

Probing systems for co-ordinate measuring machines



Introduction



Renishaw's technology

Renishaw stands at the forefront of automated metrology, with the Group's products providing manufacturers with the ability to machine components accurately, and perform measurement traceable to international standards.

Probe technology, allows fast, highly repeatable measurements to be carried out on co-ordinate measuring machines (CMMs).

A wide range of automated probing systems has been developed to meet the needs of post-process inspection, for quality control.

During the manufacturing operation, probes used on computer numerically controlled (CNC) machine tools provide the measurement capability to automatically control the machining process. This eliminates the need for costly, time consuming manual procedures.

Renishaw gives extra capability to CNC machine tools and CMMs by enabling scanning and digitising of 3-dimensional (3D) forms to generate the necessary NC programs to produce either replica parts, or moulds and dies.

Renishaw has developed the Cyclone scanning machine and associated software, a cost-effective solution to stand-alone digitising.

The revolutionary manufacturing system, RAMTIC (Renishaw's automated milling, turning and inspection centre), maximises the potential of existing machine tools, enabling milling, turning and inspection on a single machine, together with automated loading and unloading of materials and tools.

CNC machine tools and CMMs benefit from regular volumetric checking by Renishaw's automated ball-bar and machine checking gauge.

Comprehensive machine calibration can be undertaken, when necessary, using Renishaw's innovative laser calibration systems.

Renishaw has developed linear scale, laser interferometer and encoder systems for fitting to a variety of machines, to provide axis displacement measurement. Dedicated lengths of rigid scale are not required, since Renishaw's approach has been to produce flexible scale that can be dispensed from a reel and cut to the required length.

Renishaw has also applied its innovative approach to produce a Raman microscope and accessories for 2D spectral analysis of materials in a non-destructive manner.

From its leading market position, the Renishaw Group continues to expand its product range into ever increasing business sectors worldwide. Identifying and targeting new market opportunities has led to the continuous development and introduction of new, highly innovative products which significantly enhance the manufacturing capabilities in a wide range of industries.

Probing systems for co-ordinate measuring machines

Introduction to CMM probing

CMMs are used for a wide variety of industry applications, especially for post-process inspection of manufactured components. Renishaw's probes and probing systems have become the industry choice for rapid and accurate inspection. CMMs, which act as a quality reference, use probing systems to replace traditional manually operated measuring instruments such as micrometers, vernier callipers and dedicated gauges.

Probe systems

Renishaw's probe systems are available in a wide variety of types to enable a best match for a particular application.

Fitting the probe on the CMM

The probe is mounted on the CMM via a probe head. The type of head is determined by the flexibility and automation required. Renishaw has designed a range of probe heads for manual and automated systems.

Motorised heads maximise probing efficiency and give a 3-axis CMM, 5-axis capability. A motorised head can also be used with Renishaw's autochange systems which allows rapid and automatic exchange of multiple probe types and extension combinations.

Advanced control

Traditionally, scanning has been limited to relatively slow machines but Renishaw's universal CMM controller family enables this function at speeds many times faster than was previously possible.

Accessories

The range of accessories enhances the basic system by offering additional capability such as stylus changing for the probe, probe sensor changing for multiple probe requirements and extension bars to provide access to deep features.

Renishaw supplies a comprehensive range of styli for component inspection and scanning applications which are available in a variety of profiles, sizes and fittings to best suit the probe employed and the components' features and dimensions.

To avoid the risk of compromising measurement performance, always use a replacement stylus from Renishaw!

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How to use this guide

This TECHNICAL SPECIFICATIONS document is intended to help you select the most appropriate probing system for your CMM. The probing system includes the probe with stylus, the method of attachment of the probe to the CMM by use of a probe head or simple shank, and the necessary probe/head controlling interfaces.

Probe system selection

Before selecting the most appropriate probe system, you should clearly understand the scope of measurement applications to be addressed on your CMM. Renishaw's product range covers all types of probing requirements, from simple touch-trigger point measurement through to advanced part profile scanning. Where a standard product proves not to be ideal, Renishaw's custom design service is available to accommodate your requirements.

This technical specifications document is divided into sections that focus on the different parts of the probing system and indicates the particular benefits of each product. The technical information for each product is also given so that performance data can be compared where more than one product appears suitable.

Step-by-step selection procedure

Step 1 (see sections 5, 6, 7 and 8)

Systems suitable for your CMM

Q? Which type of CMM do you have or wish to purchase?

Manual CMM - go to sections 5/6 to see the family trees of probing systems that are suited to manual CMMs. Identify the probe(s) and probe head(s) that are of interest, and then proceed to steps 2 and 3 to find out more information on these products and finalise your selection.

DCC CMM - go to sections 7/8 to see the family trees of probing systems that are suited to DCC CMMs. Identify the probe(s) and probe head(s) that are of interest, and then proceed to steps 2 and 3 to find out more information on these products and finalise your selection.

NOTE: All probes shown in this document are suitable for use on DCC CMMs.

Step 2 (see sections 2/3/4)

Probe selection

Detailed information on each probe is given in one of three sections as described below.

Contact trigger probes (see sections 2 and 3)

Discrete point, contact trigger probes (also called touch-trigger probes) are ideal for inspection of 3 dimensional prismatic parts and known geometries. These probes are highly versatile and are suitable for a diverse range of applications, materials and surfaces, and there is a wide range of accessories available for them. The probes are segregated into two sections here - **probes without, and probes with stylus module changing**.

Stylus module changing is a very important consideration as it enables higher productivity and the ability to always select the best measurement solution for the application. A further distinction between contact trigger probes is their type of design. There are **kinematic probes and electronic probes** to choose from. Probe sizes vary due to the features of the probe. The larger kinematic probes are extremely robust and are very well suited to manual CMMs due to their large overtravel capability. The smaller probes are suited to applications where there is a need to access restricted spaces. Renishaw's electronic probes offer extended life suitable for high density point profile measurement and also permit higher accuracy than kinematic probes. Depending on the type of CMM and the level of utility required, there is a choice between shank mounted, M8 thread or autojoint mounted probes. Renishaw's autojoint mounted probes and extensions can be rapidly interchanged for increased flexibility and productivity.

Contact scanning probes (see section 4)

Scanning is ideal for the inspection of geometric forms and full profile measurement where thousands of data points can describe the form more fully than a few discrete points. A large amount of information can be collected in a very short time giving better direct results. Renishaw's range of fixed and indexable type scanning probes offers high accuracy, excellent robustness and low contact force scanning. All Renishaw scanning probes feature rapid interchange between stylus configurations to further increase flexibility and productivity.

Step 3 (see sections 5/6/7/8)

Probe head selection

Having selected the probe type, refer again to the family trees (sections 5 and 6 for manual CMMs or sections 7 and 8 for DCC CMMs) to see which probe head(s) are suitable.

Manual CMMs - are usually fitted with shank-mounted probes or manual probe heads. Renishaw offer varieties of manual probe heads which are segregated into sections 5/6 here detailing **manual probe heads with integral M8/ autojoint or with integral TP20 stylus module mount**.

A further design consideration is the choice of **fixed or articulating/indexing manual head types**. The type of probe head required can be determined by examining the features of each head and matching them to your requirements.

DCC CMMs - can be fitted with either manual or motorised probe head systems, so the choice must be made having considered the applications of the CMM. Motorised heads are segregated into sections 7/8 here detailing **servo type and indexing type motorised heads**. Fitting the probe on a CMM using a motorised head is the easiest way to vastly improve the capability of the CMM and maximise productivity. The indexing type motorised heads are designed to position the probe at one of 720 positions, in 7.5° steps, so probing can be carried out at many angles. The repeatability of the head means that these positions can be recalled at any time without the need for re-qualification. This can save a great deal of time for the operator, and encourages system optimisation by applying the probe to the surface at the best angle for the most accurate result. Servo type motorised heads provide almost unlimited angular positioning and are ideally suited to horizontal arm CMMs.

Step 4 (see section 9)

Probe / probe head, interface selection

The probe data in sections 2, 3 and 4 defines the electrical interface(s) compatible with the chosen probe. See section 9 for full details of probe interfaces.

The probe head data in sections 5, 6, 7 and 8 defines the type of controller required to integrate the probe head into the CMM. See section 9 for full details of probe head interfaces.

Step 5 (see sections 11 and 12)

Extension bar / shank selection

For probes and probe heads that are shank mounted on the CMM, go to section 12 to choose the appropriate shank. Section 11 details a comprehensive range of extension bars to enhance the versatility of your probe system. Remember that **Renishaw offers a custom design service** if the type of shank/extension you require is not a standard product.

Step 6 (see sections 2, 3, 4 and 10)

Changer system selection

Many of Renishaw's probes, when fitted to DCC CMMs, are capable of **rapid automatic interchange between stylus configurations or even between different types of probe**. Refer to sections 2, 3 and 4 to see if your chosen probe has change rack compatibility, and for details of these highly productive systems. **Renishaw's autochange rack systems allow rapid exchange between probe sensors and extensions with the Renishaw autojoint** and are detailed in section 10.

Step 7 (see section 13)

Accessories

Check the accessories section 13, for other accessories available for your chosen probe system.

Step 8 (see section 14)

Stylus selection

Renishaw produces a wide range of styli designed to optimise measurement performance. A brief overview is given in section 14. **Please also see Renishaw's Styli and accessories guide (part number H-1000-3200) for comprehensive details.**

NOTE: Section 15 contains a glossary of terms used in this document.

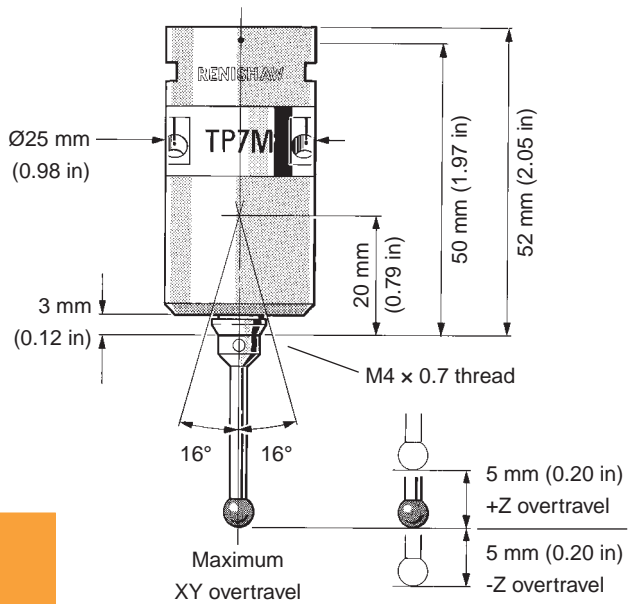
This document contains information on Renishaw's current CMM products range. If you require additional information on these and discontinued products, please visit our website: **www.renishaw.com**

TP7M / TP7M EP probes

The TP7M range comprises electronic probes using strain gauge technology which gives higher accuracy than kinematic touch-trigger probes. Incorporating a multiwired autojoint connection, the TP7M is compatible with the PH10M/PH10MQ motorised heads, PH6M fixed probe head, and the range of PEM extension bars.

The autojoint also allows fast probe changing, either manually or automatically, with a Renishaw autochange rack system.

The enhanced performance TP7M EP is capable of achieving a 3D accuracy of $<0.6 \mu\text{m}$ tested to ISO 10360 Pt 2.



TP7M / TP7M EP features and benefits:

- Excellent repeatability and high precision 3D form measurement
- 6-way measuring capability ($\pm X$, $\pm Y$, $\pm Z$)
- Stylus reach up to 180 mm (7.09 in) using GF range
- Zero reseat errors and no lobing effect
- Fitment is to PH10M/PH10MQ or PH6M heads via the autojoint coupling which gives the capability of fast probe changing when used with a Renishaw autochange rack system

PI 7-2 probe interface

The PI 7-2 interface has two switchable levels of trigger sensitivity to accommodate differing applications. Please see section 9 for full details.

Specification summary		TP7M	TP7M EP
PRINCIPAL APPLICATION		FMS and automated systems. Universal DCC and manual CMMs.	As TP7M but where high accuracy measurement is required.
SENSE DIRECTIONS		6-axis: $\pm X$, $\pm Y$, $\pm Z$	6-axis: $\pm X$, $\pm Y$, $\pm Z$
3D ACCURACY (test to ISO 10360 Pt 2)*		N/A	$<0.6 \mu\text{m}$ ($<0.000024 \text{ in}$)
UNIDIRECTIONAL REPEATABILITY ($2\sigma \mu\text{m}$)	Trigger level 1	$0.25 \mu\text{m}$ (0.00001 in)	$0.25 \mu\text{m}$ (0.00001 in)
	Trigger level 2	$0.25 \mu\text{m}$ (0.00001 in)	$0.25 \mu\text{m}$ (0.00001 in)
XY (2D) FORM MEASUREMENT DEVIATION	Trigger level 1	$\pm 0.25 \mu\text{m}$ (0.00001 in)	$\pm 0.25 \mu\text{m}$ (0.00001 in)
	Trigger level 2	$\pm 0.50 \mu\text{m}$ (0.00002 in)	$\pm 0.50 \mu\text{m}$ (0.00002 in)
XYZ (3D) FORM MEASUREMENT DEVIATION	Trigger level 1	$\pm 0.50 \mu\text{m}$ (0.00002 in)	$\pm 0.50 \mu\text{m}$ (0.00002 in)
	Trigger level 2	$\pm 1 \mu\text{m}$ (0.00004 in)	$\pm 1 \mu\text{m}$ (0.00004 in)
TRIGGER FORCE (at stylus tip)	XY plane	0.02 N	0.02 N
	Z axis	0.15 N	0.15 N
OVERTRAVEL FORCE	XY plane	0.78 N	0.78 N
	Z axis	11.75 N	11.75 N
WEIGHT		85 g (3 oz)	85 g (3 oz)
MAXIMUM EXTENSION (if on a PH10 series head)		200 mm (7.87 in)	200 mm (7.87 in)
MAXIMUM RECOMMENDED STYLUS LENGTH (M4 styli range)		150 mm (5.91 in) steel - 180 mm (7.09 in) GF	150 mm (5.91 in) steel - 180 mm (7.09 in) GF
MOUNTING METHOD		Multiwired autojoint	Multiwired autojoint
SUITABLE INTERFACE		PI 7-2	PI 7-2
AUTOMATIC PROBE CHANGING		Autochange rack	Autochange rack

Above data applies for test conditions as follows: Stylus length 50 mm (1.97 in) Stylus velocity 240 mm/min (1.57 ft/min)

* Test performed on a CMM specification U3 = $0.48 \mu\text{m} + L/1000$

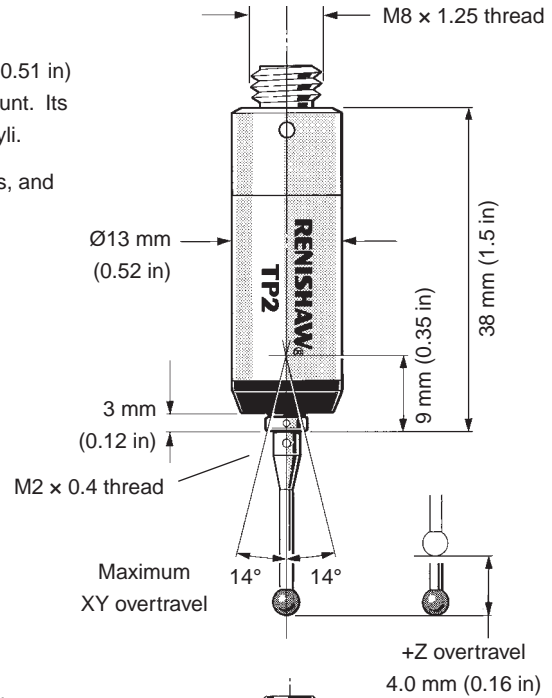
TP2-5W probes

The TP2-5W is one of Renishaw's best known products. It is a 13 mm (0.51 in) diameter standard kinematic touch-trigger probe with an M8 thread mount. Its adjustable stylus force enables the probe to support a wide range of styli.

The TP2 is small, light and compatible with a wide range of accessories, and is suitable for manual and DCC CMMs.

TP2-5W features and benefits:

- Small, light, versatile probe
- Adjustable trigger force
- Compatible with M2 styli
- Compatible with the full range of Renishaw probe heads and accessories
- Suitable for manual and DCC CMMs

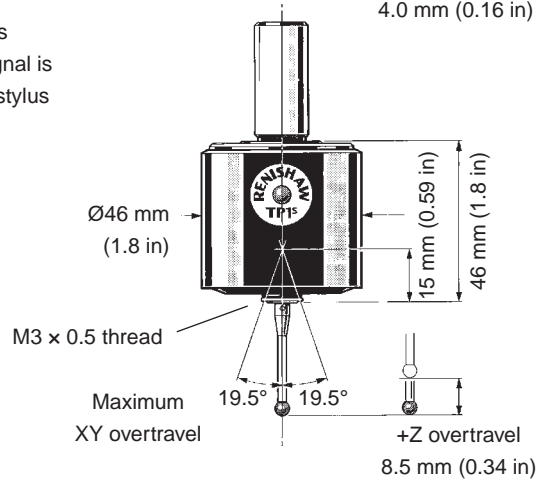


TP1 (S) probe

This large, robust kinematic probe has a high degree of overtravel and is shank mounted, making it ideal for use on manual CMMs. The probe signal is carried to the CMM via an external cable and the probe has adjustable stylus force to help optimise its performance.

TP1(S) features and benefits:

- Ideal for manual CMMs
- Robust
- Large overtravel range
- Large adjustable trigger force range
- Shank mounted



Specification summary	TP2-5W	TP1(S)
PRINCIPAL APPLICATION	Universal DCC and manual CMMs.	Manual CMMs.
SENSE DIRECTIONS	5-axis: $\pm X$, $\pm Y$, $+Z$	5-axis: $\pm X$, $\pm Y$, $+Z$
UNIDIRECTIONAL REPEATABILITY MAXIMUM (2σ μm) (at stylus tip)	0.35 μm (0.000014 in)	0.50 μm (0.00002 in)
PRE-TRAVEL VARIATION 360° (XY PLANE)	± 0.80 μm (0.000032 in)	± 2 μm (0.00008 in)
WEIGHT *excluding shank and cable	22 g (0.78 oz)	128 g* (4.52 oz*)
STYLUS RANGE	M2	M3
STYLUS FORCE RANGE (ADJUSTABLE)	0.07 N - 0.15 N	0.1 N - 0.5 N
STYLUS FORCE (SET BY RENISHAW)	0.07 N - 0.08 N	0.15 N
STYLUS OVERTRAVEL (TYPICAL)	XY PLANE $\pm 14^\circ$ $+Z$ axis 4 mm (0.16 in) @ 0.07 N 3 mm (0.12 in) @ 0.15 N	$\pm 19.5^\circ$ 8.5 mm (0.34 in) @ 0.1 N 5 mm (0.20 in) @ 0.5 N
MAXIMUM EXTENSION ON PH10 SERIES	300 mm (11.81 in)	N/A
MOUNTING METHOD	M8 thread	Shank to suit machine
SUITABLE INTERFACE	PI 4-2, PI 7-2, PI 200, UCC	PI 4-2, PI 7-2, PI 200, UCC

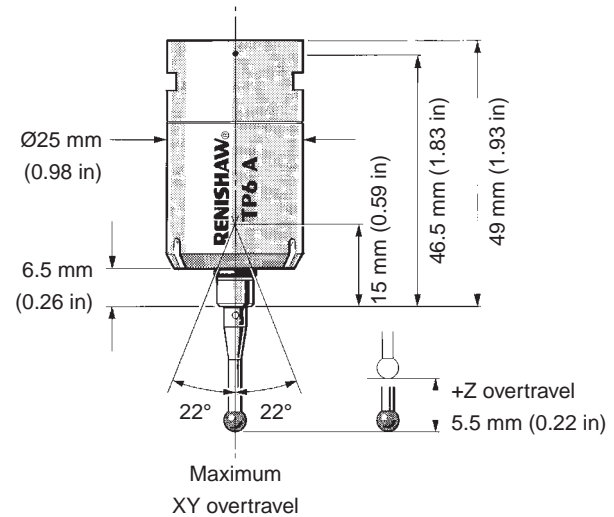
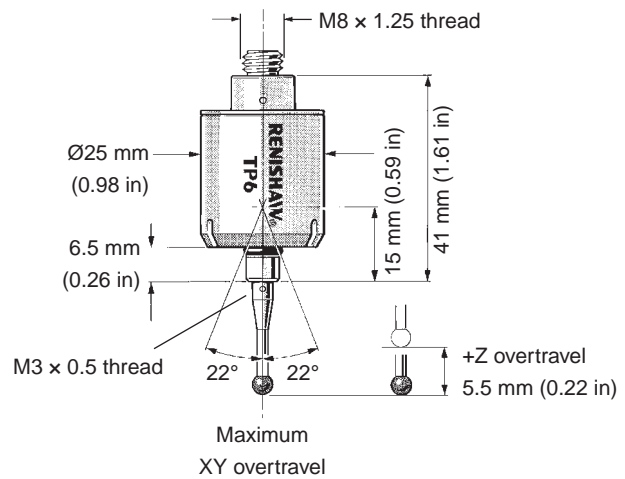
Above data applies to test conditions as follows: Stylus length 10 mm (0.39 in) [re TP2-5W] or 31 mm (1.22 in) [re TP1(S)]. Stylus velocity 480 mm/min (1.57 ft/min). Stylus force 0.07-0.08 N [re TP2-5W] or 0.15 N [re TP1(S)].

TP6 / TP6A probes

The TP6 is an M8 thread mounted probe while the TP6A has an autojoint, which means that it can be changed quickly and easily without the need to re-qualify stylus tips. The probe design is robust with large overtravel and adjustable trigger force.

TP6 / TP6A features and benefits:

- Autojoint or M8 version
- Long stylus carrying capability
- Large stylus overtravel
- Robust
- Adjustable trigger force range
- M3 stylus mount



Specification summary	TP6	TP6A
PRINCIPAL APPLICATION	Robust universal DCC and manual CMMs.	As TP6 but with fast probe exchange without requalification.
SENSE DIRECTIONS	5-axis: $\pm X$, $\pm Y$, $+Z$	5-axis: $\pm X$, $\pm Y$, $+Z$
UNIDIRECTIONAL REPEATABILITY MAXIMUM (2σ μm) (at stylus tip)	0.35 μm (0.000014 in)	0.35 μm (0.000014 in)
PRE-TRAVEL VARIATION 360° (XY PLANE)	± 1 μm (± 0.00004 in)	± 1 μm (± 0.00004 in)
WEIGHT	56 g (1.98 oz)	76 g (2.68 oz)
STYLUS RANGE	M3	M3
STYLUS FORCE RANGE (ADJUSTABLE)	0.11 N - 0.3 N	0.11 N - 0.3 N
STYLUS FORCE (SET BY RENISHAW)	0.11 N - 0.13 N	0.11 N - 0.13 N
STYLUS OVERTRAVEL (TYPICAL)	XY plane	$\pm 22^\circ$
	+Z axis	5.5 mm (0.22 in) @ 0.11 N 2 mm (0.08 in) @ 0.3 N
MAXIMUM EXTENSION ON PH10 SERIES	200 mm (7.87 in)	200 mm (7.87 in)
MOUNTING METHOD	M8 thread	Autojoint
SUITABLE INTERFACE	PI 4-2, PI 7-2, PI 200, UCC	PI 4-2, PI 7-2, PI 200, UCC

Above data applies to test conditions as follows: Stylus length 21 mm (0.83 in). Stylus velocity 480 mm/min (1.57 ft/min). Stylus force 0.11-0.13 N

TP200 / TP200B modular probes

The TP200/TP200B are electronic probes using strain gauge technology, which gives higher accuracy than kinematic touch-trigger probes. They combine outstanding metrology performance with superior functionality to produce a highly versatile DCC CMM probing system with excellent productivity.

The TP200 system components are:

- TP200 probe body – the standard model
- TP200B probe body – a variant model with increased vibration tolerance
- TP200 stylus module – choice of fixed overtravel forces: 'SF' (standard force) or 'LF' (low force)

There is also the 'EO' (extended overtravel) module, which has the same overtravel force as the 'SF' but provides increased operating range and protection in the probe Z axis

- PI 200 probe interface
- SCR200 stylus changing rack

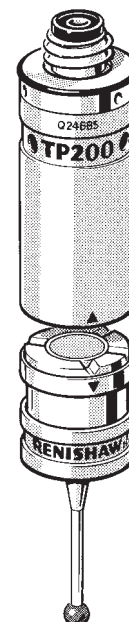
TP200 probe body

The TP200 probe incorporates micro strain gauge transducers, delivering excellent repeatability and accurate 3D form measurement even with long styli. The sensor technology gives sub-micron triggering performance and eliminates the lobing characteristics encountered with standard probes. The solid-state ASIC electronics within the probe ensure reliable operation over millions of trigger points.

TP200B probe body

The TP200B probe uses the same technology as TP200 but has been designed to have a higher tolerance to vibration. This helps to overcome the problem of 'air' trigger generation which can arise from vibrations transmitted through the CMM or when using longer styli with faster positioning speeds.

NOTE: We do not recommend the use of TP200B with the LF module or cranked/star styli.



TP200
probe
body

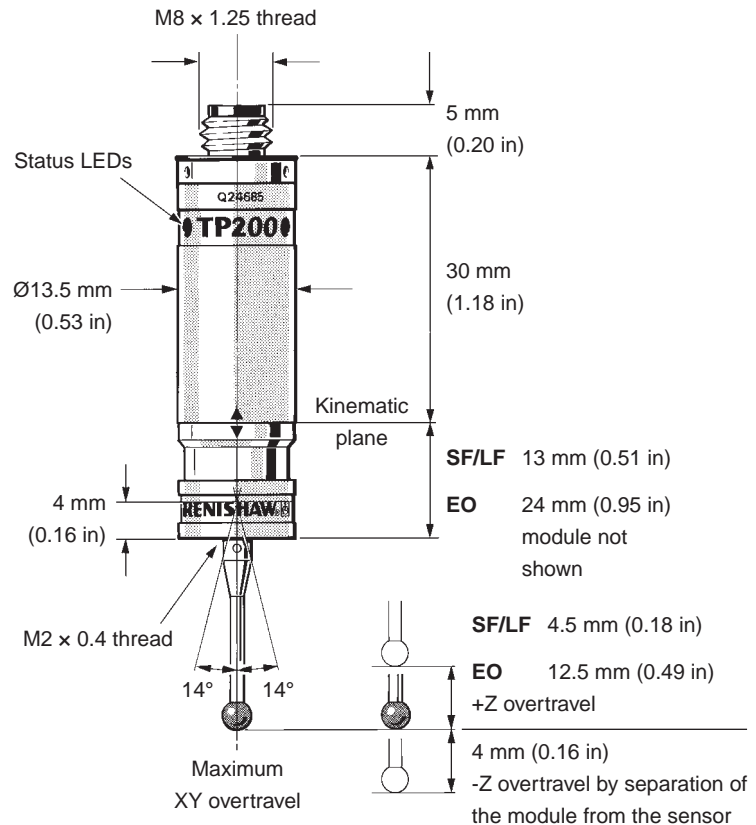
TP200
stylus
module

TP200 stylus module

The stylus module is mounted on the probe via a highly repeatable magnetic kinematic joint, providing a rapid stylus changing capability and probe overtravel protection.

There are three modules available, with two different overtravel forces:

- The SF (standard force) module is suitable for most applications.
- The LF (low force) module is recommended for use with small precision ball styli or on delicate materials.
- The EO (extended overtravel) module is recommended for use when increasing the speed of the CMM may lead to stopping distances which exceed the overtravel range provided in the SF/LF modules. The EO module has an additional 8 mm (0.32 in) of overtravel in the probe Z axis to protect against damage to the sensor in such circumstances. Overtravel force is the same as the SF module.



PI 200 probe interface

The PI 200 is a unit capable of the automatic recognition and interfacing of TP200/B and also conventional touch-trigger probes (TP2, TP6, TP20). Two switchable levels of probe trigger sensitivity are provided to accommodate differing applications. The PI 200 interface is covered fully in section 9.



SCR200 stylus changing rack

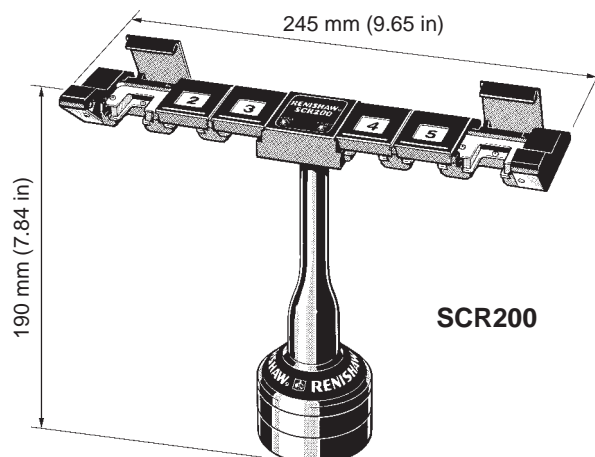
The SCR200 provides rapid, automatic changing of stylus modules without the need to re-qualify stylus tips. The SCR200 is powered entirely by the PI 200 and provides features to facilitate safe stylus changing.

MSR1 module storage rack

For manual storage of modules - see section 13.

Probe maintenance

CK200 (Renishaw part number A-1085-0016) is a specialised cleaning material supplied for the removal of contamination from the location faces of the magnetically retained kinematic couplings of the TP20, TP200 and SP25M probe systems. The frequency of cleaning should be determined according to the conditions of use.



TP200 / TP200B features and benefits:

- Excellent repeatability and precision 3D form measurement
- Rapid exchange between stylus configurations without the need to re-calibrate
- 6-way measuring capability ($\pm X$, $\pm Y$, $\pm Z$)
- SF and LF modules to give overtravel force to suit the application
- EO module to give increased overtravel in probe Z axis
- Zero reseat errors and no lobing effect
- Suitable for intensive 'peck' or 'stitch' scanning
- Stylus reach up to 100 mm (3.99 in) GF range
- Module life of >10 million triggers
- Compact size
- Compatible with the full range of Renishaw probe heads and accessories



Specification summary			TP200	TP200B
PRINCIPAL APPLICATION			DCC CMM where high accuracy is required.	As TP200 but where 'air'* trigger events occur.
SENSE DIRECTIONS			6-axis: ±X, ±Y, ±Z	6-axis: ±X, ±Y, ±Z
UNIDIRECTIONAL REPEATABILITY (2σ μm)	Trigger level 1		0.40 μm (0.000016 in)	0.40 μm (0.000016 in)
	Trigger level 2		0.50 μm (0.00002 in)	0.50 μm (0.00002 in)
XY (2D) FORM MEASUREMENT DEVIATION	Trigger level 1		±0.80 μm (0.000032 in)	±1 μm (0.00004 in)
	Trigger level 2		±0.90 μm (0.000036 in)	±1.2 μm (0.000047 in)
XYZ (3D) FORM MEASUREMENT DEVIATION	Trigger level 1		±1 μm (0.00004 in)	±2.50 μm (0.0001 in)
	Trigger level 2		±1.40 μm (0.000056 in)	±4 μm (0.00016 in)
REPEATABILITY OF STYLUS CHANGE	With SCR200		±0.50 μm (0.00002 in) max.	±0.50 μm (0.00002 in) max.
	Manual		±1 μm (0.00004 in) max.	±1 μm (0.00004 in) max.
TRIGGER FORCE (at stylus tip)	XY plane	All modules	0.02 N	0.02 N
	Z axis	All modules	0.07 N	0.07 N
OVERTRAVEL FORCE (@ 0.50 mm displacement)	XY plane	SF/EO module	0.2 N to 0.4 N	0.2 N to 0.4 N
		LF module	0.1 N to 0.15 N	0.1 N to 0.15 N
	Z axis	SF/EO module	4.90 N	4.90 N
		LF module	1.60 N	1.60 N
WEIGHT (probe sensor and module)			22 g (0.78 oz)	22 g (0.78 oz)
MAXIMUM EXTENSION (if on a PH10 series head)			300 mm (11.81 in)	300 mm (11.81 in)
MAXIMUM RECOMMENDED STYLUS LENGTH (M2 styli range)	SF/EO module		50 mm (1.97 in) steel to 100 mm (3.94 in) GF	50 mm (1.97 in) steel to 100 mm (3.94 in) GF
	LF module		20 mm (0.79 in) steel to 50 mm (1.97 in) GF	20 mm (0.79 in) steel to 50 mm (1.97 in) GF
MOUNTING METHOD			M8 thread	M8 thread
SUITABLE INTERFACE			PI 200, UCC	PI 200, UCC
STYLUS MODULE CHANGING RACK	Automatic		SCR200	SCR200
	Manual		MSR1	MSR1

Above data applies for test conditions as follows: Stylus length 50 mm (1.97 in) Stylus velocity 480 mm/min (1.57 ft/min).

* Air trigger (or false trigger). The TP200B reduces probe triggers that may be caused by vibrations.

TP20 / TP20 NI modular probes

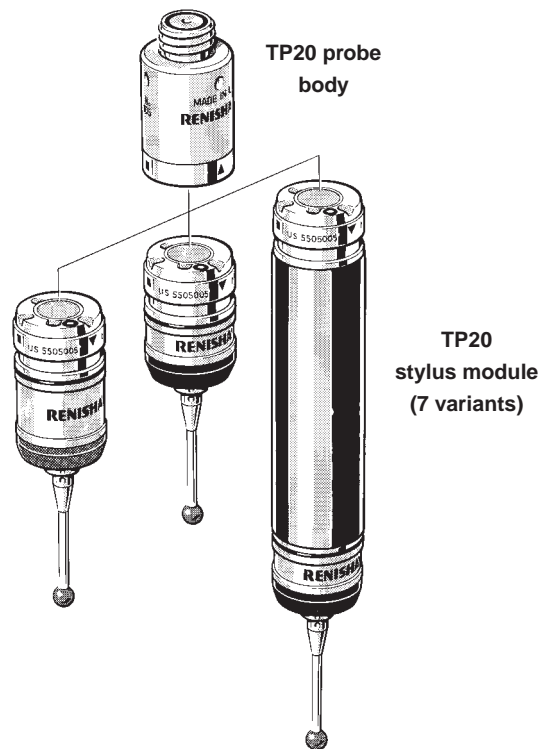
The TP20 is a 5-way or 6-way kinematic touch-trigger probe. Its two piece design comprises a probe body and detachable stylus module(s), which gives the ability to change stylus configurations either manually or automatically without re-qualification of the stylus tips, providing significant time savings in inspection routines.

