DPU-1. Results are saved to blocks of machine tool variables, and optionally to a .csv file on the DPU-1.

Key features and benefits:

- Fastest available on-machine probing solution for workpiece set-up and prismatic feature measurement
- Surface condition monitoring and form indication
- Stand-alone, macro-based solution – no separate programming interface required
- DPU-1 data processing unit provides all necessary programming and configuration macros
- Optional Surface Reporter app to view surface condition data in real time

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OSI-S interface

An optical interface providing input/output communication with the machine tool.

DPU-1 data processing unit

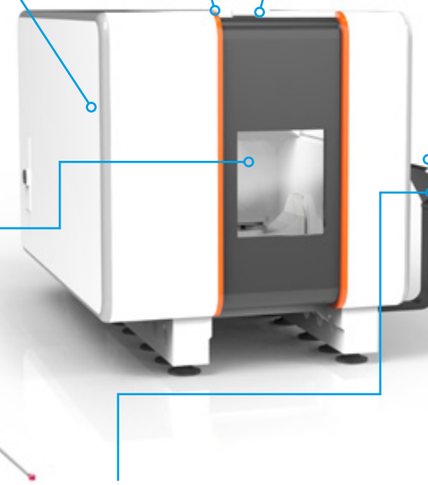
Processes and stores scanned measurement data. Saves results into machine variables (via the CNC API) for use in downstream processes.

OMM-S receiver

An optical receiver specific to the OSP60 probe.

SupaScan macros

G-code macro specific to the OSP60 probe. Provides compatibility with the Renishaw Inspection Plus macro suite and existing touch-probe routines.



OSP60 probe

An analogue scanning probe for machine tools, capable of scanning and touch measurements.

Inspection Plus for OSP60

G-code macros specific to the OSP60 probe.

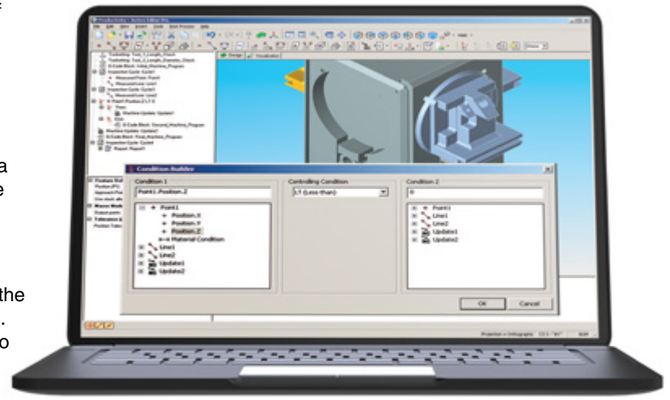
Surface Reporter app

An app displaying surface condition trace, part pass/fail and Wt value. Resides on a device running Microsoft® Windows™ connected to the machine tool.

For more information including machine tool controller compatibility, refer to the *Probe software for machine tools - programs and features* data sheet (Renishaw part no. H-2000-2298) or visit **www.renishaw.com/supascan**

Productivity+™ software

Productivity+™ is the collective name for a family of closely integrated software packages for use with Renishaw touch-trigger probes and the OSP60 scanning probe.



Productivity+™ Active Editor Pro

Productivity+ Active Editor Pro 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.

Simply import a component solid model and select the required feature geometry to generate a probe path. Manual programming options are available where no solid model exists.

Measurements, logic and updates may be added to existing CNC machining code and then post processed to provide a single comprehensive NC program containing metal cutting and component inspection operations.

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 controller platforms

“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 (Turkey)

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For more information including machine tool controller compatibility, refer to the *Probe software for machine tools - programs and features* data sheet (Renishaw part no. H-2000-2298) or visit **www.renishaw.com/productivityplus**

Productivity+™ Scanning Suite

The Productivity+™ Scanning Suite is a collection of software packages that use the OSP60 probe with SPRINT™ technology to record absolute XYZ surface position data with exceptional accuracy.

A core element of the Scanning Suite is the Productivity+™ CNC plug-in. This on-machine software controls the OSP60 probe and the machine tool providing significantly enhanced data processing and analysis capability in comparison with traditional methods.

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

Close integration of the controller and the 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.

The Scanning Suite also comprises a variety of optional application-specific toolkits and stand-alone cycles, each focused on an individual task or industry sector.

Key features and benefits:

Productivity+ Scanning Suite

- 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
- Includes toolkits and cycles focused on individual tasks and industry sectors

Productivity+ Toolkits

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

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OSI-S interface

An optical interface providing input/output communication with the machine tool.

DPU-2 data processing unit

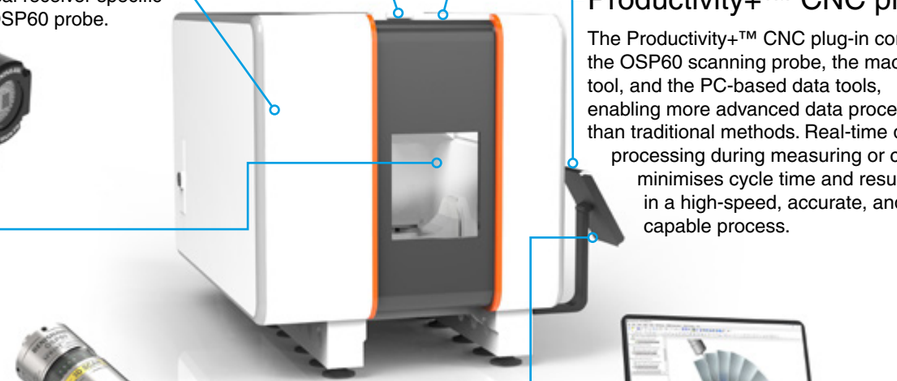
The DPU-2 data processing unit optionally hosts the Productivity+™ CNC plug-in software and any associated application toolkits.

OMM-S receiver

An optical receiver specific to the OSP60 probe.

Productivity+™ CNC plug-in

The Productivity+™ CNC plug-in controls the OSP60 scanning probe, the machine tool, and the PC-based data tools, enabling more advanced data processing than traditional methods. Real-time data processing during measuring or cutting minimises cycle time and results in a high-speed, accurate, and capable process.



OSP60 probe

An analogue scanning probe for machine tools, capable of scanning and touch measurements.

Productivity+™ Active Editor Pro

Productivity+™ Active Editor Pro provides a simple-to-use environment for incorporating measurement and inspection probe routines and in-process decision making into machining cycles.

For more information including machine tool controller compatibility, refer to the *Probe software for machine tools - programs and features* data sheet (Renishaw part no. H-2000-2298) or visit **www.renishaw.com/mtpsoftware**

Set and Inspect

Set and Inspect is a simple, on-machine probing app for use on a Microsoft® Windows®-based controller – or on a Windows®-based tablet connected to the controller via Ethernet.

An intuitive interface guides the user through the process of creating a probing cycle, automatically generates the required machine code for the probing cycle and loads it to the controller, eliminating data entry errors while reducing programming times.

'Single cycle' allows users to manually position the probe and quickly program and run individual cycles. 'Program builder' allows users to program multiple probing cycles in a single program that can be automatically run as part of the manufacturing process.

Key features and benefits:

- User-friendly interface for use with Inspection Plus and tool setting macro software
- No probing experience or machine code knowledge required
- Embedded help text and images
- Immediately view results data for single measurements
- Compatible with a wide range of machine tools and controllers
- Supplied with Reporter (installed automatically)

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For more information including machine tool controller compatibility, refer to the *Probe software for machine tools - programs and features* data sheet (Renishaw part no. H-2000-2298) or visit **www.renishaw.com/setandinspect**

Reporter

Reporter is an easy-to-use, real-time process monitoring app for customers who wish to view component and tool measurement data. Measurement data can be viewed on the machine tool or exported externally for analysis by using the Data export option. The app is installed onto a Windows®-based controller or a Windows® tablet connected to the controller via Ethernet.

Data export option (licensed)

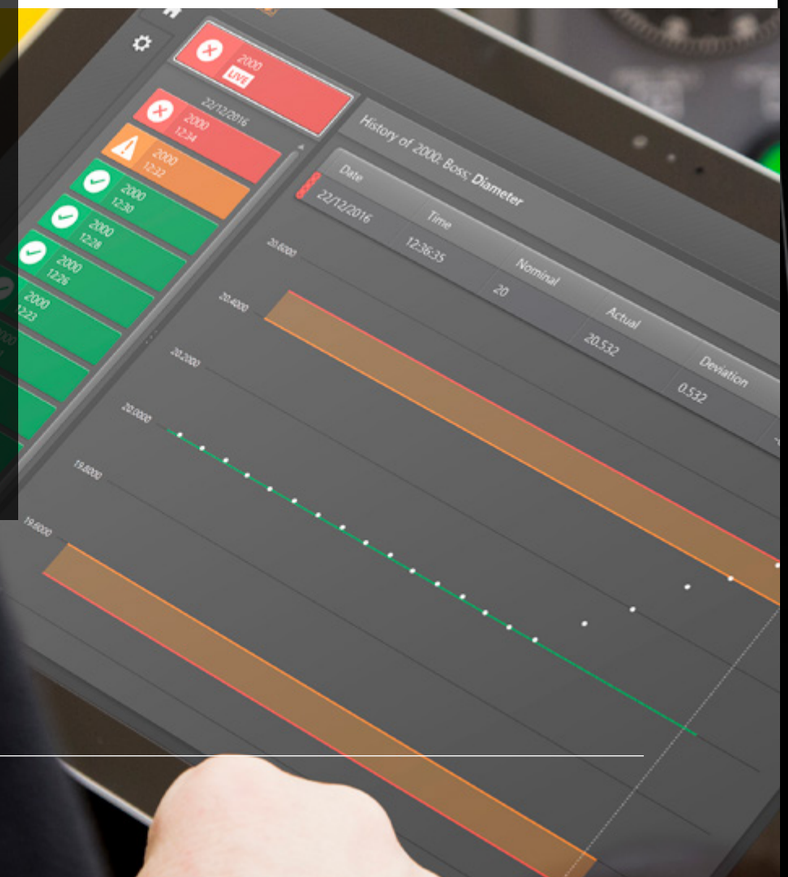
Measurement data can be exported from Reporter by purchasing and activating the Data export option. This option provides users with the following functionality:

- Export measurement data to a .csv file
- Generate a measurement data report as a .pdf file
- Automatically stream measurement data via MTConnect (requires MTConnect connection from the machine tool builder)

Exported data can be stored as part records for traceability, or imported into the user's in-house quality analysis software, providing manufacturers with valuable insights into their machining processes.

Key features and benefits:

- Quickly view pass and fail measurement data at the machine
- Displays measurement trends for every probed part
- Results can be viewed live, as parts and tools are measured
- Collect and share on-machine measurement data using the Data export option
- Compatibility with Inspection Plus, contact and non-contact tool setting macro software means that this single app can be used across a wide range of machine tools and controllers



For more information including machine tool controller compatibility, refer to the *Probe software for machine tools - programs and features* data sheet (Renishaw part no. H-2000-2298) or visit **www.renishaw.com/reporter**

Smartphone apps

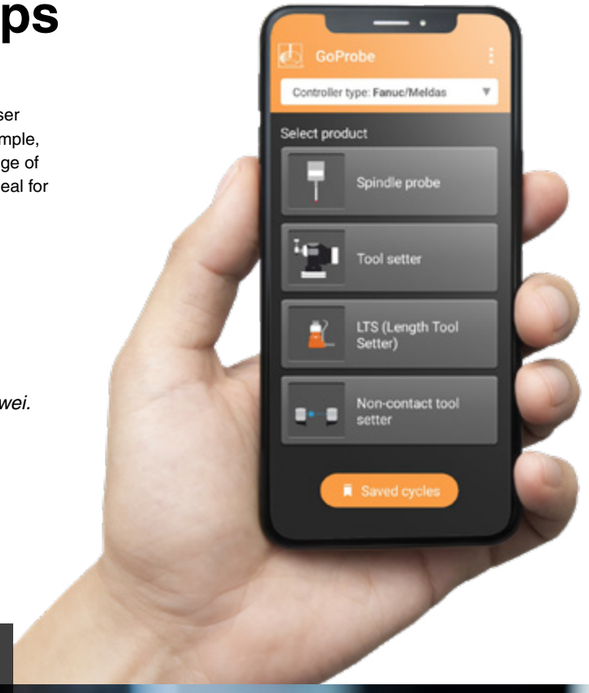
Smartphone apps are available to almost every user with a smartphone and provide information in a simple, convenient format. Available globally in a wide range of languages, Renishaw's free-of-charge apps are ideal for both new and experienced users.

Renishaw smartphone apps are available on the App Store™ and on Google Play.

Download on the App Store

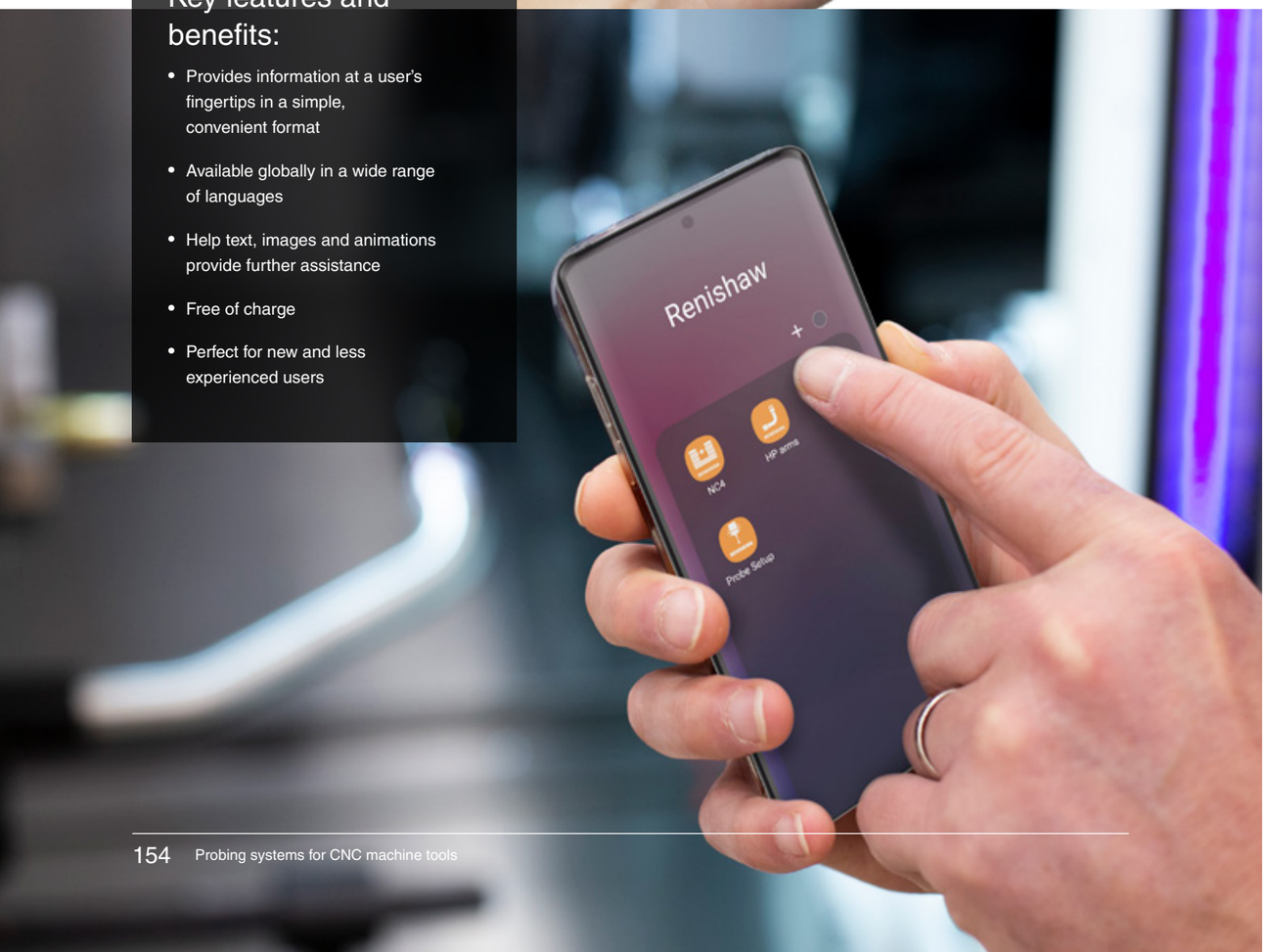
GET IT ON Google Play

Also available in China via Tencent and Huawei.



Key features and benefits:

- Provides information at a user's fingertips in a simple, convenient format
- Available globally in a wide range of languages
- Help text, images and animations provide further assistance
- Free of charge
- Perfect for new and less experienced users

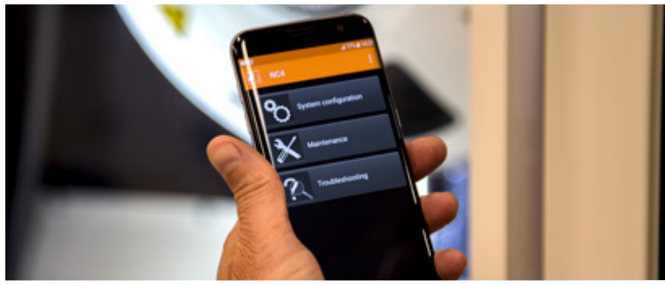


GoProbe app

The GoProbe app creates a probing routine with just a few quick taps. Simply select the required cycle and populate the data entry fields. The result is a single-line command that is entered into the CNC controller.

NC4 app

The NC4 app makes configuring and supporting the range of NC4 non-contact tool setters simple. Engineers have a single point of reference for configuration, maintenance and troubleshooting tasks at their fingertips.



Probe Setup app

The Probe Setup app provides users with a simplified method of customising their Renishaw probe settings that is faster and easier than following traditional printed instructions.

New Opti-Logic™ technology uses pulses of light to send and receive probe settings from a smartphone to a machine tool probe, simplifying the configuration process.

HP arms app

HP arms app The HP arms app provides engineers with an interactive support app for the range of Renishaw high-precision tool setting arms.
The app makes system configuration, maintenance and troubleshooting tasks simple with easy-to-follow animations and step-by-step instructions.

Renishaw HPMA, HPMA-X , HPPA and HPRA tool setting arms are supported by the app.

For more information including machine tool controller compatibility, refer to the *Probe software for machine tools-programs and features* data sheet (Renishaw part no. H-2000-2298) or visit **www.renishaw.com/smartphoneapps**

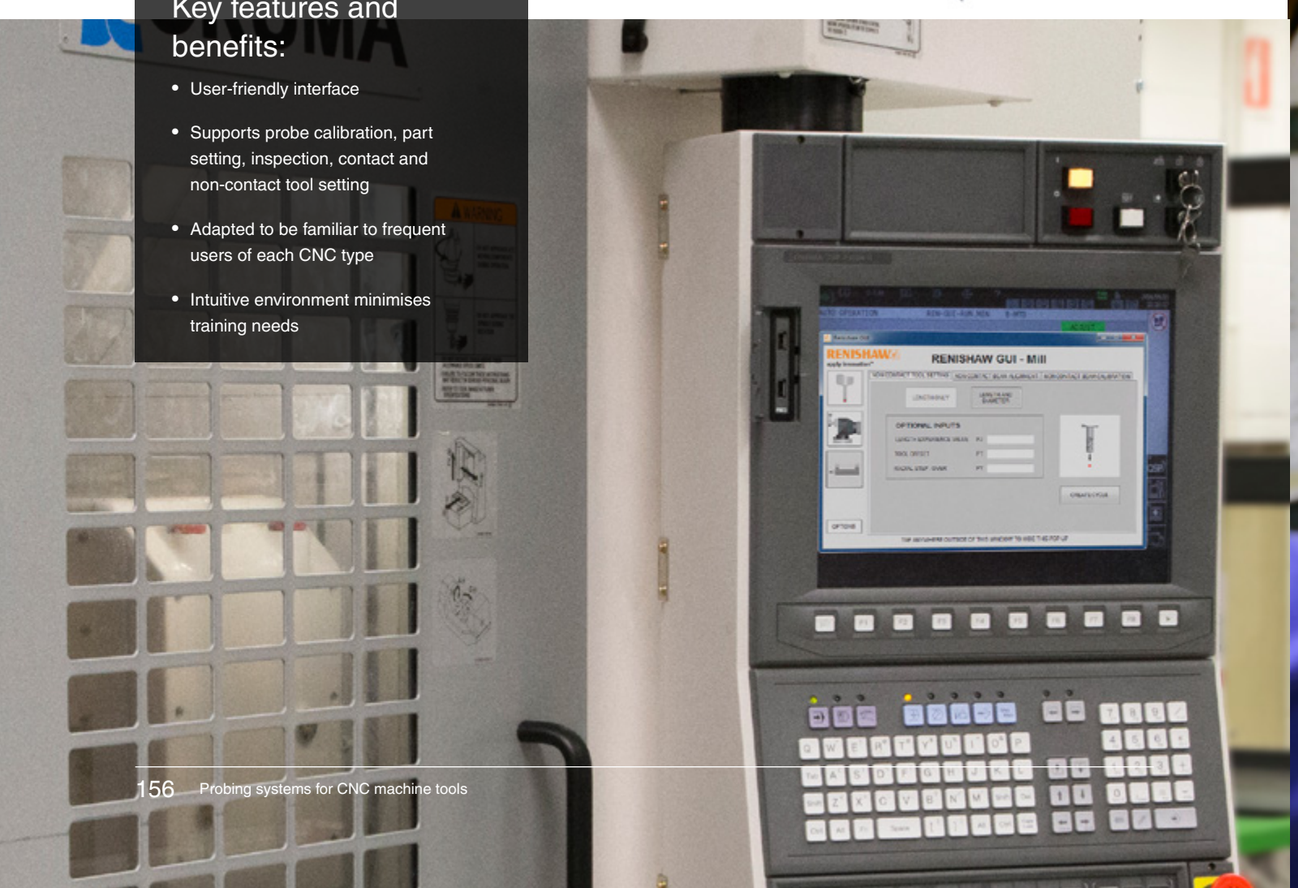
GUIs

In addition to Set and Inspect, Renishaw supports the widest range of CNCs with dedicated user-friendly GUIs to guide users through the process of part setting, inspection and tool setting.

Each GUI is adapted to be familiar to users of that machine tool controller. It provides an intuitive, user-friendly environment designed to assist users in generating a probing cycle which eliminates the difficulty associated with traditional machine tool programming. This allows cycles to be produced and selected with minimal user input.

Key features and benefits:

- User-friendly interface
- Supports probe calibration, part setting, inspection, contact and non-contact tool setting
- Adapted to be familiar to frequent users of each CNC type
- Intuitive environment minimises training needs



GoProbe iHMI for Fanuc

GoProbe iHMI utilises the embedded Windows O/S, Fanuc Picture Technology and touch-screen interface of the Fanuc iHMI to deliver a simple-to-use probing solution that is perfect for users with no or limited probing experience.

GoProbe iHMI can either be factory fitted by the machine tool builder or retrofitted.

