



USER MANUAL

Gocator Snapshot Sensors

Gocator 3100 Series; Gocator 3210 & 3506

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Contact Information

LMI Technologies, Inc.
9200 Glenlyon Parkway
Burnaby BC V5J 5J8
Canada

Telephone: +1 604-636-1011
Fax: +1 604-516-8368

www.lmi3d.com

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Introduction

Gocator snapshot LED projection sensors are designed for 3D measurement and control applications. Gocator sensors are configured using a web browser and can be connected to a variety of input and output devices.

This documentation describes how to connect, configure, and use a Gocator. It also contains reference information on the device's protocols and job files. The documentation applies to the following sensors:

- Gocator 3100 series
- Gocator 3210
- Gocator 3506

Notational Conventions

This documentation uses the following notational conventions:



Follow these safety guidelines to avoid potential injury or property damage.



Consider this information in order to make best use of the product.

Safety and Maintenance

The following sections describe the safe use and maintenance of Gocator sensors.

Electrical Safety



Failure to follow the guidelines described in this section may result in electrical shock or equipment damage.

Sensors should be connected to earth ground

All sensors should be connected to earth ground through their housing. All sensors should be mounted on an earth grounded frame using electrically conductive hardware to ensure the housing of the sensor is connected to earth ground. Use a multi-meter to check the continuity between the sensor connector and earth ground to ensure a proper connection.

Minimize voltage potential between system ground and sensor ground

Care should be taken to minimize the voltage potential between system ground (ground reference for I/O signals) and sensor ground. This voltage potential can be determined by measuring the voltage between Analog_out- and system ground. The maximum permissible voltage potential is 12 V but should be kept below 10 V to avoid damage to the serial and encoder connections.

See *Gocator I/O Connector* on page 488 for a description of the connector pins.

Use a suitable power supply

The +24 to +48 VDC power supply used with Gocator sensors should be an isolated supply with inrush current protection or be able to handle a high capacitive load.

Use care when handling powered devices

Wires connecting to the sensor should not be handled while the sensor is powered. Doing so may cause electrical shock to the user or damage to the equipment.

Handling, Cleaning, and Maintenance



Dirty or damaged sensor windows (emitter or camera) can affect accuracy. Use caution when handling the sensor or cleaning the sensor's windows.

Keep sensor windows clean

Use dry, clean air to remove dust or other dirt particles. If dirt remains, clean the windows carefully with a soft, lint-free cloth and non-streaking glass cleaner or isopropyl alcohol. Ensure that no residue is left on the windows after cleaning.

Avoid excessive modifications to files stored on the sensor

Settings for Gocator sensors are stored in flash memory inside the sensor. Flash memory has an expected lifetime of 100,000 writes. To maximize lifetime, avoid frequent or unnecessary file save

operations.

Environment and Lighting

Avoid strong ambient light sources

The imager used in this product is highly sensitive to ambient light hence stray light may have adverse effects on measurement. Do not operate this device near windows or lighting fixtures that could influence measurement. If the unit must be installed in an environment with high ambient light levels, a lighting shield or similar device may need to be installed to prevent light from affecting measurement.

Avoid installing sensors in hazardous environments

To ensure reliable operation and to prevent damage to Gocator sensors, avoid installing the sensor in locations

- that are humid, dusty, or poorly ventilated;
- with a high temperature, such as places exposed to direct sunlight;
- where there are flammable or corrosive gases;
- where the unit may be directly subjected to harsh vibration or impact;
- where water, oil, or chemicals may splash onto the unit;
- where static electricity is easily generated.

Ensure that ambient conditions are within specifications

Gocator sensors are suitable for operation between 0–50° C and 25–85% relative humidity (non-condensing).

The Master 400/800/1200/2400 is similarly rated for operation between 0–50° C.

The storage temperature is -30–70° C.



The sensor must be heat-sunk through the frame it is mounted to. When a sensor is properly heat sunk, the difference between ambient temperature and the temperature reported in the sensor's health channel is less than 15° C.



Gocator sensors are high-accuracy devices, and the temperature of all of its components must therefore be in equilibrium. When the sensor is powered up, a warm-up time of at least one hour is required to reach a consistent spread of temperature in the sensor.

Getting Started

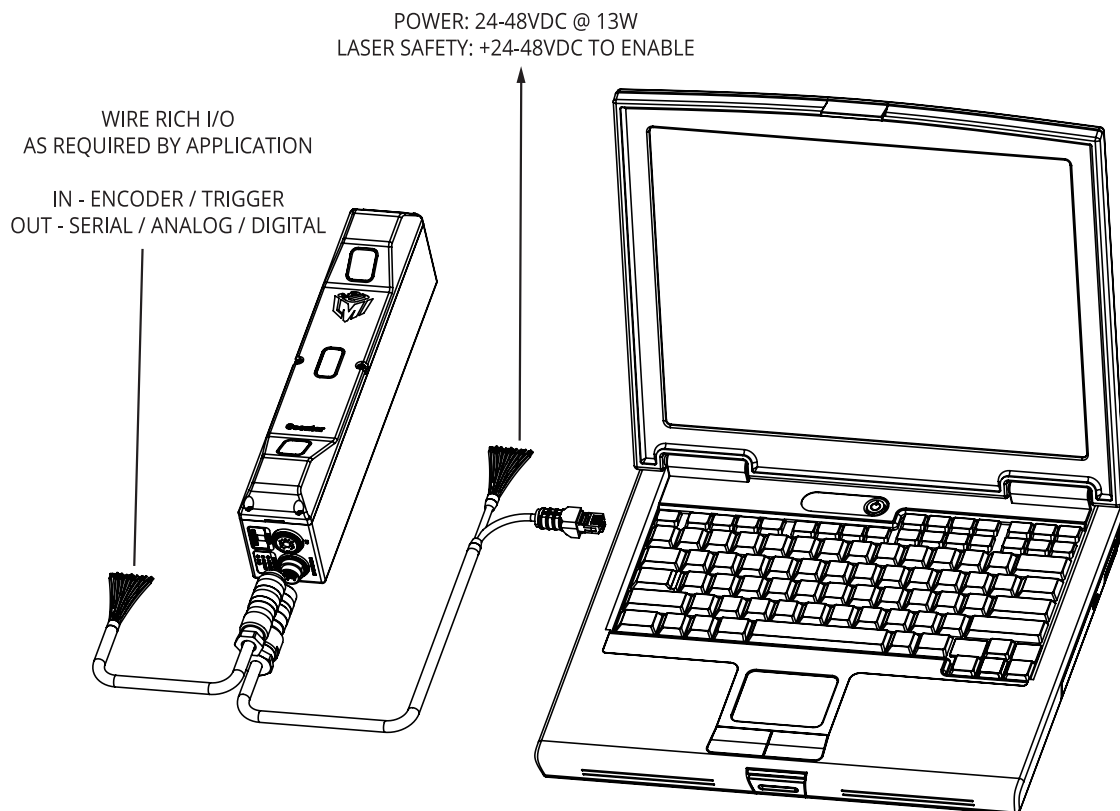
The following sections provide system and hardware overviews, in addition to installation and setup procedures.

System Overview

Gocator sensors can be installed and used in scenarios where the target to be scanned is static in position relative to the sensor for the short duration of camera exposure. Sensors can be connected as standalone devices or in a multi-sensor system.

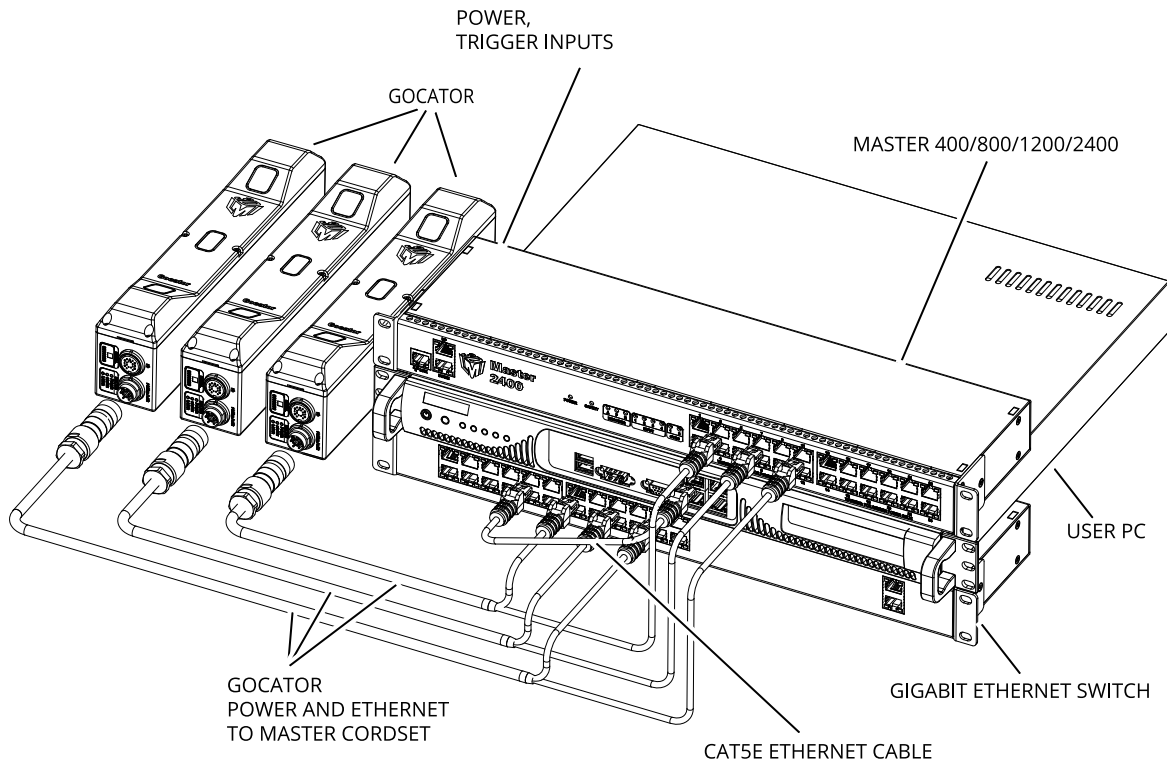
Standalone System

Standalone systems are typically used when only a single Gocator sensor is required. The sensor can be connected to a computer's Ethernet port for setup and can also be connected to devices such as encoders, photocells, or PLCs.



Multi-Sensor System

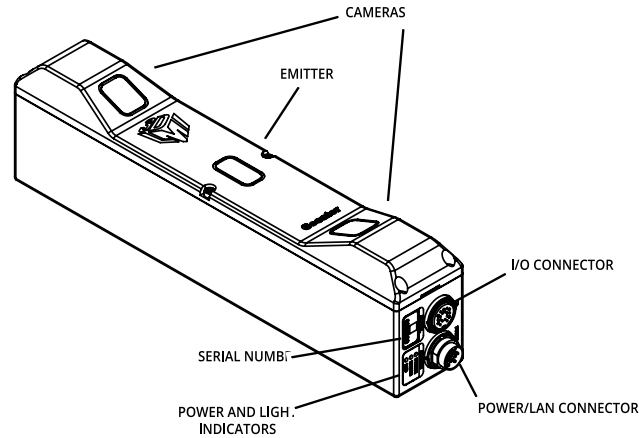
A [Master network controller](#) (excluding Master 100) can be used to connect two or more sensors into a multi-sensor system. Gocator Master cordsets are used to connect the sensors to a Master. The Master provides a single point of connection for power, safety, encoder, and digital inputs. A Master 400/800/1200/2400 can be used to ensure that the scan timing is precisely synchronized across sensors. Sensors and client computers communicate via an Ethernet switch (1 Gigabit/s recommended).



Hardware Overview

The following sections describe Gocator and its associated hardware.

Gocator Sensor



Gocator 3110

Item	Description
Camera	Observes light reflected from target surfaces.
Light Emitter	Emits structured light for 3D data acquisition.
I/O Connector	Accepts input/output signals.
Power/LAN Connector	Connects to 1000 Mbit/s Ethernet network.
Power Indicator	Illuminates when power is applied (blue).
Safety Indicator	Illuminates when laser safety input is active (amber).
Serial Number	Unique sensor serial number.

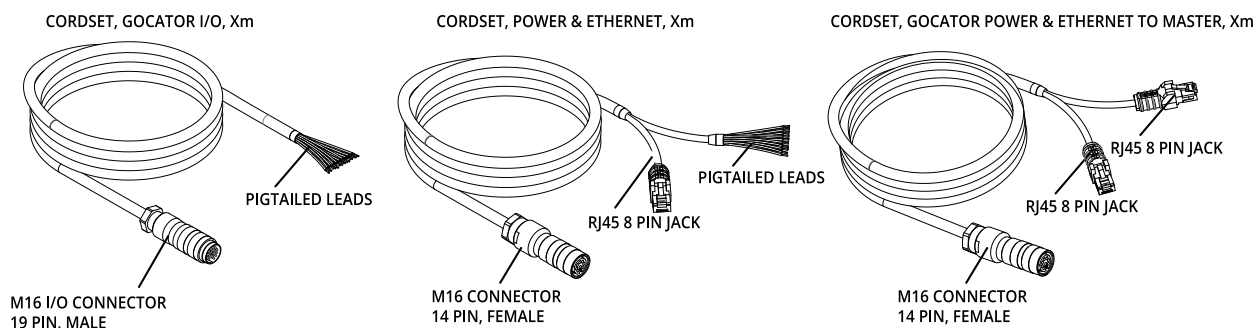
Gocator 3100 Cordsets

Gocator 3100 sensors use two types of cordsets.

The Power & Ethernet cordset provides power and safety interlock to the sensor. It is also used for sensor communication via 1000 Mbit/s Ethernet with a standard RJ45 connector. The Master version of the Power & Ethernet cordset provides direct connection between the sensor and a [Master network controller](#) (excluding Master 100).

The Gocator 3100 I/O cordset provides digital I/O connections, an encoder interface, RS-485 serial connection, and an analog output.

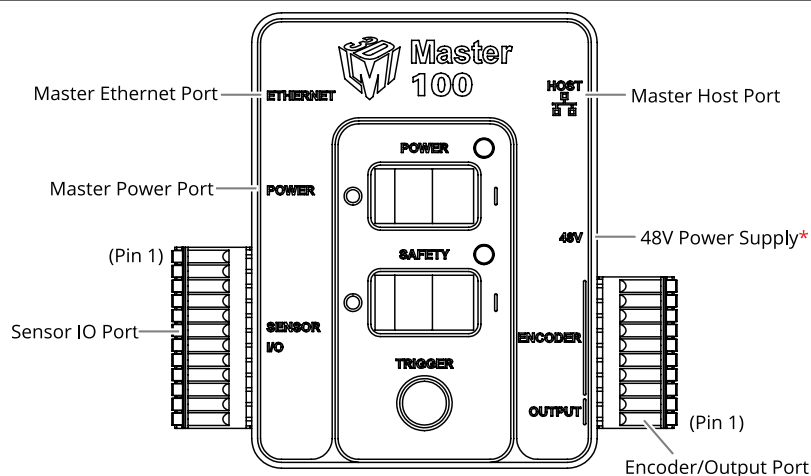
- If you use a Master 100 with a Gocator 3100 series sensor, you must use the latest version of the Master 100 with a metal-shielded Master Power Port and a Power & Ethernet cordset with a metal-shielded Power/Sync RJ45 plug.



The maximum cordset length is 60 m. See *Gocator I/O Connector* on page 488 and See *Gocator Power/LAN Connector* on page 486 for pinout details.

See *Accessories* on page 508 for cordset lengths and part numbers. Contact LMI for information on creating cordsets with customized lengths and connector orientations.

Master 100



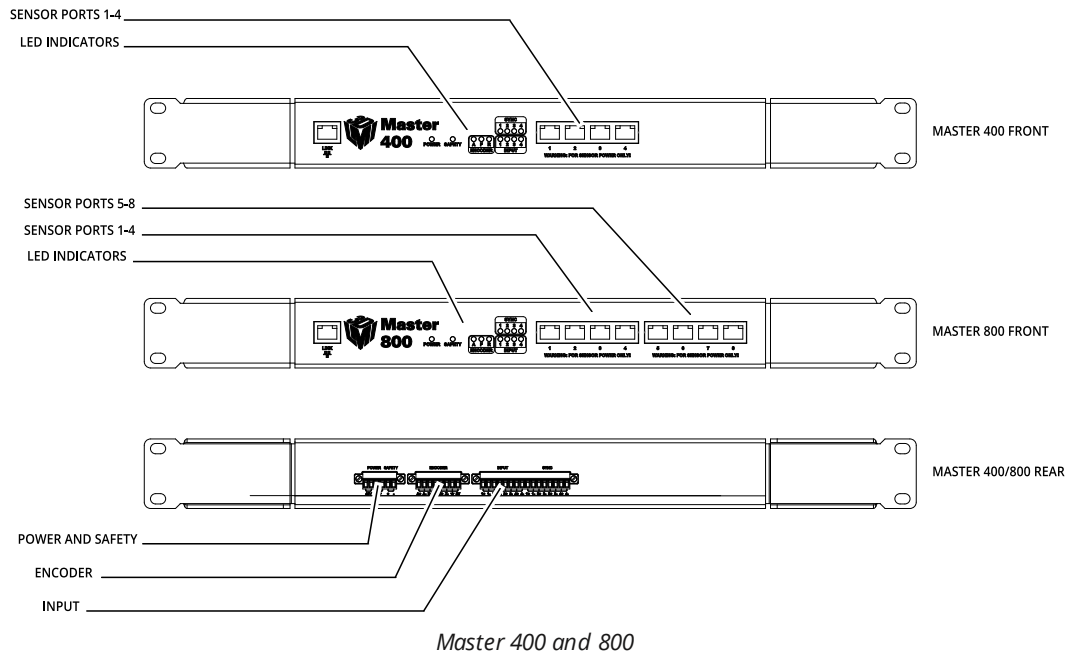
Item	Description
Master Ethernet Port	Connects to the RJ45 connector labeled Ethernet on the Power/LAN to Master cordset.
Master Power Port	Connects to the RJ45 connector labeled Power/Sync on the Power/LAN to Master cordset. Provides power and laser safety to the Gocator.
Sensor I/O Port	Connects to the Gocator I/O cordset.
Master Host Port	Connects to the host PC's Ethernet port.
Power	Accepts power (+48 V).
Power Switch	Toggles sensor power.
Laser Safety Switch	Toggles laser safety signal provided to the sensors [O= laser off, I= laser on].
Trigger	Signals a digital input trigger to the Gocator.
Encoder	Accepts encoder A, B and Z signals.
Digital Output	Provides digital output.

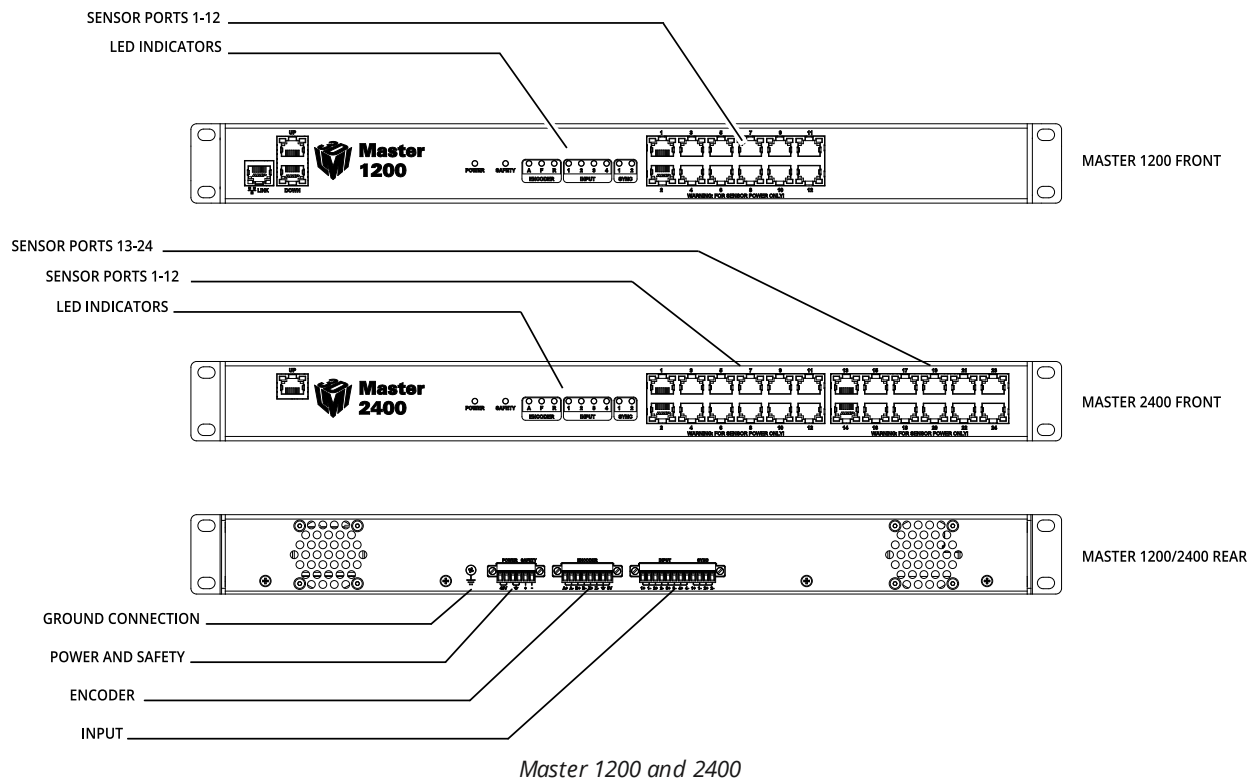
See *Master 100* on page 492 for pinout details.

Master 400 / 800 / 1200 / 2400

The Master 400, 800, 1200, and 2400 network controllers let you connect more than two sensors:

- Master 400: accepts four sensors
- Master 800 accepts eight sensors
- Master 1200: accepts twelve sensors
- Master 2400: accepts twenty-four sensors





Item	Description
Sensor Ports	Master connection for Gocator sensors (no specific order required).
Ground Connection	Earth ground connection point.
Power and Safety	Power and laser safety connection.
Encoder	Accepts encoder signal.
Input	Accepts digital input.

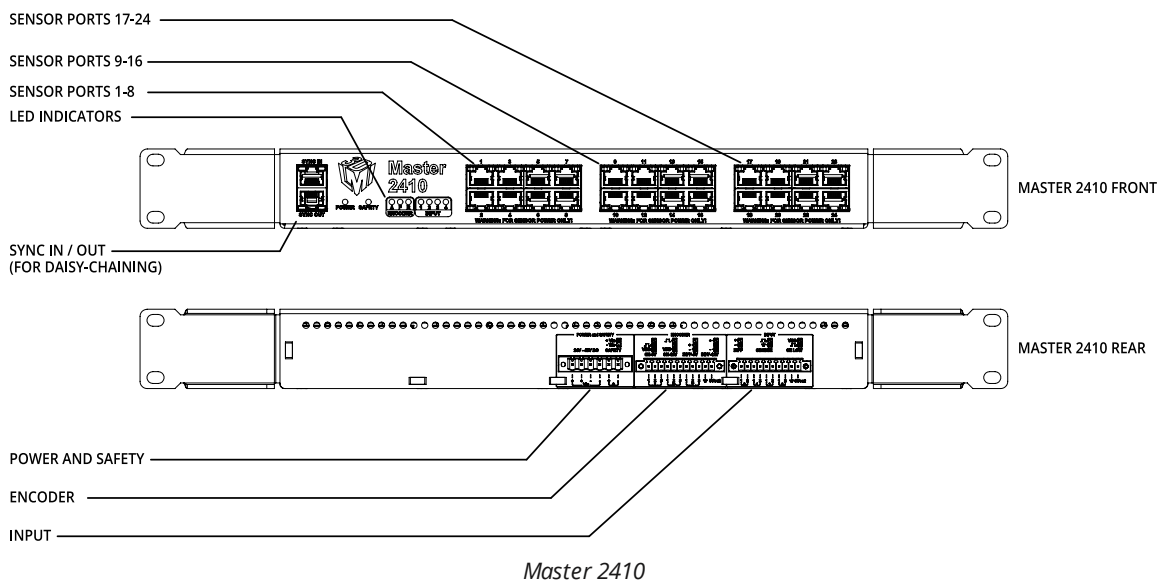
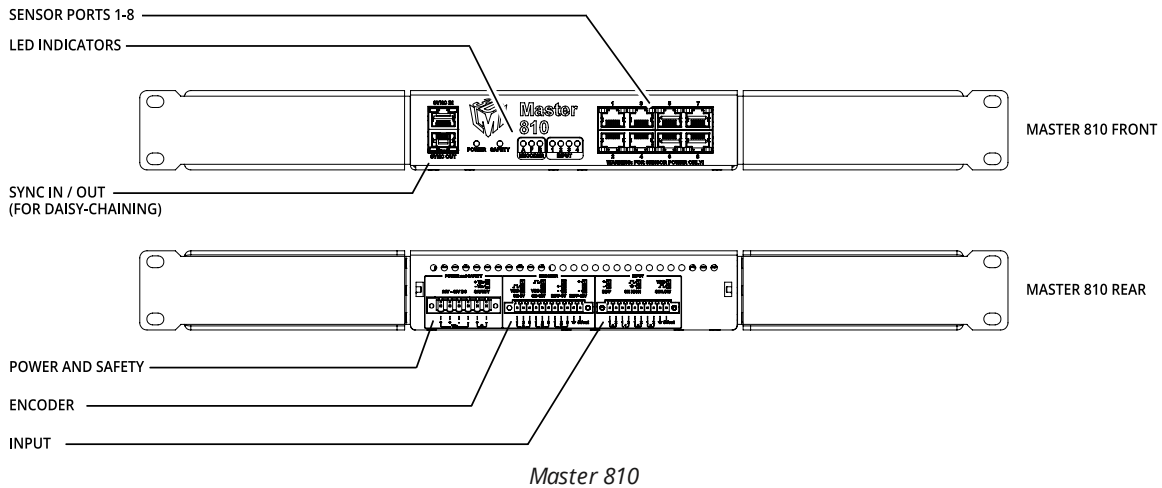
For pinout details for Master 400 or 800, see *Master 400/800* on page 494.

For pinout details for Master 1200 or 2400, see *Master 1200/2400* on page 505.

Master 810 / 2410

The Master 810 and 2410 network controllers let you connect more than two sensors:

- Master 810 accepts eight sensors
- Master 2410: accepts twenty-four sensors



Item	Description
Sensor Ports	Master connection for Gocator sensors (no specific order required).
Power and Safety	Power and laser safety connection.
Encoder	Accepts encoder signal.
Input	Accepts digital input.

For pinout details, see *Master 810/2410* on page 497.

Installation

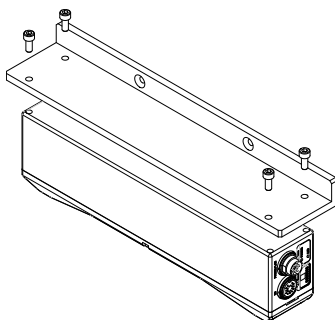
The following sections provide grounding, mounting, and orientation information.

Mounting

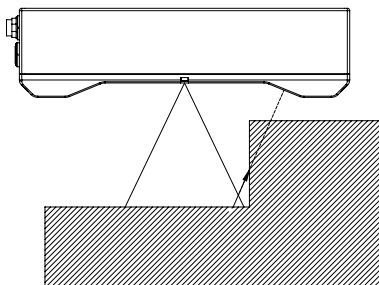
Sensors should be mounted using a model-dependent number of screws. Some models also provide the option to mount using bolts in through-body holes. Refer to the Dimension drawings of the sensors in *Specifications* on page 469 for the appropriate screw diameter, pitch, and length, and bolt hole diameter.



Proper care should be taken in order to ensure that the internal threads are not damaged from cross-threading or improper insertion of screws.



With the exception of Gocator 2880, sensors should not be installed near objects that might occlude a camera's view of the LED light pattern. (Gocator 2880 is specifically designed to compensate for occlusions.)



The sensor must be heat sunk through the frame it is mounted to. When a sensor is properly heat sunk, the difference between ambient temperature and the temperature reported in the sensor's health channel is less than 15° C.



Gocator sensors are high-accuracy devices. The temperature of all of its components must be in equilibrium. When the sensor is powered up, a warm-up time of at least one hour is required to reach a consistent spread of temperature within the sensor.

Grounding: Gocator

Gocators should be grounded to the earth/chassis through their housings and through the grounding shield of the Power I/O cordset. Gocator sensors have been designed to provide adequate grounding

through the use of M5 x 0.8 pitch mounting screws. Always check grounding with a multi-meter to ensure electrical continuity between the mounting frame and the Gocator's connectors.



The frame or electrical cabinet that the Gocator is mounted to must be connected to earth ground.

Installing DIN Rail Clips: Master 810 or 2410

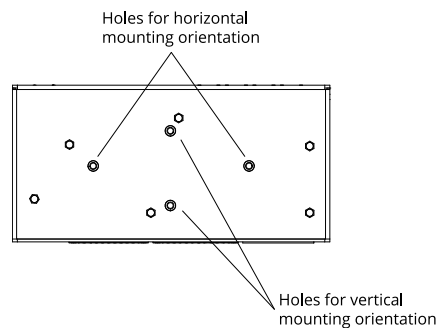
You can mount the Master 810 and 2410 using the included DIN rail mounting clips with M4x8 flat socket cap screws. The following DIN rail clips ([DINM12-RC](#)) are included:



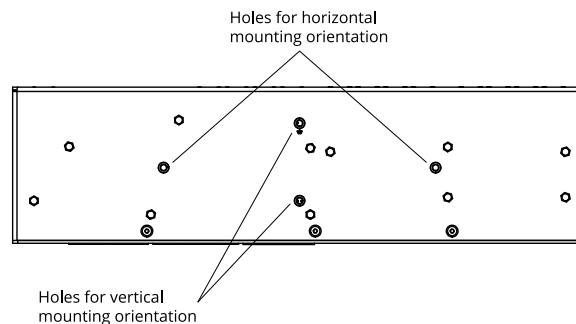
To install the DIN rail clips:

1. Remove the 1U rack mount brackets.
2. Locate the DIN rail mounting holes on the back of the Master (see below).

Master 810:

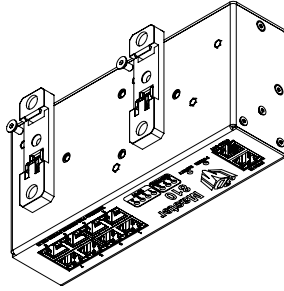


Master 2410:



3. Attach each of the two DIN rail mount clips to the back of the Master using an M4x8 flat socket cap screw for each one.

The following illustration shows the installation of clips on a Master 810 for horizontal mounting:



Ensure that there is enough clearance around the Master for cabling.

Grounding: Master Network Controllers

The rack mount brackets provided with all Masters are designed to provide adequate grounding through the use of star washers. Always check grounding with a multi-meter by ensuring electrical continuity between the mounting frame and RJ45 connectors on the front.



When using the rack mount brackets, you *must* connect the frame or electrical cabinet to which the Master is mounted to earth ground.

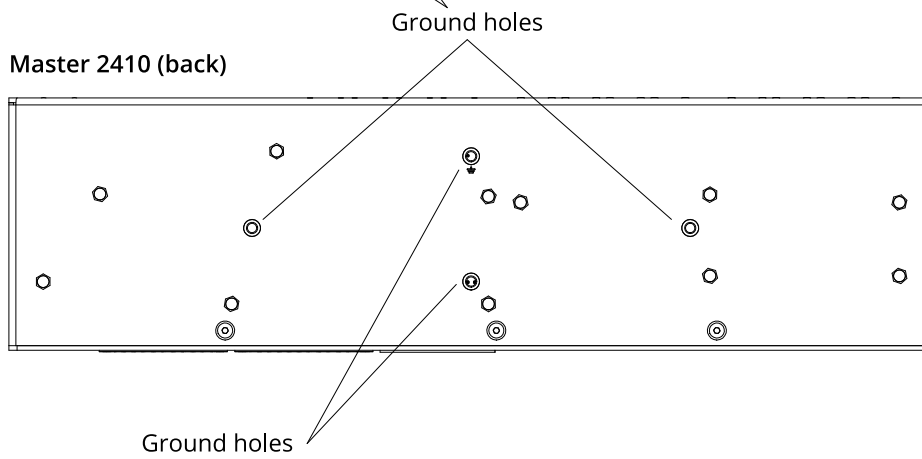
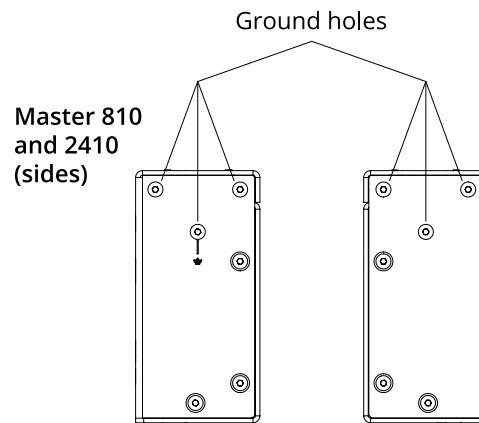
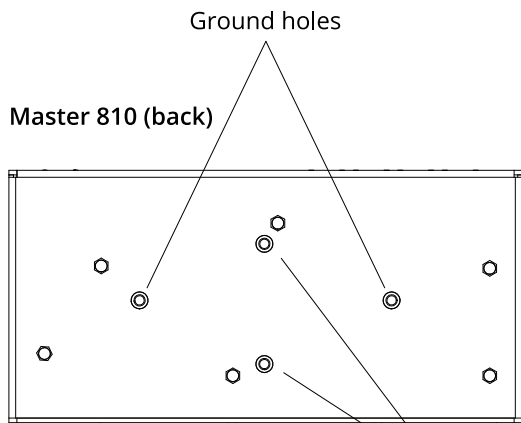


You *must* check electrical continuity between the mounting frame and RJ45 connectors on the front using a multi-meter.

If you are mounting Master 810 or 2410 using the provided DIN rail mount adapters, you must ground the Master directly; for more information, see *Grounding When Using a DIN Rail (Master 810/2410)* below.

Grounding When Using a DIN Rail (Master 810/2410)

If you are using DIN rail adapters instead of the rack mount brackets, you must ensure that the Master is properly grounded by connecting a ground cable to one of the holes indicated below. The holes accept M4x5 screws.



Network Setup

The following sections provide procedures for client PC and Gocator network setup.



DHCP is not recommended for Gocator sensors. If you choose to use DHCP, the DHCP server should try to preserve IP addresses. Ideally, you should use static IP address assignment (by MAC address) to do this.

Client Setup

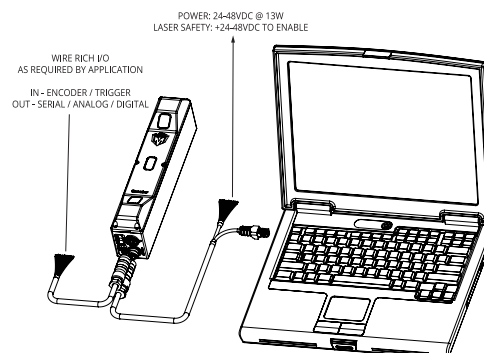
Sensors are shipped with the following default network configuration:

Setting	Default
DHCP	Disabled
IP Address	192.168.1.10
Subnet Mask	255.255.255.0
Gateway	0.0.0.0

To connect to a sensor for the first time:

1. Connect cables and apply power.

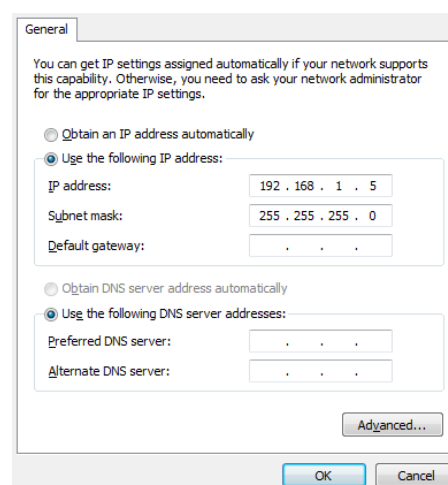
Sensor cabling is illustrated in *System Overview* on page 13.



2. Change the client PC's network settings.

Windows 7

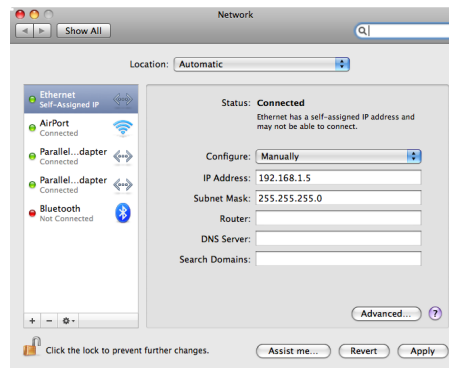
- a. Open the Control Panel, select **Network and Sharing Center**, and then click **Change Adapter Settings**.
- b. Right-click the network connection you want to modify, and then click **Properties**.
- c. On the **Networking** tab, click **Internet Protocol Version 4 (TCP/IPv4)**, and then click **Properties**.
- d. Select the **Use the following IP address** option.
- e. Enter IP Address "192.168.1.5" and Subnet



Mask "255.255.255.0", then click **OK**.

Mac OS X v10.6

- Open the Network pane in **System Preferences** and select **Ethernet**.
- Set **Configure** to **Manually**.
- Enter IP Address "192.168.1.5" and Subnet Mask "255.255.255.0", then click **Apply**.



See *Troubleshooting* on page 467 if you experience any problems while attempting to establish a connection to the sensor.

Gocator Setup

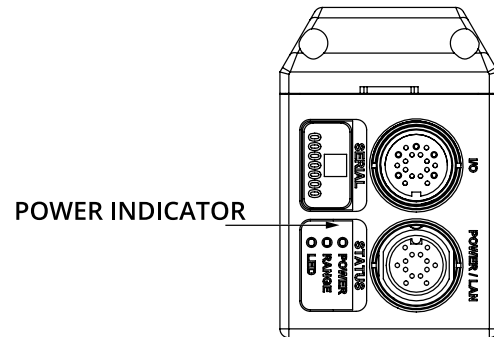
The Gocator is shipped with a default configuration that will produce 3D data for most targets.

The following sections describe how to set up a standalone sensor system and a multi-sensor system for operations. After you have completed the setup, 3D data can be acquired to verify basic sensor operation.

Running a Standalone Sensor System

To configure a standalone sensor system:

1. Power up the sensor.
The power indicator (blue) should turn on immediately.



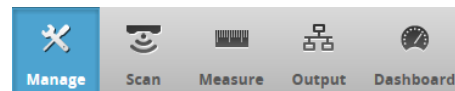
2. Enter the sensor's IP address (192.168.1.10) in a web browser.

The Gocator interface loads.

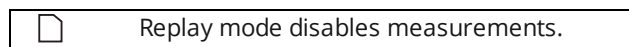
If a password has been set, you will be prompted to provide it and then log in.



3. Go to the **Manage** page.

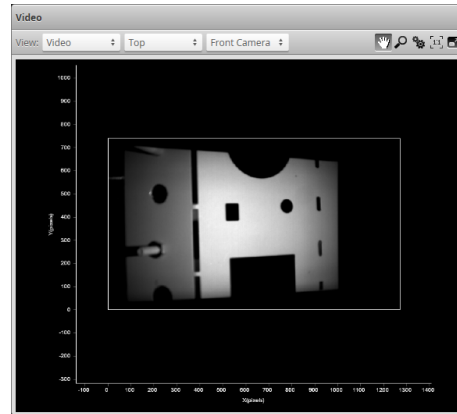


4. Ensure that Replay mode is off (the slider is set to the left).



5. Go to the **Scan** page.
6. Observe the profile in the data viewer
7. Press the **Start** button or the **Snapshot** on the **Toolbar** to start the sensor.
The **Start** button is used to run sensors continuously.
The **Snapshot** button is used to trigger the capture of a single 3D point cloud.

8. Move a target into the LED light pattern.
If a target object is within the sensor's measurement range, the data viewer will display the shape of the target, and the sensor's range indicator will illuminate. If you cannot see the laser, or if a 3D heightmap is not displayed in the Data Viewer, see *Troubleshooting* on page 467.



9. Press the **Stop** button.
The LED light projection should turn off.

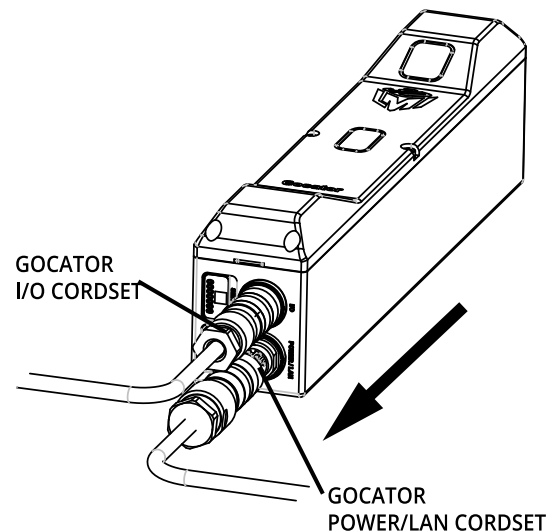


Running a Multi-Sensor System

All sensors are shipped with a default IP address of 192.168.1.10. Ethernet networks require a unique IP address for each device, so you must set up a unique address for each sensor. For each additional sensor, follow the steps below.

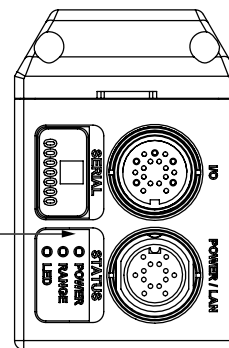
To configure a multi-sensor system:

1. Turn off the sensor and unplug the Ethernet network connection of any configured sensors.



2. Power up the new sensor.
The power LED (blue) of the new sensor should turn on immediately.

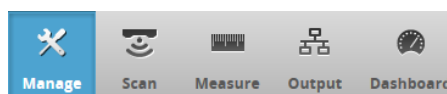
POWER INDICATOR



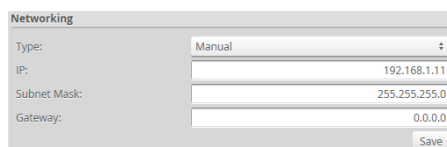
3. Enter the new sensor's default IP address (192.168.1.10) in a web browser.
The Gocator interface loads.



4. Go to the **Manage** page.

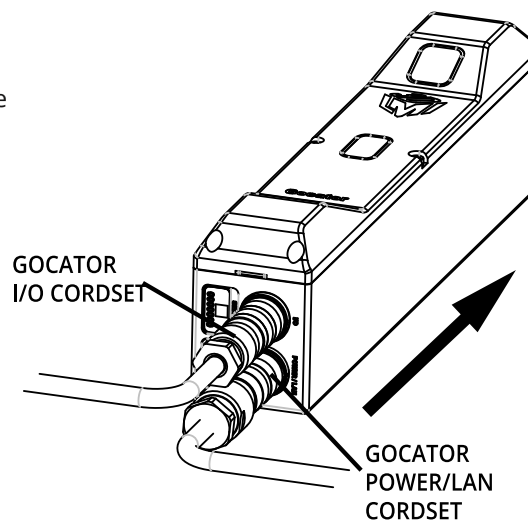


5. Modify the IP address in the **Networking** category and click the **Save** button.
You should increment the last octet of the IP address for each additional sensor you need to use. For example, if the IP address of the first sensor you configured is 192.168.1.10, use 192.168.1.11 for the second sensor; use 192.168.1.12 for the third; etc.



When you click the **Save** button, you will be prompted to confirm your selection.

6. Power-cycle or reset the sensor.
After changing a sensor's network configuration, the sensor must be reset or power-cycled before the change will take effect.



7. Repeat these steps for each additional sensor.

Next Steps

After you complete the steps in this section, the Gocator measurement system is ready to be configured for an application using the software interface. The interface is explained in the following sections:

Management and Maintenance (page 51)

Contains settings for sensor system layout, network, motion and alignment, handling jobs, and sensor maintenance.

Scan Setup and Alignment (page 63)

Contains settings for scan mode, trigger source, detailed sensor configuration, and performing alignment.

Models (page 98)

Contains settings for creating part matching models and sections.

Measurement (page 119)

Contains built-in measurement tools and their settings.

Output (page 234)

Contains settings for configuring output protocols used to communicate measurements to external devices.

Dashboard (page 246)

Provides monitoring of measurement statistics and sensor health.

Toolbar (page 40)

Controls sensor operation, manages jobs, and replays recorded measurement data.

How Gocator Works

The following sections provide an overview of how Gocator acquires and produces data, detects and measures parts, and controls devices such as PLCs. Some of these concepts are important for understanding how you should mount sensors and configure settings such as active area.

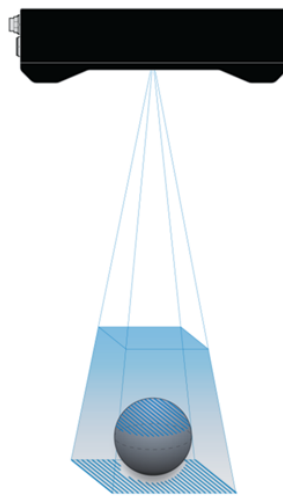


You can use the Gocator Accelerator to speed up processing of data. For more information, see *Gocator Accelerator* on page 264.

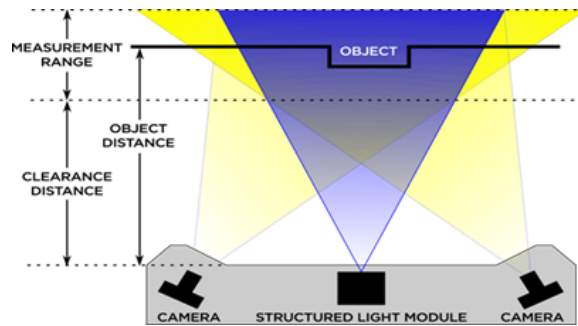
3D Acquisition

After a Gocator system has been set up and is running, it is ready to start capturing 3D data.

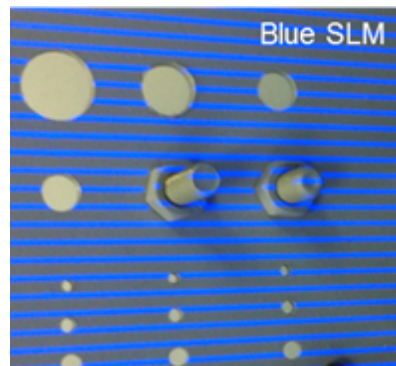
Gocator 3100 series sensors are 3D snapshot sensors, meaning they capture an entire surface in 3D in a single snapshot. These sensors project several structured light patterns in a rapid sequence onto the target. The reflection of the pattern off the target is captured by two cameras. The target must remain stationary during the camera exposure of the light patterns. The required exposure time depends on the shape, color, and reflectiveness of the target, but is often shorter than 1 second.



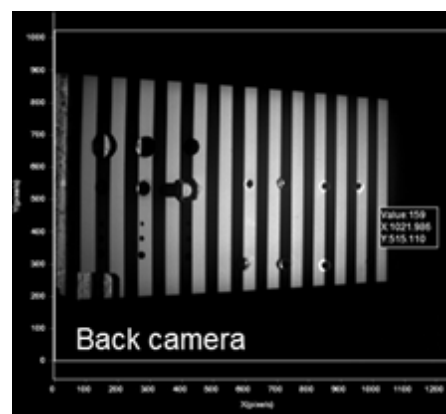
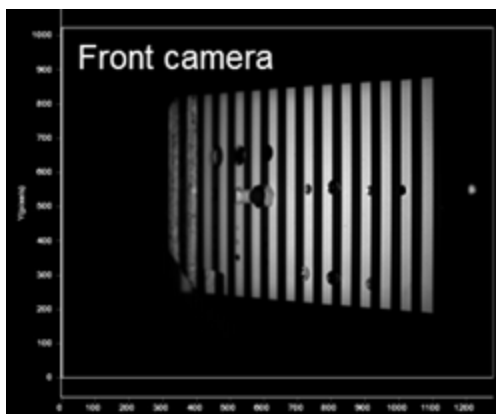
A Structured Light Modulator (SLM) produces a sequence of high resolution/high contrast light patterns using a blue LED. Two cameras capture the reflected light pattern from different viewing angles. The sensor can then use either stereo correlation or independent triangulation to generate 3D points from the light pattern.



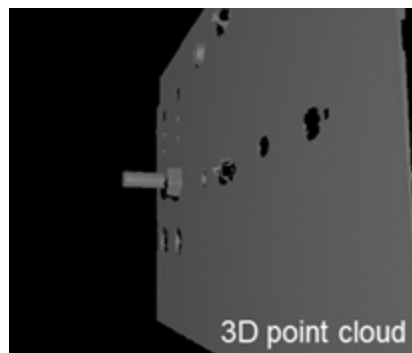
These are the steps of the acquisition of a 3D point cloud:



Step 1: Light pattern projected on target



Step 2: Reflected light captured by two cameras



Step 3: Use stereo correlation or independent triangulation to generate 3D point cloud



Gocator sensors are always pre-calibrated to deliver 3D data in engineering units throughout their measurement range.

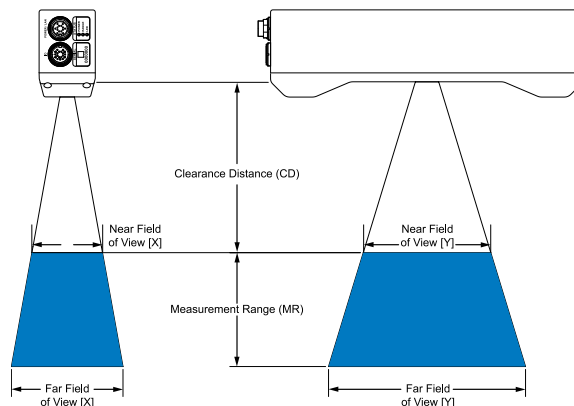
Clearance Distance, Field of View and Measurement Range

Clearance distance (CD), field of view (FOV), and measurement range (MR) are important concepts for understanding the setup of a Gocator sensor and for understanding results.

Clearance distance – The minimum distance from the sensor that a target can be scanned and measured. A target closer than this distance will result in invalid data.

Measurement range – The vertical distance, starting at the end of the clearance distance, in which targets can be scanned and measured. Targets beyond the measurement range will result in invalid data.

Field of view – The the area on the XY plane along the measurement range. At the far end of the measurement range, the field of view is larger, but the resolution is lower. At the near end, the field of view is smaller, but the resolution is higher. When resolution is critical, if possible, place the target closer to the near end. (For more information on the relation between target distance and resolution, see



Stereo Correlation vs. Independent Triangulation

Stereo correlation means that the sensor locates the same point on the physical target in the two images captured at different viewing angles. Since the exact distance between the two cameras and the viewing angles are known, the distance to the point can be calculated. In order for stereo correlation to work and produce a 3D data point, the point on the target must be visible in both cameras. Stereo acquisition may produce more stable measurements on targets with a simple shape, but will be affected by occlusions on targets with complicated shapes and protruding features.

Independent triangulation means that each camera independently triangulates off the LED light pattern, based on the calibration process that takes place when the sensor is manufactured. Since the Gocator 3100 sensor has two cameras, a point on the physical target only needs to be visible to one of the

cameras in order to generate a 3D point. Independent triangulation may improve performance on targets with complicated shapes that can cause occlusion, but it relies on the sensor's internal components being fully stable.

The **Reduce Occlusion** setting determines whether 3D data is acquired by using stereo correlation or both stereo correlation and independent triangulation. See *Reduce Occlusion* on page 68 for more details.

Acquisition Speed

The following table provides estimates of the acquisition speed (Hz) for Gocator 3110 under different field-of-view, resolution, intensity, and occlusion reduction settings.

The exposure was set to 2 milliseconds with no measurement tools added.

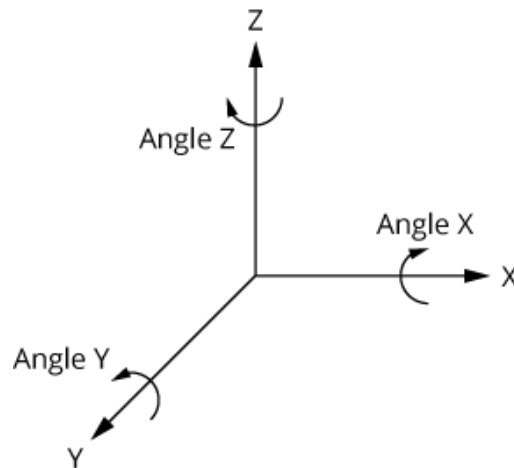
Field of View (X x Y x MR)	Resolution (mm)	Speed (Hz)
		Acquire Intensity and Reduce Occlusion options disabled
90x160x100	0.5	1.2
90x160x100	0.2	0.8
90x160x100	0.1	0.2
35x35x100	0.5	7.5
35x35x100	0.2	2.7
35x35x100	0.1	1.9
35x35x35	0.5	9
35x35x35	0.2	6.8
35x35x35	0.1	4.0

3D Data Output

Gocator measures the shape of the object calculated from either dual triangulation or stereo correlation. The Gocator reports a series of 3D coordinates from the surface of the target in the sensor's field of view.

Coordinate Systems

Gocator 3100 sensors use Cartesian left-hand notation for defining 3D coordinates.



The Z axis represents the sensor's measurement range (MR), where the values increase toward the sensor. The X axis and Y axis represent the sensor's field of view (FOV).

X offset, Y offset, and Z offset define the translations from the origin.

Rotations are specified based on rotating the target around the X axis (Angle X), followed by rotating around the Y axis (Angle Y), followed by rotating around the Z axis.

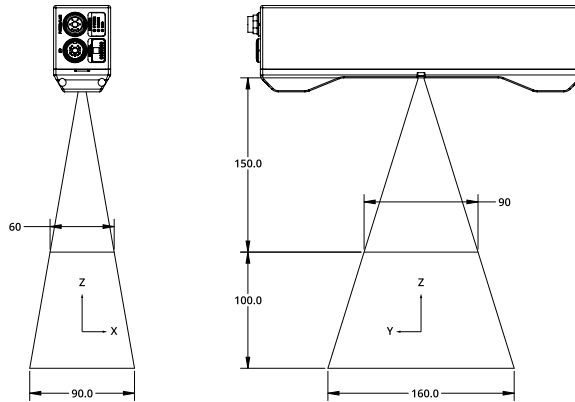
3D point cloud data is reported in sensor coordinates or system coordinates depending on the alignment state of the sensor. These coordinate systems are described below.

Sensor Coordinates

Unaligned sensors use the coordinate system shown below.

The measurement range (MR) is along the Z axis. Values increase toward the sensor. The origin is at the center of the MR.

Before alignment, the origin of the sensor is at the center of the sensor's measurement range (MR) and field of view (FOV).



System Coordinates

Aligning sensors adjusts the coordinate system in relation to sensor coordinates.

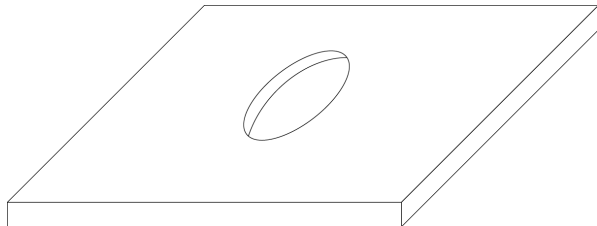
Alignment is used with a single sensor to compensate for mounting misalignment and to set a zero reference, such as a conveyor belt surface.

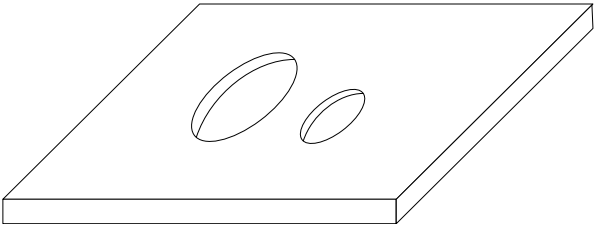
Alignment is also used to set a common coordinate system for dual-sensor systems. That is, profiles and measurements from the sensors are expressed in a unified coordinate system.

Alignment can be used to establish a transformed coordinate system according to the user's needs.

Alignment determines the adjustments to X, Y, and Z, as well as rotation angle around each axis.

Transformed coordinate systems can be associated with specific sensor jobs. For details, see *Alignment Types* on page 80.

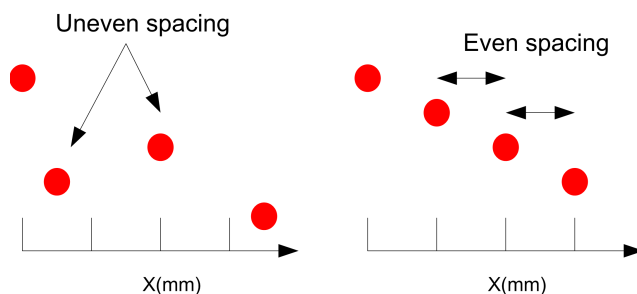
Target	Alignment	Explanation
Flat surface	Z offset	System coordinates are aligned such that the system Z axis is perpendicular to the calibration plate surface. The system Z origin is set to the base of the calibration plate (using the Z Offset parameter).
	Angle X	
	Angle Y	
Plate (single reference hole)	X offset	The center of the hole defines the location of the X, Y and Z origins. The orientation of the surface determines Angle X and Y.
	Y offset	
	Z offset	
	Angle X	
	Angle Y	
		
Plate (with two reference holes)	X offset	The sizes of the primary and the secondary holes must be different. The center of the primary hole defines the location of the X, Y, and Z origins. The orientation of the surface determines Angle X and Y. The direction of the primary and secondary holes determines Angle Z.
	Y offset	
	Z offset	
	Angle X	
	Angle Y	
	Angle Z	

Target	Alignment	Explanation
		

For more information on aligning sensors, see *Alignment* on page 79.

Resampling

The internal acquisition engine in the Gocator produces a random 3D point cloud where each individual point is an (X,Y,Z) coordinate triplet. In Surface mode, the random 3D point cloud is resampled to an even grid in the X-Y plane. The resampling divides the X-Y plane into fixed size square "bins." 3D points are projected along the Z axis, perpendicular to the X-Y plane, and points that fall into the same bin will be combined into a single Z value. The size of the resampling bins can be set with the **X Spacing Interval** setting; for details, see *Spacing Interval* on page 78. The X-Y resampling plane is established through the Gocator's built-in alignment routine. That is, the resampling plane is set to match the plane described by the calibration plate; for more information, *System Coordinates* on the previous page.



In the Ethernet data channel, only the Z values are reported and the X and Y positions can be reconstructed through the 2D-array index at the receiving end (the client). Resampling reduces the complexity for the algorithms in the Gocator's built-in measurement tools, allowing them to run on the embedded processors. All built-in measurement tools in the Gocator operate on resampled data in Surface mode.

Data Generation and Processing

After scanning a target, Gocator can process the scan data to allow the use of more sophisticated measurement tools. This section describes the following concepts:

- Part detection
- Sectioning

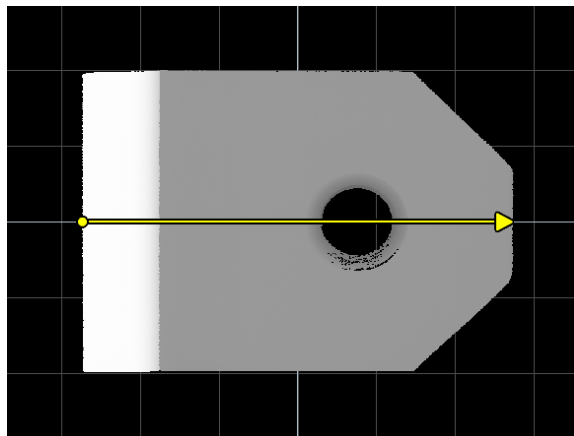
Part Detection

Gocator can isolate discrete parts on a generated surface into separate scans representing parts. Gocator can then perform measurements on these isolated parts.

For more information on part detection, see *Part Detection* on page 85.

Sectioning

In Surface mode, Gocator can also extract a profile from a surface or part using a line you define on that surface or part. The resulting profile is called a “section.” A section can have any orientation on the surface, but its profile is parallel to the Z axis.



You can use most of Gocator's profile measurement tools on a section, letting you perform measurements that are not possible with surface measurement tools.

For more information on sections, see *Sections* on page 113.

Part Matching

Gocator can match scanned parts to the edges of a model based on a previously scanned part (see *Using Edge Detection* on page 100) or to the dimensions of a fitted bounding box or ellipse that encapsulate the model (see *Using Bounding Box and Ellipse* on page 109). When parts match, Gocator can rotate scans so that they are all oriented in the same way. This allows measurement tools to be applied consistently to parts, regardless of the orientation of the part you are trying to match.

Measurement and Anchoring

After Gocator scans a target and, optionally, [further processes](#) the data, the sensor is ready to take measurements on the scan data.

Gocator provides several measurement tools, each of which provides a set of individual measurements, giving you dozens of measurements ideal for a wide variety of applications to choose from. The configured measurements start returning pass/fail decisions, as well as the actual measured values, which are then sent over the enabled [output](#) channels to control devices such as PLCs, which can in turn control ejection or sorting mechanisms. (For more information on measurements and configuring measurements, see *Measurement* on page 119.)



You can create custom measurement tools that run your own algorithms. For more information, see *GDK* on page 443.

A part's position can vary on a transport system. To compensate for this variation, Gocator can anchor a measurement to the positional measurement (X, Y, or Z) or Z angle of an easily detectable feature, such as the edge of a part. The calculated offset between the two ensures that the anchored measurement will always be properly positioned on different parts.

If combined with the matching and rotation capabilities of [part matching](#), anchoring accounts for most sources of variation in part position and orientation and, consequently, avoids many measurement errors. For more information on anchoring, see *Measurement Anchoring* on page 131.

Output and Digital Tracking

After Gocator has scanned and measured parts, the last step in the operation flow is to output the results and/or measurements.

One of the main functions of Gocator sensors is to produce pass/fail decisions, and then control something based on that decision. Typically, this involves rejecting a part through an eject gate, but it can also involve making decisions on good, but different, parts. This is described as “output” in Gocator. Gocator supports the following output types:

- Ethernet (which provides industry-standard protocols such as Modbus, EtherNet/IP, and ASCII, in addition to the Gocator protocol)
- Digital
- Analog
- Serial interfaces

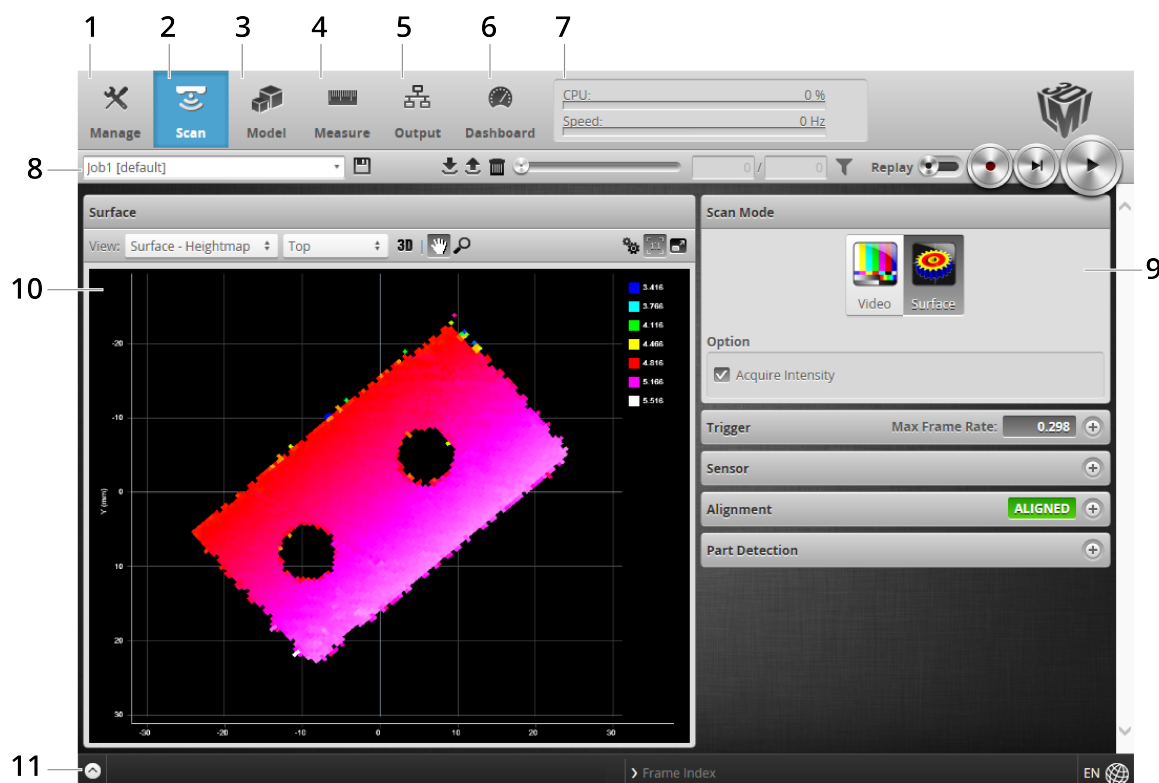
An important concept is digital output tracking. Different production lines can place an ejection or sorting mechanism at different distances from where the sensor scans the target. For this reason, Gocator lets you schedule a delayed decision over the digital interfaces. Because the conveyor system on a typical production line will use an encoder or have a known, constant speed, targets can effectively be “tracked” or “tagged.” Gocator will know when a defective part has traveled far enough and trigger a PLC to activate an ejection/sorting mechanism at the correct moment. For more information on digital output tracking, see *Digital Output* on page 239.

Gocator Web Interface

The following sections describe the Gocator web interface.

User Interface Overview

Gocator sensors are configured by connecting to a *Main* sensor with a web browser. The Gocator web interface is illustrated below.

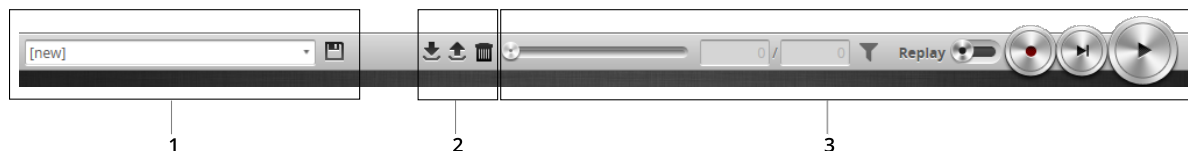


Element	Description
1	Manage page Contains settings for sensor system layout, network, motion and alignment, handling jobs, and sensor maintenance. See <i>Management and Maintenance</i> on page 51.
2	Scan page Contains settings for scan mode, trigger source, detailed sensor configuration, and performing alignment. See <i>Scan Setup and Alignment</i> on page 63.
3	Model page Lets you set up sections and part matching. See <i>Models</i> on page 98

	Element	Description
4	Measure page	Contains built-in measurement tools and their settings. See <i>Measurement</i> on page 119.
5	Output page	Contains settings for configuring output protocols used to communicate measurements to external devices. See <i>Output</i> on page 234.
6	Dashboard page	Provides monitoring of measurement statistics and sensor health. See <i>Dashboard</i> on page 246.
7	CPU Load and Speed	Provides important sensor performance metrics. See <i>Metrics Area</i> on page 47.
8	Toolbar	Controls sensor operation, manages jobs, and filters and replays recorded measurement data. See <i>Toolbar</i> below.
9	Configuration area	Provides controls to configure scan and measurement tool settings.
10	Data viewer	Displays sensor data, tool setup controls, and measurements. See <i>Data Viewer</i> on page 89 for its use when the Scan page is active and on page 120 for its use when the Measure page is active.
11	Status bar	Displays log messages from the sensor (errors, warnings, and other information) and frame information , and lets you switch the interface language . For more information,

Toolbar

The toolbar is used for performing operations such as managing jobs, working with replay data, and starting and stopping the sensor.



	Element	Description
1	Job controls	For saving and loading jobs.
2	Replay data controls	For downloading, uploading, and exporting recorded data.
3	Sensor operation / replay control	Use the sensor operation controls to start sensors, enable and filter recording, and control recorded data.

Creating, Saving and Loading Jobs (Settings)

A Gocator can store several hundred jobs. Being able to switch between jobs is useful when a Gocator is used with different constraints during separate production runs. For example, width decision minimum and maximum values might allow greater variation during one production run of a part, but might allow less variation during another production run, depending on the desired grade of the part.

Most of the settings that can be changed in the Gocator's web interface, such as the ones in the **Manage**, **Measure**, and **Output** pages, are temporary until saved in a job file. Each sensor can have

multiple job files. If there is a job file that is designated as the default, it will be loaded automatically when the sensor is reset.

When you change sensor settings using the Gocator web interface in the emulator, some changes are saved automatically, while other changes are temporary until you save them manually. The following table lists the types of information that can be saved in a sensor.

Setting Type	Behavior
Job	Most of the settings that can be changed in the Gocator's web interface, such as the ones in the Manage , Measure , and Output pages, are temporary until saved in a job file. Each sensor can have multiple job files. If there is a job file that is designated as the default, it will be loaded automatically when the sensor is reset.
Alignment	Alignment can either be fixed or dynamic, as controlled by the Alignment Reference setting in Motion and Alignment in the Manage page. Alignment is saved automatically at the end of the alignment procedure when Alignment Reference is set to Fixed . When Alignment Reference is set to Dynamic , however, you must manually save the job to save alignment.
Network Address	Network address changes are saved when you click the Save button in Networking on the Manage page. The sensor must be reset before changes take effect.

The job drop-down list in the toolbar shows the jobs stored in the sensor. The job that is currently active is listed at the top. The job name will be marked with "[unsaved]" to indicate any unsaved changes.



To create a job:

1. Choose **[New]** in the job drop-down list and type a name for the job.
2. Click the **Save** button  or press **Enter** to save the job.
The job is saved to sensor storage using the name you provided. Saving a job automatically sets it as the default, that is, the job loaded when the sensor is restarted.

To save a job:

- Click the **Save** button .
- The job is saved to sensor storage. Saving a job automatically sets it as the default, that is, the job loaded when the sensor is restarted.

To load (switch) jobs:

- Select an existing file name in the job drop-down list.
- The job is activated. If there are any unsaved changes in the current job, you will be asked whether you want to discard those changes.

You can perform other job management tasks—such as downloading job files from a sensor to a computer, uploading job files to a sensor from a computer, and so on—in the **Jobs** panel in the **Manage** page. See *Jobs* on page 54 for more information.

Recording, Playback, and Measurement Simulation

Gocator sensors can record and replay recorded scan data, and also simulate measurement tools on recorded data. This feature is most often used for troubleshooting and fine-tuning measurements, but can also be helpful during setup.

Recording and playback are controlled using the toolbar controls.



Recording and playback controls when replay is off

To record live data:

1. Toggle **Replay** mode off by setting the slider to the left in the **Toolbar**.

 Replay mode disables measurements.

2. (Optional) Configure recording filtering.
For more information on recording filtering, see *Recording Filtering* on page 44.
3. Click the **Record** button to enable recording.

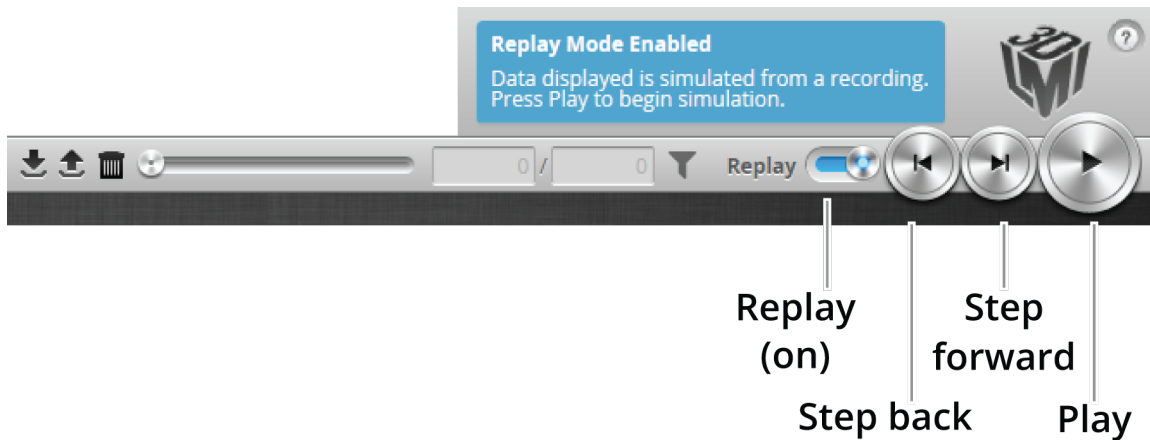


The center of the Record button turns red.

When recording is enabled (and replay is off), the sensor will store the most recent data as it runs. Remember to disable recording if you no longer want to record live data. (Press the **Record** button again to disable recording).

4. Press the **Snapshot** button or **Start** button.
The **Snapshot** button records a single frame. The **Start** button will run the sensor continuously and all frames will be recorded, up to available memory. When the memory limit is reached, the oldest data will be discarded.

 Newly recorded data is appended to existing replay data unless the sensor job has been modified.



Playback controls when replay is on

To replay data:

1. Toggle **Replay** mode on by setting the slider to the right in the **Toolbar**.
The slider's background turns blue and a Replay Mode Enabled message is displayed.
2. Use the **Replay** slider or the **Step Forward**, **Step Back**, or **Play** buttons to review data.
The **Step Forward** and **Step Back** buttons move and the current replay location backward and forward by a single frame, respectively.
The **Play** button advances the replay location continuously, animating the playback until the end of the replay data.
The **Stop** button (replaces the **Play** button while playing) can be used to pause the replay at a particular location.
The **Replay** slider (or **Replay Position** box) can be used to go to a specific replay frame.

To simulate measurements on replay data:

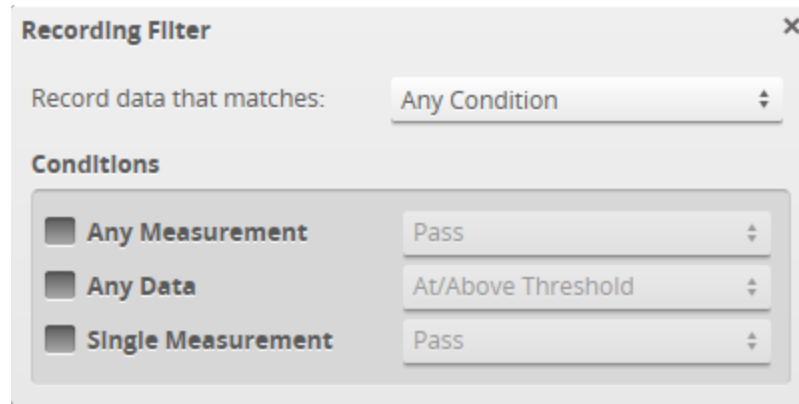
1. Toggle **Replay** mode on by setting the slider to the right in the **Toolbar**.
The slider's background turns blue and a Replay Mode Enabled message is displayed.
To change the mode, **Replay Protection** must be unchecked.
2. Go to the **Measure** page.
Modify settings for existing measurements, add new measurement tools, or delete measurement tools as desired. For information on adding and configuring measurements, see *Measurement* on page 119.
3. Use the **Replay Slider**, **Step Forward**, **Step Back**, or **Play** button to simulate measurements.
Step or play through recorded data to execute the measurement tools on the recording.
Individual measurement values can be viewed directly in the data viewer. Statistics on the measurements that have been simulated can be viewed in the **Dashboard** page; for more information on the dashboard, see *Dashboard* on page 246.

To clear replay data:

1. Stop the sensor if it is running by clicking the **Stop** button.
2. Click the **Clear Replay Data** button .

Recording Filtering

Replay data is often used for troubleshooting. But replay data can contain thousands of frames, which makes finding a specific frame to troubleshoot difficult. Recording filtering lets you choose which frames Gocator records, based on one or more conditions, which makes it easier to find problems.



How Gocator treats conditions

Setting	Description
Any Condition	Gocator records a frame when any condition is true.
All Conditions	Gocator only records a frame if all conditions are true.

Conditions

Setting	Description
Any Measurement	Gocator records a frame when <i>any</i> measurement is in the state you select. The following states are supported: • pass • fail or invalid • fail and valid • valid • invalid
Single Measurement	Gocator records a frame if the measurement with the ID you specify in ID is in the state you select. This setting supports the same states as the Any Measurement setting (see above).
Any Data	At/Above Threshold: Gocator records a frame if the number of valid points in the frame is above the value you specify in Range Count Threshold. Below Threshold: Gocator records a frame if the number of valid points is below the threshold you specify. In Surface mode, the number of valid points in the surface is compared to the threshold, not any sections that may be defined.

To set recording filtering:

1. Make sure recording is enabled by clicking the Record button.



2. Click the Recording Filtering button .
3. In the Recording Filtering dialog, choose how Gocator treats conditions:
For information on the available settings, see *How Gocator treats conditions* on the previous page.
4. Configure the conditions that will cause Gocator to record a frame:
For information on the available settings, see *Conditions* on the previous page.
5. Click the "x" button or outside of the Recording Filtering dialog to close the dialog.
The recording filter icon turns green to show that recording filters have been set.
When you run the sensor, Gocator only records the frames that satisfy the conditions you have set.

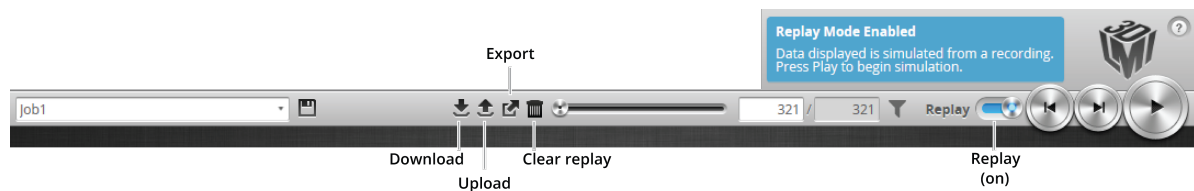
Downloading, Uploading, and Exporting Replay Data

Replay data (recorded scan data) can be downloaded from a Gocator to a client computer, or uploaded from a client computer to a Gocator.

Data can also be exported from a Gocator to a client computer in order to process the data using third-party tools.



You can only upload replay data to the same sensor model that was used to create the data.



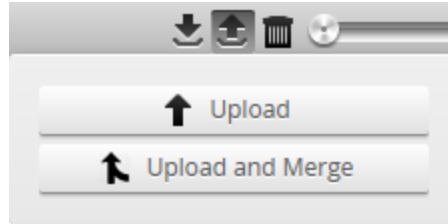
Replay data is not loaded or saved when you load or save jobs.

To download replay data:

1. Click the Download button .
2. In the **File Download** dialog, click **Save**.
3. In the **Save As...** dialog, choose a location, optionally change the name (keeping the .rec extension), and click **Save**.

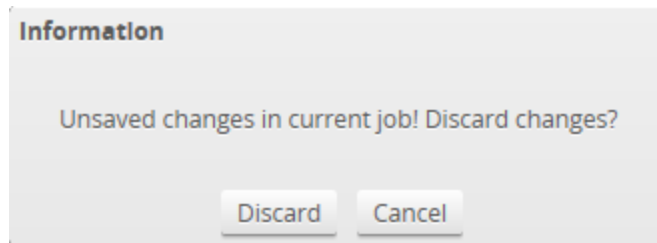
To upload replay data:

1. Click the Upload button .
- The Upload menu appears.



2. In the Upload menu, choose one of the following:
 - **Upload:** Unloads the current job and creates a new unsaved and untitled job from the content of the replay data file.
 - **Upload and merge:** Uploads the replay data and merges the data's associated job with the current job. Specifically, the settings on the **Scan** page are overwritten, but all other settings of the current job are preserved, including any measurements or models.

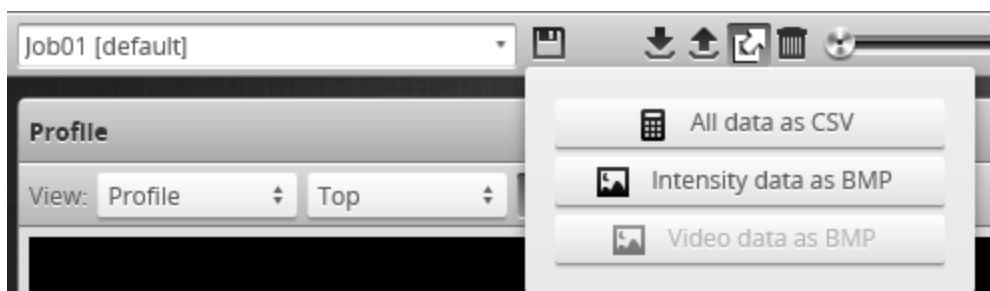
If you have unsaved changes in the current job, the firmware asks whether you want to discard the changes.



3. Do one of the following:
 - Click **Discard** to discard any unsaved changes.
 - Click **Cancel** to return to the main window to save your changes.
4. If you clicked **Discard**, navigate to the replay data to upload from the client computer and click **OK**. The replay data is loaded, and a new unsaved, untitled job is created.

Replay data can be exported using the CSV format.

 *Surface* intensity data cannot be exported to the CSV format. It can only be [exported separately as a bitmap](#).



To export replay data in the CSV format:

1. In the **Scan Mode** panel, switch to Profile or Surface.
2. Click the Export button  and select **All Data as CSV**.
Only data at the current replay location is exported.
Use the playback control buttons to move to a different replay location; for information on playback, see *To replay data in Recording, Playback, and Measurement Simulation* on page 42.
3. (Optional) Convert exported data to another format using the CSV Converter Tool. For information on this tool, see *CSV Converter Tool* on page 465.



The decision values in the exported data depend on the *current* state of the job, not the state during recording. For example, if you record data when a measurement returns a *pass* decision, change the measurement's settings so that a *fail* decision is returned, and then export to CSV, you will see a *fail* decision in the exported data.

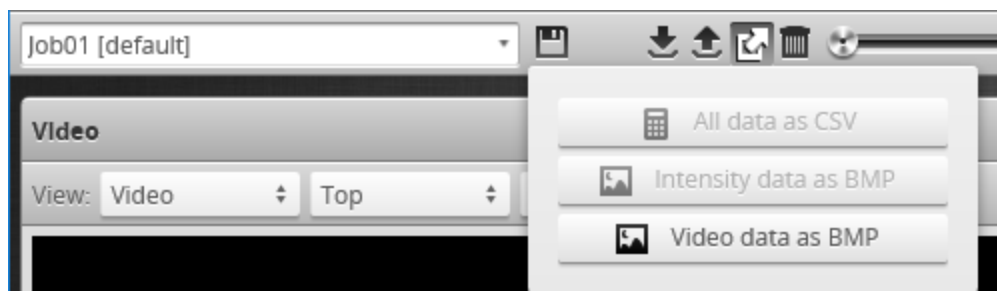
Recorded intensity data can be exported to a bitmap (.BMP format). **Acquire Intensity** must be checked in the **Scan Mode** panel while data was being recorded in order to export intensity data.

To export recorded intensity data to the BMP format:

- Click the **Export** button  and select **Intensity data as BMP**.

Only the intensity data in the current replay location is exported.

Use the playback control buttons to move to a different replay location; for information on playback, see *To replay data in Recording, Playback, and Measurement Simulation* on page 42.



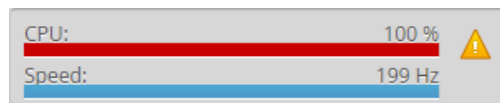
To export video data to a BMP file:

1. In the **Scan Mode** panel, switch to Video mode.
Use the playback control buttons to move to a different replay location; for information on playback, see *To replay data in Recording, Playback, and Measurement Simulation* on page 42.
2. Click the Export button  and select **Video data as BMP**.

Metrics Area

The **Metrics** area displays two important sensor performance metrics: CPU load and speed (current frame rate).

The **CPU** bar in the **Metrics** panel (at the top of the interface) displays how much of the CPU is being utilized.

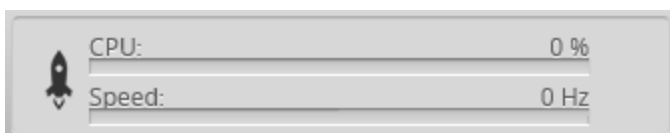


CPU at 100%

The **Speed** bar displays the frame rate of the sensor. A warning symbol (⚠) will appear next to it if triggers (external input or encoder) are dropped because the external rate exceeds the maximum frame rate.

Open the log for details on the warning. For more information on logs, see *Log* below.

When a sensor is [accelerated](#) a "rocket" icon appears in the metrics area.



Data Viewer

The data viewer is displayed in both the **Scan** and the **Measure** pages, but displays different information depending on which page is active.

When the **Scan** page is active, the data viewer displays sensor data and can be used to adjust the active area and other settings. Depending on the selected operation mode (page 64), the data viewer can display video images, sections, or surfaces. For details, see *Data Viewer* on page 89.

When the **Measure** page is active, the data viewer displays sensor data onto which representations of measurement tools and their measurements are superimposed. For details, see *Data Viewer* on page 120.

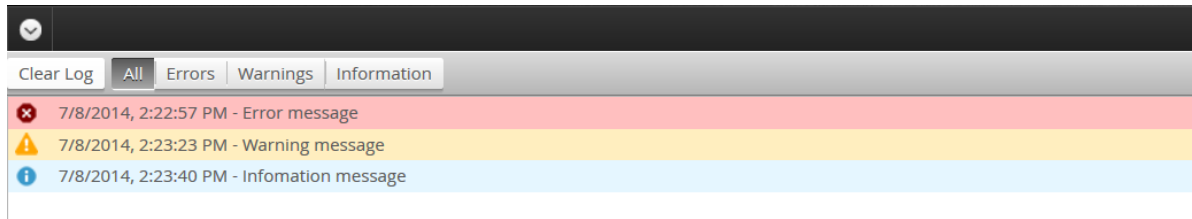
Status Bar

The status bar lets you do the following:

- See sensor messages in the [log](#).
- See [frame information](#).
- Change the [interface language](#).

Log

The log, located at the bottom of the web interface, is a centralized location for all messages that the Gocator displays, including warnings and errors.



A number indicates the number of unread messages:



To use the log:

1. Click on the Log open button  at the bottom of the web interface.
2. Click on the appropriate tab for the information you need.

Frame Information

The area to the right of the status bar displays useful frame information, both when the sensor is running and when viewing recorded data.



This information is especially useful when you have enabled [recording filtering](#). If you look at a recording playback, when you have enabled recording filtering, some frames can be excluded, resulting in variable "gaps" in the data.

The following information is available:

Frame Index: Displays the index in the data buffer of the current frame. The value resets to 0 when the sensor is restarted or when recording is enabled.

Master Time: Displays the recording time of the current frame, with respect to when the sensor was started.

Encoder Index: Displays the encoder index of the current frame.

Timestamp: Displays the timestamp the current frame, in microseconds from when the sensor was started.

To switch between types of frame information:

- Click the frame information area to switch to the next available type of information.

Interface Language

The language button on the right side of the status bar lets you change the language of the Gocator interface.

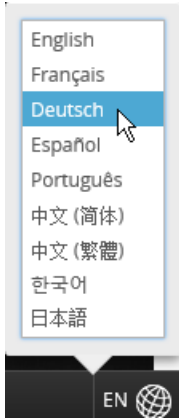


To use the log:

1. Click the language button at the bottom of the web interface.



2. Choose a language from the list.



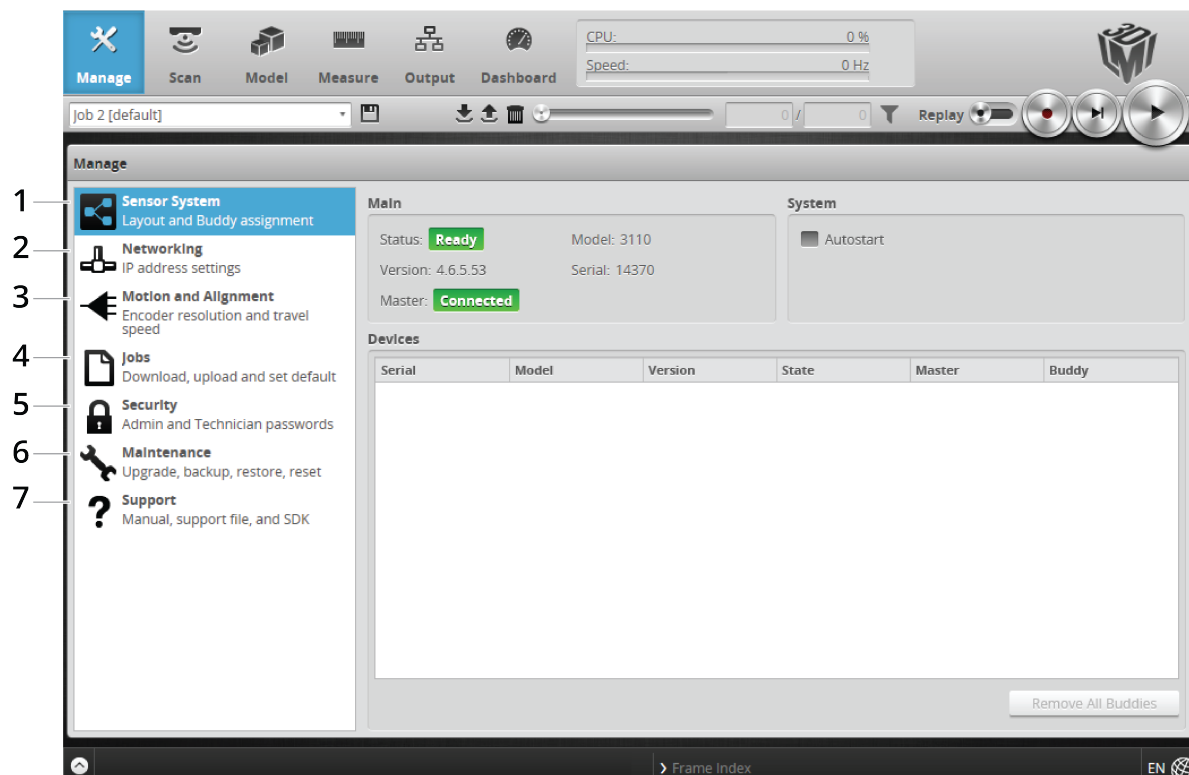
The Gocator interface reloads on the page you were working in, displaying the page using the language you chose. The sensor state is preserved.

Management and Maintenance

The following sections describe how to set up the sensor connections and networking, how to calibrate encoders and choose the alignment reference, and how to perform maintenance tasks.

Manage Page Overview

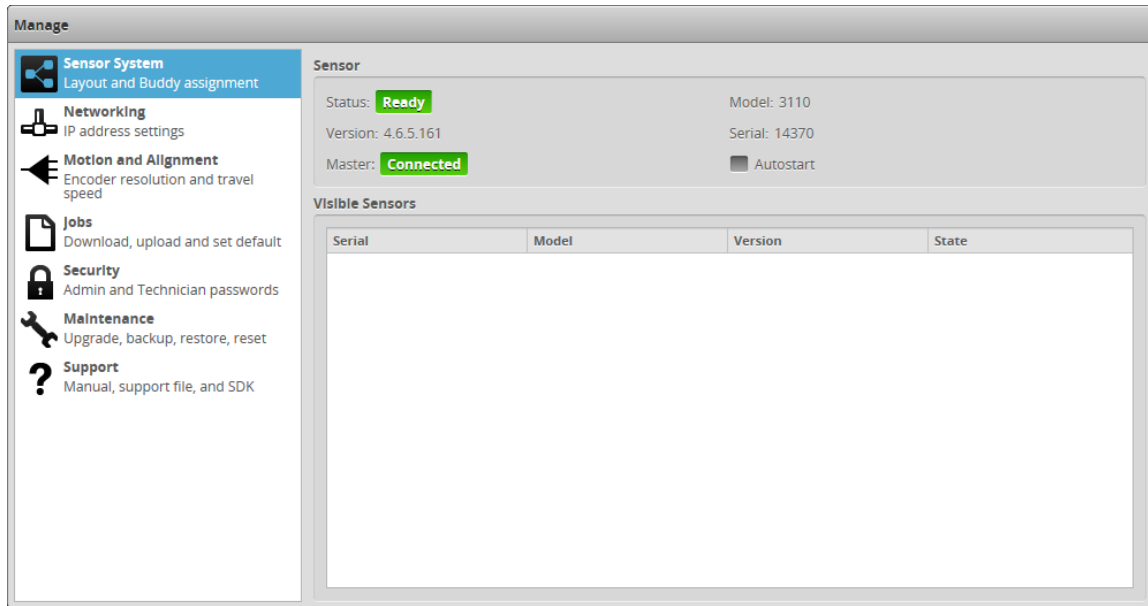
Gocator's system and maintenance tasks are performed on the **Manage** page.



Element	Description
1 Sensor System	Contains sensor information and the autostart setting. See <i>Sensor System</i> on the next page.
2 Networking	Contains settings for configuring the network. See <i>Networking</i> on the next page.
3 Motion and Alignment	Contains settings to configure the encoder. See <i>Motion and Alignment</i> on page 53.
4 Jobs	Lets you manage jobs stored on the sensor. See <i>Jobs</i> on page 54.
5 Security	Lets you change passwords. See <i>Security</i> on page 56.
6 Maintenance	Lets you upgrade firmware, create/restore backups, and reset sensors. See <i>Maintenance</i> on page 57.
7 Support	Lets you open an HTML version or download a PDF version of the manual, download the SDK, or save a support file. Also provides device information. See <i>Support</i> on page 60

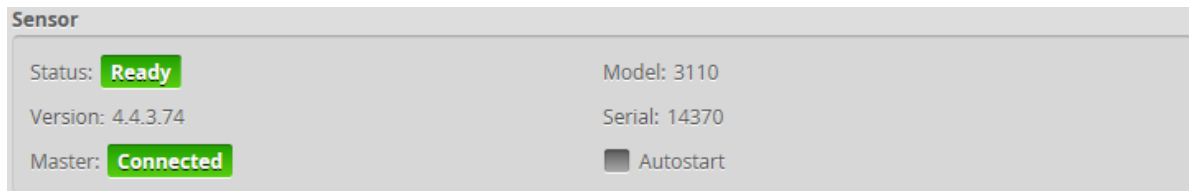
Sensor System

The following sections describe the **Sensor System** category on the **Manage** page. This category provides sensor information and the autostart setting.



Sensor Autostart

With the **Autostart** setting enabled, laser ranging profiling and measurement functions will begin automatically when the sensor is powered on. Autostart must be enabled if the sensor will be used without being connected to a computer.

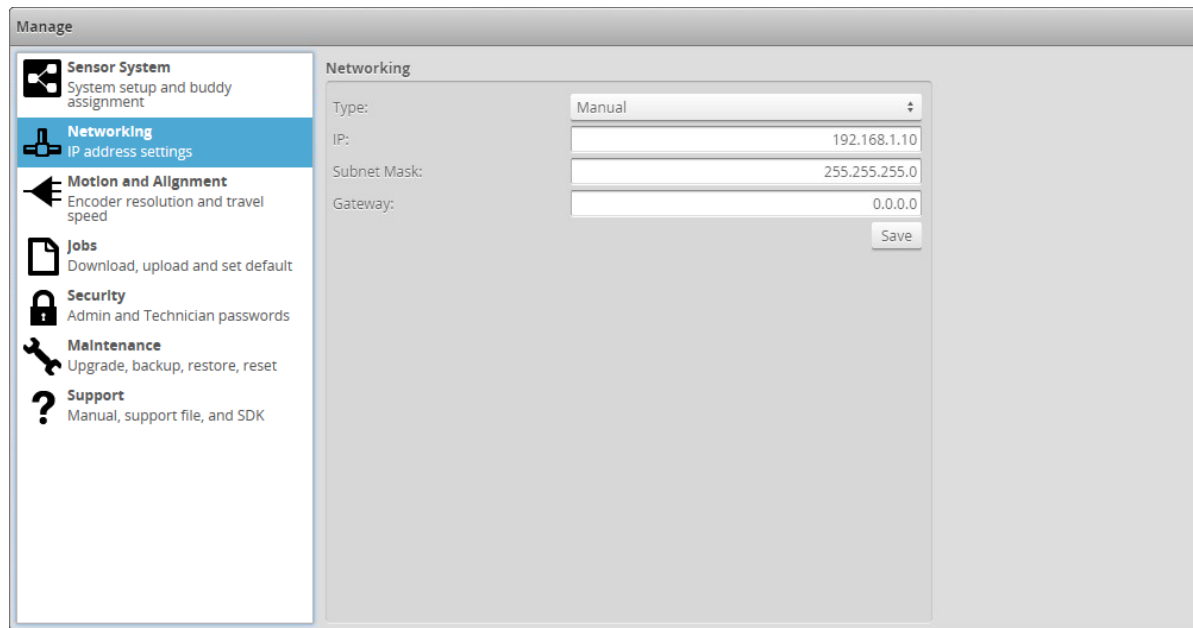


To enable/disable Autostart:

1. Go to the **Manage** page and click on the **Sensor System** category.
2. Check/uncheck the **Autostart** option in the **Main** section.

Networking

The **Networking** category on the **Manage** page provides network settings. Settings must be configured to match the network to which the Gocator sensors are connected.

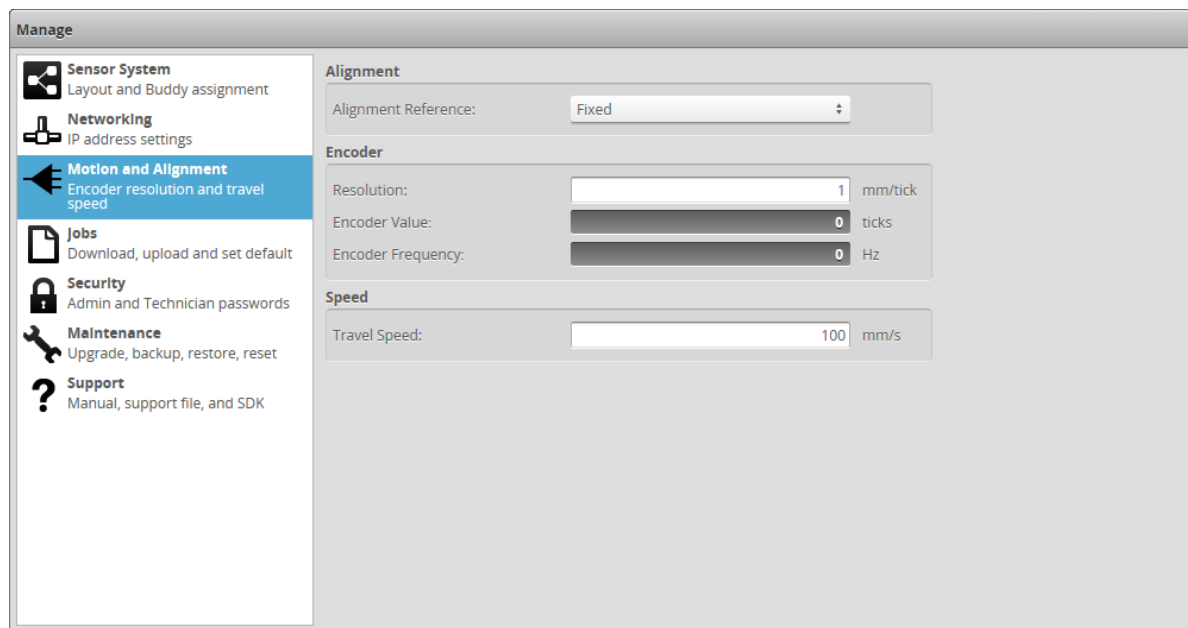


To configure the network settings:

1. Go to the **Manage** page.
2. In the **Networking** category, specify the Type, IP, Subnet Mask, and Gateway settings.
The Gocator sensor can be configured to use DHCP or assigned a static IP address.
3. Click on the **Save** button.
You will be prompted to confirm your selection.

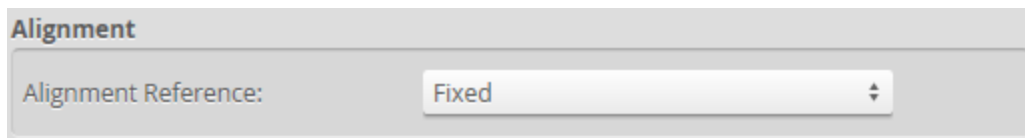
Motion and Alignment

The **Motion and Alignment** category on the **Manage** page lets you configure alignment reference, encoder resolution, and travel speed, and confirm that encoder signals are being received by the sensor.



Alignment Reference

The **Alignment Reference** setting can have one of two values: **Fixed** or **Dynamic**.



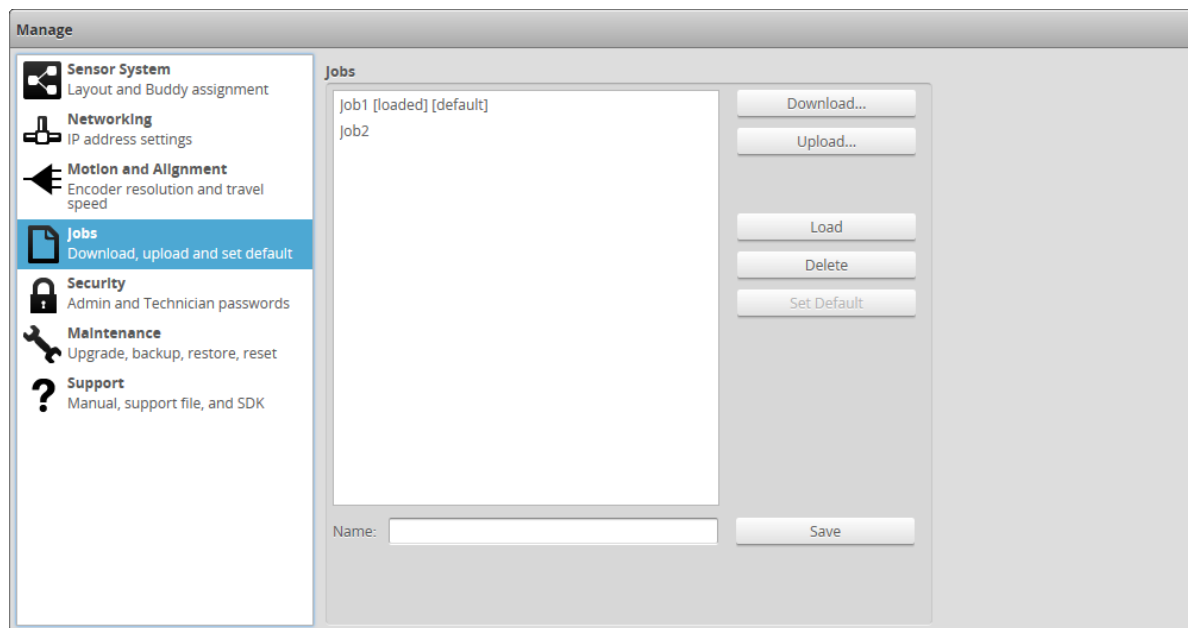
Setting	Description
Fixed	A single, global alignment is used for all jobs. This is typically used when the sensor mounting is constant over time and between scans, for example, when the sensor is mounted in a permanent position over a conveyor belt.
Dynamic	A separate alignment is used for each job. This is typically used when the sensor's position relative to the object scanned is always changing, for example, when the sensor is mounted on a robot arm moving to different scanning locations.

To configure alignment reference:

1. Go to the **Manage** page and click on the **Motion and Alignment** category.
2. In the Alignment section, choose **Fixed** or **Dynamic** in the **Alignment Reference** drop-down.

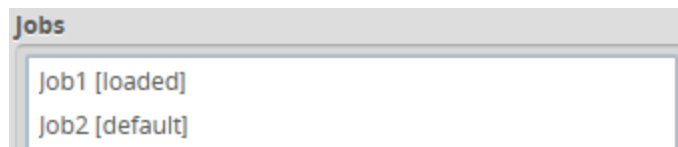
Jobs

The **Jobs** category on the **Manage** page lets you manage the jobs stored on a sensor.

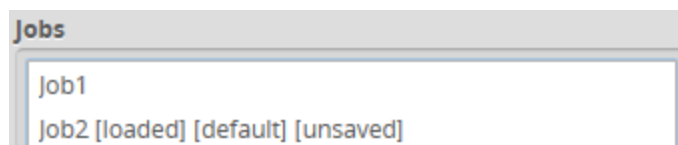


Element	Description
Name field	Used to provide a job name when saving files.
Jobs list	Displays the jobs that are currently saved in the sensor's flash storage.
Save button	Saves current settings to the job using the name in the Name field.
Load button	Loads the job that is selected in the job list. Reloading the current job discards any unsaved changes.
Delete button	Deletes the job that is selected in the job list.
Set as Default button	Sets the selected job as the default to be loaded when the sensor starts. When the default job is selected, this button is used to clear the default.
Download... button	Downloads the selected job to the client computer.
Upload... button	Uploads a job from the client computer.

Jobs can be loaded (currently activated in sensor memory) and set as default independently. For example, Job1 could be loaded, while Job2 is set as the default. Default jobs load automatically when a sensor is power cycled or reset.



Unsaved jobs are indicated by "[unsaved]".



To save a job:

1. Go to the **Manage** page and click on the **Jobs** category.
2. Provide a name in the **Name** field.
To save an existing job under a different name, click on it in the **Jobs** list and then modify it in the **Name** field.
3. Click on the **Save** button or press **Enter**.
Saving a job automatically sets it as the default, that is, the job loaded when the sensor is restarted.

To download, load, or delete a job, or to set one as a default, or clear a default:

1. Go to the **Manage** page and click on the **Jobs** category.
2. Select a job in the **Jobs** list.
3. Click on the appropriate button for the operation.

Security

You can prevent unauthorized access to a Gocator sensor by setting passwords. Each sensor has two accounts: Administrator and Technician.

By default, no passwords are set. When you start a sensor, you are prompted for a password only if a password has been set.

The screenshot shows the 'Manage' page of the Gocator web interface. On the left is a sidebar with icons and labels for different sections: Sensor System (System setup and buddy assignment), Networking (IP address settings), Motion and Alignment (Encoder resolution and travel speed), Jobs (Download, upload and set default), Security (Admin and Technician passwords), Maintenance (Upgrade, backup, restore, reset), and Support (Manual, support file, and SDK). The 'Security' section is highlighted in blue. The main content area is titled 'Administrator' and 'Technician'. Each section has a 'Password:' field, a 'Confirm Password:' field, and a 'Change Password' button.

Gocator Account Types

Account	Description
Administrator	The Administrator account has privileges to use the toolbar (loading and saving jobs, recording and

Account	Description
	viewing replay data), to view all pages and edit all settings, and to perform setup procedures such as sensor alignment.
Technician	The Technician account has privileges to use the toolbar (loading and saving jobs, recording and viewing replay data), to view the Dashboard page, and to start or stop the sensor.

The Administrator and Technician accounts can be assigned unique passwords.

To set or change the password for the Administrator account:

1. Go to the **Manage** page and click on the **Security** category.
2. In the **Administrator** section, enter the Administrator account password and password confirmation.
3. Click **Change Password**.
The new password will be required the next time that an administrator logs in to the sensor.

To set or change the password for the Technician account:

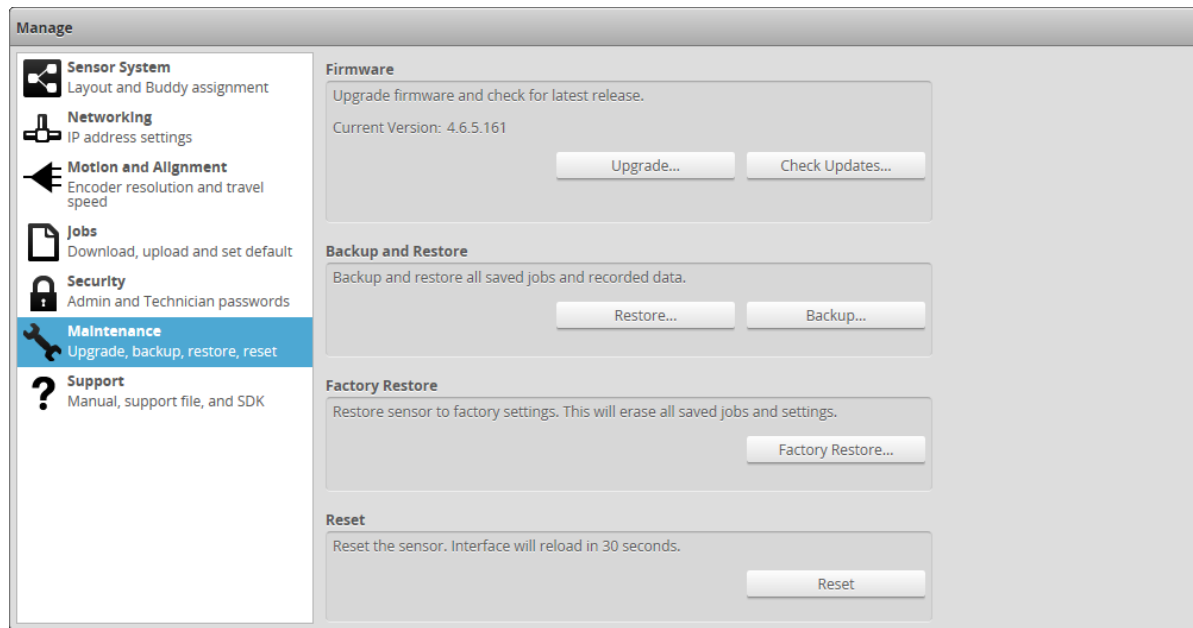
1. Go to the **Manage** page and click on the **Security** category.
2. In the **Technician** section, enter the Technician account password and password confirmation.
3. Click **Change Password**.
The new password will be required the next time that a technician logs in to the sensor.

If the administrator or technician password is lost, the sensor can be recovered using a special software tool. See *Sensor Recovery Tool* on page 446 for more information.

Maintenance

The **Maintenance** category in the **Manage** page is used to do the following:

- upgrade the firmware and check for firmware updates;
- back up and restore all saved jobs and recorded data;
- restore the sensor to factory defaults;
- reset the sensor.



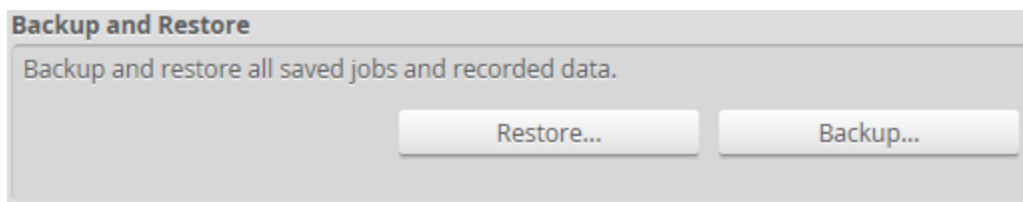
Sensor Backups and Factory Reset

You can create sensor backups, restore from a backup, and restore to factory defaults in the **Maintenance** category.

Backup files contain all of the information stored on a sensor, including jobs and alignment.

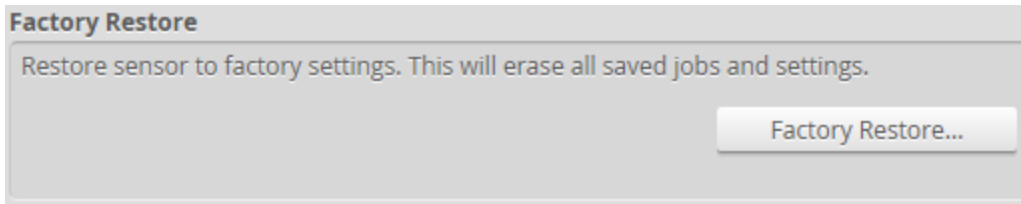


An Administrator should create a backup file in the unlikely event that a sensor fails and a replacement sensor is needed. If this happens, the new sensor can be restored with the backup file.



