USER MANUAL

Gocator 3100 Series

Version 3.6.4.178 Revision: A

Proprietary

Trademarks and Restrictions

Contact Information

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Introduction

The Gocator 3000 family of 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 guide describes the installation and use of Gocator 3100 sensors.

Notational Conventions

This guide uses the following notational conventions:

Warning	Follow these safety guidelines to avoid potential injury or property damage.
Note	Consider this information in order to make best use of the product or to avoid confusion.

Table of Contents

Safety and Maintenance

Electrical Safety

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. Refer to Gocator 3100 I/O Connector (page 239) for a description of 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.

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

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.

⚠ It is critical that the sensor is 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. It is critical that the temperature of all of its components are in equilibrium. When the sensor is powered up, a warm-up time of at least one hour is required in order to reach a consistent spread of temperature within the sensor.

Sensor Maintenance

Keep sensor windows clean

Gocator sensors are high-precision optical instruments. To ensure the highest accuracy is achieved in all measurements, the windows on the front of the sensor should be kept clean and clear of debris.

Use care when cleaning sensor windows

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.

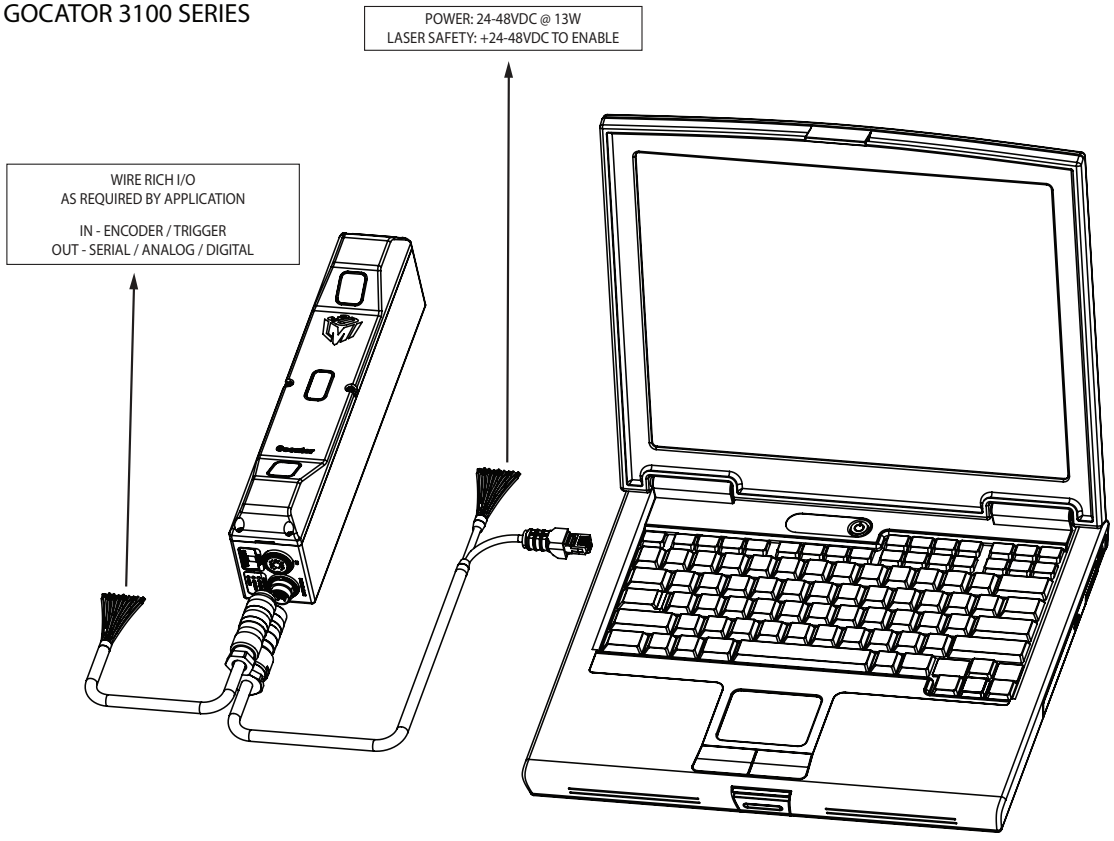
Getting Started

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.

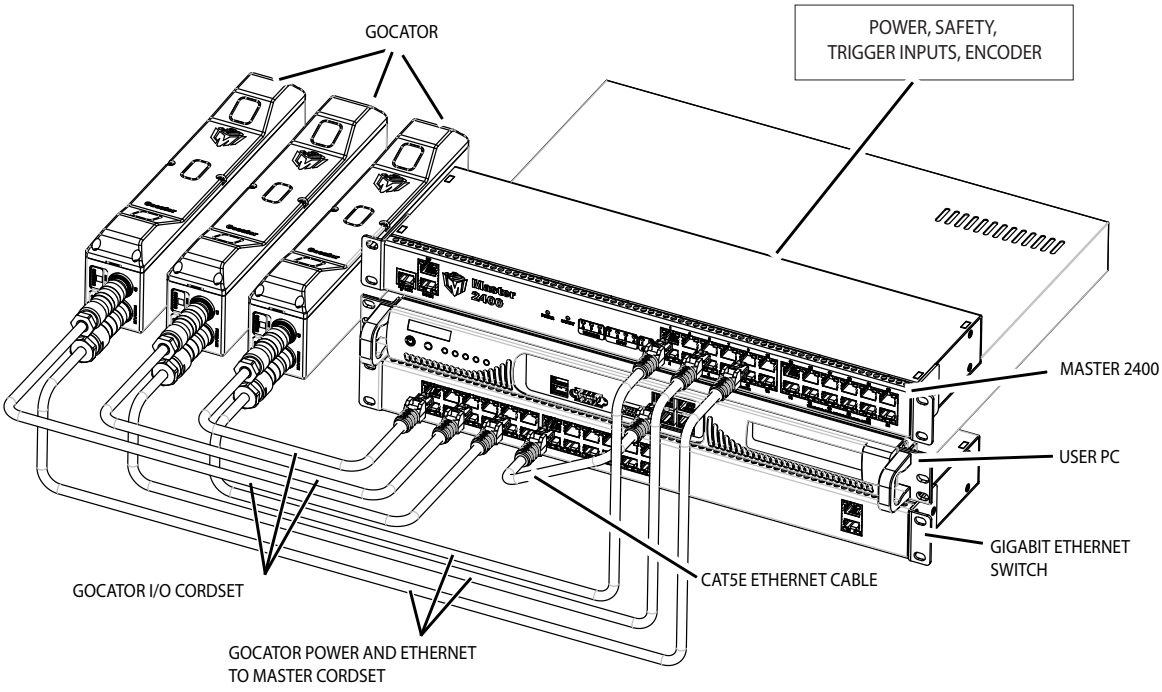
Standalone System

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.



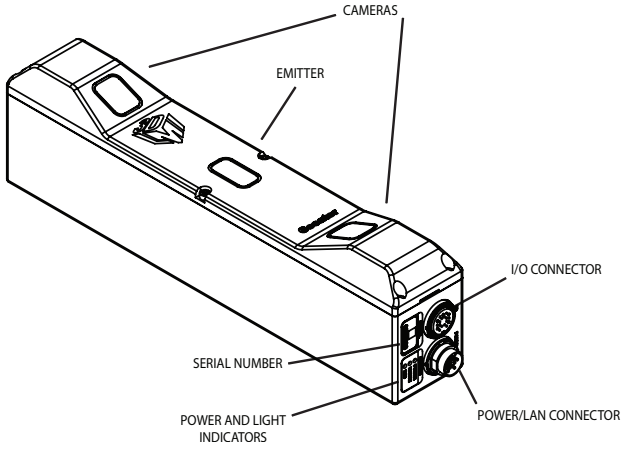
Multi-sensor System

Master 400/800/1200/2400 networking hardware 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 (minimum 100 Mbit/s).



Hardware Overview

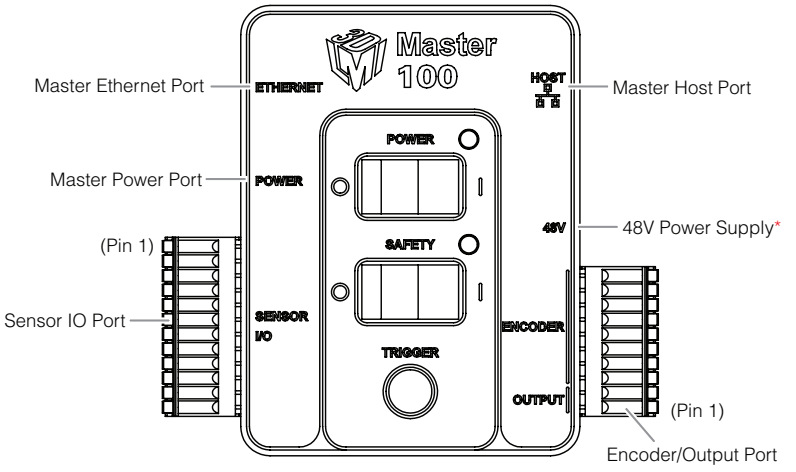
Gocator 3110 Sensor



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

Master 100

The Master 100 is used by the Gocator 3100 series for standalone system setup.

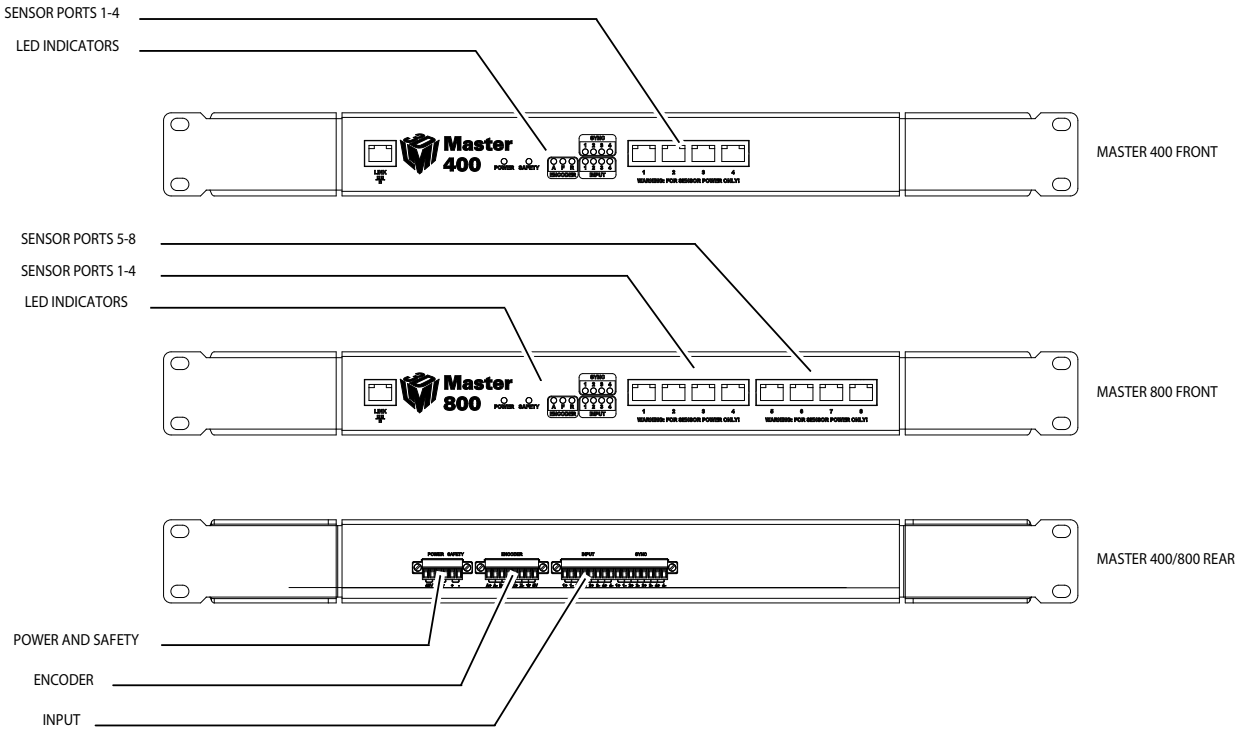


Item	Description
Master Ethernet Port	Connects to the RJ45 connector labeled *Ethernet* on the Power and Ethernet to Master cordset.
Master Power Port	Connects to the RJ45 connector labeled *Power/Sync* on the Power and Ethernet to Master cordset. Provides power and safety to the Gocator.
Sensor I/O 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.
Safety Switch	Toggles safety signal provided to the sensors [O= light off, I= light on].
Trigger Button	Signals a digital input trigger to the Gocator.
Encoder	Accepts encoder A, B, and Z signals.
Digital Output	Provides digital output.

Refer to Master 100 (page 244) for pinout details.

Master 400/800

The Master 400 and the Master 800 allow you to connect more than two sensors. The Master 400 accepts four sensors, and the Master 800 accepts eight sensors.

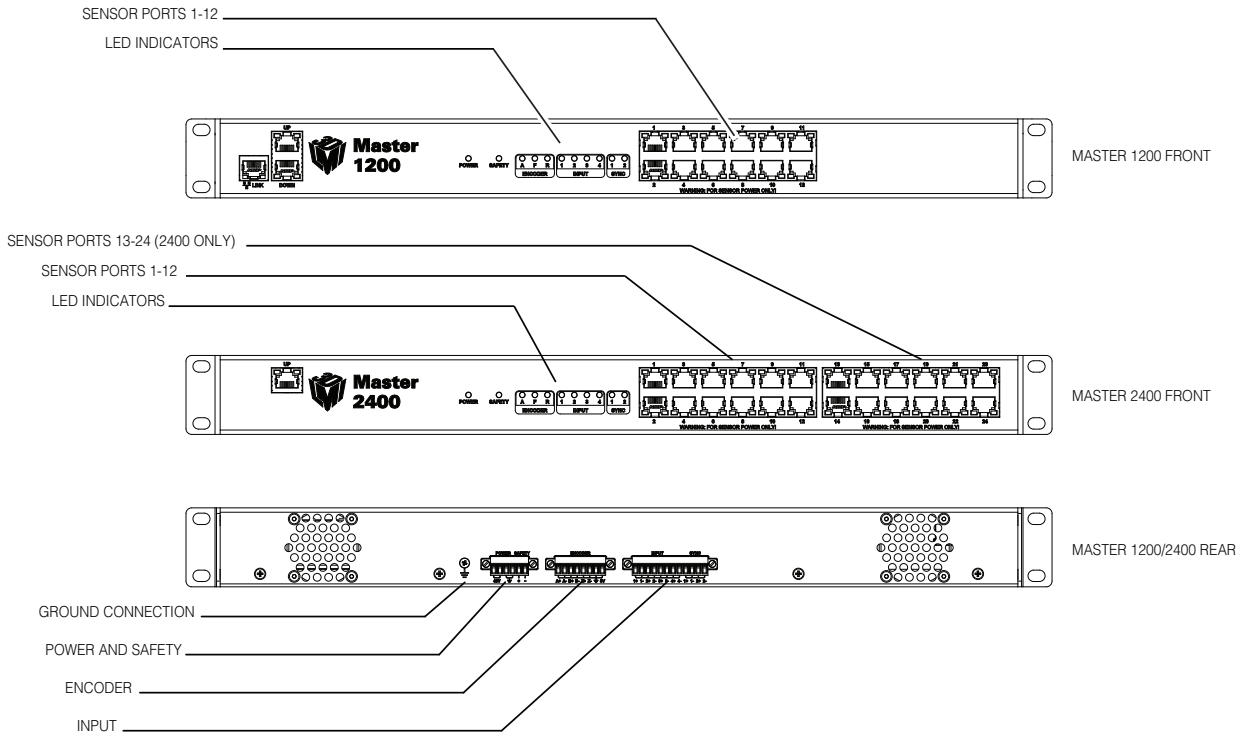


Item	Description
Sensor Ports	Master connection for Gocator sensors (no specific order required).
Ground Connection	Earth ground connection point.
Safety	Safety connection.
Encoder	Accepts encoder signal.
Input	Accepts digital input.

Refer to Master 400/800 (page 246) for pinout details.

Master 1200/2400

The Master 1200 and the Master 2400 allow you to connect more than two sensors. The Master 1200 accepts twelve sensors, and the Master 2400 accepts twenty-four sensors

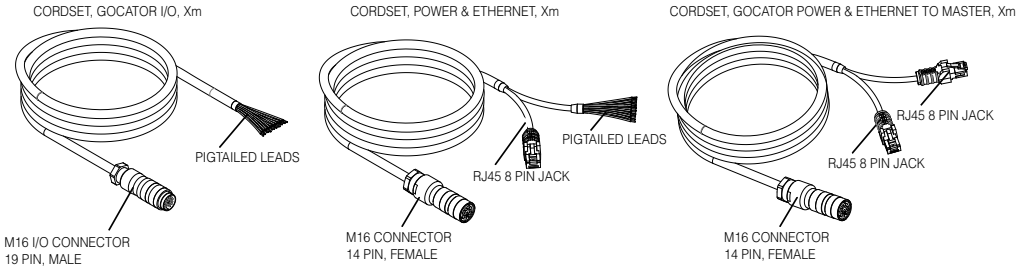


Item	Description
Sensor Ports	Master connection for Gocator sensors (no specific order required).
Ground Connection	Earth ground connection point.
Safety	Safety connection.
Encoder	Accepts encoder signal.
Input	Accepts digital input.

Refer to Master 1200/2400 (page 249) for pinout details.

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 Gocator 3100 I/O cordset provides digital I/O connections, an encoder interface, RS-485 serial connection, and an analog output. The Master version of the Power & Ethernet cordset provides direct connection between the sensor and a Master 400/800/1200/2400.



The maximum cordset length is 60m. Refer to Gocator 3100 I/O Connector (page 239) and Gocator 3100 Power/LAN Connector (page 237) for pinout details. Refer to Parts and Accessories (page 251) for cordset lengths and part numbers. Contact LMI for information on creating cordsets with custom length or connector orientation.

Installation

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.

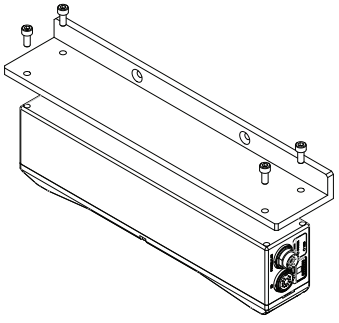
Grounding - Master 400/800/1200/2400

The mounting brackets of all Masters have been 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.

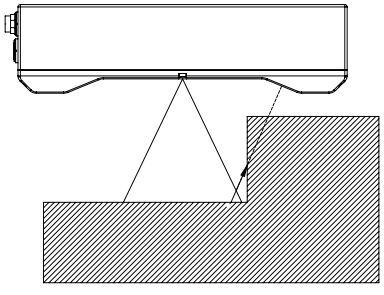
⚠ The frame or electrical cabinet that the Master is mounted to must be connected to earth ground.

Mounting

Sensors should be mounted using four M5 x 0.8 pitch screws of suitable length. The recommended thread engagement into the housing is 8 - 10 mm. Proper care should be taken in order to ensure that the internal threads are not damaged from cross-threading or improper insertion of screws.



Sensors should not be installed near objects that might occlude a camera's view of the light.



⚠ 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 in order to reach a consistent spread of temperature within the sensor.

Network Setup

Client Setup

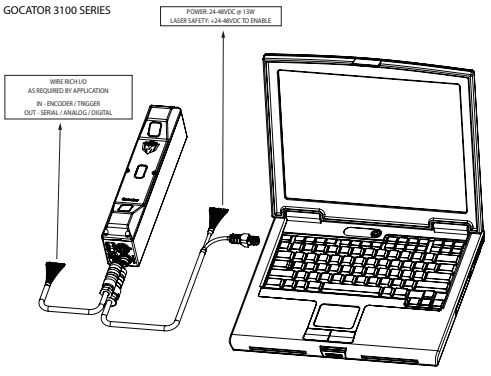
Sensors are shipped with the following default network configuration:

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

All Gocator sensors are configured to 192.168.1.10 as the default IP address. For a system with multiple Gocators, the sensors must be assigned unique addresses before they can be used on the same network. Before proceeding, connect the sensors one at a time (to avoid an address conflict) and use the steps on page 22 to assign each sensor a unique address.

To connect to a sensor for the first time:

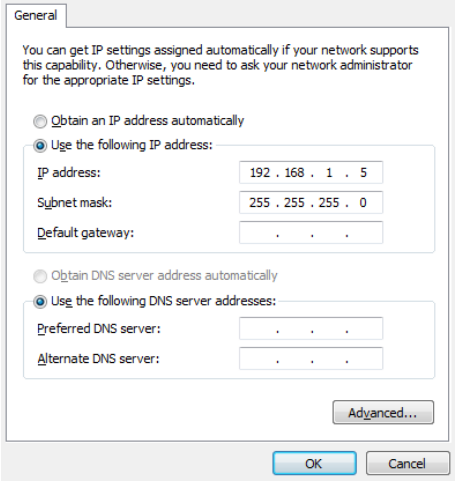
1 Connect cables and apply power.
Sensor cabling is illustrated in System Overview (page 10)



2 Change the client PC's network settings.

Windows 7:

- » Open the Control Panel and select Network and Sharing Center, then click Change Adapter Settings.
- » Right-click the desired network connection, and then click Properties.
- » On the Networking tab, click Internet Protocol Version 4 (TCP/IPv4), and then click Properties.
- » Select “Use the following IP address” option.
- » Enter IP Address “192.168.1.5” and Subnet Mask “255.255.255.0”, then click OK.

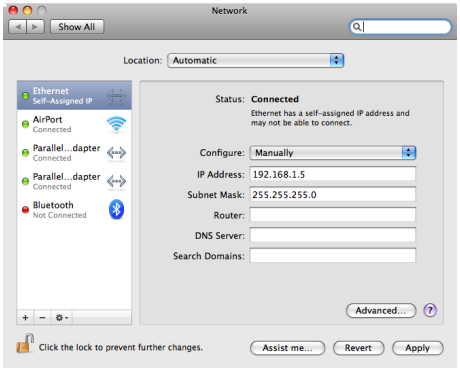


Mac OS X v.10.6:

» 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.



Refer to Troubleshooting (page 232) if you experience any problems while attempting to establish a connection to the sensor.

Gocator Setup

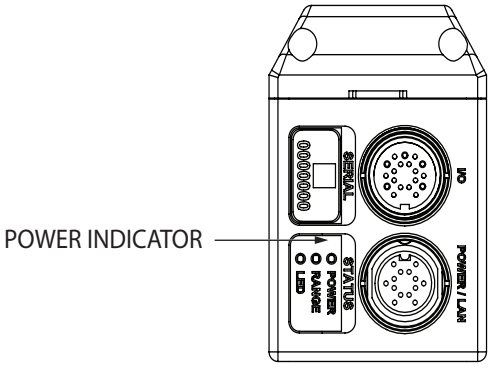
Gocator sensors are shipped with a default configuration that will produce 3D data on most targets.

The following sections walk you through the steps required to set up a standalone sensor system and a multi-sensor system for operations. After you have completed installation, 3D data can be acquired to verify basic sensor operation.

Running a Standalone Sensor System

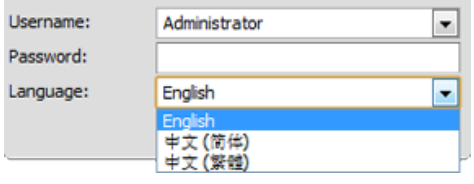
To configure a standalone sensor system:

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

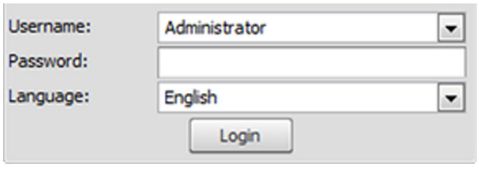


2 Enter the sensor's IP address (192.168.1.10) in a web browser.

3 Select the language
After selecting the language, the browser will refresh and the web interface will display in the selected language.

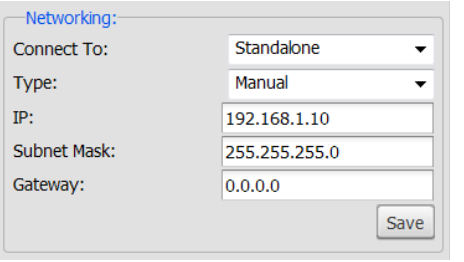


4 Log in as Administrator with no password.
The interface display language can be changed using the language option. After selecting the language, the browser will refresh and the web interface will display in the selected language.



5 Select the Connection Page.

6 **Specify the Connect To setting.**
The Connect To setting specifies whether the sensor system is standalone or connected to a Master 100/400/800/1200/2400. For single sensor operations select Standalone or Master 100.

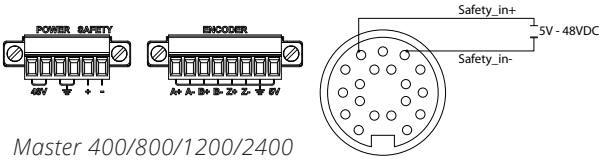


7 **Ensure that the Data Source selector is showing LIVE.**

8 **Ensure that the LED Safety Switch is enabled or the LED Safety input is high.**

9 **Select the Setup Page.**

10 **Press the Start button to start the sensor.**
The Start button is used to run sensors continuously, while the Snapshot button is used to trigger a single capture.

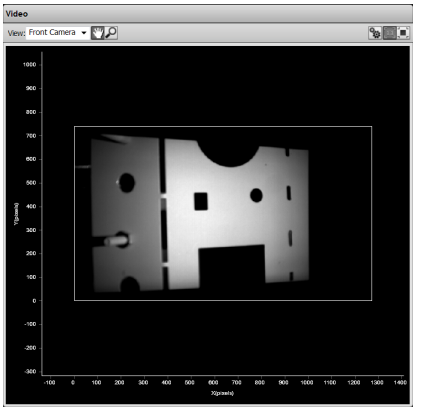


Master 400/800/1200/2400

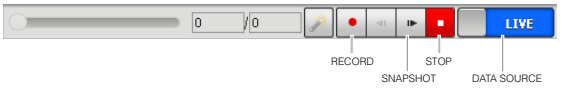
Standalone

11 **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 LED will illuminate.

If you cannot see the LED projected light, or if a 3D Heightmap is not displayed in the Data Viewer, refer to Troubleshooting (page 232).



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

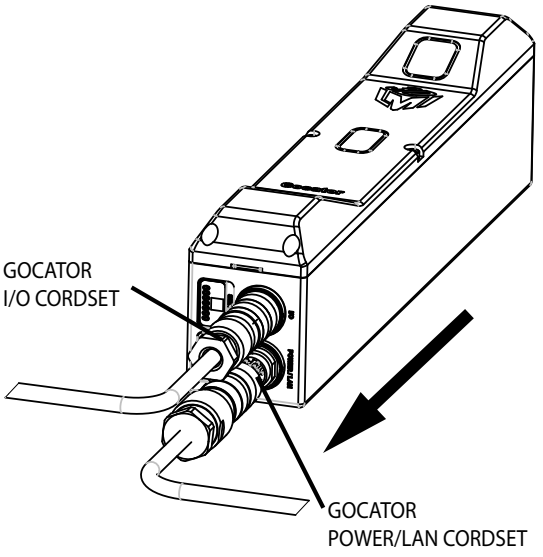


Running a Multi-sensor System

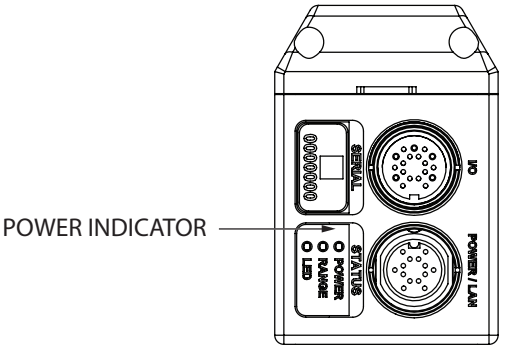
All sensors are shipped with a default IP address of 192.168.1.10. Ethernet networks require a unique IP address for each device, so you must set up a unique address for each sensor. For each additional sensor, follow the steps below.

To configure a multi-sensor system:

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

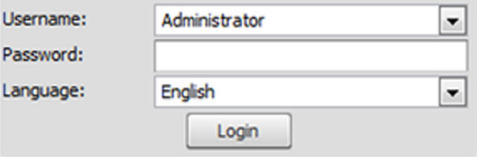


2 Power up the new sensor.
The power LED (blue) of the new sensor should turn on immediately.



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

4 Log in as Administrator with no password.

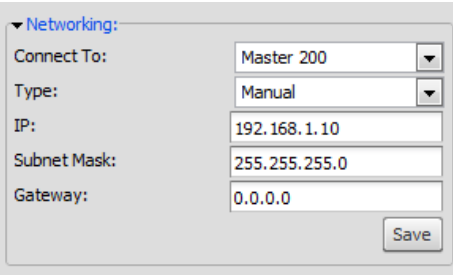


5 Select the Connection Page.

6 Modify the IP address in the Networking settings and click the Save button.

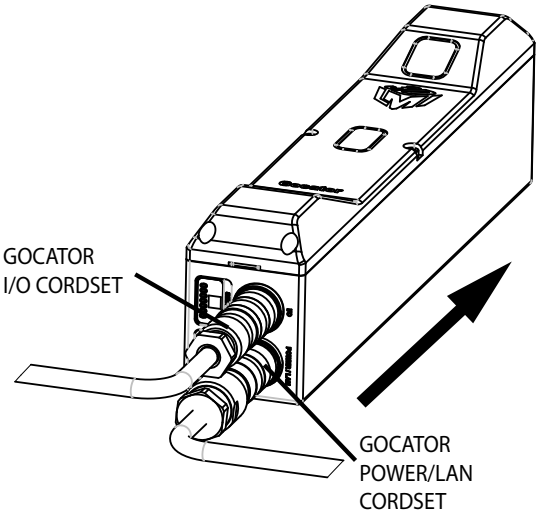
Ideally, you should increment the last octet of the IP address for each additional sensor you need to use. For example, if the IP address of the first sensor you configure is 192.168.1.10, use 192.168.1.11 for the second sensor; use 192.168.1.12 for the third; etc.

Click the Save button. You will be prompted to confirm your changes.



7 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.



8 Repeat these steps for each additional sensor.

Next Steps

After completing the steps in this chapter, the Gocator measurement system is ready to be configured for an application using the software interface. The interface is explained in the following sections of the "Gocator Web Interface" chapter:

Connection and Maintenance (page 41)
Sets up sensor connections and networking, and performs maintenance tasks.

Setup and Calibration (page 47)
Fine-tunes 3D data acquisition for an application.

Measurement (page 69)
Programs measurements on sensors that are equipped with *measurement tools*.

Output (page 113)
3D point cloud data, measurements, and Pass/Fail results can be transmitted to external devices for process control or data analysis.

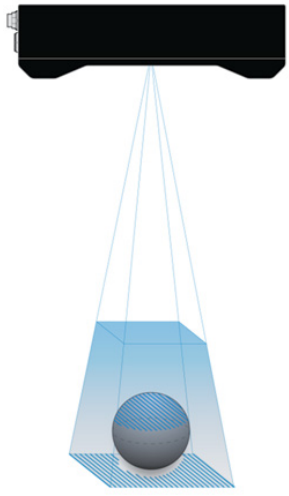
Toolbar (page 34)
Controls system operation, record and playback data, and manages sensor configurations.

Dashboard (page 124)
Provides real-time monitoring of the sensor's health and measurement results.

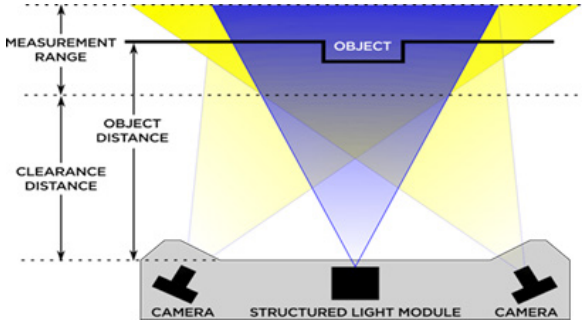
Theory of Operation

Principle of 3D Acquisition

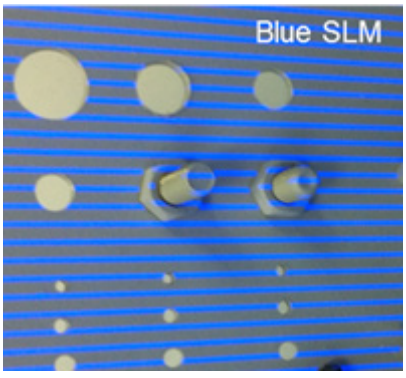
The Gocator 3100 is called a 3D snapshot sensor, meaning that it captures an entire surface in 3D in a single snapshot. The sensor projects several structured light patterns in a rapid sequence onto the target. The reflection of the pattern off the target is captured by two cameras. The target must remain 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.



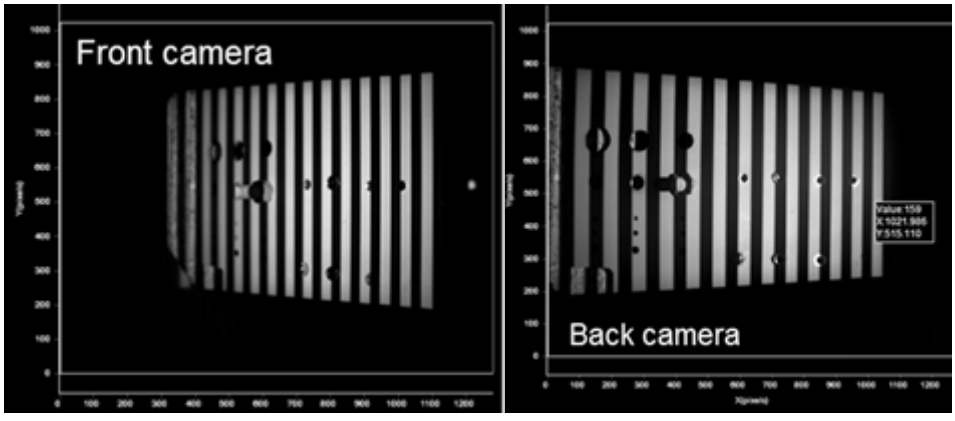
A Structured Light Modulator (SLM) produces a sequence of high resolution/high contrast light patterns using a blue LED. Two cameras capture the reflected light pattern from different viewing angles. The sensor can then use either stereo correlation or independent triangulation to generate 3D points from the light pattern. Gocator sensors are always pre-calibrated to deliver 3D data in engineering units throughout the specified measurement range.



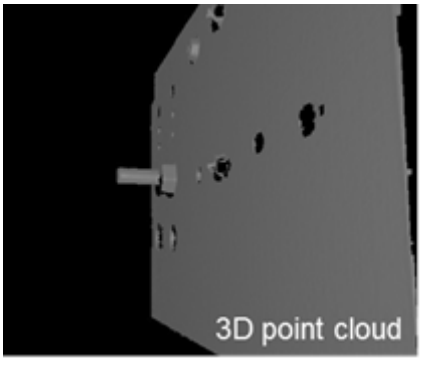
These are the steps involved in the acquisition of a 3D point cloud:



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

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 suffer from occlusions on targets with complicated shape 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. This is the same triangulation principle used in the Gocator 1000 and 2000 family sensors. 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 relies on the sensor's internal components being fully stable.

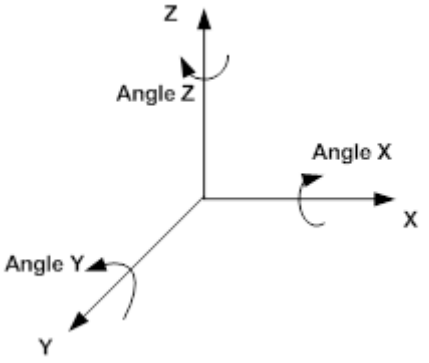
The mode to acquire 3D data in the Gocator is controlled by the Reduce Occlusion setting (page 49).

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

The 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 represents the sensor's field of view (FOV).

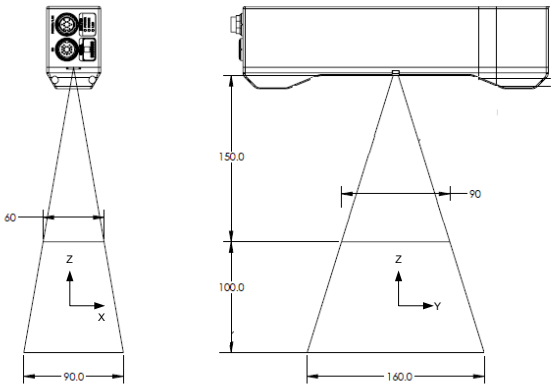
X-offset, y-offset, and z-offset define the translations from the origin.

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 calibration (alignment) state of the sensor. These coordinate systems are described below.

Sensor Coordinates

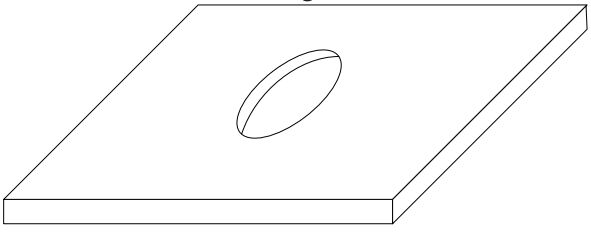
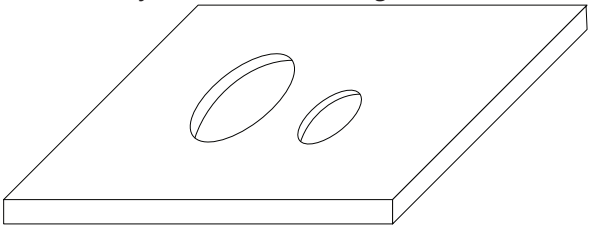
Before alignment calibration, the origin of the sensor is at the center of the sensor's MR and FOV.



System Coordinates

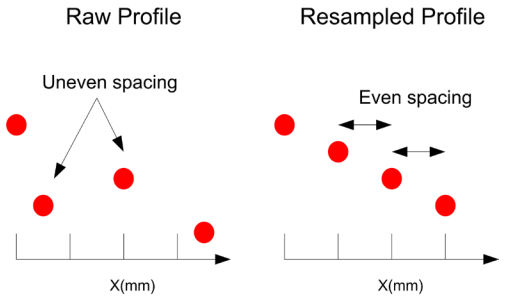
Alignment calibration can be used to establish a transformed coordinate system according to the user's needs. Alignment calibration determines the adjustments to X, Y, and Z, as well as rotation angle about each axis.

Transformed coordinate systems can be associated with specific sensor configurations. For details, see Transformation Sources (page 60).

Target	Alignment	Explanation
Flat surface	Z-offset Angle X Angle Y	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).
Plate (single reference hole)	X-offset Y-offset Z-offset Angle X Angle Y	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. 
Plate (with two reference holes)	X-offset Y-offset Z-offset Angle X Angle Y Angle Z	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. 

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 Whole Part 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 configured with the X/Y Resolution setting in the Sensor panel (page 52). The X-Y resampling plane is established through the Gocator's built-in calibration routine. That is, the resampling plane is set to match the plane described by the calibration plate (see page 30).



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 Whole Part mode.

Acquisition Speed

The following table provides estimates of the acquisition speed under different field-of-view, resolution, intensity, and occlusion reduction settings.

