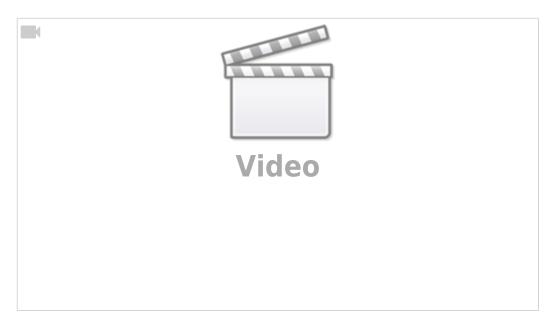
# **CNC Vision Setup**

This manual is designed to introduce the reader to the setup process of the CNC vision system, and some of its applications.

Please note that the Vision System license for correcting the generated G-code using visual markers is a separate license that must be purchased in addition to the myCNC controller in order to be enabled (available as part of the CNC Vision Kit package in our Online Shop).

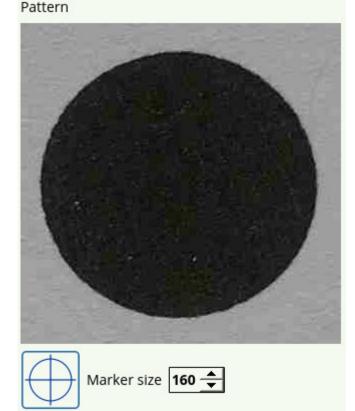
A video with the recap of the manual below is available here:



In order to set up the camera, you must go into the **CNC Settings > Config > Camera**. The screen presented to you will be the one shown below:

Info Support Camera Config		CFG CFG
CNC Settings Axes/Motors	Camera interface	IP Camera 👻
Inputs/Outputs/Sensors Network	IP Camera initialization line	rtsp://192.168.0.80
Motion	Pattern Size	
<ul> <li>PLC</li> <li>G-codes settings</li> </ul>	Region of Interest, px	1920 * 1080
DXF import settings	Coefficient Pixel-to-Length	0.02560 * 0.10000
Macro List ▶ Macro Wizard	Camera Shift, mm	99 * 99
<ul> <li>Probing Wizard</li> </ul>	Tool number assigned to Camera	99
Preferences	Camera Offset, mm	
<ul> <li>Screen</li> <li>Work Offsets</li> </ul>	Camera "Tool Length"	0
Parking Coordinates	-	<u> </u>
Technology     Camera	Ignore Decoder Errors	X
5 axes RTCP	Pattern Match Level	20 _
<ul> <li>Panel/Pendant</li> <li>Hardware</li> </ul>		
▶ Advanced	95 85 75 65 95 95 95 95 95 95 95 95 95 9	Reset Min/Max Data

- - **Camera Interface** allows to choose No Camera and a camera that is connected through LAN. If the camera is connected through LAN, the **Initialization line** must list the correct IP address of the camera.
  - **IP Camera Initialization line** lists the camera IP for the connection to be established.
  - **Pattern size** can be set experimentally to be about 30-50% larger than the marker itself, in order to account for the visual transition between the marker and its surroundings.
    - In the case of the particular marker used in this scenario, its size has been set to 160 pixels, which is on the low end of the relative pattern size a larger pattern size is typically a safer choice in low-light conditions.
    - NOTE: The camera focus must be properly adjusted in order for the camera to recognize markers.



- **Region of interest** (in pixels) signifies the area in which the camera is actively looking for markers, and should usually be set to be equal or slightly smaller than the actual resolution of the camera. It is set automatically in the newer software versions during the calibration process (software versions after July 2019).
- **Pixel to length coefficient** is used to convert the pixels travelled into the actual physical distance moved, in mm. You are able to calibrate this for both the x- and the y-axes. In order to set up the correct coefficient for your camera, use the Calibrate button in the Camera tab, or consult the full set of manual set up instructions below (useful for older software versions).
- **Camera Shift** describes the distance the machine will move by if it does not locate a marker after it has been instructed to look for one. This can happen when the marker is not fully within the region of interest. In that case, the camera will keep on moving around until it either finds the marker or reaches the end of this specified Camera Shift. It is set automatically in the newer software versions during the calibration process. If no marker is found during the Camera Shift

process, the machine will be stopped.