Key supported controllers:

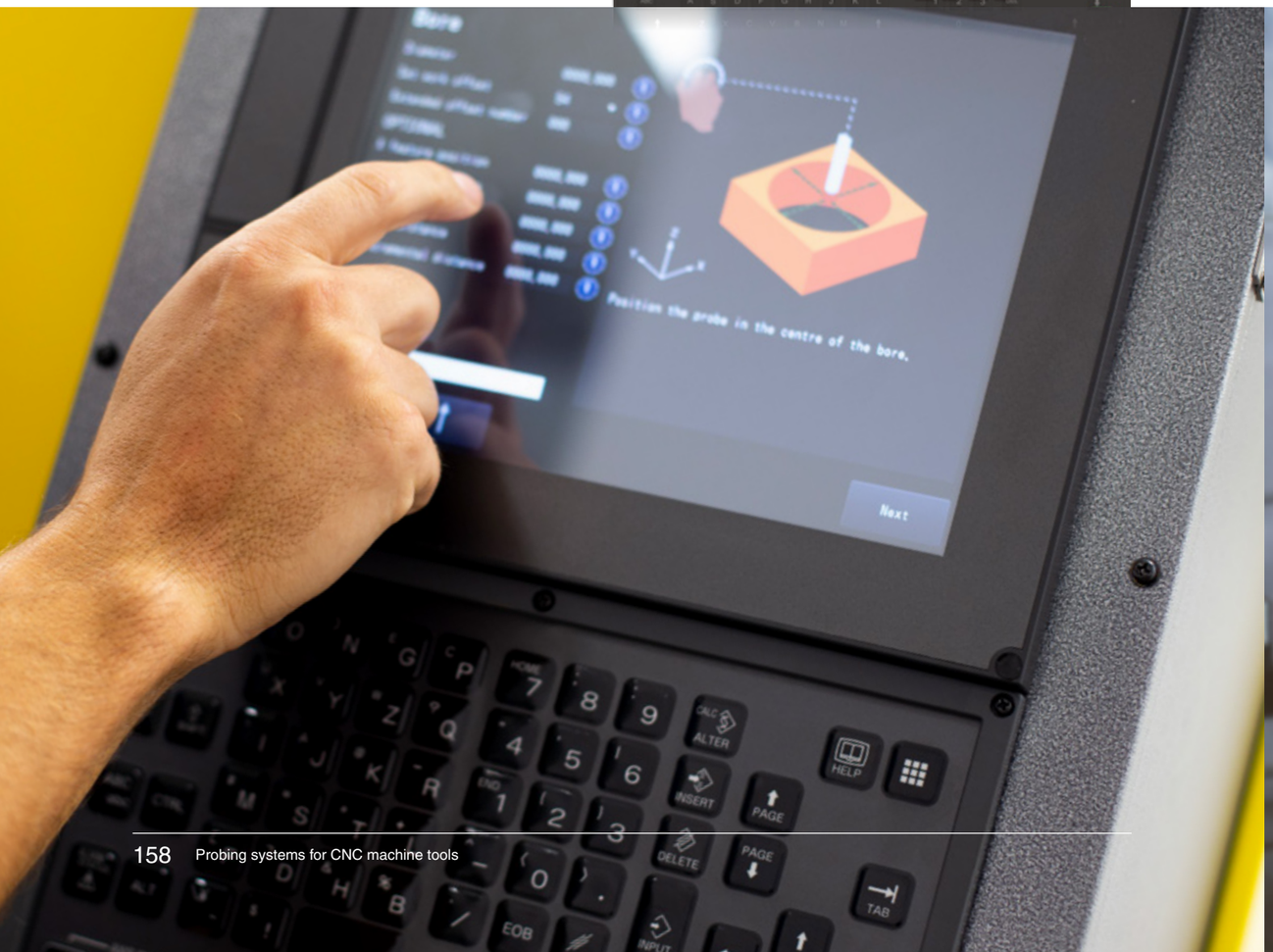
- Fanuc PLUS CNCs
- Fanuc Robodrill machines

Non-contact tool setting GUIs

Non-contact tool setting GUIs provide a user-friendly interface to a wide range of non-contact tool setting cycles, making the on-machine tool measurement process quick and easy.

Key supported controllers:

- Fanuc
- Siemens
- Heidenhain



GoProbe GUI (for Mitsubishi M80/M800S)

GoProbe GUI (for Mitsubishi M80/M800S) is simple to use – users are guided with easy-to-follow menus and instructions. The GUI is available on Mitsubishi M80/M800S controllers that are not supported by Set and Inspect. This kit is for OEM, dealer and Mitsubishi installation only.

Key supported controllers:

- Mitsubishi M80 / M800S

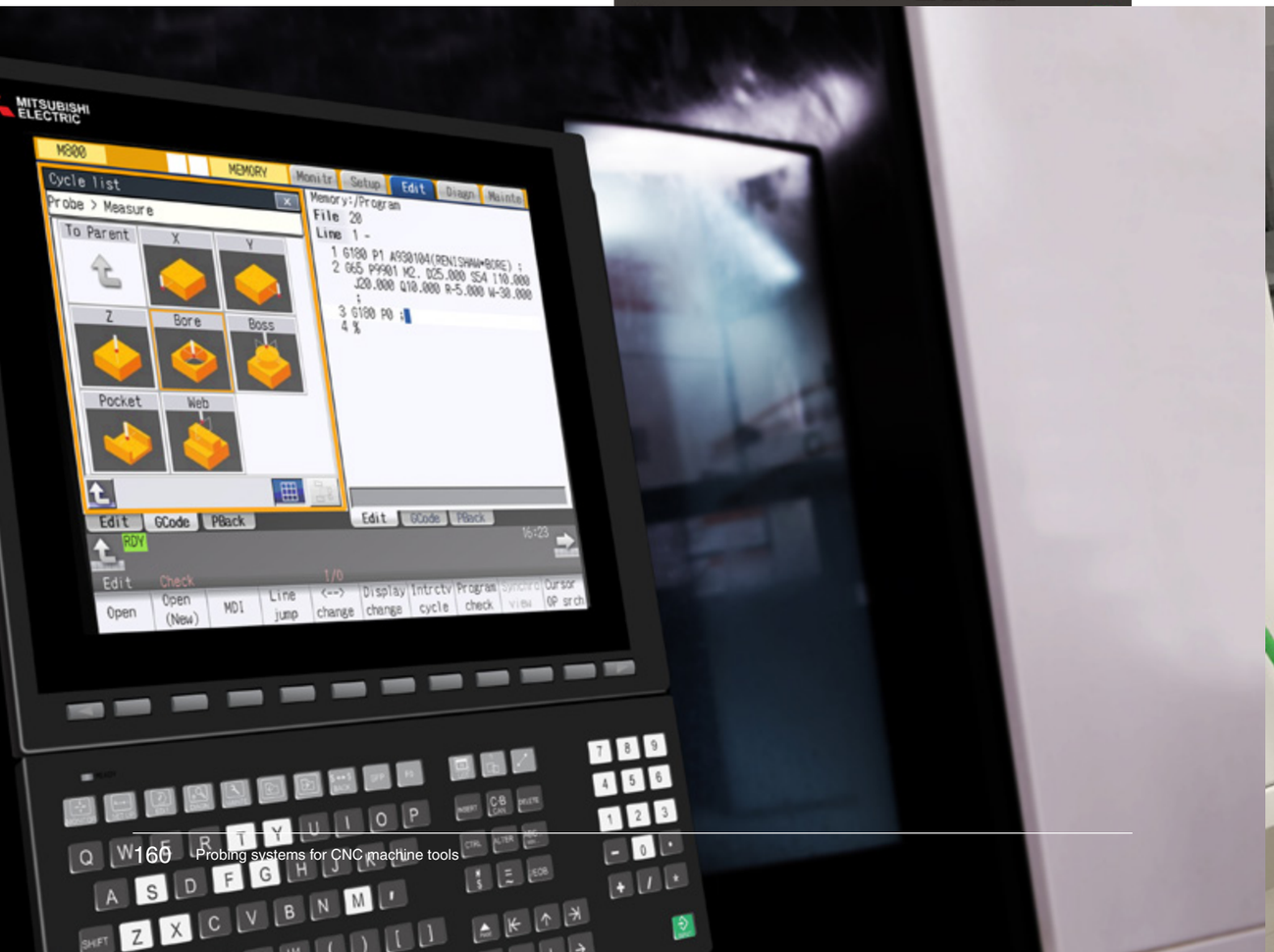
Siemens HMI

The Siemens HMI provides a user-friendly on-machine programming interface that simplifies the process of creating inspection and non-contact tool setting routines for multi-tasking machines.

Key supported controllers:

- Siemens

For more information including machine tool controller compatibility, refer to the *Probe software for machine tools - programs and features* data sheet (Renishaw part no. H-2000-2298) or visit **www.renishaw.com/guis**



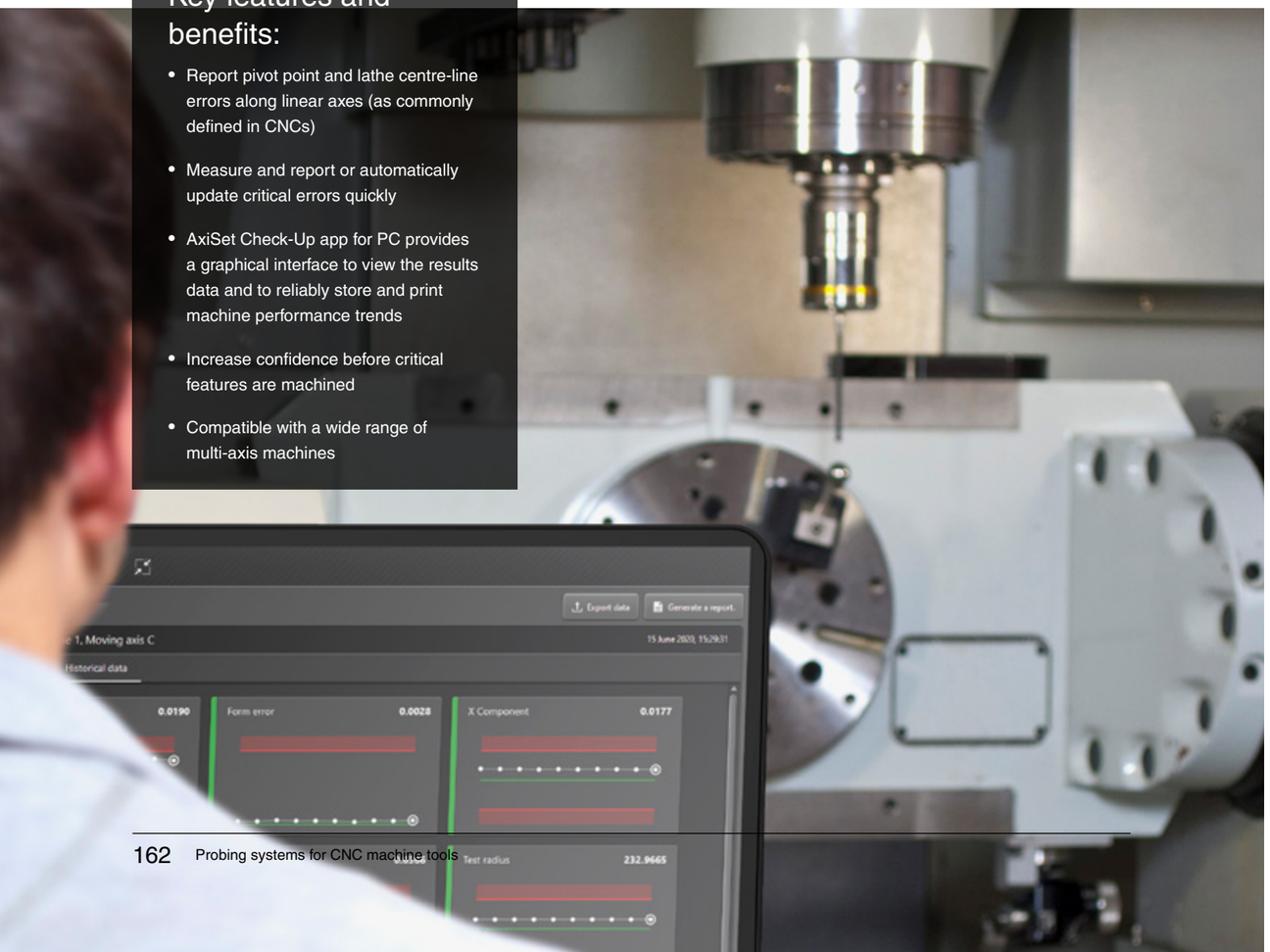
AxiSet™ Check-Up

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 maximising the stability of the environment and machine. When used alongside Renishaw's QC20 ballbar and laser interferometers, AxiSet Check-Up gives an unparalleled machine diagnosis solution.

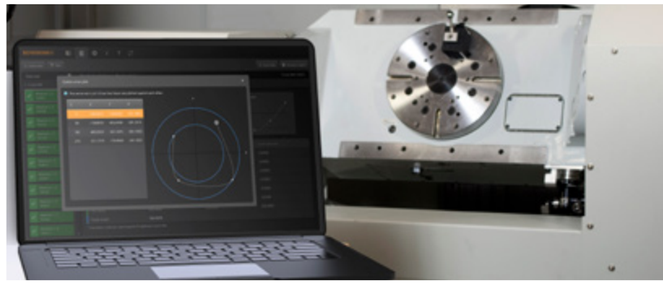
Key features and benefits:

- Report pivot point and lathe centre-line errors along linear axes (as commonly defined in CNCs)
- Measure and report or automatically update critical errors quickly
- AxiSet Check-Up app for PC provides a graphical interface to view the results data and to reliably store and print machine performance trends
- Increase confidence before critical features are machined
- Compatible with a wide range of multi-axis machines



Macros

Written for a range of CNC controllers, 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 and update measurement data which can be accessed through the dedicated AxiSet™ Check-Up app.



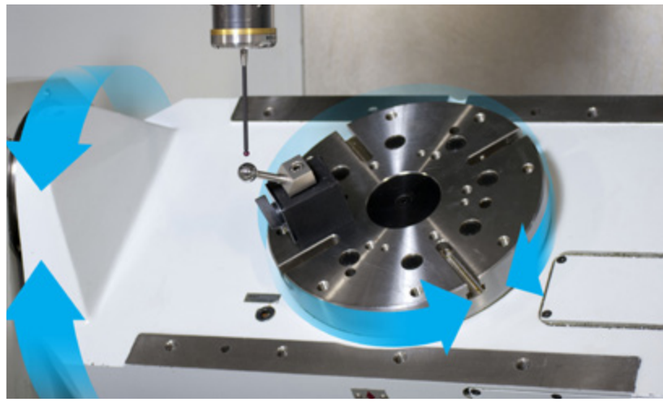
Hardware

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 with RENGAGE™ technology.
- Calibrated test bar – ensures that AxiSet Check-Up measurements are traceable and comparable to the settings made by machine tool builders.



For more information including machine tool controller compatibility, refer to the *Probe software for machine tools - programs and features* data sheet (Renishaw part no. H-2000-2298) or visit **www.renishaw.com/axiset**

Renishaw Central

The Renishaw Central manufacturing data platform provides a consistent method of connecting your Renishaw measurement and manufacturing devices, to make it easy for a variety of systems and processes to access Renishaw device data.

The right information, in the right place, at the right time.

- Metrology data
- Utilisation data
- Alert data

For more information visit **www.renishaw.com/central**

Key features and benefits:

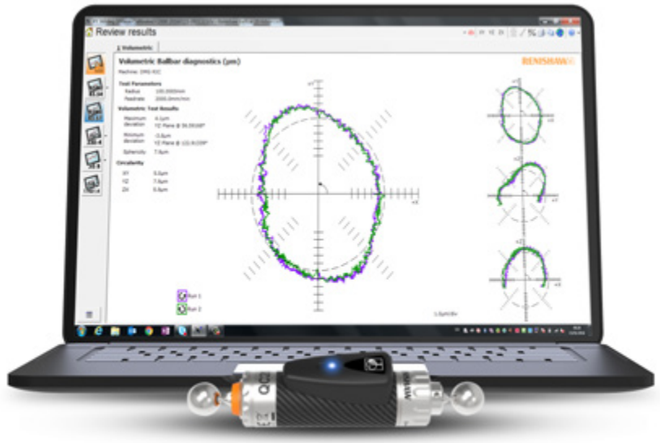
- Store and visualise your data
- Consume data into your digital systems
- Use standards-based connections

Ballbar 20 software

Testing with the QC20 ballbar provides a simple, rapid check of a CNC machine tool's positioning performance to recognised international standards (e.g. ISO, ANSI/ASME).

Ballbar 20 software allows users to benchmark and track the performance of their machines, and to quickly diagnose problems that may require maintenance. It also identifies the error sources that produce them.

For more information visit **www.renishaw.com/qc20**

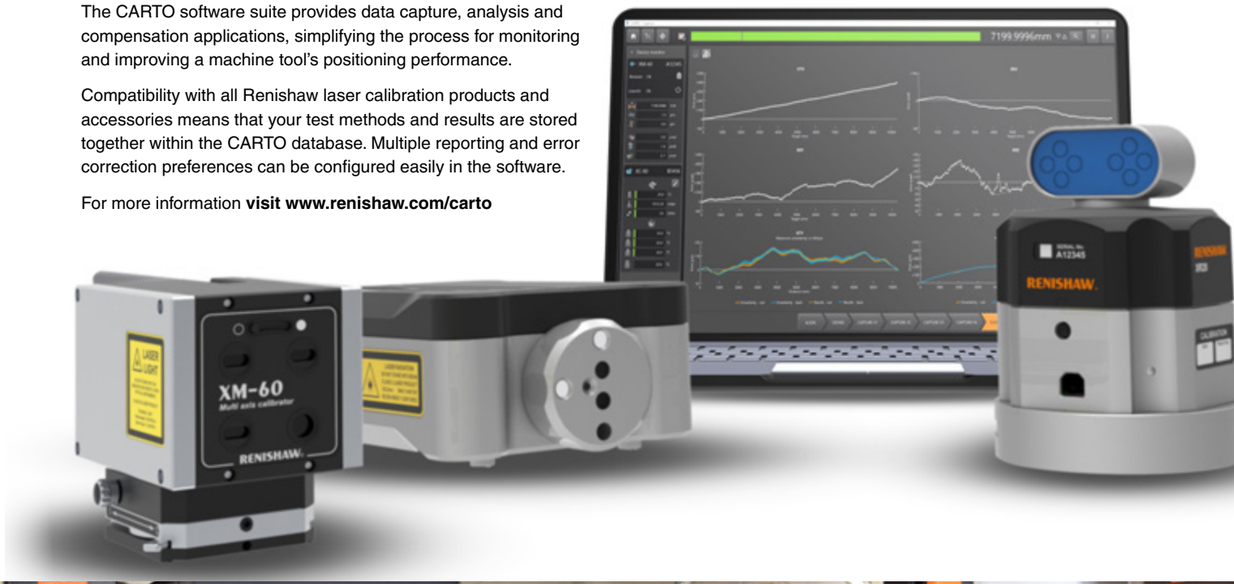


CARTO software suite

The CARTO software suite provides data capture, analysis and compensation applications, simplifying the process for monitoring and improving a machine tool's positioning performance.

Compatibility with all Renishaw laser calibration products and accessories means that your test methods and results are stored together within the CARTO database. Multiple reporting and error correction preferences can be configured easily in the software.

For more information **visit www.renishaw.com/carto**



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Machine tool diagnostics hardware

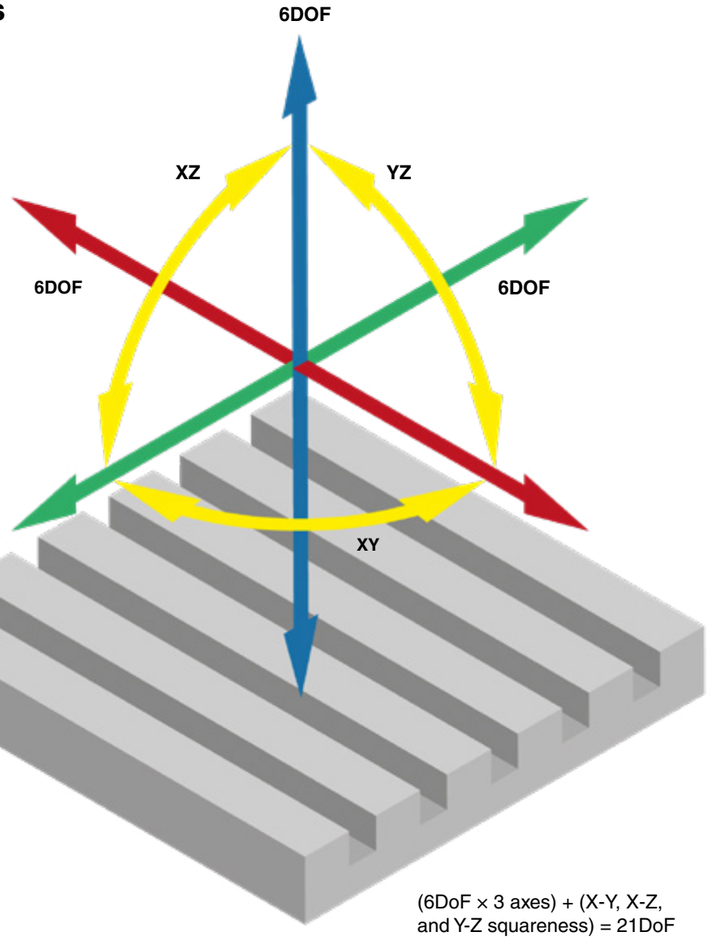
Introduction

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.

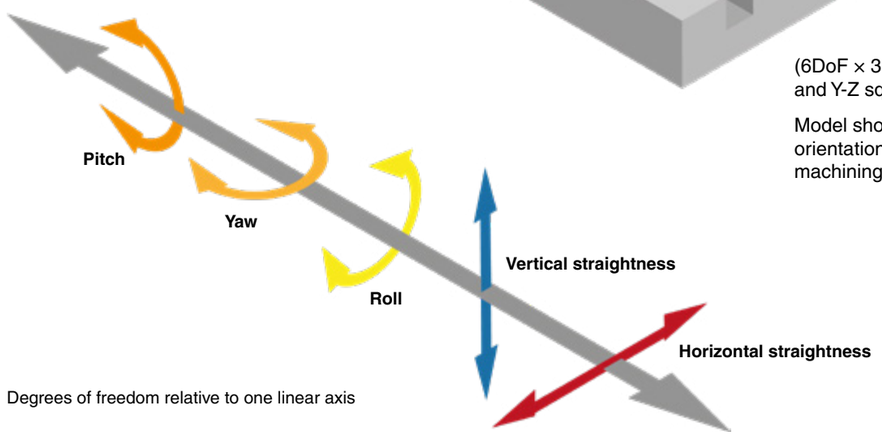
All of these can have a detrimental effect on the machine's overall positioning accuracy and therefore the accuracy of machined parts.

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

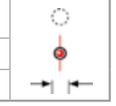
Model shown illustrates 3-axis orientation for a vertical machining centre



Degrees of freedom relative to one linear axis

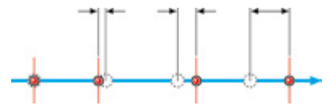
Error types explained

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	

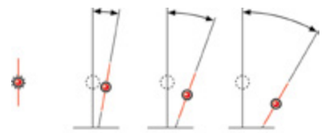
Linear

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



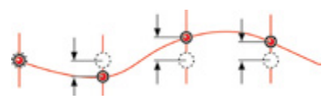
Angular

- 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.



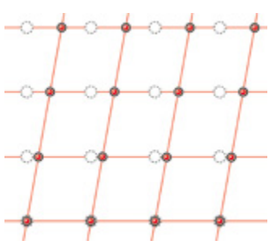
Straightness

- 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

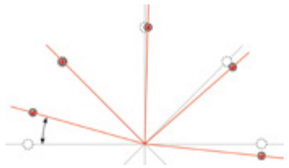
- Two orthogonal axes are not at 90° to each other.
- Often caused by bending, misalignment or wear.
- Machined faces on components will not be square.



Machine tool errors

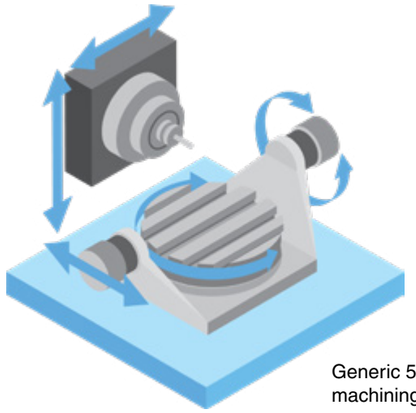
Rotary errors

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



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 controller system must know these precisely in order to position the cutting tool's tip relative to the workpiece.

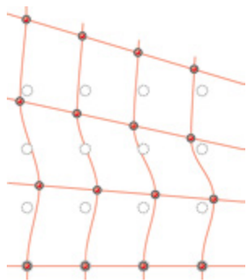
AxiSet™ Check-Up is designed to identify errors in rotary axis position and performance, including making recommendations for pivot point corrections.



