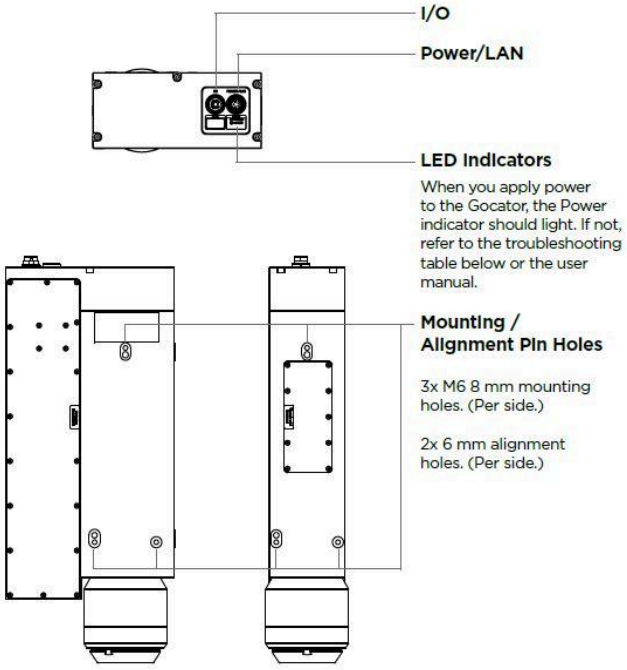
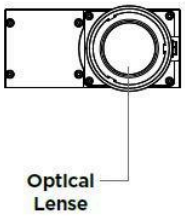
G4000 / G5500 Confocal Sensor First Time User Guide

G4000 Series Coaxial Confocal Sensor Physical Overview

Each sensor model in the Gocator 4xxx series is designed with a unique Clearance Distance (CD), Measurement Range (MR) and Field of View (FOV). For more information about your model, see the sensor specifications in the user manual. The G4020 is shown in the diagrams below.

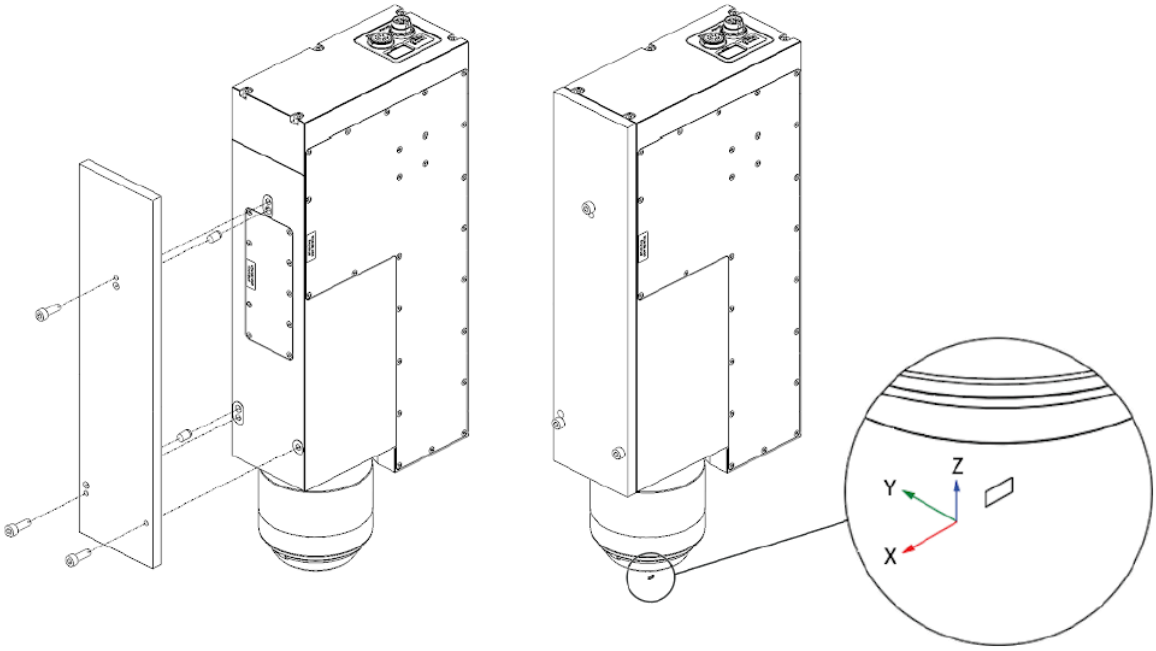




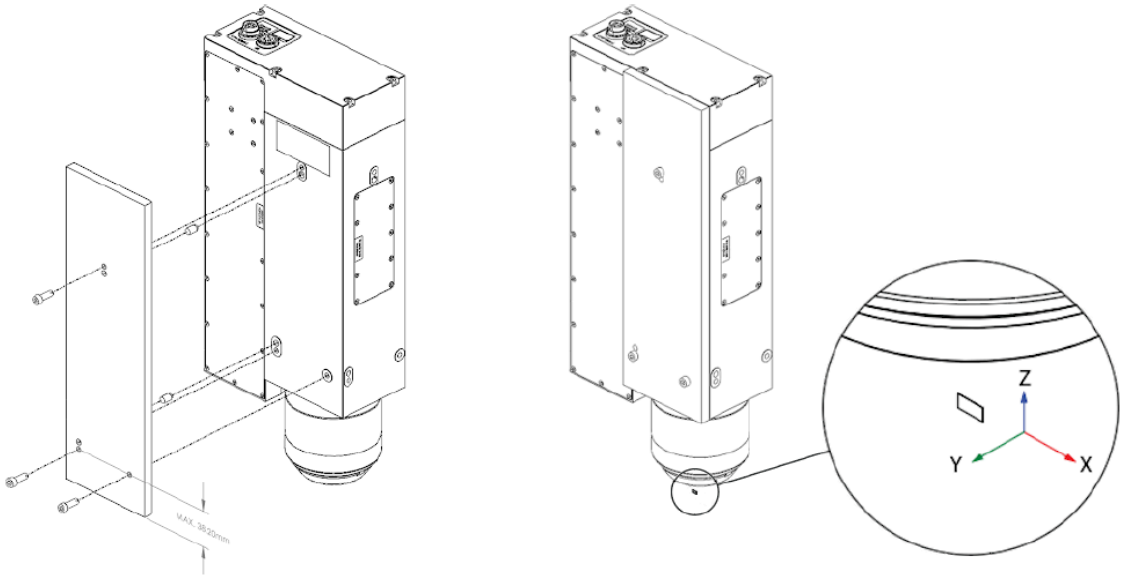
Take care mounting the G4000 sensors as some models can weigh up to 12kg. We recommend having one extra person to assist mounting the sensor.

Mounting the G4000 Series Coaxial Sensor

Mounting holes are available on two sides of the sensor. Use three M6 screws to mount the sensor to a mounting plate. Hole depth on sensor is 8mm.



