RANGEVISION

Setup and calibration

SPECTRUM

Contents

Introduction 3

Technical specifications 4
System requirements 4

Preparing for work

Package contents 5
Installing software and drivers 7
Setting up your computer for work with the scanner
- Connecting projector 8
- Configuring computer parameters 9
- Scanner Assembly

Scanner setup

ScanCenter NG launch 11
Select scanning zone 12
Calibration field parameters 13
Placing the calibration plate 13
Initial setup of cameras and lenses 14
Checking camera arrangement 15
Finding a working distance 15
Adjustment of the projector focus 16
Bringing the cameras together 16
Final calibration of the cameras 17

Calibrating the scanner

Calibration plate 21
Full calibration 23
Fast calibration (orientation) 25
Focus assessment during calibration 27

Introduction

Thank you for choosing RangeVision Spectrum!

Please read this manual before using RangeVision 3D scanner. Here are described the procedures for preparing the scanner, installing the required drivers, calibration procedure, scanning procedure, and tips for acquiring high-quality three-dimensional object model.

Information may be amended from time to time. These changes will be inserted into the new versions of the manual, or in the additional documents and publications.

Warning!

1. Do not expose the scanner to liquids.
2. Do not use liquid cleaners or aerosol cleaners.
3. Do not store or use the scanner in dusty or humid environments.
4. Do not expose the scanner and its components to contamination, shock or drops.
5. Do not connect power to a faulty wall outlet.
6. Do not aim the scanner at people and animals in order to avoid directing the bright projectors light at the eyes.
7. Patterns and holes are provided for ventilation of the scanner to ensure its reliable operation and to prevent overheating. Do not block or cover the openings.

Technical specifications

Scanning zone	L	M	S
Scanning Area (WxHxD) (mm)	520*400*400	320*250*220	120*90*100
3D point accuracy	0.12 mm	0.06 mm	0.04 mm

Model	Spectrum
Resolution of cameras	3 Mpix
Diagonal of the matrix	1/2”
Texture scanning	Yes

3D resolution

Scanning zone	L	M	S
3D resolution	0.25 mm	0.15 mm	0.06 mm
Operation distance	1.05 m	0.6 m	0.3 m

System requirements

- operating system - Windows 7/8/10 64bit,
- processor - Intel Core i3/i5 1.8 GHz and better,
- graphics card with HDMI output,
- RAM - Not less than 8 GB,
- 3 USB-ports.

Preparing for work

Package contents

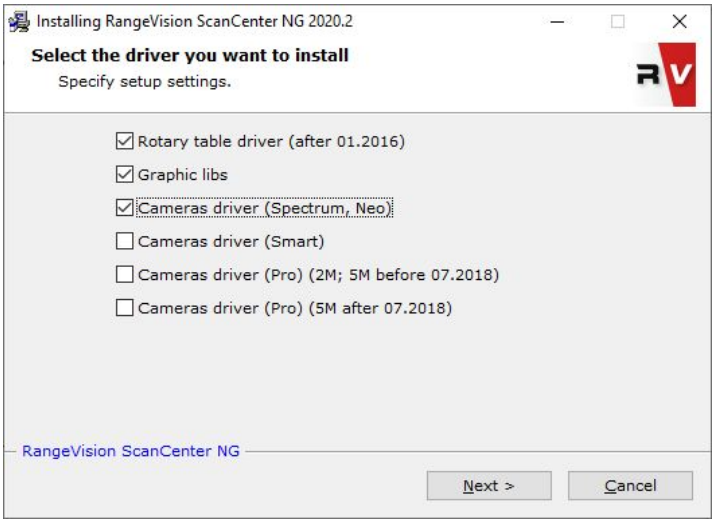
RangeVision 3D scanner is supplied in a protected road hard case. Camera tripod is placed in a separate bag.

The scanner is equipped with three scanning areas. Scanning area is a calibration plate and stand for the calibration plate.

№	Name	qty.
1	Scanning module:	
	Installation construction with projector	1
	Cable kit for connection to a PC (2 USB + HDMI)	1
2	Machine vision camera	2
3	Tripod	1
4	Calibration plate	3
5	Kit of optics	1
6	Stand for the calibration plate	2
7	USB disk with the software	1
8	License dongle	1
9	Power Cord 5 m	1
10	USB hub	1
11	Hex key	1
12	Rotary table + cables	1

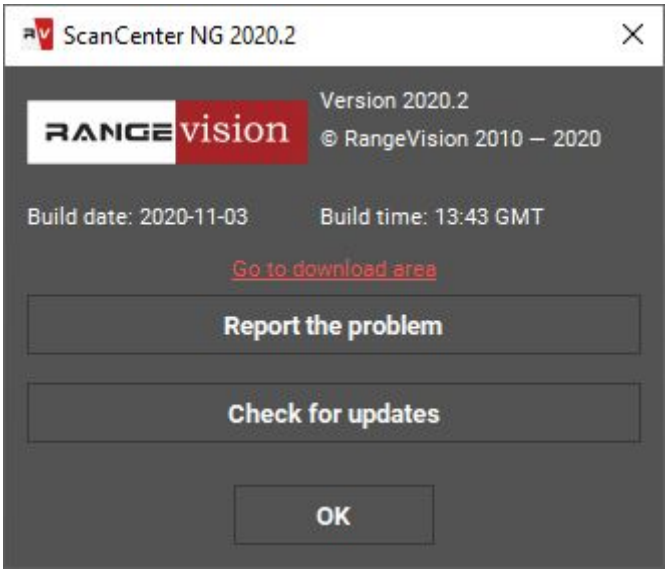
Installing software and drivers

Get the RangeVision software (equipped with the scanner) and run the installer - RangeVision ScanCenter setup.



Following the prompts, select the desired language, type and path for installation. After the files have been copied install drivers and graphics libraries, necessary for the correct operation of RangeVision 3D scanner.

If you have access to the Internet RangeVision ScanCenter NG will automatically notify you when updates are available. You can check for updates manually by clicking About → Check for Updates.



