

Micrometric Distance Sensor for Arex™



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Micrometric Distance Sensor
Application Note
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This Application Note refers to:

- Micrometric Distance Sensor for Arex™
- Lighter™ Suite version **6.4** and later.

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Conventions

Warnings



This symbol identifies a hazard or procedure that, if incorrectly performed, could cause personal injury or result in equipment damage. It is also used to bring the user's attention to details that are considered **IMPORTANT**.

High Voltage



This symbol alerts the user they are about to perform an action involving, either a dangerous level of voltage, or to warn against an action that could result in damage to devices or electrical shock.

Laser Caution



This symbol alerts the user they are about to perform an action involving possible exposure to laser light radiation.

ESD

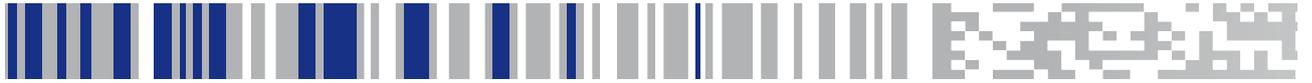


This symbol identifies a procedure that requires you take measures to prevent Electrostatic Discharge (ESD) e.g., use an ESD wrist strap. Circuit boards are most at risk. Please follow ESD procedures.

Notes



This symbol draws attention to details or procedures that may be useful in improving, maintaining, or enhancing the performance of the hardware or software being discussed.



Chapter 1

Supported Topologies and Operations

SYSTEM CONFIGURATION starting on page 2
HOW THE SYSTEM WORKS starting on page 3

System Configuration

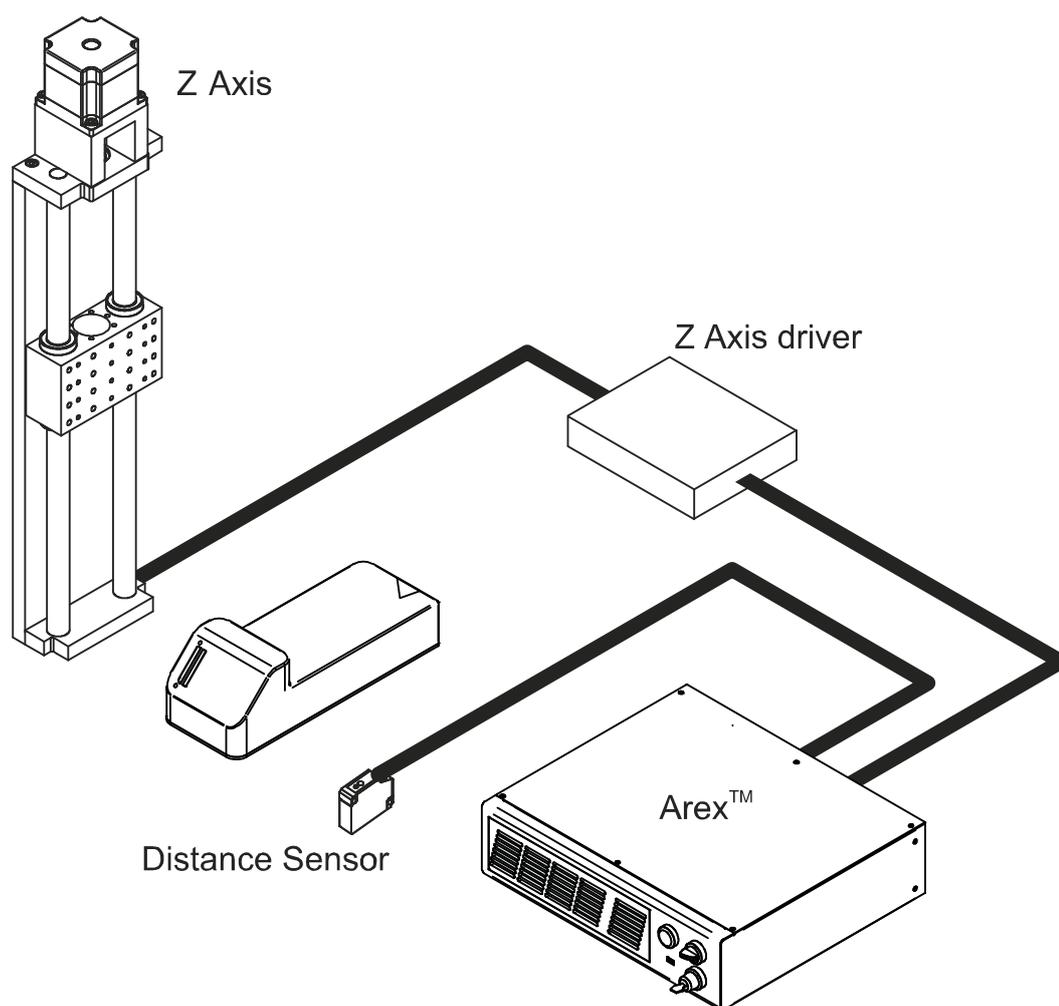


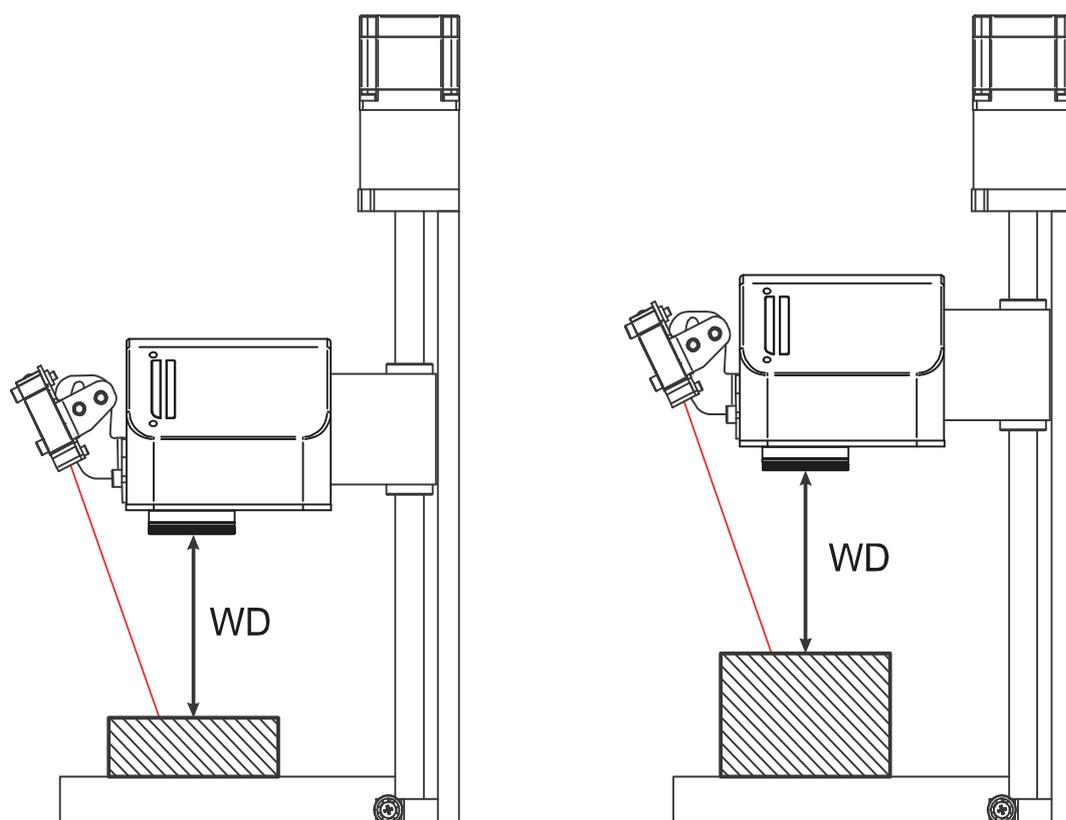
Figure 1: Integration with Arex™

How The System Works

The purpose of the system is to maintain the correct **Working Distance (WD)** for the F-Theta scan lens in use, even if the objects to be marked have different heights.