To create a backup:

1. Go to the **Manage** page and click on the **Maintenance** category.
2. Click the **Backup...** button under **Backup and Restore**.
3. When you are prompted, save the backup.
Backups are saved as a single archive that contains all of the files from the sensor.



To restore from a backup:

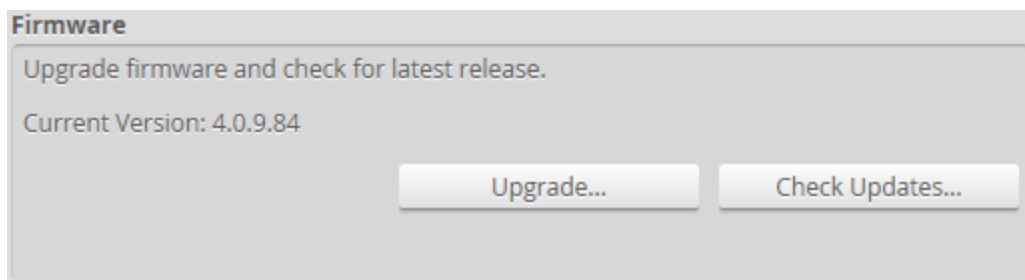
1. Go to the **Manage** page and click on the **Maintenance** category.
2. Click the **Restore...** button under **Backup and Restore**.
3. When you are prompted, select a backup file to restore.
The backup file is uploaded and then used to restore the sensor. Any files that were on the sensor before the restore operation will be lost.

To restore a sensor to its factory default settings:

1. Go to the **Manage** page and click on **Maintenance**.
2. Consider making a backup.
Before proceeding, you should perform a backup. Restoring to factory defaults cannot be undone.
3. Click the **Factory Restore...** button under **Factory Restore**.
You will be prompted whether you want to proceed.

Firmware Upgrade

LMI recommends routinely updating firmware to ensure that Gocator sensors always have the latest features and fixes.



To download the latest firmware:

1. Go to the **Manage** page and click on the **Maintenance** category.
2. Click the **Check Updates...** button in the **Firmware** section.
3. Download the latest firmware.
If a new version of the firmware is available, follow the instructions to download it to the client computer.

If the client computer is not connected to the Internet, firmware can be downloaded and transferred to the client computer by using another computer to download the firmware from LMI's website:
<http://www.lmi3d.com/support/downloads>.

To upgrade the firmware:

1. Go to the **Manage** page and click on the **Maintenance** category.
2. Click the **Upgrade...** button in the **Firmware** section.
3. Locate the firmware file in the **File** dialog and then click open.
4. Wait for the upgrade to complete.

After the firmware upgrade is complete, the sensor will self-reset. If a buddy has been assigned, it will be upgraded and reset automatically.

Support

The **Support** category in the **Manage** page is used to do the following:

- open an HTML version or download a PDF version of the manual
- download the SDK
- save a support file
- get device information

The screenshot shows the 'Manage' page of the Gocator Web Interface. On the left is a sidebar with a tree view of categories: Sensor System, Layout, Networking, Motion and Alignment, Jobs, Security, Maintenance, and Support. The 'Support' category is highlighted in blue. The main content area is divided into sections. The 'Device Information' section shows 'Part Number: 313110-LED-B-01', 'Serial: 15093', and 'Version: 4.4.3.74'. Below this is the 'Support File' section, which includes a description: 'Download a support file which contains all jobs, data and current state of the sensor.' There is a 'Filename:' input field with the text 'support' and a 'Description:' text area. A 'Download' button is at the bottom right of this section. At the bottom of the main content area, there are two rows of buttons. The first row has 'User Manual:' followed by 'Open HTML' and 'Download PDF' buttons. The second row has 'Software Development Kit (SDK):' followed by a 'Download' button.

Support Files

You can download a support file from a sensor and save it on your computer. You can then use the support file to create a scenario in the Gocator emulator (for more information on the emulator, see *Gocator Emulator* on page 249). LMI's support staff may also request a support file to help in troubleshooting.

Support File

Download a support file which contains all jobs, data and current state of the sensor.

Filename:

Description:

Sensor running in surface mode. Contains Surface Stud and Countersunk Hole measurements, in addition to scan data from the current production run.

[Download](#)

To download a support file:

1. Go to the **Manage** page and click on the **Support** category.
2. In **Filename**, type the name you want to use for the support file.
When you create a scenario from a support file in the emulator, the filename you provide here is displayed in the emulator's scenario list.
Support files end with the .gs extension, but you do not need to type the extension in **Filename**.
3. (Optional) In **Description**, type a description of the support file.
When you create a scenario from a support file in the emulator, the description is displayed below the emulator's scenario list.
4. Click **Download**, and then when prompted, click **Save**.

 Downloading a support file stops the sensor.

Manual Access

You can access the Gocator manuals from within the Web interface.

User Manual: [Open HTML](#) [Download PDF](#)

 You may need to configure your browser to allow pop-ups to open or download the manual.

To access the manuals:

1. Go to the **Manage** page and click on the **Support** category
2. Next to **User Manual**, click one of the following:
 - **Open HTML**: Opens the HTML version of the manual in your default browser.
 - **Download PDF**: Downloads the PDF version of the manual to the client computer.

Software Development Kit

You can download the Gocator SDK from within the Web interface.

Software Development Kit (SDK):

Download

To download the SDK:

1. Go to the **Manage** page and click on the **Support** category
2. Next to **Software Development Kit (SDK)**, click **Download**
3. Choose the location for the SDK on the client computer.



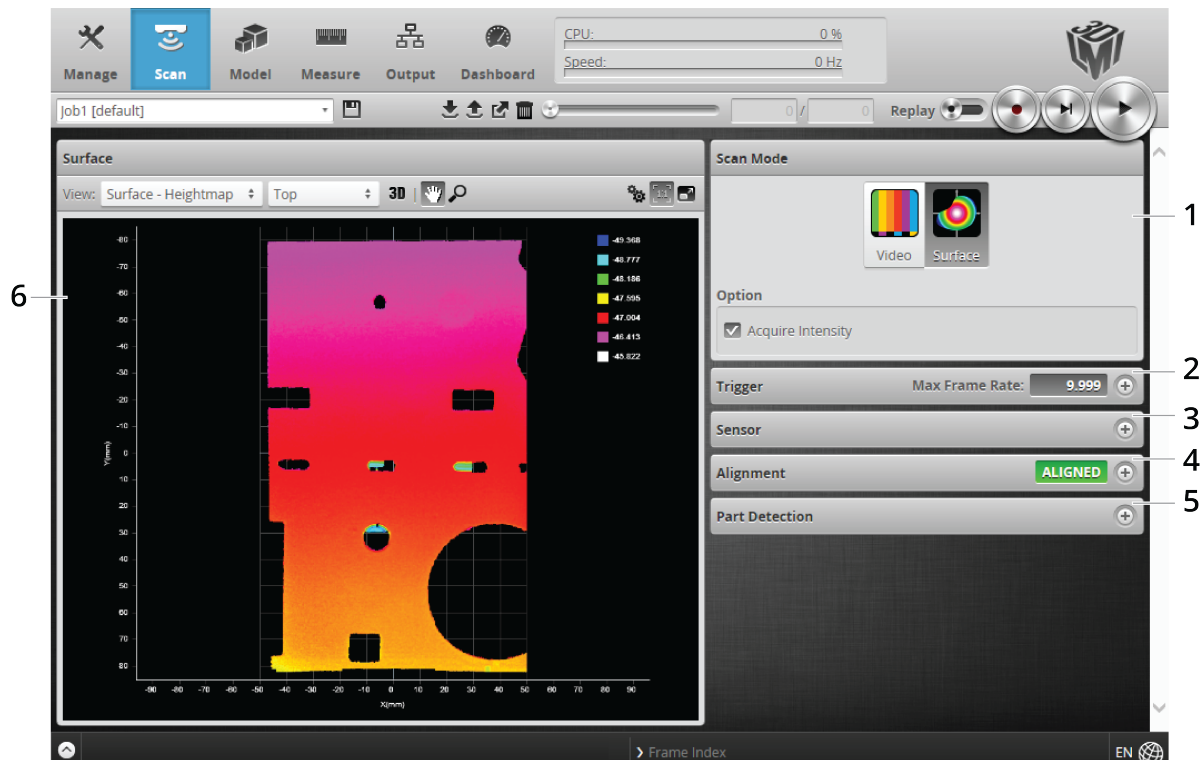
For more information on the SDK, see *SDK* on page 434.

Scan Setup and Alignment

The following sections describe the steps to configure Gocator sensors for 3D data acquisition using the **Scan** page. Setup and alignment should be performed before adding and configuring measurements or outputs.

Scan Page Overview

The **Scan** page lets you configure sensors and perform alignment.



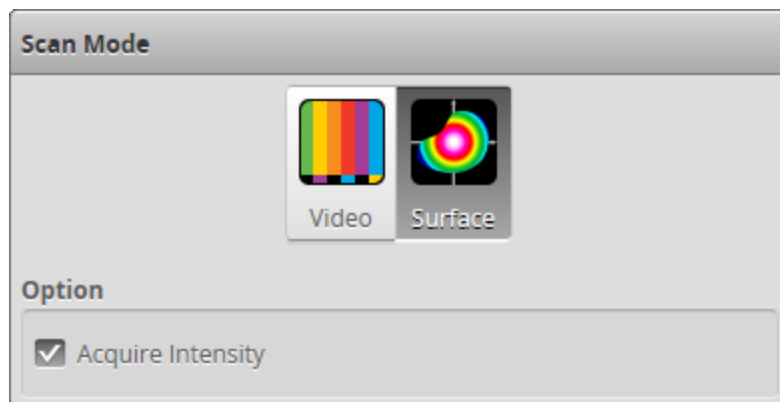
Element	Description
1 Scan Mode panel	Contains settings for the current scan mode (Video or Surface) and other options. See <i>Scan Modes</i> on the next page.
2 Trigger panel	Contains trigger source and trigger-related settings. See <i>Triggers</i> on the next page.
3 Sensor panel	Contains settings for an individual sensor, such as active area or exposure. See <i>Sensor</i> on page 68.
4 Alignment panel	Used to perform alignment. See <i>Alignment</i> on page 79.
5 Part Detection panel	Used to set the part detection logic for sorting data into discrete objects. See <i>Part Detection</i> on page 85.
6 Data Viewer	Displays sensor data and adjusts regions of interest. Depending on the current operation mode, the data viewer can display video images or surface views. See <i>Data Viewer</i> on page 89.

The following table provides quick references for specific goals that you can achieve from the panels in the **Scan** page.

Goal	Reference
Select a trigger source that is appropriate for the application.	Triggers (page 64)
Ensure that camera exposure is appropriate for 3D data acquisition.	Exposure (page 71)
Find the right balance between data quality, speed, and CPU utilization.	Active Area (page 69) Exposure (page 71) Job Files (page 270)
Calibrate the system so that 3D data can be aligned to a reference plane.	
Set up the part detection logic to create discrete objects from surfaces.	Part Detection (page 85)

Scan Modes

The Gocator web interface supports two scan modes: Video and Surface. The scan mode can be selected in the **Scan Mode** panel.



Mode and Option	Description
Video	Outputs video images from the Gocator. This mode is useful for configuring exposure time and troubleshooting stray light or ambient light problems.
Surface	Outputs 3D point clouds and performs surface measurements. Part detection can be enabled on a surface to identify discrete parts (<i>Part Detection</i> on page 85).
Acquire Intensity	When this option is enabled, an intensity value will be produced for each point in the 3D point cloud.

Triggers

A trigger is an event that causes a Gocator sensor to take a single 3D snapshot. Triggers are configured in the **Trigger** panel.

When a trigger is processed, the LED light pattern is strobed and the cameras expose to produce images. The resulting images are processed inside the sensor to yield a 3D point cloud, which can then be used for measurement.

The top-right of the **Trigger** panel displays the maximum speed at which an object could be captured at, calculated based on the exposure values, active area and the number of projection patterns required.

The sensor can be triggered by one of the sources described in the table below.

	If the sensor is connected to a Master 400 or higher, encoder and digital (external) input signals over the IO cordset are <i>ignored</i>. The sensor instead receives these signals from the Master; for encoder and digital input pinouts on Masters, see the section corresponding to your Master in <i>Master Network Controllers</i> on page 492. If the sensor is connected to a Master 100 (or no Master is used), the sensor receives signals over the IO cordset. For information on connecting encoder and digital input signals to a sensor in these cases, see <i>Encoder Input</i> on page 490 <i>Digital Input</i> on page 489 <i>Encoder Input</i> on page 490
---	---

Trigger Source	Description
Time	Sensors have an internal clock that can be used to generate fixed-frequency triggers. The external input can be used to enable or disable the time triggers.
External Input	A digital input can provide triggers in response to external events (e.g., photocell). When triggers are received at a frequency higher than the maximum frame rate, some triggers may not be accepted. The Trigger Drops Indicator in the Dashboard page can be used to check for this condition. For information on the maximum input trigger rate, see <i>Maximum Input Trigger Rate</i> on page 68.
Software	A network command can be used to send a software trigger. See <i>Protocols</i> on page 353 for more information.

Depending on the setup and measurement tools used, the CPU utilization may exceed 100%, which reduces the overall acquisition speed. If the **Clear Calibration** button is pressed, the calibration will be erased and the sensor will revert to using sensor coordinates. See *Acquisition Speed* on page 33 for the estimated acquisition speeds under different settings.

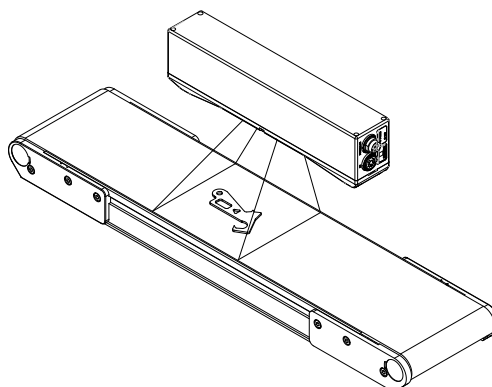
For examples of typical real-world scenarios, see *Trigger Examples* below. For information on the settings used with each trigger source, see *Trigger Settings* on the next page

Trigger Examples

Example: External Input + Conveyor

External input triggering can be used to produce a snapshot for 3D measurement.

For example, a photocell can be connected as an external input to generate a trigger pulse when a target object has moved into position.

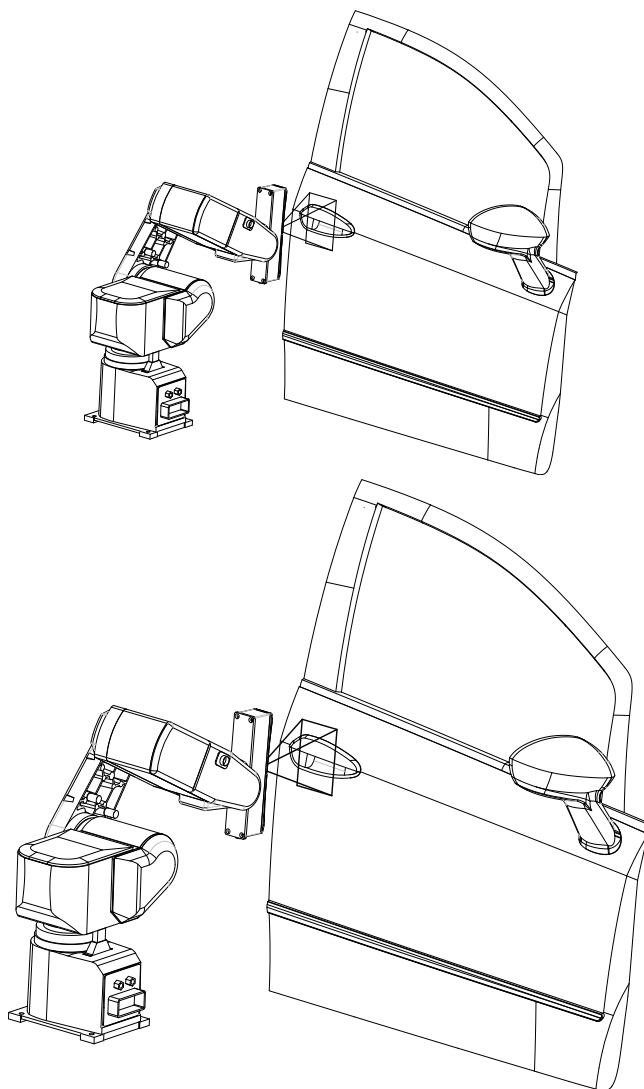


An external input can also be used to gate the trigger signals when time or encoder triggering is used. For example, a photocell could generate a series of trigger pulses as long as there is a target in position.

Example: Software Trigger + Robot Arm

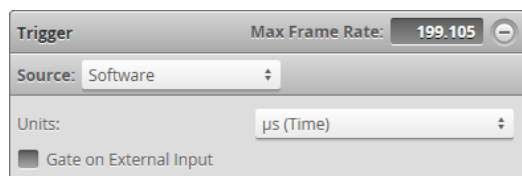
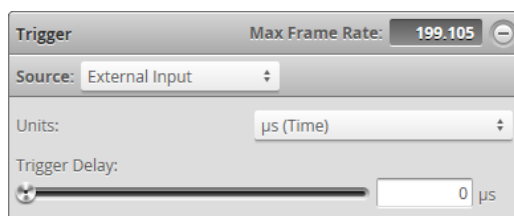
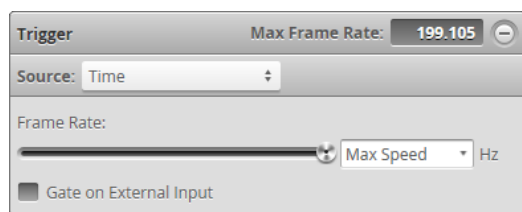
Software triggering can be used to produce a snapshot for 3D measurement.

A software trigger can be used in systems that use external software to control the activities of system components.



Trigger Settings

The trigger source is selected using the **Trigger** panel in the **Scan** page.



After specifying a trigger source, the **Trigger** panel shows the parameters that can be configured.

Parameter	Trigger Source	Description
Source	All	Selects the trigger source (Time , Encoder , External Input , or Software).
Frame Rate	Time	Controls the frame rate. Select Max Speed from the drop-down to lock to the maximum frame rate. Fractional values are supported. For example, 0.1 can be entered to run at 1 frame every 10 seconds.
Gate on External Input	Time, Encoder	External input can be used to enable or disable 3D data acquisition in a sensor. When this option is enabled, the sensor will respond to time or encoder triggers only when the external input is asserted. See <i>Digital Input</i> on page 489 for more information on connecting external input to Gocator sensors.
Units	External Input, Software	Specifies whether the trigger delay, output delay, and output scheduled command operate in the time domain. The unit is implicitly set to microseconds with Time trigger source.
Trigger Delay	External Input	Controls the amount of time or the distance the sensor waits before producing a frame after the external input is activated. This is used to compensate for the positional difference between the source of the external input trigger (e.g., photocells) and the sensor. Trigger delay is only supported in single exposure mode; for details, see <i>Exposure</i> on page 71.

To configure the trigger source:

1. Go to the **Scan** page.
2. Expand the **Trigger** panel by clicking on the panel header.

3. Select the trigger source from the drop-down.
4. Configure the settings.
See the trigger parameters above for more information.
5. Save the job in the **Toolbar** by clicking the **Save** button .

Maximum Input Trigger Rate



The maximum external input trigger rate in a system including Master 400 or higher is 20 kHz.

When using a standalone sensor or a sensor connected to a Master 100, the maximum trigger rate is 32 kHz. This rate is limited by the fall time of the signal, which depends on the V_{in} and duty cycles. To achieve the maximum trigger rate, the V_{in} and duty cycles must be adjusted as follows:

Maximum Speed	V_{in}	Maximum Duty Cycle
32 kHz	3.3 V	88%
32 kHz	5 V	56%
32 kHz	7 V	44%
32 kHz	10 V	34%

At 50% duty cycle, the maximum trigger rates are as follows:

V_{in}	Maximum Speed
3.3 V	34 kHz
5 V	34 kHz
10 V	22 kHz

Maximum Encoder Rate

On a standalone sensor, with the encoder directly wired into the I/O port or through a Master 100, the maximum encoder rate is about 1 MHz.

For sensors connected through a Master 400 or higher, with the encoder signal supplied to the Master, the maximum rate is about 300 kHz.

Sensor

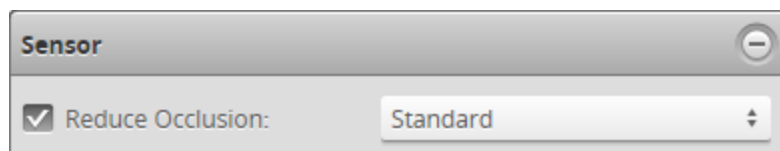
The following sections describe the settings that are configured in the **Sensor** panel on the **Scan** page.

Reduce Occlusion

When the **Reduce Occlusion** option is disabled, 3D data is acquired using *only* stereo correlation between the two cameras, meaning that a point on the target must be visible in both cameras to produce a 3D data point.

When this option is enabled (default), in addition to stereo correlation, each camera independently triangulates off the LED light pattern, which may improve performance on targets with complicated shapes that can cause occlusions.

For more information, see *Stereo Correlation vs. Independent Triangulation* on page 32.



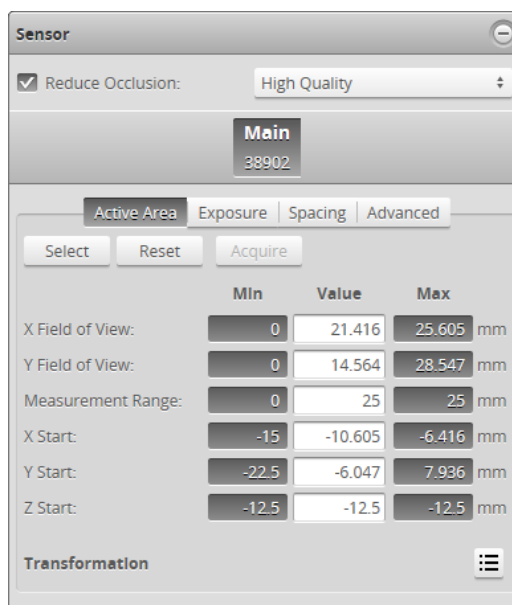
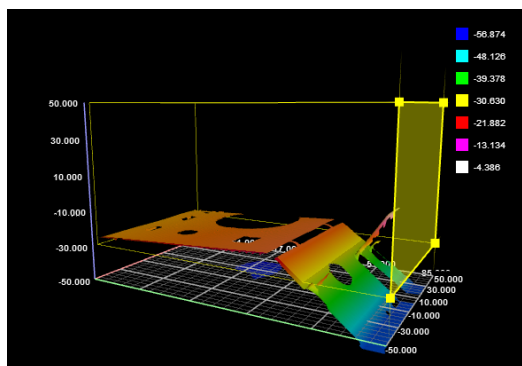
To enable or disable the Reduce Occlusion option:

1. Go to the **Scan** page.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, the **Sensor** panel will not be displayed.
3. Expand the **Sensor** panel by clicking on the panel header.
4. Check or uncheck the **Reduce Occlusion** checkbox.
5. In the dropdown next to **Reduce Occlusion**, choose one of the following:
Standard: The standard algorithm for merging images from each camera is used.
High Quality: An enhanced algorithm is used to merge images from each camera, which reduces the seam where images merge. Processing time may be increased.
6. Save the job in the **Toolbar** by clicking the **Save** button .

Active Area

Active area refers to the region within the sensor's maximum field of view that is used for 3D data acquisition.

By default, the active area covers the sensor's entire field of view. By reducing the active area, the sensor can operate at higher speeds.



To set the active area:

1. Go to the **Scan** page.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, tools will not be available in the **Measure** panel.
3. Expand the **Sensor** panel by clicking on the panel header or the  button.
4. Click on the **Active Area** tab.
5. Click the **Select** button.
6. Click the **Acquire** button to see a scan while setting the active area.
7. Set the active area.
Enter the active area values in the edit boxes or adjust the active area graphically in the data viewer.
The 2D view allows you to adjust the sizes and positions in the X axis and Z axis. The 3D view allows you to adjust the sizes and positions in the X axis, Y axis, and Z axis. See *Regions* on page 121 for more information.
8. Click the **Save** button in the **Sensor** panel.
Click the **Cancel** button to cancel setting the active area.
9. Save the job in the **Toolbar** by clicking the **Save** button .



3D acquisition devices are usually more accurate at the near end of their measurement range. If your application requires a measurement range that is small compared to the maximum measurement range of the sensor, mount the sensor so that the active area can be defined at the near end of the measurement range.

Transformations

The transformation settings determine how 3D data are converted from sensor coordinates to system coordinates. Typically, transformations are set when you [align a sensor](#). However, you can also manually set values.

Transformation 	
X Offset:	-0.046 mm
Y Offset:	-0.202 mm
Z Offset:	19.171 mm
Angle X:	0.603 °
Angle Y:	0.137 °
Angle Z:	-0.001 °

Parameter	Description
X Offset	Specifies the shift along the X axis. With Normal orientation, a positive value shifts the data to the right. With Reverse orientation, a positive value shifts the data to the left.
Y Offset	Specifies the shift along the Y axis.
Z Offset	Specifies the shift along the Z axis. A positive value shifts the data toward the sensor.
Angle X	Specifies the tilt around the X axis.
Angle Y	Specifies the tilt around the Y axis.
Angle Z	Specifies the tilt around the Z axis.

When applying the transformations, Angle is applied before the offsets: the object is first rotated around X, then Y, and then Z.

To configure transformation settings:

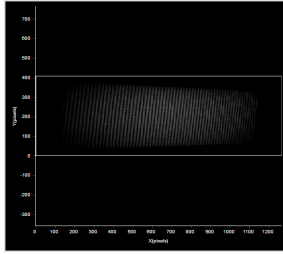
1. Go to the **Scan** page.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, tools will not be available in the **Measure** panel.
3. Expand the **Sensor** panel by clicking on the panel header.
4. Expand the Transformations area by clicking on the expand button .
See the table above for more information.
5. Set the parameter values.
See the table above for more information.
6. Save the job in the **Toolbar** by clicking the **Save** button .
7. Check that the transformation settings are applied correctly after 3D acquisition is restarted.

Exposure

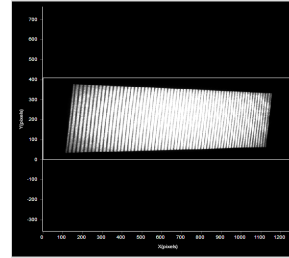
Exposure determines the duration of camera and light on-time. Longer exposures can be helpful to detect light patterns on dark or distant surfaces, but increasing exposure time decreases the maximum speed. Different target surfaces may require different exposures for optimal results. Gocator sensors provide two exposure modes for the flexibility needed to scan different types of target surfaces.

Exposure Mode	Description
Single	Uses a single exposure for all objects. Used when the surface is uniform and is the same for all targets.
Multiple	Uses multiple exposures to create a single scan. Used when the target surface has a varying reflectance within a single scan (e.g., white and black).

Video mode lets you see how the reflected light pattern appears on the camera and identify any stray light or ambient light problems. When exposure is tuned correctly, the light pattern should be clearly visible along the entire length of the viewer. If it is too dim, increase the exposure value; if it is too bright decrease exposure value.

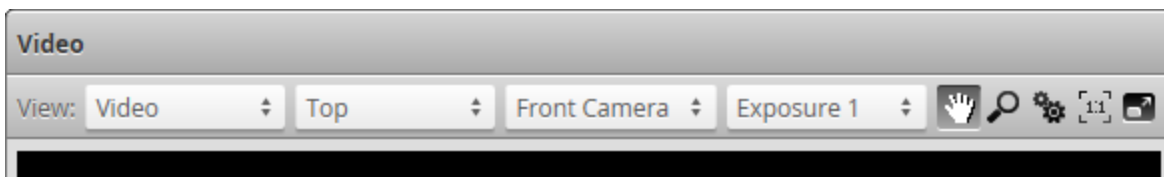


*Under-exposure:
Light pattern is not fully detected.
Increase the exposure value.*



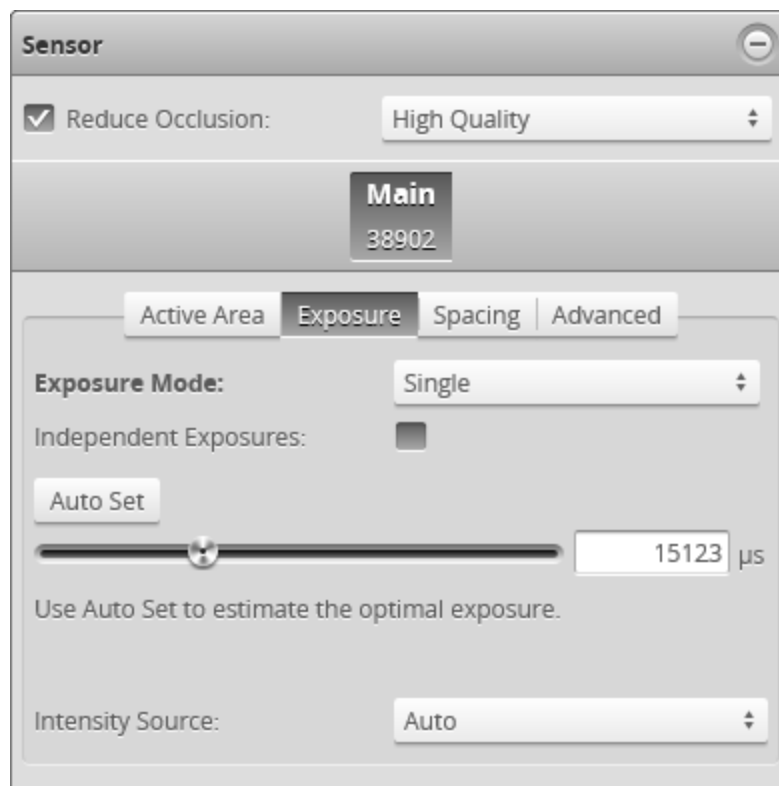
*Over-exposure:
Light pattern is saturated in the center.
Decrease the exposure value.*

When the Gocator is in Multiple exposure mode, select which exposure to view using the second drop-down box next to "View" in the data viewer. This drop-down is only visible in Video scan mode when the **Multiple** option is selected in the **Exposure** section in the **Sensor** panel.



Single Exposure

The sensor uses a fixed exposure in every scan. Single exposure is used when the target surface is uniform and is the same for all parts.



When the exposure mode is set to **Single**, you can optionally configure the sensor to allow setting exposure individually for each camera. This can be useful, for example, when reflections affect only camera: you could lower the exposure setting for that camera to improve scan data from that camera. (Automatic setting of exposure is not available when you this option is enabled.)

You can also choose which camera is used as the source for intensity data: if the front camera is typically affected by reflections off a part but not the back camera, you could choose the back camera as the source for intensity data.

To enable single exposure:

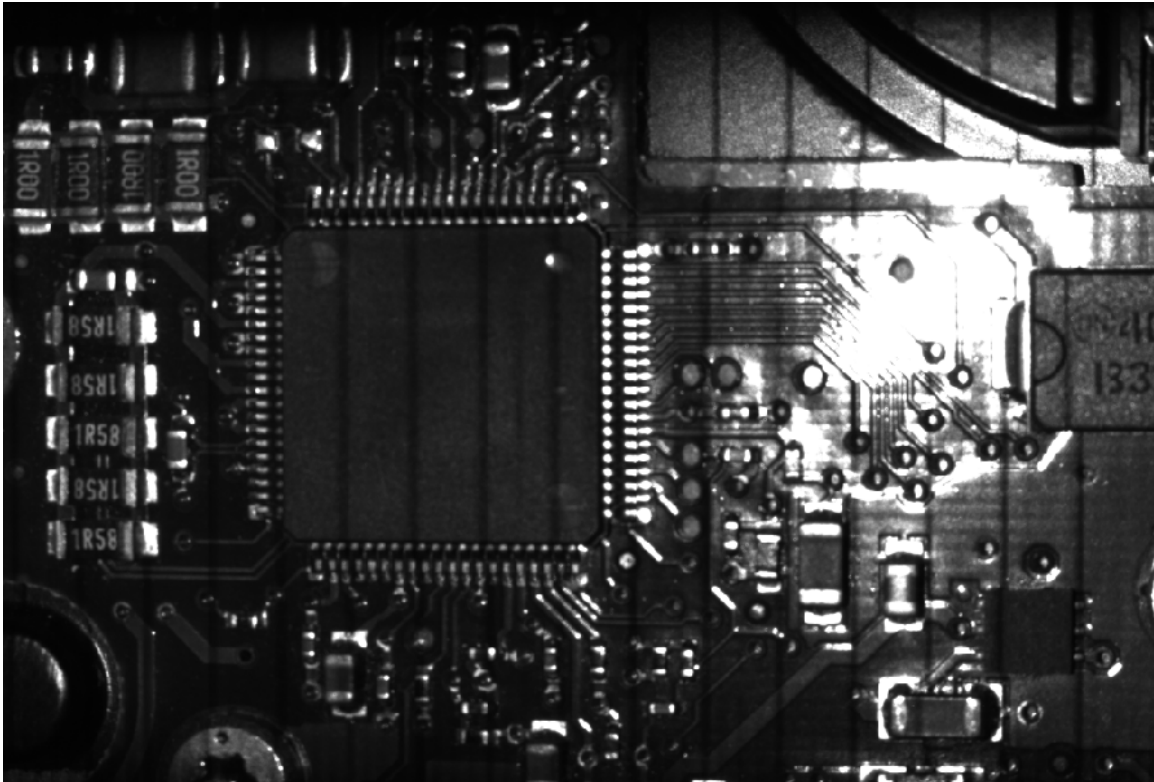
1. Place a representative target in view of the sensor.
The target surface should be similar to the material that will normally be measured.
2. Go to the **Scan** page.
3. Expand the **Sensor** panel by clicking on the panel header or the  button.
4. Click the **Exposure** tab.
5. Select **Single** from the **Exposure Mode** drop-down.
6. (Optional) Enable **Independent Exposure**.
7. Edit the exposure setting by using the slider or by manually entering a value.
You can automatically tune the exposure by pressing the **Auto Set** button, which causes the sensor to turn on and tune the exposure time. **Auto Set** is not available when **Independent Exposure** is enabled.
8. (Optional) Choose the source for intensity in **Intensity Source**.
Auto: The default value. Video from both cameras is used to create intensity data.
Front Camera: Video from the front camera is used to create intensity data.
Back Camera: Video from the back camera is used to create intensity data.
9. Run the sensor and check that 3D data acquisition is satisfactory.
If 3D data acquisition is not satisfactory, adjust the exposure values manually. Switch to **Video** mode to use video to help tune the exposure; see *Exposure* on page 71 for details.

When the sensor is set to [Video mode](#), you can use a special "line" focus pattern to aid in focusing the sensor. A focused sensor produces more accurate scans, which in turn results in more reliable measurements.

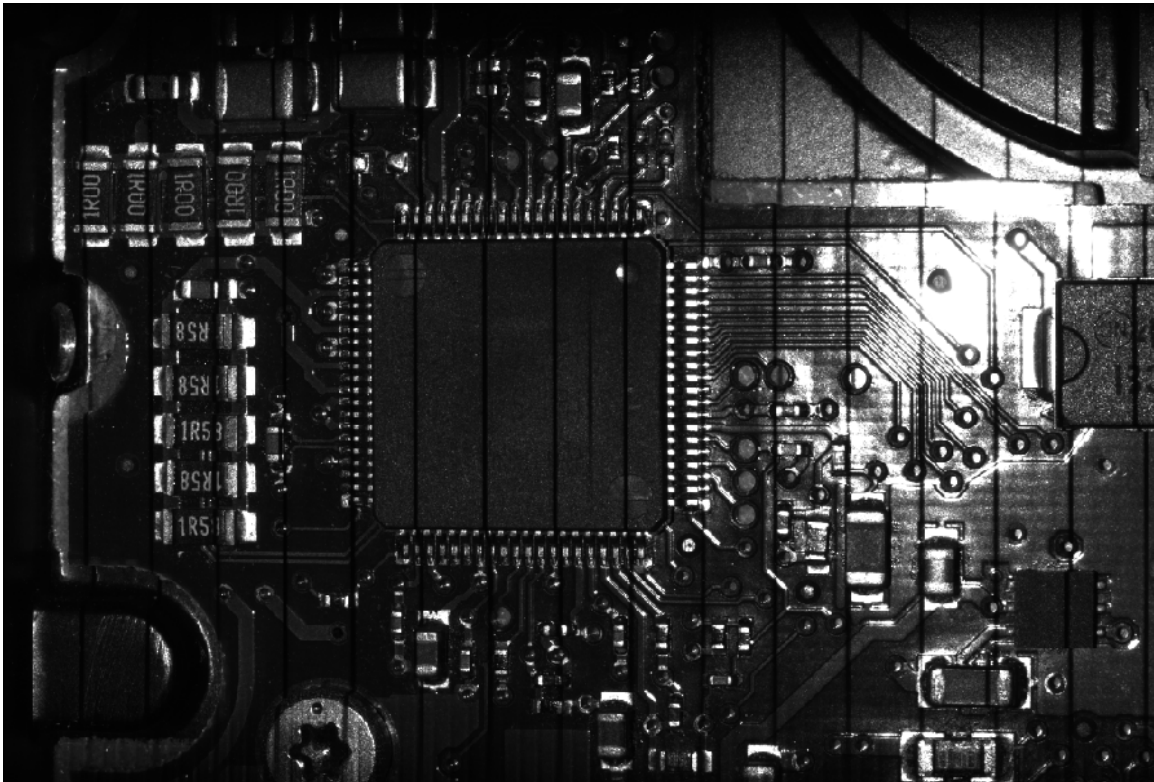
To use the focus pattern:

1. Place a representative target in view of the sensor.
The target surface should be similar to the material that will normally be measured.
2. Go to the **Scan** page and choose Video mode.
3. Expand the **Sensor** panel by clicking on the panel header or the  button.
4. Click the **Exposure** tab.
5. In **Pattern Sequence**, choose **Focus Pattern**.
A vertical line pattern is projected onto the surface (see next).
6. Move the sensor up and down until the dark lines are as sharp as possible.

In the following image, the vertical lines are blurry:



After focusing, the lines are more sharply defined:

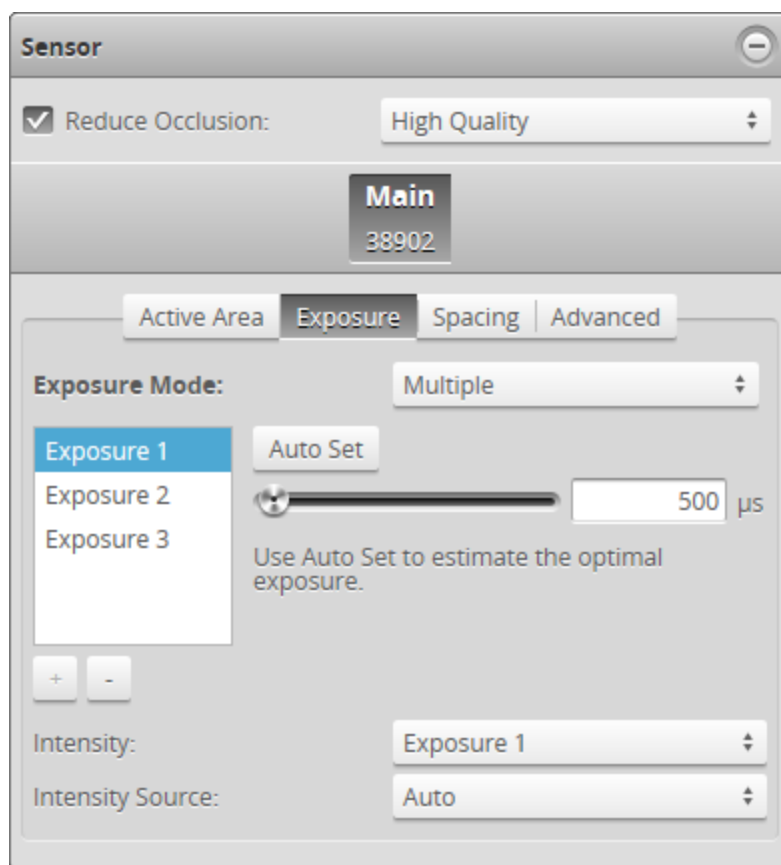


Multiple Exposure

The sensor combines data from multiple exposures to create a single 3D point cloud. Multiple exposures can be used to increase the ability to detect light and dark materials that are in the field of view simultaneously.

Up to three exposures can be defined with each set to a different exposure level. For each exposure, the sensor will perform a complete scan at the current frame rate making the effective frame rate slower. For example, if two exposures are selected, then the speed will be half of the single exposure frame rate. The sensor will perform a complete multi-exposure scan for each external input.

The resulting 3D point cloud is a composite created by combining data collected with different exposures.



If you have enabled intensity in the **Scan Mode** tab, you can use the **Intensity** setting to choose which of the exposures Gocator uses for acquiring intensity data. This lets you choose the exposure that produces the best image for intensity data.

You can also choose which camera is used as the source for intensity data using the **Intensity Source** setting: if the front camera is typically affected by reflections off a part but not the back camera, you could choose the back camera as the source for intensity data.

To enable multiple exposure:

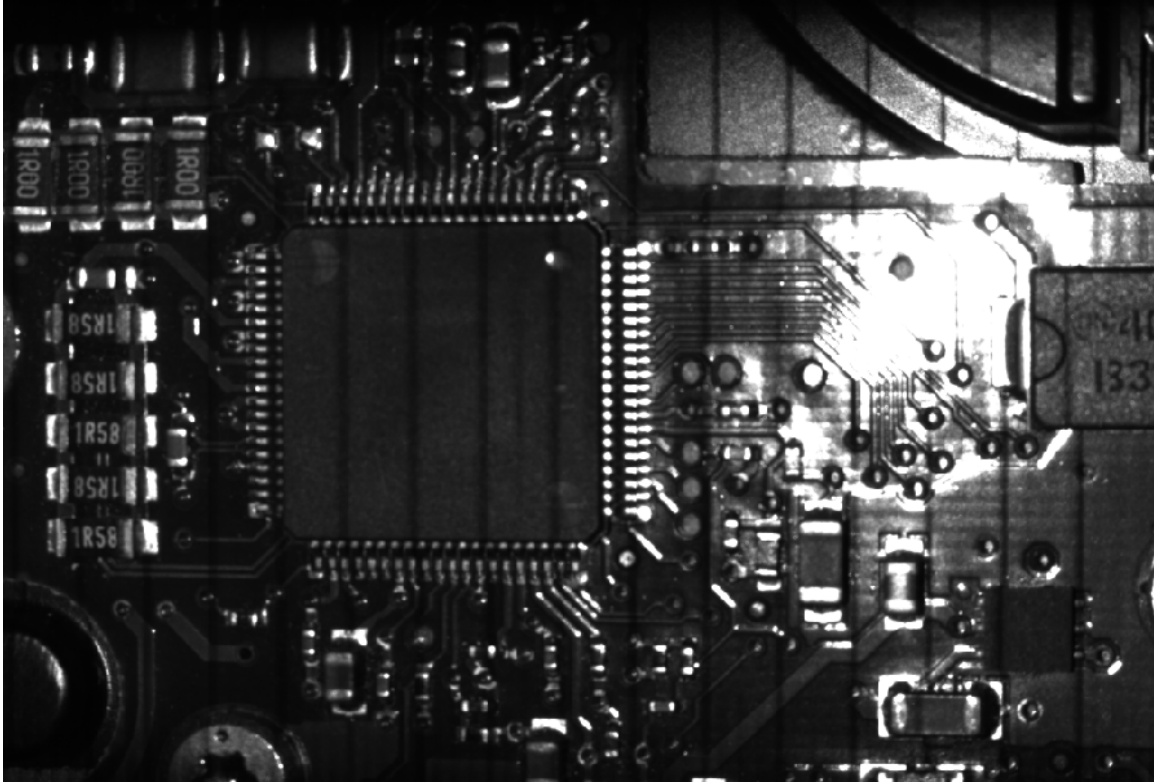
1. Go to the **Scan** page.
2. Expand the **Sensor** panel by clicking on the panel header or the  button.

3. Click the **Exposure** tab.
4. Select **Multiple** from the **Exposure Mode** drop-down.
5. Click the  button to add an exposure step.
Up to a maximum of three exposure settings can be added.
To remove an exposure, select it in the exposure list and click the  button
6. Set the exposure level for each exposure to make the Gocator's camera less or more sensitive, as required.
7. If **Acquire Intensity** is enabled in **Scan Mode**, select the exposure that is used to capture the intensity output.
8. Run the sensor and check that 3D data acquisition is satisfactory.
If 3D data acquisition is not satisfactory, adjust the exposure values manually. Switch to **Video** mode to use video to help tune the exposure; see *Exposure* on page 71 for details.

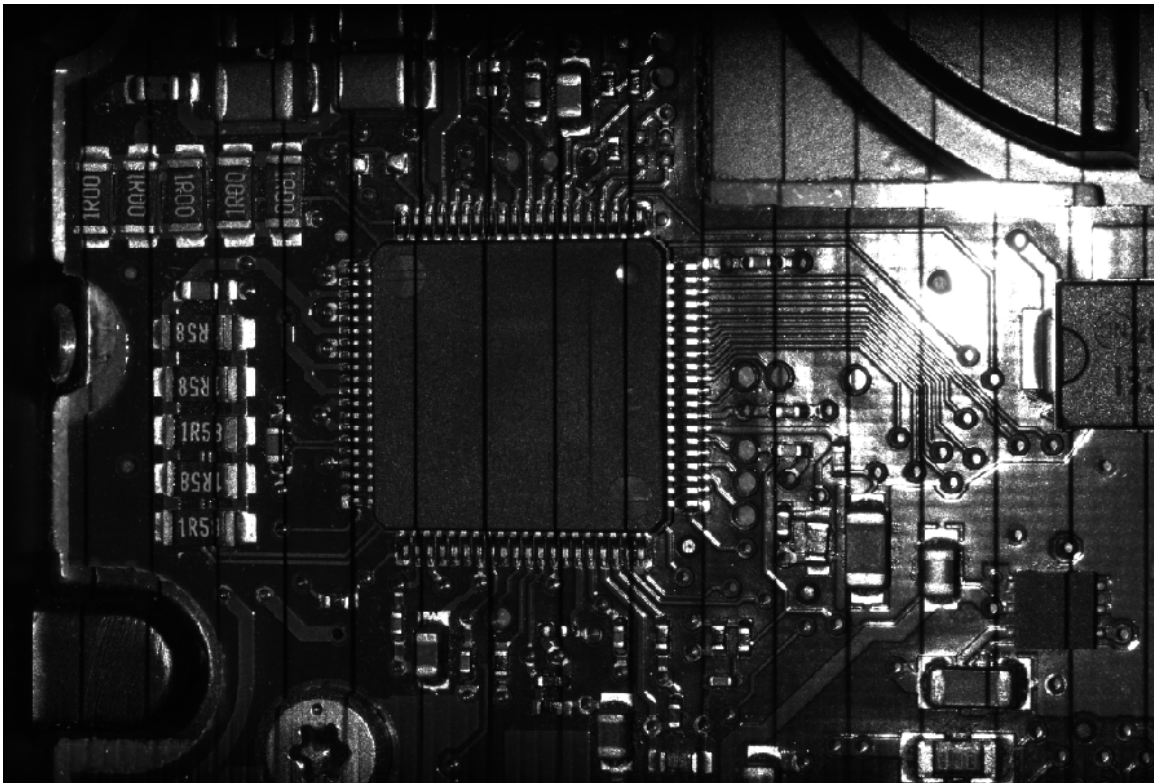
When the sensor is set to [Video mode](#), you can use a special "line" focus pattern to aid in focusing the sensor. A focused sensor produces more accurate scans, which in turn results in more reliable measurements.

To use the focus pattern:

1. Place a representative target in view of the sensor.
The target surface should be similar to the material that will normally be measured.
2. Go to the **Scan** page and choose Video mode.
3. Expand the **Sensor** panel by clicking on the panel header or the  button.
4. Click the **Exposure** tab.
5. In **Pattern Sequence**, choose **Focus Pattern**.
A vertical line pattern is projected onto the surface (see next).
6. Move the sensor up and down until the dark lines are as sharp as possible.
In the following image, the vertical lines are blurry:

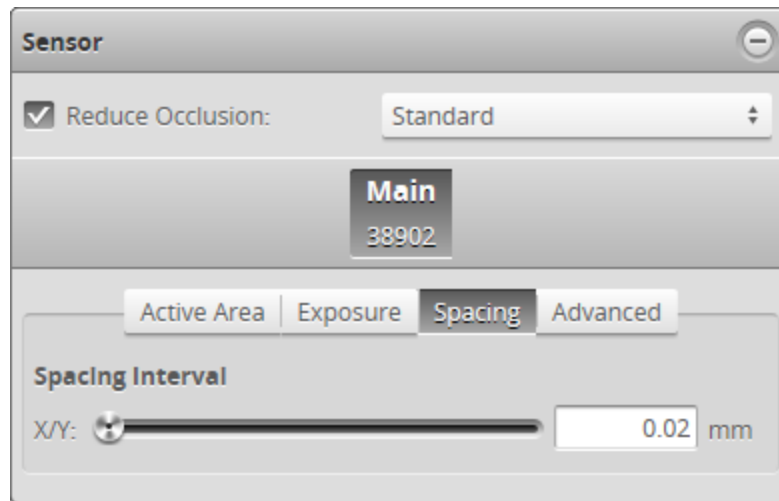


After focusing, the lines are more sharply defined:



Spacing

The **Spacing** tab lets you configure the spacing interval.



Spacing Interval

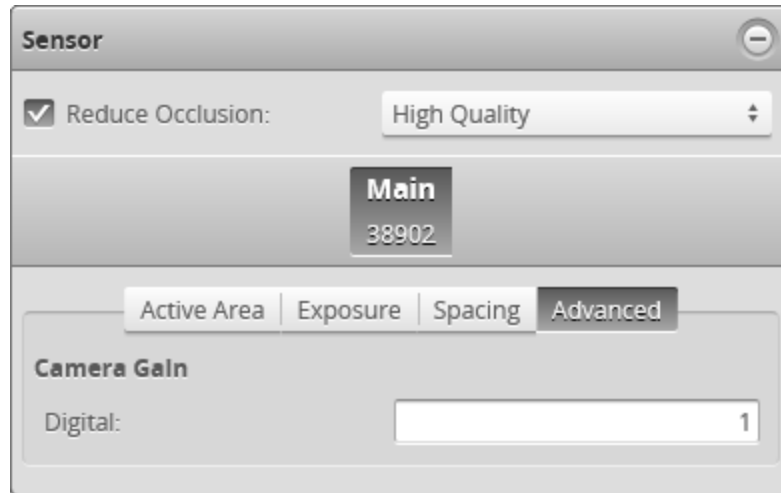
Spacing interval is the spacing between data points in resampled data. A larger interval creates scans with lower X/Y resolution, reduces CPU usage, and potentially increases the maximum frame rate. A larger interval also reduces the data output rate. For more information on resampled data, see *Resampling* on page 36.

To configure the spacing interval:

1. Go to the **Scan** page.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, you will not be able to configure the spacing interval.
3. Expand the **Sensor** panel by clicking on the panel header or the  button.
4. Click the button corresponding to the sensor you want to configure.
The button is labeled **Top**, **Bottom**, **Top-Left**, or **Top-Right**, depending on the system.
Spacing is configured separately for each sensor.
5. Click the **Spacing** tab.
6. Do one of the following:
7. Select a spacing interval level.
8. Save the job in the **Toolbar** by clicking the **Save** button .

Advanced

The Advanced tab contains settings to configure camera gain.



To configure advanced settings:

1. Go to the **Scan** page.
2. Switch to Video mode.
3. Expand the **Sensor** panel by clicking on the panel header or the  button.
4. Click on the **Advanced** tab.
5. Configure camera gain.
See *Advanced* on the previous page and *Camera Gain* below for more information.
6. Save the job in the **Toolbar** by clicking the **Save** button .
7. Check that scan data is satisfactory.

Camera Gain

You can set camera gain to improve data acquisition.

Setting	Description
Camera Gain	Analog camera gain can be used when the application is severely exposure limited, yet dynamic range is not a critical factor. Digital camera gain can be used when the application is severely exposure limited, yet dynamic range is not a critical factor.

Alignment

Gocator sensors are pre-calibrated and ready to deliver 3D data in engineering units (mm) out of the box. However, alignment procedures are required to compensate for sensor mounting inaccuracies. Alignment is performed using the **Alignment** panel on the **Scan** page.

Once alignment has been completed, the derived transformation values are displayed under **Transformations** in the **Sensor** panel; see *Transformations* on page 70 for details.

Alignment States

A Gocator can be in one of two alignment states: Unaligned and Aligned.

Alignment State

State	Explanation
Unaligned	The sensor or sensor system is not aligned. 3D point clouds are reported in sensor coordinates.
Aligned	The sensor is aligned using the alignment procedure (see <i>Aligning Sensors</i> below) or by manually modifying the values under Transformation in the Sensor tab on the Scan page (for more information, see <i>Transformations</i> on page 70).

An indicator on the **Alignment** panel display ALIGNED or UNALIGNED, depending on the Gocator's state.

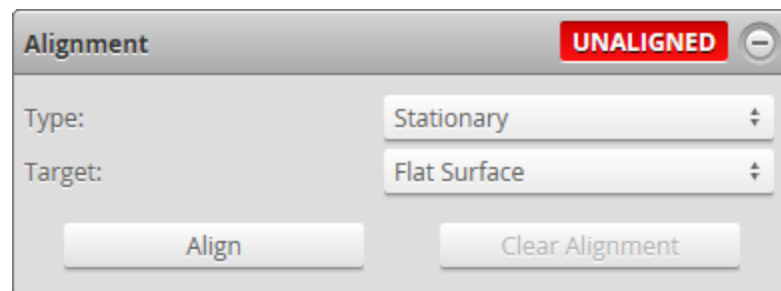
Alignment Types

Gocator sensors support two types of alignment: stationary or moving.

Type	Description
Stationary	Stationary is used when the sensor mounting is constant over time and between scans, for example, when the sensor is mounted in a permanent position over a conveyor belt.
Moving	Moving is used when the sensor's position relative to the object scanned is always changing, for example, when the sensor is mounted on a robot arm moving to different scanning locations.

Aligning Sensors

Alignment can be used to compensate for mounting inaccuracies by aligning sensor data to a common reference surface.



To prepare for alignment:

1. Choose an alignment reference in the **Manage** page if you have not already done so. See *Alignment Reference* on page 54 for more information.
2. Go to the **Scan** page.
3. Choose Surface mode in the **Scan Mode** panel.

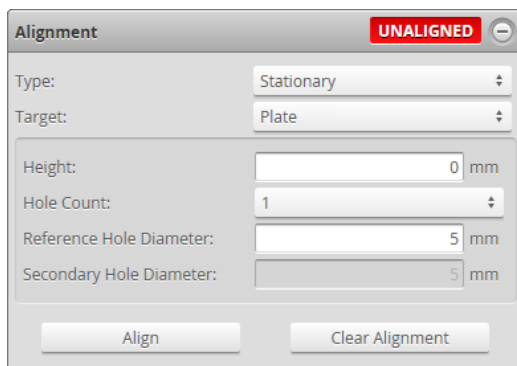
If this mode is not selected, tools will not be available in the **Measure** panel.

4. Expand the **Alignment** panel by clicking on the panel header or the  button.
5. Ensure that all sensors have a clear view of the target surface.
Remove any irregular objects from the sensor's field of view that might interfere with alignment.

To perform alignment for stationary targets:

1. In the **Alignment** panel, select **Stationary** as the **Type**.
2. Clear the previous alignment if present.
Press the **Clear Alignment** button to remove an existing alignment.s
3. Select an alignment **Target**.
 - Select **Flat Surface** to use the conveyor surface (or other flat surface) as the alignment reference
 - Select **Plate** to use a custom calibration plate. If using a calibration plate, specify the bar dimensions and reference hole layout. See *System Coordinates* on page 35 for more information on plates.

Configure the characteristics of the target.



4. Place the target under the sensor
5. Click the **Align** button.
The sensors will start, and the alignment process will take place. Alignment is performed simultaneously for all sensors. If the sensors do not align, check and adjust the exposure settings (page 71).



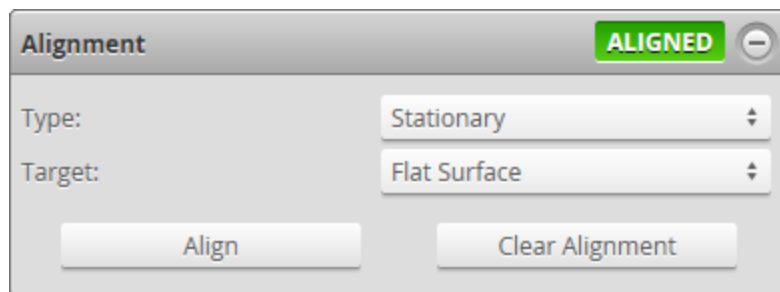
Alignment uses the exposure defined for single exposure mode, regardless of the current exposure mode.

6. Check the alignment results under **Transformation** in the **Active Area** tab in the **Sensor** panel.



Clearing Alignment

Alignment can be cleared to revert the sensor to sensor coordinates.



To clear alignment:

1. Go to the **Scan** page.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, tools will not be available in the **Measure** panel.
3. Expand the **Alignment** panel by clicking on the panel header or the  button.
4. Click the **Clear Alignment** button.
The alignment will be erased and sensors will revert to using sensor coordinates.

Filters

Filters are used to post-process scan data along the X or Y axis to remove noise or clean it up before it is output or is used by measurement tools.

The following types of filters are supported:

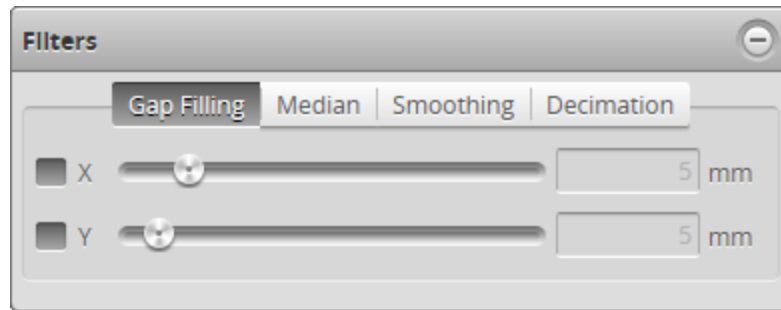
Filter	Description
Gap Filling	Fills in missing data caused by occlusions using information from the nearest neighbors. Gap filling also fills gaps where no data is detected, which can be due to the surface reflectivity, for example dark or specular surface areas, or to actual gaps in the surface.
Median	Substitutes the value of a data point with the median within a specified window around the data point.
Smoothing	Applies moving window averaging to reduce random noise.
Decimation	Reduces the number of data points.

Filters are applied in the order displayed in the table above. The filters are configured in the **Filters** panel on the **Scan** page.

Gap Filling

Gap filling works by filling in missing data points using either the lowest values from the nearest neighbors or linear interpolation between neighboring values (depending on the Z difference between neighboring values), in a specified X or Y window. The sensor can fill gaps along both the X axis and the Y axis.

If both X and Y gap filling are enabled, missing data is filled along the X and Y axes at the same time, using the available neighboring data.



To configure X or Y gap filling:

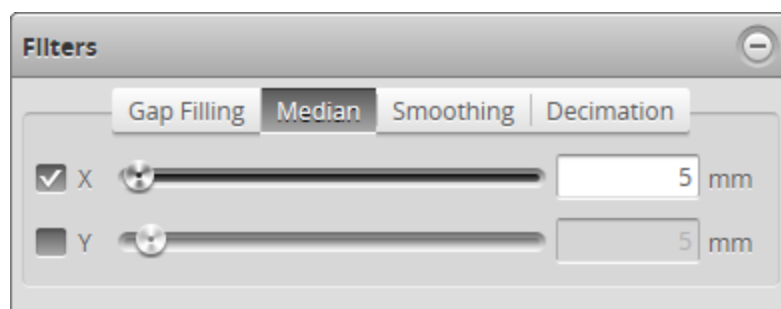
1. Go to the **Scan** page.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, you will not be able to configure gap filling.
3. Expand the **Filters** panel by clicking on the panel header or the  button.
4. Click on the **Gap Filling** tab.
5. Enable the **X** or **Y** setting and select the maximum width value.
The value represents the maximum gap width that the Gocator will fill. Gaps wider than the maximum width will not be filled.
6. Save the job in the **Toolbar** by clicking the **Save** button .
7. Check that the laser profiling is satisfactory.

Median

The Median filter substitutes the value of a data point with the median calculated within a specified window around the data point.



Missing data points will not be filled with the median value calculated from data points in the neighbourhood.



To configure X or Y median:

1. Go to the **Scan** page.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, you will not be able to configure the median filter.
3. Expand the **Filters** panel by clicking on the panel header or the  button.
4. Click on the **Median** tab.
5. Enable the **X** or **Y** setting and select the maximum width value.
6. Save the job in the **Toolbar** by clicking the **Save** button .
7. Check that the laser profiling is satisfactory.

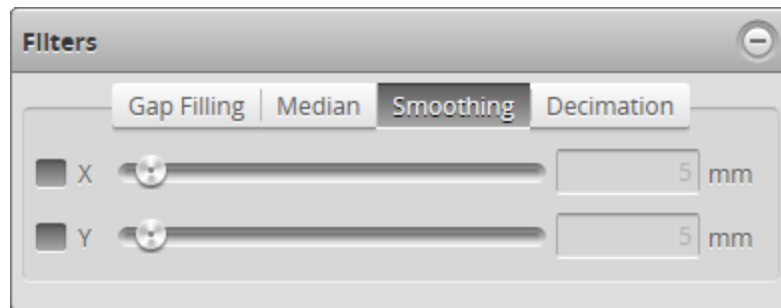
Smoothing

Smoothing works by substituting a data point value with the average value of that data point and its nearest neighbors within a specified window. Smoothing can be applied along the X axis or the Y axis. X smoothing works by calculating a moving average across samples along the X axis. Y smoothing works by calculating a moving average along the X axis.

If both X and Y smoothing are enabled, the data is smoothed along X axis first, then along the Y axis.



Missing data points will not be filled with the mean value calculated from data points in the neighbourhood.

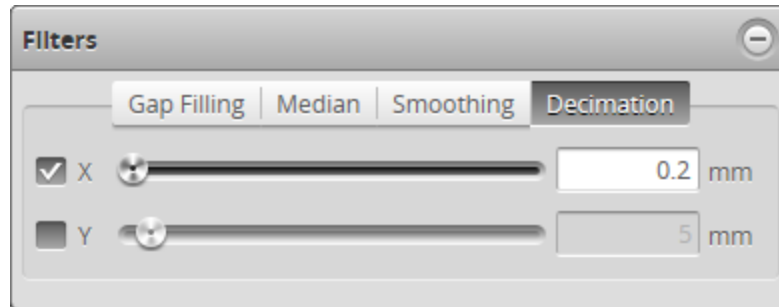


To configure X or Y smoothing:

1. Go to the **Scan** page.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, you will not be able to configure smoothing.
3. Expand the **Filters** panel by clicking on the panel header or the  button.
4. Click on the **Smoothing** tab.
5. Enable the **X** or **Y** setting and select the averaging window value.
6. Save the job in the **Toolbar** by clicking the **Save** button .
7. Check that the laser profiling is satisfactory.

Decimation

Decimation reduces the number of data points along the X or Y axis by choosing data points at the end of a specified window around the data point. For example, by setting X to .2, only points every .2 millimeters will be used.



To configure X or Y decimation:

1. Go to the **Scan** page.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, you will not be able to configure the decimation filter.
3. Expand the **Filters** panel by clicking on the panel header or the  button.
4. Click on the **Decimation** tab.
5. Enable the **X** or **Y** setting and select the decimation window value.
6. Save the job in the **Toolbar** by clicking the **Save** button .
7. Check that the laser profiling is satisfactory.

Part Detection

Multiple parts can be detected from a single surface and will be individually tracked.

Part Detection

Frame Of Reference

Sensor

Part

Height Threshold:

5 mm

Threshold Direction:

Above

Gap Width:

5 mm

Gap Length:

5 mm

Padding Width:

0 mm

Padding Length:

0 mm

Min Area:

5 mm²

Max Part Length:

210 mm

☒ Edge Filtering

The following settings can be tuned to improve the accuracy and reliability of part detection.

Setting	Description
Height Threshold	Determines the height threshold for part detection. The setting for Threshold Direction determines if parts should be detected above or below the threshold. Above is typically used to prevent the belt surface from being detected as a part when scanning objects on a conveyor.
Threshold Direction	Determines if parts should be detected above or below the height threshold.
Gap Width	Determines the minimum separation between objects on the X axis. If parts are closer than the gap interval, they will be merged into a single part.
Gap Length	Determines the minimum separation between objects on the Y axis. If parts are closer than the gap interval, they will be merged into a single part.
Padding Width	Determines the amount of extra data on the X axis from the surface surrounding the detected part that will be included. This is mostly useful when processing part data with third-party software such as HexSight, Halcon, etc.
Padding Length	Determines the amount of extra data on the Y axis from the surface surrounding the detected part that will be included. This is mostly useful when processing part data with third-party software such as HexSight, Halcon, etc.
Min Area	Determines the minimum area for a detected part. Set this value to a reasonable minimum in order to filter out small objects or noise.
Max Part Length	Determines the maximum length of the part object. When the object exceeds the

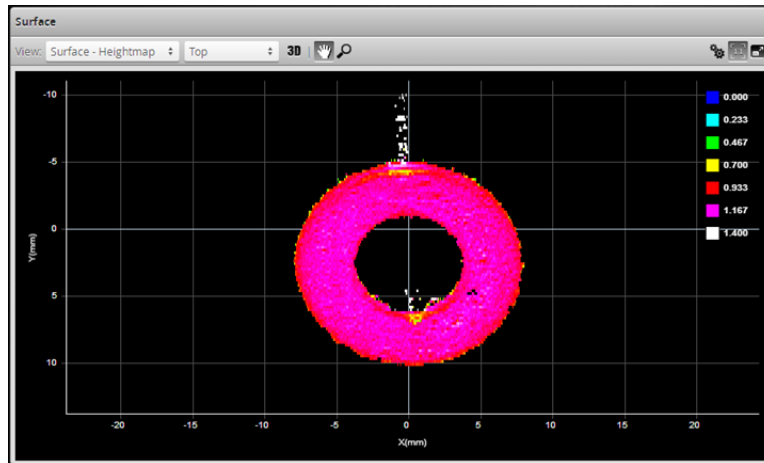
Setting	Description
	maximum length, it is automatically separated into two parts. This is useful to break a long object into multiple sections and perform measurements on each section.
Frame of Reference	Determines the coordinate reference for surface measurements.
	Sensor When Frame of Reference is set to Sensor, the sensor's frame of reference is used. When set to Sensor, all measurement values are relative to the sensor's field of view in X and relative to the encoder zero position in Y. Part When Frame of Reference is set to Part, all measurements except Bounding Box X and Y are relative to the center of the bounding box of the part. For Bounding Box X and Y, the measurement values are always relative to the sensor frame of reference (see <i>Bounding Box</i> on page 169).
Edge Filtering	See <i>Edge Filtering</i> below.

To set up part detection:

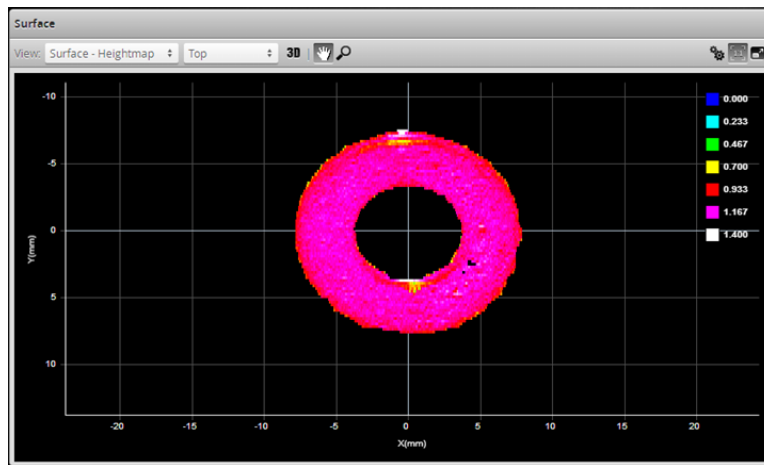
1. Go to the **Scan** page and choose **Surface** in the **Scan Mode** panel.
If this mode is not selected, you will not be able to configure part detection.
2. Expand the **Part Detection** panel by clicking on the panel header or the  button.
3. If necessary, check the **Enabled** option.
When **Generation** is set to **Continuous**, part detection is always enabled.
4. Adjust the settings.
See the part detection parameters above for more information.

Edge Filtering

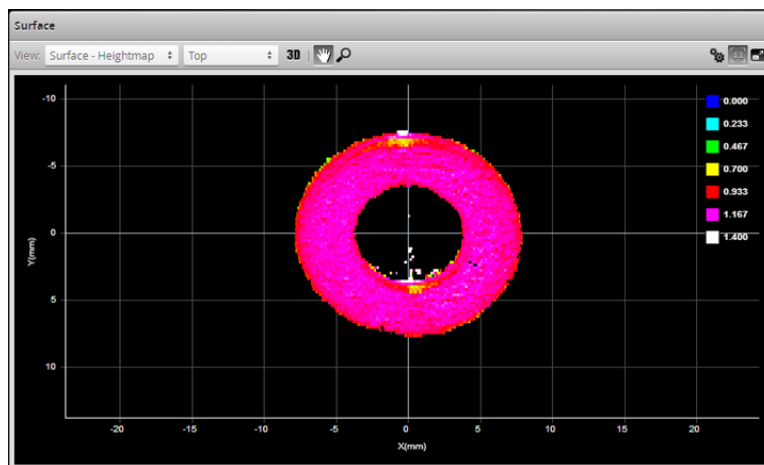
Part scans sometimes contain noise around the edges of the target. This noise is usually caused by the sensor's light being reflected off almost vertical sides, rounded corners, etc. Edge filtering helps reduce edge noise in order to produce more accurate and repeatable volume and area measurements, as well as to improve positioning of relative measurement regions. Optionally, the **Preserve Interior Feature** setting can be used to limit filtering to the outside edges of the target.



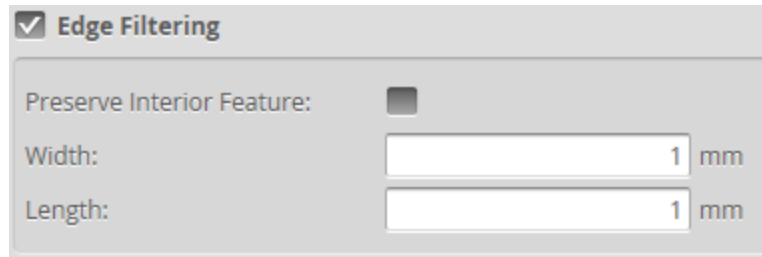
Edge Filtering disabled (scan shows reflection noise)



Edge Filtering enabled (reflection noise eliminated or reduced)



Edge Filtering enabled, Preserve Interior Feature enabled

The image shows a software configuration panel titled "Edge Filtering" with a checked checkbox. Below the title, there are three settings: "Preserve Interior Feature:" with an unchecked checkbox, "Width:" with a text input field containing "1" and "mm" to its right, and "Length:" with a text input field containing "1" and "mm" to its right.

✓ **Edge Filtering**

Preserve Interior Feature: ☐

Width: mm

Length: mm

To configure edge filtering:

1. Go to the **Scan** page and choose **Surface** in the **Scan Mode** panel.
If this mode is not selected, you will not be able to configure part detection.
2. Expand the Part Detection panel by clicking on the panel header or the  button and enable part detection if necessary.
3. Check the **Edge Filtering** checkbox to enable edge filtering.
4. Configure the **Width** and **Length** settings.
The **Width** and **Length** settings represent the size of the filter on the X axis and the Y axis, respectively.
5. Set the **Preserve Interior Feature** setting if necessary.
The **Preserve Interior Feature** setting limits filtering to the outside edges of the target.

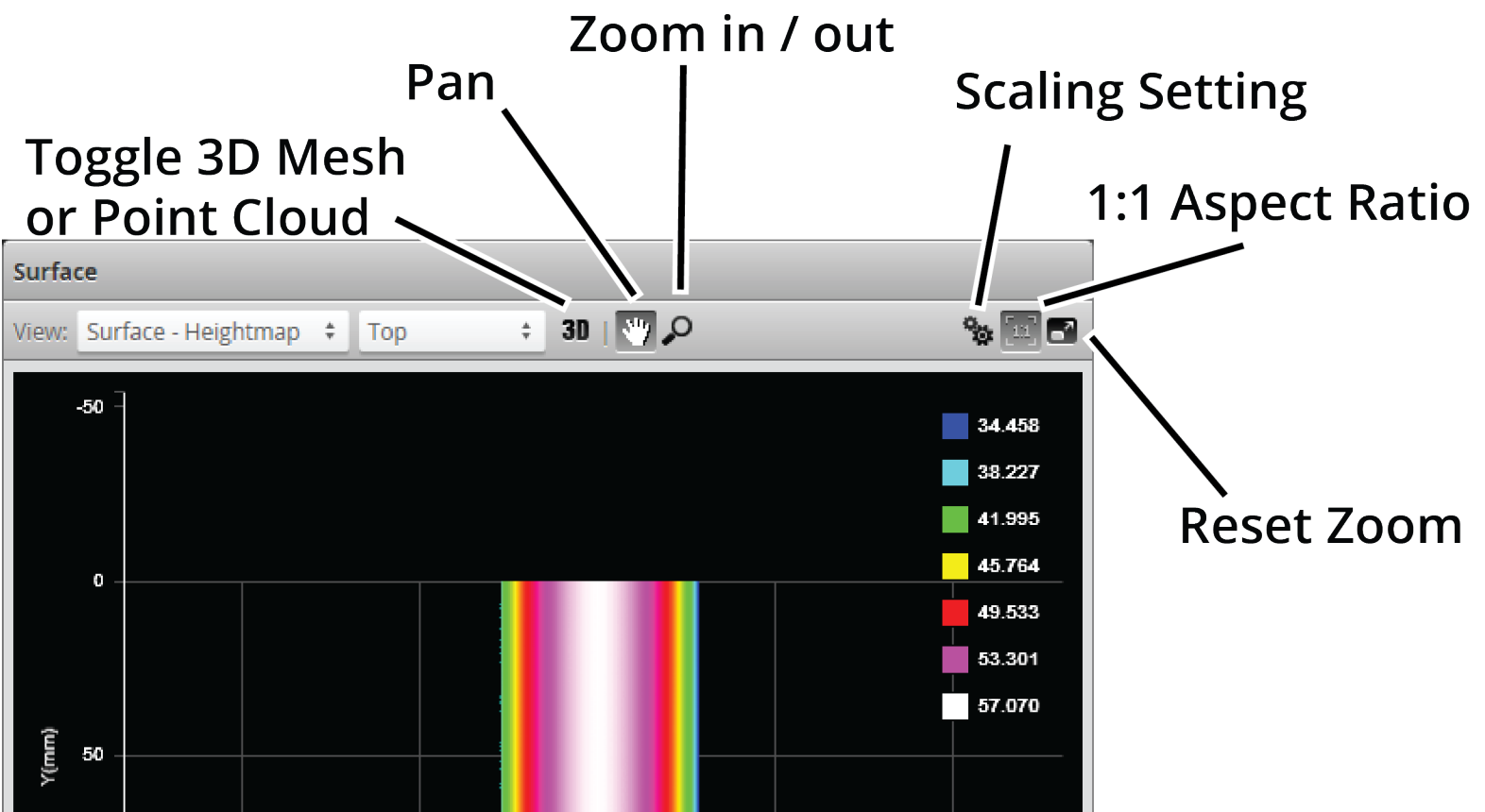
Data Viewer

The data viewer can display images in a 2D view and height map (resampled point cloud) or intensity in 2D or 3D views. The data viewer changes depending on the current operation mode and the panel that has been selected. Use the drop down list at the top-left corner to select the data source to view. The available data sources depend on the operation mode settings.

Data Viewer Controls

The data viewer is controlled by mouse clicks and by the buttons on the display toolbar. The mouse wheel can also be used for zooming in and out.

Press 'F' when the cursor is in the data viewer to switch to full screen.



Video Mode

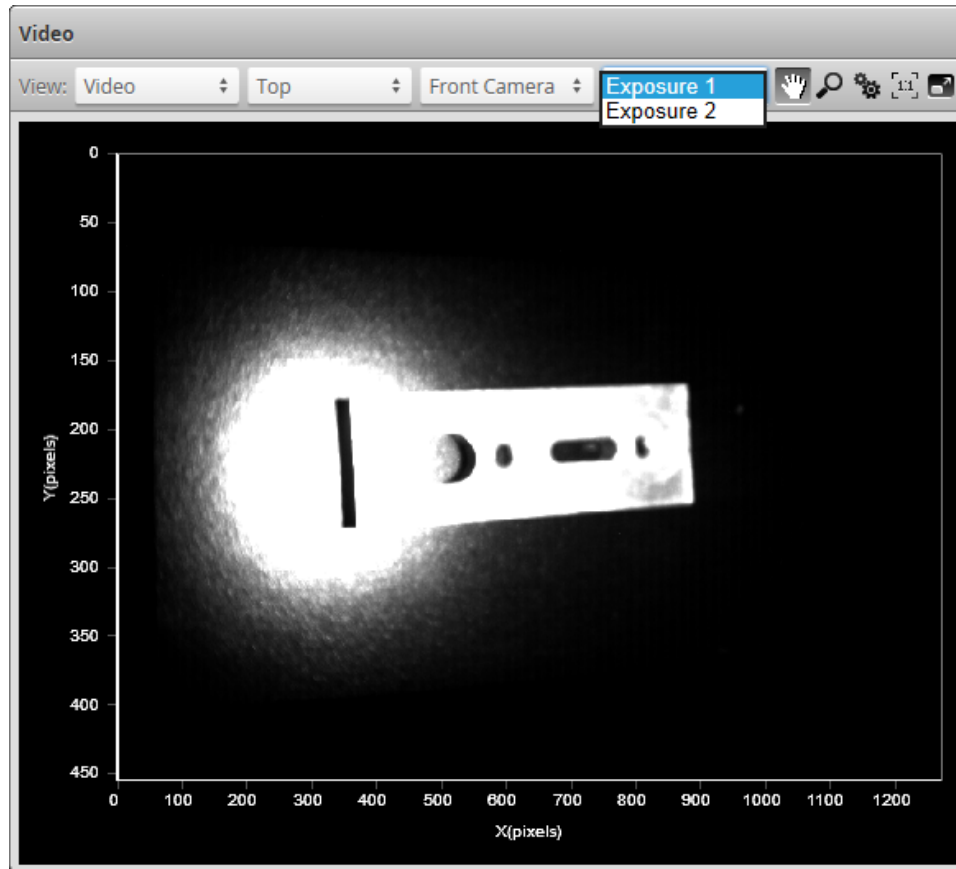
In Video mode, the data viewer displays a camera image from either of the two cameras in the sensor. In this mode, you can configure the data viewer to display exposure, spot, and dropout information that can be useful in properly setting up the system for scanning.

Exposure Information

In Video mode, you can display exposure-related information.

Exposures

If you have set **Exposure Mode** to **Multiple**, and have set more than one exposure, a drop-down at the top of the data viewer lists the available exposures. Choosing an exposure changes the view of the data viewer to that exposure.



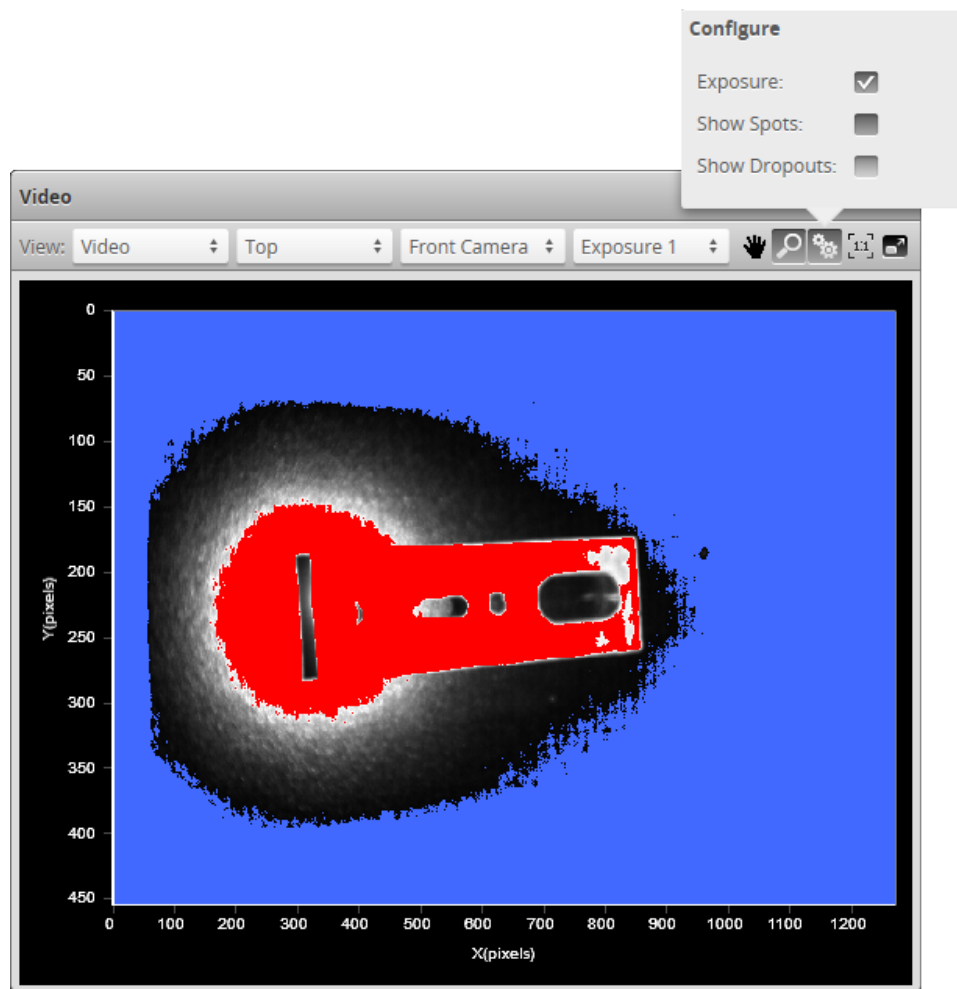
For details on setting exposure in the **Exposure** tab in the **Sensor** panel, see *Exposure* on page 71.

To select the exposure view of the display:

1. Go to the **Scan** page and choose **Video** mode in the **Scan Mode** panel.
2. Select the camera view in the data viewer.
Use the first drop-down list next to **View** at the top of the data viewer to select **Front Camera** or **Back Camera**.
3. Select the exposure.
Use the second drop-down list next to **View** at the top of the data viewer to select the exposure.

Overexposure and Underexposure

You can display a color exposure overlay on the video image to help set the correct exposure.



The **Exposure** setting uses the following colors:

- Blue: Indicates background pixels ignored by the sensor.
- Red: Indicates saturated pixels.

Correct tuning of exposure depends on the reflective properties of the target material and on the requirements of the application. Settings should be carefully evaluated for each application.

The Gocator 3100 cannot generate 3D points in over-saturated (areas indicated with red) or in under-exposed areas (indicated with blue). If it's not possible to set a single exposure to capture the entire object target without red areas appearing in the image, the **Multiple** exposure feature should be enabled. Use the drop-down selection box to view each exposure and tune one high exposure for dark areas on the target and one low exposure for bright areas on the target. Note that multiple exposures reduce the maximum speed the sensor can run at.

To display an overlay:

1. Go to the **Scan** page and choose **Video** mode in the **Scan Mode** panel.
2. Check **Exposure** at the top of the data viewer.

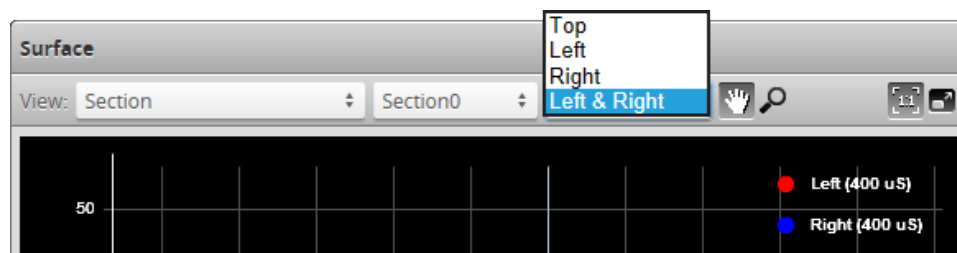
Section Mode

When the Gocator is in Surface scan mode, the data viewer can display [sections](#) (profiles extracted from surfaces).



In a dual-sensor system, profiles from individual sensors or from a combined view can be displayed.

When in the **Scan** page, selecting a panel (e.g., **Sensor** or **Alignment** panel) automatically sets the display to the most appropriate display view.



To manually select the display view in the Scan page:

1. Go to the **Scan** page.
2. Choose **Surface** mode in the **Scan Mode** panel.
3. Just above the data viewer, choose **Section** in the **View** drop-down.
The view from an individual sensor or the combined view of two sensors can be selected from the drop-down list at the top of the data viewer.
Top: View from a single sensor, from the top sensor in an opposite-layout dual-sensor system, or the combined view of sensors that have been aligned to use a common coordinate system.

Bottom: View from the bottom sensor in an opposite-layout dual-sensor system.

Left: View from the left sensor in a dual-sensor system.

Right: View from the right sensor in a dual-sensor system.

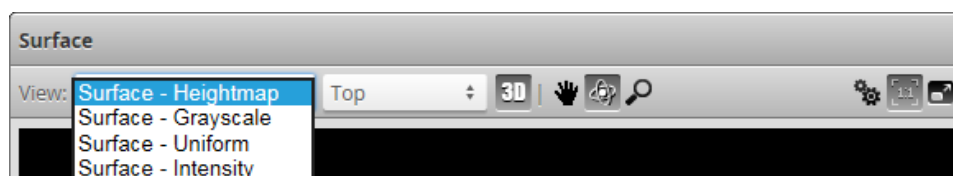
Left & Right: Views from both sensors, displayed at the same time in the data viewer, using the coordinate systems of each sensor.

1. Go to the **Scan** page.
2. Choose **Surface** mode in the **Scan Mode** panel.
3. Just above the data viewer, choose **Section** in the **View** drop-down.
The view from an individual sensor or the combined view of two sensors can be selected from the drop-down list at the top of the data viewer.
Top: View from a single sensor, from the top sensor in an opposite-layout dual-sensor system, or the combined view of sensors that have been aligned to use a common coordinate system.
Bottom: View from the bottom sensor in an opposite-layout dual-sensor system.
Left: View from the left sensor in a dual-sensor system.
Right: View from the right sensor in a dual-sensor system.
Left & Right: Views from both sensors, displayed at the same time in the data viewer, using the coordinate systems of each sensor.

In the **Measure** page, the view of the display is set to the profile source of the selected measurement tool.

Surface Mode

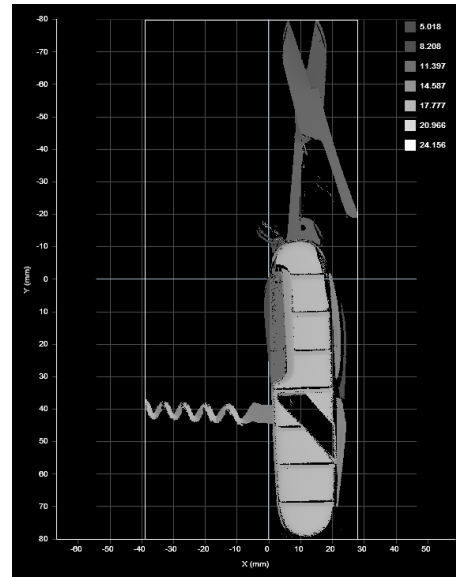
When the Gocator is in Surface [scan mode](#), the data viewer can display height maps and intensity images. You can select the data to display from the **View** drop-down.



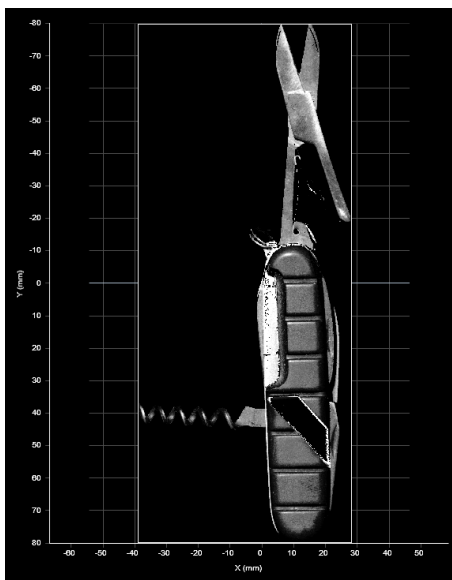
View Option	Description
Surface - Heightmap	In 2D view, displays the pseudo color height map. In 3D view, overlays the 2D pseudo color height map on the 3D model.
Surface - Grayscale	In 2D view, displays the grayscale height map. In 3D view, overlays the grayscale height map on the 3D model.
Surface - Uniform	Overlays a uniform shaded surface on the 3D model. (Only available in 3D view.)
Surface - Intensity	In 2D view, displays the intensity. In 3D view, overlays the intensity map on the 3D model. (Acquire Intensity must be checked in the Scan Mode panel.)



2D viewer with height map overlay



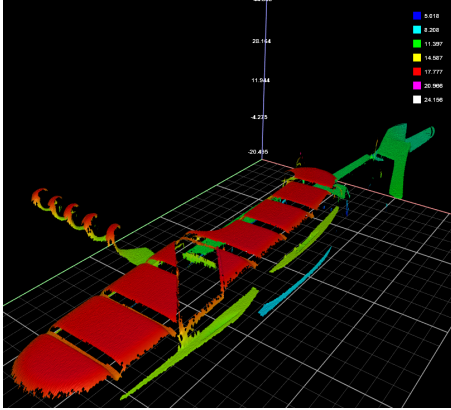
2D viewer with grayscale overlay



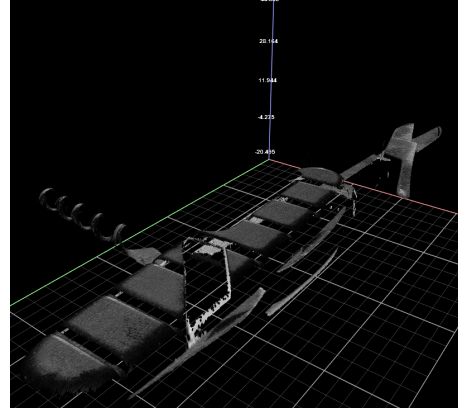
2D viewer with intensity overlay

If you have defined any [sections](#), a **Sections** option will display.

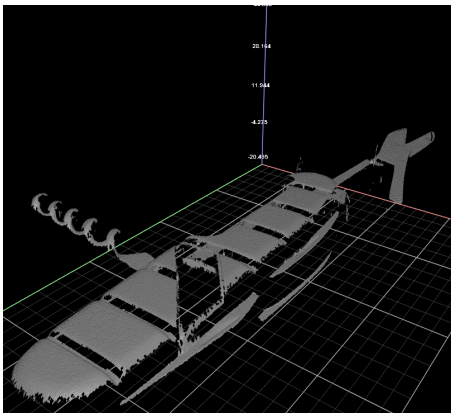
Clicking the **3D** button toggles between the 2D and 3D viewer. The 3D model is overlaid with the information that corresponds to the selected **View** option.



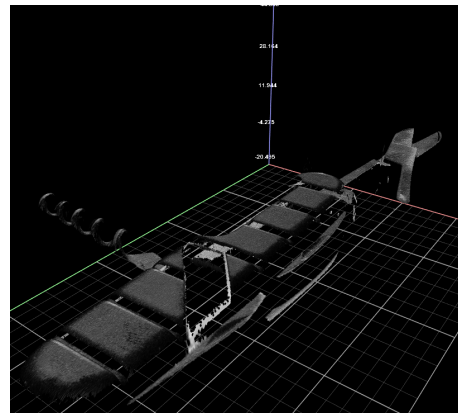
3D viewer with height map overlay



3D viewer with grayscale overlay



3D viewer with uniform overlay



3D viewer with uniform overlay

In 3D mode, you can choose how the data viewer renders the model:

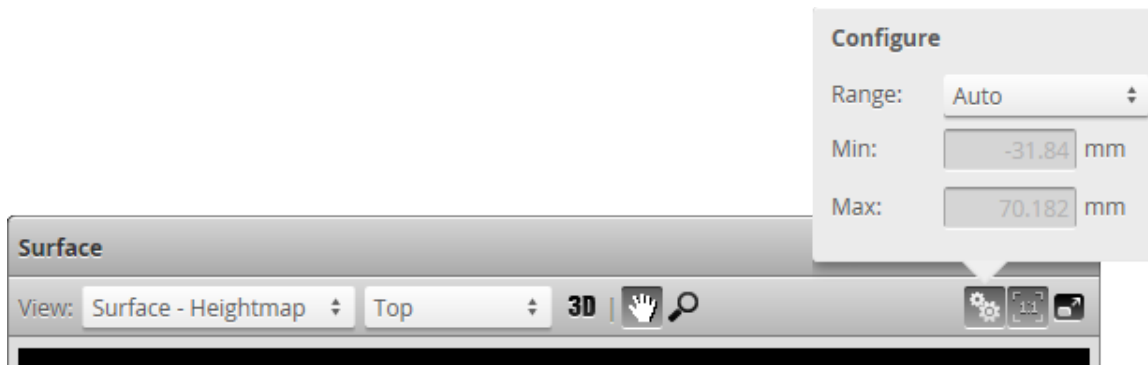
Rendering Mode	Description
Point Cloud (default) 	Renders 3D models using point clouds. Useful in scan data that contains noise around edges, and shows hidden structure.
Mesh 	Renders 3D models using "meshing," connecting 3D point clouds with polygons.

To manually select the display type and the display view in the Scan page:

1. Go to the **Scan** page.
2. Select the View options in the data viewer.
Heightmap, **Grayscale**, **Uniform**, or **Intensity** can be selected from the left drop-down list.

Height Map Color Scale

Height maps are displayed in pseudo-color. The height axis (Z) is color-coded. The scaling of the height map can be adjusted.



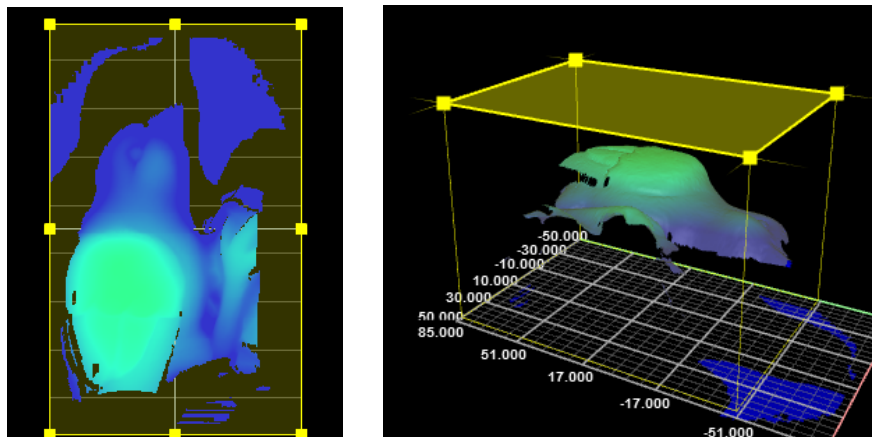
To change the scaling of the height map:

1. Select **Heightmap** from the **View** drop-down in the data viewer.
2. Click the **Scaling** button.
 - To automatically set the scale, choose **Auto** in the **Range** drop-down.
 - To automatically set the scale based on a user-selected sub-region of the heightmap, choose **Auto - Region** in the **Range** drop-down and adjust the yellow region box in the data viewer to the desired location and size.
 - To manually set the scale, choose the **Manual** in the **Range** drop-down and enter the minimum and maximum height to which the colors will be mapped.

Region Definition

Regions, such as an active area or a measurement region, can be graphically set up using the data viewer in the 2D or in the 3D view.

When the **Scan** page is active, the data viewer can be used to graphically configure the active area. The **Active Area** setting can also be configured manually by entering values into its fields and is found in the **Sensor** panel (see *Sensor* on page 68).



To set up a region of interest:

1. Move the mouse cursor to the rectangle. In the 3D viewer, you must first select which side of the 3D rectangle to adjust by clicking on it.
The rectangle is automatically displayed when a setup or measurement requires an area to be specified.
2. Drag the rectangle to move it, and use the handles on the rectangle's border to resize it.

Intensity Output

Gocator sensors can produce intensity images that measure the amount of light reflected by an object. An 8-bit intensity value is output for each point in the 3D point cloud.

Intensity output is enabled by checking **Acquire Intensity** in the **Scan Mode** panel.

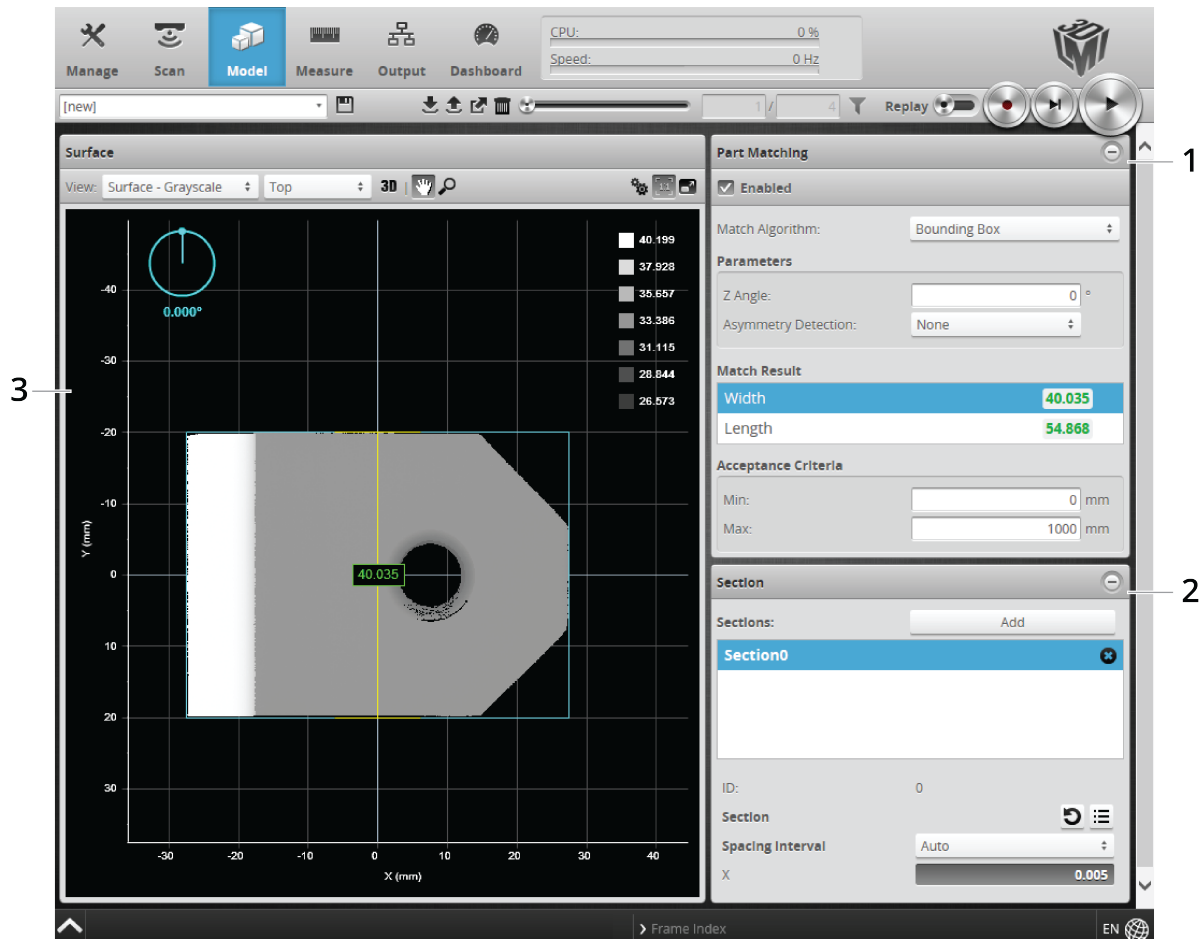


Models

The following sections describe how to set up part matching using a model, a bounding box, or an ellipse. It also describes how to configure sections.

Model Page Overview

The **Model** page lets you set up part matching and sections.



Element	Description
1	Part Matching panel Contains settings for configuring models and for part matching.
2	Sections panel Contains settings for configuring sections, which let you extract profiles from surfaces.
3	Data Viewer Displays sensor data and lets you add and remove model edge points.

Part Matching

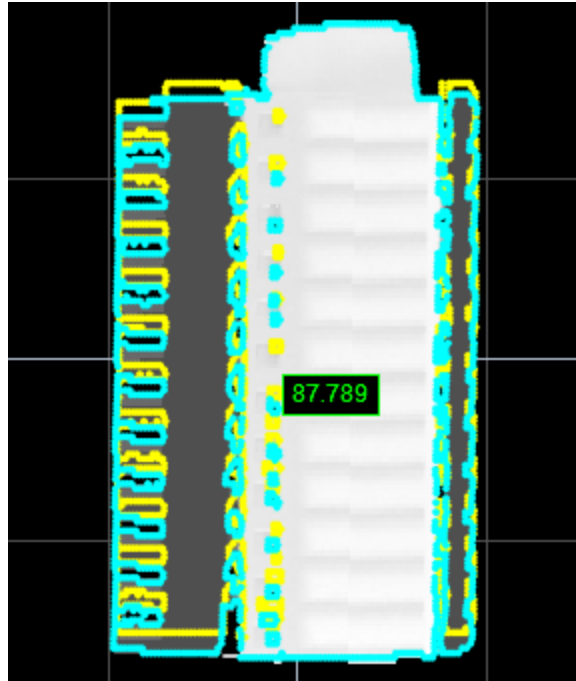
Gocator can match scanned parts to the edges of a model based on a previously scanned part (see *Using Edge Detection* on page 100) or to the dimensions of a fitted bounding box or ellipse that encapsulate the model (see *Using Bounding Box and Ellipse* on page 109). When parts match, Gocator can rotate scans so that they are all oriented in the same way. This allows measurement tools to be applied consistently to parts, regardless of the orientation of the part you are trying to match.

When the match quality between a model and a part reaches a minimum value (a percentage), or the bounding box or ellipse that encapsulates the part is between minimum and maximum dimension values, the part is "accepted" and any measurements that are added in the **Measure** page will return valid values, as long as the target is in range, etc. If the part is "rejected," any measurements added in the **Measure** page will return an Invalid value. For more information on measurements and decision values, see *Measurement* on page 119.

Using Edge Detection

When using edge detection for part matching, the Gocator compares a model that you must create from a previous scan to a "target" (one of the parts you want to match to the model).

In the data viewer, a model is represented as a yellow outline. The target is represented as a blue outline. If the part match quality above a minimum user-defined level, any measurements configured on the **Measure** page are applied.



*Model (yellow outline) and target (blue outline).
Part match quality is 87.789%, which is greater
than the minimum set by the user, so the parts match.*

When you create a model, the Gocator runs an edge detection algorithm on either the heightmap or intensity image of a scanned part. The resulting model is made up of the detected edge points. The scan used to create the model should be of a reference (or "golden") part to which all other parts will be compared.

After the model has been created, you optionally modify the model by adjusting the sensitivity (how many edge points are detected), or selectively remove edge points from the model, to improve matching.

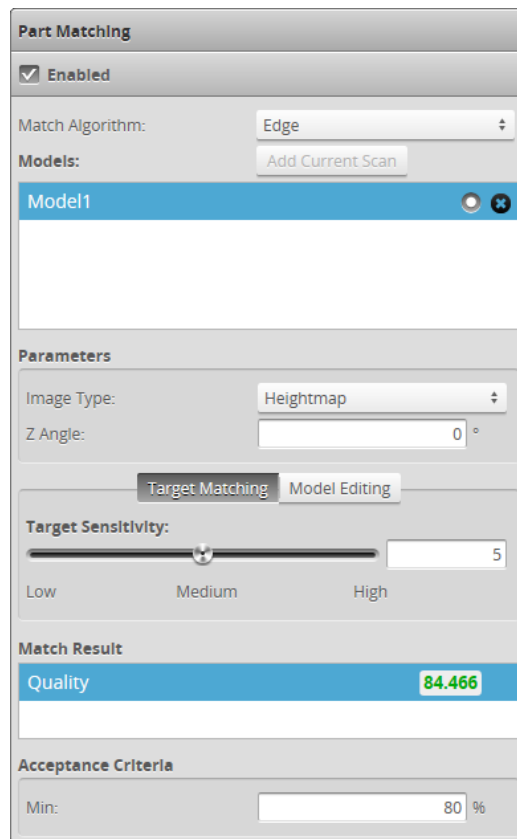


Models are saved as part of a job.

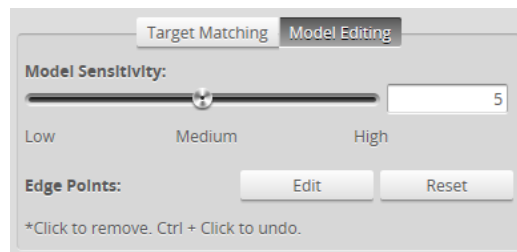
Once you have finished modifying the model, you can also modify target sensitivity, which controls how many edge points are detected on the subsequently scanned targets that will be compared to the model; the same edge detection algorithm used for creating models is used to compare a model to a part.

Typically, setting up edge detection to perform part matching involves the following steps:

1. Scan a reference part (you can also use replay data that you have previously saved).
2. Create a model based on the scan (using either heightmap or intensity data).
3. Adjust the model (edge detection algorithm sensitivity and selective removal of edge points).
4. Scan another part typical of the parts that would need to match the model.
5. Adjust the target sensitivity.
6. Set match acceptance level.



Part Matching panel showing Target Matching tab



Model Editing tab on Part Matching panel

The following settings are used to configure part matching using edge detection.

Setting	Description
Match Algorithm	Determines which algorithm the sensor will use to attempt a match. Set this to Edge for edge detection.
Image Type	Determines what kind of data the Gocator will use to detect edges and therefore for part matching. Choose this setting based on the kinds of features that will be used for part matching: Heightmap: Surface elevation information of the scanned part will be used to determine edges. This setting is most commonly used. Intensity: Intensity data (how light or dark areas of a scanned part are) will be used to determine edges. Use this setting if the main distinguishing marks are printed text or patterns on the parts. The Acquire Intensity option must be checked in the Scan Mode panel on the Scan page for this option to be available.
Z Angle	Corrects the orientation of the model to accurately match typical orientation and simplify measurements.
Target Sensitivity (Target Matching tab)	Controls the threshold at which an edge point is detected on the target's heightmap or intensity image. (The "target" is any part that is matched to the model and which will subsequently be measured if the match is accepted.) Setting Target Sensitivity higher results in more edge points. Setting it lower results in fewer edge points and results in higher performance. Use this setting to exclude noise from the detected edges and to make sure distinguishing features are properly detected. The level of this setting should generally be similar to the level of Model Sensitivity.
Model Sensitivity (Model Editing tab)	Controls the threshold at which an edge point is detected on the heightmap or intensity image used to create the model. Setting Model Sensitivity higher results in more edge points. Setting it lower results in fewer edge points and results in higher performance. Use this setting to exclude noise from the detected edges and to make sure distinguishing features are properly detected. The level of this setting should generally be similar to the level of Target Sensitivity. Changing this setting causes the edge detection algorithm to run again at the new threshold. If you have edited edge points manually (removing them selectively), those changes will be lost. See <i>Using Edge Detection</i> on page 100 for more information.
Edge Points (Model Editing tab)	The Edit button lets you selectively remove edge point that are detected by the edge detection algorithm at the current Model Sensitivity setting. See <i>Using Edge Detection</i> on page 100 for more information.
Acceptance Criteria	Determines the minimum quality level of the match as a percentage value. <i>Part rejected: Quality result is less than Min</i>

To run part matching, simply make sure that the **Enabled** option is checked on the **Part Matching** panel when the Gocator is running. Any measurements that are added and configured on the **Measure**

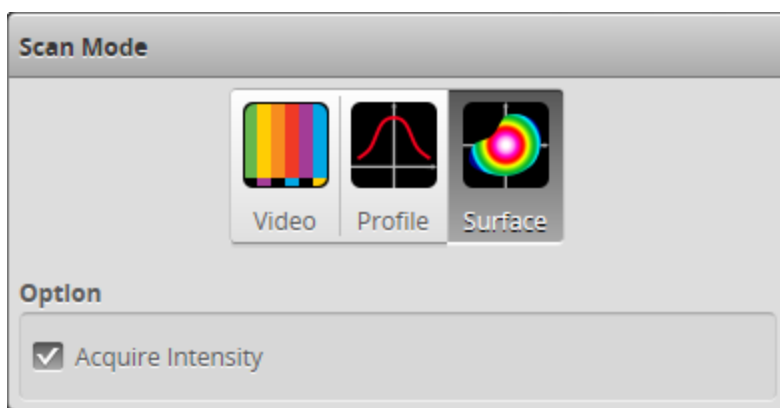
page will be applied to parts if a part match is accepted, regardless of the part's orientation (a successfully matched part is rotated to match orientation of the model), returning a value and decision (as long as the part is in range, etc.). If a part match is rejected, measurements will return an Invalid value.

Creating a Model

Gocator creates a model by running an edge detection algorithm on the heightmap or intensity image of a scan. The algorithm is run when a model is first created and whenever the **Model Sensitivity** setting is changed.

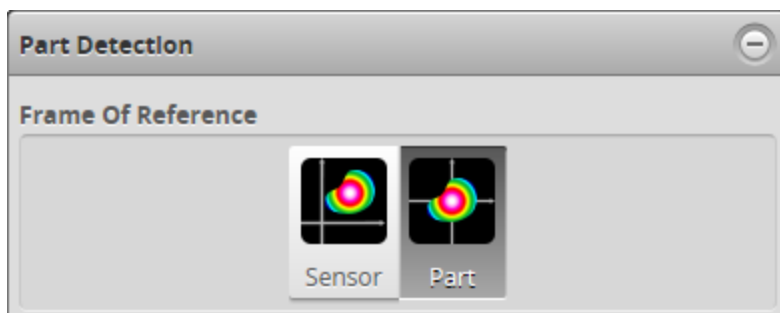
To create a model:

1. Go to the **Scan** page.
 - a. In the **Scan Mode** panel, choose **Surface**.



You must choose **Surface** in order to scan a part. Furthermore, the **Model** page is only displayed in Surface mode.

