PC-DMIS Vision Manual

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Copyright and Licensing

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PC-DMIS Vision

PC-DMIS Vision: Introduction

This PC-DMIS Vision documentation documents how to use PC-DMIS Vision with your optical measuring system to measure features on a part. Vision probes provide a way to collect many measured points for a single feature. You can also use this non-contact probing method to measure certain types of "flat" features. For example, a circuit board could have an overlay of a different color to the main circuit board. A contact probe running over the part won't detect the feature. However, you could use a vision probe to "capture" the feature.

You can use PC-DMIS Vision to prepare a measurement routine in either Offline or Online mode. The CAD Camera functionality gives you the versatility to run this measurement routine in either mode. In addition, many other machine types can be supported by using a generic Metronics interface. Installation may require some personal computer hardware upgrades.

The main topics in this PC-DMIS Vision documentation include:

- Factors for Measuring with PC-DMIS Vision
- Understanding Targets in PC-DMIS Vision
- Supported Lasers on Vision Systems
- Getting Started
- Calibrating Vision Probes
- Ring Light Migration
- Migrate Magnification Variables
- Setting Machine Options
- Available Vision Setup Options
- Vision QuickMeasure Toolbar
- Using the Graphic Display Window in PC-DMIS Vision
- Using the Probe Toolbox in PC-DMIS Vision
- Using Vision Gages
- Creating Alignments
- Measuring Auto Features with a Vision Probe

- Using AutoTune Execution
- Using On Error Commands
- Using the Image Capture Command
- Using a Single uEye Camera to Create Multiple "Virtual" Cameras

These appendices are also available:

- Appendix A: Troubleshooting PC-DMIS Vision
- Appendix B: Adding a Ring Tool

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

Factors for Measuring with PC-DMIS Vision

There are three basic elements that should be considered while measuring with PC-DMIS Vision. These factors will dramatically affect the measurement accuracy or repeatability that you can achieve.

- Lighting
- Magnification
- Edge quality

Lighting

If you can't see the product, you can't measure it. Lighting is perhaps the most fundamental factor when measuring with vision probes. It is also the FIRST parameter to enable when measuring an edge.

The type of lighting, the intensity and the mixture of lighting sources can have significant effect on the accuracy of your vision system. Where possible, use only sub-stage lighting, as it will reduce the amount of texture on the surface and improve edge detection performance.

You can "Calibrate Illumination" and make needed adjustments via the "Probe Toolbox: Illumination tab" to ensure proper lighting for measurement.

Magnification

Changing the **Pixel Size** value directly affects the accuracy of your results. In some cases, you can use the same **Pixel Size** value for the entire measurement process. However, it is quite common to change the **Pixel Size** value depending on the feature type, feature size, and accuracy requirements. Internally, PC-DMIS Vision makes the necessary adjustments to accommodate changes to the **Pixel Size** value.

Focus accuracy is particularly affected by the **Pixel Size** value. The smaller the **Pixel Size** value, the higher the focus accuracy. Measurements in Z are almost always done at the smallest **Pixel Size** value.

Magnification is calibrated through "Field of View Calibration" and adjusted for optimal measurement of your feature via the "Probe Toolbox: Magnification tab".

Edge Quality

The quality of the edge has a direct effect on the quality of the measured result. By adjusting the edge quality tools, PC-DMIS Vision may be able to improve any imperfections that might exist for the viewed edge of the feature you are measuring.

Some things that are done to improve image quality include:

- Ensuring that targets are sized to contain ideally just the target edge you're trying to measure.
- Using ring lights (if available) to ensure the edge is lit up as sharp and in high contrast as possible.
- Clever filtration and sample measurements can allow you to achieve a desired result.

Using the "Probe Toolbox: Hit Targets tab", you can limit the data that is included for the measured feature.

Understanding Targets in PC-DMIS Vision

In PC-DMIS Vision, you position targets on a feature to acquire measured points. The type of target used is automatically chosen based on the feature being measured.

In the example below:

- Measuring a line feature uses a rectangular shaped target.

- Measuring a circle feature uses a doughnut shaped target.

Line and circle target examples

Features can be measured by one or more targets. In the example below, the line is measured with 3 targets where the middle target is not being used to collect data.

Example of line being measured using three targets

The size of the feature to measure determines the span of the target. For example, a small circle that fits inside of the FOV can be measured with a single target, where a larger circle that exceeds the FOV would require multiple targets to span its circumference. After selecting the Auto feature to be measured, the targets are created by:

1. Selecting a feature from the CAD model.
2. Manually entering the nominal values.
3. Creating Target anchor points.

More information is available in the "Measuring Auto Features with a Vision Probe" topic.

Supported Sensors on Vision Systems

PC-DMIS Vision systems support these sensors:

- CWS - Chromatic White Light Sensor
- OPTIV LTS - Triangulation Sensor
- Surface Topography Sensor

Offline Support

To fully support the use of the various sensors in Offline mode, the `OfflineLaserMode` entry needs to specify the online controller and sensor configuration. For details, see "OfflineLaserMode" in the "VisionParameters" section of the PC-DMIS Settings Editor documentation.

For details on the setting options for the Topography sensor, see the "Topography" section of the PC-DMIS Settings Editor documentation.

Chromatic White Light Sensor (CWS)

If the Chromatic White Light Sensor (CWS) is the active probe in the measurement routine, the **Laser** tab is visible.

When you use a CWS, be aware that important information is displayed on the available control box indicators.

The CWS control box typically has the following indicators:

Intensity Bar

The **Intensity Bar** displays the intensity of the measurement signal in a logarithmic scale. The intensity value is commonly shown in another display near the **Intensity Bar**. The display shows the relative units as a numeric value between 0 and 999. This is important information because if you're measuring a poorly reflecting surface, the intensity of the reflected light can be low. In this case, you need to reduce the measurement rate. Conversely, over-modulation of the sensor (intensity reading: 999, blinking) can cause measurement errors.

Distance Bar

The **Distance Bar** displays the current measurement value in a linear scale.

The measured distance appears in another display as a number in µm near the **Distance Bar**. This allows you to see where in the range the sensor is currently placed.

CWS Dark Reference Command

The "PassthruToController" command and dialog box are designed to send commands to the NC controller. It is used only by Hexagon Engineering.

For Hexagon Application Engineers and Technical Support, you can find detailed information on the PassthruToController command and dialog box on the SalesForce site here.

You can use the prefix "CWS", which represents the Precitec controller (CWS), and the token "#" to send commands to the Precitec controller.

For example, to take a dark reference, in the Edit window, type the command `CWS#$DRK`.

CWS# - Sends the command to the Precitec controller.

$DRK - Starts taking the dark reference.

All Precitec controller commands need to start with $.

If there is no prefix (CWS#), the PassthruToController command is sent to the NC controller.

The solution works for:

- FDC-SLC
- FDC-VisionBox

It DOES NOT work with Embedded controllers.

Typical CWS System

An example of a typical CWS system is shown below:

1 - Light Source

2 - Fiber Optic Cables

3 - Measuring Head

4 - Surface of feature being scanned

5 - Measuring Range

6 - Intensity

CWS Spectrum

The spectrum chart from the CWS sensor is in many ways very similar to the focus graph from the camera.

Example of the CWS spectrum chart

Similar to the focus graph, the spectrum allows you to quickly see the quality of the measurement. It also helps you choose the correct settings for the material being sampled.

CWS Parameters

Probe Toolbox - CWS Parameter tab

The **CWS Parameter** tab in the Probe Toolbox (**View | Other Windows | Probe Toolbox**) is available once the system has been appropriately configured:

- The CWS has to be configured as the active laser system. Usually, this is done locally by the factory during the startup procedure or by a Service Engineer.

- Once the system is configured, you must define a probe with the correct properties. You construct the probe through the **Probe Utilities** dialog box. You should use the OPTIV_FIXED selection and a lens that includes CWS. Typically, this is defined locally by the factory in the USRPROBE.DAT file when you configure your system.

The **CWS Parameter** tab can include the following information:

Frequency (Measurement Rate)

The measurement rate sets the number of measured values the CWS records per unit time. For example, when the measurement rate is set at 2000 Hz, 2000 measurement values are taken per second. The intensity indicator on the display can help you select the correct setting. In the case of surfaces with very low reflectivity, it may be necessary to reduce the measurement rate. This has the effect of illuminating the optical sensor‘s CCD-line longer and thus making it possible to measure even if the reflected intensity is very low.

Editing in the Edit window

If you enter a frequency that is not within the range of valid frequency values, PC-DMIS displays a message to correct the entry and informs you with the closest valid frequency value:

PC-DMIS

Invalid Frequency: 3Hz

Please use a valid frequency. The closest valid frequency is 32Hz.

If you enter an invalid frequency, but it is within the range of valid frequency values (for example, it is not included in the list of valid frequencies), PC-DMIS displays a message to correct the entry. The message also informs you with the next valid frequency values above and below the entered value:

PC-DMIS

Invalid Frequency: 300Hz

Please use a valid frequency. The closest valid frequencies are 100Hz and 320Hz.

The software also checks for an invalid CWS frequency at execution. If you did not correct an invalid value after a software request to do so, PC-DMIS displays a message in the Execution window with the invalid frequency value:

Execution

Invalid Frequency: 300Hz

PC-DMIS will not allow you to continue with the execution of the measurement routine. The only option at this point is to stop the execution and enter a valid frequency value.

The same thing happens when a variable is assigned to the CWS frequency. If the variable contains an invalid value, PC-DMIS issues an appropriate message as described above.

When you press F9 on features with variable inputs or numeric values, PC-DMIS opens the Probe Toolbox. From there you can select a supported frequency from the list. If the value is stored in a variable that is assigned to the CWS frequency, when you select a valid value from the list, PC-DMIS updates the variable with the new value.

Exposure Time and Auto Intensity

Under **Intensity**, you can select the relative pulse duration of the LED, and with it the effective brightness of the light source. The **Auto Intensity** option is useful when the measurement surface changes in reflectiveness. If, for example, you are measuring a highly reflective surface, on which the highest measurement rate still results in over-modulation, then it makes sense to set **Auto Intensity** to **No** and then manually set the **Lamp Intensity** option.

Another option would be to leave **Auto Intensity** set to **Yes** and reduce the exposure time. To measure a poorly reflecting surface with a high measurement rate, use a longer pulse duration or a longer exposure time.

Dark reference is absolutely necessary after every change to the exposure time. Please refer to the appropriate section of your CWS Unit Operators Manual.

Offset

Depending on the reflectiveness of the surface and the measurement rate (frequency), optimal intensity values may occur in different areas of the sensor's range.

The **Offset** setting moves to the best scan area for the sensor. The input for this offset is a + or – value in mm.

1 - Distance (sensor range for a 3mm sensor)

2 - Offset = 0.000

3 - Offset = 0.500

Graph showing effects of changing the offset value

Offset support for the HP-OW (CWS) sensor requires that you have version 51.03.000 or later of the DC firmware installed.

For example, suppose you want to run a measurement routine with a feature to be measured using an HP-OW or CWS sensor. If the offset parameter does not equal 0 and the current DC firmware version does not support HP-OW offset parameter, PC-DMIS displays this error message:

PC-DMIS MESSAGE:

Laser parameter "Offset" not supported by machine controller.

Linear scan example before and after offset applied

A *= Scan path*

Top *- Without an appropriate offset, the lower surface falls into the measurement range which affects the linear scan of the top targeted surface.*

Bottom *- With the appropriate offset (+0.3) applied, only the targeted top face of the feature is in the measurement range and the linear scan measurement is successful.*

Thickness scan example before and after offset applied

A *= Scan path*

> ***Top*** *- Without an appropriate offset, the lower surface does not fall into the measurement range and the thickness scan fails.*
>
> ***Bottom*** *- With the appropriate offset (-0.6) applied, both of the feature faces are within the measurement range to successfully measure the thickness.*

Intensity Filter

This value defines the threshold between noise and the measurement signal. Peaks that fall beneath this threshold are recognized as invalid and show on the display as the measurement value "0".

There is no linear relationship between **Filter (Sensor Intensity)** and "Intensity". For example, if you set **Filter (Sensor Intensity)** = 50, it doesn't necessarily mean that all values below an intensity of 50 are filtered out.

For a measurement rate under 1 KHz, a **Filter (Sensor Intensity)** minimum of 40 is recommended. This prevents measurement values that are too low in intensity and rise only slightly above the noise to falsify the measurement. At a measurement rate of 1 KHz and higher, a minimum of 15 is sufficient to fully exploit the device's dynamics.

Focus

The **Auto Focus** button reads the current XYZ machine position and the distance value from the CWS sensor. These values calculate the focus position as well as the signal quality value and displays them in the four **Focus** boxes.

Note on Filter Modes

The Speed and Frequency parameters define the point density of the sensor. In the case of scans, PC-DMIS then performs secondary filtering as defined from the Nullfilter and Point Density settings.

Chromatic White Light Sensor Probe Readouts Window

If the Chromatic White Light Sensor (CWS) is the active sensor, the Probe Readouts window displays the X, Y, and Z readouts, plus the following:

Intensity - The value for this readout is a percentage that appears in a circular graphic. An intensity value above 99% indicates a measurement error; for example, the sensor may be out of detection range. If a measurement error occurs, the non-gray part of the graphic turns red.

Distance - The value for this readout is in the current unit of measurement (inches or millimeters). The value appears in a circular graphic. If the distance value is within 10% of the upper or lower limit of the sensor range, the non-gray part of the graphic turns red.

Probe Readouts window showing overmodulation

For these readouts to appear, do not select the **CWS Laser** tab. Once you select it, the readouts are no longer sent to the Probe Readouts window.

For more details on the **CWS Parameters** tab on the Probe Toolbox, see "Laser Probe Toolbox: CWS Parameter tab" in the PC-DMIS Laser documentation.

Thickness Scan

The CWS can operate in different exclusive modes:

- Distance mode (default)
- Thickness mode

You can enable Thickness mode when you open the **Thickness** scan dialog box, or when you execute the command. The software disables Thickness mode when you close the dialog box, or when the execution of the command is complete.

In Thickness mode, the software reports two pairs of values from the sensor's controller unit:

- Distance1 and Intensity1
- Distance2 and Intensity2

PC-DMIS displays these values in the Probe Readouts window when the **Thickness** scan dialog box is open or during execution.

To create a Thickness scan:

1. Ensure you are in DCC mode and that CWS is the active sensor.
2. Import your CAD model to define the sensor trajectory.
3. Open the **Thickness** scan dialog box (**Insert | Scan | Thickness**).

Thickness scan dialog box

4. Select the axis from the **Cross Section Axis** list. The options are X, Y, or Z.
5. Enter the **Start**, **Direction**, and **End** options, or click on the CAD model in the Graphic Display window to fill these values in automatically.

> The **Start** and **End** check boxes allow the Start and End point mouse clicks to snap to the CAD edge. PC-DMIS generates a polyline from the selected **Cross Section Axis** and the first mouse click. You can then edit the **Cross Section Axis** from the **Start** field. The software automatically updates the generated polyline from the new user-defined coordinate.

6. From the **Trajectory** area, click the **Generate** button. The software generates the scan trajectory for the sensor, displays the number of generated points and updates the display in the CAD View.

Example of a generated Thickness scan

Click the **Clear** button to remove the scan trajectory and values in the **Start**, **Direction**, and **End** fields.

The primary curve nominal data must be smooth relative to the thickness. If it is not a smooth curve and you click the **Generate** button, the software displays an error message and does not generate points.

7. Edit the **Refractive Index** value if necessary. Click the **Edit** button to open the **Select Material** dialog box. You can then review or update the current values.

Select Material dialog box for Thickness scan

8. Select the **Pointcloud** check box if you want to include the scanned points into an existing Pointcloud (COP) command. Once you select this check box, enter the ID for the COP command or select it from the list. If a COP command doesn't exist, PC-DMIS prompts if you want to generate a new one. For details on Pointcloud operators, see "Pointcloud Operators" in the PC-DMIS Laser documentation.

Triangulation Sensor (OPTIV LTS)

The OPTIV LTS Sensor uses the principle of optical triangulation, that is, it projects a visible, modulated point of light onto the target surface. The system then displays the diffuse part of the reflection of this point of light. The quality of this reflection is dependent on the distance to the position-resolving element (CMOS) by a receiver optic. The receiver is arranged to the optical axis of the laser beam in a defined angle.

A signal processor in the sensor calculates the distance of the point of light on the measuring object to the sensor. This is done through the output signal of the CMOS elements.

OPTIV LTS Parameters

Sensor Frequency

The sensor frequency indicates the number of measurements per second. At a maximum frequency of 7.5 kHz, the system exposes the CMOS element to 7500 measurements per second.

To improve the measurement results:

- The lower the frequency, the longer the maximum exposure time.

- Use a high frequency rate for bright and matte measurement objects.
- Use a low frequency rate for dark or shiny measurement objects (e.g. black painted surfaces).

Auto Lamp and Exposure Time

In Automatic Lamp mode, the sensor determines the optimal exposure time it takes to achieve the highest possible signal intensity for different measurement surfaces. In Manual mode, you can determine the exposure time when the software displays the video signal. Vary the exposure time to achieve a signal quality up to a maximum of 95%. The exposure time does not change the user-defined frequency.

OPTIV LTS Probe Readouts Window

If the OPTIV LTS is the active sensor, the Probe Readouts window displays the X, Y, and Z readouts, plus the following:

Intensity - The value for this readout is a percentage that appears in a circular graphic. If the value is higher than 95%, then the non-gray part of the graphic turns red.

Distance - The value appears in a circular graphic. If the distance value is within 10% of the upper or lower limit of the sensor range, the non-gray part of the graphic turns red.

Surface Topography Sensor

You can use the Surface Topography sensor to quickly acquire point data from a specific region of interest on smooth and rough surfaces. PC-DMIS automatically adds points to your pointcloud for analysis.

With an integrated half-transparent small mirror, topography lenses split the coaxial toplight into two light beams:

- A constant reference beam
- A scanning beam that is reflected from the surface in focus

Both beams then come together onto the camera sensor where they produce an interferometric signal depending on the distance to the surface.

When the signal moves through the focus of the surface, it varies according to the distance which can be evaluated by each single pixel independently.

Licensing

You must have the ROY-TOPOGRAPHY license enabled to use the Surface Topography sensor.

Without the license option enabled, PC-DMIS does not load the Surface Scan module on start up. When you run a measurement routine that contains a Surface Scan command, PC-DMIS displays this message:

PC-DMIS Message
The "None" command is not supported by the currently active "Surface Topography" probe.

Without the license option, PC-DMIS displays this message for the probe command:

PC-DMIS Message
Your license does not authorize you to use this probe type - Surface Topography.

Supported Lenses

The supported lenses for the Surface Topography sensor are:

- HA-OTW-S10
- HA-OTW-S2.5
- HA-OTW-S20
- HA-OTW-S5
- HA-OTW-S50

Related Topics:

See the "Surface Topography Sensor" section of the PC-DMIS MIIM documentation.

See the "Topography" section of the PC-DMIS Settings Editor documentation.

Surface Topography Illumination Settings and Measurement Strategy

Illumination Settings

You can define the illumination settings from the Probe Toolbox or the Live View Overlay. To do this, use the slider on the **Illumination** tab or the Live View Overlay as needed.

Illumination tab of the Probe Toolbox for the Surface Topography sensor

You can also adjust the Illumination settings from the Live View toolbar. For details on the Live View controls, which include descriptions of the toolbar options, see "Live View Controls".

Illumination Overlay in Vision Live View for the Surface Topography sensor

Define the Topography Sensor

To define the Topography sensor in PC-DMIS:

1. Open the **Probe Utilities** dialog box (**Insert | Hardware | Probe**) and select your Topography sensor from the **Probe file** list. For details on how to define your sensor, see the "Defining Probes" section in the PC-DMIS Core documentation.

Probe Utilities dialog box - Topography sensor probe file selected

2. After you select the Topography sensor file or build it from the **Probe description** area, click the **Edit** button.

Edit Probe Data dialog box for the Topography sensor

3. Review the settings to make sure they are correct. For details on this dialog box, see the "Edit Probe Data" section of the PC-DMIS Core documentation. Click **OK** to exit and save your changes or click **Cancel** to close the dialog box without saving.

Measurement Strategy

Measurement Strategy tab of the Probe Toolbox for the Surface Topography sensor

To setup the measurement strategy for the Surface Topography sensor:

1. Select the **Measurement Strategy** tab on the Probe Toolbox.
2. Adjust the **Drive Position** slider (**1**) to position the Micro Drive.
3. Click the **Upper Bound** button (**2**) to lock and unlock the upper bound position of the Micro Drive.
4. Click the **Center Scan Position** button (**3**) to adjust the center position of the scan range.
5. Click the **Lower Bound** button (**4**) to lock and unlock the lower bound position of the Micro Drive.
6. From the **Drive Scan Resolution** list (**5**), select the appropriate Micro Drive scan resolution option.
7. Adjust the **Quality Threshold** slider or enter the value directly into the box (**6**) to determine the points PC-DMIS filters from the scan. The software only filters out points which have a quality tag below this value.
8. Select a **Roughness Setting** from the options (**7**). Use the **Default** option for roughness measurements with an unknown Ra.

Creating a Surface Scan with the Surface Topography Sensor

To create a surface scan using the Surface Topography sensor:

1. Enter a feature ID.
2. Define the XYZ position for the surface scan. You can do this in one of these ways:

    - Click on the CAD model in the Graphic Display window. The **X**, **Y**, and **Z** boxes dynamically update based on the selected location on the CAD model.
    - Click on the image in the Live View tab.
    - Type in the entries directly into the appropriate boxes.

3. Click the **Read** button to read in a position from the machine.
4. Click the button to lock and unlock the target position. PC-DMIS sets this option to lock by default when you are in Edit mode.

    When you set the **Lock Target** to locked, you cannot move the target around the part. When you edit an existing scan, this is the default state.

Example showing the Target with the Lock Target button set to "locked" in Live View

Example showing the FOV and Target with the Lock Target button set to "locked" in CAD View

When you set the **Lock Target** button to unlocked, you can move the target around the part as needed. PC-DMIS dynamically updates the position of the surface scan as you move the target.

5. The **Width** and **Height** values are read-only and show the target's width and height.
6. Select a pointcloud from the list or create a new pointcloud. For details on how to create a pointcloud, see the "Using Pointclouds" topic in the PC-DMIS Laser documentation.

7. Select an **Avoidance move** option from the list. The available options are:

    - None
    - Both
    - Before
    - After

8. Type the **Avoidance move distance** in this box.
9. Click the **Clearance Plane** button to enable or disable this function.
10. Click the **Move To** button to move the machine to the XYZ coordinates of the surface scan. DCC is required for this step.
11. Click the **Test** button to perform a test run of the surface scan with the current settings. DCC is required for this step.
12. When you are satisfied with the setup, click the **Create** button to create the Surface Scan command in the Edit window.
13. Click the **Cancel** button to close the **Surface Scan Command** dialog box.

Notes on Surface Scans Using the Surface Topography Sensor

- When you click the **Test** button on the **Surface Scan Command** dialog box, PC-DMIS stores the measured data in a temporary pointcloud.
- When you edit an existing surface scan, the software transfers the data from the pointcloud to an internal pointcloud. If PC-DMIS detects changes to any parameter related to the measurement, it purges the existing pointcloud data.
- PC-DMIS displays the measured data in the pointcloud in the Graphic Display window.
- When you click the **Create** button, PC-DMIS transfers the data to the pointcloud referenced in the **Surface Scan Command** dialog box.
- Multiple surface scans commands can reference the same pointcloud ID.

Scan Measurement

After positioning the sensor with the optimal settings, you can either select from the CAD in the Graphic Display window, or click the **Take a Hit** icon on the **Probe Tool Box** dialog box to select points and populate the **1**, **D**, and **2** points.

Once the coordinates have been updated, you can test or create the feature.

PC-DMIS CAD++
Linear Open Scan
File Edit View Insert Operation
STARTUP
STARTUP
Edit Window - dos.PRG
File Header
STARTUP = Start
Manual/DCC Mode
Move Speed
Touch Speed
Dimension Format
Load Probe - CWS_
TIP1 = Set Active
Manual/DCC Mode
Scan type:
Linear Open Scan
<< Basic
Direction 1 Tech:
NULLFILTER
ID:
SCN1
Measure
Boundary Points
X Y Z
1 0.0000 0.0000 0.0000
0 0.0000 0.0000 0.0000
2 0.0000 0.0000 0.0000
Add
Delete
Initial Vectors
Vector: I J
EndVec 0.0000 0.0000
PlaneVec 0.0000 0.0000
Execution
Graphics
Path Definition
Control Points
Settings
Exec Controls
RELEARN
ClearPlane
Auto move
0.000000
CAD comp
Use COP
Nominals Method
MASTER
Hit Controls
VECTOR
Display Controls
Show hits
Show all
Boundary Type
PLANE
Crossings: 1
Create
Close
Probe Toolbox
CWS_3MM
TIP1
X 47.0123 1.0
Y -88.6048 1.0
Z -153.9231 1.0
W 0.0003 1.0
Ready

Note on Execution Modes:

Defined - First time execution behaves the same as **Relearn**. Subsequent executions perform a defined path scan.

Relearn - (FDC) First time and subsequent executions track the surface within the range of the sensor.

Relearn - (Non FDC) First time and subsequent executions perform a straight-line scan derived from start, direction, and end points. No Tracking is performed.

Mycrona - Tracking can be switched On/Off in the separate **Heartbeat** application.

Point Measurement

Once the position of the sensor with the optimal settings is made, select the **Read Position** icon in the dialog box to update the coordinates. You can then test or create the feature.

Auto Feature [PNT1]
Surface Point
PNT1
Feature properties
Point:
X 124
Y 7.707
Z -15
Surface:
I: 0
J: -1
K: 0
None
T: 0
<<
Measurement properties
Snap:
No
Advanced measurement options
NOMINALS
Relative to:
Analysis:
Pt. Size:
+ Tol:
- Tol:
0
0.01
-0.01
Frequency:
320
Exposure time:
150
Intensity:
Offset:
0
Intensity filter:
25
Focus:
Pointcloud:
Disabled
Feature Based Clipping
Horizontal (mm):
2
Vertical (mm):
2
Filters
Remove outliers:
Standard deviation multiple:
1

Defining a Surface Point by Clicking on a Pointcloud

Pointcloud

You can extract Auto features from previously-scanned pointcloud data.

The Pointcloud parameter defines the COP command from which the Auto feature is extracted.

To select feature extraction via pointcloud selection, select a previously-scanned pointcloud from the list. To enable PC-DMIS to use the defined CWS scan parameters and measure the Auto feature directly, select **Disabled**.

Feature Based Clipping

PC-DMIS can clip vision data in both the horizontal and vertical directions when you type a distance in the **Horizontal** and **Vertical** boxes. This distance clips all of the laser data outside of the defined distance and excludes that data when extracting the feature.

Filters

Remove outliers - If you select this check box, PC-DMIS excludes outliers from the feature based on the value for the **Standard deviation multiple** option.

The feature extractor evaluates the feature internally two or more times on the first attempt to get the standard deviation based on all points.

In successive attempts, the filter re-evaluates the feature using only the points that are in the range of the outlier multiplied by the Σ. The sigma is the range, in the Gaussian distribution of the deviations, where the 68.2% of the best points used for fitting the feature lie.

> **Standard deviation multiple** - The value for this option defines the selectivity of the filter. It can be a generic real number that is greater than 0. If m is the selected value, it means that all the scan points which deviate from the extracted cone that are greater than m x Actual standard deviation (that is, the standard deviation of the measured points with respect to the calculated feature) are cut off from the calculation. Therefore, the lower the value of m, the more selective the filter.

The readouts are not available during execution.

Often, users define a Surface Point by clicking on the CAD. In the case where no CAD exists, you can perform a scan of the part, and then click on the individual pointcloud points to define your surface feature. You can also box-select the feature from the pointcloud.

To define a Surface Point from pointcloud points:

1. Scan the surface of the part where the Surface Point exists.
2. Select **Auto Surface Point** from the **Auto Feature** toolbar or select **Insert | Feature | Auto | Surface Point**. This opens the **Auto Feature** dialog box.
3. Do one of the following:

    - Select points from the pointcloud that best define the feature's nominal position.
    - With your mouse, left-click and drag a box directly on the pointcloud. PC-DMIS extracts the feature from the points within this area.

PC-DMIS defines the Surface Point based on your selection.

Defining a Feature by Selecting Points

To define a Surface Point's location, select one point in the location of interest within the measured surface area.

Defining a Feature by Box-Selecting

In Learn mode, you can drag a box around the desired feature on the pointcloud to extract a Surface Point using the selected data points. This functionality has these limitations:

- PC-DMIS only calculates the surface vector. You may need to define the angle vector manually, such as for a polygon feature.
- If your box selection includes points at multiple depths in the Z axis, it may result in a poor feature extraction. You can avoid this by either clipping the acquisition or use the `COP/OPER,SELECT` command to exclude those points prior to the box selection. For details on the `SELECT` command, see the "SELECT" topic in the PC-DMIS Laser documentation.

Getting Started

There are a few basic steps that you should take to verify that your system has been properly prepared before using PC-DMIS Vision with your vision machine.

The best measurements result when:

- Your optical measuring system is setup in a dimly lit room.
- The room doesn't have a lot of uncovered windows or bright lights.
- The room has little temperature variation.

Follows these steps to get started with PC-DMIS Vision:

Step 2: Home your System

Step 1: Install and Launch PC-DMIS Vision

Before you work with your optical measuring system, ensure that PC-DMIS Vision has been properly installed on your computer system.

To install PC-DMIS Vision:

1. Ensure your LMS license or portlock is programmed with the **Vision** option. You must also have the correct Vision probe type from the **Vision Type** list programmed into your license. Your license must have the correct configuration before you install PC-DMIS. This ensures the correct vision components get installed. If you need assistance with your license configuration, please contact your PC-DMIS software distributor.
2. Install PC-DMIS. To do this, see the release notes in the Readme.pdf file.
3. Verify that specific calibration tests have been completed for your vision machine. A trained technician should already have completed these tests. You can verify that your machine is ready by confirming that the following files reside on your computer system. These files are in the root directory where you installed PC-DMIS:

   - ***.ilc** - Files that have an .ilc extension are created during the calibration process of your machine's lamps. They store the illumination calibration data for each lamp and optics lens combination.
   - ***.fvc**, ***.mcf**, ***.ocf** and ***.odc** - These files are created during the calibration of your machine's optics. They store the calibration data needed to map pixel size to real-world units and provide corrections for optical parcentrality and parfocality errors.
   - **Comp.dat** - This file is created during the calibration of your machine's stage; it stores the calibrations for position on the X, Y, and Z axis.

   These calibration files may or may not exist and are not necessary to run PC-DMIS Vision. If this is a new install, then the files are not there. These files are created as you execute calibrations inside of PC-DMIS.

   Do not, under any circumstances, alter these files. A trained service technician must make any calibration adjustments to these areas of the system.

4. Start PC-DMIS in Online mode by selecting **Start | Programs | <Version> | <Version> Online**, where <Version> represents your version of PC-DMIS.

5. Open an existing measurement routine or create a new one. If you create a new measurement routine, the **Probe Utilities** dialog box appears.

Step 2: Home your System

Once you have started PC-DMIS Vision you are ready to home your system.

You need to home your system before proceeding in order to find the encoder's zero position of the machine's scales. Methods for homing may vary from system to system, although most DCC vision systems will automatically home on startup. If you need additional information on homing your specific system, consult the documentation that came with your vision machine.

Step 3: Create a Vision Probe File

If your probe (camera) type has not yet been defined, use the **Probe Utilities** dialog box to create a probe file.

To create a new probe file for your vision probe, follow these steps:

1. Select the **Insert | Hardware Definition | Probe** menu option. The **Probe Utilities** dialog box appears. (This dialog box automatically appears whenever you create a new measurement routine.)

Probe Utilities dialog box

2. Type a **Probe File** name that best describes your vision probe.
3. Highlight the **No probe defined** option in the **Probe description** area of the **Probe Utilities** dialog box.
4. Select the appropriate probe from the **Probe description** list.
5. For each "empty connections", select the remaining components in the same manner until you complete the probe definition. The defined tip displays in the **Active Tip List** when completed.

Notice that PC-DMIS does not show the image of the probe. This is usually desirable so that it does not obstruct the view of the part as you perform measurements. However, you can double-click the probe component in the **Probe description** area of the **Probe Utilities** dialog box to open the **Edit Probe Component** dialog box and then select the **Draw this component** check box.

For additional information on how to define probes, see the "Defining Hardware" chapter in the PC-DMIS Core documentation.