- Tool number is typically assigned to be 10.
- **Camera offset** values are used to specify the distance from the camera to the working tool in the xy-plane.
- **Camera tool length** value is used to specify the distance from the camera to the working tool tip in the z-axis.
- Ignore decoder errors flag is set to OFF by default.
- **Shift Speed** describes the speed with which the machine is moving during its camera shift phase while trying to find the marker. NOTE: Deprecated on the newer versions of myCNC software.
- **Pattern Match Level** describes the level of parity with the original reference marker that each new marker must have for the system to recognize it. Higher numbers mean less parity (more differences between the markers), so as to avoid false positives it is advised to keep the numbers on the lower end of the scale. The graph below the Pattern Match Level indicates the parity levels during the machine search for markers, with the low points of the graph being indicative of the places where marker parity is highest (differences between new marker and reference are lowest).
  - If the program has issues locating markers due to those markers being slightly different (due to material imperfections, light reflections, etc), it is recommended to raise the Pattern Match Level until the program accepts the variations. However, raising this value too high will lead to false positives on marker recognition.
- **Image sensor correction** corrects for sensors with different aspect ratios. Use this if the marker image appears distorted or stretched when viewed through the Camera tab in myCNC software.

## **CNC Vision codes**

The Vision system is controlled through a series of M-code PLCs which can be found in Settings > Config > PLC > Hardware PLC.

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INC Settings       PLC Sources       Name: M399       Allases:         Axes/Motors       M162       Imputs/Jutputs/Sensors       M162         Inputs/Jutputs/Sensors       M166       Imputs/Jutputs/Sensors       M166         Network       M167       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors         Motion       M166       Imputs/Jutputs/Sensors       M166         Vectoria       M167       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors         Marce Nume:       M168       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors         Marce Nume:       M167       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors         Marce Nume:       M166       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors         Marce Nume:       M167       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors         Marce Nume:       M168       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors         Marce Nume:       M181       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors         Marce Nume:       M281       M210       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors       Imputs/Jutputs/Sensors         Marce Nizard       M282	SYS PLC Log	Config Info Support Camera	×	G
	<ul> <li>Inputs/Outputs/Sensors Network Motion         <ul> <li>PLC</li> <li>Hardware PLC Templates</li> <li>Hardware PLC Templates</li> <li>Hardware PLC Configuration</li></ul></li></ul>	M166 M167 M168 M169 M177 M180 M181 M181 M182 M183 M201 M212 M287 M287 M287 M287 M395 M397 M399 M62 PLC Includes Func.h mill-func.h pins.h probe-func.h	<pre>#define callback_address var01 #define camera_count var02 #define wait_camera var03 main() { camera_count=0; wait_camera=1; callback_address=3; //delay after motion stopped timer=300; do{timer-;}while (timer&gt;0); message=PLCCMD_WAIT_FOR_CAMERA; timer=2;do{timer;}while(timer&gt;0); //pause to push the message do {</pre>	

The following PLC procedures are used:

• M397 - start camera operations. Show M397 code

```
#include common.const.h
main()
{
message=PLCCMD_CAMERA_START;
texit=timer+10;do{timer++;}while(timer<texit); //pause to push the
message
exit(99); //normal exit
};</pre>
```

M399 - record the image, detect the marker position and store it in a dots array. Show M399 code

```
#define callback_address var01
#define camera_count var02
#define wait_camera var03
main()
{
    camera_count=0;
    wait_camera=1;
    callback_address=3;
```

```
//delay after motion stopped
 timer=300; do{timer--;}while (timer>0);
 message=PLCCMD WAIT FOR CAMERA;
 timer=2;do{timer--;}while(timer>0); //pause to push the message
 do
  {
   if (wait camera>1)
    {
     timer=100;do{timer--;}while(timer>0); //wait till motion started
     do { code=gvarget(6060); }while(code!=0x4d); //wait till motion
finished
     timer=300;do{timer--;}while(timer>0); //pause to push the message
     camera count=wait camera;
    wait camera=1;
     message=PLCCMD WAIT FOR CAMERA;
    timer=2;do{timer--;}while(timer>0); //pause to push the message
   };
 }while (wait camera>0);
 exit(99); //normal exit
};
```