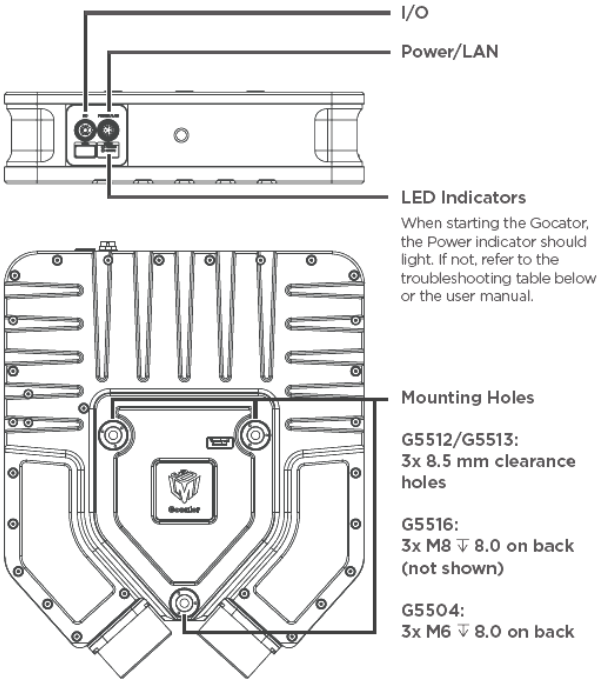
Optionally, use the two 6mm alignment pin holes (depth 6mm) to help align the plate and sensor holes. Note the indicated orientations of the coordinate system in the images above.
Note that mounting is identical for the G4010 model.

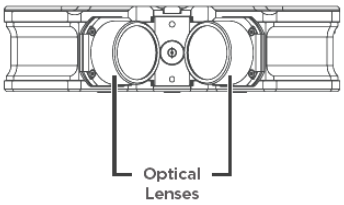


Ensure your transport system operates as smoothly as possible without vibration. The G4xxx series Gocator sensors are highly sensitive and capable of acquiring sub-micron level accuracy measurements, therefore any vibrations from a transport system will be noticeable in your scan data.

G5500 Series Coaxial Confocal Sensor Physical Overview

Each sensor model in the Gocator 4xxx series is designed with a unique Clearance Distance (CD), Measurement Range (MR) and Field of View (FOV). For more information about your model, see the sensor specifications in the user manual. The model showcased throughout this document is the G4020.



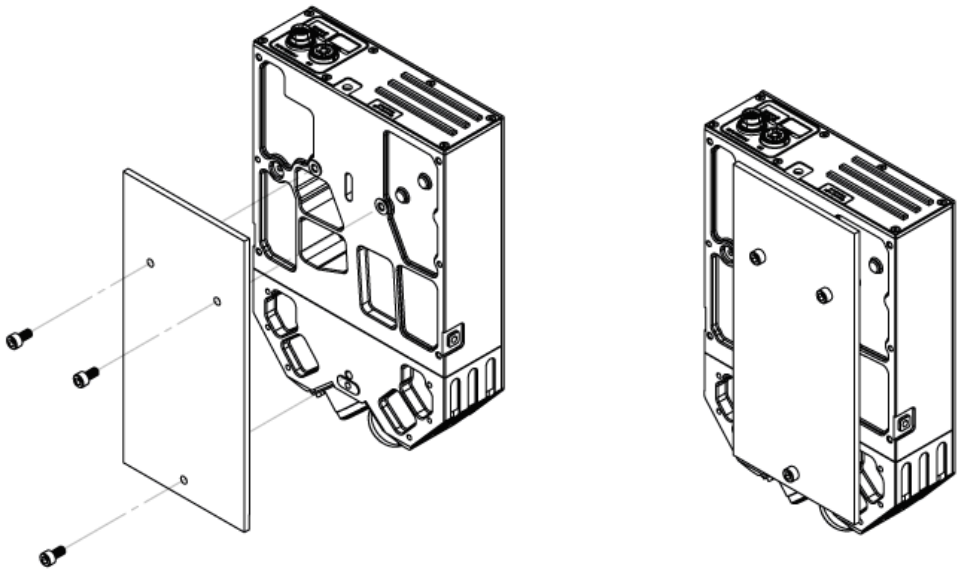


Take care mounting the G5500 sensors as some models can weigh up to 36kg. We recommend having at least one extra person to assist mounting the sensor.

Mounting the G5500 Series Coaxial Sensor

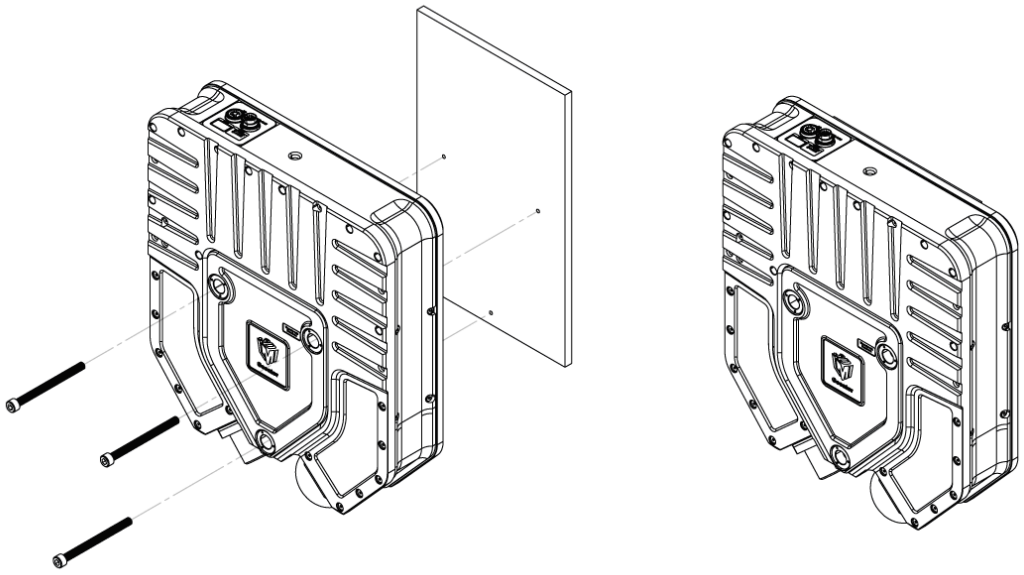
Gocator 5504

Use three M6 screws, hole depth of 8mm

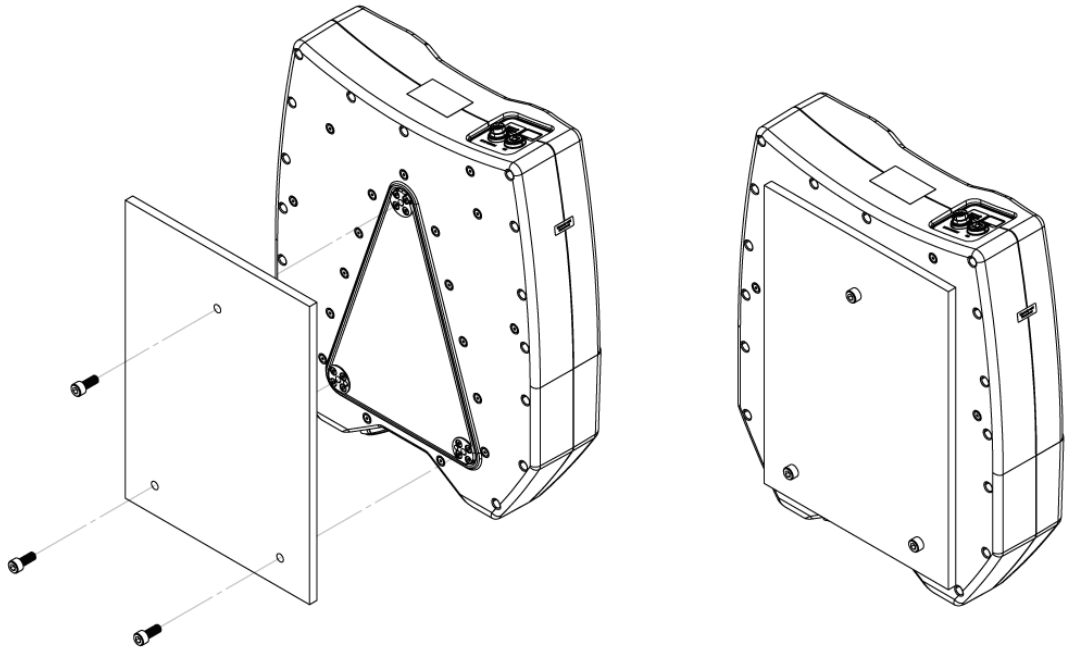


Gocator 5512/5513

Use three M8 DIN912 or 5/16” socket head cap screws ANSI/SASME B18.3, minimum lengths 90mm or 3.5. Front mounting only



