Operation manual for Automatic Signature Analysis System EyePoint P10

Contents

INTRODUCTION

Reading this manual before starting to work with the system is highly recommended.

Keep the lid closed to avoid injuries or possible components damage, when the system is working.

The following names of the main modes and commands for keyboard and computer mouse control are used in further description.

- command "Point" – mouse left-click;
- command "Hand" – move the image while holding the left mouse button mouse;
- selecting mode "Area" – moving while holding the right mouse button mouse;
- changing the "Scale" mode – scroll the mouse wheel (up – zoom in, down - zoom out).

The sequence of basic actions to perform electrical testing of arbitrary printed circuit boards is given below.

THE MAIN PART

1. Turning on the system

Power the system and the controlling computer.

Launch the program "EyePoint P10" using a shortcut on desktop.

2. Program settings

To open the settings, click the "File" button at the top of the screen and select "Settings".
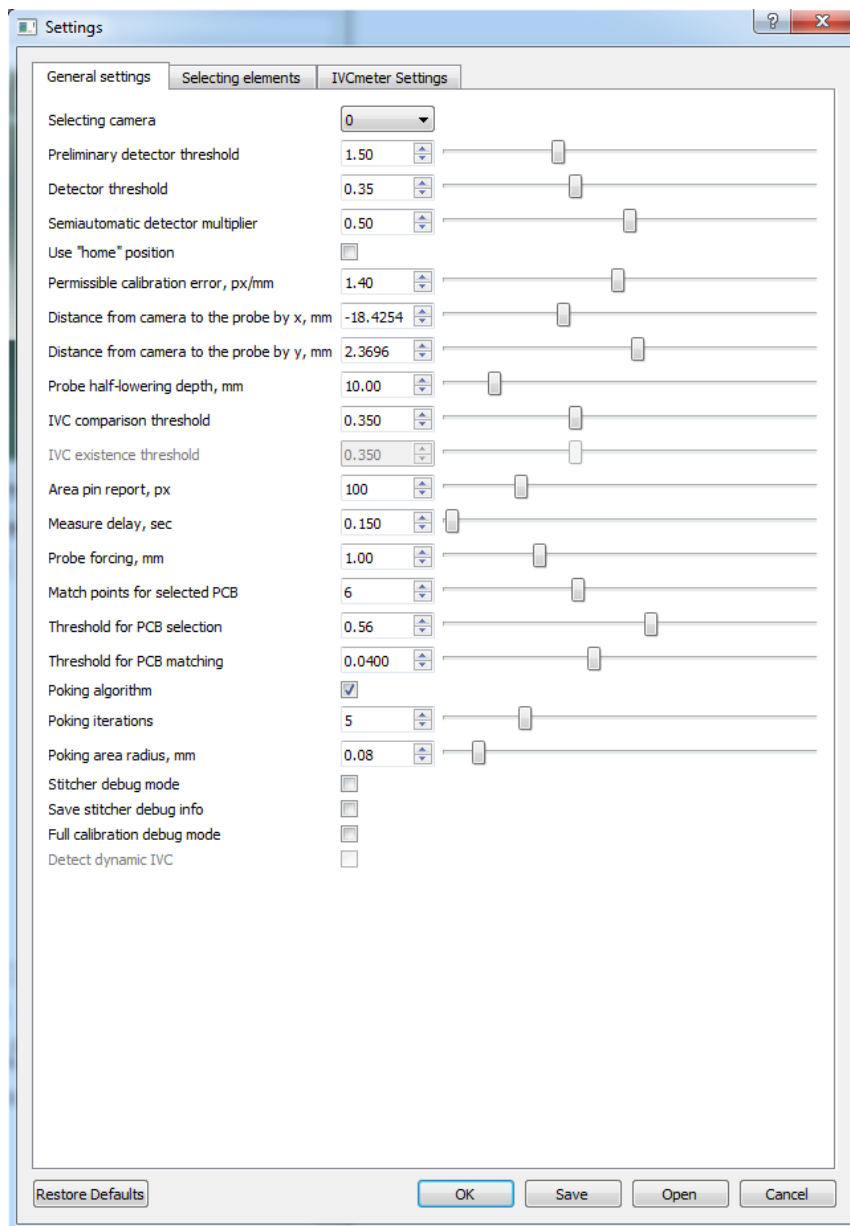

Image 1. The appearance of the settings window.

Description of the settings sections of the "General settings" tab.

1) "Selecting camera" – allows to select a camera for the EP P10 system if there is a camera connected to the PC in addition to the EP P10. The default value is set to 0.

2) "Preliminary detector threshold", "detector threshold",
"Semiautomatic detector multiplier" are for electronic components of the boards recognition quality.

3) "Home" position returns the "Head" of the system to far left corner (home) after every scanning or testing of the board.

4) "Permissible calibration error, px/mm" – defines permissible error of the probe osition relative to the camera, when fully calibrated on the X, Y axis.

5) "Distance from the camera to the probe by X, mm" and "Distance from the camera to the probe by Y, mm" are set automatically during the full calibration and affect the position of the probe relative to the camera – do not change these settings manually.

6) "Probe half-lowering depth, mm" affects the height to which the probe will rise after testing each point on the test board or the reference board.

7) "IVC comparison threshold" affects the comparison of the reference and the test boards IVC to determine whether there is a difference between them. 1 (100%) is a complete difference and 0 (0%) is a complete match of the IVC.

8) "Area pin report, px" defines the size of the pointer of the investigated point in the report and on the board in the "Scanning" and "Testing" tabs.

9) "Measuring delay, sec" defines the time required to measure the test point IVC during the testing of the board. If the test frequency is less than 20Hz, this parameter should be set to 1.

10) "Probe forcing, mm" defines how much the system will lower the probe below the board level (quick calibration points) when testing. All the probes of the system are spring-loaded, with a spring stroke of 4 mm. Do not set this value higher than 4 mm in order to avoid damaging the system and the board.

11) "Match points for selected PCB", "Threshold for PCB selection", "Threshold for PCB matching" affect quality of comparison between the reference boards from the database and the tested board. If the system poorly matches the reference or refuses to recognize it, it is necessary to reduce the values of these parameters.

12) "Poking algorithm", "Poking iterations" enable this function and set the number of attempts during which the system tries to get the IVC, in case of its absence (horizontal line)

on the test point of the reference board or test board. This function allows to test boards covered with a thin layer of varnish, a thick oxide layer, or dirt. It also helps if the reference and the testing boards were matched poorly.

13) "Stitcher debug mode", "Save stitcher debug info", "Full calibration debug mode" – debug functions, you do not need to use them.

14) "Detect dynamic IVC" – automatic detection and measuring of dynamic IVC at the testing points is not available at the moment.

Description the settings section of the "Selecting elements" tab.

This tab enables/disables the types of elements packages that the system should recognize on the boards, when creating a reference.
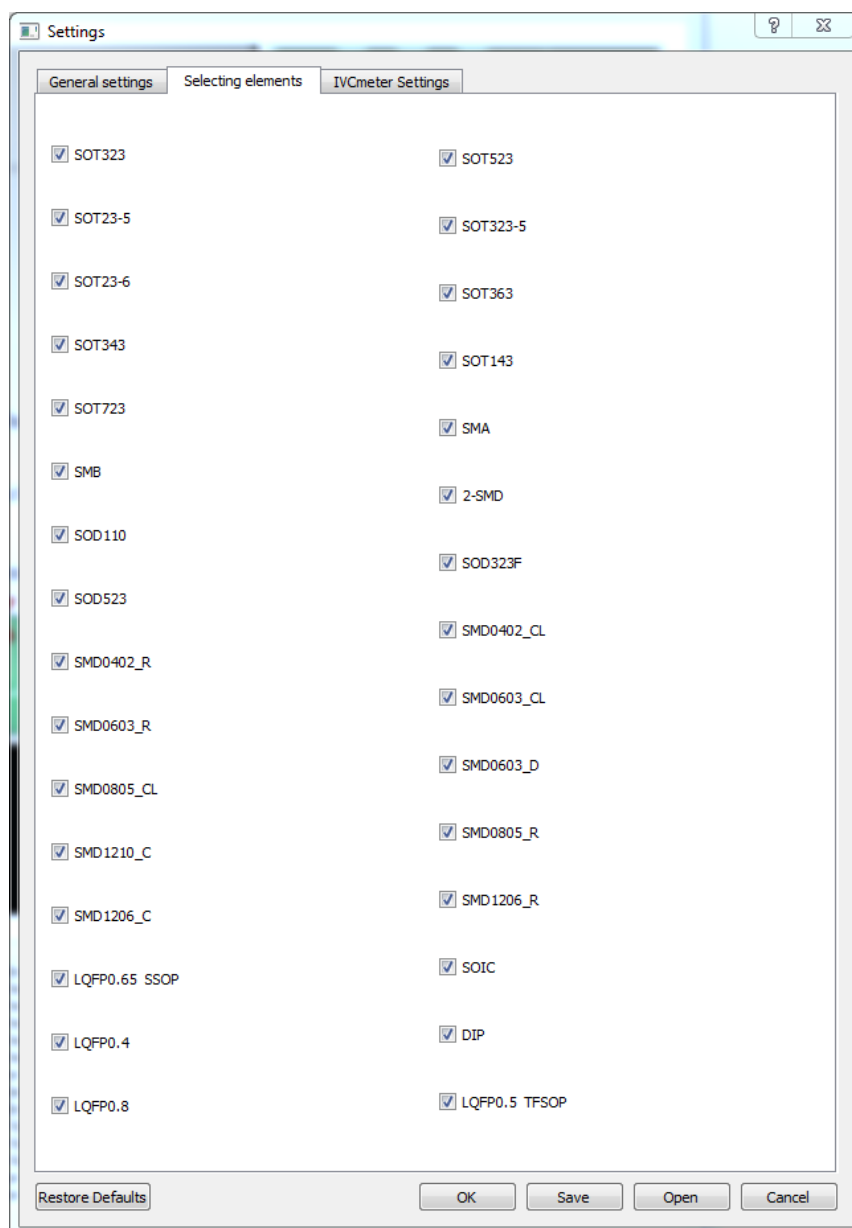

Image 2. Example of the "Selecting elements" tab.

Description the settings sections of the "IVCmeter Settings" tab.

1) "Max Voltage, V" – sets the voltage of the test signal in the range from 0 to 12V.

2) "Probe signal frequency, Hz" – sets the frequency of the test signal in the range from 1 Hz to 10 000 Hz. Do not set frequency higher than 1 kHz, because it can lead to a large measurement error.

3) "Current precision" – sets the sensitivity and limitation of the system by the current of the test signal, calculated according to Ohm's law.

4) "Number of points" and "Number of charge points" affect the appearance of received IVC, there is no need to change these parameters.
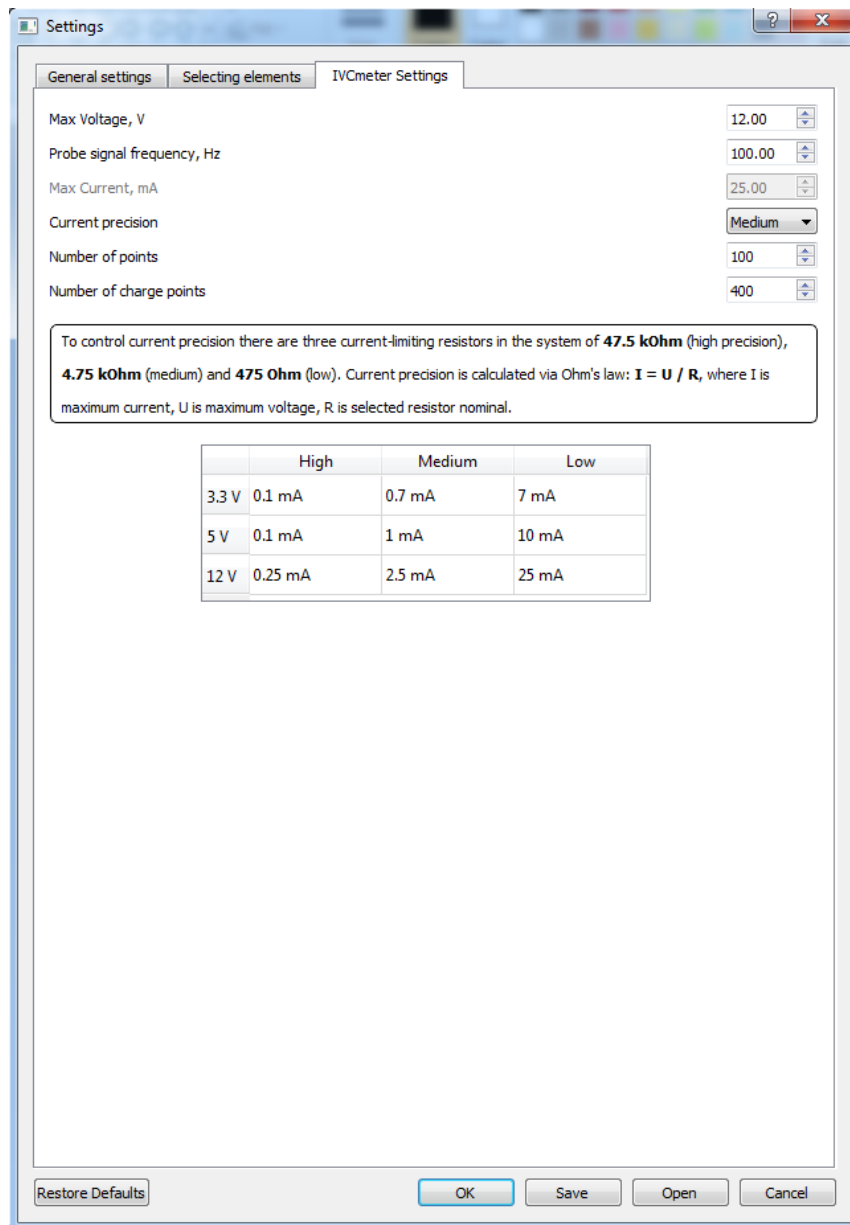

Image 3. Example of the "IVCmeter Settings" tab.

