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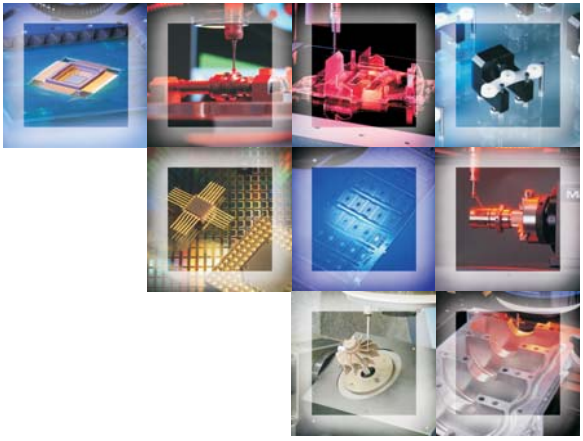

Touch Probe
Users Guide

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About This Guide

Welcome!

Optical Gaging Products (OGP) has produced this *Users Guide* as part of its ongoing effort to provide users with useful, comprehensive documentation. This document has been developed using standards and a design that enhances readability and makes it easier to find information.

We believe this manual will assist you in using the touch probe effectively. If you should have any questions that are beyond this document's scope, please do not hesitate to contact your authorized OGP representative or OGP directly.

This manual applies to all OGP video systems equipped with the touch trigger probe option.

Organization

The *Touch Probe Users Guide* is divided into three major groups of information:

- The first five sections contain information applicable to both MeasureMind 3D and Measure-X systems.
- Sections 5 and 6 only apply to MeasureMind 3D systems.
- Sections 7 and 8 only apply to Measure-X systems.

CAUTION: Since this manual covers both MeasureMind 3D MultiSensor and Measure-X, be sure you are referring to the correct sections for your particular system. Headings with measurement software in parentheses mean that section is for that version of software only. Sections without measurement software in parentheses apply to systems with either metrology software.

Sections applicable to both MeasureMind 3D and Measure-X systems:

About This Guide (this section) describes the organization of this document, lists documentation conventions, explains special symbols used in this document, and provides information regarding OGP technical support and customer service.

Section 1, Introduction, provides a brief overview of the different types of touch probes and identifies the components associated with them.

Section 2, Installing the Touch Probe Components, contains instructions on how to install the probe interface unit, probe sensor, detachable stylus module (TP20 and TP 200 touch probes), and touch probe stylus.

Section 3, Mounting the Change Rack, describes how to mount the probe change rack.

Section 4, Maintaining the Touch Probe, describes the periodic maintenance of the DSM and probe sensor.

Sections only applicable to MeasureMind 3D systems:

Section 5, Setting Up the Touch Probe (MeasureMind 3D Systems), describes how to configure and calibrate a change rack, set up the calibration artifact, perform a probe-to-optics calibration, and calibrate single-tip and multi-tip touch probes on systems equipped with MeasureMind 3D.

Section 6, Using the Touch Probe (MeasureMind 3D Systems), explains how to use the touch probe to measure features on MeasureMind 3D systems.

Sections only applicable to Measure-X systems:

Section 7, Setting Up the Touch Probe (Measure-X Systems), describes how to calibrate a change rack, set up the calibration artifact, perform a probe-to-optics calibration, and calibrate single-tip and multi-tip touch probes on systems equipped with Measure-X.

Section 8, Using the Touch Probe (Measure-X Systems), explains how to use the touch probe to measure features on Measure-X systems.

Documentation Conventions

To help you locate, interpret, enter or select information easily, this document uses consistent visual cues and standard text formats. These documentation conventions are explained in the following table.

Type Style or Symbol	Used for	Examples and Explanations
Bold or italic	• Emphasized words	• Do **not** repeat this step • Select the *highest* magnification level
Bold, sans-serif typeface	• Commands to be typed • Keys to be pressed • Menu items to be selected • Buttons to be pressed	• Type **exit** • Type the following command, then press **Enter** • In the **Tools** menu, select **Change Sensor** • Press the **Stop /Start** button
⇒	• Pull-right menus	• In the **System** menu, select **Configuration** ⇒ **Change Rack**
Bold, all caps, sans-serif, centered typeface	• System message	**SELECT THE CORNER WITH THE LEFT MOUSE BUTTON.**
Initial caps	• Proper nouns • Product names • Sections, figures	• Use the Measure function • SmartScope ZIP • See Section 3
All caps	Acronyms	• ASCII; OGP

Special Symbols Used in this Document

Throughout this manual, you will find special information and symbols set apart from the body text as *Warnings*, *Cautions*, and *Notes*. These terms and symbols are explained below.

WARNING: Warns you of the possibility of personal injury due to electrical shock when performing a task related to the installation, removal and servicing of the touch probe components.

WARNING: Warns you of the possibility of other personal injury when performing a task related to the installation, removal and servicing of the touch probe components.

For either of the above two warnings, follow all instructions precisely to ensure your safety, and the safety of those around you.

CAUTION: Alerts you to the potential for damage to hardware or software in the machine you are servicing. Special instructions may be included for minimizing this risk.

Note: Provides additional information related to the topic being discussed.

Safety Guidelines for Using the Touch Probe

CAUTION: The touch probe components are sensitive and can be damaged if proper safety precautions are not observed. To ensure safe operation and prevent damage to the docking touch probe components, follow the guidelines below.

- **Working Clearance**
  - The longest seated probe must always clear (be above) the part or fixture whenever you drive the Detachable Stylus Module (DSM) to the probe module change rack.
  - Ensure that there is sufficient clearance for the probe sensor to dock with the DSM without any collisions with the change rack.
  - Make sure that the straight line path between the DSM and the change rack is always clear whenever you perform any docking operation.
- **Stage Initialization**
  - If you perform a stage initialization with a seated DSM, make sure that the path is clear for any XYZ movement of the DSM.
- **Stage Motion**
  - There may be times when unexpected stage motion may result in contact with the change rack, which can damage the probe or change rack. In this case, be ready to press the Stop/Start button to stop stage movement.
- **TP20 Touch Probe**, which uses a magnetically-actuated inhibit system. The probe will be automatically disabled when it approaches the front of the change rack.
  - Do not enable the probe until it is at least 50 mm away from the port.
  - The seating of the DSM uses a high precision magnetic coupling device. The use of high power magnetic fixtures in close proximity to the DSM or the measuring of highly magnetic parts may cause the DSM to disengage from the TP20 probe body.
- **Pinch Hazards**
  - Pinch hazards exist between moving and stationary parts. Beware of unexpected movement.
  - Remain outside the touch probe working envelope.

- **Probe Module Change Rack Locations**
  - The probe module change rack needs to be placed only in locations that allows access to all ports when calibrating their location and measuring with the touch probes (see Section 3).
- **Breakaway**
  - The base of the probe module change rack is designed with a breakaway so that it can absorb small amounts of movement if it is contacted by the optics or DSM.
  - The ports of the probe module change rack flip down if there is inadvertent contact by the optics or DSM.

Technical Support and Customer Service

OGP offers service and support contracts that are tailored to meet your specific needs and protect the value of your investment:

- **Hardware service contracts** for cleaning, general inspection, preventive maintenance and certification — includes a discount on replacement parts and emergency service labor rates
- **Software support contracts** with updates of software products, application assistance, and a discount on new software products.

For more information, call (585) 544-0400.

If You Need Help

If you need help with your touch probe, contact your local authorized OGP representative first. If he or she cannot solve your problem, you may contact us —

- By phone at (585) 544-0400
- By FAX at (585) 544-8092 (Sales) or (585) 544-0131 (Service)
- By e-mail at *sales@ogpnet.com* or *service@ogpnet.com*
- On the Internet at http://www.ogpnet.com

When you contact us, please have the serial number of your system and the version of MeasureMind 3D MultiSensor or Measure-X (as applicable) that you are currently using. The more information we have, the faster we can help you.

Section 1

Introduction

The touch probe is an optional system component that is used to measure features using a contact method. For example, the touch probe can be used to measure depths, counterbores, planes, spheres, cylinders, and cones.

This section describes the kinds of touch probes that can be used on SmartScope/Avant ZIP, SmartScope ATS, SmartScope Flash, SmartScope CNC, and SmartScope Quest/Vantage systems, identifies the touch probe components, and explains assumptions and requirements.

The table below lists the characteristics of each type of touch probe module.

Probe Sensor	Type	Detachable Stylus Module (DSM)
TP2	Fixed	None
TP6	Fixed	None
TP20	Fixed or dockable	Magnetic
TP200	Fixed or dockable	Magnetic

All touch probes can be equipped with single-tip or multi-tip styli.

The TP2 and TP6 touch probes are mounted on the probe holder and they remain in a fixed location, that is, their location does not change. They cannot be attached to a DSM and put in a change rack.

The TP20 and TP200 touch probes are attached to DSMs and can be:

- Mounted on the probe holder and remain in a fixed location if a change rack is not used
- Docked in optional change racks that have up to four ports

Touch Probe Components

The most common touch probe components are shown below. They must be installed and set up before you can calibrate and use the touch probe for measurements.

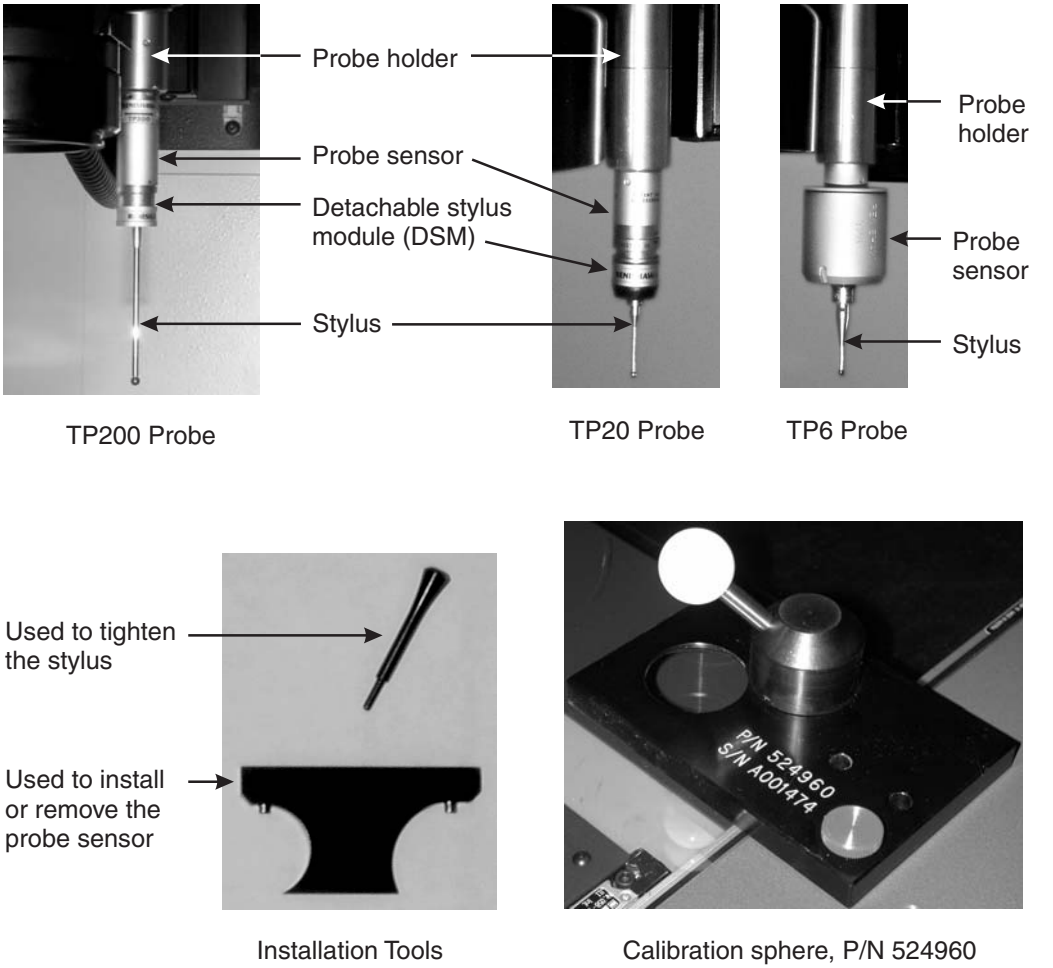


Figure 1-1. Touch Probe Components

Note: The components associated with a dockable touch probe are shown in Sections 2 and 3.

- Touch probes can be installed on SmartScope/Avant ZIP, SmartScope ATS, SmartScope Flash, SmartScope CNC, and SmartScope Quest/Vantage systems that are already equipped with:
  - Probe holder (wand) and bracket
  - One of the boards listed below:
    - DSP multi-axis board (P/N 038281) with a P400 expansion port; a ribbon cable connects the expansion port to the external connector and an external cable from the Renishaw PI200 probe interface unit gets plugged into the external connector.
    - DSP multi-axis board (P/N 038282) with a P400 expansion port; a ribbon cable connects the expansion port to the external connector and an external cable from the Renishaw PI200 probe interface unit gets plugged into the external connector.
- The touch probe assembly supports the following Renishaw touch probes:
  - TP2, TP20 and TP200 on all systems
  - TP6 only on systems that are not equipped with a SmartRing Light
- The system must be equipped with the MeasureMind 3D software (version 11.24 or higher) or the Measure-X software (version 1.1.17 or higher).
- It is assumed that you know how to use the MeasureMind 3D or Measure-X software (as applicable) and operate the video metrology system, and you have previous knowledge of how to use Renishaw touch probes.
- It is assumed that all the optics and the stage are calibrated.
- SmartScope Flash 200 systems are equipped with a TP20 low change rack so that the machine travel is less restricted by the change rack. The low-rack design allows the optics cover and SmartRing Light to move over the change rack when measuring. The length of the docked touch probe cannot exceed 20 mm, with 5 mm clearance.
- The touch probe is compatible with the standard SmartRing Light. However, it is not compatible with the Horizon SmartRing Light. If the system is equipped with the Horizon SmartRing Light, you must remove it before using the touch probe.
- A Renishaw PI200 interface unit (P/N 038235) is required with all touch probe packages.

Adapter Plates

An adapter plate may be required when installing a probe module change rack on floor-model machines. This enables the change rack to protrude over the stage so that the ports are accessible by the probe sensor.

- Adapter plate P/N 525436 is used for SmartScope ZIP 300, 400, and 600 machines not equipped with a SmartRing Light.

- Adapter plate P/N 526238 is used for SmartScope CNC 500 and SmartScope Flash 300, 400, 500, 600, and 700 machines.

- Adapter plate P/N 526556 is used for Avant ATS and SmartScope Quest/Vantage 450, 600, and 650 machines.

Section 2

Installing the Touch Probe Components

This section describes the procedures to install the touch probe components:

- Touch probe stylus
- Probe sensor
- Detachable Stylus Module (DSM)
- Probe Interface Unit

Installation Setup Tasks

Complete the following steps before installing the touch probe components:

1. Lower or raise the optics to a comfortable level so the probe holder is accessible. Remove the optics cover if necessary.
2. Verify that the probe holder is set at the proper height. Typically, it should be as high as possible so the attached probe sensor can access the port without interference with the optics and ring light. If the height needs to be adjusted, loosen the screw (button-head screw, Phillips screw, or M4 socket-head screw) and lower or raise the probe holder as needed. Then re-tighten the screw.
3. Remove all the components from their packages:
   - Remove the probe sensor. If you have a TP200 probe sensor, pull off the caps from both ends of the protective tube containing the probe sensor. Then unscrew the sensor from the protective tube.
   - Remove the DSM. If you have a TP200 DSM, it is in a protective tube. It is held magnetically, so you may need to use some force when pulling it.
   - Remove the stylus and make any adjustments, if desired, using the stylus tool (shown on the next page).

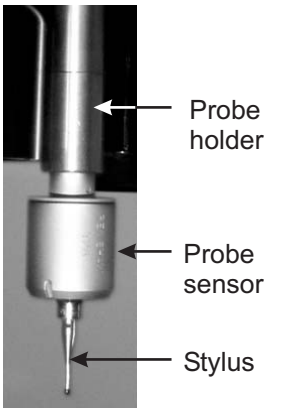
Touch Probe Stylus Installation

To install the touch probe stylus.

1. Screw the stylus to the bottom of:
   - The DSM (TP20 and TP200 touch probes)
   - The probe sensor (TP2 and TP6 touch probes)
2. Tighten the stylus with the stylus tool.

TP2 and TP6 Probe Sensor Installation

To install the probe sensor (the stylus is already attached), simply screw it into the probe holder that is mounted on the left or right side of the optical housing. Make sure that the sensor is screwed in and seated snugly.



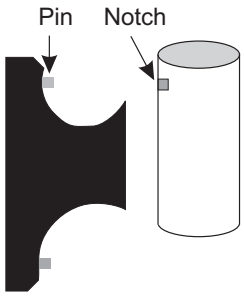
TP20 and TP200 Probe Sensor Installation

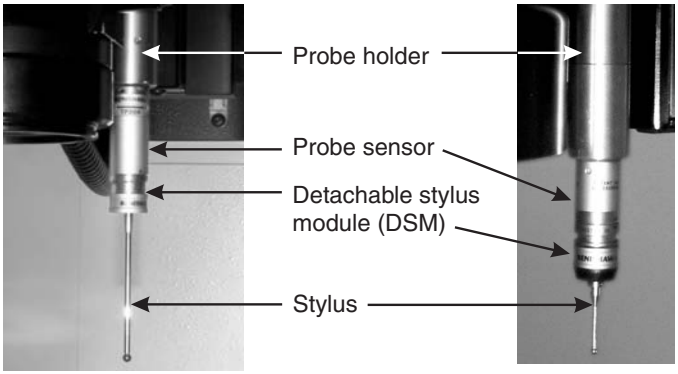
To install the probe sensor.

1. Turn the sensor in your hand and note the three symbols around the bottom of the sensor where the magnet is located. The same three symbols are also on the top of the DSM. You will need to line up one of these symbols on the sensor with its corresponding symbol on the DSM when the DSM is installed (described on the next page).

2. Screw the sensor into the probe holder that is mounted on the left or right side of the optical housing. Do not squeeze it too tightly.

   - Use the smaller side of the black tool to screw the sensor in. To do so, insert the pin into the notch on top of the sensor and turn the tool.
   - Make sure that the sensor is screwed in and seated snugly.
   - The TP20 and TP200 probe sensor should protrude below the adjacent optics or the SmartRing Light so that it can access the port without any interference. Typically this is about 6 to 10 mm (¼ to 3/8").





TP200 Probe

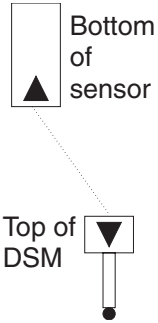
TP20 Probe

TP20 and TP200 DSM Installation

You can install the DSM (with the attached stylus) by attaching it to the probe sensor.

To attach the DSM to the probe sensor:

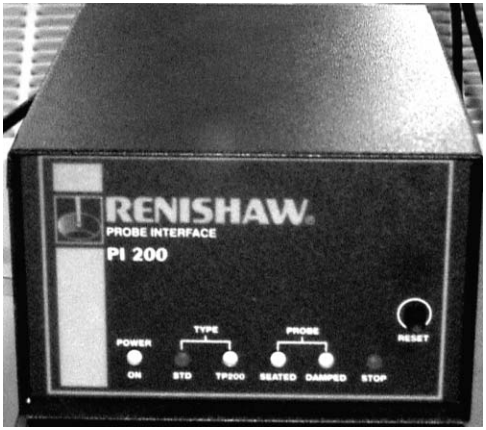
1. Rotate the DSM to visually line up the symbol (e.g., arrowhead) on the top of the DSM with the same symbol on the bottom of the probe sensor.
2. Carefully attach the DSM to the probe sensor.



Once the DSM is attached to the probe sensor, you can use the probe as a fixed touch probe (a change rack is not used) or as a dockable touch probe (a change rack is used and it has been configured and calibrated as described in subsequent sections).

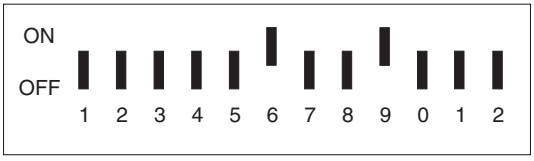
Probe Interface Unit Installation

The Renishaw PI200 probe interface unit (P/N 038235) controls the probe functions and the communications between the measurement software, the probe sensor and the DSMs in each port. This enables the automatic use and exchange of touch probes once calibration is completed.

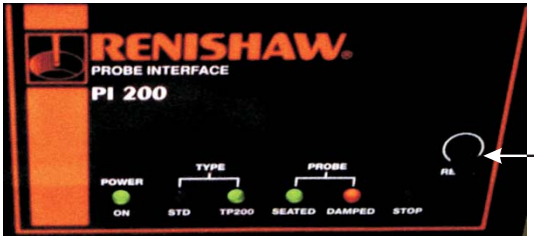


To install the probe interface unit, follow the steps below.

1. Unpack the probe interface unit. The kit contains the unit, a cable (P/N 038426) that connects the unit to the machine, an extender cable (P/N 049034; for floor-model machines only), a power cable, and two brackets with screws, which are not used.
2. Plug the two connectors into the receptacles on the back of the probe interface unit. Then plug the single 25-pin connector into:
   - The 25-pin touch probe connector on a benchtop machine
   - The extender cable on a floor-model machine and plug the extender cable into the 25-pin touch probe connector on the machine.
3. Plug one end of the power cable into the probe interface unit and the other end into an electrical outlet.



Note: The DIP switches on the back of the probe interface unit are set at the factory. Do not change any of these settings.



Note: LEDs on the front of the probe interface unit display the type of probe that is in use and the status of the probe. It also contains a Reset button. You need to press this button when you hear a steady beep, which may indicate a false contact.

Completion of the Touch Probe Installation

Perform the following tasks after the touch probe and probe interface unit installation have been completed.

1. Put away the tools, boxes and sensor (or DSM) protective tubes.
2. If necessary, re-install the optics cover.
3. If your system is equipped with a dockable touch probe, install all the components associated with dockable touch probes (described in Section 3).
4. Perform the configuration and calibration procedures described in Section 5 (MeasureMind 3D systems) or Section 7 (Measure-X Systems). You cannot use the touch probe for measurements until the calibration is completed.

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Section 3

Mounting the Change Rack

This section describes how to mount a change rack on your machine.

Different probe module change racks can be used on OGP video machines. The racks can have up to four ports to hold the DSM modules with their attached styli.

This enables the rapid, automatic changing of the styli when measuring a part.

A change rack needs to be installed only if you plan to use one or more single- or multi-tip stylus and you wish to change styli by getting them from their respective ports in the change rack or docking them when they are not in use.

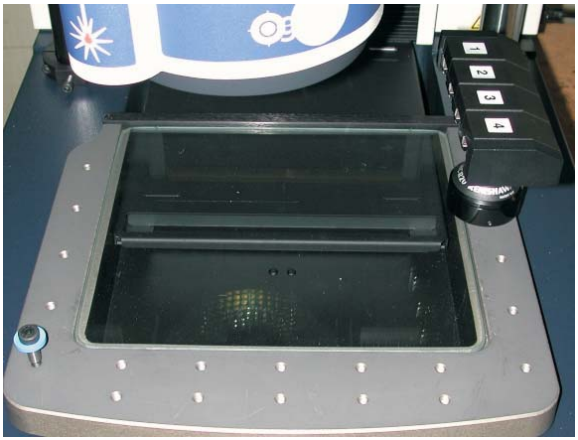
Change Rack Locations

The change rack must be placed in a location that allows the probe sensor to access all ports when measuring with the touch probes. Typically, the location of the change rack is based on the location of the probe holder as described and shown in the examples below.