Step 4: Edit the Vision Tip

Once you have created a vision tip, select **Edit** from the **Probe Utilities** dialog box to edit the probe data for the selected tip. Default values are provided according to the defined probe. This opens the **Edit Probe Data** dialog box.

Edit Probe Data dialog box for vision tips

You can edit or view the following values for your vision tip as needed according to the defined vision probe:

Tip ID - This field displays the Tip ID for the selected probe.

DMIS Label - This box displays the DMIS label. When importing DMIS files, PC-DMIS uses this value to identify any SNSDEF statement inside the imported DMIS file.

XYZ Center - This box displays the center of the focal point of the camera. This is updated by the "Calibrate Probe Offset", so that the camera and touch probe are in the same reference system.

Shank IJK - These three values provide the optical vector for the direction that the optical lens is pointing.

Lens Mag - This box displays the magnification of the defined probe lens.

Camera ID - This box allows you to provide an ID for your camera.

- For single camera configurations, the ID is 0.
- For multiple camera support, the ID indicates the camera associated with this tip, which is usually 0 or 1.
- For virtual multiple camera configurations where there are multiple camera configurations for a single physical camera, the ID also controls the camera parameter processing mode. If you add 1000 to the camera ID (for example, 1000 or 1001), PC-DMIS processes a minimal subset of the parameters instead of the complete parameters file. This allows the software to switch between cameras much faster.

CMOS Pixel Size - This box displays the pixel size PC-DMIS uses to evaluate the image data. Smaller values indicate a higher resolution for image capturing.

You can also set the default value for the pixel size in the Settings Editor application. If the camera hardware supports reporting the sensor pixel size, then PC-DMIS automatically updates the pixel size for the camera ID. For details, see the "VisionParameters\Optics" section of the PC-DMIS Settings Editor documentation.

Min FOV - This value allows you to adjust the minimum allowable field of view size.

Max FOV - This value allows you to adjust the maximum allowable field of view size.

Min NA - This value allows you to provide the minimum allowable numerical aperture.

Max NA - This value allows you to provide the maximum allowable numerical aperture.

The NA is commonly printed on microscope objective lenses. The software uses this to estimate the appropriate focus ranges. The undefined value is -1.

CMOS Width - This value provides the width of the video frame of your optical device.

CMOS Height - This value provides the height of the video frame of your optical device.

CMOS Center X - This value provides the optical center along the X axis for the video frame.

CMOS Center Y - This value provides the optical center along the Y axis for the video frame.

PC-DMIS uses and updates the **CCD Width**, **Height**, and **Center XY** values when it calibrates the optical center of your vision probe. See "Calibrate Optical Center".

CMOS Gutter (TBLR) - These values provide the number of top (**T**) and bottom (**B**) rows and the left (**L**) and right (**R**) columns (in pixels) around the edge of the camera image that should be avoided during calibration and measurement. Some cameras show "dead pixels" in this area.

Calibration Date - This box displays the calibration date of your vision tip.

Calibration Time - This box displays the calibration time of your vision tip.

Focus Area

Up Delay - This box displays the approximate time delay in seconds for focus motion to start and stabilize when focus motion is positive or up.

Latency - This box displays the average time in seconds between when PC-DMIS records the stage position and the video frame data.

Down Delay - This box displays the approximate time delay in seconds for focus motion to start and stabilize when focus motion is negative or down.

Frames/Second - This box displays the measured frames per second during focus.

Depth - This is a table of the field of view X dimension size and the corresponding depth of field factor.

Nickname - This box displays the user-defined name given to the tip.

Step 5: Perform Calibrations

Before you begin measuring with your vision probe, in most cases it is necessary to perform the various calibration procedures on your machine. These include the following:

- Optical Center
- Optics
- Illumination
- Probe Offset

For information on how to calibrate your vision probe, see the "Calibrating Vision Probes" topic.

For stage calibration and certification, contact Hexagon Technical Support.

Step 6: Modify Machine Options

Now that you have created your vision probe file and edited the tip data for that probe you are ready to modify the machine options. The machine options control the various aspects of working with a vision Machine.

To edit vision machine options, follow these steps:

1. Select the **Edit | Preferences | Machine Interface Setup** menu option to open the **Machine Interface Setup** dialog box.
2. Adjust the values as described in the "Setting Machine Options" chapter.

Frame Grabber

A **Frame Grabber** is a PC board that converts an analog video signal to a digital signal. This creates individual pictures or frames that the software can then retrieve and analyze. PC-DMIS Vision supports multiple Frame Grabbers as the video data input. The Frame Grabber delivers the live image from your analog camera to the Live View in PC-DMIS.

Digital cameras act as a combined camera and frame grabber since they already provide the video image data in digital form.

You need to install and configure the vendor-specific software for your camera or frame grabber before PC-DMIS Vision can process the camera's images. Digital cameras use

configuration files provided by the factory to match the camera behavior with the machine and the PC.

For details on how to setup and configure a vision Frame Grabber and camera in PC-DMIS, see the "PC-DMIS Vision Frame Grabber and Camera Setup" section of the MIIM documentation.

The MIIM is typically used only by Hexagon service engineers.

You can access the MIIM help file in the folder where you installed the PC-DMIS Help.

Calibrating Vision Probes

You can calibrate your vision probe with the **Probe Utilities** dialog box. In most cases, you need to complete each of the calibrations before you can measure with your vision probe.

To access this dialog box, select a probe that has already been added from the **Edit Window**. Then click **F9** or select the **Insert | Hardware Definition | Probe** menu item.

Probe Utilities dialog box - vision probe specified

Define the vision probe with the needed components. Then select the tip from the **Active Tip List**, and click **Measure** to access the **Calibrate Probe** dialog box.

Calibrate Probe dialog box

The **Calibrate Probe** dialog box allows you to select and perform the following calibrations. You need to calibrate in the listed order:

- Calibrate Optical Center
- Calibrate Optics
- Calibrate Illumination
- Calibrate Probe Offset

For Probe Offset and Illumination calibrations, you must calibrate the pixel size first. If not, PC-DMIS disables the **Calibrate** button and displays a warning message in the dialog box. For information, see the "Pixel Size" description under the "Calibrate Optics" topic.

Calibrate Optical Center

This procedure calibrates the optical center position of a zoom cell. The optical center is the point in the camera field of view where a feature does not move laterally as the cell zooms. This location information keeps the image view stable as the magnification is changed. This minimizes measurement error between features at different magnifications. The optics hardware should be assembled so as to keep this location near the center of the field of view to allow maximum field of view utilization. The optical center calibration fine tunes the position location in the software. Note that it is desirable to measure related features at the same magnification. A zoom cell that changes magnification without a lateral shift in the image is said to be parcentric. A zoom cell that changes magnification without a change in focus is said to be parfocal.

No physical change takes place in the video camera or stage in any way. Any changes you make appear only in the **Vision** tab of the Graphic Display window.

Before you begin to calibrate the Optical Center, open the **Probe Toolbox** dialog box, select the **Gage** tab, and select the **Cross Hair** gage. This displays the Cross Hair gage in the **Vision** tab.

To calibrate the optical center:

1. On the **Calibrate Probe** dialog box, from the drop-down list, select **Calibrate Optics**.
2. Click **Calibrate** to open the **Calibrate Optical Center** dialog box.

Calibrate Optical Center dialog box

3. Specify the **Calibrated Center**. PC-DMIS Vision supports any size of Video Frame, though the most common are 640 X 480 and 768 X 576 pixels. Edit the values in the **X Pixel** and **Y Pixel** boxes to adjust the position of the optical center of the video frame.

> Your service technician has set the initial displayed values. If you make any physical changes to the optics or camera relative to the optics, the optical center values will need to be re-evaluated.

4. Click the ++ button to go to the highest magnification level. With the lens completely zoomed in, you may need to adjust the lighting to see clearly.
5. Identify a small dust particle, and manually move the stage so the center of the cross hair coincides with the dust particle.
6. Click the -- button to go to the lowest magnification level. With the lens completely zoomed out, you may need to adjust the lighting to see clearly.
7. If the center of the cross hair does not coincide with the "dust", click the arrows in the **Manually Moved Center** area to align the cross hair with the "dust". After the "dust" is aligned, repeat steps 4 through 7.
8. When there is no perceivable shift or the shift is less than one pixel when going from high magnification to low magnification, click **Calibrate** to update the **Calibrated Center** values with the manually adjusted values.
9. Click **Close** when *parcentricity* has been established.

Calibrate Optics

This option calibrates the optics on the system. PC-DMIS supports five separate calibrations (depending on hardware and the available calibration artifact):

- **Pixel Size** - This calibration method calibrates the size of the field of view (FOV) throughout the zoom cell's magnification (mag) range or with a given optic's configuration. Follow the manufacturer's guidelines on optical calibration intervals. You need to recalibrate the optical magnification any time the zoom cell or microscope is altered (such as when it is sent in for repair).
- **2D lens distortion** - This calibration method calibrates the non-linear errors in the FOV throughout the zoom cell's magnification range or for a given optics configuration. This can significantly improve measurement accuracy away from the center of the FOV, especially on lower magnification optics.
- **Camera Rotation** - This calibration method calibrates the rotation of the camera to the stage and removes any rotation. This is particularly evident on CMM-V systems or systems with the HP-C-x family of sensors.
- **Parcentrality/Parfocality** - This calibration method ensures that the center of the lens and the center of the FOV are aligned. This option is only available if the following are true:

    - You are using a zoom lens.
    - The selected lamp was previously calibrated. See "Calibrate Illumination".
    - You selected the **Pixel Size** calibration.

- **Focus** - This is the Focus Depth and Latency calibration method which are calibrated through a series of focus adjustments at various magnification levels (**Pixel Size**).

If your zoom cell automatically calibrates, then you won't need to perform a specific magnification calibration. Instead, PC-DMIS displays a message when it completes the calibration process.

To calibrate the optics, follow these steps:

1. From the list on the **Calibrate Probe** dialog box, select **Calibrate Optics**.
2. Click **Calibrate** to open the **Calibrate Optics** dialog box.

Calibrate Optics dialog box

When the calibration procedure starts, DO NOT move the calibration standard.

3. From the **Calibrate** area, select the needed options.

    - **Pixel Size** - This option calibrates the pixel size at a different magnification to determine the size of a measured feature.
    - **2D lens distortion** - This option calibrates for any 2D distortion in the camera image.
    - **Camera Rotation** - This option allows PC-DMIS Vision to determine if there is any rotation in the camera relative to the stage. PC-DMIS then makes the necessary adjustments. The software automatically enables this option if you enable the **2D lens distortion** calibration option.

- **Parcentrality/Parfocality** - When you select this option, PC-DMIS performs the parcentrality/parfocality calibration using the **Pixel size** calibration. This process replaces the need to do an Optical Center calibration. This option is only available when you use the **HexagonMI Slide** (Hexagon Manufacturing Intelligence) and when your machine uses a zoom lens. Also, see the "Parcentricity Calibration Modes" topic.

  Accuracy - There are two methods for calibrating parcentrality/parfocality:

  - **Normal** - This method does the calibration on the same rectangles that were used for the FOV (pixel size) calibration. This method results in a faster calibration process.
  - **High** - This method does the calibration on the concentric circles on the calibration standard. This method gives better quality results, but it takes longer to perform.

- **Focus** - This option performs focus calibration for depth and latency.

4. From the **Settings** area, select the calibration settings:

   - **Illumination** - Select the **Illumination** source. Calibration is usually best done with bottom or sub-stage lighting as the edge contrast is sharper. Select **<Current>** to use the current illumination settings and not change the illumination during calibration. CMM-V or the HP-C-x sensors can now use its ring light, and they will default to that light source.
   - **Focus - Lens N.A.** - Specify the numeric aperture (N.A.) of the current lens if known; otherwise, leave this box blank. This value allows the calibration program to optimize the focus used during the calibration.
   - **Focus - Range** - Specify the focus range if no numeric aperture is given. This provides the range over which the focus is done.
   - **Auto Range** - Select this check box to auto calculate the best focus range to use. (This option may not be available on all systems.)

5. Click the **Calibrate** button. The software displays a message box stating that your calibration standard must be clean and aligned with the X axis. You must also ensure that the standard is face up.

PC-DMIS

The calibration standard must be clean and aligned with the X axis.

Ensure that the standard is face up by verifying that the logo and target sizes are readable.

Although the calibration processing employs noise and dirt rejection techniques, a dirty calibration standard may trigger calibration failures or yield less accurate measurement values. Be sure to clean any dust, dirt, fingerprints, or other material from the calibration standard's glass portion. Use a mild non-depositing cleaning solution, such as rubbing alcohol, and a soft, lint-free cloth. Be sure to also clean the stage glass where the calibration standard is positioned. For proper cleaning techniques, refer to your hardware documentation. If the stage carrying the glass standard might move during the calibration sequence, hold the standard to the stage with clay or putty.

6. Place the calibration artifact on the stage so the length of the standard runs along the X axis of the machine. Verify the alignment with the X axis by watching the horizontal line on the standard while traversing the stage X axis. The line should remain in the field of view and ideally very near center.
7. Click the **OK** button. Additional messages appear, requesting that you center the target.
8. Place a target so that it completely fits within the camera's view. This target should be roughly centered within the FOV and focused. The focus does not need to be optimal, just a good starting place for the software focus process.
9. Click the **OK** button. If you have a DCC machine, it automatically focuses on the target. If you have a manual machine, the software displays a prompt for you to focus on the target.
10. Use the manual controls to move the optical measuring system and roughly center the rectangle or square calibration standard in the FOV. PC-DMIS determines the target size based on your optics.

Do not change the Z position or the focus during the rest of the calibration procedure.

11. Click **OK** after you have centered the target. The calibration routine automatically proceeds based on the calibration options you selected:

- *If the machine supports DCC illumination control*, and an illumination lamp has been selected in the Illumination field, PC-DMIS Vision performs a lighting grayscale adjustment where it measures the target (or series of targets) across the range of magnifications.
- *If the system has Manual Illumination control*, you are prompted to increase or decrease the illumination level as required.
- *If you select* **Pixel Size**, PC-DMIS measures the series of calibration targets automatically.

Pixel Size calibration

- *If you select* **2D lens distortion**, at each magnification in the **Pixel Size** calibration, PC-DMIS Vision measures one or more solid circle targets in a rectangular pattern that covers most of the FOV. If the software doesn't automatically locate the first circle, PC-DMIS Vision prompts you to move the specified circle to the center of the FOV.

2D lens distortion

- *If under* **Parcentrality / Parfocality***, under the* **Accuracy** *drop-down list, you chose* **Normal***,* PC-DMIS Vision performs Parcentrality/Parfocality calibration on the same rectangles that it used for the **Pixel Size** calibration.
- *If you chose* **Focus***,* the system moves in and out of focus at various levels of magnification. PC-DMIS does focus calibrations to determine focus depth and focus latency.

Focus calibration

- *If you chose* **Camera Rotation**, PC-DMIS Vision measures the line at the bottom of the slide at different positions multiple times to identify the camera-to-stage rotation. If the rotation angle that PC-DMIS calculates is greater than five degrees, a warning indicates that the hardware should be physically adjusted to make the angle smaller. You can still apply the calibration to compensate, but it is recommended that you get the physical wrist/camera adjusted to the stage.

Camera Rotation calibration

- *If under* **Parcentrality / Parfocality***, under the* **Accuracy** *drop-down list, you chose* **High**, PC-DMIS Vision prompts you to "Align the HexagonMI Standard Concentric Circle in Target". Align the circle as depicted in the image below and click **OK**.

Target centered on concentric circles of HexagonMI Standard

The Calibration Process continues. It focuses and takes a series of measurements at different magnification levels. This process establishes that the optical center and focal depth coincide through the focal range. This means if you focus and measure a circle at one magnification, it gives the same XYZ position at another magnification.

12. Near the end of calibration, PC-DMIS generates and runs a series of dynamic measurement routines in the background. It does this to perform a basic verification that measures a subset of the calibration data. As the software measures each target in these measurement routines, the **Status** area on the **Calibrate Optics** dialog box updates its message to show the step number.

Status message showing pixel size and error

13. There is a pixel size verification which is turned off by default and is controlled by the ProbeQualVisionOpticsCalPixelSizeVerifyEnabled entry in the PC-DMIS Settings Editor. If this entry is enabled, then at the end of calibration, PC-DMIS performs a basic verification that measures a subset of the calibration data. As the software measures each target in these measurement routines, the **Status** area on the **Calibrate Optics** dialog box updates its message to show the step number.

Pixel Size Verification dialog box

If the **Pixel Size Verification** dialog box appears, you can click **Run Again** to re-run the verification. This helps determine if any errors were simply anomalies in the verification. If the verification fails multiple times, try and re-run the entire pixel size calibration. If both the calibration and the verification fail repeatedly, contact Hexagon Technical Support.

Click **Continue** to accept the results of the verification.

> The ProbeCal section of the PC-DMIS Settings Editor contains entries that affect the pixel size calibration.

14. Click the **Close** button to close the **Calibrate Optics** dialog box. The software also writes the calibration results to the **Calibration Results** dialog box so that you can view the results of the calibration later. To view the results, click the **Results** button on the **Probe Utilities** dialog box:

Calibration Results dialog box

You have now calibrated the field of view. Repeat this process for each lens that you wish to use on the machine.

On a CMM-V camera or systems using the HP-C-x family of sensors, you only need to calibrate the FOV for the A0B0 wrist angle. You may wish to place some reflective white paper on the CMM table under the "Calibration Artifact Holder" (Part Num. CALB-0001). The "Calibration Artifact Holder" includes a glass slide (CALB-0002) and a ring gage (CALB-0003). The artifact holder is used for calibration of the CMM-V camera or the HP-C-x family of sensors.

Calibrate Illumination

This calibration procedure allows you to calibrate the lamps for your machine. Lamp calibration ensures that the illumination range is linear, and that changing magnification (**Pixel Size**) on zoom cells will not significantly change the illumination on the part within the capability of the hardware.

You should calibrate your optical system's lighting at these times:

- Whenever you change or replace a lamp, you should recalibrate that lamp.
- Whenever you have a significant change to the lighting within the room.
- Periodically throughout the life of the lamp.
- When you change the brightness or gain setting on the camera.
- When the optics are replaced.
- When the zoom cell is repaired.
- When the camera is replaced.
- Prior to calibrating Parcentrality/Parfocality when you "Calibrate Optics" since this is required for this calibration.

To calibrate lamps, follow these steps:

1. On the **Calibrate Probe** dialog box, from the drop-down list, select **Calibrate Illumination**.
2. Click **Calibrate** to show the **Calibrate Illumination** dialog box with the calibration date for each lamp in parenthesis. If you haven't calibrated a lamp the text in parenthesis says "Uncalibrated".

Calibrate Illumination dialog box

3. Select the check box next to the lamp that needs to be calibrated.
4. Prepare for calibration as directed according to the lamp type:
    - **Sub-stage** (bottom/profile) lamps require the stage to be cleared during calibration, with the image focused on the stage.
    - **Top** (surface/ring) lamps require an artifact or piece of paper to be in the Field of View, with the image focused on the surface.
5. Mark the **Adaptive Mode** check box to apply the adaptive calibration mode to the calibration process if required.

Calibrate Illumination dialog box with Adaptive Mode check box marked

The Adaptive Calibration mode may cause issues with existing measurement routines. Without the Adaptive Calibration mode, the levels across some hardware configurations were inconsistent. The actual illumination seen in the camera did not match the commanded value. After the Adaptive Calibration mode illumination calibration, the machine illumination seen in the camera will match the commanded value.

6. Click **Calibrate**. The calibration process begins. The process takes several minutes.

    - During calibration on systems with a zoom cell, PC-DMIS Vision selects different magnifications for illumination measurement as indicated by the **Magnification Step** value. This value displays the current magnification and corresponds to the value displayed in the **Magnification** tab of the **Probe Toolbox**.
    - The calibration also sets the illumination intensity corresponding to the different commanded illumination values at different magnifications. The

Lighting Grayscale indicates the intensity of this illumination. The values range from 0 (black) to 100 (white).

Calibration Illumination - in progress

- Once the calibration finishes, the **Calibrate Illumination** dialog box displays the new date for the calibrated lamp.

7. After PC-DMIS completes the calibration process, click the **Close** button or repeat steps 3 through 6 to calibrate another lamp.

The **Abort** button is only available during a calibration. This button stops the calibration, aborts any data collected during the process, and reinstates any pre-existing calibration files for the current lamp.

Calibrate Probe Offset

This calibration procedure allows you to determine the probe offset for your vision probe. PC-DMIS Vision also allows you to calibrate multi-sensor configurations with different probe tip types. For example, a vision probe and Contact probe are measured against the same tool or tools to establish a common offset frame of reference. The calibrated offset values for each tip are cross-referenced in relation to a common tool,

such as a ring gage or sphere. See the "Relationship of Tips and Tools" topic for more information.

Calibrating tip types (be they all contact or a mix of contact, vision, and laser) against a common tool or standard allows measurements taken with one tip to be used with measurements taken by a different tip.

When Probe Offset Calibration is Used

Probe calibration is used at these times:

- When you have multiple probes on your measuring system
- When you have a video probe with different magnifications (such as 1X and 2X lenses or dual virtual cameras)

It does not matter which probe type you calibrate first. However, on a CMM, you would usually calibrate the Touch Probe first and on a vision Multi Sensor machine, you would calibrate the Optical Probe first. During calibration of the second probe, you must answer **No** to the question, "Has the qualification tool been moved or has the Machine Zero point changed?".

Once the tool position on stage is known and the probe tip offset has been calibrated once from the **Probe Utilities** dialog box, an AutoCalibrate Active Probe step can be added in the measurement routine to calibrate the probe offset as part of a measurement routine. As with a contact probe, the AutoCalibrate execution for a vision probe is based on the specified parameter set.

For more information on vision probes, see the "A Note on Probe Definitions" and "Considerations for vision probes" topics.

Probe tip offset calibration has been expanded to support calibrating the contact probe and vision probe offset using a sphere or ring tool. The usage follows the general rules for tip offset and diameter calibration.

Before you begin vision probe calibration, be sure to calibrate the optical center (if a zoom cell), field of view, and illumination for your vision probe. In this example, a ring tool is used for measurement.

Calibrating the Vision Probe Offset

CWS sensors do not have a tab option on the **Setup Options** dialog box. For details on calibrating probe offsets for CWS sensors, see "Step 4: Calibrate the Laser Probe" in the PC-DMIS Laser documentation.

1. Identify a Z measurement point of the face of the ring. The position of this point is defined in machine coordinates and is relative to the top center of the ring gage bore. This can be done using the "Probe Toolbox: Gage tab". These values are used when adding a ring tool.
2. On the **Calibrate Probe** dialog box, from the drop-down list, select **Calibrate Probe Offset**.
3. Select the needed tool from the **List of Available Tools** or click **Add** to define a new tool.

In this example, you can specify a 20 mm ring tool with the following values:

- **Tool ID:** 20mm Ring
- **Tool Type:** RING
- **Diameter:** 20
- **Z Point Offset X:** 15
- **Z Point Offset Y:** 0
- **Z Point Offset Z:** 0
- **Datum Depth Start:** 1 (to accommodate the chamfer on the ring bore)
- **Datum Depth End:** 14
- **Focus Offset:** -0.5 (provides distance in Z from the top surface to the bore circle focus height)

See "Appendix B: Adding a Ring Tool".

4. Click **Calibrate** to open the **Calibrate Probe Offset** dialog box.

Calibrate Probe Offset dialog box

5. Set the following **parameters** as needed:

Operation Mode - **Default Mode** uses the default values. **User Defined** lets you alter the values.

Motion - **Man+DCC** mode requires that three manual points be taken at the start of the sequence whether or not you indicate that the tool position has changed. The remaining points will be taken automatically. **DCC** mode takes all points automatically unless you indicate that the tool has moved.

Start Angle - Angle in degrees in a Cartesian coordinate system as seen when looking down or –Z. A start angle of zero would be aligned to the +X. A start angle of 90 would be aligned to the +Y axis. The default value is 0.

End Angle - Angle in degrees in a Cartesian coordinate system as seen when looking down or –Z. An end angle of zero would be aligned to the +X. An end angle of 90 would be aligned to the +Y axis. The default value is 359.

The start angle and end angle specified here are different than the angle used for the contact probe and a sphere tool, which relates to the angle from the sphere equator to the pole.

Magnification - This option allows you to set the magnification to the "Maximum" setting or use the **<Current>** magnification. To ensure the highest accuracy, you should use the "Maximum" magnification to calibrate the vision probe offset. "Maximum" is the default setting.

Coverage - This percentage defines what portion of the zone is included for measurement. The default is 10%.

The start angle, end angle, and coverage percentage together define the location and size of the vision measurement targets around the circle. For larger circle sizes and higher optical magnifications, significant speed improvement can be achieved by reducing the coverage percentage. See the "Sample vision Circle Targets for Calibrate Probe Offset Parameters" topic.

Z Samples - This value is the number of Z samples that are taken to compute the Z position. The default is 5.

Illumination XY - This value indicates which illumination source to use for the XY measurements. Normally, bottom or sub-stage illumination is used for ring gage bore edge. This value can also be set to **<Current>** to use the current illumination settings.

Illumination Z - This value indicates which illumination source to use for the Z measurements. Normally, top or ring illumination is used for ring gage surface. This value can also be set to **<Current>** to use the current illumination settings.

Using **<Current>** for either of the illumination settings includes whether bulbs are on or off for Ring lamps.

If you find illumination settings that work well for calibration, create an illumination Quick Set so that these settings can be quickly recalled.

Parameter Sets - This area allows you to create, save, and use saved sets for your vision probe. This information is saved as part of the probe file and includes the settings for your vision probe. This parameter set can be retrieved for later calibrations, including the auto-calibration measurement routine feature.

To create your own named parameter sets:

a. On the **Calibrate Probe Offset** dialog box, modify any parameters.
b. From the **Parameter Sets** area, type a name for the new parameter set in the **Name** box, and click **Save**. PC-DMIS displays a message informing you that it created the new parameter set. To delete a saved parameter set, select it, and click **Delete**.

6. Click **Calibrate**. A message asks if the qualification tool has been moved or the machine zero point changed:

- If PC-DMIS has not measured the actual tool location on the stage, select **Yes**.
- If the tool has already been measured with a different probe type, select **No**.

7. Click **OK** on the reminder that the tip must be calibrated.

8. If the tool has moved or **Man+DCC** motion is selected, take the three manual crosshair points evenly around the top of the datum bore circle. Adjust the stage position, including focus, as needed. The remainder of the calibration sequence executes automatically. It focuses on the bore top edge, measures the bore circle, moves to the Z focus offset relative to the bore, and does the Z position focus measurements. The probe tip offset data is updated with the measured offset based on the ring tool measurement. If you confirmed that the tools was moved, this measurement determines the XYZ location of the tool on the stage.

Sample Vision Circle Targets for Calibrate Probe Offset Parameters

In the following examples, the filled or cross hatched areas in the circle target indicate where PC-DMIS will not take edge measurements.

Example 1

This example is more suitable for larger ring diameters and higher magnification optics where you want to keep the execution time low.

Target pattern start angle of 0, end angle of 358, and 5% coverage

Example 2

This example is more suitable for larger ring diameters and higher magnification optics where longer execution time is acceptable for a more repeatable measurement.

Target pattern start angle of 0, end angle of 358, and 10% coverage

Example 3

This example is more suitable for smaller ring diameters and medium to lower magnification optics.

Target pattern start angle of 0, end angle of 358, and 50% coverage

Contact Probe Offset

When you calibrate the contact probe offset with the same tool that you used to calibrate your vision probe, the calibration establishes a common offset frame of reference.

To calibrate the contact probe offset, follow these steps:

1. Select the **Insert | Hardware Definition | Probe** menu item.
2. In the **Probe Utilities** dialog box, define the contact probe and tip.
3. Select **Measure** to open the **Measure Probe** dialog box.
4. Specify the following values in the **Measure Probe** dialog box:

    - **Motion:** Man+DCC
    - **Type of Operation:** Calibrate Tips
    - **Calibration Mode:** User Defined
    - **Start Angle:** 0
    - **End Angle:** 359
    - **List of Available Tools:** 20mm Ring (Select the same tool that you used to determine the vision probe offset.)

5. Select **Measure** when asked if the tool has moved, click **No** this time. This tells PC-DMIS that it does know the actual tool location on the stage.
6. Click **OK** on the tip reminder message box.
7. A message box prompts you to take one hit on the tool face below or in the –Y direction from the bore center. Click **OK** and then take the contact point. The calibration routine then does a coarse bore measurement, a face plane measurement, a more precise bore measurement, and then the Z offset point measurements.

Now both probes have measured the tool and have offset values based on the same tool position data.

CMM-V and HP-C-x Probe Offset

To calibrate a CMM-V and HP-C-x probe offset, follow these steps:

1. Create a touch probe with all the angles that you'll use to take measurements with your CMM-V or HP-C-x vision sensor.

    Your touch probe must be a star probe with at least 3 tips.

2. Calibrate all specified touch probe angles on a sphere.
3. Measure the A0B0 touch probe angle on a ring gage.
4. Measure the A0B0 video probe on the same ring gage, click **No** when the software asks if the tool has moved.

5. When you have the CMM-V or HP-C-x sensor selected, click **Add Angles**. Instead of showing the standard **Add Angles** dialog box, PC-DMIS Vision prompts you with a list of touch probes.
6. Select the touch probe that you have calibrated on the sphere and press **OK**. PC-DMIS Vision automatically adds those angles and calibrations to your CMM-V or HP-C-x sensor.

Star probe with 3 orthogonally arranged Styli

It is recommended that the touch probe with the Star configuration include a Weighted Calibration Extension suitable for the camera type you are using. For example, the HP-C-VE camera uses the weighted extension shown below.

Weighted calibration extension for a touch probe with a star configuration

Relationship of Tips and Tools

The probe tip offset calibration is based on the position of the tool on the stage. When a tip is calibrated and the tool is said to have moved, the tool position on the stage is determined based on the tip offset. If the tip has not yet been calibrated, then the nominal tip offset from the probe.dat data is used.

It may be important to maintain a common frame of reference for the tip offset calibrations. When multiple tips are calibrated using a common tool, the tips have the same offset frame of reference. This frame of reference can be extended to a second tool by saying the second tool moved and doing a tip offset calibration with a tip calibrated on the first tool. Feature locations measured with tips in the same frame of reference should yield the same answer (within the equipment measurement capability). If you calibrate a tip on a tool that is not in the same frame of reference and do not say the tool moved, the tip calibration frame of reference is changed to the tool. Features measured with tips calibrated in different frames of reference may yield dramatically different answers.

Consider a new system where no probes or tools have been calibrated where a sphere and a ring tool are used for tip calibration. Calibrate the contact probe using the sphere tool and say the tool moved. Then calibrate the same contact probe on the ring gage and say the tool moved. The two calibrations for the contact probe tip establish the reference between the tools and the contact probe tip. Now, calibrate the vision probe tip on the ring gage. The contact probe tip and vision probe tip will now have the same offset calibration frame of reference. The offset calibrations of the two probes with the

two tools are linked because the probe that had its offset calibrated on the sphere tool was calibrated on the ring tool when the ring tool was said to have moved. Because the ring tool was said to have moved (or its position is unknown), when the contact probe tip was calibrated using the ring tool, the position of the ring tool on the stage was determined based on the contact probe tip’s measured offset. The contact probe tip's offset was used to determine the stage position of both tools and then the vision probe offset was based on the stage position of one of these tools.

The two probe tips would not be cross referenced if the contact probe tip had been calibrated on the sphere tool and then the vision probe tip had been calibrated on the ring. If the contact probe tip were calibrated on the sphere tool, the vision probe tip calibrated on the ring tool, and then the contact probe calibrated on the ring tool, the two probe tips would be in the same frame of reference, but this would be a different frame of reference than the sphere tool or any probe tips previously calibrated on the sphere tool. This is because the vision probe tip was used to determine the ring tool’s position when it was said to have moved, but the vision probe tip had not been calibrated on the sphere tool. The contact tips frame of reference was changed to match the ring tool. To maintain the linkage of tips across tools, whenever a tool is said to have moved (which also means a tool whose position is unknown), the calibration tip used on the just moved tool must be in the frame of reference of the first tool.

You can only calibrate the bottom tip of a star tip contact probe on the ring gage. A sphere tool or a sphere tool in combination with a ring gage can be used to provide cross referencing between the probe star tips and the vision probe. Normally this cross referencing would be done by calibrating all contact probe star tips on the sphere tool. Then calibrate the bottom tip on the ring tool saying that the tool had moved. Then calibrate the vision probe(s) on the ring tool. You can then calibrate contact tips on the sphere tool and vision probes on the ring tool.

