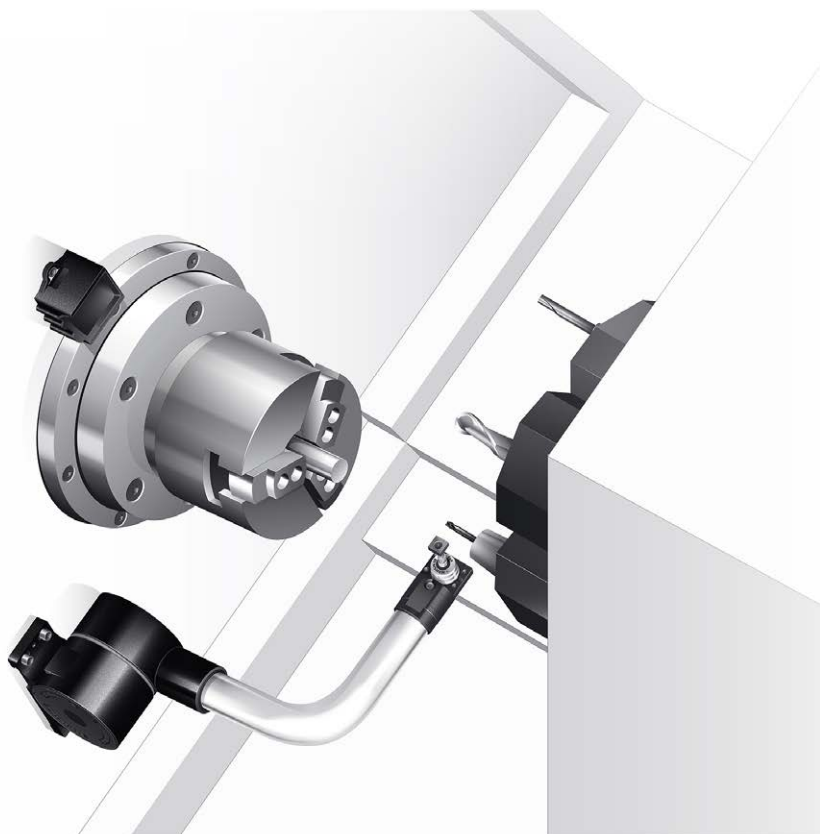


HPPA and TSI 2 / TSI 2-C pulldown arm and interface



Original instructions – translations of these original instructions are available on request.

Compliance information for this product is available by scanning the QR code or visiting www.renishaw.com/mtpdoc



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Before you begin

Trade marks

Google Play and the Google Play logo are trademarks of Google LLC.

Apple and the Apple logo are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc., registered in the U.S. and other countries.

Warranty

Unless you and Renishaw have agreed and signed a separate written agreement, the equipment and/or software are sold subject to the Renishaw Standard Terms and Conditions supplied with such equipment and/or software, or available on request from your local Renishaw office.

Renishaw warrants its equipment and software for a limited period (as set out in the Standard Terms and Conditions), provided that they are installed and used exactly as defined in associated Renishaw documentation. You should consult these Standard Terms and Conditions to find out the full details of your warranty.

Equipment and/or software purchased by you from a third-party supplier is subject to separate terms and conditions supplied with such equipment and/or software. You should contact your third-party supplier for details.

CNC machines

CNC machine tools must always be operated by fully-trained personnel in accordance with the manufacturer's instructions.

Care of the system

Keep system components clean and treat the system as a precision tool.

Patents

Features of the Renishaw HPPA, and other related products, are subject of one or more of the following patents and/or patent applications:

EP 1537376

Intended use

The HPPA system is a tool setting solution predominantly intended for use on CNC turning machines for high-precision measurement of cutting tools.

Safety

Information to the user

In all applications involving the use of machine tools, eye protection and safety footwear is recommended.

Remove power before performing any maintenance operations.

The expected method of providing an emergency stop for Renishaw products is to remove power.

Information to the machine supplier / installer

It is the machine supplier's responsibility to ensure that the user is made aware of any hazards involved in operation, including those mentioned in Renishaw product literature, and to ensure that adequate guards and safety interlocks are provided.

If the probe system fails, the probe signal may falsely indicate a probe seated condition. Do not rely on probe signals to halt the movement of the machine.

The high-precision pulldown arm (HPPA) system must be installed by a competent person, observing relevant safety precautions. Before starting work, ensure that the machine tool is in a safe condition with the power switched OFF and the power supply to the TSI 2 or TSI 2-C disconnected.

CAUTION: HPPA and TSI 2 / TSI 2-C are intended for exclusive use as part of the HPPA system. Any attempts to integrate with other arms or interfaces could result in unexpected behaviour and/or product damage.

Information to the equipment installer

All Renishaw equipment is designed to comply with the relevant UK, EU and FCC regulatory requirements. It is the responsibility of the equipment installer to ensure that the following guidelines are adhered to, in order for the product to function in accordance with these regulations:

- the dc supply to this equipment must be derived from a source which is compliant with current local electrical safety requirements and is approved to IEC 60950-1, UL BS EN IEC 62368-1, UL BS EN IEC 61010-1 or suitable equivalent;
- any interface **MUST** be installed in a position away from any potential sources of electrical noise (for example, power transformers, servo drives);
- all 0 V/ground connections should be connected to the machine “star point” (the “star point” is a single point return for all equipment ground and screen cables). This is very important and failure to adhere to this can cause a potential difference between grounds;
- all screens must be connected as outlined in the user instructions;
- cables must not be routed alongside high current sources (for example, motor power supply cables), or be near high-speed data lines;
- cable lengths should always be kept to a minimum.

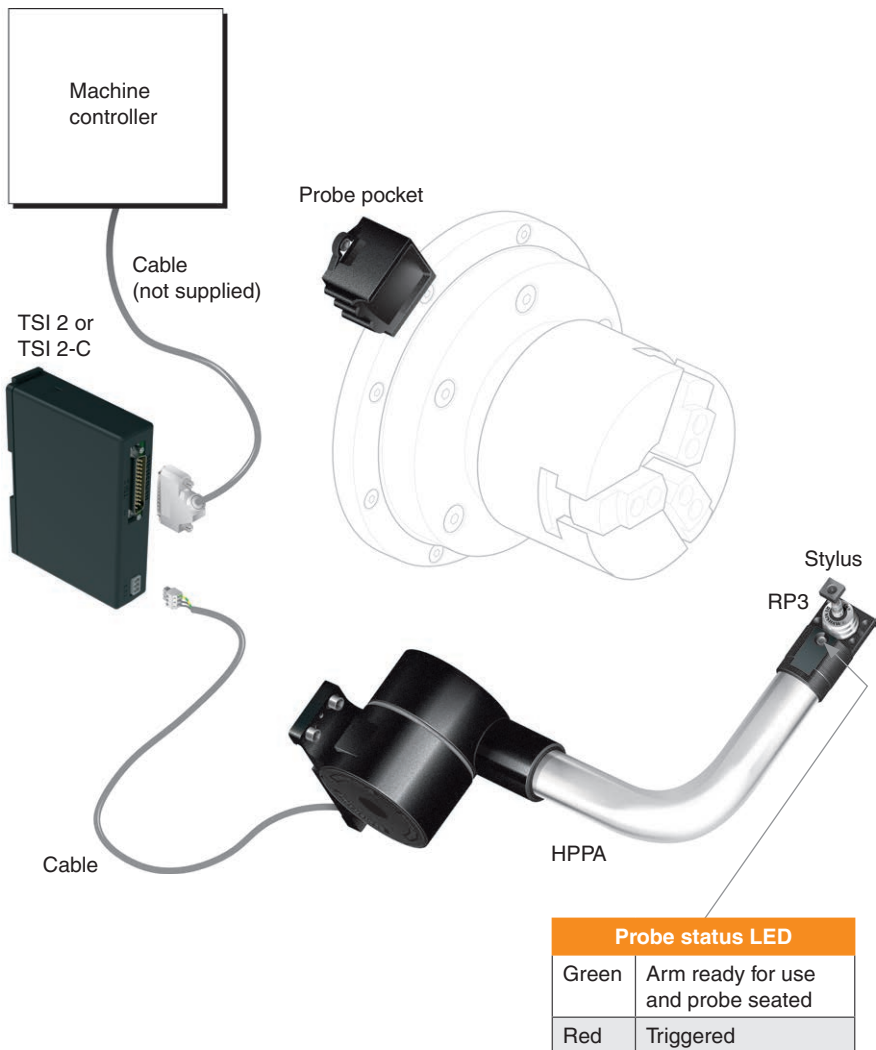
Equipment operation

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Glossary of terms

| Abbreviation | Definition |
|--------------|-------------------------------|
| HPPA | High-precision pulldown arm |
| CNC | Computer numerical control |
| TSI | Tool setting interface |
| ARO | Arm ready output |
| MRO | Machine ready output |
| INH | Inhibit input |
| SEL | Select input |
| NO | Normally open |
| NC | Normally closed |
| SCR | Screen |
| O/C | Open circuit |
| OCT | Open collector transistor |
| SSR | Solid-state relay |
| COM | Common |
| PELV | Protective extra-low voltage |
| LED | Light-emitting diode |
| EMI | Electro-magnetic interference |

System kit



NOTE: For part numbers, refer to the parts list on **page 50**.

The HPPA system is a mechanism for manually presenting a probe into the working envelope of a machine tool, in order for tool setting to be carried out. Once complete, the probe is manually retracted to a safe location.

HPPA specification

| Variant | | Standard rear exit | Standard side exit |
|--|-----------------------|---|---|
| Principal application | | Tool measuring on 2-axis and 3-axis CNC lathes. | |
| Transmission type | | Hard-wired transmission | |
| Weight | | ≈ 5 kg (176 oz) | |
| Probe | | RP3 ¹ | |
| Compatible interfaces | | TSI 2 or TSI 2-C | |
| Cable (arm to interface) | Type | Ø5.25 mm (0.21 in), 5-core screened cable, each core is 0.34 mm ² | Ø4.0 mm (0.16 in), 2-core screened cable, each core is 0.34 mm ² |
| | Length | 2 m (6.5 ft), 5 m (16.4 ft), 10 m (32.8 ft) | 7 m (22.9 ft) |
| Sense directions | | ±X, ±Y, +Z (probe axes; refer to page 17 , “HPPA dimensions”, for definition) | |
| Typical positional repeatability (probe axes) ^{2,3} | | 5 µm (197 µin) 2σ X/Y (arms for machines with 6 in to 15 in chucks) 8 µm (315 µin) 2σ X/Y (arms for machines with 18 in to 24 in chucks) | |
| Stylus trigger force (probe axes) ^{4,5} XY low force XY high force +Z direction | | 1.5 N, 153 gf (5.4 ozf) 3.5 N, 357 gf (12.59 ozf) 12 N, 1224 gf (43.16 ozf) | |
| Arm sweep angle | | 90° (if not using Renishaw probe pocket, maximum arm sweep angle is 91°) | |
| Mounting | | M8 bolts (× 3) | |
| Probe pocket mounting | | M6 bolts (× 2) | |
| Environment | IP rating | IPX6 and IPX8, BS EN 60529:1992+A2:2013 | |
| | Storage temperature | −25 °C to +70 °C (−13 °F to +158 °F) | |
| | Operating temperature | +5 °C to +55 °C (+41 °F to +131 °F) | |

¹ Where the RP3 is to be used in the probe's Z axis (typically the CNC lathe Y axis), a five-faced stylus is available to order from the Renishaw Online store at www.renishaw.com/shop.