3. Installing the board

Open the lid of the system and fix the test board in the center of the working area of the system to the 4 attached magnetic standoffs, or in a special board holder, if there is one.

It is not necessary to strictly observe the geometric position of the board, image correction is performed automatically.

Connect the "common" meter conductor to the common line of the board (preferably to GND) using the "crocodile" clip. The GND circuit is output to the corner metallized pads on the calibration board.

Close the lid of the system.

4. Calibrations

IMPORTANT!!! The "common" wire of the tester must be connected to the board with the "crocodile" clip or another clip, depending on the board.

Go to the "Calibration" tab (it opens automatically when the program starts).

4.1. Full calibration

Full calibration is necessary in the following situations:

- first launch of the system after unpacking

- the system stopped hitting the specified points

- the probe was caught on the high elements during testing

- the probe was replaced

- there was a factory reset

Full calibration selects the X, Y coordinates of the probe location relative to the camera, and determines the height of the installed probe.

In the main program window, in the "Calibration" tab, "Point" to the center of the metal square on the calibration board Calibration 2.0. The selection is controlled in the camera window. The "Scale" of the image can be changed with the mouse wheel for more convenience. The appearance of the program window is shown in the Image 4.
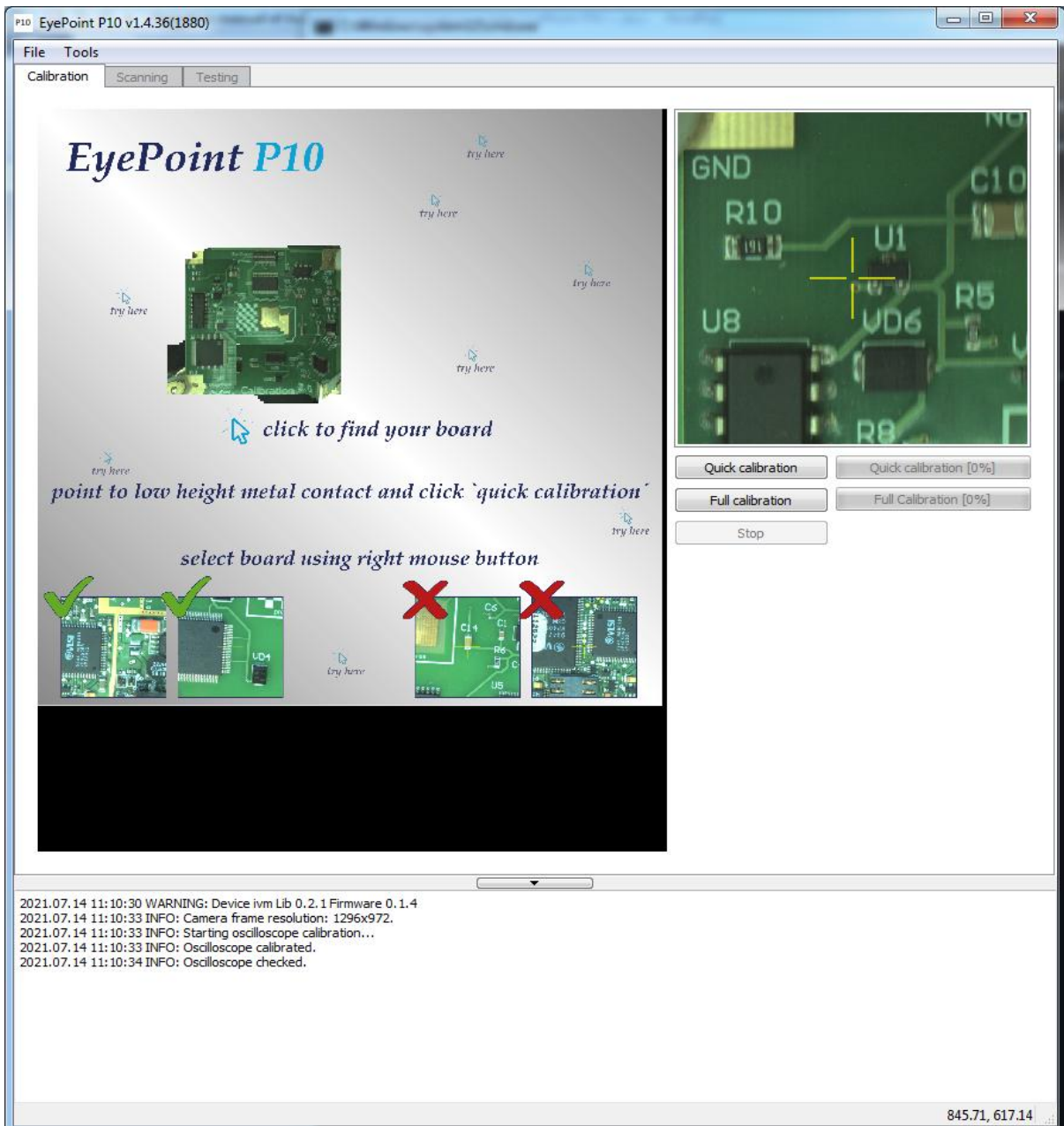
.

Image 4. Program interface in the "Calibration" tab

Press the "Full Calibration" button and wait for the calibration to complete. When the operation is completed, the message "Successfully calibrated" should appear at the bottom of the screen.

4.2. Quick calibration

A quick calibration is required every time a new board is set for testing. It defines the focal length to the board, also if there is a contact with the board and the distance from the probe to the board.

To start a quick calibration you need to select the lowest contact pad on the board, for example the contact pad of the chip, and press "Quick calibration" on the right side of the screen and wait for the calibration to complete. When the calibration is complete, the message "Successfully calibrated" should appear at the bottom of the screen.
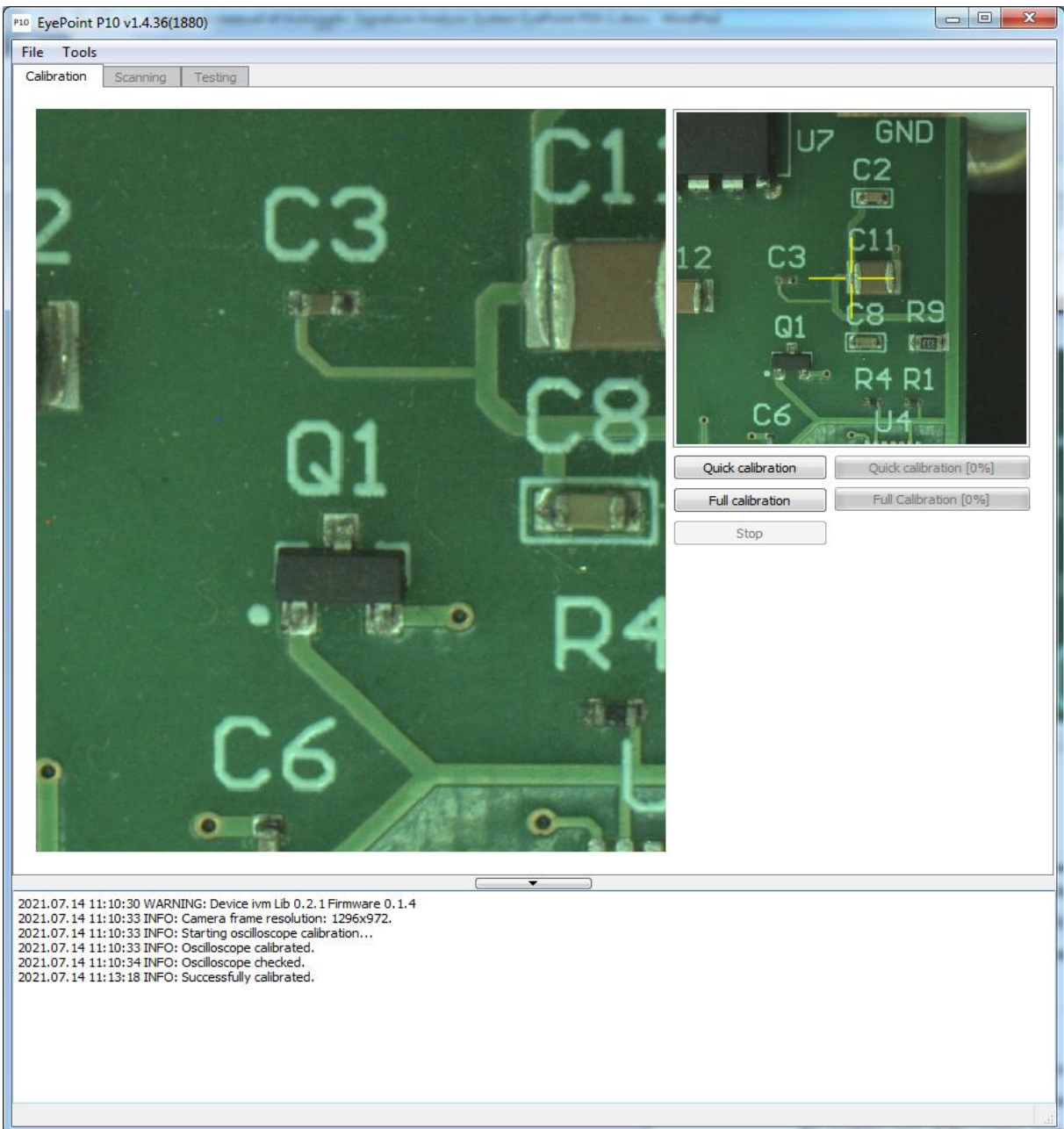

Image 5. Quick calibration.

The Image may look muddy and blurry before the quick calibration, but after it is complete the image should be as sharp as on the Image 5.

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4.3. Calibration of a new probe

Calibration of a new probe is required after changing the probe.

To start the calibration of the new probe, set calibration board "Calibration 2.0" into the working area of the system and connect it with the "common" wire and move the pointer in the center of the metalized square as shown on the Image 4. Find the "Tools" section in the upper part of the screen, select "Calibrate new probe", select "OK" when the question "if the system is grounded" appears, and wait for the operation to complete.