To achieve this result, the **DynamicFocusHandlerArexUniQ** script has been developed. The script is able to make a distance sensor work together with the Z Axis controller integrated in the marker in order to maintain the correct working distance (WD).

The distance sensor communicates with the laser marker through the RS232 interface and is powered through the ENCODER connector.



WD = Working Distance

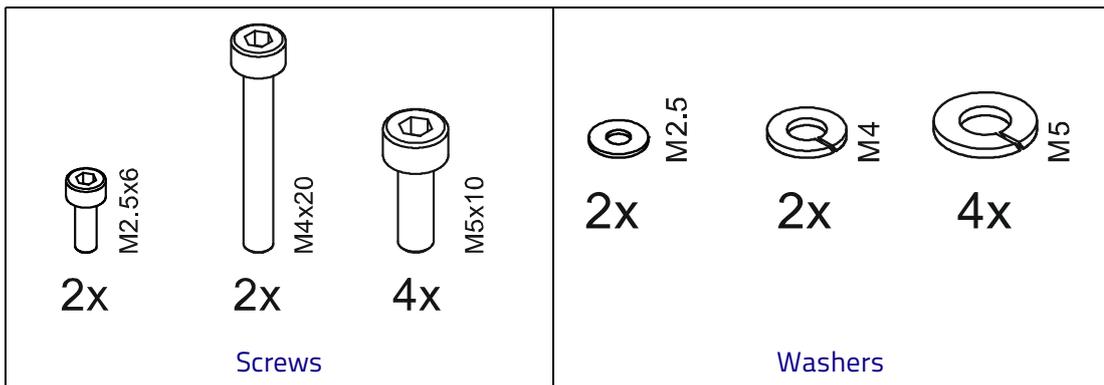
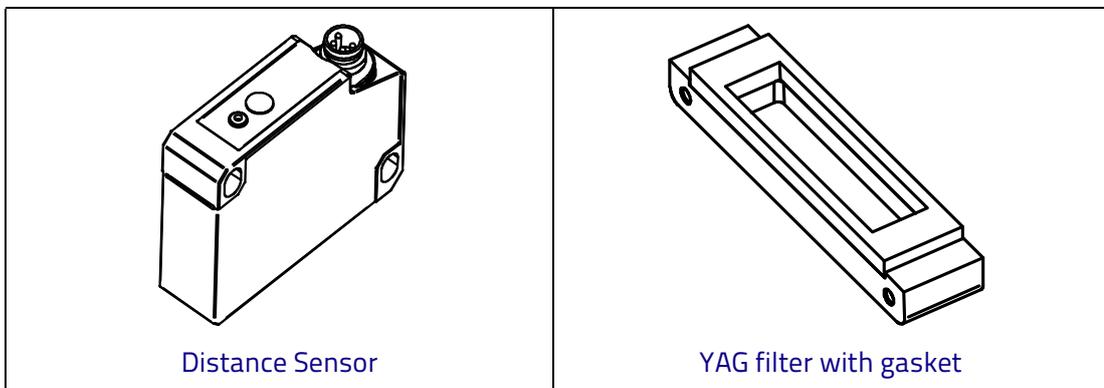
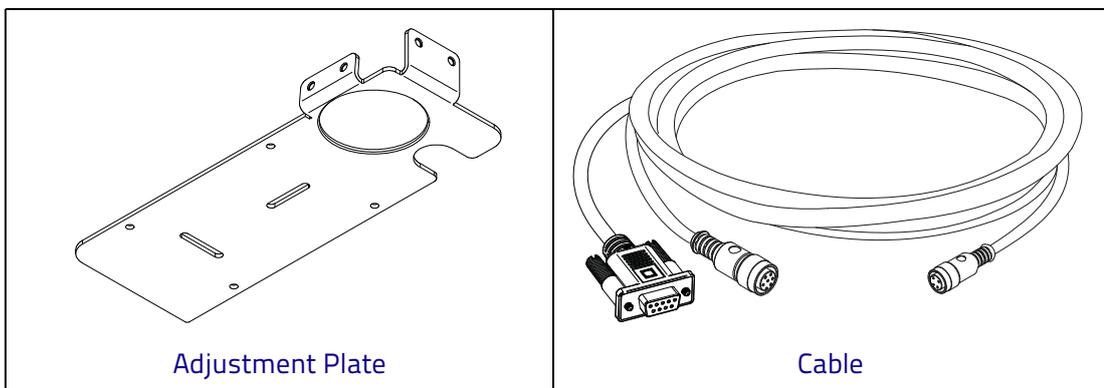
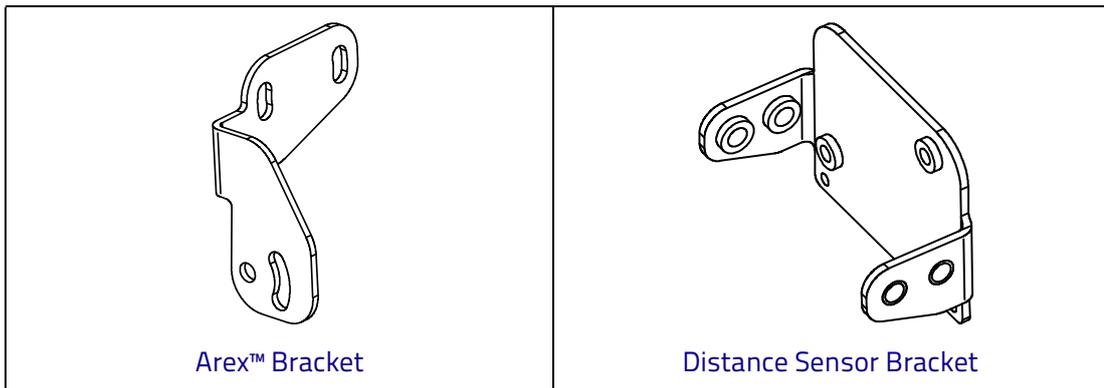
Figure 2: How the system works



Chapter 2 Hardware Installation

CONTENT OF THE PACKAGING starting on page 6
MOUNTING INSTRUCTIONS starting on page 7
DISTANCE SENSOR CONNECTIONS starting on page 11
SENSOR POSITIONING starting on page 12
RECOMMENDATIONS ON SENSOR POSITIONING starting on page 14