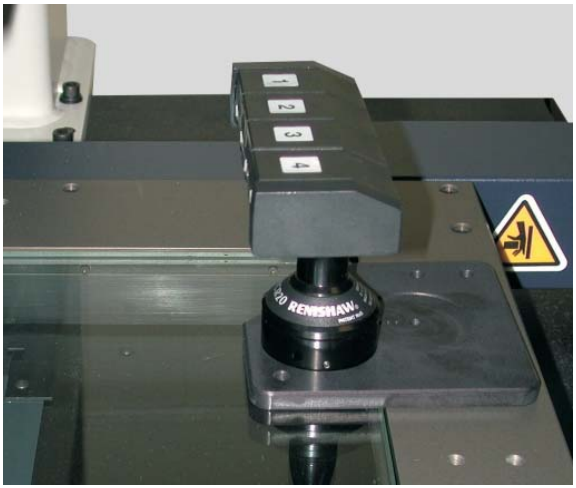
- **SmartScope ZIP, Flash/CNC 250, and Quest/Vantage 250 fixed-lens benchtop machines**. The probe holder is mounted to the back-right of the optics and the change rack is mounted near the back-right corner. It can be parallel to the Y axis (as shown here) or the X axis.

- **SmartScope Quest/Vantage zoom benchtop machines.** The probe holder is mounted to the front-left of the optics and the change rack is mounted on the left side, parallel to the Y axis.
- **SmartScope ZIP 300, 400, and 600** (ZIP 300 shown below). The probe holder is mounted to the back-right of the optics and the change rack is mounted directly on the right side of the stage toward the back, if the machine is equipped with a SmartRing Light. The change rack is mounted on the adapter plate, which is mounted on the right side of the stage toward the back, if the machine is not equipped with a SmartRing Light.

- **SmartScope Flash 200**. The probe holder is mounted to the right of the optics and the change rack is mounted in the back-right corner, with the rack parallel to the Y axis.



- **SmartScope Flash 300, 400, 600, and 700**. The probe holder is mounted to the right of the optics and the change rack is mounted on the adapter plate, which is mounted in the back-right corner of the stage. The change rack is parallel to the Y axis.



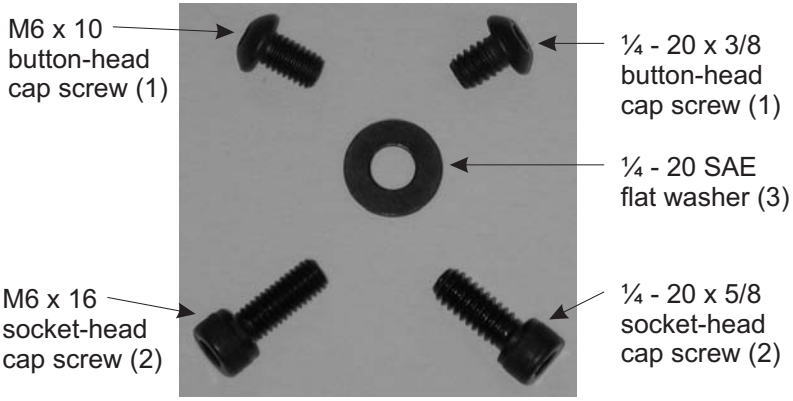
- **SmartScope Flash/CNC 500**. The probe holder is mounted on the right side of the optics and the change rack is mounted on the adapter plate, which is mounted in the back-right corner of the stage. The change rack is parallel to the Y axis.

- **SmartScope Quest/Vantage 450, 600, and 650.** The probe holder is mounted to the front-left of the optics and the change rack is mounted on the mounting plate, which is mounted on the left side of the stage. The change rack is parallel to the Y axis.

CAUTION: Mounting the change rack anywhere else could result in the optics contacting the fixture and damaging the change rack and touch probes. Also, the ports may not be accessible to the DSM.

Change Rack Installation Screw Kit

The screw kit (P/N 526818) contains a flat washer and the screws that are needed to install the change rack.



The screws that you will need to use depend on the type of machine you have.

- Use the M6 x 10 button-head cap screw and washer to secure:
  - The change rack bracket to the stage of a SmartScope Flash 200
  - The Renishaw fixture plate (located at the bottom of the change rack post) to the adapter plate on SmartScope Flash 300, 400, 500, 600, and 700; SmartScope ZIP 300, 400, and 600; SmartScope ATS; and SmartScope CNC 500
  - The Renishaw fixture plate to the stage on SmartScope ZIP 250, SmartScope Flash/CNC 250, and SmartScope Quest/Vantage 250
  - The Renishaw fixture plate to the stage on a SmartScope ZIP 300 equipped with a SmartRing Light—an adapter plate is not used in this case

- Use the two M6 x 16 socket-head cap screws to secure the adapter plate to the stage on SmartScope ZIP 300, SmartScope Quest/Vantage 450, 600, and 650
- Use one ¼ -20 x 5/8 socket-head cap screw to secure the adapter plate to the stage on SmartScope Flash 300, 400, 600, and 700
- Use two ¼ -20 x 5/8 socket-head cap screws to secure the adapter plate to the stage on SmartScope ZIP 400 or 600, and SmartScope ATS
- Use the ¼ -20 x 3/8 button-head screw and washer to secure the Renishaw fixture plate to the stage on SmartScope ZIP 400 and 600 equipped with a SmartRing Light—an adapter plate is not used in this case

CAUTION: The ¼ - 20 x 3/8 and M6 x 10 button-head screws are very similar in size. If one of the screws does not fit properly, do not force it; use the other screw instead.

Mounting the Change Rack on SmartScope Flash 200

To install the change rack on a SmartScope Flash 200, follow the steps below.

1. Remove the change rack from the box. The post and bracket should already be screwed in.
2. Make sure that each port can be reached by the probe holder.
   - Place the bracket hole over the front tapped hole on the left side of the stage and, while holding the fixture, move the holder over a port.
   - If a port cannot be reached, use a 3 mm hex key (Allen) wrench to loosen the post screw and swing the fixture closer to the stage. Then tighten the post screw.

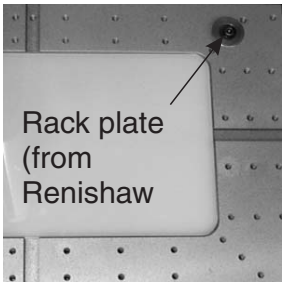
3. Place the washer in the bracket cavity and screw the M6 x 10 button-head cap screw into the tapped hole so that the change rack is secured tightly and does not pivot. Make sure that the rack is parallel to the Y axis.

Mounting the Change Rack on the Stage

The change rack is installed on the stage on SmartScope ZIP 250; SmartScope ZIP 300, 400, and 600 (equipped with a SmartRing Light); SmartScope Flash 250; SmartScope CNC 250; and SmartScope Quest/Vantage 250.

To install the change rack on the stage, follow the steps below.

1. Remove the change rack from the box and loosen the set screw at the bottom using the hex key (Allen) wrench provided in the kit.
2. Install the Renishaw fixture plate.
   - Place the tapered edge on the stage and place the washer in the recessed side of the plate.
   - Secure the plate with either the M6 x 10 or ¼ - 20 button-head screw (depends on the stage type).
3. Place the change rack over the fixture plate. Make sure that the change rack is parallel to the X or Y axis.
4. Screw in the set screw until it is snug.

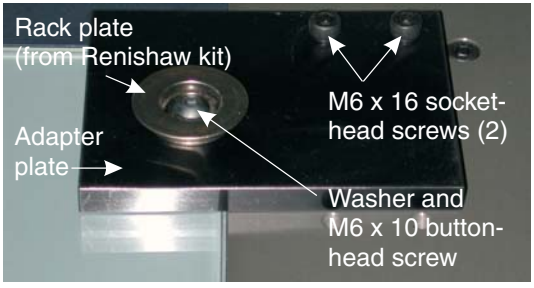


Mounting the Change Rack on an Adapter Plate

The change rack is installed on an adapter plate on SmartScope ZIP 300, 400, and 600 (not equipped with a SmartRing Light); SmartScope Flash 300, 400, 600, and 700; SmartScope Flash 500; SmartScope CNC 500, and SmartScope Quest/Vantage 450, 600, and 650.

To install the change rack on the adapter plate, follow the steps below.

1. Secure the adapter plate to the stage using the two M6 x 16 (shown here) or ¼ -20 socket-head screws (depends on the stage type).



2. Remove the change rack from the box and remove the fixture plate by loosening the set screw at the bottom with the hex key (Allen) wrench provided in the kit.
3. Install the Renishaw fixture plate on the adapter plate.
   - Place the tapered edge on the adapter plate and place the washer in the recessed side of the fixture plate.
   - Secure the fixture plate with either the M6 x 10 or ¼ - 20 button-head screw (depends on the stage type).
4. Place the change rack over the fixture plate. Make sure that the change rack is parallel to the Y axis.
5. Screw in the set screw until it is snug.

Section 4

Maintaining the Touch Probe

Each TP20 and TP200 touch probe is supplied with a Renishaw cleaning kit and cleaning instructions. The kit contains a specialized material to effectively remove contamination from the precision ball/V groove seatings, electrical contacts, and permanent magnets of the DSM.

To ensure continued high performance, we recommend that the DSM and probe sensor be cleaned periodically. Follow the cleaning instructions provided in the cleaning kit.

DSMs which are not attached to the probe sensor should be stored in the probe module change rack or the protective tubes to prevent airborne contamination.

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MeasureMind 3D Sections

The next two sections contain information that only applies to MeasureMind 3D systems. Measure-X users should refer to Sections 7 and 8 for information applicable to Measure-X systems.

Section 5: Setting Up the Touch Probe (MeasureMind 3D Systems)

Section 6: Using the Touch Probe (MeasureMind 3D Systems)

Section 5

Setting Up the Touch Probe (MeasureMind 3D Systems)

Important: This section describes how configure and calibrate the touch probe on systems equipped with MeasureMind 3D, revision 12.56 or higher. For information about configuring and calibrating the touch probe on Measure-X systems, see Section 7.

If you wish to do multi-sensor measurements (measure features optically and with the touch probe), you must perform the following alignment and calibration procedures before you can measure features with a touch probe:

- **Stylus configuration**, which identifies each stylus by name and configures all the settings for each stylus, for example, stylus type, number of tips, length, tip diameter, etc.
- **Change rack configuration**, which specifies the change rack(s) to be used and associates styli with specific ports. This procedure needs to be done only if a change rack is used.
- **Touch probe calibrations**:
  - **Probe-to-optics calibration**, which determines the location of the reference sphere and establishes the camera XYZ center.
  - **Primary tip calibration**, which establishes the offset from the optics to the primary tip and calculates the tip diameter.
- **Change rack calibration**, which "teaches" the system the physical and clearance locations of each port. This procedure needs to be done only if a change rack is used.
- **Auxiliary tip calibration**, which calibrates all the other probe tips (single tips or tips on a multi-tip stylus) that you plan to use. This establishes the offset of each auxiliary tip from the primary tip and calculates the tip diameter.

These procedures ensure the accuracy of the probes for the current measurements. A probe measurement will produce errors if the probe is configured or calibrated improperly.

You only need to perform selected procedures in the following cases:

- If you change the primary tip, perform the probe-to-optics calibration, primary tip calibration, and auxiliary tip calibration for every stylus.
- If you add or replace a probe stylus that is not the primary tip, configure the stylus and perform the auxiliary tip calibration.
- If you use an add-on lens or a fixed lens and the calibrations have not been done with that lens, perform the probe-to-optics calibration and the primary tip calibration.
- If you add a new change rack or move an existing one to a new location, perform the change rack configuration and calibration.

These procedures are done when there is no routine in memory. Before you begin the calibrations, make sure that the calibration mode is enabled.

Note: You do not need to perform any of these procedures if you updated the MeasureMind 3D software but you did not make any changes to the existing touch probe configurations and calibrations. The software keeps the existing settings intact when you update the software.

Configuration Settings

Before you can configure and calibrate the change rack(s) or begin the touch probe calibrations on MeasureMind 3D systems, you must specify two parameters:

- The *Probe Sphere_Diameter* parameter in the TPROBE1.CFG file indicates the diameter of the reference sphere used for the calibrations.
- The *Dockable_Touch_Probe* parameter in the HARDWARE.CFG file indicates which type of touch probe is installed.

To specify or change these parameters, press the **F8** key (or use an editing tool such as Notepad):

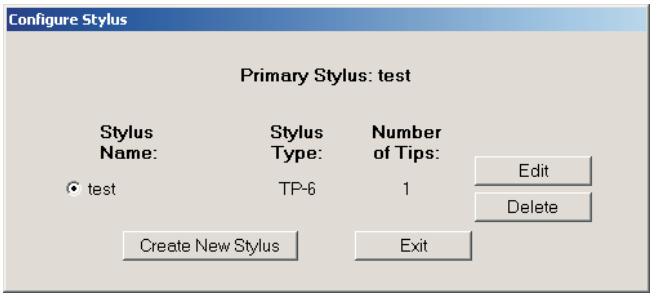
1. Edit the TPROBE1.CFG file and change the parameter for *Probe_Sphere_Diameter* to the certified size of the reference calibration sphere.
2. Edit the HARDWARE.CFG file and change the parameter for *Dockable_Touch_Probe* to:
   - 0 = No touch probe installed
   - 1 = Fixed touch probe (no change rack)
   - 2 = Dockable touch probe

Configuring the Probe Stylus

A probe stylus must be configured properly before it can be calibrated and used for measurements.

To configure a stylus, select **Configuration** ⇒ **Probe Tips** in the **System** menu.

The software displays the Configure Stylus dialog box.



You can access the following functions from this dialog box:

- To add a new stylus, click **Create New Stylus**.
- To edit the stylus settings, select the desired stylus and click **Edit**.
- To remove an existing stylus, click **Delete**.

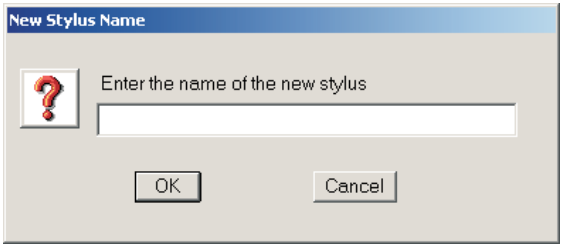
Notes:

1. If the system is configured for a fixed off-axis touch probe, the software immediately displays the Touch Probe Stylus Settings window.
2. This menu item is only available if the system is equipped with a touch probe.

Adding a New Touch Probe Stylus

1. Select the desired stylus in the Configure Stylus dialog box (shown on the previous page) and click **Create New Stylus**.

   The software displays the New Stylus Name dialog box.



2. Type the desired name in the box.
   - The name must contain less than 32 alphanumeric characters (no spaces) and it cannot have a suffix.
   - You cannot specify the name of an existing stylus.
3. When finished, click **OK**.

   The software displays the Stylus Settings window (shown on the next page).

Note: If you click Cancel, the software does not add the stylus and returns you to the Configure Stylus dialog box.

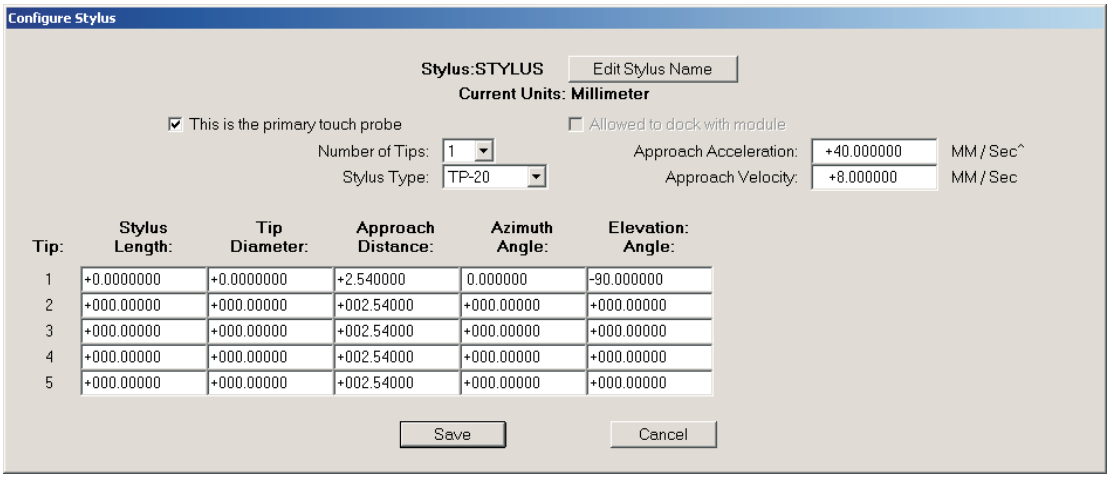
Editing a Touch Probe Stylus

1. Select the desired stylus in the Configure Stylus dialog box (shown on the previous page) and click **Edit**.

   The software displays the Stylus Settings window (shown on the next page).
2. Make the desired changes to the stylus settings.
3. Click **Save** to save your changes or Cancel to discard them.

Probe Stylus Settings

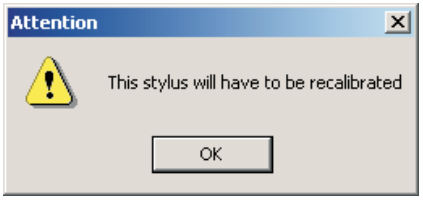
The software displays the Stylus Settings window after you select the desired stylus in the Configure Stylus dialog box and click **Edit** or if you create a new stylus.



To edit the settings for the selected probe stylus:

1. Select the number of tips that will be used for measurements. The default is 1.
2. Select a standard stylus type (i.e., TP6, TP20. or TP200)
3. If this stylus will be the primary probe, select the **This is the primary touch probe** checkbox. Tip 1 will be the primary tip. The primary probe can be configured only in a "down tip" state (i.e., the Elevation angle must be -90°.
4. Change the Approach Acceleration and Velocity, if necessary.
5. Specify the following information for each tip that was selected in Step 1.
   - **Nominal stylus length and tip diameter**, which must be specified before any probe calibrations can be done. The defaults are 0.
   - **Approach distance**. The default is 0.1 inches.
   - **Azimuth angle** (the tip angle from the machine's positive X axis in the XY plane) if this is a star stylus or knuckled stylus. The default azimuth angle is 0 for tips 1 and 2, and 90, 180 and 270 for tips 3, 4 and 5 respectively, if the number of tips is set to 5.
   - **Elevation angle** (the tip angle from the machine's XY plane in 3D space) if this is a star stylus or knuckled stylus. The default elevation angles are -90 for tip 1, and 0 for all other tips if the number of tips is set to 5.

6. If you want to change the name of the stylus, click **Edit Stylus Name**.
7. When finished making changes, do one of the following:
   - Click **Save** to save all of your changes. The software updates the Touch Probe configuration file, and then displays a Recalibration Notification message indicating that if any probe was reconfigured, all the tips will need to be recalibrated.



   - Click **Cancel** to discard your changes without saving them. The software does not update the system and displays Stylus Configuration window.

Approach Acceleration and Velocity

The approach acceleration and velocity parameters control the rate and speed at which the touch probe approaches the contact point within the approach distance.

The approach parameters are specified for each named stylus in the Probe Stylus Settings window.

- The range for the approach acceleration is from 1.0 to 1000.0 mm/sec2 or the maximum Autogo acceleration, whichever is lower. The default is 40.0 mm/sec2, or the equivalent in inches/sec2.
- The range for the approach velocity is from 0.000001 to 80.0 mm/sec or the maximum Autogo velocity, whichever is lower. The default is 8.0 mm/sec, or the equivalent in inches.

The values specified for the approach acceleration and velocity parameters are applied to all touch probe measurement operations regardless of the approach angle. The system calculates the X, Y, and Z axis approach and acceleration values such that the specified approach acceleration and approach velocity are applied as the vector motion for measurements made with the named stylus. If the named stylus has multiple tips, the same approach acceleration and approach velocity is used for all tips.

The following factors must be taken into account when setting the approach acceleration: stylus type, stylus length, stylus tip diameter, and approach distance.

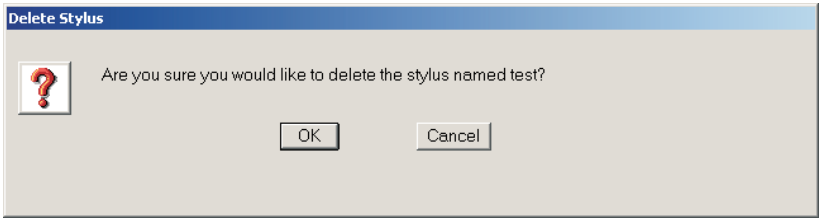
- A value that is too high can introduce false triggers or cause vibrations that produce inaccurate readings with poor reproducibility.
- A value that is too low may prevent the stylus from reaching the proper approach velocity and can unnecessarily add time to the part routine.

CAUTION: Do not use inappropriate approach acceleration settings for a probe tip's acceleration distance.

Removing an Existing Touch Probe Stylus

1. Select the desired stylus in the Configure Stylus dialog box (shown on page 5-3, and then click **Delete**.

   The software displays a Delete Stylus confirmation message.



2. Click **OK**.

   The software returns you to the Configure Stylus dialog box.

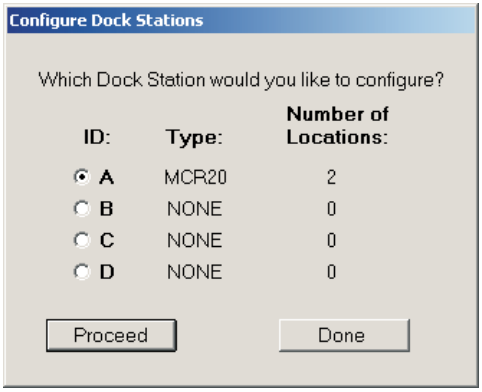
Note: If you click Cancel, the software does not delete the stylus and returns you to the Configure Stylus dialog box.

If you use a change rack to dock probe modules and styli, it is necessary to configure the change rack after the stylus has been configured. The change rack configuration identifies the change rack(s) that will be used and associates styli with specific ports. Up to four change racks can be configured for use on one system.

To configure the change rack, follow the steps below.

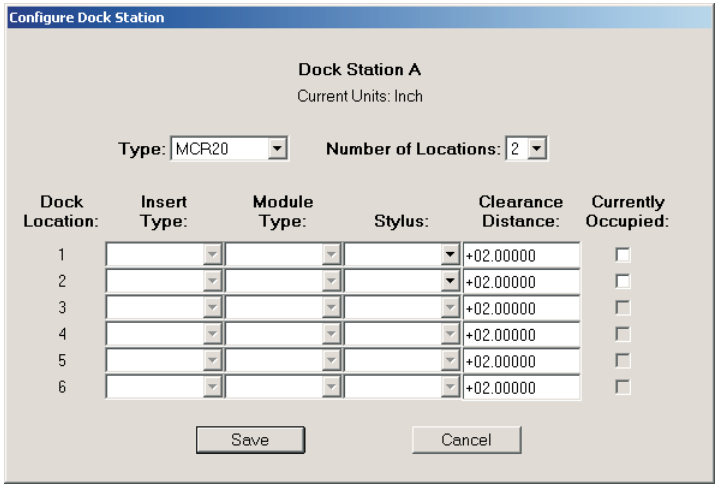
1. In the **System** menu, select **Configuration** ⇒ **Change Rack**.