A direct replacement for the industry standard Renishaw TP2 probe, the TP20 probe system brings a range of new benefits to manual and DCC CMM applications, and can easily be retrofitted to existing TP2 installations.

The TP20 can be used on a wide range of Renishaw's manual or motorised probe heads, either by direct mounting using the standard M8 thread or, alternatively, by using a PAA# adaptor to connect to an autojoint.

The system components are:

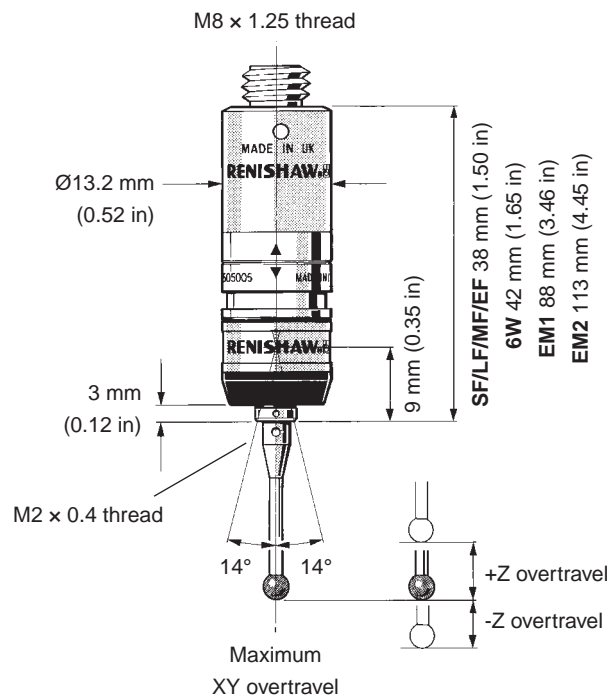
- TP20/TP20 NI probe body
- TP20 stylus module – seven module variants allow for optimisation of performance to suit the application
- MCR20 module changing rack – automatic operation
- The TP20 probe system may be used with Renishaw's PI 4-2, PI 7-2 or PI 200 probe interfaces (see section 9)



TP20 probe body

The TP20 probe body houses one half of the highly repeatable magnetic kinematic coupling that attaches the stylus module and body. The body also contains a magnetic proximity switch to inhibit triggering of the probe during automatic module changing with MCR20.

NOTE: If the probe is operated close to magnetised parts/clamping etc, the probe trigger may become inhibited. Countermeasures include the use of long styli, stylus extensions or body orientation to increase the distance to the magnetic source. Alternatively, use the TP20 NI probe body.



TP20 NI probe body

The TP20 NI probe differs from the TP20 body in that it is not affected by magnetic fields. However the probe trigger must be inhibited through software during change cycles using the MCR20.

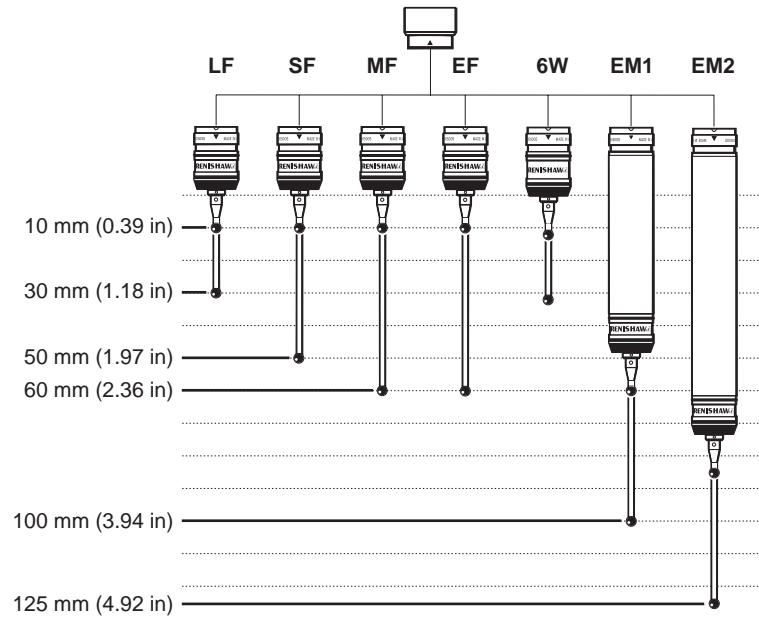
+Z overtravel		-Z overtravel	
SF/EM1/EM2	4 mm (0.16 in)	6W	1.5 mm (0.06 in)
LF	3.1 mm (0.12 in)		
MF	3.7 mm (0.15 in)		
EF	2.4 mm (0.09 in)		
6W	4.5 mm (0.18 in)		

TP20 stylus module

The TP20 stylus module houses the kinematic switching touch sensor mechanism, carries the stylus assembly and provides overtravel in $\pm X$, $\pm Y$ and $\pm Z$ axes (or $\pm Z$ in the case of TP20 6-way module). The stylus mounting thread accepts styli from the Renishaw M2 range.

A range of seven, application specific, stylus modules is available, being identified by coloured caps:

- **SF** - Standard force stylus module (black cap)
- **LF** - Low force stylus module (green cap)
- **MF** - Medium force stylus module (grey cap)
- **EF** - Extended force stylus module (brown cap)
- **6W** - 6-way stylus module (blue cap)
- **EM1 SF** - Standard force extension module
- **EM2 SF** - Standard force extension module



Stylus comparison

MCR20 module changing rack

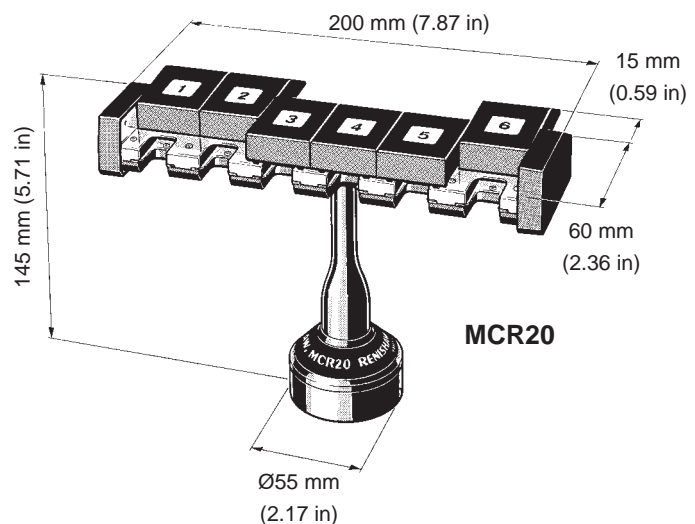
The MCR20 probe module changing rack is designed to securely store stylus modules ready for rapid automatic changing, whilst protecting mating surfaces from any airborne contaminants within the working environment.

MSR1 module storage rack

For manual storage of modules - see section 13.

Probe maintenance

CK200 (Renishaw part number A-1085-0016) is a specialised cleaning material supplied for the removal of contamination from the location faces of the magnetically retained kinematic couplings of the TP20, TP200 and SP25M probe systems. The frequency of cleaning should be determined according to the conditions of use.



TP20 / TP20 NI features and benefits:

- A kinematic touch-trigger probe system for manual and DCC CMMs
- Rapid exchange between stylus configurations without the need to re-calibrate
- A choice of seven stylus modules, giving 5-axis or 6-axis operation, allow optimisation of probe and stylus performance to the given application
- Easily retrofitted to all Renishaw standard probe heads (M8 or autojoint fitting) and compatible with existing TTP interfaces
- Metrology performance equivalent to industry proven TP2-5W probe
- Compatible with the full range of Renishaw probe heads and accessories



Specification summary (1)		TP20	TP20 NI
PRINCIPAL APPLICATION		DCC and manual CMMs suitable for most applications.	DCC and manual CMMs where operation is within a magnetic field.
SENSE DIRECTIONS	All modules except 6W	5-axis: $\pm X, \pm Y, +Z$	5-axis: $\pm X, \pm Y, +Z$
	6W	6-axis: $\pm X, \pm Y, \pm Z$	6-axis: $\pm X, \pm Y, \pm Z$
PRE-TRAVEL VARIATION	LF	$\pm 0.60 \mu\text{m}$ (± 0.000023 in)	$\pm 0.60 \mu\text{m}$ (± 0.000023 in)
	SF/EM1/EM2	$\pm 0.80 \mu\text{m}$ (± 0.000032 in)	$\pm 0.80 \mu\text{m}$ (± 0.000032 in)
	MF	$\pm 1 \mu\text{m}$ (± 0.000039 in)	$\pm 1 \mu\text{m}$ (± 0.000039 in)
	EF	$\pm 2 \mu\text{m}$ (± 0.000079 in)	$\pm 2 \mu\text{m}$ (± 0.000079 in)
	6W	$\pm 1.50 \mu\text{m}$ (± 0.000058 in)	$\pm 1.50 \mu\text{m}$ (± 0.000058 in)
UNIDIRECTIONAL REPEATABILITY ($2\sigma \mu\text{m}$) (at stylus tip)	SF/LF/EM1/EM2	$\pm 0.35 \mu\text{m}$ (± 0.000014 in)	$\pm 0.35 \mu\text{m}$ (± 0.000014 in)
	MF	$\pm 0.50 \mu\text{m}$ (± 0.000020 in)	$\pm 0.50 \mu\text{m}$ (± 0.000020 in)
	EF	$\pm 0.65 \mu\text{m}$ (± 0.000026 in)	$\pm 0.65 \mu\text{m}$ (± 0.000026 in)
	6W	$\pm 0.80 \mu\text{m}$ (± 0.000032 in)	$\pm 0.80 \mu\text{m}$ (± 0.000032 in)
REPEATABILITY OF STYLUS CHANGE (maximum)	With MCR20	$\pm 0.50 \mu\text{m}$ (± 0.000020 in)	$\pm 0.50 \mu\text{m}$ (± 0.000020 in)
	Manual	$\pm 1 \mu\text{m}$ (± 0.000040 in)	$\pm 1 \mu\text{m}$ (± 0.000040 in)
STYLUS RANGE		M2	M2
MOUNTING METHOD		M8 thread	M8 thread
SUITABLE INTERFACE		PI 4-2, PI 7-2, PI 200, UCC	PI 4-2, PI 7-2, PI 200, UCC
STYLUS MODULE CHANGING RACK	Automatic	MCR20	MCR20
	Manual	MSR1	MSR1

Above data applies for test conditions as follows: Stylus length 10 mm (0.39 in). Stylus velocity 480 mm/min (1.57 ft/min)

Specification summary (2)

Module	Application guide	Maximum extension on PH10 series head	Weight (body and module)
LF	The low force stylus module, identified by a green cap, is suited to applications that require low trigger force, e.g. rubber seals.	300 mm (11.81 in)	22 g (0.78 oz)
SF	The standard force stylus modules, identified by black caps, are suited to the majority of applications.	300 mm (11.81 in)	22 g (0.78 oz)
EM1		300 mm (11.81 in)*	28 g (0.99 oz)
EM2		300 mm (11.81 in)*	30 g (1.06 oz)
MF	The medium force stylus module, identified by a grey cap, is for use where a higher trigger force than standard is required.	300 mm (11.81 in)	22 g (0.78 oz)
EF	The extended force stylus module is identified by a brown cap. Typically, this stylus module will only be required with large stylus assemblies, and where spurious 'air' triggers caused by machine vibration and acceleration, preclude the use of either SF, LF or MF modules.	300 mm (11.81 in)	22 g (0.78 oz)
6W	The 6-way stylus module, identified by a blue cap, has been designed for applications requiring measurement in the -Z direction, for example when measuring the width of undercuts.	300 mm (11.81 in)	22 g (0.78 oz)

* **NOTE:** Dependant on CMM used and operating conditions.

Specification summary (3)

Module type and text stylus length	Trigger force		Overtravel force			Overtravel displacement		
	XY	Z	XY	+Z	-Z	XY	+Z	-Z
LF 10 mm	0.06 N	0.65 N	0.09 N	1.15 N	-	±14°	3.10 mm (0.12 in)	-
SF EM1 EM2 10 mm	0.08 N	0.75 N	0.20 N to 0.30 N	3.50 N	-	±14°	4 mm (0.16 in)	-
MF 25 mm	0.10 N	1.9 N	0.20 N to 0.40 N	7 N	-	±14°	3.70 mm (0.15 in)	-
EF 50 mm	0.10 N	3.2 N	0.20 N to 0.50 N	10 N	-	±14°	2.40 mm (0.09 in)	-
6W 10 mm	0.14 N	1.60 N	0.25 N	2.50 N	9 N	±14°	4.50 mm (0.18 in)	1.50 mm (0.06 in)

Above data applies for test conditions as follows: Stylus length as stated above. Stylus velocity 480 mm/min (1.57 ft/min)

SP25M compact scanning probe system

SP25M scanning probe

Only 25 mm (0.98 in) in diameter, and with a range of modules for high performance scanning and touch-trigger probing, the SP25M is the world's most compact and versatile scanning probe system.

The SP25M is actually two sensors in one, enabling scanning and touch-trigger probing in a single probe system. SP25M gives highly accurate scanning performance with stylus lengths from 20 mm to 400 mm (0.79 in to 15.75 in) using M3 stylus range. In addition, the ability to carry Renishaw's TP20 range of touch-trigger stylus modules means that the SP25M system enables best optimisation of the measurement solution to suit the application.

The SP25M's compact size and autojoint mounting make it compatible with the PH10M/MQ motorised probe heads and PH6M fixed probe head. It can also be mounted on a multiwired extension bar of up to 100 mm (3.94 in) length. Together, this combination permits excellent reach and access to part features.

A unique pivoting design achieves exceptional dynamic performance. Four scanning modules have been designed to optimise scanning accuracy across a wide range of stylus lengths, avoiding most of the deterioration in performance seen in other types of scanning probe as stylus lengths increase.

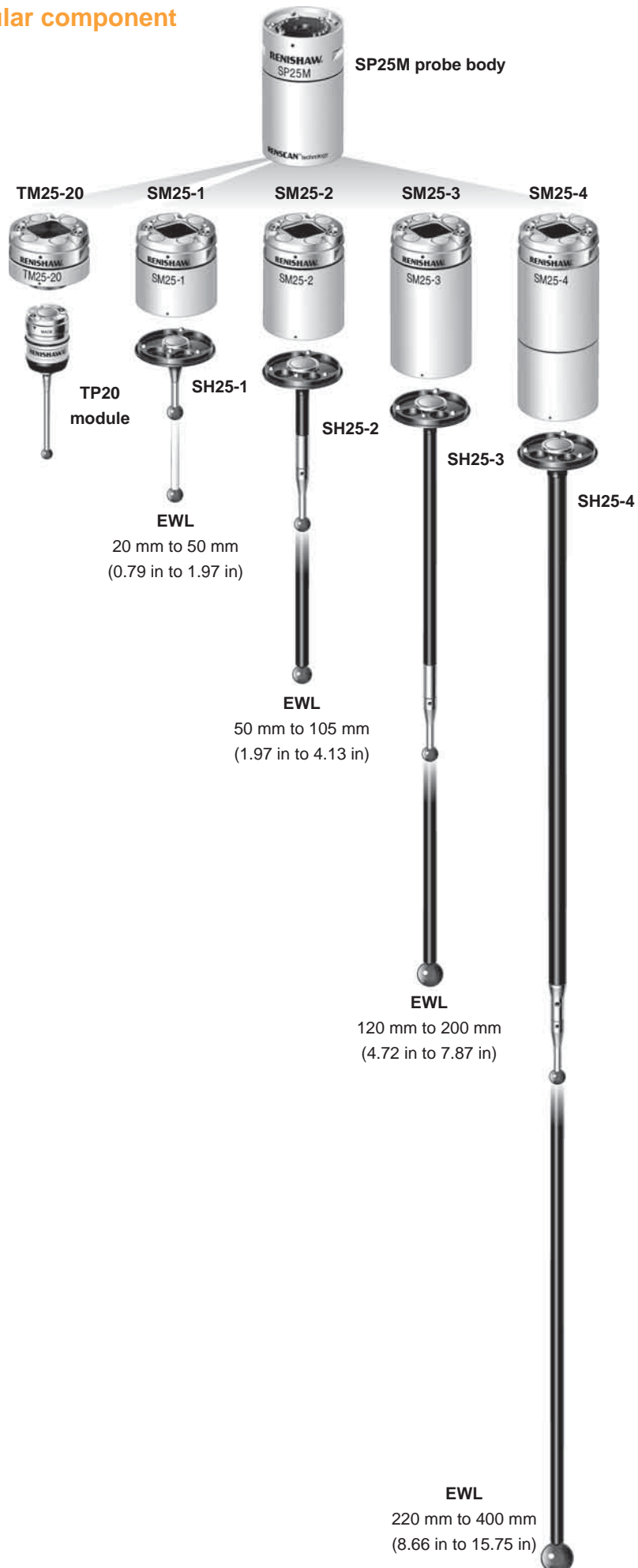


SM25-4 module can scan very deep features - shown here with 400 mm (15.75 in) stylus

SP25M features and benefits:

- The world's most compact and versatile scanning probe system
- Two sensors in one - a scanning probe, and a touch-trigger probe using TP20 stylus modules
- Rapid and repeatable interchange between highly modular system elements provides the most efficient solution to suit the measurement task
- Excellent scanning accuracy across the entire stylus range of 20 mm to 400 mm (0.79 in to 15.75 in)
- Can be used with extension bars up to 100 mm for even greater reach
- Probe can be mounted on an articulating head, allowing access to many features with fewer styli
- Ultra-compact at Ø25 mm (Ø0.98 in) for superior part accessibility
- Isolated optical metrology technology gives unrivalled measurement performance, even with long styli
- Flexible change rack where ports can be easily configured to carry any system element
- Bump-stop crash protection in the Z axis, together with a detachable stylus holder for XY crash protection
- Low-cost, entry level kits available with ability to easily expand the system

SP25M modular component system



The SP25M system components

The SP25M probe body, which houses the isolated optical metrology transducer system, has autojoint compatibility with Renishaw's PH10M/MQ, and PH6M probe heads, extension bars and ACR1/3 sensor changers.

A range of four scanning modules SM25-1/-2/-3/-4 has been designed to provide optimised scanning performance over their specified stylus length ranges. The SP25M's innovative pivot-action motion, and the isolated optical metrology approach, mean that excellent accuracy is achieved over the entire stylus length range of 20 mm to 400 mm (0.79 in to 15.75 in).

SH25-1/-2/-3/-4 stylus holders provide the flexibility to have multiple stylus set-ups for each scanning module. The detachable stylus holder is located on the scanning module using a repeatable magnetic kinematic joint. It provides automatic stylus changing capability and directly carries Renishaw's M3 stylus range.

It is also possible to carry Renishaw's TP20 range of touch-trigger probe modules by using the TM25-20 adaptor module mounted on the SP25M probe body.

Rapid and repeatable interchange between all system elements allows easy selection of best probe solution. This can be automated to maximise productivity by using the FCR25 flexible change rack.

The SP25M can be connected directly to the **UCC2** controller while a daughtercard permits use with Renishaw's UCC1 controller. The AC3 interface card allows integration with other controllers.

Using SP25M as a scanning probe:

The probe body has one of the four scanning modules attached (SM25-1/-2/-3/-4) which have matching stylus holders (SH25-1/-2/-3/-4). Each combination is optimised to maintain high accuracy and low contact forces over their dedicated range of effective stylus lengths. These are:

- SM25-1 + SH25-1 = 20 mm to 50 mm (0.79 in to 1.97 in) EWL
by use of 20 mm to 50 mm (0.78 in to 1.97 in) stylus
- SM25-2 + SH25-2 = 50 mm to 105 mm (1.97 in to 4.13 in) EWL
by use of 20 mm to 75 mm (0.78 in to 2.95 in) stylus
- SM25-3 + SH25-3 = 120 mm to 200 mm (4.72 in to 7.87 in) EWL
by use of 20 mm to 100 mm (0.79 in to 3.94 in) stylus
- SM25-4 + SH25-4 = 220 mm to 400 mm (8.66 in to 15.75 in) EWL
by use of 20 mm to 200 mm (0.79 in to 7.87 in) stylus

Using SP25M as a touch-trigger probe:

The probe body has the TM25-20 adaptor module attached, which directly carries any of Renishaw's TP20 range of stylus modules:

- TP20 LF/SF/MF/EF
- TP20 EM1/EM2
- TP20-6W

Interfacing options

SP25M can be integrated:

- directly using the **UCC2** controller (requires scanning upgrade)
- by using Renishaw's UCC1 controller (requires scanning upgrade) together with a SP25M/UCC1 daughtercard
- by using Renishaw's AC3 interface card (ISA Bus) within the machine builder's controller



**SP25M with
100 mm (3.94 in)
extension bar
between PH10
head and probe
body**



SP25M scanning



**SP25M taking
points with a TP20
module**

Automation using the FCR25 flexible change rack

The full potential of the SP25M system is realised when the measurement routine is automated using the FCR25 flexible change rack, a passive triple-port unit capable of storing any of the system elements.

The FCR25 port stores the SM25-1/-2/-3/-4 and TM25-20 modules, but can instantly be configured to store the SH25-1/-2/-3/-4 stylus holders or TP20 modules by using the appropriate port adaptor insert: PA25-SH (for SH25-1/-2/-3/-4) or PA25-20 (for TP20 modules).

The FCR25 mounts directly on Renishaw's MRS modular rack system for multiple port solutions (3, 6, 9, 12, 15 etc). Alternatively, there are the FCR25-L3 (3 port) and FCR25-L6 (6 port) stand-alone rack variants that are ideal where machine space is limited.

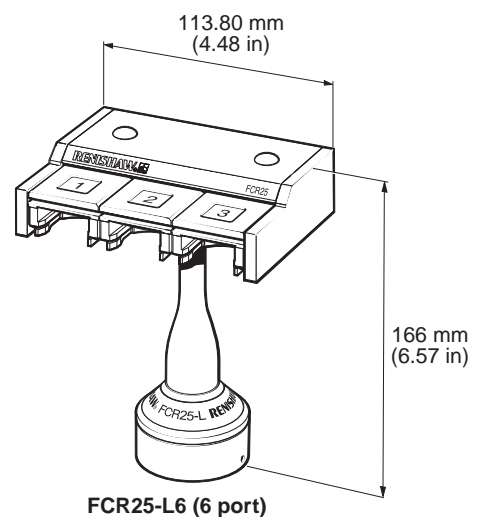
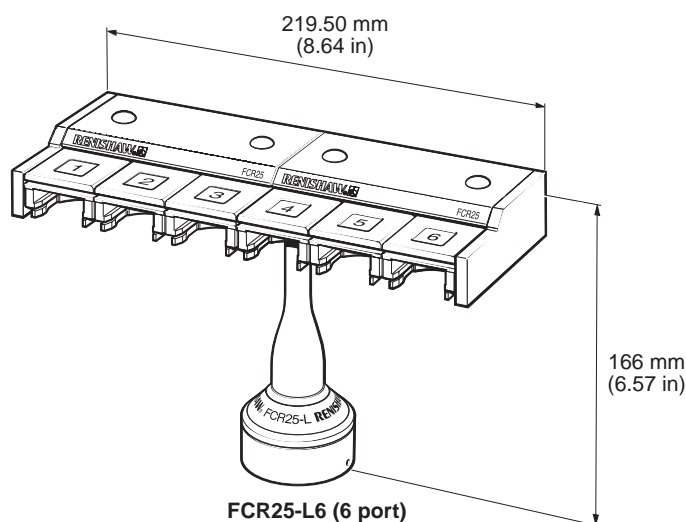
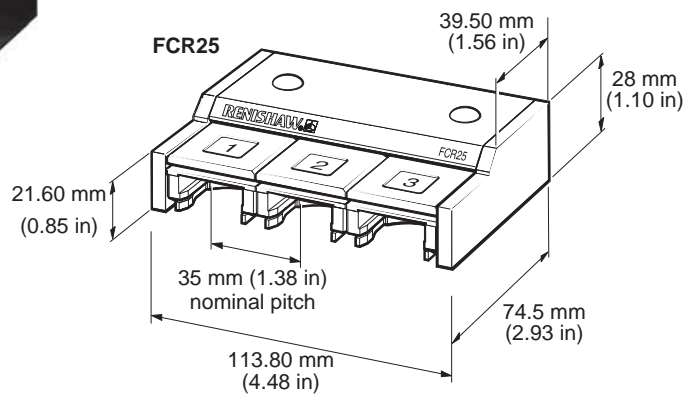
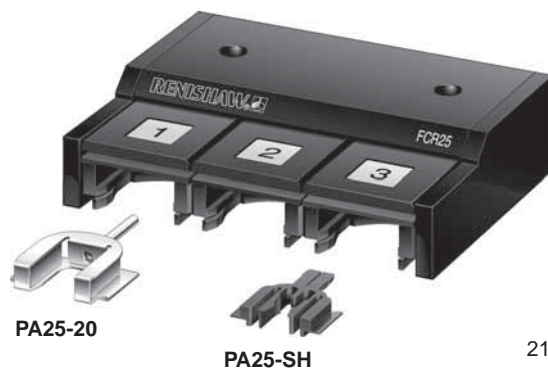


FCR25's mounted to the MRS



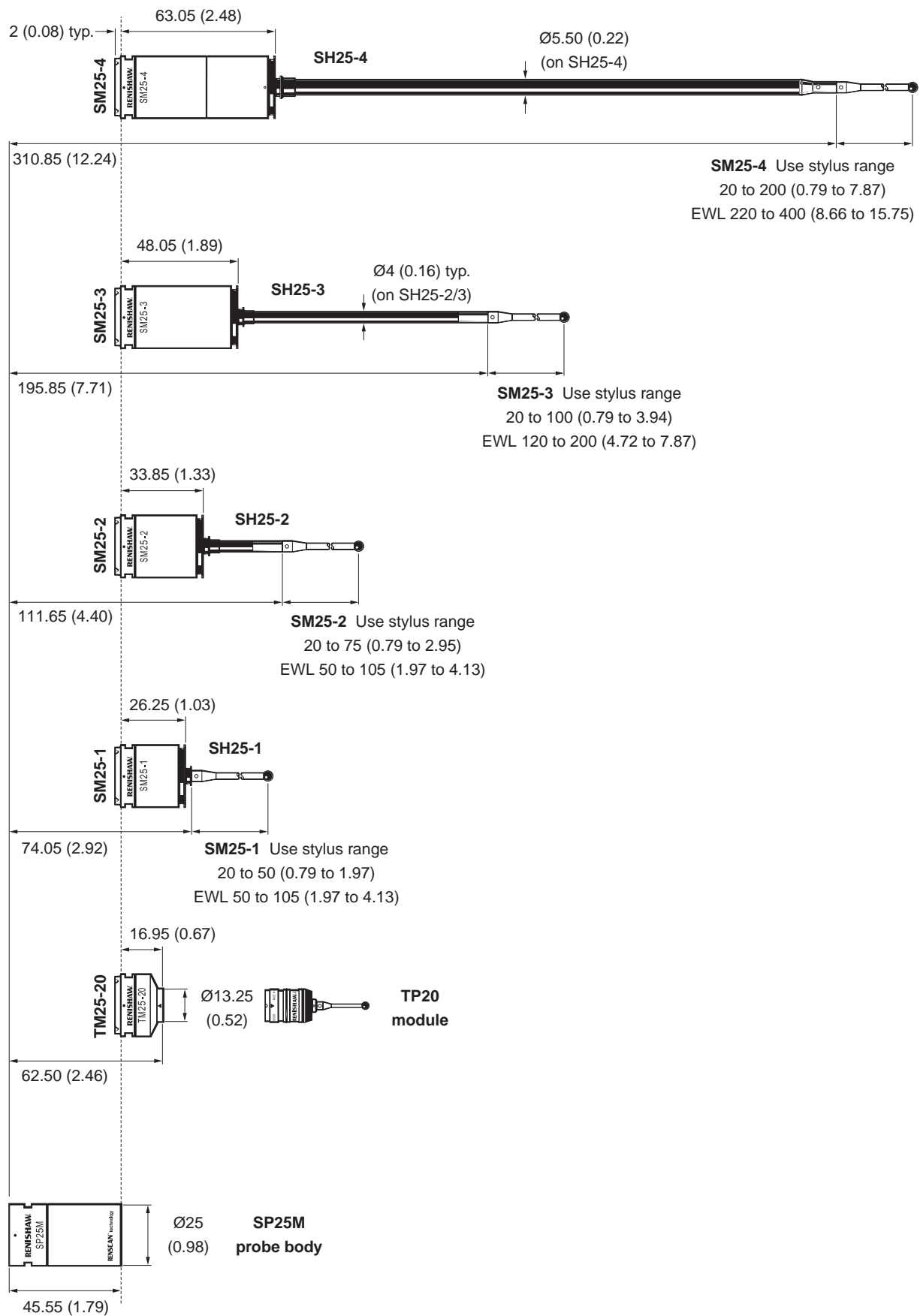
Probe maintenance

CK200 (Renishaw part number A-1085-0016) is a specialised cleaning material, for the removal of contamination from the location faces of the magnetically retained kinematic couplings of the TP20, TP200 and SP25M probe systems. The frequency of cleaning should be determined according to the conditions of use.



SP25M system component dimensions

dimensions mm (in)



Specification summary	SP25M												
PROBE ATTRIBUTES	Scanning with 3-axis measurement (X, Y, Z) Touch-trigger probing using TP20 modules *												
MEASUREMENT RANGE	±0.50 mm (0.02 in) deflection in all directions in all orientation												
OVERTRAVEL RANGE (nom)	X, Y = ±2 mm (±0.08 in) min, +Z = 1.70 mm (0.07 in), -Z = 1.20 mm (0.05 in)												
RESOLUTION	Capable of <0.10 µm (<0.00004 in)												
SPRING RATE	Nominally 0.60 N/mm - when using modules shortest specified stylus Nominally 0.20 N/mm - when using modules longest specified stylus												
PROBE DIMENSIONS	Ø25 mm x length dependent on module used (see schematic on previous page)												
WEIGHT	<table> <tr> <td>SP25M body</td><td>60 g (2.12 oz)</td></tr> <tr> <td>SM25-1 scan module</td><td>35 g (1.24 oz) including SH25-1 but excluding stylus</td></tr> <tr> <td>SM25-2 scan module</td><td>40 g (1.41 oz) including SH25-2 but excluding stylus</td></tr> <tr> <td>SM25-3 scan module</td><td>49 g (1.73 oz) including SH25-3 but excluding stylus</td></tr> <tr> <td>SM25-4 scan module</td><td>71 g (2.50 oz) including SH25-4 but excluding stylus</td></tr> <tr> <td>TM25-20 TTP module</td><td>40 g (1.41 oz) including TP20 SDT module but excluding stylus</td></tr> </table>	SP25M body	60 g (2.12 oz)	SM25-1 scan module	35 g (1.24 oz) including SH25-1 but excluding stylus	SM25-2 scan module	40 g (1.41 oz) including SH25-2 but excluding stylus	SM25-3 scan module	49 g (1.73 oz) including SH25-3 but excluding stylus	SM25-4 scan module	71 g (2.50 oz) including SH25-4 but excluding stylus	TM25-20 TTP module	40 g (1.41 oz) including TP20 SDT module but excluding stylus
SP25M body	60 g (2.12 oz)												
SM25-1 scan module	35 g (1.24 oz) including SH25-1 but excluding stylus												
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SM25-3 scan module	49 g (1.73 oz) including SH25-3 but excluding stylus												
SM25-4 scan module	71 g (2.50 oz) including SH25-4 but excluding stylus												
TM25-20 TTP module	40 g (1.41 oz) including TP20 SDT module but excluding stylus												
EFFECTIVE STYLUS LENGTH RANGE (Always observe the specified stylus range for the scanning module being used)	SM25-1 + SH25-1 = EWL 20 mm to 50 mm (0.79 in to 1.97 in) using 20 mm to 50 mm stylus SM25-2 + SH25-2 = EWL 50 mm to 105 mm (1.97 in to 4.13 in) using 20 mm to 75 mm stylus SM25-3 + SH25-3 = EWL 120 mm to 200 mm (4.72 in to 7.87 in) using 20 mm to 100 mm stylus SM25-4 + SH25-4 = EWL 220 mm to 400 mm (8.66 in to 15.75 in) using 20 mm to 200 mm stylus (Uses Renishaw's M3 range of styli)												
MOUNTING	Multiwired autojoint - compatible with PH10M/MQ and PH6M probe heads, extension bars and ACR1/3 sensor changers												
CRASH PROTECTION	±X, ±Y, -Z via break out of module or stylus holder +Z via integral bump-stop design												
SIGNAL OUTPUTS	Non-linear and non-orthogonal analogue outputs - rate, gain and resolution are not fixed												
POWER SUPPLY	+12 V (±5%), -12 V (+10 / -8*), 5 V (+10% / -13%) dc at probe												
PROBE CALIBRATION	Requires that a non-linear, third order polynomial calibration is used												
CHANGE RACK OPTIONS	<table> <tr> <td>FCR25</td><td>Triple port unit(s) which mount to MRS</td></tr> <tr> <td>FCR25-L3/6</td><td>3/6 port standalone racks</td></tr> </table>	FCR25	Triple port unit(s) which mount to MRS	FCR25-L3/6	3/6 port standalone racks								
FCR25	Triple port unit(s) which mount to MRS												
FCR25-L3/6	3/6 port standalone racks												
INTERFACE OPTIONS	Directly into UCC2 (requires scanning upgrade) or into the UCC1 using an SP25M/UCC1 daughtercard (scanning upgrade required) or AC3 interface card. Interface for TP20 also required if applicable (see page 3-6)												

* **NOTE:** Please refer to page 3-4 for TP20 specification information.



SP80 - ultra-high accuracy scanning probe

The SP80 is a passive scanning probe using digital scale and readheads which enable a system resolution of $0.02\text{ }\mu\text{m}$ (0.00000079 in). This gives exceptional scanning performance, even with long styli.

The SP80 can carry styli up to 800 mm (31.50 in) long and 500 g (17.64 oz) mass, including star configurations. Unbalanced star configurations do not require counterbalancing. Kinematic stylus holder changing allows for the repeatable re-location of the stylus, optimises stylus arrangements for each feature, and overcomes the need for re-qualification.

The SP80 has a kinematic mount that provides a repeatable connection to the mating plate mounted on the quill (KM80), allowing the probe to be easily removed.

Kinematic stylus holders provide crash protection in the XY plane, and a bump-stop prevents damage to the probe in the Z axis.