Generic 5-axis machining centre

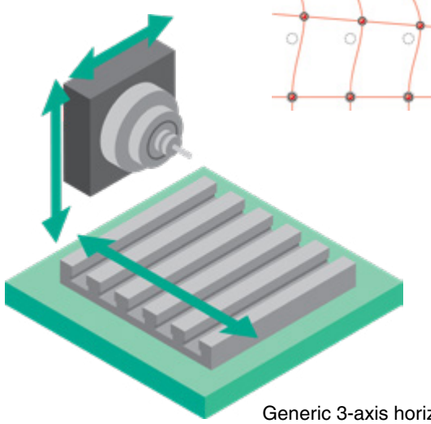
Multiple errors

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



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.



Generic 3-axis horizontal machine

Product selector

Comparison chart

Products	AxiSet™ Check-Up	QC20	XL-80	XM-60
Page	162	174	176	178
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			●	
Roll measurement				●
Rotary axis angular error			●	●
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	●			

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 ballbar and, if necessary, an XL-80 or XM-60 laser can be used to provide detailed correction data.

Crucially, the XL-80 and XM-60 laser systems and the QC20 ballbar are independent measuring devices, which means they make use of their own feedback system and are independent of the machine's encoders.

The XL-80 and XM-60 lasers are usually used for initial comprehensive machine calibration and correction with the QC20 ballbar providing periodic verification back to the initial performance.

Together with AxiSet™ Check-Up, 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.

QC20 ballbar

The QC20 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:

- 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

Specification

Measurement	
Accuracy	± (0.7 + 0.3% L) µm
Range	±1.0 mm
Maximum sample rate	1000 Hz
Data transmission range	10 m typical

L = length over which error is measured

> **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 (Switzerland)

For further information and the best possible application and performance support, 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, co-ordinate 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 ppm accuracy traceable to national standards
- Measures linear, angular and straightness errors on linear axes
- Combined with the XR20 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

Specification

Measurement	Accuracy	Resolution	Range
Linear	±0.5 ppm	0.001 µm	0 m to 80 m
Angular	±0.002A ±0.5 ±0.1M µrad ±0.0002A ±0.5 ±0.1M µrad (calibrated)	0.1 µm/m	0 m to 15 m
Straightness **(short range)** **(long range)**	 ±0.005A ±0.5 ±0.15 M^2 µm ±0.025A ±5 ±0.015 M^2 µm	 0.01 µm 0.1 µm	 0.1 m to 4.0 m* 1 m to 30 m
Rotary	up to ±1 arcsec (at 20 °C)	0.1 arcsecs	up to 25 revolutions
Flatness	±0.002A ±0.02 M^2 µm	0.01 µm	0 m to 15 m
Squareness **(short range)** **(long range)**	 ±0.005A ±2.5 ±0.8 M µrad ±0.025A ±2.5 ±0.08 M µrad	 0.01 µm/m	 ±3/M mm/m

A = displayed error reading
M = measurement distance in metres
* Longer ranges are achievable with data stitch

> **High-precision calibration of these machines with a Renishaw laser or ballbar is key to quality and reliable performance.**
>
> Godrej (India)

For further information and the best possible application and performance support, contact Renishaw or visit **www.renishaw.com/xl80**

XM-60 multi-axis calibrator

The XM-60 multi-axis calibrator provides users with powerful machine diagnostic capability through the measurement of all degrees of freedom from a 'single shot'. By capturing six degrees of freedom, users can discover the source of their errors, rather than the effect which is often seen when performing linear measurement alone.

Reducing measurement uncertainties is important for any user. The XM-60 has been designed to measure machine errors directly, by aligning the laser beams with a machine axis. This reduces the inaccuracies which can result from complex mathematics used in alternative measurement techniques.
Direct measurement makes comparison before and after machine adjustments a quick and simple task.

> **To evaluate the machining capability of a machine tool, it is necessary to measure all machine axis errors. An object's position in space is defined by six degrees of freedom, similar to the relationship between a cutting tool and a workpiece in a machine tool. In order to directly and simultaneously measure all errors, the Volumetric Accuracy Research Institute Company introduced the XM-60 multi-axis calibrator. As a result, we succeeded in reducing labour costs and accurately evaluating machine performance.**
>
> Volumetric Accuracy Research Institute Co., Ltd. (Japan)

Key features and benefits:

- Simultaneous measurement of linear, pitch, yaw, roll, horizontal and vertical straightness
- Automatic sign detection and graphical alignment minimise human error
- Roll measurement capability in any orientation
- Measure all errors directly to see results as the test is in progress

Specification

Measurement	Axial range	Measurement range	Accuracy	Resolution
Linear	0 m to 8 m	0 m to 8 m	±0.5 ppm (with environmental compensation)	1 nm
Angular (pitch/yaw)	0 m to 8 m	±500 µrad	±0.004A ± (0.5 µrad +0.11M µrad)	0.03 µrad
Straightness*	0 m to 6 m	±50 µm ±250 µm	±0.01A ±1 µm ±0.01A ±1.5 µm	0.25 µm
Roll*	0 m to 4 m 4 m to 6 m	±500 µrad	0 m to 4 m: ±0.01A ±6.3 µrad 4 m to 6 m: ±0.01A ±10.0 µrad	0.12 µrad

Note Accuracy values are reported to a statistical confidence of 95% (k=2). They do not include the errors associated with the normalisation of the readings to a material temperature of 20 °C

A = displayed error reading
M = measurement distance in metres
* The data stitch functionality in CARTO supports accurate readings for all six degrees of freedom beyond 6 metres.

For further information and the best possible application and performance support, contact Renishaw or visit **www.renishaw.com/xm60**

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Position and motion control

Introduction

Enclosed optical absolute linear encoders

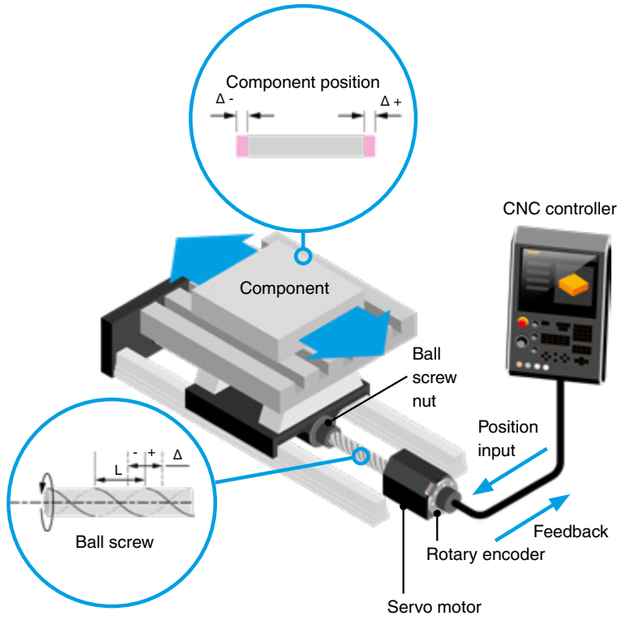
CNC machine tools require positional feedback to enable them to function accurately and repeatably.

Typically, feedback systems may be either a semi-closed loop type where a rotary encoder measures rotation of a ball screw, or the closed loop type where a linear encoder directly measures the actual movement of a linear axis.

The semi-closed loop system is sufficient for many machine tool specifications. It is, however, accepted that closed loop systems mitigate for positioning errors caused by backlash, wear, and thermal variation in ballscrews.

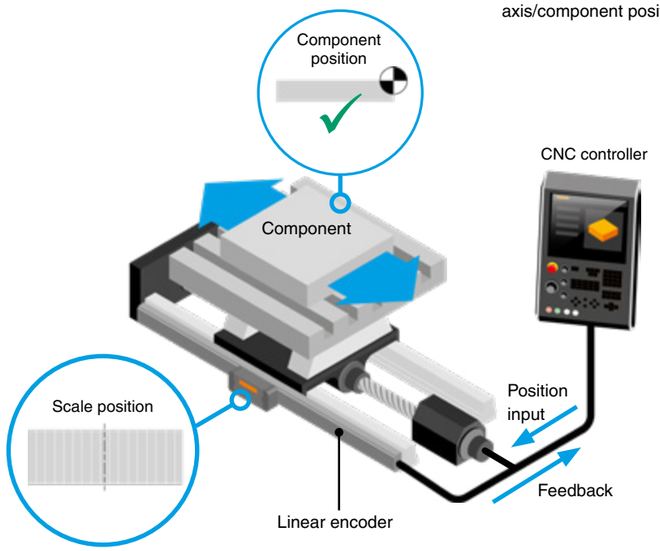
Where machine tool applications require the highest levels of accuracy and repeatability, optical linear encoders are widely adopted.

Renishaw's enclosed optical linear encoders have an exceptionally robust design for use in harsh industrial environments where high performance position measurement is required. Finely graduated stainless steel scale combined with a sealed optoelectronic readhead converts motion relative to the scale into position data.



Semi-closed loop system example: a rotary encoder measures rotation of a ball screw and feeds it back to a controller. Linear position along an axis is calculated; 1 revolution = ball screw pitch (L).

Any variation (Δ) of the pitch is transferred to the axis/component position.



Closed loop system example: a linear encoder directly measures a position along a linear axis and feeds it back to a controller.

Technology explained

FORTiS™ encoder systems apply Renishaw's proven absolute position measurement technology. A miniature ultra-high speed digital camera, housed in a sealed readhead, reads a single track, fine pitch (30 µm) optical steel scale to deliver superior performance in position feedback, motion control and metrology.

The scale has an exceptional breakage threshold and a high resistance to contamination even when exposed. The scale's coefficient of thermal expansion (CTE) of 10.1 ±0.2 µm/m/°C is similar to the base material used in the majority of machines, reducing errors due to thermal effects whilst increasing measurement certainty.

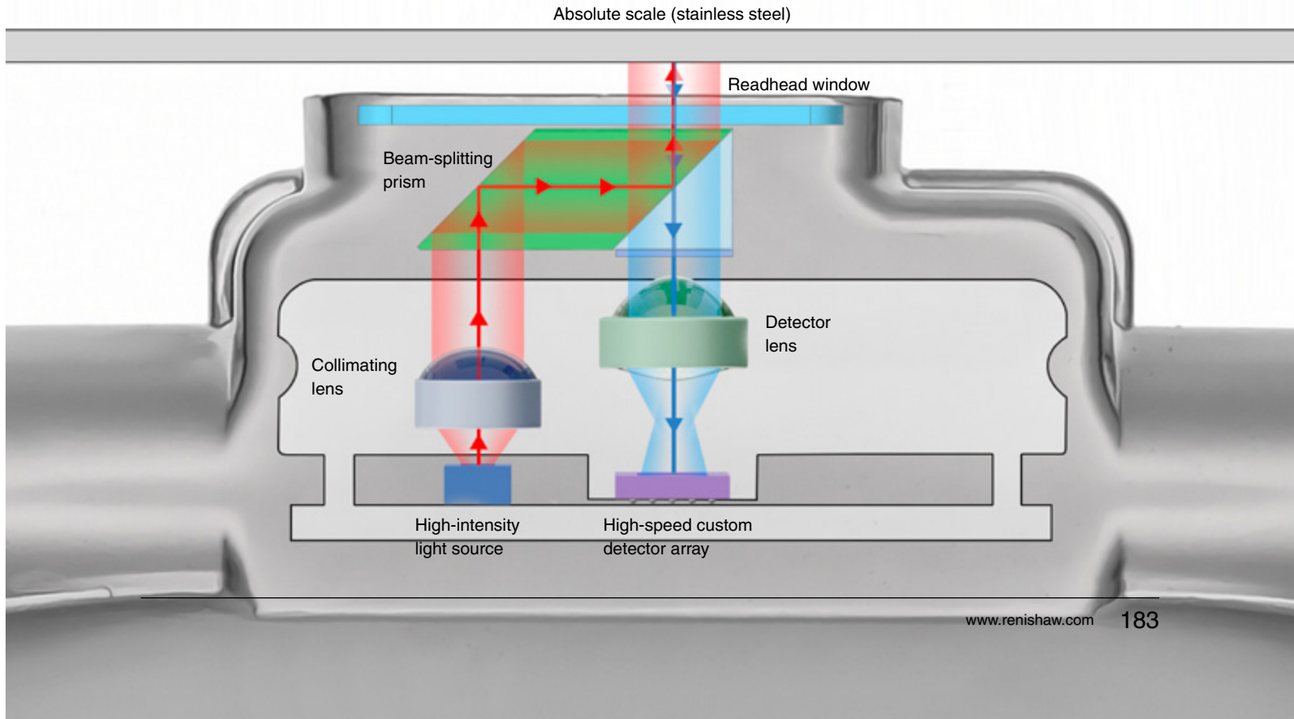
Low noise (jitter below 10 nm RMS) and SDE Sub-Divisional Error, the error within a scale period) of just ±40 nm enables encoder feedback of superior fidelity, to ensure smoother velocity control and rock-solid positional stability.

Having no internal moving parts such as bearings, springs or wheeled carriages eliminates wear, minimises risk of breakage and improves reliability, to deliver longer system lifespan.

Both readhead models are sealed against ingress of liquid and solid contaminants, which ensures that they remain undamaged and working even after full immersion.

Application of tuned mass damping technology enables class-leading vibration resistance. Tested beyond 30 g, both FORTiS-N (narrow size) and FORTiS-S (standard size) models achieve the same specification and can endure the same harsh conditions

The non-contact design reduces hysteresis and backlash errors, improving workpiece surface finish and form.



What encoder?

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

Product selector

Products	FORTIS-S	FORTIS-S FS	FORTIS-N	FORTIS-N FS
Features				
Measuring standard	Renishaw stainless steel scale with single track absolute encoding			
Coefficient of thermal expansion (at 20 °C)	10.1 ±0.2 µm/m/°C			
Thermal datum	At centre position (encoder position of 0.5 × measuring length)			
Accuracy grades	High grade: ±3 µm Standard grade: ±5 µm			
Maximum speed	4 m/s			
Acceleration (readhead relative to scale)	< 200 m/s² in measuring direction			
Sub-Divisional Error (typical)	±40 nm			
Jitter (RMS)	10 nm			
Standard size body - 37 mm	●	●		
Narrow size body - 18 mm			●	●
Measuring lengths available (mm)	140, 240, 340, 440, 540, 640, 740, 840, 940, 1040, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040, 2240, 2440, 2640, 2840, 3040		70, 120, 170, 220, 270, 320, 370, 420, 470, 520, 570, 620, 670, 720, 770, 820, 920, 1020, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040	
Resolution (nm)	0.5, 1, 1.25, 10, 12.5, 25, 50	1, 10, 50	0.5, 1, 1.25, 10, 12.5, 25, 50	1, 10, 50
Multiple readheads	●	●	●	●
Short end caps			●	●
Mounting spar (recommended for > 620 mm length)			●	●
Functional safety		●		●
Absolute position serial interface	BiSS C, FANUC (α/αi), Mitsubishi, Panasonic, Siemens DRIVE-CLiQ (with external interface), Yaskawa	BiSS Safety, Siemens DRIVE-CLiQ (with external interface)	BiSS C, FANUC (α/αi), Mitsubishi, Panasonic, Siemens DRIVE-CLiQ (with external interface), Yaskawa	BiSS Safety, Siemens DRIVE-CLiQ (with external interface)
Environment protection	IP53 when installed correctly, IP64 with air purge			
		Protection class III Pollution degree II Altitude 2000 m		Protection class III Pollution degree II Altitude 2000 m
EMC immunity	IEC 61800-5-2:2016 Electromagnetic immunity requirement for safety related systems - Annex E, second environment			

Accuracy grade									
3 µm	Single								
	Serial interface	BiSS C, Mitsubishi, Panasonic, Siemens DRIVE-CLiQ		BiSS C, Safety Siemens DRIVE-CLiQ		BiSS C, Mitsubishi, Panasonic, Siemens DRIVE-CLiQ		BiSS C, Safety Siemens DRIVE-CLiQ	
	Resolution nm	1		1		1		1	
	Dual								
	Serial interface	Fanuc		N/A		Fanuc		N/A	
	Resolution nm	1/0.5	10/1.25	N/A		1/0.5	10/1.25	N/A	
5 µm	Single								
	Serial interface	BiSS C, Mitsubishi, Panasonic, Siemens DRIVE-CLiQ		BiSS C, Safety Siemens DRIVE-CLiQ		BiSS C, Mitsubishi, Panasonic, Siemens DRIVE-CLiQ		BiSS C, Safety Siemens DRIVE-CLiQ	
	Resolution nm	10	50	10	50	10	50	10	50
	Dual								
	Serial interface	Fanuc		N/A		Fanuc		N/A	
		50/12.5	50/25	N/A		50/12.5	50/25	N/A	

Product naming conventions

Renishaw's comprehensive range of encoders are informatively named for identification. The naming conventions are explained here to help with understanding and product selection.

Encoders and can be identified using the following classification:

Nomenclature

Product	F	FORTiS
Series	S	Standard (37 mm)
	N	Narrow (18 mm)
Encoder type	1	Absolute
Scale type	0	30 µm B code RTLA
End caps	0	Standard
	1	Small end caps (N type only)
Lip seal configuration	A	DuraSeal™ x 1
	B	DuraSeal™ x 2 (S type only)
Measuring length	304	FORTiS-S 014 = 140 mm to 304 = 3040 mm
	204	FORTiS-N 007 = 70 mm to 204 = 2040 mm
System accuracy	S	Standard accuracy
	H	High-accuracy
Thermal datum protection	C	Centrally located
Serial interface	36B	BiSS 36 bit
	37F	37 bit FANUC α and αi
	40N	40 bit Mitsubishi 4 wire
	48P	48 bit Panasonic
	28D	Siemens DRIVE-CLiQ 28 bit (50 nm only)
	30D	Siemens DRIVE-CLiQ 30 bit (10 nm only)
	34D	Siemens DRIVE-CLiQ 34 bit (1 nm only)
Functional Safety	X	Standard
	S	Functional safety (BiSS Safety and Siemens DRIVE-CLiQ only)
Resolution	001	1 nm (all protocols except FANUC)
	010	10 nm (all protocols except FANUC)
	050	50 nm (all protocols except FANUC)
	T12	1/0.5 nm (FANUC only)
	108	10/1.25 nm (FANUC only)
	502	50/25 nm (FANUC only)
	504	50/12.5 nm (FANUC only)
Additional field	X	Standard, no option
	D	Standard with additional readhead

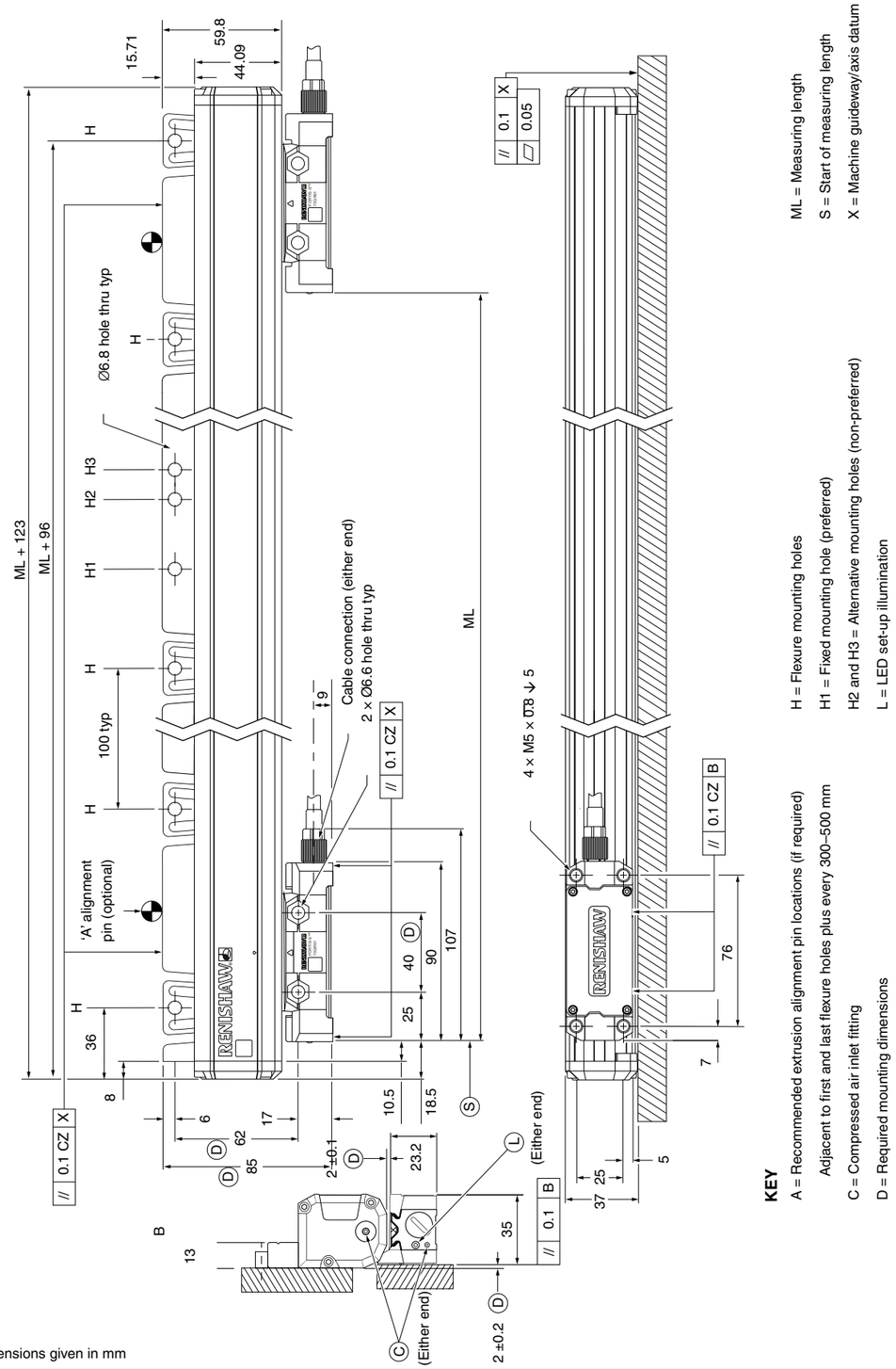
FORTiS-S™ standard size enclosed linear encoders

Featuring Renishaw's proven absolute encoder technology within an exceptionally robust enclosed design, FORTiS encoders deliver high performance measurement in the harshest of environments, offering significant benefits over conventional systems.

