PC-DMIS Portable Manual

For PC-DMIS 2011

By Wilcox Associates, Inc.

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```
lpsolve citation data
----------------------
Description: Open source (Mixed-Integer) Linear Programming system
Language: Multi-platform, pure ANSI C / POSIX source code, Lex/Yacc based parsing
Official name: lp_solve (alternatively lpsolve)
Release data: Version 5.1.0.0 dated 1 May 2004
Co-developers: Michel Berkelaar, Kjell Eikland, Peter Notebaert
License terms: GNU LGPL (Lesser General Public License)
Citation policy: General references as per LGPL
Module specific references as specified therein
You can get this package from:
http://groups.yahoo.com/group/lp_solve/
```

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PC-DMIS Portable

PC-DMIS Portable: Introduction

This manual documents how to use PC-DMIS Portable with your portable measuring device to measure features on a part. Portable devices are manually operated measuring machines that are relatively easy to move to new locations due to their size and design. These are sometimes called "manual machines", or "hard probe machines", because they cannot run in DCC mode nor do they have a touch-trigger mechanism to record hits.

PC-DMIS Portable supports these hardware configurations:

- ☐ Romer Arms – Sigma Series, Flex Series, Omega Series, & Infinite series.
- ☐ Leica Laser Trackers – See the "Leica Laser Tracker: Introduction" topic for supported Leica versions.
- ☐ Faro Arms and SMX Trackers – These devices are supported by PC-DMIS and additional support is being added.

The main topics in this manual include:

- Launching PC-DMIS Portable
- PC-DMIS Portable: User Interface
- Configuring Portable Interfaces
- Common Portable Functionality
- Using a Romer Portable CMM
- Using a Leica Laser Tracker
- Using Total Station
- Creating Alignments
- Measuring Features
- Portable Hard Probe Scanning

Use this manual in conjunction with the main *PC-DMIS reference* manual if you come across something in the software that isn't covered here.

Launching PC-DMIS Portable

PC-DMIS allows you to launch a slightly different user interface when working with portable devices. A **Portable** toolbar appears (see "Portable Toolbar" in the "Using Toolbars" chapter of the core PC-DMIS documentation). In addition, toolbar icons and menu items will be larger, easier to see from a distance.

The Portable interface becomes available in one of two ways:

- Your portlock is programmed with the **Romer**, **Leica**, **SMX Laser**, **Faro Manual**, or **Total Station** interface prior to installing PC-DMIS. The appropriate portable interface will be installed and used whenever you launch PC-DMIS.

or

- Your portlock is programmed with "All Interfaces". In this case, you will need to append a command line switch to a new shortcut for your currently used portable interface. When using that shortcut, that portable interface will be used.

Creating a Custom Shortcut with a /portable Switch:

1. Inside a folder in Windows, right-click and select **New | Shortcut**. The **Create Shortcut** wizard appears.
2. Click **Browse**, and select Pcdlrn.exe from where you have PC-DMIS installed.
3. In the box that points to the location of Pcdlrn.exe append the following switch to a path depending on your interface:

   ```
   /portable:romer
   ```

   ```
   /portable:leica
   ```

   ```
   /portable:smxlaser
   ```

   ```
   /portable:faro
   ```

   ```
   /portable:leicatps
   ```

   So, if PC-DMIS was installed in the "C:\Pcdmisw" directory, the command line in the wizard would look something like this: **C:\Pcdmisw /portable:Romer**

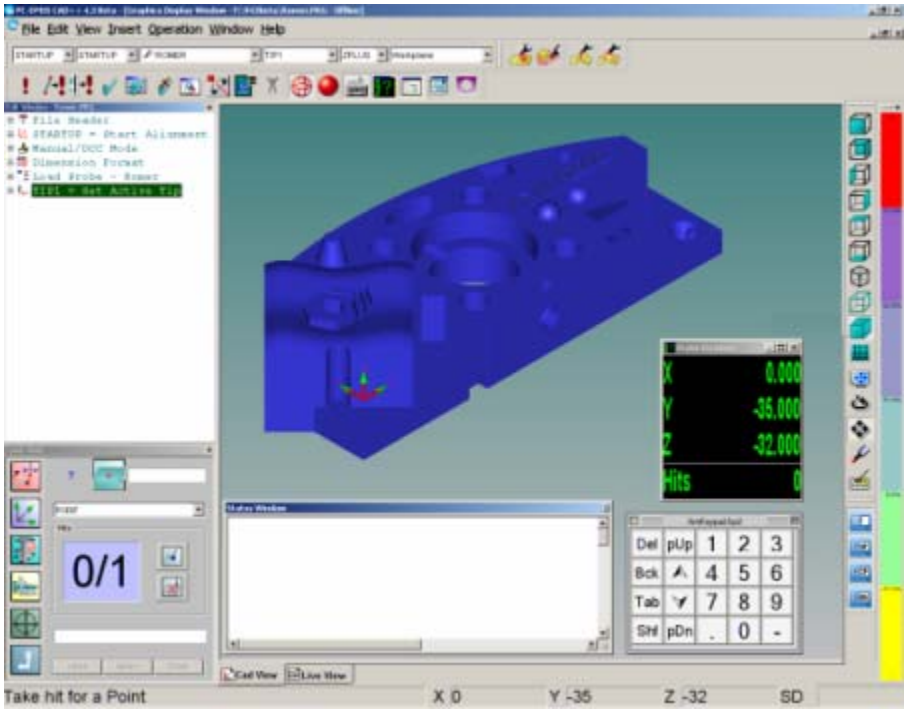
   Additionally you can add the **/VK** switch to you command so that the virtual keyboard is also displayed on startup (**C:\Pcdmisw /VK /portable:Romer**). This option is only available for arm interfaces.

4. Click **Next** and specify a name for the shortcut.
5. Click **Finish**. The shortcut gets created at the specified location.
6. Double-click on the newly created shortcut to launch PC-DMIS Portable.

Note: Alternately, you can access the **Customize** dialog box (right-click on toolbar area and select **Customize**) and then select the **Use Large Menus** and **Use Large Toolbar Icons** check boxes.

PC-DMIS Portable: User Interface

There are PC-DMIS user interface elements that are particularly useful when using portable devices. The image below shows an example portable layout.



Example Portable User Interface

These following UI elements are discussed in greater detail in the PC-DMIS Core documentation or elsewhere in this documentation:

- **Settings Toolbar**
- **Probe Mode Toolbar**
- **Portable Toolbar**
- **Edit Window**
- **Quick Start Interface**
- **Status Bar**
- **Status Window**
- **Probe Readouts**
- **Status Window**
- **Virtual Keyboard**
- **Build and Inspect Toolbar**
- **Menu Bar:** All PC-DMIS functionality can be accessed from the menu bar and the corresponding drop-down lists.
- **Graphic View Toolbar:** Allows you to easily change the view of the Graphics Display Window

- **Graphic Item Toolbar:** Toggles the display of Graphics Display window labels. See the "Graphic Items Toolbar" topic in the PC-DMIS Core documentation.
- **Graphic Display Window:** Displays a the geometric features that are being measured. See the "Editing the CAD Display" chapter in the PC-DMIS Core documentation.
- **Dimension Colors Window:** Shows the colors for dimension tolerances and their associated scale values. See "Using the Dimensions Colors Window" topic in the PC-DMIS Core documentation.

Note: If your portlock is programmed for "All Interfaces", you will need to run the PC-DMIS installation program with one of the following switches: /Interface:romer, /Interface:leica, /Interface:smxlaser, or /Interface:faro Adding these case sensitive switches can be done by creating a shortcut to the PC-DMIS Setup.exe and appending the needed switch to the Target field (For example: c:\download\PC-DMIS\setup.exe /Interface:romer). If you are installing with a portlock programmed for a specific interface, the correct interface should be installed automatically.

Settings Toolbar

The **Settings Toolbar** allows you to easily recall and change system information such as:

- Recall saved views.
- Recall any previous alignment.
- Recall a Probe File.
- Recall a Tip from the Probe File.
- Recall a system workplane for 2D measurements and calculations.
- Recall a measured plane for reference for 2D measurements and calculations.

See the "Settings Toolbar" topic in the "Using Toolbars" chapter in the PC-DMIS Core documentation.

Probe Mode Toolbar

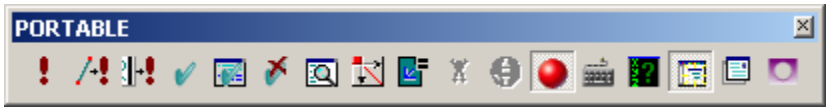
The **Probe Mode Toolbar** has buttons to determine how points are taken in PC-DMIS Portable. The following options are available:

- Point Auto Trigger Mode allows PC-DMIS to automatically take a reading when a the probe is a close to the surface point. See the "Point Auto Trigger" topic.

- Plane Auto Trigger Mode allows PC-DMIS to automatically take a reading when a the probe is a close to an edge point. See the "Plane Auto Trigger" topic.

- Find Nominals from CAD Mode allows PC-DMIS to automatically find the appropriate nominal from the CAD model when measuring on-line.
- When in Point Only Mode, PC-DMIS will interpret all measurements as points only. The Done key is not required.

Portable Toolbar



Portable Toolbar for Romer interface

The **Portable Toolbar** contains several icons that allow you to access various frequently used functions and windows that are helpful when programming or measuring with portable devices.

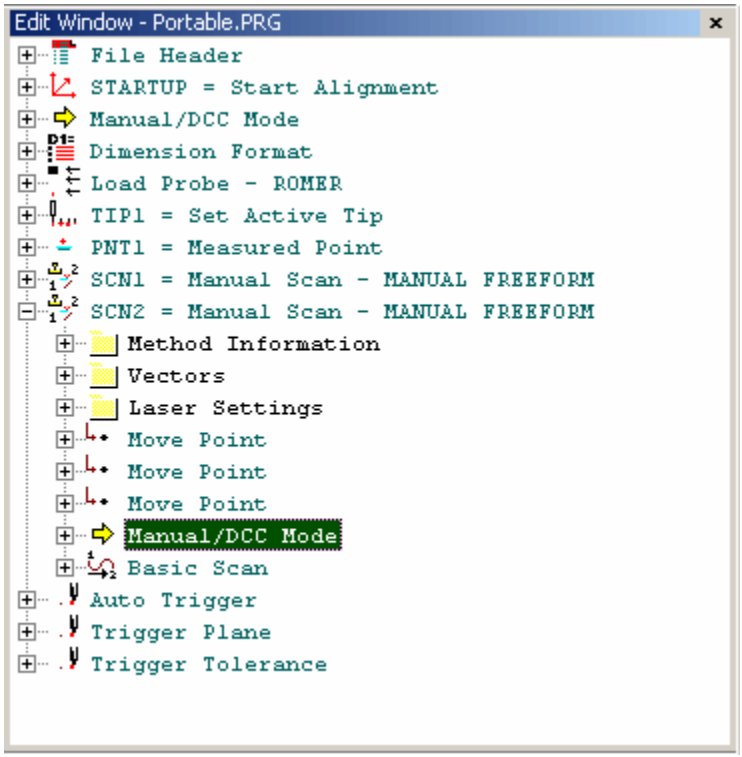
The available toolbar icons for Romer arms are described in this table:

Icon		Description
	Execute	Executes the measurement process for any currently marked feature(s). See "Execute" in the "Using Advanced File Options" chapter in the PC-DMIS Core documentation.
	Execute Feature	Executes the selected feature. See "Execute Feature" in the "Using Advanced File Options" chapter in the PC-DMIS Core documentation.
	Execute from Cursor	Executes the part program starting at the selected feature and then working down the Edit window. See "Execute From Cursor" in the "Using Advanced File Options" chapter in the PC-DMIS Core documentation.
	Mark	Marks the selected feature with the specified mark color and prepares it for execution. See "Mark" in the "Editing a Part Program" chapter in the PC-DMIS Core documentation.
	Mark All	Marks *all* features in the Edit window. See "Mark All" in the "Editing a Part Program" chapter.
	Clear Marked	Removes all highlights from currently marked features within the Edit window. See "Clear All" in the "Editing a Part Program" chapter in the PC-DMIS Core documentation.
	Edit Dialog	Accesses the dialog box associated with the currently selected command if one exists.
	Import IGES Files	Begins the import operation for the IGES CAD file type (.igs or .iges). See "Importing an IGES File" in the "Using Advanced File Options" chapter in the PC-DMIS Core documentation.
	Set Alignment	Links the CAD data to the measured data. See "CAD Equals Part" in the "Creating and

		Using Alignments" chapter in the PC-DMIS Core documentation.
	Leap Frog Alignment	Performs a Leapfrog operation. See "Performing a Leapfrog Operation".
	Curve Mode	Places PC-DMIS into Curve mode (for use with wire-frame). See "Switching Between Curve and Surface Modes" in the "Editing the CAD Display" chapter in the PC-DMIS Core documentation.
	Surface Mode	Places PC-DMIS into Surface mode (for use with surface data). See "Switching Between Curve and Surface Modes" in the "Editing the CAD Display" chapter in the PC-DMIS Core documentation.
	Virtual Keyboard	Displays a Virtual Keyboard. See "Using the Virtual Keyboard" in the "Using Other Windows, Editors, and Tools" chapter in the PC-DMIS Core documentation.
	Probe Readouts	Displays or hides the Probe Readout window. See "Using the Probe Readout Window" in the "Using Other Windows, Editors, and Tools" chapter in the PC-DMIS Core documentation.
	Large Status Window	Displays or hides the Status window. See "Using the Status Window" in the "Using Other Windows, Editors, and Tools" chapter in the PC-DMIS Core documentation.
	Report Window	Displays or hides the Report window. See "About the Report Window" in the "Reporting Measurement Results" chapter in the PC-DMIS Core documentation.
	Auto Circle	This allows quick access to the **Auto Feature** dialog box without having all auto feature buttons on the screen. Once the **Auto Feature** dialog box is open, you can select another auto feature if needed.

Important: Different and additional icons are displayed on the Portable toolbar for Leica trackers.

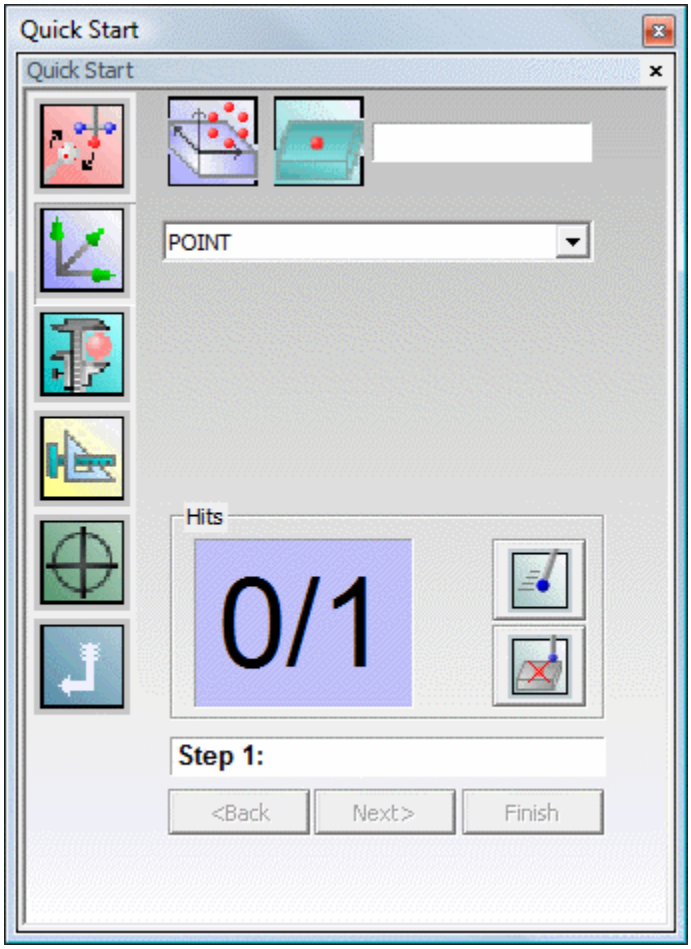
Edit Window



The **Edit Window** displays the part program being created. All listed program steps can be expanded and edited as needed. New program statements are added AFTER the high-lighted line.

See the "Using the Edit Window" chapter in the PC-DMIS Core documentation.

Quick Start Interface



The **Quick Start** interface is the started to place for performing most of the functions for working with portable devices. If it isn't already visible, select **View | Other Windows | Quick Start** to access it.

From this interface, you can:

Calibrate Probes

Create Alignments

Measure Features

Construct Features

Create Dimensions

Reset the Window

See "Using the Quick Start Interface" in the "Using Other Windows, Editors, and Tools" chapter in the PC-DMIS Core documentation.

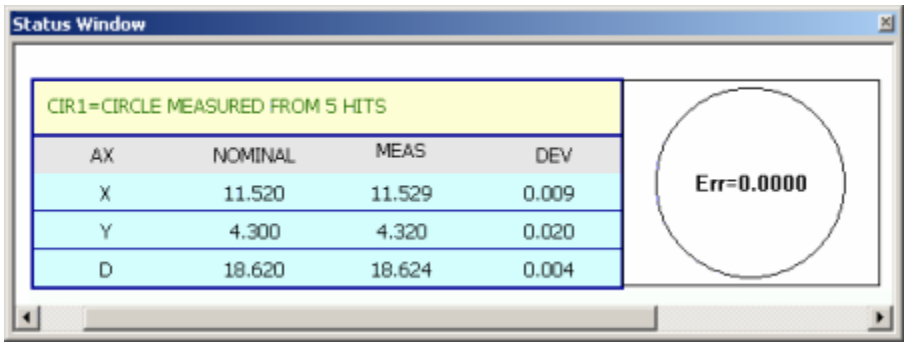
Status Bar

The **Status Bar** provides PC-DMIS system information such as:

- Help on buttons with mouse-over
- XYZ Counter
- StdDev of Feature Display
- Probing Point Counter (Normal size only)
- Unit Display: MM or INCH (Normal size only)
- Line / Column counter to show where the cursor is within the **Edit Window**. (Normal size only)

To change the status bar to large size, select the **View | Status Bar | Large** menu option.

Status Window



The **Status Window** displays user information as a program is being created such as:

- Feature information as they are being measured.
- Dimension reports as they dimension tolerances are being evaluated.

See the "Using the Status Window" topic in the "Using Other Windows, Editors, and Tools" chapter in the PC-DMIS Core documentation.

Probe Readout

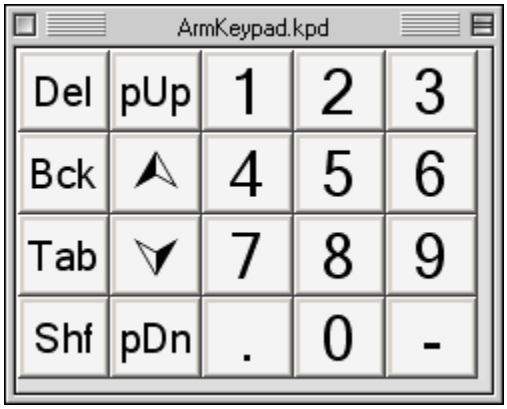
The **Probe Readout** primarily displays the XYZ probe location. The display of the **Probe Readout** can be toggled from the **Portable** toolbar or by pressing and holding the portable arm left button for greater than 1 second. Pressing and holding the portable arm left button for greater than 1 second when the **Probe Readout** is already open will display the "T" value in the **Probe Readout**. The "T" value provides the distance to the CAD nominal.

When working with Build / Inspect mode, the tolerance colors used in **Probe Readout** indicate whether the current location is *in* or *out* of tolerance. The following colors are used:

- In Tolerance: Green
- Out-of-tolerance negative: Blue
- Out-of-tolerance positive: Red

For more information about the Probe Readout window see the "Using the Probe Readout Window" in the "Using Other Windows, Editors, and Tools" chapter in the PC-DMIS Core documentation.

Virtual Keyboard



The **Virtual Keyboard** allows you to enter data when measuring with an arm without having to return to the PC to type data. You can click the ArmKeypad keys with the arm in mouse mode (see "Using Romer Arm Buttons").

To access the Virtual Keyboard:

1. Select from the **Portable** toolbar or the **Virtual Keypad** toolbar.
2. To enable the ArmKeypad, right-click within the Virtual Keyboard and select **ArmKeypad** from the drop-down list.

See the "Using the Virtual Keyboard" topic in the "Using Other Windows, Editors, and Tools" chapter in the PC-DMIS Core documentation.

Build / Inspect Toolbar

Build and Inspect Toolbar

The **Build and Inspect Toolbar** has buttons to determine how the Build and Inspect modes are used in PC-DMIS Portable. The following options are available:

 Inspect / Build mode:	default (Inspect mode), PC-DMIS displays the deviation (T) as *'Difference = Actual - Nominal'*. • **Build Mode:** The general purpose is to provide real-time deviations between a real object and its nominal data or CAD model. This allows you to position your part as it relates to the CAD design data. Selecting this option will display the distance and direction that you need to move the measured point to reach the nominal position or *'Difference = Nominal - Actual'*. **Note:** When you are moving the part into position, there are just real-

	time deviations displayed without storing any data (taking hits). After the part is positioned within a reasonable deviation (e.g. 0.1mm), you would typically measure (hits are taken) the final position of the feature. • **Inspect Mode:** In this mode, the position of an object (point, line of surface, etc.) is checked and compared with design data.
 Surface Inspection:	Applies the **Probe Readout** settings that are useful for inspecting surfaces/curves.
 Point Inspection:	Applies the **Probe Readout** settings that are useful for inspecting points.
 Distance to closest feature:	When this option is enabled, the distance to the closest feature is displayed in the **Probe Readout**.
 Show Deviation Arrow:	When this option is enabled, arrows are displayed in the Graphics Display window according to the inspect mode. The arrows are placed at the probe location in inspect mode (default) or at the measured point during build mode.

Configuring Portable Interfaces

The **Edit | Preferences | Machine Interface Setup** menu option invokes the **Machine Options** dialog box with the specific settings for your portable device. Machine options are only available when working in on-line mode.

Caution: In most cases you *shouldn't* change any of the values in this dialog box. Some items in this dialog box, such as the **Mechanical Offsets** area, permanently overwrite values stored for your machine on the controller's hard drive. For questions on how and when to use the **Machine Options** dialog box, you should contact your local service representative:

The parameters found in the **Machine Options** dialog box are discussed for the following machine interfaces:

- Romer Arm Interface
- Leica Tracker Interface
- Axila Arm Interface
- Faro Arm Interface
- SMX Tracker Interface
- GOM Arm Interface
- Total Station Interface

Machine interface information for other PC-DMIS supported interfaces is discussed in the "Setting Up the Machine Interface" topic of the PC-DMIS Core manual.

Romer Arm Interface

The **Romer** interface is used with a *Romer* arm machine. PC-DMIS v3.7 and above supports USB arms.

Copy this file from Wilcox's ftp site:
ftp://ftp.wilcoxassoc.com/Hardware/Portable/Romer/GDS/Romosoft V1Sr8.zip

Unzip the file(s) and run setup.

Set the environment parameters so that PC-DMIS can access Romer's DLLs:

- Go to **Control panel**.
- Select **System**, then click on **Advanced** tab then click on the **Environment variables** button.
- In the system variables list box, edit the Path variable. Add a semicolon followed by the WinRDS installation directory. Normally this is means adding ";C:\Program Files\cimcore\winrds" (without the quotation marks) to the end of the Path string.

Before starting PC-DMIS, rename the romer.dll to interfac.dll.

The **Machine Option** dialog box has five tabs for the Romer interface:

Debug tab

See the "Generating a Debug File" topic.

Tools tab

This tab provides a **Diagnostics** button. This button launches Romer software to configure and test your Romer Arm. See the WinRDS User Guide, located in the WinRDS install directory for more information. *The WinRDS User Guide is a PDF file that gets installed when you install WinRDS.*

Note: Additional information for this interface is provided in the Machine Interface Installation Manual (MIIM).

Romer Pulled Hit Feature

The Romer interface supports pulled hits. See "Pulled Hits Method" in the "Probe Compensation" chapter.

Leica Tracker Interface

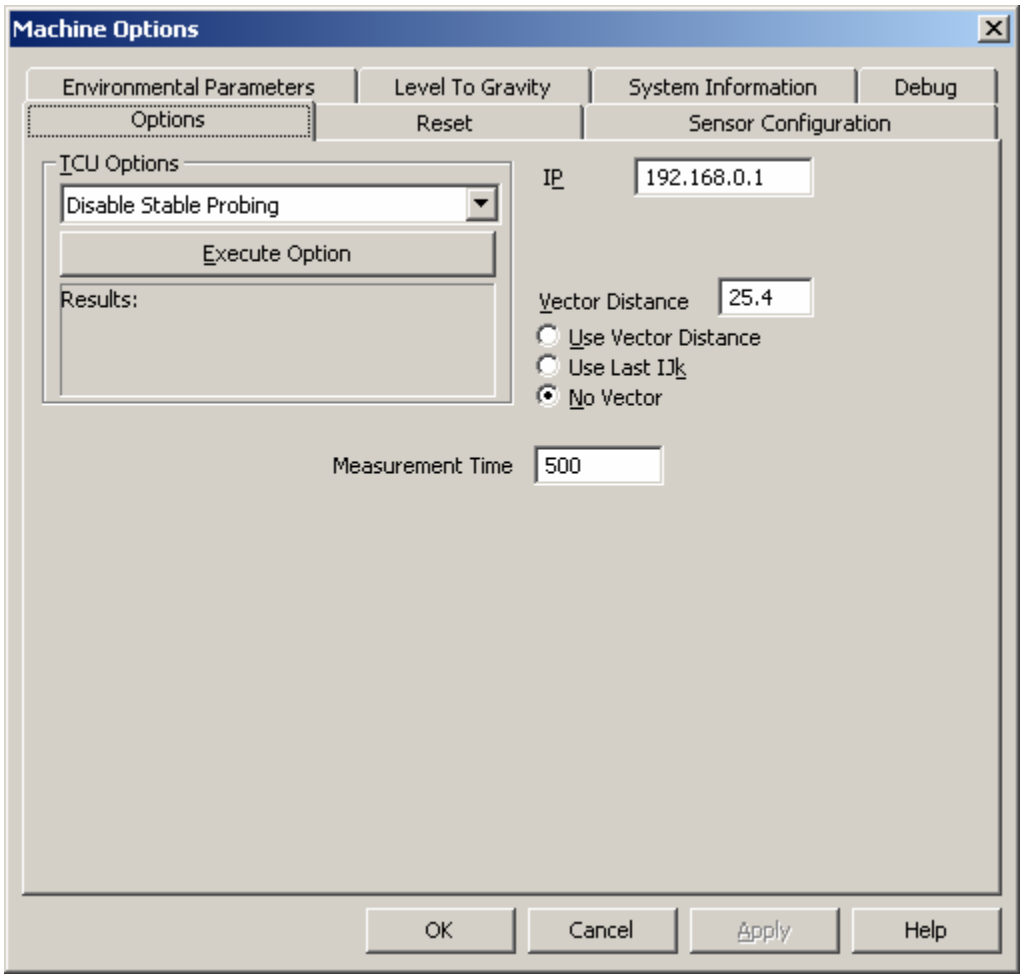
The parameters that control how PC-DMIS interfaces with the Leica interface can be configured by selecting the **Edit | Preferences | Machine Interface Setup** menu item. This opens the **Machine Options** dialog box. The following seven tabs are available:

- **Options tab**
- **Reset tab**

- **Sensor Configuration tab**
- **Environmental Parameters tab**
- **Level To Gravity tab**
- **System Information tab:** Displays information for your configured Leica system. Included values are: IP Address, Tracker Type with Serial # (if available), Controller Type, T-CAM Type and Serial # (if available), emScon version, TP-Firmware version, Bootdriver version, and Nivel Type and Serial # (if available).
- **Debug tab:** See the "Generating a Debug File" topic in the core PC-DMIS document.

Note: Additional information for this interface is provided in the Machine Interface Installation Manual (MIIM). Also review the documentation that came with you Leica Tracker.

Options tab



Machine Options dialog box - Options tab

The **Options** tab provides the means to execute various TCU (Tracker Control Unit) Options and configure communication and other parameters. TCU options are also available as menu items.

TCU Options: This area allows you to execute the following options:

- **Disable Stable Probing:** Disables stable probing. See the **Stable Probing ON/OFF** menu item in the "Tracker Menu" topic for information.
- **Enable Stable Probing:** Enables stable probing. See the **Stable Probing ON/OFF** menu item in the "Tracker Menu" topic for information.
- **Go Birdbath:** See the **Go BirdBath** menu item in the "Tracker Menu" topic for information.
- **Initialize:** See the **Initialize** menu item in the "Tracker Menu" topic for information.
- **Level to Gravity:** See the **Initialize** menu item in the "Nivel Commands" topic for information.
- **Live Image:**
- **Motors Off:** See the **Release Motors** menu item in the "Tracker Menu" topic for information.
- **Reset Nivel:** Makes a new reference measurement.
- **TScan:**
- **Zero Pos (6DoF):** See the **Go 6DoF 0 Position** menu item in the "Tracker Menu" topic for information.

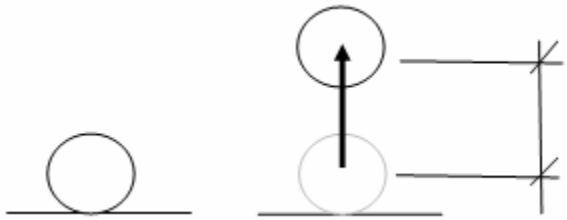
Note: TCU Options are more readily available from the Tracker toolbar/menu.

IP Address: Specify the IP address of your Laser Tracker controller (default 192.168.0.1).

Vector Distance: This defines the distance that you need to move the T-Probe/Reflector from hit location before a "Pulled Hit" will be taken.

"Pulled Hit" - Changes the vector to that of the line between the location where you first depress the hit button (at the "Normal Hit" location) to the location where you release the hit button. This line must be longer than the **Use Vector Distance** to successfully register a "Pulled Hit".

"Normal Hit" - A "Normal Hit" is taken when you press and release the hit button in the same location.



Example showing vector distance and movement

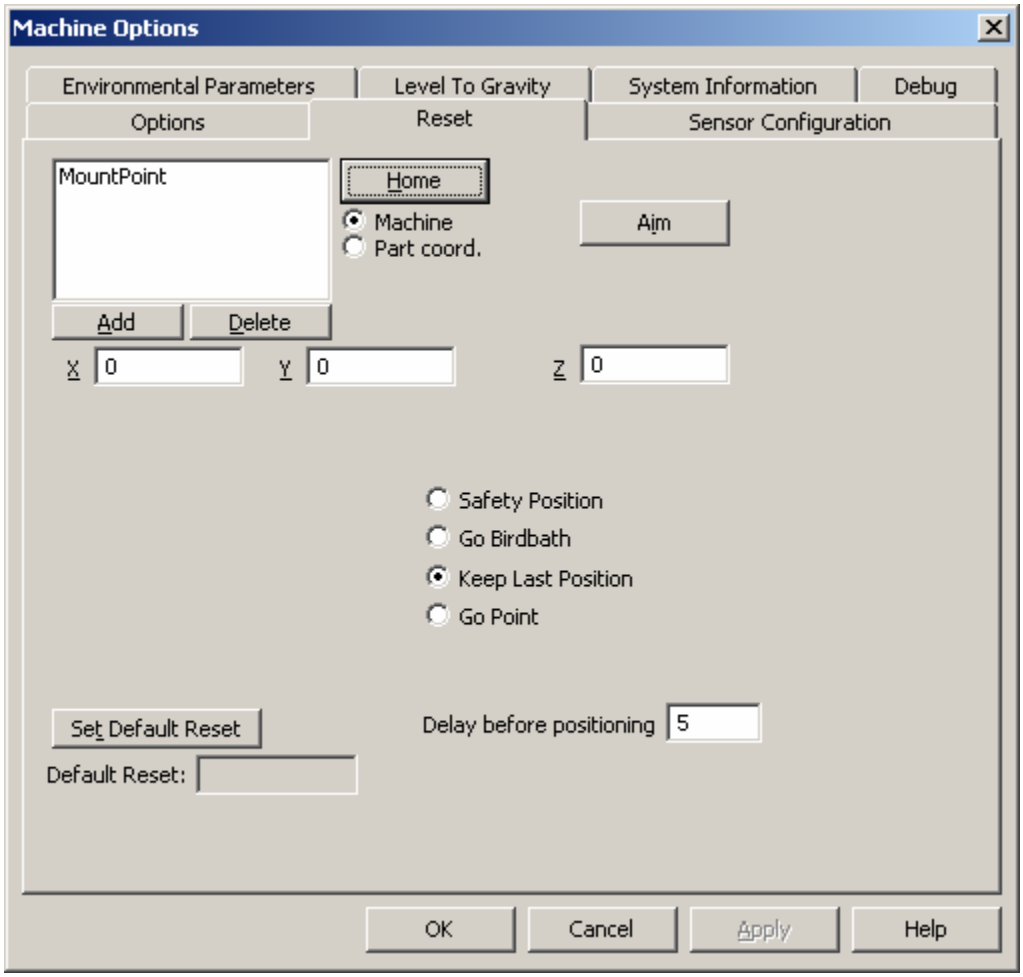
Vector Option: Choose one of these vector options:

- **Use Vector Distance:** Allows you to establish the vector using a "Pulled Hit".
- **Use Last IJK:** Uses there same IJK vector values of the last measured point.
- **No vector:** When this option is selected, you are able to produce scan data when you press and hold a button on the T-Probe.

Measurement Time: This determines the time interval in milliseconds. The data stream of measurements of the IFM is averaged, in this time interval, to a single measurement value. 500ms = 500 measurements in 500ms. This results in an XYZ coordinate with an RMS quality indication which is available on the DRO.

Note: Measurement Time supports a value between 500ms and 100000ms (.5 - 100 seconds)

Reset tab



Machine Options dialog box - Reset tab

Home: Aims laser to the BirdBath position.

Machine or **Part coord. option:** Select **Machine** if you are using Machine Coordinates, or **Part coord.** if you are using part coordinates.

Aim: Select a point from the Reset Point list, and click the **Aim** to move the laser to the specified point.

Add: Click the button to open the **Point** dialog box. Provide a **Title** and the **XYZ** values, and click **Create**. The new point is added to the Reset Point list above. For example, you

might have attached reflectors to positions on a car door. You could then name these positions Door1, Door2, Door3, etc.

Delete: Select a point from the Reset Point list, and click **Delete**. The selected point is deleted.

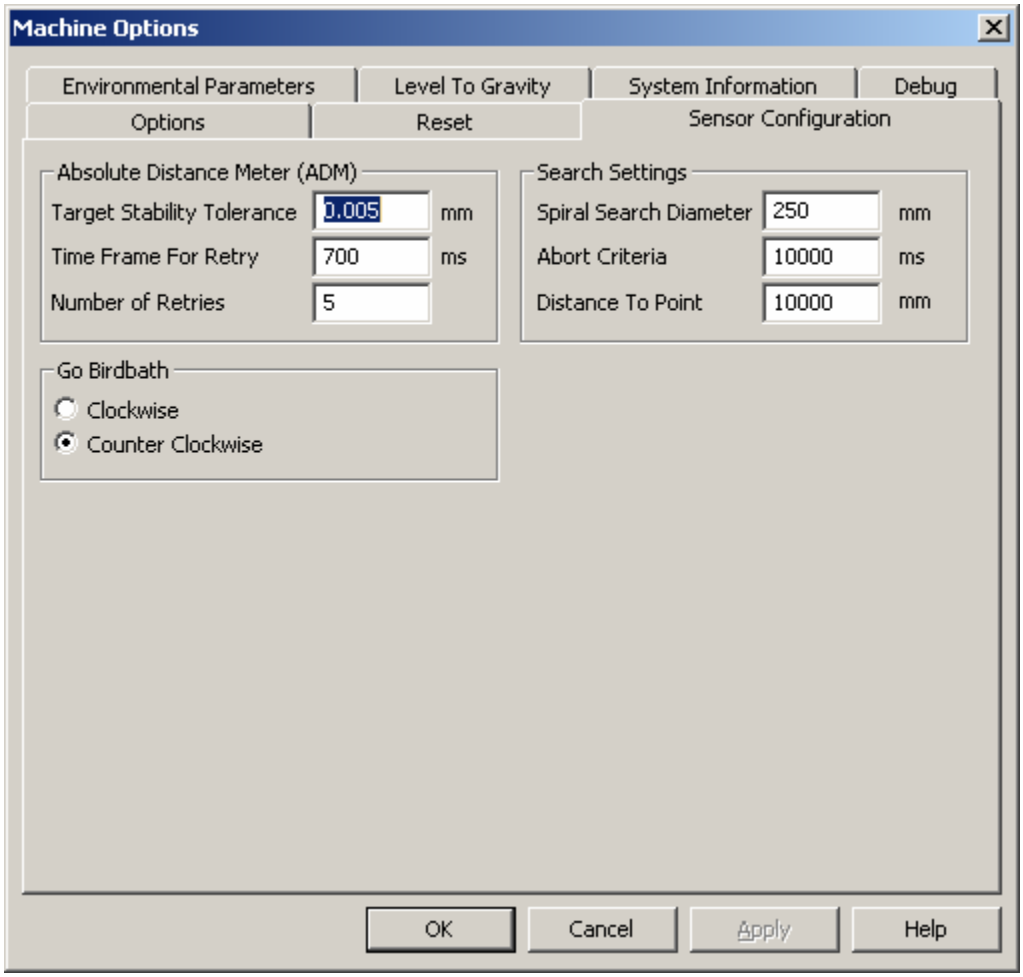
Reset Radio Buttons: In case of laser beam broken event, the following is done:

- **Safety Position:** The tracker points to the safe position which is also called the park position.
- **Go Birdbath:** The tracker goes back to birdbath position.
- **Keep Last Position:** The laser beam stays at its current positions and locks on accordingly if possible.
- **Go Point:** Points to the Default Reset point.

Set Default Reset: Select a point from the list above (to the left of the Home button), and click **Set Default Reset**. This is now the **Default Reset**. If the beam is broken with your reflector, the laser will point to the defined **Default Reset**.

Delay Before Positioning: Provides the time in milliseconds before the laser tracker will point to the next position.