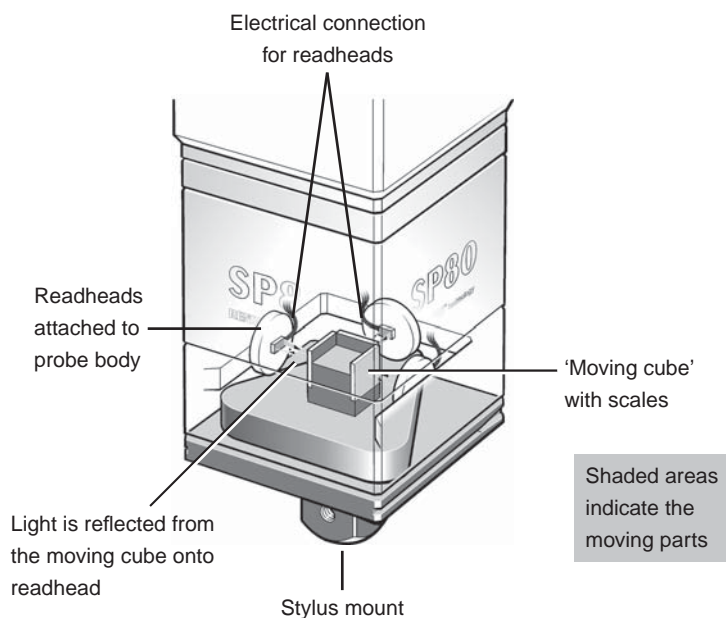
NOTE: Please see the accessories page 13-4 for details of adaptor plates PHA80 and PHA3 which permit rapid interchange between SP80 and PH10MQ indexing motorised head.

Isolated optical metrology system

Using an isolated optical metrology system, SP80 directly measures the deflection of the whole mechanism, thus providing outstandingly accurate position sensing.

The isolated optical metrology system can detect sources of variable error such as thermal and dynamic effects. In contrast, probes with displacement sensors mounted to stacked axes suffer from latency under changing inertial loads, and cannot detect thermal growth in their mechanisms.

The readheads for each axis are fixed to the body of the probe, and measure the deflection in each direction. Any inter-axis errors caused by the arc motion of each pair of parallel-acting springs are directly measured by the sensor system. Isolated optical metrology systems have no moving wire connections.



Isolated optical metrology

SP80 probe body

The sensor mechanism comprises an arrangement of three sets of parallel springs, one for each body axis, set in a cube - hence the body shape. The motion of the stylus is coupled to a 'moving cube' holding graduated reflective scales - again one for each axis. The readheads are mounted on the wall of the probe and the light projected from them is reflected from the moving scales. This method of motion detection does not require any form of moving wire connection.

Interface options

Interfacing the SP80 to a CMM can be achieved by:

- Using an SP80 daughtercard for direct UCC1 or **UCC2** integration
- Using a Renishaw PCI counter card (CC6) and the Renishaw interpolator unit IU80
- Using interface cards designed by the machine builder and used in conjunction with an IU80
- Using a counter card and interpolator unit designed by the machine builder

The IU80 conditions the probe signal to provide a digital industry standard EIA RS422 quadrature scale output, which can be accepted by CMM controllers.

Please contact Renishaw for full information on the methods detailed above.

KM80 quill mount

This is fixed to the quill and provides rapid and repeatable kinematic mounting of the SP80 body to the CMM.

SH80 stylus holder

The detachable stylus holder is located on the probe body using a repeatable kinematic joint and magnets. It provides automatic stylus changing capability and has an M5 stylus mount attachment. For additional flexibility, this may be rotated by adjusting a grub screw, and does not need to be removed from the probe body to make the adjustment.

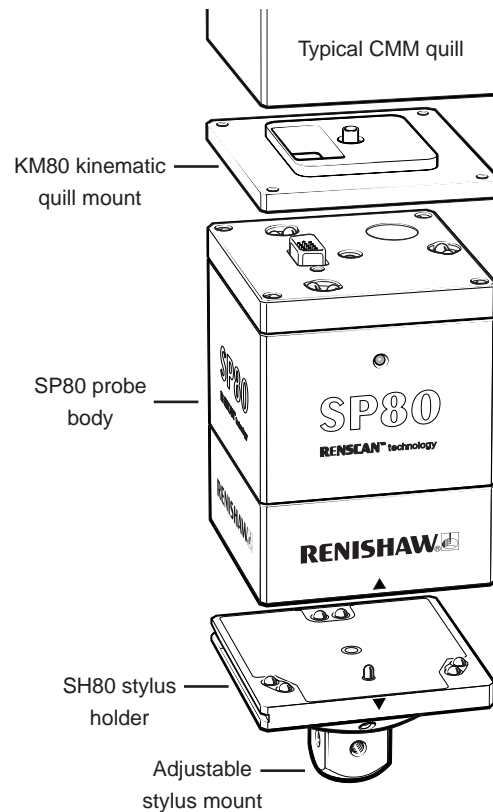
SCP80 stylus changing port

The SH80 stylus holder can be removed automatically and replaced on the probe body using an SCP80 mounted on a modular rack system (MRS). The SCP80 has a spring loaded mechanism which has been designed to ease the stylus holders away from the probe body. Using the SCP80, the SP80 pull-off force is reduced to less than 20 N.

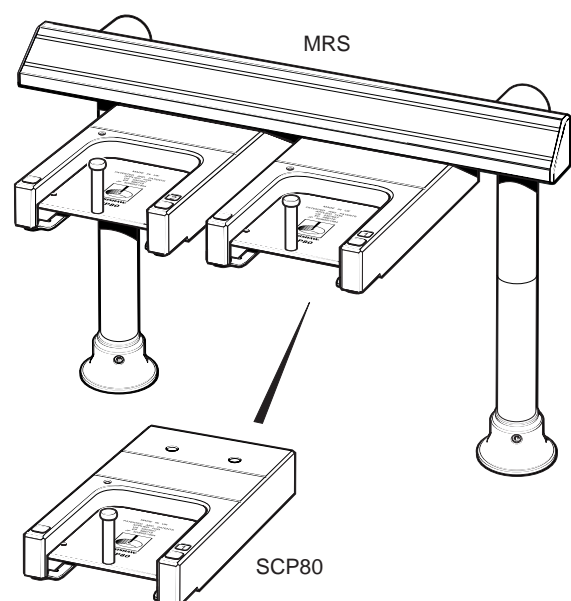
PHA3 and PHA80

The PHA3 and PHA80 adaptor plates enable rapid interchange between PH10MQ (using PHA3) and SP80 (using PHA80) on the same CMM.

SP80 probe kit

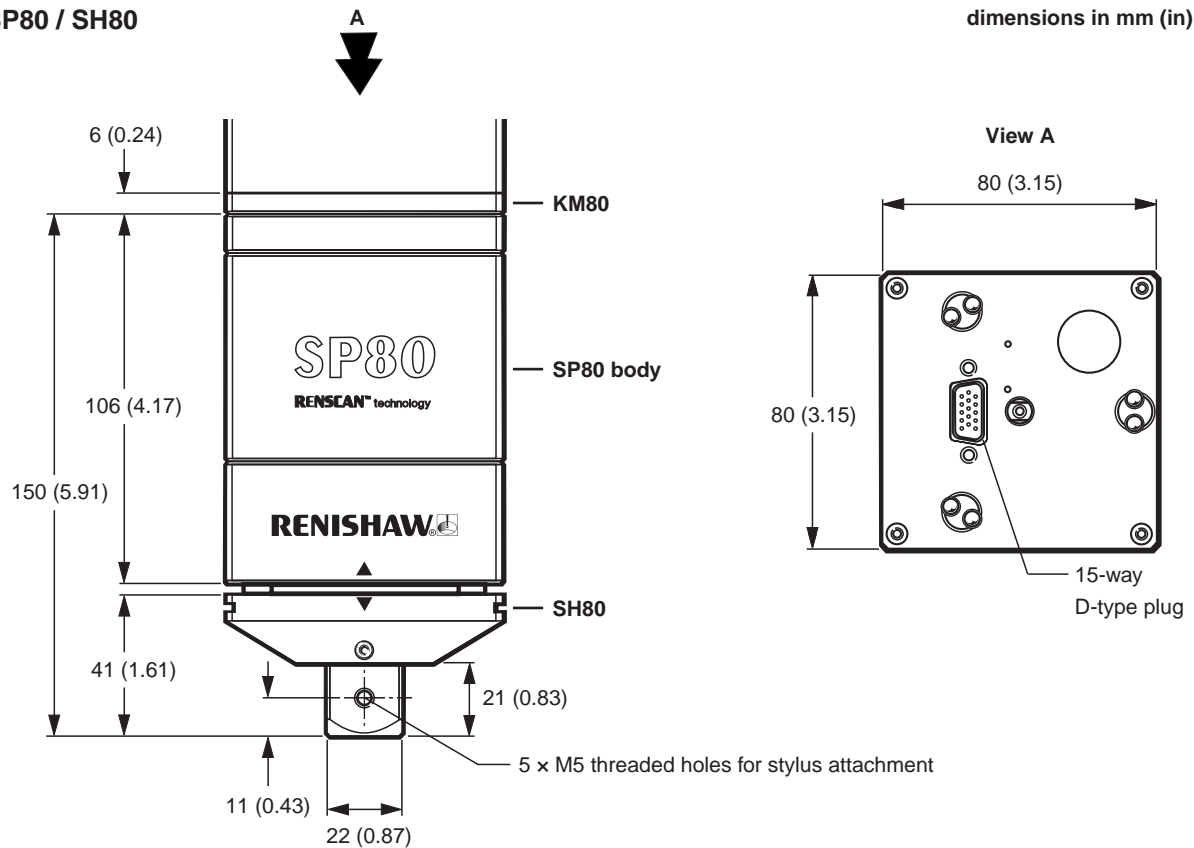


Two SCP80's mounted on an MRS

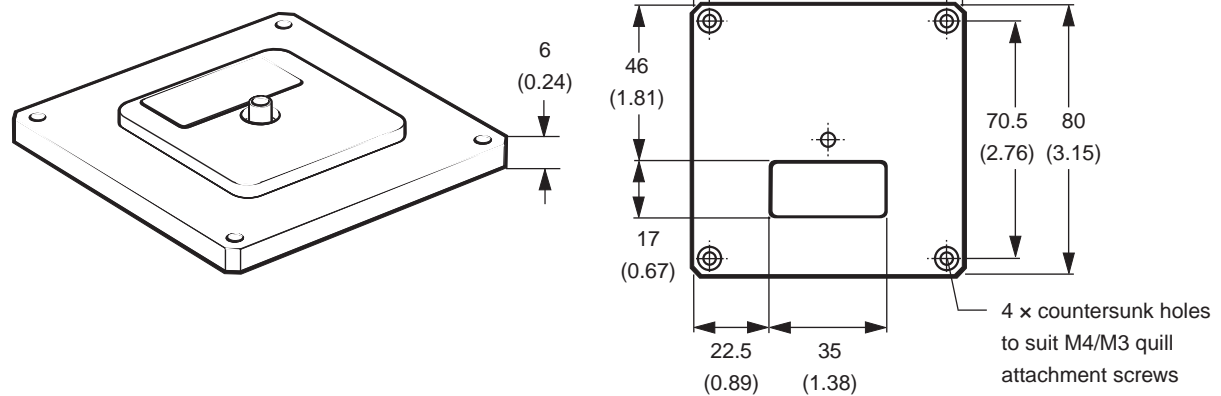


SP80 / SH80

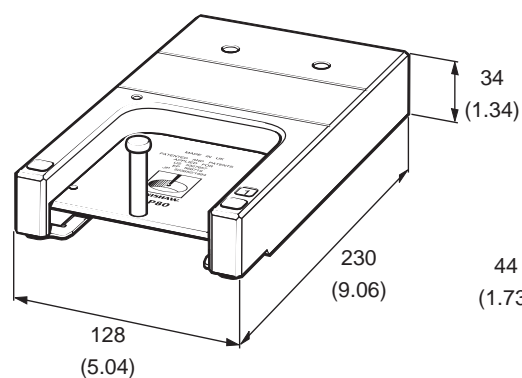
dimensions in mm (in)



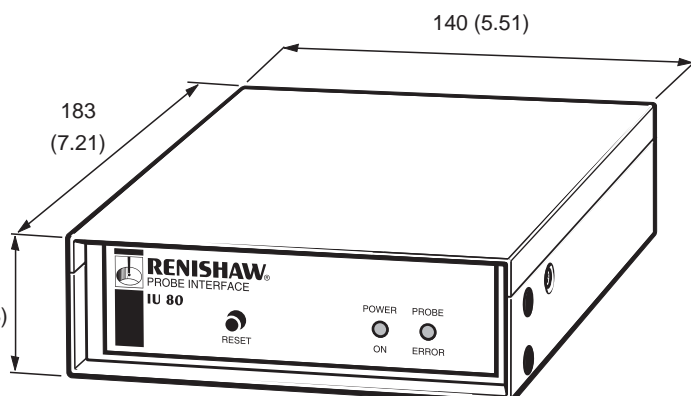
KM80



SCP80

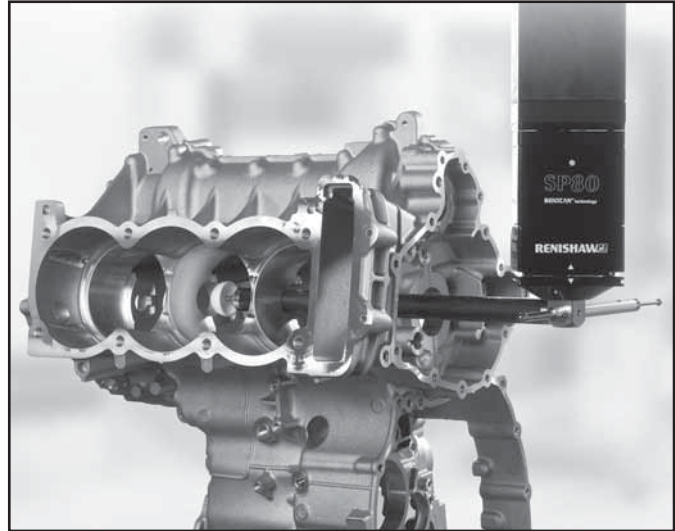


IU80



SP80 features and benefits:

- Ultra-high accuracy measurement, provided by digital scale and readheads
- Long styli carrying capability for access to deep features
- Isolated optical metrology for direct accurate measurement of stylus deflection
- Kinematic stylus changing for system flexibility
- Low inertia mechanism for excellent dynamic response
- Bump-stop crash protection in the Z axis, together with a detachable stylus holder for XY crash protection
- No motors, therefore improved thermal stability and reliability



Specification summary	SP80
PROBE ATTRIBUTES	Ultra-high accuracy scanning probe with 3-axis measurement (X, Y, Z)
ORIENTATION	Vertical
SIZE	80 mm (3.15 in) square body, 150 mm (5.91 in) long including stylus holder
QUILL MOUNTING	80 mm (3.15 in) kinematic quill mount (KM80) as standard Shank mount (SM80) and other custom made adaptor plates available - contact your nearest Renishaw supplier for details
MEASUREMENT RANGE	±2.50 mm (±0.10 in) X, Y, Z (3-axis measurement)
OVERTRAVEL RANGE	X and Y protected by a kinematic break-out joint on SH80 +Z has a mechanical 'bump-stop'
RESOLUTION OF SCALES	0.02 µm (0.0000007 in)
SPRING RATE	Approximately 1.8 N/mm (X, Y, Z)
WEIGHT	SP80: 860 g (30.34 oz) excluding mount and stylus holder SH80 stylus holder: 185 g (6.53 oz) KM80 quill mount: 110 g (3.88 oz)
PULL OFF FORCE OF MODULE	<20 N when using SCP80, otherwise approximately 80 N
PROBE POWER SUPPLY	+9 V to +18 V, maximum 300 mA dc
SYSTEM POWER SUPPLY (inc. IU80)	+5 V ±0.25 V @ 1 A maximum dc
SP80 PROBE OUTPUTS (X, Y, Z)	1.5 V ±0.25 V p-p. analogue quadrature signal (about 2.5 V ref.)
INTERFACING OPTIONS	The options are: <ul style="list-style-type: none"> • Using an SP80 daughtercard for direct UCC1 or UCC2 integration • Using a Renishaw PCI counter card (CC6) and the Renishaw interpolator unit (IU80) • Using an interface card designed by the machine builder and used in conjunction with an IU80 • Using a counter card and interpolator unit designed by the machine builder
CHANGE RACK SYSTEM	SCP80 single port unit(s) mounted to the MRS

SP600, SP600M and SP600Q scanning probes

The SP600 (shank mounting), SP600M (multiwired autojoint mounting) and SP600Q (fixed in-quill mounting) are highly reliable analogue probes which are ideal for profile scanning and measurement on CMMs.

The SP600 family of scanning probes allow large amounts of data to be rapidly gathered for inspection and digitising purposes. Axis movement in each direction (X, Y and Z) is ± 1 mm (± 0.04 in) (in all orientation positions on a PH10) and stylus lengths up to 300 mm (11.81 in) can be used with the SH600 EXT stylus holder.

The SH600 provides overtravel protection, and allows rapid and repeatable interchange between stylus configurations. This can be automated by using the SCR600 stylus change rack or alternatively, individual SCP600 stylus change ports mounted to a MRS.

The probe design gives an excellent self centring figure of $<5 \mu\text{m}$ (<0.0002 in); a measure of its ability to return to zero mechanically when not in contact with the part. This low figure, although irrelevant to the probe's accuracy, enables the use of small deflections and therefore low contact forces. The probe output always gives its precise position relative to the probe body.

Low mass, high structural stiffness and friction-free viscous damping give excellent dynamic performance characteristics.

SP600 probe

The SP600 allows simple fixed mounting via a Renishaw shank.

SP600M probe

The SP600M is mounted via an autojoint and can therefore be orientated by use with Renishaw's PH10M or PH10MQ motorised probe heads. Rapid interchange with other autojoint probes is possible by using a Renishaw ACR1 or ACR3 autochange rack system.

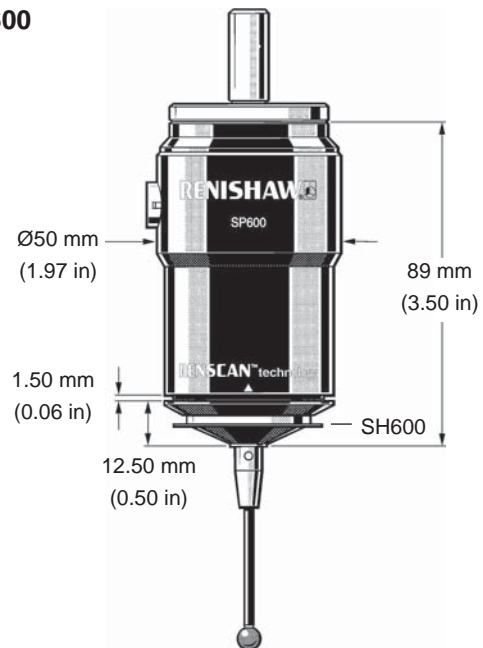


CAUTION: When using a SP600M with a PH10MQ a PEM25 extension bar is required to achieve $A = 97.5^\circ$ or $A = 105^\circ$ in all B axis positions.

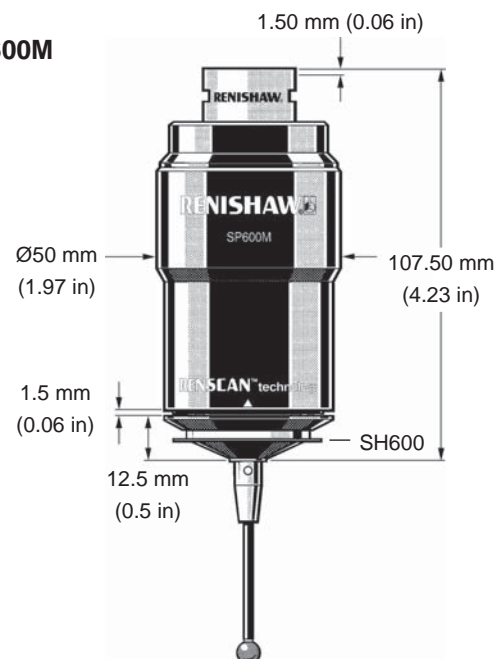
SP600Q probe

Compact in size, the SP600Q mounts directly onto the quill of the CMM. Together with the significant reduction in size, the SP600Q provides a more cost-effective scanning option to CMM users with small working area requirements.

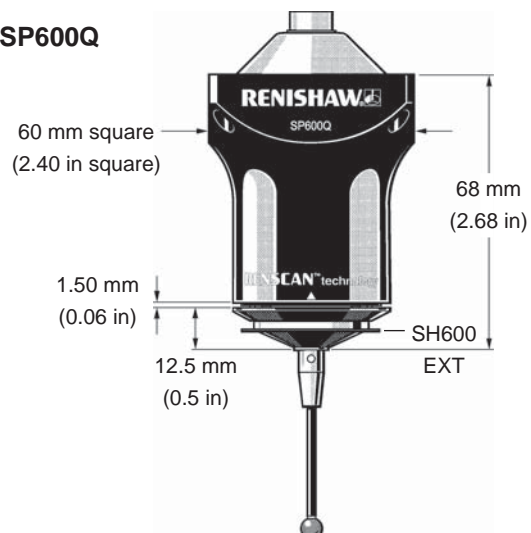
SP600



SP600M



SP600Q

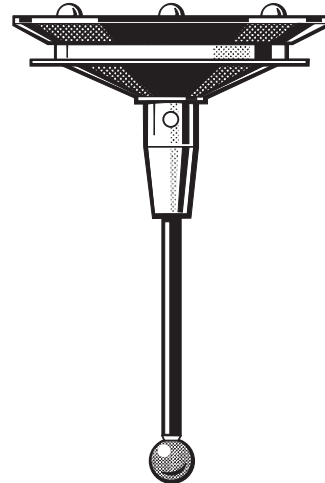


SH600 STD / SH600 EXT stylus holders

The SH600 stylus holder provides overtravel protection, and allows rapid and repeatable interchange between stylus configurations. This can be automated by using the SCR600 stylus change rack or, alternatively, individual SCP600 stylus change ports mounted on a MRS.

There are two variants, SH600 STD and SH600 EXT, the difference being the stylus carrying capacity. The STD can carry up to 200 mm (7.87 in) and the EXT up to 300 mm (11.81 in) long stylus.

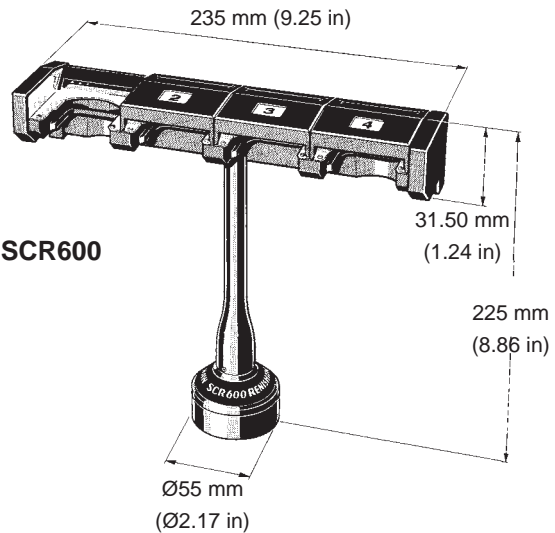
SH600



SCR600 stylus change rack

The SCR600 is a passive stylus change rack for use with the SP600 probe family, and requires no electrical connections. It is protected from overtravel (in the probe entry direction) by a mechanism in the base which can be manually reset. It houses up to four SH600 stylus holders per rack and any number of racks can be used in a system.

SCR600



SCP600 stylus change port

The SCP600 has passive operation like the SCR600 and mounts on the MRS. This allows flexibility for users to configure multiple ports, to suit the application.

MRS

SCP600 ports
mount to MRS



SCP600

SP600 family features and benefits:

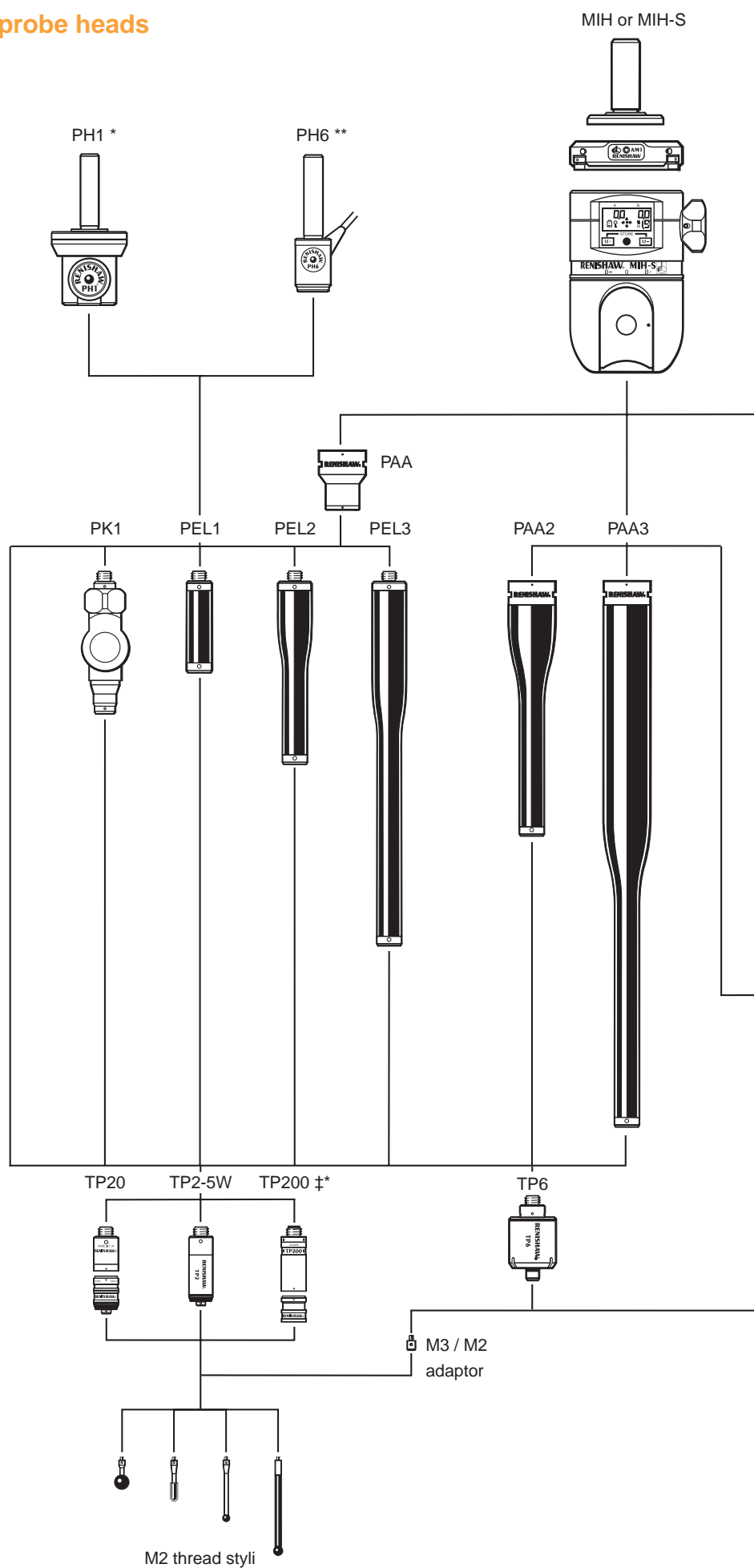
- High speed scanning up to 300 mm/s (11.81 in/s), fast point measurement and high frequency response
- Low probing forces give maximum application flexibility
- Three variants; SP600, SP600M and SP600Q allows the ideal probe match to suit the CMM
- Extremely robust design will withstand moderate collisions
- Fast interchange between stylus configurations permits the best solution for the application and increases productivity - automatic changing with either SCR600 or SCP600 mounted on MRS
- Compatible with Renishaw's autochange rack systems to allow changing between Renishaw's other probes fitted with an autojoint
- Excellent product life with a MTBF in excess of 50,000 hours gives low cost of ownership



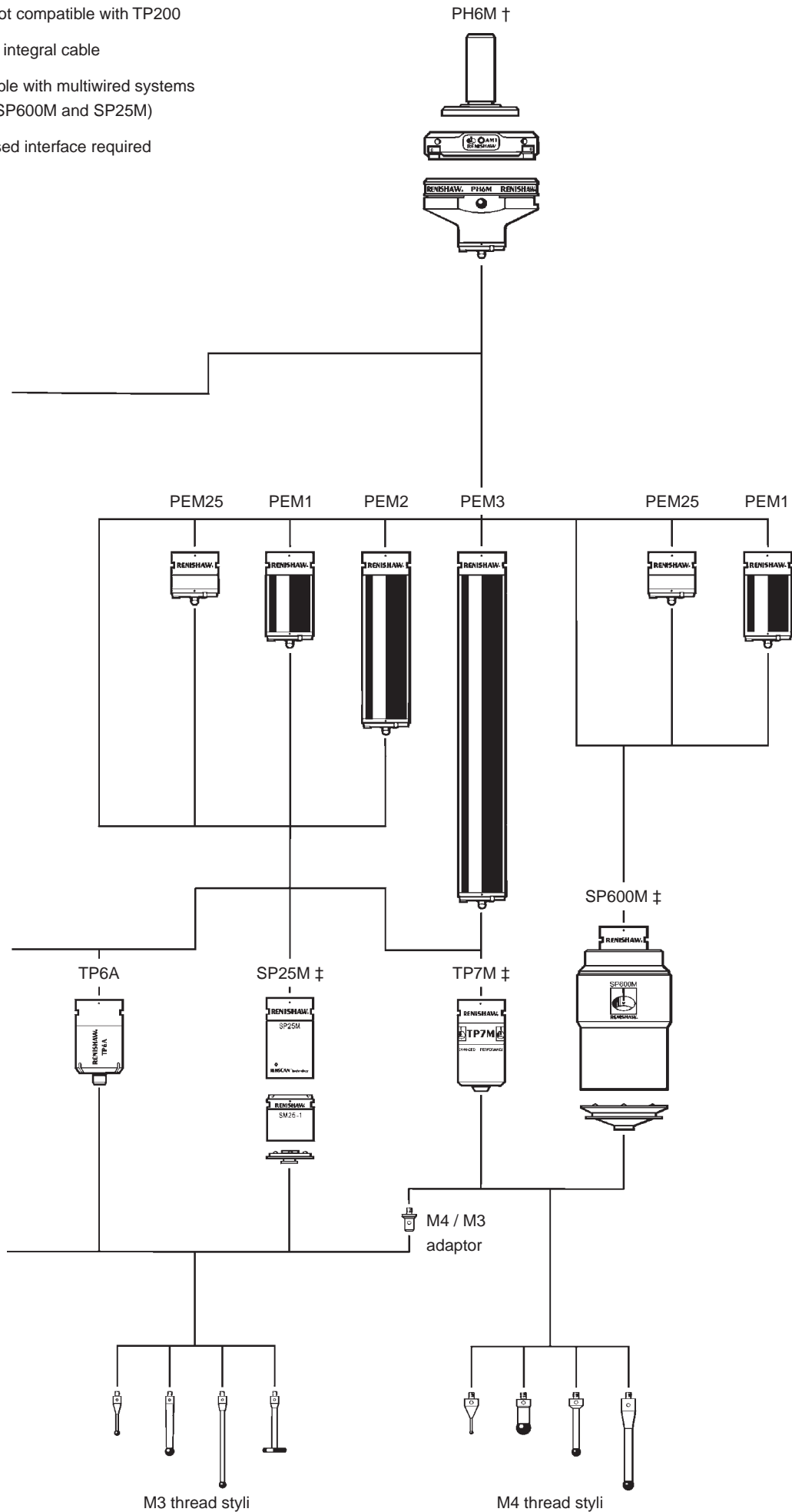
Specification summary		SP600, SP600M and SP600Q
PRINCIPLE APPLICATION		High speed, contact form scanning and fast point measurement applications
PROBE ATTRIBUTES		3-axis measurement X, Y, Z Linear and parallel motion in all axes
MEASUREMENT RANGE		± 1 mm (± 0.04 in) X, Y, Z in any attitude using a 300 mm (11.81 in) stylus
OVERTRAVEL RANGE		$\pm X$, $\pm Y$ and $+Z$ are protected by a kinematic break out joint on the SH600 $+Z$ is protected by a bump-stop design
RESOLUTION		0.1 μ m (0.000004 in) with optional AC2 interface design 1 μ m (0.00004 in) with optional AC1 interface card
SPRING RATE		1.2 N/mm (7.05 ozf) nominal (X, Y, Z)
STYLI	Thread	M4 standard range
	Length	200 mm (7.87 in) maximum using SH600 STD 300 mm (11.81 in) maximum using SH600 EXT
	Mass	20 g (0.7 oz) maximum
POWER SUPPLY		+12 V to -12 V, 5 V ($\pm 10\%$)
OUTPUTS (X, Y, Z)		Analogue proportional Voltage output scaling: 4 V/mm to 8.5 V/mm (dependant on stylus)
WEIGHT	SP600	172 g (6.07 oz) excluding stylus
	SP600M	216 g (7.62 oz)
	SP600Q	299 g (10.55 oz)
MOUNTING	SP600	Adaptors to suit clutch, shank adaptor or CMM shank
	SP600M	Multiwired autojoint
	SP600Q	Direct quill mounting to the CMM
SUITABLE INTERFACE		Directly to UCC or AC1 or AC2 interface cards (ISA bus)
CHANGING RACK OPTIONS		SCR600 4 port rack SCP600 single port unit(s) mounted to the MRS



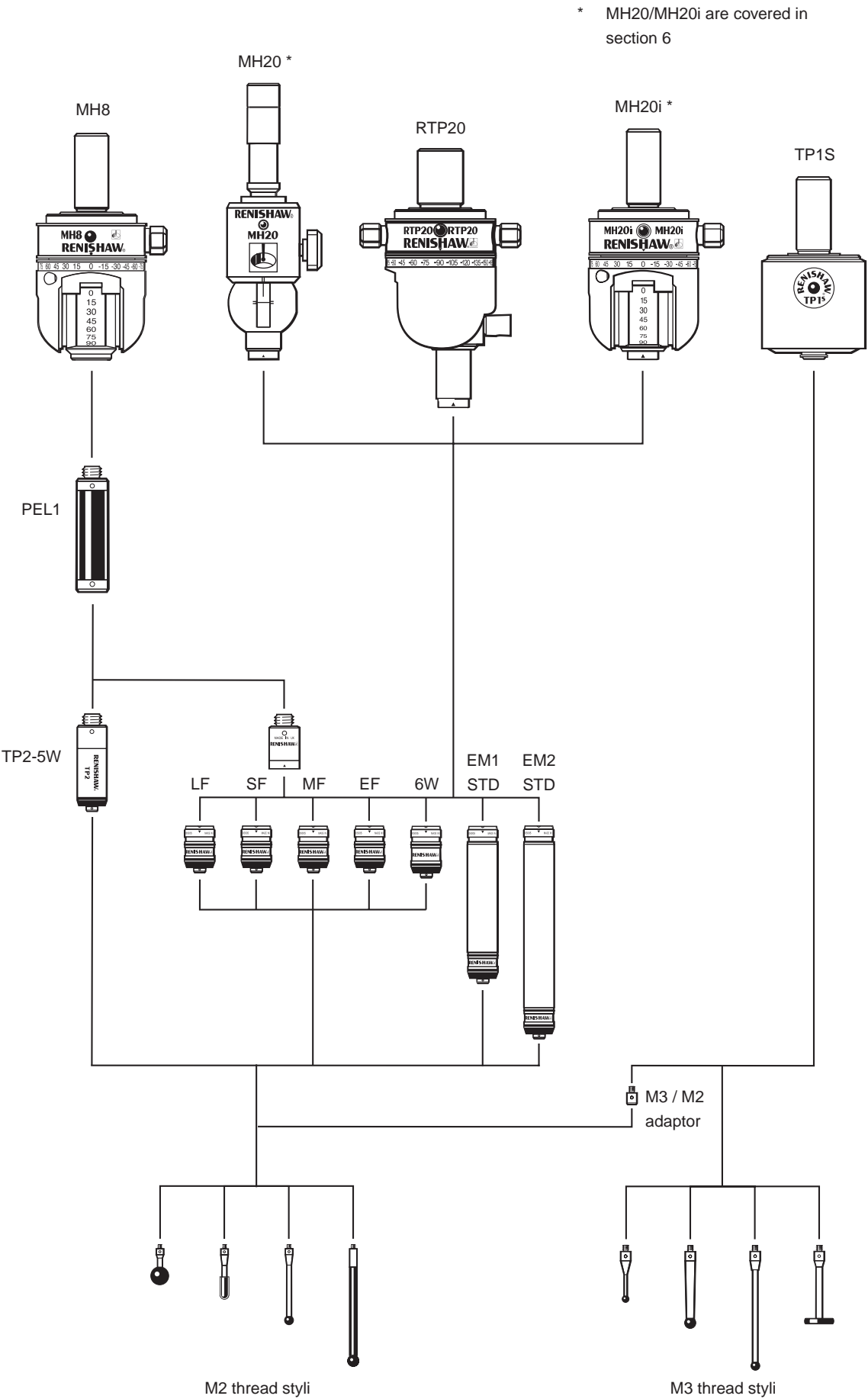
Manual probe heads



- * PH1 is not compatible with TP200
- ** PH6 has integral cable
- † Compatible with multiwired systems (TP7M, SP600M and SP25M)
- ‡ Specialised interface required



Probing systems for
co-ordinate measuring machines



* MH20/MH20i are covered in
section 6

MIH manual indexing probe head

The MIH is a versatile manual indexing probe head. It has programmable indexing positions using 7.5° increments and has an autojoint probe mount for fast repeatable probe changing. These features can increase the productivity of a manual CMM.