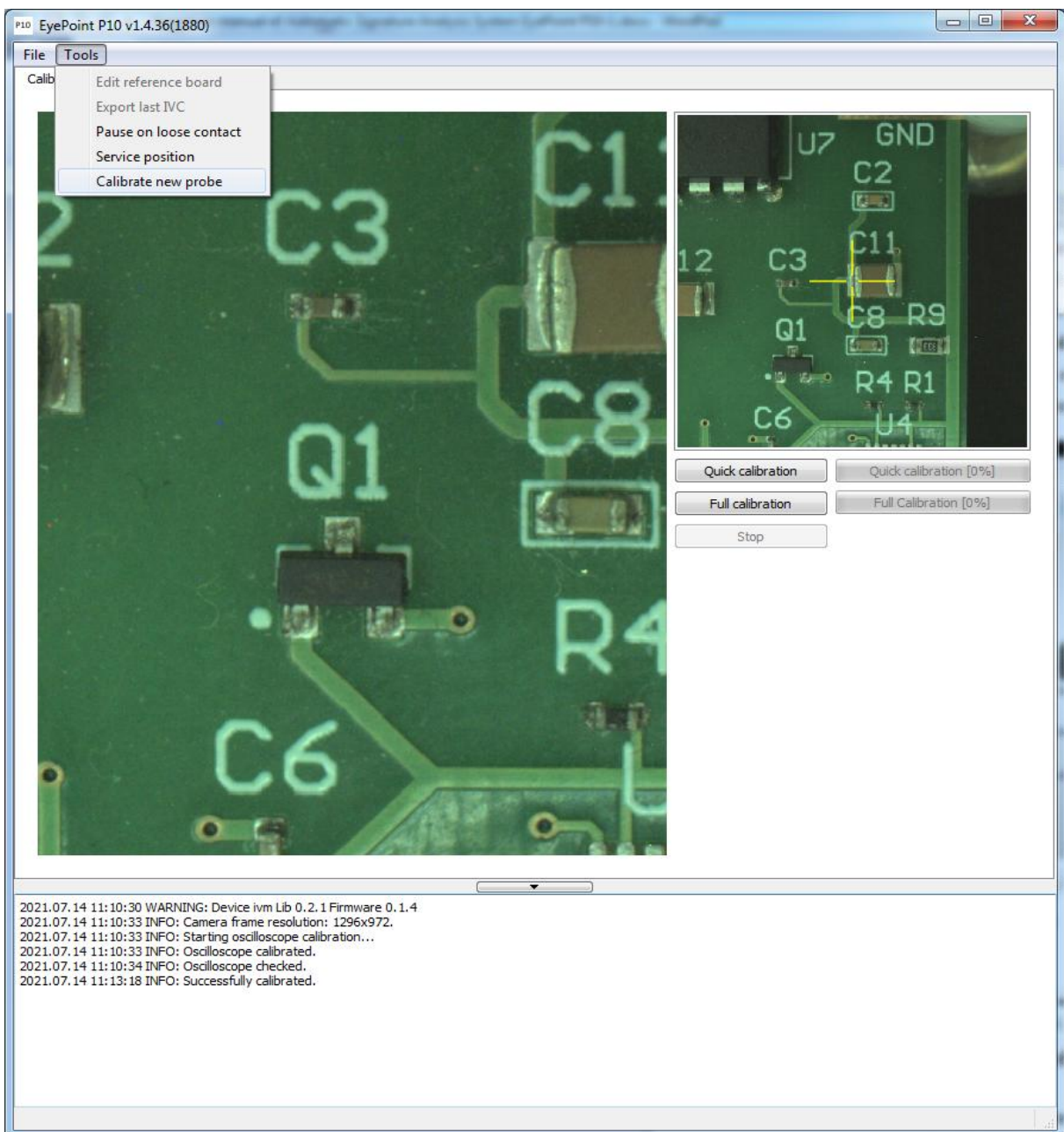The appearance of the calibration of a new probe menu is shown in the Image 6.

Image 6. Calibration of a new probe.

5. Selecting working area of the board

Set the test board in the center of the working area of the system and start a quick calibration as specified in 4.2 section, then you can select the working area.

Check the board for the presence of high components. According to their height, set the required value of the "Probe half-lowering depth, mm" parameter in the system settings.

Find the board on the working space by "pointing" on in the image. Select the board in the frame using the "Area" mode. The example of the selected board is in the Image 7.
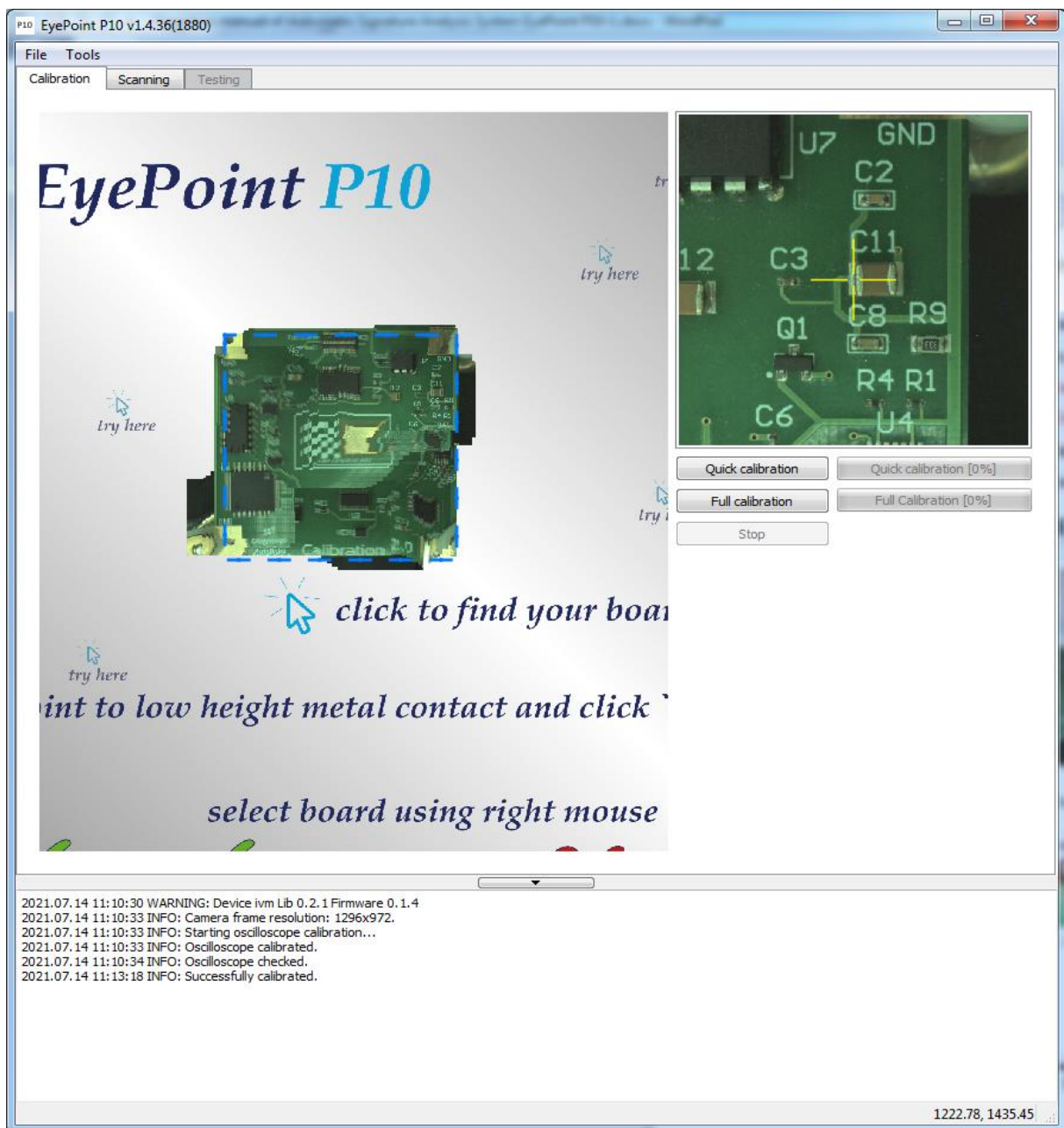

Image 7. Selected area with the board.

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6. Scanning

To start scanning the board, go to the "Scanning" tab in the upper area of the program window. Press "Scan" button in the right area of the program window in the "Scanning" tab. The appearance of the "Scanning" tab is shown in the Image 8.
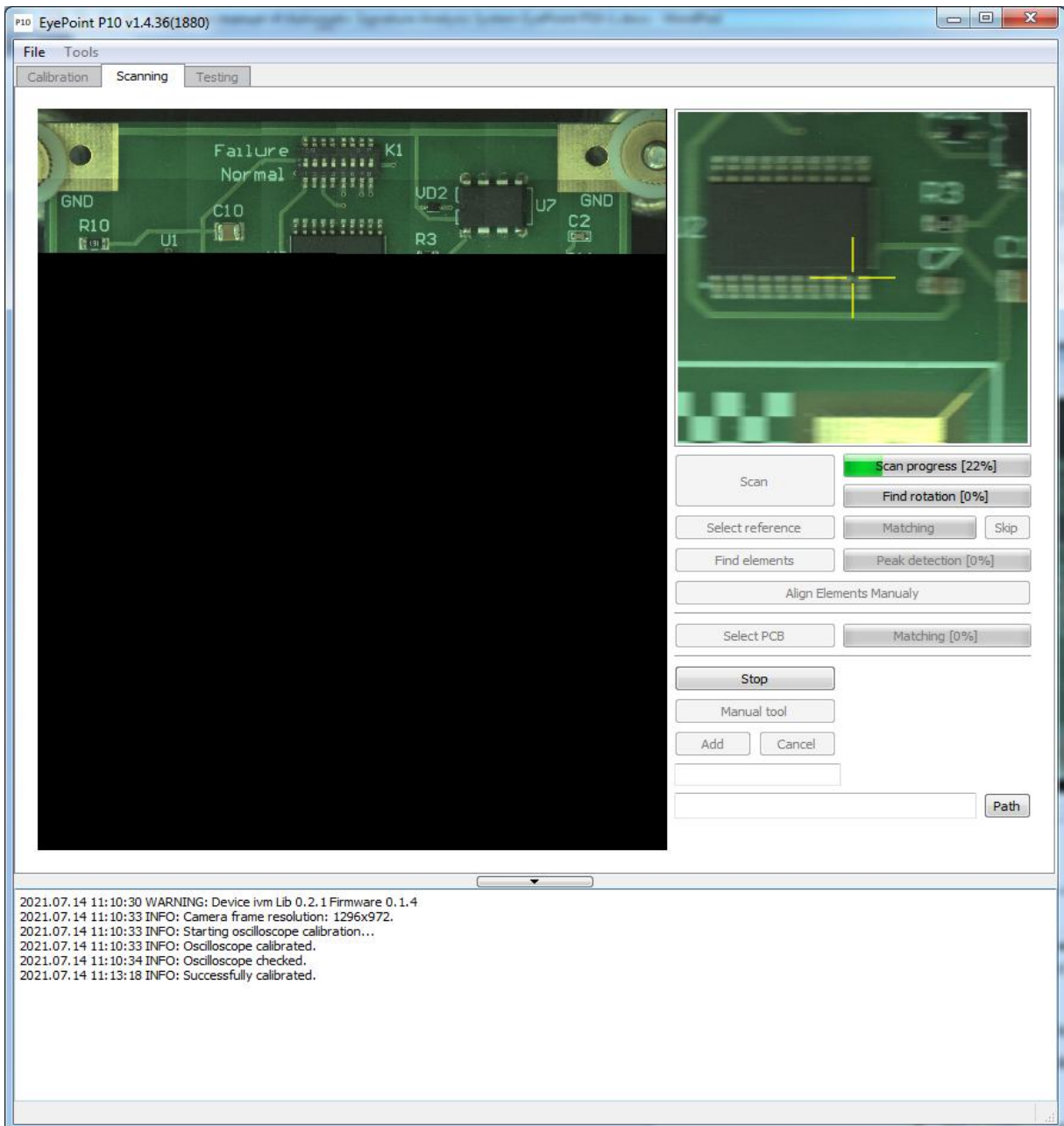

Image 8. The appearance of the "Scanning" tab.

During the scanning the lid of the system must be closed!

The resulting image should display the interested area of the installed board. The possible result is shown in the Image 9.

