

# Micrometric Distance Sensor for Arex™ 400



**Application Note**

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Micrometric Distance Sensor Application Note  
Application Note  
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This Application Note refers to:

- Micrometric Distance Sensor for Arex™ 400
- Lighter™ Suite version **7.1.1** 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

<b>SYSTEM CONFIGURATION</b> <a href="#">starting on page 2</a>
<b>HOW THE SYSTEM WORKS</b> <a href="#">starting on page 3</a>

## System Configuration

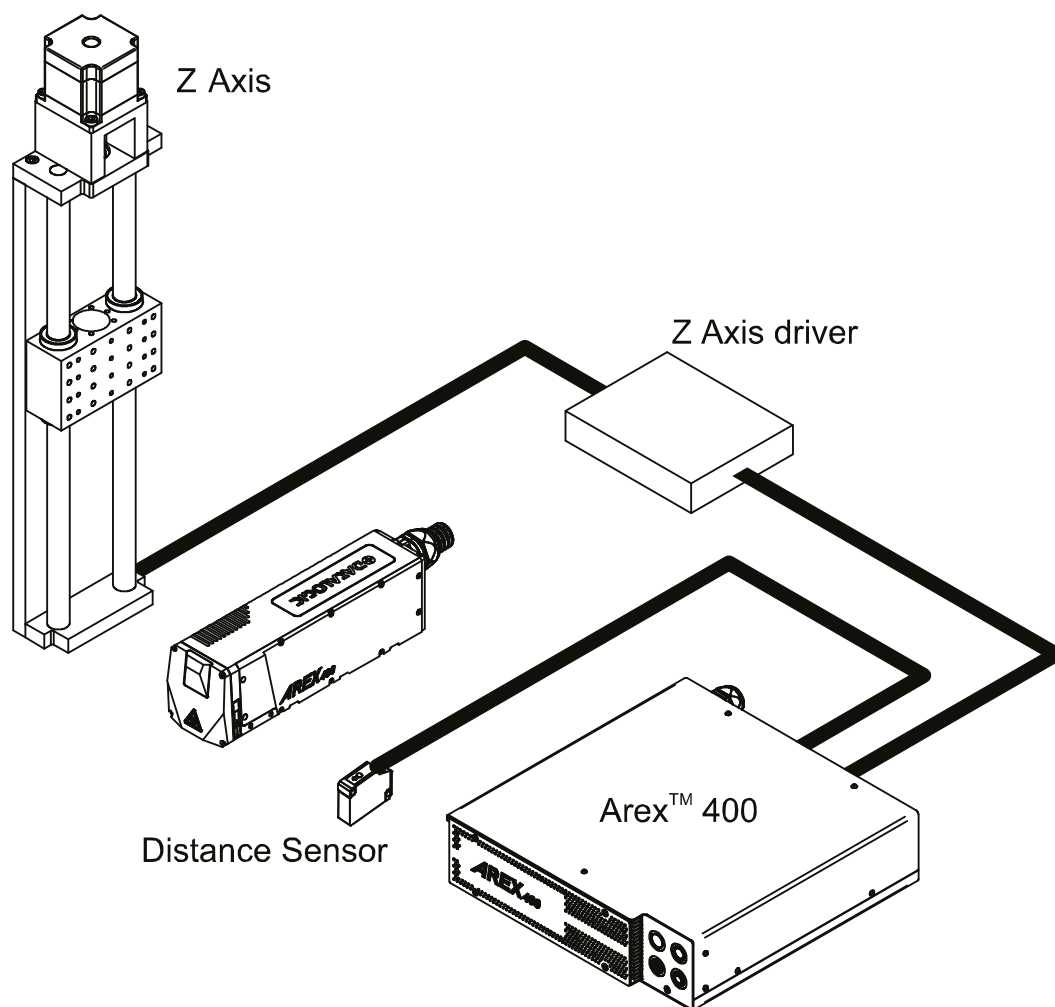
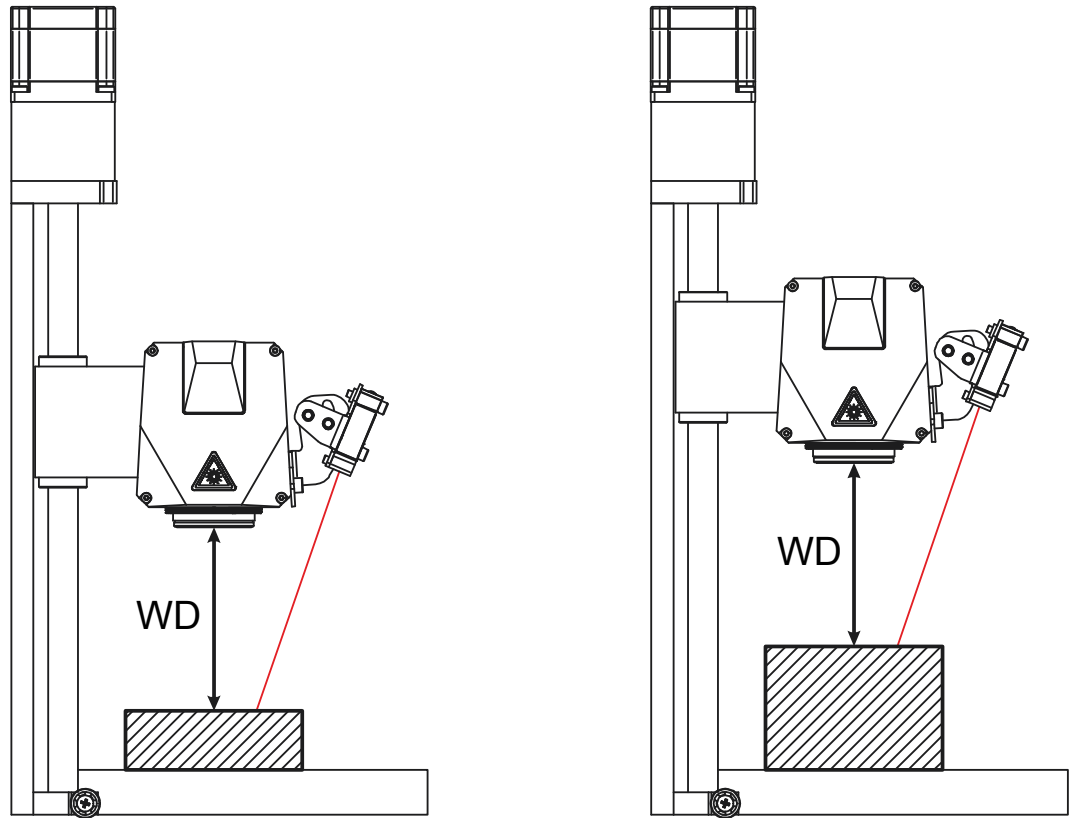


Figure 1: Integration with Arex™ 400

## 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 system uses the interaction between a Distance Sensor and the integrated **Z Axis** control.



WD = Working Distance

Figure 2: How the system works





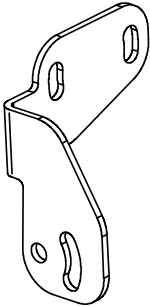
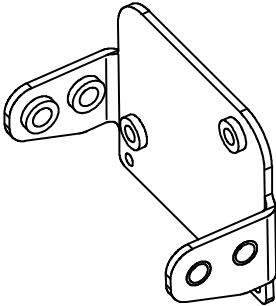
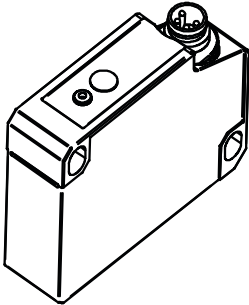
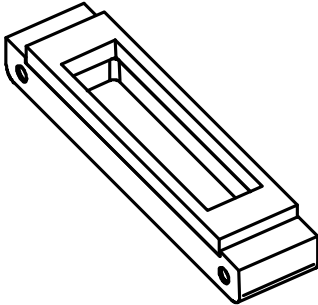
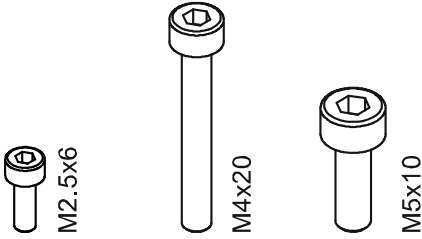

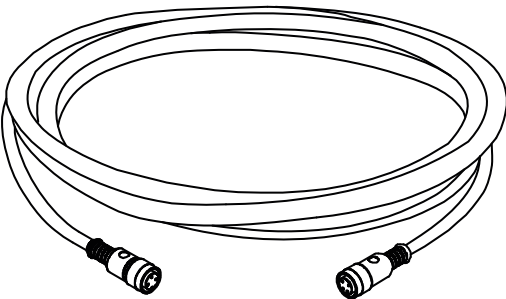


## Chapter 2

# Hardware Installation

<b>CONTENTS OF THE PACKAGING</b> <a href="#">starting on page 6</a>
<b>MOUNTING INSTRUCTIONS</b> <a href="#">starting on page 7</a>
<b>DISTANCE SENSOR CONNECTIONS</b> <a href="#">starting on page 10</a>
<b>SENSOR POSITIONING</b> <a href="#">starting on page 11</a>
<b>RECOMMENDATIONS ON SENSOR POSITIONING</b> <a href="#">starting on page 12</a>