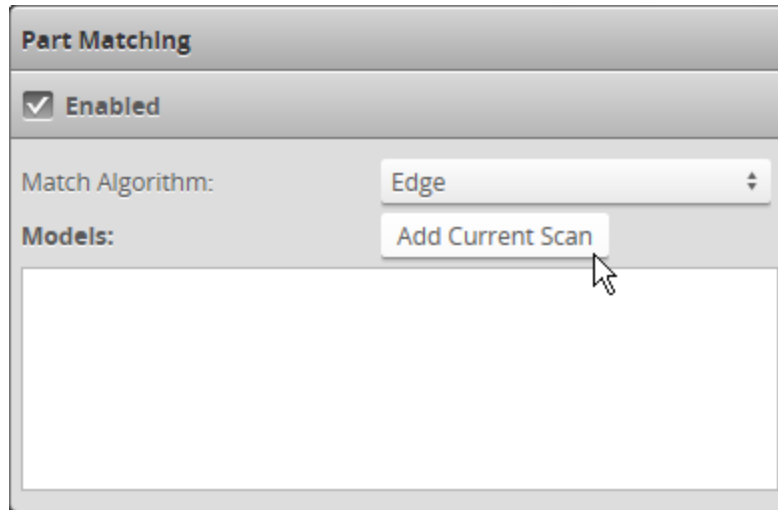
- b. If you want to use intensity data to create the model, make sure **Acquire Intensity** is checked.
 - c. In the **Part Detection** panel, choose **Part** for the **Frame of Reference**.



Part matching is only available when **Part** has been selected.

2. Do one of the following:
 - Scan a reference part. See *Scan Setup and Alignment* on page 63 for more information on setting up and aligning Gocator. See *Running a Standalone Sensor System* on page 26 for more information on running a system to scan a part.

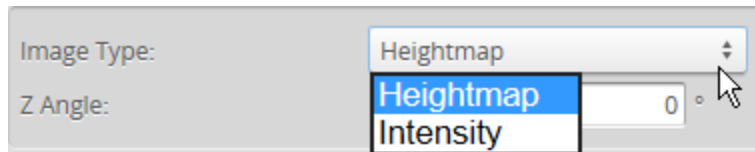
- Locate some previously recorded replay data and load it. See *Recording, Playback, and Measurement Simulation* on page 42 and *Downloading, Uploading, and Exporting Replay Data* on page 45 for more information on replay data.
- Go to the **Model** page.
 - Make sure the **Enabled** option is checked in the **Part Matching** panel.
 - In the **Match Algorithm** drop-down, choose **Edge**.



- Click **Stop** on the toolbar if the sensor is running.
- Click **Add Current Scan**.


 After adding the model, the Gocator will show that the match quality is 100%, because it is in effect comparing the model to the scan that was used to create the model. This value can be ignored.

- In the **Image Type** drop-down, choose **Heightmap** or **Intensity**.



- If you need to correct the orientation of the model, provide a value in the **Z Angle** field.
Correcting the Z angle is useful if the orientation of the model is not close to the typical angle of target parts on the production line.
- Save the job by clicking the **Save** button .

Models are saved in job files.

See *Creating, Saving and Loading Jobs (Settings)* on page 40 for more information on saving jobs.

After you have created a model, you may wish to modify it to remove noise to improve its matching capabilities. You may also wish to modify a model to exclude certain areas. See *Creating a Model* on the previous page for more information.

Model names can be renamed.

To rename a model:

1. In the **Models** list, double-click on a model name.
2. Type a new name in the model name field.
3. Press Enter or click outside the model name field.
4. Save the job by clicking the **Save** button .

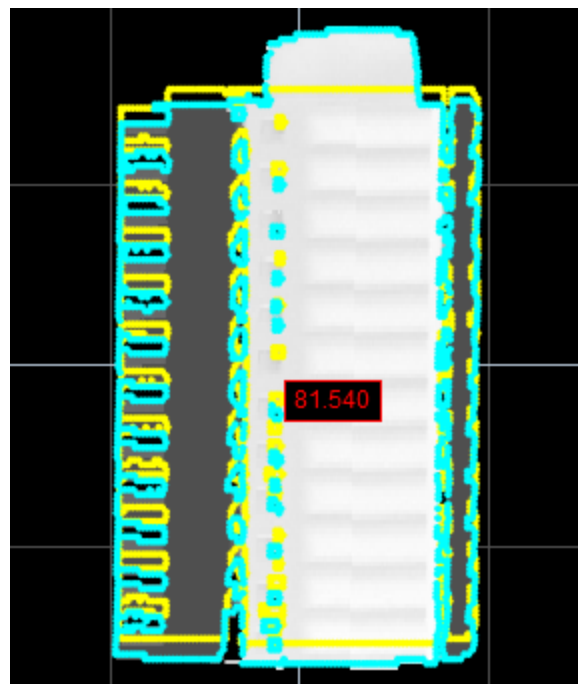
To delete a model, click the  button.

Modifying a Model's Edge Points

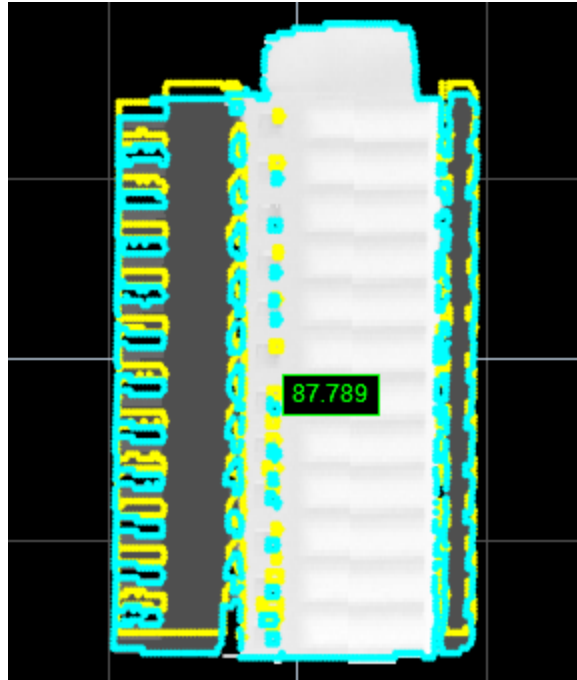
Modifying a model's edge points is useful to exclude noise in the detected edge points and to make sure distinguishing features are properly detected, which can improve matching. You can modify edge points in two ways.

First, you can control the overall number of edge points that are detected by the edge detection algorithm by raising and lowering the edge detection threshold (the **Model Sensitivity** setting). Modifying **Model Sensitivity** causes the edge detection algorithm to run again.

Second, you can fine-tune the model's edge points by selectively removing edge points that are detected by the edge detection algorithm. This could be useful, for example, if an edge on the target parts frequently presents minor variations such as flashing (excess material caused by leakage during molding): the edge points that make up the model can be edited to exclude that region. Editing the model can allow parts to match it more easily.



*Edge points along top of model not removed.
Part is rejected. (Min set to 85%)*



*Edge points along top of model removed.
Part is accepted. (Min set to 85%.)*

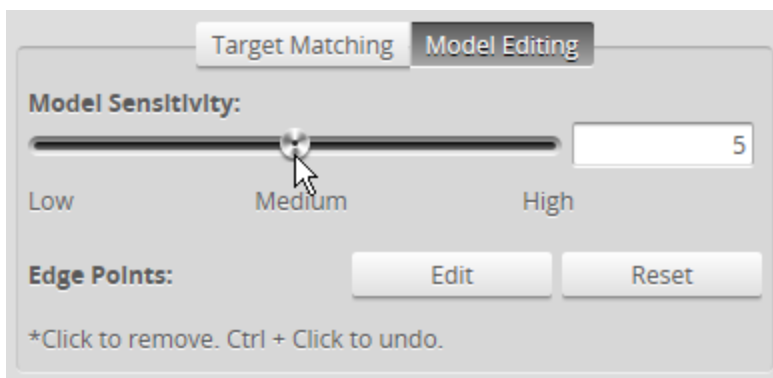
Removing edge points does not cause the edge detection algorithm to run again.

To change model sensitivity:

1. In the **Models** list, select the model you want to configure by clicking on its selection control.



2. Click the **Model Editing** tab.
3. Adjust the **Model Sensitivity** slider to exclude noise and to properly detect the distinguishing features that will match parts.



You can also set the sensitivity value manually in the provided text box.

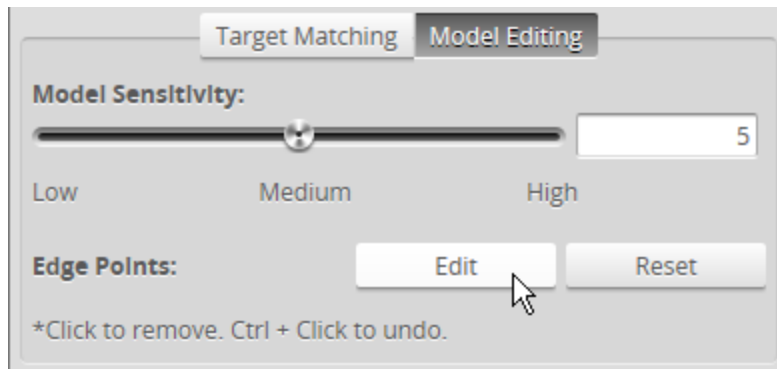
4. Save the job by clicking the **Save** button .

To manually remove model edge points:

1. In the **Models** list, select the model you want to configure by clicking on its selection control.



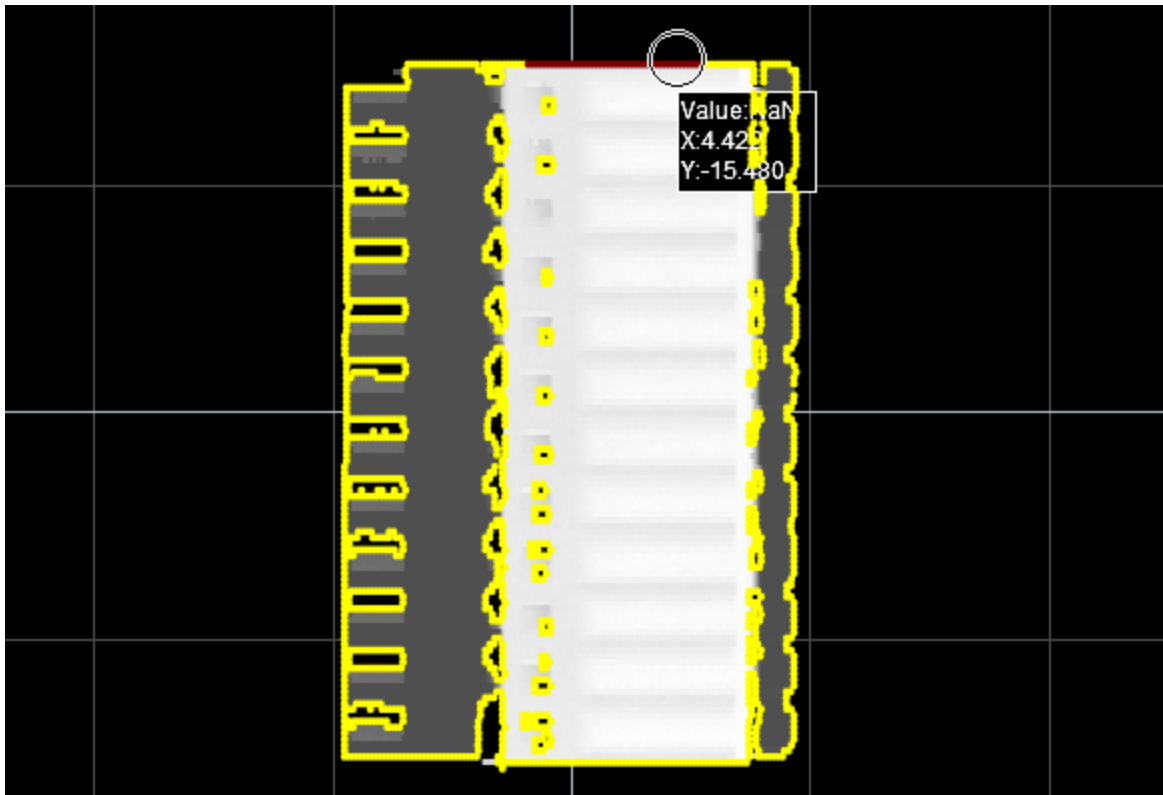
2. In the **Model Editing** tab, click on the **Edit** button.



3. On the toolbar above the data viewer, make sure the **Select** tool is active.



4. Click in the data viewer and hold the mouse button while moving the pointer over the edge points you want to remove.



Points within the circular **Select** tool are removed from the model. Removed edge points turn red in the data viewer.

You can zoom in to see individual edge points by using the mouse wheel or by using the Zoom mode ().

5. If you have removed too many edge points, use Ctrl + Click in the data viewer to add the edge points back.
6. When you have finished editing the model, click **Save** in the **Model Editing** tab.
7. Save the job by clicking the **Save** button  on the toolbar.

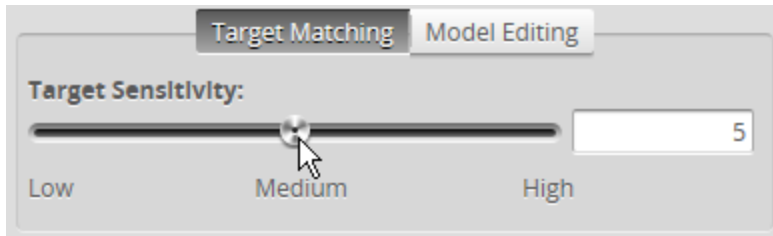
Adjusting Target Sensitivity

After you have added a model and optionally adjusted it, you must scan a different part, one that is typical of parts that must match the model.

Much in the same way that you can adjust a model's sensitivity, you can adjust the target sensitivity, that is, the threshold at which edge points are detected on the heightmaps or intensity images of parts that you want to match to the model. Adjusting the target sensitivity is useful to exclude noise, improving part matching.

To change target sensitivity:

1. Click the **Target Matching** tab.
2. Adjust the **Target Sensitivity** setting to exclude noise in order to properly detect the distinguishing features that will allow parts to match.



You can also set the sensitivity value manually in the provided text box.

Setting the Match Acceptance Criteria

In order for a part to match a model, the match quality must reach the minimum set in the **Min** field in **Acceptance Criteria** section of the **Part Matching** panel.

 A screenshot of the 'Match Result' and 'Acceptance Criteria' section. The 'Match Result' section shows a 'Quality' bar with the value '87.789' in green. Below it is an empty text box. The 'Acceptance Criteria' section has a 'Min:' label followed by a text box containing '85 %'.

Part accepted: Quality result is greater than Min

 A screenshot of the 'Match Result' and 'Acceptance Criteria' section. The 'Match Result' section shows a 'Quality' bar with the value '87.789' in red. Below it is an empty text box. The 'Acceptance Criteria' section has a 'Min:' label followed by a text box containing '90 %'.

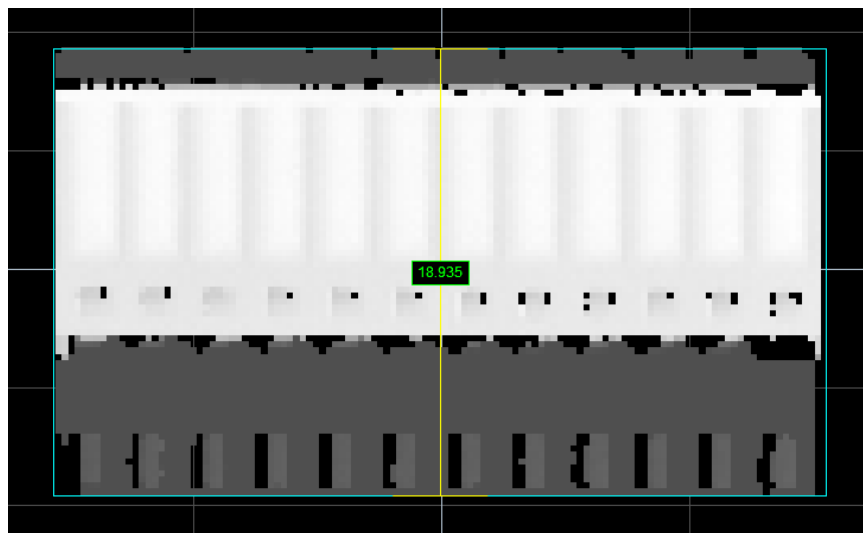
Running Part Matching

To run part matching, simply make sure that the **Enabled** option is checked on the **Part Matching** panel when the Gocator is running. Any measurements that are added and configured on the **Measure** page will be applied to parts if a part match is accepted, regardless of the part's orientation (a successfully matched part is rotated to match orientation of the model), returning a value and decision (as long as the part is in range, etc.). If a part match is rejected, measurements will return an Invalid value.

Using Bounding Box and Ellipse

When using a bounding box or an ellipse to match parts, the Gocator tests whether a part fits into a bounding box or ellipse that you define. A match will occur regardless of orientation.

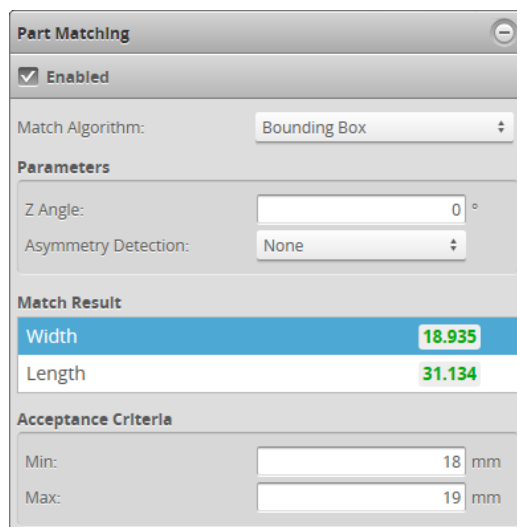
In the data viewer, a bounding box or ellipse is displayed with a blue outline. If a part fits in the bounding box or ellipse, any measurements configured on the **Measure** page are applied.



*Blue bounding box around a part.
(Yellow lines show currently selected
dimension in Part Matching panel.)*

Typically, setting up a bounding box or an ellipse to perform part matching involves the following steps:

1. Scan a reference part (you can also use replay data that you have previously saved).
2. Set the characteristics of the bounding box (width and length) or ellipse (major and minor axes).



Part Matching panel (Bounding Box match algorithm)

The following settings are used to configure part matching using a bounding box or ellipse.

Setting	Description
Match Algorithm	Determines which algorithm the sensor will use to attempt a match. Set this to

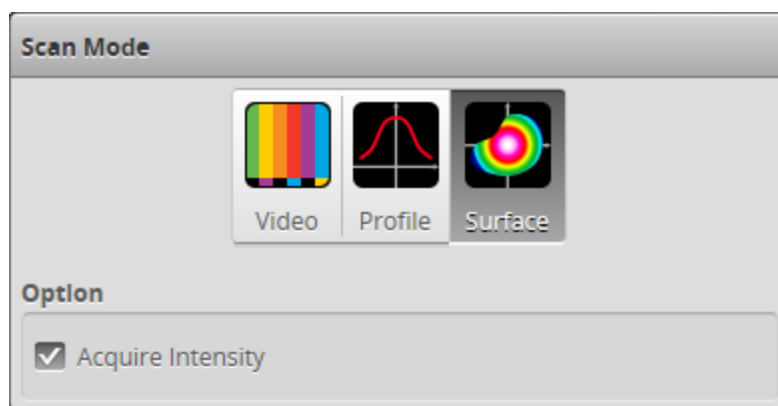
Setting	Description
	Bounding Box or Ellipse.
Z Angle	Corrects the orientation of the bounding box or ellipse to accurately match typical orientation and simplify measurements.
Asymmetry Detection	Rotates scans based on the asymmetry of the scanned part. Gocator calculates the number of points on each side of the part's centroid in the bounding box or ellipse. Along Major Axis – The scan is flipped so that the greater number of points is to the left. Along Minor Axis – The scan is flipped so that the greater number of points is on the bottom. None – The scan is not flipped.
Acceptance Criteria	Determines the minimum and maximum acceptable values of the selected dimension (Width and Length for bounding box, Major and Minor for ellipse) in Match Result.

Configuring a Bounding Box or an Ellipse

To use a bounding box or an ellipse to match a part, you must set its dimensions, taking into account expected acceptable variations when compared to a reference (or "golden") part.

To configure a bounding box or ellipse for part matching:

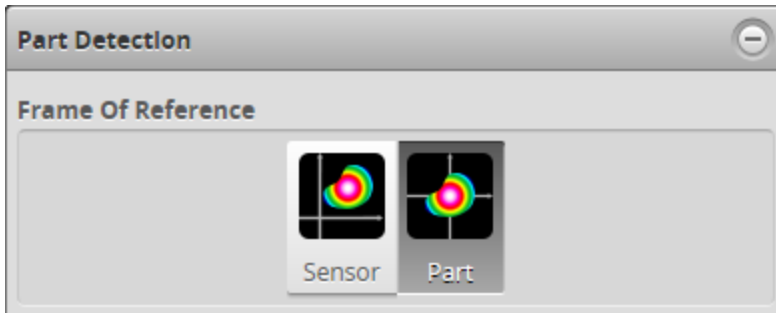
1. Go to the **Scan** page.
 - a. In the **Scan Mode** panel, choose **Surface**.



You must choose **Surface** in order to scan a part. Furthermore, the **Model** page is only displayed in Surface mode.

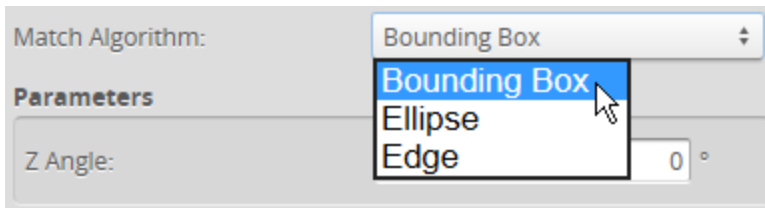
Intensity data is not used when part matching using a bounding box or an ellipse, but you can enable the **Acquire Intensity** option if you need intensity data for other reasons.

- b. In the **Part Detection** panel, choose **Part** for the **Frame of Reference**.



Part matching is only available when **Part** has been selected.

2. Do one of the following:
 - Scan a reference part. See *Scan Setup and Alignment* on page 63 for more information on setting up and aligning Gocator. See *Running a Standalone Sensor System* on page 26 for more information on running a system to scan a part.
 - Locate some previously recorded replay data and load it. See *Recording, Playback, and Measurement Simulation* on page 42 and *Downloading, Uploading, and Exporting Replay Data* on page 45 for more information on replay data.
3. Go to the **Model** page.
 - a. Make sure the **Enabled** option is checked in the **Part Matching** panel.
 - b. In the **Match Algorithm** drop-down, choose **Bounding Box** or **Ellipse**.



4. Set **Min** and **Max** of both of the dimensions of the selected match algorithm shape, taking into account expected acceptable variations.
 - If you chose **Bounding Box** for the match algorithm, select **Width** and then **Length** in **Match Result**, setting the minimum and maximum values acceptable for each dimension.
 - If you chose **Ellipse** for the match algorithm, select **Minor** and then **Major** in **Match Result**, setting the minimum and maximum values acceptable for each dimension.
 5. Save the job by clicking the **Save** button .
- See *Creating, Saving and Loading Jobs (Settings)* on page 40 for more information on saving jobs.

Running Part Matching

To run part matching, simply make sure that the **Enabled** option is checked on the **Part Matching** panel when the Gocator is running. Any measurements that are added and configured on the **Measure** page will be applied to parts if a part match is accepted, regardless of the part's orientation (a successfully matched part is rotated to match orientation of the bounding box or ellipse), returning a value and decision (as long as the part is in range, etc.). If a part match is rejected, measurements will return an Invalid value.

Using Part Matching to Accept or Reject a Part

Part matching results only determine whether a measurement is applied to a part. Whether the measurement returns a pass or fail value—its decision—depends on whether the measurement's value is between the **Min** and **Max** values set for the measurement. This decision, in addition to the actual value, can in turn be used to control a PLC for example. The part matching "decision" itself is not passed to the Gocator output, but you can simulate this by setting up a measurement that will always pass if it is applied.

For example, you could set up a Position Z measurement, choosing Max Z as the feature type, and setting the **Min** and **Max** values to the measurement range of the sensor. This way, as long as a part matches and the target is in range, etc., the measurement will pass. This measurement decision, which is passed to the Gocator's output, could in turn be used to control a PLC.

Sections

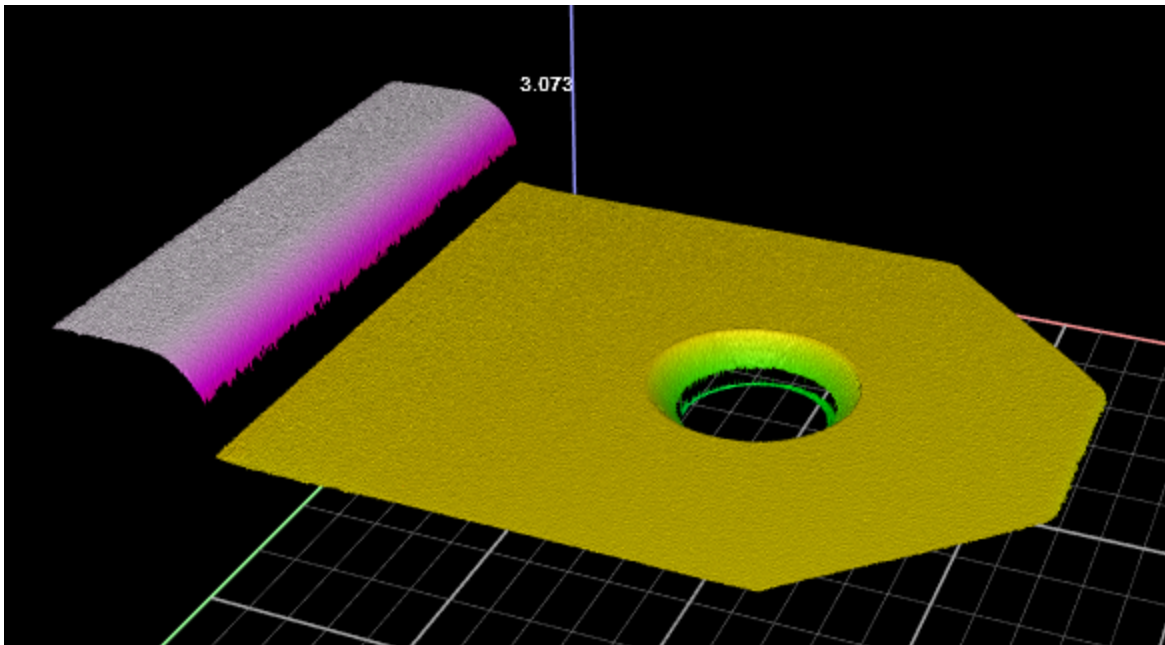
In Surface mode, Gocator can also extract a profile from a surface or part using a line you define on that surface or part. The resulting profile is called a "section." A section can have any orientation on the surface, but its profile is parallel to the Z axis.

You can use most [profile measurement tools](#) on a section: you can't use tools that work with unresampled data. Using sections and the profile measurements, you can therefore use measurements that are not otherwise possible in Surface mode, for example:

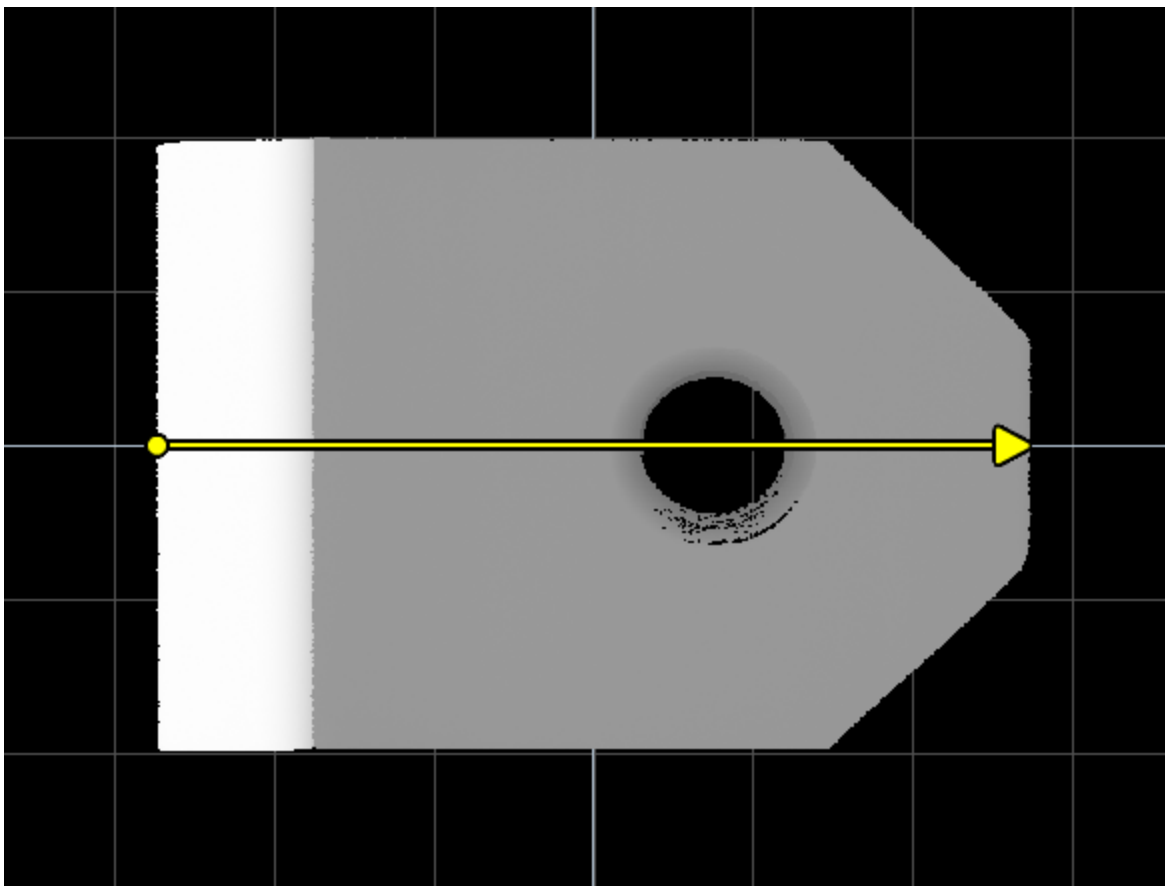
- Gap and flush measurements
- Surface radius measurements (for example, rounded edges or corners)
- Intersections
- Point-to-point dimension measurements between profile features

Gocator supports multiple sections, letting you take multiple measurements on the same object.

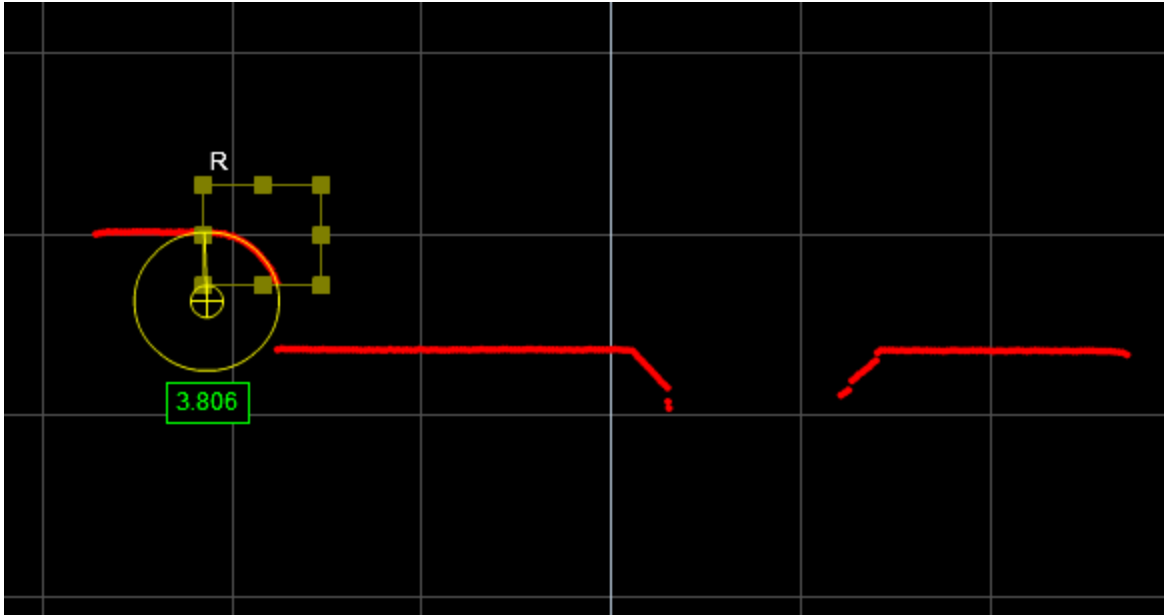
On the **Output** page, in Surface mode, you can output both surface measurements and section-based profile measurements at the same time. Gocator can also output the surfaces and section profiles themselves at the same time.



Part in data viewer (3D view)

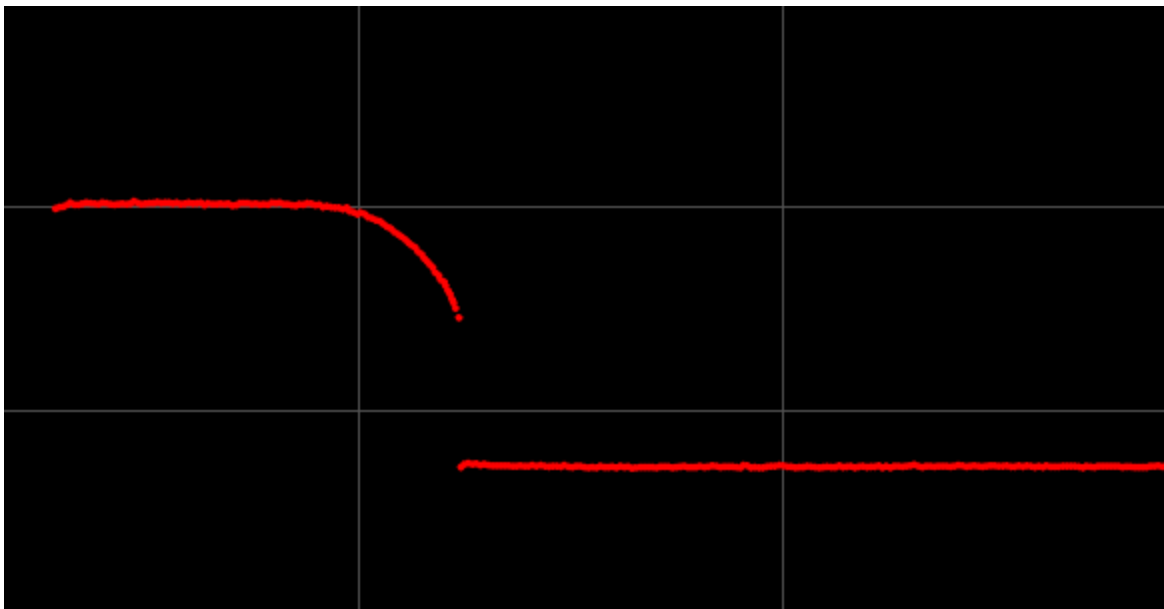


Section defined on top of part (2D view)

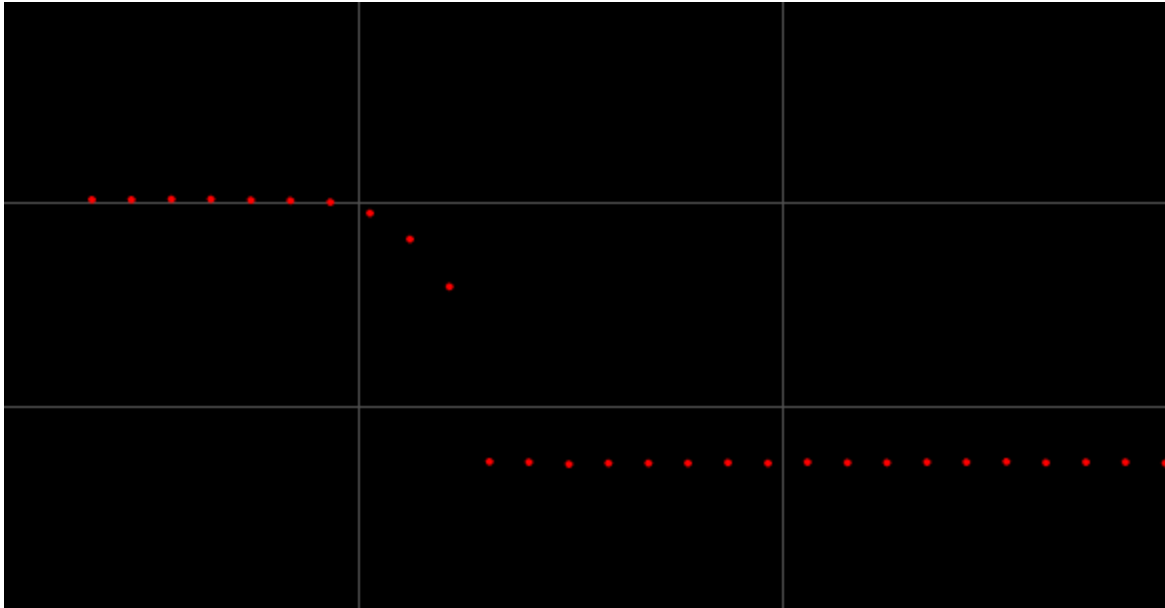


Circle Radius measurement running on profile extracted from surface using defined section

You can configure the sampling distance between points along the section. Reducing the sampling distance reduces the resolution of the profile, but increases the sensor's performance and results in less data being sent over the output.



Minimum spacing interval: highest profile resolution, greater sensor CPU usage and data output



*Maximum spacing interval: lowest profile resolution,
lower sensor CPU usage and data output*



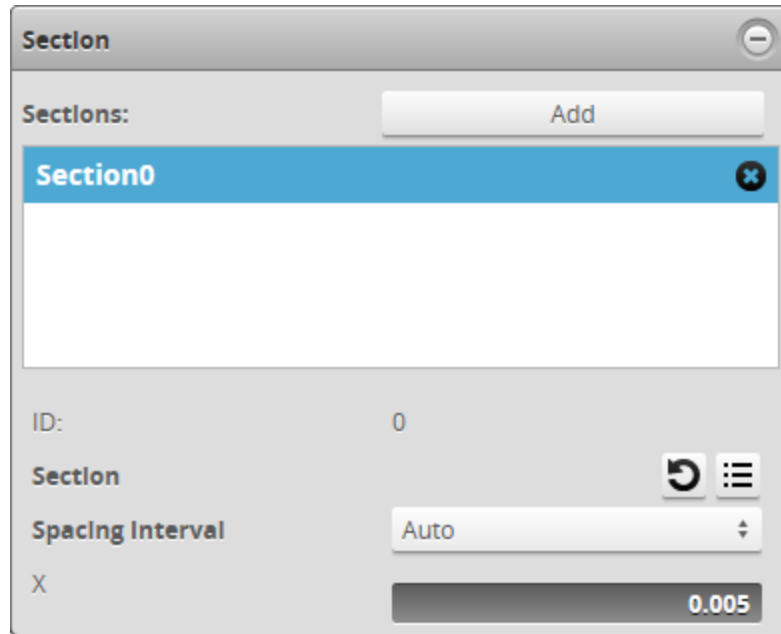
Using a higher spacing interval can produce different measurement results compared to using a smaller spacing interval. You should therefore compare results using different spacing intervals before using sections in production.

The sections you add to a surface are directional, and their start and end points are defined using X and Y coordinates. The start point always corresponds to the leftmost point on the extracted profile, whereas the end point always corresponds to the rightmost point on the extracted profile, no matter the orientation of the section on the surface.

For more information on profile tools, see *Profile Measurement* on page 139.

Creating a Section

Before you create a section, you should first scan a target in Surface mode to create a surface on which you can create the section. You can use either live data or recorded data.



After creating a section, the following settings are available:

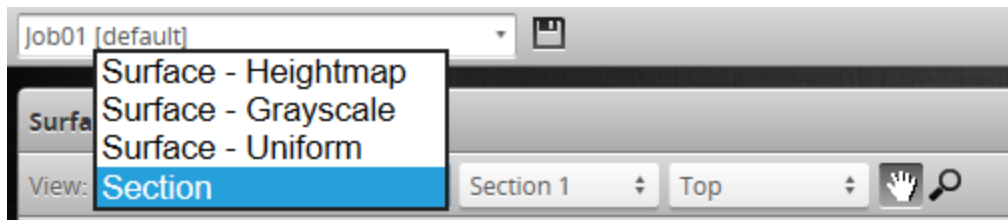
Setting	Description
Spacing Interval	Determines the space between the points of the extracted profile. Auto: The highest resolution, calculated using the X and Y resolution of the scan. Custom: Lets you set the spacing interval by using a slider or setting the value manually.
Section	Lets you manually set the X and Y coordinates of the start and end points of the section. Setting the coordinates manually is useful if you need to create a section that is perfectly horizontal or vertical. For example, to create a horizontal section, copy the Y value of either the start or end point to the other point's Y field. You can reverse the start and end points by clicking the  button. To reset the start and end points to their initial values, click the  button.

To create a section:

1. On the **Scan** page, in the **Scan Mode** panel, click **Surface**.
2. On the **Model** page, in the **Section** panel, click **Add**.
You may need to click the  button to expand the panel.
Gocator creates a section on the surface.
3. Rename the section if you want.
4. Move the section and adjust the start and end points of the section to extract the desired profile.
You can move or adjust the section graphically in the data viewer, or you can manually adjust the X and Y coordinates of the section.
5. (Optional) Adjust the **Spacing Interval**.

After you create a section, Gocator lists the profile measurement tools in the **Tools** panel on the **Measure** page. If you have created more than one section, you must select it in the tool. For more information on profile measurement tools, see *Profile Measurement* on page 139.

Gocator also adds a **Section** option to the **View** drop-down above the data viewer, which lets you view an extracted profile, as well as a section selector drop-down for cases where multiple sections are defined.



Sections are also added to the [Stream](#) drop-down in [Profile](#) and [Feature](#) tools.

If parts are not consistently oriented in the same way from scan to scan, you can use [part matching](#) to correct their rotation, if the entire part is visible in the scan. Parts will then be consistently oriented, and sections will fall on the same area on each part. You can also use [anchoring](#) to ensure that measurements are consistently placed on a part.

Deleting a Section

When you delete a section, Gocator removes any associated measurements. After you remove the last section, Gocator no longer displays profile measurement tools in the **Measure** page.

To delete a section:

1. On the **Scan** page, in the **Scan Mode** panel, click **Surface**.
2. On the **Model** page, in the **Section** panel, click the  button of the section you want to delete.

You may need to click the  button to expand the panel.

If you have associated a measurement tool to the section by setting the tool's **Stream** setting to the section, Gocator asks if you want to delete all of the associated measurement tools.

Gocator deletes the section on the surface.

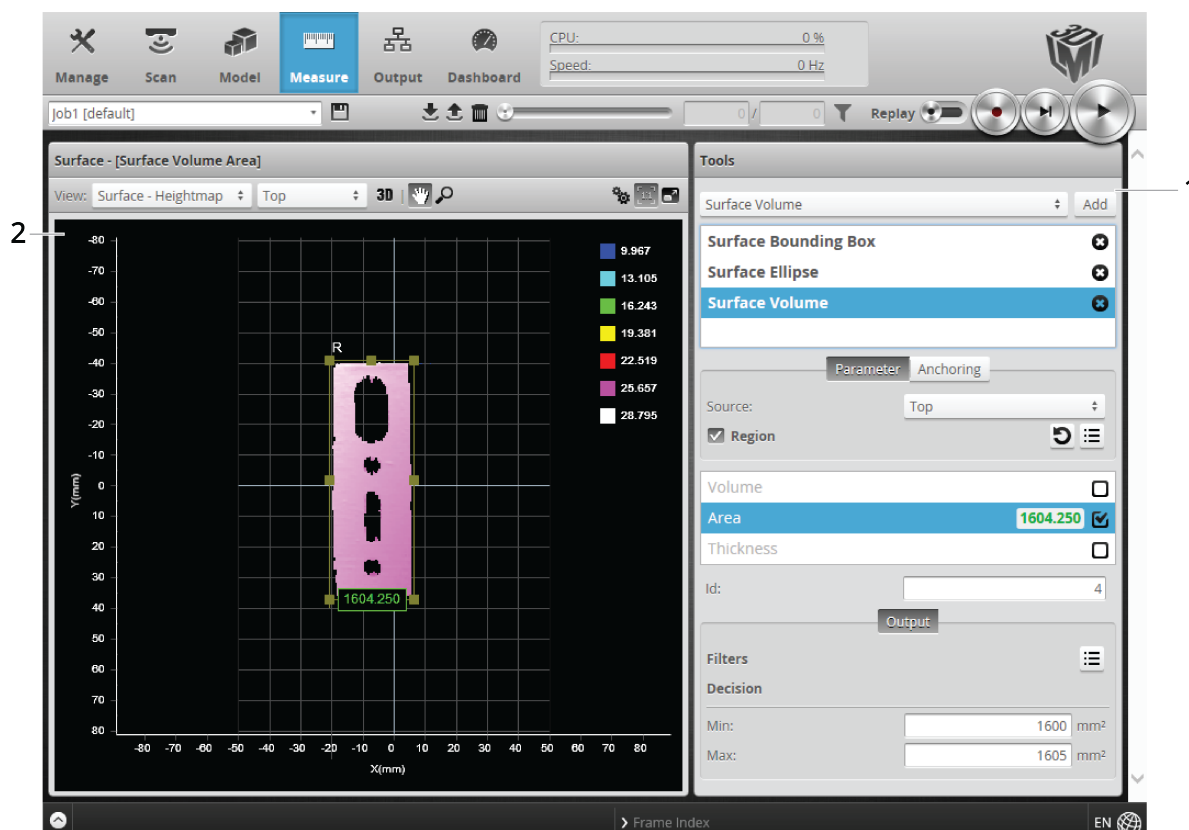
Measurement

The following sections describe Gocator's tools and measurements.

Measure Page Overview

Measurement tools are added and configured in the **Measure** page.

The content of the **Tools** panel in the **Measure** page depends on the current scan mode. In Surface mode, the **Measure** page displays tools for surface measurement. If you have defined a section in Surface mode, profile tools are also displayed. In Video mode, tools are not accessible.



Element	Description
1 Tools panel	Used to add, manage, and configure tools and measurements (see <i>Tools Panel</i> on the next page) and to choose anchors (<i>Measurement Anchoring</i> on page 131).
2 Data Viewer	Displays surface data, sets up tools, and displays result calipers related to the selected measurement. Parts are displayed using a height map, which is a top-down view of the XY plane, where color represents height. See <i>Data Viewer</i> on the next page.
3 Feature Area	Configurable region of interest from which feature points are detected. These feature points are used to calculate the measurements. The number of feature areas displayed depends on which measurement tool is currently selected.

Data Viewer

When the **Measure** page is active, the data viewer can be used to graphically configure measurement regions in the 2D or in the 3D views. Measurement regions can also be configured manually in measurements by entering values into the provided fields (see *Regions* on the next page).

For instructions on how to set up measurement regions graphically, *Region Definition* on page 97.

Tools Panel

The **Tools** panel lets you add, configure, and manage measurement tools. Tools contain related measurements. For example, the Position tool provides X, Y, and Z position measurements.

Some settings apply to tools, and therefore to all measurements; these settings are found in the **Parameters** tab below the list of tools. Other settings apply to specific measurements, and are found in a **Parameters** tab below the list of measurements; not all measurements have parameters.

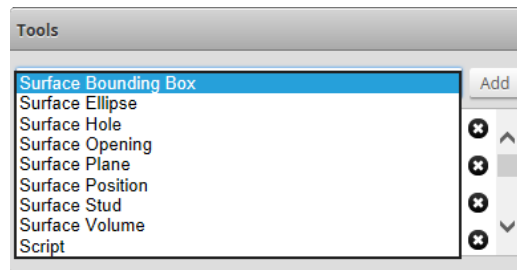
See *Surface Measurement* on page 169 for information on the measurement tools and their settings.



Tool names in the user interface include the scan mode, but not in the manual. So for example, you will see "Surface Bounding Box" in the user interface, but simply "Bounding Box" in the manual.

Adding and Configuring a Tool

Adding a tool adds all of the tool's measurements to the **Tools** panel. You can then enable and configure the measurements selectively.



To add and configure a tool:

1. Go to the **Scan** page by clicking on the **Scan** icon.
2. Choose Profile or Surface mode in the **Scan Mode** panel.
If one of these modes is not selected, tools will not be available in the **Measure** panel.
3. Go to the **Measure** page by clicking on the **Measure** icon.
4. In the Tools panel, select the tool you want to add from the drop-down list of tools.
5. Click on the **Add** button in the Tools panel.
The tool and its available measurements are added to the tool list. The tool parameters are listed in the area below the tool list.
6. (Optional) If the measurement is a profile measurement running on a section, and you have created

more than one section, choose the section that will provide data to the measurement in **Stream**.
For more information on streams, see *Streams (Sections)* below.

7. Select a measurement at the bottom of the tool panel.
8. Set any tool- or measurement-specific settings.
For tool- and measurement-specific settings, see the topics for the individual [profile](#) or [surface](#) tools.
9. Set the **Min** and **Max** decision values.
For more information on decisions, see *Decisions* on page 128.
10. (Optional) Set one or more filters.
For more information on filters, see *Filters* on page 129.
11. (Optional) Set up anchoring.
For more information on anchoring, see *Measurement Anchoring* on page 131.

Streams (Sections)

If you create more than one [section](#) on a surface and then add a [profile measurement](#), you must choose which section profile that measurement uses using the **Stream** setting in the measurement.

 The **Stream** setting applies to all of a tool's measurements.

To choose a stream:

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. See *Enabling and Disabling Measurements* on page 136 for instructions on how to enable a measurement.
4. If it is not already selected, click on the **Parameter** tab in the tool configuration area.
5. Select the section in the **Stream** drop-down list.

Regions

Many measurement tools use user-defined regions to limit the area in which measurements occur . 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. Regions apply to all of a tool's measurements.

☒ **Region**

X:

-54.122 mm

Z:

-36.593 mm

Width:

109.67 mm

Height:

109.67 mm

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.

To configure regions:

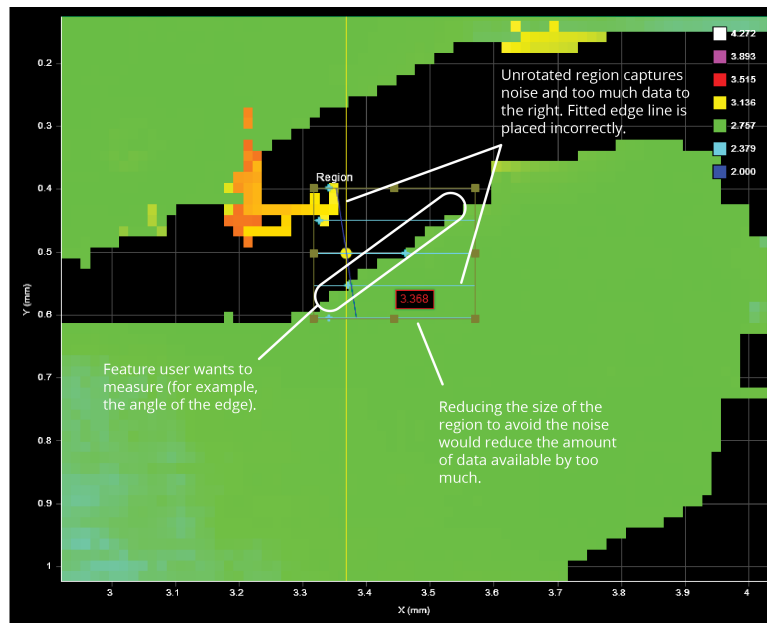
1. Go to the **Measure** page by clicking on the **Measure** icon.



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.

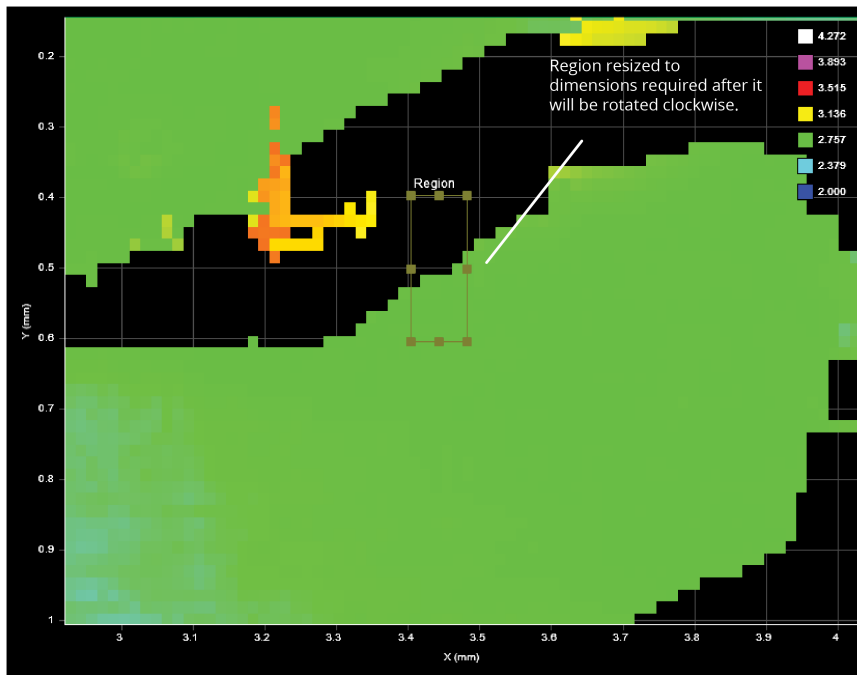
2. In the **Tools** panel, click on a tool in the tool list.
3. Expand the region section by clicking on the expand button . Some region settings are found within other settings in this area.
4. Configure the region using the fields or graphically using the mouse in the data viewer.

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:

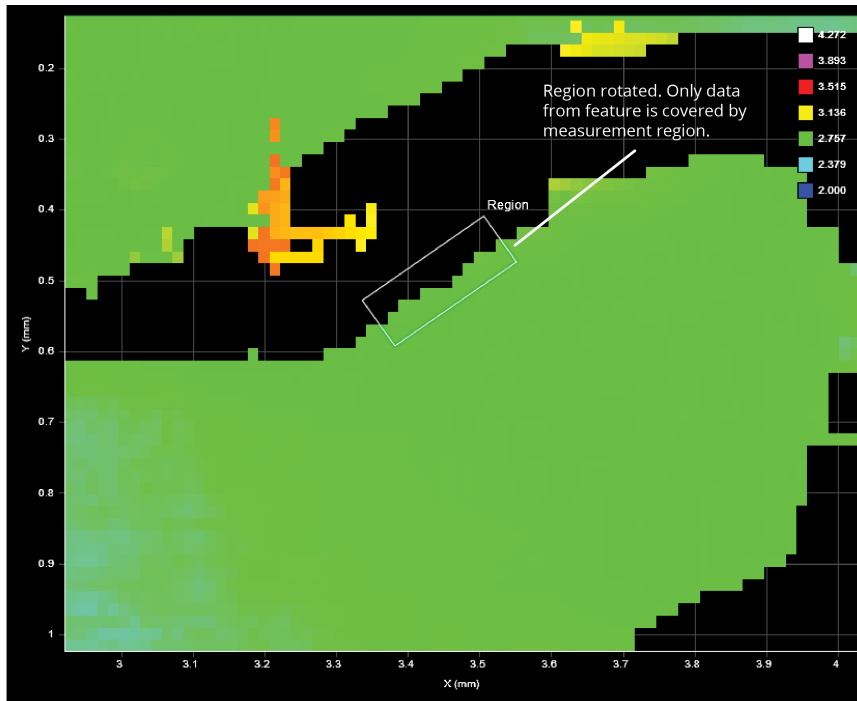
1. Determine the length and width of the region that will be required once it is rotated.



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

Region	
X:	3.404 mm
Y:	0.397 mm
Z:	-16.725 mm
Width:	0.079 mm
Length:	0.207 mm
Height:	28.346 mm
Z angle:	55 °

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



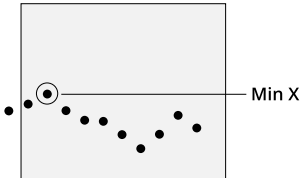
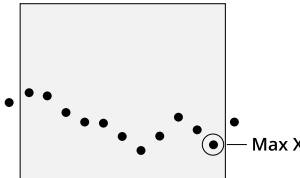
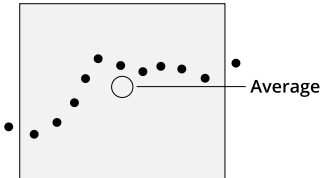
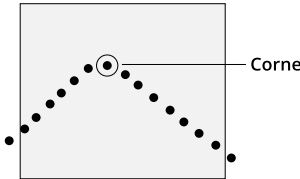
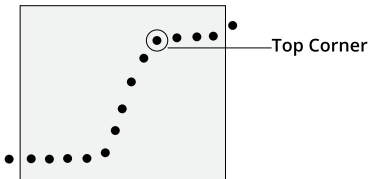
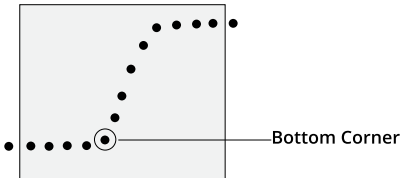
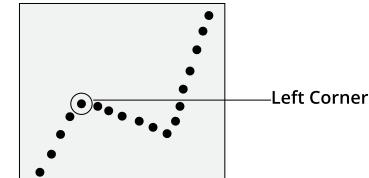
Once the region has been rotated, you cannot modify it in the data viewer using the mouse. You can however modify its dimensions and its location manually by changing the region's values in the **Region** setting.

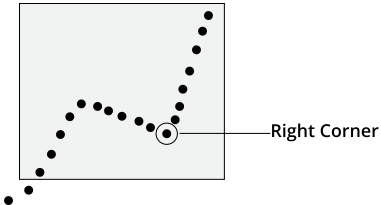
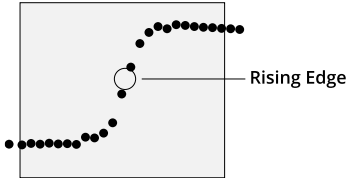
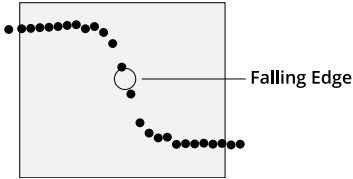
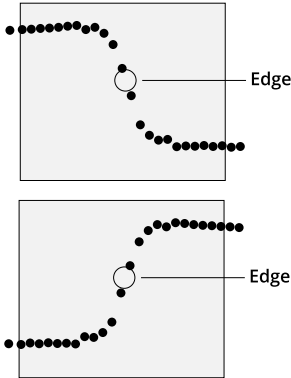
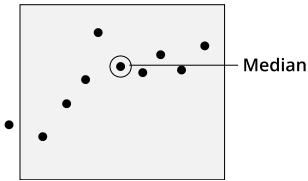
Feature Points

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.

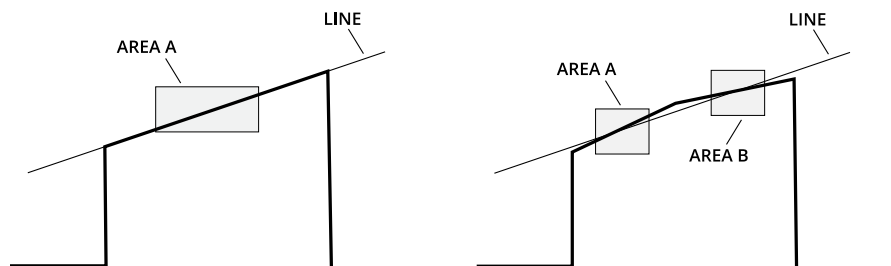
Point Type	Examples
Max Z Finds the point with the maximum Z value in the region of interest.	
Min Z Finds the point with the minimum Z value in the region of interest.	

Point Type	Examples
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.	
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.	

Point Type	Examples
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.	
Falling Edge Finds a falling edge in the region of interest.	
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.

Geometric Features

Most Surface tools, and many Profile tools, can output features that Feature tools can take as input to produce measurements. These features are called *geometric features*. Feature tools use these entities to produce measurements based on more complex geometry. (For more information on Feature tools, see *Feature Measurement* on page 222.)

Gocator's measurement tools can currently generate the following kinds of geometric features:

Points: A 2D or 3D point. Can be used for point-to-point or point-to-line measurements.

Lines: A straight line that is infinitely long. Useful for locating the orientation of an enclosure or part, or to intersect with another line to form a reference point that can be consumed by a Feature tool.

The following tables list Gocator's measurement tools and the geometric features they can generate:

Geometric features generated by Surface tools

	Point				Line		
	Center	Tip	Base	Point	Edge	Major Axis	Minor Axis
Tool							
Bounding Box	X						
Countersunk Hole	X						
Dimension							
Edge	X				X		
Ellipse	X					X	X
Hole	X						
Opening	X						
Plane							
Position				X			
Stud		X	X				
Volume							

Geometric features generated by Profile tools

	Point						Line	
	Center	Point	Intersect	Corner	Min Point	Max Point	Line	Base
Tool								
Area	X							
Bounding Box	X			X				
Circle	X							
Dimension								

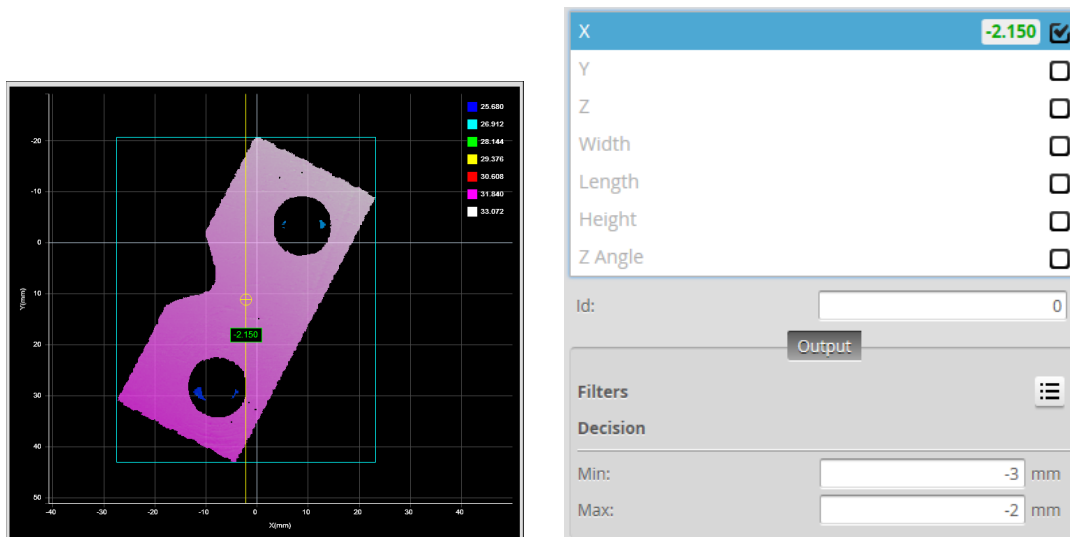
	Point			Line
Groove				
Intersect	X			X X
Line		X	X	X
Panel				
Position	X			
Round				
Corner				
Strip				

The [Feature Intersect](#) tool can also produce an intersect point. [Script tools](#) do not currently take geometric features as input.

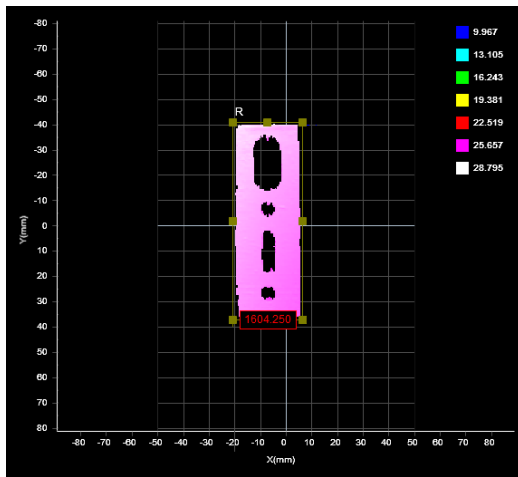
Decisions

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 (-2.150) within decision thresholds (Min: -3, Max: -2). Decision: Pass



Parameter Anchoring

Source: Top

☒ Region

Volume ☐

Area **1604.250** ☒

Thickness ☐

Id: 4

Output

Filters

Decision

Min: 1500 mm²

Max: 1600 mm²

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. See *Output* on page 234 for more information on transmitting values and decisions.

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. See *Enabling and Disabling Measurements* on page 136 for instructions on how to enable a measurement.
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.

Filters

Scale:

Offset:

Hold Last Valid: ☐

☒ Smoothing: 1 Samples

Preserve Invalid: ☐

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 the measurement value according to the following formula: $\text{Scale} * \text{Value} + \text{Offset}$ 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.
Hold Last Valid	Holds the last valid value when the measurement is invalid. Measurement is invalid if there is no valid value.
Smoothing	Applies moving window averaging to reduce random noise in a measurement output. The averaging window is configured in number of frames. If Hold Last Valid is enabled, smoothing uses the output of the Hold Last Valid filter.
Preserve Invalid	When enabled, smoothing is only applied to valid measurements and not to invalid results. When disabled, smoothing is applied to both valid and invalid results. (This setting is only visible when Smoothing is enabled.)

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. See *Enabling and Disabling Measurements* on page 136 for instructions on how to enable a measurement.
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.

Measurement Anchoring

When parts that a sensor is scanning move on a transport mechanism such as a conveyor, their position typically changes from part to part in one or both of the following ways:

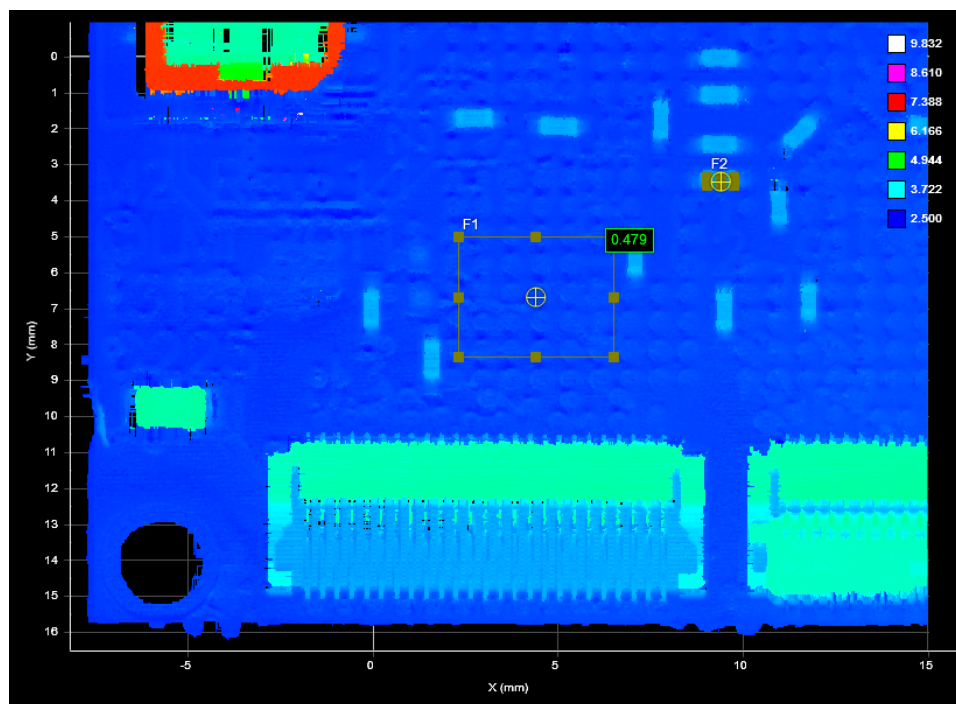
- along the X, Y, and Z axes (basically, horizontally and vertically)
- around the Z axis (orientation angle)

When the position and angle variation between parts is minor—for example, when scanning electronic parts in trays—you can anchor one tool to one or more measurements from another tool to compensate for these minor shifts. As a result, Gocator can correctly place the anchored tool's measurement regions on each part. This increases the repeatability and accuracy of measurements.

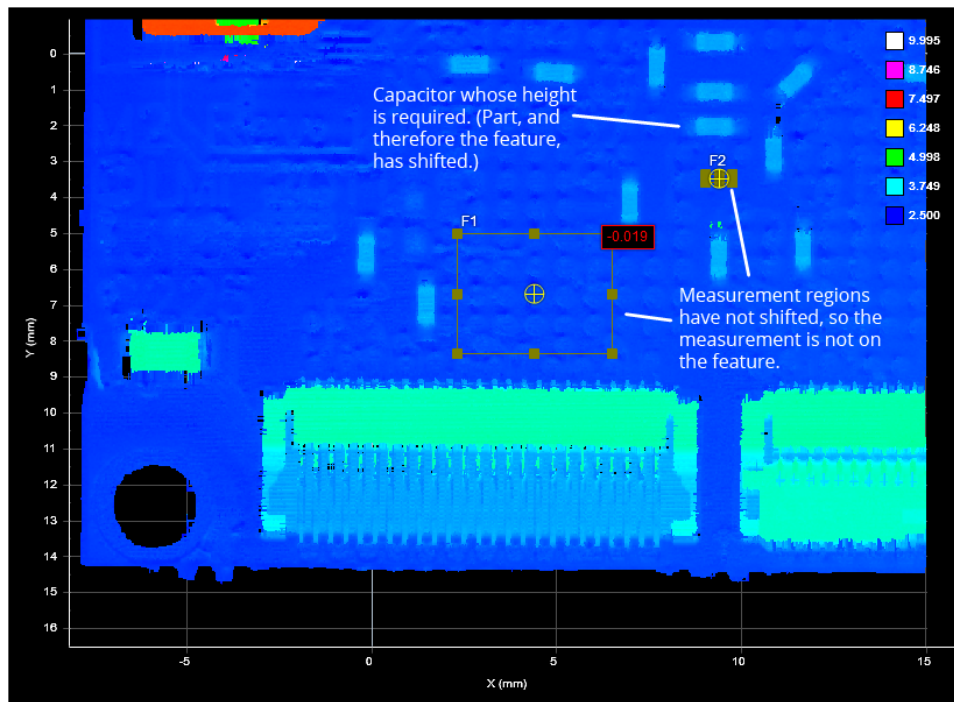


For cases where movement from part to part is more drastic, you can use part matching to compensate. However, in order for [part matching](#) to work properly, the entire part typically must be visible in the field of view.

For example, the following image shows a surface scan of a PCB. A [Surface Dimension](#) height measurement returns the height of a surface-mount capacitor relative to a nearby surface (the F1 region).

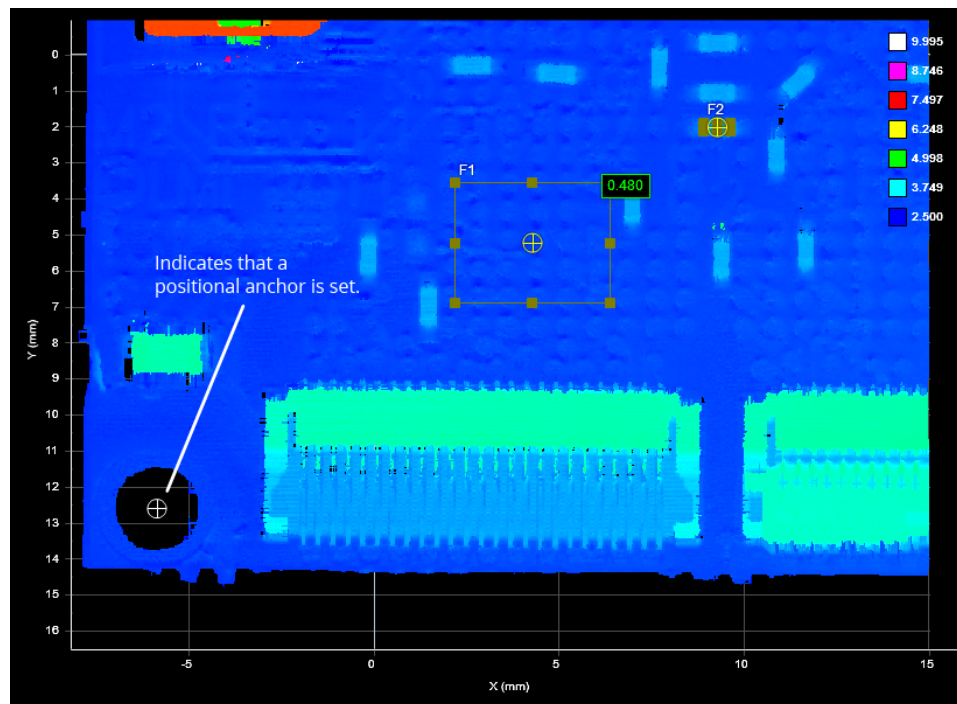


In the following scan, the part has shifted, but the measurement regions remain where they were originally configured, in relation to the sensor or system coordinate system, so the measurement returned is incorrect:

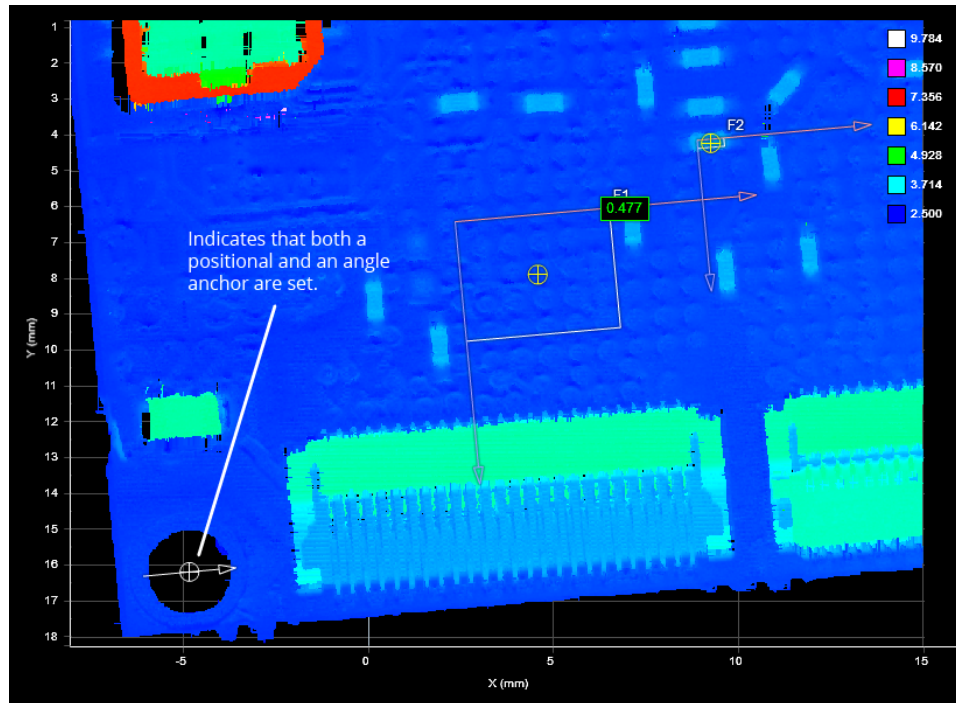


When you set a tool's anchor source, an offset is calculated between the anchored tool and the anchor source. This offset is used for each frame of scanned data: the anchored tool's [measurement region](#) is placed in relation to the anchor source, at the calculated offset.

In the following image, after the Surface Dimension tool is anchored to the X and Y measurements from a [Surface Hole tool](#) (placed over the hole to the lower left), Gocator compensates for the shift—mostly along the Y axis in this case—and returns a correct measurement, despite the shift.



You can combine the positional anchors (X, Y, or Z measurements) with an angle anchor (a Z Angle measurement) for optimum measurement placement. For example, in the following scan, the part has not only shifted on the XY plane but also rotated around the Z axis. Anchoring the Surface Dimension tool to the Z Angle measurement of a [Surface Edge tool](#) (placed on the lower edge in this case) compensates for the rotation, and the anchored tool returns a correct measurement.



If Z Angle anchoring is used with both X and Y anchoring, the X and Y anchors should come from the same tool.



If Z Angle anchoring is used without X or Y anchoring, the tool's measurement region rotates around its *center*. If only one of X or Y is used, the region is rotated around its center and then shifted by the X or Y offset.

Several anchors can be created to run in parallel. For example, you could anchor the measurements of one tool relative to the left edge of a target, and anchor the measurements of another tool relative to the right edge of a target.

You can combine positional anchors (X, Y, or Z) with angle anchors (Z Angle) for optimum measurement placement.

To anchor a profile or surface tool to a measurement:

1. Place a representative target object in the field of view.

In Profile mode

- a. Use the **Start** or **Snapshot** button to view live profile data to help position the target.

In Surface mode

- a. Adjust Part Detection settings (see *Part Detection* on page 85) if applicable.
 - b. Start the sensor, scan the target, and then stop the sensor.
2. On the **Measure** page, add a suitable tool to act as an anchor.
A suitable tool is one that returns an X, Y, or Z position or Z Angle as a measurement value.

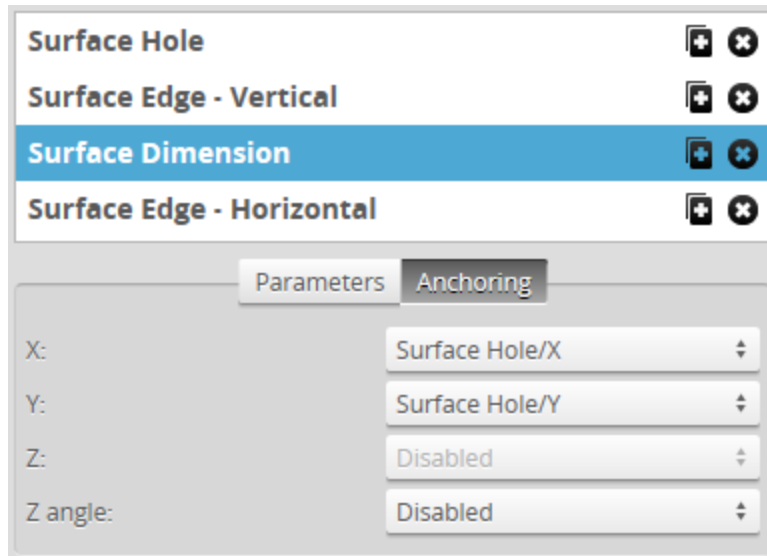
- Adjust the anchoring tool's settings and measurement region, and choose a feature type (if applicable). You can adjust the measurement region graphically in the data viewer or manually by expanding the **Regions** area.

The position and size of the anchoring tool's measurement regions define the zone within which movement will be tracked.



If you intend to use angle anchoring and the part in the initial scan is rotated too much, you may need to rotate the anchoring tool's region to accommodate this rotation. For more information on region rotation, see *Regions* on page 121.

- Add the tool that you want to anchor. Any tool can be anchored.
- Adjust the tool and measurement settings, as well as the measurement regions, on a scan of the representative target.
- Click on the tool's **Anchoring** tab.
- Choose an anchor from one of the drop-down boxes.



If the sensor is running, the anchored tool's measurement regions are shown in white to indicate the regions are locked to the anchor. The measurement regions of anchored tools cannot be adjusted. The anchored tool's measurement regions are now tracked and will move with the target's position and angle under the sensor, as long as the anchoring measurement produces a valid measurement value. If the anchoring measurement is invalid, for example, if part moves outside its measurement region, the anchored tool will not show the measurement regions at all and an "Invalid-Anchor" message will be displayed in the tool panel.

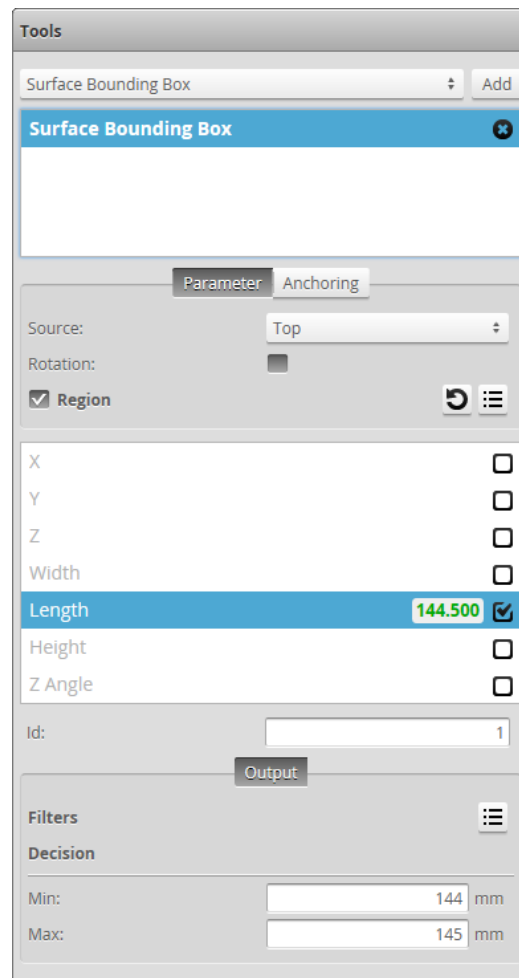
- Verify that the anchored tool works correctly on other scans of targets in which the part has moved slightly.

To remove an anchor from a tool:

- Click on the anchored tool's Anchoring tab. Select **Disabled** in the X, Y, or Z drop-down.

Enabling and Disabling Measurements

All of the measurements available in a tool are listed in the measurement list in the **Tools** panel after a tool has been added. To configure a measurement, you must enable it.



To enable a measurement:

1. Go to the **Scan** page by clicking on the **Scan** icon.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, tools will not be available in the **Measure** panel.
3. Go to the **Measure** page by clicking on the **Measure** icon.
4. In the measurements list, check the box of the measurement you want to enable.
The measurement will be enabled and selected. The **Output** tab, which contains output settings will be displayed below the measurements list. For some measurements, a **Parameters** tab, which contains measurement-specific parameters, will also be displayed.

To disable a measurement:

1. Go to the **Scan** page by clicking on the **Scan** icon.
2. Choose Surface mode in the **Scan Mode** panel.
3. Go to the **Measure** page by clicking on the **Measure** icon.
4. In the measurement list, uncheck the box of the measurement you want to disable.
The measurement will be disabled and the **Output** tab (and the **Parameters** tab if it was available) will be hidden.

Editing a Tool or Measurement Name

You can change the names of tools you add in Gocator. You can also change the names of their measurements. This allows multiple instances of tools and measurements of the same type to be more easily distinguished in the Gocator web interface. The measurement name is also referenced by the Script tool.

To change a tool or measurement name:

1. Go to the **Scan** page by clicking on the **Scan** icon.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, tools will not be available in the **Measure** panel.
3. Go to the **Measure** page by clicking on the **Measure** icon.
4. Do one of the following:
 - **Tool:** In the tool list, double-click the tool name you want to change
 - **Measurement:** In a tool's measurement list, double-click the measurement name you want to change.
5. Type a new name.
6. Press the Tab or Enter key, or click outside the field.
The name will be changed.

Changing a Measurement ID

The measurement ID is used to uniquely identify a measurement in the Gocator protocol or in the SDK. The value **must** be unique among all measurements.

To edit a measurement ID:

1. Go to the **Scan** page by clicking on the **Scan** icon.
2. Choose Surface mode in the **Scan Mode** panel.
If this mode is not selected, tools will not be available in the **Measure** panel.
3. Go to the **Measure** page by clicking on the **Measure** icon.
4. In the measurement list, select a measurement.

To select a measurement, it must be enabled. See *Enabling and Disabling Measurements* on page 136 for instructions on how to enable a measurement.

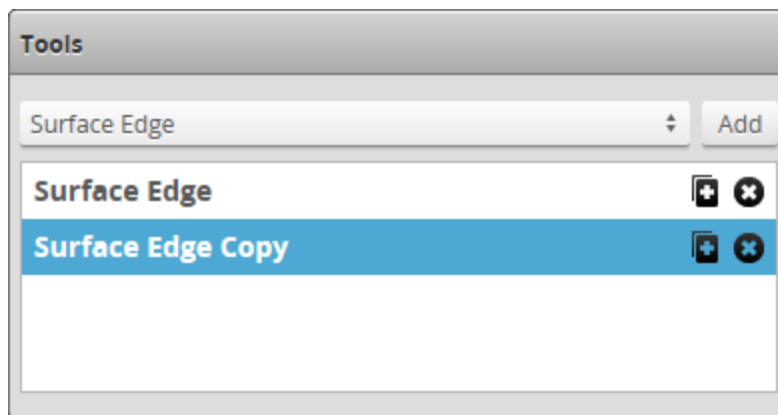
5. Click in the ID field.
6. Type a new ID number.
The value must be unique among all measurements.
7. Press the Tab or Enter key, or click outside the ID field.
The measurement ID will be changed.

Duplicating a Tool

You can quickly create a copy of a previously added tool in Gocator. All settings of the original are copied. This is useful, for example, when you need almost identical tools with only minor variations, such as different Min and Max values.

To duplicate a tool:

1. Go to the **Scan** page by clicking on the **Scan** icon.
2. Choose Profile or Surface mode in the **Scan Mode** panel.
If one of these modes is not selected, tools will not be available in the **Measure** panel.
3. Go to the **Measure** page by clicking on the **Measure** icon.
4. In the tool list, click on the Duplicate button (📄) of the tool you want to duplicate.
A copy of the tool appears below the original.



5. Configure the copy as desired and rename it if necessary.
For information on renaming a tool, see *Editing a Tool or Measurement Name* on the previous page.

Removing a Tool

Removing a tool removes all of its associated measurements.

To remove a tool:

1. Go to the **Scan** page by clicking on the **Scan** icon.
2. Choose Profile or Surface mode in the **Scan Mode** panel.
If this mode is not selected, tools will not be available in the **Measure** panel.

3. Go to the **Measure** page by clicking on the **Measure** icon.
4. In the tool list, click on the Duplicate button (⌕) of the tool you want to duplicate.
A copy of the tool appears below the original.

Profile Measurement

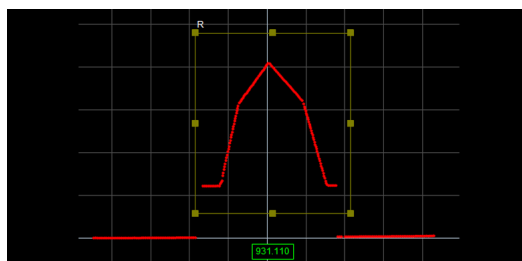
This section describes the profile measurement tools available in Gocator sensors.

Profile measurement tools can be used on sections. For more information on sections, see *Sections* on page 113.

Area

The Area tool determines the cross-sectional area within a region. Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



ParametersAnchoring

Source: Top
Type: Object
Baseline: Line
☒ Region
Line: 1 Region

MeasurementsFeatures

Area 931.110 ☒
Centroid X ☐
Centroid Z ☐

ID: 0

Output

Filters

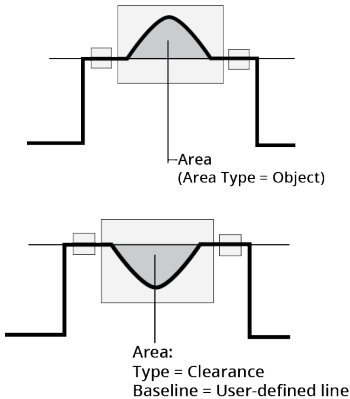
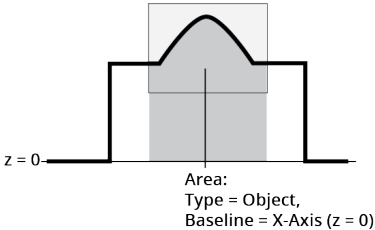
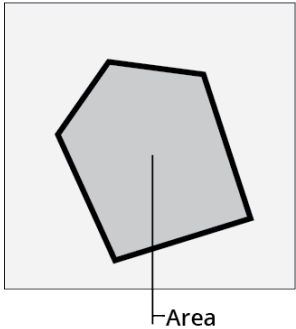
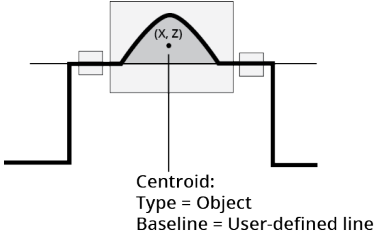
Decision

Min: 930 mm²
Max: 940 mm²

Areas are positive in regions where the profile is above the X axis. In contrast, areas are negative in regions where the profile is below the X axis.

Measurements, Features, and Settings

Measurements

Measurement	Illustration
Area Measures the cross-sectional area within a region that is above or below a fitted baseline.	 Area (Area Type = Object) Area: Type = Clearance Baseline = User-defined line Standalone, or dual-sensor setup in Wide orientation  Area: Type = Object, Baseline = X-Axis (z = 0) Dual-sensor setup in Opposite orientation  Area
Centroid X Determines the X position of the centroid of the area.	
Centroid Z Determines the Z position of the centroid of the area.	 Centroid: Type = Object Baseline = User-defined line

Features

Type	Description
Center Point	The center point of the area.



For more information on geometric features, see *Geometric Features* on page 127.

Parameters

Parameter	Description
Type	Object area type is for convex shapes above the baseline. Regions below the baseline are ignored. Clearance area type is for concave shapes below the baseline. Regions above the baseline are ignored.
Baseline	Baseline is the fit line that represents the line above which (Object clearance type) or below which (Clearance area type) the cross-sectional area is measured. When this parameter is set to Line, you must define a line in the Line parameter. See <i>Fit Lines</i> on page 126 for more information on fit lines. When this parameter is set to X-Axis, the baseline is set to $z = 0$.
Line	When Baseline is set to Line, you must set this parameter. See <i>Fit Lines</i> on page 126 for more information on fit lines.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Filters	See <i>Filters</i> on page 129.

Bounding Box

The Bounding Box tool provides measurements related to the smallest box that contains the profile (for example, X position, Z position, width, etc.).

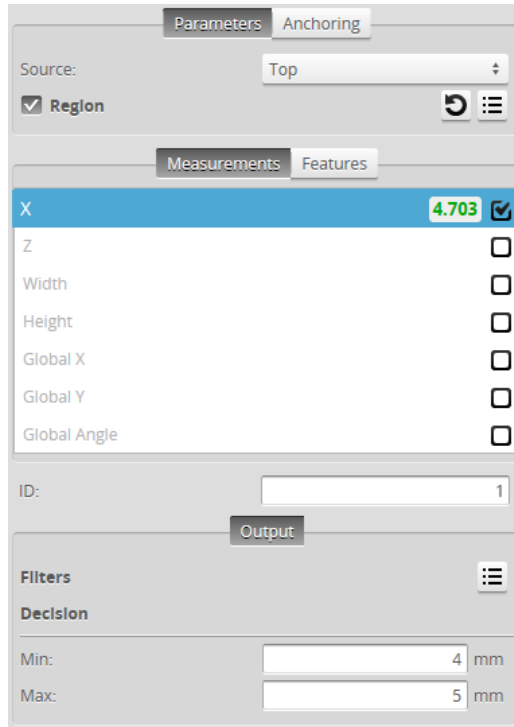
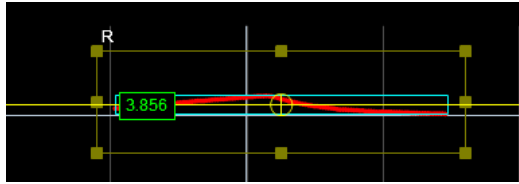
Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.

The bounding box provides the absolute position from which the Position centroids tools are referenced.



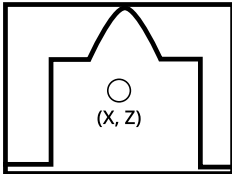
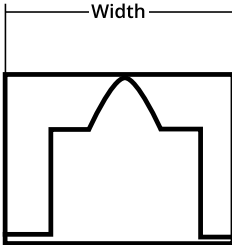
When you use measurement tools on parts or sections, the coordinates returned are relative to the part or section. You can use the values returned by the Bounding Box tool's "Global" (see below) measurements as an offset in a Gocator script to convert the positional (X, Y, or Z) measurements of other measurement tools to [sensor](#) or [system](#) coordinates (depending on whether the sensor is aligned). For more information on Gocator scripts, see *Scripts* on page 228.

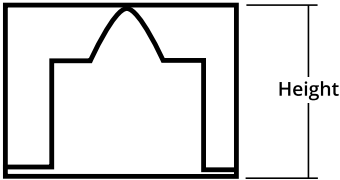


Measurement Panel

Measurements, Features, and Settings

Measurements

Measurement	Illustration
X Determines the X position of the center of the bounding box that contains the profile. The value returned is relative to the profile.	
Z Determines the Z position of the center of the bounding box that contains the profile. The value returned is relative to the profile.	

Measurement	Illustration
Height Determines the height (thickness) of the bounding box that contains the profile.	
Global X* Determines the X position of the center of the bounding box that contains the profile relative to the surface from which the profile is extracted.	
Global Y* Determines the Y position of the center of the bounding box that contains the profile relative to the surface from which the profile is extracted.	
Global Angle* Determines the angle around Z of the section used to create the profile, relative to the surface from which it is extracted, where a line parallel to the X axis is 0 degrees. Angles of sections pointing to the bottom of the data viewer are positive. Angles of sections pointing to the top of the data viewer are negative.	



*The Global X, Global Y, and Global Angle measurements are intended to be used with profiles extracted from a surface using a section.

When used with profiles not generated from a section, the Global X measurement returns the same value as the X measurement, and the Global Y and Global Angle measurements return 0.000.

Features

Type	Description
Center Point	The center point of the bounding box.
Corner Point	The lower left corner of the bounding box.



For more information on geometric features, see *Geometric Features* on page 127.

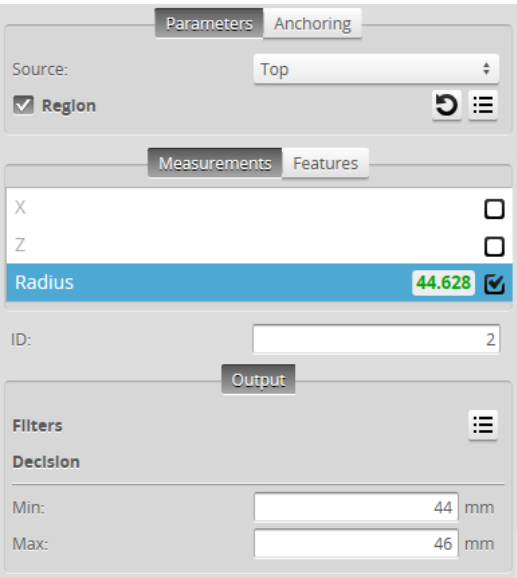
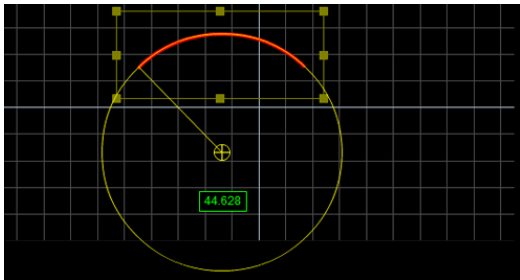
Parameters

Parameter	Description
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Filters	See <i>Filters</i> on page 129.

Circle

The Circle tool provides measurements that find the best-fitted circle to the live profile and measure various characteristics of the circle. Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



Measurements, Features, and Settings

Measurements

Measurement	Illustration
Radius Measures the radius of the circle.	
X Finds the circle center position in the X axis.	
Z Finds the circle center position in the Z axis.	

Features

Type	Description
Center Point	The center point of the fitted circle.

 For more information on geometric features, see *Geometric Features* on page 127.

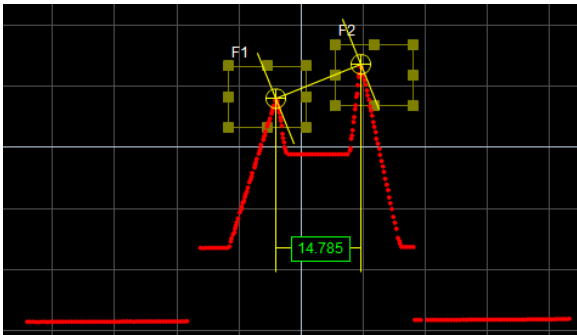
Parameters

Parameter	Description
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Filters	See <i>Filters</i> on page 129.

Dimension

The Dimension tool provides Width, Height, Distance, Center X, and Center Z measurements.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



ParametersAnchoring

Source:Top

Feature 1Max Z

Feature 2Max Z

Width

Height

Distance14.785

Center X

Center Z

Id:4

Output

Filters

Decision

Min:14 mm

Max:15 mm

The tool's measurements require two feature points. See *Feature Points* on page 124 for information on point types and how to configure them.

Measurements

Measurement	Illustration
Width Determines the difference along the X axis between two feature points. The difference can be calculated as an absolute or signed result. The difference is calculated by: $\text{Width} = \text{Feature 2}_{X \text{ position}} - \text{Feature 1}_{X \text{ position}}$	

Measurement

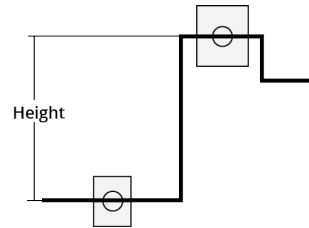
Illustration

Height

Determines the difference along the Z axis between two feature points.

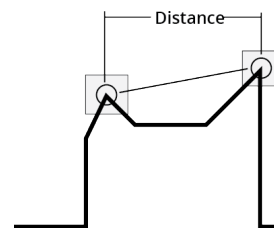
The difference can be expressed as an absolute or signed result. The difference is calculated by:

$$\text{Height} = \text{Feature 2}_{Z \text{ position}} - \text{Feature 1}_{Z \text{ position}}$$



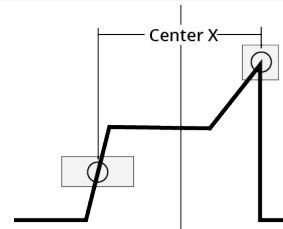
Distance

Determines the direct, Euclidean distance between two feature points.



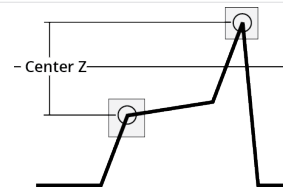
Center X

Finds the average location of two features and measures the X axis position of the average location



Center Z

Finds the average location of two features and measures the Z axis position of the average location.



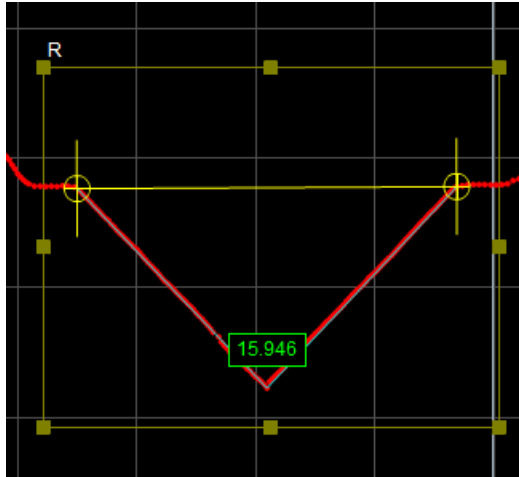
Parameters

Parameter	Description
Absolute (Width and Height measurements only)	Determines if the result will be expressed as an absolute or a signed value.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Filters	See <i>Filters</i> on page 129.

Groove

The Groove tool provides measurements of V-shape, U-shape, or open-shape grooves. Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



Parameter

Anchoring

Source: Top
Shape: U-Shape
Min Depth: 0 mm
Min Width: 0 mm
Max Width: 0 mm
☒ Region

Width
Add

X
Z
Width 15.946
Depth

Id: 6

Parameters

Output

Select Type: Max Depth
Index: 0

The Groove tool uses a complex feature-locating algorithm to find a groove and then return measurements. See "Groove Algorithm" in the *Gocator Measurement Tool Technical Manual* for a detailed explanation of the algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

The Groove tool lets you add multiple measurements of the same type to receive measurements and set decisions for multiple grooves. Multiple measurements are added by using the drop-down above the list of measurements and clicking on the **Add** button.

For example, if a target has three grooves, by adding two measurements, choosing **Index From The Left** in the **Select Type** setting of those measurements, and providing values of 0 and 2 in the **Index** setting of the measurements, respectively, the Groove tool will return measurements and decisions for the first and third grooves.

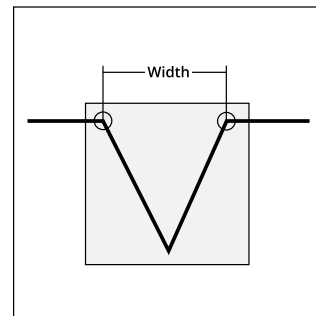
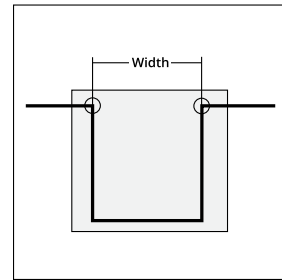
Measurements

Measurement

Illustration

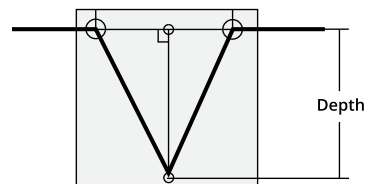
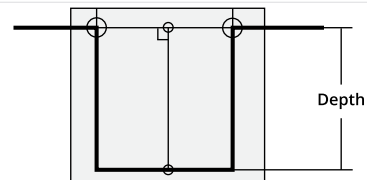
Width

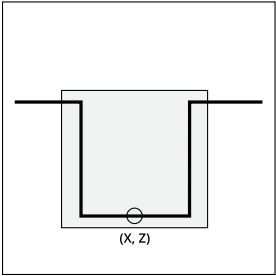
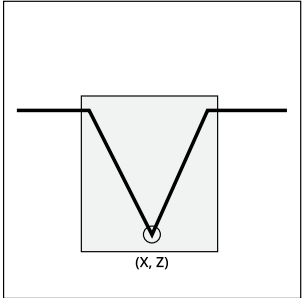
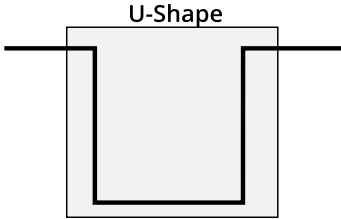
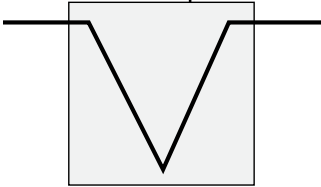
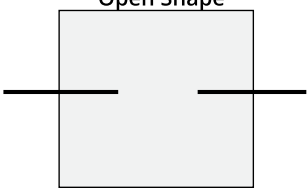
Measures the width of a groove.

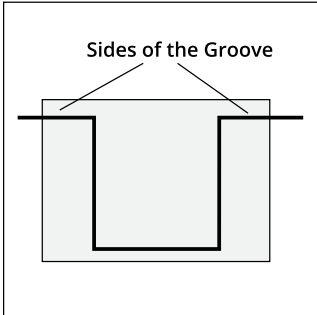


Depth

Measures the depth of a groove as the maximum perpendicular distance from a line connecting the edge points of the groove.



Measurement	Illustration
X Measures the X position of the bottom of a groove.	
Z Measures the Z position of the bottom of a groove.	
Parameters	
Parameter	Description
Shape	Shape of the groove  U-Shape  V-Shape  Open Shape
Location <i>(Groove X and Groove Z measurements only)</i>	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.

Parameter	Description
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.
Minimum Depth	Minimum depth for a groove to be considered valid.
Minimum Width	Minimum width for a groove to be considered valid. The width is the distance between the groove corners.
Maximum 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.
Decision	See <i>Decisions</i> on page 128.
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. See <i>Regions</i> on page 121.
 The diagram shows a cross-section of a groove. A large rectangle represents the measurement region. Inside this region is a smaller rectangle representing the groove. Two lines point from the text 'Sides of the Groove' to the vertical walls of the groove. The area outside the groove but within the measurement region is shaded light gray.	
Filters	See <i>Filters</i> on page 129.

Intersect

The Intersect tool determines intersect points and angles. Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

The Intersect tool's measurements require two fit lines, one of which is a reference line set to the X axis ($z = 0$), the Z axis ($x = 0$), or a user-defined line.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



ParametersAnchoring

Source:Top

Reference Type:Line

Line (L)2 Regions

Ref Line (RL)2 Regions

MeasurementsFeatures

X-0.291

Z

Angle

ID:3

Output

Filters

Decision

Min:-3 mm

Max:-2 mm

Measurements, Features, and Settings

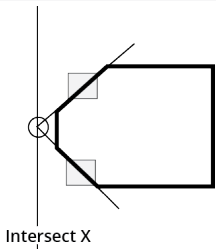
Measurements

Measurement

Illustration

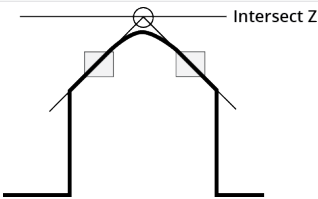
X

Finds the intersection between two fitted lines and measures the X axis position of the intersection point.



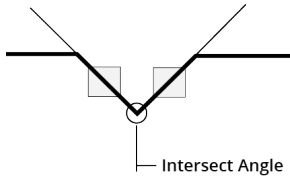
Z

Finds the intersection between two fitted lines and measures the Z axis position of the intersection point.



Angle

Finds the angle subtended by two fitted lines.



Features

Type	Description
Intersect Point	The point of intersection.
Line	The intersect line.
Base Line	The base line.



For more information on geometric features, see *Geometric Features* on page 127.

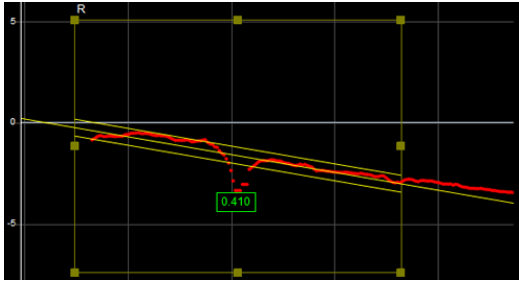
Parameters

Parameter	Description
Reference Type	Determines the type of the reference line. X-Axis: The reference line is set to the X axis. Z-Axis: The reference line is set to the Z axis Line: The reference line is defined manually using the Ref Line parameter. One or two regions can be used to define the line.
Ref Line	Used to define the reference line when Line is selected in the Reference Type parameter.
Line	One or two fit areas can be used for each fit line. See <i>Fit Lines</i> on page 126 for more information.
Angle Range (Angle measurement only)	Determines the angle range. The options are: -90 – 90 0 – 180
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Filters	See <i>Filters</i> on page 129.

Line

The Line tool fits a line to the live profile and measures the deviations from the best-fitted line. Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



Parameters
Anchoring

Source: Top

☒ Region

X: -25.63 mm

Z: -22.355 mm

Width: 52.404 mm

Height: 52.404 mm

☐ Fitting Regions All Data

Measurements
Features

Standard Deviation 0.410 ☒

Min Error ☐

Max Error ☐

Percentile ☐

Offset ☐

Angle ☐

Min Error X ☐

Min Error Z ☐

Max Error X ☐

Max Error Z ☐

ID: 4

Output

Filters

Decision

Min: 0 mm

Max: 1 mm

Measurements, Features, and Settings

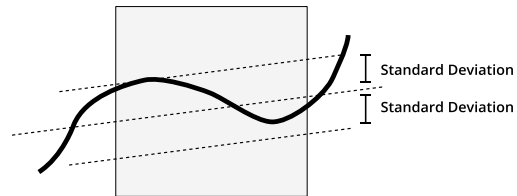
Measurements

Measurement

Standard Deviation

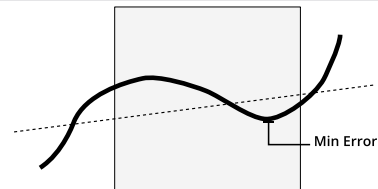
Finds the best-fitted line and measures the standard deviation of the laser points from the line.

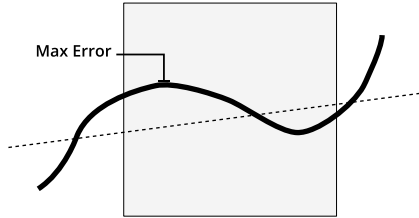
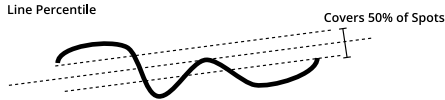
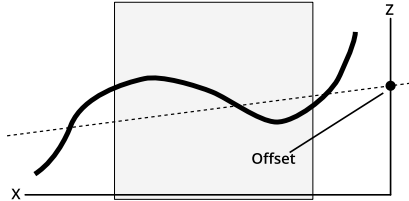
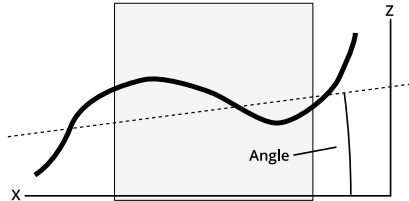
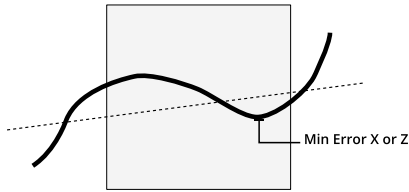
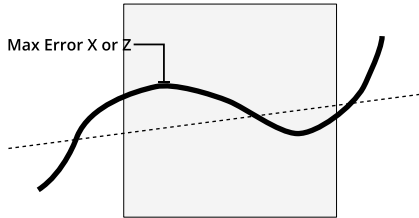
Illustration



Min Error

Finds the best-fitted line and measures the minimum error from the line (the maximum distance below the line).



Measurement	Illustration
Max Error Finds the best-fitted line and measures the maximum error from the line (the maximum distance above the line).	
Percentile Finds the best-fitted line and measures the range (in Z) that covers a percentage of points around the line.	
Offset Finds the best-fitted line and returns the intersection point between that line and the Z axis.	
Angle Finds the best-fitted line and returns the angle relative to the X axis.	
Min Error X Min Error Z Finds the best-fitted line and returns the X or Z position of the minimum error from the line (the maximum distance below the line).	
Max Error X Max Error Z Finds the best-fitted line and returns the X or Z position of the maximum error from the line (the maximum distance above the line).	
Features	
Type	Description
Line	The fitted line.
Error Min Point	The point of minimum error.
Error Max Point	The point of maximum error.


 For more information on geometric features, see *Geometric Features* on page 127.

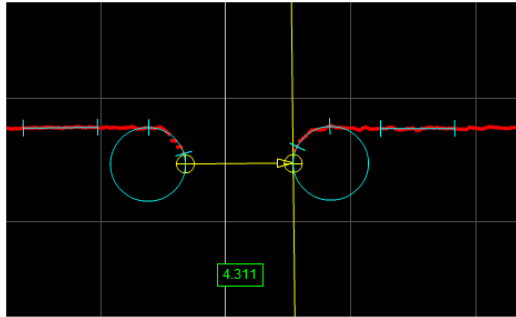
Parameters

Parameter	Description
Percent (Percentile measurement only)	The specified percentage of points around the best-fitted line.
Fitting Regions	Determines which data Gocator uses to <i>fit the line</i> over the profile. When Fitting Regions is enabled, Gocator uses the data indicated by one of the following options: • All Data: All of the data in the profile is used to fit the line. • 1 Region: Data from a fitting region you define in the data viewer is used to fit the line. • 2 Regions: Data from two fitting regions you define is used to fit the line. When Fitting Regions is disabled, to fit the line, Gocator uses the measurement region if Region is enabled, or the entire profile if Region is disabled.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Filters	See <i>Filters</i> on page 129.