Gocator 5516
Use three M8 x 1.25 screws, hole depth of 8mm



Ensure your transport system operates as smoothly as possible without vibration. The G5500 series Gocator sensors are highly sensitive and capable of acquiring sub-micron level accuracy measurements, therefore any vibrations from a transport system will be noticeable in your scan data.

Grounding the G4000/G5000 Confocal Sensor

Gocator housings should be grounded to the earth and the grounding shield of the Gocator I/O cordsets. Gocator 4000 and 5500 series sensors are designed to provide adequate grounding through the mounting surfaces and screws. Always check grounding with a multimeter to ensure electrical continuity between the mounting frame and the Gocator connectors. The frame, or electrical cabinet, that the Gocator is mounted to must be connected to earth ground.

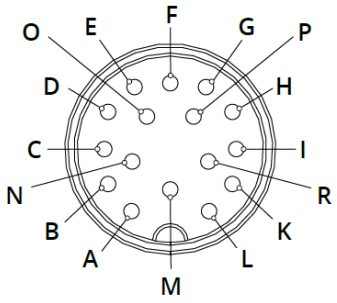
To minimize interference with other equipment, the High Power & Ethernet cordset can be grounded by terminating the cordset shield before the split. The most effective grounding method is to use a 360-degree clamp. For instructions please see the user manual.

Minimize voltage potential between system ground (ground reference for I/O signals) and sensor ground by using shielded cables with shield grounded at both ends. The sensor housing should be connected to earth ground. The +24-48V power supply used with Gocator 4000/5500 sensors should be an isolated supply with inrush current protection. 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.

Connecting Your G4000/G5500 Sensor to a Host Computer

The connector pins on the G4000/G5500 Gocator are shown in the diagrams below

Power/LAN



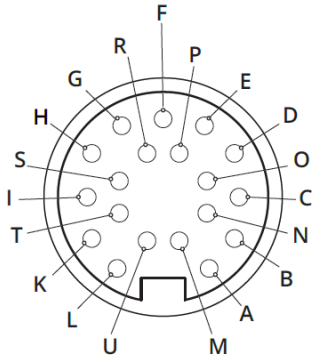
View: Looking into the connector **on** the sensor.

Pin	Function	Conductor Color
L	24-48V (MAIN)*	Grey/Red
M	GND_24-48V (MAIN)**	Grey/Black
L	24-48V (MAIN)*	Pink/Red
M	GND_24-48V (MAIN)**	Pink/Black
A	24-48V (AUX)*	Red
N	GND_24-48V (AUX)**	Black
A	24-48V (AUX)*	Orange/Red
N	GND_24-48V (AUX)**	Orange/Black
B	24-48V (AUX)*	Yellow/Red
C	GND_24-48V (AUX)**	Yellow/Black
O	-	White/Red
D	-	White/Black
E	Ethernet MX1+	Violet/Red
F	Ethernet MX1-	Violet/Black
G	Ethernet MX2+	Green/Red
H	Ethernet MX2-	Green/Black
R	Ethernet MX3-	Blue/Red
P	Ethernet MX3+	Blue/Black
I	Ethernet MX4+	Brown/Red
K	Ethernet MX4-	Brown/Black

*All 24-48V wires (MAIN and AUX) are soldered together.

**All GND_24-48V (MAIN and AUX) wires are soldered together.

I/O

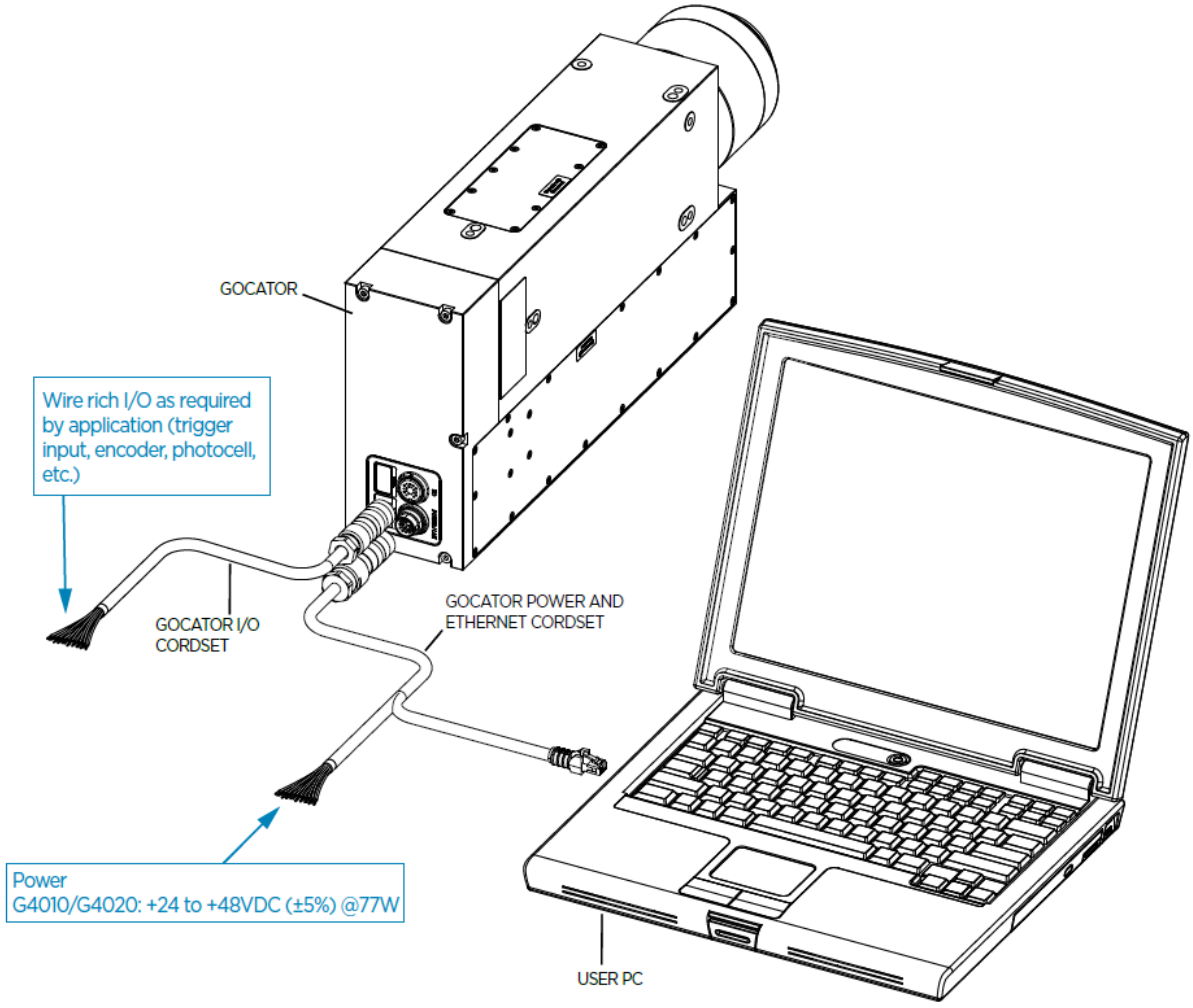


View: Looking into the connector **on** the sensor.