   A dialog box displays the IDs for up to four change racks. The default ID is A.



2. Select the desired ID and click **Proceed**.

   Something similar to the following is displayed:



3. In the **Type** list, select the type of change rack. This indicates the nominal dimensions of the change rack and the offsets between the ports.
   - The default is blank, which means that a change rack is not used and the styli will be attached/detached manually.
   - Select MCR20 if you use TP20 and TP200 touch probes.
4. Specify the number of ports in the change rack. The default is 1 if a change rack is not used.
5. Click **Next** to display the dialog box for associating styli with specific ports in the selected change rack.
6. Select the Stylus Type. The drop-down list contains the name of every configured stylus. The default is blank, which means that the port will not contain a stylus.
7. Specify the distance from the port to the clearance location, which is a safe distance away from a change rack port. The default is 2 inches. The actual distance is determined during the change rack calibration (described later).
8. Do **not** select the Currently Occupied check box; this default setting means that the port is empty. This ensures that the software will prompt you to attach the stylus manually during the change rack calibration so you can drive it into the port yourself.
9. Repeat Steps 7 through 9 for each port.
10. Click **OK** to save the settings and return to the previous dialog box.
11. Repeat this procedure for other change racks, if appropriate.
12. When finished configuring the change rack, click **Done**.

Note: The Insert Type and Module Type drop-down lists only apply to systems equipped with the scanning probe option. They are unavailable (disabled) on touch probe systems.

Calibrating the Touch Probe

In order to make multi-sensor measurements (measure features optically and with a touch probe), you must perform the probe sensor alignment, which includes two procedures. The probe-to-optics calibration is done first, and is immediately followed by the primary tip calibration.

You can perform the sensor alignment using a reference sphere (P/N 524960) or a ring gage.

- If you only plan to calibrate the primary tip (this must be the down tip), you can use a ring gage for the calibration.
- If you plan to use other probes (for example, a multi-tip stylus or other DSM), you must use a reference sphere for the primary tip calibration because auxiliary tips can only be calibrated with the reference sphere.

Before you begin the calibrations, make sure that:

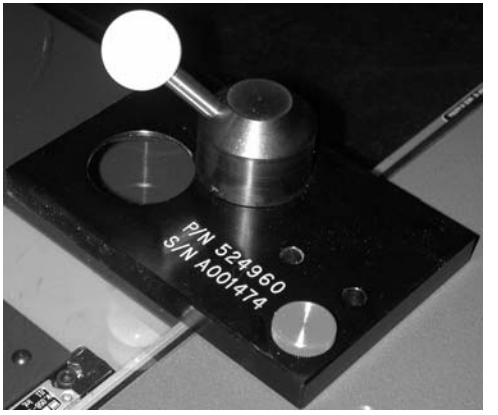
- The reference sphere or ring gage is mounted securely (described on the next page)
- The calibration mode is enabled (see the *Calibration and Alignment Manual* for your system)
- The probe stylus configurations have been completed (see page 5-3)

Calibration Artifact Setup

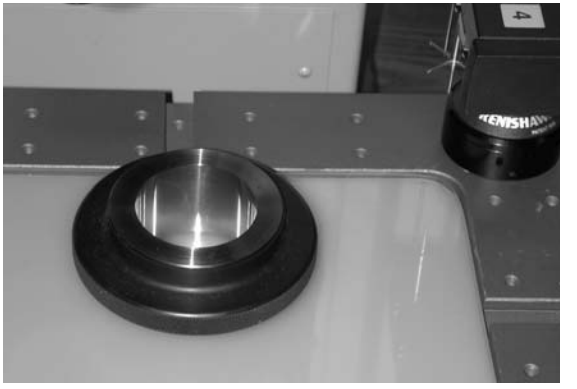
You can perform the probe-to-optics calibration and the calibration of the primary tip using a reference sphere (P/N 524960) or a ring gage. However, each auxiliary tip needs to be calibrated with the reference sphere.

Note: We recommend using the supplied reference sphere to calibrate the primary tip.

The calibration artifact (reference sphere or ring gage) must be placed in a location that is accessible by the optics and touch probe. Make sure that it is mounted securely on the stage so that it will not move during calibration. For example, screw the two knurled thumbscrews into the tapped holes in the base of the table.



Reference Sphere



Ring Gage

Probe-to-Optics Calibration

The probe-to-optics calibration, which is the first part of the touch probe calibrations, consists of video measurements on the calibration artifact (reference sphere or ring gage). This calibration is done when there is no routine in memory. This determines the location of the reference calibration artifact and establishes the camera XYZ center.

To perform the probe-to-optics calibration, follow the steps below.

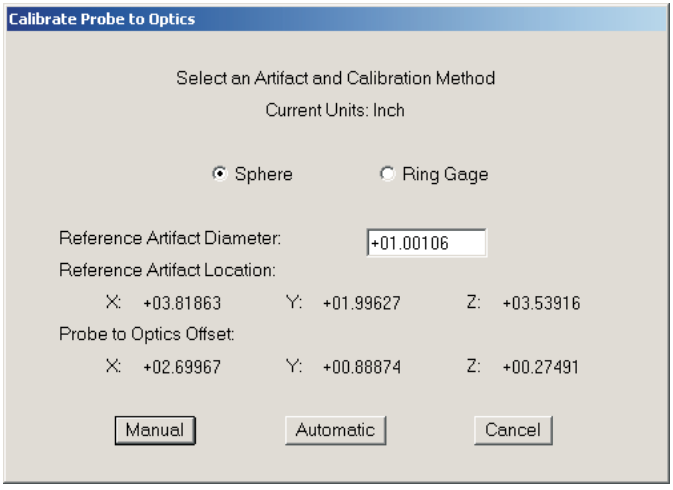
1. Make sure that no touch probe is deployed.
2. Display the calibration artifact in the Image window.
   - Select the *lowest* magnification and turn on the surface illumination.
   - Using the joystick, move the stage so the top of the sphere or the surface of the ring gage appears in the center of the Image window.

Note: If you are unable to locate the top of the sphere by using surface illumination, turn on the back light and use the X and Y axis readouts to center the top of the sphere.

---

3. In the **System** menu, select **Calibration** ⇒ **Sensor Align** ⇒ **Probe-to-Optics**.

   A dialog box displays the calibration artifact that was used last and its last-measured location.



4. Select the **Sphere** or **Ring Gage** radio button to specify the calibration artifact you are using for this calibration.
5. If the diameter of the calibration artifact is different from the artifact used in the last calibration, type the new diameter in the **Reference Artifact Diameter** box.
6. Click **Manual** to start the calibration routine if the artifact has been moved since the last calibration (see note below).

   The Measurement window displays the current status of the calibration. The software also displays the magnification and light settings specified in the configuration file and it displays the basic focus target.
7. Perform a manual focus on the top of the sphere (for ceramic spheres, be sure to go past the ghost image) or on the surface of the ring gage, and then enter a focus point (press Enter on the joystick).

   The software displays a Strong Edge target.
8. Measure the sphere equator or the inner diameter of the ring gage.
   - If a sphere is used, the optics move to the right edge. Measure a point on the edge and press **Enter** on the joystick. Repeat this for the other three edges. The software then remeasures all the points automatically.
   - If a ring gage is used, measure three points on the inner diameter, pressing **Enter** on the joystick. The software then automatically measures focus points on the surface of the ring gage and additional strong edge points on the inner diameter.
9. In the Measurement window, click **OK**.

   The software performs the measurement automatically.
10. When finished, click **OK**.

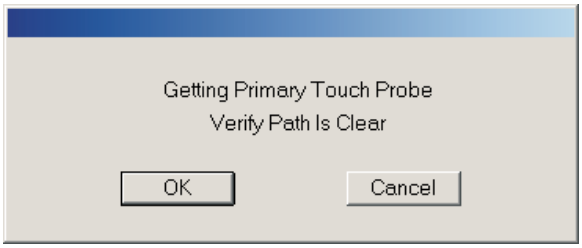
    This completes the first part of the sensor alignment and begins the second part, which is the primary tip calibration.

Note: If the calibration has been performed before and nothing has changed or been moved, you can click Automatic to verify the calibration.

Primary Tip Calibration

The primary tip calibration, which is the second part of the touch probe calibrations, consists of touch probe measurements on the calibration artifact (reference sphere or ring gage) with the primary tip. This calibration is done immediately after the probe-to-optics calibration, and establishes the offset from the optics to the primary tip and calculates the tip diameter.

When you click **OK** in the Measurement window to complete the optical measurement of the artifact, the software displays a message indicating that it will get the primary probe, which was specified in the Probe Stylus Settings window.

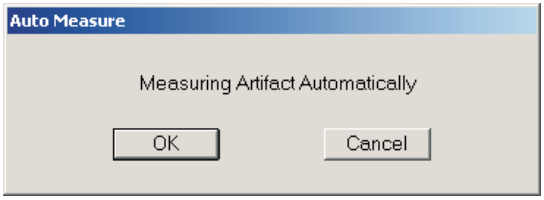


To calibrate the primary tip, follow the steps below.

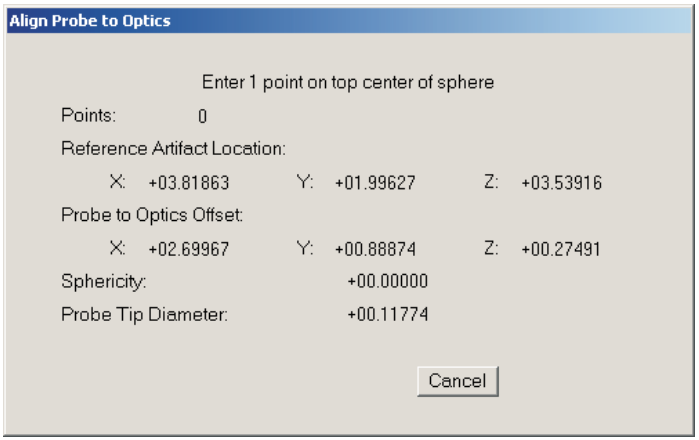
1. Click **OK** in response to the prompt shown above.

   The system gets the primary touch probe and displays a dialog box for the calibration. If a probe is not in a port, the software also displays a prompt to attach it.

   - If the probe-to-optics calibration was done automatically, the software immediately displays an Automeasure confirmation prompt. In this case, go to Step 3.

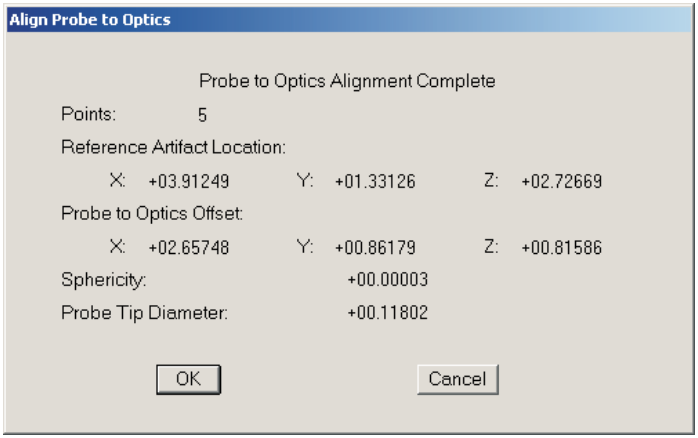


- If the probe-to-optics calibration was done manually, the software displays a dialog box with instructions to measure the top of the reference sphere or ring gage.



2. Measure the first point(s).
   - If you are using a calibration sphere, take one point on top of the sphere.
   - If you are using a ring gage, measure a point on the surface and then measure three points on the inner diameter.
3. Click **OK** after measuring the required point(s).

   The software remeasures all the points automatically two times and redisplays the calibration dialog box with a calibration completed message.



Note: The dialog box displays different parameters, depending on whether the calibration artifact is a reference sphere or a ring gage.

4. Click **OK** after the automatic measurements are completed. This updates the probe-to-optics calibration values in the touch probe configuration file.

If you plan to use other tips (on other DSMs or on a multi-tip stylus), you must also perform the auxiliary probe tip calibration procedure (described on page 5-23).

Calibrating the Change Rack

If you want to dock probe modules and styli, you must first calibrate a change rack. The calibration "teaches" the system the actual and clearance locations of each port.

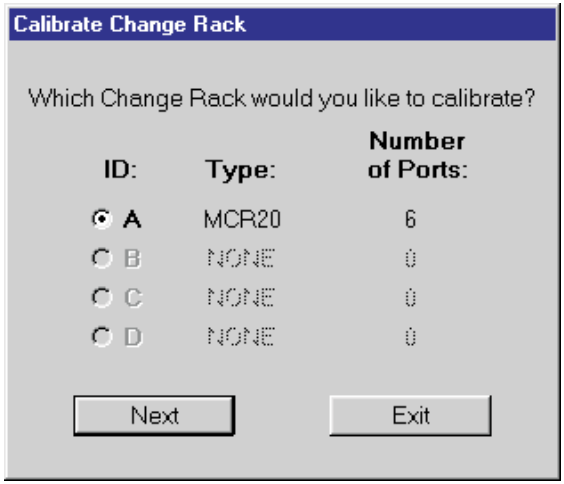
Before calibrating a change rack, be sure that you have:

- Configured the change rack you want to calibrate (the software needs to know that the change rack exists)
- Calibrated the primary tip (you will use a calibrated tip to calibrate the change rack)

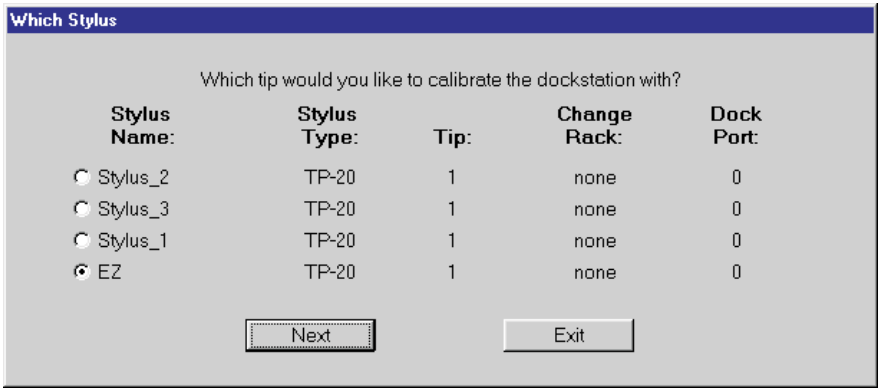
To calibrate the change rack, follow the steps below. This procedure assumes that the change rack has not been calibrated before.

1. Retract the dust covers of all the ports and make sure that all the ports are empty.
2. In the **System** menu, select **Calibration** ⇒ **Change Rack**.

   The software displays a prompt that asks which change rack to calibrate and displays the IDs of the configured change racks. The default ID is A.



3. Select the desired change rack ID and click **Next**.
   - If a calibrated stylus is not attached to the sensor, a dialog box displays a list of the configured styli. The default is the primary tip. Go to Step 4.
   - If a calibrated stylus is attached to the sensor, go to Step 6.



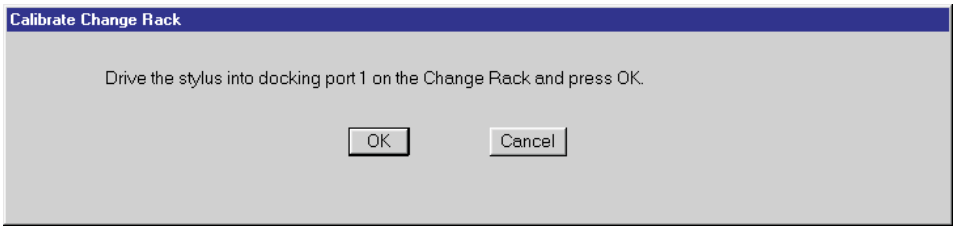
4. Select a calibrated stylus and click **Next**. (The software displays an error message if you selected a tip that was not calibrated.)

   The software displays a prompt to attach the stylus.

5. Attach the stylus and click **OK**.

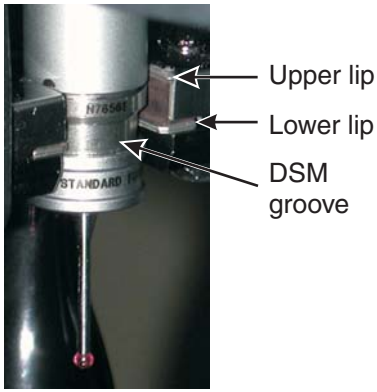
   The software displays a prompt to drive the stylus into Port 1.

Important: Do not click OK until after the next step. If you mistakenly click OK before completing the next step, simply click Cancel in the displayed prompt and start over.



6. Carefully drive the stylus into the specified port.

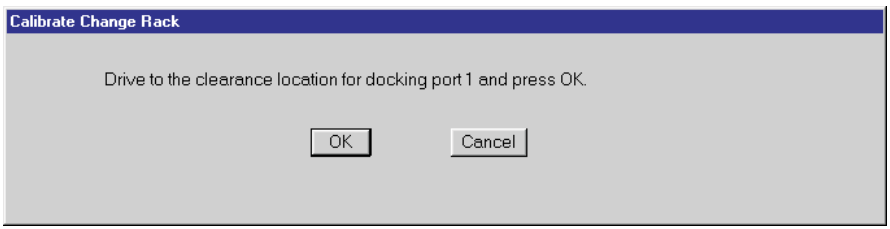
   - Carefully center the stylus in the X and Y axes next to the middle of the port.
   - Lower or raise the stylus so that the top of the DSM is between the upper and lower lips of the port and the lower lip is centered in the DSM groove. This enables the DSM to be moved into the port smoothly.
   - Slowly drive the DSM into the port. You may need to move the sensor slightly in the X, Y and/or Z axes to ensure smooth movement.



7. After the stylus is in the port, click **OK** in response to the prompt.

   The software changes the prompt to drive the stylus to a clearance location.

Important: Do not click OK until after the next step. If you mistakenly click OK before completing the next step, simply click Cancel in the displayed prompt and start over.



8. Drive the stylus to a safe clearance location (only move in the X or Y axis, depending on the orientation of the change rack). It should be at least 10 mm (0.25") away from the change rack.

Important: If you create a safe zone around the change rack, make sure that the clearance location is outside the safe zone.

Note: Set the clearance location far enough away from the change rack to prevent the accidental collision between the optical components and the change rack when the system moves in the negative Z direction immediately after putting or getting a stylus from the change rack.

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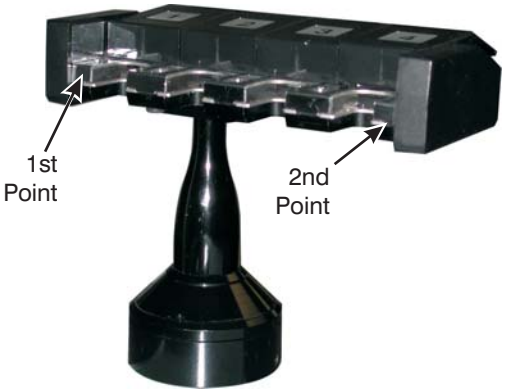
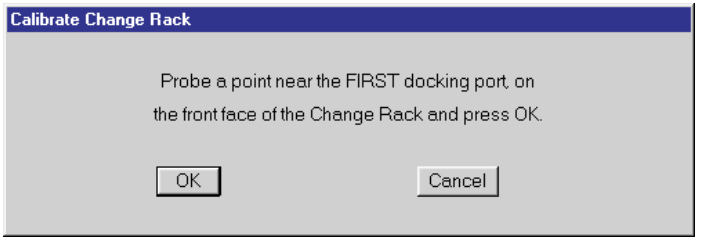
9. Click **OK**.

   The software now needs to determine the alignment of the change rack. This is done by taking two points, one on each end of the front face of the change rack.



   The software displays a prompt to take a point near the first port on the front face of the change rack.



10. Take a point with the stylus and click **OK**.

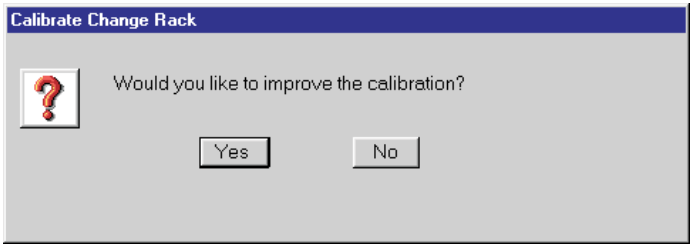
    The software displays a prompt to take a point near the last port on the front face of the change rack.

11. Take a point with the stylus and click **OK**.

    The software updates the following configuration parameters:

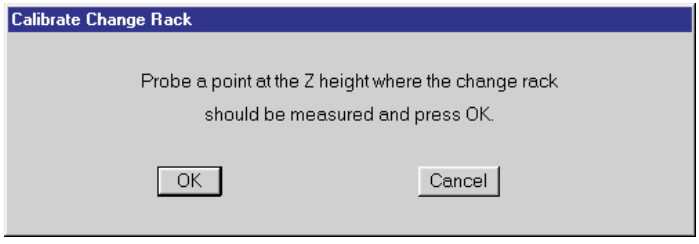
    - XYZ center location of the change rack
    - XYZ vector direction for clearance moves.
    - Information for each port: clearance location, insert type (if used), stylus name, and “currently occupied” status.

    Then the software displays a prompt to automatically improve the calibration.

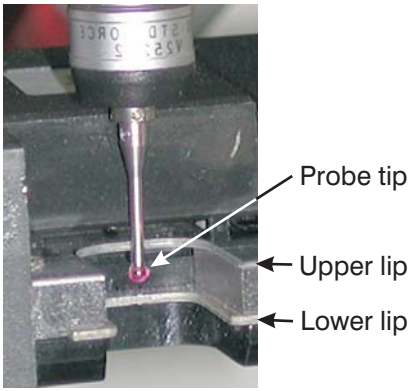


12. Click **OK** to perform the automatic calibration (recommended). If you click Cancel, the calibration is ended and the software displays a dialog box indicating that the change rack has been calibrated

    The software displays a prompt to take a point at the Z height of a port.

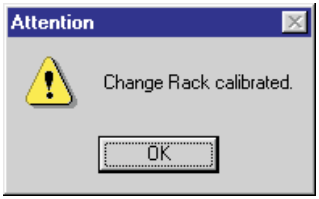


13. Carefully take a point inside any port to establish the Z height.
    - Carefully center the tip in the X and Y axes next to the middle of the port.
    - Lower or raise the stylus so the touch probe tip is between the upper and lower lips of the port
    - Drive the probe tip to the back of the port until it makes contact.