Content of the packaging



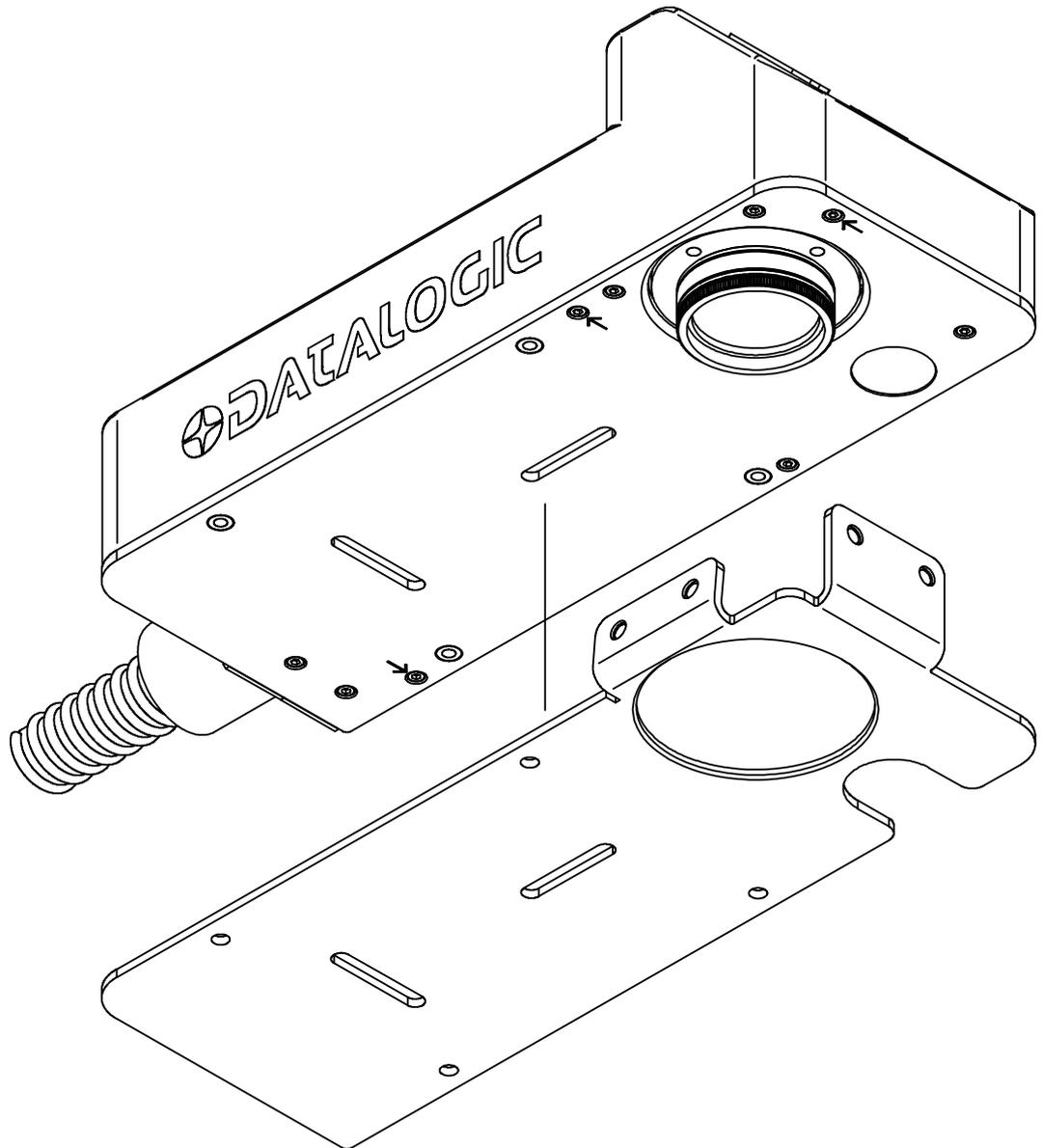
Mounting Instructions



Install the system following the instructions present in the relative installation manual.

NOTE

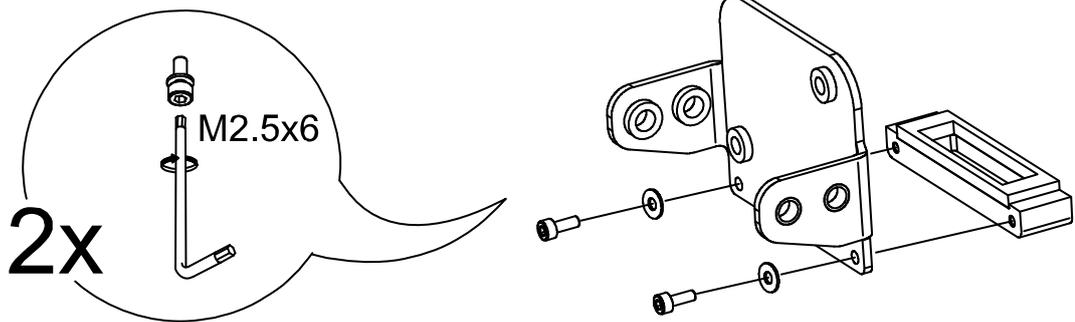
Mount the adjustment plate on the base plate of Arex™:



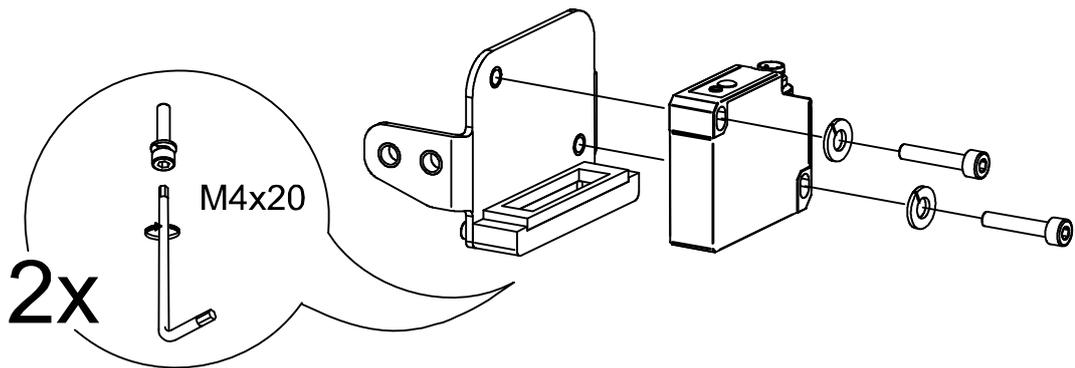
WARNING

The assembly of the following accessory changes the fixing distance by the value of the base plate thickness (3 mm).

Mount the YAG filter with gasket on the Distance Sensor sensor bracket:



Mount the Distance Sensor on the bracket:

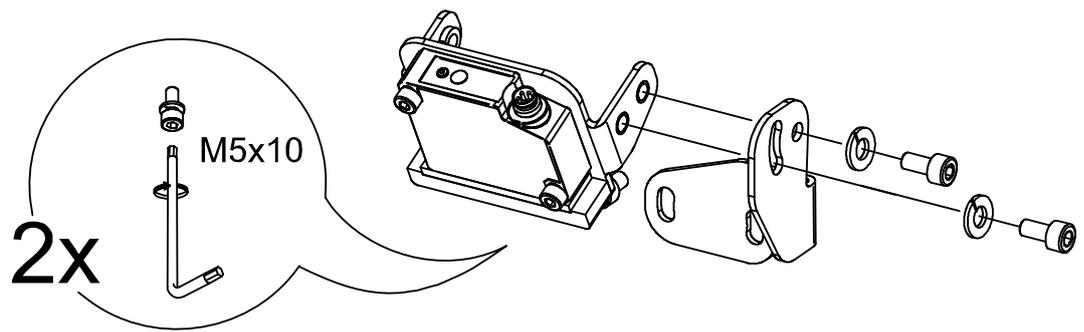


NOTE

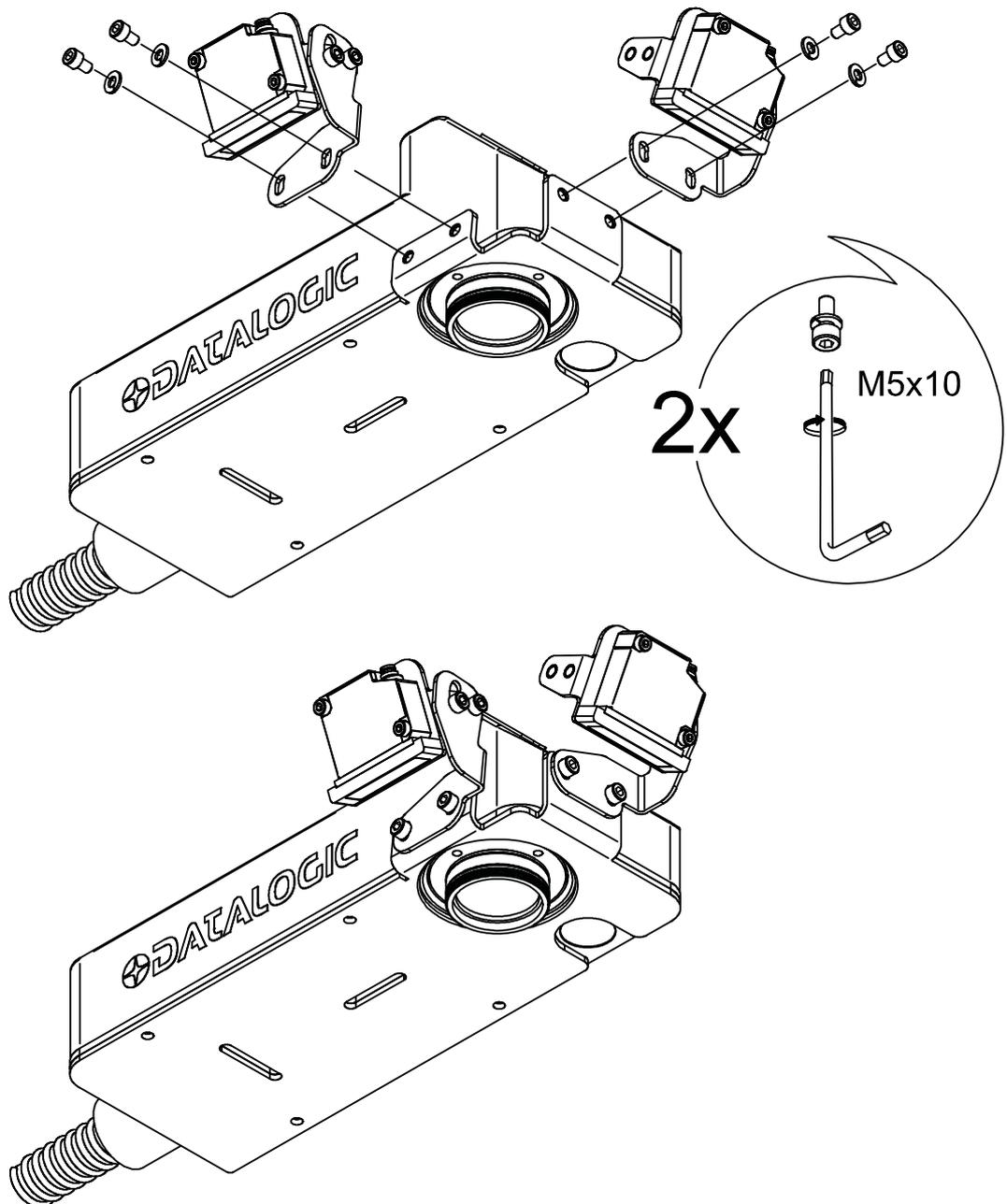
Fix the sensor so that it is in contact with the filter gasket.

Mounting instruction for the F-Theta scan lens 100L-160S-160L-254S

Mount the Distance Sensor and the brackets like the following picture:

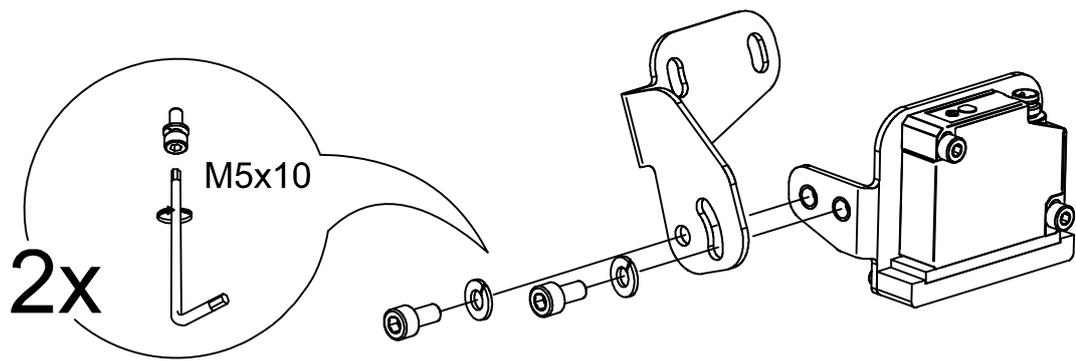


Mount Distance Sensor and the brackets on the side/front of the Arex™ scan head:

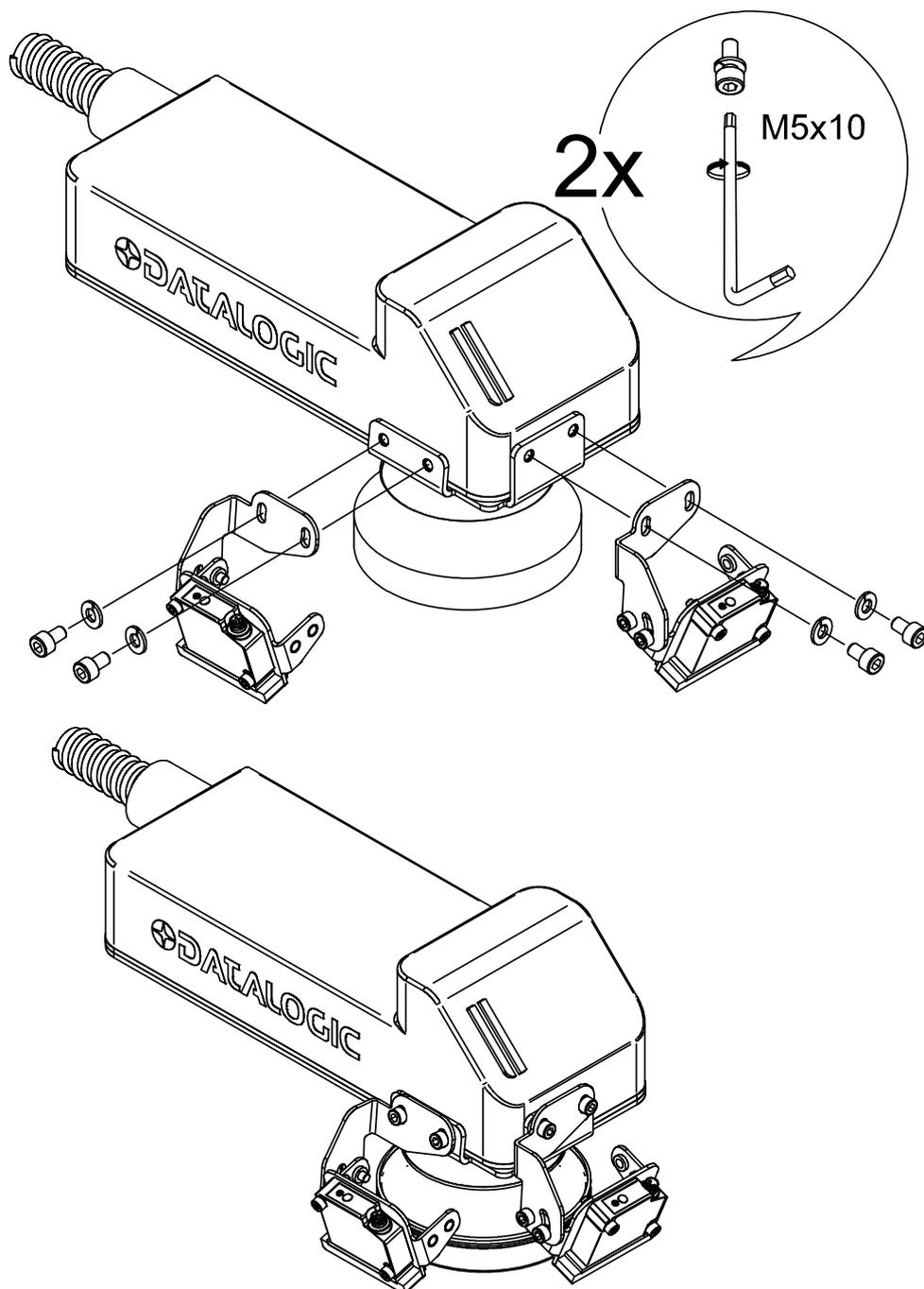


Mounting instruction for the F-Theta scan lens 254L

Mount the Distance Sensor and the bracket like the following picture:



Mount Distance Sensor and the brackets on the side/front of the Arex™ scan head:



Distance Sensor Connections

This section describes the system wiring. Carry out the connecting operations as described below.