Panel

The Panel tool provides Gap and Flush measurements. Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



Parameters
Anchoring

Source: Top
Reference Side: Left
Max Gap Width: 0 mm

Left
Right

Gap 4.311

Flush
Left Gap X
Left Gap Z
Left Flush X
Left Flush Z
Left Surface Angle
Right Gap X
Right Gap Z
Right Flush X
Right Flush Z
Right Surface Angle

ID: 0

Parameters
Output

Measurement Axis Edge

The Panel tool uses a complex feature-locating algorithm to find the gap or calculate flushness and return measurements. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel. See "Gap and Flush Algorithm" in the *Gocator Measurement Tool Technical Manual* for a detailed explanation of the algorithm.



You must make sure that there are enough data points to define the edge in the profile, by properly setting up exposure, etc. If not, the algorithm will not function.

Measurement	Illustration
Gap Measures the distance between two surfaces. The surface edges can be curved or sharp.	
Flush Measures the flushness between two surfaces. The surface edges can be curved or sharp.	
Left Gap X Returns the X position of the edge feature on the left side used to measure the gap.	
Left Gap Z Returns the Z position of the edge feature on the left side used to measure the gap.	
Left Flush X Returns the X position of the feature on the left side used to measure flushness.	
Left Flush Z Returns the Z position of the feature on the left side used to measure flushness.	
Left Surface Angle The angle of the left side surface relative to the X axis.	

Measurement	Illustration
Right Gap X Returns the X position of the edge feature on the right side used to measure the gap.	
Right Gap Z Returns the Z position of the edge feature on the right side used to measure the gap.	
Right Flush X Returns the X position of the feature on the right side used to measure flushness.	
Right Flush Z Returns the Z position of the feature on the right side used to measure flushness.	
Right Surface Angle The angle of the right side surface relative to the X axis.	

Parameters

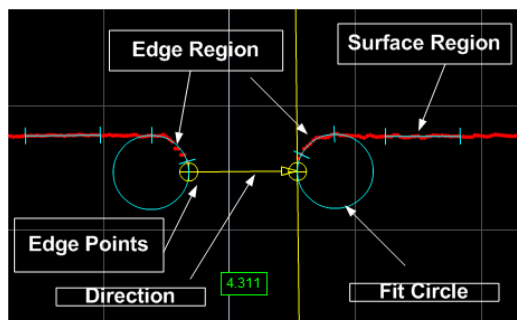
Parameter	Description
Max Gap Width	The maximum width of the gap. Allows the tool to filter gaps greater than the expected width. This can be used to single out the correct gap when there are multiple gaps in the field of view.
Reference Side	Defines the side used to calculate the measurement axis (see below).
Measurement Axis <i>Gap measurement only</i>	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 <i>Flush measurement only</i>	When enabled, returns an absolute value rather than a signed value.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

Left/Right SideParameters

Parameter	Description
Max Void Width	The maximum allowed width of missing data caused by occlusion or data dropout.
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.

Parameter	Description
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.
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.

The Data Viewer displays the gap measurement in real time. It also displays the results from the intermediate steps in the algorithm.



Position

The Position tool finds the X or Z axis position of a feature point. The feature type must be specified and is one of the following: Max Z, Min Z, Max X, Min X, Corner, Average (the mean X and Z of the data points), Rising Edge, Falling Edge, Any Edge, Top Corner, Bottom Corner, Left Corner, Right Corner, or Median (median X and Z of the data points). Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



Parameters
Anchoring

Source:
Top

Feature
Max Z

Measurements
Features

X 0.357

Z

ID:
5

Output

Filters

Decision

Min:
0 mm

Max:
1 mm

Measurements, Features, and Settings

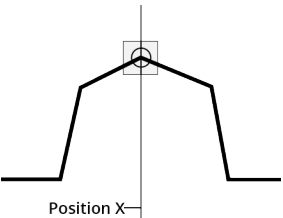
Measurements

Measurement

Illustration

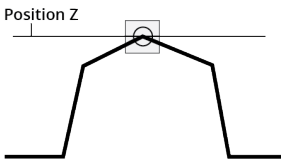
X

Finds the position of a feature on the X axis.



Z

Finds the position of a feature on the Z axis.



Features

Type

Description

Point

The returned position.



For more information on geometric features, see *Geometric Features* on page 127.

Parameters

Parameter

Description

Feature Type

Choose Max Z, Min Z, Max X, Min X, Corner, Average, Rising Edge, Falling Edge, Any Edge, Top Corner, Bottom Corner, Left Corner, Right Corner, or Median.

Decision

See *Decisions* on page 128.

Region

See *Regions* on page 121.

Output

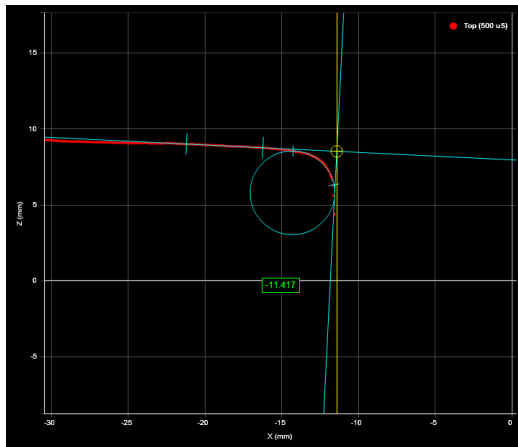
See *Filters* on page 129.

Round Corner

The Round Corner tool measures corners with a radius, returning the position of the edge of the corner and the angle of adjacent surface with respect to the X axis.

Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



Parameters Anchoring

Source: Top

Reference Direction: From the Left

Edge

Max Void Width: 0 mm

Min Depth: 0 mm

Surface Width: 5 mm

Surface Offset: 2 mm

Nominal Radius: 2.75 mm

Edge Angle: 90 °

Edge Type: Corner

Region

X: -11.417

Z: 8.529

Angle: -2.813

ID: 6

Output

Filters

Decision

Min: -20 mm

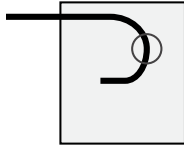
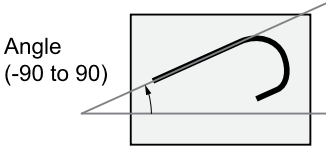
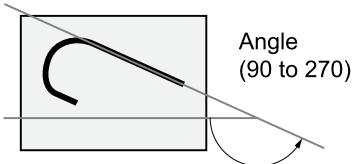
Max: 20 mm

The Round Corner tool uses a complex feature-locating algorithm to find the edge and return measurements. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel. See "Gap and Flush Algorithm" in the *Gocator Measurement Tool Technical Manual* for a detailed explanation of the algorithm.



You must make sure that there are enough data points to define the edge (proper exposure, etc.). If not, the algorithm will not function.

Measurements

Measurement	Illustration
X Measures the X position of the location where the tangent touches the edge, or intersect of the tangent and the line fitted to the surface used by the measurement (see Reference Side, below).	
Z Measures the Z position of the location where the tangent touches the edge, or intersect of the tangent and the line fitted to the surface used by the measurement (see Reference Side, below).	
Angle Measures the angle of the line fitted to the surface next to the corner (see Reference Side, below), with respect to the x-axis. Left edge angles are from -90 to 90. Right edge angles are from 90 to 270.	 

Parameters

Parameter	Description
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.
Reference Direction	Defines the side used to calculate the rounded corner.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

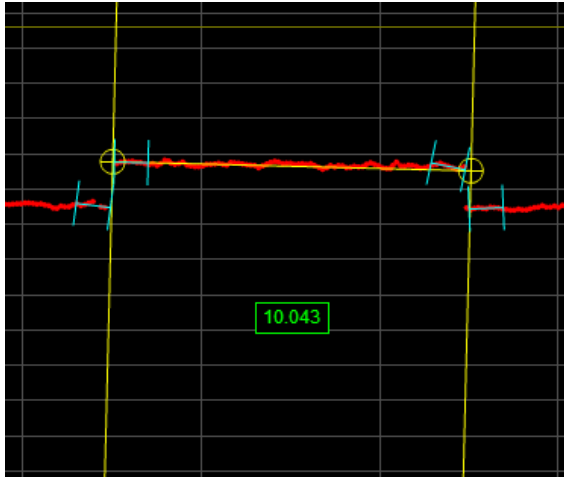
Edge Parameters

Parameter	Description
Max Void Width	The maximum allowed width of missing data caused by occlusion or data dropout.
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.
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.

Strip

The Strip tool measures the width of a strip. Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



ParametersAnchoring

Source:Top
Base Type:Flat

Left Edge

☒ Rising

☒ Data End

☒ Falling

☒ Void

Right Edge

☒ Tilt Enabled

Support Width:5 mm
Transition Width:0 mm
Min Width:0 mm
Min Height:2 mm
Max Void Width:0 mm

☒ Region

XAdd

X

Z

Width10.043

Height

☐

☐

☒

☐

Id:12

ParametersOutput

Select Type:Index Left
Index:0

The Strip tool uses a complex feature-locating algorithm to find a strip and then return measurements. See "Strip Algorithm" in the *Gocator Measurement Tool Technical Manual* for a detailed explanation of the algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

The Strip tool lets you add multiple measurements of the same type to receive measurements and set decisions for multiple strips. Multiple measurements are added by using the drop-down above the list of measurements and clicking on the **Add** button.

For example, if a target has three strips, by adding two measurements, choosing **Index From The Left** in the **Select Type** setting, and providing values of 1 and 3 in the **Index** of field of the measurements, respectively, the Strip tool will return measurements and decisions for the first and third strip.

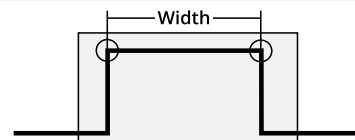
Measurements

Measurement

Width

Measures the width of a strip.

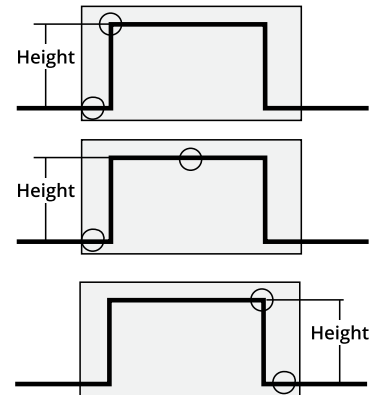
Illustration



Measurement**Illustration**

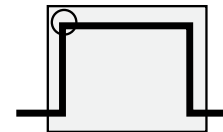
Height

Measures the height of a strip.

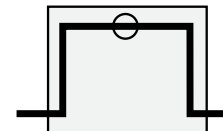
**X**

Measures the X position of a strip.

(X, Z)

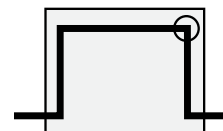


(X, Z)

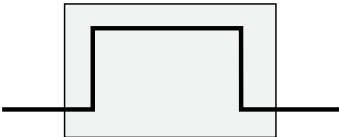
**Z**

Measures the Z position of a strip.

(X, Z)



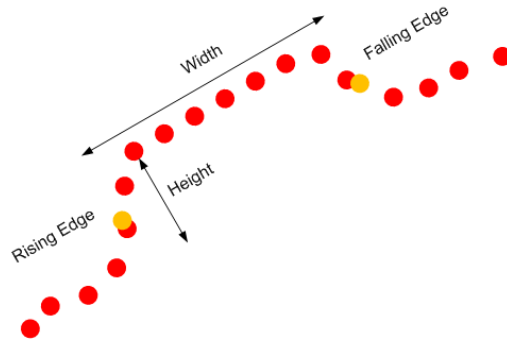
Parameters

Parameter	Description
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.
Location <i>(Strip Height, Strip X, and Strip Z measurements only)</i>	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.
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 the <i>Gocator Measurement Tool Technical Manual</i> for the definitions of these conditions.
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.
Min Height	Specifies the minimum deviation from the strip base. See "Strip Step Edge Definitions" in the <i>Gocator Measurement Tool Technical Manual</i> on how this parameter is used for different base types.

Parameter	Description
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 the <i>Gocator Measurement Tool Technical Manual</i> 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 the <i>Gocator Measurement Tool Technical Manual</i> on how this parameter is used by different base types.
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. See <i>Gap Filling</i> on page 82 for information.
Min Width	Specifies the minimum width for a strip to be considered valid.
Tilt Enabled	Enables/disables tile correction.
Decision	See <i>Decisions</i> on page 128.
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. See <i>Regions</i> on page 121 for more information.
Output	See <i>Filters</i> on page 129.

Tilt

The strip may be tilted with respect to the sensor's coordinate X axis. This could 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.

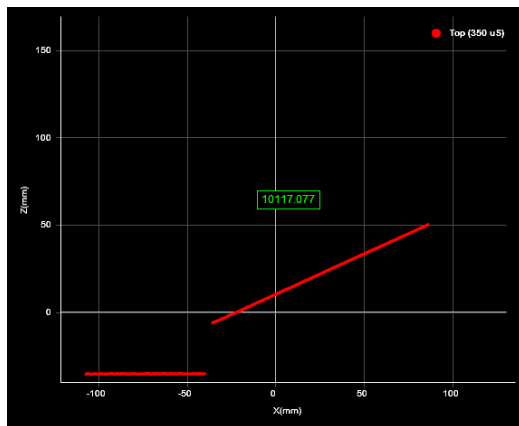


Script

A Script measurement can be used to program a custom measurement using a simplified C-based syntax. A script measurement can produce multiple measurement values and decisions for the output.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.

See *Scripts* on page 228 for more information on scripts.



Code

```

1 double DimensionDistance = Measurement_Value(2);
2
3 if (Measurement_Valid(2))
4 {
5     Output_Set(DimensionDistance + 10000, 1);
6 }
7 else
8 {
9     Output_SetAt(0, 0);
10 }

```

*Press save button or 'Ctrl+S' to apply change.
Press 'Esc' to exit full screen.

Output:

Add

Output 0

10117.077

✕

Id:

0

See *Scripts* on page 228 for more information on the script syntax.

To create or edit a Script measurement:

1. Add a new Script tool or select an existing Script measurement.
2. Edit the script code.
3. Add script outputs using the **Add** button.
For each script output that is added, an index will be added to the **Output** drop-down and a unique ID will be generated.
To remove a script output, click on the  button next to it.

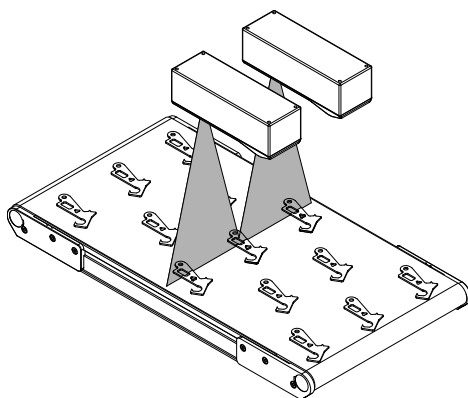
4. Click the **Save** button  to save the script code.

If there is a mistake in the script syntax, the result will be shown as a "Invalid" with a red border in the data viewer when you run the sensor.

Outputs from multiple measurement tools can be used as inputs to the script. A typical script would take results from other measurement tools using the value and decision function, and output the result using the output function. Stamp information, such as time and encoder stamps, are available in the script, whereas the actual profile data is not. (The script engine is not powerful enough to process the data itself.) Only one script can be created.

Surface Measurement

Surface measurement involves capturing 3D point cloud data, optionally identifying discrete objects, and measuring properties of the surface or the objects, such as the volume of the object or the height at a certain position of the object. All volumetric tools have the ability to operate either on the entire surface or the full object, or within a region of interest at a certain position in relation to the surface or an object.



Multiple measurements can be performed on the entire surface or each discrete object, limited only by the available CPU resources.

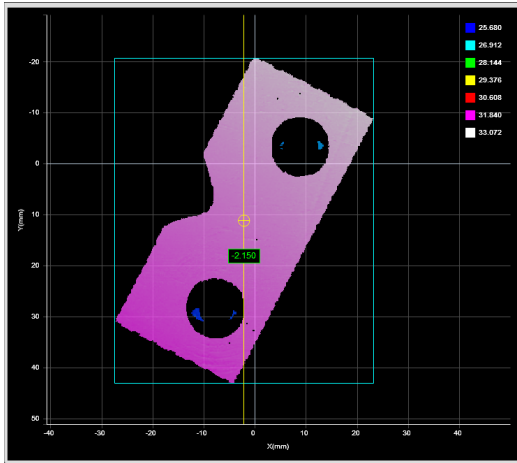
Bounding Box

The Bounding Box tool provides measurements related to the smallest box that contains the part (for example, X position, Y position, width, length, etc.).

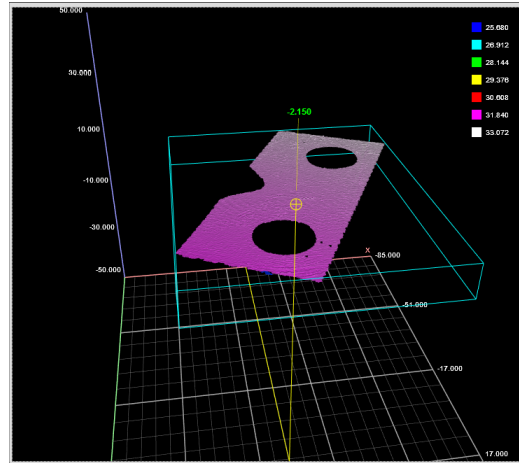
Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.

A bounding box can be vertical or rotated. A vertical bounding box provides the absolute position from which the Position centroids tools are referenced.



2D View



3D View

Parameters
Anchoring

Source:
Top

Rotation:
☐

☒ Region

Measurements
Features

X	-2.150	☒
Y		☐
Z		☐
Width		☐
Length		☐
Height		☐
Z Angle		☐
Global X		☐
Global Y		☐
Global Z Angle		☐

ID:

Output

Filters

Decision

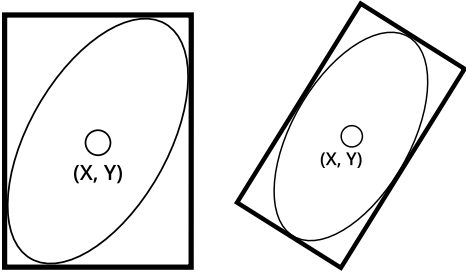
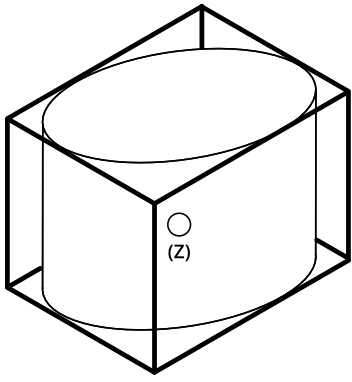
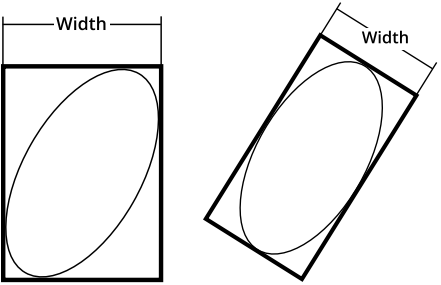
Min:
 mm

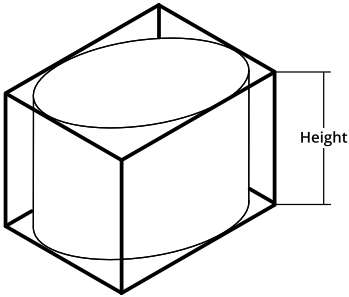
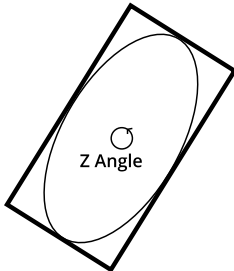
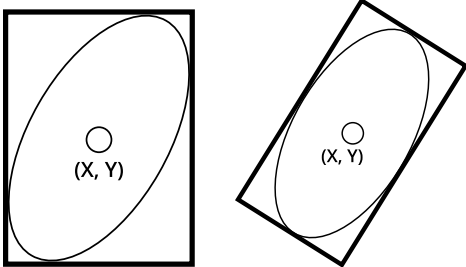
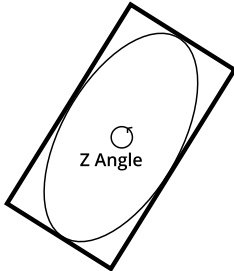
Max:
 mm

Measurement Panel

Measurements, Features, and Settings

Measurements

Measurement	Illustration
X Determines the X position of the center of the bounding box that contains the part. The value returned is relative to the <i>part</i>.	
Y Determines the Y position of the center of the bounding box that contains the part. The value returned is relative to the <i>part</i>.	
Z Determines the Z position of the center of the bounding box that contains the part. The value returned is relative to the <i>part</i>.	
Width Determines the width of the bounding box that contains the part. When the Rotation setting is disabled, the bounding box is the smallest rectangle whose sides are parallel to the X and Y axes. Width is on the X axis. When Rotation is enabled, the width is the smaller side dimension.	
Length Determines the length of the bounding box that contains the part. When the Rotation setting is disabled, the bounding box is the smallest rectangle whose sides are parallel to the X and Y axes. Length is on the Y axis. When Rotation is enabled, the length is the longer side dimension.	

Measurement	Illustration
Height Determines the height of the bounding box that contains the part.	
Z Angle Determines the rotation around the Z axis and the angle of the longer side of the bounding box relative to the X axis. If Rotation is not enabled, the measurement returns 90.000 degrees. In order to use this measurement for angle anchoring, you must enable Rotation; for more information on anchoring, see <i>Measurement Anchoring</i> on page 131.	
Global X* Determines the X position of the center of the bounding box that contains the part <i>on the surface from which the part was extracted</i>.	
Global Y* Determines the Y position of the center of the bounding box that contains the part <i>on the surface from which the part was extracted</i>.	
Global Z Angle* Determines the rotation of the longer side of the bounding box around the Z axis <i>on the surface from which the part was extracted</i>. If part matching is enabled, the returned value represents the rotation of the part <i>before</i> part matching rotates it. If Rotation is not enabled, the measurement returns 90.000 degrees.	
 *These measurements are mostly useful with parts extracted from a surface. For more information on parts, see <i>Part Detection</i> on page 85.	

Features

Type	Description
Center Point	The center point of the bounding box.
 For more information on geometric features, see <i>Geometric Features</i> on page 127..	

Parameters

Parameter	Description
Rotation	A bounding box can be vertical or rotated. A vertical bounding box provides the absolute position from which the part's Position centroid measurements are referenced. Check the Rotation setting to select rotated bounding box.
Asymmetry Detection	Resolves the orientation of an object over 360 degrees. The possible values are: 0 – None 1 – Along Major Axis 2 – Along Minor Axis This setting is only visible if Rotation is checked.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

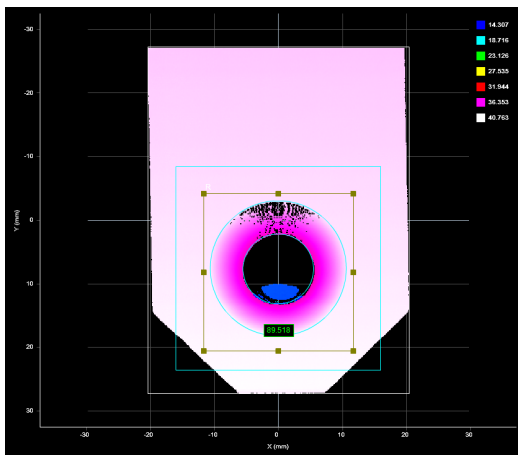
Countersunk Hole

The Countersunk Hole tool locates a countersunk circular opening within a region of interest on the surface and provides measurements to evaluate characteristics of countersunk holes, including the position (X, Y, and Z) of the center of the hole, outside radius of the hole, hole bevel angle, and the depth of the hole. The countersunk hole can be on a surface at an angle to the sensor. The tool also supports measuring holes drilled at an angle relative to the surrounding surface.

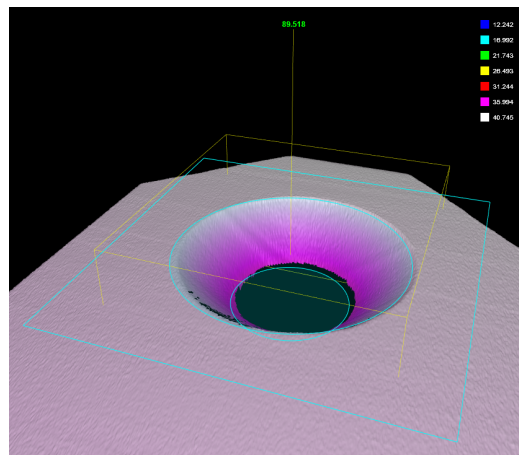


The Countersunk Hole tool does not search for or detect a hole. The tool expects that a hole conforming reasonably well to the defined parameters is present and that it is on a sufficiently uniform background.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



2D View



3D View

ParametersAdvancedAnchoring

Source:Top
Shape:Cone
Nominal Bevel Angle:100°
Nominal Outer Radius:10 mm
Nominal Inner Radius:4 mm
Bevel Radius Offset:4 mm
Partial Detection:
Plane Fit Range:0 mm
☒ Region

MeasurementsFeatures

X	89.518	☒
Y		☐
Z		☐
Outer Radius		☐
Depth		☐
Bevel Radius		☐
Bevel Angle		☐
X Angle		☐
Y Angle		☐
Counterbore Depth		☐
Axis Tilt		☐
Axis Orientation		☐

ID:1

Output

Filters

Decision

Min:89 mm
Max:90 mm

Parameters
Advanced
Anchoring

☐ Curved Surface

☐ Reference Region
Auto Set

Tilt Correction
Auto Set

X
89.518
☒

Y
☐

Z
☐

Outer Radius
☐

Depth
☐

Bevel Radius
☐

Bevel Angle
☐

X Angle
☐

Y Angle
☐

Counterbore Depth
☐

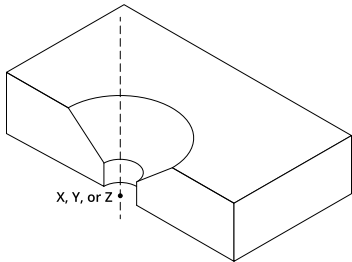
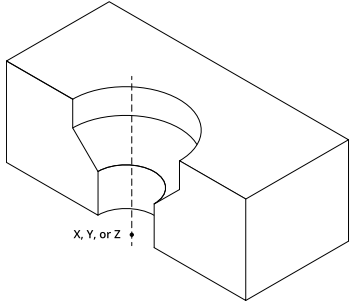
Axis Tilt
☐

Axis Orientation
☐

Measurement Panel

Measurements, Features, and Settings

Measurements

Measurement	Illustration
X Determines the X position of the center of the countersunk hole.	
Y Determines the Y position of the center of the countersunk hole.	
Z Determines the Z position of the center of the countersunk hole.	

Measurement

Illustration

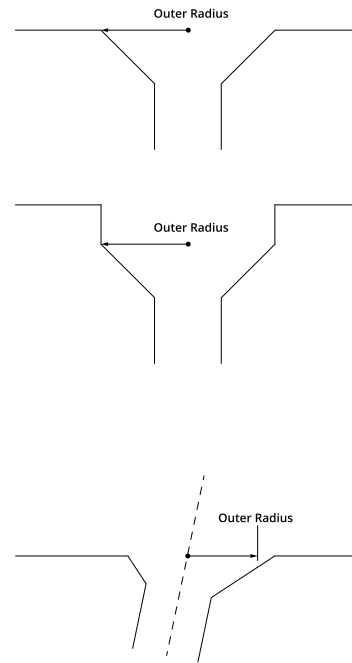
Outer Radius

Determines the outer radius of the countersunk hole.

When a hole is cut at an angle relative to the surrounding surface, the outer radius is calculated as if the hole were not cut at an angle.

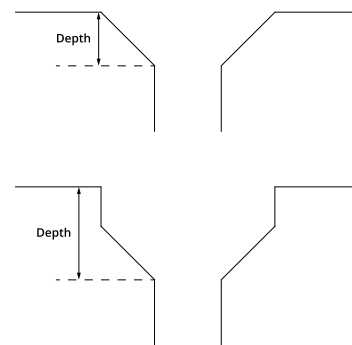


To convert the radius to a diameter, set the **Scale** setting in the **Output** panel (displayed after expanding the **Filters** section) to 2.



Depth

Determines the depth of the countersunk hole relative to the surface that the countersunk hole is on.



Measurement

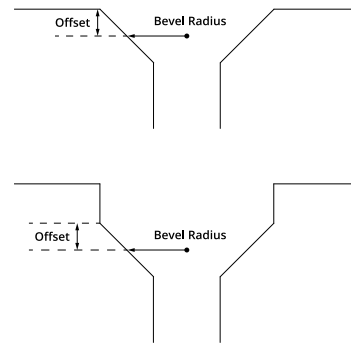
Illustration

Bevel Radius

Determines the radius at a user-defined offset (**Offset** setting) relative to the surface that the countersunk hole is on.

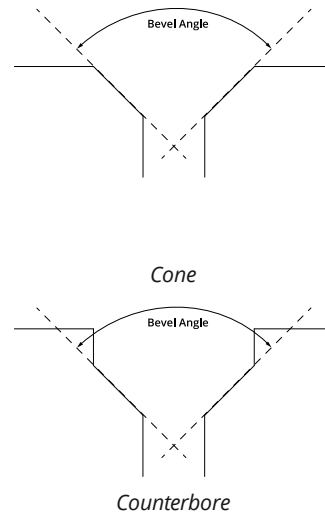


To convert the radius to a diameter, set the **Scale** setting in the **Output** panel (displayed after expanding the **Filters** section) to 2.



Bevel Angle

Determines the angle of the hole's bevel.

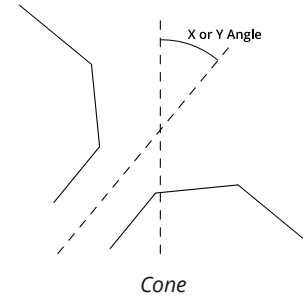


Measurement

Illustration

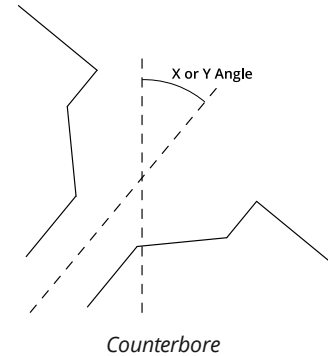
X Angle

Determines the angle the hole relative to the X axis.



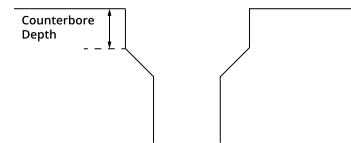
Y Angle

Determines the angle of the hole relative to the Y axis.



Counterbore Depth

Determines the depth of a counterbore.

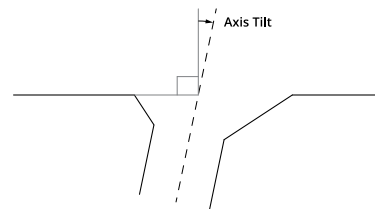


Axis Tilt

Measures the tilt of the axis of the hole relative to the surface surrounding the hole.



This measurement is not supported when **Shape** is set to **Counterbore**.

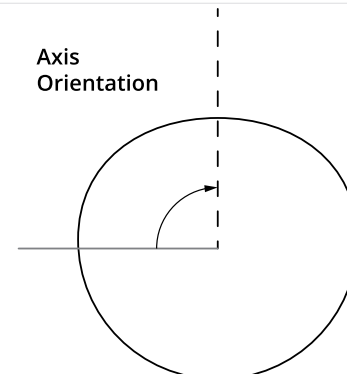


Axis Orientation

Measures the angle of the axis of the hole around the normal of the surface surrounding the hole, relative to the X axis.



This measurement is not supported when **Shape** is set to **Counterbore**.



Features

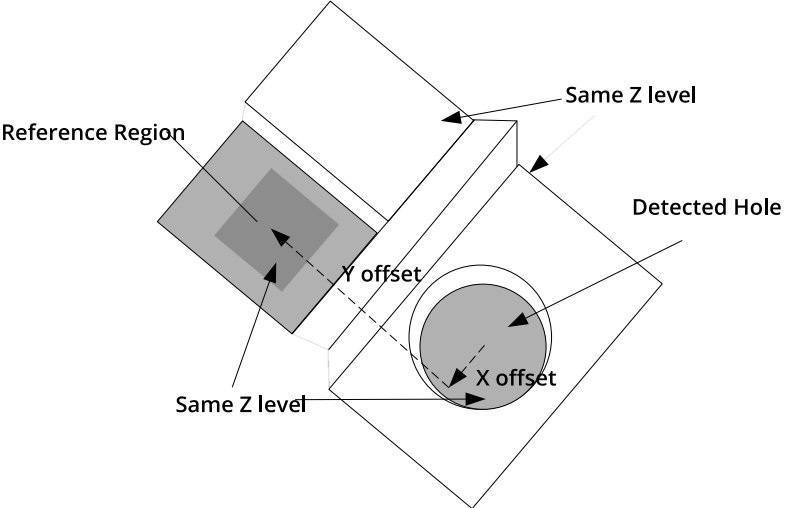
Type	Description
Center Point	The center point of the countersunk hole. The Z position of the center point is at the Z position of the surrounding surface.



For more information on geometric features, see *Geometric Features* on page 127.

Parameters

Parameter	Description
Shape	The shape of the countersunk hole. (See illustrations above.) 0 – Cone 1 – Counterbore
Nominal Bevel Angle	The expected bevel angle of the countersunk hole.
Nominal Outer Radius	The expected outer radius of the countersunk hole.
Nominal Inner Radius	The expected inner radius of the countersunk hole.
Bevel Radius Offset	The offset, relative to the surface that the countersunk hole is on, at which the bevel radius will be measured.
Curved Surface	Whether the surface that the countersunk hole is on is curved. When this setting is enabled, specify the orientation of the curvature in degrees in the Curve Orientation setting.

Parameter	Description
Reference Regions	The algorithm uses the Reference Regions option 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, the user manually specifies the reference region. The location of the reference region is relative to the detected center of the hole and positioned on the nominal surface plane. When the Reference Regions option 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. When this option is set to Autoset, the tool automatically detects the tilt. Otherwise, the user must enter the angles manually. Autoset requires the measurement region to cover more areas on the surface plane than other planes. The results from the Plane X and Y tool can be used for angles X and Y parameters.
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.
Plane Fit Range	Excludes data beyond the specified distance from the plane surrounding the hole. You can use this setting to exclude surfaces close to the countersunk hole that step down from the plane surrounding the hole that could make measurement of the hole less reliable.

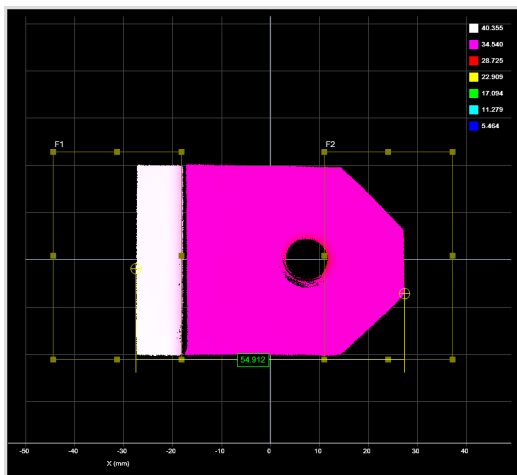
Parameter	Description
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

Dimension

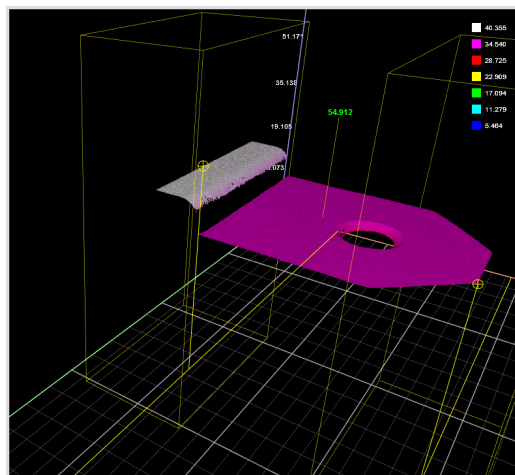
The Dimension tool returns various dimensional measurements of a part. You must specify two feature types (see below).

Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



2D View



3D View

ParametersAnchoring

Source:

Top

Feature 1

Min X

Feature 2

Max X

Width

54.912

☒

Length

☐

Height

☐

Distance

☐

Plane Distance

☐

Center X

☐

Center Y

☐

Center Z

☐

ID:

0

ParametersOutput

Filters

Decision

Min:

54.9

mm

Max:

55

mm

Measurement Panel

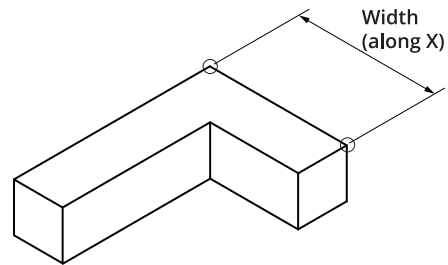
Measurements

Measurement

Illustration

Width

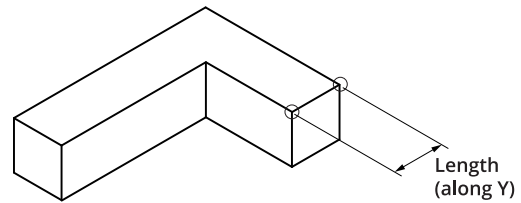
Determines the distance between the selected features along the X axis.



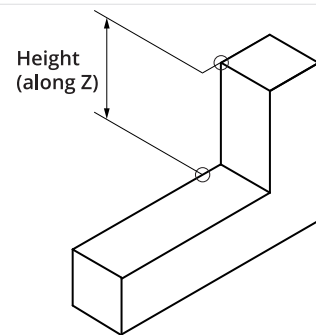
Measurement**Illustration**

Length

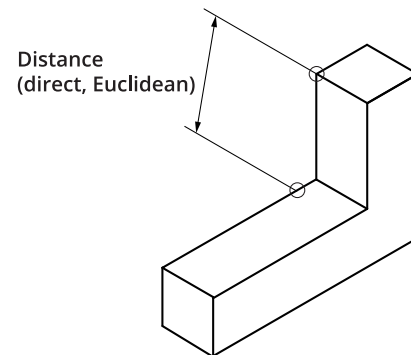
Determines the distance between the selected features along the Y axis.

**Height**

Determines the distance between the selected features along the Z axis.

**Distance**

Determines the direct, Euclidean distance between the selected features.



Measurement	Illustration
Plane Distance Determines the distance between the selected features. The position of the lowest feature point is projected onto the XY plane of the highest feature point.	
Center X Determines the X position of the center point between the selected features.	
Center Y Determines the Y position of the center point between the selected features.	
Center Z Determines the Z position of the center point between the selected features.	
Parameters	
Parameter	Description
Feature 1	One of the following: • Average (the mean X, Y, and Z of the data points) • Median (median X, Y, and Z of the data points) • Centroid (the centroid of the data considered as a volume with respect to the $z = 0$ plane) • Min X • Max X • Min Y • Max Y • Min Z • Max Z
Feature 2	
Decision	
Region	
Output	

Edge

The Edge tool fits a line to a straight edge in the scan data, using either height map or intensity data. After the tool locates an edge, the position (X, Y, and Z) of the center of the edge line, as well as its angle

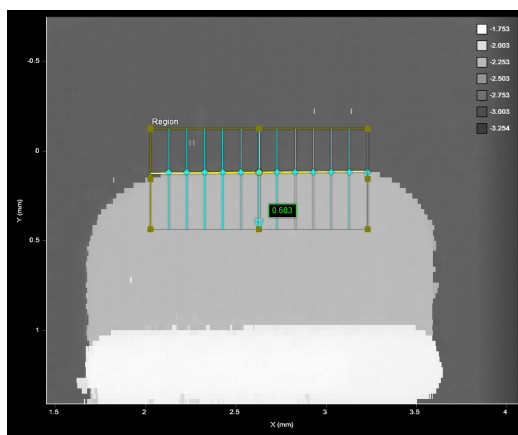
around the Z axis and the step height between the upper and lower surfaces adjacent to the edge, can be returned as measurements.

You can use the Z Angle measurement of the edge line with some tools to perform angle anchoring, compensating for minor part rotations around the Z axis, greatly increasing repeatability between part scans; for more information see *Measurement Anchoring* on page 131.

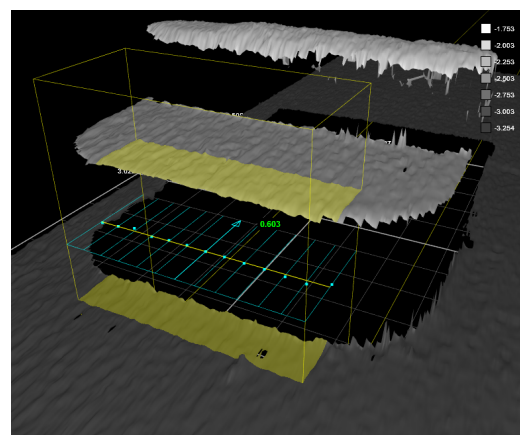
The tool can also generate edge line and center point geometric features that Feature tools can take as input for measurement. For more information on Feature tools, see *Feature Measurement* on page 222.

Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



2D View



3D View

ParametersAnchoring

Source:Top

☒ Use Intensity

Region

↺⋮

Search Direction90 degrees

Path Spacing0.1 mm

Path Width0 mm

Selection TypeBest

Step DirectionRising

Intensity Threshold0

Step Smoothing0 mm

Step Width0 mm

Max Gap0 mm

☒ Include Null Edges

Null Fill Value0 mm

Intensity Null Fill Value0

☒ Show Detail

MeasurementsFeatures

X
☐

Y
☐

Z
☐

Z Angle
☐

Step Height0.603☒

ID:1

ParametersOutput

Filters⋮

Decision

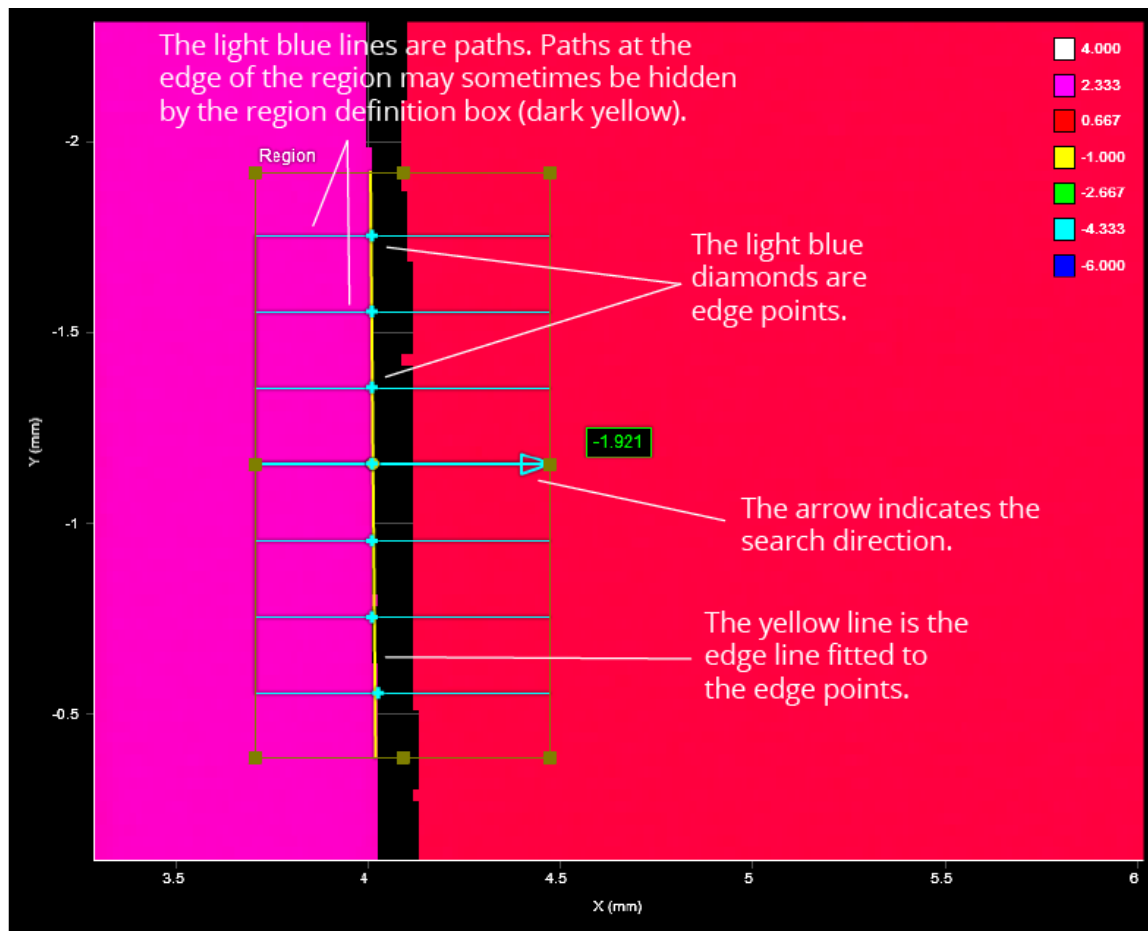
Min:0.595 mm

Max:0.605 mm

Measurement Panel

Paths and Path Profiles

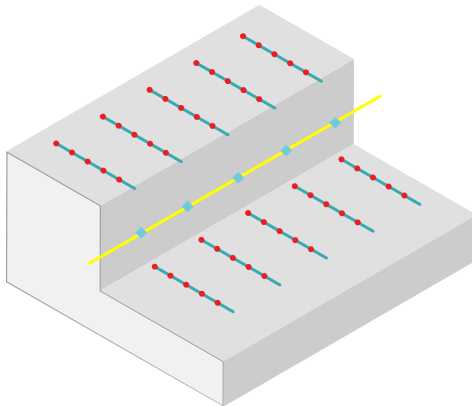
To fit an edge line to the scan data, the Surface Edge tool overlays evenly spaced, parallel *paths* (light blue lines in the interface; see below) in the defined region of interest.



For each path, a profile is generated internally from the height map's data points that fall under or, optionally, near the path. The tool then examines each path profile for steps (changes in height) that meet the criteria set by the tool's settings, such as minimum height, direction (whether it is rising or falling), and so on.

Red dots are data points from the scan data that fall under paths (light blue lines).

A single path profile extracted from a path.



For the step on each path profile that matches the settings, the tool places an edge point between the upper and lower area (light blue diamonds in the interface). The tool then fits a line to those edge points (yellow line in the interface). You can choose the orientation of the paths around the Z axis to accommodate different edge orientations.

Measurements, Features, and Settings

Measurements

Measurement

X

Returns the X position of the center point of the fitted edge line.

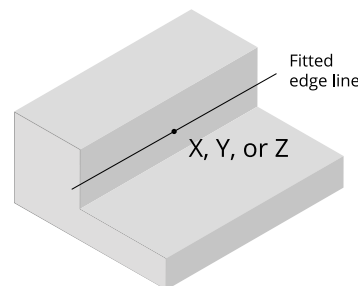
Y

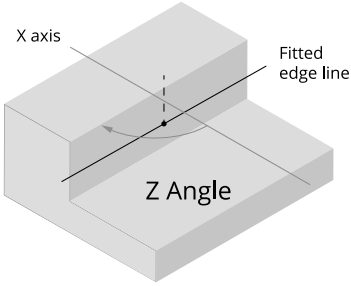
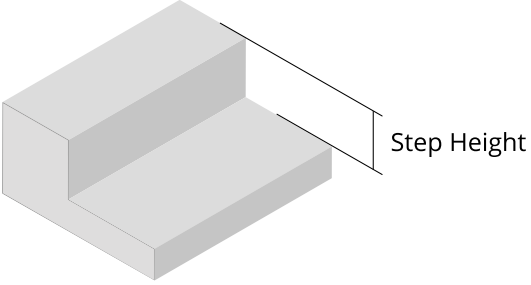
Returns the Y position of the center point of the fitted edge line.

Z

Returns the Z position of the center point of the fitted edge line.

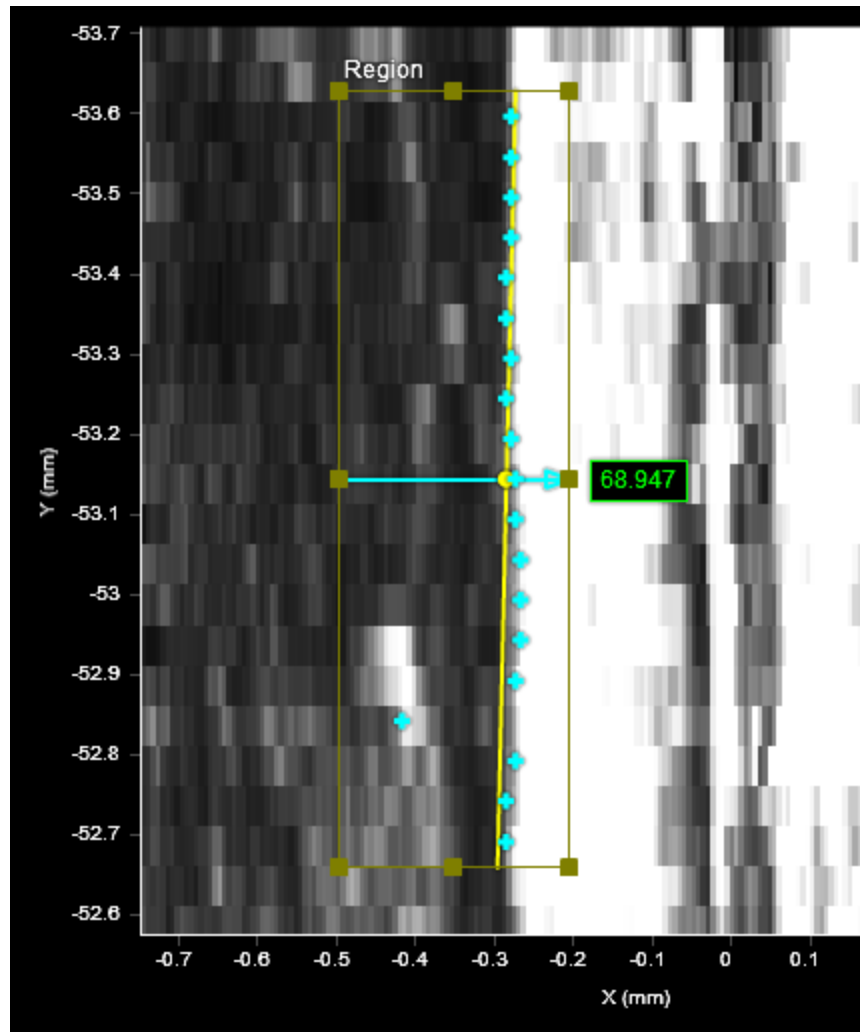
Illustration



Measurement	Illustration
Z Angle Returns the rotation, around the Z axis, of the fitted edge line. Rotating the measurement region has no impact on the angle that is returned unless a different edge is detected. Useful for using minor variations in the rotation of an edge on target as an anchor for other measurements. For more information, see <i>Measurement Anchoring</i> on page 131.	
Step Height Returns the height of the step, calculated by averaging the step heights of all of the path profiles. (When Use Intensity is enabled, the value returned is the difference in intensity.)	
Features	
Type	Description
Edge line	The fitted edge line.
Center Point	The intersection point of the fitted edge line and a line through the center of the region at the path angle.
 For more information on geometric features, see <i>Geometric Features</i> on page 127.	

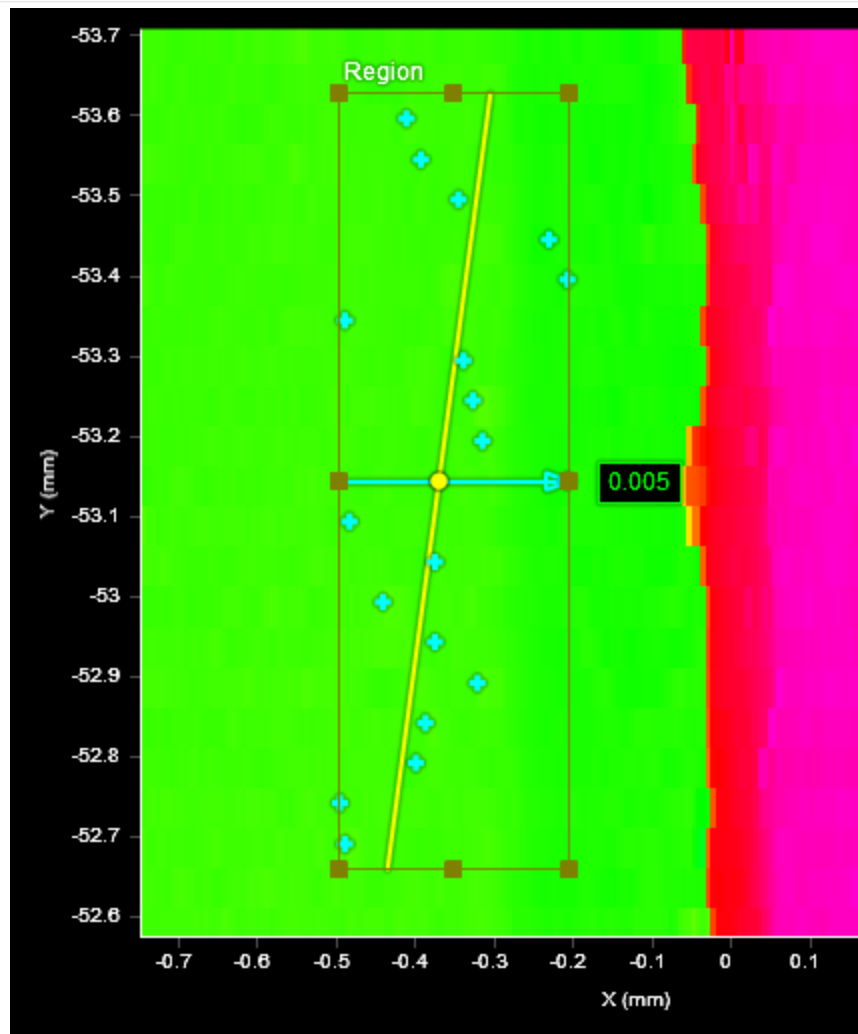
Parameters

Parameter	Description
Use Intensity	(This setting is only available when Acquire Intensity is enabled in the Scan Mode panel; for more information, see <i>Scan Modes</i> on page 64.) Uses intensity data rather than height data to find an edge. Useful when color differences on a flat area of a target, which would not be detected using height map data, are distinct, letting you use the detected "line" as an anchor source or perform geometric feature measurements.



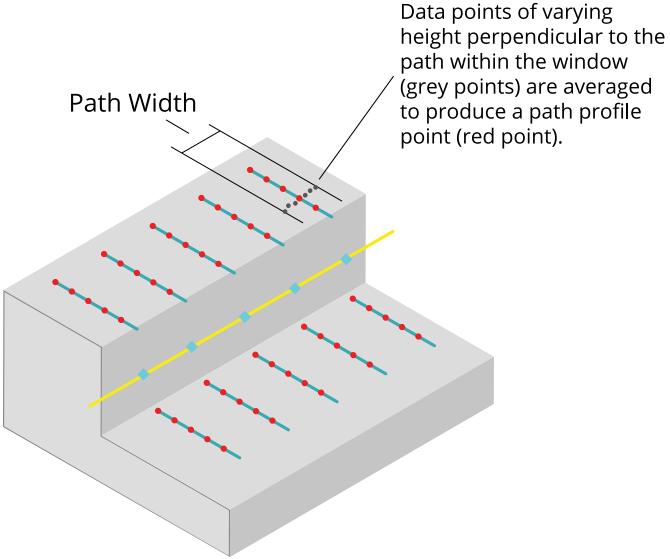
Use Intensity enabled (intensity view): Surface Edge tool finds the edge using intensity data.

Parameter	Description
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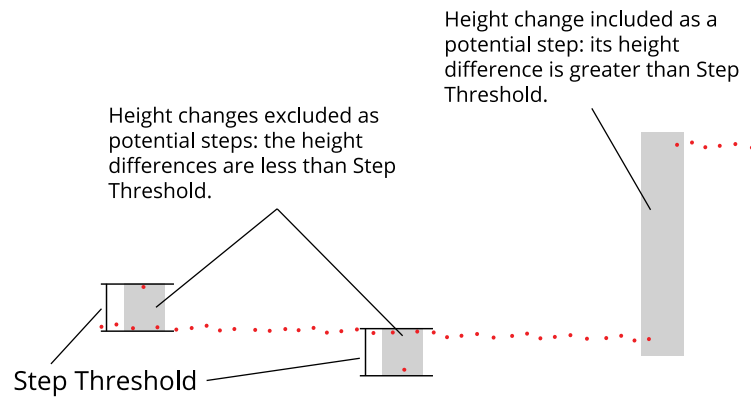


Use Intensity disabled (heightmap view of the same area): Surface Edge tool unable to find edge using height data.

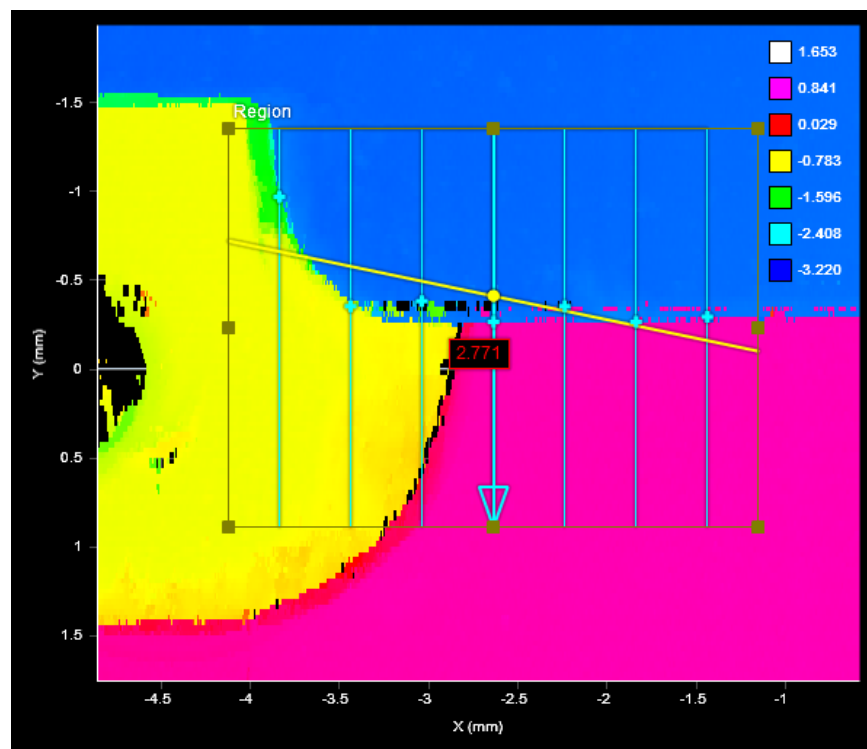
Search Direction	The search direction for steps, specified as an orientation around the Z axis, relative to the X axis. Can be 0, 90, 180, or 270 degrees. Choose a value that is roughly perpendicular to the edge on the target. The direction is indicated by a light blue arrow in the data viewer.
Path Spacing	Sets the spacing between paths in the measurement region used to extract the profiles that determine the edge. A higher number of paths results in a higher number of edge points, which makes the fitting of the edge line more accurate. However, a higher number of edge points results in a greater tool execution time. When Path Spacing is set to 0, the resolution of the scan data is used as the basis for spacing. No paths are displayed in the data viewer in this case.

Parameter	Description
Path Width	The size of the windows perpendicular to the path used to calculate an average for each data point on a path profile. Useful to average out noise along the path caused by reflections, and so on.  If Path Width is set to 0, no averaging is performed (only the data point under the path is used). For averaging along the path, use Step Smoothing (see below).
Selection Type	Determines which step the tool uses on each path profile when there are multiple steps in the profile. An edge point is placed on each chosen step. Steps must pass the criteria of the tool's Step Threshold and Step Direction settings. Best: Selects the greatest on each path profile. First: Selects the first step on each path profile. Last: Selects the last step on each path profile.
Step Direction	Determines whether the expected step rises or falls along the path. Either Rising, Falling, or Rising or Falling.

Parameter	Description
Step Threshold or Intensity Threshold	When Use Intensity is disabled, the setting specifies the minimum height difference between points on a path profile to be considered a step. Useful to exclude small height differences caused by noise, but also to exclude smaller steps on a part that should not be considered as steps.

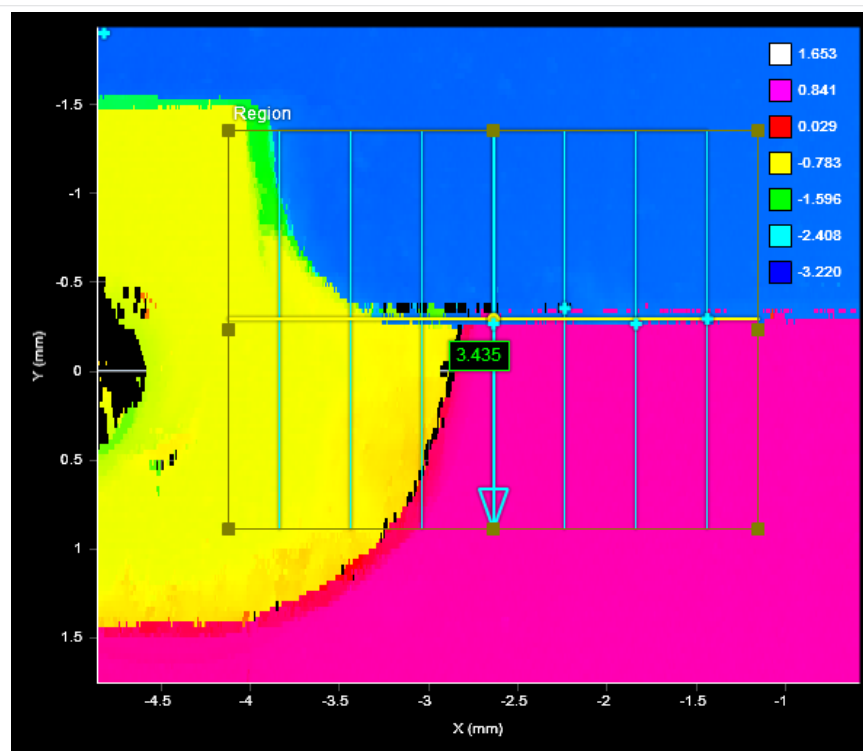


In the image below, when **Step Threshold** is left at the default of 0, all steps are included as possible candidates for an edge, and will be used to fit an edge line. The resulting edge line is angled upward to the left.



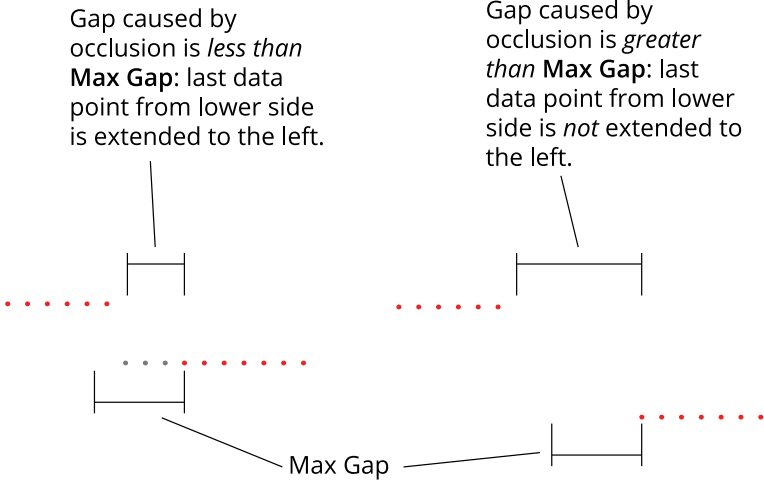
When **Step Threshold** is set to 3 with the same data (see image below), steps going from the yellow to pink regions (roughly 1.37 mm) and from the blue to yellow regions (roughly 2 mm) are excluded. Only steps from the blue to pink regions (roughly 3 mm) are included.

Parameter	Description
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When **Use Intensity** is enabled, this setting is labeled **Intensity Threshold** and differences in intensity are examined for step thresholding.

Parameter	Description
Step Smoothing	The size of the windows along the path used to calculate an average for each data point on a path profile. The setting is useful for averaging out noise. Step Smoothing Data points of varying height along the path within the window (grey points) are averaged to produce a path profile point (red point). If Step Smoothing is set to 0, no averaging is performed (only the data point under the path is used). For averaging perpendicular to the path, use Path Width (see above).
Step Width	The distance, along a path profile, separating the points used to find steps on a path profile. Step Width The setting is useful when you must detect a slope as an edge, rather than a sharply defined edge: setting Step Width to a value greater than the width of the edge ensures that the tool measures the height difference between the flat regions on either side of the edge. As a result, the height of the step is accurately measured, and the edge is correctly located.  Setting Step Width wider than necessary can reduce the precision of edge location.

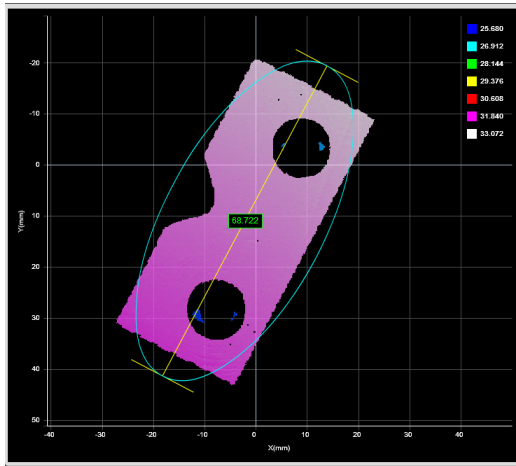
Parameter	Description
Max Gap	Fills in regions of missing data caused by an occlusion near the desired edge. Use this setting when continuity on the target is expected. When Max Gap is set to a non-zero value, the tool holds and extends the last data point on the low side next to an edge across a gap of null points, up to the distance specified in Max Gap.  Gap caused by occlusion is <i>less than</i> Max Gap: last data point from lower side is extended to the left. Gap caused by occlusion is <i>greater than</i> Max Gap: last data point from lower side is <i>not</i> extended to the left. Max Gap
Include Null Edges	Indicates whether null points (points where no height or intensity value is available, due to dropouts or regions outside of the measurement range) are filled with the value in Null Fill Value as a general “background level.” If Use Intensity (see above) is enabled, the intensity value in Intensity Null Fill Value is also used. A typical example is a discrete part produced by part detection of an object sitting on a flat background. The background is not visible in the part, so the tool assumes that any null region are at the background level. To find edges along a region of null points, you must use either this option and an appropriate value in Null Fill Value (and Intensity Null Fill Value if Use Intensity is enabled) or Max Gap. Otherwise, only edges within areas of contiguous data will be detected.
Null Fill Value	The height value (in mm) used to replace null points not filled by Max Gap when Include Null Edges is enabled.
Intensity Null Fill Value	The intensity value (0-255) used to replace null points when Include Null Edges and Use Intensity are enabled.
Show Detail	When disabled, hides the light blue path lines and edge points.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

Ellipse

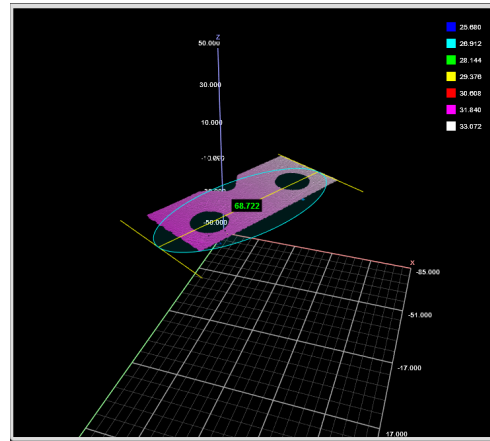
The Ellipse tool provides measurements for the major and minor axis lengths of an ellipse fitted to the part's shape in the XY plane, and also for the ratio of the major and minor axis lengths and for the

orientation angle of the ellipse. Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



2D View



3D View

ParametersAnchoring

Source:Top

Asymmetry Detection:None

☒ Region

MeasurementsFeatures

Major68.722☒

Minor☐

Ratio☐

Z Angle☐

ID:2

Output

Filters

Decision

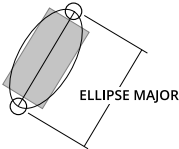
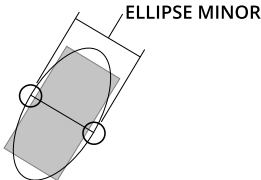
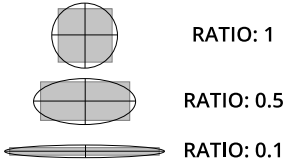
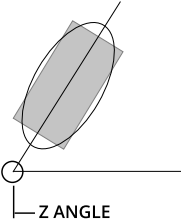
Min:68 mm

Max:69 mm

Measurement Panel

Measurements, Features, and Settings

Measurements

Measurement	Illustration
Major Determines the major axis length of an ellipse fitted to the part's area in the XY plane.	
Minor Determines the minor axis length of an ellipse fitted to the part's area in the XY plane.	
Ratio Determines the minor/major axis ratio of an ellipse fitted to the part's area in the XY plane.	
Z Angle Determines the orientation angle of an ellipse fitted to the part's area in the XY plane.	

Features

Type	Description
Center Point	The center point of the fitted ellipse.
Major Axis	A line representing the major axis of the fitted ellipse.
Minor Axis	A line representing the minor axis of the fitted ellipse.

 For more information on geometric features, see *Geometric Features* on page 127.

Parameters

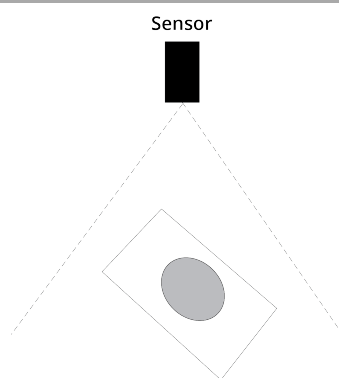
Parameter	Description
Asymmetry Detection	Resolves the orientation of an object over 360 degrees. The possible values are: 0 – None 1 – Along Major Axis 2 – Along Minor Axis
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

Hole

The Hole tool measures a circular opening within a region of interest on the surface and returns its position and radius.



The Hole tool does not search for or detect a hole. The tool expects that a hole conforming reasonably well to the defined parameters is present and that it is on a sufficiently uniform background.

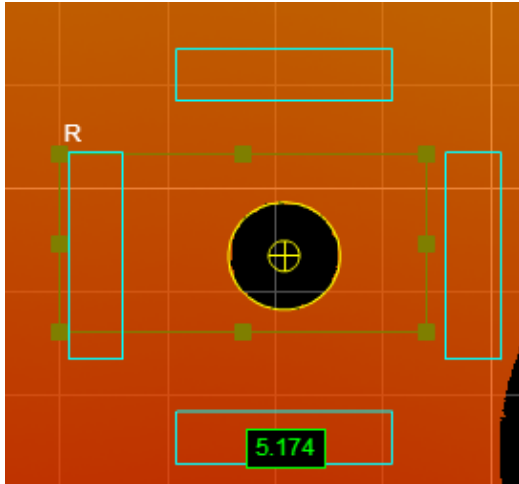


See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.

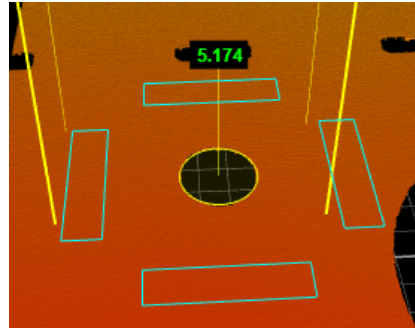
The hole can be on a surface at an angle to the sensor.

The tool uses a complex feature-locating algorithm to find a hold and then return measurements. See "Hole Algorithm" in the *Gocator Measurement Tool Technical Manual* for a detailed explanation of the algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.



2D View



3D View

Parameters
Advanced
Anchoring

Source: Top
Nominal Radius: 10 mm
Radius Tolerance: 5 mm
Partial Detection:
Depth Limit: 5 mm
☒ Region

Measurements
Features

X	5.174	☒
Y		☐
Z		☐
Radius		☐

ID: 3

Output

Filters
Decision

Min: 5 mm
Max: 5.2 mm

ParameterAdvancedAnchoring

☒ Reference Region

Auto Set

Tilt Correction

Auto Set

X

Y

Z

Radius

5.174

☒

Id:

10

Output

Filters

Decision

Min:

3 mm

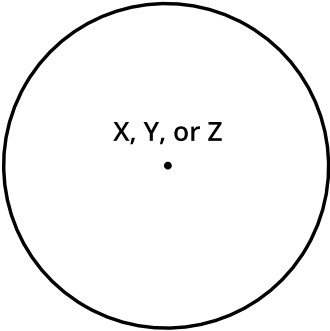
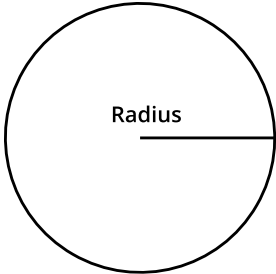
Max:

8 mm

Measurement Panel

Measurements, Features, and Settings

Measurements

Measurement	Illustration
X Determines the X position of the hole center.	
Y Determines the Y position of the hole center.	
Z Determines the Z position of the hole center.	
Radius Determines the radius of the hole.	

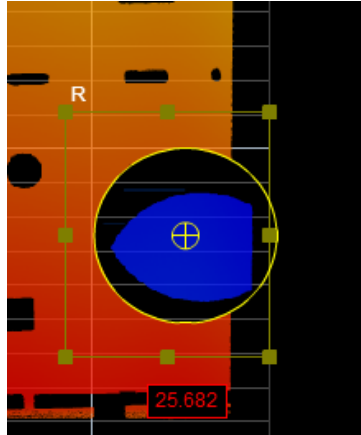
Features

Type	Description
Center Point	The center point of the hole. The Z position of the center point is at the Z position of the surrounding surface.

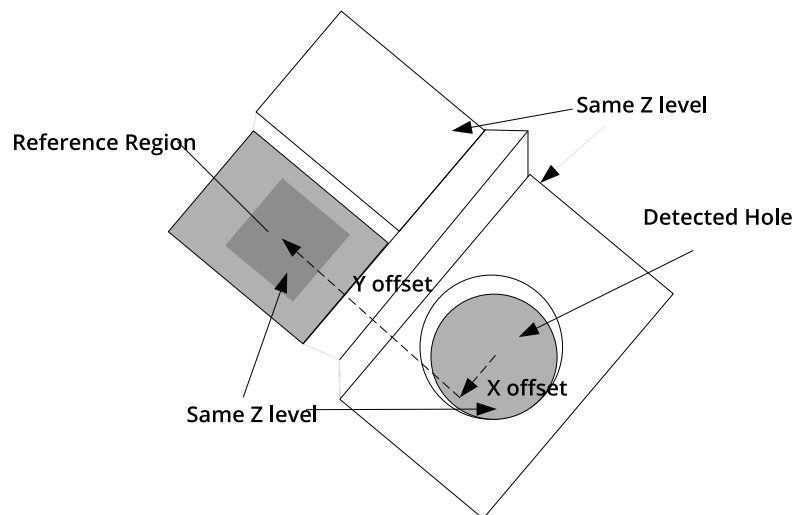
 For more information on geometric features, see *Geometric Features* on page 127.

Parameters

Parameter	Description
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 calculations.
Reference Regions	The algorithm uses the Reference Regions option to calculate the Z position of the hole. It is typically used in cases where the surface around the hole is not flat.



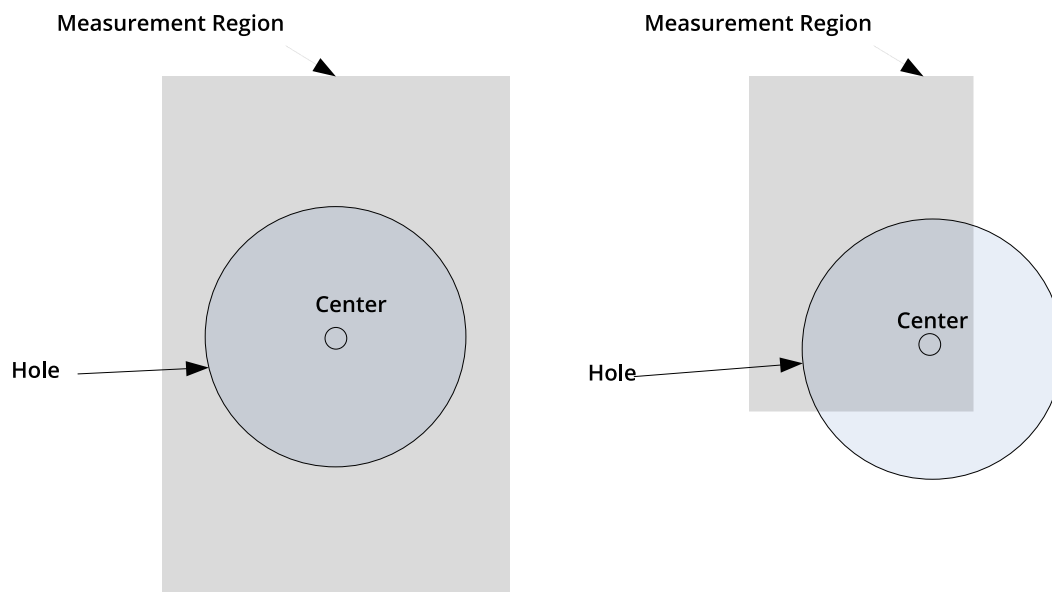
When this option is set to Autoset, the algorithm automatically determines the reference region. When the option is not set to Autoset, the user manually specifies the reference region. The location of the reference region is relative to the detected center of the hole and positioned on the nominal surface plane.

When the Reference Regions option 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.

Parameter	Description
Tilt Correction	Tilt of the target with respect to the alignment plane. When this option is set to Autoset, the tool automatically detects the tilt. Otherwise, the user must enter the angles manually. Autoset requires the measurement region to cover more areas on the surface plane than other planes. The results from the Plane X and Y tool can be used for angles X and Y parameters.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

Measurement Region

The center of the hole must be inside the measurement region, even if the Partial Detection option is enabled.



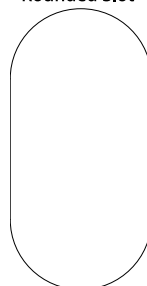
Opening

The Opening tool locates rounded, rectangular, and rounded corner openings. The opening can be on a surface at an angle to the sensor.

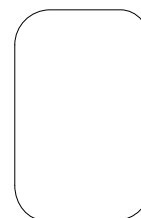


The Opening tool does not search for or detect an opening. The tool expects that an opening conforming reasonably well to the defined parameters is present and that it is on a sufficiently uniform background.

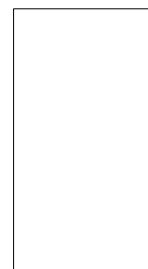
Rounded Slot



Rounded Corner Slot



Rectangular Slot

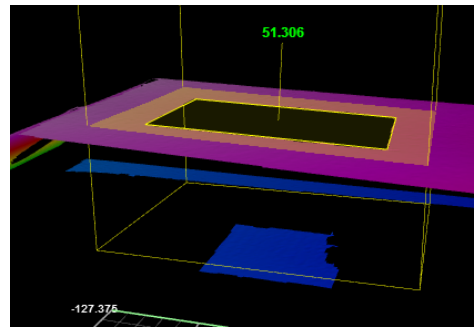


See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.

The tool uses a complex feature-locating algorithm to find a hold and then return measurements. See "Opening Algorithm" in the *Gocator Measurement Tool Technical Manual* for a detailed explanation of the algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

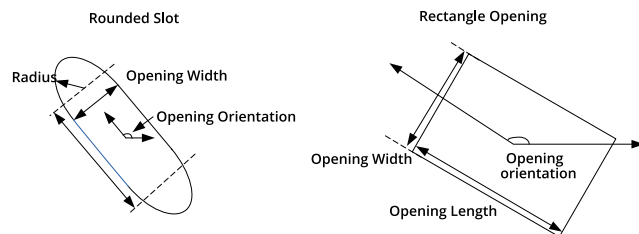
Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128. You can select the measurement region in which the opening is expected to appear.

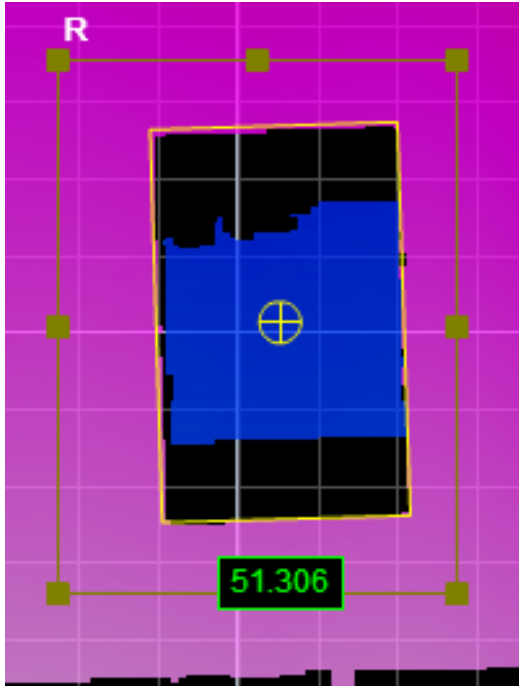
The algorithm can separate out background information that appears inside the opening. It can also detect a slot that only partially appears in the data.



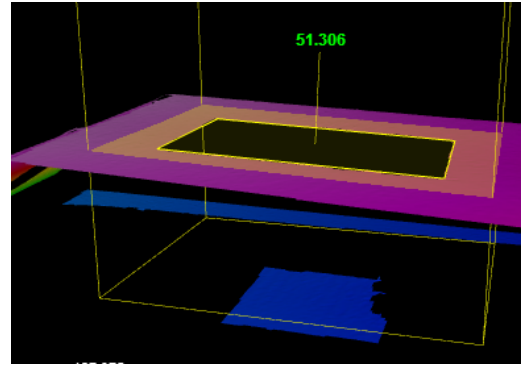
The shape of the opening is defined by its type and its nominal width, length, and radius.

The orientation defines the rotation around the normal of the alignment plane.





2D View



3D View

Parameters
Advanced
Anchoring

Source:
Top

Type:
Rectangle

Nominal Width:
30
mm

Nominal Length:
45
mm

Nominal Angle:
90
°

Nominal Radius:
5
mm

Width Tolerance:
10
mm

Length Tolerance:
10
mm

Angle Tolerance:
5
°

Partial Detection:
☐

☐ Depth Limit:
5
mm

☒ Region

Measurements
Features

X
☐

Y
☐

Z
☐

Width
☐

Length
51.306
☒

Angle
☐

ID:
5

Output

Filters

Decision

Min:
50
mm

Max:
60
mm

ParameterAdvancedAnchoring

Reference Region

Auto Set

Tilt Correction

Auto Set

X

Y

Z

Width

Length

Angle

51.306

Id:

11

Output

Filters

Decision

Min:

50 mm

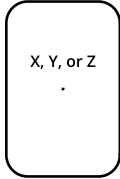
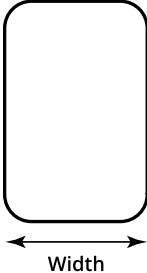
Max:

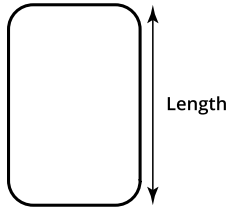
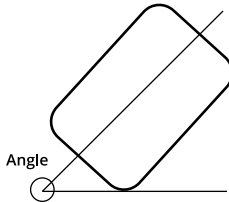
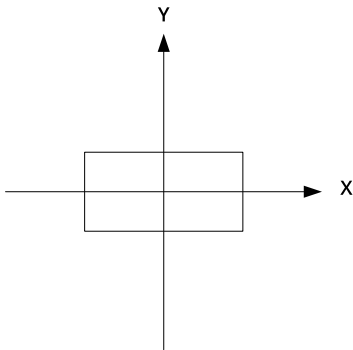
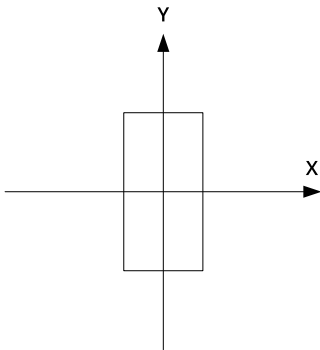
60 mm

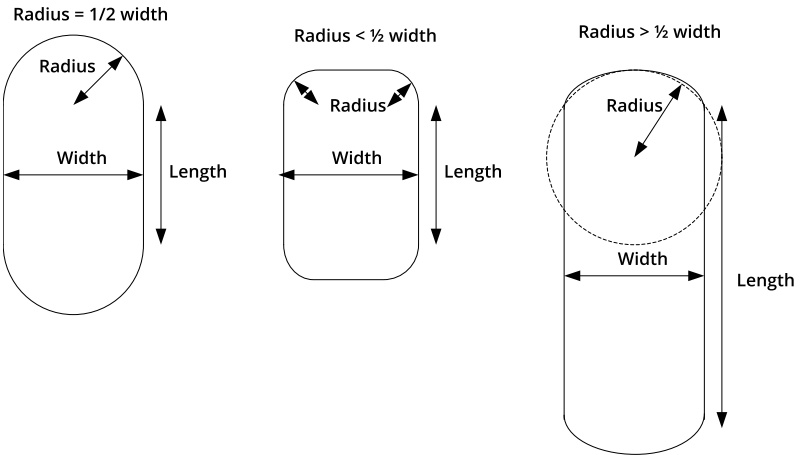
Measurement Panel

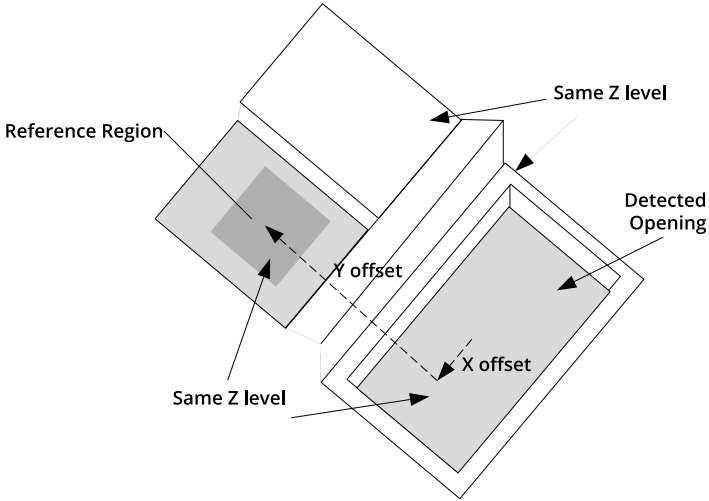
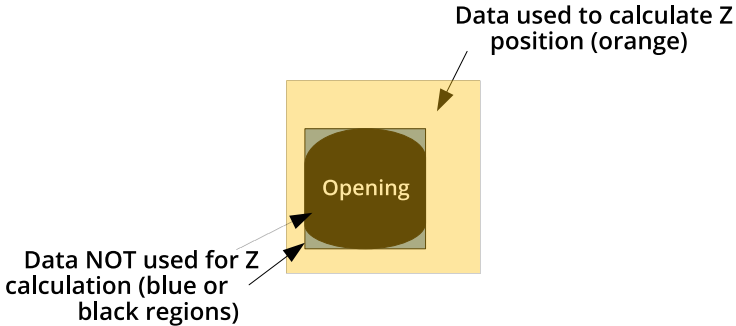
Measurements, Features, and Settings

Measurements

Measurement	Illustration
X Determines the X position of the opening's center.	
Y Determines the Y position of the opening's center.	
Z Determines the Z position of the opening's center.	
Width Determines the width of the opening.	

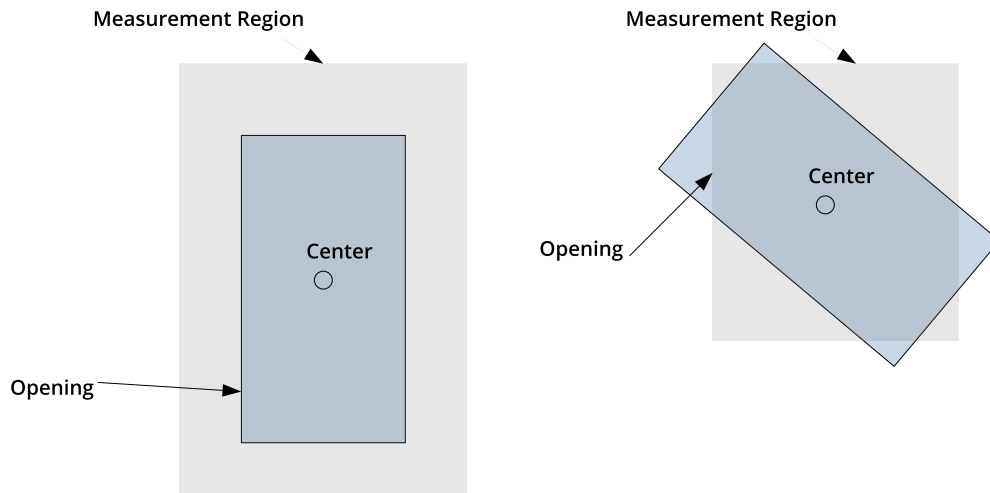
Measurement	Illustration
Length Determines the length of the opening.	
Angle Determines the angle (rotation) around the normal of the alignment plane.	
Features	
Type	Description
Center Point	The center point of the opening. The Z position of the center point is at the Z position of the surrounding surface.
 For more information on geometric features, see <i>Geometric Features</i> on page 127.	
Parameters	
Parameter	Description
Type	Rounded Slot, Rectangle.
Nominal Width	Nominal width of the opening.
Nominal length	Nominal length of the opening.
Nominal Angle	Nominal angle of the opening. The default orientation is the length of the opening along the X axis.
Orientation: 0 degrees  Orientation: 90 degrees 	
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	

Parameter	Description
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 $\frac{1}{2}$ of the width. The opening is a rounded rectangle when the radius is less than $\frac{1}{2}$ 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).
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 opening calculations.

Parameter	Description
Reference Regions	The algorithm uses reference regions to calculate the Z position of the 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 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 region, the algorithm calculates the Z positions as the average values of the data within the regions. When the user places the reference region manually, all of the data is used, whether the data is inside or outside the opening. The user should place the reference region carefully.
Tilt Correction	Tilt of the target with respect to the alignment plane. Set to Auto-Set to have the tool automatically detect the target's tilt, or enter the angles manually. Auto-Set requires the measurement region to cover more areas on the surface plane than other planes. The results from the Plane X and Y tool can be used for angles X and Y parameters.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

Measurement Region

The center and the two sides and ends of the opening must be within the measurement region, even if Partial Detection is enabled.



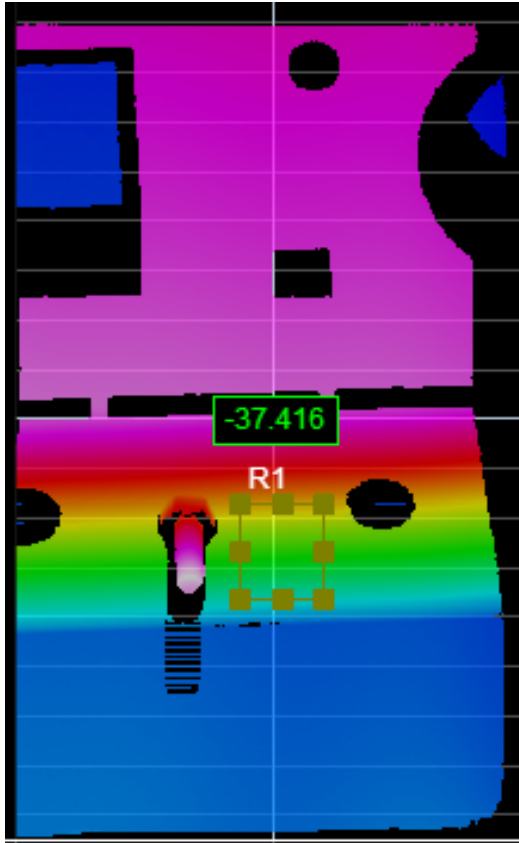
Plane

The Plane tool provides measurements that report angle X, angle Y, and offset Z of the surface with respect to the alignment target. Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

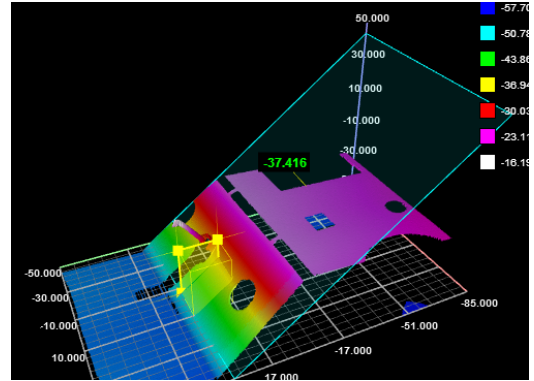
See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.

The Z offset reported is the Z position at zero position on the X axis and the Y axis.

The results of the Plane Angle X and Plane Angle Y measurements can be used to customize the tilt angle in the Hole, Opening, and Stud tools.



2D View



3D View

ParameterAnchoring

Source:

Top

Regions

1 Region

X Angle

-37.416

Y Angle

Z Offset

Standard Deviation

Min Error

Max Error

Id:

5

Output

Filters

Decision

Min:

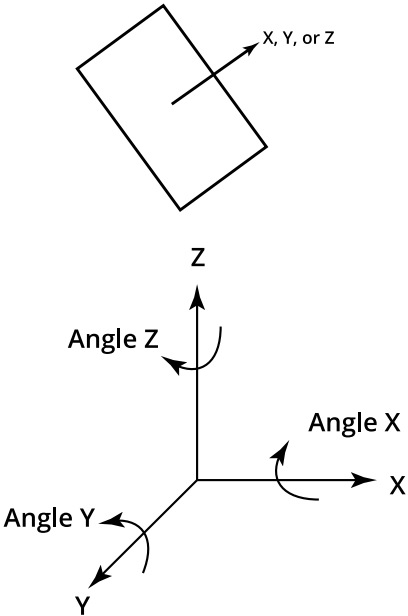
-38 mm

Max:

0 mm

Measurement Panel

Measurements

Measurement	Illustration
Angle X Determines the X angle of the surface with respect to the alignment target.	
Angle Y Determines the Y angle of the surface with respect to the alignment target.	
Offset Z Determines the Z offset of the surface with respect to the alignment target.	
Standard Deviation Measures the standard deviation of the points of the surface from the detected plane.	
Min Error Measures the minimum error from the detected plane (the maximum distance below the plane, perpendicular to the plane).	
Max Error Measures the maximum error from the detected plane (the maximum distance above the plane, perpendicular to the plane).	
X Normal Returns the X component of the surface normal vector.	
Y Normal Returns the Y component of the surface normal vector.	
Z Normal Returns the Z component of the surface normal vector.	
Distance Distance from the origin to the plane.	

Parameters

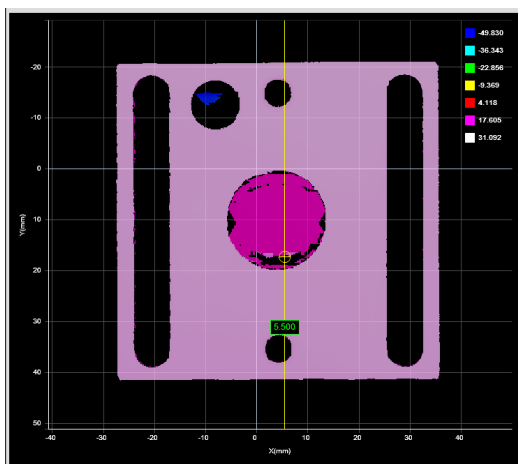
Parameter	Description
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

Position

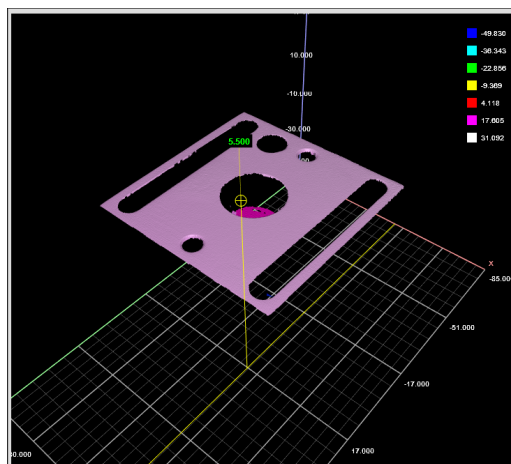
The Position tool reports the X, Y, or Z position of a part. The feature type must be specified and is one of the following: Average (the mean X, Y, and Z of the data points), Median (median X, Y, and Z of the data points), Centroid (the centroid of the data considered as a volume with respect to the $z = 0$ plane), Min X, Max X, Min Y, Max Y, Min Z, or Max Z.

Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



2D View



3D View

ParametersAnchoring

Source:Top
FeatureMax Z

MeasurementsFeatures

X5.500
Y
Z

ID:

6

Output

Filters

Decision

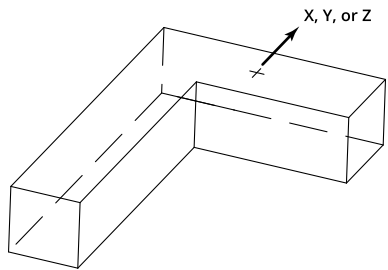
Min:5 mm

Max:6 mm

Measurement Panel

Measurements, Features, and Settings

Measurements

Measurement	Illustration
X Determines the X position of the selected feature type.	
Y Determines the Y position of the selected feature type.	
Z Determines the Z position of the selected feature type.	

Features

Type	Description
Center Point	The returned position.


For more information on geometric features, see *Geometric Features* on page 127.

Parameters

Parameter	Description
Feature Type	One of the following: Average, Centroid, Min X, Max X, Min Y, Max Y, Min Z, Max Z, Median.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

Stud

The Stud tool measures the location and radius of a stud.



The Stud tool does not search for or detect a stud. The tool expects that a stud conforming reasonably well to the defined parameters is present and that it is on a sufficiently uniform background.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.

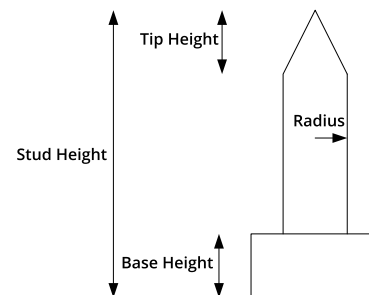
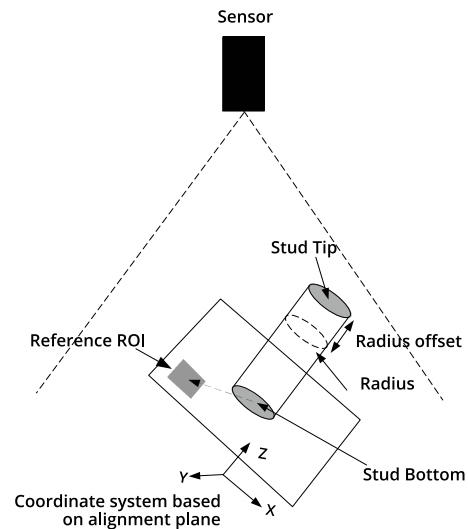
The tool uses a complex feature-locating algorithm to find a stud and then return measurements. See "Stud Algorithm" in the *Gocator Measurement Tool Technical Manual* for a detailed explanation of the algorithm.

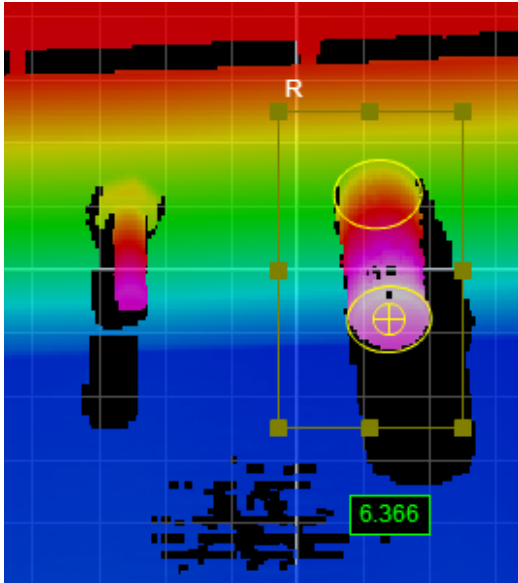
The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

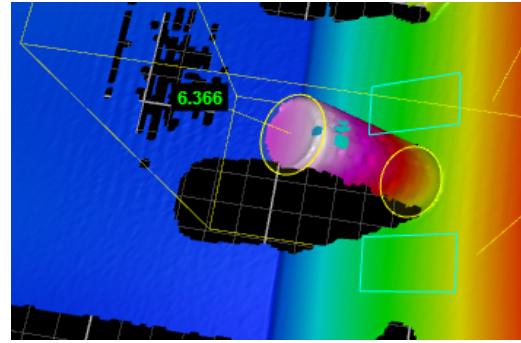
The location of the stud is defined at either the stud tip or the stud base. The tip is the intersection of the stud axis and the top of the stud; the base is the intersection of the stud axis and the surrounding plane.

The stud shape is defined by the tip height and base height. The base and tip heights specify where the shaft with the nominal radius begins and ends.





2D View



3D View

Parameters
Advanced
Anchoring

Source:
Top

Stud Radius:
5 mm

Stud Height:
20 mm

Base Height:
0 mm

Tip Height:
0 mm

☒ Region

Measurements
Features

Base X
Base Y
Base Z
Tip X
Tip Y
Tip Z
Radius
6.366

ID:
8

Parameters
Output

Filters

Decision

Min:
6.25 mm

Max:
6.4 mm

ParameterAdvancedAnchoring

Reference Region

Auto Set

Tilt Correction

Auto Set

Base X

Base Y

Base Z

Tip X

Tip Y

Tip Z

Radius

Id:

13

Parameters

Output

Radius Offset:

0 mm

Measurement Panel

Measurements, Features, and Settings

Measurements

Measurement	Illustration
Tip X Determines the X position of the stud tip.	
Tip Y Determines the Y position of the stud tip.	
Tip Z Determines the Z position of the stud tip.	
Base X Determines the X position of the stud base.	
Base Y Determines the Y position of the stud base.	
Base Z Determines the Z position of the stud base.	
Radius Determines the radius of the stud.	

Features

Type	Description
Tip Point	The center point of the tip of the stud.
Base Point	The center point of the base of the stud.



For more information on geometric features, see *Geometric Features* on page 127.

Parameters

Parameter	Description
Nominal Stud Radius	Expected radius of the stud.
Nominal Stud Length	Expected 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.
Radius Offset	The distance from the tip of the stud from which the radius is measured.
<i>(Radius measurement only)</i>	
Reference Regions	The algorithm uses 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. Set to Auto-Set to have the tool automatically detect the tilt, or enter the angles manually. Auto-Set requires the measurement region to cover more areas on the surface plane than other planes. The results from the Plane X and Y tool can be used for angles X and Y parameters.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

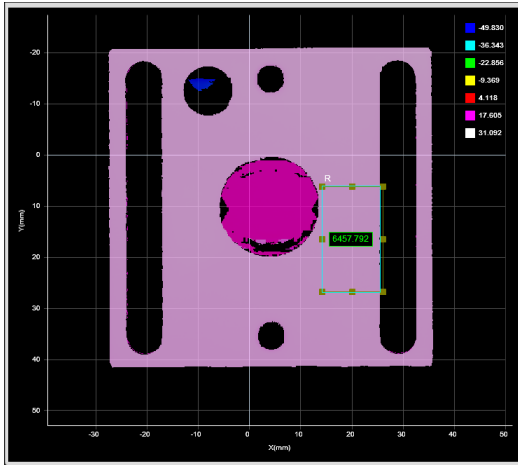
Measurement Region

The tip and the side of the stud must be within the measurement region.

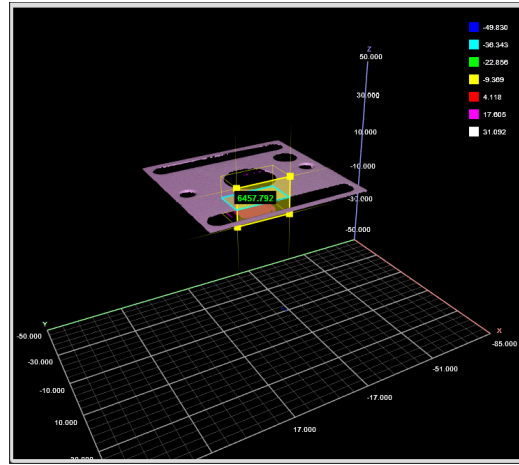
Volume

The Volume tool determines the volume, area, and thickness of a part. Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



2D View



3D View

ParametersAnchoring

Source:Top

☒ Region

Volume6457.792☒

Area☐

Thickness☐

Id:8

Output

Filters

Decision

Min:6540 mm³

Max:6560 mm³

Measurement Panel

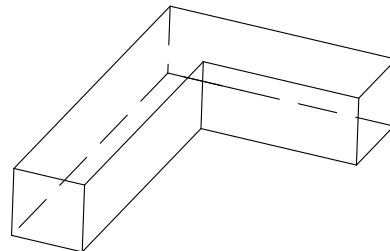
Measurements

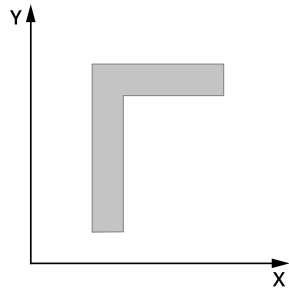
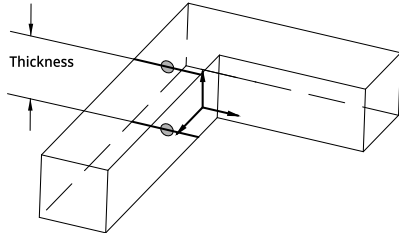
Measurement

Volume

Measures volume in XYZ space.

Illustration



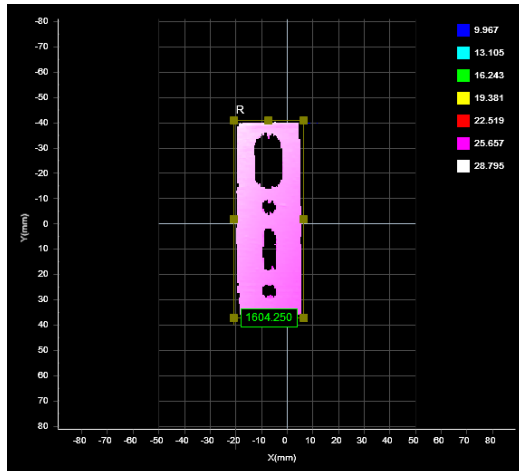
Measurement	Illustration
Area Measures area in the XY plane.	
Thickness Measures thickness (height) of a part.	
Parameters	
Parameter	Description
Location <i>(Thickness measurement only)</i>	One of the following: maximum height, minimum height, average height, median height, the height at the 2D centroid in the XY plane, or the height at the 3D centroid in XYZ space.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

Script

A Script measurement can be used to program a custom measurement using a simplified C-based syntax. A script measurement can produce multiple measurement values and decisions for the output.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.

See *Scripts* on page 228 for more information on scripts.



Code

```

1 double VolumeArea = Measurement_Value(4);
2
3 if (Measurement_Valid(4))
4 {
5     Output_Set(VolumeArea + 10000, 1);
6 }
7 else
8 {
9     Output_SetAt(0, 0);
10 }

```

*Press save button or 'Ctrl+S' to apply change.
Press 'Esc' to exit full screen.

Output:

Add

Output 0 1604.250

Id: 0

See *Scripts* on page 228 for more information on the script syntax.

To create or edit a Script measurement:

1. Add a new Script tool or select an existing Script measurement.
2. Edit the script code.
3. Add script outputs using the **Add** button.
For each script output that is added, an index will be added to the **Output** drop-down and a unique ID will be generated.
To remove a script output, click on the  button next to it.
4. Click the **Save** button  to save the script code.
If there is a mistake in the script syntax, the result will be shown as a "Invalid" with a red border in the data viewer when you run the sensor.
Outputs from multiple measurement tools can be used as inputs to the script. A typical script would take results from other measurement tools using the value and decision function, and output the result using the output function. Stamp information, such as time and encoder stamps, are available in the script, whereas the actual 3D point cloud data is not. (The script engine is not powerful enough to process the data itself.) Only one script can be created.

Feature Measurement

The following sections describe Gocator's Feature tools.

Feature tools produce measurements based on more complex geometry, letting you implement applications more quickly by reducing dependence on writing scripts to accomplish these kinds of measurements. Feature tools take [geometric features](#) generated by other tools as input and perform measurements on those features.

Feature tools are available in either Profile or Surface mode.

Dimension

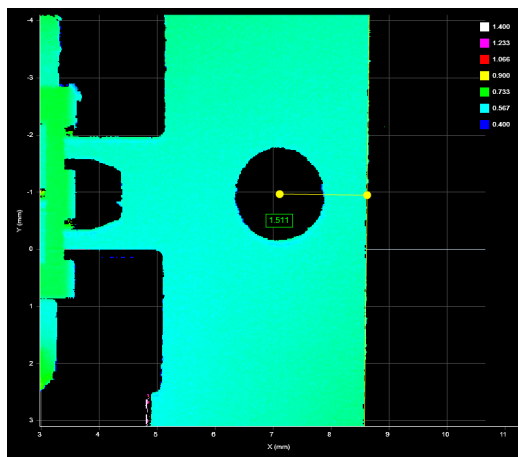
The Feature Dimension tool provides dimensional measurements that you can apply to geometric features generated by Profile or Surface tools.

Some examples:

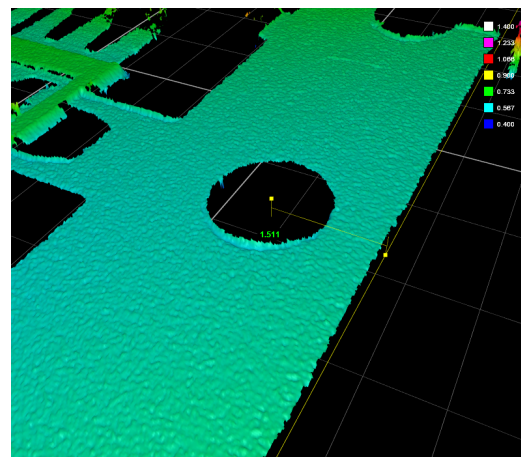
- Measuring the distance between the center of a hole and an edge.
- Measuring the distance between the centers of two holes.
- Obtaining the length of a stud by measuring the distance between its tip and base.

Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



2D View



3D View

Parameters

PointSurface Hole/Center Point
Reference FeatureSurface Edge/Edge Line

Width
Length
Height
Distance
Plane Distance1.511

ID:4

ParametersOutput

Filters

Decision

Min:1.5 mm
Max:1.55 mm

Measurement Panel

Measurements

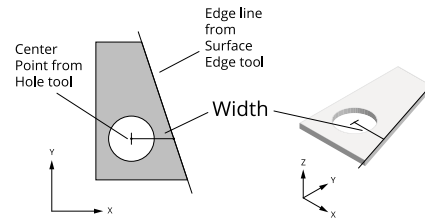
Measurement

Illustration

Width

Point-point: Separation, along and parallel to the X axis, between two point geometric features.

Point-line: Separation, along and parallel to the X axis, between a point geometric feature (**Point** setting) and the intersection of a line extending from that point along the X axis and the line geometric feature selected in the **Reference Feature** setting.

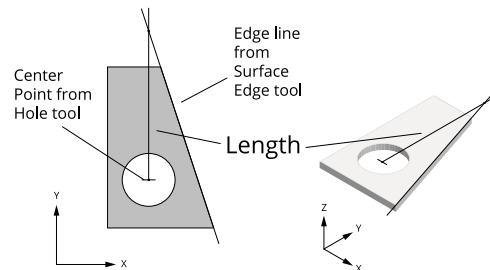


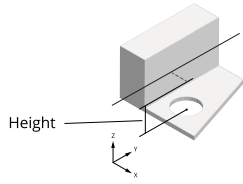
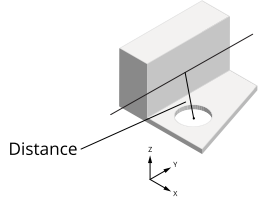
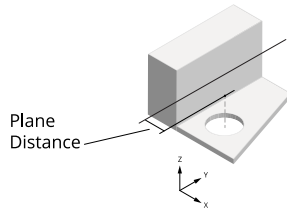
Length

Point-point: Separation, along and parallel to the Y axis, between two point geometric features.

Point-line: Separation, along and parallel to the Y axis, between a point geometric feature (**Point** setting) and the intersection of a line extending from that point along the Y axis and the line geometric feature selected in the **Reference Feature** setting.

For profiles, always 0.



Measurement	Illustration
Height <i>Point-point:</i> Separation, along and parallel to the Z axis, between two point geometric features. <i>Point-line:</i> Separation, along and parallel to the Z axis, between a point geometric feature (Point setting) and the Z position of the center of the line geometric feature selected in the Reference Feature setting.	
Distance <i>Point-point:</i> The direct, Euclidean separation between two point geometric features. <i>Point-line:</i> The direct, Euclidean separation between a point geometric feature (Point setting) and the intersection of a line extending from that point and the line geometric feature selected in Reference Feature.	
Plane Distance <i>Point-point:</i> The distance between two point geometric features, projected onto the XY plane (for surfaces) or the XZ plane (for profiles). <i>Point-line:</i> The distance between a point geometric feature (Point setting) and the intersection of a line extending from that point and the line geometric feature selected in Reference Feature, projected onto the XY plane (for surfaces) or the XZ plane (for profiles).	
Parameters	
Parameter	Description
Point	A point geometric feature generated by another tool.
Reference Feature	A point or line geometric feature generated by another tool. Dimensional measurements are calculated <i>from</i> the reference feature <i>to</i> the point in the Point setting.
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

Intersect

The Feature Intersect tool returns the intersection of the specified line [geometric features](#) projected onto the Z = reference Z line plane for features extracted from a surface, and the intersection of the lines projected onto the Y = 0 plane for features extracted from a profile. The angle measurement between the two lines is also returned. The lines the tool takes as input are generated by other tools, such as [Surface Edge](#) or [Surface Ellipse](#).

The Feature Intersect tool saves you from having to write complicated calculations in [script tools](#) to find intersect point between lines. Previously, calculating the intercept point of two lines was difficult and prone to bugs, involving finding lines in indirect ways.

The Feature Intersect tool's positional measurements are particularly useful as anchor sources. For example, you can easily find a corner point on a part from two edges (produced by two Surface Edge tools) and using the X and Y positions as anchor sources.

When you use these positional anchors in combination with a Z Angle anchor from tools such as Surface Edge, you can achieve extremely robust, repeatable measurements.



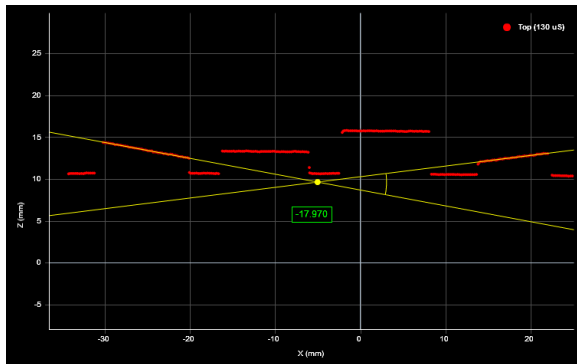
This tool's Angle measurement cannot be used as an angle anchor source. Only Z Angle measurements can be used as angle anchor sources.

For more information on anchoring, see *Measurement Anchoring* on page 131.

The Feature Intersect tool can also generate a point [geometric feature](#) representing the point of intersection of the lines that the [Feature Dimension](#) tool can use in measurements.

Gocator compares the measurement value with the values in **Min** and **Max** to yield a decision. For more information on decisions, see *Decisions* on page 128.

See *Adding and Configuring a Tool* on page 120 for instructions on how to add measurement tools.



Parameters

Line: Profile Line - Left/Line

Reference Line: Profile Line - Right/Line

Measurements Features

X ☐

Y ☐

Z ☐

Angle -17.970 ☒

ID: 3

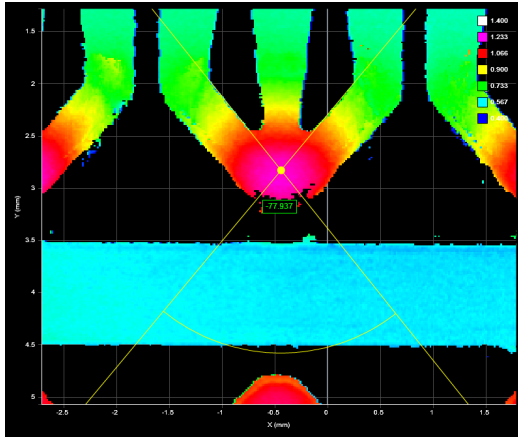
Parameters Output

Filters

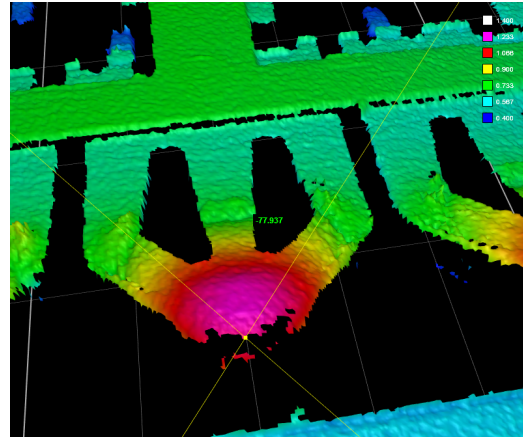
Decision

Min: -18 mm

Max: -17.9 mm



2D View



3D View

Parameters

Line

Surface Edge Left/Edge Line

Reference Line

Surface Edge Right/Edge Line

Measurements

Features

X

☐

Y

☐

Z

0.473

☒

Angle

-77.937

☒

ID:

3

Parameters

Output

Filters

Decision

Min:

-78 mm

Max:

-77.9 mm

Measurement Panel

Measurements

Measurement

X

The X position of the intersect point the lines in **Line** and **Reference Line**.

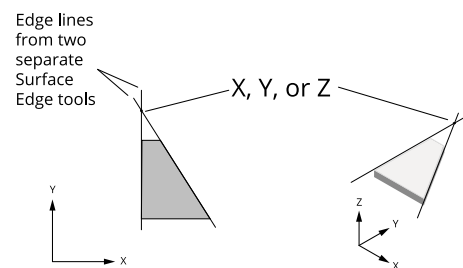
Y

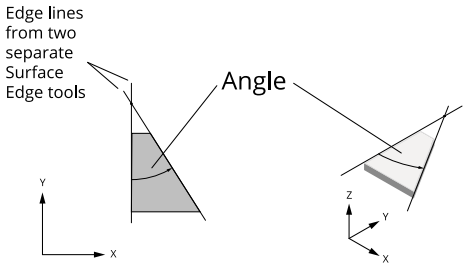
The Y position of the intersect point the lines in **Line** and **Reference Line**.

Z

The Z position of the intersect point the lines in **Line** and **Reference Line**.

Illustration



Measurement	Illustration
Angle The angle between the lines, as measured from the line geometric feature selected in Reference Line to the one selected in Line .	 Edge lines from two separate Surface Edge tools Angle

Features

Type	Description
Intersect Point	The intersect point of the two edge lines.

Parameters

Parameter	Description
Line	A line geometric feature generated by another tool.
Reference Line	A line geometric feature generated by another tool. For the Angle measurement, the angle is measured <i>from</i> the reference line.
Angle Range (Angle measurement only)	Determines the angle range. The options are: -180 – 180 0 – 360
Decision	See <i>Decisions</i> on page 128.
Region	See <i>Regions</i> on page 121.
Output	See <i>Filters</i> on page 129.

Scripts

Scripts use outputs from other measurement tools to produce custom measurements.

Similar to other measurement tools, a script measurement can output multiple measurement values and decisions. Scripts are added, configured, and removed much like other measurement tools; for more information on this, see *Script* under *Profile Measurement* on page 139 or *Surface Measurement* on page 169.



Scripts must be less than 27,000 characters long.

Scripts use a simplified C-based syntax. The following elements of the C language are supported:

Supported Elements

Elements	Supported
Control Operators	if, while, do, for, switch and return.

Elements	Supported
Data Types	char, int, unsigned int, float, double, long long (64-bit integer).
Arithmetic and Logical Operator	Standard C arithmetic operators, except ternary operator (i.e., "condition? trueValue: falseValue"). Explicit casting (e.g., int a = (int) a_float) is not supported.
Function Declarations	Standard C function declarations with argument passed by values. Pointers are not supported.

Built-in Functions

Measurement Functions

Function	Description
int Measurement_Exists(int id)	Determines if a measurement exists by ID. Parameters: id – Measurement ID Returns: 0 – measurement does not exist 1 – measurement exists
int Measurement_Valid(int id)	Determines if a measurement value is valid by its ID. Parameters: id - Measurement ID Returns 0 - Measurement is invalid 1 - Measurement is valid
double Measurement_Value (int id)	Gets the value of a measurement by its ID. Parameters: id - Measurement ID Returns: Value of the measurement 0 – if measurement does not exist 1 – if measurement exists
int Measurement_Decision (int id)	Gets the decision of a measurement by its ID. Parameters: ID - Measurement ID Returns: Decision of the measurement 0 – if measurement decision is false 1 – If measurement decision is true
int Measurement_NameExists(char* toolName, char* measurementName)	Determines if a measurement exist by name. Parameter:

Function	Description
	toolName – Tool name measurementName – Measurement name Returns: 0 – measurement does not exist 1 – measurement exists
int Measurement_Id (char* toolName, char* measurementName)	Gets the measurement ID by the measurement name. Parameters: toolName – Tool name measurementName – Measurement name Returns: -1 – measurement does not exist Other value – Measurement ID

Output Functions

Function	Description
void Output_Set (double value, int decision)	Sets the output value and decision on Output index 0. Only the last output value / decision in a script run is kept and passed to the Gocator output. To output an invalid value, the constant INVALID_VALUE can be used (e.g., Output_SetAt(0, INVALID_VALUE, 0)) Parameters: value - value output by the script decision - decision value output by the script. Can only be 0 or 1
void Output_SetAt(unsigned int index, double value, int decision)	Sets the output value and decision at the specified output index. To output an invalid value, the constant INVALID_VALUE can be used (e.g., Output_SetAt(0, INVALID_VALUE, 0)) Parameters: index – Script output index value – value output by the script decision – decision value output by the script. Can only be 0 or 1
void Output_SetId(int id, double value, int decision)	Sets the output value and decision at the specified script output ID. To output an invalid value, the constant INVALID_VALUE can be used (e.g., Output_SetId(0, INVALID_VALUE, 0)) Parameters: id – Script output ID

Memory Functions

Function	Description
void Memory_Set64s (int id, long long value)	Stores a 64-bit signed integer in persistent memory. Parameters:

Function	Description
	id - ID of the value value - Value to store
long long Memory_Get64s (int id)	Loads a 64-bit signed integer from persistent memory. Parameters: id - ID of the value Returns: value - Value stored in persistent memory
void Memory_Set64u (int id, unsigned long long value)	Stores a 64-bit unsigned integer in the persistent memory Parameters: id - ID of the value value - Value to store
unsigned long long Memory_Get64u (int id)	Loads a 64-bit unsigned integer from persistent memory. Parameters: id - ID of the value Returns: value - Value stored in persistent memory
void Memory_Set64f (int id, double value)	Stores a 64-bit double into persistent memory. Parameters: id - ID of the value value - Value to store
double Memory_Get64f (int id)	Loads a 64-bit double from persistent memory. All persistent memory values are set to 0 when the sensor starts. Parameters: id - ID of the value Returns: value - Value stored in persistent memory
int Memory_Exists (int id)	Tests for the existence of a value by ID. Parameters: id – Value ID Returns: 0 – value does not exist 1 – value exists
void Memory_Clear (int id)	Erases a value associated with an ID. Parameters: id – Value ID
void Memory_ClearAll()	Erases all values from persistent memory

Runtime Variable Functions

Function	Description
int RuntimeVariable_Count()	Returns the number of runtime variables that can be accessed. Returns: The count of runtime variables.
int RuntimeVariable_Get32s(int id)	Returns the value of the runtime variable at the given index. Parameters: Id – ID of the runtime variable Returns: Runtime variable value

Stamp Functions

Function	Description
long long Stamp_Frame()	Gets the frame index of the current frame.
long long Stamp_Time()	Gets the time stamp of the current frame.
long long Stamp_Encoder()	Gets the encoder position of the current frame.
long long Stamp_EncoderZ()	Gets the encoder index position of the current frame.
unsigned int Stamp_Inputs()	Gets the digital input state of the current frame.

Math Functions

Function	Description
float sqrt(float x)	Calculates square root of x
float sin(float x)	Calculates sin(x) (x in radians)
float cos(float x)	Calculates cos(x) (x in radians)
float tan(float x)	Calculates tan(x) (x in radians)
float asin(float x)	Calculates asin(x) (x in radians)
float acos(float x)	Calculates acos(x) (x in radians)
float atan(float x)	Calculates atan(x) (x in radians)
float pow (float x, float y)	Calculates the exponential value. x is the base, y is the exponent
float fabs(float x)	Calculates the absolute value of x

Example

The following example shows how to create a custom measurement that is based on the values from other measurements. The example calculates the 3-Dimensional Euclidean distance between the center of a hole and the center of the base of a nearby stud, then checks decision limits on this metric before sending the output.

```
/* Calculate the 3-Dimensional Euclidean distance between two points in 3D space*/
```

```

/* Retrieve 3D coordinate from Hole X, Y and Z tools (assumes these tools have been
configured as ID 0, ID 1 and ID 2 respectively) */
double HoleX = Measurement_Value(0);
double HoleY = Measurement_Value(1);
double HoleZ = Measurement_Value(2);

/* Retrieve 3D coordinate from StudBase X, Y and Z tools (assumes these tools have been
configured as ID 3, ID 4 and ID 5 respectively) */
double StudX = Measurement_Value(3);
double StudY = Measurement_Value(4);
double StudZ = Measurement_Value(5);

/* Calculate distance between points in 3D space */
double Distance = sqrt((HoleX - StudX)*(HoleX - StudX) + (HoleY - StudY)*(HoleY - StudY)
+ (HoleZ - StudZ)*(HoleZ - StudZ));

/* Min and Max Decision Limits */
/* Note that measurement values are in the unit of thousands of a millimeter in the
script */
/* In this example the distance is considered good if it's between 17.9 mm and 18.1 mm */
double MinDecisionLimit = 17.900;
double MaxDecisionLimit = 18.100;

if (Distance > MinDecisionLimit && Distance < MaxDecisionLimit)
{
    Output_Set(Distance, 1);
}
else
{
    Output_Set(Distance, 0);
}

```

Output

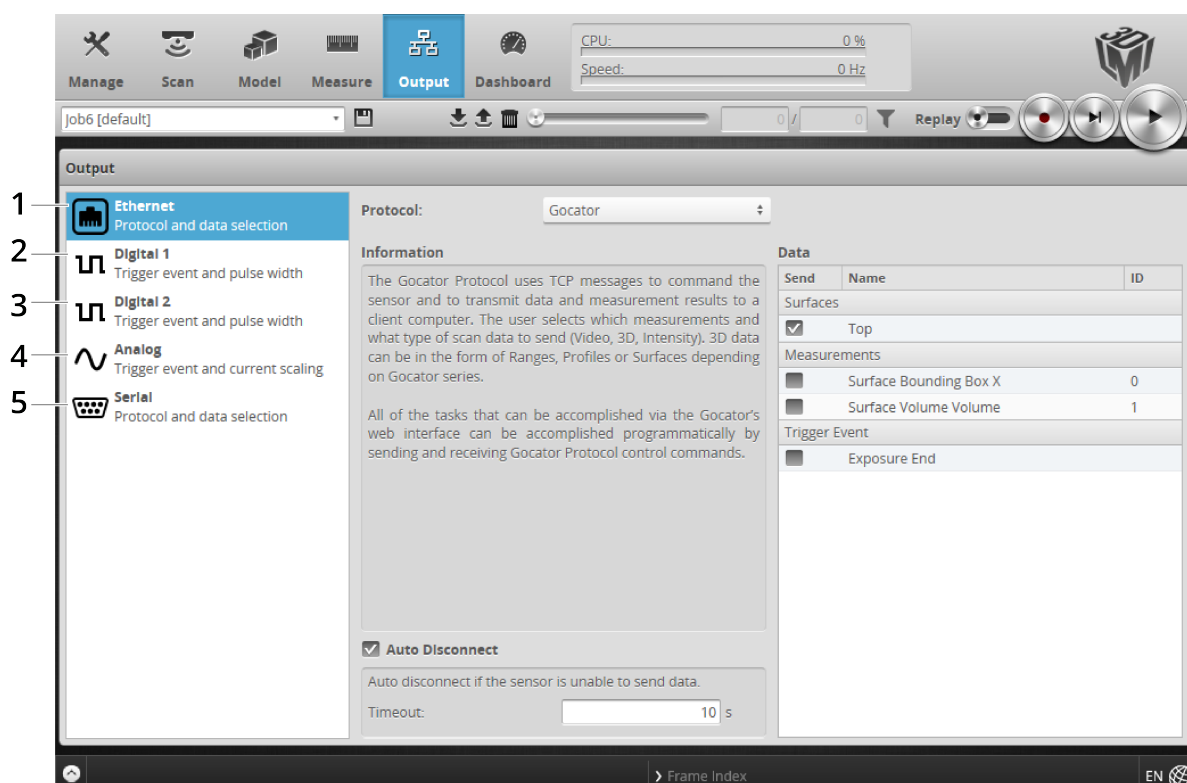
The following sections describe the **Output** page.

Output Page Overview

Output configuration tasks are performed using the **Output** page. Gocator sensors can transmit 3D point cloud data and measurement results to various external devices using several output interface options.



Up to two outputs can have scheduling enabled with ASCII as the Serial output protocol. When Selcom is the current Serial output protocol, only one other output can have scheduling enabled.



Category	Description
1 Ethernet	Used to select the data sources that will transmit data via Ethernet. See <i>Ethernet Output</i> on the next page.
2 Digital Output 1	Used to select the data sources that will be combined to produce a digital output pulse on Output 1. See <i>Digital Output</i> on page 239.
3 Digital Output 2	Used to select the data sources that will be combined to produce a digital output pulse on Output 2. See <i>Digital Output</i> on page 239.
4 Analog Panel	Used to convert a measurement value or decision into an analog output signal. See <i>Analog Output</i> on page 242.
5 Serial Panel	Used to select the measurements that will be transmitted via RS-485 serial output. See <i>Serial Output</i> on page 243.

Ethernet Output

A sensor uses TCP messages (Gocator protocol) to receive commands from client computers, and to send video, 3D point clouds, intensity, and measurement results to client computers. The sensor can also receive commands from and send measurement results to a PLC using ASCII, Modbus TCP, or EtherNet/IP protocol. See *Protocols* on page 353 for the specification of these protocols.

The specific protocols used with Ethernet output are selected and configured within the panel.

The screenshot shows the 'Output' configuration panel for the Ethernet protocol. The 'Protocol' dropdown is set to 'Gocator'. The 'Information' section explains that the Gocator Protocol uses TCP messages to command the sensor and transmit data. The 'Data' section on the right lists various data items to be sent, including Surfaces, Surface Intensities, and Measurements. The 'Auto Disconnect' checkbox is checked, and the 'Timeout' is set to 10 seconds.

Send	Name	Id
Surfaces		
☒	Top	
Surface Intensities		
☐	Top	
Measurements		
☐	Surface Bounding Box X	0
☐	Surface Ellipse Major	2
☒	Surface Hole Radius	10
☐	Surface Opening Length	11
☐	Surface Plane X Angle	5
☒	Surface Position X	6
☐	Surface Stud Radius	13
☐	Surface Volume Volume	8
☐	Script Output 0	9
Trigger Event		
☐	Exposure End	

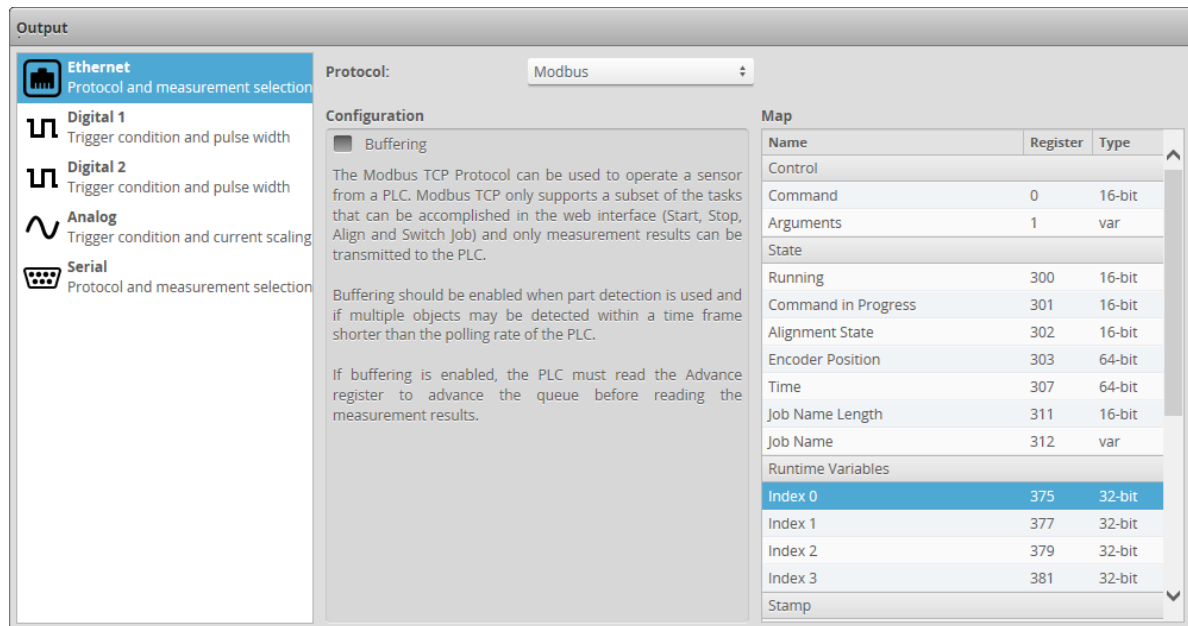
To receive commands and send results using Gocator Protocol messages:

1. Go to the **Output** page.
2. Click on the **Ethernet** category in the **Output** panel.
3. Select **Gocator** as the protocol in the **Protocol** drop-down.
4. Check the video, data, intensity, or measurement items to send.
5. (Optional) Uncheck the Auto Disconnect setting.
By default, this setting is checked, and the timeout is set to 10 seconds.



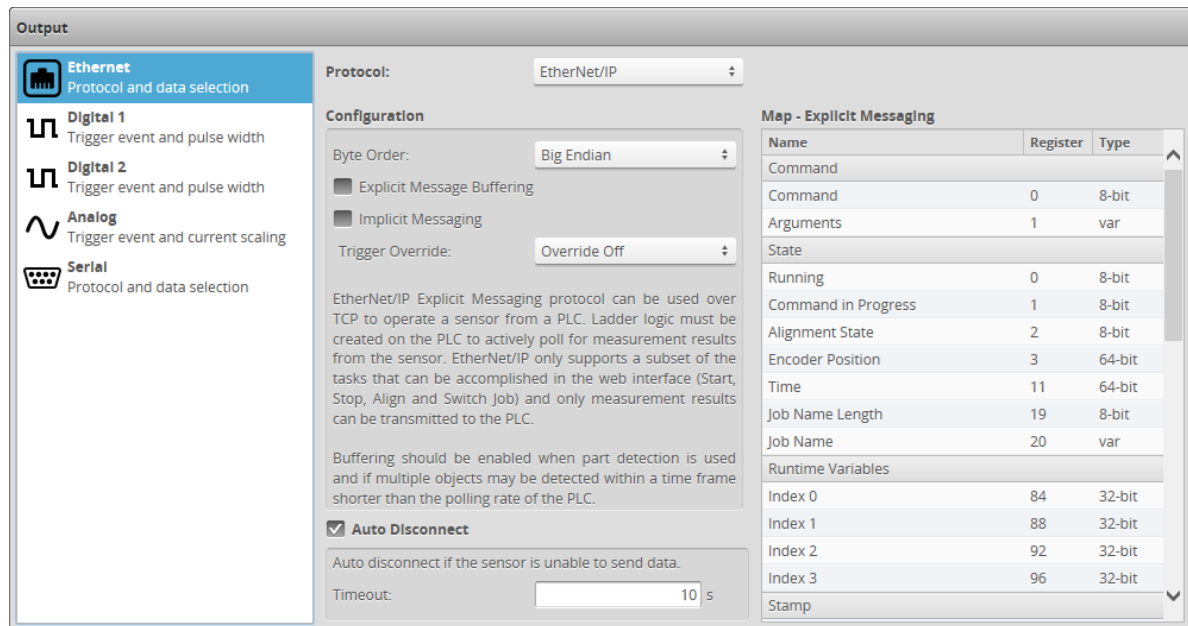
Measurements shown here correspond to measurements that have been added using the **Measure** page (see *Measure Page Overview* on page 119).

All of the tasks that can be accomplished with the Gocator's web interface (creating jobs, performing alignment, sending data and health information, and software triggering, etc.) can be accomplished programmatically by sending Gocator protocol control commands.



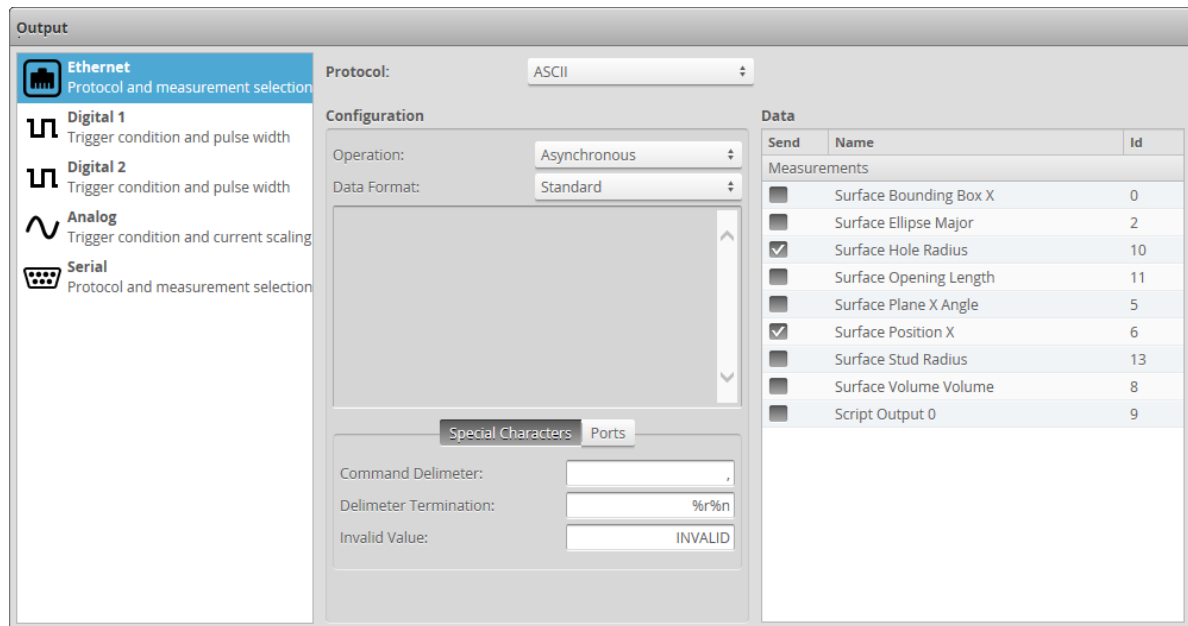
To receive commands and send results using Modbus TCP messages:

1. Go to the **Output** page.
2. Click on **Ethernet** in the **Output** panel.
3. Select **Modbus** as the protocol in the **Protocol** drop-down.
 Unlike the Gocator Protocol, you do not select which measurement items to output. The Ethernet panel will list the register addresses that are used for Modbus TCP communication.
 The Modbus TCP protocol can be used to operate a sensor. Modbus TCP only supports a subset of the tasks that can be performed in the web interface. A sensor can only process Modbus TCP commands when Modbus is selected in the **Protocol** drop-down.
4. Check the **Buffering** checkbox, if needed.
 Buffering is needed, for example, in Surface mode if multiple objects are detected within a time frame shorter than the polling rate of the PLC.
 If buffering is enabled with the Modbus protocol, the PLC must read the Advance register to advance the queue before reading the measurement results.



To receive commands and send results using EtherNet/IP messages:

1. Go to the **Output** page.
2. Click on **Ethernet** in the **Output** panel.
3. Select **EtherNet/IP** in the **Protocol** option.
Unlike using the Gocator Protocol, you don't select which measurement items to output. The **Ethernet** panel will list the register addresses that are used for EtherNet/IP messages communication.
The EtherNet/IP protocol can be used to operate a sensor. EtherNet/IP only supports a subset of the tasks that can be accomplished in the web interface. A sensor can only process EtherNet/IP commands when the EtherNet/IP is selected in the **Protocol** option.
4. Check the **Explicit Message Buffering** option, if needed.
Buffering is needed, for example, in Surface mode if multiple objects are detected within a time frame shorter than the polling rate of the PLC. If buffering is enabled with the EtherNet/IP protocol, the buffer is automatically advanced when the Sample State Assembly Object is read (*Sample State Assembly* on page 418).
5. Check the **Implicit Messaging** option, if needed.
Implicit messaging uses UDP and is faster than explicit messaging, so it is intended for time-critical applications. However, implicit messaging is layered on top of UDP. UDP is connectionless and data delivery is not guaranteed. For this reason, implicit messaging is only suitable for applications where occasional data loss is acceptable.
For more information on setting up implicit messaging, see http://lmi3d.com/sites/default/files/APPNOTE_Implicit_Messaging_with_Allen-Bradley_PLCS.pdf.
6. Choose the byte order in the **Byte Order** dropdown.



To receive commands and send results using ASCII messages:

1. Go to the **Output** page.
2. Click on **Ethernet** in the **Output** panel.
3. Select **ASCII** as the protocol in the **Protocol** drop-down.
4. Set the operation mode in the **Operation** drop-down.
In asynchronous mode, the data results are transmitted when they are available. In polling mode, users send commands on the data channel to request the latest result. See *Polling Operation Commands (Ethernet Only)* on page 423 for an explanation of the operation modes.
5. Select the data format from the **Data Format** drop-down.
Standard: The default result format of the ASCII protocol. Select the measurement to send by placing a check in the corresponding checkbox. See *Standard Result Format* on page 430 for an explanation of the standard result mode.
Standard with Stamp: Select the measurement to send by placing a check in the corresponding checkbox. See *Standard Result Format* on page 430 for an explanation of the standard result mode.
Custom: Enables the custom format editor. Use the replacement patterns listed in **Replacement Patterns** to create a custom format in the editor.
6. Set the special characters in the **Special Characters** tab.
Set the command delimiter, delimiter termination, and invalid value characters. Special characters are used in commands and standard-format data results.
7. Set the TCP ports in the **Ports** tab.
Select the TCP ports for the control, data, and health channels. If the port numbers of two channels are the same, the messages for both channels are transmitted on the same port.

Digital Output

Gocator sensors can convert measurement decisions or software commands to digital output pulses, which can then be used to output to a PLC or to control external devices, such as indicator lights or air ejectors.

A digital output can act as a measurement valid signal to allow external devices to synchronize to the timing at which measurement results are output. In this mode, the sensor outputs a digital pulse when a measurement result is ready.

A digital output can also act as a strobe signal to allow external devices to synchronize to the timing at which the sensor exposes. In this mode, the sensor outputs a digital pulse when the sensor exposes.

Each sensor supports two digital output channels. See *Digital Outputs* on page 488 for information on wiring digital outputs to external devices.

Trigger conditions and pulse width are then configured within the panel.

Send	Name	Id
☐	Surface Bounding Box X	0
☐	Surface Ellipse Major	2
☒	Surface Hole Radius	10
☐	Surface Opening Length	11
☐	Surface Plane X Angle	5
☒	Surface Position X	6
☐	Surface Stud Radius	13
☐	Surface Volume Volume	8
☐	Script Output 0	9

To output measurement decisions:

1. Go to the **Output** page.
2. Click **Digital 1** or **Digital 2** in the **Output** panel.
3. Set **Trigger Event** to **Measurement**.
4. In **Configuration**, set **Assert On** and select the measurements that should be combined to determine the output.
If multiple measurement decisions are selected and **Assert On** is set to **Pass**, the output is activated when all selected measurements pass.
If **Assert On** is set to **Fail**, the output is activated when any one of the selected measurements fails.

5. Set the **Signal** option.
The signal type specifies whether the digital output is a continuous signal or a pulsed signal. If **Signal** is set to **Continuous**, the signal state is maintained until the next transition occurs. If **Signal** is set to **Pulsed**, you must specify the pulse width and how it is scheduled.
6. Specify a pulse width using the slider.
The pulse width is the duration of the digital output pulse, in microseconds.
7. Check the **Scheduled** option if the output needs to be scheduled; otherwise, leave it unchecked for immediate output.
A scheduled output becomes active after the delay from the start of Gocator exposure. A scheduled output can be used to track the decisions for multiple objects as these objects travel from the sensor to the eject gates.
The **Delay** setting specifies the distance from the sensor to the eject gates.
An immediate output becomes active as soon as measurement results are available. The output activates after the sensor finishes processing the data. As a result, the time between the start of sensor exposure and output activates can vary and is dependent on the processing latency. The latency is reported in the dashboard and in the health messages.
8. If you checked **Scheduled**, specify a delay and a delay domain.
The **Delay** specifies the time or encoder distance between the start of sensor exposure and when the output becomes active. The delay should be larger than the time needed to process the data inside the sensor. It should be set to a value that is larger than the processing latency reported in the dashboard or in the health messages.
The unit of the delay is configured with the **Delay Domain** setting.
9. If you want to invert the output signal, check **Invert Output Signal**.

To output a measurement valid signal:

1. Go to the **Output** page.
2. Click on **Digital 1** or **Digital 2** in the **Output** panel.
3. Set **Trigger Event** to **Measurement**.
4. In **Configuration**, set **Assert On** to **Always**.
5. Select the measurements.
The output activates when the selected decisions produce results. The output activates only once for each frame even if multiple decision sources are selected.
6. Specify a pulse width using the slider.
The pulse width determines the duration of the digital output pulse, in microseconds.

To respond to software scheduled commands:

1. Go to the **Output** page.
2. Click **Digital 1** or **Digital 2** in the **Output** panel.

3. Set **Trigger Event** to **Software**.
4. Specify a **Signal** type.
The signal type specifies whether the digital output is a continuous signal or a pulsed signal. If the signal is continuous, its state is maintained until the next transition occurs. If the signal is pulsed, user specifies the pulse width and the delay.
5. Specify a **Pulse Width**.
The pulse width determines the duration of the digital output pulse, in microseconds.
6. Specify if the output is immediate or scheduled.
A pulsed signal can become active immediately or be scheduled. A continuous signal always becomes active immediately.
Immediate output becomes active as soon as a scheduled digital output (*Schedule Digital Output* on page 376) is received.
Scheduled output becomes active at a specific target time or position, given by the Scheduled Digital Output command. Commands that schedule an event in the past will be ignored. An encoder value is in the future if the value will be reached by moving in the forward direction (the direction that encoder calibration was performed in).

To output an exposure signal:

1. Go to the **Output** page.
2. Click **Digital 1** or **Digital 2** in the **Output** panel.
3. Set **Trigger Event** to **Exposure Begin** or **Exposure End**.
4. Set the **Pulse Width** option.
The pulse width determines the duration of the digital output pulse, in microseconds.

To output an alignment signal:

1. Go to the **Output** page.
2. Click **Digital 1** or **Digital 2** in the **Output** panel.
3. Set **Trigger Event** to **Alignment**.
The digital output state is High if the sensor is aligned, and Low if not aligned. Whether the sensor is running does not affect the output.

To respond to exposure begin/end:

1. Go to the **Output** page.
2. Click **Digital 1** or **Digital 2** in the **Output** panel.
3. Set **Trigger Event** to **Exposure Begin** or **Exposure End**.

Analog Output

Gocator sensors can convert a measurement result or software request to an analog output. Each sensor supports one analog output channel.

For information on wiring analog output to an external device, see *Analog Output* on page 491

Send	Name	Id
☐	None	
Values		
☐	Surface Bounding Box X	0
☐	Surface Ellipse Major	2
☐	Surface Hole Radius	10
☒	Surface Opening Length	11
☐	Surface Plane X Angle	5
☐	Surface Position X	6
☐	Surface Stud Radius	13
☐	Surface Volume Volume	8
☐	Script Output 0	9

To output measurement value or decision:

1. Go to the **Output** page.
2. Click on **Analog** in the **Output** panel.
3. Set **Trigger Event** to **Measurement**.
4. Select the measurement that should be used for output.
Only one measurement can be used for analog output. Measurements shown here correspond to measurements that have been programmed using the **Measurements** page.
5. Specify **Data Scale** values.
The values specified here determine how measurement values are scaled to the minimum and maximum current output. The **Data Scale** values are specified in millimeters for dimensional measurements such as distance, square millimeters for areas, cubic millimeters for volumes, and degrees for angle results.
6. Specify **Current Range** and **Invalid** current values.
The values specified here determine the minimum and maximum current values in milliamperes. If **Invalid** is checked, the current value specified with the slider is used when a measurement value is not valid. If **Invalid** is not checked, the output holds the last value when a measurement value is not valid.
7. Specify if the output is immediate or scheduled.
An analog output can become active immediately or scheduled. Check the **Scheduled** option if the

output needs to be scheduled.

A scheduled output becomes active after a specified delay from the start of Gocator exposure. A scheduled output can be used to track the decisions for multiple objects as these objects travel from the sensor to the eject gates. The delay specifies the distance from the sensor to the eject gates.

An Immediate output becomes active as soon as the measurement results are available. The output activates after the Gocator finishes processing the data. As a result, the time between the start of Gocator exposure and output activates depends on the processing latency. The latency is reported in the dashboard and in the health messages.

8. Specify a delay.

The delay specifies the time or spatial location between the start of Gocator exposure and the output becomes active. The delay should be larger than the time needed to process the data inside the Gocator. It should be set to a value that is larger than the processing latency reported in the dashboard and in the health messages.

The unit of the delay is configured in the trigger panel. See *Triggers* on page 64 for details.



The analog output takes about 75 us to reach 90% of the target value for a maximum change, then another ~40 us to settle completely.

To respond to software scheduled commands:

1. Go to the **Output** page.

2. Click on **Analog** in the **Output** panel.

3. Set **Trigger Event** to **Software**.

4. Specify if the output is immediate or scheduled.

An analog output value becomes active immediately or scheduled. Immediate output becomes active as soon as a Scheduled Analog Output command (see *Schedule Analog Output* on page 377) is received. Software scheduled command can schedule an analog value to output at a specified future time or encoder value, or changes its state immediately. The Delay setting in the panel is ignored. Commands that schedule event in the past will be ignored. An encoder value is in future if the value will be reached by moving in the forward direction (the direction that encoder calibration was performed in).

Serial Output

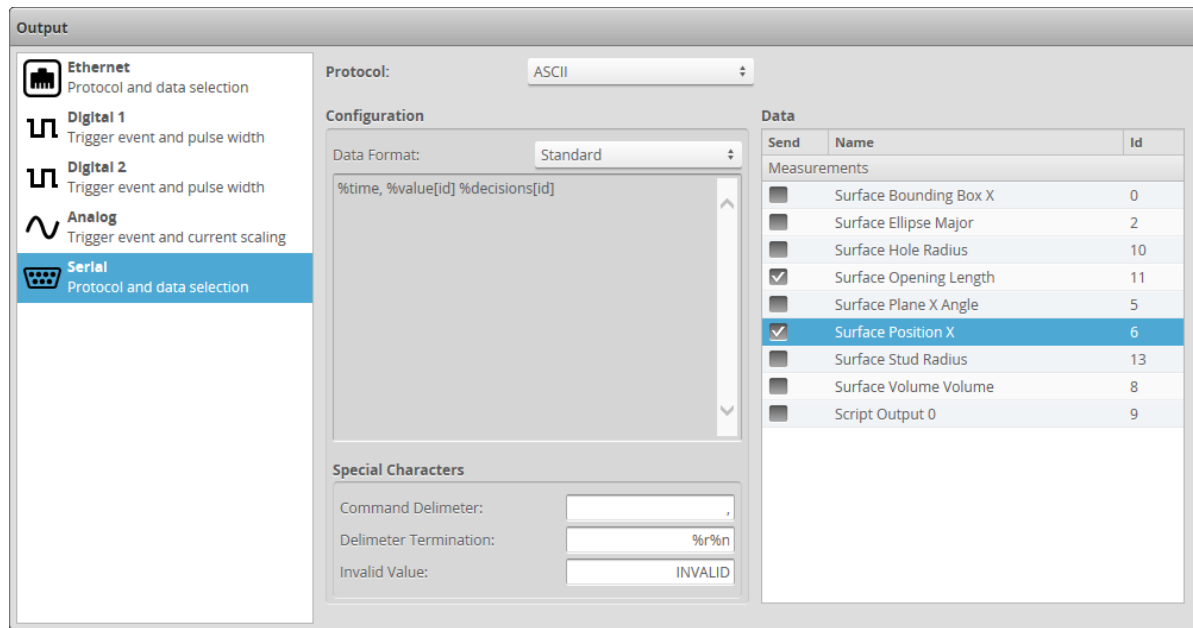
Gocator's web interface can be used to select measurements to be transmitted via RS-485 serial output. Each sensor has one serial output channel.

Two protocols are supported: ASCII Protocol and Selcom Serial Protocol.

The ASCII protocol outputs data asynchronously using a single serial port. For information on the ASCII Protocol parameters and data formats, see *ASCII Protocol* on page 422.

The Selcom Serial Protocol outputs synchronized serial data using two serial ports. For information on the Selcom serial protocol and data formats, see *Selcom Protocol* on page 432.

For information on wiring serial output to an external device, see *Serial Output* on page 491.



To configure ASCII output:

1. Go to the **Output** page.
2. Click on **Serial** in the **Output** panel.
3. Select **ASCII** in the **Protocol** option.
4. Select the **Data Format**.
Select **Standard** to use the default result format of the ASCII protocol. Select value and decision to send by placing a check in the corresponding check box. See *Standard Result Format* on page 430 for an explanation of the standard result mode.
Select **Custom** to customize the output result. A data format box will appear in which you can type the format string. See *Custom Result Format* on page 430 for the supported format string syntax.
5. Select the measurements to send.
Select measurements by placing a check in the corresponding check box.
6. Set the **Special Characters**.
Select the delimiter, termination and invalid value characters. Special characters are used in commands and standard-format data results.

Output

Ethernet
Protocol and data selection

Digital 1
Trigger event and pulse width

Digital 2
Trigger event and pulse width

Analog
Trigger event and current scaling

Serial
Protocol and data selection

Protocol: Selcom

Configuration

Rate: 96000

Format: SLS

Data Scale: 0 - 10000

Specifies the range of output values to use in scaling to the range selected in the Format above.
Default output units are in mm, mm², mm³ and degrees depending on the output type. Values outside this range are clamped to the minimum or maximum values.

Scheduled

Delay: 3000 µs

Data

Send	Name	Id
Measurements		
☒	Range Position Z	0

To configure Selcom output:

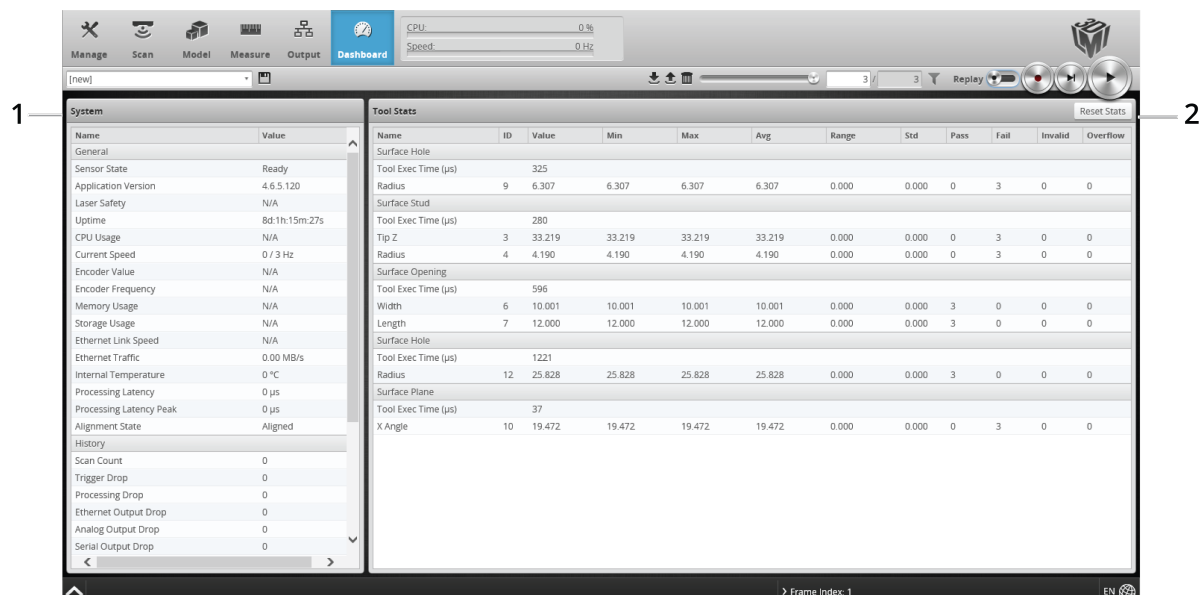
1. Go to the **Output** page.
2. Click on **Serial** in the **Output** panel.
3. Select **Selcom** in the **Protocol** option.
4. Select the measurements to send.
To select an item for transmission, place a check in the corresponding check box. Measurements shown here correspond to measurements that have been programmed using the **Measurements** page.
5. Select the baud rate in **Rate**.
6. Select the **Data Format**.
See *Selcom Protocol* on page 432 for definitions of the formats.
7. Specify **Data Scale** values.
The **Data Scale** values are specified in millimeters for dimensional measurements such as distance, square millimeters for areas, cubic millimeters for volumes, and degrees for angle results.
The results are scaled according to the number of serial bits used to cover the data scale range. For example, the 12-bit output would break a 200 mm data scale range into 4096 increments (0.0488 mm/bit), and the 14-bit output would break a 200 mm data scale range into 16384 increments (0.0122 mm/bit).
8. Set the output delay in **Delay**.
The scheduled delay must be longer than the processing latency to prevent drops.

Dashboard

The following sections describe the **Dashboard** page.

Dashboard Page Overview

The **Dashboard** page summarizes sensor health information and provides measurement statistics.



	Element	Description
1	System	Displays sensor state and health information. See <i>State and Health Information</i> below.
2	Tool Stats	Displays measurement tool statistics. See <i>Tool Statistics</i> on the next page.

State and Health Information

The following state and health information is available in the **System** panel on the **Dashboard** page:

Dashboard General System Values

Name	Description
Sensor State*	Current sensor state (Conflict, Ready, or Running).
Application Version	Gocator firmware version.
Laser Safety	Whether Safety is enabled.
Uptime	Length of time since the sensor was power-cycled or reset.
CPU Usage	Sensor CPU utilization (%).
Current Speed*	Current speed of the sensor.
Encoder Value	Current encoder value (ticks).
Encoder Frequency	Current encoder frequency (Hz).

Name	Description
Memory Usage	Sensor memory utilization (MB used / MB total available).
Storage Usage	Sensor flash storage utilization (MB used / MB total available).
Ethernet Link Speed	Speed of the Ethernet link (Mbps).
Ethernet Traffic	Network output utilization (MB/sec).
Internal Temperature	Internal sensor temperature.
Processing Latency	Last delay from camera exposure to when results can be scheduled to.
Processing Latency Peak	Peak latency delay from camera exposure to when results can be scheduled to Rich I/O. Reset on start.
Alignment State	Whether the sensor or sensor system has been aligned.

Dashboard History Values

Name	Description
Scan Count*	Number of scans performed since sensor state last changed to Running.
Trigger Drop**	Count of camera frames dropped due to excessive trigger speed.
Processing Drop**	Count of frame drops due to excessive CPU utilization.
Ethernet Output Drop**	Count of frame drops due to slow Ethernet link.
Analog Output Drop**	Count of analog output drops because last output has not been completed.
Serial Output Drop**	Count of serial output drops because last output has not been completed.
Digital Output 1 Drop**	Count of digital output drops because last output has not been completed.
Digital Output 2 Drop**	Count of digital output drops because last output has not been completed.
Digital Output 1 High Count	Count of high states on digital output.
Digital Output 2 High Count	Count of high states on digital output.
Digital Output 1 Low Count	Count of low states on digital output.
Digital Output 2 Low Count	Count of low states on digital output.
Anchor Invalid Count**	Count of invalid anchors.
Valid Spot Count	Count of valid spots detected in the last frame.
Max Spot Count*	Maximum number of spots detected since sensor was started.
Camera Search Count	Count of camera frame where laser has lost tracked. Only applicable when tracking window is enabled.

* When the sensor is accelerated, the indicator's value is reported from the accelerating PC.

** When the sensor is accelerated, the indicator's value is the sum of the values reported from the sensor and the accelerating PC.

Tool Statistics

Measurement statistics are displayed for each measurement tool that has been configured on the **Measure** page. Use the **Reset Stats** button to reset the statistics.

Tool Stats											Reset Stats
Name	ID	Value	Min	Max	Avg	Range	Std	Pass	Fail	Invalid	Overflow
Profile Area											
Tool Exec Time (µs)		32									
Area	0	0.083	0.000	262.862	38.564	262.862	40.806	688	657	47	0
Centroid X	5	-13.803	-16.665	17.276	2.828	33.941	7.232	69	1274	49	0
Profile Line											
Tool Exec Time (µs)		20									
Offset	3	0.074	-0.005	13.333	7.628	13.338	4.346	868	477	47	0
Angle	4	-0.062	-8.216	15.583	1.026	23.799	2.691	731	614	47	0
Profile Position											
Tool Exec Time (µs)		9									
X	2	-8.448	-20.064	20.284	7.466	40.348	12.659	290	1055	47	0
Z	6	0.118	0.045	17.000	9.646	16.955	5.494	607	738	47	0

For each tool, Gocator displays the time the tool took to execute on the current frame, in microseconds (Tool Exec Time).

For each measurement, Gocator displays the following information:

Measurement Statistics

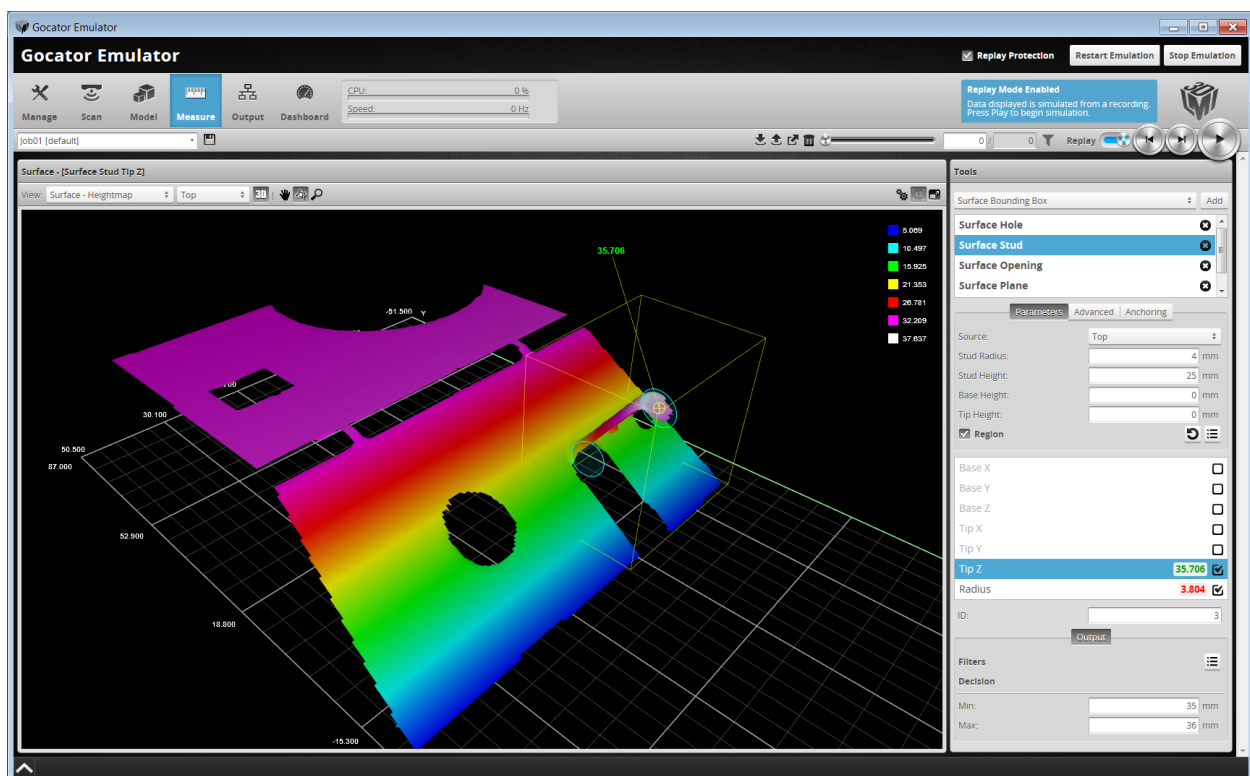
Name	Description
ID	The measurement ID as set in the measurement's ID field on the Measure page .
Value	The most recent measurement value.
Min	The minimum measurement value that has been observed.
Max	The maximum measurement value that has been observed.
Avg	The average of all measurement results collected since the sensor was started.
Std	The standard deviation of all measurement results collected since the sensor was started.
Range	The difference between Max and Min.
Pass	The number of pass decisions that have been generated by the measurement.
Fail	The number of fail decisions that have been generated by the measurement.
Invalid	The number of frames from which no valid measurement value was returned.
Overflow	The number of frames returned an overflow.

Gocator Emulator

The Gocator emulator is a stand-alone application that lets you run a "virtual" sensor. In a virtual sensor, you can test jobs, evaluate data, and even learn more about new features, rather than take a physical device off the production line to do this. You can also use a virtual sensor to familiarize yourself with the overall interface if you are new to Gocator.



The Gocator emulator is only supported on 64-bit versions of Windows 7, 8, and 10.



*Emulator showing a part in recorded data.
A measurement is applied to the recorded data.*

Limitations

In most ways, the emulator behaves like a real sensor, especially when visualizing data, setting up models and part matching, and adding and configuring measurement tools. The following are some of the limitations of the emulator:

- Changes to job files in the emulator are *not* persistent (they are lost when you close or restart the emulator). However, you can keep a modified job by first [saving](#) it and then [downloading](#) it from the

Jobs list on the **Manage** page to a client computer. The job file can then be loaded into the emulator at a later time or even onto a physical sensor for final testing.

- Performing alignment in the emulator has no effect and will never complete.
- Only one instance can be run at a time.

For information on saving and loading jobs in the emulator, see *Creating, Saving, and Loading Jobs* on page 255 .

For information on uploading and downloading jobs between the emulator and a computer, and performing other job file management tasks, see *Downloading and Uploading Jobs* on page 259.

Downloading a Support File

The emulator is provided with several virtual sensors preinstalled.

You can also create virtual sensors yourself by downloading a support file from a physical Gocator and then adding it to the emulator.

Support files can contain jobs, letting you configure systems and add measurements in an emulated sensor. Support files can also contain replay data, letting you test measurements and some configurations on real data. Dual-sensor systems are supported.

Support File

Download a support file which contains all jobs, data and current state of the sensor.

Filename:

Description:

Download

To download a support file:

1. Go to the **Manage** page and click on the **Support** category.
2. In **Filename**, type the name you want to use for the support file.
When you create a scenario from a support file in the emulator, the filename you provide here is displayed in the emulator's scenario list.
Support files end with the .gs extension, but you do not need to type the extension in **Filename**.
3. (Optional) In **Description**, type a description of the support file.
When you create a scenario from a support file in the emulator, the description is displayed below the emulator's scenario list.

- Click **Download**, and then when prompted, click **Save**.

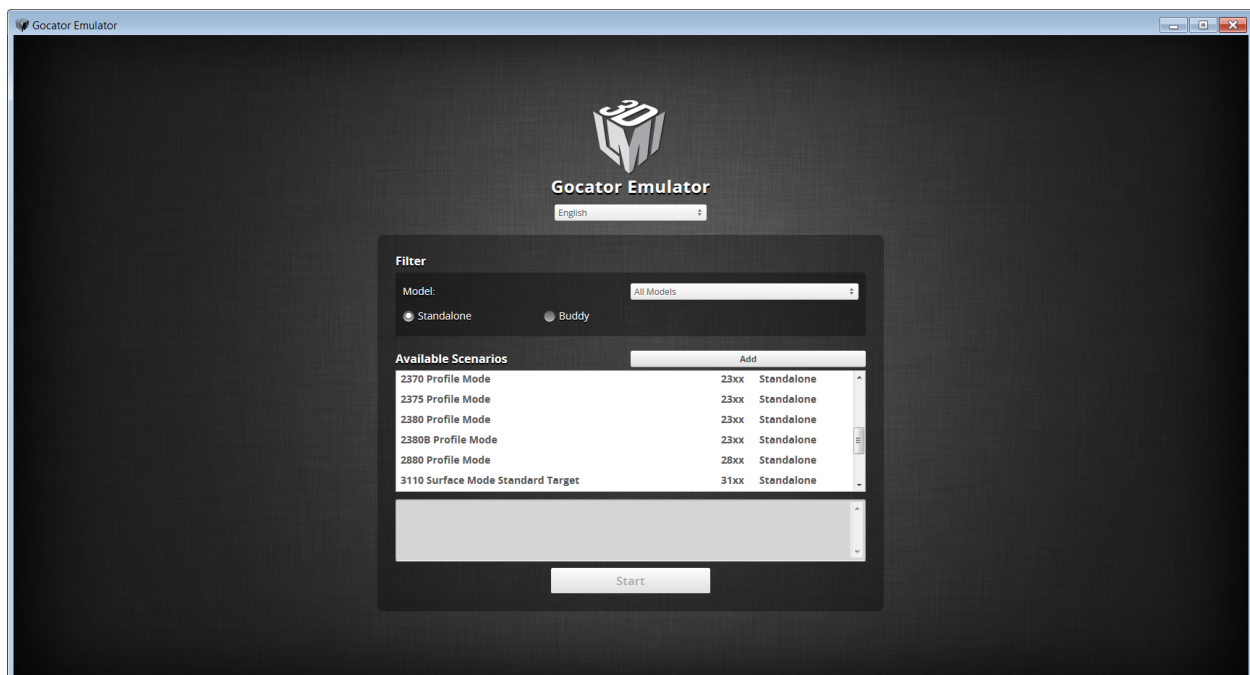


Downloading a support file stops the sensor.

Running the Emulator

The emulator is contained in the Gocator tools package (14405-x.x.x.x_SOFTWARE_GO_Tools.zip). To get the package, go to <http://lmi3d.com/support>, choose your product from the Product Downloads section, and download the package from the Download Center.

To run the emulator, unzip the package and double-click the *GoEmulator* link in the unzipped emulator folder.



Emulator launch screen

You can change the language of the emulator's interface from the launch screen. To change the language, choose a language option from the top drop-down:



Selecting the emulator interface language

Adding a Scenario to the Emulator

To simulate a physical sensor using a support file downloaded from a sensor, you must add it as a scenario in the emulator.



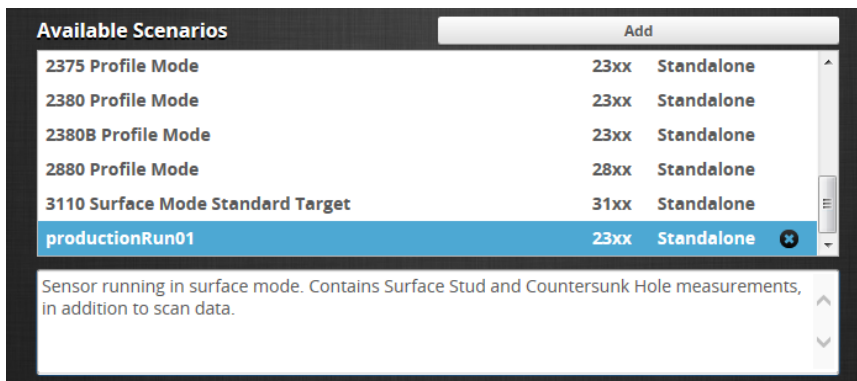
You can add support files downloaded from any series of Gocator sensors to the emulator.

To add a scenario:

1. Launch the emulator if it isn't running already.
2. Click the **Add** button and choose a previously saved support file (.gs extension) in the **Choose File to Upload** dialog.



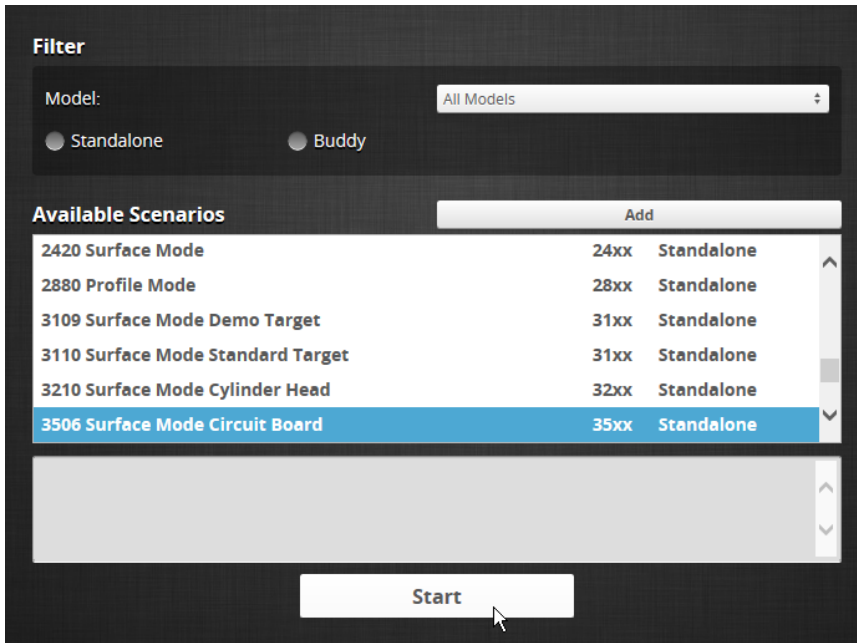
3. (Optional) In **Description**, type a description.



You can only add descriptions for user-added scenarios.

Running a Scenario

After you have added a virtual sensor by uploading a support file to the emulator, you can run it from the **Available Scenarios** list on the emulator launch screen. You can also run any of the scenarios included in the installation.



To run a scenario:

1. If you want to filter the scenarios listed in **Available Scenarios**, do one or both of the following:
 - Choose a model family in the **Model** drop-down.
 - Choose **Standalone** or **Buddy** to limit the scenarios to single-sensor or dual-/multi-sensor scenarios, respectively.
2. Select a scenario in the **Available Scenarios** list and click **Start**.

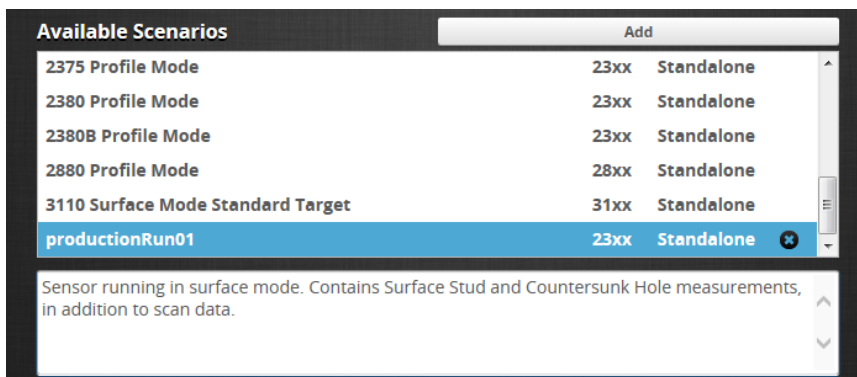
Removing a Scenario from the Emulator

You can easily remove a scenario from the emulator.

 You can only remove user-added scenarios.

To remove a scenario:

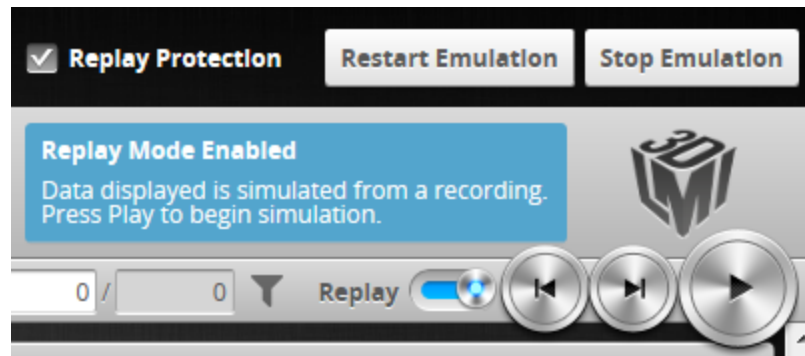
1. If the emulator is running a scenario, click **Stop Emulation** to stop it.
2. In the **Available Scenarios** list, scroll to the scenario you want to remove.



3. Click the  button next to the scenario you want to remove.
The scenario is removed from the emulator.

Using Replay Protection

Making changes to certain settings on the **Scan** page causes the emulator to flush replay data. The **Replay Protection** option protects replay data by preventing changes to settings that affect replay data. Settings that do not affect replay data can be changed.



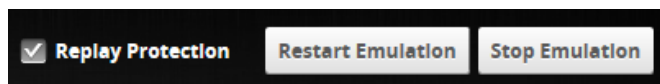
If you try to uncheck **Replay Protection**, you must confirm that you want to disable it.

Replay Protection is on by default.

Stopping and Restarting the Emulator

To stop the emulator:

- Click **Stop Emulation**.



Stopping the emulator returns you to the launch screen.

To restart the emulator when it is running:

- Click **Restart Emulation**.

Restarting the emulator restarts the currently running simulation.

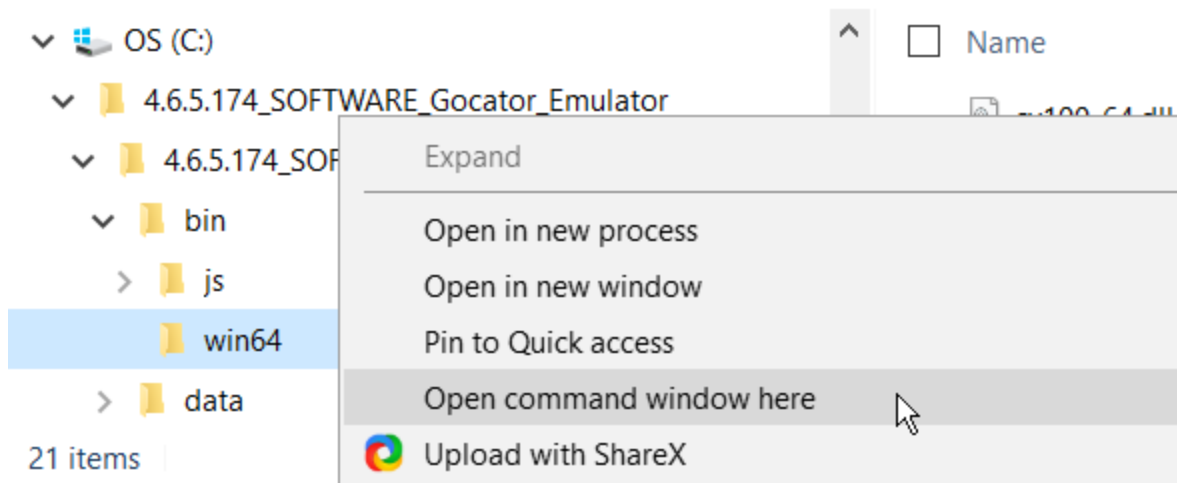
Running the Emulator in Default Browser

When you use the `/browser` command line parameter, the emulator application launches normally but also launches in your default browser. This provides additional flexibility when using the emulator. For example, you can resize the emulator running in a browser window.

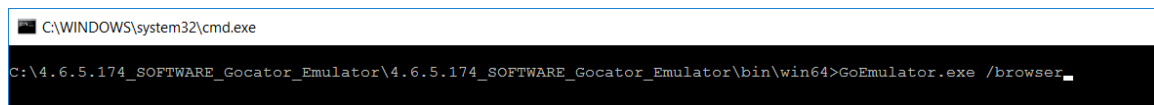
To run the emulator in your default browser:

1. In Windows Explorer (Windows 7) or File Explorer (Windows 8 or 10), browse to the location of the emulator.
The emulator is under `bin\win64`, in the location in which you installed the emulator.

2. Press and hold **Shift**, right-click the **win64** folder containing the emulator, and choose **Open command window here**.



3. In the command prompt, type `GoEmulator.exe /browser`, followed by an IPV4 address.



After the emulator application starts, the emulator also launches in your default browser.

Working with Jobs and Data

The following topics describe how to work with jobs and replay data (data recorded from a physical sensor) in the emulator.

Creating, Saving, and Loading Jobs

Changes saved to job files in the emulator are *not* persistent (they are lost when you close or restart the emulator). To keep jobs permanently, you must first save the job in the emulator and then download the job file to a client computer. See below for more information on creating, saving, and switching jobs. For information on downloading and uploading jobs between the emulator and a computer, see *Downloading and Uploading Jobs* on page 259.

The job drop-down list in the toolbar shows the jobs available in the emulator. The job that is currently active is listed at the top. The job name will be marked with "[unsaved]" to indicate any unsaved changes.



To create a job:

1. Choose **[New]** in the job drop-down list and type a name for the job.
2. Click the **Save** button  or press **Enter** to save the job.
The job is saved to the emulator using the name you provided.

To save a job:

- Click the **Save** button .

The job is saved to the emulator.

To load (switch) jobs:

- Select an existing file name in the job drop-down list.

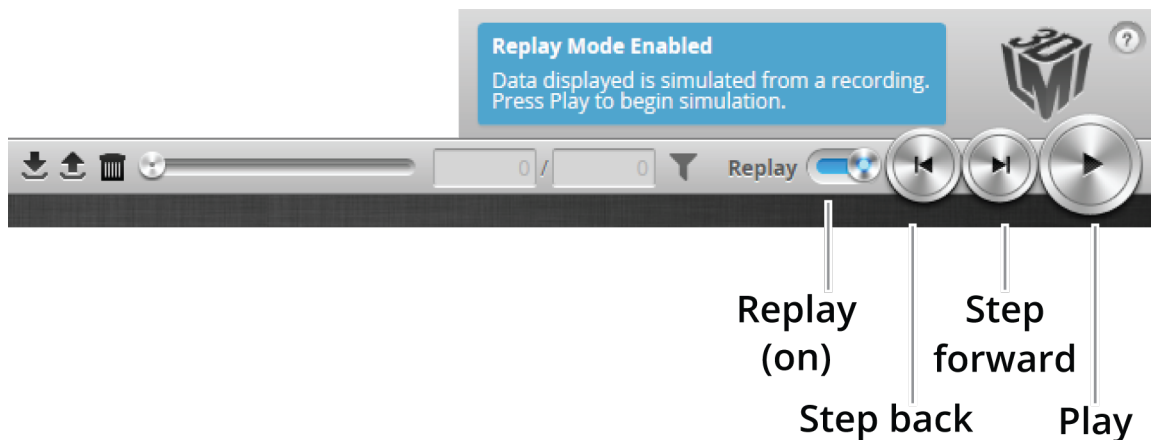
The job is activated. If there are any unsaved changes in the current job, you will be asked whether you want to discard those changes.

Playback and Measurement Simulation

The emulator can replay scan data previously recorded by a physical sensor, and also simulate measurement tools on recorded data. This feature is most often used for troubleshooting and fine-tuning measurements, but can also be helpful during setup.

Playback is controlled using the toolbar controls.

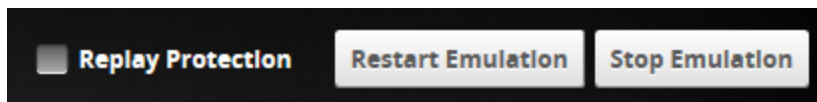
 Recording is not functional in the emulator.



Playback controls when replay is on

To replay data:

- Toggle **Replay** mode on by setting the slider to the right in the **Toolbar**. The slider's background turns blue. To change the mode, you must uncheck **Replay Protection**.



- Use the **Replay** slider or the **Step Forward**, **Step Back**, or **Play** buttons to review data. The **Step Forward** and **Step Back** buttons move and the current replay location backward and forward by a single frame, respectively.

The **Play** button advances the replay location continuously, animating the playback until the end of the replay data.

The **Stop** button (replaces the **Play** button while playing) can be used to pause the replay at a particular location.

The **Replay** slider (or **Replay Position** box) can be used to go to a specific replay frame.

To simulate measurements on replay data:

1. Toggle **Replay** mode on by setting the slider to the right in the **Toolbar**.
The slider's background turns blue.
To change the mode, **Replay Protection** must be unchecked.
2. Go to the **Measure** page.
Modify settings for existing measurements, add new measurement tools, or delete measurement tools as desired. For information on adding and configuring measurements, see *Measurement* on page 119.
3. Use the **Replay Slider**, **Step Forward**, **Step Back**, or **Play** button to simulate measurements.
Step or play through recorded data to execute the measurement tools on the recording.
Individual measurement values can be viewed directly in the data viewer. Statistics on the measurements that have been simulated can be viewed in the **Dashboard** page; for more information on the dashboard, see *Dashboard* on page 246.

To clear replay data:

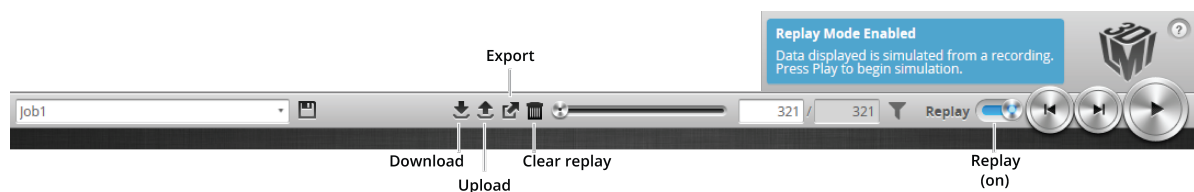
- Click the **Clear Replay Data** button .

Downloading, Uploading, and Exporting Replay Data

Replay data (recorded scan data) can be downloaded from the emulator to a client computer, or uploaded from a client computer to the emulator.

Data can also be exported from the emulator to a client computer in order to process the data using third-party tools.

 You can only upload replay data to the same sensor model that was used to create the data.



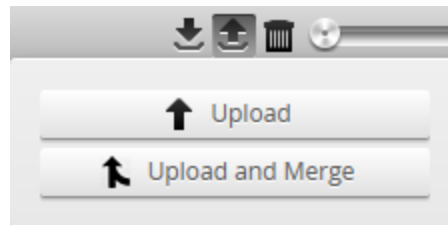
 Replay data is not loaded or saved when you load or save jobs.

To download replay data:

1. Click the Download button .
2. In the **File Download** dialog, click **Save**.
3. In the **Save As...** dialog, choose a location, optionally change the name (keeping the .rec extension), and click **Save**.

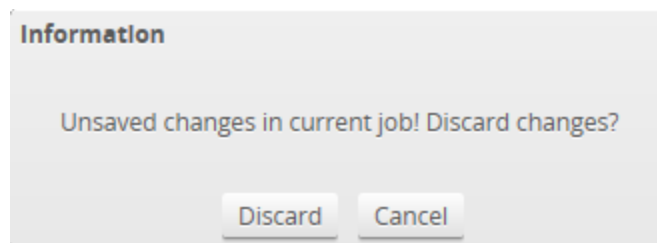
To upload replay data:

1. Click the Upload button .
The Upload menu appears.



2. In the Upload menu, choose one of the following:
 - **Upload:** Unloads the current job and creates a new unsaved and untitled job from the content of the replay data file.
 - **Upload and merge:** Uploads the replay data and merges the data's associated job with the current job. Specifically, the settings on the **Scan** page are overwritten, but all other settings of the current job are preserved, including any measurements or models.

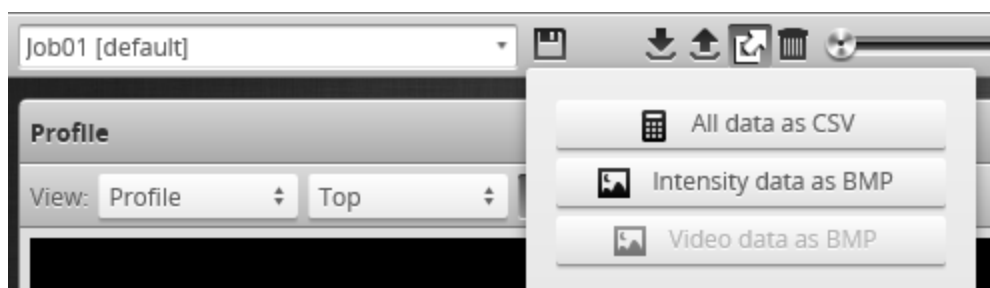
If you have unsaved changes in the current job, the firmware asks whether you want to discard the changes.



3. Do one of the following:
 - Click **Discard** to discard any unsaved changes.
 - Click **Cancel** to return to the main window to save your changes.
4. If you clicked **Discard**, navigate to the replay data to upload from the client computer and click **OK**.
The replay data is loaded, and a new unsaved, untitled job is created.

Replay data can be exported using the CSV format.

 Surface intensity data cannot be exported to the CSV format. It can only be [exported separately as a bitmap](#).



To export replay data in the CSV format:

1. In the **Scan Mode** panel, switch to Profile or Surface.
2. Click the Export button  and select **All Data as CSV**.
Only data at the current replay location is exported.
Use the playback control buttons to move to a different replay location; for information on playback, see *To replay data in Playback and Measurement Simulation* on page 256.
3. (Optional) Convert exported data to another format using the CSV Converter Tool. For information on this tool, see *CSV Converter Tool* on page 465.



The decision values in the exported data depend on the *current* state of the job, not the state during recording. For example, if you record data when a measurement returns a *pass* decision, change the measurement's settings so that a *fail* decision is returned, and then export to CSV, you will see a *fail* decision in the exported data.

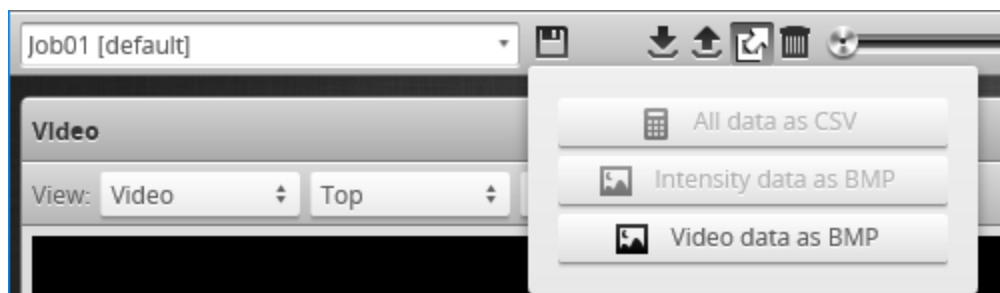
Recorded intensity data can be exported to a bitmap (.BMP format). **Acquire Intensity** must be checked in the **Scan Mode** panel while data was being recorded in order to export intensity data.

To export recorded intensity data to the BMP format:

- Click the **Export** button  and select **Intensity data as BMP**.

Only the intensity data in the current replay location is exported.

Use the playback control buttons to move to a different replay location; for information on playback, see *To replay data in Playback and Measurement Simulation* on page 256.

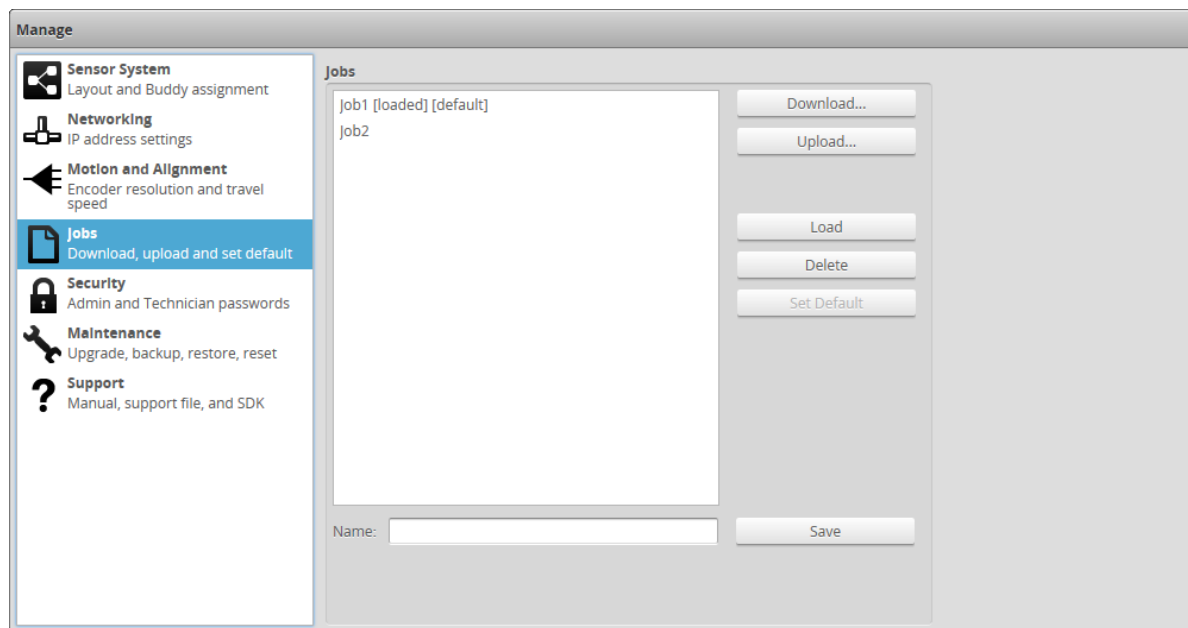


To export video data to a BMP file:

1. In the **Scan Mode** panel, switch to Video mode.
Use the playback control buttons to move to a different replay location; for information on playback, see *To replay data in Playback and Measurement Simulation* on page 256.
2. Click the Export button  and select **Video data as BMP**.

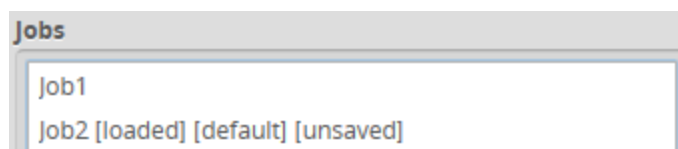
Downloading and Uploading Jobs

The **Jobs** category on the **Manage** page lets you manage the jobs in the emulator.



Element	Description
Name field	Used to provide a job name when saving files.
Jobs list	Displays the jobs that are currently saved in the emulator.
Save button	Saves current settings to the job using the name in the Name field. Changes to job files are not persistent in the emulator. To keep changes, first save changes in the job file, and then download the job file to a client computer. See the procedures below for instructions.
Load button	Loads the job that is selected in the job list. Reloading the current job discards any unsaved changes.
Delete button	Deletes the job that is selected in the job list.
Set as Default button	Setting a different job as the default is not persistent in the emulator. The job set as default when the support file (used to create a virtual sensor) was downloaded is used as the default whenever the emulator is started.
Download... button	Downloads the selected job to the client computer.
Upload... button	Uploads a job from the client computer.

Unsaved jobs are indicated by "[unsaved]".



Changes to job files in the emulator are *not* persistent (they are lost when you close or restart the emulator). However, you can keep modified jobs by first saving them and then downloading them to a client computer.

To save a job:

1. Go to the **Manage** page and click on the **Jobs** category.
2. Provide a name in the **Name** field.
To save an existing job under a different name, click on it in the **Jobs** list and then modify it in the **Name** field.
3. Click on the **Save** button or press **Enter**.

To download, load, or delete a job, or to set one as a default, or clear a default:

1. Go to the **Manage** page and click on the **Jobs** category.
2. Select a job in the **Jobs** list.
3. Click on the appropriate button for the operation.

Scan, Model, and Measurement Settings

The settings on the **Scan** page related to actual scanning will clear the buffer of any scan data that is uploaded from a client computer, or is part of a support file used to create a virtual sensor. If **Replay Protection** is checked, the emulator will indicate in the log that the setting can't be changed because the change would clear the buffer. For more information on Replay Protection, see *Using Replay Protection* on page 254.

Other settings on the **Scan** page related to the post-processing of data can be modified to test their influence on scan data, without modifying or clearing the data, for example edge filtering (page 87), and filters on the X axis (page 82). Note that modifying the Y filters causes the buffer to be cleared.

For information on creating models and setting up part matching, see *Models* on page 98. For information on adding and configuring measurement tools, see *Measurement* on page 119.

Calculating Potential Maximum Frame Rate

You can use the emulator to calculate the potential maximum frame rate you can achieve with different settings.

For example, when you reduce the active area, in the **Active Area** tab on the **Sensor** panel, the maximum frame rate displayed on the **Trigger** panel is updated to reflect the increased speed that would be available in a physical Gocator sensor. (See *Active Area* on page 69 for more information on active area.)

Similarly, you can adjust exposure on the **Exposure** tab on the **Sensor** panel to see how this affects the maximum frame rate. (See *Exposure* on page 71 for more information on exposure.)



To adjust active area in the emulator, **Replay Protection** must be turned off. See *Using Replay Protection* on page 254 for more information.



Saving changes to active area causes replay data to be flushed.

Protocol Output

The emulator simulates output for all of Gocator's Ethernet-based protocols.

- [Gocator](#)
- [ASCII](#)
- [Modbus](#)
- [EtherNet/IP](#)

Clients (such as PLCs) can connect to the emulator to access the simulated output and use the protocols as they would with a physical sensor.

The emulator allows connections to emulated sensors on localhost (127.0.0.1). You can also allow connections to emulated sensors on your computer's network card; for more information, see *Remote Operation* below.

Remote Operation

You can specify the IP address of one of your computer's network cards to allow clients to connect remotely to an emulated sensor using the `/ip` command line parameter. When the `/ip` parameter is not used, emulated sensors are only available on the local machine (that is, 127.0.0.1 or localhost).



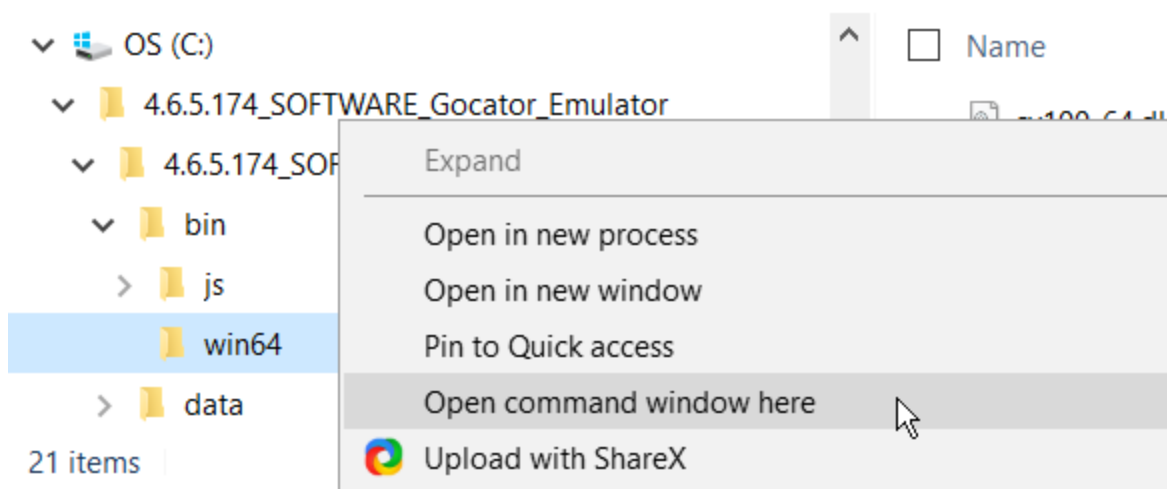
Clients can only connect to emulated sensors, not to the emulator's launch page.



You may need to contact your network administrator to allow connections to the computer running the emulated sensor.

To allow remote connections to an emulated sensor:

1. In Windows Explorer (Windows 7) or File Explorer (Windows 8 or 10), browse to the location of the emulator. The emulator is under `bin\win64`, in the location in which you installed the emulator.
2. Press and hold **Shift**, right-click the `win64` folder containing the emulator, and choose **Open command window here**.



3. In the command prompt, type `GoEmulator.exe /ip`, followed by an IPV4 address, for example:

```
C:\WINDOWS\system32\cmd.exe

C:\4.6.5.174_SOFTWARE_Gocator_Emulator\4.6.5.174_SOFTWARE_Gocator_Emulator\bin\win64>GoEmulator.exe /ip 192.168.1.42
```

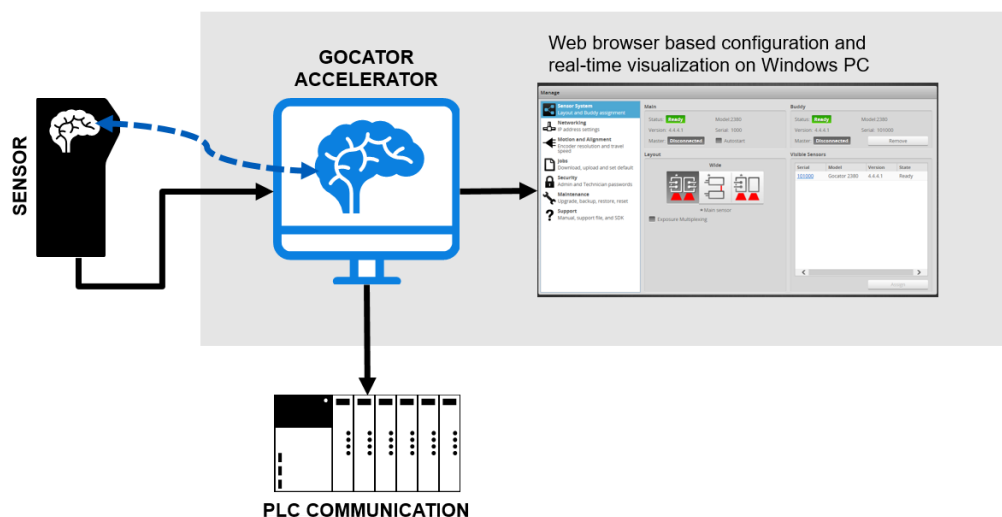
The emulator application starts.

 The emulator does not check that the IP address is valid.

4. From the emulator launch page, start a scenario.
For more information, see *Running a Scenario* on page 252.
5. Provide the IP address you used with the `/ip` parameter, followed by port number 3191, to users who want to connect to the emulated sensor, for example:
`192.168.1.42:3191`

Gocator Accelerator

The Gocator Accelerator improves a Gocator system's processing capability by transferring the processing to PCs that are in the system.



The web interface and the supported output protocols (Gocator, EtherNet/IP, and ASCII protocols over Ethernet) are identical to an unaccelerated sensor.



The Gocator Accelerator does not currently support the Modbus protocol. It also does not currently support digital, analog, and Selcom serial output.

An application that can accelerate a standalone sensor or a dual-sensor system is provided in the Accelerator package (see below). You can also fully integrate Gocator acceleration into a client SDK-based application.

When a sensor is accelerated, it sends data directly to the Accelerator application or an accelerator-enabled SDK application. Users access the Gocator web interface using the IP address of the computer running the application.



Some health indicators behave differently when a sensor is accelerated. For information on which indicators in the Dashboard that acceleration affects, see *State and Health Information* on page 246. For information on which indicators available through the Gocator protocol acceleration affects, see *Health Results* on page 401.

For installation and usage instructions, as well as information on implementing acceleration in an [SDK](#) application, see the technical user manual (15201-x.x.x.xxx_MANUAL_Technical_Gocator_Measurement_Tool.pdf). To get the manual, go to <http://lmi3d.com/support>, choose your product from the Product Downloads section, and download it from the Download Center. You can download the

GoAccelerator application in the 14405-4.5.x.xxx_SOFTWARE_GO_Tools.zip package from the same location.

Benefits

Accelerated sensors provide several benefits.

Acceleration is completely transparent: because the output protocols of an accelerated sensor are identical to those of an unaccelerated sensor, SDK and PLC applications require no changes whatsoever for controlling accelerated sensors and receiving health information and data.

Measurement latency is reduced on accelerated sensors, which results in shorter cycle times. This means a sensor can scan more targets in a given time period.

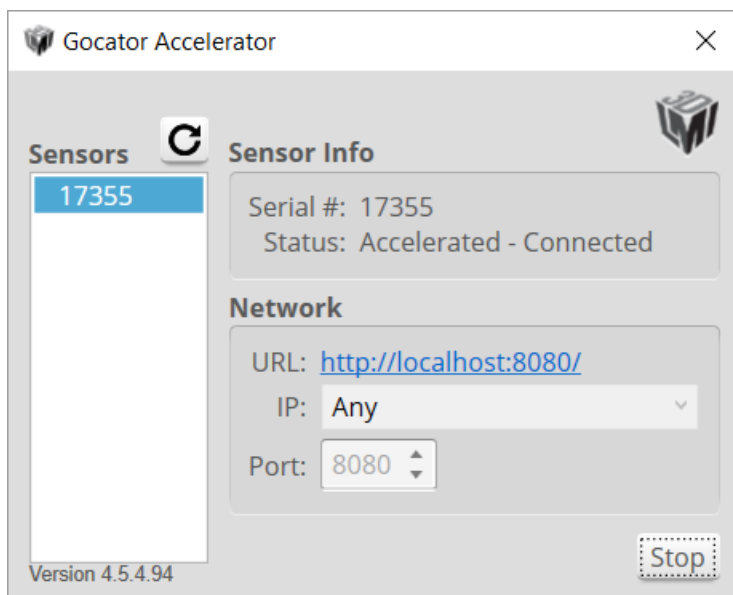
The memory of accelerated sensors is limited only by the memory of the PC on which the Accelerator is running. Accelerated sensors can therefore handle large 3D point clouds more effectively.

Installation

To get the Accelerator, go to <http://lmi3d.com/support>, choose your product from the Product Downloads section, and download it from the Download Center. You can find the GoAccelerator application in the 14405-X.X.X.X_SOFTWARE_GO_Tools.zip package. The libraries and DLL for integrating GoAccelerator into a SDK application are included in the 14400-X.X.X.X_SOFTWARE_GO_SDK.zip, available at the same location.

Gocator Accelerator Application

The Gocator Accelerator application accelerates the standalone sensor or dual-sensor system you choose.



An SDK application can interface to the Accelerator application the same way as a physical sensor. For more information on SDK application integration, see *SDK Application Integration* on page 267.

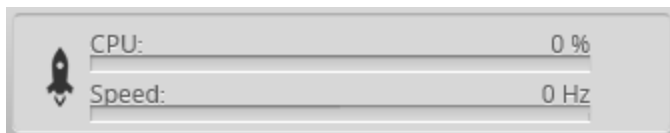
To accelerate a sensor using the Gocator Accelerator application:

1. Power up the sensor system you want to accelerate.
2. Launch the Gocator Accelerator application.
3. If a Windows Security alert asks whether you want to allow GoAccelerator.exe to communicate on networks, make sure **Public** and **Private** are checked, and then click **Allow Access**.
4. Click the sensor you want to accelerate in the **Sensors** list.
If you do not see the sensor, you may need to wait a few seconds and then click the Refresh button ().
5. (Optional) Choose an IP in the **IP** list, or choose **Any** to let the application choose.
6. (Optional) Change the port in **Port**.

 If port 8080 is already in use, set **Port** to another port.

7. Click **Start**.
The sensor is now accelerated.
8. In the Gocator Accelerator application, click the link next to **URL** to open the accelerated sensor's web interface.

When a sensor is accelerated, a "rocket" icon appears in the [metrics area](#).



 If you restart an accelerated sensor, the sensor will continue to be accelerated when it restarts.

To stop an accelerated sensor in the Gocator Accelerator application:

1. Select the sensor in the **Sensors** list.
2. Click **Stop**.

To exit the Gocator Accelerator application:

1. Right-click the icon Gocator Accelerator icon () in the notification tray.
Clicking the X icon in the application only minimizes the application.
2. Choose **Exit**.

Dashboard and Health Indicators

After a sensor is accelerated, the values of some health indicators come from the accelerating PC instead of the sensor. Others come from a combination of the accelerated sensor and the accelerating PC.

- For information on which indicators are affected in the Dashboard in the web interface, see *State and Health Information* on page 246.
- For information on which indicators accessed through the Gocator protocol are affected, see *Health Results* on page 401.

SDK Application Integration



When you integrate the Gocator accelerator into an SDK application, the firmware version of the accelerator must match the firmware version of the sensor to guarantee proper operations.

Gocator Accelerator can be fully integrated into a SDK application. Users simply need to instantiate the GoAccelerator object and connect it to a sensor object.

```
GoAccelerator accelerator = kNULL;

// obtain GoSensor object by sensor IP address
if ((status = GoSystem_FindSensorByIpAddress(system, &ipAddress, &sensor)) != kOK)
{
    printf("Error: GoSystem_FindSensorByIpAddress:%d\n", status);
    return;
}

// construct accelerator
if ((status = GoAccelerator_Construct(&accelerator, kNULL)) != kOK)
{
    printf("Error: GoAccelerator_Construct:%d\n", status);
    return;
}

// start accelerator
if ((status = GoAccelerator_Start(accelerator)) != kOK)
{
    printf("Error: GoAccelerator_Start:%d\n", status);
    return;
}

printf("GoAccelerator_Start completed\n");
if ((status = GoAccelerator_Attach(accelerator, sensor)) != kOK)
{
    printf("Error: GoAccelerator_Attach:%d\n", status);
    return;
}

// create connection to GoSensor object
if ((status = GoSensor_Connect(sensor)) != kOK)
{
    printf("Error: GoSensor_Connect:%d\n", status);
    return;
}
```

After, the SDK application is the same as controlling and acquiring data from a standalone sensor.

Limitations

The Gocator Accelerator currently has the following limitations:

1. Digital, Serial and Analog I/Os are not supported.
2. Only one instance of the Gocator Accelerator can run at a time. Note that one instance can accelerate one standalone sensor or a dual-sensor system.

These limitations will be removed in future releases.

Gocator Device Files

This section describes the user-accessible device files stored on a Gocator.

Live Files

Various "live" files stored on a Gocator sensor represent the sensor's active settings and transformations (represented together as "job" files), the active replay data (if any), and the sensor log.

By changing the live job file, you can change how the sensor behaves. For example, to make settings and transformations active, [write to](#) or [copy to](#) the `_live.job` file. You can also save active settings or transformations to a client computer, or to a file on the sensor, by [reading from](#) or [copying](#) these files, respectively.



The live files are stored in volatile storage. Only user-created job files are stored in non-volatile storage.

The following table lists the live files:

Live Files

Name	Read/Write	Description
<code>_live.job</code>	Read/Write	The active job. This file contains a Configuration component containing the current settings. If Alignment Reference in the active job is set to Dynamic, it also contains a Transform component containing transformations. For more information on job files (live and user-created), accessing their components, and their structure, see <i>Job Files</i> on the next page.
<code>_live.cfg</code>	Read/Write	A standalone representation of the Configuration component contained in <code>_live.job</code> . Used primarily for backwards compatibility.
<code>_live.tfm</code>	Read/Write	If Alignment Reference of the active job is set to Dynamic: A copy of the Transform component in <code>_live.job</code> . Used primarily for backwards compatibility. If Alignment Reference of the active job is set to Fixed: The transformations that are used for <i>all</i> jobs whose Alignment Reference setting is set to Fixed.
<code>_live.log</code>	Read	A sensor log containing various messages. For more information on the log file, see <i>Log File</i> below.
<code>_live.rec</code>	Read/Write	The active replay simulation data.
<code>ExtendedId.xml</code>	Read	Sensor identification.

Log File

The log file contains log messages generated by the sensor. The root element is *Log*.

To access the log file, use the [Read File](#) command, passing "_live.log" to the command. The log file is read-only.

Log Child Elements

Element	Type	Description
@idStart	64s	Identifier of the first log.
@idEnd	64s	Identifier of the final log.
List of (Info Warning Error)	List	An ordered list of log entries. This list is empty if idEnd < idStart.

Log/Info | Log/Warning | Log/Error Elements

Element	Type	Description
@time	64u	Log time, in uptime (μ s).
@source	32u	The serial number of the sensor the log was produced by.
@id	32u	The Identifier, or index, of the log
@value	String	Log content; may contain printf-style format specifiers (e.g. %u).
List of (IntArg FloatArg Arg)	List	An ordered list of arguments: IntArg – Integer argument FloatArg – Floating-point argument Arg – Generic argument

The arguments are all sent as strings and should be applied in order to the format specifiers found in the content.

Job Files

The following sections describe the structure of job files.

Job files, which are stored in a Gocator's internal storage, control system behavior when a sensor is running. Job files contain the settings and potentially the transformations and models associated with the job (if [Alignment Reference](#) is set to Dynamic).

There are two kinds of job files:

- A special job file called "_live.job." This job file contains the *active* settings and potentially the transformations and models associated with the job. It is stored in volatile storage.
- Other job files that are stored in non-volatile storage.

Job File Components

A job file contains components that can be loaded and saved as independent files. The following table lists the components of a job file:

Job File Components

Component	Path	Description
Configuration	config.xml	The job's configurations. This component is always present.
Transform	transform.xml	Transformation values. Present only if Alignment Reference is set to Dynamic.
Part model	<name>.mdl	One or more part model files. Part models are created using models and part matching .

Elements in the components contain three types of values: settings, constraints, and properties. Settings are input values that can be edited. Constraints are read-only limits that define the valid values for settings. Properties are read-only values that provide supplemental information related to sensor setup.

When a job file is received from a sensor, it will contain settings, constraints, and properties. When a job file is sent to a sensor, any constraints or properties in the file will be ignored.

Changing the value of a setting can affect multiple constraints and properties. After you upload a job file, you can download the job file again to access the updated values of the constraints and properties.

All Gocator sensors share a common job file structure.

Accessing Files and Components

Job file components can be accessed individually as XML files using path notation. For example, the configurations in a user-created job file called *productionRun01.job* can be read by passing "productionRun01.job/config.xml" to the [Read File](#) command. In the same way, the configurations in the active job could be read using "_live.job/config.xml".



If [Alignment Reference](#) is set to Fixed, the active job file (_live.job) will not contain transformations. To access transformations in this case, you must access them via _live.tfm.



The following sections correspond to the XML structure used in job file components.

Configuration

The Configuration component of a job file contains settings that control how a Gocator sensor behaves.

You can access the Configuration component of the active job as an XML file, either using path notation, via "_live.job/config.xml", or directly via "_live.cfg".

You can access the Configuration component in user-created job files in non-volatile storage, for example, "productionRun01.job/config.xml". You can only access configurations in user-created job files using path notation.

See the following sections for the elements contained in this component.

Configuration Child Elements

Element	Type	Description
@version	32u	Configuration version (101).

Element	Type	Description
@versionMinor	32u	Configuration minor version (5).
Setup	Section	For a description of the Setup elements, see <i>Setup</i> below.
Replay	Section	Contains settings related to recording filtering (see <i>Replay</i> on page 290).
Streams	Section	Read-only collection of available data streams (see <i>Streams/Stream (Read-only)</i> on page 291).
ToolOptions	Section	List of available tool types and their information. See <i>ToolOptions</i> on page 292 for details.
Tools	Collection	Collection of sections. Each section is an instance of a tool and is named by the type of the tool it describes. For more information, see the sections for each tool under <i>Tools</i> on page 294.
Tools.options	String (CSV)	Deprecated. Replaced by ToolOptions .
Outputs	Section	For a description of the Output elements, see <i>Output</i> on page 343.

Setup

The Setup element contains settings related to system and sensor setup.

Setup Child Elements

Element	Type	Description
TemperatureSafetyEnabled	Bool	Enables laser temperature safety control.
TemperatureSafetyEnabled.used	Bool	Whether or not this property is used.
ScanMode	32s	The default scan mode.
ScanMode options	String (CSV)	List of available scan modes.
OcclusionReductionEnabled	Bool	Enables occlusion reduction.
OcclusionReductionEnabled.used	Bool	Whether or not property is used.
OcclusionReductionEnabled.value	Bool	Actual value used if not configurable.
OcclusionReductionAlg	32s	The Algorithm to use for occlusion reduction: 0 – Standard 1 – High Quality
OcclusionReductionAlg.used	Bool	Whether or not property is used
OcclusionReductionAlg.value	Bool	Actual value used if not configurable
UniformSpacingEnabled	Bool	Enables uniform spacing.
UniformSpacingEnabled.used	Bool	Whether or not property is used.
UniformSpacingEnabled.value	Bool	Actual value used if not configurable.
IntensityEnabled	Bool	Enables intensity data collection.

Element	Type	Description
IntensityEnabled.used	Bool	Whether or not property is used.
IntensityEnabled.value	Bool	Actual value used if not configurable.
FlickerFreeModeEnabled	Bool	Enables flicker-free operation.
FlickerFreeModeEnabled.used	Bool	Whether flicker-free operation can be used on this sensor.
ExternalInputZPulseEnabled	Bool	Enables the External Input based encoder Z Pulse feature.
Filters	Section	See <i>Filters</i> below. Used by Gocator profile and snapshot sensors.
Trigger	Section	See <i>Trigger</i> on page 276.
Layout	Section	See <i>Layout</i> on page 277.
Alignment	Section	See <i>Alignment</i> on page 278.
Devices	Collection	A collection of two Device sections (with roles main and buddy). See <i>Devices / Device</i> on page 279.
SurfaceGeneration	Section	See <i>SurfaceGeneration</i> on page 284. Used by Gocator profile sensors.
SurfaceSections	Section	See <i>SurfaceSections</i> on page 286.
ProfileGeneration	Section	See <i>ProfileGeneration</i> on page 286. Used by Gocator displacement sensors.
PartDetection	Section	See <i>PartDetection</i> on page 287.
PartMatching	Section	See <i>PartMatching</i> on page 289.
Custom	Custom	Used by specialized sensors.

Filters

The Filters element contains settings related to post-processing profiles before they are output or used by measurement tools. This element is used by Gocator profile and snapshot sensors.

XSmoothing

XSmoothing Child Elements

Element	Type	Description
@used	Bool	Whether or not this field is used
Enabled	Bool	Enables filtering.
Window	64f	Window size (mm).
Window.min	64f	Minimum window size (mm).
Window.max	64f	Maximum window size (mm).

YSmoothing

YSmoothing Child Elements

Element	Type	Description
@used	Bool	Whether or not this field is used
Enabled	Bool	Enables filtering.

Element	Type	Description
Window	64f	Window size (mm).
Window.min	64f	Minimum window size (mm).
Window.max	64f	Maximum window size (mm).

XGapFilling

XGapFilling Child Elements

Element	Type	Description
@used	Bool	Whether or not this field is used
Enabled	Bool	Enables filtering.
Window	64f	Window size (mm).
Window.min	64f	Minimum window size (mm).
Window.max	64f	Maximum window size (mm).

YGapFilling

YGapFilling Child Elements

Element	Type	Description
@used	Bool	Whether or not this field is used
Enabled	Bool	Enables filtering.
Window	64f	Window size (mm).
Window.min	64f	Minimum window size (mm).
Window.max	64f	Maximum window size (mm).

XMedian

XMedian Child Elements

Element	Type	Description
@used	Bool	Whether or not this field is used
Enabled	Bool	Enables filtering.
Window	64f	Window size (mm).
Window.min	64f	Minimum window size (mm).
Window.max	64f	Maximum window size (mm).

YMedian

YMedian Child Elements

Element	Type	Description
@used	Bool	Whether or not this field is used
Enabled	Bool	Enables filtering.
Window	64f	Window size (mm).
Window.min	64f	Minimum window size (mm).
Window.max	64f	Maximum window size (mm).

XDecimation

XDecimation Child Elements

Element	Type	Description
@used	Bool	Whether or not this field is used
Enabled	Bool	Enables filtering.
Window	64f	Window size (mm).
Window.min	64f	Minimum window size (mm).
Window.max	64f	Maximum window size (mm).

YDecimation

YDecimation Child Elements

Element	Type	Description
@used	Bool	Whether or not this field is used
Enabled	Bool	Enables filtering.
Window	64f	Window size (mm).
Window.min	64f	Minimum window size (mm).
Window.max	64f	Maximum window size (mm).

XSlope

	This filter is only available on displacement sensors.
---	--

XSlope Child Elements

Element	Type	Description
@used	Bool	Whether or not this field is used
Enabled	Bool	Enables filtering.
Window	64f	Window size (mm).
Window.min	64f	Minimum window size (mm).
Window.max	64f	Maximum window size (mm).

YSlope

	This filter is only available on displacement sensors.
---	--

YSlope Child Elements

Element	Type	Description
@used	Bool	Whether or not this field is used
Enabled	Bool	Enables filtering.
Window	64f	Window size (mm).
Window.min	64f	Minimum window size (mm).
Window.max	64f	Maximum window size (mm).

Trigger

The Trigger element contains settings related to trigger source, speed, and encoder resolution.