Sensor Configuration tab



Machine Options dialog box - Sensor Configuration tab

Absolute Distance Meter (ADM)

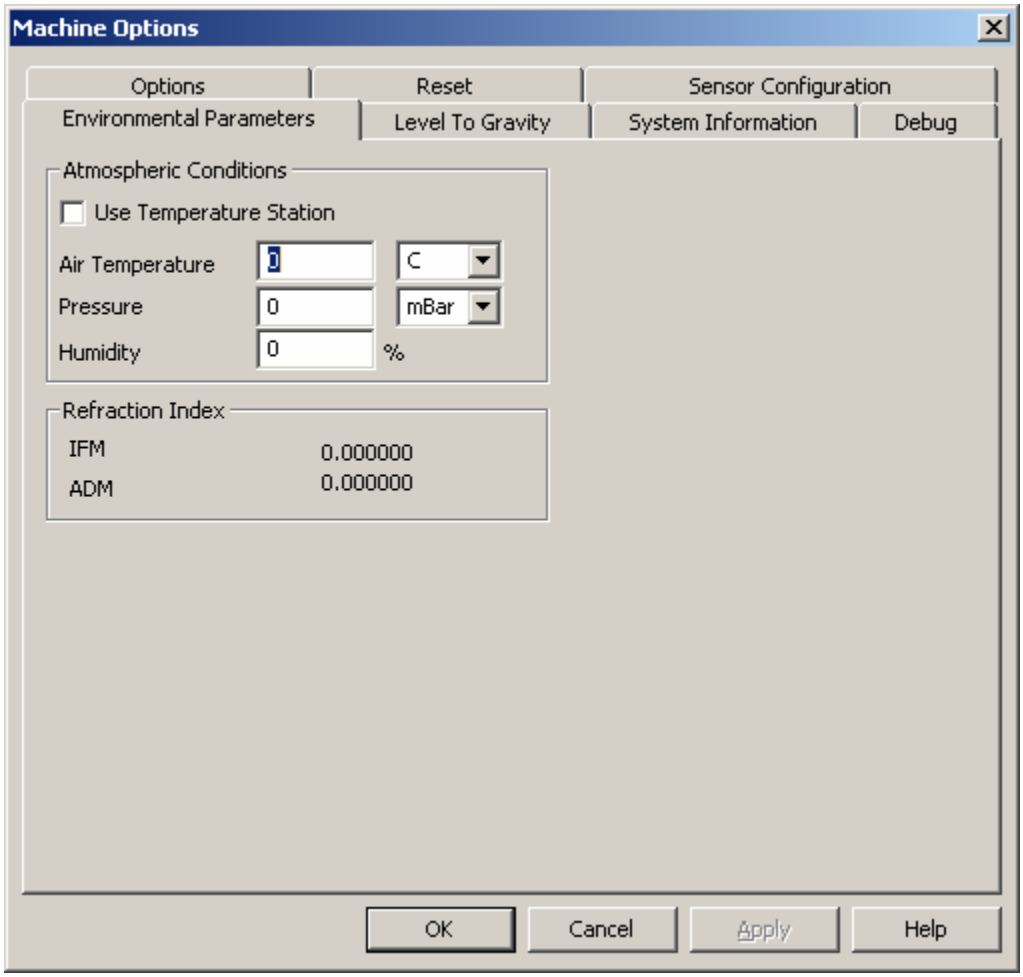
- **Target Stability Tolerance:** This tolerance (between 0.005 and 0.1 mm) determines the maximum range of movement of a reflector target during ADM measurements. Values beyond this range will show an error message.
- **Time Frame For Retry:** Sets the period of time for determining target stability. If the target is stable, an ADM measurement is taken.
- **Number of Retries:** Sets the number of attempts for an ADM measurement before aborting, because the stability of the target has exceeded the given tolerance.

Search Settings: If any of these search criteria are not met then the search process is aborted.

- **Spiral Search Diameter:** Diameter in which to search for the target.
- **Abort Criteria:** Time in which the target should be found.
- **Distance to Point:** Distance at which to search for the target.

Go Birdbath: The Leica Tracker will rotate to the Birdbath position in the **Clockwise** or **Counter Clockwise** direction from its current position.

Environmental Parameters tab



Machine Options dialog box - Environmental Parameters tab

Atmospheric Conditions

- **Use Temperature Station:** This determines whether or not the Leica Meteo Station is used. A Meteo Station collects data automatically and requires no manual interaction.

  If no Meteo Station is connected, make sure that the correct values are entered manually. This is also possible from the Tracker Status bar.

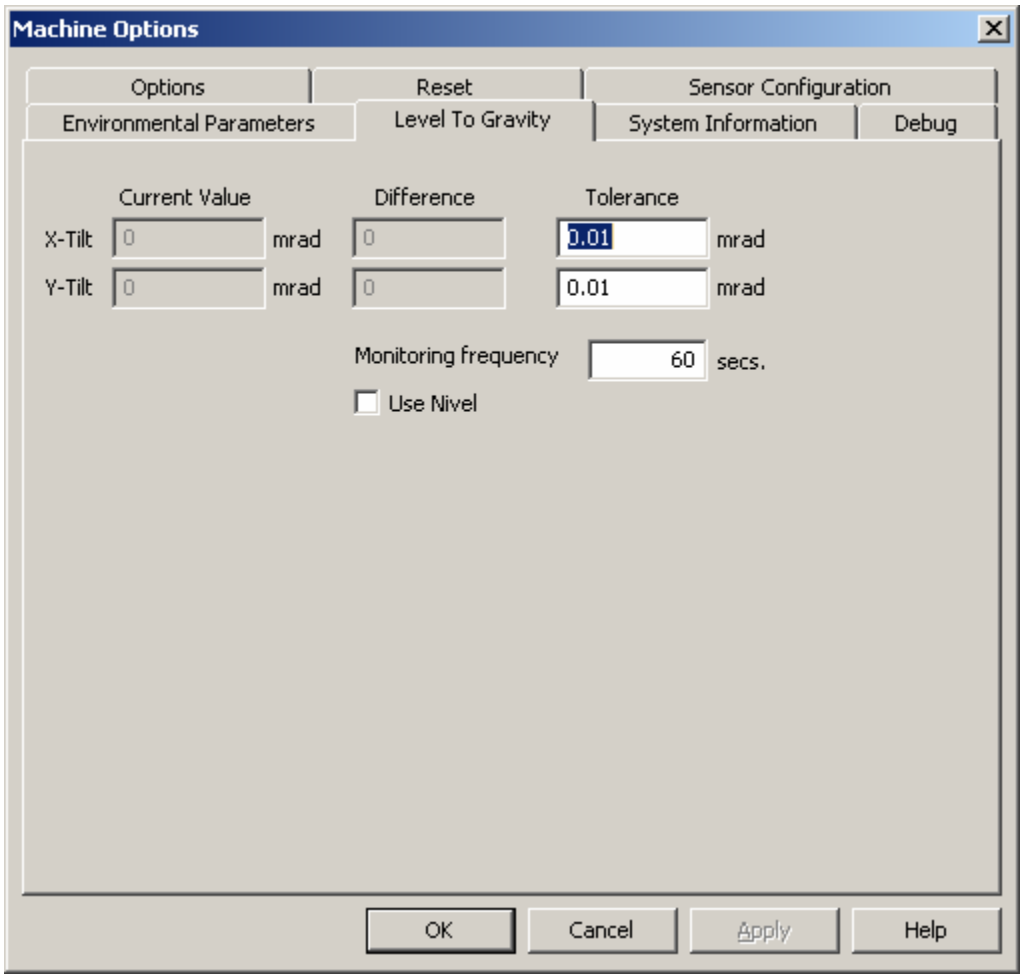
- **Air Temperature:** Allows you to specify the current temperature of the working environment in either Fahrenheit (**F**) or Celsius (**C**).
- **Pressure:** Allows you to specify the air pressure of your working environment in terms of **mBar**, **HPascal**, **MmHg**, or **InHg**.
- **Humidity:** Allows you to specify the percentage of humidity of your working environment.

Important: These Meteo parameters have a direct influence on the distance measurement. A change of 1°C causes a measurement difference of 1ppm. A change of 3.5mbar causes a measurement difference of 1ppm.

Refraction Index

- **IFM:** Displays the Interferometer refraction value.
- **ADM:** Displays the Absolute Distance Meter refraction value.

Level To Gravity tab



Machine Options dialog box - Level To Gravity tab

The **Level to Gravity** tab allows you to set up monitoring properties of the Nivel inclination device.

Current Value: Displays the current X-tilt and Y-tilt level values for the Nivel.

Difference: Displays the difference in milliradians between the actual reading of the current X-tilt and Y-tilt values from the current value.

Tolerance: Specifies the angle in milliradians that the Nivel level can change and still be considered in tolerance. Otherwise, you will need to use the **Reset Nivel** option on the "Options tab".

Monitoring frequency: Defines how often (in seconds) a Nivel monitoring value is read.

Use Nivel: Defines whether or not a Nivel is used. This toggles the visibility of the Nivel menu items and toolbars.

Axila Arm Interface

The **Axila** interface is used with an *Axila* arm machine. PC-DMIS software should be installed first, before proceeding with installing driver and arm-specific data delivered with your machine. The GDS driver for your Axila machine is protected by an HASP dongle that you must attach to your computer. The GTech/ROMER CD-ROM provides utilities for use with your machine.

Before starting PC-DMIS, rename the axila.dll to interfac.dll.

The **Machine Option** dialog box has two tabs for the Axila interface:

Debug tab

See the "Generating a Debug File" topic.

GDS Setup tab

This tab provides a button (**Start Setup**) that initiates the setup software that you installed with your Axila interface.

Note: The GDS document for the Axila interface is available from the Wilcox FTP site: ftp://ftp.wilcoxassoc.com/docs/How To Docs/E121 Gds manual UK.pdf

Axila Pulled Hit Feature

The Axila interface supports pulled hits. See "Pulled Hits Method" in the "Probe Compensation" chapter.

Faro Arm Interface

The **Faro** interface is used with a *Faro* arm machine. Software for your Faro arm is available on Wilcox's FTP server (ftp://ftp.wilcoxassoc.com/Hardware/Portable/Faro/).

Before starting PC-DMIS, rename the faro.dll to interfac.dll.

The **Machine Option** dialog box has five tabs for the Faro interface:

Comm tab

See the "Setting the Communication Protocol" topic. Default value is Comm Port **1**, **38400** Baud, **No** parity, **7** data bits, and **1** stop bit.

Axis tab

See the "Assigning the Machine Axes" topic.

Debug tab

See the "Generating a Debug File" topic.

Machine as Mouse tab

See the "Machine as Mouse Settings" topic.

Tools tab

This tab provides a **Diagnostics** button and **Hardware Config.** button. These buttons launch Programs from Faro to test and configure your Faro Arm.

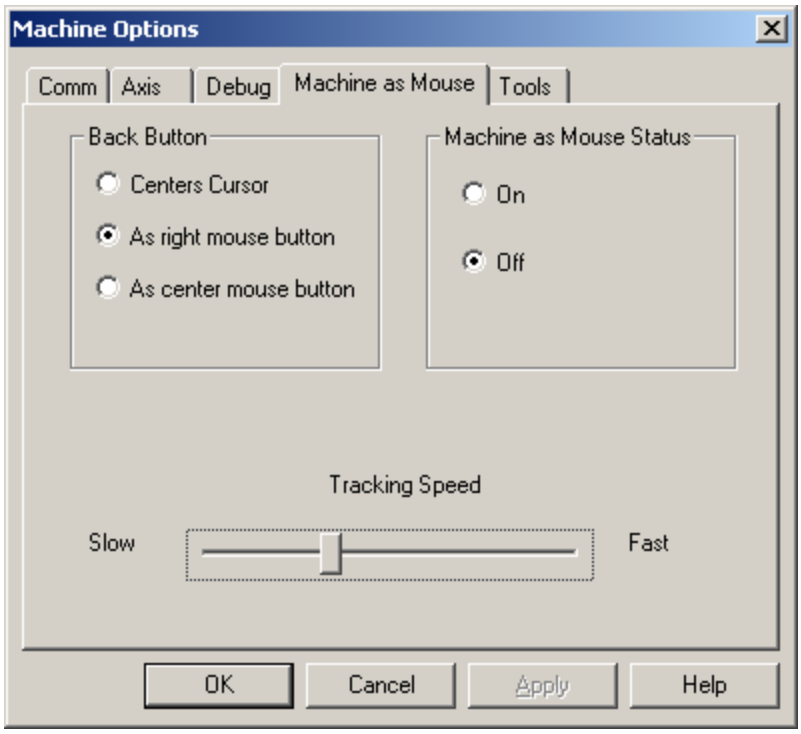
Note: Additional information for this interface is provided in the Machine Interface Installation Manual (MIIM).

Faro Pulled Hit Feature

The Faro interface supports pulled hits. See "Pulled Hits Method" in the "Probe Compensation" chapter.

See "Appendix A: Faro Portable Arm"

Machine as Mouse Settings



Machine Options dialog box - Machine as Mouse tab

The **Machine as Mouse** tab allows you configure the capabilities of the Faro arm movement and button clicks to control the pointer movement and mouse button clicks.

Back Button: You can set the Back button of the Faro arm to: *Centers Cursor* (moves the mouse pointer the center of the screen), *As right mouse button,* or *As center mouse button.*

Machine as Mouse Status: Select whether Machine as Mouse mode is **On** or **Off**.

Tracking Speed: Controls how quickly the mouse moves relative to the Faro arm movement.

Enabling and Disabling Mouse Mode

- To enable mouse mode, press the front and back button together.
- To disable mouse mode, when PC-DMIS screen is maximized (note that the window MUST be maximized), move the mouse cursor to the very top of the title bar (which is also the very top of the screen because PC-DMIS is maximized), then click the button that simulates left mouse button.

SMX Tracker Interface

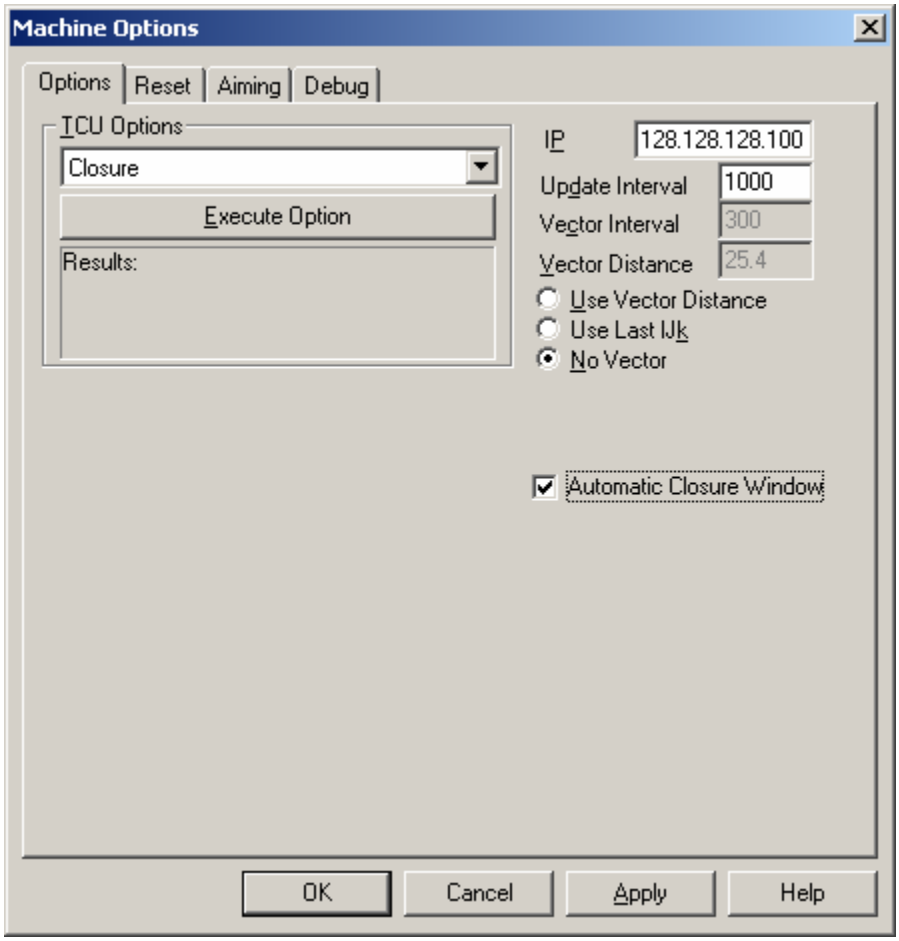
The parameters that control how PC-DMIS interfaces with the Faro SMX Laser interface can be configured by selecting the **Edit | Preferences | Machine Interface Setup** menu item. This opens the **Machine Options** dialog box. The following four tabs are available:

- **Options tab**
- **Reset tab**
- **Aiming tab**
- **Debug tab:** See the "Generating a Debug File" topic in the core PC-DMIS document.

Note: Additional information for this interface is provided in the Machine Interface Installation Manual (MIIM). Also review the documentation that came with you SMX Tracker.

Files used with the SMX Tracker are located here:
ftp://ftp.wilcoxassoc.com/Hardware/Portable/Faro-SMXLaser/

Options tab



Machine Options dialog box - Options tab

The **Options** tab provides the means to execute various TCU (Tracker Control Unit) Options and configure communication and other parameters. TCU options are also available as menu items.

TCU Options: This area allows you to execute the following options:

- **Closure:** Opens the **Closure** window. See "Using the Closure Window" topic.
- **Home:** Point your laser tracker to the home position.
- **Log Off:** Log Off from the SMX Tracker.
- **Log On:** Log On to the SMX Tracker
- **Motors Off:** Releases the horizontal and vertical tracker head motors in order to allow manual tracker head movement.
- **Motors On:** Engages the horizontal and vertical tracker head motors in order to allow manual tracker head movement.
- **Operational Checks:** See "Performing Operational Checks".
- **Tracker Pad:**
- **Wake Up:**

Note: TCU Options are more readily available from the Tracker toolbar/menu.

IP Address: Specify the IP address of your Laser Tracker controller (default 128.128.128.100).

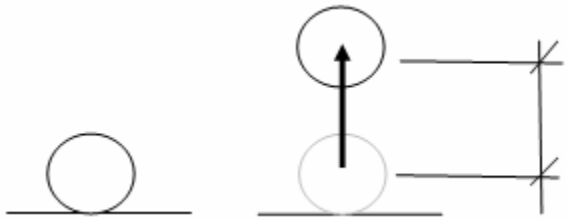
Update Interval:

Vector Interval:

Vector Distance: This defines the distance that you need to move the T-Probe/Reflector from hit location before a "Pulled Hit" will be taken.

"Pulled Hit" - Changes the vector to that of the line between the location where you first depress the hit button (at the "Normal Hit" location) to the location where you release the hit button. This line must be longer than the **Use Vector Distance** to successfully register a "Pulled Hit".

"Normal Hit" - A "Normal Hit" is taken when you press and release the hit button in the same location.



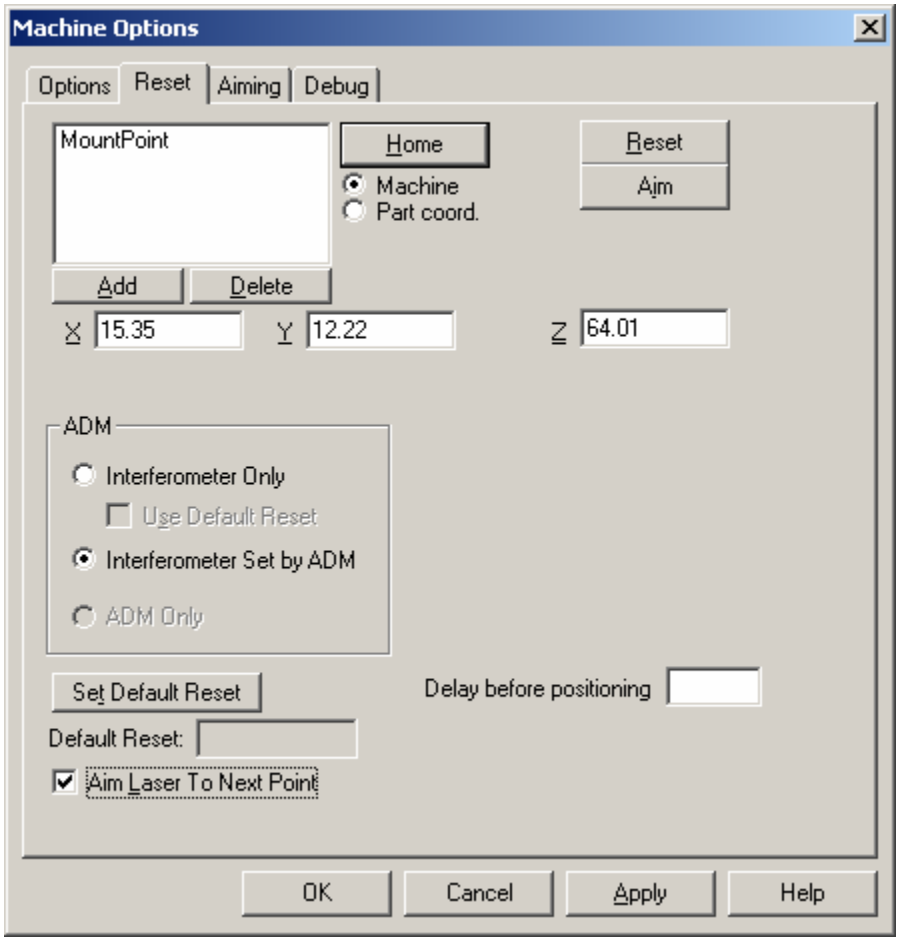
Example showing vector distance and movement

Vector Option: Choose one of these vector options:

- **Use Vector Distance:** Allows you to establish the vector using a "Pulled Hit".
- **Use Last IJK:** Uses there same IJK vector values of the last measured point.
- **No vector:** When this option is selected, you are able to produce scan data when you press and hold a button on the T-Probe.

Automatic Closure Window: When this check box is enabled, the **Closure** window will automatically be opened if the reflector is very close to the home position (the nest).

Reset tab



Machine Options dialog box - Reset tab

Home: Aims laser to the BirdBath position.

Machine or **Part coord. option:** Select **Machine** if you are using Machine Coordinates, or **Part coord.** if you are using part coordinates.

Aim: Select a point from the Reset Point list, and click the **Aim** to move the laser to the specified point.

Add: Click the button to open the **Point** dialog box. Provide a **Title** and the **XYZ** values, and click **Create**. The new point is added to the Reset Point list above. For example, you might have attached reflectors to positions on a car door. You could then name these positions Door1, Door2, Door3, etc.

Delete: Select a point from the Reset Point list, and click **Delete**. The selected point is deleted.

ADM

Interferometer Only:

Use Default Reset:

Interferometer Set by ADM:

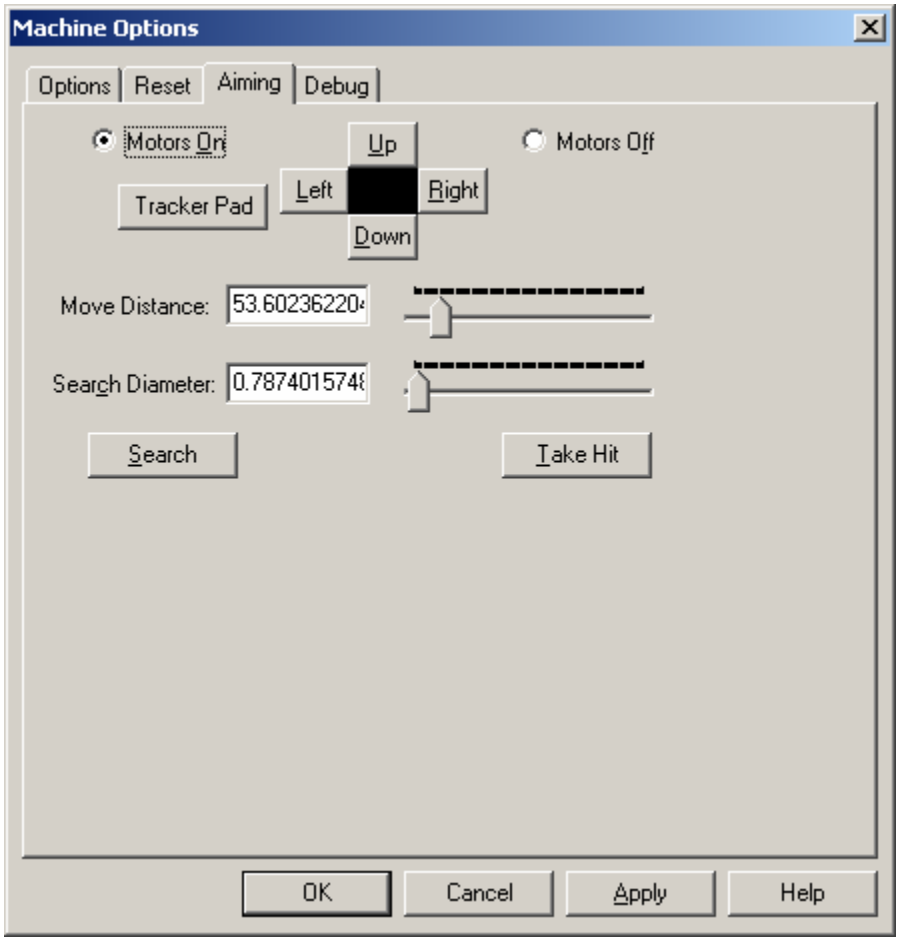
ADM Only:

Set Default Reset: Select a point from the list above (to the left of the Home button), and click **Set Default Reset**. This is now the **Default Reset**. If the beam is broken with your reflector, the laser will point to the defined **Default Reset**.

Delay Before Positioning: Provides the time in milliseconds before the laser tracker will point to the next position.

Aim Laser To Next Point: The laser tracker will point to the next point after completion of the previous point.

Aiming tab



Machine Options dialog box - Aiming tab

Motors On: Engages the horizontal and vertical tracker head motors in order to allow manual tracker head movement.

Motors Off: Releases the horizontal and vertical tracker head motors in order to allow manual tracker head movement.

Tracker Pad:

Control buttons (Left, Up, Right, Down): Clicking the control buttons will move the laser in the respective direction. Click a control button once and the tracker slowly begins to move until you click Stop. Each successive click will cause the tracker to move more quickly in that direction. The black box in the middle of these buttons will flash with a green indicator when the reflector is considered to be settled.

Move Distance: This value provides the approximate distance at which the laser will search for the reflector when you click **Search**. Moving the associated slider to the right will increase the **Move Distance** value will moving it to the left will decrease the value.

Search Diameter: Provides the diameter for the search area at the approximate **Move Distance** when you click **Search**. Moving the associated slider to the right will increase the **Search Diameter** value will moving it to the left will decrease the value.

Take Hit: Will measure a stationary hit (same as Ctrl-h) at the current location of the reflector.

GOM Interface

The **GOM** interface is used with the *CTR*, *GOM*, and *Krypton* machines. This interface works via a serial port. A generic parser can be used to adapt the interface to work with other manual machines where the format of data being received is known. *Traconsa*, *Layout*, and *Manual Mitutoyo* machines can be used in this manner with additional registry values (see the MIIM).

Before starting PC-DMIS, rename the GOM.dll to interfac.dll.

The **Machine Option** dialog box has three tabs for the GOM interface:

Controller tab

See the "Setting the Communication Protocol" topic. Default value is Comm Port **1**, **9600** Baud, **No** parity, **8** data bits, and **1** stop bit.

Axis tab

See the "Assigning the Machine Axes" topic.

Debug tab

See the "Generating a Debug File" topic.

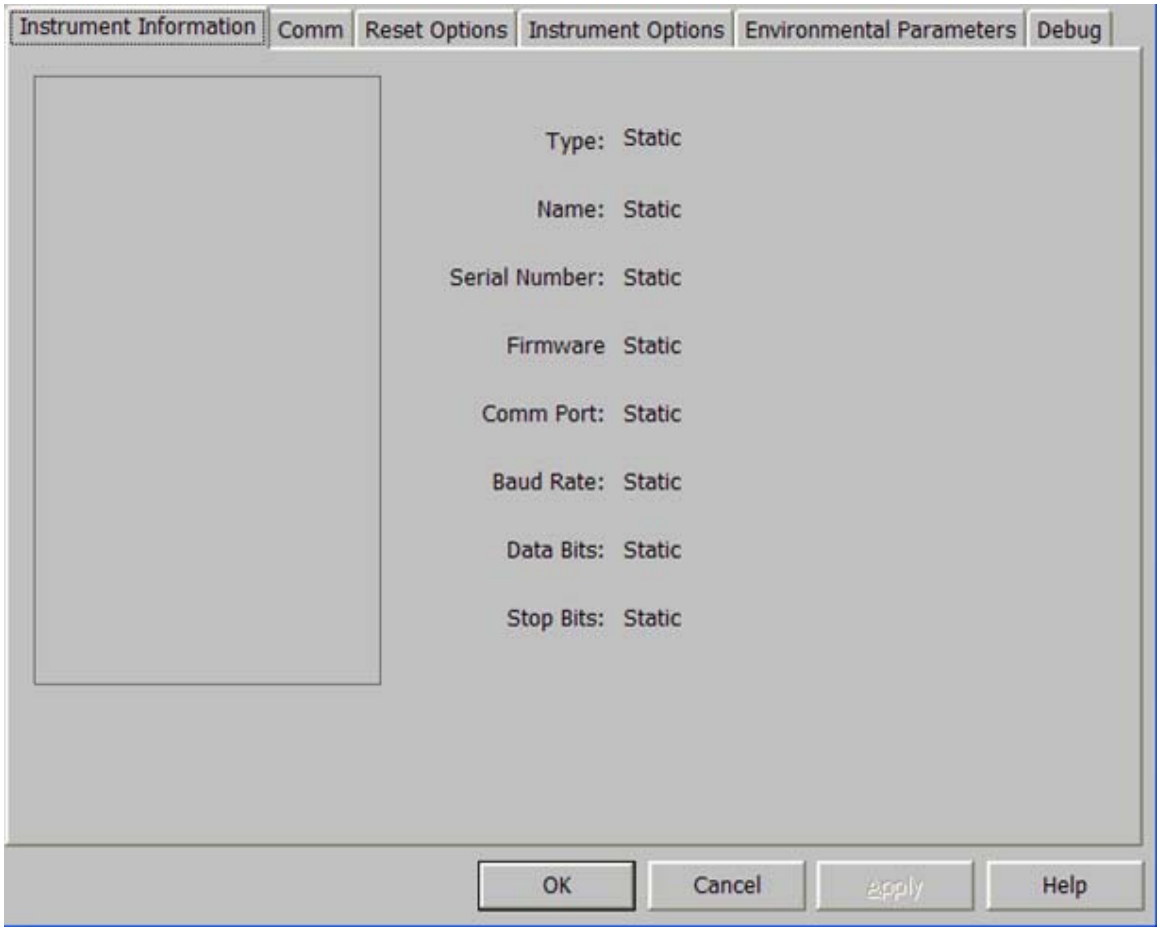
Note: Additional information for this interface is provided in the Machine Interface Installation Manual (MIIM).

Total Station Interface

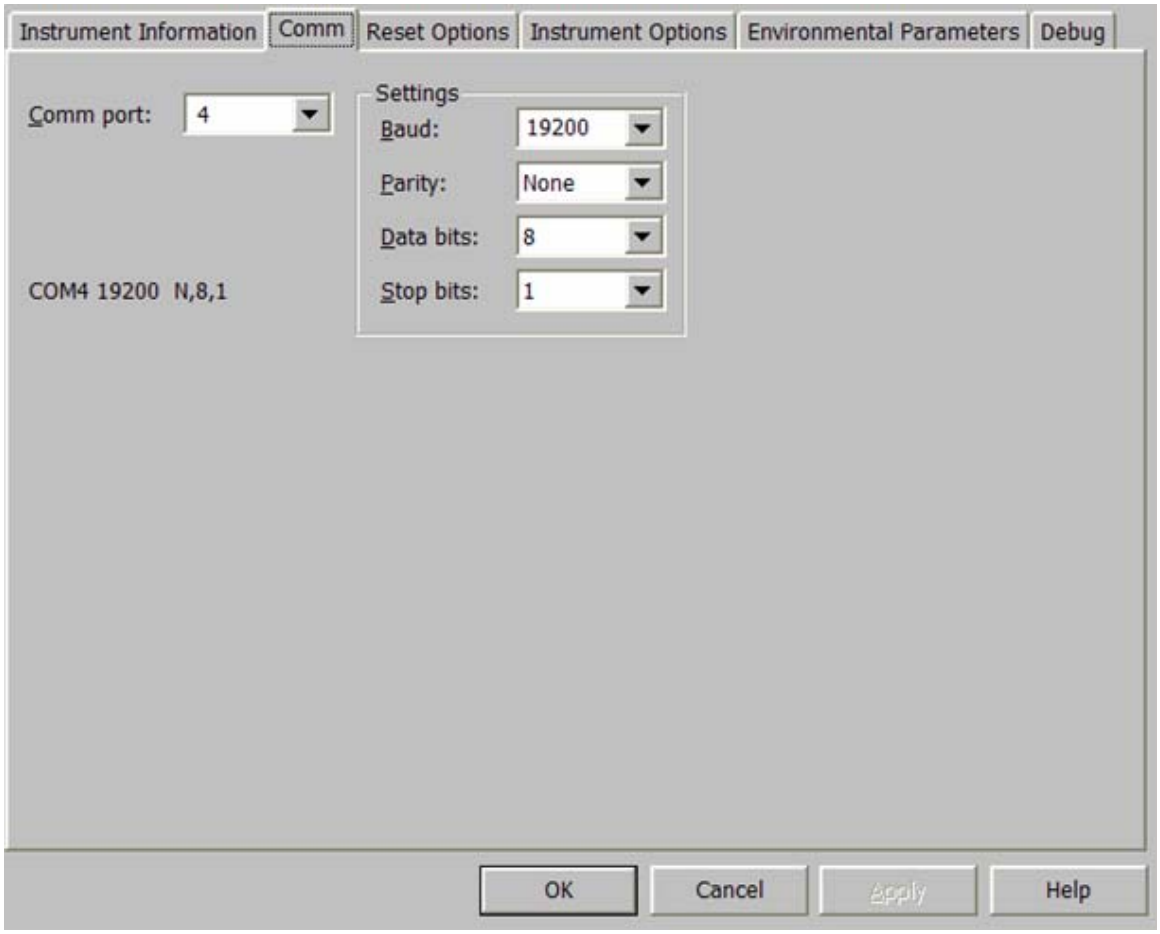
The parameters that control how PC-DMIS interfaces with the Total Station interface can be configured by selecting the **Edit | Preferences | Machine Interface Setup** menu item. This opens the **Machine Options** dialog box. The following tabs are available:

- Instrument Information Tab
- Comm Tab
- Reset Options Tab
- Instrument Options Tab
- Environmental Parameters Tab
- Debug Tab

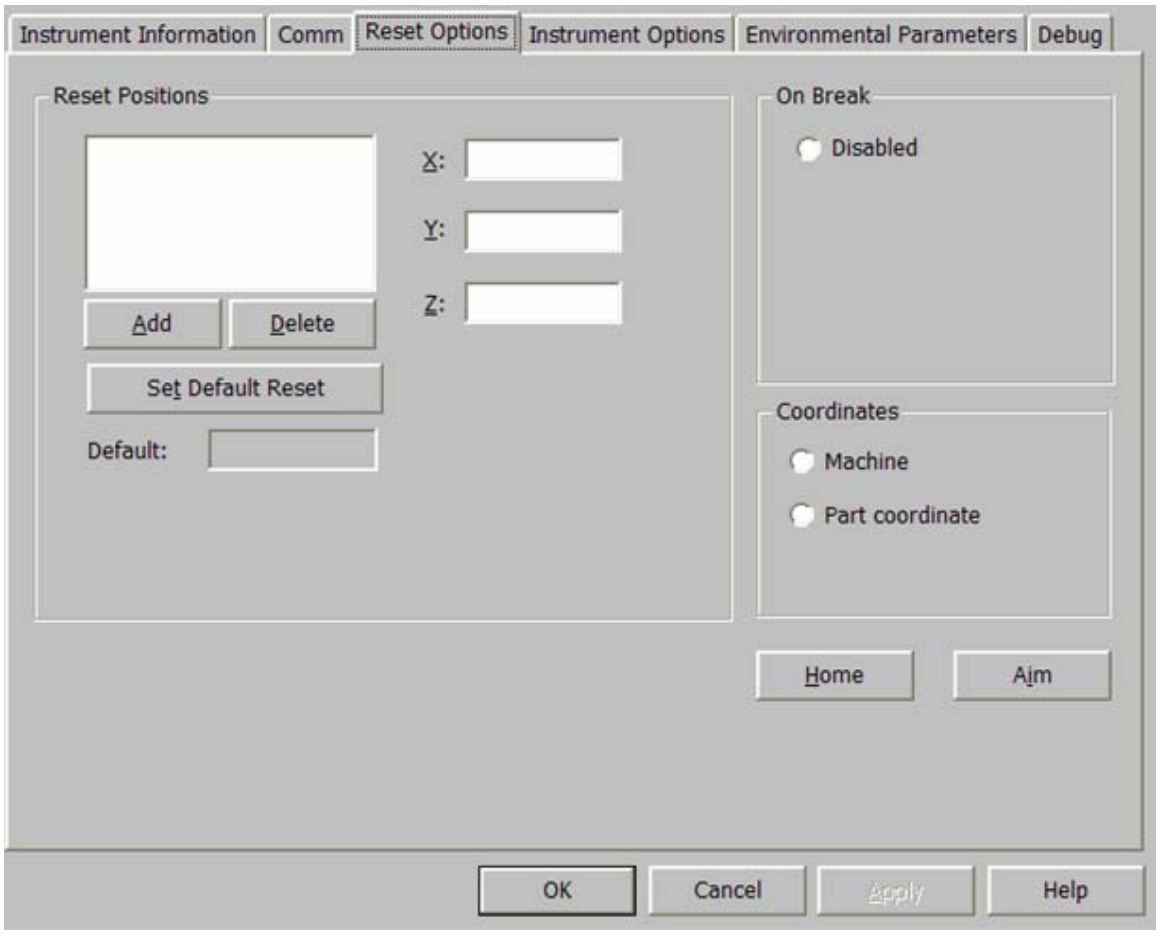
Instrument Information Tab



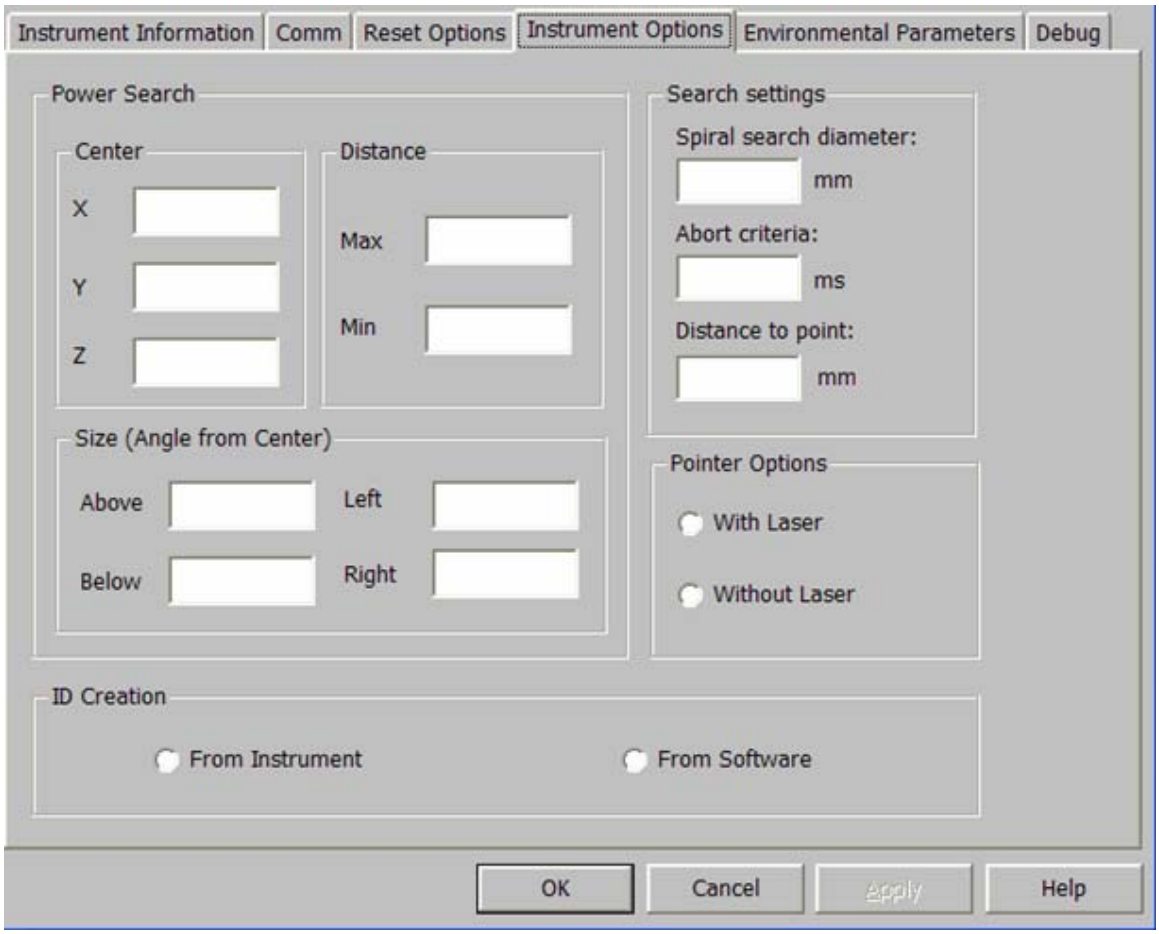
Comm Tab



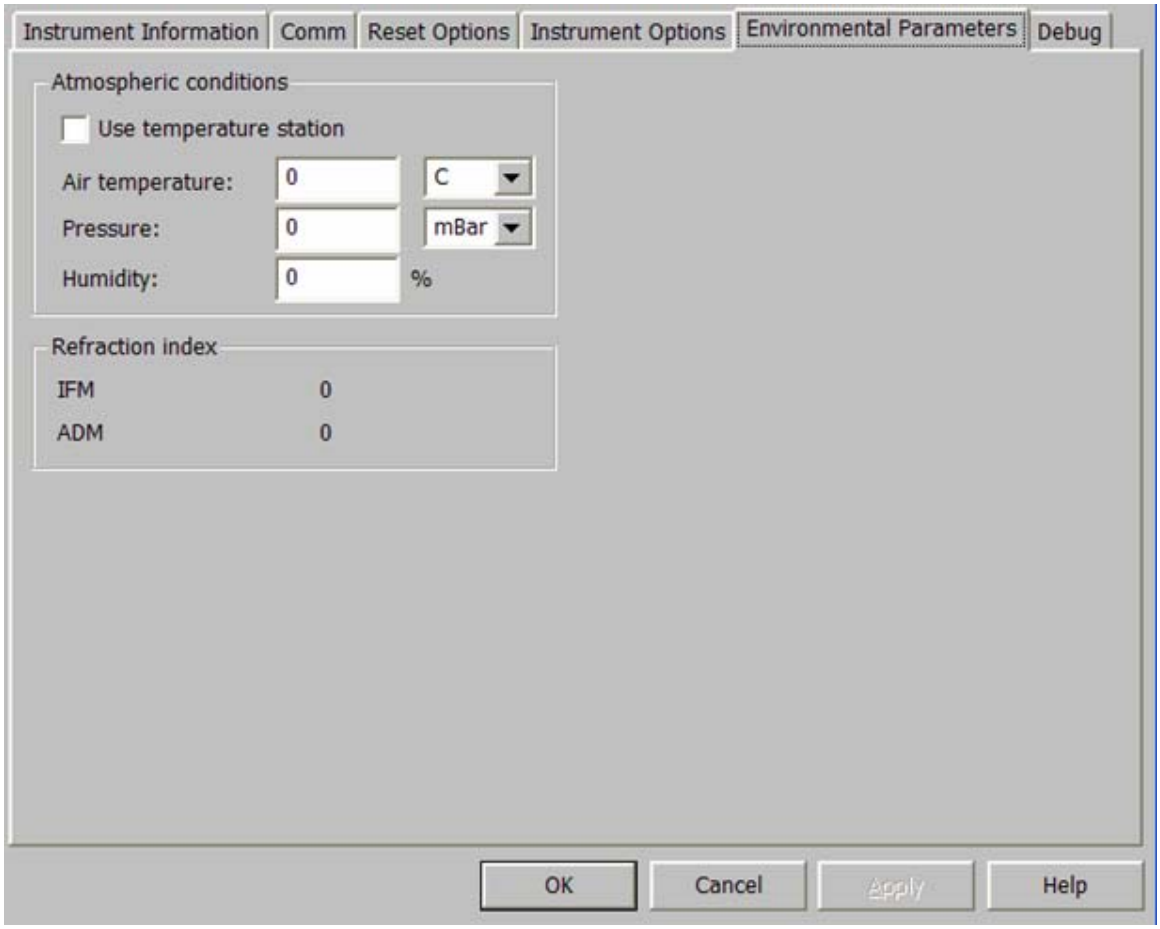
Reset Options Tab



Instrument Options Tab



Environmental Parameters Tab



Debug Tab

See the "Generating a Debug File" topic in the core PC-DMIS document.

Common Portable Functionality

Some PC-DMIS Portable capabilities are common among portable devices. This chapter provides information about this basic functionality. Common elements include:

- Importing Nominal Data
- Probe Compensation
- Using Hard Probes
- Probe Trigger Options
- Converting Hits to Points
- Edge Point Mode

Importing Nominal Data

PC-DMIS allows you to import nominal data of various types for the extraction of feature nominals.

Import the Following CAD Data Types:

- **Standard Formats:** DXF, IGES, SETP, STL, VDAFS, XYZ
- **Optional:** Catia 4, Catia 5, Parasolid, Pro-engineer, Unigraphics
- **Direct CAD (DCI):** ACIS, AIMS, CATIA, I-DEAS, Pro-engineer, Solidworks, Unigraphics

See "Importing CAD Data or Program Data" in the "Using Advanced File Options" chapter of the Core PC-DMIS documentation.

If you have **Inspection Planner** programmed on your portlock, you may also use the Generic Parser to import ASCII files. See "Using the Generic Parser to Import ASCII Files" in the Core documentation for more information.

Probe Compensation

To accurately measure hits, points are compensated from the center of the probe tip to the part surface. There are a couple of things that should be understood when measuring with a portable device.

- The XYZ values of the DRO (Digital Readout) are the 3D location of the CENTER of the probe.
- When probing a single point on a part, PC-DMIS compensates for the probe radius by doing using one of two methods:

    1. Probe Shaft: Monitoring the angle of the probe shaft and compensating along the vector of the shaft to the point location on the surface.
    2. Pulled Hit: Monitoring the direction of a "pulled hit" and compensating along the direction vector between the where the hit button was pressed and subsequently released.

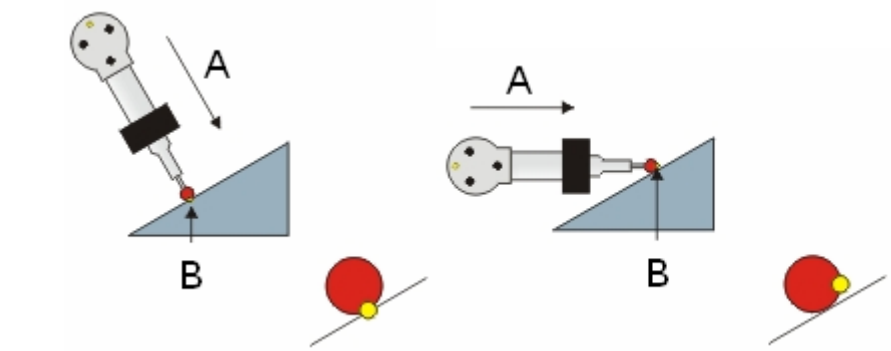
Normally, when measuring with portable CMMs with a hard probe, the probe's shank vector is used as the hit vector. However, due to the shape of a particular part, you may not be able to position the probe's shank to get a proper hit vector.

For example, if you want to measure a small, deep hole, but the end of the arm is too large to fit into that hole, you need to take "pulled hits" to get each hit vector to properly point towards the center of the hole, thereby determining the proper in/out compensation. Pulled hits are hits whose vectors match the direction pulled away from the hit location, not the default shank vector of the probe.

Probe Shaft Method

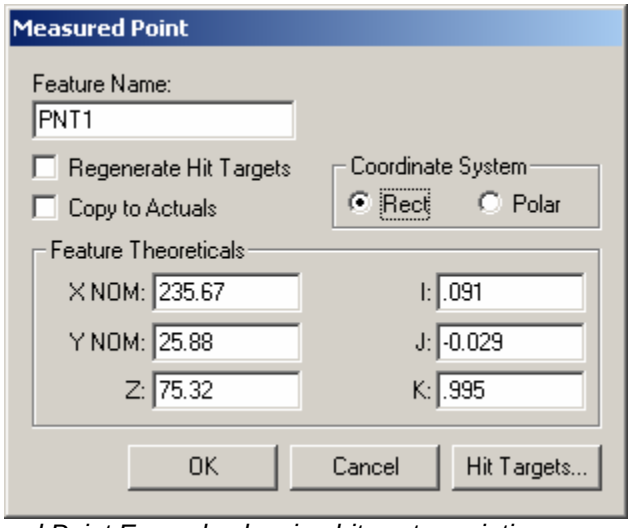
For a portable arm device, you would follow this procedure to measure a point on a top surface using the probe shaft for probe compensation:

1. Place the probe on the top surface with the probe shaft straight up (perpendicular to the surface) from the point location (B). The point will be compensated in the direction (A) of the probe shaft.



Correct Position *Incorrect Position*

2. Press the **Hit** button.
3. Press the **Done** button. Notice the measured point has been added to the **Edit Window.**
4. With the point high-lighted, press **F9** to open the **Measured Point** dialog box.



Measured Point Example showing hit vector pointing up.

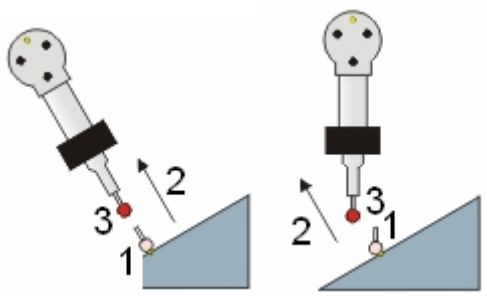
5. Notice the IJK values in the example are generally pointing up (0,0,1). These values should generally coincide with the surface vector at the points location.

Important: Care should be taken to hold the probe normal to (perpendicular) the surface when probing single points.

Pulled Hits Method

For a portable arm device, you would follow this procedure to measure a point using a "pulled hit" for probe compensation:

1. Place the probe on the surface at the point location (1). The probe shaft vector does not matter when performing a "pulled hit".



Either one of these examples will work for pulled hits

2. Press and hold the hit button long enough to get a pulled hit, but not so long that PC-DMIS starts scanning the part. To change the length of time to distinguish between "pulled hit" or "start scanning", you can modify the **`DelayToStartSendingScanPointsToManualHit`** registry entry using the PC-DMIS Settings Editor.
3. Move the tip in the direction of the vector (2) you want to send to PC-DMIS, away from the hit location. You must move it a distance equal to or greater than the defined vector distance (3). To define the minimum distance from the hit that you must move the probe for a pulled hit to be accepted, you can modify the **`VectorToIMM`** registry entry using the PC-DMIS Settings Editor.
4. Release the button. You will hear a different lower audible tone. Notice the measured point has been added to the **Edit Window.**
5. With the point high-lighted, press **F9** to open the **Measured Point** dialog box. Verify that the vector is following the PULL direction not the shaft direction.

Note: For Auto Features, the last hit vector determines the compensation direction. For Measured Features, the first hit vector determines the compensation direction.

Supported Interfaces

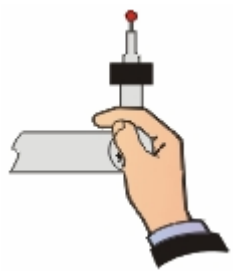
The following interfaces support pulled hits:

- Faro Interface
- Romer
- Axila
- SMXLaser (Faro tracker)
- Leica

Using Hard Probes

PC-DMIS Portable supports a variety of hard probes. The use and calibration of hard probes is similar to that of TTP probes.

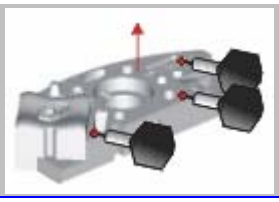
If a hard probe is selected, PC-DMIS expects a probe that does not automatically trigger when it comes in contact with the part. DCC calibration cannot be done using a hard probe. Verify that the correct probe type is selected.



When measuring with an arm machine, it is recommended to hold it such that the probe is between you fingers with the buttons accessible with your thumb.

When measuring geometric features (lines, circles, planes, etc.) the probe radius is compensated based on the resolved feature itself rather than the individually compensated points.

For example: If you are measuring a plane, the individual hit points that comprise the plane feature do not have to have to be measured with the probe shaft perpendicular to the surface of the feature.



PC-DMIS Portable monitors the probe shaft of the FIRST HIT when measuring a circle, cone, or cylinder to determine if you are measuring the inside diameter (ID) of the outside diameter (OD).

In most cases you cannot physically orient the probe exactly normal to the surface of an ID circle without interference from the other side of the circle feature. The probe should be tipped as much as possible toward the center of the circle to register an inside diameter circle and away from the center to register an outside diameter circle.

After measurement of an ID or OD circle, you can verify that PC-DMIS has correctly determined the circle type by pressing **F9** on the highlight feature in the **Edit Window**. Check the **Circular Feature Type** option.

Probe Trigger Options

Using Probe Trigger Options allows you to trigger a hit when certain conditions are met while using manual CMM machines. The interfaces that support probe trigger options include: **Romer**, **Leica**, **BackTalk**, **Faro**, **Garda**, **GOM** (Krypton), **Axila**, **Polar**, and **SMXLaser**.

Inserting POINT AUTOTRIGGER, PLANE AUTOTRIGGER, and POINT MANUAL TRIGGER commands into your part program can be done from the **Probe Trigger Options** tab of the **Parameters** dialog box (**Edit | Preferences | Parameters** or **F10**) or from the **Probe Mode** toolbar.

These trigger commands function with the following supported features:

- **Auto Features:** Circle, Ellipse, Edge Point, Round Slot, Square Slot, Notch Slot, and Polygon

- **Measured Features:** Circle, Line, and Round Slot

The available Probe Trigger options are:

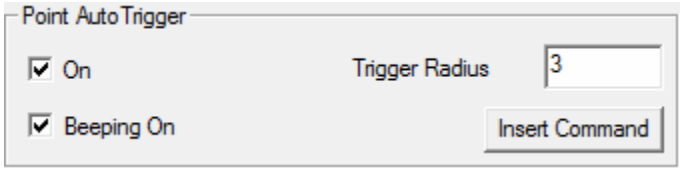
- Point AutoTrigger
- Plane AutoTrigger
- Point Manual Trigger

Point AutoTrigger

The POINT AUTOTRIGGER/ command tells PC-DMIS to automatically take a hit when the probe enters a tolerance zone at a specified distance from the original hit location. For example, if the tolerance zone, the Radius value, is set to 2 mm, a hit is taken when the probe is within 2 mm of the hit location.

You can use this option with manual machines; instead of pressing a button to take a hit, you can place POINT AUTOTRIGGER/ commands at any standard location in the Edit window.

You can add AutoTrigger commands from the **Point AutoTrigger** area of the **Probe Trigger Options** tab or by clicking the **Surface Auto Trigger Mode** button from the **Probe Mode** toolbar.



Point AutoTrigger area on the Probe Trigger Options tab

Note: In addition to the standard supported features (as noted in the "Probe Trigger Options" topic), the AUTOTRIGGER command supports the Auto Vector Point feature and the Measured Point feature.

On: Selecting this check box activates the POINT AUTOTRIGGER command. Commands in the Edit Window that follow the inserted POINT AUTOTRIGGER command will use the point auto trigger functionality as defined.

If you do not select this check box and you click the **Insert Command** button, PC-DMIS inserts the command line into the Edit Window but doesn't activate the command.

Beeping On: Selecting this check box activates a beeping sound associated with your POINT AUTOTRIGGER/ command. As you approach the target with the probe, beeps become more frequent.

Trigger Radius: The Radius box allows you to type a tolerance zone value. When the probe moves into this tolerance zone, it automatically and immediately takes a hit.

Insert Command: Clicking the Insert Command button inserts the POINT AUTOTRIGGER/ command into the Edit window for the current part program.

This command line reads:

```
POINT AUTOTRIGGER/ TOG1, TOG2, RAD
```

TOG1: This toggle field corresponds to the Point AutoTrigger **On** check box. It displays either ON or OFF.

TOG2: This toggle field corresponds to the **Beeping On** check box. It displays either ON or OFF.

RAD: The radius field contains the value for the tolerance zone, and it corresponds to the **Trigger Radius** box. This value is the distance from the actual point that PC-DMIS takes the hit.

Plane AutoTrigger

The PLANE AUTOTRIGGER/ command tells PC-DMIS to automatically take a hit when the probe passes the plane defined by the surface normal of a supported feature at the level of the defined depth. For auto features, this defined location will be adjusted based on options such as sample hits or RMEAS features. As the probe center passes from one side of the plane to the other, the probe will trigger and the hit will be taken.

You can use this command with manual machines; instead of pressing a button to take a hit, you can place PLANE AUTOTRIGGER/ commands at any standard location within the Edit window.

You can add TriggerPlane commands from the **Plane AutoTrigger** area of the **Probe Trigger Options** tab or by clicking the **Edge Auto Trigger Mode** button from the **Probe Mode** toolbar.

This command only works in online mode. If the AUTOTRIGGER/ command is used, it will take precedence over the PLANE AUTOTRIGGER/ command.

Plane AutoTrigger area on the Probe Trigger Options tab

Note on Faro and Romer Machines: As defined above, PC-DMIS will automatically take a hit when the probe passes the plane. However, if you are using a Faro or a Romer machine, the probe will not trigger again until you press the **Accept** button (or **Release** button). You must press this button after each registered hit in order to continue.

On: Selecting this check box activates the PLANE AUTOTRIGGER/ command. Commands in the Edit Window that follow the inserted PLANE AUTOTRIGGER/ command will use the plane auto trigger functionality as defined.

If you do not select this check box and you click the **Insert Command** button, PC-DMIS inserts the command line into the Edit Window but doesn't activate the command. The PLANE AUTOTRIGGER/ command will not function until the option is turned on.

Beeping On: Selecting this check box activates a beeping sound associated with your PLANE AUTOTRIGGER/ command. As you approach the target with the probe, beeps become more frequent.

Insert Command: Clicking the Insert Command button inserts the PLANE AUTOTRIGGER/ command into the Edit window for the current part program.

This command line reads:

```
PLANE AUTOTRIGGER/ TOG1,TOG2
```

TOG1: This toggle field corresponds to the **On** check box. It displays either ON or OFF.

TOG2: This toggle field corresponds to the **Beeping On** check box. It displays either ON or OFF.

Point Manual Trigger

The POINT MANUAL TRIGGER/ command tells PC-DMIS to only accept a manual hit when it is within the specified tolerance zone.

You can add POINT MANUAL TRIGGER/ commands from the **Point Manual Trigger** area of the **Probe Trigger Options** tab.

You can use this option with manual machines; when PC-DMIS prompts you to take a hit, trigger the probe as you wish. Each trigger will be evaluated to see if it is within the cylindrical trigger tolerance zone. If it is not, you will receive an error in the **Machine Errors** list of the **Execution Mode Options** dialog box. PC-DMIS will then ask you to take the hit again. You can place POINT MANUAL TRIGGER/ commands at any standard location within the Edit window.

This option only works in online mode.

Point Manual Trigger area on the Probe Trigger Options tab

Use Trigger Tolerance: Selecting this check box activates the POINT MANUAL TRIGGER/ command. Commands in the Edit Window that follow the inserted POINT MANUAL TRIGGER/ command will use the point manual trigger functionality as defined.

If you do not select this check box and you click the **Insert Command** button, PC-DMIS inserts the command line into the Edit Window but doesn't activate the command. The **Trigger Radius** capability is disabled until the option is turned on.

Trigger Radius: The **Trigger Radius** box allows you to type a tolerance radius value. When the probe is triggered, PC-DMIS will check to see if the probe is within this tolerance zone. If it is, the hit will be accepted. It is it not, you will be asked to take another hit.

Insert Command: Clicking the **Insert Command** button inserts the POINT MANUAL TRIGGER/ command into the Edit window for the current part program with the following options.

This command line reads:

```
POINT MANUAL TRIGGER/ TOG1, RAD
```

TOG1: This toggle field corresponds to the **On** check box. It displays either ON or OFF.

RAD: The radius field contains the value for the tolerance zone, and it corresponds to the **Trigger Radius** box. This value is the distance from the actual point that PC-DMIS accepts the hit.

Converting Hits to Points

You can cause PC-DMIS to receive a stream of points from the interface. To do this, hold down the **Take Hit** button on your portable device. This lets you quickly scan over a surface taking several points in a very short amount of time.

Once PC-DMIS receives the stream of points, it can do one of two things with them:

- **Create Individual Point Features**. If you are in Point Only Mode or if you have the Auto Feature **Vector Point** dialog box open, PC-DMIS will create individual point features from this stream of points.
  - To enter Point Only Mode, click **Point Only Mode** from the **Graphics Modes** toolbar.

  - To access the **Vector Point** dialog box, select the **Vector Point** from the **Auto Features** toolbar.
- **Guess the Feature**. If you are not in either of these mode the points will go onto the hits buffer and you will see the hit count increment on the Status Bar. When you finish measuring, the resulting feature depends on your settings and if Guess Mode is being used.

Edge Point Mode

Edge Point Mode allows for walk-up measurement of sheet metal features without using the Auto Features dialog box. The features generated using this mode are all Measured Features rather than Auto Features with two exceptions: If you are in point only mode, then PC-DMIS will create either an auto vector point or an auto edge point. An auto edge point will be created if you take your hit close to an edge and then slide it over the edge to complete the guiding.

For this mode to be enabled you must do the following:

- Program the **Sheet Metal** option into your portlock.
- Import a CAD model with surfaces for the part you are measuring.
- Select the **Find Nominals** check box from the **General** tab of the **Setup Options** dialog box.
- Specify the needed tolerance distance in the **Settings Editor** for the `DistanceToClosestEdgeToleranceInMM` value in the **Option** section. The default value is 5MM. Hits taken within this distance from the edge will initiate guided mode for completion of the edge point.

To measure points in Edge Point Mode:

1. Take measurements in Learn Mode within the tolerance (`DistanceToClosestEdgeToleranceInMM`) near the edge point location. PC-DMIS finds the nominals from the CAD model and checks to see if the hit is within tolerance. If the measurement is within tolerance, PC-DMIS will go into guided mode rather than storing the hit in the buffer.
2. In guided mode, slide the probe tip over the edge to complete the edge hit.
3. PC-DMIS will place the completed edge hit into the buffer in learn mode. This allows for the guessing of features as you measure.
4. If you didn't want an edge hit, press the end button and PC-DMIS will cancel guided mode and add the previous hit to the buffer.

Note: When creating features in Guess mode from edge hits; circles, lines, and slots will be 3D features.

To eliminate internal borders between surfaces for determining edges, use the `AdjacentEdgeToleranceInMM` in the **Option** section of the **Settings Editor**. This is useful in situations where the CAD model has gaps between surfaces. If the gaps are large, you may need to increase the default value of 0.1MM.

Edge Point Mode also uses *half* of the thickness value from the **Auto Feature** dialog box to determine the depth. Normally, you only need to set this once to the part thickness and then close the Auto Feature dialog box. This value is written to the registry.

Note: Edge Point Mode is designed for portable devices, but will work with any device with a hard probe.

Using a Romer Portable CMM

This section discusses the configuration and general usage of your Romer Portable CMM with PC-DMIS. Refer to documentation provided by Romer for detailed information on configuring and using your Romer arm.

- Romer Portable CMM: Introduction
- Getting Started
- Configuring a Perceptron Contour Sensor
- Calibrating a Romer Hard Probe
- Calibrating the Perceptron Sensor
- Using Romer Arm Buttons
- Using a Romer Laser Sensor

Romer Portable CMM: Introduction

Romer Portable CMMs are articulated arm machines used to measure parts using either a hard probe or Perceptron laser probe.

PC-DMIS uses WinRDS to interface with your Romer arm. Please refer to the WinRDS documentation for detailed information for configuration and usage of your portable arm. The latest WinRDS software is available from the Wilcox FTP site at ftp://ftp.wilcoxassoc.com/Hardware/Portable/Romer/.

Note: To use a Romer arm device with PC-DMIS you must have your portlock programmed with the **Romer** interface option. You may additionally need to have the **Laser Probe** option with the "Perceptron" **Probe Type** programmed if you are using a Perceptron probe on a Romer arm.

Important: The **Rotary Table** portlock option MUST NOT be selected when you are using a portable device since it will cause problems with your portable device.

The information provided in the topics in this chapter were written specifically for Romer arms, but may be relevant to non-Romer arms.

Getting Started

There are a few basic steps that you should take to verify that your system has been properly prepared before beginning the measurement process with your portable arm.

If you plan to use a Perceptron Contour sensor with your Infinite arm, then you will also needs to follow the steps outlined in the "Configuring a Perceptron Contour Sensor" topic.

This section contains supplemental material to the standard WinRDS documentation for your Romer Infinite Arm. For additional setup information please consult the WinRDS documentation and Perceptron Contour sensor documentation.

To configure your Romer Infinite arm follow these steps:

- Step 1: Set Up the Romer Infinite Arm
- Step 2: Set WinRDS Environment Variables
- Step 3: Install PC-DMIS for Romer

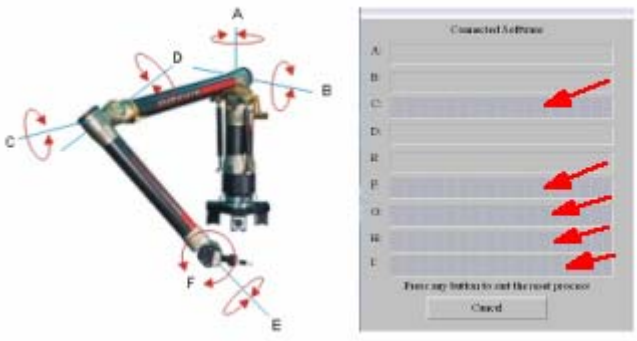
Step 1: Set Up the Romer Infinite Arm

1. Mount the fixturing base to a stable platform using the mounting screws or magnetic chucks.
2. Place the arm on the fixturing base by screwing the large threaded ring at the base of the arm to the fixturing base.
3. Once the arm is securely mounted, plug in the power to the arm and verify the power comes on. Turn off the arm until step 6.
4. Install WinRDS (version 2.3.5 or later) if it has not already been installed on the computer. WinRDS 3.1 is available via this link: ftp://ftp.wilcoxassoc.com/Hardware/Portable/Romer/RDS/. Installing WinRDS will place two icons on your computer desktop; One is called **Cimcore Arm Utilities** and the other **Quick Check Tools**.

Note: WinRDS versions earlier than 2.3.5 are not adequately supported for use with Perceptron Contour sensors.

Important: There are two ways of communicating with the Infinite arm. 1) via USB connection, 2) via wireless connection if your computer has a wireless Network Interface Card (NIC). Because of the high communication speed required by laser scanners, it is preferred that you connect your computer to the Infinite arm via the USB port when using a Perceptron Contour Sensor. Wireless communication is not covered in this document. If you want to connect via the wireless, please see your **Infinite Setup Guide** and other documentation installed with the WinRDS installation.

5. Plug in the USB connector into one of the USB ports on your computer (or verify Wi-Fi communication if you are not using a Perceptron Contour sensor).
6. Start up the arm by toggling the power switch. If you are running Window 2K or Windows XP, your computer will detect the connection and ask you if you want to install the USB drivers for the arm. Go ahead and install the USB drivers.
7. Once the driver installation is complete, double click the **Cimcore Arm Utilities** icon on your desktop. This will launch the **Arm Utilities** application. When the application starts up, it will automatically try to connect to the machine. If the machine is connected properly, it will connect to the arm and ask you to reset the axes. If there are problems, please consult the WinRDS and Cimcore documentation.
8. To reset the axes, move all of the joints on the arm until each of the joints are zeroed out. As each axis is zeroed out the corresponding axes bar graphs will fill as shown below. When all the axes are homed (zeroed out) the dialog box will automatically close.



At this point the machine is connected and ready to work.

Step 2: Set WinRDS Environment Variables

There is one last step to work with PC-DMIS. If you are using a version of WinRDS prior to version 5.0, you will need to set the WinRDS directory in the path of the computer. To do this, follow these steps:

1. Open the **Control Panel** by clicking the **Start** button and selecting **Control Panel**.
2. Double-click the **System** icon to open the **System Properties** dialog box.
3. Select the **Advanced** tab.
4. Select the **Environment Variables** button.
5. In the **System Variables** section of the **Environment Variables** dialog box, scroll down until you see *Path* on the left. Select *Path* from the list and select the **Edit** button.
6. Go to the end of the **Variable Value** line and add a semicolon (;) followed by the path of the WinRDS installation (i.e. c:\Program Files\CIMCORE\WinRDS)
7. Click **OK** on the **Edit System Variable** dialog box, click **OK** on the **Environment Variables** dialog box and click **OK** on the **System Properties** dialog box.

At this point you can launch PC-DMIS. You may get a message saying “Retrieving arm specs from the machine” depending on how you have configured WinRDS. This setting can be changed through the Arm Utilities program.

Step 3: Install PC-DMIS for Romer

Once you have verified connection of the PC to the arm, install PC-DMIS by doing the following:

NOT using a Perceptron Laser Sensor

1. Your portlock should have already been programmed with the **Romer** interface option <u>before</u> installing PC-DMIS.

Note: If ***All interfaces*** is programmed inyour portlock (like a demo dongle), you will need to manually rename Romer.dll to interfac.dll. Romer.dll is found in the PC-DMIS install directory.

2. Install PC-DMIS. PC-DMIS is now ready to use.

ARE using a Perceptron Laser Sensor

1. Your portlock should have already been programmed with the **Laser Probe**, **Perceptron,** and the **Romer** interface options before installing PC-DMIS. If you don't have **Laser** and **Perceptron** specified in the portlock, you will not have the necessary Perceptron files as indicated below. Additional files will be installed that are required by WinRDS when you install PC-DMIS.

Note: If ***All interfaces*** is programmed inyour portlock (like a demo dongle), you will need to manually rename Romer.dll to interfac.dll. Romer.dll is found in the PC-DMIS install directory.

2. Install PC-DMIS. Do not run PC-DMIS at this point.
3. Verify that the *probe.8* file has been installed in your ArmData directory (usually c:\Program Files\CIMCORE\WinRDS\ArmData). This file should be installed by PC-DMIS during the install process as long as your port lock is programmed correctly. The *probe.8* file is used by WinRDS as the identifier for the Perceptron Contour sensor. If you do not have a copy of this file, make sure that you contact your PC-DMIS distributor.
4. Continue to the "Configuring a Perceptron Contour Sensor" section.

Important: The **Rotary Table** portlock option MUST NOT be selected when you are using a portable device since it will cause problems with your portable device.

Configuring a Perceptron Contour Sensor

This section discusses the configuration of your Perceptron Contour sensor once you have configured you Infinite Arm outlined in the "Getting Started" section.

To configure the Perceptron Contour sensor follow these steps:

- Step 1: Connect the Perceptron Sensor Controller Box
- Step 2: Configure the Network Card
- Step 3: Attach Your Contour Sensor
- Step 4: Complete the PC-DMIS Configuration
- Step 5: Verify Sensor Installation

Step 1: Connect the Perceptron Sensor Controller Box

The connection to the Perceptron Sensor controller box requires a dedicated Network Interface Card (NIC). You will need to use the integrated NIC on your computer or purchase an additional NIC because the Perceptron requires a dedicated NIC for communication with their Perceptron Sensor controller box.

Important: A USB NIC is not sufficient for this connection. If you are using a desktop computer, you will need an additional PCI NIC or if you are using a laptop, you will need a PCMCIA NIC.

To Connect Your Perceptron Sensor Controller Box:

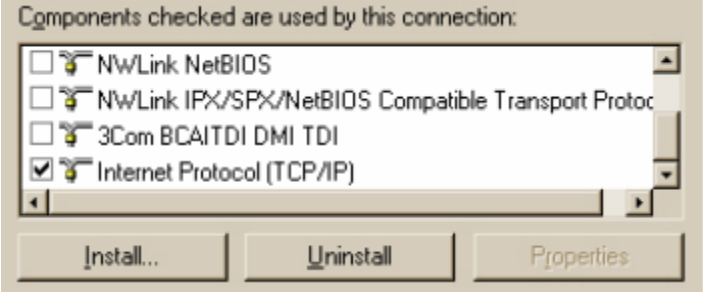
1. Remove the cap on the back of the Infinite Arm labeled "SCANNER".
2. Take the sensor cable from the Perceptron box and plug it into the "Sensor" connector on the Perceptron controller box. Plug the other end into the "SCANNER" connection on the back of the arm.
3. There may be a small pig-tail that comes off of the end plugged into the Perceptron controller box depending on what version of Perceptron controller you have. If you have a pig tail, plug the pig tail into the connector marked "Trigger".

4. On the other side of the Perceptron controller box, connect a crossover RJ45 cable. Connect the other end to the dedicated NIC on the computer.

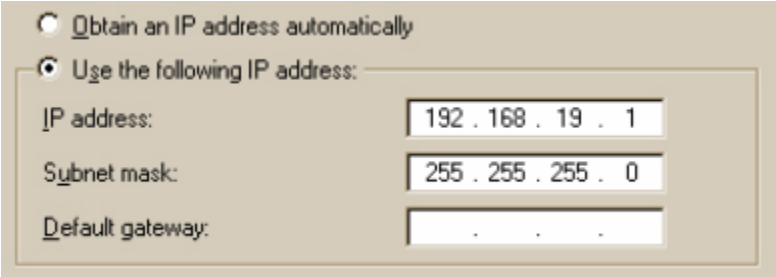
Step 2: Configure the Network Card

In order to communicate with the Perceptron controller box you will need to configure your dedicated NIC following these steps:

1. Open the **Control Panel** by clicking the **Start** button and selecting **Control Panel**.
2. Double-click the **Network Connections** icon to view the current Network Connections.
3. From the list of **LAN or High Speed-Internet**, double click on the name of the NIC connected to the Perceptron controller box.
4. Click **Properties** on the **General** tab.
5. Unselect all items except **Internet Protocol (TCP/IP)** by clicking in the check box next to any of the items that are currently checked. This should leave the list with only Internet Protocol checked.



6. Highlight **Internet Protocol** by selecting the text (not the check box) and select **Properties**.
7. On the **General** tab of the **Internet Protocol (TCP/IP) Properties** dialog box, select the radio button labeled **Use the following IP address** and type the following values as shown in the image:



- **IP address**: 192.168.19.1
- **Subnet mask**: 255.255.255.0

8. Click **Advanced** to open the **Advanced TCP/IP Setting** dialog box.
9. From the **Advanced TCP/IP Settings** dialog box select the **WINS** tab.
10. Select the **Disable NetBIOS over TCP/IP** option in the **NetBIOS setting** area.
11. Click **OK** on the **Advanced TCP/IP Settings** dialog box, click **OK** on the **Internet Protocol (TCP/IP) Properties** dialog box and then click **OK** on the <dedicated NIC> **Properties** dialog box.

Step 3: Attach Your Contour Sensor

1. Mount the Contour sensor to the wrist. If you are using a seven axis infinite, you will need to mount the sensor in the mount that is in the axis of the seventh joint.
2. Turn on the Perceptron Sensor controller box by pressing the power button located close to the power connector and the trigger connector. This is not to be confused with the sensor power rocker switch located on the same side of the controller box. The boot sequence for the controller box may take as long as two minutes. You will know when the boot cycle is complete because the green Ready LED will be lit.
3. When the boot cycle is complete, turn the sensor power rocker switch to the on position. This will provide power to the sensor. You can verify that the sensor has power by looking at the three LED's on the side of the sensor head. The LED's labeled +12V and +5V should be lit. If they are not on, check the power on the sensor controller box and the sensor cable. The LED marked LASER only comes on when scanning.
4. With the power on, browse to the Perceptron sub-directory inside the PC-DMIS install directory. Double click on the WinSen application. This is a diagnostic application provided by Perceptron. When the application is launched it will try to establish communication with the sensor. If successful you should receive several messages with Status=0x00000000 (All OK). You should also see a line indicating the sensor ID. If there is no sensor ID, there is no communication with the sensor.
5. Point the sensor at something and then select the **Image | Live Sensor Display** menu item. You should then be able to see (if you are within the cameras field of view) the live camera image of the part you are scanning. You should also see a red laser stripe projected onto the part.
6. Once you are satisfied the system is working correctly, close WinSen.

Note: The sensor cannot communicate with two different host applications at the same time. When you run PC-DMIS you must make sure that WinSen or any other application that communicates with the sensor controller is off.

Step 4: Complete the PC-DMIS Configuration

You are now ready to start PC-DMIS. After launching PC-DMIS, open a new part program and follow these steps to complete the configuration:

1. Open the **Setup Options** dialog box by pressing **F5**.
2. Select the **Laser** tab.
3. Type the path to the CSGMain.bin file in the **Sensor Binary File** edit box. This is normally installed with PC-DMIS into the Perceptron subdirectory of the main PC-DMIS installation. Alternatively, you can use the **Browse** button to locate this file.
4. Click **OK** on the **Setup Options** dialog box.

To verify that the sensor is working in PC-DMIS, close down PC-DMIS and restart. This will ensure that all necessary information is written to the system registry.

Step 5: Verify Sensor Installation

1. Start PC-DMIS and open the original part program created in the previous step. PC-DMIS should be able to identify the probe that is currently on the system. Once you have a

probe in your part program, you will see the **Live View** tab in the Graphics Display Window of PC-DMIS. It allows you to see real time data that is collected by the sensor.

2. Switch to the **Live View** tab. It might take ten or twenty seconds to initialize the sensor so be patient. You should see a slightly skewed green trapezoid in the center of the window with a cross hair about two thirds the way to the top of the trapezoid. If you see anything else, PC-DMIS was unable to connect to the sensor and should give you an error message. If this happens, it usually means that the contour.dll file did not register correctly during installation. See the "Contour.dll Registration" topic.

Note: Another potential problem is duplicate CSGMain.bin files. Verify that there are no other copies of the CSGMain.bin file. If you do not have the correct version of CSGMain.bin, the sensor will not initialize. Delete (or rename) any other CSGMain.bin files not in the current install of PC-DMIS.

3. Press the **Live View** button to start the scanner striping. The live image should update with the data being collected by the scanner. You can now use your scanner in PC-DMIS.

Note: If you are still having problems, call PC-DMIS support.

For additional information on how to use the scanner in PC-DMIS, please consult the PC-DMIS Laser online help.

For additional information on the Perceptron system, see the Perceptron documentation included with your PC-DMIS installation in the Perceptron sub-directory.

Contour.dll Registration

To Manually Register the Contour.dll:

1. Check that the power on the Perceptron Sensor controller box is on as well as the power to the arm.
2. Open a command window (DOS prompt) and change to the Perceptron directory. This is a sub-directory of the main PC-DMIS install directory.
3. Type the following on the command line “regsvr32 contour.dll”. After a few seconds you should get a message saying “Contour.dll registered successfully”.
4. If the file does not register successfully, contact PC-DMIS support. Otherwise, restart PC-DMIS.

Calibrating a Romer Hard Probe

Calibration of a Romer Infinite probe is accomplished via the WinRDS software. PC-DMIS interfaces with WinRDS to acquire probe calibration data. Follow the steps found in the **Arm Utilities User Guide** document to calibrate your probe.

Perceptron Contour sensors are calibrated using the PC-DMIS **Probe Utilities** dialog box. See the "Calibrating a Perceptron Contour Sensor" topic for information on how this is done.

Calibrating the Perceptron Sensor

Once you have configured your Perceptron sensor, complete the following steps to calibrate your laser probe:

Before You Begin

Exposure and Gray Sums During Calibration

Before you start calibrating your laser probe, be aware that PC-DMIS will automatically set the exposure to the default calibration value of 300 and the gray sums to the default calibration values of 10 for the minimum and 300 for the maximum. These values work best for most calibration scenarios. Your original exposure and gray sums values will be restored once the process finishes. While gray sums with values of 10, 300 are often appropriate for calibration, values of 30, 300 are typical for normal scanning.

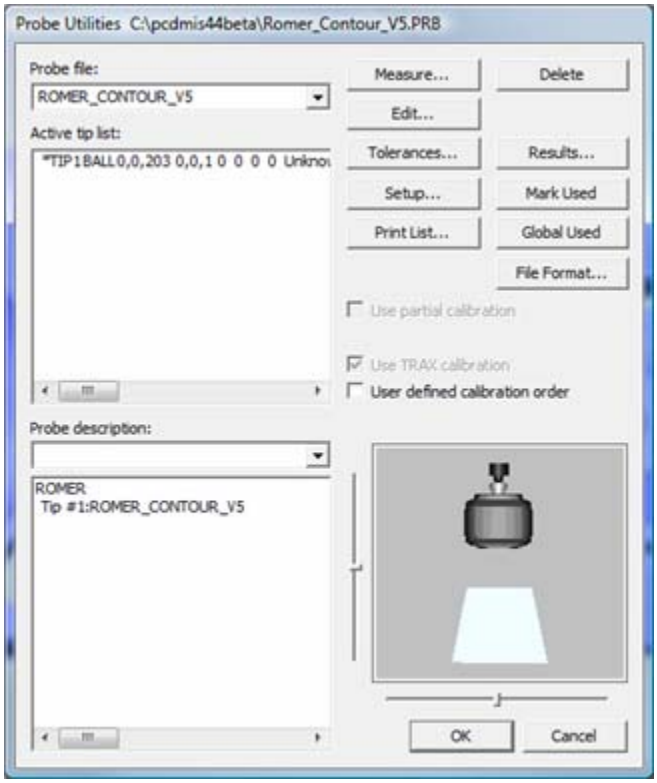
Exposure for Rare Lighting Conditions

An exposure value of 300 is sometimes not sufficient in rare lighting conditions, such as V4i in a sodium lighting environment. If, due to such lighting conditions, it appears that PC-DMIS has trouble accepting the laser arcs during the calibration process, you may need to lower the default calibration exposure to a value close to 200. To do this, use the PC-DMIS Settings Editor, and modify the `PerceptronDefaultCalibrationExposure` registry entry, located under the **NCSensorSettings** group accordingly.

See the Laser documentation for information on exposure and gray sums.

Step 1: Define the Laser Probe

1. Open an existing part program, or create a new one.
2. Select the **Insert | Hardware Definition | Probe** menu option to open the **Probe Utilities** dialog box (this dialog box will automatically appear whenever you create a new part program.)



Probe Utilities dialog box

3. Define a probe configuration that uses the **CONTOUR** probe and the appropriate Romer arm inside the **Probe Utilities** dialog box. The type of Perceptron Contour probe is specified in the **SetUp Options** dialog box.

Step 2: Calibrate the Laser Probe

The calibration process described in this step will vary depending on the type of "Measure Laser Probe Options" and the type of installed interface. Refer to the "Measure Laser Probe Options" topic for detailed information on calibration options. The following steps outline the procedure that would be used when you are first calibrating your laser probe:

1. Once the tip is defined in Step 1, click **Measure** from the **Probe Utilities** dialog box. This opens the **Measure Laser Probe Options** dialog box.
2. Click **Measure** to begin the calibration procedure. If you are NOT using a Perceptron V5 sensor, skip to step 5. If you are using a Perceptron V5 sensor you will first be prompted to scan the entire range of the laser's Z depth on a flat target.
3. Measure the Z-depth of your V5 sensor by doing the following:

a. Place a white piece of paper on a flat surface where you will perform the flat target calibration.
b. Hold the V5 sensor close to the flat surface so the scan line is beyond the laser's projected grid box.
c. Press and hold the sensor's trigger while moving away to the full extent of the laser's range such that the laser line crosses the grid box to the other side.
d. Release the trigger. This completes the flat target calibration.

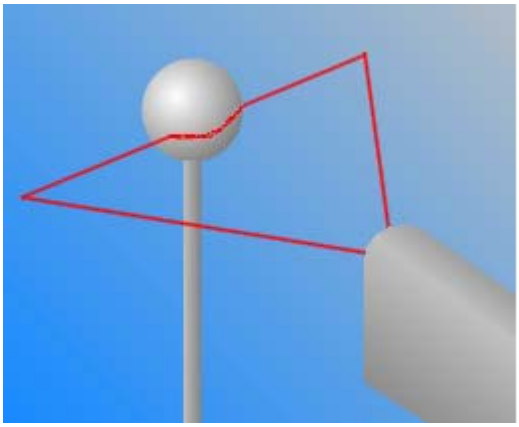
4. Follow any on-screen instructions and visual indicators from the **Laser View** to complete the sensor calibration on the calibration sphere.

. You will be prompted to move the probe to 15 different locations on the calibration sphere (5 different positions around the sphere with three different fields at each position). The laser probe will continually be probing, but it will only accept a stripe of data when *certain criteria* are met. The system needs 5 stripes of data at each of the *15 different locations* to complete the calibration. When calibrating in the three fields ("far", "left", and "right") for the 5 different positions, be sure to take a hit (laser stripe) at both of the tropics (indicated as "Band 1" and "Band 2"). Also, when probing at 0, 120, and 240 degrees around the equator, favor the lower part of the sphere by taking 2 stripes on the lower location and only 1 on the upper location. This is because additional data will be taken during sets 4 and 5 which occur on the top of the sphere.

Graphical Depiction of the Different Probing Locations

- *5 Positions* around the sphere:

  Position 1: The laser stripe should be horizontal along the side of the sphere as in the image below.



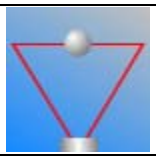
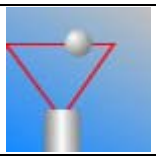
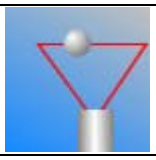
  Position 2: Rotate the sensor 120 degrees around the sphere from Position 1.

  Position 3: Rotate the sensor 120 degrees around the sphere from Position 2.

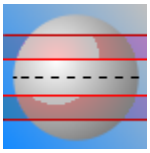
  Position 4: Point the sensor straight down on the top of the sphere.

  Position 5: Point the sensor straight down on the top of the sphere with the laser stripe located 90 degrees from Position 4.

- *3 Sensor Fields* (Far, Right, and Left) within the laser's range:

		
Field 1: Far	**Field 2:** Right	**Field 3:** Left

- *2 Bands* on the sphere's surface. Hold the probe within either of these bands for five stripes.



Band 1: 20 Degrees *above* the equator (mid-line) of the sphere.

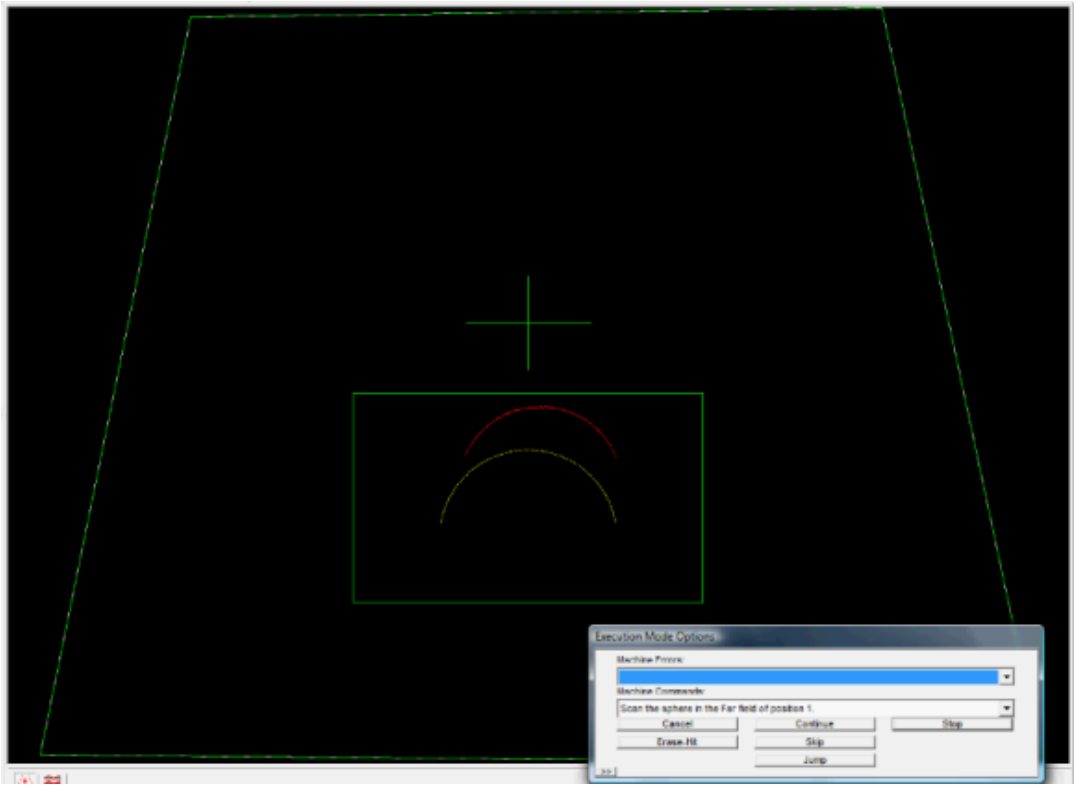
Band 2: 20 Degrees *below* the equator (mid-line) of the sphere.

Criteria for an Acceptable Stripe:

- The probe must not be against the hardstop of the arm.
- The stripe must be comprised of more than 100 points.
- In the **Laser View**, the laser's red arc must be inside the green rectangular area that bounds the yellow arc.
- The solved circle which is created by the laser's arc must have at least 100 degrees of arc angle, the difference between the starting vector and the ending vector of the arc.
- The laser must probe a diameter of .875 multiplied by the theoretical diameter of the calibration sphere. This means it should probe between 81.9% and 96.6% of the theoretical diameter.
- The probe must remain motionless. It should not move more than 1.5 mm over the last 5 probings.

a. For each hit (or laser stripe) of the calibration, use the **Laser View** to align the red arc of the laser with the yellow arc (representing the sphere's theoretical arc) so the form and size match as close as possible.

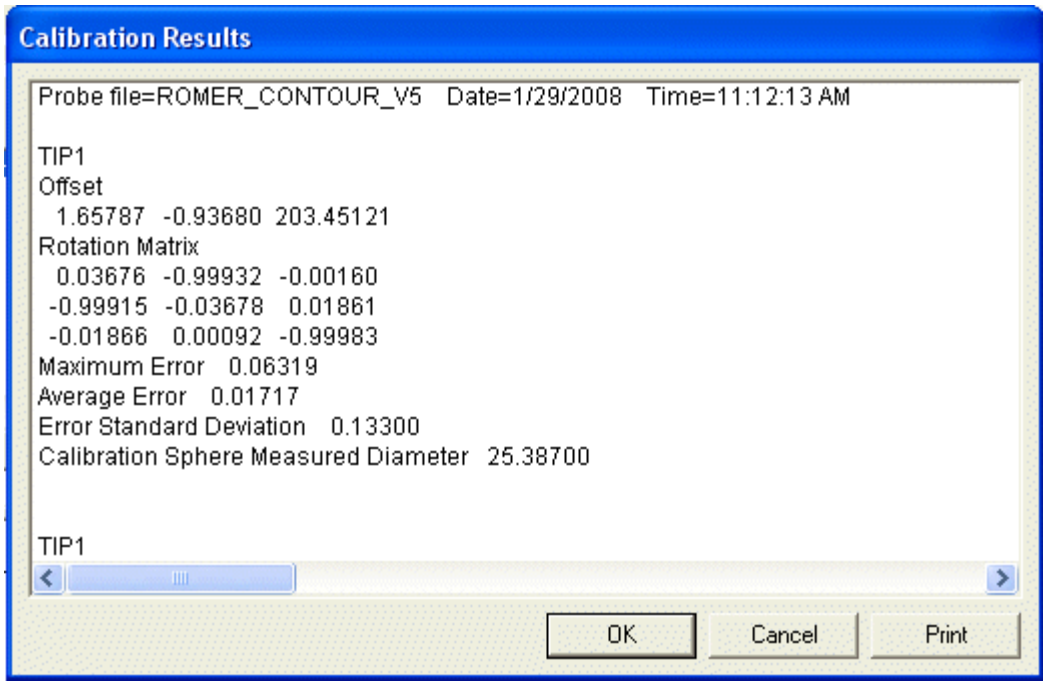
b. Move the laser's red arc so that it remains within the green rectangular box surrounding the yellow arc. As you position the laser's arc on top of the yellow arc, an audible beeping sound increases in frequency and pitch. This helps you know when you are approaching the desired location.



d. Hold the laser probe motionless at the appropriate location until the various criteria are met. PC-DMIS will automatically accept the stripe, and prompt you to probe at a new location.

Step 3: Check the Calibration Results

Click on the **Results** button in the **Probe Utilities** dialog box. The **Calibration Results** dialog box appears.



Calibration Results

PC-DMIS records several things from the calibration in this dialog box. Take a look at the maximum, average, and standard deviation values. The **Average Error** should be around 0.05mm. The **Maximum Error** should be around 0.15mm.

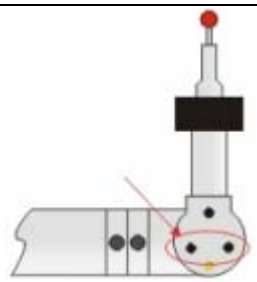
If the results look correct, click the **OK** button to close down the **Calibration Results** dialog box.

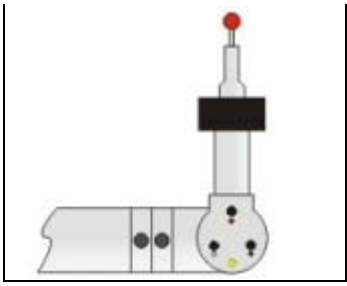
You are now done setting up and calibrating your laser probe. You should now have access to all laser-related functionality.

Note: If the calibration exceeds the tolerance value defined in the standard_deviation_limit registry entry, PC-DMIS adds a line of text that says, "Standard deviations for the probe calibration exceed limit" in the **Calibration Results** dialog box

Using Romer Arm Buttons

There are two types of button configurations that exist:

	**Two Button Configuration:** 2 Buttons are programmed for use by PC-DMIS (even though 3 buttons exist). The two buttons indicated in the image to the right perform the same function. See "Two Button Configuration"

	**Three Button Configuration:** 3 Buttons are programmed for use by PC-DMIS. The buttons have color coded dots. See "Three Button Configuration"

Mouse Mode

PC-DMIS lets you place your portable device into "Mouse Mode". This special mode lets you perform standard mouse pointer actions (move the pointer, click or right-click, etc.) inside PC-DMIS by moving the arm and probe head around and pressing buttons to perform mouse "clicks". PC-DMIS interprets the motion as if you were using a standard mouse. This allows you to remain with your portable device rather than continually switching between device and computer.

If PC-DMIS is in Mouse Mode and you attempt to pick up and use your regular mouse, it will behave erratically. You should exit out of this mode prior to using your standard mouse functionality.

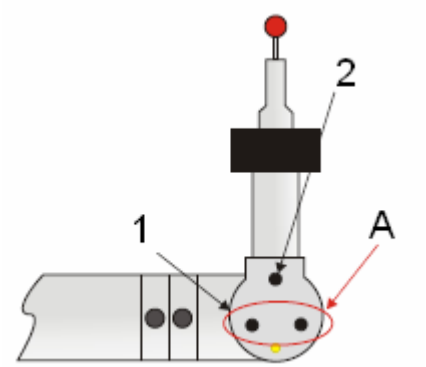
Mouse Mode functions outside of PC-DMIS but only if PC-DMIS remains running and minimized in the background.

See the "Two Button Configuration" and "Three Button Configuration" topics for more information on how mouse mode is used.

Two Button Configuration

The two modes for a two button configuration are discussed below:

Measure Mode



The following Measure Mode functions are available for the buttons indicated above:

1: DONE - Press < 1 second.

1: ERASE last hit - Hold > 1 second.

1: OPEN DRO - Hold > 1 second when there is no hit in the buffer.

1: TOGGLE DRO - Hold > 1 second when the DRO is already open. XYZ **<->** XYZT. The "T" value is displayed.

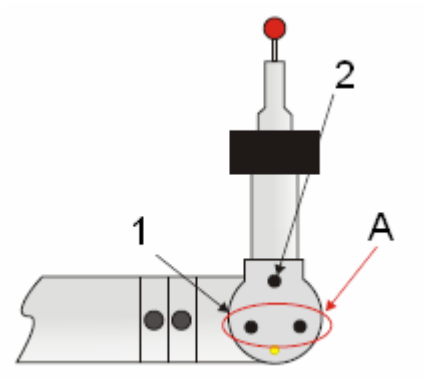
2: HIT POINT - Press < 1 second.

2: PULLED HIT -Press, pull back, release with 1 second. See "Using Pulled Hits for Probe Compensation"

2: SCAN - Press, hold > 1 second, drag.

A: Buttons indicated by a circle with a red arrow perform the same function.

Mouse Mode



The following Mouse Mode functions are available for the buttons indicated above:

1: Mouse **RIGHT** Button - Used for popup menus.

1: PAN - Press and hold on the CAD model.

2: Mouse **LEFT** Button - Used for screen selections.

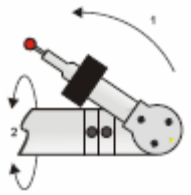
A: Buttons indicated by a circle with a red arrow perform the same function.

Switching Between Mouse Mode and Measure Mode

To switch to Mouse Mode: Press and hold the take hit button and then quickly press the done button (within the first second).

To switch to Measure Mode: Move the cursor to the top of the screen and press the middle button (left mouse button).

To toggle from either mode:

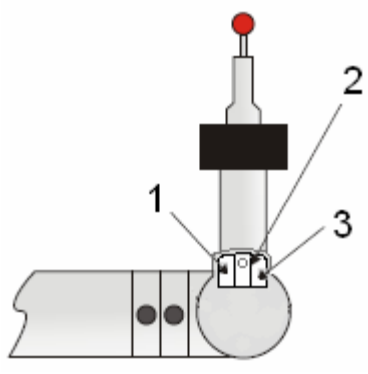


1. Turn the "F" axis to the limit, then
2. Turn the "E" axis 90 degrees.

Three Button Configuration

The two modes for a three button configuration are discussed below:

Measure Mode



The following Measure Mode functions are available for the buttons indicated above:

1: DONE - Press < 1 second

1: ERASE last hit - Hold > 1 second

1: OPEN DRO - Hold > 1 second when there is no hit in the buffer.

1: TOGGLE DRO - Hold > 1 second when the DRO is already open. XYZ **<->** XYZT. The "T" value is displayed.

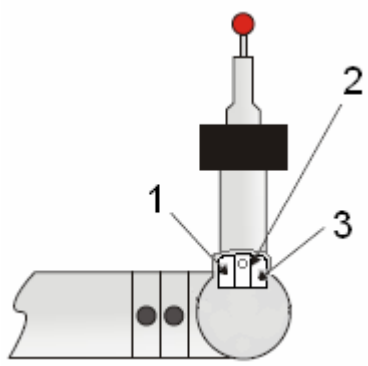
2: HIT POINT - Press < 1 second.

2: PULLED HIT - Press, pull back, release with 1 second. See "Using Pulled Hits for Probe Compensation".

2: SCAN - Press, hold > 1 second, drag.

3: TOGGLE Between Modes - Press < 1 second.

Mouse Mode



The following Mouse Mode functions are available for the buttons indicated above:

1: PAN - Press and hold the CAD model.

2: Mouse **LEFT** Button - Used for screen selections.

1+ 2: BOX ZOOM - Press and hold.

3: TOGGLE Between Modes - Press < 1 second.

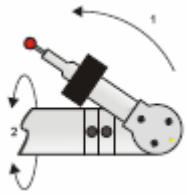
3: ROTATE - Press and hold the CAD model.

Optional Methods for Switching Between Mouse Mode and Measure Mode

To switch to Mouse Mode: Press and hold the take hit button and then quickly press the done button (within the first second).

To switch to Measure Mode: Move the cursor to the top of the screen and press the middle button (left mouse button).

To toggle from either mode:

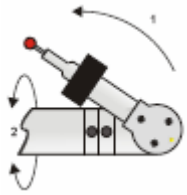


1. Turn the "F" axis to the limit, then
2. Turn the "E" axis 90 degrees.

Three Button Configuration for the RA7 Arm

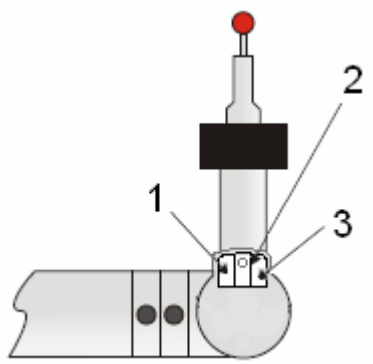
The two modes for a three button configuration used on the RA7 arm are discussed below.

To switch between measure and mouse mode,



1. Turn the "F" axis to the limit, then
2. Turn the "E" axis 90 degrees.

Measure Mode

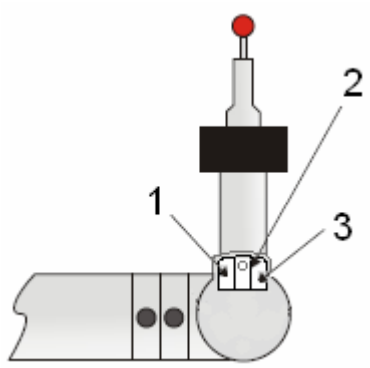


The following Measure Mode functions are available for the buttons indicated above:

Desired Action	Arm Procedure to Follow
Click **Done**, **OK**, **Yes**, **Finish**, **Next**, or **Create** on a dialog box	Press button 1 for less than 1 second.
Erase the last hit from the hit buffer.	Press and hold button 1 for more than 1 second.
Click **Cancel**, **No**, or **Previous** buttons on a dialog box	Press and hold button 1 for more than 1 second.
Bring up the Readout window (DRO)	Press and hold button 1 for more than 1 second when no hit is in the hit buffer.
Toggle the display of information in the	With the DRO already open, press button 1 for less than 1 second. The T value is displayed with the XYZ values

readout window (DRO)	in the DRO: XYZT
Take a point	Press button 2 for less than 1 second without moving the arm.
Take a "pulled hit"	Press and hold button 2 while pulling back on the arm, releasing it in under 1 second. See "Using Pulled Hits for Probe Compensation".
Scan	Press and hold button 2 for more than one second while dragging the probe along a part's surface.
Select features on the part using the arm	Position the probe near the feature, press and hold button 1 and then press button 2.

Mouse Mode



The following Mouse Mode functions are available for the buttons indicated above:

Desired Action	Arm Procedure to Follow
Use the left mouse button	Press button 1.
Use the right mouse button	Press button 2.
Use the middle mouse button	Press button 3.
Zoom out of the current CAD view	Press button 1 (left mouse click) above the imaginary center line of the current CAD view. The further above the center line the larger the zoom.
Zoom in on the current CAD view	Press button 1 (left mouse click) below the imaginary center line of the current CAD view. The further above the center line the larger the zoom.
Pan the view	Press and hold button 1 on the CAD model while dragging the arm.
Create a Point Info or Dimension Info box on the CAD view	Press button 1 twice (double click) on a feature label.
Rotate the CAD view	Press and hold button 3 while dragging.
Box Zoom	Press and hold button 1, press and hold button 2 and drag a box on the part model. Release the buttons to zoom in on the selected portion.

Using a Romer Laser Sensor

When using a laser sensor on you Romer portable arm, you should use the information from this document in conjunction with the information provided in the "PC-DMIS Laser" document. The "PC-DMIS Laser" document provides greater detail on measuring with a laser device.

See the "Portable Laser Probe Scanning" topic for information on manual scanning.

Using Sound Events

Sound Events provide audible feedback in addition to the visual user interface. This allows you to perform measuring actions without needed to look at the PC screen. To access the **Sound Events** tab of the **SetUp Options** dialog box, select the **Edit | Preferences | Setup** menu item.

Calibration Sound Events

When calibrating a laser device there are Sound Event options that are particularly useful. They are:

Laser Manual Calibration Bottom: The associated sound is played when calibration measurements for a given field should be taken in the upper region (location) of the sphere.

Laser Manual Calibration Field Counter: The associated sound is played to indicate in which field calibration measurements should be taken.

- 1 Beep - Measurement should be taken in the *Far* field.
- 2 Beeps - Measurement should be taken in the *Left* field.
- 3 Beeps - Measurement should be taken in the *Right* field.

Laser Manual Calibration Top: The associated sound is played when calibration measurements for a given field should be taken in the lower region (location) of the sphere.

Laser Probe Initialization End: The associated sound is played when at the end of the laser sensor initialization.

Laser Probe Initialization Start: The associated sound is played when at the beginning of the laser sensor initialization.

Laser Scan: The associated sound is played for each new step of the sensor calibration.

Sound Events for Laser Measurement

When measuring with a laser device audible feedback is provided from the Romer speaker based on the calculated Z distance. This pitch will vary according to the distance from the surface in relation to the optimal target distance.

- **Low pitched continuous sound** - Indicates that you are closer than the middle 50% of the laser range.
- **High pitched continuous sound** - Indicates that you are farther than the middle 50% of the laser range.
- **Series of beeps** - Indicates that you are in the middle 50% (25% below to 25% above) of the optimal target. This the desired range for optimal scanning.

Note: This functionality is probably best used on larger, flatter surfaces. When using a V5 sensor, you may combine the sound events with the V5 projector option to ensure scanning at the optimal focal length. You can compare the V5 projector in relation to the audible cues to learn what the beeps mean.

Using a Leica Laser Tracker

This section discusses the configuration and general usage of your Leica device with PC-DMIS. Refer to documentation provided by Leica for detailed information on configuring and using your Leica Tracker.

The following topics discuss using your Leica device with PC-DMIS:

- Leica Laser Tracker: Introduction
- Getting Started
- Leica User Interface
- Using Leica Utilities
- Using Auto-Inspect Mode
- Using Move Feature (Move To / Point To)
- Using Leica Probes
- Using Bundle Alignments
- Constructing Points for Hidden Point Devices

Leica Laser Tracker: Introduction

Leica Trackers are laser tracker-based portable CMMs used to take measurements using the Leica T-Probe or reflector. The portable Leica Tracker is a line of sight sensor that can be moved around the part to access different features. The Leica Tracker provides a “Walk-Around” solution to measure even hidden points.

The Laser Tracker takes measurements of single points or scans to create any feature type, similar to a traditional CMM.

Note: To use a Leica device with PC-DMIS you must have your portlock programmed with the **Leica** interface option.

Important: The **Rotary Table** portlock option MUST NOT be selected when you are using a portable device since it will cause problems with your portable device.

PC-DMIS supports the following Leica Laser Tracker Models:

LT500, LTD500, LT300, LT800, LTD800, LT700, LTD700, LT600, LTD600, LT640, LTD640, LTD706, LTD709, LTD840, AT901, AT401

PC-DMIS supports the following emScon version:

emScon version 2.4.666 or higher

PC-DMIS supports the following 6DoF systems:

T-ProbeII or T-ProbeI with FW 1.62 or higher (4 button support).

The information provided in the topics in this chapter was written specifically for Leica Laser trackers, but may be relevant to non-Leica trackers.

Getting Started

There are a few basic steps that you should take to verify that your system has been properly prepared before beginning the measurement process with your laser tracker.

To get started, complete the following steps:

- Step 1: Install PC-DMIS Portable for Leica
- Step 2: Connect the Leica Tracker
- Step 3: Launch PC-DMIS and Configure the Leica Interface
- Step 4: Customize the User Interface

Step 1: Install PC-DMIS Portable for Leica

1. Connect your port lock (dongle) to your USB port. The portlock must be present during PC-DMIS installation.
2. Execute setup.exe from the PC-DMIS Installation CD. Follow the on-screen instructions.

    - If ***Leica*** interface is programmed in your portlock, PC-DMIS will load and use the Leica interface when working on-line.
    - If ***All interfaces*** is programmed in your portlock (like a demo dongle), you may need to manually rename Leica.dll to interfac.dll. Leica.dll is found in the PC-DMIS install directory.

3. Copy a shortcut of PC-DMIS online

and modify its target as follows:

    For 6dof Capable Trackers (AT901):

    ```
    C:\<PC_DMIS_INSTALL_DIRECTORY>\PCDLRN.exe" /portable:LEICA
    ```

For 3D Trackers (AT401):