Setting up your computer for work with the scanner

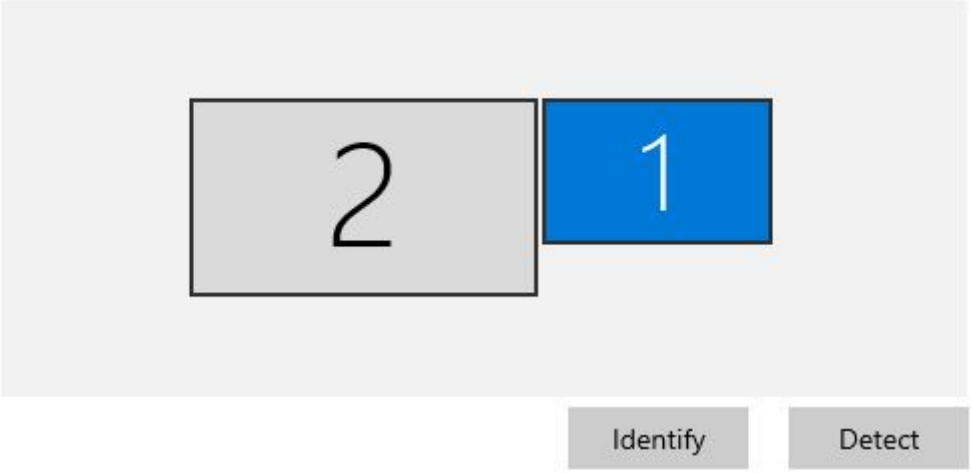
For the correct operation of Rangevision 3D scanner you will need to setup your computer. This procedure is performed once before the first use of the scanner .

Connecting projector

Turn on the projector and connect it to the HDMI-port of your video card. After connecting the projector, it should be displayed in the system. If the computer has several video outputs, define the one to be used.

If the second monitor (projector) is not defined by the system, check the cable connections and restart the computer. Also, try to connect the cable to your computer when the projector is on, if it was off earlier.

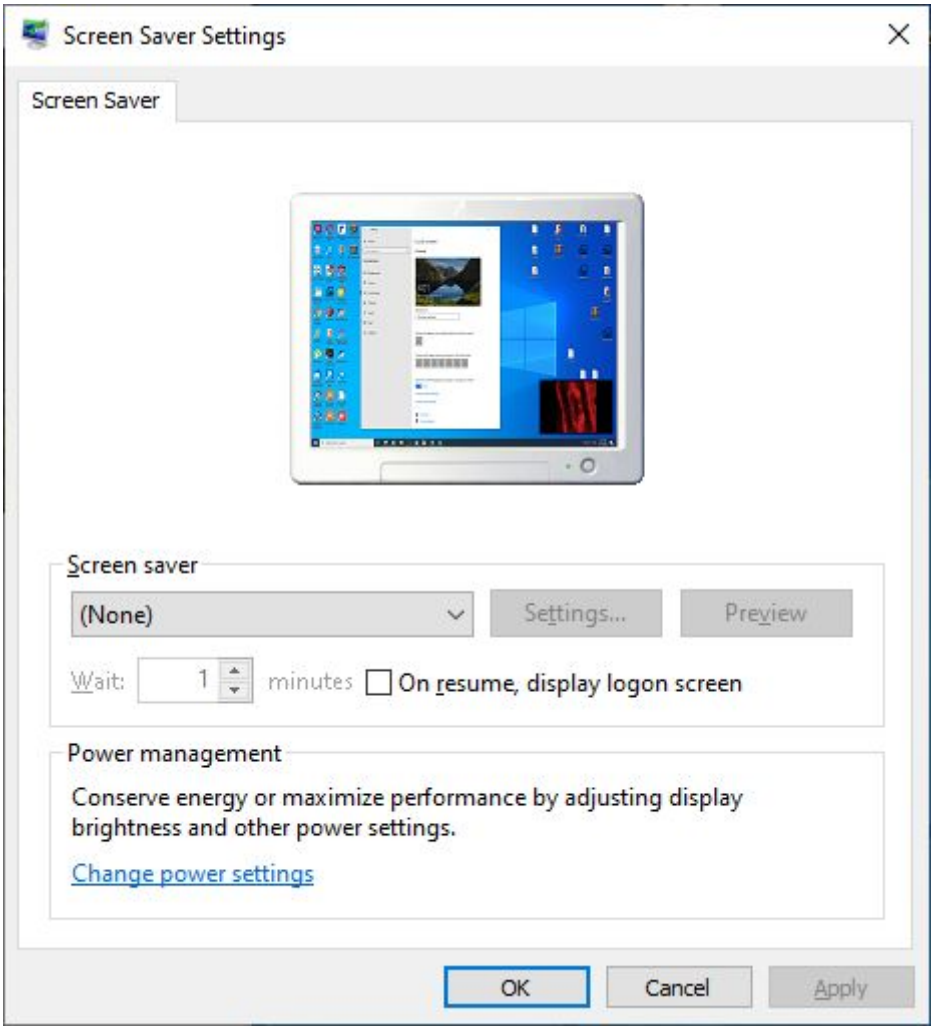
1. Right click on the desktop, select Screen resolution,
2. Make sure that the projector has been successfully recognized by the system and that both connected screens are displayed.

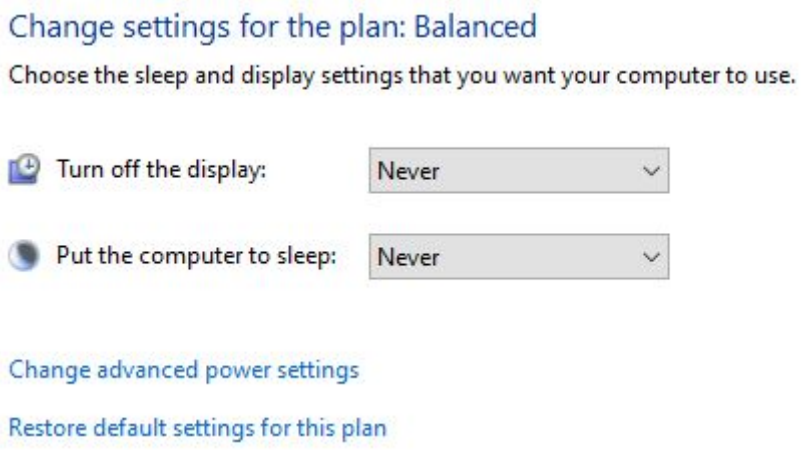


Configuring computer parameters

To avoid a recurrence of the problems during the scanner operation, you must turn off the screensaver and sleep mode.

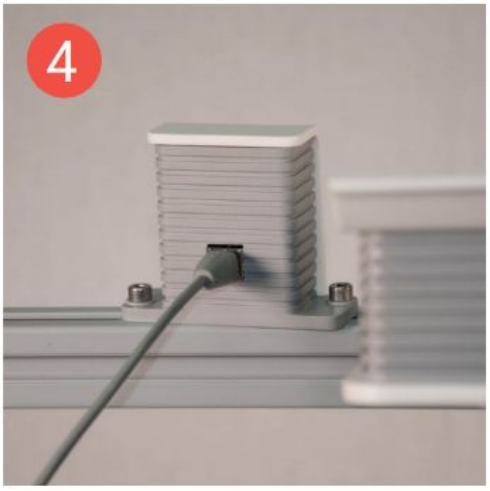
By clicking right mouse button on the desktop, select Personalize → Screensaver and turn off the screensaver, disable turning off the display and putting the computer in sleep mode.