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

³ Repeatability performance is not specified in the arm rotational axis. Refer to **page 17**, “HPPA dimensions”, to identify this axis.

⁴ Trigger force, which is critical in some applications, is the force exerted on the stylus by the tool when the probe triggers. The maximum force applied will occur after the trigger point (overtravel). The force value depends on related variables including measuring speed and machine deceleration.

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

TSI 2 / TSI 2-C specification

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

HPPA installation

WARNINGS:

Safety footwear and eye protection should be worn while installing the HPPA.

Remove all power before commencing installation.

Care should be taken to avoid any finger traps.

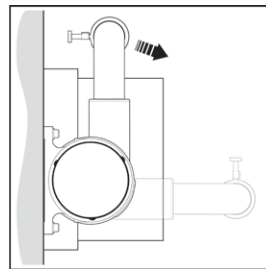
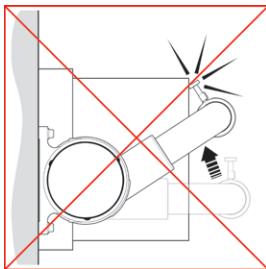
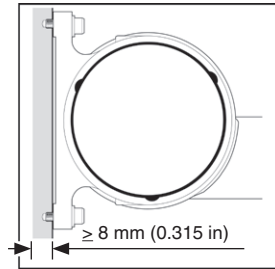
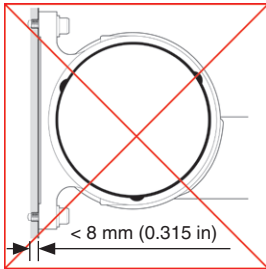
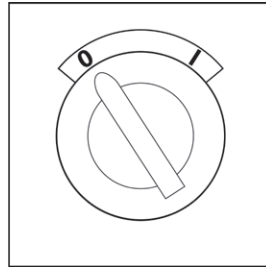
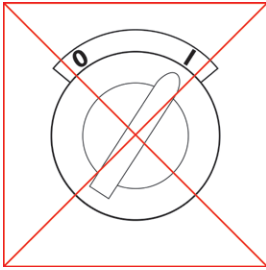
CAUTIONS:

Lifting equipment may be attached around the tube, around the hub and base, and around the probe holder (taking care to avoid the probe), if required.

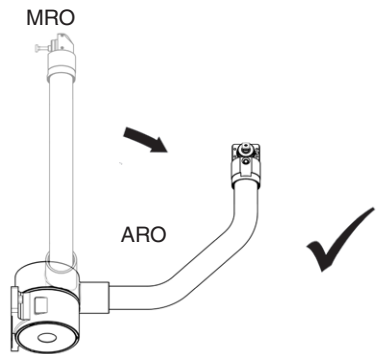
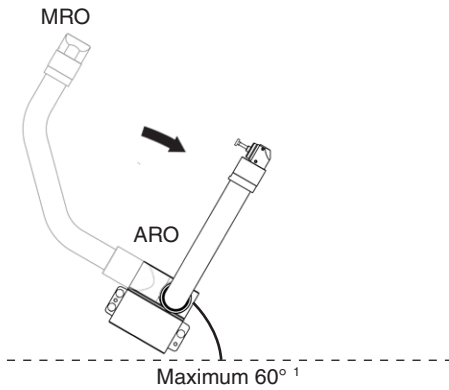
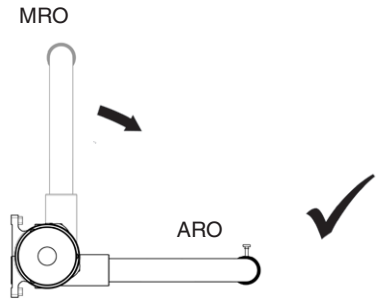
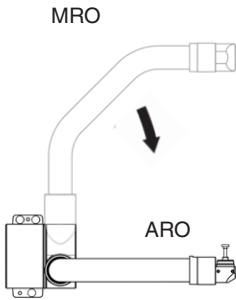
Do not add any attachments to the arm. If any attachment is deemed essential, contact Renishaw.

For best performance of the HPPA, the following installation guidelines are recommended:

- The HPPA is ideally mounted on a solid fixed part of the machine tool, such as a casting. If mounting brackets or plates are used, these must be designed to maximise stiffness with minimal joints. If mounted onto a moving part of the machine tool, repeatability may be adversely affected.
- The HPPA can be orientated at any angle between 0° and 60° from the horizontal, with the arm lowering into “arm ready position”. Performance can be compromised if the HPPA is orientated with the arm rising vertically into “arm ready position” and this should be avoided unless the installation is approved by Renishaw.
- The HPPA is sealed to IPX6 and IPX8, designed for the harsh environments inside a machine tool. However, high-pressure jets and reflected jets can exceed this specification and must not spray directly onto the HPPA. If it is not possible to position the HPPA away from these jets, the hub and base should be protected with suitable guarding. Guarding is not supplied by Renishaw.
- Like all metrology systems, repeatability can be adversely affected by thermal effects on the machine tool. Renishaw recommends that thermal compensation routines are incorporated into the measurement software cycles to counteract these effects.



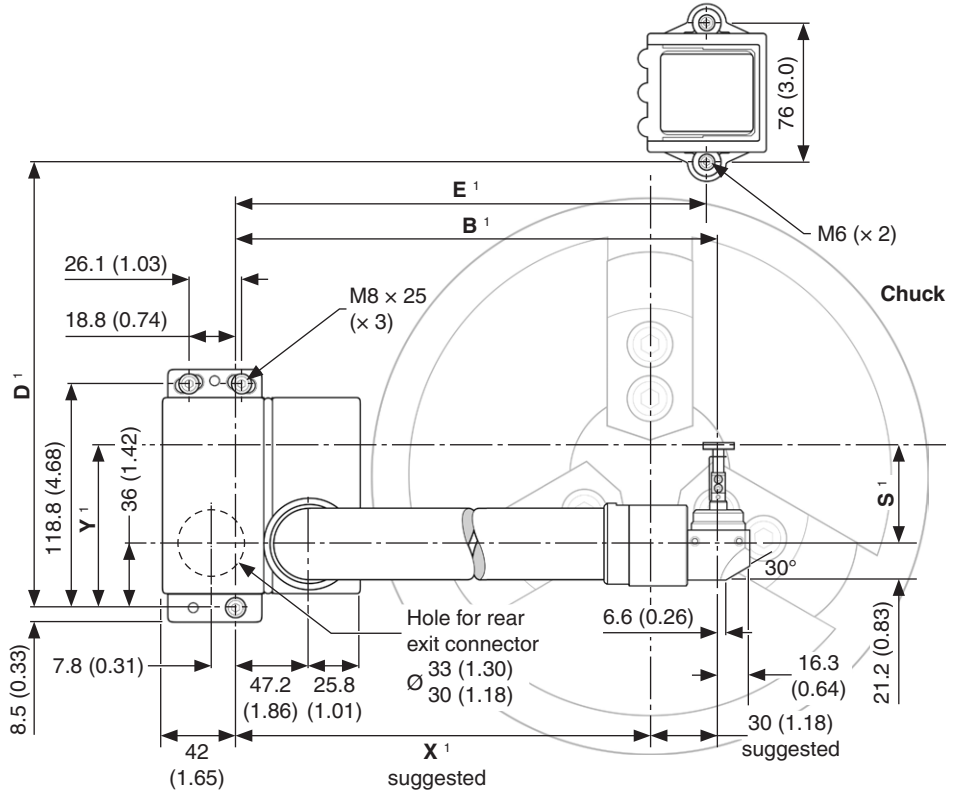
Acceptable orientation of hub and base



¹ For applications outside of this range, contact Renishaw.

HPPA mounting details

The arm and probe holder arrangement shown is for illustration purposes only.

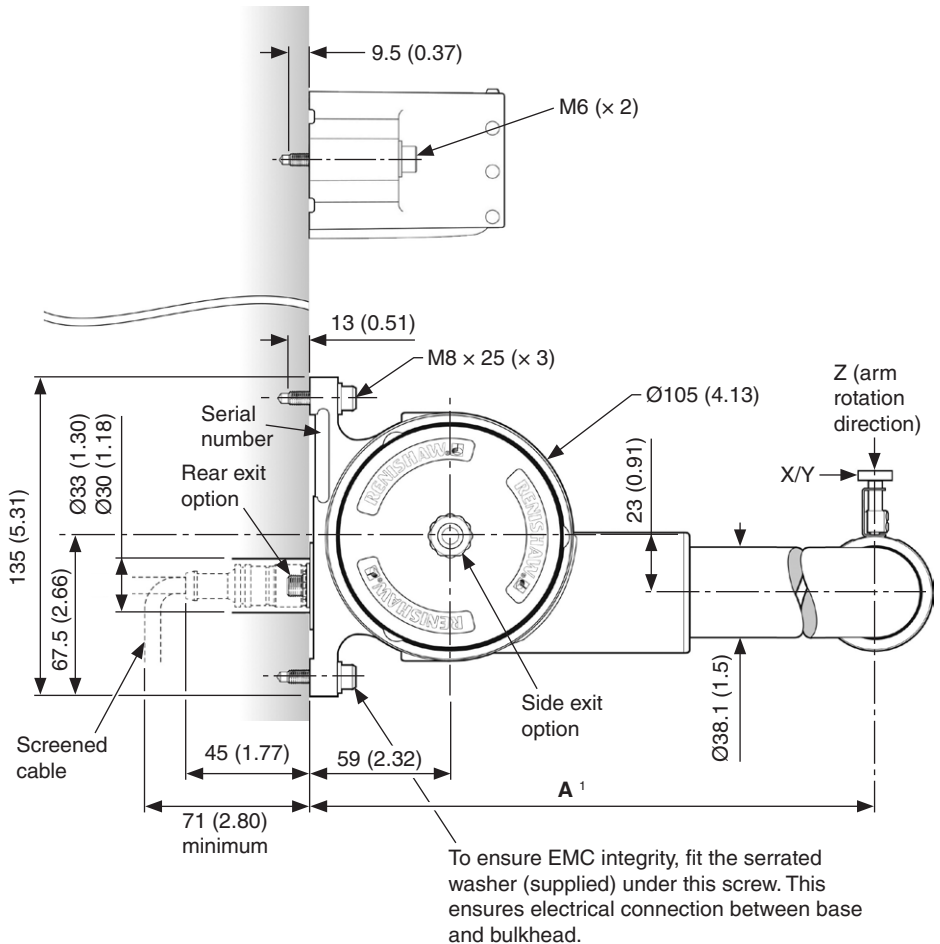


Dimensions given in mm (in)

¹ A range of standard sizes are available, with either a rear or side exit connection. See the table on **page 19** for further information.

