Mitutoyo

Line Laser Sensor
SurfaceMeasure

SurfaceMeasure1008S

Measurement tool
Technical manual
- Instruction Manual -

Read this document thoroughly before operating the product. After reading, retain it close at hand for future reference.
This English language version of the document contains the original instructions.

No. A61F22-502C
Date of publication: June 30, 2022 (1)

■ Product names and model numbers covered in this document

Product name	Model number
Line Laser Sensor SurfaceMeasure	SurfaceMeasure1008S

■ Notice regarding this document

- Mitutoyo Corporation assumes no responsibilities for any damage to the product, caused by its use not conforming to the procedure described in this document.
- Upon loan or transfer of this product, be sure to attach this document to the product.
- In the event of loss or damage to this document, immediately contact your dealer or the nearest Mitutoyo sales office.
- Fully understand the descriptions of "Safety Precautions" mentioned below before using this product.
- The contents in this document are based on the information disclosed as of June, 2022.
- No part or whole of this document may be transmitted or reproduced by any means without prior written permission of Mitutoyo Corporation.
- Some screen displays in this document may be highlighted, simplified or partially omitted for convenience of explanation. In addition, some of them may differ from actual ones to the extent that no user will misunderstand the functions and operations.
- The corporation, organization and product names that appear in this document are their trademarks or registered trademarks.

■ Copyright

About This Document

■ Positioning of this document in document map

This section describes the positioning of this document and its relationship with other manuals.

- Hardware and Software manuals

Line Laser Sensor SurfaceMeasure SurfaceMeasure1008S User's Manual	Provides precautions for use, operations and functions of SurfaceMeasure1008S.
Line Laser Sensor SurfaceMeasure SurfaceMeasure1008S 1 Sheet Guide	A quick guide for using the SurfaceMeasrue1008S.
Line Laser Sensor SurfaceMeasure SurfaceMeasure1008S Measurement tool Technical Manual	Provides technical descriptions and algorithms of SurfaceMeasure1008S.

- Others

Line Laser Sensor SurfaceMeasure SurfaceMeasure1008S Grounding Guide	Provides guides for reducing the effects of potential differences and noise.

■ Intended readers and purpose of this document

- Intended readers

  This is intended for those who use this product, and those who build inspection and evaluation systems, and perform various kinds of non-contact form measuring.

- Purpose

  The purpose of this document is to help you to understand the functional outline of the product, functions of each part, how to use it and maintenance details.

CONTENTS

Product names and model numbers covered in this document ····· i
Notice regarding this document ····· i
Copyright····· i
About This Document ·····ii
Positioning of this document in document map·····ii
CONTENTS·····iii

1 Overview 1
2 Built-in Measurement Tools 3
2.1 Profile Tools..... 3
2.2 Surface Tools 21
2.3 Common Parameters..... 30
3 Software Licenses..... 37

SERVICE NETWORK·····App-1

1 Overview

Several of SurfaceMeasure1008S's measurement tools use complex algorithms to find features and then return measurements and decisions. This document describes the algorithms used by the following profile tools:

- Panel
- Groove
- Strip

This document also describes the algorithms used by the following surface tools.

- Hole
- Stud
- Opening

Memo

2 Built-in Measurement Tools

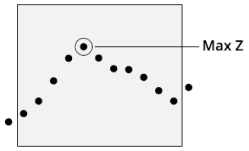
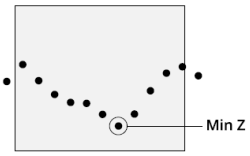
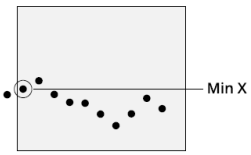
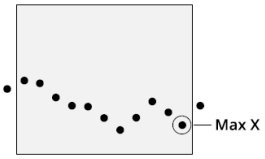
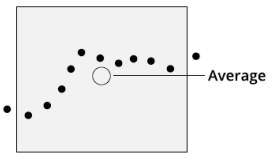
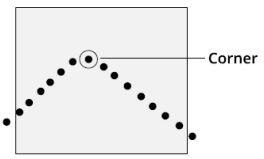
The following sections describe the algorithms and parameters used by some of SurfaceMeasure1008S's profile and surface measurement tools.

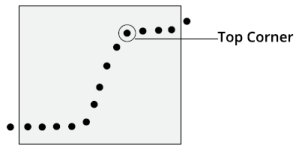
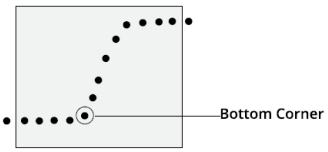
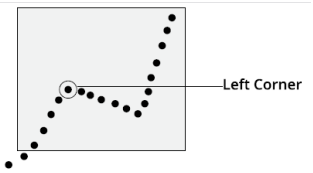
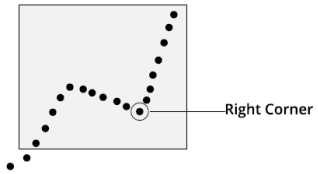
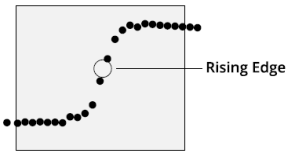
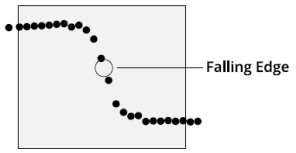
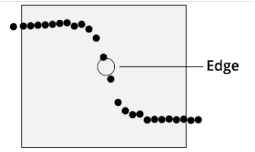
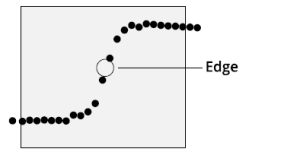
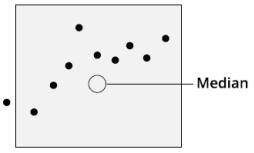
2.1 Profile Tools

■ Feature Points

Dimensional and positional measurements detect feature points found within the defined measurement region and then compare measurement values taken at the selected point with minimum and maximum thresholds to produce a decision. Feature points are selected in one or more Feature dropdowns in a tool and are used for all of the tool's measurements.

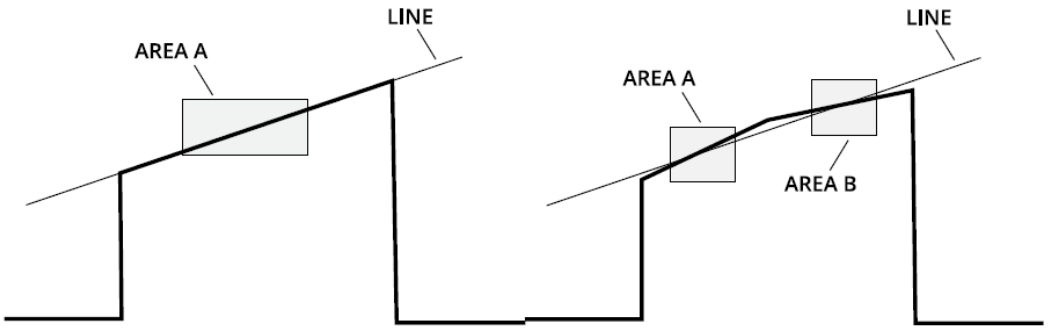
The following types of points can be identified in a measurement region.

Point Type	Examples
Max Z Finds the point with the maximum Z value in the region of interest.	
Min Z Finds the point with the minimum Z value in the region of interest.	
Min X Finds the point with the minimum X value in the region of interest.	
Max X Finds the point with the maximum X value in the region of interest.	
Average Determines the average location of points in the region of interest.	
Corner Finds a dominant corner in the region of interest, where corner is defined as a change in profile slope.	

Point Type	Examples
Top Corner Finds the top-most corner in the region of interest, where corner is defined as a change in profile shape.	
Bottom Corner Finds the bottom-most corner in the region of interest, where corner is defined as a change in profile shape.	
Left Corner Finds the left-most corner in the region of interest, where corner is defined as a change in profile shape.	
Right Corner Finds the right-most corner in the region of interest, where corner is defined as a change in profile shape.	
Rising Edge Finds a rising edge in the region of interest (moving from left to right).	
Falling Edge Finds a falling edge in the region of interest (moving from left to right).	
Any Edge Finds a rising or falling edge in the region of interest.	 
Median Determines the median location of points in the region of interest.	

■ Fit Lines

Some measurements involve estimating lines in order to measure angles or intersection points. A fit line can be calculated using data from either one or two fit areas.

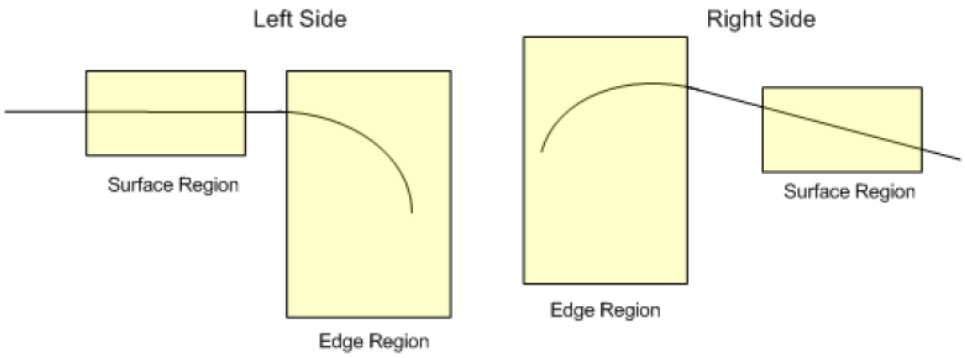


A line can be defined using one or two areas. Two areas can be used to bypass discontinuity in a line segment.

■ Panel (Gap and Flush) and Round Corner Algorithm

The Panel measurement tool uses the same algorithm to find a feature using either the Gap or the Flush measurement. The Round Corner tool uses the same algorithm, but applies it only to the left or the right; you must choose the side in the tool.

This algorithm first searches for two regions on a side: a surface region and an edge region. (See the tables below for the parameters used by the algorithm.)

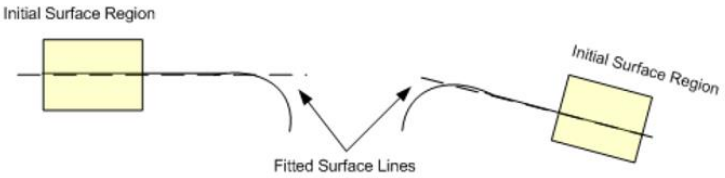


After the algorithm finds the regions, it places a feature point on the surface region based on a set of parameters. You can control the measurement regions, which contain the surface and the edge regions, for the left and the right side. A measurement region also defines the region in which the measurement tool will search for the feature points. Feature points are located on a side using the following algorithm.

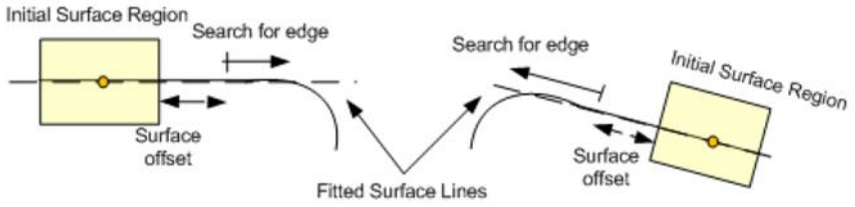
●Algorithm details

1. On the left side, search from left to right to find a surface region with data that covers at least the value specified in the Surface Width setting. For the right side, do the same, searching from right to left.

2. If a surface region is found, fit a line, called the surface line, using the data within the area.

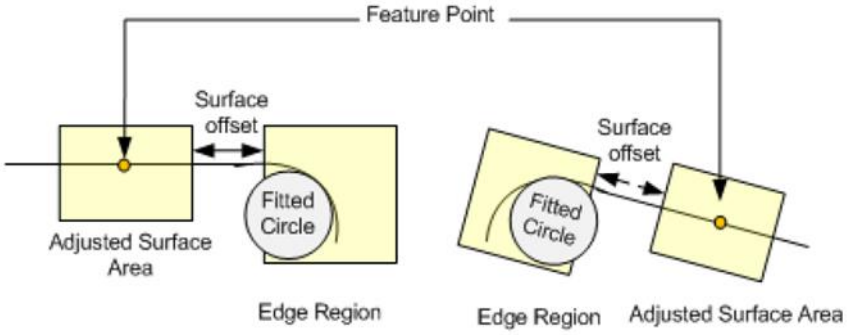


3. Search for a valid edge region that is located at least the distance specified in the Surface Offset setting from the end of the surface region. If a surface region is not found, move along the search direction and repeat step 1.