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Image 9. Scanned area with the board.
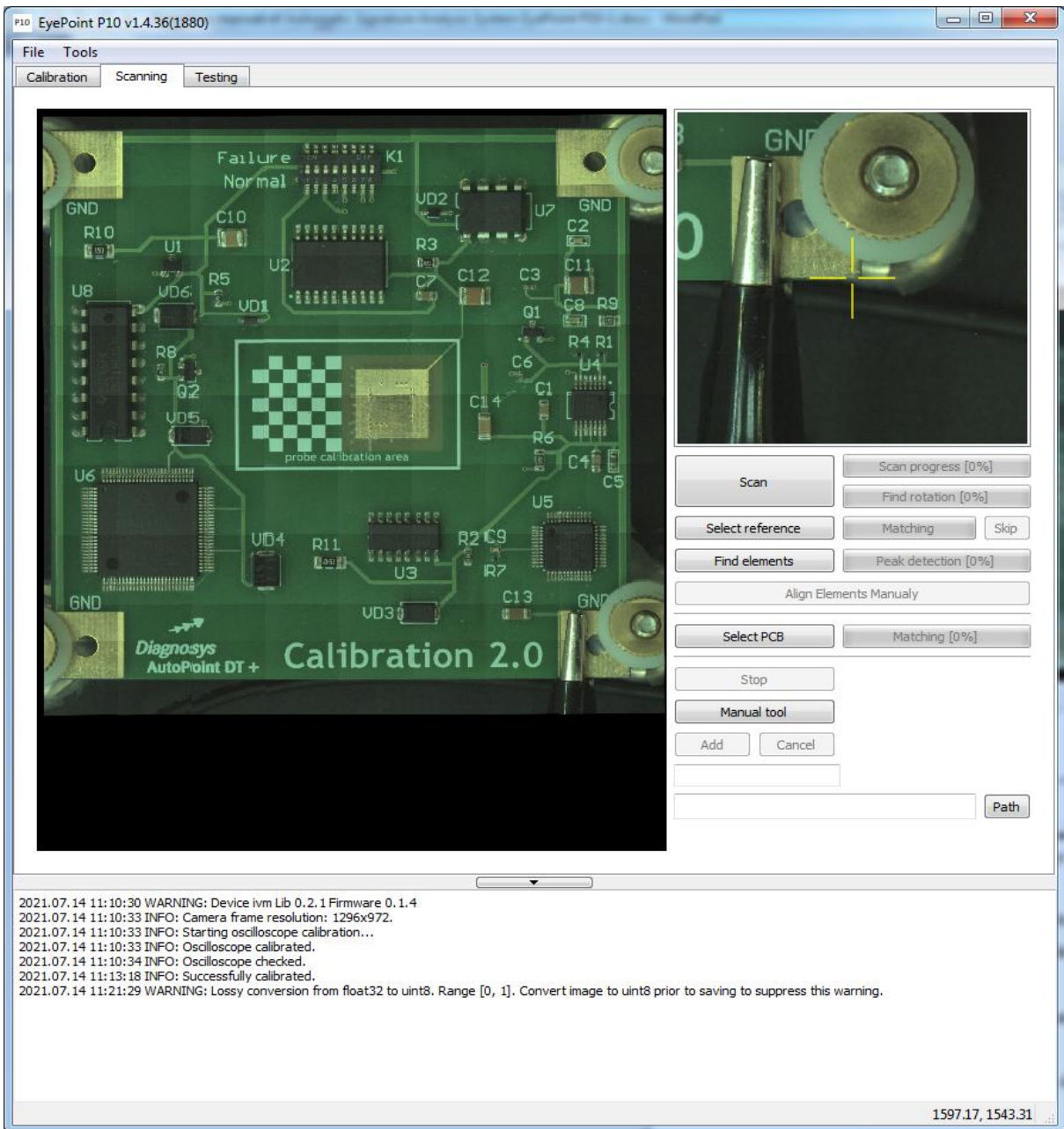
If the board is not fully displayed, perform one of the following actions:

1. Change the position of the board if it was close to the system lid or in the depth of the working area.

2. Set a wider scanning area. Repeat the scanning.

If the resulting image clearly shows frame stitching defects, repeat the quick calibration.

Do not move the board after successful scanning!

7. Elements recognition and creating the reference board

Elements recognition and creating the reference board should be performed in the "Scanning" tab.

7.1. Creating the reference

To start the elements recognition on the reference board press "Find the elements" button and then press "Next" after the start of the recognition. In this case the system will not be searching for the board in the database, and will start elements recognition on the board right away. The elements recognition on the board is affected by the parameters described in subparagraph 2 of the settings description in paragraph 2. When the elements recognition is complete, some incorrectly recognized elements may appear on the board, they need to be deleted by left-click select and pressing the "Delete" button.

There are two ways to add unrecognized elements on the board:
1. Semi-automatic method
2. Manually adding an element.

7.2. Semi-automatic elements recognition method

To start semi-automatic elements recognition select the area with the required element, right-click on it and select "Recognize one element in the selected area" or "Recognize elements in the selected area" in the appearing menu. The appearance is shown in the Image 10.
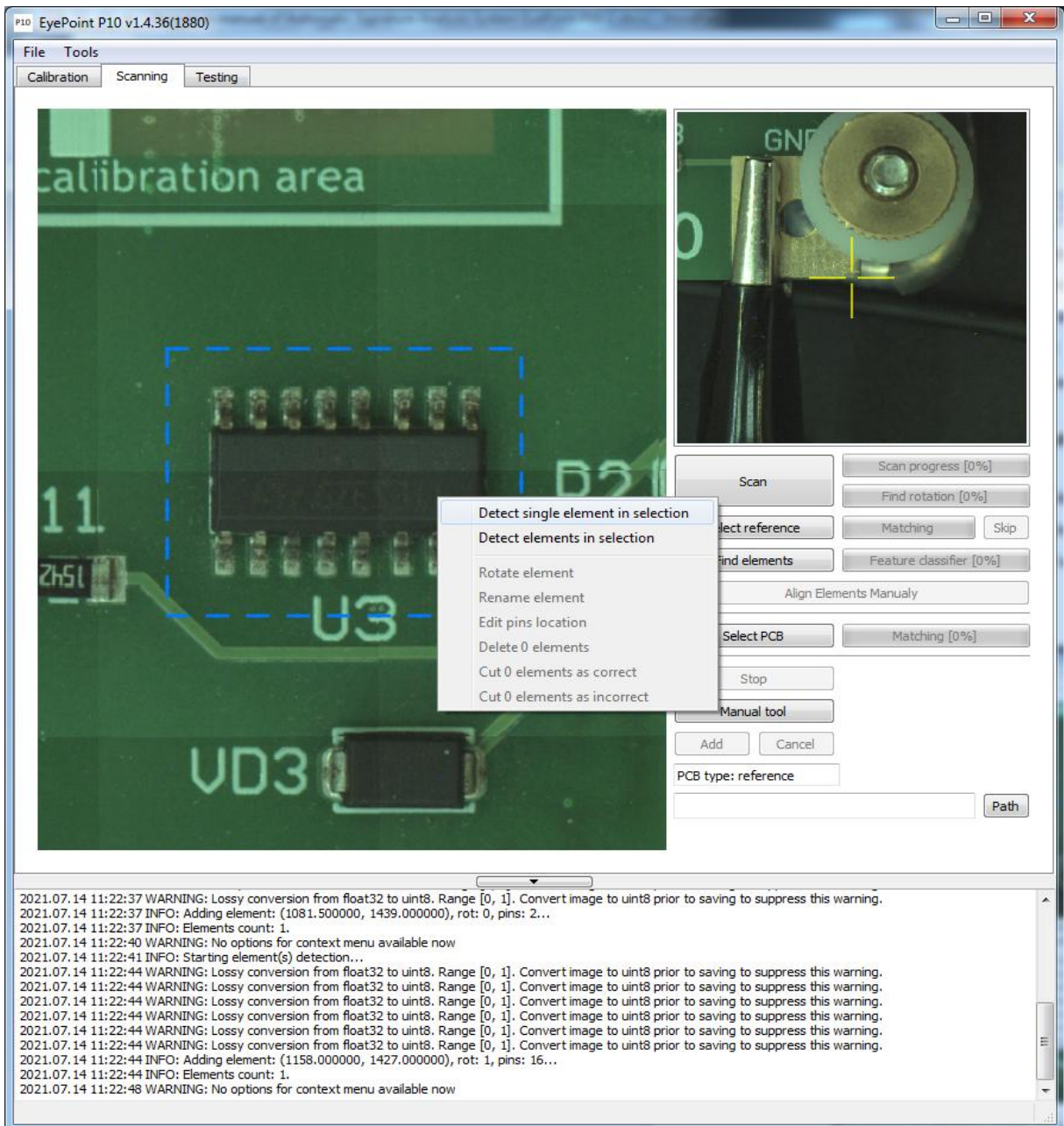
Image 10. Semi-automatic elements recognition.

If the elements recognition failed, select wider area and repeat the procedure. The example of successful element recognition is shown in the Image 11.
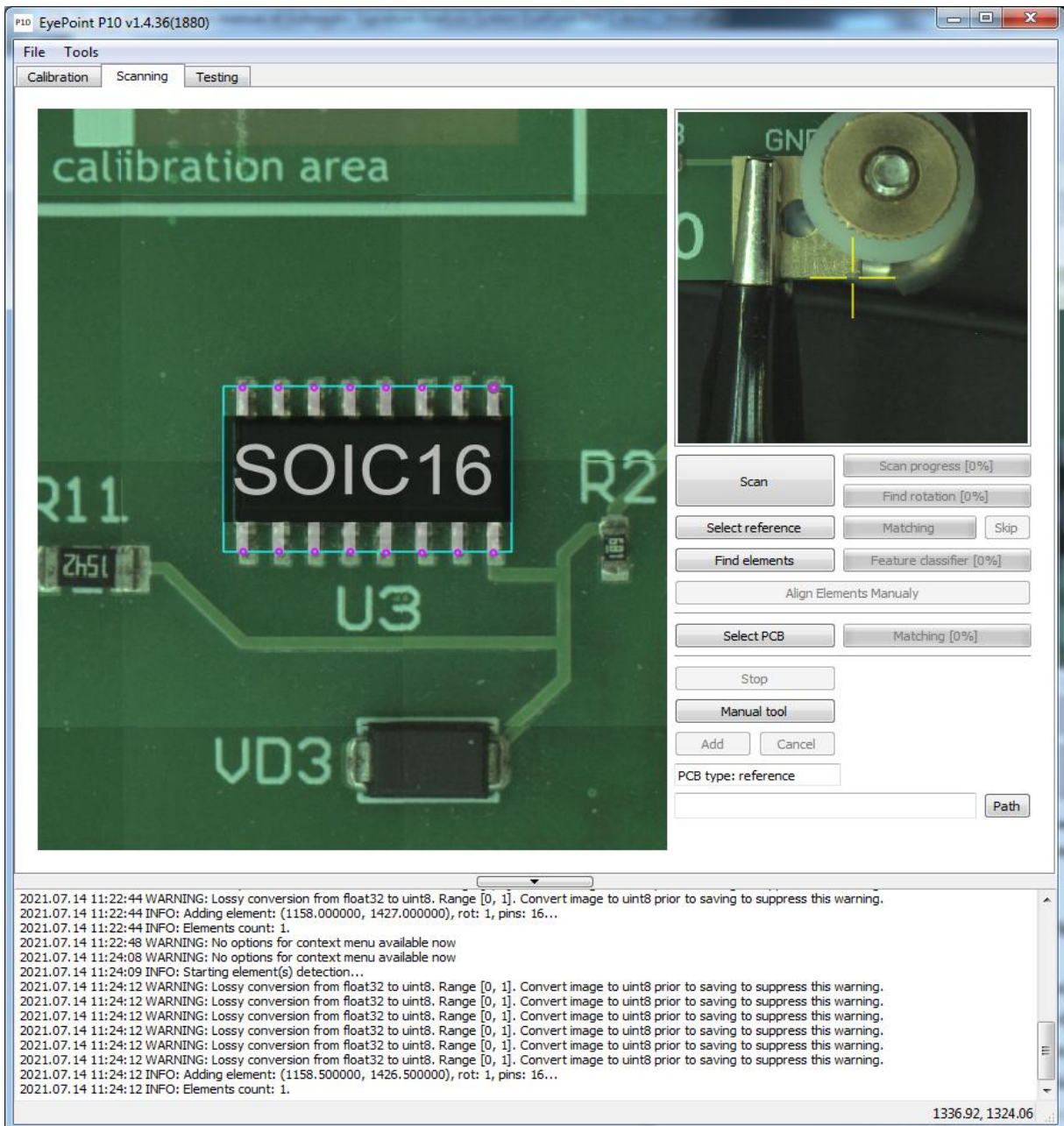
Image 11. The example of successful element recognition.