HPPA dimensions

The arm and probe holder arrangement shown is for illustration purposes only.

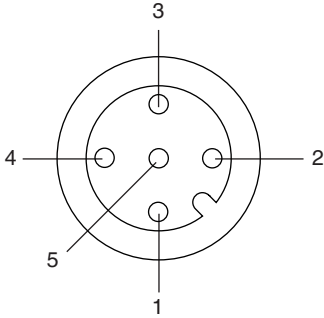


Dimensions given in mm (in)

¹ A range of standard sizes are available, with either a rear or side exit connection. See the table on **page 19** for further information.

Rear exit wiring

5-way M12 panel mount connector



NOTE: Connect the cable before fitting the HPPA. Ensure the connector is fitted finger-tight using the M12 knurled fitting.

| Pin | Function |
|-------|----------|
| 1 | Probe + |
| 2 | Probe - |
| 3 | Screen |
| 4 | - |
| 5 | - |
| Shell | Screen |

Side exit wiring



Cable to TSI 2 or TSI 2-C
7 m (23 ft)

19 mm A/F conduit adaptor suitable for ¼ in flexible metal conduit.

| Colour | Function |
|------------|----------|
| Blue | Probe + |
| Grey/black | Screen |
| Green | Probe - |

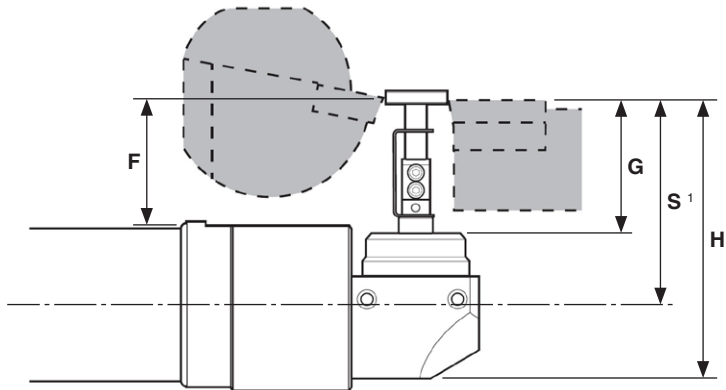
Standard arms dimension table

| Chuck size | Tooling size | Arm size | | D | E | S ¹ | X | Y |
|------------|--------------|----------|---------|----------------|----------------|----------------|------------------|-------------|
| | | A | B | | | | | |
| 6 in | 16 mm | 250 | 219.2 | 212 (8.35) | 212 (8.35) | 35.7 (1.40) | 189.2 (7.45) | 71.7 (2.82) |
| | 20 mm | (9.84) | (8.63) | | | 41 (1.61) | | 77 (3.03) |
| | 25 mm | | | | | 51 (2.01) | | 87 (3.42) |
| | 32 mm | | | | | 56 (2.20) | | 92 (3.62) |
| 8 in | 16 mm | 286 | 249.2 | 248 (9.76) | 242 (9.53) | 35.7 (1.40) | 219.2 (8.63) | 71.7 (2.82) |
| | 20 mm | (11.26) | (9.81) | | | 41 (1.61) | | 77 (3.03) |
| | 25 mm | | | | | 51 (2.01) | | 87 (3.42) |
| | 32 mm | | | | | 56 (2.20) | | 92 (3.62) |
| 10 in | 16 mm | 335 | 298.2 | 297 (11.69) | 291 (11.46) | 35.7 (1.40) | 268.2 (10.56) | 71.7 (2.82) |
| | 20 mm | (13.19) | (11.74) | | | 41 (1.61) | | 77 (3.03) |
| | 25 mm | | | | | 51 (2.01) | | 87 (3.42) |
| | 32 mm | | | | | 56 (2.20) | | 92 (3.62) |
| | 40 mm | | | | | 61 (2.40) | | 97 (3.82) |
| 12 in | 16 mm | 368 | 298.2 | 330 (12.99) | 291 (11.46) | 35.7 (1.40) | 268.2 (10.56) | 71.7 (2.82) |
| | 20 mm | (14.49) | (11.74) | | | 41 (1.61) | | 77 (3.03) |
| | 25 mm | | | | | 51 (2.01) | | 87 (3.42) |
| | 32 mm | | | | | 56 (2.20) | | 92 (3.62) |
| | 40 mm | | | | | 61 (2.40) | | 97 (3.82) |
| | 50 mm | | | | | 71 (2.80) | | 107 (4.21) |
| 15 in | 20 mm | 400 | 343.2 | 362 (14.25) | 336 (13.23) | 41 (1.61) | 313.2 (12.33) | 77 (3.03) |
| | 25 mm | (15.75) | (13.51) | | | 51 (2.01) | | 87 (3.42) |
| | 32 mm | | | | | 56 (2.20) | | 92 (3.62) |
| | 40 mm | | | | | 61 (2.40) | | 97 (3.82) |
| | 50 mm | | | | | 71 (2.80) | | 107 (4.21) |
| 18 in | 25 mm | 469 | 383.2 | 431 (16.97) | 376 (14.80) | 51 (2.01) | 353.2 (13.91) | 87 (3.42) |
| | 32 mm | (18.46) | (15.09) | | | 56 (2.20) | | 92 (3.62) |
| | 40 mm | | | | | 61 (2.40) | | 97 (3.82) |
| | 50 mm | | | | | 71 (2.80) | | 107 (4.21) |
| 24 in | 25 mm | 555 | 458.2 | 517 (20.35) | 451 (17.76) | 51 (2.01) | 428.2 (16.86) | 87 (3.42) |
| | 32 mm | (21.85) | (18.04) | | | 56 (2.20) | | 92 (3.62) |
| | 40 mm | | | | | 61 (2.40) | | 97 (3.82) |
| | 50 mm | | | | | 71 (2.80) | | 107 (4.21) |

Dimensions given in mm (in)

¹ Stylus height, S, is adjustable. See "Stylus coarse adjustment" on page 22.

Stylus dimensions by tool size

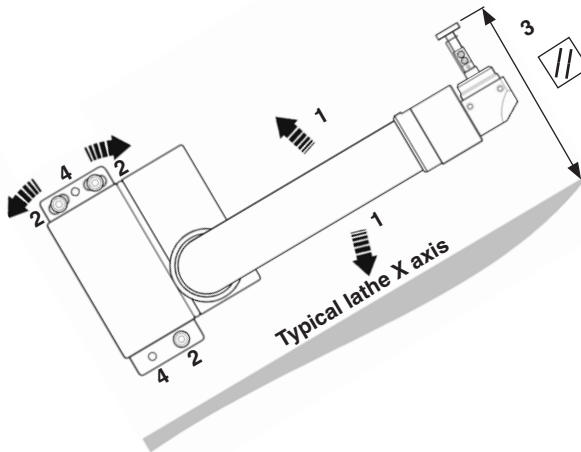


¹ Stylus height, S, is adjustable. See "Stylus coarse adjustment" on [page 22](#).

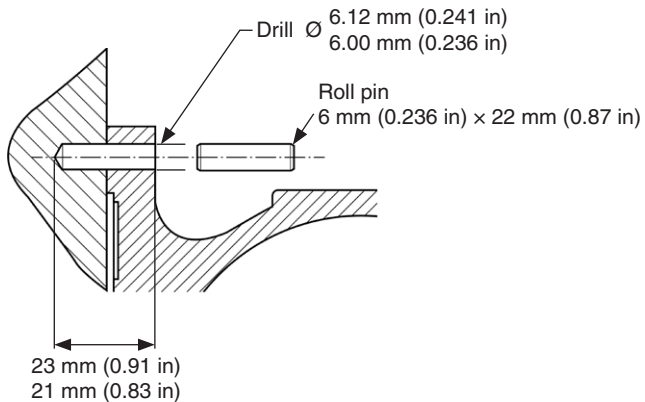
| Tooling size | Stylus length (see "Parts list" on page 50) | F | G | H | S |
|--------------|--|-------------|-------------|-------------|-------------|
| 16 mm | 14.2 (0.56) | 14.2 (0.56) | 19.1 (0.75) | 56.9 (2.24) | 35.7 (1.40) |
| 20 mm | 19.5 (0.77) | 19.5 (0.77) | 24.4 (0.96) | 62.2 (2.45) | 41 (1.61) |
| 25 mm | 29.5 (1.16) | 29.5 (1.16) | 34.4 (1.35) | 72.2 (2.84) | 51 (2.01) |
| 32 mm | 34.5 (1.36) | 34.5 (1.36) | 39.4 (1.55) | 77.2 (3.04) | 56 (2.20) |
| 40 mm | 39.5 (1.56) | 39.5 (1.56) | 44.4 (1.75) | 82.2 (3.24) | 61 (2.40) |
| 50 mm | 49.5 (1.95) | 49.5 (1.95) | 54.4 (2.14) | 92.2 (3.63) | 71 (2.80) |

Dimensions given in mm (in)

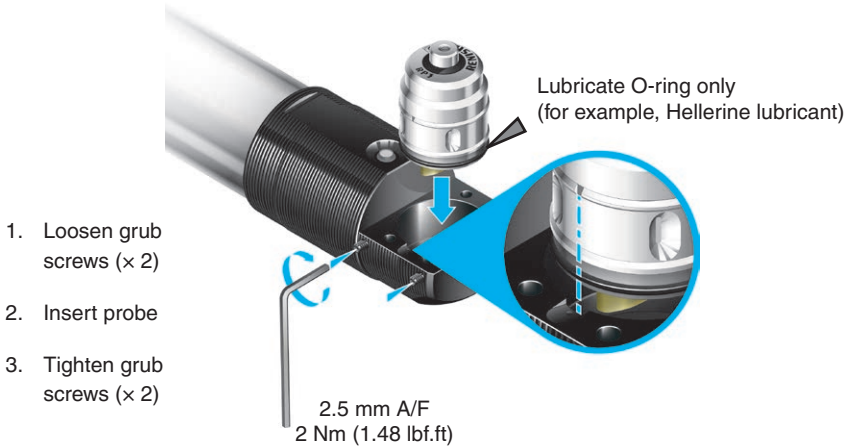
Top face parallelism



1. Rotate arm on bottom mounting screw to set stylus alignment.
2. Tighten all screws to 10 Nm (7.38 lbf.ft).
3. Check that stylus alignment has not moved after tightening.
4. Drill through base into mounting using pilot holes as a guide.
5. Fit roll pins supplied in base fixing kit. Apply corrosion inhibitor to pins after fitting.