MIH-S manual indexing probe head

The MIH-S is an enhanced version of the MIH which enables the feedback of positional status to the PC over an RS232 serial communication link, via the MIH-SI interface.

This enables the CMM computer to:

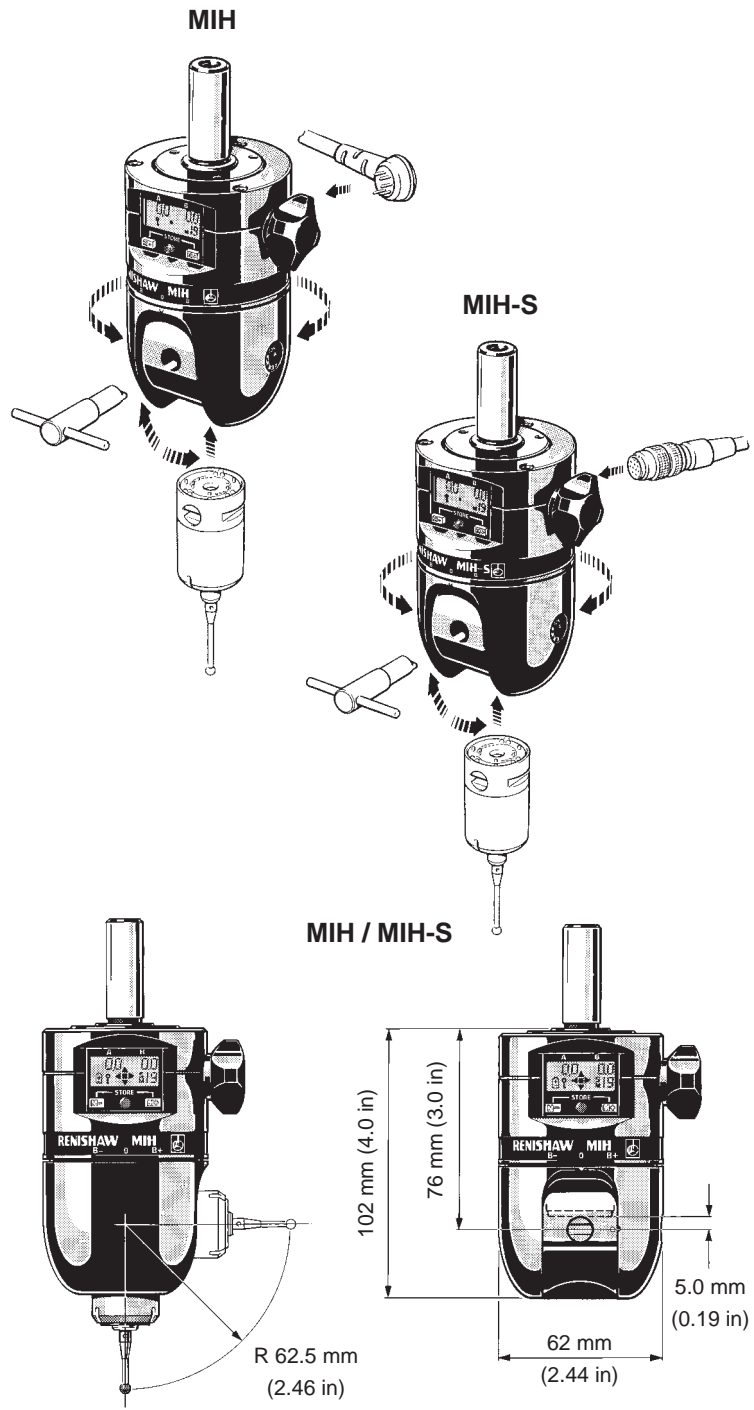
- Verify that the MIH-S has been moved to the correct position and locked into place.
- Identify the locked position of the MIH-S.

Measurement performance, functionality and dimensions are the same as for the MIH.

MIH features and benefits:

- Repeatable indexing in 720 positions
- An integral LCD enables easy programming of probe orientation positions
- 20 probe positions can be memorised
- Compatible with most Renishaw probes (excluding all multiwire e.g. TP7M)
- Capable of carrying up to 300 mm (11.81 in) extension for deep part measurement

Please refer to page 5-1 for probe compatibility information



Specification summary	MIH and MIH-S	
HEAD MOUNTING	Shank to suit CMM (MS range)	
PROBE MOUNTING	Autojoint (i.e. there is no multiwire capacity)	
PROBE STATUS INDICATION	LED	
CABLE CONNECTION	MIH - 5-pin DIN 180° socket	MIH-S - 12-pin Hirose
A AXIS INDEXING	0° to 105° in 7.5° steps = 15 positions	
B AXIS INDEXING	±180° in 7.5° steps = 48 positions	
WEIGHT	580 g (20.45 oz)	
REPEATABILITY OF POSITION (2σ)	1 μm (0.00004 in) when used with a TP6A and 21 mm (0.83 in) stylus	
MAXIMUM EXTENSION BAR	300 mm (11.81 in)	
MAXIMUM RECOMMENDED TORQUE	0.45 Nm	
SUITABLE HEAD INTERFACE	PI 4-2, PI 200 or PI 7-2	
MIH-S HEAD INTERFACE	Uses MIH-SI interface (RS232 communication)	

Probing systems for co-ordinate measuring machines

MH8 manual indexing probe head

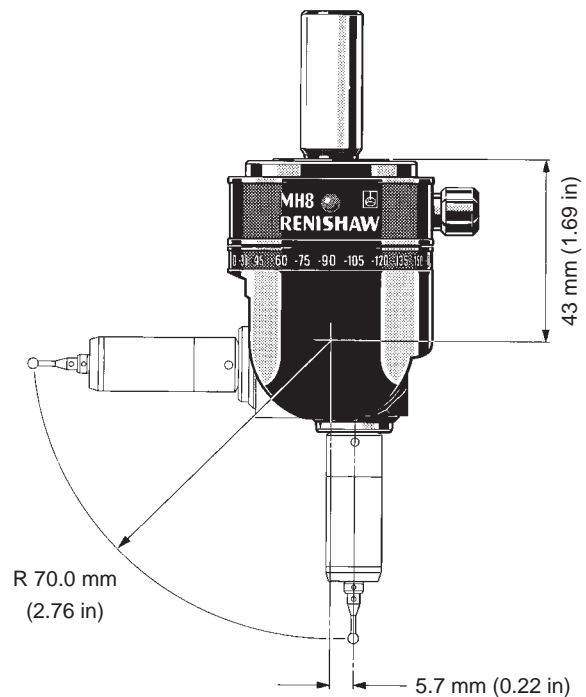
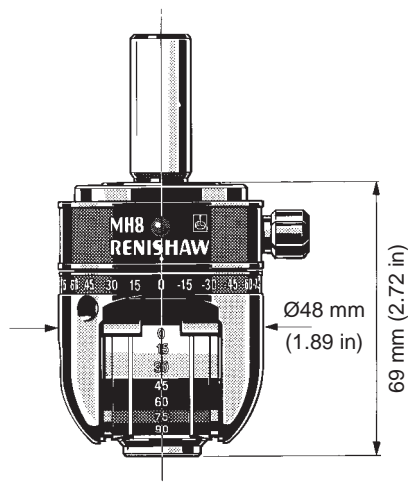
The MH8 is a compact, indexing probe head that is designed for use on small manual CMMs.

It is compatible with TP20, TP6 and TP2 probes.

MH8 features and benefits:

- Universal M8 thread for probe connection
- Repeatable indexing in 168 positions
- The CMM operator need only qualify the required probe positions once during set up
- 50 mm (1.97 in) probe extension bar can be fitted to extend measurement capability

Please refer to page 5-3 for probe
compatibility information



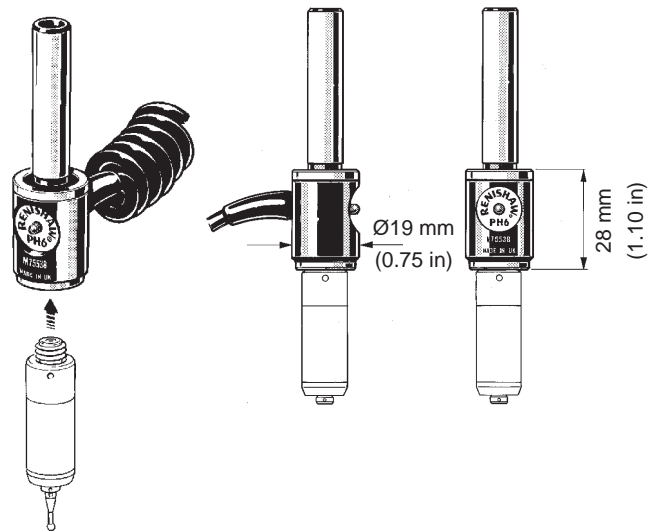
Specification summary	MH8
HEAD MOUNTING	Shank to suit CMM (MS range)
PROBE MOUNTING	M8 thread
PROBE STATUS INDICATION	1 LED
CABLE CONNECTION	5-pin DIN 180° socket
A AXIS INDEXING	0° to 90° in 15° repeatable steps = 7 positions
B AXIS INDEXING	±180° in 15° repeatable steps = 24 positions
WEIGHT	205 g (7.23 oz)
REPEATABILITY OF POSITION (2σ)	1.5 µm (0.00006 in) TP2 and 10 mm (0.39 in) stylus fitted
MAXIMUM EXTENSION BAR	50 mm (1.97 in) PEL1 only
SUITABLE HEAD INTERFACE	PI 4-2, PI 200

PH6 fixed probe head

A compact, vertical probe head with a mount for M8 thread probes.

PH6 features and benefits:

- Universal M8 thread for probe connection
- Shank mounted
- Integral cable
- Simple to fit to a CMM

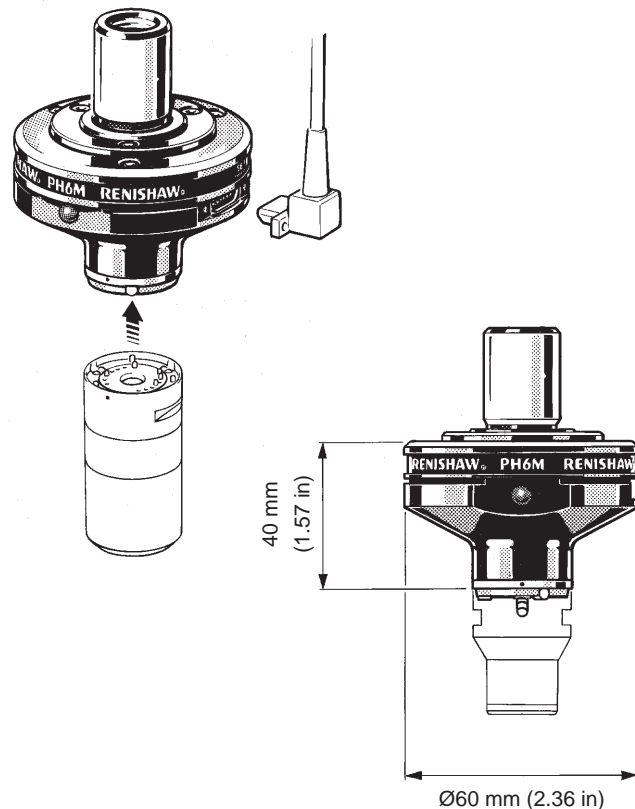


PH6M fixed probe head

The PH6M is the multiwired version of the PH6 and is fitted with an autojoint.

PH6M features and benefits:

- Fixed, vertical probe head
- Autojoint for fast, repeatable probe changing
- Compatible with the complete Renishaw multiwire probe range and standard probes with autojoint adaptors and extension bars



Please refer to page 5-1 and 5-2 for probe compatibility information

Specification summary	PH6	PH6M
HEAD MOUNTING	Shank to suit CMM (MS range)	Shank to suit CMM (MS range)
PROBE MOUNTING	M8 thread	Autojoint (full multiwire capability)
PROBE STATUS INDICATION	1 LED	1 LED
CABLE CONNECTION	Hard-wired 5-core cable	Micro 'D' connector for multiwire cable fitment
WEIGHT	48 g (1.69 oz)	160 g (5.64 oz)
REPEATABILITY OF POSITION (2σ)	n/a	1 μm (0.00004 in) at 50 mm (1.97 in) from autojoint
SUITABLE HEAD INTERFACE	PI 4-2, PI 200	PI 4-2, PI 200, PI 7-2

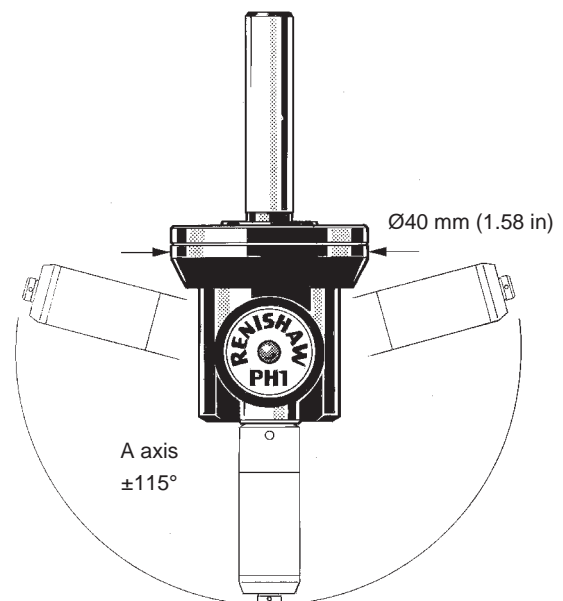
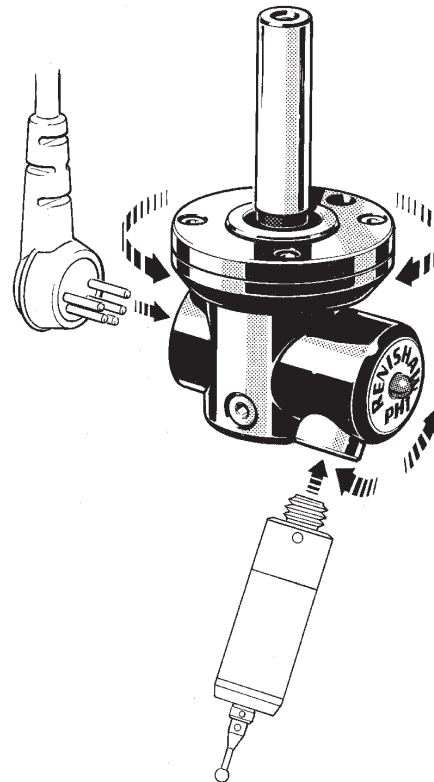
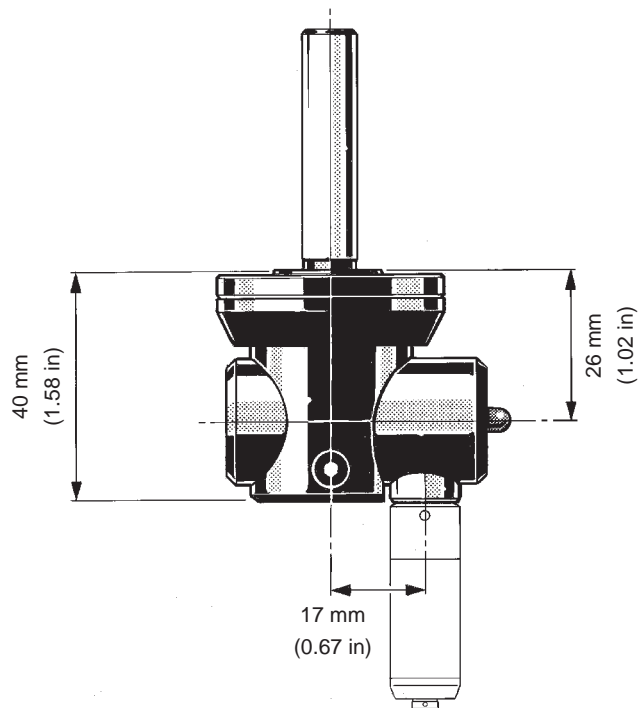
PH1 manual articulating probe head

A manual probe head with non-repeatable indexing in the B axis and $\pm 115^\circ$ rotation in the A axis. The probe is shank mounted to the CMM.

PH1 features and benefits:

- Adjustable in both the A and B axes
- Limited overtravel protection
- M8 thread probe mount that is offset from the mounting shank Z axis

Please refer to page 5-1 for probe
compatibility information



Specification summary	PH1
HEAD MOUNTING	Shank to suit CMM (MS range)
PROBE MOUNTING	M8 thread (excluding TP200)
PROBE STATUS INDICATION	1 LED
CABLE CONNECTION	5-pin DIN 180° socket
OVERTRAVEL BREAK LOAD	Adjustable from 0.2 N to locked solid
A AXIS ARTICULATION	Swivel of $\pm 115^\circ$ locked with hexagonal key (3 mm A/F)
B AXIS INDEXING	15° steps through 360° (non-repeatable)
WEIGHT	125 g (4.41 oz)
SUITABLE HEAD INTERFACE	PI 4-2

* Excluding shank and cable

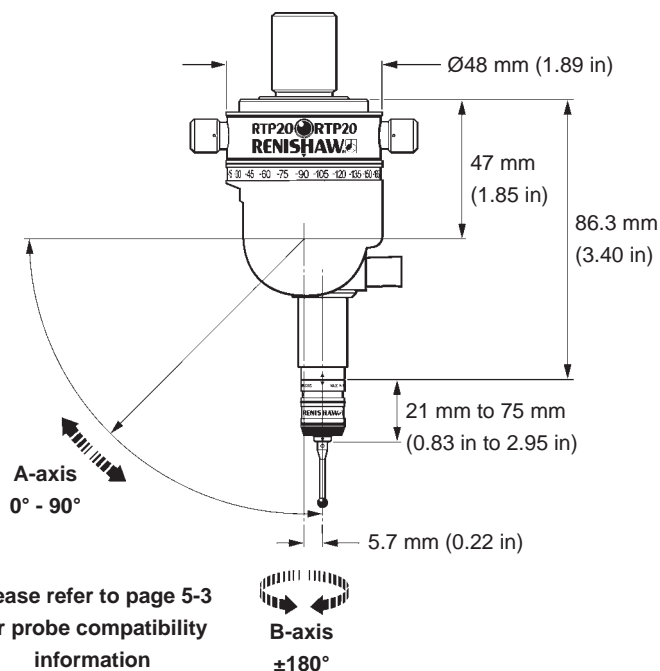
RTP20 indexing head with integral TP20 touch-trigger probe

The RTP20 probe head allows the integral TP20 probe to be moved to 168 repeatable positions in 15-degree increments using both A and B axes, requiring a one-time qualification for each stylus tip position. This eliminates the need for costly time consuming requalification routines, ensuring fast throughput for part inspection.

Automated indexing of the RTP20 probe head is realised through an innovative process which uses the motion of a CMM to achieve 'motorised' head style operation.

An RTP20 integral TP20 probe mount optimises the working volume of the CMM and provides compatibility with all existing TP20 modules. Although modules can be changed manually, the RTP20 can be used with the MCR20 module change rack to allow fully automated module changing.

The RTP20 can be installed on new and existing measuring machines via a shank mounting, involving just the initial qualification of each measuring position and stylus combination.



RTP20 features and benefits:

- Improved productivity is achieved via probe module changing and automated indexing, without the need for constant requalification.
- A built-in extension together with existing extension bars allow reach up to 168 mm (including maximum stylus length).
- Utilising the CMM motion to lock, unlock and orientate the head, together with the MCR20, provides a fully automated system.
- TP20 modules have overtravel in all directions. The magnetic mounting provides additional crash protection in X and Y.

Specification summary	RTP20
HEAD MOUNTING	Shank to suit CMM (MS range)
PROBE MOUNTING	TP20 kinematic
POSITIONAL REPEATABILITY (2σ)	1.5 µm (0.00006 in) at stylus tip with TP20 SF stylus module and 10 mm (0.39 in) styli 2.5 µm (0.0001 in) at stylus tip with TP20 EM2 stylus module and 20 mm (0.78 in) styli
PROBE STATUS INDICATION	1 LED
CABLE CONNECTION	5-pin DIN 180° socket
A AXIS INDEXING	0° to 90° in 15° repeatable steps = 7 positions
B AXIS INDEXING	±180° in 15° repeatable steps = 24 positions
MAXIMUM LOAD	EM2 extended module - 94.5 mm (3.72 in)
WEIGHT (without shank)	208 g (7.34 oz)
OPERATING TEMPERATURE RANGE	10 °C to 40 °C (50 °F to 104 °F)
STORAGE TEMPERATURE RANGE	-10 °C to +70 °C (14 °F to 158 °F)
SUITABLE PROBE INTERFACE	Standard touch-trigger interface

MH20 manual articulating probe head with integral TP20 module mount

The MH20 is a compact probe head with fully adjustable orientation.

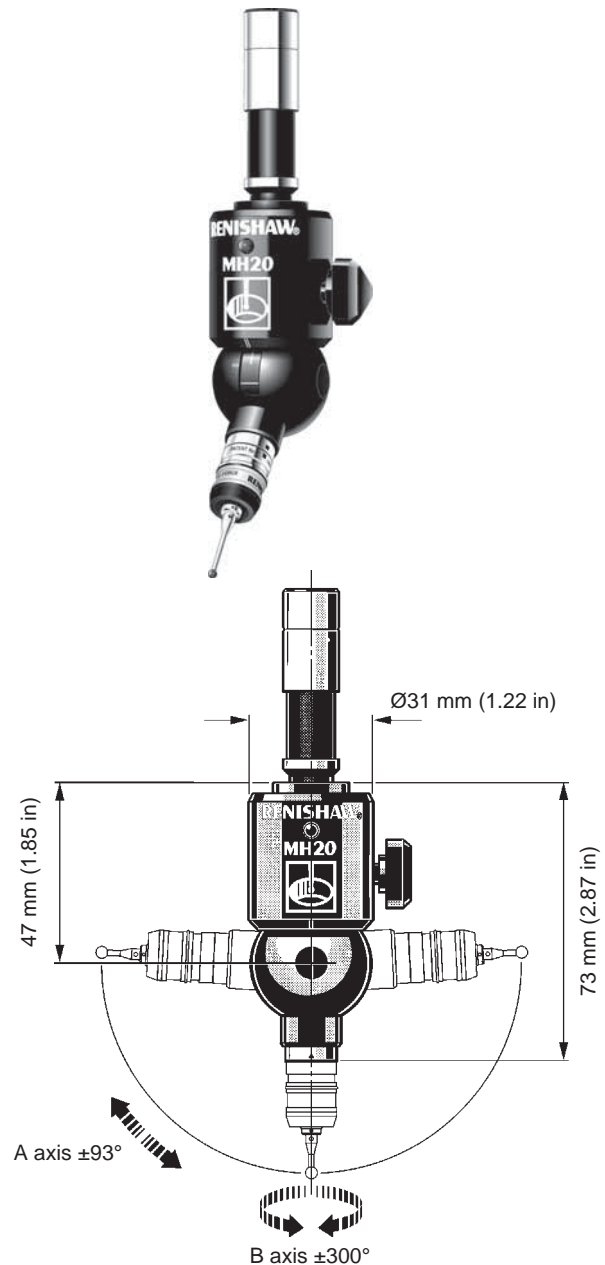
The integral TP20 kinematic stylus module mount enables repeatable stylus module changing, without the need for re-qualification, providing head adjustment has not taken place. It is compatible with the full range of TP20 stylus modules, which comprises 5-way module versions with either length or trigger force options, plus a 6-way module. Multiple stylus configurations are easily interchanged allowing quick and easy access to work piece features.

The head is pre-mounted with a customer-specified shank to suit the CMM and features a red LED which indicates probe status.

MH20 features and benefits:

- Fast repeatable stylus module changing to improve productivity
- Ultra compact design that maximises CMM working volume
- Infinite positioning within the range of the head to optimise access to complex parts.
- TP20 compatibility ensures a wide range of stylus configurations are easily interchanged enhancing flexibility

Please refer to page 5-3 for probe compatibility information



Specification summary	MH20
HEAD MOUNTING	Shank to suit CMM (MS range)
PROBE MOUNTING	TP20 kinematic
PROBE STATUS INDICATION	1 LED
CABLE CONNECTION	5-pin DIN socket
RANGE OF ARTICULATION	A axis $\pm 93^\circ$ B axis $\pm 300^\circ$
MAXIMUM LOAD	EM2 extended module - 94.5 mm (3.72 in)
WEIGHT (without shank)	100 g (3.53 oz)
DUAL AXES LOCK	Single rotary thumbwheel
OPERATING TEMPERATURE RANGE	10 °C to 40 °C (50 °F to 104 °F)
STORAGE TEMPERATURE RANGE	-10 °C to +70 °C (14 °F to 158 °F)
SUITABLE PROBE INTERFACE	PI 4-2

NOTE: The MH20 is compatible with the MSR1 module storage rack, but not with the MCR20 module change rack.

MH20i manual indexing probe head with integral TP20 module mount

The MH20i is a manual probe head with 2-axis adjustable indexing. Compact in design, it features an integral TP20 kinematic mount that enables repeatable stylus module changing without the need for re-qualification.

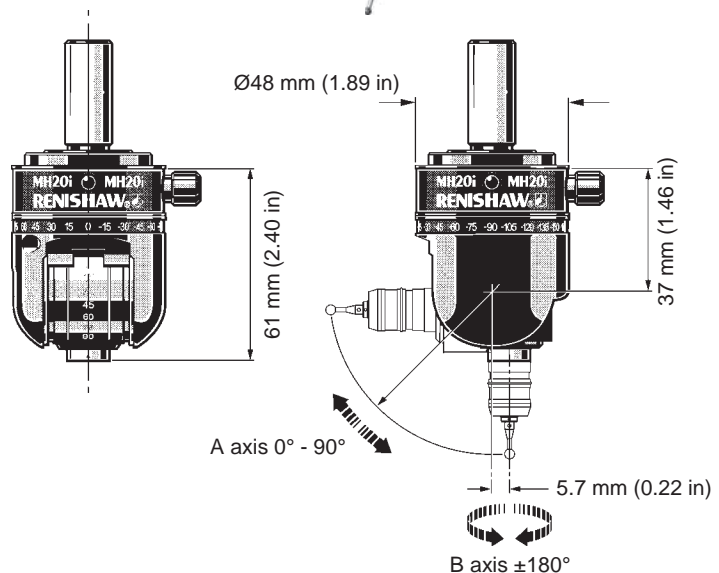
The MH20i offers 168 repeatable index positions which are set at 15° increments to maximise flexibility and productivity. Easy to read scales permit rapid re-orientation to pre-qualified positions, and its lock/unlock feature allows ease of positioning and eliminates unnecessary wear.

It is compatible with the full range of TP20 stylus modules, which comprises 5-way module versions with either length or trigger force options, plus a 6-way module. Multiple stylus configurations are easily interchanged allowing quick and easy access to work piece features.



MH20i features and benefits:

- Enhanced inspection capability from adjustable probe orientation with 168 repeatable index positions set at 15° increments
- Repeatable TP20 stylus module changing in each pre-qualified position without the need for re-qualification significantly enhances productivity
- TP20 compatibility, providing a wide range of force and length options to optimise machine performance and access capability
- Easy-to-read scales allow rapid re-orientation



Please refer to page 5-3 for probe compatibility information

Specification summary	MH20i
HEAD MOUNTING	Shank to suit CMM (MS range)
PROBE MOUNTING	TP20 kinematic
POSITIONAL REPEATABILITY (2σ)	1.5 μm (0.00006 in) at stylus tip with TP20 SF stylus module and 10 mm (0.39 in) styli 2.5 μm (0.0001 in) at stylus tip with TP20 EM2 stylus module and 20 mm (0.78 in) styli
PROBE STATUS INDICATION	1 LED
CABLE CONNECTION	5-pin DIN socket
A AXIS INDEXING	0° to 90° in 15° repeatable steps = 7 positions
B AXIS INDEXING	±180° in 15° repeatable steps = 24 positions
MAXIMUM LOAD	EM2 extended module - 94.5 mm (3.72 in)
WEIGHT (without shank)	210 g (7.41 oz)
MOUNTING	MS range of shanks
DUAL AXES LOCK	Single lock lever
OPERATING TEMPERATURE RANGE	10 °C to 40 °C (50 °F to 104 °F)
STORAGE TEMPERATURE RANGE	-10 °C to +70 °C (14 °F to 158 °F)
SUITABLE PROBE INTERFACE	PI 4-2

NOTE: The MH20i is compatible with the MSR1 module storage rack, but not with the MCR20 module change rack.

Probing systems for co-ordinate measuring machines

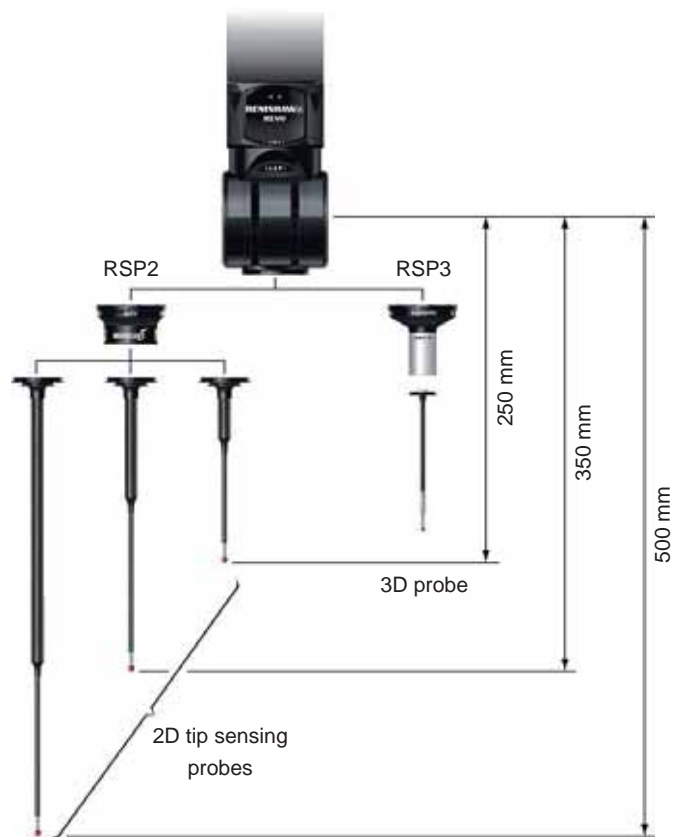
REVO™

The REVO™ measuring head features spherical air bearing technology in each of its two axes, driven by brushless motors linked to high-resolution encoders to provide fast, ultra-high accuracy positioning.