Scanner Assembly

1. Mount the cameras on the scanning module.
2. Install the scanning module on tripod.
3. Connect the projector with HDMI cable.
4. Connect cameras with USB cables.
5. Connect power supply and turn on the projector.



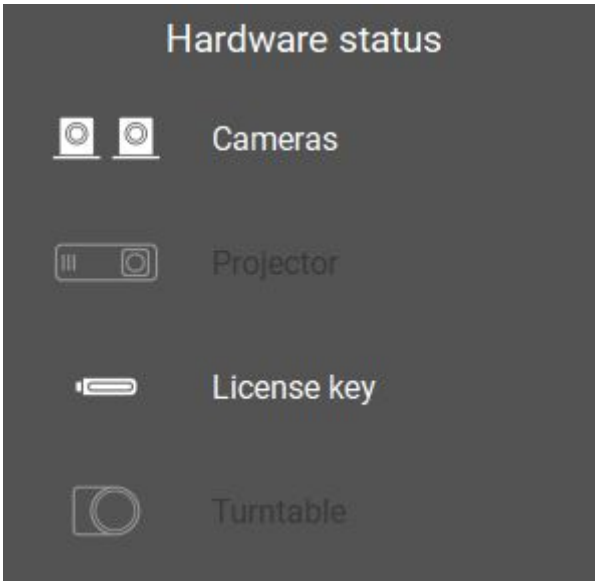
*

*old color variant with identical specifications is pictured

Scanner setup

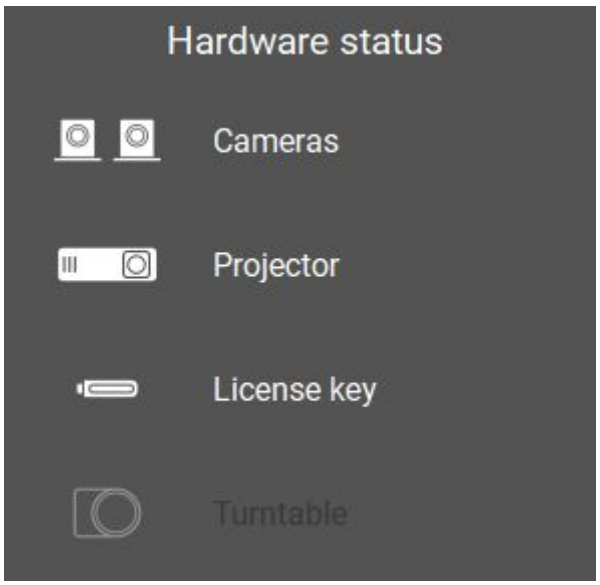
ScanCenter NG launch

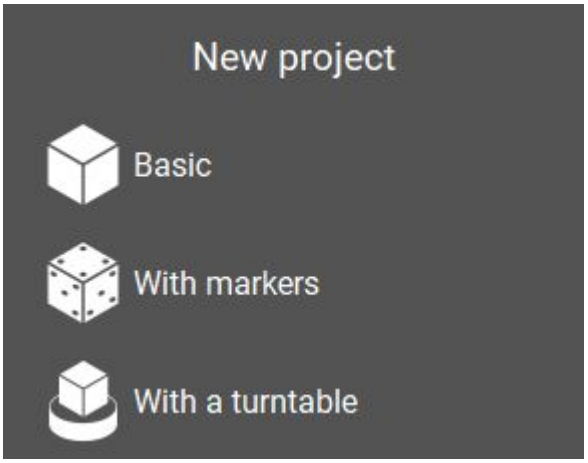
Run RangeVision ScanCenter NG.
If the scanner is not connected or drivers aren't installed, an indication will appear on the Start Screen, as shown below:



Check the connection of cables, power supply, and then click Update. If you are sure that all the components of the scanner are connected correctly and the connection error persists, manually select hardware in Hardware settings. If necessary, contact the technical support of your reseller. If the scanner is not connected intentionally and none of the components can be found, only the processing functions of ScanCenter NG will be available.

In the case if all the settings are correct, after starting the program, you should see the image from the cameras in the main application window.

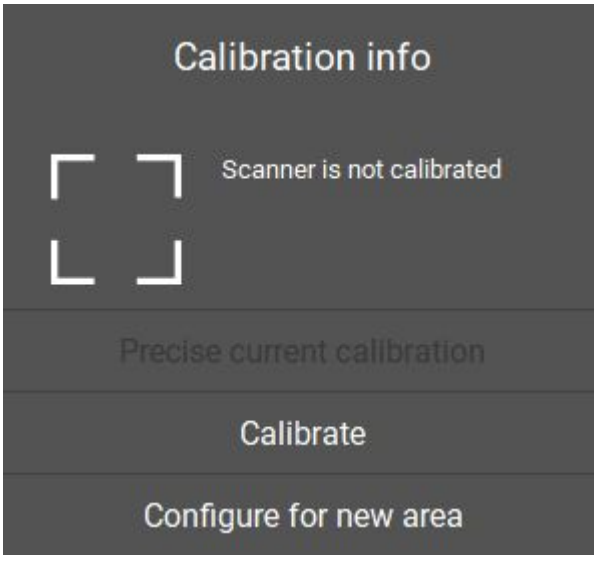




Select scanning zone

After preparatory actions on setting up the computer, you should carry the scanner setting procedure. Select Configure scanner for a new area in Calibration window on the Start screen and follow the instructions for each step.

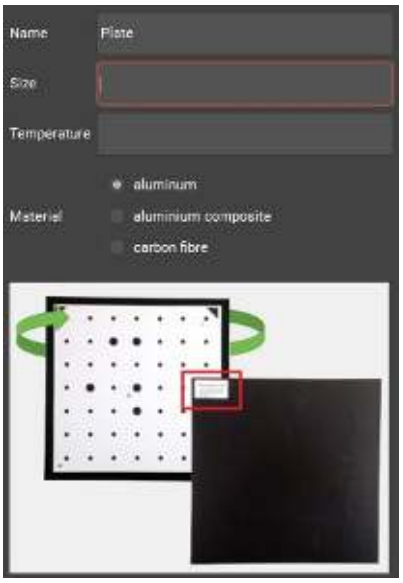
Before beginning the configuration, select the desired scan area (zone), depending on the object scanned. Scanning area is a set of interchangeable optics, calibration plate and stand for the calibration plate, which help to configure the scanner to scan a certain area. In the majority of cases, scan area is correctly matched, if the size of the object approximately equals to the size calibration plate.