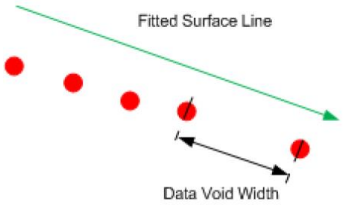
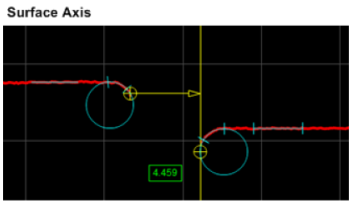
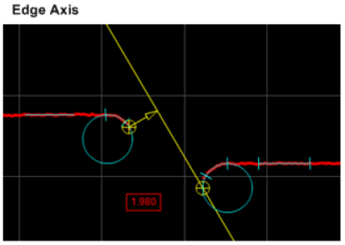
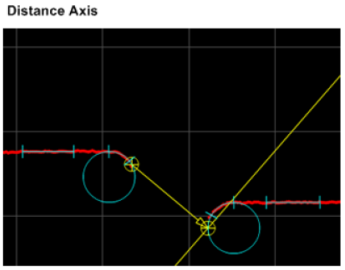
A valid edge region is detected when an edge matches the value in the Nominal Radius setting or when the depth exceeds the value in the Min Depth setting. The search algorithm uses the Max Void Width setting to distinguish between an actual edge and an area of missing data.

4. If a valid edge region is detected, a model fit is applied to the surface and edge regions to accurately determine the region positions and feature point locations. The model fit takes into account the Surface Width, Surface Offset, Edge Angle and the Edge Type parameters.

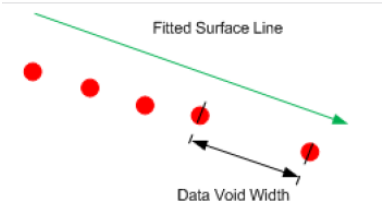
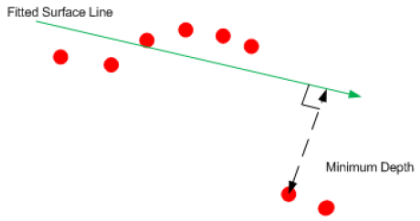
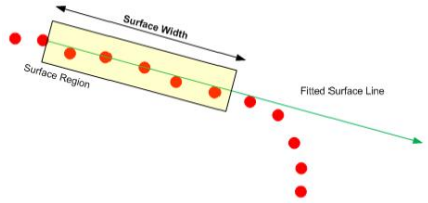
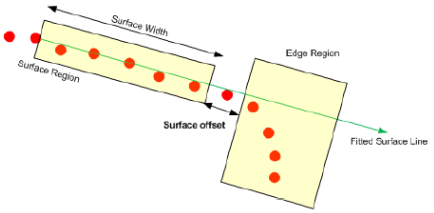
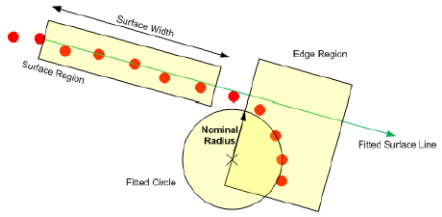


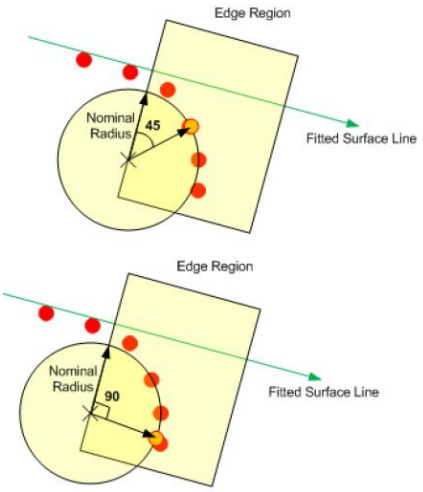
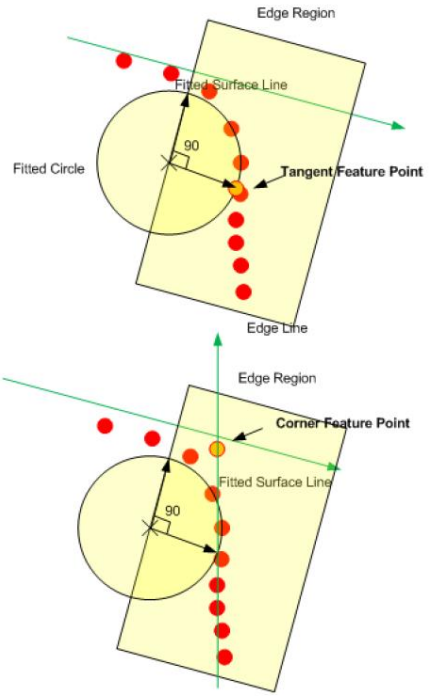
Parameters

Parameter	**Description**	**Illustration**
Source	The sensor, or combination of sensors, that provides data for the tool's measurements.	
Stream	The section profile data that the tool will apply measurements to. This setting is only displayed in Surface mode when a section is defined on the surface data.	
Reference SideDirection	Defines the side used to calculate the measurement axis (see below) rounded corner.	

Parameter	Description	Illustration
Max Gap Width	The maximum width of the gap. Allows the tool to filter gaps greater than the expected width. This can be used to single out the correct gap when there are multiple gaps in the field of view.	
Measurement Axis Panel Gap measurement only	Defines the direction that the gap is calculated, in relation to the reference side (see above). **Surface**: In the direction of the fitted surface line of the reference surface. **Edge**: In the direction perpendicular to the edge of the reference surface. **Distance**: The Cartesian distance between the two feature locations.	  
Absolute Panel Flush measurement only	When enabled, returns an absolute value rather than a signed value.	
Filters	The filters that are applied to measurement values before they are output. For more information, see Filters on page 31.	
Decision	The Max and Min settings define the range that determines whether the measurement tool sends a pass or fail decision to the output. For more information, see Decisions on page 30.	

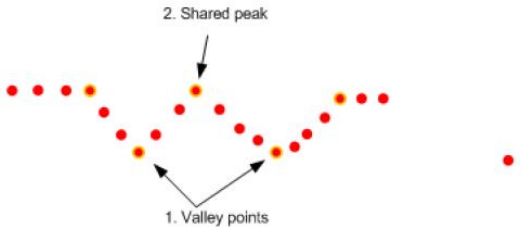
Left/Right SideEdge Parameters

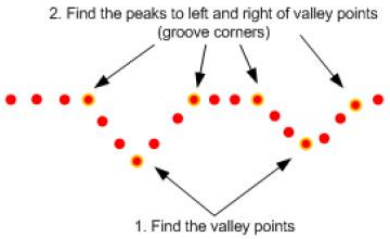
Parameter	Description	Illustration
Max Void Width	The maximum allowed width of missing data caused by occlusion or data dropout. A larger value prevents the algorithm from registering a section of missing data as an edge. Setting the value to 0 causes the algorithm to try to detect an edge in every missing data section.	
Min Depth	Defines the minimum depth before an opening could be considered to have a potential edge. The depth is the perpendicular distance from the fitted surface line.	
Surface Width	The width of the surface area in which laser data is used to form the fitted surface line. This value should be as large as the surface allows.	
Surface Offset	The distance between the edge region and the surface region. Setting a small value allows the edge within a tighter region to be detected. However, the measurement repeatability could be affected if the data from the edge are considered as part of the surface region (or vice versa). A rule of thumb is to set **Surface Offset** equal to **Nominal Radius**.	
Nominal Radius	The radius of the curve edge that the tool uses to locate the edge region. The algorithm searches for a start position in which the remaining data most resemble a circle of the specified nominal radius.	

Parameter	Description	Illustration
Edge Angle	A point on the best fit circle to be used to calculate the feature point. The selected point is on the circumference at the specified angle from the start of the edge region. The angle is measured from the axis perpendicular to the fitted surface line.	
Edge Type	Defines the type of feature point to use for the edge (Corner or Tangent). A tangent edge point is the point selected based on the defined Edge Angle. A corner edge point is the intersect point between the fitted surface line and a edge line formed by interpolating the points at and after the tangent within the edge region.	
Region	The region to which the tool's measurements will apply. For more information, see Regions on page 33.	

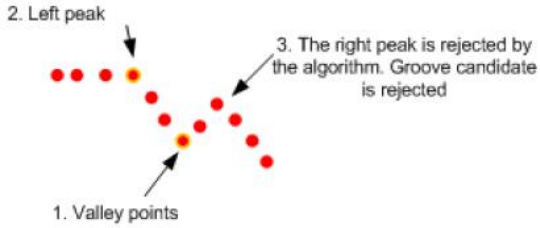
■ Groove Algorithm

The Groove measurement tool first locates valley along the profile line. The bottom point of a valley, the valley point, is the first estimation of the position of the groove bottom. For each valley, the algorithm searches for corner to the left and to the right to find the groove corners. A groove candidate is found when the groove corners are located on the left and right before the next valley is reached. Two groove candidates may share the same corner as shown in the right image below. (See the tables below for the parameters used by the algorithm.)

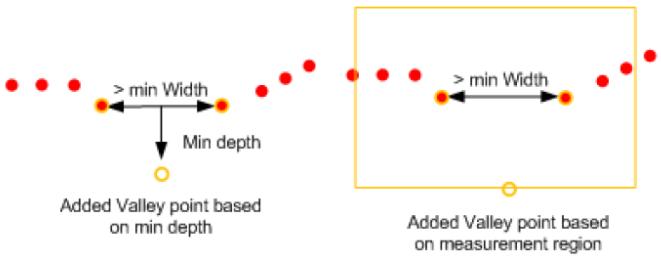




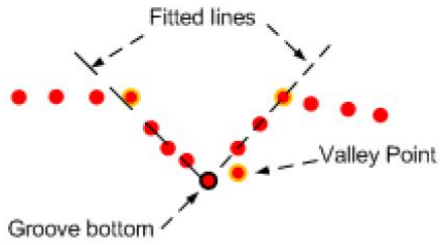
The algorithm derives search parameters from the user settings to prevent noise from triggering false detections. When detecting multiple grooves, an adaptive algorithm is used to ensure that candidate grooves are approximately the same scale.



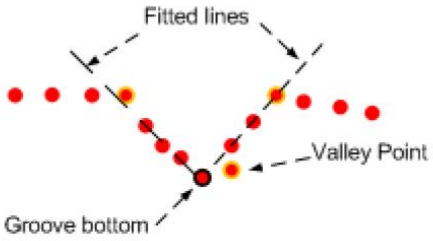
The valley points of open grooves may not be visible or may fall outside of the measurement region. Voids in the data (regions with no profile data) between pairs of valid points are detected. A valley point is added midway between the pair of valid points. The Z position of the valley point is either the minimum groove depth below the lower of the corners or the bottom edge of the measurement region.
The algorithm then proceeds as if to find a U-shaped groove.



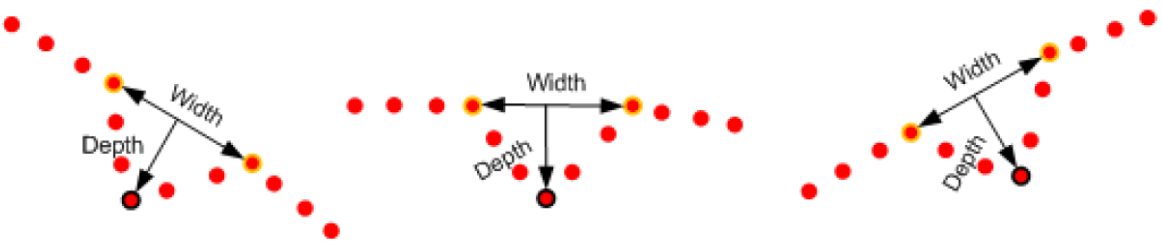
The actual groove bottom is calculated differently for different shapes. For a V-shaped groove, a line is fitted to the sides of the valley points starting from the corners, up to (but not including) the valley point. The groove bottom is the intersection of the left and right lines. Line fitting is used such that an accurate groove bottom can be found even when the real bottom is not visible (i.e., blocked by reflections).



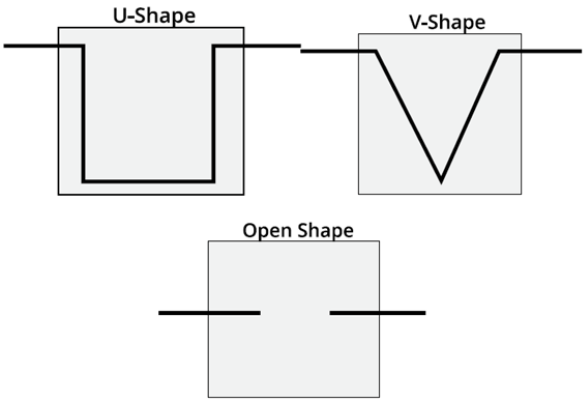
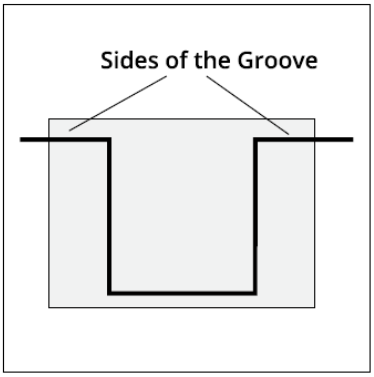
For U-shaped and open groove, the distance from each point within the groove (including the added point for open-shaped groove) is projected onto the width line. The groove bottom's X is at the centroid of the projected values along the width. The groove bottom's Z is at the maximum depth of the groove.