REVO™ system overview

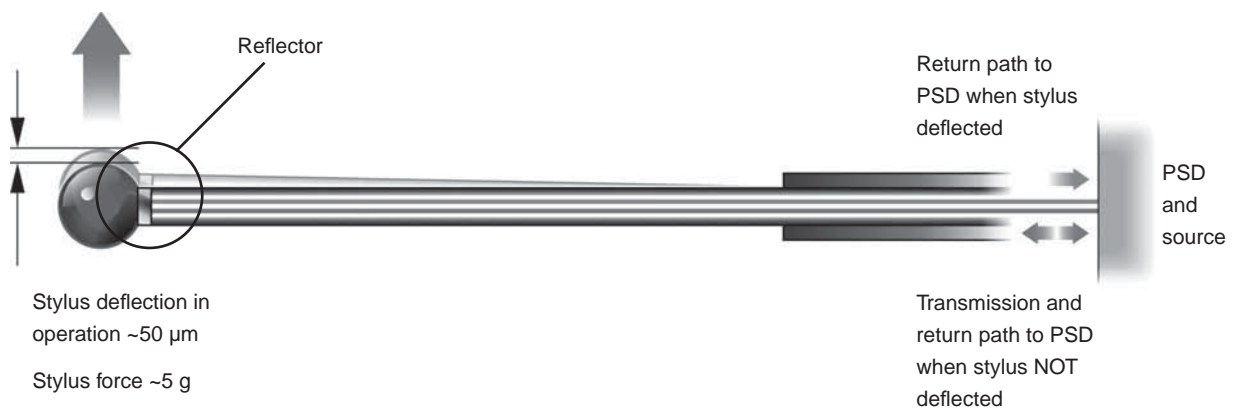
The system comprises the following elements:

- REVO™ head
- RSP2 2D tip sensing probe and associated stylus holders and accessories
- RSP3 3D probe and associated accessories
- **UCC2** universal CMM controller
- REVO™ PCI interface card (for **UCC2**)
- **SPA2** servo power amplifier
- Air filter unit



REVO™ - 'tip sensing' probe technology

- Enclosed laser directed onto a reflector at the stylus tip.
- The stylus touches the part and bends.
- The reflector is displaced.
- The exact tip position is known because the reflector and the stylus ball are close together.
- Stylus wear is minimised by using a low scanning force.
- The altered return path of the laser is sensed by a PSD.



REVO™ features and benefits:

- Incorporates **Renscan5™** five axis scanning technology minimising CMM motion and the associated CMM dynamic errors
- Increased measuring speed, up to 500 mm/sec resulting in increased measurement throughput
- Data collection rates up to 6,000 points per second
- Infinite positioning and five axis motion reduces nonproductive transitions between features
- Stylus wear minimised by extremely low scanning forces
- Infinite positioning and five axis motion aid access to difficult features
- Rapid calibration with all positions inferred means more time measuring
- Maximum reach up to 500 mm with maintained effective working length
- Standard M2 styli for convenience
- Probe and stylus changing capability allowing flexibility and future probing technology compatibility

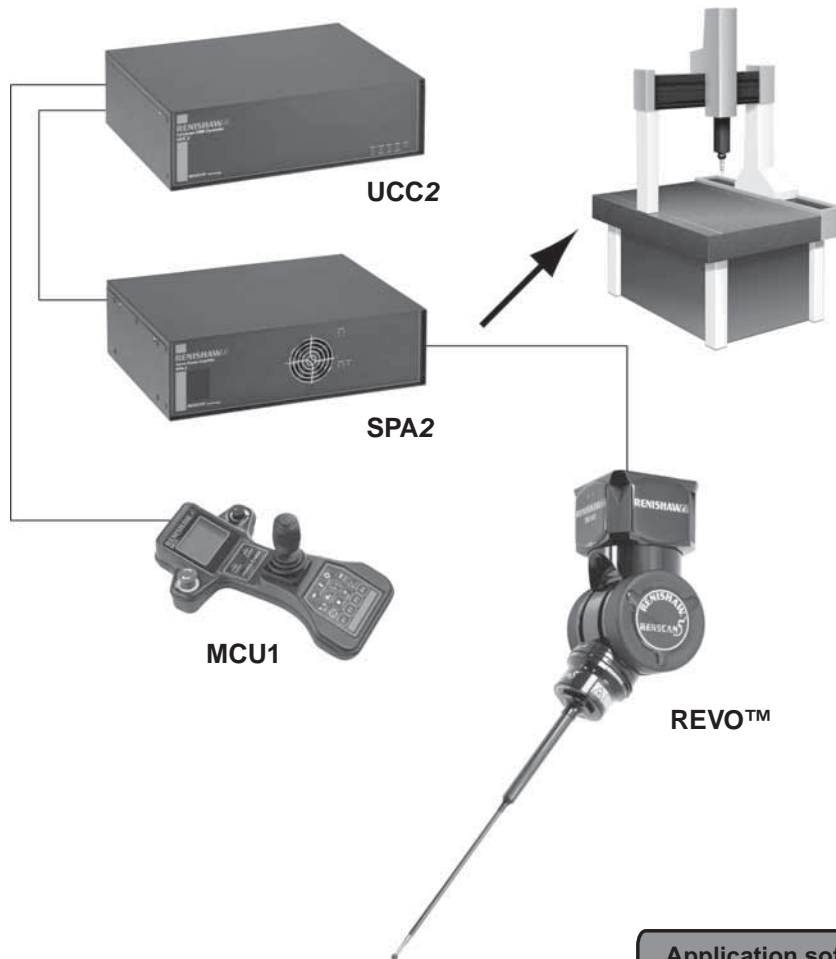


Specification summary		REVO™				
OPERATING TEMPERATURE		14 °C to + 30 °C (57 °F to 86 °F)				
STORAGE TEMPERATURE		-10 °C to +70 °C (14 °F to 158 °F)				
WEIGHT (excluding probe and cables)		1.75 kg				
DIMENSIONS	Height (overall)	239 mm (9.41 in)				
	B axis	86 mm (3.40 in) square				
	A axis swept diameter	118 mm (4.65 in)				
AIR SPECIFICATION	Incoming supply to filter specification (ref: ISO8537.1)	Particle size	Class 4	15 µm	Line pressure of 6 to 6.5 bar	
		Dirt concentration	Class 4	8 mg/m³		
		Dewpoint	Class 4	+3 °C		
		Oil	Class 4	5 mg/m³		
	After filtration air specification (ref: ISO8537.1)	Particle size	Class 2	1 µm	Pressure 5 Bar.	
		Dirt concentration	Class 2	1 mg/m³		
		Dewpoint	Class 3	-20 °C		
		Oil	Class 2	0.1 mg/m³		
MOVEMENT SPEED		3 revs/sec				
ROTATION ANGLES	A axis	-5° to +120°				
	B axis	Continuous				
ANGULAR RESOLUTION		0.08 arc sec				
BEARINGS		Air				
CHANGE RACK SYSTEM		Allowing both probe changing and stylus holder changing				

Probing systems for co-ordinate measuring machines

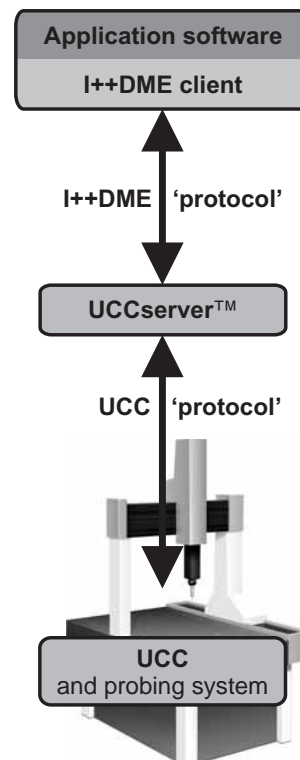
Hardware integration

- The **UCC2** is fundamental to the REVO™ system
- The **UCC2** controller features **Renscan5™** scanning routines particular to five-axis motion and scanning
- **SPA2** is a servo power amplifier used to drive the head and CMM
- MCU1 is the multi-function hand control unit required for the system



Software integration

- The Renishaw **UCCserver™** software application will provide the interface for REVO™ control
- **UCCserver™** is based on I++DME command protocol



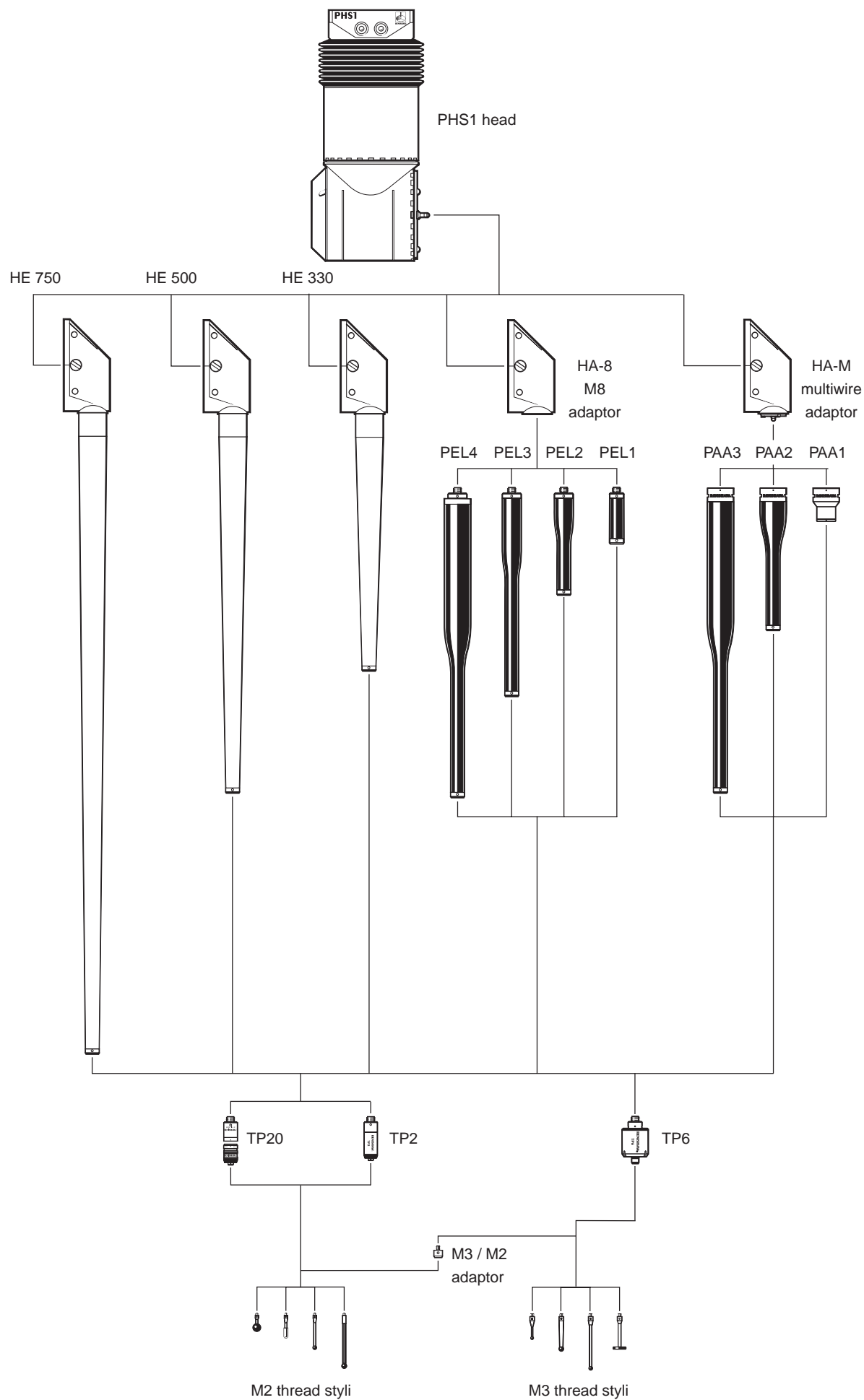
PHS1 motorised (servo type) probe head

The Renishaw servo positioning head (PHS1) is a 2-axis motorised head with continuous servo drive enabling the probe configuration to be positioned at almost any angle.

The PHS1 has been designed to meet the demanding requirements of “body in white” measurement where fine angular positioning and long reach are needed.



Probing systems for co-ordinate measuring machines



PHS1 head kit

The PHS1 head is not locked into position in the same manner as an indexing head. Instead, it is driven to approximately the required position and when a probing point is taken, the axes of the head latch simultaneously with the axes of the CMM to give accurate probe readings.

The PHS1 head is controlled directly via a PC interface card in the CMM controller, and requires full integration by the equipment supplier. Full information is given in the PHS1 programmers guide (PD-2100-9015).

A range of different probes can be fitted and automatically exchanged. These include touch-trigger probes and non-contact scanning probes.

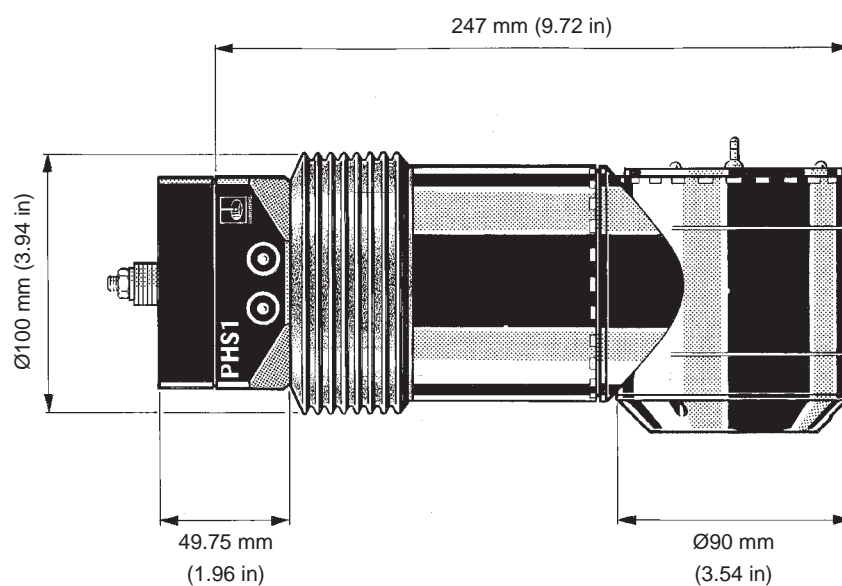
Extra long extensions allow the Renishaw trigger probes to measure otherwise inaccessible features.

A kinematic mount (KM1/KM2) allows quick fixing of the head to the machine and fast changeover to other heads.

PH10M or PH10T heads can be fitted (via a PHA1, PHA2 or a PHA3 probe head adaptor - details on request) instead of PHS1 in applications where existing parts need to be inspected without the need to re-write the programs for PHS1.

The head is protected by a built-in overtravel protection unit that can be configured to stop the machine in the event of a collision.

An air supply to the head is recommended for axis motor cooling and optimum metrology performance.



PHS1 system features and benefits:

- Repeatable exchange of PHS1 probe heads via KM1/KM2
- Easy interchange with Renishaw's PH10M/T motorised head systems
- 2-axis servo operated with $\pm 184^\circ$ variable positioning capability in both axes
- Orientation to almost any angle
- Long reach up to 750 mm (29.53 in)
- Automatic probe changing
- Accommodation of a range of sensors – trigger probes and non-contact scanning probes

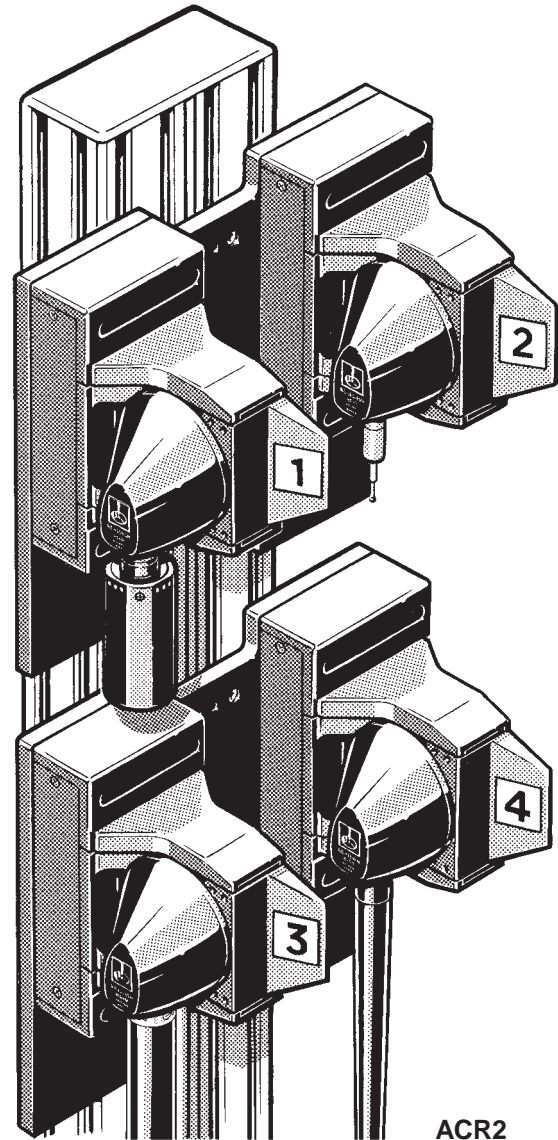
ACR2 port pair kit

The ACR2 autochange rack is an extension arm changing system for the PHS1 servo positioning head system.

It allows probe extensions or probe adaptors to be exchanged to suit the probing task required without manual intervention.

Its modular construction and simple operation enable any number of racks to be positioned on a pillar within the machine volume.

The rack is passive, all locking and unlocking of adaptors and extensions is done by the motion of the CMM.



Specification summary	PHS1
OPERATING TEMPERATURE	15 °C to 40 °C (50 °F to 104 °F)
WEIGHT *	<3 kg (<6.61 lb)
CARRYING CAPABILITY	Combined probe and extension mass of 1 kg (2.20 lb)
MAXIMUM TORQUE	2 Nm
MECHANICAL CLUTCH SLIP	3 Nm \pm 0.5 Nm
MOVEMENT SPEED	150 °s ⁻¹ maximum, 120 °s ⁻¹ typical
ARM ROTATION ANGLE	D axis $\pm 184^\circ$ E axis $\pm 184^\circ$
ANGULAR RESOLUTION	0.2 arc second (equivalent to 0.1 μ m at 100 mm radius)
COLLISION PROTECTION	Signal for head protection with kinematic overtravel unit
SUITABLE HEAD INTERFACE	PC interface card and UCC2 controller
CHANGE RACK SYSTEM	ACR2

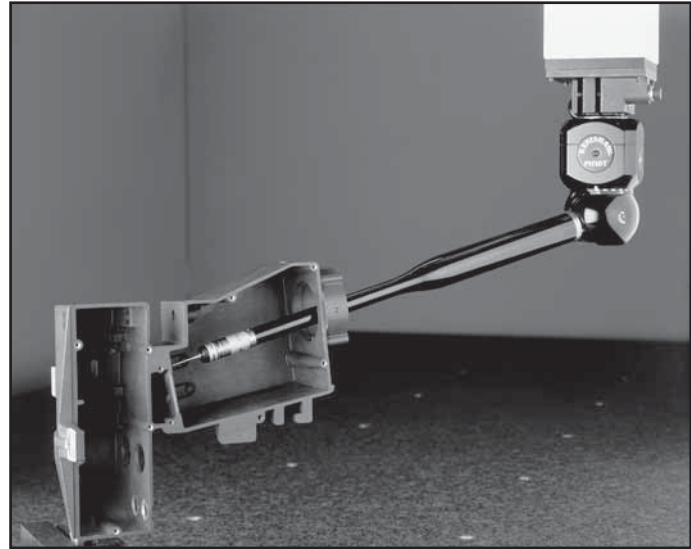
* (including probe extension and kinematic joint)

PH10T motorised indexing probe head

The PH10T is a motorised indexing head that mounts and re-orientates the probe. The PH10T can be repeatably orientated to any one of 720 positions.

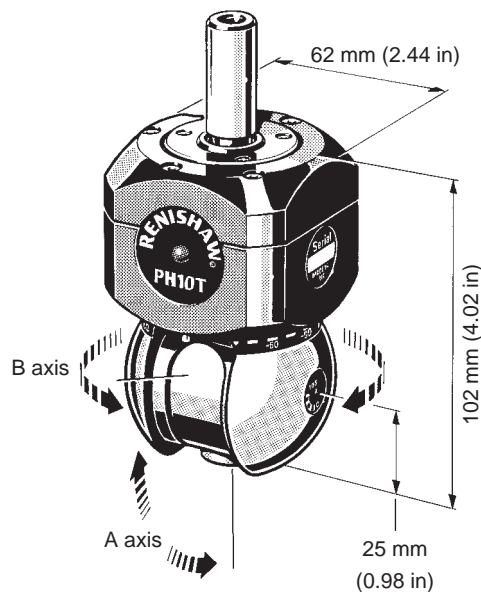
All M8 thread probes can be fitted directly onto the mount of the PH10T. The PH10T is operated by the PHC10-2 and is compatible with other Renishaw M8 threaded products.

The AM1 adjustment module permits the correction of the alignment of the probe head to the machine and is fitted between the head and the shank.



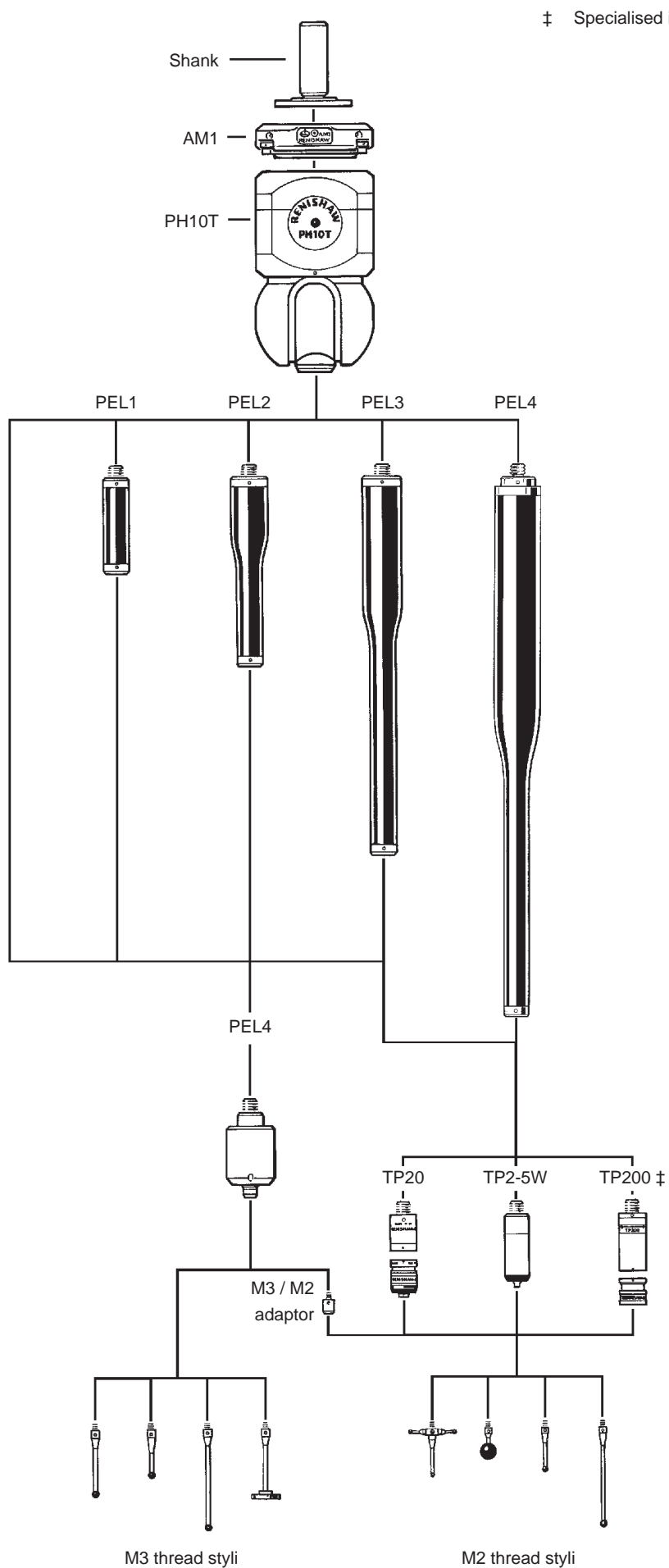
PH10T features and benefits:

- Compatible with M8 thread probes
- Compatible with PEL range of extension bars up to 300 mm (11.81 in) long
- 720 repeatable positions at 7.5° increments
- Shank-mounted



Specification summary		PH10T
REPEATABILITY OF POSITION* (2σ)		<0.5 μm (<0.00002 in) specified at a distance of 48 mm (1.89 in) - equivalent to a TP2 and PS1R stylus
* At constant temperature		
ACCURACY OF STEP SPACING FROM THEORETICAL POSITION		±0.24 mm (±0.012 in) (using TP6 probe and stylus part number A-5000-3553)
CYCLE TIME	7.5° step	2.5 seconds
	Maximum 90° move	3.5 seconds
TOTAL ANGULAR MOVEMENT	A axis	0° to 105° in 7.5° steps
	B axis	±180° in 7.5° steps
TOTAL NUMBER OF POSITIONS		720
MAXIMUM OUTPUT TORQUE		0.45 Nm
MAXIMUM EXTENSION BAR LENGTH (WITH TP2/TP200)		300 mm (11.81 in)
HEAD MOUNTING		Shank to suit CMM (MS range)
WEIGHT (excluding shank)		645 g (22.75 oz)
WORKING TEMPERATURE RANGE		10 °C to 40 °C (50 °F to 104 °F)
PROBE MOUNTING FACILITY		M8 thread
PROBE HEAD CONTROLLER		PHC10-2
HAND HELD CONTROL UNIT		HCU1

Probing systems for co-ordinate measuring machines



‡ Specialised interface required

PH10M / PH10MQ motorised indexing probe heads

The PH10M and PH10MQ are versatile motorised indexing heads that incorporate the Renishaw autojoint with multiwire capability. This allows PH10M/MQ heads to carry long extension bars and sophisticated multiwired probes such as SP25M and TP7M. There are 720 repeatable positions, set at 7.5° increments to provide probe orientation.

The highly repeatable, kinematic autojoint allows rapid probe or extension bar changing without the need for re-qualification.

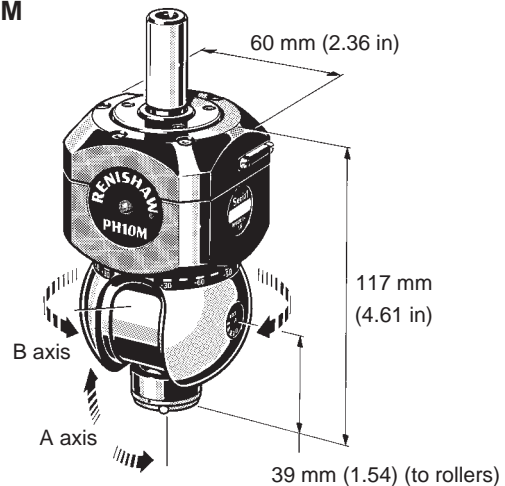
The PH10MQ is a variant that allows the motorised head to be attached directly to the quill with the 'cube' of the head inside the quill itself. This option provides a neater and shorter probe mount, with only the swivel protruding from the quill.

The AM1 and AM2 adjustment modules permit correction of alignment of the probe head to machine and are fitted between the probe head and the shank/quill of the machine.

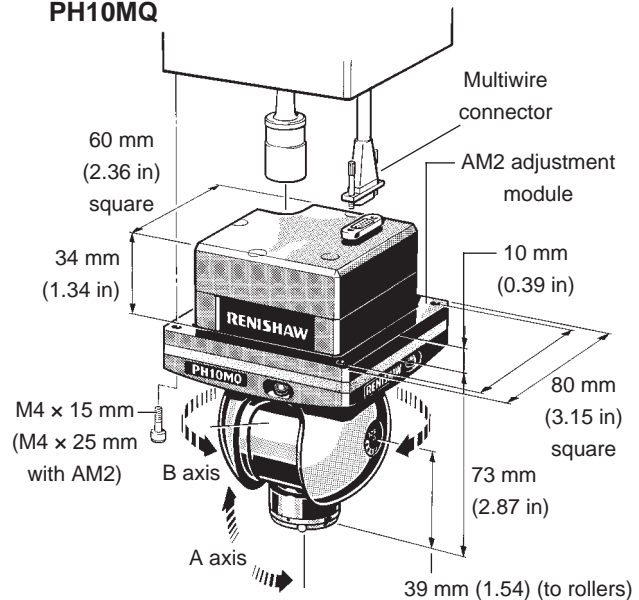
PH10M/MQ features and benefits:

- Autojoint mount, repeatable probe positioning
- Rapid automatic probe interchange via ACR1 or ACR3
- Full multiwire capability
- 720 repeatable positions at 7.5° increments
- Torque capable of lifting 300 mm (11.81 in) long extension bar

PH10M



PH10MQ



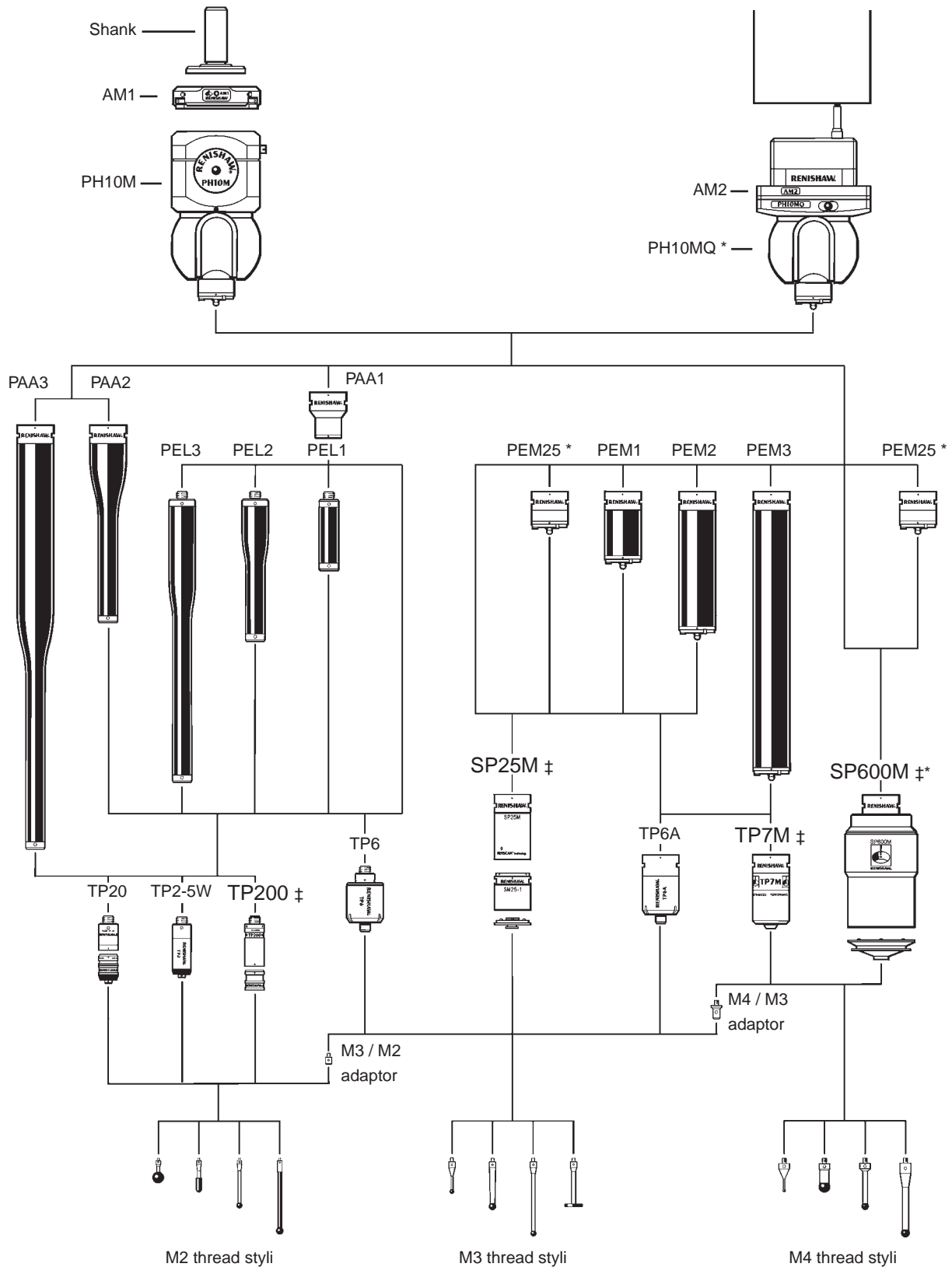
Specification summary		PH10M / PH10MQ
REPEATABILITY OF POSITION* (2σ)		<0.5 μm (<0.00002 in) specified at a distance of 62 mm (2.44 in)
* At constant temperature		- equivalent to a TP6A and 21 mm stylus
ACCURACY OF STEP SPACING FROM THEORETICAL POSITION		±0.3 mm (±0.012 in) (using TP6A probe and stylus part number A-5000-3553)
CYCLE TIME	7.5° step	2.5 seconds
	Maximum 90° move	3.5 seconds
TOTAL ANGULAR MOVEMENT	A axis	0° to 105° in 7.5° steps
	B axis	±180° in 7.5° steps
TOTAL NUMBER OF POSITIONS		720
MAXIMUM OUTPUT TORQUE		0.45 Nm
MAXIMUM EXTENSION BAR LENGTH	PAA3	300 mm (11.81 in)
	Carbon fibre extension	450 mm (17.72 in) (please contact Renishaw for more details)
HEAD MOUNTING		PH10M shank to suit CMM PH10MQ direct to quill (M3/M4 screws)
WEIGHT (excluding shank)		PH10M - 645 g (22.75 oz) PH10MQ - 730 g (25.8 oz)
WORKING TEMPERATURE RANGE		10 °C to 40 °C (50 °F to 104 °F)
PROBE MOUNTING FACILITY		Autojoint
PROBE HEAD CONTROLLER		PHC10-2 (PHC1050 card for UCC controller)
HAND HELD CONTROL UNIT		HCU1
CHANGE RACK SYSTEM		ACR1, ACR3

Probing systems for co-ordinate measuring machines

NOTE: Please see the accessories page 13-4 for details of adaptor plates PHA3 and PHA80 which permit rapid interchange between PH10MQ and SP80 scanning probe.