NOTE

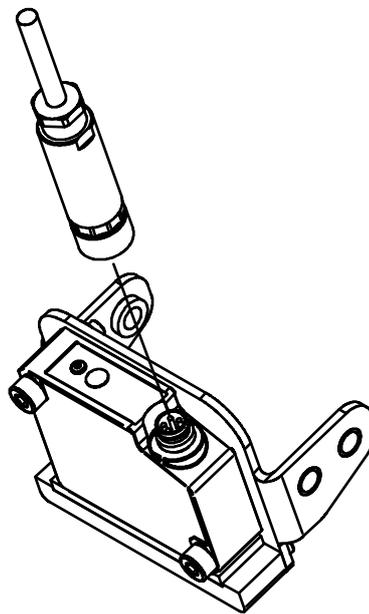
Refer to the corresponding user manual of the laser marker product for the main connections.



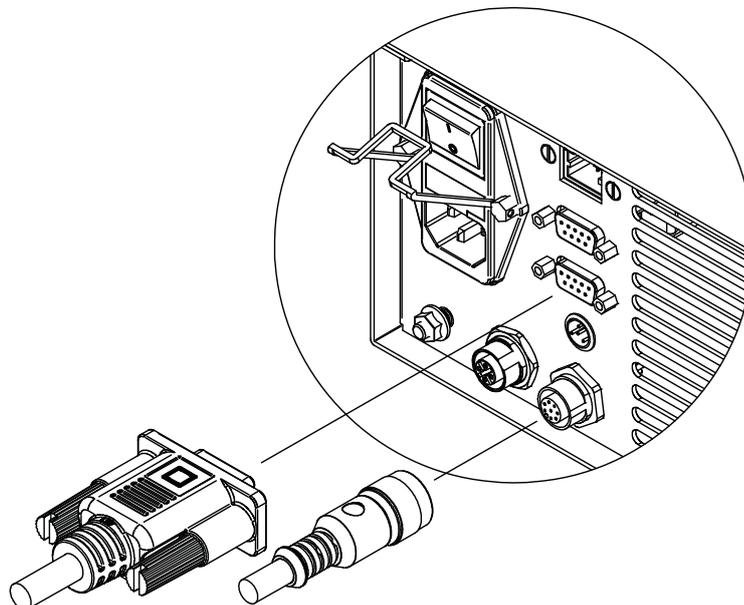
WARNING

Connect the Distance Sensor when the Laser Marker is turned off, in order to avoid risks to the operator and the equipment.

Connect the **M8** connector to the sensor:



Connect the **M12** connector to the **Encoder** connector and the **DB9** connector to the **RS232** port on the control rack back panel:



Sensor Positioning

Adjust the Distance Sensor position so that the red laser beam points towards the object to be marked.



WARNING

The inclination between the laser beam of the Distance Sensor and the surface of the object to be marked, must not exceed 25° for a reliable measure.



WARNING

The measuring range of the Distance Sensor is 50 to 350mm. Make sure that the reading distance is always included in the operating range during Autofocus procedure.



NOTE

For a correct Distance Sensor positioning refer to "Recommendations on Sensor Positioning" on page 14.

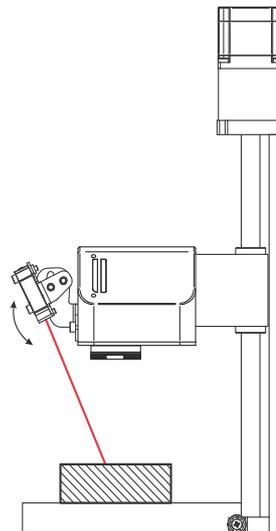


Figure 1: Sensor positioning with F-Theta scan lens 100L-160S-160L-254S

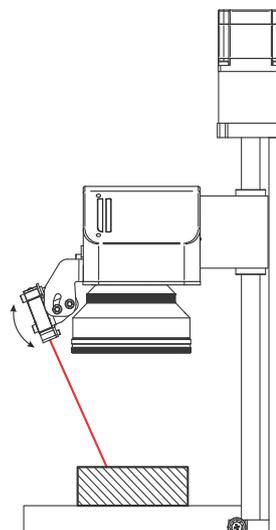


Figure 2: Sensor positioning with F-Theta scan lens 254L

**WARNING**

The sensor could provide incorrect and unreliable distance readings if this is dazzled by the laser reflection emitted by external sources.

When positioning the sensor, it is necessary to keep in mind the problems related to the laser light reflections coming from external sources (for example the focusing beam) that could occur during the Autofocus search. These reflections may cause the Autofocus search to fail.

Take care to position the Distance Sensor so that it is not dazzled by the reflection coming for example from the **Focusing Beam (FB)**.

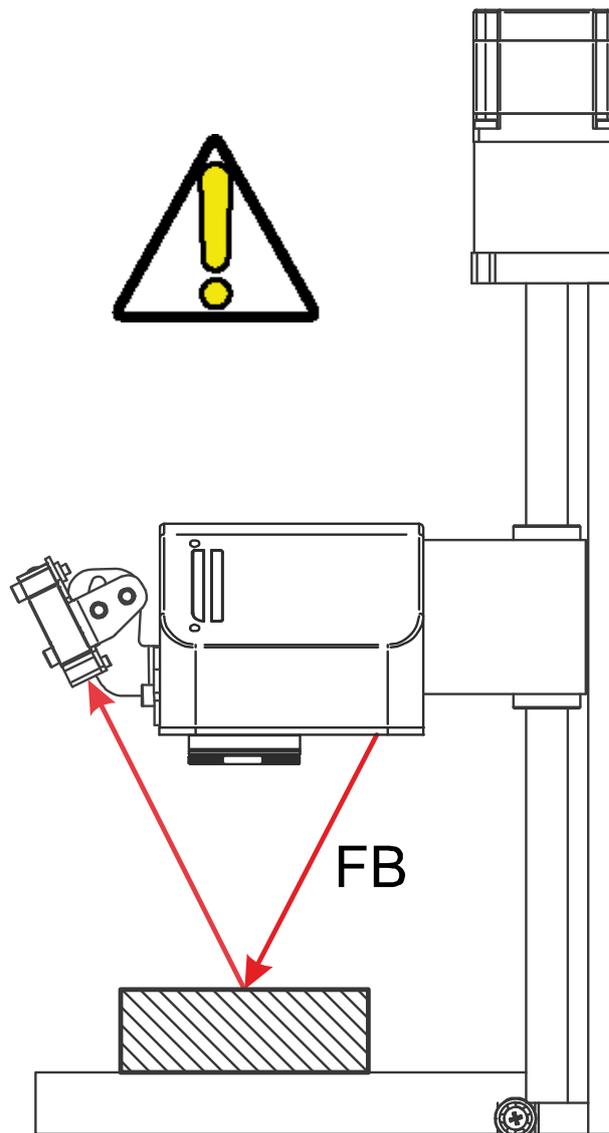


Figure 3: Focusing Beam reflections.

**NOTE**

If it is not possible to eliminate the reflections coming from Focusing beam by changing the sensor position, disable the Focusing beam functionality. Refer to "Configure the Focusing beam" on page 17.