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

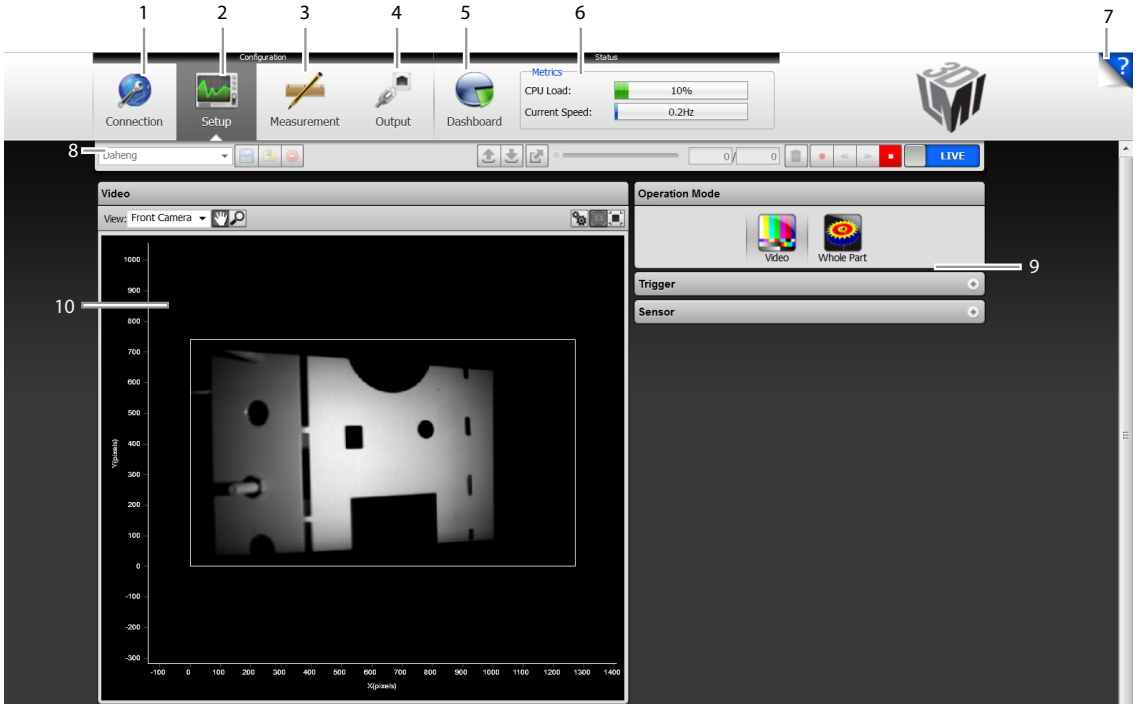
FOV (X x Y x MR)	Resolution (mm)	Speed (Hz) Acquire Intensity and Reduce Occlusion options disabled
90x160x100	0.5	1.2
90x160x100	0.2	0.8
90x160x100	0.1	0.2
35x35x100	0.5	7.5
35x35x100	0.2	2.7
35x35x100	0.1	1.9
35x35x35	0.5	9
35x35x35	0.2	6.8

FOV (X x Y x MR)	Resolution (mm)	Speed (Hz) Acquire Intensity and Reduce Occlusion options disabled
35x35x35	0.1	4.0

Gocator Web Interface

User Interface Overview

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



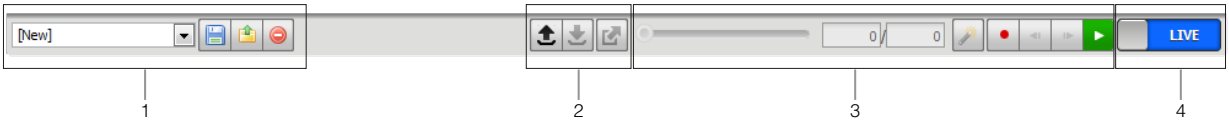
	Element	Description
1	Connection Page	For network configuration and maintenance. See Connection and Maintenance (page 41).
2	Setup Page	For configuring settings such as trigger source and exposure, and to perform calibration steps. See Setup and Calibration (page 47).
3	Measurement Page	For configuring measurements. See Measurement (page 69).
4	Output Page	For configuring measurement result outputs to external devices. See Output (page 113)
5	Dashboard Page	For viewing performance statistics and results. See Dashboard (page 124).
6	Metrics Panel	Summarizes important performance statistics. Metrics Panel (page 40).
7	Help	Online help resources, including User Manual, Firmware updates, and SDK.

	Element	Description
8	Toolbar	Controls sensor operation, manages configurations, and replays recorded measurement data. See Toolbar (page 34)
9	Configuration Area	Provides controls to configure 3D data acquisition and measuring parameters.
10	Data Viewer	Displays sensor data, tool setup controls, and measurements. See page 63 for its use when the Setup page is active; see page 72 for its use when the Measurement page is active.

Common Elements

Toolbar

The toolbar is the central place for performing common operations. This chapter explains how to use the toolbar to manage the sensor configurations and to operate the sensor.



	Element	Description
1	Configuration Controls	Use the configuration controls to manage sensor settings.
2	Recorded Data Controls	Use the recorded data controls to download, export and upload recorded data.
3	Sensor Operation / Replay Control	Use the sensor operation controls to start sensors, enable recording and control recorded data.
4	Data Source	Use the Data Source button to switch the sensor between live and replay mode.

Saving and Loading Settings

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

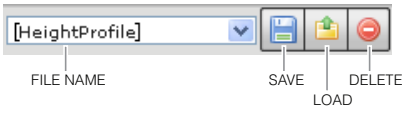
Saved Information

Information Type	Behavior
Network Address	Network address changes are saved when you click the Save button in Main panel on the Connection Page. The sensor must be reset before changes take effect.
Configuration	Most of the settings that can be changed in the Gocator's web interface, such as those shown on Setup, Measurement, and Output pages, are temporary until saved in a *configuration* file. Each sensor can have multiple configuration files. If there is a configuration file that is designated as the *default*, it will be loaded automatically when the sensor is reset.

Information Type	Behavior
Calibration	*Calibration* files, described in Calibration (page 129), are saved automatically at the end of the calibration process (page 81). The sensor contains a global calibration file that is hidden from the user and not visible in the file manager. This file will automatically be loaded when the sensor is reset. Configurations can be associated with specific calibration files, which are created by selecting Current Configuration as the source when calibrating the Gocator (page 59). These files are visible in the file manager and can be handled manually there. Associated files have the same file name (but a different extension). If there is a configuration file that is designated as default and it has an associated calibration file, that calibration will be loaded automatically when the sensor is reset.

Each sensor can have only one global calibration file. But a sensor can contain many calibrations associated with specific configurations. The number of files is limited only by the sensor's flash storage capacity. The Gocator's web interface provides toolbar commands to load and save these files as a *bundle*.

Gocator can be set up to operate with a global calibration or with a calibration associated with a specific configuration (see page 60). An associated calibration file is only included in the file bundle if Current Configuration is currently selected as the calibration source.



The File Name drop down list shows the list of file bundles stored in the sensor. The configuration that is currently loaded will be listed at the top. The name will be marked with an asterisk if the live configuration is different from the loaded configuration to indicate unsaved changes.

To save a new bundle of files:

1. **Select [New] in the File Name drop list.**
2. **Enter a name for the file bundle.**
3. **Press the Enter key or click the Save button.**
   The configuration and the template will be saved to flash memory using the name provided. The saved files will be set as the defaults to be loaded automatically when the sensor is reset.

To overwrite an existing bundle files:

1 **Select an existing file name in the File Name drop list.**

2 **Click the Save button.**
A dialog will be prompted to confirm overwriting the existing files. The configuration and the template will be saved to flash memory using the selected name. The saved files will be set as the defaults to be loaded automatically when the sensor is reset.

To load a bundle of files:

1 **Select an existing file name in the File Name drop list.**

2 **Click the Load button.**
The configuration and the template are loaded from flash memory. Any unsaved changes to current settings will be overwritten when the files are loaded.

To delete a bundle of files:

1 **Select an existing file name in the File Name drop list.**

2 **Click the Delete button.**
The configuration and the template are deleted from the flash memory.

Managing individual files is described in the Files Panel (page 44) section.

Managing Multiple Settings

A Gocator can store multiple bundles of configurations, calibrations, and templates. This can be used when one set of equipment is used for different purposes or with different constraints during separate production runs. For example, width decision constraints might be loose during one production run and tight during another depending on the desired grade of the part.

To manage a system with multiple configurations:

1 **Configure settings for the first target object.**
Use the Setup, Measurement, and Output Pages to configure settings for the first target.

2 **Save the first configuration.**
Enter a file name and use the Save button to save the configuration.

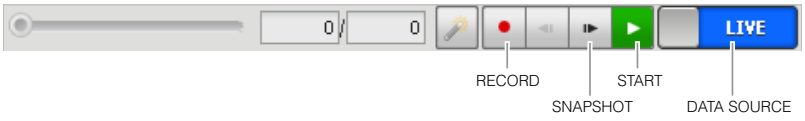
3 **Configure settings for the second target object.**
Use the Setup, Measurement, and Output Pages to configure settings for the second target.

4 **Save the second configuration.**
Enter a file name (different from the one used for the first configuration) and use the Save button to save the configuration

5 **When production changes, load the desired configuration.**
Select the desired configuration and click the Load button. The configuration will be loaded and the sensors will ready for production.

Gocator sensors have the ability to record and replay data, and also to 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 by using commands in the toolbar.



Recording and Playback commands when Data Source is Live

Recording and Playback commands when Data Source is Replay

To record live data:

1 **Toggle the Data Source to Live.**

2 **Press the Record button.**
When the Data Source is set to Live and recording is enabled, the sensor will store the most recent data as it runs. Remember to disable recording if you no longer wish to record live data (press the Record button again to disable).

3 **Press the Snapshot button or Start button.**
Snapshot will cause a single frame to be recorded. 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. New data is appended to the record buffer unless the configuration has changed.

New record data is appended to existing replay data unless the sensor configuration has been modified.

To replay recorded data:

1 **Toggle the Data Source to Replay.**

2 **Use the Replay Slider, Step Forward, Step Back, or Play buttons to review data.**
The Step buttons advance / reverse the current replay location by a single frame. The Play button advances the replay location continuously, animating the playback. The Pause 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 navigate to a specific replay frame.

To simulate measurements on recorded data:

1 **Toggle the Data Source to Replay.**

2 **Go to the Measurement page.**

Modify settings for existing measurements, add new measurement tools, or delete measurement tools as desired.

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 measurement results across the entire recording can be viewed in the Dashboard page (see page 124).

To clear recorded data:

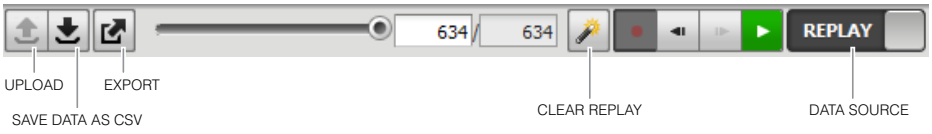
1 **Toggle the Data Source to Replay.**

2 **Press the Clear Replay button.**

Downloading, Exporting and Uploading Recorded Data

Recorded data can be downloaded or exported to the client computer or uploaded to the Gocator. Export is often used for processing the recorded data using 3rd party tools. Recorded data can also be downloaded in a binary format. It is used to backup the data for reviewing in the future.

Recorded data is not saved or loaded along with other files when you use the Save or Load commands in the Gocator's toolbar.



To download recorded data:

1 **Toggle the Data Source to Replay.**

2 **Press the Download button.**

3 **Select the directory and file name to store on the client computer. Press OK.**

To upload recorded data:

1 **Toggle the Data Source to Live.**

2 **Press the Upload button.**

3 **Select the directory and the file name to load from the client computer. Press OK.**

Recorded profile, part and measurement data can be exported to CSV format. Recorded data can be exported by using the export command in the Gocator toolbar in replay mode.

To export recorded data to CSV:

1 **Toggle the Data Source to Replay.**

2 **Press the Export button.**
Select Export Ranges as CSV. In Profile and Raw mode, all data in the record buffer is exported. In Part Mode, only data in the current replay location is exported. Use the step button to move to a different replay location (page 37).

3 **Select the directory and file name to store on the client computer. Press OK.**

4 **Convert exported data to another format using the CSV Converter Tool (see page 230).**

Similarly, recorded intensity data can be exported to a bitmap (.BMP format).

To export recorded intensity data to BMP:

1 **Toggle the Data Source to Replay.**

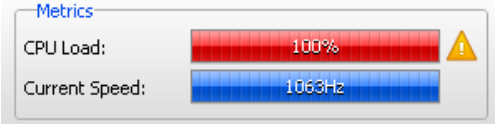
2 **Press the Export To BMP button.**
Select Export Intensity as BMP. Only the intensity data in the current replay location is exported. Use the step button to move to a different replay location.

3 **Select the directory and file name to store on the client computer. Press OK.**

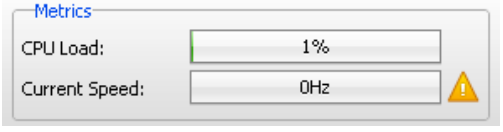
Metrics Panel

The Metrics panel displays two important performance statistics in real-time: CPU Load and Current Frame Rate (Speed).

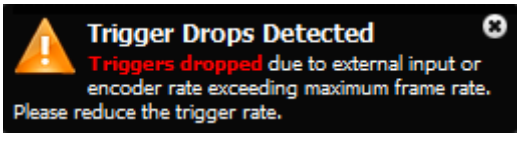
The CPU Load bar in the Metrics panel (at the top of the interface) displays how much of the CPU is being utilized. A warning symbol will appear if the sensor drops profiles because CPU is over utilized.



The Speed bar displays the frame rate of the sensor. A warning symbol will appear if triggers (external input) are dropped because the external rate exceeds the maximum frame rate.



Click on a warning symbol to reveal notifications that display more detailed information.



Data Viewer

The Data Viewer is visible in both the Setup and the Measurement pages, but displays different information depending on which page is active.

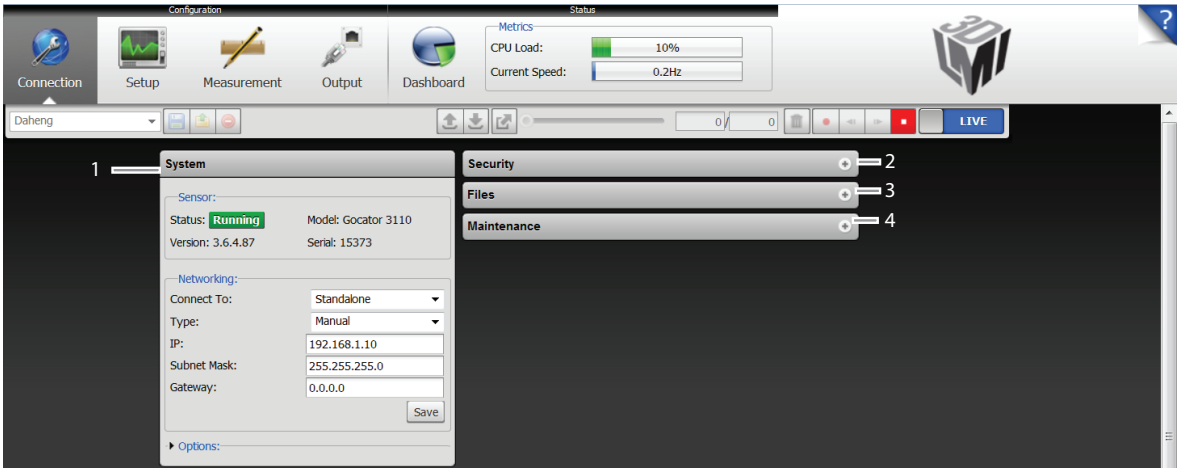
When the Setup page is active, the Data Viewer displays sensor data and can be used to adjust regions of interest. Depending on the selected operation mode (page 49), the data viewer can display video images or whole part views. For details, see page 63.

When the Measurement page is active, the Data Viewer displays sensor data onto which representations of measurement tools and their measurements are superimposed. For details, see page 72.

Connection and Maintenance

Connection Page Overview

Gocator's security, file management and maintenance tasks are performed on the Connection Page.

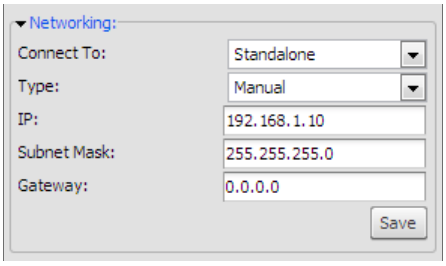


	Element	Description
1	System Panel	Use the System panel to configure sensor network and boot-up settings (page 42).
2	Security Panel	Use the Security panel to change passwords (page 43).
3	Files Panel	Use the Files panel to manage files stored on the main sensor (page 44).
4	Maintenance Panel	Use the Maintenance panel to upgrade firmware, create/restore backups or reset sensors (page 45).

System Panel

Network Settings

The network settings need to be configured to match the network to which the Gocator sensors are connected.



To configure the network settings:

1 **Navigate to the System panel.**
Click the arrow next to Networking to expand the panel.

2 **Specify the Connect To setting.**
The Connect To setting specifies whether the sensor system is standalone or connected to a Master.

3 **Specify the Type, IP, Subnet Mask and Gateway settings.**
The Gocator sensor can be configured to use DHCP, or assigned a static IP address.

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

5 **Reset or power-cycle the sensor.**
After changing network settings, the sensor must be reset or power-cycled before the change will take effect.

The Reset Sensor button in the Maintenance panel (see "Maintenance Panel" on page 45) can be used to perform a software reset.

Sensor Autostart

With the Autostart setting enabled, 3D acquisition and measurement functions will begin automatically when the sensor is powered on. This setting is necessary when the sensor will be used without a computer connected.

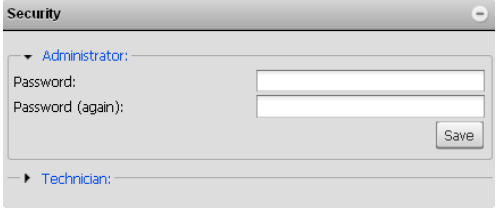
To enable/disable Autostart:

1 **Check/Uncheck Autostart option box.**

2 **Save configuration.**

Security Panel

Gocator sensors can be secured with passwords to prevent unauthorized access. Each sensor has two accounts: Administrator and Technician.



Gocator Account Types

Account	Description
Administrator	The Administrator account has privileges to view and edit all settings, and to perform setup procedures such as sensor calibration.
Technician	The Technician account has privileges to view the Dashboard Page and to Start or Stop the sensor.

The Administrator and Technician accounts can be assigned unique passwords. By default, passwords are blank (empty).

To set or change the password for the Administrator account:

1 **Navigate to the Security panel.**
Click the arrow next to Administrator to expand the panel.

2 **Enter the new Administrator account password and password confirmation.**

3 **Click Save.**
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 **Navigate to the Security panel.**

Click the arrow next to Technician to expand the panel.

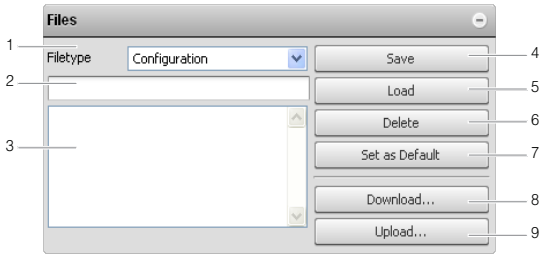
2 **Enter the new Technician account password and password confirmation.**

3 **Click Save.**
The new password will be required the next time that a technician logs in to the sensor.

If the administrator or technician password is misplaced, the sensor can be recovered using a special software tool. Refer to Sensor Recovery Tool (page 224) for more information.

Files Panel

The Files panel can be used to manage configuration and transformation files.



	Element	Description
1	File Type	Specifies the type of file to manage (Configuration or Transformation).
2	File Name Field	Used to provide a file name when saving files.
3	File List	Displays the files that are currently saved in the sensor's flash storage.
4	Save Button	Saves currently loaded data to file using the name in the File Name Field.
5	Load Button	Loads the file that is selected in the File List.
6	Delete Button	Deletes the file that is selected in the File List.
7	Set as Default Button	Sets the selected file as the default to be loaded at boot time.
8	Download Button	Downloads the selected file to the client computer.
9	Upload Button	Uploads a file from the client computer.

The following types of files can be saved and loaded:

File types

File Type	Description
Configuration	Contains the settings specified in the Setup, Measurement, and Output Pages.
Calibration	Contains settings resulting from calibration.

To manage a configuration or transformation file:

1 **Navigate to Files panel.**

2 **Select the File Type.**

3 **Select the file in the File list.**
To save the live configuration or transformation to a file, type in a new file name or select a file to replace with.

4 **Select the action.**

Maintenance Panel

Sensor Backups and Factory Reset

The Maintenance panel can be used to create sensor backups, restore from a backup, or restore to factory defaults.

Backup files contain all of the information stored on board a sensor, including configuration, calibration, and template.

It is recommended that Administrators create a backup file in the unlikely event that a sensor fails and a replacement sensor is needed. In such an event, the new sensor can be restored with the backup file.

To create a backup:

1 **Navigate to the Maintenance panel.**

2 **Click the Backup Sensor... button.**

3 **When prompted, specify a location to save the backup.**
The backup will be saved to the specified location on the client computer. Backups are saved as a single archive that contains all of the files from the sensor.

To restore from a backup:

1 **Navigate to the Maintenance panel.**

2 **Click the Restore Sensor... button.**

3 **When prompted, select a backup file to restore.**
The backup file will be 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 **Navigate to the Maintenance panel.**

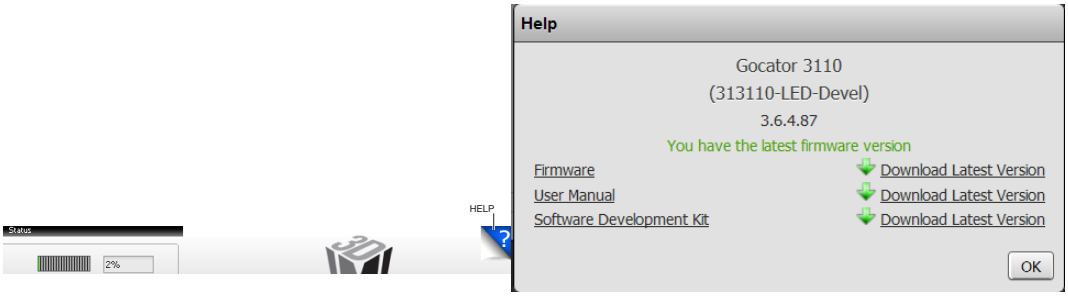
2 **Consider making a backup.**
Restoring factory defaults cannot be undone. It is recommended to make a backup before proceeding.

3 **Click the Restore to Factory button.**

4 **Reset the sensor.**
After restoring factory defaults, it is necessary to reset the sensor before the changes will take effect. Use the Reset Sensor button or cycle the power to affect a reset.

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 **Click on the Help Link.**
Ensure that the client computer is connected to the Internet.

2 **Determine if an update is required.**
The Help panel will check the LMI website to determine if the sensor's firmware is up to date.

3 **Download the latest firmware.**
If sensor firmware is not up to date, click the Firmware Link to visit the LMI website and then download the latest firmware.

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 the LMI Technologies website: *http://www.lmi3D.com/support/downloads*

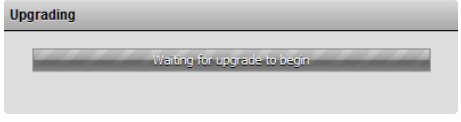
To upgrade the firmware

1 **Navigate to the Maintenance panel.**

2 **Click the Update Firmware button.**

3 **Provide the location of the firmware file in the File dialog.**

4 **Wait for the upgrade to complete.**
After the firmware upgrade is complete, the sensor will self-reset.

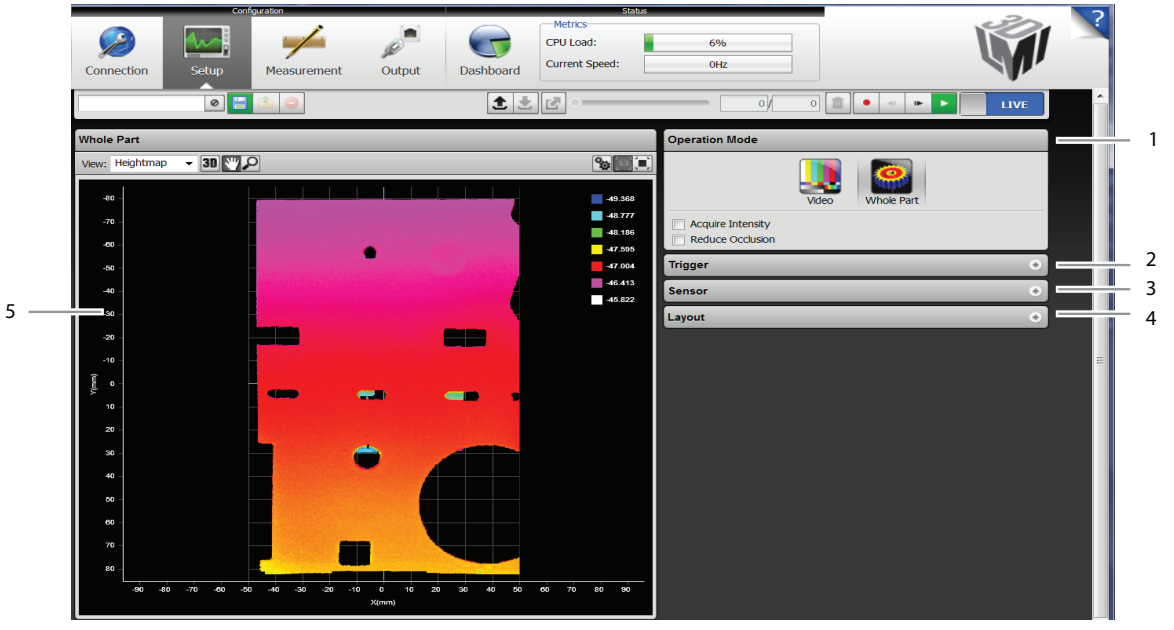


Setup and Calibration

This section describes the steps to configure Gocator sensors for 3D data acquisition using the Setup Page. Setup and calibration steps should be performed before programming measurements or outputs.

Calibration in the user interface and in this manual refers to aligning a sensor to system coordinates.

Setup Page Overview



	Element	Description
1	Operation Mode Panel	Use the Operation Mode panel to set the current operation mode (Video or Whole Part) and other options (page 49).
2	Trigger Panel	Use the Trigger panel to specify the trigger source and trigger-related settings (page 50).
3	Sensor Panel	Use the Sensor panel to specify sensor-specific settings, such as active area or exposure (page 52).
4	Layout Panel	Use the Layout panel to perform alignment calibration (page 61).
5	Data Viewer	Use the Data Viewer to display sensor data and adjust regions of interest. Depending on the current operation mode, the data viewer can display video images or part views (page 63).

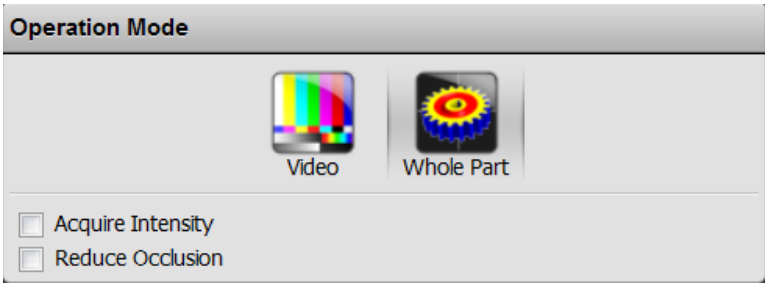
The following table provides quick references for specific goals that users could achieve from the panels in the Setup page.

	Goal	References
1	Select a trigger source that is appropriate for the application.	Trigger Panel (page 50)
2	Ensure that camera exposure is appropriate for 3D data acquisition.	Exposure (page 55)

	Goal	References
3	Find the right balance between data quality, speed, and CPU utilization.	Active Area (page 52) Exposure (page 55) Resolution (page 57)
4	Calibrate the system so that 3D data can be aligned to a reference plane.	Calibration (page 129)

Operation Mode Panel

The Gocator web interface supports two *operation modes*: Video and Whole Part. The operation mode can be selected in the Operation Mode panel.



Mode and Option	Description
Video	Outputs raw video images from the Gocator. This mode is useful for configuring exposure time and troubleshooting stray light or ambient light problems.
Whole Part	Outputs 3D point clouds with each snapshot and performs part measurements. The parts are processed internally to produce measurements. "Whole Part" is often referred to as "Part" in the Gocator web interface and in this document. The 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 configured with the X/Y Resolution setting in the Sensor panel (see page 52).
Acquire Intensity	When this option is enabled, an 8-bit intensity value representing the amount of light reflected by an object will be produced for each point in the 3D point cloud.
Reduce Occlusion	When this option is enabled (default), each camera independently triangulates off the LED light pattern, which may improve performance on targets with complicated shapes that can cause occlusions. When this option is disabled, 3D data is acquired through 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. Stereo acquisition may produce more stable measurements on simple targets without occlusions

Trigger Panel

A trigger is an event that causes a sensor to take a single 3D snapshot. When a trigger is processed, the LED light pattern is strobed and the two 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 Triggering 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 light and camera inside a Gocator 3100 series sensor can be triggered by one of the following sources:

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 can be used to check for this condition. Refer to Digital Inputs (page 241) for more information on connecting external input to Gocator.
Software	A network command can be used to send a software trigger. Refer to Gocator Protocol (page 167) for more information.

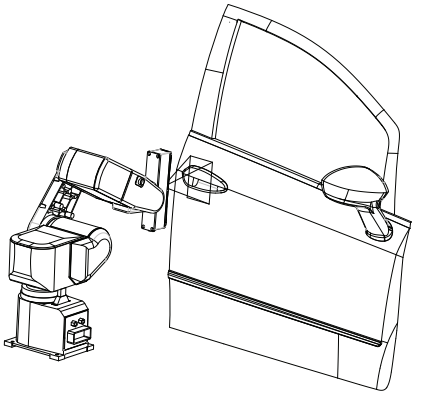
Depending on the setup and measurement tools used, the CPU utilization may exceed 100%, which reduces the overall acquisition speed. Refer to If the Clear Calibration button is pressed, the calibration will be erased and the sensor will revert to using Sensor Coordinates. (page 63) for the estimated acquisition speeds under different settings.

Examples

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 employ external software to orchestrate the activities of system components.

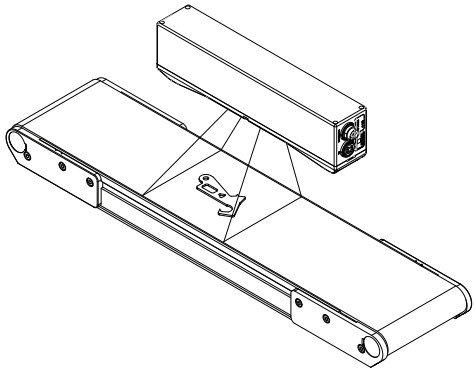


Example: External Input + Conveyor

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

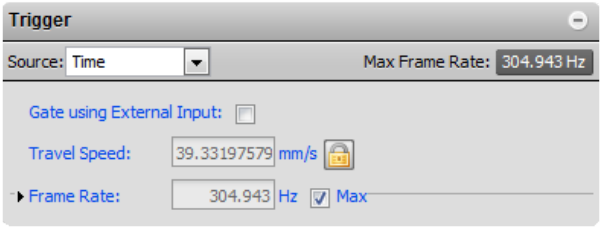
For example, a photocell can be connected as an External Input to generate a trigger pulse when a target object has moved into position.

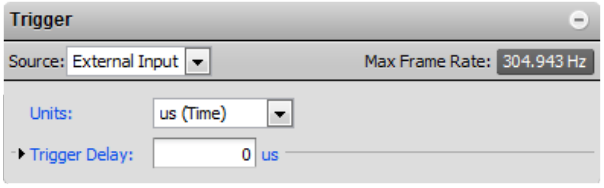
Note that the conveyor must be stationary for the duration of camera exposure.

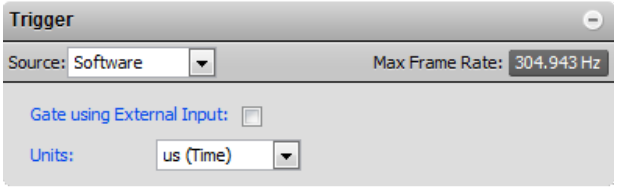


Settings

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







After specifying a trigger source, the Trigger Panel will show the parameters that can be configured.

Parameters	Trigger Source	Description
Trigger	All	Selects the trigger source (Time, External Input, or Software).
Max Frame Rate	All	Reports the maximum frame rate, which is a function of the current Active Area, Exposure, and Resolution settings.
Frame Rate	Time	The Frame Rate setting can be used to control the frame rate. Select the Max check box 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 using External Input	Time	External input can be used to enable or disable profiling in a sensor. When this option is enabled, the sensor will respond to time triggers only when the external input is asserted. Refer to Digital Inputs (page 241) for more information on connecting external input to a Gocator senor.
Units	External Input, Software	Units specifies whether the trigger delay, output delay and output scheduled command operates in the time domain. The unit is implicitly set to microseconds with Time trigger source.
Trigger Delay	External Input	Trigger delay can be used to control the time or spacing the sensor waits before 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 the single exposure mode (page 55).

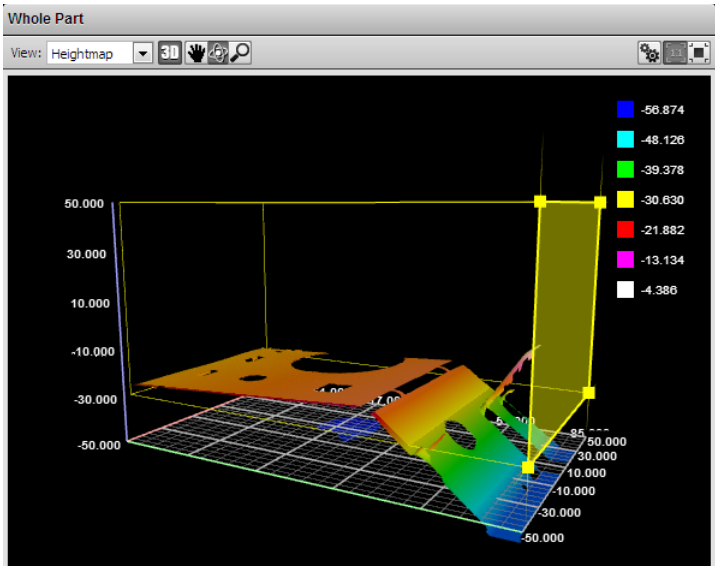
Sensor Panel

Active Area

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

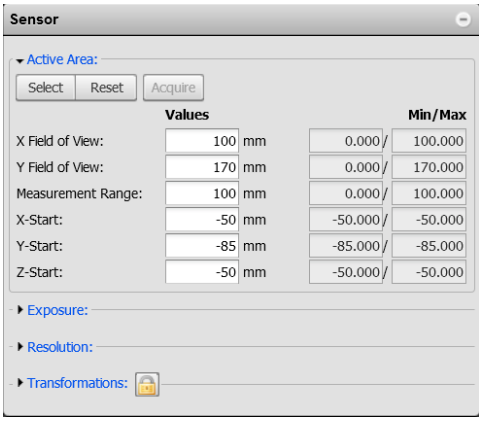
By default, the active area covers the sensor's entire field of view. By reducing the active area, the sensor can operate at higher speeds.

When the active area is being configured, the data viewer displays the 3D data in sensor coordinates, rather than in system coordinates. As a result, if the sensor is already alignment calibrated, press the Acquire button to display uncalibrated data before configuring the active area. Refer to Coordinate Systems (page 29) for more information on sensor and system coordinates.



To set the active area:

1 **Navigate to the Sensor panel.**
Click the arrow next to Active Area to expand the panel.



2 **Click the Select button.**

3 **Define the active area.**
Enter the active area in the edit box or adjust it graphically in the data viewer. The 2D view allows adjusting the sizes and positions in the x-axis and y-axis. The 3D view allows adjusting the sizes and positions in the x-axis, y-axis, and z-axis. See Region Definition (page 66) for details.

4 **Click the Acquire button to see a scan while setting up the active area.**

5 **Click the Save button.**

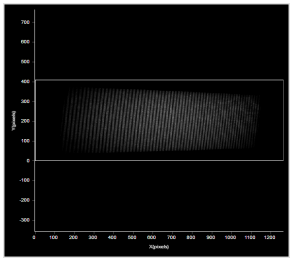
3D acquisition devices are usually more accurate at the near end of the measurement range. If your application requires a measurement range that is small relative to the maximum measurement range of the sensor, mount the sensor such that the active area can be specified at the near end of the measurement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

Exposure

Exposure determines the duration of camera and light on-time. Longer exposures can be helpful to measure on dark or distant surfaces, but increasing exposure time decreases the maximum speed. Different target surfaces could 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 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 3D point cloud. Used when the target surface has a varying reflectance within a single snapshot (e.g. white and black color).

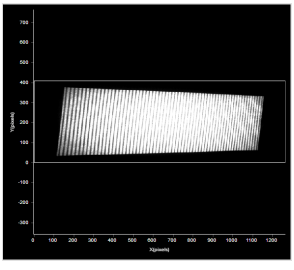
Video mode enables you to see how the reflected light appears on the camera and to identify any stray light or ambient light problems. When exposure is tuned correctly, the light pattern should be clearly visible across the entire image. If it is too dim, increase the exposure value; if it is too bright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



Under exposure

Light pattern is not fully detected.

Increase the exposure value.



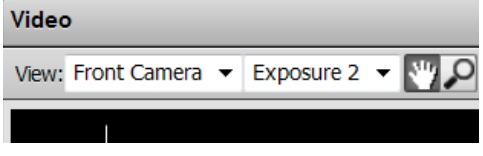
Over exposure

Light pattern is saturated in the center.

Decrease the exposure value.

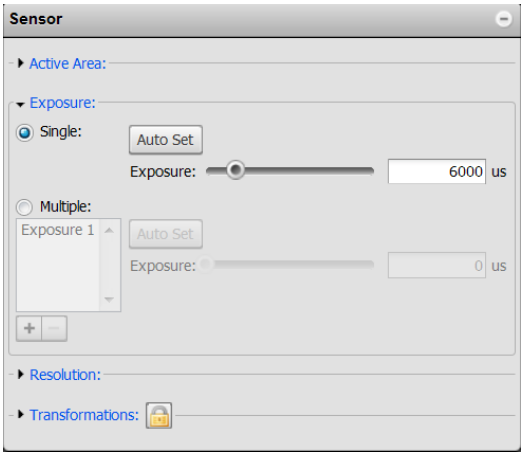
The exposure value is defined as the exposure time for each pattern. Each scan requires multiple patterns to be projected to the screen.

When operating using 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 operation 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.



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 **Select Whole Part mode.**

3 **Navigate to the Sensor panel.**
Click the arrow next to Exposure to expand the panel.

4 **Select Single.**

5 **Edit the Exposure setting.**
The auto-set function can be used to automatically tune the exposure. Press the Auto Set button and the sensor will turn on and automatically tune the exposure time.

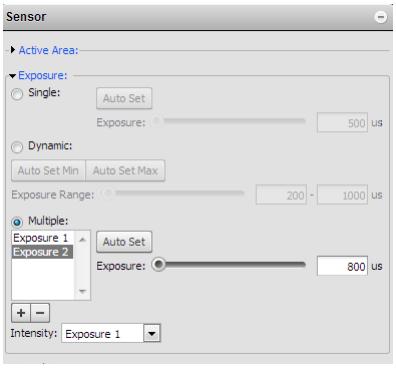
6 **Run the sensor and check that 3D data acquisition is satisfactory.**
If not satisfactory, adjust the exposure values manually. Switch to Video mode to use video to help tune the exposure (page 55).

Multiple Exposures

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 combing data collected with different exposures.



To enable multiple exposures:

1 **Select Whole Part mode.**

2 **Navigate to the Sensor panel.**
Click the arrow next to Exposure to expand the panel.

3 **Select Multiple.**

4 **Press the + button to add an exposure step.**
Up to a maximum of five exposure settings can be added.

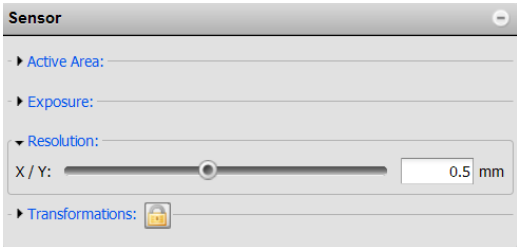
5 **Set the exposure level to make the Gocator less or more sensitive (as required).**
The auto-set function can be used to automatically set the exposure. To use the auto-set function, place target material in the field of view then select an exposure step and press the Auto Set button. Repeat this procedure for each exposure step.

6 **Select the exposure step used for intensity output**
If intensity acquisiton is enabled, select the exposure step that is used to capture the intensity output.

7 **Run the sensor and check that 3D data acquisition is satisfactory.**
If not satisfactory, adjust the exposure values. Switch to Video mode to help tune the exposure (page 55).

Resolution

Resolution refers to the density of the 3D data point cloud. Reducing the resolution improves performance by increasing speed or reducing CPU utilization while maintaining the sensor's field of view.



The X/Y Resolution setting can be used to decrease the x- and y-resolution in order to improve performance.

The CPU Load bar at the top of the interface displays how much of the CPU is being utilized.

To configure X/Y Resolution:

1 **Navigate to the Sensor panel.**
Click the arrow next to Resolution to expand the panel.

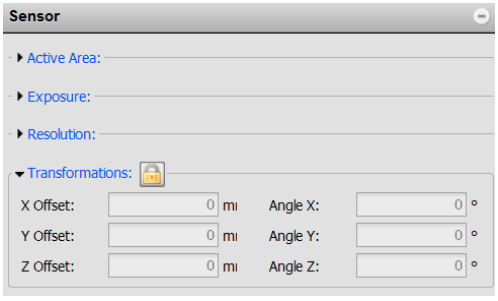
2 **Select a resolution value.**
The X/Y resolution value is expressed millimeters.