‡ Specialised interface required

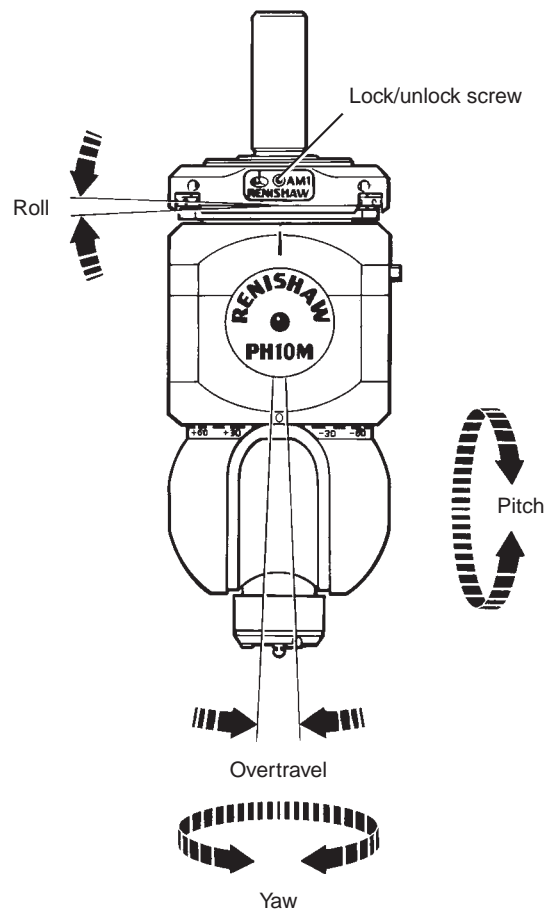
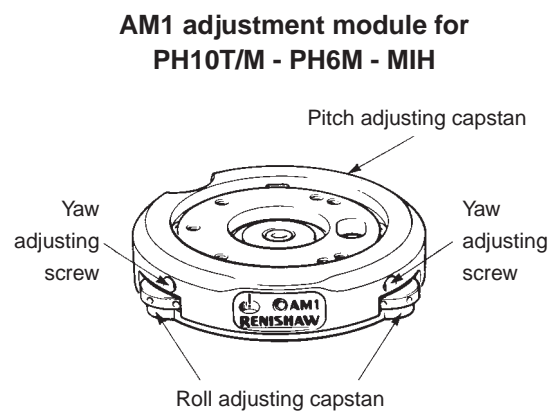
* When using a SP600M with a PH10MQ a PEM25 extension bar is required to achieve $A = 97.5^\circ$ or $A = 105^\circ$ in all B axis positions



AM1 adjustment module for PH10T/M, PH6M and MIH

The AM1 adjustment module has been designed for use with the PH6M and MIH manual probe heads and the PH10T/M motorised probe heads. It provides quick and accurate angular alignment of the probe head with the CMM's axes and/or the autochange rack.

In addition, the quick release mechanism allows the head to be removed for storage and subsequently replaced without further alignment. Built in overtravel protection decreases the risk of head damage.

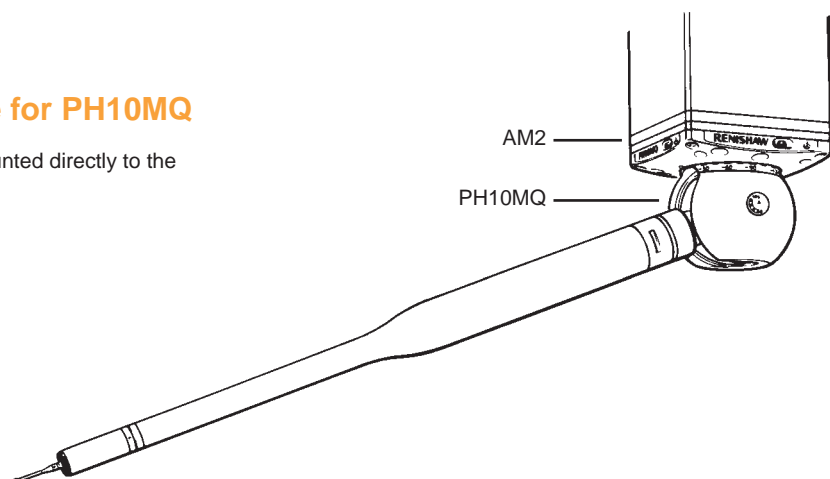


AM2 adjustment module for PH10MQ

PH10MQ motorised probe head is mounted directly to the quill via the AM2 adjustment module.

M = Multiwire

Q = Quill mounted



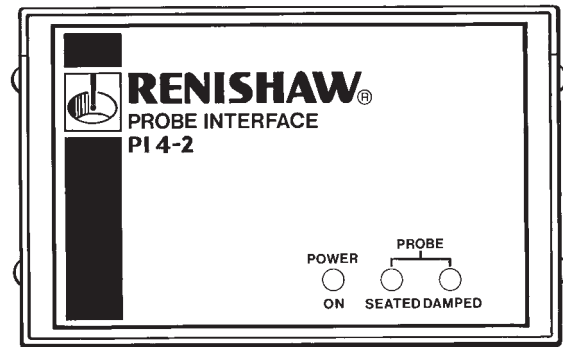
Specification summary	AM1	AM2
SIZE	60 × 15.5 mm (2.36 × 0.61 in) nominal	80 × 10 mm (3.15 × 0.39 in) nominal
ADJUSTMENT	±2° in pitch and roll* (recommended) ±4.5° in yaw	±1° in pitch and roll* (recommended) ±1° in yaw
OVERTRAVEL	±3.5° in pitch and roll	0°
MOUNTING	Mounts to quill using shanks Alternatively direct to quill using OEM adaptor	Mounts direct to quill
WEIGHT	150 g (5.29 oz)	48 g (1.69 oz)

* up to ±5.5° in pitch and roll is possible but this is at the expense of overtravel

PI 4-2 probe interface

Application - TP1, TP2, TP6, TP6A, TP20, SP25M (when using TP20)

The PI 4-2 is the basic interface for standard touch-trigger probes that allows for a PICS (product interconnection system) or SSR (solid state relay) output, the supply voltage being automatically detected. The unit is usually free standing but can be rack mounted.

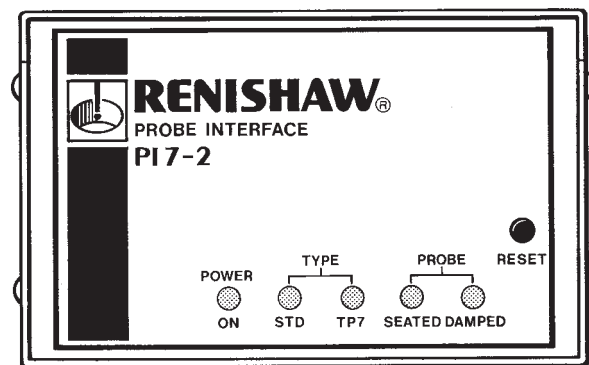


PI 7-2 probe interface

Application - TP7M + TP2, TP6, TP6A, TP20

The PI 7-2 is a dual purpose interface designed to process signals from the TP7M strain gauge probe and standard touch-trigger probes.

Special autoselecting electronics within the interface allow exchange of these probes without any changes to the interface.

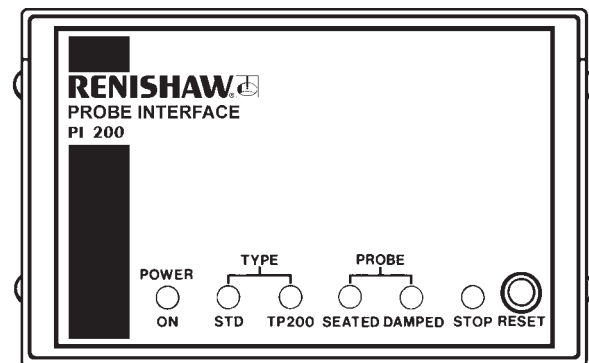


PI 200 probe interface

Application - TP200 + TP2, TP6, TP6A, TP20, SP25M (when using TP20)

The PI 200 is a dual purpose interface designed to process signals from the TP200 strain gauge probe and standard touch-trigger probes.

Special autoselecting electronics within the interface allow exchange of these probes without any changes to the interface.



Specification summary		PI 4-2 / PI 7-2 / PI 200	
POWER SUPPLY		85 V to 264 V 47 Hz to 66 Hz	
CURRENT CONSUMPTION (AT 240 V)		Less than 200 mA	
ENVIRONMENT	Storage	-10 °C to +70 °C (14 °F to 158 °F)	
	Operation	10 °C to 50 °C (50 °F to 122 °F)	
DIMENSIONS	Height	88 mm (3.48 in)	2 'U'
	Width	146 mm (5.75 in)	1/3 of a 19 in rack
	Depth	183 mm (7.21 in)	
WEIGHT		1.6 kg (56.44 oz)	
COMPATIBILITY	Output	PICS (Product interconnection system) or SSR (solid state relay)	
	Cable	Refer to Renishaw subsidiary, distributor or CMM manufacturer	

PHC10-2 head controller

The PHC10-2 head controller receives instructions from the CMM controller and controls the head functions and reports system status to the CMM:

- Drives PH10 to position sent either from the HCU1 or CMM.
- Checks and reports position.
- Flags up errors e.g. failure to reach position, obstruction before or after locking etc. Probe triggering signals are routed through the controller to the probe interface.



Specification summary		PHC10-2
DATA TRANSMISSION		RS232 IEEE (only available to special order)
USER DEFINABLE PARAMETERS	Serial	Baud rate 300 - 19200
	Parallel	Address, parallel poll bit
VOLTAGE RANGE		85 - 264 V 47 - 66 Hz
CURRENT CONSUMPTION (at 240 V)		Less than 500 mA
INPUT CONNECTORS		15-way 'D'
PROBE OUTPUT CONNECTORS		7-pin DIN or 9-way 'D' type
DIMENSIONS	Height	88 mm (3.47 in) 2 'U'
	Width	289.3 mm (11.39 in) 2/3 of a 19 in rack
	Depth	220 mm (8.66 in)
WEIGHT		2.86 kg (100.88 oz)
MAXIMUM CABLE LENGTH		50 m (164.04 ft)
HAND HELD CONTROL UNIT		HCU1 only

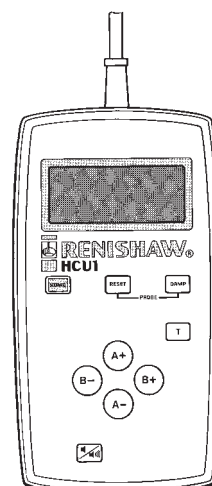
HCU1 hand held control unit

The HCU1 hand control and display unit is used with the PHC10-2 to drive the PH10 probe head position.

It is useful for setting up a component, operator controlled inspection and teach-cycle programming. Features include two speed action (jog and rapid move), 2-axis head display, transmit button for teach cycle, status and error LEDs.

Features

- Manual control of head movements
- LCD dot matrix showing : Head position, system status, and error analysis.



IS1-2 interface selector

The IS1-2 interface selector is a fully automatic system for use on CMM installations requiring multiple sensor types (e.g. SP25M – scanning probe, TP7M – touch-trigger probe, OTP6M – optical trigger probe, etc). The unit functions by identifying which probe has been fitted to the probe head and switches the probe signal / power lines to the appropriate interface.

The system comprises a standalone or rack-mountable interface selector. The IS1-2 has four separate channel outputs. These outputs allow any combination of the following Renishaw probes to be integrated into one automated system:

- SP25M
- SP80
- SP600
- OTP6M*
- TP7M
- TP2/TP6/TP20/TP200*

* These probes can be incorporated into a multiple sensor system consisting of any one of the other probe systems specified without the necessity to use an IS1-2 unit. Please contact Renishaw for further details.

The IS1-2 is also fully compatible with Renishaw's ACR1 and ACR3 probe exchange systems, the PH10M range of motorised heads and the PHS1 motorised servo head system using the Renishaw product interconnection system (PICS).

A set of four programming modules are supplied pre-installed within the IS1-2 unit which identify the probe in use. These are TP7M, SP600M, SP80 and SP25M modules. The remaining modules are supplied loose and can be installed by the user. TP2, TP6, TP20, TP200 have an integral identification system and therefore do not require a module.

Plugging the required product module into the respective channel selector socket ensures that the probe connections are made to the correct IS1-2 output port.

Third party probes, that carry the female autojoint, will require specific identification resistors to be fitted within the female autojoint. Special modules to permit the recognition of these probes by the IS1-2 will also be required.



UCC2 universal CMM controller system

The **UCC2** controller together with its associated products - the **SPA2** or the **SPA/lite** servo power amplifiers and the **MCU1** joystick, form a comprehensive CMM control system. This system is a sophisticated integrated motion controller that precisely controls CMM motion, including comprehensive scanning capabilities and automated probe calibration.

With **UCC2** operating through an **SPA2** or **SPA/lite**, the CMM motion control is smooth, fast and accurate, permitting irregular contours to be easily followed thanks to the 'move blending' software.

The **UCC2** has three levels of operating capability: touch-trigger probing, **Renscan3™** full 3-axis scanning capability which includes Renishaw's patented **RenscanDC™**, and **Renscan5™** our new integrated 5-axis scanning system. All **UCC2** controllers have I++DME capability enabled.

Future hardware and software upgrades can be carried out easily, with function enhancements available by email or telephone support. Software enhancements are simply applied, as the control software is loaded at boot up. Additional new products require only plug-in daughtercards.

All new probes and heads will be available with a controller interface option that will also include any appropriate calibration or set-up software.

The **UCC2** controller is housed in a standard rack-mountable enclosure and is connected to the host PC via a conventional Ethernet link. It does not contain user application software.

The **SPA2** and **SPA/lite** servo power amplifiers are housed in standard rack-mountable enclosures and the cables necessary to connect them to the **UCC2** are supplied as part of the kits.

The **MCU1** machine control unit (joystick) is an ergonomically designed unit suitable for both hand held or table based operation. It is supplied with a 5-metre cable as standard but other cable lengths or extensions can be used.

Scanning with UCC2

The **UCC2** scanning capability provides a choice of scanning techniques:

- Unknown part scanning, both 2D and 3D
- Known part adaptive scanning, with sophisticated scanning routines that include :
 - Cylinder scan (a helical scan path that can adapt to cones and spheres, as well as cylinders. It will also adapt to out-of-round and out-of-position parts).
 - Gasket scan (a known path scan constructed from a series of lines and arcs).
 - Grid scan (a 3D scan of a pre-defined area)
 - Automatic find centre:- Utilisation of a scanning probe to automatically find the centre of a groove or conical hole
- Advanced data filtering
- Advanced analogue probe calibration

UCC2 features and benefits:

- Capable of smooth, fast and accurate blending of CMM motion control
- Close integration between probing and the CMM optimises system measuring performance
- Closed-loop known part scanning includes cylinder, gasket and grid routines
- Available with three levels of operating capability: touch-trigger probing, **Renscan3™** and **Renscan5™**
- Integrated control of all Renishaw standard touch-trigger and scanning probe systems plus stylus changing
- Full future product compatibility using plug-in daughtercards
- I++ DME server application



RenscanDC™ – the ultimate scanning performance from your CMM

Renishaw's patented **RenscanDC™** system enables measurement at extremely high speeds, but with the accuracy of low speed measurement.

The traditional conflict between accuracy and scanning speed is resolved by **RenscanDC's** feature based approach, which follows two steps:

1. Measure the feature at slow speed to establish an accurate measurement. Repeat measurement at high speed to identify errors introduced at high speed.
2. **UCC2** automatically computes the dynamic error at each point around the feature to derive a dynamic correction map.

All subsequent parts can be measured at high speed and the application of dynamic corrections will provide low-speed accuracy at the fast measurement speeds.

UCC^{lite} controller

For applications needing only a basic TTP (touch-trigger probing) capability, there is **UCC^{lite}**, a lower specification controller configurable for use with either manual or DCC CMMs and which uses simple USB1 connection.



UCC^{lite} features and benefits:

- Low cost
- Entry level controller
- Manual and dcc option
- Touch-trigger only
- Remote PHC10 and TP200 I/F
- USB1.1 link to PC
- Digital tuning
- Common software
- Customer Microsoft compatible joystick

Function/ specification	UCC ^{lite}	UCC2
Configured for manual (MAN) CMMs	■	-
Configured for direct CNC controlled (DCC) CMMs	□ (with DCC upgrade)	■
Touch-trigger probing (TTP) function	■	■
Renscan3TM function featuring: <ul style="list-style-type: none"> • 3-axis control • Advanced analogue scanning probe calibration • Advanced data filtering • Unknown part scanning (2D and 3D) • Known part adaptive scanning routines as follows: <ul style="list-style-type: none"> • Circle scan • Cylinder scan • Gasket scan • Grid scan • Auto find-centre using a scanning probe 	-	□
RenscanDCTM function	-	This is a standard feature of Renscan3 TM .
Renscan5TM function featuring: <ul style="list-style-type: none"> • 5-axis control • Ultra-rapid inferred probe calibration • Advanced data filtering • Scanning routines as follows: <ul style="list-style-type: none"> • Head touch • Circle scan • Cylinder scan • Gasket scan • Sweepscan - flat plane • Sweepscan - curved plane 	-	□
Processor: type (speed)	Uses PC processor	Pentium 4 (1 GHz)
Number of axes controlled	3 □ (only with DCC upgrade)	4 (XYZ + 1 additional axis)
Configurable additional axis, (rotary table, dual scale, dual drive)	-	□ further axes by additional interface card(s)
Suitable hand control unit	3D PC joystick (Direct X)	MCU1
SPA (servo power amp) compatibility	□ (only with DCC upgrade) SPA^{lite} , SPA2 or SPA1 also other manufacturers +/-10 V SPA's	SPA2 or SPA^{lite} (also compatible with SPA1)

■ Standard specification

□ Available as a configuration upgrade

Function/ specification		UCC <i>lite</i>	UCC2
Renishaw UCCserver™ (I++DME)		■	■
Renishaw UCCassist™ compatible		■	■
Basic TTP interface (TP2, TP20)		■	■
TP200/SCR200 interface		□ (requires external PI200)	■
SP600 interface		-	■
SP25M interface		-	■
SP80 interface		-	□ (by interface card)
REVO™ head interface		-	□ (by interface card)
PH10 interface		□ (requires external PHC10)	□ (by interface card)
PHS interface		-	□ (by interface card)
Temperature sensor inputs (x 24)		-	□ (by interface card)
Analogue SPA output ± 10 V		□ (only with DCC upgrade)	■
Digital SPA control output		□ (only with DCC upgrade)	■
Communications link with PC		USB1	Ethernet
PC operating system compatibility		Windows 2000 / XP pro	Windows 2000 / XP pro
Servo loop time		10 ms ⁽¹⁾	0.5 ms
OSIS compliant		-	■
Common UCC software integration		■	■
Compatible with existing daughtercards		-	■
Maximum real time scanning data rate		-	2000 points/s
Maximum buffered scanning data rate		-	6000 points/s
Integral AC power supply		-	■
External DC power supply		■ ⁽²⁾	-
Digital scale input: RS422 - Renishaw RGH22, RGH24 and other digital scales directly supported		■	■
Analogue scale input		□ (by external interface)	□ (by internal interface)
Uncommitted CMM I/O		■ (1 input + 2 outputs)	■ (6 inputs + 7 outputs)
Power available for I/O		24 V at 1 A	24 V at 1 A
I/O specification		User configurable: Active HIGH or LOW Voltage range 5 V to 48 V	User configurable: Active HIGH or LOW Voltage range 5 V to 48 V
Outer and inner limit switch compliant		(□ only with DCC upgrade)	■
Soft limit compliant		(□ only with DCC upgrade)	■
CMM volumetric error map function		■	■
Power supply		External PSU supplying 24 V at 3 A or provided by SPA<i>lite</i>	85 V to 132 V ac, 170 V to 264 V ac, 47 Hz to 63 Hz, 150 W
Environment	Storage	-10 °C to +70 °C (14 °F to 158 °F)	-10 °C to +70 °C (14 °F to 158 °F)
	Operation	10 °C to 50 °C (50 °F to 122 °F)	10 °C to 50 °C (50 °F to 122 °F)
Dimensions:	Width	435 mm (19" enclosure)	435 mm (19" enclosure)
	Height	1U (42.5 mm)	3U (127 mm)
	Depth	130 mm	330 mm
Weight		1.25 kg (2.75 lb) without cables	8 kg (17.64 lb) - without cables and option boards

■ Standard specification

□ Available as a configuration upgrade

⁽¹⁾ Velocity loop is closed in the PC, nominally 10 ms (PC dependant)

⁽²⁾ If used with **SPA*lite*** the external power supply is not required

UCC1 universal CMM controller

The UCC1 is a sophisticated integrated motion controller that precisely controls CMM motion, probe calibration and scanning capabilities. With UCC1, the CMM motion control is smooth, fast and accurate, permitting irregular contours to be easily followed thanks to the 'move blending' software.

The UCC1 has three levels of operating capability: touch-trigger probing, full scanning and **UCCserver™** (I++DME) capability.

Future hardware and software upgrades can be carried out easily, with function enhancements available by email or telephone. Software enhancements are simply applied, as the control software is loaded at boot up. Additional new products require only plug-in daughtercards.

All new probes and heads will be available with a controller interface option that will also include any appropriate calibration or set-up software.

The UCC1 controller is housed in a standard rack-mountable enclosure with a twin optical fibre link to a simple PC plug-in card. It does not contain user application software.

UCC1 features and benefits:

- Capable of smooth, fast and accurate blending of CMM motion control
- Closer integration between probing and the CMM optimises system measuring performance
- Closed-loop known part scanning includes cylinder, gasket and grid routines
- Available with three levels of operating capability: touch-trigger probing, full scanning and **UCCserver™** (I++DME) capability
- Integrated control of all Renishaw standard touch-trigger probe systems and stylus changing
- Full future product compatibility using plug-in daughtercards



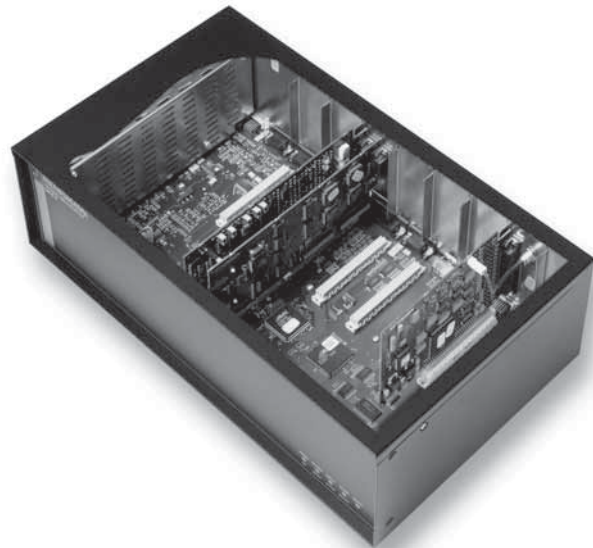
Scanning with UCC1

The UCC1 scanning capability provides a choice of scanning techniques:

- Known part adaptive scanning, with sophisticated scanning routines that include :
 - Cylinder scan (a helical scan path that can adapt to cones and spheres, as well as cylinders. It will also adapt to out-of-round and out-of-position parts).
 - Gasket scan (a known path scan constructed from a series of lines and arcs).
 - Grid scan (a 3D scan of a pre-defined area)
- Advanced data filtering
- Advanced analogue probe calibration
- Automatic find centre:- Utilisation of a scanning probe to automatically find the centre of a groove or conical hole

UCC1 technical specification

- 19" 3U standard rack-mountable enclosure with 7 expansion slots for option cards
- Simple PCI plug-in card for the front-end computer
- 10 Mb capacity high-speed optical data link between UCC1 and front-end PC
- 3-axis control
- Scale inputs:- Renishaw RGH22, RGH24, RGH41 and other digital scales directly supported, analogue scales supported via an external interface
- Uncommitted Binary I/O:- 6 inputs and 7 outputs available as standard
- Comprehensive joystick interface
- TP20, TP200/SCR200 and SP600 interfaces available as standard
- Compatibility with other Renishaw probes, such as SP25M and SP80 by use of daughter card
- Internal error-map
- The following option cards are available:-
 - PH10/50 motorised head interface
 - PICS/RS232 auxiliary product interface
 - SP25M scanning probe interface
 - SP80 scanning probe interface
 - Temperature sensor inputs (24)
 - Joystick interface (for 3rd party analogue joysticks)



Operational

- Touch-trigger
- Scanning
- **UCCserver™** (I++DME)

Specification summary			UCC1
POWER SUPPLY			85 V to 264 V 47 Hz to 66 Hz
ENVIRONMENT	Storage		-10 °C to +70 °C (14 °F to 158 °F)
	Operation		10 °C to 50 °C (50 °F to 122 °F)
DIMENSIONS	Height		127 mm (5.00 in)
	Width		435 mm (17.13 in)
	Depth		260 mm (10.24 in)
WEIGHT			6.00 kg (211.64 oz)
Hand held control unit			MCU1
Servo power amplifier			SPA1

SPA2 servo power amplifier for UCC2

The **SPA2** is available as a 3 or 6 channel digital servo power amplifier with an integral power supply. An additional axis can simply be added to either model to convert it into a 4 or 7 channel SPA. The design has been optimised to work with the **UCC2** or **UCClite** CMM controllers and all the necessary interconnection cables are provided in the kits.

When the **SPA2** is used with the **UCC2** controller and MCU1 joystick, you have an ideal retrofit package.

For each amplifier channel, there are individual software controls for all the tuning parameters including offset, gain, integral and proportional settings. The motor and tacho polarities can also be inverted by software.

The power supply can be set to provide a voltage output from 12 V to 60 V. The maximum total output power is 600 W and each channel can deliver 10 A peak or 5 A continuous.

As well as the servo power amplifiers, the unit contains all the relays to control the motor engaging process. It also contains all the necessary hardware to implement a category '2' emergency stop system.

With mounting brackets, the system may be housed in a 3U high × 19 in wide, rack mountable enclosure.



SPA2 features and benefits:

- Full digital tuning capability
- Linear, DC brushed and brushless motor capability
- Tacho, tacholess and encoder motor feedback
- Integral power supply
- Up to 7 servo amplifier channels

SPA^{lite} servo power amplifier

SPA^{lite} is a lower powered 3-axis servo power amplifier unit suitable for smaller CMMs typically up to 1 m³ volume.

SPA2 and **SPA^{lite}** both feature digital tuning.



SPA^{lite} features and benefits:

- Low cost
- Compatible with **UCC^{lite}** and **UCC2**
- Tacho, tacholess and encoder motor velocity control
- 3-axes
- Digital tuning

Function / specification		SPA ^{lite}	SPA2 (3-axis)	SPA2 (6-axis)	SPA2 (REVO™)
UCC controller compatibility		UCC^{lite} (with DCC upgrade) or UCC2	UCC2 or UCC^{lite}	UCC2 only	UCC2 only
Servo amplifier channels (as standard)		3	3	6	5
Additional servo amplifier channels		-	1 (UCC2 systems only)	1	1
Total output power		250 W	600 W	600 W	600 W
Maximum continuous power per channel		120 W	300 W ⁽¹⁾	300 W ⁽¹⁾	300 W ⁽¹⁾
Peak power per channel (dependent on application)		240 W	600 W	600 W	600 W
Amplifier output (motor) voltage		24 V to 48 V variable	12 V to 60 V variable	12 V to 60 V variable	12 V to 60 V variable
Amplifier current		0 to 5 A programmable	0 to 10 A programmable	0 to 10 A programmable	0 to 10 A programmable
E-Stop and contactor circuits included		■	■	■	■
Emergency stop compatibility		Category 'B' ESTOP	Category '2' ESTOP	Category '2' ESTOP	Category '2' ESTOP
Tuning method		Digital	Digital	Digital	Digital
DC brushed motor compatibility		■	■	■	■
Tacho motor velocity feedback		■	■	■	■
Tacholeless velocity feedback		■	■	■	■
Encoder velocity feedback		■	■	■	■
Integral AC power supply		■	■	■	■
Power supply	Input	85 V to 132 V ac, 170 V to 264 V ac, 47 Hz to 63 Hz, 650 W		85 V to 132 V ac, 170 V to 264 V ac, 47 Hz to 63 Hz, 650 W	
	Output	12 V to 60 V dc, 10 A maximum		12 V to 60 V dc, 10 A maximum	
Environment	Storage	-10 °C to +70 °C (14 °F to 158 °F)		-10 °C to +70 °C (14 °F to 158 °F)	
	Operation	10 °C to 50 °C (50 °F to 122 °F) local to UCC		10 °C to 50 °C (50 °F to 122 °F) local to UCC	
Dimensions:	Width	435 mm (19 " enclosure)		435 mm (19 " enclosure)	
	Height	2U (85 mm)		3U (127 mm)	
	Depth	330 mm		330 mm	
Weight		5.5 kg (12.2 lb)		8 kg (17.64 lb)	

■ Standard specification

□ Available as a configuration upgrade

⁽¹⁾ Peak power of 600 W can be drawn for a maximum of 50 seconds

SPA1 servo power amplifier for UCC1

The SPA1 is a 3-channel servo power amplifier with an integral power supply.

The design has been optimised to work with the UCC1 CMM controller and all the necessary interconnection cables are provided in the kit.

When the SPA1 is used together with the UCC1 controller and MCU1 joystick, you have an ideal retrofit package.

For each amplifier channel there are individual controls for offset, gain, derivative and proportional settings.

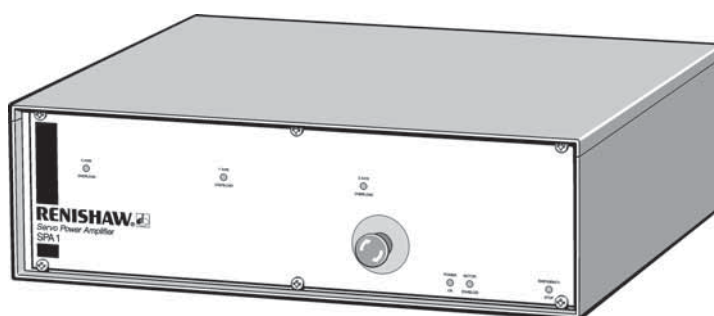
The power supply can be set to provide either 24 V or 48 V, the maximum total output current is 10 A and each individual channel can deliver 10 A peak (for 2 seconds) or 7 A continuous.

There are selectable chokes fitted to accommodate low inductance motors.

As well as the servo power amplifiers, the unit incorporates a category 'B' Emergency Stop system and the necessary relays to control the motor engaging process.

The system is housed in a 3U high x 19 in wide, rack mountable enclosure.

A SPA1 service pack is available, it consists of a full set of connectors and backshells, a set of potentiometers to assist the tuning process are also included.



Specification summary		SPA1
POWER SUPPLY	Input	85 to 264 V ac, 47 to 63 Hz, 600 W maximum
	Output	24 or 48 V dc, 10 A maximum
ENVIRONMENT	Storage	-10 °C to +70 °C (14 °F to 158 °F)
	Operation	10 °C to 50 °C (50 °F to 122 °F)
DIMENSIONS	Height	127 mm (5.00 in)
	Width	435 mm (17.13 in)
	Depth	260 mm (10.24 in)
WEIGHT		13.00 kg (28.70 oz)
EMERGENCY STOP		Category 'B'

MCU1 multi-functional hand control unit

The MCU1 is a multi-functional hand control unit that provides complete CMM control.

Designed for use with the UCC range of controllers, the MCU1 is housed in an ergonomically styled enclosure that allows for hand held (suitable for both right and left handed operators) or table mounted operation.

The MCU1 is supplied as standard with a 5 metre cable, other cable lengths and/or extensions can be used.

A large LCD screen gives status information and allows for interaction with the metrology program.

A MCU1 docking port is also available that allows the MCU1 to be stored on the side of a cabinet, CMM bed or any other non-horizontal surface.



Function / specification	MCU1	3D PC joystick (Direct X compatible)
Supplied by	Renishaw	OEM / retrofitter
UCC controller compatibility	UCC1 or UCC2	UCClite (with DCC upgrade)
Emergency stop button	■	Separate E-stop pendant unit (supplied by Renishaw)
Standard functionality	<ul style="list-style-type: none"> Control motion of CMM (3-axis) Index motorised head Operate rotary table Emergency stop Speed control potentiometer allowing speed override from 0 –100% during automatic moves Joystick enable switch (programmable as “dead-man’s-handle”) Individual axis locks “Engage servos” switch “Probe override” switch “Mode” switch to scroll through operating modes:- CMM, motorised head, rotary table etc. Orientation switch to rotate joystick axes to suit users orientation to CMM Customisation of part or all of the LCD screen Fast / slow joystick speed 	<ul style="list-style-type: none"> Control motion of CMM (3-axis) Individual axis locks Fast/slow speed operation switch Speed override
Additional functionality available dependant upon software integration	<ul style="list-style-type: none"> Menu system to navigate through operating software Operate as PC mouse “Start/stop program” switch “Take point” (way point) switch “Cancel last point” switch “Axis system” switch to select joystick operation with machine, part and stylus co-ordinate systems Four programmable function switches (F1 to F4) 	-

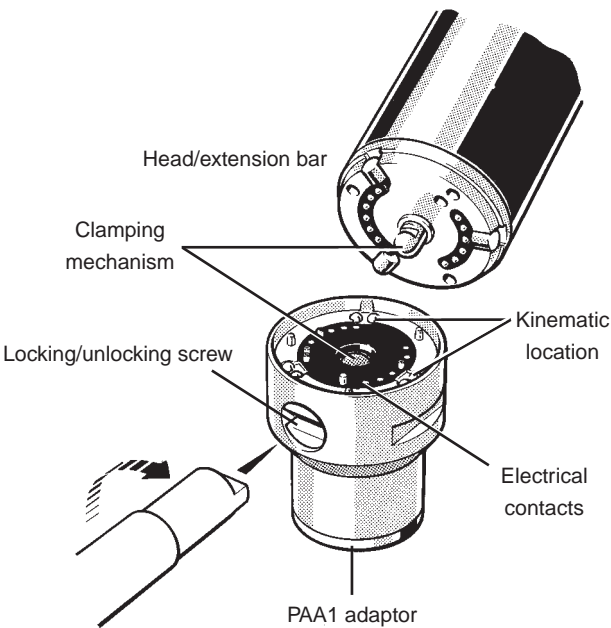
Autochange system

The autojoint

The essential feature of Renishaw's autochange systems is the autojoint itself. This is a highly repeatable kinematic joint, one half of which is attached to the probe head, the other is attached to an adaptor, extension bar or probe.

Locking and unlocking the autojoint is achieved either manually, using an autojoint key or, automatically, using either the ACR1 or ACR3 autochange rack systems. In all cases, the connection repeatability eliminates the need for probe requalification after each probe exchange.

In addition to mechanical repeatability, the autojoint carries thirteen electrical connections, known as the Renishaw multiwire. These carry simple two wire TTP signals and also the more demanding signals from analogue scanning and non-contact laser probes, providing the benefit of the complete Renishaw range.