Pin	Function	Conductor Color
D	Trigger_in+	Blue/Red
H	Trigger_in-	Blue/Black
N	Out_1+ (Digital Output 0)	Brown/Red
O	Out_1- (Digital Output 0)	Brown/Black
S	Out_2+ (Digital Output 1)	Green/Red
T	Out_2- (Digital Output 1)	Green/Black
M	Encoder_A+	Pink/Red
U	Encoder_A-	Pink/Black
I	Encoder_B+	Yellow/Red
K	Encoder_B-	Yellow/Black
A	Encoder_Z+	White/Red
L	Encoder_Z-	White/Black
B	Serial_out+	Purple/Red
C	Serial_out-	Purple/Black
E	Reserved	Red
G	Reserved	Black
P	Reserved	Gray/Red
F	Reserved	Gray/Black & Orange/Black
R	Reserved	Orange/Red (not connected)

We recommend using LMI manufactured Gocator cordsets with the G4000/G5500 series sensor, and ensuring that your system is powered down before connecting or removing the cable to your sensor.

The Power/LAN cable splits into a power source cable and an ethernet RJ45 jack. The G4xxx sensor can be powered by +24 to +48VDC (+/-5% @ 77W). The RJ45 ethernet cable must be connected directly to your computer to access the Gocator software. Use a RJ45 to USB adapter if needed, ensuring it has a minimum speed of 1gbps.



If this is the first time connecting an LMI sensor to this host computer, you must change the network settings on the host computer.

<u>In Windows 10</u>

1. From the Start menu, launch the Settings app and click Network & Internet, and then click Change adapter options under Advanced network settings..
2. Right-click desired network connection, and then click Properties
3. On the Networking tab, click Internet Protocol Version 4 (TCP/IPv4), and then click Properties
4. Select “Use the following IP address” option
5. Enter IP Address “192.168.1.5” and Subnet Mask “255.255.255.0”, then click OK

In MAC OS 11

1. Click Apple menu > System Preferences, and then click Network
2. In the list to the left, select Ethernet
3. Click Advanced, click Hardware, click the Configure pop-up menu,and set it to "Manually"
4. Enter IP Address "192.168.1.5" and Subnet Mask "255.255.255.0", and then click Apply

LMI Gocator sensors are shipped with the following default network configuration:

DCHP	Disabled
IP Address	192.168.1.10
Subnet Mask	255.255.255.0
Gateway	0.0.0.0

Accessing the G4000/G5500 Sensor UI On Sensor

The Gocator G4xxx coaxial sensor software can be accessed directly on your sensor using a web browser when you want to access your sensor quickly.

1. Ensure your G4xxx sensor is powered on and the ethernet cordset is connected to your computer
2. Open a web browser window
3. Enter the default sensor IP address 192.168.1.10

We recommend running GoPxL Manager on PC whenever possible for a better user experience. Gocator confocal sensors are configured through an easy-to-use web-based interface called GoPxL, which provides built-in measurement tools, I/O connectivity, and multi-layer profiling support. Although GoPxL can run on-sensor, with confocal sensors the frequency is limited. Therefore, in most confocal applications, you should configure and run sensors through the PC-based version.

Using GoPxL Manager on PC

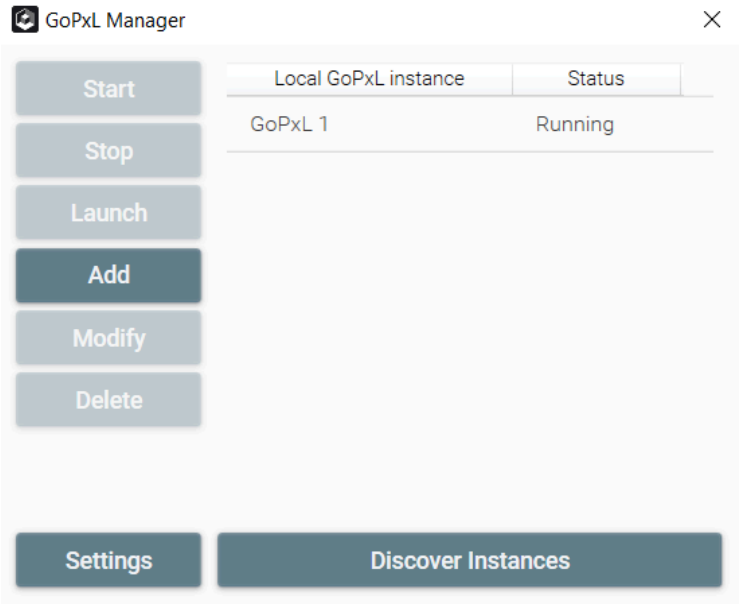
GoPxL Manager lets you create, launch, and manage GoPxL PC instances. These provide sensor acceleration, as well as let you evaluate scan data or configure tools while not connected to your sensor. You can also launch the discovery tool from GoPxL Manager to find all sensors and PC instances visible on the network.

Run the GoPxL x64 shortcut inside the Software_GoPxL_UserTools download package, which will open an instance of GoPxL in a web browser as well as launch GoPxL Manager.

1. Open downloaded folder Software_ GoPxL_UserTools
2. Open the GoPxL_UserTools folder
3. Run GoPxL x64 by double clicking the shortcut
    a. This will run GoPxL Manager in the system tray
    b. An instance of GoPxL will automatically open in a new browser tab

4. To open the GoPxL Manager window, click on the GoPxL Manager icon in the Windows taskbar or system tray

   a. In the GoPxL Manager window you can see the running instance, or instances of GoPxL in the Local GoPxL Instance table
      i. Click the Discover Instances button to see more details about existing instances
      ii. You can run multiple instances of GoPxL on PC if desired from the GoPxL Manager window. This will allow you to run multiple inspection windows simultaneously, each with their own tools and jobs.



Adding a Sensor in GoPxL (PC)

This step is only required when running an instance of GoPxL on PC. If you have accessed your G4000/G5500 Sensor directly (192.168.1.10), please disregard this step. We recommend running GoPxL on PC for most applications, as mentioned previously. Running GoPxL on PC enables your PC to lend processing power that will help with scanning at higher frequencies.

