USER'S MANUAL

Gocator 2000 & 2300 Series

Version 3.5.2.131 Revision: A

Proprietary

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Information contained within this manual is subject to change.

This product is designated for use solely as a component and as such it does not comply with the standards relating to laser products specified in U.S. FDA CFR Title 21 Part 1040.

Contact Information

For more information, please contact LMI Technologies.

LMI Technologies, Inc.
1673 Cliveden Ave.
Delta, BC V3M 6V5
Canada

Telephone: +1 604 636 1011
Facsimile: +1 604 516 8368

www.lmi3D.com

Introduction

The Gocator 2000 and 2300 series of laser profiling 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 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.

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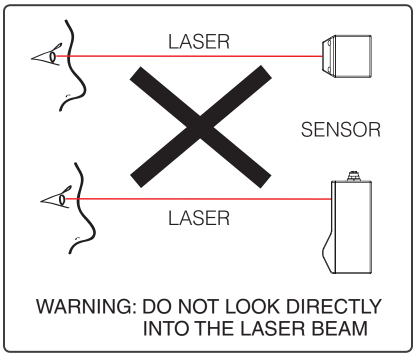
Safety and Maintenance

Laser Safety

Gocator sensors contain semiconductor lasers that emit visible or invisible light and are designated as Class 2M, Class 3R, or Class 3B, depending on the chosen laser option.

Gocator sensors are referred to as *components*, indicating that they are sold only to qualified customers for incorporation into their own equipment. These sensors do not incorporate safety items that the customer may be required to provide in their own equipment (e.g. remote interlocks, key control. Refer to references for detail information). As such, these sensors do not fully comply with the standards relating to laser products specified in IEC 60825-1 and FDA CFR Title 21 Part 1040.



⚠ Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

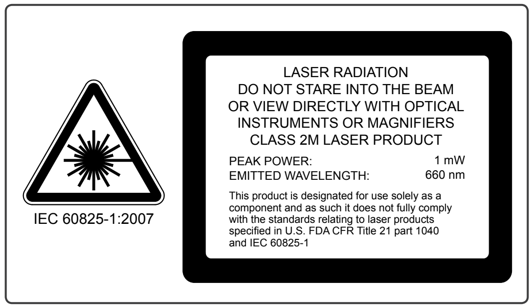
References

1. *International standard IEC 60825-1 (2001-08) consolidated edition*, Safety of laser products – Part 1: Equipment classification, requirements and user's guide.
2. *Technical report 60825-10*, Safety of laser products – Part 10. Application guidelines and explanatory notes to IEC 60825-1.
3. *Laser Notice No. 50*, FDA and CDRH http://www.fda.gov/cdrh/rad-health.html

Laser Classes

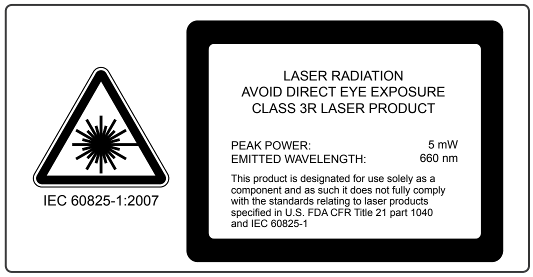
Class 2M laser components

Class 2M laser components would not cause permanent damage to the eye under reasonably foreseeable conditions of operation, provided that any exposure can be terminated by the blink reflex (assumed to take 0.25 seconds). Because classification assumes the blink reflex, the wavelength of light must be in the visible range (400 nm to 700 nm). The Maximum Permissible Exposure (MPE) for visible radiation for 0.25 seconds is 25 watts per square meter, which is equivalent to 1 mW entering an aperture of 7 mm diameter (the assumed size of the pupil).



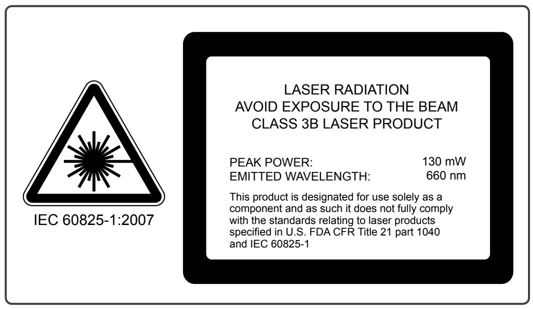
Class 3R laser components

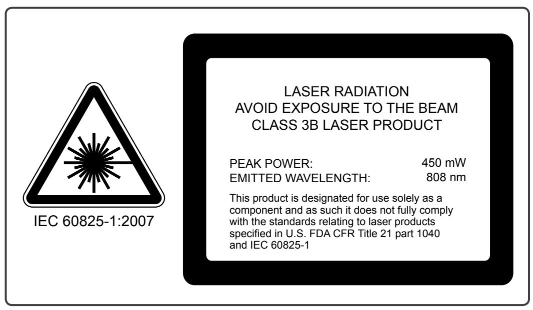
Class 3R laser products emit radiation where direct intrabeam viewing is potentially hazardous, but the risk is lower with 3R lasers than for 3B lasers. Fewer manufacturing requirements and control measures for 3R laser users apply than for 3B lasers.



Class 3B laser components

Class 3B components are unsafe for eye exposure. Usually only ocular protection will be required. Diffuse reflections are safe if viewed for less than 10 seconds.





Labels reprinted here are examples only. For accurate specifications, refer to the label on your sensor.

Precautions and Responsibilities

Precautions specified in IEC 60825-1 and FDA CFR Title 21 Part 1040 are as follows:

Requirement	Class 2M	Class 3R	Class 3B
Remote interlock	Not required	Not required	Required*
Key control	Not required	Not required	Required – cannot remove key when in use*
Power-on delays	Not required	Not required	Required*
Beam attenuator	Not required	Not required	Required*
Emission indicator	Not required	Not required	Required*
Warning signs	Not required	Not required	Required*
Beam path	Not required	Terminate beam at useful length	Terminate beam at useful length
Specular reflection	Not required	Prevent unintentional reflections	Prevent unintentional reflections
Eye protection	Not required	Not required	Required under special conditions
Laser safety officer	Not required	Not required	Required
Training	Not required	Required for operator and maintenance personnel	Required for operator and maintenance personnel

**LMI Class 3B laser components do not incorporate these laser safety items. These items must be added and completed by the customer in their system design.*

Class 3B Responsibilities

LMI Technologies has filed reports with the FDA to assist customers in achieving certification of laser products. These reports can be referenced by an accession number, provided upon request. Detailed descriptions of the safety items that must be added to the system design are listed below.

Remote Interlock

A remote interlock connection must be present in Class 3B laser systems. This permits remote switches to be attached in serial with the keylock switch on the controls. The deactivation of any remote switches must prevent power from being supplied to any lasers.

Key Control

A key operated master control to the lasers is required that prevents any power from being supplied to the lasers while in the OFF position. The key can be removed in the OFF position but the switch must not allow the key to be removed from the lock while in the ON position.

Power-On Delays

A delay circuit is required that illuminates warning indicators for a short period of time prior to supplying power to the lasers.

Beam Attenuators

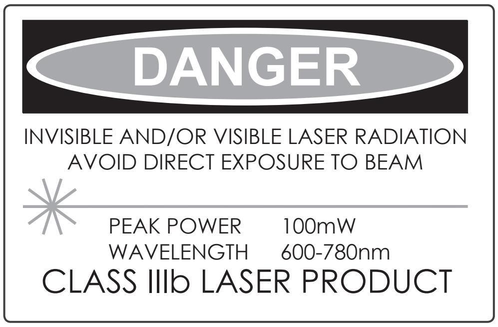
A permanently attached method of preventing human access to laser radiation other than switches, power connectors or key control must be employed. On some LMI laser sensors, the beam attenuator is supplied with the sensor as an integrated mechanical shutter.

Emission Indicator

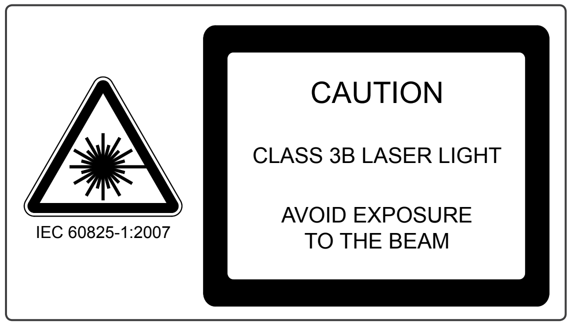
It is required that the controls that operate the sensors incorporate a visible or audible indicator when power is applied and the lasers are operating. If the distance between the sensor and controls is more than 2 meters, or mounting of sensors intervenes with observation of these indicators, then a second power-on indicator should be mounted at some readily-observable position. When mounting the warning indicators, it is important not to mount them in a location that would require human exposure to the laser emissions. User must ensure that the emission indicator, if supplied by OEM, is visible when viewed through protective eyewear.

Warning Signs

Laser warning signs must be located in the vicinity of the sensor such that they will be readily observed. Examples of laser warning signs are as follows:



FDA warning sign example



IEC warning sign example

Systems Sold or Used in the USA

Systems that incorporate laser components or laser products manufactured by LMI Technologies require certification by the FDA.

Customers are responsible for achieving and maintaining this certification.

Customers are advised to obtain the information booklet *Regulations for the Administration and Enforcement of the Radiation Control for Health and Safety Act of 1968: HHS Publication FDA 88-8035*.

This publication, containing the full details of laser safety requirements, can be obtained directly from the FDA, or downloaded from their web site at http://www.fda.gov/cdrh.

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 2000 I/O Connector (page 337) and Gocator 2300 I/O Connector (page 345) 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). Measurement error due to temperature is limited to 0.015% of full scale per degree C.

The Master 200/400/800/1200/2400 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.

Turn off lasers when not in use

LMI Technologies uses semiconductor lasers in 3D measurement sensors. To maximize the lifespan of the sensor, turn off the laser when not in use.

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.

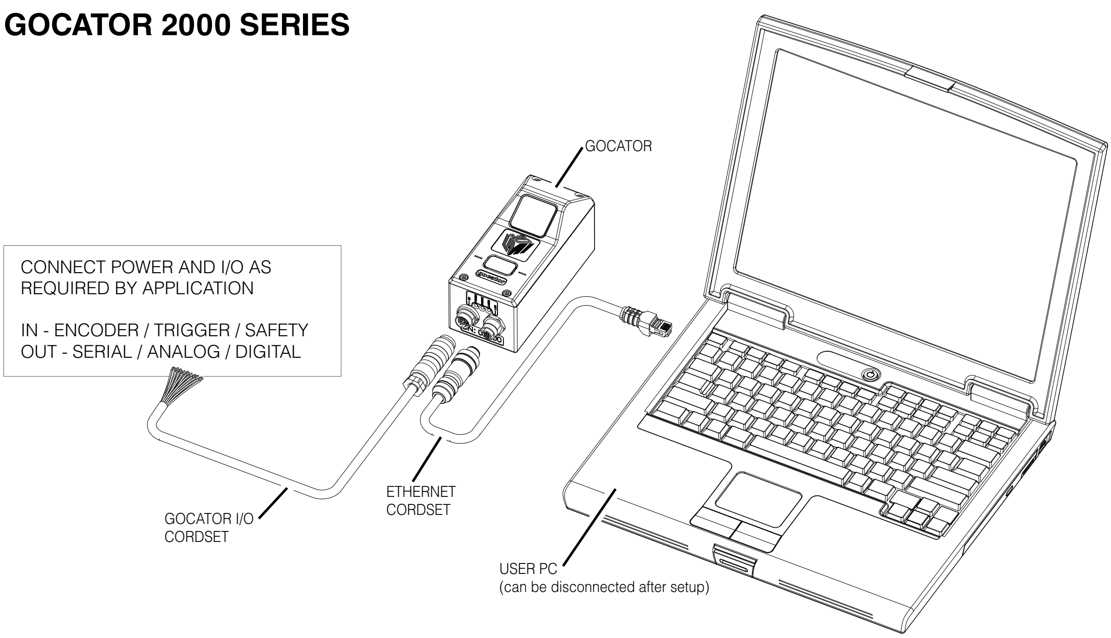
Getting Started

System Overview

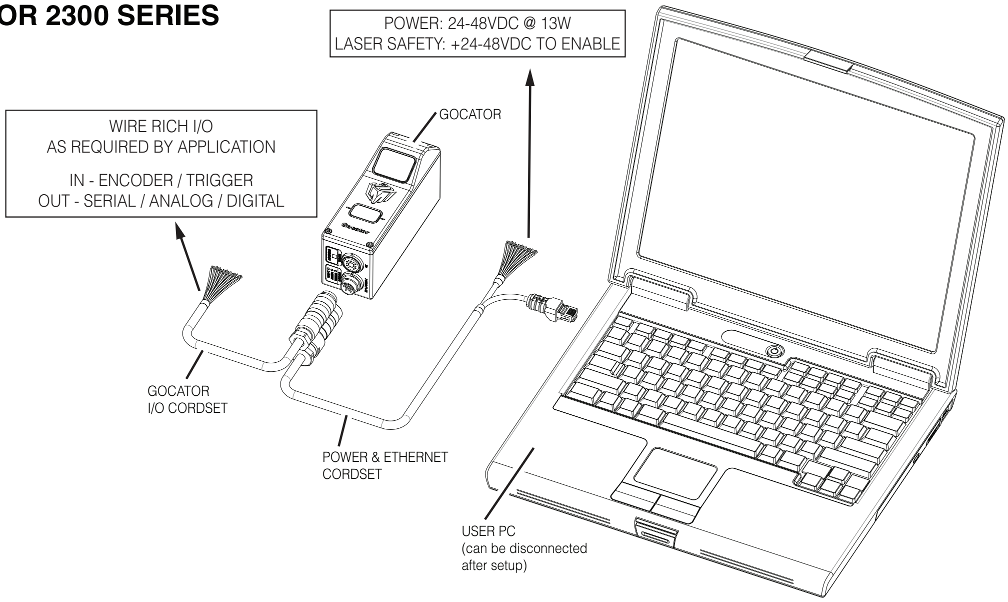
Gocator sensors can be installed and used in a variety of scenarios. Sensors can be connected as standalone devices, dual sensor (Main and Buddy) system, or multi-sensor system.

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.



GOCATOR 2300 SERIES

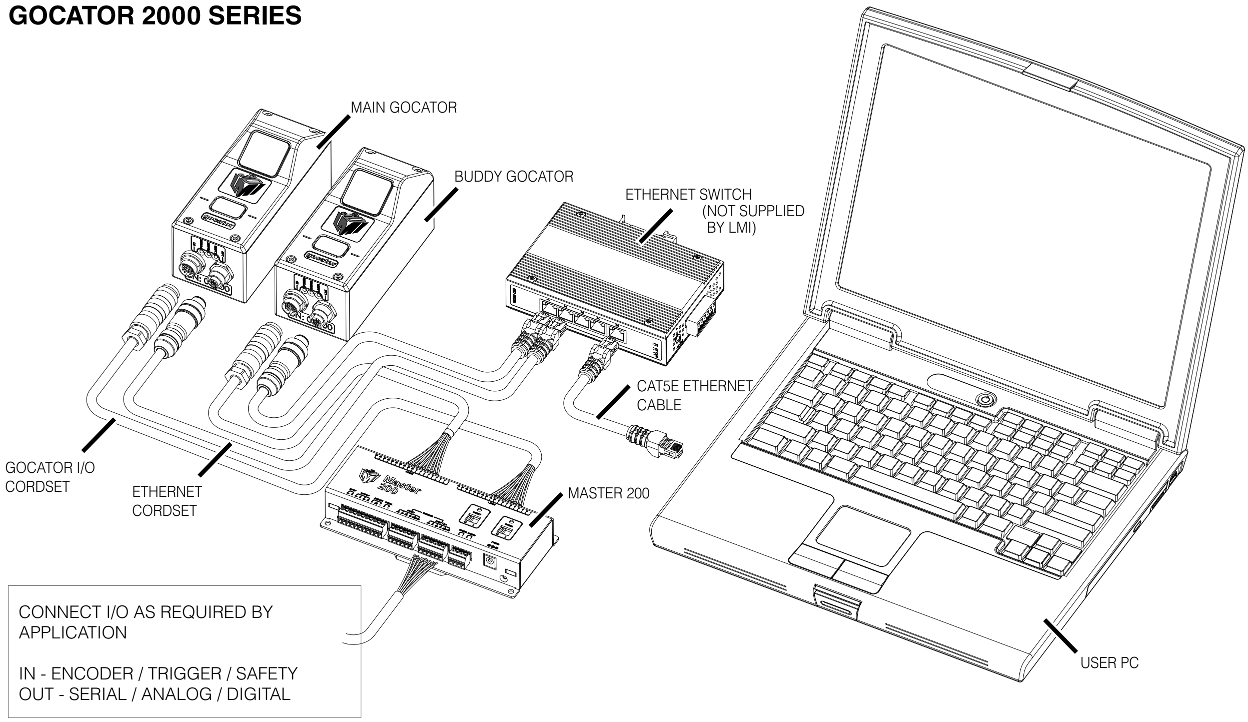


Dual Sensor System

In a dual sensor system, two Gocator sensors work together to perform profiling and output the combined results. The controlling sensor is referred to as the Main sensor, and the helper is referred to as the Buddy sensor. Gocator's software recognizes three installation orientations – None, Opposite and Wide.

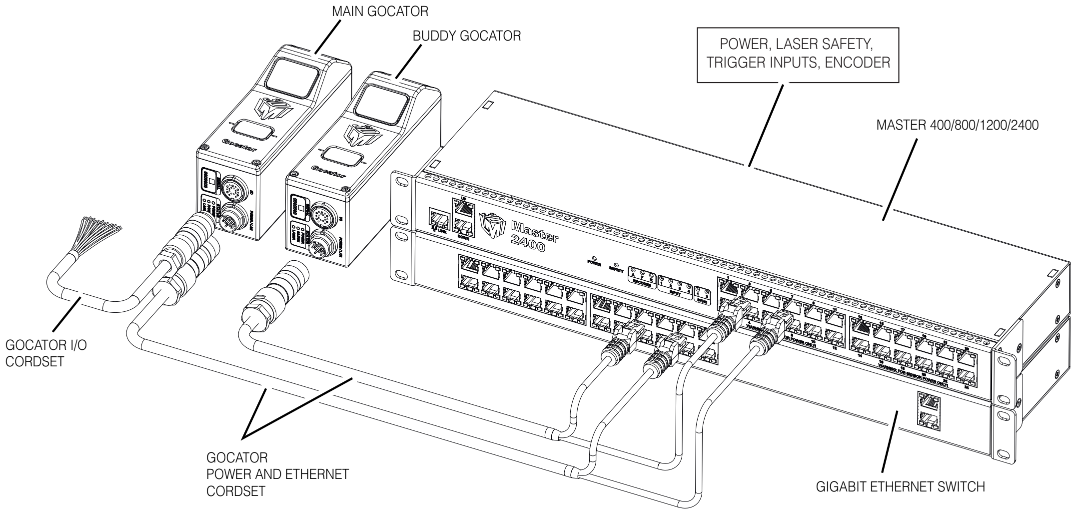
For the Gocator 2000 series sensors, the Master 200 must be used to connect two sensors in a Dual Sensor (Buddy) system. Gocator 20x0 I/O cordsets are used to connect sensors to the Master 200. The Master 200 provides a single point of connection for system I/O and power. The Master 200 ensures that the scan timing is precisely synchronized across sensors. Sensors and client computers typically communicate via an Ethernet switch (minimum 100 Mbit/s).

GOCATOR 2000 SERIES



For the Gocator 2300 series sensors, a Master 400/800/1200/2400 must be used to connect two sensors in a Dual Sensor (Buddy) system. Gocator 23x0 Master cordsets are used to connect sensors to the Master.

GOCATOR 2300 SERIES

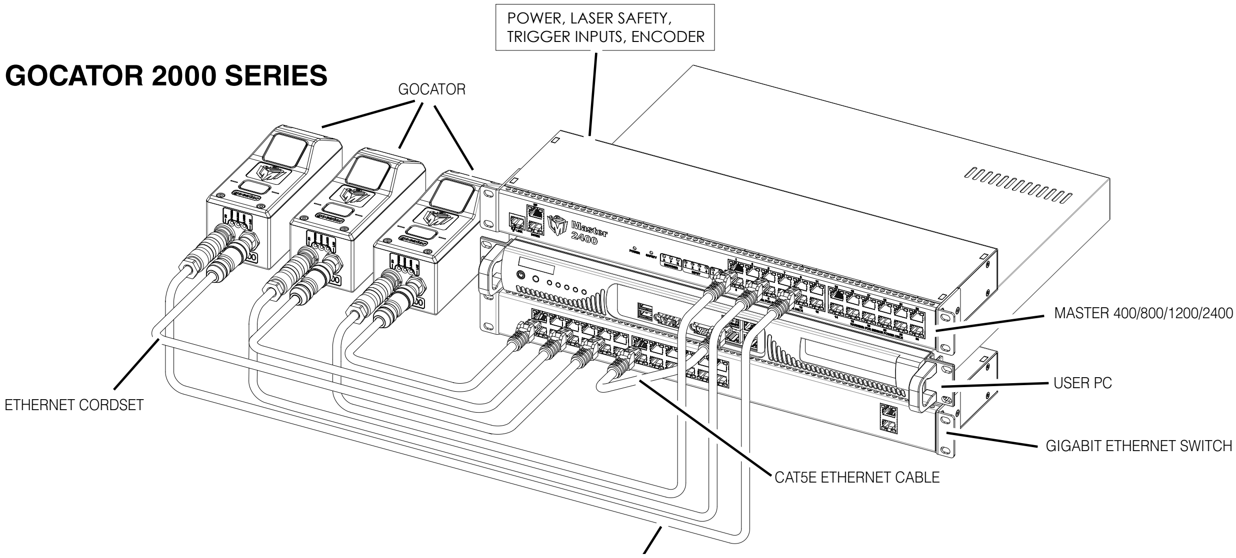


Multi-Sensor System

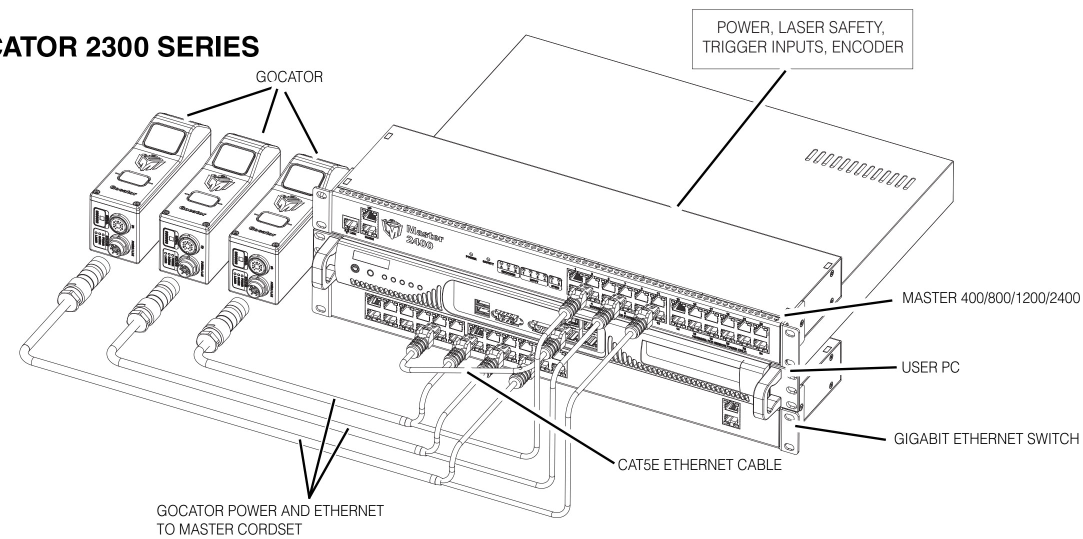
Master 400/800/1200/2400 networking hardware can be used to connect two or more sensors into a Multi-sensor system. Gocator Master cordsets are used to connect the sensors to a Master. The Master provides a single point of connection for power, safety, encoder and digital inputs. A Master 400/800/1200/2400 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).

Unlike the Master 200, Master 400/800/1200/2400 does not support digital, serial or analog output.

GOCATOR 2000 SERIES

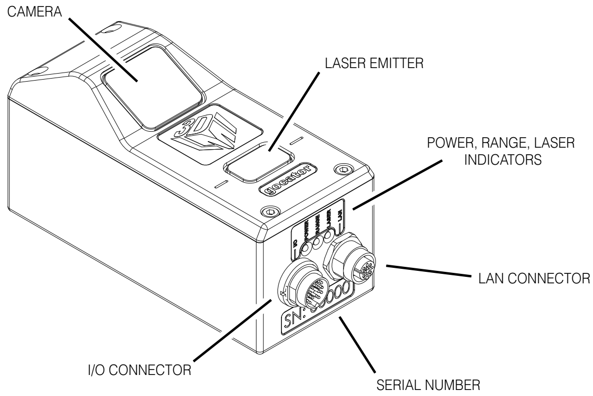


GOCATOR 2300 SERIES



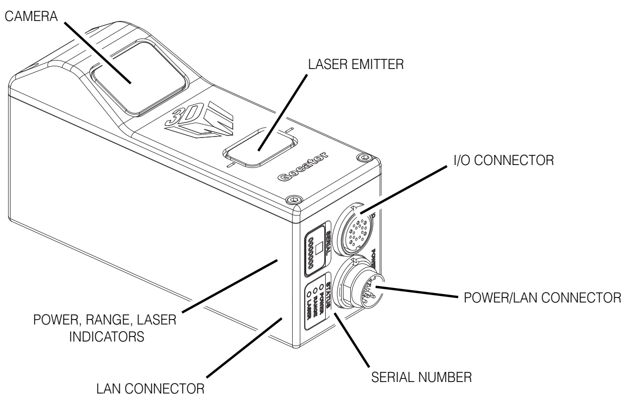
Hardware

Gocator 2000 Sensor



Item	Description
Camera	Observes laser light reflected from target surfaces.
Laser Emitter	Emits structured light for laser profiling.
I/O Connector	Accepts power and input/output signals.
LAN Connector	Connects to 100 Mbit/s Ethernet network.
Power Indicator	Illuminates when power is applied (blue).
Range Indicator	Illuminates when camera detects laser light and is within the target range (green).
Laser Indicator	Illuminates when laser safety input is active (amber).
Serial Number	Unique sensor serial number.

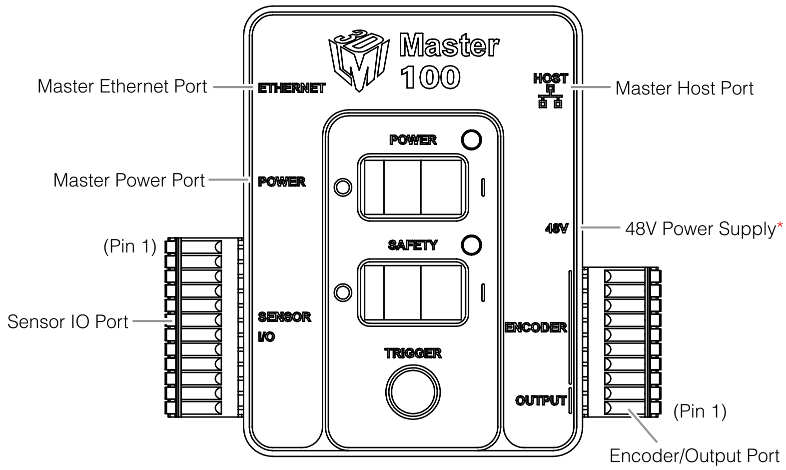
Gocator 2300 Sensor



Item	Description
Camera	Observes laser light reflected from target surfaces.
Laser Emitter	Emits structured light for laser profiling.
I/O Connector	Accepts input and output signals.
Power / LAN Connector	Accepts power and laser safety signals and connects to 1000 Mbit/s Ethernet network.
Power Indicator	Illuminates when power is applied (blue).
Range Indicator	Illuminates when camera detects laser light and is within the target range (green).
Laser Indicator	Illuminates when laser safety input is active (amber).
Serial Number	Unique sensor serial number.

Master 100

The Master 100 is used by the Gocator 2300 series for standalone system setup. The Master 100 is designed for development use only.

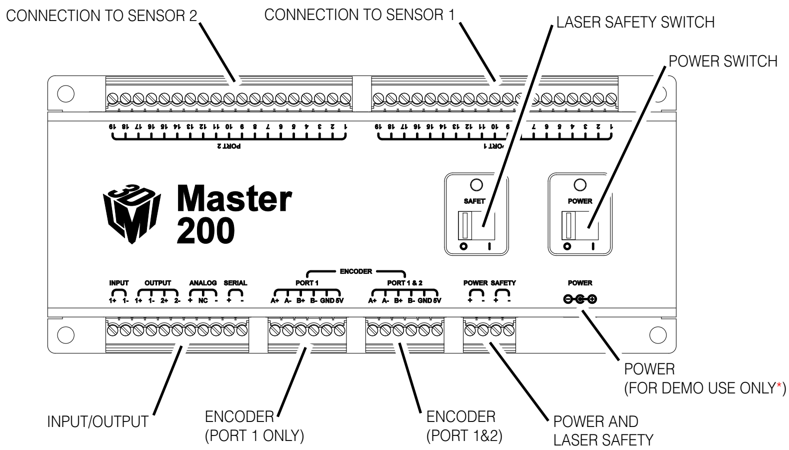


Item	Description
Gocator Power Port	Connects to the Gocator Power/LAN connector. Provides power and laser safety to the Gocator.
Gocator Sensor I/O Port	Connects to the Gocator I/O connector.
Laser Safety Switch	Toggles laser safety signal provided to the sensors [O= laser off, I= laser on].
Power Switch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

Refer to Master 100 (page 350) for pinout details.

Master 200

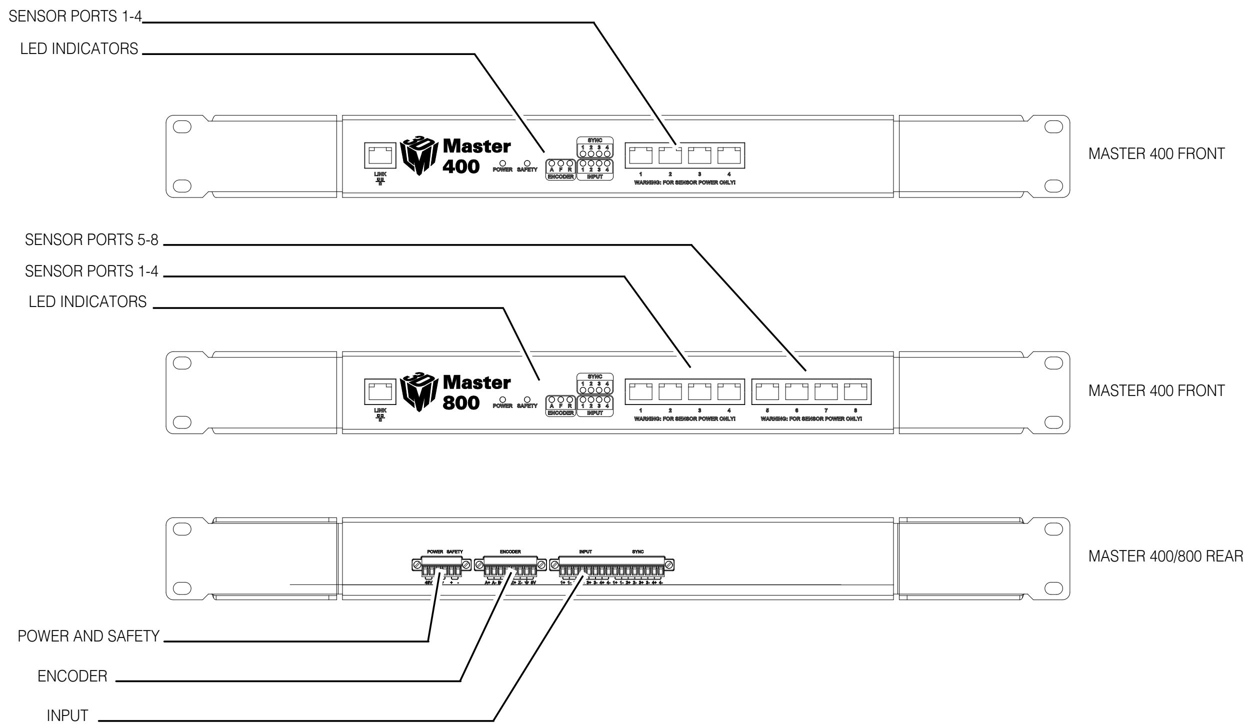
The Master 200 supports standalone or dual sensor setup. It is only used by the Gocator 2000 series.



Item	Description
Connection to Sensor 2	Gocator I/O connection for Sensor 2 (Buddy sensor).
Connection to Sensor 1	Gocator I/O connection for Sensor 1 (Main sensor).
Laser Safety Switch	Toggles laser safety signal provided to the sensors [O= laser off, I= laser on].
Power Switch	Toggles sensor power.
Input/Output	Accepts digital input and provides digital output, serial output, and analog output.
Encoder (Port 1 only)	Accepts encoder for Standalone sensor operation (Main sensor only).
Encoder (Port 1 & 2)	Accepts encoder for Dual Sensor operation (Main and Buddy sensors).
Power and Laser Safety	Accepts power (+24 to +48 V at 10 Watts) and laser safety inputs.

Refer to Master 200 (page 352) for pinout details.

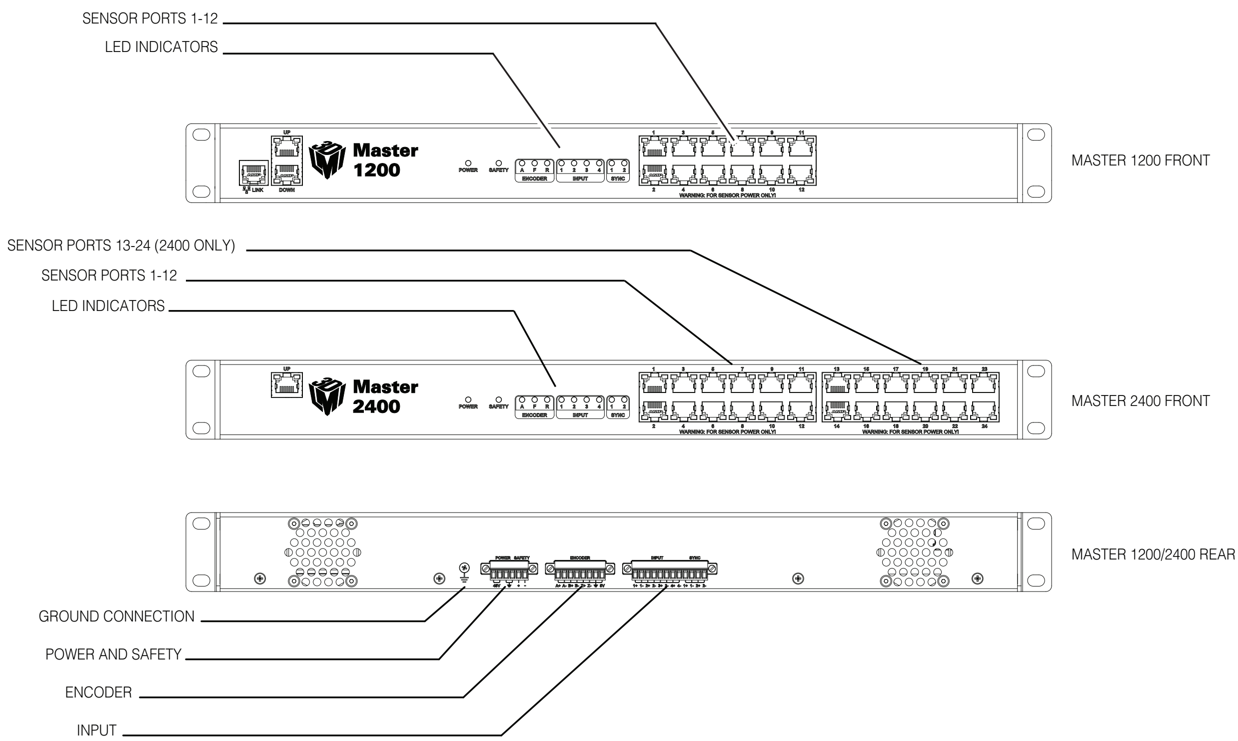
Master 400/800



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

Refer to Master 400/800 (page 355) for pinout details.

Master 1200/2400

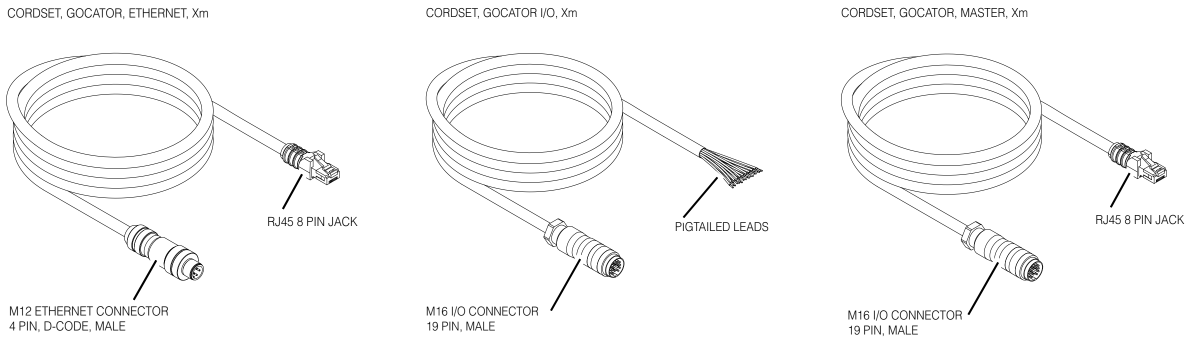


Item	Description
Sensor Ports	Master connection for Gocator sensors (no specific order required).
Ground Connection	Earth ground connection point.
Laser Safety	Laser safety connection.
Encoder	Accepts encoder signal.
Input	Accepts digital input.

Refer to Master 1200/2400 (page 358) for pinout details.

Gocator 2000 Cordsets

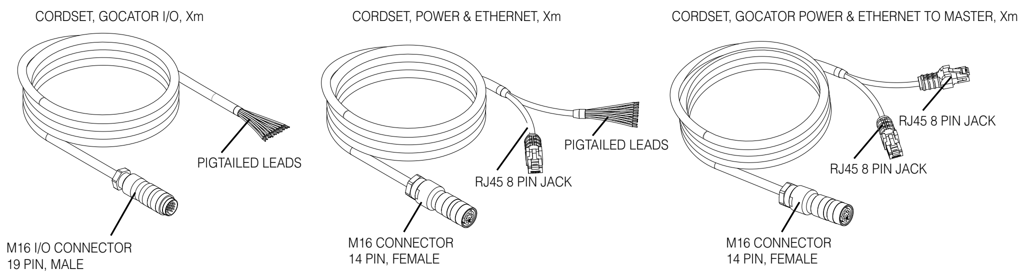
Gocator 2000 sensors use three cordsets. The Ethernet cordset is used for sensor communication via 100 Mbit/s Ethernet with a standard RJ45 connector. The Gocator I/O cordset provides power and laser safety interlock to sensors. It also provides digital I/O connections, an encoder interface, RS-485 serial connection, and an analog output. The Gocator Master cordset provides electrical connection between the sensor and a Master 400/800/1200/2400.



The maximum cordset length is 60m. Refer to Gocator 2000 I/O Connector (page 337) for pinout details. Refer to Parts and Accessories (page 360) for cordset lengths and part numbers. Contact LMI for information on creating cordsets with customized length and connector orientation.

Gocator 2300 Cordsets

Gocator 2300 sensors use two types of cordsets. The Power & Ethernet cordset provides power, laser safety locklock to the sensor. It is also used for sensor communication via 1000 Mbit/s Ethernet with a standard RJ45 connector. The Gocator 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.

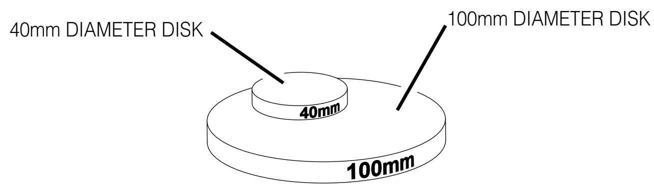


The maximum cordset length is 60m. Refer to Gocator 2300 I/O Connector (page 345) and Gocator 2300 Power/LAN Connector (page 343) for pinout details. Refer to Parts and Accessories (page 360) for cordset lengths and part numbers. Contact LMI for information on creating cordsets with custom length or connector orientation.

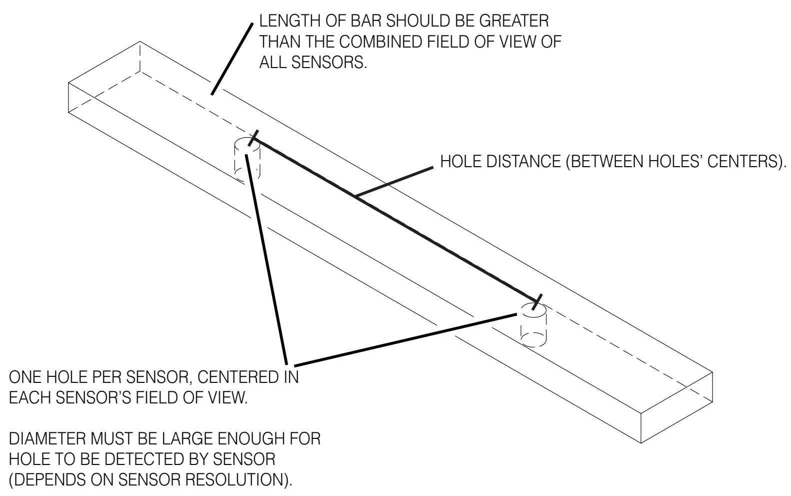
Calibration Targets

Calibration targets are used for *alignment calibration* or *travel calibration*.

Calibration *disks* are typically used with systems containing a single sensor and can be ordered from LMI Technologies. When choosing a disk for your application, select the largest disk that fits entirely within the required field of view. Refer to Parts and Accessories (page 360) for calibration disk part numbers.



For wide, multi-sensor systems, calibration *bars* are required to match the length of the system by following the guidelines illustrated below. (LMI Technologies does not manufacture or sell calibration bars.)



Refer to Calibration (page 72) for more information on calibration procedures.

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.

⚠ It is imperative that the frame or electrical cabinet that the Gocator is mounted to is connected to earth ground.

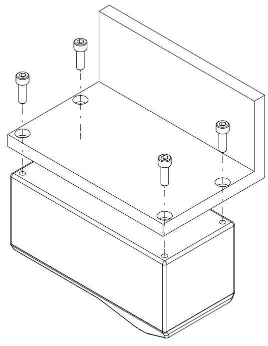
Grounding - Master 400/800/1200/2400

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.

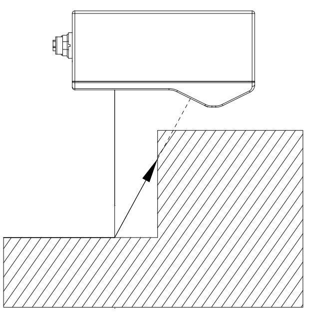
⚠ It is imperative that the frame or electrical cabinet that the Master is mounted to is connected to earth ground.

Mounting

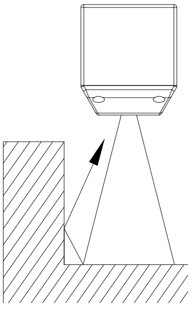
Sensors should be mounted using four M5 x 0.8 pitch screws of suitable length. The recommended thread engagement into the housing is 8 - 10 mm. Proper care should be taken in order to ensure that the internal threads are not damaged from cross-threading or improper insertion of screws.

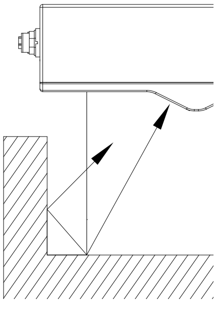


Sensors should not be installed near objects that might occlude a camera's view of the laser.



Sensors should not be installed near surfaces that might create unanticipated laser reflections.





⚠ 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.

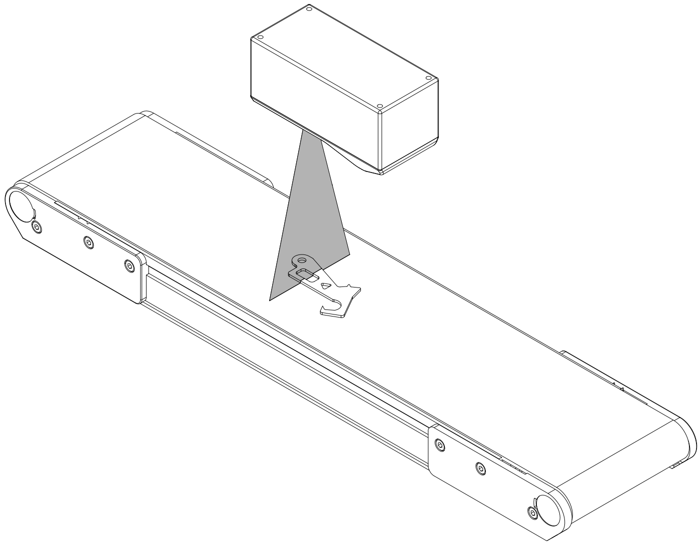
⚠ Gocator sensors are high accuracy devices. It is critical that the temperature of all of its components are in equilibrium. When the sensor is powered up, a warm-up time of at least one hour is required in order to reach a consistent spread of temperature within the sensor.

Orientations

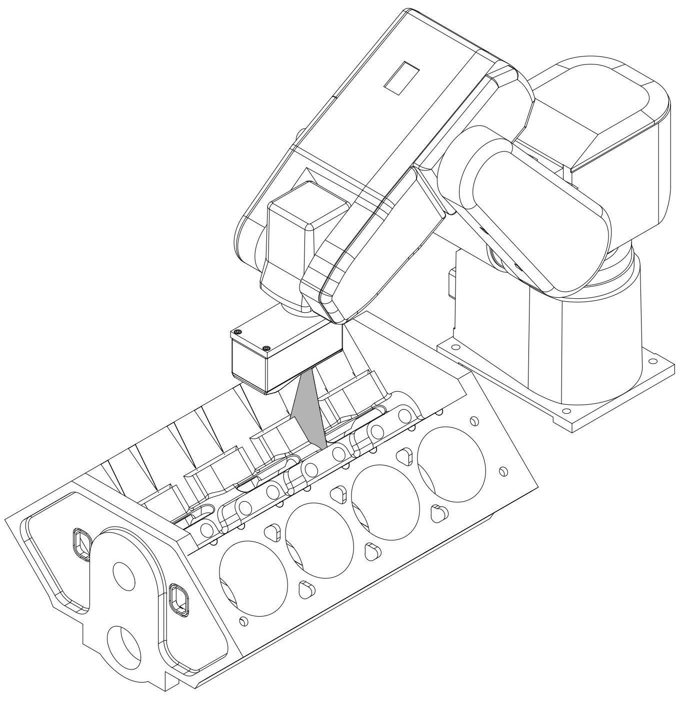
The examples below illustrate the possible mounting orientations for standalone and dual sensor system.

For more information on orientations, refer to Dual Sensor System Layout (page 70).

Single Sensor Orientations:

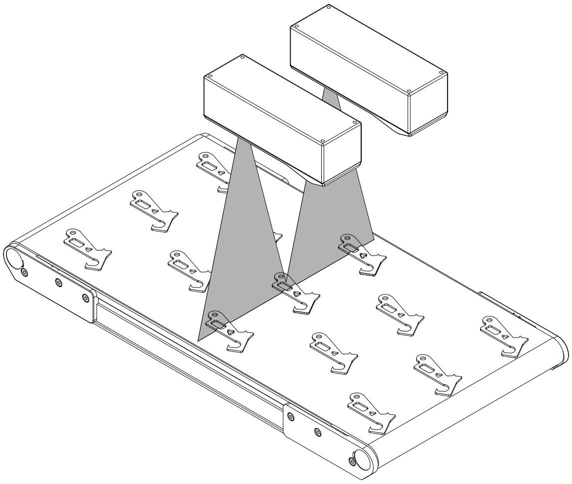


Single sensor above conveyor

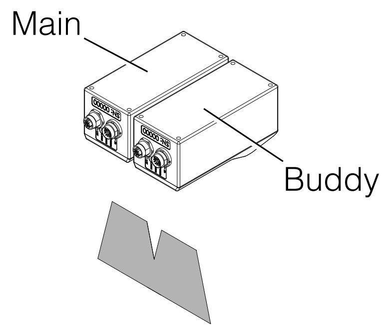


Single sensor on robot arm

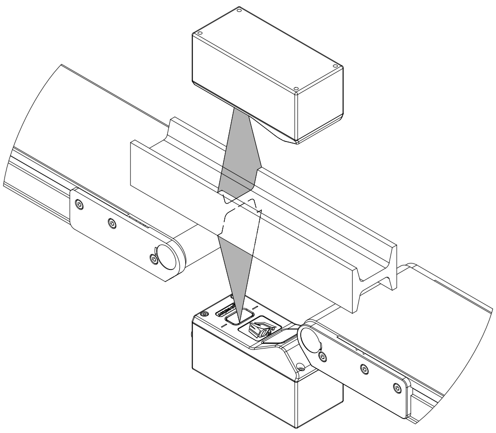
Dual Sensor System Orientations:



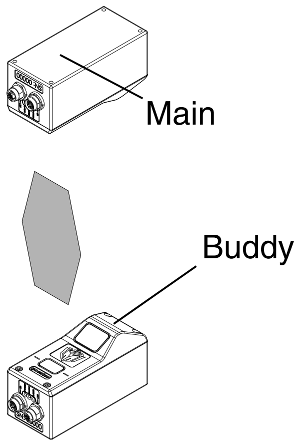
Side-by-side for wide-area measurement (Wide)



Main must be on the left side (when looking into the connector) of the Buddy (Wide)



Above/below for two-sided measurement (Opposite)

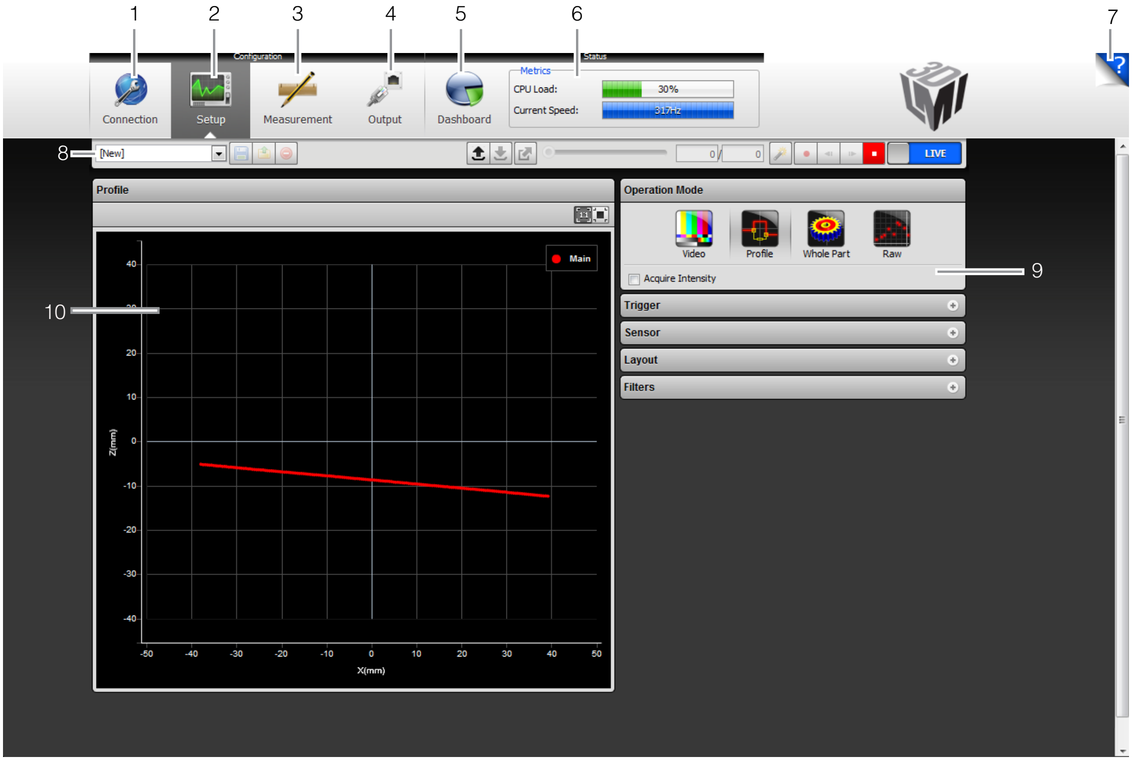


Main must be on the top with Buddy on the bottom (Opposite)

Software

User Interface Overview

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



	Element	Description
1	Connection Page	For network configuration and maintenance.
2	Setup Page	For configuring settings such as trigger source and exposure, and to perform calibration steps.
3	Measurement Page	For configuring measurements.
4	Output Page	For configuring measurement result outputs to external devices.
5	Dashboard Page	For viewing performance statistics and results.
6	Metric Panel	Summarizes important performance statistics.
7	Help	Online help resources, including User Manual, Firmware updates, and SDK.
8	Toolbar	Controls sensor operation, manages configurations and replays recorded measurement data.
9	Configuration Area	Provides controls to configure profiling and measuring parameters.
10	Data Viewer	Displays sensor data, tool setup controls, and measurements.

Connecting to a New Sensor

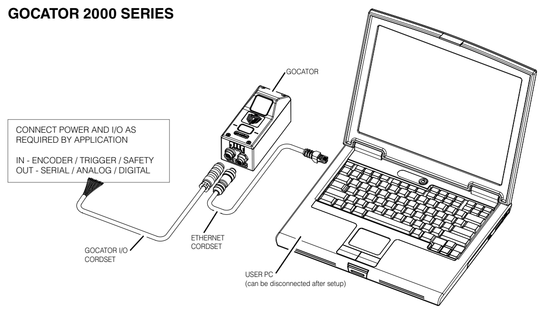
Sensors are shipped with the following default network configuration:

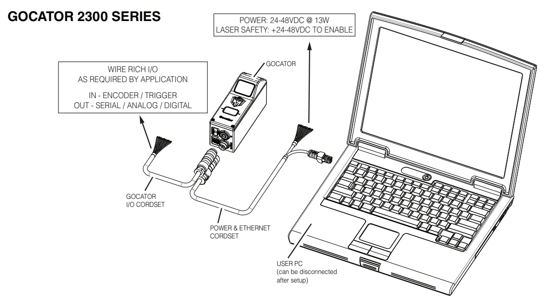
Setting	Default
DHCP	Disabled
IP Address	192.168.1.10
Subnet Mask	255.255.255.0
Gateway	0.0.0.0

All Gocator sensors are configured to 192.168.1.10 as the default IP address. For a dual sensor system, the Main and Buddy sensors must be assigned unique addresses before they can be used on the same network. Prior to proceeding, connect the Main and Buddy sensors one at a time (to avoid an address conflict) and use the steps on page 38 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 16)





2 Change client network settings.

Windows 7:

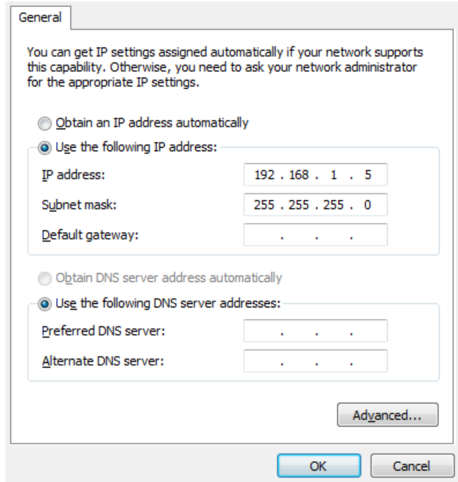
» Open the Control Panel and select Network and Sharing Center, then click Change Adapter Settings.

» 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.

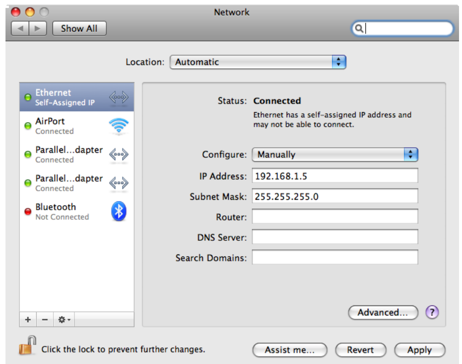


Mac OS X v.10.6:

» 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.

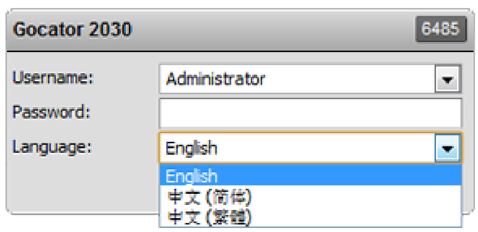


3 Enter the sensor's IP address 192.168.1.10 in a web browser.

Firefox 3.5+, Chrome 4.0+, and Internet Explorer 8.0+ are supported. IMPORTANT! The Adobe Flash browser plug-in, version 10.0+, must be installed.