Calibration field parameters

Take the necessary calibration to configure the scanner to the selected scan area. Make sure that the scan area is included in the package of your scanner.

The exact size and measurement temperature are written on the label on the reverse side of the calibration plate. Enter these values into the Configuration Wizard or select from the drop-down list of previously entered values.



Placing the calibration plate

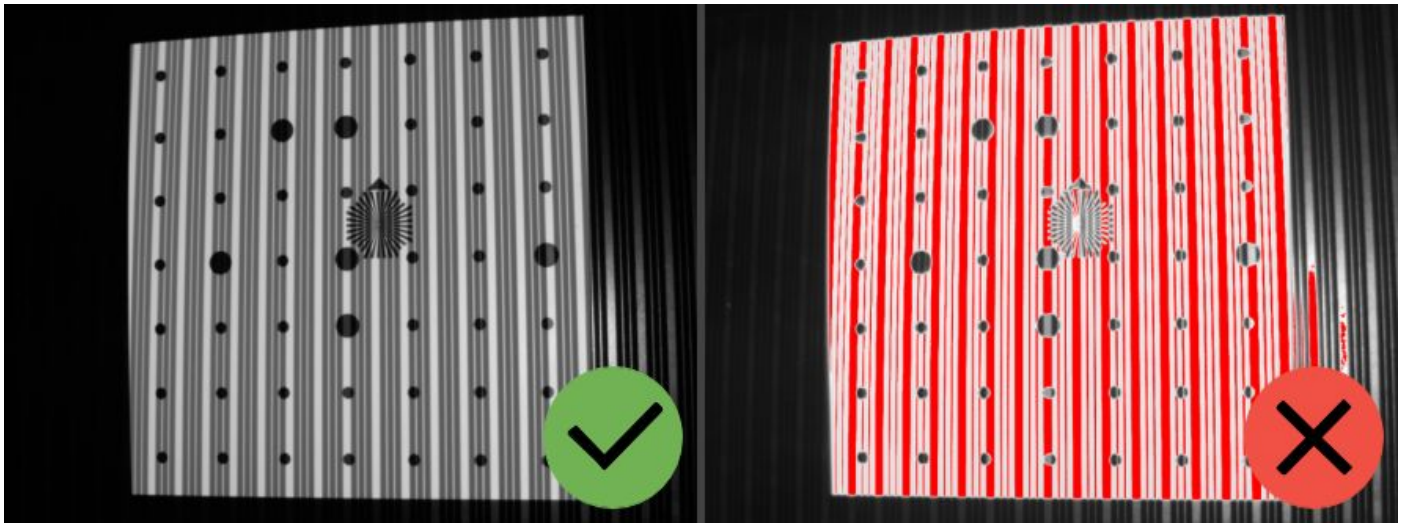
To find a working distance place the calibration plate in front one of the cameras. To install calibration plate use special stands.

For plates L and M use large stand with special slots for plate installation; for plates S and axis evaluation plate use a small stand.

Initial setup of cameras and lenses

When you first set up the scanner, image from the cameras may not be in focus or can be too bright or too dark due to different external lighting conditions. Adjust camera lenses, so that the brightness is acceptable: without the red overexposed areas and not too dark.

Lens adjustment is carried out by rotating the ring on the objective. Loosen (do not unscrew!) the retention screw and rotate the ring.



Lens adjustment is carried out by the following elements:

1. The iris tuning ring
2. The iris ring retention screw
3. The focus tuning ring
4. The focus ring retention screw

Do not completely remove the retaining screws of the lens rings, it is enough just to loosen them. After you finished tuning the lens, lock the adjustment rings with the screws provided.

Checking camera arrangement

Images from right and left cameras can be mismatched or flipped. Use the buttons present on this step to arrange them correctly.

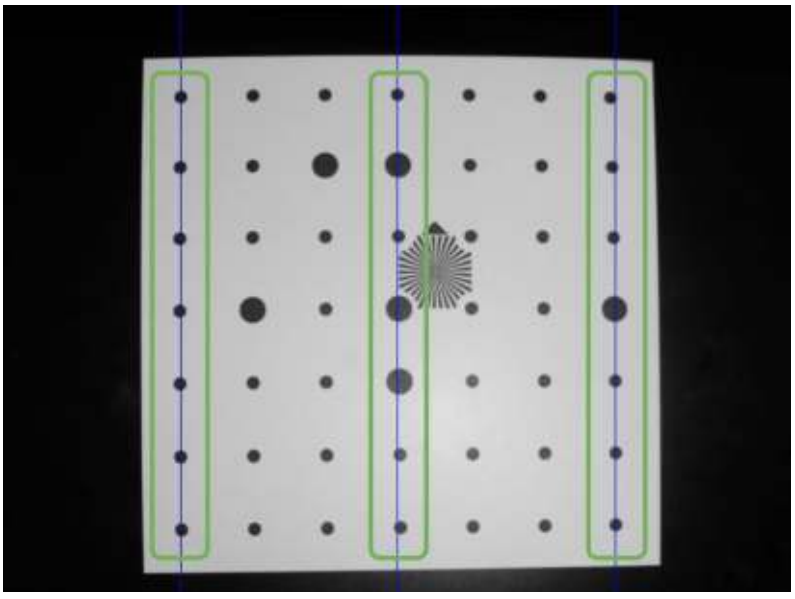
If this setup wizard step is not needed after completion, it can be turned off by checking the Don't show this step anymore box. It can be brought back by checking the Show the camera arrangement step in setup wizard box located in Settings → Software → Cameras menu.

Finding a working distance

The scanner has own working distance (distance to the object) for each scanning area. When you configure your scanner, this distance is determined by calibration plate.

To find a working distance place the calibration plate in front of one of the cameras. By moving the field closer to or further away from the camera, align the far markers of calibration plate with blue lines on the camera view, as shown in the figure below. Blue vertical lines in the camera view must match the marks on the calibration plate.

