RIFTEK
Sensors & Instruments

TUBE SHEET HOLE ID INSPECTION SYSTEM

RF013 Series

User's manual

www.riftek.com
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Contents

1. Safety precautions

- Do not use the system in locations close to powerful light sources.

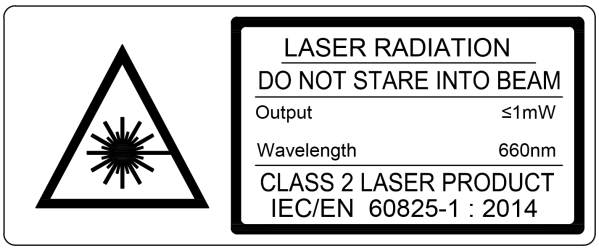
2. CE compliance

The system has been developed for use in industry and meets the requirements of the following Directives:

- EU directive 2014/30/EU. Electromagnetic compatibility (EMC).
- EU directive 2011/65/EU, “RoHS“ category 9.

3. Laser safety

The sensors make use of a c.w. 660 nm wavelength semiconductor laser. The maximum output power is 1 mW. The sensors belong to the 2 laser safety class according to IEC/EN 60825-1:2014. The following warning label is placed on the housing:



The following safety measures should be taken while operating the system:

- Do not target the laser beam at humans.
- Do not disassemble the laser sensor.
- Avoid staring into the laser beam.

4. General information

The system is designed for automated control of tube sheet hole diameters.

5. Basic technical data

Parameter	Value
ID measuring range, mm	10...45 (two probes with measuring ranges 10...20 and 16...45)
ID measurement error, mm	probe 10...20: ±0.004 probe 16...45: ±0.008
Hole depth range, mm	0...120 (specified when ordering)
Measurement time for one hole, no more, s	1.5
Measuring cycle (including transition between holes), no more, s	5
Nominal probe rotation speed, r/s	10
Light source	red semiconductor laser, 660 nm wavelength
Laser output power, mW	<1
Laser safety class	2 (IEC60825-1)
Interface	Wi-Fi
Probe power supply	NCR18650GA batteries, 3.7V
Probe weight, kg	0.6
Tablet weight, kg	1.5
Total weight, kg	15

Parameter	Value
Permissible instability of machine spindle speed	≤10%
Continuous operation time between battery replacements	at least 4 hours

6. Main features of the software

The software is intended for:

- Parameterization and control of the hole measurement process.
- System calibration.
- Sorting and generating a report based on data obtained during the measurement process.
- Viewing the measurement results.
- Saving, reading and exporting data.

7. Structure and operating principle

The operation of the system is based on the principle of scanning the inner surface of holes with a rotating laser triangulation sensor.

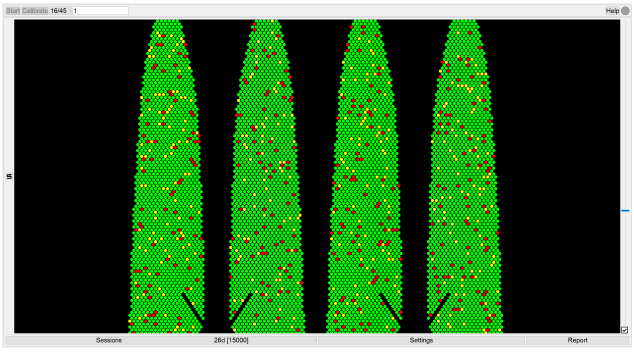
Main components of the system:

- Laser triangulation probe(s) RF609-Wi-Fi Series
https://riftek.com/products/laser_probes/?change_lang=en
- Industrial tablet with software

Hole inspection is performed as follows:

- The laser triangulation probe is installed in the spindle of the CNC machine, see the picture below.
- The CAD file of the controlled tube sheet is uploaded into the program on the tablet.
- The operator enters the spindle rotation speed, the probe feed rate and the sequence of measuring the tube sheet holes into the machine program and the system program.
- The tablet is switched to data reception mode, and the scanning program is launched on the machine.

During the measurement process, the machine sequentially, in accordance with the selected algorithm, inserts a rotating laser probe into the controlled hole. The laser probe transmits measurement data to the tablet, and the tablet software calculates the geometric parameters of each hole and displays them in a graphic color code. After completing the measurements, the operator generates a report.