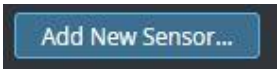
After the following steps, you will notice that this page will be redirected to a different IP address

1. Under the System Category on the far left side of the GUI, click on the Discover Page
2. You will see your sensor listed in the panel
   a. Confirm you are connecting the correct sensor by confirming the serial number here matches the sticker on the sensor housing
   b. You cannot connect the PC instance of GoPxL to your sensor if the PC and sensor are not the same version. If your sensor is connected to the network, but not shown as available, ensure that you are running the same version of GoPxL

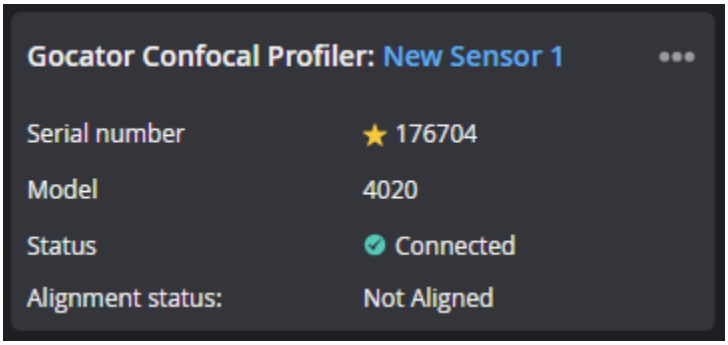
on sensor as your PC. To check your sensor software version, open a web browser to the default sensor address (i.e., 192.168.1.10) to access the sensor.

c. Also make sure that the sensor is not running otherwise the status will be shown as “In use” or “Unconnectable” and you will not be able to connect it.

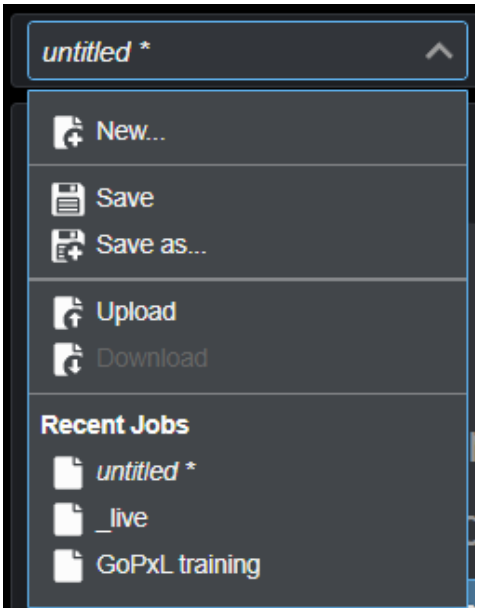
3. Navigate to the Design Page by clicking on the title in the column
    a. Click Add New Sensor



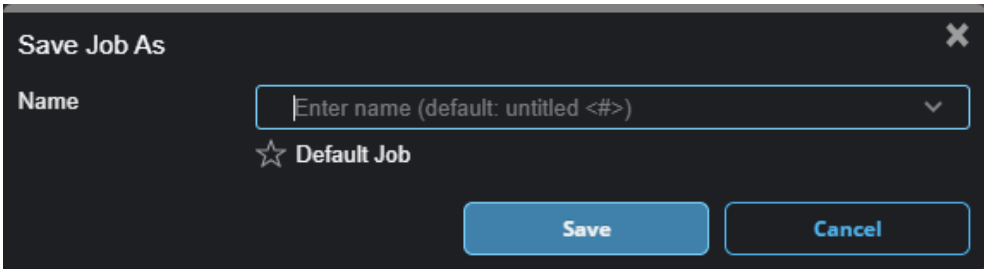
    b. In the Scan Engine drop down menu select Gocator Confocal Profiler
        i. You can Input a Sensor Group Name in the Name field
    c. Select the Add box of the sensor(s) you want to add
        i. If you have more than one sensor you can enable Manage sensor group layout
    d. Click Add Sensor
        i. Your sensor will show up as Connected



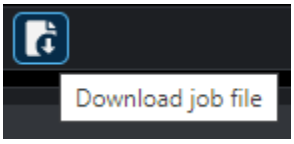
4. Navigate to the Discover page
    a. Note that the sensor you added is now showing In Use
5. Switch to the original browser tab with GoPxL GUI running on-sensor (192.168.1.10). Note how, after connecting a sensor to a PC instance, this tab explains the sensor is controlled by another instance
6. Save your settings as a new Job
    a. Open the job menu and click “Save as…” to save a new job



b. Enter a title and click Save



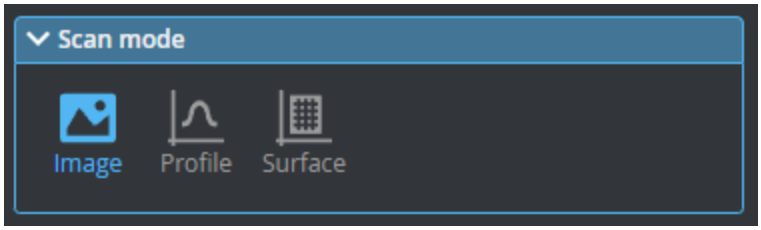
c. Navigate to the Jobs page
d. Select the newly created job by clicking on it
e. Download the saved job to your computer by clicking on the download Job File icon



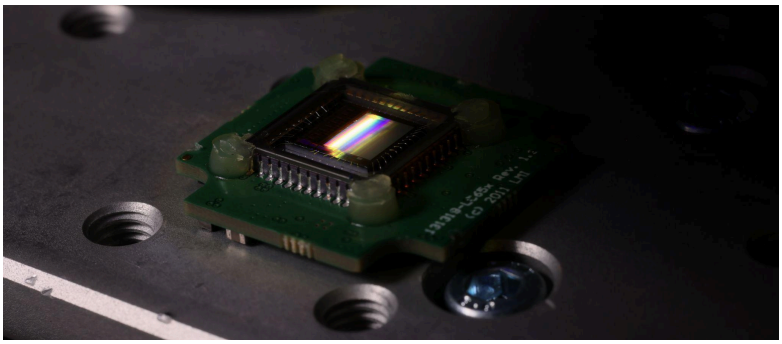
Preparing Your Object for a Single Exposure Profile Scan

You can find the right Exposure setting for your application by using the Image Scan Mode. In Image mode, the data viewer displays images and spots directly from a sensor's camera. Use the data viewer to display exposure, spot and dropout information to begin properly setting system exposure for scanning

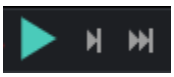
1. Navigate to the Scan Page and click on it
2. In the Scan Mode panel select Image



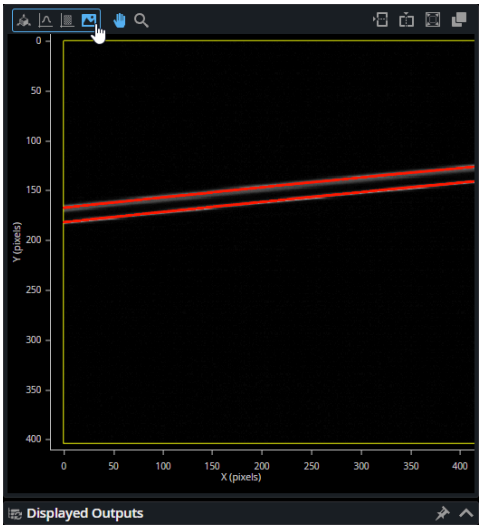
3. In the Trigger panel use Time as Source
    a. This will allow the Gocator to acquire an image without requiring the transport system to be moving, as we want to acquire a stationary profile image
    b. Frame Rate should not affect a stationary Image scan too much at this stage. This can be left at the default value
4. Ensure that your object is directly under the Gocator and within proper Measurement Range of the G4xxx sensor
    a. It may be easier to find the correct position and height of your object under the sensor while your sensor is turned on and continuously acquiring an image



