



# Setting up ZSK OPS2 (optical positioning system II)

## CONTENTS

Mounting the camera	2
Connecting the T8 and the OPS2 laptop	3
Setting up the network connection of the T8	4
General settings	4
Network connection for monogram mode	5
Activating the ZSK OPS2 system	9
Connecting ring light power supply	10
Access to focus and zoom adjustment	11
Calibrating the camera	12
1 Preparation for calibration process	12
2 Removing barrel distortion	14
3 Correlating pixels and pantograph movements	17
Aligning the reference sheet	17
4 Determining the distance between needle and camera (in 2D space)	20
Setting an origin for a design	22
Check accuracy of needle to camera distance	23
Start from a specific part	24
Setting the image postprocessing values	24
Manual mode	25
Keyboard shortcuts	26

## MOUNTING THE CAMERA

The ZSK camera for the OPS2 systems is a combination of a camera and a ring light to provide sufficient illumination in difficult lighting situations and enhance the ability to detect perforations. To mount the camera there are only two allen screws necessary, which attach the complete case including the ring light to an aluminium support on the machine.



Mount the camera as close as possible to the pantograph. But as high as necessary to enable the pantograph (incl. clamping mechanisms) to move freely underneath the camera. Make sure, that the camera is mounted upright. An inevitable slight tilt will be corrected by the calibration process afterwards.

The camera has its USB cable attached to it. It cannot be removed. The ring light uses an external power supply with a 5.1 mm coaxial connector.

NOTE: For convenience, the camera can be mounted with a lateral offset related to the stitch hole in order to give more space for threading the machine. However, there is a tradeoff between this offset and the usable area for embroidery: The more lateral offset, the smaller the remaining area for embroidery with the OPS2.



## CONNECTING THE T8 AND THE OPS2 LAPTOP

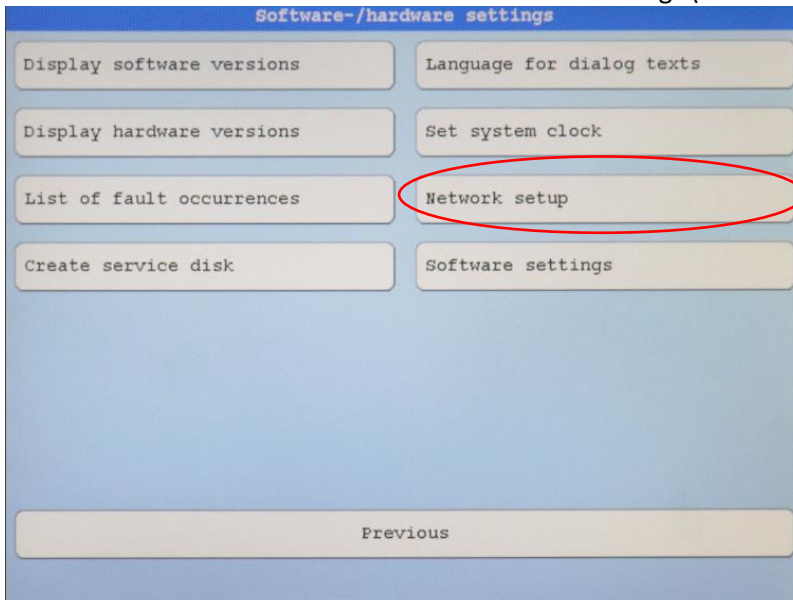
For all subsequent installation steps the network connection between T8 and OPS2 laptop must be available.

If the machine and the laptop are connected without any network switch or hub in between, a crossover Ethernet network cable has to be used. There is one supplied with the OPS2 system.

## SETTING UP THE NETWORK CONNECTION OF THE T8

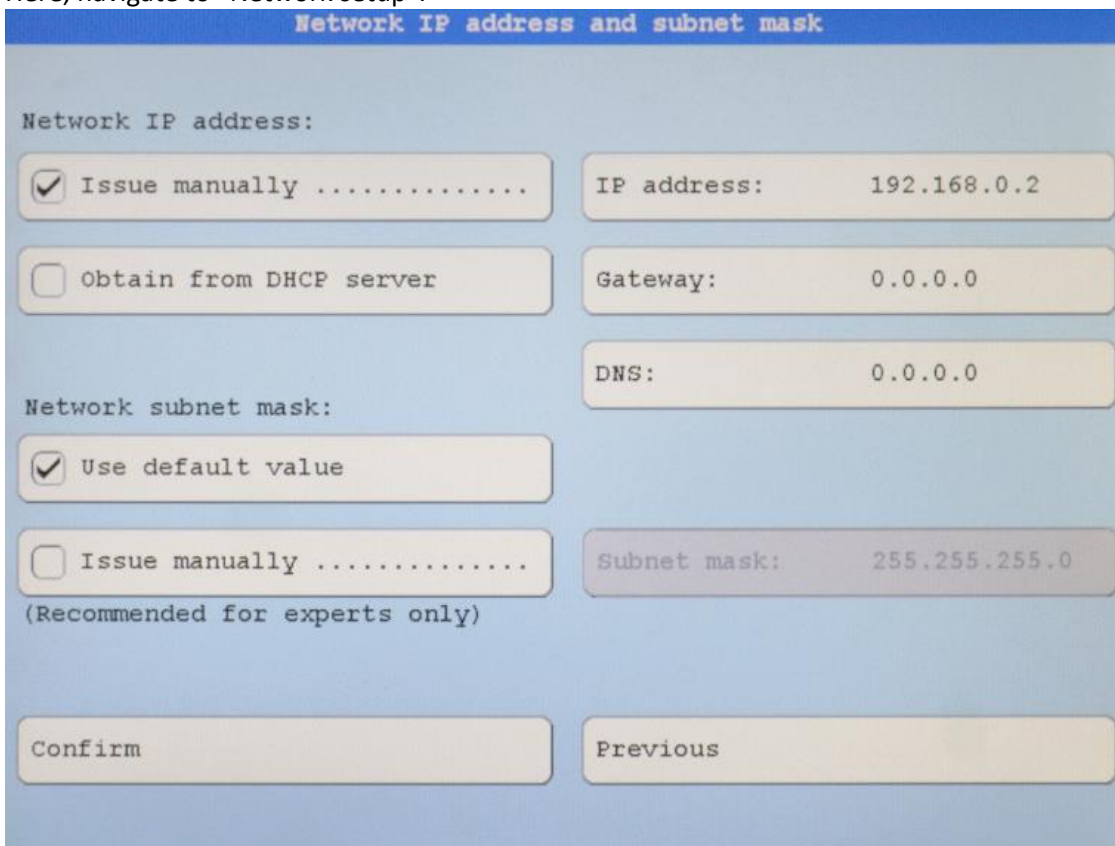
### GENERAL SETTINGS

Enter the main menu for software and hardware settings (button L7):



The screenshot shows a menu titled "Software-/hardware settings". It contains several options: "Display software versions", "Language for dialog texts", "Display hardware versions", "Set system clock", "List of fault occurrences", "Network setup" (circled in red), "Create service disk", and "Software settings". At the bottom, there is a "Previous" button.

Here, navigate to "Network setup".

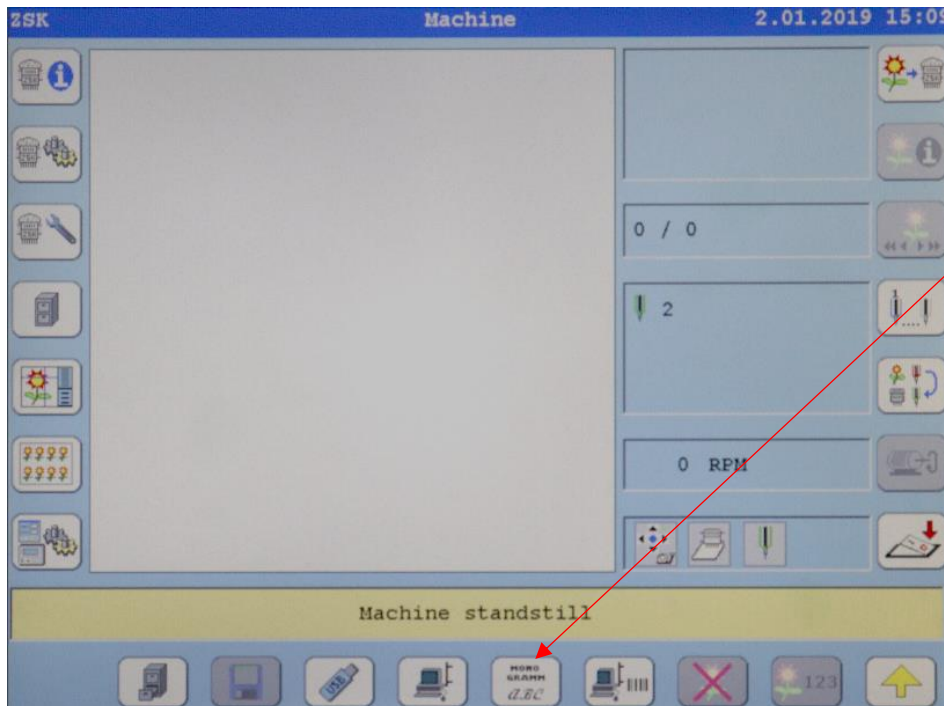


The screenshot shows the "Network IP address and subnet mask" configuration screen. It has two main sections: "Network IP address:" and "Network subnet mask:". In the "Network IP address:" section, the "Issue manually" option is selected, and the IP address is set to 192.168.0.2. The "Obtain from DHCP server" option is unselected. In the "Network subnet mask:" section, the "Use default value" option is selected. The "Subnet mask" is set to 255.255.255.0. There are also fields for "Gateway" (0.0.0.0) and "DNS" (0.0.0.0). At the bottom, there are "Confirm" and "Previous" buttons.