# Contents of the packaging

 <p>Arex™ 400 Bracket</p>	 <p>Distance Sensor Bracket</p>
 <p>Distance Sensor</p>	 <p>YAG filter with gasket</p>
 <p>2x      2x      4x</p> <p>Screws</p>	 <p>2x      2x      4x</p> <p>Washers</p>
 <p>Cable</p>	

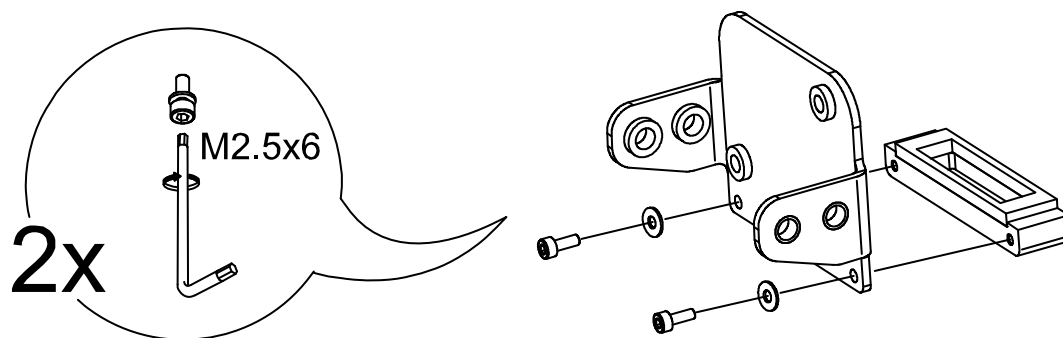
# Mounting Instructions



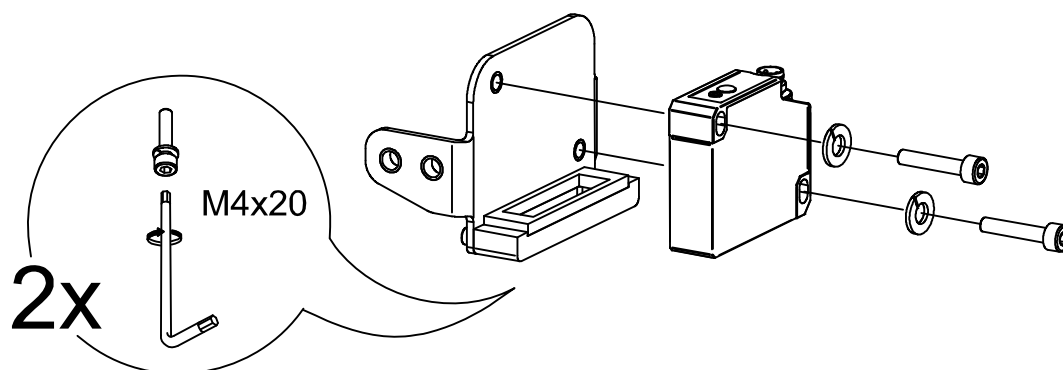
Install the system following the instructions present in the relative installation manual.

## NOTE

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



Mount the Distance Sensor on the bracket:

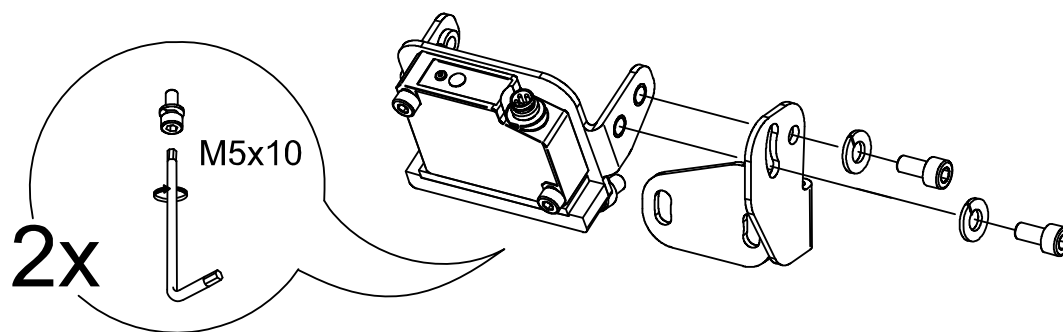


Fix the sensor so that it is in contact with the filter gasket.

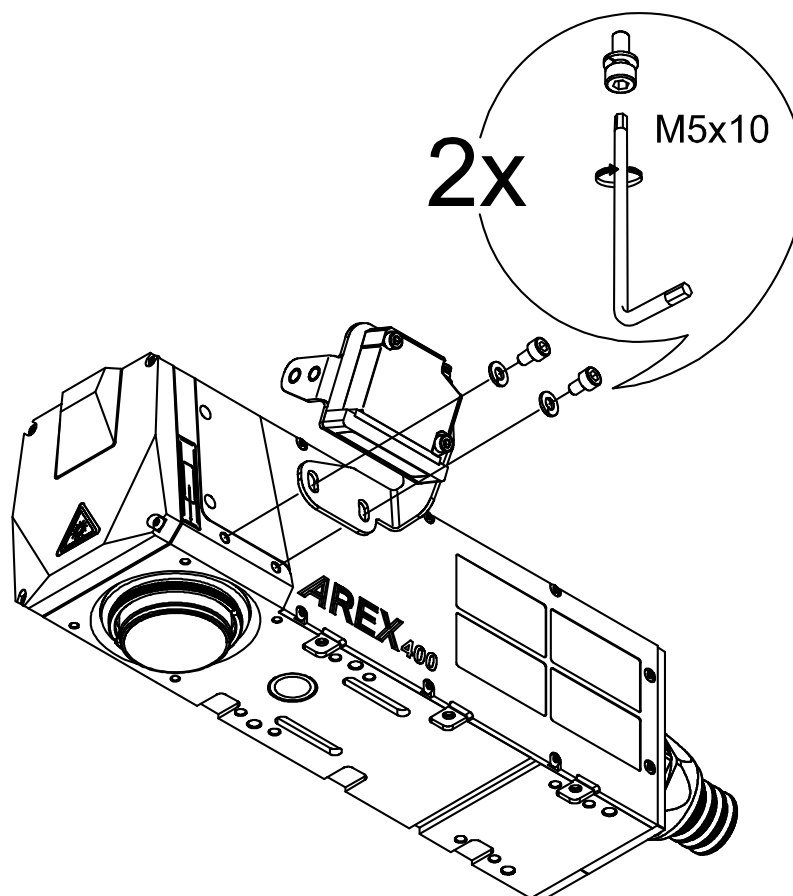
## NOTE

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

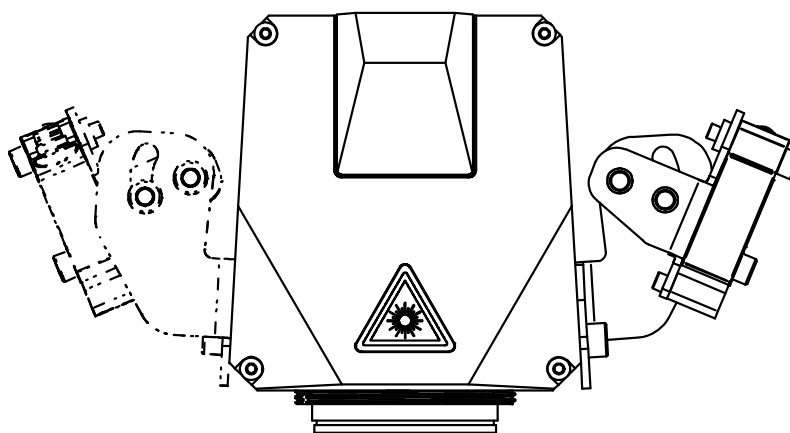
Mount the Distance Sensor and the brackets like the following picture:



Mount Distance Sensor and the brackets on the side of the Arex™ 400 scan head:

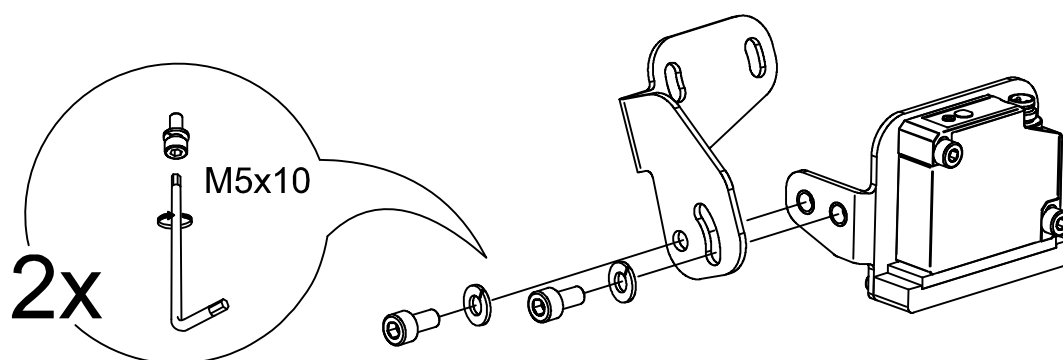


It is possible to mount the accessory on both sides of the scan head:

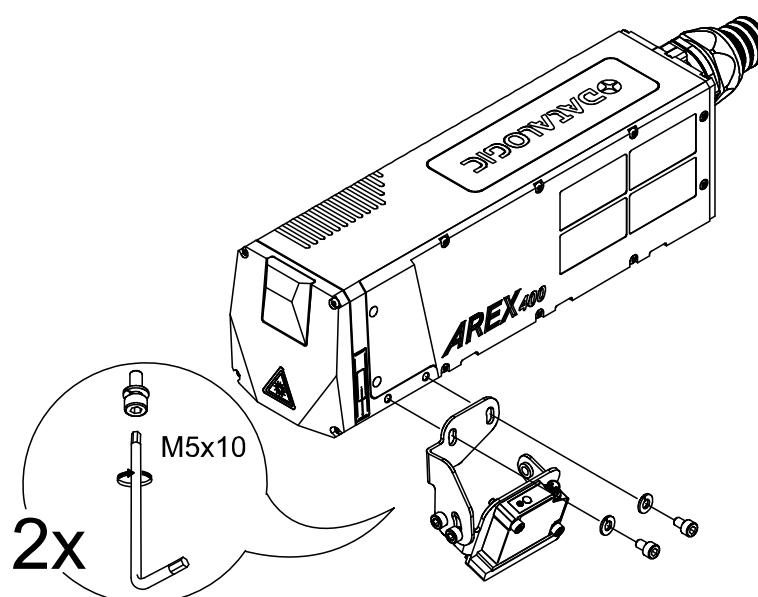


## Mounting instruction for the F-Theta scan lens 254L

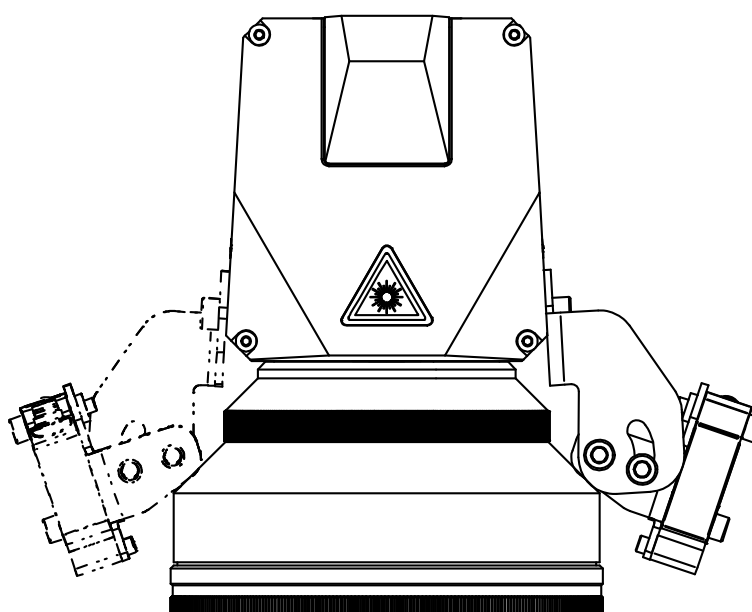
Mount the Distance Sensor and the bracket like the following picture:



Mount Distance Sensor and the brackets on the side of the Arex™ 400 scan head:



It is possible to mount the accessory on both sides of the scan head:



## Distance Sensor Connections

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



### NOTE

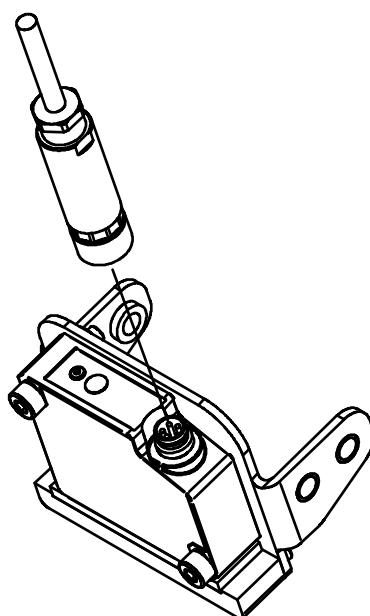
Refer to the corresponding user manual of the laser marker product for the main connections.



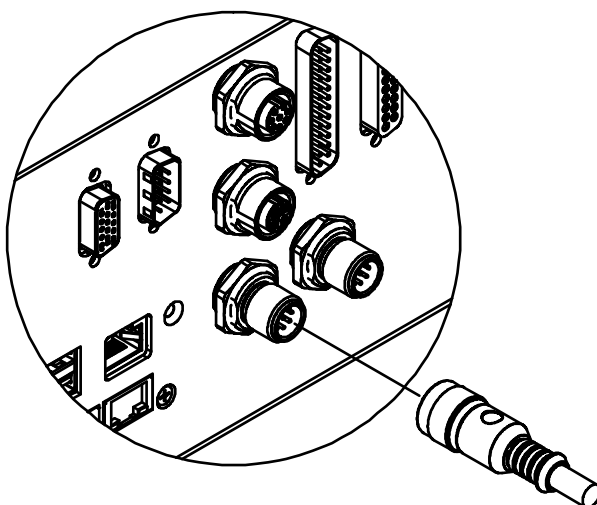
### WARNING

Connect the Distance Sensor **WITHOUT** voltage in order to avoid risks to the operator and to the laser marker.

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



Connect the **M12** connector to the **Device Port 1** connector 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  $25^\circ$  for a reliable measure.



**WARNING**

The measuring range of the Distance Sensor is 50 to 350mm. Make sure that the reading distance does not exceed the operating range during Autofocus operation.



**NOTE**

For a correct Distance Sensor positioning refer to "Recommendations on Sensor Positioning" on page 12.

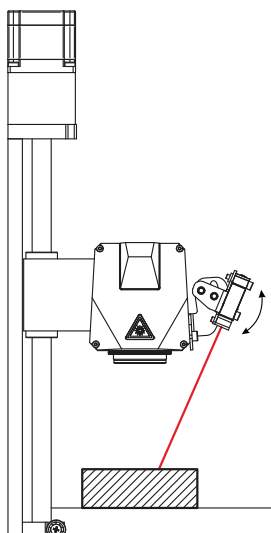


Figure 1: Sensor positioning with F-Theta scan lens 100L-160S-160L-254S

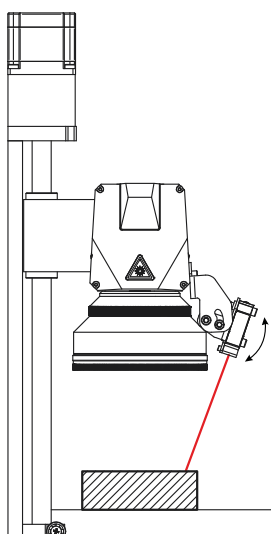


Figure 2: Sensor positioning with F-Theta scan lens 254L

## Recommendations on Sensor Positioning

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

- Steps:

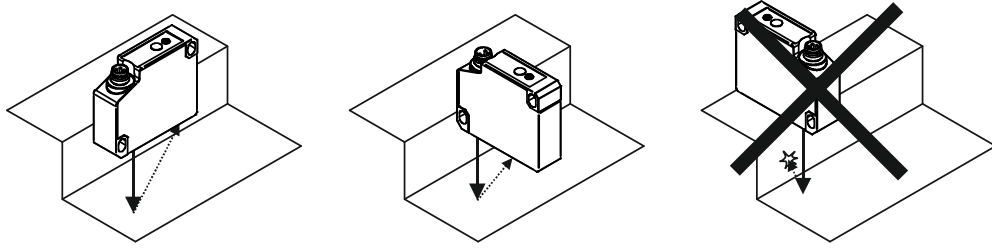


Figure 3: Steps

- Round glossy surfaces:

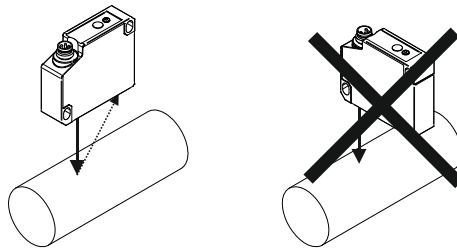


Figure 4: Round glossy surfaces

- Glossy surfaces:

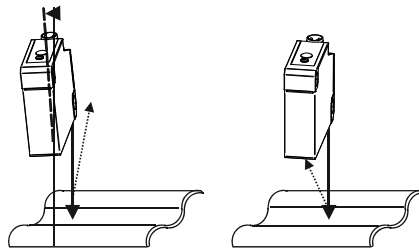


Figure 5: Glossy surfaces

- Different reflection of surfaces:

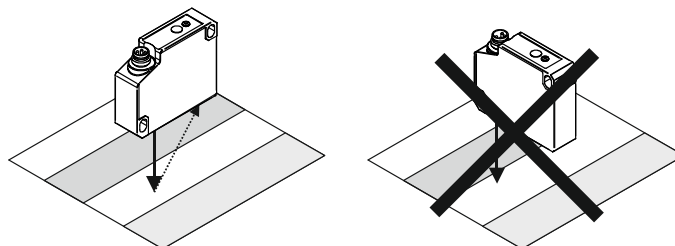


Figure 6: Reflection of surfaces

- Effect of ambient light:

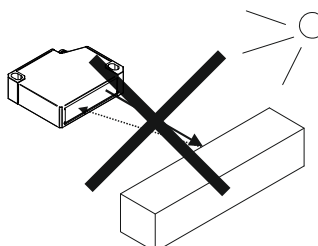


Figure 7: Effect of ambient light





## Chapter 3

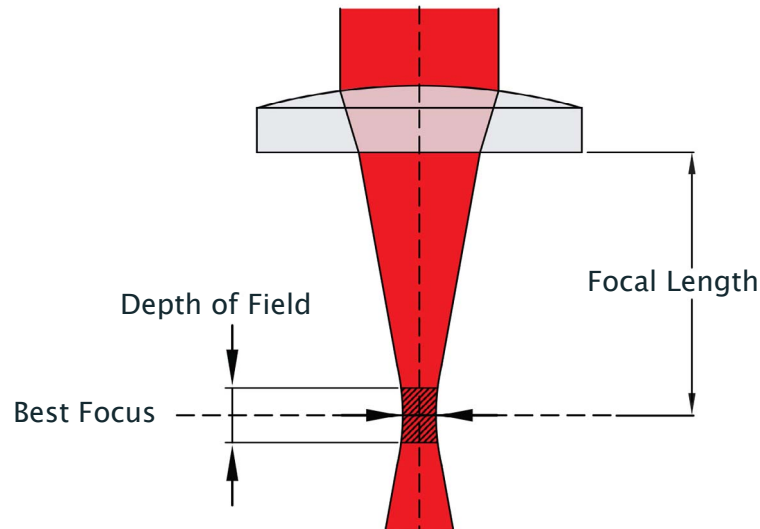
# Software Configuration

<b>CONFIGURATION PARAMETERS</b> <a href="#">starting on page 14</a>
<b>CONFIGURE THE Z AXIS PARAMETERS</b> <a href="#">starting on page 16</a>
<b>CONFIGURE THE DISTANCE SENSOR PARAMETERS</b> <a href="#">starting on page 17</a>

## Configuration Parameters

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.

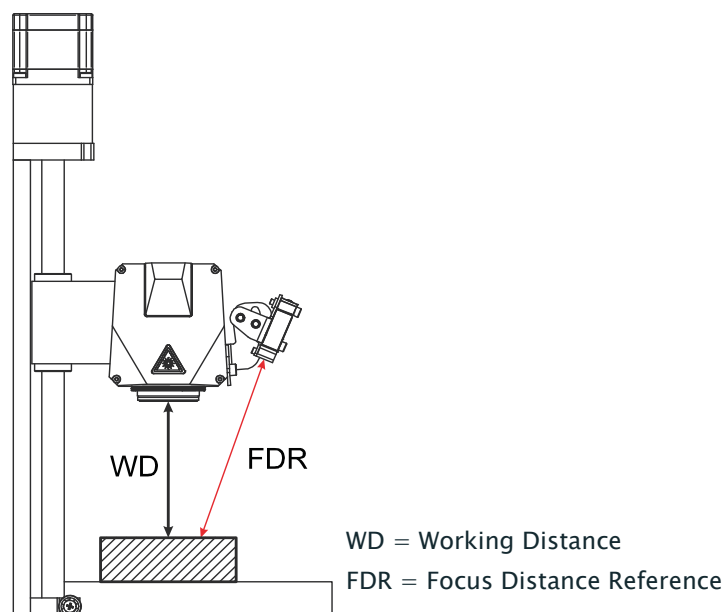
The Depth of Field of an F-Theta scan lens system is its ability to maintain a desired spot quality, without refocusing, if the surface of the object to be marked is positioned closer to/farther from the **Best Focus**.



### NOTE

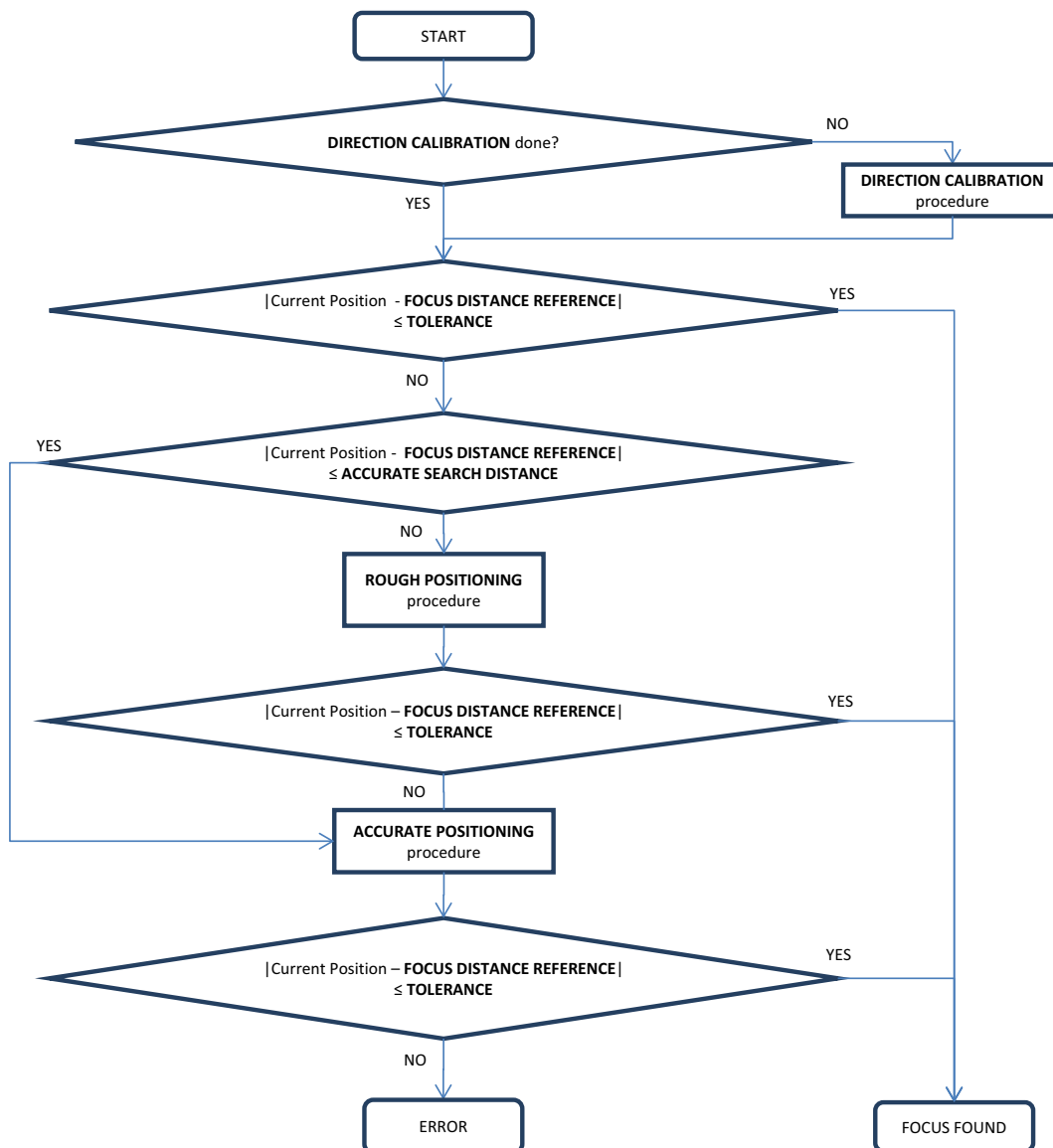
The Depth of Field of an F-Theta scan lens system is not a product specification and must be verified on the specific application.

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  $< (\text{Depth of Field} / 2)$ .

The flowchart below shows how the Autofocus procedure works:



Procedure	Description
DIRECTION CALIBRATION	This procedure defines the Z Axis direction way to be used by Auto-focus procedure
ROUGH POSITIONING	This procedure is performed to roughly reach the focus position. The system performs this procedure when the difference between the current distance and the FOCUS DISTANCE REFERENCE is higher than the ACCURATE SEARCH DISTANCE parameter. The Z Axis moves at standard speed ( <b>Speed</b> parameter)
ACCUATE POSITIONING	This procedure is performed to accurately reach the focus position. The system performs this procedure when the difference between the current distance and the FOCUS DISTANCE REFERENCE is lower than the ACCURATE SEARCH DISTANCE parameter. The Z Axis moves at low speed ( <b>Autofocus Search Speed</b> parameter)

## 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.

Property (*)	Description
Autofocus Search Speed [step/s]	Z Axis speed used by Autofocus procedure during the Accurate Positioning procedure. This parameter should be set to a significantly lower value than the Z Axis <b>Start Speed</b> .
Autofocus Search Speed [unit/s]	

(\*) Tests with the mechanical Z Axis in use are required to define the value of this parameter