14. Click **OK**.
    - The system automatically drives the probe 1" above the Z height specified in the previous step, over, and then down into each port.
    - A point is taken on each side of each port

    Finally, the system displays a prompt indicating that the change rack has been calibrated.



15. Click **OK** to close the dialog box.

Note: If the touch probe has an unexpected contact or the system enters E-Stop during the automatic portion of the change rack calibration, the system displays a dialog box indicating that the automatic portion has failed. In this case, the calibration is ended and the system displays a dialog box indicating that the change rack has been calibrated.

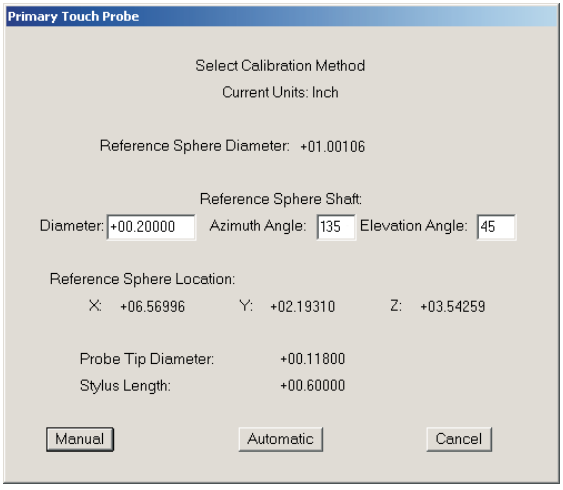
Calibrating the Auxiliary Probe Tip

The auxiliary probe tip calibration is used to calibrate the other probe tips on a multi-tip stylus or in other detachable stylus modules (DSMs) using the reference calibration sphere. This establishes the offset of each auxiliary tip from the primary tip.

This calibration is done after the sensor alignment (probe-to-optics calibration and primary tip calibration) has been completed.

To perform the auxiliary probe tip calibration, follow the steps below.

1. In the **System** menu, select **Calibration** ⇒ **Auxiliary Tips**. The software displays the Primary Probe Calibration dialog box.



2. Verify the calibration sphere shaft parameters (described on page 5-26). These values are only important only if star-cluster tips will be used; otherwise they can be left unchanged.
3. Select the calibration method.
   - Click **Automatic** if the reference sphere has not been moved since the last calibration.
   - If the reference sphere was moved, or if the tip cannot be calibrated using a standard system-generated path, click **Manual**.
4. If the primary probe is not already deployed, the software displays the appropriate dialog boxes to put the current module/probe (if attached) and to get the module/primary probe. Click **OK** in response to the prompts. When the software gets the primary probe, it makes sure that Tip 1 (primary tip) is active.

5. The software then performs the selected calibration.

   - If you selected Automatic in step 3, the software automatically runs the calibration routine one time using the currently stored values for sphere diameter and location, and the probe tip diameters and stylus length (the distance between the center of the ruby tip and the tapered end of the stylus).

   - If you selected Manual in Step 3, you need to position the probe as indicated in the dialog box. Then click OK so the software can measure the points automatically. The software automatically re-measures the sphere two times.

6. Click **OK** in the Primary Probe dialog box after the automatic measurements are completed. This updates the calibration values in the touch probe configuration file. The software then displays a dialog box to select the auxiliary tip to be calibrated. It also lists the stylus type, number of tips, port, and dock location for each stylus.

7. Click the radio button of the desired probe stylus. If the auxiliary tips are in a star cluster, select the specific tip from the drop-down list.

8. Click **Next**.

   - If a stylus is still mounted, the software displays the appropriate dialog boxes to put the current module/probe and to get the module/auxiliary probe. Click OK in response to the prompts.

   - Then the software displays a dialog box to select the calibration method in the Auxiliary Probe Tip Calibration dialog box.

   - If you are calibrating an auxiliary probe tip on a PH10 probe head, the software displays the Move PH10 window where you must specify the articulation angles of the tip being calibrated and move the probe to the specified angles. Remember to close the dialog box when you're done.

9. Click the appropriate button for the calibration method you want to use.

   - If the auxiliary probe tip is not a straight-down tip (elevation angle is not –90 degrees) or its stylus length is less than the radius of the calibration sphere, you will be prompted either to use a system-generated path or to take the points yourself.

10. If you selected the system-generated option, click **OK** in the Auxiliary Probe Tip Calibration dialog box after the system-generated measurements are completed. This updates the calibration values in the touch probe configuration file. The software then returns to the dialog box to select another auxiliary tip to be calibrated.

    OR

    If you choose to take points yourself, measure the sphere manually using 5 points on the sphere that the tip can reach.

11. Click **OK**. The software offers to retake the same points automatically.
    - Click **No** if there is a possibility that the automatic movements will contact the shaft. In this case the software accepts the points that you measured.
    - Click **Yes** only if you know that an automatic measurement will not contact the shaft. The software then accepts the automatically measured points.
12. Repeat Steps 6 to 9 for other auxiliary probe tips.
13. Click **Exit** to end the calibration.

Calibration Sphere Shaft Parameters

The reference sphere shaft parameters in the auxiliary probe tip calibration procedures are used to determine the measurement areas for the calibration of star probes. The parameters indicate the position and size of the shaft, and are used to avoid shank hits and unexpected contact during scanning. These values are important only if star-cluster tips will be used; otherwise they can be left unchanged.

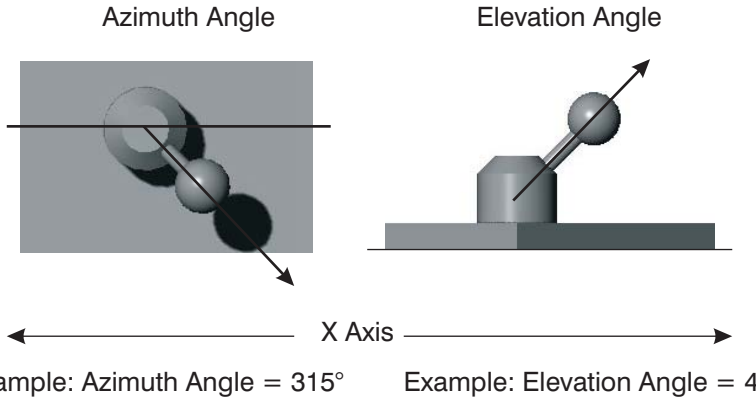
For example, many users have a calibration sphere that can be removed from the black post and repositioned in a vertical position for calibrating such probes. The parameters ensure that the probes do not collide with the shaft.

All angles are based on machine stage home coordinates, even if you have done a part setup.

When you calibrate star probes, verify the following parameters:

- The default diameter of the shaft leading to the ball from the black post is 0.2 inches. You do not need to change this value unless you use another reference sphere.
- The Azimuth angle is the shaft's -XY angle from the positive X axis of the machine starting at the black post vectoring toward the calibration sphere; the default is 135.
- The Elevation angle is the Z axis angle of the shaft from the XY plane of the stage in 3D space, starting at the black post and vectoring toward the calibration sphere; the default is 45.

When running the calibration procedure, the system will adjust for the shaft location. For example, on a right-angle star probe the system will take 1 point in line with the probe and then four additional points 45 degrees off of a NESW (North, East, South, West) path.



Section 6

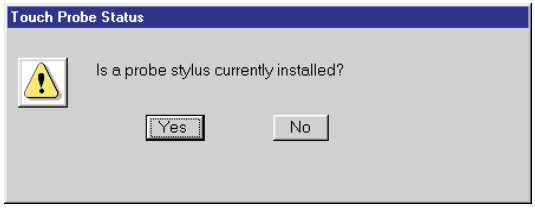
Using the Touch Probe (MeasureMind 3D Systems)

Important: This section describes how to use the touch probe to measure features on systems equipped with MeasureMind 3D. For information about using the touch probe on Measure-X systems, see Section 8.

Starting MeasureMind 3D

1. Turn on the power and access MeasureMind 3D.

   The software displays a prompt asking if the probe stylus is installed (attached to the probe sensor).



2. Click the appropriate button.
   - If the touch probe is not installed, click **No**.
   - If the touch probe is installed. In this case the system is configured such that the touch probe is enabled, click **Yes**.
3. If you clicked Yes in the previous step, select the stylus in the displayed window and then click **Proceed**.

The system goes through the stage initialization process.

Touch Probe Locations

A fixed touch probe is typically mounted on the probe sensor. In this case, you must **be very careful when measuring features with the optics so the touch probe does not contact a part or the change rack during optical measurements.**

A dockable touch probe can be in two locations:

- In the port. We recommend that the DSM remain in the port whenever it is not in use. This avoids possible collisions with a part.
- Mounted on the probe sensor as described above.

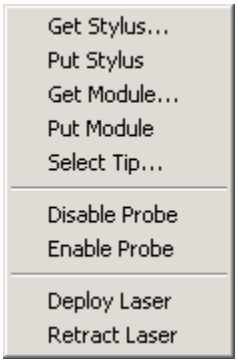
CAUTION:

1. Once the touch probe is mounted on the sensor, you must be very careful not to accidentally run the touch probe or styli into anything to prevent damage to the touch probe or optical components.
2. To avoid unexpected contacts and damage to touch probe components, press the Stop button to stop stage movement.

Important: It is assumed that the optics, port and the touch probe(s) that you will be using have been calibrated as described in Section 5.

Enable and Disable a Touch Probe

In the **System** menu, select **Change Sensor** ⇒ **Enable Probe** if the stylus is already attached to the sensor or probe body in a disabled mode. The system automatically enables the probe and you are ready to use it.



Select **Disable Probe** if you want to leave a stylus attached to the sensor or probe body while making other non-touch probe measurements. The software automatically disables the stylus. You must be very careful with the stage and Z axis motion to prevent damage to the touch probe components during video/laser operations.

CAUTION: Once the stylus is mounted on the sensor, you must be very careful not to accidentally run the sensor or styli into anything to prevent damage to the touch probe or optical components.

Notes:

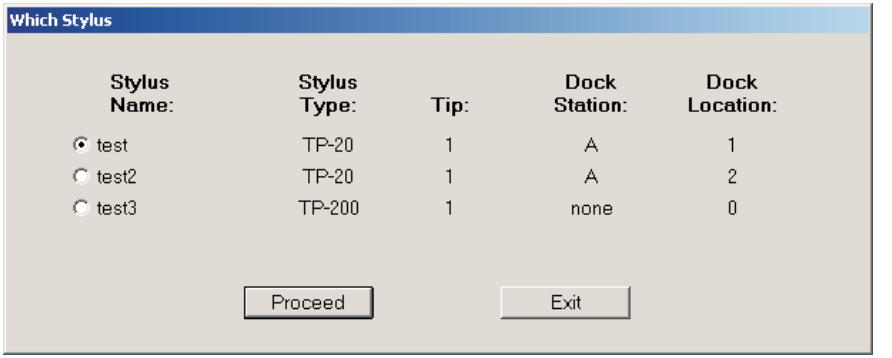
1. While the system is in touch probe mode, the joystick operates at a slower speed. Depress the top button on the joystick to override this safety feature and increase the velocity for Z axis and XY joystick motion.
2. When the touch probe is disabled, the joystick continues to operate in the slower touch probe mode. However, the system performs the routine at full speed.
3. If the probe is disabled but not docked, you can control the zoom only with the slider; you cannot use the joystick to control the zoom.
4. The Get Module and Put Module items in the System / Change Sensor menu are only available to systems equipped with the scanning probe option. These items are disabled (greyed out) on touch probe systems.

Get Stylus Option

When you are ready to use a stylus, follow the steps below. It is assumed that the touch probe setup (configuration and calibration) procedures have been completed.

1. Be sure that the path is clear between the probe sensor and the change rack (if used).
2. In the **System** menu, select **Change Sensor** ⇒ **Get Stylus**.

   The system displays the following dialog box to select the desired stylus.



   For each stylus, the dialog box indicates the stylus type, number of the tip that will be enabled, the ID of the change rack (if any), and the port (if it is in a change rack).

3. Click the desired radio button.
4. If you selected a multi-tip probe, activate the tip that will be used for measurements.

5. Click **Proceed**.

   - If a stylus is mounted on the sensor and you selected a different stylus, the software returns the stylus to its port (if configured). If it is not configured to a port in a change rack, the software drives the Z axis all the way up (if the Safe Docking parameter is On) and displays a prompt to detach the stylus. In this case you need to manually remove the existing stylus and attach the selected stylus.
   - If the selected stylus is in a port, the software immediately gets the stylus from its configured port, moves it to the specified clearance location, and enables it for measurements.
   - If the stylus is not mounted on the sensor and it is not configured to a port, the software drives the Z axis all the way up (if the Safe Docking parameter is On) and displays a prompt to attach the stylus. In this case, manually attach the stylus and click OK in the prompt. If you click Cancel, the software does not complete the operation.

CAUTION: Once the stylus is mounted on the sensor, you must be very careful not to accidentally run the sensor or styli into anything to prevent damage to the touch probe or optical components.

Note: If the Get Stylus operation is unsuccessful for any reason when you run a routine, the software automatically stops the run.

Put Stylus Option

Whenever you do not need to use the probe, you can:

- Return the stylus to its port, if configured (described below)
- Manually detach the stylus (described below)
- Disable the stylus

When you are done using a stylus and you wish to put it away or detach it, follow the steps below.

1. Be sure that the path is clear between the probe sensor and the change rack (if used).
2. In the **System** menu, select **Change Sensor** ⇒ **Put Stylus**.
   - If a port is configured to hold the stylus, the software immediately drives the stylus to its clearance location, slowly drives the stylus into the port, and disables the stylus.
   - If the stylus is not configured to a port, the software drives the Z axis all the way up (if the Safe Docking parameter is On) and displays a prompt to detach the stylus. In this case, manually detach the stylus and click OK in the prompt. If you click Cancel, the software does not complete the operation.

Note: If the Put Stylus operation is unsuccessful for any reason when you run a routine, the software automatically stops the run.

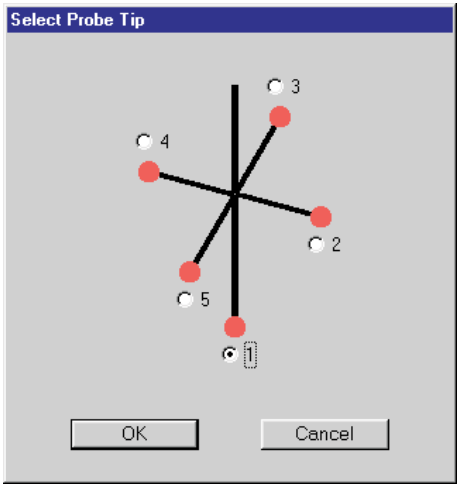
Using a Multi-Tip Touch Probe

To use a multi-tip touch probe, follow the steps below. The tips that will be used for measurements must be calibrated.

1. In the **System** menu, select **Change Sensor** ⇒ **Select Tip** or click the multi-tip icon at the bottom of the screen.

   A pop-up window displays an image of the multi-tip stylus with a radio button next to each tip.

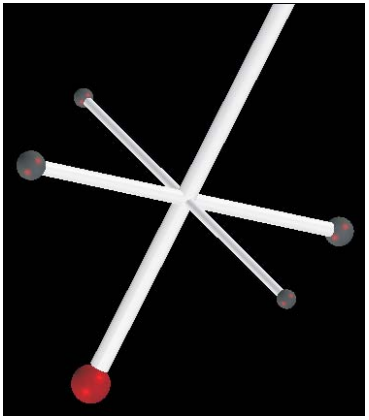
2. Click the radio button to select the desired tip and then click **OK**.



This activates the selected tip. All contact measurements will be based on the selected tip, even if there is an accidental contact with another calibrated tip. In this case, the measurement results will be in error because the location of the **selected tip** is used for the calculations.

An image of the multi-tip probe is displayed in the 3D Model window when the probe is enabled.

- The stylus length is taken from the probe stylus settings and is drawn to scale.
- The probe tip diameter is taken from the calibration and is drawn to scale. If a tip is not calibrated, its color is grayed out.



Joystick Functions When Using the Touch Probe

The joystick has the following functions for touch probe measurement points.

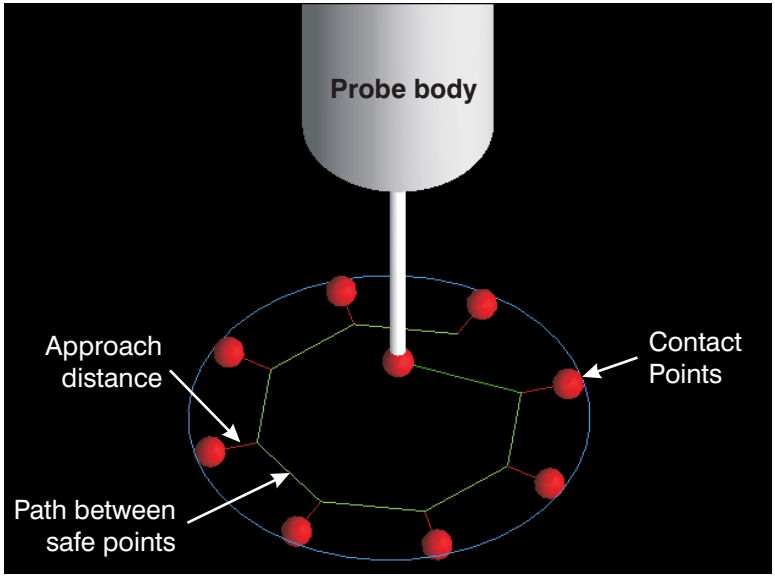
Use	To
Joystick knob	Move the probe axis up or down
Joystick lever	Move the probe/stage along the X and Y axes
Enter button	Record a “safe” point
Enter button and joystick lever	Move the probe away from the part (if it is still touching the part after the backoff move)
Cancel button	Delete the last point taken (applies to both measured points and safe points)
Top button	Press and hold the button to increase the velocity for Z axis and XY joystick motion

An audible beep is produced each time the probe tip makes a contact. The beep for the safe point has a slightly higher pitch and can be turned On/Off in System / Configuration ⇒ Sound.

Touch Probe Features in the Model Window

Touch probe features are displayed in the following ways in the 3D Model window:

- A graphic of the touch probe sensor is displayed, including the probe body, stylus and probe tip (when the touch probe is enabled).
  - The stylus length is taken from the probe stylus settings and is drawn to scale.
  - The probe tip diameter is taken from the calibration and is drawn to scale. If the tip is not calibrated, its color is grayed out.
- Touch probe path, when a feature measured with a touch probe is selected.
  - The path between safe points is shown in green.
  - The approach distance path (between the approach point and contact point) is shown in red.
- Contact points are displayed as red dots.



Note: When you click on a feature that was measured with a touch probe and the touch probe is not enabled, the software displays a confirmation prompt to get the probe.

Touch Probe Measurement Terms

The following terms are used in the descriptions of touch probe measurements.

- A **contact point** is the point where the probe makes contact with (touches) the object being measured. The software produces an audible “beep” and increments the number next to the Points button in the Measurement window.
- A **safe point** is the location where the probe is moved to between contact points. Typically there is at least one safe point before every contact point in a step. Safe points can be created in the following ways:
  - Move the probe to a safe location and press the Enter button on the joystick. The software increments the number next to the Point button in the Measurement window.
  - Select the AutoPoints Vector Points mode or AutoPath probe strategy. The software automatically includes safe points wherever they are needed.
- A **safe location** indicates a location, relative to the Z part datum, for the touch probe both at the beginning and end of a measured step.
  - If you use the AutoPoints Points mode, you must enter a safe point at the beginning of the step and at the end of the step.
  - If the AutoPoints Vector Points mode or an AutoPath probe strategy is selected, select the Safe check box and specify a value in the Safe Location field in the Advanced Probe Strategy parameters. As soon as you generate a new path, the software replaces the start and end safe points from the feature measurement with the specified safe location.
- The **approach distance** is the distance between the expected contact point and the point where the servo motors slow down as the probe approaches the contact point. The default approach distance for each probe tip is specified when you configure the probe tips (described at the beginning of Section 5). These parameters are stored in the TPROBE1.CFG file.
  - If you need to change the approach distance for a feature measurement, you can do so in the Advanced Probe Strategy Parameters window for that feature. If the probe strategy is Vector Points or AutoPath, this changes the locations of all the safe points, i.e., their distance to the contact points.
  - The approach distance is carried forward to the next touch probe measurement of the same kind of feature.
- The **backoff distance** is the distance that the probe backs away from the contact point. Typically, the approach distance is also used as the backoff distance during the creation of a routine.
- The **search distance** is the distance in which the probe will try to find a contact point. The total search distance is twice the approach distance.

Measuring Features with the Touch Probe

You can use the touch probe to measure depths, counterbores, planes, cones, cylinders, and spheres.

When you measure features with the touch probe it creates steps in the routine. You can use it at any time during the creation or editing of a routine.

You can use the touch probe to create the following kinds of routines:

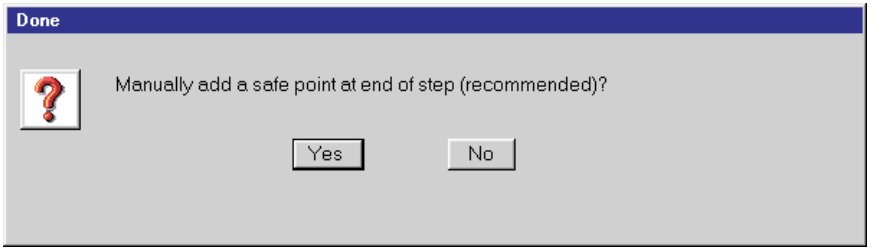
- Routines with touch probe measurements only
- Routines combining touch probe and video/laser measurements

Guidelines for Creating a Multi-Sensor Routine

If you plan on creating a multi-sensor routine, use the guidelines listed below.

- Whenever possible, do all the measurements with one sensor first before switching to the other sensor, i.e., avoid interchanging optical and touch probe measurements multiple times. This decreases the length of time to create and run the routine and enables the routine to run faster.
- Before starting to measure features with a touch probe, decide on which probing strategy you will be using. For example, the AutoPoints Points mode requires user-defined safe points, whereas safe points are defined automatically with the AutoPoints Vector Points or AutoPath modes. The modes are described later in this section.
- Use the AutoPoints Vector Points or AutoPath modes to normalize the probing vector to the nominal feature. If this is not possible, you can use the F4 key to edit the probe points (described later in this section).
- If a touch probe has an unexpected contact with an object, the probe interface unit beeps. Press the **Reset** button on the interface unit to eliminate the beep.

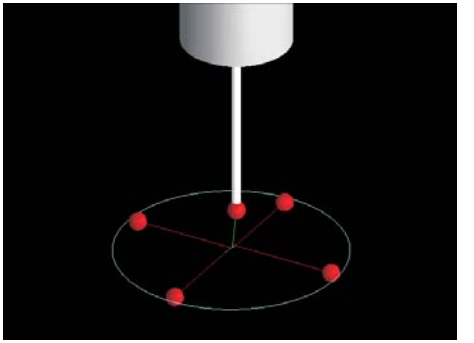
- We strongly recommend that you specify the initial and ending safe points in a measurement step by entering a safe location value in the Advanced Probe Strategy parameters for a feature. This prevents unexpected contacts and ensures a clear path to the next feature to be measured or to the port. If you do not use the safe location value, add the initial and ending safe points manually.
  - If you click **Done** or **Again** in the step without specifying a safe location or safe points at the beginning and end of a step, a pop-up window displays a confirmation prompt.