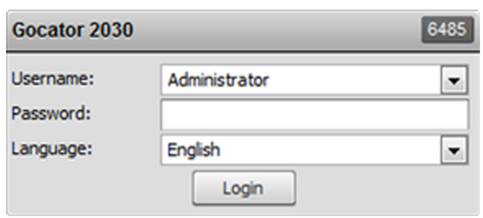
4 Select the language

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



5 Press the Login button.

The Administrator password is initially blank.



Refer to Troubleshooting (page 312) if you experience any problems while attempting to establish a connection to the sensor.

Running for the First Time

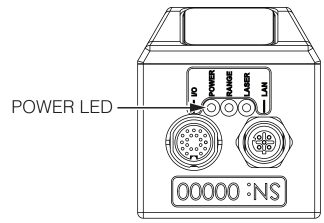
The Gocator is shipped with a default configuration that will produce laser ranges on most targets. The following sections walk through the steps required to setup the sensor(s) to produce laser ranges.

Running a Standalone Sensor System

After the sensor is installed, laser profiling can be exercised to verify basic sensor operation.

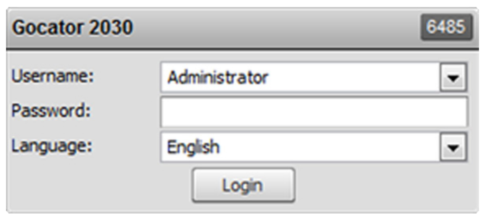
To run a sensor for the first time:

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



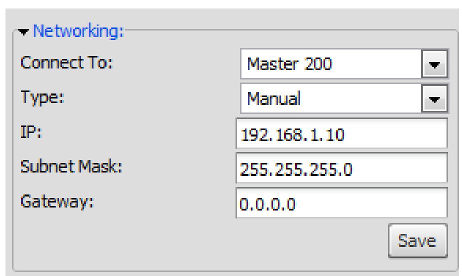
2 **Enter the sensor's IP address 192.168.1.10 in a web browser.**

3 **Login 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.

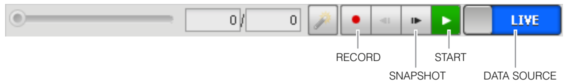


4 **Select the Connection Page.**

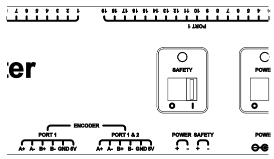
5 **Specify the Connect To setting.**
The Connect To setting specifies whether the sensor system is standalone, connected to a Master 200 or a Master 400/800/1200/2400. For single sensor operations select Standalone or Master 200.



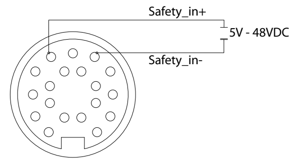
6 Ensure that the Data Source selector is showing LIVE.



7 Ensure that the Laser Safety Switch is enabled or the Laser Safety input is high.



Master 200

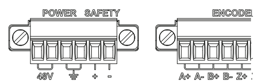


Standalone

8 Select the Setup Page.

9 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 profile.

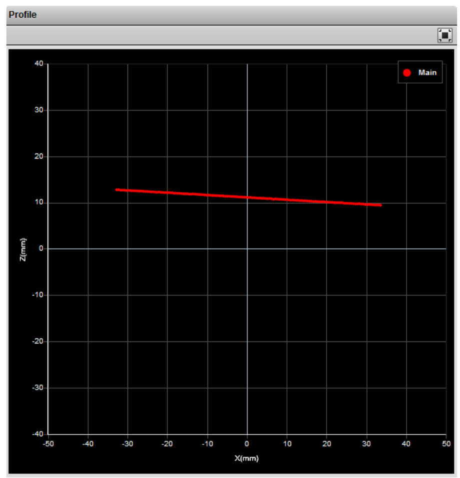


Master 400/800/1200/2400

10 Move a target into the laser plane.

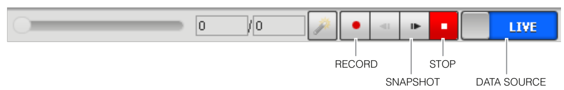
If a target object is within the sensor's measurement range, the Data Viewer will display the shape of the target and the sensor's range indicator LED will illuminate.

If you cannot see the laser, or if a profile is not displayed in the Data Viewer, refer to Troubleshooting (page 312).



11 Press the Stop button.

You should now see the laser turns off.



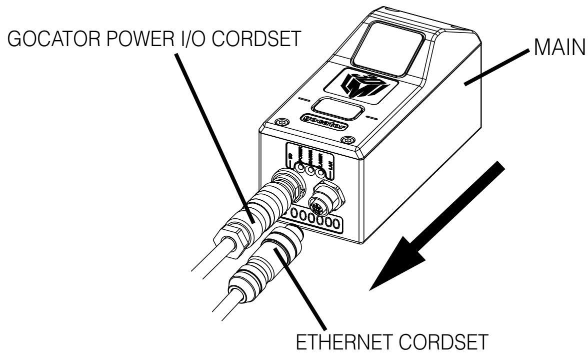
Running a Dual Sensor System

After the sensors are installed, laser profiling can be exercised to verify basic sensor operation.

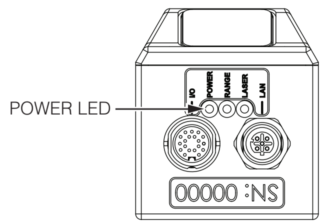
If Master 200 is used and an encoder input is required, the encoder signals must be connected to the Encoder (Port 1 & 2). Refer to Master 200 (page 24) for more details.

To run a dual sensor setup for the first time:

1 **Turn off the sensors and unplug the Ethernet network connection of the Main sensor.**
All sensors are shipped with a default IP address of 192.168.1.10. Ethernet networks require a unique IP address for each device. Skip step 1 to 3 if the Buddy sensor's IP address is already setup with an unique address.

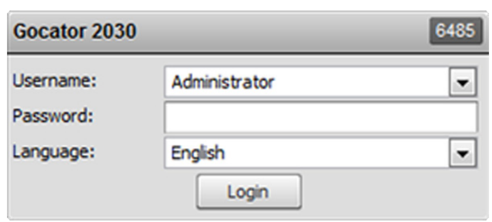


2 **Power up the Buddy sensor.**
The power LED (blue) of the buddy sensor should turn on immediately.



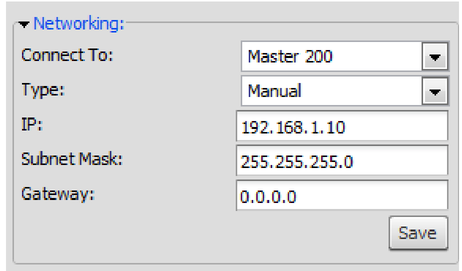
3 **Enter the sensor's IP address 192.168.1.10 in a web browser.**
This will log into the Buddy sensor.

4 **Login as Administrator with no password.**

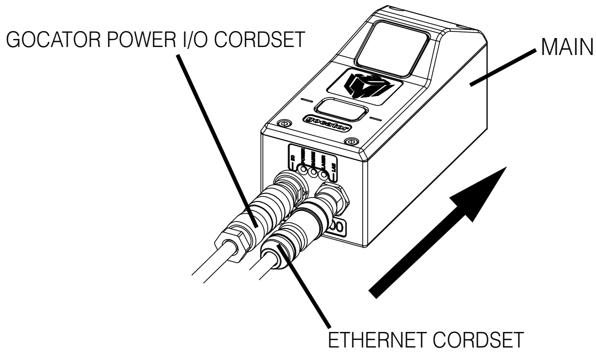


5 **Select the Connection Page.**

6 **Modify the IP address to 192.168.1.11 in the Network settings and click the Save button.**
When you click the Save button, you will be prompted to confirm your selection.

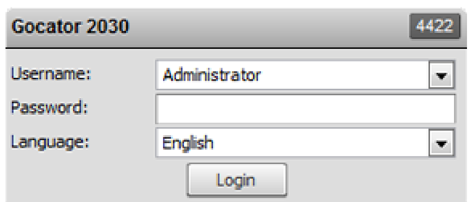


7 **Turn off the sensors, re-connect the Main sensor's Ethernet connection and power-cycle the sensors.**
After changing network configuration, the sensors must be reset or power-cycled before the change will take effect.



8 **Enter the sensor's IP address 192.168.1.10 in a web browser.**
This will log into the Main sensor.

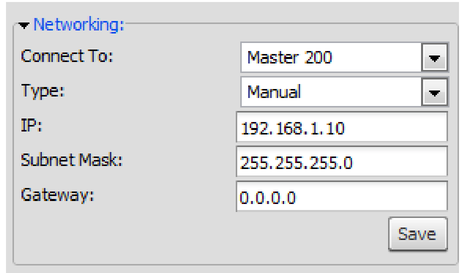
9 **Login as Administrator with no password.**
The interface display language can be changed using the language option. After selecting the language, the browser will refresh and the web interface will display in the selected language.



10 **Select the Connection Page.**

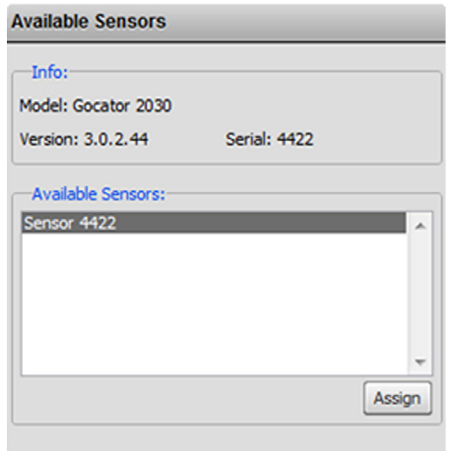
11 Specify the Connect To setting.

The Connect To setting specifies whether the sensor system is standalone, connected to a Master 200 or a Master 400/800/1200/2400. For dual sensor operation select Master 200 or Master 400/800/1200/2400.



12 Go to Connection Page > Available Sensors panel.

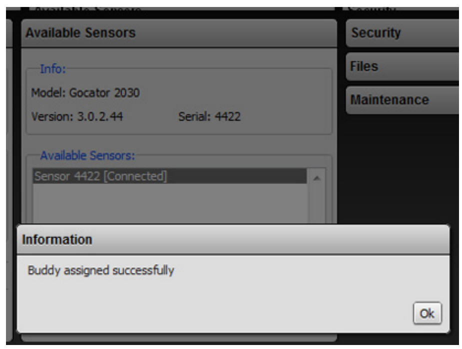
The serial number of the Buddy sensor is listed in the Available Sensors panel.



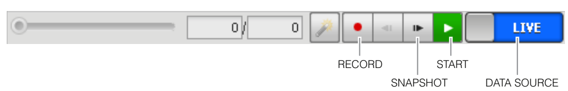
13 Select the Buddy sensor. Click the Assign button.

The Buddy sensor will be assigned to the Main sensor and its status will be updated in the System panel

The firmware on Main and Buddy sensors must be the same for Buddy assignment to be successful. If the firmware is different, connect the Main and Buddy sensor one at a time and follow the steps in Firmware Upgrade (page 212) to upgrade the sensors.



14 Ensure that the Data Source selector is showing LIVE.

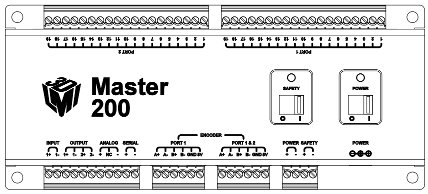


15 Ensure that the Laser Safety Switch is enabled or the Laser Safety input is high.

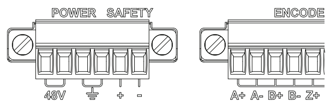
16 Select the Setup Page.

17 Press the Start button to start the sensors.

The Start button is used to run sensors continuously, while the Snapshot button is used to trigger a single profile.



Master 200 (for Gocator 2000)



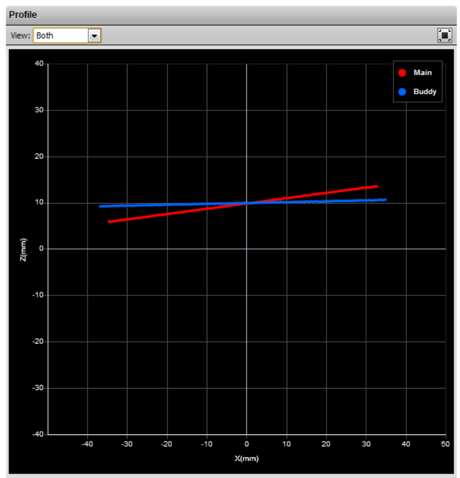
Master 400/800/1200/2400 (for Gocator 2300)

18 Move a target into the laser plane.

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.

Click the Main and Buddy button under the Setup Page to view the profile data from the main and buddy sensor

If you cannot see the laser, or if a profile is not displayed in the Data Viewer, refer to Troubleshooting (page 312).



19 Press the Stop button.

You should now see the lasers turn off.

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 chapters:

Setup and Calibration (page 43)

Fine tunes laser profiling for an application.

Measurement (page 82)

Programs measurements on sensors that are equipped with *profile tools*.

Output (page 182)

Profile data, measurements, and Pass/Fail results can be transmitted to external devices for process control or data analysis.

Toolbar (page 193)

Controls system operation, record and playback data, and manages sensor configurations.

Dashboard (page 201)

Provides real-time monitoring of its health and measurement results.

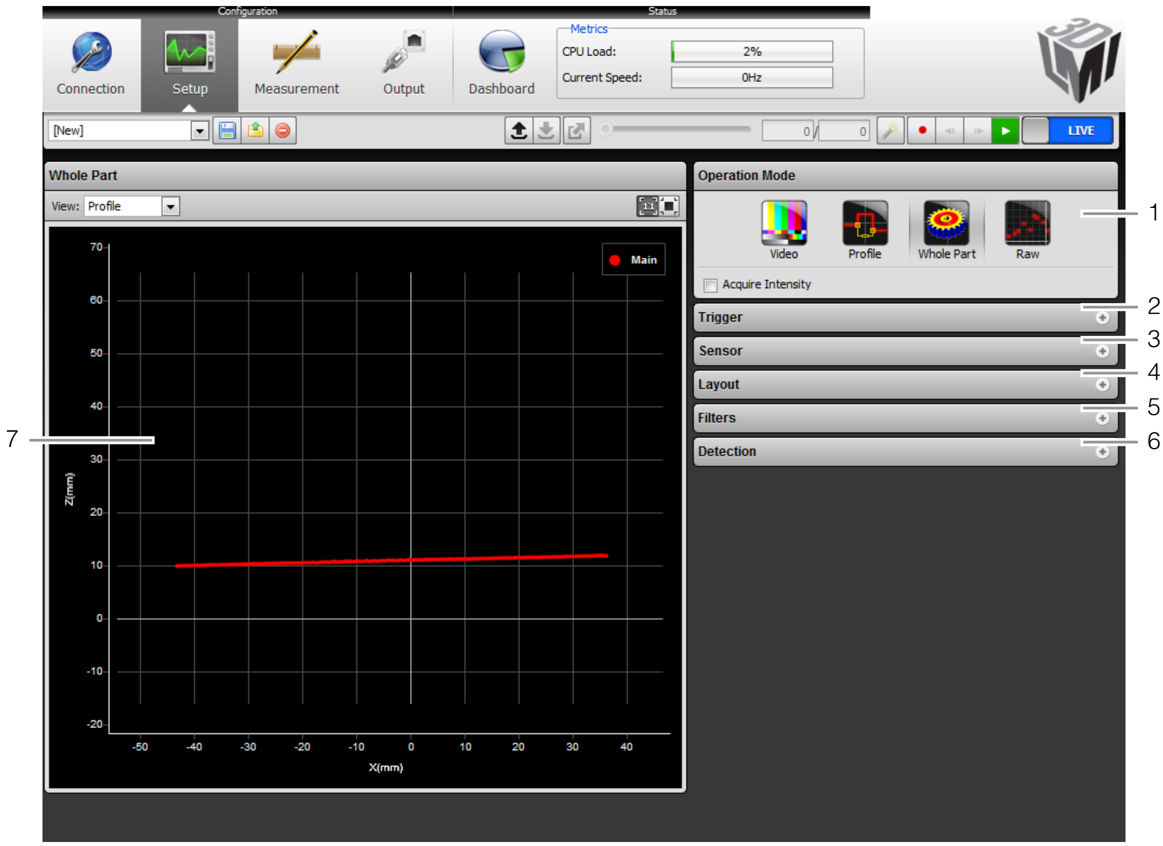
Connection and Maintenance (page 205)

Setups the sensor connections, networking and performs maintenance tasks.

Setup and Calibration

Setup Page

This chapter describes the steps to configure Gocator sensors for laser profiling using the Setup Page. Setup and calibration steps should be performed before programming measurements or outputs.



	Element	Description
1	Operation Mode Panel	Use the Operation Mode panel to set the current operation mode (Video, Profile, Part or Raw) and other options.
2	Trigger Panel	Use the Trigger panel to specify the trigger source and trigger related settings.
3	Sensor Panel	Use the Sensor panel to specify settings for an individual sensor, such as active area or exposure.
4	Layout Panel	Use the Layout panel to configure the dual sensor system and to perform alignment or travel calibration.
5	Filters Panel	Use the Filters panel to specify settings for post processing of the profiles.
6	Part Detection Panel	Use the Part Detection panel to set the part detection logic for sorting profiles into discrete objects.

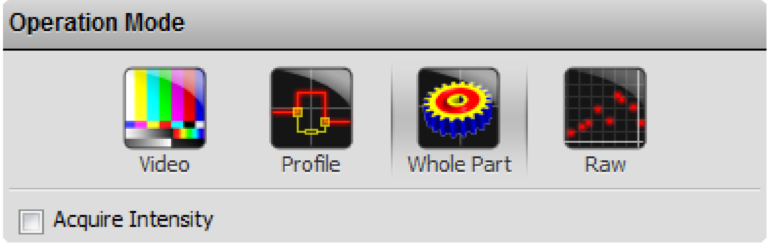
	Element	Description
7	Data Viewer	Use the Data Viewer to display sensor data and adjust regions of interest. Depending on the current operation mode, the data viewer can display video images, profile plots or part views.

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 (page 55)
2	Ensure that camera exposure is appropriate for laser profiling.	Exposure (page 63)
3	Find the right balance between profile quality, speed, and CPU utilization.	Active Area (page 60) Exposure (page 63) Resolutions (page 67)
4	Specify mounting orientations for dual sensor systems.	Dual Sensor System Layout (page 70)
5	Calibrate the system so that laser profile data can be aligned to a common reference and values can be correctly scaled in the axis of motion.	Alignment Calibration (page 73) Travel Calibration (page 74)
6	Specify smoothing, gap-filling and resampling parameters to remove effects of occlusions.	Filters (page 76)
7	Setup the part detection logic to sort profiles into discrete objects.	Part Detection (page 80)

Operation Modes

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



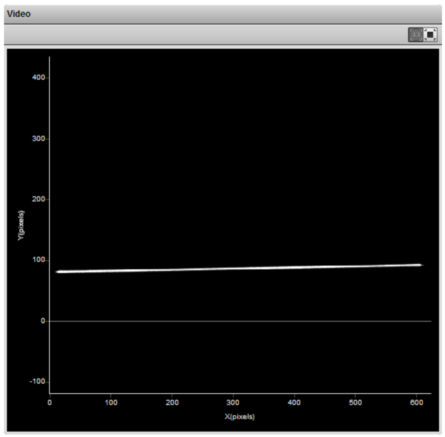
Mode and Option	Description
Video	Output video images from the Gocator. This mode is useful for configuring exposure time and troubleshooting stray light or ambient light problems.
Profile	Output profiles and perform profile measurements. Video images are processed internally to produce laser profiles and cross-sectional measurements.
Whole Part	Output 3D point clouds and perform part measurements. Laser profiles are sorted into discrete parts. The parts are then processed internally to produce measurements . "Whole Part" is often referred to as "Part" in the Gocator web interface and in this document.
Raw	Output profiles. In Raw Mode, video images are processed internally by the sensor to produce laser profiles. Use this mode to extract unprocessed ranges from the Gocator at the highest possible rate. Post-profiling processing and measurements are disabled.
Acquire Intensity	When enabled, an intensity value will be produced for each laser profile point.

Data Viewer

The Data Viewer can display video images, profile plots, intensity images and height maps. It is also used to configure active area and measurement tools. Its use is dependent on the current operation mode and the panel selection.

Video Mode

The Data Viewer displays camera images. In a dual sensor system, camera images from the Main or the Buddy sensor can be displayed.



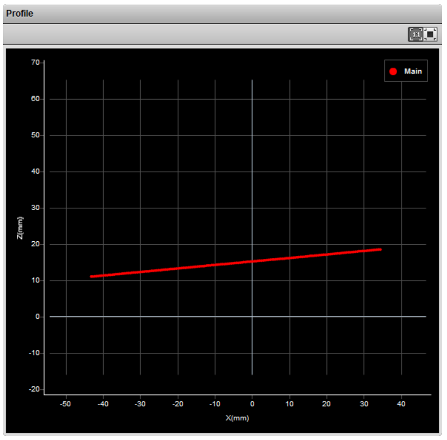
To select the view of the display:

1 **Navigate to the Setup Page.**

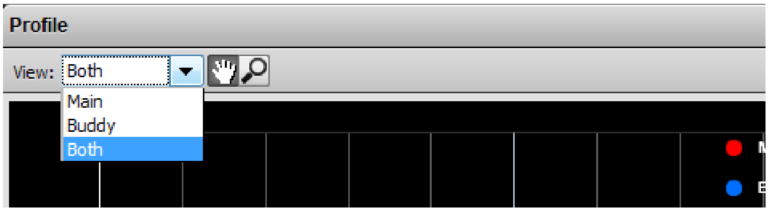
2 **Select the View.**
Select the Main or the Buddy sensor from the drop-down list at the top of the Data Viewer.

Profile and Raw Mode

In Profile and Raw mode, the Data Viewer displays profile plots.



In a dual sensor system, profiles from individual sensors or from a combined view can be displayed. While in the Setup Page, selecting a panel (e.g. Sensor Panel or Layout Panel) will automatically set the display to the most appropriate display view.



To manually select the display view in the Setup Page:

1 **Navigate to the Setup Page.**

2 **Select the View.**
An individual sensor or the combined view can be selected from the drop-down list at the top of the Data Viewer.

In the Measurement Page, the view of the display is set to the Profile Source of the selected measurement tool (page 86).

Whole Part

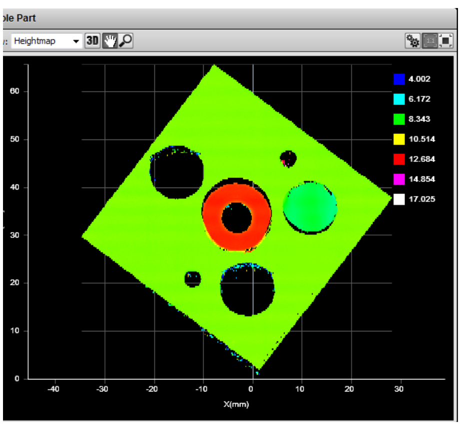
In addition to displaying profiles, the Data Viewer can display height maps and intensity images of the detected objects. Users select the data to display from the View option.

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

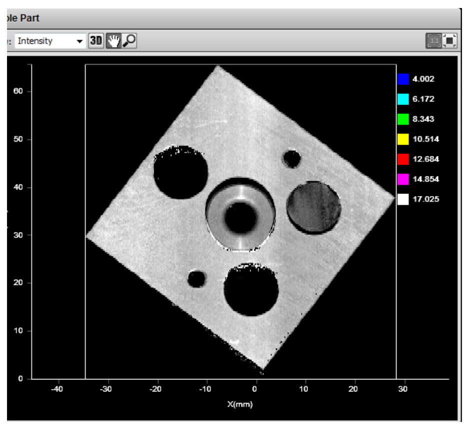
View Option

View Option	Information
Profile	Only available in 2D view. Plots the last collected profile.
Heightmap	In 2D view, displays the pseudo color height map. In 3D view, overlays the 2D pseudo-color map ion the 3D model.
Uniform	Only available in 3D view. Overlays a uniform shaded surface on the 3D model.
Intensity	In 2D view, display the intensity. In 3D view, overlays the intensity map on the 3D model.

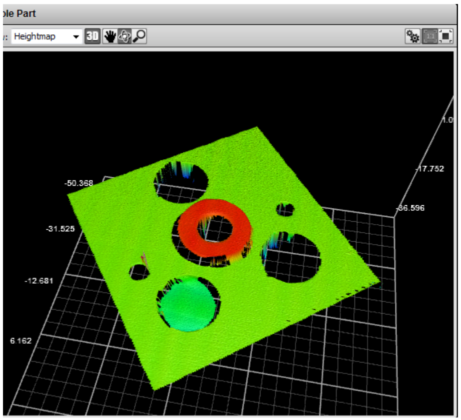
Choosing the Profile view option will switch the data viewer out of the 3D viewer and display the profile plot.



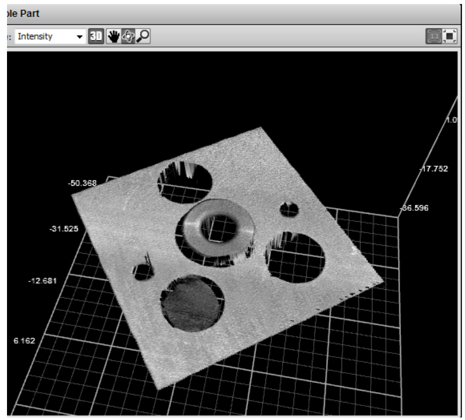
2D viewer for height map



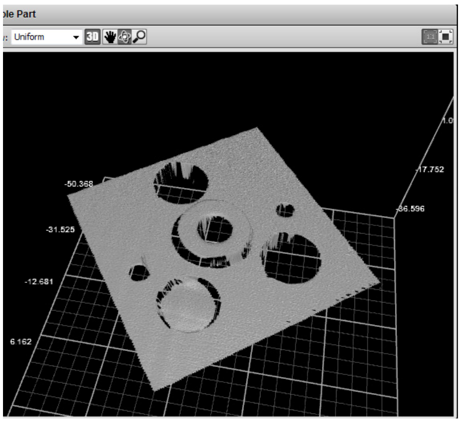
2D viewer for intensity



3D viewer with height map overlay



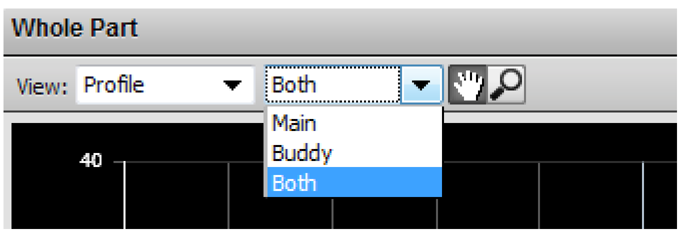
3D viewer dwith intensity overlay



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 50) for explanations on the available controls.

In a dual sensor system, data from individual sensors or from a combined view can be selected. While in the Setup Page, selecting a panel (e.g. Sensor Panel, Layout Panel or Part Detection panel) will automatically set the display to the most appropriate display type and display view.



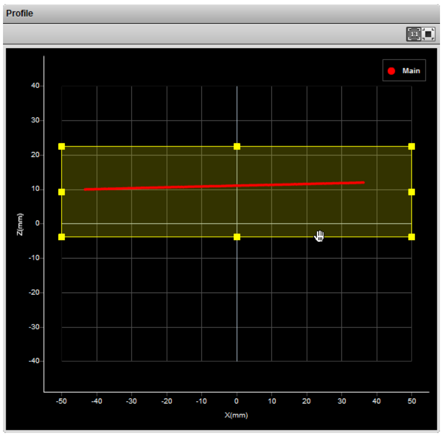
To manually select the display type and the display view in the Setup Page:

1 Navigate to the Sensor Page.

2 Select the View.
Profile, Height map, uniform and Intensity can be selected from the left drop-down list. An individual sensor or the combined view can be selected from the right drop-down list.

Region Definition

The Data Viewer can also be used to define a region of interest.



To setup a region of interest:

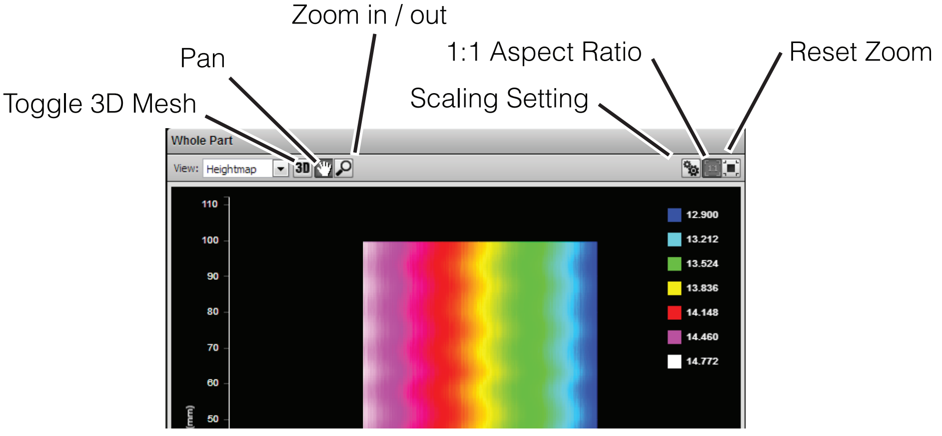
1 **Move the mouse cursor to the rectangle.**
The rectangle is automatically displayed when a setup or measurement requires an area to be specified.

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

Data Viewer Controls

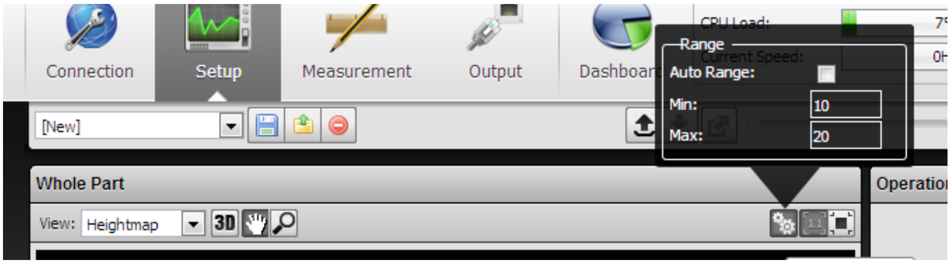
The data viewer is controlled by mouse clicks and by the buttons on the display tool bar. The mouse wheel can be also be used for zooming in and out.

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



Height Map Color Scale

Height maps 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 Height Map from the View setting.**

2 **Click the Scaling button.**
This will bring up the range scaling dialog box. To manually set the scale, uncheck the Auto Range option. Enter the minimum and maximum height to which the colors will be mapped.

Profile Output

Goactor measures the height of the object calculated from laser triangulation. The Gocator reports a series of ranges along the laser line, with each range representing the distance from the sensor's origin plane. Each range contains a height and a position in the sensor's field of view.

Coordinate Systems

Range data is reported in sensor or system coordinates depending on the calibration state. The coordinate systems are described below.

Sensor Coordinates

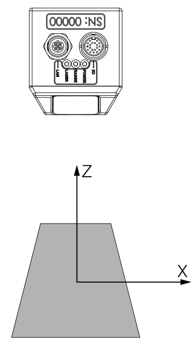
Prior to calibration, individual sensors use the coordinate system shown here.

The *z-axis* represents the sensor’s measurement range (MR), with the values increasing towards the sensor.

The *x-axis* represents the sensor’s field of view (FOV).

The origin is at the center of the MR and FOV.

In Part data, the Y-axis represents the relative position of the part in the direction of travel. y-position increases as the object moves forward (increasing encoder position).



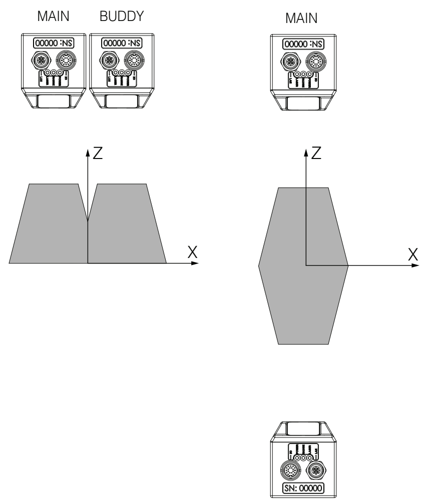
System Coordinates

Alignment calibration or travel calibration can be used to establish a common coordinate system for the Main and Buddy sensors. Calibration determines the adjustments to X, Z, and *Tilt* (rotation in the X–Z plane) required to align the data from each sensor.

System coordinates are aligned such that the system x-axis is parallel to the calibration target surface. The system Z-origin is set to the base of the calibration target object. The Tilt angle is positive when rotating from the X to the Z axis.

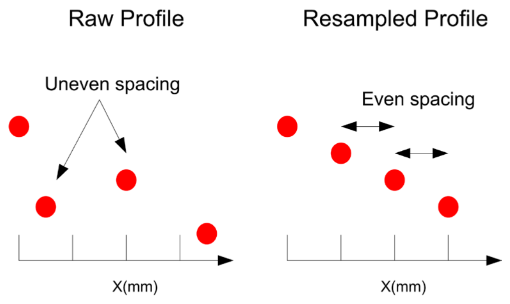
Similar to the sensor coordinates, y-positions increases when the encoder increases.

For Wide and Opposite layouts, profiles and measurements from the Main and Buddy sensors are expressed in a unified coordinate system. Isolated layouts express results using a separate coordinate system for each sensor.



Resampled And Raw Profile Format

Profile data produced by Profile or Part mode are processed differently than by Raw Mode. In Profile or Part mode, the ranges are resampled to an even interval along the laser line (x-axis). The resampling divides the x-axis into fixed size "bins" at even intervals. Profile points that fall into the same bin will be combined into a single range value (z). The size of the resampling interval can be configured in the Filters panel (page 76).



In the Ethernet data channel, only the range values (z) are reported and the x-positions can be reconstructed through the array index at the receiving end (the client).

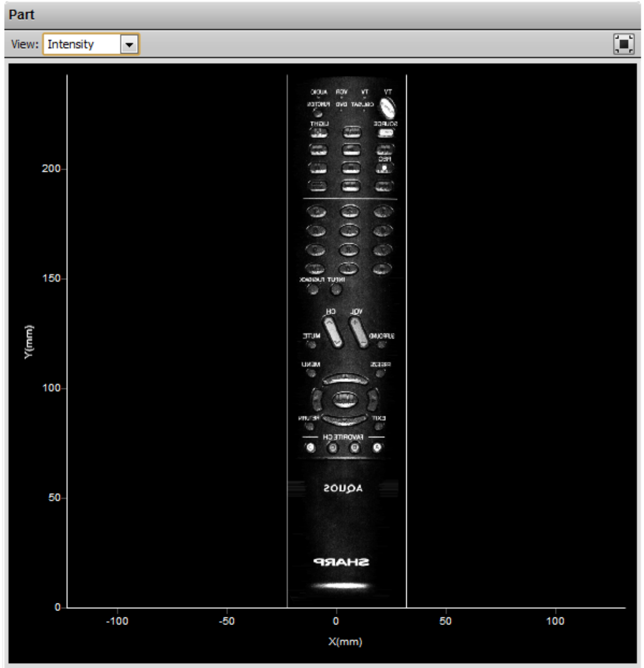
Resampling reduces the complexity for downstream algorithms to process the profile data from the Gocator, but at the cost of higher processing load on the sensor's CPU.

In contrast, Raw Mode outputs unprocessed range data. Ranges are reported in (x,z) coordinate pairs, freeing up processing resources in the Gocator, but typically requiring more complicated processing on the client side.

All built-in measurement tools in the Gocator operate on resampled data in Profile or Part Mode.

Intensity Output

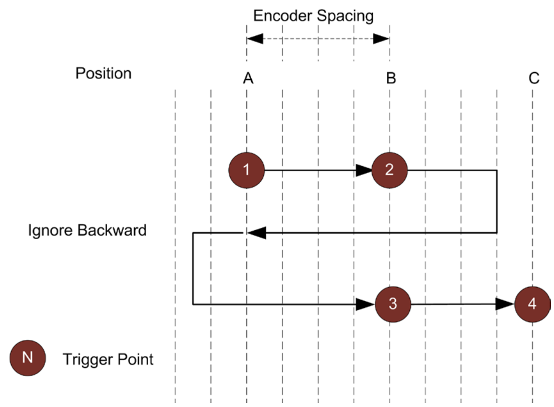
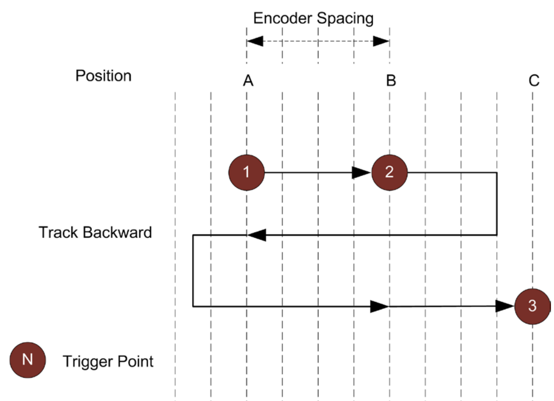
Gocator sensors can produce intensity images that measure the amount of light reflected by an object. An 8-bit intensity value is output for each range value along the laser line. Gocator applies the same coordinate system and resampling logic as the ranges (page 52) to the intensity values.

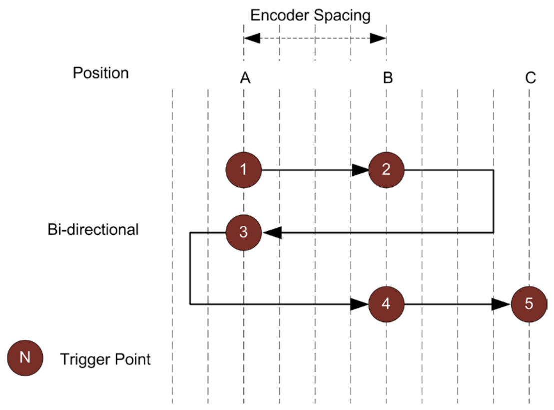


Trigger

A trigger is an event that causes a sensor to take a single picture. When a trigger is processed, the laser is strobed and the camera exposes to produce an image. The resulting image is processed inside the sensor to yield a *laser profile* (range/distance information), which can then be used for measurement.

The laser and camera inside a sensor can be triggered by one of four 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.
Encoder	An encoder can be connected to provide triggers in response to motion. Three encoder triggering behaviors are supported: 1. Ignore Backward A scan is triggered only when the target object moves forward. If the target object moves backward, it must move forward by at least the distance of one encoder spacing to trigger a scan.  2. Track Backward A scan is triggered when the target object moves forward. If the target object moves backward, it must move forward by at least the distance that the target travelled backward, plus one encoder spacing, to trigger a scan. 

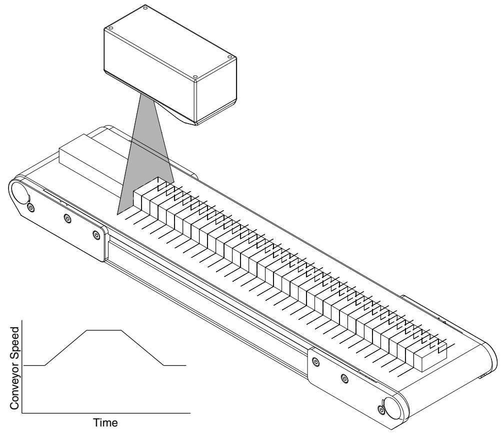
Trigger Source	Description
Encoder	3. Bi-directional A scan is triggered when the target object moves forward or backward.  When triggers are received at a frequency higher than the maximum frame rate, some triggers may not be accepted. The *Trigger Drops Indicator* in the Dashboard can be used to check for this condition. The external input can be used to enable or disable the encoder triggers. Refer to Encoder Input (page 341) for more information on connecting the encoder to Gocator sensors.
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 340) 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 253) for more information.

Examples

Example: Encoder + Conveyor

Encoder triggering is used to perform profile measurements at a uniform spacing.

The speed of the conveyor can vary while the object is being measured; an encoder ensures that the measurement spacing is consistent, independent of conveyor speed.

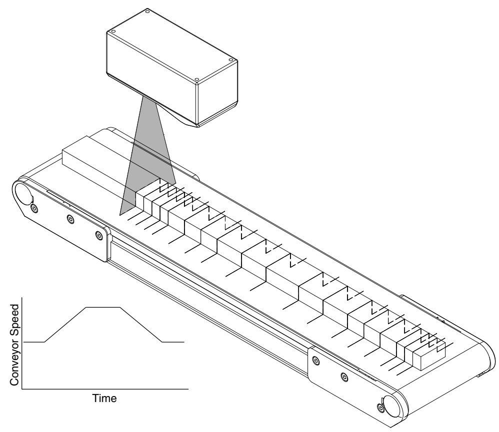


Example: Time + Conveyor

Time triggering can be used instead of encoder triggering to perform profile measurements at a fixed frequency.

Measurement spacing will be non-uniform if the speed of the conveyor varies while the object is being measured.

It is strongly recommended to use an encoder with transport-based systems due to the difficulty in maintaining constant transport velocity.

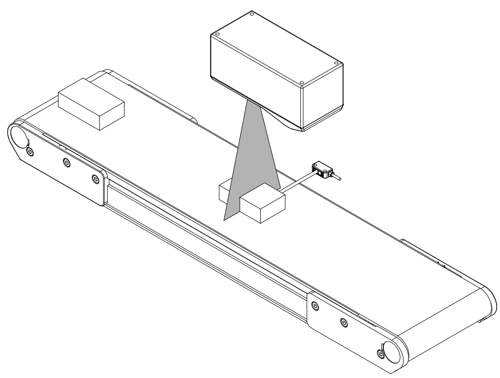


Example: External Input + Conveyor

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

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

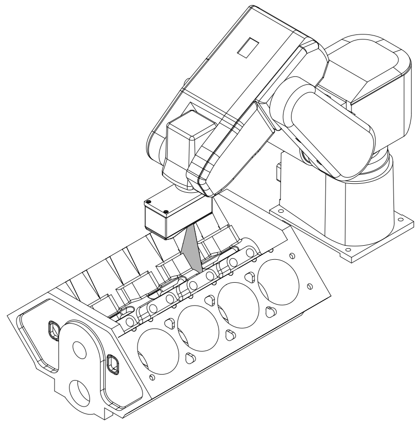
An External Input can also be used to gate the trigger signals when Time or Encoder triggering is used. For example, a photocell could generate a train of trigger pulses as long as there is a target in position.



Example: Software Trigger + Robot Arm

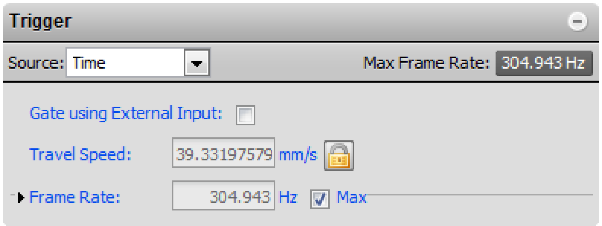
Software triggering can be used to produce a snapshot for profile measurement.

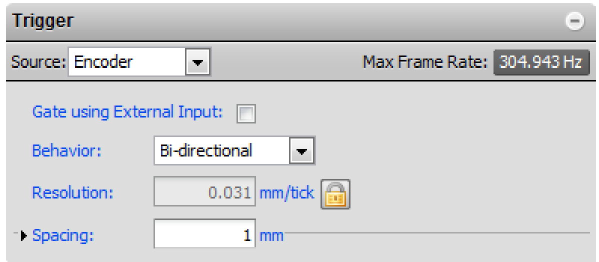
A software trigger can be used in systems that employ external software to orchestrate the activities of system components.

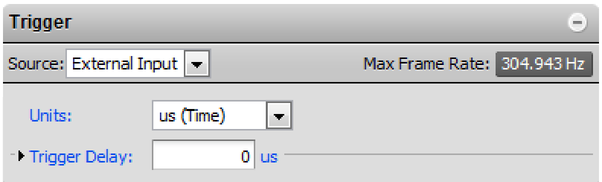


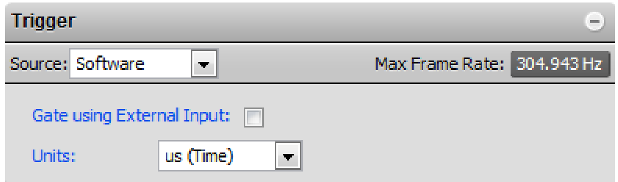
Settings

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.

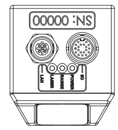
Parameters	Trigger Source	Description
Trigger	All	Selects the trigger source. (Time, Encoder, External Input, or Software)
Max Frame Rate	All	Reports the maximum frame rate, which is a function of the current Active Area, Exposure, and Resolution settings.
Frame Rate	Time	The Frame Rate setting can be 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, Encoder	External input can be used to enable or disable profiling in a sensor. When enabled, the sensor will respond to time or encoder triggers only when the external input is asserted. Refer to Digital Inputs (page 340) for more information on connecting external input to a Gocator senor.
Travel Speed	Time	Travel Speed provides proper scaling in the y-axis (axis of motion). Travel Speed can be calculated automatically by performing Travel Calibration or set manually after clicking on the unlock button.
Encoder Behavior	Encoder	Encoder Behavior setting is used to specify how the Gocator sensor is triggered when the target moves.
Encoder Resolution	Encoder	Encoder Resolution (millimeters per tick) provides proper scaling in the y-axis (axis of motion). The encoder resolution can be calculated automatically by performing Travel Calibration or set manually after clicking on the unlock button.
Spacing	Encoder	Encoder Spacing setting is used to specify the distance between triggers (mm). Internally the Gocator sensor rounds the spacing to a multiple of the encoder resolution.
Units	External Input, Software	Units specifies whether the trigger delay, output delay and output scheduled command operates in the time or the encoder domain. The unit is implicitly set to microseconds with Time trigger source, and millimeters with Encoder 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 63).

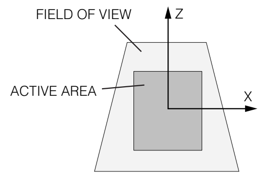
Active Area

Active area refers to the region within the sensor's maximum field of view that is used for laser profiling.

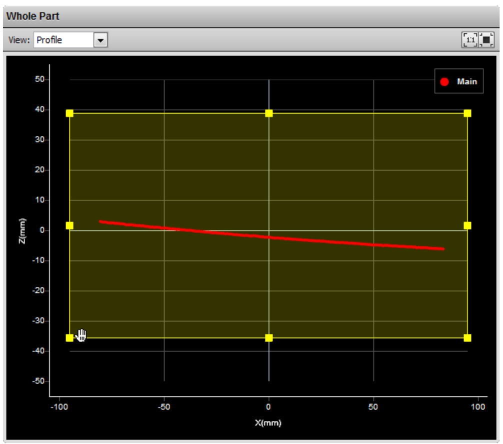
By default, the active area covers the sensor's entire field of view. By reducing the active area, the sensor can operate at higher speeds.

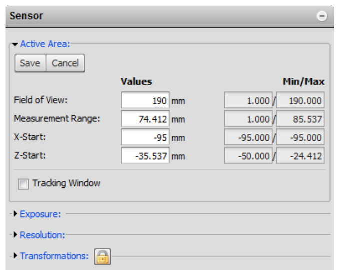
Active area is specified in sensor coordinates, rather than in system coordinates. As a result, active area must be configured before Alignment or Travel calibration is performed. Refer to Coordinate Systems (page 52) for more information on sensor and system coordinates.





Active Area can only be set when the sensor is not calibrated.





To set the active area:

1 Navigate to the Sensor panel.
Active area is specified separately for each sensor. Click the arrow next to Active Area to expand the panel.

2 Click the Select button.
If the Select Active Area button is disabled, then calibration may need to be cleared. Refer to Clearing Calibration (page 75) in this chapter for information on clearing calibration.

3 Position and resize the Active Area rectangle shown in the Data Viewer.

4 Click the Save button.

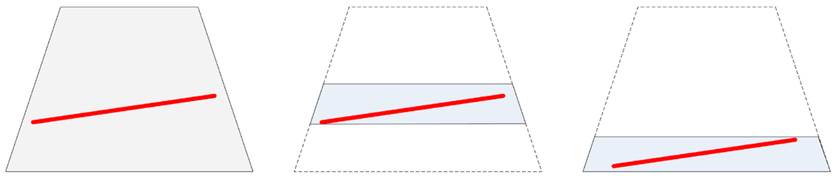
Laser profiling devices are usually more accurate at the near end of the measurement range. If your application requires a measurement range that is small relative to the maximum measurement range of the sensor, mount the sensor such that the active area can be specified at the near end of the measurement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

Tracking Window

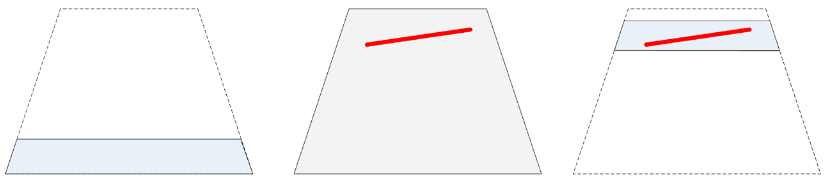
The Gocator can track a relatively flat object in real-time to achieve very high scan rates. This feature is based on tracking the object height using a small window, called the Tracking Window, that moves dynamically to cover a larger measurement range. Users can balance the gain in speed and the tracking ability by configuring the size of the tracking area. This feature is typically used in road or web scanning applications where the target is a continuous flat surface.

A laser line remains tracked as long as the percentage of detected laser point exceeds the user defined search threshold. When the sensor loses track of the laser line, the sensor will search for the laser line using the full active area.

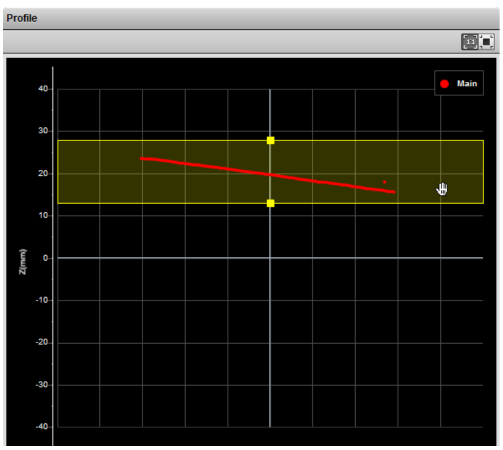
Tracking Window is only supported on the Gocator 2300 series.

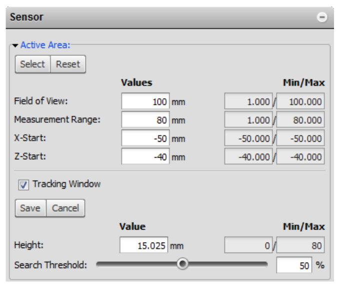


1. Search using the Full Active Area 2. Track using the Tracking Window 3. Track using the Tracking Window



4. Lose track of laser line. 5. Search using the Full Active Area 6. Track using the Tracking Window





To enable tracking window:

1. **Check the Tracking Window box.**
   Checking the Tracking Window box expands the panel to reveal the settings for the window used to track the object height.

2. **Resize the Tracking Window shown in the Data Viewer.**
   Only the height of the window is required. User can move the position of the tracking window to cover a live profile to help adjust the window height.

3. **Edit the Search Threshold setting.**
   The search threshold defines the minimum percentage of the points detected across the profile for the laser to be considered tracked. If the tracking is lost, the sensor will search for the laser using the full active area.

The sensor adjusts the position of the tracking window such that the area is centered around the average height of the entire visible laser profile. Users should adjust the lighting and the active area to remove all background objects (i.e. conveyer belt surface, ambient lights).

Exposure

Exposure determines the duration of camera and laser on-time. Longer exposures can be helpful to detect laser signals 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 three exposure modes for the flexibility needed to scan different types of target surfaces.

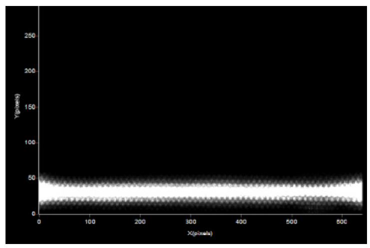
Exposure Mode	Description
Single Exposure	Uses single exposure for all objects. Used when the surface is uniform and is the same for all targets.
Dynamic Exposure	Automatically adjust the exposure after each frame. Used when the target surface varies between scans.
Multiple Exposures	Uses multiple exposures to create a single profile. Used when the target surface has a varying reflectance within a single profile (e.g. white and black color)

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

Under exposure

Laser line is not detected.

Increase the exposure value.



Over exposure

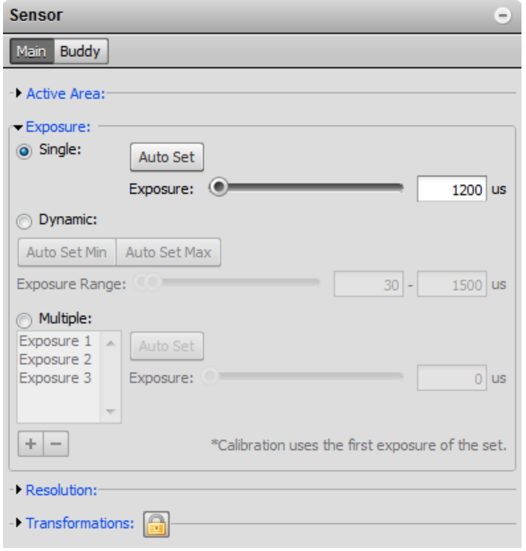
Laser line is too bright.

Decrease the exposure value.

In a dual sensor system, the Main and the Buddy sensor must use the same exposure mode or the system will fail to start.

Single Exposure

The sensor uses a fixed exposure in every scan. The 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 Profile, Part or Raw Mode.**

3 **Navigate to the Sensor panel.**
Click the arrow next to Exposure to expand the panel. Click the Main or Buddy sensor button to select the sensor.

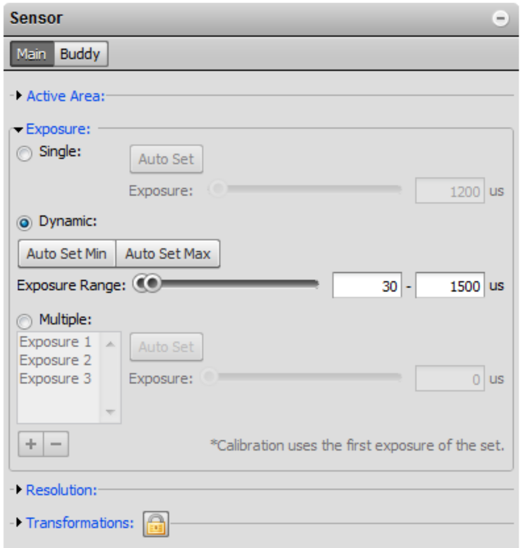
4 **Select Single.**

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 laser profiling is satisfactory.**
If not satisfactory, adjust the exposure values manually. Switch to Video mode to use video to help tune the exposure (page 62).

Dynamic Exposure

The sensor automatically uses past profile information to adjust the exposure to yield the best profile. This is used when the target surface changes from scan to scan.



To enable dynamic exposure:

1 Select Profile, Part or Raw Mode.

2 Navigate to the Sensor panel for the Main or Buddy sensor.
Click the arrow next to Exposure to expand the panel. Click the Main or Buddy button to select the sensor.

3 Select Dynamic.

4 Set the minimum and maximum exposure.
The auto-set function can be used to automatically set the exposure. First, place the brightest target in the field of view and press the Auto Set Min button to set the minimum exposure. Then, place the darkest target in the field of view and press the Auto Set Max button to set the maximum exposure.

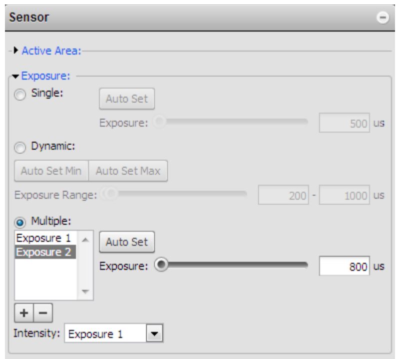
5 Run the sensor and check that laser profiling is satisfactory.
If not satisfactory, adjust the exposure values. Switch to Video mode to use video to help tune the exposure (page 62).

Multiple Exposures

The sensor combines data from multiple exposures to create a single laser profile. 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 five 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 halved of the single exposure frame rate. The sensor will perform a complete scan for each external input or encoder trigger.

The resulting profile is a composite created by combing data collected with different exposures. The sensor will choose profile data that is available from the lowest numbered exposure step. It is recommended to use larger exposure for higher numbered step.



Users must ensure the exposure steps set for composite exposure are the same between the Main and Buddy sensors in Dual Sensor Mode.

To enable multiple exposures:

1 **Select Profile, Part or Raw Mode.**

2 **Navigate to the Sensor panel.**
Click the arrow next to Exposure to expand the panel. Click the Main or Buddy button to select the sensor.