Trigger Child Elements

Element	Type	Description
Source	32s	Trigger source: 0 – Time 3 – Software
Source.options	32s (CSV)	List of available source options.
Units	32s	Sensor triggering units when source is not clock or encoder: 0 – Time 1 – Encoder
FrameRate	64f	Frame rate for time trigger (Hz).
FrameRate.min	64f	Minimum frame rate (Hz).
FrameRate.max	64f	Maximum frame rate (Hz).
FrameRate.maxSource	32s	Source of maximum frame rate limit: 0 – Imager 1 – Surface generation
MaxFrameRateEnabled	Bool	Enables maximum frame rate (ignores FrameRate).
EncoderSpacing	64f	Encoder spacing for encoder trigger (mm).
EncoderSpacing.min	64f	Minimum encoder spacing (mm).
EncoderSpacing.max	64f	Maximum encoder spacing (mm).
EncoderSpacing.minSource	32s	Source of minimum encoder spacing: 0 – Resolution 1 – Surface generation
EncoderSpacing.used	Bool	Whether or not this parameter is configurable.
EncoderTriggerMode	32s	Encoder triggering mode: 0 – Tracking backward 1 – Bidirectional 2 – Ignore backward
Delay	64f	Trigger delay (μ s or mm).
Delay.min	64f	Minimum trigger delay (μ s or mm).
Delay.max	64f	Maximum trigger delay (μ s or mm).
GateEnabled	Bool	Enables digital input gating.
GateEnabled.used	Bool	True if this parameter can be configured.
GateEnabled.value	Bool	Actual value if the parameter cannot be configured.
BurstEnabled	Bool	Enables burst triggering.
BurstEnabled.Used	Bool	Whether or not this parameter is configurable.
BurstCount	32u	Number of scans to take during burst triggering.

Element	Type	Description
BurstCount.used	Bool	Whether or not this parameter is configurable.
BurstCount.max	32u	Maximum burst count.

Layout

Layout Child Elements

Element	Type	Description
DataSource	32s	Data source of the layout output (read-only): 0 – Top 1 – Bottom 2 – Top left 3 – Top right 4 – Top Bottom 5 – Left Right
XSpacingCount	32u	Number of points along X when data is resampled.
YSpacingCount	32u	Number of points along Y when data is resampled.
TransformedDataRegion	Region3D	Transformed data region of the layout output.
Orientation	32s	Sensor orientation: 0 – Wide 1 – Opposite 2 – Reverse 3 – Grid
Grid	Grid	Grid representation of the multi-sensor layout.
Orientation.options	32s (CSV)	List of available orientation options.
Orientation.value	32s	Actual value used if not configurable.
MultiplexBuddyEnabled	Bool	Enables multiplexing for buddies.
MultiplexSingleEnabled	Bool	Enables multiplexing for a single sensor configuration.
MultiplexSingleExposureDuration	64f	Exposure duration in μ s (currently rounded to integer when read by the sensor)
MultiplexSingleDelay	64f	Delay in μ s. (Currently gets rounded up when read by the sensor.)
MultiplexSinglePeriod	64f	Period in μ s. (Currently gets rounded up when read by the sensor.)
MultiplexSinglePeriod.min	64f	Minimum period in μ s.

Region3D Child Elements

Element	Type	Description
X	64f	X start (mm).
Y	64f	Y start (mm).
Z	64f	Z start (mm).
Width	64f	X extent (mm).
Length	64f	Y extent (mm).

Element	Type	Description
Height	64f	Z extent (mm).
ZAngle	64f	Z Angle start (degrees).
ZAngle.used	Bool	Whether or not this property is used.

Grid Elements

Element	Type	Description
ColumnCount	32u	Column count.
ColumnCount.value	32u	Column count value.

Alignment

The Alignment element contains settings related to alignment and encoder calibration.

Alignment Child Elements

Element	Type	Description
@used	Bool	Whether or not this field is used
InputTriggerEnabled	Bool	Enables digital input-triggered alignment operation.
InputTriggerEnabled.used	Bool	Whether or not this feature can be enabled. This feature is available only on some sensor models.
InputTriggerEnabled.value	Bool	Actual feature status.
Type	32s	Type of alignment operation: 0 – Stationary 1 – Moving
Type.options	32s (CSV)	List of available alignment types.
StationaryTarget	32s	Stationary alignment target: 0 – None 1 – Disk 2 – Bar 3 – Plate
StationaryTarget.options	32s (CSV)	List of available stationary alignment targets.
MovingTarget	32s	Moving alignment target: 0 – None 1 – Disk 2 – Bar 3 – Plate
MovingTarget.options	32s (CSV)	List of available moving alignment targets.
EncoderCalibrateEnabled	Bool	Enables encoder resolution calibration.
Disk	Section	See <i>Disk</i> on the next page.
Bar	Section	See <i>Bar</i> on the next page.
Plate	Section	See <i>Plate</i> on the next page.

Disk

Disk Child Elements

Element	Type	Description
Diameter	64f	Disk diameter (mm).
Height	64f	Disk height (mm).

Bar

Bar Child Elements

Element	Type	Description
Width	64f	Bar width (mm).
Height	64f	Bar height (mm).
HoleCount	32u	Number of holes.
HoleCount.value	32u	Actual number of holes expected by system.
HoleCount.used	Bool	Whether the hole count will be used in the bar alignment procedure.
HoleDistance	64f	Distance between holes (mm).
HoleDistance.used	Bool	Whether the hole distance will be used in the bar alignment procedure.
HoleDiameter	64f	Diameter of holes (mm).
HoleDiameter.used	Bool	Whether the hole diameter will be used in the bar alignment procedure.

Plate

Plate Child Elements

Element	Type	Description
Height	64f	Plate height (mm).
HoleCount	32u	Number of holes.
RefHoleDiameter	64f	Diameter of reference hole (mm).
SecHoleDiameter	64f	Diameter of secondary hole(s) (mm).

Devices / Device

Devices / Device Child Elements

Element	Type	Description
@role	32s	Sensor role: 0 – Main
Layout	Layout	Multiplexing bank settings.
DataSource	32s	Data source of device output (read-only): 0 – Top
XSpacingCount	32u	Number of resampled points along X (read-only).
YSpacingCount	32u	Number of resampled points along Y (read-only).
ActiveArea	Region3D	Active area. (Contains min and max attributes for each element.)

Element	Type	Description
TransformedDataRegion	Region3D	Active area after transformation (read-only).
FrontCamera	Window	Front camera window (read-only).
BackCamera	Window	Back camera window (read-only).
BackCamera.used	Bool	Whether or not this field is used.
PatternSequenceType	32s	The projector pattern sequence to display when a projector equipped device is running. The following types are possible: -1 – None 0 – Default 100 – Nine Lines
PatternSequenceType.options	32s	List of available pattern sequence types.
PatternSequenceType.used	Bool	Whether or not this field is used.
PatternSequenceCount	32u	Number of frames in the active sequence (read-only).
ExposureMode	32s	Exposure mode: 0 – Single exposure 1 – Multiple exposures
ExposureMode.options	32s (CSV)	List of available exposure modes.
Exposure	64f	Single exposure (μ s).
Exposure.min	64f	Minimum exposure (μ s).
Exposure.max	64f	Maximum exposure (μ s).
Exposure.used	Bool	Whether or not this field is used.
DynamicExposureMin	64f	Dynamic exposure range minimum (μ s).
DynamicExposureMax	64f	Dynamic exposure range maximum (μ s).
ExposureSteps	64f (CSV)	Mutiple exposure list (μ s).
ExposureSteps.countMin	32u	Minimum number of exposure steps.
ExposureSteps.countMax	32u	Maximum number of exposure steps.
IntensitySource	32s	Intensity source: 0 – Both cameras 1 – Front camera 2 – Back camera
IntensitySource.options	32s (CSV)	List of available intensity sources.
ZSubsampling	32u	Subsampling factor in Z.
ZSubsampling.options	32u (CSV)	List of available subsampling factors in Z.
SpacingInterval	64f	Uniform spacing interval (mm).
SpacingInterval.min	64f	Minimum spacing interval (mm).
SpacingInterval.max	64f	Maximum spacing interval (mm).

Element	Type	Description
SpacingInterval.used	Bool	Whether or not field is used.
SpacingInterval value	64f	Actual value used.
SpacingIntervalType	32s	Spacing interval type: 0 – Maximum resolution 1 – Balanced 2 – Maximum speed 3 – Custom
SpacingIntervalType.used	Bool	Whether or not this field is used.
Tracking	Section	See <i>Tracking</i> on the next page.
Material	Section	See <i>Material</i> on the next page.
IndependentExposures	Section	See <i>IndependentExposures</i> on page 284
Custom	Custom	Used by specialized sensors.

Region3D Child Elements

Element	Type	Description
X	64f	X start (mm).
Y	64f	Y start (mm).
Z	64f	Z start (mm).
Width	64f	X extent (mm).
Length	64f	Y extent (mm).
Height	64f	Z extent (mm).
ZAngle	64f	Z Angle start (degrees).
ZAngle.used	Bool	Whether or not this property is used.

Window Child Elements

Element	Type	Description
X	32u	X start (pixels).
Y	32u	Y start (pixels).
Width	32u	X extent (pixels).
Height	32u	Y extent (pixels).

Layout Child Elements

Element	Type	Description
Grid	Grid	Layout grid information.
MultiplexingBank	32u	Multiplexing bank ID
MultiplexingBank.used	32u	Whether or not this field can be specified
MultiplexingBank.value	32u	Actual value used by system

Grid Child Elements

Element	Type	Description
@used	Bool	Whether or not this section is used.
Row	32s	Device row position in grid layout.
Row.value	32s	Value in use by the sensor, useful for determining value when used is false.
Column	32s	Device column position in grid layout.
Column.value	32s	Value in use by the sensor, useful for determining value when used is false.
Direction	32s	Sensor orientation direction.
Direction.value	32s	Value in use by the sensor, useful for determining value when used is false.

Tracking

	Tracking is only available on Gocator 2300 and 2400 series sensors.
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Tracking Child Elements

Element	Type	Description
Enabled	Bool	Enables tracking.
Enabled.used	Bool	Whether or not this field is used.
SearchThreshold	64f	Percentage of spots that must be found to remain in track.
Height	64f	Tracking window height (mm).
Height.min	64f	Minimum tracking window height (mm).
Height.max	64f	Maximum tracking window height (mm).

Material

Material Child Elements

Element	Type	Description
Type	32s	Type of Material settings to use. 0 – Custom 1 – Diffuse
Type.used	Bool	Determines if the setting's value is currently used.
Type.value	32s	Value in use by the sensor, useful for determining value when used is false.
SpotThreshold	32s	Spot detection threshold.
SpotThreshold.used	Bool	Determines if the setting's value is currently used.
SpotThreshold.value	32s	Value in use by the sensor, useful for determining value when used is false.
SpotWidthMax	32s	Spot detection maximum width.
SpotWidthMax.used	Bool	Determines if the setting's value is currently used.

Element	Type	Description
SpotWidthMax.value	32s	Value in use by the sensor, useful for determining value when used is false.
SpotWidthMax.min	32s	Minimum allowed spot detection maximum value.
SpotWidthMax.max	32s	Maximum allowed spot detection maximum value.
SpotSelectionType	32s	Spot selection type 0 – Best. Picks the strongest spot in a given column. 1 – Top. Picks the spot which is most Top/Left on the imager 2 – Bottom. Picks the spot which is most Bottom/Right on the imager 3 – None. All spots are available. This option may not be available in some configurations. 4 – Continuity. Picks the most continuous spot.
SpotSelectionType.used	Bool	Determines if the setting's value is currently used.
SpotSelectionType.value	32s	Value in use by the sensor, useful for determining value when used is false.
SpotSelectionType.options	32s (CSV)	List of available spot selection types.
CameraGainAnalog	64f	Analog camera gain factor.
CameraGainAnalog.used	Bool	Determines if the setting's value is currently used.
CameraGainAnalog.value	64f	Value in use by the sensor, useful for determining value when used is false.
CameraGainAnalog.min	64f	Minimum value.
CameraGainAnalog.max	64f	Maximum value.
CameraGainDigital	64f	Digital camera gain factor.
CameraGainDigital.used	Bool	Determines if the setting's value is currently used.
CameraGainDigital.value	64f	Value in use by the sensor, useful for determining value when used is false.
CameraGainDigital.min	64f	Minimum value.
CameraGainDigital.max	64f	Maximum value.
DynamicSensitivity	64f	Dynamic exposure control sensitivity factor. This can be used to scale the control setpoint.
DynamicSensitivity.used	Bool	Determines if the setting's value is currently used.
DynamicSensitivity.value	64f	Value in use by the sensor, useful for determining value when used is false.
DynamicSensitivity.min	64f	Minimum value.
DynamicSensitivity.max	64f	Maximum value.
DynamicThreshold	32s	Dynamic exposure control threshold. If the detected number of spots is fewer than this number, the exposure will be increased.

Element	Type	Description
DynamicThreshold.used	Bool	Determines if the setting's value is currently used.
DynamicThreshold.value	32s	Value in use by the sensor, useful for determining value when used is false.
DynamicThreshold.min	32s	Minimum value.
DynamicThreshold.max	32s	Maximum value.
SensitivityCompensationEnabled	Bool	Sensitivity compensation toggle. Used in determining analog and digital gain, along with exposure scale.
SensitivityCompensationEnabled.used	Bool	Determines if the setting's value is currently used.
SensitivityCompensationEnabled.value	Bool	Value in use by the sensor, useful for determining value when used is false.
GammaType	32s	Gamma type.
GammaType used	Bool	Determines if the setting's value is currently used.
GammaType value	32s	Value in use by the sensor. Useful for determining value when used is false.
SpotContinuitySorting	Section	See <i>SpotContinuitySorting Child Elements</i> below.

SpotContinuitySorting Child Elements

Element	Type	Description
MinimumSegmentSize	32u	Smallest continuous segment considered in continuity sorting.
SearchWindow/X	32u	X component of continuity sorting search window size.
SearchWindow/Y	32u	Y component of continuity sorting search window size.

IndependentExposures

IndependentExposures Child Elements

Element	Type	Description
@used	Bool	Whether this field is used
Enabled	Bool	Whether to allow using separate exposure values for each camera
FrontCameraExposure	64f	The exposure value to use for the front camera
FrontCameraExposure.min	64f	The minimum exposure value possible for front camera
FrontCameraExposure.max	64f	The maximum exposure value possible for back camera
BackCameraExposure	64f	The exposure value to use for the front camera
BackCameraExposure.min	64f	The minimum exposure value possible for front camera
BackCameraExposure.max	64f	The maximum exposure value possible for back camera

SurfaceGeneration

The SurfaceGeneration element contains settings related to surface generation.

This element is used by Gocator laser profile sensors.

SurfaceGeneration Child Elements

Element	Type	Description
Type	32s	Surface generation type: 0 – Continuous 1 – Fixed length 2 – Variable length 3 – Rotational
FixedLength	Section	See <i>FixedLength</i> below.
VariableLength	Section	See <i>VariableLength</i> below.
Rotational	Section	See <i>Rotational</i> below.

FixedLength

FixedLength Child Elements

Element	Type	Description
StartTrigger	32s	Start trigger condition: 0 – Sequential 1 – Digital input
Length	64f	Surface length (mm).
Length.min	64f	Minimum surface length (mm).
Length.max	64f	Maximum surface length (mm).

VariableLength

VariableLength Child Elements

Element	Type	Description
MaxLength	64f	Maximum surface length (mm).
MaxLength.min	64f	Minimum value for maximum surface length (mm).
MaxLength.max	64f	Maximum value for maximum surface length (mm).

Rotational

Rotational Child Elements

Element	Type	Description
Circumference	64f	Circumference (mm).
Circumference.min	64f	Minimum circumference (mm).
Circumference.max	64f	Maximum circumference (mm).

SurfaceSections

SurfaceSections Child Elements

Element	Type	Description
@xMin	64f	The minimum valid X value to be used for section definition.
@xMax	64f	The maximum valid X value to be used for section definition.
@yMin	64f	The minimum valid Y value to be used for section definition.
@yMax	64f	The maximum valid Y value to be used for section definition.
Section	Collection	A series of Section elements.

Section Child Elements

Element	Type	Description
@id	32s	The ID assigned to the surface section.
@name	String	The name associated with the surface section.
StartPoint	Point64f	The beginning point of the surface section.
EndPoint	Point64f	The end point of the surface section.
CustomSpacingIntervalEnabled	Bool	Indicates whether a user specified custom spacing interval is to be used for the resulting section.
SpacingInterval	64f	The user specified spacing interval.
SpacingInterval.min	64f	The spacing interval limit minimum.
SpacingInterval.max	64f	The spacing interval limit maximum.
SpacingInterval.value	64f	The current spacing interval used by the system.

ProfileGeneration

The ProfileGeneration element contains settings related to profile generation.

This element is used by Gocator laser displacement sensors.

ProfileGeneration Child Elements

Element	Type	Description
Type	32s	Profile generation type: 0 – Continuous 1 – Fixed length 2 – Variable length 3 – Rotational
FixedLength	Section	See <i>FixedLength</i> on the next page.
VariableLength	Section	See <i>VariableLength</i> on the next page.
Rotational	Section	See <i>Rotational</i> on the next page.

FixedLength

FixedLength Child Elements

Element	Type	Description
StartTrigger	32s	Start trigger condition: 0 – Sequential 1 – Digital input
Length	64f	Profile length (mm).
Length.min	64f	Minimum profile length (mm).
Length.max	64f	Maximum profile length (mm).

VariableLength

VariableLength Child Elements

Element	Type	Description
MaxLength	64f	Maximum surface length (mm).
MaxLength.min	64f	Minimum value for maximum profile length (mm).
MaxLength.max	64f	Maximum value for maximum profile length (mm).

Rotational

Rotational Child Elements

Element	Type	Description
Circumference	64f	Circumference (mm).
Circumference.min	64f	Minimum circumference (mm).
Circumference.max	64f	Maximum circumference (mm).

PartDetection

PartDetection Child Elements

Element	Type	Description
Enabled	Bool	Enables part detection.
Enabled.used	Bool	Whether or not this field is used.
Enabled value	Bool	Actual value used if not configurable.
Threshold	64f	Height threshold (mm).
Threshold.min	64f	Minimum height threshold (mm).
Threshold.max	64f	Maximum height threshold (mm).
ThresholdDirection	32u	Threshold direction: 0 – Above 1 – Below
MinArea	64f	Minimum area (mm ²).
MinArea.min	64f	Minimum value of minimum area.

Element	Type	Description
MinArea.max	64f	Maximum value of minimum area.
MinArea.used	Bool	Whether or not this field is used.
GapWidth	64f	Gap width (mm).
GapWidth.min	64f	Minimum gap width (mm).
GapWidth.max	64f	Maximum gap width (mm).
GapWidth.used	Bool	Whether or not this field is used.
GapLength	64f	Gap length (mm).
GapLength.min	64f	Minimum gap length (mm).
GapLength.max	64f	Maximum gap length (mm).
GapLength.used	Bool	Whether or not this field is used.
PaddingWidth	64f	Padding width (mm).
PaddingWidth.min	64f	Minimum padding width (mm).
PaddingWidth.max	64f	Maximum padding width (mm).
PaddingWidth.used	Bool	Whether or not this field is used.
PaddingLength	64f	Padding length (mm).
PaddingLength.min	64f	Minimum padding length (mm).
PaddingLength.max	64f	Maximum padding length (mm).
PaddingLength.used	Bool	Whether or not this field is used.
MinLength	64f	Minimum length (mm).
MinLength.min	64f	Minimum value of minimum length (mm).
MinLength.max	64f	Maximum value of minimum length (mm).
MinLength.used	Bool	Whether or not this field is used.
MaxLength	64f	Maximum length (mm).
MaxLength.min	64f	Minimum value of maximum length (mm).
MaxLength.max	64f	Maximum value of maximum length (mm).
MaxLength.used	Bool	Whether or not this field is used.
FrameOfReference	32s	Part frame of reference: 0 – Sensor 1 – Scan 2 – Part
FrameOfReference.used	Bool	Whether or not this field is used.
FrameOfReference.value	32s	Actual value.
EdgeFiltering	Section	See <i>EdgeFiltering</i> on the next page.

EdgeFiltering

EdgeFiltering Child Elements

Element	Type	Description
@used	Bool	Whether or not this section is used.
Enabled	Bool	Enables edge filtering.
PreserveInteriorEnabled	Bool	Enables preservation of interior.
ElementWidth	64f	Element width (mm).
ElementWidth.min	64f	Minimum element width (mm).
ElementWidth.max	64f	Maximum element width (mm).
ElementLength	64f	Element length (mm).
ElementLength.min	64f	Minimum element length (mm).
ElementLength.max	64f	Maximum element length (mm).

PartMatching

The PartMatching element contains settings related to part matching.

PartMatching Child Elements

Element	Type	Description
Enabled	Bool	Enables part matching.
Enabled.used	Bool	Whether or not this field is used.
MatchAlgo	32s	Match algorithm. 0 – Edge points 1 – Bounding Box 2 – Ellipse
Edge	Section	See <i>Edge</i> below.
BoundingBox	Section	See <i>BoundingBox</i> below.
Ellipse	Section	See <i>Ellipse</i> on the next page.

Edge

Edge Child Elements

Element	Type	Description
ModelName	String	Name of the part model to use. Does not include the .mdl extension.
Acceptance/Quality/Min	64f	Minimum quality value for a match.

BoundingBox

BoundingBox Child Elements

Element	Type	Description
ZAngle	64f	Z rotation to apply to bounding box (degrees).
AsymmetryDetectionType	32s	Determine whether to use asymmetry detection and, if enabled, which dimension is the basis of detection. The possible values are:

Element	Type	Description
		0 – None 1 – Length 2 – Width
Acceptance/Width/Min	64f	Minimum width (mm).
Acceptance/Width/Max	64f	Maximum width (mm).
Acceptance/Length/Min	64f	Minimum length (mm).
Acceptance/Length/Max	64f	Maximum length (mm).

Ellipse

Ellipse Child Elements

Element	Type	Description
ZAngle	64f	Z rotation to apply to ellipse (degrees).
AsymmetryDetectionType	32s	Determine whether to use asymmetry detection and, if enabled, which dimension is the basis of detection. The possible values are: 0 – None 1 – Major 2 – Minor
Acceptance/Major/Min	64f	Minimum major length (mm).
Acceptance/Major/Max	64f	Maximum major length (mm).
Acceptance/Minor/Min	64f	Minimum minor length (mm).
Acceptance/Minor/Max	64f	Maximum minor length (mm).

Replay

Contains settings related to recording filtering.

RecordingFiltering

RecordingFiltering Child Elements

Element	Type	Description
ConditionCombineType	32s	0 – Any: If any enabled condition is satisfied, the current frame is recorded. 1 – All: All enabled conditions must be satisfied for the current frame to be recorded.
Conditions	Collection	A collection of AnyMeasurement , AnyData , or Measurement conditions.

Conditions/AnyMeasurement

Conditions/AnyMeasurement Elements

Element	Type	Description
Enabled	Bool	Indicates whether the condition is enabled.
Result	32s	The measurement decision criteria to be included in the filter. Possible values are: 0 – Pass 1 – Fail 2 – Valid 3 – Invalid

Conditions/AnyData

Conditions/AnyData Elements

Element	Type	Description
Enabled	Bool	Indicates whether the condition is enabled.
RangeCountCase	32s	The case under which to record data: 0 – Range count at or above threshold of valid data points. 1 – Range count below threshold.
RangeCountThreshold	32u	The threshold for the number of range points that are valid.

Conditions/Measurement

Conditions/Measurement Elements

Element	Type	Description
Enabled	Bool	Indicates whether the condition is enabled.
Ids	32s	The ID of the measurement to filter.
Result	32s	The measurement decision criteria for the selected ID to be included in the filter. Possible values are: 0 – Pass 1 – Fail 2 – Valid 3 – Invalid

Streams/Stream (Read-only)

Streams/Stream Child Elements

Element	Type	Description
Step	32s	The data step of the stream being described. Possible values are: 1 – Video 2 – Range 3 – Surface

Element	Type	Description
		4 – Section
Id	32u	The stream ID.
TempoGroup	32u	Represents a stage in the data processing pipeline. The greater the number, the farther removed from the initial acquisition stage.
Sources	Collection	A collection of Source elements as described below.

Source Child Elements

Element	Type	Description
Id	32s	The ID of the data source. Possible values are: 0 – Top 1 – Bottom 2 – Top Left 3 – Top Right 4 – Top Bottom 5 – Left Right
Capability	32s	The capability of the data stream source. Possible values are: 0 – Full 1 – Diagnostic only 2 – Virtual
Region	Region3d	The region of the given stream source.
AdditionalRegions	Collection	Collection of additional regions (for example, for the second camera).
AdditionalRegions/Region	Region3d	Additional regions.

ToolOptions

The ToolOptions element contains a list of available tool types, their measurements, and settings for related information.

ToolOptions Child Elements

Element	Type	Description
<Tool Names>	Collection	A collection of tool name elements. An element for each tool type is present.

Tool Name Child Elements

Element	Type	Description
@displayName	String	Display name of the tool.
@isCustom	Bool	Reserved for future use.
MeasurementOptions	Collection	See <i>MeasurementOptions</i> on the next page
FeatureOptions	Collection	See <i>FeatureOptions</i> on the next page.
StreamOptions	Collection	See <i>StreamOptions</i> on the next page.

MeasurementOptions

MeasurementOptions Child Elements

Element	Type	Description
<Measurement Names>	Collection	A collection of measurement name elements. An element for each measurement is present.

<Measurement Name> Child Elements

Element	Type	Description
@displayName	String	Display name of the tool.
@minCount	32u	Minimum number of instances in a tool.
@maxCount	32u	Maximum number of instances in a tool.

FeatureOptions

FeatureOptions Child Elements

Element	Type	Description
<Feature Names>	Collection	A collection of feature name elements. An element for each measurement is present.

<Feature Name> Child Elements

Element	Type	Description
@displayName	String	Display name of the feature.
@minCount	32u	Minimum number of instances in a tool.
@maxCount	32u	Maximum number of instances in a tool.
@dataType	String	The data type of the feature. One of: – PointFeature – LineFeature – CircleFeature – PlaneFeature

StreamOptions

StreamOptions Child Elements

Element	Type	Description
@step	32s	The data step of the stream being described. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
@ids	CSV	A list representing the available IDs associated with the given step.

Tools

The Tools element contains measurement tools. The following sections describe each tool and its available measurements.

Tools Child Elements

Element	Type	Description
@options	String (CSV)	A list of the tools available in the currently selected scan mode.
<ToolType>	Section	An element for each added tool.

Profile Types

The following types are used by various measurement tools.

ProfileFeature

An element of type ProfileFeature defines the settings for detecting a feature within an area of interest.

ProfileFeature Child Elements

Element	Type	Description
Type	32s	Determine how the feature is detected within the area: 0 – Max Z 1 – Min Z 2 – Max X 3 – Min X 4 – Corner 5 – Average 6 – Rising Edge 7 – Falling Edge 8 – Any Edge 9 – Top Corner 10 – Bottom Corner 11 – Left Corner 12 – Right Corner 13 – Median
RegionEnabled	Bool	Indicates whether feature detection applies to the defined Region or to the entire active area.
Region	ProfileRegion2D	Element for feature detection area.

ProfileLine

An element of type ProfileLine defines measurement areas used to calculate a line.

ProfileLine Child Elements

Element	Type	Description
RegionCount	32s	Count of the regions.
Regions	(Collection)	The regions used to calculate a line. Contains one or two Region elements of type ProfileRegion2D , with RegionEnabled fields for each.

ProfileRegion2d

An element of type ProfileRegion2d defines a rectangular area of interest.

ProfileRegion2d Child Elements

Element	Type	Description
X	64f	Setting for profile region X position (mm).
Z	64f	Setting for profile region Z position (mm).
Width	64f	Setting for profile region width (mm).
Height	64f	Setting for profile region height (mm).

Surface Types

The following types are used by the various measurement tools.

Region3D

An element of type Region3D defines a rectangular area of interest in 3D.

Region3D Child Elements

Element	Type	Description
X	64f	Volume X position (mm).
Y	64f	Volume Y position (mm).
Z	64f	Volume Z position (mm).
Width	64f	Volume width (mm).
Length	64f	Volume length (mm).
Height	64f	Volume height (mm).

SurfaceFeature

An element of type SurfaceFeature defines the settings for detecting a feature within an area of interest.

SurfaceFeature Child Elements

Element	Type	Description
Type	32s	Setting to determine how the feature is detected within the area: 0 – Average (formerly Centroid 2d) 1 – Centroid (formerly Centroid 3d) 2 – X Max 3 – X Min 4 – Y Max 5 – Y Min 6 – Z Max 7 – Z Min 8 – Median
RegionEnabled	Boolean	Setting to enable/disable region: 0 – Disable 1 – Enable
Region	Region3D	Element for feature detection volume.

SurfaceRegion2d

An element of type SurfaceRegion2d defines a rectangular area of interest on the X-Y plane.

SurfaceRegion2d Child Elements

Element	Type	Description
X	64f	Setting for surface region X position (mm).
Y	64f	Setting for surface region Y position (mm).
Width	64f	Setting for region width (mm).
Length	64f	Setting for region length (mm).

Geometric Feature Types

The Geometric Feature type is used by various measurement tools.

Feature Child Elements

Element	Type	Description
@id	32s	The identifier of the geometric feature. -1 if unassigned.
@dataType	String	The data type of the feature. One of: - PointFeature - LineFeature
@type	String	Type name of feature.
Name	String	The display name of the feature.
Enabled	Bool	Whether the given feature output is enabled.
Parameters	Collection	Collection of GdkParam elements.

Parameter Types

The following types are used by internal and custom (user-created) GDK-based tools.

GDK Parameter Child Elements

Element	Type	Description
@label	String	Parameter label.
@type	String	Type of parameter. It is one of the following (see tables below for elements found in each type): - Bool - Int - Float - ProfileRegion - SurfaceRegion2d - SurfaceRegion3d - GeometricFeature
@options	Variant (CSV)	Options available for this parameter.
@optionNames	String (CSV)	Names

GDK Parameter Bool Type

Element	Type	Description
	Bool	Boolean value of parameter.

GDK Parameter Int Type

Element	Type	Description
	32s	Integer value of parameter of integer type.

GDK Parameter Float Type

Element	Type	Description
	64f	Floating point value of parameter.

GDK Parameter String Type

Element	Type	Description
	String	String value of parameter.

GDK Parameter Profile Region Type

Element	Type	Description
X	64f	X value of region.
Z	64f	Z value of region.
Width	64f	Width value of region.
Height	64f	Height value of region.

GDK Parameter Surface Region 2D Type

Element	Type	Description
X	64f	X value of region.
X	64f	X value of region.
Y	64f	Y value of region.
Width	64f	Width value of region.
Length	64f	Length value of region.

GDK Parameter Surface Region 3D Type

Element	Type	Description
X	64f	X value of region.
Y	64f	Y value of region.
Z	64f	Z value of region.
Width	64f	Width value of region.
Length	64f	Length value of region.
Height	64f	Height value of region.
ZAngle	64f	ZAngle value of region.

GDK Parameter Geometric Feature Type

Element	Type	Description
	32s	Geometric feature Id for parameter.

ProfileArea

A ProfileArea element defines settings for a profile area tool and one or more of its measurements.

ProfileArea Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>ProfileArea</i> above.
Source	32s	Profile source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
Type	Boolean	Area to measure: 0 – Object (convex shape above the baseline) 1 – Clearance (concave shape below the baseline)
Type.used	Boolean	Whether or not field is used.
Baseline	Boolean	Baseline type: 0 – X-axis 1 – Line
Baseline.used	Boolean	Whether or not field is used.
RegionEnabled	Boolean	If enabled, the defined region is used for measurements. Otherwise, the full active area is used.
Region	ProfileRegion2d	Measurement region.
Line	ProfileLine	Line definition when Baseline is set to Line.
Measurements\Area	Area tool measurement	Area measurement.
Measurements\CentroidX	Area tool measurement	CentroidX measurement.
Measurements\CentroidZ	Area tool measurement	CentroidZ measurement.
Features\CenterPoint	GeometricFeature	CenterPoint PointFeature.

Area Tool Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

ProfileBoundingBox

A ProfileBoundingBox element defines settings for a profile bounding box tool and one or more of its measurements.

ProfileBoundingBox Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>ProfileBoundingBox</i> above.
Source	32s	Profile source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video

Element	Type	Description
		2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
RegionEnabled	Bool	Whether or not to use the region. If the region is disabled, all available data is used.
Region	ProfileRegion2d	Measurement region.
Measurements\X	Bounding Box tool measurement	X measurement.
Measurements\Z	Bounding Box tool measurement	Z measurement.
Measurements\Width	Bounding Box tool measurement	Width measurement.
Measurements\Height	Bounding Box tool measurement	Height measurement.
Measurements\GlobalX	Bounding Box tool measurement	GlobalX measurement
Measurements\GlobalY	Bounding Box tool measurement	GlobalY measurement
Measurements\GlobalAngle	Bounding Box tool measurement	GlobalAngle measurement
Features\CenterPoint	GeometricFeature	CenterPoint PointFeature.
Features\CornerPoint	GeometricFeature	CornerPoint PointFeature.

Bounding Box Tool Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state

Element	Type	Description
		0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

ProfileCircle

A ProfileCircle element defines settings for a profile circle tool and one or more of its measurements.

ProfileCircle Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>ProfileCircle</i> above.
Source	32s	Profile source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
RegionEnabled	Bool	Whether or not to use the region. If the region is disabled, all available data is used.
Region	ProfileRegion2d	Measurement region.
Measurements\X	Circle tool measurement	X measurement.
Measurements\Z	Circle tool measurement	Z measurement.
Measurements\Radius	Circle tool measurement	Radius measurement.
Features\CenterPoint	GeometricFeature	CenterPoint PointFeature.

Circle Tool Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

ProfileDimension

A ProfileDimension element defines settings for a profile dimension tool and one or more of its measurements.

ProfileDimension Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Not used.
Source	32s	Profile source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video

Element	Type	Description
		2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
RefFeature	ProfileFeature	Reference measurement region.
Feature	ProfileFeature	Measurement region.
Measurements\Width	Dimension tool measurement	Width measurement.
Measurements\Height	Dimension tool measurement	Height measurement.
Measurements\Distance	Dimension tool measurement	Distance measurement.
Measurements\CenterX	Dimension tool measurement	CenterX measurement.
Measurements\CenterZ	Dimension tool measurement	CenterZ measurement.

Dimension Tool Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.

Element	Type	Description
DecisionMax	64f	Maximum decision threshold.
Absolute (Width and Height measurements only)	Boolean	Setting for selecting absolute or signed result: 0 – Signed 1 – Absolute

ProfileGroove

A ProfileGroove element defines settings for a profile groove tool and one or more of its measurements.

The profile groove tool is dynamic, meaning that it can contain multiple measurements of the same type in the Measurements element.

ProfileGroove Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Not used.
Source	32s	Profile source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
Shape	32s	Shape: 0 – U-shape 1 – V-shape 2 – Open
MinDepth	64f	Minimum depth.
MinWidth	64f	Minimum width.
MaxWidth	64f	Maximum width.
RegionEnabled	Bool	Whether or not to use the region. If the region is disabled, all available data is used.
Region	ProfileRegion2d	Measurement region.
Measurements\X	Groove tool measurement	X measurement.

Element	Type	Description
Measurements\Z	Groove tool measurement	Z measurement.
Measurements\Width	Groove tool measurement	Width measurement.
Measurements\Depth	Groove tool measurement	Depth measurement.

Groove Tool Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.
SelectType	32s	Method of selecting a groove when multiple grooves are found: 0 – Max depth 1 – Ordinal, from left 2 – Ordinal, from right
SelectIndex	32s	Index when SelectType is set to 1 or 2.
Location (X and Z measurements only)	32s	Setting for groove location to return from: 0 – Bottom 1 – Left corner 2 – Right corner

ProfileIntersect

A ProfileIntersect element defines settings for a profile intersect tool and one or more of its measurements.

ProfileIntersect Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>ProfileIntersect</i> above.
Source	32s	Profile source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
RefType	32s	Reference line type: 0 – Fit 1 – X Axis
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
RefLine	ProfileLine	Definition of reference line. Ignored if RefType is not 0.
Line	ProfileLine	Definition of line.
Measurements\X	Intersect tool measurement	X measurement.
Measurements\Z	Intersect tool measurement	Z measurement.
Measurements\Angle	Intersect tool measurement	Angle measurement.
Features\IntersectPoint	GeometricFeature	IntersectPoint PointFeature.
Features\Line	GeometricFeature	Line LineFeature.
Features\BaseLine	GeometricFeature	BaseLine LineFeature.

Intersect Tool Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).

Element	Type	Description
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.
Absolute (Angle measurement only)	Boolean	Setting for selecting the angle range: 0 – A range of -90 to 90 degrees is used. 1 – A range of 0 to 180 degrees is used.

ProfileLine

A ProfileLine element defines settings for a profile line tool and one or more of its measurements.

ProfileLine Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>ProfileLine</i> above.
Source	32s	Profile source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video

Element	Type	Description
		2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
RegionEnabled	Bool	Whether or not to use the region. If the region is disabled, all available data is used.
Region	ProfileRegion2d	Measurement region.
FittingRegions	ProfileLine	ProfileLine describing regions to fit to.
FittingRegionsEnabled	Bool	Whether the fitting regions are enabled.
Measurements\StdDev	Line tool measurement	StdDev measurement.
Measurements\MaxError	Line tool measurement	MaxError measurement.
Measurements\MinError	Line tool measurement	MinError measurement.
Measurements\Percentile	Line tool measurement	Percentile measurement.
Measurements\Offset	Line tool measurement	Offset measurement.
Measurements\Angle	Line tool measurement	Angle measurement.
Measurements\MinErrorX	Line tool measurement	Minimum Error in X measurement.
Measurements\MinErrorZ	Line tool measurement	Minimum Error in Z measurement.
Measurements\MaxErrorX	Line tool measurement	Maximum Error in X measurement.
Measurements\MaxErrorZ	Line tool measurement	Maximum Error in Z measurement.
Features\Line	GeometricFeature	Line LineFeature.
Features\ErrorMinPoint	GeometricFeature	ErrorMinPoint PointFeature.
Features\ErrorMaxPoint	GeometricFeature	ErrorMaxPoint PointFeature.

Line Tool Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable

Element	Type	Description
		1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.
Percent	64f	Error percentile. (Percentile measurement only)

ProfilePanel

A ProfilePanel element defines settings for a profile panel tool and one or more of its measurements.

ProfilePanel Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Not used.
Source	32s	Profile source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.

Element	Type	Description
RefSide	32s	Setting for reference side to use.
MaxGapWidth	64f	Setting for maximum gap width (mm).
LeftEdge	ProfilePanelEdge	Element for left edge configuration.
RightEdge	ProfilePanelEdge	Element for right edge configuration.
Measurements\Gap	Gap/Flush measurement	Gap measurement.
Measurements\Flush	Gap/Flush measurement	Flush measurement.
Measurements\LeftGapX	Gap/Flush measurement	Left Gap X measurement.
Measurements\LeftGapZ	Gap/Flush measurement	Left Gap Z measurement.
Measurements\LeftFlushX	Gap/Flush measurement	Left Flush X measurement.
Measurements\LeftFlushZ	Gap/Flush measurement	Left Flush Z measurement.
Measurements\LeftSurfaceAngle	Gap/Flush measurement	Left Surface Angle measurement.
Measurements\RightGapX	Gap/Flush measurement	Right Gap X measurement.
Measurements\RightGapZ	Gap/Flush measurement	Right Gap Z measurement.
Measurements\RightFlushX	Gap/Flush measurement	Right Flush X measurement.
Measurements\RightFlushZ	Gap/Flush measurement	Right Flush Z measurement.
Measurements\RightSurfaceAngle	Gap/Flush measurement	Right Surface Angle measurement.
<i>ProfilePanelEdge</i>		
Element	Type	Description
EdgeType	32s	Edge type: 0 – Tangent 1 – Corner
MinDepth	64f	Minimum depth.
MaxVoidWidth	64f	Maximum void width.
SurfaceWidth	64f	Surface width.
SurfaceOffset	64f	Surface offset.
NominalRadius	64f	Nominal radius.

Element	Type	Description
EdgeAngle	64f	Edge angle.
RegionEnabled	Bool	Whether or not to use the region. If the region is disabled, all available data is used.
Region	ProfileRegion2d	Edge region.

Gap/Flush Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.
Axis (Gap measurement only)	32s	Measurement axis: 0 – Edge 1 – Surface 2 – Distance
Absolute (Flush measurement only)	Boolean	Setting for selecting absolute or signed result: 0 – Signed 1 – Absolute

ProfilePosition

A ProfilePosition element defines settings for a profile position tool and one or more of its measurements.

ProfilePosition Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>ProfilePosition</i> on the previous page.
Source	32s	Profile source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
Feature	ProfileFeature	Element for feature detection.
Measurements\X	Position tool measurement	X measurement.
Measurements\Z	Position tool measurement	Z measurement.
Features\Point	GeometricFeatureTypes.htm eature	Point PointFeature

Position Tool Measurement

Element	Type	Description
id (attribute)	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable

Element	Type	Description
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

ProfileRoundCorner

A ProfileRoundCorner element defines settings for a profile round corner tool and one or more of its measurements.

ProfileRoundCorner Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Not used.
Source	32s	Profile source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
RefDirection	32s	Setting for reference side to use: 0 – Left 1 – Right
Edge	ProfilePanelEdge	Element for edge configuration
Measurements\X	Round Corner tool measurement	X measurement.
Measurements\Z	Round Corner tool measurement	Z measurement.
Measurements\Angle	Round Corner tool measurement	Angle measurement.

ProfilePanelEdge

Element	Type	Description
EdgeType	32s	Edge type: 0 – Tangent 1 – Corner
MinDepth	64f	Minimum depth.
MaxVoidWidth	64f	Maximum void width.
SurfaceWidth	64f	Surface width.
SurfaceOffset	64f	Surface offset.
NominalRadius	64f	Nominal radius.
EdgeAngle	64f	Edge angle.
RegionEnabled	Bool	Whether or not to use the region. If the region is disabled, all available data is used.
Region	ProfileRegion2d	Edge region.

Round Corner Tool Measurement

Element	Type	Description
id (attribute)	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

ProfileStrip

A ProfileStrip element defines settings for a profile strip tool and one or more of its measurements.

The profile strip tool is dynamic, meaning that it can contain multiple measurements of the same type in the Measurements element.

ProfileStrip Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Not used.
Source	32s	Profile source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
BaseType	32s	Setting for the strip type: 0 – None 1 – Flat
LeftEdge	Bitmask	Setting for the left edge conditions: 1 – Raising 2 – Falling 4 – Data End 8 – Void
RightEdge	Bitmask	Setting for the right edge conditions: 1 – Raising 2 – Falling 4 – Data End 8 – Void
TiltEnabled	Boolean	Setting for tilt compensation: 0 – Disabled 1 – Enabled
SupportWidth	64f	Support width of edge (mm).
TransitionWidth	64f	Transition width of edge (mm).
MinWidth	64f	Minimum strip width (mm).

Element	Type	Description
MinHeight	64f	Minimum strip height (mm).
MaxVoidWidth	64f	Void max (mm).
Region	ProfileRegion2d	Region containing the strip.
Measurements\X	Strip tool measurement	X measurement.
Measurements\Z	Strip tool measurement	Z measurement.
Measurements\Width	Strip tool measurement	Width measurement.
Measurements\Height	Strip tool measurement	Width measurement.

Strip Tool Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.
SelectType	32s	Method of selecting a groove when multiple grooves are found: 0 – Best 1 – Ordinal, from left 2 – Ordinal, from right

Element	Type	Description
SelectIndex	32s	Index when SelectType is set to 1 or 2.
Location (X, Z, and Height measurements only)	32s	Setting for groove location to return from: 0 – Left 1 – Right 2 – Center

Script

A Script element defines settings for a script measurement.

Script Child Elements

Element	Type	Description
Name	String	Tool name.
Code	String	Script code.
Measurements\Output	(Collection)	Dynamic list of Output elements.

Output

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.

SurfaceBoundingBox

A SurfaceBoundingBox element defines settings for a surface bounding box tool and one or more of its measurements.

SurfaceBoundingBox Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>SurfaceBoundingBox</i> above.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Anchor\ZAngle	String (CSV)	The Z Angle measurements (IDs) used for anchoring.
Anchor\ZAngle.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.

Element	Type	Description
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
ZRotationEnabled	Boolean	Setting to enable/disable rotation of bounding box
AsymmetryDetectionType	32s	Determine whether to use asymmetry detection and if enabled, which dimension would be the basis of detection. The possible values are: 0 – None 1 – Length 2 – Width
RegionEnabled	Boolean	Setting to enable/disable region.
Region	Region3D	Measurement region.
Measurements\X	Bounding Box tool measurement	X measurement.
Measurements\Y	Bounding Box tool measurement	Y measurement.
Measurements\Z	Bounding Box tool measurement	Z measurement.
Measurements\Width	Bounding Box tool measurement	Width measurement.
Measurements\Length	BoundingBoxMeasurement	Length measurement
Measurements\Height	Bounding Box tool measurement	Height measurement.
Measurements\ZAngle	Bounding Box tool measurement	ZAngle measurement.
Measurements\GlobalX	Bounding Box tool measurement	Global X measurement.
Measurements\GlobalY	Bounding Box tool measurement	Global Y measurement.
Measurements\GlobalZAngle	Bounding Box tool measurement	Global Z Angle measurement.
Features\CenterPoint	GeometricFeature	CenterPoint PointFeature
<i>Bounding Box Tool Measurement</i>		
Element	Type	Description
id (attribute)	32s	Measurement ID. Optional (measurement disabled if not

Element	Type	Description
		set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

SurfaceCsHole

A SurfaceCsHole element defines settings for a surface countersunk hole tool and one or more of its measurements.

SurfaceCsHole Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>SurfaceCsHole</i> above.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Anchor\ZAngle	String (CSV)	The Z Angle measurements (IDs) used for anchoring.
Anchor\ZAngle.options	String (CSV)	The Z measurements (IDs) available for anchoring.

Element	Type	Description
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
NominalBevelAngle	64f	Nominal bevel angle (mm).
NominalOuterRadius	64f	Nominal outer radius (mm).
NominalInnerRadius	64f	Nominal inner radius (mm).
BevelRadiusOffset	64f	Bevel radius offset (mm).
Shape	32s	The shape of the countersunk hole: 0 – Cone 1 – Counterbore
PartialDetectionEnabled	Boolean	Setting to enable/disable partial detection: 0 – Disable 1 – Enable
RegionEnabled	Boolean	Setting to enable/disable region: 0 – Disable 1 – Enable
Region	Region3D	Measurement region.
RefRegionsEnabled	Boolean	Setting to enable/disable reference regions: 0 – Disable 1 – Enable
RefRegionCount	32s	Count of the reference regions which are to be used
RefRegions	(Collection)	Reference regions. Contains 2 SurfaceRegion2D elements.
AutoTiltEnabled	Boolean	Setting to enable/disable tilt correction: 0 – Disable 1 – Enable
TiltXAngle	64f	Setting for manual tilt correction angle X.
TiltYAngle	64f	Setting for manual tilt correction angle Y.
CurveFitEnabled	Boolean	Setting to enable/disable curve fitting: 0 – Disable 1 – Enable
CurveOrientation	64f	The orientation of the curvature, in degrees.

Element	Type	Description
PlaneFitRangeEnabled	Boolean	Setting to enable/disable the use of the plane fit range
PlaneFitRange	64f	Setting for the tolerance to use when doing the plane fit
Measurements\X	Countersunk Hole tool measurement	X measurement.
Measurements\Y	Countersunk Hole tool measurement	Y measurement.
Measurements\Z	Countersunk Hole tool measurement	Z measurement.
Measurements\OuterRadius	Countersunk Hole tool measurement	Outer Radius measurement.
Measurements\Depth	Countersunk Hole tool measurement	Depth measurement.
Measurements\BevelRadius	Countersunk Hole tool measurement	Bevel Radius measurement.
Measurements\BevelAngle	Countersunk Hole tool measurement	Bevel Angle measurement.
Measurements\XAngle	Countersunk Hole tool measurement	X Angle measurement.
Measurements\YAngle	Countersunk Hole tool measurement	Y Angle measurement.
Measurements\CounterboreDepth	Countersunk Hole tool measurement	CounterboreDepth measurement.
Features\CenterPoint	GeometricFeature	CenterPoint PointFeature

Countersunk Hole Tool Measurement

Element	Type	Description
id (attribute)	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>SurfaceCsHole</i> on page 319.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable

Element	Type	Description
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

SurfaceDimension

A SurfaceDimension element defines settings for a surface dimension tool and one or more of its measurements.

SurfaceDimension Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Not used.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Anchor\ZAngle	String (CSV)	The Z Angle measurements (IDs) used for anchoring.
Anchor\ZAngle.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
Measurements\CenterX	Dimension tool measurement	Center X measurement
Measurements\CenterY	Dimension tool measurement	Center Y measurement
Measurements\CenterZ	Dimension tool measurement	Center Z measurement

Element	Type	Description
Measurements\Distance	Dimension tool measurement	Distance measurement
Measurements\PlaneDistance	Dimension tool measurement	Plane Distance measurement
Measurements\Height	Dimension tool measurement	Height measurement
Measurements\Length	Dimension tool measurement	Length measurement
Measurements\Width	Dimension tool measurement	Width measurement

Dimension Tool Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.
Absolute (Height, Length, and Width measurements only)	Boolean	Setting for selecting absolute or signed result. 0 – Signed 1 – Absolute

Tool

A Tool element of type SurfaceEdge defines settings for a surface edge tool and one or more of its measurements.

SurfaceEdge Child Elements

Element	Type	Description
@type	String	Type name of the tool.
@version	String	Version string for custom tool.
Name	String	Tool name.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Parameters\Region	GdkParamSurfaceRegion3d	Region Parameter.
Parameters\PathCount	GdkParamInt	Number of paths.
Parameters\PathWidth	GdkParamFloat	Path width.
Parameters\PathWidth.units	String	Units of path width (eg: mm).
Parameters\SelectEdge	GdkParamInt	Edge selection type. Is either: 0 – Best 1 – First 2 – Last
Parameters\EdgeDirection	GdkParamInt	Edge direction type. Is either: 0 – Rising 1 – Falling
Parameters\EdgeThreshold	GdkParamFloat	Edge threshold value.
Parameters\EdgeThreshold.units	String	Units of edge threshold (eg: mm).
Parameters\IntensityThreshold	GdkParamFloat	Intensity threshold value.
Parameters\EdgeSmoothing	GdkParamFloat	Edge smoothing value.
Parameters\EdgeSmoothing.units	String	Units of edge smoothing (eg: mm).
Parameters\EdgeMaxGap	GdkParamFloat	Edge max gap value.
Parameters\EdgeMaxGap.units	String	Units of edge max gap (eg: mm).
Parameters\FillBackground	GdkParamBool	Fill background boolean
Parameters\FillValue	GdkParamFloat	Fill value value.
Parameters\FillValue.units	String	Units of fill value (eg: mm).
Parameters\IntensityFillValue	GdkParamFloat	Intensity fill value value.
Parameters\IntensityFillValue.	8u	Intensity fill value minimum value.

Element	Type	Description
min		
Parameters\IntensityFillValue. max	8u	Intensity fill value maximum value.
Parameters\FillValue.units	String	Units of fill value (eg: mm).
Parameters\RenderDetail	GdkParamBool	Render detail Boolean.
Measurements\Measurement @type=X	Edge Measurement	Base X measurement.
Measurements\Measurement @type=Y	Edge Measurement	Base Y measurement.
Measurements\Measurement @type=Z	Edge Measurement	Base Z measurement.
Measurements\Measurement @type=ZAngle	Edge Measurement	Base ZAngle measurement.
Measurements\Measurement @type=Height	Edge Measurement	Base Height measurement.
Features\Feature @type=EdgeLine	Gdk Feature	EdgeLine line feature.
Features\Feature @type=CenterPoint	Gdk Feature	CenterPoint point feature.
Edge Measurement Child Elements		
@id	32s	Measurement ID. Optional (measurement disabled if not set).
@type	String	Type name of measurement.
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.

Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

SurfaceEllipse

A SurfaceEllipse element defines settings for a surface ellipse tool and one or more of its measurements.

SurfaceEllipse Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>SurfaceEllipse</i> above.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Anchor\ZAngle	String (CSV)	The Z Angle measurements (IDs) used for anchoring.
Anchor\ZAngle.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
RegionEnabled	Boolean	Setting to enable/disable region.
Region	Region3D	Measurement region.
AsymmetryDetectionType	32s	Determine whether to use asymmetry detection and if enabled, which dimension would be the basis of detection. The possible values are: 0 – None 1 – Major 2 – Minor
Measurements\Major	Ellipse tool measurement	Major measurement.
Measurements\Minor	Ellipse tool measurement	Minor measurement.

Element	Type	Description
Measurements\Ratio	Ellipse tool measurement	Ratio measurement.
Measurements\ZAngle	Ellipse tool measurement	ZAngle measurement.
Features\CenterPoint	GeometricFeature	CenterPoint PointFeature
Features\MajorAxisLine	GeometricFeature	MajorAxisLine LineFeature
Features\MinorAxisLine	GeometricFeature	MinorAxisLine LineFeature

Ellipse Tool Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

SurfaceHole

A SurfaceHole element defines settings for a surface hole tool and one or more of its measurements.

SurfaceHole Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>SurfaceHole</i> above.

Element	Type	Description
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Anchor\ZAngle	String (CSV)	The Z Angle measurements (IDs) used for anchoring.
Anchor\ZAngle.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
NominalRadius	64f	Nominal radius (mm).
RadiusTolerance	64f	Radius tolerance (mm).
PartialDetectionEnabled	Boolean	Setting to enable/disable partial detection: 0 – Disable 1 – Enable
DepthLimitEnabled	Boolean	Setting to enable/disable depth limit: 0 – Disable 1 – Enable
DepthLimit	64f	The depth limit relative to the surface. Data below this limit is ignored.
RegionEnabled	Boolean	Setting to enable/disable region: 0 – Disable 1 – Enable
Region	Region3D	Measurement region.
RefRegionsEnabled	Boolean	Setting to enable/disable reference regions: 0 – Disable 1 – Enable
RefRegionCount	32s	Count of the reference regions that are to be used.
RefRegions	(Collection)	Reference regions. Contains two RefRegion elements of type SurfaceRegion2D .

Element	Type	Description
AutoTiltEnabled	Boolean	Setting to enable/disable tilt correction: 0 – Disable 1 – Enable
TiltXAngle	64f	Setting for manual tilt correction angle X.
TiltYAngle	64f	Setting for manual tilt correction angle Y.
Measurements\X	Hole tool measurement	X measurement.
Measurements\Y	Hole tool measurement	Y measurement.
Measurements\Z	Hole tool measurement	Z measurement.
Measurements\Radius	Hole tool measurement	Radius measurement.
Features\CenterPoint	GeometricFeature	CenterPoint PointFeature

Hole Tool Measurement

Element	Type	Description
@id	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

SurfaceOpening

A SurfaceOpening element defines settings for a surface opening tool and one or more of its measurements.

SurfaceOpening Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>SurfaceOpening</i> above.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Anchor\ZAngle	String (CSV)	The Z Angle measurements (IDs) used for anchoring.
Anchor\ZAngle.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
Type	32s	Type of the opening: 0 – Rounded 1 – Slot
NominalWidth	64f	Nominal width (mm).
NominalLength	64f	Nominal length (mm).
NominalAngle	64f	Nominal angle (degrees).
NominalRadius	64f	Nominal radius (mm).
WidthTolerance	64f	Radius tolerance (mm).
LengthTolerance	64f	Length tolerance (mm).
AngleTolerance	64f	Angle tolerance (degrees).
PartialDetectionEnabled	Boolean	Setting to enable/disable partial detection: 0 – Disable 1 – Enable
DepthLimitEnabled	Boolean	Setting to enable/disable depth limit:

Element	Type	Description
		0 – Disable 1 – Enable
DepthLimit	64f	The depth limit relative to the surface. Data below this limit is ignored.
RegionEnabled	Boolean	Setting to enable/disable region: 0 – Disable 1 – Enable
Region	Region3D	Measurement region.
RefRegionsEnabled	Boolean	Setting to enable/disable reference regions: 0 – Disable 1 – Enable
RefRegionCount	32s	Count of the reference regions that are to be used.
RefRegions	(Collection)	Reference regions. Contains two RefRegion elements of type SurfaceRegion2D .
AutoTiltEnabled	Boolean	Setting to enable/disable tilt correction: 0 – Disable 1 – Enable
TiltXAngle	64f	Setting for manual tilt correction angle X.
TiltYAngle	64f	Setting for manual tilt correction angle Y.
Measurements\X	Opening tool measurement	X measurement.
Measurements\Y	Opening tool measurement	Y measurement.
Measurements\Z	Opening tool measurement	Z measurement.
Measurements\Width	Opening tool measurement	Width measurement.
Measurements\Length	Opening tool measurement	Length measurement.
Measurements\Angle	Opening tool measurement	Angle measurement.
Features\CenterPoint	GeometricFeature	CenterPoint PointFeature
<i>Opening Tool Measurement</i>		
Element	Type	Description
id (attribute)	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state:

Element	Type	Description
		0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

SurfacePlane

A SurfacePlane element defines settings for a surface plane tool and one or more of its measurements.

SurfacePlane Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Not used.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Anchor\ZAngle	String (CSV)	The Z Angle measurements (IDs) used for anchoring.
Anchor\ZAngle.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface

Element	Type	Description
		4 – Section
Stream\ld	32u	The stream source ID.
RegionsEnabled	Boolean	Setting to enable/disable regions: 0 – Disable 1 – Enable
RegionCount	32s	Count of the regions.
Regions	(Collection)	Measurement regions. Contains one or two Region elements of type Region3D .
Measurements\XAngle	Plane tool measurement	XAngle measurement.
Measurements\YAngle	Plane tool measurement	YAngle measurement.
Measurements\ZOffset	Plane tool measurement	ZOffset measurement.
Measurements\StdDev	Plane tool measurement	Standard deviation measurement
Measurements\MinError	Plane tool measurement	Minimum error measurement
Measurements\MaxError	Plane tool measurement	Maximum error measurement
<i>Plane Tool Measurement</i>		
Element	Type	Description
id (attribute)	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.

Element	Type	Description
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

SurfacePosition

A SurfacePosition element defines settings for a surface position tool and one or more of its measurements.

SurfacePosition Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>SurfacePosition</i> above.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Anchor\ZAngle	String (CSV)	The Z Angle measurements (IDs) used for anchoring.
Anchor\ZAngle.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
Feature	SurfaceFeature	Measurement feature.
Measurements\X	Position tool measurement	X measurement.
Measurements\Y	Position tool measurement	Y measurement.
Measurements\Z	Position tool measurement	Z measurement.
Features\Point	GeometricFeature	Point PointFeature

Position Tool Measurement

Element	Type	Description
id (attribute)	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.

SurfaceStud

A SurfaceStud element defines settings for a surface stud tool and one or more of its measurements.

SurfaceStud Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Collection of geometric feature outputs available in the tool. See <i>Feature Child Elements</i> on page 337.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Anchor\ZAngle	String (CSV)	The Z Angle measurements (IDs) used for anchoring.

Element	Type	Description
Anchor\ZAngle.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
StudRadius	64f	Radius of stud (mm).
StudHeight	64f	Height of stud (mm).
BaseHeight	64f	Height of stud's base.
TipHeight	64f	Height of stud's tip.
RegionEnabled	Boolean	Setting to enable/disable region.
Region	Region3D	Measurement region.
RefRegionsEnabled	Boolean	Setting to enable/disable reference regions: 0 – Disable 1 – Enable
RefRegionCount	32s	Count of the reference regions that are to be used.
RefRegions	(Collection)	Reference regions. Contains two RefRegion elements of type SurfaceRegion2D .
AutoTiltEnabled	Boolean	Setting to enable/disable tilt correction: 0 – Disable 1 – Enable
TiltXAngle	64f	Setting for manual tilt correction angle X.
TiltYAngle	64f	Setting for manual tilt correction angle Y.
Measurements\BaseX	Stud tool measurement	BaseX measurement.
Measurements\BaseY	Stud tool measurement	BaseY measurement.
Measurements\BaseZ	Stud tool measurement	BaseZ measurement.
Measurements\TipX	Stud tool measurement	TipX measurement.
Measurements\TipY	Stud tool measurement	TipY measurement.
Measurements\TipZ	Stud tool measurement	TipZ measurement.

Element	Type	Description
Measurements\Radius	Stud tool measurement	Radius measurement.
Features\TipPoint	GeometricFeature	TipPoint PointFeature
Features\BasePoint	GeometricFeature	BasePoint PointFeature

Stud Tool Measurement

Element	Type	Description
id (attribute)	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.
RadiusOffset	64f	Radius offset of the stud.

(Radius measurement only)

Feature Child Elements

Element	Type	Description
@id	32s	The identifier of the geometric feature. -1 if unassigned.
@dataType	String	The data type of the feature. One of: – PointFeature – LineFeature
Name	String	The display name of the feature.
Enabled	Bool	Whether the given feature output is enabled.

SurfaceVolume

A SurfaceVolume element defines settings for a surface volume tool and one or more of its measurements.

SurfaceVolume Child Elements

Element	Type	Description
Name	String	Tool name.
Features	Collection	Not used.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Anchor\ZAngle	String (CSV)	The Z Angle measurements (IDs) used for anchoring.
Anchor\ZAngle.options	String (CSV)	The Z measurements (IDs) available for anchoring.
StreamOptions	Collection	A collection of <i>StreamOptions</i> on page 293 elements.
Stream\Step	32s	The stream source step. Possible values are: 1 – Video 2 – Range 3 – Surface 4 – Section
Stream\ld	32u	The stream source ID.
RegionEnabled	Boolean	Setting to enable/disable region.
Region	Region3D	Measurement region.
Measurements\Volume	Volume tool measurement	Volume measurement.
Measurements\Area	Volume tool measurement	Area measurement.
Measurements\Thickness	Volume tool measurement	Thickness measurement.

Volume Tool Measurement

Element	Type	Description
id (attribute)	32s	Measurement ID. Optional (measurement disabled if not set).
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable

Element	Type	Description
		1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.
Location (Thickness measurement only)	32s	Measurement type: 0 – Maximum 1 – Minimum 2 – 2D Centroid 3 – 3D Centroid 4 – Average 5 – Median

Tool

A Tool element of type FeatureDimension defines settings for a feature dimension tool and one or more of its measurements.

Tool Child Elements

Element	Type	Description
@type	String	Type name of the tool.
@version	String	Version string for custom tool.
Name	String	Tool name.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.

Element	Type	Description
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Parameters\RefPoint	GdkParamGeometricFeature	Reference point feature.
Parameters\Feature	GdkParamGeometricFeature	Reference feature.
Parameters\PathWidth	GdkParamFloat	Path width.
Measurements\Measurement @type=Width	Dimension Measurement	Width measurement.
Measurements\Measurement @type=Length	Dimension Measurement	Length measurement.
Measurements\Measurement @type=Height	Dimension Measurement	Width measurement.
Measurements\Measurement @type=Distance	Dimension Measurement	Distance measurement.
Measurements\Measurement @type=PlaneDistance	Dimension Measurement	Plane distance measurement.
Measurements\Measurement @type=CenterX	Dimension Measurement	Center x measurement.
Measurements\Measurement @type=CenterY	Dimension Measurement	Center y measurement.
Measurements\Measurement @type=CenterZ	Dimension Measurement	Center z measurement.
<i>Dimension Measurement Child Elements</i>		
@id	32s	Measurement ID. Optional (measurement disabled if not set).
@type	String	Type name of measurement.
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.

Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.
Parameters\WidthAbsolute (Width measurement only)	GdkParamBool	Absolute width enabled boolean.
Parameters\LengthAbsolute (Length measurement only)	GdkParamBool	Absolute length enabled boolean.
Parameters\HeightAbsolute (Height measurement only)	GdkParamBool	Absolute height enabled boolean.

Tool

A Tool element of type FeatureIntersect defines settings for a feature intersection tool and one or more of its measurements.

Tool Child Elements

Element	Type	Description
@type	String	Type name of the tool.
@version	String	Version string for custom tool.
Name	String	Tool name.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Parameters\Line	GdkParamGeometricFeature	Line feature input.
Parameters\RefLine	GdkParamGeometricFeature	Reference line feature input.
Measurements\Measurement @type=X	Intersect Measurement	X measurement.
Measurements\Measurement @type=Y	Intersect Measurement	Y measurement.
Measurements\Measurement @type=Z	Intersect Measurement	Z measurement.
Measurements\Measurement @type=Angle	Intersect Measurement	Angle measurement.

Intersect Measurement Child Elements

@id	32s	Measurement ID. Optional (measurement disabled if not set).
-----	-----	---

@type	String	Type name of measurement.
Name	String	Measurement name.
Enabled	Boolean	Measurement enable state: 0 – Disable 1 – Enable
HoldEnabled	Boolean	Output hold enable state: 0 – Disable 1 – Enable
SmoothingEnabled	Boolean	Smoothing enable state: 0 – Disable 1 – Enable
PreserveInvalidsEnabled	Boolean	Preserve invalid measurements enable state 0 – Disable 1 – Enable
SmoothingWindow	32u	Smoothing window.
Scale	64f	Output scaling factor.
Offset	64f	Output offset factor.
DecisionMin	64f	Minimum decision threshold.
DecisionMax	64f	Maximum decision threshold.
Parameters\AngleRange	GdkParamInt	Angle range option choice. Is one of: 0 – -180 To 180 1 – 0 To 360

Custom

A Custom element defines settings for a user-created GDK-based tool and one or more of its measurements.

Custom Child Elements

Element	Type	Description
@type	String	Type name of the tool.
@version	String	Version string for custom tool.
Name	String	Tool name.
Source	32s	Surface source.
Anchor\X	String (CSV)	The X measurements (IDs) used for anchoring.
Anchor\X.options	String (CSV)	The X measurements (IDs) available for anchoring.
Anchor\Y	String (CSV)	The Y measurements (IDs) used for anchoring.
Anchor\Y.options	String (CSV)	The Y measurements (IDs) available for anchoring.
Anchor\Z	String (CSV)	The Z measurements (IDs) used for anchoring.

Element	Type	Description
Anchor\Z.options	String (CSV)	The Z measurements (IDs) available for anchoring.
Parameters	GDK Parameter	Collection of parameters . The element name in the job file is the name of the parameter.
Measurements	GDK Measurement	Collection of measurements .
Features	GDK Feature	Collection of features .

Output

The Output element contains the following sub-elements: Ethernet, Serial, Analog, Digital0, and Digital1. Each of these sub-elements defines the output settings for a different type of Gocator output.

For all sub-elements, the source identifiers used for measurement outputs correspond to the measurement identifiers defined in each tool's Measurements element. For example, in the following XML, in the options attribute of the Measurements element, 2 and 3 are the identifiers of measurements that are enabled and available for output. The value of the Measurements element (that is, 2) means that only the measurement with id 2 (Surface Hole X) will be sent to output.

```
<SurfaceHole>    ...
  <Measurements>
    <X id="2">    ...
    <Y id="3">    ...

<Output>
  <Ethernet>      ...
    <Measurements options="2,3">2</Measurements>
```

Ethernet

The Ethernet element defines settings for Ethernet output.

In the Ethernet element, the source identifiers used for video, range, profile, and surface output, as well as range, profile, and surface intensity outputs, correspond to the *sensor* that provides the data. For example, in the XML below, the *options* attribute of the Surfaces element shows that only two sources are available (see the table below for the meanings of these values). The value in this element—0—indicates that only data from that source will be sent to output.

```
<Output>
  <Ethernet>
    ...
    <Ranges options=""/>
    <Profiles options=""/>
    <Surfaces options="0,1">0</Surfaces>
    ...
```

Ethernet Child Elements

Element	Type	Description
Protocol	32s	Ethernet protocol: 0 – Gocator 1 – Modbus 2 – EtherNet/IP 3 – ASCII
TimeoutEnabled	Boolean	Enable or disable auto-disconnection timeout. Applies only to the Gocator protocol.
Timeout	64f	Disconnection timeout (seconds). Used when TimeoutEnabled is true and the Gocator protocol is selected.
Ascii	Section	See <i>Ascii</i> on the next page.
EIP	Section	See <i>EIP</i> on page 346.
Modbus	Section	See <i>Modbus</i> on page 346.
Videos	32s (CSV)	Selected video sources: 0 – Top 1 – Bottom 2 – Top left 3 – Top right
Videos.options	32s (CSV)	List of available video sources (see above).
Ranges	32s (CSV)	Selected range sources: 0 – Top 1 – Bottom 2 – Top left 3 – Top right
Ranges.options	32s (CSV)	List of available range sources (see above).
Profiles	32s (CSV)	Selected profile sources: 0 – Top 1 – Bottom 2 – Top left 3 – Top right
Profiles.options	32s (CSV)	List of available profile sources (see above).
Surfaces	32s (CSV)	Selected surface sources: 0 – Top 1 – Bottom 2 – Top left 3 – Top right

Element	Type	Description
Surfaces.options	32s (CSV)	List of available surface sources (see above).
RangeIntensities	32s (CSV)	Selected range intensity sources. 0 – Top 1 – Bottom 2 – Top left 3 – Top right
RangeIntensities.options	32s (CSV)	List of available range intensity sources (see above).
ProfileIntensities	32s (CSV)	Selected profile intensity sources. 0 – Top 1 – Bottom 2 – Top left 3 – Top right
ProfileIntensities.options	32s (CSV)	List of available profile intensity sources (see above).
SurfaceIntensities	32s (CSV)	Selected surface intensity sources: 0 – Top 1 – Bottom 2 – Top left 3 – Top right
SurfaceIntensities.options	32s (CSV)	List of available surface intensity sources (see above).
Measurements	32u (CSV)	Selected measurement sources.
Measurements.options	32u (CSV)	List of available measurement sources.
Events	32s (CSV)	CSV list of possible event options: 0 – Exposure Begins 1 – Exposure Ends
Events.options	32s (CSV)	List of available event options (see above).

Ascii

Ascii Child Elements

Element	Type	Description
Operation	32s	Operation mode: 0 – Asynchronous 1 – Polled
ControlPort	32u	Control service port number.
HealthPort	32u	Health service port number.
DataPort	32u	Data service port number.
Delimiter	String	Field delimiter.

Element	Type	Description
Terminator	String	Line terminator.
InvalidValue	String	String for invalid output.
CustomDataFormat	String	Custom data format.
CustomFormatEnabled	Bool	Enables custom data format.
StandardFormatMode	32u	The formatting mode used if not a custom format: 0 – Standard 1 – Standard with Stamp

EIP

EIP Child Elements

Element	Type	Description
BufferEnabled	Bool	Enables EtherNet/IP output buffering.
EndianOutputType	32s	Endian output type: 0 – Big endian 1 – Little endian
ImplicitOutputEnabled	Bool	Enables Implicit (I/O) Messaging.
ImplicitTriggerOverride	32s	Override requested trigger type by client: 0 – No override 1 – Cyclic 2 – Change of State

Modbus

Modbus Child Elements

Element	Type	Description
BufferEnabled	Bool	Enables Modbus output buffering.

Digital0 and Digital1

The Digital0 and Digital1 elements define settings for the Gocator's two digital outputs.

Digital0 and Digital1 Child Elements

Element	Type	Description
Event	32s	Triggering event: 0 – None (disabled) 1 – Measurements 2 – Software 3 – Alignment state 4 – Acquisition start 5 – Acquisition end

Element	Type	Description
SignalType	32s	Signal type: 0 – Pulse 1 – Continuous
ScheduleEnabled	Bool	Enables scheduling.
PulseWidth	64f	Pulse width (μs).
PulseWidth.min	64f	Minimum pulse width (μs).
PulseWidth.max	64f	Maximum pulse width (μs).
PassMode	32s	Measurement pass condition: 0 – AND of measurements is true 1 – AND of measurements is false 2 – Always assert
Delay	64f	Output delay (μs or mm, depending on delay domain defined below).
DelayDomain	32s	Output delay domain: 0 – Time (μs) 1 – Encoder (mm)
Inverted	Bool	Whether the sent bits are flipped.
Measurements	32u (CSV)	Selected measurement sources.
Measurements.options	32u (CSV)	List of available measurement sources.

Analog

The Analog element defines settings for analog output.

The range of valid measurement values [DataScaleMin, DataScaleMax] is scaled linearly to the specified current range [CurrentMin, CurrentMax].

Only one Value or Decision source can be selected at a time.

Analog Child Elements

Element	Type	Description
Event	32s	Triggering event: 0 – None (disabled) 1 – Measurements 2 – Software
ScheduleEnabled	Bool	Enables scheduling.
CurrentMin	64f	Minimum current (mA).
CurrentMin.min	64f	Minimum value of minimum current (mA).
CurrentMin.max	64f	Maximum value of minimum current (mA).
CurrentMax	64f	Maximum current (mA).
CurrentMax.min	64f	Minimum value of maximum current (mA).

Element	Type	Description
CurrentMax.max	64f	Maximum value of maximum current (mA).
CurrentInvalidEnabled	Bool	Enables special current value for invalid measurement value.
CurrentInvalid	64f	Current value for invalid measurement value (mA).
CurrentInvalid.min	64f	Minimum value for invalid current (mA).
CurrentInvalid.max	64f	Maximum value for invalid current (mA).
DataScaleMin	64f	Measurement value corresponding to minimum current.
DataScaleMax	64f	Measurement value corresponding to maximum current.
Delay	64f	Output delay (µs or mm, depending on delay domain defined below).
DelayDomain	32s	Output delay domain: 0 – Time (µs) 1 – Encoder (mm)
Measurement	32u	Selected measurement source.
Measurement.options	32u (CSV)	List of available measurement sources.



The delay specifies the time or position at which the analog output activates. Upon activation, there is an additional delay before the analog output settles at the correct value.

Serial

The Serial element defines settings for Serial output.

Serial Child Elements

Element	Type	Description
Protocol	32s	Serial protocol: 0 – ASCII 1 – Selcom
Protocol.options	32s (CSV)	List of available protocols.
Selcom	Section	See <i>Selcom</i> below.
Ascii	Section	See <i>Ascii</i> on the next page.
Measurements	32u (CSV)	Selected measurement sources.
Measurements.options	32u (CSV)	List of available measurement sources.

Selcom

Selcom Child Elements

Element	Type	Description
Rate	32u	Output bit rate.
Rate.options	32u (CSV)	List of available rates.
Format	32s	Output format: 0 – 12-bit 1 – 12-bit with search

Element	Type	Description
		2 – 14-bit 3 – 14-bit with search
Format.options	32s (CSV)	List of available formats.
DataScaleMin	64f	Measurement value corresponding to minimum word value.
DataScaleMax	64f	Measurement value corresponding to maximum word value.
Delay	64u	Output delay in μ s.

Ascii

Ascii Child Elements

Element	Type	Description
Delimiter	String	Field delimiter.
Terminator	String	Line terminator.
InvalidValue	String	String for invalid output.
CustomDataFormat	String	Custom data format.
CustomFormatEnabled	Bool	Enables custom data format.
StandardFormatMode	32u	The formatting mode used if not a custom format: 0 – Standard 1 – Standard with Stamp

Transform

The transformation component contains information about the physical system setup that is used to:

- Transform data from sensor coordinate system to another coordinate system (e.g., world)
- Define encoder resolution for encoder-based triggering
- Define the travel offset (Y offset) between sensors for staggered operation

You can access the Transform component of the active job as an XML file, either using path notation, via "_live.job/transform.xml", or directly via "_live.tfm".

You can access the Transform component in user-created job files in non-volatile storage, for example, "productionRun01.job/transform.xml". You can only access transformations in user-created job files using path notation.

See the following sections for the elements contained in this component.

Transformation Example:

```
<?xml version="1.0" encoding="UTF-8"?>
<Transform version="100">
  <EncoderResolution>1</EncoderResolution>
  <Speed>100</Speed>
  <Devices>
```

```

<Device role="0">
  <X>-2.3650924829</X>
  <Y>0.0</Y>
  <Z>123.4966803469</Z>
  <XAngle>5.7478302588</XAngle>
  <YAngle>3.7078302555</XAngle>
  <ZAngle>2.7078302556</XAngle>
</Device>
<Device id="1">
  <X>0</X>
  <Y>0.0</Y>
  <Z>123.4966803469</Z>
  <XAngle>5.7478302588</XAngle>
  <YAngle>3.7078302555</XAngle>
  <ZAngle>2.7078302556</XAngle>
</Device>
</Devices>
</Transform>

```

The Transform element contains the alignment record for the sensor.

Transform Child Elements

Element	Type	Description
@version	32u	Major transform version (100).
@versionMinor	32u	Minor transform version (0).
EncoderResolution	64f	Encoder Resolution (mm/tick).
Speed	64f	Travel Speed (mm/s).
Devices	(Collection)	Contains two Device elements.

Device

A Device element defines the transformation for a sensor. There is one entry element per sensor, identified by a unique role attribute (0 for main and 1 for buddy):

Device Child Elements

Element	Type	Description
@role	32s	Role of device described by this section: 0 – Main 1 – Buddy
X	64f	Translation on the X axis (mm).
Y	64f	Translation on the Y axis (mm).
Z	64f	Translation on the Z axis (mm).
XAngle	64f	Rotation around the X axis (degrees).
YAngle	64f	Rotation around the Y axis (degrees).
ZAngle	64f	Rotation around the Z axis (degrees).

The rotation (counter-clockwise in the X-Z plane) is performed before the translation.

Part Models

Part models represent models created using the part matching feature.

You can access a model in the active job using path notation. For example, to access a model called scan.mdl, use "_live.job/scan.mdl".

You can access part models in user-created job files in non-volatile storage, for example, "productionRun01.job/model1.mdl". You can only access part models in user-created job files using path notation.

See the following sections for the elements contained in a model.

Part models contain the following subcomponents. You can access the subcomponents using path notation, for example, "productionRun01.job/myModel.mdl/config.xml".

Part Model Child Elements

Element	Type	Description
Configuration	config.xml	Model configuration XML. It is always present. (See <i>Configuration</i> on the next page.)
Edge Points	edge-height-top	Edge points for the top heightmap. (See <i>Edge Points</i> below.)
Edge Points	edge-height-bottom	Edge points for the bottom heightmap.
Edge Points	edge-intensity-top	Edge points for the top intensity map.
Edge Points	edge-intensity-bottom	Edge points for the bottom intensity map.

The edge points file exists only when the model contains the source data for the edge points.

Edge Points

Edge Points Data

Field	Type	Offset	Description
id	16s	0	Sender ID -1 – Part matching
source	8s	2	Source 0 – Model 1 – Target
imageType	8s	3	Image type 0 – Height map 1 – Intensity map

Field	Type	Offset	Description
imageSource	8s	4	Image source 0 – Top 1 – Bottom
width	32u	5	Width of model space, in units of xScale
length	32u	9	Length of model space, un units of yScale
xScale	32u	13	X scale (nm)
yScale	32u	17	Y scale (nm)
xOffset	32s	21	X offset (μm)
yOffset	32s	25	Y offset μm
zAngle	32s	29	Z rotation (microdegrees)
pointCount	32u	33	Number of edge points
points[pointCount]	(32u, 32u)	37	Edge points collection. Each point is a tuple of x and y values, in units of xScale and yScale, respectively.

Configuration

Delete this text and replace it with your own content.

Configuration Child Elements

Element	Type	Description
@version	32u	Major version (1).
@versionMinor	32u	Minor version (0).
Edges	Collection	Collection of Edge items (described below).
EdgeSensitivity	64f	Sensitivity recorded during model edges generation (read-only).
TransformedDataRegion	Region3d	Data region of the model.
ZAngle	64f	Additional rotation applied to the model (degrees).
TargetEdgeSensitivity	64f	Sensitivity used to generate target edges.
ImageType	32s	Selects type of image used to generate edges: 0 – Height map 1 – Intensity map
ImageType.options	32s (CSV)	List of available image types.

Protocols

Gocator supports protocols for communicating with sensors over Ethernet (TCP/IP) and serial output. For a protocol to output data, it must be enabled and configured in the active job.

Protocols Available over Ethernet

- [Gocator](#)
- [Modbus](#)
- [EtherNet/IP](#)
- [ASCII](#)

Protocols Available over Serial

- [ASCII](#)
- [Selcom](#)

Gocator Protocol

This section describes the TCP and UDP commands and data formats used by a client computer to communicate with Gocator sensors using the Gocator protocol. It also describes the connection types (Discovery, Control, Upgrade, Data, and Health), and data types. The protocol enables the client to:

- Send commands to run sensors, provide software triggers, read/write files, etc.
- Receive data, health, and diagnostic messages.
- Upgrade firmware.



The Gocator 4.x firmware uses mm, mm², mm³, and degrees as standard units. In all protocols, values are scaled by 1000, as values in the protocols are represented as integers. This results in effective units of mm/1000, mm²/1000, mm³/1000, and deg/1000 in the protocols.

To use the Gocator protocol, it must be enabled and configured in the active job.



Gocator sensors send UDP broadcasts over the network over the Internal Discovery channel (port 2016) at regular intervals during operation to perform peer discovery.



The Gocator SDK provides open source C language libraries that implement the network commands and data formats defined in this section. For more information, see *SDK* on page 434.

For information on configuring the protocol using the Web interface, see *Ethernet Output* on page 235.

For information on job file structures (for example, if you wish to create job files programmatically), see *Job Files* on page 270.

Data Types

The table below defines the data types and associated type identifiers used in this section.

All values except for IP addresses are transmitted in little endian format (least significant byte first) unless stated otherwise. The bytes in an IP address "a.b.c.d" will always be transmitted in the order a, b, c, d (big endian).

Data Types

Type	Description	Null Value
char	Character (8-bit, ASCII encoding)	-
byte	Byte.	-
8s	8-bit signed integer.	-128
8u	8-bit unsigned integer.	255U
16s	16-bit signed integer.	-32768 (0x8000)
16u	16-bit unsigned integer.	65535 (0xFFFF)
32s	32-bit signed integer.	-2147483648 (0x80000000)
32u	32-bit unsigned integer.	4294967295 (0xFFFFFFFF)
64s	64-bit signed integer.	-9223372036854775808 (0x8000000000000000)
64u	64-bit unsigned integer.	18446744073709551615 (0xFFFFFFFFFFFFFFFF)
64f	64-bit floating point	-1.7976931348623157e+308
Point16s	Two 16-bit signed integers	-
Point64f	Two 64-bit floating point values	-
Point3d64f	Three 64-bit floating point values	-
Rect64f	Four 64-bit floating point values	-
Rect3d64f	Eight 64-bit floating point values	-

Commands

The following sections describe the commands available on the Discovery (page 355), Control (page 358), and Upgrade (page 391) channels.

When a client sends a command over the Control or Upgrade channel, the sensor sends a reply whose identifier is the same as the command's identifier. The identifiers are listed in the tables of each of the commands.

Status Codes

Each reply on the Discovery, Control, and Upgrade channels contains a *status* field containing a status code indicating the result of the command. The following status codes are defined:

Status Codes

Label	Value	Description
OK	1	Command succeeded.
Failed	0	Command failed.
Invalid State	-1000	Command is not valid in the current state.
Item Not Found	-999	A required item (e.g., file) was not found.
Invalid Command	-998	Command is not recognized.
Invalid Parameter	-997	One or more command parameters are incorrect.
Not Supported	-996	The operation is not supported.
Simulation Buffer Empty	-992	The simulation buffer is empty.

Discovery Commands

Sensors ship with the following default network configuration:

Setting	Default
DHCP	0 (disabled)
IP Address	192.168.1.10
Subnet Mask	255.255.255.0
Gateway	0.0.0.0 (disabled)

Use the [Get Address](#) and [Set Address](#) commands to modify a sensor's network configuration. These commands are UDP broadcast messages:

Destination Address	Destination Port
255.255.255.255	3220

When a sensor accepts a discovery command, it will send a UDP broadcast response:

Destination Address	Destination Port
255.255.255.255	Port of command sender.

The use of UDP broadcasts for discovery enables a client computer to locate a sensor when the sensor and client are configured for different subnets. All you need to know is the serial number of the sensor in order to locate it on an IP network.

Get Address

The Get Address command is used to discover Gocator sensors across subnets.

Command

Field	Type	Offset	Description
length	64s	0	Command length.
type	64s	8	Command type (0x1).

Field	Type	Offset	Description
signature	64s	16	Message signature (0x0000504455494D4C)
deviceld	64s	24	Serial number of the device whose address information is queried. 0 selects all devices.

Reply

Field	Type	Offset	Description
length	64s	0	Reply length.
type	64s	8	Reply type (0x1001).
status	64s	16	Operation status.
signature	64s	24	Message signature (0x0000504455494D4C)
deviceld	64s	32	Serial number.
dhcpEnabled	64s	40	0 – Disabled 1 – Enabled
reserved[4]	byte	48	Reserved.
address[4]	byte	52	The IP address in left to right order.
reserved[4]	byte	56	Reserved.
subnetMask[4]	byte	60	The subnet mask in left to right order.
reserved[4]	byte	64	Reserved.
gateway[4]	byte	68	The gateway address in left to right order.
reserved[4]	byte	72	Reserved.
reserved[4]	byte	76	Reserved.

Set Address

The Set Address command modifies the network configuration of a Gocator sensor. On receiving the command, the Gocator will perform a reset. You should wait 30 seconds before re-connecting to the Gocator.

Command

Field	Type	Offset	Description
length	64s	0	Command length.
type	64s	8	Command type (0x2).
signature	64s	16	Message signature (0x0000504455494D4C)
deviceld	64s	24	Serial number of the device whose address information is queried. 0 selects all devices.
dhcpEnabled	64s	32	0 – Disabled 1 – Enabled
reserved[4]	byte	40	Reserved.
address[4]	byte	44	The IP address in left to right order.
reserved[4]	byte	48	Reserved.
subnetMask[4]	byte	52	The subnet mask in left to right order.
reserved[4]	byte	56	Reserved.

Field	Type	Offset	Description
gateway[4]	byte	60	The gateway address in left to right order.
reserved[4]	byte	64	Reserved.
reserved[4]	byte	68	Reserved.

Reply

Field	Type	Offset	Description
length	64s	0	Reply length.
type	64s	8	Reply type (0x1002).
status	64s	16	Operation status. For a list of status codes, see <i>Commands</i> on page 354.
signature	64s	24	Message signature (0x0000504455494D4C).
deviceId	64s	32	Serial number.

Get Info

The Get Info command is used to retrieve sensor information.

Command

Field	Type	Offset	Description
length	64s	0	Command length.
type	64s	8	Command type (0x5).
signature	64s	16	Message signature (0x0000504455494D4C).
deviceId	64s	24	Serial number of the device whose address information is queried. 0 selects all devices.

Reply

Field	Type	Offset	Description
length	64s	0	Reply length.
type	64s	8	Reply type (0x1005).
status	64s	16	Operation status. For a list of status codes, see <i>Commands</i> on page 354.
signature	64s	24	Message signature (0x0000504455494D4C).
attrCount	16u	32	Byte count of the attributes (begins after this field and ends before propertyCount).
id	32u	34	Serial number.
version	32u	38	Version as a 4-byte integer (encoded in little-endian).
uptime	64u	42	Sensor uptime (microseconds).
ipNegotiation	byte	50	IP negotiation type: 0 – Static 1 – DHCP

Field	Type	Offset	Description
addressVersion	byte	51	IP address version (always 4).
address[4]	byte	52	IP address.
reserved[12]	byte	56	Reserved.
prefixLength	32u	68	Subnet prefix length (in number of bits).
gatewayVersion	byte	72	Gateway address version (always 4).
gatewayAddress[4]	byte	73	Gateway address.
reserved[12]	byte	77	Reserved.
controlPort	16u	89	Control channel port.
upgradePort	16u	91	Upgrade channel port.
healthPort	16u	93	Health channel port.
dataPort	16u	95	Data channel port.
webPort	16u	97	Web server port.
propertyCount	8u	99	Number of sensor ID properties.
properties [propertyCount]	Property	100	List of sensor ID properties.

Property

Field	Type	Description
nameLength	8u	Length of the name.
name[nameLength]	char	Name string.
valueLength	8u	Length of the value.
value[valueLength]	char	Value string.

Control Commands

A client sends control commands for most operations over the Control TCP channel (port 3190).

The Control channel and the Upgrade channel (port 3192) can be connected simultaneously. For more information on Upgrade commands, see *Upgrade Commands* on page 391.

States

A Gocator system can be in one of two states: Ready or Running. The client sends the [Start](#) and [Stop](#) control commands to change the system's current state to Running and Ready, respectively. The sensor can also be configured to boot in either the Ready or Running state, by enabling or disabling autostart, respectively, using the [Set Auto Start Enabled](#) command.

In the Ready state, a sensor can be configured. In the Running state, a sensor responds to input signals, performs measurements, drives its outputs, and sends data messages to the client.

The state of the sensor can be retrieved using the [Get States](#) or [Get System Info](#) command.

Progressive Reply

Some commands send replies progressively, as multiple messages. This allows the sensor to stream data without buffering it first, and allows the client to obtain progress information on the stream.

A progressive reply begins with an initial, standard reply message. If the *status* field of the reply indicates success, the reply is followed by a series of “continue” reply messages.

A continue reply message contains a block of data of variable size, as well as status and progress information. The series of continue messages is ended by either an error, or a continue message containing 0 bytes of data.

Protocol Version

The Protocol Version command returns the protocol version of the connected sensor.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4511)

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4511).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
majorVersion	8u	10	Major version.
minorVersion	8u	11	Minor version.

Get Address

The Get Address command is used to get a sensor address.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x3012)

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x3012).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
dhcpEnabled	byte	10	0 – DHCP not used 1 – DHCP used
address[4]	byte	11	IP address (most significant byte first).
subnetMask[4]	byte	15	Subnet mask.
gateway[4]	byte	19	Gateway address.

Set Address

The Set Address command modifies the network configuration of a Gocator sensor. On receiving the command, the Gocator will perform a reset. You should wait 30 seconds before re-connecting to the Gocator.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x3013)
dhcpEnabled	byte	6	0 – DHCP not used 1 – DHCP used
address[4]	byte	7	IP address (most significant byte first).
subnetMask[4]	byte	11	Subnet mask.
gateway[4]	byte	15	Gateway address.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x3013).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Get System Info

The Get System Info command reports information about the local node, remote nodes and assigned buddies.

Firmware version refers to the version of the Gocator's firmware installed on each individual sensor. The client can upgrade the Gocator's firmware by sending the Start Upgrade command (see *Start Upgrade* on page 391). Firmware upgrade files are available from the downloads section under the support tab on the LMI web site. For more information on getting the latest firmware, see *Firmware Upgrade* on page 59.

Every Gocator sensor contains factory backup firmware. If a firmware upgrade command fails (e.g., power is interrupted), the factory backup firmware will be loaded when the sensor is reset or power cycled. In this case, the sensors will fall back to the factory default IP address. To avoid IP address conflicts in a multi-sensor system, connect to one sensor at a time and re-attempt the firmware upgrade.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4010)

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4010).
localInfoSize	16u	10	Size of localInfo structure. Current: 52.
localInfo	Device Info	12	Info for this device.
remoteCount	32u	-	Number of discovered sensors.
remoteInfoSize	16u	-	Size of remoteInfo structure. Current 60.
remoteInfo [remoteCount]	Remote Info	-	List of info for discovered sensors.
buddyInfoCount	32u	-	Number of buddies assigned (can be 0).
buddyInfoSize	16u	-	Size of buddyInfo structure. Current: 8.
Buddies[buddyCount]	Buddy Info	-	List of info for the assigned buddies.

Sensor Info

Field	Type	Offset	Description
deviceId	32u	0	Serial number of the device.
address[4]	byte	4	IP address (most significant byte first).
modelName[32]	char	8	Model name.
firmwareVersion[4]	byte	40	Firmware version (most significant byte first).
state	32s	44	Sensor state 0 – Ready 1 – Running For more information on states, see <i>Control Commands</i> on page 358.
role	32s	48	Sensor role 0 – Main

Remote Info

Field	Type	Offset	Description
deviceId	32u	0	Serial number of the device.
address[4]	byte	4	IP address (most significant byte first).
modelName[32]	char	8	Model name.
firmwareVersion[4]	byte	40	Firmware version (most significant byte first).
state	32s	44	Sensor state 0 – Ready 1 – Running For more information on states, see <i>Control Commands</i> on page 358.
role	32s	48	Sensor role

Field	Type	Offset	Description
			0 – Main
mainId	32u	52	Serial number of the main device, or zero.
buddiableStatus	32s	56	Whether or not the device can be buddied: 1 – Can be buddied
			Errors: 0 – Unbuddiable (General Error) -100 – Already buddied -99 – Invalid State (e.g. running) -98 – Version Mismatch -97 – Model Mismatch

Buddy Info

Field	Type	Offset	Description
deviceId	32u	2	Serial number of the device.
state	k32s	6	Buddy state 2 - Connecting 1 – Connected
			Errors: 0 – Unbuddiable (General Error) -100 – Already buddied -99 – Invalid State (e.g. running) -98 – Version Mismatch -97 – Model Mismatch -95 – Device Missing

Get System Info



This version of the Get System Info command is deprecated. Use [Get System Info \(v2\)](#) instead.

The Get System Info command reports information for sensors that are visible in the system.

Firmware version refers to the version of the Gocator's firmware installed on each individual sensor. The client can upgrade the Gocator's firmware by sending the Start Upgrade command (see *Start Upgrade* on page 391). Firmware upgrade files are available from the downloads section under the support tab on the LMI web site. For more information on getting the latest firmware, see *Firmware Upgrade* on page 59.

Every Gocator sensor contains factory backup firmware. If a firmware upgrade command fails (e.g., power is interrupted), the factory backup firmware will be loaded when the sensor is reset or power

cycled. In this case, the sensors will fall back to the factory default IP address. To avoid IP address conflicts in a multi-sensor system, connect to one sensor at a time and re-attempt the firmware upgrade.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4002)

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4002).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
localInfo	Sensor Info	10	Info for this device.
remoteCount	32u	66	Number of discovered sensors.
remoteInfo [remoteCount]	Sensor Info	70	List of info for discovered sensors.

Sensor Info

Field	Type	Offset	Description
deviceId	32u	0	Serial number of the device.
address[4]	byte	4	IP address (most significant byte first).
modelName[32]	char	8	Model name.
firmwareVersion[4]	byte	40	Firmware version (most significant byte first).
state	32s	44	Sensor state 0 – Ready 1 – Running For more information on states, see <i>Control Commands</i> on page 358.
role	32s	48	Sensor role 0 – Main

Get States

The Get States command returns various system states.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4525)

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4525).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
count	32u	10	Number of state variables.
sensorState	32s	14	Sensor state 0 – Ready 1 – Running For more information on states, see <i>Control Commands</i> on page 358.
loginState	32s	18	Device login state 0 – No user 1 – Administrator 2 – Technician
alignmentReference	32s	22	Alignment reference 0 – Fixed 1 – Dynamic
alignmentState	32s	26	Alignment state 0 – Unaligned 1 – Aligned
recordingEnabled	32s	30	Whether or not recording is enabled 0 – Disabled 1 – Enabled
playbackSource	32s	34	Playback source 0 – Live data 1 – Recorded data
uptimeSec	32s	38	Uptime (whole seconds component)
uptimeMicrosec	32s	42	Uptime (remaining microseconds component)
playbackPos	32s	46	Playback position
playbackCount	32s	50	Playback frame count
autoStartEnabled	32s	54	Auto-start enable (boolean)

Log In/Out

The Log In/Out command is used to log in or out of a sensor.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4003).
userType	32s	6	Defines the user type 0 – None (log out) 1 – Administrator 2 – Technician
password[64]	char	10	Password (required for log-in only).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4003).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Change Password

The Change Password command is used to change log-in credentials for a user.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4004).
user type	32s	6	Defines the user type 0 – None (log out) 1 – Administrator 2 – Technician
password[64]	char	10	New password.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4004).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.



Passwords can only be changed if a user is logged in as an administrator.

Set Buddy

The Set Buddy command is used to assign or unassign a Buddy sensor.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4005).
buddyId	32u	6	Id of the sensor to acquire as buddy. Set to 0 to remove buddy.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4005).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

List Files

The List Files command returns a list of the files in the sensor's file system.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x101A).
extension[64]	char	6	Specifies the extension used to filter the list of files (does not include the "."). If an empty string is used, then no filtering is performed.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x101A).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
count	32u	10	Number of file names.
fileNames[count][64]	char	14	File names.

Copy File

The Copy File command copies a file from a source to a destination within the connected sensor (a .job file, a component of a job file, or another type of file; for more information, see *Job Files* on page 270).

To make a job active (to load it), copy a saved job to "_live.job".

To "save" the active job, copy from "_live.job" to another file.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.

Field	Type	Offset	Description
id	16u	4	Command identifier (0x101B).
source[64]	char	6	Source file name.
destination[64]	char	70	Destination file name.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x101B).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Read File

Downloads a file from the connected sensor (a .job file, a component of a job file, or another type of file; for more information, see *Job Files* on page 270).

To download the live configuration, pass "_live.job" in the *name* field.

To read the configuration of the live configuration only, pass "_live.job/config.xml" in the *name* field.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x1007).
name[64]	char	6	Source file name.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x1007).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
length	32u	10	File length.
data[length]	byte	14	File contents.

Write File

The Write File command uploads a file to the connected sensor (a .job file, a component of a job file, or another type of file; for more information, see *Job Files* on page 270).

To make a job file live, write to "_live.job". Except for writing to the live file, the file is permanently stored on the sensor.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x1006).
name[64]	char	6	Source file name.
length	32u	70	File length.
data[length]	byte	74	File contents.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x1006).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Delete File

The Delete File command removes a file from the connected sensor (a .job file, a component of a job file, or another type of file; for more information, see *Job Files* on page 270).

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x1008).
name[64]	char	6	Source file name.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x1008).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

User Storage Used

The User Storage Used command returns the amount of user storage that is used.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x1021).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x1021).
status	32s	6	Reply status.
spaceUsed	64u	10	The used storage space in bytes.

User Storage Free

The User Storage Free command returns the amount of user storage that is free.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x1022).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x1022).
status	32s	6	Reply status.
spaceFree	64u	10	The free storage space in bytes.

Get Default Job

The Get Default Job command gets the name of the job the sensor loads when it powers up.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4100).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4100).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
name[64]	char	10	The file name (null-terminated) of the job the sensor loads when it powers up.

Set Default Job

The Set Default Job command sets the job the sensor loads when it powers up.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4101).
fileName[64]	char	6	File name (null-terminated) of the job the sensor loads when it powers up.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4101).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Get Loaded Job

The Get Loaded Job command returns the name and modified status of the currently loaded file.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4512).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4512).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
fileName[64]	char	10	Name of the currently loaded job.
changed	8u	74	Whether or not the currently loaded job has been changed (1: yes; 0: no).

Get Alignment Reference

The Get Alignment Reference command is used to get the sensor's alignment reference.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4104).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4104).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
reference	32s	10	Alignment reference 0 – Fixed 1 – Dynamic

Set Alignment Reference

The Set Alignment Reference command is used to set the sensor's alignment reference.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4103).
reference	32s	6	Alignment reference 0 – Fixed 1 – Dynamic

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4103).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Clear Alignment

The Clear Alignment command clears sensor alignment.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4102).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4102).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Get Timestamp

The Get Timestamp command retrieves the sensor's timestamp, in clock ticks. All devices in a system are synchronized with the system clock; this value can be used for diagnostic purposes, or used to synchronize the start time of the system.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x100A).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x100A).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
timestamp	64u	10	Timestamp, in clock ticks.

Get Encoder

This command retrieves the current system encoder value.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x101C).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x101C).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
encoder	64s	10	Current encoder position, in ticks.

Reset Encoder

The Reset Encoder command is used to reset the current encoder value.



The encoder value can be reset only when the encoder is connected directly to a sensor. When the encoder is connected to the master, the value cannot be reset via this command.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x101E).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x101E).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Start

The Start command starts the sensor system (system enters the Running state). For more information on states, see *Control Commands* on page 358.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x100D).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x100D).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Scheduled Start

The scheduled start command starts the sensor system (system enters the Running state) at target time or encoder value (depending on the trigger mode). For more information on states, see *Control Commands* on page 358.

Command

Field	Type	Offset	Description
length	32u	0	Command size – in bytes.
id	16u	4	Command identifier (0x100F).
target	64s	6	Target scheduled start value (in ticks or μ s, depending on the trigger type).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size – in bytes.
id	16u	4	Reply identifier (0x100F).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Stop

The Stop command stops the sensor system (system enters the Ready state). For more information on states, see *Control Commands* on page 358.

Command

Field	Type	Type	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x1001).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x1001).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Get Auto Start Enabled

The Get Auto Start Enabled command returns whether the system automatically starts after booting.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x452C).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x452C).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
enable	8u	10	0: disabled 1: enabled

Set Auto Start Enabled

The Set Auto Start Enabled command sets whether the system automatically starts after booting (enters Running state; for more information on states, see *Control Commands* on page 358).

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x452B).
enable	8u	6	0: disabled 1: enabled

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x452B).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Start Alignment

The Start Alignment command is used to start the alignment procedure on a sensor.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4600).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4600).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
opId	32u	10	Operation ID. Use this ID to correlate the command/reply on the Command channel with the correct Alignment Result message on the Data channel. A unique ID is returned each time the client uses this command.

Start Exposure Auto-set

The Start Exposure Auto-set command is used to start the exposure auto-set procedure on a sensor.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4601).
role	32s	6	Role of sensors to auto-set. 0 – Main 1 – Buddy

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4601).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Field	Type	Offset	Description
			354.
opId	32u	10	Operation ID. Use this ID to correlate the command/reply on the Command channel with the correct Exposure Calibration Result message on the Data channel. A unique ID is returned each time the client uses this command.

Software Trigger

The Software Trigger command causes the sensor to take a snapshot while in software mode and in the Running state.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4510).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4510).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Schedule Digital Output

The Schedule Digital Output command schedules a digital output event. The digital output must be configured to accept software-scheduled commands and be in the Running state. For more information on setting up digital output, see *Digital Output* on page 239.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4518).
index	16u	6	Index of the output (starts from 0).
target	64s	8	Specifies the time (clock ticks) when or position (μm) at which the digital output event should happen. The target value is ignored if ScheduleEnabled is set to false. (Scheduled is unchecked in Digital in the Output panel.) The output will be triggered immediately.
value	8u	16	Specifies the target state: 0 – Set to low (continuous) 1 – Set to high (continuous) Ignored if output type is pulsed.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4518).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Schedule Analog Output

The Schedule Analog Output command schedules an analog output event. The analog output must be configured to accept software-scheduled commands and be in the Running state. For information on setting up the analog output, see *Analog Output* on page 242.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4519).
index	16u	6	Index of the output. Must be 0.
target	64s	8	Specifies the time (clock ticks) or position (encoder ticks) of when the event should happen. The target value is ignored if ScheduleEnabled is set to false. (Scheduled is unchecked in Analog in the Output panel.) The output will be triggered immediately.
value	32s	16	Output current (microamperes).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4519).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.



The analog output takes about 75 us to reach 90% of the target value for a maximum change, then roughly another 40 us to settle completely.

Ping

The Ping command can be used to test the control connection. This command has no effect on sensors.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x100E).
timeout	64u	6	Timeout value (microseconds).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x100E).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.



If a non-zero value is specified for timeout, the client must send another ping command before the timeout elapses; otherwise the server would close the connection. The timer is reset and updated with every command.

Reset

The Reset command reboots the Main sensor and any Buddy sensors. All sensors will automatically reset 3 seconds after the reply to this command is transmitted.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4300).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4300).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Backup

The Backup command creates a backup of all files stored on the connected sensor and downloads the backup to the client.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x1013).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x1013).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
length	32u	10	Data length.
data[length]	byte	14	Data content.

Restore

The Restore command uploads a backup file to the connected sensor and then restores all sensor files from the backup.



The sensor must be reset or power-cycled before the restore operation can be completed.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x1014).
length	32u	6	Data length.
data[length]	byte	10	Data content.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x1014).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Restore Factory

The Restore Factory command restores the connected sensor to factory default settings.



The command erases the non-volatile memory of the main device.

This command has no effect on connected Buddy sensors.

Note that the sensor must be reset or power-cycled before the factory restore operation can be completed.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4301).
resetip	8u	6	Specifies whether IP address should be restored to default: 0 – Do not reset IP 1 – Reset IP

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4301).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Get Recording Enabled

The Get Recording Enabled command retrieves whether recording is enabled.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4517).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4517).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
enable	8u	10	0: disabled; 1: enabled.

Set Recording Enabled

The Set Recording Enabled command enables recording for replay later.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4516).
enable	8u	6	0: disabled; 1: enabled.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4516).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Clear Replay Data

The Clear Replay Data command clears the sensors replay data..

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4513).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4513).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Get Playback Source

The Get Playback Source command gets the data source for data playback.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4524).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4524).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
source	32s	10	Source 0 – Live 1 – Replay buffer

Set Playback Source

The Set Playback Source command sets the data source for data playback.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4523).
source	32s	6	Source 0 – Live 1 – Replay buffer

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4523).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Simulate

The Simulate command simulates the last frame if playback source is live, or the current frame if playback source is the replay buffer.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4522).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4522).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
bufferValid	8u	10	Whether or not the buffer is valid.



A reply status of -996 means that the current configuration (mode, sensor type, etc.) does not support simulation.

A reply status of -992 means that the simulation buffer is empty. Note that the buffer can be valid even if the simulation buffer is actually empty due to optimization choices. This scenario means that the simulation buffer would be valid if data were recorded.

Seek Playback

The Seek Playback command seeks to any position in the current playback dataset. The frame is then sent.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4503).
frame	32u	6	Frame index.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4503).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Step Playback

The Step Playback command advances playback by one frame.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4501).
direction	32s	6	Define step direction 0 – Forward 1 – Reverse

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4501).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.



When the system is running in the Replay mode, this command advances replay data (playback) by one frame. This command returns an error if no live playback data set is loaded. You can use the [Copy File](#) command to load a replay data set to _live.rec.

Playback Position

The Playback Position command retrieves the current playback position.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4502).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4502).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
Frame Index	32u	10	Current frame index (starts from 0).
Frame Count	32u	14	Total number of available frames/objects.

Clear Measurement Stats

The Clear Measurement Stats command clears the sensor's measurement statistics.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4526).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4526).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Read Live Log

The Read Live Log command returns an XML file containing the log messages between the passed start and end indexes.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x101F).
Start	32u	6	First log to read
End	32u	10	Last log to read

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x101F).
status	32s	6	Reply status.
length	32u	10	File length
data[length]	byte	14	XML Log File

Clear Log

The Clear Log command clears the sensor's log.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x101D).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x101D).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Simulate Unaligned

The Simulate Unaligned command simulates data before alignment transformation.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x452A).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x452A).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Acquire

The Acquire command acquires a new scan.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4528).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4528).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.



The command returns after the scan has been captured and transmitted.

Acquire Unaligned

The Acquire Unaligned command acquires a new scan without performing alignment transformation.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4527).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4527).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.



The command returns after the scan has been captured and transmitted.

Create Model

The Create Model command creates a new part model from the active simulation scan.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4602).
modelName[64]	char	6	Name of the new model (without .mdl extension)

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4602).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Detect Edges

The Detect Edges command detects and updates the edge points of a part model.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4604).
modelName[64]	char	6	Name of the model (without .mdl extension)
sensitivity	16u	70	Sensitivity (in thousandths).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4604).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Add Tool

The Add Tool command adds a tool to the live job.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4530).
typeName[64]	char	6	Type name of the tool (e.g., ProfilePosition)
name[64]	char	70	User-specified name for tool instance

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4530).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Add Measurement

The Add Measurement command adds a measurement to a tool instance.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4531).
toolIndex	32u	6	Index of the tool instance the new measurement is added to.
typeName[64]	char	10	Type name of the measurement (for example, X).
name[64]	char	74	User-specified name of the measurement instance.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4531).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.



This command can only be used with dynamic tools (tools with a dynamic list of measurements). The maximum number of instances for a given measurement type can be found in the [ToolOptions](#) node. For dynamic tools, the maximum count is greater than one, while for static tools it is one.

Read File (Progressive)

The progressive Read File command reads the content of a file as a stream.

This command returns an initial reply, followed by a series of "continue" replies if the initial reply's *status* field indicates success. The continue replies contain the actual data, and have 0x5000 as their identifier.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4529).
name[64]	char	6	Source file name.

Initial Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4529).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
progressTotal	32u	10	Progress indicating completion (100%).
progress	32u	14	Current progress.

Continue Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x5000).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
progressTotal	32u	10	Progress indicating completion (100%).
progress	32u	14	Current progress.
size	32u	18	Size of the chunk in bytes.
data[size]	byte	22	Chunk data.

Export CSV (Progressive)

The progressive Export CSV command exports replay data as a CSV stream.

This command returns an initial reply, followed by a series of "continue" replies if the initial reply's *status* field indicates success. The continue replies contain the actual data, and have 0x5000 as their identifier.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4507).

Initial Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4507).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
progressTotal	32u	10	Progress indicating completion (100%).
progress	32u	14	Current progress.

Continue Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x5000).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
progressTotal	32u	10	Progress indicating completion (100%).
progress	32u	14	Current progress.
size	32u	18	Size of the chunk in bytes.
data[size]	byte	22	Chunk data.



Only the current surface scan, as determined by the playback position, is exported to the CSV stream.

Export Bitmap (Progressive)

The progressive Export Bitmap command exports replay data as a bitmap stream.

This command returns an initial reply, followed by a series of "continue" replies if the initial reply's *status* field indicates success. The continue replies contain the actual data, and have 0x5000 as their identifier.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4508).
type	32s	6	Data type: 0 – Range or video 1 – Intensity
source	32s	10	Data source to export.

Initial Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4508).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
progressTotal	32u	10	Progress indicating completion (100%).
progress	32u	14	Current progress.

Continue Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.

Field	Type	Offset	Description
id	16u	4	Reply identifier (0x5000).
status	32s	6	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
progressTotal	32u	10	Progress indicating completion (100%).
progress	32u	14	Current progress.
size	32u	18	Size of the chunk in bytes.
data[size]	byte	22	Chunk data.

Get Runtime Variable Count

The Get Runtime Variable Count command gets the number of runtime variables that can be accessed.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4537).

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4537).
status	32s	6	Reply status.
valueLength	32u	10	The count of runtime variables.

Set Runtime Variables

The Set Runtime Variables command sets the runtime variables at the given index for the given length.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4536).
index	32u	6	The starting index of the variables to set.
length	32u	10	The number of values to set from the starting index.
values[length]	32s	14	The runtime variable values to set.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4536).
status	32s	6	Reply status.

Get Runtime Variables

The Get Runtime Variables command gets the runtime variables for the given index and length.

Command

Field	Type	Offset	Description
length	32u	0	Command size including this field, in bytes.
id	16u	4	Command identifier (0x4535).
index	32u	6	The starting index of the variables to retrieve.
length	32u	10	The number of values to retrieve from the starting index.

Reply

Field	Type	Offset	Description
length	32u	0	Reply size including this field, in bytes.
id	16u	4	Reply identifier (0x4535).
status	32s	6	Reply status.
index	32u	10	The starting index of the variables being returned.
length	32u	14	The number of values being returned.
values[length]	32s	18	The runtime variable values.

Upgrade Commands

A client sends firmware upgrade commands over the Upgrade TCP channel (port 3192).

The Control channel (port 3190) and the Upgrade channel can be connected simultaneously. For more information on Control commands, see *Control Commands* on page 358.

After connecting to a Gocator sensor, you can use the [Protocol Version](#) command to retrieve the protocol version. Protocol version refers to the version of the Gocator Protocol supported by the *connected sensor* (the sensor to which a command connection is established), and consists of major and minor parts. The minor part is updated when backward-compatible additions are made to the Gocator Protocol. The major part is updated when breaking changes are made to the Gocator Protocol.

Start Upgrade

The Start Upgrade command begins a firmware upgrade for the sensors in a system. All sensors automatically reset 3 seconds after the upgrade process is complete.

Command

Field	Type	Offset	Description
length	64s	0	Command size including this field, in bytes.
id	64s	8	Command identifier (0x0000).
length	64s	16	Length of the upgrade package (bytes).
data[length]	byte	24	Upgrade package data.