Specification summary	Autojoint
FITTING	Ø25 mm (Ø0.98 in)
CONNECTION REPEATABILITY	1 µm (0.00004 in) at stylus tip 50 mm (0.97 in) from autojoint

ACR1 autochange rack

The ACR1 system is a fully integrated 8-port probe autochange system. It is mounted within the machine's working envelope and allows probe/stylus combinations to be exchanged automatically from heads and extension bars, without the need for re-qualification.

ACR1 has been revised to allow on-site configuration of the ports to accommodate extra large probes such as optical sensors.

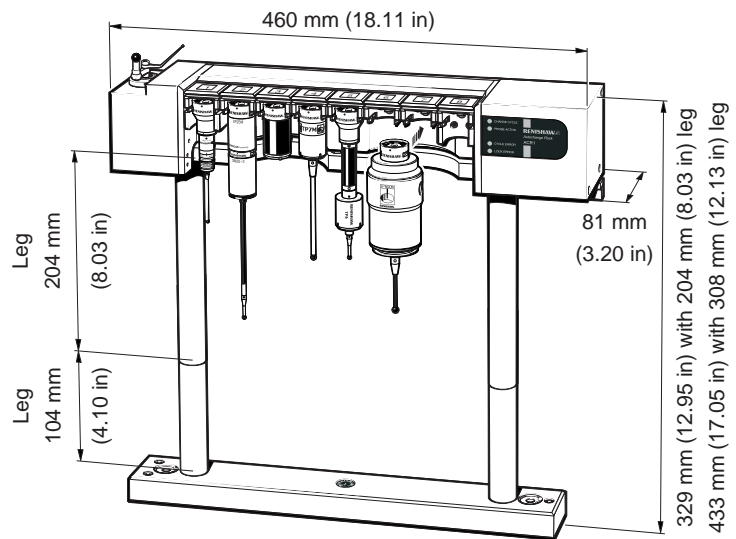
It is also possible to use the ACR3 to autochange between the head and probe (please see page 10-3).

For further assistance in choosing your system, please see H-1000-3032/ H-1000-3033 autochange systems brochure.

NOTE: This system can be mounted both horizontally (as shown) or vertically. To mount vertically a vertical mounting kit is required (not supplied).

The example shows the flexibility which substantially increases the usefulness and effectiveness of the CMM.

Legs are constructed from 104 mm and 204 mm (4.09 in and 8.03 in) modules.



**ACR1 autochange rack
with adjustable base**

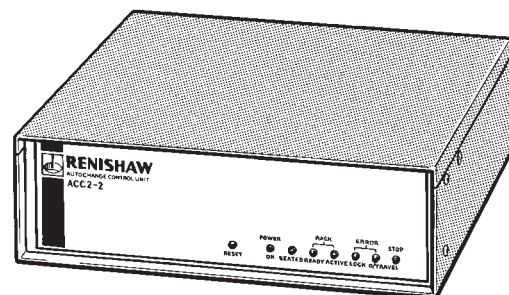
Specification summary	ACR1
NUMBER OF PORTS	8
DIMENSIONS (without legs)	460 x 100 x 81 mm (18.11 x 3.94 x 3.20 in)

ACR1 key benefits:

- On-site port configuration facility
- Horizontal and vertical mounting
- Removal of probes from extension bars
- Crash protection system

ACC2-2 autochange controller for ACR1

The ACC2-2 is the RS232 only version of the ACR1 autochange controller. For IEEE support please contact Renishaw.



Specification summary		ACC2-2
DATA TRANSMISSION	Serial	RS232
USER DEFINABLE PARAMETERS	Serial	Baud rate 300 - 19200
VOLTAGE RANGE		85 - 264 V 50/60 Hz
DIMENSIONS	Height	88 mm (3.47 in) 2 'U'
	Width	289.30 mm (11.40 in) 2/3 of a 19 in rack
	Depth	220 mm (8.66 in)
WEIGHT		3.85 kg (8.49 lb)

Probing systems for co-ordinate measuring machines

ACR3 autochange rack

Renishaw's ACR3 autochange rack is a passive, 4-port probe changing system. It is fitted to Renishaw's modular rack system (MRS) which has been designed to provide a platform for Renishaw's latest range of stylus and probe changing racks.

The ACR3 uses the motion of the CMM to lock/unlock the autojoint between the probe head and the probe/extension. ACR3 is therefore a passive mechanical design without the need for rack motors or electrical interfacing.

Integration with the metrology software is required (please consult your machine supplier for details).

All Renishaw probes and extension bars fitted with the autojoint can be carried. Some third party probes that incorporate the Renishaw autojoint can also be used with ACR3. (Please consult your machine supplier for details).

For additional flexibility, two four port units can be linked to provide an eight port system.

The total swept volume along the MRS during a change cycle is:

1 × ACR3 275 mm (10.83 in)

2 × ACR3s linked 460 mm (18.11 in)

The extruded rail of the MRS is available in different lengths 400 mm/600 mm/1000 mm (15.8 in/23.6 in/39.4 in) to suit the number and combination of changer requirements. In addition the height of the MRS can easily be upgraded after installation allowing further flexibility to meet application needs. For more details on the MRS please refer to section 13-1. Additionally an ACR3 data sheet H-1000-2024, and autochange systems brochure H-1000-3032/H-1000-3033 are available.

ACR3 features and benefits:

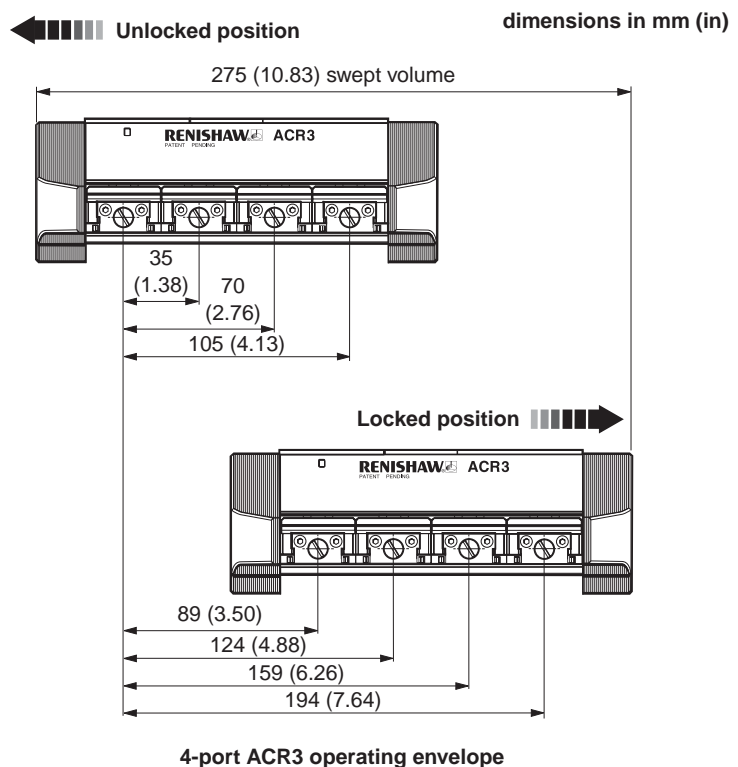
- 4 ports
- Rapid exchange between autojointed products
- Can be configured to provide 8 ports
- Simple installation/operation



ACR3 4-port system mounted to MRS



ACR3 and two SCP600's mounted to MRS



MAPS manual autojoint probe stand

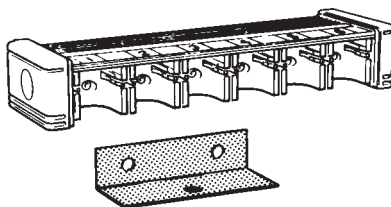
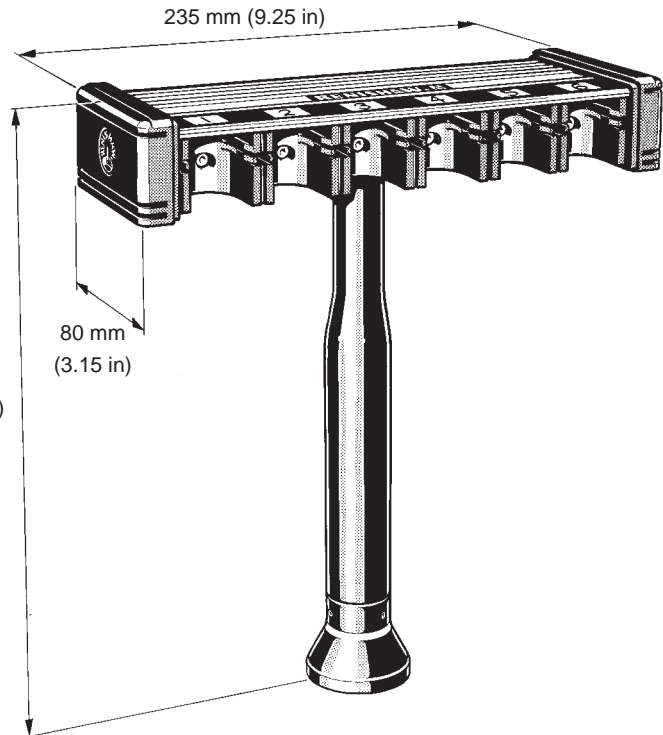
Renishaw's manual autojoint probe stand (MAPS) is a low cost storage rack capable of holding up to six combinations of autojointed probes, extension bars and accessories.

The stand can be mounted directly onto the table of a CMM (or any suitable surface) using the leg mount.

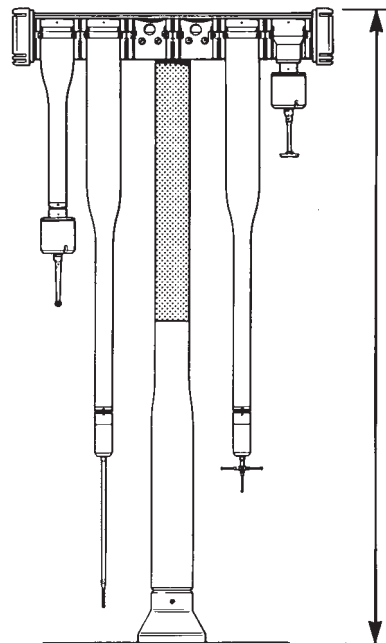
Standard ACR1 autochange rack legs (100 mm and 200 mm long) are compatible with this stand and can be stacked to accommodate longer probe extensions with longer stylus extensions.

As an alternative to the leg mount, a wall mounting bracket is available to enable the stand to be mounted to a cabinet, wall or any vertical surface.

285 mm
(11.22 in)



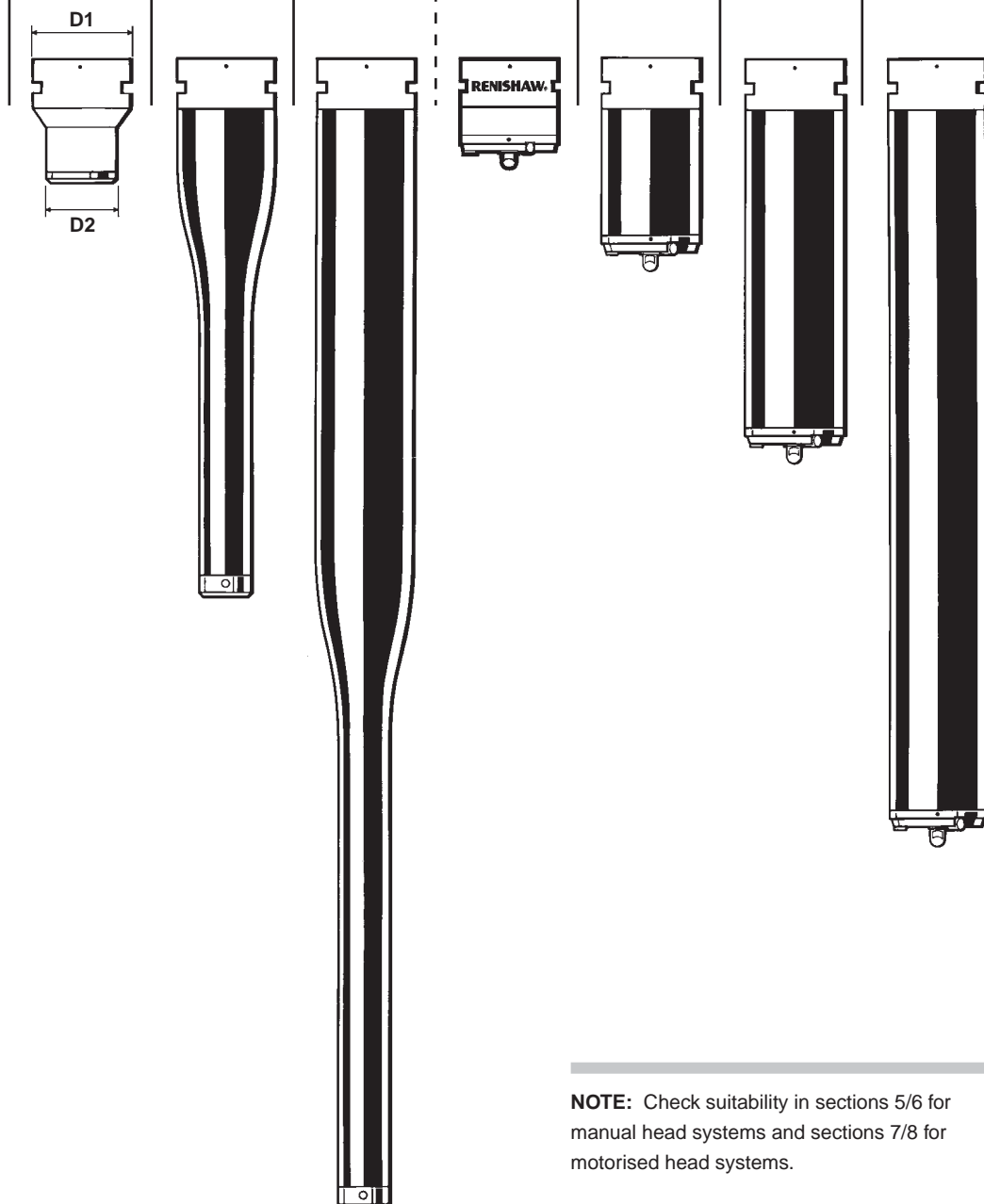
Wall mounting bracket with bolt



Specification summary		MAPS
DIMENSIONS	Height	285 mm (11.22 in) without leg extensions
	Depth	80 mm (3.15 in)
	Width	235 mm (9.25 in)
ADDITIONAL LEGS	Height	100 mm (3.94 in), or 200 mm (7.87 in)
MOUNTING		Single leg or wall bracket

Extension bars - autojoint type

	Autojoint to M8 thread			Autojoint to autojoint			
	PAA1	PAA2	PAA3	PEM25	PEM1	PEM2	PEM3
Material	Steel	Aluminium	Aluminium	Steel	Aluminium	Aluminium	Aluminium
Effective length	32 mm (1.26 in)	140 mm (5.51 in)	300 mm (11.81 in)	25 mm (0.98 in)	50 mm (1.97 in)	100 mm (3.94 in)	200 mm (7.87 in)
D1	Ø24.95 mm (0.98 in)	Ø24.95 mm (0.98 in)	Ø24.95 mm (0.98 in)	Ø24.95 mm (0.98 in)	Ø24.95 mm (0.98 in)	Ø24.95 mm (0.98 in)	Ø24.95 mm (0.98 in)
D2	Ø17.8 mm (0.70 in)	Ø13 mm (0.51 in)	Ø13 mm (0.51 in)	Ø24.95 mm (0.98 in)	Ø24.95 mm (0.98 in)	Ø24.95 mm (0.98 in)	Ø24.95 mm (0.98 in)
Weight	57 g (2.01 oz)	85 g (2.10 oz)	144 g (5.08 oz)	60 g (2.11 oz)	64 g (2.26 oz)	93 g (3.66 oz)	147 g (5.18 oz)



NOTE: Check suitability in sections 5/6 for manual head systems and sections 7/8 for motorised head systems.

PEM extension bars are designed to be used with the TP7M multiwired probe, the SP600M and SP25M scanning probes, as well as other touch-trigger probes using an adaptor.

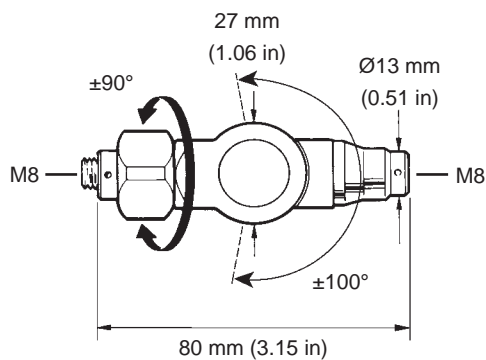
Extension bars - M8 to M8 type

	PEL1	PEL2	PEL3	PEL4
Material	Aluminium	Aluminium	Aluminium	Aluminium
Effective length	50 mm (1.97 in)	100 mm (3.94 in)	200 mm (7.87 in)	300 mm (11.81 in)
D1	Ø13 mm (0.51 in)	Ø18 mm (0.71 in)	Ø18 mm (0.71 in)	See note below
D2	Ø13 mm (0.51 in)	Ø13 mm (0.51 in)	Ø13 mm (0.51 in)	Ø13 mm (0.51 in)
Weight	60 g (2.11 oz)	64 g (2.26 oz)	93 g (3.66 oz)	147 g (5.18 oz)



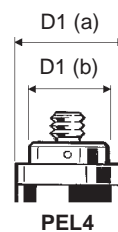
PK1 knuckle joint

The PK1 can be used with all heads except MH20 and MH20i.



NOTE:

- D1 (a) Ø24.95 mm (0.98 in)
- D1 (b) Ø17.8 mm (0.70 in)



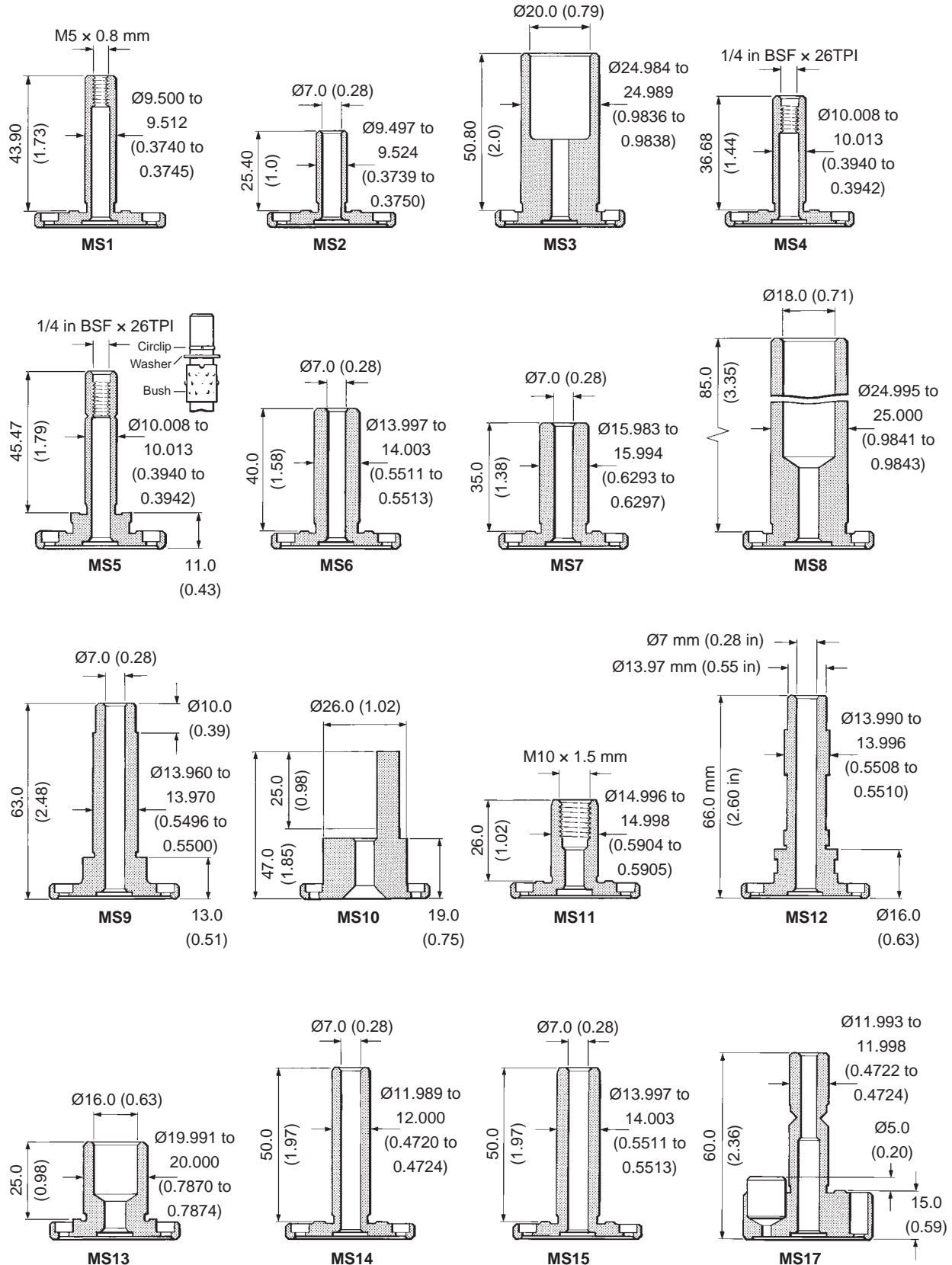
Shanks (except PH6 and MH20)

Shanks are used to mount the probe head to the quill of the machine.

All dimensions in mm (in)

The shanks detailed below are suitable for all Renishaw manual and motorised probe heads (except PH6 and MH20), as well as the TP1 probe. The correct shank must be chosen to suit the mounting facility of your CMM.

Standard base diameter is 41.35 mm - 41.45 mm (1.62 in - 1.63 in).

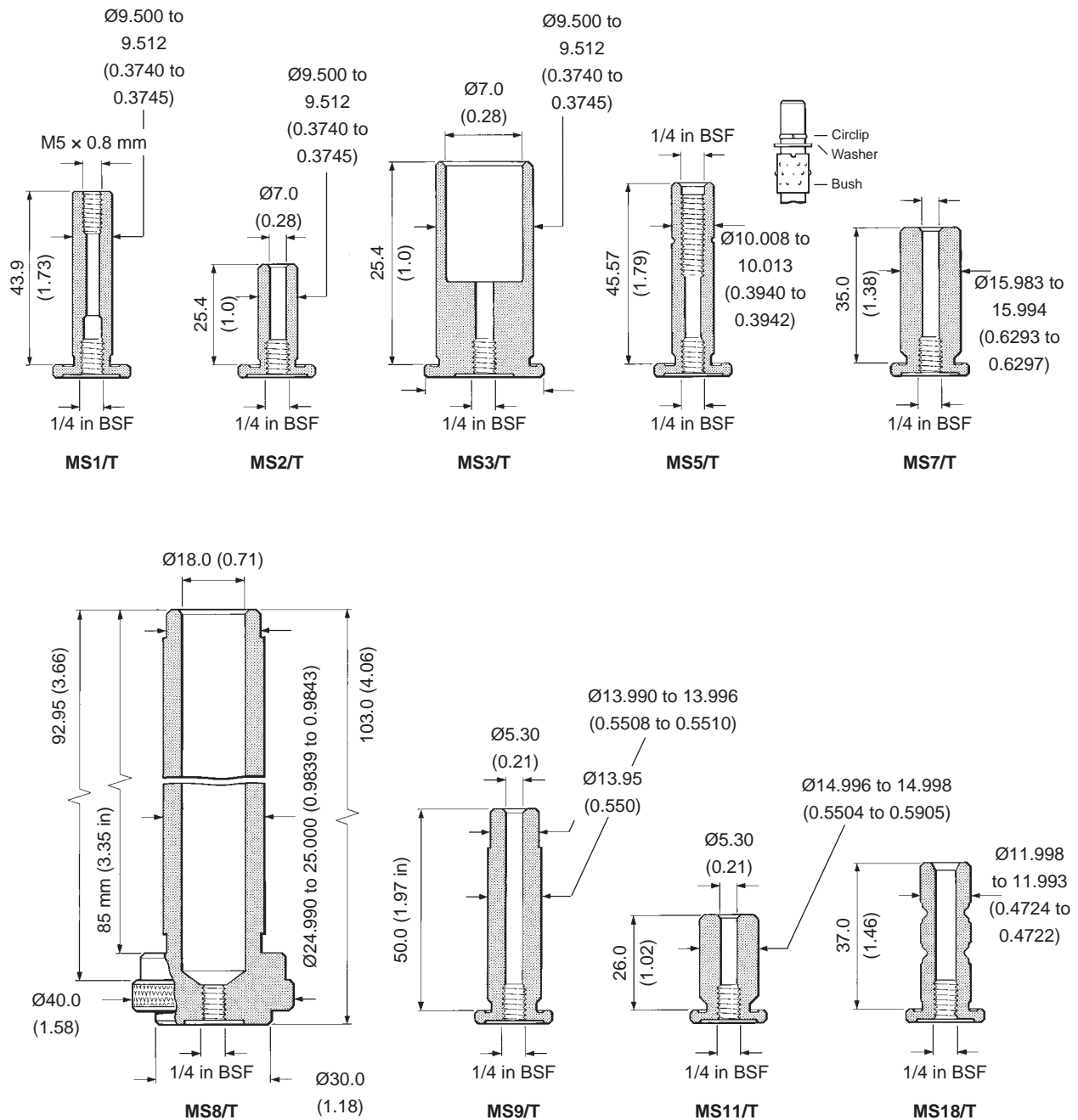


Shanks (for PH6 and MH20 only)

The shanks detailed on this page are suitable for the PH6 and MH20 manual probe heads only.

All dimensions in mm (in)

Standard base diameter is 18.9 mm - 19.1 mm (0.74 in - 0.75 in) unless otherwise stated.



MRS modular rack system

Renishaw's modular rack system (MRS) allows customisation of probe and stylus changing racks to optimise CMM functionality.

The MRS is a modular system designed to provide a platform for Renishaw probe and stylus changing racks. It comprises a rail and two leg assemblies, and is available in three different standard rail lengths, 400 mm, 600 mm and 1000 mm (15.75 in, 23.62 in and 39.37 in) to suit a number of changer requirements.

The MRS rail can also be placed at different heights from the CMM's bed by using multiple MRS legs to allow the required clearance for long styli and extension bars.

The standard interconnecting MRS legs supplied (4 per kit) are each 125 mm (4.92 in) long. A maximum recommended leg length of 500 mm (19.69 in) can be achieved by purchasing additional legs. These are available in either 62.5 mm or 125 mm (2.46 in or 4.92 in) lengths. The rack is mounted on the CMM bed via two MRS feet attached to the legs.

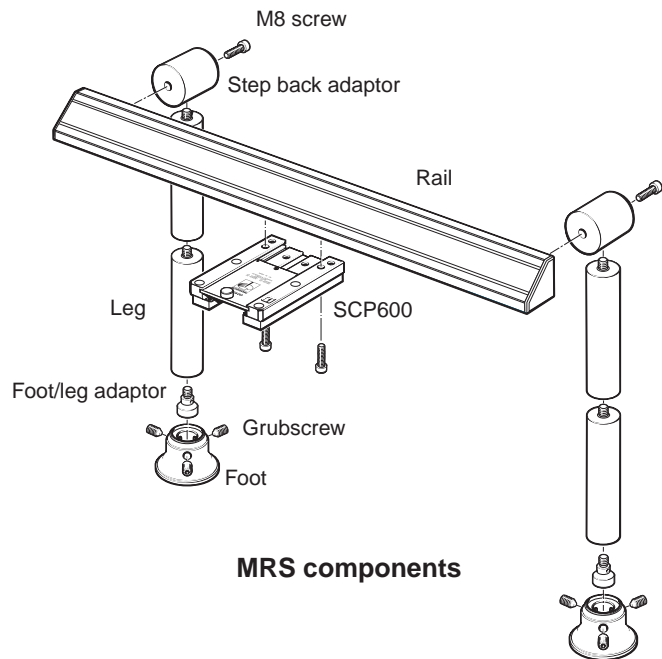
Where heavier rack system configurations are to be used e.g. multiple SCP80s mounted to a 1000 mm (39.37 in) rail length, the MRS system can be upgraded by using the optional heavy duty legs which are Ø60 mm × 350 mm long (Ø2.36 in × 13.78 in long). These legs mount beneath the standard legs/feet and are attached to the CMM bed.

The MRS is compatible with the following Renishaw change rack systems:

- FCR25 (flexible change rack for SP25M)
- SCP80 (stylus change port for SP80)
- SCP600 (stylus change port for SP600/SP600M/SP600Q)
- ACR3 (autochange rack)



MRS with SCP600



MRS components

MRS heavy duty legs

Where an MRS installation has numerous SCP80s containing heavy stylus arrangements, or vertical stylus arrangements exceeding 190 mm (7.48 in), it is recommended that the optional MRS heavy duty leg kits are used to provide additional rigidity/height.

These kits are purchased separately to match the number of legs used in the MRS installation. The heavy duty leg kit stands 330 mm (12.99 in) tall and is positioned between the CMM table and the standard MRS leg assembly.

NOTE: The MRS heavy-duty leg kit part number is A-4192-0020 and comprises one heavy duty leg assembly. Therefore, two kits are required for a typical MRS installation.

MRS heavy duty leg kit

1. Heavy duty leg
2. Double-ended threaded stud *
3. Footplate

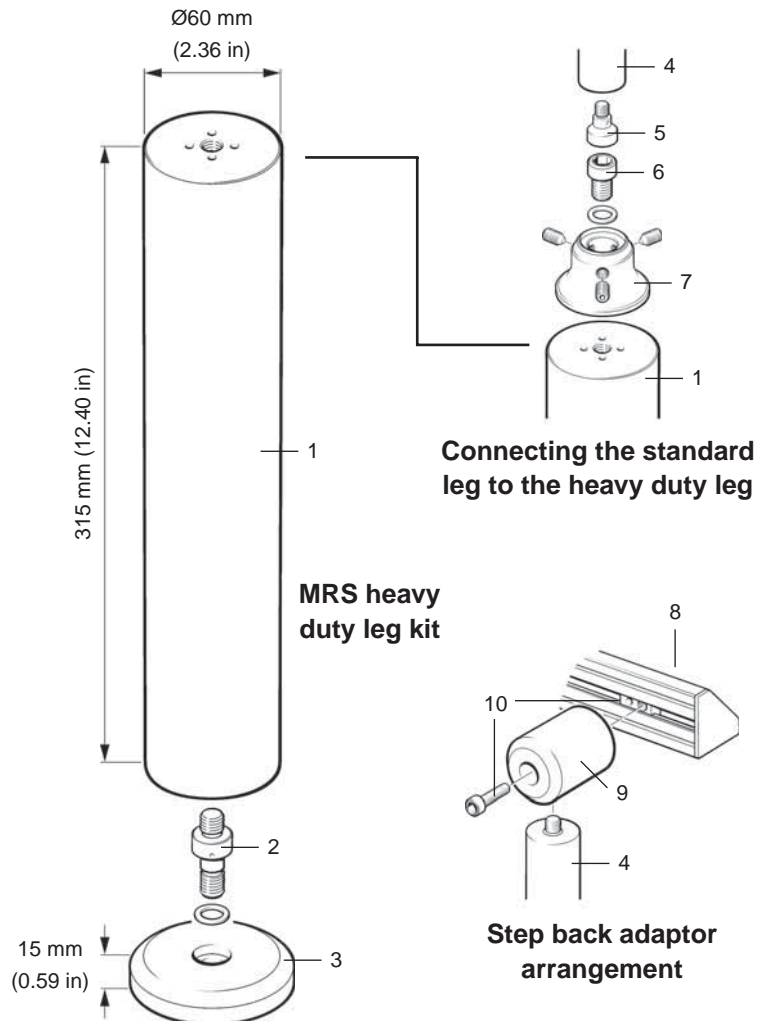
Standard MRS kit parts

4. Standard MRS leg
5. Leg to foot adaptor
6. M10 bolt
7. MRS foot
8. MRS rail
9. Step back adaptor
10. Tee nut and bolt

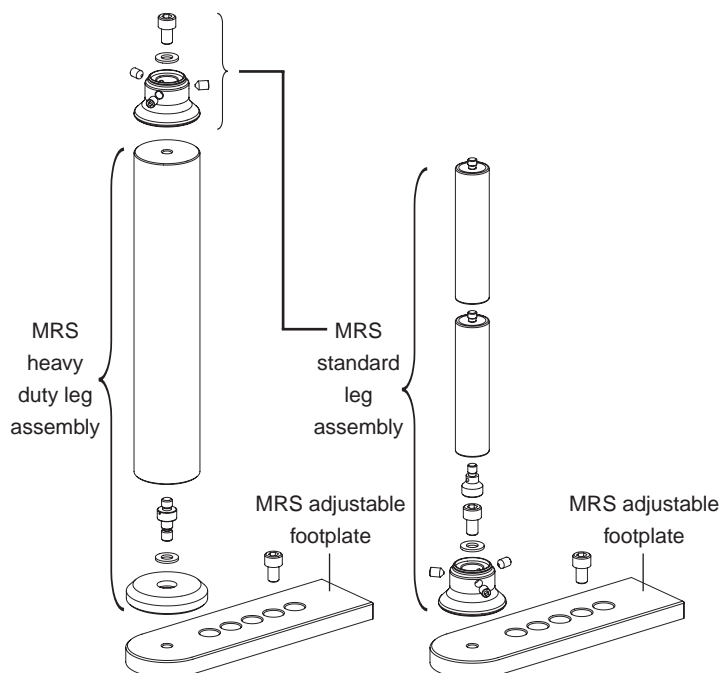
MRS adjustable footplates

By using the optional MRS adjustable footplates, the MRS rail can also be placed at different positions on the CMM's table thereby ensuring that a maximised working volume can be achieved. The MRS adjustable footplates can be used with the MRS standard leg and the MRS heavy duty leg arrangements. The range of adjustment is via four boltholes in steps: 25 mm/50 mm/75 mm/100 mm (0.98 in/1.97 in/2.95 in/3.94 in).

NOTE: The MRS adjustable footplates kit part number is A-4192-0702 and comprises two footplates.