3 **Select Multiple.**

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

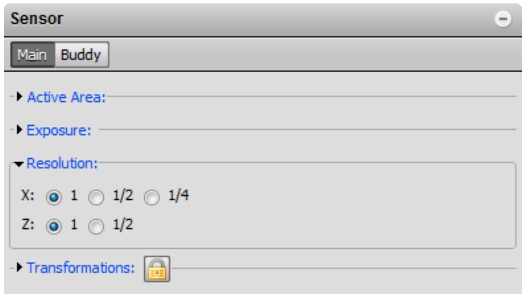
5 **Set the exposure level to make the Gocator less or more sensitive (as required).**
The auto-set function can be used to automatically set the exposure. To use the auto-set function, place target material in the field of view then select an exposure step and press the Auto Set button. Repeat this 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 laser profiling is satisfactory.**
If not satisfactory, adjust the exposure values. Switch to Video mode to help tune the exposure (page 62).

Resolutions

Resolutions can be set independently for the x-axis and z-axis. Reducing the resolution increases speed or reduces CPU utilization while maintaining the sensor's field of view.



X Resolution

The X Resolution setting can be used to decrease the profile's x-resolution in order to decrease sensor CPU utilization. The X Resolution setting works by reducing the number of image columns used for laser profiling.

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

To configure X resolution:

1 **Navigate to the Sensor panel.**
Click the arrow next to Resolution to expand the panel. Click the Main or Buddy button to select the sensor. X resolution is specified separately for each sensor.

2 **Select a resolution value.**
X resolution values are expressed as fractions. For example, a resolution value of 1/2 indicates that every second camera column will be used for laser profiling.

3 **Check that laser profiling is satisfactory.**
After adjusting the resolution, confirm that laser profiling characteristics are satisfactory.

Z Resolution

The Z Resolution setting can be used to decrease the profile's Z resolution in order to increase speed. The Z Resolution setting works by reducing the number of image rows that is used for laser profiling.

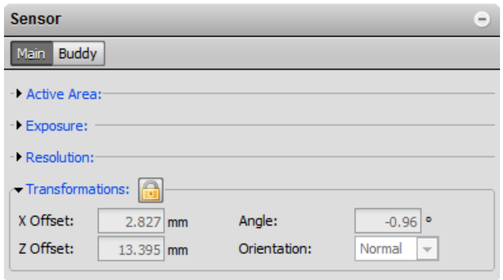
On the Gocator 2000, decrease Z resolutions will increase speed. On the Gocator 2300, both X and Z resolutions need to be decreased to increase speed.

To configure Z resolution:

1. **Navigate to the Sensor panel.**
   Click the arrow next to Resolution to expand the panel. Click the Main or Buddy button to select the sensor. Z resolution is specified separately for each sensor.
2. **Select a resolution value.**
   Z resolution values are expressed as fractions. For example, a resolution value of 1/2 indicates that every second camera row will be used for laser profiling.
3. **Check that laser profiling is satisfactory.**
   Decreasing z resolution can reduce laser profiling accuracy. After adjusting the resolution, confirm that laser profiling characteristics are satisfactory.

Transformations

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



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.
Z Offset	Specifies the shift along the z-axis. A positive value shifts the profiles towards the sensor.
Angle	Specifies the tilt (rotation in the X-Z plane). A positive value rotates the profile counter-clockwise.
Orientation	Specifies the direction of the x-axis. Setting to Reverse will flip the profile about the z-axis.

When applying the transformations, Angle is applied before X and Z offsets.

To configure transformation settings:

1 **Select the Profile, Part or Raw Mode.**

2 **Navigate to the Sensor panel.**
Click the arrow next to Transformation to expand the panel. Click the Main or Buddy button to select the sensor. Transformations can be configured separately for each sensor (click the arrow next to Transformations to expand the settings).

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

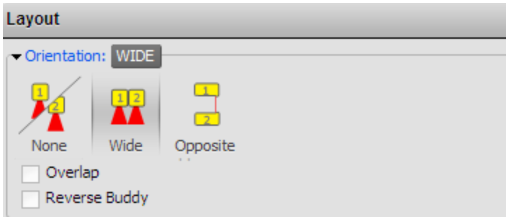
4 **Set the parameter values.**

5 **Check that the transformation settings are applied correctly after profiling is restarted.**

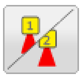
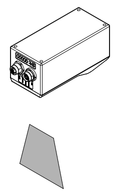
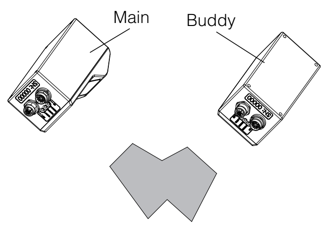
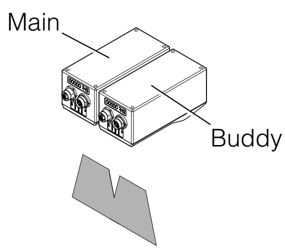
Dual Sensor System Layout

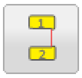
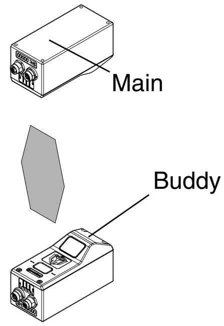
Mounting orientations need to be specified for a dual sensor (Buddy) system. This information allows the Alignment or Travel Calibration procedures to determine the correct system-wide coordinates for laser profiling and measurements. Refer to Coordinate Systems (page 52) in this chapter for more information on sensor and system coordinates.

To specify the layout, navigate to the Layout panel on the Setup Page:



Supported Orientations

	Orientation	Example
	**None (Isolated)** Each sensor operates as an isolated device. Measurements are reported in a separate coordinate system for each sensor.	
	**Wide** Sensors are mounted in *Left* (Main) and *Right* (Buddy) positions for a larger combined field of view. Sensors may be angled to avoid occlusions.	

	Orientation	Example
	**Opposite** Sensors are mounted in *Top* (Main) or *Bottom* (Buddy) positions for a larger combined measurement range and the ability to perform Top/Bottom differential measurements.	

Overlap

If the Main and Buddy sensors are mounted such that the camera from one sensor can detect the laser from the other sensor, the *Overlap* feature can be used to eliminate laser interference. Overlap creates a time offset for laser exposures and ensures that interfering lasers are not strobed at the same time. Use of the overlap feature may reduce the maximum frame rate.

Reverse

In the Wide layout, the Buddy sensors can be mounted such that it is rotated 180 degrees around the z-axis to prevent occlusion along the y-axis. Enable the Reverse feature when the buddy is mounted in this reverse orientation.

Calibration

Although Gocator sensors are pre-calibrated and ready to deliver profiles out of the box, calibration procedures are required to compensate for sensor mounting inaccuracies, to align multiple sensors into a common coordinate system, and to determine the resolution (with encoder) and speed of the transport system.

Gocator sensors support two types of calibration procedures: *Alignment Calibration* and *Travel Calibration*. Travel calibration performs essentially the same role as alignment calibration, but calibrates encoder resolution and y-axis offsets in addition to the corrections provided by alignment calibration.

Once calibration has been completed, the values derived will be saved automatically and reloaded each time the sensor is reset or powered up.

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 or encoder resolution.
Auto	Sensor is calibrated using either alignment or travel calibration.

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

Alignment vs. Travel Calibration

The table below summarizes the differences between alignment calibration and travel calibration.

Alignment Calibration vs. Travel Calibration

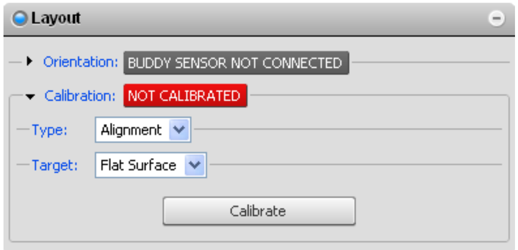
	Alignment Calibration	Travel Calibration
Target Type	Flat Surface or Cal Bar	Cal Disk or Cal Bar
Target/Sensor Motion	Stationary	Linear Motion
Calibrates Tilt	Yes	Yes
Calibrates z-axis Offset	Yes	Yes
Calibrates x-axis Offset	Yes (Cal Bar Required)	Yes
Calibrates Encoder	No	Yes
Calibrates Travel Speed	No	Yes

Refer to Coordinate Systems (page 52) for definitions of coordinate axes. Calibration disks and bars are described in Calibration Targets (page 28).

The procedures to perform alignment calibration or travel calibration are described in the next sections. After calibration, the coordinate system for laser profiles will change from Sensor Coordinates to System Coordinates.

Alignment Calibration

Alignment calibration can be used to compensate for mounting inaccuracies by aligning sensor data to a common reference surface (often a conveyor belt).



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. If using a calibration bar for dual sensor system, ensure that the lasers illuminate a reference hole on the calibration bar.

2 **Navigate to the Layout panel and select Alignment Calibration.**
Click the arrow button next to Calibration to expand the panel.

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

4 **Select a calibration Target.**
Select *Flat Surface* to use the conveyor surface (or other flat surface) as the calibration reference, or *Bar* to use a custom calibration bar. If using a calibration bar, specify the bar dimensions and reference hole layout. Refer to Calibration Targets (page 28) for more information.

5 **Press the Calibrate button.**
The sensors will start and the alignment calibration process will take place. Calibration is performed simultaneously for all sensors. If the sensors do not calibrate, check and adjust the exposure settings.

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

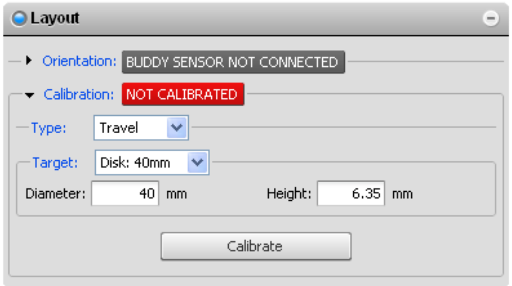
6 **Use Profile Mode to inspect calibration results.**
Laser profiles from all sensors should now be aligned to the calibration target surface. The base of the calibration target (or target surface) provides the origin for the system z-axis.

Alignment calibration does not automatically calibrate the resolution of the encoder (if present) or the travel speed. However, the these values can be manually entered if desired. Refer to Trigger (page 55) for more information.

When using a calibration bar, there can be at most one hole in each sensor's field of view.

Travel Calibration

Travel calibration can be used to achieve alignment calibration and motion calibration in a single procedure.



To perform travel calibration:

1 **Place the calibration target prior to the laser plane.**
Remove extraneous objects from the transport system such that the calibration target will be the only object that is scanned.

2 **Navigate to the Layout panel and select Travel Calibration.**
Click the arrow button next to Calibration to expand the panel.

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

4 **Select a calibration Target.**
Select one of the *Disk* options to use a standard disk target or *Bar* to use a custom-made calibration bar. If using a calibration bar, specify the bar dimensions and reference hole layout. Refer to Calibration Targets (page 28) for more information.

5 **Press the Calibrate button.**
The sensors will start and then wait for the calibration target to pass through the laser plane.

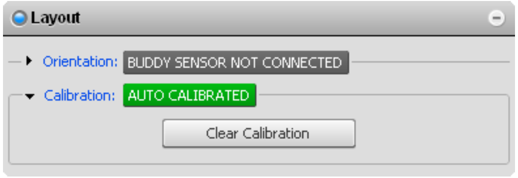
Travel calibration uses the exposure defined for the single exposure mode, regardless of the current exposure mode.

6 **Engage the transport system.**
When the calibration target has passed completely through the laser plane, the calibration process will complete automatically. To properly calibrate the travel speed, the transport system must be running at the production operating speed before the target passes through the laser plane.

7 **Use Profile Mode to inspect calibration results.**
Laser profiles from all sensors should now be aligned to the calibration target surface. The base of the calibration target (or target surface) provides the origin for the system z-axis.

When using a calibration bar, there can be at most one hole in each sensor's field of view. If a disk is used for calibrating a dual-sensor setup in a wide layout, half of the disk must be in each sensor's field of view.

Clearing Calibration



To clear calibration:

1. **Navigate to the Calibration panel on the Setup page.**
2. **Click the Calibration or Clear Calibration button.**
   If the Clear Calibration button is pressed, the calibration will be erased and sensors will revert to using Sensor Coordinates.

Filters

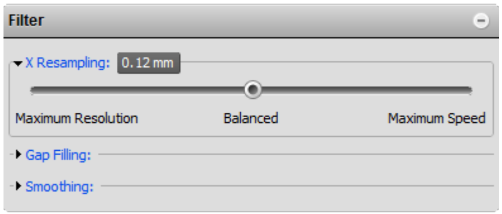
The Filters Panel can be used to post process the profile before it is output or is used by measurement tools. Three types of filters are supported:

Filters	Description
X Resampling Interval	Configure resampling interval size to balance between CPU loading, output data rate and x-resolution.
Smoothing	Apply moving window averaging to reduce random noise in a profile.
Gap Filling	Fill in missing data caused by occlusions using information from the nearest neighbors.

X Resampling Interval

Resampling interval is the spacing between data points in a resampled profile (page 52). A larger interval creates profiles with lower x-resolution but reduces CPU usage and potentially increases the maximum frame rate. A larger interval also reduces the data output rate.

By default, the Gocator output data at the medium resolution.



To configure the X resampling interval:

1 **Select the Profile or Part Mode.**

2 **Navigate to the Filters panel.**
Click the arrow next to X Resampling to expand the panel.

3 **Select a resampling interval level.**
Maximum Speed: Use the lowest x-resolution within the active area as the resampling interval. This setting minimizes CPU usage and data output rate but the profile has the lowest x-resolution (i.e. least detail)

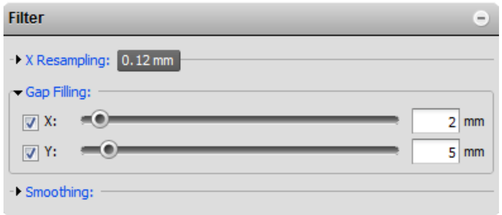
Balanced: Use the x-resolution at the middle of the active area as the resampling interval. This setting balances CPU load, data output rate and the x-resolution.

Maximum Resolution: Use the highest x-resolution within the active area as the resampling interval. This setting maximizes resolution but has higher CPU load and has the highest data output rate. (i.e. greatest detail).

Gap Filling

Gap filling works by filling in missing data points using the lowest values from the nearest neighbors. The sensor can fill gaps along both the x-axis and the y-axis. X gap filling works by filling in the gaps within the same profile. Y gap filling works by filling in gaps in the direction of travel at each x location.

If both X and Y gap filling are enabled, missing data is filled along the x-axis first, then along the y-axis.



To configure X gap filling:

1 **Select the Profile or Part Mode.**

2 **Navigate to the Filters panel.**
Click the arrow next to Gap Filling to expand the panel.

3 **Enable X gap filling and select the maximum width value.**
The maximum gap value represents the maximum gap width that the Gocator will fill. Gaps wider than the maximum width will not be filled.

4 **Check that the laser profiling is satisfactory.**

To configure Y gap filling:

1 **Select the Profile or Part Mode.**

2 **Navigate to the Filters panel**
Click the arrow next to Gap Filling to expand the panel.

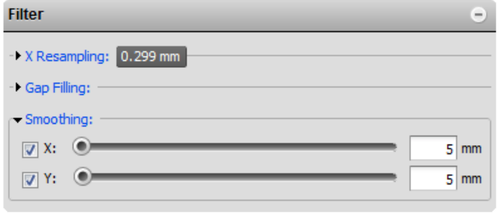
3 **Enable Y gap filling and select the maximum width value.**
The maximum gap value represents the maximum gap width that the Gocator will fill. Gaps wider than the maximum width will not be filled.

4 **Check that the laser profiling is satisfactory.**

Smoothing

Smoothing works by substituting a profile result with the average value of itself and its nearest neighbors. Smoothing can be applied along the x-axis or the y-axis. X smoothing works by calculating a moving average across samples within the same profile. Y smoothing works by calculating a moving average in the direction of travel at each x location.

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



To configure X smoothing:

1 **Select the Profile or Part Mode.**

2 **Navigate to the Filters panel.**
Click the arrow next to Smoothing to expand the panel.

3 **Enable X Smoothing and select the window value.**
The window value represents the averaging window size in the x-axis.

4 **Check that the laser profiling is satisfactory.**

To configure Y smoothing:

1 **Select the Profile or Part Mode.**

2 **Navigate to the Filters panel.**
Click the arrow next to Smoothing to expand the panel.

3 **Enable Y Smoothing and select the window value.**
The window value represents the average window size in the y-axis.

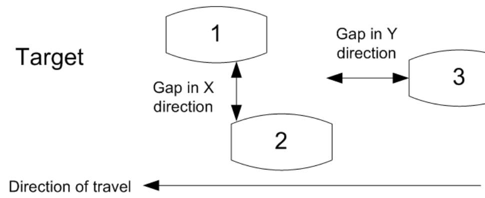
4 **Check that the laser profiling is satisfactory.**

Part Detection

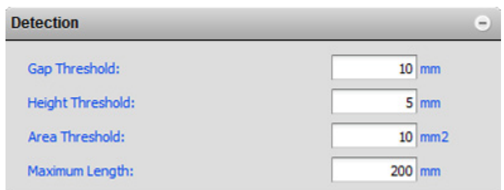
In Part Mode, the Gocator sensor analyzes each profile to identify discrete objects. Part measurements can then be performed on each discrete object.

Part detection can be performed when the trigger source is set to Time or Encoder. To use the Time trigger source, the travel speed needs to be calibrated. To use the Encoder trigger source, the encoder resolution needs to be calibrated. Refer to Travel Calibration (page 74) for more information.

Multiple parts can pass through the laser at the same time and will be individually tracked. Parts can be separated along the laser line (x-axis), in the direction of travel (y-axis) or by gated external input.



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



Setting	Description
Gap Threshold	Determines the minimum separation between objects in the XY plane. If parts are closer than the gap interval, they will be merged into a single part.
Height Threshold	Determines the minimum profile height for part detection. This setting is useful when measuring objects on a conveyor, to prevent the conveyor from being detected as a part. Any data points below the height threshold will not be taken into account when calculating the part measurements In an opposite layout, the threshold is applied to the difference between the top and the bottom profile. Target thinner than the threshold value is ignored, including places where only one of either top or bottom is detected. To separate part by gated external input, set the Height Threshold to the Active area Z-offset (i.e. minimum Z position of the current Active Area), set the trigger source to Time or Encoder and check the Gate Using External Input check box.
Area Threshold	Determines the minimum area for a detected part. Set this value to a reasonable minimum in order to filter out small objects or noise.
Length Max	Determines the maximum length of the part object. When the object exceeds the maximum length, it is automatically separated into two parts. This is useful to break a long object into multiple sections and perform measurements on each section.

To setup part detection:

1 Navigate to the Operation Mode Panel, select Part Mode.

2 Navigate to the Part Detection panel.

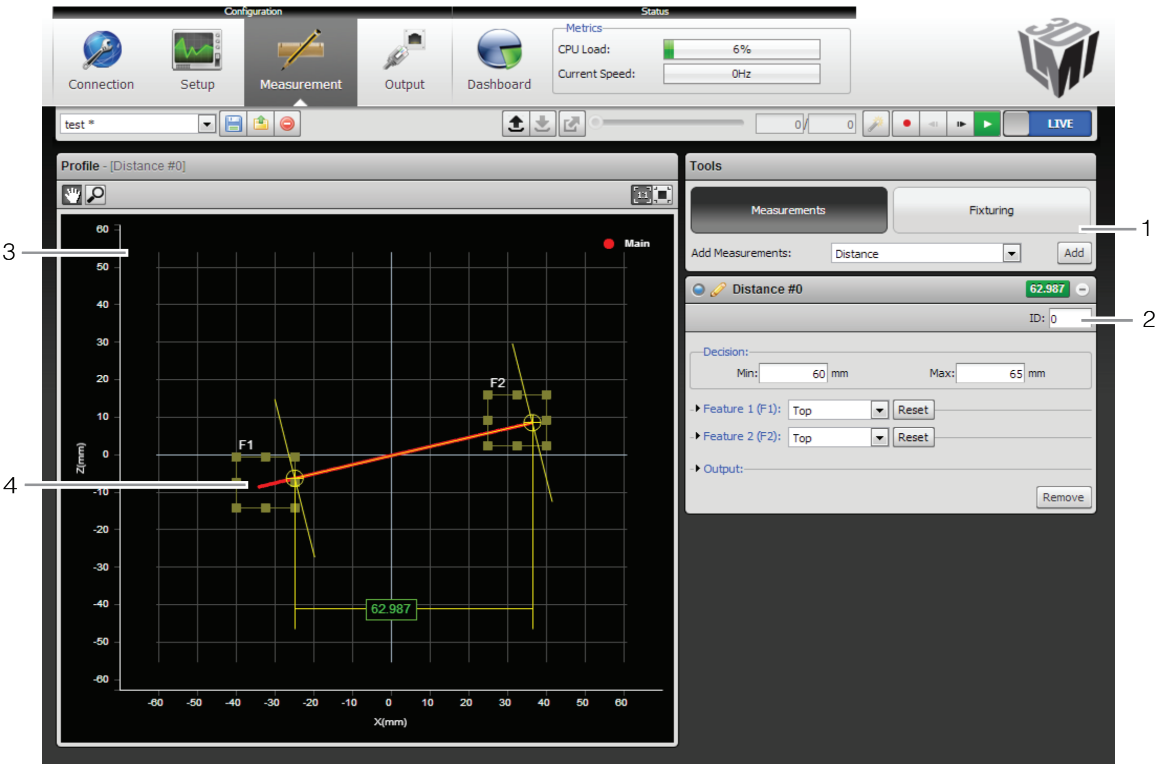
3 Adjust the settings.

Measurement

Measurement Page

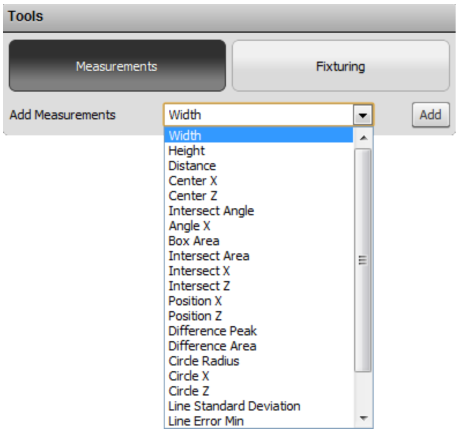
Measurement tools are configured using the Measurement Page.

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



	Element	Description
1	Tools Panel	Use the Tools panel to add new measurements or to configure fixturing.
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 laser profile or part data, setup tools and display result calipers related to the selected measurement. Parts are displayed using a height map; 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 area displayed depends on which measurement tool is currently selected.

Adding and Removing Measurements



To add a new profile measurement:

1 **Select the desired measurement type.**
Click on the item in the drop-down list next to Add Measurement 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 new profile 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.

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 edit a measurement name:

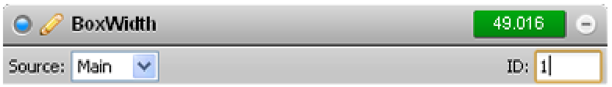
1 **Click on the measurement name.**

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 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.

Profile Sources

For dual sensor systems, measurements must specify a *profile source*. The profile source determines the data that will be used for the measurement.

The following options are available:

Profile Source	Description
Main	Profile data is provided by the Main sensor. This is the only option for standalone systems.
Buddy	Profile data is provided by the Buddy sensor.
Both	Profile data is provided by the Main and the Buddy sensor.

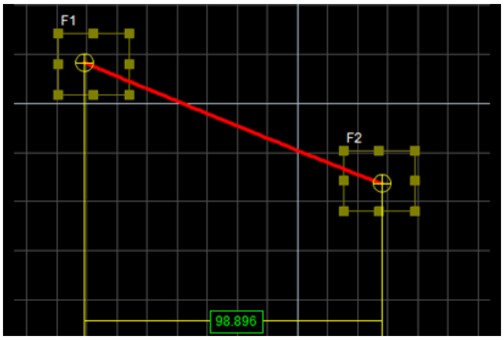
To select the profile source:

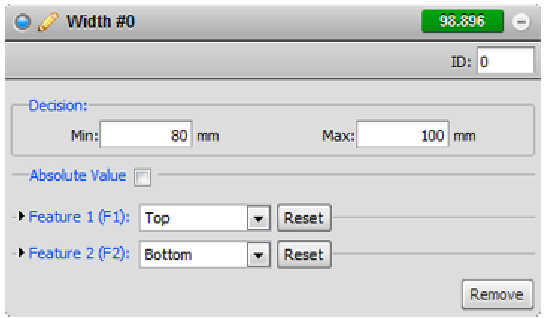
1 **Select a measurement.**
Click on the + in a measurement panel to expand it.

2 **Select the profile Source.**
Select the source in the drop down list. The drop down list will not appear if Main is the only option.

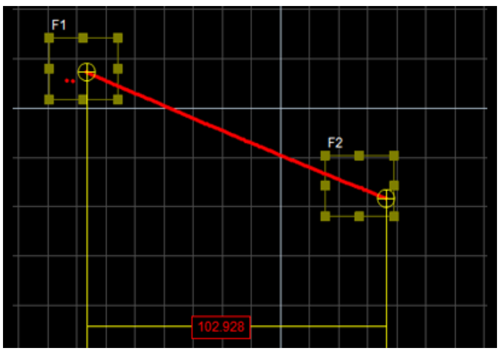
Decisions

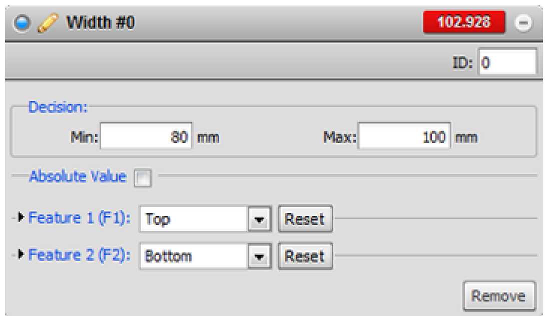
Results from a measurement tool can be compared against minimum and maximum thresholds to generate *pass* / *fail decisions*. The decision state is pass (value displayed in green) if a measurement value is between the minimum and maximum threshold, otherwise the decision state is *fail* (value displayed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





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





Value (51.216) is outside decision thresholds (Min:80, Max:100)
Decision: Fail

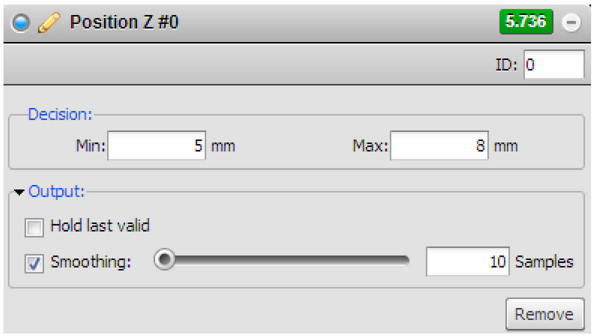
Value (51.216) is outside the decision thresholds (Min: 80, Max: 100). Decision: Fail

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 182) for more information on transmitting values and decisions.

Output Filters

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

Operation	Description
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:

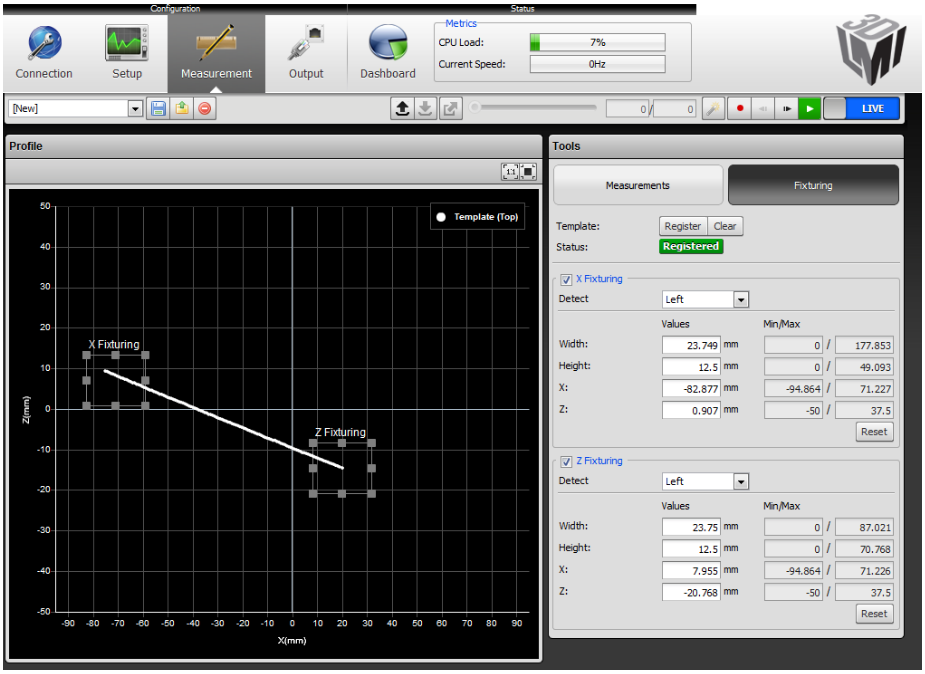
1 Select a measurement.
Click on the + in a measurement panel to expand it. Click the arrow next to Output to expand the panel.

2 Enable filters and configure the settings.

Profile Fixturing

Profile fixturing is used to track the movement of parts along the laser line (x-axis and z-axis). The movement is calculated as an offset and is used to correct the positions of the feature areas. This ensures that the regions-of-interest used to detect features are correctly positioned for every part.

Profile fixturing is not required in order to use measurement functions. This is an optional feature intended to make measurements more robust when the x-position and the height of the target varies from target to target.



A profile template is needed for fixturing to function. The profile template is the reference used to calculate the profile movement in the x-axis and z-axis. User defines a detection area (white rectangles in the picture above) and the type of feature point to detect within the area. When the profile template and the live profile falls into the area, the movement is calculated by computing the difference between the positions of the feature point of the profile template and the live profile.

To register a profile template:

1 **Position a representative target object within the field of view.**
The target should be similar to the objects that will later be measured. The Start or Snapshot buttons can be used to view live profile data while positioning the target.

2 **Click the Register button.**
A snapshot of the target object will be captured and set as the current profile template. The profile template is shown in white within the Data Viewer.

After a profile is registered, fixturing in the x-axis and z-axis can be configured independently.

To set up profile fixturing in the x-axis:

1 **Press the Fixturing button in the Measurement panel.**

2 **Enable X Fixturing**
Check the X-Fixturing box to enable fixturing in the x-axis.

3 **Adjust the detection area.**
Profile data within the detection area will be used to calculate the feature point for fixturing.

4 **Select an feature point type.**
Select the feature point type from the Detect drop-down box. The point type determines how the feature point is calculated from the profile data within the detection area.

To set up profile fixturing in the z-axis with a new template:

1 **Press the Fixturing button in the Measurement panel.**

2 **Enable Z Fixturing.**
Check the Z Fixturing box to enable fixturing in the z-axis.

3 **Adjust the detection area.**
Profile data within the detection area will be used to calculate the feature point for fixturing.

4 **Select an feature point type.**
Select the feature point type from the Detect drop-down box. The point type determines how the feature point is calculated from the profile data within the detection area.

When profile fixturing is used, the measurement's areas should be setup to match with the profile template. The profile template is hidden when the sensor is running. When the sensor is stopped and the user is viewing the measurement page, the profile template will be automatically reloaded in the Data Viewer.

To clear a registered profile template:

1 **Press the Fixturing button in the Measurements panel.**

2 **Click the Clear button.**

Changes to profile fixturing and the template are temporary until they are saved. Refer to Saving and Loading Settings (page 194) for more details on how to save changes.

Script Measurement

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 a measurement value and a measurement decision.

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 tertiary 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 does not exist

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. Only the last output value / decision in a script run is kept and passed to the Gocator output. Parameters: value - value output by the script decision - decision value output by the script. Can only be 0 or 1

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

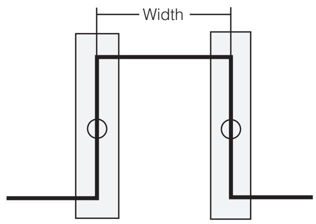
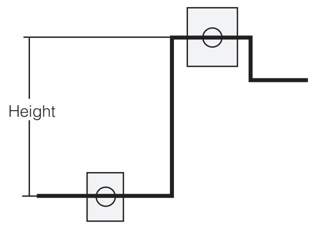
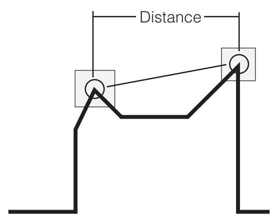
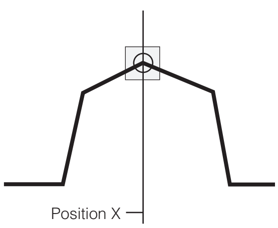
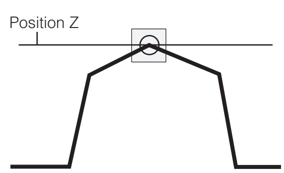
The following example demonstrates how to create a custom measurement that is based on the values from other measurements and persistent values. The example calculates the volume of the target using a series of box area measurement values.

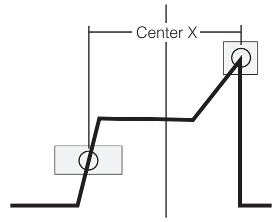
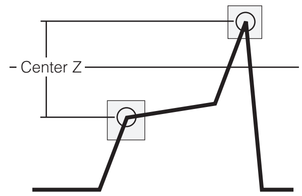
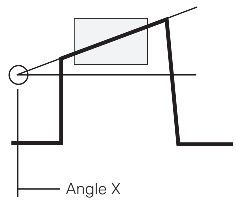
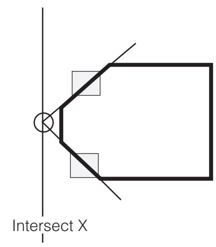
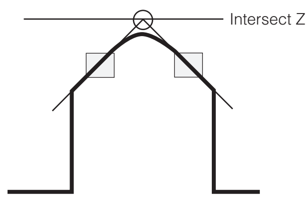
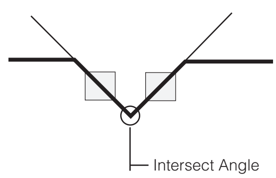
```
/* Calculate the volume of an object by accumulating the boxArea measurements*/
/* Encoder Resolution is 0.5mm. */
/* BoxArea Measurement ID is set to 1*/

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);
}
```

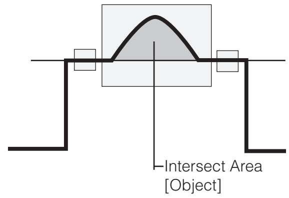
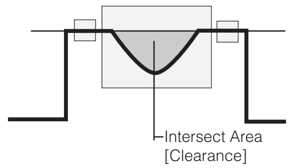
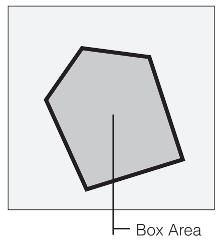
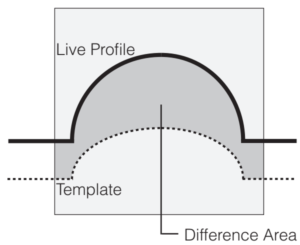
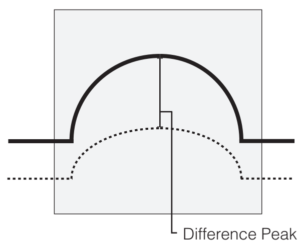
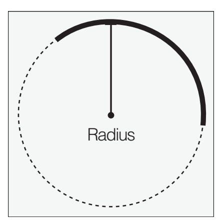
Profile Measurement Tools

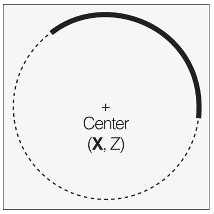
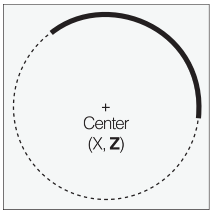
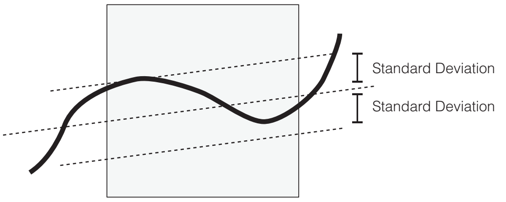
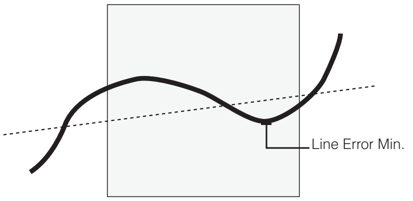
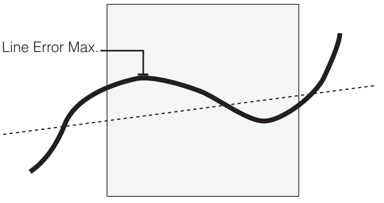
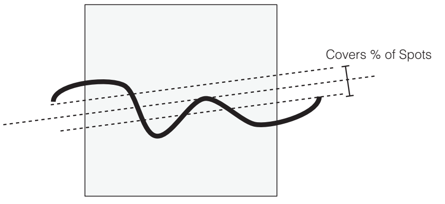
This chapter describes the profile measurement tools available in sensors that are equipped with *Measurement Tools*.

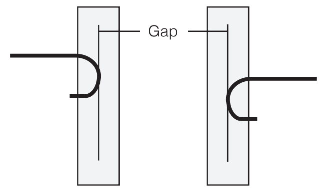
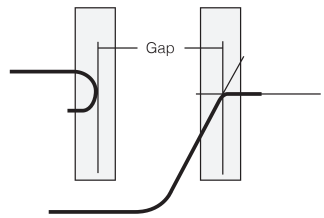
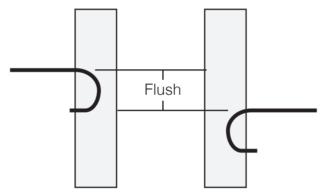
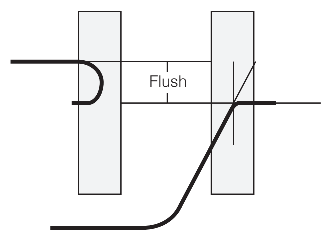
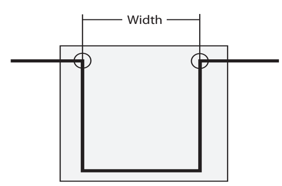
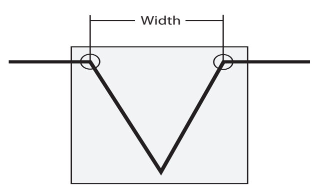
Most measurement functions detect and compare *feature points* or *lines* found within laser profile data. Measurement *values* are compared against minimum and maximum thresholds to yield *decisions*.

Measurement	Examples
Width Measures the difference in the x-axis position of two feature points. Refer to Width (page 105).	
Height Measures the difference in the z-axis position of two features. Refer to Height (page 106).	
Distance Measures the Euclidean distance between two features. Refer to Distance (page 107).	
Position X Finds the x-axis position of a feature. Refer to Position X (page 108).	
Position Z Finds the z-axis position of a feature. Refer to Position Z (page 109).	

Measurement	Examples
Center X Finds the average location of two features and measures the x-axis position of the average location. Refer to Center X (page 110).	
Center Z Finds the average location of two features and measures the z-axis position of the average location. Refer to Center Z (page 111).	
Angle X Fits a line to profile points within one or two areas and measures the angle between the fitted line and the x-axis. Refer to Angle X (page 112).	
Intersect X Finds the intersection between two fitted lines and measures the x-axis position of the intersection point. Refer to Intersect X (page 113).	
Intersect Z Finds the intersection between two fitted lines and measures the z-axis position of the intersection point. Refer to Intersect Z (page 114).	
Intersect Angle Finds the angle subtended by two fitted lines. Refer to Intersect Angle (page 115).	

Measurement	Examples
Intersect Area Measures the cross-sectional area within a region that is above or below a fitted baseline. Refer to Intersect Area (page 116).	 
Box Area Measures the cross-sectional area within a region. Refer to Box Area (page 117).	
Difference Area Measures the difference in cross-sectional area between live profile and the template. Refer to Difference Area (page 118).	
Difference Peak Measures the maximum difference in height between the live profile and the template. Refer to Difference Peak (page 119).	
Circle Radius Finds the best-fitted circle and measures the circle radius. Refer to Circle Radius (page 120).	

Measurement	Examples
Circle X Finds the best-fitted circle and measures the circle center position in the x-axis. Refer to Circle X (page 121).	
Circle Z Finds the best-fitted circle and measures the circle center position in the z-axis. Refer to Circle Z (page 122).	
Line Standard Deviation Finds the best-fitted line and measures the standard deviation of the laser points from the best-fitted line. Refer to Line Standard Deviation (page 123).	
Line Error Min Finds the best-fitted line and measures the minimum error from the best-fitted line. Refer to Line Error Min (page 124).	
Line Error Max Find the best-fitted line and measures the maximum error from the best-fitted line. Refer to Line Error Max (page 125).	
Line Percentile Finds the best-fitted line and measures the range (in z) that covers a percentage of points around the best-fitted line. Refer to Line Percentile (page 126)	

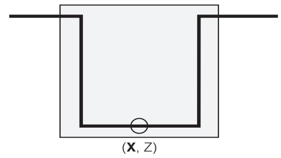
Measurement	Examples
Gap Measures the distance between two surfaces. The surface edges can be curved or sharp. Refer to Gap (page 127)	 
Flush Measures the flatness between two surfaces. The surface edges can be curved or sharp. Refer to Flush (page 132)	 
Groove Width Measures the width of a groove. Refer to Groove Width (page 138)	 

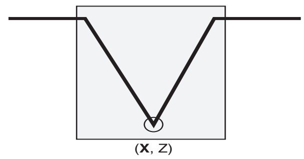
Measurement	Examples

Groove X

Measures the x-position of the bottom of a groove.

Refer to Groove X (page 140)

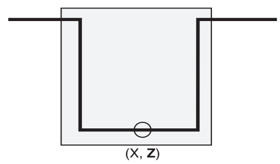


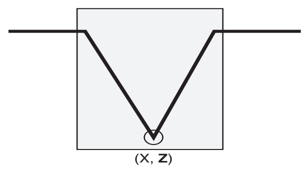


Groove Z

Measures the z-position of the bottom of a groove.

Refer to Groove Z (page 142)

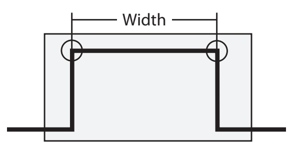




Strip Width

Measures the width of a strip.

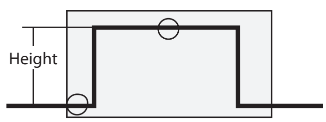
Refer to Strip Width (page 146)

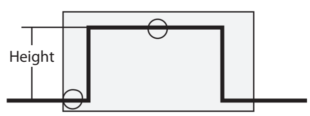


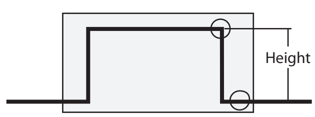
Strip Height

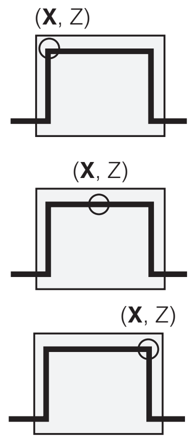
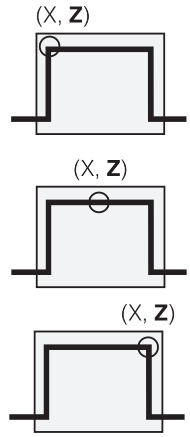
Measures the height of a strip.

Refer to Strip Height (page 149)



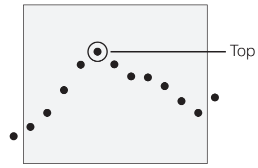
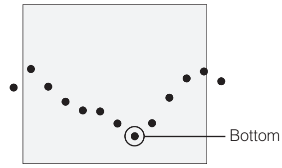
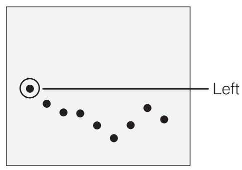
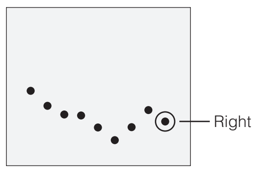
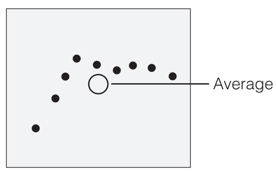
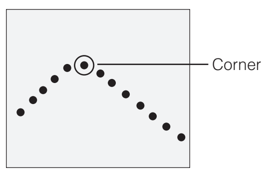
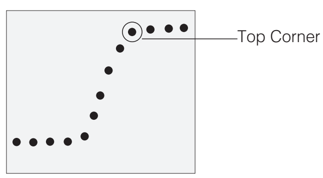


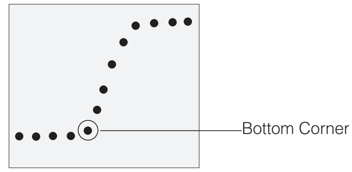
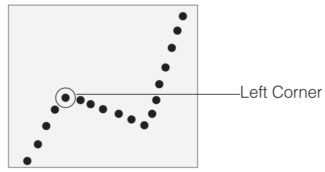
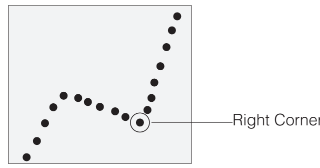
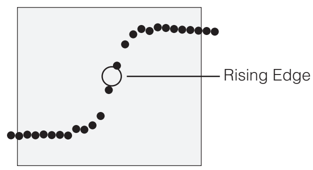
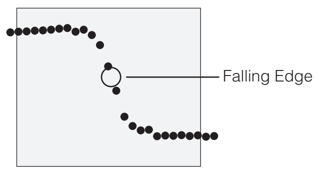
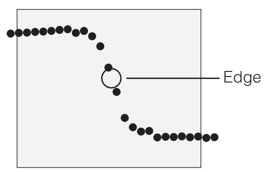
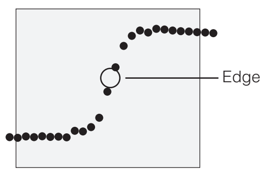
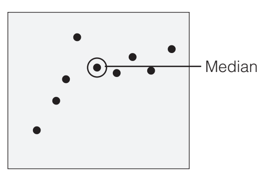


<table>
<tr><th>Measurement</th><th>Examples</th></tr>
<tr><td>Strip X
Measures the x-position of a strip.
Refer to Strip X (page 152)</td><td>
</td></tr>
<tr><td>Strip Z
Measures the z-position of a strip.
Refer to Strip Z (page 155)</td><td>
</td></tr>
</table>

Feature Points

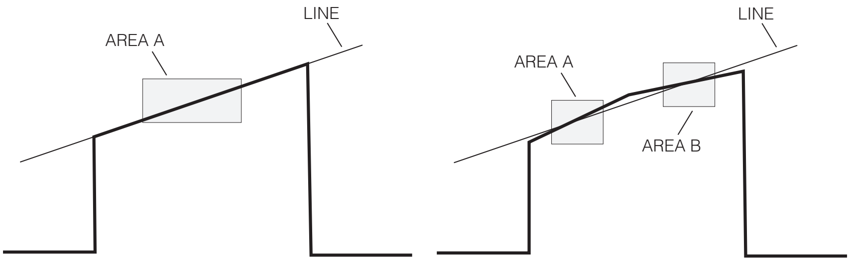
Many profile measurements involve estimating the locations of feature points and then making comparisons between the feature points. The following types of points can be identified.

Point Type	Examples
Top Finds the point with the maximum z-value within the region of interest.	
Bottom Finds the point with the minimum z-value within the region of interest.	
Left Finds the point with the minimum x-value within the region of interest.	
Right Finds the point with the maximum x-value within the region of interest.	
Average Determines the average location of points within the region of interest.	
Corner Finds a dominant corner within the region interest, where *corner* is defined as a change in profile slope.	
Top Corner Finds the top-most corner within the region interest, where corner is defined as a change in profile shape.	

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

Fit Lines

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

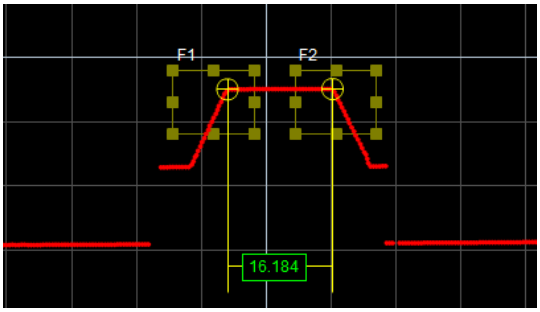


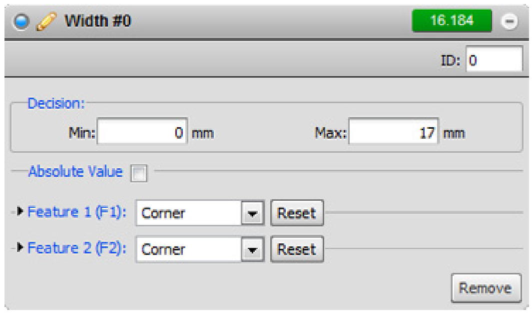
A line can be defined using one or two areas. Two areas can be used to bypass discontinuity in a line segment.

Measurement Types

Width

A width measurement determines the difference along the x-axis between two feature points. The measurement value can be compared with minimum and maximum constraints to yield a decision.





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

$$Width = Feature\ 2_{x\text{-}POSITION} - Feature\ 1_{x\text{-}position}$$

To create or edit a Width measurement:

1 **Add a new Width measurement or select an existing Width measurement.**

2 **Select the measurement Source.**
Choices that are available depend on the system layout.

3 **Adjust the feature point areas.**
A Width measurement requires two feature points.

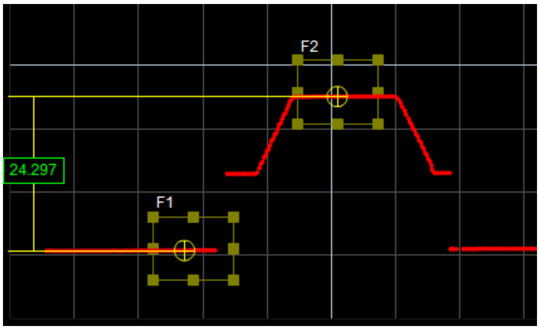
4 **Specify the types of feature points to be detected.**
Refer to Feature Points (page 102) in this chapter for information on point types.

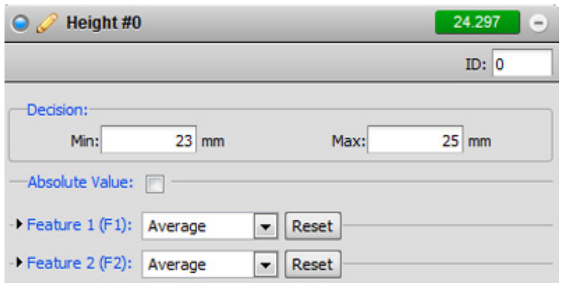
5 **Select absolute or signed result.**
Check the Absolute box to select absolute result.

6 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Height

A height measurement determines the difference along the z-axis between two feature points. The measurement value can be compared with minimum and maximum constraints to yield a decision.





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

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

To create or edit a Height measurement:

1 **Add a new Height measurement or select an existing Height measurement.**

2 **Select the measurement Source.**
Choices that are available depend on the system layout.

3 **Adjust the feature point areas.**
A Height measurement requires two feature points.

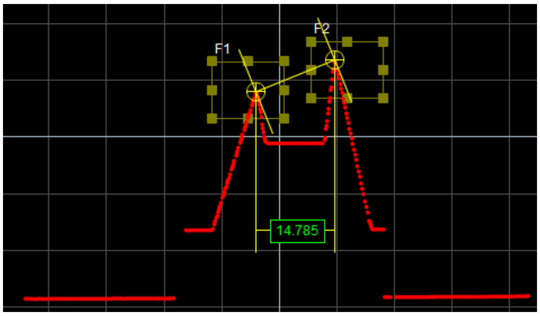
4 **Specify the types of feature points to be detected.**
Refer to Feature Points (page 102) in this chapter for information on point types.

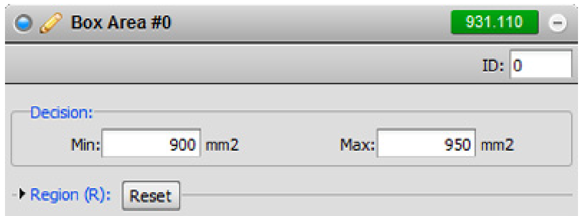
5 **Select absolute or signed result.**
Check the Absolute box to select absolute result.

6 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Distance

A distance measurement determines the Euclidean distance between two feature points. The measurement value can be compared with minimum and maximum constraints to yield a decision.





To create or edit a Distance measurement:

1 **Add a new Distance measurement or select an existing Distance measurement.**

2 **Select the measurement Source.**
Choices that are available depend on the system layout.

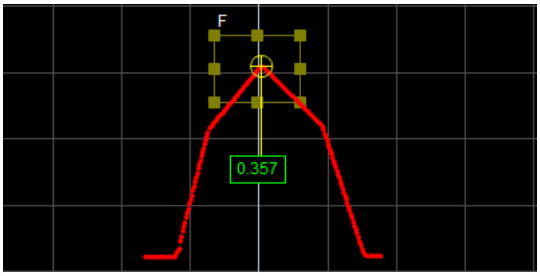
3 **Adjust the feature point areas.**
A Distance measurement requires two feature points.

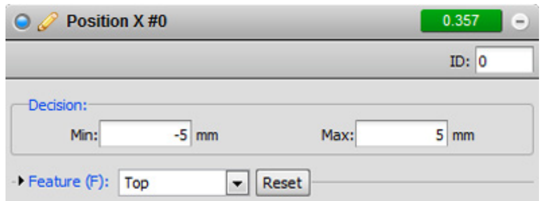
4 **Specify the types of feature points to be detected.**
Refer to Feature Points (page 102) in this chapter for information on point types.

5 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Position X

A Position X measurement finds the x-axis position of a feature point. The measurement value can be compared with minimum and maximum constraints to yield a decision.





To create or edit a Position X measurement:

1. **Add a new Position X measurement or select an existing Position X measurement.**

2. **Select the measurement Source.**
   Choices that are available depend on the system layout.

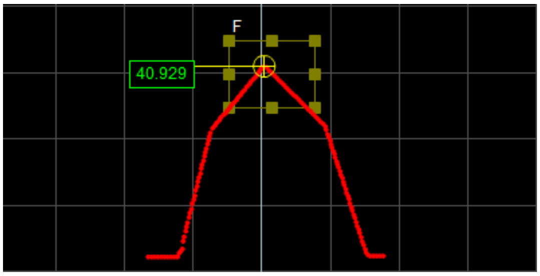
3. **Adjust the feature point area.**
   A Position X measurement requires one feature point.

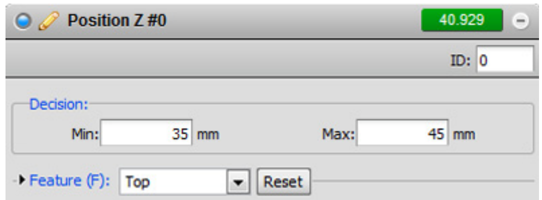
4. **Specify the type of feature to be detected.**
   Refer to Feature Points (page 102) in this chapter for information on point types.

5. **Provide minimum and maximum constraints for a decision.**
   Refer to Decisions (page 87) for more information on decisions.

Position Z

A Position Z measurement finds the z-axis position of a feature point. The measurement value can be compared with minimum and maximum constraints to yield a decision.



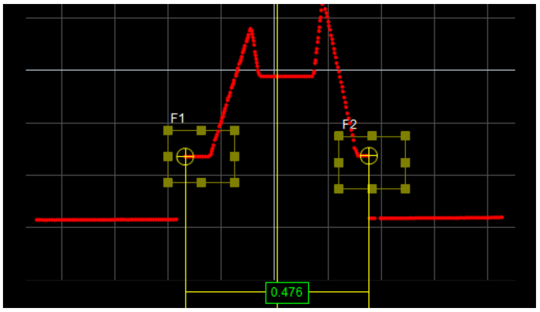


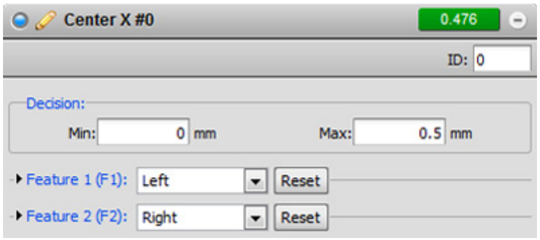
To create or edit a Position Z measurement:

1. **Add a new Position Z measurement or select an existing Position Z measurement.**
2. **Select the measurement Source.**
   Choices that are available depend on the system layout.
3. **Adjust the feature point area.**
   A Position Z measurement requires one feature point.
4. **Specify the type of feature to be detected.**
   Refer to Feature Points (page 102) in this chapter for information on point types.
5. **Provide minimum and maximum constraints for a decision.**
   Refer to Decisions (page 87) for more information on decisions.