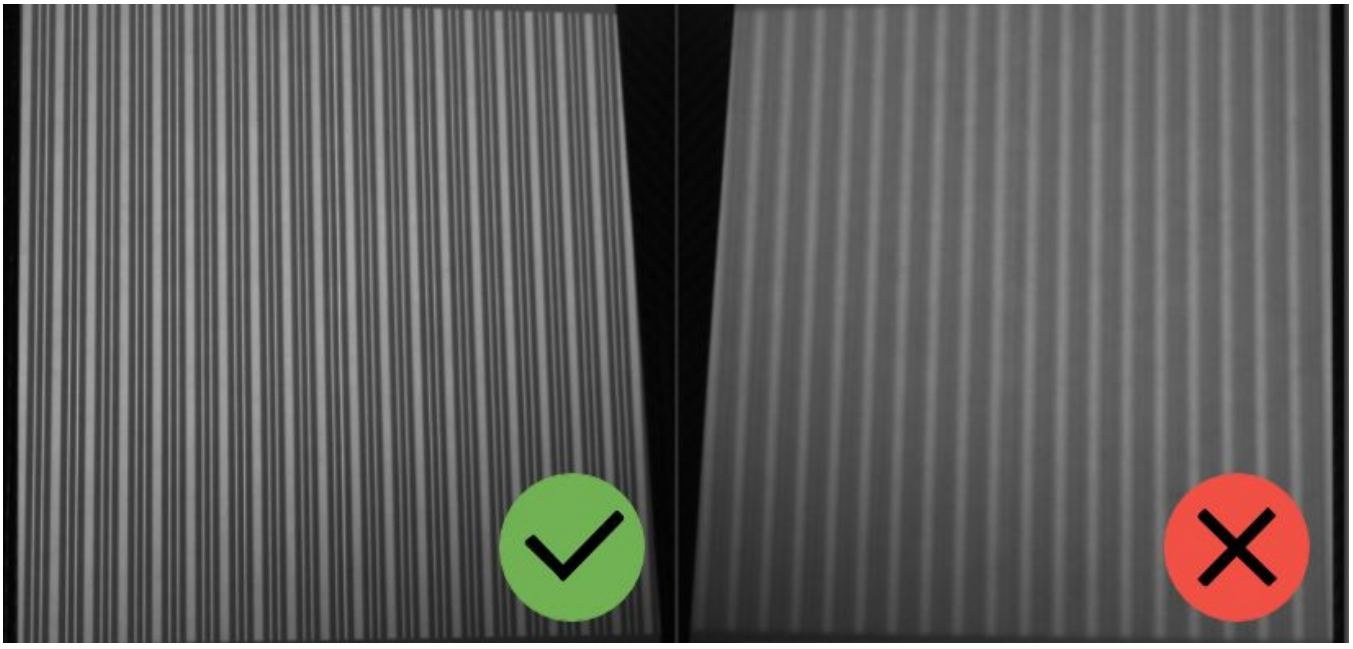
In Hardware settings → Cameras menu use Preview smoothing to enable or disable interpolation of camera preview images. In some cases interpolation can make the images too blurry.



Adjustment of the projector focus

During the scanner operation the projector project structured light to the object - coded lines and stripes. To ensure that the lines are sharp, the projector must be focused on the working distance of the scanner.

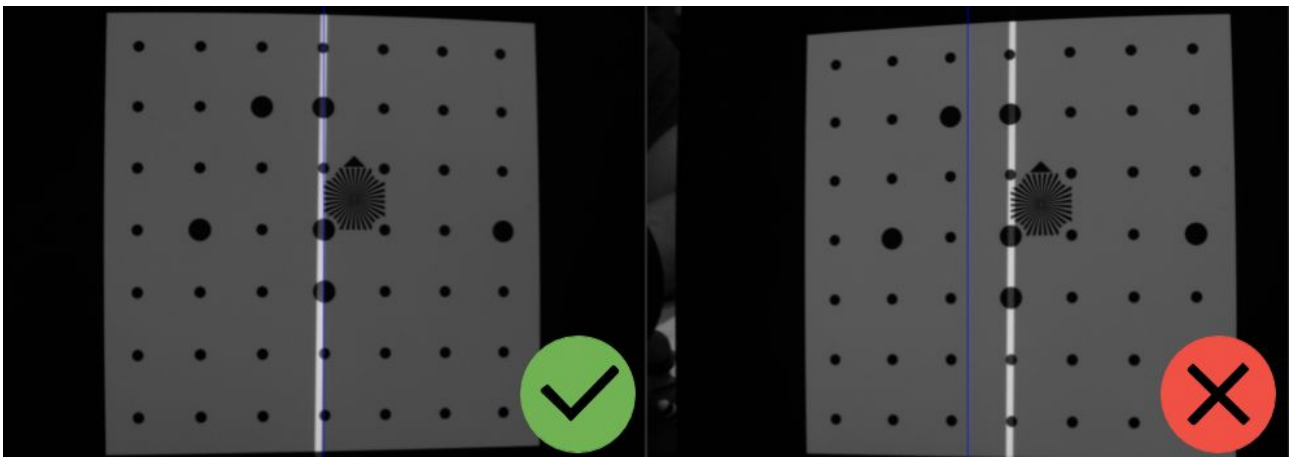
By switching the mode "Lines and Stripes", adjust the focus of the projector, so that the lines on the calibration plate were as sharp as possible. Check and if it's necessary to adjust the projector focus.



Bringing the cameras together

For the work of the scanner it is necessary to point both cameras to the same position on the specified working distance. Install the calibration plate in front of the scanner on the found working distance (if you changed its position after the projector focusing procedure).

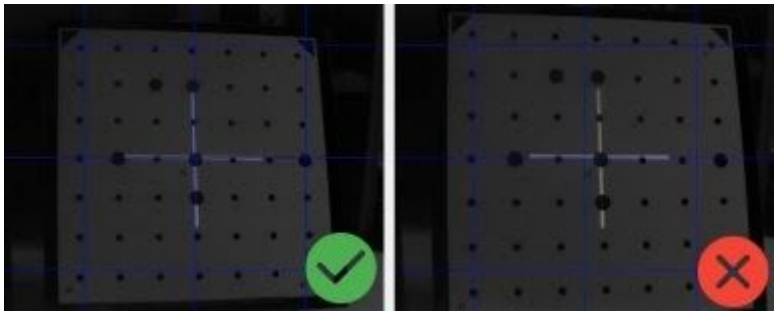
Turn on the Cross light mode and aim the scanner to the calibration plate. It is not necessary to combine cross with marks on the plate at this stage, the focused projector should be projecting a cross on any surface, located at the working distance from the scanner. Move the cameras on the bar so that the vertical line of the light cross lies approximately on the central vertical blue line in the both camera views.



A small deviation between the right-hand and left-hand cameras in height does not affect the scan quality, select the middle position between the cameras.