Reply

Field	Type	Offset	Description
length	64s	0	Reply size including this field, in bytes.
id	64s	8	Reply identifier (0x0000).
status	64s	16	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Start Upgrade Extended

The Start Upgrade Extended command begins a firmware upgrade for the sensors in a system. All sensors automatically reset 3 seconds after the upgrade process is complete.

Command

Field	Type	Offset	Description
length	64s	0	Command size including this field, in bytes.
id	64s	8	Command identifier (0x0003).
skipValidation	64s	16	Whether or not to skip validation (0 – do not skip, 1 – skip).
length	64s	24	Length of the upgrade package (bytes).
data[length]	byte	32	Upgrade package data.

Reply

Field	Type	Offset	Description
length	64s	0	Reply size including this field, in bytes.
id	64s	8	Reply identifier (0x0003).
status	64s	16	Reply status. For a list of status codes, see <i>Commands</i> on page 354.

Get Upgrade Status

The Get Upgrade Status command determines the progress of a firmware upgrade.

Command

Field	Type	Offset	Description
length	64s	0	Command size including this field, in bytes.
id	64s	8	Command identifier (0x1)

Reply

Field	Type	Offset	Description
length	64s	0	Reply size including this field, in bytes.
id	64s	8	Reply identifier (0x1).
status	64s	16	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
state	64s	24	Upgrade state: -1 – Failed

Field	Type	Offset	Description
			0 – Completed 1 – Running 2 – Completed, but should run again
progress	64s	32	Upgrade progress (valid when in the Running state)

Get Upgrade Log

The Get Upgrade Log command can retrieve an upgrade log in the event of upgrade problems.

Command

Field	Type	Offset	Description
length	64s	0	Command size including this field, in bytes.
id	64s	8	Command identifier (0x2)

Reply

Field	Type	Offset	Description
length	64s	0	Reply size including this field, in bytes.
id	64s	8	Reply identifier (0x2).
status	64s	16	Reply status. For a list of status codes, see <i>Commands</i> on page 354.
length	64s	24	Length of the log (bytes).
log[length]	char	32	Log content.

Results

The following sections describe the results (data and health) that Gocator sends.

Data Results

A client can receive data messages from a Gocator sensor by connecting to the Data TCP channel (port 3196).

The Data channel and the Health channel (port 3194) can be connected at the same time. The sensor accepts multiple connections on each port. For more information on the Health channel, see *Health Results* on page 401.

Messages that are received on the Data and Health channels use a common structure, called Gocator Data Protocol (GDP). Each GDP message consists of a 6-byte header, containing *size* and *control* fields, followed by a variable-length, message-specific content section. The structure of the GDP message is defined below.

Gocator Data Protocol

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last Message flag Bits 0-14: Message type identifier. (See individual data result sections.)

GDP messages are always sent in groups. The Last Message flag in the *control* field is used to indicate the final message in a group. If there is only one message per group, this bit will be set in each message.

Stamp

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 1.
count (C)	32u	6	Count of stamps in this message.
size	16u	10	Stamp size, in bytes (min: 56, current: 56).
source	8u	12	Source (0 – Main).
reserved	8u	13	Reserved.
stamps[C]	Stamp	14	Array of stamps (see below).

Stamp

Field	Type	Offset	Description
frameIndex	64u	0	Frame index (counts up from zero).
timestamp	64u	8	Timestamp (µs).
encoder	64s	16	Current encoder value (ticks).
encoderAtZ	64s	24	Encoder value latched at z/index mark (ticks).
status	64u	32	Bit field containing various frame information: Bit 0: sensor digital input state Bit 4: master digital input state Bit 8-9: inter-frame digital pulse trigger (Master digital input if master is connected, otherwise sensor digital input. Value is cleared after each frame and clamped at 3 if more than 3 pulses are received).
serialNumber	32u	40	Sensor serial number. (In a dual-sensor system, the serial number of the main sensor.)
reserved[2]	32u	44	Reserved.

Video

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 2.
attributesSize	16u	6	Size of attributes, in bytes (min: 20, current: 20).
height (H)	32u	8	Image height, in pixels.

Field	Type	Offset	Description
width (W)	32u	12	Image width, in pixels.
pixelSize	8u	16	Pixel size, in bytes.
pixelFormat	8u	17	Pixel format: 1 – 8-bit greyscale 2 – 8-bit color filter 3 – 8-bits-per-channel color (B, G, R, X)
colorFilter	8u	18	Color filter array alignment: 0 – None 1 – Bayer BG/GR 2 – Bayer GB/RG 3 – Bayer RG/GB 4 – Bayer GR/BG
source	8u	19	Source 0 – Top 1 – Bottom 2 – Top Left 3 – Top Right
cameraIndex	8u	20	Camera index.
exposureIndex	8u	21	Exposure index.
exposure	32u	22	Exposure (ns).
flippedX	8u	26	Indicates whether the video data must be flipped horizontally to match up with profile data.
flippedY	8u	27	Indicates whether the video data must be flipped vertically to match up with profile data.
pixels[H][W]	(Variable)	28	Image pixels. (Depends on pixelSize above.)

Surface

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 8.
attributeSize	16u	6	Size of attributes, in bytes (min: 40, current: 40).
length (L)	32u	8	Surface length (rows).
length (W)	32u	12	Surface width (columns).
xScale	32u	16	X scale (nm).
yScale	32u	20	Y scale (nm).

Field	Type	Offset	Description
zScale	32u	24	Z scale (nm).
xOffset	32s	28	X offset (μm).
yOffset	32s	32	Y offset (μm).
zOffset	32s	36	Z offset (μm).
source	8u	40	Source 0 – Top 1 – Bottom 2 – Top Left 3 – Top Right
exposure	32u	41	Exposure (ns).
reserved[7]	8u	45	Reserved.
ranges[L][W]	16s	52	Surface ranges.

Surface Intensity

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 9.
attributeSize	16u	6	Size of attributes, in bytes (min: 32, current: 32).
length (L)	32u	8	Surface length (rows).
width (W)	32u	12	Surface width (columns).
xScale	32u	16	X scale (nm).
yScale	32u	20	Y scale (nm).
xOffset	32s	24	X offset (μm).
yOffset	32s	28	Y offset (μm).
source	8u	32	Source 0 – Top 1 – Bottom 2 – Top Left 3 – Top Right
exposure	32u	33	Exposure (ns).
reserved[3]	8u	37	
intensities[H][W]	8u	40	Surface intensities.

Surface Section

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 20.
attributeSize	16u	6	Size of attributes, in bytes (min: 45, current: 45).
count (C)	32u	8	Number of profile arrays.
width (W)	32u	12	Number of points per profile array.
xScale	32u	16	X scale (nm).
zScale	32u	20	Z scale (nm).
xOffset	32s	24	X offset (μm).
zOffset	32s	28	Z offset (μm).
source	8u	32	Source 0 – Top 1 – Bottom 2 – Top Left 3 – Top Right
sectionId	32u	33	Section Id
exposure	32u	37	Exposure (ns).
poseAngle	32s	41	Z angle of the pose (microdegrees).
poseX	32s	45	X offset of the pose (μm)
poseY	32s	49	Y offset of the pose (μm)
ranges[C][W]	16s	53	Profile ranges.



The pose field can be used to transform the section data into the surface frame of reference, via a rotation and then a translation.

Surface Section Intensity

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 21.
attributesSize	16u	6	Size of attributes, in bytes (min: 37, current: 37).
count (C)	32u	8	Number of profile intensity arrays
width (W)	32u	12	Number of points per profile intensity array
xScale	32u	16	X scale (nm).
xOffset	32s	20	X offset (μm).

Field	Type	Offset	Description
source	8u	24	Source 0 – Top 1 – Bottom 2 – Top Left 3 – Top Right
sectionId	32u	25	Section Id.
exposure	32u	29	Exposure (ns).
poseAngle	32s	33	Z angle of the pose (microdegrees).
poseX	32s	37	X offset of the pose (μm).
poseY	32s	41	Y offset of the pose (μm).
points[C][W]	8u	45	Intensity arrays.

Measurement

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 10.
count (C)	32u	6	Count of measurements in this message.
reserved[2]	8u	10	Reserved.
id	16u	12	Measurement identifier.
measurements[C]	Measurement	14	Array of measurements (see below).

Measurement

Field	Type	Offset	Description
value	32s	0	Measurement value.
decision	8u	4	Measurement decision bitmask. Bit 0: 1 – Pass 0 – Fail Bits 1-7: 0 – Measurement value OK 1 – Invalid value 2 – Invalid anchor
reserved[3]	8u	5	Reserved.

Operation Result

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 11.
attributesSize	16u	6	Size of attributes, in bytes (min: 8, current: 8).
opId	32u	8	Operation ID.
status	32s	12	Operation status. 1 – OK 0 – General failure -1 – No data in the field of view for stationary alignment -2 – No profiles with sufficient data for line fitting for travel alignment -3 – Invalid target detected. Examples include: - Calibration disk diameter too small. - Calibration disk touches both sides of the field of view. - Too few valid data points after outlier rejection. -4 – Target detected in an unexpected position. -5 – No reference hole detected in bar alignment. -6 – No change in encoder value during travel calibration -988 – User aborted -993 – Timed out -997 – Invalid parameter

Exposure Calibration Result

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 12.
attributesSize	16u	6	Size of attributes, in bytes (min: 12, current: 12).
opId	32u	8	Operation ID.
status	32s	12	Operation status.
exposure	32s	16	Exposure result (ns).

Edge Match Result

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 16.
decision	byte	6	Overall match decision.
xOffset	32s	7	Target x offset in model space (μm).
yOffset	32s	11	Target y offset in model space (μm).
zAngle	32s	15	Target z rotation in model space (microdegrees).
quality	32s	19	Match quality (thousandth).
qualityDecision	byte	23	Quality match decision.
reserved[2]	byte	24	Reserved.

Bounding Box Match Result

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 17.
decision	byte	6	Overall match decision.
xOffset	32s	7	Target x offset in model space (μm).
yOffset	32s	11	Target y offset in model space (μm).
zAngle	32s	15	Target z rotation in model space (microdegrees).
width	32s	19	Width axis length (μm)
widthDecision	8u	23	Width axis decision.
length	32s	24	Length axis length (μm)
lengthDecision	8u	28	Length axis decision.

Ellipse Match Result

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 18.
decision	byte	6	Overall match decision.
xOffset	32s	7	Target x offset in model space (μm).
yOffset	32s	11	Target y offset in model space (μm).
zAngle	32s	15	Target z rotation in model space (microdegrees).

Field	Type	Offset	Description
minor	32s	19	Minor axis length (μm)
minorDecision	8u	23	Minor axis decision.
major	32s	24	Major axis length (μm)
majorDecision	8u	28	Major axis decision.

Feature Point

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 24.
id	16u	6	Feature Id
Point.x	64u	14	X Coordinate of Point (Scaled by 10 ⁶)
Point.y	64u	22	Y Coordinate of Point (Scaled by 10 ⁶)
Point.z	64u	30	Z Coordinate of Point (Scaled by 10 ⁶)

Feature Line

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. For this message, set to 25.
id	16u	6	Feature Id
Point.x	64u	14	X Coordinate of Point (Scaled by 10 ⁶)
Point.y	64u	22	Y Coordinate of Point (Scaled by 10 ⁶)
Point.z	64u	30	Z Coordinate of Point (Scaled by 10 ⁶)
Direction.x	64u	38	X Component of Direction Vector (Scaled by 10 ⁶)
Direction.y	64u	46	Y Component of Direction Vector (Scaled by 10 ⁶)
Direction.z	64u	54	Z Component of Direction Vector (Scaled by 10 ⁶)

Health Results

A client can receive health messages from a Gocator sensor by connecting to the Health TCP channel (port 3194).

The Data channel (port 3196) and the Health channel can be connected at the same time. The sensor accepts multiple connections on each port. For more information on the Data channel, see *Data Results* on page 393.

Messages that are received on the Data and Health channels use a common structure, called Gocator Data Protocol (GDP). Each GDP message consists of a 6-byte header, containing *size* and *control* fields,

followed by a variable-length, message-specific content section. The structure of the GDP message is defined below.

Gocator Data Protocol

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last Message flag Bits 0-14: Message type identifier. (See individual data result sections.)

GDP messages are always sent in groups. The Last Message flag in the *control* field is used to indicate the final message in a group. If there is only one message per group, this bit will be set in each message.

A Health Result contains a single data block for health *indicators*. Each indicator reports the current status of some aspect of the sensor system, such as CPU usage or network throughput.

Health Result Header

Field	Type	Offset	Description
size	32u	0	Count of bytes in message (including this field).
control	16u	4	Bit 15: Last message flag. Bits 0-14: Message type identifier. Always 0.
count (C)	32u	6	Count of indicators in this message.
source	8u	10	Source (0 – Main, 1 – Buddy).
reserved[3]	8u	11	Reserved
indicators[C]	Indicator	14	Array of indicators (see format below).

The health indicators block contains a 2-dimensional array of indicator data. Each row in the array has the following format:

Indicator Format

Field	Type	Offset	Description
id	32u	0	Unique indicator identifier (see <i>Health Indicators</i> on the next page table below).
instance	32u	4	Indicator instance.
value	64s	8	Value (identifier-specific meaning).

The following health indicators are defined for Gocator sensor systems.



When a sensor is accelerated, some health indicators report values from the *PC* that is accelerating the sensor, or a combination of both. In the table below, values are reported from the sensor unless otherwise indicated.



Undocumented indicators may be included in addition to the indicators defined below.

Health Indicators

Indicator	ID	Instance	Value
Encoder Value	1003	-	Current system encoder tick.
Encoder Frequency	1005	-	Current system encoder frequency (ticks/s).
App Version	2000	-	Firmware application version.
Uptime	2017	-	Time elapsed since node boot-up or reset (seconds).
Laser safety status	1010	-	0 if laser is disabled; 1 if enabled.
Internal Temperature	2002	-	Internal temperature (centidegrees Celsius).
Projector Temperature	2404	-	Projector module temperature (centidegrees Celsius). Only available on projector based devices.
Control Temperature	2028	-	Control module temperature (centidegrees Celsius). Available only on 3B-class devices.
Memory Usage	2003	-	Amount of memory currently used (bytes).
Memory Capacity	2004	-	Total amount of memory available (bytes).
Storage Usage	2005	-	Amount of non-volatile storage used (bytes).
Storage Capacity	2006	-	Total amount of non-volatile storage available (bytes).
CPU Usage	2007	-	CPU usage (percentage of maximum).
Net Out Capacity	2009	-	Total available outbound network throughput (bytes/s).
Net Out Link Status	2034	-	Current Ethernet link status.
Sync Source*	2043	-	Gocator synchronization source. 1 - FireSync Master device 2 - Sensor
Digital Inputs*	2024	-	Current digital input status (one bit per input).
Event Count	2102	-	Total number of events triggered.
Camera Trigger Drops	2201	-	Number of dropped triggers.
Analog Output Drops	21014 (previously 2501)	Output Index	Number of dropped outputs.
Digital Output Drops	21015 (previously 2601)	Output Index	Number of dropped outputs.
Serial Output Drops	21016 (previously 2701)	Output Index	Number of dropped outputs.

Indicator	ID	Instance	Value
Sensor State*	20000	-	Gocator sensor state. -1 – Conflict 0 – Ready 1 – Running
Current Sensor Speed*	20001	-	Current sensor speed. (Hz)
Maximum Speed*	20002	-	The sensor's maximum speed.
Spot Count*	20003	-	Number of found spots in the last profile.
Max Spot Count*	20004	-	Maximum number of spots that can be found.
Scan Count*	20005	-	Number of surfaces detected from a top device.
Master Status*	20006	0 for main 1 for buddy	Master connection status: 0 – Not connected 1 – Connected The indicator with instance = buddy does not exist if the buddy is not connected.
Cast Start State*	20007		The state of the second digital input. (NOTE: Only available on XLine capable licensed devices)
Laser Overheat*	20020	-	Indicates whether laser overheat has occurred. 0 – Has not overheated 1 – Has overheated Only available on certain 3B laser devices.
Laser Overheat Duration*	20021	-	The length of time in which the laser overheating state occurred. Only available on certain 3B laser devices.
Playback Position*	20023	-	The current replay playback position.
Playback Count*	20024	-	The number of frames present in the replay.
FireSync Version	20600	-	The FireSync version used by the Gocator build.
Processing Drops**	21000	-	Number of dropped frames. The sum of various processing drop related indicators.
Last IO Latency	21001	-	Last delay from camera exposure to when rich IO scheduling occurs. Valid only if rich IO is enabled.
Max IO Latency	21002	-	Maximum delay from camera exposure to when rich IO scheduling occurs. Valid only if rich IO is enabled. Reset on start.
Ethernet Output	21003	-	Number of bytes transmitted.
Ethernet Rate	21004	-	The average number of bytes per second being transmitted.

Indicator	ID	Instance	Value
Ethernet Drops	21005	-	Number of dropped Ethernet packets.
Digital Output Pass	21006	Output Index	Number of pass digital output pulse.
Digital Output Fail	21007	Output Index	Number of fail digital output pulse.
Trigger Drops**	21010		Number of dropped triggers. The sum of various triggering-related drop indicators.
Output Drops**	21011		Number of dropped output data. The sum of all output drops (analog, digital, serial, host server, and ASCII server).
Host Server Drops**	21012		The number of bytes dropped by the host data server. Not currently emitted.
ASCII Server Drops**	21013		The number of bytes dropped by the ASCII Ethernet data server. Not currently emitted.
Range Valid Count**	21100	-	Number of valid ranges.
Range Invalid Count**	21101	-	Number of invalid ranges.
Anchor Invalid Count**	21200	-	Number of frames with anchoring invalid.
Z-Index Drop Count	22000	-	The number of dropped surfaces due to a lack of z-encoder pulse during rotational part detection.
Value	30000	Measurement ID	Measurement Value.
Pass	30001	Measurement ID	Number of pass decision.
Fail	30002	Measurement ID	Number of fail decision.
Max	30003	Measurement ID	Maximum measurement value.
Min	30004	Measurement ID	Minimum measurement value.
Average	30005	Measurement ID	Average measurement value.
Std. Dev.	30006	Measurement ID	Measurement value standard deviation.
Invalid Count	30007	Measurement ID	Number of invalid values.
Overflow	30008	Measurement ID	Number of times this measurement has overflowed on any output. Multiple simultaneous overflows result in only a single increment to this counter. Overflow conditions include: -Value exceeds bit representation available for given protocol -Analog output (mA) falls outside of acceptable range (0-20 mA) When a measurement value overflow occurs, the value is set to the null value appropriate for the given protocol's measurement value output type. The Overflow health indicator increments.
Tool Run Time	22004	Tool Index	The most recent time taken to execute the tool.

* When the sensor is accelerated, the indicator's value is reported from the accelerating PC.

** When the sensor is accelerated, the indicator's value is the sum of the values reported from the sensor and the accelerating PC.

Modbus Protocol

Modbus is designed to allow industrial equipment such as Programmable Logic Controllers (PLCs), sensors, and physical input/output devices to communicate over an Ethernet network.

Modbus embeds a Modbus frame into a TCP frame in a simple manner. This is a connection-oriented transaction, and every query expects a response.

This section describes the Modbus TCP commands and data formats. Modbus TCP communication lets the client:

- Switch jobs.
- Align and run sensors.
- Receive measurement results, sensor states, and stamps.

To use the Modbus protocol, it must be enabled and configured in the active job.



The Gocator 4.x firmware uses mm, mm², mm³, and degrees as standard units. In all protocols, values are scaled by 1000, as values in the protocols are represented as integers. This results in effective units of mm/1000, mm²/1000, mm³/1000, and deg/1000 in the protocols.

If buffering is enabled with the Modbus protocol, the PLC must read the Buffer Advance output register (see *State* on page 410) to advance the queue before reading the measurement results.

For information on configuring the protocol using the Web interface, see *Ethernet Output* on page 235.

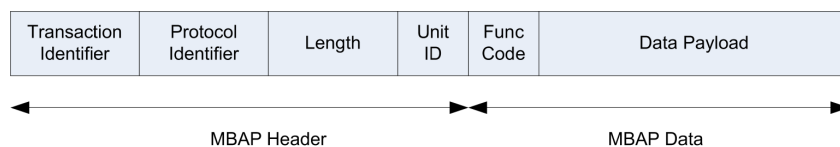
Concepts

A PLC sends a command to start each Gocator. The PLC then periodically queries each Gocator for its latest measurement results. In Modbus terminology, the PLC is a Modbus Client. Each Gocator is a Modbus Server which serves the results to the PLC.

The Modbus protocol uses TCP for connection and messaging. The PLC makes a TCP connection to the Gocator on port 502. Control and data messages are communicated on this TCP connection. Up to eight clients can be connected to the Gocator simultaneously. A connection closes after 10 minutes of inactivity.

Messages

All Modbus TCP messages consist of an MBAP header (Modbus Application Protocol), a function code, and a data payload.



The MBAP header contains the following fields:

Modbus Application Protocol Header

Field	Length (Bytes)	Description
Transaction ID	2	Used for transaction pairing. The Modbus Client sets the value and the Server (Gocator) copies the value into its responses.
Protocol ID	1	Always set to 0.
Length	1	Byte count of the rest of the message, including the Unit identifier and data fields.
Unit ID	1	Used for intra-system routing purpose. The Modbus Client sets the value and the Server (Gocator) copies the value into its responses.

Modbus Application Protocol Specification describes the standard function codes in detail. Gocator supports the following function codes:

Modbus Function Code

Function Code	Name	Data Size (bits)	Description
3	Read Holding Registers	16	Read multiple data values from the sensor.
4	Read Input Registers	16	Read multiple data values from the sensor.
6	Write Single Register	16	Send a command or parameter to the sensor.
16	Write Multiple Registers	16	Send a command and parameters to the sensor.

The data payload contains the registers that can be accessed by Modbus TCP messages. If a message accesses registers that are invalid, a reply with an exception is returned. Modbus Application Protocol Specification defines the exceptions and describes the data payload format for each function code.

The Gocator data includes 16-bit, 32-bit, and 64-bit data. All data are sent in big endian format, with the 32-bit and 64-bit data spread out into two and four consecutive registers.

32-bit Data Format

Register	Name	Bit Position
0	32-bit Word 1	31 .. 16
1	32-bit Word 0	15 .. 0

64-bit Data Format

Register	Name	Bit Position
0	64-bit Word 3	63 .. 48
1	64-bit Word 2	47 .. 32
2	64-bit Word 1	31 .. 16
3	64-bit Word 0	15 .. 0

Registers

Modbus registers are 16 bits wide and are either control registers or output registers.

Control registers are used to control the sensor states (e.g., start, stop, or calibrate a sensor).

The output registers report the sensor states, stamps, and measurement values and decisions. You can read multiple output registers using a single Read Holding Registers or a single Read Input Registers command. Likewise, you can control the state of the sensor using a single Write Multiple Register command.

Control registers are write-only, and output registers are read-only.

Register Map Overview

Register Address	Name	Read/Write	Description
0 - 124	Control Registers	WO	Registers for Modbus commands. See <i>Control Registers</i> below for detailed descriptions.
300 - 899	Sensor States	RO	Report sensor states. See <i>State</i> on the next page for detailed descriptions.
900 - 999	Stamps	RO	Return stamps associated with each surface. See <i>State</i> on the next page for detailed descriptions.
1000 - 1060	Measurements & Decisions	RO	20 measurement and decision pairs. See <i>Measurement Registers</i> on page 412 for detailed descriptions.

Control Registers

Control registers are used to operate the sensor. Register 0 stores the command to be executed. Registers 1 to 21 contain parameters for the commands. The Gocator executes a command when the value in Register 0 is changed. To set the parameters before a command is executed, you should set up the parameters and the command using a single Multiple Write register command.

Control Register Map

Register Address	Name	Read/Write	Description
0	Command Register	WO	Command register. See the Command Register Values table below for more information.
1 - 21	Job Filename	WO	Null-terminated filename. Each 16-bit register holds a single character. Only used for Load Job Command. Specifies the complete filename, including the file extension ".job".

The values used for the Command Register are described below.

Command Register Values

Value	Name	Description
0	Stop running	Stop the sensor. No effect if sensor is already stopped.
1	Start Running	Start the sensor. No effect if sensor is already started.
2	Align (stationary target)	Start the alignment process. State register 301 will be set to 1 (busy) until the alignment process is complete.

Value	Name	Description
3	Align (moving target)	Start alignment process and also calibrate encoder resolution. State register 301 will be set to 1 (busy) until the motion calibration process is complete.
4	Clear Alignment	Clear the alignment.
5	Load Job	Activate a job file. Registers 1 - 21 specify the filename.
6	Set Runtime Variables	Registers 1 through 9 are used to set the values of all four runtime variables.

Output Registers

Output registers are used to output states, stamps, and measurement results. Each register address holds a 16-bit data value.

State

State registers report the current sensor state.

State Register Map

Register Address	Name	Type	Description
300	Stopped / Running		Sensor State: 0 - Stopped 1 - Running
301	Busy		Busy State: 0 - Not busy 1 - Busy Registers 302 to 363 below are only valid when the Busy State is not Busy
302	Alignment State		Current Alignment State: 0 - Not aligned 1 - Aligned
303 – 306	Encoder Value	64s	Current Encoder value (ticks).
307 – 310	Time	64s	Current time (µs).
311	Job File Name Length	16u	Number of characters in the current job file name.
312 – 371	Live Job Name		Current Job Name. Name of currently loaded job file. Does not include the extension. Each 16-bit register contains a single character.
375	Runtime Variable 0 High	32s	Runtime variable value
376	Runtime Variable 0 Low		
...	...	...	...
381	Runtime Variable 3 High	32s	Runtime variable value
382	Runtime Variable 3 Low		

Stamp

Stamps contain trigger timing information used for synchronizing a PLC's actions. A PLC can also use this information to match up data from multiple Gocator sensors.

In Surface mode, the stamps are updated after each surface has been processed.

Stamp Register Map

Register Address	Name	Type	Description
976	Buffer Advance		If buffering is enabled this address must be read by the PLC Modbus client first to advance the buffer. After the buffer advance read operation, the Modbus client can read the updated Measurements & Decisions in addresses 1000-1060.
977	Buffer Counter		Number of buffered messages currently in the queue.
978	Buffer Overflow		Buffer Overflow Indicator: 0 - No overflow 1 - Overflow
979	Inputs		Digital input state.
980	zPosition High	64s	Encoder value when the index is last triggered.
981	zPosition		
982	zPosition		
983	zPosition Low		
984	Exposure High	32u	Laser exposure (μ s).
985	Exposure Low		
986	Temperature High	32u	Sensor temperature in degrees Celcius * 100 (centidegrees).
987	Temperature Low		
988	Position High	64s	Encoder position
989	Position		
990	Position		
991	Position Low		
992	Time Low	64u	Timestamp (μ s).
993	Time		
994	Time		
995	Time Low		
996	Frame Index High	64u	Frame counter. Each new sample is assigned a frame number.
997	Frame Index		
998	Frame Index		
999	Fame Index Low		

Measurement Registers

Measurement results are reported in pairs of values and decisions. Measurement values are 32 bits wide and decisions are 8 bits wide.

The measurement ID defines the register address of each pair. The register address of the first word can be calculated as $(1000 + 3 * ID)$. For example, a measurement with ID set to 4 can be read from registers 1012 (high word) and, 1013 (low word), and the decision at 1015.

In Surface mode, the measurement results are updated after each discrete part has been processed.

Measurement Register Map

Register Address	Name	Type	Description
1000	Measurement 0 High	32s	Measurement value in μm (0x80000000 if invalid)
1001	Measurement 0 Low		
1002	Decision 0	16u	Measurement decision. A bit mask, where: Bit 0: 1 - Pass 0 - Fail Bits 1-7: 0 - Measurement value OK 1 - Invalid value 2 - Invalid anchor
1003	Measurement 1 High		
1004	Measurement 1 Low		
1005	Decision 1		
1006	Measurement 2 High		
1007	Measurement 2 Low		
1008	Decision 2		
...	...	...	...
1057	Measurement 19 High		
1058	Measurement 19 Low		
1059	Decision 19		

EtherNet/IP Protocol

EtherNet/IP is an industrial protocol that allows bidirectional data transfer with PLCs. It encapsulates the object-oriented Common Industrial Protocol (CIP).

This section describes the EtherNet/IP messages and data formats. EtherNet/IP communication enables the client to:

- Switch jobs.
- Align and run sensors.
- Receive sensor states, stamps, and measurement results.

To use the EtherNet/IP protocol, it must be enabled and configured in the active job.



The Gocator 4.x firmware uses mm, mm², mm³, and degrees as standard units. In all protocols, values are scaled by 1000, as values in the protocols are represented as integers. This results in effective units of mm/1000, mm²/1000, mm³/1000, and deg/1000 in the protocols.

For information on configuring the protocol using the Web interface, see *Ethernet Output* on page 235.

Concepts

To EtherNet/IP-enabled devices on the network, the sensor information is seen as a collection of objects, which have attributes that can be queried.

Gocator supports all required objects, such as the Identity object, TCP/IP object, and Ethernet Link object. In addition, assembly objects are used for sending sensor and sample data and receiving commands. There are three assembly objects: the command assembly (32 bytes), the sensor state assembly (100 bytes), and the sample state assembly object (380 bytes). The data attribute (0x03) of the assembly objects is a byte array containing information about the sensor. The data attribute can be accessed with the GetAttribute and SetAttribute commands.

The PLC sends a command to start a Gocator. The PLC then periodically queries the attributes of the assembly objects for its latest measurement results. In EtherNet/IP terminology, the PLC is a scanner and the Gocator is an adapter.

The Gocator supports unconnected or connected explicit messaging (with TCP). Implicit I/O messaging is supported as an advanced setting. For more information, see http://lmi3d.com/sites/default/files/APPNOTE_Implicit_Messaging_with_Allen-Bradley_PLCs.pdf.

The default EtherNet/IP ports are used. Port 44818 is used for TCP connections and UDP queries (e.g., list Identity requests). Port 2222 for UDP I/O Messaging is not supported.

Basic Object

Identity Object (Class 0x01)

Attribute	Name	Type	Value	Description	Access
1	Vendor ID	UINT	1256	ODVA-provided vendor ID	Get
2	Device Type	UINT	43	Device type	Get
3	Product Code	UINT	2000	Product code	Get
4	Revision	USINT USINT	x.x	Byte 0 - Major revision Byte 1 - Minor revision	Get
6	Serial number	UDINT	32-bit value	Sensor serial number	Get
7	Product Name	SHORT STRING 32	"Gocator"	Gocator product name	Get

TCP/IP Object (Class 0xF5)

The TCP/IP Object contains read-only network configuration attributes such as IP Address. TCP/IP configuration via Ethernet/IP is not supported. See Volume 2, Chapter 5-3 of the CIP Specification for a complete listing of TCP/IP object attributes.

Attribute	Name	Type	Value	Description	Access
1	Status	UDINT	0	TCP interface status	Get
2	Configuration Capability	UINT	0		Get
3	Configuration Control	UINT	0	Product code	Get
4	Physical Link Object	Structure (See description)		See 5.3.3.2.4 of CIP Specification Volume 2: Path size (UINT) Path (Padded EPATH)	Get
5	Interface Configuration	Structure (See description)		See 5.3.3.2.5 of CIP Specification Volume 2: IP address (UDINT) Network mask (UDINT) Gateway address (UDINT) Name server (UDINT) Secondary name (UDINT) Domain name (UDINT)	Get

Ethernet Link Object (Class 0xF6)

The Ethernet Link Object contains read-only attributes such as MAC Address (Attribute 3). See Volume 2, Chapter 5-4 of the CIP Specification for a complete listing of Ethernet Link object attributes.

Attribute	Name	Type	Value	Description	Access
1	Interface Speed	UDINT	1000	Ethernet interface data rate (mbps)	Get
2	Interface Flags	UDINT		See 5.4.3.2.1 of CIP Specification Volume 2: Bit 0: Link Status 0 – Inactive 1 – Active Bit 1: Duplex 0 – Half Duplex 1 – Full Duplex	Get
3	Physical Address	Array of 6 USINTs		MAC address (for example: 00 16 20 00 2E 42)	Get

Assembly Object (Class 0x04)

The Gocator Ethernet/IP object model includes the following assembly objects: Command, Sensor State, and Sample State.

All assembly object instances are static. Data in a data byte array in an assembly object are stored in the big endian format.

Command Assembly

The command assembly object is used to start, stop, and align the sensor, and also to switch jobs on the sensor.

Command Assembly

Information	Value
Class	0x4
Instance	0x310
Attribute Number	3
Length	32 bytes
Supported Service	0x10 (SetAttributeSingle)

Attributes 1 and 2 are not implemented, as they are not required for the static assembly object.

Attribute 3

Attribute	Name	Type	Value	Description	Access
3	Command	Byte Array	See Below	Command parameters Byte 0 - Command. See table below for specification of the values.	Get, Set

Command Definitions

Value	Name	Description
0	Stop running	Stop the sensor. No action if the sensor is already stopped

Value	Name	Description
1	Start Running	Start the sensor. No action if the sensor is already started.
2	Stationary Alignment	Start the stationary alignment process. Byte 1 of the sensor state assembly will be set to 1 (busy) until the alignment process is complete, then back to zero.
4	Clear Alignment	Clear the alignment.
5	Load Job	Load the job. Set bytes 1-31 to the file name (one character per byte, including the extension).

Runtime Variable Configuration Assembly

The runtime variable configuration assembly object contains the sensor's intended runtime variables.

Runtime Variable Configuration Assembly

Information	Value
Class	0x04
Instance	0x311
Attribute Number	3
Length	64 bytes
Supported Service	0x10 (SetAttributeSingle)

Attribute 3

Attribute	Name	Type	Value	Description	Access
3	Command	Byte Array	See below	Runtime variable configuration information. See below for more details.	Get

Sensor State Information

Byte	Name	Type	Description
0-3	Runtime Variable 0	32s	Stores the intended value of the Runtime Variable at index 0.
4-7	Runtime Variable 1	32s	Stores the intended value of the Runtime Variable at index 1.
8-11	Runtime Variable 2	32s	Stores the intended value of the Runtime Variable at index 2.
12-15	Runtime Variable 3	32s	Stores the intended value of the Runtime Variable at index 3.
16-63	Reserved		

Sensor State Assembly

The sensor state assembly object contains the sensor's states, such as the current sensor temperature, frame count, and encoder values.

Sensor State Assembly

Information	Value
Class	0x04
Instance	0x320
Attribute Number	3
Length	100 bytes
Supported Service	0x0E (GetAttributeSingle)

Attributes 1 and 2 are not implemented, as they are not required for the static assembly object.

Attribute 3

Attribute	Name	Type	Value	Description	Access
3	Command	Byte Array	See below	Sensor state information. See below for more details.	Get

Sensor State Information

Byte	Name	Type	Description
0	Sensor's state		Sensor state: 0 - Ready 1 - Running
1	Command in progress		Command busy status: 0 - Not busy 1 - Busy performing the last command Bytes 2 to 43 below are only valid when there is no command in progress.
2	Alignment state		Alignment status: 0 - Not aligned 1 - Aligned The value is only valid when byte1 is set to 0.
3-10	Encoder	64s	Current encoder position
11-18	Time	64s	Current timestamp
19	Current Job Filename Length	16u	Number of characters in the current job filename. (e.g., 11 for "current.job"). The length includes the .job extension. Valid when byte 1 = 0.
20-43	Current Job Filename		Name of currently loaded job file, including the ".job" extension. Each byte contains a single character. Valid when byte 1 = 0.
84-87	Runtime Variable 0	32s	Runtime variable value at index 0
...	...		
96-99	Runtime Variable 3	32s	Runtime variable value at index 3

Sample State Assembly

The sample state object contains measurements and their associated stamp information.

Sample State Assembly

Information	Value
Class	0x04
Instance	0x321
Attribute Number	3
Length	380 bytes
Supported Service	0x0E (GetAttributeSingle)

Attribute 3

Attribute	Name	Type	Value	Description	Access
3	Command	Byte Array	See below	Sample state information. See below for more details.	Get

Sample State Information

Byte	Name	Type	Description
0-1	Inputs		Digital input state.
2-9	Z Index Position	64s	Encoder position at time of last index pulse.
14-17	Temperature	32u	Sensor temperature in degrees Celsius * 100 (centidegrees).
18-25	Position	64s	Encoder position.
26-33	Time	64u	Time.
34-41	Frame Counter	64u	Frame counter.
42	Buffer Counter	8u	Number of buffered messages currently in the queue.
43	Buffer Overflow		Buffer Overflow Indicator: 0 - No overflow 1 - Overflow
44 - 79	Reserved		Reserved bytes.
80-83	Measurement 0	32s	Measurement value in μm (0x80000000 if invalid).
84	Decision 0	8u	Measurement decision. A bit mask, where: Bit 0: 1 - Pass 0 - Fail Bits 1-7: 0 - Measurement value OK 1 - Invalid value

Byte	Name	Type	Description
			2 - Invalid anchor
...	...		
375-378	Measurement 59	32s	Measurement value in μm (0x80000000 if invalid).
379	Decision 59	8u	Measurement decision. A bit mask, where: Bit 0: 1 - Pass 0 - Fail Bits 1-7: 0 - Measurement value OK 1 = Invalid value 2 = Invalid anchor

Measurement results are reported in pairs of values and decisions. Measurement values are 32 bits wide and decisions are 8 bits wide.

The measurement ID defines the byte position of each pair within the state information. The position of the first word can be calculated as $(80 + 5 * \text{ID})$. For example, a measurement with ID set to 4 can be read from byte 100 (high word) to 103 (low word) and the decision at 104.

In Surface mode, the measurement results are updated after each discrete part has been processed. If buffering is enabled in the Ethernet Output panel, reading the Extended Sample State Assembly Object automatically advances the buffer. See *Ethernet Output* on page 235 for information on the **Output** panel.

Implicit Messaging Command Assembly

Implicit Messaging Command Assembly

Information	Value
Class	0x04
Instance	0x64
Attribute Number	3
Length	32 bytes

Implicit Messaging Command Assembly Information

Byte	Name	Type	Description
0	Command	8u	A bit mask where setting the following bits will only perform the action with highest priority*: 8 – Set Runtime Variables 7 – Stop sensor 6 – Start sensor

Byte	Name	Type	Description
			5 – Perform Stationary Alignment 4 – Perform Moving Alignment 3 – Clear alignment *The priority of commands is currently as follows: 1. Stop sensor 2. Start sensor 3. Perform Stationary Alignment 4. Perform Moving Alignment 5. Clear alignment 6. Set Runtime Variables
1-31	Reserved (except for configuring runtime variables)		For setting runtime variables, bytes 4 through 20 are used to define the values of each of the four runtime variables in Little Endian format.

Implicit Messaging Output Assembly

Implicit Messaging Output Assembly

Information	Value
Class	0x04
Instance	0x322
Attribute Number	3
Length	376 bytes

Implicit Messaging Output Assembly Information

Byte	Name	Type	Description
0	Sensor State	8u	Sensor state is a bit mask where: Bit 0: 1 – Running 0 – Stopped Bits [1-7]: 0 – No state issue 1 – Conflict
1	Alignment and Command state	8u	A bit mask where: Bit 0: 1 – Explicit or Implicit Command in progress 0 – No Explicit or Implicit command is in

Byte	Name	Type	Description
			progress Bit 1 1 – Aligned 0 – Not aligned
2-3	Inputs	16u	Digital input state
4-11	Z Index Position	64u	Encoder position at time of last index pulse
12-15	Exposure	32u	Laser exposure in μ s
16-19	Temperature	32u	Sensor temperature in degrees celsius * 100 (centidegrees)
20-27	Encoder Position	64s	Encoder position
28-35	Time	64u	Time
36-43	Scan Count	64u	Represents the number of scans
44-55	Reserved		
56	Decision 0	8u	Measurement decision is a bit mask where: Bit 0: 1 – Pass 0 – Fail Bits [1-7]: 0 – Measurement value OK 1 – Invalid Value 2 – Invalid Anchor
...	...		
119	Decision 63	8u	Measurement decision is a bit mask where: Bit 0: 1 – Pass 0 – Fail Bits [1-7]: 0 – Measurement value OK 1 – Invalid Value 2 – Invalid Anchor
120-123	Measurement 0	32s	Measurement value in μ m. (0x80000000 if invalid)
...	...		
372-375	Measurement 63	32s	Measurement value in μ m. (0x80000000 if invalid)

ASCII Protocol

This section describes the ASCII protocol.

The ASCII protocol is available over either serial output or Ethernet output. Over serial output, communication is asynchronous (measurement results are automatically sent on the Data channel when the sensor is in the running state and results become available). Over Ethernet, communication can be asynchronous or can use polling. For more information on polling commands, see *Polling Operation Commands (Ethernet Only)* on the next page.

The protocol communicates using ASCII strings. The output result format from the sensor is user-configurable.

To use the ASCII protocol, it must be enabled and configured in the active job.



The Gocator 4.x firmware uses mm, mm², mm³, and degrees as standard units. In all protocols, values are scaled by 1000, as values in the protocols are represented as integers. This results in effective units of mm/1000, mm²/1000, mm³/1000, and deg/1000 in the protocols.

For information on configuring the protocol with the Web interface (when using the protocol over Ethernet), see *Ethernet Output* on page 235.

For information on configuring the protocol with the Web interface (when using the protocol over Serial), see *Serial Output* on page 243.

Connection Settings

Ethernet Communication

With Ethernet ASCII output, you can set the connection port numbers of the three channels used for communication (Control, Data, and Health):

Ethernet Ports for ASCII

Name	Description	Default Port
Control	To send commands to control the sensor.	8190
Data	To retrieve measurement output.	8190
Health	To retrieve specific health indicator values.	8190

Channels can share the same port or operate on individual ports. The following port numbers are reserved for Gocator internal use: 2016, 2017, 2018, and 2019. Each port can accept multiple connections, up to a total of 16 connections for all ports.

Serial Communication

Over serial, Gocator ASCII communication uses the following connection settings:

Serial Connection Settings for ASCII

Parameter	Value
Start Bits	1
Stop Bits	1
Parity	None
Data Bits	8
Baud Rate (b/s)	115200
Format	ASCII
Delimiter	CR

Up to 16 users can connect to the sensor for ASCII interfacing at a time. Any additional connections will remove the oldest connected user.

Polling Operation Commands (Ethernet Only)

On the Ethernet output, the Data channel can operate asynchronously or by polling.

Under asynchronous operation, measurement results are automatically sent on the Data channel when the sensor is in the running state and results become available. The result is sent on all connected data channels.

Under polling operation, a client can:

- Switch to a different job.
- Align, run, and trigger sensors.
- Receive sensor states, health indicators, stamps, and measurement results

Gocator sends Control, Data, and Health messages over separate channels. The Control channel is used for commands such as starting and stopping the sensor, loading jobs, and performing alignment (see *Control Commands* on the next page).

The Data channel is used to receive and poll for measurement results. When the sensor receives a [Result](#) command, it will send the latest measurement results on the same data channel that the request is received on. See *Data Commands* on page 427 for more information.

The Health channel is used to receive health indicators (see *Health Commands* on page 429).

Command and Reply Format

Commands are sent from the client to the Gocator. Command strings are not case sensitive. The command format is:

<COMMAND><DELIMITER><PARAMETER><TERMINATION>

If a command has more than one parameter, each parameter is separated by the delimiter. Similarly, the reply has the following format:

<STATUS><DELIMITER><OPTIONAL RESULTS><DELIMITER>

The status can either be "OK" or "ERROR". The optional results can be relevant data for the command if successful, or a text based error message if the operation failed. If there is more than one data item, each item is separated by the delimiter.

The delimiter and termination characters are configured in the Special Character settings.

Special Characters

The ASCII Protocol has three special characters.

Special Characters

Special Character	Explanation
Delimiter	Separates input arguments in commands and replies, or data items in results. Default value is ",".
Terminator	Terminates both commands and result output. Default value is "%r%n".
Invalid	Represents invalid measurement results. Default value is "INVALID"

The values of the special characters are defined in the Special Character settings. In addition to normal ASCII characters, the special characters can also contain the following format values.

Format values for Special Characters

Format Value	Explanation
%t	Tab
%n	New line
%r	Carriage return
%%	Percentage (%) symbol

Control Commands

Optional parameters are shown in *italic*. The placeholder for data is surrounded by brackets (<>). In the examples, the delimiter is set to ','.

Start

The Start command starts the sensor system (causes it to enter the Running state). This command is only valid when the system is in the Ready state. If a start target is specified, the sensor starts at the target time or encoder (depending on the trigger mode).

Formats

Message	Format
Command	Start,start target The start target (optional) is the time or encoder position at which the sensor will be started. The time and encoder target value should be set by adding a delay to the time or encoder position returned by the Stamp command. The delay should be set such that it covers the command response time of the Start command.
Reply	OK or ERROR, <Error Message>

Examples:

Command: Start
Reply: OK
Command: Start,1000000
Reply: OK
Command: Start
Reply: ERROR, Could not start the sensor

Stop

The stop command stops the sensor system (causes it to enter the Ready state). This command is valid when the system is in the Ready or Running state.

Formats

Message	Format
Command	Stop
Reply	OK or ERROR, <Error Message>

Examples:

Command: Stop
Reply: OK

Trigger

The Trigger command triggers a single frame capture. This command is only valid if the sensor is configured in the Software trigger mode and the sensor is in the Running state. If a start target is specified, the sensor starts at the target time or encoder (depending on the unit setting in the Trigger panel; see *Triggers* on page 64).

Formats

Message	Format
Command	Trigger,start target The start target (optional) is the time or encoder position at which the sensor will be started. The time and encoder target value should be set by adding a delay to the time or encoder position returned by the Stamp command. The delay should be set such that it covers the command response time of the Start command.
Reply	OK or ERROR, <Error Message>

Examples:

Command: Trigger
Reply: OK
Command: Trigger,1000000
Reply: OK

LoadJob

The Load Job command switches the active sensor configuration.

Formats

Message	Format
Command	LoadJob,job file name If the job file name is not specified, the command returns the current job name. An error message is generated if no job is loaded. ".job" is appended if the filename does not have an extension.
Reply	OK or ERROR, <Error Message>

Examples:

```
Command: LoadJob,test.job
Reply: OK,test.job loaded successfully
Command: LoadJob
Reply: OK,test.job
Command: LoadJob,wrongname.job
Reply: ERROR, failed to load wrongname.job
```

Stamp

The Stamp command retrieves the current time, encoder, and/or the last frame count.

Formats

Message	Format
Command	Stamp,time,encoder,frame If no parameters are given, time, encoder, and frame will be returned. There could be more than one selection.
Reply	If no arguments are specified: OK, time, <time value>, encoder, <encoder position>, frame, <frame count> ERROR, <Error Message> If arguments are specified, only the selected stamps will be returned.

Examples:

```
Command: Stamp
Reply: OK,Time,9226989840,Encoder,0,Frame,6
Command: Stamp,frame
Reply: OK,6
```

Stationary Alignment

The Stationary Alignment command performs an alignment based on the settings in the sensor's live job file. A reply to the command is sent when the alignment has completed or failed. The command is timed out if there has been no progress after one minute.

Formats

Message	Format
Command	StationaryAlignment

Message	Format
Reply	If no arguments are specified OK or ERROR, <Error Message>

Examples:

Command: StationaryAlignment

Reply: OK

Command: StationaryAlignment

Reply: ERROR, ALIGNMENT FAILED

Clear Alignment

The Clear Alignment command clears the alignment record generated by the alignment process.

Formats

Message	Format
Command	ClearAlignment
Reply	OK or ERROR, <Error Message>

Examples:

Command: ClearAlignment

Reply: OK

Data Commands

Optional parameters are shown in *italic*. The placeholder for data is surrounded by brackets (<>). In the examples, the delimiter is set to ','.

Result

The Result command retrieves measurement values and decisions.

Formats

Message	Format
Command	Result, measurement ID, measurement ID...
Reply	If no arguments are specified, the custom format data string is used. OK, <custom data string> ERROR, <Error Message> If arguments are specified, OK, <data string in standard format> ERROR, <Error Message>

Examples:

Standard data string for measurements ID 0 and 1:

Result, 0, 1

OK, M00, 00, V151290, D0, M01, 01, V18520, D0

Standard formatted measurement data with a non-existent measurement of ID 2:

```
Result,2
```

```
ERROR,Specified measurement ID not found. Please verify your input
```

Custom formatted data string (%time, %value[0], %decision[0]):

```
Result
```

```
OK,1420266101,151290,0
```

Value

The Value command retrieves measurement values.

Formats

Message	Format
Command	Value,measurement ID,measurement ID...
Reply	If no arguments are specified, the custom format data string is used. OK, <custom data string> ERROR, <Error Message> If arguments are specified, OK, <data string in standard format, except that the decisions are not sent> ERROR, <Error Message>

Examples:

Standard data string for measurements ID 0 and 1:

```
Value,0,1
```

```
OK,M00,00,V151290,M01,01,V18520
```

Standard formatted measurement data with a non-existent measurement of ID 2:

```
Value,2
```

```
ERROR,Specified measurement ID not found. Please verify your input
```

Custom formatted data string (%time, %value[0]):

```
Value
```

```
OK, 1420266101, 151290
```


Decision

The Decision command retrieves measurement decisions.

Formats

Message	Format
Command	Decision,measurement ID,measurement ID...
Reply	If no arguments are specified, the custom format data string is used. OK, <custom data string> ERROR, <Error Message> If arguments are specified, OK, <data string in standard format, except that the values are not sent> ERROR, <Error Message>

Examples:

Standard data string for measurements ID 0 and 1:

```
Decision,0,1
```

```
OK,M00,00,D0,M01,01,D0
```

Standard formatted measurement data with a non-existent measurement of ID 2:

```
Decision,2
```

```
ERROR,Specified measurement ID not found. Please verify your input
```

Custom formatted data string (%time, %decision[0]):

```
Decision
```

```
OK,1420266101, 0
```

Health Commands

Optional parameters are shown in *italic*. The placeholder for data is surrounded by brackets (<>). In the examples, the delimiter is set to ','.

Health

The Health command retrieves health indicators. See *Health Results* on page 401 for details on health indicators.

Formats

Message	Format
Command	Health,health indicator ID.Optional health indicator instance ... More than one health indicator can be specified. Note that the health indicator instance is optionally attached to the indicator ID with a ' <i>.</i> '. If the health indicator instance field is used the delimiter cannot be set to ' <i>.</i> '.
Reply	OK, <health indicator of first ID>, <health indicator of second ID> ERROR, <Error Message>

Examples:

health,2002,2017

OK,46,1674

Health

ERROR,Insufficient parameters.

Standard Result Format

Gocator can send measurement results either in the standard format or in a custom format. In the standard format, you select in the web interface which measurement values and decisions to send. For each measurement the following message is transmitted:

M	t _n	,	i _n	,	V	v _n	,	D	d ₁	CR
---	----------------	---	----------------	---	---	----------------	---	---	----------------	----

Field	Shorthand	Length	Description
MeasurementStart	M	1	Start of measurement frame.
Type	t _n	n	Hexadecimal value that identifies the type of measurement. The measurement type is the same as defined elsewhere (see <i>Data Results</i> on page 393).
Id	i _n	n	Decimal value that represents the unique identifier of the measurement.
ValueStart	V	1	Start of measurement value.
Value	v _n	n	Measurement value, in decimal. The unit of the value is measurement-specific.
DecisionStart	D	1	Start of measurement decision.
Decision	d ₁	1	Measurement decision, a bit mask where: Bit 0: 1 – Pass 0 – Fail Bits 1-7: 0 – Measurement value OK 1 – Invalid value 2 – Invalid anchor

Custom Result Format

In the custom format, you enter a format string with place holders to create a custom message. The default format string is "%time, %value[0], %decision[0]".

Result Placeholders

Format Value	Explanation
%time	Timestamp
%encoder	Encoder position
%frame	Frame number
%value[Measurement ID]	Measurement value of the specified measurement ID. The ID must correspond to an existing measurement. The value output will be displayed as an integer in micrometers.
%decision[Measurement ID]	Measurement decision, where the selected measurement ID must correspond to an existing measurement. Measurement decision is a bit mask where: Bit 0: 1 – Pass 0 – Fail Bits 1-7: 0 – Measurement value OK 1 – Invalid value 2 - Invalid anchor

Selcom Protocol

This section describes the Selcom serial protocol settings and message formats supported by Gocator sensors.

To use the Selcom protocol, it must be enabled and configured in the active job.

For information on configuring the protocol using the Web interface, see *Serial Output* on page 243.



Units for data scales use the standard units (mm, mm², mm³, and degrees).

Serial Communication

Data communication is synchronous using two unidirectional (output only) RS-485 serial channels: data (Serial_Out0) and clock (Serial_Out1). See *Serial Output* on page 491 for cable pinout information.

Measurement results are sent on the serial output (data) in asynchronous mode. Measurement values and decisions can be transmitted to an RS-485 receiver, but job handling and control operations must be performed through the Gocator's web interface or through communications on the Ethernet output.

Connection Settings

The Selcom protocol uses the following connection settings:

Serial Connection Settings

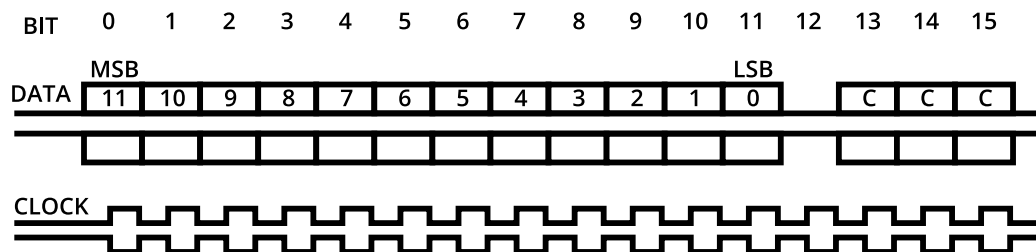
Parameter	Value
Data Bits	16
Baud Rate (b/s)	96000, 512000, 1024000
Format	Binary

Message Format

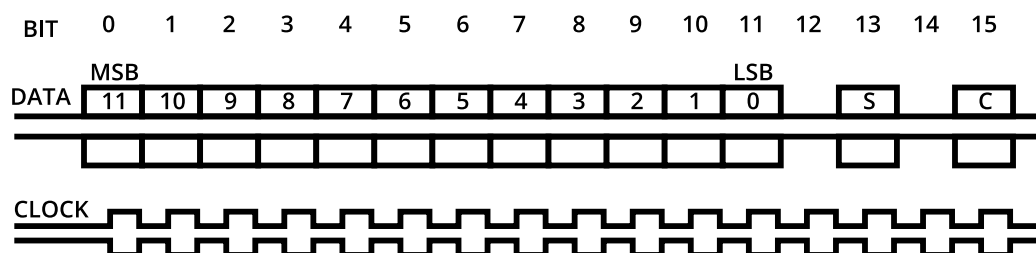
The data channel is valid on the rising edge of the clock and data is output with the most significant bit first, followed by control bits for a total of 16 bits of information per frame. The time between the start of the camera exposure and the delivery of the corresponding range data is fixed to a deterministic value.

The sensor can output data using one of four formats, illustrated below, where:

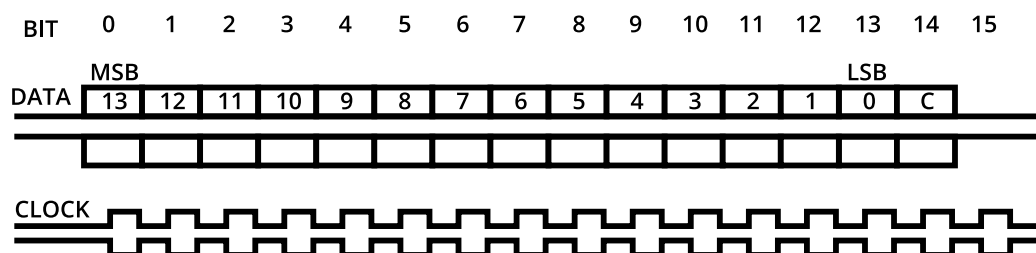
- MSB = most significant bit
- LSB = least significant bit
- C = data valid bit (high = invalid)
- S = whether data is acquired in search mode or track mode (high = search mode)



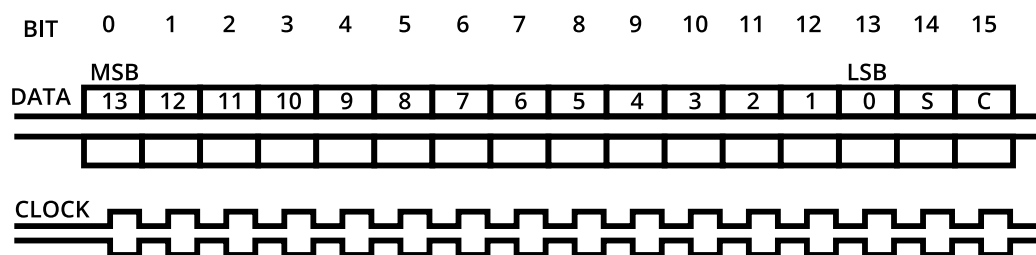
12-bit data format (SLS mode; "SLS" in Gocator web interface)



12-bit data format with Search/Track bit



14-bit data format



14-bit data format with Search/Track bit

Development Kits

Gocator includes two development kits:

- [Software Development Kit \(SDK\)](#)
- [Gocator Development Kit \(GDK\)](#)

SDK

The Gocator Software Development Kit (SDK) includes open-source software libraries and documentation that can be used to programmatically access and control Gocator sensors. To get the latest version of the SDK, go to <http://lmi3d.com/support>, choose your product from the Product Downloads section, and download it from the Download Center.

You can download the Gocator SDK from within the Web interface.

Software Development Kit (SDK):

Download

To download the SDK:

1. Go to the **Manage** page and click on the **Support** category
2. Next to **Software Development Kit (SDK)**, click **Download**
3. Choose the location for the SDK on the client computer.

Applications compiled with previous versions of the SDK are compatible with Gocator firmware if the major version numbers of the protocols match. For example, an application compiled with version 4.0 of the SDK (which uses protocol version 4.0) will be compatible with a Gocator running firmware version 4.1 (which uses protocol version 4.1). However, any new features in firmware version 4.1 would not be available.

If the major version number of the protocol is different, for example, an application compiled using SDK version 3.x being used with a Gocator running firmware 4.x, you must rewrite the application with the SDK version corresponding to the sensor firmware in use.

The Gocator API, included in the SDK, is a C language library that provides support for the commands and data formats used with Gocator sensors. The API is written in standard C to allow the code to be compiled for any operating system. A pre-built DLL is provided to support 32-bit and 64-bit Windows operating systems. Projects and makefiles are included to support other editions of Windows and Linux.

For Windows users, code examples explaining how to wrap the calls in C# and VB.NET are provided in the tools package, which can be downloaded at go to <http://lmi3d.com/support>, choose your product from the Product Downloads section, and download it from the Download Center.

For more information about programming with the Gocator SDK, refer to the class reference and sample programs included in the Gocator SDK.

Setup and Locations

Class Reference

The full SDK class reference is found by accessing 14400-4.x.x.xx_SOFTWARE_GO_SDK\GO_SDK\doc\GoSdk\Gocator_3x00\GoSdk.html.

Examples

Examples showing how to perform various operations are provided, each one targeting a specific area. All of the examples can be found in *GoSdkSamples.sln*.

To run the SDK samples, make sure *GoSdk.dll* and *kApi.dll* (or *GoSdkd.dll* and *kApid.dll* in debug configuration) are copied to the executable directory. All sample code, including C examples, is now located in the *Tools* package, which can be downloaded by going to <http://lmi3d.com/support>, choose your product from the Product Downloads section, and download it from the Download Center.

Sample Project Environment Variable

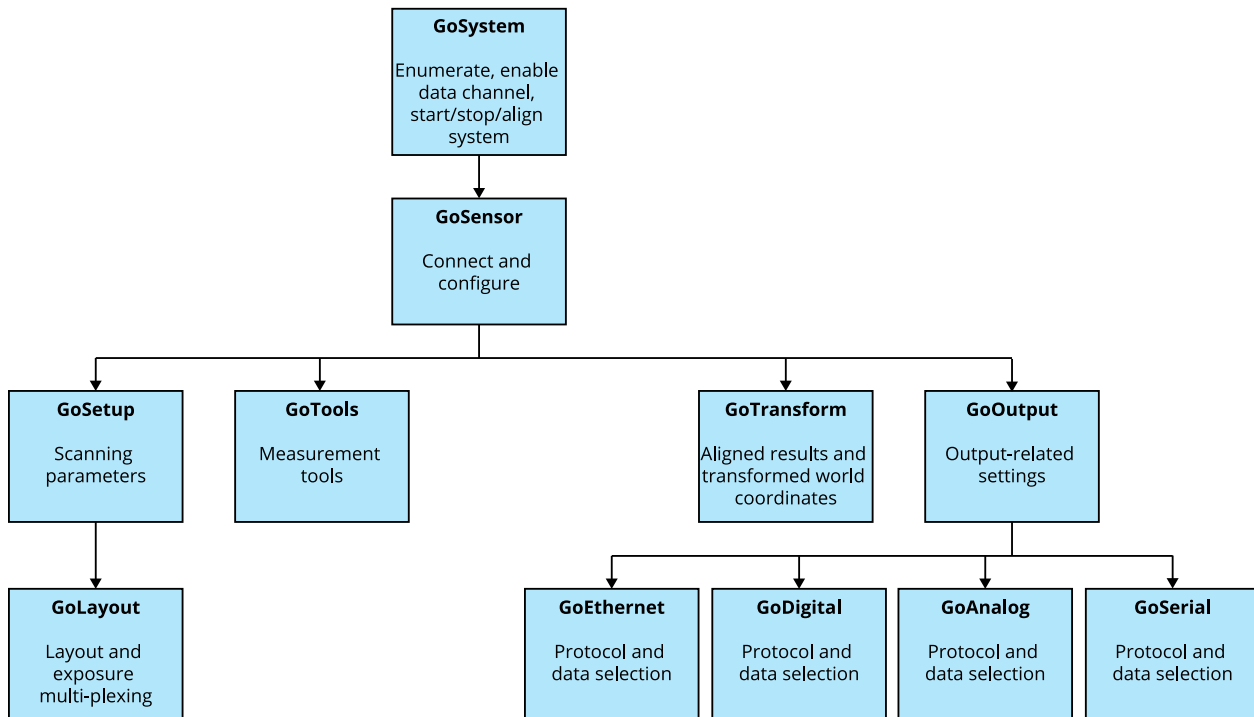
All sample projects use the environment variable *GO_SDK_4*. The environment variable should point to the *GO_SDK* directory, for example, *C:\14400-4.0.9.156_SOFTWARE_GO_SDK\GO_SDK*.

Header Files

Header files are referenced with GoSdk as the source directory, for example: `#include <GoSdk/GoSdk.h>`. The SDK header files also reference files from the *kApi* directory. The include path must be set up for both the GoSdk and the kApi directories. For example, the sample projects set the include path to `$(GO_SDK_4)\Gocator\GoSdk` and `$(GO_SDK_4)\Platform\kApi`.

Class Hierarchy

This section describes the class hierarchy of the Gocator 4.x SDK.



GoSystem

The *GoSystem* class is the top-level class in Gocator 4.x. Multiple sensors can be enabled and connected in one *GoSystem*. Only one *GoSystem* object is required for multi-sensor control.

Refer to the *How To Use The Open Source SDK To Fully Control A Gocator Multi-sensor System* how-to guide in http://lmi3d.com/sites/default/files/APPNOTE_Gocator_4.x_Multi_Sensor_Guide.zip for details on how to control and operate a multi-sensor system using the SDK.



All objects that are explicitly created by the user or passed via callbacks should be destroyed by using the *GoDestroy* function.

GoSensor

GoSensor represents a physical sensor. If the physical sensor is the Main sensor in a dual-sensor setup, it can be used to configure settings that are common to both sensors.

GoSetup

The *GoSetup* class represents a device's configuration. The class provides functions to get or set all of the settings available in the Gocator web interface.

GoSetup is included inside *GoSensor*. It encapsulates scanning parameters, such as exposure, resolution, spacing interval, etc. For parameters that are independently controlled for Main and Buddy sensors, functions accept a role parameter.

GoLayout

The *GoLayout* class represents layout-related sensor configuration.

GoTools

The *GoTools* class is the base class of the measurement tools. The class provides functions for getting and setting names, retrieving measurement counts, etc.

GoTransform

The *GoTransform* class represents a sensor transformation and provides functions to get and set transformation information, as well as encoder-related information.

GoOutput

The *GoOutput* class represents output configuration and provides functions to get the specific types of output (Analog, Digital, Ethernet, and Serial). Classes corresponding to the specific types of output (*GoAnalog*, *GoDigital*, *GoEthernet*, and *GoSerial*) are available to configure these outputs.

Data Types

The following sections describe the types used by the SDK and the *kApi* library.

Value Types

GoSDK is built on a set of basic data structures, utilities, and functions, which are contained in the *kApi* library.

The following basic value types are used by the *kApi* library.

Value Data Types

Type	Description
k8u	8-bit unsigned integer
k16u	16-bit unsigned integer
k16s	16-bit signed integer
k32u	32-bit unsigned integer
k32s	32-bit signed integer
k64s	64-bit signed integer
k64u	64-bit unsigned integer
k64f	64-bit floating number
kBool	Boolean, value can be kTRUE or kFALSE
kStatus	Status, value can be kOK or kERROR
kIpAddress	IP address

Output Types

The following output types are available in the SDK.

Output Data Types

Data Type	Description
GoAlignMsg	Represents a message containing an alignment result.

Data Type	Description
GoBoundingBoxMatchMsg	Represents a message containing bounding box based part matching results.
GoDataMsg	Represents a base message sourced from the data channel. See <i>GoDataSet Type</i> below for more information.
GoEdgeMatchMsg	Represents a message containing edge based part matching results.
GoEllipseMatchMsg	Represents a message containing ellipse based part matching results.
GoExposureCalMsg	Represents a message containing exposure calibration results.
GoMeasurementMsg	Represents a message containing a set of GoMeasurementData objects.
GoProfileIntensityMsg	Represents a data message containing a set of profile intensity arrays.
GoProfileMsg	Represents a data message containing a set of profile arrays.
GoRangeIntensityMsg	Represents a data message containing a set of range intensity data.
GoRangeMsg	Represents a data message containing a set of range data.
GoResampledProfileMsg	Represents a data message containing a set of resampled profile arrays.
GoSectionMsg	Represents a data message containing a set of section arrays.
GoSectionIntensityMsg	Represents a data message containing a set of profile intensity arrays.
GoStampMsg	Represents a message containing a set of acquisition stamps.
GoSurfaceIntensityMsg	Represents a data message containing a surface intensity array.
GoSurfaceMsg	Represents a data message containing a surface array.
GoVideoMsg	Represents a data message containing a video image.

Refer to the *GoSdkSamples* sample code for examples of acquiring data using these data types.

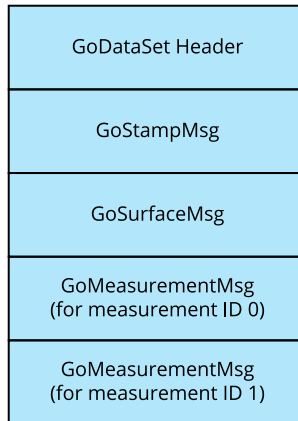


See *Setup and Locations* on page 435 for more information on the code samples.

GoDataSet Type

Data are passed to the data handler in a *GoDataSet* object. The *GoDataSet* object is a container that can contain any type of data, including scan data (sections or surfaces), measurements, and results from various operations. Data inside the *GoDataSet* object are represented as messages.

The following illustrates the content of a *GoDataSet* object of a surface mode setup with two measurements.



After receiving the *GoDataSet* object, you should call *GoDestroy* to dispose the *GoDataSet* object. You do not need to dispose objects within the *GoDataSet* object individually.



All objects that are explicitly created by the user or passed via callbacks should be destroyed by using the *GoDestroy* function.

Measurement Values and Decisions

Measurement values and decisions are 32-bit signed values (k32s). See *Value Types* on page 437 for more information on value types.

The following table lists the decisions that can be returned.

Measurement Decisions

Decision	Description
1	The measurement value is between the maximum and minimum decision values. This is a pass decision.
0	The measurement value is outside the maximum and minimum. This is a fail decision.
-1	The measurement is invalid (for example, the target is not within range). Provides the reason for the failure.
-2	The tool containing the measurement is anchored and has received invalid measurement data from one of its anchors. Provides the reason for the failure.

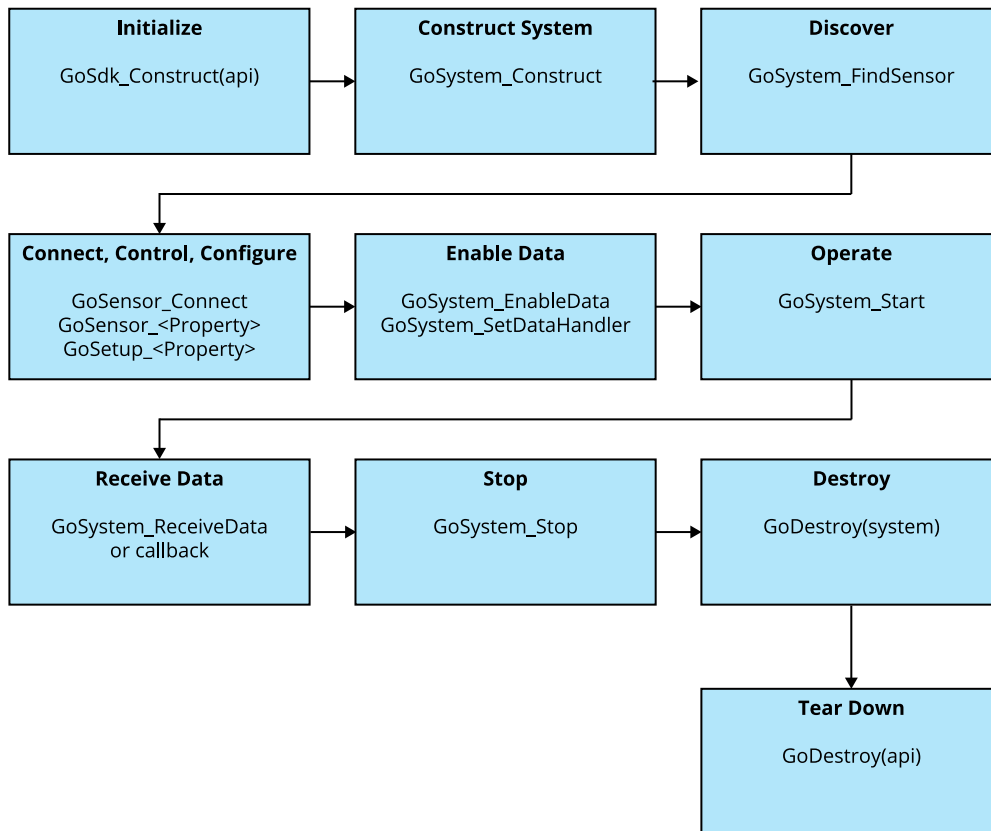
Refer to the *SetupMeasurement* example for details on how to add and configure tools and measurements. Refer to the *ReceiveMeasurement* example for details on how to receive measurement decisions and values.



You should check a decision against ≤ 0 for failure or invalid measurement.

Operation Workflow

Applications created using the SDK typically use the following programming sequence:



See *Setup and Locations* on page 435 for more information on the code samples referenced below.



Sensors must be connected before the system can enable the data channel.



All data functions are named *Go<Object>_<Function>*, for example, *GoSensor_Connect*. For property access functions, the convention is *Go<Object>_<Property Name>* for reading the property and *Go<Object>_Set<Property Name>* for writing it, for example, *GoMeasurement_DecisionMax* and *GoMeasurement_SetDecisionMax*, respectively.

Initialize GoSdk API Object

Before the SDK can be used, the *GoSdk* API object must be initialized by calling *GoSdk_Construct(api)*:

```

kAssembly api = kNULL;
if ((status = GoSdk_Construct(&api)) != kOK)
{
    printf("Error: GoSdk_Construct:%d\n", status);
    return;
}

```

When the program finishes, call *GoDestroy(api)* to destroy the API object.

Discover Sensors

Sensors are discovered when *GoSystem* is created, using *GoSystem_Construct*. You can use *GoSystem_SensorCount* and *GoSystem_SensorAt* to iterate all the sensors that are on the network.

GoSystem_SensorCount returns the number of sensors physically in the network.

Alternatively, use *GoSystem_FindSensorById* or *GoSystem_FindSensorByIpAddress* to get the sensor by ID or by IP address.

Refer to the *Discover* example for details on iterating through all sensors. Refer to other examples for details on how to get a sensor handle directly from IP address.

Connect Sensors

Sensors are connected by calling *GoSensor_Connect*. You must first get the sensor object by using *GoSystem_SensorAt*, *GoSystem_FindSensorById*, or *GoSystem_FindSensorByIpAddress*.

Configure Sensors

Some configuration is performed using the *GoSensor* object, such as managing jobs, uploading and downloading files, scheduling outputs, setting alignment reference, etc. Most configuration is however performed through the *GoSetup* object, for example, setting scan mode, exposure, exposure mode, active area, speed, alignment, filtering, subsampling, etc. Surface generation is configured through the *GoSurfaceGeneration* object and part detection settings are configured through the *GoPartDetection* object.

See *Class Hierarchy* on page 435 for information on the different objects used for configuring a sensor. Sensors must be connected before they can be configured.

Refer to the *Configure* example for details on how to change settings and to switch, save, or load jobs. Refer to the *BackupRestore* example for details on how to back up and restore settings.

Enable Data Channels

Use *GoSystem_EnableData* to enable the data channels of all connected sensors. Similarly, use *GoSystem_EnableHealth* to enable the health channels of all connected sensors.

Perform Operations

Operations are started by calling *GoSystem_Start*, *GoSystem_StartAlignment*, and *GoSystem_StartExposureAutoSet*.

Refer to the *StationaryAlignment* and *MovingAlignment* examples for details on how to perform alignment operations. Refer to the *ReceiveRange*, *ReceiveProfile*, and *ReceiveWholePart* examples for details on how to acquire data.

Example: Configuring and starting a sensor with the Gocator API

```
#include <GoSdk/GoSdk.h>
```

```
void main()  
{
```

```

kIpAddress ipAddress;
GoSystem system = kNULL;
GoSensor sensor = kNULL;
GoSetup setup = kNULL;

//Construct the GoSdk library.
GoSdk_Construct(&api);
//Construct a Gocator system object.
GoSystem_Construct(&system, kNULL);
//Parse IP address into address data structure
kIpAddress_Parse(&ipAddress, SENSOR_IP);
//Obtain GoSensor object by sensor IP address
GoSystem_FindSensorByIpAddress(system, &ipAddress, &sensor)
//Connect sensor object and enable control channel
GoSensor_Connect(sensor);
//Enable data channel
GoSensor_EnableData(system, kTRUE)
//[Optional] Setup callback function to receive data asynchronously
//GoSystem_SetDataHandler(system, onData, &contextPointer)
//Retrieve setup handle
setup = GoSensor_Setup(sensor);
//Reconfigure system to use time-based triggering.
GoSetup_SetTriggerSource(setup, GO_TRIGGER_TIME);
//Send the system a "Start" command.
GoSystem_Start(system);

//Data will now be streaming into the application
//Data can be received and processed asynchronously if a callback function has been
//set (recommended)
//Data can also be received and processed synchronously with the blocking call
//GoSystem_ReceiveData(system, &dataset, RECEIVE_TIMEOUT)
//Send the system a "Stop" command.
GoSystem_Stop(system);

//Free the system object.
GoDestroy(system);

//Free the GoSdk library
GoDestroy(api);
}

```

Limiting Flash Memory Write Operations

Several operations and Gocator SDK functions write to the Gocator's flash memory. The lifetime of the flash memory is limited by the number of write cycles. Therefore it is important to avoid frequent write operation to the Gocator's flash memory when you design your system with the Gocator SDK.



Power loss during flash memory write operation will also cause Gocators to enter rescue mode.



This topic applies to all Gocator sensors.

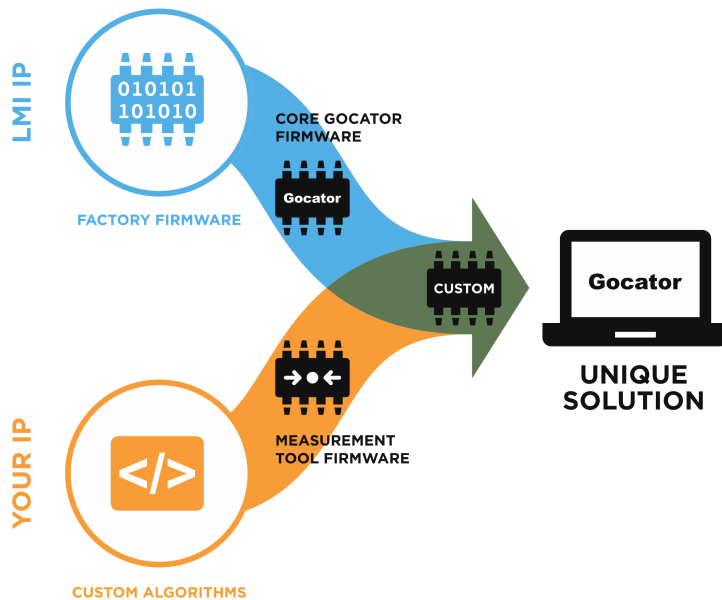
Gocator SDK Write-Operation Functions

Name	Description
GoSensor_Restore	Restores a backup of sensor files.
GoSensor_RestoreDefaults	Restores factory default settings.
GoSensor_CopyFile	Copies a file within the connected sensor. The flash write operation does not occur if GoSensor_CopyFile function is used to load an existing job file. This is accomplished by specifying "_live" as the destination file name.
GoSensor_DeleteFile	Deletes a file in the connected sensor.
GoSensor_SetDefaultJob	Sets a default job file to be loaded on boot.
GoSensor_UploadFile	Uploads a file to the connected sensor.
GoSensor_Upgrade	Upgrades sensor firmware.
GoSystem_StartAlignment	When alignment is performed with alignment reference set to fixed, flash memory is written immediately after alignment. GoSensor_SetAlignmentReference() is used to configure alignment reference.
GoSensor_SetAddress	Configures a sensor's network address settings.
GoSensor_ChangePassword	Changes the password associated with the specified user account.

System created using the SDK should be designed in a way that parameters are set up to be appropriate for various application scenarios. Parameter changes not listed above will not invoke flash memory write operations when the changes are not saved to a file using the GoSensor_CopyFile function. Fixed alignment should be used as a means to attach previously conducted alignment results to a job file, eliminating the need to perform a new alignment.

GDK

The Gocator Development Kit (GDK) is a framework for developing and testing custom Gocator measurement tools containing your own algorithms, and then deploying them to Gocator sensors.



Custom tools created with the GDK act much like native Gocator measurement tools, running at native speeds and taking advantage of features such as anchoring. The GDK supports all data types (profile and surface), and tools created with the GDK use the same data visualization as native tools.

For more information on the GDK, see the technical user manual (15201-4.x.x.xxx_MANUAL_Technical_Gocator-Measurement-Tool.pdf). To get the manual, go to <http://lmi3d.com/support>, choose your product from the Product Downloads section, and download it from the Download Center. You can download the GDK package (14524-4.5.4.102_SOFTWARE_GDK.zip) and the prerequisite tools package (14525_1.0.0.0_SOFTWARE_GDK_Prerequisites.zip) from the same location.

Benefits

When you use the GDK to create custom measurement tools, you have complete control over how and where your custom measurement tools are used, which protects your intellectual property.

You can also easily troubleshoot and modify your tools on-site, letting you respond quickly to your customers' urgent issues.

Supported Sensors

The GDK is available for free for the following Gocator sensors:

- Gocator 1300 series
- Gocator 2300 series
- Gocator 2400 series
- Gocator 3100 series

Typical Workflow

The following is the typical workflow for creating and deploying custom measurement tools:

- Develop and build measurement tools using the GDK project files and libraries in Microsoft Visual Studio, targeting Win32.
- Debug the measurement tools using the emulator on a PC.
- Build the measurement tools into a custom firmware binary.
- Upload the custom firmware to a sensor.

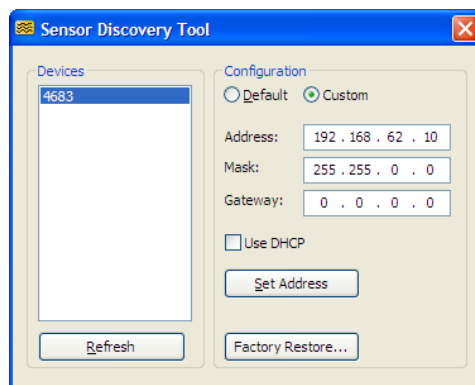
Tools and Native Drivers

The following sections describe the tools and native drivers you can use with a Gocator.

Sensor Recovery Tool

If a sensor's network address or administrator password is forgotten, the sensor can be discovered on the network and/or restored to factory defaults by using a special software tool called the Sensor Discovery tool. This software tool can be obtained from the downloads area of the LMI Technologies website: <http://www.lmi3D.com>.

After downloading the tool package [14405-x.x.x.x_SOFTWARE_GO_Tools.zip], unzip the file and run the Sensor Discovery Tool [bin>win32>kDiscovery.exe].



Any sensors that are discovered on the network will be displayed in the Devices list.

To change the network address of a sensor:

1. To change the network address of a sensor.
2. Select the **Custom** option.
3. Enter the new network address information.
4. Press the Set Address button.

To restore a sensor to factory defaults:

1. Select the sensor serial number in the **Devices** list.
2. Press the **Factory Restore...** button.
Confirm when prompted.



The Sensor Discovery tool uses UDP broadcast messages to reach sensors on different subnets. This enables the Sensor Discovery tool to locate and re-configure sensors even when the sensor IP address or subnet configuration is unknown.

GenTL Driver

GenTL is an industry standard method of controlling and acquiring data from an imaging device. The GenTL driver included with Gocator allows GenTL-compliant third-party software applications such as Halcon and Common Vision Blox to acquire and process 3D point clouds and intensity generated from the Gocator's Video, Surface mode in real-time.



To use these third-party software applications, you *must* configure a system variable so the software can access the GenTL driver. For instructions, see *To configure system variables to use the driver in Windows 7*, below.

To get the toolset package containing the driver (14405-x.x.x_SOFTWARE_GO_Tools.zip), go to <http://lmi3d.com/support>, choose your product from the Product Downloads section, and download it from the Download Center.

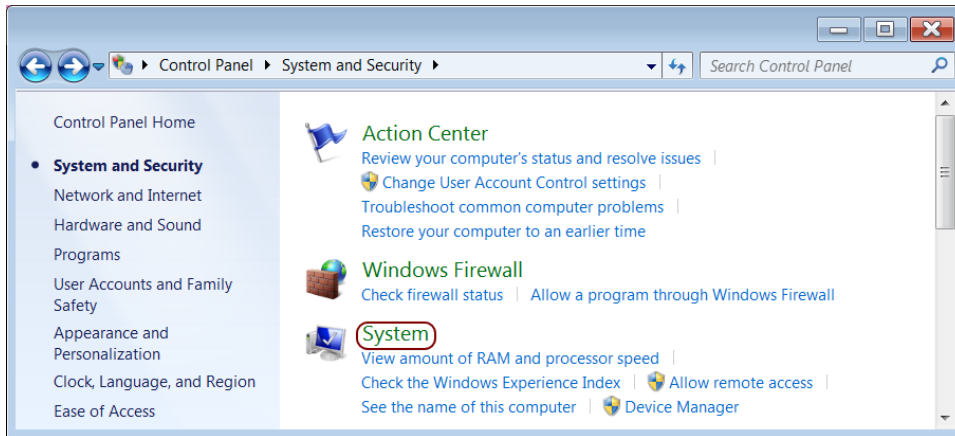
After downloading the package and unzipping the file to a location you will remember, you will find the driver in the GenTL\x86 or GenTL\x64 folder (you can move the GenTL folder to a more convenient location).

To configure system variables to use the driver in Windows 7:

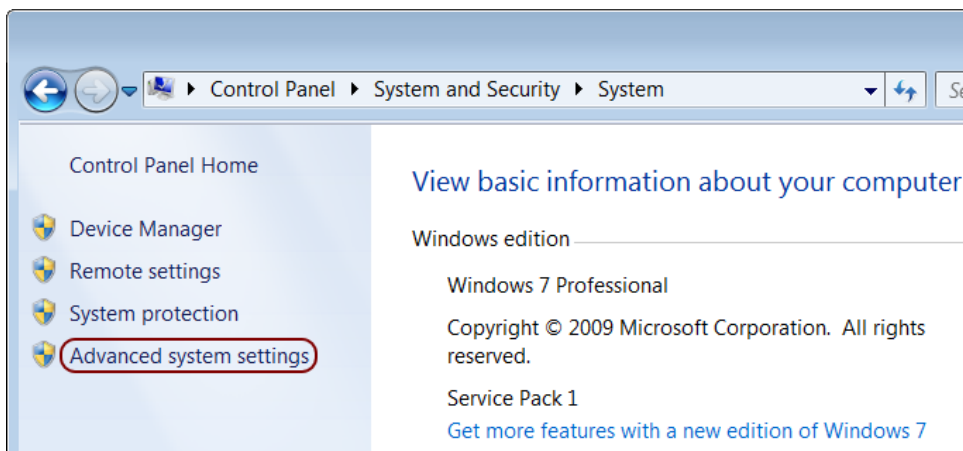
1. From the Start menu, open the **Control** panel and then click **System and Security**.



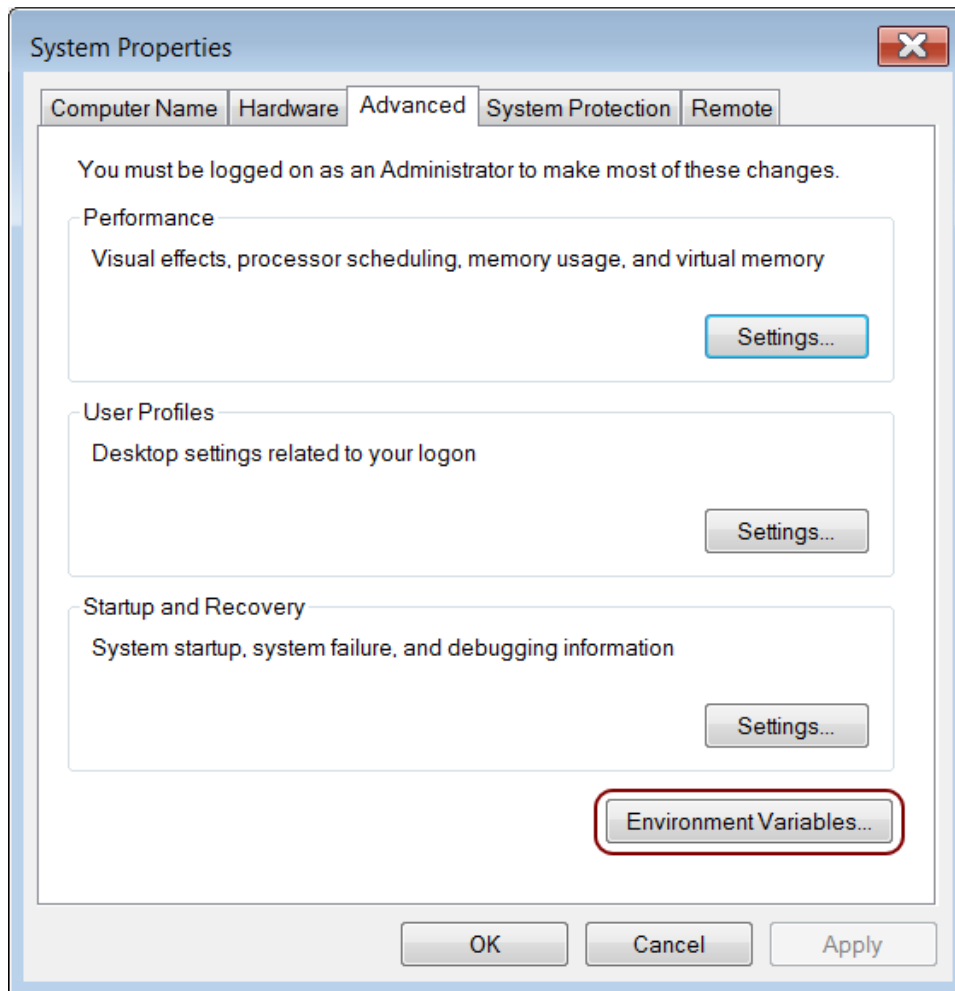
2. Click **System**.



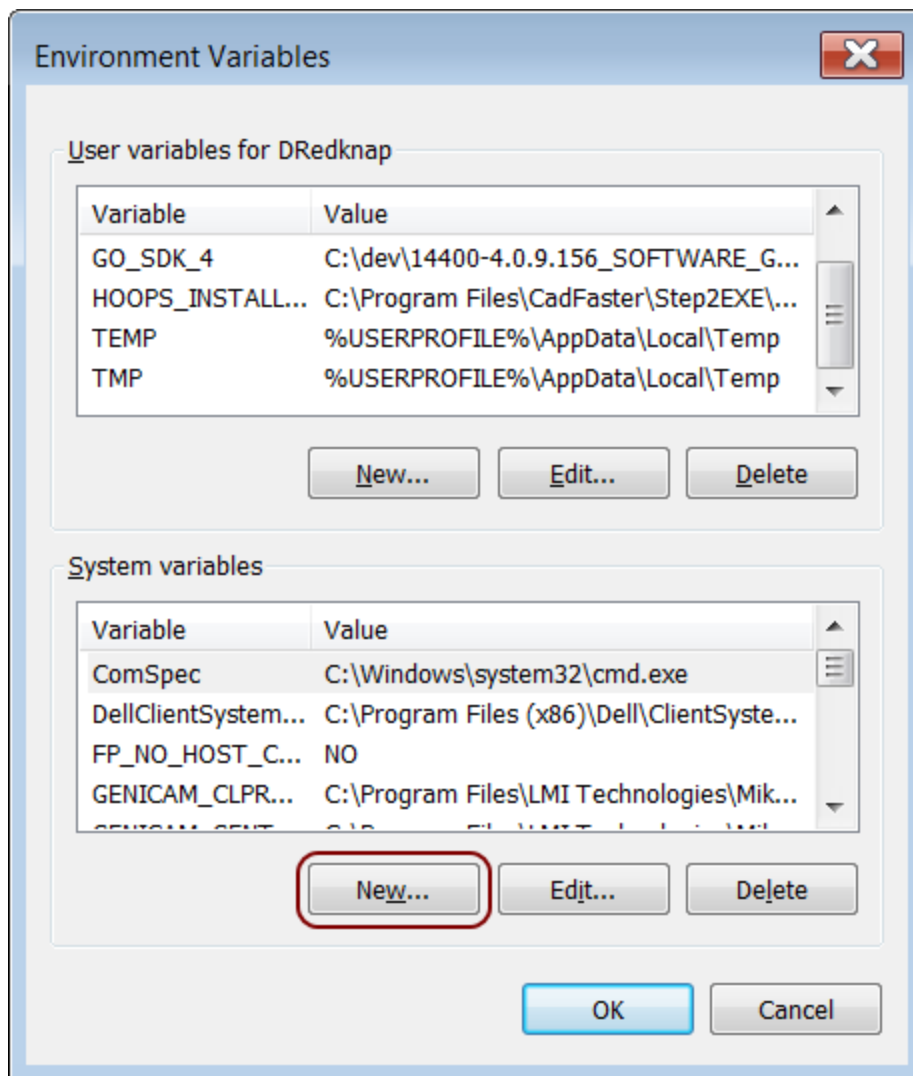
3. Click **Advanced System Settings**.



4. In the **System Properties** dialog, on the **Advanced** tab, click **Environment Variables...**

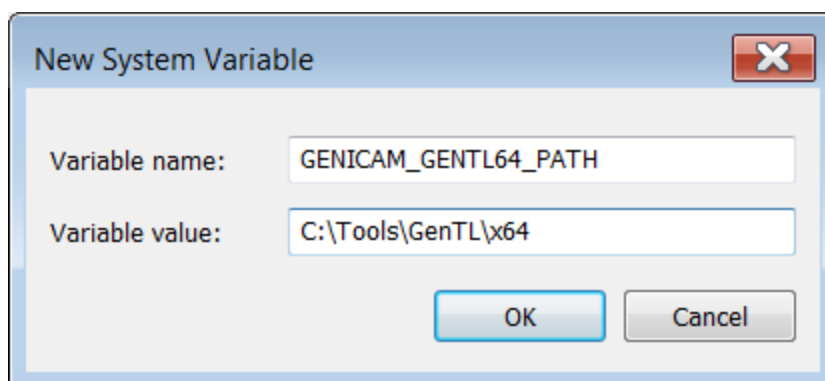


5. In the **Environment Variables** dialog, under the **System variables** list, click **New**.



6. In the **New System Variable** dialog, enter the following information, depending on your system:

	Variable name	Variable value
32-bit system	GENICAM_GENTL32_PATH	The full path to the GenTLx86 folder.
64-bit system	GENICAM_GENTL64_PATH	The full path to the GenTLx64 folder.



7. Click OK in the dialogs until they are all closed.

To work with the Gocator GenTL driver, the Gocator must operate in Surface or Video mode with its the appropriate output enabled in the **Ethernet** panel in the **Output** page. Check **Acquire Intensity** in the **Scan Mode** panel on the **Scan** page and enable intensity output in the **Ethernet** panel if intensity data is required.

The GenTL driver packs the part output, intensity, and stamps (e.g., time stamp, encoder index, etc.) into either a 16-bit RGB image or a 16-bit grey scale image. You can select the format in the Go2GenTL.xml setting file.

The width and height of the 16-bit RGB or grey scale image is calculated from the maximum number of columns and rows needed to accommodate the sensor's field of view and the maximum part length.

16-bit RGB Image

When the 16-bit RGB format is used, the height map, intensity, and stamps are stored in the red, green, and blue channel respectively.

Channel	Details
Red	Height map information. The width and height of the image represent the dimensions in the X and Y axis. Together with the pixel value, each red pixel presents a 3D point in the real-world coordinates. The following formula can be used to calculate the real-world coordinates (X, Y, Z) from pixel coordinates (Px, Py, Pz): $X = X \text{ offset} + Px * X \text{ resolution}$ $Y = Y \text{ offset} + Py * Y \text{ resolution}$ $Z = Z \text{ offset} + Pz * Z \text{ resolution}$ Refer to the blue channel on how to retrieve the offset and resolution values. If Pz is 0 if the data is invalid. The Z offset is fixed to $-32768 * Z \text{ resolution}$. Z is zero if Pz is 32768.
Green	Intensity information. Same as the red channel, the width and height of the image represent the dimension in the X and the Y axis. Together with the pixel value, each blue pixel represents an intensity value in the real-world coordinates. The following formula can be used to calculate the real-world coordinates (X, Y, Z) from pixel coordinates (Px, Py, Pz): $X = X \text{ offset} + Px * X \text{ resolution}$ $Y = Y \text{ offset} + Py * Y \text{ resolution}$ $Z = 16\text{-bit intensity value}$ The intensity value is 0 if the intensity image is not available. Gocator outputs 8-bit intensity values. The values stored in the 16-bit RGB image is multiplied by 256. To obtain the original values, divide the intensity values by 256. Refer to the blue channel on how to retrieve the offset and resolution values.
Blue	Stamp information. Stamps are 64-bit auxiliary information related to the height map and intensity content. The next table explains how the stamps are packed into the blue

Channel	Details
	pixel channel
	See <i>Data Results</i> on page 393 for an explanation of the stamp information.

The following table shows how the stamp information is packed into the blue channel. A stamp is a 64-bit value packed into four consecutive 16-bit blue pixels, with the first byte position storing the most significant byte.

Stamp Information from GenTL driver

Stamp Index	Blue Pixel Position	Details
0	0..3	Version
1	4..7	Frame Count
2	8..11	Timestamp (µs)
3	12..15	Encoder value (ticks)
4	16..19	Encoder index (ticks) This is the encoder value when the last index is triggered
5	20..23	Digital input states
6	24..27	X offset (nm)
7	28..31	X resolution(nm)
8	32..35	Y offset (nm)
9	36..39	Y resolution (nm)
10	40..43	Z offset (nm)
11	44..47	Z resolution (nm)
12	48..51	Height map Width (in pixels)
13	52..55	Height map length (in pixels)
14	56..59	Specify if the intensity is enabled

16-bit Grey Scale Image

When the 16-bit grey scale format is used, the height map, intensity, and stamps are stored sequentially in the grey scale image.

The last row of the image contains the stamp information.

Rows	Details
0 .. (max part height - 1)	Height map information. The width and height of the image represent the dimensions in the X and Y axis. Together with the pixel value, each pixel presents a 3D point in the real-world coordinates. The following formula can be used to calculate the real-world coordinates (X, Y, Z) from pixel coordinates (Px, Py, Pz): $X = X \text{ offset} + Px * X \text{ resolution}$

Rows	Details
	$Y = Y \text{ offset} + P_y * Y \text{ resolution}$ $Z = Z \text{ offset} + P_z * Z \text{ resolution}$ Refer to the blue channel on how to retrieve the offset and resolution values. If P_z is 0 if the data is invalid. The Z offset is fixed to $-32768 * Z \text{ Resolution}$. Z is zero if P_z is 32768.
(max part height) .. 2* (max part height) If intensity is enabled	Intensity information. The width and height of the image represent the dimension in the X and the Y axis. Together with the pixel value, each blue pixel represents an intensity value in the real-world coordinates. The following formula can be used to calculate the real-world coordinates (X, Y, Z) from pixel coordinates (Px, Py, Pz): The following formula assumes Py is relative to the first row of the intensity information, not the first row of the whole 16-bit grey scale image. $X = X \text{ offset} + P_x * X \text{ resolution}$ $Y = Y \text{ offset} + P_y * Y \text{ resolution}$ $Z = 16\text{-bit intensity value}$ This intensity value is 0 if the intensity image is not available. Gocator outputs 8-bit intensity values. The values stored in the 16-bit Grey scale image is multiplied by 256. To obtain the original values, divide the intensity values by 256. Refer to the stamps on how to retrieve the offset and resolution values.
The last row of the 16-bit grey scale image	Stamp information. Stamps are 64-bit auxiliary information related to the height map and intensity content. The next table explains how the stamps are packed into the blue pixel channel See <i>Data Results</i> on page 393 for an explanation of the stamp information.

The following table shows how the stamp information is packed into the last row. A stamp is a 64-bit value packed into four consecutive 16-bit pixels, with the first byte position storing the most significant byte.

Stamp Information from GenTL driver

Stamp Index	Column Position	Details
0	0..3	Version
1	4..7	Frame Count
2	8..11	Timestamp (μ s)
3	12..15	Encoder value (ticks)
4	16..19	Encoder index (ticks) This is the encoder value when the last index is triggered
5	20..23	Digital input states
6	24..27	X offset (nm)
7	28..31	X resolution(nm)
8	32..35	Y offset (nm)

Stamp Index	Column Position	Details
9	36..39	Y resolution (nm)
10	40..43	Z offset (nm)
11	44..47	Z resolution (nm)
12	48..51	Height map Width (in pixels)
13	52..55	Height map length (in pixels)
14	56..59	Specify if intensity is enabled or not

Registers

GenTL registers are multiples of 32 bits. The registers are used to control the operation of the GenTL driver, send commands to the sensors, or to report the current sensor information.

Register Map Overview

Register Address	Name	Read/Write	Length (bytes)	Description
260	WidthReg	RO	4	Specify the width of the returned images. The part height map is truncated if it is wider than the specified width.
264	HeightReg	RO	4	Specify the height of the returned images (i.e., length of the part). The part height map is truncated if it is longer than the specified length.
292	ResampleMode	RO	4	Enable the resampling logic in the GenTL driver 0 – Disable resampling 1 – Enable resampling When resampling is enabled, the GenTL driver will resample the height map so that the pixel spacing is the same in the X and Y axis.
296	EncoderValue0	RO	4	Report the current encoder value (least significant 32-bit). The current encoder value is latched from the sensor when this register is read.
300	EncoderValue1	RO	4	Report the current encoder value (most significant 32-bit). The encoder value is latched when EncoderValue0 register is read. User should read EncoderValue0 before reading EncoderValue1.
304	Configuration File	RW	16	Read the name of sensor live configuration file or switch (write) the sensor configuration file. The configuration name is NULL terminated and includes the extension ".job". Writing to this register causes the sensor to switch to the specified configuration.

Register Address	Name	Read/Write	Length (bytes)	Description
320	Transformation X offset	RO	4	Return the sensor transformation X offset
324	Transformation Z offset	RO	4	Return the sensor transformation Z offset
328	Transformation Angle	RO	4	Return the sensor transformation angle
332	Transformation Orientation	RO	4	Return the sensor transformation orientation
336	Clearance distance	RO	4	Return the sensor clearance distance

XML Settings File

The settings file, Go2GenTL.xml, resides in the same directory as the Gocator GenTL driver. Users can set the resample mode and output format by changing the setting in this file.

Element	Type	Description
ResampleMode	32u	Settings to disable or enable resampling mode: 0 – Disable 1 – Enable When resampling mode is enabled, the GenTL driver will resample the height map so that the pixel spacing is the same in the X and Y axis. The default value is 1.
DataFormat	32u	Settings to choose 16-bit RGB or 16-bit grey scale image output: 0 – 16-bit RGB Image 1 – 16-bit grey scale Image The default value is 0.

Interfacing with Halcon

Halcon is a comprehensive software package for machine vision applications with an integrated development environment. Gocator can use the included GenTL driver to stream 3D point clouds and intensity data into Halcon in real-time.



The Gocator 4.x GenTL driver does not currently support scanning in profile mode.

For information on setting up the GenTL driver, see *GenTL Driver* on page 448.

This section describes how to configure Halcon to acquire data from the Gocator 4.x firmware. You should be familiar with Gocator's Surface mode. Before continuing, make sure Halcon is installed.

Requirements

Sensor	Gocator laser profile sensor
Firmware	Firmware 4.0.9.136 or later
Halcon	Version 10.0 or later

Setting Up Halcon

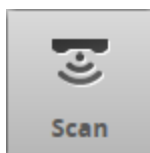
Before using Halcon with Gocator, you must set up Halcon.

To set up Halcon:

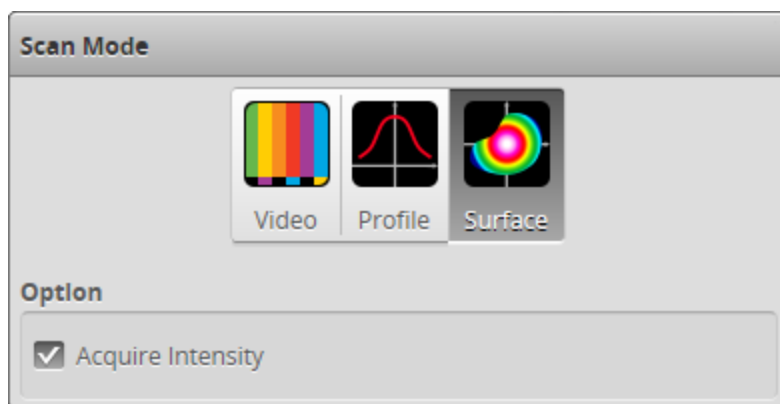
1. Connect a Gocator sensor to the PC running Halcon.

You will need a Master hub to connect the sensor to the PC. For more information, see *Installation* on page 20 and *Network Setup* on page 24.

2. Click the **Scan** page icon.



3. On the **Scan** page, click the **Surface** icon to switch to Surface mode.



4. (Optional) If you need intensity data, check the **Acquire Intensity** option.

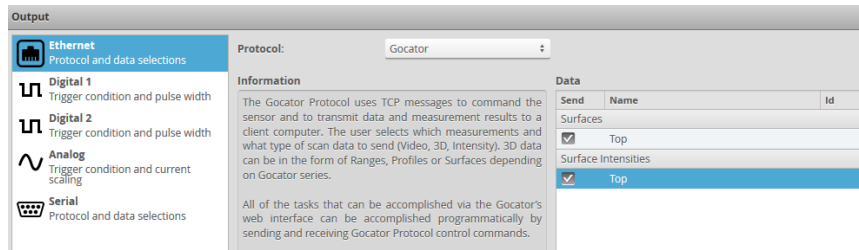
5. Configure the sensor to produce the desired surface data.

For more information on configuring Gocator sensors, see *Scan Setup and Alignment* on page 63 and *Models* on page 98.

6. Click the **Output** page icon.

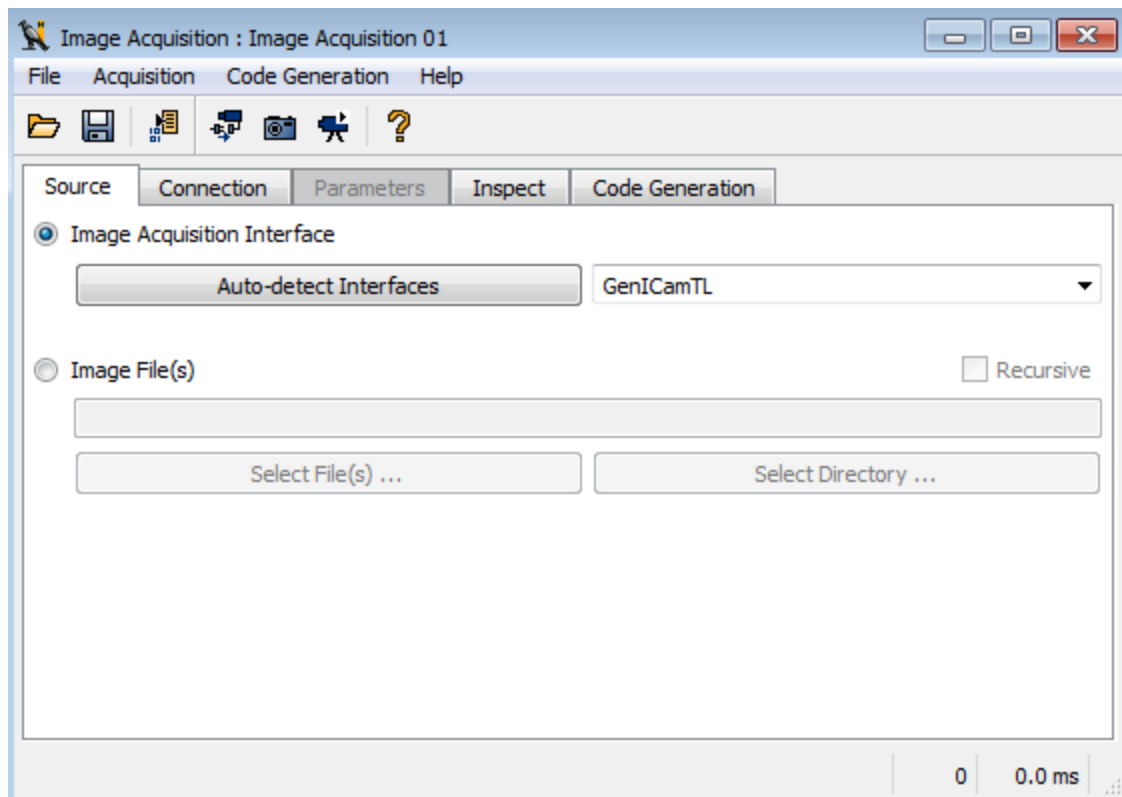


7. On the **Output** page, enable the required surface under **Data** and choose Gocator in **Protocol**.



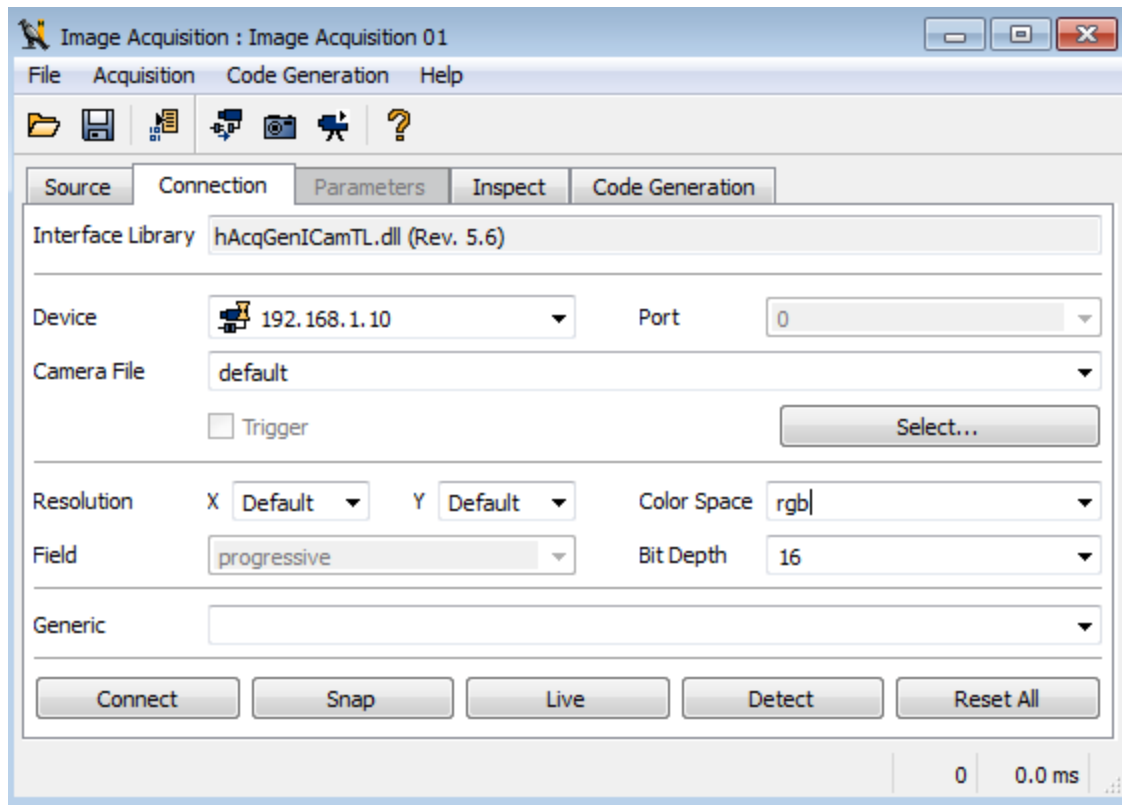
For more information on configuring Ethernet output, see *Ethernet Output* on page 235.

8. Make sure the Gocator is running.
9. On the PC, launch Halcon.
10. In Halcon, in the **Assistants** menu, click **Open New Image Acquisition**.
11. In the dialog that opens, in the **Source** tab, check the **Image Acquisition Interface** option and choose GenICamTL in the drop-down.



The driver uses the Gocator protocol discovery messages to search for available Gocator sensors. Discovery messages can be blocked by a PC's firewall. You should therefore turn off the firewall and try again if the Gocator sensor can't be detected.