3 **Check that 3D data acquisition is satisfactory.**
After adjusting the resolution, confirm that 3D data acquisition characteristics are satisfactory.

Transformations

The transformation settings are used to control how ranges are converted from sensor coordinates to system coordinates.

The system coordinate transformation is normally set through the Gocator's automatic calibration procedure (page 129) and are locked by default. However, if the user needs to manually adjust the transformation the settings are available in this section.



Element	Description
X Offset	Specifies the shift along the x-axis. With Normal orientation, a positive value shifts the profiles to the right. With Reverse orientation, a positive value shifts the profile to the left.
Y Offset	Specifies the shift along the x-axis.
Z Offset	Specifies the shift along the z-axis. A positive value shifts the profiles towards 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, angles are applied before offsets: the object is first rotated around X, then Y, and then Z .

To configure transformation settings:

1 **Select Whole Part mode.**

2 **Navigate to the Sensor panel.**
Click the arrow next to Transformation to expand the panel.

3 **Click the unlock button to make the fields editable.**

4 **Set the parameter values.**

5 **Check that the transformation settings are applied correctly after 3D acquisition is restarted.**

Layout Panel

Calibration

Although Gocator sensors are pre-calibrated and ready to deliver 3D data in engineering units (mm) out of the box, calibration procedures are required to compensate for sensor mounting inaccuracies.

Gocator 3100 series sensors support alignment calibration. Once calibration has been completed, the derived transformation values will be displayed under Transformations (see page 59).

Calibration States

A Gocator can be in one of three calibration states: None, Manual, or Auto.

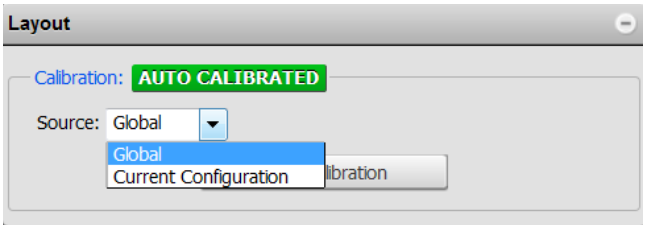
Calibration States

State	Explanation
None	Sensor has no calibration. Ranges are reported in default sensor coordinates.
Manual	User has manually edited transformations.
Auto	Sensor is calibrated using alignment calibration.

An indicator on the Calibration panel will display CALIBRATED, MANUALLY CALIBRATED or NOT CALIBRATED.

Transformation Sources

Gocator sensors support two types of transformation sources: Global or Current Configuration. The choice for the transformation source depends on how the sensor will be used.



You can switch between these transformation sources at any time.

Source	Description
Global	A single global transformation is applied to the 3D data that is acquired, regardless of what configuration is currently loaded on the sensor. The global transformation is saved on the sensor in a separate hidden file and is retained when the sensor is reset or powered off. Global transformation is typically used when the sensor mounting is constant over time and between scans, e.g. when the sensor is mounted in a permanent position over a conveyor belt.
Current Configuration	The transformation is associated with the current configuration. The transformation is saved with the same file name as the current configuration (but with a different extension). The transformation is accessible to the user through the File Manager (see page 44). When a configuration is loaded on the sensor, the transformation is automatically loaded together with it. Current Configuration is typically used when the sensor's position relative to the object scanned is always changing, e.g. when the sensor is mounted on a robot arm moving to different scanning locations.

Alignment Calibration

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

To perform alignment calibration:

1 **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 calibration.

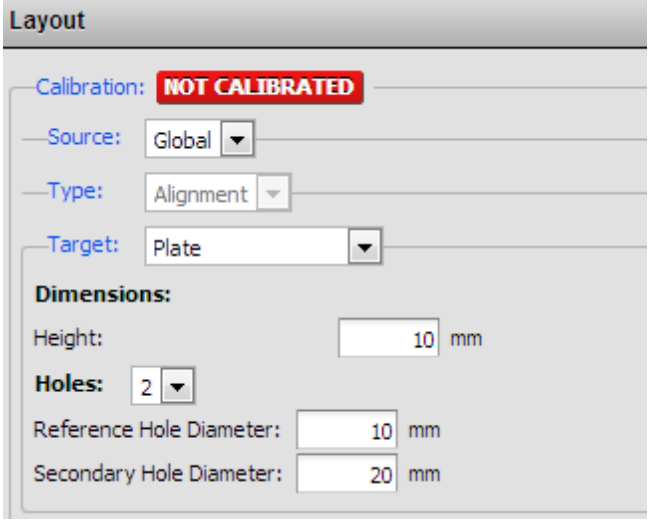
2 **Navigate to the Layout panel and select Global or Current Configuration as the Source.**
Click the arrow button next to Calibration to expand the panel.

3 **Select Alignment Calibration as the Type.**
Click the arrow button next to Calibration to expand the panel.

4 **Clear the previous calibration if present.**
Press the Clear Calibration button to remove the existing calibration.

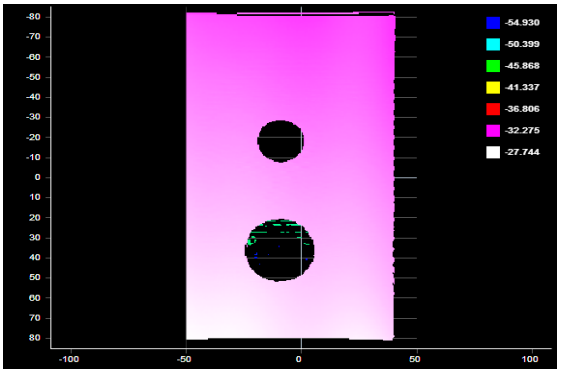
5 **The calibration target.**

Configure the characteristics of the target.

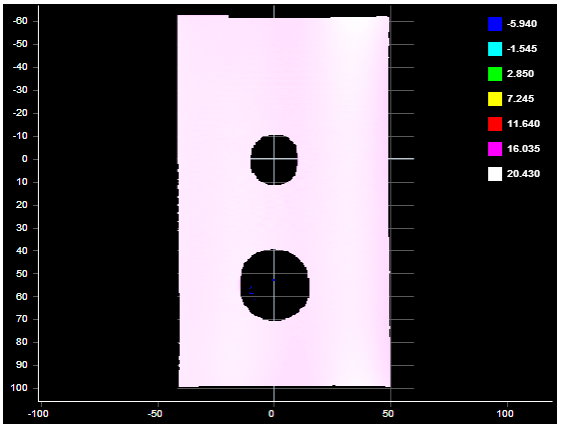


6 **Place the target under the sensor.**

7 **Press Calibrate**

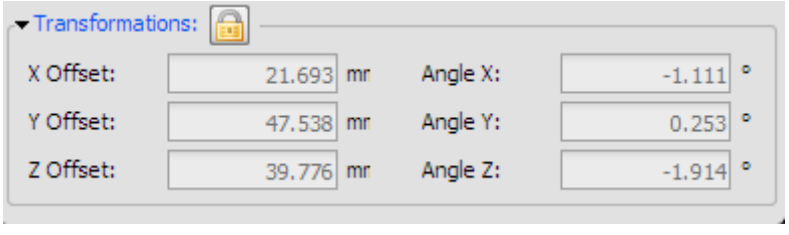


Before calibration



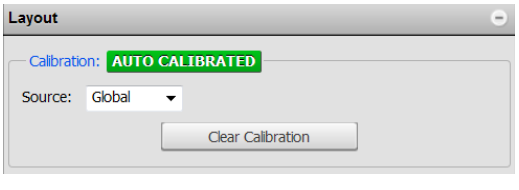
After calibration

8 Check the calibration results in the Transformation field in the Sensor panel.



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

Clearing Calibration



To clear calibration:

1 **Navigate to the Calibration panel on the Setup page.**

2 **Select whether to clear the Global or the Current Configuration transformation source.**

3 **Click the Calibration or Clear Calibration button.**
If the Clear Calibration button is pressed, the calibration will be erased and the sensor will revert to using Sensor Coordinates.

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.

When the Setup page is active, the data viewer can also be used to graphically define the active area parameter (page 52) located in the Sensor panel.

Video Mode

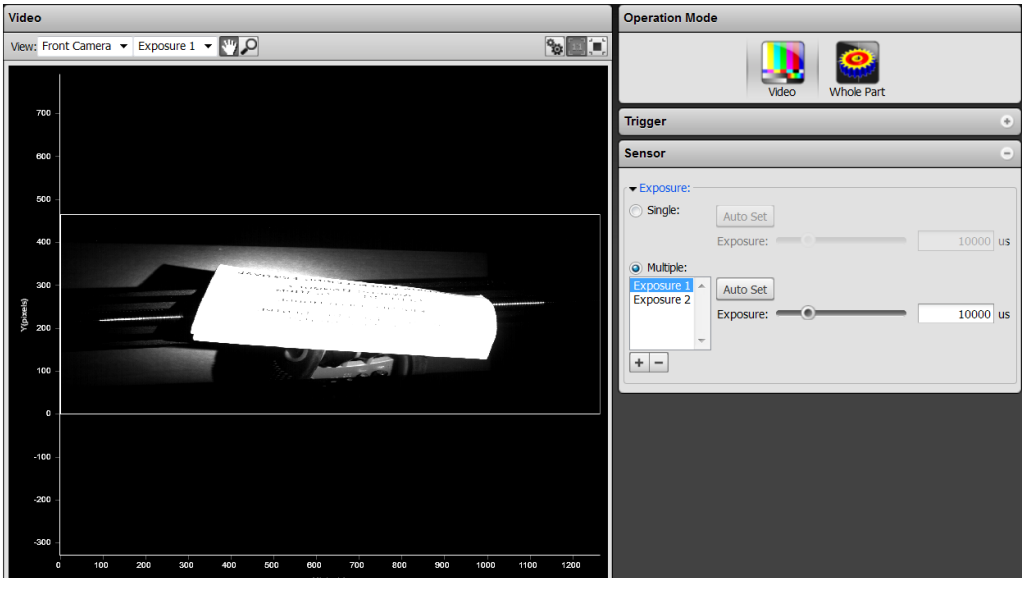
In Video operation mode, the Data Viewer can display the camera image from either of the two cameras in the sensor.

Exposure Mode View

Exposure can be set to either Multiple or Single. For details on setting exposure, see page 55.

If the Multiple option is selected in the Exposure field in the Sensor panel, a second drop-down is displayed at the top of the Data Viewer. This drop-down lists the exposures that have been added. Choosing an exposure changes the view of the Data Viewer to that exposure.

If the Single option is selected in the Exposure field section, the exposure drop-down will not be shown and only one exposure will be displayed.



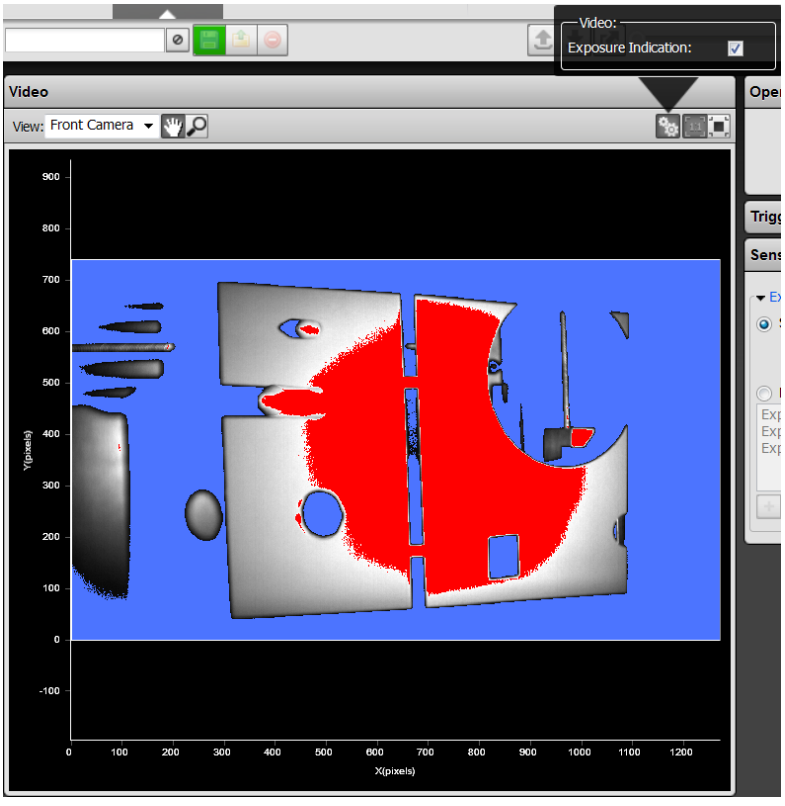
To select the view of the display:

1 **Navigate to the Setup Page.**

2 **Select the camera view.**
Select Front Camera or Back Camera from the first drop-down list next to "View" at the top of the Data Viewer.

3 **Select the exposure.**
Select the exposure from the second drop-down list next to "View" at the top of the Data Viewer. This drop-down is only be visible if the Multiple option is selected.

To display a color exposure overlay on the video image to help set the correct exposure, enable Exposure Indication at the top of the Data Viewer.



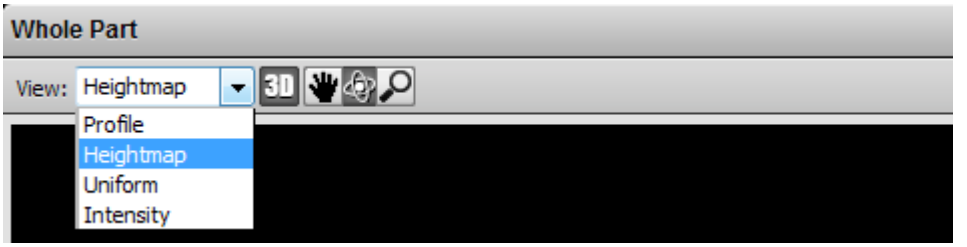
Exposure Indication uses the following colors:

- 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.

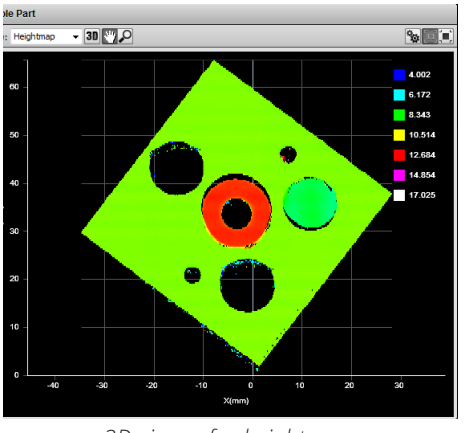
Whole Part Mode

In Whole Part operation mode, the Data Viewer can display height maps and intensity images of the detected objects. Users select the data to display from the View option.

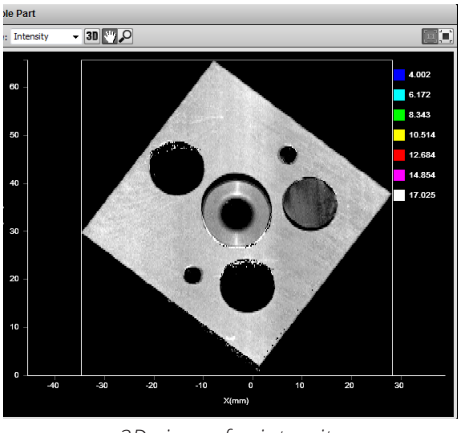


Users can click on the 3D button to view Whole Part data in the 3D viewer. The 3D model is overlaid with the information that corresponds to the selected View option.

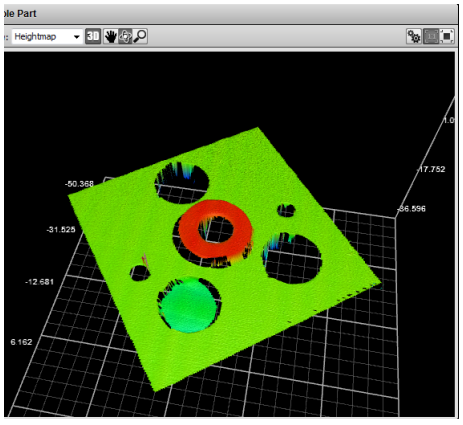
View Option	Information
Heightmap	In 2D view, displays the pseudo color height map. In 3D view, overlays the 2D pseudo color height map on the 3D model.
Uniform	Overlays a uniform shaded surface on the 3D model. (Only available in 3D view.)
Intensity	In 2D view, displays the intensity. In 3D view, overlays the intensity map on the 3D model. (Note: Acquire Intensity must be checked in the Operation Mode panel.)



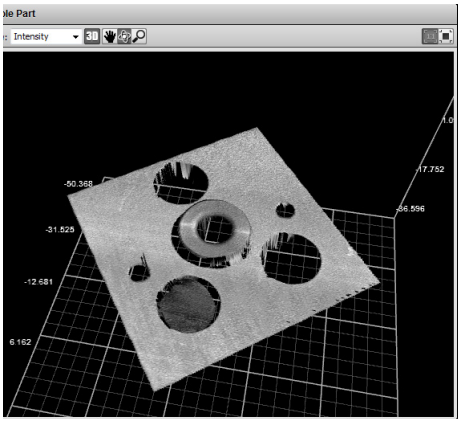
2D viewer for height map



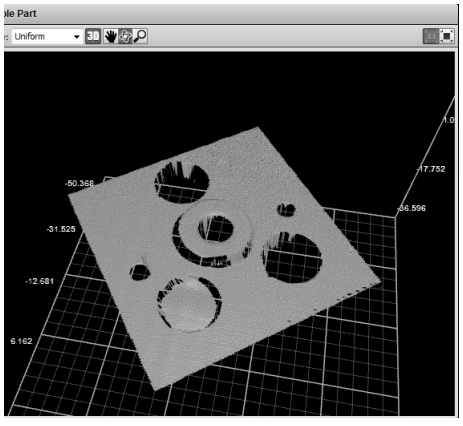
2D viewer for intensity



3D viewer with heightmap overlay



3D viewer with intensity overlay



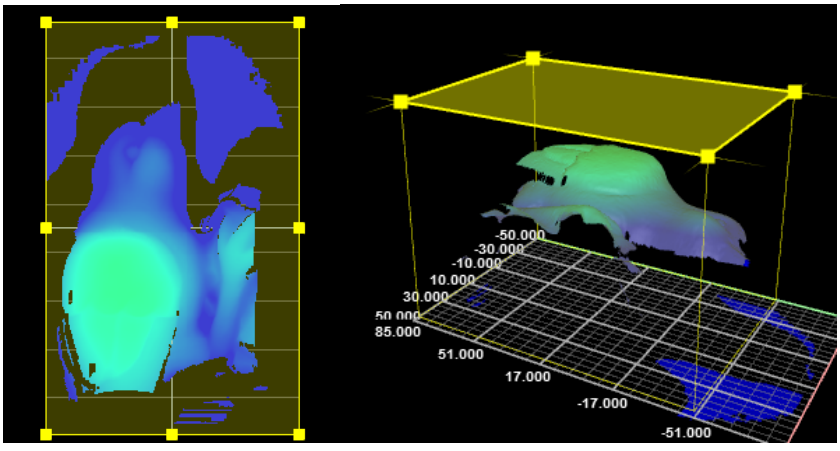
3D data viewer with uniform overlay

Users can toggle between 2D and 3D viewer by clicking on the 3D button. Refer to Data Viewer Controls (page 67) for explanations on the available controls.

Region Definition

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

When the Setup 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 (page 52).



To set up a region of interest:

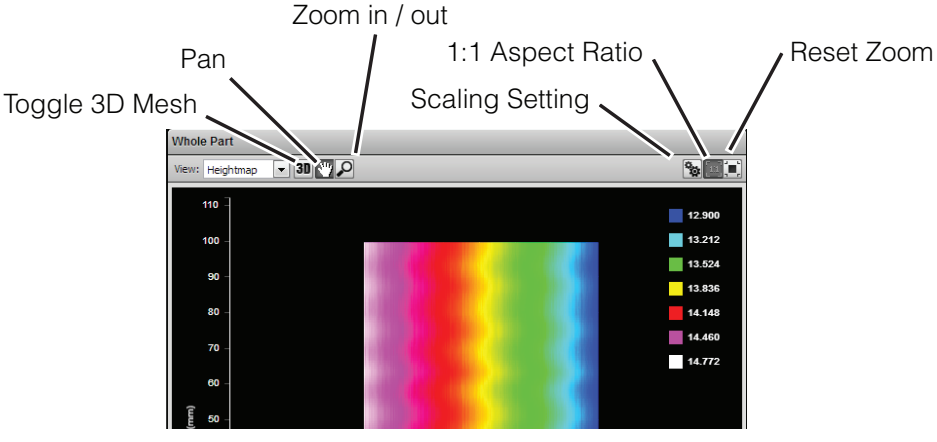
1 **Move the mouse cursor to the rectangle. In the 3D viewer, the user must first select which side of the 3D rectangle to adjust by clicking on it.**
The rectangle is automatically displayed when a setup or measurement requires an area to be specified.

2 **Drag the rectangle to move it, and use the handles on the rectangle's border to resize it.**

Data Viewer Controls

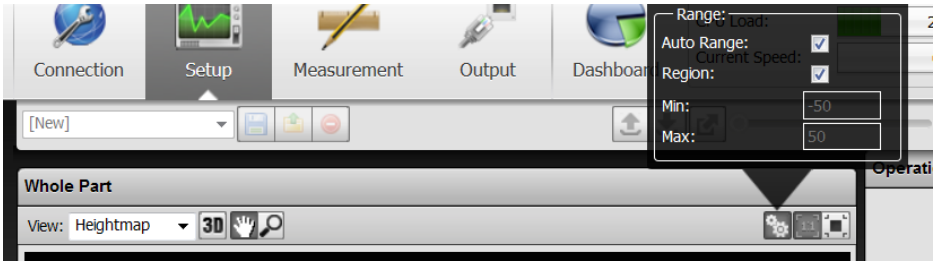
The data viewer is controlled by mouse clicks and by the buttons on the display toolbar. The mouse wheel can be also be used for zooming in and out.

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



Height Map Color Scale

Heightmaps are displayed in pseudo-color; the height (Z) axis is color coded. The scaling of the colors to the height values can be adjusted.



To change the scaling of the height map:

1 Select Heightmap from the drop-down.

2 Click the Scaling button.

Range options

» To automatically set the scale, check the Auto Range checkbox in the range scaling dialog box that is displayed.

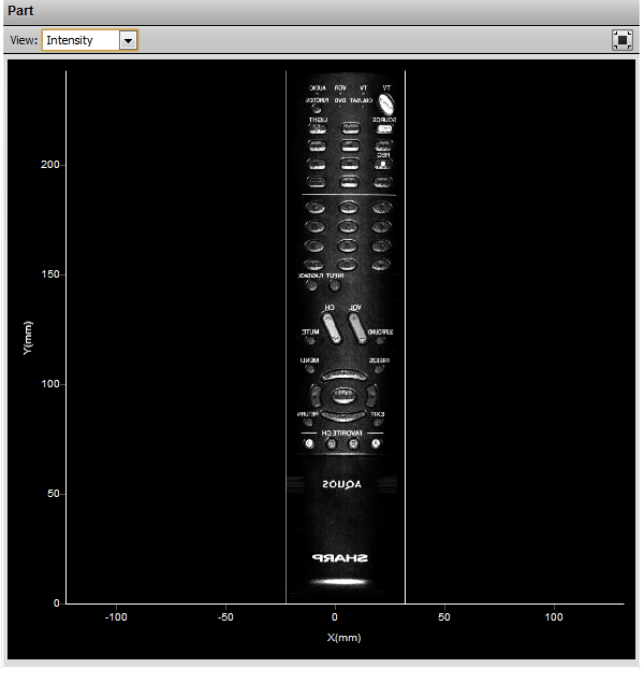
» To manually set the scale, uncheck the Auto Range checkbox, and then enter the minimum and maximum height to which the colors will be mapped.

Sub-region options

» To auto-scale the color scale based on a user-selected sub-region of the heightmap, check the Region option and adjust the yellow region box in the data viewer to the desired location and size.

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.

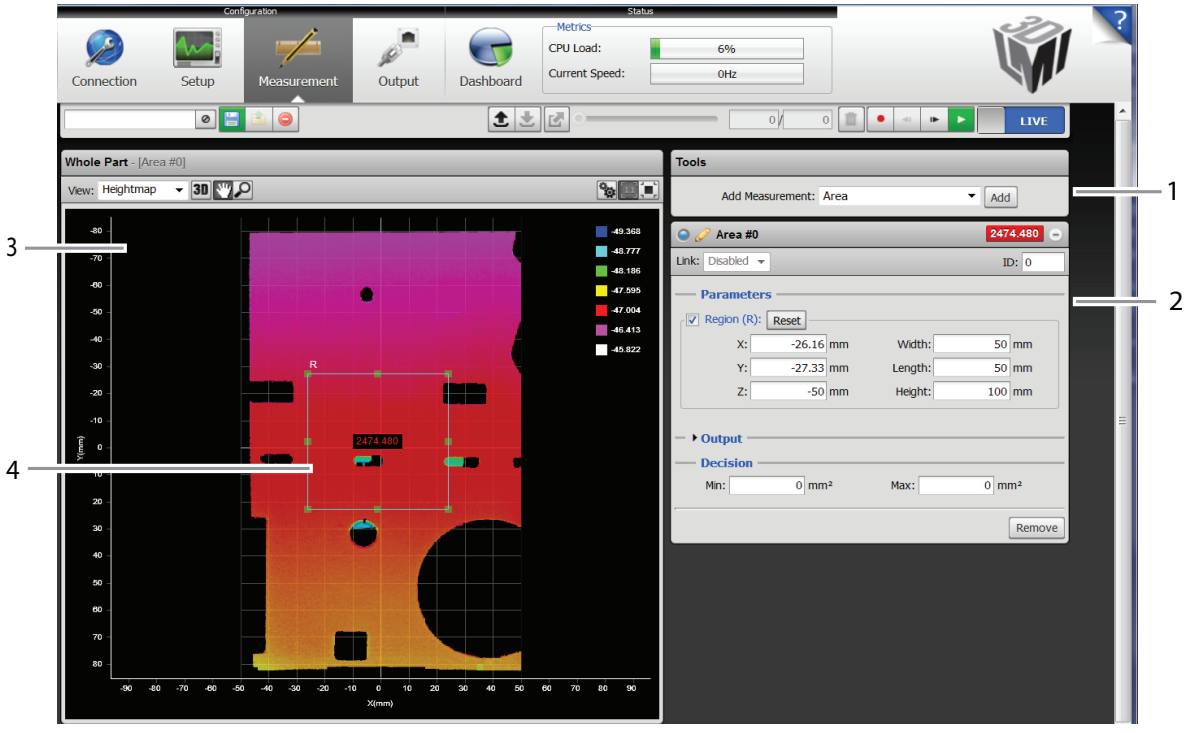


Measurement

Measurement Page Overview

Measurement tools are configured using the Measurement page.

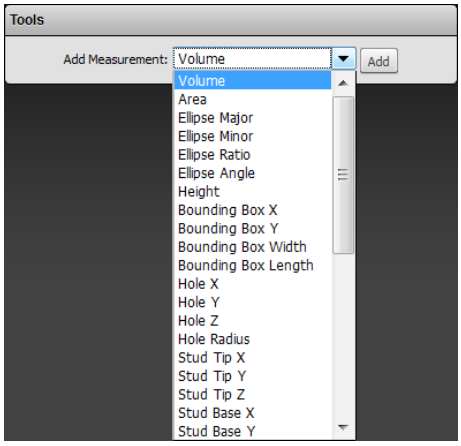
The content of the Measurement Page is controlled by the current operation mode. In Whole Part mode, the Measurement page displays tools for part measurement. The Measurement page is disabled in Video mode.



	Element	Description
1	Tools Panel	Use the Tools panel to add new measurements.
2	Measurement Panel	For each measurement that is added, a configuration area will appear below the Measurements panel. Use this area to adjust settings for the measurement.
3	Data Viewer	Displays 3D point cloud data or part 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.
4	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.

Tools Panel

Adding and Removing Measurements



To add a measurement:

1 **Select the desired measurement type.**
Click on the item in the drop-down list next to Add Measurements to select the measurement type.

2 **Press the Add button.**
A configuration panel for the new measurement will be added to the bottom of the stack.

To remove a measurement:

1 **Select the desired measurement.**
Click on the title bar of the measurement to select it.

2 **Click the Remove button.**
The measurement will be removed from the list of measurements.

If the Add Measurement list contains only the *Distance* measurement, then the sensor is not equipped with profile tools. The Distance measurement is provided in all sensors to demonstrate the measurement capability.

Data Viewer

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

When the Measurement page is active, the data viewer can be used to graphically configure measurement regions. Measurement regions can also be configured manually in measurements by entering values into the provided fields (see page 74).

For instructions on how to set up measurement regions graphically, see page 66.

Measurement Management

Changing the Measurement Name

Each measurement can be assigned a unique name. This allows multiple measurements of the same type to be distinguished in the web interface. The name is also referenced by the Script tool.

To change a measurement name:

1 **Click on the measurement name.**

2 **Enter a new name.**

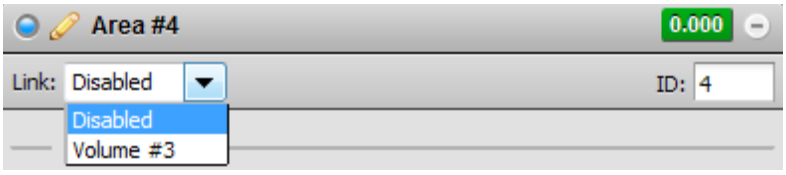
3 **Press the Tab key.**
The name change will be completed when you press the Tab Key or click outside of the name edit field.

Measurement Tool Linking

Tool linking can be used to reduce CPU load when running multiple tools of the same type group, using the same tool settings. For example, a Hole X tool can be linked with a Hole Radius tool, but not with a Position X tool.

The following tools support linking within each type group:

- Volume and Area
- Ellipse Major, Ellipse Minor, Ellipse Ratio, and Ellipse Angle
- Bounding Box X, Bounding Box Y, Bounding Box Width, and Bounding Box Height
- Hole X, Hole Y, Hole Z, and Hole Radius
- Stud Tip X, Stud Tip Y, Stud Tip Z, Stud Base X, Stud Base Y, Stud Base Z, and Stud Radius
- Opening X, Opening Y, Opening Z, Opening Width, Opening Length, and Opening Angle
- Plane Angle X, Plane Angle Y, and Plane Offset Z
- Position X, Position Y, and Position Z
- Texture Roughness and Texture Invalid Count



To link measurement tools:

1 **Add two or more measurement tools of the same type.**

2 **Configure settings in one tool.**
This tool is considered the "master" tool, whose settings will be used by the other linked tools.

3 **In the Link drop-down list, select the master tool.**
This will cause the tool to use all settings of the master tool and the CPU will only be loaded with one instance of the tool.

Repeat this step for any other tools you wish to link to the master tool.

Measurement ID

Measurement ID is used to uniquely identify a measurement in the Gocator protocol or in the SDK. The value must be unique amongst all profile and part measurements.

To edit a measurement ID:

1 **Select a measurement.**
Click on the + in a measurement panel to expand the panel.

2 **Click on the measurement ID.**

3 **Enter a new number.**
The value must be unique amongst all measurements in Profile and Part Mode.

4 **Press the Tab key.**
The name change will be completed when you press the Tab Key or click outside of the measurement ID edit field.

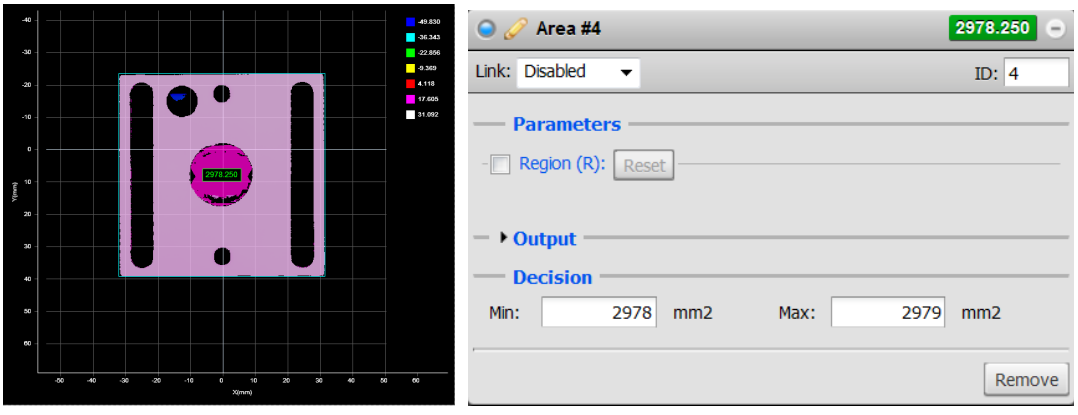
Common Measurement Parameters

All measurements provide the following parameters: Decision, Region, and Output. (See below.)

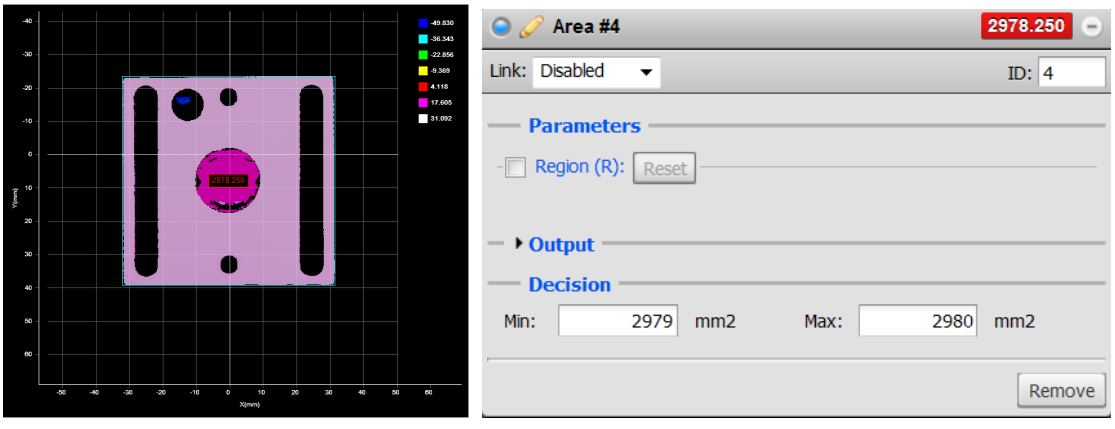
Many measurements also have tool-specific parameters or measurement-specific parameters. See the individual tools and measurements (page 76).

Decisions

Results from a measurement tool can be compared against minimum and maximum thresholds to generate *pass / fail decisions*. The decision state is pass (value displayed in green) if a measurement value is between the minimum and maximum threshold, otherwise the decision state is *fail* (value displayed in red).



Value (50.380) is within the decision thresholds (Min: 80, Max:100). Decision: Pass



Value (102.928) is outside the decision thresholds (Min: 80, Max: 100). Decision: Fail

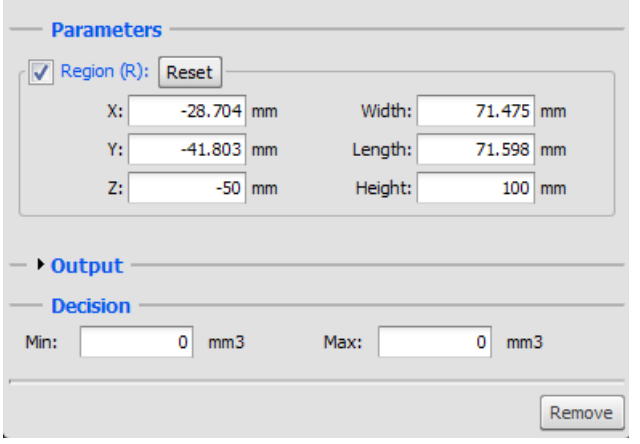
Along with measurement values, decisions can be sent to external programs and devices. In particular, decisions are often used in conjunction with digital outputs to trigger an external event in response to a measurement. Refer to Output (page 113) for more information on transmitting values and decisions.

Regions

The Region parameter is used to limit the region in which a measurement will occur. See the individual tools for details on the best way to use this parameter with each tool.

The parameter can also be configured graphically using the mouse in the data viewer when the Measurement page is active.

Some measurements use more than one region.



This parameter is also referred to as a measurement region.

To configure regions:

1 **Select a measurement.**
Click on the + in a measurement panel to expand it.

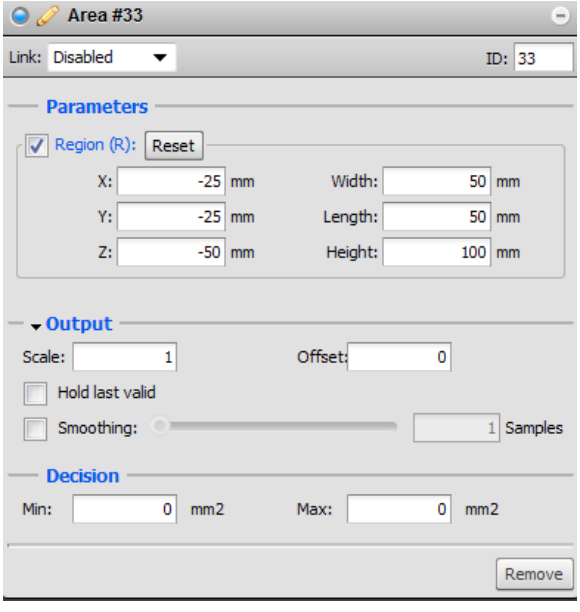
2 **Check the Region checkbox to enable a region.**

3 **Configure the region using the fields.**
You may also configure the region graphically using the mouse in the data viewer.

Output Filters

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

Operation	Description
Scale and Offset	The Scale and Offset settings are applied to the measurement value according to the following formula: Scale*Value + Offset Scale and Offset can be used to transform the output without the need to write a script. For example, to convert the measurement value from millimeters to thousands of an inch, set Scale to 39.37.
Hold Last Valid	Hold the last valid value when the measurement is invalid. Measurement is invalid if there is no valid value.
Smoothing	Apply 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.



To configure the output filters:

1 **Select a measurement.**
Click on the + in a measurement panel to expand it. Click the arrow next to Output to expand the panel.

2 **Enable filters and configure the settings.**

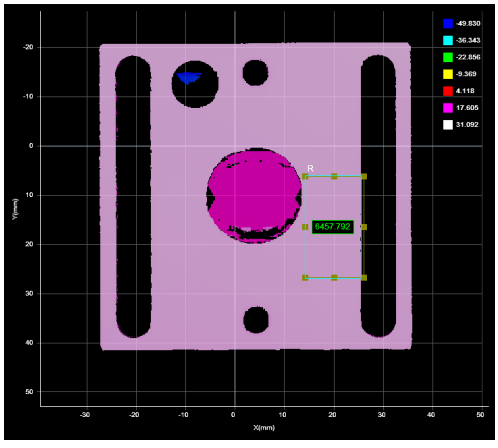
Whole Part Measurement

Whole part measurement involves measuring properties of whole objects. Measurements include the volume of the object or the height at a certain position of the object. All volumetric tools have the ability to either operate on the full object or within a region of interest at a certain position of the object.

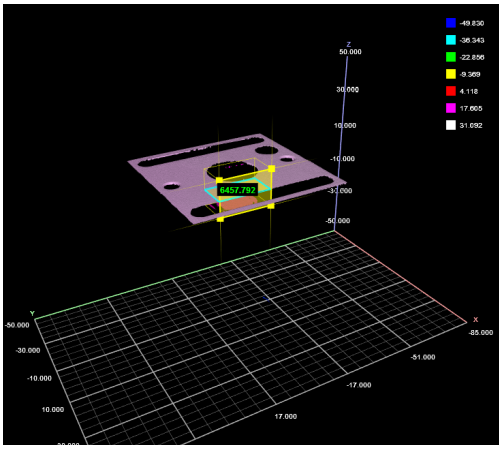
Multiple measurements can be performed on each part, limited only by the available CPU resources. The part measurement tools supported by Gocator sensors are summarized below. Each type is described under Volume (page 77).

Volume

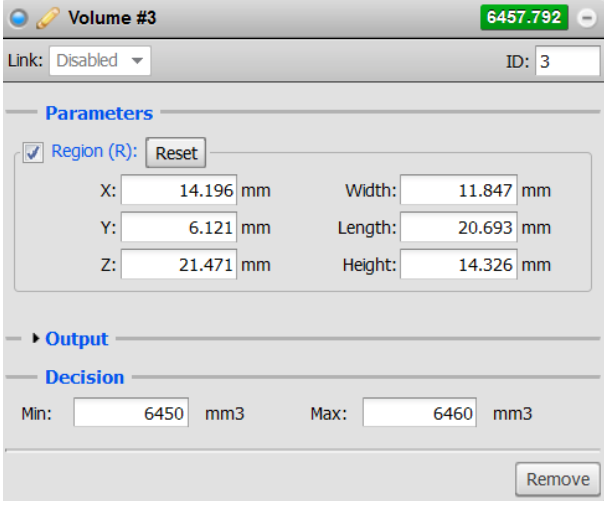
The Volume tool provides the volume of a part. The measurement value can be compared with minimum and maximum constraints to yield a decision. See Adding and Removing Measurements (page 70) for instructions on adding measurements.