```
C:\<PC_DMIS_INSTALL_DIRECTORY>\PCDLRN.exe" /portable:LEICARIO
```

This newly created shortcut will be used to launch PC-DMIS. This will open PC-DMIS with the additional Leica interface items. Do not launch PC-DMIS at this time.

Step 2: Connect the Leica Tracker

Procedure for 6dof Capable Trackers - AT901:

Communication with this Leica Tracker is accomplished using the TCP/IP protocol via a cross-over cable that is connected directly to the Leica Tracker Controller (LTC plus/base). This is the preferred method for connection, but you may also connect over your local area network (LAN). For detailed information about setting up your Leica Tracker hardware, see the Laser Tracker Hardware Guide that came with your tracker.

To connect to your Leica Tracker:

1. Secure your tracker in the position from which you will first take measurements.
2. Connect your tracker to the LT controller's "Sensors" and "Motors" ports.
3. Mount the T-Cam (if you are using one) to the top of the tracker and connect T-Cam cable from the tracker to the LT controller.
4. Attach the Meteo station to the serial port on the LT controller if you have one. The Meteo station is used to report environmental data to the LT controller.
5. Directly connect your LT Controller to the computer where PC-DMIS is installed via a cross-over cable with RJ45 connecters. You may also connect the LT controller to the network (LAN) via a twisted-pair ethernet cable.
6. Turn on the power to the LT controller which provides power to the Leica Tracker as well.
7. Check the status display on the back of the LT controller. This provides information about the IP address (typically 192.168.0.1/255.255.255.0), name, emScon firmware version, and current operation. If your LT controller has a different IP address than the standard 192.168.0.1, do one of the following:

    - Change the IP Address from the "Options tab" of the **Machine Options** dialog box to the new IP Address of the controller.
    - Use the PC-DMIS Settings Editor and change the TrackerIPAddress entry to the new IP Address of the controller. See the "Editing PC-DMIS Registry Entries" section of the PC-DMIS Settings Editor document for information on editing registry settings.

8. Make sure that the IP address for the PC-DMIS computer is in the same subnet as the controller. For example, if the LT controller has an address of 192.168.0.1, then you would need to assign an address between 192.168.0.2 and 192.168.0.254. You must avoid IP Address conflicts with other devices on the same network.
9. Type **PING 192.168.0.1** (or a different address of your controller) from the command prompt on the PC-DMIS computer to verify communication to the LT controller.

Important: The Leica Tracker should be powered on for at least 4 hours to ensure the most accurate measuring result. If you are not going to be using the laser for a while you should turn it

off to conserve the laser's life-span. However, each time you turn it on, it takes 20 minutes to warm-up.

Procedure for 3D Trackers - AT401

Communication with this Leica Tracker is accomplished using the TCP/IP protocol via a cross-over cable that is connected directly to the Leica AT Controller 400. This is the preferred method for connection, but you may also connect over your local area network (LAN). For detailed information about setting up your Leica Tracker hardware, see the Laser Tracker Hardware Guide that came with your tracker.

To connect to your Leica Tracker:

1. Secure your tracker in the position from which you will first take measurements.
2. Install batteries in the tracker and the tracker controller. The tracker must have a battery in the bay in order to measure however, the battery in the AT Controller 400 is optional.
3. Connect your tracker to the AT controller's "Sensors" port.
4. Optionally connect the power input to the power port on the AT controller. Note, if there is a battery installed in the AT controller and the external power is connected, the battery will NOT be charged. This is due to the amount of heat generated by Li-Ion batteries while they charge.
5. Directly connect your AT Controller 400 to the computer where PC-DMIS is installed via a cross-over cable with RJ45 connecters. You may also connect the AT controller to the network (LAN) via a twisted-pair ethernet cable.
6. Turn on the power to the AT controller which provides power to the Leica Tracker as well.
7. Check the status display on the face of the AT controller. You will be prompted to level the device first since the Nivel is integrated into the AT 400 unlike the add on with the LT controllers. The display on the top face of the AT controller also provides you with the ATC400 firmware version, system status, graphical connection information, and weather information. To access the different views press the down arrow button.
8. Make sure that the IP address for the PC-DMIS computer is in the same subnet as the controller. For example, if the AT controller has an address of 192.168.0.1, then you would need to assign an address between 192.168.0.2 and 192.168.0.254. You must avoid IP Address conflicts with other devices on the same network.
9. Type **PING 192.168.0.1** (or a different address of your controller) from the command prompt on the PC-DMIS computer to verify communication to the LT controller.

Step 3: Launch PC-DMIS and Configure the Leica Interface

Once you have correctly installed PC-DMIS and connected your Leica tracker, you are ready to launch PC-DMIS.

1. Start PC-DMIS using the shortcut you created in Step 1. The Leica Tracker will initialize upon PC-DMIS startup. Initialization will cause the tracker to go through a series of movements to ensure proper functionality. If there are other issues that cause the Leica Tracker to not initialize correctly, the LT controller will send messages to PC-DMIS for display.

2. For 6dof systems, PC-DMIS will warn you *if* the laser is still warming up. Warming up the laser takes about 20 minutes.
3. Select the needed probe file from the **Select Probe File** dialog box.
4. "Configure the Leica Interface" using **Machine Options** dialog box that is accessed using the **Edit | Machine Interface Setup** menu item.

Step 4: Customize the User Interface

You can fully customize the colors, fonts, toolbars, and status bars of the PC-DMIS user interface to work optimally with your Leica Laser Tracker. Changing the following interface elements may prove helpful when measuring features at a distance from your computer monitor.

- **Fonts:** Select the **Edit | Preferences | Fonts** menu item to change the fonts and font sizes for PC-DMIS.
- **Background:** Select the **Edit | Graphics Window Display | Screen Color** menu item to alter the background color of the Graphics Display Window.
- **Menus:** Select the **View | Toolbars | Customize** menu item, and select the **Use Large Menus** option from the **Menu** tab for large menus.
- **Toolbars:** Select the **View | Toolbars | Customize** menu item, and select the **Use Large Toolbars** option from the **Menu** tab for large toolbars.
- **Status Bar:** Select the **View | Status Bar | Large** menu item for large status bar.
- **Tracker Status Bar:** Select the **View | Status Bar | Tracker** menu item to toggle the display of the **Tracker Status** Bar.

Note: The above settings are pre-configured and installed for the tracker interface.

Creating Customized Toolbars

Toolbars can be customized and exchanged between PC-DMIS installations. The toolbar.dat file is found in the <PC-DMIS Install Directory>/<user name> directory. Copy the toolbar.dat file to the other PC-DMIS installation to make the custom toolbars available. The default toolbars for Leica trackers are discussed in the "Tracker Toolbars" topic.

Customizing Open GL Settings

Adapt the Open GL settings for the solid view mode as required by the installed video card. To do this, select the **Edit | Preferences | OpenGL** menu item and make adjustments as explained in the "Changing OpenGL Options" topic in the core PC-DMIS documentation.

Leica User Interface

When you have configured PC-DMIS to use the Leica interface, additional menu options and status information become available in PC-DMIS.

PC-DMIS provides specific menu options as well as standard menu options that are available when using the Leica interface. Primarily there is a new "Tracker Menu" that has functions that are specific to Leica. Additionally, there is a sub-menu with "Nivel Commands" for controlling the leveling and monitoring processes of the Nivel.

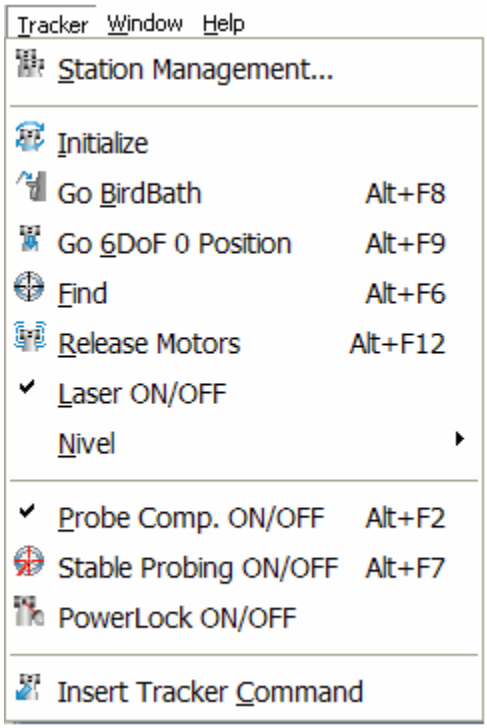
Also, unique to the Leica interface are the "Tracker Status Bar", "Special Leica Controls" and the "Tracker Overview Cam".

There are also "Other PC-DMIS Menu Items" and "Other PC-DMIS Windows and Toolbars" that are common to PC-DMIS that are useful for Leica devices.

This section discusses only a few of the menu items that would be used with the Leica interface. Please refer to the core PC-DMIS documentation for general information on using PC-DMIS.

Tracker Menu

Tracker Menu for 6dof Trackers



Station Management: Brings up the tracker **Station Manager** dialog box. For details see the "Adding and Removing Stations" topic.

Initialize: This command initializes encoders and internal components of the laser tracker. This command is automatically called when PC-DMIS first connects to the Laser Tracker (emScon) controller once the tracker is warmed up. The tracker goes through a series of movements to verify functionality.

Go Birdbath: The Leica Tracker points the laser to the BirdBath position. The beam is 'attached' to the reflector in the BirdBath and the interferometer distance is set to the known BirdBath distance. This command is especially important for LT series trackers without integrated ADM. For such trackers, there is no other way to set the interferometer distance.

With the laser pointed at the BirdBath position, this provides a known and convenient location at which you can recapture the beam. This may be necessary if the beam to the Reflector has been broken.

Go 6DoF 0 Position: The Leica Tracker points the laser in the opposite direction of the BirdBath position to the 6DoF 0 position. This provides a known and convenient location at which you can recapture the beam with the T-Probe.

Find: Searches for a reflector or T-Probe at the current laser position. The find function is performed based upon the **Search Settings** provided in the "Sensor Configuration tab".

Release Motors: Releases the horizontal and vertical tracker head motors in order to allow manual tracker head movement.

Laser ON/OFF: Toggles the laser to be on or off.

Important: Turning the laser on again requires about 20 minutes until it stabilizes!

Nivel: See "Nivel Commands".

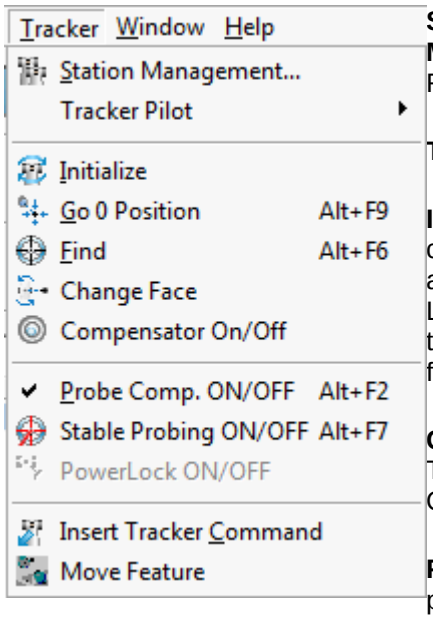
Probe Comp ON/OFF: When the probe compensation is "on", PC-DMIS will compensate by the radius of the T-Probe tip or the reflector sphere. During bundle alignment creation, PC-DMIS will automatically activate or deactivate probe compensation as needed when measuring points.

Stable Probing ON/OFF: Whenstable probing is "on", PC-DMIS will automatically trigger a hit if you leave a reflector in a position for a specified time. This allows for hits to be taken, without using a remote control or interacting directly with the computer.

PowerLock ON/OFF: Thisturns thePowerLock functionality on or off. When turned on, the tracker's laser beam can very quickly re-lock on the device without needing you to catch the beam manually. If you break the laser beam, simply point the reflector or other supported T-product measuring device at the tracker, and the tracker immediately catches the beam for you. This is usually very helpful while you are relatively close to the tracker. If you are working far away from the tracker, you may want to turn off PowerLock because the field of view is so large that the laser always locks on even if that isn't what you want. In addition, multiple reflectors in the field of view could confuse the tracker and cause problems. This icon will be disabled for trackers that do not support the PowerLock functionality.

Insert Tracker Command: Determines whether or not PC-DMIS inserts a command into the Edit window when you select to perform a Tracker operation from the **Tracker** menu or **Tracker Operations** toolbar. If this menu item is enabled, a check mark appears next to it. You can also toggle this on or off by using the **Insert a tracker command** icon from the **Tracker Operations** toolbar.

Tracker Menu for 3D Trackers



Station Management: Brings up the tracker **Station Manager** dialog box. For details see the "Adding and Removing Stations" topic.

Tracker Pilot: See the "Tracker Pilot Commands" topic.

Initialize: This command initializes encoders and internal components of the laser tracker. This command is automatically called when PC-DMIS first connects to the Laser Tracker controller once the tracker is warmed up. The tracker goes through a series of movements to verify functionality.

Go 0 Position: This moves the tracker to the zero position. This is a user-defined setting located in the Machine Optionsdialog box (**Edit | Preferences | Machine Interface**).

Find: Searches for a reflector or T-Probe at the current laser position. The find function is performed based upon the **Search Settings** provided in the "Sensor Configuration tab".

Change Face: This rotates the tracker head and camera by 180 degrees. The final target position will be the same as it was before the command was issued, except that now the optics are inverted.

Compensator On/Off: This turns the compensator on or off. The compensator adjusts the measurements taken by the device in order to level them to the gravity vector calculated on the

machine. This can be helpful when all measurements need to be referenced off of the level of the ground.

Release Motors: Releases the horizontal and vertical tracker head motors in order to allow manual tracker head movement.

Probe Comp ON/OFF: When the probe compensation is "on", PC-DMIS will compensate by the radius of the T-Probe tip or the reflector sphere. During bundle alignment creation, PC-DMIS will automatically activate or deactivate probe compensation as needed when measuring points.

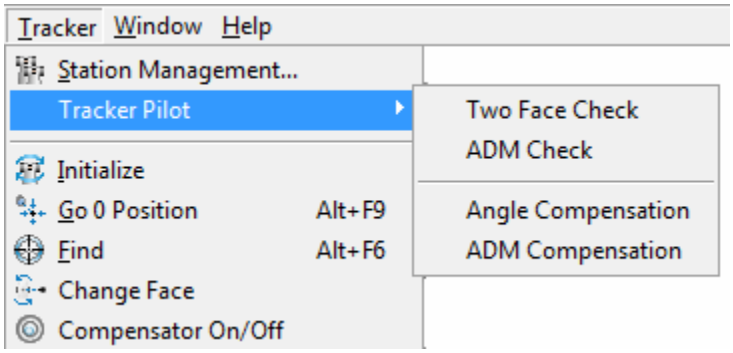
Stable Probing ON/OFF: Whenstable probing is "on", PC-DMIS will automatically trigger a hit if you leave a reflector in a position for a specified time. This is set from the **Probing** tab on the **Parameter Settings** dialog box (F10). It is only available if you are running as a tracker. This allows for hits to be taken, without using a remote control or interacting directly with the computer.

PowerLock ON/OFF: Thisturns thePowerLock functionality on or off. When turned on, the tracker's laser beam can very quickly re-lock on the device without needing you to catch the beam manually. If you break the laser beam, simply point the reflector or other supported T-product measuring device at the tracker, and the tracker immediately catches the beam for you. This is usually very helpful while you are relatively close to the tracker. If you are working far away from the tracker, you may want to turn off PowerLock because the field of view is so large that the laser always locks on even if that isn't what you want. In addition, multiple reflectors in the field of view could confuse the tracker and cause problems. This icon will be disabled for trackers that do not support the PowerLock functionality.

Insert Tracker Command: Determines whether or not PC-DMIS inserts a command into the Edit window when you select to perform a Tracker operation from the **Tracker** menu or **Tracker Operations** toolbar. If this menu item is enabled, a check mark appears next to it. You can also toggle this on or off by using the **Insert a tracker command** icon from the **Tracker Operations** toolbar.

Tracker Pilot Commands

The **Tracker | Pilot Commands** sub menu appears for 3D trackers. It contains these menu items:



- Two Face Check -
- ADM Check -
- Angle Compensation -
- ADM Compensation -

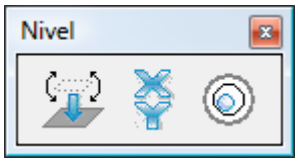
Tracker Toolbars

Shown below, are the default Leica tracker toolbars. These are available when you launch PC-DMIS portable using a Leica tracker interface.

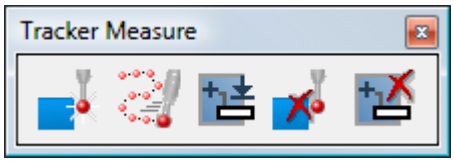
:

Toolbars for 6dof Trackers

- Tracker | Insert Tracker Command
- Tracker | Station Management
- Tracker | Initialize
- Tracker | Go Birdbath
- Tracker | Go 6DoF 0 Position
- Tracker | Find
- Tracker | Release Motors
- Tracker | Laser ON/OFF
- Tracker | Probe Comp. ON/OFF
- Tracker | PowerLock ON/OFF
- Insert | Alignment | Bundle
- View | Other Windows | Tracker Overview Cam
- Tracker | Move Feature

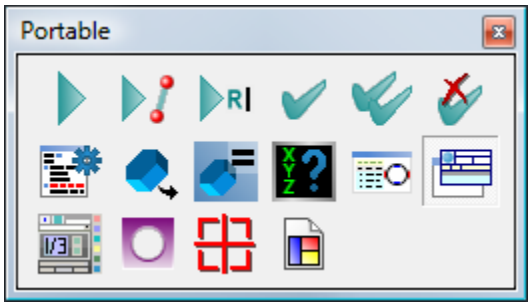


- Tracker | Nivel | Start Orient to Gravity Process
- Tracker | Nivel | Start Tilt Readout
- Tracker | Nivel | Start Monitoring



- Edit | Preferences | Machine Interface Setup
- Operation | Take Hit
- Operation | Start/Stop Continuous mode

- Operation | End Feature
- Operation | Erase Hit
- Edit | Delete | Last Feature



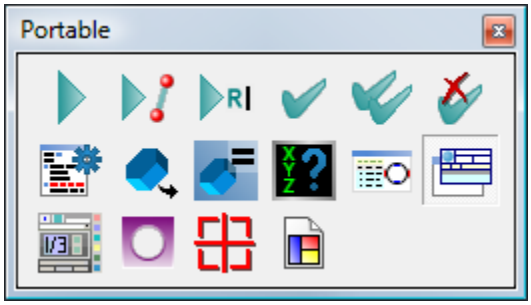
- File | Execute
- File | Partial Execution | Execute Feature
- File | Partial Execution | Execute From Cursor
- Edit | Markings | Mark
- Edit | Markings | Mark All
- Edit | Markings | Clear All
- Edit | Command
- File | Import | IGES (Alternate)
- Operation | Graphics Display Window | Cad Equals Part
- View | Other Windows | Probe Readouts
- View | Other Windows | Status Window
- View | Other Windows | Quick Start
- Insert | Feature | Auto | Circle
- Insert | Dimension | Location
- Insert | Report Command | Create Viewset

Toolbars for 3D Trackers

- Tracker | Insert Tracker Command
- Tracker | Station Management
- Tracker | Initialize
- Tracker | Go 0 Position

- Tracker | Find
- Tracker | Change Face
- Tracker | Compensator On/Off
- Tracker | Probe Compensation
- Tracker | Stable Probing
- Tracker | PowerLock ON/OFF
- View | Other Windows | Tracker Overview Cam
- Insert | Alignment | Bundle
- Tracker | Move Feature

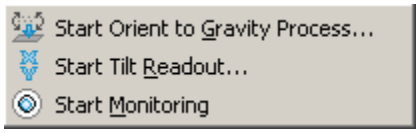
- Edit | Preferences | Machine Interface Setup
- Operation | Take Hit
- Operation | End Feature
- Operation | Erase Hit
- Edit | Delete | Last Feature



- File | Execute
- File | Partial Execution | Execute Feature
- File | Partial Execution | Execute From Cursor
- Edit | Markings | Mark
- Edit | Markings | Mark All
- Edit | Markings | Clear All
- Edit | Command
- File | Import | IGES (Alternate)

- Operation | Graphics Display Window | Cad Equals Part
- View | Other Windows | Probe Readouts
- View | Other Windows | Status Window
- View | Other Windows | Quick Start
- Insert | Feature | Auto | Circle
- Insert | Dimension | Location
- Insert | Report Command | Create Viewset

Nivel Commands



Start Orient to Gravity Process: Using the Nivel 20/230 device, PC-DMIS creates a gravity plane and then automatically creates a coordinate system based on the gravity plane information. Once the process has been completed, the monitoring process is started automatically.

Start Tilt Readout: Starts an X, Y tilt readout to bring the tracker into the working range of the Nivel by adjusting the Tracker base foot screws.

Start/Stop Monitoring: Starts/Stops Monitoring independent from the Orient to Gravity process.

See: "Orienting the Tracker to Gravity"

Tracker Status Bar

Tracker Status bar visibility can be toggled using the **View | Statusbar | Tracker** menu item.

Status Bar for 6dof Machines:

1. **System Laser Status Indicator:** This indicates the status of the Laser Tracker system.

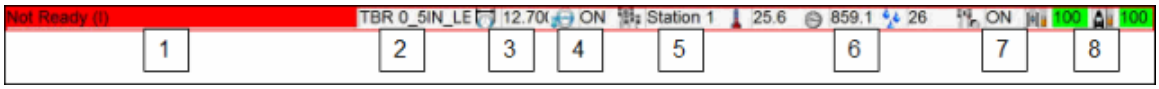
    - **Green** (Ready): The system is ready to measure
    - **Yellow** (Busy): The system is currently measuring
    - **Red** (Not ready): The system is not ready to measure. This may be due to a broken beam or a T-Probe reflector mismatch.
    - **Blue** (6dof error): The camera cannot see enough LED's on the device (usually T-Probe) to accurately calculate the orientation of the probe.

2. **Active Station Indicator:** Indicates which station is currently active. A double click onto the station Indicator opens the **Station Manager**dialog box.

   - **Red** (Not oriented): The station position is not computed yet.
   - **Green** (Oriented) The station position has been computed.

3. **Environmental Parameter Display:** Shows the active environmental parameters: temperature, pressure, and humidity. If no weather station is connected, it is possible to double-click on the edit boxes to change their values.

Status Bar for 3D Machines:



1. **System Laser Status Indicator:** This indicates the status of the Laser Tracker system.

   - Green (Ready): The system is ready to measure
   - Yellow (Busy): The system is currently measuring
   - Red (Not ready): The system is not ready to measure. This may be due to a broken beam or a T-Probe reflector mismatch.
   - Blue (6dof error): The camera cannot see enough LED's on the device (usually T-Probe) to accurately calculate the orientation of the probe.

2. **Active Probe Name:** This displays the currently active reflector.
3. **Active Probe Diameter:** Current reflector diameter.
4. **Probe Compensation Indicator:** Displays the current state of probe compensation.
5. **Active Station Indicator:** Indicates which station is currently active. A double click onto the station Indicator opens the **Station Manager**dialog box.

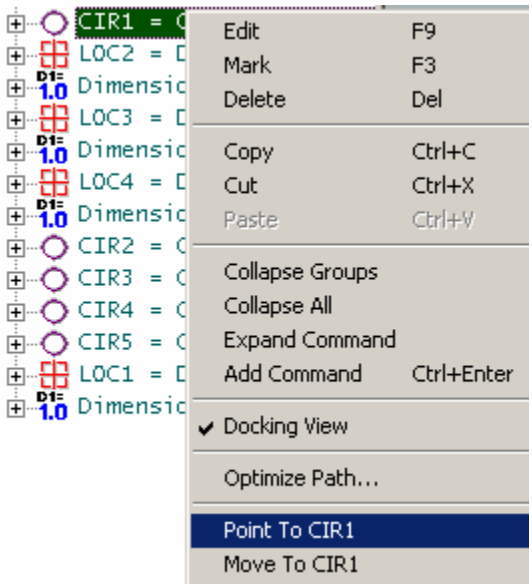
   - Red (Not oriented): The station position is not computed yet.
   - Green (Oriented) The station position has been computed.

6. **Environmental Parameter Display:** Shows the active environmental parameters: temperature, pressure, and humidity. If no weather station is connected, it is possible to double-click on the edit boxes to change their values.
7. **Power Lock Indicator:** Displays the current status of PowerLock.
8. **Battery Indicators:** There are two indicators, one for the device and one for the controller. If the batteries are active, the status indicators display the percent power left in each individual battery. If the battery has more than 25% power, the background of the text is green. If the power level is between 10% & 25%, the color is yellow. If the power drops below 10%, the color changes to red. If the external power is active, the color of the fields change to gray and there are no numbers in the fields. Also, the battery icons change to display small external power chords.

   - Device Icons:
   - Controller Icons:

Special Leica Controls

Tracker Head Movements: You can control the direction that the laser is pointing by using the Alt + left arrow, right arrow, up arrow, down arrow keyboard keys. Use Alt + Space to stop movement of the laser. The tracker motors must be engaged for these controls to work (**Tracker | Release Motors** - Alt-F12).



Point To: Use the pop-up menu that appears when you right-click on a feature in the Edit Window to **Point To** the feature's nominal position (Laser Pointer).

Move To: Use the pop-up menu that appears when you right-click on a feature in the Edit Window to **Move To** the features nominal position (Go Position).

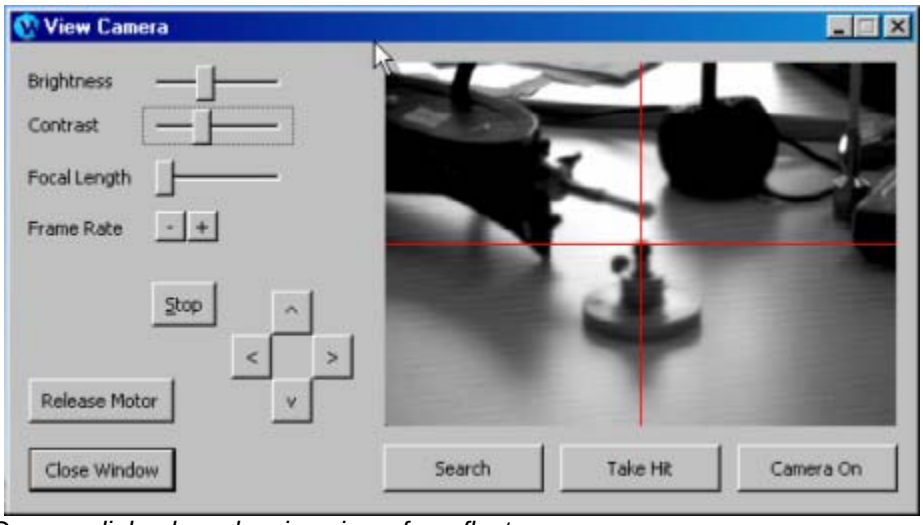
Using the Tracker Overview Cam

The Leica T-Cam mounts to the top of your Leica Tracker and provides true depiction and calculation of the Target Device's spatial position, with respect to the T-Cam/Tracker. The tracker provides the horizontal movement for the T-Cam.

This displays the view from the Overview Camera (T-Cam) which allows you to move the tracker head and easily find reflective targets.

To find a measured target using the T-Cam:

1. Mount the T-Cam to the top of the Leica Tracker according to the "T-Cam Hardware Guide" provided by Leica.
2. Select the **View | Other Windows | Tracker Overview Cam** menu item to open the **View Camera** dialog box.

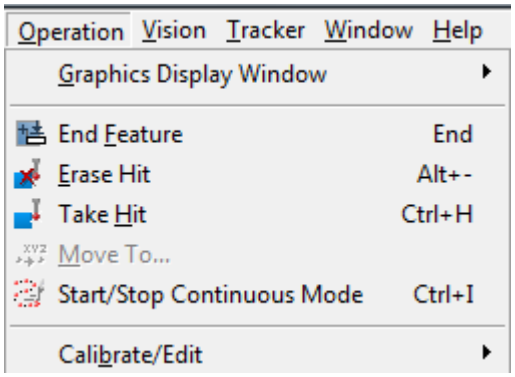


View Camera dialog box showing view of a reflector

3. Click **Release Motor** and approximately aim the camera at the target by moving the laser tracker head. The Overview Cam will move in relation to the movements that are made with the tracker head. When the camera/tracker laser are pointing at the target, click **Release Motor** again to re-engage the tracker motors.
4. Adjust the **Brightness**, **Contrast**, **Focal Length**, and **Frame Rate** as needed to clearly see the target.
5. Use the arrow keys to more precisely aim the laser at the intended target. Click **Stop** to stop any movement initiated by the arrow keys when the laser points to the target. You may also use the "Special Leica Controls" to aim the laser.
6. Click **Search** to run the procedure that will automatically find the center of the target and lock the laser onto that position.
7. Click **Take Hit** to measure the target's location. If you are unable to take a hit you may need to redo some or all of the previous steps to ensure that the laser is able to measure from the intended reflector.
8. Use the **Camera On** button to toggle the display of the camera image.

Other PC-DMIS Menu Items

Operation Menu



End Feature (END): Tells PC-DMIS that the amount of hits for the feature has been reached and the feature can be calculated.

Erase Hit (ALT+-): Deletes the last measured hit.

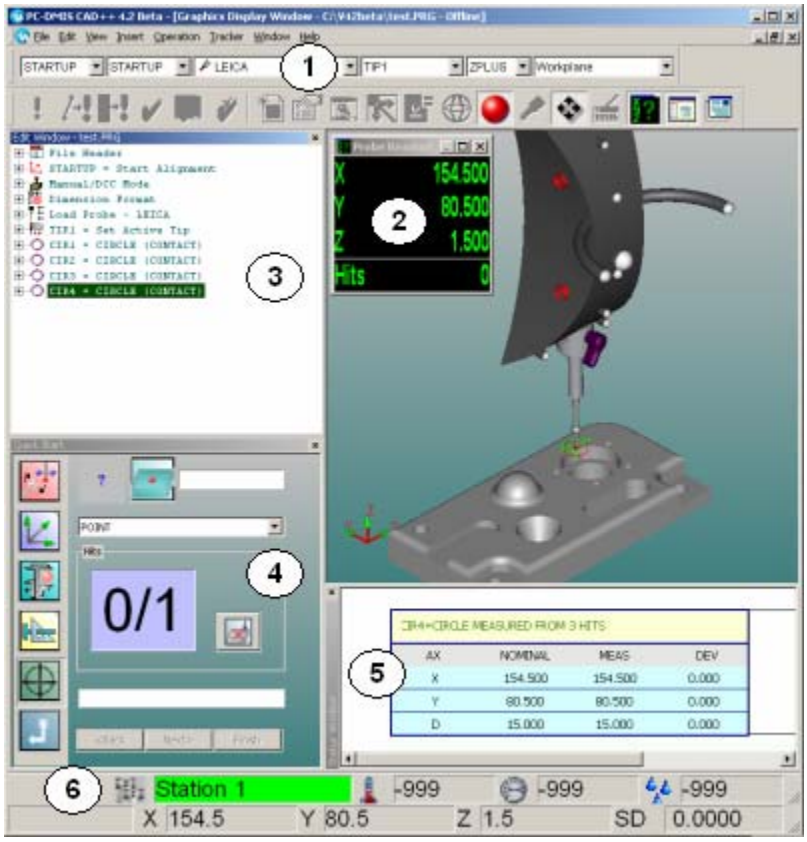
Take Hit (CTRL+H): Measures a stationary T-Probe or Reflector position, based on the measuring time specified in the "Sensor Configuration tab" of the **Machine Options** dialog box.

Move To: Accesses the **Move Point** dialog box, allowing you to insert a `MOVE/POINT` command into the part program. See the "Inserting a Move Point Command" in the core documentation for more information.

Start/Stop Continuous Mode (CTRL+I): Starts/Stops a scan, based on the basic scan settings found on the **Part/Machine** tab of the **SetUp Options** dialog box (**Edit | Preferences | Setup**). The default value for **Scanning Min Distance Delta** provides a continuous distance separation of 2mm.

Other PC-DMIS Windows and Toolbars

The PC-DMIS core documentation provides additional information that is relevant for using trackers. Review the following topics for the elements indicated in the image:



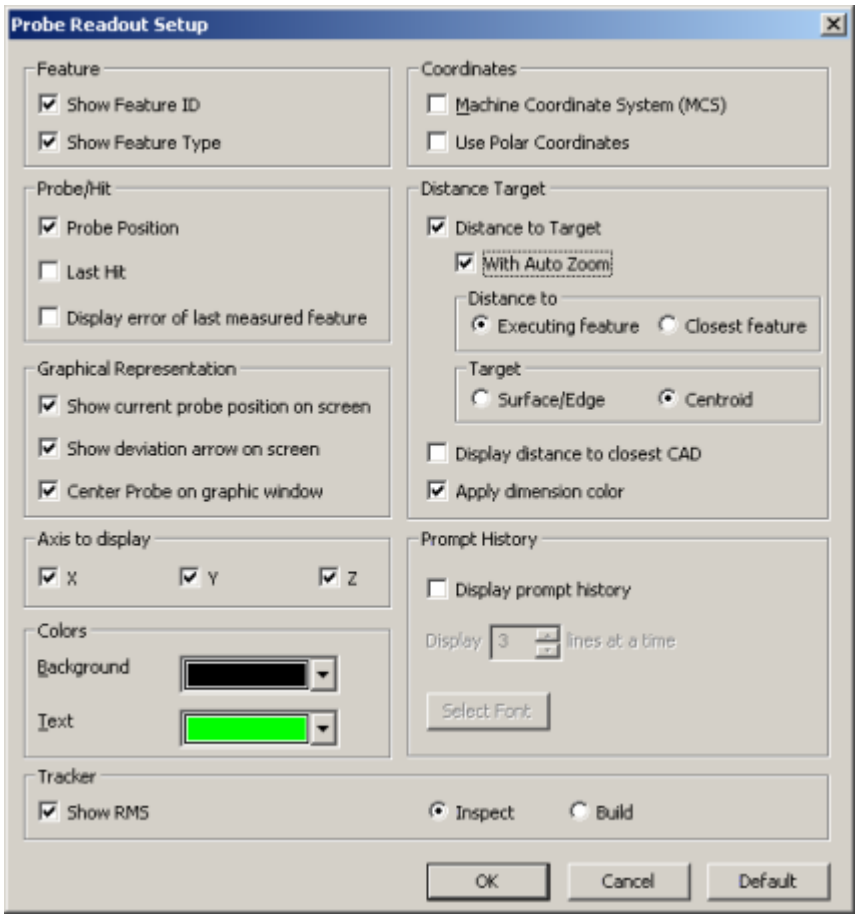
1. **Settings Toolbar:** See "Settings Toolbar" in the "Using Toolbars" chapter from the core PC-DMIS documentation. The third drop-down box displays Reflector and T-Probe compensations coming from emScon server (and additional ones manually defined, if any).
2. **Probe Readout:** See "Setting Up the Readout Window" in the "Setting Your Preferences" chapter from the core PC-DMIS documentation. Also, see the "Customizing the Probe Readout" topic for Leica specific settings.

3. **Edit Window:** See the "Using the Edit Window" chapter from the core PC-DMIS documentation.
4. **Quick Start Interface:** See "Using the Quick Start Interface" in the "Using Other Windows, Editors, and Tools" chapter from the core PC-DMIS documentation.
5. **Status Window:** See "Using the Status Window" in the "Using Other Windows, Editors, and Tools" chapter from the core PC-DMIS documentation.
6. **Tracker Status Bar:** See the "Tracker Status Bar" topic.

Customizing the Probe Readout

The **Probe Readout Setup** dialog box has various options for working with Leica trackers. This topic discusses a few key options that relate to Leica tracker usage (See "Setting Up the Readout Window" in the "Setting Your Preferences" chapter from the core PC-DMIS documentation).

To access the **Probe Readout Setup** dialog box, select the **Edit | Preferences | Probe Readout Setup** menu item. You may also access this dialog box directly from the **Probe Readout** window by right-clicking and selecting **Setup**.



Probe Readout Setup dialog box

Show Feature ID: Displays the Feature ID for the feature being executed, or the closest feature depending on the **Display distance to closets CAD** option.

Show Feature Type: Displays the type of feature corresponding to the feature being executed.

Show current probe position on screen: Displays a 3D representation of the current position on the Graphics Display window.

Show deviation arrow on screen: Displays a 3D arrow on the Graphic Display window indicating the direction of deviation. The tail of the arrow is always drawn to the probe location in inspect mode and the measured point in build mode.

Center Probe on graphic window: The graphical representation of the current probe will always be displayed at the center of the Graphics Display window.

Distance to Target: This is an execute-only option. In execute mode, it shows the distance from the probe to the feature being executed or the closest feature depending on the **Display distance to closets CAD** option.

Distance to... **Executing Feature** or **Closest Feature:** This option allows you to display the currently executing feature ID or the feature ID for the closest feature to your current probe location. The distance to that feature will update according to the feature selected (executing or closest).

Target: Selecting **Centroid** will calculate the distance to the centroid of the feature. Selecting Surface/Edge point will calculate the distance to the point which is on the feature or CAD element and closest to the centroid.

Display Distance to closest CAD: Shows the distance from probe to closest CAD element.

Apply dimension color: This check box changes the colors of the deviation values (Distance to Target values) to match the out of tolerance dimension colors.

Show RMS: Displays the RMS value as hits are taken.

Inspect / Build mode: By default (**Inspect** mode), PC-DMIS displays the deviation (T) as *'Difference = Actual - Nominal'*.

- **Build Mode:** The general purpose is to provide real-time deviations between a real object and its nominal data or CAD model. This allows you to position your part as it relates to the CAD design data.

Selecting this option will display the distance and direction that you need to move the measured point to reach the nominal position or *'Difference = Nominal - Actual'*.

Note: When you are moving the part into position, there are just real-time deviations displayed without storing any data (taking hits). After the part is positioned within a reasonable deviation (e.g. 0.1mm), you would typically measure (hits are taken) the final position of the feature.

- **Inspect Mode:** In this mode, the position of an object (point, line of surface, etc.) is checked and compared with design data.

Useful Hotkeys for Trackers

When using a Leica tracker, the following Hotkeys are useful for remote control usage:

Function	Supported Devices	Hotkey
Go Birdbath	6dof only	Alt+F8
Go 6DoF 0 Position	6dof only	Alt+F9
Go 0 Position	3D only	Alt+F9
Find		Alt+F6
Release Motors	6dof only	Alt+F12
Probe Compensation ON/OFF		Alt+F2
Stable Probing ON/OFF		Alt + F7
Measure stationary point		Ctrl+H
Start/Stop continuous measurement	6dof only	Ctrl+I
End Feature		End
Erase Hit		Alt+-

Leica Feature Parameters in Offline Mode

When using a Leica Tracker in online mode to generate feature commands, PC-DMIS automatically inserts the following information into the Edit window inside those feature commands:

- **RMS:** Root Mean Squared value of each hit.
- **Probe Type:** The type of probe used to measure the feature.

- **Time Stamp:** The time the feature was executed or learned. PC-DMIS only updates this when it actually measures a feature in online mode.
- **Environmental Conditions:** Information such as temperature, pressure, and humidity.

In offline mode PC-DMIS behaves differently. These Leica Tracker items only appear after you select the **Show tracker parameters in offline** check box on the **General** tab of the **Setup Options** dialog box. These parameters will only appear for new feature commands inserted into the part program after you have selected this option. Previously measured features will remain unaffected except for a permanent structure change adding in an empty Tracker Parameter group into each feature command.

Note: Selecting this check box performs a permanent change to your part program structure for inserted feature commands regardless of whether or not you later clear this check box. For example, if you clear this check box after you've already used it for some features, newly inserted features will still contain a Tracker Parameter group; although that group will not contain any group items.

Using Leica Utilities

The Leica interface provides new utilities that are specific to the Leica interface. This functionality is discussed in the following topics:

- Initializing the Leica Tracker
- Orienting the Tracker to Gravity (6dof devices only)
- Defining Environmental Parameters
- Toggling the Laser and Probe Compensation (Toggling the laser is only valid for 6dof devices)
- Resetting the Tracker Beam (6dof devices only)
- Releasing Tracker Motors (6dof devices only)
- Finding a Reflector

Initializing the Leica Tracker

When PC-DMIS is started, the Leica Tracker starts the initialization process, which performs a series of self checks by the Leica Tracker to verify that everything is working correctly. You may also initialize the Leica tracker by selecting the **Tracker | Initialize** menu item.

When you move the tracker to a new station for a "Bundle Alignment" it is necessary to re-initialize the tracker. When you turn the laser back on, you will also be required to initialize the tracker.

Important: It is strongly recommended that you initialize the encoders and internal components of your tracker 2-3 times a day. This is important due to thermal expansion of the tracker hardware, which has a direct influence on the measurement accuracy.

Orienting the Tracker to Gravity (6dof devices only)

The NIVEL inclination sensor is designed to be used with Leica Geosystems Laser Tracker series. The NIVEL mounts on the top of the sensor unit or on top of the Overview Camera / T-CAM in order to establish the parameters for the Orientation to Gravity. It is then mounted on a bracket to monitor the stability of the Laser Tracker.

See the "Nivel 230 Hardware Guide" provided with you Nivel sensor for detailed information on the configuration and use of the Nivel sensor. Leveling to gravity is not required, but does improve Leica Tracker measurement results.

To Level to Gravity and Monitor the Leica Tracker:

1. Mount the Nivel sensor to the top of the Leica Tracker or the top of the T-Cam (if it is already mounted to the tracker). See the "Nivel 230 Hardware Guide".
2. Connect the LEMO cable to the Nivel.
3. Select the **Tracker | Nivel | Start Tilt Readout** menu item to display the **Tilt Readouts** window. The **Tilt Readouts** window helps by reading the Nivel measurement 3 times per second. The values can be maximized on the whole screen if needed.

Using the Tilt Readouts window to roughly level the tracker

4. Using the **Tilt Readouts** window, level the Leica Tracker base and the Nivel according to the steps in the "Nivel 230 Hardware Guide".
5. When the tracker it roughly leveled and brought into an acceptable working range, select the **Tracker | Nivel | Start Orient to Gravity Process** menu item. The laser tracker then performs Nivel measurements in all 4 Quadrants of the laser tracker and creates a generic plane feature and a leveled sensor coordinate system based on this plane.

Note: Any additional new alignments can use the gravity information if required.	

6. Once the procedure has been completed, PC-DMIS prompts you to move the Nivel to the monitoring position.

7. Mount the Nivel to the monitoring position according to the steps in the "Nivel 230 Hardware Guide".
8. Select the **Tracker | Nivel | Start Monitoring** menu item. This begins the process of monitoring the status of the Leica Tracker. The "Level To Gravity tab" of the **Machine Options** dialog box provides information about the leveled status. Every 60 seconds a reference Nivel measurement is made and compared with the original orientation.

Note: The Monitoring process is used to make sure that nobody moves or hits the tracker. It can be started explicitly if no Gravity plane is needed. In which case only the stability of the system should be monitored.

Defining Environmental Parameters

Temperature, pressure, and humidity affect the measurement values acquired by your Leica tracker. Compensation is provided for measurements based on the changes in these values which are used to calculate the refraction index of IFM / ADM.

You can use a Meteo Station to provide these values or you can enter these values manually if you do not have a Meteo Station. When the Meteo station is enabled, the refraction is calculated every 30 seconds. For changes that are greater than 5 ppm, the parameters are will be updated accordingly.

To manually alter these values either:

- Edit the "Leica Environmental Parameters" from the **Machine Options** dialog box. If you have a Meteo station but would like to manually edit the values, deselect the **Use Temperature Station** option.

or...

- Edit the Environmental values by clicking the value and typing the new value in the Status Bar. To view the Leica status bar, select the **View | Status Bar | Tracker** menu item.

Toggling the Laser and Probe Compensation

Laser Toggle (6dof devices only)

To toggle the Laser on and off, use the **Tracker | Laser ON/OFF** menu item. This allows you to preserve the laser's life-span (lasers last about 20,000 hours). There also may be time that you just don't want or need to have the laser on. The laser requires about 20 minute to warm-up before you begin using it.

Note: Once you turn the laser off, you will be required to wait for 20 minutes when you turn it back on. You will also need to re-initialize the Leica Tracker.

Probe Comp Toggle

To determine whether or not probe compensation is applied for a measured point, use the **Tracker | Probe Comp. ON/OFF** menu item. When this is "on", PC-DMIS will compensate by the

radius of the T-Probe tip or the reflector sphere. During bundle alignment creation, PC-DMIS will automatically activate or deactivate probe compensation as needed when measuring points.

Resetting the Tracker Beam (6dof devices only)

If the laser beam from the Leica Tracker is broken and the tracker is unsuccessful in following the reflector or T-Probe location, it might be necessary to reset the position to which the laser is pointing. This allows you to recapture the beam at a known location.

This is mainly used for LT trackers which do not have an integrated ADM.

You can reset the laser to point to one of two positions:

- **Birdbath:** Select **Tracker | Go Birdbath** to reset the laser to point to the Birdbath position. This is used when working with reflectors.
- **6DoF:** Select **Tracker | Go 6DoF 0 Position** to reset the laser position by pointing to the predefined T-Probe 0 position. This will allow you to catch the beam at that location. This is used when working with a T-Probe.

Use Case - You can use these options to catch the reflector again and bring the reflector or T-Probe to a stable position, this will re-establish a distance via ADM and allows you to continue…

Releasing Tracker Motors (6dof devices only)

You can release the Tracker Motors to allow you to manually move the Leica tracker to the desired location. This can be done by pressing the green "Motors" button on the LT controller or by selecting the **Tracker | Release Motors** menu item. Releasing motors can also be done from the **View Camera** dialog box or by pressing Alt-F12.

Finding a Reflector

The Find function allows you to search in a spiral pattern to find the actual location of a reflector or T-Probe (6dof system only) with your Leica Tracker or Total Station device.

Finding a Reflector Location Using a Leica Tracker Device

1. Approximately point the Tracker laser to the location of the desired reflector. This can be done by one or all of the following:
    - "Releasing Tracker Motors" (6dof system only) and manually moving the laser to the location. Note: There is no need to release the motors on the 3D systems.
    - Using the control buttons on the "ADM" tab of the **Machine Options** dialog box...
    - Using the Overview camera ...
    - Using the Alt + left arrow, right arrow, up arrow, down arrow keyboard keys to move the tracker head. Use Alt + Space to stop movement of the laser.
2. Select the **Tracker | Find** menu item. The tracker device will search in a spiral pattern and take readings until the reflector sends the signal back to the device. This will locate the position.

Finding a Reflector Location Using a Total Station Device

1. Approximately point the Total Station laser to the location of the desired reflector. This can be done by one or all of the following:
    - Manually moving the laser to the location...
    - Using the Alt + left arrow, right arrow, up arrow, down arrow keyboard keys to move the tracker head. Use Alt + Space to stop movement of the laser.
2. Select the **Total Station | Find** menu item. The total station device will search in a spiral pattern and take readings until the reflector sends the signal back to the device. This will locate the position.

Note: This function can also be executed from the **View Camera** dialog box.

Using Auto-Inspect Mode

Auto-Inspect mode provides automated inspection of a sequence of points using a Leica tracker. This process is essentially the same as the typical point inspection process except for the fact that the process may run unattended as the tracker moves from one position to the next one automatically.

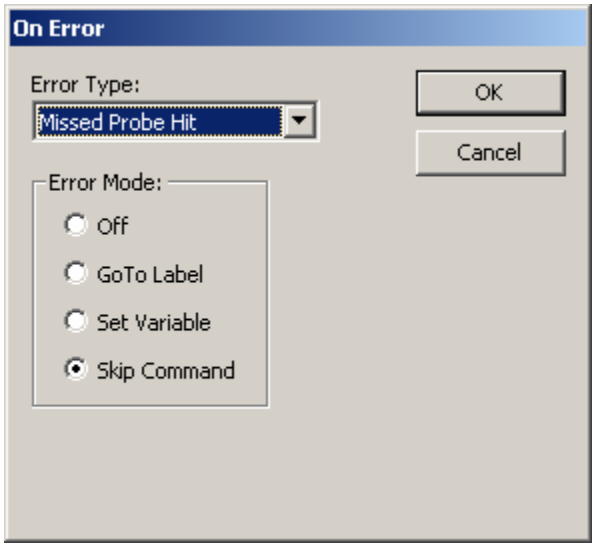
This process is often used for deformation measurements or repeated stability studies over a long time range. Each of the positions which are going to be auto inspected, are typically equipped with a separate reflector.

For example, some typical cases for Auto-Inspect might include:

- Inspecting four points distributed over the full working range of the laser tracker. Those four points could be inspected automatically at the beginning and end of a part program to verify that the tracker position has not moved during the measurement process.
- Checking the repeatability of ten reflector positions mounted to a large structure. For example, you could measure these ten points every 15 minutes over a time span of 24 hours.

To use Auto-Inspect mode:

1. Open or Create a Part Program.
2. Insert Manual/DCC mode command, and set it to DCC.
3. Insert an **On Error** command by selecting the **Insert | Flow Control Command | On Error** menu item.



On Error dialog box

4. Select the 'Missed Probe Hit' **Error Type** and the **Skip Command** option selected.
5. Insert Points for each mounted reflector. To insert each point into your part program:

a. Aim the tracker at the reflector.
b. Press CTRL+H to take a hit.
c. Press the end key.

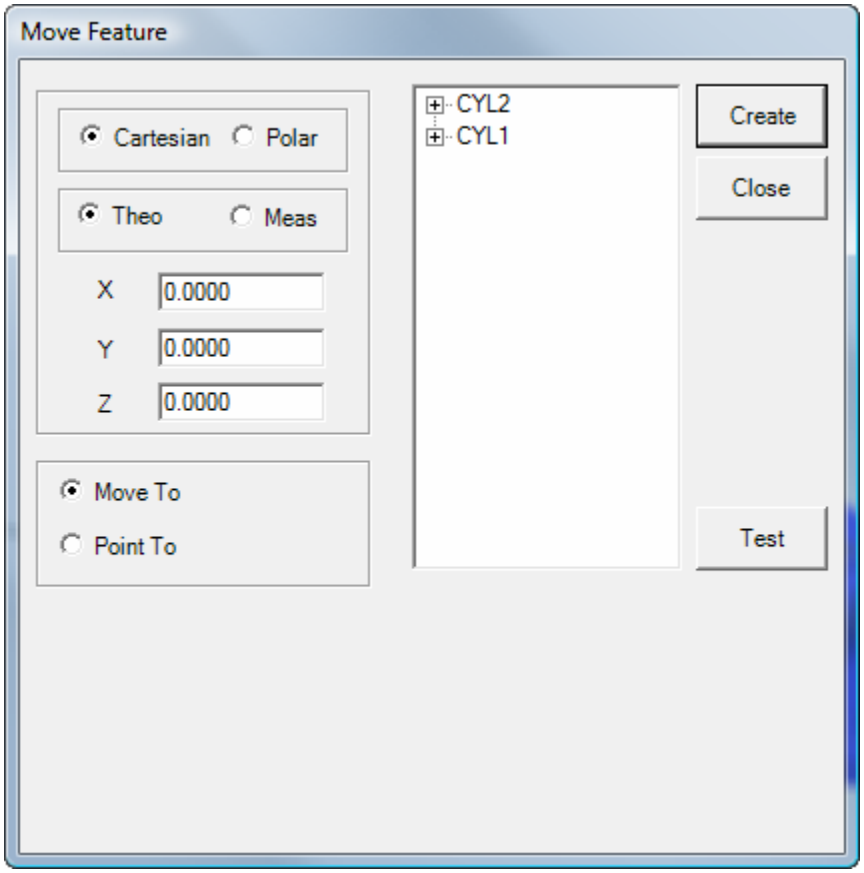
6. Execute program.

In execution mode, PC-DMIS will automatically measure each of these points as follows:

1. The Leica tracker will point to the first point (position).
2. The laser locks onto the positions if possible. If no reflector is there, or no reflector has been found with the current search settings, PC-DMIS will continue to the next feature.
3. Measurement of the point it taken.
4. The process is repeated (step 1 through 3) until all points have been measured or skipped.

For any points that were skipped, an error message "Reflector not Found" will be displayed to alert the operator to the problem(s). Corrective action can then be taken for skipped points. The error contains a message that there was an error, the feature ID for the error and coordinate location of the feature. The created report will also contain a message for any points that were skipped.

Move Feature (Move To/ Point To)



Move Feature dialog box

The **Move Feature** dialog box is available when using either a Lieca Tracker or a Leica Total Station device. It appears when you select the **Move Feature** *toolbar icon* on the **Tracker Operation** toolbar or on the **Total Station Operation** toolbar. You can also access it by selecting the **Tracker | Move Feature** or **Total Station | Move Feature** menu items.

The **Move Feature** dialog box contains the **Move To** and **Point To** options. These commands are used only with the Lieca Total Station or Leica Tracker devices. In addition to the standard move ability of other DCC systems, the **Point To** command exploits the unique capabilities of these tracker-type systems by using the device as a laser pointer to identify directly on the part the location of out-of-tolerance points.

Move To

This option moves the device to a specific location where it then tries to find a reflector.

To move to a point, select the **Move To** option and then define where it should move to. There are three ways to specify the location to which it should move.

- **Method 1:** Type the values into the **X**, **Y**, and **Z** boxes (or **R**, **A**, and **Z** if the **Polar** option is used).
- **Method 2:** Select the feature that you are going to move to out of the **Feature** list. When you select the feature, PC-DMIS will fill in the **X**, **Y**, and **Z** values based on the centroid of the feature.
- **Method 3:** Expand the feature by selecting the **+** symbol next to it to display the hits on the feature. While "hits" is something of a misnomer, it simply means the point measured by the laser device. Select one of the hits from the list. PC-DMIS will fill in the **X**, **Y**, and **Z** values for that hit.

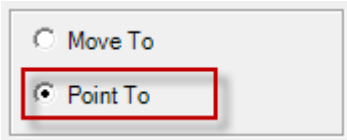
You can choose to move to the measured or the theoretical value for the point by choosing either the **Theo** or **Meas** option.

Once you have set up the command correctly, click **Create** to insert the command into the Edit window.