A Note on Probe Definitions

When PC-DMIS calibrates the vision probe in DCC mode, it uses existing measurement data or, if that is not available, the nominal values from the probe definition. PC-DMIS stores standard probe definitions in the probe.dat file, whereas machine specific probe definitions can be created in the usrprobe.dat file. Probe.dat files may be deleted or replaced during a PC-DMIS uninstall or version upgrade installation, but the usrprobe.dat file will not be deleted or replaced.

Since the positioning tolerances to have the tool in the field of view and in focus for high magnification systems can be very small, creating data in the usrprobe.dat provides a means for fine tuning the default probe attributes. Machine specific default tip offset values may be necessary to provide the more accurate nominal offset information.

Considerations for Vision Probes

Contact probe hardware tends to be an assembly of well-defined mechanical components (probe mount point, probe body, probe module, probe tip) with predictable mount point and nominal tip offsets where position variances can be handled by the probing motion. However, vision probes are normally less predictable, as they often have non-standard mounting hardware, variances in the working distances, hardware adjustment or calibration, and so on. Because of this, it may be more difficult to find the desired target with probing motion. The vision probe does not scan the way contact probes to, so the variances are more noticeable.

Some machines may also have adjustable probe mounts that make the probe position unpredictable in the default probe.dat definitions. Because of such tight tolerances from higher magnifications or machine variances, you may need to do a manual+DCC execution the first time the probe offset is calibrated on a new probe tip, even if the tool position is known. This provides high quality measured offset data for subsequent tip offset calibration sequences, as the measured tip offset is used instead of the nominal.

Unlike most CMMs, most vision multi-sensor machines do not have a single standard end of arm probe mount. Instead they have a Z column that provides a proprietary mount for the optics and a standard mount for the touch probe. In order to define the nominal probe offset values with accurate relative offsets, an adaptor component is often used in the probe.dat or usrprobe.dat definition. This adaptor defines the offset between the machine probe reference point (such as end of ARM) and the probe. For example, if you were to select the zoom cell lens face as your reference point, you would need an adaptor component that defined the offset distance from the zoom cell lens face to the touch probe mount point. Then, to define a touch probe, you would select the adaptor, then the probe (such as a TP200), then the stylus. When finished, the nominal probe offset between the vision probe and the contact probe would approximate the hardware.

Using Optical Calibration Standard Certification Data

During the optics calibration of a vision probe, if a certification data file (fovcert.dat) exists in the probe directory, PC-DMIS reads the file and uses it to adjust the calibration data from the nominal. A fovcert.dat file supports data for these feature parameters:

- The X and Y size of the concentric rectangles
- The X and Y center positions of the concentric circles

Information about the fovcert.dat File

- The first line must be the file schema number.
- A semicolon at the start of a line denotes that the line is a comment.
- Comment lines may not start with a space character.

- The [PATTERN] value is a hex bitmask that denotes the rectangle edges to be measured in X and Y. The position of the edges is from left to right and from top to bottom. For example, a value of 0xAA hex is 1010 1010 binary. This translates to use the first and third edges in the X direction and the first and third edges in the Y direction for rectangle measurement.

- All values are in mm.

This example contains a sample nominal fovcert.dat file:

```
2
[PATTERN]
0xAA
[RECTANGLES]
;X size  Y size
17.2  13.2
10.75  8.25
 6.45 4.95
 4.3  3.3
 2.15 1.65
 1.29  0.99
 0.86  0.66
 0.5375  0.4125
 0.3225  0.2475
 0.215  0.165
 0.1075  0.0825
 0.043 0.033
[CIRCLES]
; nom diam  centerx  centery
```

```
30          0.0     0.0
20          0.0     0.0
10          0.0     0.0
5           0.0     0.0
2.5         0.0     0.0
1.25        0.0     0.0
0.625       0.0     0.0
0.25        0.0     0.0
```

Parcentricity Calibration Modes

There are three modes for parcentricity calibration:

- **Mode 1:** This mode uses concentricity data from the fovcert.dat file. If a fovcert.dat file exists and it contains concentricity certification data, PC-DMIS uses this calibration mode.
- **Mode 2:** This mode measures the series of circles, and it links together the circles in order to automatically correct for any concentricity error in the standard. If there is no concentricity data in the fovcert.dat file, and the `ProbeQualVisionParCalibrationUseBridging` entry (located in the **USER_ProbeCal** section of the Settings Editor) remains at its default setting of TRUE then this mode is used.
- **Mode 3:** This mode measures the standard concentric circles and assumes they are perfectly concentric. If the fovcert.dat file doesn't contain concentricity data, and the `ProbeQualVisionParCalibrationUseBridging` entry is set to FALSE then PC-DMIS uses this calibration mode.

A related entry, `ProbeQualVisionParCalibrationXYSamples`, located in the same section of the Settings Editor, defaults to 3. This defines the number of times a given circle is measured at a given magnification during the parcentric high calibration.

Ring Light Migration

PC-DMIS Vision provides a feature called Ring Light Migration. The purpose of this feature is to improve the migration of ring light settings between machines that use

different ring light configurations. This feature also allows you to select specific Ring Light settings offline.

Anyone who generates their measurement routines offline, or needs to run their measurement routines on different machines with different ring light configurations should use this functionality.

The reason for this feature is that PC-DMIS currently has the option of transferring programs from one machine to another machine of the same type since it has Adaptive Illumination Calibration. However, if you want to transfer programs between machines that have different ring light configurations, no migration occurred. This required you to reset the ring light intensities.

With this new functionality, PC-DMIS migrates the ring light intensities whenever it detects a different ring light configuration. This reduces the amount of editing required when migrating between machines.

Ring Light Migration Method

The goals of the Ring Light Migration method are:

- Maintain contrast of the image.
- Maintain overall lighting strength.

Migration method steps:

1. Determine if the physical size of the ring lights between the source and destination are different. PC-DMIS stretches or reduces the size of the ring light to match the size of the source. This is done by making both the inner-most and outer-most ring light diameters the same. All other diameters are resized proportionally.
2. PC-DMIS recalculate the light intensity based on these rules, from source ring light to destination ring light.

Ring Light Migration Workflow

Offline Migration

PC-DMIS Offline can define a specific ring light in the following ways:

- Create a measurement routine with the ring light which matches the ring light on the target machine.

- From an existing measurement routine with a single ring light, you can migrate to a different ring light without loading the measurement routine onto an actual machine.

To do this:

1. Start up PC-DMIS in Offline mode but DO NOT load a measurement routine.
2. Open the **Machine Options** dialog box (**Edit | Machine Interface Setup**).
3. From the **Illumination** tab, select the specific ring light configuration for the measurement routine.

Machine Options dialog box - Illumination tab for ring light migration

You cannot change the ring light if a measurement routine is loaded.

If you wish to migrate a measurement routine written with a specific ring light to a different ring light, PC-DMIS allows you to select the new ring light in the **Machine**

Options dialog box. You can then open the measurement routine and it will use the new ring light.

Online Migration

With PC-DMIS online, if you run a measurement routine from one machine on another machine with a different ring light configuration, the software detects this and prompts if you would like the ring light settings migrated to match the new settings.

If there is more than one ring light in the measurement routine, PC-DMIS reverts to the legacy method which requires you to select a ring light to migrate from.

If you select **No** in the above message, no migration takes place, and the measurement routine opens as in previous versions of PC-DMIS.

If you select **Yes**, PC-DMIS attempts to migrate the ring light values.

Legacy Measurement Routines

For measurement routines that were created prior to PC-DMIS version 2019 R2, the ring light migration process requires an additional step due to the lack of information.

When you open a legacy measurement routine with a ring light, PC-DMIS displays the **Ring Light Migration** dialog box and prompts you with instructions in the Status bar to select the ring light the measurement routine was created with.

Ring Light Migration dialog box

Once you select the ring light, click **OK**, and then save the measurement routine in 2019 R2 or later format. You can then follow the Offline or Online migration procedure to complete the process.

To avoid this additional step, always save your measurement routines created prior to 2019 R2 in the latest PC-DMIS version format with the **Save As** menu option (**File | Save As**).

Migrate Magnification Variables

Opening a Measurement Routine

When you open a measurement routine that was created in a version earlier than 2022.1 and you are running it on a vision machine or in Offline mode, PC-DMIS reviews

all vision features to see if they use variables to specify the magnification. If PC-DMIS finds any, it shows the **Migration Report** dialog box.

The dialog box has a section that shows all the variables used for magnification and the estimated pixel size.

The dialog box also has a section that shows all the features that use each variable.

Migration Report dialog box

Saving a Measurement Routine

When you save a measurement routine to a version prior to PC-DMIS version 2022.1, PC-DMIS reviews the measurement routine for any instances of pixel size variables. If any are found, PC-DMIS shows a message similar to this:

PC-DMIS

Pixel size is not supported in version 2021.1. Please ensure all variables used to control pixel size are updated for optical magnification.

Setting Machine Options

Select the **Edit | Preferences | Machine Interface Setup** menu option to open the **Machine Options** dialog box. The tabs in this dialog box may vary depending on the type of optical machine you have and whether you’re running in Online or Offline mode. A typical optical machine would allow you to:

- Specify the active hardware components you will use with your optical measuring system. This potentially allows you to still use some components of your optical

machine if certain hardware components are broken. See "Machine Options: General Tab".

- Change your machine's speed and travel limits. See "Machine Options: Motion Tab".
- Specify the available lamps on your machine. See "Machine Options: Illumination Tab". This feature is available in Online and Offline modes.
- Specify the settings for your wrist device. See "Machine Options: Wrist Tab".
- Specify the communications port and settings used to connect your computer to your optical measuring device. See "Machine Options: Motion Controller Communication Tab" and "Machine Options: Illumination Communication Tab".
- Store any communications between PC-DMIS Vision and your optical machine for debug purposes. See "Machine Options: Debug Tab".

If you are running PC-DMIS Vision with the CMM-V or HP-C-x sensor on a CMM, then not all of the above pages are available. To access the standard CMM controller setup, select the **Setup** button on the **CMMI** section of the **General** tab.

Many of the functions are on the **Probe Utilities** dialog box as part of the centralized calibration processes. Calibration is probe specific.

Machine Options: General Tab

Machine Options dialog box – General tab

The **General** tab allows you to enable or disable controllers for use with PC-DMIS. If you change any of the options on this tab, you must restart PC-DMIS. These three main areas exist on this tab:

- Active Controllers
- Controller Information
- Timer Interval

Active Controllers

The **Active Controllers** section defines which machine interface PC-DMIS uses to control each hardware component during PC-DMIS online operation. You can select three options: **MSI**, **CMMI**, or **None**.

- **MSI:** (Multi Sensor Interface). Select this option to have the MSI handle the controller section. For dedicated vision machines (such as TESA and MYCRONA), this makes all active controllers that are present on the machine go through the MSI. On a CMM, only the vision-specific controllers (Illumination, Optics, and Framegrabber) are set to MSI. The others (Motion, Pendant, Toolchanger, Wrist, Touch Probe, and Laser Probe) use the standard CMM interface (CMMI).
- **CMMI:** Select this option for a vision probe on a CMM (such as the CMM-V camera or the HP-C-x family of sensors), where the original controller (such as LEITZ) is used to control the Motion, Touch Probe, Wrist, Laser Probe, and Tool Changer elements of machine operation.
- **None:** Select this option if the hardware component does not exist or is broken. If the component is broken and you select this option, the software allows you to continue to use functional parts of your optical machine.

MSI and CMMI selections are not mutually exclusive. You can mix an MSI with a CMMI controller during the selection.

Controller Information

The **Controller Information** area displays the controller discovered by PC-DMIS during execution in Online mode. This section shows four display boxes with this information:

- **Controller** drop-down list: Select your machine model for interfaces that support multiple machine models. For example, the Metronics interface would have **TESA VISIO 300 Manual**, **TESA VISIO 300 DCC**, and **Custom** types. This option MUST be set in order to configure machine configuration settings correctly for the target machine. For interfaces that only support one type of machine, the option is automatically selected for you.
- **PC-DMIS** connectivity: Displays the supported version of the Hardware Abstraction Layer (HAL) interface for this version of PC-DMIS supports. The HAL

version should be the same for PC-DMIS, MSI, and HSI. A warning is given if differences are encountered.

- **MSI** (Multi Sensor Interface) connectivity: Displays the supported version of the HAL interface for this MSI.
- **HSI** (Hardware Specific Interface): Displays the HSI used during execution. This component controls the specific hardware device.
- **CMMI** (Coordinate Measuring Machine Interface): Displays the name of the CMMI interface to be used. Click **Setup** to open the Machine Interface Setup options for the CMMI controller (e.g. Brown and Sharpe LEITZ).

You should provide this information to Hexagon Technical Support when you report problems.

Timer Interval

The **Timer Interval** box indicates the maximum time that PC-DMIS Vision waits before asking the hardware for current motion, illumination and optics settings.

Unless directed by a trained technician, **do not** alter this value.

Machine Options: Motion Tab

Machine Options dialog box - Motion tab

The **Motion** tab allows you to define the movement parameters of your machine. Your service technician has already set your motion options during the installation of this system.

This tab is not available for CMM-V or HP-C-x sensors.

Homing Enabled Check Box

You need to perform the homing operation if you want to use the stage with a fixture. Homing is also needed for systems using any segmented linear or nonlinear error correction. A specific stage position must be identified in order to correlate the stage

position with the error correction data. This operation establishes the machine's zero location.

With this check box selected, PC-DMIS homes the machine when it starts. Some hardware may retain its homed state until you switch it off. If the hardware does not need homing, or if it isn't configured for homing, selecting this check box will not have an effect.

Travel Limits and Volumetric Compensation Areas

These areas specify the travel limits and volume compensation of your machine.

The service technician has already determined the best travel limits and volume compensation values for your system.

Only a trained service technician should run the stage calibration utility. The dialog box displays the date and time when the last stage calibration was performed.

Limits Enabled check box: This check box allows you to turn off the checking of the limits. The only time you would normally turn this check off is on certain systems when you are performing a stage calibration, and you need to work right to the limit of the stage travel. We do not recommend disabling this check box at any other time because it can help protect the hardware from being damaged when the hardware is moved outside its limits.

Calibrate: This button begins the stage calibration procedure. For stage calibration and certification, contact Hexagon Technical Support.

Unless directed by a trained technician, DO NOT alter these values.

The **Calibration date** field is the date when the **Calibrate** button was last used to generate a new or updated calibration file.

The **Grid** field shows the current data format version being used for the grid data in the hybrid volcomp. If you are using any lenses other than the lens used to collect the grid data used for the hybrid volcomp, the **Grid** field must indicate a comp grid version of 2 or higher. If it does not, contact Hexagon Technical Support.

Max Speed Box

The **Maximum Speed** edit box indicates the speed of DCC moves. If you find that you need to modify the move speed percentages, it is better to make any changes from the **Motion** tab of the **Parameter Settings** dialog box.

Unless directed by a trained technician, **do not** alter this value.

Machine Options: Illumination Tab

Machine Options dialog box – Illumination tab

The **Illumination** tab allows you to select the lamps that are installed on your machine from those available from the machine vendor.

From the **Available Lamps** list, select the check box next to the lamps that are physically installed on your machine.

Selecting **Restore last lamp state at startup** turns the lamps on to the last state when PC-DMIS is started.

Selecting **Turn lamps off at end of execution** turns the lamps off when the measurement routine is completed. This feature is not used for single feature execution (Ctrl + E, or Measure Now, or Test), only for execution such as Full, Execute Block, or Execute from Cursor. By default, this option is OFF.

Illumination Calibration is done from the **Probe Utilities** dialog box. See the "Calibrate Illumination" topic

Machine Options: Wrist Tab

Machine Options dialog box - Wrist tab

The **Wrist** tab allows you to specify the communications port and settings that are used to connect your computer to your optical measuring device's wrist controller. This is for dedicated vision machines that have a PH9 type wrist fitted and the **Wrist** LMS license or portlock option selected (such as Mycrona).

On a CMM-V or HP-C-x sensor, this tab is not available, because the wrist control is done through the existing CMMI interface.

Machine Options: Motion Controller Communication Tab

Machine Options dialog box - Motion Controller Communication tab

The **Motion Controller Communication** tab allows you to specify the communications port and settings used to connect your computer to your optical measuring device's motion controller.

For TESA Visio1 machines, there is a single **Machine Controller** tab for Motion and Illumination.

For Metronics (such as TESA VISIO 300) and Mycrona interface systems, there are no **Machine Controller** tabs.

Machine Options: Illumination Communication Tab

Machine Options dialog box - Illumination Communication tab

The **Illumination Communication** tab allows you to specify the communications port and settings used to connect your computer to the Illumination instruments used by your optical measuring device.

For TESA Visio1 machines, there is a single **Machine Controller** tab for Motion and Illumination.

For Metronics (such as TESA VISIO 300) and Mycrona interface systems, there are no **Machine Controller** tabs.

Machine Options: Debug Tab

Machine Options dialog box - Debug tab when connected to a vision machine

PC-DMIS Vision has the ability to generate a file that records any communication between the software and the hardware during the execution of your measurement routine. This "debug" file is useful in determining the cause of any problems that you might have with your optical measuring system.

When connected to a vision machine, the **Focus** mode option is available:

Focus list: To log debug information related to focus on vision systems, select:

- **None** - No focus logging
- **On error** - Log focus data only when a focus error occurs
- **Always** - Log all focus data

The focus log file name is debug_focus.txt.

By default, PC-DMIS sends the debug file to the ProgramData directory. This is typically "C:\ProgramData\Hexagon\PC-DMIS\<version>", where <version> is the version of PC-DMIS you're running.

For more information on how to generate a debug file, see "Generating a Debug File" in the "Setting Your Preferences" chapter in the PC-DMIS Core documentation.

For more information on the default locations for PC-DMIS files, see "Understanding File Locations" in the "Setting Your Preferences" chapter in the PC-DMIS Core documentation.

When you use a CMM-V or HP-C-x sensor, you can access the **Debug** tab from the **CMMI Setup** dialog box. Vision and standard CMM debug information are both written to the same debug.txt file.

Available Vision Setup Options

In addition to setting your machine options, there are some vision-specific software options that you can set using the **Setup Options** dialog box (**Edit | Preferences | Setup**). The following check boxes that are used with vision machines appear in the **General** tab:

Suppress Vision Load Probe Dialogs

☑ Suppress Vision Load Probe Dialogs

This setting affects vision multi-sensor machines. It helps to minimize load probe messages for the vision probe by suppressing the **Probe Utilities** dialog box when you create a measurement routine and insert the last active vision probe. It only does this if all these conditions are met:

- The vision option is enabled on your portlock or LMS license.
- The type of vision system you use is something other than a CMM-V or the HP-C-x family of sensors.
- The last loaded probe is a vision probe.

PC-DMIS stores the last-used vision probe name in the `LastProbeFileMultisensor` entry located in the **Option** section of the PC-DMIS Settings Editor.

Focus Along Camera Vector

☑ Focus Along Camera Vector

The default mode for feature-based focus operations uses the camera vector and not the feature normal vector. If you want to use the feature normal vector, you need to clear this check box. This setting is valid for the current measurement routine.

Auto Edge Strength

☑ Auto Edge Strength

This determines whether or not PC-DMIS updates the edge strength based on teaching results. The default behavior automatically checks the edge strength at teach time and update it accordingly. If you clear this check box, then the edge strength remains unchanged before and after teaching takes place.

Vision QuickMeasure Toolbar

The vision **QuickMeasure** toolbar models the typical flow of operation on a vision system. You can access it from the **View | Toolbars** menu depending on your system's configuration. This is identical to the **QuickMeasure** toolbar in the PC-DMIS CMM documentation. For information on the **QuickMeasure** toolbar, see the "CMM QuickMeasure Toolbar" topic in the "PC-DMIS CMM" documentation.

Using the Graphic Display Window in PC-DMIS Vision

PC-DMIS Vision lets you switch between two view modes in the Graphic Display window: **CAD** view and **Live** view.

If the Chromatic White Light Sensor (CWS) is the active probe in the measurement routine, the **Laser** view is also visible.

CAD View

Sample CAD View showing the vision probe's field of view

The **CAD** tab (also called the "CAD View" throughout this PC-DMIS Vision documentation) is the standard view of the part. It works the same way as in the standard PC-DMIS software. For in-depth information on the **CAD** tab, see the "The Graphic Display Window" topic in the "Navigating the Interface" chapter in the PC-DMIS Core documentation.

The green rectangular region is the "field of view" (FOV). The FOV represents the view through the video camera. The center of the field of view has a crosshair. On a machine supporting DCC motion, you can click and drag this crosshair to move the FOV to a new location on the part:

Moving the FOV

On a machine supporting DCC optics changing, you can also resize (magnify or shrink) the FOV by dragging the corners of the green box. This changes the current magnification:

Sizing the FOV

Importing a Vision Demo Part

You can import CAD models in various formats and use them to create measurement routines.

Examples in this PC-DMIS Vision documentation that use CAD data, use a version of the vision training demo part. Hexagon offers a more comprehensive Vision training demo part (SKU #H00025491) that you can purchase from the Hexagon store. For details on this or any other available demo part, see the HMI Store - Training Parts.

To import a demo part:

1. Select the **File | Import** menu option and then select the correct demo part file type.
2. From the **Open** dialog box, locate and select the Vision demo part file, and click **Import**. If this file came with the PC-DMIS installation, it is normally located in the PC-DMIS install directory.

   You can find downloaded purchased demo block files in your Downloads folder.

3. When the import process finishes, select the **CAD View** tab in the Graphic Display window to view the imported CAD demo part.

Live View

Sample Live View of the Graphic Display window

If the software is in Online mode, the **Vision** tab shows the actual "real time" view from the video camera.

If the software is in Offline mode, the **Vision** tab displays a "simulated" view of what a video camera would see, based on the imported CAD drawing. It simulates the geometry and also the illumination. This process is called *CAD Camera*.

Simulated Live View (CAD Camera)

You can right-click on the image and drag your pointer. This essentially drags the image underneath the camera so that you can position the FOV to a new location on the part. This functionality only works on a DCC machine or when offline.

Display Features in Live View

You can display features in measurement routines in Live View.

Example of features displayed in Live View

All features must have approximately the same vector and Z position as the camera image.

To display features in Live View, select the **Show features** check box option in the **Live View Setup** dialog box (**Edit | Graphic Display window | Live View Setup**).

Under certain conditions, features in the measurement routine are not drawn in the Live View. This is done to prevent the drawing of out-of-context information or from cluttering the Live View with too much information.

These conditions are:

- During the execution of the measurement routine.
- When a gage is active on the Live View. You can then move the gage to a feature and use it without the overlay getting in the way.

- During the focusing process.
- When the Illumination Overlay is active.
- When measured or filtered points are shown while editing a feature. This gives you the possibility of looking at the measured point without the overlay getting in the way.
- During 2D Profile tracing.

Live View Screen Elements

This topic discusses the various screen elements available to you within the **Vision** tab.

PC-DMIS Vision - Live View showing tracker and targets

You can alter the elements in the **Vision** tab by clicking and dragging the handles (green or yellow dots) to the desired location. Handles can control the size, orientation, and start and end angles for the targets.

> **Tracker:** This is the visual user interface to features. In the Circle feature illustrated above, the tracker shows the size of the circle (**1a -** green dotted circle between the lines of the bright yellow donut), and allows the Start angle (**1b**), end

angle (**1c**), and orientation (**1d** - altered by dragging the green dot *handle* on the end of a line) to be changed.

Target: This is an addressable user interface to point detection. For each region, you can control each Target parameter by clicking in the target, or by dragging the handles. Target parameters are changed in the **Hit Targets** tab of the **Probe Toolbox**. In the Circle feature above, the circle has three targets (**2a**, **2b**, and **2c**). Each target has slightly different point detection parameters. **2a** - configured with a smaller scan width. **2b** - configured to detect NO points.

PC-DMIS Vision - Live View showing ROI and FOV coordinates

ROI (regions of interest)**:** During run time, PC-DMIS Vision may need to divide a target into pieces so that each piece may fit into the Field Of View (FOV). ROIs are different from Targets in that the target may be bigger than the FOV. There is no user interaction with ROIs except for some visual indicators (**3a** in the image above. The AutoShutter halo for the upper-left piece outlines the ROI; the target piece that can safely fit into the FOV at this magnification).

FOV Coordinates: At the top and bottom of the screen, the overlay numbers list the X and Y positions for the top left and bottom right corners of the FOV (**4a** in the image above). When right-clicking and dragging in the Live View, other numbers appear in brackets which show the distance the camera will move.

Additional information is given, depending on currently selected **Probe Toolbox** tab, but in the example above, you can see the feature and target names.

AutoShutter & Auto Compass: According to the Live View Settings, any manual features that you measure with Automatic Targets make use of a technology called "AutoShutter" and "AutoCompass". For more information on AutoShutter and AutoCompass settings found in the **Live View Setup** dialog box, see "Setting up the Live View"

Auto Compass: This guides the operator to move the stage to get the next feature into the Field Of View. It does this by showing an arrow and a distance to move.

PC-DMIS Vision - Live View showing Auto Compass

You need to move the stage so the entire dashed rectangle box is comfortably within the FOV.

PC-DMIS Vision - Live View showing the colored light countdown

Auto Shutter: Once the target is within the FOV, a colored light countdown is shown on the Live View (see the above image). It checks for stage stability, before automatically performing the edge detection on all targets that are within the current Live View.

If a stage movement is detected during AutoShutter, it discards the points and automatically restarts the countdown to measure again.

Focus Graph: When you execute a Surface Point, Probe Toolbox focus, or SensiFocus, the software draws a graph of the focus data. The software draws it to the right or left of the target as space permits. If there is insufficient room to the side of the target, the software draws the graph in the upper right corner. When you resize the target, move the stage, or press the Shift key, the graph is not drawn.

Live View Controls

This topic discusses the controls located at the bottom of the **Vision** tab.

Live View Freeze - This button "pauses" the update of the Live View display. This is useful if you want to keep something on the screen to analyze or take a screen capture, but you want the measurement to continue in the background. To restart the Live View update, release this button.

Move to Previous Hit Target - This button moves the Field of View (FOV) to the previous target in a list of targets.

Skip Backwards on Hit Target - This button moves the FOV part way backward along a target towards the previous target. This helps you see how an entire feature might be measured even though the entire feature does not fit inside the FOV.

Skip Forwards on Hit Target - This button moves the FOV part way forward along a target towards the next target. This helps you see how an entire feature might be measured even though the entire feature does not fit inside the FOV.

Move to Next Hit Target - This button moves the FOV to the next target in a list of targets.

Snap Mouse Clicks to Edge - This button causes selected points for feature creation to snap to the closest point along the nearest edge. If this button is not selected, points remain where they are clicked. For more information on this feature, see "Setting Up the Live View".

Snap Mouse Clicks to Edge is also used at execution time for Manual Targets. If this option is on, and you drag and drop a manual target, PC-DMIS will do an edge detection to snap the crosshair to the edge.

AutoShutter - This button enables AutoShutter capability to measure features. For more information on this feature, see "Setting up the Live View".

Feature Compass - This button causes the AutoCompass to display an arrow and the distance to move for the next target. For more information on this feature, see "Setting up the Live View".

Show Hit Targets - This button toggles the display of targets in the Graphic Display window or the Live View. This is the same functionality as the show target button on the

Auto Feature dialog box. This is particularly useful when you are using the Quick Start window and the **Auto Feature** dialog box is not open.

Lock Target To Part - When you select this button, the software locks the display of targets in the Graphic Display window or the Live View. If this is locked, you cannot click and drag the target to a new location on the **Vision** tab.

Show Gray Scale - When you select this button, the software shows a gray-scale depiction of the **Vision** tab. This button only appears when a color camera is used. For black-and-white or monochrome cameras, this button does not appear.

Overlay Transparency - When you select this button, the software *displays a slider* underneath it. You can drag the slider to set the transparency of the overlays displayed within the Live View. The transparency dynamically updates as you drag the slider. This is the only place that you can change the overlay transparency. The default value is 50%. 0% = fully transparent. 100% = solid.

Magnification - When you select this button, the software *displays a slider* underneath it. You can drag the slider to set the magnification of the Live View without having to use **Magnification** tab on the Probe Toolbox. The magnification dynamically updates as you drag the slider. For more information on magnification, see "Probe Toolbox: Magnification tab".

Display Gage - When you select this button, the software toggles the display of the currently selected gage overlay. Select the black down arrow to display the *Gage Selector* toolbar underneath the button, enabling you to select a different gage type to be displayed. For more information on gages, see "Probe Toolbox: Gages tab".

AutoVoid - When you select this button, the software performs a void detection for the currently edited feature. It automatically adds targets with zero point density at the detected void areas.

SensiFocus - This button executes an automatic "sensible focus" on the center of the **Vision** tab.

- On a DCC machine, it automatically moves the stage and then returns it to the focus position. The parameters used for this focus *do not* come from **Focus** tab of the Probe Toolbox. Instead, they are based on available data such as pixel size, depth of focus, frame rate, and so on. The focus target size is fixed and located in the center of the **Vision** tab.
- On a manual machine, this button is disabled.

SensiLight - This button performs an on-the-spot automatic "sensible lighting" adjustment in an attempt to achieve optimal results. The **Illumination** tab will quickly be selected as this automatic adjustment is made. For additional information on how SensiLight is used as a parameter for edge features, see the SensiLight description under "Automatic Hit Target - Edge Parameter Set".

Illumination Adjustment - This button toggles the display of the *Illumintation Overlay* on the **Vision** tab so you can make adjustments to the illumination. For more information on illumination, see "Probe Toolbox: Illumination tab".

Laser On/Off - This button toggles the laser on and off. This is available for systems with a laser probe or laser pointer fitted (such as TESA VISIO 300 and 500).

Setting Up the Live View

Live View Setup dialog box - manual mode

To open the **Live View Setup** dialog box, select **Edit | Graphic Display window | Live View Setup** from the menu, or right-click within the **Vision** tab and select **Setup** from the resulting shortcut menu.

The **Live View Setup** option is only available if the **Vision** option is enabled on your LMS license or portlock.

The **Live Image Setup** dialog box allows you to configure how the image appears in the **Vision** tab of the Graphic Display window. It contains these controls:

Scale to Fit - This check box determines whether PC-DMIS scales the display of the part to fit within the limits of the Graphic Display window. This check box is only available on some optical machines.

Auto freeze frame

When you select the **Enabled** check box, you can press the **Live View Freeze** button to toggle it on and off at measurement routine execution time. This action freezes the measured points on the screen until the next points are available for display.

This is also useful for machines where "image tear" occurs during stage movements.

AutoShutter

AutoShutter detects when a target (which may consist of multiple ROIs) is ready to measure points. The three criteria for readiness are:

- The ROI is entirely within the FOV.
- The stage has stopped moving.
- The user-defined delays have elapsed.

When these criteria are satisfied, PC-DMIS automatically takes the points and proceeds to the next ROI.

PC-DMIS uses the options in this area when you select **AutoShutter** from the bottom of the **Vision** tab (see "Live View Controls").

AutoShutter does not fire for DCC mode features with Manual Pre-Position enabled.

Active - This option determines when the software uses the **AutoShutter** capability to measure features. The options are: **Always**, **After Partial Alignment**, or **After Full Alignment**.

Movement settle time (seconds) - This box specifies a settle time (in seconds) before point detection takes place. This settle time begins once the current ROI that was not entirely in the FOV has entirely entered the FOV. You can use this field to slightly delay the automatic point detection to review and improve ROI placement within the FOV.

Measure settle time (seconds) - This box specifies a settle time (in seconds) before point detection for the FIRST ROI of a feature, even if this ROI is already entirely in the FOV. You can use this field to slightly delay the automatic detection to review and improve ROI placement within the FOV. This value is only applied to the first ROI of a feature.

The **Movement Detected settle** is the dominate value if it conflicts with the **Measure Feature settle** value.

Feature Compass

The **Feature Compass** features are only available in Manual mode.

The Feature Compass guides you to move the stage to get the next feature into the Field Of View by showing an arrow and a distance to move.

Active - Determines when the software uses the **Feature Compass** capability to measure features. The options are: **Always**, **After Partial Alignment**, or **After Full Alignment**.

PC-DMIS applies the **Active** option when you select the **Feature Compass** from the bottom of the **Vision** tab (see "Live View Controls").

MultiCapture

To speed up the execution, the MultiCapture functionality causes the software to look at features ahead in the measurement routine and create groups that PC-DMIS can execute within a single camera picture (Live View). The software bundles them together and executes them simultaneously. Mark the **Enabled** check box to use this functionality.

PC-DMIS marks this check box by default to speed up measurement. Clear this check box when you want more visual data on each feature as it is measured.

The **MultiCapture** area of the dialog box is only active in DCC mode or in Manual mode when the AutoShutter conditions have been met.