Key features and benefits:

- Non-contact design – no mechanical wear and greater longevity
- Reduced hysteresis – smoother feedback and improved dynamic performance
- Breakthrough in readhead design – superior vibration resistance
- Uniquely sealed – greater resistance to contamination by fluids and solid debris
- Patented set-up LEDs – integral LED signal strength indicator for simple and quick installation and set-up

Dimensions: standard



Dimensions given in mm

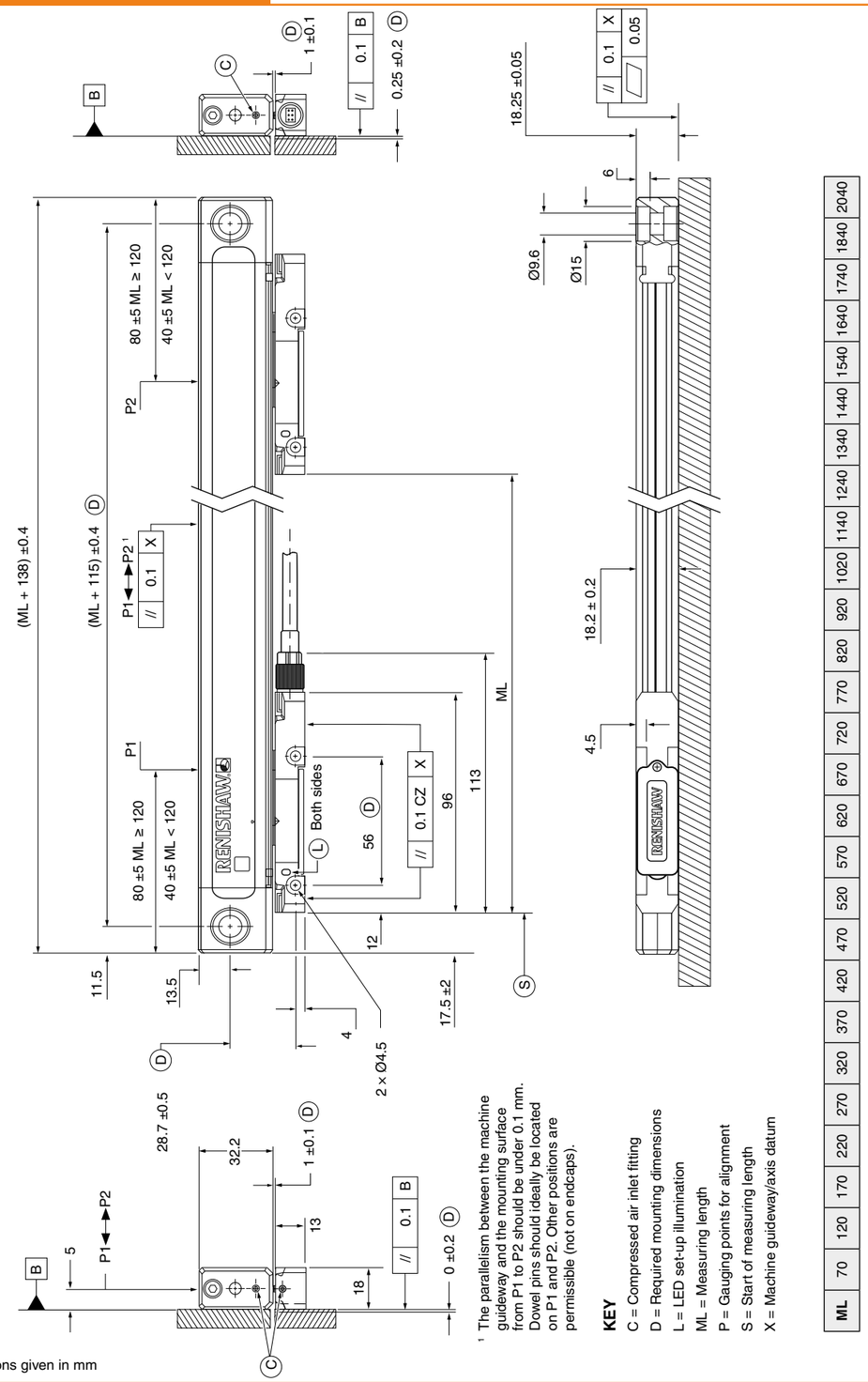
FORTiS-N™ narrow size enclosed linear encoders

Incorporating identical encoder technology and delivering the same benefits as the FORTiS-S models, FORTiS-N linear encoders have been designed with a more compact readhead in a narrower extrusion, making them ideally suited to applications in more confined spaces.

Key features and benefits:

- Non-contact design – no mechanical wear and greater longevity
- Tuned mass damper technology delivers class leading vibration resistance
- Suitable for smaller and lighter machine designs
- Can be fastened directly to a machined surface or optional mounting spar
- Patented set-up LED for fast and intuitive right-first-time installation

Dimensions: standard end caps



ML	70	120	170	220	270	320	370	420	470	520	570	620	670	720	770	820	920	1020	1140	1240	1340	1440	1540	1640	1740	1840	2040

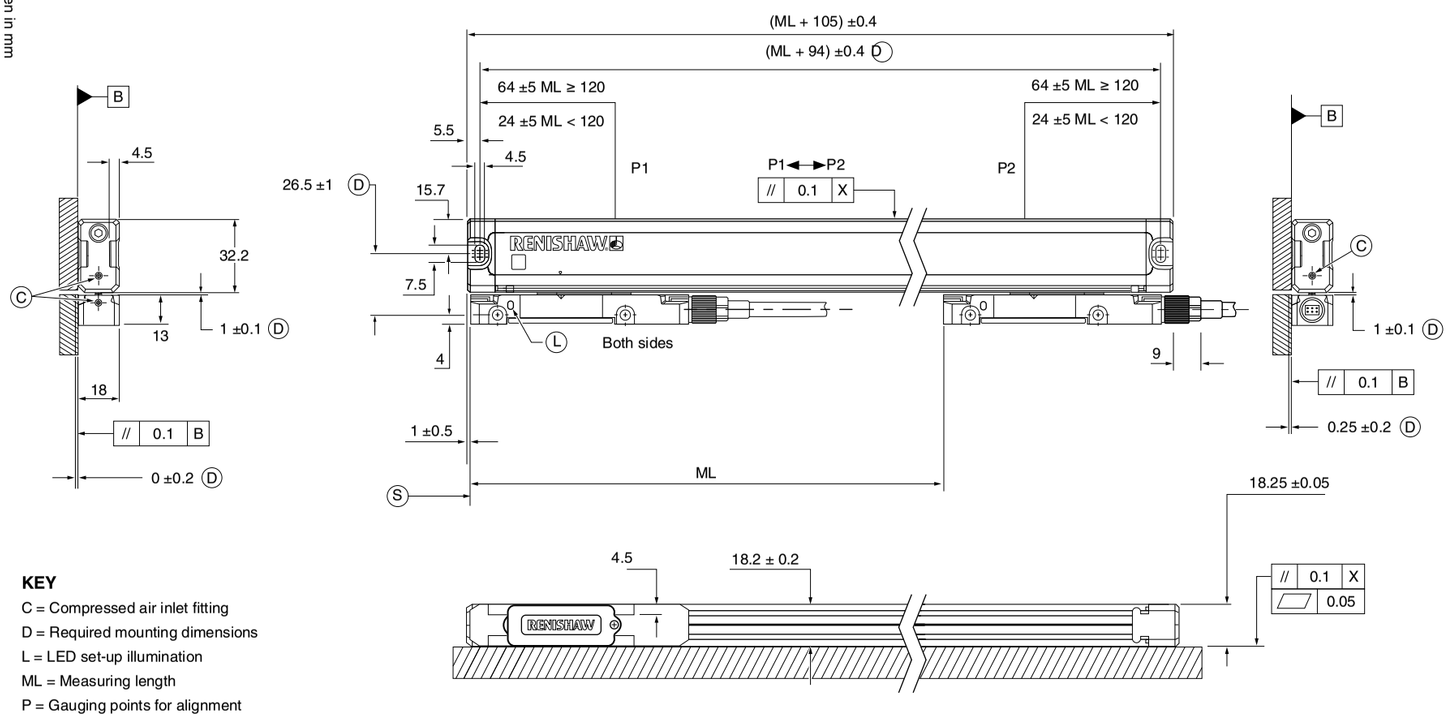
¹ The parallelism between the machine guideway and the mounting surface from P1 to P2 should be under 0.1 mm. Dowel pins should ideally be located on P1 and P2. Other positions are permissible (not on endcaps).

KEY

C = Compressed air inlet fitting
D = Required mounting dimensions
L = LED set-up illumination
ML = Measuring length
P = Gauging points for alignment
S = Start of measuring length
X = Machine guideway/axis datum

Dimensions given in mm

Dimensions given in mm

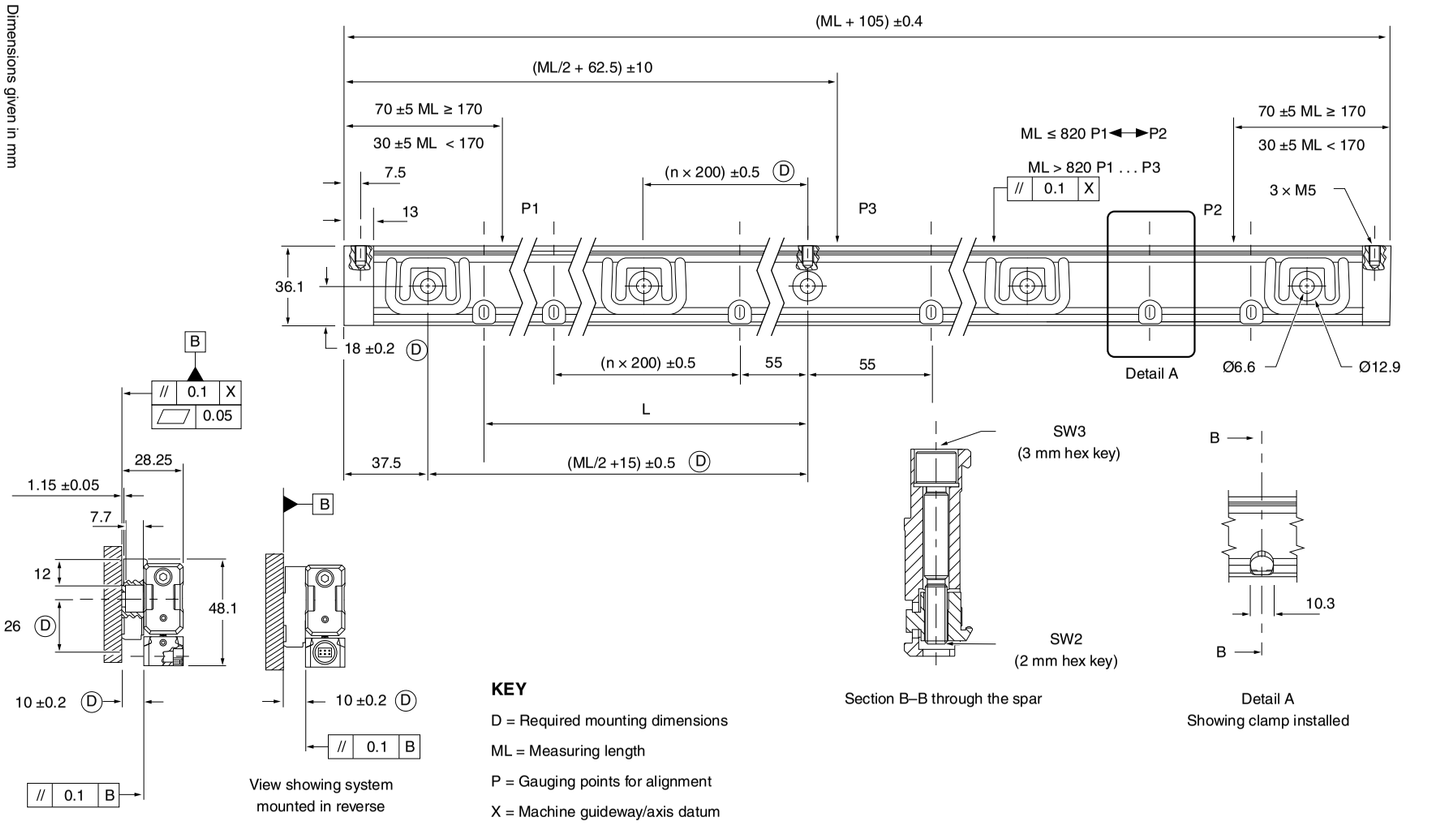


KEY

C = Compressed air inlet fitting
D = Required mounting dimensions
L = LED set-up illumination
ML = Measuring length
P = Gauging points for alignment
S = Start of measuring length
X = Machine guideway/axis datum

ML	70	120	170	220	270	320	370	420	470	520	570	620	670	720	770	820	920	1020	1140	1240	1340	1440	1540	1640	1740	1840	2040

Dimensions given in mm



KEY

D = Required mounting dimensions
ML = Measuring length
P = Gauging points for alignment
X = Machine guideway/axis datum

View showing system mounted in reverse

Section B–B through the spar

Detail A
Showing clamp installed

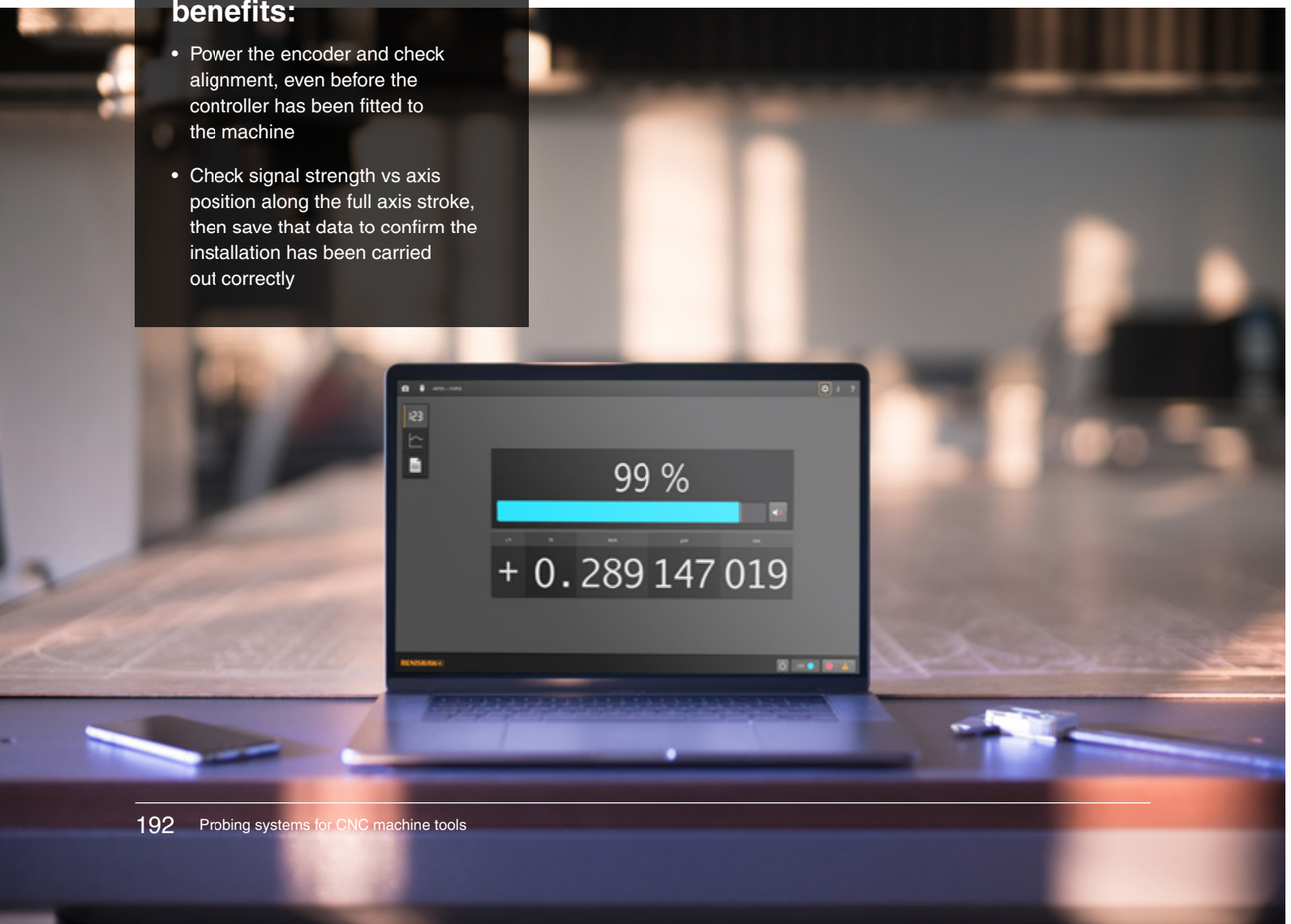
ML	70	120	170	220	270	320	370	420	470	520	570	620	670	720	770	820	920	1020	1140	1240	1340	1440	1540	1640	1740	1840	2040
L	37.5	55	75	100	115	140	175	200	225	250	275	300	325	350	375	400	450	500	550	640	655	710	760	810	855	910	1010
n	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1	1	2	2	2	2	3	3	3	3	4	4

Advanced Diagnostic Tool ADTa-100 and ADT View software

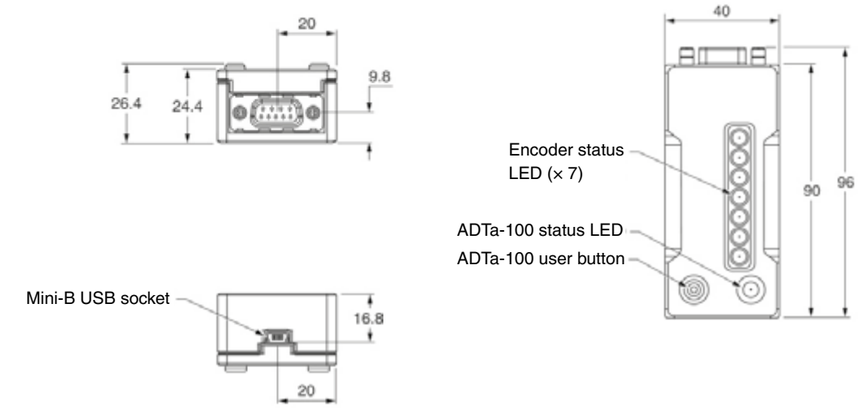
The FORTiS encoder system is compatible with the Advanced Diagnostic Tool ADTa-100 and ADT View software.
They provide comprehensive real-time encoder data feedback to aid more challenging installations and diagnostics.

Key features and benefits:

- Power the encoder and check alignment, even before the controller has been fitted to the machine
- Check signal strength vs axis position along the full axis stroke, then save that data to confirm the installation has been carried out correctly



Dimensions



Dimensions given in mm

RENISHAW
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Receivers, interfaces and data processing units

Which transmission?

Compatibility chart

Products		Transmission type: Receivers/ interfaces: Optical: OMI-2 anddOMI-2T	Optical: OMM-2C	Radio: RMI-QE	Hard-wired: MI 8-4	Hard-wired: HSI	Hard-wired: HSI-C	Hard-wired: NCi-6	Hard-wired: TSI 2 and TSI 2-C	Hard-wired: TSI 3 and TSI 3-C	Hard-wired: TSI 3-X	Optical modular systems: OSI with OMM-2/C	Optical modular systems: OSI-S with OMM-S
	Page	198	202	216	220	222	224	228	230	232	234	200	204
Probes													
OMP40-2	34	●	●									●	
OMP40M	40	●	●									●	
OLP40	36	●	●									●	
OMP60	38	●	●									●	
OMP60M	40	●	●									●	
RMP40	40			●									
RMP40M	50			●									
RLP40	46			●									
RMP60	48			●									
RMP60M	50			●									
LP2	52	△	△	◊	●	●	●					△	
MP11	56	Integrated to CNC machine's control via cable.											
JCP	58	Not required.											
OMP400	64	●										●	
OMP600	66	●										●	
RMP400	68			●									
RMP600	70			●									
MP250	72					●	●						
OSP60	78												●
Tool setters													
OTS	100	●	●									●	
RTS	102			●									
TS27R	104				●	●	●						
TS34	106				●	●	●						
NC4+ Blue	114							●					
NCPCB	118	Designed to work with SIEB and MEYER 44.20.020, 44.20.020A, and 44.20.0120 laser cards											
TRS2	120	Interface not required											
HPRA	124								●				
HPPA	126								●				
HPMA	128									●			
HPMA-X	130										●		
HPGA	132					●				●			

◊ If used with an OMP40M or OMP60M
△ If used with an RMP40M or RMP60M
* 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.

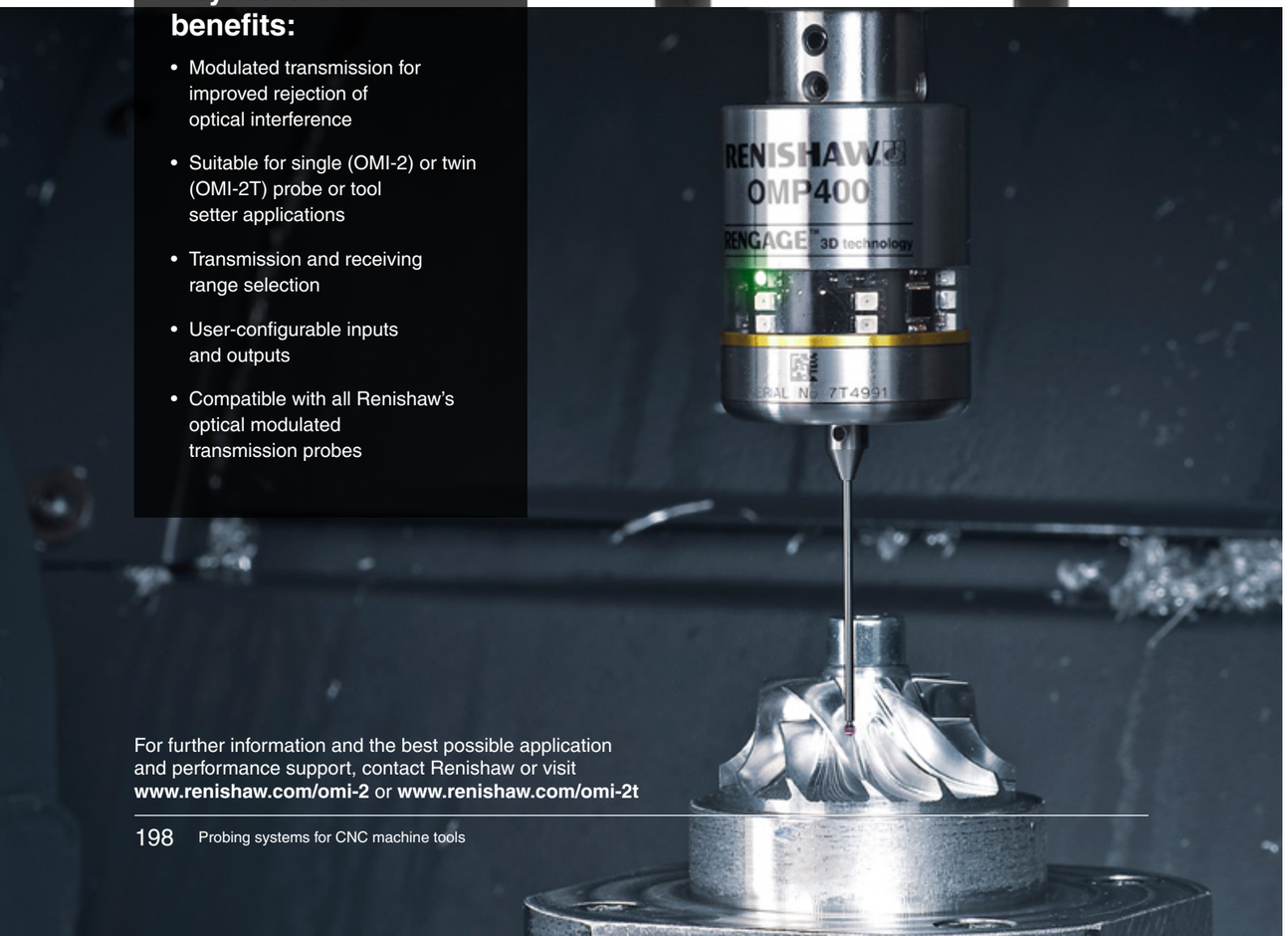
The OMI-2T also provides visual indication of the selected probe.

OMI-2 interface

OMI-2T interface

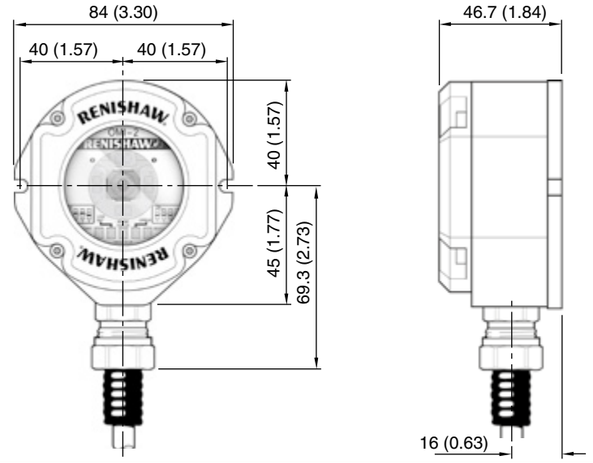
Key features and benefits:

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



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

Dimensions



Dimensions given in mm (in)

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 machine tool controller.	The OMI-2T processes signals from RENGAGE™ or standard probes and converts them into machine outputs, which are then transmitted to the machine tool controller. The system allows two probes to be used with one interface.
Transmission type		Infrared optical transmission (modulated)	
Probes per system		One	Up to two
Compatible probes		OMP40-2, OMP40M, OLP40, OMP60, OMP60M, OMP400, OMP600 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		5 °C to +55 °C (+41 °F to +131 °F)	

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.