7.3. Manually adding an element

To manually add an element, click the "Manual Tool" button in the right part of the program window. Select the area where the element is located by right-clicking and then use left-click to add the required points to the contact pads of the element. After adding the required points to the element, click the "Add" button in the right part of the program window, you can specify the name of the element in the appearing window, if needed, and click "OK" to save the element. The example of adding a new element is shown in the Image 12.
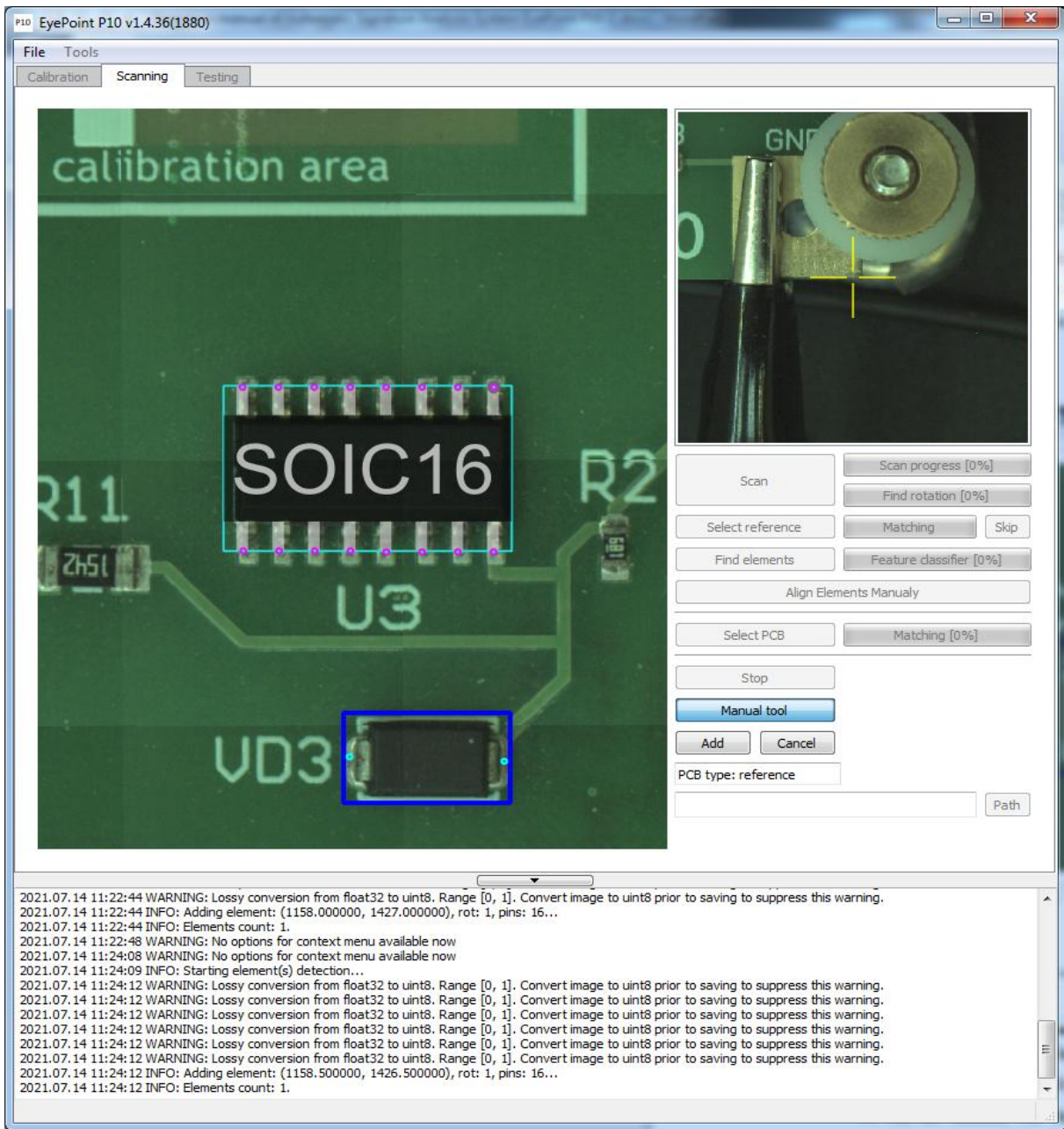
Image 12. Manually adding an element to the board.

Repeat the operation until all the required elements are added.

To edit the element, exit the "Manual Tool" by pressing the undo key, select the element with the left-click, then right-click on the component in the appearing menu, select "Edit the location of the leads" or "Delete 1 element" (you can also use the Delete key after selecting the element or a group of elements), depending on what is required. The appearance of the editing menu of the added element is shown in the Image 13.
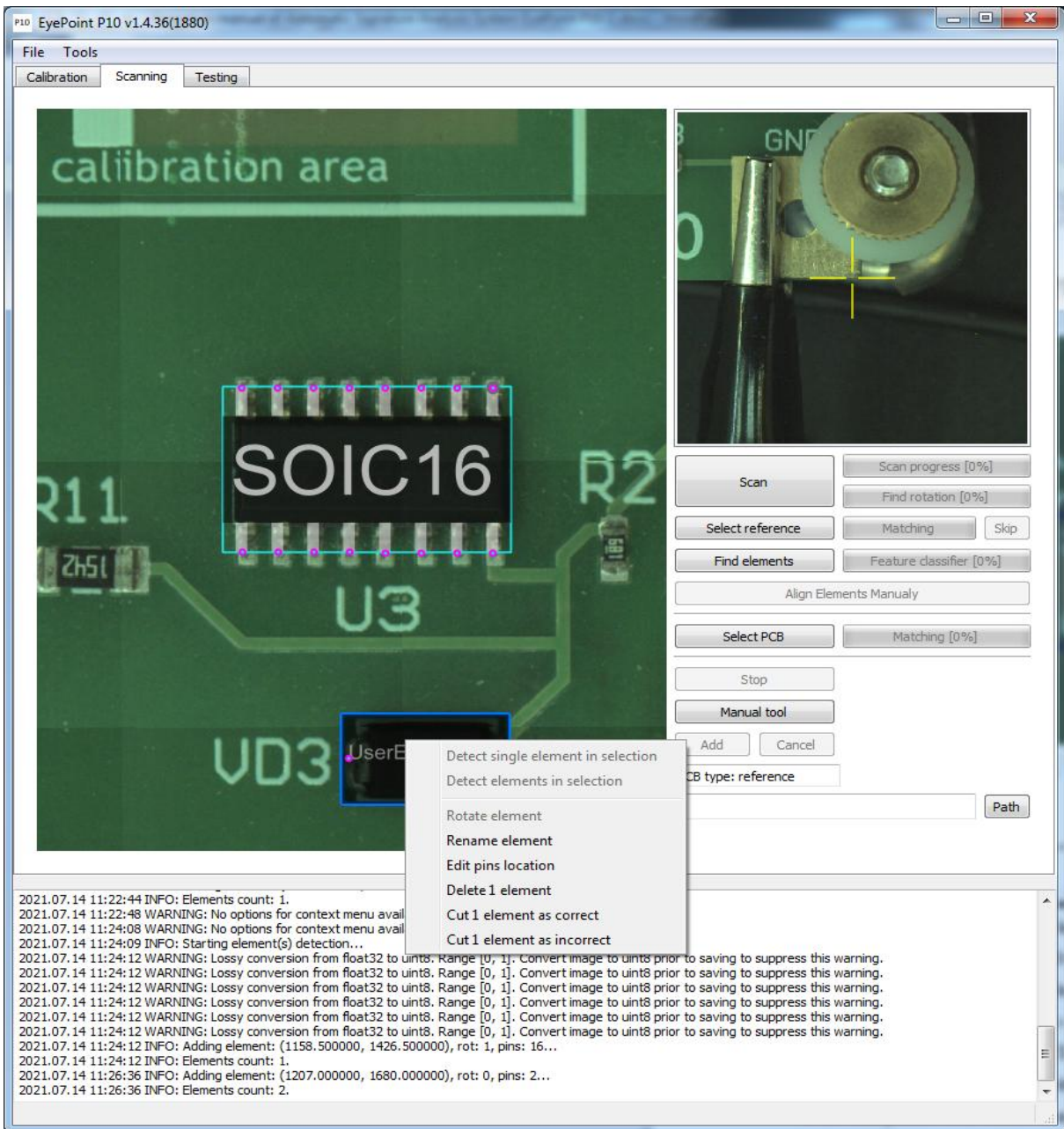
Image 13. Element editing menu.

After adding all the required elements, save the reference board. Select "File" at the top of the screen and then click "Save the board", assign a name to the board in the appearing window and click "OK".

7.4. Testing the reference

After the reference with all the required elements has been created, it needs to be tested, by measuring Current-Voltage characteristics (IVC). Enter the settings by clicking File - Settings and go to the "IVC meter settings" tab and set the required parameters:

- Maximum voltage, V

- Probe signal frequency, Hz

- Current sensitivity

The most optimal settings are 12V, 100 Hz and average sensitivity.

To apply the settings, click "OK".

To start the testing go to the "Testing" tab at the top of the program window.

Click "Test" in the "Testing" tab to start the procedure, and wait fo the testing to complete.
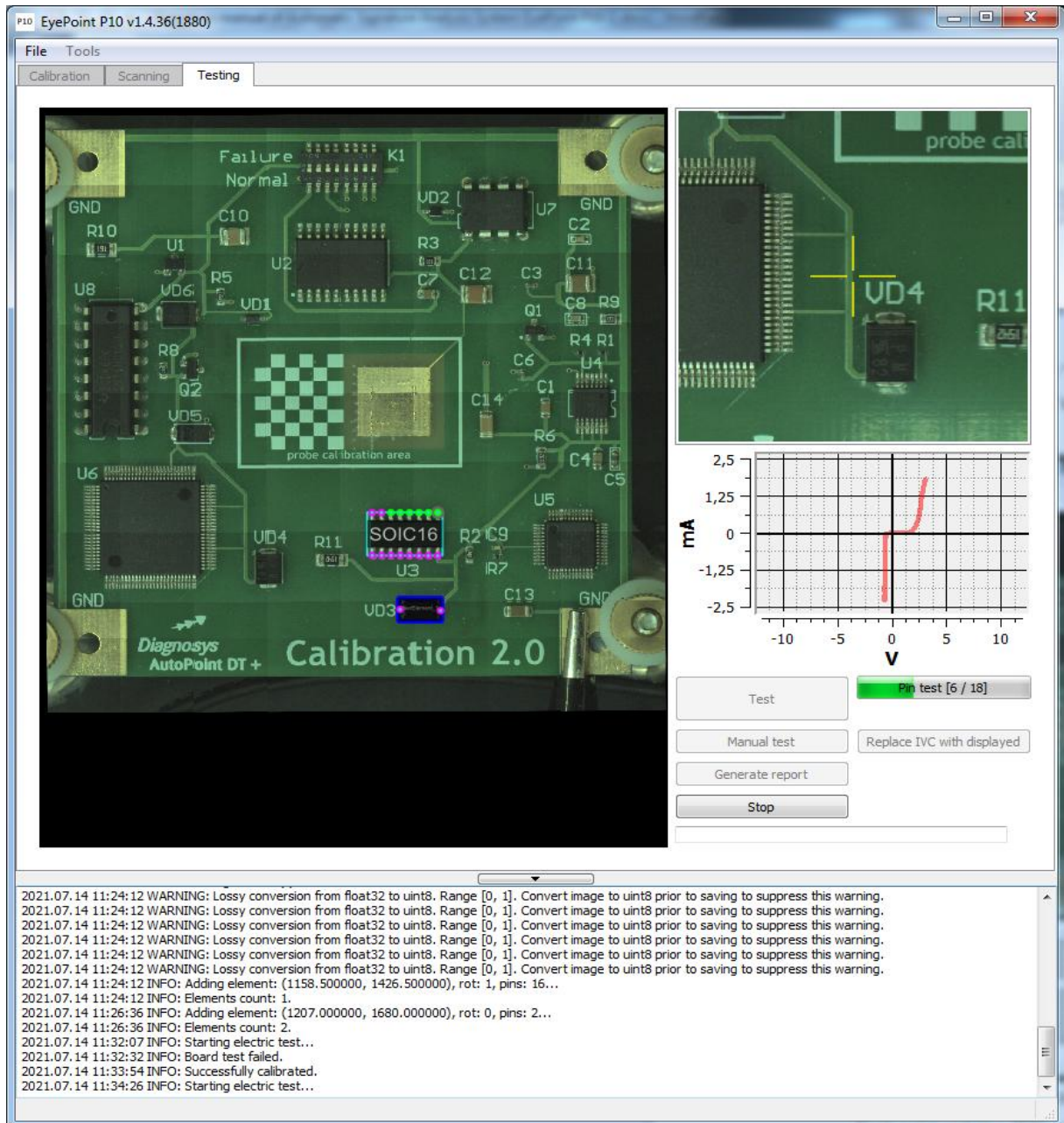
Image 14. Testing the reference board.

Each point real-time IVC will be displayed in the right part of the program window during testing. The appearance of the program window during testing is shown in the Image 14.

The system will again offer to assign a name to the board after testing, you can edit it and click "OK" to save it. After that click "Generate report" and the reference is ready. Reference boards are stored in the **sample** folder in the program folder.

8. Matching the reference and testing the test board

Set the test board in the center of the working area of the system EP P10 and connect a "common" wire to the ground contact of the board, start a quick calibration as specified in 4.2 section.

Check the board for the presence of high components. According to their height, set the required value of the "Probe half-lowering depth, mm" parameter in the system settings.

After the quick calibration, select an area at the board similar to the area at the reference board, and start scanning.

Do not move the board after successful scanning!