  - To specify a safe point, click **Yes**, move the probe to a safe location, and press the Enter button on the joystick to record the safe point. If you click No, the software completes the step without a safe point.

How to Measure Features with the Touch Probe

The procedure below provides a general overview of how to measure a feature using the touch probe. In this procedure, the touch probe is used to measure the diameter of the counterbore on the 3D training part.



Before you begin to measure a feature, make sure that the path from the port or the previous feature is clear to prevent any damage to the touch probe or the part.

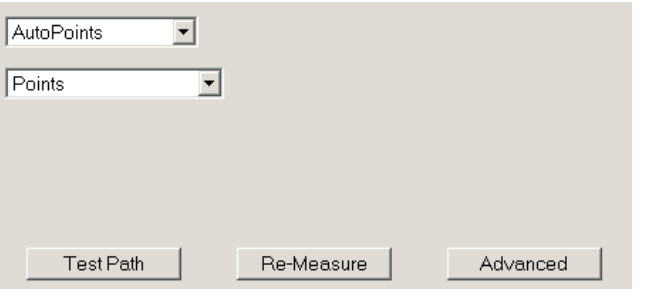
1. Make sure that the touch probe is mounted and enabled.
2. Select the desired **Measure** function, for example, **Circle**.
3. Move the probe to a location near the part, for example, approximately ½ inch above the center of the counterbore.
4. [Optional; use for more complex features] Press **Enter** on the joystick to enter a safe point to define a safe location at the beginning of the measurement.
5. [Optional; use for more complex features] Drive the probe approximately ½ inch along the Z axis and enter another safe point, with the probe tip inside the counterbore.
6. Slowly drive the probe to the first contact point, contact the part, and release the joystick.
7. Drive the probe to each of the other three contact points, keeping them roughly an equal distance apart from each other. The feature calculations in the Measurement window become non-zero when the minimum number of points are measured.
8. Drive the probe to a safe location near the part, e.g., approximately 1 inch above the counterbore.
9. Select **AutoPath** in the Probe Strategy Settings window. The software updates the display in the Model window.
10. Click **Advanced** to display the advanced probe strategy parameters.
11. Enter a safe height (for example, use the Z value in the DRO), select the **Safe** check box, and click **OK** to close the window.
12. Place the mouse cursor in the Model window and rotate the Model to verify that the path is correct.
13. Look at the Model window to verify the safe location.
14. In the Probe Settings window, click **Test Path** to verify the measurement and view the safe entry point, the entire path, and the safe location at the end of the measurement.
15. Click **Remeasure** to check that the measurement is done properly.
16. Click **Done** in the Measurement window.

Probe Strategy Settings Window

The Probe Strategy Settings window is used to select the touch probe path generation method (described next) and control how the automatic probe path is generated and displayed in the Model window.

This window is displayed if:

- The touch probe is deployed and the probe tip is properly calibrated.
- A probe step is being created or edited in the Measurement window and it contains the minimum number of points needed to define that feature.



You can select or change the following settings in this window:

- In the first drop-down list, select an automated probing method: **AutoPoint** (default), or **AutoPath**
- In the second drop-down list, select how the automatic probe path is generated and displayed in the Model window:
  - Vector mode, if AutoPoint is selected: **Points** (default) and **Vector Points**.
  - AutoPath Probe Strategy, if AutoPath is selected and the probe is used to measure a plane, cylinder, or cone.
- The buttons in the Probe Strategy Settings window have the following functions:
  - Click **Test Path** to view the probing path that the system will take based on the current settings. This displays a simulation of the probe path in the Model window. If you wish to end a test path simulation, click the **right** mouse button during the operation.
  - Click **Remeasure** to measure the current path based on any changed parameters. The software physically remeasures the feature with the touch probe and recalculates the measurement results.
  - Click **Advanced** to display the advanced probe strategy parameters in the Measurement window (described later). This window displays different parameters depending on what kind of feature is being measured.

Note: If you make any changes to probe settings (for example, switching modes, changing parameters, editing nominals), this will result in the loss of any changes made in the F4 window (see the on-line Help topic *F4 Key* for more information). This is due to the automatic path regeneration.

Probe Path Generation

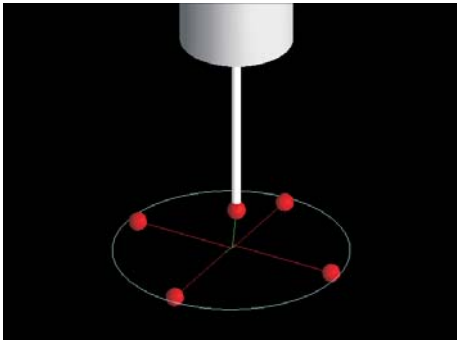
The touch probe path generation function enables you to define the automatic generation of a touch probe path based on selected probe strategies and specified parameters. This function is typically used to increase the accuracy of probe measurements, enhance productivity, reduce the time for creating inspection routines, and allow probe steps to be edited easily.

Each path generation method is described in more detail on the following pages.

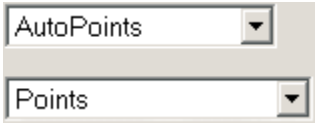
AutoPoint Method

The AutoPoint generation method, selected in the Probe Strategy Settings window, displays all the touch probe points that were taken when a feature was measured. This method can be used with all feature measurements.

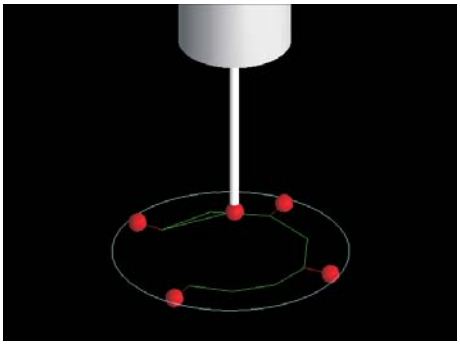
Points Mode



When used with the Points mode, the Model window displays the points and paths exactly as you measured them. If you want, you can press the **F4** key to change the locations of the safe and contact points. This is described in the topic *Editing Safe and Contact Points*.

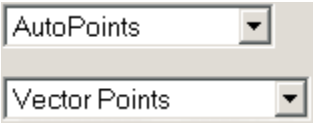


Vector Points Mode



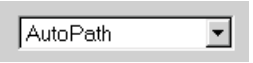
When used with the Vector Points mode:

- The Model window displays the vectored path between the contact points and safe points.
- The software keeps the contact points at the entered locations, but it modifies the path and adjusts the attack angles of the contact points.
- The software automatically inserts additional intermediate and safe points, if needed.



Note: Once you select the Vector Points mode and click Done in the measurement step, you cannot go back and select the Points mode.

AutoPath Method



The AutoPath method, selected in the Probe Strategy Settings window, enables you to automatically generate a touch probe path using touch probe points that were taken when a feature was measured. This method does not apply to a measured Point step.

This method helps to increase your productivity and the accuracy of a feature measurement. For example, you can measure the minimum number of points required for a feature (e.g., 3 points for a circle) and then use this method to add more contact points and “fill in” the feature measurement.

Notes:

1. Once you select the AutoPath method in the measurement step, you can go back and select the AutoPoint method, but you cannot select the Points mode.
2. When you click on an AutoPath feature and the touch probe is not enabled, the software displays a confirmation prompt to get the probe. If you click No, you can edit the nominal values, but you cannot access the Probe Strategy Settings window.
3. The AutoPath method can be used if Part on Rotary is selected in the Part Setup menu; however, you cannot include a rotation when creating an Autopath in the measurement step

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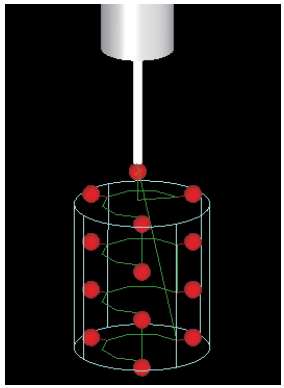
AutoPath Probe Strategies

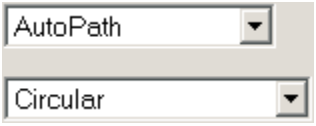
If AutoPath is selected in the Probe Strategy Settings window, the second drop-down list displays the AutoPath probe strategies, which depend on the feature being measured with the touch probe. These strategies also control which parameters are available in the advanced cylinder, cone and plane windows.

Note: The software displays an asterisk on the Nominal button to indicate that the nominals have been auto-populated after an auto path probe strategy has been completed.

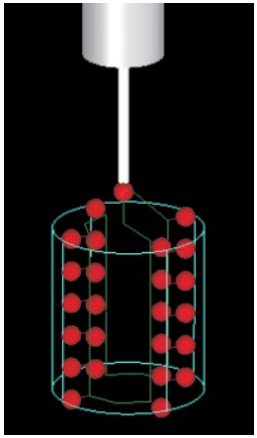
When a cylinder or cone is being measured, you can select one of three paths:

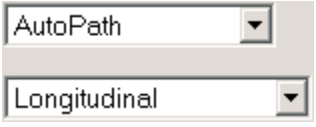
- **Circular**, which automatically generates concentric circles that are equally spaced apart. The number of concentric circles depends on the parameter entered; the default value is 2. The sections, selected in the advanced parameters for the feature (e.g., cylinder), are displayed around the feature and then down the length of the feature.



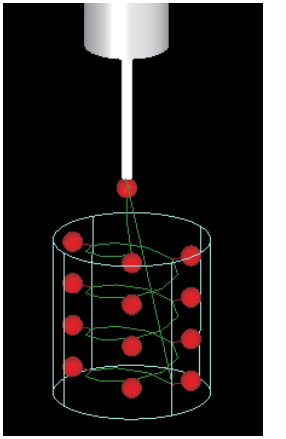


- **Longitudinal**, which automatically generates lengthwise sections that are equally spaced apart. The number of sections depends on the parameter entered; the default value is 3. The sections, selected in the advanced parameters for the feature (e.g., cylinder), are displayed down the length of the feature and then around the feature.



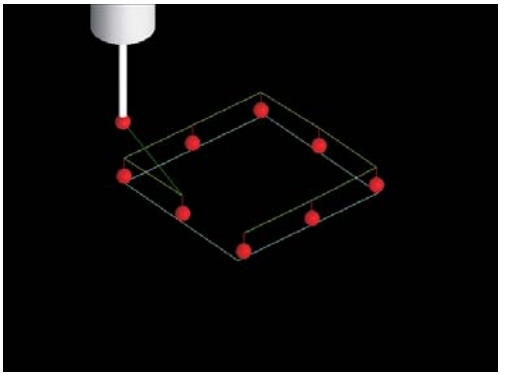


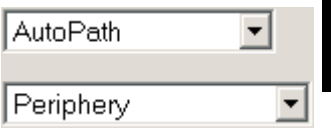
- **Helical**, which automatically generates a spiral path around the feature. The number of spirals around the feature depends on the parameter entered; the default value is 2. This method should only be used for complete (360°) features.



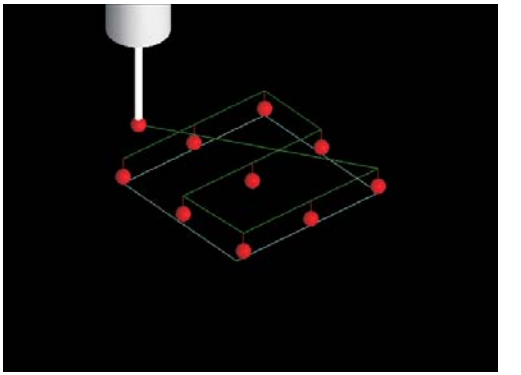
When a plane is being measured, you can select two paths:

- **Periphery**, which automatically generates points around the boundary (perimeter) of the plane. The number of points generated depends on the parameter entered; the default is 3 points.





- **Grid**, which automatically generates points that are evenly spaced in a grid pattern over the entire plane. The number of points generated depends on the parameters entered; the default is 2 for points per row and total rows.



Advanced Probe Strategy Parameters

The advanced probe strategy parameters are displayed in the Measurement Window area when you click **Advanced** in the Probe Strategy Settings window.

The window displays the following parameters, depending on the feature being measured and the selected auto method and vector/probe strategy in the Probe Strategy Settings window.

- **Approach**, which is the distance between the expected contact point and the point where the probe approach servo parameters take effect as the probe approaches the contact point. The default approach distance for each probe tip is specified when you configure the probe tips. It is also used as the backoff distance during the creation of a routine.

  If you need to change the approach distance for a feature measurement, you can do so in this window. The value must be greater than zero. If the probe strategy is Vector Points or AutoPath, this changes the locations of all the safe points, i.e., their distance to the contact points.

  The approach distance is carried forward to the next probe measurement of the same kind of feature.

  If you want, you can override the approach distance for a contact point in a step by setting a lower value for the safe point associated with that contact point. For example, you can press the F4 key and edit the safe point to get it closer to the part. The procedure is described in the topic, *Editing Safe and Contact Points*.

  The total search distance is twice the approach distance.

- **Safe**, which indicates the safe location, relative to the Z part datum, for the touch probe both at the beginning and end of a measured step. The default value is 0.
  - The Safe location is displayed for all features if the AutoPoints Vector mode is selected or if AutoPath generation is selected.
  - To specify a safe location that is not at the top of the Z travel, click in the check box and specify a value that does not exceed the Z travel from the current datum.
  - If you enable the safe height, this will result in a loss of lead-in and trailing safe points due to the automatic path regeneration.

CAUTION: As soon as you select the Safe check box and generate a new path, the software replaces the start and end safe points from the feature measurement with the specified safe location. If you select it and then clear it without providing any safe location, the probe may have unexpected contact with the part when you try to remeasure it.

The following feature-dependent parameters are displayed, if the Vector Points mode or AutoPath is selected:

- **Probe Attack Angles**, if a point or line is being measured. The attack angles indicate the direction at which the touch probe approaches the contact point. The default selection and values are taken from the measurement in the step. You may make a different selection and specify the desired value. The attack angles have two components:
  - Approach angle, which is relative to the datum plane. You can select one of six angles (+ and - indicate the feature's vector direction; the first letter indicates the primary axis; the second letter indicates the secondary axis of the projection plane):

    XY Angle and -XY Angle
    YZ Angle and -YZ Angle
    ZX Angle and -ZX Angle

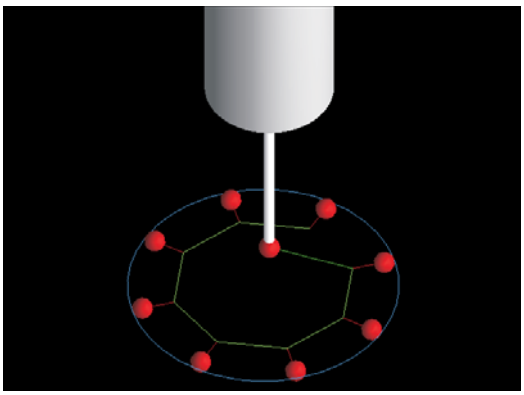
    The value of the angle must be between -360.0 and +360.0 degrees.
  - Elevation and Declination of the attack angle.

  The attack angles are displayed in the Advanced Probe Strategy Parameters window if the Vector Points mode or AutoPath is selected, and a point or line is being measured. The default selection and value are taken from the measurement in the step. You may make a different selection and specify the desired value.
- **Internal and External**, if a circle, sphere, cone, or cylinder is being measured. This indicates whether the points are taken inside or outside of the feature. Typically you do not need to change this.

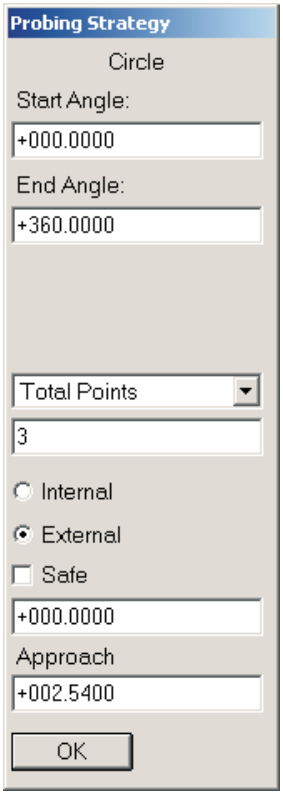
If you make changes in this window, we recommend that you click **Test Path** in the Probe Strategy Settings window to generate a new path and see the effects of your changes.

See the following pages for the additional advanced AutoPath parameters for the different features.

AutoPath Circle Parameters



When you select AutoPath in the Probe Strategy Settings window after measuring a circle, the software automatically recalculates the safe and contact points and the path, and then redisplays the updated path in the Model window. The software uses the default advanced parameters or the advanced parameters carried forward from the measurement of the previous feature.

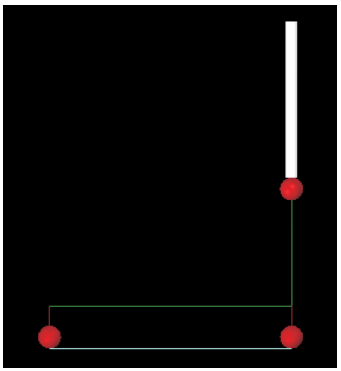


Click **Advanced** to view and change the Advanced Probe Strategy parameters. In addition to the advanced probe strategy parameters that are displayed for all features, the software displays the following additional parameters for a circle:

- **Start Angle** (default is 0) and **End Angle** (default is 360).
  - Both values must be positive.
  - Changing the start and/or end angles enables you to select and measure sections of a feature. For example, to measure the radius of the through-slot on the right side of the QVI 3D training part, specify 90 as the Start Angle and 270 as the End Angle.
- Point drop-down list, which is used to change the number of contact points. You can select either:
  - **Total Points**: This displays the total number of specified points, equally spaced apart from one another. The value must be 3 or higher; the default value is the measured value.
  - **Point Spacing**: This calculates and displays points based on the specified spacing value.

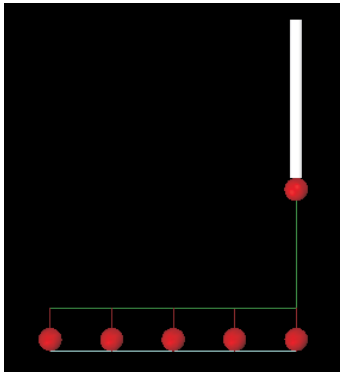
AutoPath Line Parameters

When you select AutoPath in the Probe Strategy Settings window after measuring a line, the software automatically recalculates the safe and contact points and the path, and then redisplays the updated path in the Model window. The software uses the default advanced parameters or the advanced parameters carried forward from the measurement of the previous feature.

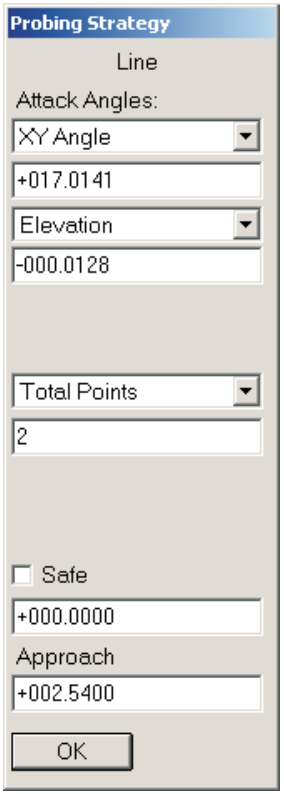


Click **Advanced** to view and change the Advanced Probe Strategy parameters. In addition to the advanced probe strategy parameters that are displayed for all features, the software displays the following additional parameters for a line:

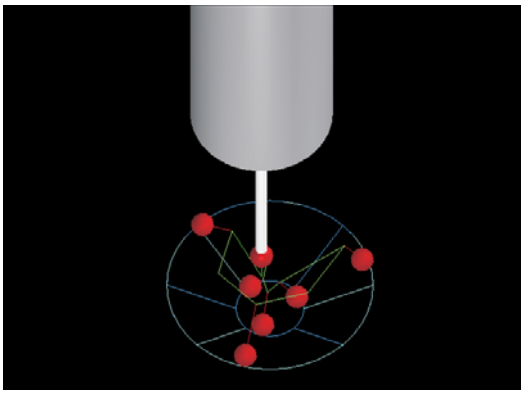
- **Attack angles**. The default selections and values are taken from the measurement in the step. You may make a different selection and specify the desired value.
- Point drop-down list, which is used to change the number of contact points. You can select either:



- **Total Points**: This displays the total number of specified points, equally spaced apart from one another. The value must be 2 or higher; the default value is the measured value. In the examples shown here, the total number of points was changed from 2 to 5.
- **Point Spacing**: This calculates and displays points based on the specified spacing value.

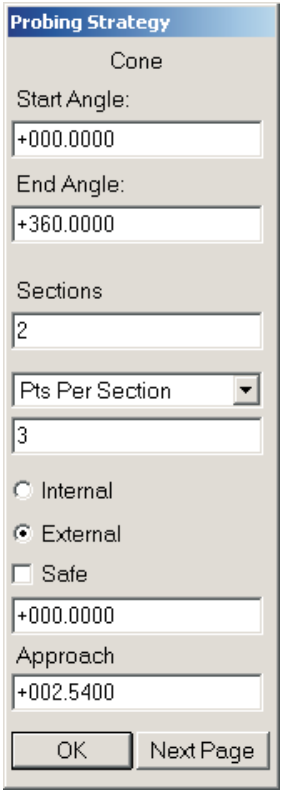


AutoPath Cone Parameters

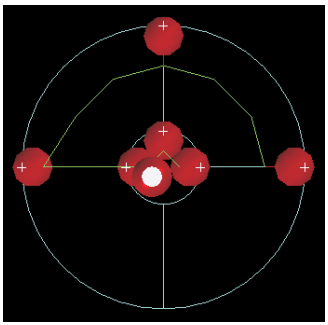


When you select AutoPath in the Probe Strategy Settings window after measuring a cone, the software automatically recalculates the safe and contact points and the path, and then redisplays the updated path in the Model window. The software uses the default advanced parameters or the advanced parameters carried forward from the measurement of the previous feature.

Click **Advanced** to view and change the Advanced Probe Strategy parameters. In addition to the advanced probe strategy parameters that are displayed for all features, the software displays the following additional parameters for a cone, which also depend on the selected AutoPath probe strategy:



- **Start Angle** (default is 0) and **End Angle** (default is 360). Changing the start and/or end angles enables you to select and measure sections of a feature.



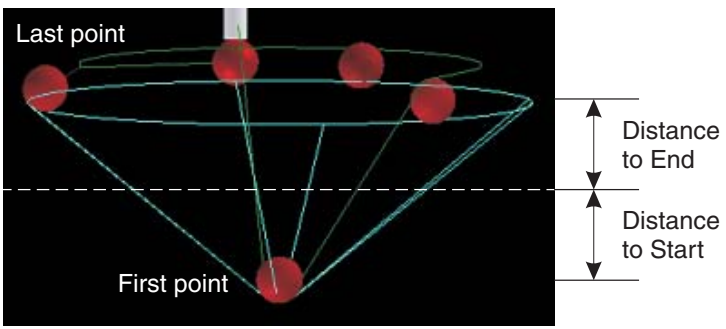
  - Both values must be positive.
  - The End Angle is not available if a Helical AutoPath probe strategy is selected.
  - For example, to measure the radius of the cone on the QVI 3D training part, specify 0 for the Start Angle, and 180 for the End Angle (top view shown here).