Final calibration of the cameras

After the cameras are positioned align the projected cross with the central mark on the calibration plate and proceed.

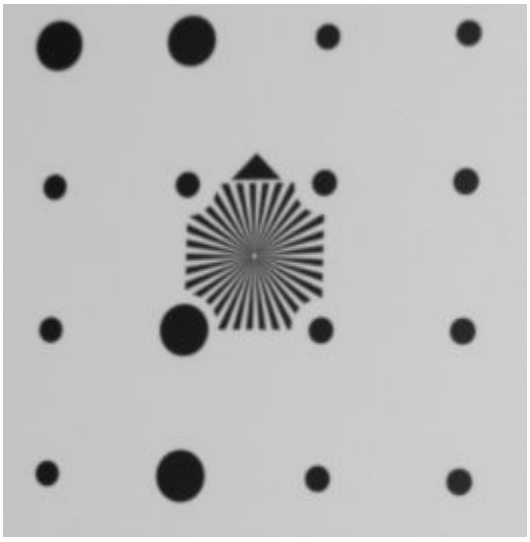


Please note, at the correct location of plate at a distance the vertical line of cross will match the central vertical blue line on the view from the cameras. Otherwise, you will notice the difference in one direction or the other.

Before setting the exposure adjust the sharpness of the lenses:

1. Turn on "Black light" projector mode.
2. Set the minimal exposure value (1) using the slider.
3. Open the lens iris as much as possible without getting overexposure.
4. Adjust the lens sharpness.

It is convenient to use camera view zoom by left-clicking the camera views to assess sharpness.

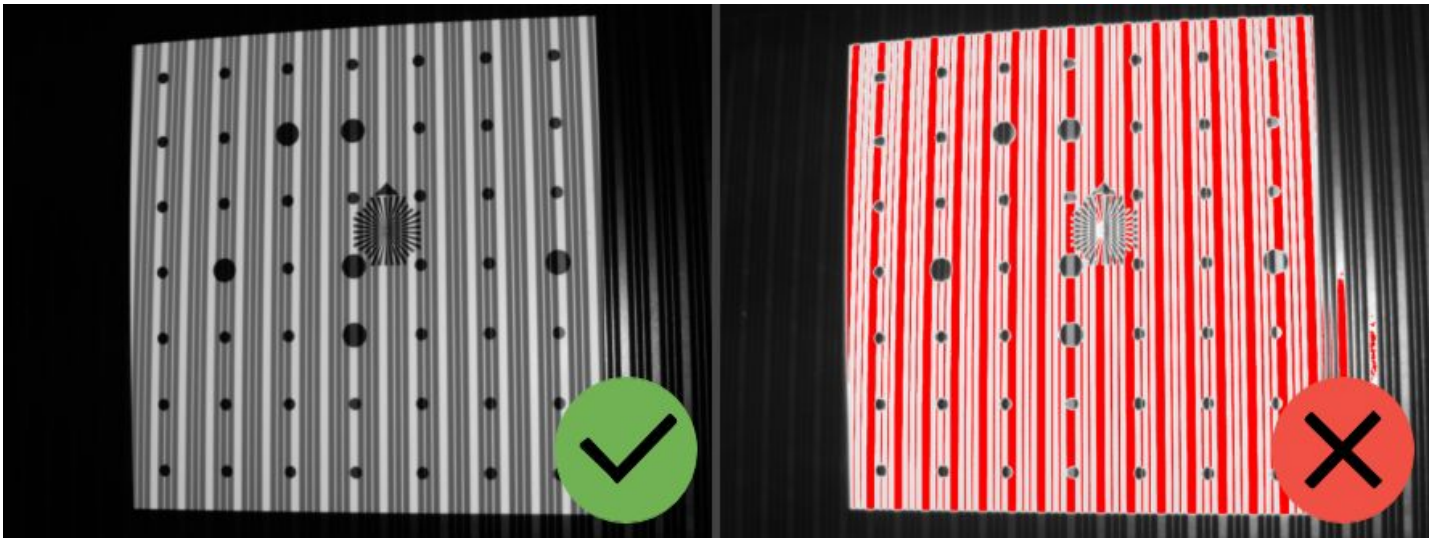


Set the projector to the lines and stripes mode. Set the exposure for the cameras between 30 and 60 (less if the object, which you are planning to scan is dark and more if it is bright). By default the value is 45.

Areas illuminated with red mean overlit areas with too bright image.

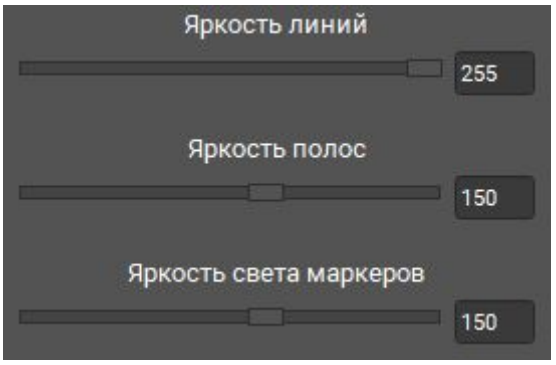
Configure lenses iris so that the lines on the calibration plate are as bright as possible, but without a significant amount of excessive light. Image brightness of both cameras must be the same!

In order to better align the same exposure on both chambers, you can leave a small area with excessive light (red area). The same "figure" of area with excessive light on both cameras will allow to more accurately set up the diaphragm of lenses.



If excessive light does not disappear even when the diaphragm is closed, reduce the value of electronic exposure. Check the projector settings, probably the light is too bright. Reduce ambient light level.

If you are setting up the 3rd scanning area, it may be necessary to decrease the brightness of lines and stripes due to the close distance to object. Decrease the brightness value, as shown in the figure. Brightness value of lines is approximately 2 times greater than the brightness of the stripes. Visually lines and stripes must be the same brightness.



After the end of the setting up procedure carefully lock sharpness and diaphragm rings with screws on the camera lenses in order not to lose their position.

Upon completion of all scanner adjustments, you should fulfil the following conditions:

- cameras are pointed to one point, located at the working distance from the scanner,
- at the same distance focused cameras and image from the projector,
- at the standard values of electronic exposure (30-60) image from the cameras is not excessively bright and not too dark,
- all the adjustment and the clamping screws are tightened.

Calibrating the scanner

You need to perform calibration in order to ensure the work of the scanner after the adjustment of lenses. Scanning software analyses the image of the plate, obtained from the cameras and compares it with the mathematical model, marked by the algorithm. There are 3 types of calibration: Full calibration, fast calibration (orientation) and Calibration of turntable (finding the table axis).