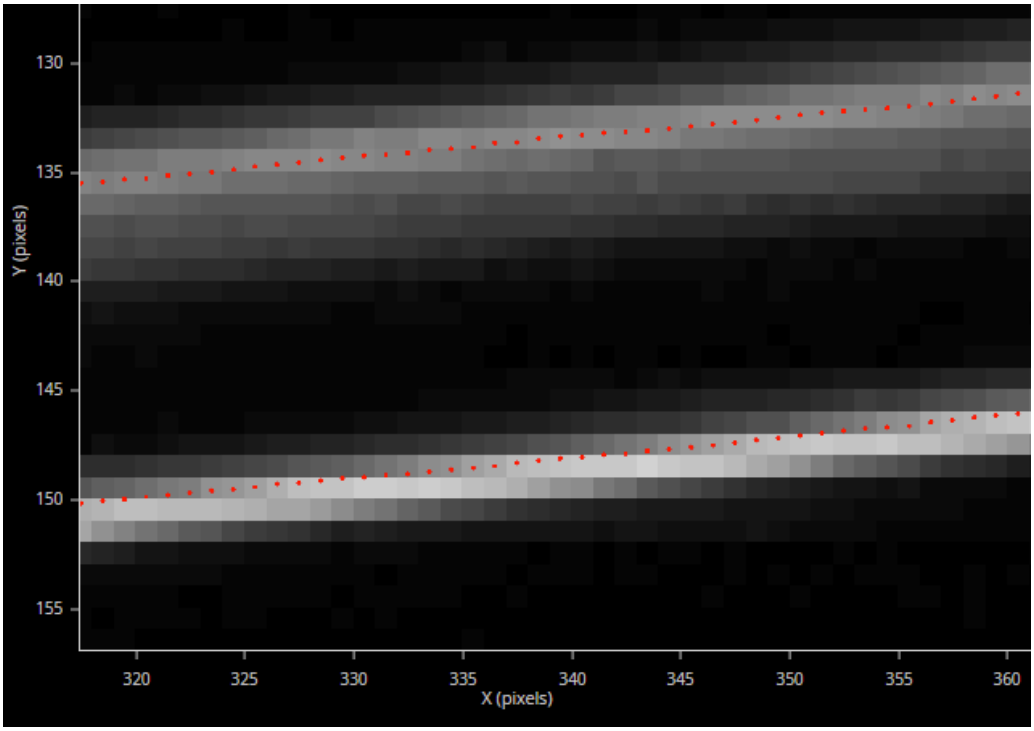
    b. Click the ‘play’ triangle icon in the top right corner of the UI to start and stop your sensor



    c. You will see red profile line data when your object is in the correct position and height under the G4xxx sensor



5. Adjust Exposure to acquire the best scan possible. Exposure determines the duration of camera and light-source on-time, given in microseconds (µs). Be aware that increasing exposure time decreases the maximum speed
    a. Scroll down to the Exposure panel and click to open
    b. For now remain in Single Exposure Mode
        i. Light Intensity can remain at the default value of 100
    c. Set Exposure according to the material of your object
        i. In general, shiny and mirror-like surfaces require a short pulse width, while low-gloss surfaces require a high pulse width
        ii. With Scan mode in Image, zoom in, and move the pointer over the profile to find the highest intensity value. Check the entire region of interest on the profile. The image in the active measurement area should not be saturated. The intensity value range is from 0 to 255. We recommend using a small safety margin and keeping the maximum intensity below 240
    d. You will know you have a good starting Exposure value when you see a small cluster of white, gray and black pixels around the data points on the Display Viewer window (example shown below).

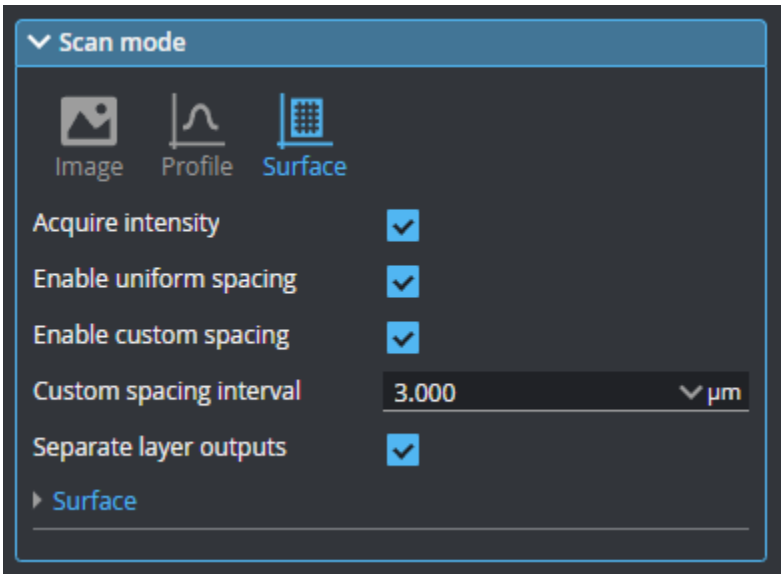


    Once you have completed this step, you can make further fine-tuned adjustments to Exposure after acquiring a Surface Scan
6. Acquire a Profile Scan
    a. Navigate to the Scan page
    b. In Scan Mode select Profile
    c. Start and stop the sensor as desired in coordinated with your transport system

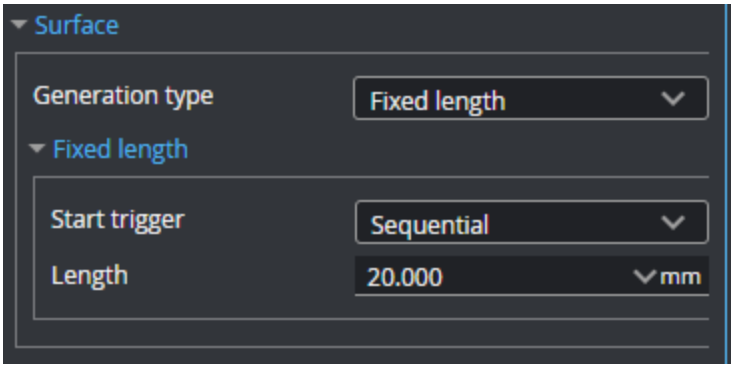
Acquiring a Surface Scan

This section will walk you through acquiring a surface scan for the first time. For more detail on how to use a coaxial or confocal Gocator sensor please refer to the GoPxL for G5 Sensor User Manual. Be sure that you have set up your Exposure and Alignment settings, outlined in the previous section Preparing Your Object for a Single Exposure Profile Scan

1. Navigate to the System Category in the expandable menu on the far left of the screen
    a. Click on the Alignment Page
    b. You will have to find the encoder resolution value of your transport system or scan bed
    c. If you want to use Time as a Trigger you must make sure you match Speed to your transport system speed
2. Click on the Scan Page
    a. Enable Uniform Spacing is the resampling of your data points. Note that most measurement tools cannot be used if Uniform Spacing is turned off
3. Navigate to the Scan Mode panel. Click on the tab to expand the panel if setting options are hidden
    a. Select Surface scan