Groove candidates that do not meet the minimum and maximum width and depth settings are rejected. The width and depth measurements are invariant to the groove rotation. The width is the distance between the groove corners and the depth is perpendicular distance of the groove bottom from the groove width.



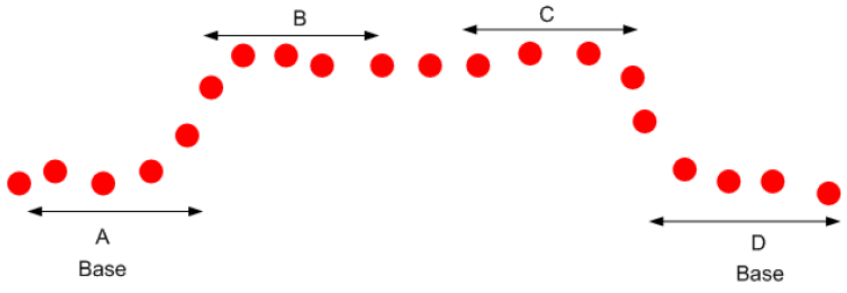
Parameters

Parameter	Description
Source	The sensor, or combination of sensors, that provides data for the tool's measurements.
Stream	The section profile data that the tool will apply measurements to. This setting is only displayed in Surface mode when a section is defined on the surface data.
Shape	Shape of the groove 
Min Depth	Minimum depth for a groove to be considered valid.
Min Width	Minimum width for a groove to be considered valid. The width is the distance between the groove corners.
Max Width	Maximum width of a groove to be considered valid. If set to 0, the maximum is set to the width of the measurement area.
Region	The measurement region defines the region in which to search for the groove. For a stable measurement, the measurement region should be made large enough to cover some laser data on the left and right sides of the groove.  For more information on regions, see Regions on page 33.

Parameter	Description
Location (Groove X and Groove Z measurements only)	Specifies the location type to return Bottom - Groove bottom. For a U-shape and open-shape groove, the X position is at the centroid of the groove. For a V-shape groove, the X position is at the intersection of lines fitted to the left and right sides of the groove. See algorithm section below for more details. Left - Groove's left corner. Right - Groove's right corner.
Select Type	Specifies how a groove is selected when there are multiple grooves within the measurement area. Maximum Depth - Groove with maximum depth. Index from The Left - 0-based groove index, counting from left to right Index from the Right - 0-based groove index, counting from right to left.
Index	0-based groove index.
Filters	The filters that are applied to measurement values before they are output. For more information, see Filters on page 31.
Decision	The **Max** and **Min** settings define the range that determines whether the measurement tool sends a pass or fail decision to the output. For more information, see Decisions on page 30.

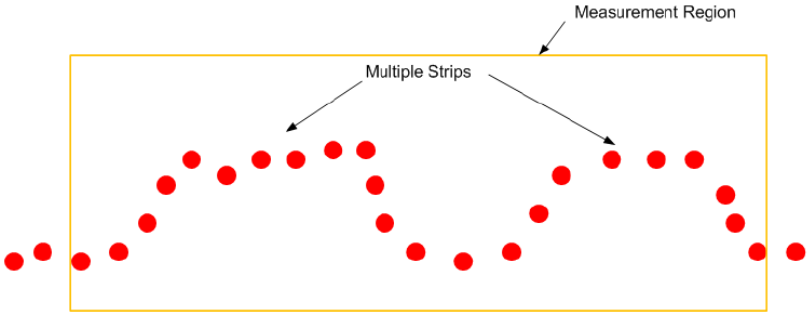
■ Strip Algorithm

A strip is a flat region bounded on the left and on the right by edges. The Strip tool can measure the edge positions, width, and height of a strip. The Strip tool assumes that regions outside the strip, referred to as the base regions (Region A and D below), deviate in height from the start and end parts of a strip (Region B and C). (See the tables below for the parameters used by the algorithm.)

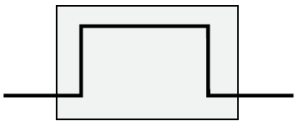
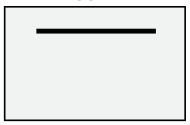


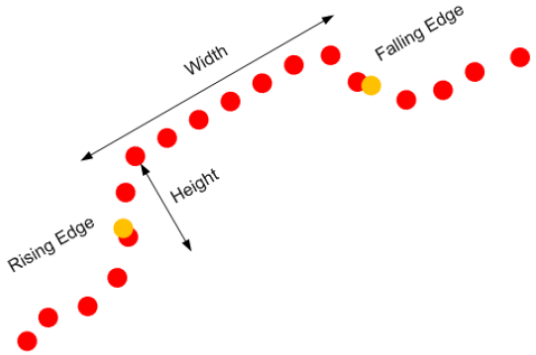
When the target is sitting on the surface, the base is lower than the strip (as shown above). Alternatively for a groove the base is above the strip surface. The base could be missing when the target is hanging in the air or the surface holding the target falls outside the sensor's active area. You can control the base type in the measurement panel.

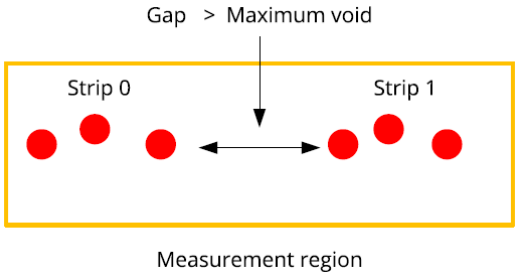
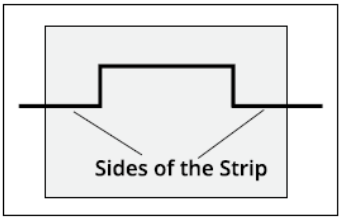
The Strip tool can detect multiple strips. You can select a region of interest, referred to as the measurement region, from which the algorithm search for multiple strips.



Parameters

Parameter	**Description**
Source	The sensor, or combination of sensors, that provides data for the tool's measurements.
Stream	The section profile data that the tool will apply measurements to. This setting is only displayed in Surface mode when a section is defined on the surface data.
Base Type	Affects detection of rising and falling edges. Base Type = Flat  Base Type = None  When **Base Type** is set to **Flat**, both strip (raised area) and base support regions are needed. When set to **None**, only a point that deviates from a smooth strip support region is needed to find a rising or falling edge.

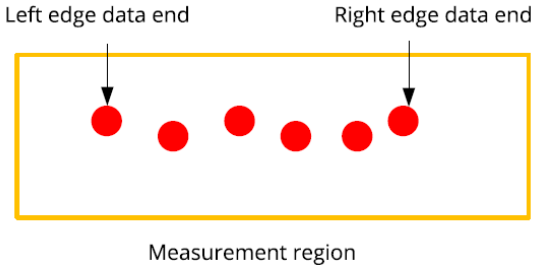
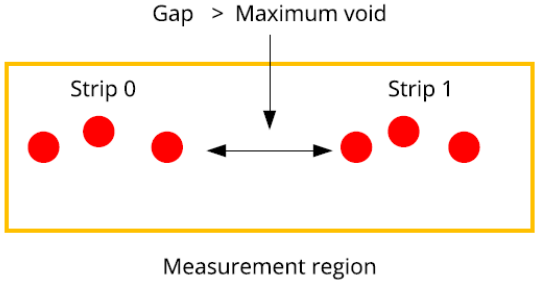
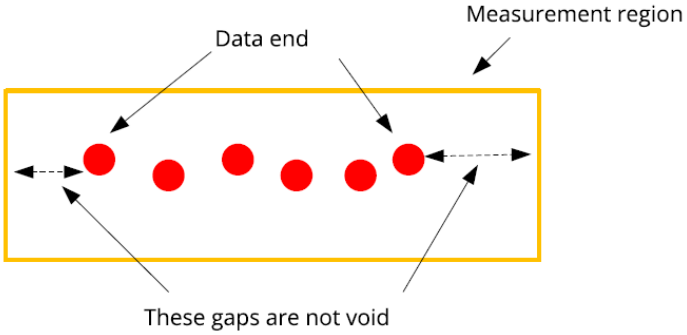
Parameter	Description
Left Edge Right Edge	Specifies the features that will be considered as the strip's left and right edges. You can select more than one condition. **Rising** - Rising edge detected based on the strip edge parameters. **Falling** - Falling edge detected based on the strip edge parameters. **Data end** - First valid profile data point in the measurement region. **Void** - Gap in the data that is larger than the maximum void threshold. Gaps connected to the measurement region's boundary are not considered as a void. See "Strip Start and Terminate Conditions" in this Measurement Tool Technical Manual for the definitions of these conditions.
Tilt Enabled	Enables/disables tilt correction. The strip may be tilted with respect to the sensor's coordinate X axis. This can be caused by conveyor vibration. If the Tilt option is enabled, the tool will report the width and height measurements following the tilt angle of the strip. 
Support Width	Specifies the width of the region around the edges from which the data is used to calculate the step change. See "Strip Step Edge Definitions" in this Measurement Tool Technical Manual on how this parameter is used by different base types.
Transition Width	Specifies the nominal width needed to make the transition from the base to the strip. See "Strip Step Edge Definitions" in this Measurement Tool Technical Manual on how this parameter is used by different base types.
Min Width	Specifies the minimum width for a strip to be considered valid.
Min Height	Specifies the minimum deviation from the strip base. See "Strip Step Edge Definitions" in this Measurement Tool Technical Manual on how this parameter is used for different base types.

Parameter	Description
Max Void Width	The maximum width of missing data allowed for the data to be considered as part of a strip when **Void** is selected in the **Left** or **Right** parameter. This value must be smaller than the edge **Support Width**.  When occlusion and exposure causes data drops, users should use the gap filling function to fill the gaps.
Region	The measurement region defines the region in which to search for the strip. If possible, the region should be made large enough to cover the base on the left and right sides of the strip.  For more information, see Regions on page 33.
Location (Strip Height, Strip X, and Strip Z measurements only)	Specifies the strip position from which the measurements are performed. **Left** - Left edge of the strip. **Right** - Right edge of the strip. **Center** - Center of the strip.
Select Type	Specifies how a strip is selected when there are multiple strips within the measurement area. **Best** - The widest strip. **Index Left** - 0-based strip index, counting from left to right. **Index Right** - 0-based strip index, counting from right to left.
Index	0-based strip index.
Filters	The filters that are applied to measurement values before they are output. For more information, see Filters on page 31.
Decision	The **Max** and **Min** settings define the range that determines whether the measurement tool sends a pass or fail decision to the output. For more information, see Decisions on page 30.

- **Strip Start and Terminate Conditions**

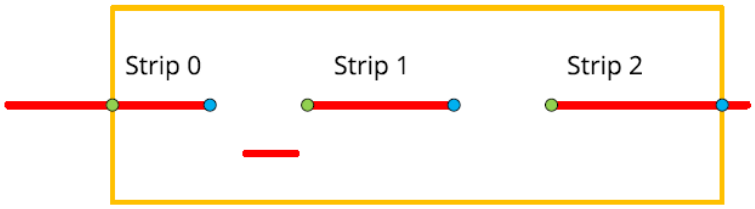
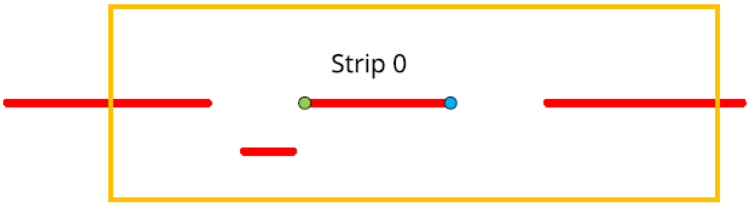
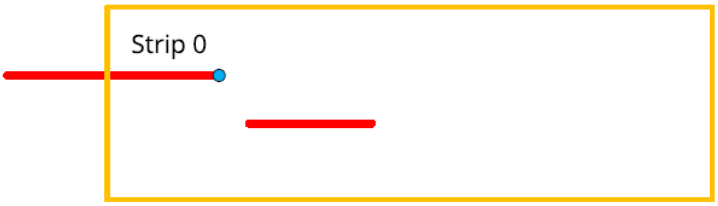
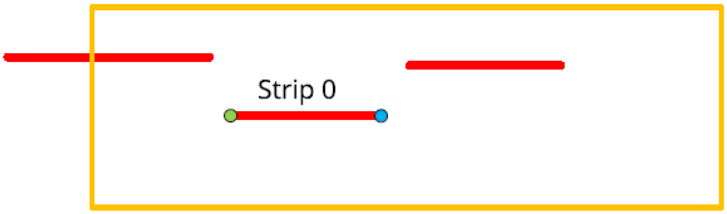
  The Strip tool allows you to define how a strip starts and ends. The Left Edge parameter controls how a strip starts and the Right Edge parameter controls how a strip ends.