2D View

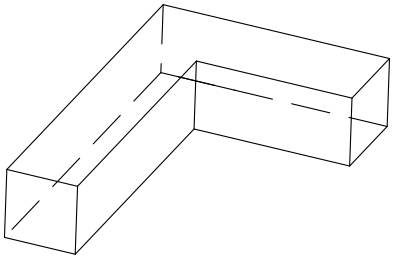


3D View



Measurement Panel

Measurements

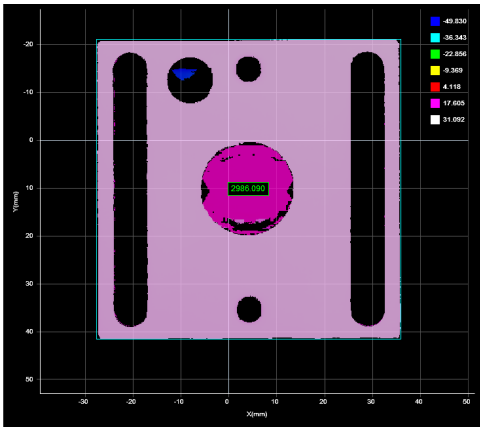
Measurement	Illustration
Volume Measures volume in XYZ space.	

Parameters

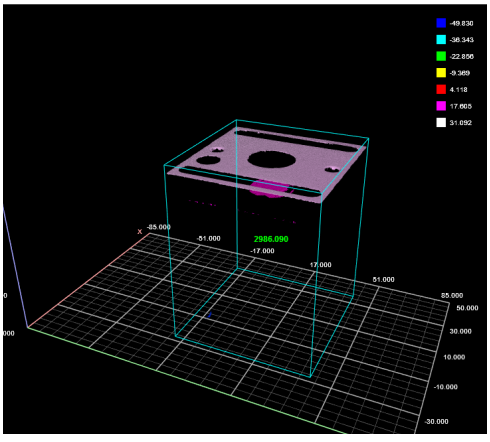
Parameter	Description
Decision	See Decisions (page 73).
Region	See Regions (page 74).
Output	See Output Filters (page 75).

AREA

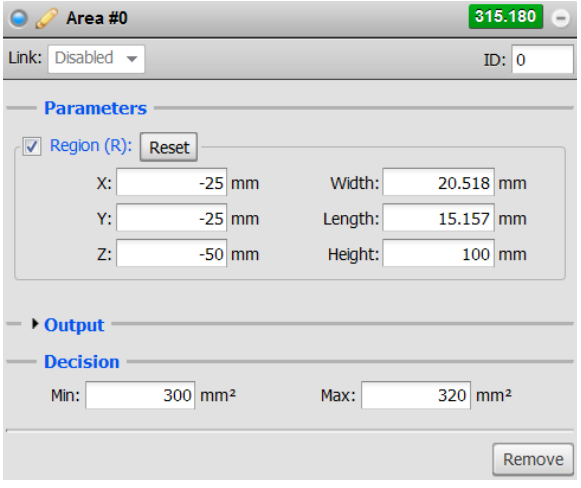
The Area tool provides a measurement of the area of an object's surface. The measurement value can be compared with minimum and maximum constraints to yield a decision. See Adding and Removing Measurements (page 70) for instructions on adding measurements.



2D View

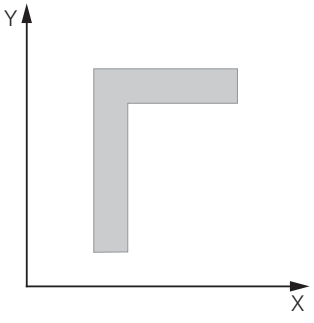


3D View



Measurement Panel

Measurements

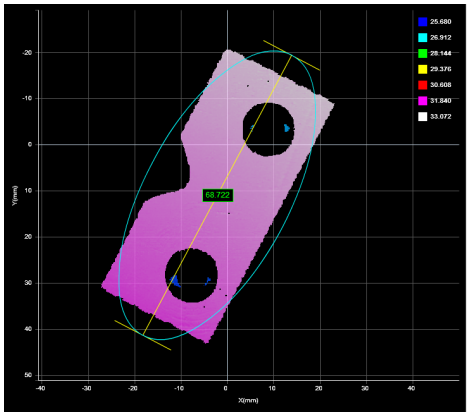
Measurement	Illustration
Area Measures area in the XY plane.	

Parameters

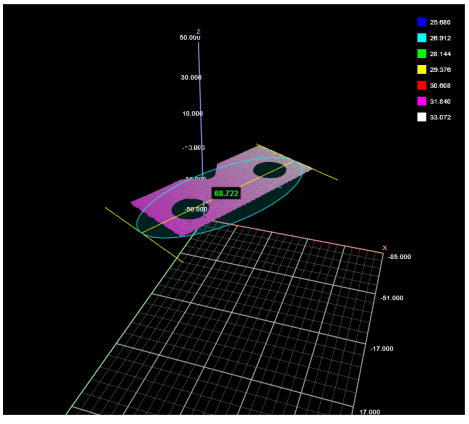
Parameter	Description
Decision	See Decisions (page 73).
Region	See Regions (page 74).
Output	See Output Filters (page 75).

ELLIPSE

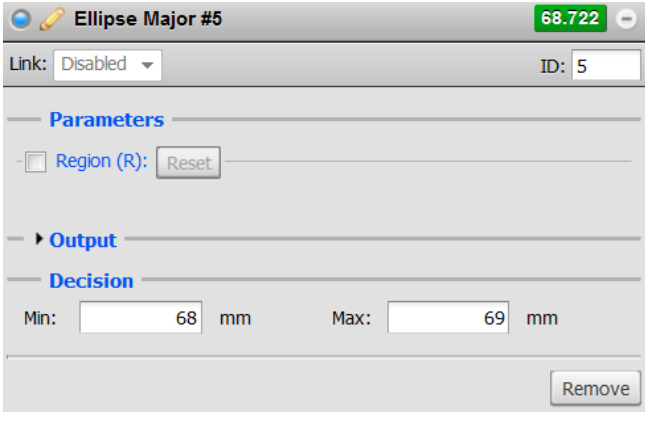
The Ellipse tool provides measurements for the major and minor axis lengths of an ellipse fitted to the part's shape in the XY plane, and also for the ratio of the major and minor axis lengths and for the orientation angle of the ellipse. The measurement values can be compared with minimum and maximum constraints to yield a decision. See Adding and Removing Measurements (page 70) for instructions on adding this measurement.



2D View

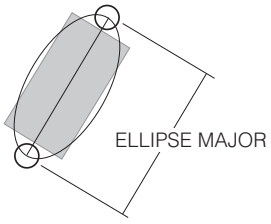


3D View



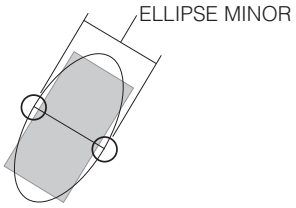
Measurement Panel

Measurements

Measurement	Illustration
Ellipse Major Determines the major axis length of an ellipse fitted to the part's area in the XY plane.	

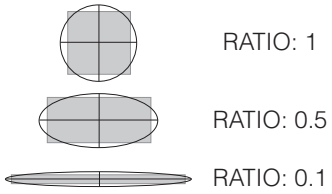
Ellipse Minor

Determines the minor axis length of an ellipse fitted to the part's area in the XY plane.



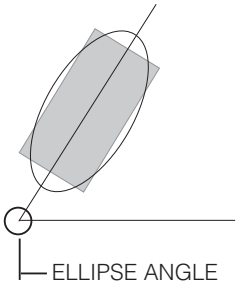
Ellipse Ratio

Determines the minor/major axis ratio of an ellipse fitted to the part's area in the XY plane.



Ellipse Angle

Determines the orientation angle of an ellipse fitted to the part's area in the XY plane.

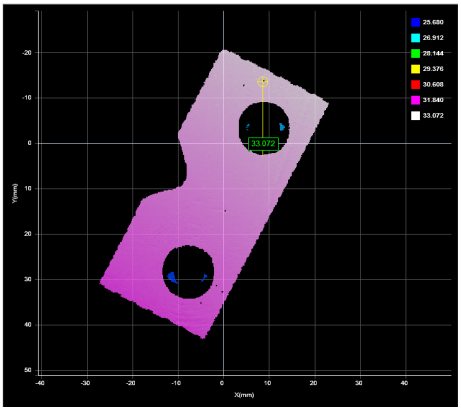


Parameters

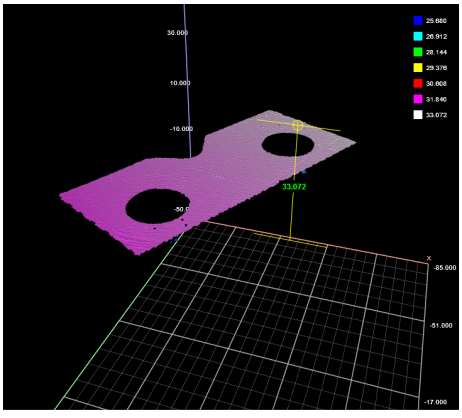
Parameter	Description
Decision	See Decisions (page 73).
Region	See Regions (page 74).
Output	See Output Filters (page 75).

HEIGHT

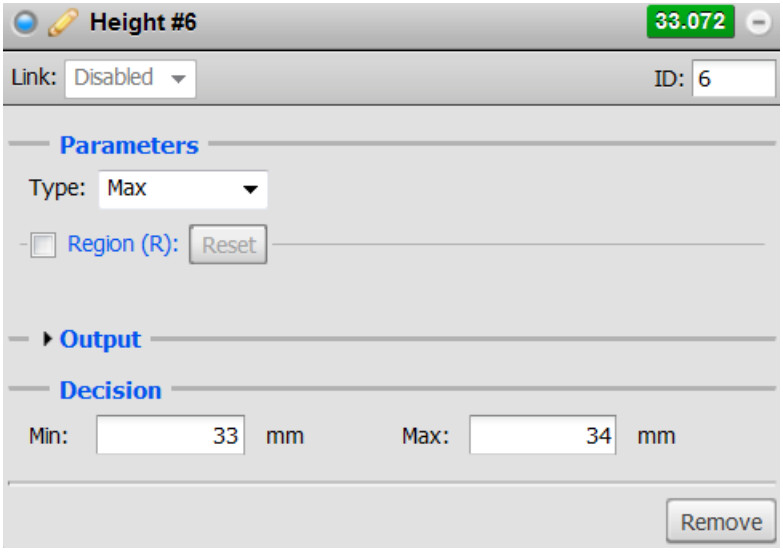
The Height tool provides a height measurement of a part. The measurement value can be compared with minimum and maximum constraints to yield a decision. See Adding and Removing Measurements (page 70) for instructions on adding this measurement.



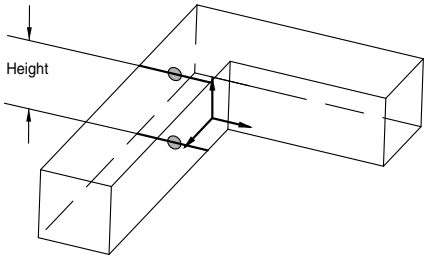
2D View



3D View



Measurements

Measurement	Illustration
Height Determines the height (thickness) of a part.	

Parameters

Parameter	Description
Height Type	The minimum height, maximum height, 2D centroid height, 3D centroid height, median height, and average height can be calculated. A 2D centroid uses part perimeter information to quickly estimate the center of the part in the XY plane. A 3D centroid uses all available data to compute the center of the part in XYZ coordinates.
Decision	See Decisions (page 73).
Region	See Regions (page 74).
Output	See Output Filters (page 75).

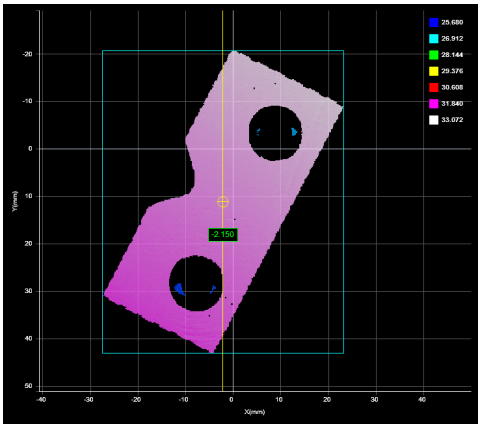
Bounding Box

The Bounding Box tool provides measurements related to the smallest rectangle box that encapsulates the part (x-position, y-position, width, and length).

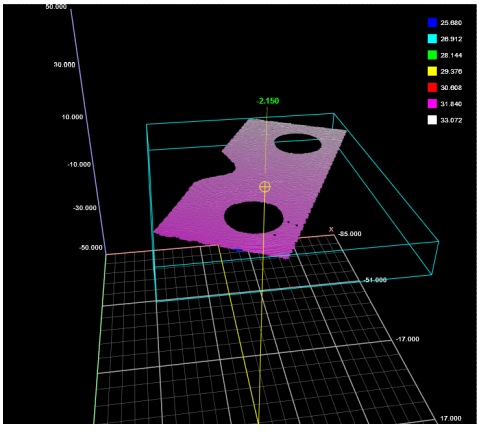
The measurement values can be compared with minimum and maximum constraints to yield a decision.

A bounding box can be vertical or rotated. A vertical bounding box provides the absolute position from which the Whole Part's Centroids tools are referenced.

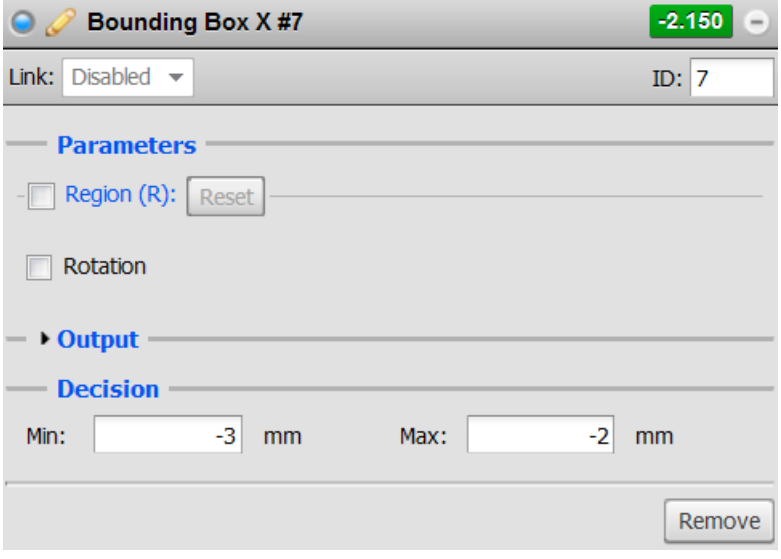
See Adding and Removing Measurements (page 70) for instructions on adding measurements.



2D View

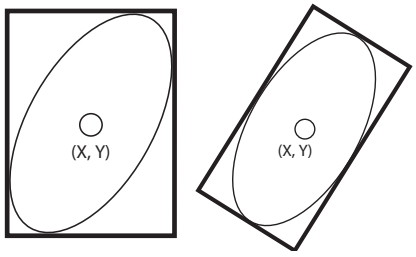
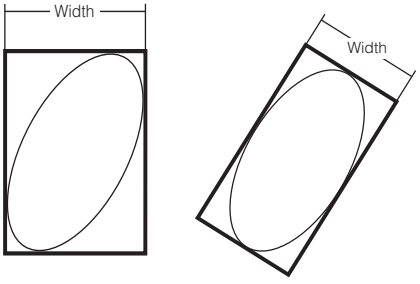
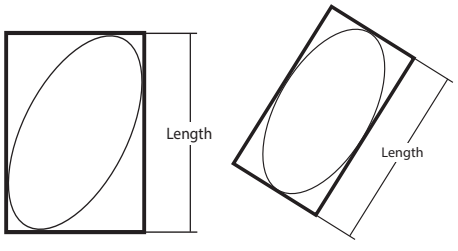


3D View



Measurement Panel

Measurements

Measurement	Illustration
Bounding Box X Determines the x-position of the smallest rectangle box that encapsulates the part. When rotation is enabled and the angle is positive, the x-position is the left most corner. When the angle is negative, the x-position is the topmost corner.	
Bounding Box Y Determines the y-position of the smallest rectangle box that encapsulates the part. When rotation is enabled and the angle is positive, the y-position is the left most corner. When the angle is negative, the y-position is the topmost corner.	
Bounding Box Width Determines the width of the smallest rectangle box that encapsulates the part. The width reports the dimension of the box in the direction of the minor axis. When rotation is enabled, the bounding box is rotated by the angle of an ellipse fitted to the part data.	
Bounding Box Length Determines the height (thickness) of the smallest rectangle box that encapsulates the part. The length reports the dimension of the box in the direction of the major axis. When rotation is enabled, the bounding box is rotated by the angle of an ellipse fitted to the part data.	

Parameters

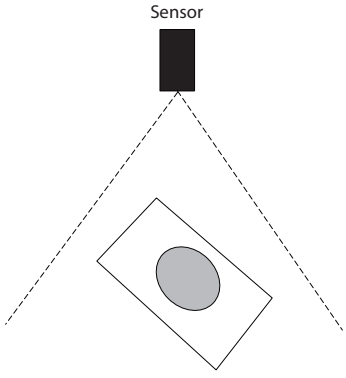
Parameter	Description
Rotation	A bounding box can be vertical or rotated. A vertical bounding box provides the absolute position from which the Whole Part's Centroids tools are referenced. Check the Rotation check box to select rotated bounding box.
Decision	See Decisions (page 73).
Region	See Regions (page 74).
Output	See Output Filters (page 75).

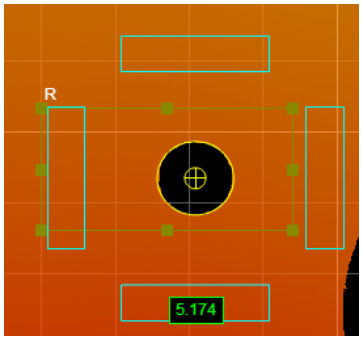
HOLE

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

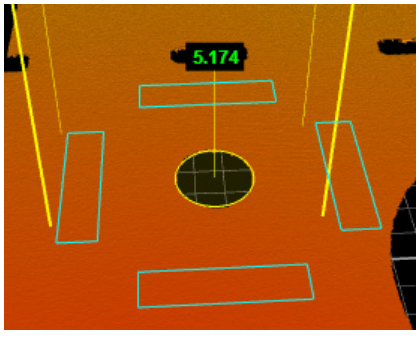
The hole can be on a surface at an angle to the sensor.

See Adding and Removing Measurements (page 70) for instructions on adding this measurement.

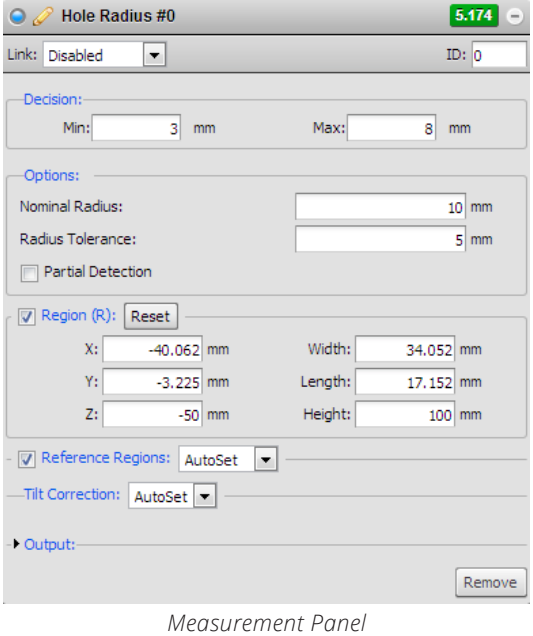




2D View



3D View



Measurement Panel

Measurements

Measurement	Illustration

Hole X

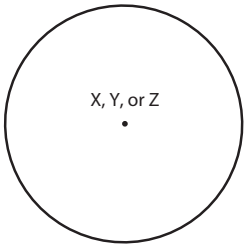
Determines the x-position of the hole center.

Hole Y

Determines the y-position of the hole center.

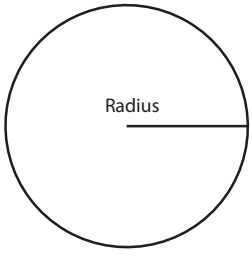
Hole Z

Determines the z-position of the hole center.



Hole Radius

Determines the radius of the hole.



Algorithm

Refer to the tool's parameters for an explanation of the options that affect the algorithm used by the tool.

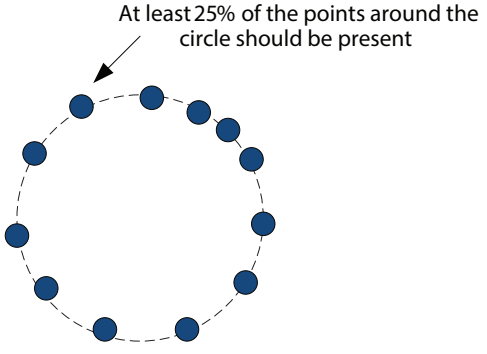
The Hole tool processes the data in three phases: Search, Measure, and Filter. The algorithm can separate out background information that appears inside the hole. It can also detect holes that only partially appear in the data.

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

Measure phase - A more rigorous edge detection algorithm is applied to precisely determine the edges around the feature. Edge detection at this stage will reject outliers and noise. The algorithm requires at least 25% of the data around the hole for the candidate to remain valid.

The accuracy of the algorithm improves when the points are spread more evenly along the hole's circumference.

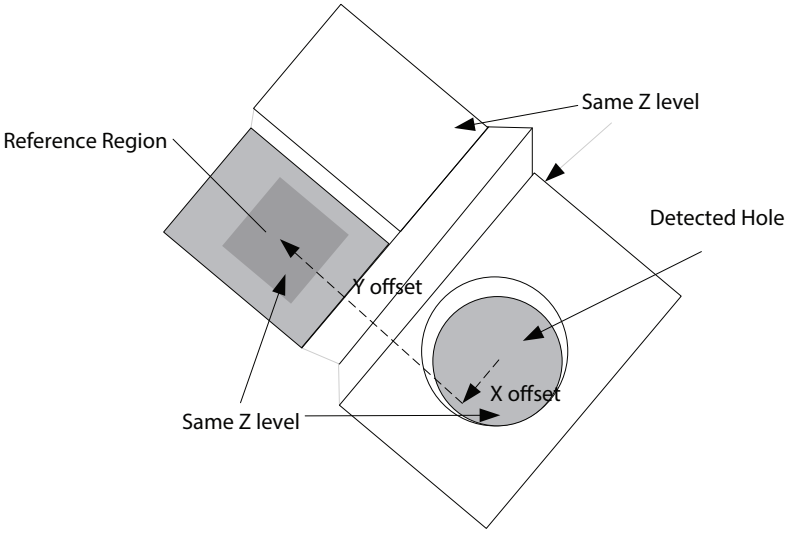
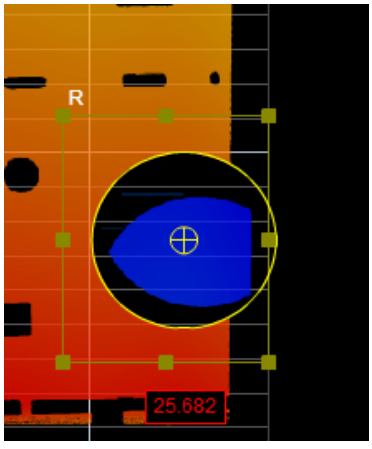
The set of refined edges is then used to locate and inspect the feature. If the Reference Regions option is enabled and set to AutoSet, the edges are also used to calculate the location of the reference regions.



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

Parameters

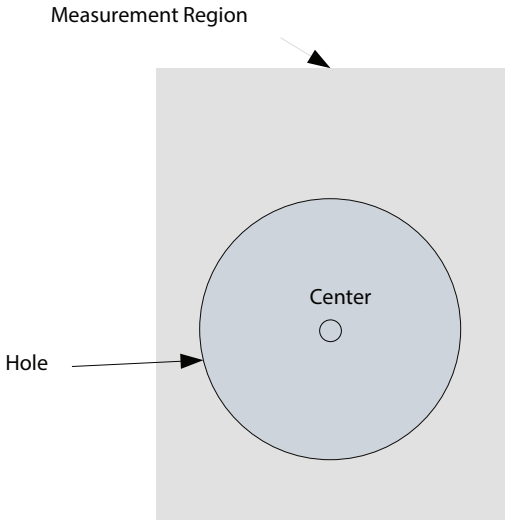
Parameter	Description
Nominal Radius	Expected radius of the hole.
Radius Tolerance	The maximum variation from the nominal radius (+/- from the nominal radius).

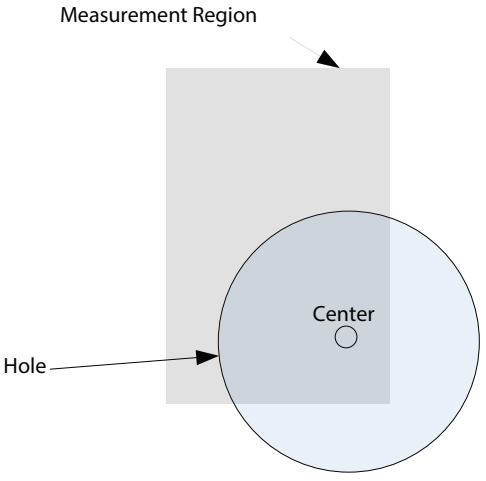
Reference Regions	The algorithm uses the Reference Regions option to calculate the z-position of the hole. It is typically used in cases where the surface around the hole is not flat.  When this option is set to Autoset, the algorithm automatically determines the reference region. When the option is 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 within the region of interest for results to be valid. 
Decision	See Decisions (page 73).
Region	See Regions (page 74).

Output	See Output Filters (page 75).

Measurement Region

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

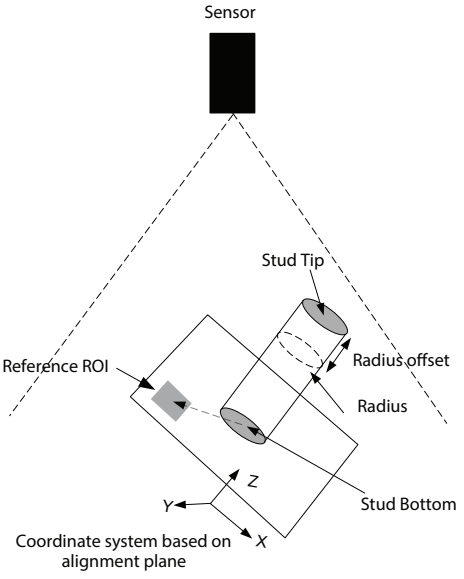




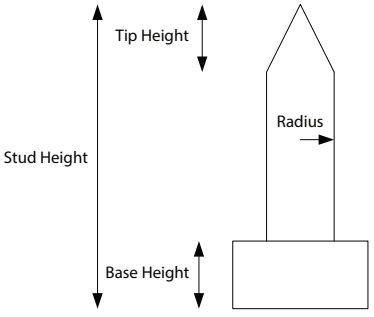
Stud

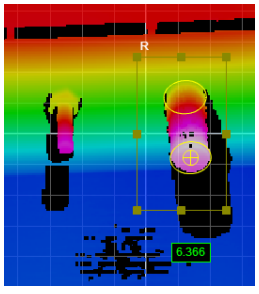
The Stud tool measures the location and radius of a stud.

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.

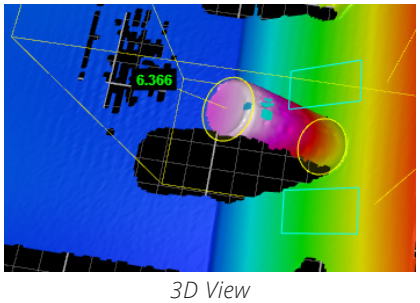


The stud shape is defined by the tip height and base height. The base and tip heights specify where the shaft with the nominal radius begins and ends.

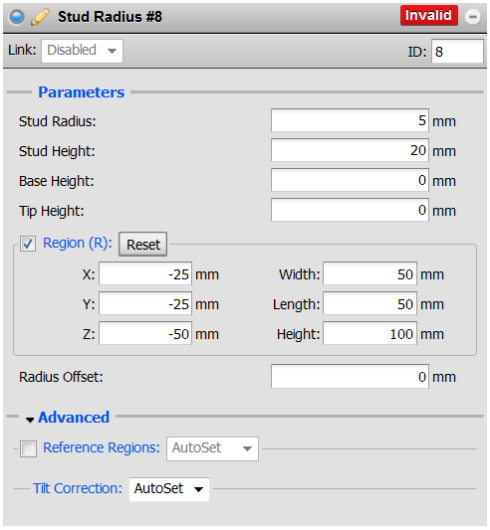




2D View

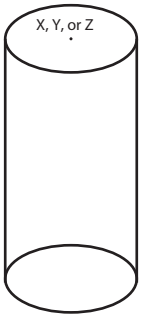
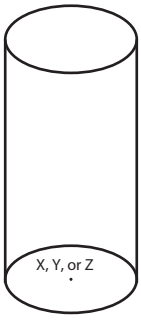


3D View



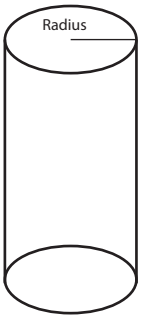
Measurement Panel

Measurements

Measurement	Illustration
Stud Tip X Determines the x-position of the stud tip.	
Stud Tip Y Determines the y-position of the stud tip.	
Stud Tip Z Determines the z-position of the stud tip.	
Stud Base X Determines the x-position of the stud base.	
Stud Base Y Determines the y-position of the stud base.	
Stud Base Z Determines the z-position of the stud base.	

Stud Radius

Determines the radius of the stud.



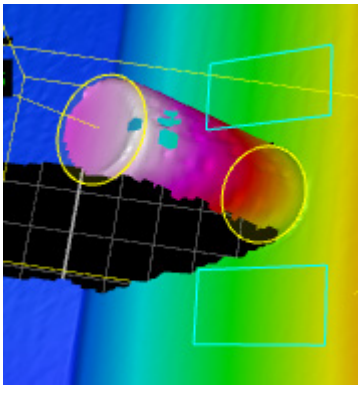
Algorithm

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

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

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

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



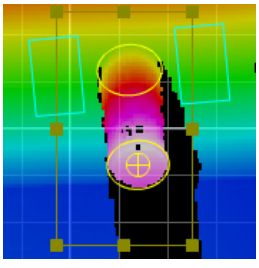
Parameters

Parameter	Description
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.
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 Decisions (page 73).
Region	See Regions (page 74).
Output	See Output Filters (page 75).

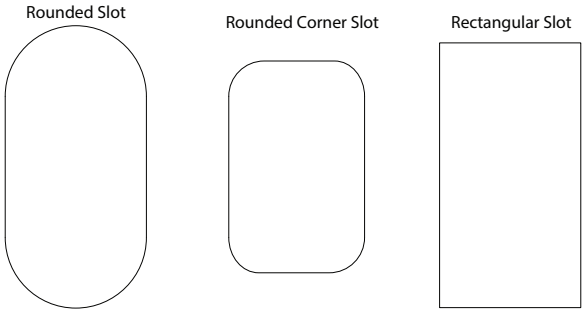
Measurement Region

The tip and the side of the stud must be within the measurement region.

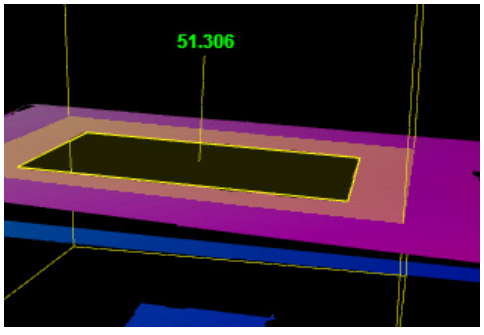


Opening

The Opening tool locates rounded, rectangular, and rounded corner openings. The opening can be on a surface at an angle to the sensor. Users select the measurement region in which the opening is expected to appear.

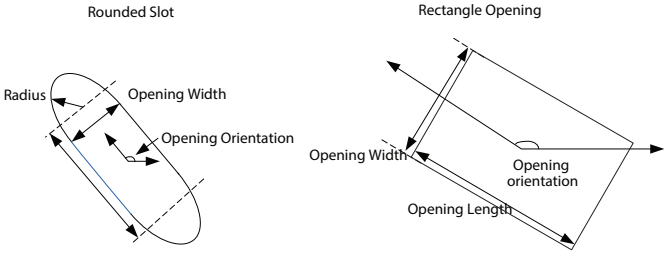


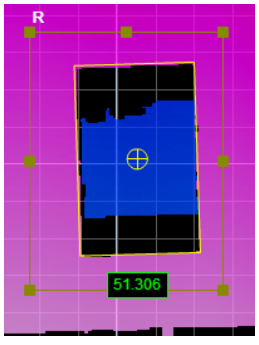
The algorithm can separate out background information that appears inside the opening. It can also detect a slot that only partially appears in the data.



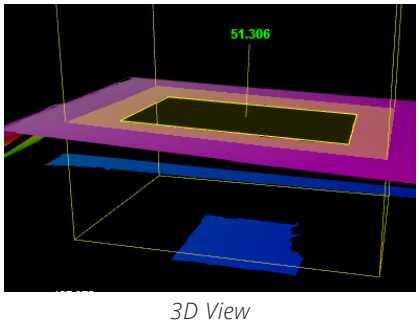
The shape of the opening is defined by its type and its nominal width, length, and radius.

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

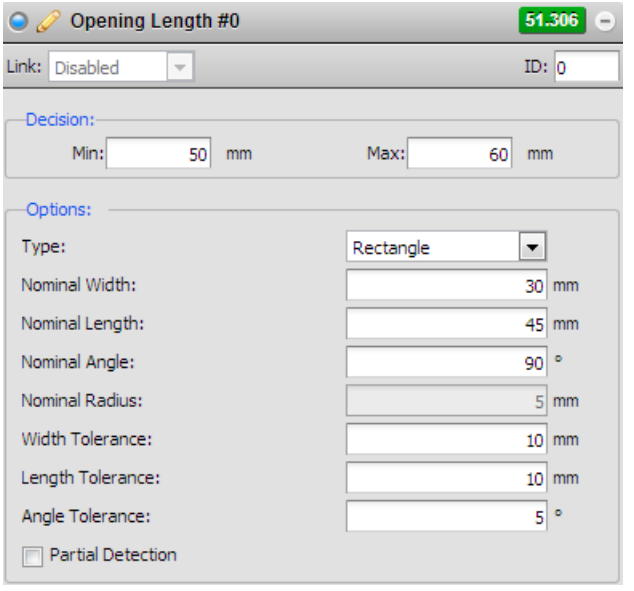




2D View



3D View



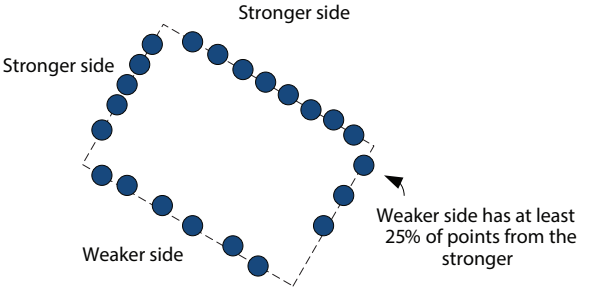
Measurement panel

Algorithm

The Opening tool processes the data in three phases: Search, Measure, and Filter.

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

Measure phase - A more rigorous edge detection algorithm is applied to precisely determine the edges around the feature. Edge detection at this stage will reject outliers and noise. The algorithm requires opposite sides and ends to be associated with a comparable number of edge pixels, with the weaker side or end having at least 25% of the stronger.

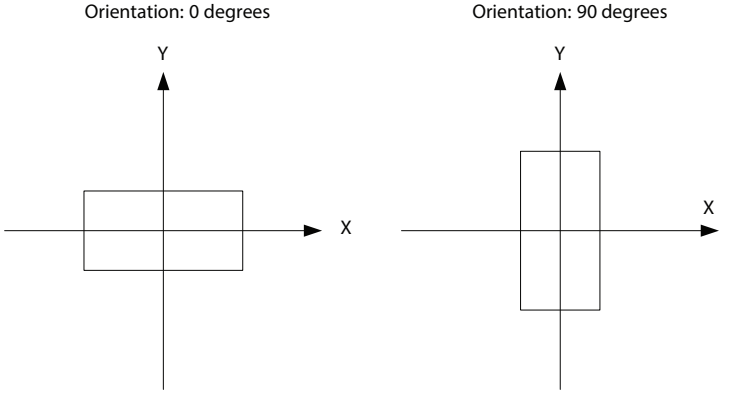
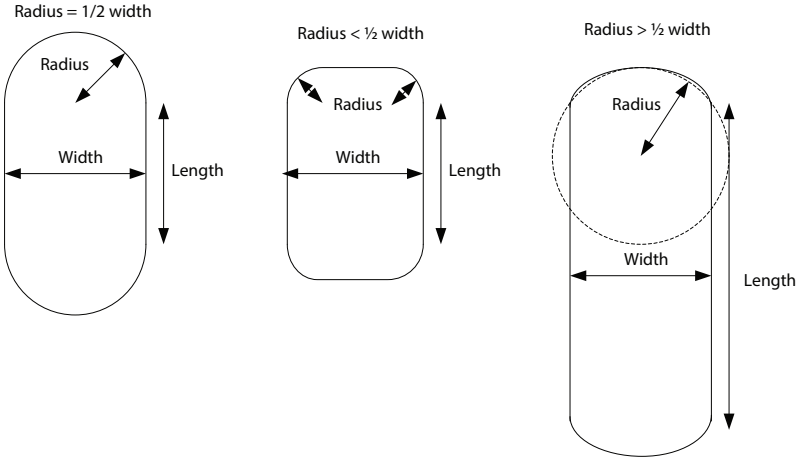


The set of refined edges is then used to locate and inspect the feature. If Reference Regions is enabled, the edges are also used to calculate the location of the reference regions.

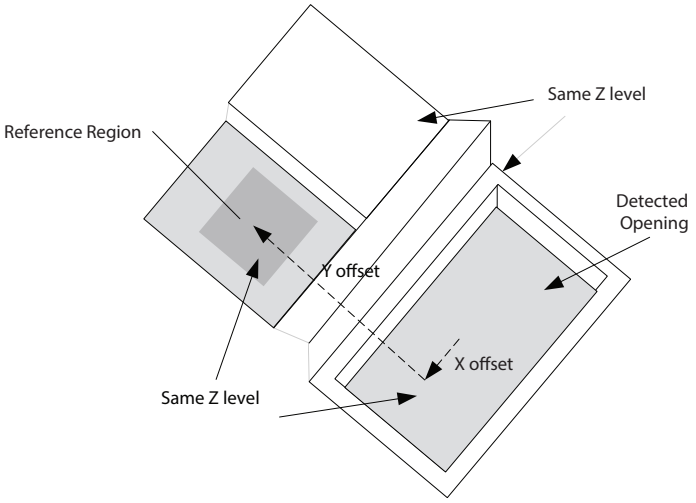
Filter phase - The detected location and dimensions are compared to the nominal and tolerance settings. If the refined feature falls within the measurement region and its measurements fit within the specified tolerance, the results are reported. If not, an invalid result is returned.

Parameters

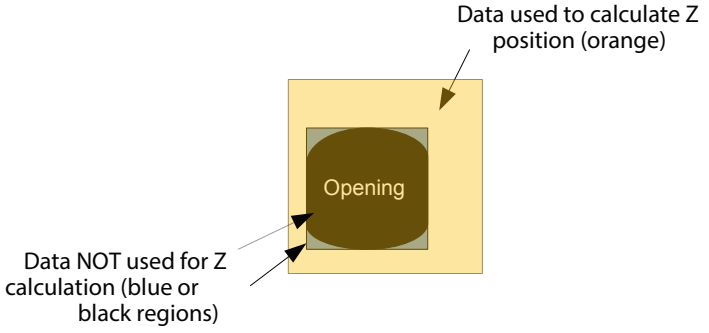
Parameter	Description
Type	Rounded Slot, Rectangle.
Nominal Width	Nominal width of the opening.
Nominal length	Nominal length of the opening.