- **Sections**, which indicates how many sections to measure around the cone, if a Circular or Longitudinal auto path probe strategy is selected. The sections are spaced apart equally around the entire feature. The value must be 2 or higher if the path is circular and 3 or higher if the path is longitudinal.

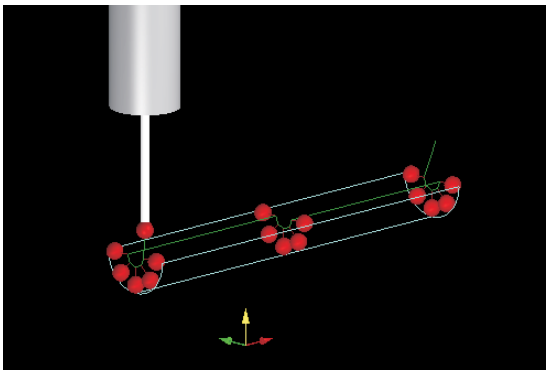
- **Revolutions**, which indicates how many times to measure around the cone, **if a Helical auto path probe strategy is selected**. This value can be a decimal value that is greater than 2.
- Point drop-down list, which is used to change the number of contact points. You can select:
  - **Point Spacing**: This indicates the number of points based on the specified spacing value. After clicking OK, the software calculates and displays points equally spaced around the feature for the number of sections that were specified.
  - **Points per Section** (for a circular or longitudinal probe strategy): This displays the total number of specified points per section, equally spaced apart from one another. The value must be 2 or higher for a longitudinal probe strategy and 3 or higher for a circular probe strategy. After clicking OK, the software calculates and displays points equally spaced around the feature for the number of sections that were specified. For example, if 6 sections are selected with 3 points per section, the software will measure a total of 18 points.
  - **Points per Revolution** (for a helical probe strategy): This displays the total number of specified points per revolution, equally spaced apart from one another. The value must be 3 or higher. After clicking OK, the software calculates and displays points equally spaced around the feature for the number of revolutions that were specified.

Click **Next Page** to view the following parameters:

- **Distance to Start** (to first point measured) and **Distance to End** (to last point measured), which indicates how far up or down the measurements should begin from the center location of the measured cone. After clicking OK, the software displays the changed point locations. The values cannot both be 0; the default values are the measured values.



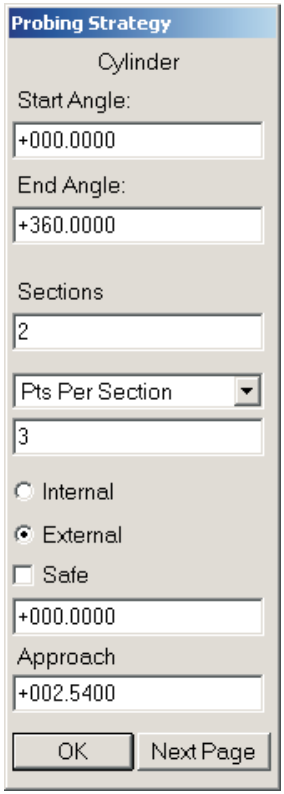
AutoPath Cylinder Parameters

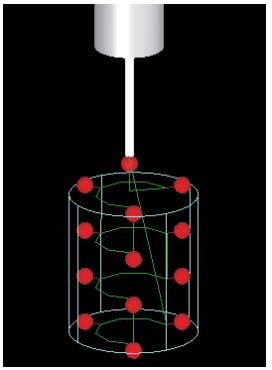


When you select AutoPath in the Probe Strategy Settings window after measuring a cylinder, the software automatically recalculates the safe and contact points and the path, and then redisplays the updated path in the Model window. The software uses the default advanced parameters or the advanced parameters carried forward from the measurement of the previous feature.

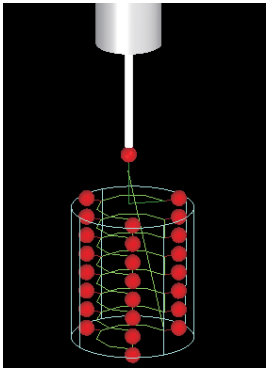
Click **Advanced** to view and change the Advanced Probe Strategy parameters. In addition to the advanced probe strategy parameters that are displayed for all features, the software displays the following additional parameters for a cylinder, which also depend on the selected AutoPath probe strategy:

- **Start Angle** (default is 0) and **End Angle** (default is 360). Changing the start and/or end angles enables you to select and measure sections of a feature.
  - Both values must be positive.
  - The End Angle is not available if a Helical probe strategy is selected.
  - For example, to measure the radius of the cylinder on the front of the QVI 3D training part, specify 5 for the Start Angle and 175 for the End Angle (as shown in the illustration above).





- **Sections**, which indicates how many sections to measure around the cylinder, if a Circular or Longitudinal probe strategy is selected. The sections are spaced apart equally from the start angle to the end angle. The value must be 2 or higher if the path is circular and 3 or higher if the path is longitudinal. In the examples shown here, the number of sections was changed from 4 to 8.

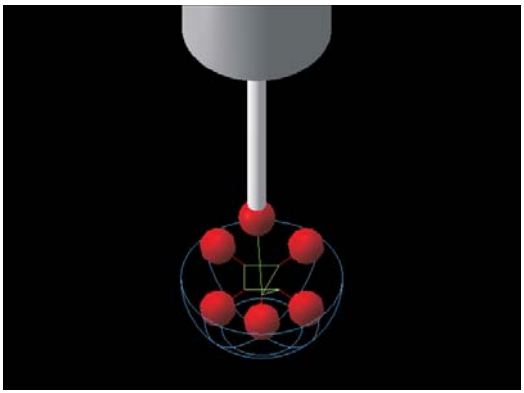


- **Revolutions**, which indicates how many times to measure around the cylinder, if a Helical auto path probe strategy is selected. This value can be a decimal value that is greater than 2.
- Point drop-down list, which is used to change the number of contact points. You can select:
  - **Point Spacing**: This indicates the number of points based on the specified spacing value. After clicking OK, the software calculates and displays points equally spaced around the feature for the number of sections that were specified.
  - **Points per Section** (for a circular or longitudinal probe strategy): This displays the total number of specified points per section, equally spaced apart from one another. The value must be 2 or higher for a longitudinal probe strategy and 3 or higher for a circular probe strategy. After clicking OK, the software calculates and displays points equally spaced around the feature for the number of sections that were specified. For example, if 6 sections are selected with 3 points per section, the software will measure a total of 18 points.
  - **Points per Revolution** (for a helical probe strategy): This displays the total number of specified points per revolution, equally spaced apart from one another. The value must be 3 or higher. After clicking OK, the software calculates and displays points equally spaced around the feature for the number of revolutions that were specified.

Click **Next Page** to view the following parameters:

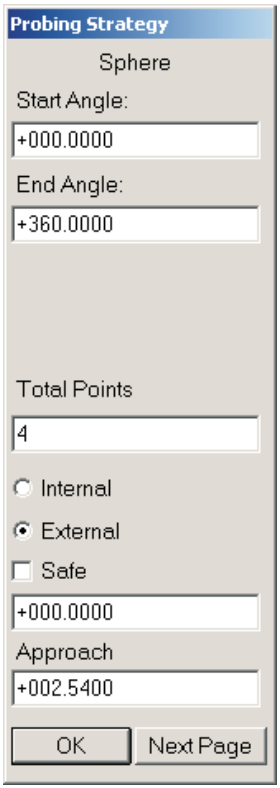
- **Distance to Start** (to first point measured) and **Distance to End** (to last point measured), which indicates how far up or down the measurements should begin from the center location of the measured cylinder. After clicking OK, the software displays the changed point locations. The values cannot both be 0; the default values are the measured values.

AutoPath Sphere Parameters



When you select AutoPath in the Probe Strategy Settings window after measuring a sphere, the software automatically recalculates the safe and contact points and the path, and then redisplays the updated path in the Model window. The software uses the default advanced parameters or the advanced parameters carried forward from the measurement of the previous feature.

Click **Advanced** to view and change the Advanced Probe Strategy parameters. In addition to the advanced probe strategy parameters that are displayed for all features, the software displays the following additional parameters for a sphere:

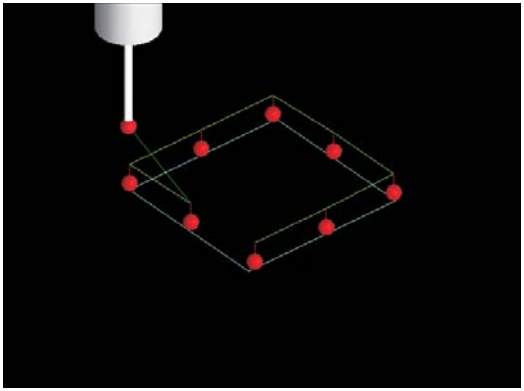


- **Start Angle** (default is 0) and **End Angle** (default is 360).
  - Both values must be positive.
  - Changing the start and/or end angles enables you to select and measure sections of the sphere.
- **Total Points**: This changes and displays the total number of specified contact points, spread out evenly around the sphere. The value must be 4 or higher; the default value is the measured value.

Click **Next Page** to view the following parameters:

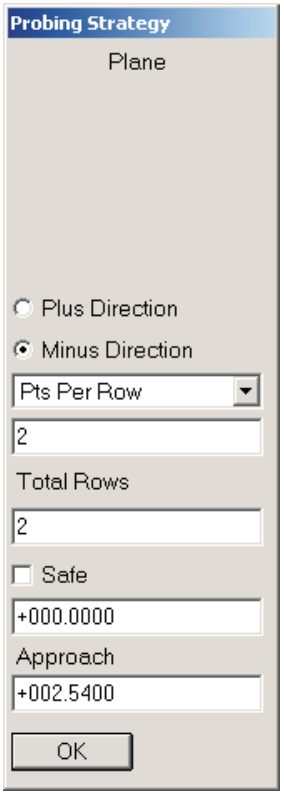
- **Start Elevation** (default is 0, at the equator) and **End Elevation** (default is 90, at the peak of an external sphere or the very bottom of an internal sphere).
  - The start value must be less than the end value.
  - Changing the start and/or end elevation enables you to measure sections of the sphere.

AutoPath Plane Parameters



When you select AutoPath in the Probe Strategy Settings window after measuring a plane, the software automatically recalculates the safe and contact points and the path, and then redisplays the updated path in the Model window. The software uses the default advanced parameters or the advanced parameters carried forward from the measurement of the previous feature.

Click **Advanced** to view and change the Advanced Probe Strategy parameters. In addition to the advanced probe strategy parameters that are displayed for all features, the software displays the following additional parameters for a plane:



- Direction of the attack vector, which defines the approach direction of the probe.
  - The **Plus** and **Minus direction** toggles the approach direction from one side of the plane to the other.
  - The software defaults the approach to the correct side. Typically you do not need to change the direction for a plane that has already been measured with a touch probe.
- Point drop-down list, which is used to change the number of contact points. You can select:
  - **Point Spacing**: This indicates the number of points based on the specified spacing value. After clicking OK, the software calculates and displays points equally spaced around the plane.
  - **Total Points** (for a Periphery probe strategy): This displays the total number of specified points. The default is what was measured by the user. The value must be 3 or higher. After clicking OK, the software calculates and displays points equally spaced around the perimeter of the plane.
  - **Points Per Row** (for a Grid probe strategy): This indicates the number of points per row. The value must be 2 or higher. After clicking OK, the software calculates and displays the specified number of points in each row of the plane, equally spaced apart from one another.

- **Total Rows**: If Points Per Row is selected, this changes and displays the total number of rows, spread out evenly across/down the plane. The value must be 2 or higher; the default value is the measured value.
- **Row Spacing** (if a Grid probe strategy and Point Spacing are selected): This displays the number of rows based on the spacing between the points in each row. After clicking OK, the software calculates and displays points in equally spaced rows.

CAUTION: When you measure a plane, be sure to measure all the points in a "forward" direction; do not measure a point and then go backward to measure the next point. If you do, this may cause unpredictable results.

Editing Touch Probe Steps

You can edit touch probe steps in the following ways:

- In AutoPoints - Point**s** mode, delete safe and contact points by clicking **Points** in a feature Measurement window or delete safe points by pressing the **Cancel** button on the joystick.
- Add safe points by moving the touch probe to the desired safe location and pressing the **Enter** button on the joystick.
- Add contact points by measuring touch probe points.
- Change the probe strategies and parameters as described earlier.
- Change the X, Y, or Z values of safe and contact points.
- Step edit touch probe features.

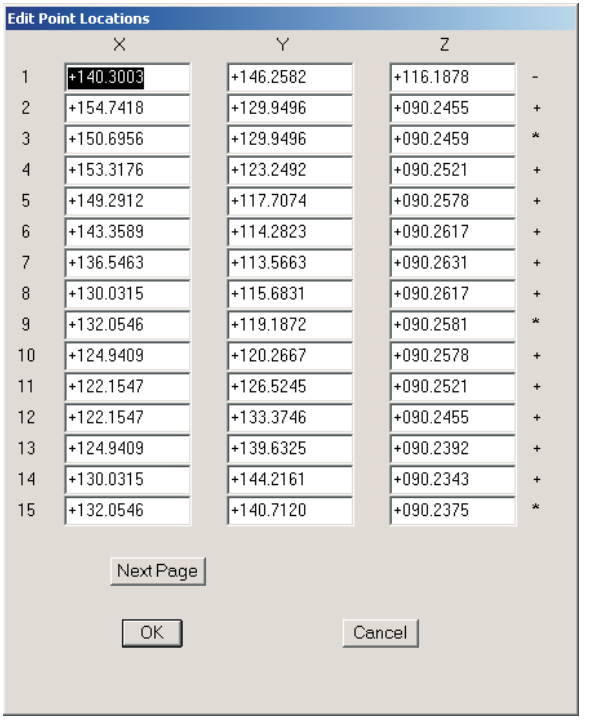
Editing Safe and Contact Points

You can edit safe points and contact points by changing their XYZ location values:

- Changing the XYZ values of safe points ensures that the probe moves straight up and down.
- Changing the XYZ values of the contact point ensures that the probe moves orthogonally with respect to the surface being measured.

Notes:

1. If you select the AutoPoints Points mode, you can edit any of the contact and safe points as desired.
2. If you select the AutoPoints Vector Points mode, you can edit the contact and safe points as desired. However, it is recommended that you do not edit the generated link points because they get regenerated, e.g., when you click Test Path or change a nominal/tolerance value or an Advanced Probe Strategy parameter.
3. If you select the AutoPath method, do not edit any contact or safe points except the safe location in the Advanced Probe Strategy window.



To edit the safe and contact points:

1. Click a feature in the Model window to display the touch probe step in the Measurement window.
2. Press **F4**. A pop-up window displays all the points in the step.
   - Contact points are indicated with asterisks (*).
   - Safe points are indicated with minus signs (-).
   - Generated AutoPath link points are indicated with plus signs (+).
3. Change the **X**, **Y** and/or **Z** values as desired.
4. Click **OK** to accept the changes.
5. Click **Test Path** and/or **Remeasure** in the Probe Strategy Settings window to verify the changes.
6. Click **Done** in the Measurement window.

Step Edit of Touch Probe Features

During a step edit of a touch probe feature, the system goes through the standard step edit mode. However, you have additional options depending on the probe strategy that was used when the feature was measured.

- With **AutoPoints - Points** mode, the system goes through the standard step edit mode. You can also display the Probe Strategy Settings window and use the different probe strategy controls after measuring the minimum number of points for the feature. You can insert or delete points if needed.
- With **AutoPoints - Vector Points** mode or **AutoPath** mode, the software automatically displays the Probe Strategy Settings window. You can change parameters, select Test Path or Remeasure, and add points; however; you cannot delete points. Also, you cannot go back to the AutoPoints - Points mode.

Running a Routine with Optical and Touch Probe Measurements

When you run a routine that has touch probe steps, the software measures features with the touch probe in the same way as you defined the path when you created each step. For each measurement step in the routine, the software remembers:

- Which sensor was used in that step
- The location of the touch probe, i.e. whether a probe is mounted (enabled or disabled) or in the port
- The port which the touch probe came from
- When to retrieve and return the touch probe to its port

To run a routine with multi-sensor measurements click the **Run Routine** icon and then click **OK** in the Measurement window.

- If the first step was measured with the optics, the system begins measuring the features. When the system encounters a step that was measured with the touch probe, it repeats what was defined during the creation of the routine:
  - If you retrieved the touch probe from the port, it automatically gets the touch probe from the port and measures that feature with the touch probe. Then, when it encounters a step measured with the optics, it automatically puts the touch probe back in the port and measures the next step with the optics.
  - If you enabled the touch probe, it automatically enables the touch probe and measures the feature. Then, when it encounters a step measured with the optics, it automatically disables the touch probe and measures the next step with the optics.
- If the first step was measured with a touch probe:
  - If the probe is not mounted on the sensor, the system automatically gets the touch probe from the port and measures that feature with the touch probe. Then, when it encounters a step measured with the optics, it automatically puts the touch probe back in the port and measures the next step with the optics.
  - If the probe is already mounted on the sensor, the system measures the feature with the touch probe. Then, when it encounters a step measured with the optics, it automatically disables the touch probe and measures the next step with the optics.

Missed Contact During the Routine Run

If the routine expects a touch probe contact but it is absent, the software moves the probe to the safe point prior to the contact point. It also displays the message shown below along with the button to stop the routine. The flashing red triangle in the Model window identifies the expected contact point.

Missed touch probe point!

You can resolve this kind of problem in the following ways:

- Measure the point manually. When you press Enter, the routine will continue running.
- Stop the routine and edit the point.
  - Click the **Stop** button (on the lower-right corner of the screen) to stop the routine. The system displays a confirmation prompt.
  - Click **OK** to stop the routine. Then you can edit the point and check the values of each point in the step, and run the routine again.

Unexpected Contact During the Routine Run

An unexpected contact is any action that causes the probe to trigger before reaching the next safe point. For example, the probe may touch an object during the run:

- If the safe point before a given contact point has the wrong values
- If an insufficient number of safe points have been entered
- If features are at different heights and safe points have not been entered to control the movement of the touch probe from one feature to the next

If the touch probe has an unexpected contact, the software displays the message shown below. It also displays the button to stop the routine.

To resolve this kind of problem:

1. Click **OK** in the message window and then the **Stop** button (in the lower-right corner of the screen) to stop the routine. The system displays a confirmation prompt.
2. Click **OK** to stop the routine. Then you can edit the point and check the values of each point in the step and run the routine again.

If the unexpected contact is due to an approach or backoff distance value that is too large, change the Approach Distance value in the Advanced Probe Strategy Settings window.

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Measure-X Sections

The next two sections contain information that only applies to Measure-X systems. MeasureMind 3D users should refer to Sections 5 and 6 for information applicable to MeasureMind 3D systems.

Section 7: Setting Up the Touch Probe (Measure-X Systems)

Section 8: Using the Touch Probe (Measure-X Systems)

Section 7

Setting Up the Touch Probe (Measure-X Systems)

Important: This section describes how to calibrate a change rack, set up the calibration sphere, and calibrate the touch probe on systems equipped with Measure-X. For information about configuring and calibrating the touch probe on MeasureMind 3D systems, see Section 5.

Configuration Settings

Before you can begin the touch probe calibration, be sure that you have specified the calibration sphere diameter and the number of port locations (if using a change rack).

To specify or change the settings, follow the steps below:

1. In the **System** menu, select **Configuration** ⇒ **Editor**.
2. In the **Section** list, select **TP General**.
3. Change the parameter for *Sphere_Diameter* to the certified size of the calibration sphere.
4. Change the parameter for *Dockable_Touch_Probe* to 1 if you are not using a change rack or to the number of ports if you are using a change rack.
5. Click **Close** and then save the changes.

“Teaching” Port and Clearance Locations for Each DSM

The touch probe change rack consists of ports (also called dock stations) that hold the touch probes when they are not being used.

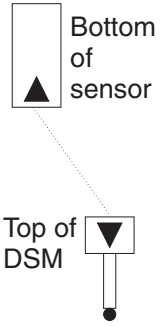
In this procedure the system “learns” the port and clearance locations for each DSM. Perform this procedure whenever the change rack is mounted or moved.

Repeat this procedure and the touch probe calibration (described on page 7-2) for each DSM set up in the change rack.

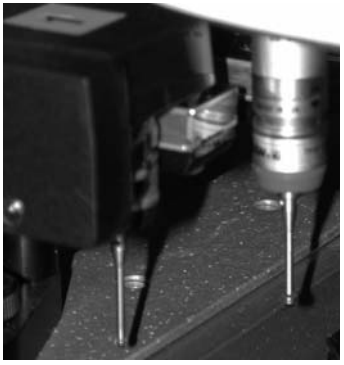
Note: Be careful about putting a multi-tip (star cluster) probe into the port that is closest to the post; make sure that it does not make contact with the post.

To “teach” the system a port location and clearance location, follow the steps below. It is assumed that the touch probe is attached to the dock station module (DSM) and the probe sensor.

1. (Optional) Remove the optics cover if you wish to have a clearer view of the touch probe holder and sensor as you perform this procedure.
2. Turn the probe interface unit On. The switch is in the back of the unit.
3. Place a soft pad (for example, a mouse pad) on the stage in front of the change rack.



4. Attach the touch probe to the port module (DSM) and the probe sensor. Make sure that the symbols line up properly.
5. If the probe sensor is enabled, select **Change Sensor** ⇒ **Disable Probe** in the **Tools** menu.
6. Open the dust cover (lid) of each port in which a DSM will be inserted.
   - On a 3-port change rack, lift the cover and carefully pull it toward yourself to lock it in the Open position.
   - On a 4-port change rack, slide the cover away from the post until it locks in the Open position.
7. Carefully drive the touch probe and lower/raise the probe sensor so that it gets close to the port that you want to calibrate. Make sure that there is always sufficient space, for example, 25 mm (1"), between the touch probe and the change rack.



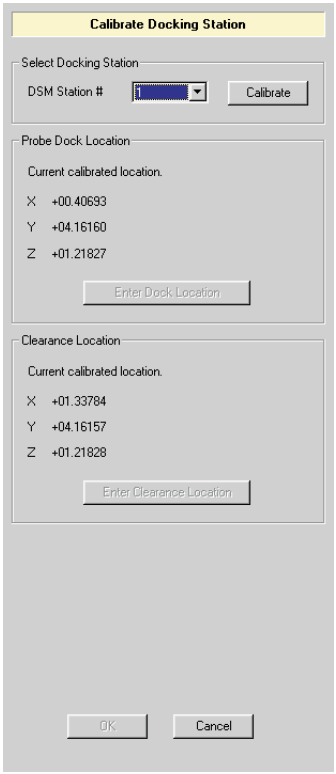
8. Select **Calibration** ⇒ **Dock Station** in the **System** the menu.

   The measurement window displays a drop-down box to select a port as well as the last known port and clearance locations. The coordinates are relative to stage home. If the system has not yet been taught the location, the XYZ values are all zeros.