Start / terminate conditions

Condition	Description
Rising	Rising step edge detected based on the strip edge parameters. See Strip Step Edge Definitions on the next page for details on how the step edge is detected.
Falling	Falling step edge detected based on the strip edge parameters. See Strip Step Edge Definitions on the next page for details on how the step edge is measured.
Data end	The first (for the left edge) or the last (for the right edge) valid profile data point in the measurement region. 
Void	Gaps in the data that are larger than the maximum void threshold.  Gaps at the ends of the measurement region's boundary are not considered as a void. 

The following examples show how the parameters affect the strip detection in different scenarios.

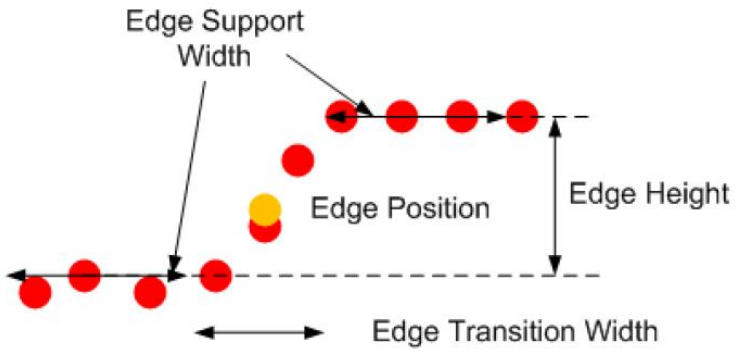
Left and Right Edge conditions

Condition	Example
Left: Rising, data end, void Right: Falling, data end, void	
Left: Rising, void Right: Falling, void	
Left: Rising Right: Data end, void	
Left: Data end, void Right: Falling	
Left: Falling Right: Rising	

- **Strip Step Edge Definitions**

  The Strip tool detects step edges based on the parameters Base Type, Edge Transition Width, Edge Support Width, and Minimum Edge Height.

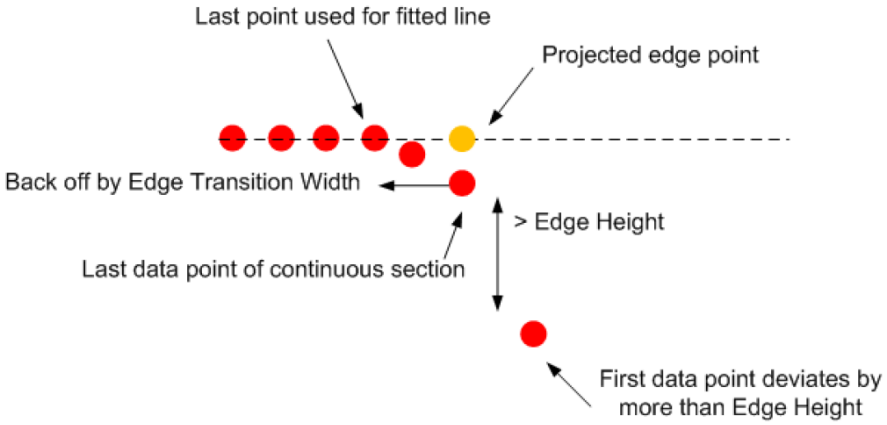
  When Base Type is set to Flat, the regions around the edges are visible and the edge positions are between the base and the strip surface.



The Minimum Edge Height parameter defines the size of the step edge. The Edge Transition Width parameter specifies the nominal width of the transition, from the base to the strip surface.

The Edge Support Width parameter defines the width of the region around the edges from which the data is used to measure the step change. To improve noise immunity, the height level of the Edge Support Width parameter is calculated by averaging the data within the region.

When the base is set to None, the tool looks for continuous sections that are wider than the Edge Support Width parameter and have no data points that deviate positively or negatively more than the value of the Minimum Edge Height parameter. The data in the strip support region (the raised area) must be smooth. The height level of the continuous region is calculated based on the fitted line as shown below.



The algorithm then backs off by the value of the Edge Transition Width parameter and uses the data up to the back-off point to create the fitted line and projects the edge point on the line. This step prevents the points near the end of a rounded strip from affecting the height of the strip.

2.2 Surface Tools

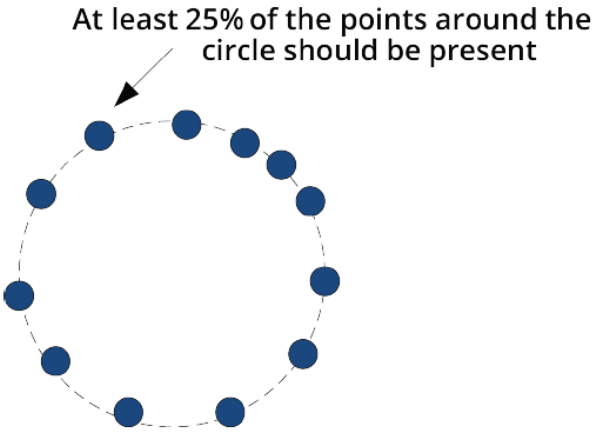
■ Hole Algorithm

The Hole tool processes the data in three phases: Search, Measure, and Filter. The algorithm can separate out background information that appears inside the hole. It can also detect holes that only partially appear in the data.

See the tables below for the parameters used by the algorithm.

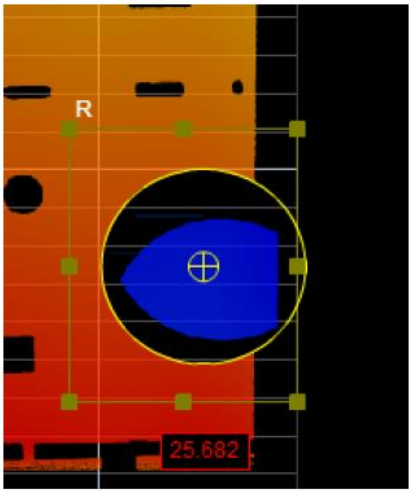
Search phase - The tool searches for coarse data transitions (edge data) and performs a coarse fitting of the hole model (specified by the orientation angles and the nominal value) to determine the most likely candidate. If Tilt Correction is set to Autoset, the algorithm uses the data within the measurement region to estimate the orientation of the part.

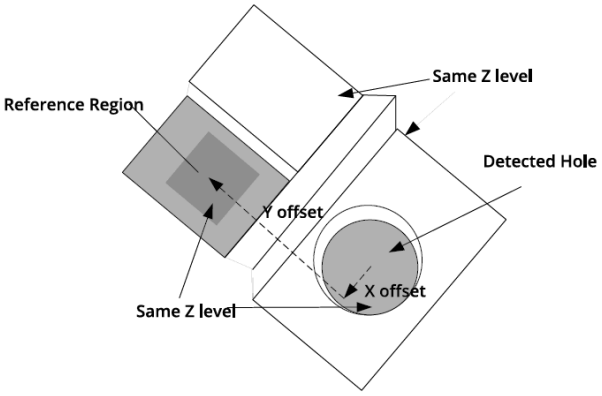
Measure phase - A more rigorous edge detection algorithm is applied to precisely determine the edges around the feature. Edge detection at this stage will reject outliers and noise. The algorithm requires at least 25% of the data around the hole for the candidate to remain valid.
The accuracy of the algorithm improves when the points are spread more evenly along the hole's circumference.
The set of refined edges is then used to locate and inspect the feature. If the Reference Regions option is enabled and set to AutoSet, the edges are also used to calculate the location of the reference regions.



Filter phase - The detected location and dimensions are then compared to the nominal and tolerance settings. If the refined feature falls within the measurement region and its measurements fit within the specified tolerance, the results are reported. If not, an invalid result is returned.

Parameters

Parameter	Description
Source	The sensor, or combination of sensors, that provides data for the tool's measurements.
Nominal Radius	Expected radius of the hole.
Radius Tolerance	The maximum variation from the nominal radius (+/- from the nominal radius).
Partial Detection	Enable if only part of the hole is within the measurement region. If disabled, the hole must be completely in the region of interest for results to be valid. 
Depth Limit	Data below this limit (relative to the surface) is excluded from the hole opening calculations.
Region	The region to which the tool's measurements will apply. For more information, see Regions on page 33.

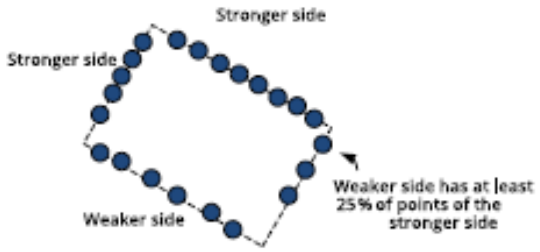
Parameter	Description
Reference Region	The tool uses the reference regions to calculate the Z position of the hole. It is typically used in cases where the surface around the hole is not flat.  When this option is set to **Autoset**, the algorithm automatically determines the reference region. When the option is not set to **Autoset**, you must manually specify one or two reference regions. The location of the reference region is relative to the detected center of the hole and positioned on the nominal surface plane. When **Reference Region** is disabled, the tool measures the hole's Z position using all the data in the measurement region, except for a bounding rectangular region around the hole.
Tilt Correction	Tilt of the target with respect to the alignment plane. **Autoset**: The tool automatically detects the tilt. The measurement region to cover more areas on the surface plane than other planes. **Custom**: You must enter the X and Y angles manually in the X Angle and Y Angle parameters (see below).
X Angle Y Angle	The X and Y angles you must specify when **Tilt Correction** is set to **Custom**. You can use the Surface Plane tool's X Angle and Y Angle measurements to get the angle of the surrounding surface, and then copy those measurement's values to the **X Angle** and **Y Angle** parameters of this tool.
Filters	The filters that are applied to measurement values before they are output. For more information, see Filters on page 31.
Decision	The Max and Min settings define the range that determines whether the measurement tool sends a pass or fail decision to the output. For more information, see Decisions on page 30.

■ Opening Algorithm

The Opening tool processes the data in three phases: Search, Measure, and Filter. See the tables below for the parameters used by the algorithm.

Search phase - The tool searches for coarse data transitions (edge data) and performs a coarse fitting of the opening shape (specified by the orientation angles and the nominal dimensions) to determine the most likely candidate. If **Tilt Correction** is enabled, the algorithm uses the flat surface in the measurement region to estimate the orientation of the part.

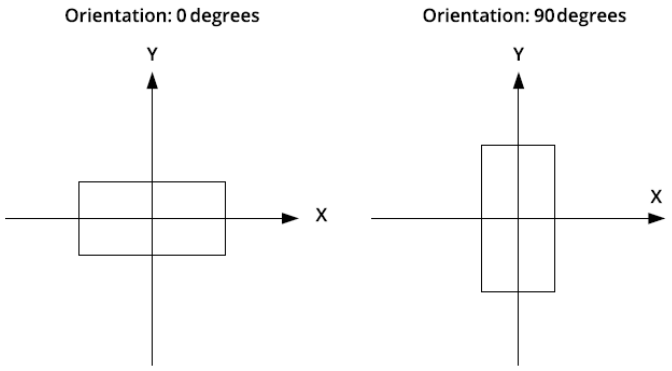
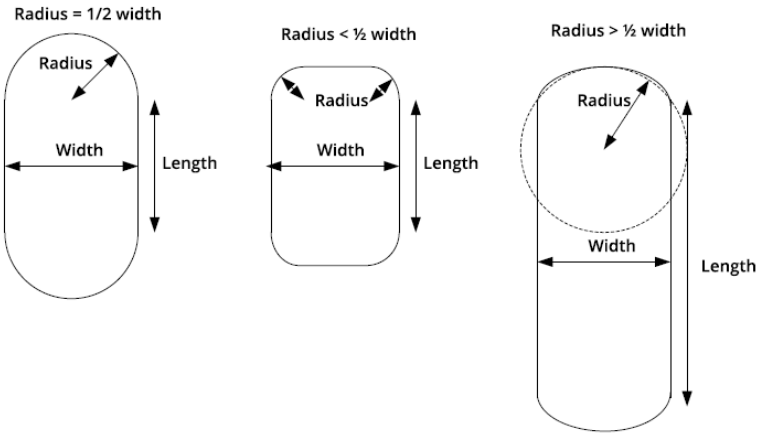
Measure phase - A more rigorous edge detection algorithm is applied to precisely determine the edges around the feature. Edge detection at this stage will reject outliers and noise. The algorithm requires opposite sides and ends to be associated with a comparable number of edge pixels, with the weaker side or end having at least 25% of the stronger.
The set of refined edges is then used to locate and inspect the feature. If the **Reference Regions** setting is enabled, the edges are also used to calculate the location of the reference regions.