Center X

A Center X measurement finds the average location of two features points and measures the x-axis position of the average location. The measurement value can be compared with minimum and maximum constraints to yield a decision.





To create or edit a Center X measurement:

1 **Add a new Center X measurement or select an existing Center X measurement.**

2 **Select the measurement Source.**
Choices that are available depend on the system layout.

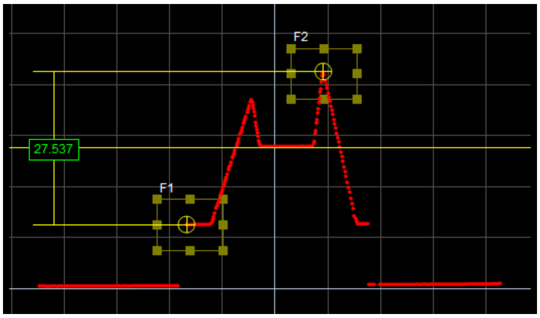
3 **Adjust the feature point areas.**
A Center X measurement requires two feature points.

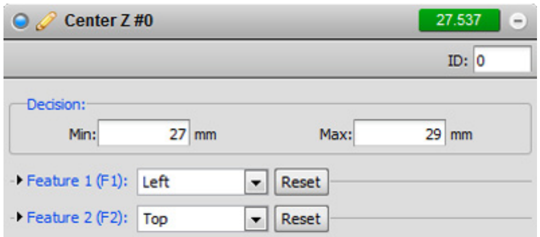
4 **Specify the types of feature points to be detected.**
Refer to Feature Points (page 102) in this chapter for information on point types.

5 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Center Z

A Center Z measurement finds the average location of two features points and measures the z-axis position of the average location. The measurement value can be compared with minimum and maximum constraints to yield a decision.





To create or edit a Center Z measurement:

1 **Add a new Center Z measurement or select an existing Center Z measurement.**

2 **Select the measurement Source.**
Choices that are available depend on the system layout.

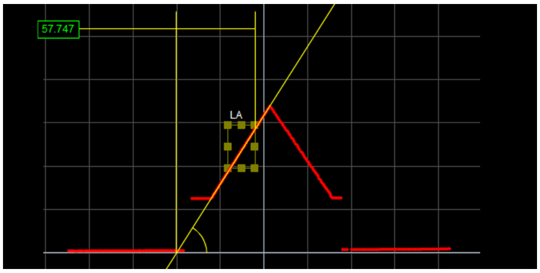
3 **Adjust the feature point areas.**
A Center Z measurement requires two feature points.

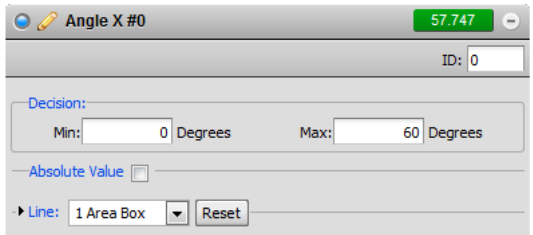
4 **Specify the types of feature points to be detected.**
Refer to Feature Points (page 102) in this chapter for information on point types.

5 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Angle X

An Angle X measurement determines the angle between a fit line and the x axis. The measurement value can be compared with minimum and maximum constraints to yield a decision.

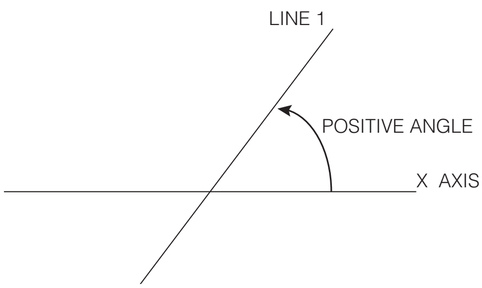




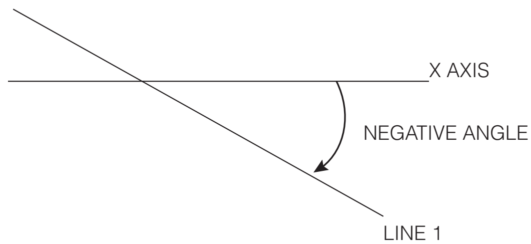
The angle can be expressed as a signed or an absolute result. The absolute result is used when the minimum and maximum constraints need to cover both positive and negative angles.

For a signed result, the angle is between -90 degrees and 90 degrees and is measured from the x-axis. Positive angle is measured counter clockwise and negative angle is measured clockwise.

For an absolute result, the angle range is between 0 degrees and 90 degrees and is the absolute value of the angle between the line and the x-axis.



When the angle of Line 1 is less than 90° counter clockwise from the X axis, the angle returned is positive.



When the angle of Line 1 is less than 90° clockwise from X axis, the angle returned is negative.

To create or edit an Angle X measurement:

1 **Add a new Angle X measurement or select an existing Angle X measurement.**

2 **Select the measurement Source.**
Choices that are available depend on the system layout.

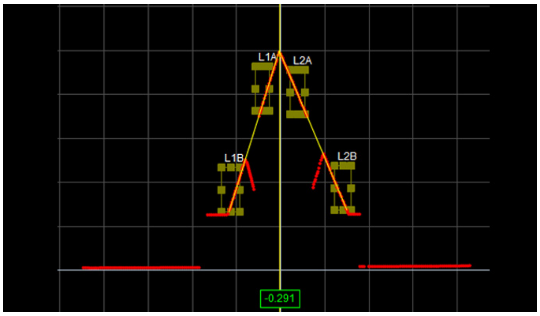
3 **Adjust the fit line area(s).**
An Angle X measurement requires one fit line. One or two fit areas can be used for each fit line. Refer to Fit Lines (page 104) for more information.

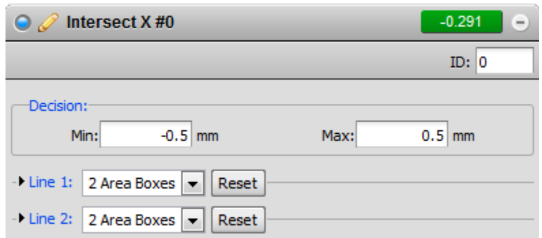
4 **Select absolute or signed result.**
Check the Absolute box to select absolute result.

5 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Intersect X

An Intersect X measurement determines the intersection between two fit lines and measures the x-axis position of the intersection point. The measurement value can be compared with minimum and maximum constraints to yield a decision.





To create or edit an Intersect X measurement:

1 **Add a new Intersect X measurement or select an existing Intersect X measurement.**

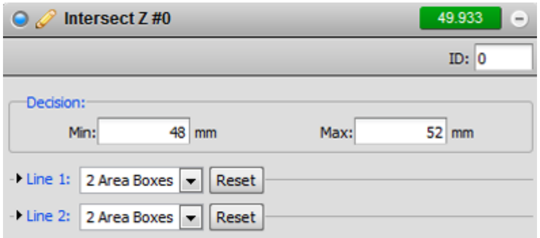
2 **Select the measurement Source.**
Choices that are available depend on the system layout.

3 **Adjust the fit line area(s).**
An Intersect X measurement requires two fit lines. One or two fit areas can be used for each fit line. Refer to Fit Lines (page 104) for more information.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Intersect Z

An Intersect Z measurement determines the intersection between two fit lines and measures the z-axis position of the intersection point. The measurement value can be compared with minimum and maximum constraints to yield a decision.



To create or edit an Intersect Z measurement:

1 **Add a new Intersect Z measurement or select an existing Intersect Z measurement.**

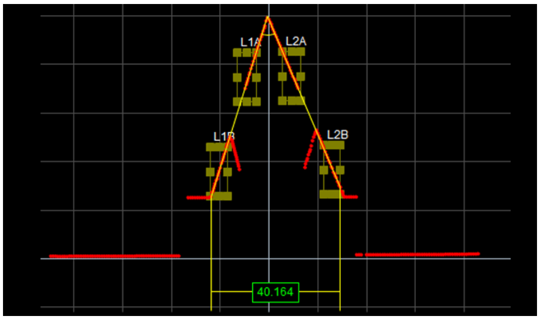
2 **Select the measurement Source.**
Choices that are available depend on the system layout.

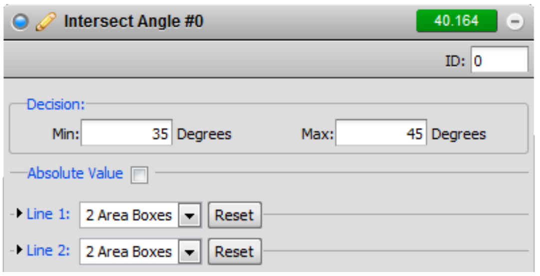
3 **Adjust the fit line area(s).**
An Intersect Z measurement requires two fit lines. One or two fit areas can be used for each fit line. Refer to Fit Lines (page 104) for more information.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Intersect Angle

An Intersect Angle measurement determines the angle subtended by two fit lines. The measurement value can be compared with minimum and maximum constraints to yield a decision.

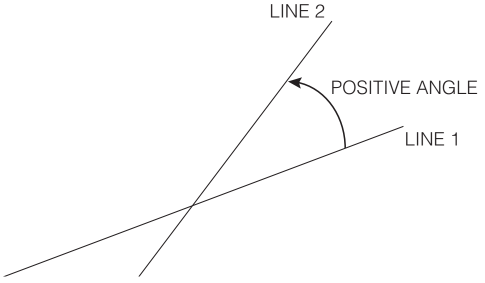




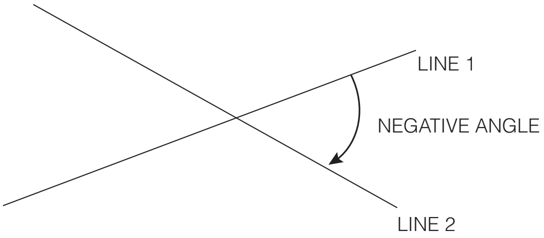
The angle can be expressed as a signed or absolute result. The absolute result is used when the minimum and maximum constraints need to cover both positive and negative angles.

For a signed result, the angle range is between -90 degrees and 90 degrees and is measured from the Line 1. Positive angle is measured counter clockwise and negative angle is measured clockwise.

For an absolute result, the angle range is between 0 degrees and 90 degrees and is the absolute value of the angle between Line 1 and Line 2.



When the angle of Line 2 is less than 90° counter clockwise from Line 1, the angle is returned positive.



When the angle of Line 2 is less than 90° clockwise from Line 1, the angle is returned negative.

To create or edit an Intersect Angle measurement:

1 **Add a new Intersect Angle measurement or select an existing Intersect Angle measurement.**

2 **Select the measurement Source.**
Choices that are available depend on the system layout.

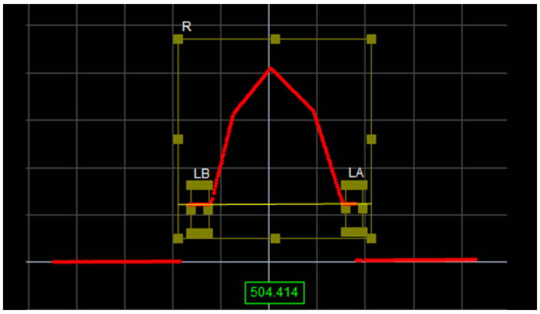
3 **Adjust the fit line area(s).**
An Intersect Angle measurement requires two fit lines. One or two fit areas can be used for each fit line. Refer to Fit Lines (page 104) for more information.

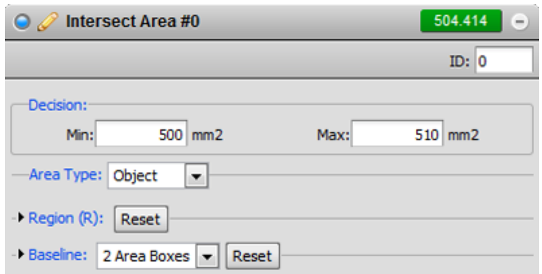
4 **Select absolute or signed result.**
Check the Absolute box to select absolute result.

5 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Intersect Area

An Intersect Area measurement determines the cross-sectional area within a region that is above a baseline. The measurement value can be compared with minimum and maximum constraints to yield a decision.





To create or edit an Intersect Area measurement:

1 **Add a new Intersect Area measurement or select an existing Intersect Area measurement.**

2 **Select the measurement Source.**
Choices that are available depend on the system layout.

3 **Adjust the measurement region.**
The measurement region defines the zone in which cross-sectional area will be determined.

4 **Adjust the fit line area(s).**
An Intersect Area measurement uses a fit line to provide a baseline for the measurement region. One or two fit areas can be used for each fit line. Refer to Fit Lines (page 104) for more information.

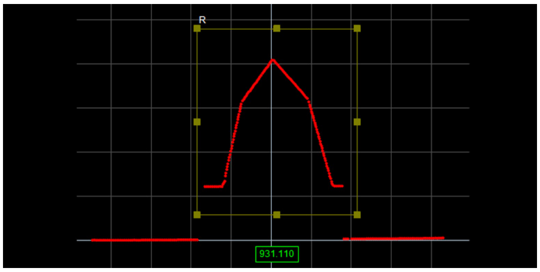
5 **Select object or clearance Area Type.**
Object area is the area of regions above the baseline, regions below the baseline are ignored.

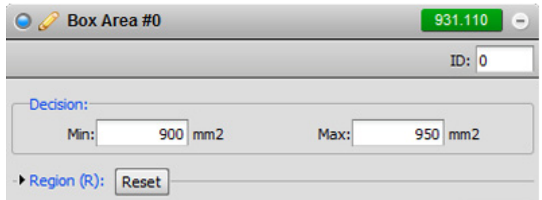
Clearance area is the area of regions below baseline (ie between profile and line), regions above the baseline are ignored.

6 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Box Area

A Box Area measurement determines the cross-sectional area within a region. The measurement value can be compared with minimum and maximum constraints to yield a decision.





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

To create or edit a Box Area measurement:

1 **Add a new Box Area measurement or select an existing Box Area measurement.**

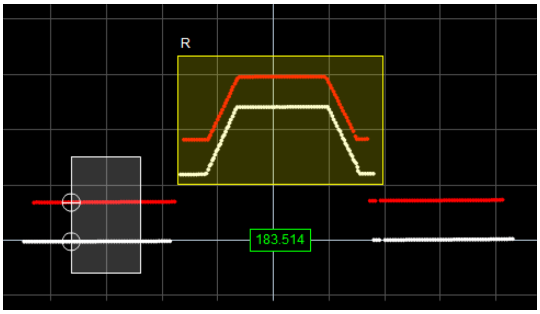
2 **Select the measurement Source.**
Choices that are available depend on the system layout.

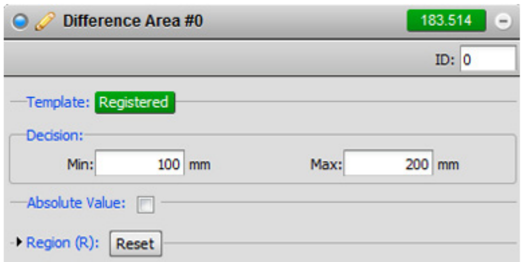
3 **Adjust the measurement region.**
The measurement region defines the zone in which cross-sectional area will be determined.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

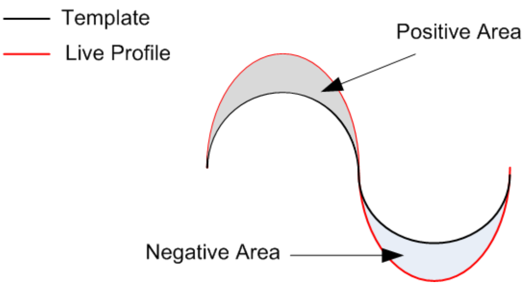
Difference Area

A Difference Area measurement determines the difference in cross-sectional area between a live profile and template. The measurement value can be compared with minimum and maximum constraints to yield a decision.





Area can be calculated as an absolute or signed value. Signed results are positive in regions where the live profile is closer to the sensors than the template. The illustrations below indicate the region where the results are positive and negative.



The result is the sum of all the areas within the measurement region.

To create or edit a Difference Area measurement:

1 **Add a new Difference Area measurement or select an existing Difference Area measurement.**

2 **Select the measurement Source.**
Choices that are available depend on the system layout. When both the Main sensor and the Buddy sensor are selected in opposite orientation, the calculation is applied to the thickness profiles of the live and template data. A thickness profile is calculated by subtracting the profile of the bottom sensor (i.e. the Buddy sensor) from the profile of the top sensor (i.e. the Main sensor).

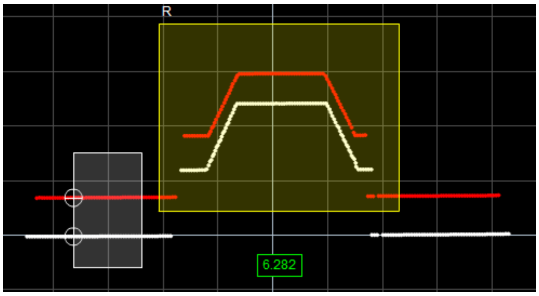
3 **Adjust the measurement region.**
The measurement region defines the zone in which cross-sectional area will be determined.

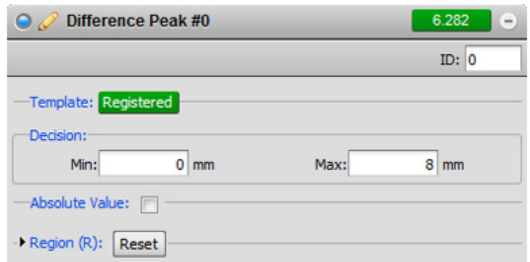
4 **Select absolute or signed result.**
Check the Absolute box to select absolute result.

5 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

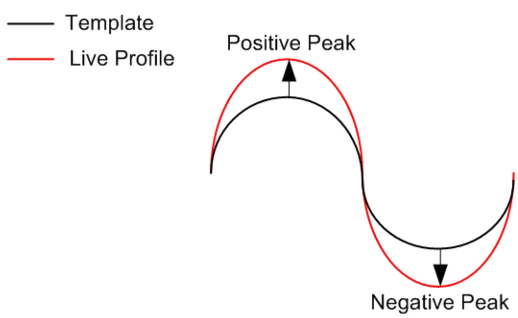
Difference Peak

A Difference Peak measurement determines the maximum difference in height between a live profile and the template. The measurement value can be compared with minimum and maximum constraints to yield a decision.





The difference in peak can be calculated as an absolute or signed value. A signed difference is positive in regions where the live profile is closer to the sensors than the template. The illustrations below indicate the region where the results are positive or negative.



The result is the peak with the largest absolute value within region.

To create or edit a Difference Peak measurement:

1 **Add a new Difference Peak measurement or select an existing Difference Peak measurement.**

2 **Select the measurement Source.**
Choices that are available depend on the system layout. When both the Main sensor and the Buddy sensor are selected in opposite orientation, the calculation is applied to the thickness profiles of the live and template data. A thickness profile is calculated by subtracting the profile of the bottom sensor (i.e. the Buddy sensor) from the profile of the top sensor (i.e. the Main sensor).

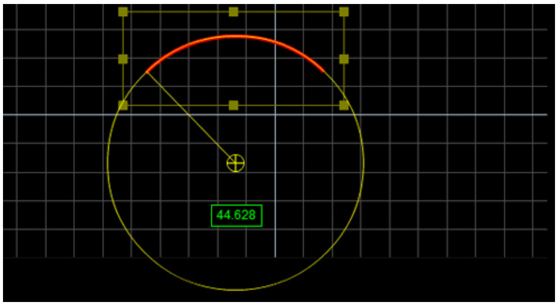
3 **Adjust the measurement region.**
The measurement region defines the zone in which cross-sectional area will be determined.

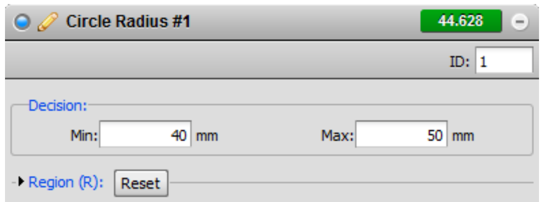
4 **Select absolute or signed result.**
Check the Absolute box to select absolute result.

5 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Circle Radius

A Circle Radius measurement fits a circle to the live profile and measures the radius of the circle. The measurement value can be compared with the minimum and maximum constraints to yield a decision.





To create or edit a Circle Radius measurement:

1. **Add a new Circle Radius measurement or select an existing Circle Radius measurement.**

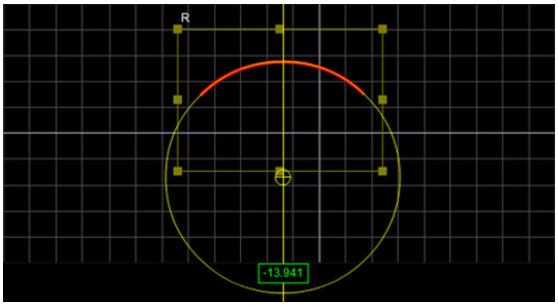
2. **Select the measurement Source.**
   Choices that are available depend on the system layout.

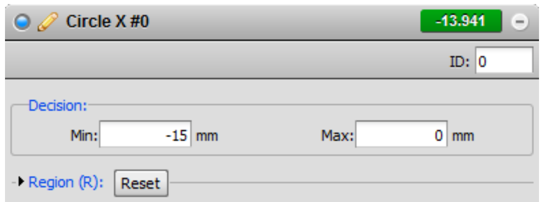
3. **Adjust the measurement region.**
   The measurement region defines the zone in which the live profile will be fitted to a circle.

4. **Provide minimum and maximum constraints for a decision.**
   Refer to Decisions (page 87) for more information on decisions.

Circle X

A Circle X measurement fits a circle to the live profile and measures the center's x-position of the circle. The measurement value can be compared with the minimum and maximum constraints to yield a decision.





To create or edit a Circle X measurement:

1 **Add a new Circle X measurement or select an existing Circle X measurement.**

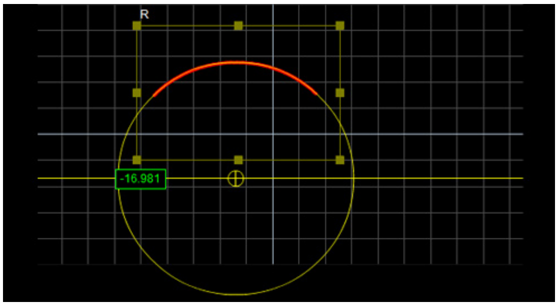
2 **Select the measurement Source.**
Choices that are available depend on the system layout.

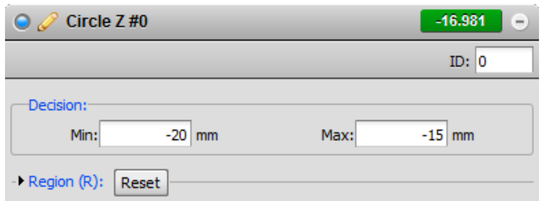
3 **Adjust the measurement region.**
The measurement region defines the zone in which the live profile will be fitted to a circle.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Circle Z

A Circle Z measurement fits a circle to the live profile and measures the center's z-position of the circle. The measurement value can be compared with the minimum and maximum constraints to yield a decision.





To create or edit a Circle Z measurement:

1 **Add a new Circle Z measurement or select an existing Circle Z measurement.**

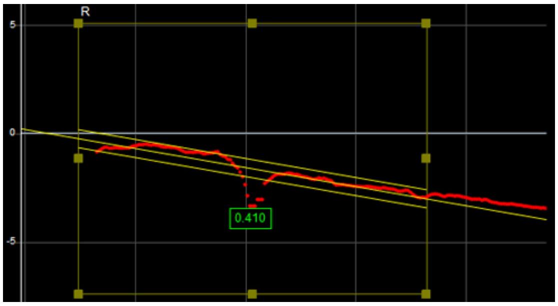
2 **Select the measurement Source.**
Choices that are available depend on the system layout.

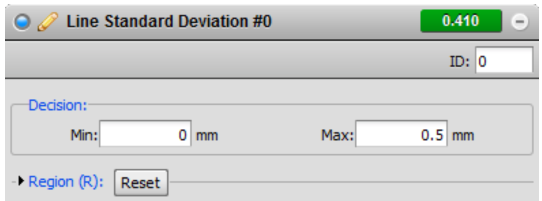
3 **Adjust the measurement region.**
The measurement region defines the zone in which the live profile will be fitted to a circle.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Line Standard Deviation

A Line Standard Deviation measurement fits a line to the live profile and measures the standard deviation of the points to the fitted line. The measurement value can be compared with the minimum and maximum constraints to yield a decision.



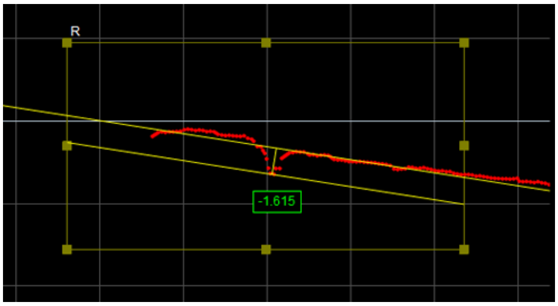


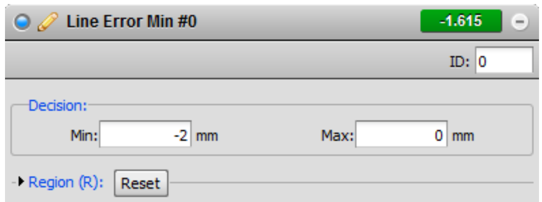
To create or edit a Line Standard Deviation measurement:

1. **Add a new Line Standard Deviation measurement or select an existing Line Standard Deviation measurement.**
2. **Select the measurement Source.**
   Choices that are available depend on the system layout.
3. **Adjust the measurement region.**
   The measurement region defines the zone in which the live profile will be fitted to a line.
4. **Provide minimum and maximum constraints for a decision.**
   Refer to Decisions (page 87) for more information on decisions.

Line Error Min

A Line Error Min measurement fits a line to the live profile and measures the point that is furthest from the bottom of the fitted line. The measurement value can be compared with the minimum and maximum constraints to yield a decision.





To create or edit a Line Error Min measurement:

1 **Add a new Line Error Min measurement or select an existing Line Error Min measurement.**

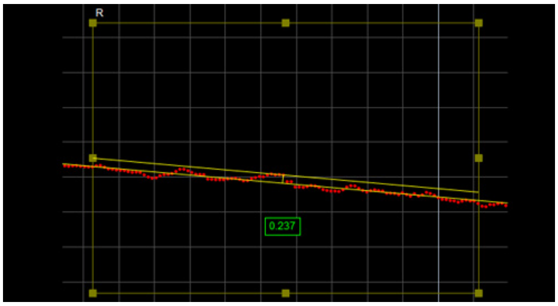
2 **Select the measurement Source.**
Choices that are available depend on the system layout.

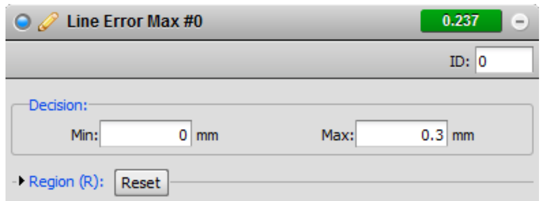
3 **Adjust the measurement region.**
The measurement region defines the zone in which the live profile will be fitted to a line.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Line Error Max

A Line Error Max measurement fits a line to the live profile and measures the point that is furthest from the top of the fitted line. The measurement value can be compared with the minimum and maximum constraints to yield a decision.



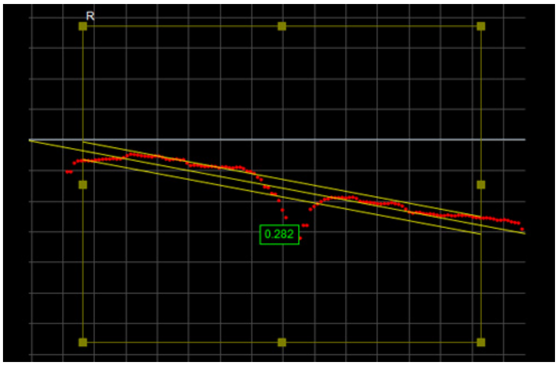


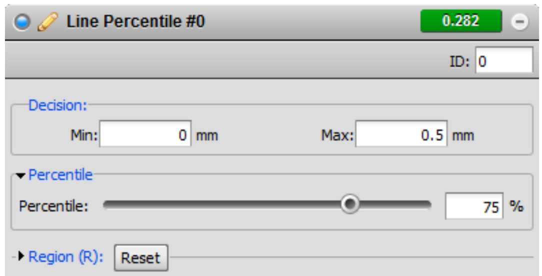
To create or edit a Line Error Max measurement:

1. **Add a new Line Error Max measurement or select an existing Line Error Max measurement.**
2. **Select the measurement Source.**
   Choices that are available depend on the system layout.
3. **Adjust the measurement region.**
   The measurement region defines the zone in which the live profile will be fitted to a line.
4. **Provide minimum and maximum constraints for a decision.**
   Refer to Decisions (page 87) for more information on decisions

Line Percentile

A Line Percentile measurement fits a line to the live profile and measures the range around the fitted line that covers a specified percentage of the points. The measurement value can be compared with the minimum and maximum constraints to yield a decision.





To create or edit a Line Percentile measurement:

1 **Add a new Line Percentile measurement or select an existing Line Percentile measurement.**

2 **Select the measurement Source.**
Choices that are available depend on the system layout.

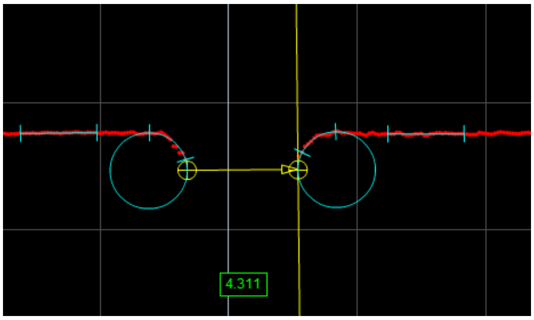
3 **Adjust the measurement region.**
The measurement region defines the zone in which the live profile will be fitted to a line.

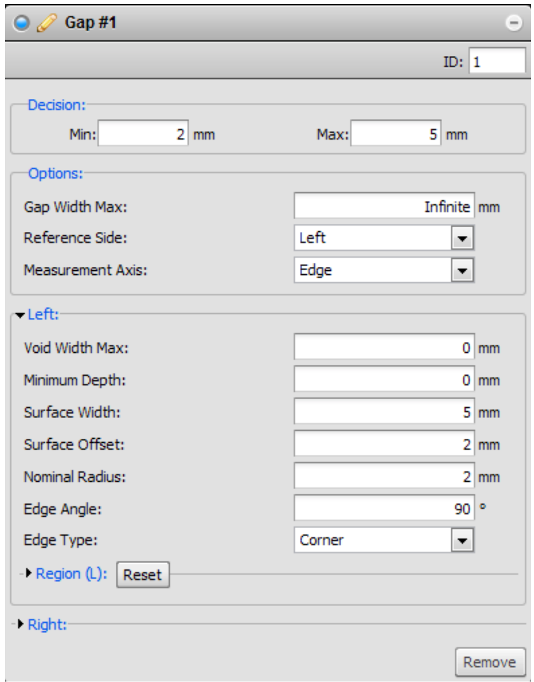
4 **Set The Percentile**

5 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Gap

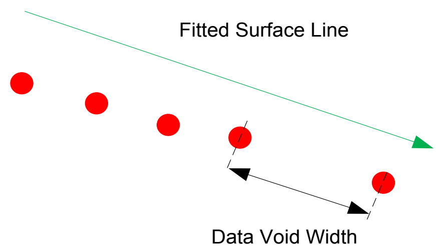
A Gap measurement measures the distance between the edges of two surfaces. The measurement value can be compared with minimum and maximum constraints to yield a decision.

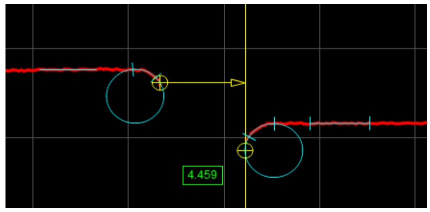
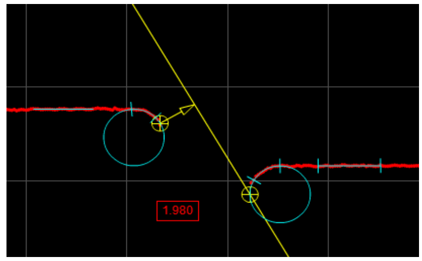
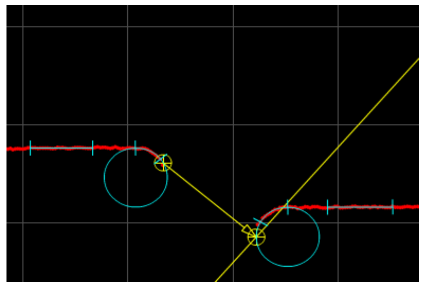




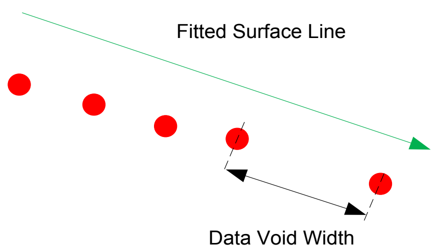
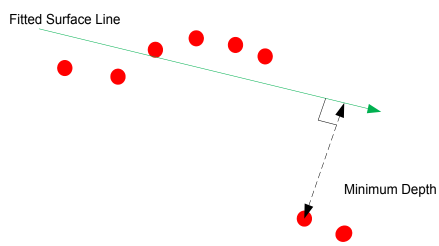
Refer to Gap and Flush Algorithm (page 136) for an explanation of the feature locating algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

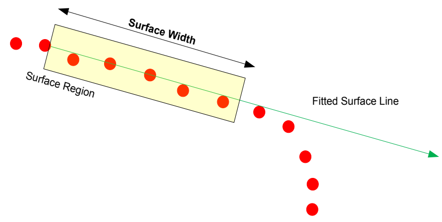
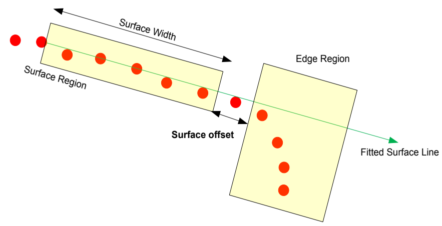
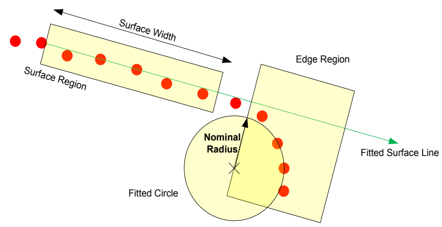
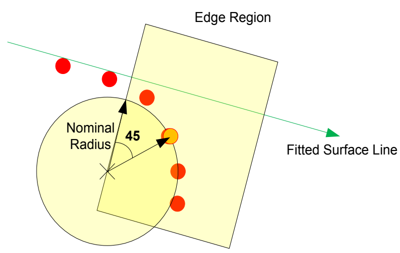
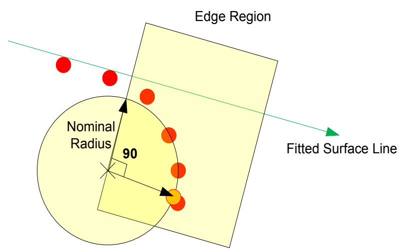
Parameters:

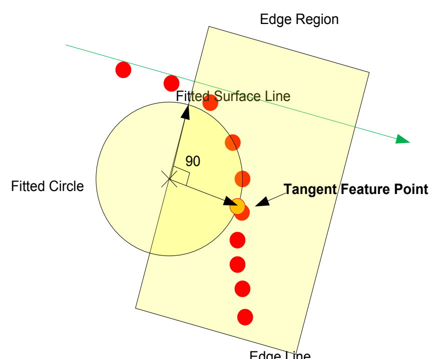
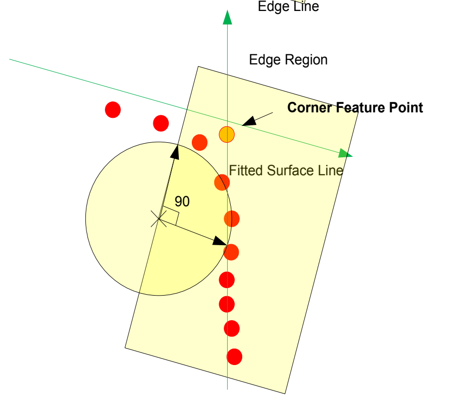
Parameters	Descriptions	Illustrations
Gap Width Max	The maximum width of the gap. Allows the tool to filter gaps longer than the expected width. This could be used to single out the correct gap when there are multiple gaps in the field of view.	

Parameters	Descriptions	Illustrations
Reference Side	Defines the side in which the gap is calculated from.	
Measurement Axis	Defines the direction that the gap is calculated. Surface - In the direction of the fitted surface line of the reference surface. Edge - In the direction perpendicular to the edge of the reference suface. Distance - The Cartesian distance between the two feature locations.	**Surface Axis**  **Edge Axis**  **Distance Axis** 

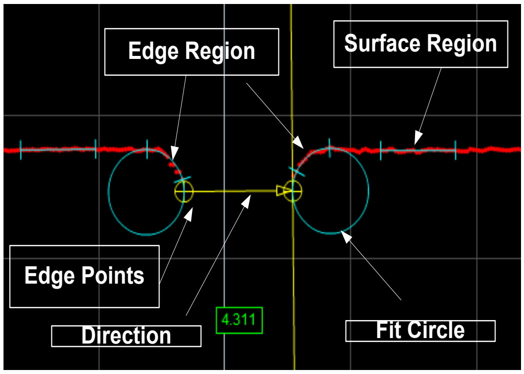
Left/Right Side Parameters:

Parameters	Descriptions	Illustrations
Void Width Max	The maximum width of the missing data caused by occlusion or data drop out. A larger value prevents the algorithm from registering a section of missing data as an edge. Setting the value to 0 causes the algorithm to try to detect an edge in every missing data section.	
Minimum Depth	Defines the minimum depth before an opening could be considered to have a potential edge. The depth is the perpendicular distance from the fitted surface line.	

Parameters	Descriptions	Illustrations
Surface Width	The width of the surface area in which laser data is used to form the fitted surface line. This value should be as large as the surface allows.	
Surface Offset	The distance between the edge region and the surface region. Setting a small value allows the edge within a tighter region to be detected. However, the measurement repeatability could be affected if the data from the edge is considered as part of the surface region (or vice versa). A rule of thumb is to set the Surface Offset equal to the Nominal Radius.	
Nominal Radius	The radius of the curve edge that the algorithm uses to locate the edge region. The algorithm searches for a start position in which the remaining data most resemble a circle of the specified nominal radius.	
Edge Angle	A point on the best fit circle to be used to calculate the feature point. The selected point is on the circumference at the specified angle from the start of the edge region. The angle is measured from the axis perpendicular to the fitted surface line.	

Parameters	Descriptions	Illustrations
Edge Type	Defines the type of feature point and it can be either a corner or a tangent. A tangent edge point is the point selected based on the defined Edge Angle. A corner edge point is the intersect point between the fitted surface line and a edge line formed by interpolating the points at and after the tangent within the edge region.	 

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



To create or edit a Gap measurement:

1 **Add a new Gap measurement or select an existing Gap measurement.**

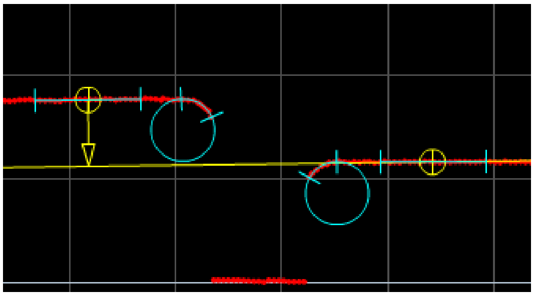
2 **Adjust the measurement regions.**
The measurement region defines the region in which to search for the left and the rigth surfaces.

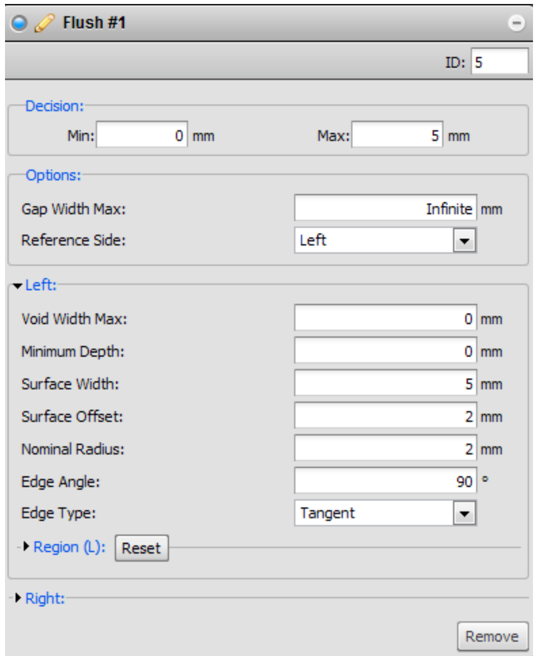
3 **Adjust the measurement parameters.**
Adjust the parameters as described above.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Flush

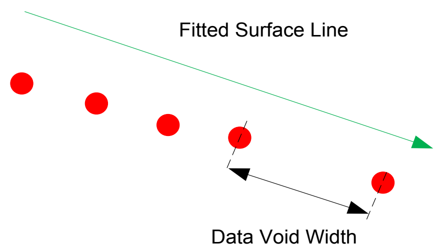
A Flush measurement measures the flatness between the edges of two surfaces. The measurement value can be compared with minimum and maximum constraints to yield a decision.



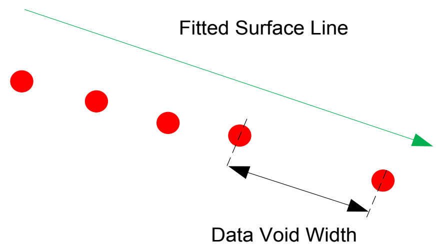
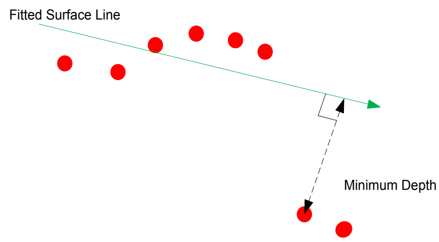
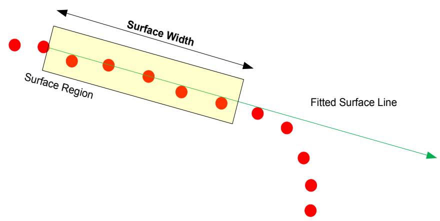
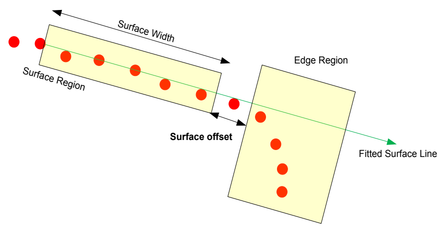
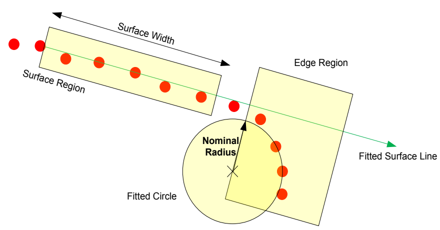


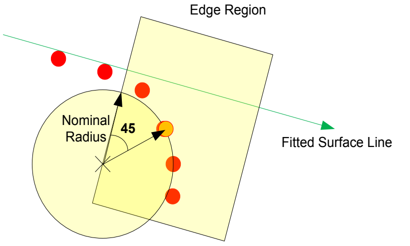
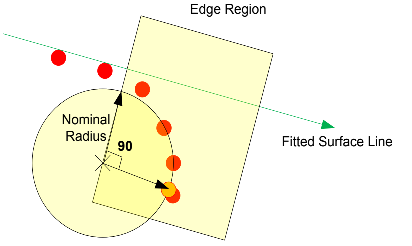
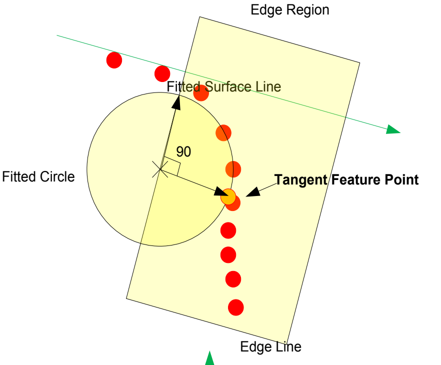
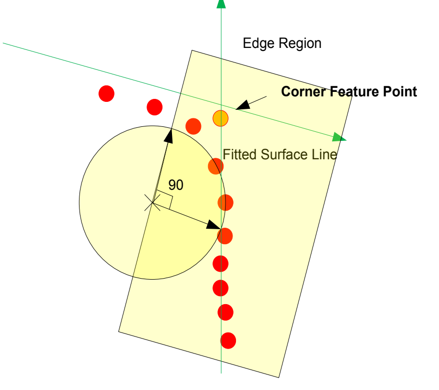
Refer to Gap and Flush Algorithm (page 136) for an explanation of the feature locating algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

Options Parameters:

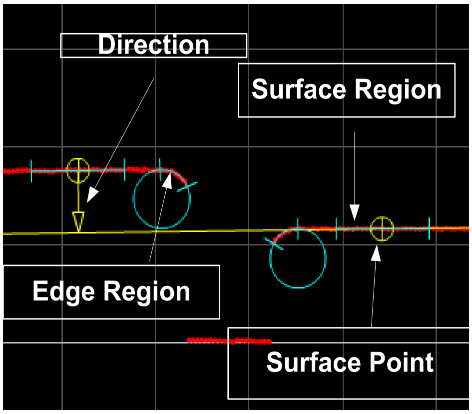
Parameters	Descriptions	Illustrations
Gap Width Max	The maximum width of the gap. Allows the tool to filter gaps longer than the expected width. This could be used to single out the correct gap when there are multiple gaps in the field of view.	
Reference Side	Defines the side in which the flush is calculated from.	

Left/Right Side Parameters:

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

Parameters	Descriptions	Illustrations
Edge Angle	A point on the best fit circle to be used to calculate the feature point. The selected point is on the circumference at the specified angle from the start of the edge region. The angle is measured from the axis perpendicular to the fitted surface line.	 
Edge Type	Defines the type of feature point and it can be either a corner or a tangent. A tangent edge point is the point selected based on the defined Edge Angle. A corner edge point is the intersect point between the fitted surface line and a edge line formed by interpolating the points at and after the tangent within the edge region.	 

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



To create or edit a Flush measurement:

1 **Add a new Flush measurement or select an existing Flush measurement.**

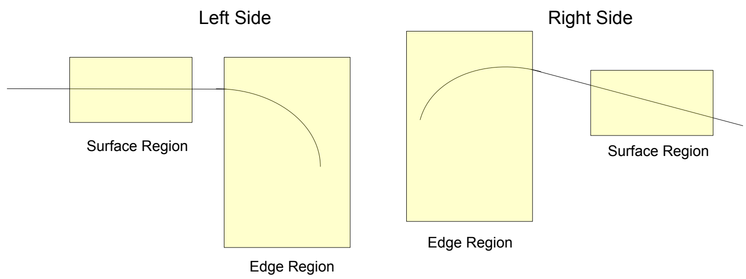
2 **Adjust the measurement regions.**
The measurement region defines the region in which to search for the left and the rigth surfaces.

3 **Adjust the measurement parameters.**
Adjust the parameters as described above.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

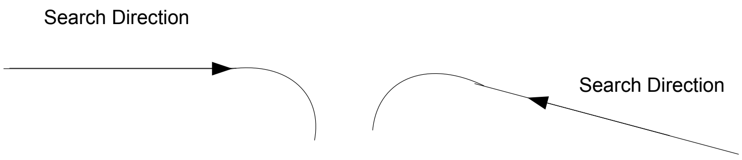
Gap and Flush Algorithm

The gap and flush tools use the same algorithm to locate the feature. It first searches for two regions on each side: a surface region and an edge region.

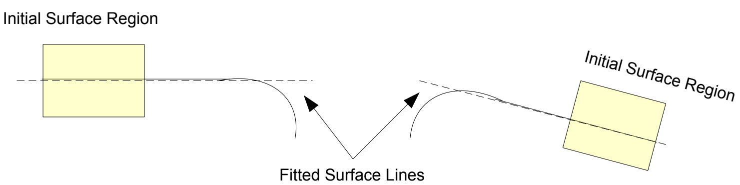


After the regions are found, the algorithm place a feature point in the surface region based on a set of parameters. .Users can control the measurement regions for both the left and the right side. A measurement region defines the region in which the measurement tool will search for the feature points. Feature points are located on each side using the following algorithm.

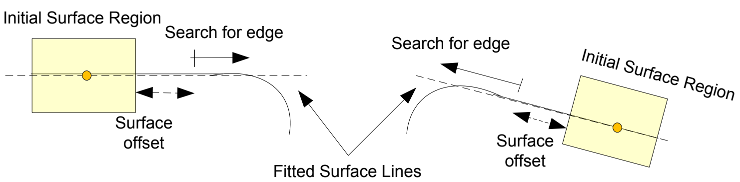
1. On the left side, search from left to right to find a surface area with data that covers at least the Surface Width. On the right side, search from right to left.



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

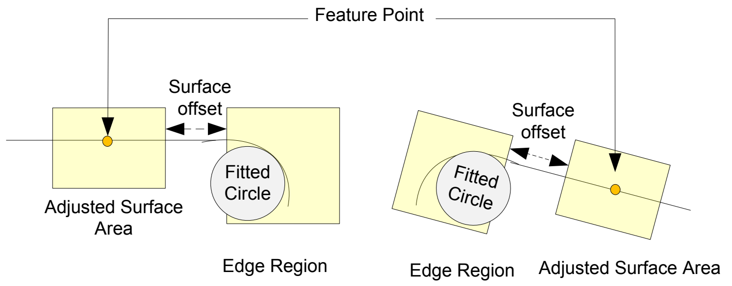


3. Search for a valid edge region that is located at least Surface Offset away from end of the surface region. If a surface region is not found, move along the search direction and repeat step 1.



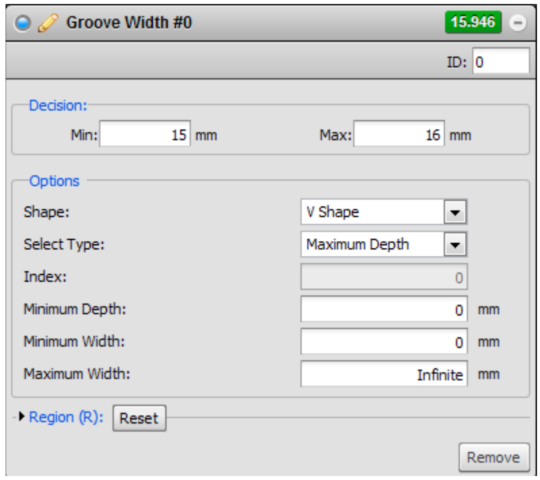
A valid edge region is detected an edge matches the Nominal Radius or when the depth exceeds the Minimum Depth. The search algorithm uses the Void Width Max to distinguish between an actual edge from an area of missing data (referred to as void).

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



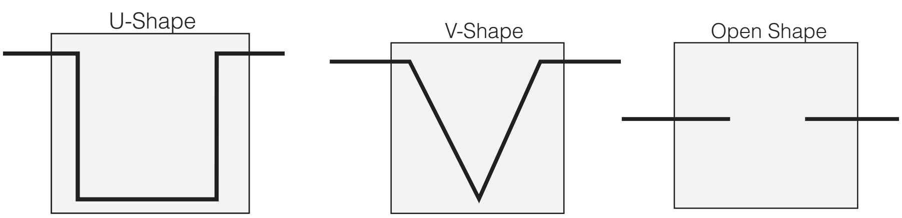
Groove Width

A Groove Width measurement measures the width of a V-shape, U-shape or open-shape groove. The measurement value can be compared with minimum and maximum constraints to yield a decision.



Refer to Groove Algorithm (page 144) for an explanation of the feature locating algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

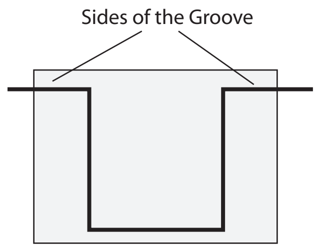
Parameters:

Parameters	Descriptions
Shape	Shape of the groove 
Select Type	Specifies how a groove is selected when there are multiple grooves within the measurement area. Maximum Depth - Groove with maximum depth. Index from The Left - 0-based groove index, counting from left to right Index from the Right - 0-based groove index, counting from right to left.
Index	0-based groove index.
Minimum Depth	Minimum depth for a groove to be considered valid.
Minimum Width	Minimum width for a groove to be considered valid. The width is the distance between the groove corners.
Maximum Width	Maximum width of a groove to be considered valid. If set to 0, the maximum is set to the width of the measurement area.

To create or edit a Groove Width measurement:

1 **Add a new Groove Width measurement or select an existing Groove Width measurement.**

2 **Adjust the measurement region.**
The measurement region defines the region in which to search for the groove. For a stable measurement, the measurement region should be made large enough to cover some laser data on the left and right sides of the groove.

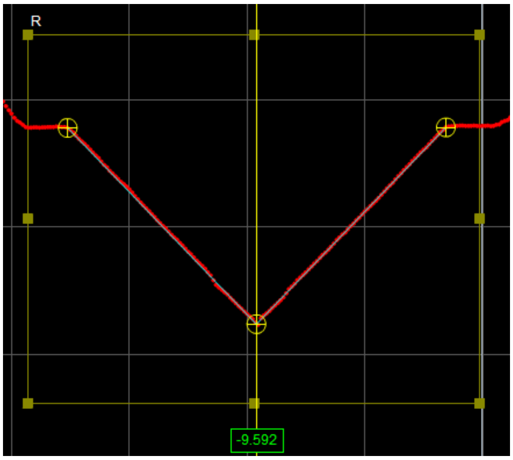


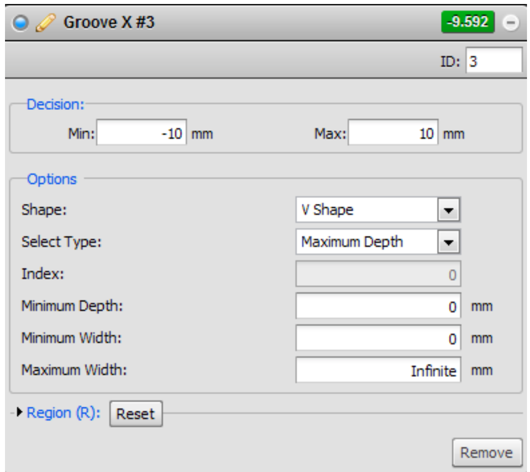
3 **Adjust the measurement parameters.**
Adjust the parameters as described above.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Groove X

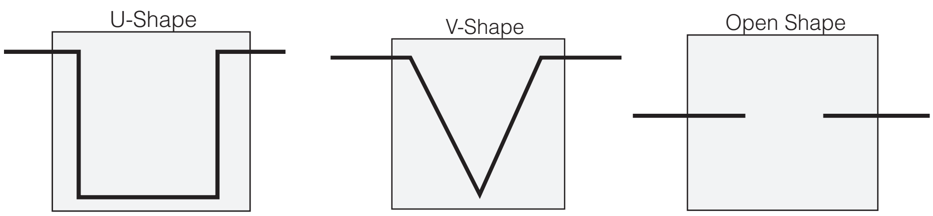
A Groove X measurement measures the x-position of the minimum point of a V-shape, U-shape or open-shape groove. The measurement value can be compared with minimum and maximum constraints to yield a decision.





Refer to Groove Algorithm (page 144) for an explanation of the feature locating algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

Parameters:

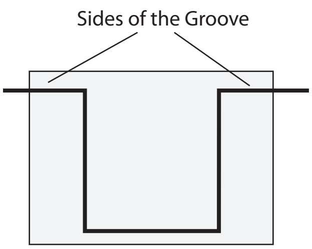
Parameters	Descriptions
Shape	Shape of the groove 
Location	Specifies the location type to return Bottom - Groove bottom. For a U-shape and open-shape groove, the x-position is at the the centroid of the groove. For a V-shape groove, the x-position is at the intersection of lines fitted to the left and right sides of the groove. See algorithm section below for more details. Left - Groove's left corner. Right - Groove's right corner.
Select Type	Specifies how a groove is selected when there are multiple grooves within the measurement area. Maximum Depth - Groove with maximum depth. Index from The Left - 0-based groove index, counting from left to right. Index from the Right - 0-based groove index, counting from right to left.
Index	0-based groove index.
Minimum Depth	Minimum depth for a groove to be considered valid.
Minimum Width	Minimum width for a groove to be considered valid.