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

Parameter	Description
Reference Regions	The algorithm uses reference regions to calculate the z-position of the hole. Reference regions are relative to the center location of the feature. This option is typically used in cases where the surface around the opening is not flat.



When the Reference Regions setting is disabled, the tool measures the hole's 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.

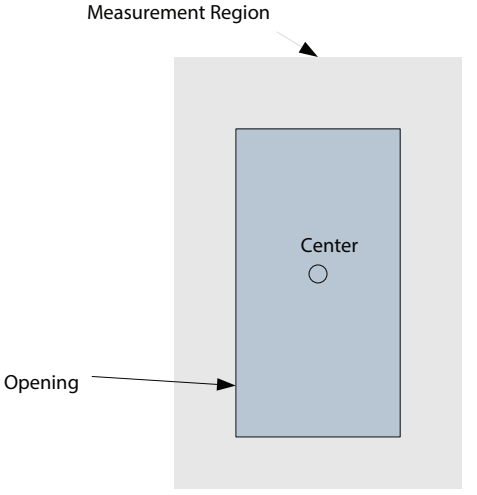
When the user places the reference region manually, all of the data is used, whether the data is inside or outside the opening. The user should place the reference region carefully. See Reference Region (page 107) for more details.

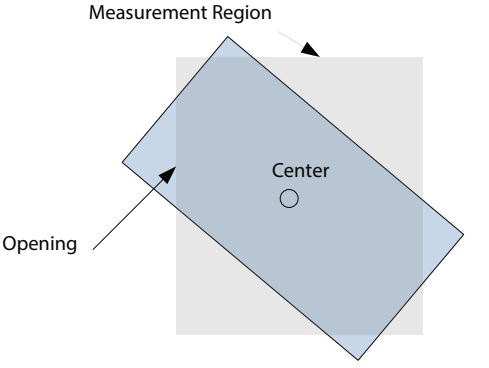
Tilt Correction	Tilt of the target with respect to the alignment plane. Set to Auto-Set to have the tool automatically detect the target's tilt, or enter the angles manually. Auto-Set requires the measurement region to cover more areas on the surface plane than other planes. The results from the Plane X and Y tool can be used for angles X and Y parameters.
Decision	See Decisions (page 73).
Region	See Regions (page 74).

Parameter	Description
Output	See Output Filters (page 75).

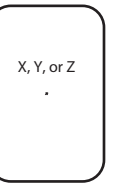
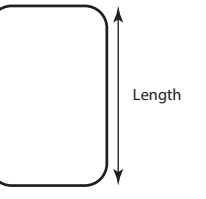
Measurement Region

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



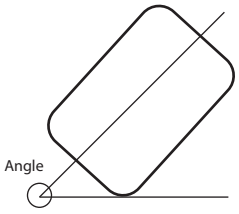


Measurements

Measurement	Illustration
Opening X Determines the x-position of the opening's center.	
Opening Y Determines the y-position of the opening's center.	
Opening Z Determines the z-position of the opening's center.	
Opening Width Determines the width of the opening.	
Opening Length Determines the length of the opening.	

Opening Angle

Determines the angle (rotation) around the normal of the alignment plane.

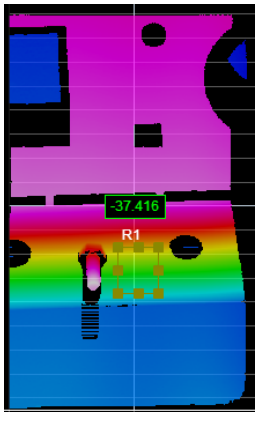


Plane

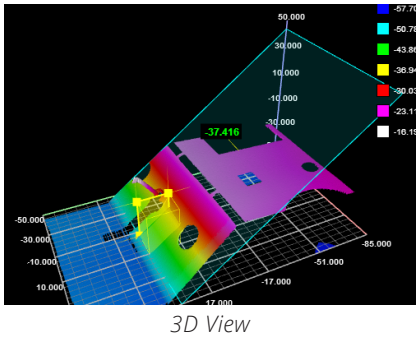
The Plane tool reports angle X, angle Y, and offset Z of the surface with respect to the alignment target.

The z-offset reported is the z-position at zero position on the x-axis and the y-axis.

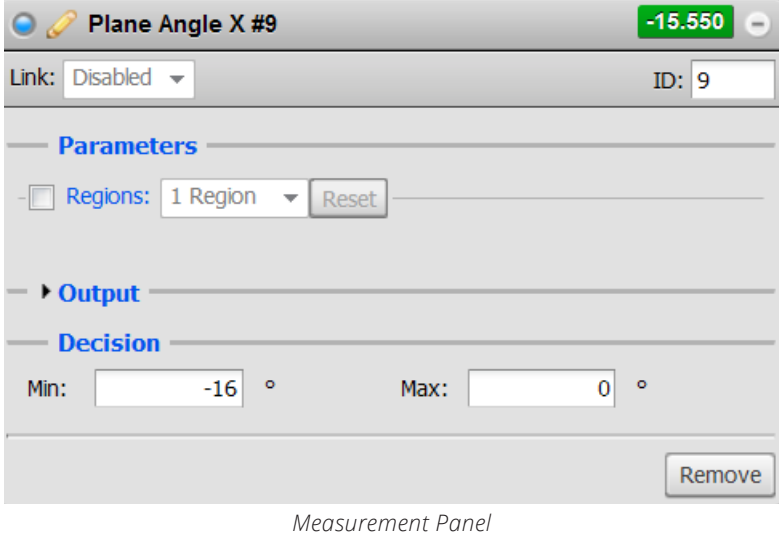
The results of the Plane Angle X and Plane Angle Y can be used to customize the tilt angle in the Hole, Opening, and Stud tools.



2D View



3D View



Measurement Panel

Measurements

Measurement	Illustration

Plane Angle X

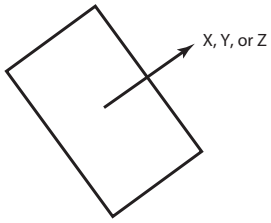
Determines the x-angle of the surface with respect to the alignment target.

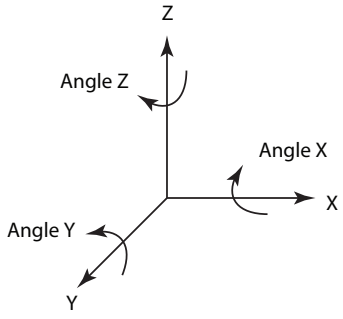
Plane Angle Y

Determines the y-angle of the surface with respect to the alignment target.

Plane Offset Z

Determines the z offset of the surface with respect to the alignment target.



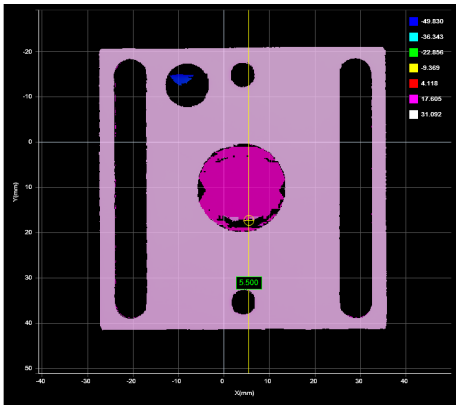


Parameters

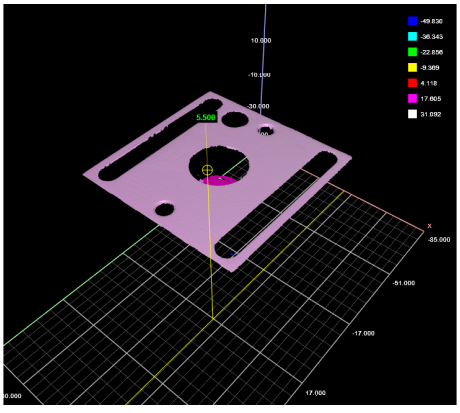
Parameter	Description
Decision	See Decisions (page 73).
Region	See Regions (page 74). Note that unlike the other tools, the Plane tool uses either one or two regions.
Output	See Output Filters (page 75).

Position

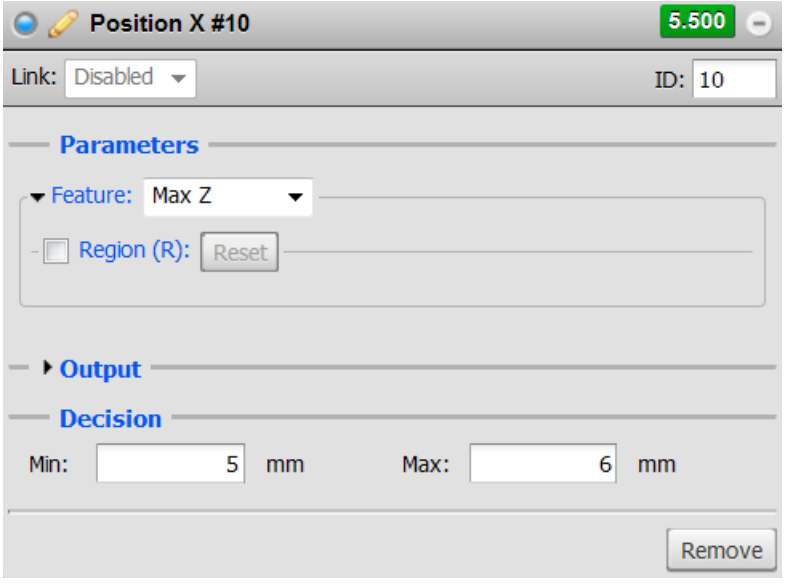
The Position tool reports the x-, y-, or z-position of a part. The feature type must be specified and is one of the following: Centroid 2D, Centroid 3D, Min X, Max X, Min Y, Max Y, Min Z, or Max Z.



2D View

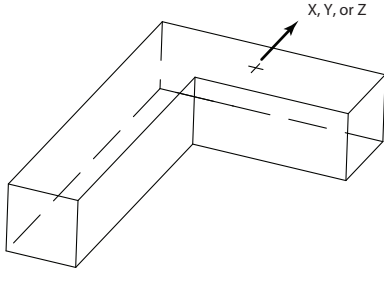


3D View



Measurement Panel

Measurements

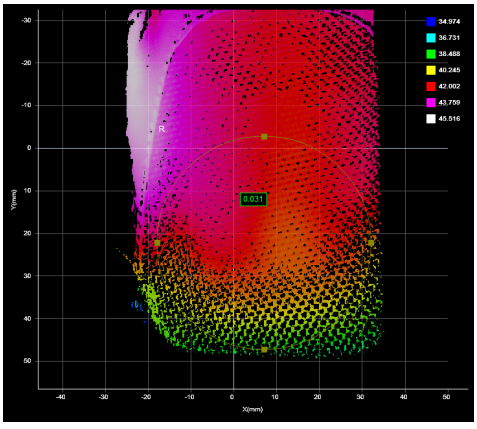
Measurement	Illustration
Position X Determines the x-position of the selected feature type.	
Position Y Determines the y-position of the selected feature type.	
Position Z Determines the z-position of the selected feature type.	

Parameters

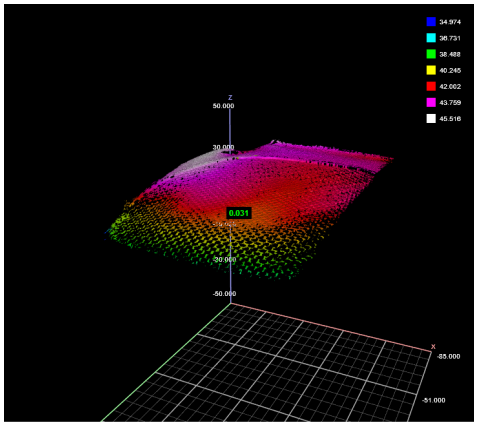
Parameter	Description
Feature Type	Choose Centroid 2D, Centroid 3D, Min X, Max X, Min Y, Max Y, Min Z, or Max Z.
Decision	See Decisions (page 73).
Region	See Regions (page 74).
Output	See Output Filters (page 75).

TEXTURE

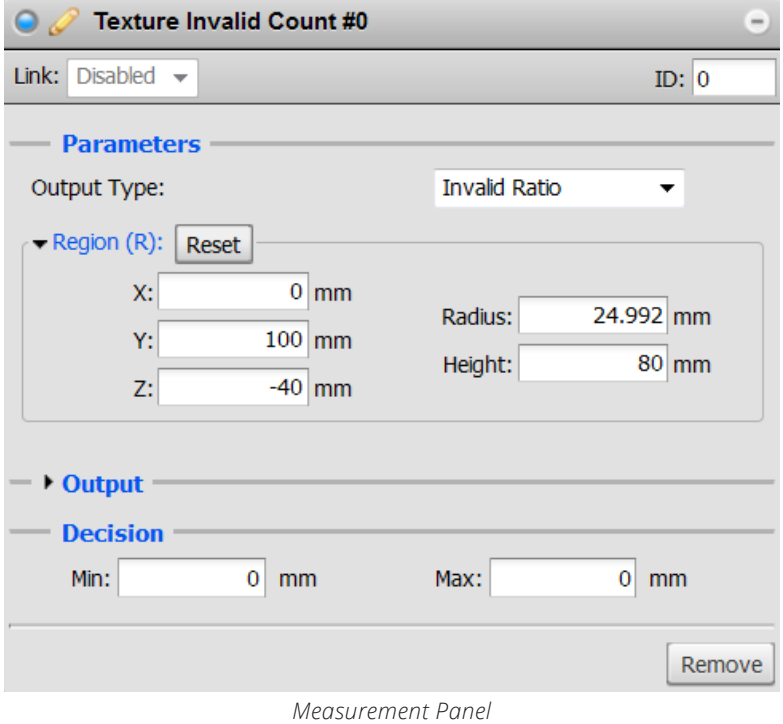
The Texture tool provides measurements related to the texture of an object.



2D View

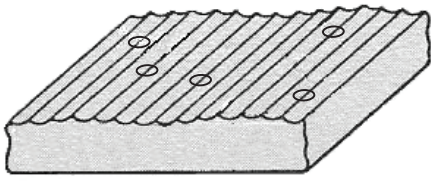


3D View



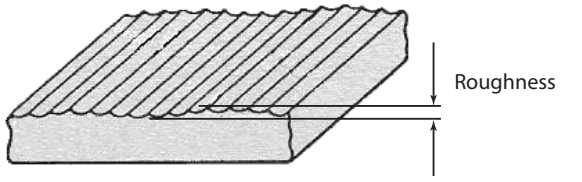
Measurement Panel

Measurements

Measurement	Illustration
Texture Invalid Count Produces one of four output types (Invalid/Valid Ratio or Invalid/Valid Area) within a circular region of interest. (See below.)	

Texture Roughness

Determines the average absolute difference in millimeters between all neighboring points within a circular region of interest.



Parameters

Parameter	Description
Output Type *(Texture Invalid Count measurement only)*	One of four types: Invalid Ratio: Percentage of invalid pixels. Valid Ratio: Percentage of valid pixels. Invalid Area: Area of invalid pixels. Valid Area: Area of valid pixels.
Decision	See Decisions (page 73).
Region	In addition to the settings described in Regions (page 74), the Texture measurements use a Height and a Z setting. Height represents the height of the cylindrical region of interest along the z-axis. Z represents the bottom of the cylindrical region of interest. Example: Z = -10 and Height = 40 is a cylinder with the bottom at -10 mm and the top at 30 mm.
Output	See Output Filters (page 75).

Script

Refer to Scripting (page 109) for more information.

Tilt Correction

Tilt correction only functions properly when the measurement region covers more areas on the surface plane than other planes.

Processing Speed

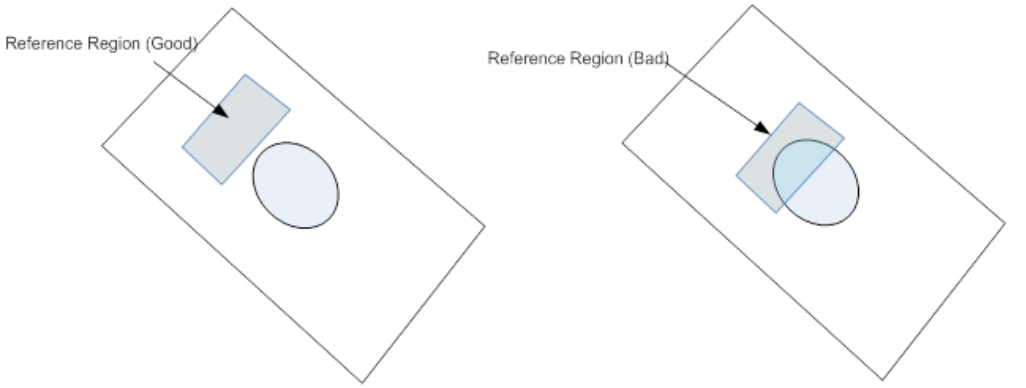
The processing speed of the measurement tools depends on the size of the measurement region, the resolution of the data, and whether tilt correction is enabled or disabled. The size of the tolerance values also affects the processing speed. The larger the tolerance is, the more time is required to search the features.

To achieve the maximum speed, manually set the tilt angles, reduce the tolerance on nominal values, and reduce the measurement region to only cover the features.

Reference Region

Misplacing reference regions can result in incorrect measurements and sometimes can even result in a failure to produce a measurement.

When users manually place the reference region, all of the data is used, regardless of whether the data is inside or outside the feature. Users should place the reference region carefully to avoid covering the feature with the reference region.



When Reference Region is disabled, the entire measurement region outside the target object is used. As with tilt correction, this area should only contain data in the reference plane, but it may not be as obvious since the region is not displayed as clearly. This also applies to stud measurements.

Feature Not Detected

The following are some common reasons why a tool might not detect a feature.

Reason	Explanation	Solution
Incorrect model parameters	The filtering phase in the hole and opening tool will reject results if the dimensions of the result candidate do not match specified nominal value +/- tolerance value.	Correct the model parameters.
Incorrect measurement region	The key elements of the feature must be within the measurement region. Refer to the tool-specific sections for more information.	Adjust the measurement region so that it follows the rules specified in the tool-specific sections.
Insufficient feature data	Sufficient feature data must be present within the measurement region. Refer to the tool-specific sections for more information.	Tune the sensor exposure and orientation to obtain more feature data.

Reason	Explanation	Solution
Incorrect Tilt Correction	The Tilt Correction parameters are incorrect. Or, when Auto-Set is enabled, the measurement region does not have significant coverage of the flat surface.	Adjust the measurement region or manually adjust the tilt angles.
Incorrect Reference Region	The Reference Regions setting is incorrectly set to a location that contains no data, or the setting is using Auto-Set when th]ere is no flat surface around the feature.	Disable Reference Regions or manually specify the location of the reference region.

Scripting

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

The following elements of the C language are supported:

Supported Elements

Elements	Supported
Control Operators	if, while, do, for, switch and return.
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

Measurement Functions	Descriptions
int Measurement_Exists(int id)	Tests for the existence of a measurement by ID. Parameters: id – Measurement ID Returns: 0 – measurement does not exist 1 – measurement exists
int Measurement_Valid(int id)	Retrieves the valid/invalid state of a measurement by its ID. Parameters: id - Measurement ID Returns 0 - Measurement is invalid 1 - Measurement is valid
long long Measurement_Value (int id)	Retrieves the value of a measurement by its ID. Parameters: id - Measurement ID Returns: Value of the measurement 0 – if measurement does not exist A measurement value is received as a fixed point integer with a scaling of 1/1000. For example, a 3.654mm value is received as 3654.
int Measurement_Decision (int id)	Retrieves 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 *name)	Determines if a measurement exist by name. Parameter: name – name of a measurement Return: 0 – measurement does not exist 1 – measurement exists
int Measurement_Id (char *name)	Retrieves the measurement ID by the measurement name. Parameters: name – name of a measurement Returns: -1 – measurement does not exist Other – Measurement ID
void Output_Set (long long value, int decision)	Output a 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, long long 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, long long 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

Memory Functions	**Descriptions**
void Memory_Set64s (int id, long long value)	Stores a 64-bit signed integer in persistent memory. Parameters: id - ID of the value value - Value to store
long long Memory_Get64s (int id)	Retrieves 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)	Retrieves 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)	Retrieves 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 a ID. Parameters: id – Value ID
void Memory_ClearAll()	Erases all value from persistent memory

Stamp Functions

Stamp Functions	**Descriptions**
long long Stamp_Frame()	Retrieves the frame index of the current frame.
long long Stamp_Time()	Retrieves the time stamp of the current frame.
long long Stamp_Encoder()	Retrieves the encoder position of the current frame.
long long Stamp_EncoderZ()	Retrieves the encoder index position of the current frame.
unsigned int Stamp_Inputs()	Retrieves the digital input state of the current frame.

Math Functions

Math Functions	**Descriptions**
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: Accumulated Volume

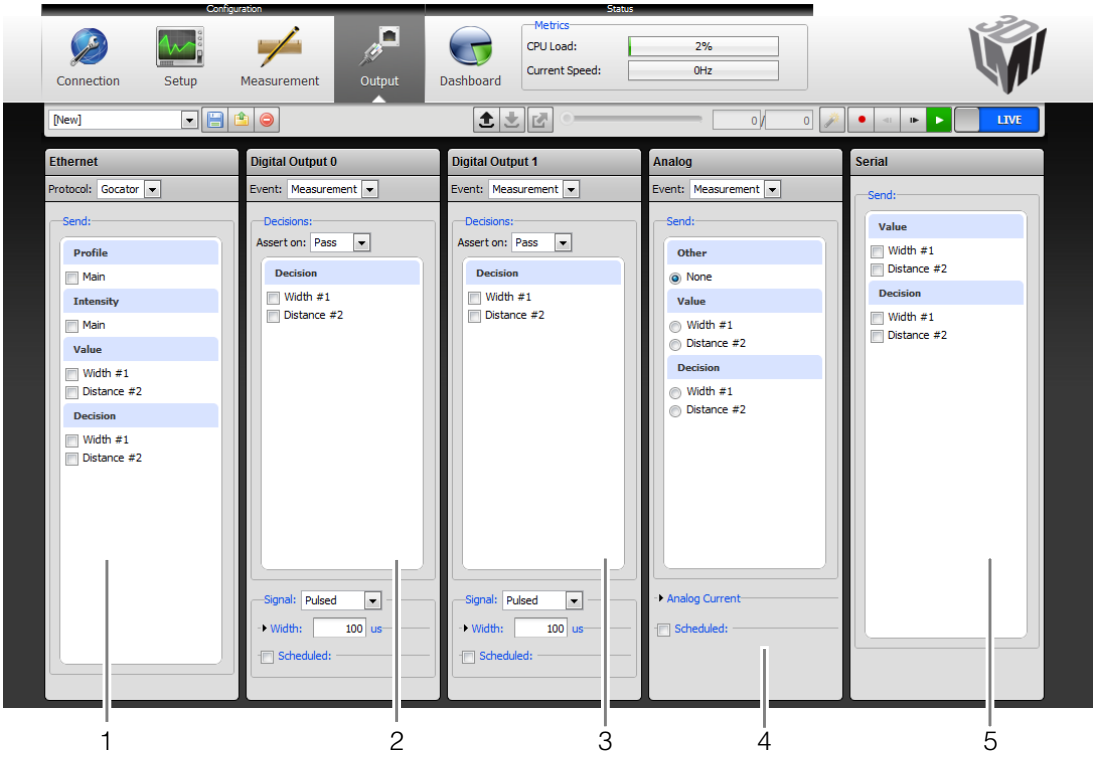
The following example demonstrates how to create a custom measurement that is based on the values from other measurements and persistent values. The example calculates the volume of the target using a series of box area measurement values.

```
/* Calculate the volume of an object by accumulating the boxArea measurements*/
/* Encoder Resolution is 0.5mm. */
/* BoxArea Measurement ID is set to 1*/

long long encoder_res = 500;
long long boxArea = Measurement_Value(1);
long long Volume = Memory_Get64s(0);

if (boxArea > 0)
{
   Volume = Volume + (boxArea/1000) * encoder_res;
}

Memory_Set64s(0, Volume);

if (Volume > 1000000)
{
   Output_Set(Volume, 1);
}
else
{
   Output_Set(Volume, 0);
}
```

Output

Output Page Overview

Output configuration tasks are performed using the Output Page. Gocator sensors can transmit laser profiles and measurement results to a variety of external devices using a variety of output interface options.

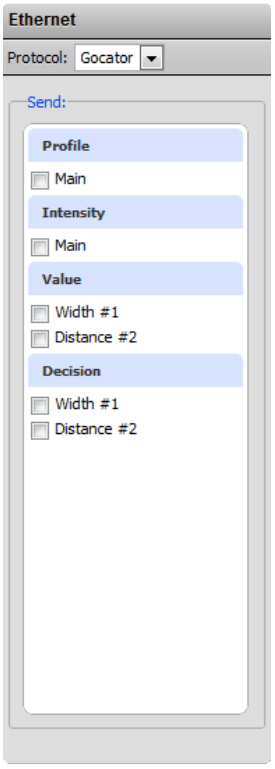


	Element	Description
1	Ethernet Panel	Use the Ethernet panel to select the data sources that will be transmitted via Ethernet (page 113).
2	Digital Output 0 Panel	Use the Digital Output 0 panel to select the data sources that will be combined to produce a digital output pulse on Output 0 (page 117).
3	Digital Output 1 Panel	Use the Digital Output 1 panel to select the data sources that will be combined to produce a digital output pulse on Output 1 (page 117).
4	Analog Panel	Use the Analog panel to convert a measurement value or decision into an analog output signal (page 120).
5	Serial Panel	Use the Serial panel to select the measurements that will be transmitted via RS-485 serial output (page 123).

Ethernet Output

A sensor uses TCP messages (Gocator Protocol) to exchange commands, video, laser profile, intensity and measurement results with client computers. The sensor can also exchange commands and measurement results with a PLC using ASCII, Modbus TCP or EtherNet/IP protocol. Refer to Gocator

Protocol (page 167), ASCII Protocol (page 213), Modbus TCP Protocol (page 197) and Ethernet/IP Protocol (page 204) for the specification of these protocols.



To exchange results using Gocator Protocol messages:

1 **Navigate to the Ethernet panel.**

2 **Select Gocator in the Protocol Option.**

3 **Select the video, profile, intensity, decision value, or decision items 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.

All of the tasks that can be accomplished via the Gocator's web interface (configuration, calibration, receiving data, health information, and software triggering, etc.) can be accomplished programmatically by sending and receiving Gocator Protocol control commands. The sensor can process the control commands regardless of the selected protocol.

To exchange results using ASCII messages:

1 Navigate to the Ethernet panel.

2 Select ASCII in the Protocol Option.

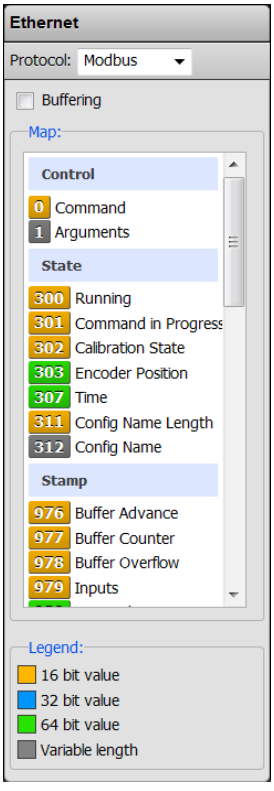
3 Select the Operation Mode.
In asynchronous mode, the data results are transmitted when they are available. In polling mode, users send commands on the data channel to request the latest result. Refer to Asynchronous and Polling Operation (page 213) for an explanation of the operation modes.

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. Refer to Standard Result Format (page 214) for an explanation of the standard result mode.

Select Custom to customize the output result. A data format box will appear in which users can type the format string. Refer to Custom Result Format (page 215) for the supported format string syntax.

5 Set the Special Characters.
Select the delimiter, termination and invalid value characters. Special characters are used in commands and standard-format data results.

6 Set the TCP Ports
Select the TCP ports for the command, 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.



To receive commands and send results using Modbus TCP messages:

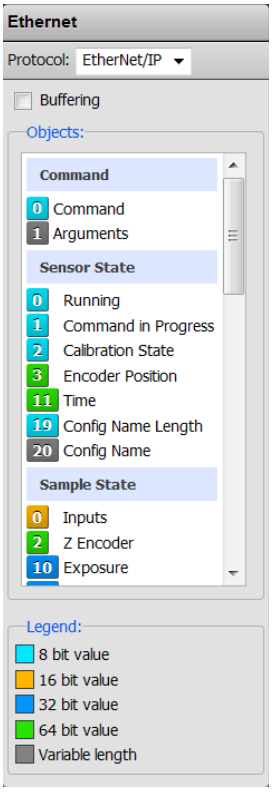
1 Navigate to the Ethernet panel.

2 Select Buffering if desired.
Buffering is needed, for example, in Whole Part mode if multiple objects are detected within a time frame shorter than the polling rate of the PLC.

NOTE: If buffering is enabled with the Modbus protocol, the PLC must read the Buffer Advance register to advance the queue before reading the measurement results.

3 Select Modbus in the Protocol Option.
Unlike using the Gocator Protocol, there is no need to 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 accomplished in the web interface. A sensor can only process Modbus TCP commands when the Modbus is selected in the protocol option.



To receive commands and send results using EtherNet/IP messages:

1 **Navigate to the Ethernet panel.**

2 **Select Buffering if desired.**
Buffering is needed, for example, in Whole Part 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 (page 211) is read.

3 **Select EtherNet/IP in the Protocol Option.**
Unlike using the Gocator Protocol, there is no need to 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.

Digital Outputs

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. For information on wiring digital outputs to external devices, refer to Gocator 3100 Power/LAN Connector (page 237).

To output measurement decisions:

1 **Navigate to the Digital Output 0 or Digital 1 panel.**

2 **Set Event to Measurement**

3 **Select Assert Mode and decision sources that should be combined to determine the output.**
If multiple decision sources are selected and assert mode is set to pass, the output is activated when all selected measurement decisions pass. Conversely, if assert mode is set to false, the output is activated when any one of the selected measurement decisions is false.

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, the user specifies the pulse width and how it is scheduled.

5 **Specify a Pulse Width.**
The pulse width is the duration of the digital output pulse, in microseconds.

6 **Specify whether the output is Immediate or Scheduled.**
A pulsed digital output can be immediate 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 mutliple 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 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.

7 **Specify a Delay.**
The delay specifies the time or spatial location 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 in the trigger panel. Refer to Trigger Panel (page 50) for details.

To output a measurement valid signal:

1 **Navigate to the Digital Output 0 or Digital 1 panel.**

2 **Set Event to Measurement.**

3 **Set Assert On to Always.**

4 **Select decision sources.**
The output activates when the selected decisions produce results. The output activate only once for each frame even if multiple decision sources are selected.

5 **Specify a Pulse Width.**
The pulse width determines the duration of the digital output pulse, in microseconds.

To respond to software scheduled commands:

1 **Navigate to the Digital Output 0 or Digital 1 panel.**

2 **Set Event to Software.**

3 **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.

4 **Specify a Pulse Width.**
The pulse width determines the duration of the digital output pulse, in microseconds.

5 **Specify if the output is Immediate or Scheduled.**
A pulsed signal can become active immediately or scheduled. Continuous signal always becomes active immediately.

Immediate output becomes active as soon as a Scheduled Digital Output command (page 184) is received.

Scheduled output becomes active at a specific target time or position, given by the Scheduled Output command. 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 travel calibration was performed in).

To output an exposure signal:

1 **Navigate to the Digital Output 0 or Digital 1 panel.**

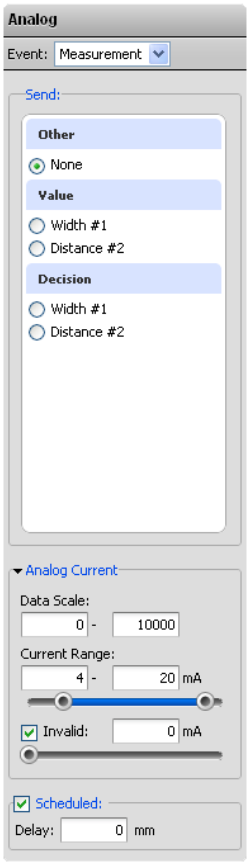
2 **Set Event to Exposure.**

3 **Specify a Pulse Width.**
The pulse width determines the duration of the digital output pulse, in microseconds.

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, refer to page 120.



To output measurement value or decision:

1 **Navigate to the Analog panel.**

2 **Set Event to Measurement.**

3 **Select the value or decision source that should be used for output.**
Only one value or decision can be used for analog output. Measurements shown here correspond to measurements that have been programmed using the Measurements Page.

4 **Specify Data Scale values.**
The values specified here determine how measurement values are scaled to the minimum and maximum current output. The Data Scale is specified in (um) for dimensional measurement, (0.001 mm^2) for area, (mm^3) for volume and (0.001 degree) for angles results.

5 **Specify Current Range and Invalid current values.**
The values specified here determine the minimum and maximum current values in milliamperes. The invalid current value 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.

6 **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.

7 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. Refer to Trigger Panel (page 50) 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 Navigate to the Analog panel.

2 Set Event to Software.

3 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 (page 253) 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 travel calibration was performed in).

Serial Output

The Gocator's web interface can be used to select measurement values and decisions to be transmitted via RS-485 serial output. Each sensor has one serial output channel.

Refer to ASCII Protocol (page 213) for serial connection parameters and data formats. For information on wiring serial output to an external device, refer to Serial Output (page 241).

To exchange results using ASCII messages:

1 **Navigate to the Ethernet panel.**

2 **Select ASCII in the Protocol Option.**

3 **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. Refer to Standard Result Format (page 214) for an explanation of the standard result mode.

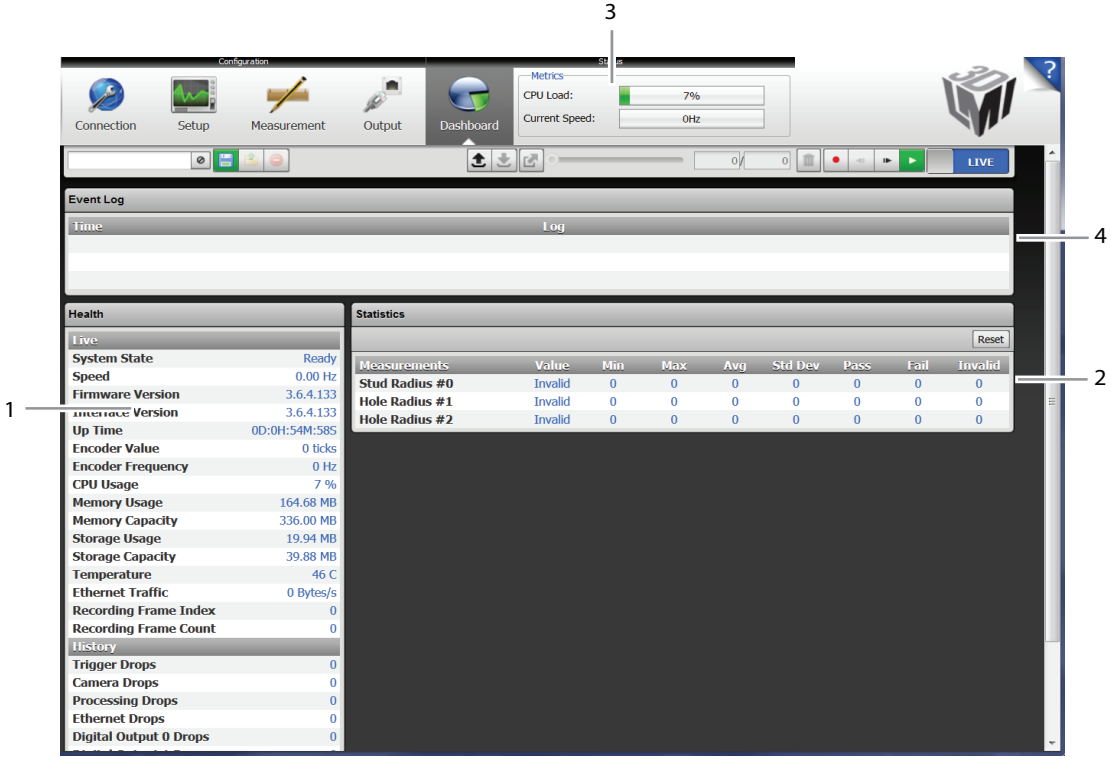
Select Custom to customize the output result. A data format box will appear in which users can type the format string. Refer to Custom Result Format (page 215) for the supported format string syntax.

4 **Set the Special Characters.**
Select the delimiter, termination and invalid value characters. Special characters are used in commands and standard-format data results.

Dashboard

Dashboard Page Overview

The Dashboard page summarizes logged events, sensor health information, and measurement statistics.



	Element	Description
1	State and Health Information	Displays sensor state and health information (page 125).
2	Measurement Statistics	Displays measurement statistics (page 126).
3	Metrics Panel	Summarizes important performance statistics (page 40).
4	Event Log	Displays log data from the sensor.

State and Health Information

The following state and health information is available on the Dashboard:

Dashboard Health Values

Name	Description
System State	Current system state (Ready or Running).
Speed	Current camera speed (Hz).
Firmware Version	Gocator firmware version.
Interface Version	Gocator interface version.
Up Time	Length of time since the sensor was power-cycled or reset.
Encoder Value	Current encoder value (ticks).
Encoder Frequency	Current encoder frequency (Hz).
Trigger Drops	Count of camera frames dropped due to excessive trigger speed.
CPU Usage	Sensor CPU utilization (%).
Memory Usage	Sensor memory utilization (MB).
Memory Capacity	Sensor memory capacity (MB).
Storage Usage	Sensor flash storage utilization (MB).
Storage Capacity	Sensor flash storage capacity (MB).
Temperature	Sensor internal temperature (C).
Ethernet Traffic	Network output utilization (Bytes/sec).
Camera Drops	Count of frame drops due to camera errors.
Processing Drops	Count of frame drops due to excessive CPU utilization.
Ethernet Drops	Count of frame drops due to slow Ethernet link.
Digital Output Drops	Count of digital output drops because last output has not been completed.
Analog Output Drops	Count of analog output drops because last output has not been completed.
Serial Output Drops	Count of serial output drops because last output has not been completed.
Processing Latency	Last delay from camera exposure to when results can be scheduled to.
Max Processing Latency	Latency Maximum delay from camera exposure to when results can be scheduled to Rich I/O. Reset on start.
Camera Frame Count	Count of camera frame captured since the sensor was started.
Valid Point Count	Count of valid spots detected in the last frame.
Part Count	Count of discrete parts.

Measurement Statistics

Statistics are displayed for each measurement that has been configured on the Measurement Page. Use the Reset button to reset the statistics.

The following information is available for each measurement:

Dashboard Measurement Statistics

Name	Description
Value	The most recent measurement value.
Minimum/Maximum Value	The minimum and maximum measurement values that have been observed.
Average	The average of all measurement results collected since the sensor was started.
Standard Deviation	The standard deviation of all measurement results collected since the sensor was started.
Pass/Fail Count	The count of pass or fail decisions that have been generated.
Invalid Count	The count of frames that no feature points could be extracted from the live profile.

Gocator Device Files

Configuration Files

Configuration files contain settings that govern system behavior in the Running state.

Configurations are saved in XML format. Elements 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 configuration file is received from a sensor, it will contain settings, constraints, and properties. When a configuration file is sent to a sensor, any constraints or properties in the file will be ignored.

Changing the value of a setting can potentially affect multiple constraints and properties. After uploading a configuration file, the configuration file can be downloaded again to access updated values.

Setup

The Setup element contains settings related to system and sensor setup.

Setup Child Elements

Element	Type	Description
StartupState	32s	Setting for the default state of the system at boot time: 0 – Ready. 1 – Running.
StartupModeOptions	String	Constraint for startup modes – comma delimited list.
StartupMode	String	Setting for the default system mode at boot time.
XResamplingType	32s	Setting for the resampling interval: 0 – Maximum resolution 1 – Balanced 2 – Maximum speed
IntensityEnable	32u	Setting to disable or enable intensity output: 0 – Disable 1 – Enable
XResamplingInterval	64f	Property for x-resampling interval (mm).

Trigger

The Trigger element contains settings related trigger source, speed, and encoder resolution.