9. Select the first port to be calibrated from the drop-down list.

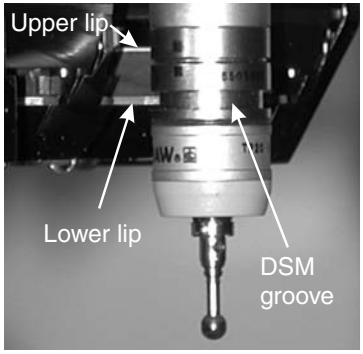
10. Click **Calibrate** and read the displayed instructions.

11. Carefully center the DSM in the X and Y axes next to the middle of the port. Make sure that the SmartRing Light clears the change rack.



12. Lower or raise the probe sensor so that the top of the DSM is between the upper and lower lips of the port and the lower lip is centered in the DSM groove. This enables the DSM to be moved into the port smoothly.

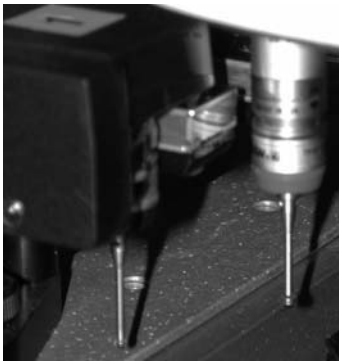
13. Drive the DSM into the port. You may need to move the sensor slightly in the X, Y and/or Z axes to ensure smooth movement.



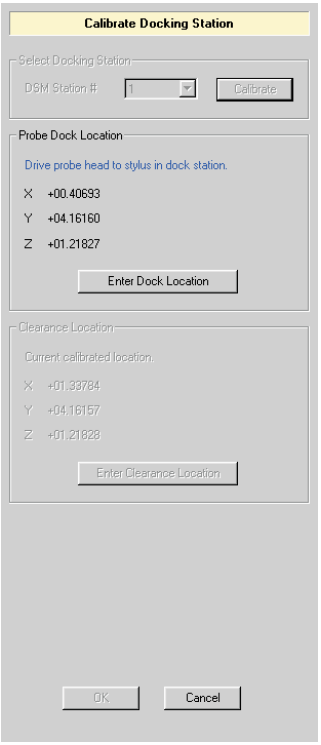
14. Click **Enter Dock Location**.

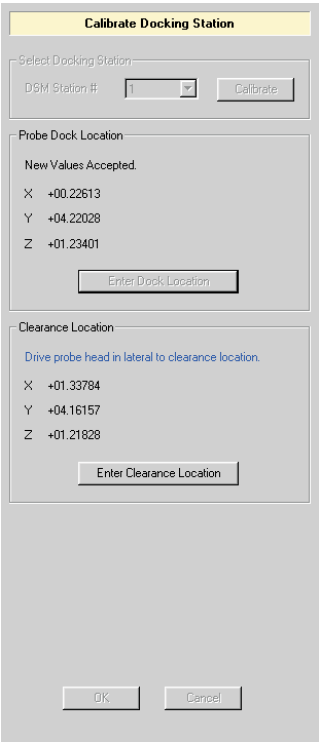
    The system updates the XYZ location of the port and changes the instructions to drive the touch probe to a clearance (safe point) location.

15. Drive the touch probe out of the port to a safe clearance location. The touch probe should be at least 6 mm (¼") away from the change rack. The clearance location should be a 12 mm (½") or more if the SmartRing Light or optics cover are very close to the change rack.



16. Click **Enter Clearance**. The system updates the XYZ clearance location and enables the OK button.
17. Click **OK** to close the measurement window.
18. Verify that the system knows both the port and clearance locations. To do so:
    - In the **Tools** menu, select **Change Sensor ⇒ Dock Probe**. The system automatically returns the DSM to its station.
    - If the return of the DSM to the port is not smooth, you may wish to repeat this procedure and then repeat this verification.
19. Close the dust cover.





20. To confirm the smooth operation of the touch probe:

    - Select **Change Sensor** ⇒ **Get Probe** in the **Tools** menu and then select the desired radio button in the Select DSM Station dialog box and click **OK**. The system automatically goes to the port, seats the DSM on the sensor, and moves it out to the clearance location.
    - Select **Change Sensor** ⇒ **Dock Probe** in the **Tools** menu. The system automatically returns the DSM to its station.

Now you need to calibrate the touch probe stylus seated on the sensor. Be sure that the optics are calibrated first.

Note: After the DSM is seated, the stage will move more slowly. If you wish to move the stage more quickly, press and hold the button on top of the joystick while moving the stage.

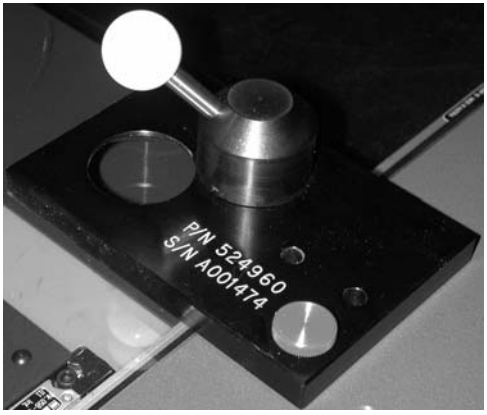
Calibration Sphere Setup

The calibration sphere, also called a reference sphere, is used to calibrate the attached lens, each probe tip, and the optics-to-probe offset. This ensures their accuracy for the current measurements. A touch probe will produce errors if it is calibrated improperly.

The calibration sphere must be placed in a location that is accessible by the optics and touch probe, for example, along the front of the stage.

To mount the calibration sphere, follow the steps below.

1. Place the base of the sphere in an accessible location.
2. Screw the knurled thumbscrew into the tapped hole in the base of the stage.



After mounting the sphere you need to perform the sphere-to-lens calibration to establish its location.

Sphere-to-Optics and Touch Probe Calibrations

If you plan to do multi-sensor measurements (measure features optically and with the touch probe), you must calibrate **both** the attached lens and the touch probe using the reference sphere. This ensures the accuracy of the optics and touch probe for the current measurements.

The multi-sensor calibrations measure five points (one autofocus point on the top of the sphere and four points on the edge of the sphere). These calibrations determine the location of the reference sphere, establish the camera XYZ center, and calculate the tip diameter.

You must perform the sphere-to-lens calibration followed by the touch probe calibration:

- Whenever you mount or move the reference sphere
- When you add or replace a touch probe stylus that hasn't been calibrated
- When you use an add-on lens and the calibrations have not been done with the add-on lens

Before you begin the calibrations:

- Make sure that the reference sphere is securely mounted on the stage.
- Make sure that the calibration mode is enabled (see the *Calibration And Alignment Manual* for your system).

Sphere-to-Optics Calibration

The sphere-to-optics calibration consists of video measurements to measure five points on the reference sphere. This calibration is done when there is no routine in memory. This calibration is typically done **after** the system knows the port locations (described earlier in this section) and **before** the single-tip or multi-tip touch probe calibration (described later in this section).

Before you begin the sphere-to-optics calibration, be sure that:

1. The reference sphere is securely mounted on the stage.
2. The touch probe is disabled (fixed touch probes) or docked in the port (dockable touch probes):
   - For a fixed touch probe, select **Change Sensor** ⇒ **Disable Probe** in the **Tools** menu to disable the probe.
   - For a dockable touch probe, select **Change Sensor** ⇒ **Dock Probe** in the **Tools** menu to return the touch probe to its port.
3. The calibration mode is enabled (see the *Calibration and Alignment Manual* for your system).

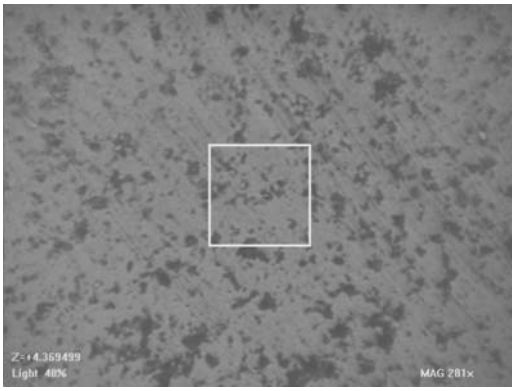
To perform the sphere-to-optics calibration on a system with auxiliary light, follow the steps below.

1. Move the stage so that the top of the sphere is directly under the optics.
2. Display the top of the sphere in the center of the Image window at low magnification.

   - Select the *lowest* magnification.
   - Turn on the surface illumination to approximately 50%.
   - Center the top of the sphere in the Image window (see notes below). For the XY location, move the stage as needed, and, if you want, use a manual target, such as Circle, as an aid. To bring it into focus, adjust the Z, and, if you want, use the Basic Focus tool as an aid.

3. Display the top of the sphere in the Image window at high magnification.

   - Select the highest magnification.
   - Increase the surface illumination to approximately 50%.
   - If needed, adjust the Z axis slightly until you can clearly see the top of the sphere.



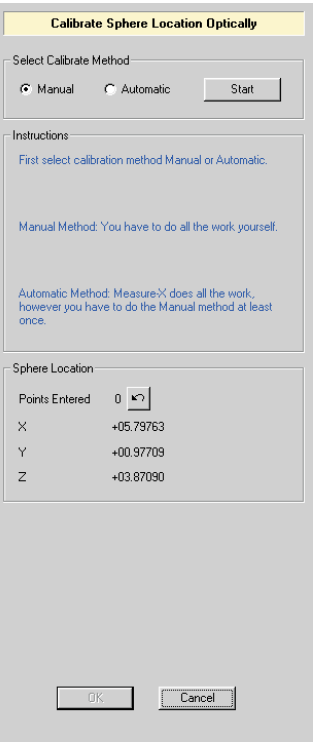
Note: If you are unable to locate the top of the sphere by using surface illumination, turn on the back light and use the X and Y axis readouts to center the top of the sphere.

Note: False images may occur on the sphere due to the sphere acting as a lens element. Be sure to choose the focal point that is highest in Z.

4. In the **System** menu, select **Calibration** ⇒ **Sensor Align** ⇒ **Sphere to Optics**.

   The system displays the Focus tool in the Image window and it changes the magnification and illumination to default system settings.

   The Measurement window displays radio buttons for the calibration method and the last-measured location of the calibration sphere (relative to stage home).

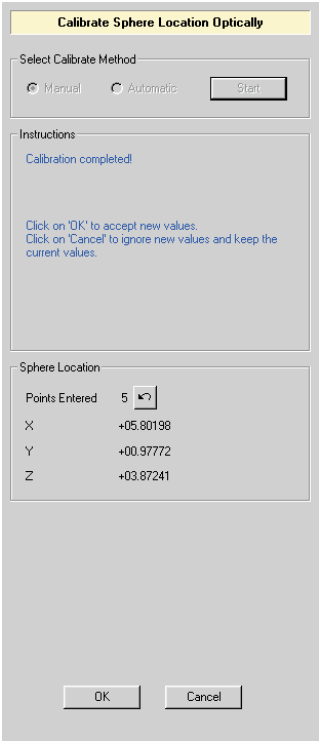


5. Click the **Manual** radio button and then click **Start** to go through a manual calibration sequence.

   The system displays instructions in the Measurement window to perform the autofocus on top of the sphere.

6. Perform an autofocus and then press **Enter** on the joystick to accept the focus point.

   After you accept the focus point, the system automatically displays the Strong Edge tool and an edge of the sphere in the Image window. The system will measure four points that are spaced apart equally.



7. Move the edge to the center of the target, press the left mouse button to capture the edge, and press **Enter** on the joystick to accept the point.

   The system automatically goes to the next edge.

8. Repeat Step 7 for the other three edges.

   The new location appears in the Measurement window. Make sure that 5 points have been measured.

   The system enables the OK button.

9. In the Measurement window, click **OK** to accept the new location. (If you click Cancel, the calibration is not done and the previously calibrated location remains in the configuration file.)

10. Perform the sphere-to-lens calibration again to verify the sphere location. To do so, repeat Step 4 and then select **Automatic** and click **Start**.

    Remember to click **OK** in the Measurement window when the calibration is completed. The system saves the location in the EEPROM and updates the touch probe configuration settings.

This completes the sphere-to-lens calibration on a system with auxiliary light.

Touch Probe Calibrations

The touch probe stylus calibration consists of measuring five points on the calibration sphere.

- This calibrates each probe tip and establishes the probe-to-optics offset.
- This calibration is done when there is no routine in memory.

The calibration procedure varies depending on whether the probe has a single tip or multiple tips (star probe).

Before you begin the touch probe calibration, be sure that:

- You have specified the calibration sphere diameter and the number of port locations (if using a change rack) in the configuration settings (described on page 7-1).
- The sphere-to-optics calibration has been performed as described on the previous pages.

For dockable touch probes, remember to perform the port location learning procedure (see page 7-2) and this touch probe calibration for each DSM in the change rack.

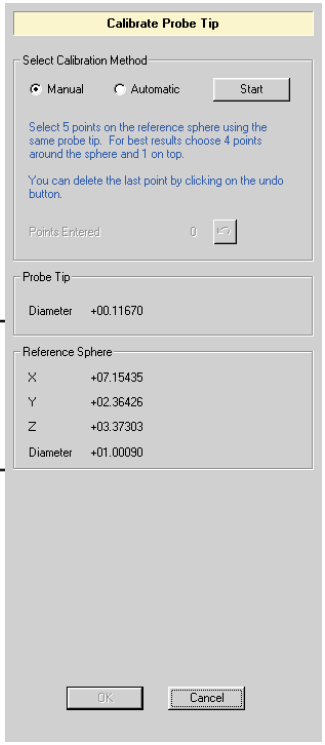
Important: After the sphere-to-lens calibration is completed, be sure to (re)calibrate **all** the probe tips that you intend to use for measurements.

Calibrating a Single-Tip Touch Probe

To perform a single-tip touch probe calibration, follow the steps below. It is assumed that the sphere-to-lens calibration has been done since the sphere was last mounted on the stage and that the touch probe is seated on the probe sensor or mounted on the probe holder. If not, select **Change Sensor** ⇒ **Get Probe** in the **Tools** menu.

1. Move the stage so that the touch probe stylus is approx. 12 mm (½") above the top of the sphere. Make sure the path is clear.
2. In the **System** menu, select **Calibration** ⇒ **Probe Tip**.

   The Measurement window displays the current location of the reference sphere (relative to stage home), the sphere diameter, and probe tip diameter, along with instructions to select five points on the calibration sphere.



3. Click the **Manual** radio button and then click **Start** to go through a manual calibration sequence.

Note: The Automatic button is used to recalibrate the touch probe after it is calibrated manually. It should **only be used with vertical touch probe styli**.

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4. Measure five points on the sphere by carefully moving the probe tip with the joystick. Each point is recorded automatically and displayed in the pop-up window as the probe tip touches the sphere.

   - Measure the first point on top of the sphere.
   - Measure the other four points around the equator of the sphere.

   Make sure that the points are distributed around the four quadrants of the sphere and spaced apart equally, for example, North, East, South, and West). If you are not able to measure a point in each quadrant because of the orientation of the tip, you may need to take two points (for example, last two points) in the same quadrant.

   After you measure a point and hear a beep, the system automatically re-measures the point at a constant velocity.

   After the last point is measured, the Measurement window displays the new calibration sphere location and enables the OK button.

5. Click **OK** to accept the new location.
6. Raise the touch probe stylus so that it is above the sphere.

Now you must perform the calibration to verify the sphere location automatically. It should **only be done with vertical touch probe styli**.

7. In the **System** menu, select **Calibration** ⇒ **Probe Tip**.
8. Click the **Automatic** radio button and then click **Start**.

   The system performs an automatic calibration sequence and increments the counter next to the Points button. After the calibration is completed, the window displays 5 for the number of points, the new reference sphere location and enables the OK button.
9. Click **OK** to accept the new location.

   The system saves the location in the EEPROM and updates the touch probe configuration settings.
10. Move the touch probe to a safe location.

If any measurement fails, a pop-up window displays an error message, in which case you need to click OK. Then you can click Cancel and restart the calibration automatically, or measure the remaining points manually.

For a dockable touch probe:

- Select **Change Sensor** ⇒ **Dock Probe** in the **Tools** menu to return the DSM to its port. Make sure that the path to the port is clear.
- If another DSM needs to be calibrated, go back to the port location learning procedure that starts on page 7-2.

If you are done with the calibration, remove the sphere from the stage. It is not needed for touch probe measurements.

This completes the single-tip touch probe calibration.

Calibrating a Multi-Tip Touch Probe

It is not necessary to calibrate all the tips on the multi-tip (star) probe. You need to calibrate only those tips that will be used for measurements. If you are not sure which tips you will need to use, calibrate all the tips.

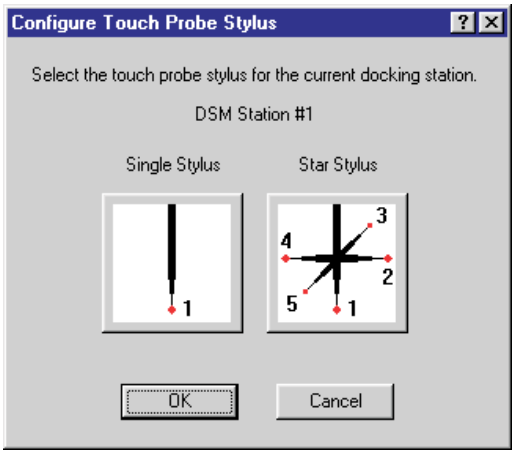
To perform a multiple-tip touch probe calibration, follow the steps below. It is assumed that the sphere-to-lens calibration has been done since the sphere was last mounted on the stage and that the touch probe is seated on the probe sensor or mounted on the probe holder. If not, select **Change Sensor** ⇒ **Get Probe** in the **Tools** menu.

1. In the **System** menu, select **Configuration** ⇒ **Probe Tips** from the menu.

   A pop-up window displays a single stylus button and a star (multi-tip) stylus button.

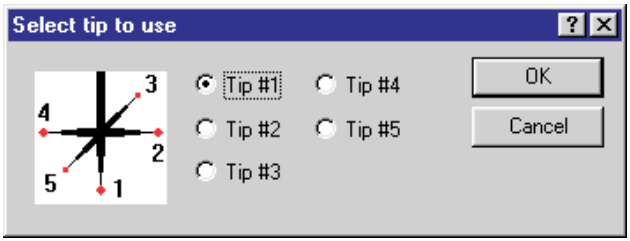
2. Click **Star stylus** and then click **OK**.

3. Move the stage so that the appropriate touch probe stylus is approximately 12 mm (½" inch) above the top of the sphere or next to the sphere. Make sure the path is clear.



4. In the **Tools** menu, select **Change Sensor** ⇒ **Select Tip**.

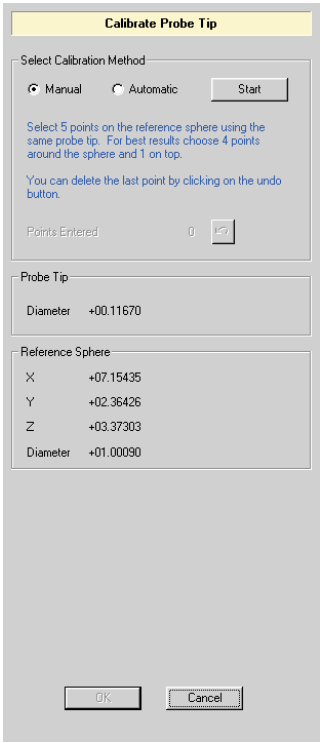
   A pop-up window displays an image of a multiple-tip stylus with a radio button for each tip. The default is the bottom-most tip.



5. Click the appropriate radio button to select the desired tip and the click **OK**.

6. In the **System** menu, select **Calibration ⇒ Probe Tip**.

   The Measurement window displays the reference sphere diameter and instructions to select the calibration method.



7. Click the **Manual** radio button and then click **Start** to go through a manual calibration sequence. The instructions now prompt you to select five points on the reference sphere.

8. Measure five points on the sphere by carefully moving the probe tip with the joystick. Each point is recorded automatically and displayed in the Measurement window as the probe tip touches the sphere. After each point is recorded, the system backs off and retakes the point automatically.

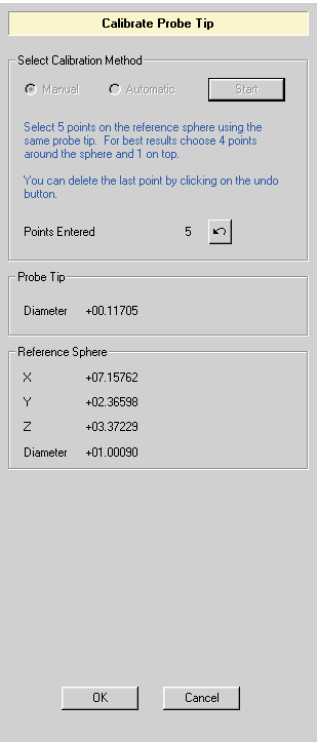
   - Measure the first point on the highest location of the quadrant that can be reached by the probe tip. For example, measure a point on top of the sphere if you are using the bottom-most tip.
   - Measure the other four points by equally distributing them around the circumference of the sphere. Depending on the length of the selected tip, you may not be able to reach some quadrants. In this case, measure the points at different locations of the quadrant that can be reached.

   After the last point is measured, the Measurement window displays the new calibration sphere location and probe tip diameter, and enables the OK button.

9. Click **OK**. The system saves the new location and updates the touch probe parameters.

10. Raise the touch probe stylus so that it is above the sphere.

Now you must perform the calibration to verify the sphere location automatically. It can be done **only with vertical touch probe styli**. The Automatic button is grayed out if any tip other than bottom-most tip (Tip 1) is selected.



11. In the **System** menu, select **Calibration** ⇒ **Probe Tip**.
12. Click the **Automatic** radio button and then click **Start**.

    The system performs an automatic calibration sequence and increments the counter next to the Points button. After the calibration is completed, the window displays 5 for the number of points, the new reference sphere location and enables the OK button.
13. Click **OK** to accept the new location. The system saves the location in the EEPROM and updates the touch probe configuration settings.
14. Move the touch probe to a safe location.
15. Repeat the calibration procedure for the other tips that you wish to calibrate.

For a dockable touch probe, after the calibration is done:

- Select **Change Sensor** ⇒ **Dock Probe** in the **Tools** menu to return the DSM to its port. Make sure that the path to the port is clear.
- Perform the *"Teaching" the Port and Clearance Locations for Each DSM* procedure (described at the beginning of this section) if another DSM needs to be calibrated.

If you are done with the calibration, remove the sphere from the stage. It is not needed for touch probe measurements.

Section 8

Using the Touch Probe (Measure-X Systems)

Important: This section describes how to use the touch probe to measure features on systems equipped with Measure-X. For information about using the touch probe on MeasureMind 3D systems, see Section 6.

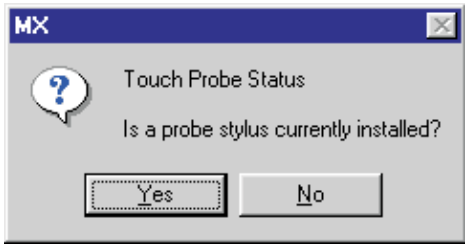
When you measure features with the touch probe it creates steps in the routine. You can use it at any time during the creation or editing of a routine. You can use the touch probe to create two kinds of routines:

- **Touch probe routines** with touch probe measurements only
- **Multi-sensor routines** consisting of both touch probe and video measurements

Starting Measure-X

1. Turn on the power and access Measure-X.

   The software displays a prompt asking if the probe stylus is installed (attached to the probe sensor).