Select "Issue manually" and choose an IP address, within the same network class as the laptop. For example: If the OPS2 laptop holds the IP address 192.168.0.1, you can choose any IP address for the T8 in the range from 192.168.0.2 to 192.168.0.255.

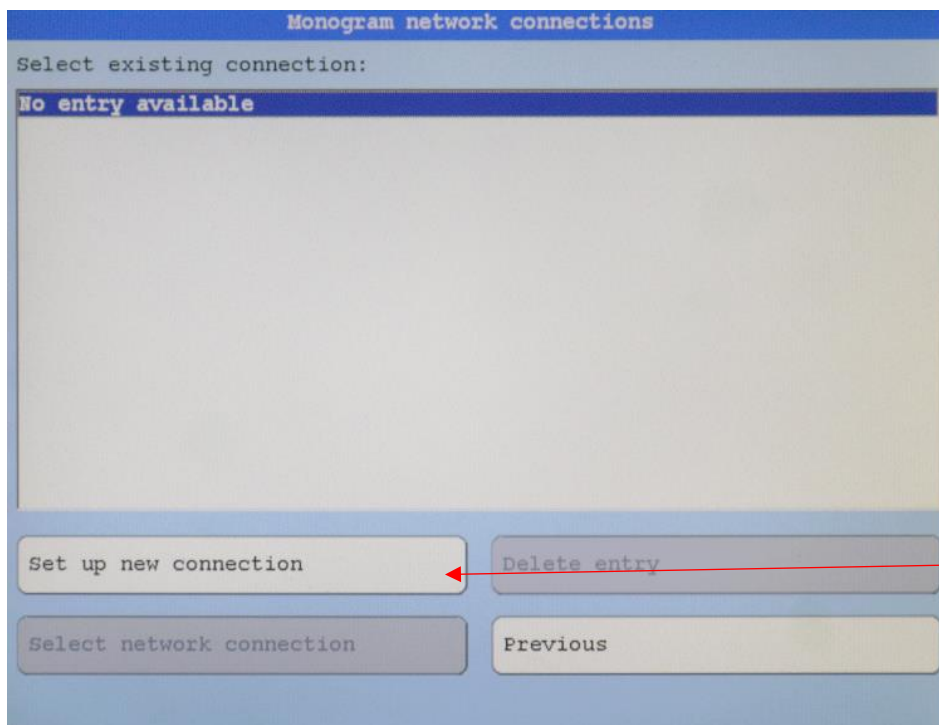
For the network subnet mask please select "Use default value".

## NETWORK CONNECTION FOR MONOGRAM MODE



You can enter the setting for monogram mode, by first pressing R1,

and then U6.



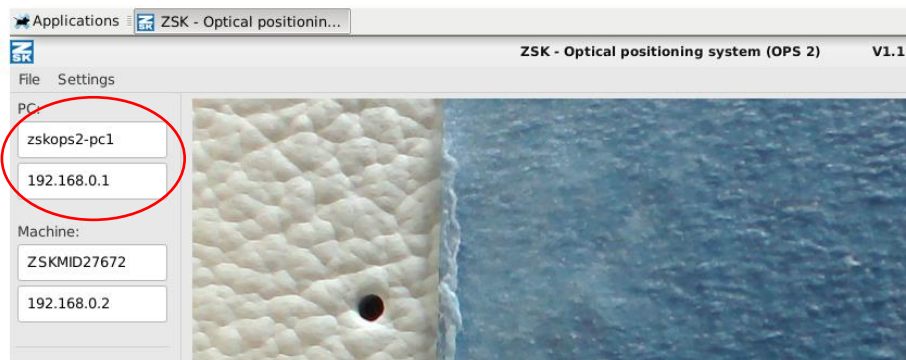
You will then find a list of all available monogram connections, where you will either have to select one, or create a new one.

NOTE: If you do not see this screen, the option "Use last network connection" might be enabled. Further information can be found at the end of this chapter.

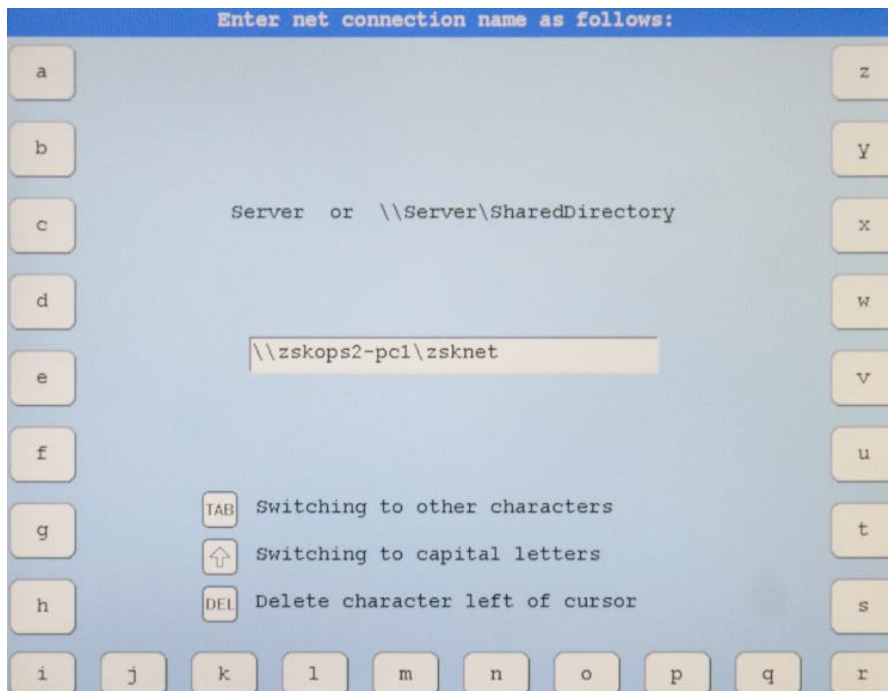
To create a new connection to the OPS2 laptop select "Set up new connection"

You have to enter the network path to the OPS2 laptop.

The path consists of two backslashes, the computer name of the OPS2 laptop (which is displayed at the left margin, whenever the OPS2 software is running), and “\zsknet”.

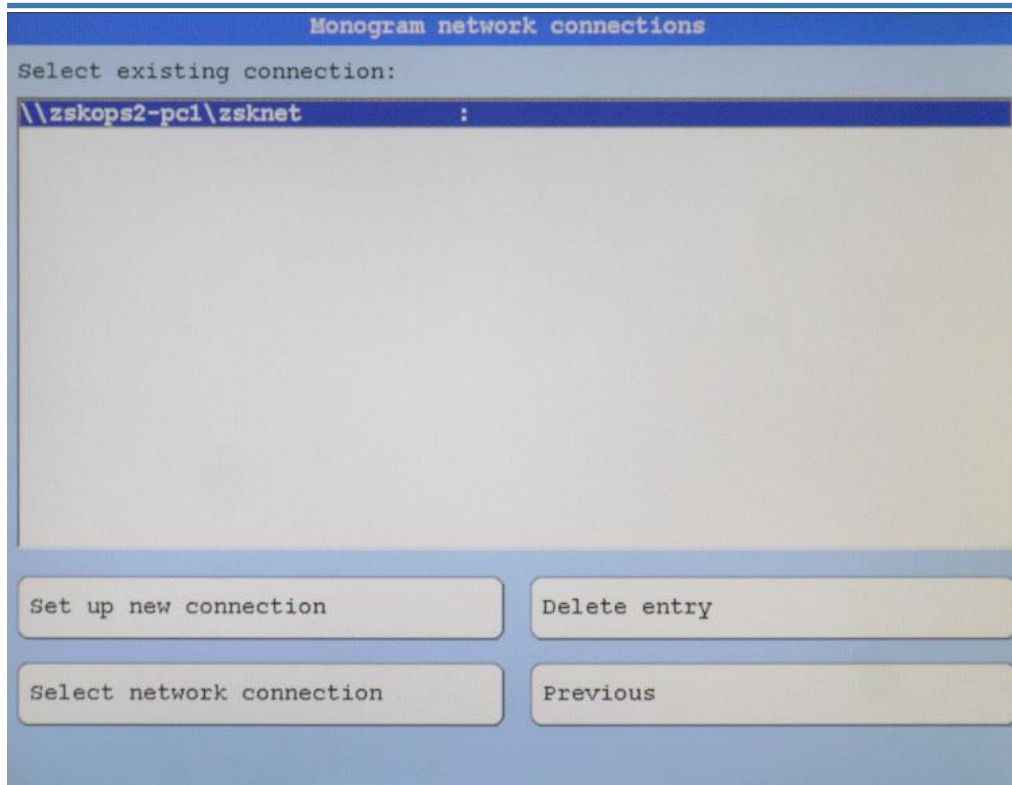


NOTE: In order to be able to set up this connection successfully, a preceding restart of the machine and the laptop might be necessary. Make sure the laptop boots up first, and then turn on the machine.