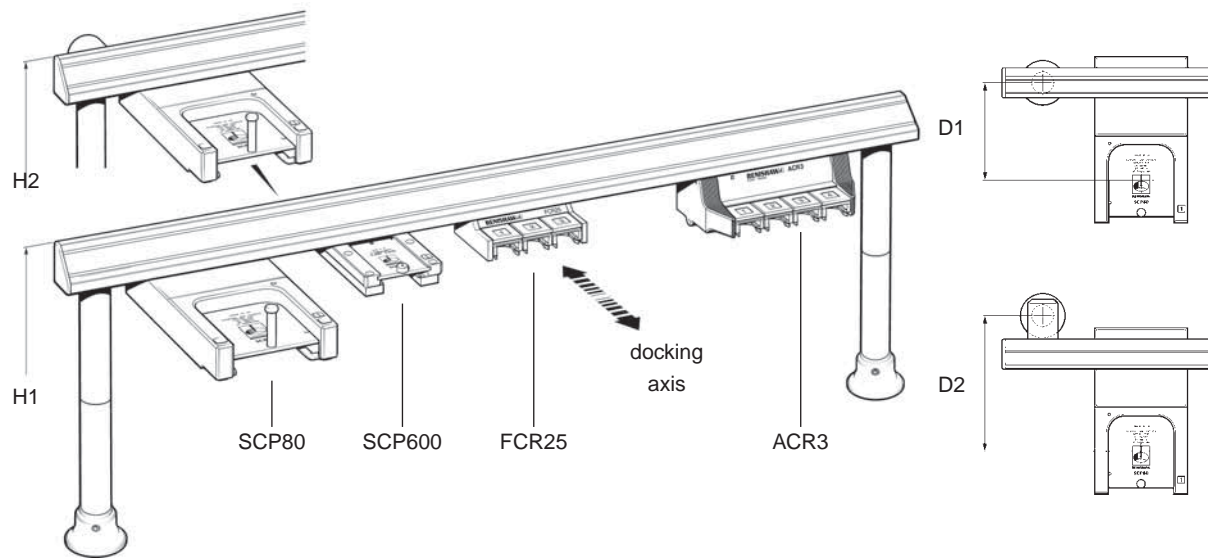


* Two sets of double ended threaded studs are provided to suit different CMM table configurations. The thread sizes supplied are M10 and M8. Alternatively, M6, 3/16 " UNC and 5/16 " UNC can be provided on request to your Renishaw supplier.



MRS adjustable footplate arrangements with standard and heavy duty MRS leg arrangements

Detail showing alternative leg arrangement
using step back adaptor



Specification summary		MRS kit 1	MRS kit 2	MRS kit 3
RAIL LENGTH		400 mm (15.75 in)	600 mm (23.62 in)	1000 mm (39.37 in)
NOTE: Allow additional 10 mm (0.39 in) for plastic end caps				
NUMBER OF LEGS REQUIRED (recommended)		2	2‡	2‡
MAXIMUM USABLE RAIL LENGTH				
With two legs mounted to underside of rail (as shown)		320 mm (12.60 in)	520 mm (20.47 in)	920 mm (36.22 in)
With legs mounted via step back adaptor (see detail)		317 mm (12.48 in)	600 mm (23.62 in)	1000 mm (39.40 in)
HEIGHT TO TOP OF RAIL (using legs supplied with MRS kit)				
H1 = with two legs mounted to underside of rail (as shown)		325 mm (12.80 in)	325 mm (12.80 in)	325 mm (12.80 in)
H2 = with legs mounted via step back adaptor (see detail)		317 mm (12.48 in)	317 mm (12.5 in)	317 mm (12.5 in)
HEIGHT OF ADDITIONAL SINGLE LEG		62.50 mm (2.46 in) 125 mm (4.92 in)	62.50 mm (2.46 in) 125 mm (4.92 in)	62.50 mm (2.46 in) 125 mm (4.92 in)
HEIGHT OF ADDITIONAL HEAVY DUTY SINGLE LEG Ø60.0 mm (2.36 in)		330 mm (12.99 in)	330 mm (12.99 in)	330 mm (12.99 in)
HEIGHT OF ADDITIONAL ADJUSTABLE FOOTPLATE		16 mm (0.63 in)	16 mm (0.63 in)	16 mm (0.63 in)
DISTANCE FROM PORT CENTRE TO LEG CENTRE (in docking axis)				
D1 = with legs mounted to underside of rail (as shown)	FCR25	41 mm (1.61 in)	41 mm (1.61 in)	41 mm (1.61 in)
	ACR3	56 mm (2.21 in)	56 mm (2.21 in)	56 mm (2.21 in)
	SCP600	69.2 mm (2.72 in)	69.2 mm (2.72 in)	69.2 mm (2.72 in)
	SCP80	134 mm (5.28 in)	134 mm (5.28 in)	134 mm (5.28 in)
D2 = with legs mounted via step back adaptor (see detail)	FCR25	94 mm (3.70 in)	94 mm (3.70 in)	94 mm (3.70 in)
	ACR3	109 mm (4.29 in)	109 mm (4.29 in)	109 mm (4.29 in)
	SCP600	122.2 mm (4.81 in)	122.2 mm (4.81 in)	122.2 mm (4.81 in)
	SCP80	187 mm (7.36 in)	187 mm (7.36 in)	187 mm (7.36 in)
RAIL LENGTH REQUIRED PER CHANGER UNIT	FCR25*	115.8 mm (4.56 in)	115.8 mm (4.56 in)	115.8 mm (4.56 in)
	ACR3**	280 mm (11.02 in)	280 mm (11.02 in)	280 mm (11.02 in)
	SCP600*	87 mm (3.43 in)	87 mm (3.43 in)	87 mm (3.43 in)
	SCP80*	133 mm (5.24 in)	133 mm (5.24 in)	133 mm (5.24 in)

* Includes 2 mm (0.08 in) extra allowance per unit

** Includes 5 mm (0.20 in) extra allowance per unit

‡ Centre leg may be required in certain applications

PHA3 and PHA80

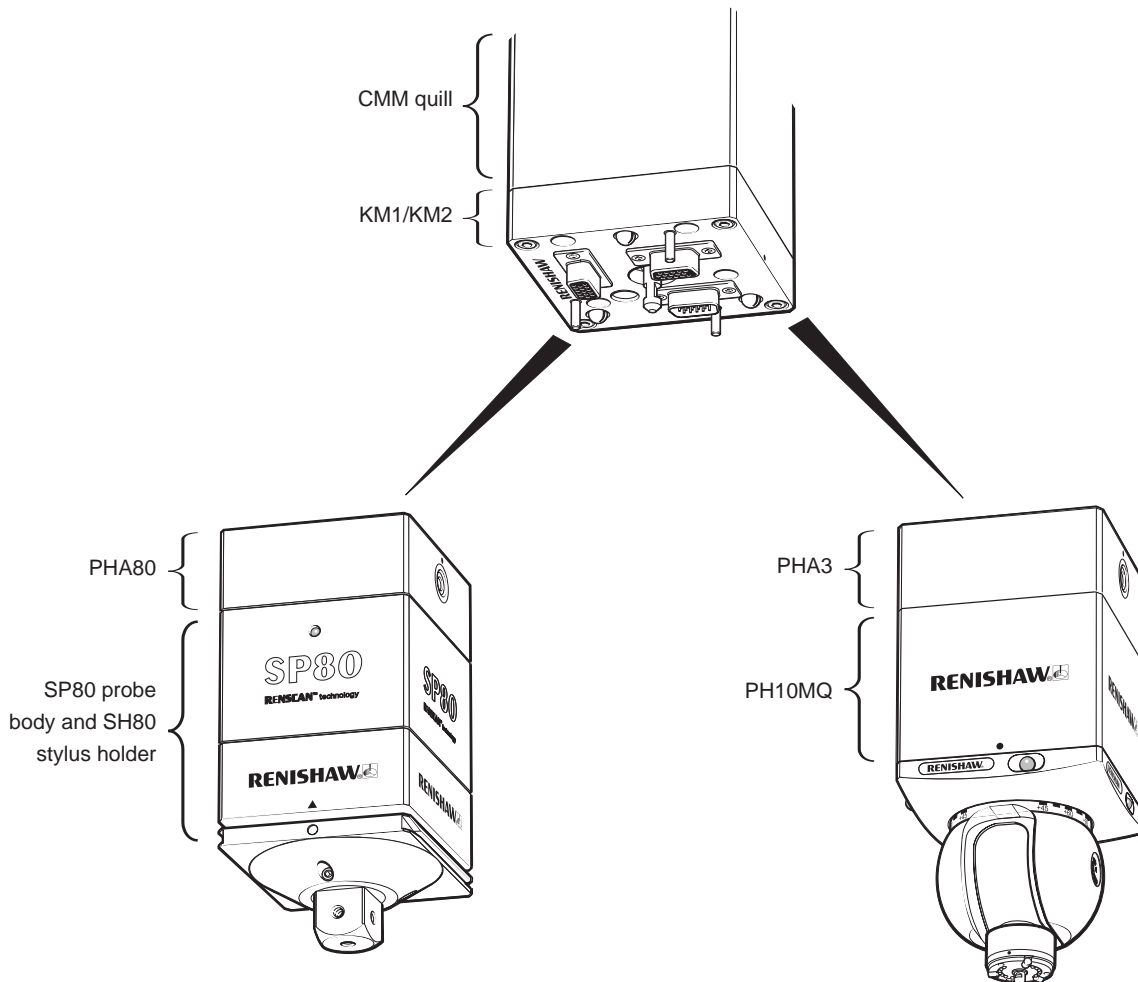
The PHA3 and PHA80 adaptor plates enable rapid interchange between PH10MQ (using PHA3) and SP80 (using PHA80) on the same CMM.

The CMM quill must first be fitted with a KM1 or KM2 (kinematic mounting plate) as appropriate, to which the PHA3/PHA80 mounts via a repeatable kinematic joint featuring quick lock/unlock by simply turning a key. The PH10MQ has to be pre-mounted on the PHA3 and similarly the SP80 to the PHA80. The general mechanical scheme is shown below.

The PHA80 is a single-piece item with the KM1/2 joint on its top face, and a direct mount to the top of the SP80 probe body on its bottom face. Therefore The KM80 is not required.

However, the PHA3 is supplied in two pieces - the PH10MQ is first mounted to the lower hollow piece making a sub-assembly, then the electrical connectors are attached before bolting this sub-assembly to the bottom face of the upper piece which has the KM1/2 joint on its top face.

It is possible to incorporate the IS1-2 interface selector unit into the system interconnection scheme.



PHA3 and PHA80 enable rapid interchange between SP80 and PH10MQ on the same CMM

Cleaning kit - CK200

CK200 (Renishaw part number A-1085-0016) is a specialised cleaning material supplied for the removal of contamination from the location faces of the magnetically retained kinematic couplings of the TP20, TP200 and SP25M probe systems.

The frequency of cleaning should be determined according to the conditions of use.

UDS universal datum sphere

The Renishaw universal datum sphere complements the performance of manual and fully automated CMMs.

Quick and easy adjustment to set ball stem over a wide range of probe qualification angles. This enables qualification above, centrally and below the ball. The hand adjustable pivot joint enables stem rotation through 360° in the horizontal plane, and ±45° in the vertical plane.

Each datum sphere is supplied with its own certificate, giving ball diameter and roundness. All sphere measurements are performed on equipment traceable to UK (NPL) standards.

A vertical positioning feature provides positive feel when the stem arrives in the vertical position.

Vertical height from the table to centre of all ball sizes is approximately 173 mm (6.81 in). An optional pillar extension increases height to 248 mm (9.76 in).

UDS features and benefits:

- Hard wearing tungsten carbide sphere (ball) available in five sizes:

Metric	Ø12, Ø19 and Ø25 mm
Imperial	Ø3/4 and Ø1 in
- Sphericity to within 0.1 µm (0.000004 in)
- Diametric tolerance ±1 µm (±0.00004 in)

Universal datum sphere kit comprises:

- One datum ball (selected by size):
Ø12 mm, Ø19 mm, Ø25 mm, Ø3/4 in or Ø1 in.
- Pivot pillar, base, 'C' spanner
- Ball certificate and storage box
- Adaptor available for twin ball applications (optional)

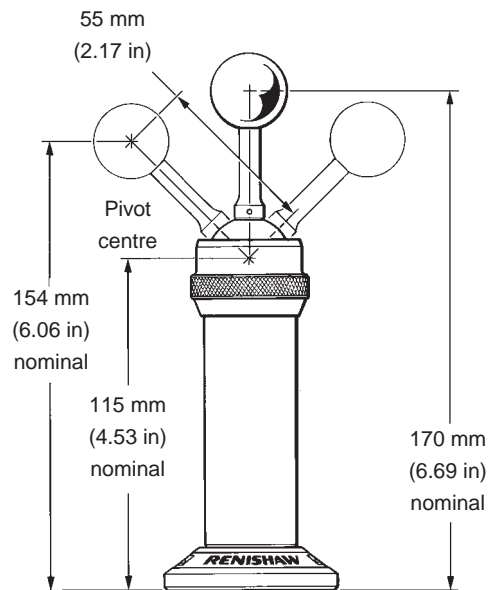
Fixing stud

A fixing stud is required with each kit to attach the pillar to the table surface. Fixing stud thread sizes are:

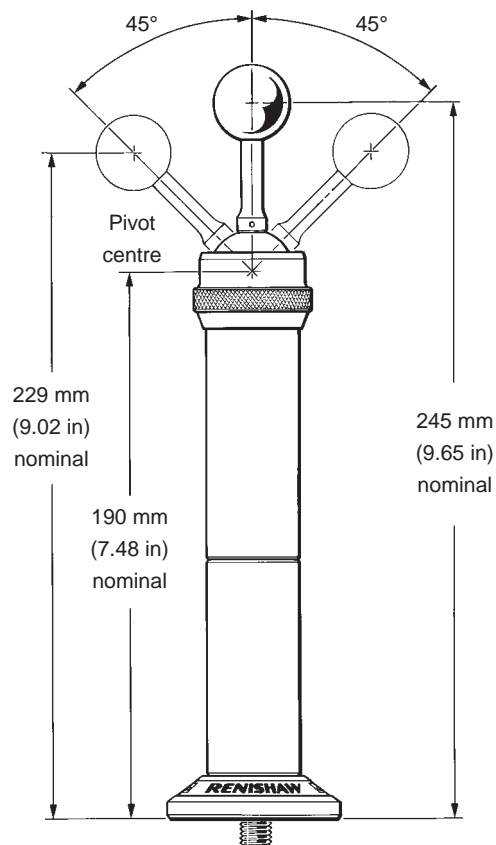
M6 × 1, M8 × 1.25, M10 × 1.5, 5/16 in UNC, 3/8 in UNC

Optional extras

Datum ball	Ø12 mm, Ø19 mm, Ø25 mm, Ø3/4 in, Ø1 in.
Adaptor	2-way adaptor, 3-way adaptor
Pillar extension	75 mm (2.96 in) long



Standard arrangement



Using optional pillar extension

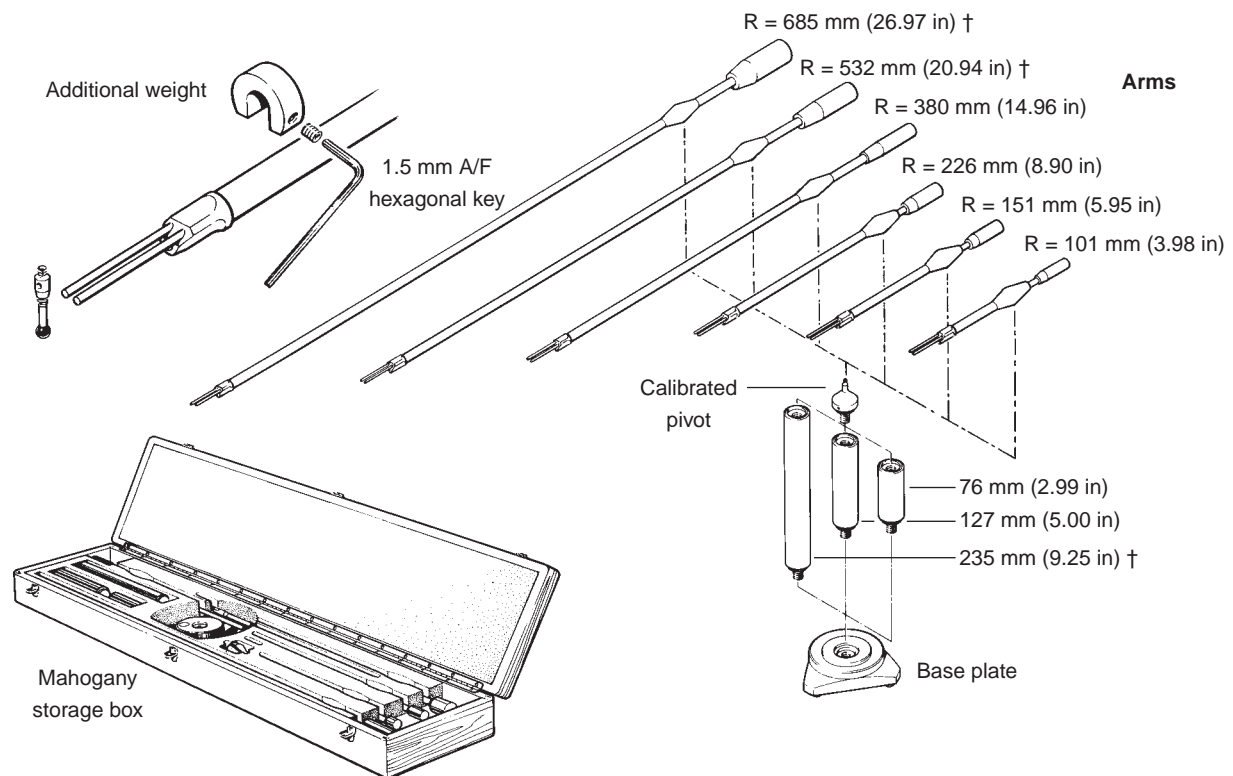
MCG machine checking gauge

Special calibrated stylus can be used with TP1, TP2, TP20, TP6, TP6A, MIP* and PH50* with suitable adaptors.

* Obsolete products

R = Radius from calibrated pivot to stylus ball centre

† These items are included in the MCG2 kit

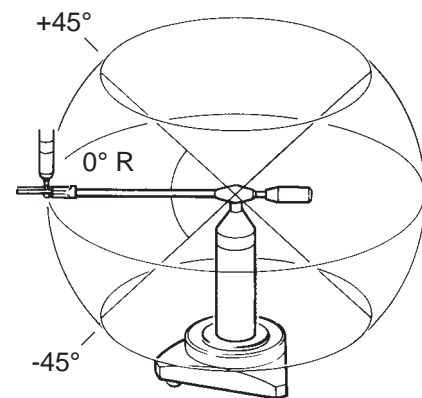


Kit	Description
MCG1	Small kit - for machines up to 1 m ³ (35.315 ft ³)
MCG2	Comprehensive kit - for machines greater than 1 m ³ (35.315 ft ³)

Calibration traceable to USA National Institute of Standards and Technology (Ref #731/23897-87). The machine checking gauge also complies with British Standard BS EN ISO 10360-2.

The probe's stylus slots into the end of what is in effect a reference ballbar. The probe carries the bar with it over a circular path, and radial readings are taken at 0°, +45° and -45° elevations. The range of these readings indicates the volumetric measuring performance of the CMM. Repetition of a sequence of readings checks the system for repeatability.

Volumetric measuring performance is the maximum error between any two points in any plane, over any distance within the full measuring volume.



Specification		
CHECKING TIME	CNC (DCC) machine	Typically 15 minutes
	Joystick machine	Typically 45 minutes
	Manual machine	
MEASURING RANGE	Vertically	±45° ‡
	Horizontally	360°
TOTAL GAUGE ERROR		±0.5 µm (0.00002 in)

‡ Maximum negative arm angle possible is 42°, when using MCG1 kit with the longest arm 320 mm (12.60 in) and both pillars supplied, 127 mm + 76 mm = 203 mm (5 in + 3 in = 8 in)

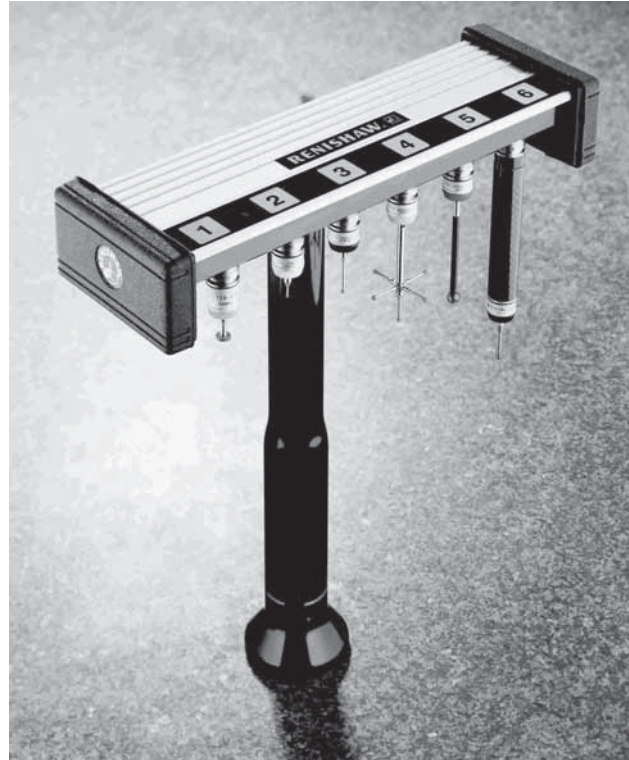
MSR1 manual storage rack

The MSR1 holds up to six pre-qualified stylus assemblies for fitting to TP20 or TP200 probe modules. It eases the operators' task where manual module changing is performed and thus aids productivity improvements.

The MSR1 can be table mounted (as shown) or wall mounted using a bracket. The rack is intended to hold pre-qualified stylus assemblies fitted to TP20 or TP200 probe modules. It provides convenient storage and protects the kinematic coupling mechanism from contamination.

Specification (table mount version)

OVERALL HEIGHT	285 mm (11.22 in)
DEPTH (inc. wall bracket)	86 mm (3.39 in)
WIDTH	236 mm (9.29 in)



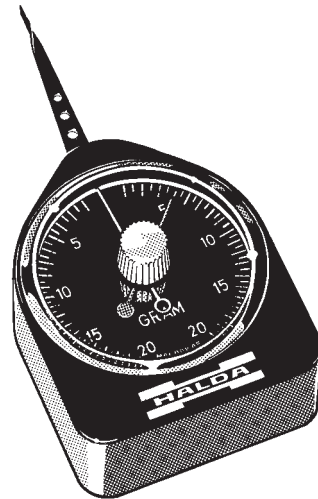
Gram gauge

Renishaw's gram gauge enables the adjustment, reset and checking of probe trigger force settings on all standard Renishaw CMM touch-trigger probes. Setting the optimum trigger force using the gram gauge maximises a probe's performance.

The gram gauge can be used to set trigger force settings over a range from 4 to 35 grams.

The scale graduations are set at 1 gram intervals which is sufficient for all probe trigger force measurements on CMMs.

Due to the use of SI units, the trigger force for probes is given in Newtons. The conversion factor used is 1 gf = 0.01 N.



Specification (table mount version)

OVERALL HEIGHT	95 mm (3.74 in)
NEEDLE LENGTH	41 mm (1.61 in)
DEPTH	27 mm (1.06 in)
WIDTH	43 mm (1.69 in)
RANGE	4 to 35 gram range with 1 gram graduations

Probe type	Stylus length	Optimum trigger force *
TP1	31 mm (1.22 in)	0.15 N (0.52 ozf)
TP2-5W	10 mm (0.39 in)	0.07 - 0.08 N (0.24 - 0.28 ozf)
TP6	21 mm (0.82 in)	0.11 - 0.13 N (0.38 - 0.45 ozf)
TP6A	21 mm (0.82 in)	0.11 - 0.13 N (0.38 - 0.45 ozf)
MIP	21 mm (0.82 in)	0.11 - 0.13 N (0.38 - 0.45 ozf)

* This is the optimum trigger force recommended by Renishaw. Higher trigger forces may be required for longer styli.

Styli

Comprehensive information on Renishaw's styli products can be found in the styli and technical specifications document (H-1000-3200).

Accuracy at the point of contact

As industry has developed its requirement for increasingly diverse and complex manufactured parts, inspection systems have had to work hard to keep up. The use of CMMs with probing systems, and in-process inspection on machine tools, are two of the solutions offered by Renishaw to help you maximise your productivity and maintain the highest possible standards of quality.

Successful gauging depends very much on the ability of the probe's stylus to access a feature and then maintain accuracy at the point of contact. Renishaw has used its expertise in probe and stylus design to develop a comprehensive range of CMM and machine tool styli to offer the greatest possible precision.

These notes explain the critical features of each stylus type, helping you to choose the right design for each inspection need.

What is a stylus?

A stylus is that part of the measuring system which makes contact with the component, causing the probe mechanism to displace, the generated signal enabling measurement to be taken. The feature to be inspected dictates the type and the size of stylus used. However, in all cases maximum rigidity of the stylus and perfect sphericity of the tip are vital.

The performance of gauging can easily be degraded if a stylus is used with poor ball roundness, poor ball location, bad thread fit or a compromised design that allows excessive bending during measurement.

To ensure the integrity of the data gathered, make certain that a stylus from the comprehensive range of genuine Renishaw styli is specified and used.

Choosing a stylus

To maintain accuracy at the point of contact it is recommended that:-

- Styli be kept short
- Joints be minimised
- A large as possible styli ball is used



Genuine Renishaw styli ball materials

Ruby

The industry standard and the optimum stylus ball material for a vast majority of measurement applications is ruby, one of the hardest known materials.

Very few applications exist where ruby is not the best ball material. However, there are two such applications where balls manufactured from other materials are recommended, and these are Silicon nitride and Zirconia.

Silicon nitride

For heavy duty scanning applications on aluminium, a phenomenon known as 'adhesive wear' can occur, which involves build up of aluminium from the surface onto the ball. The preferred ball material for this application is Silicon nitride.

Silicon nitride possesses many similar properties to ruby. It is a very hard and wear resistant ceramic which can be machined into very high precision spheres. It can also be polished to an extremely smooth surface finish. Silicon nitride does not have the attraction to aluminium and so does not exhibit the adhesive wear seen with ruby in similar applications. Silicon nitride does, however, show significant abrasive wear characteristics when scanning steel surfaces so its applications are best confined to aluminium.

Zirconia

In heavy duty scanning applications on cast iron. Interaction between the two materials can result in 'abrasive wear' of the ruby ball's surface. For such applications, Zirconia balls are recommended.

Zirconia is a particularly tough ceramic material with hardness and wear characteristics approaching those of ruby. Its surface properties, however, make it an ideal material for aggressive scanning applications on cast iron components.

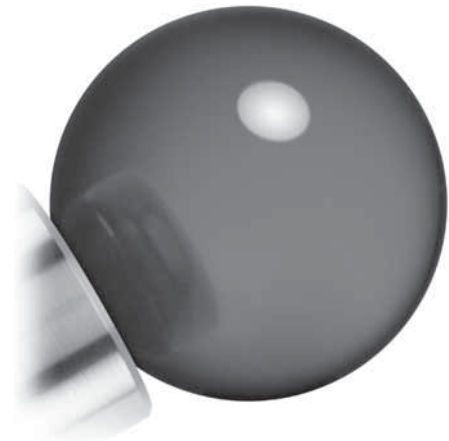
Stylus types

The genuine Renishaw stylus range comprises several types:

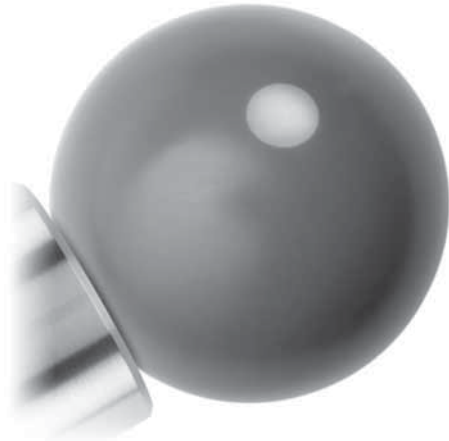
Straight styli	Cylinder styli
Star styli	Pointer styli
Disc styli	Ceramic hollow ball styli

Accessories and tools

Stylus centres	Stylus thread adaptors
Stylus knuckles	Stylus tools
Stylus extensions	Stylus cranks



Ruby



Silicon nitride



Zirconia

Custom design service

Renishaw's Styli and Custom Products Division offer a unique service by providing customers with a total solution should their probing needs for CMM, machine tool or scanning applications be specialised.

In many application problems, the solution lies in the choice of the stylus which influences access of the workpiece features, inspection times and probe performance. All of these aspects are considered within the design of a custom stylus, ensuring that the solution provided incorporates the ideal choice of materials and optimises probe performance for a particular application.

Renishaw's Styli and Custom Products Division has supplied over 5,000 different custom styli into probing applications worldwide, so the solution to an application problem may already exist. For advice and further details, please contact your nearest Renishaw distributor.

For more detailed information please refer to the styli and accessories technical specifications (H-1000-3200).

Always use genuine Renishaw styli or your probe performance will be compromised!



Glossary of terms

Accuracy	For touch-trigger probes, the accuracy is stated in terms of the uncertainty of measurement arising from error sources such as repeatability and pretravel variation.
Analogue probe	A proportional probe in which the displacement of the stylus is represented by a continuously variable output voltage or current proportional to the displacement.
Autojoint	Renishaw's patented highly repeatable 2-part coupling, incorporating a 13-pole connector, which allows probes or extension bars to be interchanged without requalification
Contact probe	A probe that uses a stylus to physically touch the target gauge point on the workpiece whose co-ordinates are to be recorded.
Controller	The electronic unit that controls the motion and positioning of an actuator or motion system. Examples are the controllers for a probe head or the axes of a CMM.
Datum	The reference feature (line or plane) from which other co-ordinates are measured.
E-bar or ebar	An abbreviated name for extension bar.
Edge triggering	The ability of a non-contact probe to automatically locate the edge or boundary of contrasting features on the workpiece.
EWL	Effective working length.
Extension	Device for increasing the reach of a probe or stylus. Extensions placed between the probe and the probe head are known as 'extension bars' or 'E-bars'.
Indexing head	An articulating probe head that may be oriented and locked in a number of repeatable kinematically seated spatial positions. After the stylus tips have been qualified at each required position, the head may be moved to any of these positions without requalification.
Jog	An incremental move of an indexing head to an adjacent position.
Kinematic seating	A mechanism in which the spatial position of a movable component, when located in the seated position, is kinematically constrained by 6 contact points formed by a system of rollers (or 'V' grooves) and ball bearings.
Kinematic	A contact probe in which the kinematic seating forms an electrical circuit where the resistance varies as the stylus is displaced in its mounting, to provide the trigger signal. After displacement, the stylus ball returns to the highly repeatable position defined by the kinematic location points.
Kinematics	The science of motion, independent of force.
Lobing	Used to describe the form measurement error of kinematic switching probes resulting characteristics from the tri-lobed pretravel pattern (in the X-Y plane) that characterises this type of sensor mechanism. Refer to pretravel variation.
M8 connector	The threaded 2-pole connector used to mount a range of probes to the probe head.
Multiwire	The method of interconnection from a probe head fitted with a 13-pole autojoint connector to a probe interface.
Overtravel	The distance that the CMM takes to stop following the assertion of a probe trigger signal.
Overtravel force	The force applied by the stylus ball to the surface at a defined overtravel displacement.
PICS	Acronym for Renishaw's product interconnection system.
Pretravel	The displacement from the point where the stylus ball contacts the workpiece, to the point where a probe trigger is asserted.

Pretravel variation (PTV or XYPTV)	Also called form measurement error or lobing, this source of systematic error is predominant in kinematic switching probes where a tri-lobed pretravel pattern (in the X-Y plane) characterises this type of sensor mechanism.
Probe	The sensor that locates the features to be gauged, relative to the CMM scales.
Probe head	A device fitted to the quill of the CMM that carries the probe mounting connector. Probe heads may have fixed orientation or may articulate to provide re-orientation of the probing axis. Articulating heads may be manually operated or motorised.
Probe interface	An electronic unit that processes the output from the probe sensor and communicates with the CMM controller
Proportional probe	A displacement measuring probe that provides an output, which may be analogue or digital, proportional to stylus displacement over a defined operating range.
Qualification	The procedure in which the measurement processor determines the radius of the stylus tip and its position relative to the scale reference marks or other datum by gauging a calibrated reference sphere or ring gauge.
Quill	The moving component of the CMM that carries the probe, also called the ram.
Repeatability	"The quantitative degree of agreement between results of successive measurements of the same quantity under identical conditions." Unidirectional repeatability is specified for touch-trigger probes.
Requalification	Repetition of the qualification procedure that may be necessary after changing or moving components in the measurement path, or following a change to ambient temperature
Retrofit	The installation of new products or parts onto equipment that is in service
Scanning probe	A proportional probe that is passed over the surface of the workpiece in a continuous movement sending data to the processor at a high rate.
Sense directions	The directions of gauging relative to the probe's coordinate system.
Servo	A motorised articulating probe head that may be oriented to virtually any desired spatial positioning head position with fine resolution. The position is held during probing by the servo control system. High precision rotary position encoders eliminate the need for requalification.
Shank	A plain or tapered shaft for mounting a probe or probe head to the quill of the CMM.
Stylus	The part of contact probes that makes physical contact with the feature to be gauged.
Stylus changing	A system based on a highly repeatable kinematically constrained coupling, to allow the fast exchange of stylus configurations without requalification.
Swept radius	On an articulating probe head, the distance from the centre of rotation of the 'A' axis to the probe or stylus mounting face.
Touch-trigger probe	A discrete point taking type of contact probe.
Trigger force	The force that must be applied at the stylus tip to trigger the probe.
TTP	Touch-trigger probe/probing
Unidirectional repeatability	The variation of the position of successive triggers taken in the same direction of triggering under constant conditions.

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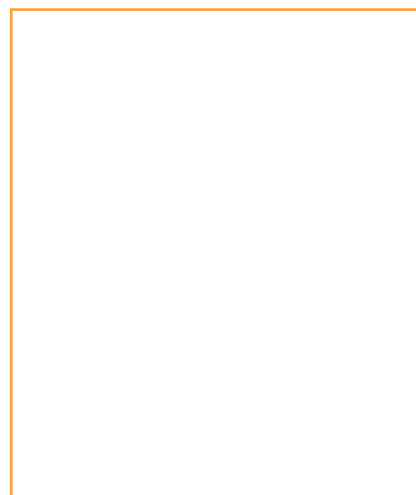


Renishaw plc
New Mills, Wotton-under-Edge,
Gloucestershire, GL12 8JR
United Kingdom

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

RENISHAW 
apply innovation™

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



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