Property	Value
<b>Conversion</b>	
Steps [steps]	80.00
Units [mm, inch, deg, ...]	1.00
<b>Parameters</b>	
Enable axis	<input checked="" type="checkbox"/>
Free Brake Output	<input type="checkbox"/>
Free Disable Input	<input type="checkbox"/>
Start speed [steps/s]	800
Start speed [units/s]	10.00
Speed [steps/s]	1600
Speed [units/s]	20.00
Ramp time [ms]	100
Autofocus Search Speed [step/s]	400
Autofocus Search Speed [unit/s]	5.00
Autofocus Nsteps [steps]	800
Autofocus Nsteps [units]	10.00
Reset at same speed	<input checked="" type="checkbox"/>
Brake release [ms]	100
After move delay [ms]	100
Home search direction	Auto
Reset on Startup	<input type="checkbox"/>
<b>Limits</b>	
Minimum [steps]	0
Minimum [units]	0.00
Maximum [steps]	26400
Maximum [units]	330.00
Zero [steps]	26400
Zero [units]	330.00
Reverse axis	<input checked="" type="checkbox"/>
<b>Commands</b>	
	Home search
Move to [steps]	10400
Move to [units]	200.00
Home flag	<input type="checkbox"/>
Current position [steps]	10400
Current position [units]	200.00

OK Cancel Apply

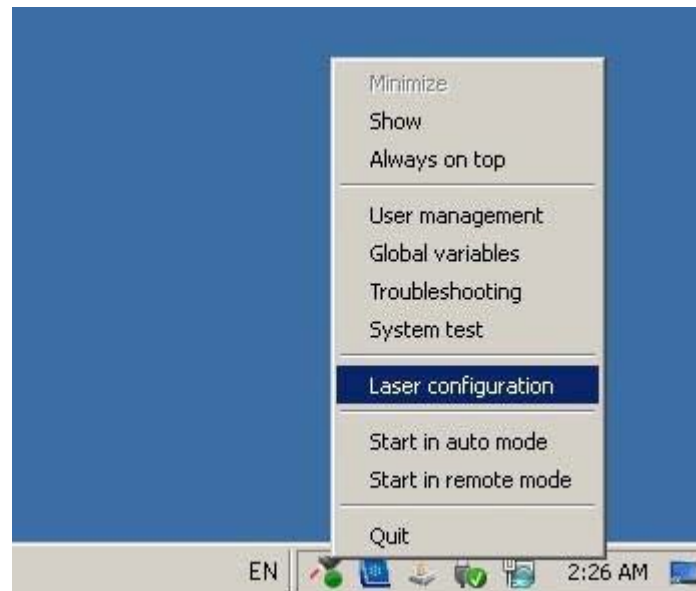
## Configure the Distance Sensor parameters



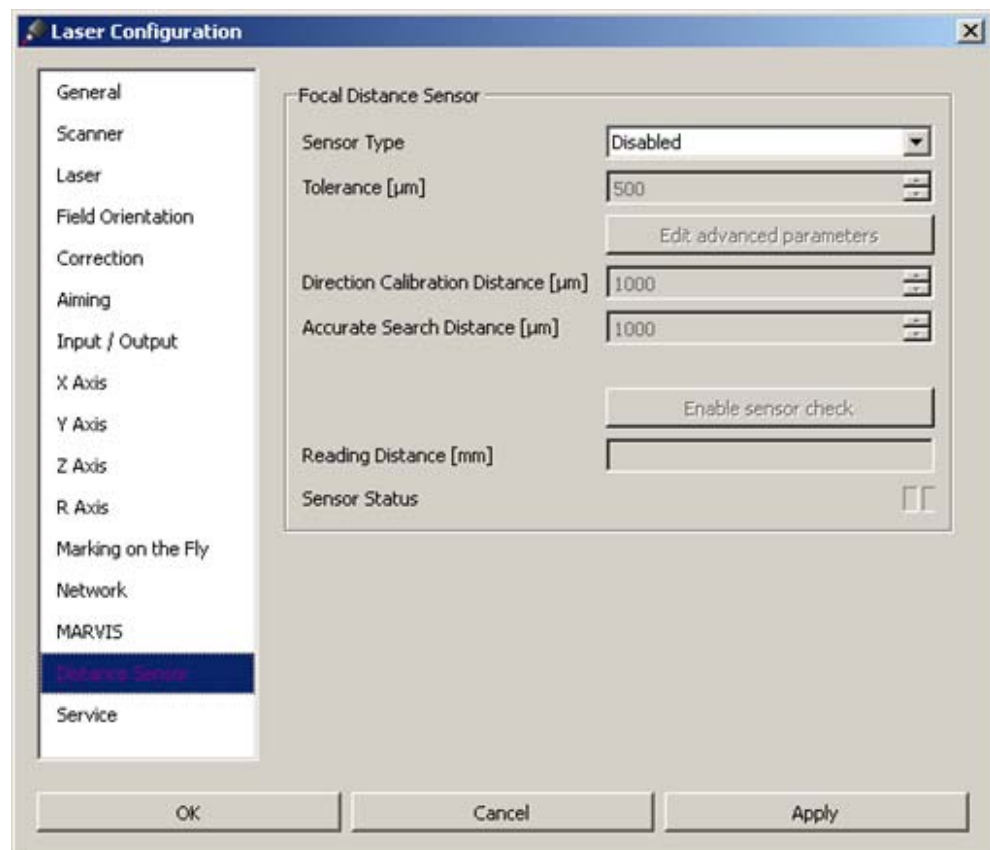
### NOTE

For the Distance Sensor parameters configuration Refer to Lighter™ Suite software user manual.

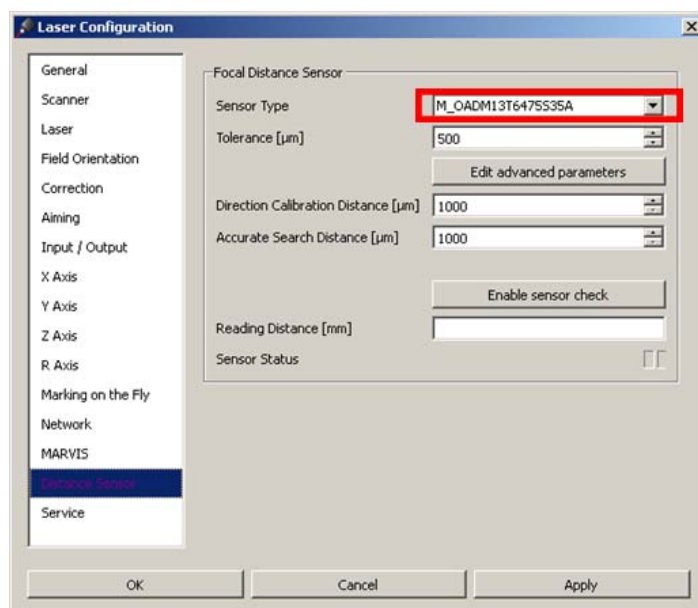
Right-click on the Laser Engine icon in the Tray Icon and select the **Laser configuration**.



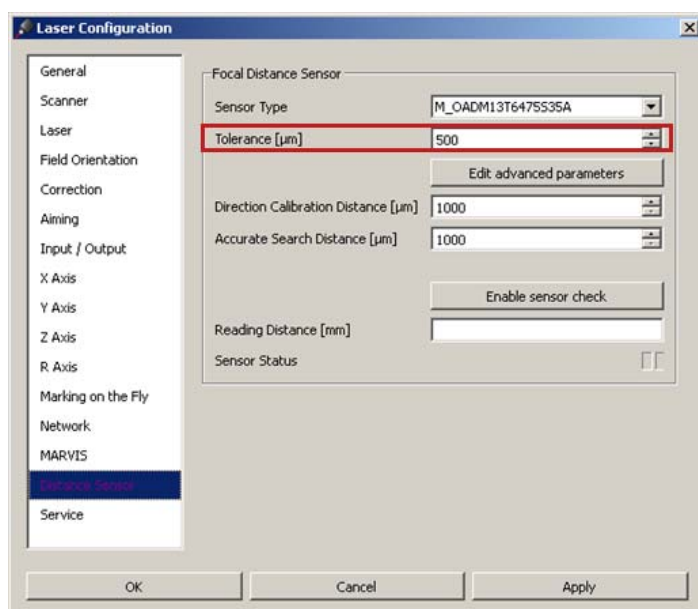
Select **Distance Sensor**:



Set Sensor Type to **M\_OADM13T6475S35A** and press **Apply** button:



Set the **Tolerance** value depending on the **F-Theta** scan lens system in use:



Property	Description
Tolerance [μm]	This parameter is based on the concept of Depth of Field of the F-Theta scan lens. The TOLERANCE parameter must be set at a value < (Depth of Field / 2)
Direction Calibration Distance [μm]	This parameter is used by the DIRECTION CALIBRATION procedure. It represents the displacement that the Z Axis must perform to define the search direction used by Autofocus procedure (this parameter is intended for specialized technicians provided with password)
Accurate Search Distance [μm]	This parameter is used to define when to use the ACCURATE POSITIONING procedure to achieve the focus position. If the difference between the current distance and the FOCUS DISTANCE REFERENCE is lower than the ACCURATE SEARCH DISTANCE parameter the ACCURATE POSITIONING will be used to achieve the focus position otherwise the ROUGH POSITIONING will be used (this parameter is intended for specialized technicians provided with password)

Press the **Enable sensor check** button to start the communication with the Distance Sensor:

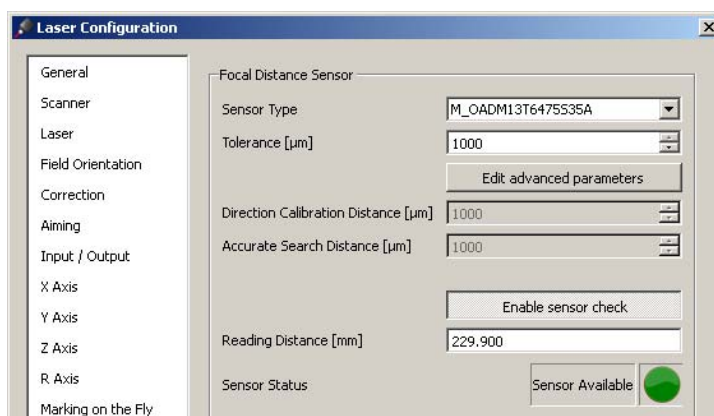
Property	Description
Reading Distance [mm]	Shows real-time distance in mm
Sensor Status	Shows Distance Sensor status



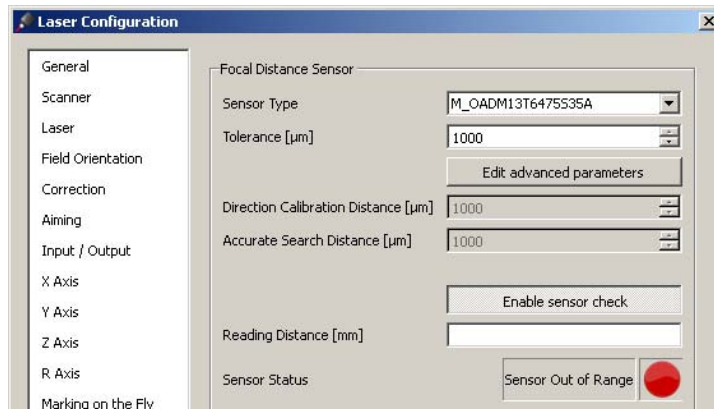
**WARNING**

The measuring range of the Distance Sensor is 50 to 350mm. Make sure that the reading distance does not exceed the operating range.

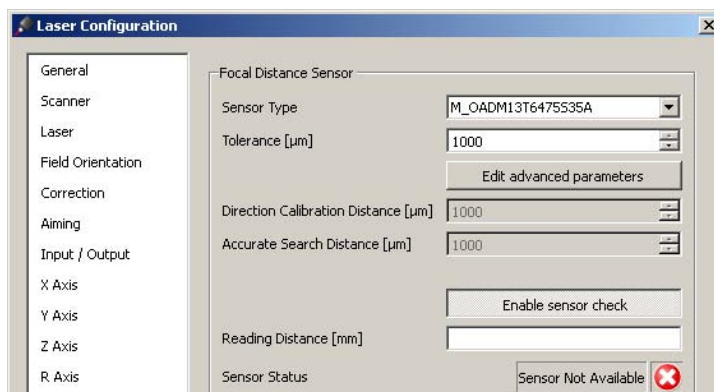
The Distance Sensor is working in the operative range:



The Distance Sensor is working out of the operative range:



The Distance Sensor does not communicate with the laser marker:









## Chapter 4

# How To Use The Autofocus

<b>SET THE FOCUS DISTANCE REFERENCE</b> <a href="#">starting on page 22</a>
<b>AUTOFOCUS USING Z AXIS TAB</b> <a href="#">starting on page 24</a>
<b>AUTOFOCUS USING SEQUENCES</b> <a href="#">starting on page 25</a>
<b>AUTOFOCUS USING SCRIPT</b> <a href="#">starting on page 26</a>

## Set the Focus Distance Reference

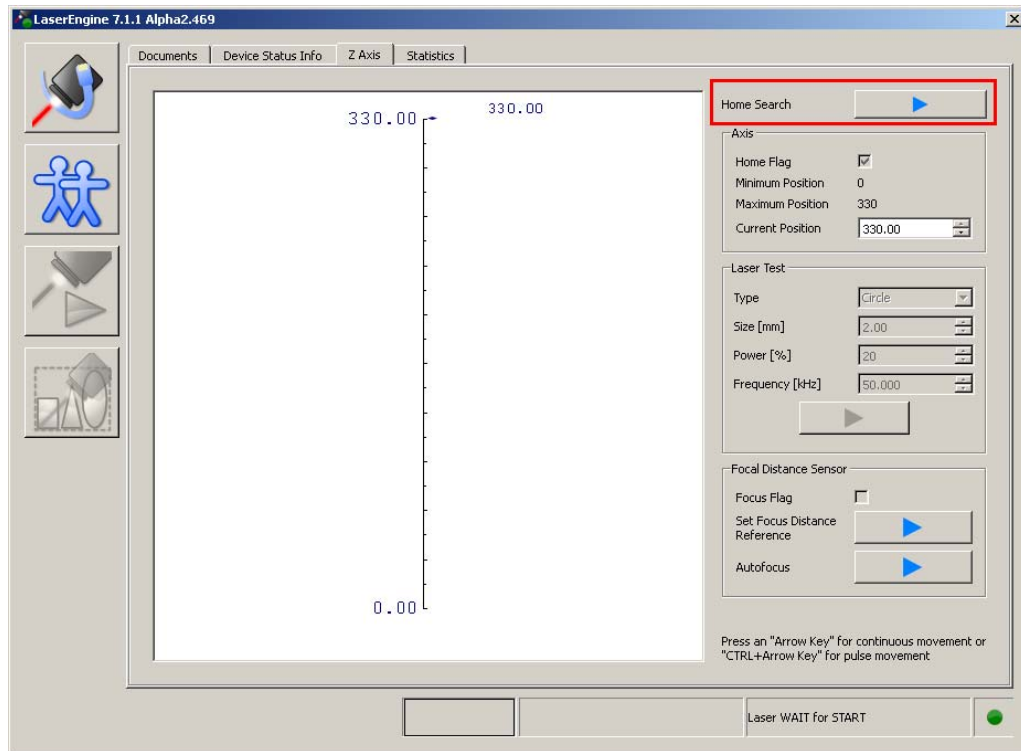
Select the **Z Axis** tab in Laser Engine.



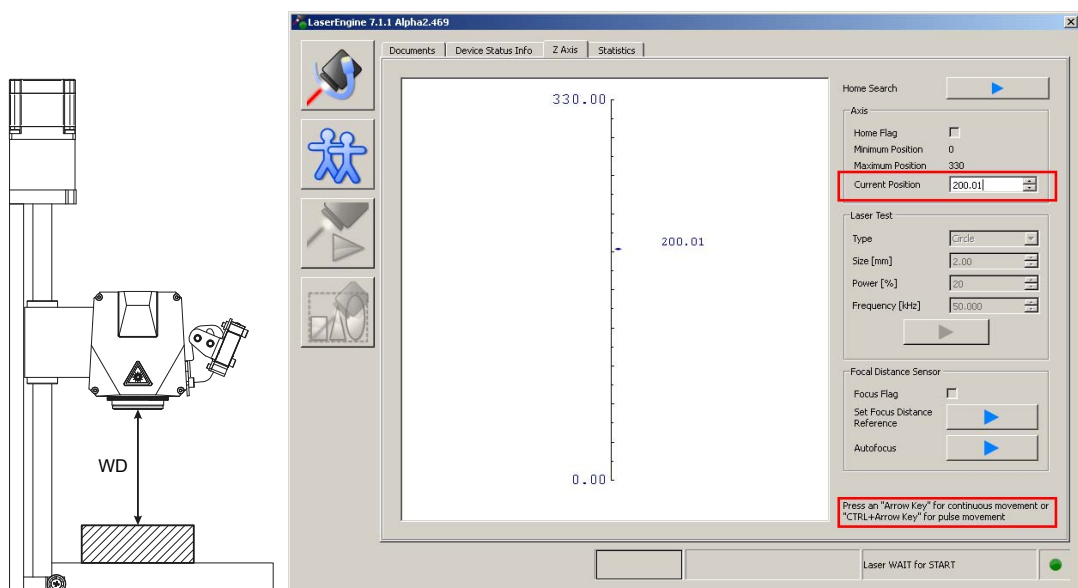
**WARNING**

Before using the Autofocus feature it is necessary to perform a Home Search command if it has never been done since Laser Engine is running.