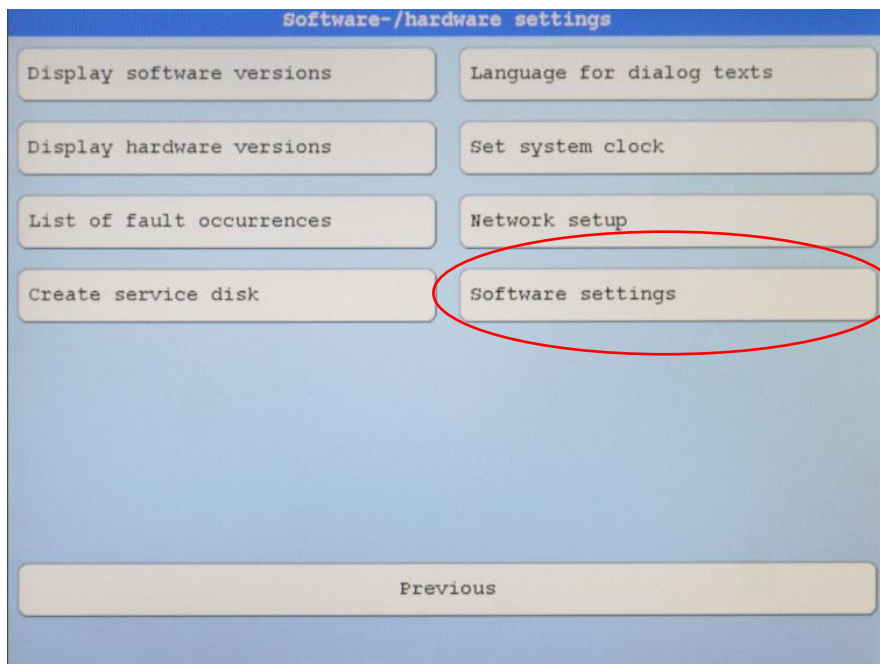


If the connection can be established, the T8 will connect to the laptop and the connection will be saved to the list. Whenever you return to this menu, you can reconnect by selecting this connection from the list, and pressing “Select network connection”.

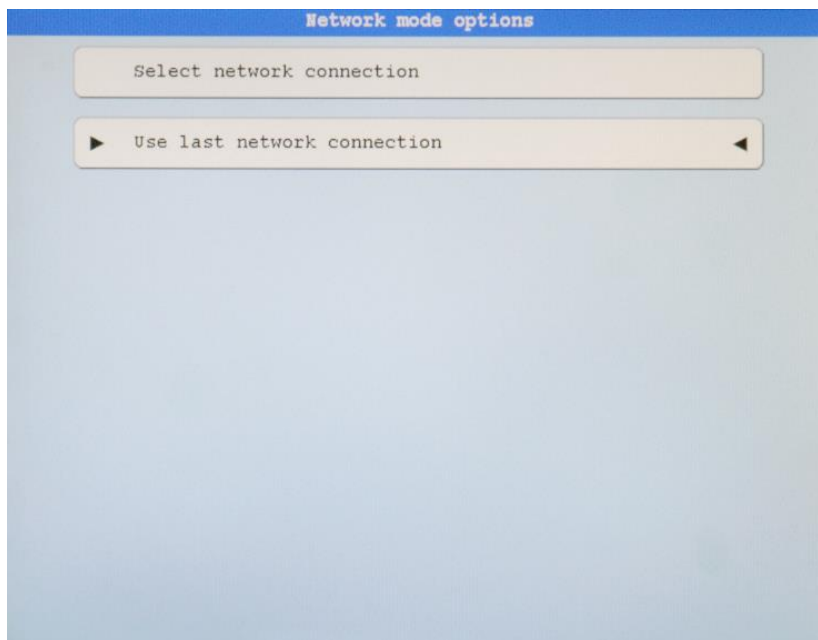
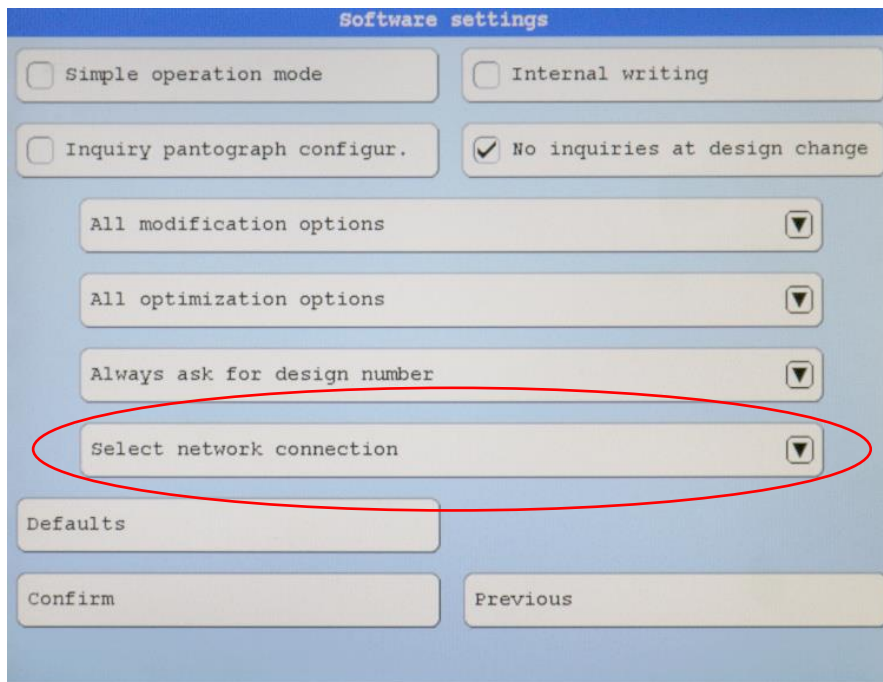




Once the network connection to the OPS2 laptop is set up, it is recommended to make the following setting:  
Navigate to "Software and hardware settings" (L7).  
There, choose "Software settings":



Use either L6 or R6 to enter the setting for “select network connection”:



Here, change the setting to “Use last network connection”.

The advantage you have now is, that you do not have to select and confirm a network connection from the list, after you activate monogram mode. This saves a lot of time.

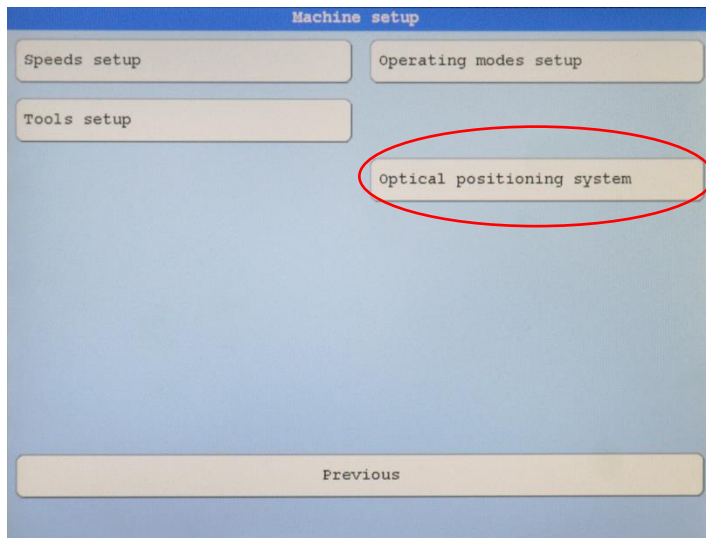
However, if you want to set up a different network connection, you need to navigate to this menu item first and bring it back to the “select network connection” setting.



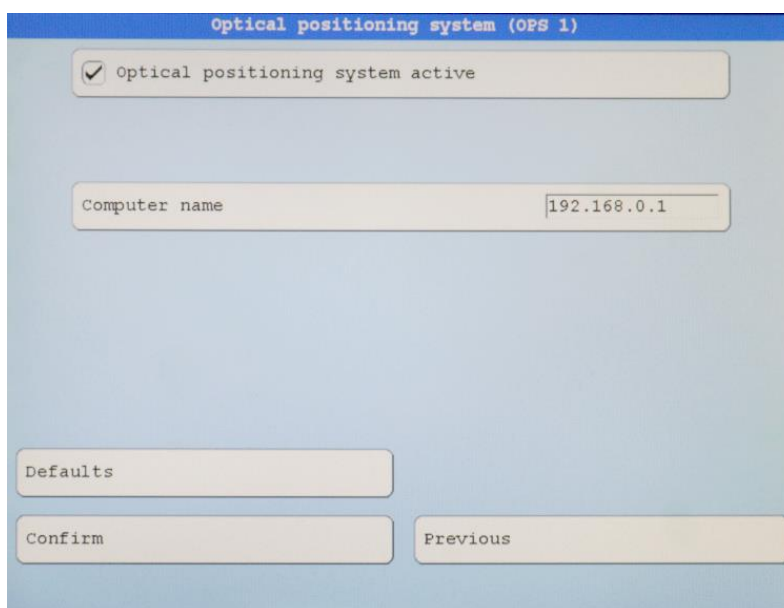
## ACTIVATING THE ZSK OPS2 SYSTEM

In order to allow the machine to interact with the OPS2 laptop, you need to activate the OPS (optical positioning system).

Navigate to “Machine setting” (L2, if you are in the main screen) and select “Optical positioning system”:



Check the box using L1 or R1



Enter the IP address, which can be found on the left margin of the OPS2 software on the laptop.

By confirming this dialog with L8, the machine tries to establish a connection to the OPS2 software on the laptop.