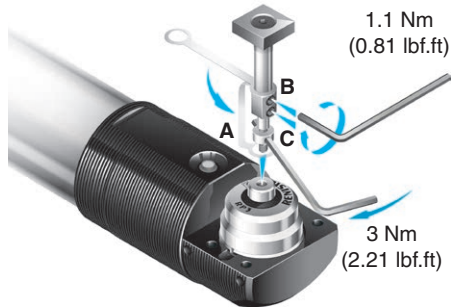


Fitting the probe to the arm

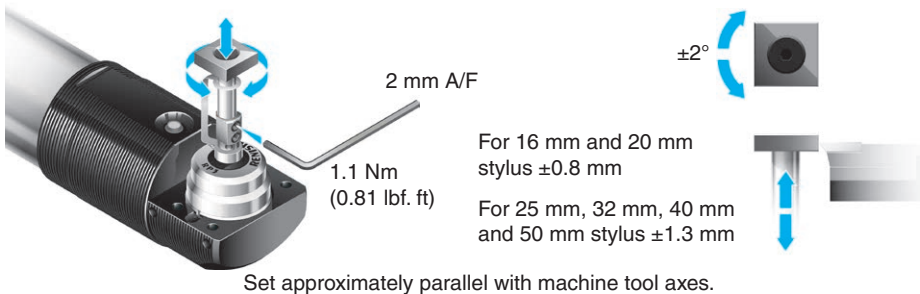


Stylus fitting

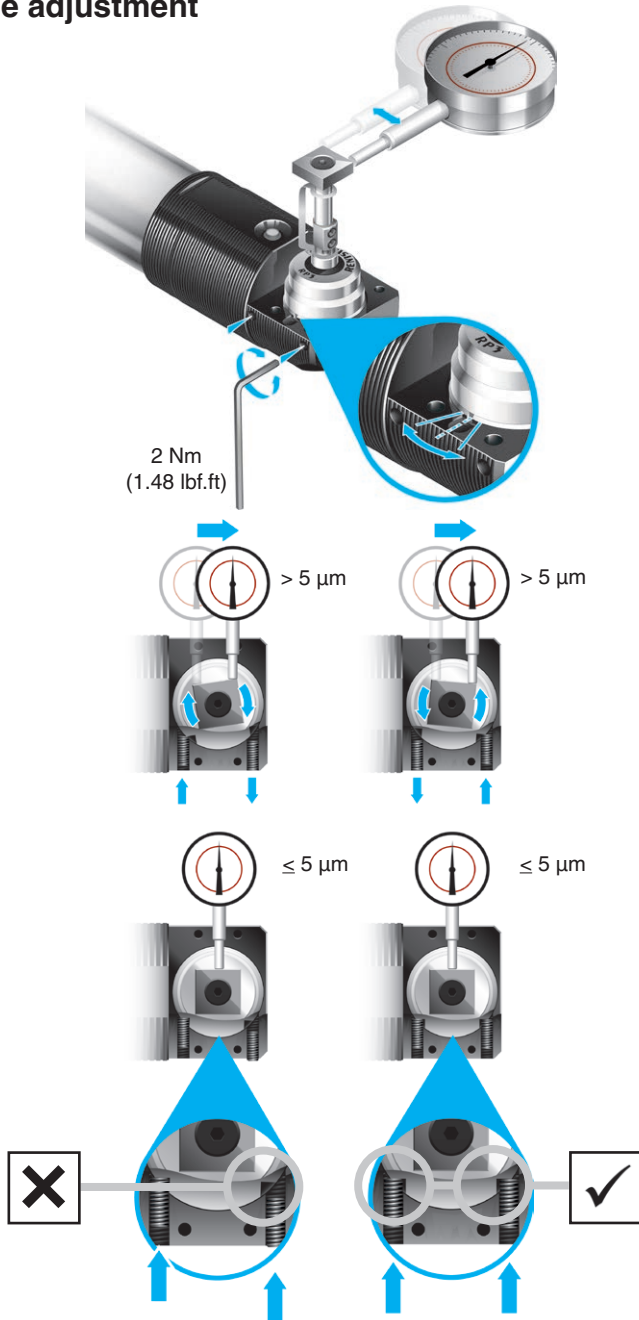
1. Fit the free end of the captive link over the threaded end of the break stem (A).
2. Fit the break stem inside the stylus and secure it by tightening the M3 grub screw(s) (B).
3. Using a 2 mm hexagonal key fitted through the hole in the break stem (C), fit the stylus to the probe.



Stylus coarse adjustment

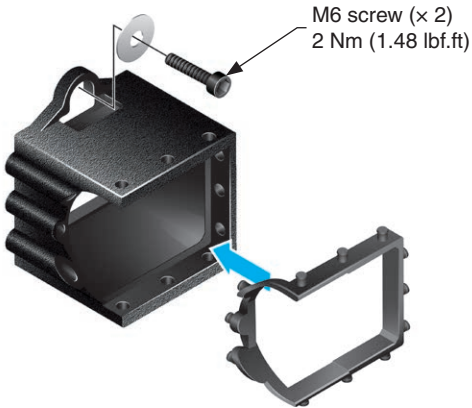


Stylus fine adjustment



Installing the probe pocket

Additional information can also be found in “HPPA mounting details” on **page 16**.



1. Fit the probe pocket using the probe pocket fixing kit supplied (M6 screws and washers). Ensure the screws are loose (finger-tight).
2. Cycle the arm to the machine ready position.
3. Ascertain the optimum position for the probe pocket by repositioning the pocket until it is aligned to the probe holder, then securely tighten the M6 screws. This step is necessary to ensure equal pressure is exerted on all sides of the probe pocket seal.
4. Check that the position of the probe pocket is correct and does not inhibit the movement of the arm by cycling the arm to the arm ready position then back to the machine ready position.

TSI 2 / TSI 2-C installation

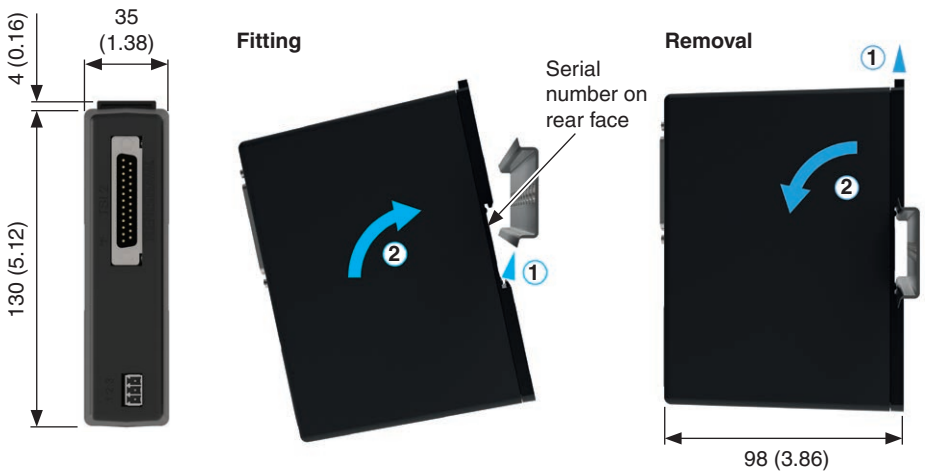
WARNINGS:

Safety footwear and eye protection should be worn while installing the TSI 2 or TSI 2-C.

Remove all power before commencing installation.

Standard mounting and dimensions

The TSI 2 or TSI 2-C interface unit should be installed in the CNC controller cabinet. Where possible, site the unit away from potential sources of interference such as transformers and motor controllers.



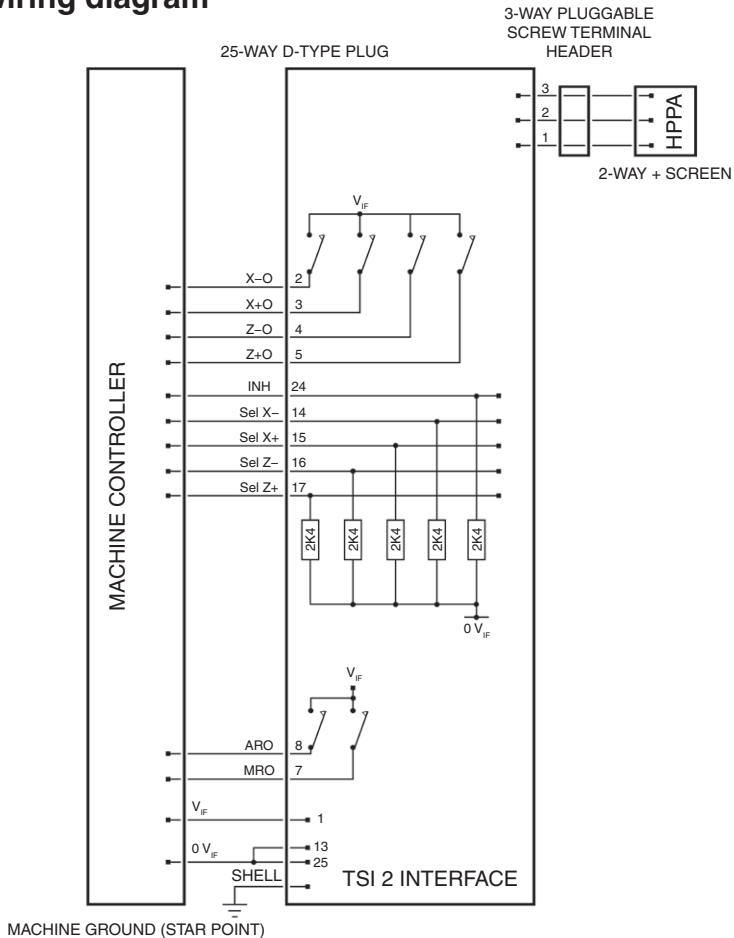
Dimensions given in mm (in)

Alternative mounting



TSI 2 installation and operation

TSI 2 wiring diagram



$V_{IF} = 24 \text{ Vdc PELV } 0.75 \text{ to } 1.25 \times \text{rated voltage.}$

This supplies the power to the system electronics which include the probe circuit.