Recommendations on Sensor Positioning

The Distance Sensor must be positioned according to the following recommendations:

- Steps:

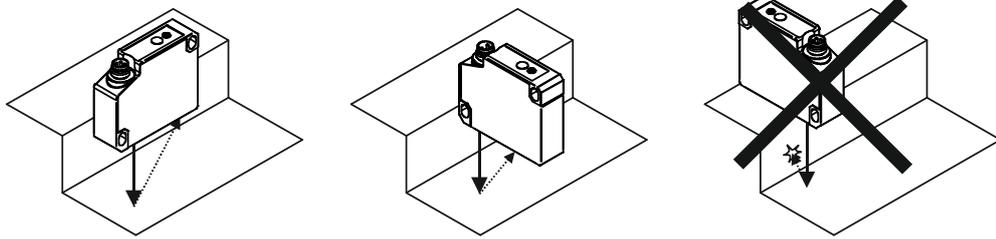


Figure 4: Steps

- Round glossy surfaces:

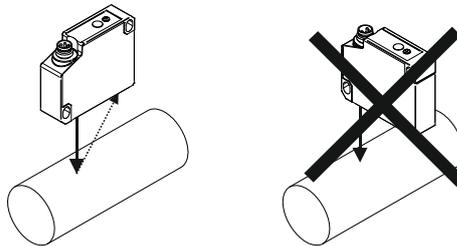


Figure 5: Round glossy surfaces

- Glossy surfaces:

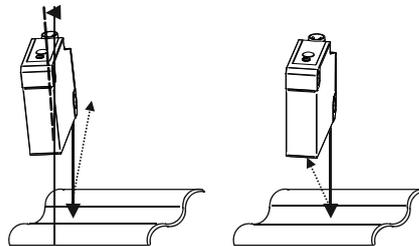


Figure 6: Glossy surfaces

- Different reflection of surfaces:

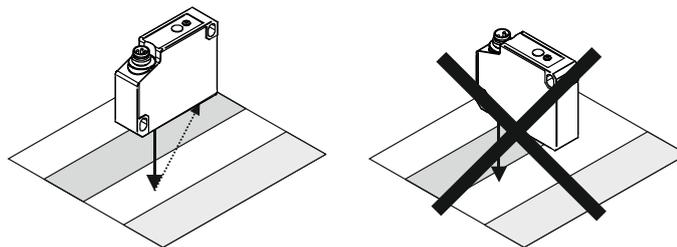


Figure 7: Reflection of surfaces

- Effect of ambient light:

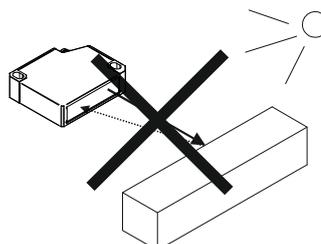
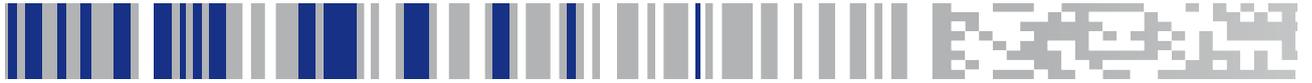


Figure 8: Effect of ambient light



Chapter 3 Software Configuration

CONFIGURE THE Z AXIS PARAMETERS starting on page 16
CONFIGURE THE FOCUSING BEAM starting on page 17

Configure the Z Axis parameters



WARNING

The Z Axis must have a resolution (steps/mm or steps/inch) compatible with the mechanical requirements of the applications and high mechanical repeatability.



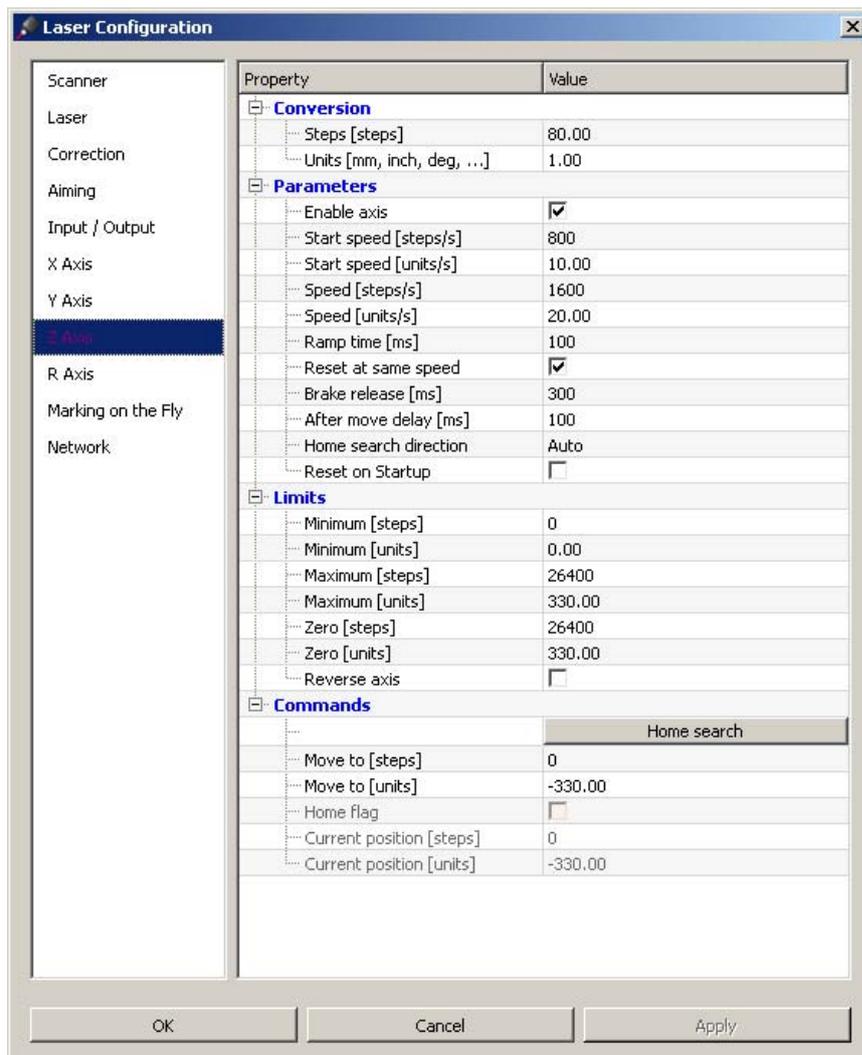
NOTE

For the Z Axis parameters configuration refer to the Lighter™ Suite software user manual.

Right-click on the Laser Engine icon in the Tray Icon and select the **Laser configuration**.



Select Z Axis:



Set the Z Axis parameters so that the operation is robust and reliable.