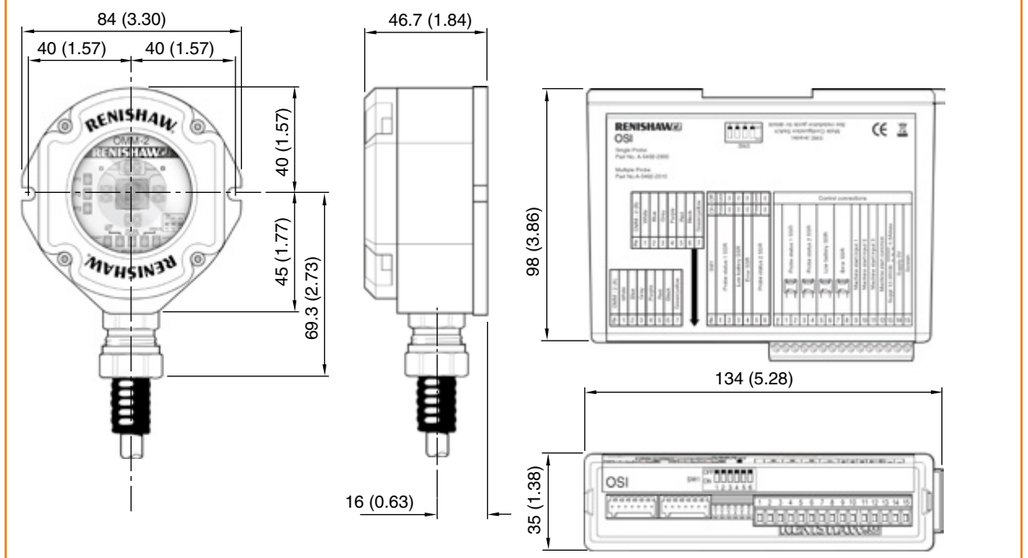
The receiver provides users with a visual indication of probe status, active probe, start signal status, battery condition and error condition.

Key features and benefits:

- Modulated 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

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

Dimensions



Dimensions given in mm (in)

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 machine tool controller. The system allows three probes to be used with one interface.	
Transmission type		Infrared optical transmission (modulated)	
Probes per system		Up to three	
Compatible probes		OMP40-2, OMP40M, OLP40, OMP60, OMP60M, OMP400, OMP600 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)	

OMM-2C

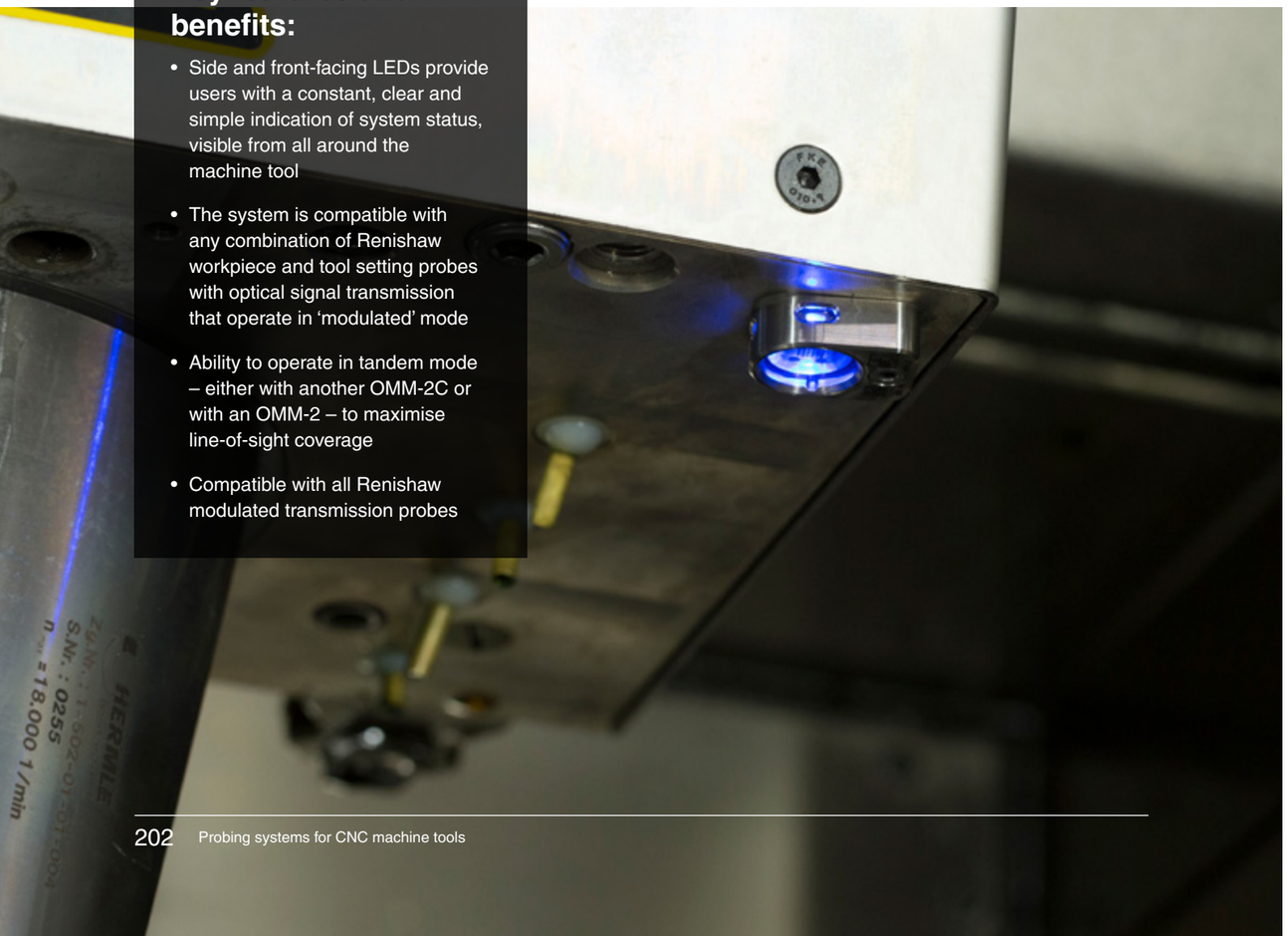
The spindle-mounted receiver provides a compact and convenient solution allowing installation of up to three Renishaw machine tool touch probes with optical signal transmission communicating via a single interface.

System design ensures robust operation whatever the operating environment. Utilisation of Renishaw's 'modulated' optical transmission technology offers unparalleled resistance to light interference, whilst an optional, integrated air blast ensures the receiver window remains clean and debris-free for uninterrupted system communications.

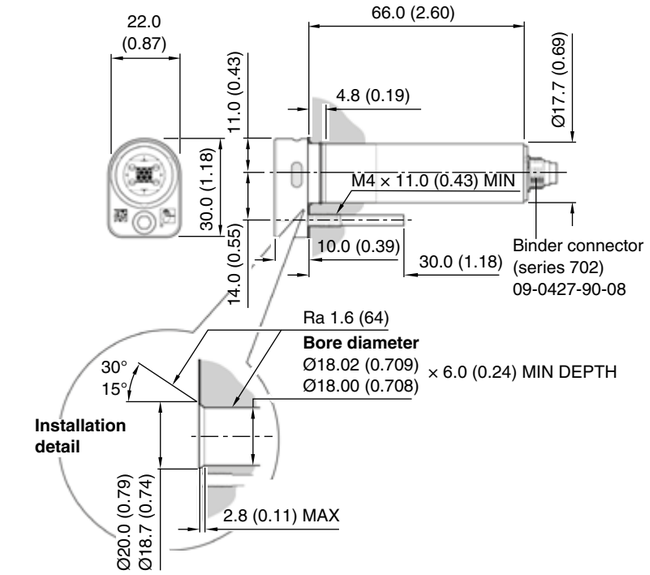
Requires OSI interface to operate.

Key features and benefits:

- Side and front-facing LEDs provide users with a constant, clear and simple indication of system status, visible from all around the machine tool
- The system is compatible with any combination of Renishaw workpiece and tool setting probes with optical signal transmission that operate in 'modulated' mode
- Ability to operate in tandem mode – either with another OMM-2C or with an OMM-2 – to maximise line-of-sight coverage
- Compatible with all Renishaw modulated transmission probes



Dimensions



Dimensions given in mm (in)

Specification

Principal application	The OMM-2C transmits control signals to the probe and receives probe data signals for onward transmission to the OSI and machine tool controller.	
Transmission type	Infrared optical transmission (modulated)	
Probes per system	Up to three	
Compatible probes	OMP40-2, OMP40M, OLP40, OMP60, OMP60M, OMP400, OMP600 and OTS	
Operating range	Up to 3 m (9.8 ft)	
Weight (excluding cable)	With airblast	80 g (2.82 oz)
	Without airblast	80 g (2.82 oz)
Cable (not supplied)	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.	
Diagnostic LEDs	Start, error, active system and signal condition.	
Pneumatic supply	Ø3 mm (0.12 in) pneumatic fitting, 9 bar (130.5 psi) max. the air supply to the OMM-2C must conform to ISO 8573-1: Class 1.7.2.	
Environment	IP rating	IPX6 (EN/IEC 60529) [for product] IPX8 (EN/IEC 60529) [for glass window]
	IK rating	IK04 (EN/IEC 62262) [for glass window]
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)

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

OSI-S and OMM-S

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

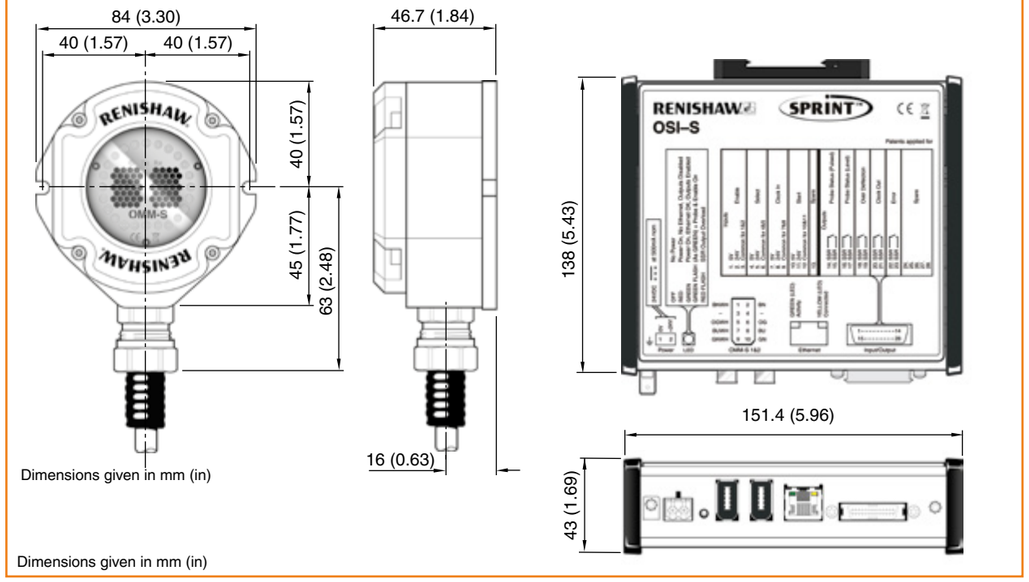
Incorporating a unique high-speed transmission system with a robust, bidirectional optical link which is particularly resistant to noise in the infrared spectrum, reliable data transmission is assured even over long distances.

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 scanning 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 given in mm (in)

Specification

Product		OSI-S	OMM-S
Principal application		High-speed scanning system for on-machine process control.	
Transmission type		Infrared optical transmission: up to 1000 3D points per second.	
Probes per system		One	
Compatible probes		OSP60	
Operating range		For optical performance envelopes, see page 6-18	
Weight		N/A	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		18 Vdc to 30 Vdc. Supply must conform to BS EN 60950-1:2006+A2:2013 (IEC 60950-1:2005+A2:2013).	
Supply current		500 mA @ 24 V nominal 4 A peak.	
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.	
Input/output protection		Power input is protected by a 1.85 A resettable fuse. Turning on the power supply will reset the OSI-S.	
Cable (to interface)	**Specification**	Cable specification: Ø6.1 mm, 8-core, twisted pair, screened cable, each core 7 × 0.146 mm.	
	Length	The OMM-S is supplied with a 15 m (49 ft) cable. Maximum cable length 30 m (98 ft).	
Mounting		DIN rail. Alternative mounting using screws.	A mounting bracket is available allowing directional setting.
Sealing		IP20	IPX8
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)	

DPU-1

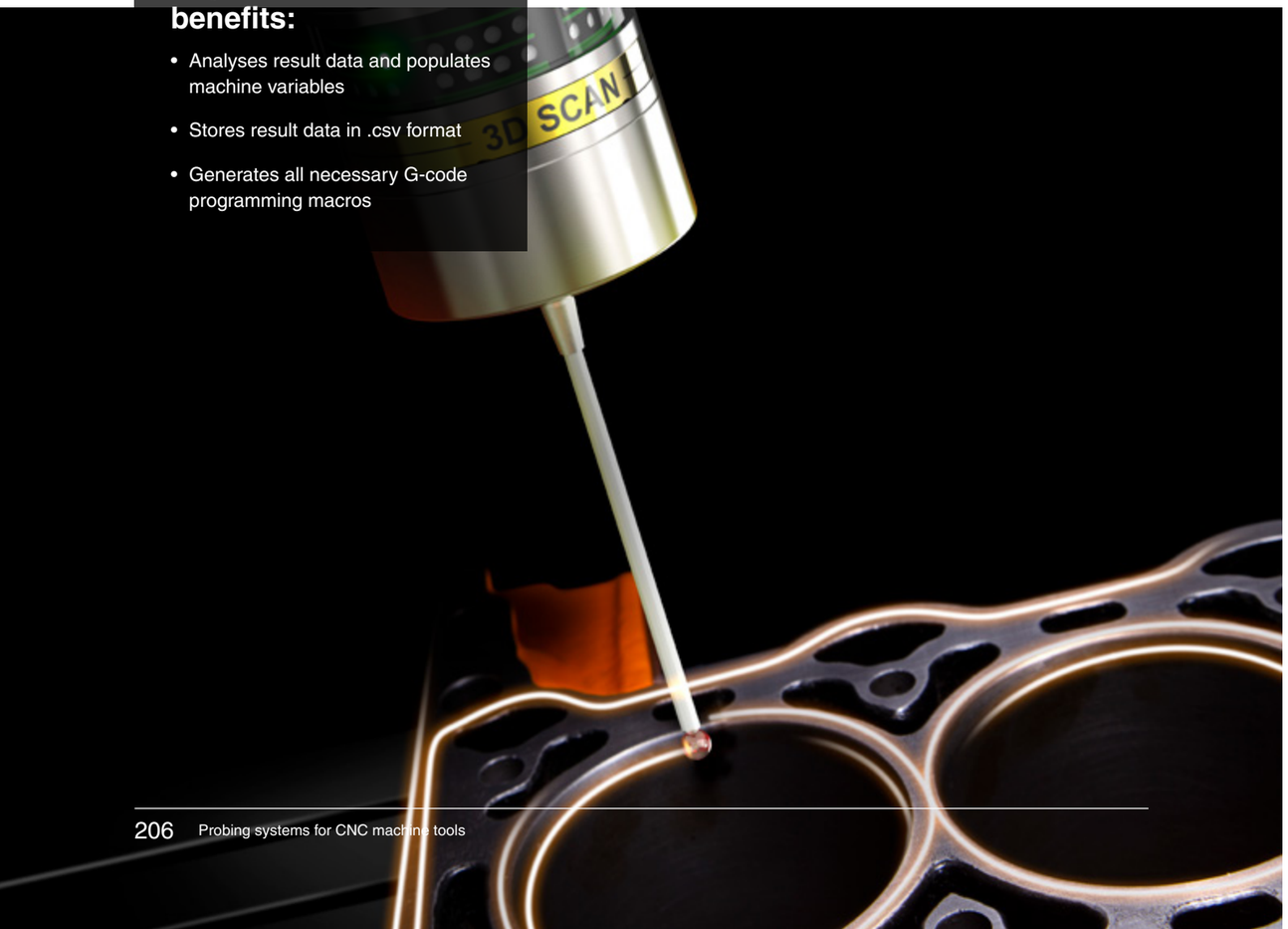
Data processing unit forming part of the SupaScan system, mounted in the machine tool control cabinet.

Using the Configuration Tool supplied on the DPU-1, users can quickly tailor the SupaScan system for their individual machine tool and generate all the necessary G-code programming macros.

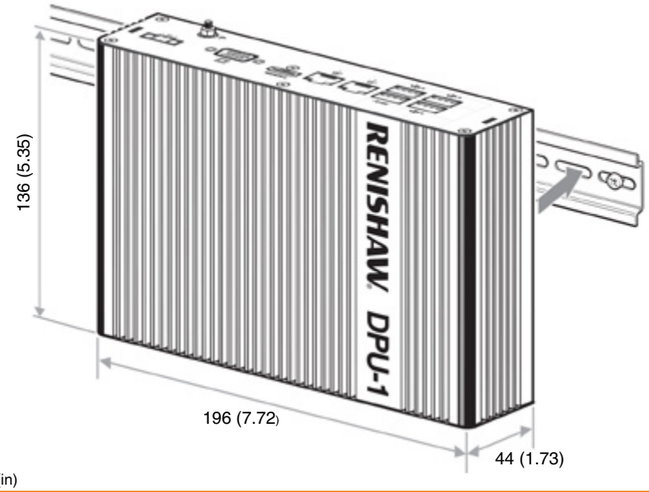
SupaScan result data is saved to machine variable blocks and in .csv format on the DPU-1.

Key features and benefits:

- Analyses result data and populates machine variables
- Stores result data in .csv format
- Generates all necessary G-code programming macros



Dimensions



Dimensions given in mm (in)

Specification

Principal application		Data processing unit forming part of the SupaScan system
Transmission type		Hard-wired
Probes per system		One
Compatible probes		OSP60
Size		196 mm × 136 mm × 44 mm (7.72 in × 5.35 in × 1.73 in) (without DIN rail mounting and brackets)
Weight		1185 g (41.8 oz)
Connectivity	**USB** **Ethernet** **Display**	3 × USB 2.0: 1 × USB 3.0 2 × GbE LAN ports 1 × HDMI: 1 × VGA
Supply voltage		24 V ±10%
Supply current		40 mA @ 12 V, 23 mA @ 24 V
Power consumption		12 W typical (during normal operation)
Input/output protection		Reverse voltage, over current, over voltage protection
Connector		2-pin Phoenix connector
Power on		Auto-on
Certification		CE, FCC
System storage		128 GB solid-state drive
Mounting		DIN rail mounting. Alternative mounting using screws.
IP rating		IPX3 BS EN 60529:1992+A2:2013 (IEC 60529:1989+A1:1999+A2:2013)
Humidity		Maximum 90% RH at +40 °C
Cooling		Fanless
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

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

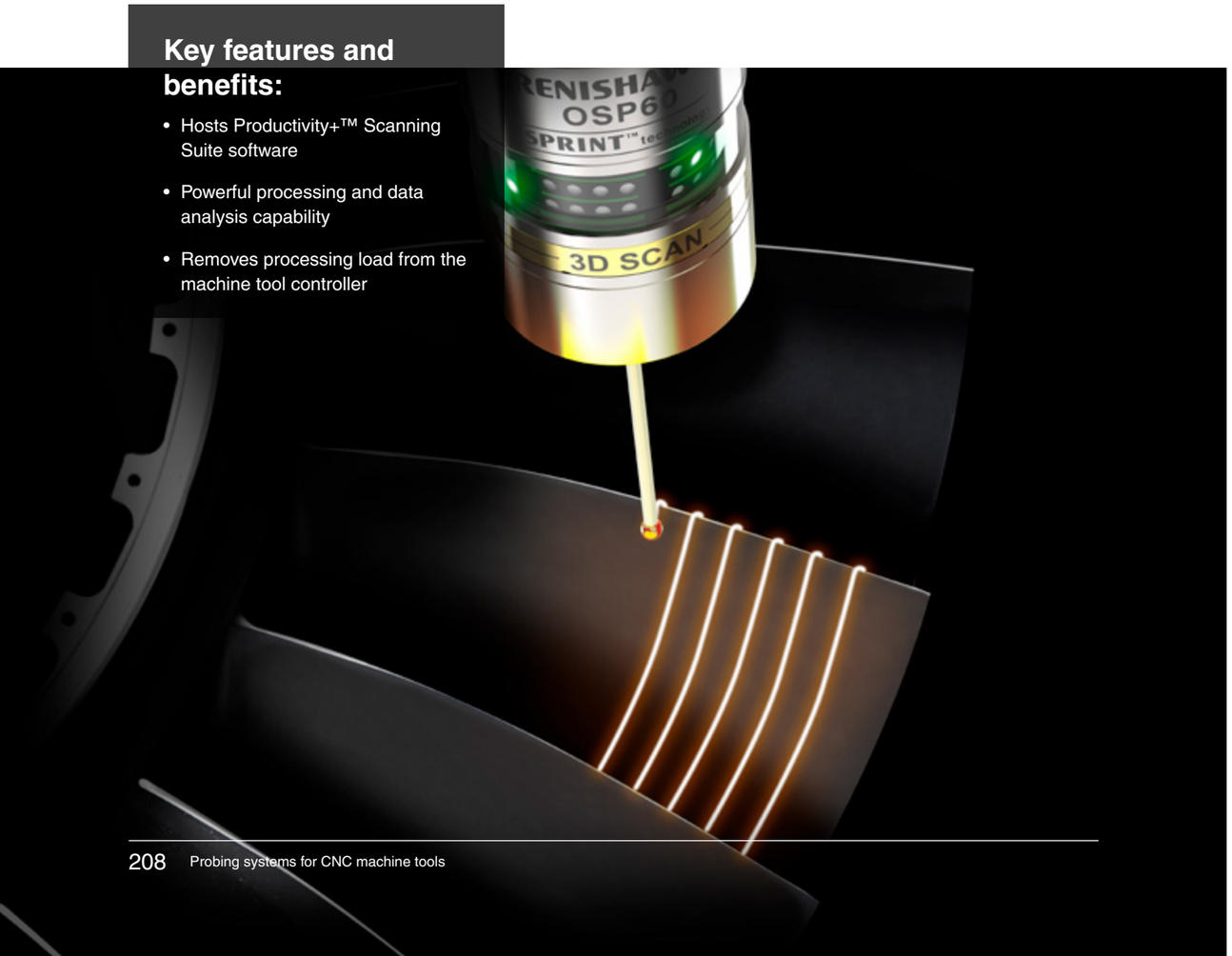
DPU-2

Optional (controller-dependent) data processing unit used with the Productivity+™ Scanning Suite, mounted in the machine tool controller cabinet.

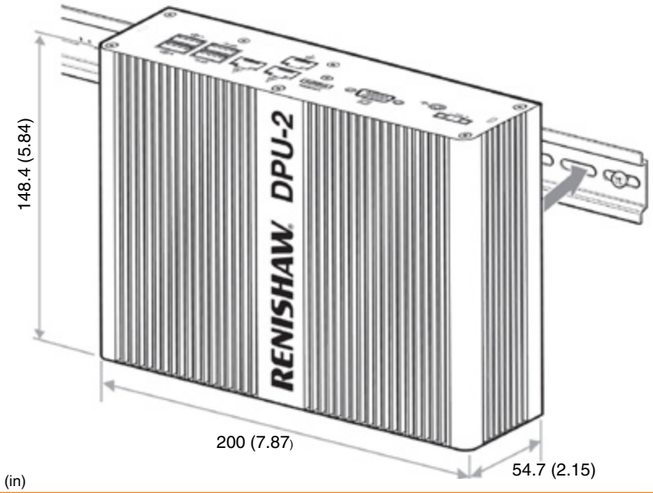
Hosts programming and data analysis software such as the Productivity+™ CNC plug-in, associated toolkits and stand-alone cycles.