There are several levels of conditions that your measurement routine must meet in order to execute features in MultiCapture.

- **Primary Feature**: This is the first feature MultiCapture finds.
- **Other Features**: You must include any additional features in the measurement routine in the same MultiCapture.

MultiCapture requirements for the primary (or other) feature:

- It can be executed in a single FOV.
- It is not a relative feature.
- It has no Sensilight.
- It has no Focus.
- It has no Template Match.
- It has Automatic Target type.
- All targets inside of a feature have the same illumination.
- The number of ROI's do not exceed the limit. The current limit is 150.

Additional requirement for other features:

- The features do not use expression in their Theo or Targ values.
- The features have not been executed.
- There are no break points set on any of the features.
- The features have the approximate magnification, surface vector, Z value, and RGB factor as the primary feature.
- The features have the same relative scope level (in the same loop level or the same subroutine) as the primary feature.
- The features have the same Illumination setting as the primary feature.
- The combined area can fit in a single FOV.

Additional condition required for 2D Profile feature:

- You must first run the 2D Profile feature in Master mode.

The MultiCapture feature collection process stops when it encounters any of these commands:

- Any type of Alignment command
- Move Rotary Table
- Move Point
- Load Fixture
- Load Machine
- Load Probe Data
- Load Probe Changer Data
- Probe Compensation

- Set Active Tip
- Comment
- Manual Mode

For example, suppose you have five edge point features that all fit within a single Live View and you have MultiCapture enabled. Instead of the machine measuring the five edge point features separately during execution, PC-DMIS displays a MultiCapture overlay for the entire feature set. This overlay provides information about what features are in the group and how many. PC-DMIS then executes them simultaneously as if they were a single feature.

The sample MultiCapture overlay here shows five edge points combined into a single grouping. The overlay provides the following information:

A. The MultiCapture message lets you know that you are in MultiCapture mode. It displays the total number of features to be measured in the current grouping, and the primary feature in that grouping.
B. This displays all the features within the MultiCapture region to be measured.
C. The dotted rectangular box is the MultiCapture region. It bounds all the features for the current grouping.
D. The numbers provide the XYZ coordinates for the top-left and bottom-right corners of the MultiCapture region.

One-click manual target

Select the **Enabled** check box in this section to enable the **Manual Targets Single Click Execution** feature. When enabled at execution time, PC-DMIS displays a larger black and white crosshair cursor on the Live Image View display. Instead of dragging and dropping a manual target to a desired location on a feature, position the crosshair to the targeted location, and click the left mouse button. If you enable **Snap Mouse Click to Edge**, PC-DMIS automatically performs edge detection to snap the crosshair to the edge.

Snap Mouse Click to Edge

When you mark the **Enabled** check box and you are programming features in the **Vision** tab, PC-DMIS Vision detects the nearest edge and snaps the target anchor points to that edge. The value in the **Range (pixels)** box indicates the distance the software searches for this edge. If you have a blurred edge that you cannot bring into focus, you may find it necessary to not use snap to edge to reliably specify anchor points when programming a feature. This also applies at execution time for Manual Targets.

The **Snap Mouse Click to Edge** found at the bottom of the **Vision** tab also enables or disables this functionality (see "Live View Controls").

Overlay properties

This area lets you set the properties for various overlay elements that can appear in the **Vision** tab.

Show textual information - This check box show or hides any live image informational overlays that appear inside the **Vision** tab.

> **Show coordinates** - This check box determines whether or not PC-DMIS displays coordinates inside the **Vision** tab.
>
> > **Absolute coordinates** - When you select this check box, the software displays the overlay coordinates as absolute values. For absolute values, the top-left and bottom-right coordinates show the actual position of those corner points in the current machine coordinates. If you do not select this option, the software displays relative values. For relative values, the top-left corner is shown as 0,0, and the bottom-right corner shows the length and width of the FOV in the current units.
>
> **Use part coordinates** - This check box determines whether PC-DMIS displays coordinates in part coordinates.

Font size - This slider changes the font size of any textual overlays.

Show scale marker - This check box displays a scale marker in the bottom-left side of the **Vision** tab.

Show features - When you select this check box, PC-DMIS shows the features which are partially or completely in the Live Image View display area. The features must have approximately the same vector and Z position as the camera image.

Crosshair - This list contains three options: **None**, **Small**, and **Large**.

- If you choose **None**, PC-DMIS does not display a crosshair.
- If you choose **Small**, PC-DMIS displays the crosshair as a small plus sign in the middle of the Live View.
- If you choose **Large**, PC-DMIS extends the crosshair to all sides of the **Vision** tab.

Large Crosshair

Small Crosshair

Overlay - This list allows you to select the color used for most of the overlay graphics and text on the **Vision** tab. This affects probe hits, targets, gages, and textual information for FOV coordinates, magnification, and focus. The default color is red.

Nominal line - This list allows you to select the color to use for the nominal line in the targets.

Highlight saturated pixels - When you select this check box, PC-DMIS highlights saturated pixels on the Live Image View. This makes those pixels more visible. The highlighted pixels are those where the illumination intensity is above the defined threshold.

Flash - This check box determines whether the highlighted saturated pixels flash.

Highlight - This list allows you to select the color to use to highlight the saturated pixels.

Threshold (%) - This slider changes the illumination intensity value. PC-DMIS considers pixels above this value to be saturated.

Point properties

When PC-DMIS executes a vision feature, it draws the detected edge points in the **Vision** tab. While these points are shown only for an instant during execution, they are not quickly erased when editing and testing features. This area lets you control the size and shape of the point overlays drawn in the **Vision** tab.

Symbol - This list determines how PC-DMIS displays point symbols. The options include **Square dot**, **Round dot**, and **None** (to not draw points at all).

Diameter (pixels) - This list determines the size of the displayed square or round-dot point symbol.

Using the Live View Illumination Overlay

The **Vision** tab also supports the ability to display an overlay image of the machine's lamp configuration. To enable this image overlay, click the **Illumination Overlay** icon from the **Vision** tab.

This overlay corresponds to the lamp configuration image displayed in the Illumination tab of the Probe Toolbox. Clicking on different areas of this image overlay allows you perform some functions that are also available on the **Illumination** tab.

The graphical illumination overlay looks something like what appears in the example image below. Your overlay may look different depending on the type of illumination your machine supports:

Example Graphical Overlay of the ring lamp in the Vision tab

The overlay represents the different bulbs and the light intensity for each of those bulbs. You can select which bulbs you wish to control by clicking on them. Click and drag the mouse cursor over the bulbs to select multiple bulbs or hold the Ctrl key and click them individually.

Toggle the On or Off state of the selected bulbs with a right click.

To adjust the intensity of the selected bulbs, use the mouse scroll wheel. Hold the Ctrl key down while you scroll to adjust the intensity by larger steps. Alternatively, click and drag the slider handle to the right of each lamp in the overlay; or hover over the slider and use the mouse wheel to adjust the intensity.

Using Shortcut Menus

Two shortcut menus are available to access commonly used commands and options:

Live View Menu

To access the **Live View** shortcut menu, access the **Vision** tab, and then right click anywhere in the **Vision** tab, but not on a target.

Move To Point: When you select this option, the view moves to center the Live View image to the location where you right-clicked.

Move To Feature: Selecting one of the nearest ten features from this submenu moves the center of the Live View image to the center of the selected feature.

Edit Feature: Selecting one of the nearest ten features from this submenu will open the **Auto Feature** dialog box so that you can edit the properties for the selected feature. See "The Auto Feature Dialog Box in PC-DMIS Vision".

> The features listed under the **Move To Feature** and **Edit Feature** submenus are listed in increasing order of distance.

SensiFocus: This performs an automatic SensiFocus at the Live View position you right-clicked to access the shortcut menu. See the "SensiFocus" button discussed in the "Live View Controls" topic.

Magnification: This submenu gives another way to affect the magnification of the camera's view of the part. This submenu contains menu options that function just like the shortcut keys discussed in "Changing the Magnification of the Part Image".

Screen Capture To: This submenu lets you save a screen capture of the **Vision** tab to a file, the Clipboard, or to a PC-DMIS report. The currently selected view (**CAD** tab or **Vision** tab) is captured.

Setup: This menu option accesses the **Live Image Setup** dialog box. See "Setting Up the Live View".

Live View Target Menu

To access the **Live View Target** menu, right-click on a target in the **Vision** tab.

Target Type: Right-click on a target and change the target type from one of the following: **Automatic Target**, **Manual Target**, **Gage Target**, and **Optical Comparator**. For detailed information on each target type, see "Probe Toolbox: Hit Targets tab".

Insert Nominal Segment: To add a segment, right-click at the needed location and select the **Insert Nominal Segment** menu option. This will add a handle to the target that you can drag to match the geometry of the target. For example, there may be a V notch on a straight edge that you need to add to the target.

Delete Nominal Segment: To delete a segment, right-click on the handle and select the **Delete Nominal Segment** menu option. This will remove the selected handle. This simplifies the nominal form of a target by removing detail.

Inserting and deleting nominal segments is only used for Profile 2D Features. These options allow you to add or remove segments to a Profile 2D shape in order to match the feature more accurately.

Insert Hit Target: To insert a new Hit Target, right-click at the needed location and select the **Insert Hit Target** menu option. This is unlike the **Insert Hit Target** button from the **Probe Toolbox** that randomly inserts a new **Hit Target**.

Delete Hit Target: To delete a Hit Target, right-click the needed target and select the **Delete Hit Target** menu option.

Feature Coverage: This menu item allows you to quickly change the coverage for a feature. New targets will be created or removed based on the selected percentage of coverage. For information, see "Hit Target Controls".

Feature Coverage Active Targets: This menu item determines the number of targets to use to display the selected coverage percentage in the **Target Feature Coverage** list. For information, see "Hit Target Controls".

Reset: To reset the target areas of a feature, right-click on a target of the needed feature and select the **Reset** menu option. This will delete the entire previously added target, leaving the single default target.

Focus: This on/off toggle allows for focus prior to target measurement. Each target section has the ability to do a focus prior to doing the edge detection. This is the same as the option found in the "Probe Toolbox: Focus tab".

Edge Selection: Right-click on a target and change the target edge selection method from one of the following: **Automatic Target, Manual Target, Gage Target,** and **Optical Comparator**. For detailed information, see "Probe Toolbox: Hit Targets tab".

Point Density: To change the target **Point Density** right-click on a target and select the needed menu option from the **Point Density** submenu. For more information on the available **Point Density** options, see "Edge Parameter Set".

Test: To test a feature, right-click on a feature and select the **Test** menu option. For more information on testing features, see the "Vision Controls - Command Buttons" topic.

Laser View

If the Chromatic White Light Sensor (CWS) is the active probe in the measurement routine, PC-DMIS Vision adds a **Laser** tab with a spectrum plot. When the software is not executing the measurement routine, the spectrum plot shows the structure ("noise") of the CWS signal. This helps you select the optimal settings for parameters, such as illumination and frequency.

Note the following:

- PC-DMIS does not update the spectrum plot during measurement routine execution.
- When the **Laser** tab is selected and updating, the CWS **Intensity** and **Distance** readouts do not appear in the Probe Readouts window.

The minimum requirements to use the spectrum plot are:

- A CHRocodile S, CHRocodile SE, or a CHRocodile 2SHS white light sensor
- CHRocodile firmware version starting with 5.97
- A CHRocodile sensor that is connected to the personal computer with a USB cable or Ethernet

X axis - The X-axis of the spectral diagram represents the total range of the calibrated distance of the sensor. As the Z axis moves in the positive direction, the plot's peak moves from left to right.

Y axis - The spectrum plot's Y axis shows the signal strength. For best results for distance measurement, there should be a single and sharp dominant peak similar to the one shown in this example:

Example of spectrum plot in Laser tab

Using the Probe Toolbox in PC-DMIS Vision

The **Probe Toolbox** is not specific to PC-DMIS Vision but is part of the standard PC-DMIS software. This toolbox presents tabs and information relative to the type of probe currently being used. When a vision probe is active, the **Probe Toolbox** contains various vision probe parameters used to acquire the data points needed by measurement routines.

Your LMS license or portlock must be programmed with the **Vision** option and a valid vision Probe Type selected. Also, you must be working with a supported vision probe in order to access the various PC-DMIS Vision related tabs.

The **Probe Toolbox** works in conjunction with the **Auto Feature** dialog box to define the parameters PC-DMIS uses to measure Auto features. Functionality, you can perform probe movements, magnification, illumination, focus, and gage measurements independently from Auto feature creation.

The **View | Other Windows | Probe Toolbox** menu option displays the **Probe Toolbox**.

The **Probe Toolbox** contains the optical parameters within these tabs:

A. Position Probe
B. Hit Targets
C. Feature Locator
D. Magnification
E. Illumination
F. Focus
G. Gage
H. Vision Diagnostics

Probe Toolbox: Position Probe Tab

Probe Toolbox - Position Probe tab

You can use the **Position Probe** tab to act like a "Virtual Joystick" to position the probe or camera so that it is over the feature that you want to measure.

To position your vision probe, follow these steps:

1. Adjust the **Increment Value** in the **Increment** edit box to specify the amount that the value in the **Current Position** edit box increases or decreases.
2. Click the **Up** and **Down** arrows to change the value in the **Current Position** edit box. This causes your **Vision Probe** to move in real-time by the specified value. Alternately, you can type the value and press Enter to cause your **Vision Probe** to move.

For machines with multiple axis (such as two rotary tables), it also selects the currently active rotary table.

If you don't see any information in the **Probes** and **Probe Tips** lists of the Probe Toolbox, you need to first define a probe. For information on how to define a probe, see the "Defining Probes" chapter in the PC-DMIS Core documentation.

Since you can use this tab with all probe types (contact, laser, or optical), this PC-DMIS Vision documentation covers only PC-DMIS Vision related items. For information about the toolbox as it relates to probes in general, see "Using the Probe Toolbox" in the PC-DMIS Core documentation.

Position Probe Tab Buttons

	Click the **Take a Hit** button to measure an edge point at the center of the Field of View. The edge point must be within a 60-pixel range of the center of the Field of View to be measured.
	Click the **Remove a Hit** button to remove the anchor point hit you just took using the left mouse. This button remains disabled until you enter an anchor point hit.
	Click the **Probe Readouts** button to display the Probe Readouts window. You can re-size or relocate this window. See the "Using the Probe Readouts Window with Optical Probes" topic.
	The **Laser On/Off** button is available for systems with a laser probe or laser pointer fitted (for example, TESA VISIO 300 and 500). This button toggles the laser on and off.

Using the Probe Readouts Window with Optical Probes

Probe Readout window

Most of the information in the Probe Readouts window is the same for all probe types and is already discussed in the "Using the Probe Readouts Window" topic of the "Using Other Windows, Editors, and Tools" chapter in the PC-DMIS Core documentation. However, if you use a vision probe, the following additional readouts appear in the window.

VX / VY / VZ: If you are using a vision probe, the X, Y, and Z values indicate the coordinates of the crosshair at the center of the field of view (FOV). The VX, VY, and VZ values indicate the feature Target or Gage location with respect to the current alignment.

DX / DY / DZ: The DX, DY, and DZ values indicate the difference between the camera and feature position. You must have the **Distance to Target** option selected in the **Probe Readouts Setup** dialog box for these values to appear. For more information, see "Setting Up the Probe Readouts Window" in the "Setting your Preferences" chapter in the PC-DMIS Core documentation.

Mag: This value shows the current camera magnification setting. Any changes you make in the **Magnification** tab are reflected on this line of the Probe Readouts window. See "Probe Toolbox: Magnification tab".

W: Displays the current rotary table axis for a single rotary table.

V: When you use a stacked rotary table, the Probe Readouts window also shows a "V" value for a second rotary axis.

Vision Laser Sensors

If a vision laser sensor is the active sensor, the Probe Readouts window displays the X, Y, and Z readouts, plus the laser parameters such as Intensity and Distance. For details, see the appropriate laser sensor section in this document.

An example appears below:

A Note on Optical Tips

The concept of a vision probe parallels a contact probe to a certain point. Obviously, a vision probe doesn't come in physical contact with the part, but both contact probes and optical probes use the term "probe tip" to specify various positions of an articulating probe head. (Some other interchangeable terms for "probe tip" are AB angles, AB positions, Tip, Tip Angles, and so on.) The actual tip on a vision probe contains the optical device (the camera).

If you select a probe from the **Probes** list or a probe tip from the **Probe Tips** list, PC-DMIS Vision inserts a `LOADPROBE`/ command or a `TIP`/ command into the Edit window.

When PC-DMIS Vision executes these commands, it performs its associated probe definition.

Probe Toolbox: Hit Targets Tab

Probe Toolbox - Hit Targets tab

This tab only appears when you define and use a supported vision probe.

The **Hit Targets** tab shows the edge detection and focus parameters that will be used to measure a feature.

When using a vision probe, you will want to adjust and test your targets. This option also allows you to split the default target into sub-targets, each with its own set of parameters. For example, you can measure a circle with the default single target, or you can split the circle into individual arcs, each with its own set of target parameters. These target parameters include edge detection method, illumination, point density, and so on.

Id	Density	Under Scan	Edge ...	Strength	Edge .
EA1	NORMAL	N/A	Matc...	10	[?]->[?
EA2	NONE	N/A	N/A	N/A	N/A
EA3	NORMAL	N/A	Matc...	10	[?]->[?
EA4	NONE	N/A	N/A	N/A	N/A
EA5	NORMAL	N/A	Matc...	10	[?]->[?
EA6	NONE	N/A	N/A	N/A	N/A
EA7	NORMAL	N/A	Matc...	10	[?]->[?

An example arc showing seven targets, with four active (Normal) target regions.

Notice that each target in the targets list has its own set of target parameters.

PC-DMIS displays feature targets and their associated parameters as a row in the tab's target list. You can define more than one target. If you select one or more targets from this list, you can see them in bold formatting in the **Vision** tab of the Graphic Display window.

Double click on the items in the list to change the parameters for a target. You can change multiple targets at the same time by selecting multiple target rows in the **Probe Toolbox** and then right clicking.

PC-DMIS displays targets in both the **Vision** tab and the **CAD** tab. While it’s possible to size the targets in either view, the targets are two dimensional so it's easier to do this on the **Vision** tab which also uses a two-dimensional display of the part.

Available Parameter Sets

Using the **Parameter Sets** list on the tab's toolbar, you can change the parameter set to change which type of target parameters you are currently viewing.

Depending on the feature type that you are targeting, the **Parameter Set** list in the top toolbar displays one or more of the available options: **Edge**, **Filter**, **Focus**, and **RGB Mixing**.

Edge: This parameter set defines the target edge parameters used for acquiring the edge points on the feature.

Filter: This parameter set defines any filters to be used on the acquired edge points and their associated parameters. Filters can be used to remove any outliers from the set of edge points, and can also clean the image prior to measurement.

Focus: This parameter set defines whether the target should perform a focus prior to acquiring the edge points, and if so, what the focus parameters are.

Icon	Feature Type	Available Parameter Sets
	Surface Point	Focus
	Edge Point	Edge, Focus
	Line	Edge, Focus, Filter
	Circle	Edge, Focus, Filter
	Round Slot	Edge, Focus, Filter
	Square Slot	Edge, Focus, Filter
	Profile 2D	Edge, Focus, Filter

RGB Mixing: This parameter set provides Red (R), Green (G), and Blue (B) color mixing controls to override the default color in the image processing and the Live View.

Id	R (Edge)	G (Edge)	B (Edge)
EA1	0.700	0.200	0.100

If all of the values are set to -1, then PC-DMIS uses the internal default value. The values define a ratio. Therefore, values of 0.7, 0.2, and 0.1 would appear as 70% red, 20% green, and 10% blue when used to compute the grayscale.

If you're using a color camera, the image data is converted to a grayscale before the edge processing is done, so the grayscale brightness is computed based on the individual red, green, and blue brightness values. When set to grayscale mode, the Live View also shows the color-weighted image.

For an explanation of the specific parameters and their usage, see the examples below.

Measuring Features Using a Vision Probe

You can specify the measurement method to use by selecting it from the **Target Type** list in the **Hit Targets** tab. Depending on your feature type, there are up to four methods of taking a feature measurement using a vision probe:

The following examples use a circle feature.

Method 1 - Gage Hit Target - Requires you to graphically size (or adjust) the feature (in this case a circle) and position it to match the feature on the **Vision** tab of the Graphic Display window. You can also view the image is within the tolerance bands. For a circle, this gives an XY position and the diameter. Parameters for this mode are discussed in the "Gage Hit Target Feature Parameters" topic.

Method 2 - Manual Hit Target - Requires you to position a specified number of points around the feature (in this case a circle). PC-DMIS Vision then uses these points to calculate the feature. Any number of targets can be used to aid in measuring the feature. Parameters for this mode are discussed in the "Manual Hit Target Feature Parameters" topic.

Method 3 - Automatic Hit Target - Uses image processing to automatically detect a feature (in this case a circle). It then calculates the circle based on the defined targets. Parameters for this mode are discussed in the "Automatic Hit Target Feature Parameters" topic.

Method 4 - Optical Comparator Hit Target - Uses an upper and lower tolerance band for target measurement. During feature execution, you visually inspect that the feature lies within this tolerance band. From the **Execution** dialog box, you can then click **Continue** (PASS) or **Skip** (FAIL) to accept or reject the feature. Parameters for this mode are discussed in the "Optical Comparator Hit Target - Edge Parameter Set" topic.

Gage Hit Target Feature Parameters

The following parameters appear in the column headings of the target list in the **Hit Targets** tab when measuring features using the **Gage** measuring method (for available measuring methods, see "Measuring Features Using a vision probe"):

Edge Parameter Set

To change a value, right click on the current value for the desired target. If a value says N/A, then that parameter is "not applicable" to the current set.

ID: This displays a unique identifier for the item in the target list. This same ID is used on the tooltip for the target in the **Vision** tab of the Graphic Display window.

Illumination: This shows the illumination values to be used for this target. To change the illumination for a specific target, select the target in the **Hit Targets** tab, or on the **Vision** tab of the Graphic Display window, and change the illumination on the **Illumination** tab. For information on how to change the illumination, see "Probe Toolbox: Illumination tab".

Focus Parameter Set

For information, see the "Hit Target Focus Parameter Set" target.

Manual Hit Target Feature Parameters

The following parameters appear in the column headings of the target list in the **Hit Targets** tab when measuring features using the **Manual Target** measuring method (for available measuring methods, see "Measuring Features Using a vision probe"):

Edge Parameter Set

To change a value, double click on the current value for the desired target. If a value says N/A, then that parameter is "not applicable" to the current set. To change a parameter for multiple targets at once, select the targets, and then right click on one of them and change the value. It will be updated for all.

ID: This displays a unique identifier for the item in the target list. This same ID is used on the tooltip for the target in the **Vision** tab of the Graphic Display window.

Illumination: This shows the illumination values to be used for this target. To change the illumination for a specific target, select the target in the **Hit Targets** tab, or on the **Vision** tab of the Graphic Display window, and change the illumination on the **Illumination** tab. For information on how to do this, see "Probe Toolbox: Illumination tab".

Focus Parameter Set

For information, see the "Hit Target Focus Parameter Set" target.

Automatic Hit Target Feature Parameters

The following parameters appear in the column headings of the target list in the **Hit Targets** tab when measuring features using the **Automatic Target** measuring method (for available measuring methods, see "Measuring Features Using a vision probe"):

Automatic Hit Target - Edge Parameter Set

To change a value, right click on the current value for the desired target. If a value says N/A, then that parameter is "not applicable" to the current set.

ID: This column displays a unique identifier for the item in the target list. This same ID is used on the tooltip for the target in the **Vision** tab of the Graphic Display window.

Min/Max Type: For edge point, when either the **Min**, **Max**, or **Mean** option is selected, the target is actually a rectangular region. It has scan directions, and the size of the rectangular area can be changed. Multiple edge scans are created parallel to the target's scan direction for edge detection within the defined rectangle region. One point is detected for each edge scan, and the result is calculated based on the selected option.

The available options are:

- **None:** Returns a normal edge point with a single line target going through the edge. Only a single point is detected.
- **Min:** Returns the point that is the minimum distance from the scan point along the scan direction.
- **Max:** Returns the point that is the maximum distance from the scan point along the scan direction.
- **Mean:** Returns the average of all the detected points along the scan direction.

Density: This column shows the hit density type for the current target. Available density types include:

The **Density** option is not available for Edge Point or Surface Point scans.

- **None:** Does not return points. Use this type when excluding a region on the target. Excluded regions are indicated with a crosshatch pattern on top of the feature.

A target with an excluded region shown by the crosshatch pattern

- **Low:** Returns a minimal number of points (one point for every 10 pixels). Use this density type if your feature form doesn't change much in this area, or if it isn't a critical area of your part.
- **Normal:** Returns the default number of points (one point for every 4 pixels) for that feature type.
- **High:** Returns the maximum number of points (one point per pixel). Use this density type if your feature form changes drastically in this area, or if it is considered a critical area of your part.

Under Scan: This defines (in current units) the under-scan distance applied to non-blending areas within a target (for example, a corner made from two edges). PC-DMIS Vision doesn't return any points from under-scan areas on a target, and the display indicates the ignored area. PC-DMIS Vision attempts to default the **Under Scan** value to an appropriate setting.

The **Under Scan** option is not available for Edge Point or Surface Point scans.

Edge Selection: PC-DMIS Vision attempts to find and use the most appropriate means of detecting an edge. It supports these methods:

- **Dominant Edge:** Often, when using the bottom lamp to illuminate the part, you can get best results by returning the dominant (or strongest) edge.
- **Nearest Nominal:** This method detects the qualified edge closest to the nominal edge. This gives you an easy way to select a non-dominant edge for measurement.
- **Matching Edge:** This method detects the edge whose size and location best matches that of the required feature. This is the default edge detection method. For steps that can be taken to speed up this Edge Selection type, see the "Troubleshooting PC-DMIS Vision" topic.
- **Specified Edge:** This method goes in the currently defined scan direction and picks a specified edge from the detected edges whose strength value exceeds that of the edge strength threshold. The Graphic Display window shows the scan direction using a blue arrow in the target. You can reverse this direction to select edges in a preferred order.

Strength: This shows the edge strength threshold to use during the feature measurement. When looking for an edge, the software ignores edges with an assigned 'strength' below this threshold. You can change the predefined value to a new value with a range of 0-255. The larger the number, the stronger the edge. If PC-DMIS Vision does not return sufficient points on an edge, try reducing this value. If vision returns a number of false edges detected, try increasing this value.

Edge Polarity: This value determines if the edge that is viewed and discovered goes from black to white, white to black, or either. This value can be specified for the following edge types: **Dominant Edge**, **Nearest Nominal**, **Matching Edge**, and **Specified Edge**.

Setting the Edge Polarity allows edges of a specific polarity to be excluded from the algorithms, providing speed improvement. For example, setting polarity to [|]>[] throws away any edges that are not black to white, as it would for dominant edge.

Hit Target Direction: This value determines the direction that the algorithm uses when determining polarity. For example, if you run across a target in one direction, and edge would be white to black ([ ]>[|]), but in the other direction, the same edge would be black to white ([|]>[ ]). This value is always available for the **Specified Edge** type. If the

polarity is set to something other than any to any [?]>[?], then it also becomes available for **Dominant Edge**, **Nearest Nominal**, and **Matching Edge**.

Specified Edge #: This value shows what edge to use for the **Specified Edge** detection method recently discussed. You can specify a value of 1-10.

Adaptive Threshold: Set this to **YES** to deal with variations in illumination. This setting is by default set to **YES** as it is appropriate in most situations. Having this on is necessary, for example, when your machine has non-uniform illumination, and the feature's learned location may differ from its location within the FOV when executed.

With fixed threshold, it is possible that different edge points are detected, causing measurement error or instability. However, if the part area included in the target band changes due to texture or other noises, those changes could cause the result of the adaptive threshold to be higher than the intended edge’s threshold. The result is that the intended edge is not detected. In this situation, it may be best to set **Adaptive Threshold** to **NO**.

SensiLight: This determines whether or not the machine should perform an auto-light adjustment prior to measurement, in an attempt to achieve optimal results. If set to **NO**, PC-DMIS sets the lighting according to the learned percentage, and the brightness is not adjusted automatically. SensiLight is short for Sensible Lighting.

At execution time, if **SensiLight** is on, a quick check is made to ensure the illumination is not too dark or too light. If it is, then it auto adjusts the illumination to make it sensible. It then gives the operator the option of saving this new illumination setting so that the next time the feature is measured it uses the new improved settings.

Illumination: This shows the illumination values to use for this target. To change the illumination for a specific target, select the target in the **Hit Targets** tab, or on the **Vision** tab of the Graphic Display window, and change the illumination on the **Illumination** tab. For information on how to do this, see "Probe Toolbox: Illumination tab".

Automatic Hit Target - Template Match

Template Match allows you to define a master image of an area of interest. You could then use it to search the Field of View before you perform any edge detection during a feature measurement. This should improve measurement repeatability since this removes location errors and part variability from the measurement process.

Template Match is available for all vision features except Blob and Surface Point.

Enable **Template Match** from the **Parameter Set** list.

When you enable **Template Match**, the software inserts two new overlays:

- **Template Area** - This is a unique rectangular area that defines a unique pattern. The pattern is what PC-DMIS locates during the execution of the measurement routine.
- **Search Area** - This is a rectangular area that PC-DMIS searches in to locate the pattern defined by the **Template Area**.

Template Correlation

Template Correlation - This defines the minimum matching percentage. While PC-DMIS is performing a template match, the software searches for the position in the **Search Area** to locate the best match based on the defined template. The Template Correlation value defines the best possible match. For example, if there is an exact template image within the **Search Area**, then the correlation value is very close to 100%. It will probably never be 100% due to slight image variations and calculation rounding errors. If the correlation value of the best match is greater than the Template Correlation value you defined, then the template match is successful; otherwise, the template match fails. If the template match fails, PC-DMIS displays a message to indicate it in the **Execution** dialog box.

If you encounter a failed execution with Template Match enabled, click **Continue** to execute the rest of the measurement routine. The execution continues as if the feature doesn't have template matching enabled.

Requirements

Template Match requirements:

- **Template Match** works for features with a single target.
- **Template Match** works for features that you can execute in a single Field of View (FOV).
- **Template Match** needs to be smaller than the Search Area.
- **Template Match** is normally within the Search Area.
- The **Template Area** and **Search Area** should be within the FOV when you save the template image.

For ease of use, PC-DMIS does not check these requirements during the process of modifying the target, **Template Area** and **Search Area**. The software checks all requirements as soon as you click the **Create** or **Test** button on the **Auto Feature** dialog box. If any of the requirements are not met, the software displays a warning message to make corrections.

Template Match is a calculation intensive process, so use it when necessary. When using **Template Match**, the size of **Template Area** and **Search Area** directly impact the speed of calculation, so that you want to set them as small as possible yet still reliable.

Automatic Hit Target - Filter Parameter Set

To change a value, right click the current value for the desired target. If the value is **N/A**, then that parameter is "Not Applicable" to the current set.

ID - This column displays a unique identifier for the item in the target list. This same ID is used on the tooltip for the target in the **Vision** tab of the Graphic Display window.

Clean Filter - This column determines whether or not to remove dust and small noise particles from the image prior to edge detection.

Strength (Clean Filter) - Specifies the size (in pixels) of an object, below which is considered to be dirt or noise.

Outlier Filter - This column determines whether or not outlier filtering is required for this target.

When you select **YES** for **Outlier Filter**, there are different Filter Parameters available for different feature types.

Filter parameters for all vision feature types except non-legacy Profile 2D

For all but non-legacy Profile 2D feature types, when you select **YES** from the **Outlier Filter** list, these options become available:

Distance Threshold (Outlier Filter) - This specifies the distance in pixels that a point can be away from nominal before discarding it.

Std Dev. Threshold (Outlier Filter) - This sets the standard deviation that a point needs to be away from the nominal CAD to determine if it's an outlier.

Filter parameters for the non-legacy Profile 2D vision feature type

For non-legacy vision Profile 2D features, the **Outlier Filter** has two **Filter Type** options, **YES** and **NO**.

If you select **YES**, two outlier **Filter Type** options are available: **Nominal Form** and **Neighbor**.

Each option has its own parameters:

Nominal Form - This outlier filter is based on form fitting and is only available for non-legacy versions of vision Profile 2D features programmed from the CAD. This filter fits the measured data to the nominal CAD curve. After fitting, the deviations of each measured point to the nominal CAD are computed. The deviations are used to determine which points, if any, are outliers.