Full calibration is used if:

- the lenses of the cameras need to be reconfigured (for example, if you change the scanning area),
- if you suspect that scanning accuracy got worse,
- after transporting the scanning complex.

Orientation is used:

- if you suspect that the camera moved due to unreliable mounting,
- if you want to check the accuracy of performed calibration,
- before the work with the scanner (recommended).

Calibration of rotary table is performed:

- in case of any change in the position of the rotary table to the scanner (when scanning on the rotary table).

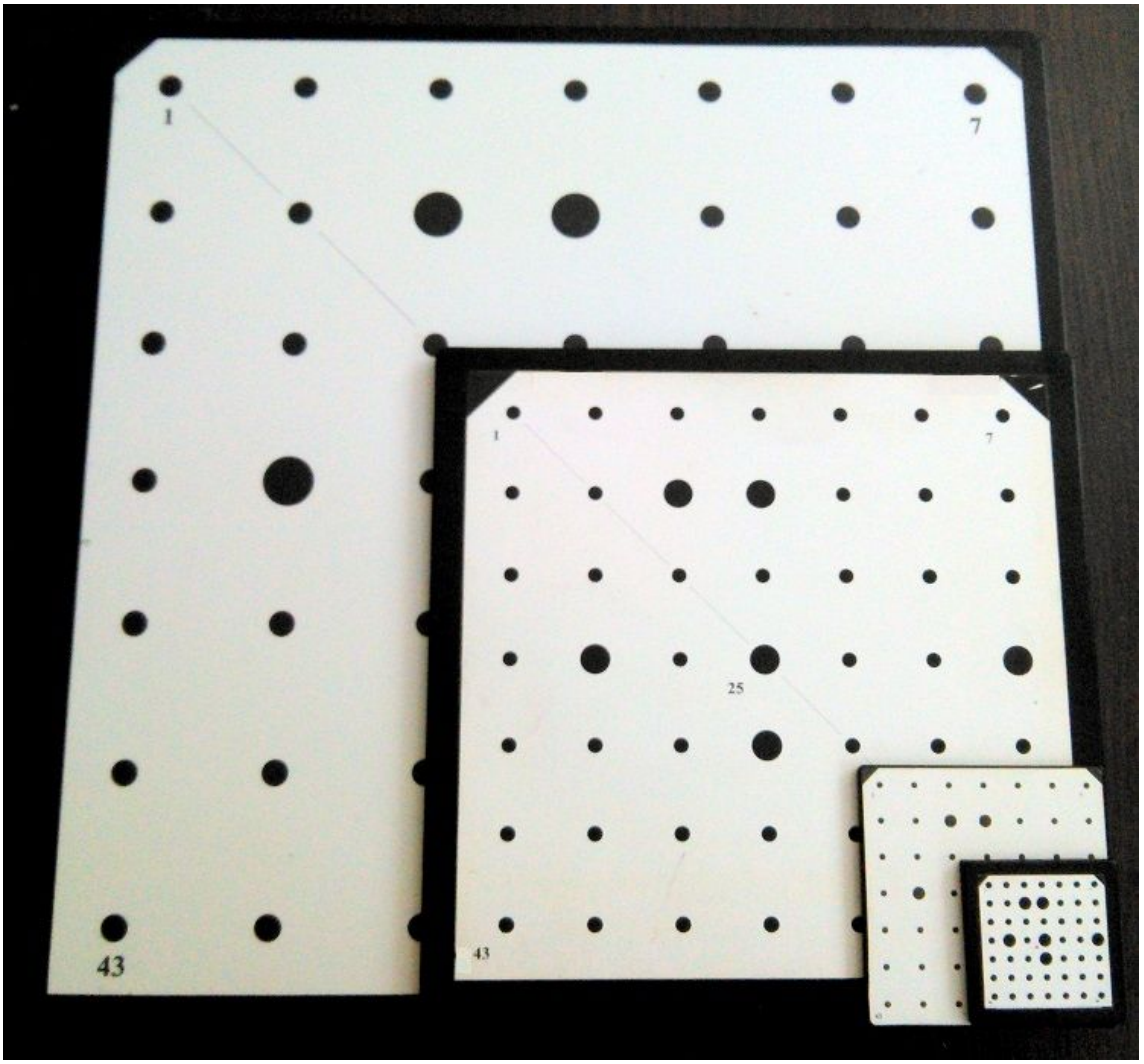
Calibration of rotary table is described in the Scanning on rotary table section.

Calibration plate

Calibration plate is a special plate with markers, the distance between which is measured with high accuracy. It is used for setting up a scanner and its calibration.

For each scanning zone a separate calibration plate is used. There are three standard plates for Spectrum : L is the largest and S is the smallest. The approximate size of plates is specified in the Scanner setup section.

For calibration of rotary table on the S scan area you should use the "axis evaluation" plate. In the picture below you can see different calibration plate examples.



Full calibration

During and after the calibration process you should not adjust camera lenses.

Calibration should be performed in the same light, in which an object will be scanned. If there is too much change of level in lighting conditions it is necessary to recalibrate the system. It is not allowed to carry the calibration procedure on direct sunlight.

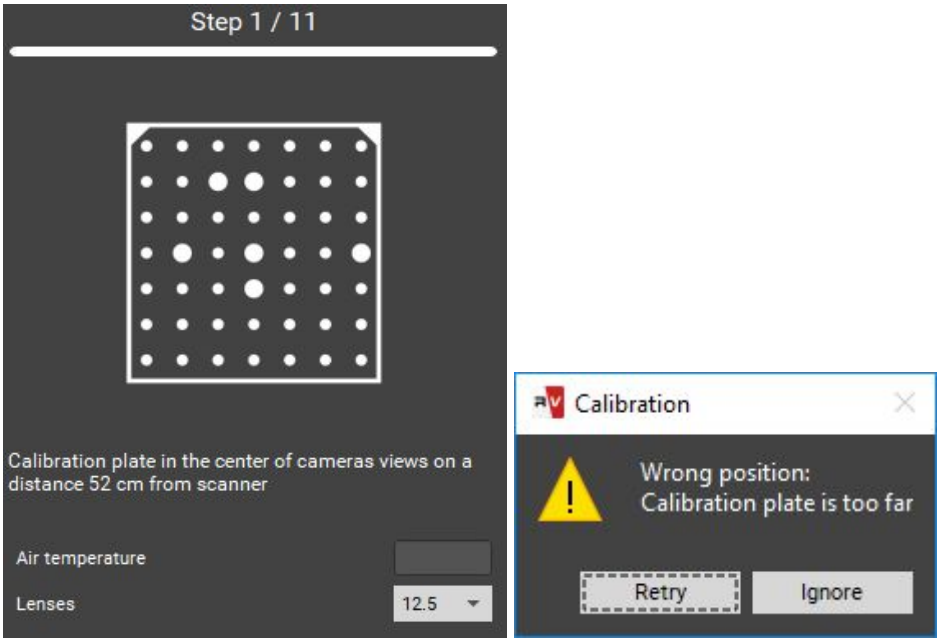
Full calibration dialog box opens automatically after the Configuration wizard or manually from the menu Configuration → Full calibration.