```
MVF1       =MOVE FEATURE/MOVE TO,CARTESIAN,THEO,<-36.3574,33.3898,-10.8127>,

            FILTER/NA,N WORST/1,

            POINT TO METHOD/NA,DELAY IN SEC/0.0000,

            REF/PNT1,
```

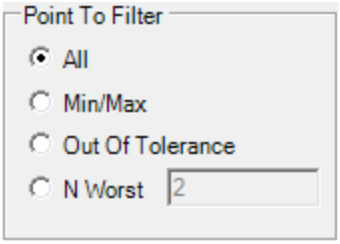
When PC-DMIS executes this command, the device will automatically move to the position indicated and attempt to find a reflector. If no reflector is found, an error will be displayed that says "AUT_FineAdjust - Request timed out". To get past this error, if there is a nearby reflector, you will need to use the **Execution Options** dialog box and stop the execution, adjust the location to point nearer the reflector, and then click **Continue**. If a reflector is not close by, you can click **Skip** to move onto the next point.

Point To



To point to different hits, the procedure is the same as the "Move To" information above, but there are some additional options. With **Point To** you can also select from available dimensions in the part program. If you select a dimension, PC-DMIS displays the **Point To Filter** and **Point To Method** areas. You do not need to select individual hits in the expanded dimension. All hits visible in the dimension will be pointed to, although you can use the **Point to Filter** area to filter hits.

Point to Filter

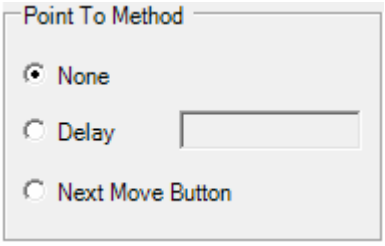


The **Point To Filter** area displays options that control which hits are pointed to. The options include:

- **All** – PC-DMIS will point to each point in the dimension.
- **Min/Max** – PC-DMIS will identify and point to only the Min and Max points.
- **Out Of Tolerance** – PC-DMIS will point to only out-of-tolerance points.
- **N Worst** – PC-DMIS will point to a number of "worst points". These points may or may not be in tolerance. This is a simple sort of the data based on the proximity to the theoretical values.

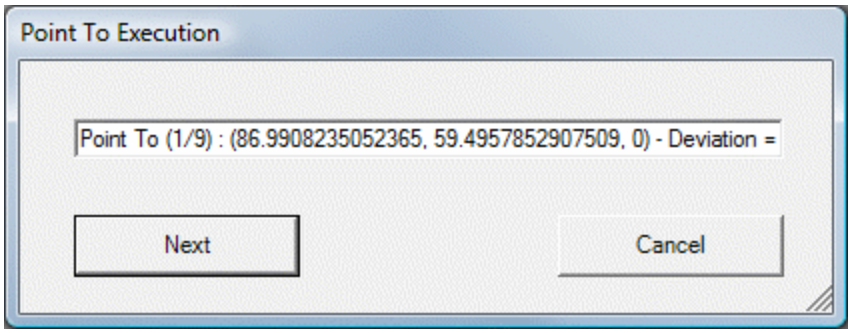
When you choose one of the options in the **Point to Filter** area, PC-DMIS updates the list of hits for the selected dimension in the dialog box to reflect the points to which PC-DMS will point the laser beam. For example, if you select **Min/Max**, the list of hits in the selected dimension will update with only two hits in the list, representing the min and the max points for that dimension. If you choose **All**, the list will update displaying all of the input hits of that dimension.

Point to Method



The **Point To Method** area lets you indicate how the device cycles through the list of points. The options include:

- **None** – There is no delay or user input needed to move to the next point. It points to each of the points without delay just as soon as the device can physically proceed to the next point.
- **Delay** – This delays the cycle time by a specified number of seconds. When executed, the device will point to the first point in the list, turn on the laser and wait the specified amount of time. When the time expires, the laser will turn off and the device will move to the next point and repeat this process until all of the points in the list have been pointed to.
- **Next Move Button** – During execution, a **Point to Execution** dialog box appears showing the index of the point in the list along with its location.



The dialog box has a **Next** and **Cancel** button, allowing the operator control over when to point to the next hit in the list. The device will move to the first point, turn on the laser and then wait until the operator clicks **Next**. It then moves to the next point in the list.

If you want to validate the command before creating it, click the **Test** button. PC-DMIS will move to the indicated position or point to the list of hits.

The command can be edited using the Edit window's Command mode or from the dialog box by selecting the command in the Edit window and pressing F9 on the keyboard.

Using Leica Probes

Once PC-DMIS connects to the emScon server, all necessary probe files (*.prb) are automatically created from the available compensated probes in the emScon database (Reflectors and T-Probes). All created *.prb files are to be found in the PC-DMIS installation directory.

In rare situations it might be necessary to create additional customized probe files, this is possible with the **Probe Utilities** dialog box. This provides full flexibility when needed. See "Defining Probes" in the "Defining Hardware" chapter of the core PC-DMIS documentation.

Review the following topics for information on using T-Probes or Reflectors:

- Measuring Points with a T-Probe
- T-Probe Button Assignments
- Scanning with Reflectors
- Measuring Circle Features and Slots with Reflectors
- Tracker Feature Parameters

Measuring Points with a T-Probe

The T-Probe represents a free movable target device to measure with the Laser Tracker and the T-Cam simultaneously. The reflector in the center of the T-Probe is responsible for providing the initial distance measurement of the Absolute Distance Meter (ADM) and the tracking measurement of the Interferometer (IFM). It also receives system command and control signals from the tracker.

Note: See the documentation that came with your T-Probe for detailed information.

Ten (10) IR LEDs with unique IDs are distributed on the T-Probe to provide real-time feedback for measurement procedures. The T-Probe is working in either measurement mode or communication mode. Measurement mode provides that when the laser beam is locked on the reflector that measurements can be taken. Communication mode uses strobing sequences from the LEDs to communicate information back to the LT controller.

Before measurement can take place, the T-Probe battery indicator must be solid green (when connected to the tracker with a cable) or flashing green (using a battery without a cable), and the status indicator must also be green.

To Measure Points:

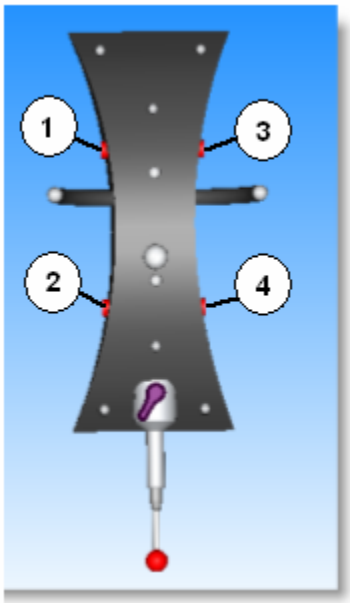
1. Attach the needed stylus to the T-Probe.
2. Switch on the power to the T-Probe.
3. Capture the laser beam in the T-Probe reflector. The Leica T-Probe will automatically be detected by PC-DMIS. The serial number of the T-Probe, the stylus assembly and the respective mount is visualized in the **Settings** toolbar and in the Graphics Display window.

Detected T-Probe Serial Number 252, Stylus Assembly 506, Mount 1

4. Move to the location of the point to be measured while maintaining the laser beam visibility.
5. Record a hit or execute a scan according to the "T-Probe Button Assignments".

Note: If the RMS value for a hit is out-of-tolerance as defined by the "RMSToleranceInMM" value the action specified by the "RMSOutTolAction" will be executed. The available actions are: 0=Accept hit, 1=Reject hit, 2=Prompt to accept or reject hit. These two values are found in the "USER_Option" section of the PC-DMIS Settings Editor.

T-Probe Button Assignments



T-Probe Buttons

1. **Button 1 (A):** Stationary Points

   - **Click for less than 1 second** - Measures a regular stationary point (duration as defined on the "Options tab"). The shank of the stylus is used to determine the probing direction.
   - **Click for greater than 1 second** - Measures a regular stationary point as a "Pulled Hit". To change the vector for the measured point, you can press this button and hold it while moving to a location that defines the vector. The vector is established by the representative line between the measured point and the release point location. See the "Options tab" topic for information about the parameters that affect the way that vectors are recorded.

2. **Button 2 (C):** Currently no functionality
3. **Button 3 (B):** Done/End

   - **Click for less than 1 second** - Ends Feature

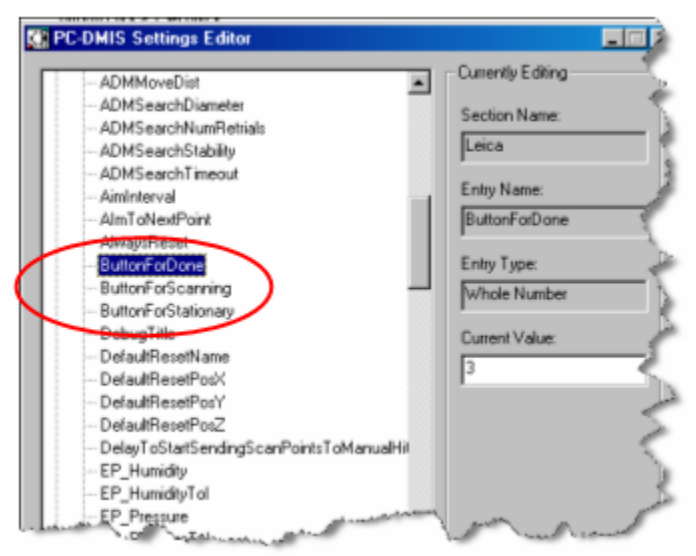
   - **Click for greater than 1 second** - Displays Read out window or enables real-time 3D Distance to CAD. Deletes the last hit.

4. **Button 4 (D):** Scanning Button - Pressing this button starts continuous measurement, while releasing it will stop measurement.

Changing Button Assignments

The standard button assignments of the T-Probe can be changed in the PC-DMIS Settings Editor if required. To do this, just change the number for each of the Leica button entries to the number

of the desired T-Probe button. See the "Settings Editor" documentation for more information on editing registry values.



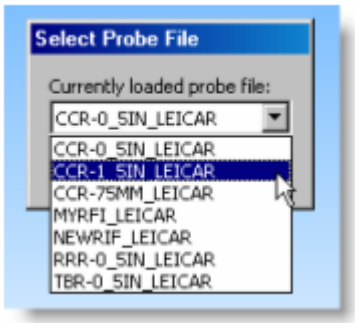
IJK Behavior on T-Probe Points

If aligned to the part, PC-DMIS will always store IJK values perpendicular to one of the active coordinate system axes, except if using Point Only mode.

Scanning with Reflectors

Reflector definitions together with the surface offsets are automatically received from the emScon server and are all available from the **Settings** toolbar. There is no need to define any new probes once the standard reflectors are being used.

Once a reflector has been detected by the Tracker system, the **Select Probe File** dialog box appears, allowing you to select the appropriate reflector.



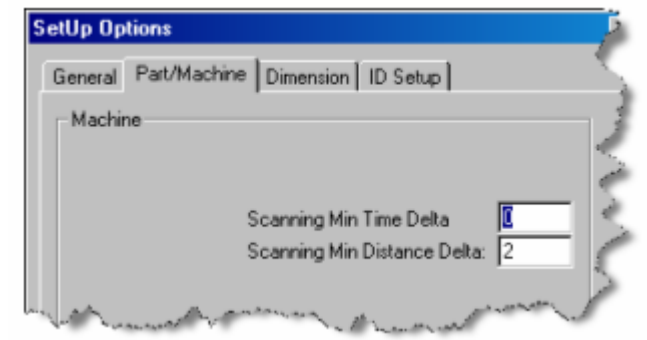
Probe compensation and offset direction

Quick Scanning

To scan a surface or feature using a reflector, you need to be in scan mode. To do this, select the **Operation | Start/Stop Continuous Mode** menu item to start continuous mode.

Continuous Mode allows incremental points to be taken for the reflector location. Scanning is executed by pressing Ctrl-I when using a reflector. Pressing Ctrl-I again will stop continuous scanning.

The **Scanning Minimum Time Delta** and **Scanning Minimum Distance Delta** can be set from the **Part/Machine** tab of the **SetUp Options** dialog box, accessed from the **Edit | Preferences | Setup** menu item. The default value for point distance separation is 2mm.



Advanced Scanning

There are many advanced scans possible like sections, multi-sections, etc. Available scans are created from the **Insert | Scan** menu. See "Performing Advanced Scans" in the "Scanning Your Part" chapter from the core PC-DMIS documentation.

Measuring Circle and Slot Features with Reflectors

When you measure a hole or a internal slot with a reflector attached to a pin nest probe, be sure to lift the probe away from the center of the internal feature when you finish creating or measuring the feature. This way PC-DMIS will properly calculate the vectors. Otherwise the feature's vector may be reversed.

Tracker Feature Parameters

When measuring features with a tracker, additional parameters are added to the feature command in the Edit Window. The parameters found in the "Tracker Parameters" section include:

- Time Stamp
- Probe Name
- Temp (temperature)
- Press (pressure)
- Humid (humidity)
- RMS value (for each hit)

These values are also reflected in the report with a new tracker label.

Constructing Points for Hidden Point Devices

PC-DMIS supports the use of "hidden point adapters" from Leica. This is accomplished by constructing a point from two point inputs and an offset distance. The two points are measured via two reflectors that are mounted along the adapter at specific locations.

After measuring two points, you can construct a point at a specified distance (offset) from the second point along the vector created between the two input points.

To construct this point:

1. Access the **Construct Point** dialog box (**Insert | Feature | Constructed | Point**).
2. Select the **Vector Distance** option from the list of options.
3. Select the first feature.
4. Select the second feature.
5. Specify a distance in the **Distance** box. You can type a negative value to construct the point between the two input features.
6. Click the **Create** button. PC-DMIS will construct a point at the specified distance from the second input feature along the line from the two features.

Using a Total Station

This section discusses the configuration and general usage of your Total Station device with PC-DMIS. Refer to documentation provided with your Total Station for detailed information on configuring and using the Total Station device.

The following topics discuss using the Total Station device with PC-DMIS:

- Getting Started with Total Station
- Total Station User Interface
- Total Station Probe Compensation
- Move Feature (Move To / Point To)
- Finding a Reflector

Getting Started with a Total Station

There are a few basic steps that you should take to verify that your system has been properly prepared before beginning the measurement process with your Total Station.

To get started, complete the following steps:

- Step 1: Install PC-DMIS Portable for Total Station
- Step 2: Connect the Total Station
- Step 3: Launch PC-DMIS

Step 1: Install PC-DMIS Portable for Total Station

To install PC-DMIS Portable for the Leica Total Station, simply insert your portlock into your computer and run the PC-DMIS setup program. Your portlock must be configured to use the Total

Station interface. Once you have run the setup program, simply run PC-DMIS and you are ready to start measuring.

Note: If you are an AE and have a portlock programmed for all interfaces, you can run the PC-DMIS setup program with the following startup option to get an install of PC-DMIS as if your portlock had been programmed specifically for Total Station. *The word "Interface" is case sensitive.*

```
/Interface:leicatps
```

This will add `/portable:leicatps` switches onto the offline and online shortcuts as well as copy the custom layouts associated with the Total Station.

Step 2: Connect the Total Station

Follow the instructions that came with your Total Station hardware for information on connecting the Total Station to your computer.

Step 3: Launch PC-DMIS

To launch PC-DMIS, double-click the **PC-DMIS Online** icon in your PC-DMIS program group. The lower left corner of the screen should display “Machine OK” once PC-DMIS has established communication with the Total Station device.

Total Station User Interface

When you have configured PC-DMIS to use the Total Station interface, additional menu options and status information becomes available in PC-DMIS.

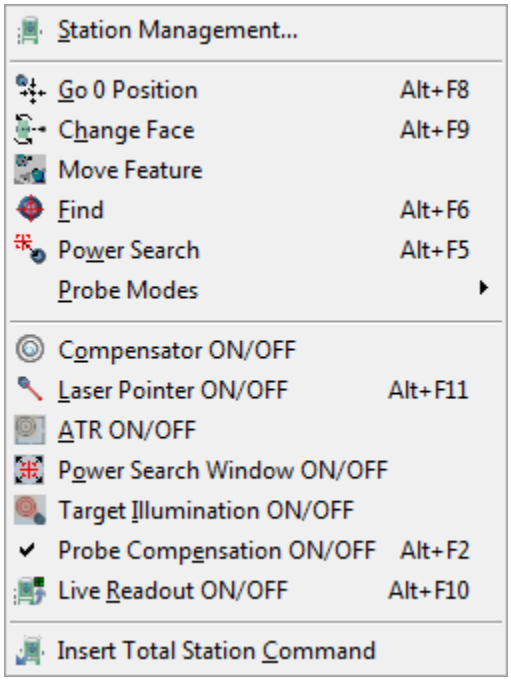
PC-DMIS provides specific menu options as well as standard menu options that are available when using the Total Station interface. Primarily there is a new "Total Station Menu" that has functions that are specific to the Total Station.

Also unique to the Total Station interface are the "Total Station Toolbar" and the "Total Station Status Bar".

There are also "Other PC-DMIS Menu Items" and "Other PC-DMIS Windows and Toolbars" that are common to PC-DMIS that may be useful for Total Station devices.

This section discusses only a few of the menu items that would be used with the Total Station interface. Please refer to the core PC-DMIS documentation for general information on using PC-DMIS.

Total Station Menu



The **Total Station** menu contains these items:

Station Management: This brings up the **Station Manager** dialog box for the Total Station. For details see the "Adding and Removing Stations" topic.

Go 0 Position: This moves the **Total Station** to the zero position. This is a user-defined setting located in the **Machine Options** dialog box (**Edit | Preferences | Machine Interface**).

Change Face: This rotates the Total Station head and camera by 180 degrees. The final target position will be the same as it was before the command was issued, except that now the optics are inverted.

Move Feature This points the total station at a specified feature or at a hit or hits within a feature. Certain dimensions can also be used as inputs to this command. See the "Move Feature (Move To / Point To)" topic for additional information.

Find: This tries to locate a target within the field of view of the Total Station camera. This does not work with tape targets.

Power Search: This attempts to locate a target either within a user-defined window if Power Search Window is enabled or a 360 degree search if not.

Probe Modes: The items in this submenu control how measurements are taken with the Total Station. There are four different modes possible:

- **Single:** This mode takes a single measurement from a single head orientation.

- **Average:** This mode takes multiple measurements from a single head orientation and reports the average of the total measurements. You can configure the number of measurements to take using the **Machine Options** dialog box.
- **Two Face:** This mode takes one measurement, rotates the head and camera by 180 degrees, and then takes a second measurement. The result of the measurement is the average of the two measurements. Note that this does the averaging in cylindrical coordinates even though PC-DMIS reports them in Cartesian coordinates.
- **Stable Probing:** This mode is used when tracking a target. It takes a measurement when target has been stationary for a specified period of time. The parameters for this are defined in the **Machine Options** dialog box.

The various ON/OFF items below are different modes that can be activated when measuring with a Total Station device. Some of these modes are available with all target types and others are only available with specific target types. A description of each mode and its availability follows:

Compensator ON/OFF: This turns the compensator on or off. The compensator adjusts the measurements taken by the device in order to level them to the gravity vector calculated on the machine. This can be helpful when all measurements need to be referenced off of the level of the ground.
Availability: All target types.

Laser Pointer ON/OFF: This turns the laser pointer on or off. The laser pointer makes it easier to locate where the Total Station is pointing. It allows you to position the total station close enough to a target that you can issue a Find command to locate and lock-on to the target if lock-in (see "Lock-in ON/OFF" below) is supported for that target type. It can also be used in conjunction with the Point To command to locate points that are identified by a filter applied to the measurement results (See "Move To Point To" above).
Availability: All target types.

ATR ON/OFF: This stands for Automatic Target Recognition. When turned on, the Total Station will locate the center of mass of the target closest to the center of the optics and make a fine adjustment to the position of the Total Station in order to take more accurate measurements.
Availability: Reflector type measurements only.

Lock-in ON/OFF: When active, the Total Station will track the movement of the target. This allows the operator to find the target and then pick it up and move it from one measurement location to another without having to go back to the Total Station to complete the next measurement. This is used in conjunction with ATR mode. If Lock-in is turned on, PC-DMIS will automatically set ATR to on as well. This works well with the stable probing measurement mode (See the "Stable Probing" item above).
Availability: Prism target types only.

Power Search Window ON/OFF: The total station has the ability to recognize targets within the field-of-view of its optics. This is called Power Search. The Power Search window is a user-specified window or region that defines where the Total Station should search for a target. The window's boundaries can be set using the **Machine Options** dialog box. If the Power Search window is off, it will default to a 360 degree search and stop at the first target found.
Availability: Prism target types only.

Target Illumination ON/OFF: This enables or disables the flashing target illumination light. This light is used to help locate a target while looking through the telescope. The light flashes alternately between red and yellow. When looking through the telescope, you can easily see the

targets because of the light reflected back to the telescope. If the Total Station is locked on a prism and loses that lock, the default action of the machine is to perform a power search to try and relocate the prism, and if one is not found, to turn on the Target Illumination light.
Availability: All target types.

Probe Compensation ON/OFF: The enables or disables the probe compensation. When the probe compensation is "on" PC-DMIS will compensate by the radius of the probe tip or the reflector sphere. During bundle alignment creation, PC-DMIS will automatically activate or deactivate probe compensation as needed when measuring points. See "Total Station Probe Compensation" for more information on probe compensation.

Live Readout ON/OFF: This enables or disables a continual update of the target location on the DRO. Since the Total Station does not send back position updates to PC-DMIS on a regular basis, the standard DRO does not update as do most other devices. This is due to the nature of the communication with the Total Station and the desire to have a responsive interface. However, the Live Readout mode is included if you want to track the location of the target in real time. This is used in conjunction with Lock-in, and PC-DMIS will automatically enable the Lock-in mode if it is not already enabled. If you take a measurement while Live Readout mode is enabled, you will notice the readout update on the DRO will pause. This happens because the measurement mode is momentarily changed in order to get a precise measurement and then switches back to Live Readout mode.
Availability: Prism target types only.

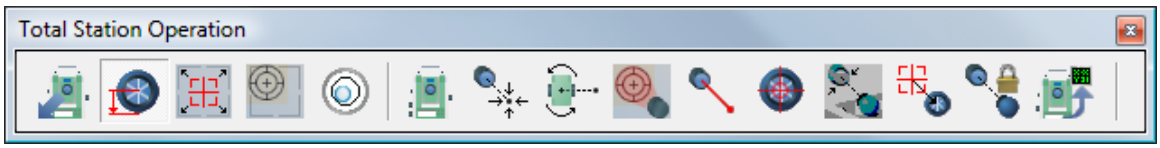
Insert Total Station Command: When enabled, this mode lets you insert selected Total Station menu items or Toolbar items as executable commands into the part program at the cursor's location in the Edit window. This lets you automate repetitive measurements or processes.

Total Station Toolbars

PC-DMIS displays the following two toolbars when you start PC-DMIS with the Total Station interface.

For convenience, the **Total Station Operation**, **Total Station Probe Modes**, **and Total Station Measure** toolbars, described below, provide the same functions that exist on the **Total Station** menu.

Total Station Operation Toolbar



Total Station Operation Toolbar

For a description of the toolbar items on this toolbar, consult the "Total Station Menu" topic.

- Insert Total Station Command

- Probe Compensation On/Off

- Power Search On/Off

- ATR On/Off

- Gravity Compensation On/Off

- Station Management

- Home Position (Go to 0 Position)

- Change Face

- Illumination Light On/Off

- Laser Pointer On/Off

- Find Target

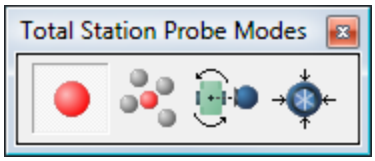
- Move Feature

- Power Search

- Lock-in On/Off

- Live Readouts On/Off

Total Station Probe Modes Toolbar



Total Station Probe Modes Toolbar

For a description of the toolbar items on this toolbar, consult the "Total Station Menu" topic.

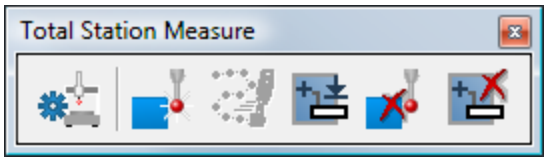
- Single Probing Mode

- Average Probing Mode

- Two Face Probing Mode

- Stable Probing Mode

Total Station Measure Toolbar



Total Station Measure Toolbar

- Machine Interface Parameters

- Take Hit

- Start/Stop Continuous Mode

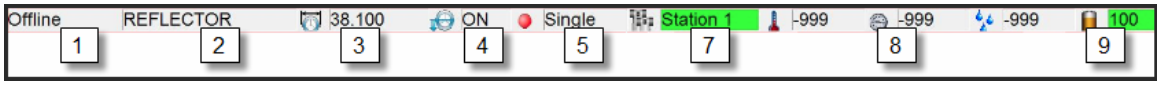
- Create Feature

- Erase Hit

- Delete Feature

Total Station Status Bar

The Total Station status bar automatically appears when you launch PC-DMIS Portable with the Total Station interface:



Total Station Status Bar

By using the **View | Status Bar** menu item you can change the status bar's size and visibility.

1. **System Laser Status Indicator:** This field is used to indicate the status of the system. When online the status will change depending on current settings and operations being performed.

2. **Probe Name:** This lists the name of the active probe.
3. **Probe Diameter:** This displays the probe's diameter.
4. **Probe Compensation:** This indicates whether probe compensation is turned ON or OFF.
5. **Probe Mode:** The probe mode pane will update the icon and text to reflect the currently active probing mode. The probe mode icons are the same ones that are used in the menu and the toolbar.

7. **Active Station Indicator:** Indicates which station is currently active. A double click onto the station indicator opens the **Station Manager** dialog box.

- **Red** (Not oriented): The station position is not computed yet.
- **Green** (Oriented) The station position has been computed.

8. **Environmental Parameter Display:** Shows the active environmental parameters: temperature, pressure, and humidity. If no weather station is connected, it is possible to double-click on the edit boxes to change their values.
9. **Battery Level:** This static icon and the text next to it reflect the current amount of power left in the battery. If the power level is between 25% and 100%, it displays a green background color. If the power level is between 10% and 25%, it displays a yellow background color. For anything 10% or less, it displays a red background color.

Total Station Probe Compensation

For a Total Station device, PC-DMIS retrieves the compensation direction information from a reference plane or work plane (for point features), feature information (hole type features) or Total Station Position (line and plane features) defined when you measure a feature using the **Quick Start** dialog box.

The options inside the **Compensation** area of the **Quick Start** dialog box change depending on the type of measured feature you are measuring. However they all perform the same function, changing the direction of the compensation.

For Points (+ or -)

The **+** and **-** buttons determine the compensation direction of the point along the vector of the reference (measured) plane. In the case of a measured plane, the **+** button will compensate in the same direction as the vector, **-** compensates in the opposite direction of the vector.

Note: The compensation area is not displayed when projecting to a workplane since you can choose plus or minus workplanes which inherently specify compensation direction.

For Measured Lines and Planes (Toward or Away)

The **Toward** or **Away** buttons determine the compensation of lines or planes by either using the vector that is toward the Total Station (measuring from the Total Station to the point) or away from the point (measuring from the point to the Total Station) as the vector for compensation.

For Circles, Cylinders, Cones, Spheres, and Slots (In or Out)

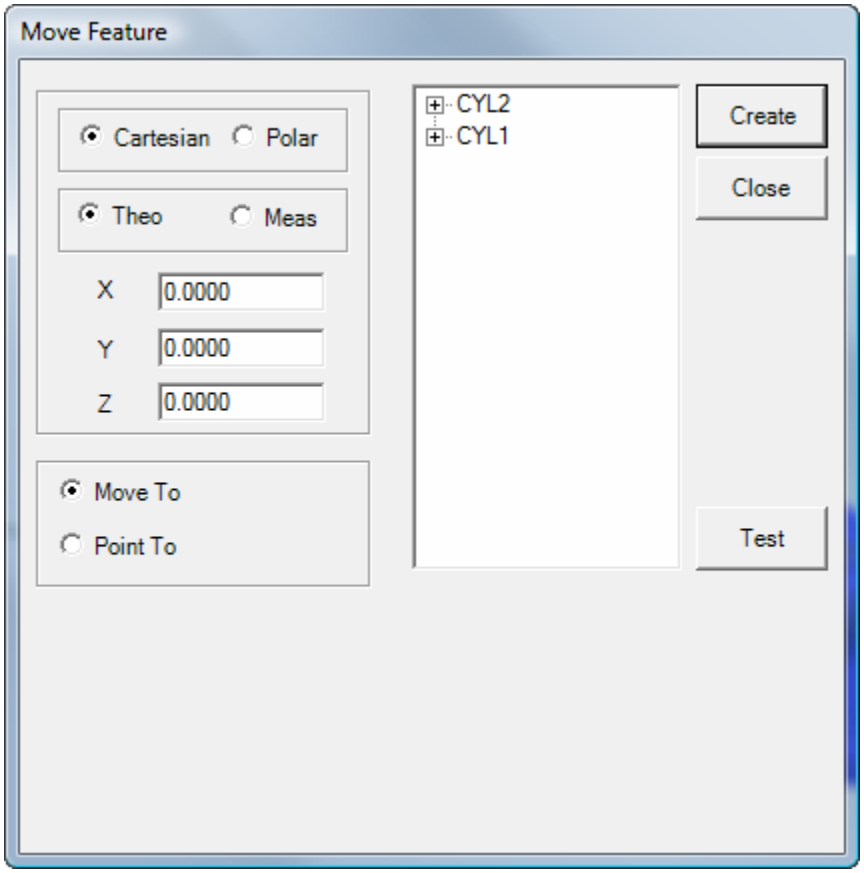
The **IN** and **OUT** buttons determine the compensation direction for hole or stud type features. If you are measuring the inside of a feature, you should choose **IN**. If you are measuring the outside of a feature, you should choose **OUT**.

For Circles and Slots (Toward or Away)

The **Toward** or **Away** buttons appear for circles or slots if you have the **3D** type selected from the **Reference Feature** area of the Quick Start interface. They determine the compensation of circles or slots by letting you specify whether or not a feature's normal vector should point more toward the Total Station or more away from the Total Station. PC-DMIS will mathematically evaluate the feature's current vector and flip it as needed based on your selection.

This does not mean that the vector then points directly at or directly away from the device, because a feature's vector might be more perpendicular to the vector of the device's optics than parallel to it. But the vector will be flipped as needed so that normal vector that points more toward or away from the device as specified.

Move Feature (Move To/ Point To)



Move Feature dialog box

The **Move Feature** dialog box is available when using either a Lieca Tracker or a Leica Total Station device. It appears when you select the **Move Feature** *toolbar icon* on the **Tracker Operation** toolbar or on the **Total Station Operation** toolbar. You can also access it by selecting the **Tracker | Move Feature** or **Total Station | Move Feature** menu items.

The **Move Feature** dialog box contains the **Move To** and **Point To** options. These commands are used only with the Lieca Total Station or Leica Tracker devices. In addition to the standard move ability of other DCC systems, the **Point To** command exploits the unique capabilities of these tracker-type systems by using the device as a laser pointer to identify directly on the part the location of out-of-tolerance points.

Move To

This option moves the device to a specific location where it then tries to find a reflector.

To move to a point, select the **Move To** option and then define where it should move to. There are three ways to specify the location to which it should move.

- **Method 1:** Type the values into the **X**, **Y**, and **Z** boxes (or **R**, **A**, and **Z** if the **Polar** option is used).
- **Method 2:** Select the feature that you are going to move to out of the **Feature** list. When you select the feature, PC-DMIS will fill in the **X**, **Y**, and **Z** values based on the centroid of the feature.
- **Method 3:** Expand the feature by selecting the **+** symbol next to it to display the hits on the feature. While "hits" is something of a misnomer, it simply means the point measured by the laser device. Select one of the hits from the list. PC-DMIS will fill in the **X**, **Y**, and **Z** values for that hit.

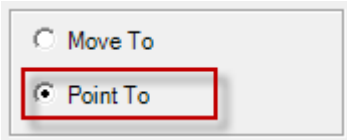
You can choose to move to the measured or the theoretical value for the point by choosing either the **Theo** or **Meas** option.

Once you have set up the command correctly, click **Create** to insert the command into the Edit window.

```
MVF1       =MOVE FEATURE/MOVE TO,CARTESIAN,THEO,<-36.3574,33.3898,-10.8127>,

            FILTER/NA,N WORST/1,

            POINT TO METHOD/NA,DELAY IN SEC/0.0000,

            REF/PNT1,
```

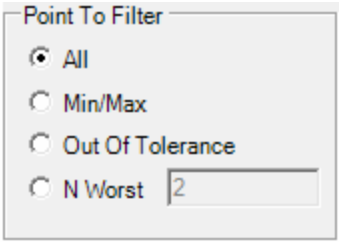
When PC-DMIS executes this command, the device will automatically move to the position indicated and attempt to find a reflector. If no reflector is found, an error will be displayed that says "AUT_FineAdjust - Request timed out". To get past this error, if there is a nearby reflector, you will need to use the **Execution Options** dialog box and stop the execution, adjust the location to point nearer the reflector, and then click **Continue**. If a reflector is not close by, you can click **Skip** to move onto the next point.

Point To



To point to different hits, the procedure is the same as the "Move To" information above, but there are some additional options. With **Point To** you can also select from available dimensions in the part program. If you select a dimension, PC-DMIS displays the **Point To Filter** and **Point To Method** areas. You do not need to select individual hits in the expanded dimension. All hits visible in the dimension will be pointed to, although you can use the **Point to Filter** area to filter hits.

Point to Filter

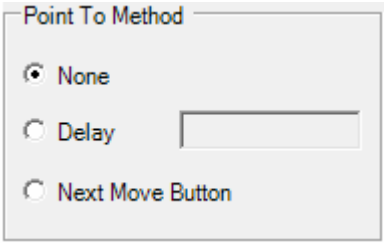


The **Point To Filter** area displays options that control which hits are pointed to. The options include:

- **All** – PC-DMIS will point to each point in the dimension.
- **Min/Max** – PC-DMIS will identify and point to only the Min and Max points.
- **Out Of Tolerance** – PC-DMIS will point to only out-of-tolerance points.
- **N Worst** – PC-DMIS will point to a number of "worst points". These points may or may not be in tolerance. This is a simple sort of the data based on the proximity to the theoretical values.

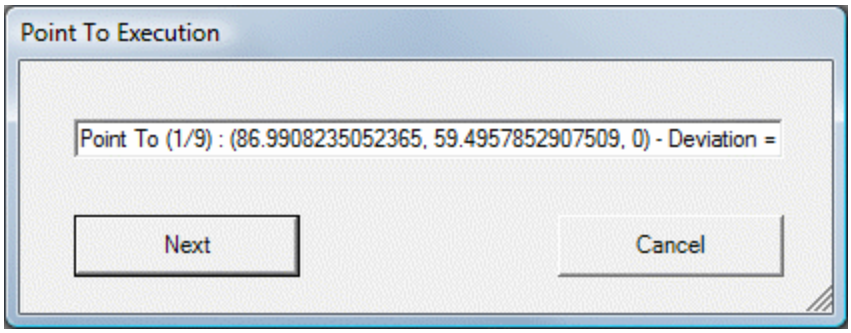
When you choose one of the options in the **Point to Filter** area, PC-DMIS updates the list of hits for the selected dimension in the dialog box to reflect the points to which PC-DMS will point the laser beam. For example, if you select **Min/Max**, the list of hits in the selected dimension will update with only two hits in the list, representing the min and the max points for that dimension. If you choose **All**, the list will update displaying all of the input hits of that dimension.

Point to Method



The **Point To Method** area lets you indicate how the device cycles through the list of points. The options include:

- **None** – There is no delay or user input needed to move to the next point. It points to each of the points without delay just as soon as the device can physically proceed to the next point.
- **Delay** – This delays the cycle time by a specified number of seconds. When executed, the device will point to the first point in the list, turn on the laser and wait the specified amount of time. When the time expires, the laser will turn off and the device will move to the next point and repeat this process until all of the points in the list have been pointed to.
- **Next Move Button** – During execution, a **Point to Execution** dialog box appears showing the index of the point in the list along with its location.



The dialog box has a **Next** and **Cancel** button, allowing the operator control over when to point to the next hit in the list. The device will move to the first point, turn on the laser and then wait until the operator clicks **Next**. It then moves to the next point in the list.

If you want to validate the command before creating it, click the **Test** button. PC-DMIS will move to the indicated position or point to the list of hits.

The command can be edited using the Edit window's Command mode or from the dialog box by selecting the command in the Edit window and pressing F9 on the keyboard.

Finding a Reflector

The Find function allows you to search in a spiral pattern to find the actual location of a reflector or T-Probe (6dof system only) with your Leica Tracker or Total Station device.

Finding a Reflector Location Using a Leica Tracker Device

1. Approximately point the Tracker laser to the location of the desired reflector. This can be done by one or all of the following:
    - "Releasing Tracker Motors" (6dof system only) and manually moving the laser to the location. Note: There is no need to release the motors on the 3D systems.
    - Using the control buttons on the "ADM" tab of the **Machine Options** dialog box...
    - Using the Overview camera ...
    - Using the Alt + left arrow, right arrow, up arrow, down arrow keyboard keys to move the tracker head. Use Alt + Space to stop movement of the laser.
2. Select the **Tracker | Find** menu item. The tracker device will search in a spiral pattern and take readings until the reflector sends the signal back to the device. This will locate the position.

Finding a Reflector Location Using a Total Station Device

1. Approximately point the Total Station laser to the location of the desired reflector. This can be done by one or all of the following:
    - Manually moving the laser to the location...
    - Using the Alt + left arrow, right arrow, up arrow, down arrow keyboard keys to move the tracker head. Use Alt + Space to stop movement of the laser.
2. Select the **Total Station | Find** menu item. The total station device will search in a spiral pattern and take readings until the reflector sends the signal back to the device. This will locate the position.

Note: This function can also be executed from the **View Camera** dialog box.

Creating Alignments

Alignments are key to setting the coordinate origin and the X,Y, Z axes. This chapter discusses alignments commonly used with portable device. For information on other alignment methods, see the "Creating and Using Alignments" chapter of the PC-DMIS Core document.

- Quick Start Alignments
- 6 Point Alignment
- Nominal Point Best Fit Alignment
- Performing a Leapfrog Operation
- Using Bundle Alignments

Quick Start Alignments

There are various alignments that can be created using the Quick Start interface with your portable device. The basic alignment examples provided here relate directly to Leica reflectors and T-Probes, but the principles are the same for all portable devices.

Example Plane-Line-Point Alignment with CAD and Reflectors

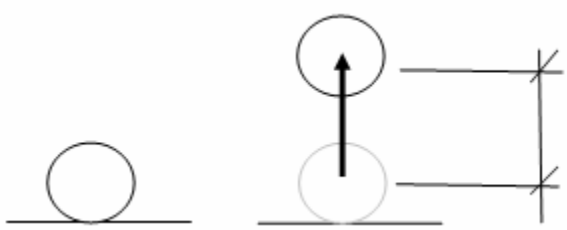
1. Import a CAD model. See "Importing Nominal Data".
2. Select **Alignments | Plane/Line/Point** from the **Quick Start** interface.

Quick Start showing Plane-Line-Point Alignment

3. Follow the instructions provided by the Quick Start interface to measure the alignment features.

IMPORTANT: While not aligned yet to your part, make sure to use the "Pulled Hits Method" to take measurements. See the "Options tab" topic in the "Leica Interface" chapter for more information on "pulled hits".

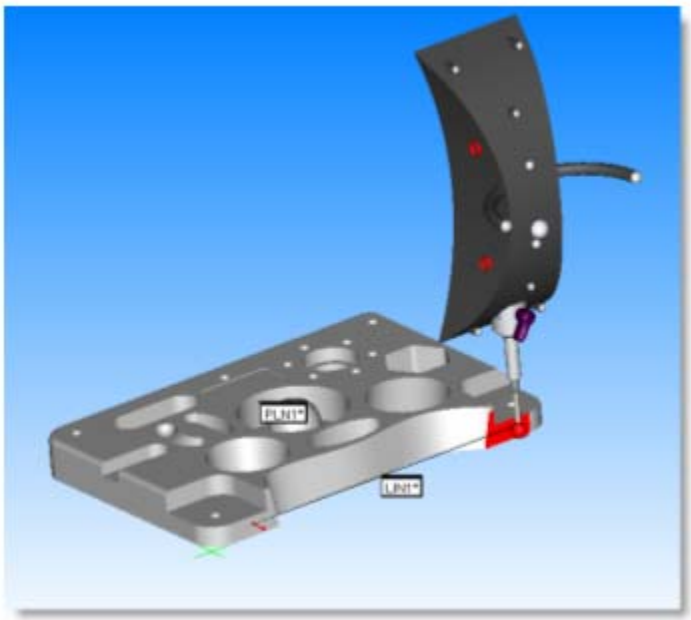
Take Hit (Ctrl-H) stores the current stationary measurement internally. After moving the vector distance, PC-DMIS calculates the IJK vector between the first and second point and compensates the offset of the resulting point accordingly.



Vector Distance depicted for reflector movement

Example Plane-Line-Line Alignment with CAD and T-Probe

1. Import a CAD model. See "Importing CAD Data or Program Data" in the "Using Advanced File Options" chapter from the core PC-DMIS documentation.
2. Switch to Program Mode and select the appropriate mode for your CAD data:
   - **Curve Mode:** Used for CAD with curve and point data.
   - **Surface Mode:** Used for CAD with surface data.
3. Select **Alignments | Plane/Line/Line** from the **Quick Start** interface.
4. Follow the instructions provided by the Quick Start interface to measure the alignment features in Programming Mode.



Measuring Alignment Features with a T-Probe

5. Once the Program is completed, execute it by pressing CTRL-Q or by selecting the **File | Execute** menu item.

IMPORTANT: While not aligned yet to your part, make sure to use the "Pulled Hits Method" to take measurements. See the "Options tab" topic in the "Leica Interface" chapter for more information on "pulled hits".

Creating Alignments Offline

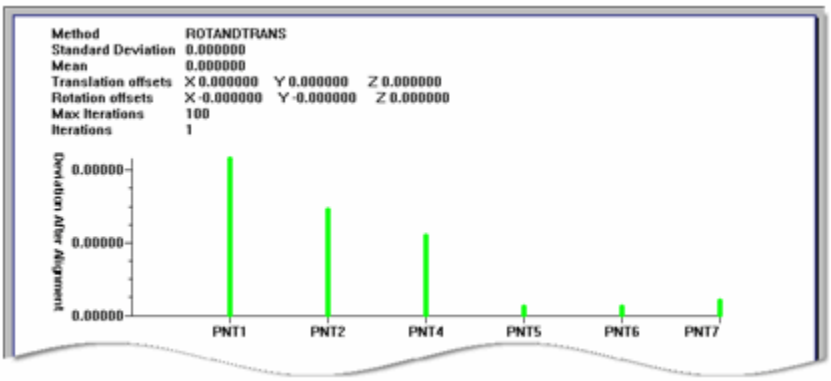
It is also possible to create an alignment offline using features that were previously measured by selecting features from the Edit Window instead of measuring them using the Quick Start interface.

6 Point Alignment

The 6 Point Alignment allows you to perform an iterative 3D Best Fit alignment. The following steps outline a typical procedure that would be used to establish a 6 Point Alignment:

1. Measure three points on the top surface to level to the Z Axis.
2. Measure two points on the front surface to rotate to the X Axis.
3. Finally, measure one point to define the origin for the Y axis.
4. Click Finish. This will establish the correct origin for the alignment.

PC-DMIS inserts the Best Fit 3D Alignment. Following execution, PC-DMIS will display a 3D Alignment Best Fit Graphical Analysis in the Report window.



A Sample Best Fit Alignment Graphical Analysis

This graphical analysis of the 3D Best Fit alignment displays this information in the Report window:

Header: This contains various values used in the Best Fit alignment: Method, Standard Deviation, Mean, Translation offsets, Rotation offsets, Max iterations, Iterations.

Vertical Axis: This shows the amount of deviation after the alignment.

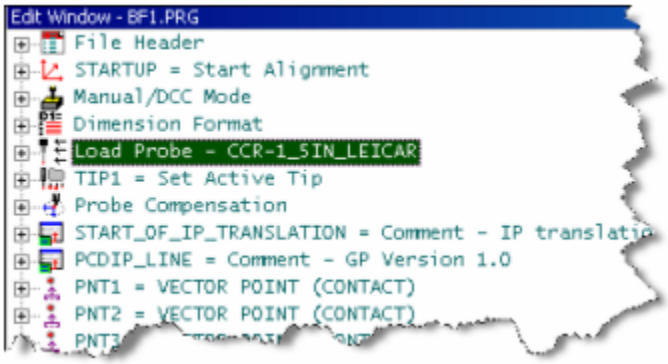
Horizontal Axis: This displays the IDs of the points used in the alignment.

Nominal Point Best Fit Alignment

To create a Nominal Point (N-Point) Best Fit Alignment:

1. Create or Import Nominal Point Data. See "Importing Nominal Data".

Note: If Nominal Data is being used for Leica Reflector offsets and supports, make sure probe compensation option command is turned off and inserted before the points in the part program.



Edit Window - Probe Compensation inserted before nominal points

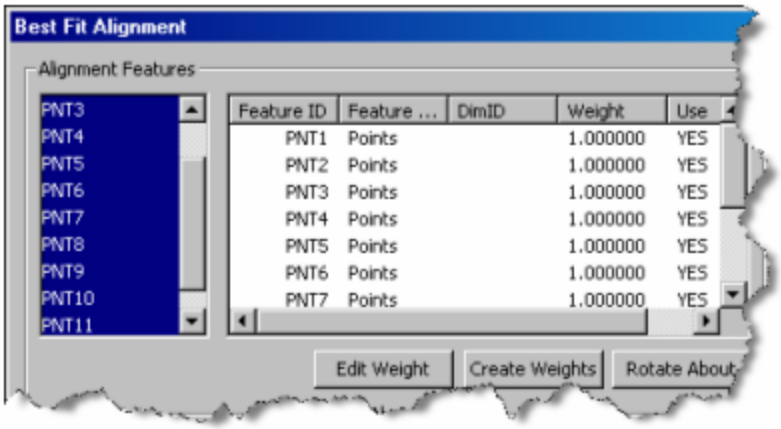
2. Execute the part program by pressing CTRL-Q or by selecting the **File | Execute** menu item.
3. The **Execution Mode Options** dialog box is displayed and guides you through the remaining measurements. Points can be skipped if necessary. Once all measurements have been completed, the dialog box closes.

Execution Mode Options dialog box

4. Insert a BestFit alignment by selecting **Alignments | Align Free** from the **Quick Start** interface or by selecting the **Insert | Alignment | New** menu item. The **Alignment Utilities** dialog box is displayed.

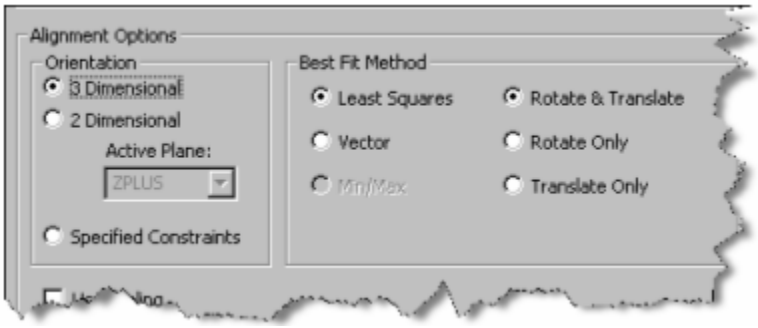
Note: The **Alignment Utilities** dialog box provides the most flexible way to create alignments but requires some experience.

5. Click **Best Fit**.
6. Select all features that should be used in the BestFit alignment.



Best Fit Alignment dialog box - Selecting Features

7. Exclude nominals for axes of selected input features for which theoretical values are not known. This is done by selecting "NO" under the axis column that should be excluded. This is useful in cases where you only know the theoretical values for one or two of the axes rather than all three.
8. Make sure that the correct options are set. In this example a Least Squares 3D alignment is created. By default, 3 Dimensional Orientation is selected for trackers.



Alignment Options

9. Press **OK** to compute the best fit alignment and insert the command into the part program. Overall results of the transformation are displayed in the standard PC-DMIS Report. The report uses the Enhanced BFAnalysis activeX control plus a new label. This new control adds a grid of results of each input before and after the alignment as well as the axes that were used in the calculations.

Since the alignment command comes after the measured features in the part program, the measured points are still presented in the previous coordinate system. To get the contributing point deviations in the newly created active coordinate system, insert Location dimensions into the part program after the alignment command.

Performing a Leapfrog Operation

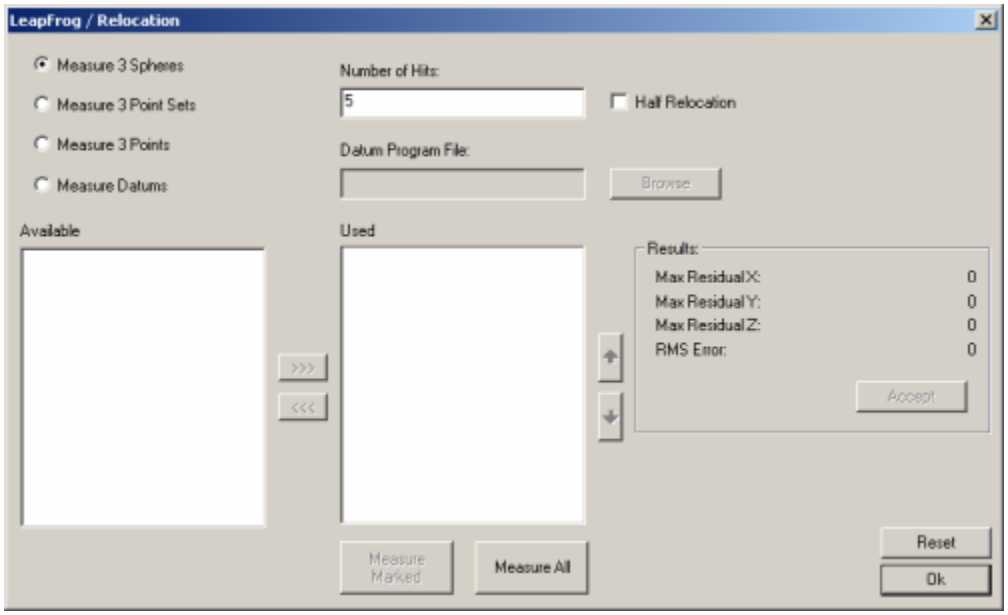
The Leapfrog alignment allows you to move your portable CMM in order to measure parts that outside the extents of your current arm location. You should be aware of machine accuracy limitations before using this method.

The basis for leapfrog is to measure a series of features and then after moving the machine re-measure the same features in the same order. This creates a transformation and makes the machine behave as if it were the same coordinate system before the move.

The transformation is independent of all part programs and affects the way the CMM reports to PC-DMIS. To remove a previously used Leapfrog transformation you must reset the Leapfrog by using the **Reset** button on the dialog box.

Leapfrog is available for some portable machines. Currently these include ROMER, Axila, Faro, Garda, and GOM. Your hardware key (portlock) also needs to be programmed to support your portable machine.

The **Insert | Alignment | Leapfrog** menu option brings up the **Leapfrog / Relocation** dialog box.



Leapfrog / Relocation dialog box

Prior to PC-DMIS version 4.2, Leapfrog transformation information was stored in a separate file and was thereby independent of all part programs. This meant the Leapfrog was still active in newly created part programs and you had to remove it by clicking the **Reset** button on the **Leapfrog / Relocation** dialog box. In version 4.2 and later, however, this has changed. Leapfrog transformation information is now stored with the part program that used the Leapfrog operation; you no longer have to remove the Leapfrog from new part programs.

A Leapfrog command is entered into the Edit window when the **Accept** button is clicked.

The command line in the Edit window would read:

```
LEAPFROG/TOG1, NUM, TOG2
```

TOG1: This first parameter in the Leapfrog command is a toggle field that relates to the three types available in the **Measure 3** area of the dialog box. These types include:

1. SPHERES (**Measure 3 Spheres** option)
2. Point Sets (**Measure 3 Points Sets** option)
3. POINTS (**Measure 3 Points** option)
4. DATUMS (**Measure Datums** option)

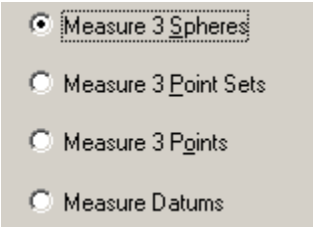
There is also an OFF value for this parameter, in which case the other two parameters will not be displayed. The OFF value will turn off leapfrog translation

NUM: This second parameter in the Leapfrog command is the number of hits you want to take. This corresponds to the **Hits** box in the **Leapfrog** dialog box.

TOG2: This last parameter in the Leapfrog command is a toggle field allowing you to switch between either a FULL or PARTIAL leapfrog. This parameter corresponds to the **Half Relocation** option in the dialog box.

When this command is executed you will be prompted to take your hits, and after all the hits are taken, a leapfrog translation will be in effect.

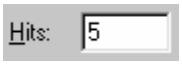
Measure Options



The available Measure option buttons allow you to select what method PC-DMIS will use to perform the translation comparison.

- The **Measure 3 Spheres** option tells PC-DMIS to use spheres as the features for translation comparison. This method uses the center of each measured sphere.
- The **Measure 3 Point Sets** option tells PC-DMIS to use the centroid of a set of points. It is recommended that you use the bottom of an inverted cone with a hard probe . This method is slightly more accurate than the spheres method and much quicker for the operator.
- The **Measure 3 Points** option tells PC-DMIS to use only three points and is the least accurate of the three methods.
- The **Measure Datums** option tells PC-DMIS to use existing datum features from a part program of your choice. Because the datum features are already assumed to have been measured in your existing part program, you only need to measure them after relocating your machine.

Number of Hits



The **Number of Hits** box allows you to specify the number of hits you wish to use when measuring spheres or point sets; you can select these feature types from the **Measure 3 Spheres** and **Measure 3 Point Sets** options. See the "Measure Options" topic.

Half Relocation

The **Half Relocation** check box lets you determine whether or not PC-DMIS performs a FULL RELOCATION (FULL LEAPFROG) operation (if not selected) or performs a PARTIAL RELOCATION (PARTIAL LEAPFROG) operation (if selected).

Relocation simply refers to moving the portable measuring machine to a new location.

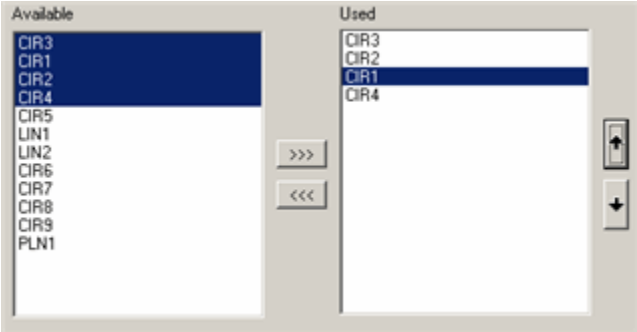
- Doing a full relocation (clearing this check box) means you would need to measure something before you move the portable machine and then re-measure some or all of those items after moving the machine. Remeasuring allows PC-DMIS to determine the new location of the machine.
- A half relocation (selecting this check box) means you move the portable machine first and then measure the datum features.

Datum Program File

This area lets you specify what program file to use as the datum program file. This box becomes enabled when you click the **Measure Datum Features** option button. You can type the full pathway to the part program (.PRG) file or you can use the **Browse** button to navigate through your directory structure and select one that way.

Once you select a file, the features available for use in the Leapfrog operation appear in the **Available** list.

Available and Used Lists



Available and Used lists

The **Available** and **Used** lists display, respectively, datum features that are available for use or datum features that you have chosen to use in the Leapfrog operation.

Available List

When you select a program file to use in the **Datum Program File** area, the available features from that program file appear in the **Available** list. You can then assign features to the current Leapfrog operation by selecting them and then clicking the **>>>** button.

Used List

Assigned features that appear in the **Used** list will be measured when you click the **Measure Marked** or **Measure All** buttons in the order that they appear in the **Used** list. You can remove them from the **Used** list by clicking the **<<<** button. You can change a feature's order of execution by selecting a feature clicking the up or down arrow buttons.

Measure Marked

The **Measure Marked** button only functions if you first select the **Measure Datums** option in the **Measure Options** area. Clicking this button causes a Leapfrog operation to begin, using only the features selected in the **Used** list.

Measure All

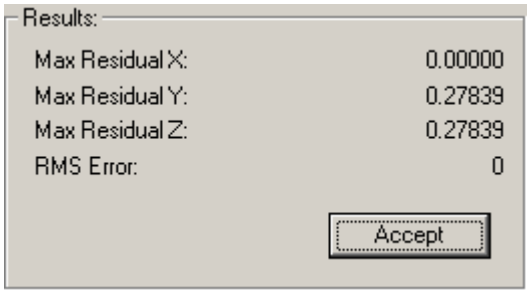
The **Measure All** button lets opens the **Execution Mode Options** dialog box.

- If you are using **Measure 3 Spheres**, **Measure 3 Point Sets**, or **Measure 3 Points**, then this dialog box will first prompt you to measure the three features before prompting you to move the CMM. After moving the machine, you will be prompted to re-measure the same features in the same order.
- If you are using **Measure Datums**, then the **Execution Mode Options** dialog box prompts you to measure all the datum features once you have moved the CMM, not before.

The results box will display the 3D distance between the features taken before the move and after the move of the CMM. If you find the results unsatisfactory then you may re-measure the last set of features again as the button will now read: **Re-measure**.

Note: If the re-measure process proves unsatisfactory, then you must reset the leapfrog and start again from the beginning. This is a problem with all leapfrog systems and should be remembered.

Results area



Results area

The **Results** area shows the deviations between the machine's first position and its subsequent position(s) by displaying the 3D distance between the features taken before the move and after the move of the CMM.

Accept

Once you have a filled out the **Leapfrog / Relocation** dialog box, you must click the **Accept** button from the **Results** area before the leapfrog transformation will be used. Clicking **Accept** will add the `LEAPFROG` command to the part program. If you don't click the **Accept** button but click the X in the upper-right corner or click **OK** first, the constructed leapfrog translation will be lost.

Reset

The **Reset** button removes any translation by adding a `LEAPFROG/OFF` command into the Edit window.

OK

Clicking **OK** closes the **Leapfrog / Relocation** dialog box. If you click this button before clicking the **Accept** button, the dialog box will close without inserting the LEAPFROG command.

Using Bundle Alignments

Bundle alignments are used for large or complex measurements where it is possible to create a number of stations in a common network by moving the same sensor to different positions around the object. As measurements are taken from different station positions around the object, measured information is bundled into one network. With all stations belonging to one single network, all measured data is part of the same coordinate system.

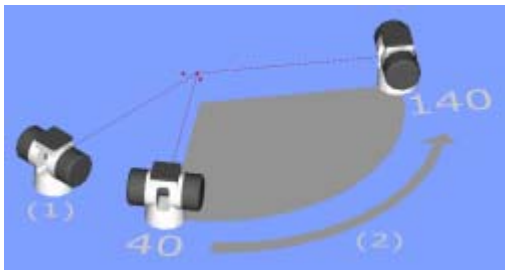
Note: Bundle Alignments can be used with any portable devices as long as you have purchased this functionality for your portable device. In this case, your portlock must be programmed to allow this functionality.

The decision to use more than one station needs to be made well in advance of taking measurements. In fact when planning for a station location, the following points should be taken into account:

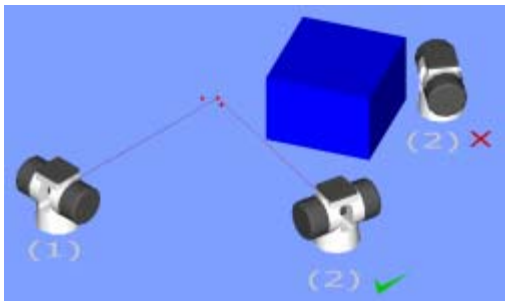
Station Planning Trackers and Total Stations

1. Points used for computing a network should have reasonable intersecting angles (40°-140°). In the example, station (2) should be located somewhere between the 40° and

140° angles in relation to the representative line between station (1) and the common measured points.



2. Points used for computing a network have to be visible to more than one station (position). In the example, station (2) indicated with the green check mark will work, where station (2) with a red X will not work since the line of sight to the common features is blocked.



3. The object points and the common points used for the network calculation must remain stable for the whole measuring process.
4. Avoid station locations that do not vary significantly in position to other station locations.

The bundle adjustment is a least squares optimization. It takes the "bundles" of instrument pointings (measurements of each of the points included in the alignment) and makes successive "adjustments" to the network parameters until there is a best fit between the mathematical model of the network and the actual measurements.

A system may contain a single tracker which is moved to different stations, or you could have multiple trackers which may be moved to different stations. A station is defined as a location where the tracker is placed.

Creating Bundle Alignments

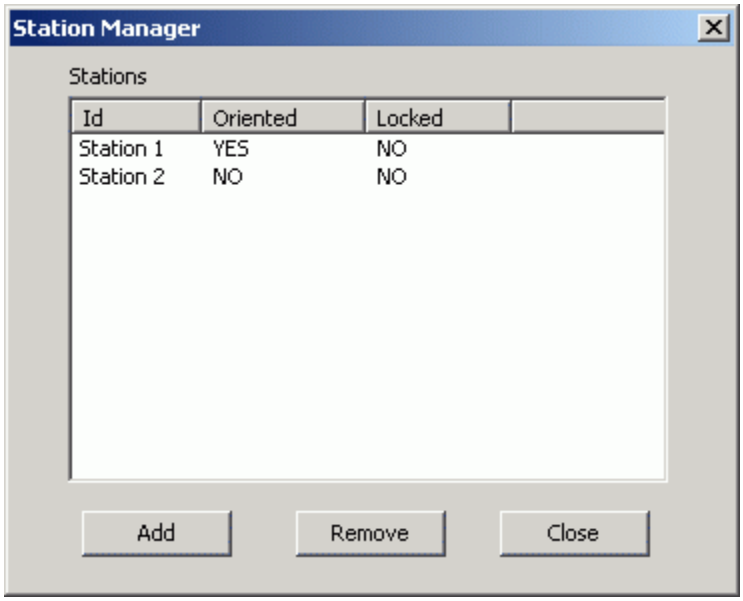
Select the **Insert | Alignment | Bundle** menu option to begin creating a Bundle Alignment. The following topics discuss the process of creating Bundle Alignments and moving stations in the Bundle Alignment:

- Adding and Removing Stations
- Setting Fit Options
- Bundle Alignment Setup
- Bundle Alignment Results
- Bundle Alignment Command Text

- Moving Bundle Alignment Stations

Adding and Removing Stations

The **Station Manager** dialog box is accessed by clicking **Station Manager** from the **Bundle Alignment** dialog box, selecting the **Tracker | Station Management** menu item or clicking the active station name in the **Tracker Status Bar**.



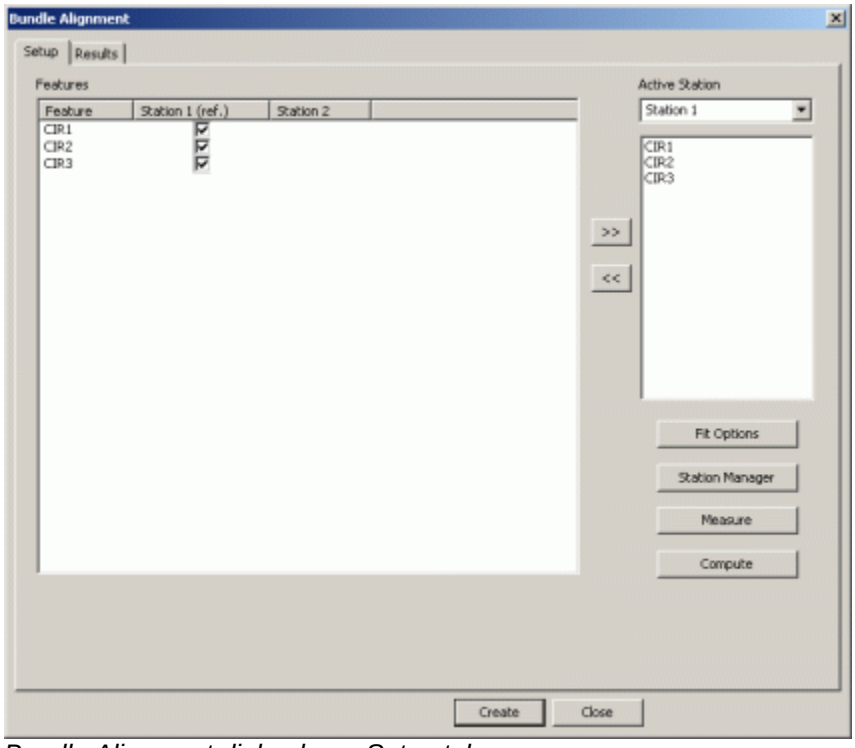
Station Manager dialog box

- Click **Add** to add a new station to the Stations list in the part program.
- Select an existing station form the **Stations** list and click **Remove** to remove that station from the part program.
- **Oriented:** When the values are **YES** in the **Oriented** column then the station location and orientation has been computed.
- **Locked:** When the values are **YES** in the **Locked** column the station will not allow any further measurements. A station becomes locked when the Tracker is moved from its position.

Note: The asterisk next to the station name indicates that it is the active station.

Note: No more than 99 stations are allowed in a bundle alignment calculation.

Bundle Alignment Setup



Bundle Alignment dialog box - Setup tab

Setting up the Bundle alignment entails associating "Bundle Alignment Features" that will be measured by multiple Leica Tracker stations. To do this:

1. Select the check boxes next to the "Bundle Alignment Features" that you would like to include in the Bundle Alignment. Checked "Bundle Alignment Features" will be included in the bundle calculation. If this is the *first* (reference) station, you would select all of the features that you will measure in Step 3. Only "Bundle Alignment Features" that are added to the **Active Station** feature list will be measured when you click **Measure**.

   Note: By clicking the station name at the top of the column, you can either select or deselect all the features under that column.

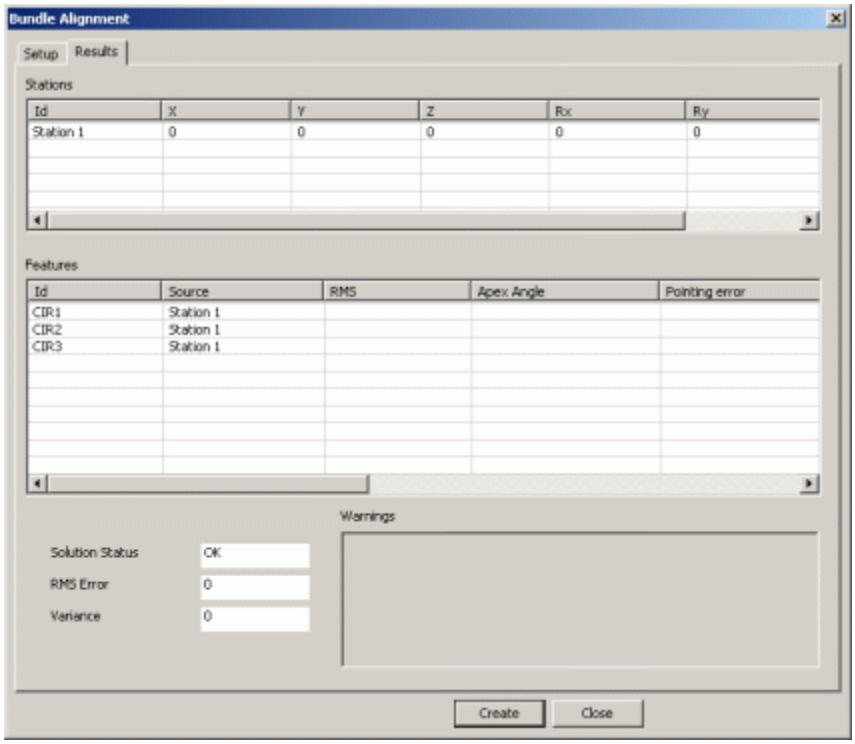
2. Select the next station to use from the **Active Station** drop-down box. "Bundle Alignment Features" can be measured by some or all of the stations.

   Note: Stations that are locked can not be selected as the active station.

3. To define the features that will be measured by the **Active Station** when you click **Measure**, select them from the **Features** list and click the Move Right button >>. This will add them to the list for the **Active Station**. To remove features from the **Active Station** feature list, select the feature and click the Move Left button <<.
4. Click **Measure** to begin measuring the selected features from the **Active Station**. The Bundle Alignment is computed after the last measurement has completed.
5. Review the "Bundle Alignment Results" via the **Results** tab.

6. To re-compute the Bundle Alignment click **Compute**. This is only needed, when you don't like the "Bundle Alignment Results" and you want to modify certain parameters, such as which features to include (check boxes in the **Features** multi-column list box), or changing the Fit Options settings (like a balanced network). This will redo the computation based on the changed parameters without remeasuring.

Bundle Alignment Results



Bundle Alignment dialog box - Results tab

After you have measured and computed the configured Bundle alignment, you can verify the results on the **Results** tab. If you are satisfied with the results, click **Create** to insert the alignment into the part program. The alignment will be executed as defined during normal part program execution.

Interpreting Bundle Alignment Results:

Stations

- **ID:** Name of the Leica Tracker station
- **XYZ:** Shows the translated position of the station with respect to the origin station.
- **Rx Ry Rz:** Shows the rotations about the origin station x, y, and z axes.

Features

- **ID:** Name of the Part Program feature name.
- **Source:** Station name from which the "Bundle Alignment Feature" was originally measured.

- **RMS:** This is the root mean square error (average error) of the given "Bundle Alignment Feature".
- **Apex Angle:** This provides the largest angle between two observations of a measured "Bundle Alignment Feature". If a "Bundle Alignment Feature" is measured from more than two trackers then the angle which is closest to 90 degrees is given as the Apex angle.
- **Pointing error:** This is a measurement of the angular error for a given "Bundle Alignment Feature".
- **XYZ:** Displays the XYZ location for the "Bundle Alignment Feature".
- **Dev XYZ:** These values provide the deviation from the measurement taken from each individual station to the respective best-fitted value.
- **Dev 3D**: This value provides the magnitude of the XYZ deviation.

Solution Status: This is either **OK** or **FAILED** indicating whether or not the algorithm was able to solve the bundle alignment.

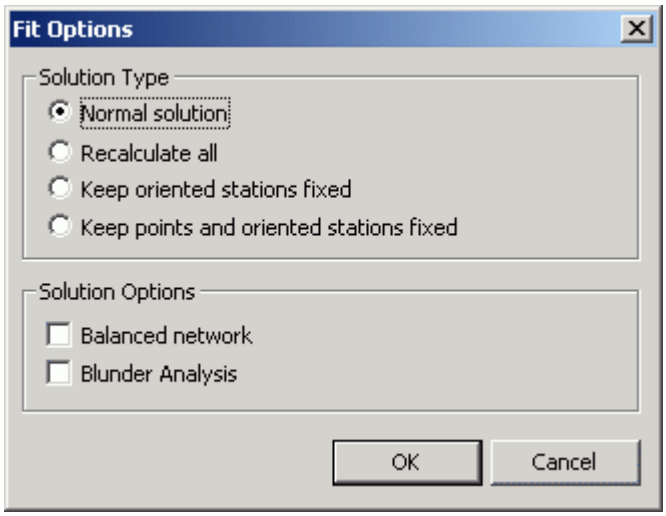
RMS Error: The total RMS error of ALL of the "Bundle Alignment Features".

Variance: The variance of ALL the "Bundle Alignment Features" combined.

Warnings: Specific messages are provided to assist in making adjustments to the Bundle Alignment Solution.

Setting Fit Options

Click **Fit Options** from the **Bundle Alignment** dialog box to open the **Fit Options** dialog box.



Fit Options dialog box

Typically, the default options (shown above) will be used. Select from the following options to determine how the Bundle Alignment solution is calculated:

- **Normal Solution:** Computes the orientation of each station and each "Bundle Alignment Feature" based on the current orientation of the stations and common "Bundle Alignment Features".

- **Recalculate all:** This recomputes the orientation of "Bundle Alignment Features″ and stations disregarding current orientation of stations and common "Bundle Alignment Features″.
- **Keep oriented stations fixed:** Previously oriented stations will remain unchanged and only the last station will be recomputed. The common "Bundle Alignment Features″ will be recomputed.
- **Keep points and oriented stations fixed:** Both previously measured stations and the common "Bundle Alignment Features″ will remain fixed.
- **Balanced network:** This is used to “balance” the system so that a single station is not constrained to be the origin.
- **Blunder Analysis:** This option makes the bundle program display the orientation results as computed by the approximation computations, before any adjustment is carried out. This is the best time to detect blunders, because blunders distort the parameters (coordinates and station parameters); the earlier blunders are detected, the better they can be identified.

Bundle Alignment Command Text

```
BUNDLE ALIGN/ID = 1,SHOW DETAIL = TOG1

FIT OPTIONS/TYPE = TOG2,BALANCED = TOG3,BLUNDER ANALYSIS = TOG4

MEASURE FEATURES/PNT1,PNT2,PNT3,

BUNDLED FEATURES/

STATION = 1,PNT1,PNT2,PNT3,PNT4,

STATION = 2,PNT1,PNT2,PNT3,,

STATION = 3,PNT1,PNT2,PNT4,,

STATION =
```

- **ID:** This field provides the active station number. This is the station from which "Bundle Alignment Features" will be measured.
- **TOG1** (SHOW DETAIL = **YES/NO**): When this value is set to **YES**, a detailed listing of the Bundle Alignment is displayed in the Edit Window. By default, this value is set to **NO**, which will not display the FIT OPTIONS.
- **TOG2** (FIT OPTIONS/TYPE = ***type***): Choose one of four available Fit Options: **NORMAL**, **POINTS AND STATIONS FIXED**, **RECALCULATE ALL**, and **STATIONS FIXED**. See "Setting Fit Options".
- **TOG3** (BALANCED = **OFF/ON**): When this value is set to **ON**, a balanced network solution is used. By default, this value is set to **OFF**. See "Setting Fit Options".
- **TOG4** (BLUNDER ANALYSIS = **OFF/ON**): When this value is set to **ON**, Blunder Analysis is used. By default, this value is set to **OFF**. See "Setting Fit Options".
- **MEASURE FEATURES:** Lists "Bundle Alignment Features" that will be measured for the active station number.
- **BUNDLED FEATURES:** Lists stations and the "Bundle Alignment Features" that are included in the Bundle Alignment computations.

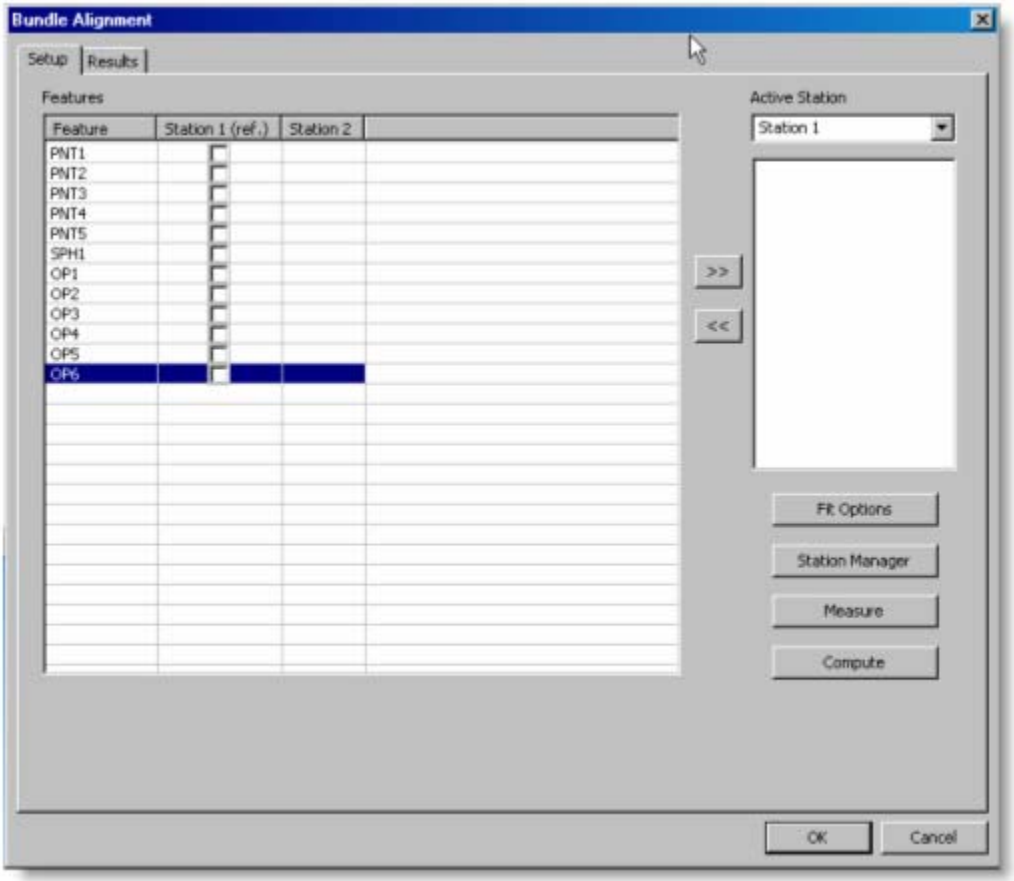
Moving Bundle Alignment Stations

To move to a new Bundle Alignment station:

1. Measure all the features that can be measured from the first tracker position.
2. Create new station by selecting the **Tracker | Station Management** menu item of by clicking in the station name of the **Tracker Status** bar.
3. Click **Add** to add a new station to the **Stations** list and then click **Close**.

Note: Make sure that if using points, the probe compensation has been turned off prior to inserting a bundle alignment command.

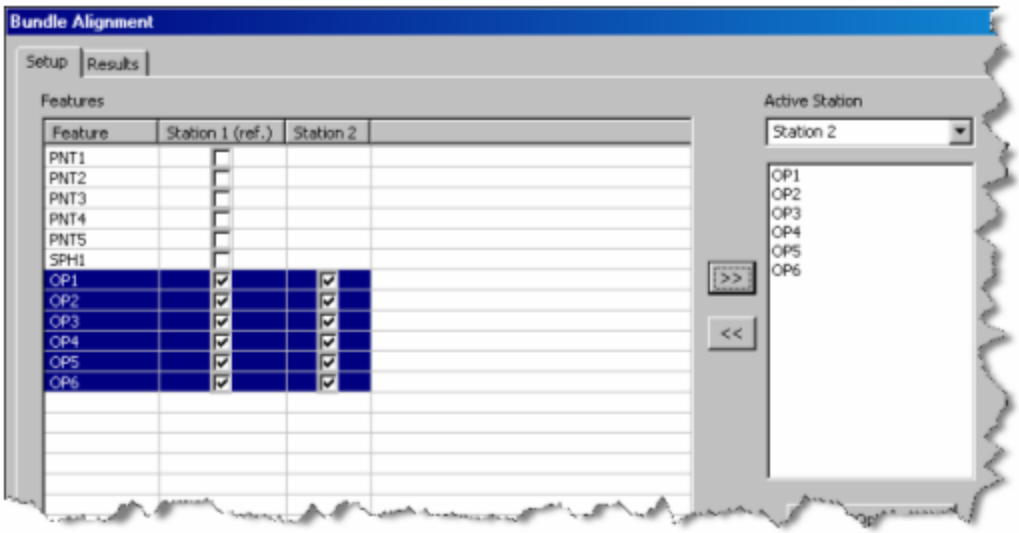
4. Select the **Insert | Alignment | Bundle** menu item to insert a Bundle alignment command. All point reducible features like points, circles and spheres are displayed under Station 1 and can be selected to be part of the bundle alignment.



Bundle Alignment dialog box showing measured features under Station 1

5. Select the next station (created in step 3) to where you will be moving the tracker from the **Active Station** combo box.
6. Select the check boxes next to the features in the column of the first tracker position that should be used for the bundle alignment at the next station position.

7. Click >> to add the selected features to the **Active Station** edit box for the next station.

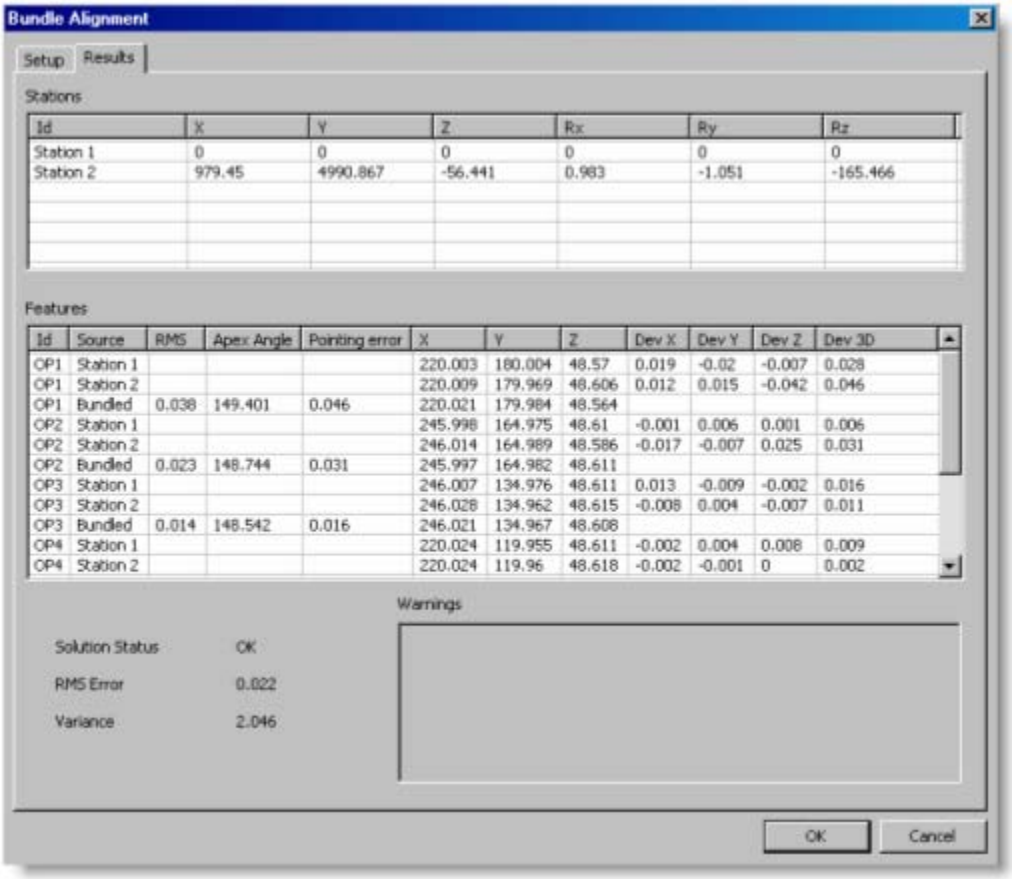


Features selected from the first station added to the next Active Station

8. Physically move the Tracker station to the new **Active Station** position.
9. Click **Measure** and the **Execution Mode Options** dialog box will guide you through the available bundle measurements for the new **Active Station**.

Note: The Status bar indicates that the station is not yet oriented in the bundle network.

10. Review the overall results from the "Results Tab" once all necessary features have been measured. The results for the measured features provides source station, orientation, RMS errors and variance.



Results tab after measuring features from the new Active Station

11. If **Solution Status** reads OK, Clicking **OK** inserts a bundle alignment command into the part program. The new station is now oriented and available in the network.

Note: If necessary, certain features can be excluded from the actual bundle computation and recomputed on the setup tab.

12. Complete the previous steps if you are moving to the next station position.

Measuring Features

Adding measured features using portable devices is typically accomplished by means of the Quick Start interface. As you take hits on the part, PC-DMIS interprets the number of hits, the hit vectors, etc to determine the feature that should be added to the part program.

The supported Measured Features are: Point, Line, Plane, Circle, Cylinder, Cone, Sphere, Round Slot, and Square Slot. From the **Measure** toolbar you can also add manual scans or create features in guess mode. See "A Note on Square Slots" for more information on measuring square slots.

For detailed information on creating Measured Features see "Inserting Measured Features" in the PC-DMIS CMM document. Additional information for measured features can be found in the "Creating Measured Features" topic in the PC-DMIS Core document.

You can also create Auto Features using portable devices. See "Creating Auto Features" in the PC-DMIS CMM document. Additional information for auto features can be found in the "Creating Auto Features" topic in the PC-DMIS Core document.

A Note on Square Slots

When measuring square slots it is important that hits are taken clockwise or counter-clockwise in order around the slot. For example, a square slot with 5 hits should have 2 hits on the first side, and one hit on the remaining 3 sides in order around the slot.

If there are 6 hits there should be 2 on the first side, 1 on the next, 2 on the next, and 1 on the last. The hits should be strictly clockwise or counter-clockwise.

A Note on Thickness Type: None

When measuring auto features using a portable arm machine, the thickness type of "None" will still apply the thickness value if specified. The thickness is applied to shank style measurement. When using a shank probe for measurement, you use the cylindrical shank of the probe to measure instead of the probe tip. To do this you need to first define sample hits. PC-DMIS can then determine the location of the supported feature (Circles, Ellipses, Slots, and Notches) using the shank.

Creating "Single-Point" Measured Circle Features

Portable devices can create a measured circle feature by taking only one hit on that feature. This is termed a "single-point" circle. This is useful when attempting to measure a hole with a probe whose sphere size is larger than the hole's diameter and therefore cannot fit entirely into the hole to take the usual minimum three hits required. In this case, PC-DMIS creates the feature at the intersection of the workplane (or projection plane if a measured plane is currently active) and the probe sphere.

To create a single-point measured circle:

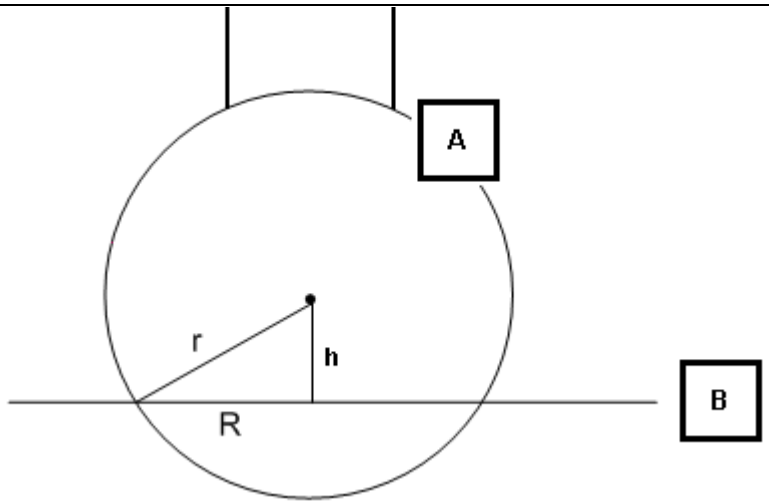
1. Select **View | Other Windows | Quick Start** to access the Quick Start interface. Single-point measured circles will not work using any other creation method.
2. From the **Measure** toolbar, select the **Measure Single Point Circle** toolbar item.

Measure Single Point Circle icon

3. Position the probe in the hole, and take a single hit. PC-DMIS enables the **Finish** button.
4. Click **Finish**. PC-DMIS creates the feature at the intersection of the workplane (or projection plane if a measured plane is currently active) and the probe sphere (see "How It Works" below).

Important: Remember that the calculation is done at the intersection of the probe tip with the workplane or projection plane. If the probe sphere is too high or too low, PC-DMIS will generate an error message indicating that the feature has failed. Also, be aware that measuring holes that are much smaller than the diameter of the probe will result in less accuracy in the resulting circle diameter.

How It Works:



Side view of the workplane and the probe sphere

A - Probe sphere

B - workplane

h - height of the sphere center to the workplane

R - radius of the measured circle

r - radius of the probe sphere