Key features and benefits:

- Hosts Productivity+™ Scanning Suite software
- Powerful processing and data analysis capability
- Removes processing load from the machine tool controller



Dimensions



Dimensions given in mm (in)

Specification

Principal application		Data processing unit for Productivity+™ CNC plug-in and associated application toolkits
Transmission type		Hard-wired
Probes per system		One
Compatible probes		OSP60
Size		200 mm × 148.4 mm × 54.7 mm (7.87 in × 5.845 in × 2.15 in) (without DIN rail mounting and brackets)
Weight		1800 g (63.49 oz)
Connectivity	**USB** **Ethernet** **Display**	3 × USB 2.0: 1 × USB 3.0 2 × GbE LAN ports 1 × HDMI: 1 × VGA
Supply voltage		24 V ±10%
Supply current		40 mA @ 12 V, 23 mA @ 24 V
Power consumption		17 W typical (during normal operation)
Input/output protection		Reverse voltage, over current, over voltage protection
Connector		2-pin Phoenix connector
Power on		Auto-on
Certification		CE, FCC
System storage		128 GB solid-state drive
Mounting		DIN rail mounting. Alternative mounting using screws.
IP rating		IP3X BS EN 60529:1992+A2:2013 (IEC 60529:1989+A1:1999+A2:2013)
Humidity		Maximum 93% RH at +40 °C
Cooling		Fanless
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

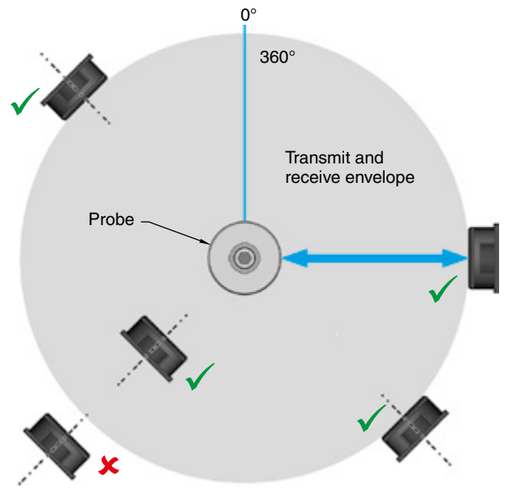
For further information and the best possible application and performance support, contact Renishaw or visit **www.renishaw.com/scanningsuite**

Optical probe, receiver and interface performance envelopes

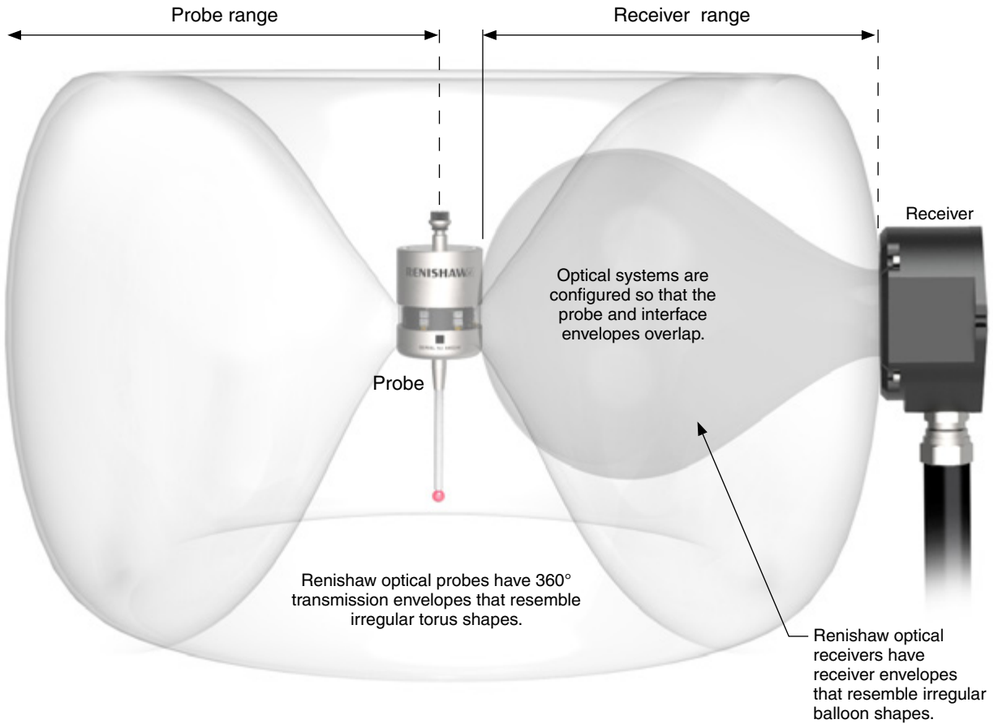
Optical probe, receiver and interface combinations are available for virtually any application. Renishaw recommends ‘line-of-sight’ installation within a tested range. A range of up to 9 meters is possible depending on the system selected.

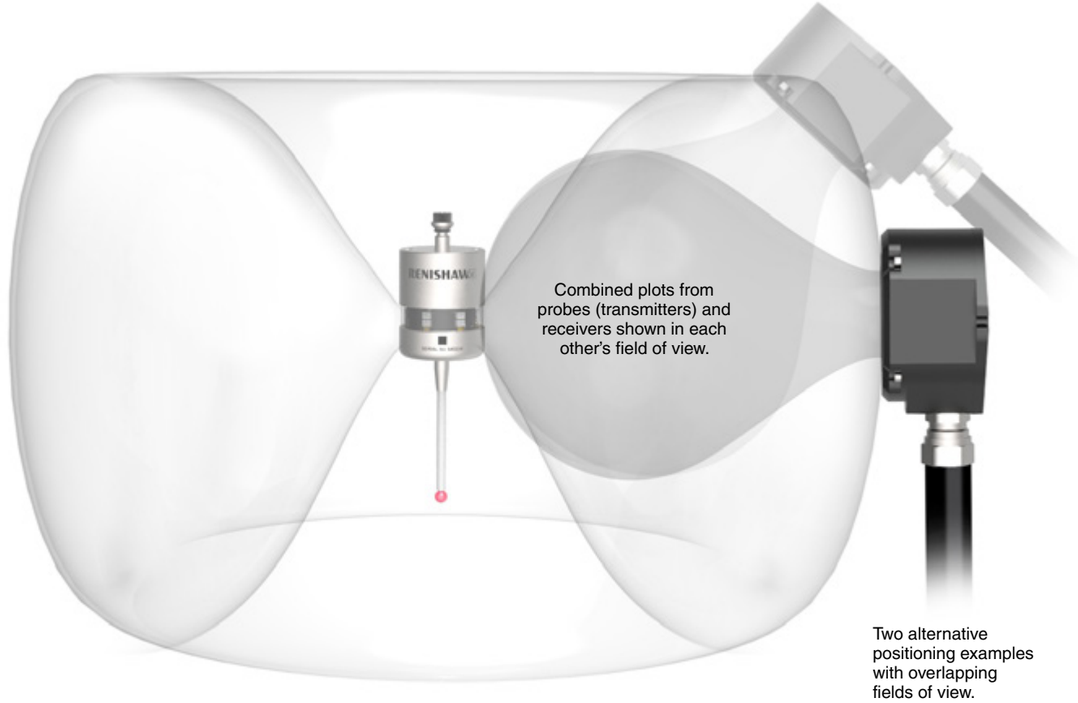
Renishaw works closely with machine tool builders to ensure installations are optimised for all factory fitted systems, providing the end user with reliable systems that work to known standards.

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



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





Two alternative positioning examples with overlapping fields of view.

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 plots on pages **212** to **214** illustrate the performance data for every combination of Renishaw optical probe, receiver and interface.

Optical receiver and interface performance envelopes

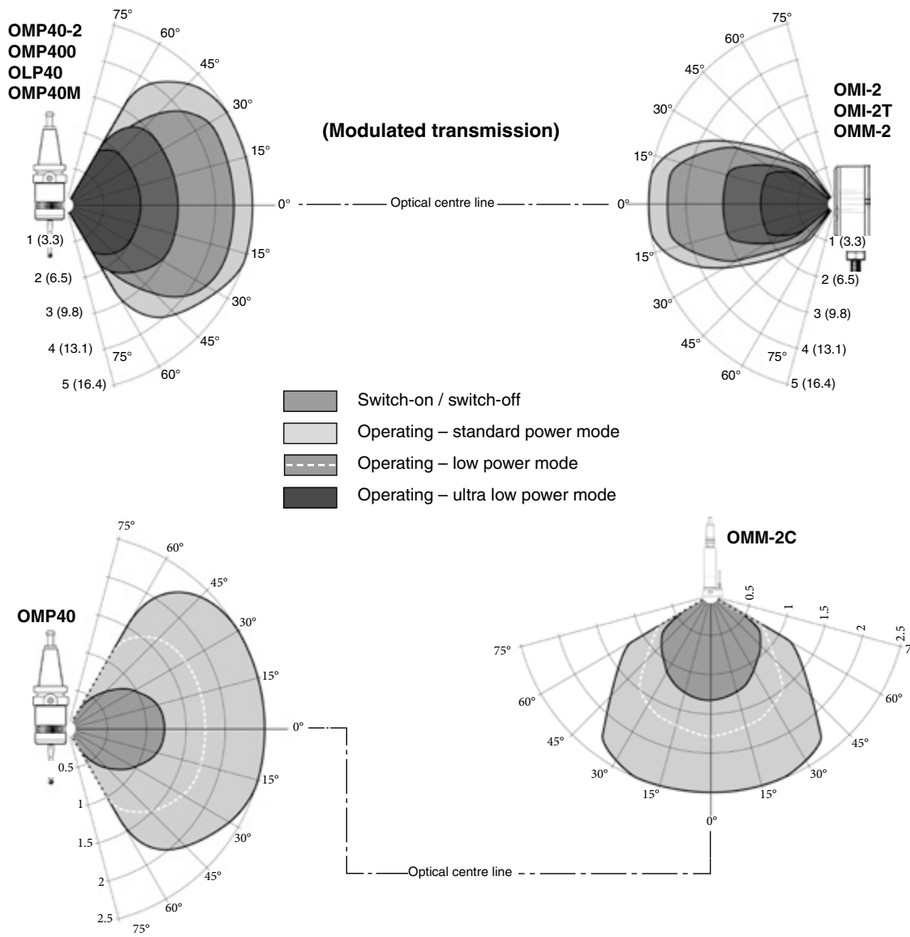
Renishaw optical probes have a 360° transmission envelope over the ranges shown below.

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.

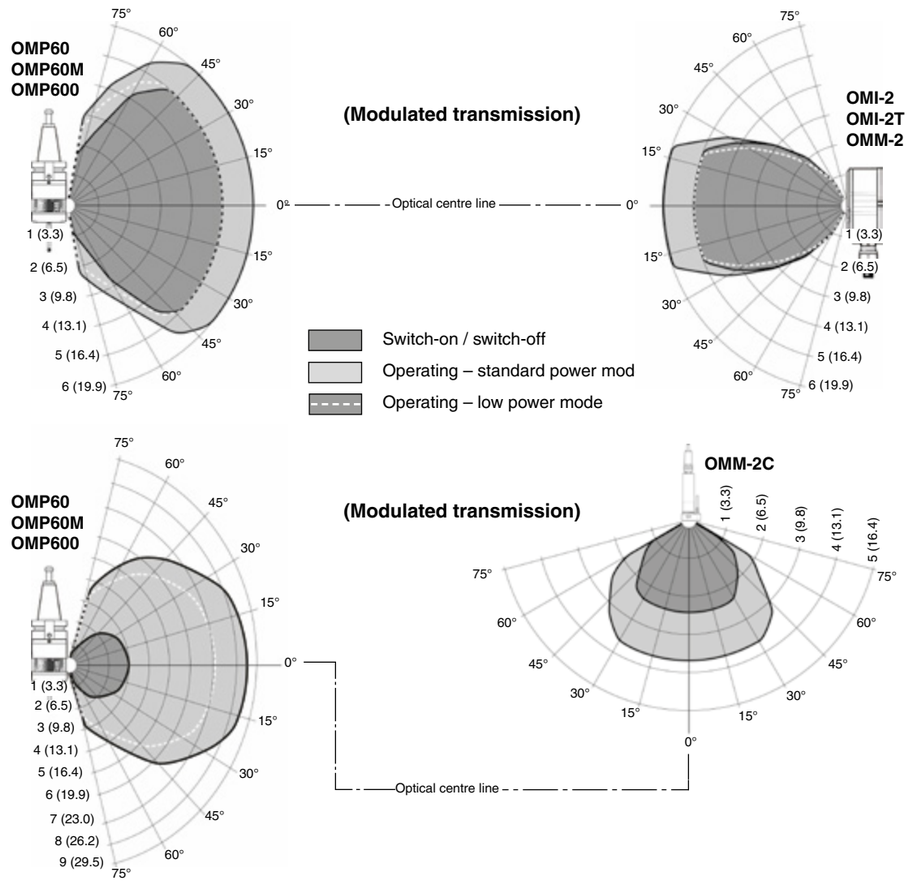
Build-up of debris around the probe or receiver may have a detrimental effect on transmission performance. We recommend that debris is removed as often as necessary to maintain optimum transmission performance.

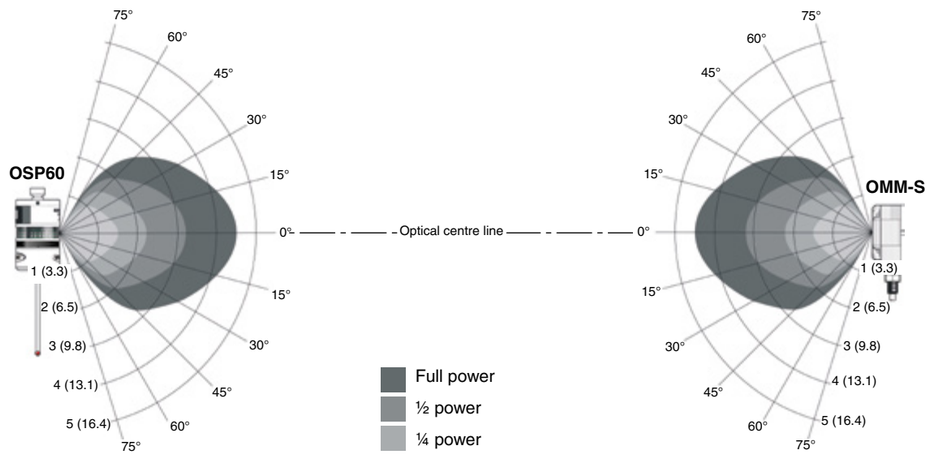
Ø40 optical performance envelopes



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

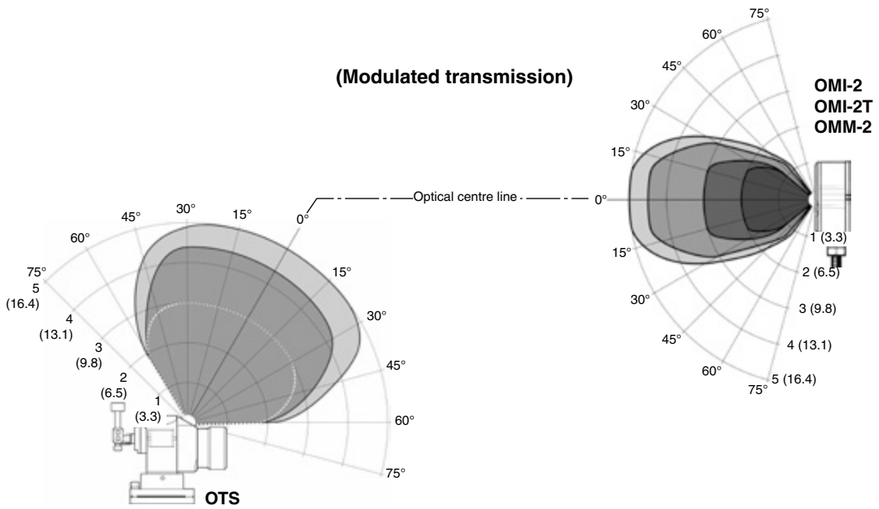
Ø60 optical performance envelopes

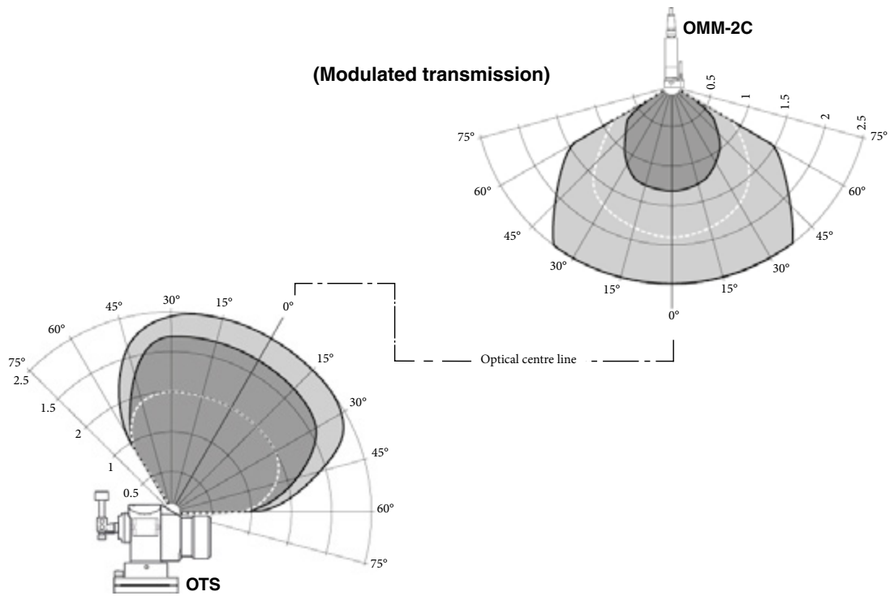




Typical plot at +20 °C (+68 °F)
360° transmission around probe axis in m (ft)

OTS performance envelope





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

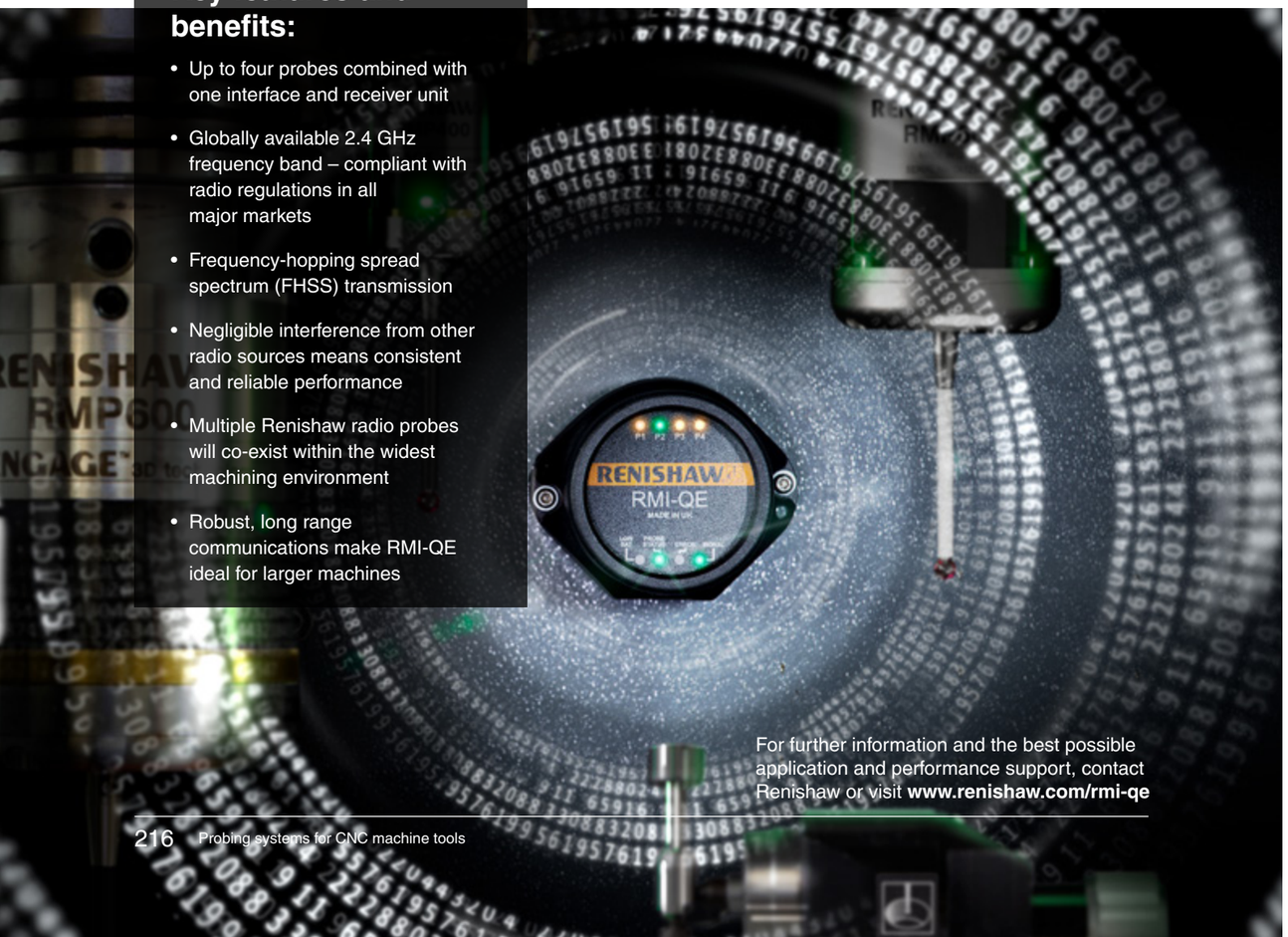
RMI-QE

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-QE with multiple Renishaw radio probes is ideal for retrofitting to existing machines.