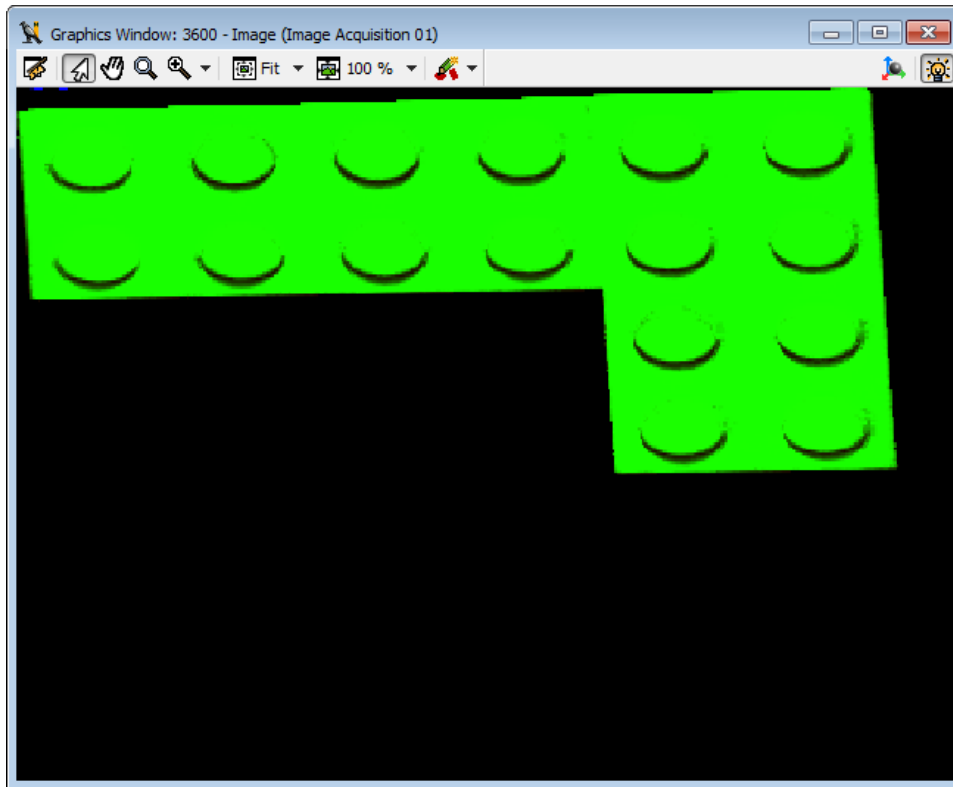
12. Switch to the **Connection** tab.
- If Halcon detects a Gocator sensor, the sensor's IP will be listed next to **Device**.



13. In the **Connection** tab, set **Color Space** to RGB and **Bit Depth** to 16.
14. In the Gocator web interface, click the Snapshot button to trigger the output of a surface.



The output displays in the Halcon **Graphics Window**.



Halcon is now configured for use with Gocator.

Halcon Procedures

The Halcon example code contains internal procedures that you can use to decompose the RGB image and to control registers that the GenTL driver opens.

You can import the procedures into your own code by selecting **File > Insert Program > Insert Procedures** and then choosing the example code `Continuous_Acq.hdev` under the `Examples/Halcon` directory.



The `Go2GenTL.xml` file for Gocator 4.x has more fields than the Gocator 3.x version. Make sure you are using the correct version.

The following section describes each of these procedures.

Halcon Procedures

Procedures	Description
Go2GenTL_ ParseData	The GenTL driver packs the height map, intensity and stamp information into a 16-bit RGB image. The function is used to extract data from the RGB image. For details on how the information is packed in the data, see the sections under <i>GenTL Driver</i> on page 448. The function accepts the image acquired from <code>grab_image_async</code>, and returns the height map, intensity and stamps. <i>Parameters (Input)</i> Image: RGB Image acquired by using <code>grab_image_async</code>.

Procedures	Description
	<i>Parameters (Output)</i> HeightMap: The height map image. Intensity: The intensity image. FrameCount: The number of frames. Timestamp: The timestamp. Encoder: The encoder position. EncoderIndex: The last index of the encoder. Inputs: The digital input states. xOffset: The X offset in millimeters. xResolution: The X resolution in millimeters. yOffset: The Y offset in millimeters. yResolution: The Y resolution in millimeters. zOffset: The Z offset in millimeters. zResolution: The Z resolution in millimeters. Width: The width (number of columns) of the image that contains the part. The part width can be less than the image width requested by the user. Height: The height or length (number of rows) of the image that contains the part. The part length can be less than the image height requested by the user. HasIntensity: Specifies if the intensity image is available. The intensity image is available if Acquire Intensity is enabled in the Gocator web interface. Each output is returned as decimal value. <i>Example</i> <pre>Go2GenTL_ParseData(Image, HeightMap, Intensity, frameCount, timestamp, encoderPosition, encoderIndex, inputs, xOffset, xResolution, yOffset, yResolution, zOffset, zResolution, width, height, hasIntensity)</pre>
Go2GenTL_ResampleMode	Returns the resample mode. <i>Parameters (Input)</i> AcqHandle: Acquisition handle created by open_framegrabber. <i>Parameters (Output)</i> ResampleMode: No - Resample is disabled. Yes - Resample is enabled. When resampling is enabled, the GenTL driver resamples the height map so that the pixel spacing is the same on the X and Y axis. <i>Example</i> <pre>Go2GenTL_ResampleMode (AcqHandle, ResampleMode)</pre>  To set the resample mode, you must directly modify Go2GenTL.xml, which is in the same directory as the Gocator GenTL driver (Go2GenTL.cti).
Go2GenTL_ConfigFileName	Returns the current live sensor job file name. <i>Parameters (Input)</i> AcqHandle: Acquisition handle created by open_framegrabber.

Procedures	Description
	<i>Parameters (Output)</i> ConfigFile: The name of the job file. The file name includes the extension .job. <i>Example</i> <pre>Go2GenTL_ConfigFileName (AcqHandle, ConfigFile)</pre>
Go2GenTL_SetConfigFileName	Sets the sensor live configuration. <i>Parameters (Input)</i> AcqHandle: Acquisition handle created by open_framegrabber. ConfigFile: The name of the job file. The file name should include the extension .job. <i>Example</i> <pre>Go2GenTL_SetConfigFileName (AcqHandle, 'test2.cfg')</pre>
Go2GenTL_Encoder	Returns the current encoder value. When this function is called, the GenTL driver retrieves the latest encoder value from the sensor. The value is returned as a two-element tuple. The first element is the least significant 32-bit value, and the second element is the most significant 32-bit value. <i>Parameters (Input)</i> AcqHandle: Acquisition handle created by open_framegrabber. <i>Parameters (Output)</i> EncoderValue: The current encoder value. <i>Example</i> <pre>Go2GenTL_Encoder (AcqHandle, EncoderValue)</pre>
Go2GenTL_ImageSize	Returns the size of the image returned by the GenTL driver. <i>Parameters (Input)</i> AcqHandle: Acquisition handle created by open_framegrabber. <i>Parameters (Output)</i> Width: The width of the image. Height: The height of the image. <i>Example</i> <pre>Go2GenTL_ImageSize (AcqHandle, Width, Height)</pre>
Go2GenTL_CoordinateXYZ	Returns the real-world coordinates (X, Y, Z) of the part given the row and column position in the height map. The values of the offset and resolution input parameters can be retrieved using Go2GenTL_ParseData. <i>Parameters (Input)</i> HeightMap: The height map image. Row: The row in the height map. Column: The column in the height map. xOffset: The X offset in millimeters. xResolution: The X resolution in millimeters. yOffset: The Y offset in millimeters. yResoluion: The Y resolution in millimeters. zOffset: The Z offset in millimeters.

Procedures	Description
	zResolution: The Z resolution in millimeters. <i>Parameters (Output)</i> coordinateXYZ: The real-world coordinates.
Go2GenTL_Exposure	Returns the current exposure. <i>Parameters (Input)</i> AcqHandle: Acquisition handle created by open_framegrabber. <i>Parameters (Output)</i> Exposure: The current exposure value (in μs). The value is returned as an integer. Decimals are truncated. <i>Example</i> <pre>Go2GenTL_Exposure(AcqHandle, exposure)</pre>
Go2GenTL_SetExposure	Sets the current exposure. <i>Parameters (Input)</i> AcqHandle: Acquisition handle created by open_framegrabber. Exposure: The current exposure value (in μs), as an integer. <i>Example</i> <pre>Go2GenTL_SetExposure(AcqHandle, exposure)</pre>
set_framegrabber_param	Generic Halcon function to set parameters on the scanner. Can be used to set scanner specific settings. For a complete list of settings that can be changed, see the SDK interface files. In the generic form: <pre>set_framegrabber_param(AcqHandle, 'Name', 'Value')</pre> <i>Parameters (Input)</i> AcqHandle: Acquisition handle created by open_framegrabber. Name: The name of the parameter to set on the scanner. Value: The parameter value to set on the scanner. <i>Examples</i> To set the format of the image buffer to 16-bit packed: <pre>set_framegrabber_param(AcqHandle, 'PixelFormat', 'RGB16Packed')</pre> To set the Scan mode to HDR (1 = no HDR, 2 = HDR, 3 = Super HDR): <pre>set_framegrabber_param(AcqHandle, 'Dynamic', '2')</pre> To set the brightness to '3': <pre>set_framegrabber_param(AcqHandle, 'Exposure', '3')</pre> To schedule a system to start in 1000000 ticks or microseconds (depends on current domain unit): <pre>set_framegrabber_param(AcqHandle, 'XMLSettings', 'GenTL/System') set_framegrabber_param(AcqHandle, 'XMLSettings', 'ScheduledStart=1') set_framegrabber_param(AcqHandle, 'XMLSettings', '000000') set_framegrabber_param(AcqHandle, 'XMLSettings', '')</pre>

Procedures	Description
------------	-------------

To schedule a *sensor* to start after a delay (ticks or microseconds), pass `GentL/Sensor` in the first call to `set_framegrabber_param`, followed by the remaining calls to the function as described in the previous example:

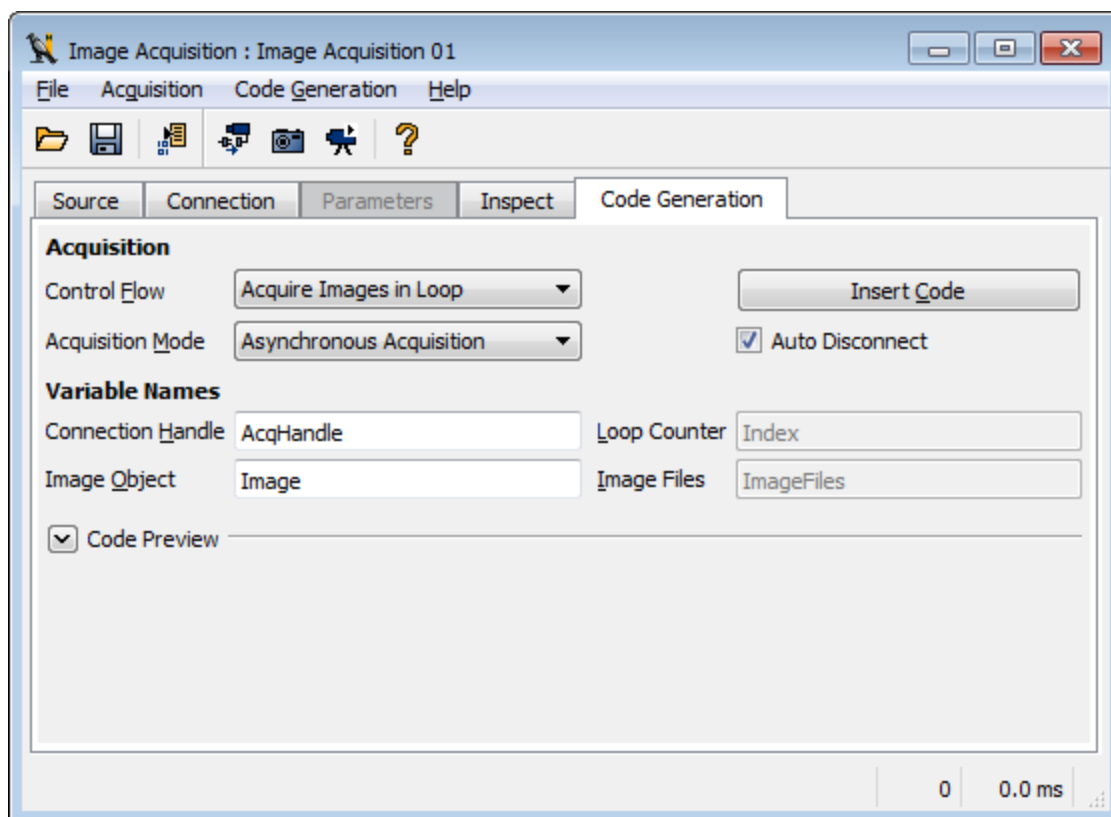
```
set_framegrabber_param( AcqHandle, 'XMLSettings', 'GentL/Sensor')
```

Generating Halcon Acquisition Code

Halcon lets you insert acquisition code into your code in the IDE.

To generate acquisition code:

1. In Halcon, in the **Assistants** menu, click **Open New Image Acquisition**.
2. In the dialog that opens, in the **Code Generation** tab, set **Acquisition Mode** to **Asynchronous Acquisition**.



3. Under **Acquisition**, click **Insert Code** to generate the code that will open the acquisition device.



To handle cases when the `grab_image` function times out while waiting for data, add a try-catch statement around the `grab_image` function code.

After the example code is generated, you should add a `catch` instruction to bypass the acquisition timeout event, and use the [Go2GentL_ParseData](#) function to extract information from the returned image.

An example, `Continuous_Acq.hdev`, is included in the `Examples/Halcon` directory and is shown below:

```

* This example illustrates how to do the following:
* 1. Acquire data from the Gocator (16-bit RGB or gray image)
* 2. Decompose the returned image into three separate image for height map, intensity and
stamps.
* 3. Extract some stamp values from the stamp image.
* Connect to the Gocator device. This code is auto generated by the Image Acquisition
dialog box. User can manually override the directory path by editing the line below.
* Set image type to 'rgb' if the format is 16-bit RGB. 'gray' if the format is 16-bit
mono
open_framegrabber ('GenICamTL', 0, 0, 0, 0, 0, 0, 'progressive', 16, 'rgb', -1, 'false',
'default', '192.168.1.10', 0, -1, AcqHandle)
grab_image_start (AcqHandle, -1)
while (true)
    try
        grab_image_async (Image, AcqHandle, -1)
    catch(Exception)
        continue
    endtry

Go2GenTL_ParseData (Image, HeightMap, Intensity, frameCount, timestamp, encoderPosition,
encoderIndex, inputs, xOffset, xResolution, yOffset, yResolution, zOffset, zResolution,
width, height, hasIntensity)

* Image Processing Routines Start ****

* Add your own routines here!

* Image Processing Routines End ****
endwhile
close_framegrabber (AcqHandle)

```

CSV Converter Tool

After you have exported recorded data to CSV, you can use the Gocator CSV Converter Tool to convert the exported part data into the following formats:

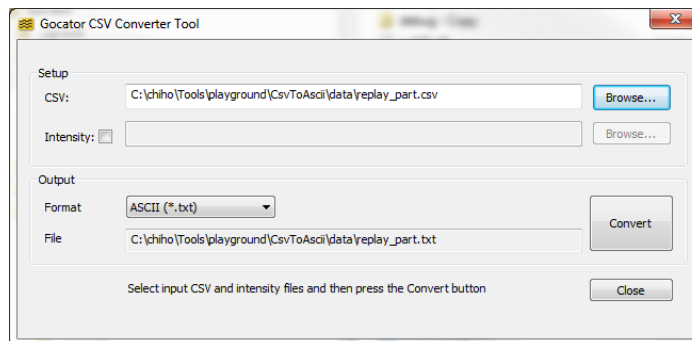
- ASCII (XYZI)
- 16-bit BMP
- 16-bit PNG
- GenTL
- OBJ
- STL
- HexSight HIG

- ODSCAD's OMC format
- SUR

To get the tool package (14405-x.x.x.x_SOFTWARE_GO_Tools.zip), go to <http://lmi3d.com/support>, choose your product from the Product Downloads section, and download it from the Download Center.

For more information on exporting recorded data, see *Downloading, Uploading, and Exporting Replay Data* on page 45.

After downloading the tool package, unzip the file and run the Gocator CSV Converter tool [bin>win32>kCsvConverter.exe].



 The software tool supports data exported from Surface mode.

 The GenTL format is a 48-bit RGB or grey scale PNG. Height map, intensity and stamp information are stored as defined in the GenTL Driver section (*GenTL Driver* on page 448). You can load the exported data into image processing software to provide simulation data for developing applications using the GenTL driver.

To convert exported CSV into different formats:

1. Select the CSV file to convert.
2. If intensity information is required, check the **Intensity** box and select the intensity bitmap. Intensity information is only used when converting to ASCII or GenTL format. If intensity is not selected, the ASCII format will only contain the point coordinates (XYZ).
3. If a dual-sensor system was used, use the **Image** spin box to select the source sensor. Use **0** for the Main sensor, **1** for the Buddy sensor.
4. Select the output format.
The converted file will reside in the same directory as the CSV file. It will also have the same name but with a different file extension. The converted file name is displayed in the **Output File** field.
5. Press the **Convert** button.

Troubleshooting

Review the guidance in this chapter if you are experiencing difficulty with a Gocator sensor system. If the problem that you are experiencing is not described in this section, see *Return Policy* on page 510.

Mechanical/Environmental

The sensor is warm.

- It is normal for a sensor to be warm when powered on. A Gocator sensor is typically 15° C warmer than the ambient temperature.

Connection

When attempting to connect to the sensor with a web browser, the sensor is not found (page does not load).

- Verify that the sensor is powered on and connected to the client computer network. The Power Indicator LED should illuminate when the sensor is powered.
- Check that the client computer's network settings are properly configured.
- Ensure that the latest version of Flash is loaded on the client computer.
- Use the LMI Discovery tool to verify that the sensor has the correct network settings. See *Sensor Recovery Tool* on page 446 for more information.

When attempting to log in, the password is not accepted.

- See *Sensor Recovery Tool* on page 446 for steps to reset the password.

3D Data Acquisition

When the Start button or the Snapshot button is pressed, the sensor does not emit light.

- The safety input signal may not be correctly applied. See *Specifications* on page 469 for more information.
- The exposure setting may be too low. See *Exposure* on page 71 for more information on configuring exposure time.
- Use the Snapshot button instead of the Start button to capture 3D point cloud data. If the LED light flashes when you use the **Snapshot** button, but not when you use the **Start** button, then the problem could be related to triggering. See *Triggers* on page 64 for information on configuring the trigger source.

Performance

The sensor CPU level is near 100%.

- Consider reducing the speed. If you are using a time trigger source, see *Triggers* on page 64 for information on reducing the speed. If you are using an external input or software trigger, consider reducing the rate at which you apply triggers.
- Consider reducing the resolution. See *Spacing* on page 78 for more information on configuring resolution.

- Review the measurements that you have programmed and eliminate any unnecessary measurements.

Specifications

The following sections describe the specifications of Gocator sensors and connectors, as well as Master hubs.

Sensors

The following sections provide the specifications of Gocator sensors.

Gocator 3100 Series

The Gocator 3100 series consists of the following models:

MODEL	3109	3110
Clearance Distance (CD) (mm)	157	150
Measurement Range (MR) (mm)	70	100
Field of View (mm)	67 x 86 - 93 x 88	60 x 105 - 90 x 160
Linearity Z (+/- % of MR)	0.038	0.050
Resolution Z (mm)	0.023 - 0.044	0.035 - 0.108
Resolution XY (mm)	0.065 x 0.071 - 0.091 x 0.092	0.090 x 0.100 - 0.150 x 0.160
Dimensions (mm)	49 x 100 x 155	49 x 74.4 x 276
Weight (kg)	1.04	1.35

Linearity Z values and Resolution Z are typical values.

Field of View and Resolution XY are specified as [X] x [Y], near to far.

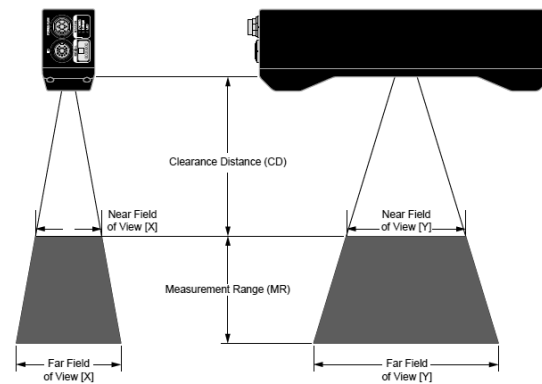
ALL 3100 SERIES MODELS	
Scan Rate	Up to 5 Hz
Light Source	Blue LED (465 nm)
Interface	Gigabit Ethernet
Inputs	Differential Encoder, Trigger
Outputs	2x Digital output, RS-485 Serial (115 kBaud) Analog Output (4 – 20 mA)
Input Voltage (Power)	+24 to +48 VDC (25 Watts); Ripple +/- 10%
Housing	Gasketed aluminum enclosure, IP67
Operating Temp.	0 to 50° C
Storage Temp.	-30 to 70° C

ALL 3100 SERIES MODELS

Vibration Resistance	10 to 55 Hz, 1.5 mm double amplitude in X, Y and Z directions, 2 hours per direction
Shock Resistance	15 g, half sine wave, 11 ms, positive and negative for X, Y and Z directions

Differential encoder requires the use of Master 400/800/1200/2400.

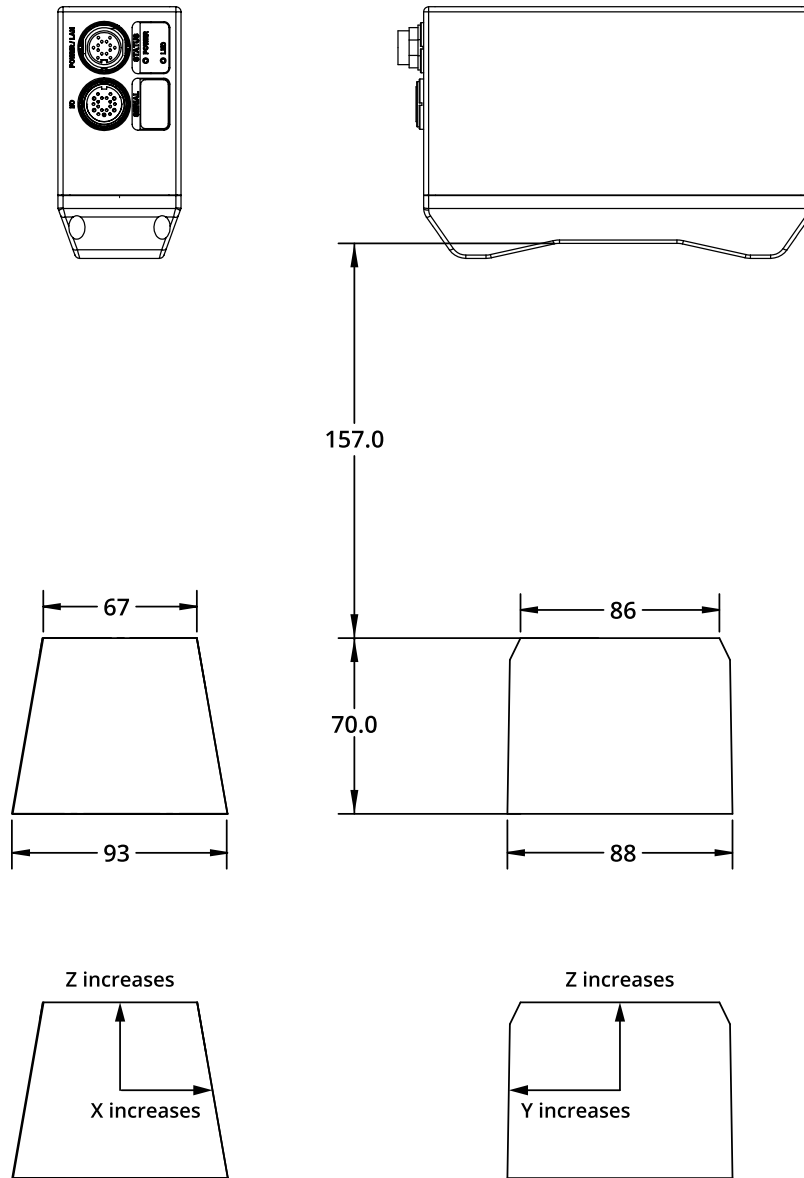
The following diagram illustrates some of the terms used in the table above.



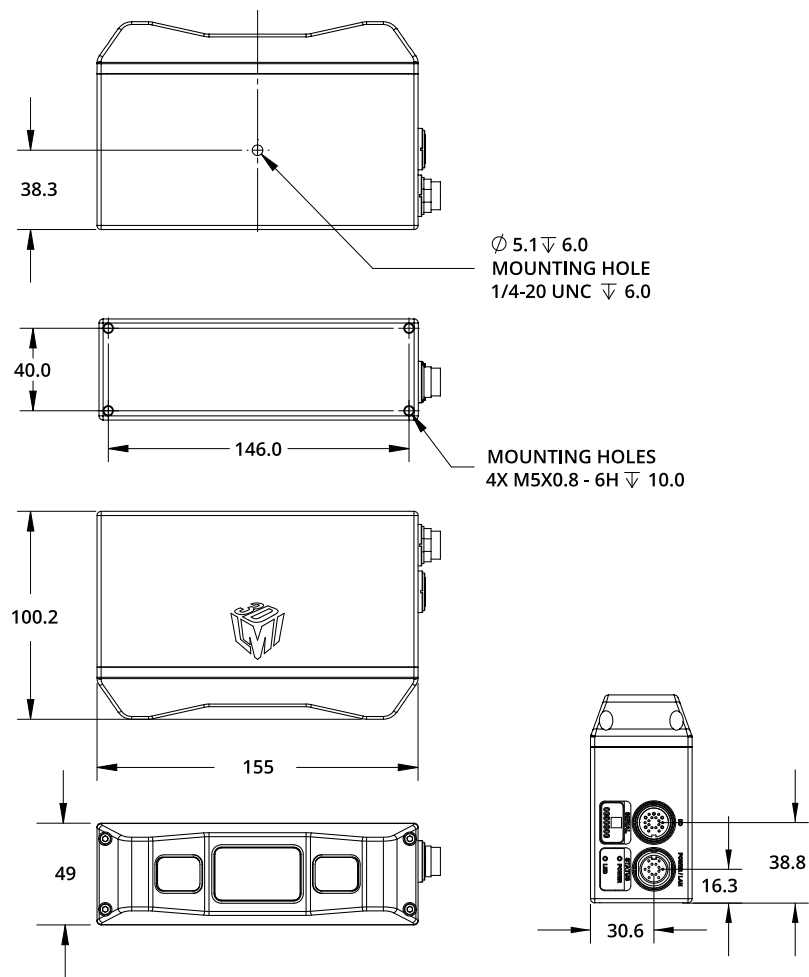
Mechanical dimensions, CD/FOV/MR, and the envelope for each sensor model are illustrated on the following pages.

Gocator 3109

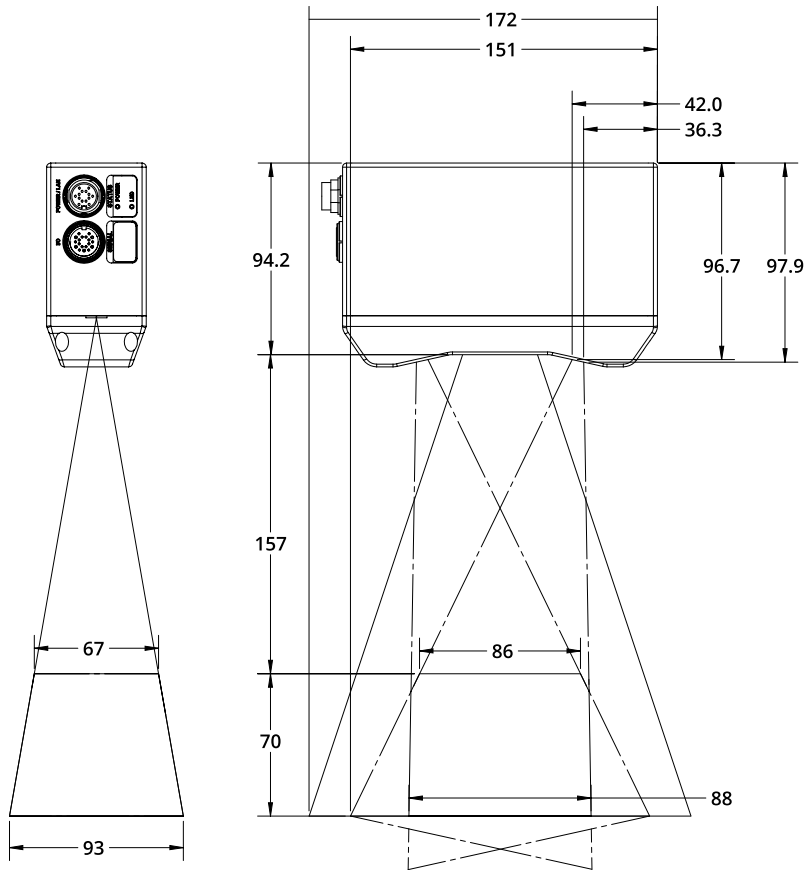
Field of View / Measurement Range / Coordinate System Orientation



Dimensions

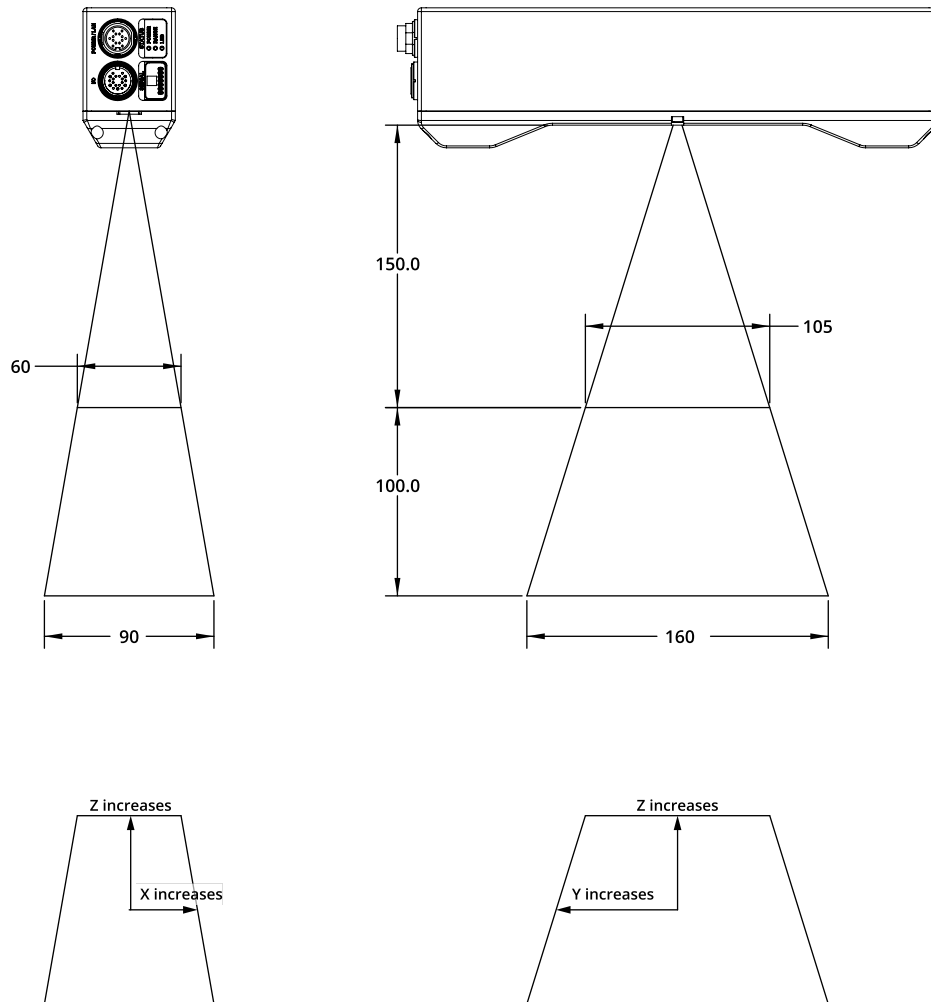


Envelope

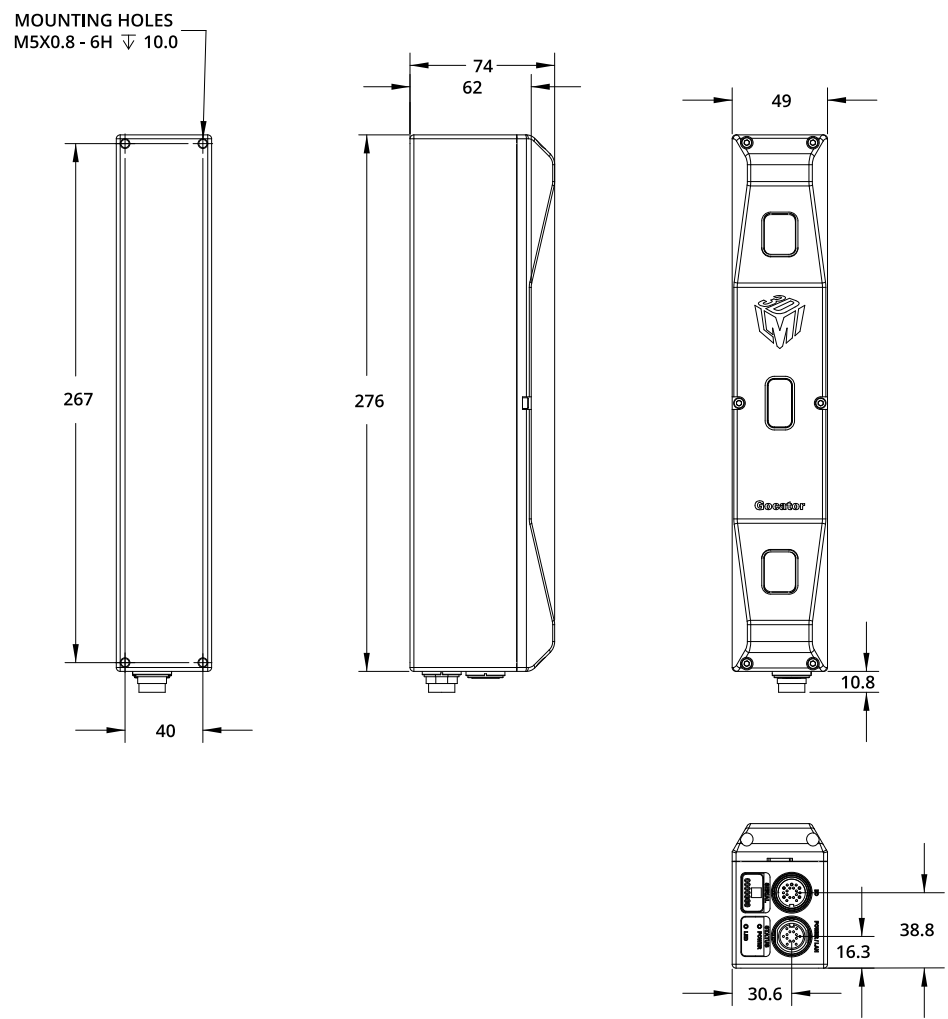


Gocator 3110

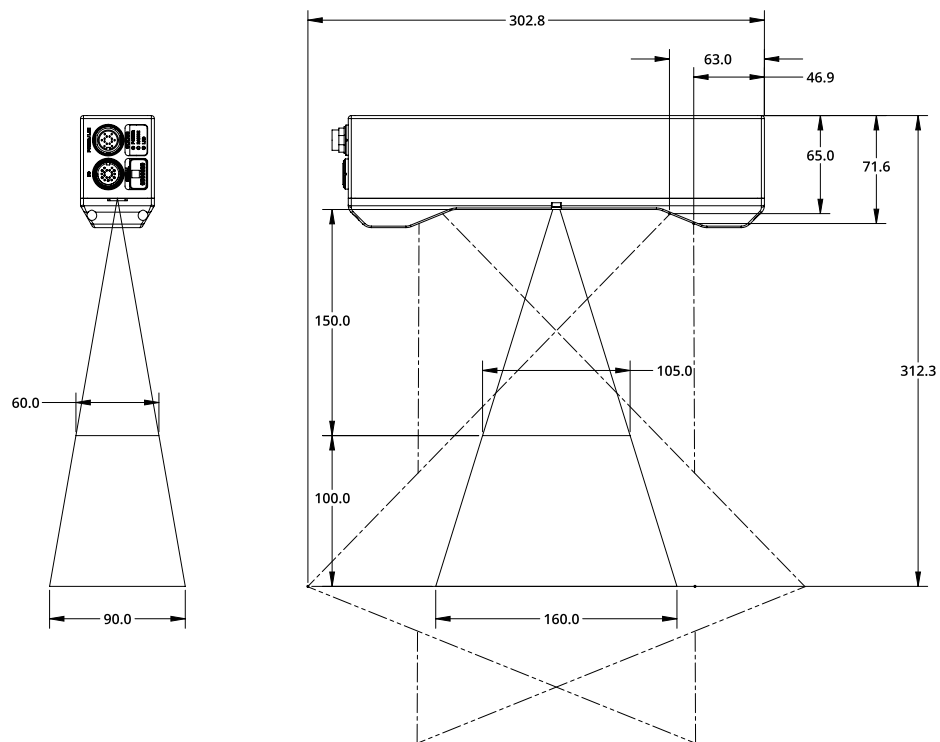
Field of View / Measurement Range / Coordinate System Orientation



Dimensions



Envelope



Gocator 3210 Sensor

The Gocator 3210 is defined below:

MODEL	3210
Scan Rate (Hz)	4
Imagers (megapixels)	2
Clearance Distance (CD) (mm)	164.0
Measurement Range (MR) (mm)	110.0
Field of View (mm)	71.0 x 98.0 - 100.0 x 154.0
Repeatability Z (µm)	4.7
Resolution XY (mm)	0.060 - 0.090
VDI/VDE Accuracy (mm)*	0.035
Dimensions (mm)	49 x 146 x 201
Weight (kg)	1.7
Light Source	Blue LED (465 nm)
Interface	Gigabit Ethernet
Inputs	Differential Encoder, Trigger
Outputs	2x Digital output, RS-485 Serial (115 kBaud) Analog Output (4 – 20 mA)
Input Voltage (Power)	+24 to +48 VDC (25 Watts); Ripple +/- 10%
Housing	Gasketed aluminum enclosure, IP67
Operating Temp.	0 to 50° C
Storage Temp.	-30 to 70° C
Vibration Resistance	10 to 55 Hz, 1.5 mm double amplitude in X, Y and Z directions, 2 hours per direction
Shock Resistance	15 g, half sine wave, 11 ms, positive and negative for X, Y and Z directions

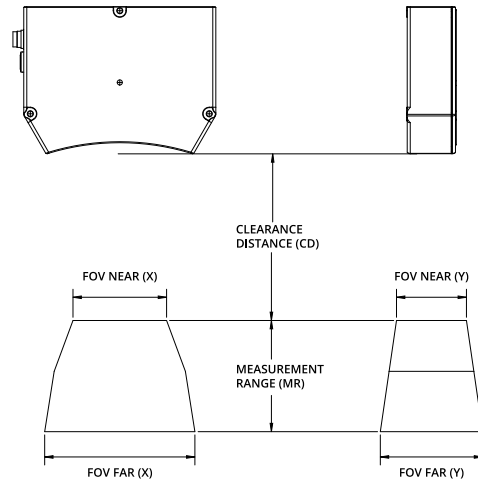
* Based on 2634, Part 2.

Linearity Z values and Resolution Z are typical values.

Field of View and Resolution XY are specified as [X] x [Y], near to far.

Differential encoder requires the use of Master 400/800/810/1200/2400/2410.

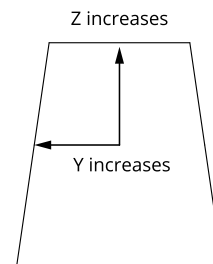
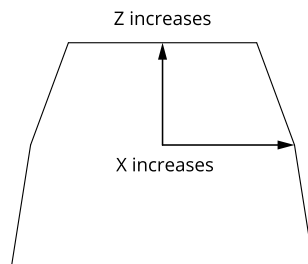
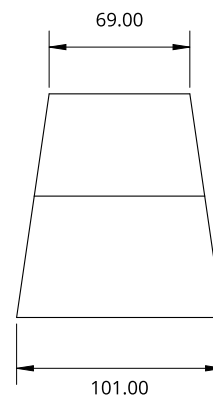
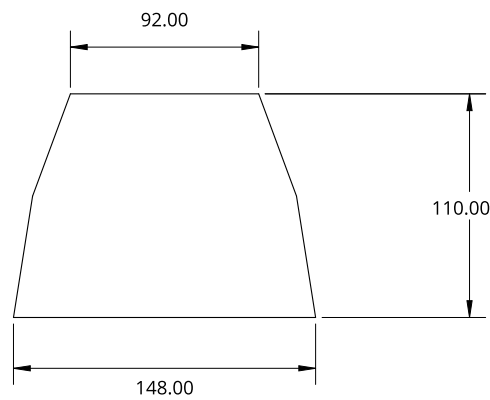
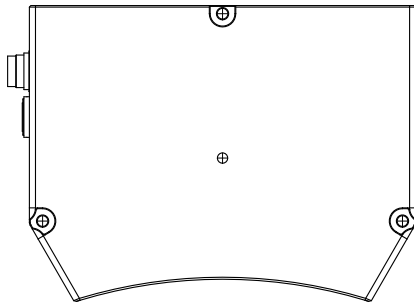
The following diagram illustrates some of the terms used in the table above.



Mechanical dimensions, CD/FOV/MR, and the envelope for each sensor model are illustrated on the following pages.

Gocator 3210

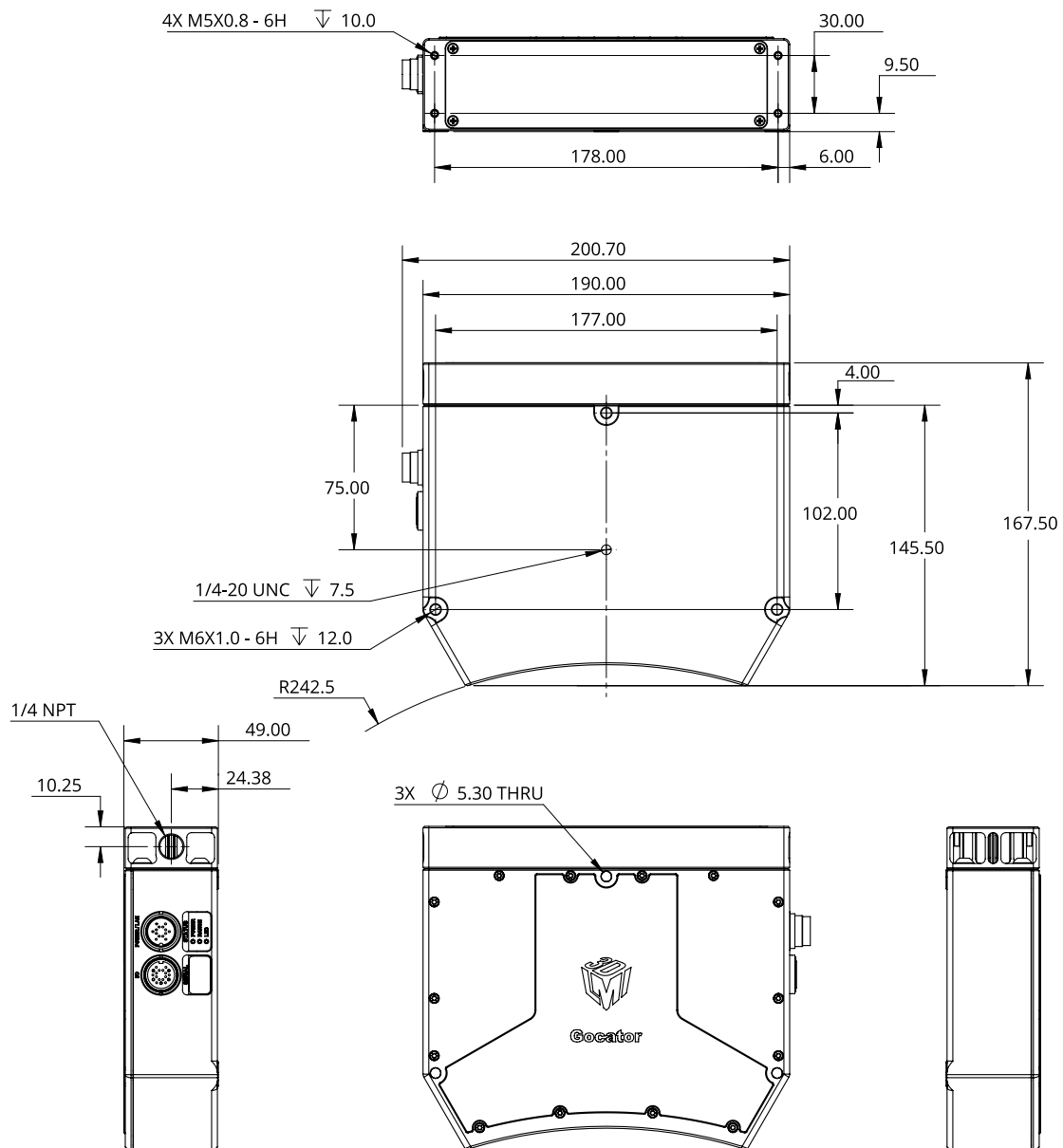
Field of View / Measurement Range / Coordinate System Orientation



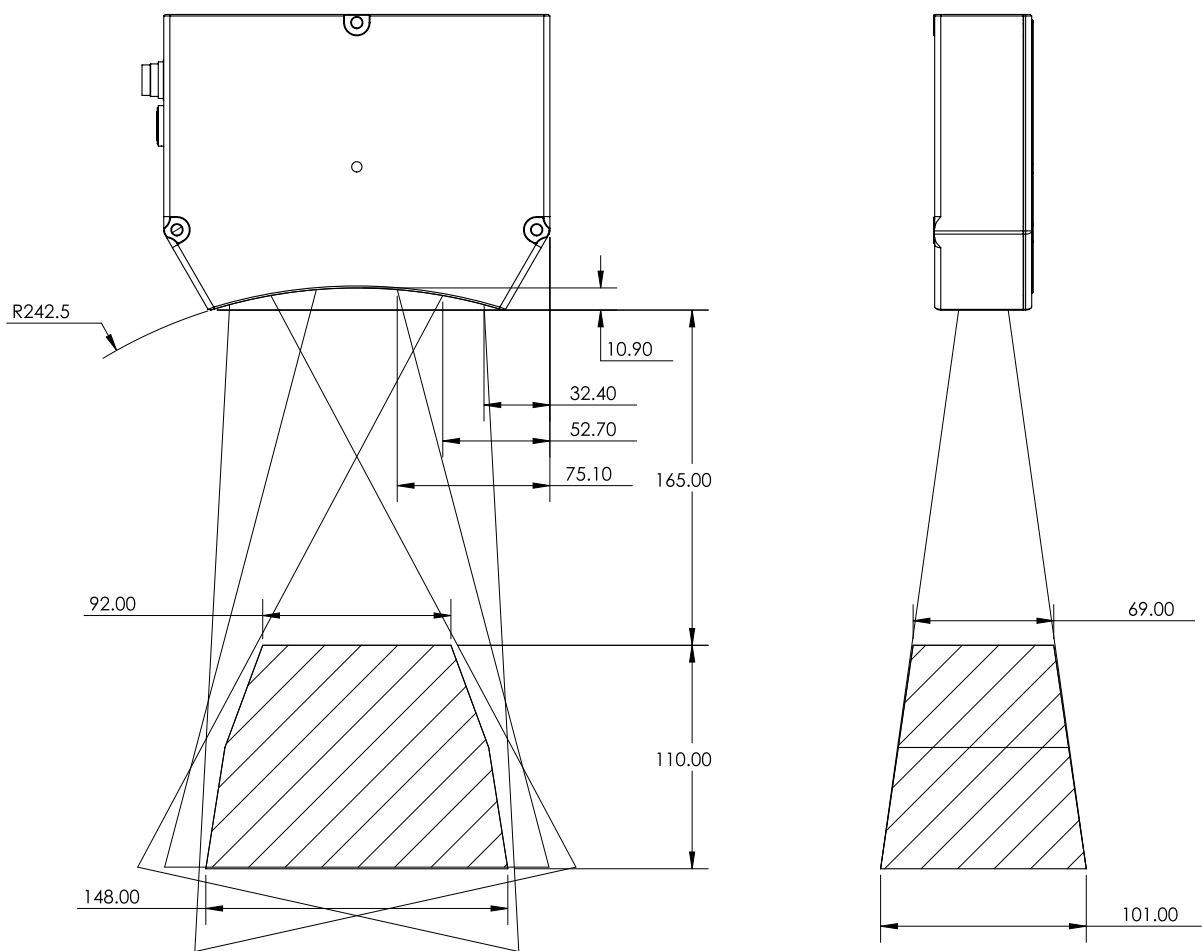
Dimensions



The following drawings include the optional shop air heat sink. For more information, see *APPNOTE_Gocator_3210_Heatsink.pdf*, available on LMI's website.



Envelope



Gocator 3506 Sensor

The Gocator 3506 sensor is defined below:

MODEL	3506
Scan Rate (Hz)	3
Imagers (megapixels)	5
Clearance Distance (CD) (mm)	87.0
Measurement Range (MR) (mm)	25.0
Field of View (mm)	27.0 x 45.0 - 30.0 x 45.0
Repeatability Z (μm)	2.0
Resolution XY (mm)	0.020 - 0.025
VDI/VDE Accuracy (mm)*	0.012
Dimensions (mm)	49 x 136 x 170
Weight (kg)	1.52
Light Source	Blue LED (465 nm)
Interface	Gigabit Ethernet
Inputs	Differential Encoder, Trigger
Outputs	2x Digital output, RS-485 Serial (115 kBaud) Analog Output (4 - 20 mA)
Input Voltage (Power)	+24 to +48 VDC (25 Watts); Ripple +/- 10%
Housing	Gasketed aluminum enclosure, IP67
Operating Temp.	0 to 50° C
Storage Temp.	-30 to 70° C
Vibration Resistance	10 to 55 Hz, 1.5 mm double amplitude in X, Y and Z directions, 2 hours per direction
Shock Resistance	15 g, half sine wave, 11 ms, positive and negative for X, Y and Z directions

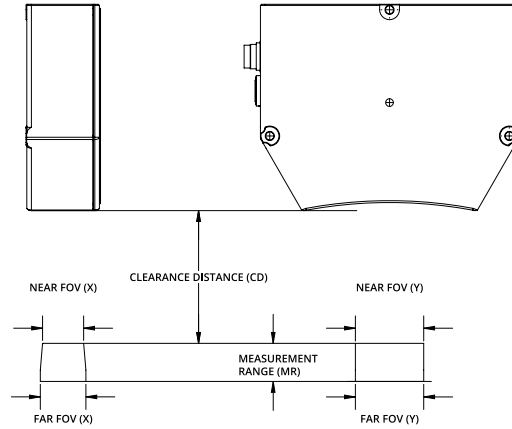
* Based on 2634, Part 2.

Linearity Z values and Resolution Z are typical values.

Field of View and Resolution XY are specified as [X] x [Y], near to far.

Differential encoder requires the use of Master 400/800/810/1200/2400/2410.

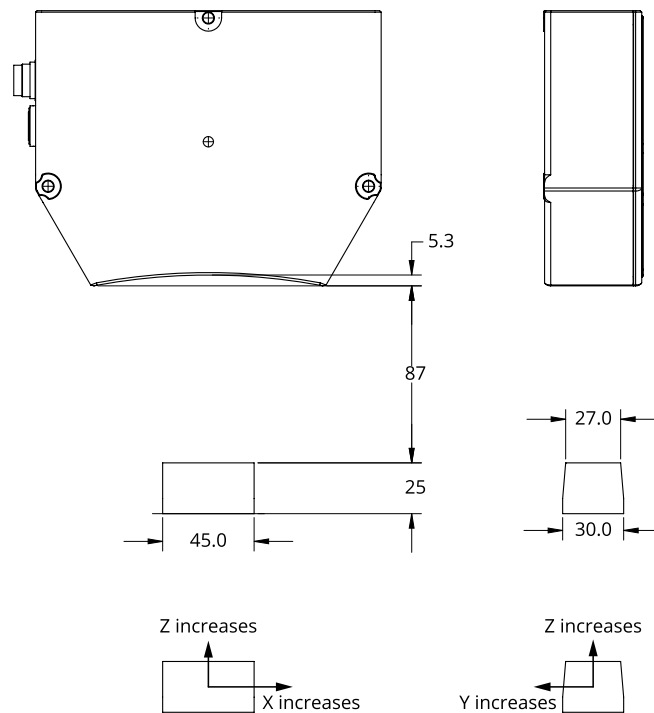
The following diagram illustrates some of the terms used in the table above.



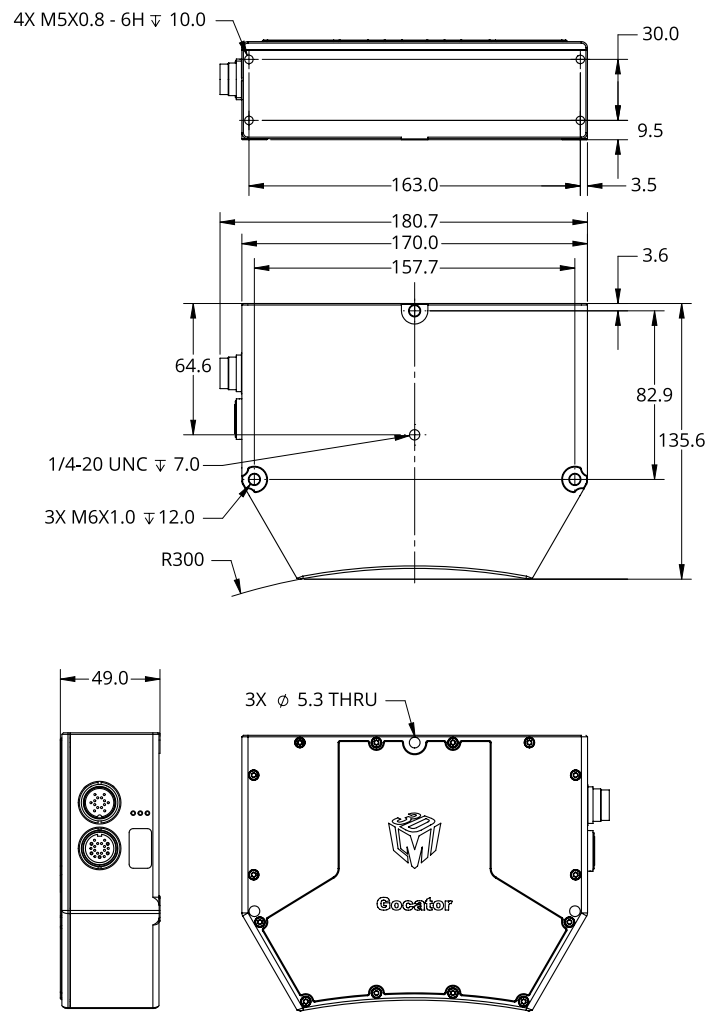
Mechanical dimensions, CD/FOV/MR, and the envelope for each sensor model are illustrated on the following pages.

Gocator 3506

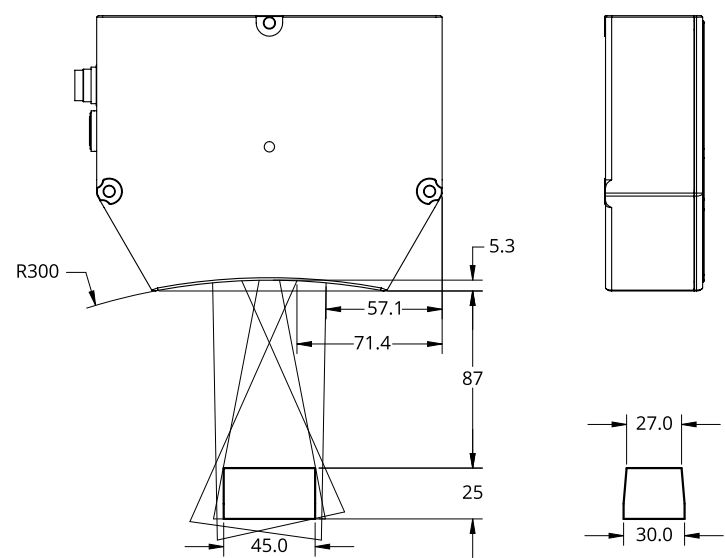
Field of View / Measurement Range / Coordinate System Orientation



Dimensions



Envelope



Sensor Connectors

The following sections provide the specifications of the connectors on Gocator sensors.

Gocator Power/LAN Connector

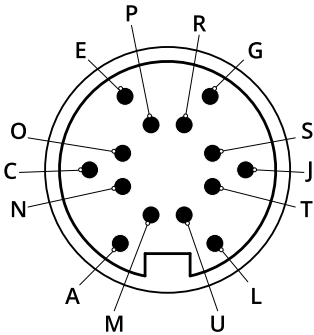
The Gocator Power/LAN connector is a 14 pin, M16 style connector that provides power input and Ethernet.

 This connector is rated IP67 only when a cable is connected or when a protective cap is used.

This section defines the electrical specifications for Gocator Power/LAN Connector pins, organized by function.

Gocator Power/LAN Connector Pins

Function	Pin	Lead Color on Cordset
GND_24-48V	L	White/ Orange & Black
GND_24-48V	L	Orange/ Black
DC_24-48V	A	White/ Green & Black
DC_24-48V	A	Green/ Black
Reserved	G	White/ Blue & Black
Reserved	J	Blue/ Black
Sync+	E	White/ Brown & Black
Sync-	C	Brown/ Black
Ethernet MX1+	M	White/ Orange
Ethernet MX1-	N	Orange
Ethernet MX2+	O	White/ Green
Ethernet MX2-	P	Green
Ethernet MX3-	S	White/ Blue
Ethernet MX3+	R	Blue
Ethernet MX4+	T	White/ Brown
Ethernet MX4-	U	Brown



View: Looking into the connector **on** the sensor

Two wires are connected to the ground and power pins.

Grounding Shield

The grounding shield should be mounted to the earth ground.

Power

Apply positive voltage to DC_24-48V. See *Gocator 3100 Series* on page 469

Power requirements

Function	Pins	Min	Max
DC_24-48V	A	24 V	48 V
GND_24-48VDC	L	0 V	0 V

Safety Input

The Safety_in+ signal should be connected to a voltage source in the range listed below. The Safety_in- signal should be connected to the ground/common of the source supplying the Safety_in+.

Laser safety requirements

Function	Pins	Min	Max
Safety_in+	J	24 V	48 V
Safety_in-	G	0 V	0 V



Confirm the wiring of Safety_in- before starting the sensor. Wiring DC_24-48V into Safety_in- may damage the sensor.

Gocator I/O Connector

The Gocator I/O connector is a 19 pin, M16 style connector that provides encoder, digital input, digital outputs, serial output, and analog output signals.

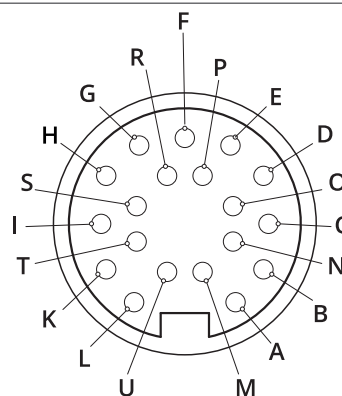


This connector is rated IP67 only when a cable is connected or when a protective cap is used.

This section defines the electrical specifications for Gocator I/O connector pins, organized by function.

Gocator I/O Connector Pins

Function	Pin	Lead Color on Cordset
Trigger_in+	D	Grey
Trigger_in-	H	Pink
Out_1+ (Digital Output 0)	N	Red
Out_1- (Digital Output 0)	O	Blue
Out_2+ (Digital Output 1)	S	Tan
Out_2- (Digital Output 1)	T	Orange
Encoder_A+	M	White / Brown & Black
Encoder_A-	U	Brown / Black
Encoder_B+	I	Black
Encoder_B-	K	Violet
Encoder_Z+	A	White / Green & Black
Encoder_Z-	L	Green / Black
Serial_out+	B	White
Serial_out-	C	Brown
Reserved	E	Blue / Black
Reserved	G	White / Blue & Black
Analog_out+	P	Green
Analog_out-	F	Yellow & Maroon / White
Reserved	R	Maroon



View: Looking into the connector **on** the sensor

Grounding Shield

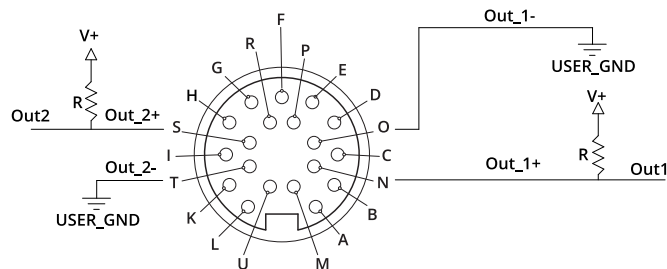
The grounding shield should be mounted to the earth ground.

Digital Outputs

Each Gocator sensor has two optically isolated outputs. Both outputs are open collector and open emitter, which allows a variety of power sources to be connected and a variety of signal configurations.

Out_1 (Collector – Pin N and Emitter – Pin O) and Out_2 (Collector – Pin S and Emitter – Pin T) are independent and therefore V+ and GND are not required to be the same.

Function	Pins	Max Collector Current	Max Collector-Emitter Voltage	Min Pulse Width
Out_1	N, O	40 mA	70 V	20 μ s
Out_2	S, T	40 mA	70 V	20 μ s

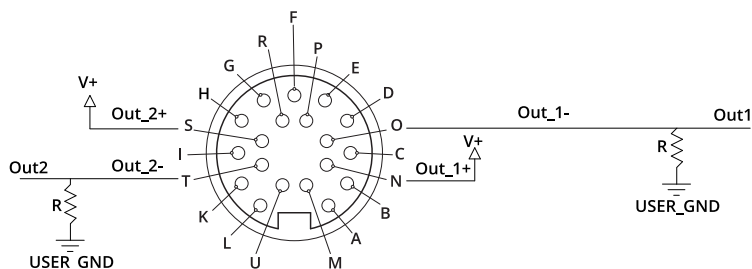


The resistors shown above are calculated by $R = (V+) / 2.5 \text{ mA}$.

The size of the resistors is determined by power = $(V+)^2 / R$.

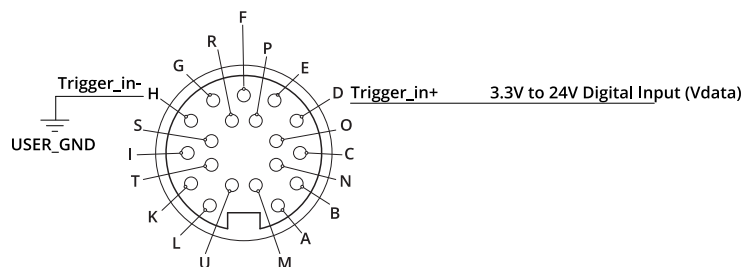
Inverting Outputs

To invert an output, connect a resistor between ground and Out_1- or Out_2- and connect Out_1+ or Out_2+ to the supply voltage. Take the output at Out_1- or Out_2-. For resistor selection, see above.



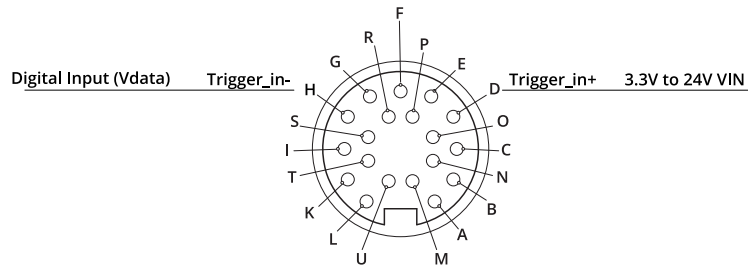
Digital Input

Every Gocator sensor has a single optically isolated input. To use this input without an external resistor, supply 3.3 - 24 V to the positive pin and GND to the negative.



Active High

If the supplied voltage is greater than 24 V, connect an external resistor in series to the positive. The resistor value should be $R = [(V_{in}-1.2V)/10mA]-680$.



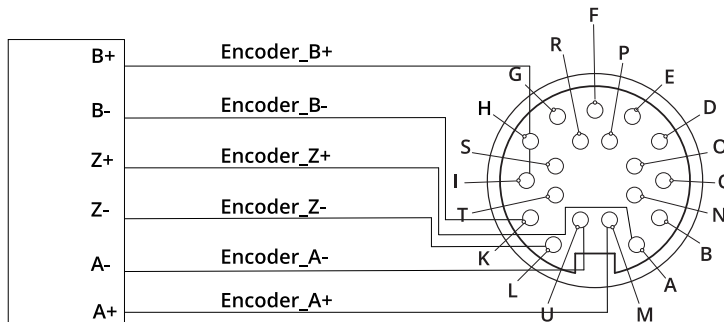
Active Low

To assert the signal, the digital input voltage should be set to draw a current of 3 mA to 40 mA from the positive pin. The current that passes through the positive pin is $I = (V_{in} - 1.2 - V_{data}) / 680$. To reduce noise sensitivity, we recommend leaving a 20% margin for current variation (i.e., uses a digital input voltage that draws 4mA to 25mA).

Function	Pins	Min Voltage	Max Voltage	Min Current	Max Current	Min Pulse Width
Trigger_in	D, H	3.3 V	24 V	3 mA	40 mA	20 μ s

Encoder Input

Encoder input is provided by an external encoder and consists of three RS-485 signals. These signals are connected to Encoder_A, Encoder_B, and Encoder_Z.



Function	Pins	Common Mode Voltage		Differential Threshold Voltage			Max Data Rate
		Min	Max	Min	Typ	Max	
Encoder_A	M, U	-7 V	12 V	-200 mV	-125 mV	-50 mV	1 MHz
Encoder_B	I, K	-7 V	12 V	-200 mV	-125 mV	-50 mV	1 MHz
Encoder_Z	A, L	-7 V	12 V	-200 mV	-125 mV	-50 mV	1 MHz



Gocator only supports differential RS485 signalling. Both + and - signals must be connected.

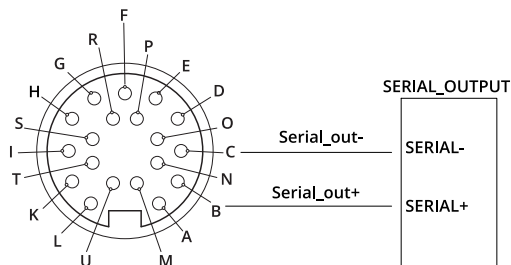


Encoders are normally specified in *pulses* per revolution, where each pulse is made up of the four quadrature *signals* (A+ / A- / B+ / B-). Because Gocator reads each of the four quadrature signals, you should choose an encoder accordingly, given the resolution required for your application.

Serial Output

Serial RS-485 output is connected to Serial_out as shown below.

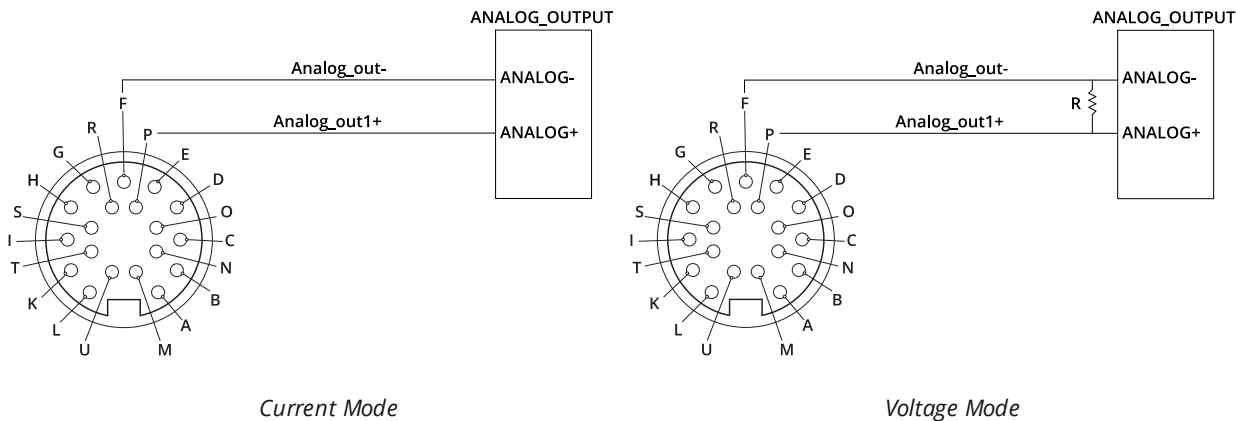
Function	Pins
Serial_out	B, C



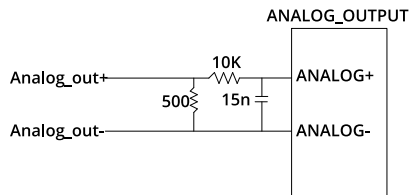
Analog Output

The Sensor I/O Connector defines one analog output interface: Analog_out.

Function	Pins	Current Range
Analog_out	P, F	4 – 20 mA



To configure for voltage output, connect a 500 Ohm ¼ Watt resistor between Analog_out+ and Analog_out- and measure the voltage across the resistor. To reduce the noise in the output, we recommend using an RC filter as shown below.



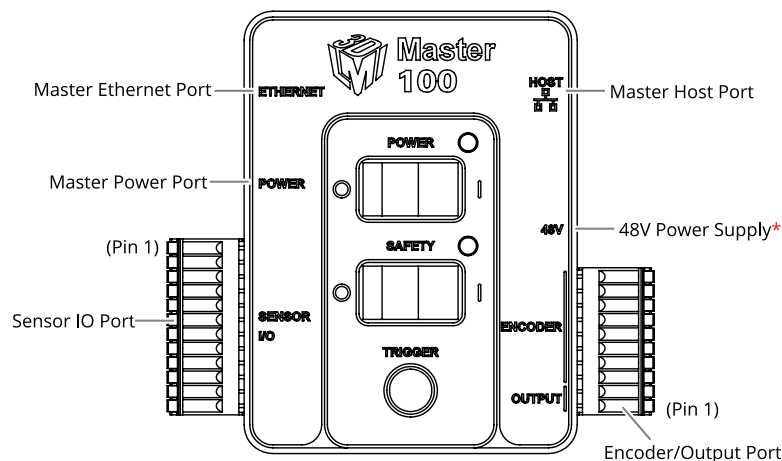
Master Network Controllers

The following sections provide the specifications of Master network controllers.

For information on maximum external input trigger rates, see *Maximum Input Trigger Rate* on page 68.

Master 100

The Master 100 accepts connections for power, safety (not supported by Gocator snapshot sensors), and encoder, and provides digital output.



*Contact LMI for information regarding this type of power supply.

Connect the Master Power port to the Gocator's Power/LAN connector using the Gocator Power/LAN to Master cordset. Connect power RJ45 end of the cordset to the Master Power port. The Ethernet RJ45 end of the cordset can be connected directly to the Ethernet switch, or connect to the Master Ethernet port. If the Master Ethernet port is used, connect the Master Host port to the Ethernet switch with a CAT5e Ethernet cable.

To use encoder and digital output, wire the Master's Gocator Sensor I/O port to the Gocator IO connector using the Gocator I/O cordset.

Sensor I/O Port Pins

Gocator I/O Pin	Master Pin	Conductor Color
Encoder_A+	1	White/Brown & Black
Encoder_A-	2	Brown/Black
Encoder_Z+	3	White/Green & Black
Encoder_Z-	4	Green/Black
Trigger_in+	5	Grey
Trigger_in-	6	Pink
Out_1-	7	Blue
Out_1+	8	Red

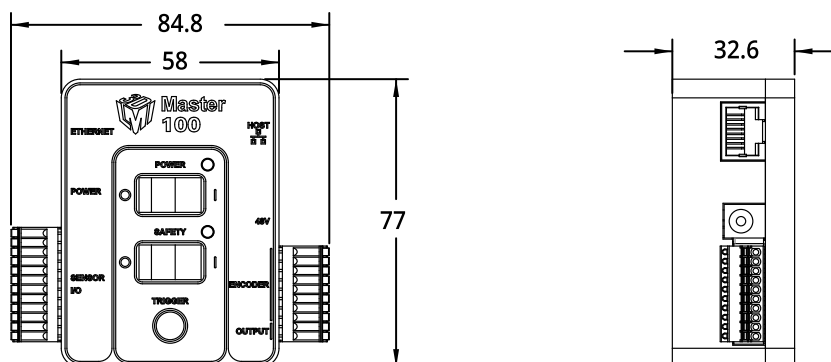
Gocator I/O Pin	Master Pin	Conductor Color
Encoder_B+	11	Black
Encoder_B-	12	Violet

The rest of the wires in the Gocator I/O cordset are not used.

Encoder/Output Port Pins

Function	Pin
Output_1+ (Digital Output 0)	1
Output_1- (Digital Output 0)	2
Encoder_Z+	3
Encoder_Z-	4
Encoder_A+	5
Encoder_A-	6
Encoder_B+	7
Encoder_B-	8
Encoder_GND	9
Encoder_5V	10

Master 100 Dimensions

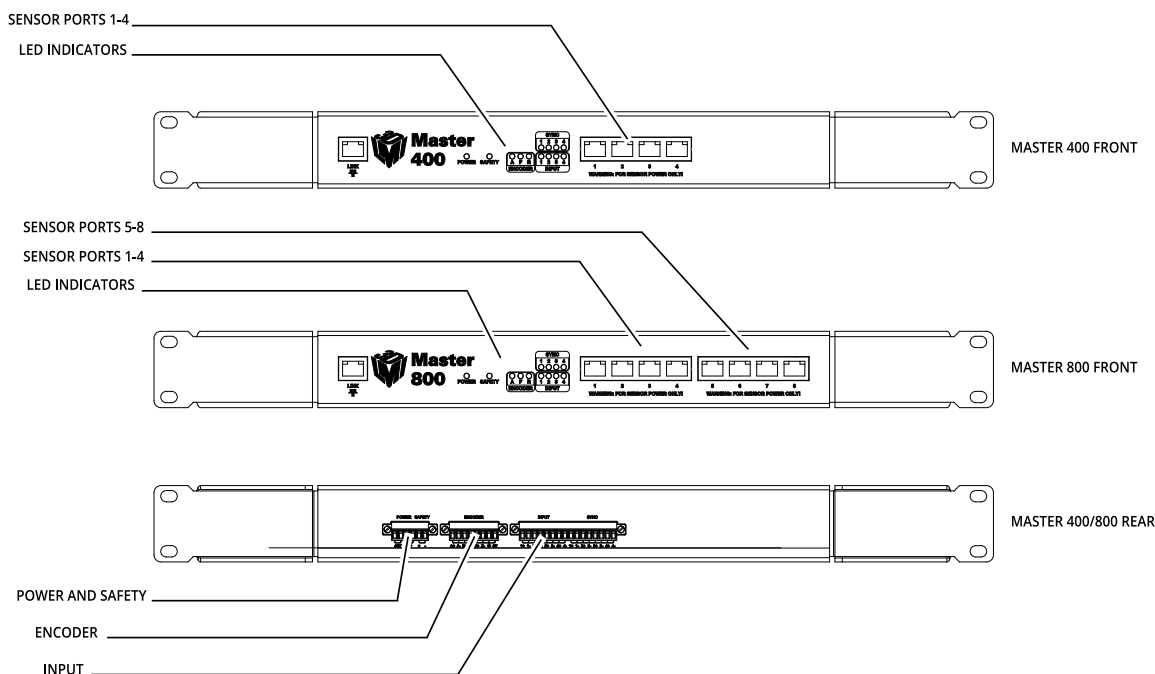


Master 400/800

Master 400 and 800 network controllers provide sensor power and safety interlock (safety interlock not supported by Gocator snapshot sensors), and broadcast system-wide synchronization information (i.e., time, encoder count, encoder index, and digital I/O states) to all devices on a sensor network.



The Phoenix connectors on Master 400/800/1200/2400 are not compatible with the connectors on Master 810/2410. For this reason, if you are switching models in your network, you must rewire the connections to the Master.



Power and Safety (6 pin connector)

Function	Pin
+48VDC	1
+48VDC	2
GND (24-48VDC)	3
GND (24-48VDC)	4
Reserved	5
Reserved	6



The +48VDC power supply must be isolated from AC ground. This means that AC ground and DC ground are not connected.

Input (16 pin connector)

Function	Pin
Input 1	1
Input 1 GND	2
Reserved	3
Reserved	4
Reserved	5
Reserved	6
Reserved	7
Reserved	8
Reserved	9
Reserved	10
Reserved	11
Reserved	12
Reserved	13
Reserved	14
Reserved	15
Reserved	16



The Input connector does not need to be wired up for proper operation.

Encoder (8 pin connector)

Function	Pin
Encoder_A+	1
Encoder_A-	2
Encoder_B+	3
Encoder_B-	4
Encoder_Z+	5
Encoder_Z-	6
GND	7
+5VDC	8

Master 400/800 Electrical Specifications

Electrical Specifications

Specification	Value
Power Supply Voltage	+48 VDC
Power Supply Current (Max.)	10 A

Specification	Value
Power Draw (Min.)	5.76 W
Encoder Signal Voltage	Differential (12 VDC)
Digital Input Voltage Range	Logical LOW: 0 to +0.1 VDC Logical HIGH: +3.3 to +24 VDC



When using a Master hub, the chassis must be well grounded.



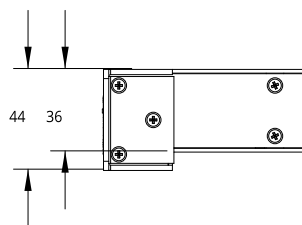
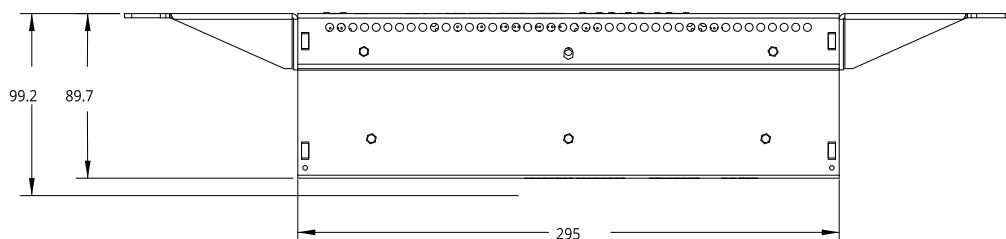
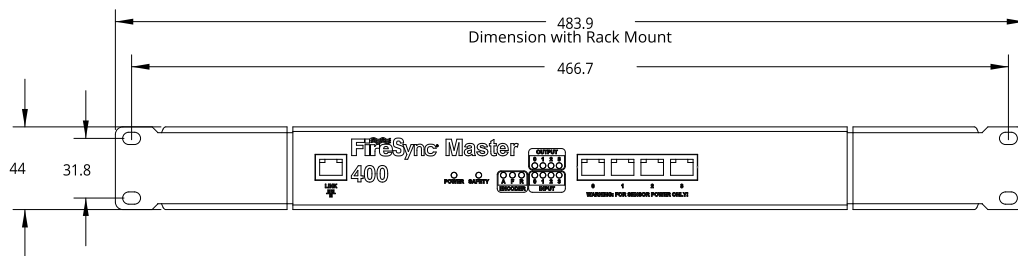
The power supply must be isolated from AC ground. This means that AC ground and DC ground are not connected.



The Power Draw specification is based on a Master with no sensors attached. Every sensor has its own power requirements that need to be considered when calculating total system power requirements.

Master 400/800 Dimensions

The dimensions of Master 400 and Master 800 are the same.



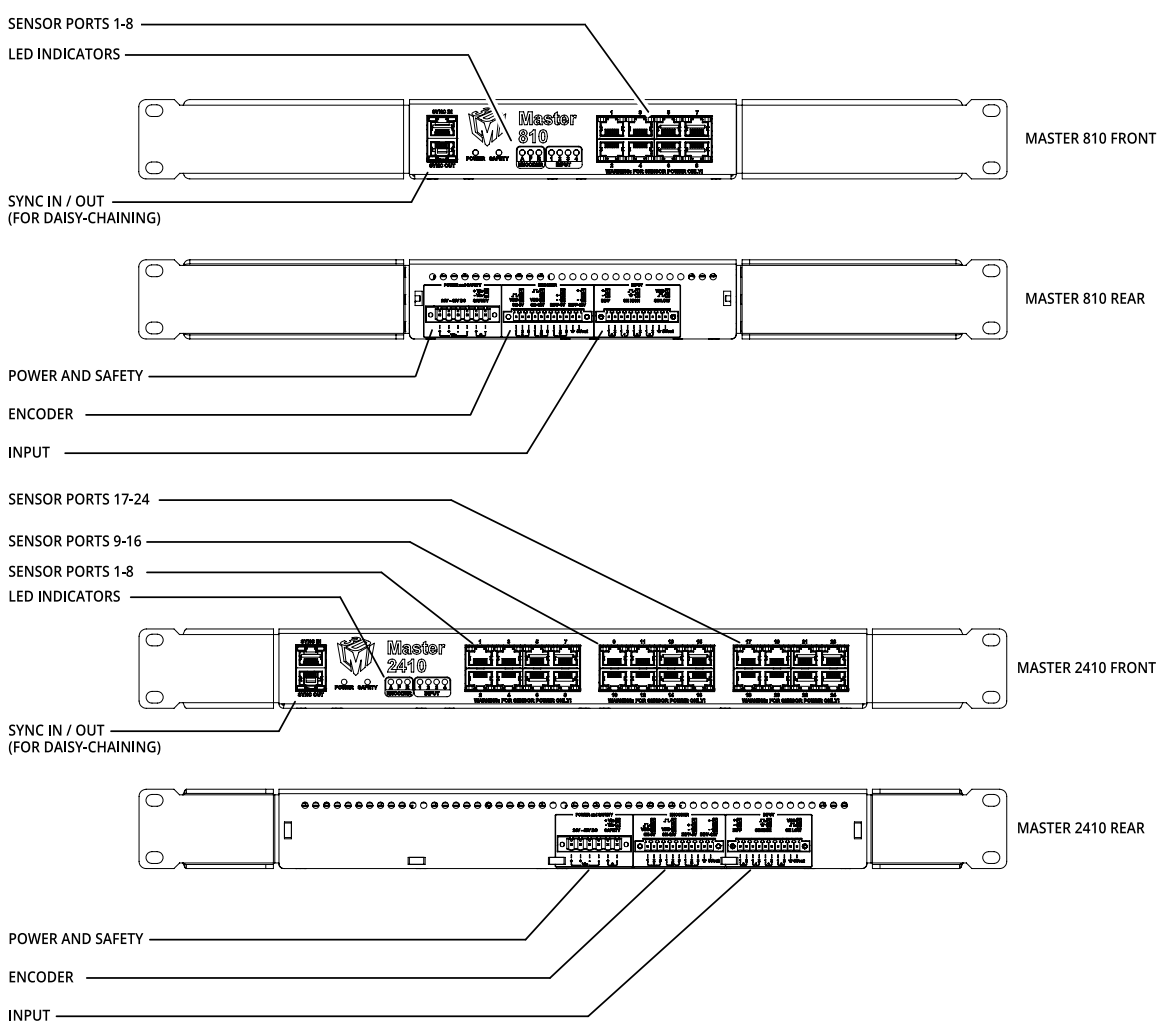
Master 810/2410

Master 810 and 2410 network controllers provide sensor power and safety interlock (safety interlock not supported by Gocator snapshot sensors), and broadcast system-wide synchronization information (i.e., time, encoder count, encoder index, and digital I/O states) to all devices on a sensor network.

Master 810 and 2410 can be mounted to DIN rails using the appropriate adapters (not included; for more information, see *Installing DIN Rail Clips: Master 810 or 2410* on page 21). The units are provided with removable adapters for 1U rack mounting; the mounting holes for this option are compatible with older Master models (400/800/1200/2400).



The Phoenix connectors on Master 810/2410 are not compatible with the connectors on Master 400/800/1200/2400. For this reason, if you are switching models in your network, you must rewire the connections to the Master.



Power and Safety (6 pin connector)

Function	Pin
Power In+	1
Power In+	2
Power In-	3
Power In-	4
Reserved	5
Reserved	6



The +24-48VDC power supply must be isolated from AC ground. This means that AC ground and DC ground are not connected.

Input (10 pin connector)

Function	Pin
Input 0 Pin 1	1
Input 0 Pin 2	2
Reserved	3
Reserved	4
Reserved	5
Reserved	6
Reserved	7
Reserved	8
GND (output for powering other devices)	9
+5VDC (output for powering other devices)	10



The Input connector does not need to be wired up for proper operation.



For Input connection wiring options, see *Input* on page 501.

Encoder (11 pin connector)

Function	Pin
Encoder_A_Pin_1	1
Encoder_A_Pin_2	2
Encoder_A_Pin_3	3
Encoder_B_Pin_1	4
Encoder_B_Pin_2	5
Encoder_B_Pin_3	6
Encoder_Z_Pin_1	7
Encoder_Z_Pin_2	8

Function	Pin
Encoder_Z_Pin_3	9
GND (output for powering external devices)	10
+5VDC (output for powering external devices)	11



For Encoder connection wiring options, see *Encoder* on the next page.

Electrical Specifications

Electrical Specifications

Specification	Value
Power Supply Voltage	+24 VDC to +48 VDC
Power Supply Current (Max.)*	Master 810: 9 A Master 2410: 25 A * Fully loaded with 1 A per sensor port.
Power Draw (Min.)	Master 810: 1.7 W Master 2410: 4.8 W
Encoder Signal Voltage	Differential (5 VDC, 12 VDC) Single-Ended (5 VDC, 12 VDC) For more information, see <i>Encoder</i> on the next page.
Digital Input Voltage Range	Single-Ended Active LOW: 0 to +0.8 VDC Single-Ended Active HIGH: +3.3 to +24 VDC Differential LOW: 0.8 to -24 VDC Differential HIGH: +3.3 to +24 VDC For more information, see <i>Input</i> on page 501.



If the input voltage is above 24 V, use an external resistor, using the following formula:

$$R = [(V_{in} - 1.2V) / 10mA] - 680$$



When using a Master hub, the chassis must be well grounded.



The power supply must be isolated from AC ground. This means that AC ground and DC ground are not connected.



24 VDC power supply is only supported if all connected sensors support an input voltage of 24 VDC.



The Power Draw specification is based on a Master with no sensors attached. Every sensor has its own power requirements that need to be considered when calculating total system power requirements.

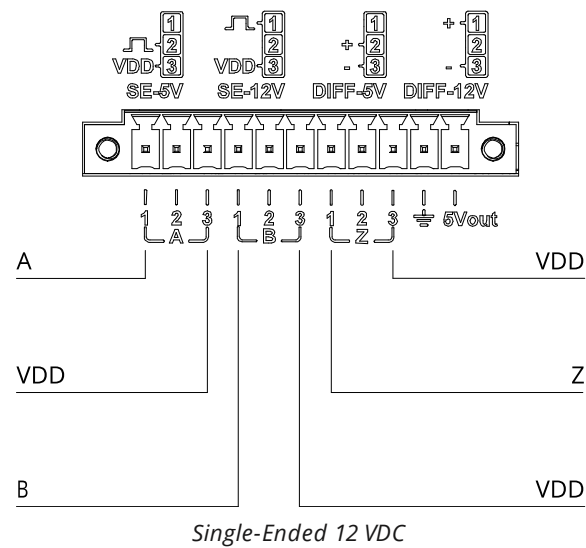
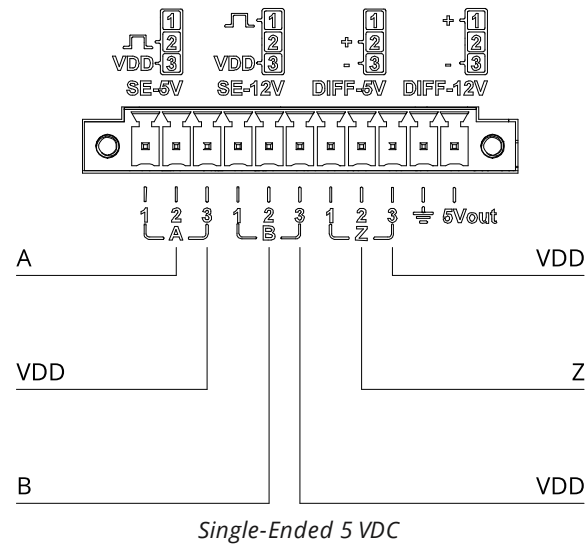
Encoder

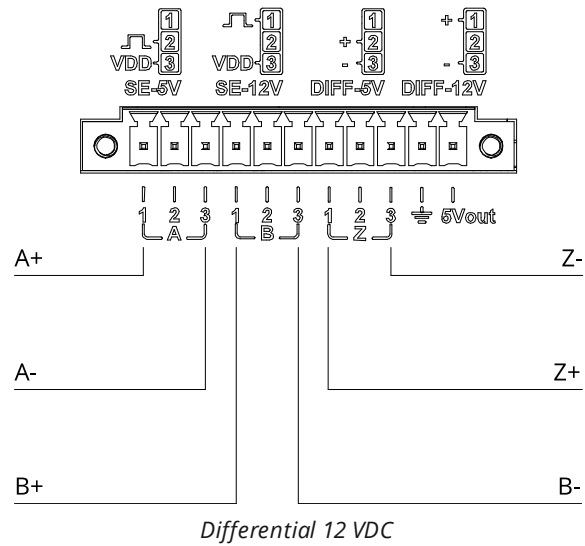
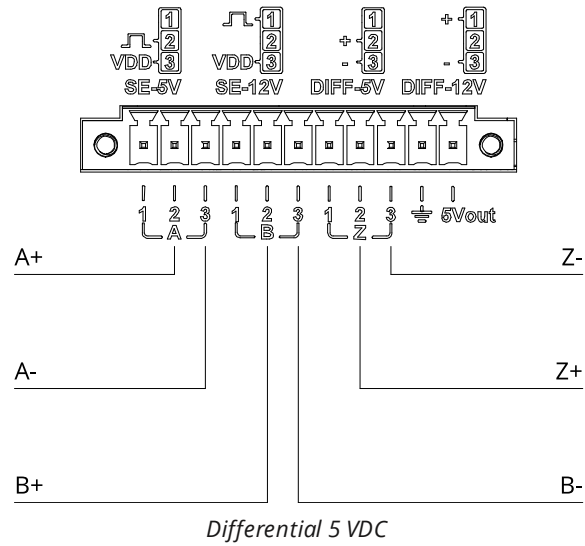
Master 810 and 2410 support the following types of encoder signals: Single-Ended (5 VDC, 12 VDC) and Differential (5 VDC, 12 VDC).

For 5 VDC operation, pins 2 and 3 of each channel are used.

For 12 VDC operation, pins 1 and 3 of each channel are used.

To determine how to wire a Master to an encoder, see the illustrations below.





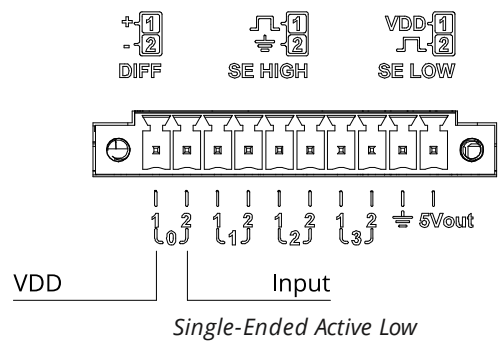
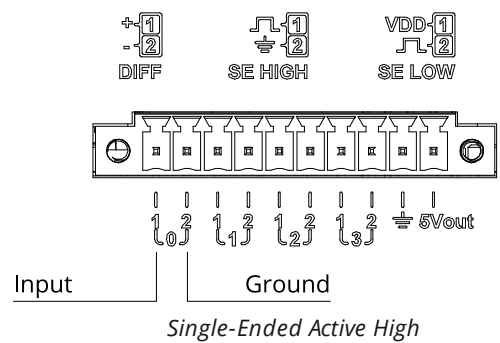
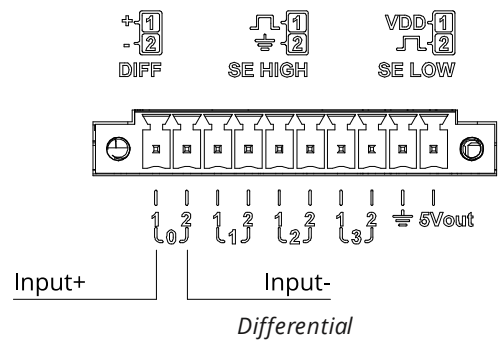
Input

Master 810 and 2410 support the following types of input: Differential, Single-Ended High, and Single-Ended Low.



Currently, only Input 0 is supported by Gocator.

For digital input voltage ranges, see the table below.

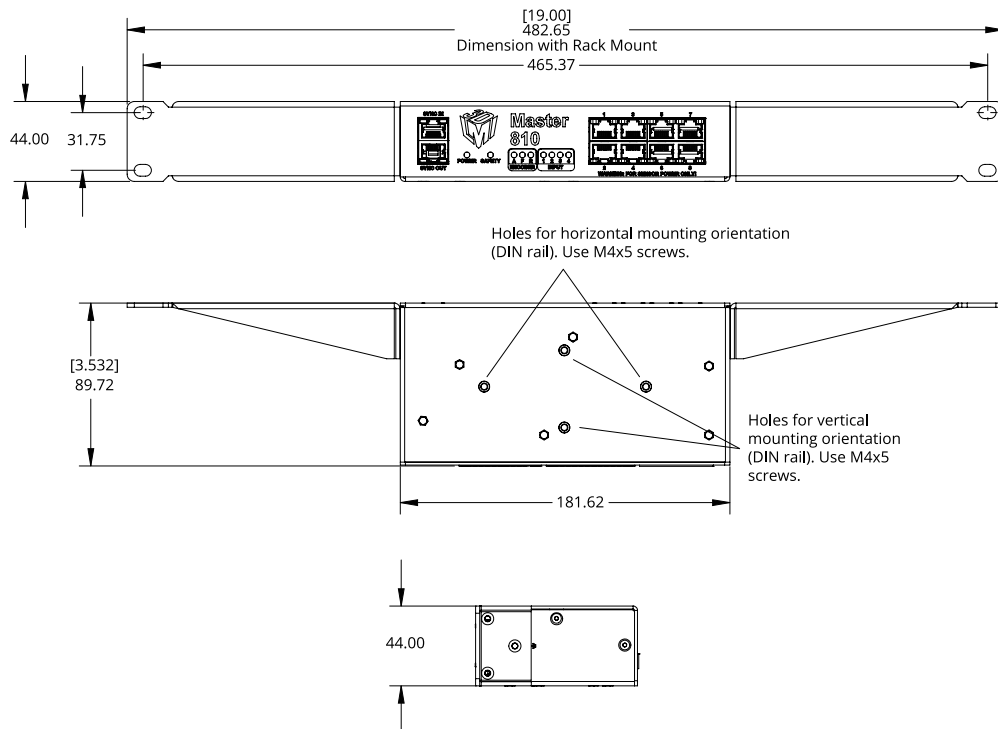


Digital Input Voltage Ranges

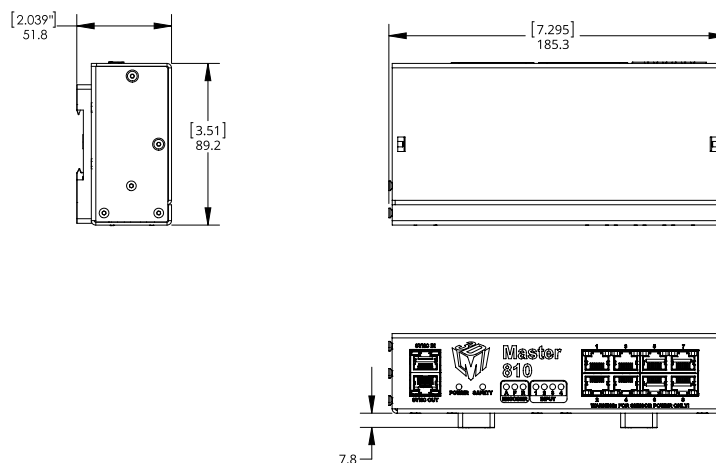
	Input Status	Min (VDC)	Max (VDC)
Single-ended Active High	Off	0	+0.8
	On	+3.3	+24
Single-ended Active Low	Off	(V _{DD} - 0.8)	V _{DD}
	On	0	(V _{DD} - 3.3)
Differential	Off	-24	+0.8
	On	+3.3	+24

Master 810 Dimensions

With 1U rack mount brackets:



With DIN rail mount clips:

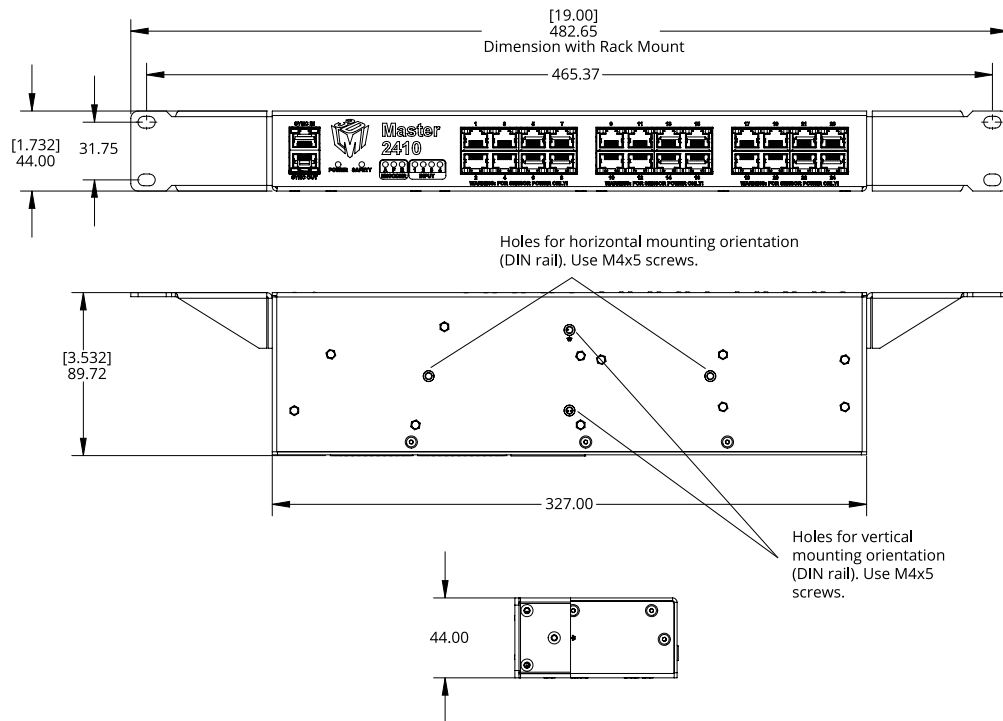


For information on installing DIN rail clips, see *Installing DIN Rail Clips: Master 810 or 2410* on page 21.

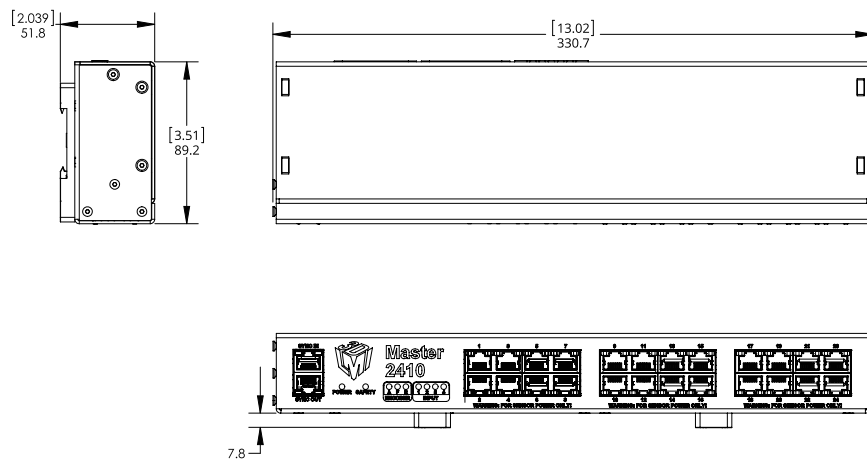
The CAD model of the DIN rail clip is available at <https://www.winford.com/products/cad/dinm12-rc.igs>.

Master 2410 Dimensions

With 1U rack mount brackets:



With DIN rail mount clips:



For information on installing DIN rail clips, see *Installing DIN Rail Clips: Master 810 or 2410* on page 21.

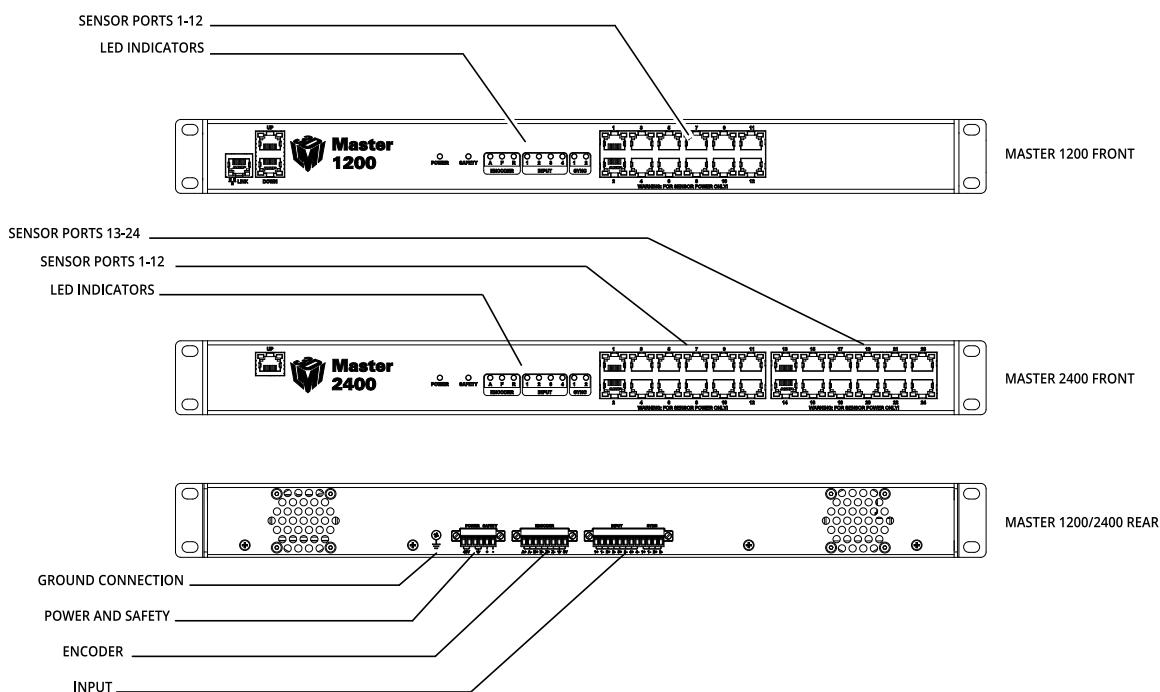
The CAD model of the DIN rail clip is available at <https://www.winford.com/products/cad/dinm12-rc.igs>.

Master 1200/2400

Master 1200 and 2400 network controllers provide sensor power and safety interlock (safety interlock not supported by Gocator snapshot sensors), and broadcast system-wide synchronization information (i.e., time, encoder count, encoder index, and digital I/O states) to all devices on a sensor network.



The Phoenix connectors on Master 400/800/1200/2400 are not compatible with the connectors on Master 810/2410. For this reason, if you are switching models in your network, you must rewire the connections to the Master.



Power and Safety (6 pin connector)

Function	Pin
+48VDC	1
+48VDC	2
GND (24-48VDC)	3
GND (24-48VDC)	4
Reserved	5
Reserved	6



The +48VDC power supply must be isolated from AC ground. This means that AC ground and DC ground are not connected.

Input (12 pin connector)

Function	Pin
Input 1	1

Function	Pin
Input 1 GND	2
Reserved	3
Reserved	4
Reserved	5
Reserved	6
Reserved	7
Reserved	8
Reserved	9
Reserved	10
Reserved	11
Reserved	12



The Input connector does not need to be wired up for proper operation.

Encoder (8 pin connector)

Function	Pin
Encoder_A+	1
Encoder_A-	2
Encoder_B+	3
Encoder_B-	4
Encoder_Z+	5
Encoder_Z-	6
GND	7
+5VDC	8

Master 1200/2400 Electrical Specifications

Electrical Specifications

Specification	Value
Power Supply Voltage	+48 VDC
Power Supply Current (Max.)	10 A
Power Draw (Min.)	5.76 W
Encoder Signal Voltage	Differential (12 VDC)
Digital Input Voltage Range	Logical LOW: 0 to +0.1 VDC Logical HIGH: +3.5 to +6.5 VDC



When using a Master hub, the chassis must be well grounded.



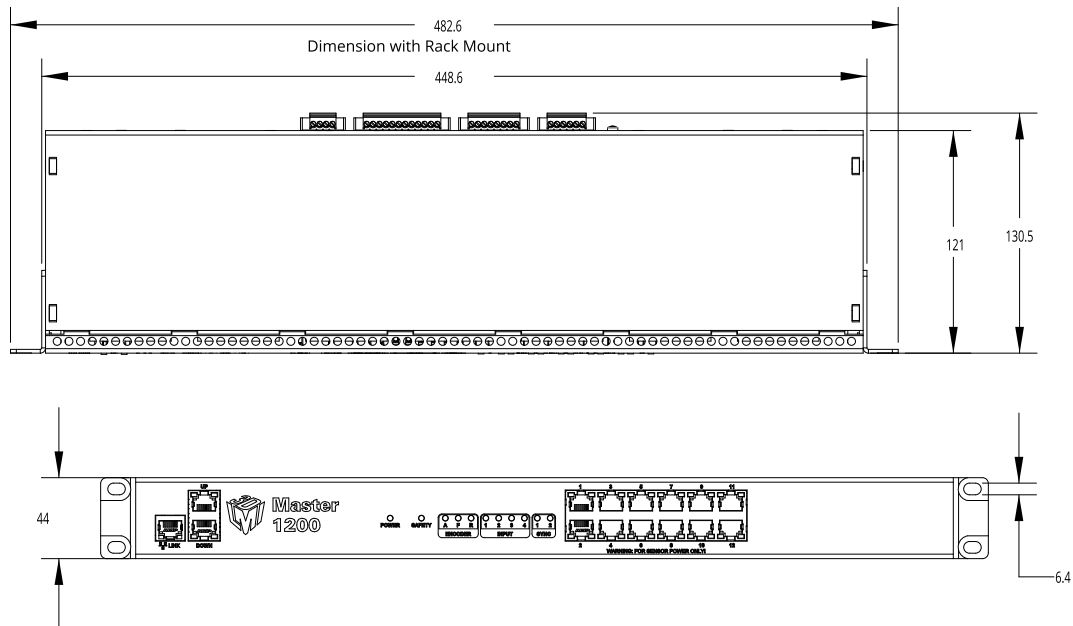
The power supply must be isolated from AC ground. This means that AC ground and DC ground are not connected.



The Power Draw specification is based on a Master with no sensors attached. Every sensor has its own power requirements that need to be considered when calculating total system power requirements.

Master 1200/2400 Dimensions

The dimensions of Master 1200 and Master 2400 are the same.



Accessories

Masters

Description	Part Number
Master 100 - for single sensor (development only)	30705
Master 810 - for networking up to 8 sensors	301114
Master 2410 - for networking up to 24 sensors	301115

Cordsets

Description	Part Number
1.2m I/O cordset, open wire end	30864-1.2m
2m I/O cordset, open wire end	30864-2m
5m I/O cordset, open wire end	30864-5m
10m I/O cordset, open wire end	30864-10m
15m I/O cordset, open wire end	30864-15m
20m I/O cordset, open wire end	30864-20m
25m I/O cordset, open wire end	30864-25m
2m Power and Ethernet cordset, 1x open wire end, 1x RJ45 end	30861-2m
5m Power and Ethernet cordset, 1x open wire end, 1x RJ45 end	30861-5m
10m Power and Ethernet cordset, 1x open wire end, 1x RJ45 end	30861-10m
15m Power and Ethernet cordset, 1x open wire end, 1x RJ45 end	30861-15m
20m Power and Ethernet cordset, 1x open wire end, 1x RJ45 end	30861-20m
25m Power and Ethernet cordset, 1x open wire end, 1x RJ45 end	30861-25m
1.2m Power and Ethernet to Master cordset, 2x RJ45 ends	30858-1.2m
2m Power and Ethernet to Master cordset, 2x RJ45 ends	30858-2m
5m Power and Ethernet to Master cordset, 2x RJ45 ends	30858-5m
10m Power and Ethernet to Master cordset, 2x RJ45 ends	30858-10m
15m Power and Ethernet to Master cordset, 2x RJ45 ends	30858-15m
20m Power and Ethernet to Master cordset, 2x RJ45 ends	30858-20m
25m Power and Ethernet to Master cordset, 2x RJ45 ends	30858-25m

Cordsets - 90-degree

Description	Part Number
2m I/O cordset, 90-deg, open wire end	30883-2m
5m I/O cordset, 90-deg, open wire end	30883-5m

Description	Part Number
10m I/O cordset, 90-deg, open wire end	30883-10m
15m I/O cordset, 90-deg, open wire end	30883-15m
20m I/O cordset, 90-deg, open wire end	30883-20m
25m I/O cordset, 90-deg, open wire end	30883-25m
2m Power and Ethernet cordset, 90-deg, 1x open wire end, 1x RJ45 end	30880-2m
5m Power and Ethernet cordset, 90-deg, 1x open wire end, 1x RJ45 end	30880-5m
10m Power and Ethernet cordset, 90-deg, 1x open wire end, 1x RJ45 end	30880-10m
15m Power and Ethernet cordset, 90-deg, 1x open wire end, 1x RJ45 end	30880-15m
20m Power and Ethernet cordset, 90-deg, 1x open wire end, 1x RJ45 end	30880-20m
25m Power and Ethernet cordset, 90-deg, 1x open wire end, 1x RJ45 end	30880-25m
2m Power and Ethernet to Master cordset, 90-deg, 2x RJ45 ends	30877-2m
5m Power and Ethernet to Master cordset, 90-deg, 2x RJ45 ends	30877-5m
10m Power and Ethernet to Master cordset, 90-deg, 2x RJ45 ends	30877-10m
15m Power and Ethernet to Master cordset, 90-deg, 2x RJ45 ends	30877-15m
20m Power and Ethernet to Master cordset, 90-deg, 2x RJ45 ends	30877-20m
25m Power and Ethernet to Master cordset, 90-deg, 2x RJ45 ends	30877-25m

Contact LMI for information on creating cordsets with custom length or connector orientation. The maximum cordset length is 60 m.

Return Policy

Return Policy

Before returning the product for repair (warranty or non-warranty) a Return Material Authorization (RMA) number must be obtained from LMI. Please call LMI to obtain this RMA number.

Carefully package the sensor in its original shipping materials (or equivalent) and ship the sensor prepaid to your designated LMI location. Please ensure that the RMA number is clearly written on the outside of the package. Inside the return shipment, include the address you wish the shipment returned to, the name, email and telephone number of a technical contact (should we need to discuss this repair), and details of the nature of the malfunction. For non-warranty repairs, a purchase order for the repair charges must accompany the returning sensor.

LMI Technologies Inc. is not responsible for damages to a sensor that are the result of improper packaging or damage during transit by the courier.

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Europe

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