```
`R=sqrt(r^2 - h^2)`
```

Note: If the probe sphere is so high that r is less than h, the intersection math will fail and PC-DMIS will not solve the circle. If the sphere center is below the workplane (B), PC-DMIS will also not solve the circle.

Creating "Two-Point" Measured Slot Features

Similar to creating "Single-Point" measured circle features, portable devices can also create a measured square or round slot feature by taking only two hits, one on each end of the slot. This is termed a "two-point" slot. This is useful when attempting to measure a slot with a probe whose sphere size is larger than the slot's diameter and therefore cannot fit entirely into the slot to take the usual minimum number of hits required for a measured slot. In this case, PC-DMIS creates the feature at the intersection of the workplane (or projection plane if a measured plane is currently active) and the probe sphere.

To create a two-point measured slot feature:

1. Select **View | Other Windows | Quick Start** to access the Quick Start interface.
2. From the **Measure** toolbar, select either the **Measure Two Point Round Slot** toolbar item or the **Measure Two Point Square Slot** toolbar item.

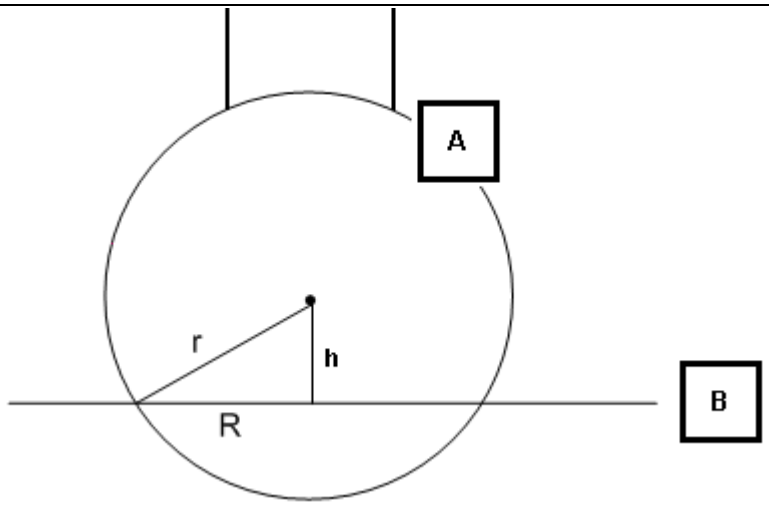
   Note: You don't have to use the Quick Start interface. If desired, you can instead simply click the desired slot feature from the standard **Measured Features** toolbar. However, this topic assumes that you are using the Quick Start interface.

3. Position the probe as far as it will go down into one of the ends of the slot, and take a hit. The hit should be on the bottom hemisphere of the probe sphere.
4. Position the probe as far as it will go down into the other end of the slot, and take a hit. The hit should be on the bottom hemisphere of the probe sphere.
   - If the probe sphere properly intersected with the workplane (or projection plane) with both hits then PC-DMIS will enable the **Finish** button.
   - If the first hit did not intersect properly with the workplane or projection plane, a message box will appear that says, "Hit 1 out of range". If the first hit did intersect with the work or reference plane, but the second did not, it will display, "Hit 2 out of range". If you receive one of these error message, you will need to retake both hits, adjusting your workplane or projection plane as needed so that a proper intersection with the probe sphere takes place.
5. Click **Finish**. PC-DMIS creates the feature at the intersection of the workplane (or projection plane if a measured plane is currently active) and the probe sphere (see "How It Works" below).

- The width of the slot is based on the amount of probe sphere that intersects with the work or projection plane when the probe comes in contact with the feature on the part.
- The length of the slot is based on the distance between the two slot points.

Important: Remember that the calculation is done at the intersection of the probe sphere with the workplane or projection plane. If the probe sphere is too high (it doesn't intersect with the plane at all) or is too low (the hit is on the upper hemisphere or higher), PC-DMIS will generate an error message indicating that the feature has failed.

How It Works:



Side view of the workplane and the probe sphere

A - Probe sphere

B - workplane

h - height of the sphere center to the workplane

R - radius of the measured slot. The slot's width is twice this value.

r - radius of the probe sphere

```
R = sqrt(r^2 - h^2)
```

Note: If the probe sphere is so high that r is less than h, the intersection math will fail and PC-DMIS will not solve the slot. If the sphere center is below the workplane (B), PC-DMIS will also not solve the slot.

Portable Hard Probe Scanning

PC-DMIS Portable allows you to scan features using one of six manual scanning methods. Measured points are collected as fast as they are read by the controller during the scanning process. Once the scan is complete, PC-DMIS will offer you an opportunity to reduce the collected data based on the scanning method selected. You must have PC-DMIS configured for using a hard probe for these scanning types to be available.

To begin creating manual scans, place PC-DMIS into **Manual mode** and then select one of the available manual scan types from the **Scan (Insert | Scan)** submenu. These include:

- Fixed Distance
- Fixed Time/Distance
- Fixed Time
- Body Axis
- MultiSection
- Manual FreeForm

The appropriate manual scan dialog box will open. For information on the options available in the **Scan** dialog box, the dialog box used to perform these scans, see the "Common Functions of the Scan Dialog Box" in the PC-DMIS Core documentation.

When creating Auto Features, sample hits can be taken using a manual scan. See "Scanning for Auto Feature Sample Hits".

Rules for Manual Scans

This topic discusses rules governing manual scanning using a hard probe on a portable device.

Rules for Manual Scans in General

The following description lists the rules that you need to follow to have manual scanning compensate correctly and with greater speed on Arm CMMs.

- You should not lock any axis during the scan. PC-DMIS takes the scan by crossing the probe over a keyed in **Body Axis** location. Each time the probe crosses this given plane the CMM takes a reading and passes it to PC-DMIS.
- On this type of scan you must type the **InitVec** and the **DirVec** values in the Part Coordinate System . This is required to work together with the **Body Axis** location.
- Make sure you type the **Body Axis** in the Part Coordinate System.

When multiple rows of manual scans are being done, we recommend that every other scan line be reversed.

For example (continuing the scan of the sphere as outlined above):

1. Begin the scan along the surface in the +X direction.

2. Move to the next row and scan along the -X axis.
3. Continue to switch the direction of the scan as needed. The internal algorithms depend on this kind of regularity and could give poor results if the scheme is not followed.

Compensation Limitations

With Fixed Distance, Fixed Time / Distance, and Fixed Time scan, PC-DMIS automatically lets you take manual hits in a three-dimensional manner, in any direction. This is useful when scanning using free moving manual CMMs (such as a Romer or Faro arm) whose axes cannot be locked.

Since you can move the probe in any direction, PC-DMIS cannot accurately determine the proper probe compensation (or the Input and Direction vectors) from the measured data.

There are two solutions to the compensation limitations:

- *If CAD surfaces exist*, then you can select **FINDNOMS** from the **Nominals** list. PC-DMIS will attempt to find the nominal values for each measured point in the scan. If the nominal data is found, then the point will be compensated along the found vector, allowing proper probe compensation; otherwise, it will remain at Ball Center.
- *If CAD surfaces do not exist*, then probe compensation will not occur. All data will remain at Ball Center with no probe compensation occurring.

Scanning for Auto Feature Sample Hits

If you measure an Auto Feature that uses sample hits, PC-DMIS will prompt you to take those sample hits during part program execution. Instead of taking just a few individual hits with your portable arm, however, you can now scan the surface with the probe to retrieve multiple hits very rapidly on each surface. This helps to improve your accuracy.

Some features, such as an Auto Circle have one sample plane. Other auto features such as Auto Angle Point or Auto Corner Point have multiple sample planes. To scan a surface, simply press the button on your portable machine that begins retrieving hits from the controller, then pass the probe over the surface for as long as you like, PC-DMIS will read in multiple hits. When you release the button and finish scanning the surface, PC-DMIS will prompt you to take the next set of sample hits on the next surface. Continue this process until you have scanned all necessary sample hits on all surfaces.

Rules of Scanning for Sample Hits

- You cannot scan for multiple sample planes in one scan segment. In other words, you can’t scan sample hits around corners. When you scan for sample hits, each scan must remain on a single surface. If a feature needs sample hits from more than one surface, such as a corner point feature that uses three surfaces, each surface needs its own scan.
- You cannot scan for sample hits and then measure a feature using the same scan segment. When scanning sample hits prior to actually scanning the feature to measure it, you should perform a scan segment for each surface needing sample hits, and then a separate scan segment for the actual feature measurement.

- When scanning the actual feature, not the sample hits, you can perform the feature measurement in a single scan. For example, for an Auto Square Slot you will scan all four sides in one continuous segment.

For information on Auto Features and sample hits, see the "Creating Auto Features" chapter of the core PC-DMIS document.

Registry Entries for Hard Probe Scanning

There are several registry entries in the PC-DMIS Settings Editor that control how when points are read into PC-DMIS from your portable arm's controller. The following entries are located in the **HardProbeScanningInFeatures** section:

- `MinDeltaBetweenPointsInMM` - This sets the minimum distance (in millimeters) that your probe must pass before a new hit gets sent from the controller to PC-DMIS.
- `MinTimeDeltaBetweenPointsInMilliseconds` - This sets the minimum time (in milliseconds) that must pass before PC-DMIS takes a new hit.
- `MaxPointsForAFeature` - This sets the maximum number of points needed for a feature. Any points read into PC-DMIS from the controller beyond this maximum number are ignored.

For information on these entries, launch your PC-DMIS Settings Editor and press F1 to access its help file. Then navigate to the appropriate topics.

Performing a Fixed Distance Manual Scan

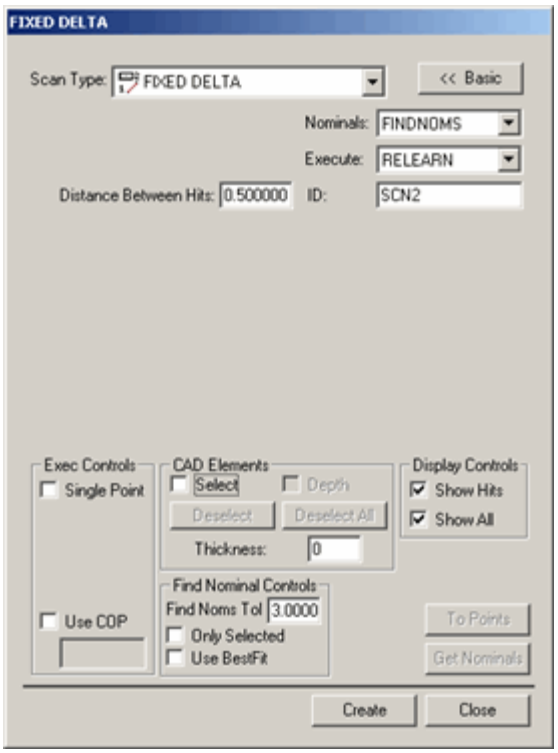
The Fixed Delta method of scanning allows you to reduce the measured data by setting a distance value in the **Distance Between Hits** box. PC-DMIS will start from the first hit and reduce the scan by deleting hits that are closer than the distance specified. The reduction of hits happens as data comes from the machine. PC-DMIS only keeps the points that are set apart by *more* than the specified increments.

Example: If you have specified an increment of 0.5, PC-DMIS will only keep hits that are at least 0.5 units apart from each other. The rest of the hits from the controller are discarded.

See the "Common Functions of the Scan Dialog Box" topic of the PC-DMIS Core documentation for information on this tab's other controls.

To Create a Fixed Distance (Delta) Scan:

1. Select the **Insert | Scan | Fixed Distance** menu option. The **FIXED DELTA** dialog box appears.



FIXED DELTA dialog box

2. Specify a custom name for the scan in the **ID** box, if you don't want to use the default name.
3. In the **Distance Between Hits** box, type the distance that the probe will need to move before PC-DMIS takes a hit. This is the 3D distance between points. For example, if you 5, and your units of measurement is millimeters, the probe has to move at least 5 mm from the last point before PC-DMIS accepts a hit from the controller.
4. If you're using a CAD model, type a **Find Nominals** tolerance in the **Find Nominals Control** area. This defines how far away the actual ball center point can be from the nominal CAD location.
5. Set any other dialog box options as needed.
6. Click **Create**. PC-DMIS inserts the basic scan.
7. Execute your part program. When PC-DMIS executes the scan, the **Execution Options** dialog box appears and PC-DMIS waits for data to come from the controller.
8. Manually drag the probe over the surface you want to scan. PC-DMIS will accept hits from the controller that are separated by any distance greater than the distance you defined in the **Distance Between Hits** box.

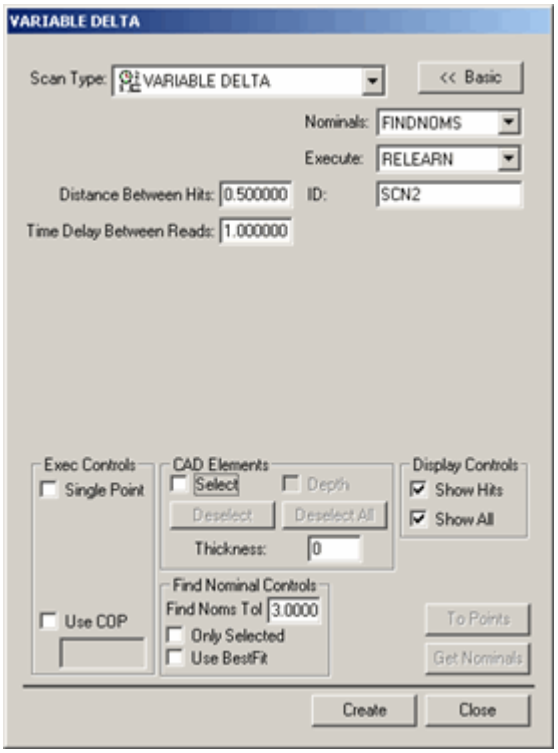
Performing a Fixed Time / Distance Manual Scan

The Fixed Time / Distance (Variable Delta) method of scanning allows you to reduce the number of hits taken in a scan by specifying the distance the probe must move as well as the time that must pass before additional hits can be accepted by PC-DMIS from the controller.

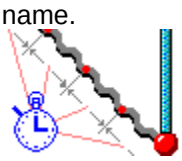
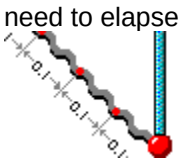
See the "Common Functions of the Scan Dialog Box" topic of the PC-DMIS Core documentation for information on this tab's other controls.

To Create a Fixed Time / Distance (Variable Delta) Scan:

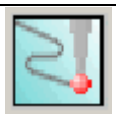
1. Select the **Insert | Scan | Fixed Time / Distance** menu option. The **VARIABLE DELTA** dialog box appears.



VARIABLE DELTA dialog box

2. Specify a custom name for the scan in the **ID** box, if you don't want to use the default name.
3.  In the **Time Delay Between Reads** box, type the time in seconds that will need to elapse before PC-DMIS takes a hit.
4.  In the **Distance Between Hits** box, type the distance that the probe will need to move before PC-DMIS takes a hit. This is the 3D distance between points. For example, if you 5, and your units of measurement is millimeters, the probe has to move at least 5 mm from the last point before PC-DMIS accepts a hit from the controller.
5. If you're using a CAD model, type a **Find Nominals** tolerance in the **Find Nominals Control** area. This defines how far away the actual ball center point can be from the nominal CAD location.
6. Set any other dialog box options as needed.
7. Click **Create**. PC-DMIS inserts the basic scan.
8. Execute your part program. When PC-DMIS executes the scan, the **Execution Options** dialog box appears and PC-DMIS waits for data to come from the controller.
9. Manually drag the probe over the surface you want to scan. PC-DMIS checks the amount of time elapsed and the distance the probe moves. Whenever the time and distance exceed the values specified, it will accept a hit from the controller.

Quick Start Manual Scan

	You can also begin execution of a variable scan from the **Quick Start** interface by clicking the **Scan** button. You will be prompted to take hits for manual scanning. Once you have completed take scan hits, click **Finish** to add the manual scan (variable delta) feature to the part program.

Performing a Fixed Time Manual Scan

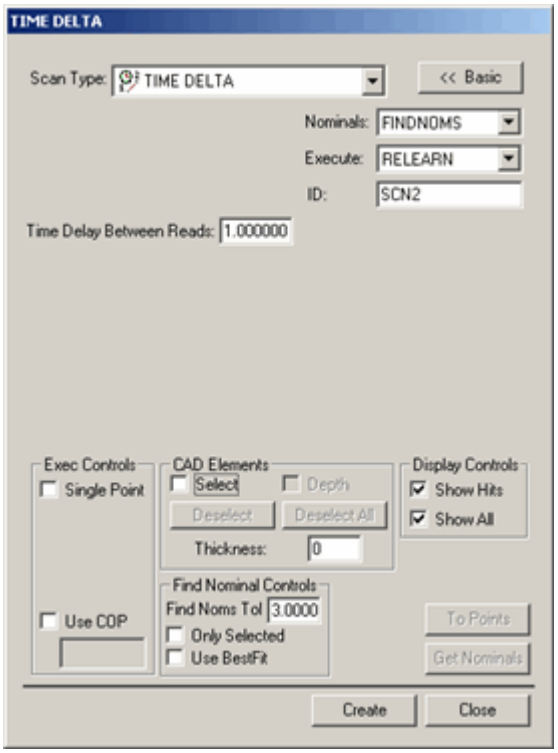
The Time Delta method of scanning allows you to reduce the scan data by setting a time increment in the **Time Delay Between Reads** box. PC-DMIS will start from the first hit and reduce the scan by deleting hits that are read in faster than the specified time delay.

Example: If you specify a time increment 0.05 seconds, then PC-DMIS will only keep hits from the controller that are measured at least 0.05 seconds apart. The other hits are excluded from the scan.

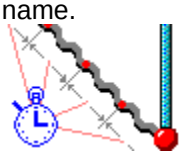
See the "Common Functions of the Scan Dialog Box" topic of the PC-DMIS Core documentation for information on this tab's other controls.

To Create a Fixed Time (Time Delta) Scan:

1. Select the **Insert | Scan | Fixed Time** menu option. The **TIME DELTA** dialog box appears.



TIME DELTA dialog box

2. Specify a custom name for the scan in the **ID** box, if you don't want to use the default name.
3.  In the **Time Delay Between Reads** box, type the time in seconds that will need to elapse before PC-DMIS takes a hit.
4. If you're using a CAD model, type a **Find Nominals** tolerance in the **Find Nominals Control** area. This defines how far away the actual ball center point can be from the nominal CAD location.
5. Set any other dialog box options as needed.
6. Click **Create**. PC-DMIS inserts the basic scan.
7. Execute your part program. When PC-DMIS executes the scan, the **Execution Options** dialog box appears and PC-DMIS waits for data to come from the controller.
8. Manually drag the probe over the surface you want to scan. Whenever the elapsed time exceeds the values specified in the Time Delay Between reads box, PC-DMIS will accept a hit from the controller.

Performing a Body Axis Manual Scan

The Body Axis method of scanning allows you to scan a part by specifying a cut plane on a certain part axis and dragging the probe across the Cut Plane. As you scan the part, you should scan so that the probe crisscrosses the defined Cut Plane as many times as desired. PC-DMIS then follows this procedure:

1. PC-DMIS gets data from the controller and finds the two data hits that are closest to the Cut Plane on either side as you crisscross.
2. PC-DMIS then forms a line between the two hits which will pierce the Cut Plane.
3. The pierced point then becomes a hit on the Cut Plane.

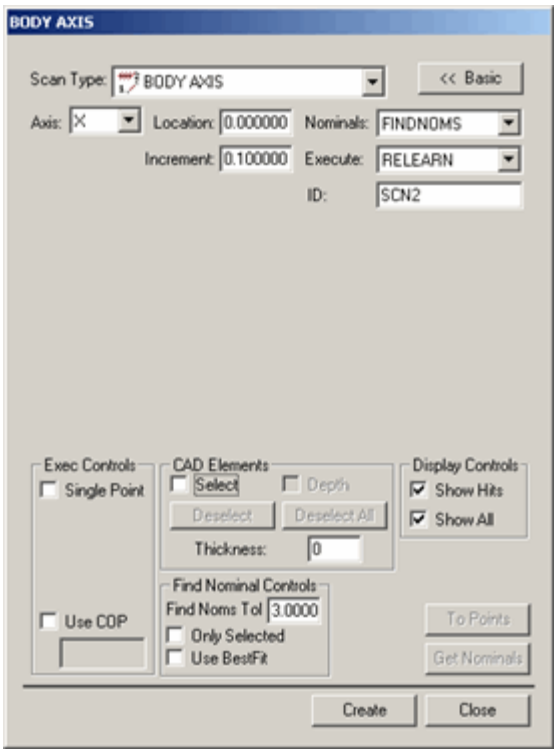
This operation happens every time you cross the Cut Plane and you will finally have many hits that are on the Cut Plane.

You can use this method to inspect multiple rows (PATCH) of scans by specifying an increment for the cut plane location. After scanning the first row, PC-DMIS will move the cut plane to the next location by adding the current location to the increment. You can then continue scanning the next row at the new Cut Plane location.

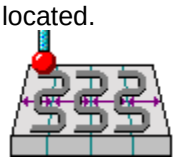
See the "Common Functions of the Scan Dialog Box" topic of the PC-DMIS Core documentation for information on this tab's other controls.

To Create a Body Axis Scan:

1. Select the **Insert | Scan | Body Axis** menu option. The **BODY AXIS** dialog box appears.



BODY AXIS dialog box

2. Specify a custom name for the scan in the **ID** box, if you don't want to use the default name.
3. From the **Axis** list, select an axis. The available axes are X, Y, and Z. The cut plane that your probe will crisscross will be parallel to this axis.
4. In the **Location** box, specify a distance from the defined axis where your cut plane will be located.
5.  In the **Increment** box, specify the distance between planes if you will be scanning across multiple planes.
6. If you're using a CAD model, type a **Find Nominals** tolerance in the **Find Nominals Control** area. This defines how far away the actual ball center point can be from the nominal CAD location.
7. Set any other dialog box options as needed.
8. Click **Create**. PC-DMIS inserts the basic scan.
9. Execute your part program. When PC-DMIS executes the scan, the **Execution Options** dialog box appears and PC-DMIS waits for data to come from the controller.
10. Manually drag the probe back and forth over the surface you want to scan. As the probe approaches a defined cut plane, you will hear a continual audible tone that gradually increases in pitch until the probe crosses the plane. This audible cue helps you determine how close the probe is to any cut planes. PC-DMIS will accept hits from the controller each time the probe crosses the defined plane.

Performing a Multisection Manual Scan

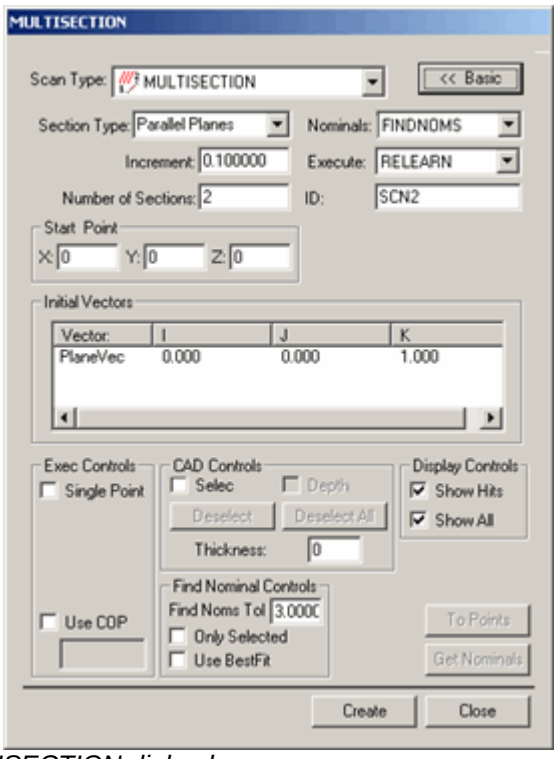
The Multisection method of scanning functions much like the Body Axis manual scan with these differences:

- It can cross multiple sections.
- It does not have to be parallel to the X, Y, or Z axis.

See the "Common Functions of the Scan Dialog Box" topic of the PC-DMIS Core for information on this tab's other controls.

To Create a Multisection Scan:

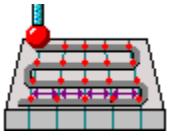
1. Select the **Insert | Scan | Multisection** menu option. The MULTISECTION dialog box appears.



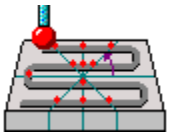
MULTISECTION dialog box

2. Specify a custom name for the scan in the ID box, if you don't want to use the default name.
3. From the Section Type list, choose the type of sections you want to scan. Available types include:

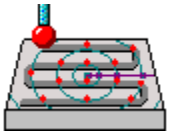
- *Parallel Planes*

 - The sections are planes running through your part. Every time the probe crosses a plane, PC-DMIS records a hit. Planes are relative to the start point and direction vector. If you select this type, define the vector of the initial plane in the Initial Vectors area.

- *Radial Planes*

 - These sections are planes radiate out from the start point. Every time the probe crosses a plane, PC-DMIS takes a hit. If you select this type, define two vectors in the Initial Vectors area. The vector of the initial plane (PlaneVec), the other, the vector around which the planes are rotated (AxisVec).

- *Concentric Circles*

 - These sections are concentric circles with increasingly larger diameters centered around the start point. Every time the probe crosses a circle, PC-DMIS takes a hit. If you select this type, define a single vector in the Initial Vectors area which defines the plane in which the circle lies (AxisVec).

4. In the Number of Sections box, type how many sections you want to have in your scan.
5. If you chose at least two sections, specify the increment between sections in the Increment box. For parallel planes and circles, this is the distance between places, for radial planes this value is an angle. PC-DMIS automatically spaces the sections on the part.
6. Define the scan's start point. In the Start Point area type the X, Y, and Z values, or click on your part to have PC-DMIS select the start point from the CAD drawing. The sections are calculated from this temporary point based on the increment value.
7. If you're using a CAD model, type a Find Nominals tolerance in the Find Nominals Control area. This defines how far away the actual ball center point can be from the nominal CAD location.
8. Set any other dialog box options as needed.
9. Click Create. PC-DMIS inserts the basic scan.
10. Execute your part program. When PC-DMIS executes the scan, the Execution Options dialog box appears and PC-DMIS waits for data to come from the controller.
11. Manually drag the probe over the surface you want to scan. As the probe approaches each section, you will hear a continual audible tone that gradually increases in pitch until the probe crosses the section. This audible cue helps you determine how close the probe is to a section crossing. PC-DMIS will accept hits from the controller each time the probe crosses the defined section(s).

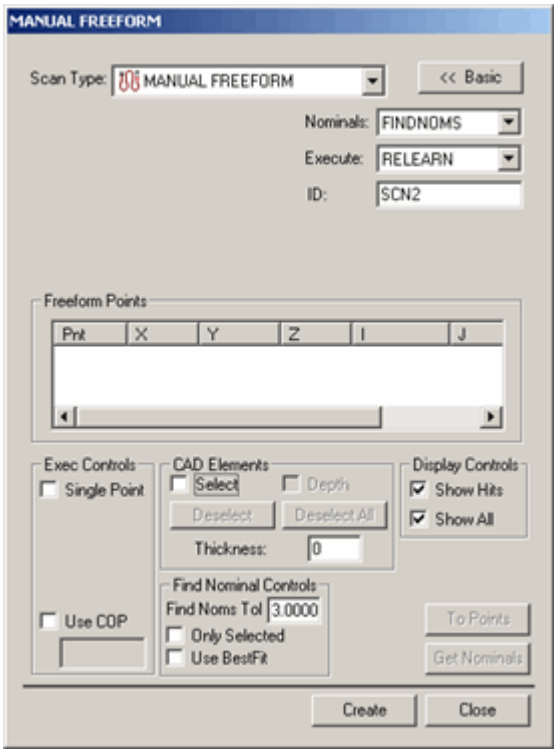
Performing a Freeform Manual Scan

The Manual Freeform scan lets you create a freeform scan with a hard probe. This scan doesn't require a initial or direction vector, like many of the other manual scans. Similar to it's DCC counterpart, all you need to do to create a freeform scan is to click points on the surface you wish to scan.

See the "Common Functions of the Scan Dialog Box" topic of the PC-DMIS Core documentation for information on this tab's other controls.

To create a Manual Freeform scan:

1. Select the **Insert | Scan | Manual Freeform** menu option. The **MANUAL FREEFORM** dialog box appears.



Manual Freeform dialog box

2. Specify a custom name for the scan in the **ID** box, if you don't want to use the default name.
3. If you're using a CAD model, type a **Find Nominals** tolerance in the **Find Nominals Control** area. This defines how far away the actual ball center point can be from the nominal CAD location.
4. Click on the surface of the part in the Graphics Display window to define your scan's path. With each click, an orange point appears on the part drawing. Each new point connects to the previous point with an orange line.
5. Once you have sufficient points for your scan, click **Create**. PC-DMIS inserts the scan into the Edit Window.

Portable Laser Probe Scanning

PC-DMIS allows you to manually scan the surface of your part into Pointclouds. From Pointclouds, you can then extract Auto Features for addition to your part program. Portable laser probe scanning can be accomplished with a Perceptron, Metris, or CMS laser probe, or you can use a Leica T-Probe scanner.

- For information on setting up and using Perceptron, Metris, or CMS Laser probes, see the "PC-DMIS Laser" documentation.
- For information on setting up and using Leica T-Probe Scanners, see "Using a Leica Laser Tracker" in this documentation.

Creating a Manual Scan

To begin scanning in Learn Mode, you should do the following:

1. [optional] Add a COP command to your part program to which the scanned data will be added. You can do this be selecting the **Insert | Pointcloud Feature** menu item or the **Pointcloud** button from the **Pointcloud** toolbar.

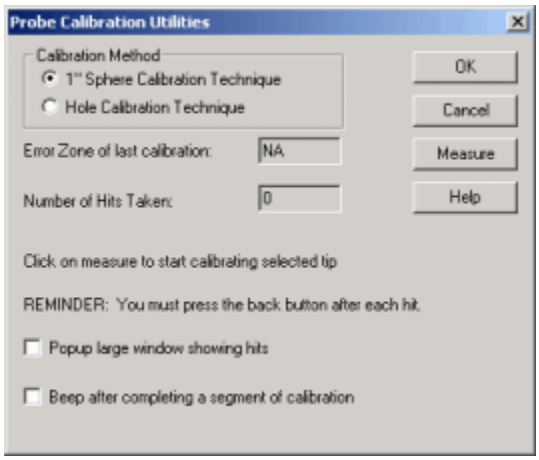
   Note: If you begin scanning without first creating a COP command, PC-DMIS will automatically create a COP for the scanned data.

2. Scan the surface in which the needed feature(s) reside. This can be accomplished by one or more passes. Scan stripes will be visualized in the **Graphics Display** window as you scan. If you are using an existing COP, you will be prompted to empty the COP.
3. Select Auto Features that reside within the Pointcloud as described in the "Auto Feature Extraction" topic in the Laser documentation. When an Auto Feature is created, the Pointcloud from which the feature is extracted is displayed on the "Laser Probe Toolbox: Laser Scan Properties tab".

Appendix A: Faro Portable Arm

Using a Faro portable arm is similar to using a Romer arm. Please refer to the "Using a Romer Portable CMM" topic and other sections throughout the Portable documentation for general information on using a portable arm machine.

If you are using a Faro arm, the **Probe Calibration Utilities** dialog box appears in place of the standard **Measure** dialog box that appears when you click **Measure** from the **Probe Utilities** dialog box.



Probe Calibration Utilities dialog box

Available Dialog Box Options

The following table lists each option available in the **Probe Calibration Utilities** dialog box and what each does.

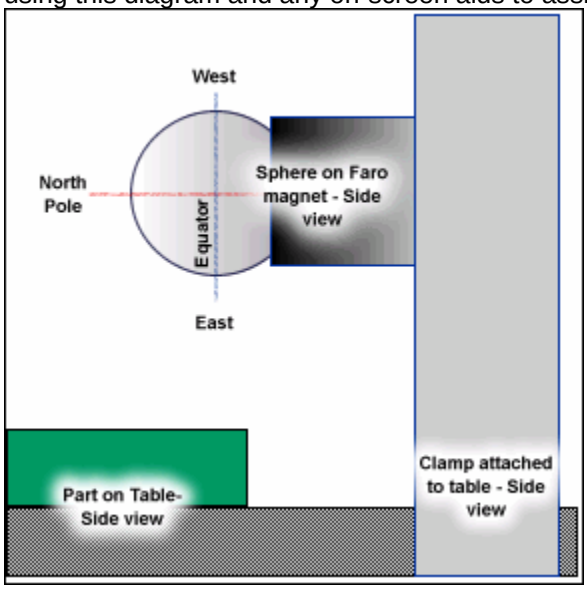
Option	Description
Calibration Method	The **Probe Calibration Utilities** dialog box allows for two methods of calibration: • **1" Sphere Calibration Technique**. Most Faro arms have a calibration sphere built into them which is usually a 1.000" ball so PC-DMIS defaults to this method of calibration. • **Hole Calibration Technique.** If preferred, you can use a hole to calibrate the Faro probe instead of the sphere.
Error Zone of Last Calibration	The **Error Zone of last calibration** box displays the volumetric number that Faro calculates after the calibration routine is complete. The Faro Controller generates this number and it is only used for display purposes. You cannot edit it.
Number of Hits Taken	The **Number of Hits Taken** box displays the number of hits taken per calibration zone.
Popup large window showing hits	Selecting the **Popup large window showing hits** check box shows the XYZ and number of hits in real-time as the calibration process takes place.
Beep after completing a segment of calibration	Selecting the **Beep after completing a segment of calibration** check box causes the computer system to emit a beeping sound when a specific calculation zone or segment is complete. The status area on the dialog box (located just below the **Number of Hits Taken** box) then tells the user what calibration zone to

	measure next and how many hits to take.

Faro Calibration Procedure

To correctly calibrate your probe using a Faro arm, follow this procedure:

1. Access the **Probe Calibration Utilities** dialog box.
2. Select the appropriate calibration method from the **Calibration Method** area.
3. Select any useful check boxes.
4. Click the **Measure** button. The calibration process will begin. PC-DMIS will display some visual aids to assist you in calibrating the Faro arm.
5. Follow any on-screen instructions (including instructions that may appear in the dialog box's status area).
6. *If you're using the one inch sphere method*, take the following hits on the spherical tool, using this diagram and any on-screen aids to assist you:



Side view of spherical tool and Faro magnet and clamp

   - Take five hits around the equator.
   - Flip the last axis, and take another five hits around the equator.
   - Take five hits normal to the sphere east to west.
   - Flip the last axis, and take four hits normal to the sphere from west to east.
   - Take four hits normal to the sphere from north to south.
   - Flip the last axis, and take four hits normal to the sphere from south to north.

7. *If you're using the hole calibration technique*, PC-DMIS will ask you to take these hits:

   - Take ten hits in the hole while rotating the handle.
   - Take ten hits in the hole from the opposite direction.

8. Click **OK** when you finish calibrating.

Appendix B: SMX Tracker

To use the SMX laser interface you need to do the following.

1. Connect your port lock (dongle) to your USB port. The portlock must be present during PC-DMIS installation.
2. Execute setup.exe from the PC-DMIS Installation CD. Follow the on-screen instructions.
   - If ***SMX Laser*** interface is programmed in your portlock, PC-DMIS will load and use the SMX Laser interface when working on-line.
   - If ***All interfaces*** is programmed in your portlock (like a demo dongle), you may need to manually rename smxlaser.dll to interfac.dll. smxlaser.dll is found in the PC-DMIS install directory.

3. Download the SMX laser DLL located at: ftp://ftp.wilcoxassoc.com/3rdParty/Faro/Tracker1331.zip.
4. Unzip the contents of the *Tracker1331.zip* file into the PC-DMIS installation directory. In additional to the SMX Laser dll, there are JAR files and a JRE directory and subdirectories included in zip file. These files and directories must be copied to PD-DMIS installation directory.
5. Test communication with your tracker by typing the following command from the command prompt:

```
ping 128.128.128.100
```

Note: For older trackers, the last number of the IP address is your tracker's serial number.

If there are problems with communication you can FTP into the tracker and test its response. Use the following commands:

```
ftp 128.128.128.100

login: supervise (doesn’t work with new Faro trackers)

> quote home

> quit
```

This should home the machine. If this fails then power down the machine, wait 1 minute and power it back up. If this still fails and SMX Insight software is loaded on the machine, you can try to perform a ‘Startup’ in Insight.

Note: Be aware that once the Tracker has been powered down for a while it can take up to 30 minutes for a reliable connection to be established.

The Faro SMX Tracker has added capability from the Faro Utilities application that can be accessed from PC-DMIS.

Using the Closure Window

PC-DMIS allows you to access **Closure** window settings. Closure is simply the reflector's current distance from the Home position. Closure helps you ensure the accuracy of your measurements, in that you would see non-zero Closure values if there was a problem.

Performing Operational Checks

The Faro Utilities provides the Operational Checks dialog box which has two tabs; General Page and Repeatability. The General tab displays environmental conditions and monitors the return intensity of the laser. The repeatability tab provides access to the Static and Dynamic repeatability tests, in addition to another way to access Closure.

Glossary

6

6DoF: Six Degrees of Freedom

A

ADM: Absolute Distance Meter

B

Birdbath: Your reflector can be attached to this known position via a magnetic connector located on the front of the laser tracker.

D

DRO: Display Readout

I

ID: Inside Diameter

IFM: Interferometer

N

Nivel: Inclination sensor designed to be used with Leica Laser Tracker. This device attaches to the laser tracker to establish orientation to gravity or monitor tracker stability.

Normal Hit: A "Normal Hit" is taken when press and release the hit button in the same location.

O

OD: Outside Diameter

P

Pulled Hit: Changes the vector to that of the line between the location where you first depress the hit button (at the "Normal Hit" location) to the location where you release the hit button. This line must be longer than the Use Vector Distance to successfully register a "Pulled Hit".

R

RMS: Root Mean Square

T

TCU: Tracker Control Unit

TTP: Touch-Trigger Probe

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