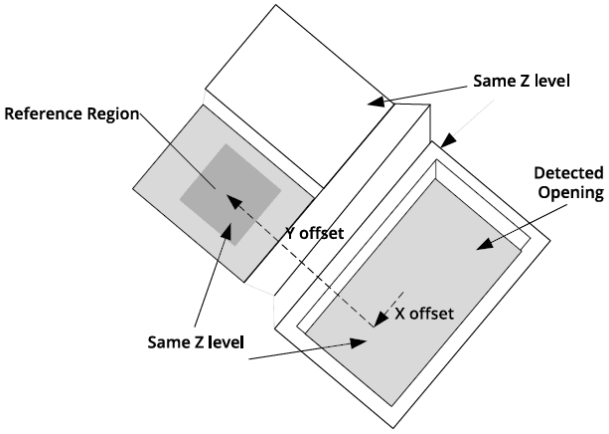
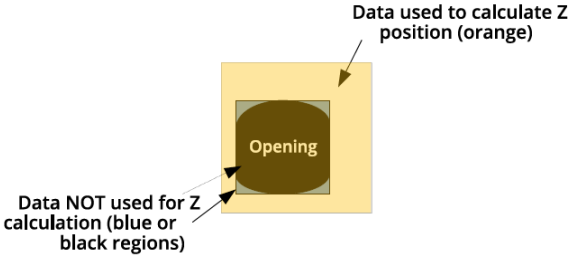


Filter phase - The detected location and dimensions are compared to the nominal and tolerance settings. If the refined feature falls within the measurement region and its measurements fit within the specified tolerance, the results are reported. If not, an invalid result is returned.

Parameters

Parameter	**Description**
Source	The sensor, or combination of sensors, that provides data for the tool's measurements.
Type	Rounded Slot, Rectangle.
Nominal Width	Nominal width of the opening.
Nominal Length	Nominal length of the opening.

Parameter	Description
Nominal Angle	Nominal angle of the opening. The default orientation is the length of the opening along the X axis.  The diagram above illustrates the case where the surface is not tilted. When the surface is tilted, the orientation is defined with respect to the normal of the surface, not with respect to the X-Y plane
Nominal Radius	Nominal radius of the opening ends. If the opening type is set to rectangular, the radius setting is disabled. The opening has an oval shape if the radius is equal to ½ of the width. The opening is a rounded rectangle when the radius is less than ½ of the width. 
Width Tolerance	The maximum variation from the nominal width (+/- from the nominal value).
Length Tolerance	The maximum variation from the nominal length (+/- from the nominal value).
Angle Tolerance	The maximum variation from the nominal orientation (+/- from the nominal value).

Parameter	Description
Partial Detection	Enable if only part of the opening is within the measurement region. If disabled, the opening must be completely in the region of interest for results to be valid.
Depth Limit	Data below this limit (relative to the surface) is excluded from the hole opening calculations.
Region	The region to which the tool's measurements will apply. For more information, see Regions on page 31.
Reference Regions	The tool uses the reference regions to calculate the Z position of the hole opening. Reference regions are relative to the center location of the feature. This option is typically used in cases where the surface around the opening is not flat.  When the Reference Regions setting is disabled, the tool measures the hole's opening's Z position using the all data in the measurement region, except for a bounding rectangular region around the opening.  With one or more reference regions, the algorithm calculates the Z positions as the averagevalues of the data within the regions. When you place the reference region manually, all of the data is used, whether the data is inside or outside the opening. You should place the reference region carefully.

Parameter	Description
Tilt Correction	Tilt of the target with respect to the alignment plane. **Autoset**: The tool automatically detects the tilt. The measurement region to cover more areas on the surface plane than other planes. **Custom**: You must enter the X and Y angles manually in the X Angle and Y Angle parameters (see below).
X Angle Y Angle	The X and Y angles you must specify when **Tilt Correction** is set to **Custom**. You can use the Surface Plane tool's X Angle and Y Angle measurements to get the angle of the surrounding surface, and then copy those measurement's values to the **X Angle** and **Y Angle** parameters of this tool.
Filters	The filters that are applied to measurement values before they are output. For more information, see Filters on page 31.
Decision	The Max and Min settings define the range that determines whether the measurement tool sends a pass or fail decision to the output. For more information, see Decisions on page 30.

■ Stud Algorithm

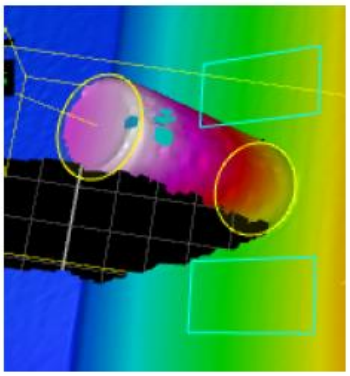
The Stud algorithm measures the stud in three steps: searching for the tip, finding the reference plane, and shaft fitting.

See the tables below for the parameters used by the algorithm.

Searching for the tip - The algorithm looks for the approximate location of the tip. If Auto-Tilt is enabled, the algorithm uses the flat surface around the tip to estimate the orientations of the part. The approximate tip is the location of the highest (maximum Z) pixel after correction for the nominal tilt angle.

Finding the reference plane - The reference regions are positioned using the approximate tip, the nominal angle values, and the nominal stud length. Compared to the hole/opening, misplaced stud reference regions are more likely to cause a failure to produce any measurement.

Shaft fitting - The shaft region is determined based on the approximate tip position, the nominal angles, the reference plane position, and the stud nominal size parameters. Shaft fitting is successful if the algorithm can fit at least three circles with the stud diameter along the shaft. Fitting each circle requires sufficient data along the top portion the shaft. Because of occlusions, the bottom of the shaft is often not visible to the sensor and the algorithm is designed to handle this situation.



Parameters

Parameter	**Description**
Source	The sensor, or combination of sensors, that provides data for the tool's measurements.
Stud Radius	Expected radius of the stud.
Stud Height	Expected height/length of the stud.
Base Height	The height above the base surface that will be ignored when the (truncated) cone is fit to the stud data.
Tip Height	The height from the top of the surface that will be ignored when the (truncated) cone is fit to the stud data.
Region	The region to which the tool's measurements will apply. For more information, see Regions on page 33.
Reference Regions	The tool uses the reference regions to calculate the base plane of the stud. Reference regions are relative to the base of the stud.
Tilt Correction	Tilt of the target with respect to the alignment plane. **Autoset**: The tool automatically detects the tilt. The measurement region to cover more areas on the surface plane than other planes. **Custom**: You must enter the X and Y angles manually in the X Angle and Y Angle parameters (see below).

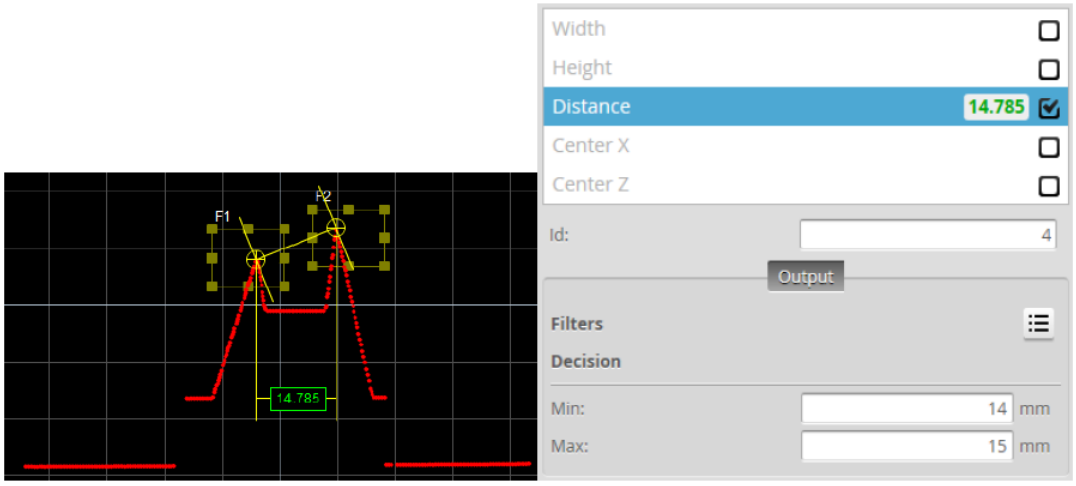
Parameter	Description
X Angle Y Angle	The X and Y angles you must specify when **Tilt Correction** is set to **Custom**. You can use the Surface Plane tool's X Angle and Y Angle measurements to get the angle of the surrounding surface, and then copy those measurement's values to the **X Angle** and **Y Angle** parameters of this tool.
Radius Offset (Radius measurement only)	The distance from the tip of the stud from which the radius is measured.
Filters	The filters that are applied to measurement values before they are output. For more information, see Filters on page 31.
Decision	The Max and Min settings define the range that determines whether the measurement tool sends a pass or fail decision to the output. For more information, see Decisions on page 30.

2.3 Common Parameters

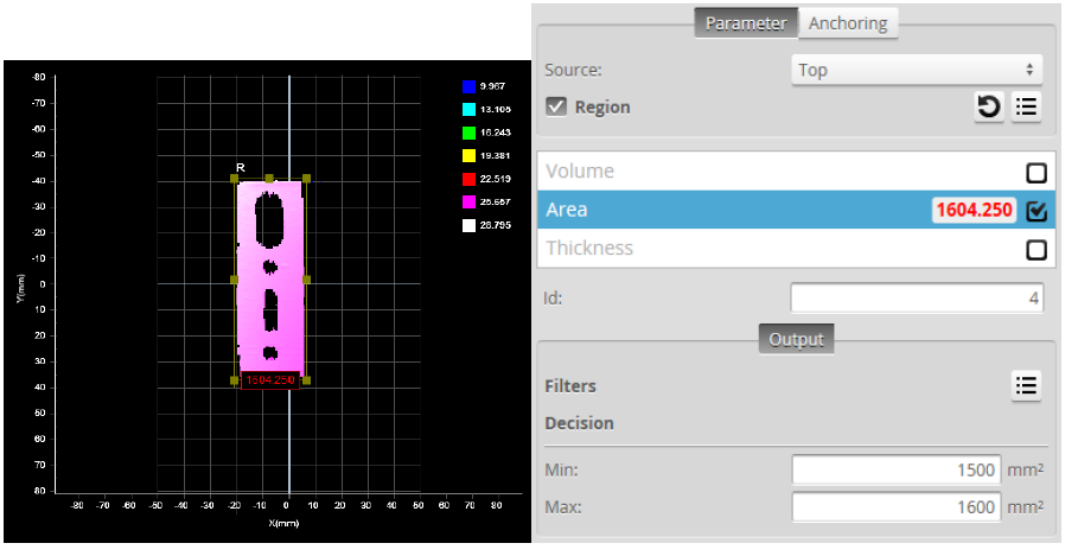
■ Decisions

Results from a measurement can be compared against minimum and maximum thresholds to generate pass / fail decisions. The decision state is pass if a measurement value is between the minimum and maximum threshold. In the data viewer and next to the measurement, these values are displayed in green. Otherwise, the decision state is fail. In the user interface, these values are displayed in red.

All measurements provide decision settings under the **Output** tab.



Value (14.785) within decision thresholds (Min: 14, Max: 15). Decision: Pass



Value (1604.250) outside decision thresholds (Min: 1500, Max: 1600). Decision: Fail

Along with measurement values, decisions can be sent to external programs and devices. In particular,decisions are often used with digital outputs to trigger an external event in response to a measurement.

To configure decisions:

1. Go to the **Measure** page by clicking on the **Measure** icon.

   The scan mode must be set to the type of measurement you need to configure.

   Otherwise, the wrong tools, or no tools, will be listed on the Measure page.

2. In the **Tools** panel, click on a tool in the tool list.
3. In the measurement list, select a measurement.

   To select a measurement, it must be enabled.

4. Click on the **Output** tab.

   For some measurements, only the **Output** tab is displayed.

5. Enter values in the **Min** and **Max** fields.

■ Filters

Filters can be applied to measurement values before they are output from the Gocator sensors.

All measurements provide filter settings under the **Output** tab. The following settings are available.

Filter	Description
Scale and Offset	The **Scale** and **Offset** settings are applied to a measurement value according to the following formula: Scale * Value + Offset **Scale** and **Offset** can be used to transform the output without the need to write a script. For example, to convert the measurement value from millimeters to thousands of an inch, set **Scale** to 39.37. To convert from radius to diameter, set **Scale** to 2.

Filter	Description
Hold Last Valid	Holds the last valid value when the measurement is invalid.
Smoothing	Averages the valid measurements in the number of preceding frames specified in **Samples**. Use this to reduce the impact of random noise on a measurement's output. If **Hold Last Valid** is enabled, the smoothing filter uses the last valid measurement value until a valid value is encountered.
Preserve Invalid	When enabled, smoothing is only applied to valid measurements and not to invalid results: invalid results are not modified and are sent to output as is. When disabled, smoothing is applied to both valid and invalid results. (This setting is only visible when **Smoothing** is enabled.) If **Hold Last Valid** is enabled, results will always be valid, in which case this setting does nothing.

To configure the filters:

1. Go to the **Measure** page by clicking on the **Measure** icon.

   The scan mode must be set to the type of measurement you need to configure.

   Otherwise, the wrong tools, or no tools, will be listed on the **Measure** page.
2. In the **Tools** panel, click on a tool in the tool list.
3. In the measurement list, select a measurement.