Parameters	Descriptions
Maximum Width	Maximum width of a groove to be considered valid. If set to 0, the maximum is set to the width of the measurement area.

To create or edit a Groove X measurement:

1 **Add a new Groove X measurement or select an existing Groove X measurement.**

2 **Adjust the measurement region.**
The measurement region defines the region in which to search for the groove. For a stable measurement, the measurement region should be made large enough to cover some laser data on the left and right sides of the groove.

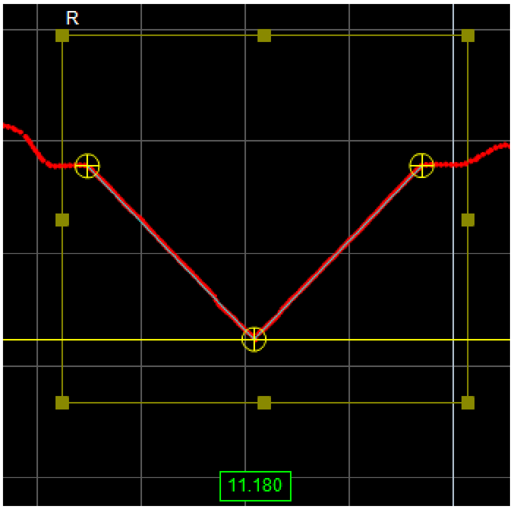


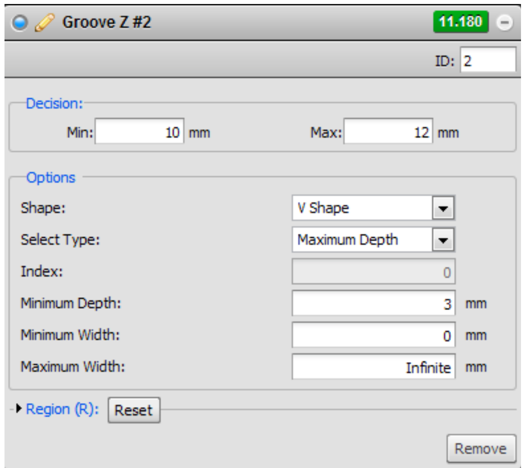
3 **Adjust the measurement parameters.**
Adjust the parameters as described above.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Groove Z

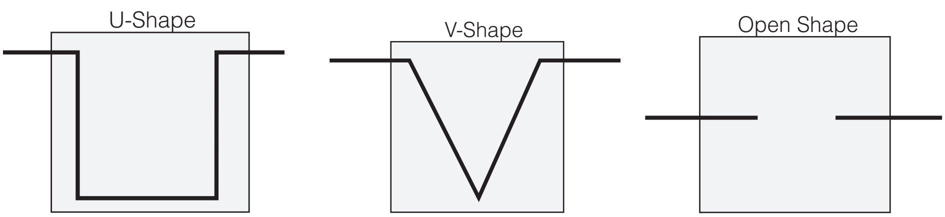
A Groove Z measurement measures the z-position of the bottom of a V-shape, U-shape or open-shape groove The measurement value can be compared with minimum and maximum constraints to yield a decision.





Refer to Groove Algorithm (page 144) for an explanation of the feature locating algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

Parameters:

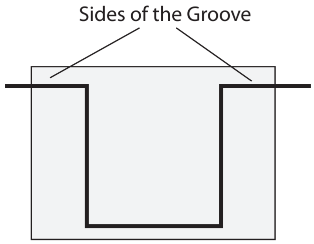
Parameters	Descriptions
Shape	Shape of the groove 
Location	Specifies the location type to return. Bottom - Groove bottom. For a U-shape and open-shape groove, the z-position is the maximum depth of the groove. For a V-shape groove, the z-position point is at the intersection of lines fitted to the left and right sides of the groove. Left - Groove's left corner. Right - Groove's right corner.
Select Type	Specifies how a groove is selected when there are multiple grooves within the measurement area. Maximum Depth - Groove with maximum depth Index from The Left - 0-based groove index, counting from left to right Index from the Right - 0-based groove index, counting from right to left.
Index	0-based groove index.
Minimum Depth	Minimum depth for a groove to be considered valid.
Minimum Width	Minimum width for a groove to be considered valid.

Parameters	Descriptions
Maximum Width	Maximum width of a groove to be considered valid. If set to 0, the maximum is set to the width of the measurement area.

To create or edit a Groove Z measurement:

1 **Add a new Groove Z measurement or select an existing Groove Z measurement.**

2 **Adjust the measurement region.**
The measurement region defines the region in which to search for the groove. For a stable measurement, the measurement region should be made large enough to cover some laser data on the left and right sides of the groove.

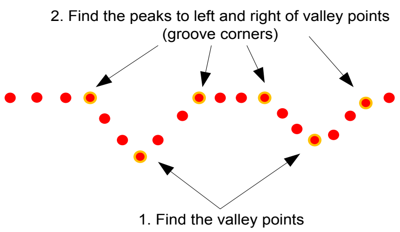


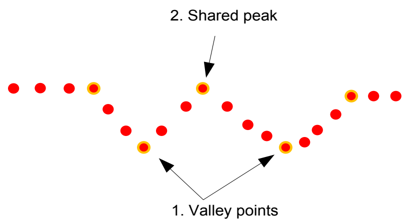
3 **Adjust the measurement parameters.**
Adjust the parameters as described above.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

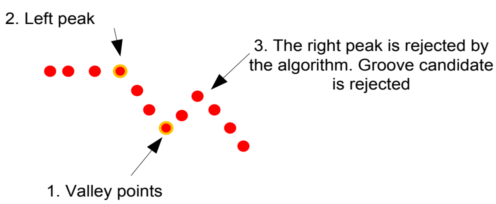
Groove Algorithm

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

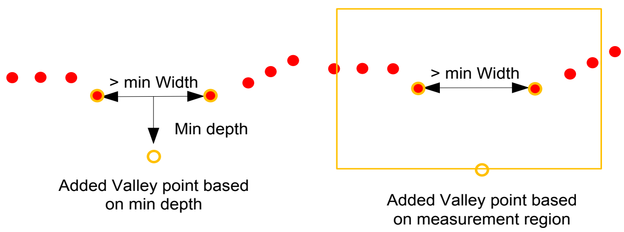




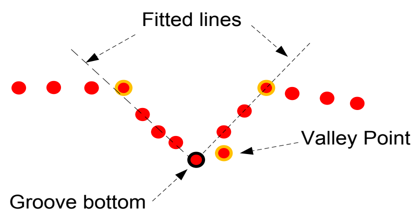
The algorithm derives search parameters from the user settings to prevent noise from triggering false detections. When detecting multiple grooves, an adaptive algorithm is used to ensure that candidate grooves are approximately the same scale.



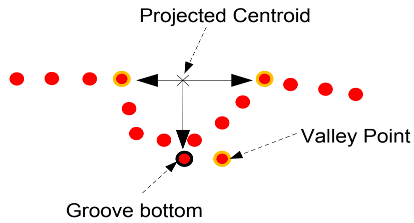
Open grooves' valley points may not be visible or may fall outside of the measurement region. Voids in the data (regions with no profile data) between pairs of valid points are detected. A valley point is added midway between the pair of valid points. The Z-position of the valley point is either the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



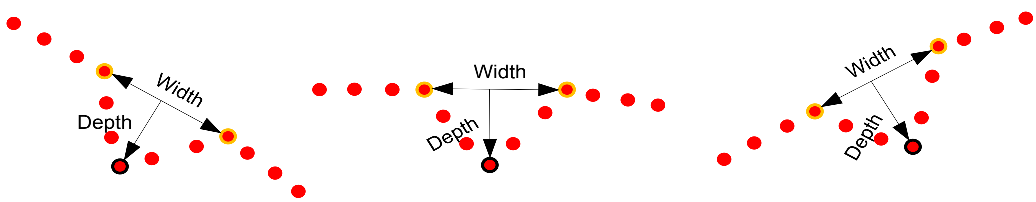
The actual groove bottom is calculated differently for different shapes. For a V-shaped groove, a line is fitted to the sides of the valley points starting from the corners, up to (but not including) the valley point. The groove bottom is the intersection of the left and right lines. Line fitting is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



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

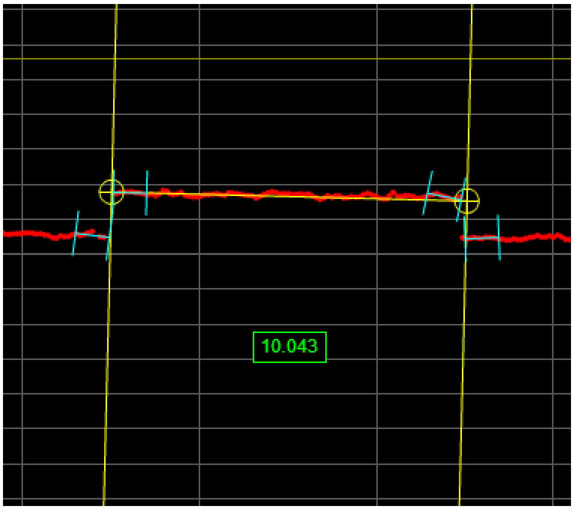


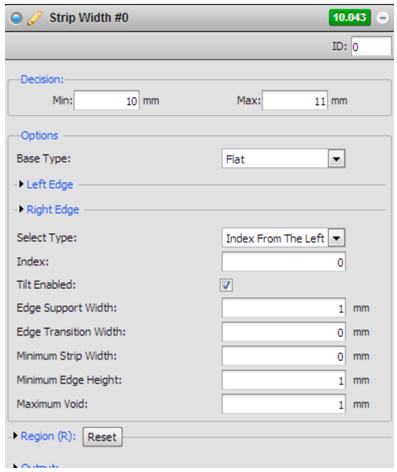
Groove candidates that do not meet the minimum and maximum width and depth settings are rejected. The width and depth measurements are invariant to the groove rotation. The width is the distance between the groove corners and the depth is perpendicular distance of the groove bottom from the groove width.



Strip Width

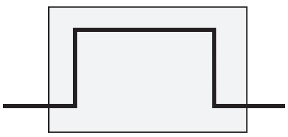
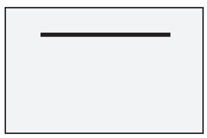
A Strip Width measurement measures the width of a strip. The measurement value can be compared with minimum and maximum constraints to yield a decision.

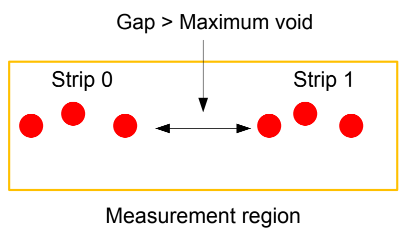




Refer to Strip Detection Algorithm (page 158) for an explanation of the strip locating algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

Parameters

Parameters	**Descriptions**
Base Type	Specifies if the strip has a base or not. Base Type = Flat  Base Type = None 
Left Edge	Specifies the features that will be considered as the strip's left edge. Users can select more than one condition. Rising - Rising edge detected based on the strip edge parameters. Falling - Falling edge detected based on the strip edge parameters. Data end - First valid profile data point in the measurement region. Void - Gap in the data that is larger than the maximum void threshold. Gaps connected to the measurement region's boundary are not considered as a void. Refer to Strip Start and Terminate Conditions (page 158) for the definitions of these conditions.

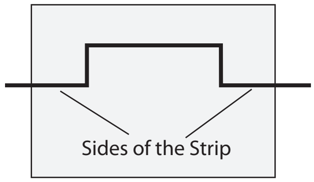
Parameters	Descriptions
Right Edge	Specifies the features that will be considered as the strip's right edge. Users can select more than one condition. Rising - Rising edge detected based on the strip edge parameters. Falling - Falling edge detected based on the strip edge parameters. Data end - Last valid profile data point in the measurement region. Void - Gap in the data that is larger than the maximum Void parameter. Gaps connected to the measurement region's boundary are not considered as a void. Refer to Strip Start and Terminate Conditions (page 158) for the definitions of these conditions.
Select Type	Specifies how a strip is selected when there are multiple strips within the measurement area. Best - The widest strip. Index from The Left - 0-based strip index, counting from left to right Index from the Right - 0-based strip index, counting from right to left
Index	0-based strip index.
Minimum Edge Height	Specifies the minimum deviation from the strip base. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used for different base types.
Edge Support Width	Specifies the width of the region around the edges from which the data is used to calculate the step change. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used by different base types.
Edge Transition Width	Specifies the nominal width needed to make the transition from the base to the strip. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used by different base types.
Maximum Void	The maximum width of missing data allowed for the data to be considered as part of a strip when 'Void" is selected in the Left or Right Edge parameter. This value must be smaller than the Edge Support Width.  When occlusion and exposure causes data drops, users should use the gap filling function to fill the gaps. Refer to Gap Filling (page 78) for information.
Minimum Strip Width	Specifies the minimum width for a strip to be considered valid.
Tilt	Enables/disables tile correction.

To create or edit a Strip Width measurement:

1 Add a new Strip Width measurement or select an existing Strip Width measurement.

2 Adjust the measurement region.

The measurement region defines the region in which to search for the strip. If possible, the region should be made large enough to cover the base on the left and right sides of the strip.

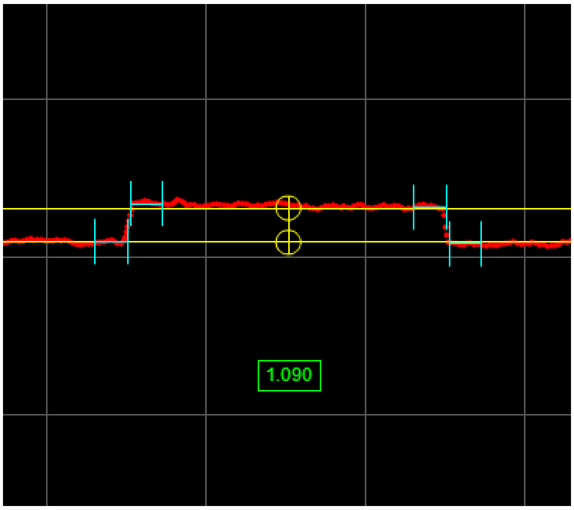


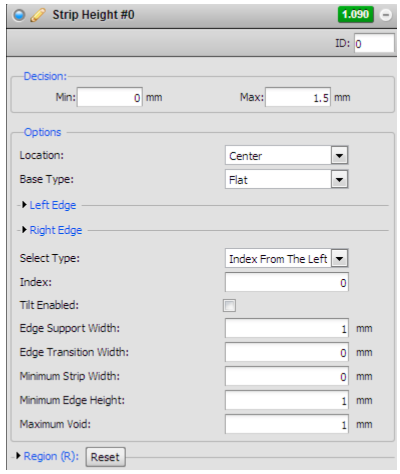
3 Adjust the measurement parameters.
Adjust the parameters as described above.

4 Provide minimum and maximum constraints for a decision.
Refer to Decisions (page 87) for more information on decisions.

Strip Height

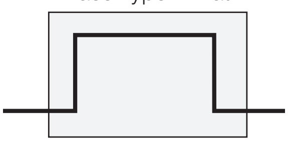
A Strip Height measurement measures the height of a strip. The measurement value can be compared with minimum and maximum constraints to yield a decision.

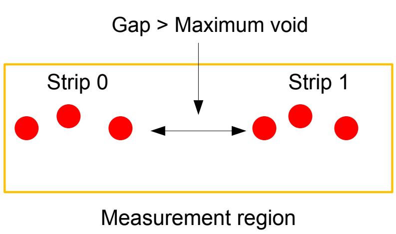




Refer to Strip Detection Algorithm (page 158) for an explanation of the strip locating algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

Parameters

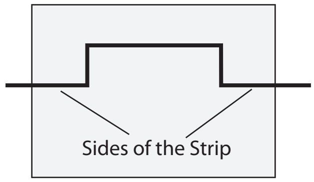
Parameters	Descriptions
Location	Specifies the strip position from which the measurements are performed. Left - Left edge of the strip. Right - Right edge of the strip. Center - Center of the strip.
Base Type	Specifies if the strip has a base or not. Base Type = Flat 
Left Edge	Specifies the features that will be considered as the strip's left edge. Users can select more than one condition. Rising - Rising edge detected based on the strip edge parameters. Falling - Falling edge detected based on the strip edge parameters. Data end - First valid profile data point in the measurement region. Void - Gap in the data that is larger than the maximum void threshold. Gaps connected to the measurement region's boundary are not considered as a void. Refer to Strip Start and Terminate Conditions (page 158) for the definitions of these conditions.

Parameters	Descriptions
Right Edge	Specifies the features that will be considered as the strip's right edge. Users can select more than one condition. Rising - Rising edge detected based on the strip edge parameters. Falling - Falling edge detected based on the strip edge parameters. Data end - Last valid profile data point in the measurement region. Void - Gap in the data that is larger than the maximum Void parameter. Gaps connected to the measurement region's boundary are not considered as a void. Refer to Strip Start and Terminate Conditions (page 158) for the definitions of these conditions.
Select Type	Specifies how a strip is selected when there are multiple strips within the measurement area. Best - The widest strip. Index from The Left - 0-based strip index, counting from left to right Index from the Right - 0-based strip index, counting from right to left
Index	0-based strip index.
Minimum Edge Height	Specifies the minimum deviation from the strip base. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used for different base types.
Edge Support Width	Specifies the width of the region around the edges from which the data is used to calculate the step change. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used by different base types.
Edge Transition Width	Specifies the nominal width needed to make the transition from the base to the strip. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used by different base types.
Maximum Void	The maximum width of missing data allowed for the data to be considered as part of a strip when 'Void" is selected in the Left or Right Edge parameter. This value must be smaller than the Edge Support Width.  When occlusion and exposure causes data drops, users should use the gap filling function to fill the gaps. Refer to Gap Filling (page 78) for information.
Minimum Strip Width	Specifies the minimum width for a strip to be considered valid.
Tilt	Enables/disables tile correction.

To create or edit a Strip Height measurement:

1 **Add a new Strip Height measurement or select an existing Strip Height measurement.**

2 **Adjust the measurement region.**
The measurement region defines the region in which to search for the strip. If possible, the region should be made large enough to cover the base on the left and right sides of the strip.

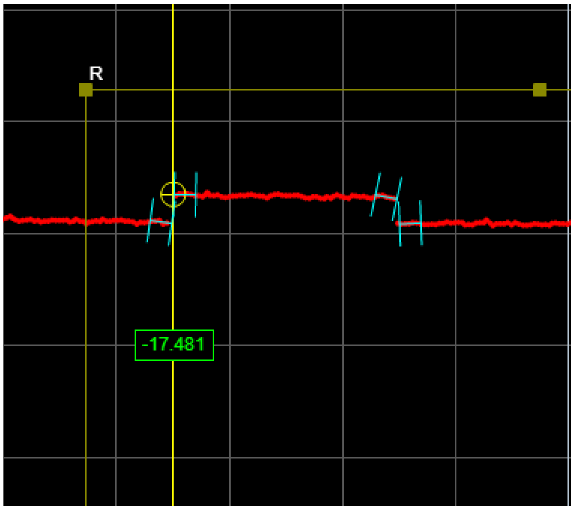


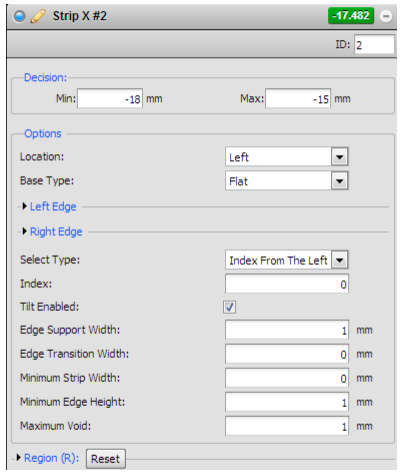
3 **Adjust the measurement parameters.**
Adjust the parameters as described above.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Strip X

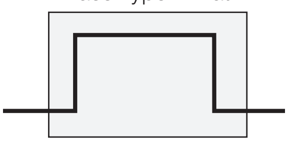
A Strip X measurement measures the x-position of a strip. The measurement value can be compared with minimum and maximum constraints to yield a decision.

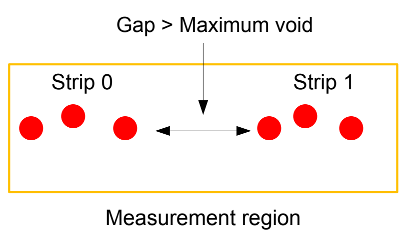




Refer to Strip Detection Algorithm (page 158) for an explanation of the strip locating algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

Parameters:\

Parameters	Descriptions
Location	Specifies the strip position from which the measurements are performed. Left - Left edge of the strip. Right - Right edge of the strip. Center - Center of the strip.
Base Type	Specifies if the strip has a base or not. Base Type = Flat 
Left Edge	Specifies the features that will be considered as the strip's left edge. Users can select more than one condition. Rising - Rising edge detected based on the strip edge parameters. Falling - Falling edge detected based on the strip edge parameters. Data end - First valid profile data point in the measurement region. Void - Gap in the data that is larger than the maximum void threshold. Gaps connected to the measurement region's boundary are not considered as a void. Refer to Strip Start and Terminate Conditions (page 158) for the definitions of these conditions.

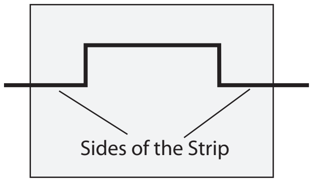
Parameters	Descriptions
Right Edge	Specifies the features that will be considered as the strip's right edge. Users can select more than one condition. Rising - Rising edge detected based on the strip edge parameters. Falling - Falling edge detected based on the strip edge parameters. Data end - Last valid profile data point in the measurement region. Void - Gap in the data that is larger than the maximum Void parameter. Gaps connected to the measurement region's boundary are not considered as a void. Refer to Strip Start and Terminate Conditions (page 158) for the definitions of these conditions.
Select Type	Specifies how a strip is selected when there are multiple strips within the measurement area. Best - The widest strip. Index from The Left - 0-based strip index, counting from left to right Index from the Right - 0-based strip index, counting from right to left
Index	0-based strip index.
Minimum Edge Height	Specifies the minimum deviation from the strip base. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used for different base types.
Edge Support Width	Specifies the width of the region around the edges from which the data is used to calculate the step change. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used by different base types.
Edge Transition Width	Specifies the nominal width needed to make the transition from the base to the strip. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used by different base types.
Maximum Void	The maximum width of missing data allowed for the data to be considered as part of a strip when 'Void" is selected in the Left or Right Edge parameter. This value must be smaller than the Edge Support Width.  To achieve the best results when occlusion and exposure causes data drops, users should use the gap filling function to fill the gaps. Refer to Gap Filling (page 78) for information.
Minimum Strip Width	Specifies the minimum width for a strip to be considered valid.
Tilt	Enables/disables tile correction.

To create or edit a Strip X measurement:

1 Add a new Strip X measurement or select an existing Strip X measurement.

2 Adjust the measurement region.

The measurement region defines the region in which to search for the strip. If possible, the region should be made large enough to cover the base on the left and right sides of the strip.

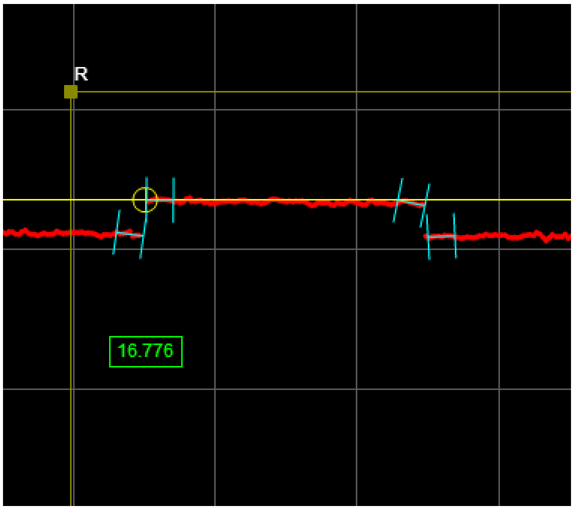


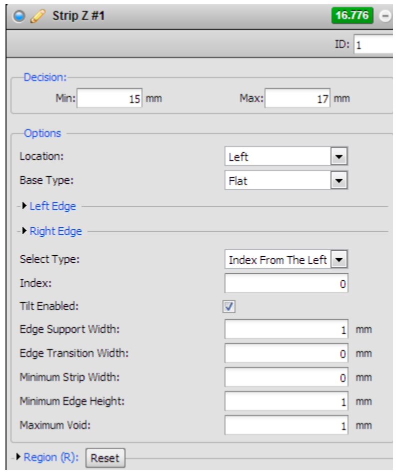
3 **Adjust the measurement parameters.**
Adjust the parameters as described above.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Strip Z

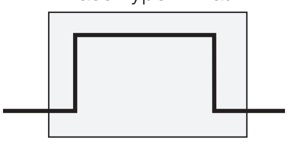
A Strip Z measurement measures the z-position of a strip. The measurement value can be compared with minimum and maximum constraints to yield a decision.

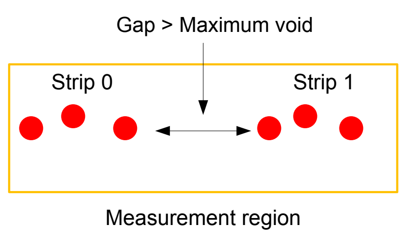




Refer to Strip Detection Algorithm (page 158) for an explanation of the strip locating algorithm. The behavior of the algorithm can be adjusted by changing the parameters in the measurement panel.

Parameters:

Parameters	Descriptions
Location	Specifies the strip position from which the measurements are performed. Left - Left edge of the strip. Right - Right edge of the strip. Center - Center of the strip.
Base Type	Specifies if the strip has a base or not. Base Type = Flat 
Left Edge	Specifies the features that will be considered as the strip's left edge. Users can select more than one condition. Rising - Rising edge detected based on the strip edge parameters. Falling - Falling edge detected based on the strip edge parameters. Data end - First valid profile data point in the measurement region. Void - Gaps in the data that is larger than the void threshold. Gaps connected to the measurement region's boundary are not considered as a void. Refer to Strip Start and Terminate Conditions (page 158) for the definitions of these conditions.

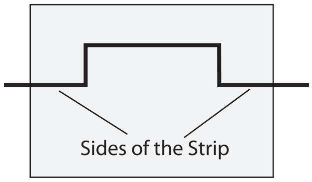
Parameters	Descriptions
Right Edge	Specifies the features that will be considered as the strip's right edge. Users can select more than one condition. Rising - Rising edge detected based on the strip edge parameters. Falling - Falling edge detected based on the strip edge parameters. Data end - Last valid profile data point in the measurement region. Void - Width of the missing data that is larger than the Maximum Void parameter. Gaps connected to the measurement region's boundary are not considered as a void. Refer to Strip Start and Terminate Conditions (page 158) for the definitions of these conditions.
Select Type	Specifies how a strip is selected when there are multiple strips within the measurement area. Best - The widest strip. Index from The Left - 0-based strip index, counting from left to right Index from the Right - 0-based strip index, counting from right to left
Index	0-based strip index.
Minimum Edge Height	Specifies the minimum deviation from the strip base. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used for different base types.
Edge Support Width	Specifies the width of the region around the edges from which the data is used to calculate the step change. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used for different base types.
Edge Transition Width	Specifies the nominal width needed to make the transition from the base to the strip. Refer to Strip Step Edge Definitions (page 160) on how this parameter is used for different base types.
Maximum Void	The maximum width of missing data allowed for the data to be considered as part of a strip when 'Void" is selected in the Left or Right Edge parameter. This value must be smaller than the Edge Support Width.  To achieve the best results when occlusion and exposure causes data drops, users should use the gap filling function to fill the gaps. Refer to Gap Filling (page 78) for information.
Minimum Strip Width	Specifies the minimum width for a strip to be considered valid.
Tilt	Enables/disables tile correction.

To create or edit a Strip Z measurement:

1 Add a new Strip Z measurement or select an existing Strip Z measurement.

2 Adjust the measurement region.

The measurement region defines the region in which to search for the strip. If possible, the region should be made large enough to cover the base on the left and right sides of the strip.

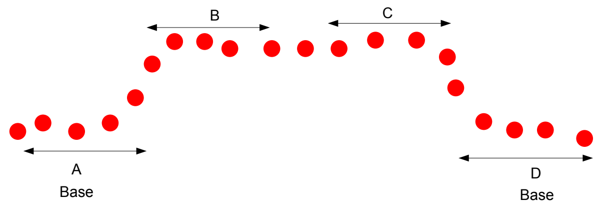


3 **Adjust the measurement parameters.**
Adjust the parameters as described above.

4 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

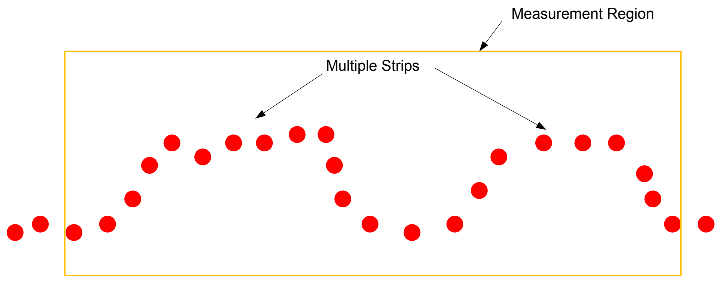
Strip Detection Algorithm

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



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

The Strip tool can detect multiple strips. Users select an ROI, referred to as the measurement region, from which the algorithm search for multiple strips.



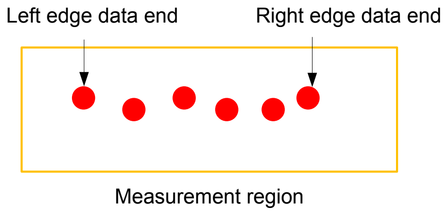
Strip Start and Terminate Conditions

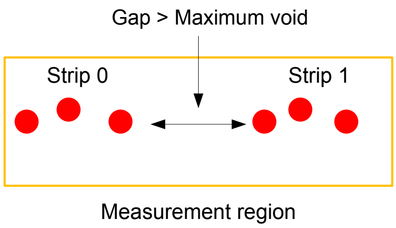
The Strip tool allows users to define how a strip starts and ends. The Left Edge parameter controls how a strip starts and the Right Edge parameter controls how a strip ends.

Start / terminate conditions

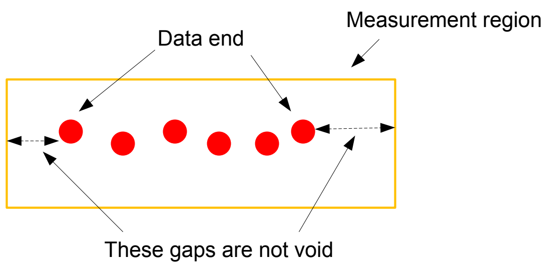
Conditions	Descriptions
Rising	Rising step edge detected based on the strip edge parameters. Refer to Strip Step Edge Definitions (page 160) for how the step edge is detected.
Falling	Falling step edge detected based on the strip edge parameters. Refer to Strip Step Edge Definitions (page 160) for how the step edge is measured.

<table>
<tr><th>Conditions</th><th>Descriptions</th></tr>
<tr><td>Data end</td><td>The first (for the left edge) or the last (for the right edge) valid profile data point in the measurement region.


</td></tr>
<tr><td>Void</td><td>Gaps in the data that are larger than the maximum void threshold.

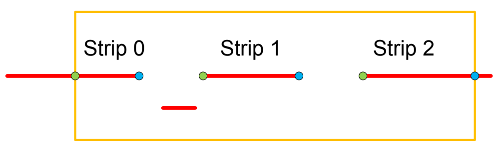
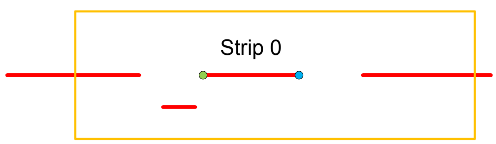


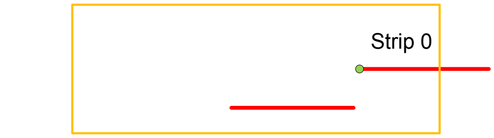
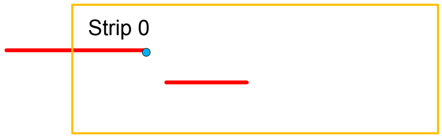
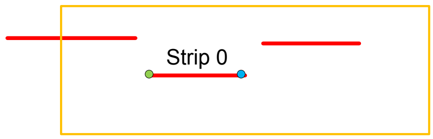
Gaps at the ends of the measurement region's boundary are not considered as a void.


</td></tr>
</table>

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

Start / terminate conditions:

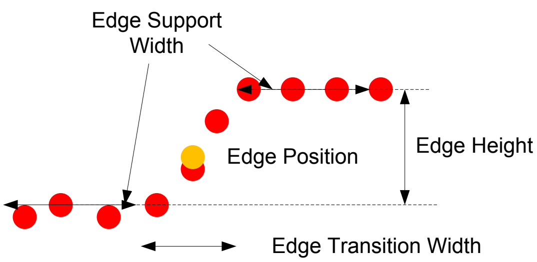
<table>
<tr><th>Left and Right Edge Conditions</th><th>Examples</th></tr>
<tr><td>Left: Rising, data end, void
Right: Falling, data end, void</td><td>
</td></tr>
<tr><td>Left: Rising, void
Right: Falling, void</td><td>
</td></tr>
</table>

Left and Right Edge Conditions	Examples
Left: Rising Right: Data end, void	
Left: Data end, void Right: Falling	
Left: Falling Right: Rising	

Strip Step Edge Definitions

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

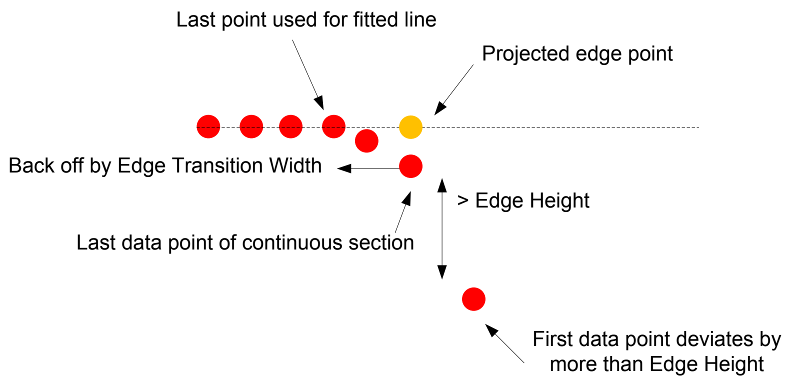
When Base Type is set to flat, the regions around the edges are visible and the edge positions are between the base and the strip surface.



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

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

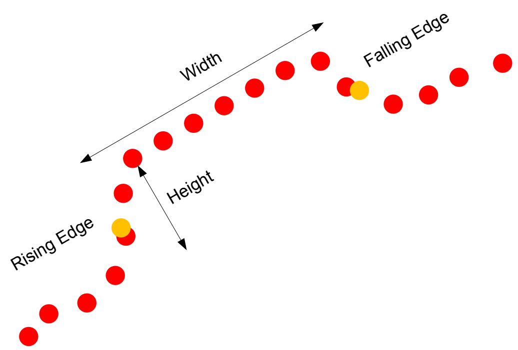
When the base is set to None, the tool looks for continuous sections that are wider than the Edge Support Width and have no data point that deviate positively or negatively more than the Minimum Edge Height. The height level of the continuous region is calculated based on the fitted line as shown below.



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

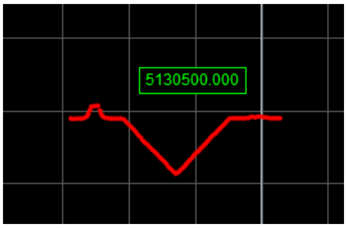
Tilt

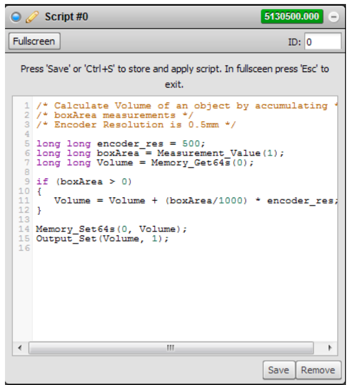
The strip may be tilted with respect to the sensor's coordinate x-axis. This could be caused by conveyer vibration. If the tilt option is enabled, the tool will report the width and height measurements following the tilt angle of the strip.



Script

A Script measurement can be used to program a custom measurement using a simplified C based syntax. A script measurement can produce a measurement value and a measurement decision.





Refer to Script Measurement (page 91) for more information on the script syntax.

To create or edit a Script measurement:

1 **Add a new Script measurement or select an existing Script measurement.**

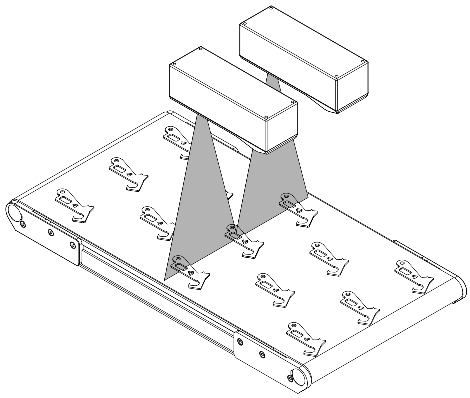
2 **Edit the script code.**
Build up your script by adding one line at a time. The script will be easier to debug if you begin with a few lines and then build it up over a few iterations.

3 **Click the Save button to save the script code.**
If there is a mistake in the script syntax, the result will be shown as a “invalid” with a red border in the Data Viewer when you run the sensor.

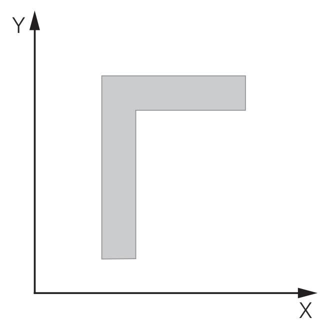
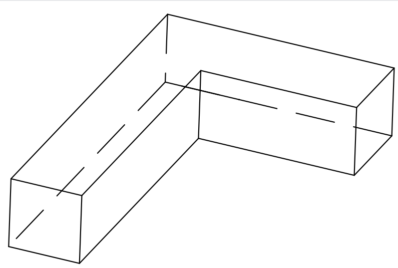
Outputs from multiple measurement tools can be used as inputs to the script. A typical script would take results from other measurement tools using the value and decision function, and output the result using the output function. Video and profile cannot be used as inputs to the script. Only one script can be created.

Whole Part Measurement Tools

Whole part measurement involves capturing a sequence of laser profiles, identifying discrete objects, and measuring properties of those objects, such as volume or maximum height.



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.

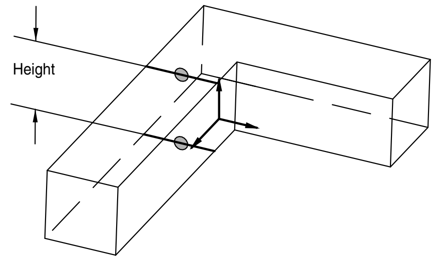
Measurement	Examples
Area Measures area in the XY plane. Refer to Area (page 167).	
Volume Measures volume in XYZ space. Refer to Volume (page 168).	

Measurement	Examples

Height

Measures maximum height, minimum height, or the height at the 2D centroid in the XY plane, or the 3D centroid in XYZ space.

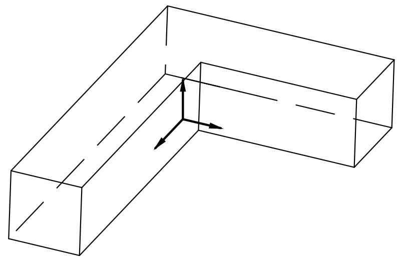
Refer to Height (page 172).



Centroid X

Measures the x-position of the part's 2D centroid in the XY plane, or the 3D centroid in XYZ space.

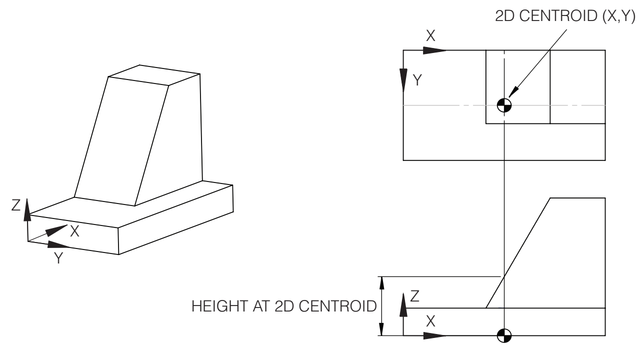
Refer to Centroid X (page 169).



Centroid Y

Measures the y-position of the part's 2D centroid in the XY plane, or the 3D centroid in XYZ space.

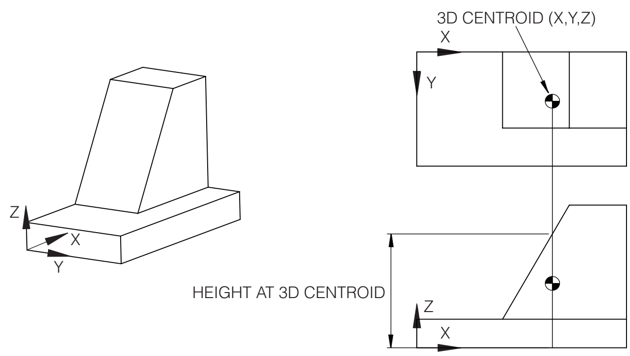
Refer to Centroid Y (page 170).



Centroid Z

Measures the z-position of the part's 2D centroid in the XY plane, or the 3D centroid in XYZ space.

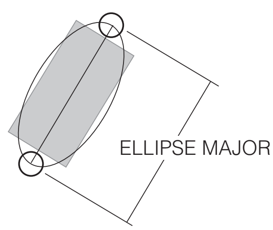
Refer to Centroid Z (page 171).

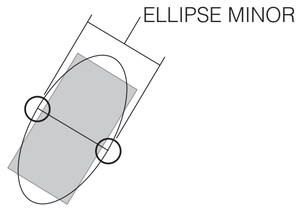
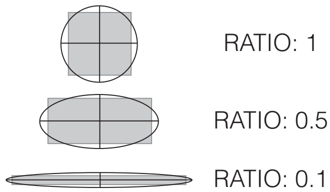
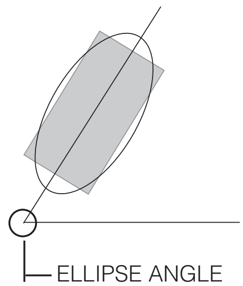
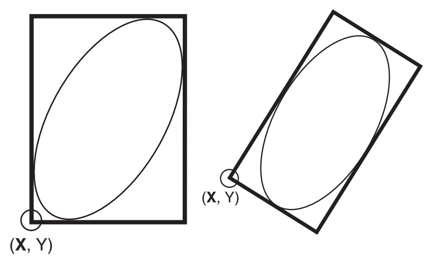
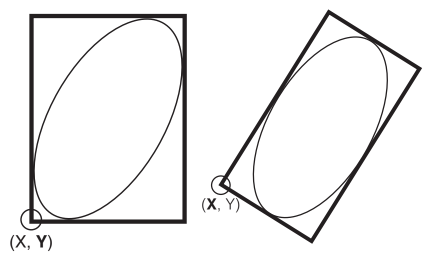


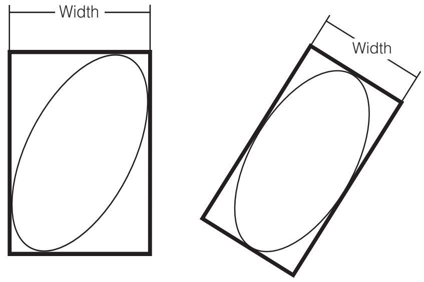
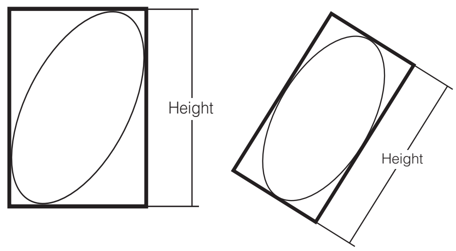
Ellipse Major

Measures the major axis length of an ellipse fitted to the part's shape in the XY plane.

Refer to Ellipse Major (page 175).



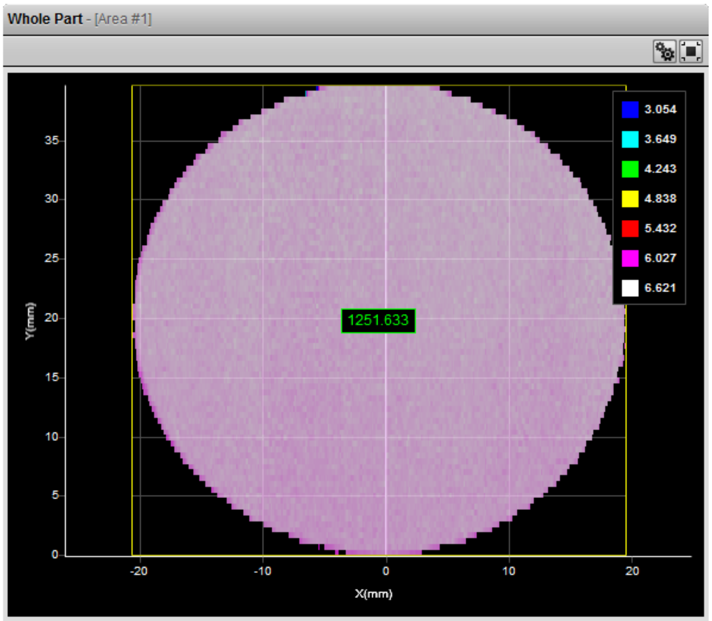
Measurement	Examples
Ellipse Minor Measures the minor axis length of an ellipse fitted to the part's shape in the XY plane. Refer to Ellipse Minor (page 174).	
Ellipse Ratio Measures the minor/major axis ratio of an ellipse fitted to the part. Refer to Ellipse Ratio (page 176).	
Ellipse Angle Measures the orientation angle of an ellipse fitted to the part's shape in the XY plane. Refer to Ellipse Angle (page 173).	
Bounding Box X Measures the x-location of the corner of the smallest box that encapsulates the part. Refer to Bounding Box X (page 177).	
Bounding Box Y Measures the y-location of the corner of the smallest box that encapsulates the part. Refer to Bounding Box Y (page 178).	

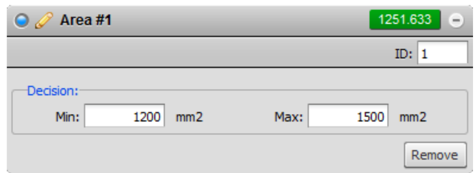
Measurement	Examples
Bounding Box Width Measures the width of the smallest box that encapsulates the part. Refer to Bounding Box Width (page 179).	
Bounding Box Length Measures the length of the smallest box that encapsulates the part. Refer to Bounding Box Length (page 180).	

Measurement Types

Area

An Area measurement determines part area in the XY plane. The measurement value can be compared with minimum and maximum constraints to yield a decision.





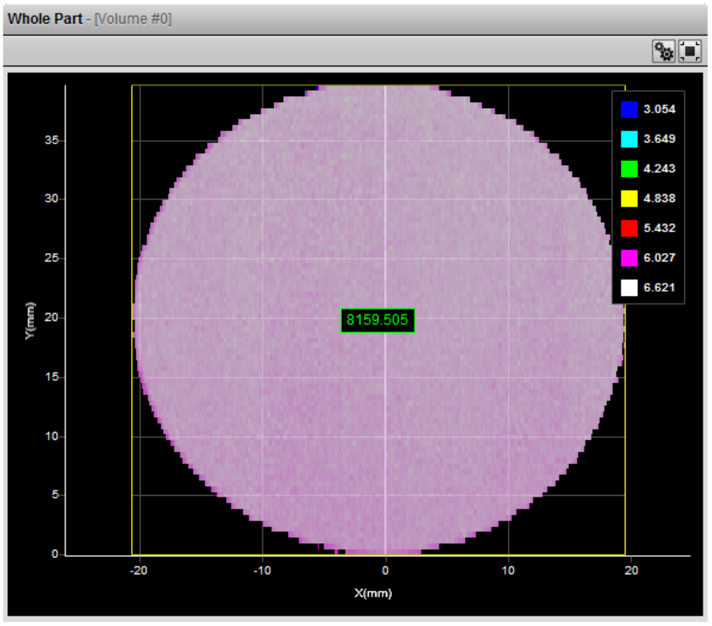
To create or edit an Area measurement:

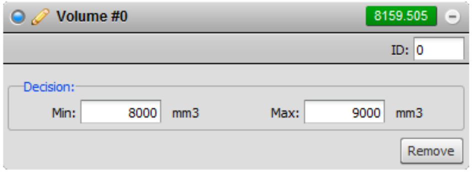
1 **Add a new Area measurement or select an existing Area measurement.**

2 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Volume

A Volume measurement determines the volume of a part. The measurement value can be compared with minimum and maximum constraints to yield a decision.





To create or edit a Volume measurement:

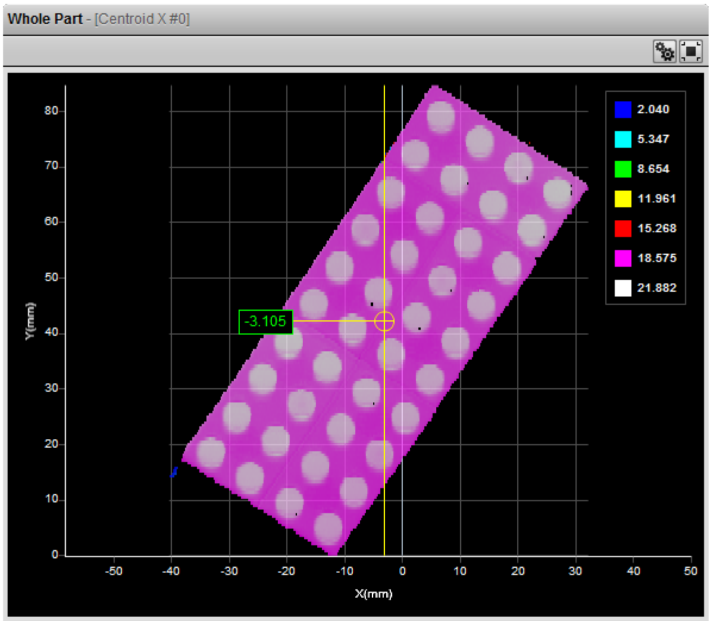
1 **Add a new Volume measurement or select an existing Volume measurement.**

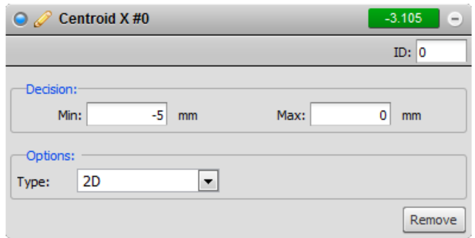
2 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Centroid X

A Centroid X measurement determines the x-position of the 2D or 3D centroid of a part. The measurement value can be compared with minimum and maximum constraints to yield a decision.

The result is relative to the vertical Bounding Box X (page 177).





To create or edit a Centroid X measurement:

1 **Add a new Centroid X measurement or select an existing Centroid X measurement.**

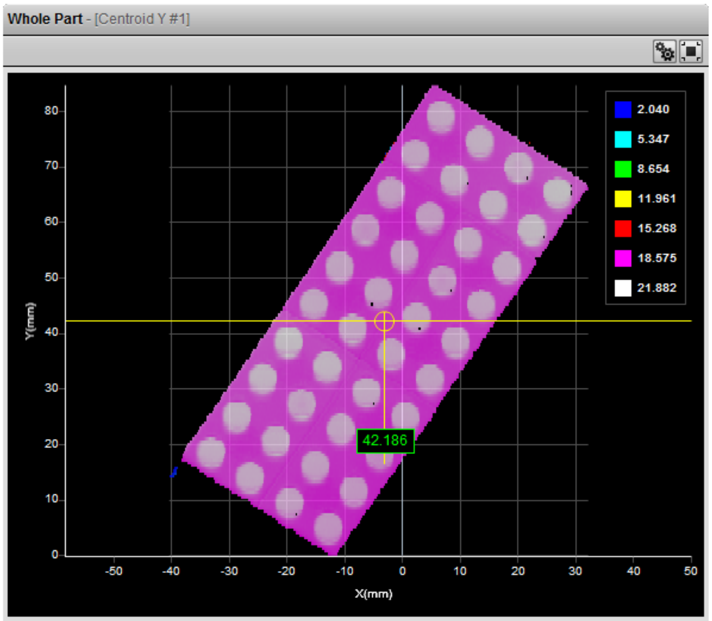
2 **Specify the centroid type.**
A 2D centroid uses part perimeter information to quickly estimate the center of the part in the XY plane. A 3D centroid uses all available profile information to compute the center of the part in XYZ coordinates.

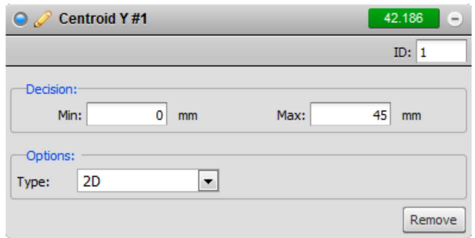
3 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Centroid Y

A Centroid Y measurement determines the y-position of the 2D or 3D centroid of a part. The measurement value can be compared with minimum and maximum constraints to yield a decision.

The y-coordinate is relative to the vertical Bounding Box Y (page 178).





To create or edit a Centroid Y measurement:

1 **Add a new Centroid Y measurement or select an existing Centroid Y measurement.**

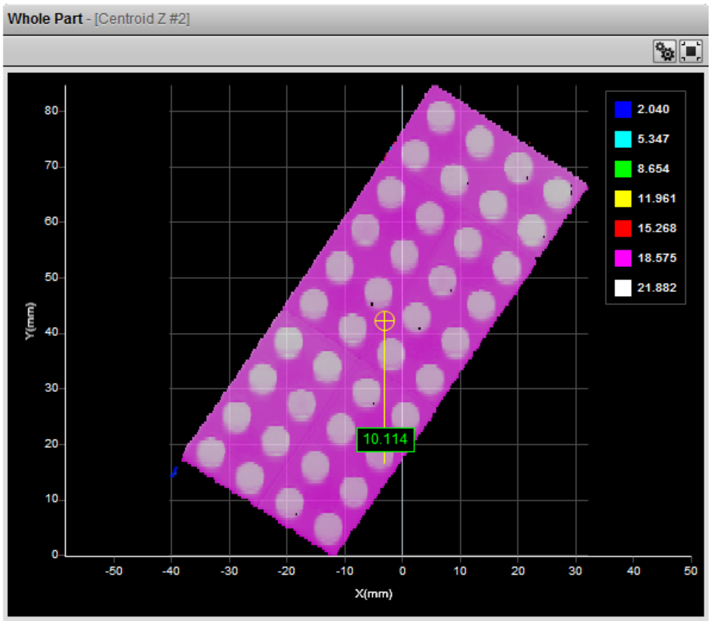
2 **Specify the centroid type.**
A 2D centroid uses part perimeter information to quickly estimate the center of the part in the XY plane. A 3D centroid uses all available profile information to compute the center of the part in XYZ coordinates.

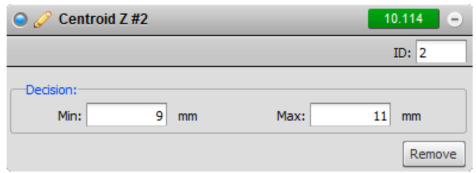
3 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Centroid Z

A Centroid Z measurement determines the z-position of the 2D or 3D centroid of a part. The measurement value can be compared with minimum and maximum constraints to yield a decision.

The z-position is relative to the sensor's system coordinate.





To create or edit a Centroid Z measurement:

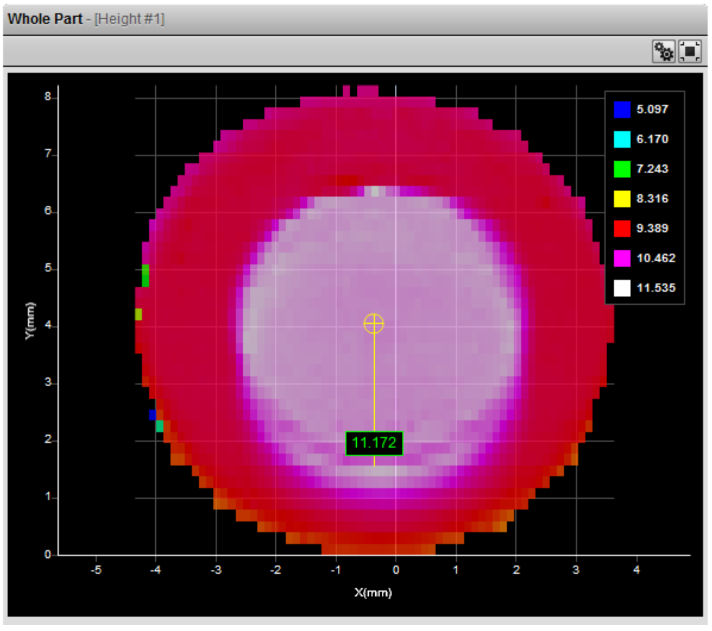
1 **Add a new Centroid Z measurement or select an existing Centroid Z measurement.**

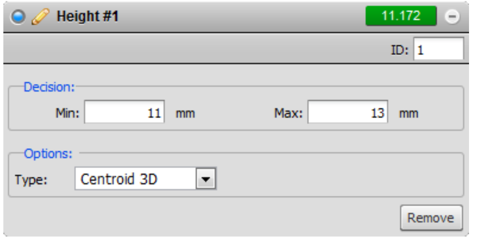
2 **Specify the centroid type.**
A 2D centroid uses part perimeter information to quickly estimate the center of the part in the XY plane. A 3D centroid uses all available profile information to compute the center of the part in XYZ coordinates.