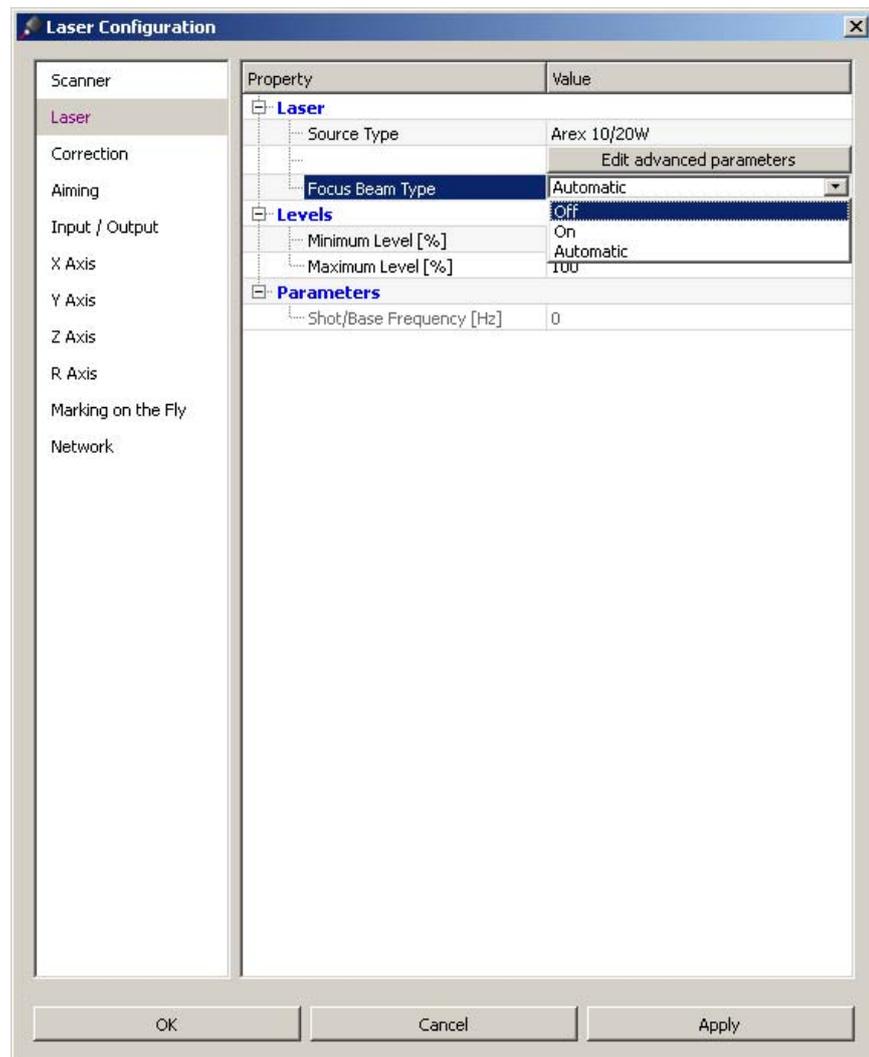
Configure the Focusing beam

Right-click on the Laser Engine icon in the Tray Icon and select the **Laser configuration**.



Select **Laser**:

Set the Focus Beam Type to **OFF** to disable the Focusing beam:





Chapter 4

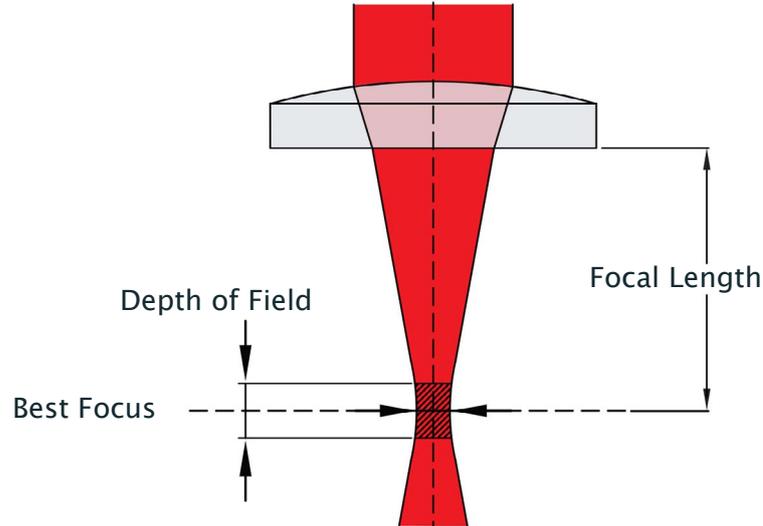
DynamicFocusHandlerArexUniQ

HOW THE SCRIPT WORKS starting on page 20
HOW TO SET THE TOLERANCE PARAMETER starting on page 21
SCRIPT AND GUI DESCRIPTION starting on page 22
HOW TO USE THE SCRIPT starting on page 23

How the script works

To define whether the object to be marked is in the correct focal position, the autofocus procedure uses the **TOLERANCE** parameter which is based on the concept of **Depth of Field** of the F-Theta scan lens system.

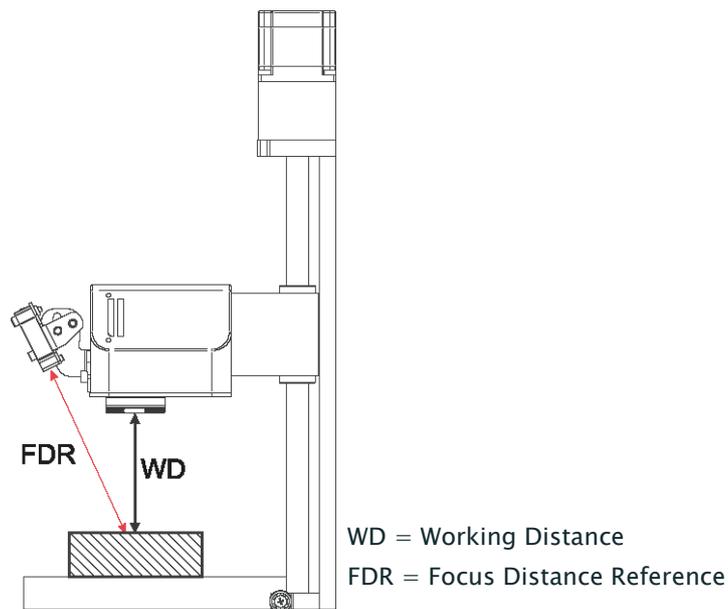
The Depth of Field of an F-Theta scan lens system is its ability to maintain a desired spot quality, without refocusing, if the surface of the object to be marked is positioned closer to/farther from the **Best Focus**.



NOTE

The Depth of Field of an F-Theta scan lens system is not a product specification and must be verified on the specific application.

When the Autofocus procedure is performed, the system checks the difference between the current measured distance and the value of the **FOCUS DISTANCE REFERENCE (FDR)**; if this value is higher than the **TOLERANCE** value, the Z Axis is moved up or down to restore the correct **Working Distance (WD)**, otherwise the procedure ends without the Z Axis being moved (system already in the right focal position).



To obtain a correct marking of the object, the **TOLERANCE** parameter must be set to a value $< (\text{Depth of Field} / 2)$.

How to set the Tolerance parameter

It is possible to adapt the **TOLERANCE** value used by the script to the F-Theta scan lens system in use.

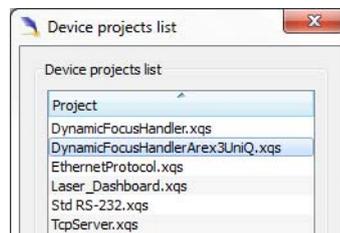
Open Laser Editor and click on **Project Editor** icon:



Click on **Select Project from Device** icon:



Select **DynamicFocusHandlerArexUniQ.xqs** and press **OK**:



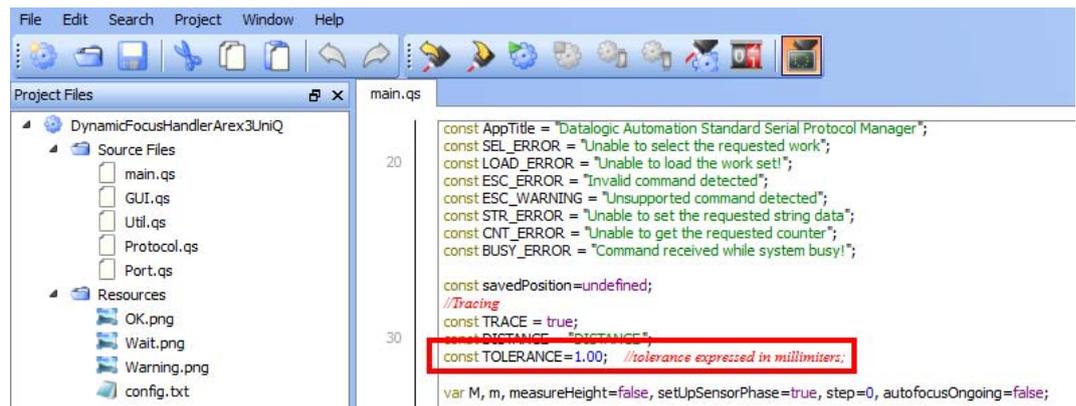
Change the value of **TOLERANCE** parameter depending on the F-Theta scan lens system in use.