Once the connection is established, the machine name and its IP address are shown on the left margin of the running OPS2 software, as well



## CONNECTING RING LIGHT POWER SUPPLY

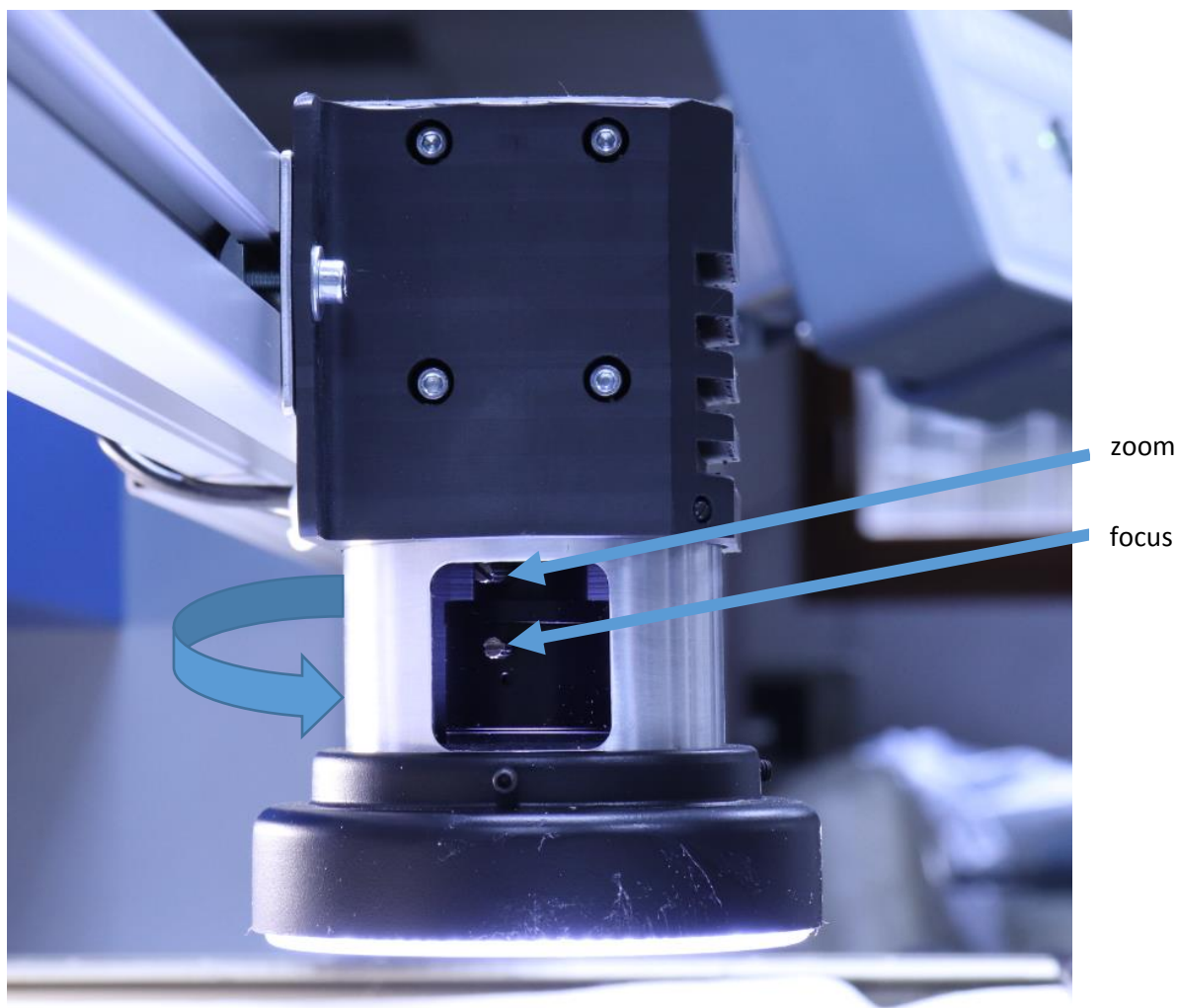


The switch for the ring light is facing the needles, if the adjustment for the intensity is facing towards you:



## ACCESS TO FOCUS AND ZOOM ADJUSTMENT

During the calibration process one of the first steps will be the adjustment of the zoom and the focus. To access the adjustment screws, turn the aluminum ring by 90° (if not already in this position). You will find an opening in the housing, through which you can access two knurled screws. The top one is for adjusting the zoom. The bottom one enables you to set focus according to the thickness of the material you want to embroider on.



## CALIBRATING THE CAMERA

### 1 PREPARATION FOR CALIBRATION PROCESS

For this step the camera needs to be connected to the laptop via USB.

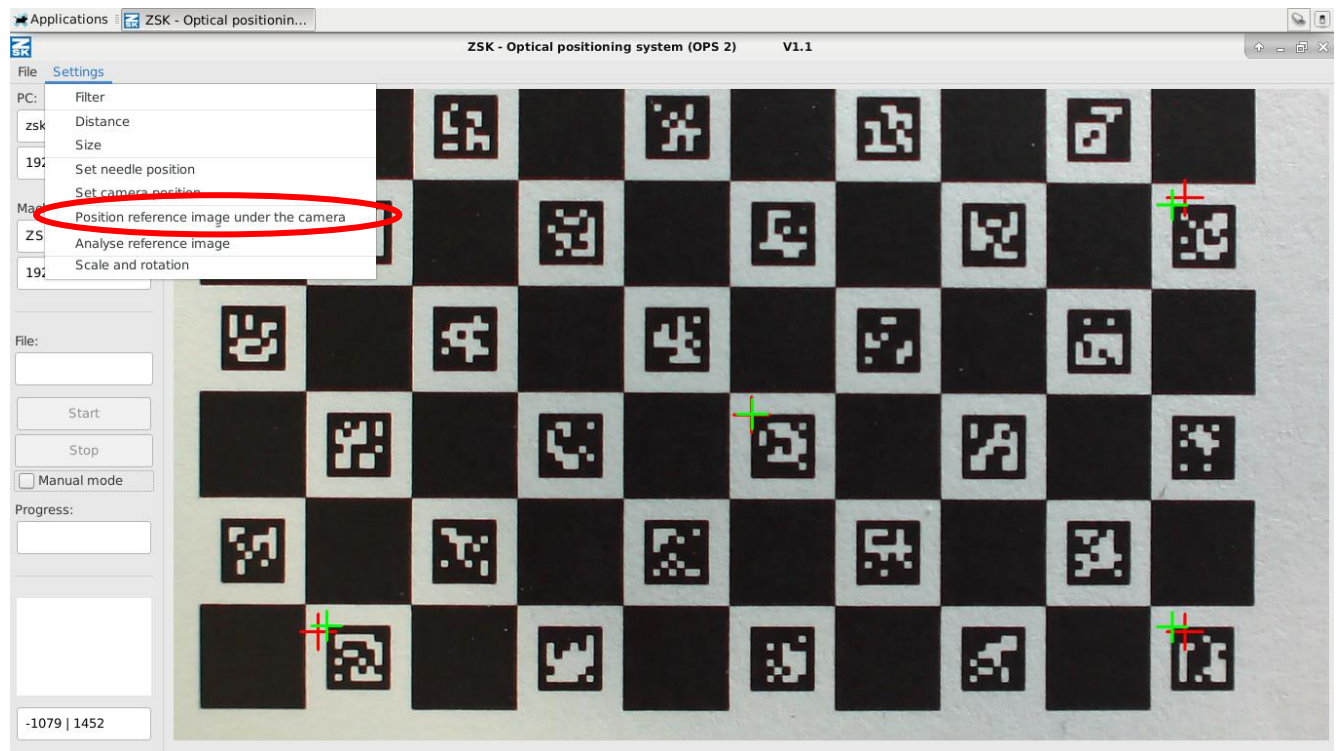
In order to set the zoom to a correct setting, place the calibration sheet onto the surface of the material, you want to embroider.



Make sure, that it lies completely flat on the surface. A weight might help you to ensure this.  
Open the OPS 2 software, if not already done.



Go to “Settings” and “Position reference image under the camera”:



Now adjust the focus, in order so see a clear image.

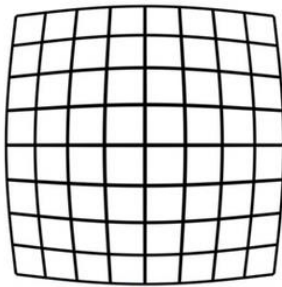
Move the reference image to align the center crosshair.

Adjust the zoom in a way, that the green crosshairs in the corners all lie notably inside the bounding box formed by the red ones.

With this setting of the zoom, please proceed with the calibration using the program “calibrate camera”, which can be found directly on the desktop.



## 2 REMOVING BARREL DISTORSION



Barrel Distortion

This step is necessary to remove the inevitable barrel distortion of the cameras optics.

For this step the camera needs to be connected to the laptop via USB.

**IMPORTANT:** The OPS2 software must be closed in order to be able to complete this step.



Place the reference image underneath the camera, on top of the material, which you want to embroider afterwards. The image has to lie completely flat on the surface. An additional weight might help to keep it flat.

Start the program "Calibrate camera", which can be found directly on the desktop of the OPS2 laptop.