   To select a measurement, it must be enabled.
4. Click on the **Output** tab.

   For some measurements, only the **Output** tab is displayed.
5. Expand the **Filters** panel by clicking on the panel header or the ⊕ button.
6. Configure the filters.

   Refer to the table above for a list of the filters.

■ Regions

Many measurement tools use user-defined regions to limit the area in which measurements occur or to help in the identification of a feature (Feature Points on page 3), a fit line (Fit Lines on page 5), or left or right side of the Panel tool (see Panel (Gap and Flush) and Round Corner Algorithm on page 6). Unlike reducing the active area, reducing the measurement region does not increase the maximum frame rate of the sensor.
You can disable regions entirely and cause the measurement tool uses the entire active area by unchecking the checkbox next to the Regions setting.

All tools provide region settings under the upper Parameters tab. This region applies to all of a tool's measurements.

Region settings are often found within expandable feature sections in the tool's panel.

In 2D mode, the tool region defaults to the center of the current data view, not the global field of view. In 3D mode, the region defaults to the global field of view.
Use the region reset button (↺) to set the size of a region to its default. This is useful after zooming in or out in the data viewer.

To configure the filters:

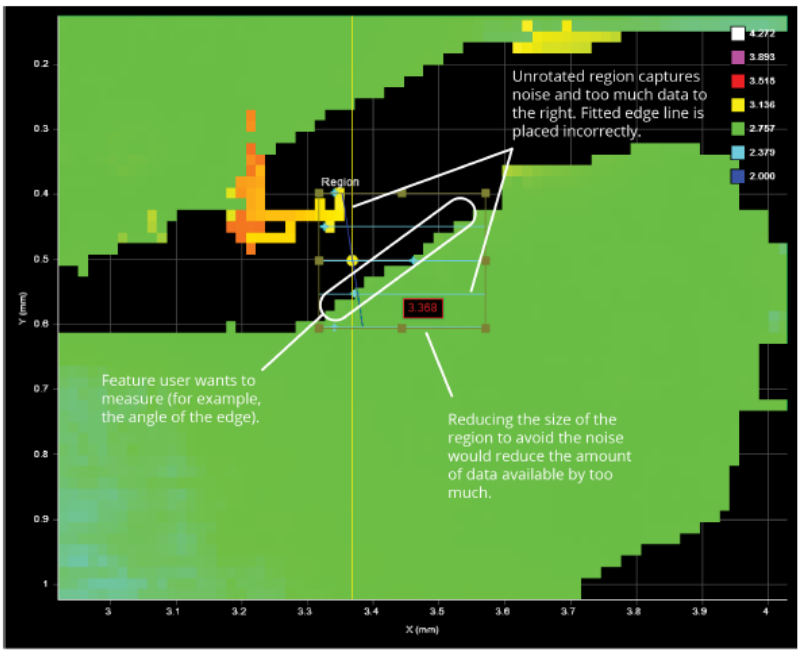
1. Go to the **Measure** page by clicking on the **Measure** icon.

   The scan mode must be set to the type of measurement you need to configure.

   Otherwise, the wrong tools, or no tools, will be listed on the **Measure** page.
2. In the **Tools** panel, click on a tool in the tool list.
3. Configure the region using the mouse in the data viewer.

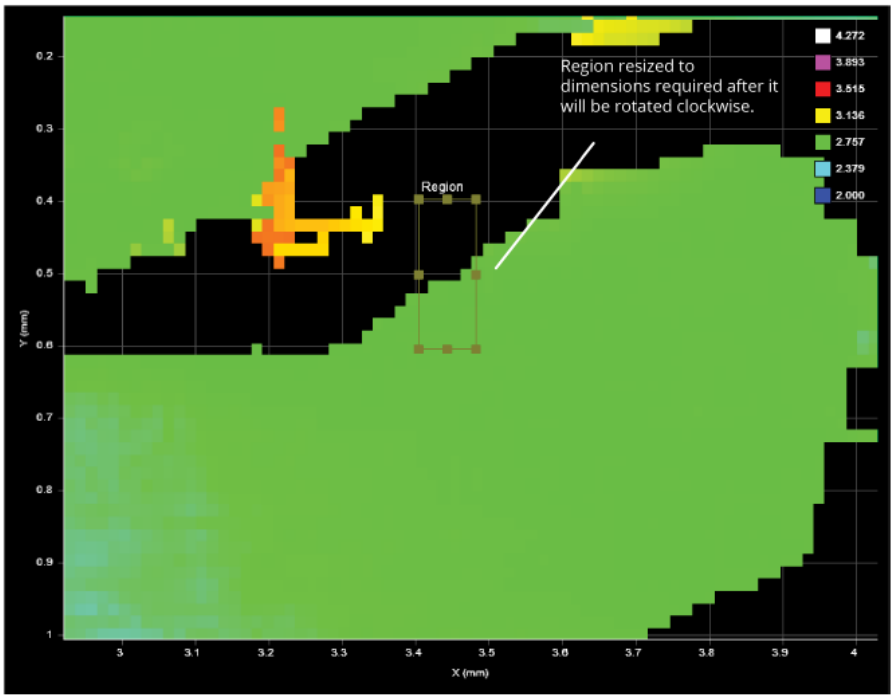
   You can also configure regions manually by clicking the expand button (☰) and entering values in the fields. This is useful if you need to set precise values.

The measurement region of some tools can be rotated by setting the region's **Z Angle** to better accommodate features that are on an angle on a target. By rotating the measurement region, data not related to the feature can often be excluded, improving accuracy of measurements.

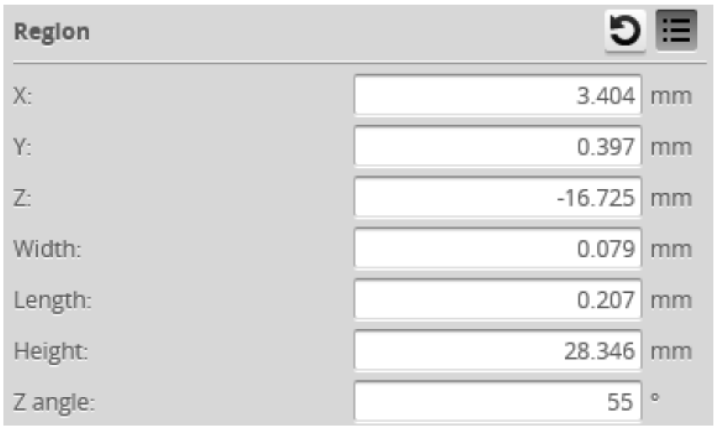


To rotate measurement regions:

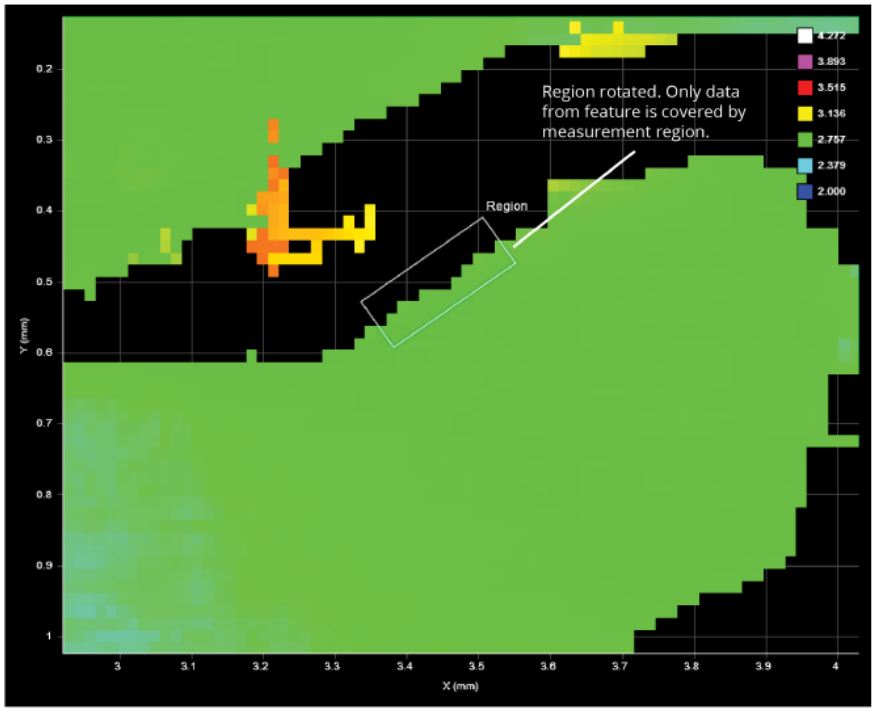
1. Determine the length and width of the region that will be required once it is rotated.



2. Expand the Region setting and then set a value in Z Angle.



The region rotates clockwise around the Z axis relative to the X axis.



Once the region has been rotated, you cannot modify it in the data viewer using the mouse. You can however modify its dimensions and its location manually by changing the region's values in the **Region** setting.

MEMO

3 Software Licenses

Pico-C

Website:

http://code.google.com/p/picoc/

License:

picoc is published under the "New BSD License".

http://www.opensource.org/licenses/bsd-license.php

BlowFish

Website:

http://www.chiark.greenend.org.uk/~sgtatham/putty/licence.html

License:

PuTTY is copyright 1997-2011 Simon Tatham.

Portions copyright Robert de Bath, Joris van Rantwijk, Delian Delchev, Andreas Schultz, Jeroen Massar, Wez Furlong, Nicolas Barry, Justin Bradford, Ben Harris, Malcolm Smith, Ahmad Khalifa, Markus Kuhn, Colin Watson, and CORE SDI S.A.

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL SIMON TATHAM BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

CodeMirror

Website:

http://codemirror.net

License:

Copyright (C) 2011 by Marijn Haverbeke marijnh@gmail.com

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANT ABILITY,FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

jQuery

Website:

http://jquery.com/

License:

Copyright (c) 2011 John Resig, http://jquery.com/

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Closure Library

Website:

http://code.google.com/closure/library/index.html

License:

Copyright 2006 The Closure Library Authors. All Rights Reserved.

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License.

You may obtain a copy of the License at http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS-IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the specific language governing permissions and limitations under the License.

jQuery.CopyEvents

Website:

http://brandonaaron.net

License:

Copyright (c) 2006 Brandon Aaron

Licensed under the MIT License (http://www.opensource.org/licenses/mit-license.php)

jQuery.history

License:

jQuery history plugin

Copyright (c) 2006 Taku Sano (Mikage Sawatari)

Licensed under the MIT License (http://www.opensource.org/licenses/mit-license.php)

Modified by Lincoln Cooper to add Safari support and only call the callback once during initialization for msie when no initial hash supplied. API rewrite by Lauris Bukis-Haberkorns

jQuery.mouseWheel

Website:

http://brandonaaron.net

License:

Copyright (c) 2010 Brandon Aaron

Licensed under the MIT License (http://www.opensource.org/licenses/mit-license.php)

jQuery.scaling

Website:

http://eric.garside.name

License:

Scaling 1.0 - Scale any page element

Copyright (c) 2009 Eric Garside

Licensed under the MIT License (http://www.opensource.org/licenses/mit-license.php)

jQuery.scrollFollow

Website:

http://kitchen.net-perspective.com/

License:

Copyright (c) 2008 Net Perspective

Licensed under the MIT License (http://www.opensource.org/licenses/mit-license.php)

Flex SDK

Website:

http://opensource.adobe.com/wiki/display/flexsdk/Flex+SDK

License:

Copyright (c) 2010 Adobe Systems Incorporated

The contents of this file are subject to the Mozilla Public License Version 1.1 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at

http://www.mozilla.org/MPL/

Software distributed under the License is distributed on an "AS IS" basis, WITHOUT WARRANTY OF ANY KIND, either express or implied. See the License for the specific language governing rights and limitations under the License.

EtherNet/IP Communication Stack

Website:

sourceforge.net/projects/opener

License:

SOFTWARE DISTRIBUTION LICENSE FOR THE ETHERNET/IP(TM) COMMUNICATION STACK (ADAPTED BSD STYLE LICENSE)

EtherNet/IP is a trademark of ODVA, Inc.