When you select the **Nominal Form** filter type, the **Std Dev. Threshold (Outlier Filter)** option is available:

Std Dev. Threshold (Outlier Filter) - This sets the standard deviation that a point needs to be away from the nominal CAD to determine if it's an outlier.

Neighbor - The outlier filter is based on distance and is available only for the non-legacy version of the vision Profile 2D feature.

When you select the **Neighbor** filter type, these options become available:

Outlier Filter - Provides a drop-down box with two options: **YES** turns the filter on, **NO** turns the filter off.

Neighbors - Defines the minimum number of neighbors required to be considered a valid point. If a point has less than the minimum number of neighbors within the distance (defined partially by the next parameter), then the point is an outlier. The default value for this parameter is 2.

Distance Multiplier - This parameter is used to calculate the distance mentioned above. The default value for this parameter is 2.0.

The distance is calculated by multiplying the median distance between neighboring points and the **Distance Multiplier**. The median distance between neighboring points is calculated from all detected points within a target.

The following are examples using different values for **Neighbors** and **Distance Multiplier**.

Example 1: With **Neighbors** = 2 and **Distance Multiplier** = 2.0:

Example 2: Same as Example 1 except **Neighbors** = 3 which causes more outliers (points displayed in red) to be identified:

Example 3: When **Neighbors** = 1 and **Distance Multiplier** = 3.0, there are fewer outliers (points displayed in red):

Optical Comparator Hit Target Parameters

The following parameters appear in the column headings of the target list in the **Hit Targets** tab when measuring features using the **Optical Comparator** measuring method (For available measuring methods, see "Measuring Features Using a vision probe"):

Edge Parameter Set

To change a value, right-click on the current value for the desired target. If a value says N/A, then that parameter is "not applicable" to the current set.

ID: This displays a unique identifier for the item in the target list. This same ID is used on the tooltip for the target in the **Vision** tab of the Graphic Display window.

Plus Tolerance: Provides the plus tolerance against which a target is visually compared during execution.

Minus Tolerance: Provides the minus tolerance against which a target is visually compared during execution.

Example of optical comparator with plus and minus tolerance bands

Illumination: This shows the illumination values to use for this target. To change the illumination for a specific target, select the target in the **Hit Targets** tab, or on the **Vision** tab of the Graphic Display window, and change the illumination on the **Illumination** tab. For information on how to change the illumination, see "Probe Toolbox: Illumination tab".

Focus Parameter Set

For information, see the "Hit Target Focus Parameter Set" target.

Hit Target Focus Parameter Set

To change a value, right click on the current value for the desired target. If a value says N/A then that parameter is "not applicable" to the current set. You can make adjustments to the focus parameter set for Automatic, Manual, Gage, and Optical Comparator Hit targets.

ID: This displays a unique identifier for the item in the target list. This same ID is used on the tooltip for the target in the **Vision** tab of the Graphic Display window.

Focus: This determines whether or not the target requires a pre-edge detection focus.

When using the CAD++ configuration, an AUTO option in addition to the standard YES/NO only does a focus if the image appears to require one.

Control (Focus): Choose either **AUTO** or **FULL**. **AUTO** mode uses the calibrated focus information to automatically set the range and duration parameters. **FULL** mode allows the user to set the range and duration manually.

Range (Focus): This displays the range from the camera to the part. It specifies the distance (in the current units) over which to perform the focus. Using this value the machine searches in the Z direction for the best focal position.

Duration (Focus): This displays the number of seconds to spend searching for the best focal position.

> If your Range and Duration combination results are too fast when you do a focus, a warning message appears and is overlaid on the **Vision** tab.

Find Surface (Focus): This displays a **YES** or **NO**. Setting this option to **YES** causes PC-DMIS to perform a second and slightly slower pass-to attempt to improve the accuracy of the focal position. The second pass is optimized based on the image data of the first pass and the Numeric Aperture of the current lens. This is useful when measuring a surface that varies in height, which requires a large range over which to focus.

Surface Variance (Focus): With the **Find Surface** option set to **YES**, this value determines the distance that is initially scanned at a fast speed to find where the part is, and then the normal focus is done around this area. Once the focal position is found, PC-DMIS does a quick focus scan in that region. This is useful for parts where variability means the focus position can vary a lot.

Assist (Focus): This option is used with systems with a laser or Projected Grid device. These devices can be switched on to assist with the focus on certain surfaces by improving the contrast. Set this option to **GRID** to enable this functionality.

Illumination-Adjust: This option determines whether or not the machine should perform an auto-light adjust prior to focus in an attempt to achieve optimal focus result. If it is set to **NO**, PC-DMIS sets the lighting according to the learned percentage, and the brightness is not adjusted automatically.

Measure At Centre: If selected, the measurement occurs at the center of the Field Of View for improved accuracy.

Using the Shortcut Menu

From the **Vision** tab, if you right click on the target, a shortcut menu appears. This menu allows you to insert and delete segments or targets; reset hit targets; change the point density; test the edge detection of the currently selected target or targets; and change hit target types.

Similarly, clicking on the **Vision** tab, but not on a target provides a menu to adjust magnification, capture the screen, or open the **Live Image Setup** dialog box.

For more information, see the "Using Shortcut Menus" topic under the "Using the Graphic Display window in PC-DMIS Vision" topic.

Hit Targets Controls

The controls shown in the **Hit Targets** tab in the **Probe Toolbox** let you edit, test, and modify the targets and parameters used to measure the feature.

This is the toolbar at the top of the tab:

The following table describes what these controls do:

Define Target Button	Description
	The **Target Type** list lets you choose the target type to create new targets. The available target types include: • Optical Comparator Hit Target • Gage Hit Target • Manual Hit Target • Automatic Hit Target
	The **Parameter Set** list lets you change between these parameter sets: • Edge • Filter • Focus • RGB Mixing These are discussed in "Available Parameter Sets".
	The **Target Feature Coverage** list allows you to quickly create target sections to measure a subset of a feature. Limiting coverage can decrease feature execution time. For example, if you measure a large feature at high a

	magnification value, it may require a lot of camera positions to get all the edge points. Selecting "10%" coverage would only measure edge points at certain locations around the feature - amounting to 10% of its form. Notice in the example below that the same feature covered at 100 percent is altered to have many targets that provide a coverage of 50 percent. Profile 2D - 100% Coverage Profile 2D - 50% Coverage
 	The **Set Target Feature Coverage Active Targets** list determines the number of targets to use to display the selected coverage percentage in the **Target Feature Coverage** list. The default value is 4. For example, a 50% coverage on an arc, with a value of 7 active targets set from this list, would result in target sections that looked like this:

	Example Active Targets
	The **Hit Target Color** list specifies the color to apply to the feature hit targets. This allows you to differentiate between features, or to ensure visibility on different surface types.
	The **Nominal Color** list specifies the color to apply to the feature nominal line. This allows you to differentiate between features, or to ensure visibility on different surface types.

This is the toolbar at the bottom of the tab:

The following table describes what these controls do:

Define Target Button	Description
	The **Lock Hit Targets to Part** button secures the size, position or rotation of the target.

	The **Center Hit Target** button centers the target or Field of View (FOV). What actually moves depends on the status of the **Lock Hit Targets to Part** button. If you first select the **Lock Hit Targets to Part** button, and then select the **Center Hit Targets** button, PC-DMIS Vision moves the current FOV to the target. This is only available on DCC Motion machines. If you deselect the **Lock Hit Targets to Part** button, and select the **Center Hit Targets** button, the target moves to the current FOV.
	The **Insert New Hit Target** button inserts a new target area. You can then set up different parameters for this specific area of the feature.
	The **Delete Hit Target** button lets you delete a previously inserted target from the feature.
	The **Reset Hit Target(s)** button deletes all of the previously inserted target areas from the feature, leaving the single default target.
	The **Hit Target Test** button tests the automatic **Target Edge** detection for the currently selected target or targets. PC-DMIS Vision displays any detected points in the **Vision** tab of the Graphic Display window.

Probe Toolbox: Feature Locator Tab

Probe Toolbox - Feature Locator tab

The **Feature Locator** tab allows you give instructions to the operator for the current feature. You can provide one or more of the following prompts during feature execution:

- A screen capture bitmap, showing the feature's location.
- An audio prompt, providing audible instructions via a prerecorded .wav file.
- A text prompt, providing written instructions.

To provide Feature Locator information:

1. Click the button next to the (speaker) button to browse to the .wav file to associate with this Auto feature. The speaker button must be selected for the audio file to play.
2. Click the **Feature Locator BMP File** toggle button to toggle the display of the associated bitmap.
3. Click the button next to the **Capture Feature Locator BMP** button to browse to the .bmp file to associate the image with this Auto feature. You must select the bitmap button in order to display the bitmap image on the **Feature Locator** tab.
4. Rather than browsing for a bitmap image, you can click the **Capture Feature Locator BMP** button to capture an image from the current CAD View or Live View (whichever is active). This file is indexed and saved in the PC-DMIS install

directory. For example, a measurement routine named Vision.prg would yield bitmap images named Vision0.bmp, Vision1.bmp, Vision2.bmp, and so on.

5. Type a message to be displayed as a caption in the text box. For example, "Measure Circle 1" is displayed on this tab with subsequent feature execution.

Probe Toolbox: Magnification Tab

Probe Toolbox - Magnification tab

The **Magnification** tab lets you change the current Field of View (FOV) camera magnification. It also provides a way for you to simultaneously view both the **CAD** and **Vision** tabs of the Graphic Display window. For information on using these tabs in the Graphic Display window, see "Using the Graphic Display window in PC-DMIS Vision".

Two values for magnification are displayed - **Pixel Size** and **Optical**.

Pixel Size - This is the pixel size of the image in the Live View.

Optical - This is the magnification size on the CCD array of the camera. This does not change when the Live View display is re-sized.

When the **Magnification** tab of the **Probe Toolbox** is open, the **Vision** tab displays the following:

FOV= - This overlay value displays the size of the FOV in the measurement routine's unit of measurement. This only appears on the screen when you select the **Magnification** tab from the **Probe Toolbox**.

[0]= - This overlay number reflects your current level of magnification (**Pixel Size**). As you zoom in closer to the part, this number decreases in size. The closer the number approaches zero, the closer your machine approaches its maximum magnification. This

only appears on the screen when you select the **Magnification** tab from the **Probe Toolbox**.

Simultaneously Viewing the CAD View and the Live View

- If you select **Cad View**, the **Magnification** tab of the **Probe Toolbox** contains a mini version of the **Vision** tab.
- If you select **Vision** tab, the **Magnification** tab of **Probe Toolbox** contains a mini version of the **CAD** tab.

Changing the Magnification of the Part Image

On a machine with a DCC Zoom, these are the several ways you can alter the magnification of the part image:

Use the Magnification tab: You can do this by either moving the slider bar up or down, or by typing a value in the box next to the slider. By default, the software uses the lowest magnification to get the largest Filed of View (FOV).

Drag the Green Handles of the FOV: Use the FOV handles in the **CAD** tab to re-size the rectangle. Grab any corner of the green box and drag the outline to its desired location. On a DCC stage, the green boxes on the edges (not the corners) allow you to move the location of the FOV, not change its size.

Zoom in Live View: In the **Vision** tab, hold down the right and left mouse buttons simultaneously. Drag the cursor across the view, creating an outline of a box. When you release the mouse buttons, the field of view magnifies in the requested location.

Use the Magnification menu: Select menu items from the **Operation | Magnification** sub-menu or use the **Magnification** shortcut menu in the Live View. You can right-click within the **Vision** tab to access the shortcut menu. Be sure that your cursor isn't over the target when you right-click to access the shortcut menu.

Use Shortcut Keys: Use these shortcut keys to alter the magnification in either the **Cad** or **Vision** tabs:

Magnify Action	Shortcut Keys
Increase Fine	ALT + *
Increase Coarse	CTRL + *
Increase Maximum	CTRL + ALT + *
Decrease Fine	ALT + /
Decrease Coarse	CTRL + /
Decrease Minimum	CTRL + ALT + /

The numbers displayed next to the top left and bottom right corners of the image in the **Field of View** box of the **Probe Toolbox**, indicate the X and Y coordinate values for the FOV. It also displays the current magnification size in pixels.

Probe Toolbox: Illumination Tab

Probe Toolbox - Illumination tab

The **Illumination** tab allows you to select which lamps are turned on or off. It also indicates the lamp's current light intensity by changing illumination values. The type and number of lamps displayed depends on the machine.

A **Top Light** is an axis lamp that is directed through the optical path. It can provide better edge and feature visibility on some parts than other light sources that illuminate

from above because the light source isn't as diffused. Since it shines parallel to the optics, it's also easier to see into holes.

A **Bottom Light** is a lamp that shines from under the stage. It creates a silhouette of the part to be viewed.

A **Ring Light** is a multi-bulb lamp that illuminates from above. This lamp is normally composed of an array of LED lights arranged in concentric rings or circles. You can usually program the ring light to illuminate a segment or 'pie wedge' of bulbs from one direction. You can control the direction and angle of illumination by illuminating just one of the rings of LEDs, a segment of one of the rings, or individual bulbs.

This tab also allows you to create and store these illumination values in sets termed *Quick Sets*. Once you create a Quick Set, you can quickly and easily recall it to set the lamps on a machine to a specific state (such as bottom light only, top light only, or another state). Quick Sets can be recalled at any time by selecting the set name from the **Quick Set** list.

Click the **Save** button to save your own Quick Sets or click the **Delete** button to delete them.

For lamps to show up on the **Illumination** tab, make sure you have the lamps selected and properly set up on the **Illumination** tab of the **Machine Interface Setup** dialog box. For information on this dialog box, see "Machine Options: Illumination tab".

You can perform the following procedures using the **Illumination** tab:

- Selecting a Pre-Defined Illumination Quick Set
- Saving an Illumination Quick Set
- Deleting an Illumination Quick Set
- Changing Illumination Values
- Illumination Calibration Override

A Note on Lamps and Contact Probes

By default, if you switch from a vision probe to a contact probe, the lamps remain turned on. Use the `IlluminationOffForContactProbe` entry in the **VisionParameters** section of the PC-DMIS Settings Editor to control the default behavior. Setting this entry to **TRUE** turns off the lamps whenever the measurement routine switches from a vision probe to a contact probe. PC-DMIS restores the illumination when you switch back to a vision probe.

Selecting a Pre-Defined Illumination Quick Set:

To choose a pre-defined illumination quick set, select the set from the **Quick Set** list.

- If you run PC-DMIS in Online mode, your system's lamps change to reflect the selected quick set.
- If the illumination changes since you selected the quick set, the **Quick Set** list shows an '*' next to the quick set's name.

Saving an Illumination Quick Set

To create a new illumination quick set:

1. Click the **Save Illumination Quick Set** button . The software displays a **Save Illumination Quick Set** input box:

Save Illumination Quick Set input box

2. Type a name for the illumination quick set. The entire name must fit in the box.
3. Click the **OK** button to create the new set and automatically select it in the **Illumination** page.

Deleting an Illumination Quick Set

To delete an illumination quick set:

1. Click the **Delete Illumination Quick Set** button . The software displays a message asking if you want to delete the illumination set.
2. Click **Yes**. The software deletes the illumination quick set permanently from your system.

Changing Illumination Values

At any one time, only one of the lamps can have its settings changed. This is referred to as the "active" lamp, and is the lamp that is not drawn in a "Dimmed" state.

Illumination tab showing active lamp (bottom light)

In the above example, the bottom light (lower left) is active, and the top light and ring light are "OFF".

Changing the Active Lamp's Values:

1. Click on the toolbox near or on the required lamp.
2. Move the slider bar or type a percentage value in the % box. Only the active lamp is affected.
3. Adjust the **Lamp Angle** to physically alter the angle of lamps that support this capability.
4. Change the **Lamp Color** by selecting the LED color of lamps that support multiple color LEDs.

For new users, there may be a tendency to "over light" or give too much lighting. Excessive lighting can cause refraction errors when locating the true edge. It is usually safer to error on the side of "less light".

Ring Light Illumination Values

The process for editing the Ring Light Illumination values is more involved than a Top or Bottom light. Additional controls are provided for Ring lights.

Changing the Ring Light Intensity – Select the required bulbs to change the intensity of any lamp. Move the slider bar or type a percentage value in the % box to change the intensity of the active segments.

Absolute and Relative Controls – For Ring lamps, it is also possible to choose whether an increase or decrease of the bulb's intensity should keep their relative differences (RELATIVE) or you should set them all to the same value (ABSOLUTE).

- If you select the **Absolute Intensity** button , all of the active LEDs get the same specified intensity.

- If you select the **Relative Intensity** button , all of the active LEDs keep their relative differences, but all increase or decrease by a specified amount. For example, if the outer ring has its intensity set to 30%, the middle ring is set to 40%, and the inner ring is set to 50%, then if you move the slider up by 10%, the intensity values for each ring moves to 40%, 50%, and 60% respectively.

Switching a Lamp or Bulb On or Off – Right-click on the selected bulb or bulbs to toggle their on or off state. When you switch a bulb off, there is no intensity value displayed inside that bulb. When a bulb is switched on, PC-DMIS displays it's current intensity and applies a shade to it to represent the current intensity value.

Click the **Apply** button to save the updated illumination values.

Illumination Calibration Override

The **Illumination Calibration Override** button is used to temporarily switch off the Illumination Calibration. This can be used for features where it is difficult to get enough intensity, and you want to force the machine intensity to the maximum.

When the **Illumination** tab is active, the **Vision** tab shows the intensity value (between 0 and 255) for the pixel you're currently pointing at with the pointer.

Probe Toolbox: Focus Tab

Probe Toolbox showing the Focus tab with bad focus graph results.

A good focus graph would show a rounded curve, like an inverted U.

The **Focus** tab allows you to perform an immediate focus on the part within the rectangular region defined in the Graphic Display window. The software doesn't generate any measurement routine commands when you use this option.

To perform the focus, use the **Vision** tab in the window to move or resize the rectangular target over the desired portion of the part, and select one of the **Focus** buttons. The machine focuses on the specified area of the target, displays the optimum focus position as an overlay on the **Vision** tab, and displays the focus curve in a graph.

If you select **Dual Pass**, the initial pass is not shown in the graph, only the second pass is shown.

To get the best focus accuracy and repeatability, focus should be performed at the highest magnification available.

You can set specific feature focus parameters within the **Hit Targets** tab, and then select the Focus Parameter set. See "Probe Toolbox: Hit Targets tab".

Warnings and errors appear on the **Vision** tab to indicate the focus success and to provide feedback.

- If a warning prefix is given, the focus value was calculated, but the accuracy could be improved by taking the warning text into account. It warns if the speed is too fast, if the focus rectangle is too small, or if the magnification is not high enough.
- If an error prefix is given, the focus calculation failed. PC-DMIS Vision restores the focus calculation values to the previous focal position.

Focus Parameters

For a machine supporting DCC Motion, the following parameters appear in the column headings of the **Focus** tab when focusing a part:

Control (Focus): AUTO control performs a focus operation based upon the previously determined values collected during the focus calibration of the "Optics Calibration" procedure. PC-DMIS will automatically set the range and speed to be optimal for your vision machine. FULL control allows you to manually set the range and duration values.

Motion (Focus): On systems with a configured rotary, the motion used to execute a focus operation can be a linear move utilizing the XYZ axes or a rotary move. If a rotary motion type is selected, the range and surface variance values is for rotary focus and is in decimal degrees. The default range and surface variance values for linear and rotary focus are saved separately.

Range (Focus): This indicates a focal range (in the current units) within which to perform the auto focus. The search for the best focal position within that range takes place (usually in the Z-axis). The available range values vary based on each system's specific parameters. You can edit this parameter by double clicking and entering a different value.

Duration (Focus): This displays the number of seconds to spend searching for the best focal position for auto and manual focus. You can edit this parameter by double clicking and entering a different value.

> As a general rule of thumb, you should aim to make your duration at least twice as large as the range.

Find Surface (Focus): This displays a **YES** or **NO**. Setting this option to YES causes PC-DMIS to perform a second, slightly slower, pass-to attempt to improve the accuracy of the focal position. The second pass is optimized based on the image data of the first pass and the Numeric Aperture of the current lens. This is useful when measuring a surface that varies in height, requiring a large range to over which to focus.

Surface Variance (Focus): With the **Find Surface** option set to YES, this value is used to determine the distance that is initially scanned at a fast speed to locate the part, and then the normal focus is done around this area. Once the focal position is found, PC-DMIS does a quick focus scan in that region. This is useful for parts where variability means the focus position can vary a lot.

Assist (Focus): This is used with systems with a laser or Projected Grid device. These devices can be switched to "ON" to assist with the focus as on certain surfaces by improving the contrast. Set this option to "GRID" to enable this functionality.

SensiLight (Focus): This determines whether or not the machine should perform an auto-light adjust prior to focus, in an attempt to achieve optimal focus result. If set to NO, PC-DMIS sets lighting according to the learned percentage, and the brightness is not adjusted automatically. SensiLight is short for "sensible lighting".

Focus Graph

Auto focus graphs the results of the focus by showing the focus score (Y) against time (X). A sharper focus will have a higher focus score.

Auto focus should result in a rounded curve (an inverted "U"). Use the Manual Focus option when you have no DCC to automatically drive the Z axis. If the graph shows a sharp increase in focus score, try reducing the speed of movement. Also, you need to ensure that your range of travel is sufficient, so that you see the base of the curve on both sides.

If the graph is not smooth, ensure the illumination is sufficient so that surface texture is evident.

Auto Focus on a Manual Machine:

1. Roughly find the in-focus position, and then move out of focus.
2. Click the **Auto Focus** button to start the graph and record the focus score.
3. Move through the focus position by moving a single axis (usually Z).
4. Continue moving the Z axis until you have moved through the focus position, and the graph is a well-proportioned, gradual, inverted U shape.
5. When the specified duration has been reached, the detected focus position is displayed in the live image view.
6. A message is displayed to accept the focus or retry the focus.
7. If there is a problem, click the **Reset Focus Graph** button to clear the graph data and start this process over.

With focus on a manual machine, you need to move the Z stage at a slow and steady speed. You will be warned if you move too fast, or the distance moved was too long or too short.

On some machines, you may find you get a better focus result by specifying a longer duration, and then moving forward and backward through the focus position three or four times to get a series of U shapes on the graph.

Focus Buttons

PC-DMIS Vision provides a number of tools to help you focus your optical hardware:

Focus Icon	Description
	The **Lock Focus to Part** button secures the position or rotation of the target to the part. You can still change the size of the focus target.
	The **Center Focus** button centers the target or Field of View (FOV). What actually moves depends on the status of the **Lock Target to Part** button. • If you click **Center Focus** with the **Lock Target to Part** button already *selected*, PC-DMIS Vision moves the current FOV to the target. This is only available on DCC Motion machines. • If you click **Center Focus** with the **Lock Target to Part** button *deselected*, the target moves to the current FOV.
	The **Reset Focus Graph** button clears all data in the Focus Graph.
	The **Auto Focus** button actually executes the focus. It uses the set parameters, moves the DCC stage, and then returns to the focus position. On a manual machine, you manually move the machine for the specified duration. When the duration is met, you have the option of accepting the focus result or retrying.

Probe Toolbox: Gage Tab

Probe Toolbox - Gage tab

The **Gage** tab only appears if you access the **Probe Toolbox** by itself. If you use the **Auto Feature** box, the **Gage** tab won't appear.

The **Gage** tab provides you with a variety of tools called "gages" that allow you to make quick optical comparisons over features that you are measuring. You don't have to create a measurement routine. You can use Gages where edges are indiscriminate, or difficult to ascertain automatically.

For step-by-step examples of working with each gage type, see "Using Vision Gages".

The gage provides nominal information that you can type into dialog boxes to create the desired nominal feature. You can also capture the information to the Clipboard as a BMP file to paste into a report.

Sometimes called "hand gages", these tools are geometric shapes that appear on your screen. You can manipulate these shapes by rotating, sizing, and positioning them on your part with your mouse to find out nominal information about a particular feature, such as position, diameter, angle, and so forth.

Available gages

There is no automatic image processing associated with these gages, they are simply tools that you visually adjust to fit a feature on the image.

Rotating, Sizing, or Moving Gages

You can rotate, size, or move the gage on the graphical representation of the part. Once you correctly position the gage over a feature and size it to fit the shape of the feature, the software dynamically updates information on the gage in the **Probe Toolbox** as well as the overlay in your **Vision** tab. You can then use this information as the nominal values of the feature.

Rotate a Gage: If there's a green dot on the gage, position the pointer over the green dot. The pointer changes to a rounded arrow. Click and drag to perform a 2D rotation of the part in either the left or right direction.

Sample rectangular gage being rotated

Laterally Sizing Gages: If there's a red dot on the gage, position the pointer over a red dot until the pointer changes to a two-way arrow. Click and drag the gage to laterally size the gage either larger or smaller.

Sample circular gage being sized

The **Radius Chart** gage and the **Grid Chart** gage don't have a red dot. To size these gages, select a part of the gage and drag it.

Moving Gages: Position the pointer over the red crosshair at the middle of the gage until the pointer changes to a four-way arrow. Click and drag the pointer to move the gage to a new location. You can also click anywhere on the part and PC-DMIS Vision moves the gage to where you clicked.

Sample circular gage being moved

Supported Gage Types and Gage Parameters

PC-DMIS Vision supports a variety of gage types. Select a gage type from the **Gage Type** list. PC-DMIS Vision places parameters for the gage inside the **Probe Toolbox**. Double click these fields to edit them if you need a gage with specific dimensions.

When you select and edit gages, it is a strictly visual process. The software doesn't insert any commands into the measurement routine.

The following table describes each gage type and then lists the parameters used by that gage:

Icon	Description	Available Parameters
+	**Cross Hair Gage**. Use this to find a point.	**Angle:** The angle by which you rotate the gage. **Display Type**: Is the cross hair drawn in solid, dashed, or dotted lines.

		Gun Sight: Draws a circle around the cross hair to help locating. **Tolerance**: Allows tolerance lines to be drawn on the cross hair at a specified distance.
	Circle Gage. Use this to find a circle's diameter and center.	**Diameter:** Diameter of the circle gage
	Rectangle Gage. Use this to find a rectangle's height, width, and center.	**Angle**: The angle by which you rotate the gage. **Width**: Determines the width of the Rectangle Gage. **Height**: Determines the height of the Rectangle Gage.
	Protractor Gage. Use this for finding angles.	**Included Angle**: Determines the angle between the two lines making up this gage.
	Radius Chart Gage. Use this to find the relative change in diameter between concentric circles and the center.	**Spacer**: Defines the relative change in diameter between circles.
	Grid Chart Gage. Use this to find the relative distance between horizontal and vertical lines.	**Grid**: Defines the relative change in distance from one grid position to another.

All gage types use the **XYZ** values to determine the gage's center relative to the Field of View center.

Gage buttons

The following **Gage** buttons are available while using gages to do optical comparisons.

Gage Button	Description
	The **Lock Gage to Part** button secures the position of the gage onto the graphical representation of the part. Until you click this button again, you can't move or edit the gage. You can still modify the size and rotation however.
	The **Center Gage** button centers the target or Field of View (FOV). What actually moves depends on the status of the **Lock Gage to Part** button. • If you click **Center Gage** with the **Lock Gage to Part** button already *selected*, PC-DMIS Vision moves the current FOV to the target. This is only available on DCC Motion machines. • If you click **Center Gage** with the **Lock Gage to Part** button *deselected*, the target moves to the current FOV.
	The **Zero Readouts DXYZ** button resets the Probe Readout window's DXYZ value to the position of the current gage. This allows you to measure distances using gages. To do this: 1. Position the gage on one feature. 2. Click to zero the readouts. 3. Move the gage to another feature and examine the **DXYZ** values on the Probe Readout window. This is the distance between the two features. See the "Using the Probe Readouts window with Optical Probes".

Probe Toolbox: Vision Diagnostics Tab

Probe Toolbox - Diagnostics tab

The **Vision Diagnostics** tab provides a method for you to diagnose problems when edge detection fails. The diagnostics collects bitmap images and the current feature parameters. You can then export them from PC-DMIS and send them to Hexagon Technical Support.

To use the **Diagnostics** tab, follow these steps:

1. Click the **Diagnostics** button so the button is depressed to allow for the collection of bitmap images during edge detection execution for the associated feature.
2. Click **Test** to execute the feature, or during normal execution of the measurement routine. The software collects bitmap images of the Live View for each feature target.
3. If the feature has multiple targets, click the up and down arrows

to review the captured images.
4. To include the overlay information with each of the bitmap images, click the **Show Target Overlay** button. Once you select this option, PC-DMIS creates the images with overlay information.
5. To create bitmap images and a descriptive text file in the root of the PC-DMIS install directory, click the **Export Feature Diagnostics** button. The software exports both the bitmap images and diagnostic text with these formats:

Bitmap Image Export Format

Bitmap image file names use this convention:

<measurement routine name>_<feature ID>_<image number>_of _<total number of feature images>_<O or no O>.bmp

For example: **Vision1_CIR5_1_of_3_O.BMP**

Files with an "O" at the end the file name include overlay information.

Text File Export Format

PC-DMIS exports text files as:

<measurement routine name>_<feature ID>.txt.

For example: **Vision1_CIR5_F.TXT**

Using Vision Gages

The gage functionality of PC-DMIS Vision provides a simple method to compare actual part geometry to a gage. For example, overlay a gage (whose diameter is set to exactly 1.0 mm) to an actual part hole to compare its size.

Considerable functionality is available with gages. This chapter gives an example of the usage of each type of gage. For detailed information in the available buttons and options, see "Probe Toolbox: Gage tab".

The six gages are:

- Cross Hair Gage
- Circle Gage
- Rectangle Gage
- Protractor Gage
- Radius Chart Gage
- Grid Chart Gage

The selected gage can be centered within the Field of View (FOV) at any time by pressing **Center Gage** from the **Gage** tab of the **Probe Toolbox**.

For each gage example the HexagonDemoPart.igs demo part is used. See "Importing the Vision Demo Part".

Using the Probe Readout with Gages

Understanding the basic functionality of the **Probe Readout** is essential for use with gages, because measurement results are displayed in the **Probe Readout**.

You can open the Probe Readout by doing one of the following:

- Press Ctrl + W.
- From the **PositionProbe** tab of the **Probe Toolbox** dialog box, select **Probe Readouts** .
- Select the **View | Other Windows | Probe Readouts** menu item.

Understanding the Probe Readout Window

Probe Readout window

- **XYZ** is the location of the **FOV center** in relation to the current alignment origin.

- **VX**, **VY**, and **VZ** are the locations of the **gage** to the current alignment origin. If the gage is centered within the Field of View (FOV), then the XYZ and VX, VY, and VZ values will be the same. Use the left mouse button to independently drag the gage to the needed position.
- **DX**, **DY**, and **DZ** are used with gages to display **relative distances**. These values are independent from the currently alignment origin and can be independently zeroed using the **Zero Readouts DXYZ** button ( ) in the **Probe Toolbox**. If the **Probe Toolbox** is closed, you can right-click in the window and click **Zero Readouts DXYZ** from the pop-up menu.

For the gage examples given in this chapter, modify the **Probe Readout** as follows:

1. Right-click in the **Probe Readout** window and click **Setup** from the pop-up menu.
2. Check the following options:

   ☑ Probe position

   ☑ Show current probe position on screen

   ☑ Distance to target

   To independently zero the **DX**, **DY**, and **DZ** values when a gage is active, select the **Zero Readouts DXYZ** option.

3. Press **OK** to save and exit.

Cross Hair Gage

The Cross Hair gage can be used to determine **X** and **Y** location as well as the **Angle** of the crosshair as read form the **Gage** tab of the **Probe Toolbox** or the corner of the **Vision** tab.

For information on controlling the Cross Hair gage, see the "Rotating, Sizing, or Moving Gages" topic.

Cross Hair Gage Example

To measure the width of a part:

1. Ensure that the part is physically square on the inspection machine. See "Creating an Alignment".
2. Open the **Probe Readout** window (Ctrl + W).
3. From the **Probe Toolbox** adjust the magnification and lighting as needed. See "Probe Toolbox: Magnification tab" and "Probe Toolbox: Illumination tab".
4. From the **Gage** tab of the **Probe Toolbox**, select the **Cross Hair** option from the drop-down list.
5. Move the machine over the *left* edge of the part. When the machine is close, you can optionally drag the crosshair to the exact edge using the mouse.

6. On the **Gage** tab, click the **Zero Readouts DXYZ** button to zero the DX, DT, and DZ values.
7. Move the machine over the *right* edge of the part. Again, drag the crosshair to the exact edge using the mouse.

8. Read the X value from the **Probe Readout** DX value.

Circle Gage

The Circle gage can be used to determine the **Circle Center** (X and Y) as well as **Diameter** as read from the **Gage** tab of the **Probe Toolbox** or the corner of the **Vision** tab.