$I_{MAX} = 100 \text{ mA, not including output load currents (all outputs o/c).}$

Circuit protection: power supply protected against overcurrent and reverse connection.

NOTES:

Cable screen must be terminated at the machine star point via the most direct route from the free end of the cable.

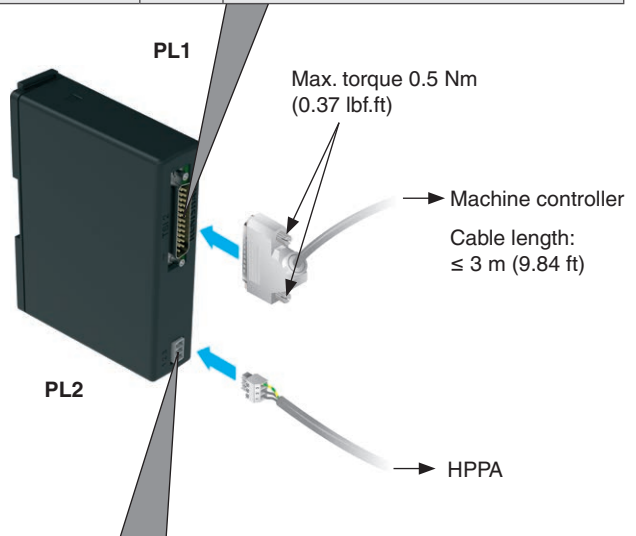
Mount interface and route cables away from known sources of EMI.

TSI 2 interface connections

| Pin | Function | Pin | Function |
|-----|---|--------------------|--------------------------------|
| 1 | Interface 24 Vdc supply (V_{IF}) ² | 14 | Select X- input (Sel X-) |
| 2 | X- output (X-O) | 15 | Select X+ input (Sel X+) |
| 3 | X+ output (X+O) | 16 | Select Z- input (Sel Z-) |
| 4 | Z- output (Z-O) | 17 | Select Z+ input (Sel Z+) |
| 5 | Z+ output (Z+O) | 24 | Probe inhibit (INH) |
| 6 | ARO | 25 | Interface 0 Vdc ($0 V_{IF}$) |
| 7 | MRO | Shell ¹ | SCR |
| 13 | Interface 0 Vdc ($0 V_{IF}$) | - | - |

¹ Shell to be connected to the machine star point

² 24 Vdc PELV
0.75 to 1.25 × rated voltage
 $I_{MAX} = 100$ mA (not including output load currents).

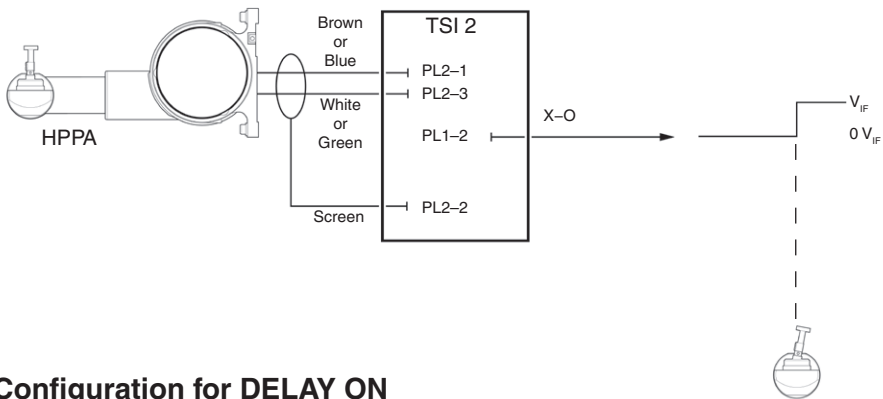


| Pin | Function | Rear exit version | | Side exit version | |
|-----|----------|-------------------|---------------|-------------------|---------------|
| | | Standard | Trigger delay | Standard | Trigger delay |
| 1 | Probe + | Brown | White | Blue | Green |
| 2 | SCR | Screen | Screen | Grey/Black | Grey/Black |
| 3 | Probe - | White | Brown | Green | Blue |

TSI 2 probe trigger delay

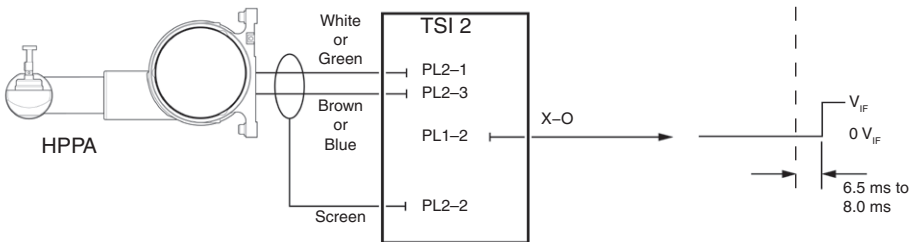
Configuration for DELAY OFF

Brown/White (rear exit) or Blue/Green (side exit)



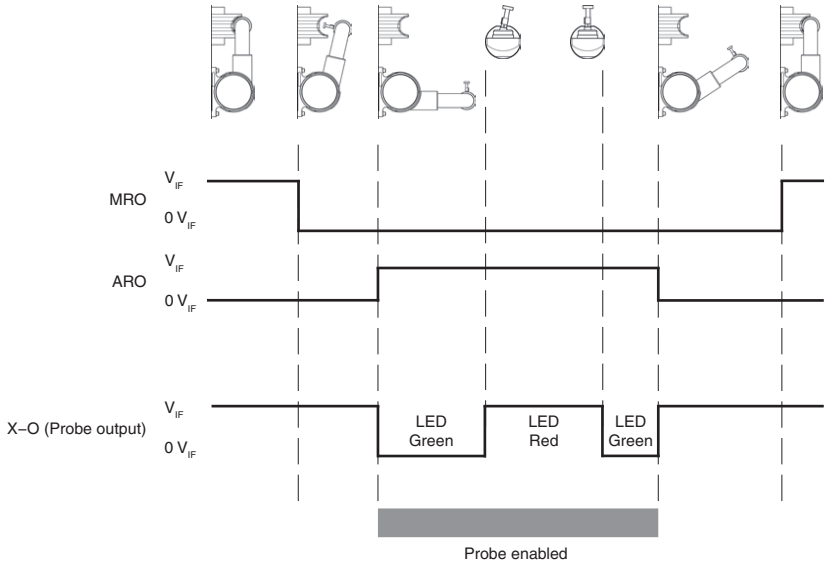
Configuration for DELAY ON

Brown/White (rear exit) or Blue/Green (side exit)



NOTE: Probe trigger delay is only compatible with on-centre length measurement; it should not be used for setting the ROTATING DIAMETER.

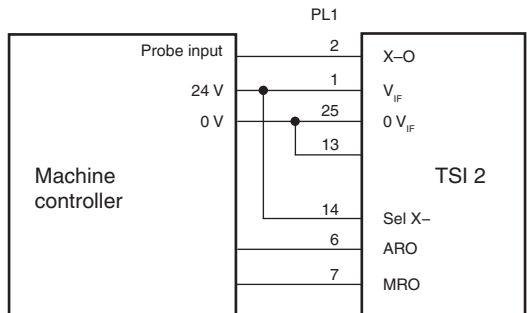
TSI 2 standard wiring for probe output



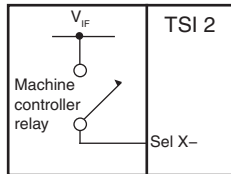
NOTES:

These wiring diagrams assume the standard one-wire Renishaw probe output can be used.

Where the four-wire option is required (for example, Fanuc automatic length management input XAE, ZAE), the user must provide **four** inputs from the controller to indicate which axis is moving in order to obtain a probe trigger (Sel X-, Sel X+, Sel Z-, Sel Z+). This signal will instruct the TSI 2 to send the probe trigger output through one of four possible channels (X-, X+, Z-, Z+).



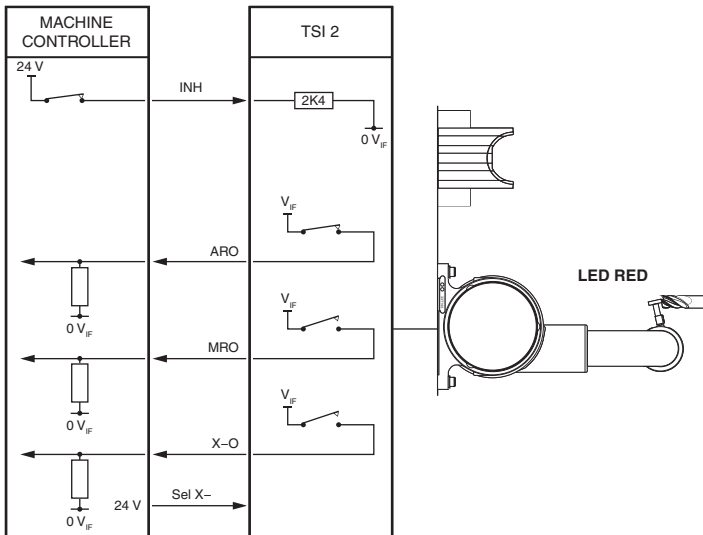
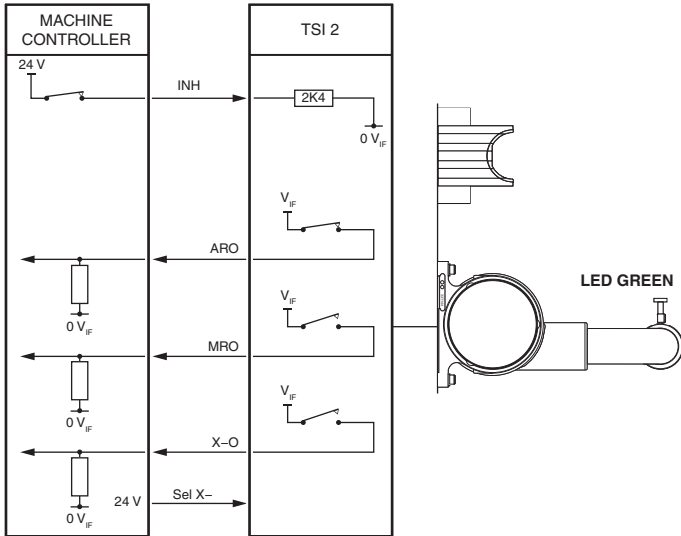
TSI 2 probe select inputs



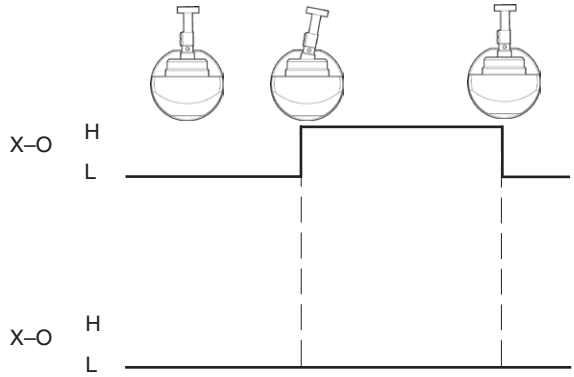
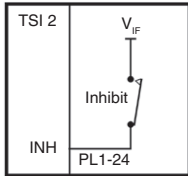
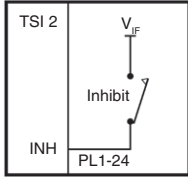
NOTE: The example above shows Sel X-; it also applies to Sel X+, Sel Z- and Sel Z+.