Key features and benefits:

- Up to four probes combined 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-QE ideal for larger machines



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

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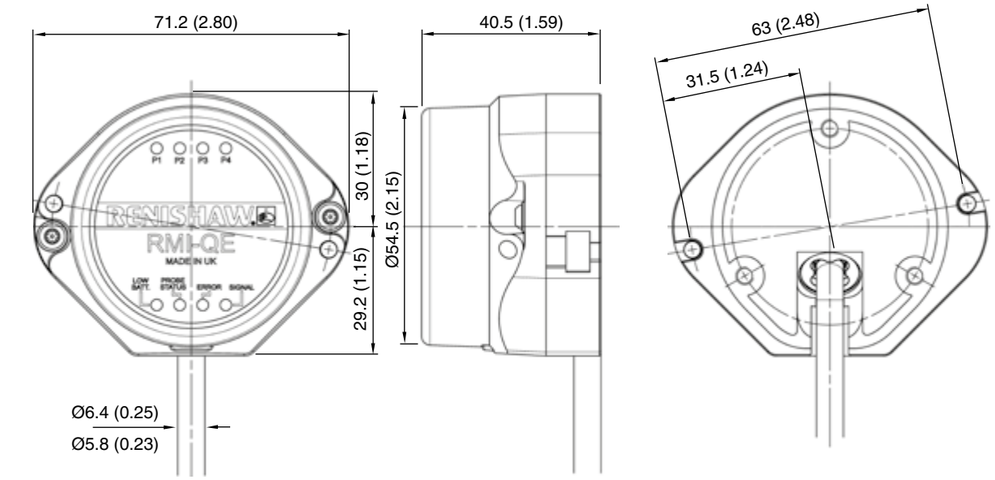
Dimensions



Dimensions given in mm (in)

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		UK, EU, EFTA, Japan and USA (China exempt). For details about other regions, contact Renishaw.
Probes per system		Radio M-code on = up to four Spin/shank switch on = up to four
Compatible probes		Component setting/inspection: RMP24-micro, RMP40, RMP40M, RMP400, RMP60, RMP60M and RMP600 Lathe inspection: RLP40 and RLP40H Tool setting: RTS
Operating range		Up to 15 m (49.2 ft)
Weight		RMI-QE including 8 m (26.2 ft) of cable = 627 g (22.12 oz) RMI-QE including 15 m (49.2 ft) of cable = 1047 g (36.93 oz)
Supply voltage		12 Vdc to 30 Vdc
Supply current		500 mA peak, < 200 mA typical from 12 V to 30 V
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		Electronically protected inputs. 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**	Ø6.1 mm (0.24 in), 16-core screened cable, each core 28 AWG.
	Length	8 m (26.2 ft) and 15 m (49.2 ft) standard lengths. Optional 30 m (98.4 ft) and 50 m (164.0 ft) cable assemblies are also available.
Mounting		Flush mounting. Sub mounting or directional mounting are also possible with optional mounting brackets (available separately).
Sealing		IPX8, BS EN 60529:1992+A2:2013 (IEC 60529:1989+A1:1999+A2:2013)
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)

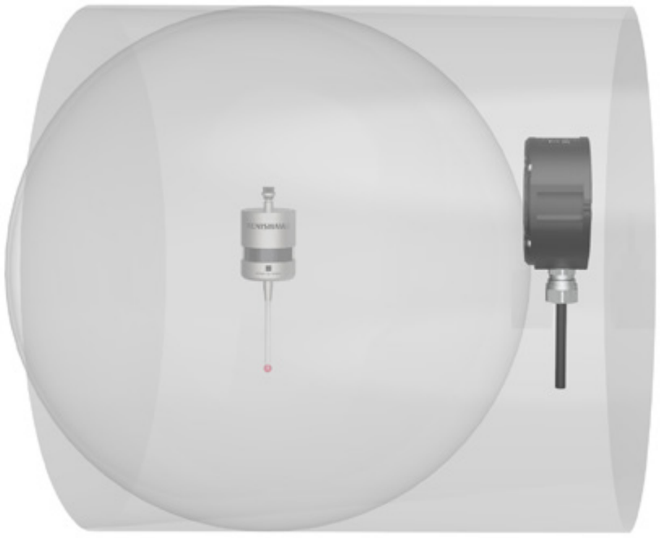
Radio receiver and interface performance envelopes

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 receiver envelopes that resemble cylindrical shapes

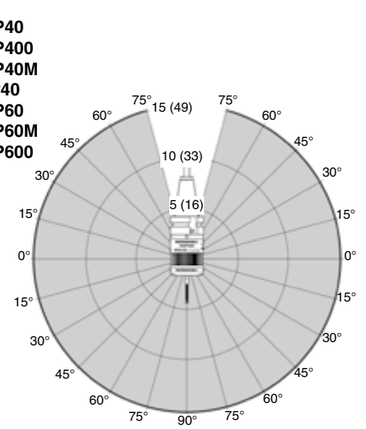
Renishaw workpiece probes have transmission envelopes that resemble spherical shapes

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

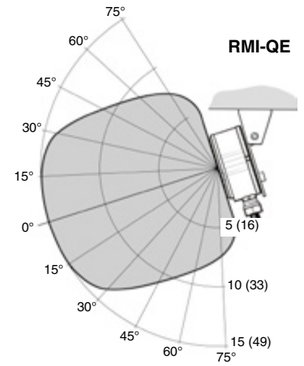
Renishaw radio probes have a 360° transmission envelope over the ranges shown. The plots on page **219** illustrate the performance data for every combination of Renishaw radio probe, receiver and interface.

Ø40 and Ø60 radio performance envelope

RMP40
RMP400
RMP40M
RLP40
RMP60
RMP60M
RMP600



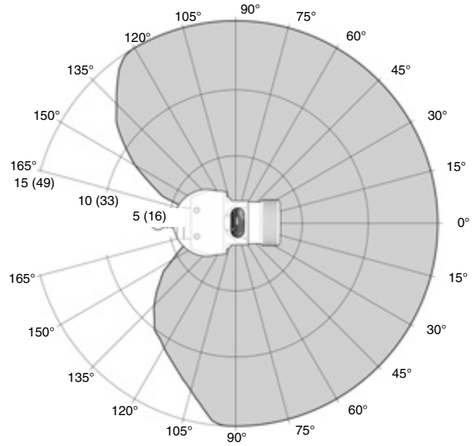
RMI-QE



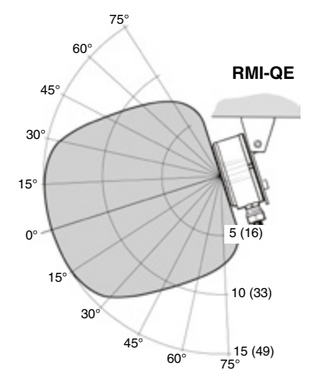
Operating and switch-on / switch-off

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

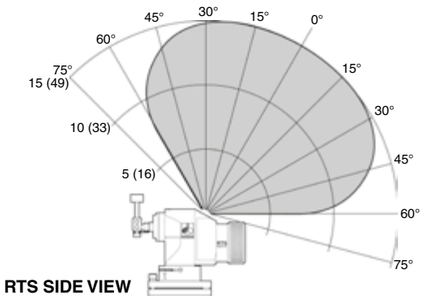
RTS radio performance envelope



RTS TOP VIEW



RMI-QE



RTS SIDE VIEW

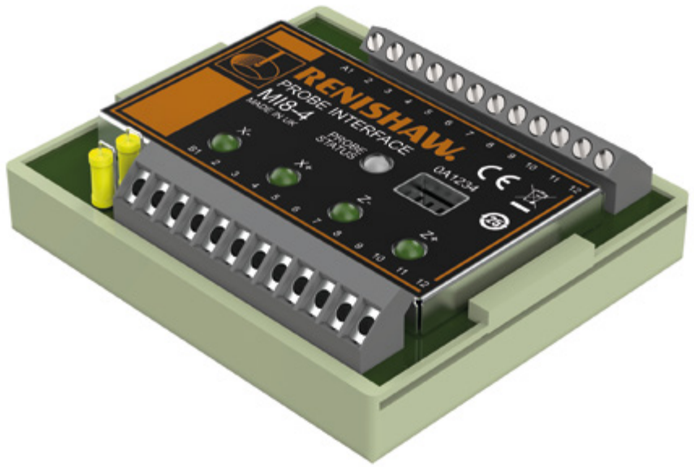
Operating and switch-on / switch-off

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

MI 8-4

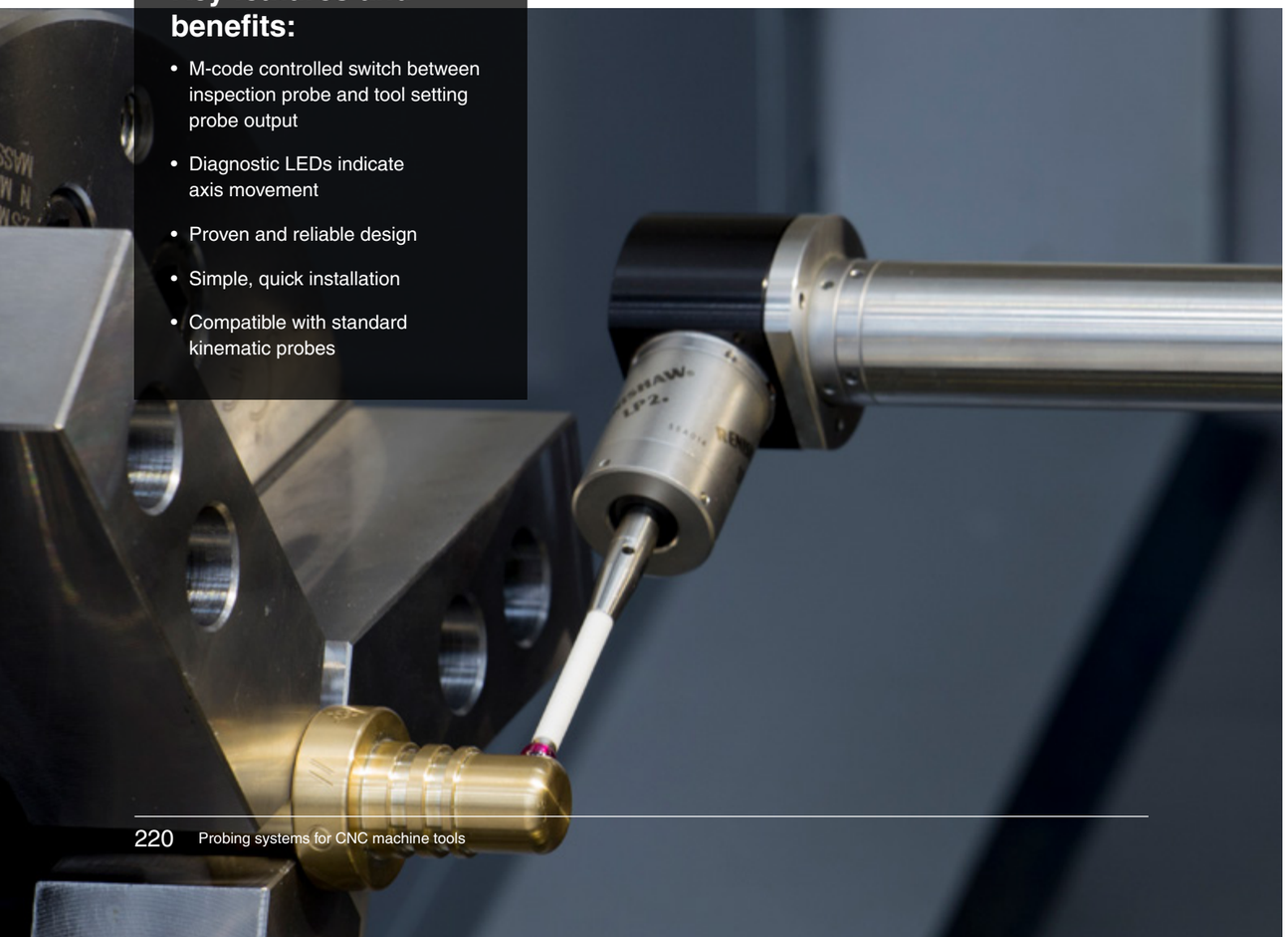
Interface for processing the probe signal from a hard-wired kinematic probe and converting it to the correct format for connection to a controller's probe input.

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.

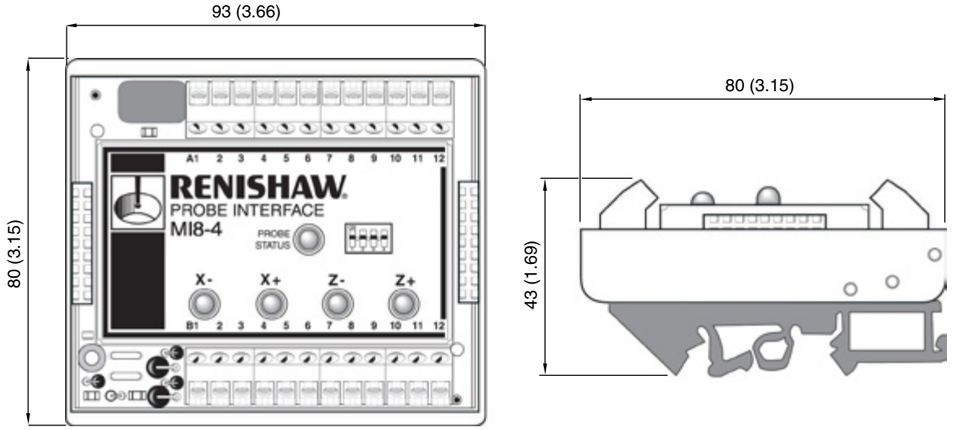


Key features and benefits:

- 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)

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 controller.
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 (Z+, Z-, X-, X+)
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, contact Renishaw or visit **www.renishaw.com/mi8-4**

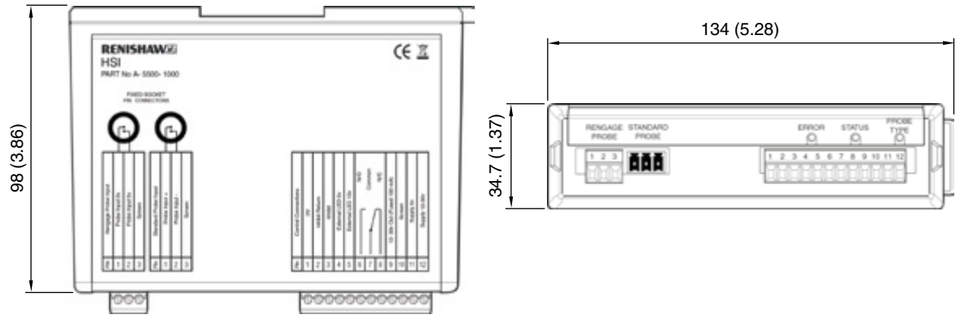
HSI

A hard-wired transmission interface, which conveys and processes signals between a probe and the machine tool controller. 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 the MP250 high-accuracy strain gauge probe with RENGAGE™ technology and standard kinematic hard-wired probes
- Proven and reliable design

Dimensions



Dimensions given in mm (in)

Specification

Principal application	The HSI processes signals from the MP250 with RENGAGE™ technology or standard hard-wired probes and converts them into machine outputs, which are then transmitted to the machine tool controller.
Transmission type	Hard-wired
Probes per system	One
Compatible probes	MP250, LP2, TS27R and APC
Supply voltage	12 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).
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, contact Renishaw or visit **www.renishaw.com/hsi**

HSI-C

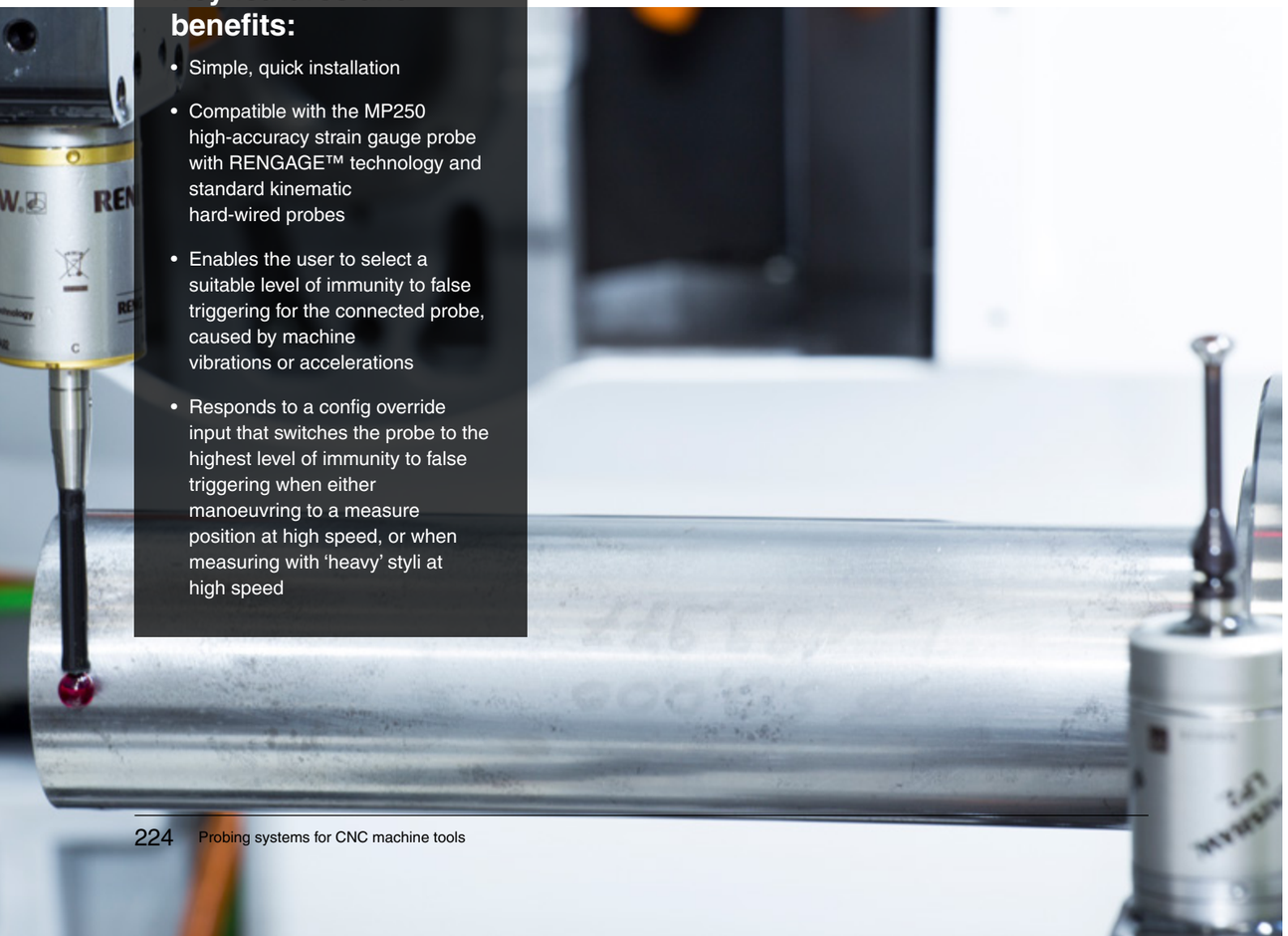
A hard-wired transmission interface that conveys and processes signals between the inspection probe and the CNC machine controller. Different probe operating configurations can be selected by a switch on the interface.

The HSI-C interface unit is compatible with the MP250 high-accuracy strain gauge probe with RENGAGE™ technology and standard kinematic hard-wired probes.

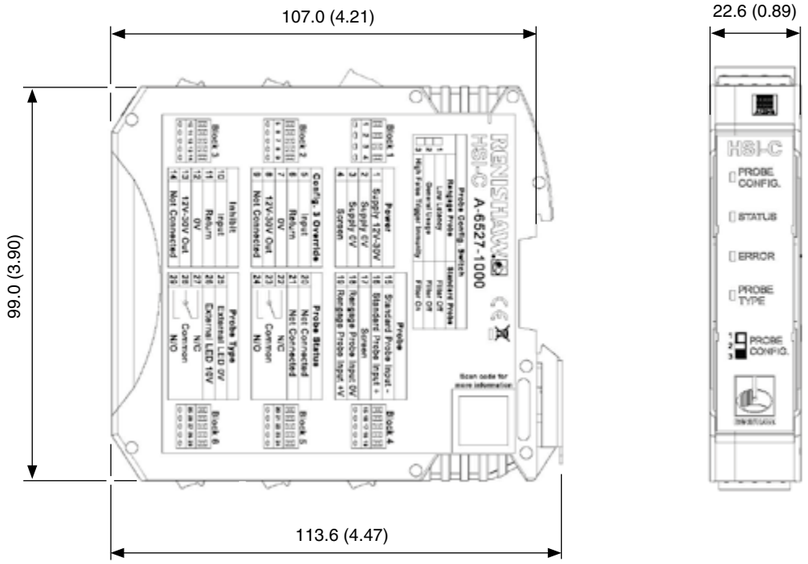
Units are DIN rail mounted and feature an ‘easy fit’ location mechanism. The HSI-C features an ‘inhibit’ mode allowing the probe to be powered off when not in use.

Key features and benefits:

- Simple, quick installation
- Compatible with the MP250 high-accuracy strain gauge probe with RENGAGE™ technology and standard kinematic hard-wired probes
- Enables the user to select a suitable level of immunity to false triggering for the connected probe, caused by machine vibrations or accelerations
- Responds to a config override input that switches the probe to the highest level of immunity to false triggering when either manoeuvring to a measure position at high speed, or when measuring with ‘heavy’ styli at high speed



Dimensions



Dimensions given in mm (in)

Specification

Principal application	The HSI-C processes signals from the MP250 with RENGAGE™ technology or standard hard-wired probes and converts them into voltage-free solid-state relay (SSR) outputs, which are then transmitted to the machine tool controller.
Transmission type	Hard-wired
Probes per system	One
Compatible probes	MP250, LP2, APC, TS27R and HPGA
Supply voltage	12 Vdc to 30 Vdc
Supply current	110 mA @ 12 Vdc, 80 mA @ 24 Vdc
Output signal	Voltage-free SSR output, normally open or normally closed.
Input/output protection	SSR output is protected by an electric circuit which limits the current to 60 mA. Power input is protected by a 140 mA resettable fuse.
Diagnostic LEDs	ERROR, STATUS, PROBE TYPE and PROBE CONFIG. Connection provided for remote device (LED or buzzer)
Mounting	DIN rail
Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)

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

FS1i and FS2i

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

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.

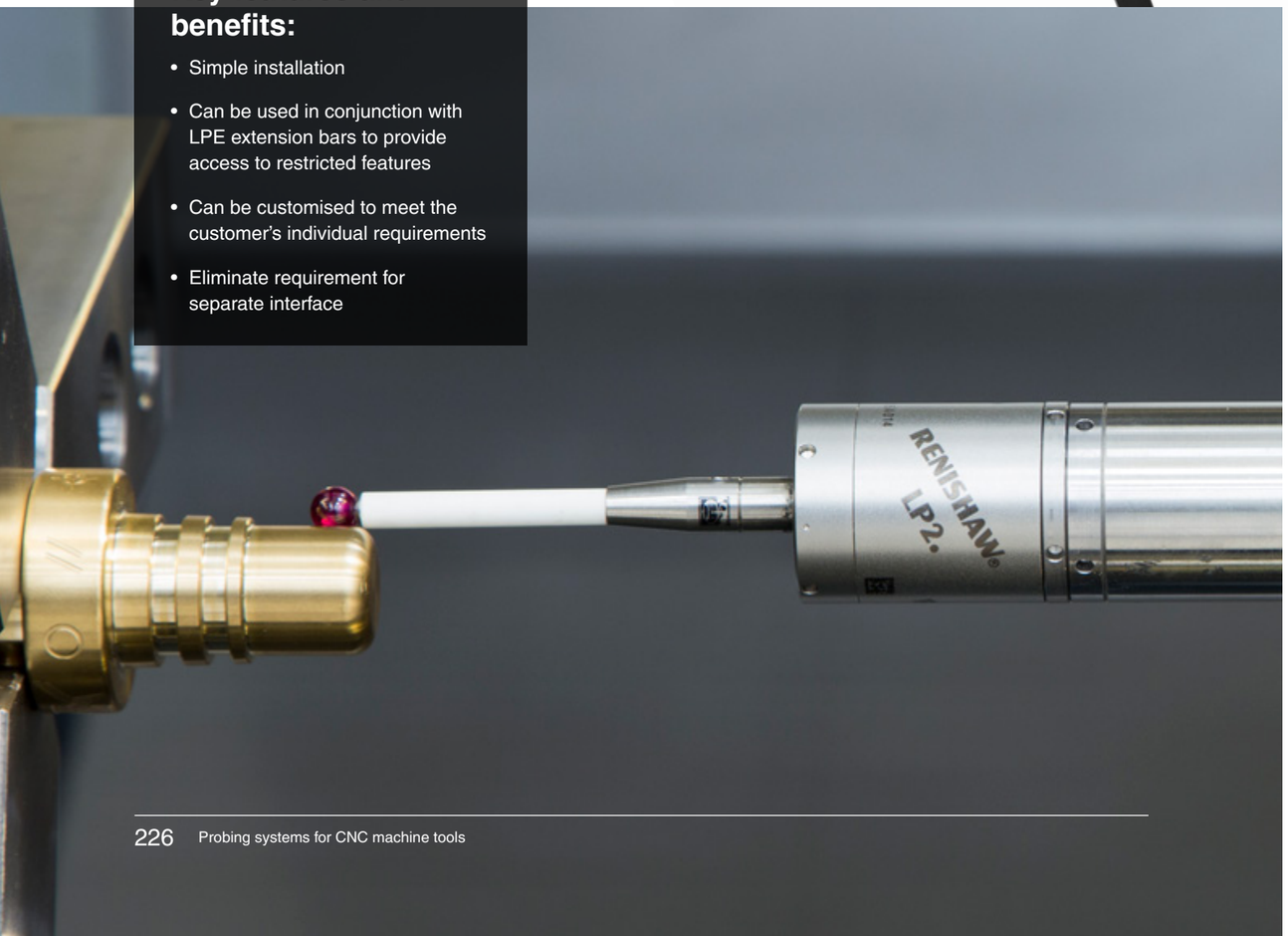
Powered from a 12 V to 30 V supply, they contain an integrated interface which converts the probe's signal into a voltage-free solid-state relay (SSR) output for transmission to the machine tool controller.

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.