2. Click the appropriate button.
   - If the touch probe is not installed, click **No**.
   - If the touch probe is installed. In this case the system is configured such that the touch probe is enabled, click **Yes** .
3. If you clicked Yes in the previous step, select the stylus in the displayed window and then click **OK**.

The system goes through the stage initialization process.

Change Sensor Menu

This **Tools** menu item is available only if your system is equipped with a touch probe. In this menu, you can select:

- **Get Probe** to get a DSM from its configured port in the change rack
- **Dock Probe** to return a DSM to its configured port in the change rack
- **Select Tip** to select a specific tip on a multi-tip touch probe if the system is configured with a multi-tip stylus
- **Disable Probe** to disable the probe that is attached to the sensor
- **Enable Probe** to enable the probe that is attached to the sensor

How to Use a Touch Probe During the Creation of a Routine

You can create a multi-sensor routine that contains both optical and touch probe measurements. A dockable touch probe can be in two locations:

- In the port. We recommend that the probe remain in the port whenever it is not in use. This avoids possible collisions with a part.
- Mounted on the probe sensor. In this case, you must **be very careful when measuring features with the optics so that the touch probe does not contact a part or the change rack during optical measurements.**

CAUTION:

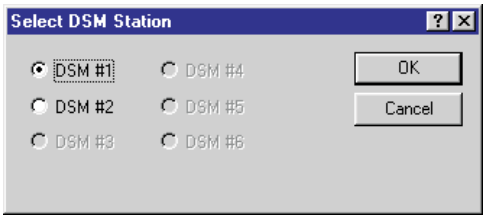
1. Once the touch probe is mounted on the sensor, you must be very careful with how you move the stage and Z axis to prevent damage to the touch probe or optical components.
2. To avoid unexpected contacts and damage to touch probe components, press the Stop/Start button to stop stage movement.

Important: It is assumed that the lens, port, and the touch probe(s) that you will be using have been calibrated.

Getting or Enabling the Touch Probe

When ready to use a touch probe in a routine, follow the steps below.

1. In **Tools** menu, select **Change Sensor** and then select the appropriate item:
   - Select **Get Probe** if the dockable touch probe is in the port.
   - Select **Enable Probe** if the touch probe is already mounted on the probe sensor in a disabled mode. The system automatically enables the probe and you are ready to use it.
2. If you selected Get Probe, the system displays a dialog box to select the port containing the DSM you want to use.
   - Click the desired radio button and then click **OK**.



The system gets the probe from the selected port and moves it to the clearance location specified for that DSM. If you selected a multi-tip probe, you need to activate the tip that will be used for measurements (described on the next page).

Returning the Touch Probe to the Port or Disabling It

Whenever you do not need to use the touch probe you can:

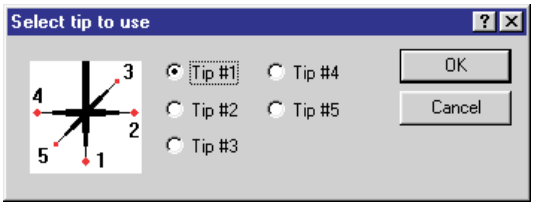
- Raise the optical assembly to a Z location that ensures sufficient clearance between the touch probe and the part(s) on the stage. Then select **Change Sensor** ⇒ **Dock Probe** in the **Tools** menu to return the touch probe to the port. The system automatically returns the touch probe to the port.
- Select **Change Sensor** ⇒ **Disable Probe** in the **Tools** menu if you have a fixed touch probe or if you wish to leave the dockable touch probe mounted on the probe sensor in a disabled mode. The system automatically disables the probe. However, **you must be very careful with the stage and Z axis motion to prevent damage to the touch probe components during video operations.**

Note: If the touch probe is disabled but not docked, you can only control the zoom with the Zoom slider; you cannot use the joystick to control the zoom.

To use a multi-tip touch probe, follow the steps below. (The tips that will be used for measurements must be calibrated.)

1. In the **Tools** menu, select **Change Sensor** ⇒ **Select Tip** or click the multi-tip icon at the bottom of the screen.

   A pop-up window displays an image of the multi-tip stylus with radio buttons for each tip.



2. Click the radio button to select the tip you want to use and then click **OK**.

   This activates the selected tip. All contact measurements will be based on the selected tip, even if there is an accidental contact with another calibrated tip. In this case, the measurement results will be in error because the location of the **selected tip** is used for the calculations.

Joystick Functions When Using the Touch Probe

The joystick has the following functions for touch probe measurement points.

Use	To
Rotation knob	Move the probe axis up or down
Enter button	Record a “safe” point
Cancel button	Delete the last point taken (applies to both measured points and safe points)
Top button	Press and hold the button to increase the velocity for Z axis and XY stage motion

An audible beep is produced each time the probe tip makes a contact. The beep for the safe point has a slightly higher pitch and can be turned On/Off in System / Configuration ⇒ Sound.

Guidelines for Creating a Multi-Sensor Routine

If you plan to create a multi-sensor routine, use the guidelines listed below.

- Whenever possible, do all the measurements with one sensor first before switching to the other sensor, that is, avoid interchanging optical and touch probe measurements multiple times. This decreases the length of time to create and run the routine and enables the routine to run faster.
- If the touch probe has an unexpected contact with an object, the probe interface unit beeps. Press the **Reset** button on the front panel to eliminate the beep.
- Edit the following fields in the touch probe step (described in the Editing Safe and Contact Points topic):
  - **Safe points**. Change the X and Y values so that they are the same when moving the probe up and down. This ensures that the probe moves straight up and down.
  - **XYZ values** of the contact point. Change the values so that the probe moves orthogonally with respect to the surface being measured.
- **Be very careful about deleting or changing steps because they may contain safe points and about inserting a step where a previous step may not contain the necessary safe point.**

When the touch probe is mounted and enabled on the probe sensor you can use it to measure the desired feature(s). After selecting the desired Measure function, you create safe points and contact points by moving the probe with the joystick.

You must specify at least one safe point before a contact point in a touch probe step. If you attempt to use the probe to measure a contact (probe) point without specifying a safe point first, a pop-up window displays a prompt. If this happens, click OK, move the probe to a safe location, and press the Enter button on the joystick or control panel to record a safe point.

To specify a safe point, click Yes, move the probe to a safe location, and press the Enter button on the joystick to record the safe point. If you click No, the software completes the step without a safe point.

CAUTION: Make sure that you select a sufficient number of safe points before and after measuring a probe point. This is critical to ensure that the probe does not collide with an object when you run the routine or if a step has been removed from the routine. If you do not select enough safe points the probe may get damaged when you run the routine.

Note: The safe point before a contact point should be normal to the measured surface.

Safe Point

A **safe point** is created when you move the probe to a safe location and press the Enter button on the joystick. The software increments the number next to the Point button in the Measurement window.

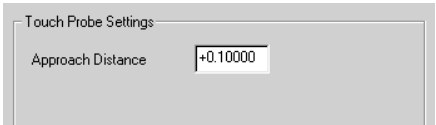
- **At least one safe point is required before every contact point in a step.**
- **We strongly recommend that the last point in the measurement step be a safe point. This helps to ensure a clear path to the next point to be measured or to the port.**
- When measuring features at different heights, we recommend that you raise the probe to establish each safe point at the same height.

Contact Point

A **contact point** is created when you move the probe and it makes contact with (touches) the object being measured. The software produces an audible “beep” and increments the number next to the Point button in the Measurement window.

Contact Point Approach Distance

The approach distance is the distance between the expected contact point and the point where the servo motors slow down as the probe approaches the contact point. The default distance appears in the Touch Probe control window.



You can change the value in this window. For example, it may be necessary to do this when measuring a feature such as a very small-diameter hole with very little room to move around between contact points.

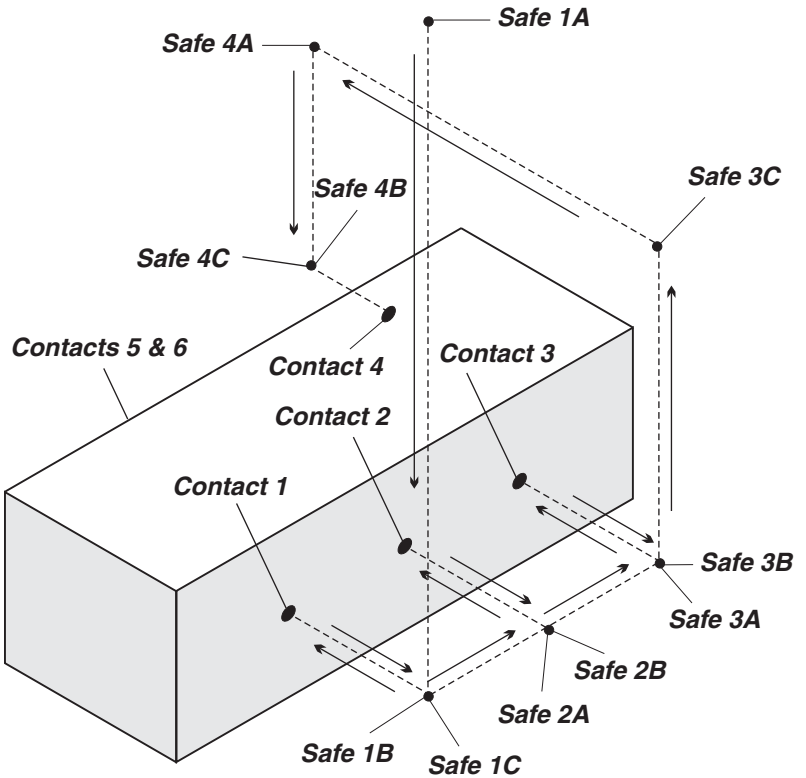
The approach distance is carried forward to the next touch probe measurement of the same kind of feature.

If you wish, you can override the approach distance for a contact point in a step by setting a lower value for the safe point associated with that contact point.

The illustration below shows how safe points and contact points are used to measure a solid rectangular block with a touch probe.

- Safe point 1A is added in the first step. It is usually at a high Z location, straight up from the last video measurement.
- Three probe steps (1 to 3) are measured on one side. The probe is moved away from the block between each contact point in each step. A safe point is created before **and** after each contact point.
- Two safe points are created above the block to prevent the probe from crashing into the block as it attempts to go to the other side to measure the next three probe steps when you run the routine.
- Three probe steps (4 to 6) are measured on the other side in the same manner as on the first side.

Six separate Measure / Point steps are used to measure the solid block.



- Step 1 contains four points: safe points 1A and 1B, contact point 1 and safe point 1C.
- Step 2 contains three points: safe point 2A, contact point 2, and safe point 2B.
- Step 3 contains four points: safe point 3A, contact point 3, and safe points 3B and 3C.
- Step 4 contains four points on the other side of the block: safe points 4A and 4B, contact point 4 and safe point 4C.
- Steps 5 and 6 are similar to Steps 2 and 3, except they are on the other side the block.

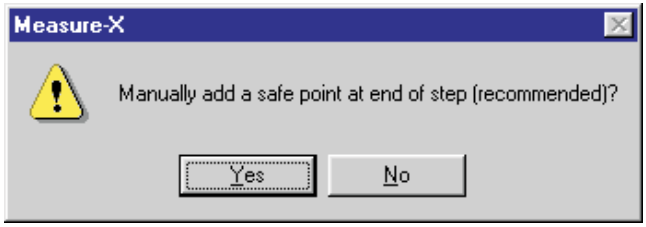
You must specify at least one safe point before a contact point in a touch probe step.

- If you attempt to use the probe to measure a contact point without specifying a safe point first, the following is displayed:

- If you attempt to measure two contact points in a row, the following is displayed:

If either of the above messages is displayed, click **OK**, move the probe to a safe location, and press the Enter button on the joystick to record a safe point.

We strongly recommend that you specify a safe point as the last point in a measurement step to ensure a clear path to the next point to be measured or to the port. If you click **OK** or **Again** in the step without specifying a safe point, the following is displayed.



To specify a safe point, click **Yes**, move the probe to a safe location, and press the Enter button on the joystick to record the safe point. If you click No, the software completes the step without a safe point.

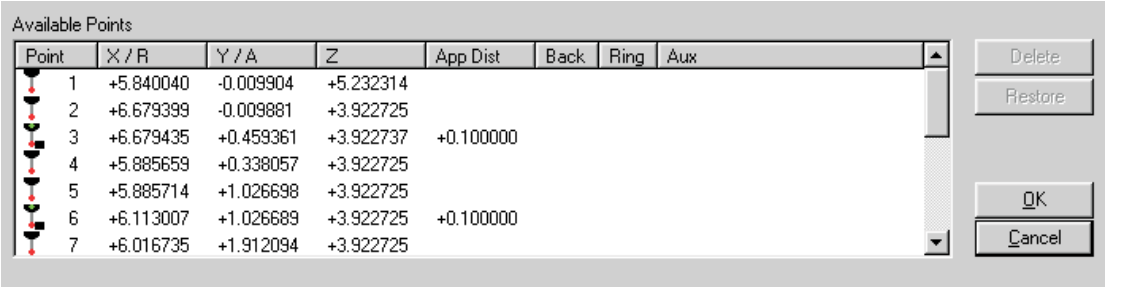
Editing Safe and Contact Points

You can edit safe points and contact points in two ways:

- Change the XYZ location values of the safe and/or contact points
  - Changing the XYZ values of safe points ensures that the probe moves straight up and down.
  - Changing the XYZ values of the contact point ensures that the probe moves orthogonally with respect to the surface being measured.
- Add/remove safe points

To view a list of the safe and contact points in a step and change their XYZ location values, follow the steps below.

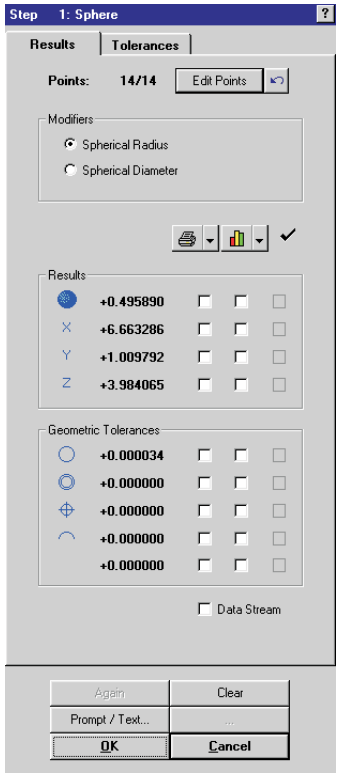
1. In the Model window, select a feature that was measured with the touch probe to display the touch probe step in the Measurement window.
2. Click **Edit Points**. The Edit Points window displays the safe points and contact points in the step. The contact points are indicated with a small square and they have an approach distance.



3. Change the **X**, **Y, Z** and/or **approach distance** values as desired.
4. Click **OK** to accept the changes.
5. In the Measurement window, click **OK** to complete the step.

To add/remove safe points, follow the steps below.

1. In the Model window, select a feature that was measured with the touch probe to display the touch probe step in the Measurement window.
2. Add and/or remove one or more safe points at the end of the step.
   - To add a safe point, move the probe to the desired location and press the **Enter** button on the joystick. The number next to the points button is incremented by 1.
   - To remove a safe point, click **Points** in the Measurement window. The number next to the Points button is decremented by 1.



CAUTION: Be very careful about removing a safe point because this may cause the probe to crash into an object when you run the routine.

3. If you want, click **Edit Points** to display the points in the step. Verify the changes and click **OK** to accept any changes and close the window.
4. In the Measurement window, click **OK** to complete the step.

Running a Routine with Optical and Touch Probe Measurements

When you run a routine that has touch probe steps, the software measures features with the touch probe in the same way as you did when you created each step. For each measurement step in the routine, the software remembers:

- Which sensor was used in that step
- The location of the touch probe, i.e. whether a probe is mounted (enabled or disabled) or in the port
- The port which the touch probe came from
- When to retrieve and return the touch probe to its port

To run a routine with multi-sensor measurements click the **Run** icon and then click **OK** in the Run window.

- If the first step was measured with the optics, the system begins measuring the features. When the system encounters a step that was measured with the touch probe, it repeats what was done during the creation of the routine:
  - If you retrieved the touch probe from the port, it automatically gets the touch probe from the port and measures that feature with the touch probe. Then, when it encounters a step measured with the optics, it automatically puts the touch probe back in the port and measures the next step with the optics.
  - If you enabled the touch probe, it automatically enables the touch probe and measures the feature. Then, when it encounters a step measured with the optics, it automatically disables the touch probe and measures the next step with the optics.
- If the first step was measured with a touch probe:
  - If the probe is not mounted on the sensor, the system automatically gets the touch probe from the port and measures that feature with the touch probe. Then, when it encounters a step measured with the optics, it automatically puts the touch probe back in the port and measures the next step with the optics.
  - If the probe is already mounted on the sensor, the system measures the feature with the touch probe. Then, when it encounters a step measured with the optics, it automatically disables the touch probe and measures the next step with the optics.

Missed Contact During the Routine Run

If the routine expects a touch probe contact but it does not occur, the software moves the probe to the safe point that was entered last. It also displays the message shown here. The flashing red triangle in the Model window identifies the expected contact point. The step also remains in the Measurement window.

Click **OK** and resolve this problem, as described on the next page.

You can resolve this kind of problem in the following ways:

- Measure the point manually.
- Stop the routine and edit the point in the measurement step.
  - Click **Stop** in the DRO window to stop the routine. The system displays a confirmation prompt.
  - Click **OK** to stop the routine. Then you can edit the point and check the values of each point in the step, and run the routine again.

Unexpected Contact During the Routine Run

An unexpected contact is any action that causes the probe to touch an object before reaching the next safe point. For example, the probe may touch an object during the run if the safe point before a given contact point has the wrong values, or an insufficient number of safe points have been entered.

The probe may also have an unexpected contact if the approach distance value is too large and there is very little room to move around between contact points.

If the touch probe has an unexpected contact, the software displays the message shown here.

Click **OK**.

To resolve this kind of problem:

1. Click **Stop** in the DRO window to stop the routine. The system displays a confirmation prompt.
2. Click **OK** to stop the routine. Then you can edit the point and check the values of each point in the step and run the routine again.

If the unexpected contact is due to an approach or backoff distance that is too large, change the Approach Distance value in the Touch Probe control window.

Running a Multi-Sensor Routine in Step Edit Mode

If you run a multi-sensor routine in step edit mode, use the guidelines below.

- Remember to do the part setup.
- Start with the last video step, if the routine contains video measurements.
- To avoid damage to touch probe components, be extremely careful and be ready to press the Start/Stop button on the joystick if you need to start at a touch probe step.
- As you measure each feature with the touch probe, remember to press the **Enter** button on the joystick to:
  - **Enter the safe points**
  - **Accept contact points**

The following examples explain how to use the touch probe to create routines. It is assumed that the touch probe has been calibrated and aligned. It is assumed that the touch probe is already mounted on the probe sensor.

Sample Routine to Measure a Counterbored Hole

Follow the steps below to measure the diameter of a counterbored hole. In this example, a safe point is entered **before** each contact point.

1. Click the **Measure** tab and **Point** icon in the toolbox.
2. Move the touch probe to a safe location above the hole.
3. Press the **Enter** button on the joystick to record a safe point.
4. Move the touch probe inside the center of the hole.
5. Press the **Enter** button on the joystick to record a safe point.
6. Move the touch probe to measure the first point. The system automatically records the point in the Measurement window and the touch probe backs off after it touches the wall of the hole. Do **not** use the center button on top of the joystick when you move the touch probe.
7. Click **Again** in the Measurement window. The system displays a confirmation prompt to add a safe point.
8. In this case click **No** because the safe point before the next contact point is sufficient when you measure this type of feature. A point appears in the Model window.
9. Repeat Steps 5, 6 and 7 to measure three other points that are spaced apart equally. After measuring the last contact point, raise the touch probe to a safe location above the part and record a safe point. Remember to click **OK** (not Again) in the Measurement window. The last point appears in the Model window.
10. Click the **Construct** and **Circle** icons and select the points in the Model window to construct the circle. The diameter is in the Measurement window.
11. Run the routine to verify the measurement.

If you are measuring another feature, remember to set a sufficient number of safe points, especially if you need to raise or lower the probe.

Sample Routine to Measure a Sphere

Follow the steps below to measure five points on a sphere. You will measure the top first, followed by four points at the North, East, South and West sides of the sphere. In this example, a safe point is entered **before** each contact point.

1. Click the **Measure** tab and **Sphere** icon in the toolbox.
2. Move the touch probe to a safe location, e.g., 2 inches (or 50 mm) above the sphere and press the **Enter** button on the joystick to record the safe point.
4. Move the probe directly over the sphere and record another safe point.
5. Move the touch probe to measure the first point on top of the sphere. The system automatically records the point in the Measurement window and the touch probe backs off after it touches the sphere.
6. Move the touch probe along the XY axis to the North side and record a safe point.
7. Move the touch probe down (Z axis only) to the outer middle on the North side of the sphere and record a safe point.
8. Move the touch probe to measure the point on the North side. The system automatically records the point in the Measurement window and the touch probe backs off after it touches the sphere.
9. Move the touch probe along the XY axis to the East side and record a safe point.
10. Move the touch probe to measure the point on the East side. The system automatically records the point in the Measurement window and the touch probe backs off after it touches the sphere.
11. Repeat Steps 9 and 10 to measure the South side.
12. Repeat Steps 9 and 10 to measure the West side.
13. Raise the probe to a safe location (imaginary plane) and record a safe point.
14. Click **OK** in the Measurement window. The sphere measurement appears in the Model window.
15. Run the routine to verify the measurement.

If you are measuring another feature, remember to set a sufficient number of safe points, especially if you need to raise or lower the probe.

Sample Routine to Measure a Plane

Follow the steps below to measure three points on a plane. In this example:

- A safe point is entered **before** each contact point.
- It is assumed that you are measuring a flat plane. If you plan to measure an inclined plane, you would also need to include a safe point after each contact point, especially when lowering/raising the touch probe.

1. Click the **Measure** tab and **Plane** icon in the toolbox.
2. Move the touch probe to a safe location, e.g., 2 inches (or 50 mm) above the object being measured and press the **Enter** button on the joystick to record a safe point.
3. Move the probe directly over the location where the first point will be measured and record another safe point.
4. Move the touch probe to measure the first point. The system automatically records the point in the Measurement window and the touch probe backs off after it touches the object.
5. Move the touch probe along the XY axis to the next point and record a safe point.
6. Move the touch probe to measure the next point. The system automatically records the point in the Measurement window and the touch probe backs off after it touches the object.
7. Move the touch probe along the XY axis to the next point and record a safe point.
8. Move the touch probe to measure the last point. The system automatically records the point in the Measurement window and the touch probe backs off after it touches the object.
9. Raise the probe to a safe location (imaginary plane) and record a safe point.
10. Click **OK** in the Measurement window. The plane measurement appears in the Model window.
11. Run the routine to verify the measurement.

If you are measuring another feature, remember to set a sufficient number of safe points, especially if you need to raise or lower the probe.

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