

## LED's Color and Position Tester: How does it Work?

### General

The LED's color and position system were designed to detect LED colors and position as a configuration on PCB boards or indication bottoms on electronics. For example, testing indication lights on keyboards or panels in the manufacturing production line. The system includes an imager with optics and software applications. The software application can be an API (DLL file) integrated into other automated testers or as a standalone tester application.

The API or application only has four commands:

- Open/Close camera (can work with images instead of the camera)
- Learning a new configuration: For example, one configuration for one type of PCB and another configuration for a different PCB type. Each PCB type (or other LED configuration) needs a specific configuration file after learning.
- Test – assessing all LEDs that are currently operated and log results to a \*.csv log file (see more information below).

In Figure 1, one can see an example of a PCB board to be tested for LED's colors, and positions are assembled appropriately.

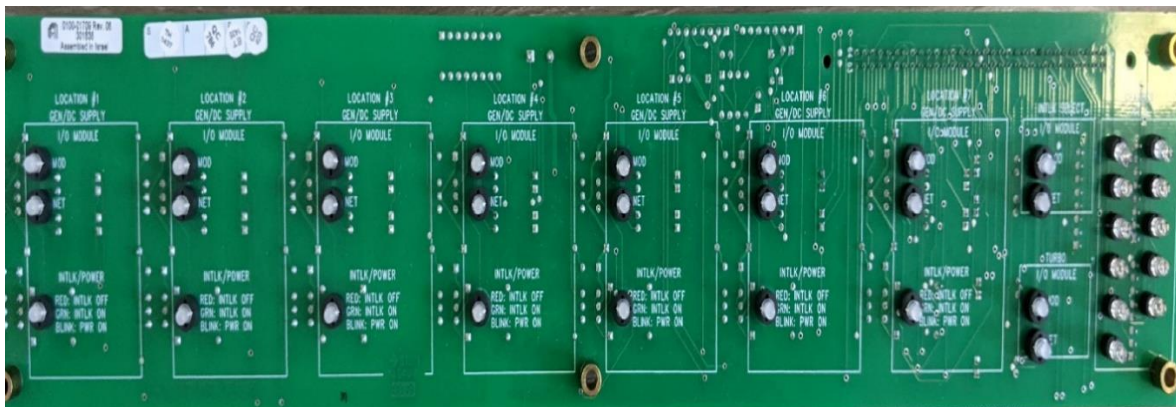


Figure 1: PCB board with 37 LED that used in these tests

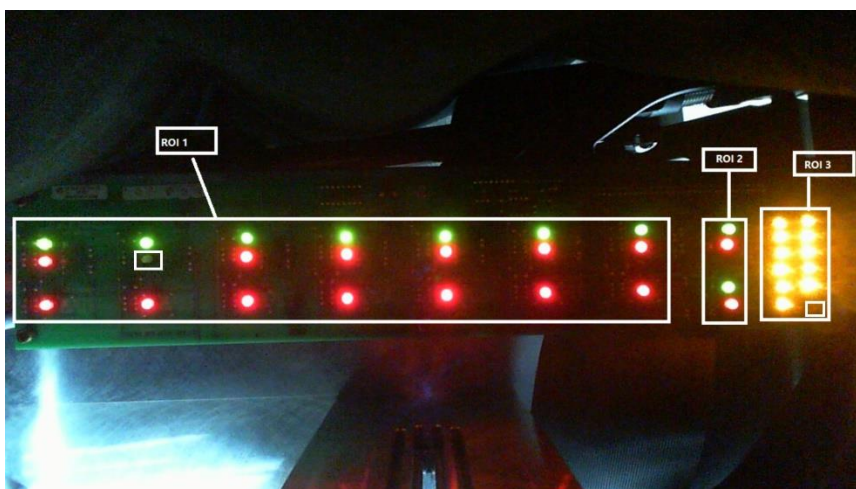


Figure 2: PCB board while all LEDs are enabled. Two LEDs are not operated in column 2, row 2, and column 10, row 7 line.