SERVICE NETWORK

*As of May 2022

Europe

Mitutoyo Europe GmbH
Borsigstrasse 8-10, 41469 Neuss, GERMANY
TEL: 49(0)2137 102-0 FAX: 49(0)2137 102-351

Mitutoyo CTL Germany GmbH
Von-Gunzert-Strasse 17, 78727 Oberndorf, GERMANY
TEL: 49(0)7423 8776-0 FAX: 49(0)7423 8776-99

KOMEG Industrielle Messtechnik GmbH
Zum Wasserwerk 3, 66333 Völklingen, GERMANY
TEL: 49(0)6898 91110 FAX: 49(0)6898 9111100

Germany

Mitutoyo Deutschland GmbH
Borsigstrasse 8-10, 41469 Neuss, GERMANY
TEL: 49(0)2137 102-0 FAX: 49(0)2137 86 85

M³ Solution Center Hamburg
Tempowerkring 9 im HIT-Technologiepark 21079 Hamburg, GERMANY
TEL: 49(0)40 791894-0 FAX: 49(0)40 791894-50

M³ Solution Center Berlin
Ernst-Lau-Straße 6, 12489 Berlin, GERMANY
TEL: 49(0)30 2611 267 FAX: 49 30 67988729

M³ Solution Center Eisenach
Neue Wiese 4, 99817 Eisenach,GERMANY
TEL: 49(0)3691 88909-0 FAX: 49(0)3691 88909-9

M³ Solution Center Ingolstadt
Marie-Curie-Strasse 1A, 85055 Ingolstadt, GERMANY
TEL: 49(0)841 954920 FAX: 49(0)841 9549250

M³ Solution Center Leonberg
Am Längenbühl 3, 71229 Leonberg, GERMANY
TEL: 49(0)7152 6080-0 FAX: 49(0)7152 608060

Mitutoyo-Messgeräte Leonberg GmbH
Heidenheimer Strasse 14, 71229 Leonberg, GERMANY
TEL: 49(0)7152 9237-0 FAX: 49(0)7152 9237-29

U.K.

Mitutoyo (UK) Ltd. HQ
Joule Road, West Point Business Park, Andover, Hampshire SP10 3UX, UNITED KINGDOM
TEL: 44(0)1264 353123 FAX: 44(0)1264 354883

Coventry M³ Solution Centre
Unit6, Banner Park, Wickmans Drive, Coventry, West Midlands CV4 9XA, UNITED KINGDOM
TEL: 44(0)2476 426300

Halifax M³ Solution Centre
Lowfields Business Park, Navigation Close, Elland, West Yorkshire HX5 9HB, UNITED KINGDOM
TEL: 44(0)1422 375566

East Kilbride M³ Solution Centre
The Bairds Building, Rankine Avenue, Scottish Enterprise Technology Park, East Kilbride G75 0QF, UNITED KINGDOM
TEL: 44(0)1355 581170

France

Mitutoyo France
Paris Nord 2-123 rue de la Belle Etoile, BP 59267 ROISSY EN FRANCE 95957 ROISSY CDG CEDEX, FRANCE
TEL: 33(0)149 38 35 00

M³ Solution Center LYON
Parc Mail 523, cours du 3ème millénaire, 69791 Saint-Priest, FRANCE
TEL: 33(0)149 38 35 70

M³ Solution Center STRASBOURG
Parc de la porte Sud, Rue du pont du péage, 67118 Geispolsheim, FRANCE
TEL: 33(0)149 38 35 80

M³ Solution Center CLUSES
Espace Scionzier 480 Avenue des Lacs, 74950 Scionzier, FRANCE
TEL: 33(0)1 49 38 35 90

M³ Solution Center TOULOUSE
Aeroparc Saint Martin Cellule B08
ZAC de Saint Martin du Touch 12 rue de Caulet
31300 Toulouse, FRANCE
TEL: 33(0)1 49 38 42 90

M³ Solution Center RENNES
2, rue Claude Chappe, PA le Vallon - ZAC Mivoie, 35230 Noyal-Châtillon-sur-Seiche, FRANCE
TEL: 33(0)1 49 38 42 10

Italy

Mitutoyo Italiana S.r.l.
Corso Europa, 7 - 20045 Lainate (Mi), ITALY
TEL: 39 02 935781 FAX: 39 02 93578255

M³ Solution Center BOLOGNA
Via dei Carpini1/A - 40011 Anzola Emilia (BO), ITALY
TEL: 39 02 93578215 FAX: 39 02 93578255

M³ Solution Center CHIETI
Contrada Santa Calcagna - 66020 Rocca S. Giovanni (CH), ITALY
TEL: 39 02 93578280 FAX: 39 02 93578255

M³ Solution Center PADOVA
Via G. Galilei 21/F - 35035 Mestrino (PD), ITALY
TEL: 39 02 93578268 FAX: 39 02 93578255

Netherlands

Mitutoyo Nederland B.V.
Koningsschot 41, 3905 PR Veenendaal,
THE NETHERLANDS
TEL: 31(0)318-534911

Mitutoyo Nederland B.V. / M³ Solution Center Enschede
Institutenweg 50, 7521 PK Enschede, THE NETHERLANDS
TEL: 31(0)318-534911

Mitutoyo Nederland B.V. / M³ Solution Center Eindhoven
De Run 1115, 5503 LB Veldhoven, THE NETHERLANDS
TEL: 31(0)318-534911

Mitutoyo Research Center Europe B.V.
De Rijn 18, 5684 PJ Best, THE NETHERLANDS
TEL:31(0)499-320200 FAX:31(0)499-320299

Belgium

Mitutoyo Belgium N.V. / M³ Solution Center Melsele
Schaarbeekstraat 20, B-9120 Melsele, BELGIUM
TEL: 32(0)3-2540444

Sweden

Mitutoyo Scandinavia AB
Släntvägen 6, 194 27 Upplands Väsby, SWEDEN
TEL: 46(0)8 594 109 50 FAX: 46(0)8 590 924 10

Mitutoyo Scandinavia AB / M³ Solution Center Alingsås
Ängsvaktaregatan 3A, 441 38 Alingsås, SWEDEN
TEL: 46(0)8 594 109 50 FAX: 46(0)322 63 31 62

Mitutoyo Scandinavia AB / M³ Solution Center Värnamo
Kalkstensvägen 7, 331 44 Värnamo, SWEDEN
TEL: 46(0)8 594 109 50 FAX: 46(0)370 463 34

Switzerland

Mitutoyo (Schweiz) AG
Steinackerstrasse 35, 8902 Urdorf, SWITZERLAND
TEL: 41(0)447361150

Mitutoyo (Suisse) SA
Rue Galilée 4, 1400 Yverdon-les Bains, SWITZERLAND
TEL: 41(0)244259422 FAX: 41(0)447361151

SERVICE NETWORK

*As of May 2022

Poland
Mitutoyo Polska Sp.z o.o.
Ul.Graniczna 8A, 54-610 Wroclaw, POLAND
TEL: 48(0)71354 83 50 FAX: 48(0)71354 83 55

Czech Republic
Mitutoyo Česko s.r.o.
Dubská 1626, 415 01 Teplice, CZECH REPUBLIC
TEL: 420 417-514-011 Email: info@mitutoyo.cz
Mitutoyo Česko s.r.o. M³ Solution Center Ivančice
Ke Karlovu 62/10, 664 91 Ivančice, CZECH REPUBLIC
TEL: 420 417-514-011 Email: info@mitutoyo.cz
Mitutoyo Česko s.r.o. M³ Solution Center Ostrava Mošnov
Mošnov 314, 742 51 Mošnov, CZECH REPUBLIC
TEL: 420 417-514-050 Email: info@mitutoyo.cz
Mitutoyo Česko s.r.o. Slovakia Branch
Hviezdoslavova 124, 017 01 Považská Bystrica, SLOVAKIA
TEL: 421 948-595-590 Email: info@mitutoyo.sk

Hungary
Mitutoyo Hungária Kft.
Galamb József utca 9, 2000 Szentendre, HUNGARY
TEL: 36 (30) 6410210

Romania
Mitutoyo Romania SRL
1A Drumul Garii Odai Street, showroom, Ground Floor, 075100 OTOPENI-ILFOV, ROMANIA
TEL: 40(0)311012088 FAX: 40(0)311012089
Showroom in Brasov
Strada Ionescu Crum Nr.1, Brasov Business Park Turnul 1, Mezanin, 500446 Brasov-Judetul Brasov, ROMANIA
TEL/FAX: 40(0)371020017

Russian Federation
Mitutoyo RUS LLC
Sharikopodshipnikovskaya St., 13, bld.5, Moscow, 115088, RUSSIAN FEDERATION
TEL: 7 495 545 43 90

Finland
Mitutoyo Scandinavia AB Finnish Branch
Viherkiitäjä 2A, 33960, Pirkkala, FINLAND
TEL: 358(0)40 355 8498

Austria
Mitutoyo Austria GmbH
Salzburger Straße 260 / 3A-4600 Wels, AUSTRIA
TEL: 43(0) 7242 219 998
Mitutoyo Austria GmbH Goetzis Regional showroom
Lastenstrasse 48a, 6840 Götzis, AUSTRIA

Singapore
Mitutoyo Asia Pacific Pte. Ltd.
Head office / M³ Solution Center
24 Kallang Avenue, Mitutoyo Building, SINGAPORE 339415
TEL: (65)62942211 FAX: (65)62996666

Malaysia
Mitutoyo (Malaysia) Sdn. Bhd.
Kuala Lumpur Head Office / M³ Solution Center
Mah Sing Integrated Industrial Park, 4, Jalan Utarid U5/14, Section U5, 40150 Shah Alam, Selangor, MALAYSIA
TEL: (60)3-78459318 FAX: (60)3-78459346
Penang Branch office / M³ Solution Center
30, Persiaran Mahsuri 1/2, Sunway Tunas, 11900 Bayan Lepas, Penang, MALAYSIA
TEL: (60)4-6411998 FAX: (60)4-6412998
Johor Branch office / M³ Solution Center
70 (Ground Floor), Jalan Molek 1/28, Taman Molek, 81100 Johor Bahru, Johor, MALAYSIA
TEL: (60)7-3521626 FAX: (60)7-3521628

Thailand
Mitutoyo (Thailand) Co., Ltd.
Bangkok Head Office / M³ Solution Center
76/3-5, Chaengwattana Road, Kwaeng Anusaowaree, Khet Bangkaen, Bangkok 10220, THAILAND
TEL: (66)2080 3500 FAX:(66)2521 6136
Chonburi Branch / M³ Solution Center
7/1, Moo 3, Tambon Bowin, Amphur Sriracha, Chonburi 20230, THAILAND
TEL: (66)2080 3563 FAX:(66)3834 5788
ACC Branch / M³ Solution Center
122/8, 122/9, Moo 6, Tambon Donhuaroh,
Amphur Muangchonburi, Chonburi 20000, THAILAND
TEL: (66)2080 3565

Indonesia
PT. Mitutoyo Indonesia
Head Office / M³ Solution Center
Jalan Sriwijaya No.26 Desa cibatu Kec. Cikarang Selatan Kab. Bekasi 17530, INDONESIA
TEL: (62)21-2962 8600 FAX: (62)21-2962 8604

Vietnam
Mitutoyo Vietnam Co., Ltd
Hanoi Head Office / M³ Solution Center
1st & 2nd floor, MHDI Building, No. 60 Hoang Quoc Viet Road, Nghia Do Ward, Cau Giay District, Hanoi, VIETNAM
TEL: (84)24-3768-8963 FAX: (84)24-3768-8960
Ho Chi Minh City Branch Office / M³ Solution Center
123 Dien Bien Phu Street,Ward 15,Binh Thanh District,
Ho Chi Minh City, VIETNAM
TEL: (84)28-3840-3489 FAX: (84)28-3840-3498
Hai Phong City Branch Office
Room 511, 5th Floor, Thanh Dat 3 Building, No. 4 Le Thanh Tong Street, May To Ward, Ngo Quyen District, Hai Phong City, VIETNAM
TEL:(84)22-5398-9909

Philippines
Mitutoyo Philippines, Inc.
Head Office / M³ Solution Center
Unit 1B & 2B LTI, Administration Building 1, Annex 1, North Main Avenue, Laguna Technopark, Binan Laguna 4024, PHILIPPINES
TEL/FAX:(63) 49 544 0272

India
Mitutoyo South Asia Pvt. Ltd. Head Office
C-122, Okhla Industrial Area, Phase-l, New Delhi-110 020, INDIA
TEL: (91) 11-40578485/86
MSA Technical Center
Plot no. 65, Ground Floor, Udyog Vihar, Phase-4 Gurgaon, Haryana - 122016, INDIA
TEL: (91) 124–2340286/287
Mumbai Region Head office
303, Sentinel Hiranandani Business Park Powai, Mumbai-400 076, INDIA
TEL: (91) 22-25700684/685/837/839
Pune Office / M³ Solution Center
G4/G5, Pride Kumar Senate, Off. Senapati Bapat Road, Pune-411 016, INDIA
TEL: (91) 20-25660043/44/45

SERVICE NETWORK

*As of May 2022

Ahmedabad Office / M³ Solution Center
A-104 & A-105, First Floor, Solitaire Corporate Park, Near Divya Bhaskar Press, S.G. Road, Ahmedabad - 380 015, INDIA
TEL: (91)079 - 29704902/903
Bengaluru Region Head office / M³ Solution Center
116/117-2, Ground Floor, Sy. No. 93 & 94, 3rd Phase, Peenya Industrial Area, Bengaluru-560 058, INDIA
TEL: (91) 80-25630946/47/48/49
Coimbatore Office
Regus, Srivari Srimath, 3rd Floor, Door No: 1045, Avinashi Road, Coimbatore - 641 018,INDIA
TEL: (91)9345005663
Chennai Office / M³ Solution Center
No. 624, Anna Salai Teynampet, Chennai-600 018, INDIA
TEL: (91) 44-24328823/24/25
Kolkata Office
Unit No. 1208,Om Tower, 32,J.L..Nehru Road, Kolkata-700 071, INDIA
TEL: (91) 33-22267088/40060635/22266817