3 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Height

A Height measurement determines the height (thickness) of a part. The measurement value can be compared with minimum and maximum constraints to yield a decision.





To create or edit a Height measurement:

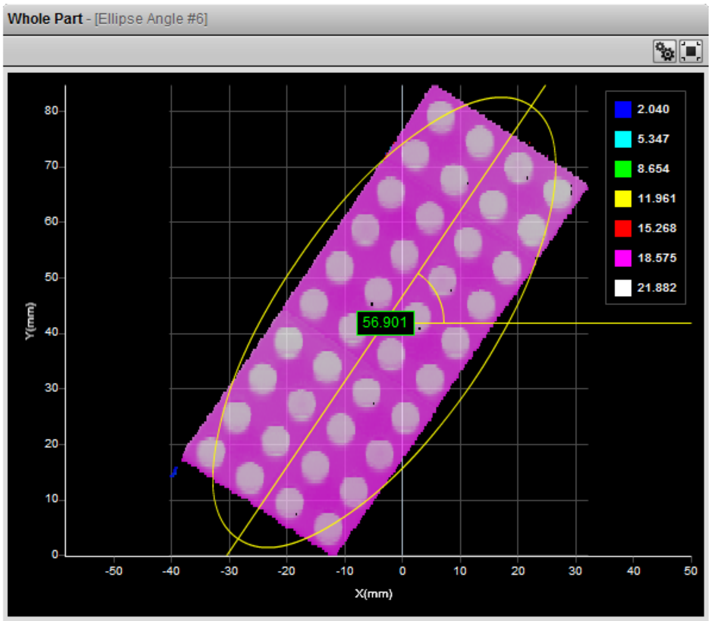
1 **Add a new Height measurement or select an existing Height measurement.**

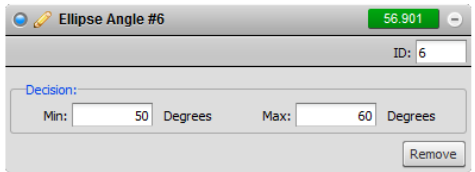
2 **Specify the height type.**
The minimum height, maximum height or height of the part at the 2D or 3D centroid can be calculated. A 2D centroid uses part perimeter information to quickly estimate the center of the part in the XY plane. A 3D centroid uses all available profile information to compute the center of the part in XYZ coordinates.

3 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Ellipse Angle

An Ellipse Angle measurement determines the orientation angle of an ellipse fitted to the part's area in the XY plane. The measurement value can be compared with minimum and maximum constraints to yield a decision.



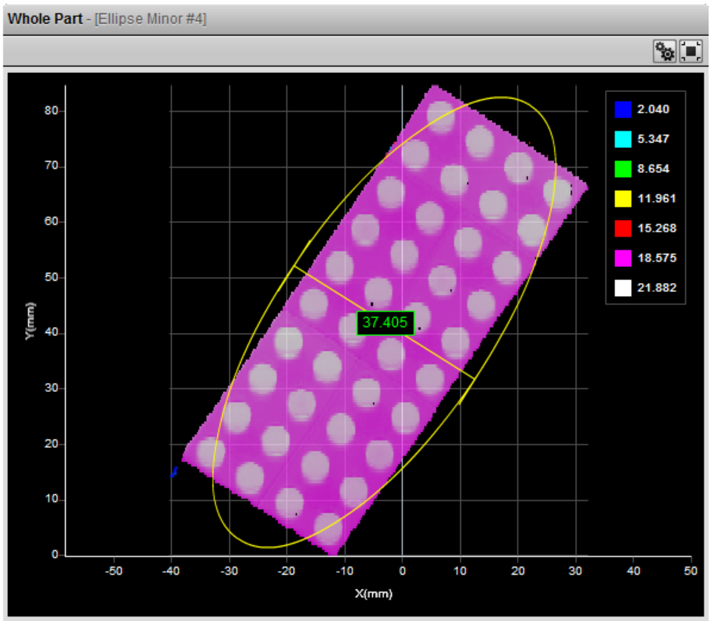


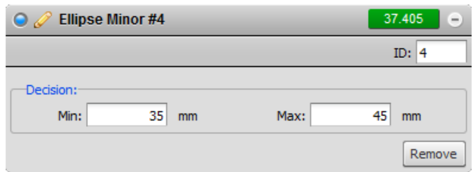
To create or edit an Ellipse Angle measurement:

1. **Add a new Ellipse Angle measurement or select an existing Ellipse Angle measurement.**
2. **Specify a reference angle for comparison.**
   The result of the measurement is the difference between the ellipse orientation angle and the specified reference angle. Angles are measured counter-clockwise from the x-axis.
3. **Provide minimum and maximum constraints for a decision.**
   Refer to Decisions (page 87) for more information on decisions.

Ellipse Minor

An Ellipse Minor measurement determines the minor axis length of an ellipse fitted to the part's area in the XY plane. The measurement value can be compared with minimum and maximum constraints to yield a decision.





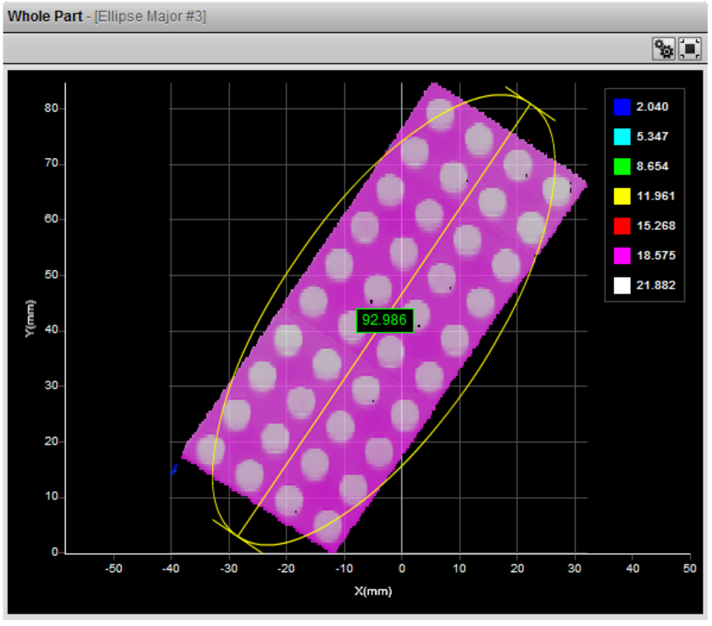
To create or edit an Ellipse Minor measurement:

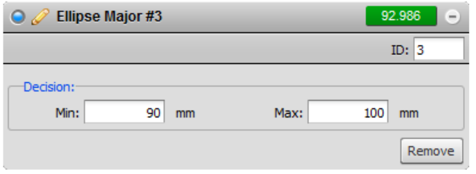
1 **Add a new Ellipse Minor measurement or select an existing Ellipse Minor measurement.**

2 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Ellipse Major

An Ellipse Major measurement determines the major axis length of an ellipse fitted to the part's area in the XY plane. The measurement value can be compared with minimum and maximum constraints to yield a decision.





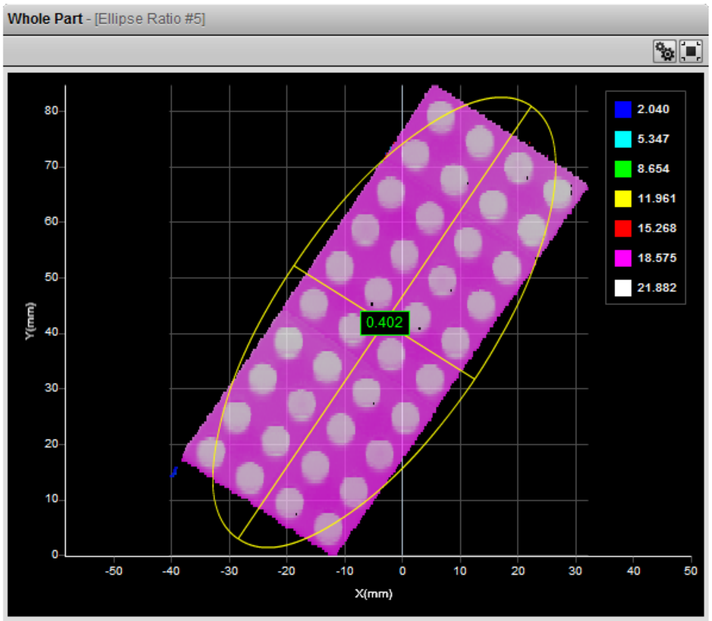
To create or edit an Ellipse Major measurement:

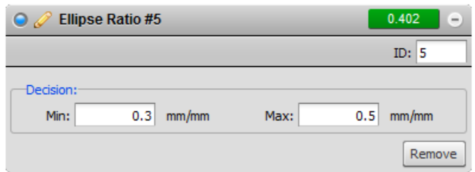
1 **Add a new Ellipse Major measurement or select an existing Ellipse Major measurement.**

2 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Ellipse Ratio

An Ellipse Ratio measurement determines the minor/major axis ratio of an ellipse fitted to the part's area in the XY plane. The measurement value can be compared with minimum and maximum constraints to yield a decision.





The axis ratio for a very elongated ellipse will be close to zero; the axis ratio for a nearly circular ellipse will be close to one.

To create or edit an Ellipse Ratio measurement:

1 **Add a new Ellipse Ratio measurement or select an existing Ellipse Ratio measurement.**

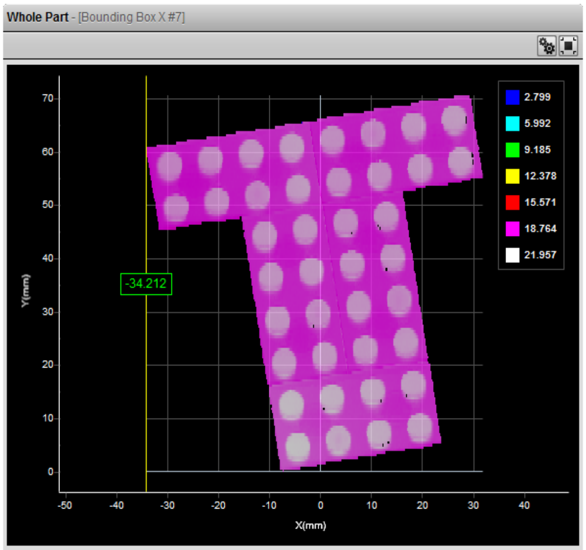
2 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

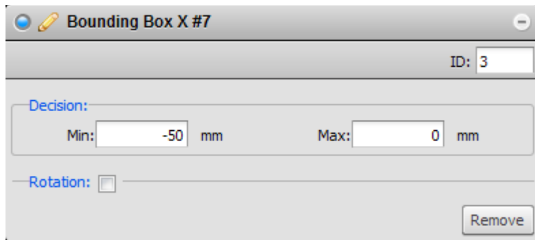
Bounding Box X

A Bounding Box X measurement determines the x-position of the smallest rectangle box that encapsulates the part. The measurement value 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 from.

When rotation is enabled, the bounding box is rotated by the angle of an ellipse fitted to the part data. If the angle is positive, The x-position is the left most corner. When the angle is negative, the x-position is the topmost corner.





To create or edit a Bounding Box X measurement:

1 **Add a new Bounding Box X measurement or select an existing Bounding Box X measurement.**

2 **Select Rotated or Vertical Bounding Box**
Check the Rotation check box to select rotated bounding box.

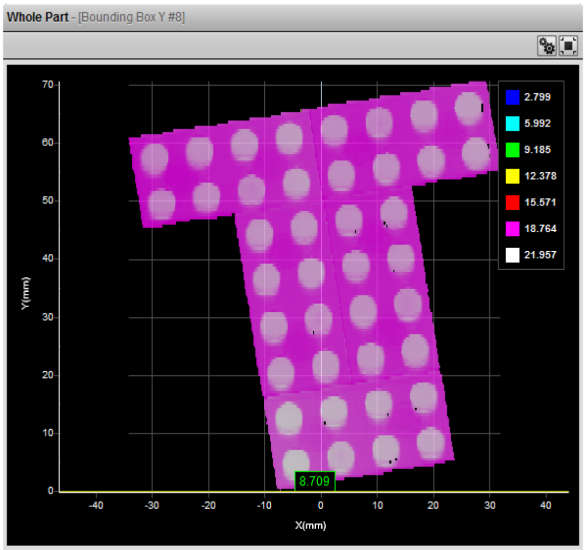
3 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

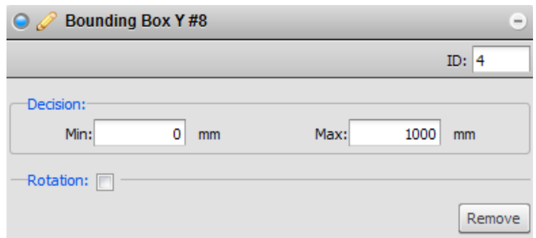
Bounding Box Y

A Bounding Box Y measurement determines the y-position of the smallest rectangle box that encapsulates the part.

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

When rotation is enabled, the bounding box is rotated by the angle of an ellipse fitted to the part data. If the angle is positive, The y-position is the left most corner. When the angle is negative, the y-position is the topmost corner.





To create or edit a Bounding Box Y measurement:

1 **Add a new Bounding Box Y measurement or select an existing Bounding Box Y measurement.**

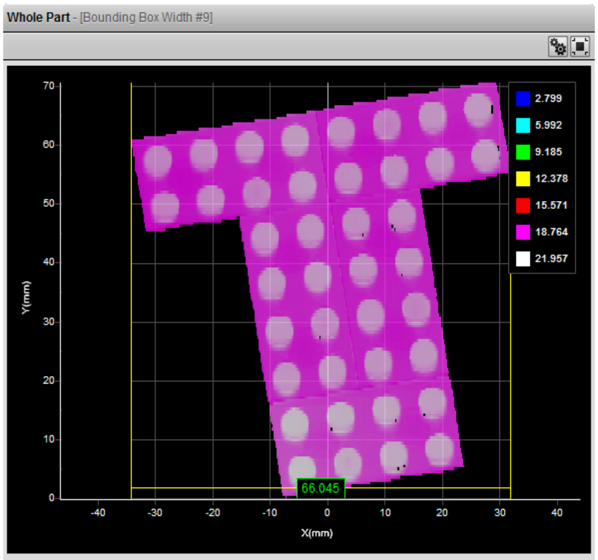
2 **Select Rotated or Vertical Bounding Box**
Check the Rotation check box to select rotated bounding box.

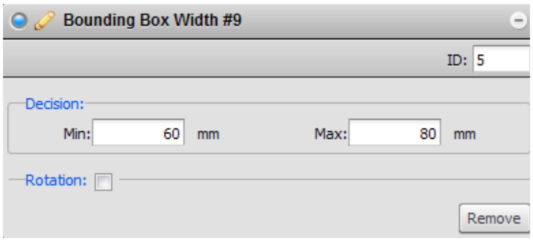
3 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

Bounding Box Width

A Bounding Box Width measurement determines the width of the smallest rectangle box that encapsulates the part.

When rotation is enabled, the bounding box is rotated by the angle of an ellipse fitted to the part data. The width reports the dimension of the box in the direction of the minor axis.





To create or edit a Bounding Box Width measurement:

1. **Add a new Bounding Box Width measurement or select an existing Bounding Box Width measurement.**

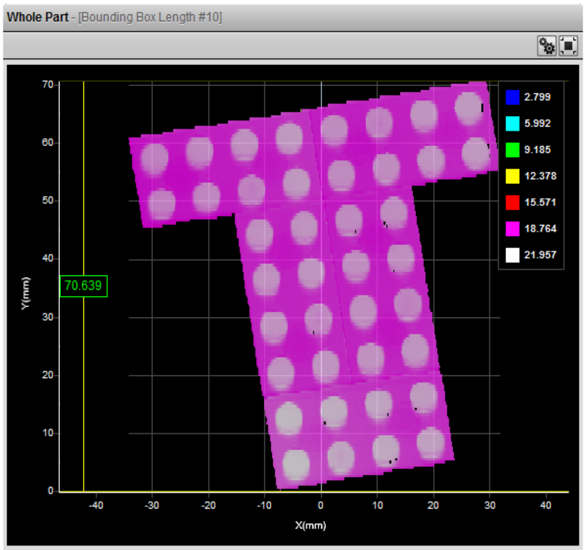
2. **Select Rotated or Vertical Bounding Box**
   Check the Rotation check box to select rotated bounding box.

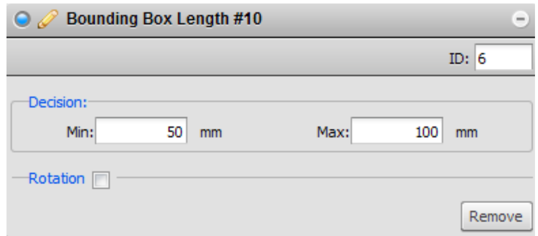
3. **Provide minimum and maximum constraints for a decision.**
   Refer to Decisions (page 87) for more information on decisions.

Bounding Box Length

A Bounding Box Length measurement determines the height (thickness) of the smallest rectangle box that encapsulates the part.

When rotation is enabled, the bounding box is rotated by the angle of an ellipse fitted to the part data. The length reports the dimension of the box in the direction of the major axis.





To create or edit a Bounding Box Height measurement:

1 **Add a new Bounding Box Length measurement or select an existing Bounding Box Length measurement.**

2 **Select Rotated or Vertical Bounding Box**
Check the Rotation check box to select rotated bounding box.

3 **Provide minimum and maximum constraints for a decision.**
Refer to Decisions (page 87) for more information on decisions.

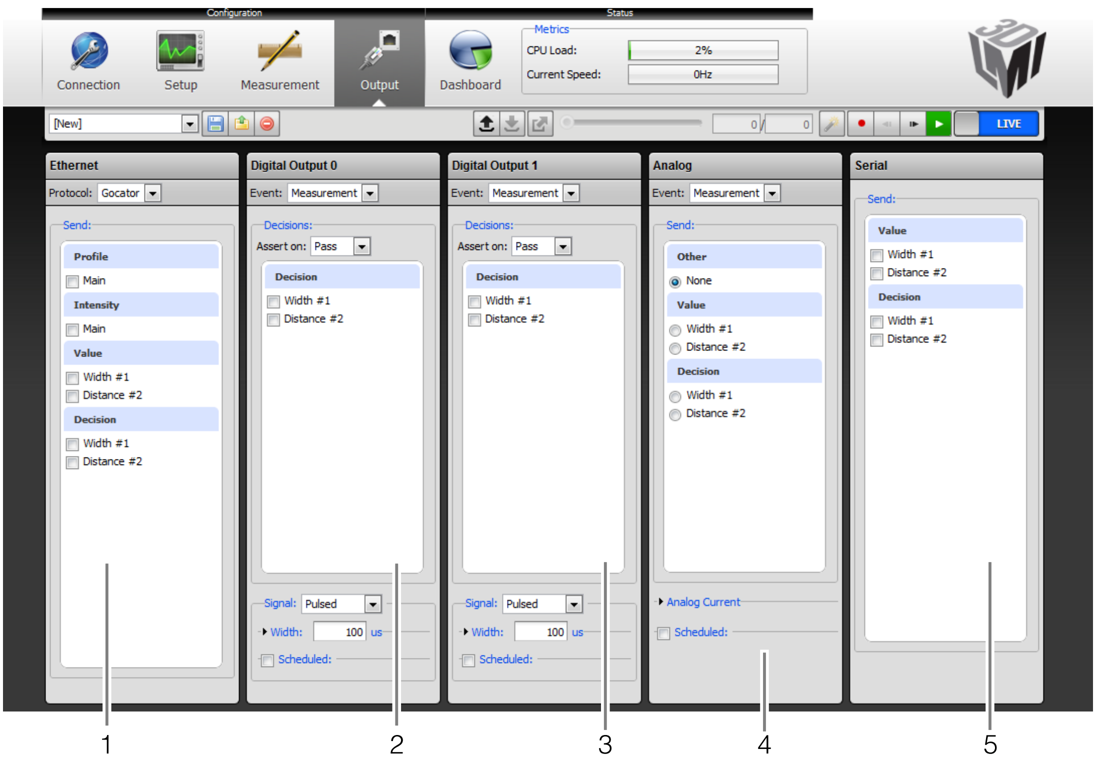
Script

Whole-part script measurements use the same syntax and functions as the profile script measurements. Refer to Script Measurement (page 91) for more information.

Output

Output Page

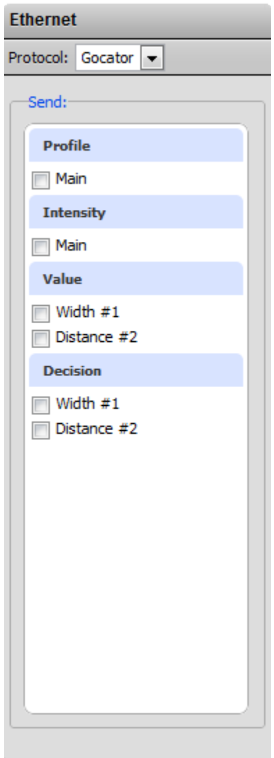
Output configuration tasks are performed using the Output Page. Gocator sensors can transmit laser profiles and measurement results to a variety of external devices using a variety of output interface options.



	Element	Description
1	Ethernet Panel	Use the Ethernet panel to select the data sources that will be transmitted via Ethernet.
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.
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.
4	Analog Panel	Use the Analog panel to convert a measurement value or decision into an analog output signal.
5	Serial Panel	Use the Serial panel to select the measurements that will be transmitted via RS-485 serial output.

Ethernet Control and 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 253), ASCII Protocol (page 296), Modbus TCP Protocol (page 284) and EtherNet/IP Protocol 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.**

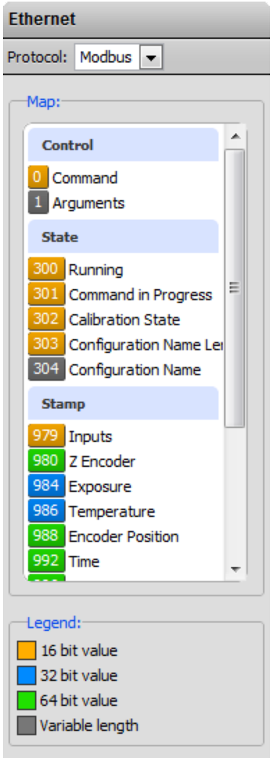
3 **Select the Operation Mode.**
In asynchronous mode, the data results are transmitted when they are available. In polling mode, users send commands on the data channel to request the latest result. Refer to Asynchronous and Polling Operation (page 296) for an explanation of the operation modes.

4 **Select the Data Format.**
Select standard format 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 297) for an explanation of the standard result mode.

Select custom format to customized the output result. The data format box will appear and users can type in the format string. Refer to Custom Result Format (page 298) for the syntax supported of the format string.

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.

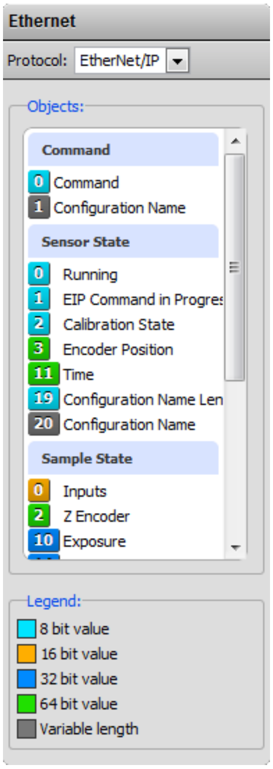


To receive commands and send results using Modbus TCP messages:

1 **Navigate to the Ethernet panel.**

2 **Select 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 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 expses.

Each sensor supports two digital output channels. For Gocator 2000 sensors, refer to Digital Outputs (page 339) for information on wiring digital outputs to external devices. For Gocator 2300 sensors, refer to Gocator 2300 Power/LAN Connector (page 343).

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 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 (page 55) 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 271) 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.**

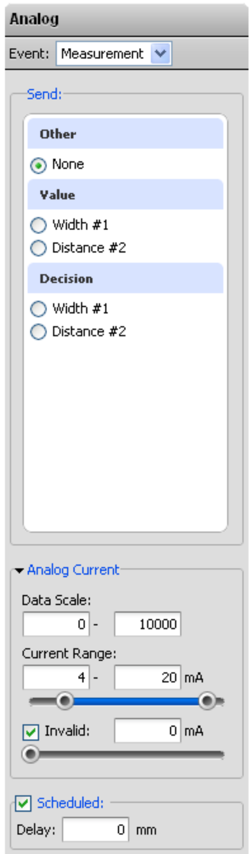
2 **Set Event to Exposure.**

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 the Gocator 2000 series, refer to Analog Output (page 342) for information on wiring analog output to an external device. For the Gocator 2300 series, refer to (page 348).



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 (page 55) 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.**

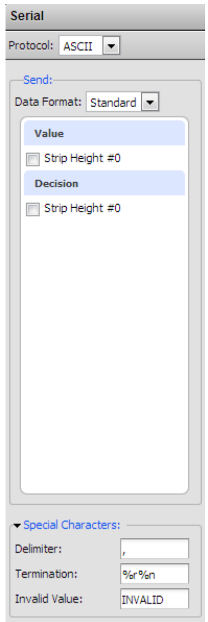
3 **Specify if the output is Immediate or Scheduled.**
An analog output value becomes active immediately or scheduled. Immediate output becomes active as soon as a Scheduled Analog Output command (page 364) is received.

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 296) for serial connection parameters and data formats. For Gocator 2000 sensors, refer to Serial Output (page 341) for information on wiring serial output to an external device. For Gocator 2300 sensors, refer to Serial Output (page 348).



To exchange results using ASCII messages:

1 **Navigate to the Ethernet panel.**

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

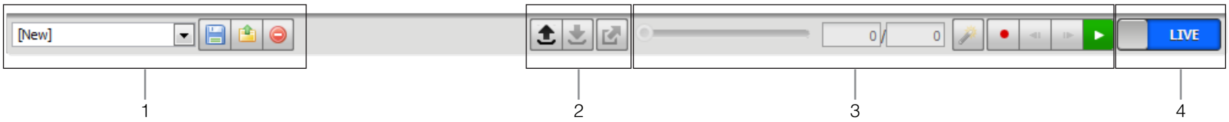
3 **Select the Data Format.**
Select standard format to use the default result format of the ASCII protocol. Select value and decision to send by placing a check in the corresponding check box. Refer to Standard Result Format (page 297) for an explanation of the standard result mode.

Select custom format to customized the output result. The data format box will appear and users can type in the format string. Refer to Custom Result Format (page 298) for the syntax supported of the format string.

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

Toolbar

The tool bar 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

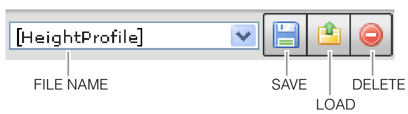
When you change sensor settings using the Gocator web interface, some changes are saved automatically, while other changes are temporary until you take action to save them. The following table summarizes the types of information that can be saved in a sensor.

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.
Calibration	*Calibration* files, described in Calibration (page 72), are saved automatically at the end of the calibration procedure. If a sensor contains a calibration file, it will automatically be loaded when the sensor is reset.
Profile Templates	*Profile templates*, described in Profile Fixturing (page 89), are temporary until saved. Each sensor can have multiple profile template files. If there is a template file that is designated as the *default*, it will be loaded automatically when the sensor is reset.

Each sensor can have, at most, one calibration record. But sensors can contain many configurations and template files – the number of files is limited only by the sensor's flash storage capacity.

Because configuration and profile template files are often used together to perform a particular task, the Gocator's web interface provides tool bar commands to load and save these files as a pair.



The File name drop down list shows the list of configuration and template pairs 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 pair of configuration and template files:

1 **Select [New] in the File Name drop list.**

2 **Enter a name for the file pair.**

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 pair of configuration and template 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 pair of configuration and template 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 pair of configuration and template 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 are described in the File Management (page 210) section.

Managing Multiple Settings

A Gocator can store multiple sets of configurations 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.

Recording and Playback

Gocator sensors have the ability to record and replay data. This feature is most often used for troubleshooting measurements, but can also be helpful during setup.

Recording and playback are controlled by using commands in the tool bar.

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 clear recorded data:

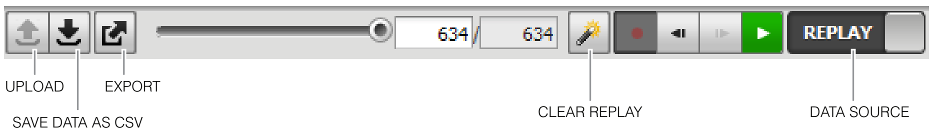
1 **Toggle the Data Source to Replay.**

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 tool bar.



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.

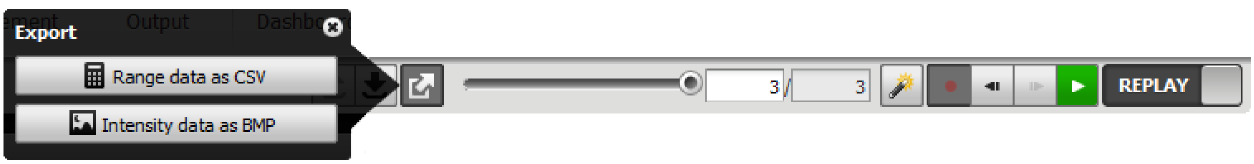
To upload recorded data:

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 tool bar 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 197).

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

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.**

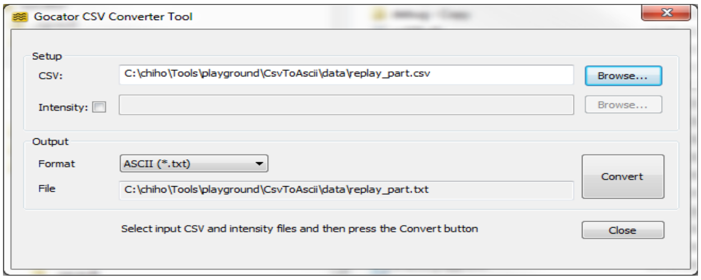
2 **Press the Export To BMP button.**
Select Export Intensity as BMP. Only the intensity data in the current replay location is exported. Use the step button to move to a different replay location.

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

Converting Recorded Data To Different Formats

After exporting the recorded data to CSV, 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 306) chapter. 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).

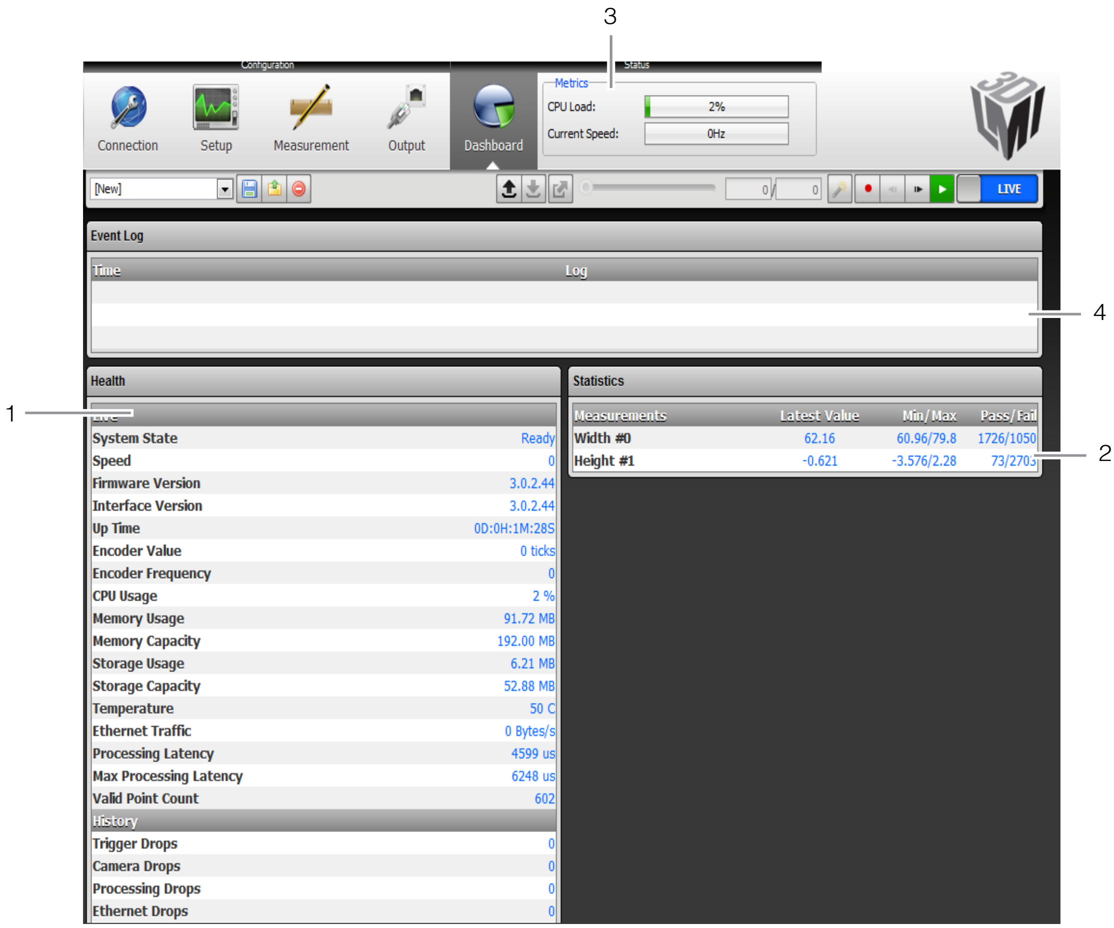
3 **Select the output format.**
The converted file will reside in the same directory as the CSV file. It will also have the same name but with a different file extension. The converted file name is displayed in the Output File field.

4 **Press the Convert button.**

Dashboard

Dashboard Page

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.
2	Measurement Statistics	Displays measurement statistics.
3	Metric Panel	Summarizes important performance statistics.
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 laser/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).
Laser Temperature	Sensor laser temperature (C). Only available on sensors equipped with 3B-N lasers
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.
Camera Search Count	Count of camera frame where laser is lost tracked. Only applicable when tracking window is enabled.
Valid Point Count	Count of valid spots detected in the last frame.
Part Count	Count of discrete parts.
Fixturing Invalid Count	Count of failed measurements because the live profile did not matched with the fixturing profile template.

Measurement Statistics

Statistics are displayed for each measurement that has been configured on the Measurement Page. The following information is available for each measurement:

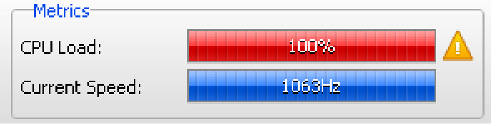
Dashboard Measurement Statistics

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.

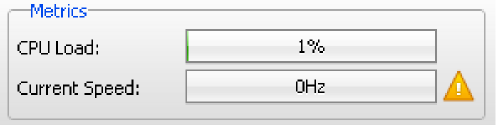
Metric Panel

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

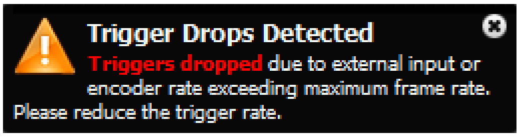
The CPU Load bar in the Metric panel (at the top of the interface) displays how much of the CPU is being utilized. A warning will appear if the sensor drops profiles because CPU is over utilized.



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



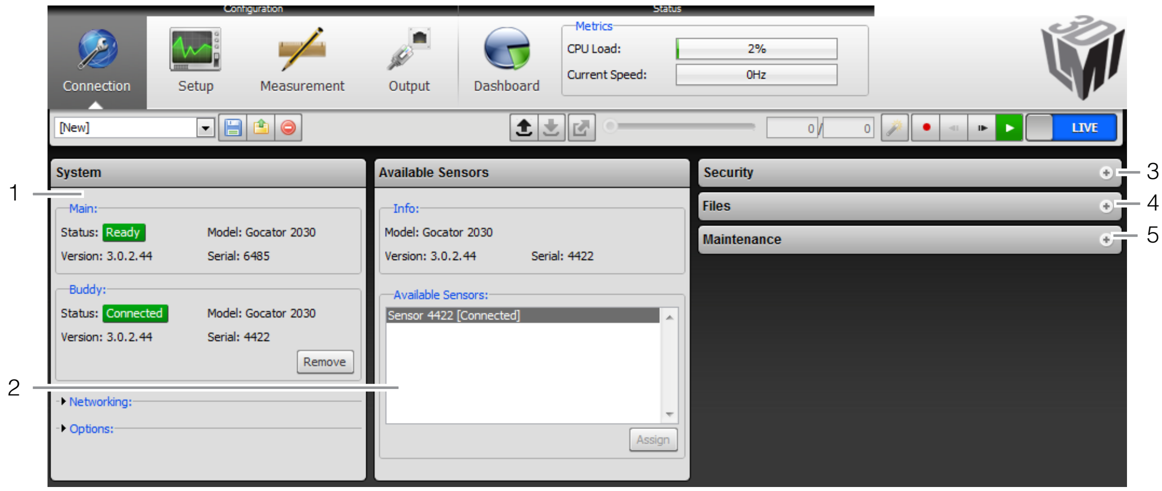
When a warning appears, click on the warning sign to reveal notifications that display more detailed information.



Connection and Maintenance

Connection Page

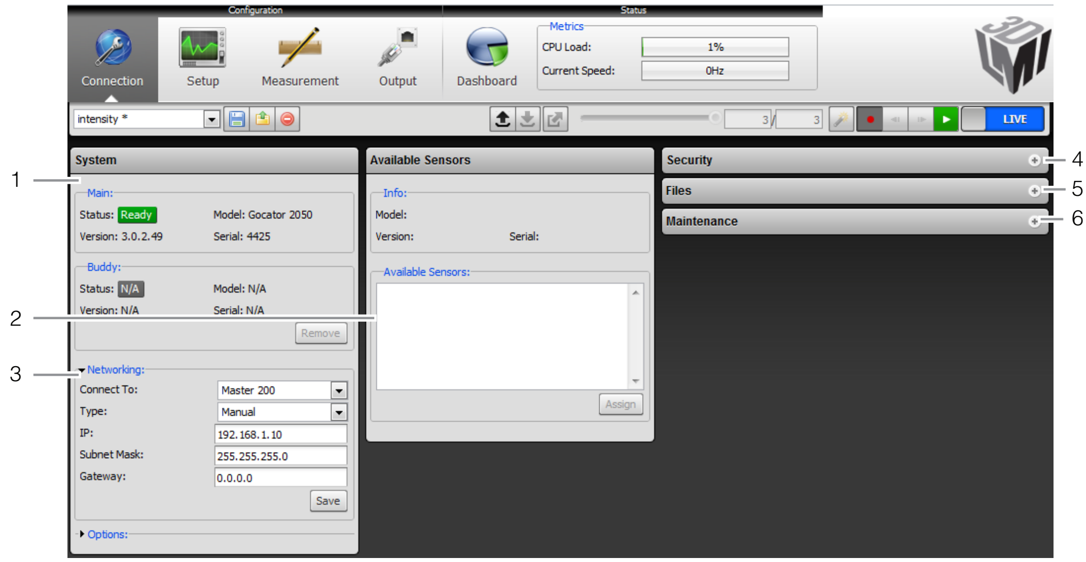
Gocator's security, file management and maintenance tasks are performed on the Connection Page.



	Element	Description
1	System Panel	Use the System panel to configure sensor network and boot-up settings.
2	Available Sensor Panel	Use the Available Sensor panel to assign or unassign Buddy sensors.
3	Security Panel	Use the Security panel to change passwords.
4	Files Panel	Use the Files panel to manage files stored on the main sensor.
5	Maintenance Panel	Use the Maintenance panel to upgrade firmware, create/restore backups or reset sensors.

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.

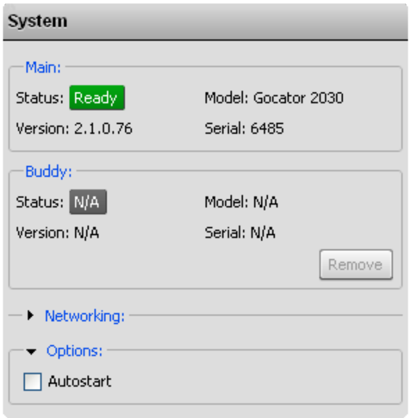
4 Click Save.
When you click the Save button, you will be prompted to confirm your selection.

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 (page 103) can be used to perform a software reset.

Auto Starting Sensors

With the Autostart setting enabled, laser profiling 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:

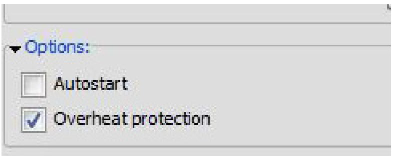
1 Check/Uncheck Autostart option box.

2 Save configuration.

Overheat Temperature Protection

Sensors with 3B-N laser by default will turn off the laser if the temperature exceeds the safe operating range. Users can override the setting by disabling the overheat protection.

⚠ Disabling the setting is not recommended. Disabling the overheat protection feature could lead to immature laser failure if the sensor operates outside the specified temperature range.



To enable/disable Overheat Temperature Protection:

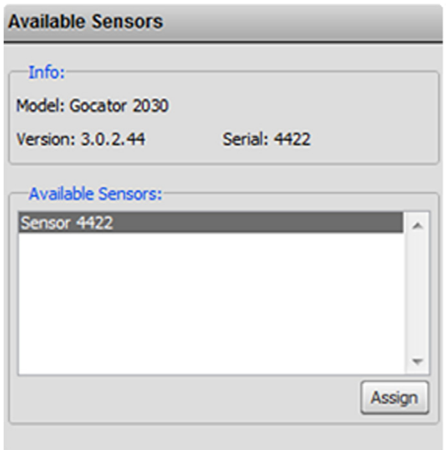
1 Check/Uncheck Overheat Protection option box.

2 Save configuration.

Buddy Assignment

In a dual sensor system, the Main sensor assumes control of the Buddy sensor after the Buddy sensor is assigned to the Main sensor. Configuration for both sensors can be performed through the Main sensor's interface.

Main and Buddy sensors must be assigned unique IP addresses before they can be used on the same network. Before proceeding, connect the Main and Buddy sensors one at a time (to avoid an address conflict) and use the steps outline in Running a Dual Sensor System (page 38) to assign each sensor a unique address.

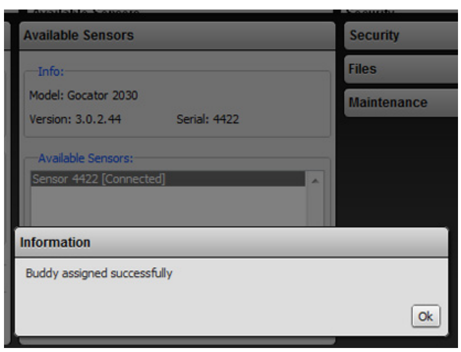


To assign a Buddy sensor:

1 **Navigate to the Available Sensors panel.**

2 **Select a Buddy sensor.**
The firmware on Main and Buddy sensors must be the same for Buddy assignment to be successful. If the firmware is different, connect the Main and Buddy sensor one at a time.

3 **Click Assign.**
The Buddy sensor will be assigned to the Main sensor and its status will be updated in the System panel.



Security

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.

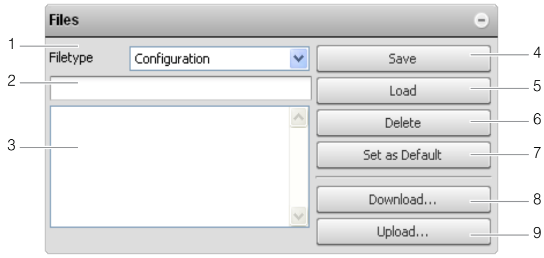
2 **Enter the new Technician account password and password confirmation.**

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 Recovery (page 213) for more information.

File Management

The Files panel can be used to manage configurations and templates.



	Element	Description
1	File Type	Specifies the type of files to manage (Configuration and Profile Template).
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.
Profile Template	Contains profile template data used for profile fixturing.

To manage a configuration or template 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 template to a file, type in a new file name or select a file to replace with.

4 Select the action.

Maintenance

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.

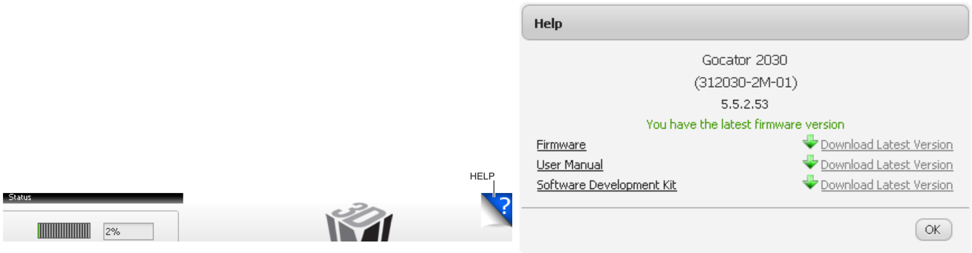
3 **Click the Restore to Factory button.**

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.

In order for the Main and Buddy sensors to work together, they must be use the same firmware version. This can be achieved by performing an upgrade through the Main sensor, or upgrading each sensor individually.



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*

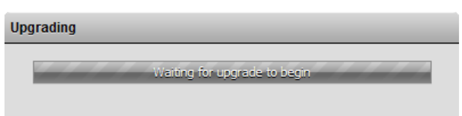
To upgrade the firmware

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. If a buddy has been assigned, it will be automatically upgraded and reset along with the Main sensor.

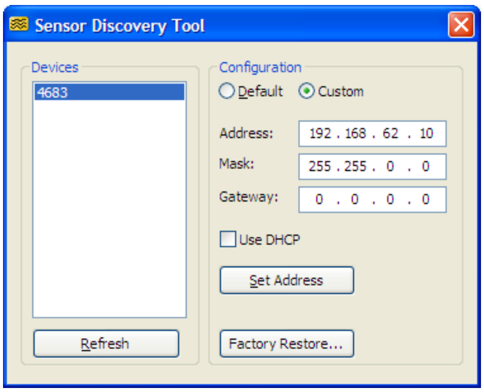


Recovery

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.

Gocator Configuration File

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

Configuration 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 1 – Encoder 2 – Input 3 – Software

Element	Type	Description
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
EncoderTriggerMode	32s	Setting for the encoder behavior: 0 – Track Reverse 1 – Ignore Reverse 2 – Bi-directional
EncoderPeriod	64f	Setting for encoder period (mm). (Applicable for encoder-based triggering)
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 or encoder trigger 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
TravelTarget	32s	Setting for travel calibration target type: 1 – Disk 2 – Bar
Disk/Diameter	64f	Setting for diameter of calibration disk (mm).
Disk/Height	64f	Setting for thickness of calibration disk (mm).
Bar/Height	64f	Setting for height of calibration bar (mm).
Bar/Width	64f	Setting for width of calibration bar (mm).
Bar/Holes	64f	Setting for number of holes on the calibration bar.
Bar/HoleDistance	64f	Setting for distance between calibration bar holes (mm).
Bar/HoleDiameter	64f	Setting for diameter of calibration bar holes (mm).

Filters

The Filters element contains the settings related to post processing the profiles before they are output or used by measurement tools.

Filters Child Elements

Element	Type	Description
XSmoothing\Enable	32u	Setting to enable or disable X Smoothing filter: 0 – Disable 1 – Enable
XSmoothing\Window	64f	Setting for X Smoothing filter window (mm).
XSmoothing\WindowMin	64f	Constraint for minimum window size (mm).
XSmoothing\WindowMax	64f	Constraint for maximum window size (mm).
YSmoothing\Enable	32u	Setting for enable or disable Y Smoothing filter: 0 – Disable 1 – Enable
YSmoothing\Window	64f	Setting for YSmoothing filter window (mm).
YSmoothing\WindowMin	64f	Minimum window size (mm).
YSmoothing\WindowMax	64f	Maximum window size (mm).
XGapFilling\Enable	32u	Setting to enable or disable X Gap Filling filter: 0 – Disable 1 – Enable
XGapFilling\Window	64f	Setting for X Gap Filling filter window (mm).
XGapFilling\WindowMin	64f	Constraint for minimum window size (mm).
XGapFilling\WindowMax	64f	Constraint for maximum window size (mm).

Element	Type	Description
YGapFilling\Enable	32u	Setting for enable or disable Y Gap Filling filter: 0 – Disable 1 – Enable
YGapFilling\Window	64f	Setting for Y Gap Filling filter window (mm).
YGapFilling\WindowMin	64f	Minimum window size (mm).
YGapFilling\WindowMax	64f	Maximum window size (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.
DynamicExposureMax	64f	Setting for maximum exposure (for dynamic exposure).
DynamicExposureMin	64f	Setting for minimum exposure (for dynamic exposure).
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.
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").

Element	Type	Description
FrontCameraX	32u	Property for x position of image ROI (pixels).
FrontCameraY	32u	Property for y position of image ROI (pixels).
FrontCameraWidth	32u	Property for width of image ROI (pixels).
FrontCameraHeight	32u	Property for height of 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).
Tracking\AreaHeightMin	64f	Constraint for minimum tracking window height
Tracking\AreaHeightMax	64f	Constraint for maximum tracking window height
Tracking\Enabled	32u	Enables or disable tracking support (2300 series only) 0 – Disable 1 – Enable
Tracking\SearchThreshold	64f	Tracking search threshold. Profiles are generated if the percentage of visible spots is equal or larger than the threshold.
Tracking\AreaHeight	64f	Height of the tracking window

Profile

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

Profile Child Elements

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

The Profile element also contains two significant sub-elements: Anchor and Measurements. The Anchor element defines profile anchoring behavior, while the Measurements element contains one sub-element for each requested profile measurement.

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

e.g. `<Width id=”1001”>`

Most profile measurement elements contain one or more Area, Feature or Line sub-elements. These common structures are described first.

Area

An Area element defines a rectangular area of interest.

Area Child Elements

Element	Type	Description
X	64f	Setting for area x position (mm).
Z	64f	Setting for area z position (mm).
Width	64f	Setting for area width (mm).
Height	64f	Setting for area height (mm).

Feature

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 – Top 1 – Bottom 2 – Right 3 – Left 4 – Corner 5 – Average 6 – Rising Edge 7 – Falling Edge 8 – Any Edge 9 – Top Corner 10 – Bottom Corner 11 – Left Corner 12 – Right Corner 13 – Median
Area	Area	Element for feature detection area.

Line

A Line element defines measurement areas used to calculate a line.

Line Child Elements

Element	Type	Description
Area[2]	Area	2 area elements used for line fitting.

Anchor

An anchor element defines settings for anchoring (fixturing in the user interface).

Anchor Child Elements

Element	Type	Description
ZEnable	32s	Setting for enable or disable Z fixturing.
XEnable	32s	Setting for enable or disable X fixturing
ZFeature\Type	32s	Setting to determine how the feature is detected within the area: 0 – Top 1 – Bottom 2 – Right 3 – Left 4 – Corner 5 – Average 6 – Rising Edge 7 – Falling Edge 8 – Any Edge 9 – Top Corner 10 – Bottom Corner 11 – Left Corner 12 – Right Corner 13 – Median
ZFeature\Area	Area	Area element used for anchoring.
XFeature\Type	32s	Setting to determine how the feature is detected within the area: 0 – Top 1 – Bottom 2 – Right 3 – Left 4 – Corner 5 – Average 6 – Rising Edge 7 – Falling Edge 8 – Any Edge 9 – Top Corner 10 – Bottom Corner 11 – Left Corner 12 – Right Corner 13 – Median
XFeature\Area	Area	Area element used for anchoring.

Measurements / Width

A Width element defines settings for a profile width measurement.

Width Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
AbsoluteResult	32u	Setting for selecting absolute or signed result: 0 – Signed result 1 – Absolute result
Feature[2]	Feature	Elements for feature detection.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames)
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames)

Measurements / Height

A Height element defines settings for a profile height measurement.

Height Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
AbsoluteResult	32u	Setting for selecting absolute or signed result: 0 – Signed result 1 – Absolute result
Feature[2]	Feature	Elements for feature detection.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Distance

A Distance element defines settings for a profile distance measurement.

Distance Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Feature[2]	Feature	Elements for feature detection.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / PositionX

A PositionX element defines settings for a profile x-position measurement.

PositionX Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Feature	Feature	Element for feature detection.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / PositionZ

A PositionZ element defines settings for a profile z-position measurement.

PositionZ Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Feature	Feature	Element for feature detection.

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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / CenterX

A CenterX element defines settings for a profile center-x measurement.

CenterX Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Feature[2]	Feature	Elements for feature detection.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / CenterZ

A CenterZ element defines settings for a profile center-z measurement.

CenterZ Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Feature[2]	Feature	Elements for feature detection.
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames).

Element	Type	Description
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / AngleX

An AngleX element defines settings for a profile angle-x measurement.

AngleX Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (degrees).
DecisionMax	64f	Setting for decision threshold maximum (degrees).
AbsoluteResult	32u	Setting for selecting absolute or signed result: 0 – Signed result 1 – Absolute result
Line	Line	Element for fit line.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / IntersectX

An IntersectX element defines settings for a profile intersect-x measurement.

IntersectX Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Line[2]	Line	Elements for fit lines.
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames).

Element	Type	Description
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / IntersectZ

An IntersectZ element defines settings for a profile intersect-z measurement.

IntersectZ Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Line[2]	Line	Elements for fit lines.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / IntersectAngle

An IntersectAngle element defines settings for a profile intersect angle measurement.

IntersectAngle Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (degrees).
DecisionMax	64f	Setting for decision threshold maximum (degrees).
AbsoluteResult	32u	Setting for selecting absolute or signed result: 0 – Signed result 1 – Absolute result
Line[2]	Line	Elements for fit lines.
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

Element	Type	Description
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / IntersectArea

An IntersectArea element defines settings for a profile intersect area measurement.

IntersectArea Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
Line	Line	Element for measurement baseline.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / BoxArea

A BoxArea element defines settings for a profile box area measurement.

BoxArea Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Difference Area

A difference area element defines settings for difference area measurement.

Difference 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).
AbsoluteResult	32u	Setting for selecting absolute or signed result: 0 – Signed result 1 – Absolute result
Source	32s	Setting for profile source.
Area	Area	Element for measurement area.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Difference Peak

A difference peak element defines settings for difference peak measurement.

Difference Area 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).
AbsoluteResult	32u	Setting for selecting absolute or signed result: 0 – Signed result 1 – Absolute result
Source	32s	Setting for profile source.
Area	Area	Element for measurement area.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Circle Radius

A CircleRadius element defines settings for a profile circle radius measurement.

CircleRadius Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Circle X

A CircleX element defines settings for a profile circle center X measurement.

CircleX Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Circle Z

A CircleZ element defines settings for a profile circle center Z measurement.

CircleZ Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.

Element	Type	Description
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Line Standard Deviation

A LineStdDev element defines settings for a profile line standard deviation measurement.

LineStdDev Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Line Error Min

A LineErrorMin element defines settings for a profile line error min measurement.

LineErrorMin Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Line Error Max

A LineErrorMax element defines settings for a profile line error max measurement.

LineErrorMAx Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Line Percentile

A LinePercentile element defines settings for a profile line percentile measurement.

LinePercentile Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
Percentile	64f	Error percentile
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).

Element	Type	Description
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Gap

A Gap element defines settings for a profile gap measurement.

Gap Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
ReferenceSide	32s	Setting for reference Side: 0 – Left 1 – Right
GapWidthMax	64f	Setting for maximum gap width (mm).
MeasurementAxis	32s	Setting for measurement axis: 0 – Edge 1 – Surface 2 – Distance
LeftSide	Side	Element for left side configuration.
RightSide	Side	Element for right side configuration.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Side Child Elements

Element	Type	Description
DepthMin	64f	Setting for minimum depth (mm).
VoidWidthMax	64f	Setting for maximum void width (mm).
SurfaceWidth	64f	Setting for surface width (mm).
SurfaceOffset	64f	Setting for surface offset (mm).
NominalRadius	64f	Setting for nominal radius (mm).
EdgeAngle	64f	Setting for edge angle (deg)
EdgeType	32s	Setting for type of edge: 0 – Tangent 1 – Corner
Area	Area	Element for measurement area

Measurements / Flush

A Flush element defines settings for a profile flush measurement.