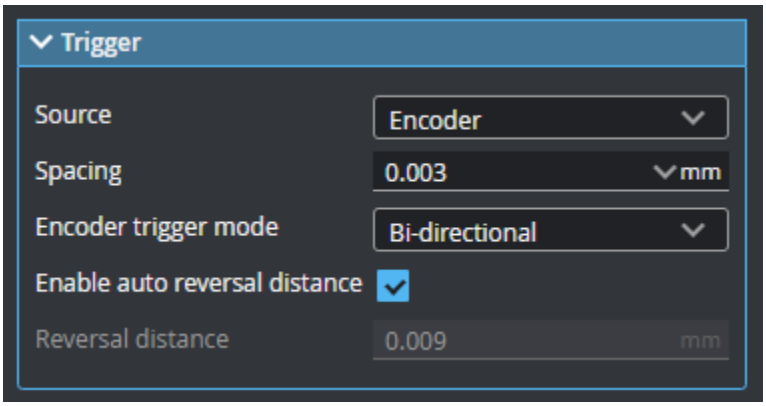


    b. Turn on Acquire Intensity by checking the box
        i. Intensity acquires a black and white image laid over top of the 3D Surface scan
    c. Ensure Uniform Spacing is enabled by checking the box
        i. We recommend enabling Uniform Spacing because measurement tools rely on uniform spacing
4. Expand the Surface menu by clicking on the blue Surface title



a. To get started we recommend using Fixed Length as your Surface Generation Type
    i. Leave the Start Trigger as Sequential
    ii. Set the Length to the desired size of your completed scan image. This tells the Gocator to create an image after it senses 'x' mm have traveled under the sensor
    iii. When setting your Length be sure that your transport system fully travels this distance. You will not generate a completed point cloud image until an object completes the travel Length you have input underneath the sensor

5. Expand the Trigger panel

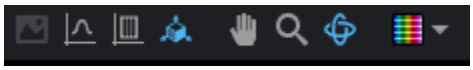


a. Select Encoder as Source if you are using a transport system equipped with an encoder. We highly recommend using an encoder whenever possible to generate the best quality scans
b. With Encoder as Trigger, set Trigger Spacing. After the first scan, adjust this value depending on your desired spacing between your Y axis data points

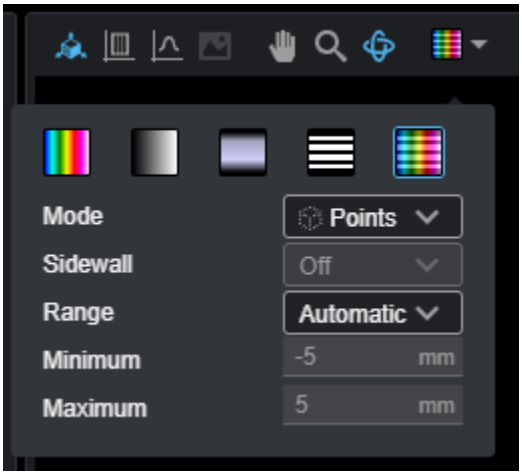
6. Now you're ready to acquire scan data
    a. Use Encoder as a Trigger
        i. Click Start Scanning 
        ii. Start your transport system movement
        iii. Ensure the distance your transport system travels is equal or more than the Fixed Length you set earlier
        iv. Turn off Scanning when you are finished

Once you have acquired a surface scan and have a 3D point cloud rendered in your Display Viewer window, use the following tips to navigate your scan data

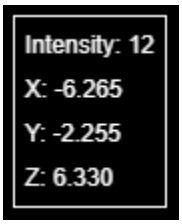
7. If you have not changed any settings, the usual default view when first creating a surface scan is Top / Surface view



    a. Change to **Profile/ Front** view to see a side profile view of your scan
8. To view other angles of your 3D point cloud, change to Perspective view by clicking the button 
    a. In Perspective view, drag your mouse to orbit your scan
    b. Hold down “shift” while dragging your mouse to Pan
    c. Double click on an area of interest on your scan to make that data point the center
9. Use your mouse wheel to zoom in on your scan. Keep zooming until our scanned image dissolves into individual data points
    a. In the Display Viewer toolbar, click on the **Configure Surface Display Options** drop down menu



    b. In the Mode drop down menu select **Points** view
    c. Hover over a single data point of your 3D point cloud to see the values of that data point. This will look like a white box with Intensity, X, Y and Z values in it

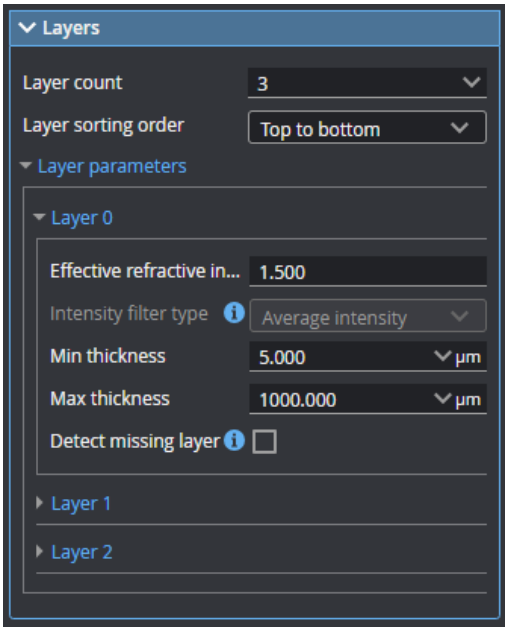


    d. Zoom back out view the grid in the Display Viewer and make sure you are in Perspective view. Orbit your scanned image to see where your point cloud is in relation to the Z, Y and Z axes

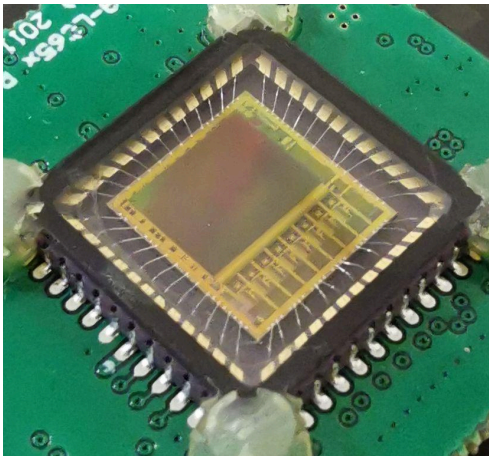
Acquiring a Multi Layer Surface Scan

Before acquiring a multi layer scan, ensure you have set up your Exposure and Alignment settings outlined in the section Preparing Your Object for a Single Exposure Profile Scan as well as adjusted your sensor settings to acquire a Surface Scan as outlined in the section Acquiring a Surface Scan. We walk through an example setup to help provide context.