Calibration procedure:

1. In the dropdown list the previously selected (in Configuration wizard) calibration plate size is chosen. Compare it to the actual calibration field, choose it from the list, if needed. Focal distance of the lenses is detected automatically, and is only allowed to change by technical support specialist when calibration problems occur.

Make sure that the plate size specified in the software matches the actual plate size written on its back side. Incorrect size may cause errors and geometric distortions on meshes.

2. In accordance with the text prompt and symbol image install the calibration plate in the desired position. The brightness of the images of calibration plate can be adjusted with exposure controller. You should not allow very dark images or images with excessive brightness areas. Press the Capture button. Original plate position - the position at the working distance from the scanner (marking on the view from cameras matches the markers on the plate), the cross is projected on the central marker.
3. If the plate placement is incorrect a error message will appear. Correct the placement and repeat the step.



In case if not all marks are found on the image, you will also see the error message. It may mean the following:

- not all markers are visible on one of the snapshots,
- not all markers are lit by the projector,
- calibration plate is mounted at large angle to the scanner,
- plate is too close or too far from the scanner - the image is not sharp, the plate is damaged or dirty.

Please correct all deficiencies and press Capture.

Calibration is carried out by the results of 11 snapshots. Carefully observe the position of the plate during each capture! In some positions it will be necessary to switch the bottom side of the plate.

After all the necessary snapshots are taken, calibration module will start automatically. Resulting accuracy of calibration is specified in pixels. A good result is accuracy no worse (not higher) than 0.1 pix. If you get a higher value, repeat the calibration, carefully making sure that the plate is sharp, bright and correctly positioned.

Calibration result in pixels is not equal to scanner accuracy in millimeters!

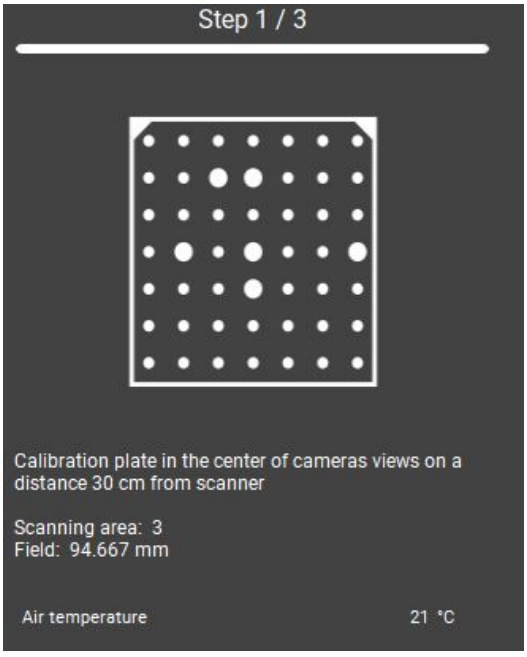
Some advice on calibration:

- do not change the distance from the center of the plate to the scanner when turning the plate. The exception are only snapshots in positions 10 and 11,
- do not rotate the plate at a very high angle. Ensure that all marks on the plate are visible from both cameras, when you turn the table,
- be careful with calibration plates! It is not permitted to contaminate or perform any mechanical damage to the surface with the marks. After the use store the plates in designated case,
- before the calibration procedure ensure that cameras and cables are secure in the designated position.

Fast calibration (orientation)

When scanning large objects and moving the scanner frequently, the scanner eventually may report that it cannot find markers. In such case you need to perform fast calibration.

Orientation is carried out by the results of 3 snapshots. Orientation is done with the same conditions as the last calibration. The corresponding controls in the dialog are disabled.



The orientation can be started from the Calibration window on the Start screen.

- place the calibration plate at the working distance to the scanner (the first calibration position),
- press the Capture button,
- next, following the steps, make two more shots,
- after this the accuracy of orientation will be shown. It should be approximately equal to the accuracy value of the last calibration.

If the accuracy during orienting starts to be very different from the original one, you need to re-calibrate the equipment.

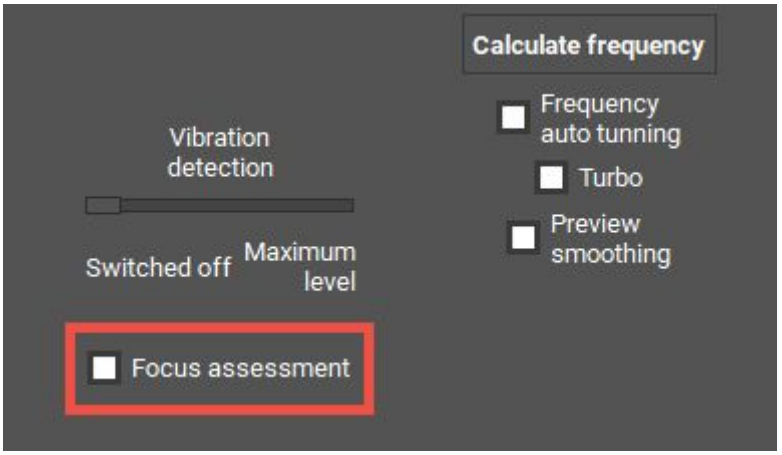
Example: The initial accuracy is 0.024, accuracy after orientation is 0.065. The value exceeded 0.05, re-calibration is required.

After calibration or orientation, the calibration plate should be removed in order to avoid the damage or contamination!

Focus assessment during calibration

While performing the calibration steps it is important to not deviate too much from the working distance in order to keep the calibration field in focus.

The focus assessment option can help with this task. It is located in the Hardware settings → Cameras menu.



When activated, the software will monitor the calibration snaps and will suggest repeating a step if low marker sharpness is detected.

Markers going out of focus can be caused by incorrect plate position or lens adjustment.

WEEE Statement

The following information is only for EU-members States: The mark shown to the right is in compliance with Waste Electrical and Electronic Equipment Directive 2002/96/EC (WEEE). The mark indicates the requirement NOT to dispose the equipment as unsorted municipal waste, but use the return and collection systems according to local law.