Gap Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
ReferenceSide	32s	Setting for reference Side: 0 – Left 1 – Right
GapWidthMax	64f	Setting for maximum gap width (mm).
LeftSide	Side	Element for left side configuration.
RightSide	Side	Element for right side configuration.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Side Child Elements

Element	Type	Description
DepthMin	64f	Setting for minimum depth (mm).
VoidWidthMax	64f	Setting for maximum void width (mm).
SurfaceWidth	64f	Setting for surface width (mm).
SurfaceOffset	64f	Setting for surface offset (mm).
NominalRadius	64f	Setting for nominal radius (mm).
EdgeAngle	64f	Setting for edge angle.
EdgeType	32s	Setting for type of edge: 0 – Tangent. 1 – Corner.
Area	Area	Element for measurement area.

Measurements / Groove Width

A Groove width element defines settings for a profile groove width measurement.

Groove Width Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
Shape	32s	Setting for shape of the groove: 0 – V-shaped. 1 – U-shaped. 2 – Open shaped.

Element	Type	Description
SelectType	32s	Setting for selecting a groove out of multiple grooves: 0 – Maximum depth. 1 – 0-based index, from left to right. 2 – 0-based index, from right to left.
SelectN	32u	Index when SelectType is set to 1 or 2.
WidthMin	64f	Setting for minimum groove width (mm).
WidthMax	64f	Setting for maximum groove width (mm).
DepthMin	64f	Setting for minimum groove depth (mm).
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Groove X

A Groove X element defines settings for a profile groove X measurement.

Groove X Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
Shape	32s	Setting for shape of the groove: 0 – V-shaped. 1 – U-shaped. 2 – Open shaped
SelectType	32s	Setting for selecting a groove out of multiple grooves. 0 – Maximum depth. 1 – 0-based index, from left to right. 2 – 0-based index, from right to left.
SelectN	32u	Index when SelectType is set to 1 or 2.
WidthMin	64f	Setting for minimum groove width (mm).
WidthMax	64f	Setting for maximum groove width (mm).
DepthMin	64f	Setting for minimum groove depth (mm).
Location	32s	Setting for groove location to return from: 0 – Bottom. 1 – Left corner. 2 – Right corner.
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames).

Element	Type	Description
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Groove Z

A Groove Z element defines settings for a profile groove Z measurement.

Groove Z Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
Shape	32s	Setting for shape of the groove: 0 – V-shaped. 1 – U-shaped.
SelectType	32s	Setting for selecting a groove out of multiple grooves: 0 – Maximum depth. 1 – 0-based index, from left to right. 2 – 0-based index, from right to left.
SelectN	32u	Index when SelectType is set to 1 or 2.
WidthMin	64f	Setting for minimum groove width (mm).
WidthMax	64f	Setting for maximum groove width (mm).
DepthMin	64f	Setting for minimum groove depth (mm).
Location	32s	Setting for groove location to return from: 0 – Bottom. 1 – Left corner. 2 – Right corner.
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Strip X

A Strip X element defines settings for a profile strip X measurement.

Strip X Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
Location	32s	Setting for the location of the strip: 0 – Left 1 – Right 2 – Center
BaseType	32s	Setting for the strip type 0 – None 1 – Flat.
LeftEdgeType	32s	Setting of the left edge conditions 0 – Rising 1 – Falling 2 – Data End 3 – Void
RightEdgeType	32s	Setting of the left edge conditions 0 – Rising 1 – Falling 2 – Data End 3 – Void
SelectType	32s	Setting for selecting a strip out of multiple strips. 0 – Best 1 – 0-based index, from left to right 2 – 0-based index, from right to left
SelectN	32u	Index when SelectType is set to 1 or 2.
TiltEnabled	32u	Setting for tilt compensation 0 – Disabled 1 – Enabled
EdgeHeightMin	64f	Setting for minimum edge height width (mm).
EdgeTransitionWidth	64f	Setting for edge transition width (mm).
EdgeSupportWidth	64f	Setting for edge support width (mm).
VoidMax	64f	Setting for maximum void (mm).
WidthMin	64f	Setting for minimum strip width (mm).
EdgeTransitionWidthMax	64f	Constraint for edge transition width maximum (mm).
VoidMaxLimitMax	64f	Constraint for maximum void (mm).
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Strip Z

A Strip Z element defines settings for a profile strip Z measurement.

Strip X Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
Location	32s	Setting for the location of the strip: 0 – Left 1 – Right 2 – Center
BaseType	32s	Setting for the strip type 0 – None 1 – Flat.
LeftEdgeType	32s	Setting of the left edge conditions. 1 – Rising 2 – Falling 4 – Data End 8 – Void Multiple values can be selected by adding the selections.
RightEdgeType	32s	Setting of the left edge conditions 1 – Rising 2 – Falling 4 – Data End 8 – Void Multiple values can be selected by adding the selections.
SelectType	32s	Setting for selecting a strip out of multiple strips. 0 – Best 1 – 0-based index, from left to right. 2 – 0-based index, from right to left.
SelectN	32u	Index when SelectType is set to 1 or 2.
TiltEnabled	32u	Setting for tilt compensation 0 – Disabled 1 – Enabled
EdgeHeightMin	64f	Setting for minimum edge height width (mm).
EdgeTransitionWidth	64f	Setting for edge transition width (mm).
EdgeSupportWidth	64f	Setting for edge support width (mm).
VoidMax	64f	Setting for maximum void (mm).
WidthMin	64f	Setting for minimum strip width (mm).
EdgeTransitionWidthMax	64f	Constraint for edge transition width maximum (mm).
VoidMaxLimitMax	64f	Constraint for maximum void (mm).
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).

Element	Type	Description
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Strip Width

A Strip Width element defines settings for a profile strip width measurement.

Strip X Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
BaseType	32s	Setting for the strip type 0 – None 1 – Flat
LeftEdgeType	32s	Setting of the left edge conditions 0 – Rising 1 – Falling 2 – Data End 3 – Void
RightEdgeType	32s	Setting of the left edge conditions 0 – Rising 1 – Falling 2 – Data End 3 – Void
SelectType	32s	Setting for selecting a strip out of multiple strips. 0 – Best 1 – 0-based index, from left to right 2 – 0-based index, from right to left
SelectN	32u	Index when SelectType is set to 1 or 2.
TiltEnabled	32u	Setting for tilt compensation 0 – Disabled 1 – Enabled
EdgeHeightMin	64f	Setting for minimum edge height width (mm).
EdgeTransitionWidth	64f	Setting for edge transition width (mm).
EdgeSupportWidth	64f	Setting for edge support width (mm).
VoidMax	64f	Setting for maximum void (mm).
WidthMin	64f	Setting for minimum strip width (mm).
EdgeTransitionWidthMax	64f	Constraint for edge transition width maximum (mm).
VoidMaxLimitMax	64f	Constraint for maximum void (mm).
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
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).

Element	Type	Description
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

Measurements / Strip Height

A Strip height element defines settings for a profile strip height measurement.

Strip X Child Elements

Element	Type	Description
Name	String	Setting for measurement name.
Source	32s	Setting for profile source.
DecisionMin	64f	Setting for decision threshold minimum (mm).
DecisionMax	64f	Setting for decision threshold maximum (mm).
Area	Area	Element for measurement area.
Location	32s	Setting for the location of the strip: 0 – Left 1 – Right 2 – Center
BaseType	32s	Setting for the strip type 0 – None 1 – Flat
LeftEdgeType	32s	Setting of the left edge conditions 0 – Rising 1 – Falling 2 – Data End 3 – Void
RightEdgeType	32s	Setting of the left edge conditions 0 – Rising 1 – Falling 2 – Data End 3 – Void
SelectType	32s	Setting for selecting a strip out of multiple strips. 0 – Best 1 – 0-based index, from left to right 2 – 0-based index, from right to left.
SelectN	32u	Index when SelectType is set to 1 or 2.
TiltEnabled	32u	Setting for tilt compensation 0 – Disabled 1 – Enabled
EdgeHeightMin	64f	Setting for minimum edge height width (mm).
EdgeTransitionWidth	64f	Setting for edge transition width (mm).
EdgeSupportWidth	64f	Setting for edge support width (mm).
VoidMax	64f	Setting for maximum void (mm).
WidthMin	64f	Setting for minimum strip width (mm).
EdgeTransitionWidthMax	64f	Constraint for edge transition width maximum (mm).
VoidMaxLimitMax	64f	Constraint for maximum void (mm).
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)

Element	Type	Description
HoldEnabled	32u	Setting to enable or disable the hold filter: 0 – Disable 1 – Enable
SourceOptions	String	Constraint for eligible profile sources (comma-delimited list).
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

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.

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”>`

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).
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).

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).
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

Element	Type	Description
SmoothingWindowMin	32u	Constraint for smoothing window minimum (frames).
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

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).
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).

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).
Type	32s	Setting for measurement type: 0 – Minimum 1 – Maximum 2 – 2D Centroid 3 – 3D Centroid
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).

Measurements / PartCentroidX

A PartCentroidX element defines settings for a centroid X measurement.

Part Centroid X 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).
Type	32s	Setting for measurement type: 0 – 2D Centroid 1 – 3D Centroid
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).

Measurements / PartCentroidY

A PartCentroidY element defines settings for a centroid Y measurement.

Part Centroid Y 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).
Type	32s	Setting for measurement type: 0 – 2D Centroid 1 – 3D Centroid
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).

Measurements / PartCentroidZ

A PartCentroidZ element defines settings for a centroid Z measurement.

Part Centroid Z 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).
Type	32s	Setting for centroid type: 0 – 2D Centroid 1 – 3D Centroid

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).

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).
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).

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).
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).

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).
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).

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.
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).

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.
SmoothingEnabled	32u	Setting to enable or disable the smoothing filter: 0 – Disable 1 – Enable
SmoothingWindow	32u	Setting for the smoothing window (frames)

Element	Type	Description
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).

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.
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).

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.
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).

Element	Type	Description
SmoothingWindowMax	32u	Constraint for smoothing window maximum (frames).

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.
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).

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 256) 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.
VideoOptions	String	Constraint for eligible video sources (comma-delimited list).
ProfileOptions	String	Constraint for eligible profile sources (comma-delimited list).

Element	Type	Description
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).
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

Element	Type	Description
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 calibration file, transform.xml, contains settings that define the transformation from sensor coordinates to system coordinates, encoder resolution and distance (in direction of travel) between main and buddy sensor.

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

Calibration Example:

```
<?xml version="1.0" ?>
<SysCal version="1">
  <YDomain>0</YDomain>
  <YResolution>0</YResolution>
  <YSpeed>0</YSpeed>
  <Entries>
    <Entry id="0">
      <X>-2.3650924829</X>
      <Y>0</Y>
      <Z>123.4966803469</Z>
      <Roll>5.7478302588</Roll>
      <Pitch>0</Roll>
      <Yaw>0</Yaw>
      <Orientation>0</Orientation>
    </Entry>
    <Entry id="1">
      <X>0</X>
      <Y>0</Y>
      <Z>123.4966803469</Z>
      <Roll>2.5</Roll>
      <Pitch>0</Roll>
      <Yaw>0</Yaw>
      <Orientation>0</Orientation>
    </Entry>
  </Entries>
</SysCal>
```

SysCal

The SysCal element contains the calibration record for both main and buddy sensor. The version attribute defines the version of the record format.

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

SysCal Child Elements

Element	Type	Description
YDomain	32s	Reserved. Must be zero.
YResolution	64f	Encoder Resolution (mm/tick).
YSpeed	64f	Travel Speed (mm/s).

Entries

An Entry element defines the transformation for a sensor. There is one entry element per sensor, identified by a unique id attribute (0 for main and 1 for buddy):

```
<Entry id="0">
```

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).
Roll	64f	Rotation about Y axis (degrees).
Pitch	64f	Rotation about X axis (degrees).
Yaw	64f	Rotation about Z axis (degrees).
Orientation	32u	Direction of X-axis: 0 – Normal 1 – Reverse

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 305). .

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.
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 212) 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.
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 256).

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.
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.

Field	Type	Description
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.
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
systemState	64s	Current system state: 1 – Conflict 2 – Ready 3 – Running

Field	Type	Description
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.
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.
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.
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.

Field	Type	Description
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).
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).

Field	Type	Description
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 187) on how to setup 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)
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 187) 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 190) on how to setup 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 190) 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.
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 258)

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).
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.
width	64s	Image width (pixel).
height	64s	Image height (pixel).
type	64s	Pixel data type (0x00).
exposure	64s	Exposure (us).
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

Field	Type	Description
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).

Field	Type	Description
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 (us).

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) 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) 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 258)

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.
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.
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.

Indicator	Id	Instance	Value
Analog Output Drops	2021	Output Index	Number of dropped analog outputs.
Serial Output Drops	2022	Output index	Number of dropped serial outputs.
Laser Temperature	2023		Laser temperature (degrees Celsius). Only available on sensors equipped with 3B-N laser.
Digital Inputs	2024		Current status of digital input
Camera Frame Count	2025		Number of camera frames
Camera Search Count	2026		Number of frames where laser has lost tracked when tracking window is used.
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	20002	Output index	Number of pass digital output pulses.
Digital Output Fail	20003	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.
X Fixturing Invalid Count	20010		Number of frames where X fixturing failed.
Z Fixturing Invalid Count	20011		Number of frames where Z fixturing failed.
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 Control and Output (page 183).

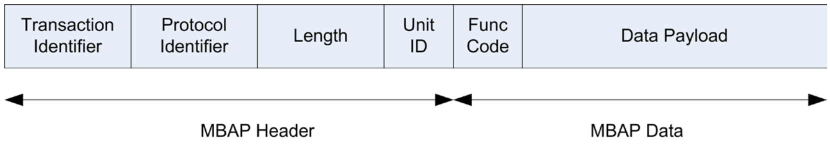
Concepts

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 a MBAP header (Modbus Application Protocol), a function code and a data payload.



The MBAP header contains the following field:

Modbus Application Protocol Header

Fields	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 details. 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 access 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-bit 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 measurement values and decisions. User can read multiple output registers using a single Read Holding Registers or a single Read Input Registers command. Likewise, 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 287) for detailed descriptions.
300 -371	Sensor States	RO	Report sensor states. Refer to Output Registers (page 288) for detailed descriptions.
900 - 999	Stamps	RO	Return stamps associated with each profile. Refer to Output Registers (page 288) for detailed descriptions.
1000 - 1060	Measurements & Decisions	RO	20 Measurement and decision pairs. Refer to Measurement Registers (page 289) 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, user should setup 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 File Name. Specifies the complete filename, including the file extension ".cfg": i.e. “test.cfg” (must be null terminated) Each 16-bit register holds a single character. Only used for Load Configuration Command.

The values used for the Command Register is 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.

Value	Name	Description
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	8	Sensor State: 0 - Stopped 1 - Running
301	Busy	8	Busy State: 0 - Not busy 1 - busy Registers 302-> 363 below are only valid when the Busy State is not busy
302	Calibration State	8	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 – 371	Live Configuration Name	8 bit for each character	Current Configuration Name. Name of currently loaded config file. does not include the ".cfg" 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
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

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 Control and Output (page 183).

Concept

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 - 21 for the filename: one ASCII character per byte. File name must be NULL terminated. The extension ".cfg" should be included

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
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 - 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.

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.

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 341) for cable pinout information.

Gocator serial communication uses the following connection settings:

Serial Connection Settings

Parameter	Value
Start Bits	1

Parameter	Value
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 276) section.
Id	i_n	n	Decimal value that represents the unique identifier of the measurement.
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.
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.
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 303) 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.

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:

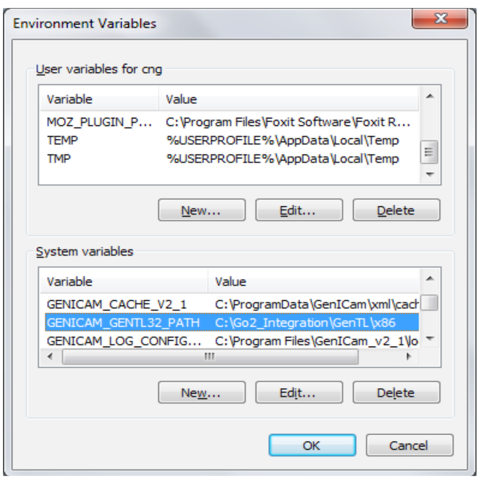
1 **Open the Control Panel**

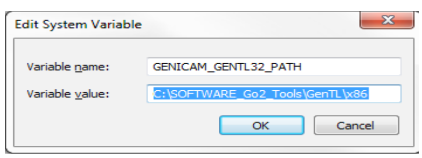
2 **Select System and Security and then Click System**

3 **Click Advanced System Settings**
The Advanced System Settings link is typically in the left column of the window.

4 **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.

5 **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 276 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 276 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 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 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

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 363) 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 Recovery (page 213) for more information.

When attempting to log in, the password is not accepted.

- Refer to Recovery (page 213) for steps to reset the password.

Laser Profiling

When the Start button or the Snapshot button is pressed, the sensor does not emit laser light.

- Ensure that the sticker covering the laser emitter window (normally affixed to new sensors) has been removed.
- The laser safety input signal may not be correctly applied. Refer to Specification (page 314) for more information.
- The exposure setting may be too low. Refer to Exposure (page 63) for more information on configuring exposure time.
- Use the Snapshot button instead of the Start button to capture a laser profile. If the laser 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 (page 55) for information on configuring the trigger source.

The sensor emits laser light, but the Range Indicator LED does not illuminate and/or points are not displayed in the Data Viewer.

- Verify that the measurement target is within the sensor's field of view and measurement range. Refer to Specification (page 314) to review the measurement specifications for your sensor model.
- Check that the exposure time is set to a reasonable level. Refer to Exposure (page 63) for more information on configuring exposure time.

Performance

The sensor CPU level is near 100%.

- Consider reducing the speed. If you are using a time or encoder trigger source, refer to Trigger (page 55) 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 laser profile resolution. Refer to Resolutions (page 67) for more information on configuring laser profile resolution.
- Review the measurements that you have programmed and eliminate any unnecessary measurements.

Specification

Gocator 2000 Series

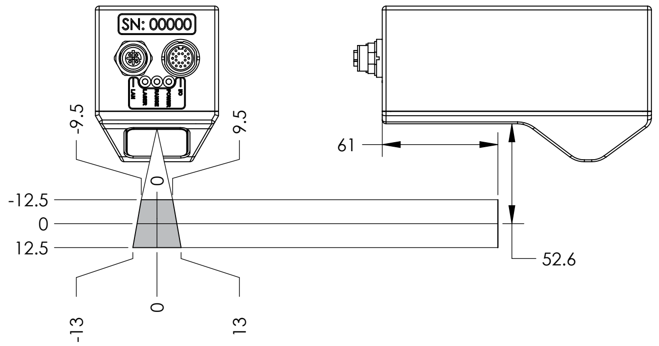
The Gocator 2000 series consists of the sensor models defined below.

MODEL	2020	2030	2040	2050	2070	2080
Data Points / Profile	640	640	640	640	640	640
Linearity Z (+/- % of MR)	0.02	0.02	0.02	0.02	0.05	0.05
Resolution Z (mm)	0.006 - 0.014	0.008 - 0.018	0.017 - 0.049	0.025 - 0.092	0.074 - 0.267	0.123 - 0.650
Resolution X (mm)	0.03 - 0.04	0.088 - 0.15	0.19 - 0.34	0.30 - 0.60	0.55 - 1.1	0.75 - 2.2
Clearance Distance (CD) (mm)	40	90	190	300	400	350
Measurement Range (MR) (mm)	25	80	210	400	500	800
Field of View (FOV) (mm)	19 - 26	47 - 85	96 - 194	158 - 365	308 - 687	390 - 1260
Standard Laser Class	2M	2M	3R	3R	3B	3B
Available Laser Classes*	3R	3R, 3B	2M, 3B	2M, 3B	2M, 3R	2M, 3R
Dimensions (mm)	65x82x142	65x75x142	65x75x197	65x75x272	65x75x272	65x75x272
Weight (kg)	1	1	1.15	1.45	1.45	1.45

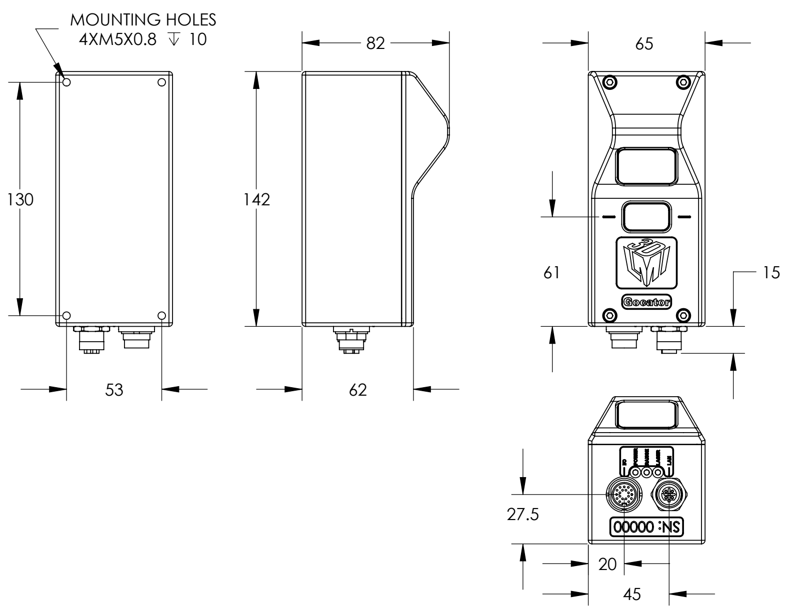
ALL 2000 SERIES MODELS	
Scan Rate	Approx. 300 Hz - 5000 Hz
Interface	100 Mbaud Ethernet
Inputs	Differential Encoder, Laser Safety Enable, Trigger
Outputs	2x Digital Output, RS-485 Serial (115 Kbaud), 1x Analog Output (4 - 20 mA)
Input Voltage (Power)	+24 to +48 VDC (10 Watts); Ripple +/- 10%
Housing	Gasketed aluminum enclosure, IP 67
Operating Temp.	0 to 50°C
Storage Temp.	-30 to 70°C

Gocator 2020

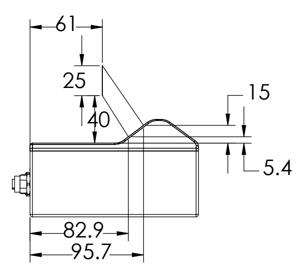
Field of View / Measurement Range



Dimensions

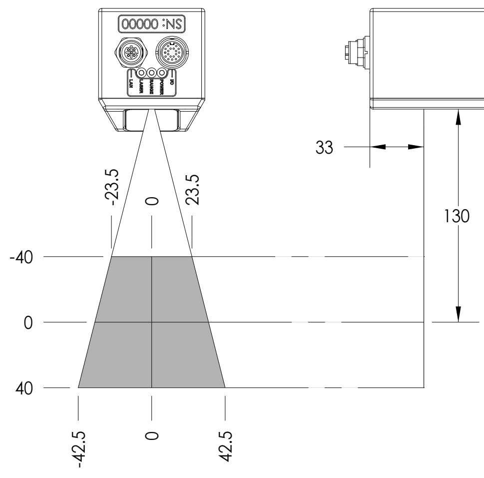


Envelope

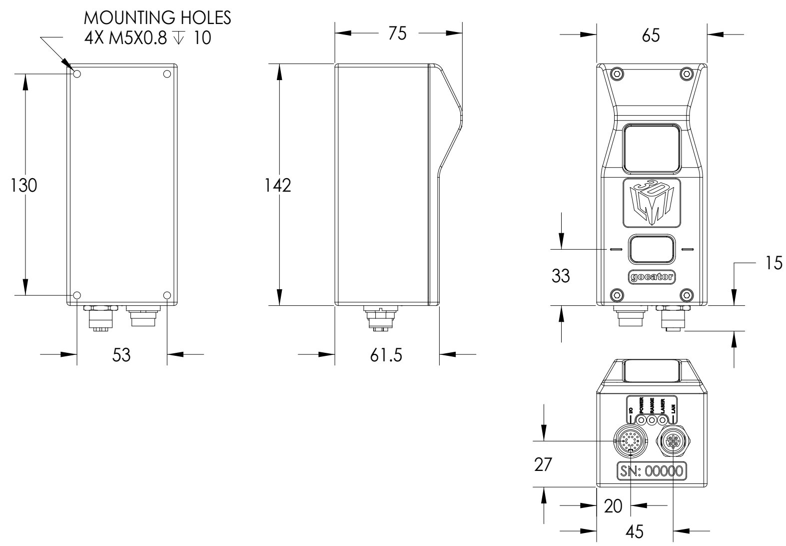


Gocator 2030

Field of View / Measurement Range



Dimensions



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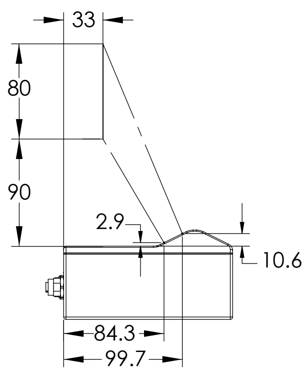
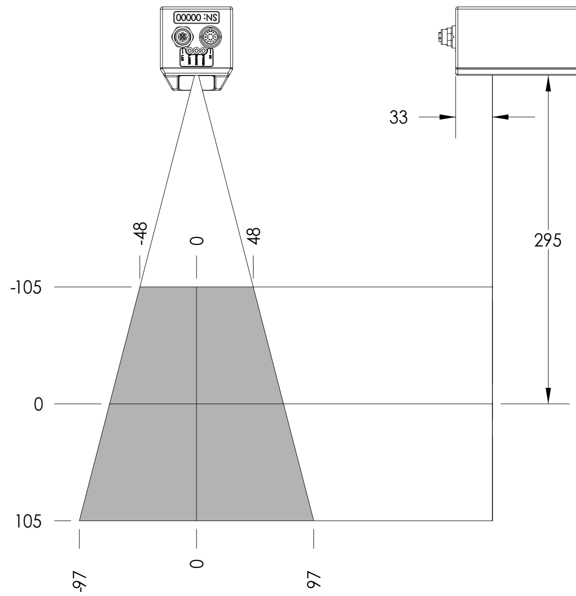
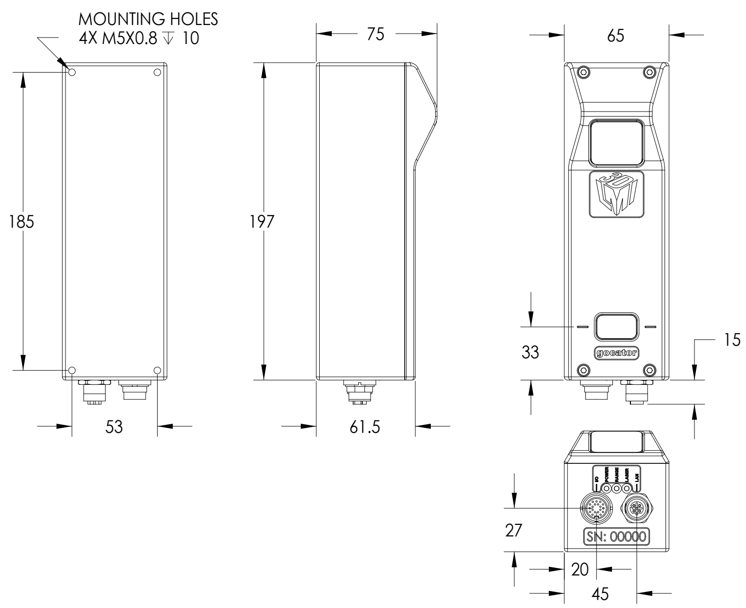


Gocator 2040

Field of View / Measurement Range



Dimensions



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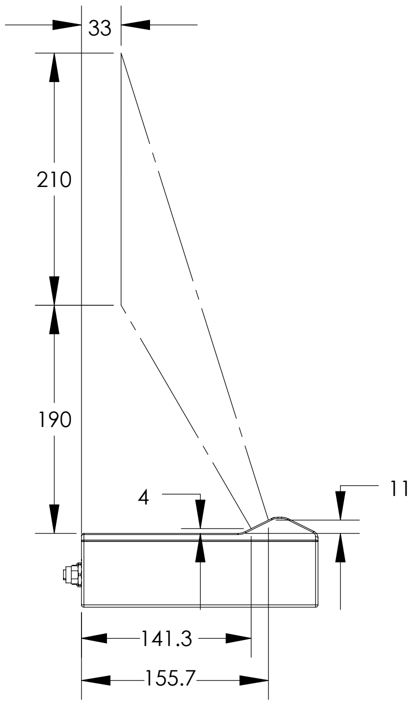
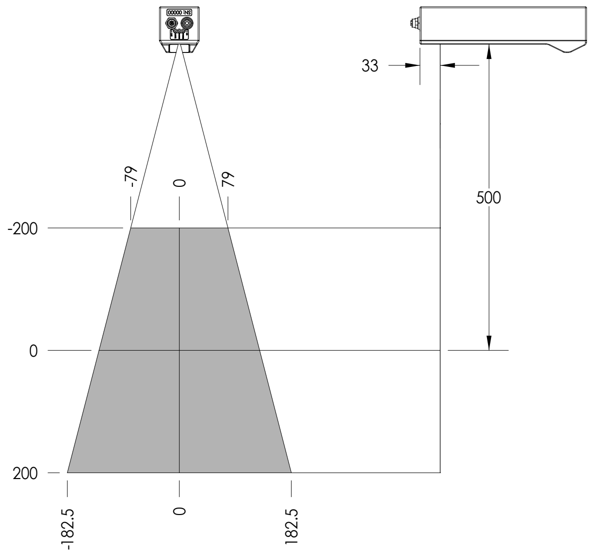
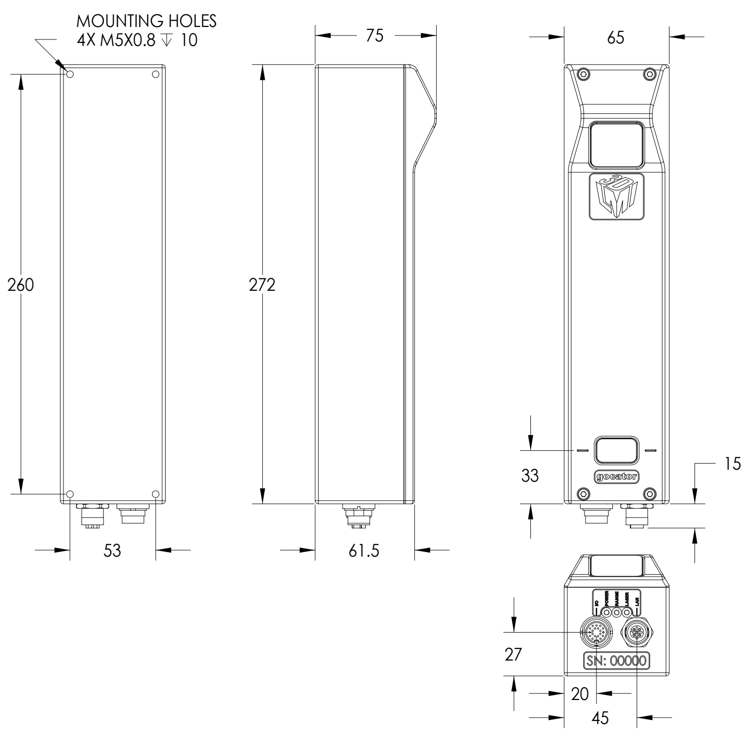


Gocator 2050

Field of View / Measurement Range



Dimensions



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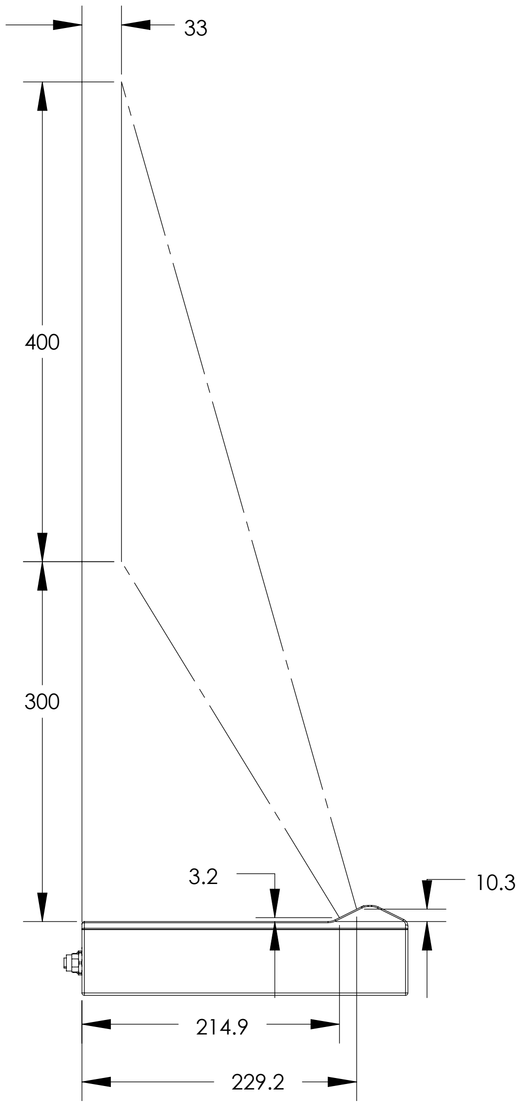
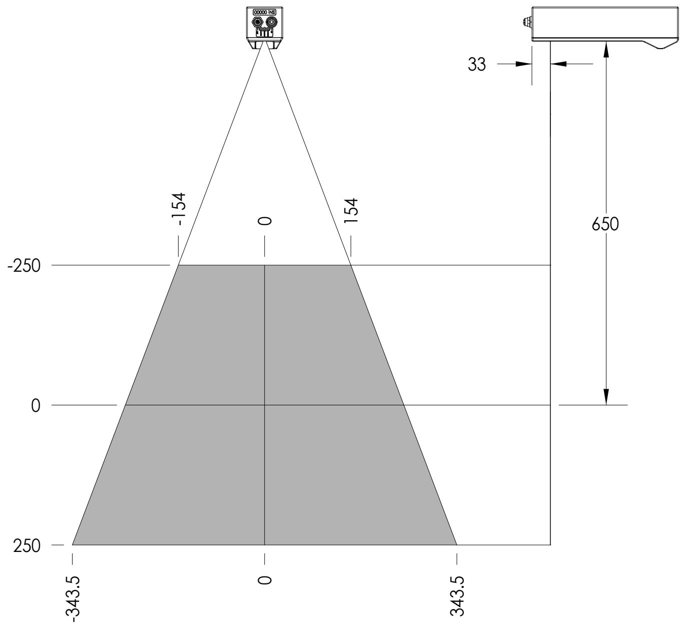
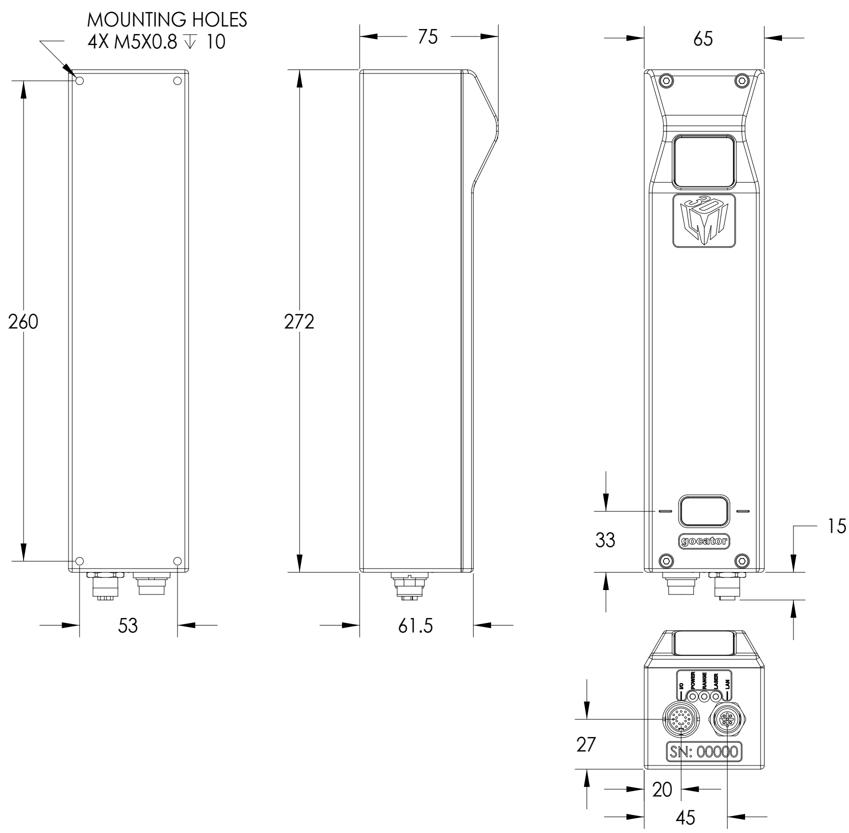


Gocator 2070

Field of View / Measurement Range



Dimensions



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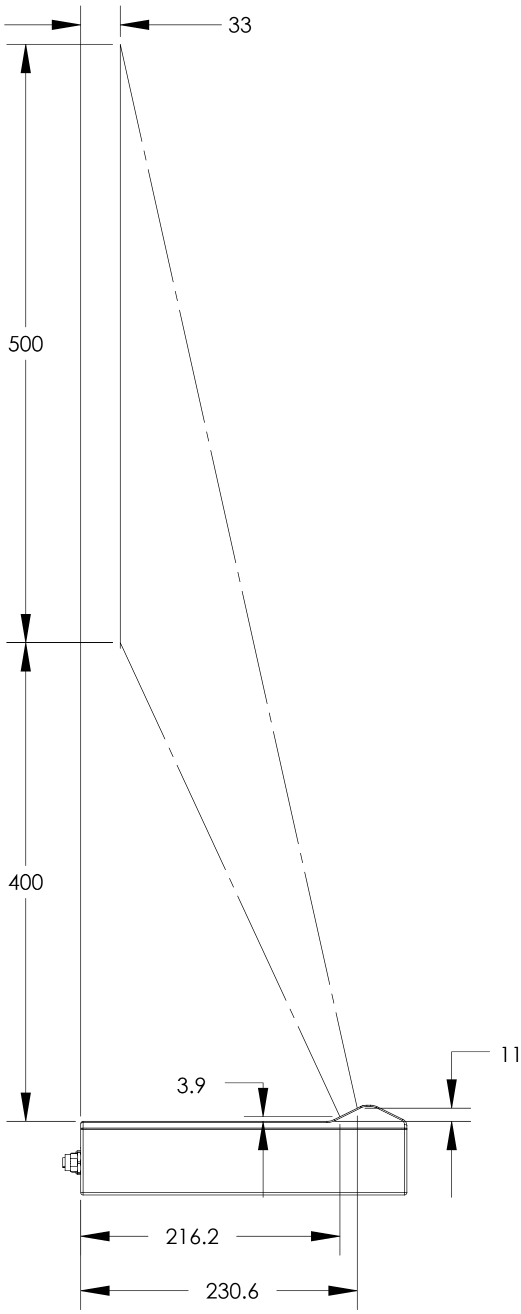
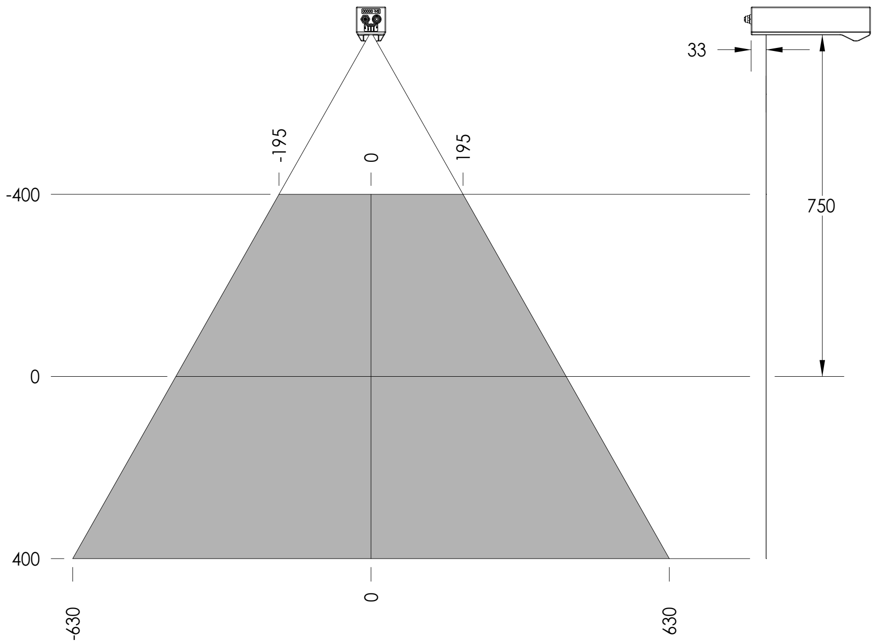
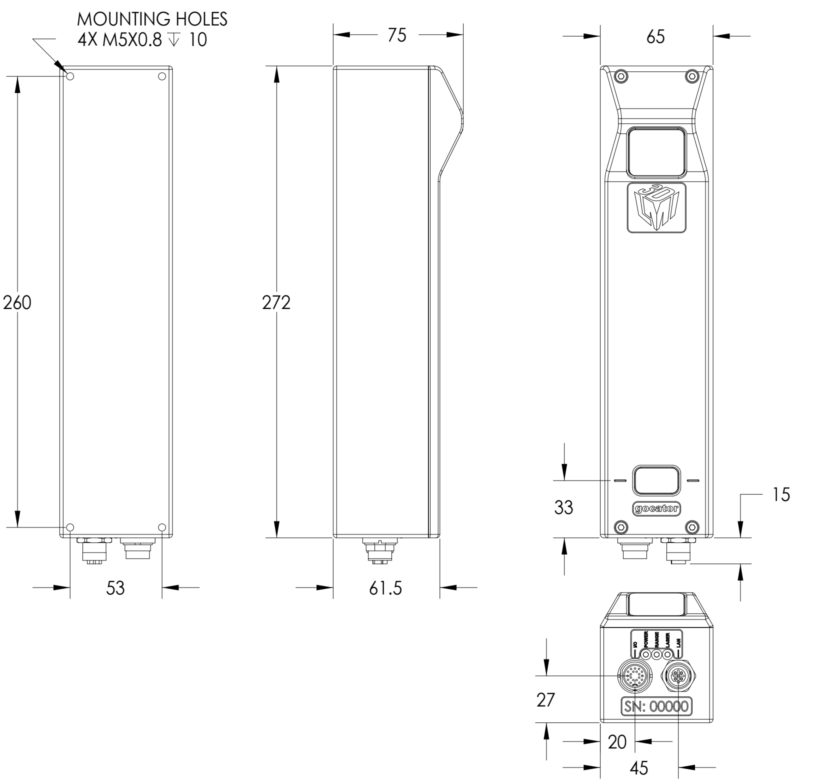


Gocator 2080

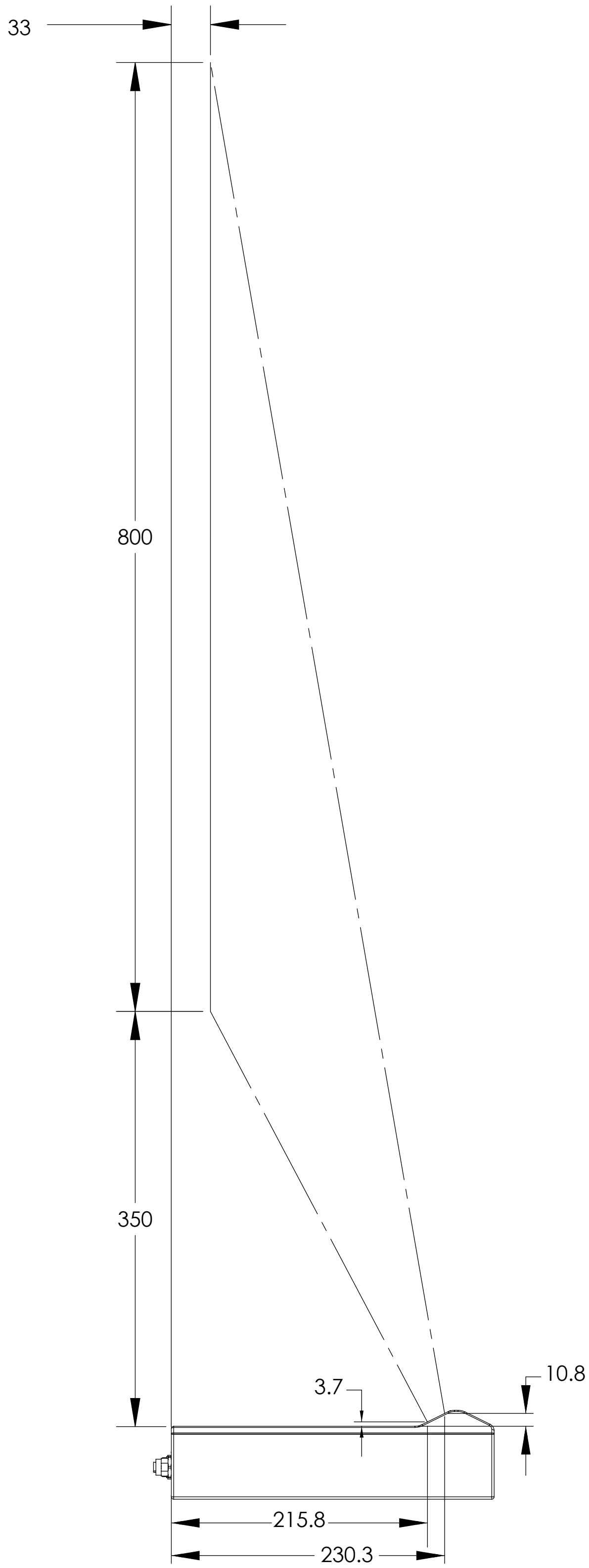
Field of View / Measurement Range



Dimensions



Envelope

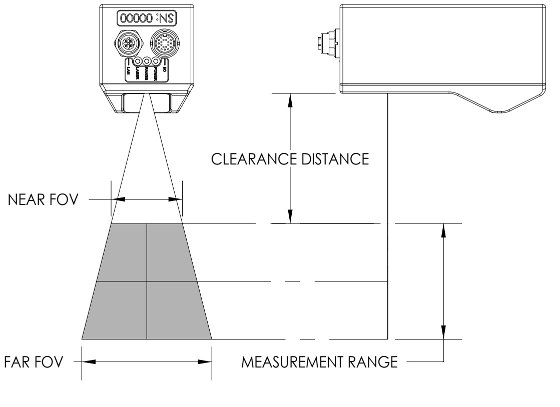


Gocator 2300 Series

The Gocator 2300 series consists of the sensor models defined below.

MODEL	2330	2340	2350	2370	2380
Data Points / Profile	1280	1280	1280	1280	1280
Linearity Z (+/- % of MR)	0.01	0.01	0.01	0.04	0.04
Resolution Z (mm)	0.006 - 0.014	0.013 - 0.037	0.019 - 0.060	0.055 - 0.200	0.092- 0.488
Resolution X (mm)	0.044 - 0.075	0.095 - 0.170	0.150 - 0.300	0.275 - 0.550	0.375 - 1.100
Clearance Distance (CD) (mm)	90	190	300	400	350
Measurement Range (MR) (mm)	80	210	400	500	800
Field of View (FOV) (mm)	47 - 85	96 - 194	158 - 365	308 - 687	390 - 1260
Standard Laser Class	2M	3R	3R	3B	3B
Available Laser Classes*	3R, 3B	2M, 3B	2M, 3B	2M, 3R	2M, 3R
Dimensions (mm)	49x75x142	49x75x197	49x75x272	49x75x272	49x75x272
Weight (kg)	0.74	0.94	1.3	1.3	1.3

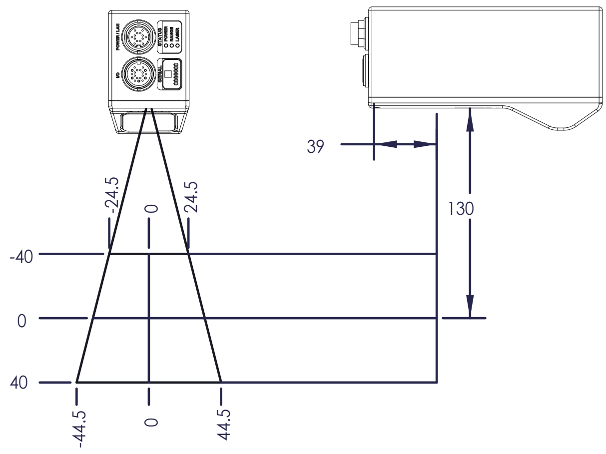
ALL 2300 SERIES MODELS	
Scan Rate	Approx. 170Hz to 5000 Hz
Interface	Gigabit Ethernet
Inputs	Differential Encoder, Laser Safety Enable, Trigger
Outputs	2x Digital output, RS-485 Serial (115 kBaud), 1x Analog Output (4 - 20 mA)
Input Voltage (Power)	+24 to +48 VDC (13 Watts); RIPPLE +/- 10%
Housing	Gasketed aluminum enclosure, IP67
Operating Temp.	0 to 50°C
Storage Temp.	-30 to 70°C



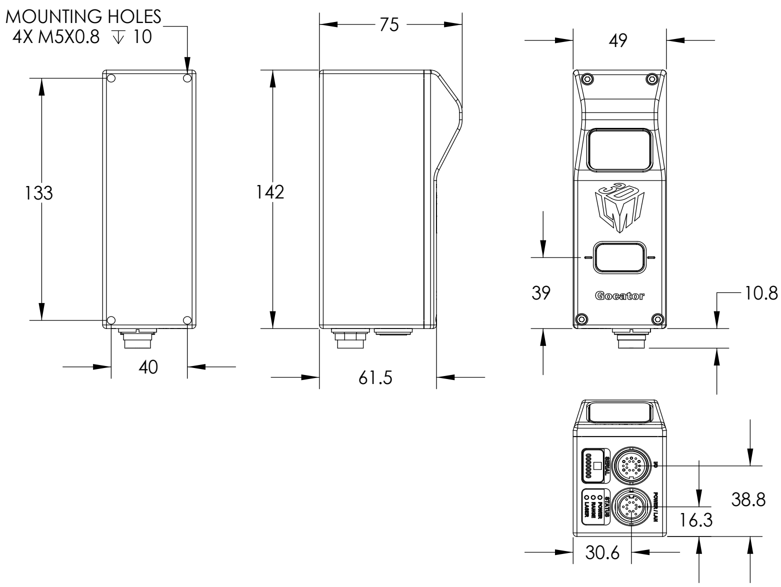
Mechanical dimensions for each sensor model are illustrated on the following pages.