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



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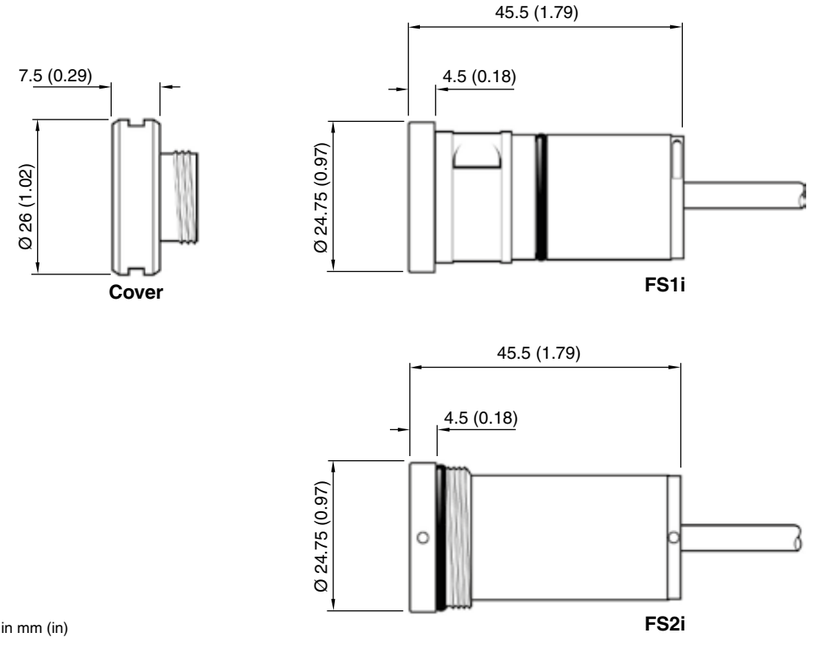
Dimensions



Dimensions given in mm (in)

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)
IP Rating		IPX8
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, contact Renishaw or visit **www.renishaw.com/lp2**

NCi-6

An interface used with 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 machine tool controller. The NCi-6 features various flexible modes of operation, including a dual measurement mode, designed to optimise measurement cycle time and eliminate false triggers.

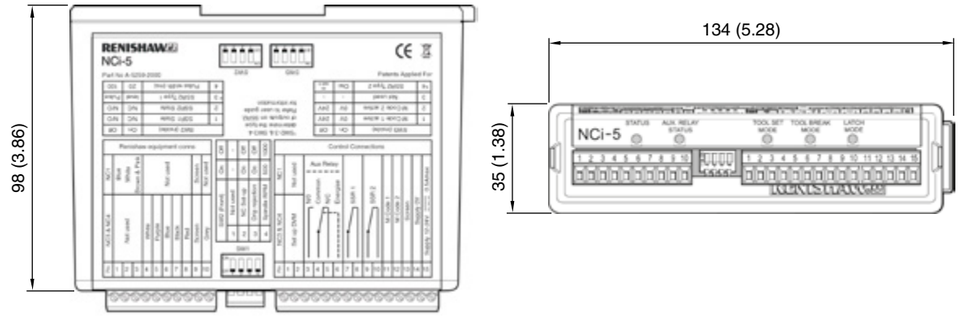
- Tool Set Mode 1 (TSM1) – The tool is measured as it enters the beam (light to dark).
- Tool Set Mode 2 (TSM2) – The tool is measured as it enters and exits the beam (dark to light). This method reduces cycle time and provides improved repeatability in wet or very wet conditions.
- Where both modes are supported, the decision to use TSM1 or TSM2 is typically based on M-code availability and measurement conditions (for example, in wet conditions, TSM2 is recommended).

Key features and benefits:

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

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

Dimensions



Dimensions given in mm (in)

Specification

Principal application	The NCi-6 processes signals from the NC4 or NC4+ Blue and converts them into a voltage-free solid-state relay (SSR) output, which is transmitted to the machine tool controller.
Supply voltage	11 Vdc to 30 Vdc.
Supply current	NC4 or NC4+ Blue connected: 120 mA @ 12 V, 70 mA @ 24 V
Output signal	Two voltage-free solid-state relay (SSR) outputs configurable normally open or normally closed, one of which can be configured level, oscillating or pulsed (pulse width can be 20 ms or 100 ms).
Auxiliary relay	Auxiliary relay for skip sharing with a spindle probe system or controlling the transmitter separately from the receiver. May alternatively be used to operate an air blast solenoid or auxiliary item.
Supply protection	0.5 A resettable fuse. Reset by removing power and cause of fault, then re-powering.
Input/output protection	SSR outputs protected by 50 mA resettable fuses. Auxiliary relay output protected by a 200 mA resettable fuse. Reset by removing power and cause of fault, then re-powering.
Response time	The system electronics will detect when the laser beam is blocked within 9 µs.
Diagnostic LEDs	Beam status, latch mode, high-speed tool breakage detection mode, auxiliary relay, Tool Set Mode 1, Tool Set Mode 2, pulse width.
Modes of operation	High-speed tool breakage detection mode. Measurement modes – Tool Set Mode 1. – Tool Set Mode 2. Latch mode – for profile checking and cutting edge checking. Drip rejection mode – rejects random drops of coolant falling through the beam.
Mounting	DIN rail. Alternative mounting using screws.
Temperature limit	Operating 5 °C to 55 °C (41 °F to 131 °F). Storage –25 °C to 70 °C (–13 °F to 158 °F).
Life	Tested to > 1 million on/off cycles.
Dimensions	Compact size 134 mm × 107.6 mm × 34.6 mm (5.28 in × 4.24 in × 1.36 in).

TSI 2 and TSI 2-C

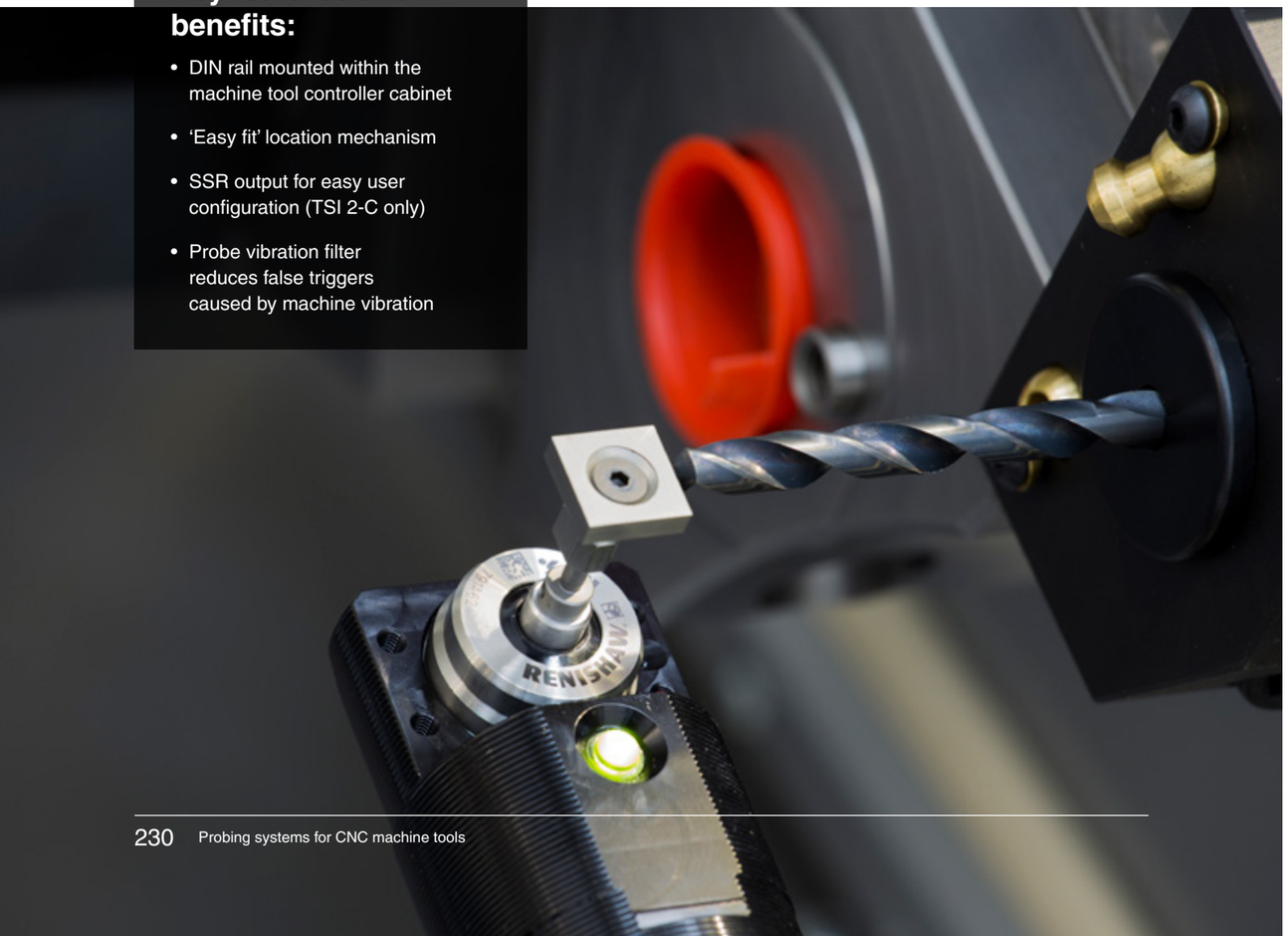
The TSI 2 and TSI 2-C interfaces process signals between the HPRA and HPPA tool setting arms and the machine tool controller.

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

For controllers 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 controllers

Key features and benefits:

- DIN rail mounted within the machine tool controller 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



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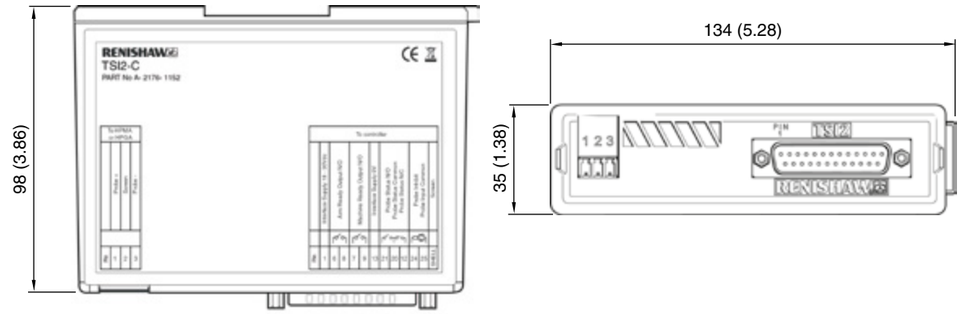
Dimensions



Dimensions given in mm (in)

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 machine tool controller.	
Weight		≈ 0.2 kg (7 oz)	
Mounting		DIN rail preferred; alternatively M4 screw (× 2)	
I/O connector type		25-way D-sub	
Inputs		Opto isolated probe inhibit command, 15 Vdc to 30 Vdc	
Output		OCT active high for ARO, MRO and X+, X–, Z+, Z–	Voltage-free SSRs for probe status, arm ready and arm stowed
Four-wire I/O probe option (for example, Fanuc automatic length measurement input XAE, ZAE)		Four internally pulled down active high inputs, four OCT active high outputs	N/A
Power supply requirement	Voltage	24 Vdc	
	Current	500 mA	
Environment	IP rating	IP20, BS EN 60529:1992+A2:2013	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)	

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

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 machine tool controller.

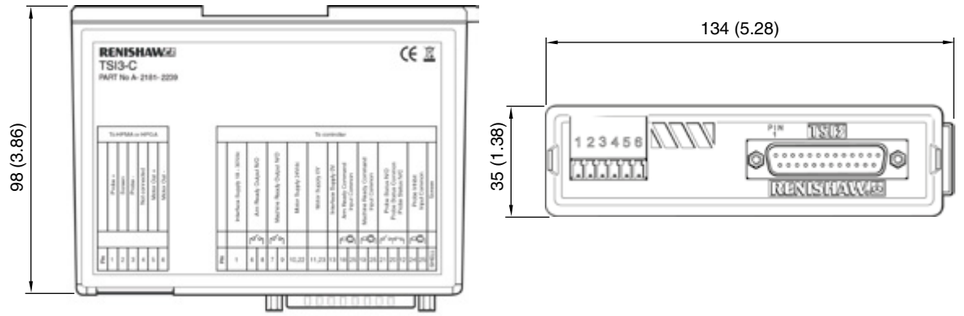
The TSI 3 interface is designed to be used with all standard +24 Vdc operated controllers, for example Fanuc and Siemens. For controllers that do not operate from standard +24 Vdc power supplies (for example Okuma and HAAS) the TSI 3-C should be used instead. This features configurable solid-state relay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

Key features and benefits:

- DIN rail mounted within the machine tool controller 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

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

Dimensions



Dimensions given in mm (in)

Specification

Variant		TSI 3	TSI 3-C
Principal application		Input and output interfacing between the HPMA and HPGA arms and the host CNC controller	
Weight		≈ 0.2 kg (7 oz)	
Mounting		DIN rail preferred; alternatively M4 screw (× 2)	
I/O connector type		25-way D-sub, 4-40 UNC (x 2)	
Inputs		Opto isolated drive commands and probe inhibit command, 15 Vdc to 30 Vdc	
Output		OCT active high for ARO, MRO and X+, X–, Z+, Z–	Voltage-free SSRs for probe status, arm ready and arm stowed
Four-wire I/O probe option (for example, Fanuc automatic length measurement input XAE, ZAE)		Four internally pulled down active high inputs, four OCT active high outputs	N/A
Power supply requirement	Voltage	24 Vdc	
	Current	3 A	
Environment	IP rating	IP20, BS EN 60529:1992+A2:2013	
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)	
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)	

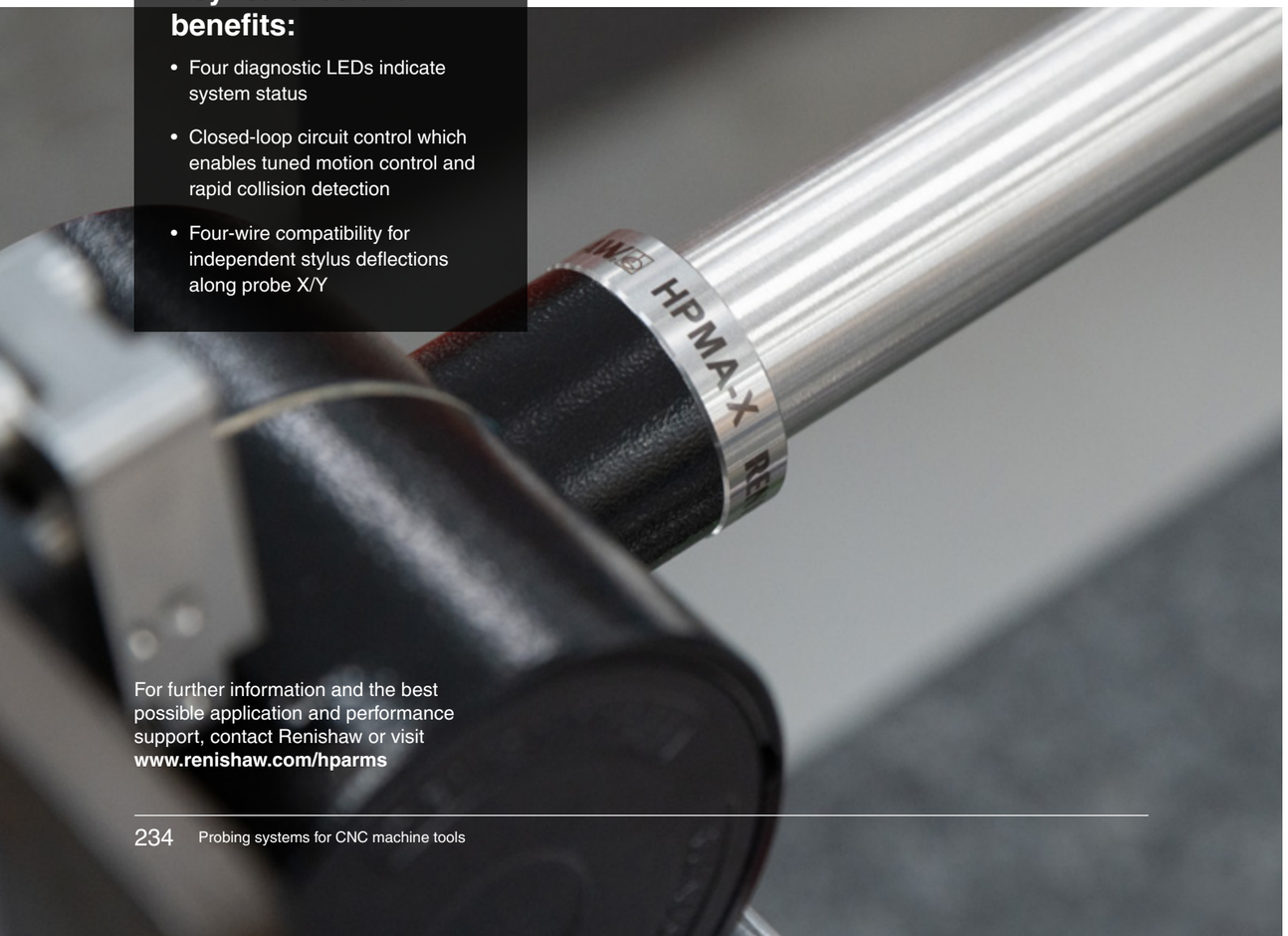
TSI 3-X

The TSI 3-X interface processes signals between the HPMA-X tool setting arm and the machine tool controller. The TSI 3-X interface has the combined output functionality of TSI 3 and TSI 3-C and is designed to be used with all controllers.

A new motor drive provides a smooth controlled motion for large arms. Four diagnostic LEDs on the TSI 3-X display the status of the arm, the probe and the drive commands, along with any operational issues.

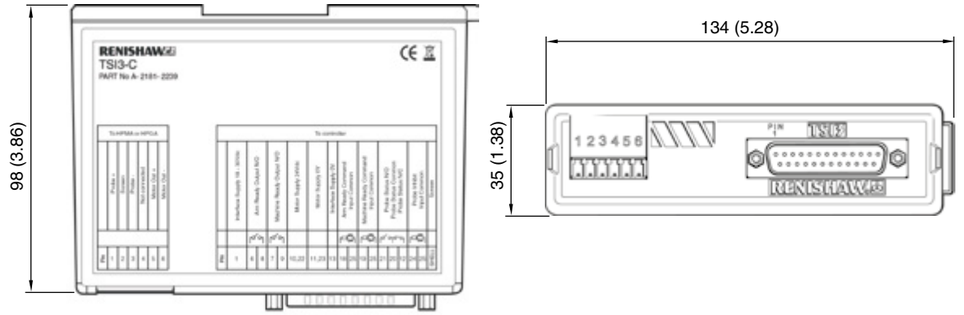
Key features and benefits:

- Four diagnostic LEDs indicate system status
- Closed-loop circuit control which enables tuned motion control and rapid collision detection
- Four-wire compatibility for independent stylus deflections along probe X/Y



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

Dimensions



Dimensions given in mm (in)

Specification

Principal application		Input and output interfacing between the HPMA-X arm and the host CNC controller
Weight		≈ 0.2 kg (7 oz)
Mounting		DIN rail preferred; alternatively M4 screw (× 2)
Status reporting		Four LEDs to identify command status, arm position, probe status and arm status
I/O connector type		25-way D-sub
Inputs		Opto isolated drive commands and probe inhibit command,15 Vdc to 30 Vdc
Output		Voltage free SSRs for probe status, arm ready and arm stowed
Four-wire I/O probe option (for example, Fanuc automatic length measurement input XAE, ZAE)		Four internally pulled down active high inputs, four OCT active high outputs
Power supply requirement	Voltage	24 Vdc
	Current	3 A maximum
Environment	IP rating	IP20, BS EN 60529:1992+A2:2013 (IEC 60529:1989+A1:1999+A2:2013)
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)

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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.

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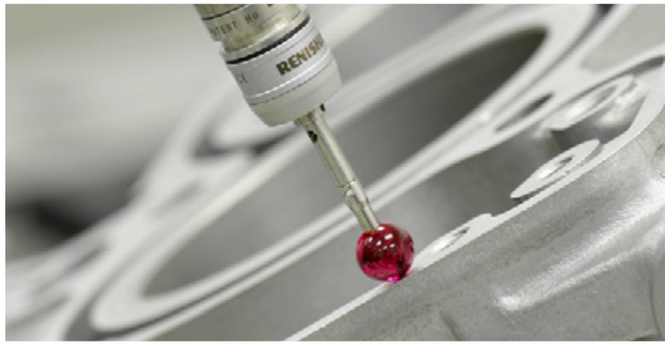
Options and accessories

Renishaw offers the widest range of stylus types and accessories to suit virtually all 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, refer to the *Precision styli* brochure (Renishaw part no. H-1000-3304).

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.

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, therefore the thinner discs require angular alignment in order to ensure correct contact with the feature being probed.

Swivel styli

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

Main application:

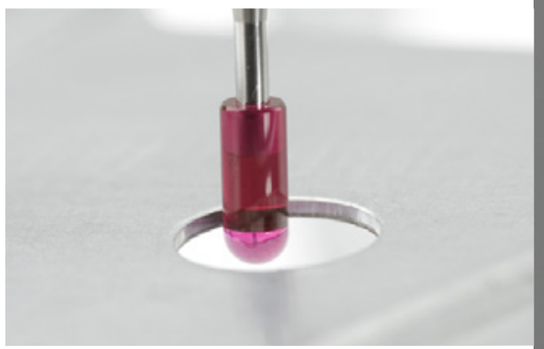
For angled surfaces and angled holes, this configuration gives flexibility, enabling you to make contact with different features without changing the stylus.

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

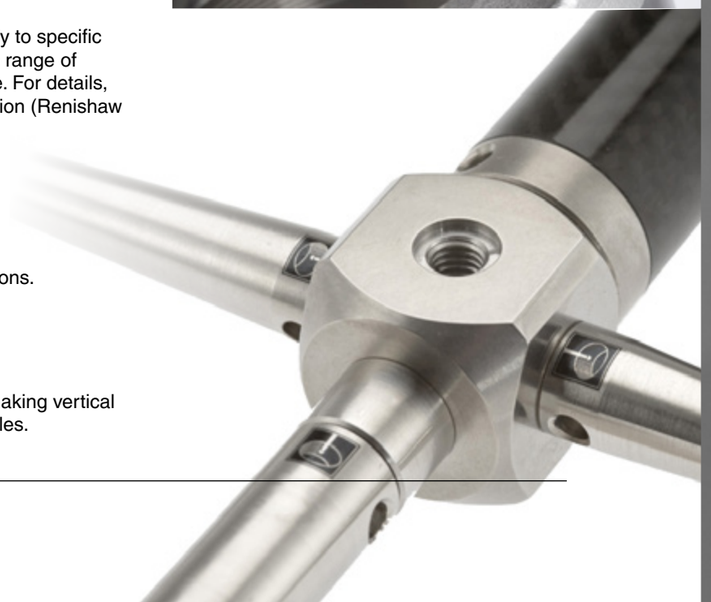
Useful for adapting probe components more precisely to specific measuring tasks. Renishaw offers an extremely wide range of accessories, which are fully covered in our catalogue. For details, refer to the *Styli and accessories* technical specification (Renishaw part no. H-1000-3200).

Bodies and cubes

Use in combination to create specific styli configurations.

Knuckles

The angular alignment of the probe component for making vertical contact with angled workpiece surfaces or angled holes.



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Custom solutions

Custom solutions - machine tool

The Custom Products team has been established at our UK headquarters for over 35 years and offers engineering and applications advice along with a tailored design services for bespoke machine Tool products, enabling you to achieve the best possible control over your manufacturing processes.

Our highly experienced team can support you with machine surveys, product recommendations, concept designs, all the way through to one-off or low-volume production with short lead times.

> **“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 (USA)

Our services include:

- Design and manufacturing solutions based on Renishaw’s knowledge and experience in product applications worldwide.
- Machine surveys to help design the best solution for your individual requirements.
- Easy integration of Renishaw’s Machine Tool Products onto your machine.
- Best application of standard and custom products on customers’ machines.
- Cost and delivery times minimised as standard parts are used where possible.

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.

For further information and the best possible application and performance support, contact Renishaw or visit **www.renishaw.com/custom-solutions**

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+44 (0) 1453 524524 uk@renishaw.com

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