There are two ways of matching the reference board after scanning:

- automatic matching of the reference

- manual selection of the reference

8.1. Automatic matching of the reference

To automatically match the reference click "Find Elements" in the "Scanning" tab and wait for the process to complete. At the bottom of the program window, the system will indicate which board it has chosen as the reference among the other reference boards stored in the folder. **IMPORTANT, the amount of references in the folder affects the time the system needs to find the required reference among others. To speed up the process move all the folders except for the required one to another temporary folder.** Parameters described in subparagraph 11 of the settings description in paragraph 2 affect the comparison, selection and accuracy of the matching of the reference board on the test board.

After the matching of the reference all the elements contacts are highlighted with the contrasting purple dots, as shown in the Image 15. After that, check the quality of the matching and shift, the points should be located similarly to the reference, if they do not match check for stickers and other markings on the test board and on the reference, they should not be different.

Note. In the future versions of the program, manual comparison of the reference and the test board are planned to be included.
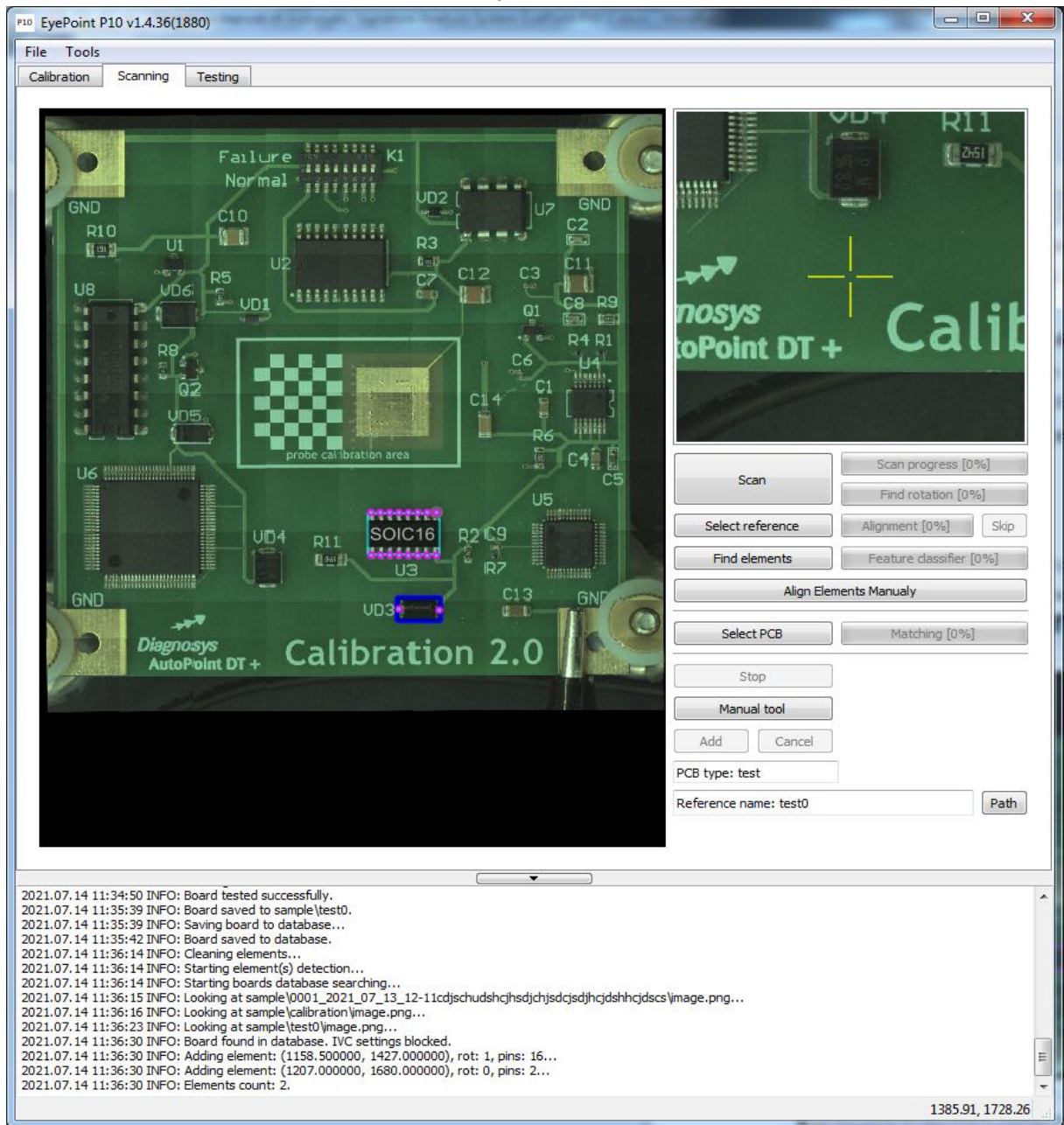
Image 15. Matching of the reference with the test board.

8.2.   Manual selection of the reference

To manually select the reference open "Scanning" tab and click "Select reference" and specify the folder with the reference board.

IMPORTANT!!! Do not change any test point, this may lead the system to consider the board as the reference.

Note. In the current version of the program, the image of the reference board and not the test board with the points compared will be displayed on the screen, therefore, there is no full guarantee that all the test points are correctly matched.

8.3. Testing the test board

To start the testing go to the "Testing" tab and click "Test".

Components' IVC compared to the reference will be displayed in the right part of the program window during testing. The blue color indicates the reference board IVC, and the red is for the current test board IVC.
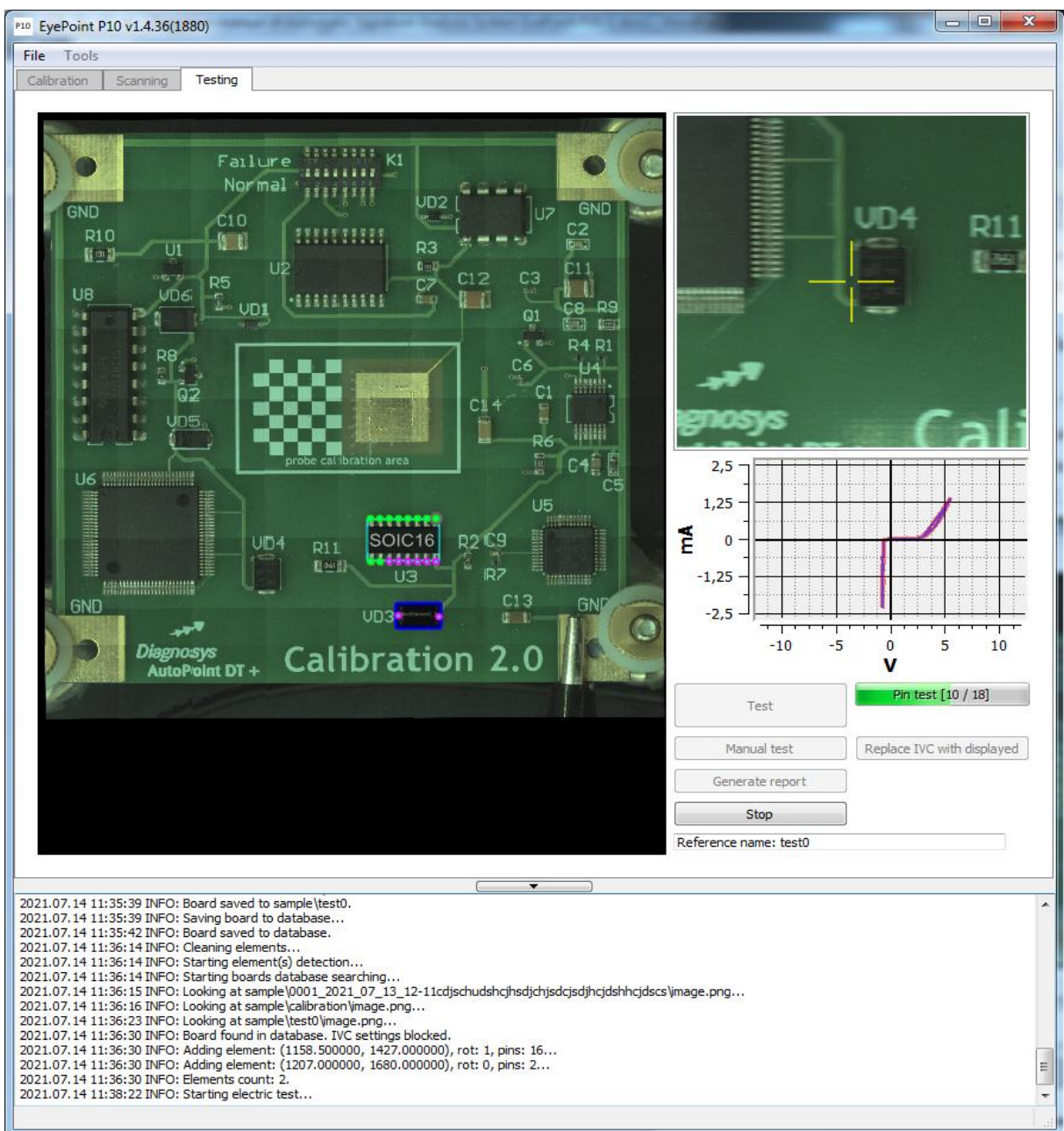

Image 16. Comparison of the test board with the reference.

During testing, all correct points that coincided with the reference are marked in green, all points that did not coincide with the reference by the comparison threshold (see the subparagraph 7 in section 2 of the setting description) are marked in red.

After electrical testing of the test board, the program will ask you to assign the name to the board, then the results will be automatically saved in the program database in the **test** folder in the program folder.

After the electrical testing of the "Test Board", the system automatically generates the "Test Report", which reflects the differences between the reference board and the elements' IVC in each test point. If the IVC comparison threshold was too high, reduce it. Go to the settings and set the required value in the "IVC comparison threshold" and click "OK", then open "Testing" tab and click "Generate report".

Some points can be tested manually, the description of this process is in the section 9.

9. Manual testing

To start the manual testing go to the "Testing" tab at the top of the program window. Then click the "Manual test" button and left-click on the interested point. The real-time current IVC measurement will be displayed in the window.

To change the testing point left-click on the new point. When all the tests are complete, lift the probe from the board by clicking on the "Stop" button. After stopping, the measured IVC can be saved as csv file by right-clicking on it and selecting "Export as CSV".

10. Testing BGA components

If you purchased this product you can enter BGA mode by launching the EyePoint BGA shortcut from the desktop, instead of EyePoint PCB.

Testing BGA components is almost similar to testing of PCB boards, except for the following:

- To select a reference after scanning the BGA element, click the "Select BGA" button on the "Scanning" tab, then choose the folder where the reference for this element is stored.

- when creating a reference, for the system to automatically recognize the contact pads or balls of the BGA element, click the "Define BGA" button on the "Scanning" tab. After recognition, adding new points and removing unnecessary ones is similar to the same procedure when working with PCB boards.
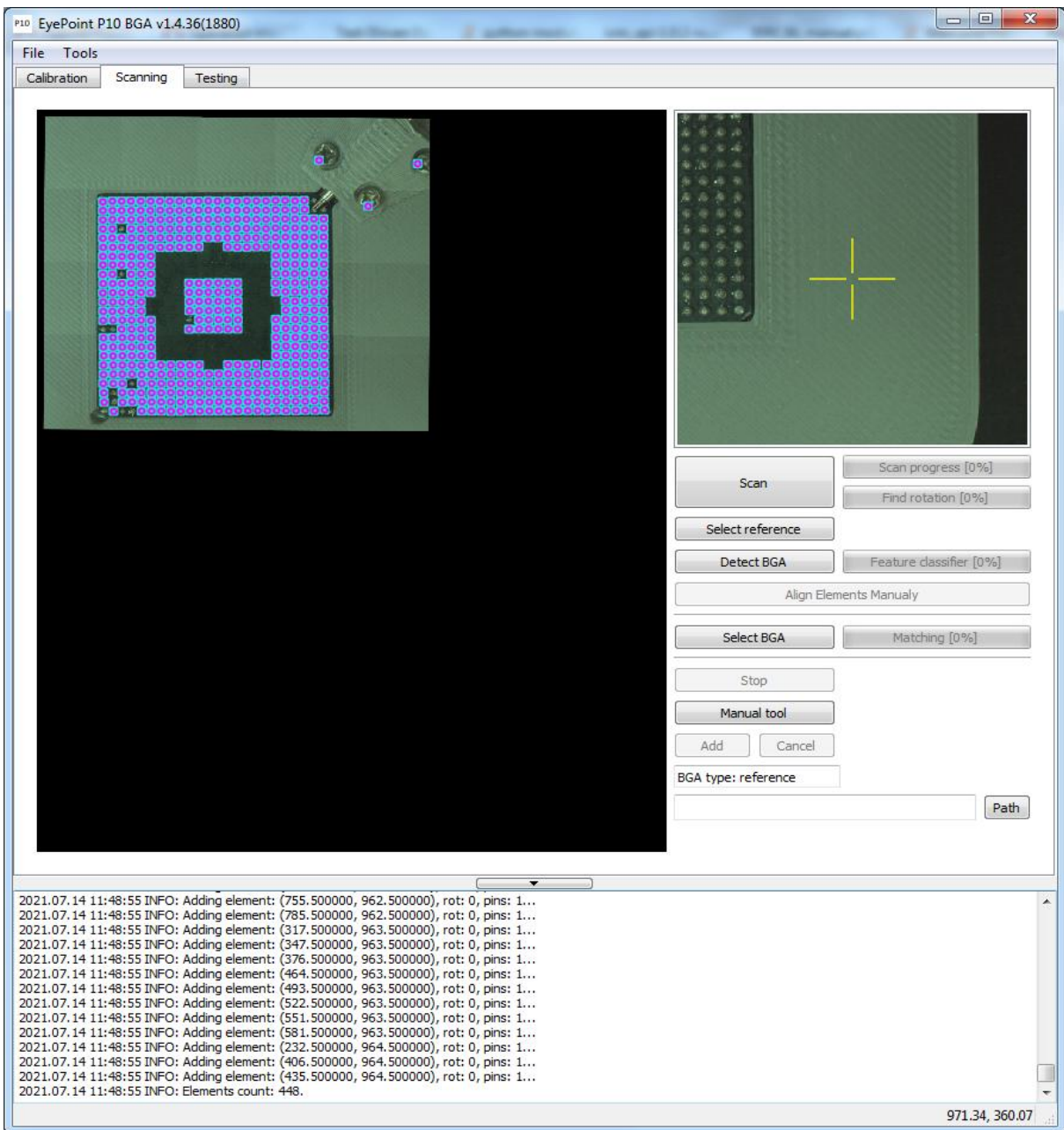

Image 17. The appearance of the "Scanning" tab for BGA elements.