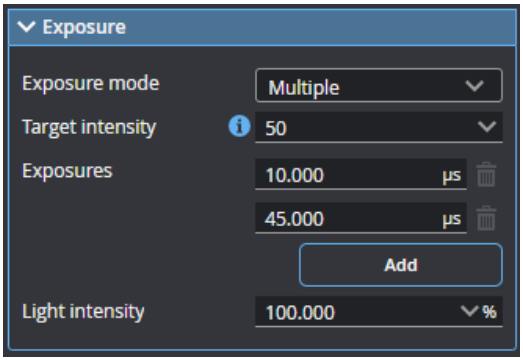
1. Navigate to the Scan Page
2. Adjust Layers settings to acquire a clean scan of each layer of your object
    a. Open the Layers panel
    b. In Layer Count input the desired number of layers to appear in your Surface scan. In the example provided, we are setting up three layers for our scan



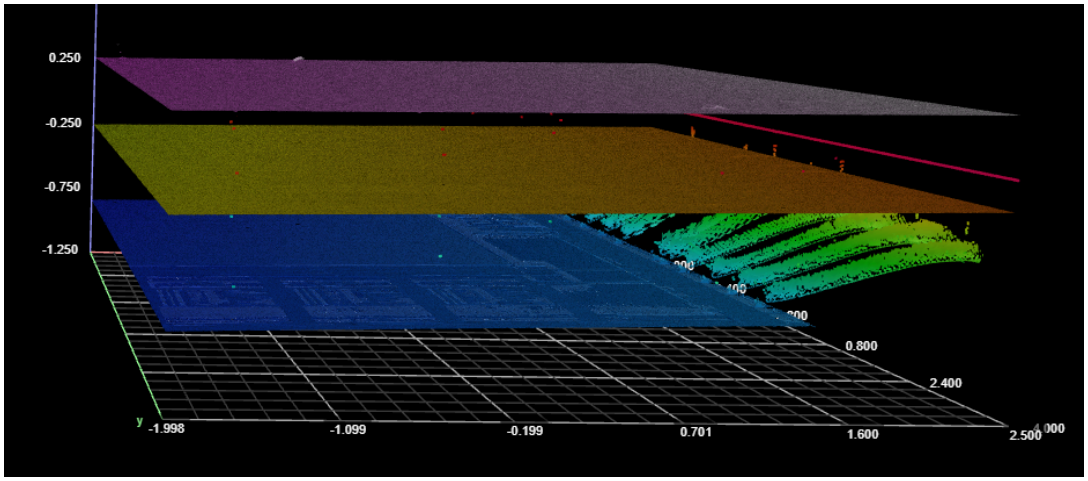
    c. Select your desired organization method of Layer Sorting Order
    d. Open the Layer Parameters menu, in blue, of each layer
        i. Input the Effective Refractive index of the material of each layer. See the Transmissivity Index of Common Materials table below as a guideline to get started. This guideline is not absolute, these values vary due to ambient temperature and differing traits of each material. Please check with your specialists to ensure you have the correct transmissivity index value for your product
        ii. Input the Minimum and Maximum thickness of each layer
3. Place your object under the G4xxx sensor at the correct position and height so that all layers are visible while acquiring a scan
    a. Walk through the exposure setting steps of Preparing Your Object for a Single Exposure Profile Scan, However in this case we demonstrate how multiple exposure can be used to improve the scan result. The example shown is a silicon based integrated circuit with soldered threads and covered with glass



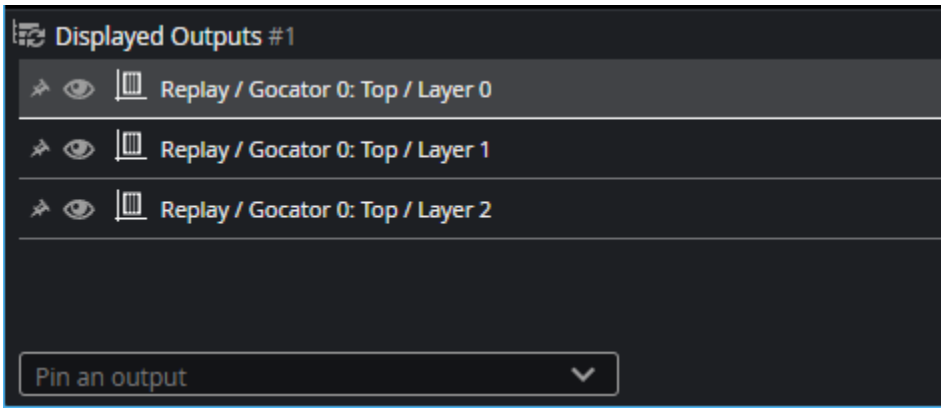
4. Setting Multiple Exposures
    a. Open the Exposure panel
    b. In Exposure Mode select Multiple



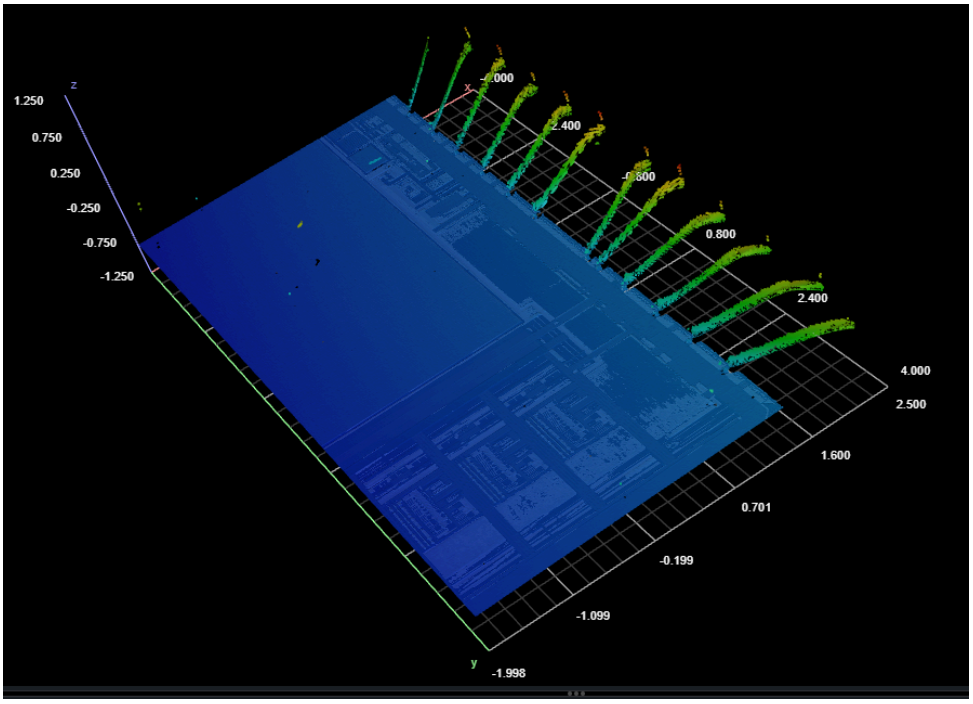
    c. In Exposures click Add to create an additional Exposure level
        i. In the example provided, we use two exposures for three layers
    d. Adjust the Exposure levels using the same process as [Preparing Your Object for a Single Exposure Profile Scan](). Ensure that each layer has a visible profile line and a small cluster of pixels surrounding data points
5. Acquire a Surface scan, following the steps outlined in [Acquiring a Surface Scan]()



6. View individual layers of your scan
    a. At the bottom of the Display Viewer window is the Displayed Outputs panel. Click to expand
    b. Each Layer listed here coincides with a layer in the Surface Scan



    c. Hide layers by clicking on the ‘eye’ icon. This will allow you to focus on the desired layer and plan measurement tool application



7. To learn how to add Measurement Tools, please watch our instructional videos on YouTube Introduction to Three Measurement Tools and Measurement Tools for Multi Layer Scans

Transmissivity Index of Common Materials

Note that the following values are suggested guidelines and are not absolute. These values vary due to ambient temperature and differing traits of each material. Please check with your specialists to ensure you have the right transmissivity index value for your product.

Glass	1.5
Corning Gorilla Glass© (590nm)	1.5 - 1.51
Plastic (polystyren)	1.59
Heavy gear oil	1.505 - 1.542
Machining lubricant	1.48 - 1.518
Gasoline (91/94 octane)	1.433
Water	1.33