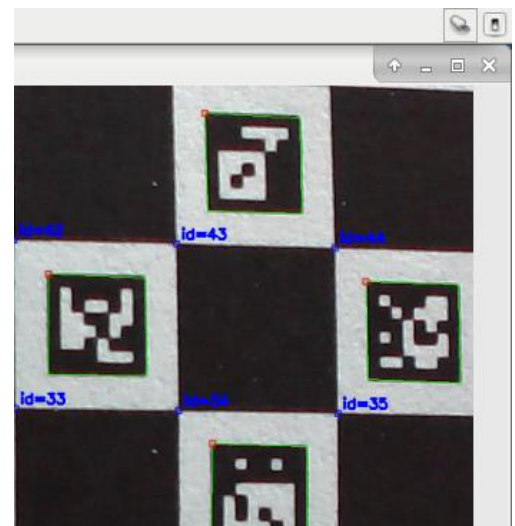


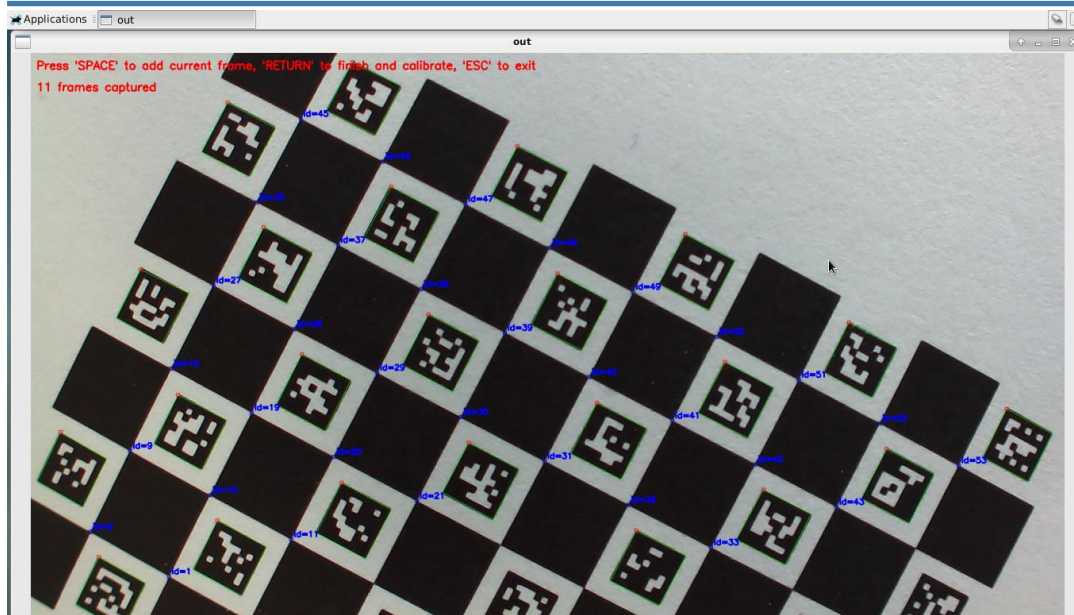
If the focus is set correctly, the calibration software recognizes the intersections of the chessboard pattern and is able to read their IDs from the QR-codes embedded in the chessboard.

To generate enough data for the calibration process, you need to capture 15 – 20 frames of the reference image in different positions. In order to do so, move the image (or the pantograph) in a way, that every captured frame is different and the recognized IDs are as close as possible to the borders of the image. If you move the reference to far out the image frame the QR code will not be read any more (the green border disappears).

Saving one frame is done by pressing the space bar.

The number in the top left corner increases by one, every time you do so.



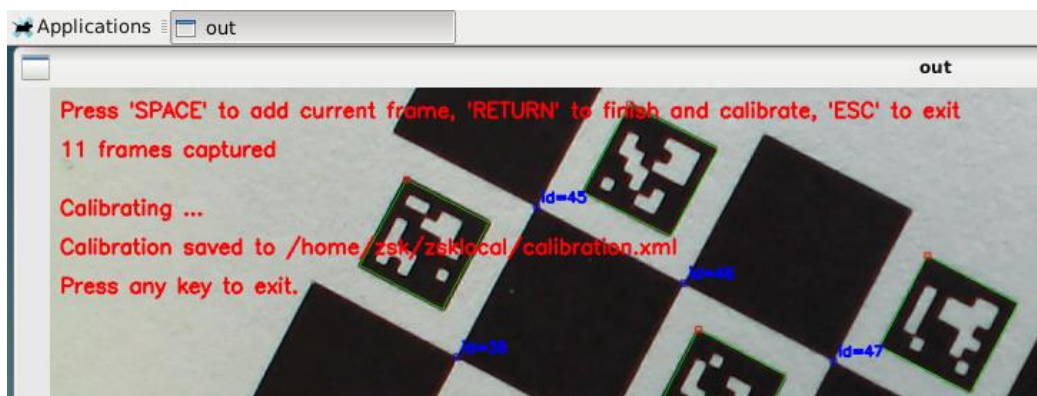


For this step the reference image does not have to be horizontally. So do not bother if it is tilted. It might even increase the precision of the calibration.

If you have captured 15-20 frames, hit the return key, to generate the calibration data.

After the generation the software confirms the saving.

Any key exits this program. You can now return to the OPS2 main software (which can also be found on the desktop).



### 3 CORRELATING PIXELS AND PANTOGRAPH MOVEMENTS

This step tells the OPS 2 software, how pixels of the camera represent distances on the level of pantograph movements.

The calibration sheet known from step two also serves as a reference for the measurement, because its dimensions are known by the software.

#### Aligning the reference sheet

The unintended rotation of the camera, and slight tilts in either direction are also removed from the raw image using the data, which is created during this step.

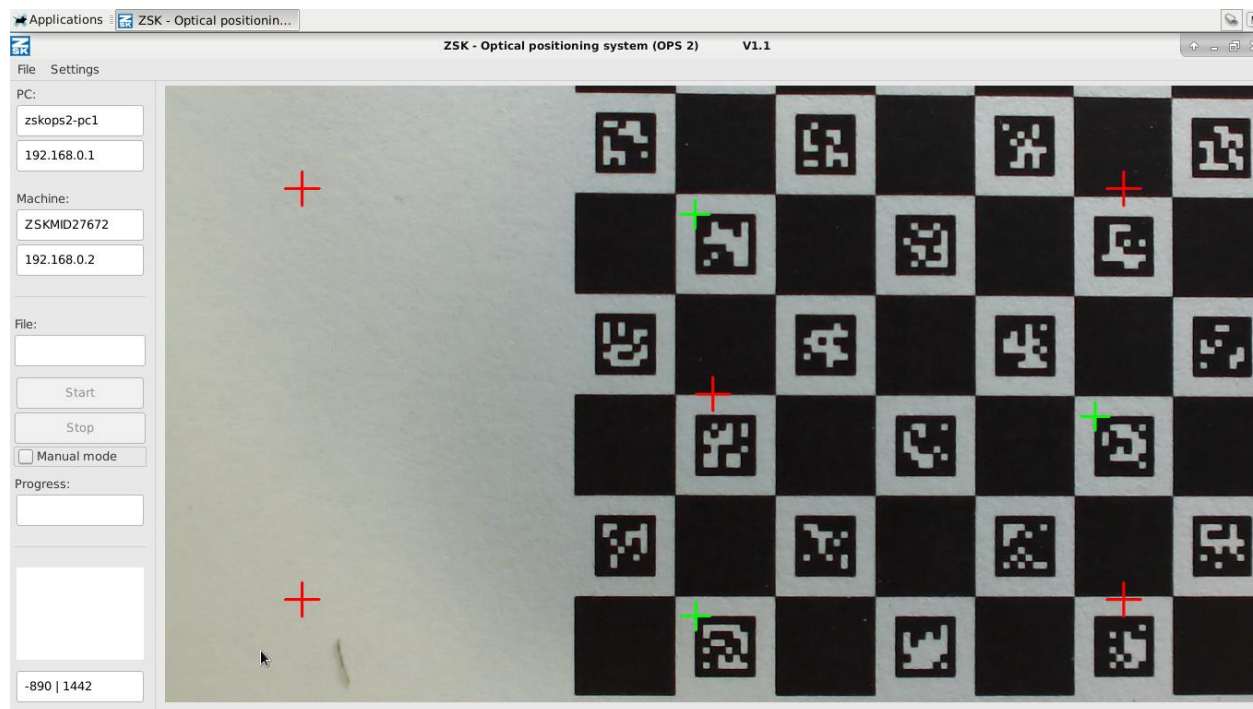
Hence, to proceed, the reference sheet must be positioned according to the pantograph.