11. Testing report

11.1. Report location

The test report is generated as **html** file, which allows to open it on any device.

- All reference reports of PCB boards are stored in the **sample** folder in the root of the program folder.

- All reference reports of BGA elements are stored in the **sample_bga** folder in the root of the program folder.

- All reference reports of PCB and BGA elements testing are stored in the **test** folder in the root of the program folder.

11.2. Structure of the report folder

The report folder contains the following files and folders:

- **Static** folder contains an image of the entire board with the test points, an image of each point, and the image of the IVC of each point

- image of the board itself in high resolution without test points

- the **elements.json** file with the coordinates of each test point and the parameters of the measured IVC of each point

- **full_img.html** - a file that opens with browser, where the board with all the tested points is displayed interactively. When you hover the mouse over any test point, its IVC is displayed in the upper-left corner of the screen. All the test points are displayed in the reference image, and the defective ones are displayed on the test board.

- **report_full.html** contains the complete testing report of the board, including all the points on the board with the corresponding IVC. This report is the only one for the reference. This report is the auxiliary one for the test board.

- **report.html** is the test board report file, which only displays the points with defective IVC that did not match the reference board.

- the **Logfile.log** - the file with the logs of the system working during the testing of the board.

11.3. Reference report example

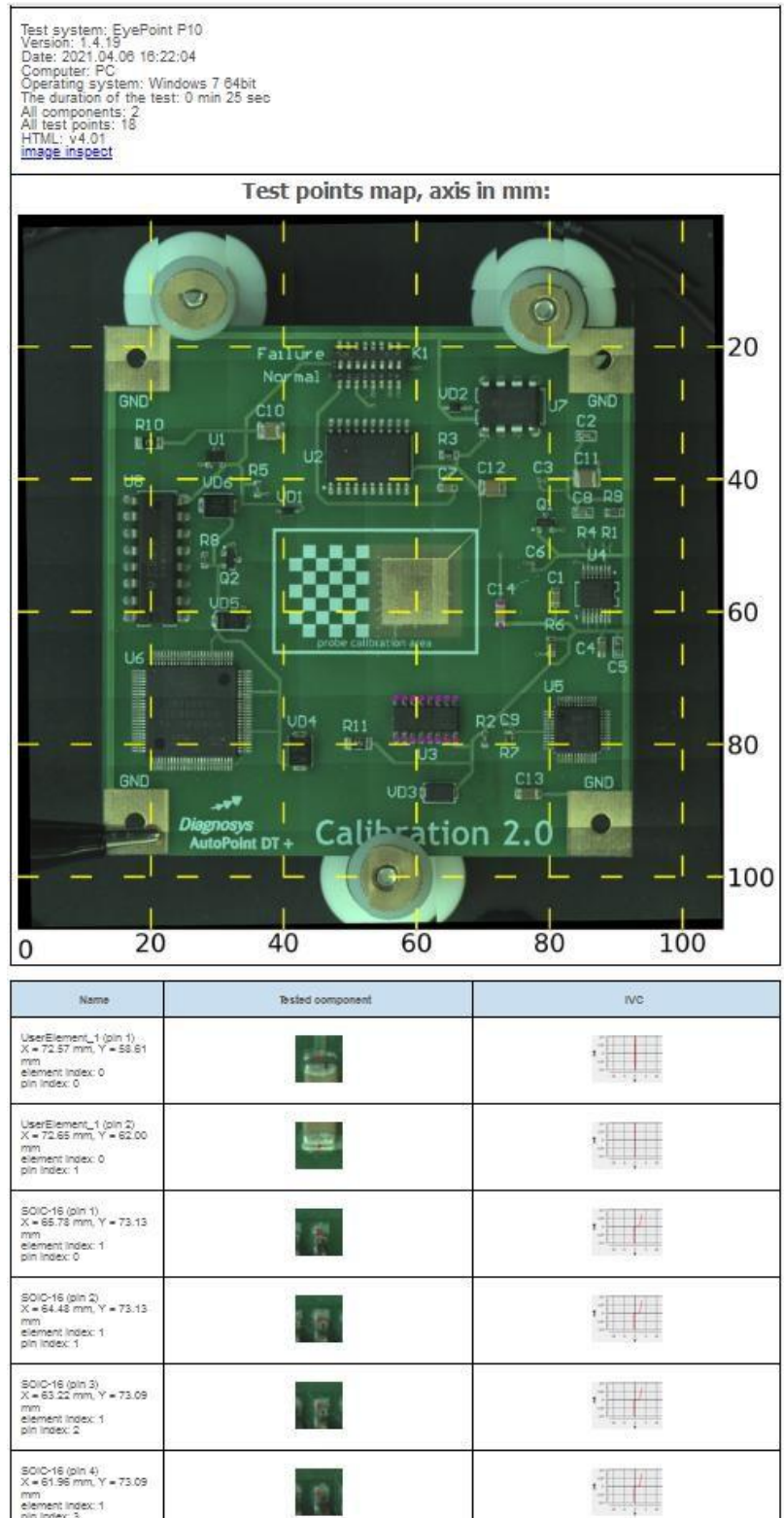Reference report example is shown in the Image 18

Image 18. Reference report example.

The following information is displayed at the top of the report:

- quantity of the elements

- quantity of the testing points on the board

- time spent on testing

- testing date

- name of the board

- additional information about the system.

Click on any of the test points in the image, and the page will automatically scroll to this point.

Hover the mouse over any image of an individual element in the report, and its location will be displayed on the board.

Click on the "image inspect" button, an enlarged photo of the board will open in a new window (tab) with all the test points of this board displayed. When you hover the mouse over any point its IVC is displayed in the upper-left corner of the screen.

11.4. Test board report example

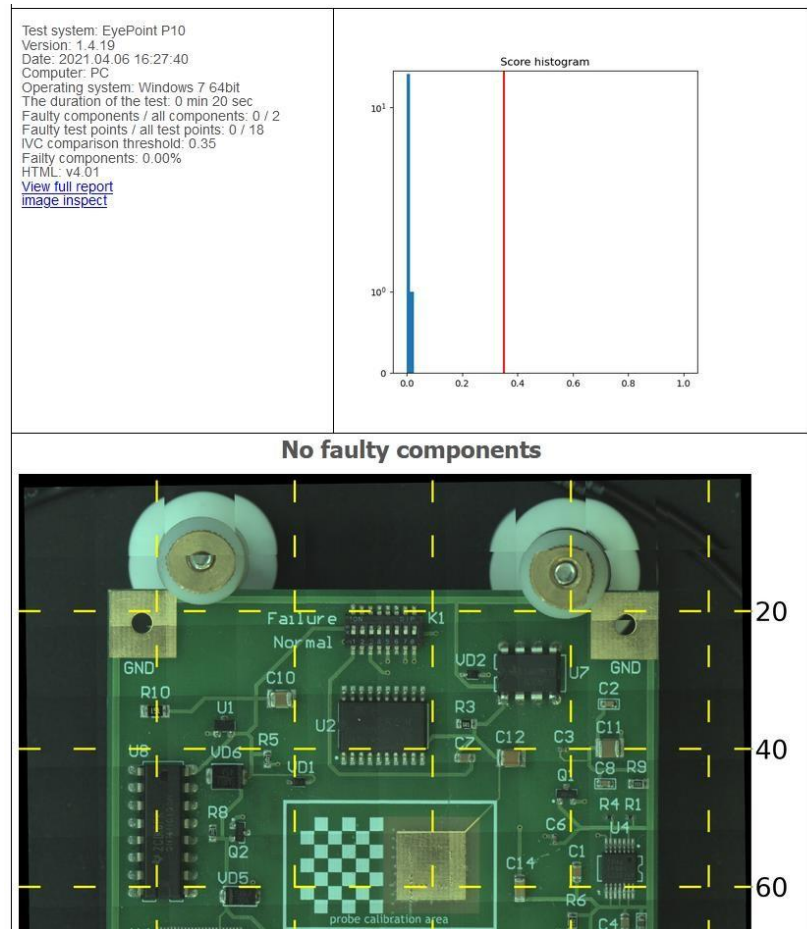The appearance of the test board report is shown in the Image 19.

Image 19. Test board report example.

The main window of the test board report only shows the points that did not match the reference.

The basic structure of the test board report is similar to the reference report except for some additional items:

- The "View full report" opens a full report of the entire test board in a new window (tab) which displays of all test points, both serviceable and defective.

- Score histogram, where the points coincided with the reference are on the left side of the red vertical line, and points that did not coincide are on the right side. The red vertical line itself represents the value specified in the "IVC comparison Threshold" parameter in the settings.

Click on the "image inspect" button, and the image of the board with only the mismatched points will be opened in a new window (tab).

12.   Switching off the system

Upon completion of the work:

1.   Click the "Exit" button in the "File" menu, or the close button in the upper-right corner of the program window.

2.   Turn off the power of the system.

3.   Turn off the controlling computer.

13. Useful information on working with the system

13.1. How to place points for testing components

It is very important to correctly place all the testing points correctly, when adding the elements to the reference board. The ability of the system to measure IVC of this point on the reference and the testing board depend on it.

Examples of the points placed correctly are given below.

When placing the testing points on the chip, the points should be placed after the chip leads, between the edge of the contact pad and the chip lead, if the footprint is big enough to do so. This allows to detect poorly soldered contacts.
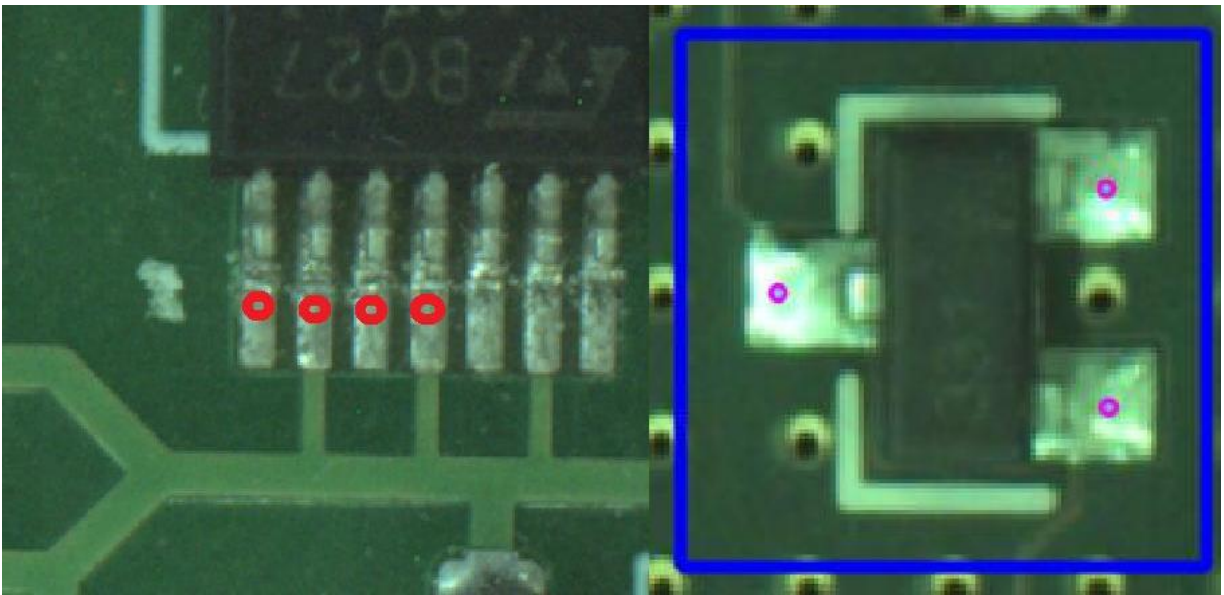

Image 20. Correct placement of the testing points on the chip.