Trigger Child Elements

Element	Type	Description
TriggerSource	32s	Setting for trigger source: 0 – Time 2 – Input 3 – Software
SystemDomain	32s	Setting for units for trigger delay and output scheduling (Ignored when TriggerSource is Time or Encoder): 0 – Microseconds 1 – Millimeters
FrameRate	64f	Setting for frame rate (Hz) (Applicable for time-based triggering).
FullFrameRateEnable	32u	Setting to enable or disable full frame rate operation: 0 – Use FrameRate setting 1 – Ignore FrameRate setting, run at maximum frame rate
TriggerDelay	64f	Setting for trigger delay (us or mm).
GateEnable	32u	Setting to disable or enable the use of digital input to gate the time source: 0 – Disable 1 – Enable
BatchCount	32u	Number of frames to batch into one bundle.
FrameRateMin	64f	Constraint for minimum frame rate (Hz).
FrameRateMax	64f	Constraint for maximum frame rate (Hz).
FrameRateMaxSource	32s	Source of maximum frame rate constraint: 0 – Imager 1 – Whole part memory usage
EncoderPeriodMin	64f	Constraint for minimum encoder period (ticks).
EncoderPeriodMax	64f	Constraint for maximum encoder period (ticks).
EncoderPeriodMinSource	32s	Source of minimum encoder period constraint: 0 – Encoder resolution 1 – Whole part memory usage
TriggerDelayMin	64f	Constraint for minimum trigger delay (us or ticks).
TriggerDelayMax	64f	Constraint for maximum trigger delay (us or ticks).
BatchCountMin	32u	Minimum batch count (frames).
BatchCountMax	32u	Maximum batch count (frames).

Layout

The Layout element contains settings related to the layout/orientation of the system.

Layout Child Elements

Element	Type	Description
Orientation	32s	Setting for orientation type: 0 – Isolated 1 – Wide 3 – Opposite
Overlap	32s	Setting for overlap: 0 – No overlap 1 – Overlap
BuddyReversed	32u	Setting for buddy sensor's y-axis orientation (relative to the main sensor) 0 – Not reversed 1 – Reversed
CalibratedX	64f	Property for system-calibrated active area X position (mm).

Element	Type	Description
CalibratedZ	64f	Property for system-calibrated active area Z position (mm).
CalibratedWidth	64f	Property for system-calibrated active area width (mm).
CalibratedHeight	64f	Property for system-calibrated active area height (mm).

Calibration

The Calibration element contains settings related to alignment and travel calibration.

Calibration Child Elements

Element	Type	Description
AlignmentTarget	32s	Setting for alignment calibration target type: 0 – None 2 – Bar 3 – Plate
CalibrationSource	32s	Setting for calibration source: 0 – Global 1 – Current Configuration
Plate/Height	64f	Setting for height of calibration plate (mm).
Plate/Holes	64f	Setting for number of holes on the calibration plate.
Plate/RefHoleDiameter	64f	Setting for diameter of the reference hole on the calibration plate (mm).
Plate/SecHoleDiameter	64f	Setting for diameter of the secondary hole on the calibration plate (mm).

Sensors / Sensor

Each Sensor element contains settings related to an individual sensor. A Sensor element has an attribute that defines the role (0 – Main, 1 – Buddy) of the sensor:

```
<Sensor role="0">
```

Sensors / Sensor / Profiling

Profiling Child Elements

Element	Type	Description
ExposureMode	32u	Setting for exposure mode: 0 – Single exposure 1 – Multiple exposures (for Gocator 2000 and 2300 series only) 2 – Dynamic exposure
ExposureDelay	32u	Setting for an optional delay (us) between triggering event and the actual start of the exposure. This is used for time multiplexing the sensors in a multi-sensor system.
ExposureStep	Collection	Collection of exposure steps.
ExposureStep/Step	64f	Setting for exposure steps (us).
Exposure	64f	Setting for exposure (us).
IntensityStepIndex	32u	Setting for the exposure step to use for intensity acquisition. Only applicable when multiple exposure mode is selected.
ActiveAreaX	64f	Setting for active area X position (mm).
ActiveAreaZ	64f	Setting for active area clearance distance (mm).
ActiveAreaWidth	64f	Setting for active area field of view (mm).
ActiveAreaHeight	64f	Setting for active area measurement range (mm).
XSubsampling	32u	Setting for X resolution divider.

Element	Type	Description
ZSubsampling	32u	Setting for Z resolution divider.
ExposureMin	64f	Constraint for minimum exposure (us).
ExposureMax	64f	Constraint for maximum exposure (us).
ActiveAreaXMin	64f	Constraint for minimum X field of view boundary (mm).
ActiveAreaXMax	64f	Constraint for maximum X field of view boundary (mm).
ActiveAreaZMax	64f	Constraint for maximum Z field of view boundary (mm).
ActiveAreaZMin	64f	Constraint for minimum Z field of view boundary (mm).
ActiveAreaWidthMin	64f	Constraint for minimum field of view width (mm).
ActiveAreaWidthMax	64f	Constraint for maximum field of view width (mm).
ActiveAreaHeightMin	64f	Constraint for minimum field of view height (mm).
ActiveAreaHeightMax	64f	Constraint for maximum field of view height (mm).
XSubsamplingOptions	String	Constraint for x resolution divider options – comma delimited list (e.g. “1,2”).
ZSubsamplingOptions	String	Constraint for z resolution divider options – comma delimited list (e.g. “1,2”).
FrontCameraX	32u	Property for x position of front camera image ROI (pixels).
FrontCameraY	32u	Property for y position of front camera image ROI (pixels).
FrontCameraWidth	32u	Property for width of front camera image ROI (pixels).
FrontCameraHeight	32u	Property for height of front camera image ROI (pixels).
BackCameraX	32u	Property for x position of back camera image ROI (pixels).
BackCameraY	32u	Property for y position of back camera image ROI (pixels).
BackCameraWidth	32u	Property for width of back camera image ROI (pixels).
BackCameraHeight	32u	Property for height of back camera image ROI (pixels).
CalibratedX	64f	Property for sensor calibrated active area X position (mm).
CalibratedZ	64f	Property for sensor calibrated active area Z position (mm).
CalibratedWidth	64f	Property for sensor calibrated active area width (mm).
CalibratedHeight	64f	Property for sensor calibrated active area height (mm).

Part

The Part element contains settings that affect part measurements. Simple child elements in Part are defined below:

Part Child Elements

Element	Type	Description
MeasurementOptions	String	Constraint for available measurement types - comma delimited list (e.g. “Area, Volume”).

The Part element also contains two significant sub-elements: Detection and Measurements. The Detection element defines the part detection behavior, while the Measurements element contains one sub-element for each requested part measurement.

The id attribute associated with each measurement defines an identifier that must be unique among all measurements in the configuration file.

e.g. `<Area id=”1001”>`

Most part measurement elements contain one or more region (2D), region (3D) or circle region.

The Id attribute of the Script tool is a common delimited list, for multiple output support.

Detection

A detection element defines settings for part detection.

Detection Child Elements

Element	Type	Description
HeightThreshold	64f	Setting for height threshold (mm).
GapThreshold	64f	Setting for gap threshold (mm).
AreaThreshold	64f	Setting for area threshold (mm2).
LengthMax	64f	Setting for maximum length of a part (mm).
HeightThresholdDirection	32u	Setting for whether data in included for above or below the threshold 0 – Above 1 – Below
FrameOfReference	32u	Setting for frame of reference 0 – Sensor 1 – Part This setting apply to all part measurement except for bounding box, which is always relative to the sensor's FOV.
HeightThresholdMin	64f	Constraint for height threshold minimum (mm).
HeightThresholdMax	64f	Constraint for height threshold maximum (mm).
GapThresholdMin	64f	Constraint for gap threshold minimum (mm).
GapThresholdMax	64f	Constraint for gap threshold maximum (mm).
AreaThresholdMin	64f	Constraint for area threshold minimum (mm^2).
AreaThresholdMax	64f	Constraint for area threshold maximum (mm^2).
LengthMaxLimitMin	64f	Constraint for lengthMax minimum (mm).
LengthMaxLimitMax	64f	Constraint for legnthMax maximum (mm).

PartRegion

A Part Region element defines a rectangular area of interest on the x-y plane.

Part Region Child Elements

Element	Type	Description
X	64f	Setting for area x position (mm).
Y	64f	Setting for area y position (mm).
Width	64f	Setting for region width (mm).
Height	64f	Setting for region height (mm).

PartRegion3D

A Part Region 3D element defines a rectangular area of interest in 3D.

Part Region 3D Child Elements

Element	Type	Description
X	64f	Setting for volume x position (mm).
Y	64f	Setting for volume y position (mm).
Z	64f	Setting for volume z position (mm).
Width	64f	Setting for volume width (mm).
Length	64f	Setting for volume length (mm).
Height	64f	Setting for volume height (mm).

SurfaceCircleRegion

A Surface Circle Region element defines a circular surface area of interest.

Surface Circle Region Child Elements

Element	Type	Description
X	64f	Setting for circle x position (mm).
Y	64f	Setting for circle y position (mm).
Radius	64f	Setting for circle radius (mm).

SurfaceFeature3D

A Feature element defines the settings for detecting a feature within an area of interest.

Feature Child Elements

Element	Type	Description
Type	32s	Setting to determine how the feature is detected within the area: 0 – Centroid 2d 1 – Centroid 3d 2 – X Min 3 – X Max 4 – Y Min 5 – Y Max 6 – Z Min 7 – Z Max
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Element for feature detection volume.

Measurements / PartArea

A PartArea element defines settings for an area measurement.

Part Area Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm^2).
DecisionMax	64f	Setting for decision threshold maximum (mm^2).
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable

Element	Type	Description
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartVolume

A PartVolume element defines settings for a volume measurement.

Part Volume Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm^3).
DecisionMax	64f	Setting for decision threshold maximum (mm^3).
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartHeight

A PartHeight element defines settings for a height measurement.

Part Height Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).

Element	Type	Description
Type	32s	Setting for measurement type: 0 – Minimum 1 – Maximum 2 – 2D Centroid 3 – 3D Centroid 4 – Average 5 – Median
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartEllipseMajor

A PartEllipseMajor element defines settings for an ellipse major measurement.

Part Ellipse Major Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value

Element	Type	Description
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartEllipseMinor

A PartEllipseMinor element defines settings for an ellipse minor measurement.

Part Ellipse Minor Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartEllipseAngle

A PartEllipseAngle element defines settings for an ellipse angle measurement.

Part Ellipse Angle Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (degrees).
DecisionMax	64f	Setting for decision threshold maximum (degrees).

Element	Type	Description
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartEllipseRatio

A PartEllipseRatio element defines settings for an ellipse ratio measurement.

Part Ellipse Ratio Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum.
DecisionMax	64f	Setting for decision threshold maximum.
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Element	Type	Description
LinkIds	32u	List of linkable measurements.

Measurements / PartBoundingBoxX

A PartBoundingBoxX element defines settings for a bounding box X measurement.

Part Bounding Box X Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RotationEnable	32u	Setting to enable or disable bounding box rotation. 0 – Vertical bounding box. 1 – Rotated bounding box.
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartBoundingBoxY

A PartBoundingBoxY element defines settings for a bounding box Y measurement.

Part Bounding Box Y Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RotationEnable	32u	Setting to enable or disable bounding box rotation. 0 – Vertical bounding box. 1 – Rotated bounding box.
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable

Element	Type	Description
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartBoundingBoxWidth

A PartBoundingBoxWidth element defines settings for a bounding box width measurement.

Part Bounding Box Width Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RotationEnable	32u	Setting to enable or disable bounding box rotation. 0 – Vertical bounding box. 1 – Rotated bounding box.
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Element	Type	Description
LinkIds	32u	List of linkable measurements.

Measurements / PartBoundingBoxLength

A PartBoundingBoxLength element defines settings for a bounding box length measurement.

Part Bounding Box Length Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RotationEnable	32u	Setting to enable or disable bounding box rotation. 0 – Vertical bounding box. 1 – Rotated bounding box.
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartHoleX

A PartHoleX element defines settings for a Hole X measurement.

Part Hole X Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalRadius	64f	Setting for the nominal radius (mm)
RadiusTolerance	64f	Setting for the radius tolerance (mm)
PartialDetectionEnabled	32u	Setting to enable/disable partial detection 0 – Disable 1 – Enable

Element	Type	Description
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartHoleY

A PartHoleY element defines settings for a Hole Y measurement.

Part Hole Y Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalRadius	64f	Setting for the nominal radius (mm)
RadiusTolerance	64f	Setting for the radius tolerance (mm)
PartialDetectionEnabled	32u	Setting to enable/disable partial detection 0 – Disable 1 – Enable
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region

Element	Type	Description
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartHoleZ

A PartHoleZ element defines settings for a Hole Z measurement.

Part Hole Z Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalRadius	64f	Setting for the nominal radius (mm)
RadiusTolerance	64f	Setting for the radius tolerance (mm)
PartialDetectionEnabled	32u	Setting to enable/disable partial detection 0 – Disable 1 – Enable
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements

Element	Type	Description
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartHoleRadius

A PartHoleRadius element defines settings for a Hole Radius measurement.

Part Hole Radius Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalRadius	64f	Setting for the nominal radius (mm)
RadiusTolerance	64f	Setting for the radius tolerance (mm)
PartialDetectionEnabled	32u	Setting to enable/disable partial detection 0 – Disable 1 – Enable
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	Setting to enable/disable tilt correction 0 – Disable 1 – Enable

Element	Type	Description
TiltXAngle	64f	Setting for manual tilt correction angle X
TiltYAngle	64f	Setting for manual tilt correction angle Y
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartOpeningX

A Part Opening X element defines settings for a Part Opening X measurement.

Part Opening X Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalWidth	64f	Setting for the nominal width (mm)
WidthTolerance	64f	Setting for the width tolerance (mm)
NominalLength	64f	Setting for the nominal length (mm)
LengthTolerance	64f	Setting for the length tolerance (mm)
NominalAngle	64f	Setting for the nominal angle (degrees)
AngleTolerance	64f	Setting for the length tolerance (degrees)
NominalRadius	64f	Setting for nominal radius(mm)
PartialDetectionEnabled	32u	Setting to enable/disable partial detection 0 – Disable 1 – Enable
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region

Element	Type	Description
AutoTiltCorrectionEnabled	32u	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
Type	32u	Opening type 0 – Slot 1 – Rectangle
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartOpeningY

A Part Opening Y element defines settings for a Part Opening Y measurement.

Part Opening Y Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalWidth	64f	Setting for the nominal width (mm)
WidthTolerance	64f	Setting for the width tolerance (mm)
NominalLength	64f	Setting for the nominal length (mm)
LengthTolerance	64f	Setting for the length tolerance (mm)
NominalAngle	64f	Setting for the nominal angle (degrees)
AngleTolerance	64f	Setting for the length tolerance (degrees)
NominalRadius	64f	Setting for nominal radius(mm)
PartialDetectionEnabled	32u	Setting to enable/disable partial detection 0 – Disable 1 – Enable
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements

Element	Type	Description
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
Type	32u	Opening type 0 – Slot 1 – Rectangle
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartOpeningZ

A Part Opening Z element defines settings for a Part Opening Z measurement.

Part Opening Z Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalWidth	64f	Setting for the nominal width (mm)
WidthTolerance	64f	Setting for the width tolerance (mm)
NominalLength	64f	Setting for the nominal length (mm)
LengthTolerance	64f	Setting for the length tolerance (mm)
NominalAngle	64f	Setting for the nominal angle (degrees)
AngleTolerance	64f	Setting for the length tolerance (degrees)
NominalRadius	64f	Setting for nominal radius(mm)
PartialDetectionEnabled	32u	Setting to enable/disable partial detection 0 – Disable 1 – Enable

Element	Type	Description
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
Type	32u	Opening type 0 – Slot 1 – Rectangle
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartOpeningLength

A Part Opening Length element defines settings for a Part Opening Length measurement.

Part Opening Length Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalWidth	64f	Setting for the nominal width (mm)
WidthTolerance	64f	Setting for the width tolerance (mm)
NominalLength	64f	Setting for the nominal length (mm)
LengthTolerance	64f	Setting for the length tolerance (mm)
NominalAngle	64f	Setting for the nominal angle (degrees)
AngleTolerance	64f	Setting for the length tolerance (degrees)

Element	Type	Description
NominalRadius	64f	Setting for nominal radius(mm)
PartialDetectionEnabled	32u	Setting to enable/disable partial detection 0 – Disable 1 – Enable
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
Type	32u	Opening type 0 – Slot 1 – Rectangle
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartOpeningAngle

A Part Opening Angle element defines settings for a Part Opening Angle measurement.

Part Opening Angle Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalWidth	64f	Setting for the nominal width (mm)
WidthTolerance	64f	Setting for the width tolerance (mm)

Element	Type	Description
NominalLength	64f	Setting for the nominal length (mm)
LengthTolerance	64f	Setting for the length tolerance (mm)
NominalAngle	64f	Setting for the nominal angle (degrees)
AngleTolerance	64f	Setting for the length tolerance (degrees)
NominalRadius	64f	Setting for nominal radius(mm)
PartialDetectionEnabled	32u	Setting to enable/disable partial detection 0 – Disable 1 – Enable
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
Type	32u	Opening type 0 – Slot 1 – Rectangle
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartStudTipX

A Part Stud Tip X element defines settings for a Part Stud Tip X measurement.

Part Stud Tip X Elements

Element	Type	Description
Name	String	Setting for measurement name.

Element	Type	Description
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalRadius	64f	Setting for nominal radius (mm)
RadiusOffset	64f	Setting for the radius offset (mm)
StudHeight	64f	Setting for the stud height (mm)
BaseHeight	64f	Setting for the stud base height (mm)
TipHeight	64f	Setting for the stud tip height (mm)
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartStudTipY

A Part Stud Tip Y element defines settings for a Part Stud Tip Y measurement.

Part Stud Tip Y Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalRadius	64f	Setting for nominal radius (mm)
RadiusOffset	64f	Setting for the radius offset (mm)

Element	Type	Description
StudHeight	64f	Setting for the stud height (mm)
BaseHeight	64f	Setting for the stud base height (mm)
TipHeight	64f	Setting for the stud tip height (mm)
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartStudTipZ

A Part Stud Tip Z element defines settings for a Part Stud Tip Z measurement.

Part Stud Tip Z Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalRadius	64f	Setting for nominal radius (mm)
RadiusOffset	64f	Setting for the radius offset (mm)
StudHeight	64f	Setting for the stud height (mm)
BaseHeight	64f	Setting for the stud base height (mm)
TipHeight	64f	Setting for the stud tip height (mm)

Element	Type	Description
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartStudBaseX

A Part Stud Base X element defines settings for a Part Stud Base X measurement.

Part Stud Base X Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalRadius	64f	Setting for nominal radius (mm)
RadiusOffset	64f	Setting for the radius offset (mm)
StudHeight	64f	Setting for the stud height (mm)
BaseHeight	64f	Setting for the stud base height (mm)
TipHeight	64f	Setting for the stud tip height (mm)
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region

Element	Type	Description
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartStudBaseY

A Part Stud Base Y element defines settings for a Part Stud Base Y measurement.

Part Stud Base Y Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalRadius	64f	Setting for nominal radius (mm)
RadiusOffset	64f	Setting for the radius offset (mm)
StudHeight	64f	Setting for the stud height (mm)
BaseHeight	64f	Setting for the stud base height (mm)
TipHeight	64f	Setting for the stud tip height (mm)
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements

Element	Type	Description
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	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
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartStudBaseZ

A Part Stud Base Z element defines settings for a Part Stud Base Z measurement.

Part Stud Base Y Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalRadius	64f	Setting for nominal radius (mm)
RadiusOffset	64f	Setting for the radius offset (mm)
StudHeight	64f	Setting for the stud height (mm)
BaseHeight	64f	Setting for the stud base height (mm)
TipHeight	64f	Setting for the stud tip height (mm)
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region

Element	Type	Description
AutoTiltCorrectionEnabled	32u	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
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartStudBaseRadius

A Part Stud Base Radius element defines settings for a Part Stud Base Radius measurement.

Part Stud Base Radius Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
NominalRadius	64f	Setting for nominal radius (mm)
RadiusOffset	64f	Setting for the radius offset (mm)
StudHeight	64f	Setting for the stud height (mm)
BaseHeight	64f	Setting for the stud base height (mm)
TipHeight	64f	Setting for the stud tip height (mm)
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
AutoRefRegionEnabled	32u	Setting to enable/disable reference region 0 – Disable 1 – Enable
RefRegions/RefRegion	PartRegion	Reference region
AutoTiltCorrectionEnabled	32u	Setting to enable/disable tilt correction 0 – Disable 1 – Enable
TiltXAngle	64f	Setting for manual tilt correction angle X

Element	Type	Description
TiltYAngle	64f	Setting for manual tilt correction angle Y
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / SurfacePlaneXAngle

A Part Plane X Angle element defines settings for a Part Plane X Angle measurement.

Part Plane X Angle Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Element	Type	Description
LinkIds	32u	List of linkable measurements.

Measurements / SurfacePlaneYAngle

A Part Plane Y Angle element defines settings for a Part Plane Y Angle measurement.

Part Plane Y Angle Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / SurfacePlaneZOffset

A Part Plane Z Offset element defines settings for a Part Plane Z Offset measurement.

Part Plane Z Offset Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
RefRegions	(Collection)	Reference regions, contains 1 or 2 RefRegion elements
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable

Element	Type	Description
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartPositionX

A Part Position X element defines settings for a Part Position X measurement.

Part Position X Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
Feature	SurfaceFeature3d	Measurement feature.
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartPositionY

A Part Position Y element defines settings for a Part Position Y measurement.

Part Position X Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
Feature	SurfaceFeature3d	Measurement feature.
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / PartPositionZ

A Part Position Z element defines settings for a Part Position Z measurement.

Part Position X Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	PartRegion3d	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
Feature	SurfaceFeature3d	Measurement feature.
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable

Element	Type	Description
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / SurfaceTextureRoughness

A Surface Texture Roughness element defines settings for a Surface Texture Roughness measurement.

Surface Texture Roughness Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	SurfaceCircleRegion	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / SurfaceTextureInvalidCount

A Surface Texture Invalid Count element defines settings for a Surface Texture Invalid Count measurement.

Surface Texture Invalid Count Elements

Element	Type	Description
Name	String	Setting for measurement name.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).

Element	Type	Description
RegionEnabled	32u	Setting to enable/disable region 0 – Disable 1 – Enable
Region	SurfaceCircleRegion	Measurement region
LinkEnabled	32u	Setting to enable/disable linking 0 – Disable 1 – Enable
Link	32u	Measurement ID to link with
Scale	64f	Setting for scale factor to apply to measurement value
Offset	64f	Setting for offset to apply to measurement value
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).
LinkIds	32u	List of linkable measurements.

Measurements / Script

A Script element defines settings for a script measurement.

Script Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Code	String	Script code.

Output

The Outputs element has the following sub-element types: Ethernet, Serial, Analog, and Digital Output. Each of these subelements defines the output settings for a different type of Gocator output.

The *Source* identifiers that are used with *Video, profile, part and intensity* outputs are *profile source identifiers*. Refer to Profile Sources (page 170) for more information.

The *Source* identifiers that are used with *Value* and *Decision* outputs correspond to the measurement identifiers defined in the Measurements element. E.g.

```
<ProfileMeasurement>
  ...
  <Measurements>
    <Width id="1000">
    ...
    <Height id="2000">
...
<Outputs>
  <Ethernet>
    ...
    <Decision>1000,2000</Decision>
    ...
```

Ethernet

The Ethernet element defines settings for Ethernet output.

Ethernet Child Elements

Element	Type	Description
Protocol	32s	Setting for selected protocol: 0 – Gocator 1 – Modbus TCP 2 – EtherNet/IP 3 – ASCII
Video	String	Setting for selected video sources (comma-delimited list).
Profile	String	Setting for selected profile sources (comma-delimited list).
ProfileIntensity	String	Setting for selected profile intensity sources (comma-delimited list).
RawProfile	String	Setting for selected raw profile sources (comma-delimited list).
Part	String	Setting for selected part sources (comma-delimited list).
PartIntensity	String	Setting for selected part intensity sources (comma-delimited list).
Value	String	Setting for selected value sources (comma-delimited list).
Decision	String	Setting for selected decision sources (comma-delimited list).
AsciiOperation	32s	Setting for the ASCII protocol operation mode: 0 – Asynchronous 1 – Polling
AsciiControlPort	32u	Setting for the ASCII protocol control channel port number.
AsciiHealthPort	32u	Setting for the ASCII protocol health channel port number.
AsciiDataPort	32u	Setting for the ASCII protocol data channel port number.
AsciiDelimiter	String	Setting for the ASCII protocol delimiter character.
AsciiTerminator	String	Setting for the ASCII protocol terminator character.
AsciiInvalidValue	String	Setting for the ASCII protocol invalid value string
AsciiCustomFormatEnabled	32u	Setting for the ASCII custom format 0 – Disable 1 – Enable
AsciiCustomDataFormat	String	Setting for the format of ASCII custom data string.

Element	Type	Description
EIPBufferEnabled	32u	Setting for enable/dissable EIP buffering 0 – Disable 1 – Enable
ModbusBuferEnabled	32u	Setting for enable/dissable Modbus buffering 0 – Disable 1 – Enable
VideoOptions	String	Constraint for eligible video sources (comma-delimited list).
ProfileOptions	String	Constraint for eligible profile sources (comma-delimited list).
ProfileIntensityOptions	String	Constraint for eligible profile intensity sources (comma-delimited list).
RawProfileOptions	String	Constraint for eligible raw profile sources (comma-delimited list).
PartOptions	String	Constraint for eligible part sources (comma-delimited list).
PartIntensityOptions	String	Constraint for eligible part intensity sources (comma-delimited list).
ValueOptions	String	Constraint for eligible value sources (comma-delimited list).
DecisionOptions	String	Constraint for eligible decision sources (comma-delimited list).

Serial

The Serial element defines settings for Serial output.

Serial Child Elements

Element	Type	Description
Value	String	Setting for selected value sources (comma-delimited list).
Decision	String	Setting for selected decision sources (comma-delimited list).
Protocol	32s	Setting for the serial protocol: 0 – Gocator 1 – Selcom Serial Selcom Serial is only available on the Gocator 2340-3B-N-12 model
SelcomRate	32u	Setting for Selcom Serial output rate (bits/s)
SelcomFormat	32s	Setting for Selcom Serial output format: 0 – 14-bit 1 – 14-bit with search/track information 2 – 12-bit 3 – 12-bit with search/track information The options are only available for the Gocator 2340-3B-N-12.
AsciiDelimiter	String	Setting for the ASCII protocol delimiter character.
AsciiTerminator	String	Setting for the ASCII protocol terminator character.
AsciiInvalidValue	String	Setting for the ASCII protocol invalid value string
AsciiCustomFormatEnabled	32u	Setting for the ASCII custom format 0 – Disable 1 – Enable
AsciiCustomDataFormat	String	Setting for the format of ASCII custom data string.
ValueOptions	String	Constraint for eligible value sources (comma-delimited list).
DecisionOptions	String	Constraint for eligible decision sources (comma-delimited list).
ProtocolOptions	String	Constraint for eligible protocol options (comma-delimited list)
SelcomRateOptions	String	Constraint for Selcom Serial rate options (comma-delimited list)
SelcomFormatOptions	String	Constraint for Selcom Serial format options (comma-delimited list)

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
CurrentMin	64f	Setting for minimum output current (mA).
CurrentMax	64f	Setting for maximum output current (mA).
CurrentInvalid	64f	Setting for invalid output current (mA).
CurrentInvalidEnable	32u	0 – Output keeps currently value if measurement is invalid. 1 – Outputs CurrentInvalid if measurement is invalid.
DataScaleMin	64f	Setting for measurement value associated with the minimum current.
DataScaleMax	64f	Setting for measurement value associated with the maximum current.
Value	32u	Setting for selected value source.
Decision	32u	Setting for selected decision source.
CurrentLimitMin	64f	Constraint for minimum output current (mA).
CurrentLimitMax	64f	Constraint for maximum output current (mA).
ValueOptions	String	Constraint for eligible value sources (comma-delimited list).
DecisionOptions	String	Constraint for eligible decision sources (comma-delimited list).
Event	32s	Setting for which event control the output: 1 – Measurement 2 – Software
ScheduleEnable	32u	Setting for scheduled output mode. When unscheduled, output updates immediately. When scheduled, output updates according to a target value in software command, or a delay. 0 – Not scheduled 1 – Scheduled
Delay	64f	Setting for output delay. The delay is measured from exposure (first exposure for multiple exposure) to when output is scheduled. Ignored when ScheduleEnable is 0. The units depends on SystemDomain.

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.

DigitalOutput

A DigitalOutput element defines settings for a digital output. There are two DigitalOutput elements, each identified by a unique id attribute (0 and 1):

```
<DigitalOutput id="0">
```

DigitalOutput Child Elements

Element	Type	Description
PassMode	32u	Setting to specify how the state of the output is defined: 0 – Pass if decision is true 1 – Pass if decision is false 2 – Pass always
PulseWidth	32u	Setting for digital pulse width (us).
Decision	String	Setting for selected decision sources (comma-delimited list).
PulseWidthMin	32u	Constraint for minimum pulse width (us).

Element	Type	Description
PulseWidthMax	32u	Constraint for maximum pulse width (us).
DecisionOptions	String	Constraint for eligible decision sources (comma-delimited list).
SignalType	32s	Setting for signal type: 0 – Pulsed output 1 – Continuous output
Event	32s	Setting for which event control the output: 1 – Measurement 2 – Software 4 – Exposure
ScheduleEnable	32u	Setting for scheduled output mode. When unscheduled, output updates immediately. When scheduled, output updates according to a target value in software command, or a delay. 0 - Not scheduled 1 - Scheduled
Delay	64f	Setting for output delay. The delay is measured from exposure (first exposure for multiple exposure) to when output is scheduled. Ignored when ScheduleEnable is 0. The units depends on SystemDomain.

Calibration File

The sensor calibration file 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 the travel offset (Y offset) between sensors for staggered operation

Use Read and Write File command to modify the transformation file.

Calibration Example:

```
<?xml version="1.0" ?>
<SysCal version="2">
  <YResolution>0</YResolution>
  <YSpeed>0</YSpeed>
  <Entries>
    <Entry id="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>
      <Orientation>0</Orientation>
    </Entry>
    <Entry 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>
      <Orientation>0</Orientation>
    </Entry>
  </Entries>
</SysCal>
```

SysCal

The SysCal element contains the calibration record for the sensor. The version attribute defines the version of the record format.

```
<SysCal version="1">
```

SysCal Child Elements

Element	Type	Description
YResolution	64f	Encoder Resolution (mm/tick).
YSpeed	64f	Travel Speed (mm/s).

Entries

An Entry element defines the transformation for a sensor.

Entry Child Elements

Element	Type	Description
X	64f	Translation in the X axis (mm).
Y	64f	Translation in the Y axis (mm).
Z	64f	Translation in the Z axis (mm).
XAngle	64f	Rotation about Y axis (degrees).
YAngle	64f	Rotation about X axis (degrees).
ZAngle	64f	Rotation about Z axis (degrees).
Orientation	32s	Direction of X-axis: 0 – Normal 1 – Reverse

The rotation (counter-clockwise in the X-Z plane) is performed before the translation. If a right-handed system is wanted instead of the normal orientation (e.g. if sensors are opposite in the Y-axis, see Coordinate Systems in the manual), then Orientation can be set to 1 to flip the coordinate system.

Protocols

Gocator Protocol

This chapter describes TCP and UDP commands and data formats used by a client computer to communicate with Gocator sensors. Network communication enables the client to:

- Discover Main and Buddy sensors on an IP network and re-configure their network addresses.
- Configure Main and Buddy sensors.
- Send commands to run sensors, provide software triggers, read/write files, etc.
- Receive data, health, and diagnostic messages.
- Upgrade firmware.

The Concepts section in this chapter defines network connection types (Discovery, Control, Upgrade, Data, Health), common data types, and other terminologies. Subsequent sections provide details about network commands and data formats.

The Gocator SDK provides open-source C language libraries that implement the network commands and data formats defined in this chapter. For more information, refer to Software Development Kit (page 223). .

Concepts

Discovery

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)

The Get Address and Set Address discovery commands can be used to modify a sensor's network configuration. Discovery commands are UDP broadcast messages:

Destination Address	Destination Port
255.255.255.255	3220

When a sensor accepts a discovery command, it will send an 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 senor 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.

Command Channels

A client can send commands and receive responses over the Control and Upgrade TCP channels.

Command Channels

Channel	Port	Description
Control	3190	Sensor accepts commands for most operations.
Upgrade	3192	Sensor accepts commands for firmware upgrades.

The Control and Upgrade channels can be connected simultaneously, but the sensor will accept only a single connection on each port. If an additional connection is attempted on a port that is already connected, the previous connection will be closed and the new connection will be accepted.

Result Channels

A client can receive data messages from a Gocator sensor by connecting to the Data or Health TCP channels.

Result Channels

Channel	Port	Description
Data	3196	Sensor sends data messages.
Health	3194	Sensor sends health messages.

The above ports can be connected simultaneously and the sensor will also accept multiple connections on each port.

Modes

A Gocator system can operate in the following modes.

System Modes

Mode	Description
Video	Sends raw video.
AlignCalibrate	Performs alignment calibration.
TravelCalibrate	Performs travel calibration.
ExpCalibrate	Performs automatic exposure adjustment.
ProfileTemplate	Performs profile template registration.
ProfileMeasure	Performs profile measurements (default mode).
PartMeasure	Performs part detection and measurements.
Raw	Performs profiling and output raw profile data.

Buddy Communication Channels

The peer-to-peer control channels are used by Gocator sensors to communicate amongst each other.

Channel	Port	Description
Discovery	2002, 2005, 2008	Gocator peer discovery port. UDP broadcasts on the subnet is sent once every second.

Channel	Port	Description
Command	2002 to 2015	Gocator request and response ports. Gocator uses UDP communications on these ports for configuration and reporting.
Data	2500	Main Gocator listens on this port for TCP traffic from the Buddy sensor. Buddy sensor communicates using a free port available at the time.

States

A Gocator system can be in one of three states: Conflict, Ready, or Running. The Start and Stop commands are sent by the client to change the current state. The sensor can be configured to boot in either the Ready or Running state.

In the Ready state, a sensor can be configured. In the Running state, a sensor will respond to input signals, perform measurements, drive its outputs, and send data messages to the client. Disconnecting to command channel will change the sensor from the Running state to the Ready state.

The conflict state indicates that a sensor has been configured with a Buddy sensor but the Buddy sensor is not present on the network. The sensor will not accept some commands until the Change Buddy command is used to remove the configured Buddy.

Versions and Upgrades

Upon connection to a Gocator device, the *Get Protocol Version* and *Get System Info* commands can be used to establish protocol and firmware versions.

Versions

Version	Description
Protocol version	Sensor protocol version (major, minor).
Firmware version	Sensor firmware version (major, minor, release, build).

The *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 will be updated in the event that breaking changes are made to the Gocator Protocol.

The *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 Upgrade command. Firmware upgrade files are available from the downloads section under the support tab on the LMI web site. Refer to Firmware Upgrade (page 46) for more information on obtaining the latest firmware.

Every Gocator sensor contains factory backup firmware. Should a firmware upgrade command fail (e.g. power is interrupted), the factory backup firmware will be loaded when the sensor is reset or re-powered. 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.

Data Types

The table below defines the data types and associated type identifiers used throughout this document. All values are transmitted in little endian format (least significant byte first) unless stated otherwise.

Data Types

Type	Id	Description
8u	1	8-bit unsigned integer.

Type	Id	Description
8s	2	8-bit signed integer.
16u	3	16-bit unsigned integer.
16s	4	16-bit signed integer.
32u	5	32-bit unsigned integer.
32s	6	32-bit signed integer.
64u	7	64-bit unsigned integer.
64s	8	64-bit signed integer.
byte	9	1 Byte.
char	10	8-bit ASCII-encoded character.
64f	11	64-bit floating point value.
32f	12	32-bit floating point value.

IP addresses are a notable exception to the little endian rule – the bytes in the address “a.b.c.d” will always be transmitted in the order a, b, c, d (big endian)..

Profile Sources

Profile data is always associated with a *profile source*. The profile source identifies the scope and nature of the laser profile information.

Profile Sources

Profile Source	Id	Description
Main	0	Data from the Main sensor
Buddy	1	Data from the Buddy sensor
Combined	100	Combined data from the Main and Buddy sensor (for wide orientation)
Sensor	X	Data from an individual sensor, where X is the sensor serial number.

Status Codes

Each reply on the Discovery, Control, and Upgrade channels contains 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.

Command and Reply Formats

Commands and replies that are sent and received on the Control and Upgrade channels each begin with a common header.

Command Header

Field	Type	Description
length	64s	Command size, in bytes.
id	64s	Command identifier.

Reply Header

Field	Type	Description
length	64s	Reply size, in bytes.
id	64s	Reply identifier (same as command identifier, unless otherwise noted).
status	64s	Reply status.

Length fields prepended to the beginning of each message refer to the size of the entire message including the length field itself. For example, the value of the length field for a command that consists of only the header (no additional fields) would be 16.

Result Format

Result messages that are received on the Data and Health channels have a common structure. Each result message has a flexible number of attributes in its header followed by a variable number of data blocks after the header. The structure of result messages is defined below.

Result

Field	Type	Description
length	64s	Message length, in bytes.
id	64s	Message type identifier.
attributeCount	64s	Count of attributes in this message.
dataCount	64s	Count of data blocks in this message.
attributes[N]	64s	List of attributes specific to a particular message type.
descriptors[M]	Descriptor	List of data block descriptors (one per data block - format defined below).
blocks[M]	-	List of data blocks specific to a particular message type.

Block Descriptor

Field	Type	Description
length0	64s	Length of block dimension 0.
length1	64s	Length of block dimension 1.
length2	64s	Length of block dimension 2.
type	Type	Data type of block elements - refer to Data Types (page 169).

Each data block is an array of primitive values with 1, 2, or 3 dimensions and is described by an accompanying descriptor. The first *length* field that contains a zero determines the dimensionality of the block . For example, the length 2 field will contain zero for a 2 dimensional block. Items in the highest numbered dimension are transmitted sequentially.

Specific result messages, described later in this chapter, are defined by identifying the attributes and data block formats necessary to express the message content.

Discovery Commands

Get Address

The Get Address command is used to discover Gocator sensors across subnets.

Command

Field	Type	Description
length	64s	Command size, in bytes.
id	64s	Command identifier (0x0001)
signature	64s	Magic number (0x0000504455494D4C).
identifier	64s	Device identifier (serial number) or zero to discover unknown devices.

Reply

Field	Type	Description
length	64s	Reply size, in bytes.
id	64s	Reply identifier (0x1001).
status	64s	Reply status.
signature	64s	Magic number (0x0000504455494D4C).
deviceId	64s	Device identifier.

Field	Type	Description
useDhcp	64s	1 if network interface uses DHCP, 0 otherwise.
reserved[4]	byte	Reserved.
address[4]	byte	IP address.
reserved[4]	byte	Reserved.
mask[4]	byte	Subnet mask.
reserved[4]	byte	Reserved.
gateway[4]	byte	Gateway.
reserved[4]	byte	Reserved.
reserved[4]	byte	Reserved.

Set Address

The Set Address command modifies the network configuration of a Gocator sensor. Upon receiving the command, the Gocator will perform a reset. User should wait for 30 seconds before re-connecting to the Gocator.

Command

Field	Type	Description
length	64s	Command size, in bytes.
id	64s	Command identifier (0x0002).
signature	64s	Magic number (0x0000504455494D4C).
deviceId	64s	Device identifier (serial number).
useDhcp	64s	1 if network interface uses DHCP, 0 otherwise.
reserved[4]	byte	Reserved. Set to 0.
address[4]	byte	IP address.
reserved[4]	byte	Reserved. Set to 0.
mask[4]	byte	Subnet mask.
reserved[4]	byte	Reserved. Set to 0.
gateway[4]	byte	Gateway.
reserved[4]	byte	Reserved. Set to 0.
reserved[4]	byte	Reserved. Set to 0.

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier (0x1002).
status	64s	Reply status.
signature	64s	Magic number (0x0000504455494D4C).
deviceId	64s	Device identifier.

Upgrade Commands

Get Protocol Version

The Get Protocol Version command reports the Upgrade protocol version of the connected sensor.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x0100).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.
majorVersion	64s	Major version.
minorVersion	64s	Minor version.

Start Upgrade

The Start Upgrade command begins a firmware upgrade for the main sensor and any Buddy sensors. All sensors will automatically reset 3 seconds after upgrade process is complete.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x0000).
fileSize	64s	Upgrade file size – in bytes.
file[fileSize]	byte	Upgrade file.

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Get Upgrade Status

The Get Upgrade Status command determines the progress of a firmware upgrade.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x0001).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.
stage	64s	Current upgrade stage: -1 – Upgrade Failed 0 – Upgrade Completed 1 – Upgrade in Progress
progress	64s	Percentage completed – valid when stage is Upgrade in Progress.

Get Upgrade Log

The Get Upgrade Log command can retrieve an upgrade log in the event of upgrade problems.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x0002).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Field	Type	Description
fileSize	64s	Log file size – in bytes.
file[fileSize]	byte	Log file.