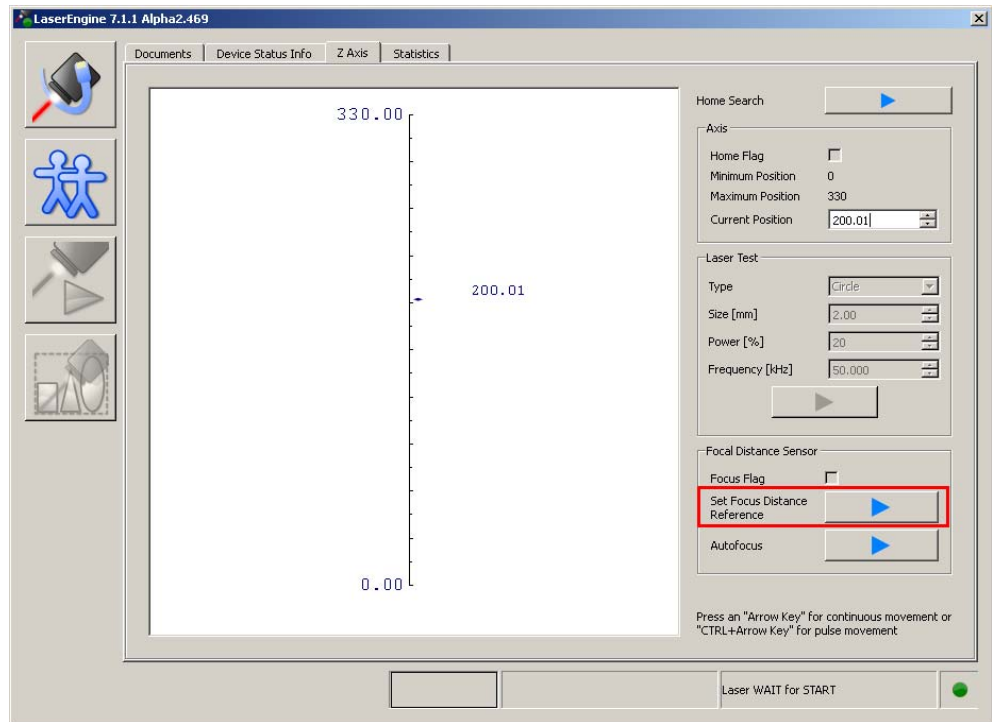
Press **Home Search** button:



Adjust the Z Axis position so that the F-Theta scan lens is at the right **Working Distance (WD)**:

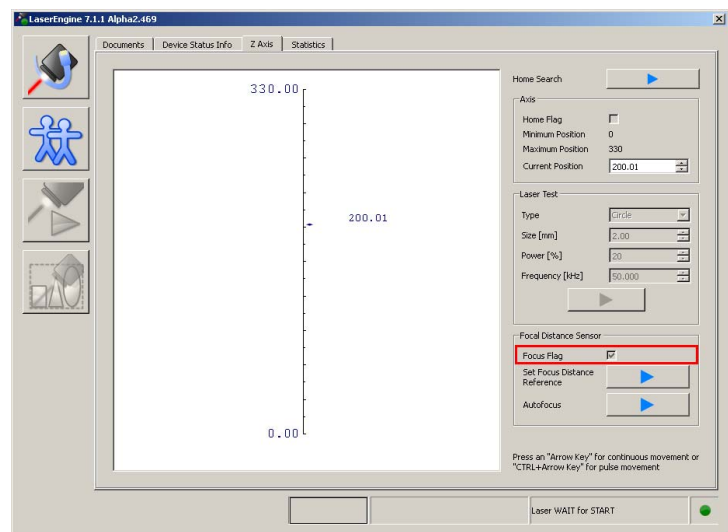
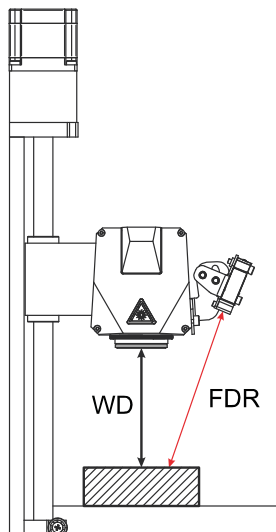


Press **Set Focus Distance Reference** button to set the current distance as the **FOCUS DISTANCE REFERENCE** that will be used by Autofocus procedure:



The sensor measures the distance between it and the object to be marked. This value is saved by the laser marker as the **FOCUS DISTANCE REFERENCE** for the Autofocus procedure.

If the **Set Focus Distance Reference** procedure is successful the **Focus Flag** will be flagged, otherwise a warning message will be displayed.



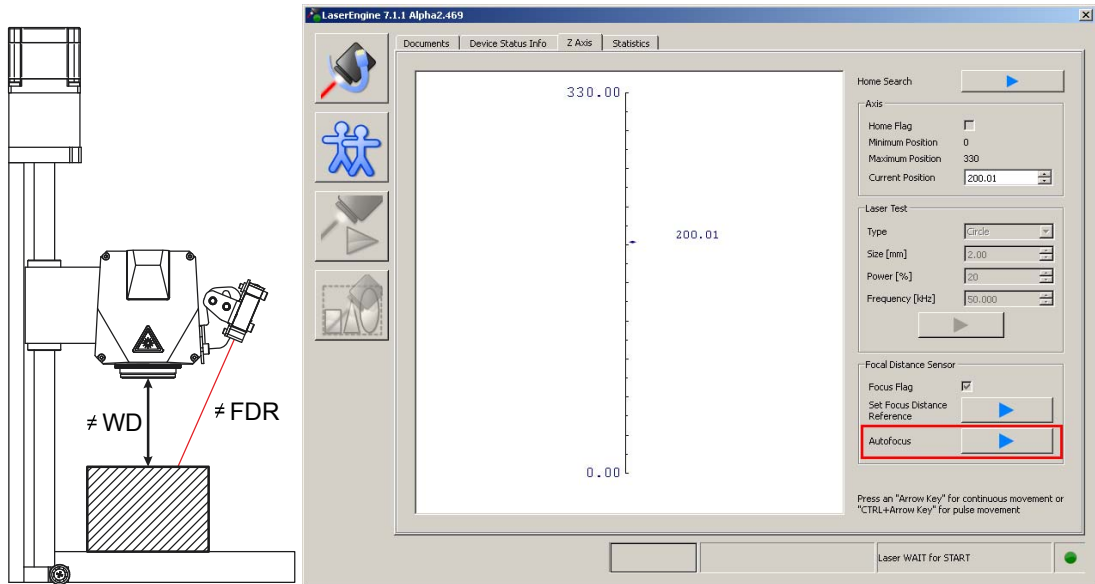
## Autofocus using Z Axis Tab

Use Z Axis tab to perform Autofocus in a work environment that involves manual operations performed by an operator.

Select the **Z Axis tab** in Laser Engine.

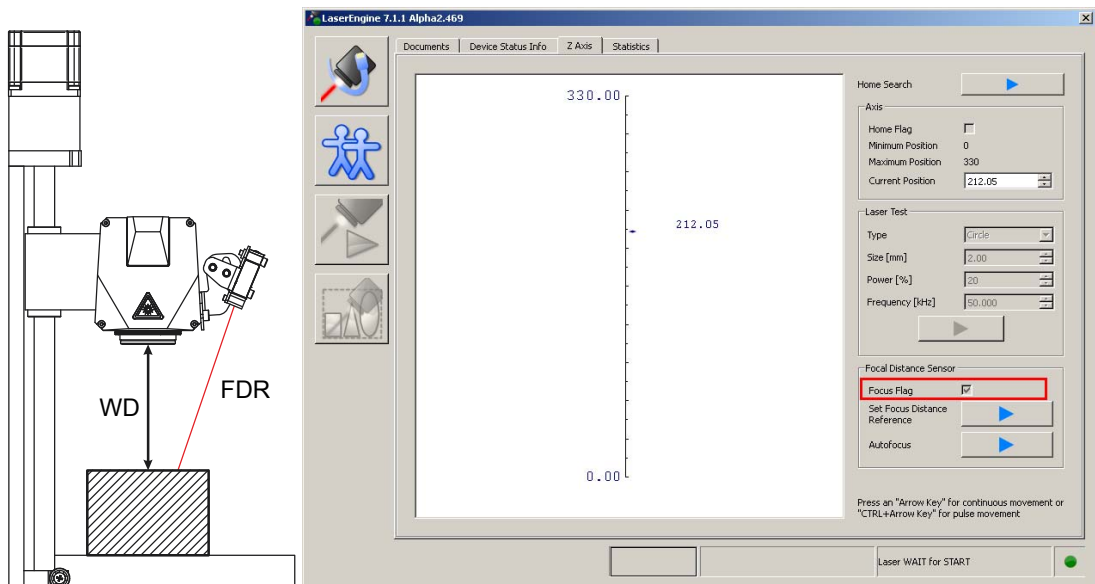
Place the object to be marked in the marking field taking care that the red laser beam of the sensor points its surface.

Press the **Autofocus** button to start the Autofocus procedure:



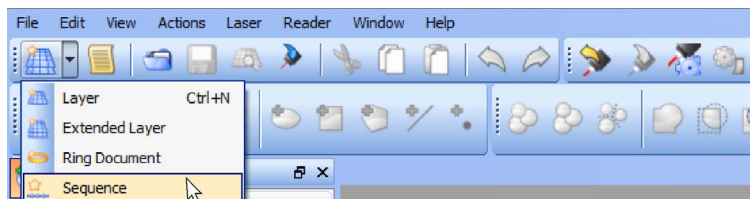
The Autofocus procedure will start and the Z Axis will be moved up or down to keep the correct **Working Distance (WD)**.

If the Autofocus procedure is successful the **Focus Flag** will be flagged, otherwise a warning message will be displayed:



## Autofocus using Sequences

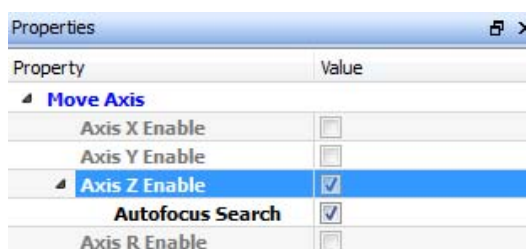
Using **Sequences**, it is possible to integrate and automate the Autofocus process in a laser marking environment.