 M398 - calculate rotation, offset and distortion values and make a correction accordingly for the rest of the G-code file, then run the corrected G-code. Show M398 code

```
#include src/common.const.h
main()
{
message=PLCCMD_CAMERA_FINISH;
texit=timer+10;do{timer++;}while(timer<texit); //pause to push the
message
message=PLCCMD_MOTION_BREAK;
texit=timer+10;do{timer++;}while(timer<texit); //pause to push the
message
exit(99); //normal exit
};</pre>
```

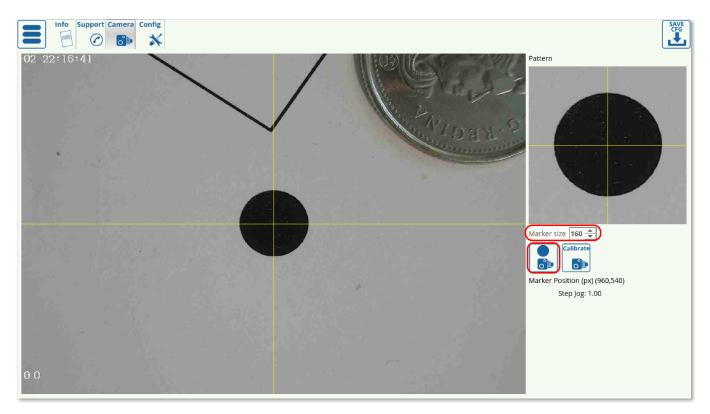
These PLCs are added automatically into the G-code when importing a DXF file into myCNC. In order for the system to recognize the markers, the markers need to be drawn as roughly 6mm circles inside a separate layer named Camera within the DXF file. The user must have a valid Vision System license

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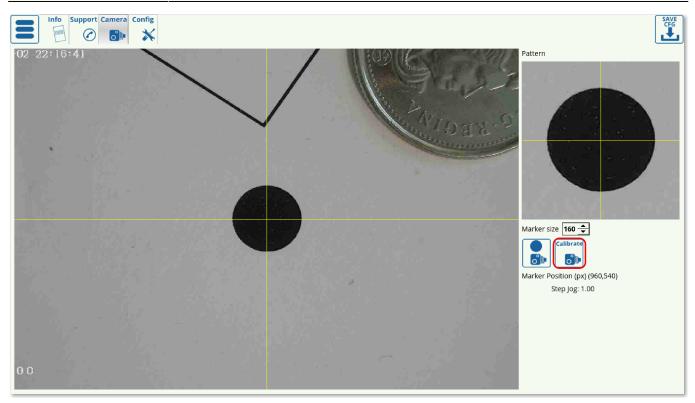
to use this function.

## Calibrating the CNC Vision System

- Go to the Camera tab of myCNC software by opening the Settings panel from the main screen
- Select an appropriate marker (pattern) size and click the Record button



• Click Calibrate. The software will automatically move a set distance in both the x- and the yaxes to determine the pixel to length coefficients. 7/14



The calibration process should be complete after the camera has moved in both the positive and the negative directions in both axes, and the results should be registered in Settings > Config > Camera:

Info		SAVE CFG
CNC Settings Axes/Motors	Camera interface	IP Camera 💌
Inputs/Outputs/Sensors Network	IP Camera initialization line	rtsp://192.168.0.80
Motion PLC	Pattern Size	
G-codes settings	Region of Interest, px	1920 * 1080
DXF import settings	Coefficient Pixel-to-Length	0.03299 * 0.03395
Macro List	Camera Shift, mm	52 * 24
Macro Wizard	Tool number assigned to Camera	99 🔹
<ul> <li>Probing Wizard</li> <li>Preferences</li> </ul>	roor number assigned to camera	
<ul> <li>Screen</li> </ul>	Camera Offset, mm	0 x 0
Work Offsets	Camera "Tool Length"	0
Parking Coordinates	camera roor cengui	
Technology	Ignore Decoder Errors	X
Camera 5 axes RTCP	Pattern Match Level	20 4
<ul> <li>Panel/Pendant</li> </ul>		20 -
Hardware		
Advanced	200 150 50 50 100 50 100 50 100 100 50 100 10	Reset Min/Max Data