For information on controlling the Circle gage, see the "Rotating, Sizing, or Moving Gages" topic.

Circle Gage Examples

To measure the location of a 2mm hole from another 2mm hole:

1. Ensure that the part is physically square on the inspection machine. See "Creating an Alignment".
2. Open the **Probe Readout** window (Ctrl + W).
3. From the **Probe Toolbox**, adjust the magnification and lighting as needed. See "Probe Toolbox: Magnification tab" and "Probe Toolbox: Illumination tab".
4. From the **Gage** tab of the **Probe Toolbox**, select the **Circle Gage** option from the drop-down list.
5. From the **Gage** tab, double-click the **Diameter** box, and type the nominal diameter of **2.000**.
6. Move the machine so the *first* hole is within the Field of View (FOV). When the machine is close, you can optionally drag the Circle gage to the exact center using the mouse.
7. Click the **Zero Readouts DXYZ** button on the **Gage** tab. This zeroes the DX, DT, and DZ values.
8. Move the machine so the *second* hole is within the FOV. Again, drag the Circle gage to the exact center using the mouse.

9. Read the X and Y values from the **Probe Readout** DX and DY values.

To measure the diameter of a hole:

1. Adjust the magnification so the circle is as large as possible within the FOV. See "Changing the Magnification of the Part Image". Notice that the gage size changes with the magnification.
2. Move and adjust the size of the Circle gage to exactly overlay the actual circle in the Live View.
3. Read the **Diameter** value as displayed in the corner of the Live View. This value is also found in the **Gage** tab of the **Probe Toolbox**.

Rectangle Gage

The Rectangle gage can be used to determine the **Rectangle Center** (X & Y) as well as the **Height**, **Width**, and **Angle** of the rectangle as read form the **Gage** tab of the **Probe Toolbox** or the corner of the **Vision** tab.

For information on controlling the Cross hair gage, see the "Rotating, Sizing, or Moving Gages" topic.

Rectangle Gage Example

To measure the size and location of a rectangle from the center of a circular hole pattern:

1. Ensure that the part is physically square on the inspection machine. See "Creating an Alignment".
2. Open the **Probe Readout** window (CTRL + W).
3. From the **Probe Toolbox** adjust the magnification and lighting as needed. See "Probe Toolbox: Magnification tab" and "Probe Toolbox: Illumination tab".

4. From the **Gage** tab of the **Probe Toolbox**, select the **Circle Gage** option from the drop-down list.
5. From the **Gage** tab, double-click the **Diameter** field and type the nominal diameter of **8.000**.
6. Move the machine so the *8mm center* hole is within the FOV. When the machine is close, you can optionally drag the Circle gage to the exact center using the mouse.
7. Click the **Zero Readouts DXYZ** button on the **Gage** tab. This zeroes the DX, DT, and DZ values.
8. Change the gage type to **Rectangle Gage**.
9. Move the machine (with the Rectangle gage visible) over the *rectangular* opening. Again, drag the rectangle to the exact center and size the rectangle as needed.

10. Read the X and Y values from the **Probe Readout** (DX and DY) values.
11. Read the **Height** and **Width** values as displayed in the corner of the Live View. This value is also found in the **Gage** tab of the **Probe Toolbox**.

Protractor Gage

You can use the Protractor gage to determine the (X & Y) location of the **Gage Apex** as well as the **Included Angle** as read from the **Gage** tab of the **Probe Toolbox** or the corner of the **Vision** tab.

For information on controlling the Cross Hair gage, see the "Rotating, Sizing, or Moving Gages" topic.

Protractor Gage Example

To measure the included angle:

1. Open the **Probe Readout** window (Ctrl + W).
2. From the **Probe Toolbox**, adjust the magnification and lighting as needed. See "Probe Toolbox: Magnification tab" and "Probe Toolbox: Illumination tab".
3. From the **Gage** tab of the **Probe Toolbox**, select the **Protractor Gage** option from the drop-down list.
4. Move the machine so the *angle* is within the FOV. When the machine is close, you can optionally drag the protractor gage, so the apex lies on top of the feature's apex.

The 2 apexes should coincide

5. Use the center dots on the two legs to rotate them coincident with the sides of the feature.

6. Read the **Included Angle** value as displayed in the corner of the Live View. This value is also found in the **Gage** tab of the **Probe Toolbox**.

Radius Chart Gage

The Radius Chart gage can be used to determine the **Center Location** (X and Y) as well as the **Spacing** between concentric circles as read form the **Gage** tab of the **Probe Toolbox** or the corner of the **Vision** tab.

For information on controlling the Circle gage, see the "Rotating, Sizing, or Moving Gages" topic.

Radius Chart Example

To check to see if circular hole pattern is concentric to a center hole:

1. Open the **Probe Readout** window (CTRL + W).
2. From the **Probe Toolbox**, adjust the magnification and lighting as needed. See "Probe Toolbox: Magnification tab" and "Probe Toolbox: Illumination tab".
3. From the **Gage** tab of the **Probe Toolbox**, select the **Circle Gage** option from the drop-down list.

4. From the **Gage** tab, double-click the **Diameter** box, and type the nominal diameter of **8.000**.
5. Move the machine so the *center* hole is within the FOV. When the machine is close, you can optionally drag the Circle gage to the exact center using the mouse.
6. Click the **Zero Readouts DXYZ** button on the **Gage** tab. This zeroes the DX, DT, and DZ values.
7. Change the gage type to **Radius Chart Gage**.
8. From the **Gage** tab, double-click the **Spacer** box, and type the nominal value of **1.000**.
9. Drag the Radius gage such that is concentric to the pattern.
10. Read the X and Y values from the **Probe Readout** DX and DY values.

Grid Chart Gage

The Grid Chart gage can be used to determine the **Center Location** (X and Y) of the grid pattern as well as the **Spacing** between grid lines as read form the **Gage** tab of the **Probe Toolbox** or the corner of the **Vision** tab.

For information on controlling the Circle gage, see the "Rotating, Sizing, or Moving Gages" topic.

Grid Chart Example

To check features in relation to grid lines:

1. From the **Probe Toolbox**, adjust the magnification and lighting as needed. See "Probe Toolbox: Magnification tab" and "Probe Toolbox: Illumination tab".
2. Move the machine so that the *features requiring comparison* are within the Field of View (FOV).

3. Change the gage type to **Grid Chart Gage**.
4. From the **Gage** tab, double-click the **Grid** box, and type the nominal value of **0.500**.
5. Drag any one grid intersect to the bottom of the "V".

(A) - Drag 1 grid point to the "V"

6. All other geometry can be visually compared to the grid lines.

Creating Alignments

Alignments are required whether you are using the "CAD Selection Method" (CAD View) or the "Target Selection Method" (Live View) for measuring your part. The alignment defines the Part Coordinate System. You must perform an alignment if you wish to do any of the following:

- Change the location or orientation of the part on the stage.
- Move the measurement routine from one machine to another.
- Program the measurement routine offline and then run it online.
- Use vision measurement hardware that does not have homing capability.
- Use the AutoShutter facility on manual machines.

You should create an alignment each time you create a measurement routine to run in DCC Mode.

There are numerous methods for creating vision alignments; the examples provided in this chapter are intended to give a basic outline for creating alignments. For more information on alignments, see the "Creating and Using Alignments" chapter in the PC-DMIS Core documentation.

There are two types of scenarios in which you can create vision alignments:

- Live View Alignments
- CAD View Alignments

Live View Alignments

This section describes the process of creating alignments using the **Vision** tab in PC-DMIS Vision. This is commonly used when you are measuring online but *have not* imported CAD. Creating both **Manual** (rough) and **DCC** (refined) alignments as outlined below will help ensure the accuracy of your alignment. This two-step alignment process is not required but is recommended.

If you are working on a manual machine, you can take advantage of this two-step alignment approach by using the AutoShutter feature to assist you. For information on the AutoShutter feature, see "Setting up the Live View".

Complete the following steps to create an alignment using the Live View:

- Step 1: Manually Measure Datum Features
- Step 2: Create a Manual Alignment
- Step 3: Re-Measure the Datum Features
- Step 4: Create a DCC Alignment

This example uses the **3 2 1 Alignment Wizard** to show how to implement this tool. The "CAD View Alignments" example uses the classic **Alignment Utilities** dialog box.

Step 1: Manually Measure Datum Features

The manual alignment in this example consists of an *Arc* and a *Line*. You can more accurately re-measure these datum features in "Step 3: Re-measure the Datum Features". Before you begin, mount the part so it is reasonably square to the axes of the measuring machine.

To measure the datum features, do the following:

1. Select the **Magnification** tab , and adjust the magnification until you decrease it to the minimum setting (zoomed out).

> With a manual (approximate) alignment, leaving the magnification at the minimum is acceptable and usually desirable, because it is easier to run the measurement routine. The DCC (refined) alignment will later improve the quality of these datum features.

2. Select the **Illumination** tab , and set the **Top Light** to 0% (Off) and the **Bottom Light** to 35%.
3. From the **Auto Feature** toolbar, click **Circle** to open the **Auto Feature** (circle) dialog box.
4. Select the **Vision** tab.
5. Move the machine so the Arc (Datum B) is within the Field of View (FOV).
6. Click three points spaced along the edge of the arc. The software overlays a radial target on the arc as shown below:

7. Click **Create** to add this circle to the measurement routine.
8. From the drop-down list box of the **Auto Feature** dialog box, select **Line** .
9. Move the machine so the Edge (Datum C), adjacent to the previously measured arc, is within the FOV.

10. Click two points - One on the left end and one on the right end. The software overlays a line target on the edge as shown below:

11. Click **Create** to add this line to the measurement routine.
12. Click **Close** to exit the **Auto Feature** dialog box.

Step 2: Create a Manual Alignment

The manual alignment is used to quickly define the part location based on the measured *Arc* and *Line* Datum features.

To create a manual alignment:

1. From the **Wizards** toolbar (**View | Toolbars | Wizards**), select the **321Alignment** button to show the **Alignment Type** dialog box.

2. Select the **Line-Point 2D** alignment and click **Next >>** to open the **2D-LinePoint** dialog box.

3. Select **LIN1** from the **List of Available Lines** and associate it with **XPLUS** axis from the **Associate with axis** drop-down list.
4. Click **Next >>** to open the **2D-LinePointAlignment - Origin** dialog box.

5. From the list of **Available Points**, select **CIR1**, and click **Next >>** to show the **Line-Point** dialog box.
6. Click **Finish** to insert the alignment command into the measurement routine. The manual alignment is complete.

Click the **+/-** (expand/collapse) next to the new alignment in the **Edit Window**. Notice the alignment steps that were created under the alignment command by the **3 2 1 Alignment Wizard**.

Step 3: Re-Measure the Datum Features

Since the approximate location of the part is known, you can re-measure the Datum Features under computer control with different vision parameters to more accurately define them.

If you are using a DCC machine, select **DCC Mode** from the **Probe Mode** toolbar. Otherwise, you can use AutoShutter to measure using a manual machine.

To re-measure the *arc* datum feature, follow these steps:

1. From the **Auto Feature** toolbar, click **Circle** to open the **Auto Feature** (circle) dialog box.
2. Select the **Vision** tab.
3. Select the **Magnification** tab , and adjust the magnification until you decrease it to the minimum setting (zoomed out).

4. Move the machine so the lower edge of the Arc (Datum B) is within the Field of View (FOV).
5. Adjust the magnification to 75% of the maximum zoomed in value.
6. Select the **Illumination** tab and set the **Top Light** to 0% (Off) and the **Bottom Light** to 35%.
7. Focus Z if necessary.
8. Use the mouse pointer to pick the first anchor point on the arc's edge.

9. Move the machine so the middle of the Arc (Datum B) is within the FOV.

10. Move the machine so the upper edge of the Arc (Datum B) is within the FOV. The software displays the target.

11. Change the **Start Angle** to **5** and the **End angle** to **85**.
12. Edit the location parameters to exact values: **X=0**, **Y=0**, **D=16**
13. From the **Hit Targets** tab , under **Density**, double-click **Normal**, and select **High** from the drop-down list to change the density. Collecting a high density of points on this arc improves its accuracy.
14. Double-click on **Strength** box and type a value of **6**.
15. Edit the Focus parameter set to automatically re-focus prior to measuring the circle feature. First, select the **Focus** from the drop-down list as shown below.

16. Change the Focus parameter set as follows: **Focus** = Yes, **Range** = 5, **Duration** = 4
17. From the **Auto Feature** dialog box, rename the default Circle Auto feature to **DATUM B**.
18. Click **Test** to test the feature measurement.
19. Click **Create** and then **Close**.

To re-measure the *line* datum feature, follow these steps:

1. From the **Auto Feature** toolbar, click **Line** to open the **Auto Feature** (line) dialog box.
2. Move the machine so that the *left* end of the Front Edge (Datum C) is within the FOV.
3. If necessary, adjust the Z axis to regain focus.
4. Use your mouse pointer to pick the first anchor point on the left front edge.

5. Move the machine so that the *right* end (just before the "V") of the Front Edge (Datum C) is within the FOV. Pick the second anchor point using your mouse pointer. The software displays the target.

6. From the **Auto Feature** dialog box, rename the default Line Auto feature to **DATUM C**.
7. Click **Test** to test the feature measurement.
8. Click **Create** and then **Close**.

Step 4: Create a DCC Alignment

DCC alignment is inherently more accurate due to the fact that features (measured in step 3) used were measured under computer control at higher magnification, with higher density of points and refocusing. The *front edge* (Datum C) and the *center point* of the arc (Datum B) are used in this example.

To create a DCC alignment:

1. From the **Wizards** toolbar (**View | Toolbars | Wizards**), select the **321Alignment** button to open the **Alignment Type** dialog box.

2. Select the **Line-Point 2D** alignment and click **Next >>** to open the **2D-LinePoint** dialog box appears.

3. From the **List of Available Lines**, select **DATUM C**, and associate it with the **XPLUS** axis from the **Associate with axis** drop-down list.
4. Click **Next >>** to open the **2D-LinePoint Alignment - Origin** dialog box.

5. From the list of **Available Points**, select **DATUM B**.
6. Click **Next >>** to show the **Line-Point** dialog box.
7. Click **Finish** to insert the alignment command into the measurement routine. The DCC (or refined manual) alignment is complete.

Click the **+/-** (expand/collapse) next to the new alignment in the **Edit Window**. Notice the alignment steps that were created under the alignment command by the **3 2 1 Alignment Wizard**.

CAD View Alignments

This section describes the process of creating alignments using the **CAD** tab in PC-DMIS Vision. This is commonly used when you are measuring online and *have* imported CAD. Creating both **Manual** (rough) and **DCC** (refined) alignments as outlined below will help ensure the accuracy of your alignment. This two-step alignment process is not required but is recommended.

If you are working on a manual machine, you can take advantage of this two-step alignment approach by using the AutoShutter feature to assist you. For information on the AutoShutter feature, see "Setting up the Live View".

For this alignment example the HexagonDemoPart.igs demo part must be imported prior to beginning. See "Importing the Vision Demo Part".

Complete the following steps to create an alignment using the Live View:

- Step 1: Manually Measure an Edge Point
- Step 2: Create a Manual Alignment
- Step 3: Measure Features for Datum A
- Step 4: Construct Datum A
- Step 5: Measure Datums B and C
- Step 6: Create a DCC Alignment
- Step 7: Update Display in CAD View

In this example the "Classic" **Alignment Utilities** dialog box will be used to show how this dialog box can be used, where the "Live View Alignments" example will use the **3 2 1 Alignment Wizard**.

Step 1: Manually Measure an Edge Point

The manual alignment in this example consists of a single *Edge Point* to approximately locate the part. In later steps, PC-DMIS measures additional datums (under DCC if applicable) to create a final alignment. Before you begin, mount the part so it is reasonably square to the axes of the measuring machine.

To measure the datum feature, do the following:

1. Select the **Magnification** tab and adjust the magnification until you decrease it to the minimum setting (zoomed out).
2. Select the **Illumination** tab and set the **Top Light** to 0% (Off) and the **Bottom Light** to 35%.
3. Select the **CAD** tab.
4. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), select the **Curve Mode** button .
5. Move the machine so the front-left corner is within the FOV as shown below:

6. From the **Auto Feature** toolbar, click **Edge Point** to open the **Auto Feature** (edge point) dialog box.
7. Click a point on the front edge, *VERY CLOSE* to the left corner.

8. Select the **Hit Targets** tab .
9. Change **Automatic Target** to **Manual Hit Target**.

Since this is actually a "Manual Target" edge point, the actual point used is where you have physically placed the crosshair.

10. Click **Create** to add this edge point to the measurement routine.
11. Click **Close** to exit the **Auto Feature** dialog box.

Step 2: Create a Manual Alignment

For this alignment, only one point was taken (previous step) so no rotational datum was measured. In this example, it is assumed that the part is reasonably square to the machine axis. The single point will be used to establish the XYZ origin.

To create a manual alignment:

1. Select the **Insert | Alignment | New** menu option. The **Alignment Utilities** dialog box appears.
2. From the feature list, select **PNT1**.
3. Next to ☑ **X**, ☑ **Y**, and ☑ **Z**, select the check boxes.
4. Click the **Origin** button.
5. Click **OK** to save and exit. The X, Y, and Z zero points all move to the edge point.

Executing the measurement routine that you just created moves the origin to this point on the actual part. To do this:

1. Select the **Vision** tab.
2. From the **Edit Window** toolbar (**View | Toolbars | Edit Window**), select **Mark All** ( ).
3. When asked if it's okay to mark manual alignment features, click **Yes**.
4. From the **QuickMeasure** toolbar, select **Execute** ( ).
5. When prompted, measure point **PNT1** by aligning the target (cross hair) to the corner and clicking **Continue**. Alternatively, you can drag and drop the cross hair. It snaps to the edge.
6. When the measurement routine execution finishes, select the **CAD** tab.
7. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), select **Scale-To-Fit** ( ).

Step 3: Measure Features for Datum A

PC-DMIS uses the *top plane* (Datum A) for the primary alignment datum. A reference plane is commonly not required in 2D vision measurements. However, in this example, the datum plane is measured to accommodate dimensioning flatness. This is useful in situations where you might have feature control frames that reference a datum plane.

Since the approximate location of the part is known, PC-DMIS can operate in DCC mode.

If you are using a DCC machine, from the **Probe Mode** toolbar, select **DCC Mode** ( ). Otherwise, you can use AutoShutter to measure using a manual machine.

To measure a plane features for **Datum A**:

1. Select the **Magnification** tab and adjust the magnification until you increase it to the maximum setting (zoomed in).
2. Select the **Live View** tab.
3. Position the camera over the part.
4. From the **Illumination** tab , adjust the **Top Light** to a value that makes the surface visible but not too bright. Move Z to focus as necessary.
5. Select the **CAD** tab.
6. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), select **Scale-To-Fit** ( ).
7. From the **Graphics Modes** toolbar, select the **Surface Mode** button ( ).

8. From the **Auto Feature** toolbar (**View | Toolbars | Auto Features**), click **Surface Point** ( ) to open the **Auto Feature** dialog box for Surface Point.
9. Click a point on the top surface.
10. Select the **Hit Targets** tab , and change the following parameters: Target Type = **Automatic Hit Target**, Range = **5.0**, Duration = **5**, and Find Surface Option = **YES**.

11. For each Automatic Hit Target, double-click the option below each property, and type the specified value.
12. Click **Create** to add this edge point to the measurement routine.
13. Click *another* point on the top surface, then click **Create**.
14. Repeat the step above (click a point, then **Create**) until a total of 8 points have been created (PNT2 - PNT9).
15. Click **Close** to exit the **Auto Feature** dialog box.

Step 4: Construct Datum A

Once you have measured the eight surface points in "Step 3: Measure Features for Datum A", you can construct **DATUM A** from those points.

To construct **DATUM A**:

1. Execute the measurement routine up to this point to measure the eight surface points. To do this:

    a. From the **Edit Window** toolbar (**View | Toolbars | Edit Window**), select **Clear Marked** . This is done so that the manual alignment point (PNT1) is not included when you select **Mark All**.

    b. Select **Mark All** .

    c. When the "Ok to mark manual alignment features?" message appears, click **NO**.

d. Select **Execute** . PC-DMIS measures the eight surface points.

2. From within the **Edit Window**, ensure that the LAST line in the measurement routine is highlighted.
3. Select the **Insert | Feature |Constructed | Plane** menu item or the **Constructed Plane** button from the **Constructed Features** toolbar (**View | Toolbars | Constructed Features**). The **Construct Plane** dialog box appears.

4. Select the **Best Fit** option.
5. From the feature list, highlight the *eight surface points* measured in "Step 3: Measure Features for Datum A". In this example, the points are PNT2 through PNT9.
6. Type **DATUM A** in the **ID** box.
7. Click **Create**, and then click **Close** to add the plane feature to the measurement routine.

Step 5: Measure Datums B and C

In this step, the software measures the *front line and left line* for **Datums B** and **C**. Based on the intersection of the two lines, a *point* is also constructed to establish the XY origin.

To measure **Datum B**:

1. Select the **Magnification** tab , and adjust the magnification to about 25% of maximum. The actual magnification value varies based on your lens.

2. Select the **Illumination** tab , and set the **Top Light** to 0% (Off). Set the **Bottom Light** to 35%.
3. Select the **CAD** tab.
4. From the **Graphic Modes** toolbar, if it's needed, select **Scale-To-Fit** ( ).
5. From the **Graphic Modes** toolbar, select the **Curve Mode** button ( ).
6. From the **Auto Feature** toolbar, click the **Line** button ( ) to open the **Auto Feature** (line) dialog box.
7. Click a *point* for the left anchor point of the line and on the front edge towards the left end.

8. Click a *point* for the right anchor point of the line and just to the left of the slot (to the right of the upside-down "V" as show in the image below). The software displays the target.

Since the line stretches across a void (the upside-down "V"), this region must be excluded so no points are taken in that segment.

9. Right-click inside the rectangular target. From the popup menu, select **Insert Hit Target**. This divides the single rectangular target into two targets.
10. Repeat the above step to insert a third target.
11. Drag the two target dividers so that one is on each side of the upside-down "V".

12. Select the **Vision** tab.
13. Position the camera over the part.
14. From the **Illumination** tab , adjust the **Top Light** to a value that makes the surface visible but not too bright. Move Z to focus as necessary.
15. Select the **Hit Targets** tab . Notice three targets are shown: EA1, EA2, and EA3. You should not use the second target (EA2) that crosses the void. Double-click on **Normal** in the EA2 density field and select **None**.

Id	Density	Under...
EA1	Normal	N/A
EA2	None	N/A
EA3	Normal	N/A

Notice that the EA2 target segment shows hash lines to indicate the area where no data will be taken.

16. From the **Auto Feature** dialog box, rename the default Line Auto feature name to **DATUM B**.
17. Click **Create** and then **Close**.

To measure **Datum C**:

1. From the **Auto Feature** toolbar, select the **Line** button ( ) to open the **Auto Feature** (line) dialog box.

> If you want to reset the number of targets to 1, close and then reopen the **Auto Feature** dialog box.

2. Click *two points* on the left edge (one in the front and one in the rear).
3. Change the default name to **DATUM C**.
4. Click **Create** to add this *line* to the measurement routine.
5. Click **Close** to exit the **Auto Feature** dialog box.

To construct a point from the intersection of the lines:

1. Select the **Insert | Feature | Constructed | Point** menu item or **Constructed Point** ( ) from the **Constructed Features** toolbar (**View | Toolbars | Constructed Features**). The **Construct Point** dialog box appears.
2. Select the **Intersection** option.
3. From the feature list, select **DATUM B** and **DATUM C**.
4. Change the ID to **FRNT LEFT CORNER**, click **Create**, and then click **Close**.

The datum features are now created.

Step 6: Create a DCC Alignment

Since the features that will comprise the DCC alignments were measured under computer control and the exact corner will be used, this alignment will inherently be more accurate.

To create a DCC alignment:

1. Select the **Insert | Alignment | New** menu option. The **Alignment Utilities** dialog box appears.

2. From the feature list, select **DATUM A**.
3. To level the plane to the ZPLUS plane, from the **Level** drop-down box, select **ZPLUS**.
4. Click the **Level** button. This levels the plane to the ZPLUS axis.
5. Select **DATUM B** from the feature list to rotate to the XPLUS axis about the ZPLUS axis.
6. From the **Rotate To** drop-down box, select **XPLUS**.
7. From the **About** drop-down box, select **ZPLUS**.
8. Click the **Rotate** button.
9. Select **FRNT LEFT CORNER** from the feature list to establish the XYZ origin.
10. Select the check boxes next to ☑ X and ☑ **Y**.
11. Click the **Origin** button.
12. Select **DATUM A**.
13. Select the check box next to ☑ **Z**.
14. Click the **Origin** button again.
15. Type **ABC** in the **ID** box for the alignment name.
16. Click **OK** to exit.

Step 7: Update Display in CAD View

At this point, the CAD View displays all measured features. You may want to disable the display of the point IDs in the CAD View.

To disable points IDs:

1. Select the **Edit | Graphic Display Window | Feature Appearance** menu item. The **Edit Feature Appearance** dialog box appears.

2. Highlight the point features (PNT-PNT9) to select them.
3. Set the **Label Display** option to ◉ **Off**.
4. Click **Apply** and then **OK**.

The CAD View should be similar to the one shown below. Notice that the coordinate system origin is in the lower-left corner. X+ is to the right, and Y+ is to the rear.

When you execute the measurement routine up to this point, it establishes the needed alignment for measuring additional features for evaluation.

Live View Alignment with CAD

You can use this method when you have a fixture, but the fiducials are not found in the CAD drawing. In this case, although you have the CAD drawing for the part, you will not be able to establish a proper alignment from the CAD file. You will need to establish the alignment in the **Vision** tab. Once you do this, you can then use the **CAD** tab to measure additional features.

To establish an alignment that matches the CAD coordinate system, follow these steps:

1. Use the method described in the "Live View Alignments" topic to create the alignment features from the **Vision** tab. Establish an alignment as follows:

    - You should generally use three *surface point* features to construct a *plan*e to level to, a *line* feature to rotate to, and then a *point* feature for the origin.
    - For simple 2D parts, however, you should generally use two *circle* features for leveling, rotating, and setting the origin.

2. Translate, rotate, and level this alignment to match the CAD coordinates.
3. Snap the two coordinate systems together in PC-DMIS.
4. Use the method described in the "CAD View Alignments" topic to create the alignment features (same features as above) from the **CAD** tab.
5. Transform the alignment so that it matches the CAD coordinate system. To do this, click the **CAD=Part** button on the **Alignment Utilities** dialog box to tell PC-DMIS that the alignment you just created should match up with the CAD coordinate system.

Measuring Auto Features with a Vision Probe

PC-DMIS Vision currently supports the creation of features using the Auto feature creation functionality. This chapter only discusses Auto features as they are used with PC-DMIS Vision operation.

For detailed information on Auto features, see the "Creating Auto Features" chapter in the PC-DMIS Core documentation.

The PC-DMIS Quick Start window supports the creation of vision Auto features using the measured feature buttons. Rather than creating measured features, vision Auto features are created when working with vision machines. Not all the available vision Auto features can be created from the Quick Start window, since the available measured feature buttons do not represent all the vision Auto features. The Quick Start window also allows you to "Auto Guess" features by taking hits.

For details on how to use the Auto Feature Guess mode, see the "Auto Feature Guess Mode" topic in this PC-DMIS Vision documentation.

For detailed information on how to use the Quick Start window, see the "Using the Quick Start Interface" chapter in the PC-DMIS Core documentation.

Implementing QuickFeatures in PC-DMIS Vision CAD View

You can use the following rules and parameters to implement vision QuickFeatures in the CAD View:

- **Illumination** - Vision QuickFeatures use the current illumination setting.
- **Magnification** - Vision QuickFeatures use the current magnification setting.
- Vision QuickFeatures do not use IPD files.
- Default parameters are used for vision QuickFeatures.
- Edited parameters are carried forward for vision QuickFeature creation.
- Vision QuickFeatures only use edited values when you edit them in the **Auto Feature** dialog box. When done via the Edit window, any change is not carried forward. This is true for contact and vision.

Supported Vision QuickFeatures in the CAD View:

Feature	Method
Surface Point	Press and hold the Shift key on your keyboard and then hover over the Planar Surface.
Edge Point	For details on the methods used to create QuickFeatures, see the "Creating QuickFeatures" topic in the "Quick Ways to Create Auto Features" chapter in the PC-DMIS Core documentation.
Round Slot	
Square Slot	
Notch Slot	
Polygon	
Line	
Circle	

Ellipse	

Non-supported Vision QuickFeatures:

- 2D Profile
- Blob

Supported parameters for Vision QuickFeatures:

Parameters	Comment
Target Type	Feature dependent.
Hit Target Color	-
Nominal Color	-
Edge Parameters	
Point Density	-
Edge Selection	-
Strength	-
Edge Polarity	-
Hit Target Direction	-
Specified Edge #	-
SensiLight	-
Filter Parameters	
Clean Filter	-
Strength	-
Outlier Filter	-
Distance	-
Std Dev	-
Focus Parameters	
Focus	-

Control	-
Range	-
Duration	-
Find Surface	-
Surface Variance	-
RGB Mixing Parameters	
RGB	-

Implementing QuickFeatures in PC-DMIS Vision Live View

QuickFeatures in the Live View are not supported when you run PC-DMIS in Offline/CAD Camera mode.

Also, QuickFeatures in the Live View are designed to work well on parts that lead to an image with high contrast edges, even illumination, and no significant high-frequency spectral components. An example is thin back-lit parts or surface illuminated parts with no significant surface texture.

The rules and parameters for creating vision QuickFeatures in the Live View are identical to those in the CAD View:

- The rules and parameters match QuickFeature functionality of the CAD View.
- With the Shift key pressed, move your mouse pointer over features in the Live View to highlight them.
- Click on the highlighted feature to create it in the Live View.
- Depending on the highlighted feature in the Live View, if you press the Ctrl + Shift keys, an Edge Point or Surface Point feature is created (see below for the rules and parameters that are specific to the Live View).
- As with CAD View parameters, **Illumination** and **Magnification** use their current settings. All other feature parameters use their previous settings.

The following rules and parameters apply only when you use vision QuickFeatures in the Live View:

- To highlight detected features, hold down the Shift key or the Ctrl + Shift keys, and move your mouse pointer in the Live View. This depends on enabling the **Snap Mouse Click to Edge** option and the value entered for the **Range (pixels)** property in the **Live View Setup** dialog box. For details on the Live View settings, see the "Setting Up the Live View" topic.
- When a Circle or Line feature is detected and highlighted, if you press the Ctrl + Shift keys, the feature changes to an Edge point.

Example of a Line feature detected in the Live View:

Example of a Circle feature detected in the Live View :

- When no Circle or Line feature is detected, but the cursor is near an edge, if you press the Ctrl + Shift keys, an Edge Point is detected. If no edge is detected, then a Surface point is highlighted.

Example of a Surface Point feature in the Live View:

- Once a feature is highlighted, and you click it to select it, the corresponding feature is added to the measurement routine.
- When detecting and highlighting an Edge Point, its vector is defined from the edge in the Live View image towards the cursor. If an Edge Point feature is created, its highlighted vector controls the feature's edge vector.

Examples of Edge Point features with possible vector orientations in the Live View:

Example 1 - When in Live View, this image shows a detected Edge Point feature with its vector pointing away from the part:

Example 2 - When in Live View, this image shows a detected Edge Point feature with its vector pointing into the part:

Supported Vision QuickFeatures in the Live View:

Feature	Method
Circle	

Edge Point	For details on the methods used to create QuickFeatures, see the "Creating QuickFeatures" topic in the "Quick Ways to Create Auto Features" chapter in the PC-DMIS Core documentation.
Line	
Surface Point	

Vision Measuring Methods

PC-DMIS Vision offers three ways to measure parts in DCC Mode:

- **CAD Selection Method** - If you have a CAD drawing, you can program the entire measurement routine offline based on the CAD drawing. You can then execute this measurement routine on a live machine. For more information on this procedure, see "CAD Selection Method".
- **Target Selection Method** - This method does not require a CAD drawing and is done entirely online using a live machine. For more information on this procedure, see "Target Selection Method".
- **Auto Feature Guess Mode** - Using the **Quick Start** window, you can begin taking hits and PC-DMIS automatically guesses the feature type. For more information on this procedure, see "Auto Feature Guess Mode".

CAD Selection Method

The CAD Selection method is used to add a feature to your measurement routine. Click the desired CAD element (such as a circle, an edge, a surface and so on) inside the **CAD** tab of the Graphic Display window. If you want to insert an open Profile 2D, select the series of CAD elements that form the Profile 2D you wish to measure.