Control Commands

Get Protocol Version

The Get Protocol Version command reports the Control protocol version of the connected sensor.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4511).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.
majorVersion	64s	Major version.
minorVersion	64s	Minor version.

Get System Info

The Get System Info command reports information for sensors that are visible in the system.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4002).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.
deviceId	64s	Connected sensor device id (serial number).
firmwareVersion	64s	Connected sensor firmware version.
modelName[32]	char	Connected sensor model name (null-terminated).
role	64s	Connected sensor network role: 0 – Standalone 1 – Main (in a Buddy setup) 2 – Buddy
loginState	64s	Authenticated user: 0 – None 1 – Administrator 2 – Technician

Field	Type	Description
systemState	64s	Current system state: 1 – Conflict 2 – Ready 3 – Running
calibrationType	64s	Current calibration state: 0 – Not calibrated 1 – Auto calibrated 2 – Manual calibrated
hasBuddy	64s	Current buddy assingment state: 0 – No Buddy assigned 1 – Buddy assigned
BuddyInfo	BuddyInfo	Assigned Buddy information (not present if hasBuddy is 0).
sensorCount	64s	Count of visible sensors.
sensorInfo[sensorCount]	SensorInfo	Sensor Information (see format below).

BuddyInfo

Field	Type	Description
deviceId	64s	Buddy device id.
state	64s	Sensor Buddy state: 0 – Connected 1 – Missing 2 – Error
modelName[32]	char	Sensor model name.
firmwareVersion	64s	Buddy firmware version.

SensorInfo

Field	Type	Description
deviceId	64s	Sensor device id.
state	64s	Sensor state: 0 – Paired (not set for main sensor) 1 – Available 2 – Unavailable
modelName[32]	char	Sensor model name (null-terminated).
firmwareVersion	64s	Sensor firmware version.

Log In/Out

The Log In/Out command is used to log in or out of a sensor.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4003).
userType	64s	User account: 0 – None (log out) 1 – Administrator 2 – Technician
password[64]	char	Password (null-terminated; required for log-in only).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Change Password

The Change Password command is used to change log-in credentials for a user.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4004).
user type	64s	User account: 1 – Administrator 2 – Technician
password[64]	char	New password (null-terminated).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Change Buddy

The Change Buddy command is used to assign or unassign a Buddy sensor.

Command

Field	Type	Description
length	64s	Command size - in bytes.
id	64s	Command identifier (0x4005).
action	64s	Action to take: 0 – Unassign Buddy. 1 – Assign Buddy.
count	64s	Count of sensors affected by action (must be 1 at present).
deviceId[count]	64s	List of target sensors.

Reply

Field	Type	Description
length	64s	Reply size - in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Get File List

The Get File List command reports the list of available files on the connected sensor.

Command

Field	Type	Description
length	64s	Command size - in bytes.
id	64s	Command identifier (0x101A).
extension[64]	char	Null-terminated file extension filter, or empty: cfg – Configuration files rec – Record/Playback data files prof – Profile template files xml – XML file

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.
count	64s	Number of file names returned.
name[count][64]	char	List of file names.

Copy File

The Copy File command copies a file from a source to a destination within the connected sensor. Copy a saved configuration to "_live.cfg" to make the configuration live. Copy a saved template to "_live.prof" to make the template live.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x101B).
source [64]	char	Source file name (null-terminated).
destination [64]	char	Destination file name (null-terminated).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Read File

Downloads a file from the connected sensor. Read the file "_live.cfg" and "_live.prof" to down the live configuration and template.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x1007).
fileName[64]	char	File name (null-terminated).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.

Field	Type	Description
status	64s	Reply status.
fileSize	64s	File size – in bytes.
file[fileSize]	byte	File content.

Write File

The Write File command uploads a file to the connected sensor. Write to "_live.cfg" and "_live.prof" to write the make the configuration and template files live. Except for writing to the live files, the file is permanently stored on the sensor.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x1006).
fileName[64]	char	File name (null-terminated).
fileSize	64s	File size – in bytes.
file[fileSize]	byte	File content.

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Delete File

The Delete File command removes a file from the connected sensor.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x1008).
fileName[64]	char	File name (null-terminated).
fileSize	64s	File size – in bytes.
file[fileSize]	byte	File content.

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Get Default File

The Get Default File command gets the name of a default file that will be loaded at boot time. Default files can be defined for configuration, calibration, and profile templates (differentiated by extension).

Command

Field	Type	Description
length	64s	Command size – in bytes.

Field	Type	Description
id	64s	Command identifier (0x4100).
extension[64]	char	Null-terminated file extension: cfg – Configuration files rec – Record/Playback data files prof – Profile template files

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.
fileName[64]	char	File name (null-terminated).

Set Default File

The Set Default File command sets the name of a default file that will be loaded at boot time. Default files can be defined for configuration, calibration, and profile templates (differentiated by extension).

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4101).
fileName[64]	char	File name (null-terminated), including the extension. cfg – Configuration files rec – Record/Playback data files prof – Profile template files

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Get Loaded File

The Get Loaded File command returns the currently loaded (i.e. live) file name and modified status for a file type.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4512).
extension[64]	char	Extension for the file type: cfg – Configuration files prof – Profile template files

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Field	Type	Description
fileName[64]	char	Name of the currently loaded file.
changed	64	Whether or not the currently loaded file has been changed (1: yes; 0: no).

Get Mode

The Get Mode command reports the name of the current system mode.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x1005).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.
mode[16]	char	Mode name (null-terminated).

Set Mode

The Set Mode command sets the name of the current system mode.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x1004).
mode[16]	char	Mode name (null-terminated).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Get Time

This command retrieves the system clock, in microseconds. 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	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x100A).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier (0x100A).

Field	Type	Description
status	64s	Reply status.
time	64u	Current time, in microseconds.

Get Encoder

This command retrieves the current system encoder value.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x101C).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier (0x101C).
status	64s	Reply status.
encoder	64s	Current encoder value, in ticks.

Start

The Start command starts the sensor system (system enters the Running state).

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x100D).
reserved	64s	Reserved field – set to 0.

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

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).

The time and encoder targets value should be set by adding a delay to the time and/or encoder tick returned by Get Time and Get Encoder command. The delay should be set such that it covers the command response time of the Scheduled start command.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x101D).
time target	64s	Specify start time target, in microseconds.
encoder target	64s	Specify start encoder target in ticks.

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier (0x101D).
status	64s	Reply status.

Stop

The Stop command stops the sensor system (system enters the Ready state).

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x1001).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Trigger

The Trigger command applies a software trigger to the system. The system must be configured to accept software triggers and must be in the Running State.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4510).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Scheduled Digital Output

The Scheduled Digital Output command schedules a digital output event. The digital output must be configured to accept software scheduled command and is in the Running State. Refer to Digital Outputs (page 117) on how to set up the digital output.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4518).
index	64s	Index of the output (starts from 0)

Field	Type	Description
target	64s	Specifies the time (us) or position (encoder ticks) of when the event should happen. The target value is ignored if the Signal type in the Digital Output panel is not set to scheduled. The output will be triggered immediately. Refer to Digital Outputs (page 117) for how to set the Signal type.
value	64s	Specifies the target state: 0 – Set to low (continuous) 1 – Set to high (continuous) Ignored if output type is pulsed.

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Scheduled Analog Output

Scheduled Analog Output command schedules a analog output event. The analog output must be configured to accept software scheduled command and is in the Running State. Refer to Analog Output (page 120) on how to set up the digital output.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4519).
index	64s	Index of the output. Must be 0.
target	64s	Specifies the time (us) or position (encoder ticks) of when the event should happen. The target value is ignored if the Signal type in the Analog Output panel is not set to scheduled. The output will be triggered immediately. Refer to Analog Output (page 120) for how to set the Signal type.
value	64s	Output current (nano amperes).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Note that 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.

Ping

The Ping command can be used to test the control connection. This command has no effect.

Command

Field	Type	Description
length	64s	Command size – in bytes.

Field	Type	Description
id	64s	Command identifier (0x100E).
reserved	64s	Reserved – set to 0.

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

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	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4300).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

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	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x1013).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.
fileSize	64s	Size of backup file – in bytes.
file[fileSize]	byte	Backup file content.

Restore

The Restore command uploads a backup file to the connected sensor and then restores all sensor files from the backup.

Note that the sensor must be reset or power-cycled before the restore operation can be completed.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x1014).
fileSize	64s	Size of backup file – in bytes.
file[fileSize]	byte	Backup file content.

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Restore Factory

The Restore Factory command restores the connected sensor to factory default settings. 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	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4301).
resetAddress	64s	Specifies whether network address should be restored to default: 0 – Do not reset address 1 – Reset address

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Set Connection Type

The Set Connection Type command save the type of the master to the sensor's non-volatile storage.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4514).
type	64s	Connection type: 0 – None 1 – Master 100 2 – Master 200 3 – Master 400 4 – Master 800 5 – Master 1200 6 – Master 2400

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Get Connection Type

The Get Connection Type command returns to the set connection type.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4515).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.
type	64s	Connection type (see Set Connection Type above).

Clear Calibration

The Clear calibration command deletes the calibration results.

Command

Field	Type	Description
length	64s	Command size – in bytes.
id	64s	Command identifier (0x4102).

Reply

Field	Type	Description
length	64s	Reply size – in bytes.
id	64s	Reply identifier.
status	64s	Reply status.

Data Results

A Data Result message adheres to the general structure for result messages as defined in Result Format (page 172)

A Data Result contains a variable number of blocks depending on the sources selected for Ethernet output. Each selected source contributes two data blocks (and accompanying data block descriptors): one block for attributes and one block for content such as video pixels or measurement results.

Data Result Header

Field	Type	Description
length	64s	Message length – in bytes.
id	64s	Message id (1).
attributeCount	64s	Count of attributes in this message header (7).
dataCount	64s	Count of data blocks in this message (variable).

Field	Type	Description
reserved	64s	Reserved for internal use.
timestamp	64s	Timestamp (us).
encoder	64s	Encoder value (ticks).
frameCount	64s	Frame count.
digitalInputs	64s	Digital input states.
encoderIndex	64s	Encoder value when the last index is triggered.
reserved	64s	Reserved for internal use.
descriptors[dataCount]	Descriptor	List of data block descriptors.
data[dataCount]	-	List of data blocks.

The formats of the data blocks contributed from specific data sources are described in the following sections.

Video

Video Attributes

Field	Type	Description
dataType	64s	Data type (0x00).
source	64s	Video source.
exposure	64s	Exposure (us).
camera index	64s	Camera index 0 – Front 1 – Back
exposure index	64s	Exposure step index
reserved{N]	64s	A variable number of additional attributes may be included.

Video Data

Field	Type	Description
pixels[height][width]	Byte	Image pixels (dimensions and data type given by block descriptor).

Profile

Profile Attributes

Field	Type	Description
dataType	64s	Data type: 0x01 – Resampled profile 0x02 – Raw profile
source	64s	Profile source.
xResolution	64s	X resolution (nm).
zResolution	64s	Z resolution (nm).
xOffset	64s	X offset (nm).
zOffset	64s	Z offset (nm).
exposure	64s	Exposure (us). Set to zero if multiple exposure mode is used.
reserved[N]	64s	A variable number of additional attributes may be included.

Profile Data (resampled)

Field	Type	Description
ranges[rangeCount]	16s	Range values (unit is z-resolution, 0x8000 represents null range). Dimensions and data type given by block descriptor Z system coordinate = zOffset + zResolution * ranges[index] X system coordinate = xOffset + xResolution * index.

Profile Data (raw)

Field	Type	Description
ranges[rangeCount][2]	16s	X values and range values (unit are X-resolution and Z-resolution respectively. 0x8000 represents NULL point). Dimensions and data type given by block descriptor. X system coordinate = xOffset + xResolution * ranges[rangeCount][0] Z system coordinate = zOffset + zResolution * ranges[rangeCount][1]

Profile Intensity

Profile Intensity Attributes

Field	Type	Description
dataType	64s	Data type: 0x7 – Resampled profile intensity values 0x8 – Raw profile.intensity values
source	64s	Profile source.
reserved[N]	64s	A variable number of additional attributes may be included.

Profile Intensity Data (resampled or raw)

Field	Type	Description
intensityValues[rangeCount]	8u	Array of profile intensity values. Items in the array are arranged in the same order as items in the part profile array. A value of 0 indicates no spot. Dimensions and data type given by block descriptor.

Part Profile

Part Profile Attributes

Field	Type	Description
dataType	64s	Data type (0x03).
source	64s	Profile source.
xResolution	64s	X resolution (nm).
yResolution	64s	Y resolution (nm).
zResolution	64s	Z resolution (nm).
xOffset	64s	X offset (nm).
yOffset	64s	Y offset (nm).
zOffset	64s	Z offset (nm).
reserved[N]	64s	A variable number of additional attributes may be included.

Part Profile Data

Field	Type	Description
ranges[partLength] [partWidth]	16s	Range values (unit is z-resolution, 0x8000 represents null range). Dimensions and data type given by block descriptor. Z system coordinate = zOffset + zResolution * ranges[indexY][indexX] X system coordinate = xOffset + xResolution * indexX Y system coordinate = yOffset + yResolution * indexY

Part Intensity

Part Intensity Attributes

Field	Type	Description
dataType	64s	Data type (0x09).
source	64s	Profile source.
xOffset	64s	X offset (nm).
yOffset	64s	Y offset (nm).
xResolution	64s	X resolution (nm).
yResolution	64s	Y resolution (nm).
reserved[N]	64s	A variable number of additional attributes may be included.

Part Intensity Data

Field	Type	Description
intensityValues[partLength] [partWidth]	8u	Array of profile intensity values. Items in the array are arranged in the same order as items in the part profile array. A value of 0 indicates no spot. Dimensions and data type given by block descriptor.

Alignment Calibration

Alignment Calibration Attributes

Field	Type	Description
dataType	64s	Data type (0x04).
reserved{N]	64s	A variable number of additional attributes may be included.

Alignment Calibration Data

Field	Type	Description
status	64s	Calibration result.

Travel Calibration

Travel Calibration Attributes

Field	Type	Description
dataType	64s	Data type (0x05).
reserved{N]	64s	A variable number of additional attributes may be included.

Travel Calibration Data

Field	Type	Description
status	64s	Calibration result.

Exposure Calibration

Exposure Calibration Attributes

Field	Type	Description
dataType	64s	Data type (0x06).
reserved{N]	64s	A variable number of additional attributes may be included.

Exposure Calibration Data

Field	Type	Description
status	64s	Calibration result.
exposure	64s	Calibrated exposure (ns).

Measurement

Measurement Attributes

Field	Type	Description
dataType	64s	Data type (0x10, 0x11, 0x12, or 0x20).
measurementType	64s	Measurement type: 0x00 – Width (um) 0x01 – Height (um) 0x02 – Distance (um) 0x03 – Center X (um) 0x04 – Center Z (um) 0x05 – Position X (um) 0x06 – Position Z (um) 0x10 – Intersect X (um) 0x11 – Intersect Z (um) 0x12 – Intersect Angle (0.001 degree) 0x13 – Angle X (0.001 degree) 0x20 – Intersect Area (0.001 mm^2) 0x21 – Box Area (0.001 mm^2) 0x23 – Difference Area (0.001 mm^2) 0x24 – Difference Peak (um) 0x25 - Gap (um) 0x26 - Flush (um) 0x27 – Circle Radius (um) 0x28 – Circle X (um) 0x29 – Circle Z (um) 0x2A – Line Standard Deviation (um) 0x2B – Line Error Min (um) 0x2C – Line Error Max (um) 0x2D – Line Percentile (um) 0x2E – Groove X (um) 0x2F – Groove Z (um) 0x31 – Groove Width (um) 0x37 - Groove Depth (um) 0x33 – Strip Width (um) 0x34 – Strip Height (um) 0x35 – Strip X (um) 0x36 – Strip Z (um) 0x40 – Area (0.001 mm^2) 0x41 – Volume (0.001 mm^3) 0x42 – Part Height (um) 0x43 – Centroid X (um) 0x44 – Centroid Y (um) 0x45 – Centroid Z (um) 0x46 – Ellipse Major (um) 0x47 – Ellipse Minor (um) 0x48 – Ellipse Angle (0.001 degree) 0x49 – Ellipse Ratio 0x4A – Bounding Box X (um) 0x4B – Bounding Box Y (um) 0x4C – Bounding Box Width (um) 0x4D – Bounding Box Length (um)

Field	Type	Description
		0x4E – Hole X (um) 0x4F – Hole Y (um) 0x50 – Hole Z (um) 0x51 – Hole Radius (um) 0x52 – Stud Tip X (um) 0x53 – Stud Tip Y (um) 0x54 – Stud Tip Z (um) 0x55 – Stud Base X (um) 0x56 – Stud Base Y (um) 0x57 – Stud Base Z (um) 0x58 – Stud Radius (um) 0x59 – Opening X (um) 0x5A – Opening Y (um) 0x5B – Opening Z (um) 0x5C – Opening Width (um) 0x5D – Opening Length (um) 0x5E – Opening Angle (0.001 degree) 0x5F – Position X (um) 0x60 – Position Y (um) 0x61 - PartPosition Z (um) 0x62 – Plane X Angle (0.001 degree) 0x63 – Plane Y Angle (0.001 degree) 0x64 – Plane Z Offset (um) 0x65 –Surface Texture Roughness (um) 0x66 - Surface Texture Invalid Count (percentage x 1000) 0x30 – Script (script-specific)
id	64s	Unique id of the measurement – as defined in the configuration.
reserved{N]	64s	A variable number of additional attributes may be included.

Measurement Data

Field	Type	Description
value	64s	Result value.
decision	64s	Result decision: 0 – Fail 1 – Pass

Health Results

A Health Result message adheres to the general structure for result messages as defined in Result Format (page 172)

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 utilization or network throughput.

Health Result Header

Field	Type	Description
length	64s	Message length, in bytes.
id	64s	Message id (1000).
attributeCount	64s	Count of attributes in this message header (1).
dataCount	64s	Count of data blocks in this message (1).
deviceId	64s	Sensor device id.
descriptors[dataCount]	Descriptor	List of data block descriptors.

Field	Type	Description
data[dataCount]	-	List of data blocks.

The health data block contains a 2 dimensional array of indicator data. Each row in the array has the following format:

Health Indicator Format

Field	Type	Description
id	64s	Indicator identifier (indicators are defined below).
instance	64s	Indicator instance.
value	64s	Indicator value.

The following health indicators are defined for Gocator sensor systems:

Health Indicators

Indicator	Id	Instance	Value
Encoder Value	1003	-	Current system encoder tick.
Encoder Index	1004	-	Current system encoder index.
Encoder Frequency	1005	-	Current system encoder frequency (ticks/s).
Firmware Version	2000	-	Firmware application version.
FireSync Version	2001	-	Firmware FireSync version.
Temperature	2002	-	Internal temperature (degrees Celsius).
Memory Used	2003	-	Amount of memory currently used (bytes).
Memory Capacity	2004	-	Total amount of memory available (bytes).
Storage Used	2005	-	Amount of non-volatile storage used (bytes).
Storage Capacity	2006	-	Total amount of non-volatile storage available (bytes).
CPU Used	2007	-	CPU usage (percentage of maximum).
Net Out Used	2008	-	Current outbound network throughput (bytes/s).
Net Out Capacity	2009	-	Total available outbound network throughput (bytes/s).
State	2010	-	Current system state.
Camera Errors	2011	-	Number of camera frame errors encountered.
Camera Drops	2012	-	Number of camera frames dropped.
Processing Drops	2015	-	Number of messages dropped before data processing.
Ethernet Drops	2016	-	Number of messages generated but not sent.
Uptime	2017	-	Time elapsed since boot-up or reset (seconds).
Speed	2018	-	Current speed (Hz).
Trigger Drops	2019	-	Number of dropped triggers.
Digital Output Drops	2020	Output index	Number of dropped digital outputs.
Analog Output Drops	2021	Output Index	Number of dropped analog outputs.
Serial Output Drops	2022	Output index	Number of dropped serial outputs.
Digital Inputs	2024		Current status of digital input
Camera Frame Count	2025		Number of camera frames
Speed (thousandth)	2028	-	Current sampling rate (milli-Hz).
Valid Frame Count	20000	-	Number of frames with valid profile data.
Invalid Frame Count	20001	–	Number of frames without valid profile data.
Digital Output Pass (port 0)	20002	Output index	Number of pass digital output pulses.
Digital Output Fail (port 0)	20003	Output Index	Number of fail digital output pulses.

Indicator	Id	Instance	Value
Digital Output Pass (port 1)	20004	Output index	Number of pass digital output pulses.
Digital Output Fail (port 1)	20005	Output Index	Number of fail digital output pulses.
Valid Spot Count	20006	–	Number of valid spots that are detected
Processing Latency	20007	–	Last delay from camera exposure to when results can be scheduled to Rich I/O.
Max Processing Latency	20008	–	Maximum delay from camera exposure to when results can be scheduled to Rich I/O. Reset on start.
Max Spot Count	20009	–	Maximum number of spots that can be detected.
Replay Position	20016	–	Replay frame position
Replay Frame Count	20017	–	Number of frames in buffer
Measurement	30000	Measurement id	Measurement value.
Measurement Pass	30001	Measurement id	Number of pass decisions.
Measurement Fail	30002	Measurement id	Number of fail decisions.
Measurement Minimum	30003	Measurement id	Minimum measurement value.
Measurement Maximum	30004	Measurement id	Maximum measurement value.
Measurement Average	30005	Measurement id	Average measurement value.
Measurement Stddev	30006	Measurement id	Standard deviation of measurement value.
Measurement Invalid Count	30007	Measurement id	Number of invalid values
Part Count	40002		Number of parts detected in Whole Part mode.

Additional undocumented indicator values may be included in addition to the indicators defined above.

Modbus TCP Protocol

Modbus TCP is designed to allow industrial equipment such as Programmable Logic Controllers (PLC), sensors and physical input/output devices to communicate over an Ethernet network.

Modbus/TCP 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 chapter describes the Modbus TCP commands and data formats. Modbus TCP communication enables the client to:

- Switch to a different active configuration.
- Calibrate and run sensors.
- Receive sensor states, stamps and measurement results.

Modbus TCP is enabled in the Output panel. For more information, refer to Ethernet Output (page 113).

If buffering is enabled with the Modbus protocol, the PLC must read the Buffer Advance output register ("Output Registers" on page 201) to advance the queue before reading the measurement results.

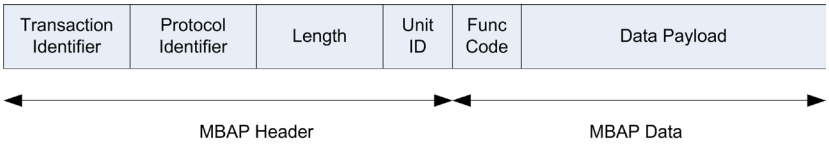
Concepts

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 TCP 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 four clients can be connected to the Gocator simultaneously. A connection will be closed 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 (bit)	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), and the output registers report the sensor states, stamps, and measurement values and decisions. The user can read multiple output registers using a single Read Holding Registers or a single Read Input Registers command. Likewise, the user 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. Refer to Control Registers (page 200) for detailed descriptions.
300 -371	Sensor States	RO	Report sensor states. Refer to Output Registers (page 201) for detailed descriptions.
900 - 999	Stamps	RO	Return stamps associated with each profile. Refer to Output Registers (page 201) for detailed descriptions.
1000 - 1060	Measurements & Decisions	RO	20 Measurement and decision pairs. Refer to Measurement Registers (page 203) for detailed descriptions.

Control Registers

Control registers are used to operate the sensor. Register 0 stores the command to be executed. Register 1-21 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, the user 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. Refer to the Command Register Values table below for more information.
1 – 21	Configuration Filename	WO	Null-terminated filename. Each 16-bit register holds a single character. Only used for Load Configuration Command. Specifies the complete filename, including the file extension ".cfg", ".set" or ".tfm": e.g. "test.cfg" (must be null terminated). If you specify a file ending with the ".cfg" extension, only a configuration will be loaded, unless you are switching from a configuration whose calibration was performed with Source set to Current Configuration in the Layout panel (see "Transformation Sources" on page 60 for more details) to a configuration that uses global transformations. In the latter case, global transformations will also be loaded. If you specify a file ending with the ".set" extension, a configuration and the transformations that were associated with it by performing calibration using Current Configuration will be loaded.

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	Alignment Calibrate	Start the alignment calibration process. State register 301 will be set to 1 (busy) until the calibration process is complete.
3	Travel Calibrate	Start the travel calibration process. State register 301 will be set to 1 (busy) until the calibration process is complete.
4	Clear Calibration	Clear the calibration.
5	Load Configuration	Activate a configuration file. Registers 1 - 21 specifies the filename.

Output Registers

Output registers are used to output states, stamps and measurements results. Each register address holds a 16-bit data value.

State report the current sensor state.

State Register Map

Register Address	Name	Data Size (bit)	Description
300	Stopped / Running	16	Sensor State: 0 - Stopped 1 - Running
301	Busy	16	Busy State: 0 - Not busy 1 - busy Registers 302-> 363 below are only valid when the Busy State is not busy
302	Calibration State	16	Current Calibration State: 0 - Not calibrated 1- Calibrated
303 – 306	Encoder Value	64	Current Encoder value (ticks).
307 – 310	Time	64	Current time (us).
311	Configuration File Length	16	Number of characters in the current configuration file name.
312 – 371	Live Configuration Name	16 bit for each character	Current Configuration Name. Name of currently loaded config file. Does not include the extension. Each 16-bit register contains a single character.

Stamps contain trigger timing information used for synchronizing PLC's actions. PLC can also use this information to match up data from multiple Gocator sensors.

In Profile mode, the stamps are updated after each profile is processed. In Part mode, the stamps are updated after each discrete part has been processed.

Stamp Register Map

Register Address	Name	Data Size (bit)	Description
976	Buffer Advance	16	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	16	Number of buffered messages currently in the queue.
978	Buffer Overflow	16	Buffer Overflow Indicator: 0 - No overflow 1 - Overflow
979	Inputs	8	Digital input state.
980 – 983	Encoder Index	64	Encoder value when the index is last triggered.
984 – 985	Exposure	32	Exposure (us).
986 – 987	Temperature	32	Sensor temperature (mC).
988 – 991	Encoder Value	64	Encoder value (ticks).
992 – 995	Timestamp	64	Time (us).
996 – 999	Frame Counter	64	Frame counter.

Measurement Registers

Measurement results are reported in pairs of value and decision. Measurement values are 32-bit wide and decisions are 8-bit 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), 1013 (low word) and the decision at 1015.

In Profile mode, the measurement results are updated after each profile is processed. In Whole Part mode, the measurement results are updated after each discrete part has been processed.

Measurement Register Map

Register Address	Name	Data Size (bit)	Description
1000 – 1001	Measurement ID 0 Value	32	Measurement ID 0 Value
1002	Measurement ID 0 Decision	8	Measurement ID 0 Decision
1003 – 1004	Measurement ID 1 Value	32	Measurement ID 1 Value
1005	Measurement ID 1 Decision	8	Measurement ID 1 Decision
…	…	…	…

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 chapter describes the EtherNet/IP messages and data formats. EtherNet/IP communication enables the client to:

- Switch to a different active configuration.
- Calibrate and run sensors.
- Receive sensor states, stamps and measurement results.

EtherNet/IP is enabled in the Output panel. For more information, refer to Ethernet Output (page 113).

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. For example, an “assembly object” is a type of object with a data attribute that can be accessed via GetAttribute and SetAttribute commands. The Gocator uses assembly objects to take commands and provide sensor state and measurement values.

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 not supported.

The default EtherNet/IP ports are used. Port 44818 is used for TCP connections and UDP queries (e.g. listIdentity 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 (Attr.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	100 for Gocator 2000, 1000 for Gocator 2300	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 3 different assembly objects: Command, State and Sample.

All assembly object instances are static. Data in a data byte array in an assembly object are stored in the Big Endian format.

Command Object

The command object is used to start, stop, calibrate and switch configuration on the sensor.

Command Assembly

Information	Value
Class	0x4
Instance	0x310
Number of Attributes	3
Length	32 bytes
Supported Service	0x10 (Write Single Attribute)

Attributes 1 and 2 are not implemented. These are not required for static assembly object.

Attribute 3

Attribute	Name	Type	Value	Description	Access
3	Command	Byte Array	See Below	Commands parameters Byte 0 - Command. See table below for specification of the values. Byte 1-31 - Used for load configuration command	Get, Set

Command Definitions

Value	Name	Description
0	Stop running	Stop the sensor. No action if the sensor is already stopped
1	Start Running	Start the sensor. No action if the sensor is already started.
2	Alignment Calibrate	Start the calibration process. Byte 1 of the Sensor State Assembly will be set to 1 (busy) until the calibration process is complete, then back to zero.
3	Travel Calibrate	Start the travel calibration process. Byte 1 of the Sensor State Assembly will be set to 1 (busy) until the calibration process is complete, then back to zero
4	Clear Calibration	Clear the calibration
5	Load Configuration	Load a configuration file. Bytes 1 - 31 for the filename: one ASCII character per byte. File name must be NULL terminated. If you specify a file ending with the ".cfg" extension, only a configuration will be loaded, unless you are switching from a configuration whose calibration was performed with Source set to Current Configuration in the Layout panel (see "Transformation Sources" on page 60 for more details) to a configuration that uses global transformations. In the latter case, global transformations will also be loaded. If you specify a file ending with the ".set" extension, a configuration and the transformations that were associated with it by performing calibration using Current Configuration will be loaded.

Sensor State Assembly Object

The sensor state assembly object contains sensor's states such as the current sensor temperature, frame count and encoder values.

Sensor State Assembly

Information	Value
Class	0x4
Instance	0x320
Number of Attributes	3
Length	100 bytes
Supported Service	0x0E (Get Single Attribute)

Attributes 1 and 2 are not implemented. These are not required for static assembly object.

Attribute 3

Attribute	Name	Type	Value	Description	Access
3	Command	Byte Array		Sensor state information. See below for more details	Get

Sensor State Information

Byte	Name	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.
2	Calibration state	Calibration status: 0 - Not calibrated 1 - Calibrated The value is only valid when the command in progress is set to 0..
3-10	Encoder	Current encoder position (64-bit signed integer)
11-18	Time	Current time (64-bit unsigned integer)
19	Current Configuration Filename Length	Number of characters in the current configuration filename. (e.g. 8 for “myconfig”). The length does NOT include the .cfg extension.
20-43	Current Configuration Filename	Name of currently loaded config file, does not include the “.cfg” extension. Each byte contains a single character (valid when byte 1 = 0).
44 - 99	Reserved	Reserved bytes

Sample State Assembly

The sample state object contains measurements and their associated stamp information.

Sample State Assembly

Information	Value
Class	0x4

Information	Value
Instance	0x321
Number of Attributes	3
Length	180 bytes
Supported Service	0x0E (Get Single Attribute)

Attribute 3

Attribute	Name	Type	Value	Description	Access
3	Command	Byte Array		Sample state information. See below for more details	Get

Sample State Information

Byte	Name	Description
0-1	Inputs	Digital input state
2-9	Z Index Position	Encoder position at time of last index pulse (64-bit signed integer)
10-13	Exposure	Laser exposure in us
14-17	Temperature	Sensor temperature in degrees celsius * 1000
18-25	Position	Encoder position 64-bit signed integer)
26-33	Time	Time (64-bit unsigned integer)
34-41	Frame Counter	Frame counter (64-bit unsigned integer)
42	Buffer Counter	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	Measurement ID 0 Value
84	Decision 0	Measurement ID 0 Decision
85-88	Measurement 1	Measurement ID 1 Value
89	Decision 1	Measurement ID 1 Decision
...	...	
175-178	Measurement 19	Measurement ID 19 Value
179	Decision 19	Measurement ID 19 Decision

Measurement results are reported in pairs of value and decision. Measurement values are 32-bit wide and decisions are 8-bit 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 * 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.

The measurement results are updated after each discrete part has been processed. If buffering is enabled in the Ethernet Output panel (page 113), reading the Sample State Assembly Object automatically advances the buffer.

Extended Sample State Assembly

The extended sample state object contains measurements and their associated stamp information.

Sample State Assembly

Information	Value
Class	0x4
Instance	0x322
Number of Attributes	3
Length	680 bytes
Supported Service	0x0E (Get Single Attribute)

Attribute 3

Attribute	Name	Type	Value	Description	Access
3	Command	Byte Array		Sample state information. See below for more details	Get

Sample State Information

Byte	Name	Description
0-1	Inputs	Digital input state
2-9	Z Index Position	Encoder position at time of last index pulse (64-bit signed integer)
10-13	Exposure	Laser exposure in us
14-17	Temperature	Sensor temperature in degrees celsius * 1000
18-25	Position	Encoder position 64-bit signed integer)
26-33	Time	Time (64-bit unsigned integer)
34-41	Frame Counter	Frame counter (64-bit unsigned integer)
42	Buffer Counter	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	Measurement ID 0 Value
84	Decision 0	Measurement ID 0 Decision
85-88	Measurement 1	Measurement ID 1 Value
89	Decision 1	Measurement ID 1 Decision
...	...	
675-678	Measurement 119	Measurement ID 119 Value
679	Decision 119	Measurement ID 119 Decision

Measurement results are reported in pairs of value and decision. Measurement values are 32-bit wide and decisions are 8-bit 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 * 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.

The measurement results are updated after each discrete part has been processed. If buffering is enabled in the Ethernet Output panel (page 113), reading the Extended Sample State Assembly Object automatically advances the buffer.

ASCII Protocol

This chapter describes the ASCII protocol available over the Ethernet and serial outputs. The protocol communicates using ASCII strings and the output result format from the sensor is user-configurable.

Ethernet Communication

Gocator's Ethernet communication is bidirectional. Measurement results are sent on the Ethernet output in one of two modes: Polling or Asynchronous. The ASCII protocol over Ethernet enables the client to

- Switch to a different active configuration.
- Calibrate, run and trigger sensors.
- Receive sensor states, health indicators, stamps and measurement results

As with the Gocator Protocol there are separate channels for Control, Data and Health messages. The Control channel is used for commands. The Data channel is used to receive and poll for measurement results. The Health channel is used to receive health indicators.

The port number used for each channel is configurable. Each port can accept multiple connections, up to a total of 16 connections for all ports.

Channels can share the same port or operate on individual ports. The default port number is 8190 for all channels. The following port numbers are reserved for Gocator internal use: 80, 843, 2000 - 2100, 2500 - 2600, 3100 - 3250.

Asynchronous and Polling Operation

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, when the sensor receives a Get Result command, it will send the latest measurement results on the same data channel that the request is received.

Serial Communication

Gocator's serial communication is unidirectional (output only). Measurement results are sent on the Serial output in Asynchronous mode. While measurement values and decisions can be transmitted to an RS-485 receiver, configuration and control operations must be performed through the Gocator's web interface or through communications on the Ethernet output.

Refer to Serial Output (page 241) for cable pinout information.

Gocator serial communication uses the following connection settings:

Serial Connection Settings

Parameter	Value
Start Bits	1
Stop Bits	1
Parity	None
Data Bits	8
Baud Rate (b/s)	115200
Format	ASCII

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

Standard Result Format

Measurement results can either be sent in the standard format, or in a custom format. In the standard format, the users 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

Standard Result Format:

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 inData Results (page 188) section.
Id	i_n	n	Decimal value that represents the unique identifier of the measurement.

Field	Shorthand	Length	Description
ValueStart	V	1	Start of measurement value. This field and the following Value field are optional – they will only be present if the measurement value has been selected for transmission.
Value	v_n	n	Measurement value, in decimal. The unit of the value is measurement-specific.
DecisionStart	D	1	Start of measurement decision. This field and the following Decision field are optional – they will only be present if the measurement decision has been selected for transmission.
Decision	d_1	1	Measurement decision: 0 – Fail 1 – Pass

Custom Result Format

In the custom format, users enter a formatting string with place holders to create a custom message. The default formatting 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
%decision[Measurement ID]	Measurement decision of the specified measurement ID

Control Commands

Optional parameters are shown in ***italic***. Placeholder for data is surrounded by brackets (<>). In the examples, the delimiter is set to ','.

Start

The Start command starts the sensor system (enters 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:

```
Start
OK
Start,1000000
ok
Start
ERROR, Could not start the sensor
```

Stop

The stop command stops the sensor system (enters 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:

```
Stop
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).

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:

```
Trigger
OK
Trigger,1000000
OK
```

Load Configuration

The Load Configuration command switches the active sensor configuration.

Formats

Message	Format
Command	LoadConfig*, configuration file name* If the configuration file name is not specified, the command returns the current configuration name. An error message is generated if there is no configuration loaded. ".cfg" is appended if the filename does not have an extension. If you specify a file ending with the ".cfg" extension, only a configuration will be loaded, unless you are switching from a configuration whose calibration was performed with Source set to Current Configuration in the Layout panel (see "Transformation Sources" on page 60 for more details) to a configuration that uses global transformations. In the latter case, global transformations will also be loaded. If you specify a file ending with the ".set" extension, a configuration and the transformations that were associated with it by performing calibration using Current Configuration will be loaded.
Reply	OK or ERROR, <Error Message>

Examples:

```
LoadConfig,test.cfg
OK,test.cfg loaded successfully
LoadConfig
OK,test.cfg
LoadConfig,wrongname.cfg
ERROR, failed to load wrongname.cfg
OK
```

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.

Message	Format
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:

```
Stamp
OK,Time, 9226989840, Encoder, 0, Frame 6
Stamp frame
OK, 6
OK,test.cfg
LoadConfig,wrongname.cfg
```

Alignment Calibration

The Alignment Calibration command performs an alignment calibration based on the calibration settings in the sensor's live configuration. A reply to the command is sent when the calibration has completed or failed. The command is timed out if there has been no progress after one minute.

Formats

Message	Format
Command	AlignCalibrate
Reply	If no arguments are specified OK or ERROR, <Error Message>

Examples:

```
AlignCalibrate
OK
AlignCalibrate
ERROR,ALIGNMENT CALIBRATION FAILED
```

Travel Calibration

The Travel Calibration command performs a travel calibration based on the calibration settings in the sensor's live configuration. A reply to the command is sent when the calibration has completed or failed. The command is timed out if there has been no progress after one minute.

Formats

Message	Format
Command	TravelCalibrate
Reply	If no arguments are specified OK or ERROR, <Error Message>

Examples:

```
TravelCalibrate
OK
TravelCalibrate
ERROR, TRAVEL CALIBRATION FAILED
```

Clear Calibration

The Clear Calibration command clears the calibration record generated by alignment or travel calibration.

Formats

Message	Format
Command	ClearCalibration
Reply	OK or ERROR, <Error Message>

Examples:

```
ClearCalibration
OK
```

Data Commands

Optional parameters are shown in ***italic***. Placeholder for data is surrounded by brackets (<>). In the examples, the delimiter is set to ','.

Get Result

The Get 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
```

Get Value

The Get 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
```

Get Decision

The Get 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***. Placeholder for data is surrounded by brackets (<>). In the examples, the delimiter is set to ','.

Get Health

The Get Health command retrieves health indicators. Refer to (page 221) for details on health indicators

Formats

Message	Format
Command	Health*, health indicator ID.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 '.'. If the health indicator instance field is used the delimiter cannot be set to '.'. .
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.
```

Software Development Kit

The Gocator Software Development Kit (SDK) includes open-source software libraries and documentation that can be used to programmatically access and control Gocator sensors.

The latest version of the SDK can be downloaded from the downloads section, under the support tab, on the LMI Technologies website *http://www.lmi3D.com*.

The following components are included in the SDK.

Component	Description
Gocator API	Gocator API is a C language library that provides support for the commands and data formats used with Gocator sensors.
Gocator Console	Gocator Console is a small console-based application that demonstrates the use of Gocator API.

A pre-built DLL is provided to support 32-bit Windows XP (SP3+) and 32-bit Windows 7. Projects and makefiles are included to support other editions of Windows and Linux.

Example: Configuring and starting a sensor with the Gocator API

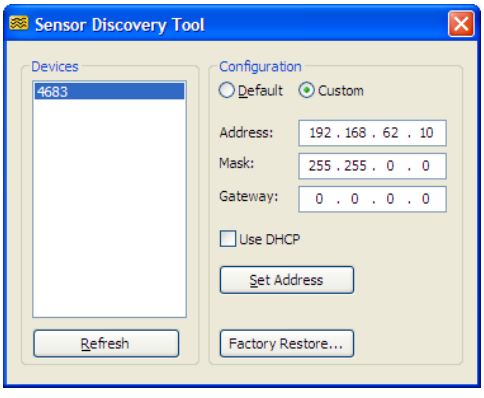
```
#include <Go2.h>

void main()
{
    Go2System system = 0;

    //Open the Go2 library.
    Go2Api_Initialize();

    //Construct a Gocator 2000 system object.
    Go2System_Construct(&system);

    //Connect to default sensor IP address, with default password (blank).
    Go2System_Connect(system, GO2_DEFAULT_IP_ADDRESS, GO2_USER_ADMIN, "");

    //Reconfigure system to use time-based triggering.
    Go2System_SetTriggerSource(system, GO2_TRIGGER_SOURCE_TIME);

    //Send the system a "Start" command.
    Go2System_Start(system);

    //Free the system object.
    Go2System_Destroy(system);

    //Close the Go2 library.
    Go2Api_Terminate();
}
```

For more information about programming with the Gocator SDK, refer to the documentation and sample programs included in the Gocator SDK.