Do so, place the reference image underneath the camera:

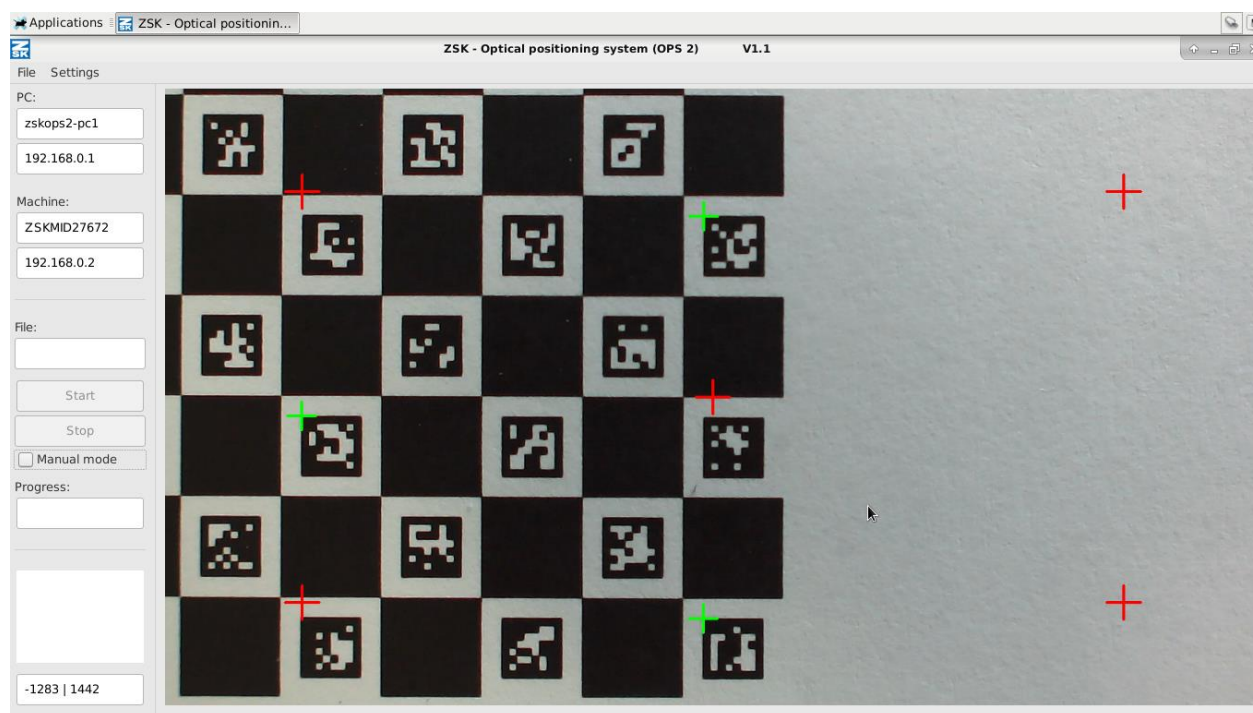


In the OPS2 software, select “Settings” -> “Position reference image under the camera”, to bring up a set of crosshairs. Move the chessboards, until the center crosshair is positioned exactly on a junction of a black and a white field of the chessboard:





Now, move the pantograph sideways:

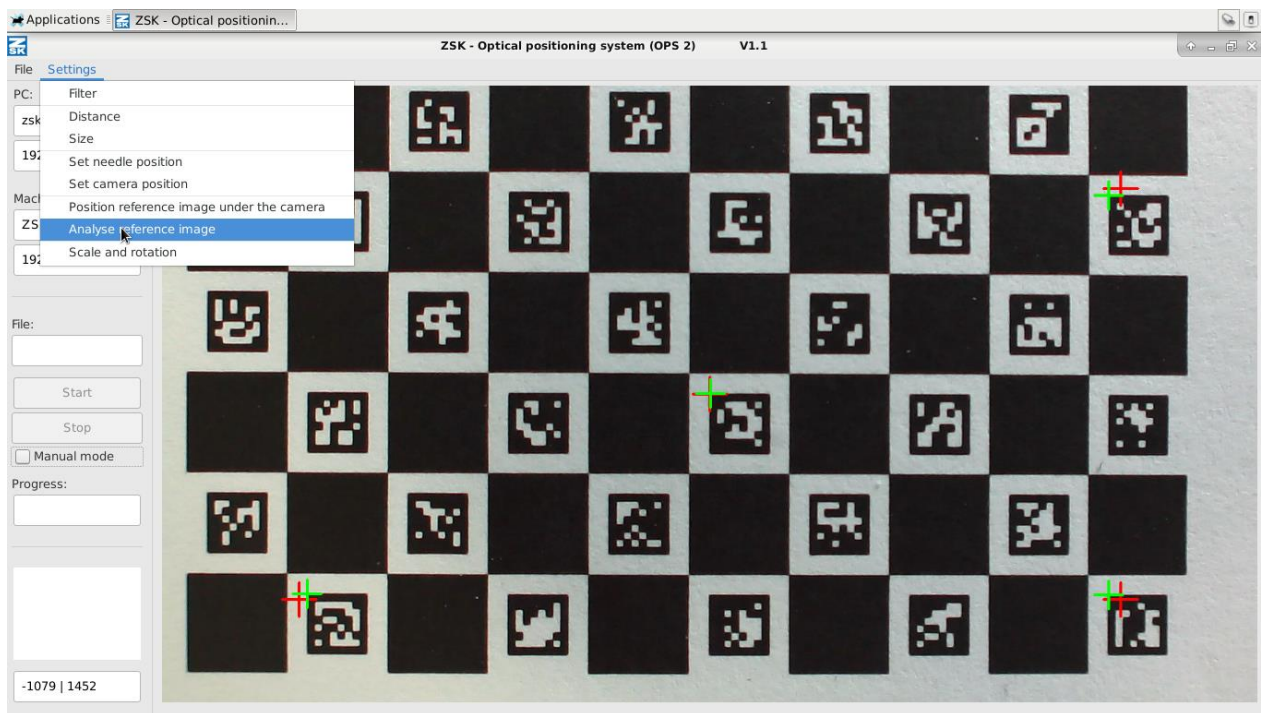


If the crosshair stays on the junction, the chessboard is perfectly aligned. If not, readjust the rotation of the chessboard accordingly.



Now move the pantograph, until the 4 outer green crosshairs are all equally misplaced from the outer red ones.

Do not care, if the ones in the middle does not line up perfectly.

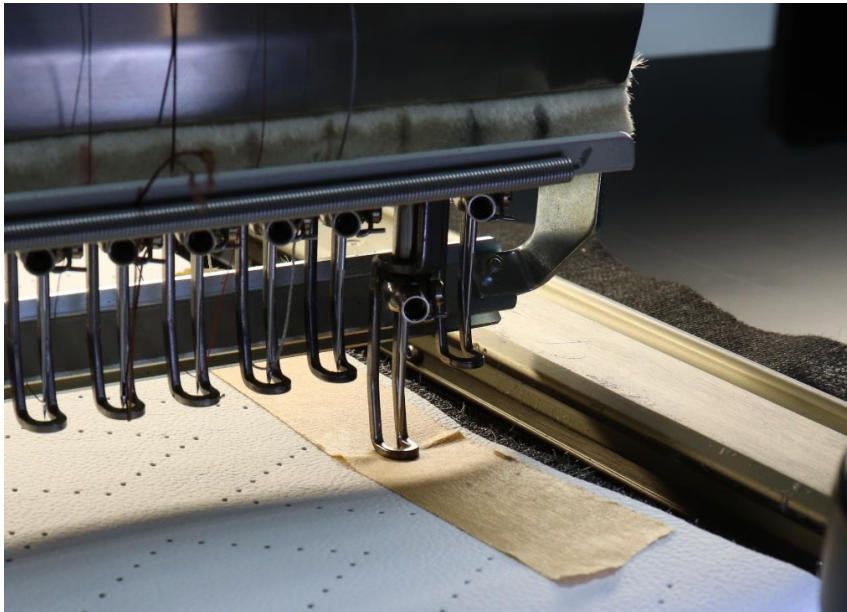


Afterwards, go to "Settings" -> "Analyze reference image".

From now on, the OPS2 software knows about the tilts of the camera (in 3D space) and the rotation (z-axis) and can remove these errors from the raw image.

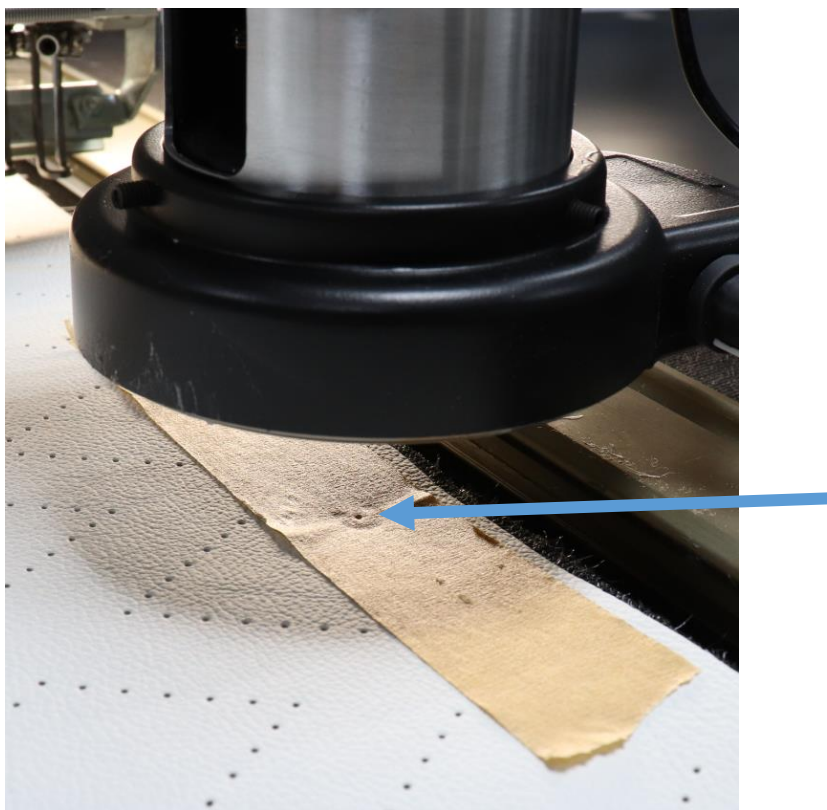
#### 4 DETERMINING THE DISTANCE BETWEEN NEEDLE AND CAMERA (IN 2D SPACE)