The following steps show how to add a circle feature to your measurement routine using the CAD selection method:

1. Access the **Auto Feature** toolbar by clicking **View | Toolbars | Auto Features** from the main menu or right-click in the toolbars area and select it from the list.

2. Click the **Circle** button. The **Auto Feature** dialog box for a circle appears.

3. Keep the **Auto Feature** dialog box open and select the **CAD** tab of the **Graphic Display** window. Then click once on the edge of the desired circle. Other features may require additional or fewer clicks. See "Required Clicks for Supported Features".

Selecting a circle from the CAD View

Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

4. PC-DMIS Vision automatically places the nominal data for the feature into the **Auto Feature** dialog box.
5. The hit targets are automatically displayed for all features. The resulting CAD window view should look something like the following:

Circle feature with target

Notice that the software selects the desired circle feature and draws a target showing the scanning region band.

6. Click **Create** on the **Auto Feature** dialog box to add the feature to the measurement routine.

Target Selection Method

To use the **Target Selection** method to add a feature to your measurement routine, use the **Vision** tab in the Graphic Display window to place target points. The following steps show how to add a circle feature to your measurement routine using this method:

1. Access the **Auto Features** toolbar.

2. Click the **Circle** button. The **Auto Feature** dialog box appears for the circle feature.

3. Keep the **Auto Feature** dialog box open and select the **Vision** tab of the Graphic Display window.
4. Click three points along the edge of the desired circle. With each click, a red target anchor point appears on your image. You can also double-click on the

edge for auto detection. Other features may require more or fewer clicks. See "Required Clicks for Supported Features".

Selecting a circle from the Vision tab

5. The Target for the feature appears in the **Vision** tab once you have placed the required number of anchor points for that feature (or double clicked to detect the edge). See "Required Clicks for Supported Features".

Target shown for circle feature

6. PC-DMIS Vision automatically places the nominal data for the feature into the **Auto Feature** dialog box.
7. Adjust the lighting and magnification to the desired level using the pendant knob control or the **Probe Toolbox**.
8. Adjust the nominal information in the dialog box to match the theoretical values of the feature.
9. Click **Create** on the **Auto Feature** dialog box to add the feature to the measurement routine.

Required Clicks for Supported Features

The following table shows the number of clicks required for each feature type and its associated method of selection:

Required Clicks per Feature

Feature Type	CAD Select Method (CAD View)	Target Point Method (Live View)
Surface Point	Click once on a surface (Surface Mode) or three times on a wireframe (Curve Mode)	Click once to automatically add a point at the clicked spot on the surface.
Edge Point	Click once near an edge	Click once to automatically add a point on the nearest edge.
Line	Click once on one end of a line and again at the other end.	Click to locate the start and end points of the line, or double click to automatically add two points at the extent of the current edge.
Circle	Click once near the edge of the circle.	Click to add three points around the circle, or double click to automatically add three points equally spaced around the circumference of the visible circle.
Ellipse	Click once near the edge of the ellipse.	Click to add five points around the ellipse, or double click to automatically add five points equally spaced around the visible ellipse.
Square Slot	Click once near the edge of the square slot.	Click two points on one of the two longer side edges, then click one point on one of the two end edges, then once on the other longer side edge, then finally once on the other end edge.
Round Slot	Click once near the edge of the round slot.	Click three points on the first arc, and then three more points on the opposite ended arc.
Notch Slot	Click once near the edge, opposite the notch opening.	Click five points as follows: Two points (1 and 2) on the edge opposite the opening; two points (3 and 4) on each of the parallel sides

		of the notch; one point (5) on the edge just outside the notch.
Polygon	Click once near the edge of the polygon.	Click two points on the first side, and then one click on all the other sides. You must set the **Number of sides** parameter in the **Auto Feature** dialog box before clicking.
Profile 2D	**Curve Mode**: Click on a series of one or more connected edges or arcs using wireframe curve data (Curve Mode). **Surface Mode**: Click on a cad entity near the edge and it will build the feature from that and all interconnecting cad elements.	Click sufficient points to define the shape of the profile, with each pair of points being joined by an arc or line. You can insert more points later by right clicking on the Target and selecting **Insert Nominal Segment**. Or, double click in the Live View image to edge trace. See the "Using 2D Profile Edge Tracer" topic.
Blob	Click once on a surface.	Click once to locate the blob center.

Auto Feature Guess Mode

PC-DMIS Vision automatically determines what type of feature to add to your measurement routine. Based on the hits taken, auto features are guessed when the **Quick Start** window is open. The example below shows the process of guessing a vision Auto Circle feature but would be similar for any of the supported features (Edge Point, Line, Circle, Round Slot, Square Slot, or Notch Slot).

To measure vision Auto Circle using Guess mode, follow these steps:

1. Select the **View | Other Windows | Quick Start** menu option to open the **Quick Start** window.

Quick Start window

2. Take your first hit on the edge of the circle feature with your machine's jog box. You can also click the feature's edge in the **Vision** tab. The **Quick Start** window updates and shows one hit (1/1) in the buffer and the guessed POINT feature.
3. Take a second hit in the same way as the first hit but in another location along the edge of the same circle. The **Quick Start** window updates and shows two hits (2/2) in the buffer and the guessed LINE feature.
4. Take a third hit in the same way but in another location along the edge of the same circle. The **Quick Start** window updates and shows three hits (3/3) in the buffer and the guessed CIRCLE feature.

Guessed measured circle hits

5. Click the **Erase Hit** button if you are not satisfied with the location of any of your hits. The hit is removed from the buffer. Repeat steps 2 through 4 to re-measure the circle.
6. Once the desired feature has been guessed, click **Finish**. The software adds the feature to your measurement routine.
7. To display the feature target, on the **Vision** tab of the Graphic Display window, click the **Show Target** button (see "Live View"). Right-click the target to perform common target-parameter changes from the pop-up menu (such as point density, edge selection type, insert target). For information, see "Using Shortcut Menus".

Circle target in the Live View

8. To edit the parameters for the feature, in the Edit window, press **F9** on the new Auto feature command.

The Auto Feature Dialog Box in PC-DMIS Vision

Auto Feature dialog box

The **Auto Feature** dialog box helps you determine what to measure. Regardless of your selection, PC-DMIS shows the **Auto Feature** dialog box with the appropriate feature type selected from the list in the **Measurement Properties** area.

You can use a vision probe to program features in a manner similar to contact probe. The three available methods are:

- Selecting CAD data in the **CAD** tab
- Placing target anchor points with mouse clicks in the **Vision** tab
- Entering values into the **Theoretical** edit boxes found in the **Auto Feature** dialog box

The **Auto Feature** dialog box controls specific to PC-DMIS Vision are discussed below. For information that is not covered in this section, see "The Auto Feature Dialog Box" in the "Creating Auto Features" chapter in the PC-DMIS Core documentation.

Probe Toolbox settings are included at the bottom of the Auto Feature dialog box. The settings are specific to the current Auto feature being edited. For information about using the probe toolbox with PC-DMIS Vision, see "Using the Probe Toolbox in PC-DMIS Vision".

A Note on the Terminology of Hits

The process of using a contact probe to measure a feature is termed "taking a hit". In PC-DMIS Vision's case, the hit refers to the actual position of the point in the measurement process. It is inaccurate to use this same terminology for vision measurements. In PC-DMIS Vision, you click on the image in the **Vision** tab to relay "hits" to the machine.

The term "Target Anchor Point" better defines the process as it occurs inside PC-DMIS Vision. The points derived from these clicks are used as a reference to calculate the nominal form of the feature.

Feature Properties Area

Based on your current feature type, this area's content changes to include any of these items:

Point: This property specifies the XYZ values for Surface or Edge Point features.

Start: This property specifies the XYZ values for the start point of a Line feature.

End: This property specifies the XYZ values for the end point of a Line feature. This is only available when you set the **Bounded** property of the "Measurement Properties Area" to **Yes**.

Center: This property specifies the XYZ values for the center of a Circle, Round Slot, Square Slot, or Profile 2D feature.

Surface: This property specifies the IJK values for the surface vector of any vision Auto feature.

Edge: This property specifies the IJK values for the edge vector for an Edge or Line feature. The Edge Point vector points away from the edge.

Angle: This property specifies the IJK values for the angle vector for a Round or Square Slot feature. The angle vector defines the feature's centerline. The feature centerline and normal vector must be perpendicular to each other. This value also specifies the reference vector for start and end angles for Circles (Arcs).

Thickness Type: This property defines how PC-DMIS applies a thickness to **Surface** or **Edge** values of a feature. The options are:

> **Theo** - PC-DMIS applies the thickness as a theoretical value.
>
> **Actl** - PC-DMIS applies the thickness as an actual value.
>
> **None** - PC-DMIS does not apply a thickness.

T: This property specifies the thickness distance to apply to the **Surface** or **Edge** value of a feature, depending on the thickness type. This value is not available if you select **None** for the **Thickness Type**.

Length: This property specifies the length for Lines, Notch Slots, Round Slots, or Square Slots.

Bounded: When you select **Yes**, this property specifies the **End** property is available in the "Feature Properties Area" to define the end point of a Line feature.

Inner/Outer: This property specifies whether Circle, Square Slot, Round Slot, Notch Slot, Ellipse, and Polygon features are inner or outer features.

Diameter: This property specifies the diameter of a Circle or Polygon feature. The diameter for a polygon defines an inscribed circle within the polygon.

Major Diam: This property specifies the diameter of the long axis of an Ellipse feature.

Minor Diam: This property specifies the diameter of the short axis of an Ellipse feature.

Width: This property defines the width for Round Slots, Square Slots, or Notch Slots.

Num Sides: This property specifies the number of sides for a Polygon feature (3-12).

Feature Properties - Control Buttons

Vision Buttons	Description
Polar / Cartesian button	This button switches between Polar and Cartesian coordinate system.
Find Nearest CAD Element button	When you select an axis (X,Y, or Z) from one of the **Point** or **Start** boxes and click this button, PC-DMIS finds the closest CAD element in the Graphic Display window to that axis.
	This option is only available for Surface Point, Edge Point, and Line features.
Read Point from Machine button	This button reads the probe tip's position (stage position) and inserts it into the X, Y, and Z boxes.
	If you are on the Gage toolbox page and you press this button, PC-DMIS uses the Gage center point instead of the stage position.
Snap to Grid button	This button snaps a supported auto point feature to the 3D grid display in the Graphic Display window. For details, see "Snap to Grid" in the "Creating Auto Features" chapter in the PC-DMIS Core documentation.
Measure Now button	This button measures the selected feature when you click **Create**.
Re-Measure button	This button determines whether or not PC-DMIS automatically re-measures the feature a second time once the feature has been measured. It uses the measured values from the first measurement as the target locations for the second measurement.

Find Vector button	This button pierces all surfaces along the XYZ point and IJK vector, looking for the closest point. The software displays the surface normal vector as the IJK NOM VEC, but the XYZ values do not change.
	This option is only available for Surface Point.
Flip Vector button	This button reverses the direction of the I, J, K vector.
Read Vector From Machine button	This button reads and applies vector values based on your vision machine's vectors.
Swap Vectors button	This button causes the current edge vector and surface vector to switch vectors with each other.

Measurement Properties Area

Based on your current feature type, this area's contents change to include a portion of these items:

Snap: When you select **Yes**, measured values "snap to" the theoretical vector for Surface Points. All deviations are along the vector of the point. This is useful for focusing on a deviation along one particular vector.

Start Angle: This option specifies the Start angle of a Circle or Ellipse feature.

End Angle: This option specifies the End angle of a Circle or Ellipse feature.

Closed: When you set this value to **Yes**, the 2D Profile Edge Tracer determines that the first nominal segment is joined to the last nominal segment. Basically, it determines if the feature is Open or Closed.

Measurement Properties - Control Buttons

Vision Buttons	Description
Manual Pre-Position button	If you select this button when running in DCC mode, PC-DMIS has the operator confirm the target position before measurement takes place.
Show Hit Targets button	Toggle this button to show and hide the Target data on the Live View and CAD View that were acquired and used to measure the feature.
View Normal button	This button orients the CAD so that you look down on the feature.
View Perpendicular button	This button orients the CAD so that you look at the side of the feature.
Show Measured Points button	This button shows and hides the image processing data points on the Live View and CAD View that were acquired and used to measure the feature.
Show Filtered Points button	This button shows and hides the image processing data points on the Live View and CAD View that were acquired and discarded by the current filter settings.

Advanced Measurement Options Area

Nominal Mode

FIND NOMS: PC-DMIS Vision pierces the CAD model to find the closest location on a CAD edge (or surface) to the measured point. It sets the nominals to that location on the CAD element.

MASTER: If you create a feature with the Mode list set to **MASTER**, then the next time you measure the part, PC-DMIS Vision sets the nominal data equal to the measured data. PC-DMIS then resets the Mode list to **NOMINALS**.

NOMINALS: This option requires you to have nominal data before the measurement process begins. PC-DMIS compares the measured feature with the theoretical data in the dialog box and uses the measured feature for any necessary calculations.

Best Fit Math Type

A vision Circle Auto feature also allows you to define the Best Fit Math Type. For details, see the "Best Fit Type for Circle" topic in the "Constructing New Features from Existing Features" chapter of the PC-DMIS Core documentation.

Relative to

This option allows you to keep the relative position and orientation between a given feature (or features) and the Auto feature. Click the button to open the **Relative Feature** dialog box to select the feature or features to which the Auto feature is relative to. You can define multiple features for each axis (XYZ) relative to your Auto feature.

Analysis area

The **Analysis** area allows you to determine how to display each measured hit/point.

Pt. Size: This value determines how big PC-DMIS draws the measured points in the CAD View. It specifies the diameter in the current measurement routine units (mm or inch).

Graphic Analysis button : If you click this button on, PC-DMIS does a tolerance check on each point (how far from the theoretical position it is), and draws them in the appropriate color based on the currently-defined dimension color range.

+ Tol: This option provides the positive tolerance from the nominal in the current measurement routine units. Points that are greater than this value from the nominal are colored based on the standard PC-DMIS positive-tolerance color.

- Tol: This option provides the negative tolerance from the nominal in the current measurement routine units. Points that are less than this value from the nominal are colored based on the standard PC-DMIS negative-tolerance color.

For information on how to edit dimension colors for the positive and negative tolerances, see the "Editing Dimension Colors" topic in the "Editing the CAD Display" chapter in the PC-DMIS Core documentation.

Command Buttons

Command Buttons	Description
Move To **Move To** button	This button moves the field of view in the Graphic Display window and centers it on the current feature's XYZ location. If a feature is composed of more than one point (such as a line), then clicking this button switches between the points making up the feature.
Test **Test** button	This button allows you to test a feature's creation and preview its dimensional data before it's actually created. This button performs a measurement using the current parameters. You can change parameters and click **Test** repeatedly until you have an acceptable measurement. Then when you click **Create**, the software converts the temporary feature into a normal feature in the measurement routine.
Create **Create** button	This button inserts the defined Auto feature into the Edit Window at the current position.
Close **Close** button	This button exits the Auto Feature dialog box.
Basic << and **Advanced** >> buttons	The **Basic** button displays just the basic Auto feature options in the **Auto Feature** dialog box. The **Advanced** button expands the **Auto Feature** dialog box to show the advanced Auto feature options.

Vision Field Definitions

The Edit window command line for a sample vision circle reads:

```
feature_name=FEAT/VISION/TOG1,TOG2,TOG3,TOG4
THEO/ <x_cord,y_cord,z_cord>,<i_vec,j_vec,k_vec>,diam
ACTL/ <x_cord,y_cord,z_cord>,<i_vec,j_vec,k_vec>,diam
TARG/ <x_cord,y_cord,z_cord>,<i_vec,j_vec,k_vec>
SHOW FEATURE PARAMETERS=TOG5
    SURFACE=TOG6,n,EDGE/TOG6,n
    MEASURE MODE=TOG7
    RMEAS=CIR1,CIR1,CIR1
    GRAPHICAL ANALYSIS=TOG8,n1,n2,n3
    DIAGNOSTICS=TOG9
    FEATURE LOCATOR=TOG10,n1,TOG11,n2,n3
SHOW VISION PARAMETERS=TOG12
    TYPE=TOG13
    COVERAGE=TOG14
    MAGNIFICATION=0.843
    HIT TARGET COLOR=TOG15,NOMINAL COLOR=TOG15
    HIT TARGET/EA1,0.202,TOG16
    FILTER=TOG17,n1,TOG18,n2,n3
    EDGE=TOG19,n1,n2,n3,n4
    FOCUS/TOG20,n1,n2,TOG21,TOG22
```

THEO, **ACTL**, and **TARG** values vary depending on the feature type.

- **THEO**: This value defines the theoretical values for measuring the vision Auto feature.
- **ACTL**: This value defines the actual measured values of the measured vision Auto feature.
- **TARG**: This value defines the target position for the measurement.

  Use these values when the THEO positions don't match the part. You should leave the THEO values to match the CAD positions. The software dimensions the results to these values but changes the TARG values so that the software measures the feature in a slightly different location.

Toggle Values

TOG1 = FEATURE TYPE
SURFACE POINT / EDGE POINT / LINE / CIRCLE / ELLIPSE / SQUARE SLOT / ROUND SLOT / NOTCH SLOT / POLYGON / PROFILE 2D are the available PC-DMIS Vision feature types.

TOG2 = CARTESIAN or **POLAR** for POINT, CIRCLE, EDGEPOINT, and LINE; **OPEN** or **CLOSED** for PROFILE 2D;

TOG3 =IN or **OUT** for CIRCLE; **POLR** or **RECT** for PROFILE 2D and SLOT (not used for POINT, LINE)

TOG4 = ALGORITHM
LEAST_SQR, MIN_SEP, MAX_INSC, MIN_CIRSC (Only used for CIRCLE)

TOG5 = SHOW FEATURE PARAMETERS
YES / NO - This toggle field determines whether the software displays the feature parameters. These values included TOG6 - TOG11.

TOG6 = THICKNESS
This toggle field determines if Actual Thickness (ACTL_THICKNESS), Theoretical Thickness (THEO_THICKNESS) or thickness is off (THICKNESS_OFF). You can specify edge thickness for lines and edge points.

n = Thickness value in current units.

TOG7 = MEASURE MODE
NOMINALS / VECTOR / FIND NOMS / MASTER

TOG8 = GRAPHICAL ANALYSIS
YES / NO - This toggle field determines if the software applies graphical analysis. When this value is set to YES, then the software applies the next three values or Point Size, Plus, and Minus Tolerances for graphical analysis.

n1 = Point Size

n2 = Plus Tolerance

n3 = Minus Tolerance

TOG9 = DIAGNOSTICS
YES / NO - This toggle field determines whether the software collects diagnostic information for diagnosing problems where edge detection fails. The diagnostics contains bitmap images and the current feature parameters that you can export from PC-DMIS and send to Hexagon Technical Support.

TOG10 = FEATURE LOCATOR (Bitmap)
Use the feature locator option to specify a bitmap image file that you want to show in the **Feature Locator** tab of the **Probe Toolbox** when you execute this feature. This option can help you locate the feature. If this option isn’t needed, switch it to NO.

n1 = Path and name of the bitmap.

TOG11 = FEATURE LOCATOR (Audio File)
Use the feature locator option to specify a .wav file that the software plays when you execute this feature. If this option isn't needed, switch it to NO.

n2 = Path and name of the .wav file.

n3 = Caption string for the **Feature Locator** tab.

TOG12 = SHOW VISION PARAMETERS
YES / NO - This toggle field determines whether the software displays vision parameters for the feature below. These values included TOG13 - 22.

TOG13 = TYPE
AUTOMATIC HIT TARGET / MANUAL HIT TARGET / GAGE HIT TARGET / OPTICAL COMPARATOR HIT TARGET - This toggle field determines the type of Hit Target.

- GAGE HIT TARGET is only available for LINE, CIRCLE, and ELLIPSE.
- OPTICAL COMPARATOR HIT TARGET is only available for LINE, CIRCLE, ELLIPSE, SQUARE SLOT, ROUND SLOT, and NOTCH SLOT.
- Only the AUTOMATIC HIT TARGET is available for Polygon features.
- Only the OPTICAL COMPARATOR HIT TARGET is available for Polygon features.

TOG14 = COVERAGE
This option allows you to change the coverage for a feature. The software creates or removes new targets based on the percentage of coverage you select.

TOG15 = COLOR
You can select from 16 basic colors to denote the HIT TARGET COLOR and the NOMINAL COLOR.

TOG16 = DENSITY
This option toggles between LOW | HIGH | NORMAL | NONE. It indicates the density of points that the software returns for this target. For more information, see "Probe Toolbox: Define Targets tab".

TOG17 = CLEAN FILTER
YES / NO - This toggle field applies the clean filter to remove dust and small noise particles from the image prior to edge detection. The software does not use this value for a SURFACE POINT.

n1 = Strength - Specifies the size (in pixels) of an object, below which is considered to be dirt or noise.

TOG18 = OUTLIER FILTER
YES / NO - This toggle field determines whether the software applies the outlier filter for this target. The software does not use this value for a SURFACE POINT.

> **n2** = Distance Threshold - This specifies the distance in pixels that a point can be away from nominal before the software discards it.
>
> **n3** = The standard deviation of a point needs to be away from the other points for the software to considered it an outlier.

TOG19 = EDGE TYPE
This toggle field switches between the available types of edge detections. They are: DOMINANT EDGE, SPECIFIED EDGE, NEAREST NOMINAL, or MATCHING EDGE. See "Probe Toolbox: Hit Targets tab" for more information. The software does not use this value for a SURFACE POINT.

> **n1** = Edge strength threshold the software uses during the teach process. PC-DMIS ignores edges which have a ‘strength’ below this threshold when it looks for an edge. Values should fall between the range of 0 and 255.
>
> **n2** = Hit target direction (**-->** or **<--**).
>
> **n3** = Specified Edge - This parameter defines the Nth edge the software uses for the specified edge detection method. Currently you can enter a number between 1-10.
>
> **n4** = This value determines if the edge that PC-DMIS found and is being viewed goes from black to white "[|] ->[ ]", white to black "[ ] ->[|]", or either "[?] ->[?].

TOG20 = FOCUS
YES / NO - This determines whether the target requires a pre-edge detection focus.

> **n1** = This value displays the range from the camera to the part. It specifies the distance (in the current units) over which to perform the focus.
>
> **n2** = This value provides the number of seconds to spend searching for the best focal position.

TOG21 = Find Surface
YES / NO - This toggle field determines whether the machine should perform a second, slightly slower, pass-to attempt to improve the accuracy of the focal position.

TOG22 = SensiLight
YES/NO - This toggle field determines whether the machine should perform an auto-light adjust prior to focus, in an attempt to achieve optimal focus result. If set to **NO**, PC-

DMIS sets the lighting according to the learned percentage and does not automatically adjust the brightness.

Creating Auto Features

The following procedures describe how to measure part features using PC-DMIS Vision. The following features are available in PC-DMIS Vision:

- Vision Surface Point
- Vision Edge Point
- Vision Line
- Vision Circle
- Vision Ellipse
- Vision Round Slot
- Vision Square Slot
- Vision Notch Slot
- Vision Polygon
- Vision Profile 2D
- Vision Blob

You can also box-select the part image to quickly create supported Auto features at once. See "Box-Selecting to Create Auto Features".

Before measuring, you must first properly set up the various machine options, calibrate your vision probe, and understand how to use the **Probe Toolbox**, **CAD**, and **Vision** tabs. You should also create alignments as needed.

See these topics for more information:

"Setting Machine Options"

"Calibrating the Vision Probe"

"Using the Graphic Display Window in PC-DMIS Vision"

"Using the Probe Toolbox in PC-DMIS Vision"

"Creating an Alignment"

Vision Surface Point

To create a vision Surface Point, follow these steps:

1. For machines supporting DCC motion, select **DCC Mode** if you want to create and measure surface points in DCC mode.
2. Select **Auto Surface Point** from the **Auto Feature** toolbar. You can also select the **Insert | Feature | Auto | Point | Surface Point** menu option. This opens the **Auto Feature** (surface point) dialog box.

Vision Surface Point Auto Feature dialog box

3. With the **Auto Feature** dialog box open, select a surface point in one of two ways:

- CAD Selection Method - From the **CAD** tab, click once on the CAD surface (surface mode) or three times on the wireframe (curve mode) to establish the point's location.
- Target Selection Method - From the **Vision** tab, click once on the surface to establish the point's location. Adjust the lighting and magnification from the Probe Toolbox as needed.

Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

4. PC-DMIS Vision automatically places the nominal data for the point into the **Auto Feature** dialog box. The hit targets will automatically be displayed for the surface point.

5. Adjust the nominal information in the **Auto Feature** dialog box to match the theoretical values of the point. Also, adjust the values of the Probe Toolbox as needed.
6. Click **Test** to test point measurement.
7. Click **Create** on the **Auto Feature** dialog box to add the surface point to the measurement routine.
8. Save the measurement routine for future execution. See "A Note on Executing a Vision Measurement Routine".

Vision Edge Point

To create a vision Edge Point, follow these steps:

1. For machines supporting DCC motion, select **DCC Mode** if you want to create and measure edge points in DCC mode.
2. Select **Auto Edge Point** from the **Auto Feature** toolbar. You can also select the **Insert | Feature | Auto | Point | Edge Point** menu option. This opens the **Auto Feature** (edge point) dialog box.

Vision Edge Point Auto Feature dialog box

3. With the **Auto Feature** dialog box open, select an edge point in one of two ways:

    - CAD Selection Method - From the **CAD** tab, click once near the edge on the CAD surface to establish the point's location.
    - Target Selection Method - From the **Vision** tab, click once near the edge of the surface to establish the point's location. Adjust the lighting and magnification from the Probe Toolbox as needed.

Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

4. PC-DMIS Vision automatically places the nominal data for the point into the **Auto Feature** dialog box. The hit targets are automatically displayed for the edge point.
5. Adjust the nominal information in the **Auto Feature** dialog box to match the theoretical values of the point. Also, adjust the values of the Probe Toolbox as needed. Double-click items under the column headings to make changes as needed.

   For example, if you double-click the **None** item under the **Min/Max Type** column, you can select **None**, **Min**, **Max**, or **Mean**.

   For details on the options available in the **Probe Toolbox**, see the topic "Using the Probe Toolbox in PC-DMIS Vision".

6. Click **Test** to test point measurement.
7. Click **Create** on the **Auto Feature** dialog box to add the edge point to the measurement routine.
8. Save the measurement routine for future execution. See "A Note on Executing a Vision Measurement Routine".

Vision Line

To create a vision Line, follow these steps:

1. For machines supporting DCC motion, select **DCC Mode** if you want to create and measure lines in DCC mode.
2. Select **Auto Line** from the **Auto Feature** toolbar. You can also select the **Insert | Feature | Auto | Line** menu option. This opens the **Auto Feature** (line) dialog box.

Vision Line Auto Feature dialog box

3. With the **Auto Feature** dialog box open, select a line in one of two ways:

    - CAD Selection Method - From the **CAD** tab, click once on one end of the line and again at the other end on the CAD surface to establish the line's location.
    - Target Selection Method - From the **Vision** tab, click to locate the start and end points of the line, or double-click to automatically add two points at the extents of the selected edge. This establishes the line's location. Adjust the lighting and magnification as needed.

Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

4. PC-DMIS Vision automatically places the nominal data for the line into the **Auto Feature** dialog box. The hit targets are automatically displayed for the line.

5. Adjust the nominal information in the **Auto Feature** dialog box to match the theoretical values of the line. Also, adjust the values of the Probe Toolbox as needed.
6. Click **Test** to test line measurement.
7. Click **Create** on the **Auto Feature** dialog box to add the line to the measurement routine.
8. Save the measurement routine for future execution. See "A Note on Executing a Vision Measurement Routine".

Vision Circle

To create a vision Circle, follow these steps:

1. For machines supporting DCC motion, select **DCC Mode** if you want to create and measure circles in DCC mode.
2. Select **Auto Circle** from the **Auto Feature** toolbar. You can also select the **Insert | Feature | Auto | Circle** menu option. This opens the **Auto Feature** (circle) dialog box.

Vision Circle Auto Feature dialog box

3. With the **Auto Feature** dialog box open, select a circle in one of two ways:

    - CAD Selection Method - From the **CAD** tab, click once near the edge of the circle on the CAD surface to establish the circle's location.
    - Target Selection Method - From the **Vision** tab, click to add three points around the circle; or double click to automatically add three points equally spaced around the circumference of the visible circle. This establishes the circle's location. Adjust the lighting and magnification as needed.

Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

4. PC-DMIS Vision automatically places the nominal data for the circle into the **Auto Feature** dialog box. The hit targets will automatically be displayed for the circle.

5. Adjust the nominal information in the **Auto Feature** dialog box to match the theoretical values of the circle. Also, adjust the values of the Probe Toolbox as needed.
6. Click **Test** to test circle measurement.
7. Click **Create** on the **Auto Feature** dialog box to add the circle to the measurement routine.
8. Save the measurement routine for future execution. See "A Note on Executing a Vision Measurement Routine".

Vision Ellipse

To create a vision Ellipse, follow these steps:

1. For machines that support DCC motion, select **DCC Mode** if you want to create and measure ellipses in DCC mode.
2. Select **Auto Ellipse** from the **Auto Feature** toolbar. You can also select the **Insert | Feature | Auto | Ellipse** menu option. This opens the **Auto Feature** (ellipse) dialog box.

Vision Ellipse Auto Feature dialog box

3. With the **Auto Feature** dialog box open, select an ellipse in one of two ways:

    - CAD Selection Method - From the **CAD** tab, click once near the edge of the ellipse on the CAD surface to establish the ellipse's location.
    - Target Selection Method - From the **Vision** tab, click to add five points around the ellipse, or double-click to automatically add five points equally spaced around the visible ellipse. This establishes the ellipse's location. Adjust the lighting and magnification as needed.

Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

4. PC-DMIS Vision automatically places the nominal data for the ellipse into the **Auto Feature** dialog box. The hit targets are automatically displayed for the ellipse.

5. Adjust the nominal information in the **Auto Feature** dialog box to match the theoretical values of the ellipse. Also, adjust the values of the Probe Toolbox as needed.
6. Click **Test** to test ellipse measurement.
7. Click **Create** on the **Auto Feature** dialog box to add the ellipse to the measurement routine.
8. Save the measurement routine for future execution. See "A Note on Executing a Vision Measurement Routine".

Vision Round Slot

To create a vision Round Slot, follow these steps:

1. For machines supporting DCC motion, select **DCC Mode** if you want to create and measure round slots in DCC mode.
2. Select **Auto Round Slot** from the **Auto Feature** toolbar. You can also select the **Insert | Feature | Auto | Round Slot** menu option. This opens the **Auto Feature** (round slot) dialog box.

Vision Round Slot Auto Feature dialog box

3. With the **Auto Feature** dialog box open, select a round slot in one of two ways:

    - CAD Selection Method - From the **CAD** tab, click once near the edge of the round slot on the CAD surface to establish the round slot's location.
    - Target Selection Method - From the **Vision** tab, click three points on the first arc, and then three more points on the opposite ended arc. This establishes the round slot's location. Adjust the lighting and magnification as needed.

Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

4. PC-DMIS Vision automatically places the nominal data for the round slot into the **Auto Feature** dialog box. The hit targets are automatically displayed for the round slot.

5. Adjust the nominal information in the **Auto Feature** dialog box to match the theoretical values of the round slot. Also, adjust the values of the Probe Toolbox as needed.
6. Click **Test** to test round slot measurement.
7. Click **Create** on the **Auto Feature** dialog box to add the round slot to the measurement routine.
8. Save the measurement routine for future execution. See "A Note on Executing a Vision Measurement Routine".

Vision Square Slot

To create a vision Square Slot, follow these steps:

1. For machines supporting DCC motion, select **DCC Mode** if you want to create and measure square slots in DCC mode.
2. Select **Auto Square Slot** from the **Auto Feature** toolbar. You can also select the **Insert | Feature | Auto | Square Slot** menu option. This opens the **Auto Feature** (square slot) dialog box.

Vision Square Slot Auto Feature dialog box

3. With the **Auto Feature** dialog box open, select a square slot in one of two ways:

    - CAD Selection Method - From the **CAD** tab, click once near the edge of the square slot on the CAD surface to establish the square slot's location.
    - Target Selection Method - From the **Vision** tab, click two points on one of the two longer side edges, then click one point on one of the two end edges, then once on the other longer side edge, then finally once on the other end edge. This establishes the square slot's location. Adjust the lighting and magnification as needed.

Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

4. PC-DMIS Vision automatically places the nominal data for the square slot into the **Auto Feature** dialog box. The hit targets are automatically displayed for the square slot.