Taiwan
Mitutoyo Taiwan Co., Ltd. / M³ Solution Center Taipei
4F., No.71, Zhouzi St., Neihu Dist.,Taipei City 114, TAIWAN
TEL: 886(2)5573-5900 FAX: 886(2)8752-3267
Taichung Branch / M³ Solution Center Taichung
1F., No. 299, Gaotie 1st Rd., Wuri Dist., Taichung City 414, TAIWAN
TEL:886(4)2338-6822 FAX:886(4)2338-6722
Kaohsiung Branch / M³ Solution Center Kaohsiung
1F., No.31-1, Haibian Rd., Lingya Dist., Kaohsiung City 802, TAIWAN
TEL: 886(7)334-6168 FAX: 886(7)334-6160

South Korea
Mitutoyo Korea Corporation
Head Office / M³ Solution Center
(Sanbon-Dong, Geumjeong High View Build.), 6F, 153-8, Ls-Ro, Gunpo-Si, Gyeonggi-Do, 15808 KOREA
TEL: 82(31)361-4200 FAX: 82(31)361-4201
Busan Office / M³ Solution Center
(3150-3, Daejeo 2-dong) 8,Yutongdanji 1-ro 49beon-gil, Gangseo-gu, Busan, 46721 KOREA
TEL: 82(51)718-2140 FAX: 82(51)324-0104
Daegu Office / M³ Solution Center
(Galsan-dong,Daegu Business Center), 301-Ho, 217, Seongseogongdan-ro, Dalseo-gu, Daegu 42704 KOREA
TEL: 82(53)593-5602 FAX: 82(53)593-5603

China
Mitutoyo Measuring Instruments (Shanghai) Co., Ltd.
8th Floor, Tower 1 Lujiazui Jinkong Square No.1788/1800 Century Ave., Pudong New District, Shanghai 200122, CHINA
TEL: 86(21)5836-0718 FAX: 86(21)5836-0717
Suzhou Office / M³ Solution Center (Suzhou)
No. 46 Baiyu Road, Suzhou 215021, CHINA
TEL: 86(512)6522-1790 FAX: 86(512)6251-3420
Wuhan Office / M³ Solution Corner
Room 1701, Wuhan Wanda Center, No. 96, Linjiang Road, Wuchang District, Wuhan Hubei 430060, CHINA
TEL: 86(27)8544-8631 FAX: 86(27)8544-6227
Chengdu Office
1-701, New Angle Plaza, 668# Jindong Road, Jinjiang District, Chengdu, Sichuan 610066, CHINA
TEL: 86(28)8671-8936 FAX: 86(28)8671-9086
Hangzhou Office
Room 804, Eastern International Business Center Building 1, No.600 Jinsha Road of Hangzhou Economic and Technological Development Zone, 310018, CHINA
TEL: 86(571)8288-0319 FAX: 86(571)8288-0320
Tianjin Office / M³ Solution Center China (Tianjin)
Room D 12/F, TEDA Building, No.256 Jie-fang Nan Road Hexi District,Tianjin 300042, CHINA
TEL: 86(22)5888-1700 FAX: 86(22)5888-1701
Changchun Office
Room 815, 8F, Building A1, Upper East International No.3000 Dongsheng Street, Erdao District, Changchun, Jilin, 130031, CHINA
TEL: 86(431)8192-6998 FAX: 86(431)8192-6998
Chongqing Office
Room 1312, Building 3, Zhongyu Plaza, No.86, Hongjin Avenue, Longxi Street, Yubei District, Chongqing, 400000, CHINA
TEL: 86(23)6595-9950 FAX: 86(23)6595-9950
Qingdao Office
Room 638, 6F, No.192 Zhengyang Road, Chengyang District, Qingdao, Shandong, 266109, CHINA
TEL: 86(532)8096-1936 FAX: 86(532)8096-1937
Xi'an Office
Room 805, Xi'an International Trade Center, No. 196 Xiaozhai East Road, Xi'an, 710061, CHINA
TEL: 86(29)8538-1380 FAX: 86(29)8538-1381
Dalian Office / M³ Solution Center China (Dalian)
Room A-106 Shuijing SOHO, No.16 Harbin Road,Economic Development Zone,Dalian, 116600 CHINA
TEL: 86(411)8718 1212 FAX: 86(411)8754-7587
Zhengzhou Office
Room1801,18/F,Unit1,Building No.23, Shangwu Inner Ring Road, Zhengdong New District,Zhengzhou City, Henan 450018, CHINA
TEL: 86(371)6097-6436 FAX: 86(371)6097-6981
Dongguan Office / M³ Solution Center China (Dongguan)
Room 801, No 65, Chang'an Section Guanchang Road, Chang'an Town, Dongguan City, Guangdong 523841, CHINA
TEL: 86(769)8541 7715 FAX: 86(769)-8541 7745
Fuzhou Office
Room 2104, City Commercial Centre, No.129 Wu Yi Road N., Fuzhou City, Fujian 350005, CHINA
TEL: 86 (591) 8761 8095 FAX: 86 (591) 8761 8096
Changsha Office
Room 2207, Building 1, Shiner International Plaza, No. 88, Kaiyuan Middle Road, Changsha City, Hunan 410100, CHINA
TEL: 86 (731) 8401 9276 FAX: 86 (731) 8401 9376
Changzhou Office
Room 1502, Joint Financial Tower, No.255, Tongjiang North Road, Tianning District, Changzhou City, Jiangsu 2130002, CHINA
TEL:86(519)8815 8319 FAX:86(519)8815 8319
Wenzhou Office
Room 512, Building 4, Xinjingdujiayuan, Sanyang Street, Ouhai District, Wenzhou City, Zhejiang 325014, CHINA
Mitutoyo Measuring Instruments (Suzhou) Co., Ltd.
No. 46 Baiyu Road, Suzhou 215021, CHINA
TEL: 86(512)6252-2660 FAX: 86(512)6252-2580

U.S.A.
Mitutoyo America Corporation
965 Corporate Blvd., Aurora, IL 60502, U.S.A.
TEL: 1-(630)820-9666 Toll Free No. 1-888-648-8869
FAX: 1-(630)978-3501
Headquarters (Aurora) / M³ Solution Center
965 Corporate Blvd., Aurora, IL 60502, U.S.A.

Seattle (Renton) Office / M³ Solution Center
1000 SW 34th St. Suite G, Renton, WA 98057 U.S.A.
TEL: 1-(888)-648-8869
Houston Office / M³ Solution Center
4560 Kendrick Plaza Drive Suite 120 Houston, TX 77032, U.S.A.
TEL: 1-(888)-648-8869 FAX: 1-(281)227-0937
Cincinnati (Mason) Office / M³ Solution Center
6220 Hi-Tek Ct., Mason, OH 45040, U.S.A.
TEL: 1-(888) -648-8869 FAX: 1-(513)754-0718
Detroit (Novi) Office / M³ Solution Center
46850 Magellan Drive, Suite 100, Novi, MI 48377, U.S.A.
TEL: 1-(888)-648-8869 FAX: 1-(248)-926-0928
Los Angeles (City of Industry) Office / M³ Solution Center
16925 E. Gale Ave., City of Industry, CA 91745, U.S.A.
TEL: 1-(888)-648-8869 FAX: 1-(626)369-3352
Charlotte (Huntersville) Office / M³ Solution Center
11515 Vanstory Dr., Suite 140, Huntersville, NC 28078, U.S.A.
TEL: 1-(888)-648-8869 FAX: 1-(704)875-9273
Boston (Marlborough) Office / M³ Solution Center
753 Forest Street, Suite 110, Marlborough,MA 01752, U.S.A.
TEL: 1-(888)648-8869 FAX: 1-(508)485-0782
Mitutoyo America Corporation Calibration Lab
965 Corporate Blvd., Aurora, IL 60502, U.S.A.
TEL: 1-(888)-648-8869 FAX: 1-(630)978-6477
Mituotyo America Corporation CT-Lab Chicago
965 Corporate Blvd., Aurora, IL 60502, U.S.A.
TEL: 1-(888)-648-8869 FAX: 1-(630)-820-3418
Mitutoyo Research & Development America, Inc.
11533 NE 118th St., Kirkland, WA 98034-7111, U.S.A.
TEL: 1-(425)821-3906 FAX: 1-(425)821-3228
Mitutoyo Research & Development America, Inc. - California Office
16925 Gale Ave. City of Industry, CA 91745-1806 U.S.A.
TEL: 1-(425)821-3906 FAX: 1-(425)821-3228

Canada
Mitutoyo Canada Inc.
2121 Meadowvale Blvd., Mississauga, Ont. L5N 5N1., CANADA
TEL: 1-(905)821-1261 FAX: 1-(905)821-4968
Montreal Office
7075 Place Robert-Joncas Suite 129, Montreal, Quebec H4M 2Z2, CANADA
TEL: 1-(514)337-5994 FAX: 1-(514)337-4498

Brazil
Mitutoyo Sul Americana Ltda.
Head office / M³ Solution Center
Rodovia Índio Tibiriçá 1555, CEP 08655-000 - Vila Sol Nascente - Suzano - SP - BRASIL
TEL: 55 (11) 5643-0004/0041
Filial Campinas / M³ Solution Center
Avenida Francisco Alfredo Junior, nº 307, Sala 01 e 02, Bairro Swiss Park – Campinas – São Paulo – BRASIL CEP 13049255
TEL: 55 (19) 3397-3412
Filial Curitiba / M³ Solution Center
Rua Sergipe, nº 101, Sala A, Bairro Boneca do Iguaçu, São José dos Pinhais – Paraná – BRASIL CEP 83040120
TEL: 55 (41) 3534-1728

Argentina
Mitutoyo Sul Americana Ltda.
Argentina Branch / M³ Solution Center
Av. B. Mitre 891/899 – C.P. (B1603CQI) Vicente López –Pcia. Buenos Aires – ARGENTINA
TEL: 54 (11) 4730-1433 FAX: 54 (11) 4730-1411
Sucursal Cordoba / M³ Solution Center
Av. Ricchieri 2872 L.4 – Bº Jardin – CP X5014OPJ Cordoba, ARGENTINA
TEL: 54 (351) 464-4125

Mexico
Mitutoyo Mexicana, S.A. de C.V.
Industria Elēctrica No.15, Parque Industrial, Naucalpan de Juārez, Estado de Mēxico C.P.53370, MÉXICO
TEL: 52 (01-55) 5312-5612 FAX: 52 (01-55) 5312-3380
Monterrey Office / M³ Solution Center
Blv. Interamericana No. 103, Parque Industrial FINSA, C.P. 66636 Apodaca, N.L., MÉXICO
TEL: 52(01-81) 8398-8227/8228/8242/8244
FAX: 52(01-81) 8398-8226
Tijuana Office / M³ Solution Center
Calle José María Velazco 10501-C, Col. Cd. Industrial Nueva Tijuana, C.P. 22500 Tijuana, B.C., MÉXICO
TEL: 52(01-664) 647-5024
Querétaro Office / M³ Solution Center
Av. Cerro Blanco No.500-1, Colonia Centro Sur, Querétaro, Querétaro, C.P. 76090, MÉXICO
TEL: 52(01-442)340-8018, 340-8019 and 340-8020
FAX: 52(01-442)340-8017
Mitutoyo Mexicana, S.A. de C.V. Querétaro Calibration Laboratory
Av. Cerro Blanco 500 30 Centro Sur, Querétaro, Querétaro, C.P. 76090, MÉXICO
TEL: 52(01-442)340-8018, 340-8019 and 340-8020
FAX: 52(01-442)340-8017
Aguascalientes Office / M³ Solution Center
Av. Aguascalientes No. 622, Local 15 Centro Comercial El Cilindro Fracc. Pulgas Pandas Norte, C.P. 20138, Aguascalientes, Ags. MÉXICO
TEL: 52(01-449)174-4140 and 174-4143
Irapuato Office / M³ Solution Center
Boulevard a Villas de Irapuato No. 1460 L.1 Col. Ejido Irapuato C.P. 36643
Irapuato, Gto., MÉXICO
TEL: 52(01-462)144-1200 and 144-1400

Revision Record

Date of publication	Revision status	Details of revision
June 30, 2022	First edition	Publication

Mitutoyo Corporation

20-1, Sakado 1-Chome, Takatsu-ku, Kawasaki-shi, Kanagawa 213-8533, Japan
Tel: +81 (0)44 813-8230 Fax: +81 (0)44 813-8231
Home page: https://www.mitutoyo.co.jp/global.h

For the EU Directive, Authorized representative and importer in the EU:
Mitutoyo Europe GmbH
Borsigstrasse 8-10, 41469 Neuss, Germany

Printed in Japan

No. A61F22-502C