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 LMI's website at http://www.lmi3D.com.

After downloading the tool package [14405-x.x.x.x_software_go2_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 **Select the sensor serial number in the Devices list.**

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. Gocator provides a GenTL driver that allows GenTL compliant third party software (e.g. Halcon and Common Vision Blox) to acquire and process 3D point clouds and intensity generated from the Gocator Whole Part Mode in real-time.

The driver can be obtained from the downloads area on the LMI website at http://www.lmi3D.com

After downloading the tool package [14405-x.x.x.x_software_go2_tools.zip], unzip the file and the driver is stored under the GenTL\x86 directory.

To install the driver in Windows 7:

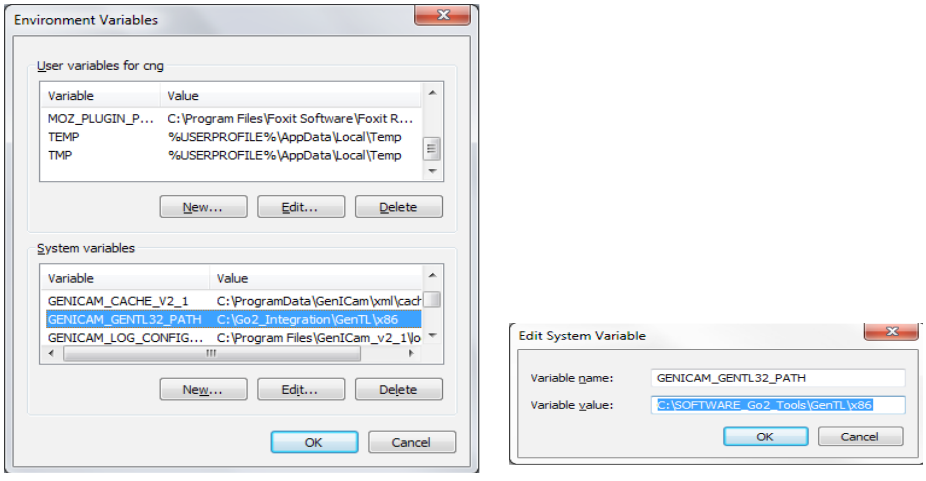
3 **Open the Control Panel**

4 **Select System and Security and then Click System**

5 **Click Advanced System Settings**
The Advanced System Settings link is typically in the left column of the window.

6 **For 32-bit systems, click New to create a system environment variable GENICAM_GENTL32_PATH and point it to the GenTL\x86 directory.**
If the system environment variable already exists, click Edit.

7 **For 64-bit systems, click New to create a system environment variable GENICAM_GENTL64_PATH and point it to the GenTL\x64 directory.**
If the system environment variable already exists, click Edit.



To work with the Gocator GenTL driver, the Gocator must operate in the Whole Part Mode with its part output enabled in the Ethernet Output Panel. Check "Acquire Intensity" and enable intensity output in the Ethernet panel in the Output page if intensity data is required.

Refer to the documentations in the GenTL\ directory for instructions on how to interface to various third party software.

Gocator 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. User 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 required to support the sensor's FOV 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-offset + Px * X-Resolution Y = Y-offset + Py * Y-Resolution Z = Z-offset + Pz * Z-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-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-offset + Px * X-Resolution Y = Y-offset + Py * Y-Resolution Z = 16-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 pixel channel Refer to "Data Results" on page 188 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 (us)
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 (um)
7	28..31	X-resolution(um)
8	32..35	Y-offset (um)
9	36..39	Y-resolution (um)
10	40..43	Z-offset (um)
11	44..47	Z-resolution (um)
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-offset + Px * X-Resolution Y = Y-offset + Py * Y-Resolution Z = Z-offset + Pz * Z-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-Resolution. Z is zero if Pz is 32768.

Rows	Details
(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-offset + Px * X-Resolution Y = Y-offset + Py * Y-Resolution Z = 16-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 Refer to "Data Results" on page 188 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 (us)
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 (um)
7	28..31	X-resolution(um)
8	32..35	Y-offset (um)
9	36..39	Y-resolution (um)
10	40..43	Z-offset (um)
11	44..47	Z-resolution (um)
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 multiple of 32-bit. 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 ".cfg". Writing to this register causes the sensor to switch to the specified configuration.
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

Setting XML File

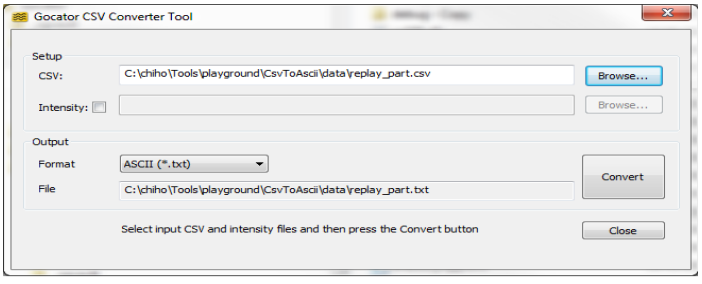
The setting file, Go2GenTL.xml, resides in the same directory as the Gocator GenTL driver. Users can set the resample mode and output format by changing the setting in this file.

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

CSV Converter Tool

After exporting recorded data to CSV (see "Downloading, Exporting and Uploading Recorded Data" on page 38), the Gocator CSV Converter Tool can be used to convert the exported profiles or part data into different formats, including ASCII (XYZI), 16-bit BMP, 16-bit PNG and GenTL formats. This software tool can be obtained from the download area on LMI's website at:
http://www.lmi3D.com

After downloading the tool package [14405-x.x.x.x_software_go2_tools.zip], unzip the file and run the Gocator CSV Converter tool [bin>win32>kCsvConverter.exe].



The software tool supports data exported from the Profile or Whole Part Mode. Data exported from the Raw Mode is not supported.

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 (page 225) section. User 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 **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.

4 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 chapter, please refer to Warranty and Return Policy (page 252) for further assistance.

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. Refer to Sensor Recovery Tool (page 224) for more information.

When attempting to log in, the password is not accepted.

- Refer to Sensor Recovery Tool (page 224) 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. Refer to Specifications (page 234) for more information.
- The exposure setting may be too low. Refer to Exposure (page 55) 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. Review the Trigger Panel (page 50) 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, refer to Trigger Panel (page 50) 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. Refer to Resolution (page 57) for more information on configuring resolution.

- Review the measurements that you have programmed and eliminate any unnecessary measurements.

Specifications

Gocator 3100 Series

The Gocator 3100 series consists of the sensor models defined below.

MODEL	3110
Clearance Distance (CD) (mm)	150
Measurement Range (MR) (mm)	100
Near Field of View (mm)	60 x 105
Far Field of View (mm)	90 x160
Linearity Z (+/- % of MR)	0.005
Resolution Z (mm)	0.035 - 0.108
Resolution XY (mm)	0.090 x 0.100 - 0.150 x 0.160
Light Source	Blue LED (465 nm)
Dimensions (mm)	49 x 74.4 x 276
Weight (kg)	1.35

Linearity Z values and Resolution Z are typical values.

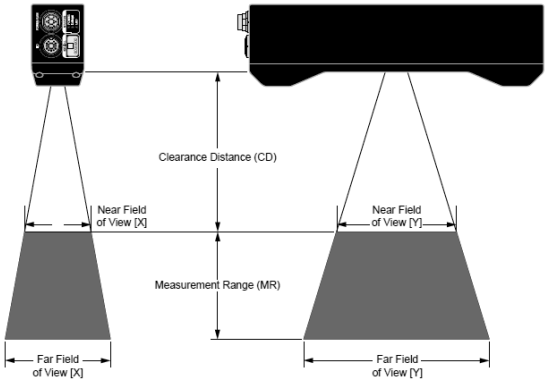
Field of view and resolution XY are specified as [X] x [Y].

ALL 3100 SERIES MODELS	
Scan Rate	Up to 5 Hz
Interface	Gigabit Ethernet
Inputs	Differential Encoder, Light Safety Enable, 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

NOTE: Differential Encoder requires the use of Master 400/800/1200/2400.

Specifications stated are based on preliminary data, final specifications may vary.

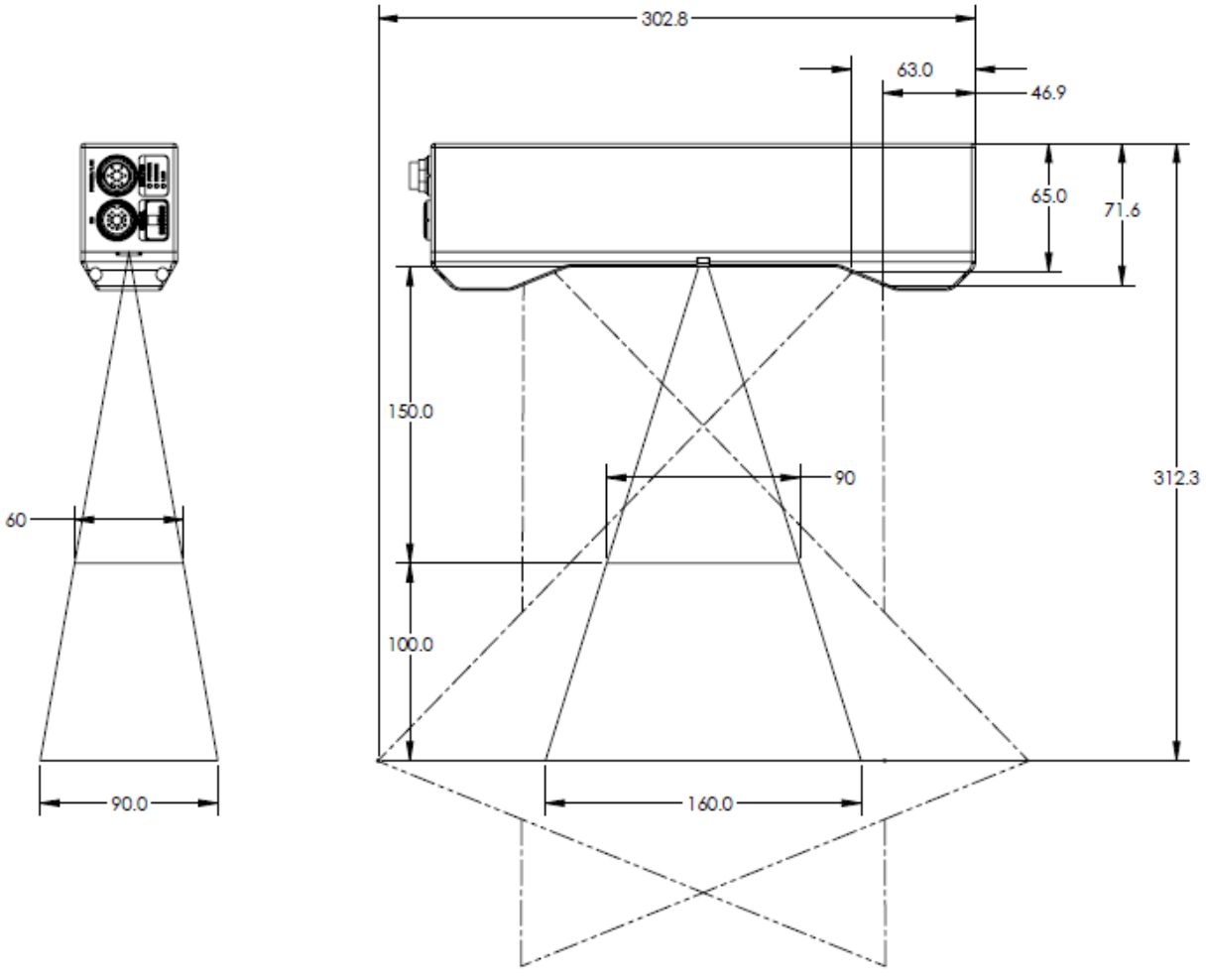
The following diagram indicates the names corresponding to various measurements in the subsequent sections.



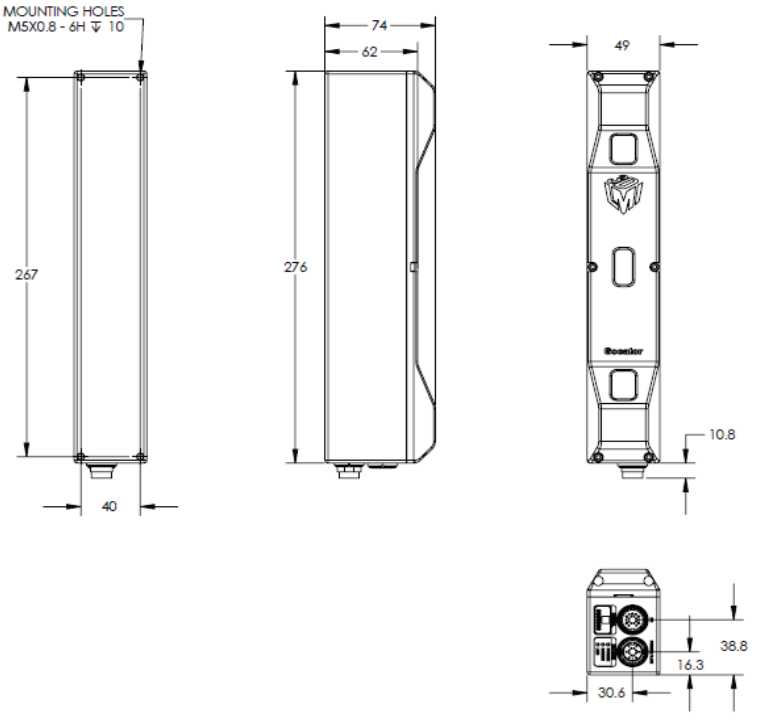
Mechanical dimensions for each sensor model are illustrated on the following pages.

Gocator 3110

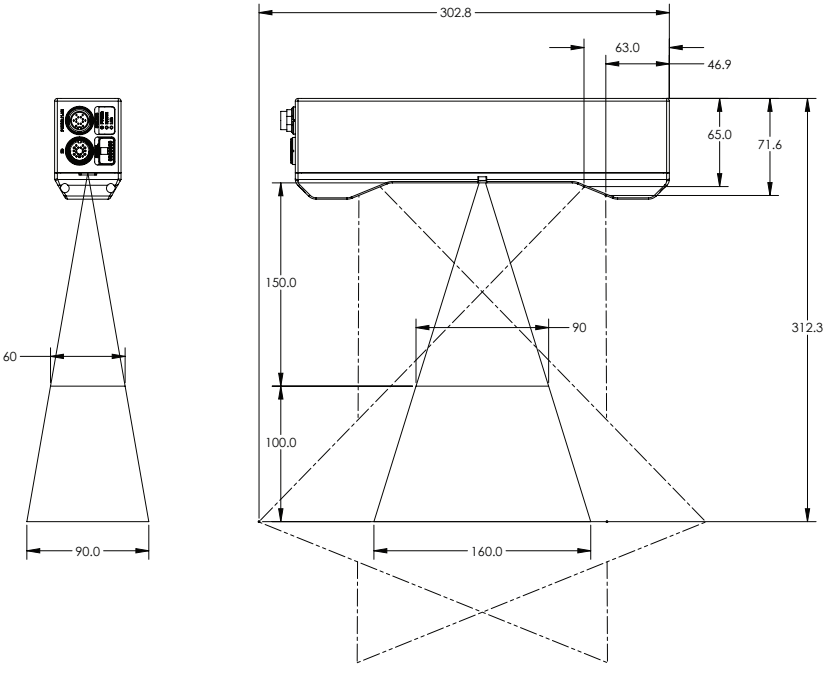
Field of View / Measurement Range / Envelope



Dimensions



Envelope



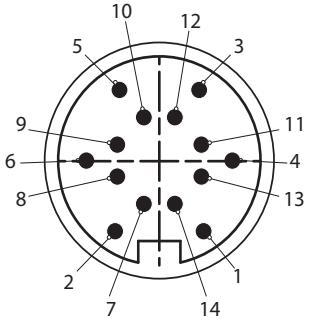
Gocator 3100 Power/LAN Connector

The Gocator 3100 Power/LAN connector is a 14 pin, M16 style connector that provides power input, safety input and Ethernet.

This section defines the electrical specifications for Gocator 3100 Power/LAN Connector pins, organized by function.

Gocator 3100 Power/LAN Connector Pins

Function	Pin	Lead Color on Cordset
GND_24-48V	1	White/Orange & Black
GND_24-48V	1	Orange/Black
DC_24-48V	2	White/Green & Black
DC_24-48V	2	Green/Black
Safety-	3	White/Blue & Black
Safety+	4	Blue/Black
Sync+	5	White/Brown & Black
Sync-	6	Brown/Black
Ethernet MX1+	7	White/Orange
Ethernet MX1-	8	Orange
Ethernet MX2+	9	White/Green
Ethernet MX2-	10	Green
Ethernet MX3-	11	White/Blue
Ethernet MX3+	12	Blue
Ethernet MX4+	13	White/Brown
Ethernet MX4-	14	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

Positive voltage is applied to DC_24-48V. Refer to "Gocator 3100 Series" on page 234 for the sensor's power requirement. Ground is applied to GND_24-48VDC.

Power requirements

Function	Pins	Min	Max
DC_24-48V	2	24 V	48 V
GND_24-48VDC	1	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+.

Safety requirements

Function	Pins	Min	Max
Safety_in+	4	24 V	48 V
Safety_in-	3	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

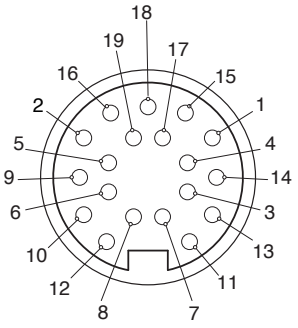
Gocator 3100 I/O Connector

The Gocator 3100 I/O connector is a 19 pin, M16 style connector that provides encoder, digital input, digital outputs, serial output, and analog output signals.

This section defines the electrical specifications for Gocator 3100 I/O Connector pins, organized by function.

Gocator 3100 I/O Connector Pins

Function	Pins	Lead Color on Cordset
Trigger_in+	1	Grey
Trigger_in-	2	Pink
Out_1+ (Digital Output 0)	3	Red
Out_1- (Digital Output 0)	4	Blue
Out_2+ (Digital Output 1)	5	Tan
Out_2- (Digital Output 1)	6	Orange
Encoder_A+	7	White/Brown & Black
Encoder_A-	8	Brown / Black
Encoder_B+	9	Black
Encoder_B-	10	Violet
Encoder_Z+	11	White/Green & Black
Encoder_Z-	12	Green / Black
Serial_out+	13	White
Serial_out-	14	Brown
Reserved	15	Blue / Black
Reserved	16	White / Blue & Black
Analog_out+	17	Green
Analog_out-	18	Yellow & Maroon/ White
Reserved	19	Maroon



View: Looking into the connector **on** the sensor

Grounding Shield

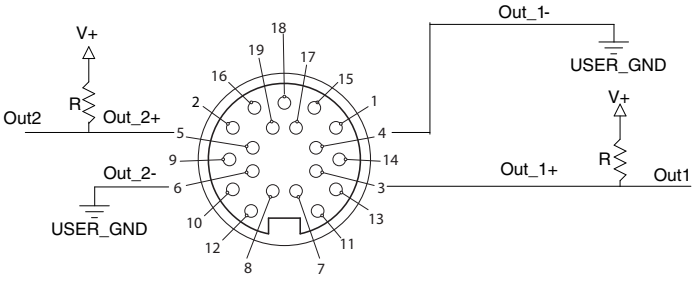
The grounding shield should be mounted to the earth ground.

Digital Outputs

Each Gocator sensor has two optically-isolated outputs. Both outputs are open collector and open emitter, this allows a variety of power sources to be connected and a variety of signal configurations.

Out_1 (Collector – Pin 6 and Emitter – Pin 4) and Out_2 (Collector – Pin 5 and Emitter Pin 8) are independent and therefore V+ and GND are not required to be the same.

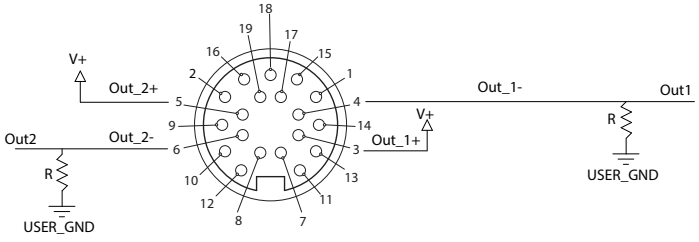
Function	Pins	Max Collector Current	Max Collector –Emitter Voltage	Min Pulse Width
Out_1	3, 4	40 mA	70 V	20 us
Out_2	5, 6	40 mA	70 V	20 us



The resistors shown above are calculated by R = (V+) / 2.5mA.
The size of the resistors is determined by power = (V+)^2 / R.

Inverting Outputs

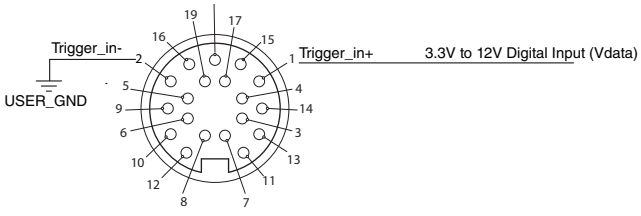
To invert an output, connect a resistor between ground and Out_1- or Out_2- and connect Out_1+ or Out_2+ to the supply voltage. Take the output at Out_1- or Out_2-. The resistor selection is the same as what is shown above.



Digital Inputs

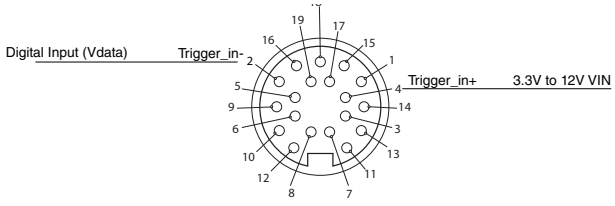
Every Gocator sensor has a single optically-isolated input. To use this input without an external resistor, supply 3.3 - 12 V to Pin 1 and GND to Pin 2.

Active High



If the supplied voltage is greater than 12 V, connect an external resistor in series to Pin 1.
The resistor value should be R = [(Vin-1.2V)/10mA]-680.

Active Low



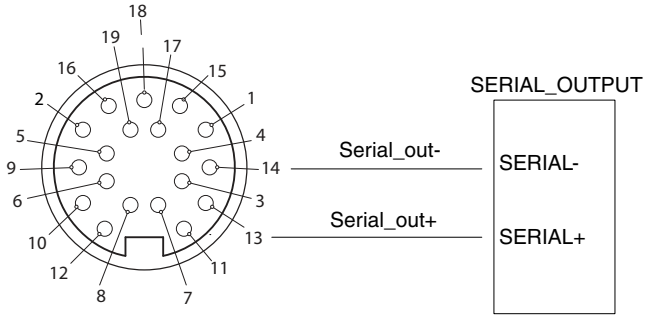
To assert the signal, the digital input voltage should be set to draw a current of 3 mA to 40 mA from Trigger_In+. The current that passes through Trigger_In+ is I = (Vin – 1.2 – Vdata) / 680. To reduce noise sensitivity, we recommend leaving a 20% margin for current variation (i.e. uses a digital input voltage that draws 4mA to 25mA).

Function	Pins	Min Voltage	Max Voltage	Min Current	Max Current	Min Pulse Width
Trigger_in	1, 2	3.3 V	24V	3 mA	40 mA	20 us

Serial Output

Serial RS-485 output is connected to Serial_out as shown below.

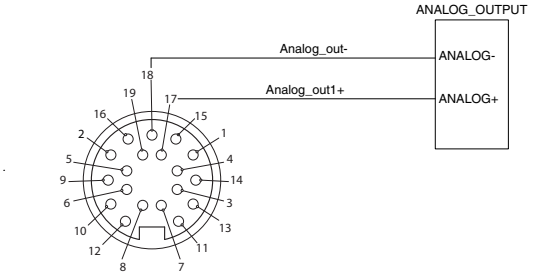
Function	Pins
Serial_out	13, 14


18
19
17
16
15
2
1
5
4
9
14
6
3
10
13
12
11
8
7
SERIAL_OUTPUT
Serial_out-
SERIAL-
Serial_out+
SERIAL+

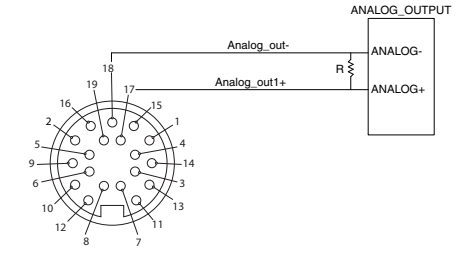
Analog Output

The Sensor I/O Connector defines one analog output interfaces: Analog_out.

Function	Pins	Current Range
Analog_out	17, 18	4 – 20 mA

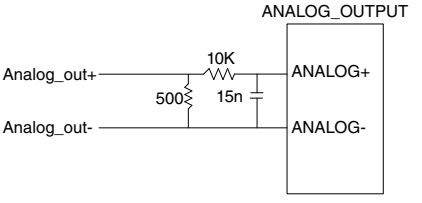


Current Mode



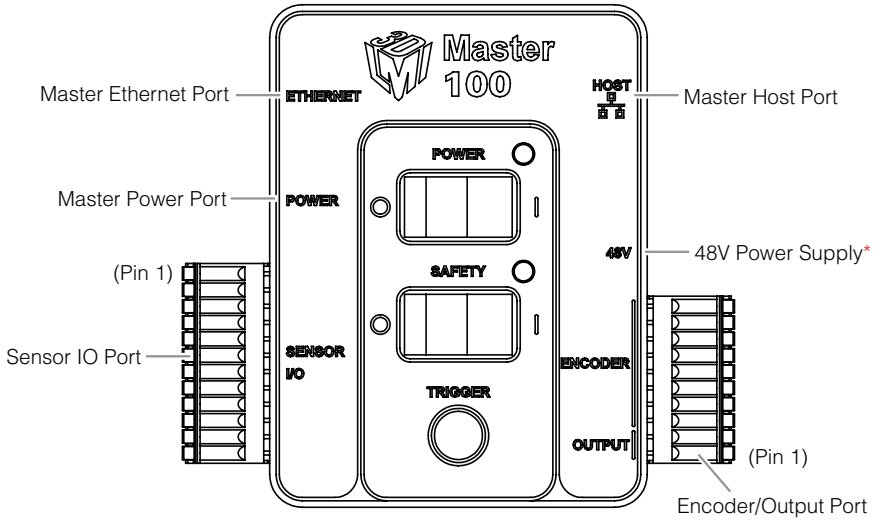
Voltage Mode

To configure for voltage output, connect a 500 Ohm ¼ Watt resistor between Analog_out+ and Analog_out1- and measure the voltage across the resistor. To reduce the noise in the output, we recommend using a RC filter as shown below.



Master 100

The Master 100 accepts connections for power, safety, 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

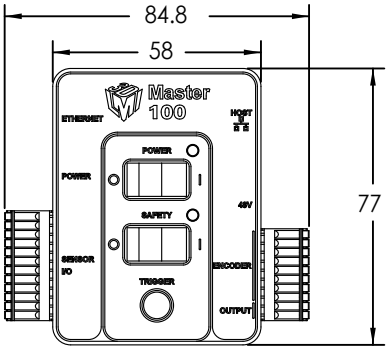
Gocator I/O Pin	Master Pin	Conductor Color
Encoder_A+	1	White/Brown & Black
Encoder_A-	2	Brown/Black
Encoder_Z+	3	White/Green & Black
Encoder_Z-	4	Green/Black
Trigger_in+	5	Grey
Trigger_in-	6	Pink
Out_1-	7	Blue
Out_1+	8	Red
Encoder_B+	11	Black
Encoder_B-	12	Violet

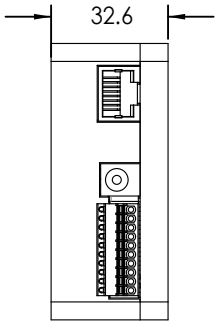
The rest of the wires in the Gocator I/O cordset are not used.

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

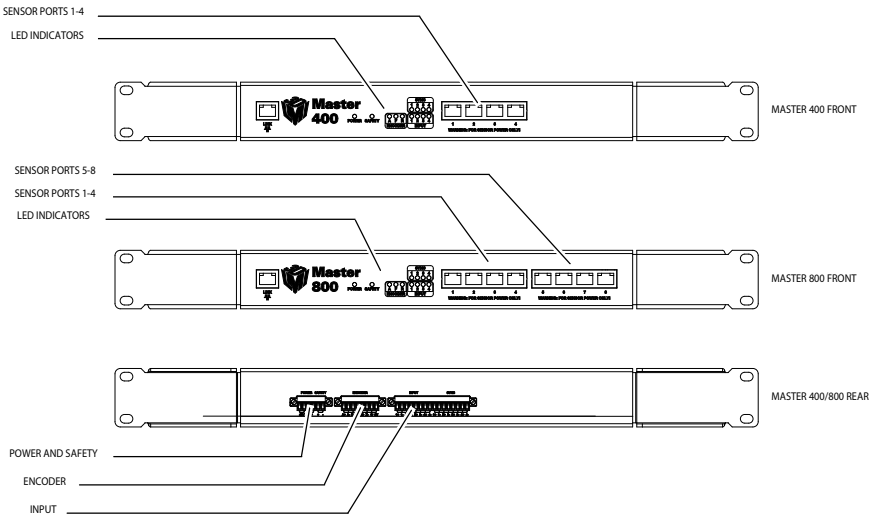
Master 100 Dimensions





Master 400/800

The Master 400/800 provides sensor power, safety interlock and broadcasts system-wide synchronization information (ie. time, encoder count, encoder index and digital I/O states) to all devices on a sensor network.



Power and Safety (6 pin connector)

Function	Pin
+48VDC	1
+48VDC	2
GND(48VDC)	3
GND(48VDC)	4
Safety Control+	5
Safety Control–	6

The +48VDC power supply must be isolated from AC ground. This means that AC ground and DC ground are not connected.

The Safety Control requires a voltage differential 12VDC to 48VDC across the pin to enable the LED light.

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

Digital 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

This connector does not need to be wired up for proper operation.

Master 400/800 Electrical Specifications

Electrical specifications for Master 400/800:

	Master 400	800
Power Supply Voltage	+48VDC	
Power Supply current (Max.)	10A	
Power Draw (Min.)	15W	
Safety Voltage	+12 to +48VDC	
Encoder signal voltage range	RS485 Differential	
Digital input voltage range	Logical LOW: 0 VDC to +0.1VDC Logical HIGH: +11 VDC to +22.5VDC	

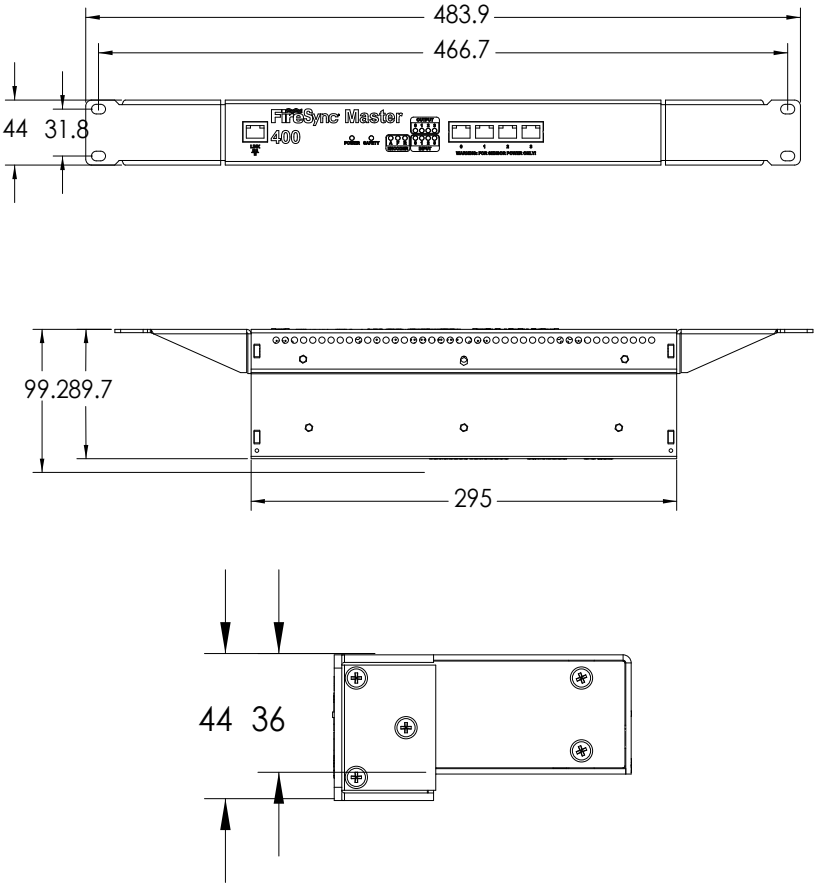
When using a Master 400/800 it is crucial that its chassis be well grounded.

The +48VDC 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 it's own power requirements which need to be considered when calculating total system power requirements.

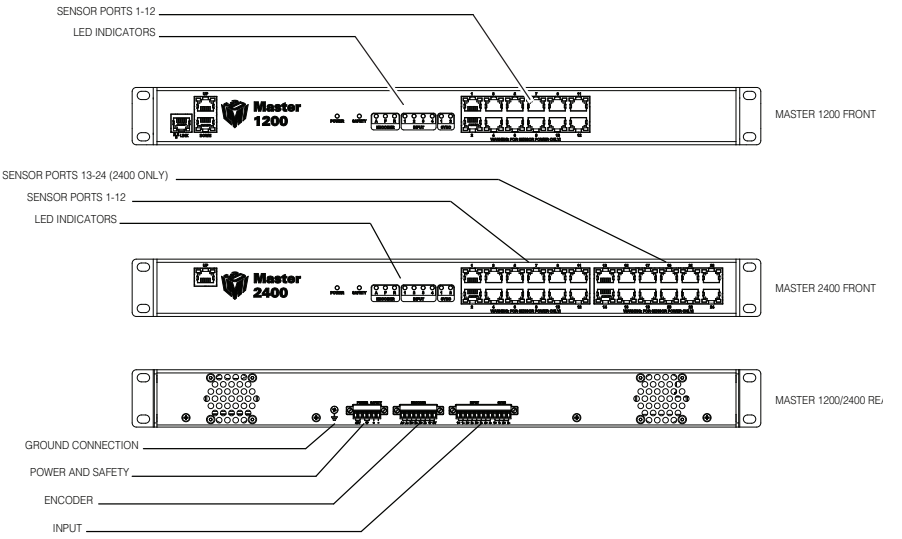
Master 400/800 Dimensions

Dimensions of Master 400 and Master 800 are the same.



Master 1200/2400

The Master 1200/2400 provides sensor power, safety interlock and broadcasts system-wide synchronization information (i.e. time, encoder count, encoder index, and digital I/O states) to all devices on a sensor network.



Power and Safety (6 pin connector)

Function	Pin
+48VDC	1
+48VDC	2
GND(48VDC)	3
GND(48VDC)	4
Safety Control+	5
Safety Control–	6

The +48VDC power supply must be isolated from AC ground. This means that AC ground and DC ground are not connected.

The Safety Control requires a voltage differential 12VDC to 48VDC across the pin to enable the LED light.

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

Digital 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

This connector does not need to be wired up for proper operation.

Master 1200/2400 Electrical Specifications

Electrical specifications for Master 1200/2400:

	Master 1200	2400
Power Supply Voltage	+48VDC	
Power Supply current (Max.)	10A	
Power Draw (Min.)	15W	
Safety Voltage	+12 to +48VDC	
Encoder signal voltage range	RS485 Differential	
Digital input voltage range	Logical LOW: 0 VDC to +0.1VDC Logical HIGH: +3.5 VDC to +6.5VDC	

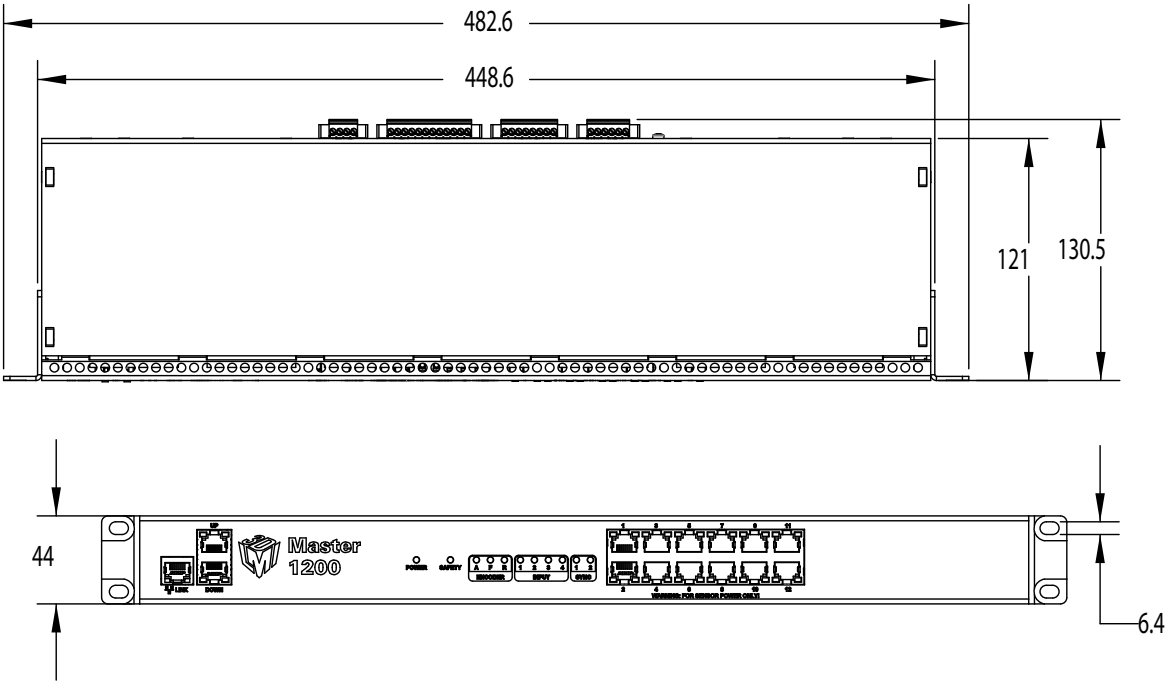
⚠ When using a Master 1200/2400 it is crucial that its chassis be well grounded.

The +48VDC 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 it's own power requirements which need to be considered when calculating total system power requirements.

Master 1200/2400 Dimensions

Dimensions of Master 1200 and Master 2400 are the same.



Parts and Accessories

Gocator 3100 Sensors (Model)

Description	Part Number
Gocator 3110, No tools	313110A-LED-B-00
Gocator 3110, Measurement tools	313110A-LED-B-01

Masters

Description	Part Number
Master 100 - for single sensor	30705
Master 400 - for networking up to 4 sensors	30680
Master 800 - for networking up to 8 sensors	30681
Master 1200 - for networking up to 12 sensors	30649
Master 2400 - for networking up to 24 sensors	30650

Cordsets

Description	Part Number
5m shielded Gocator I/O cordset, open wire end	30862
10m shielded Gocator I/O cordset, open wire end	30863
5m shielded Gocator power and Ethernet cordset, 1x open wire end, 1x RJ45 end	30859
10m shielded Gocator power and Ethernet cordset, 1x open wire end, 1x RJ45 end	30860
5m shielded Gocator power and Ethernet cordset to Master, 2x RJ45 end	30856
10m shielded Gocator power and Ethernet cordset to Master, 2x RJ45 end	30857

Contact LMI for information on creating cordsets with custom length or connector orientation. The maximum cordset length is 60m.

Warranty and Return Policy

Warranty Policy

The sensor is warranted for two years from the date of purchase from LMI Technologies Inc. Products that are found to be non-conforming during their warranty period are to be returned to LMI Technologies Inc.

The shipper is responsible for covering all duties and freight for returning the sensor to LMI. It is at LMI's discretion to repair or replace sensors that are returned for warranty work. LMI Technologies Inc. warranty covers parts, labor and return shipping charges.

If the warranty stickers on the sensors are removed or appear to be tampered with, LMI will void the warranty of the sensor.

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.

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jQuery history plugin

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

jQuery.mouseWheel
Website:

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