Gocator 2330

Field of View / Measurement Range



Dimensions



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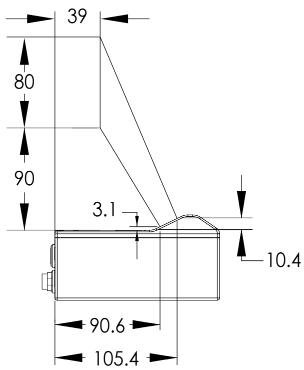
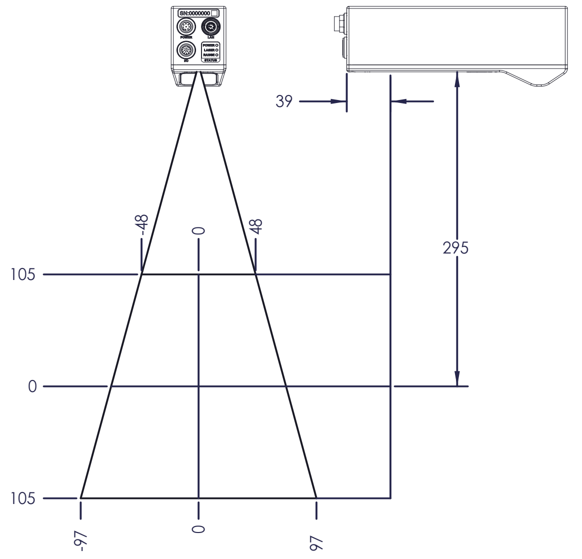
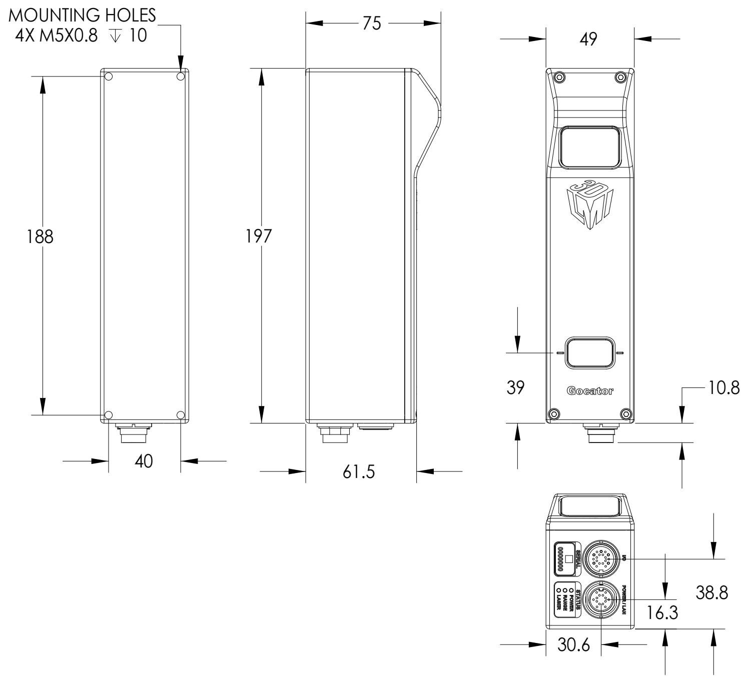


Gocator 2340

Field of View / Measurement Range



Dimensions



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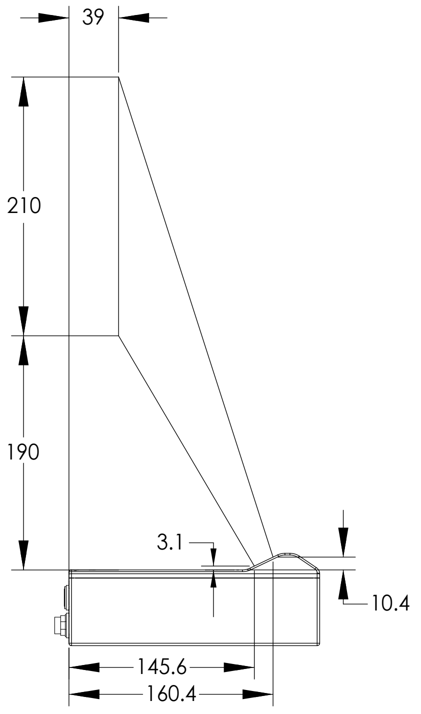
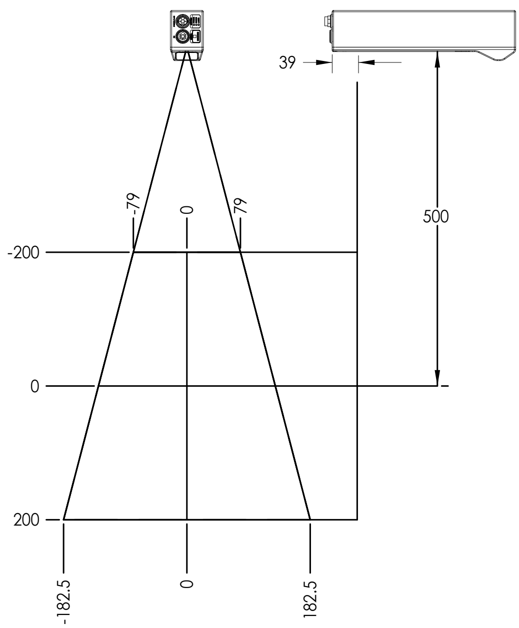
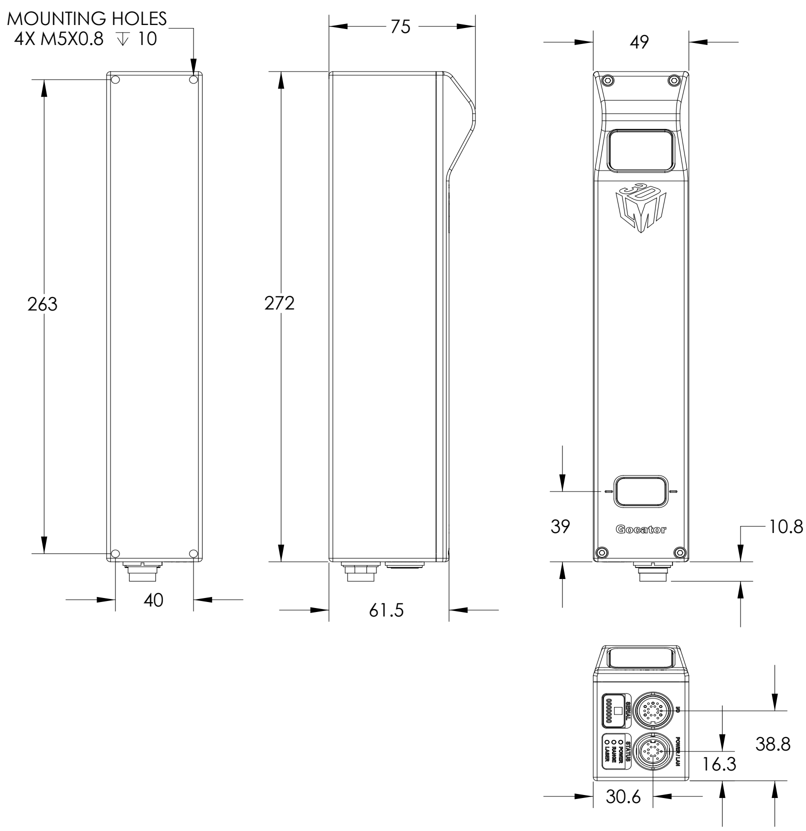


Gocator 2350

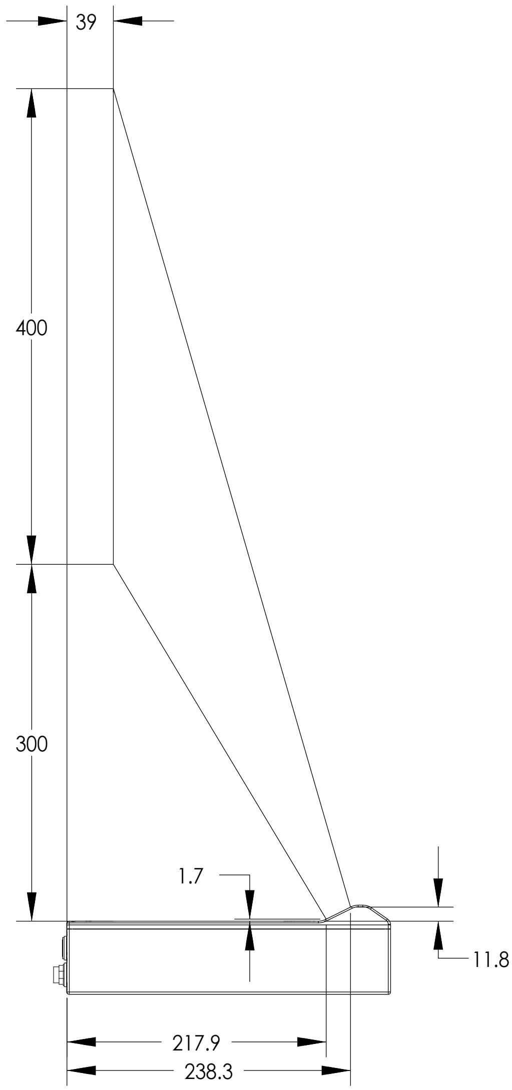
Field of View / Measurement Range



Dimensions

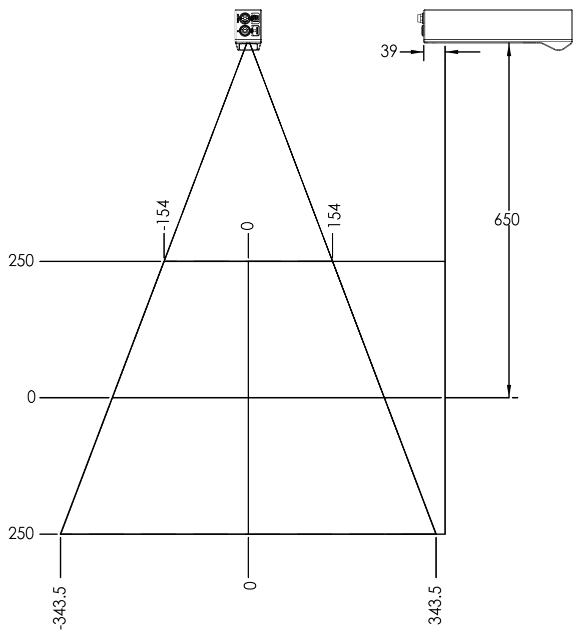


Envelope

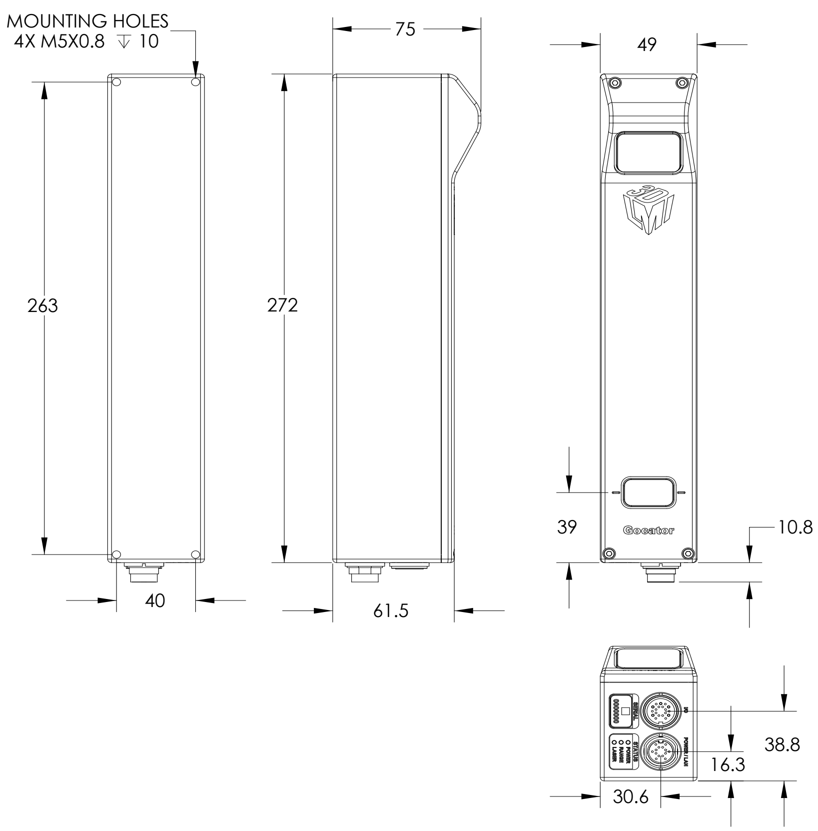


Gocator 2370

Field of View / Measurement Range



Dimensions



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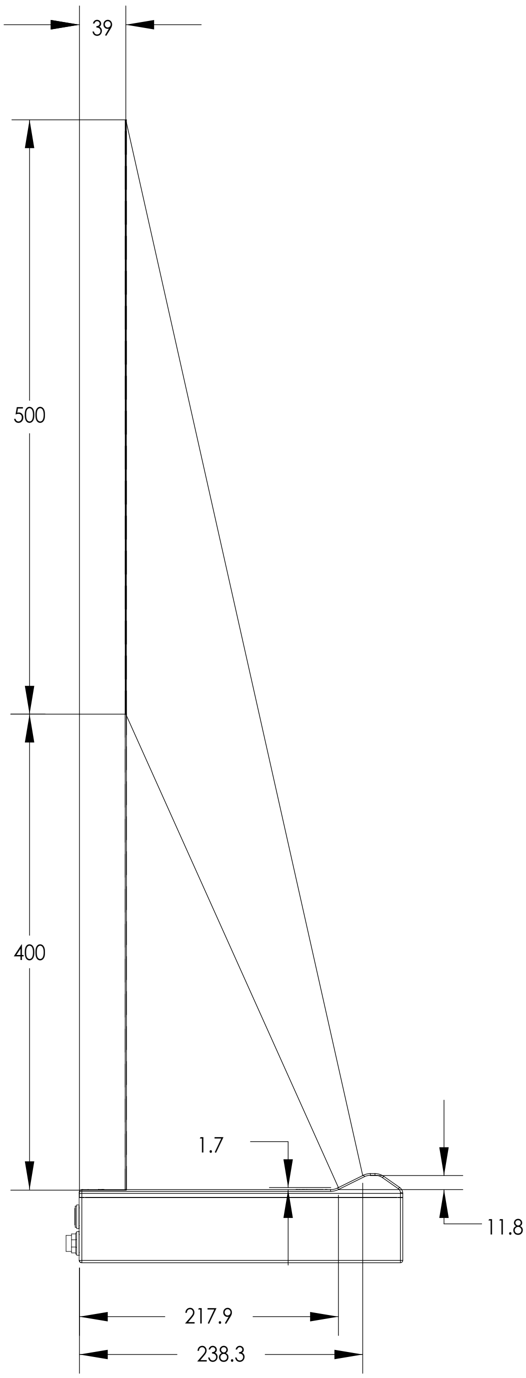
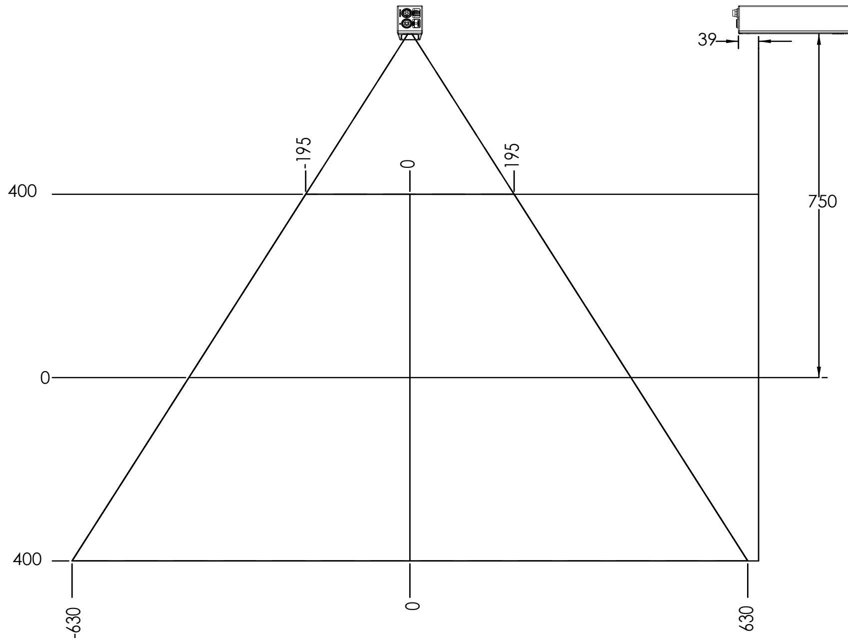
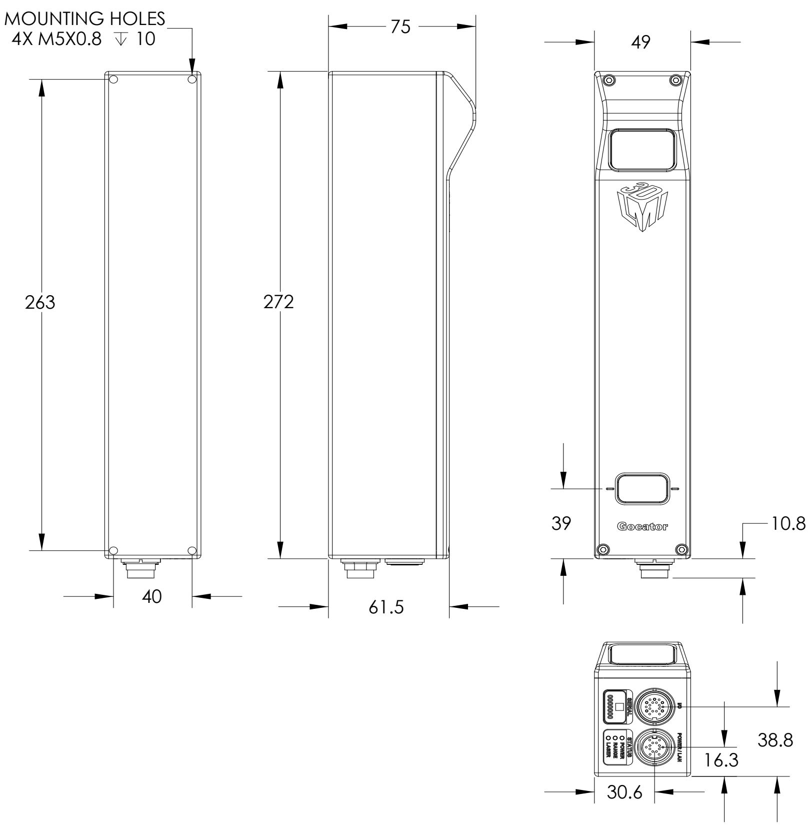


Gocator 2380

Field of View / Measurement Range



Dimensions



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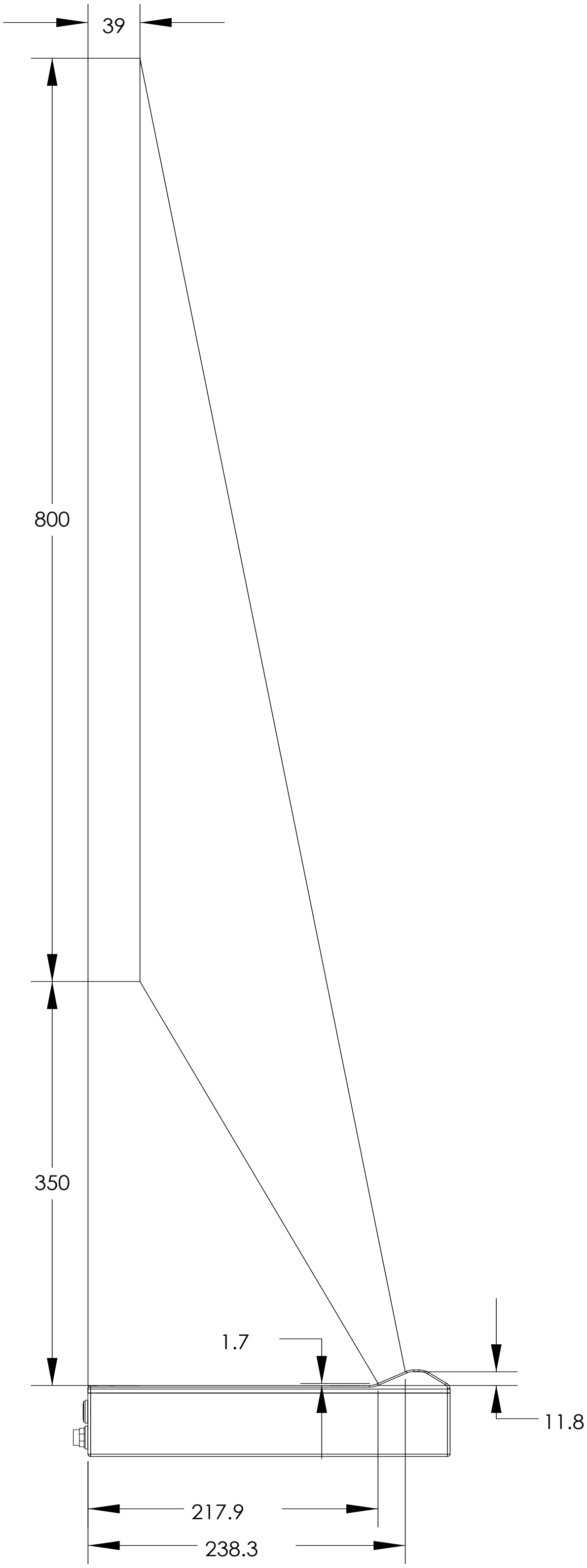


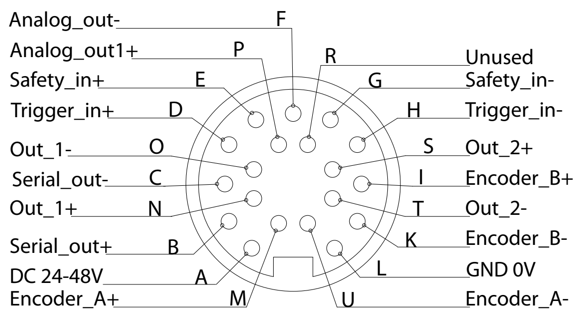
Gocator 2000 I/O Connector

The Gocator 20x0 I/O connector is a 19 pin, M16 style connector that provides power input, laser safety input, digital input, digital output, serial output, and analog output signals.

This section defines the electrical specifications for Gocator I/O Connector pins, organized by function.

Gocator I/O Connector Pins

Function	Pins	Color
DC_24-48V	A	(White Green & Black) and (Green Black)
Serial_out+	B	White
Serial_out-	C	Brown
Trigger_in+	D	Grey
Safety_in+	E	Blue/Black
Analog_out-	F	(Yellow) & (Maroon/White)
Safety_in-	G	White/Blue & Black
Trigger_in-	H	Pink
Encoder_B+	I	Black
Encoder_B-	K	Violet
GND_0V	L	(White/Orange & Black) & (Orange/Black)
Encoder_A+	M	(White/Brown) & Black
Out_1+ (Digital Output 0)	N	Red
Out_1- (Digital Output 0)	O	Blue
Analog_out1+	P	Green
Unused	R	Maroon
Out_2+ (Digital Output 1)	S	Tan
Out_2- (Digital Output 1)	T	Orange
Encoder_A-	U	Brown/Black



View: Looking into the connector

This connector has the same number of pins as the Gocator 2300 I/O connector. Users must make sure the this pinout is used for Gocator 2000 sensors only.

Grounding Shield

The grounding shield should be mounted to the earth ground.

Power

Positive voltage is applied to DC_24-48V @ 10 Watts and Ground is applied to GND_0VDC.

Power requirements

Function	Pins	Min	Max
DC_24-48V	A	24 V	48 V
GND_0VDC	L	0 V	0 V

Laser Safety Input

The Safety_in+ signal should be connected to a voltage source in the range listed below. The Safety_in- signal should be connected to the ground/common of the source supplying the Safety_in+.

Laser safety requirements

Function	Pins	Min	Max
Safety_in+	E	24 V	48 V
Safety_in-	G	0 V	0 V

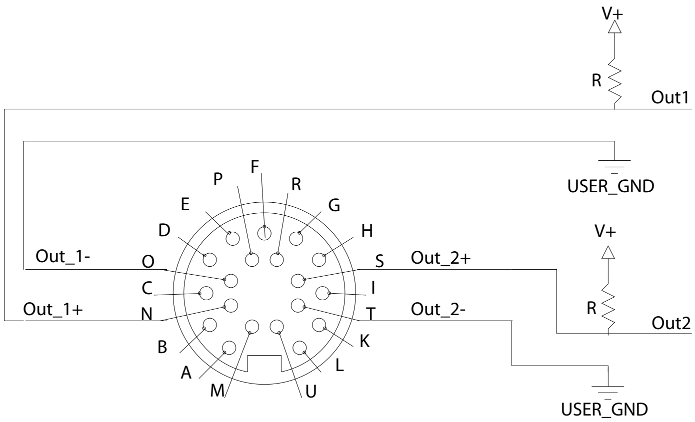
⚠ Confirm the wiring of Safety_in- before starting the sensor. Wiring DC_24-48V into Safety_in- may damage the sensor

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 N and Emitter – Pin O) and Out_2 (Collector – Pin S and Emitter Pin T) are independent and therefore V+ and GND are not required to be the same.

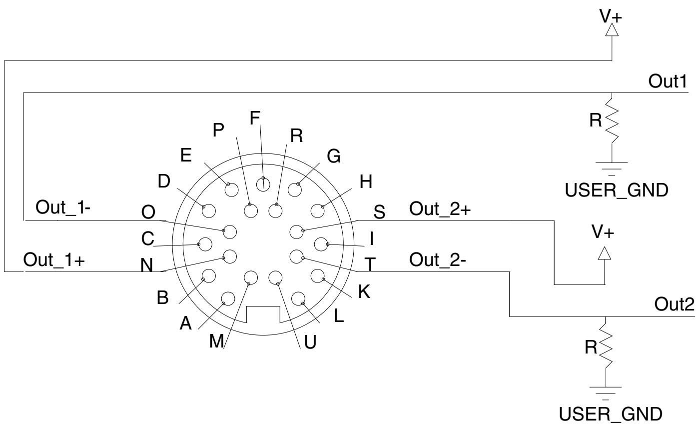
Function	Pins	Max Collector Current	Max Collector –Emitter Voltage	Min Pulse Width
Out_1	N,O	40 mA	70 V	20 us
Out_2	S,T	40 mA	70 V	20 us



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

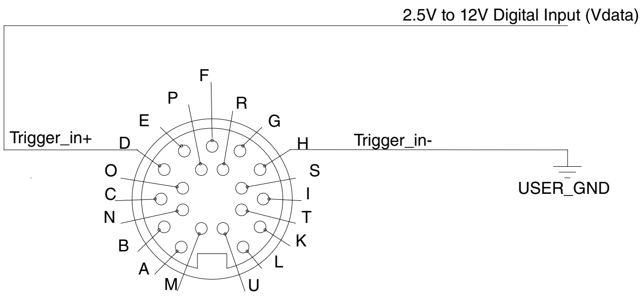
To invert an output, connect a resistor between ground and Out_1- or Out_2- and connect Out_1+ or Out_2+ to the supply voltage. Take the output at Out_1- or Out_2-. The resistor selection is the same as what is shown above.



Digital Inputs

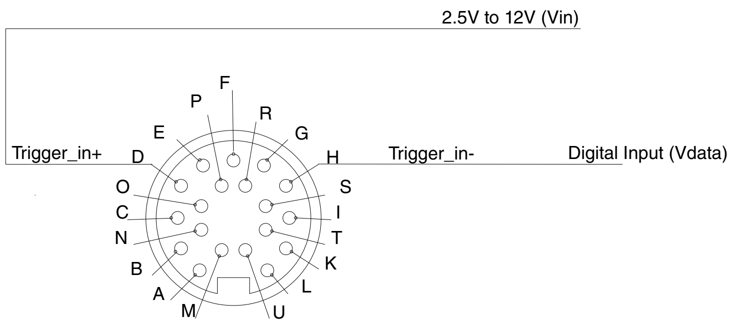
Every Gocator sensor has a single optically-isolated input. To use this input without an external resistor, supply 2.5 - 12 V to Pin D and GND to Pin H.

Active High



If the supplied voltage is greater than 12 V, connect an external resistor in series to Pin D. The resistor value should be R = [(Vin-1.2V)/10mA]-330.

Active Low

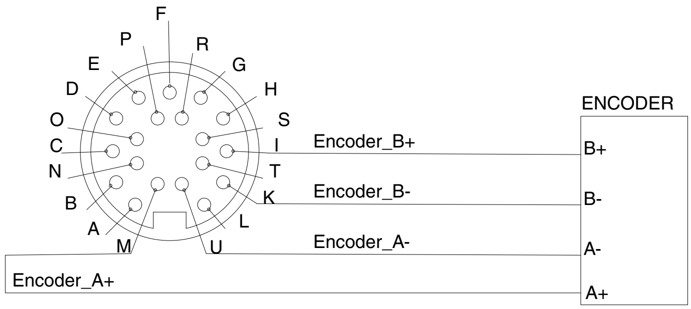


To assert the signal, the digital input voltage should be set to draw a current of 3 mA to 50mA from Trigger_In+. The current that passes through Trigger_In+ is I = (Vin – 1.2 – Vdata) / 330. To reduce noise sensitivity, we recommend leaving a 20% margin for current variation (i.e. uses a digital input voltage that draws 4mA to 25mA).

Function	Pins	Min Voltage	Max Voltage	Min Current	Max Current	Min Pulse Width
Trigger_in	D	2.5 V	12 V	3 mA	40 mA	20 us

Encoder Input

Encoder input is provided by an external encoder and consists of 2 RS-485 signals. These signals are connected to Encoder_A and Encoder_B.



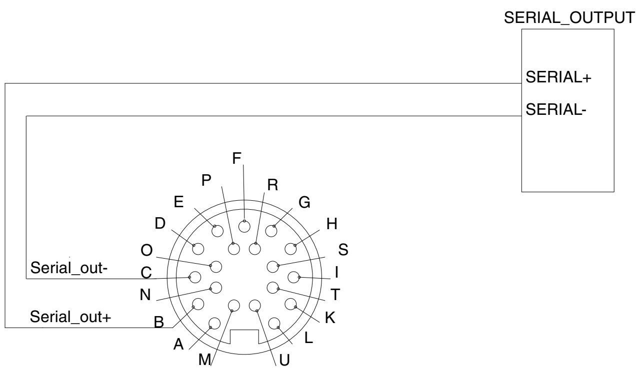
Function	Pins	Common Mode Voltage		Differential Threshold Voltage			Max Data Rate
		Min	Max	Min	Typ	Max	
Encoder_A	M, U	-7 V	12 V	-200 mV	-125 mV	-50 mV	1 MHz
Encoder_B	I, K	-7 V	12 V	-200 mV	-125 mV	-50 mV	1 MHz

Gocator only supports differential RS485 signalling. Both + and - signals must be connected.

Serial Output

Serial RS-485 output is connected to Serial_out as shown below.

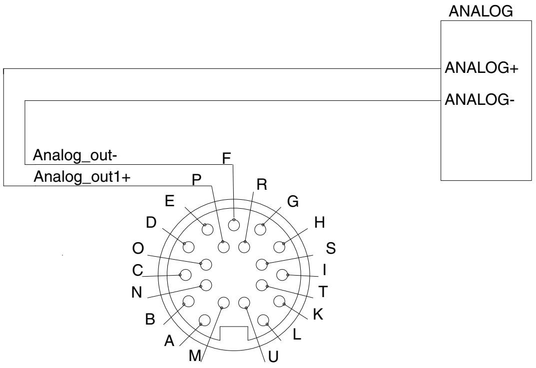
Function	Pins
Serial_out	B, C



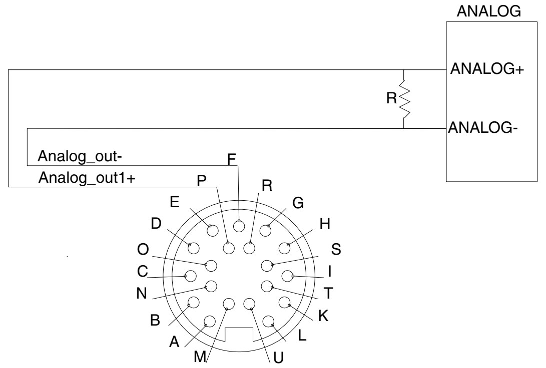
Analog Output

The Sensor I/O Connector defines one analog output interfaces: Analog_out1.

Function	Pins	Current Range
Analog_out1	P, F	4 – 20 mA

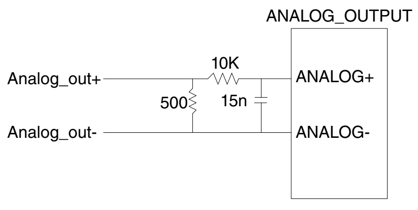


Current Mode



Voltage Mode

To configure for voltage output, connect a 500 Ohm ¼ Watt resistor between Analog_out- and Analog_out+ and measure the voltage across the resistor. To reduce the noise in the output, we recommend using a RC filter as shown below.



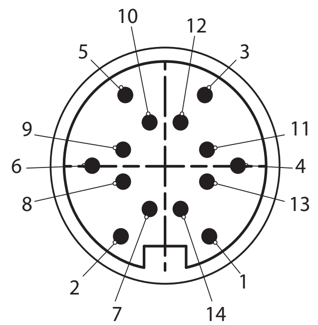
Gocator 2300 Power/LAN Connector

The Gocator 2300 Power/LAN connector is a 14 pin, M16 style connector that provides power input, laser safety input and Ethernet.

This section defines the electrical specifications for Gocator 2300 Power/LAN Connector pins, organized by function.

Gocator Power Connector Pins

Function	Pin	Color
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

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 @ 10 Watts and 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

Laser Safety Input

The Safety_in+ signal should be connected to a voltage source in the range listed below. The Safety_in- signal should be connected to the ground/common of the source supplying the Safety_in+.

Laser safety requirements

Function	Pins	Min	Max
Safety_in+	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

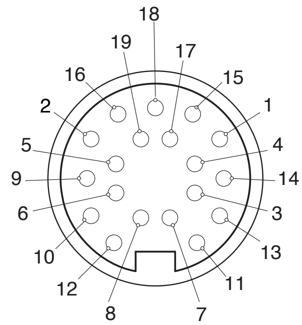
Gocator 2300 I/O Connector

The Gocator 2300 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 2300 I/O Connector pins, organized by function.

Gocator I/O Connector Pins

Function	Pins	Color
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

This connector has the same number of pins as the Gocator 2000 I/O connector. Users must make sure the this pinout is used for Gocator 2300 sensors only.

Grounding Shield

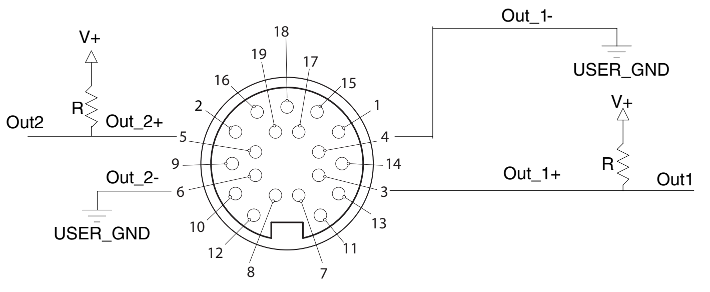
The grounding shield should be mounted to the earth ground.

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.

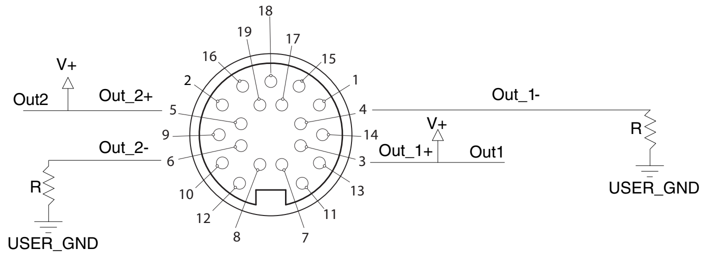
Function	Pins	Max Collector Current	Max Collector –Emitter Voltage	Min Pulse Width
Out_1	3, 4	40 mA	70 V	20 us
Out_2	5, 6	40 mA	70 V	20 us



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

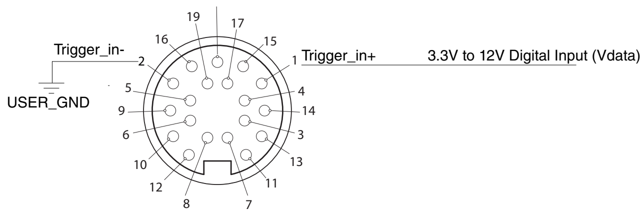
To invert an output, connect a resistor between ground and Out_1- or Out_2- and connect Out_1+ or Out_2+ to the supply voltage. Take the output at Out_1- or Out_2-. The resistor selection is the same as what is shown above.



Digital Inputs

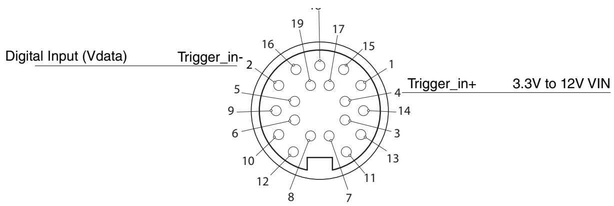
Every Gocator sensor has a single optically-isolated input. To use this input without an external resistor, supply 3.3 - 12 V to Pin 1 and GND to Pin 2.

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

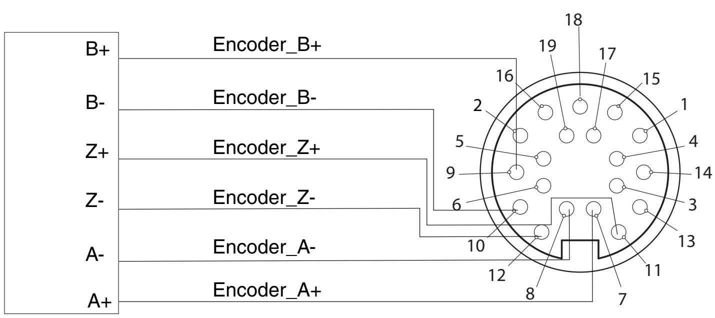


To assert the signal, the digital input voltage should be set to draw a current of 3 mA to 32mA from Trigger_In+. The current that passes through Trigger_In+ is I = (Vin – 1.2 – Vdata) / 680. To reduce noise sensitivity, we recommend leaving a 20% margin for current variation (i.e. uses a digital input 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	32 mA	20 us

Encoder Input

Encoder input is provided by an external encoder and consists of 3 RS-485 signals. These signals are connected to Encoder_A, Encoder_B and Encoder_Z.



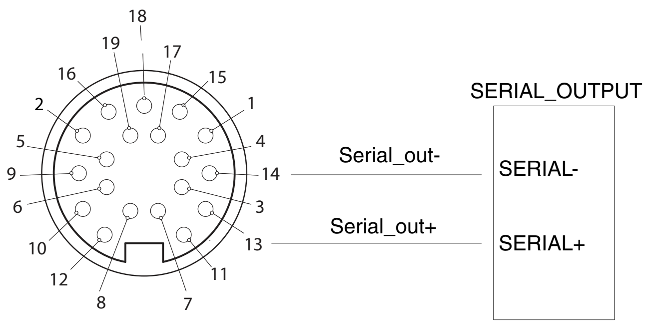
Function	Pins	Common Mode Voltage		Differential Threshold Voltage			Max Data Rate
		Min	Max	Min	Typ	Max	
Encoder_A	7, 8	-7 V	12 V	-200 mV	-125 mV	-50 mV	1 MHz
Encoder_B	9, 10	-7 V	12 V	-200 mV	-125 mV	-50 mV	1 MHz
Ecnoder_Z	11, 12	-7 V	12 V	-200 mV	-125 mV	-50 mV	1 MHz

Gocator only supports differential RS485 signalling. Both + and - signals must be connected.

Serial Output

Serial RS-485 output is connected to Serial_out as shown below.

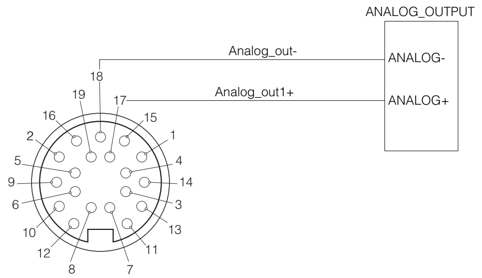
Function	Pins
Serial_out	13, 14



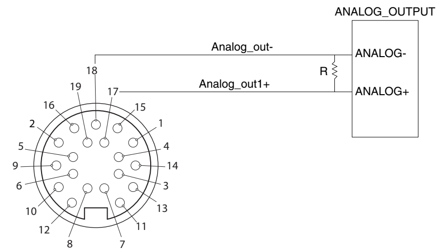
Analog Output

The Sensor I/O Connector defines one analog output interfaces: Analog_out.

Function	Pins	Current Range
Analog_out	17, 18	4 – 20 mA

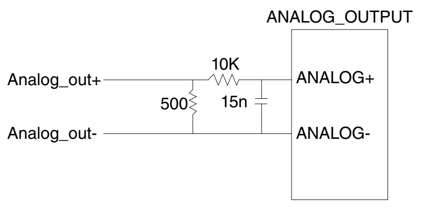


Current Mode



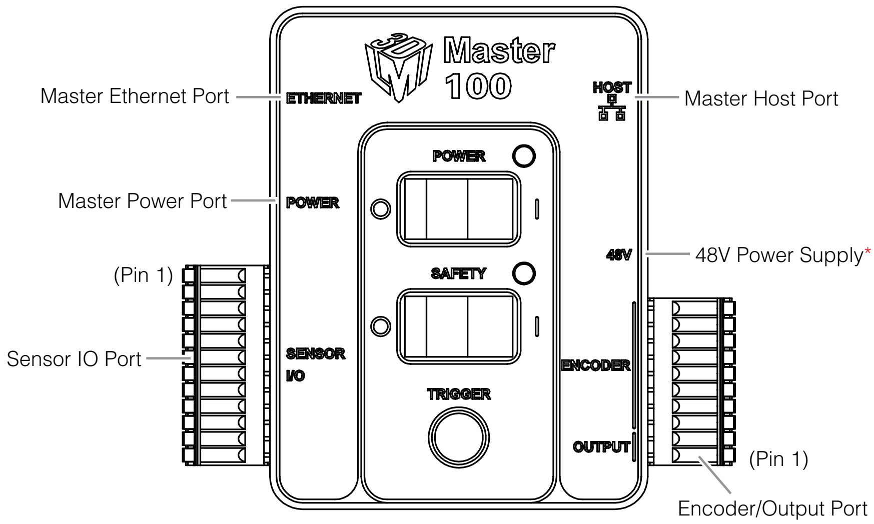
Voltage Mode

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

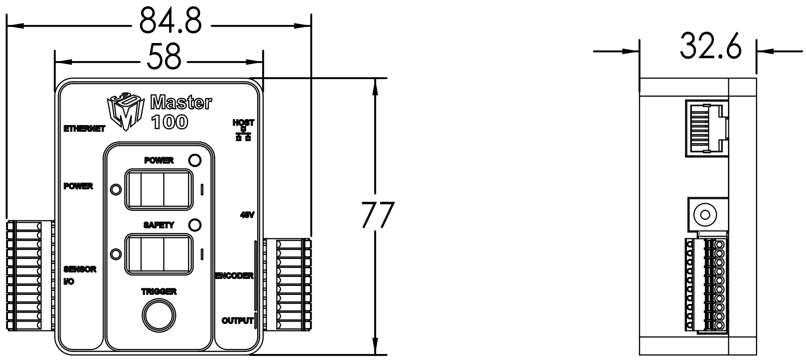
Gocator I/O Pin	Master Pin	Conductor Color
Encoder_A+	1	White/Brown & Black
Encoder_A-	2	Brown/Black
Encoder_Z+	3	White/Green & Black
Encoder_Z-	4	Green/Black
Trigger_in+	5	Grey
Trigger_in-	6	Pink
Out_1-	7	Blue
Out_1+	8	Red
Encoder_B+	11	Black
Encoder_B-	12	Violet

The rest of the wires in the Gocator I/O cordset are not used.

Encoder/Output Port Pins

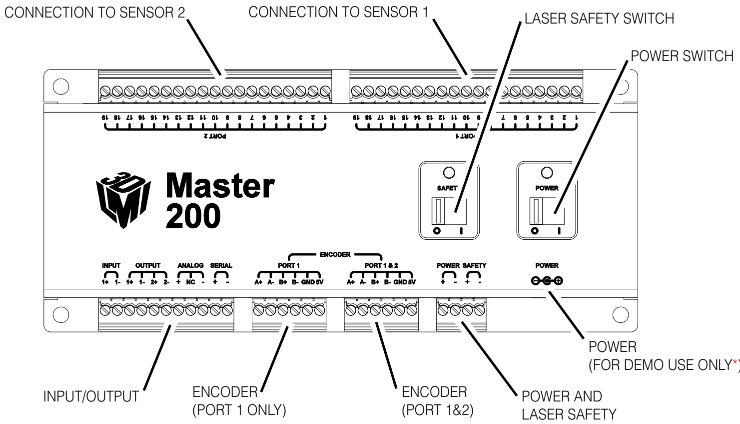
Function	Pin
Output_1+ (Digital Output 0)	1
Output_1- (Digital Output 0)	2
Encoder_Z+	3
Encoder_Z-	4
Encoder_A+	5
Encoder_A-	6
Encoder_B+	7
Encoder_B-	8
Encoder_GND	9
Encoder_5V	10

Master 100 Dimensions



Master 200

The Master 200 accepts I/O connections for power, safety, encoder, serial output, analog output, digital output, as well as digital input, and distributes these signals among 1 or 2 connected sensors.



*Contact LMI for information regarding this type of power supply.

When using the Master 200 with a single sensor, connect the sensor to *Sensor Port 1* and connect the encoder to *Encoder (Port 1 Only)*. When using the Master 200 with two sensors, connect the sensors to *Sensor Port 1* and *Sensor Port 2*, and connect the encoder to *Encoder (Port 1&2)*.

Specifications for the Master 200 input, output, analog, serial, encoder, power (using a single sensor), and safety signals are identical to the specifications for the Gocator I/O Connector. Power required for 2 sensors is DC_24 - 48V @ 20 Watts.

Sensor Port 1 and Port 2 Pins

Gocator I/O Pin	Master Pin	Conductor Color
DC_24-48V	1	(White/Green &Black) and (Green/Black)
GND_0VDC	2	(White/Orange &Black) and (Orange/Black)
Safety_in+	3	Blue/Black
Safety_in-	4	White/Blue & Black
Trigger_in+	5	Grey
Trigger_in-	6	Pink
Out_1+	7	Red
Out_1-	8	Blue
Out_2+	9	Tan
Out_2-	10	Orange
Analog_out1+	11	Green
Unused	12	Maroon
Analog_out-	13	(Yellow) and (Maroon/White)
Encoder_A+	14	White/Brown & Black
Encoder_A-	15	Brown/Black
Serial_out+	16	White
Serial_out-	17	Brown
Encoder_B+	18	Black
Encoder_B-	19	Violet

Input/Output Pins

Function	Pin
Input+	1
Input-	2
Output_1+ (Digital Output 0)	3
Output_1- (Digital Output 0)	4
Output_2+ (Digital Output 1)	5
Output_2- (Digital Output 1)	6
Analog+	7
Unused	8
Analog-	9
Serial+	10
Serial-	11

Power and Safety Pins

Function	Pin
DC_+24 to +48V	1
GND_0VDC	2
Safety+	3
Safety-	4

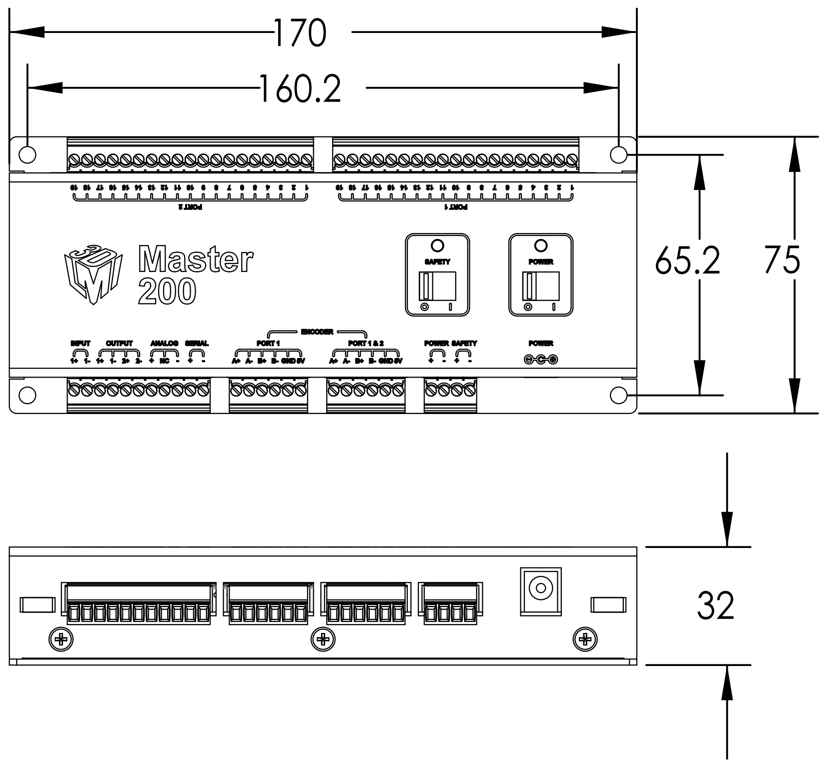
Encoder (Port 1 Only) Pins

Function	Pin
Encoder_A+	1
Encoder_A-	2
Encoder_B+	3
Encoder_B-	4
Encoder_0V	5
Encoder_5V	6

Encoder (Port 1&2) Pins

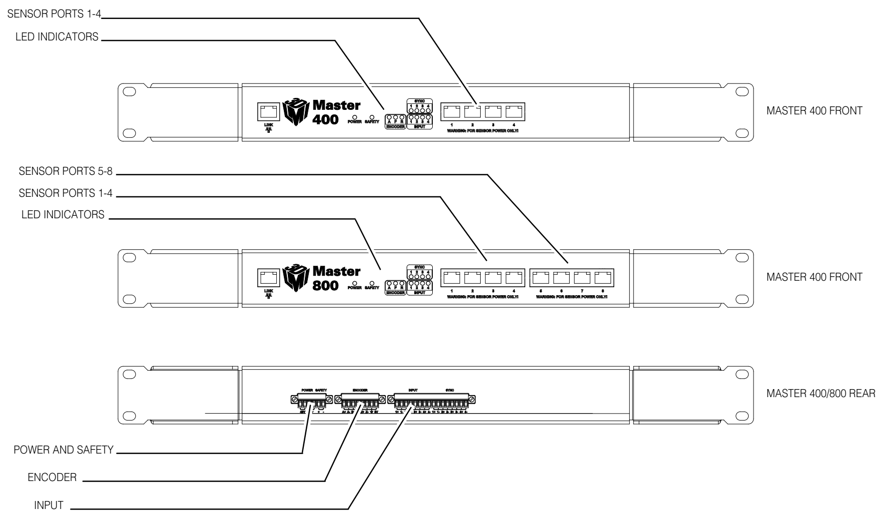
Function	Pin
Encoder_A+	1
Encoder_A-	2
Encoder_B+	3
Encoder_B-	4
Encoder_0V	5
Encoder_5V	6

Master 200 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 laser.

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	

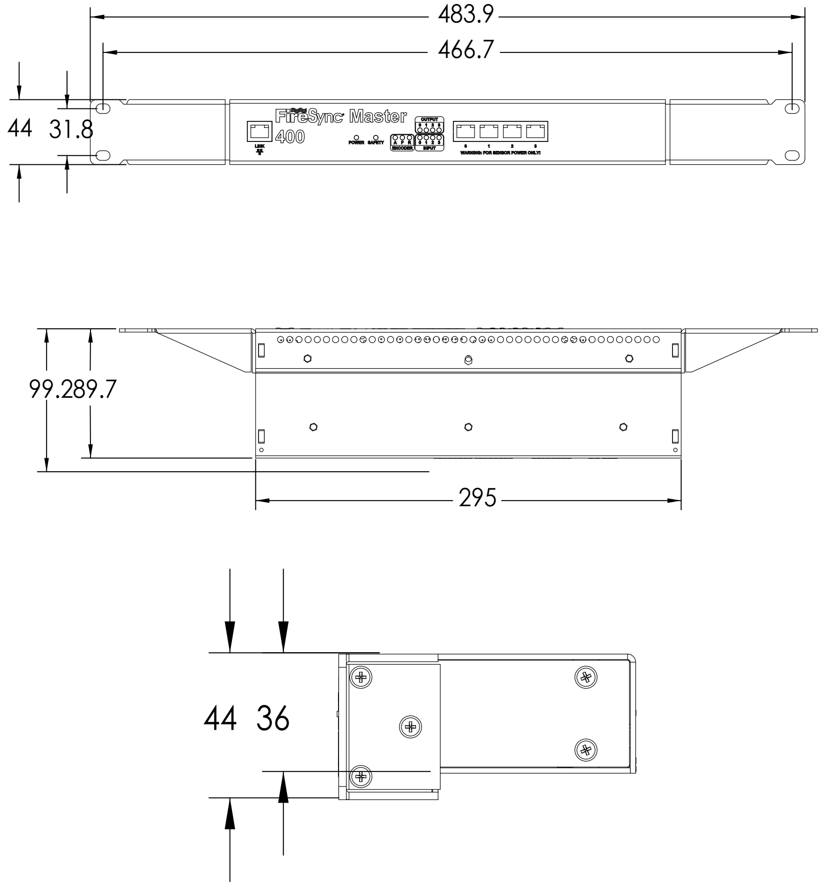
⚠ When using a Master 400/800 it is crucial that its chassis be well grounded.

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.

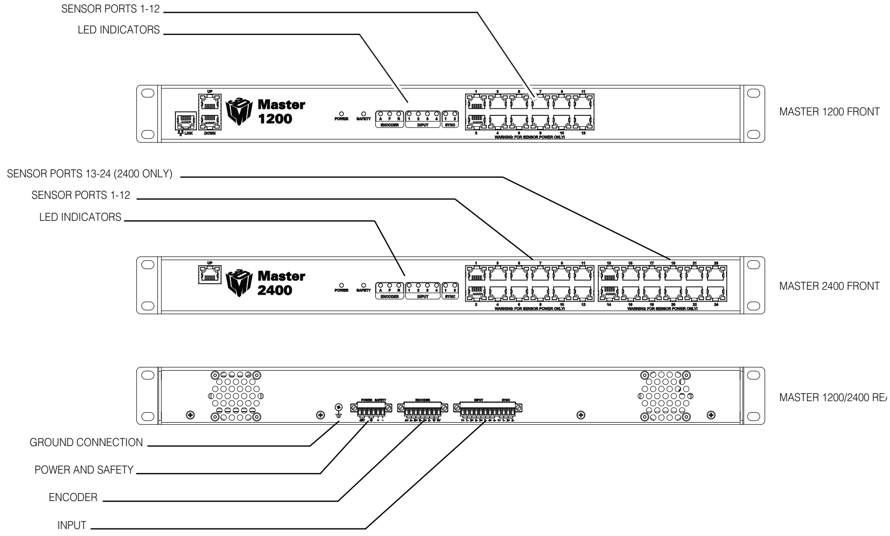
Master 400/800 Dimensions

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 laser.

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	

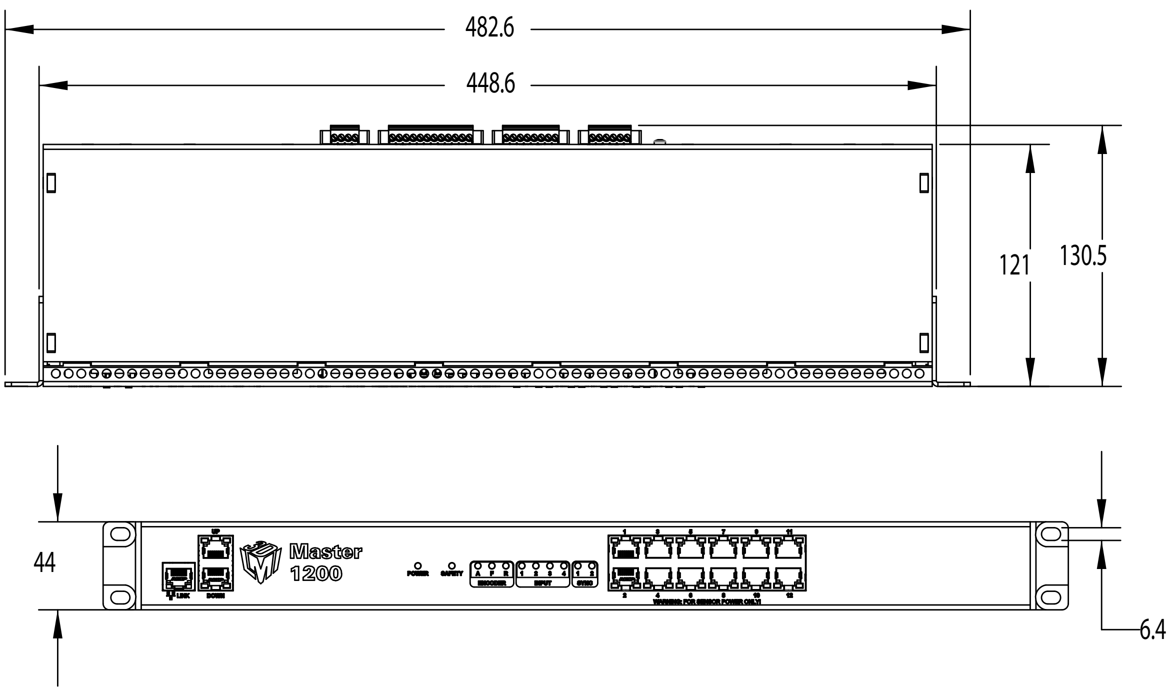
⚠ When using a Master 1200/2400 it is crucial that its chassis be well grounded.

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.

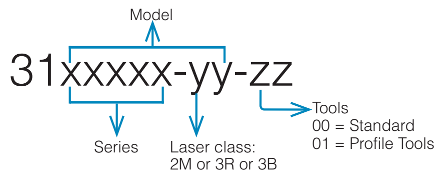
Master 1200/2400 Dimensions

Dimensions of Master 1200 and Master 2400 are the same.



Parts and Accessories

Gocator Part Number Legend



Gocator 2000 Sensors (Model)

Description	Part Number
Gocator 2020 with Class 2M laser (2020-2M)	312020-2M-00
with Class 3R laser (2020-3R)	312020-3R-00
Gocator 2030 with Class 2M laser (2030-2M)	312030-2M-00
with Class 3R laser (2030-3R)	312030-3R-00
with Class 3B laser (2030-3B)	312030-3B-00
Gocator 2040 with Class 2M laser (2040-2M)	312040-2M-00
with Class 3R laser (2040-3R)	312040-3R-00
with Class 3B laser (2040-3B)	312040-3B-00
Gocator 2050 with Class 2M laser (2050-2M)	312050-2M-00
with Class 3R laser (2050-3R)	312050-3R-00
with Class 3B laser (2050-3B)	312050-3B-00
Gocator 2070 with Class 2M laser (2070-2M)	312070-2M-00
with Class 3R laser (2070-3R)	312070-3R-00
with Class 3B laser (2070-3B)	312070-3B-00
Gocator 2080 with Class 2M laser (2080-2M)	312080-2M-00
with Class 3R laser (2080-3R)	312080-3R-00
with Class 3B laser (2080-3B)	312080-3B-00
Standard tools	31XXXX-YY-00
Profile tools	31XXXX-YY-01

Masters

Description	Part Number
Master 200 - for networking up to 2 sensors	30704
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 20x0 Power and I/O cordset, open wire end	30737
10m shielded Gocator 20x0 Power and I/O cordset, open wire end	30738
5m shielded Gocator 20x0 Ethernet cordset, RJ45 end	30741
10m shielded Gocator 20x0 Ethernet cordset, RJ45 end	30742
5m shielded Gocator 20x0 I/O to Master cordset, RJ45 end	30739
10m shielded Gocator 20x0 I/O to Master cordset, RJ45 end	30740

Contact LMI for information on creating cordsets with custom length or connector orientation. The maximum cordset length is 60m.

Accessories

Description	Part Number
Calibration Disk, 40mm	30727
Calibration Disk, 100mm	30728

Gocator 2300 Sensors (Model)

Description	Part Number
Gocator 2330 with Class 2M laser (2330-2M)	312330A-2M-00
with Class 3R laser (2330-3R)	312330A-3R-00
with Class 3B laser (2330-3B)	312330A-3B-00
Gocator 2340 with Class 2M laser (2340-2M)	312340A-2M-00
with Class 3R laser (2340-3R)	312340A-3R-00
with Class 3B laser (2340-3B)	312340A-3B-00
Gocator 2350 with Class 2M laser (2350-2M)	312350A-2M-00
with Class 3R laser (2350-3R)	312350A-3R-00
with Class 3B laser (2350-3B)	312350A-3B-00
Gocator 2370 with Class 2M laser (2370-2M)	312370A-2M-00
with Class 3R laser (2370-3R)	312370A-3R-00
with Class 3B laser (2370-3B)	312370A-3B-00
Gocator 2380 with Class 2M laser (2380-2M)	312380A-2M-00
with Class 3R laser (2380-3R)	312380A-3R-00
with Class 3B laser (2380-3B)	312380A-3B-00
Standard tools	31XXXXX-YY-00
Profile tools	31XXXXX-YY-01

Masters

Description	Part Number
Master 100 - for single sensor (development only)	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

Description	Part Number
5m shielded Gocator 23x0A I/O cordset, open wire end	30862
10m shielded Gocator 23x0A 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
5m shielded Gocator power and Ethernet cordset to Master, 2x RJ45 end	30857

Accessories

Description	Part Number
Calibration Disk, 40mm	30727
Calibration Disk, 100mm	30728

Warranty and Return Policy

Warranty Policy

The sensor is warranted for one year 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.

LMI Technologies Inc. is not responsible for damages to a sensor that are the result of improper packaging or damage during transit by the courier.

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http://jquery.com/

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jQuery.CopyEvents
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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:
http://brandonaaron.net

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jQuery.scaling
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http://eric.garside.name

License:
Scaling 1.0 - Scale any page element

jQuery.scrollFollow
Website:
http://kitchen.net-perspective.com/

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

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Website:
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Support

For assistance regarding a component or product, please contact LMI Technologies.

World

Email	support@lmi3D.com
Web	http://www.lmi3D.com

North America

Phone	+1 604 636 1011
Fax	+1 604 516 8368

Europe

Phone	+31 45 850 7000
Fax	+31 45 574 2500

For more information on safety and laser classifications, please contact:

U.S. Food and Drug Administration
Center for Devices and Radiological Health
WO66-G609
10903 New Hampshire Avenue
Silver Spring, MD 20993-0002
USA

North America

LMI Technologies Inc.
1673 Cliveden Avenue
Delta BC V3M 6V5
Canada
Phone: +1 604 636 1011
Fax: +1 604 516 8368

Europe

LMI Technologies BV
Valkenburgerweg 223
NL-6419AT Heerlen
The Netherlands
Phone: +31 45 850 7000
Fax: +31 45 574 2500