The **Move Axis** item has been updated with the **Autofocus** feature.

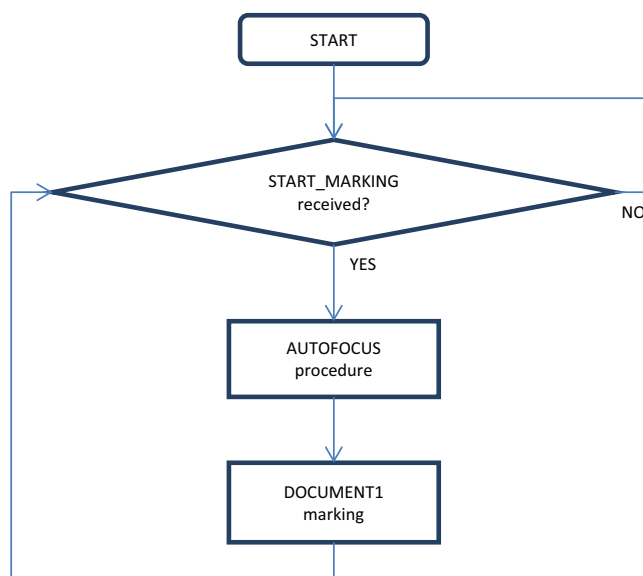
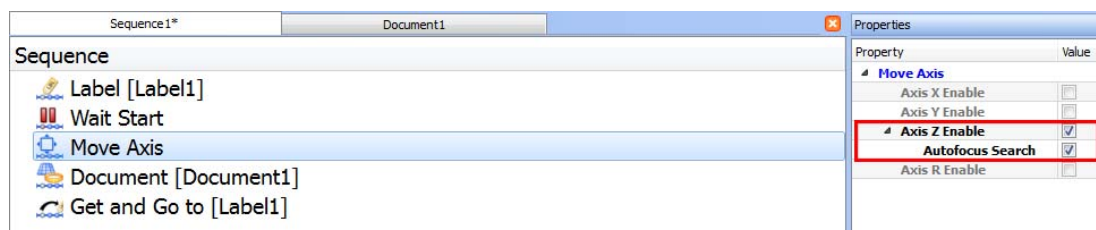


Set the property **Autofocus Search** to perform the Autofocus



Insert the **Move Axis** item before a **Document** item to perform the Autofocus procedure before the document is marked.

Below is an example of a sequence in which the Autofocus is performed before a document is marked.



## Autofocus using Script

Lighter™ Suite allows to develop custom GUI and automate the laser marking process using Scripts functions. Script functions are also available to integrate and automate the Autofocus in a laser marking environment.



### NOTE

For a proper use refer to **Lighter™ Suite software user manual**.

## Dynamic Focus Handler script description

Datalogic provides the **Dynamic Focus Handler** 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.

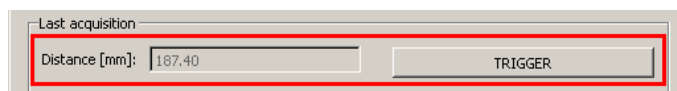
**START AUTOFOCUS** button: when this button is pressed, the AUTOFOCUS procedure starts. This button is active only if the **FOCAL DISTANCE REFERENCE** has been already set.

## How to use the Dynamic Focus Handler script

Select **DynamicFocusHandler** 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:



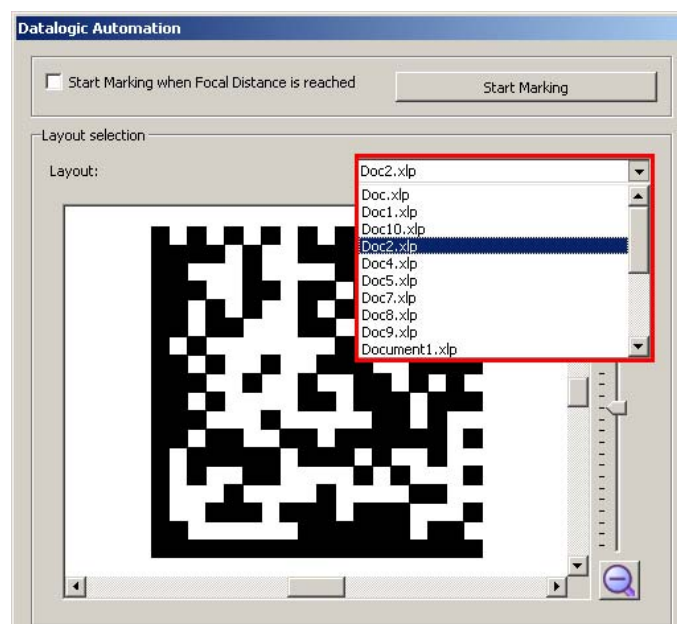
Press **SAVE CURRENT DISTANCE** to use the current distance as **FOCUS DISTANCE REFERENCE** value for the Autofocus procedure.



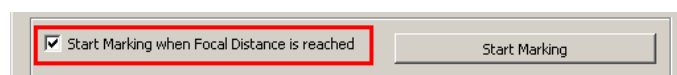
### NOTE

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.

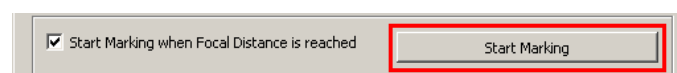
Select the layout to be marked from the list. The layout preview will be shown:



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.

## Autofocus using ActiveX

Lighter™ Suite allows to develop custom GUI and automate the laser marking operations using ActiveX functions.

ActiveX functions are also available to integrate and automate the Autofocus process in a laser marking environment.



### NOTE

For a proper use refer to Lighter™ Suite software user manual.

## Autofocus using communication protocols

The Autofocus functionality can also be managed via the following communication protocols:

- TCPServer
- EthernetIP



### NOTE

For a proper use refer to Lighter™ Suite software user manual.





## Chapter 5

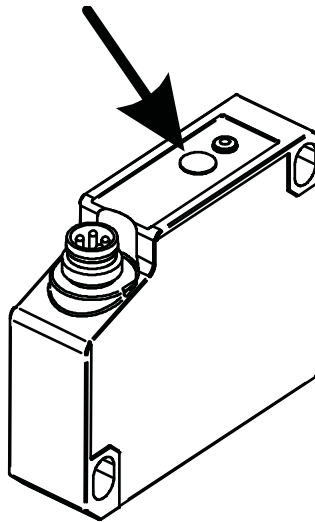
# Troubleshooting

**TROUBLESHOOTING** [starting on page 30](#)

# Troubleshooting

## 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 10)
		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 12)
	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



### NOTE

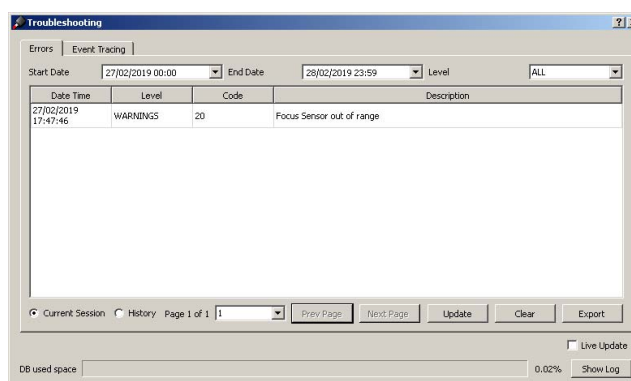
During the Z Axis movements due to Autofocus operations the LED could flash between green and red. This behavior is to be considered normal.

# Lighter™ Error Messages

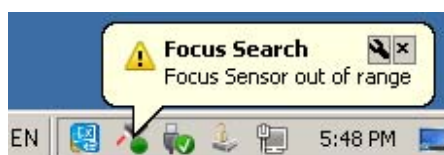
Laser Engine is able to notify Autofocus errors to the user.

The error messages are notified through the following tools:

- Laser Engine Log files (...\\Data\\Logs)
- Laser Engine Troubleshooting




- Laser Engine tray icon



The following table shows the error messages associated with the Distance Sensor:

Error Message	Cause	Action
Invalid Focus search	The AUTOFOCUS procedure failed due to unreliable sensor reading or to invalid configuration parameters	<p>Check the Distance Sensor parameters (see 'Configure the Distance Sensor parameters" on page 17)</p> <p>Check the Distance Sensor positioning (see 'Recommendations on Sensor Positioning" on page 12)</p> <p>Check the mechanical Z Axis parameters (see 'Configure the Z Axis parameters" on page 16)</p>
Invalid Focus reference	The AUTOFOCUS DISTANCE REFERENCE is not set or is invalid	Set a valid AUTOFOCUS DISTANCE REFERENCE (see 'Set the Focus Distance Reference" on page 22)
Focus Sensor unavailable	The Distance Sensor functionality is disabled in Laser Configuration	Enable the Distance Sensor functionality in Laser Configuration (see 'Configure the Distance Sensor parameters" on page 17)
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
Focus Sensor connection 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)
Focus Sensor communication error	Communication error with the Distance Sensor (command error, unknown command, overrun error, frame error, invalid parameter, checksum error)	Check that the Distance Sensor connection cable is not too close to electromagnetic field able to compromise communication



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