As a last step the software needs to know the distance of the needle to the camera, as a 2 dimensional vector. The easiest way to mark the current needle position is, to lower it (using the T8) until it punches a small hole into the fabric. You can use a part of the workpiece, which is not visible in the final product to do so. A piece of sticky tape helps to increase the contrast, so the hole can be found by the camera more easily:

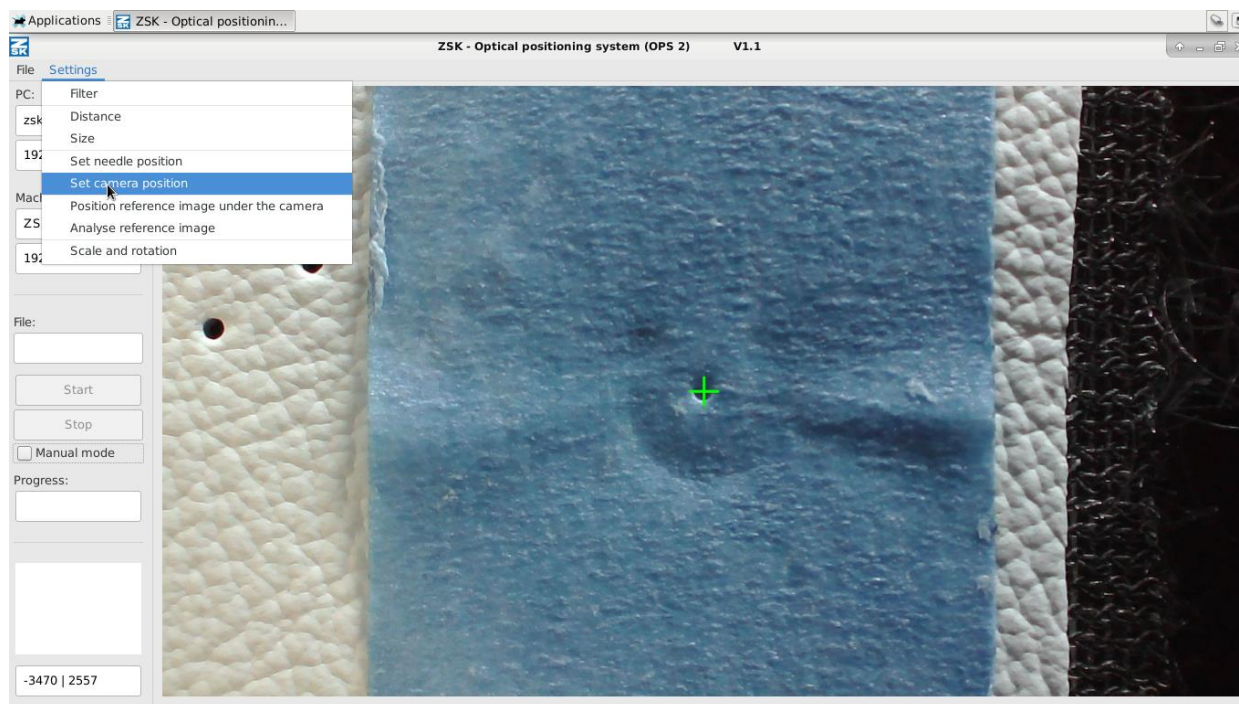


Once the hole was punched, go to "Settings" -> "Set needle position". Immediately a green crosshair shows up, which helps you to place the punched hole underneath the center of the camera.

NOTE: Do not forget to raise the needle again, before moving the pantograph!



After moving the pantograph such that the hole lines up with the crosshair, go to  
“Settings” -> “Set camera position”.  
After you confirm this step, the resulting 2D vector is saved to the calibration data.



The camera system is now ready to work.

## SETTING AN ORIGIN FOR A DESIGN

Once you have chosen a file in the OPS2 software, you will have to tell the system where the origin of the so called "ZEPL" file (ZSK embroidery programming language) is located on the pantograph. The ZEPL file composes the separate stich files to an overall design on your workpiece.

This setting in particular correlates the orientation and positioning of the overall design to the workpiece. If you are using a clamping frame which is dedicated to your workpiece (batch production), this setting has only to be done once.

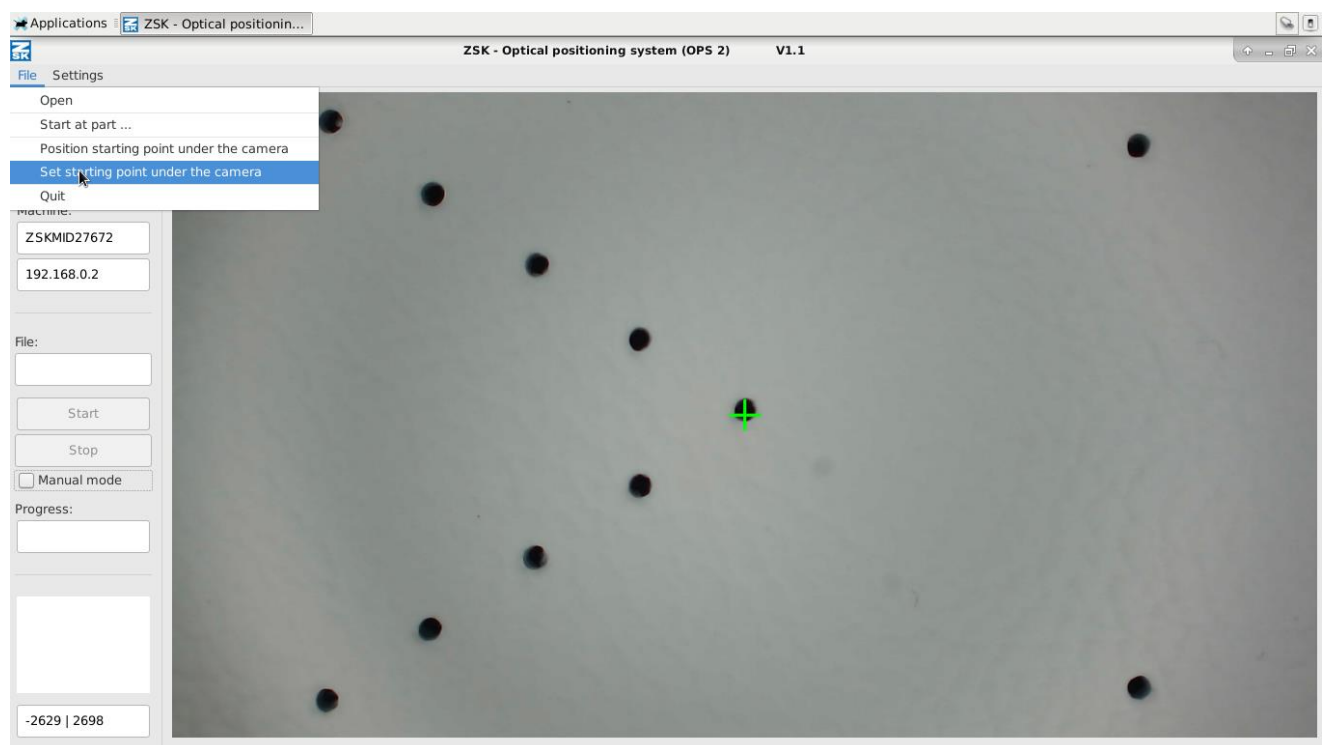
NOTE: A valid ZEPL file must be opened first to set the origin.

Navigate to "File" and select "Position starting point under the camera".

This brings up a live view camera image and a green crosshair in the middle of the image.

You can now position the origin of the ZEPL file underneath the crosshair using the pantograph positioning buttons on the T8.

Once this is done to your satisfaction, select "File" -> "Set starting point under the camera", to save these pantograph coordinates to the opened ZEPL file.



The origin is saved permanently to the ZEPL file.

If you reopen it later, and the workpiece is clamped exactly in the same orientation as before, this setting can be skipped.

After completing this step, the loaded ZEPL file is ready for being embroidered.



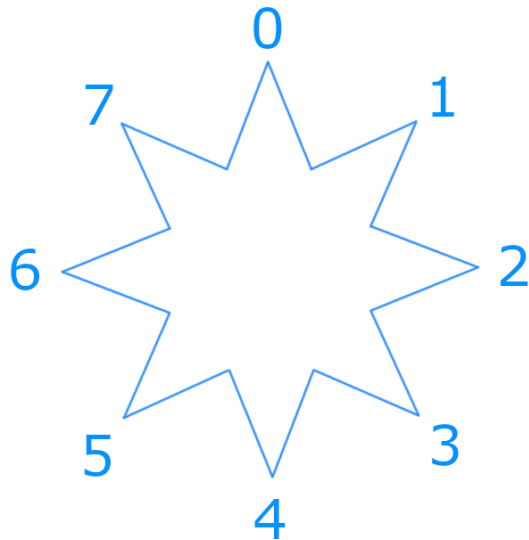
## CHECK ACCURACY OF NEEDLE TO CAMERA DISTANCE

Place the leather panel (incl. the punch holes!) in the machine.

Drive the pantograph under the camera and take a reference image (press B) of a group of holes.

Now analyze the image by pressing "A".