## Setting up the pixel to length coefficients

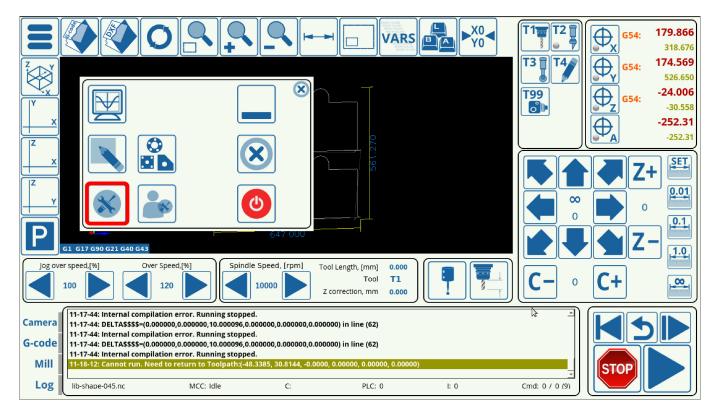
Obsolete method only used on program versions older than July 2019. In all recent versions the pixel to length coefficients is calculated automatically by the program during the calibration process.

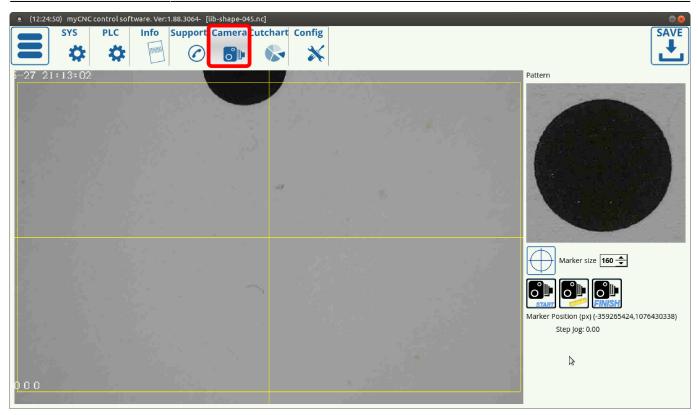
#### Click to expand the instructions

The pixel to length coefficient is necessary for the camera to know how many millimeters it had moved after having traversed a certain number of pixel to the left/right/top/bottom of its original position. This procedure is done by finding the ratio of millimeters moved to pixels travelled. While it is automated in the newer versions of myCNC software, it can also be done manually in the older software versions.

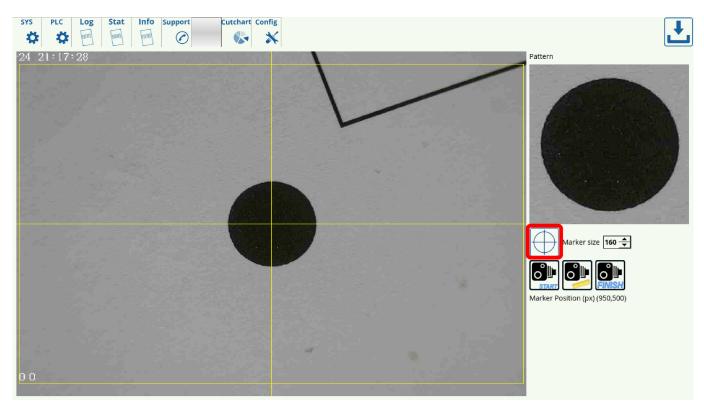
In order to do so:

1. Go to the **Camera** tab of the myCNC software

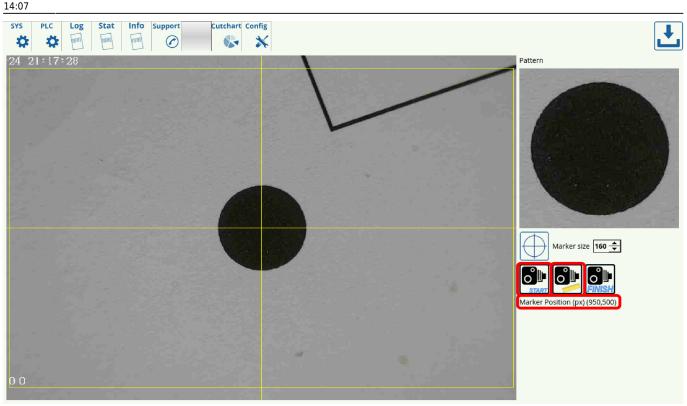




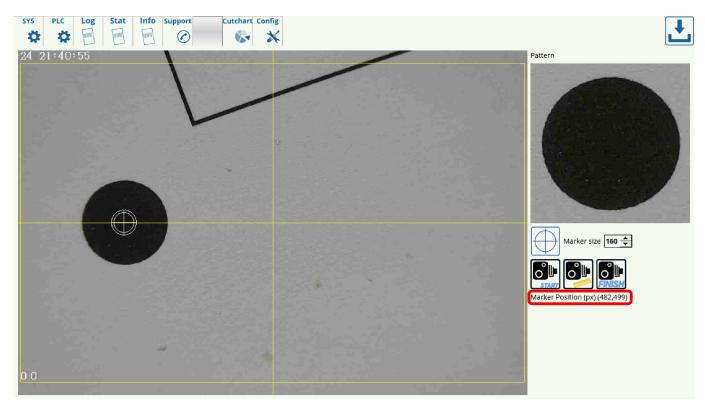
2. Move your camera to the center of the marker and press the Center button



3. Press the **Start** and **Measure** buttons, and note the xy-position of the camera before moving it.



4. Move the camera some distance (in mm) and record that distance. Note the change from the original pixel xy-position, and find out how many pixels the camera has travelled over this movement. Divide the millimeters moved by the pixels travelled to obtain the pixel to length coefficient for each respective axis.



For example, in this setup, the machine has moved 12 mm to the right, while the x-position value has changed from 950 to 482.

```
950 - 482 = 468 pixels
12 mm ÷ 468 pixels = 0.0256
```

Therefore, the pixel to length coefficient is 0.256

5. Input the new coefficient into the CNC Settings > Camera > Pixel to length coefficient and press Save

Info Support Camera Config		SAVE
CNC Settings Axes/Motors	Camera interface	IP Camera 💌
Inputs/Outputs/Sensors Network	IP Camera initialization line	rtsp://192.168.0.80
Motion ▶ PLC	USB camera channel	0 _
G-codes settings DXF import settings	Region of Interest, px	1900 × 1000
Macro List	Marker size	160 🚖
<ul> <li>Macro Wizard</li> <li>Probing Wizard</li> </ul>	Coefficient Pixel-to-Length	0.0256
<ul> <li>Preferences</li> <li>Screen</li> </ul>	Tool number assigned to Camera	99
Work Offsets Parking Coordinates	Camera Offset, mm	
Technology     Camera	Camera "Tool Length"	0
5 axes RTCP ▶ Panel/Pendant	Ignore Decoder Errors	
Hardware     Advanced	Camera Shift, mm	99 <b>•</b> × 99 <b>•</b>
Auvanced	Pattern Match Level	
	95 55 55 55 55 55 55 55 55 55	Reset Min/Max Data

6. Repeat the procedure for the other axis.

After both axes have been calibrated, the machine will now have a proper coefficient of the number of pixels it moved by versus actual distance travelled in millimeters.

### Using the hotkeys to move the camera

In order to move the camera straight from the Camera tab, a set of hotkeys have been designed specifically for that purpose. Note that the hotkeys are only present in the more recent versions of myCNC software. Please update the myCNC application if the camera hotkeys are not present in your profile version.

НОТКЕҮ	ACTION	
Arrow Up	Move in the positive y-direction	
Arrow Right	Move in the positive x-direction	
Arrow Down	Move in the negative y-direction	
Arrow Left	Move in the negative x-direction	
Space	Switch the step jog size (00.1 through 1 mm)	
Hold Control and Arrow keys Move by the selected step jog		

# **CNC Vision Example**

The CNC Vision correction of a program to be used on a shifted or distorted working material can be done easily after the markers have been calibrated. In order to open and use a file with the CNC Vision system, use the following instructions:

1. From the myCNC software's main screen, click the Open DXF File button.

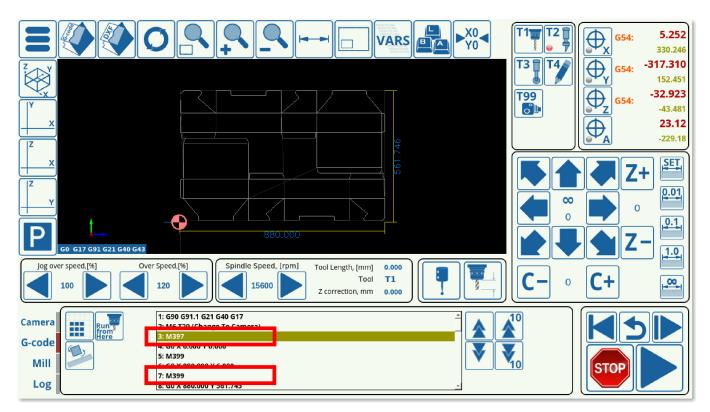
		G54: 5.252 330.246 ↓ G54: -317.310 152.451 33.023
		G54: -32.923 -43.481 -23.12 -229.18
Jog over speed,[%]         Over Speed,[%]           100         120		C+
Camera G-code Mill X intere X	2.500000 Y71.078389	

2. Select the particular DXF file you would like to open.

3. When selecting the tools, include Camera as one of the tools, and assign to it the same tool number as the one specified in the Camera Settings (this will be Tool 99 in our case). Assign the other tool or tools and their priorities as necessary for your particular program.

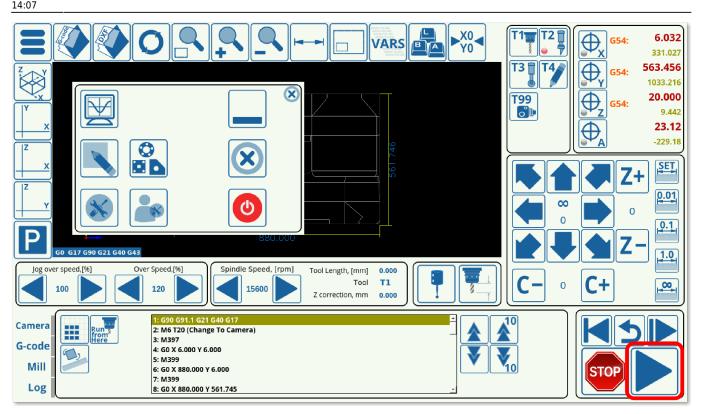
2024/04/26 02:39	13/14		CNC Vision (Optical Registration Mark Reading) Setu
Path /home/mycnc/DNC/XHC v /home/mycnc/DNC/ demo-plasma kerf knives v vision TEST VISION 2.dxf TEST VISION.dxf testMultipleParts002.DXF	Folder /home/r Folder /home/r Folder /home/r Folder /home/r Folder /home/r Folder /home/r File /home/r	nycnc/DNC/ nycnc/DNC/XHC nycnc/DNC/ nycnc/DNC//demo-plasma nycnc/DNC//kerf nycnc/DNC//knives nycnc/DNC//vision nycnc/DNC//vision/TEST VISION 2.dxf nycnc/DNC//vision/TEST VISION.dxf nycnc/DNC//testMultipleParts002.DXF	
			Scale 1 Offset X, Y 0 0 Enable Priority Dir. Double Pass V 0 V X DRAWING Pen V T5 V V 0 V X MARKS Camera V T20 V
Destination Folder: /home/mycno File name: /home/mycno	/DNC/XHC /DNC//Vision/TEST VISI	DN.dxf	
		<b>E</b>	

4. Once you have loaded the DXF file, the program should now have inserted the M397, M398, and M399 macros which refer to camera actions into the program G-code.



5. Press Run.

Last update: 2020/01/16 quickstart:mycnc-quick-start:cnc-vision-setup http://docs.pv-automation.com/quickstart/mycnc-quick-start/cnc-vision-setup?rev=1579201669



The machine will move the camera towards the supposed marker positions, and, if the markers are not immediately present in the Region of Interest, will move around this supposed marker position by the distance specified by the Camera Shift. After running through the camera macros and locating all of the markers for which the program has been calibrated, the program will automatically adjust for any shift or distortion that was introduced, and will immediately begin running the main program.

NOTE: The program will not begin the main cutting process unless all the markers that were expected to be adjusted for have been located.

## **Camera troubleshooting**

A camera troubleshooting guide is available here: Camera Troubleshooting