When placing the testing points on passive elements, you can use the same method as when placing points on the chip. The points should be placed after the lead, between the edge of the contact pad and the lead. In extreme cases, when the length of the contact area of the element is equal to the length of the element, the point should be placed as close to the center of the contact of the element as possible.
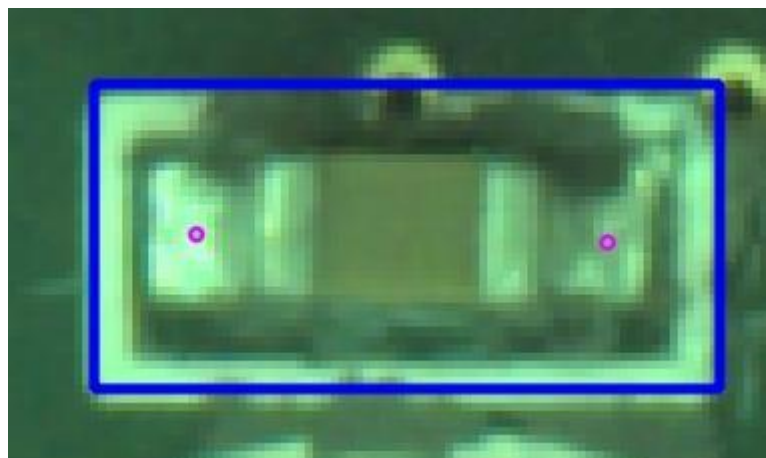

Image 21. Correct placement of the testing points on the passive element.

When placing the testing points on the no-leads package (QFN), the points should be placed as far from the package as possible, to prevent the probe from reaching the element's package.
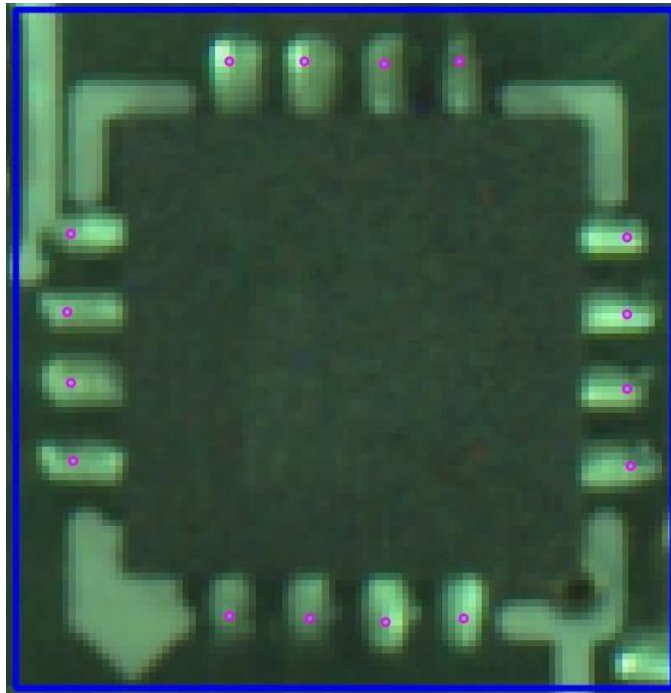
Image 22. Correct placement of the testing points on the no-leads package (QFN).

Note. This method does not give 100% guarantee of hitting in the lead of the component, as the contact pads for such chips can be very small, and the system can not hit them due to the probe radius and height of the component package.

13.2. How to add components to the reference board

The best way to add the elements to the reference board is to add each element individually using automatic, semi-automatic and manual modes. The advantages of this method:

- define the quantity of real elements added to the board that will be tested

- easy to edit the reference board and individual elements

- the ability to assign a name to each element. Disadvantages of this method:

- increases the time to create the reference

- increases the time needed to test the reference

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13.3. Connecting the "common" wire to the testing board

If the board is grounded in multiple areas, then they need be connected into one and then connected to the "common" wire with a "crocodile" clip in the ground connecting point.

13.4. Types of current–voltage characteristic (IVC) of different elements and their combinations

For the resistors

1. The resistor's IVC looks like an inclined line in the right to left direction.
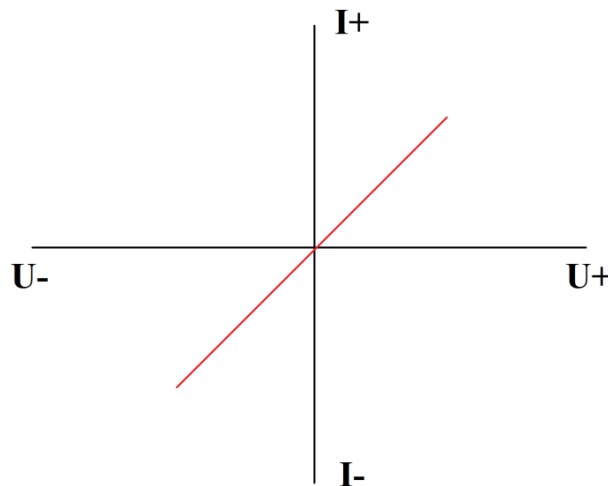

2. The value of resistance affects the curve incline, when parameters of the test signal are the same.
3. Increase of the current limits of the test signal leads to the same resistor's IVC line to become more horizontal, and decrease of the current limits makes the line more vertical.
4. If the current limits of the test signal are increased over 400 kHz the resistor's IVC line will turn into elongated ellipse due to the capacitive and inductive components on high frequencies.

For the capacitors:

1. The capacitor's IVC has the shape of an ellipse.
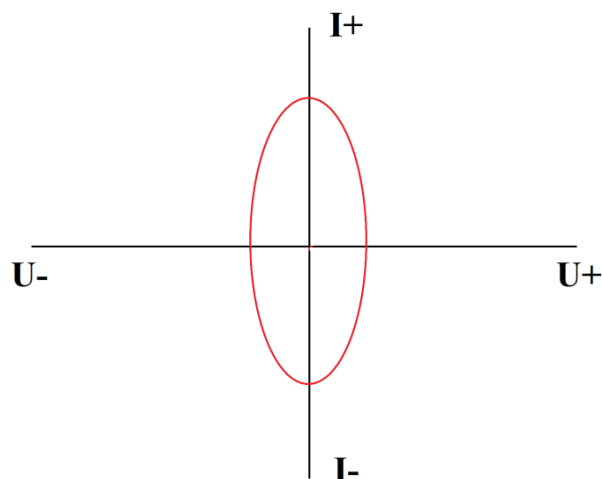
2. The capacitance affects the width and height of the ellipse, when parameters of the test signal are the same.

3. Also the capacitor has resistance, which depends on the test signal frequency. To measure the capacity, set the higher frequency of the test signal, if the capacity is small, and set lower frequency if the capacity is large. For example, to measure a capacity of 100uF, you need to set a frequency from 1 to 10 Hz, and for a capacity of 2pF, you need to set a frequency from 6 MHz or higher.

The calculating formula for the capacitor resistance is: $X=1/FC$, where X is the capacitor resistance, F is the frequency of the test signal, C is the capacitance.

4. If you see a short circuit or a break when measuring the capacitance, try to change the frequency of the test signal.

For inductance:

1. The inductance's IVC line looks similar to the resistor's IVC line, but directed oppositely, it also can appear as ellipse, depending on the frequency.

2. The size of the ellipse depends on the value of inductance, when parameters of the test signal are the same.

3. The size of the ellipse when the value is constant, depends on parameters of the test signal.

For semiconductor elements:

1. Semiconductor element's IVC (Zener diode)
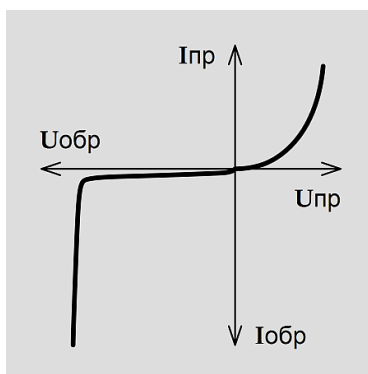
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Figure 23. Zener diode's IVC

2. Depending on the type of semiconductor element, the IVC graph can have either one or two arms. The position of the arms depends on the connecting polarity of the meter probes.

3. The distance between the arms, their height and the inflection point depend on the measured element parameters and the test signal parameters.
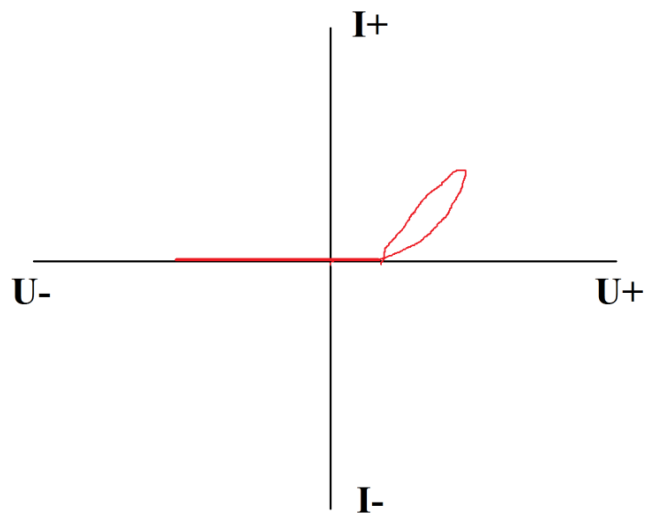
Connecting various elements with each other:

1. RC circuit's IVC looks like this:
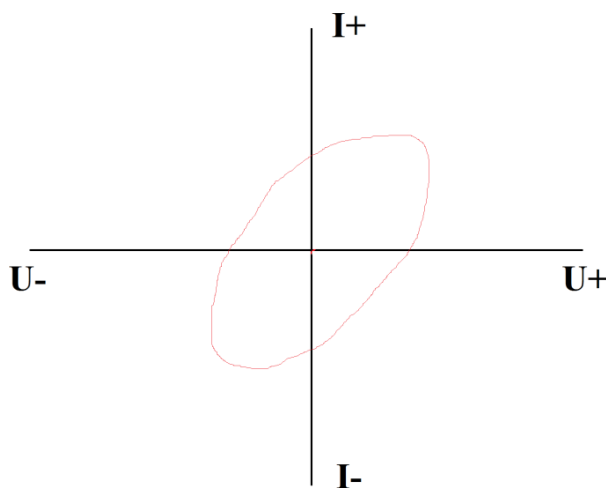
The ellipse incline depends on the value of resistance, and it's size depends on the capacitance.

2. The capacitor and the diode connection looks like this:

The width of the ellipse on the end of the IVC line depends on the capacitance, and the inflection point depends on the diode forward voltage (p-n junction)

3. The resistor and the diode connection looks like this:
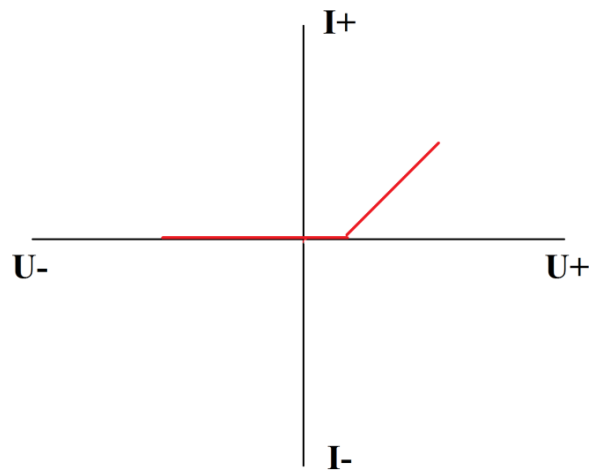
IVC line incline depends on value of resistance, and the inflection point depends on diode forward voltage (p-n junction)

4. When connecting a resistor, a capacitor and a diode, the IVC is similar to the one described in paragraph 2 of this subsection, but taking into account the value of the components of the chain.

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