TSI 2 probe inhibit

Shown as “active high”.



TSI 2 inhibit inputs



NOTE: The probe status LED will still function when inhibit is active.

TSI 2 system inputs and outputs

Input specification

| | | |
|--------|---|---|
| INH | } | Internally pulled down (2K4) ACTIVE HIGH inputs |
| Sel X- | | |
| Sel X+ | | |
| Sel Z- | | |
| Sel Z+ | | |

Output specification

ARO and MRO are current limited.

X-O, X+O, Z-O, Z+O are protected by the supply fuse in the TSI 2.

Probe signal outputs

| | | | |
|-------------|---|---|---|
| (PL1-2) X-O | } | OCT ACTIVE HIGH outputs (one probe signal output only) | $V_{IF} - 3.8\text{ V @ max. source } 120\text{ mA}$ $V_{IF} - 2.4\text{ V @ } 20\text{ mA}$ |
| (PL1-3) X+O | | | |
| (PL1-4) Z-O | | | |
| (PL1-5) Z+O | | | |

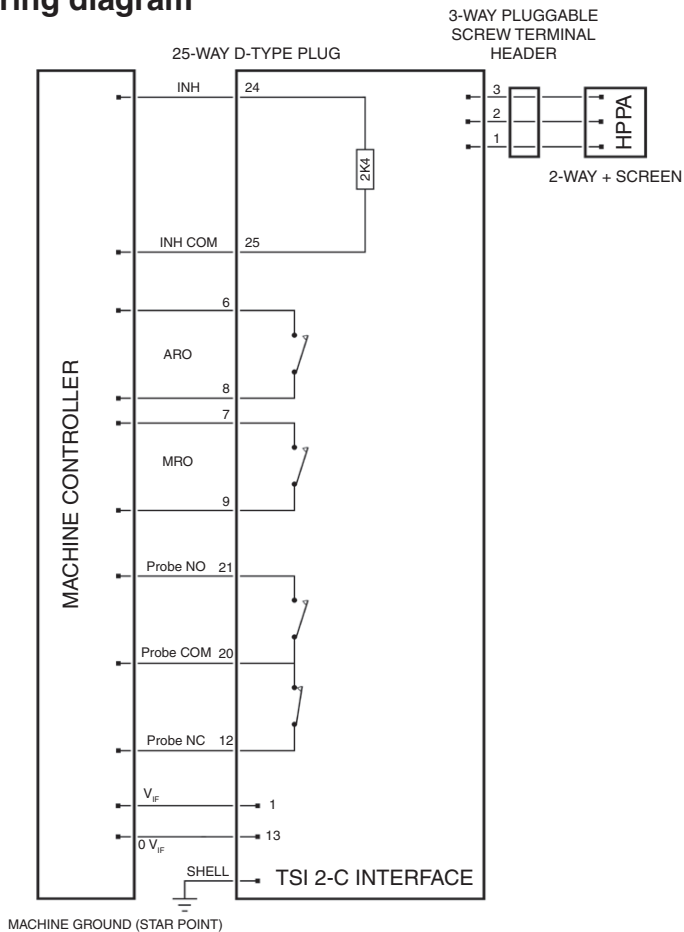
Arm ready (ARO) / Machine ready (MRO) outputs

ARO (PL1-6) MRO (PL1-7)

OCT ACTIVE HIGH outputs $V_{IF} - 2.4\text{ V @ } 20\text{ mA}$

TSI 2-C installation and operation

TSI 2-C wiring diagram



$V_{IF} = 24$ Vdc PELV 0.75 to 1.25 × rated voltage.

This supplies the power to the system electronics which include the probe circuit.

$I_{MAX} = 100$ mA, not including output load currents (all outputs o/c).

Circuit protection: power supply protected against overcurrent and reverse connection.

NOTES:

Cable screen must be terminated at the machine star point via the most direct route from the free end of the cable.

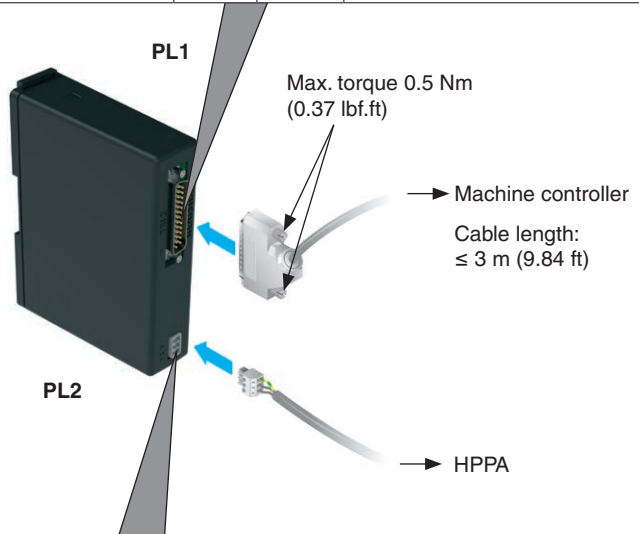
Mount interface and route cables away from known sources of EMI.

TSI 2-C interface connections

| Pin | Function | Pin | Function |
|-----|---|--------------------|---|
| 1 | Interface 24 Vdc supply (V_{IF}) ² | 12 | Probe status (NC) |
| 6 | ARO (NO) | 20 | Probe COM |
| 8 | | 21 | Probe status (NO) |
| 7 | MRO (NO) | 24 | Probe inhibit (INH) (15 Vdc to 30 Vdc) |
| 9 | | 25 | |
| 13 | Interface 0 Vdc supply ($0 V_{IF}$) | Shell ¹ | SCR |

¹ Shell to be connected to the machine star point

² 24 Vdc PELV
0.75 to 1.25 × rated voltage
 $I_{MAX} = 100$ mA (not including output load currents).

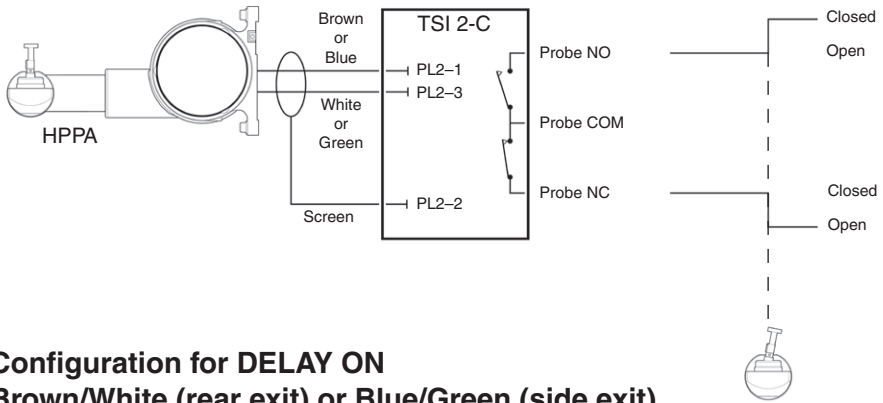


| Pin | Function | Rear exit version | | Side exit version | |
|-----|----------|-------------------|---------------|-------------------|---------------|
| | | Standard | Trigger delay | Standard | Trigger delay |
| 1 | Probe + | Brown | White | Blue | Green |
| 2 | SCR | Screen | Screen | Grey/Black | Grey/Black |
| 3 | Probe - | White | Brown | Green | Blue |

TSI 2-C probe trigger delay

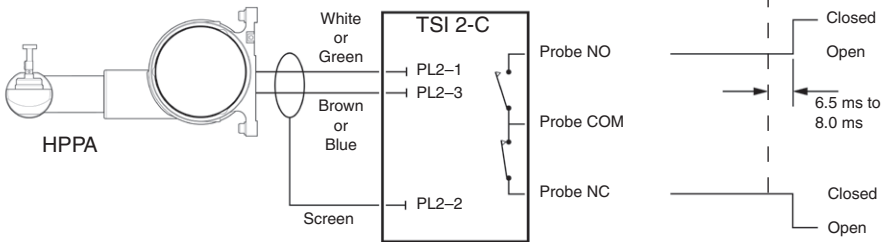
Configuration for DELAY OFF

Brown/White (rear exit) or Blue/Green (side exit)