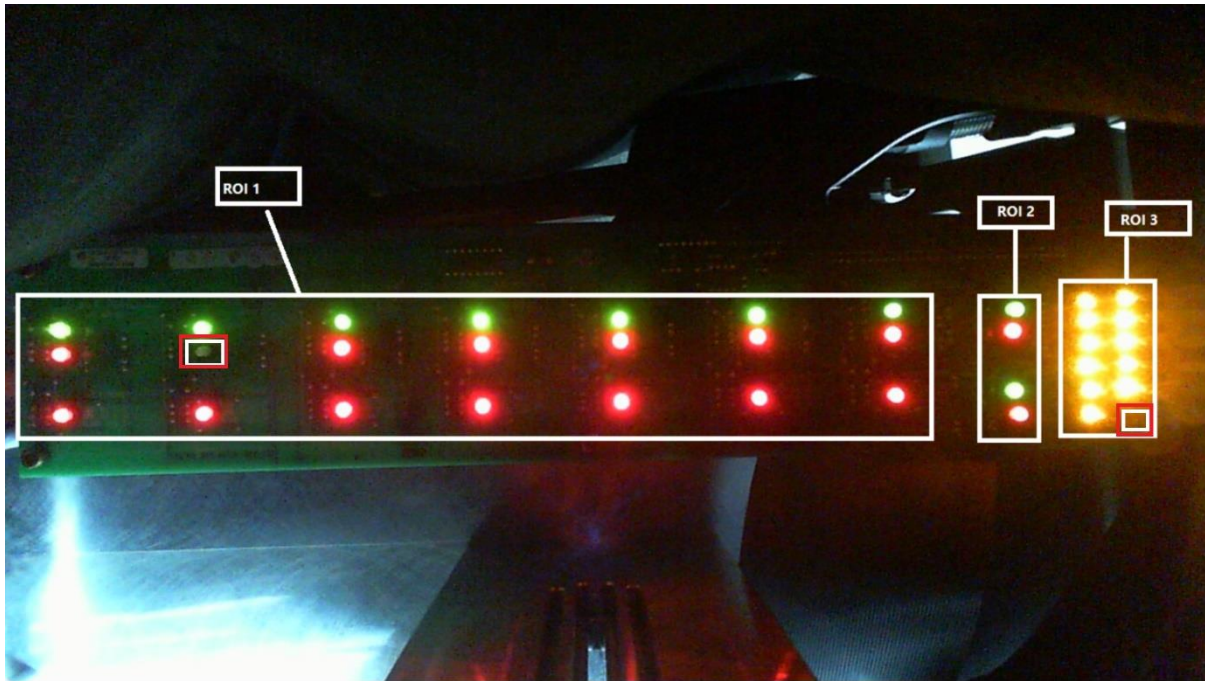


Figure 3: Two LEDs are not operated in purpose for this demo and are marked with white and red rectangles. The non-working LEDs are from column 2, row 2 and column 10, row 7

As seen in Figure 2, for convenience, LEDs were segmented into three ROIs: 1, 2, and 3.

After learning the software application, the LED position, and color, the application recognizes non-working LEDs, see Figure 3 in position 1.1 (column 2 and row 2)



Figure 4: Live view of LEDs operation mode as calculated in software application

In Figure 4, one can see how the application detects LEDs after learning. Each LED has:

1. Position address in the form of Column. Row such as 1.1, 1.2, etc.
2. Indication if the LED works appropriately (for example, LED location 1.1 is off)
3. Matching grade with respect to the reference board that was learned. The matching grade is based on spectrum and intensity analysis. Pass/Fail criteria are based on the matching grade.

The test command is executed without any GUI and provides Pass/Fail test results based on matching grade criteria defined by the user. For example, if matching grade criteria were set to 500, all LEDs that detect with matching grade above 500 are passed, and all other LEDs with matching criteria above 500 are failed.

The API with all commands is shown in Figure 5.

Test command can be run for a single ROI or all ROIs. For example, test results for ROI 1 are shown in Figure 6.