5. Adjust the nominal information in the **Auto Feature** dialog box to match the theoretical values of the square slot. Also, adjust the values of the Probe Toolbox as needed.
6. Click **Test** to test square slot measurement.
7. Click **Create** on the **Auto Feature** dialog box to add the square slot to the measurement routine.
8. Save the measurement routine for future execution. See "A Note on Executing a Vision Measurement Routine".

Vision Notch Slot

To create a vision Notch Slot, follow these steps:

1. For machines supporting DCC motion, select **DCC Mode** if you want to create and measure notch slots in DCC mode.
2. Select **Auto Notch Slot** from the **Auto Feature** toolbar. You can also select the **Insert | Feature | Auto | Notch Slot** menu option. This opens the **Auto Feature** (notch slot) dialog box.

Vision Notch Slot Auto Feature dialog box

3. With the **Auto Feature** dialog box open, select a notch slot in one of two ways:

    - CAD Selection Method - From the **CAD** tab, click once near the edge of the notch slot on the CAD surface to establish the notch slot's location.
    - Target Selection Method - From the **Vision** tab, click five points as follows: Two points (1 and 2) on the edge opposite the opening; two points (3 and 4) on each of the parallel sides of the notch; one point (5) on the edge just outside the notch. This establishes the notch slot's location. Adjust the lighting and magnification as needed.

Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

4. PC-DMIS Vision automatically places the nominal data for the notch slot into the **Auto Feature** dialog box. The hit targets are automatically displayed for the notch slot.

5. Adjust the nominal information in the **Auto Feature** dialog box to match the theoretical values of the notch slot. Also, adjust the values of the Probe Toolbox as needed.
6. Click **Test** to test notch slot measurement.
7. Click **Create** on the **Auto Feature** dialog box to add the notch slot to the measurement routine.
8. Save the measurement routine for future execution. See "A Note on Executing a Vision Measurement Routine".

Vision Polygon

To create a Polygon:

1. Select **DCC Mode** if you want to create and measure polygons in DCC mode and your machine supports DCC motion.
2. Select **Auto Polygon** from the **Auto Feature** toolbar (**Insert | Feature | Auto | Polygon**). This opens the **Auto Feature** dialog box for the Polygon Auto feature.

Vision Polygon Auto Feature dialog box

3. From the **Auto Feature** dialog box, select a polygon in one of two ways:

    - CAD Selection Method - From the **CAD** tab, click once near the edge of the polygon on the CAD surface to establish the polygon's location.
    - Target Selection Method - To use this method to select a polygon, follow these steps:

        a. In the **Feature Properties** area of the dialog box, type or use the up and down arrows to set the value in the **Num Sides** box.
        b. From the Graphic Display area, select the **Vision** tab to display the Live View window.
        c. Click two points on the first edge, and then click once on all the other sides to define the feature. The total number of sides should

correspond with the value in the **Num Sides** box you set in the first step.

d. Adjust the lighting and magnification as needed.

> Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

4. PC-DMIS Vision automatically places the nominal data for the polygon into the **Auto Feature** dialog box. The hit targets are automatically displayed for the polygon.

5. Adjust the nominal information in the **Auto Feature** dialog box to match the theoretical values of the polygon. Also, adjust the values of the Probe Toolbox as needed.
6. Click **Test** to test the polygon measurement.
7. Click **Create** on the **Auto Feature** dialog box to add the polygon to the measurement routine.
8. Save the measurement routine for future execution. See "A Note on Executing a Vision Measurement Routine".

Vision Profile 2D

> PC-DMIS has an option to switch between the Legacy Profile 2D and the latest version of Profile 2D. For details, see the "Use Legacy Profile 2D" topic in the "Dimensioning Features" chapter in the PC-DMIS Core documentation.

Legacy Profile 2D

To create a Legacy Profile 2D, follow these steps:

1. For machines that support DCC motion, select the **DCC Mode** icon if you want to create and measure Profile 2D features in DCC mode.
2. To open the **Auto Feature** (Profile 2D) dialog box, select the **Auto Profile 2D** icon from the **Auto Feature** toolbar. You can also select the **Insert | Feature | Auto | Profile 2D** menu option.

Vision Profile 2D Auto Feature dialog box

3. From the **Auto Feature** dialog box, select a profile 2D in one of two ways:

    - CAD Selection method - From the **CAD** tab, click once (in Surface mode) near the edge of the Profile 2D on the CAD surface to establish the Profile 2D's location. In Curve mode, you must select each CAD entity that makes up the feature's form.
    - Target Selection method - From the **Vision** tab, click a sufficient number of points to define the shape of the profile, with each pair of points being joined by an arc or a line. You can insert more points later by right-clicking on the target and selecting **Insert Nominal Segment**. Or, you may also double-click in the **Vision** tab to edge trace. See the "Using 2D Profile Edge Tracer" topic. This establishes the Profile 2D's location. Adjust the lighting and magnification as needed.

Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

4. PC-DMIS Vision automatically places the nominal data for the Profile 2D into the **Auto Feature** dialog box. The hit targets are automatically displayed for the Profile 2D.

For all features (except for Profile 2D), the hit targets are automatically displayed for the feature. For a Profile 2D feature, you need to click on the **Show Hit Targets** button on the **Auto Feature** dialog box when you've defined the profile's nominal position. See "Required Clicks for Supported Features".

5. Adjust the nominal information in the **Auto Feature** dialog box to match the theoretical values of the Profile 2D. Also, adjust the values of the Probe Toolbox as needed.
6. Click **Test** to test the Profile 2D measurement.
7. Click **Create** on the **Auto Feature** dialog box to add the Profile 2D to the measurement routine.
8. Save the measurement routine for future execution. See "A Note on Executing a Vision Measurement Routine".

Non-Legacy (Latest) Profile 2D

The latest version of the Profile 2D has the following capabilities:

Live View Selection

You can program a Profile 2D feature by double-clicking near the edge of the feature in the Live View. PC-DMIS Vision automatically traces around the edge of the feature and moves the machine stage on a DCC machine if necessary.

Rules for Clicks to Start Edge Tracer

- When you double-click an edge, PC-DMIS Vision traces around the selected edge and attempts to return to the start position.
- If you first single-click a point before double-clicking, the first clicked point is your start point, and the double-clicked point is your targeted end point.

- If you click two points before double-clicking, the first click is the start point, and the second click dictates the direction in which the trace will proceed. The double-click position will be the end point.
- At first-time execution, as there is no Nominal data and if Master mode is not selected, a dialog box is displayed stating that Master mode execution is required. You are then prompted to switch to Master mode. All subsequent executions will be compared against this data.

If you wish to re-define the Master data, you can switch Measure Mode to MASTER in the Edit window (or press F9 on the feature) and select MASTER from the dialog box to display a dialog box that asks if you want to replace the existing nominal data.

CAD View Selection

Set the **Closed** option in the **Measurement properties** section of the feature dialog box to **Yes** to program a Profile 2D feature.

- **Closed** - Setting this **Measurement properties** option to Yes allows a single click on the CAD. Multiple clicks are no longer required.
- **Open** - Setting the **Measurement properties** to No allows you to click the first point. The second point defines the direction, and the third point defines the end point.

If a Profile 2D feature is created from CAD, it will always use CAD as nominal.

PC-DMIS will use the CAD objects as the nominal regardless of the Nominal, Master, or Find Noms Mode choice in the **Advanced Measurement options** section of the **Auto Feature** dialog box. Even if the mode choice is changed, the feature still uses the CAD object as nominal.

Targets can be edited after creating the new 2D profile in the CAD View or Live View by right-clicking within the target to display a menu. Select or de-select the **Edit Nominal Segments** option to turn on or off nominal segment editing. This feature allows you to adjust or delete existing targets or insert additional targets.

Reporting Material Condition properly when creating a vision Profile 2D on a CAD wireframe model

To ensure the correct material condition is represented when creating a vision Profile 2D on a wireframe CAD model:

- **Outer Profile** - The **First**, **Direction** and **End Points** should be taken in a clockwise direction
- **Inner Profile** - The **First**, **Direction** and **End Points** should be taken in a counterclockwise direction

A Closed Contour on a wireframe CAD model should be considered an Open Contour adhering to the clockwise or counterclockwise convention. Once programmed with the correct direction, select the **Contour** option in the dialog box to close it.

To create a vision Profile 2D on a surface CAD model, create the Outer or Inner Profile in a clockwise or counterclockwise direction; the material condition is guaranteed to be correct.

Using 2D Profile Edge Tracer

You can program a Profile 2D feature by double-clicking near the edge of the feature in the **Vision** tab. PC-DMIS Vision automatically traces around the edge of the feature and moves the machine stage on a DCC machine if necessary.

Rules for Clicks to Start Edge Tracer

- If you just double-click, PC-DMIS Vision travels around the edge in a counterclockwise direction to try and return to the start position.
- If you single click a point before double-clicking, that first-clicked point is your start point, and the double-click point is your targeted end point.
- If you click two points before double-clicking, the first click is the start point, and the second click dictates the direction in which the trace proceeds. The double-click position is also the end point.

Once the edge trace is completed, you can adjust the nominal segments as necessary.

Vision Blob

Overview

To access the **Blob** Auto Feature dialog box, do one of the following:

- Click **Insert | Feature | Auto | Blob** from the main menu.
- Click the **Blob** button on the **Auto Features** toolbar.

To use the **Blob** Auto feature, the required feature must fit within the Field of View. The Blob feature is designed to work well on parts that lead to an image with high contrast edges, even illumination, and no significant high-frequency spectral components. For example, it works well on thin, back-lit parts, or on surface-illuminated parts with no significant surface texture.

When you open the **Blob** dialog box, click the **Vision** tab to create the target.

Example of creating the Blob | Auto Feature target in the Live View

Once you create the target, you can re-size it in the same way as other Auto features. PC-DMIS highlights the pixels included in the blob calculation in the Live View.

Creating a Vision Blob feature

1. For machines that support DCC motion, select **DCC Mode** if you want to create and measure the **Blob | Auto Feature** in DCC mode.
2. Select **Auto Blob** from the **Auto Feature** toolbar. You can also select the **Insert | Feature | Auto | Blob** menu option. This opens the **Auto Feature (Blob)** dialog box.

Vision Blob Auto Feature dialog box

3. With the **Auto Feature** dialog box open, use the Target Selection method. To do this, from the **Vision** tab, click once on the surface to establish the point's location. Adjust the lighting and magnification from the Probe Toolbox as needed.

> Click as close as possible to the CAD element to ensure PC-DMIS does not choose an incorrect element.

PC-DMIS Vision automatically places the nominal data for the Blob into the **Auto Feature** dialog box. The software automatically displays the hit targets for the Blob.

4. Adjust the nominal information in the **Auto Feature** dialog box to match the theoretical values of the Blob. Also, adjust the values in the Probe Toolbox as needed.

This image and the description below it highlight the important elements when you define the **Blob | Auto Feature**:

A. The **Theoreticals** area allows you to manually enter the nominal **Area** value in the current measurement routine units.
B. The **Actuals** area updates automatically when you execute the measurement routine.
C. You can set the **Blob** Auto feature parameters such as **Minimum Area**, **Threshold**, **Polarity**, and **Clean Filter** in the **Hit Targets** section of the measurement routine as well as with the respective sliders in the **Hit Targets** tab of the **Blob | Auto Features** dialog box (shown below).

Hits Target tab of the Blob | Auto Feature dialog box

Minimum Area slider - Use the **Minimum Area** slider to adjust the filter value. The target size determines the scale of the slider as the maximum is set as half the calculated area within the target.

Threshold slider and **Polarity** buttons - Use these options to determine which pixels the software includes in the feature calculation. If you select the **Dark** polarity button, the software uses any pixels within the target area below the threshold. If you select the **Light** polarity button, the software uses any pixels within the target area above the threshold. Use the **Threshold** slider to set the target area pixel range for the selected polarity button.

Clean Filter slider - Use this option to apply filtering as needed to remove noise such as dust or small dirt. The strength determines the size of the noise to remove. The options are **Off**, **Weak**, **Medium**, and **Strong**.

When the **Hit Targets** tab is active in the Probe Toolbox, the software highlights the pixels that form the blob within the live image view. The highlighted pixels automatically update when you change any relevant parameters.

5. Click **Create** on the **Auto Feature** dialog box to add the blob to the measurement routine.

PC-DMIS currently does not support the **Blob** Auto feature functionality with MultiCapture (for details, see the MultiCapture section in the "Setting up the Live View" vision help topic).

6. Save the measurement routine for future execution. See "A Note on Executing a Vision Measurement Routine".

Returning the Blob's Area with Expressions

If you need to return the theoretical or measured value for a Blob feature, you can use the `.AREA` or `.TAREA` extensions with the Blob's ID. These return the measured area and theoretical area values of the Blob feature respectively. For more information, see the "References of Type Double" topic in the "Using Expressions" chapter in the PC-DMIS Core documentation.

Access to the individual blobs found within the Blob Auto feature is illustrated in the following command examples:

```
Assign / V1 = blb1.Numhits
Assign / V2 = blb1.hit[C].XYZ
Assign / V3 = blb1.hit[C].AREA
```

Returning the Blob's Area with the Location Dimension

From the **Feature Location** dialog box (**Insert | Dimension | Location**), in the **Axes** area, you can mark the **Area** check box to have your report calculate and display a Blob feature's area. It appears as AR in the report and in the Edit window's Command mode. For more information, see the "Dimensioning Location" topic in the "Using Legacy Dimensions" chapter in the PC-DMIS Core documentation.

Box-Selecting to Create Auto Features

You can create multiple Auto features for these supported feature types by box-selecting the desired features in the image within the **Vision** tab:

- Auto Line
- Auto Circle

To do this, follow these steps:

1. Click the desired feature (Circle or Line) from the **Auto Features** toolbar (**View | Toolbars | Auto Features**) to access the corresponding **Auto Feature** dialog box. You can also select the **Insert | Feature | Auto | Line** or **Circle** menu option.
2. Click and drag a box around the desired features in the part image.

Example of box-selected circle features

3. When you release the button, PC-DMIS automatically detects and generates any features for the selected Auto feature type within the drawn box.

A Note on Executing a Vision Measurement Routine

When you execute your measurement routine, there are steps that you can take that may cause a feature to be in tolerance (PASS) or out of tolerance (FAIL). This is done by clicking **Continue** in the **Execution Mode Option** dialog box to PASS the feature or by clicking **Skip** to FAIL the feature.

- If you PASS a feature, the MEAS values for the CENTROID are set to the THEO values.
- If you FAIL a feature, the MEAS values for the CENTROID are set to the THEO values + 100mm in the probe vector direction (usually Z). The feature is shown in the Graphic Display window as floating above the part. However, if looking straight down in the Graphic Display window, the feature appears to be drawn correctly.

So, if you have a dimension on the position of the feature, it is in tolerance or out of tolerance depending on whether you clicked **Continue** or **Skip**.

Modifying a Programmed Feature Using the Auto Feature Dialog Box

To modify a feature command in your measurement routine, follow these steps:

1. Place your cursor on the feature that you want to edit in the Edit window, and press F9 to access its **Auto Feature** dialog box.

2. If you have a DCC machine and have already established and ran your "first alignment" with a real part, you can click the **Move To** button in the **Auto Feature** dialog box to move the Field of View (FOV) to the center of the feature. This button works only on DCC-enabled machines.

> If you have not established the "first alignment" for your measurement routine, do *not* click the **Move To** button. Doing so may cause the stage to run off or damage the part you are measuring. Remember that PC-DMIS first needs to know the location of the part on the stage (its orientation and level) to calculate the target feature location. See "Creating an Alignment".

3. Switch to the **Vision** tab in the Graphic Display window.
4. Ensure that the lamps are properly illuminating the edges of the feature. If you need to make changes, switch to the **Illumination** tab on the **Probe Toolbox** and make the necessary adjustments.
5. Click the **Test** button in the **Auto Feature** dialog box. PC-DMIS Vision inserts a temporary test feature into the Edit window and executes the feature.
6. Examine the detected points in the **Vision** tab. These points indicate the raw hits PC-DMIS uses to fit the geometry. If there are outliers that you want to reject, use the **Hit Targets** tab on the **Probe Toolbox**, and make changes to the **Filter Parameter Set**. If the detected points are not at the location you expect, continue to the next step.
7. Access the Preview window (**View | Other Windows | Preview**) to ensure that the feature was properly measured in this test.
8. If the test data appears to be incorrect, these suggestions may help to fix the problem:

    - If most of the feature appears to be correct but one region is returning incorrect points, insert a new target in that region. Set different parameters

(such as illumination, edge detection, and filters) until that region of the feature also measures correctly.

- Click the **Hit Targets** tab of the **Probe Toolbox** and insert a new target in the target region. See "Probe Toolbox: Hit Targets tab".
- Click the **Hit Targets** tab of the **Probe Toolbox** and adjust the target parameters. See "Probe Toolbox: Hit Targets tab".
- Click the **Illumination** tab of the **Probe Toolbox** and adjust any illumination settings. See "Machine Options: Illumination tab". The software applies the changed illumination settings to any targets currently selected in the **Hit Targets** tab. You may also use the attached pendant to set the luminosity if the machine supports it.

9. Once you have made the suggested changes, test the results of the target by clicking the **Test** button again. When you are satisfied with the target results, continue with the next step.
10. Make adjustments to the options on the dialog box as needed.
11. Click the **OK** button on the **Auto Feature** dialog box to update the feature with the new settings.

The **Auto Feature** dialog box shown above is the expanded version of this dialog box. Click the **<<** button to see the reduced version of the dialog box.

Modifying a feature command in an offline measurement routine is very similar to modifying an online measurement routine. The only difference is that in Offline mode, you don’t have an external pendant. Dragging with the right mouse button in the **CAD** tab simulates the stage motion.

Large Feature Measurement Mode

You can target and measure large features in the CAD View and Live View. The measurement strategy allows "Measure-as-you-go" functionality when programming via the Live View.

Using Large Feature Target Mode

Target mode for large features is available for the CAD View and Live View with the following caveats:

- It is currently only available for Line features
- It is available for Teach Mode only

To use Target mode for large features:

1. Click the **Large Feature Mode** icon located along the bottom of the **Hit Target** tab in the **Probe Toolbox** in the **Auto Feature** dialog box for the **Line** feature.

The **Large Feature Mode** option is only available with the **Automatic Hit Target** type.

When you close PC-DMIS, the state of the button is saved. The next time you start PC-DMIS, the button is in the same state ("On" or "Off") it was in when you last closed PC-DMIS.

2. Click the button to toggle it between the "On" and "Off" states. Each time you toggle the button, a **Warning** dialog box displays.

You can reset warning messages through the **General** tab in the **Setup Options** dialog box. For details, see the "Warnings" topic in the "Setup Options: General tab" chapter in the PC-DMIS Core documentation.

3. Once the Large Feature Mode button is toggled "On", and the feature definition has begun:
    - The **Insert New Hit Target** icon and the right-click menu option are disabled
    - The **Delete Hit Target** icon and the right-click menu are disabled
    - The **Hit Target Test** icon and the right-click menu are disabled
    - The **Target Feature Coverage** icon and the right-click menu are disabled
    - The **Set Target Feature Coverage Active Targets** icon and the right-click menu are disabled

Using Large Feature Mode in the Live View

Once the new measurement strategy is active, you can generate alternate active and void targets with multiple mouse clicks. Alternating active and void targets allows you to focus only on those areas of interest.

For Large Feature mode, you cannot convert between active and void, or between void and active, targets.

Hits may be deleted with the Alt key combination.

The following example shows the results in the Live View of four hits taken defining a **Line** feature that extends over a void area.

Example of alternate active and void target hits in the Live View

The resulting targets are defined in the **Probe Toolbox** of the **Auto Feature** dialog box for your **Line** feature.

Results of hits in the Probe Toolbox

In the image above:

1 - Target is defined from clicks 1 and 2

2 - Target is defined from clicks 2 and 3

3 - Target is defined from clicks 3 and 4

As each active target is generated, automatic execution is performed.

Example showing the results of automatic execution

If the second click that defines the active target is outside the current Field Of View (FOV), a warning message appears and alerts you about machine movement.

Once an active target has been executed, parameters such as **Target Width**, **Edge Type**, **Edge Polarity**, **Focus**, and **Filter** can be edited. If changes are made to any of these parameters, a re-execution of the last active target is triggered.

1. Right-click in the **Vision** tab to display the pop-up menu.

2. Click **Focus**, **Edge Selection**, or **Point Density**, and select the appropriate menu option to edit it as needed. Click **Reset** to remove all the hits and clear all targets.
3. Click and drag any of the handles on the target area boundary box to re-size the target area as necessary.

4. Click in each of the **Edge Polarity** fields to change the settings as necessary.

Changes made to the last Active Target causes the automatic execution to restart.

In the event of an execution error, parameters can be edited to ensure successful measurement. Once the execution error has been cleared, feature and target definitions can continue.

Target and feature generation through double-clicking or box-selecting functionality is still available while in Large Feature mode. If either of these actions are performed, however, a warning message appears.

Using Large Feature Mode in the CAD View

Once the new strategy active, you can generate alternate active and void targets with multiple mouse clicks in the CAD View.

The procedure is the same as the Live View procedure with the following differences:

- Automatic execution is not performed on target generation.
- Because there is no automatic execution, no warning is displayed if generated target is outside the Field Of View (FOV).

The following example shows the results in the CAD View window of four hits taken defining a **Line** feature that extends over a void area.

Example of alternate active and void target hits in the CAD View

A mix of Live View and CAD View clicks is not allowed.

Using AutoTune Execution

You can turn the AutoTune functionality on or off through the `AutoTuneDisable` entry. For details, see the "AutoTuneDisable" topic in the PC-DMIS Settings Editor documentation.

The *button* places your computer into AutoTune execution mode.

To enter AutoTune execution, from the **Edit Window** toolbar or from the **File** menu, select **AutoTune** .

AutoTune execution mode allows you to conveniently teach illumination, magnification, and image processing parameters of your measurement routine commands for the target optical machine.

You should use this mode when you move your measurement routine from one computer to another or when you are ready to execute an offline-prepared measurement routine in an online environment.

If you are running an offline measurement routine in Online mode for the first time, PC-DMIS Vision automatically enters AutoTune execution. It needs to do this because during offline preparation, PC-DMIS uses simulated lighting that may not match the actual lighting behavior on the target machine.

In summary, you may want to execute your measurement routine using AutoTune execution when you have any of the following conditions:

- You move a measurement routine from one machine to another.
- You need to run a measurement routine in Online mode that was prepared in Offline mode.
- You change hardware components that affect the lighting, such as lamps.
- Lighting conditions of the room where you have your optical machine change.
- You want to change the magnification setting for a number of features in one operation rather than individually (feature by feature).

You will find that there are slight differences between different hardware systems and, over time, even within the same hardware system. AutoTune execution addresses these issues.

How AutoTune Execution Works

To enter AutoTune execution, from the **Edit Window** toolbar or from the **File** menu, select **AutoTune** .

> You can elect to have the AutoTune functionality turned on or off through the `AutoTuneDisable` entry. For details, see the "AutoTuneDisable" topic in the PC-DMIS Settings Editor documentation.

When you execute your measurement routine in AutoTune execution mode, PC-DMIS Vision steps you through the measurement routine feature by feature.

It performs a test measurement on each feature and then displays the **AutoTune** dialog box for that feature. The dialog box indicates what has been changed.

You have the option to apply one or more of those changes to one or more subsequent features in the measurement routine.

Once you are satisfied with the feature and click **Continue**, PC-DMIS Vision then tests the next feature. It continues doing this until the entire measurement routine has been executed in AutoTune execution. You can also use the **Apply and Finish** button at any time to apply changes to the selected features and end the AutoTune execution sequence.

Once you finish executing the measurement routine in AutoTune execution, you can return to the PC-DMIS regular execution mode.

Using On Error Commands

On Error commands allow you to specify the actions taken for *focus* or *edge* detection errors. When errors are detected during measurement routine execution, the specified action is performed.

You must have the **Vision** option enabled on your portlock or LMS license for these error types to appear in the dialog box.

To use On Error commands:

1. Open or create a measurement routine.
2. Insert a Manual/DCC mode command and set it to DCC.
3. Select the **Insert | Flow Control Command | On Error** menu item to insert an **On Error** command.

On Error dialog box

4. In the **Error Type** list, select either **Edge not detected** or **Focus not detected**.
5. In the **Error Mode** area, choose the action to perform:
   - **Off** - Do nothing.
   - **GoTo Label** - Change the program flow to a defined label.
   - **Set Variable** - Set a variable's value to one.
   - **Skip Command** - Skip over the current command and move to the next marked command in the measurement routine.

For more information about the **On Error** functionality, see "Branching on an Error" in the "Branching by Using Flow Control" chapter in the PC-DMIS Core documentation.

Using the Image Capture Command

The **Vision | Image Capture** menu item inserts an `IMAGECAPTURE` command into the Edit window. During execution, PC-DMIS moves the vision probe to the specified position. It then uses the past magnification and illumination values and captures an image of the camera's **Vision** tab. It saves this image as a bitmap file to the specified location.

The command in the Edit window has the following syntax:

```
IMAGECAPTURE/<TheoX, TheoY, TheoZ>,n1
ILLUMINATION/Top Lamp [ON:60%] : Bottom Lamp [ON:69%] : Ring Lamp [ON:59%{1110}]
FILENAME=s1
```

TheoX, **TheoY**, **TheoZ** are the X, Y, and Z coordinates to which the machine moves to take the image capture.

n1 is a number value that indicates the desired optical magnification.

The `ILLUMINATION` line of the command block contains read-only illumination information of the lamps at the time the command was inserted. Currently, you cannot modify any of that information directly in the Edit window. You must predefine the Illumination settings in the Probe Toolbox or use manual controls (if available) before you can insert the command.

Specifically, the `ILLUMINATION` line shows whether a lamp is on or off and what the light intensity is for each lamp. Since the ring lamp is made up of four separate lights, the four numbers in parentheses indicate the ON/OFF state for each of those lights. If they have differing levels of intensity, the command only shows the highest value.

s1 is a string value providing the file pathway and name for the captured bitmap image.

A finished command might look something like this:

```
IMAGECAPTURE/<10.825,0.714,-95.008>,1.863
ILLUMINATION/Top Lamp [ON:60%] : Bottom Lamp [ON:69%] : Ring Lamp [ON:59%{1110}]
FILENAME=D:\Images\ImageCapture_4.bmp
```

Currently, this command does not have a dialog box associated with it. You make parameter changes in the Edit window or you can create a new command.

Using a Single uEye Camera to Create Multiple "Virtual" Cameras

PC-DMIS Vision supports IDS uEye cameras. With this type of camera, you can define multiple camera configurations which PC-DMIS then treats as virtual cameras. One possible application of this capability is to create a full field of view (FOV) and a zoomed-in view. This would then emulate a dual camera/dual optics hardware configuration using a single camera and optics hardware structure.

You can specify and use up to nine uEye INI files to create the desired configuration of virtual cameras.

The presence of an underscore followed by a number at the end of the frame grabber configuration file name indicates the use of multiple camera configurations. The number specifies the number of camera configurations, and thus the camera configuration files to use. For example, if you have an INI file name of c:\IDS_2.ini, it causes PC-DMIS to use c:\IDS_1.ini and c:\IDS_2.ini configuration files to create two virtual cameras.

When you define probe tips in PC-DMIS, you can specify which virtual camera to use just like you would specify multiple physical cameras. To do this, select the **Edit** button for the specified tip in the **Probe Utilities** dialog box.

Appendix A: Troubleshooting PC-DMIS Vision

Use this troubleshooting guide to find solutions to your PC-DMIS Vision problems.

Problem: No image in Live View

- Ensure the Frame Grabber drivers have been installed.

Problem: DCC machine does not move

- Check the **Max Speed** setting in the **Motion** tab of the **Machine Interface Setup** dialog box.

Problem: Point Detection takes a long time

When using **Matching Edge** selection type for an Automatic Hit Target, image detection can sometimes take a long time. Try the following to speed up the detection:

- Reduce scan tolerance (width of the target band). With a narrower band, PC-DMIS Vision has fewer "edges" it has to evaluate to find the correct one.
- Change the illumination. You may have a lot of surface texture, which can give the **Matching Edge** algorithm more to do. Make the feature a backlight measured one (as you'd normally do on holes). Switch *off* the top light, and switch *on* the back light.
- Use the **Clean Filter** from the Filter Parameter Set to remove small dirt and weak edges from the image.
- If the previous steps don’t help, use one of the other edge detection methods. **Matching Edge** is the most reliable for finding the correct edge, but it is the most

processor intensive. On this particular edge, try **Specified Edge**, with the direction going from inner to outer.

Problem: Point Detection finds false edge points on parts with strong surface texture

- Use the **Clean Filter** from the Filter Parameter Set to remove small dirt and weak edges from the image.
- Where possible, use bottom light sources with no top light.

Problem: Point Detection finds false edge points on parts with gentle gradient/shadow

- Switch off the **Clean Filter** from the Filter Parameter Set.

Problem: Poor Focus accuracy

- Focus operations (manual and automatic) should always be done at the highest possible magnification.
- Use AUTO control mode where possible. If using FULL control, a slower speed allows for more data collection, which improves the accuracy.
- Set the illumination to provide as much contrast as possible on the surface/edge.

Problem: Poor Manual Focus repeatability

- When moving the stage, aim for a slow and steady speed.
- You can move forwards and backwards over the focus point (to get multiple peaks on your graph) if the focus time allows it. See the "Focus Graph" topic.

Appendix B: Adding a Ring Tool

PC-DMIS Vision supports the use of a ring tool for Probe Offset calibration. The ring tool is used for vision and Multi-sensor machines. For information, see the "Calibrate Probe Offset" topic.

Add Tool dialog box - Ring tool

Specify the following ring tool values:

- **Tool ID**: Provide a descriptive name for the ring tool.
- **Tool Type**: Ring is selected.
- **Shank Vector IJK**: Specifies the vector of the center axis of the ring tool.
- **Search Override IJK**: These boxes allow you to specify a vector used by PC-DMIS to determine the most efficient order to measure all the tips when you select the **User Defined Calibration Order** check box in the **Probe Utilities** dialog box.
- **Diameter**: Provides the diameter of the ring gage hole or bore.
- **Z Point Offset X**: Specifies the X offset of the Z value measurement point from the top center of the bore.

- **Z Point Offset Y**: Specifies the Y offset of the Z value measurement point from the top center of the bore.
- **Z Point Offset Z**: Specifies the Z offset of the Z value measurement point from the top center of the bore.
- **Datum Depth Start**: Specifies the minimum depth into the bore where the bore cylinder is the datum.
- **Datum Depth End**: Specifies the maximum depth into the bore where the bore cylinder is the datum.
- **Focus Offset**: Provides distance in Z from the top surface to the bore circle focus height.

Glossary

C

CCD: Charge Coupled Device - This device is one of the two main types of image sensors used in digital cameras.

CMMI: Standard CMM Interface, such as a LEITZ.DLL

CWS: Chromatic White Light Sensor

F

Fiducials: A point of reference. For example, in the case of a CAD file of a circuit board, these fiducials reference the location of soldering. These references may not exist in the CAD file.

Field of View: The FOV represents the view through the video camera. In the Live View, the FOV is everything you see. In the CAD View, PC-DMIS Vision represents the FOV by a green rectangle that appears on top of the graphical image.

FLS: Focus Laser Sensor

FOV: Field of View

H

HSI: Hardware Specific Interface

I

Image Tear: This is where "breaks" in the image occur due to the refresh rate not keeping up with the speed of movement.

Intensity Circle: The circle that is located in the middle of the Top light, Bottom light, or segment of a ring light that shows the current intensity value for that light.

M

MSI: Multi Sensor Interface

N

NA: Numerical Aperture (NA) is a measure the light-gathering ability of a vision device. NA is a measure of the number of highly diffracted image-forming light rays captured by the objective. Higher values of numerical aperture allow increasingly

oblique rays to enter the objective front lens, producing a more highly resolved image.

O

OPTIV LTS: Triangulation Laser Sensor

P

Parcentricity: This is when the Focal XY Center of the optics is aligned with the Video Frame center through the zoom range.

Parfocality: When the focal clarity is consistent through the zoom range.

Q

Quality Tag: A value assigned to each point from the Vision controller.

R

Ra: This is one of the most effective surface roughness measures commonly adopted in general engineering practice. It gives a good general description of the height variations in the surface. The units of Ra are micrometers or microinches.

ROI: Region of Interest - Targets are divided into multiple regions based upon the Field of View. Point detection will be determined for each ROI

T

Target: Individual regions that are used for point detection for the specified feature.

Tracker: The visual user interface to features that controls the size of the circle, start angle, end angle, and orientation.

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