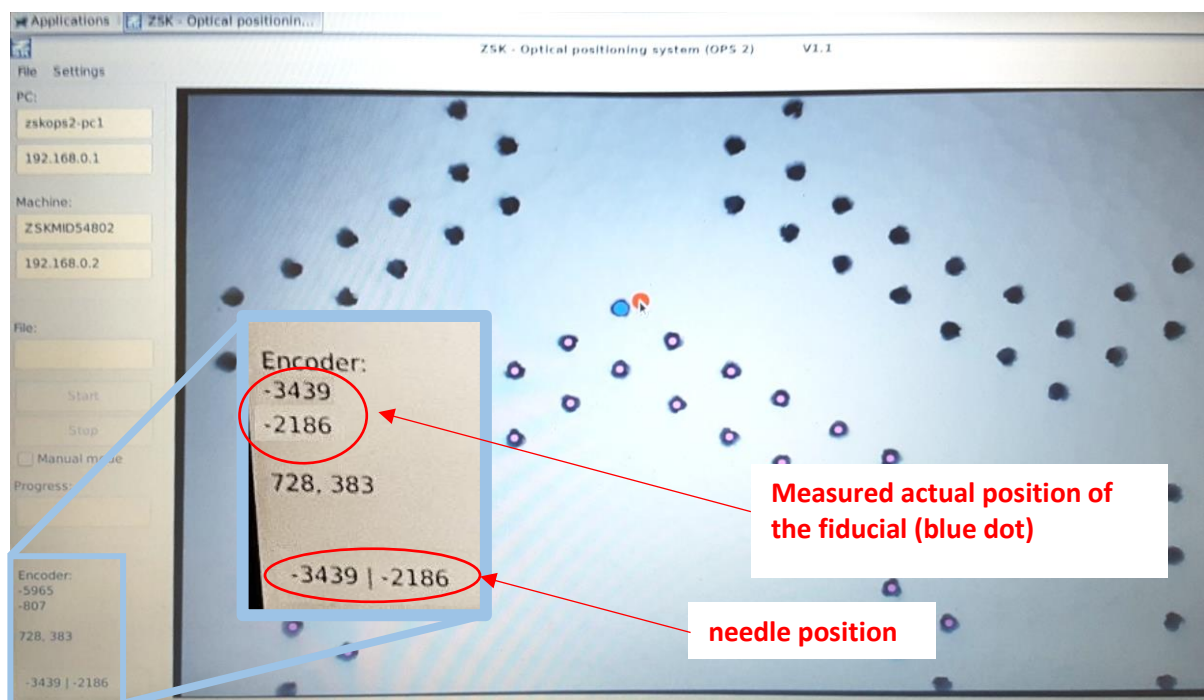
Pick a point of the group.



Therefore select the type of point you are looking for (press "T" until the correct type of the fiducial is shown in the left window). The different types of the fiducials are explained here.

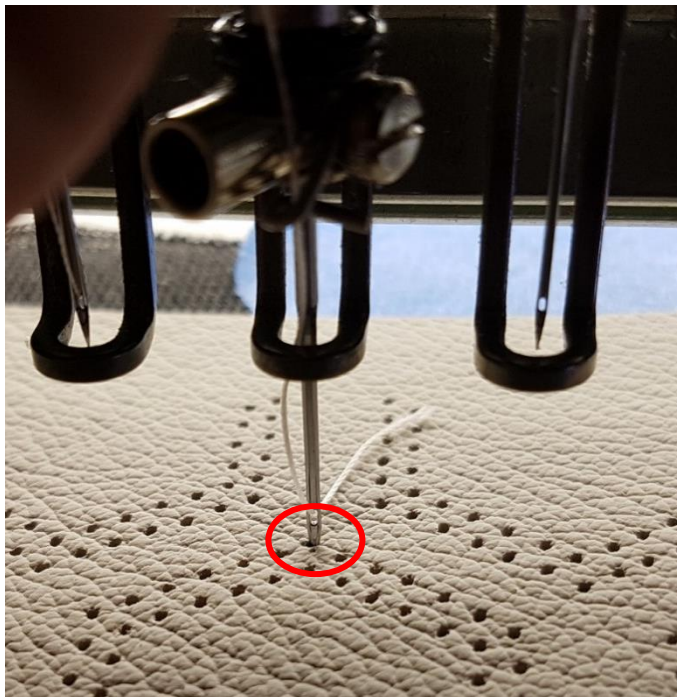
A "type 1" fiducial means it is the top right hole of a group of holes. Please refer to the drawing for the other types accordingly.

Now click anywhere inside the group of holes. The actual position of the fiducial should appear in blue. The red dot indicates where you have clicked. On the left hand the encoder values of the current needle position and the recently measured actual position of the fiducial are displayed.





Now move pantograph until the needle position has the same values as the actual position of the fiducial. The needle should now be exactly above the hole. If you lower the needle it should be centered in the hole:



## START FROM A SPECIFIC PART

If you want to redo a certain part you can open the design once again and skip until the part you want to start from. Therefore click onto "Start from part..." and enter the number of the part.

## SETTING THE IMAGE POSTPROCESSING VALUES

If the camera picked the wrong reference hole there are different values to be changed:

**Filter:** The filter clears up the image and removes artefacts inside holes so that they appear self-colored.

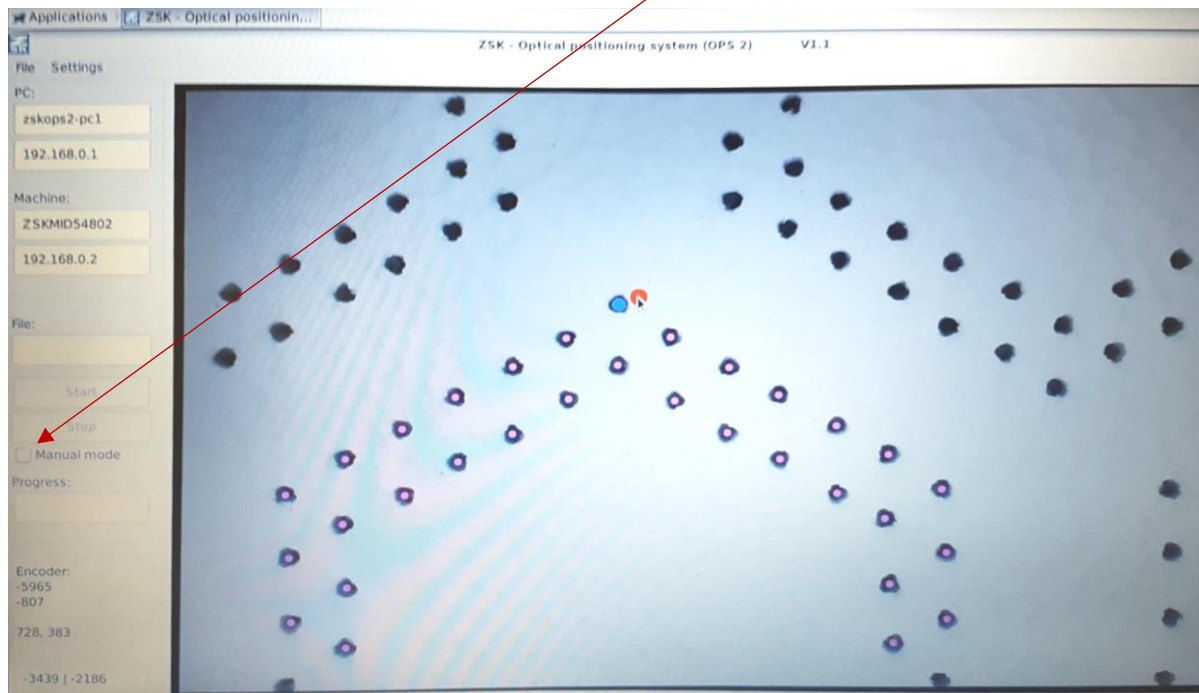
**Distance:** Here the distance between the holes is changed. The radius around the holes should be set big enough to connect the holes belonging to one group.

**Size:** Here you can select limits for the smallest and biggest diameter of holes. Objects, which are smaller will be ignored and objects that are bigger than the setting will be ignored, as well. This allows you to lock out small objects like dust, and big objects like the frame or edges from the recognition. The red marked holes are actually recognized. All other points are being ignored. Change the value until all holes are being noticed and nothing else.

## MANUAL MODE

If the system runs into problems, due to difficult conditions such as lighting, poor contrast (black material with a shiny surface), or missing fiducials (incomplete perforation), the system allows you to select fiducials manually.

In order to activate this mode, please check the box “Manual mode” prior to the embroidery of the critical part.



The pantograph will move the fiducial under the camera but then pauses and waits for your input.

All recognizable holes will be selectable on the computer screen. If you click one of them it will turn red and indicate, that it has been selected.

You will have to push the green button on the T8 to proceed to the next fiducial.

After selecting the second hole in the same way and after confirming this step once more with the green button, the machine will proceed the embroidery using the two manually selected fiducials.

Once you are done with the critical part(s), you will have to cancel the manual mode by unchecking the box again.

NOTE: Be aware, that you have full control over the selection. Due to the nature of the manual mode being a problem solver, you can even override the type of the fiducial.

Selecting the wrong fiducial will result in an incorrect rotation and stretching and therefore likely ruin the embroidery!



## KEYBOARD SHORTCUTS

Key	Function
b	Capture image
a	Capture image + apply calibration data + analyze fiducials
r	Overlay reference points as green crosshairs
R	Overlay reference lines
m/M	<p>Select the mode for the display</p> <ul style="list-style-type: none"> <li>0: „normal“ mode</li> <li>1: apply filters</li> <li>2: black and white image</li> <li>3: show recognized contours</li> <li>4: show recognized circles</li> <li>5: overlay circles onto the image</li> <li>6: show recognized group of circles (mousedown)</li> <li>7: show recognized group of circles (mouseup)</li> </ul>
t	<p>Select the type of the fiducial</p> 