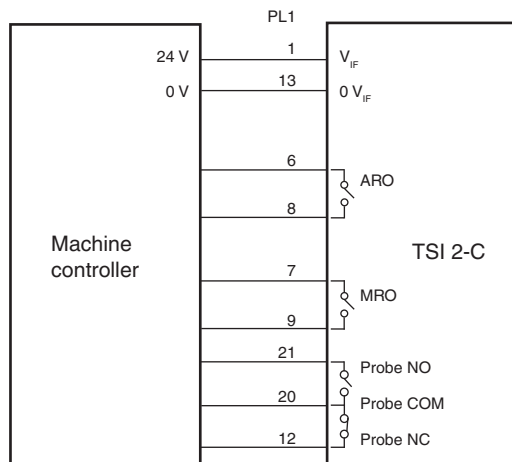
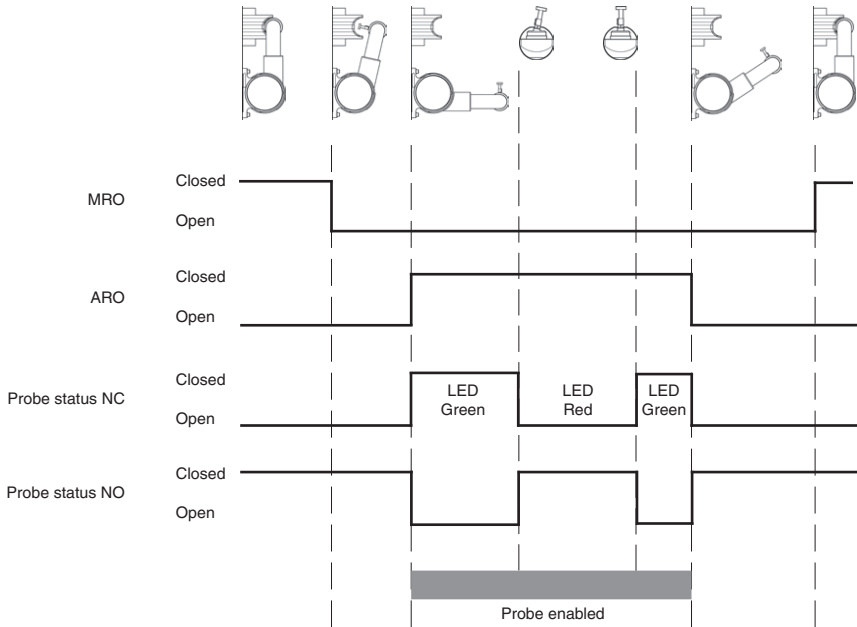


Configuration for DELAY ON

Brown/White (rear exit) or Blue/Green (side exit)

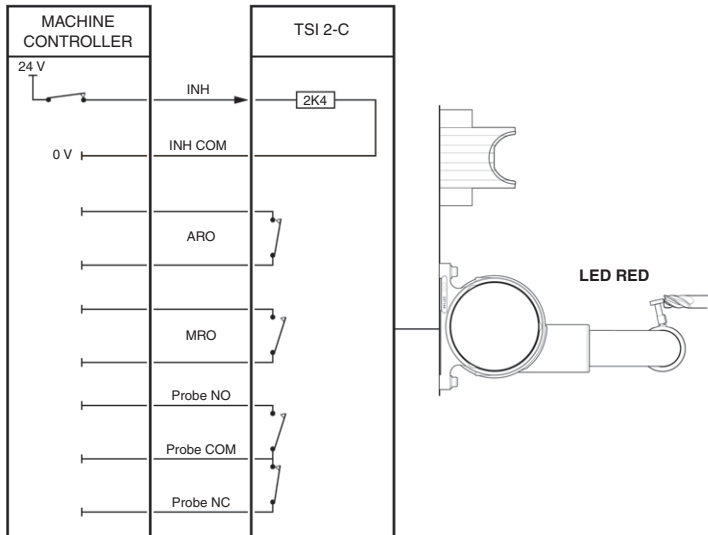
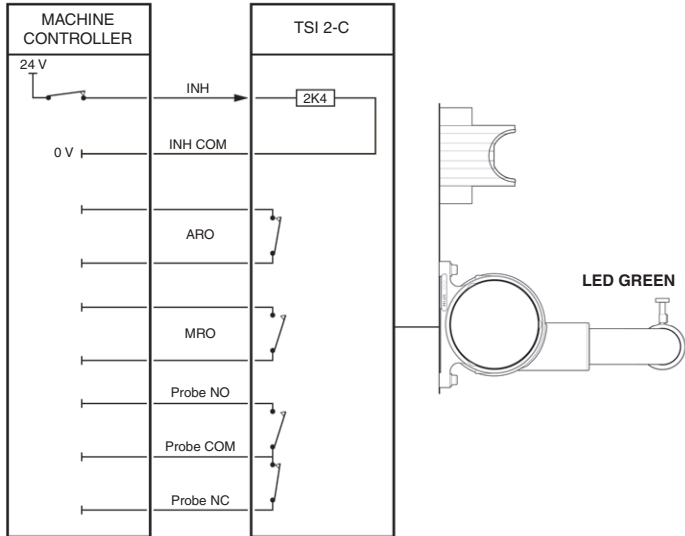


TSI 2-C standard wiring for probe output



TSI 2-C probe inhibit

Shown as “active high”.

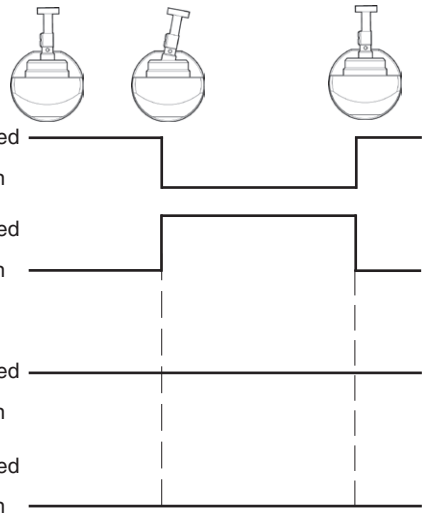
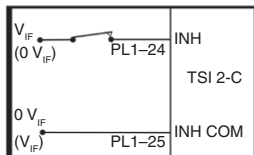
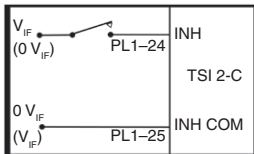


TSI 2-C inhibit inputs

Shown as “active high” (with “active low” shown in brackets).

NOTE: The inhibit input is not polarity sensitive.

Apply a voltage of 18 Vdc to 30 Vdc across PL1-24 and PL1-25 to activate. The inhibit input presents a load of 12.5 mA max. Probe inhibit disables the probe outputs.



NOTE: The probe status LED will still function when inhibit is active.

TSI 2-C system inputs and outputs

Input specification

| | | |
|---------|---|--------------------------------------|
| INH | } | Opto isolated. |
| INH COM | | 12.5 mA max. @ 30 V. |
| | | 30 V max. |
| | | Activation voltage: 15 Vdc to 30Vdc. |

Output specification

ARO and MRO are voltage-free SSR contacts.

ARO: NO, MRO: NO.

40 mA max., 30 V max., 10 V min.

Current limited.

Probe signal outputs

Probe status outputs are voltage-free SSR contacts.

Probe status: NO, Probe status: NC.

40 mA max., 30 V max., 10 V min.

Current limited.

For more information, see “Interface connections” on **page 35**.

Tool setting definitions

Probe datuming

Determines the relationship between the machine spindle and the stylus location, as well as the effective size of the tool setting stylus.

Your Renishaw tool setting probe can be datumed by measuring a 'datum tool' of known size and position.

Tool setting

Establishes the size and position of your cutting tools before you use them to machine a component. This enables you to produce parts that are 'right first time'.

With a Renishaw tool setting probe, you can determine the size and position of your cutting tools quickly and easily.

Why datum the probe?

A Renishaw touch-trigger probe allows you to use your machine tool to determine the size and position of your tools. When the stylus contacts the surface of your tool, the positions of the machine axes are recorded at that moment.

To determine the location of the surface of the tool, the software must know the size and position of the stylus.

Various probe datuming techniques allow you to determine the relationship between the stylus and the machine spindle.

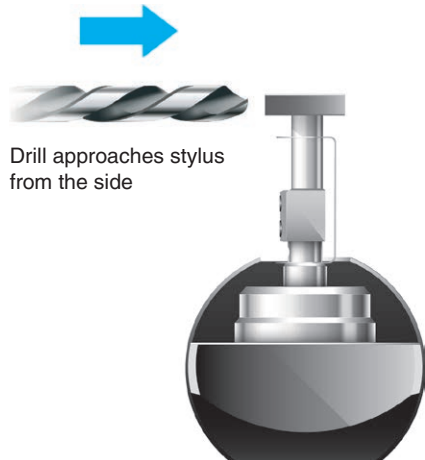
Whilst the spindle/stylus relationship will not change under normal conditions, there are certain circumstances under which you should redatum the tool setting probe:

- Before using the probe for the first time on a machine.
- Whenever a new stylus is fitted.
- If you have made any adjustment to the probe alignment.
- If you suspect that the stylus has become distorted.

Setting tools

Static tool length setting

Suitable for tools whose cutting edges are located on the spindle centre line, for example, drills. Static length setting involves moving the tip of a tool to contact the stylus.



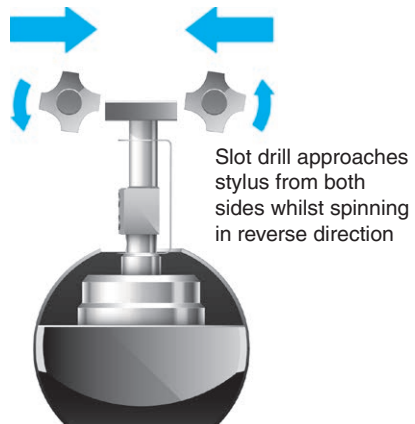
Rotating tool length setting (for driven tools)

Suitable for tools whose cutting edges are located around the circumference, for example, slot drills. As with static length setting, rotating length setting involves moving the tip of a tool to contact the stylus but doing so while rotating, and doing so in the opposite direction to that which is used for cutting.

Rotating length setting ensures that the true high or low point of the tool is detected.

Rotating diameter setting (for driven tools)

Suitable for tools that are used to interpolate features, for example, slot drills, and which must be set for diameter. It involves moving the side of a tool to contact the stylus tip and, as with rotating length setting, the tool must be rotating in the opposite direction to that which is used for cutting (to protect the stylus).



NOTE: Do not use “Probe trigger delay” if setting the diameter of rotating tools.

Maintenance and fault-finding

The following section describes the maintenance actions that can be carried out on the HPPA. A fault-finding section for assisting the user in diagnosing faults begins on **page 48**.

WARNING: It is recommended that eye protection and protective gloves be worn while inspecting and cleaning the HPPA.

HP Arms app



The HP Arms app makes configuring and supporting the range of Renishaw high-precision tool setting arms simple.

Intended for suitably-trained installation and maintenance engineers, the app provides a convenient, single point of reference for typical configuration, maintenance and troubleshooting tasks.

The app is easy to use with detailed animations, images, help text and step-by-step instructions and can be downloaded by searching for 'HP Arms' on the following stores:



HPPA calibration

The exact procedure adopted is specific to each machine, controller system and software package. However, certain rules are common.

Before setting tools, it is necessary to calibrate the stylus position to establish its trigger points in relation to a datum on the machine. This can be achieved by using a tool of known reference.