The **TOLERANCE** parameter must be set to a value $< (\text{Depth of Field} / 2)$.



NOTE

The Depth of Field of an F-Theta scan lens system is not a product specification and must be verified on the specific application.



Click on **Save Project to Device** icon to save the changes to the project:



Script and GUI description

Datalogic provides the **DynamicFocusHandlerArexUniQ** script as an example for the integration and automation of Autofocus functionality in a laser marking environment.

Start Marking button: when this button is pressed, the marking process of the current layout starts.

Start Marking when Focus Distance is reached check box: if checked, the system marks the current layout as soon as the Autofocus Search procedure has been completed successfully.

Layout selection group:

- **Layout:** allows the selection of a layout from the ...*Data/Docs/Layouts*
- **Preview** window: this screen shows the preview of the selected layout



Outcome group: contains textual and graphical information about the state of Autofocus.

Last acquisition group:

- **Distance [mm]:** this field shows the distance read by the Distance Sensor, expressed in mm
- **TRIGGER** button: when this button is pressed, the sensor reads the current distance and writes its value in the Distance text box

SAVE CURRENT DISTANCE button: when this button is pressed, the current distance is saved and used as **FOCAL DISTANCE REFERENCE** value for the Autofocus procedure.

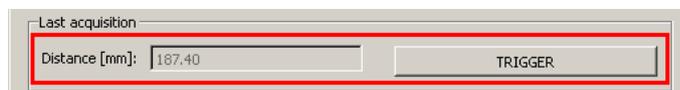
START AUTOFOCUS button: when this button is pressed, the AUTOFOCUS procedure starts. This button is active only if the **FOCAL DISTANCE REFERENCE** has been already set.

How to use the script

Select **DynamicFocusHandlerArexUniQ** script from Laser Engine **Document TAB** and press **TO AUTO MODE** button to starts the script.

Adjust the Z Axis so that the F-Theta is at the right Working Distance.

Press **TRIGGER** button and check if the current distance is inside the operative range of the sensor:



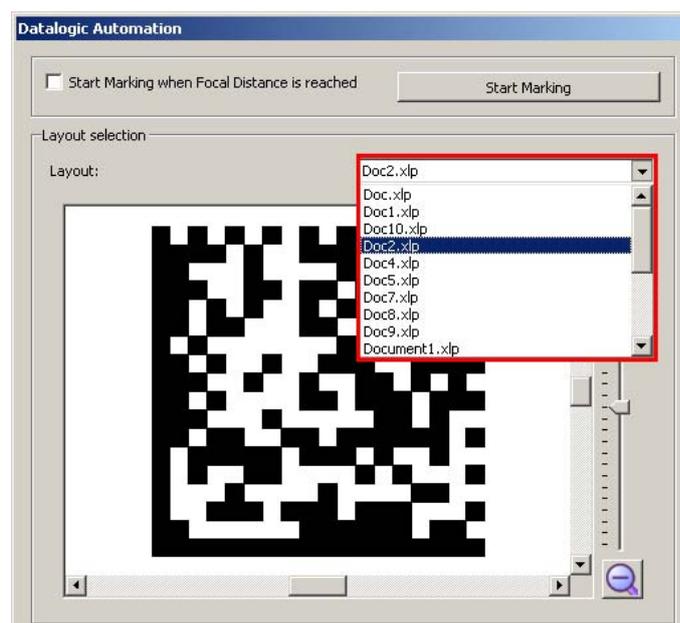
Press **SAVE CURRENT DISTANCE** to use the current distance as **FOCUS DISTANCE REFERENCE** value for the Autofocus procedure.



NOTE

The previous action doesn't have to be repeated every time the script is executed: the **CURRENT DISTANCE** is saved by the laser marker and loaded as the reference every time the script is executed.

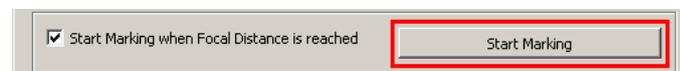
Select the layout to be marked from the list. The layout preview will be shown:



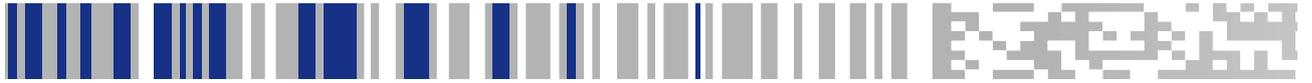
Check the **Start Marking when Focus Distance is reached** to perform an Autofocus procedure before the next marking process starts:



Press the **Start Marking** button to start the marking process manually



It is possible to automate the marking process using the **EXT_START** signal on the Command Box connector or a **PHOTOCELL** connected to the control rack.



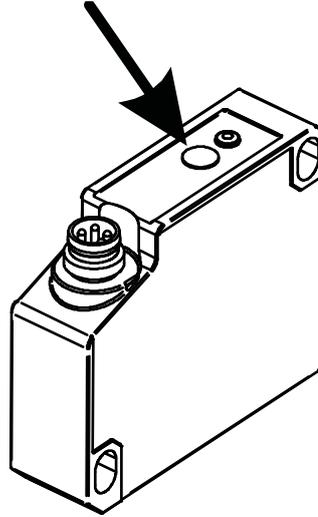
Chapter 5

Troubleshooting

DISTANCE SENSOR STATES starting on page 26
SCRIPT ERROR MESSAGES starting on page 27

Distance Sensor States

The Distance Sensor is provided with a LED that shows the sensor state:



LED color	Sensor State
GREEN	Power ON
RED	Alarm

LED state	Cause	Action
OFF	The sensor is not powered	Check that the Laser Marker is powered
		Check the sensor connection (see 'Distance Sensor Connections' on page 11)
		Check for damage to the sensor cable
RED	The sensor performs unreliable distance reading	Check the sensor positioning (see 'Recommendations on Sensor Positioning' on page 14)
	The reading distance exceed the operative range (<50mm or >350mm)	Make sure to position the sensor so that the reading distance does not exceed the operative range



During the Z Axis movements due to Autofocus operations the LED could flash between green and red. This behavior is to be considered normal. When the Z Axis is not moving the LED shall be steady green for a reliable distance reading.

Script Error Messages

The script is able to notify errors to the user.

The error messages are notified in the **Outcome** group:



The following table shows the error messages:

Error Message	Cause	Action
AUTOFOCUS HAS NOT BEEN COMPLETED CORRECTLY	The AUTOFOCUS procedure failed to find the correct focus position	<p>Check the Tolerance parameter (see 'How to set the Tolerance parameter' on page 21)</p> <p>Check the Distance Sensor positioning (see 'Recommendations on Sensor Positioning' on page 14)</p> <p>Check the mechanical Z axis parameters (see 'Configure the Z Axis parameters' on page 16)</p>
COMMUNICATION ERROR	The Distance Sensor is not connected or doesn't answer on time	Check the Distance Sensor connection (see 'Distance Sensor Connections' on page 10)
CANNOT MOVE OUTSIDE Z AXIS RANGE	The final position which has to be reached by the Z axes is not inside the Z axis range	Make sure to position the Distance Sensor and the target so that the Z axis position does not exceed the operative range during AUTOFOCUS procedure
FOCUS SENSOR OUT OF RANGE	The Distance Sensor reading distance exceed the operative range (<50mm or >350mm)	Make sure to position the Distance Sensor so that the reading distance does not exceed the operative range
	The distance sensor is dazzled by the laser reflection emitted by external sources (for example the focusing beam)	Take care to position the Distance Sensor so that it is not dazzled by the reflection coming for example from the Focusing Beam (see 'Sensor Positioning' on page 12)



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