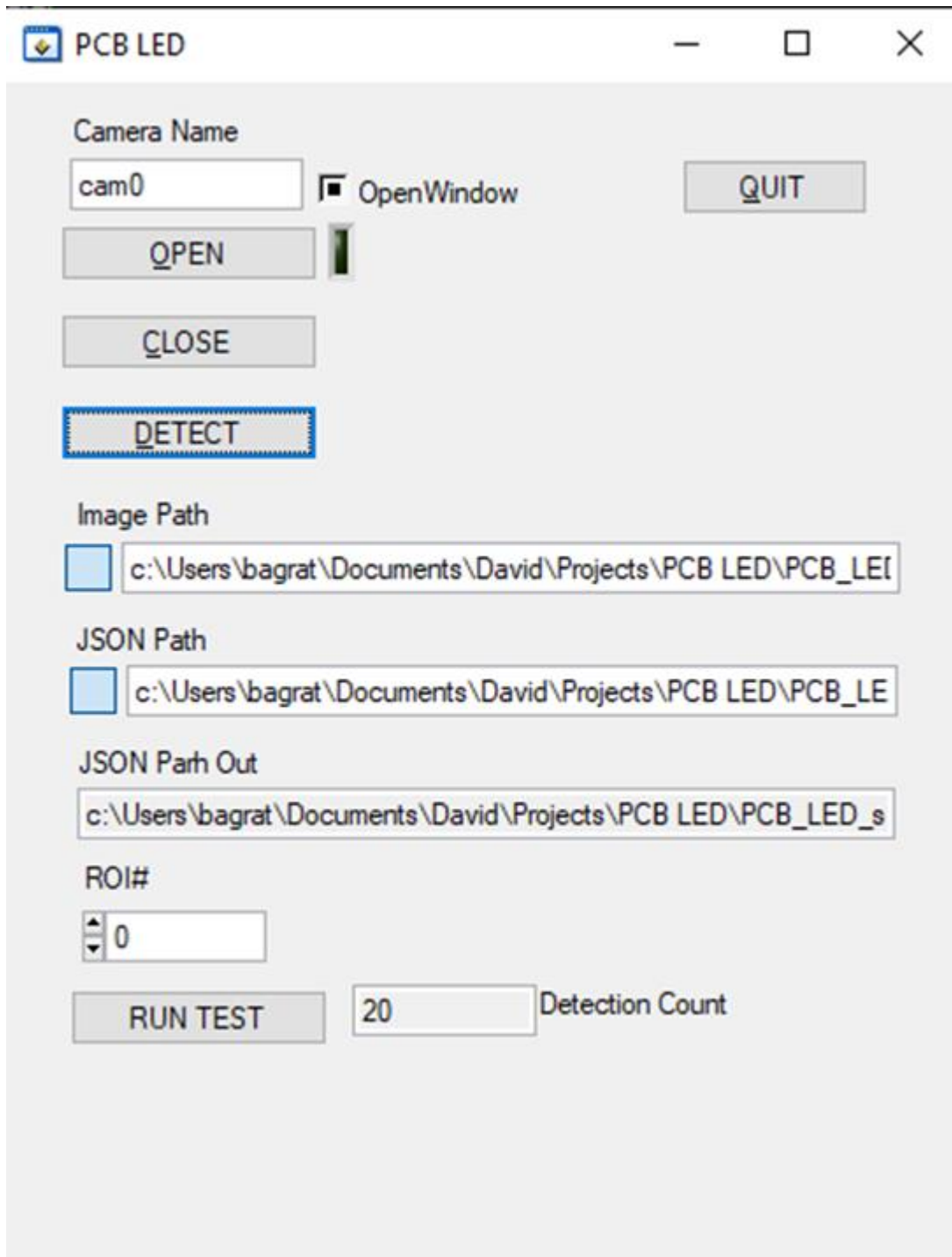
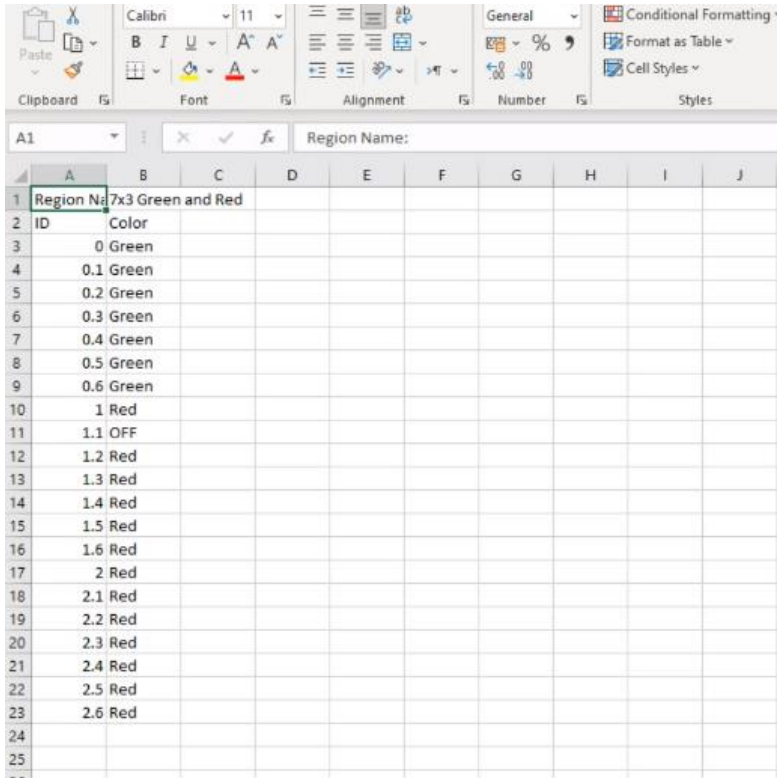


Figure 5: API example with Four commands - 1.) Open, 2.) Close, 3.) Detect-Learn, 4.) Learn. API examples are available in LabVIEW or CVI.



Region Name	ID	Color
7x3 Green and Red	0	Green
	0.1	Green
	0.2	Green
	0.3	Green
	0.4	Green
	0.5	Green
	0.6	Green
	1	Red
	1.1	OFF
	1.2	Red
	1.3	Red
	1.4	Red
	1.5	Red
	1.6	Red
	2	Red
	2.1	Red
	2.2	Red
	2.3	Red
	2.4	Red
	2.5	Red
	2.6	Red

```

TestResults.csv - Notepad
File Edit Format View Help
Region Name:,7x3 Green and Red
ID,Color
0.0,Green
0.1,Green
0.2,Green
0.3,Green
0.4,Green
0.5,Green
0.6,Green
1.0,Red
1.1,OFF
1.2,Red
1.3,Red
1.4,Red
1.5,Red
1.6,Red
2.0,Red
2.1,Red
2.2,Red
2.3,Red
2.4,Red
2.5,Red
2.6,Red
    
```

Figure 6: Test results in CSV file for ROI

The system can save time and money and increase quality assurance in manufacturing for manufacturing managers, testing managers and quality managers in the medical world, sensors manufacturers, electronics manufacturers, assembly factories, and more.