The HPPA must be recalibrated periodically (at least every 6 months), and in special circumstances, for example, if the arm has been subjected to a crash or if the stylus has been replaced.

The recommended frequency of normal recalibration is dependent on how frequently the arm is used. This may vary greatly depending on the application of the tool setting arm; for example, a typical jobbing shop may want to set tools twice per day and have eight tools to set. This would therefore result in two arm operations per day. A large volume manufacturer, however, may only wish to check for broken tools, but with a typical cycle time of 5 minutes and 24-hour working days, would operate the arm 288 times per day.

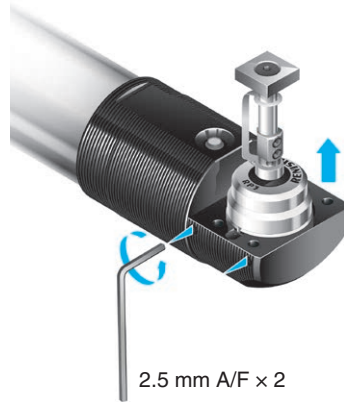
Use the table below to determine how frequently you should recalibrate your HPPA.

| Recommended frequency of arm recalibration | |
|--|-----------------------|
| Arms operations per day | Recalibrate every ... |
| < 50 | 6 months |
| < 100 | 3 months |
| > 100 | 1 month |

RP3 probe removal

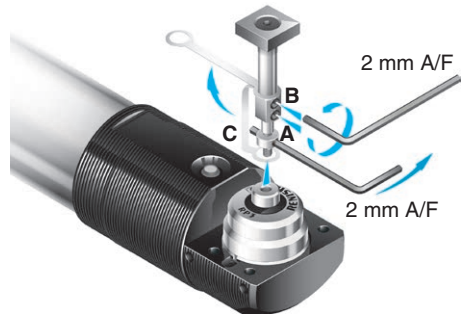
CAUTION: Ensure the area around the probe is dry and free of swarf and coolant before removing the probe.

1. Remove the M5 grub screws prior to cleaning to allow any coolant to escape.
2. Clean the probe and the area around the probe using clean dry air (Dust Remover clean air spray).
3. Remove the probe.



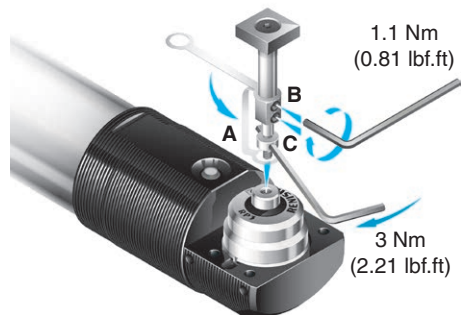
Stylus and break stem removal

1. Using a 2 mm hexagonal key fitted through the hole in the break stem (A), unscrew the stylus from the probe.
2. Using a 2 mm hexagonal key, unscrew the M3 grub screw(s) (B) that hold the break stem to the stylus.
3. Free the end of the captive link from the threaded end of the break stem (C) and remove the break stem.



Break stem and stylus fitting

1. Fit the free end of the captive link over the threaded end of the break stem (A).
2. Fit the break stem inside the stylus and secure it by tightening the M3 grub screw(s) (B).
3. Using a 2 mm hexagonal key fitted through the hole in the break stem (C), fit the stylus to the probe.



RP3 probe care

The probe mechanism is protected from coolant and debris by a diaphragm. This provides adequate protection under normal working conditions.

Periodically clean the probe and check the diaphragm for signs of damage.

CAUTION: Do not remove the diaphragm. If the diaphragm is damaged, return the probe to your supplier for repair.

Cleaning and diaphragm inspection

1. Leaving the probe in the arm, use a screwdriver to release and remove the front cover.
2. Clean the probe mechanism with low-pressure clean coolant.

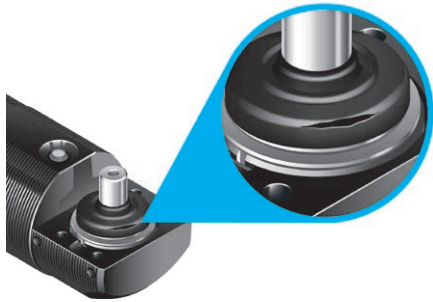
CAUTION: Do not use high-pressure water jets to clean the probe mechanism.

3. Inspect the diaphragm for damage. If it is damaged, return the probe to your supplier.

CAUTION: Do not remove the diaphragm, as this will invalidate your warranty.

Fitting the cover

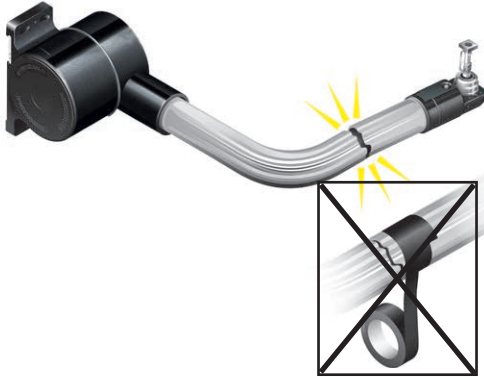
4. Fit the front cover by pressing it back into place with your hand, while supporting the probe holder.



HPPA inspection

Periodically inspect the arm for signs of damage.

CAUTION: Contact your supplier if damaged. Do not attempt to fix it yourself.



Spring seal and probe pocket inspection

Regularly clean the spring seal, probe pocket and surrounding areas with a brush to prevent swarf build-up, taking care not to push debris into the seals or between the HPPA and its mounting surface.

CAUTION: Do not use high-pressure water jets to clean the spring seal.

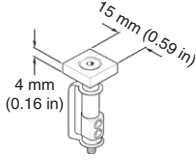
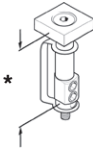

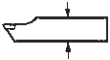
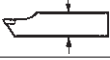
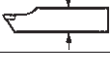
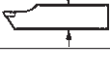
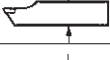



Fault-finding

| Symptom | Cause | Action |
|-----------------------------------|---|---|
| Poor system repeatability. | Mounting screws not fully tightened. | Tighten screws to specified torque. |
| | Loose probe. | Verify tightness of probe in arm assembly. |
| | Loose stylus. | Ensure tip of stylus is tight. Ensure M4 grub screw in stylus stem is tight. Ensure break stem is fully tightened into RP3 probe. |
| | Swarf on tool tip. | Remove swarf. |
| | Calibration and updating of offsets is not occurring. | Review software. |
| | Calibration and probing speeds are not the same. | Review software. |
| | Probing is being performed within the machine's acceleration/deceleration zones. | Review software. |
| | Arm not mounted as recommended (for example, on sheet metal guards). | Mount on solid base. |
| | Probing feedrate is too high for the machine controller. | Perform repeatability trials at various feedrates. |
| | Temperature variation is causing excessive movement of the machine and the HPPA. | Minimise machine and HPPA temperature changes. Increase the frequency of calibration. |
| | Machine has poor repeatability due to loose encoders, backlash, tight slideways and/or accidental damage. | Perform health check on machine. |

| Symptom | Cause | Action |
|--|----------------------------------|---|
| Poor system repeatability (continued). | Excess machine vibration. | Eliminate vibration. Change wiring to enable probe trigger delay circuit. |
| | Minor collision. | Move arm to stow position and back to active position to reset arm to kinematic seating. |
| No probe output (probe status LED not lit). | Damaged or dirty probe contacts. | Check condition of probe contacts. If contacts are dirty, clean using compressed air and a clean lint-free cloth. |
| | Probe not connected. | Check wiring to machine. Check that the probe is properly located in the holder. |
| | Probe has failed. | Remove probe and check probe for continuity across probe contacts (resistance should be less than 1 K Ω). |

Parts list

| | | | |
|--|---|---|---|
| Recommended for: |  |  |  |
| | Stylus assembly | * Stylus length | Break stem |
|  16 mm | A-2197-0157 | 14.2 mm (0.56 in) | M-2197-0156 |
|  20 mm | A-2197-0158 | 19.5 mm (0.77 in) | M-2197-0156 |
|  25 mm | A-2197-0159 | 29.5 mm (1.16 in) | M-2197-0150 |
|  32 mm | A-2197-0160 | 34.5 mm (1.36 in) | M-2197-0150 |
|  40 mm | A-2197-0161 | 39.5 mm (1.55 in) | M-2197-0150 |
|  50 mm | A-2197-0162 | 49.5 mm (1.95 in) | M-2197-0150 |

| Item | Part number | Description |
|---------------|-------------|--|
| Tools | A-2176-0636 | Standard HP arm tool kit. |
| | A-2176-0639 | Micro HP arm tool kit. |
| Base fixing | A-2275-0113 | HPPA base fixing kit. |
| Front cover | A-2197-0006 | RP3 probe front cover kit. |
| Spring seal | M-2275-0549 | Spring seal for HPPA base. |
| Probe pockets | A-2275-0098 | HPPA arm probe pocket long. |
| | A-2275-0099 | HPPA arm probe pocket short. |
| TSI 2-C | A-2176-1152 | TSI 2-C interface unit with DIN rail mounting. |
| TSI 2 | A-2176-0010 | TSI 2 interface unit with DIN rail mounting. |
| RP3 probe | A-2197-0004 | RP3 probe assembly. |
| Cables | P-CA82-1010 | 2 m SCR HPPA cable, 5 W M12 socket. |
| | P-CA82-1009 | 5 m SCR HPPA cable, 5 W M12 socket. |
| | P-CA82-1011 | 10 m SCR HPPA cable, 5 W M12 socket. |

| Item | Part number | Description |
|---|-------------|---|
| Publications. These can be downloaded from our website at www.renishaw.com . | | |
| RP3 | H-2000-5187 | User guide: RP3 probe. |
| HPPA and TSI 2 / TSI 2-C | H-2000-2032 | Data sheet: HPPA and TSI 2 / TSI 2-C pulldown arm and interface. |
| HPMA and TSI 3 / TSI 3-C | H-2000-2037 | Data sheet: HPMA and TSI 3 / TSI 3-C motorised arm and interface. |
| HPMA and TSI 3 / TSI 3-C | H-2000-5347 | Installation and user guide: HPMA and TSI 3 / TSI 3-C motorised arm and interface. |
| Styli | H-1000-3200 | Technical specifications guide: Styli and accessories – or visit our Online store at www.renishaw.com/shop . |
| Probe software | H-2000-2298 | Data sheet: Probe software for machine tools – programs and features. |

www.renishaw.com/hppa

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