8. Complete set to be supplied

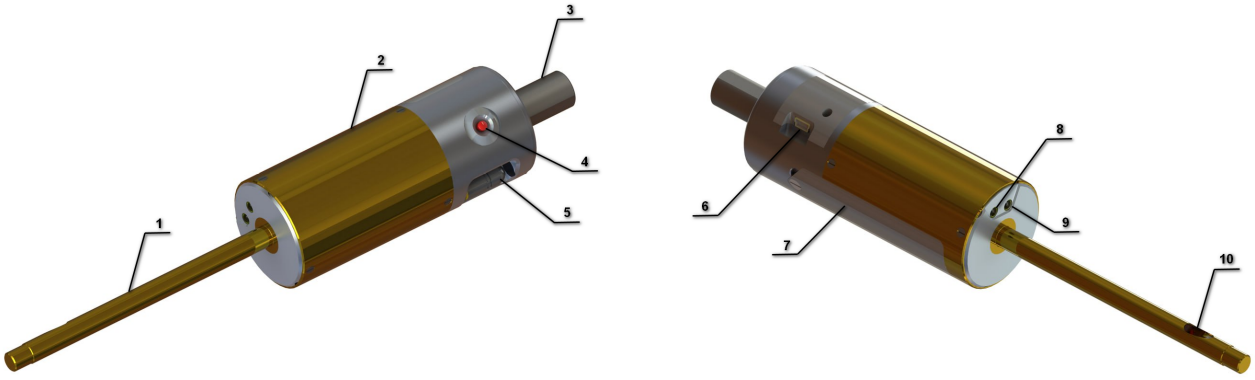
The standard kit is shown below. Contents can be changed upon request.

#	Name	Quantity
1	System in a protective case	1
2	Laser triangulation probe RF609-10/20	1
3	Laser triangulation probe RF609-16/45	1
4	Calibration ring, inner diameter 14 mm	1
5	Calibration ring, inner diameter 32 mm	1
6	Industrial tablet with built-in Wi-Fi modules	1
7	Probe simulator RF609-16/45	1
8	Probe simulator RF609-10/20	1
9	Chargers	1
10	Batteries NCR18650GA	2

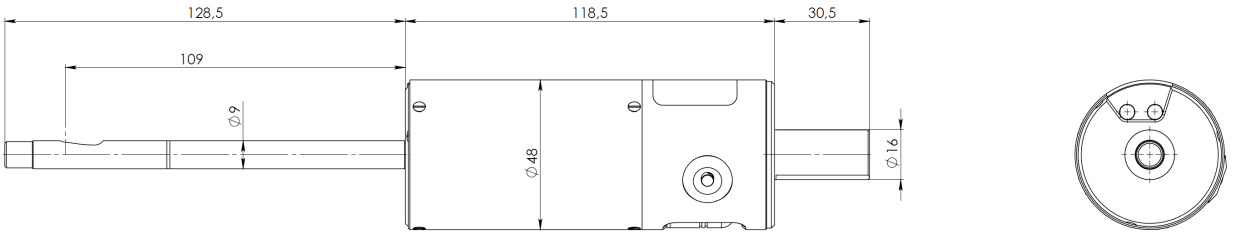
8.1. Laser triangulation probe

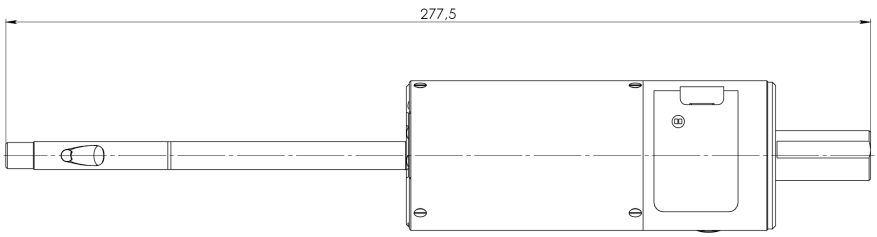
The system can use one or more laser triangulation probes RF609-Wi-Fi. The number of sensors and ranges are determined when ordering.

The main components of the laser triangulation sensor and overall dimensions are shown in the figures below:

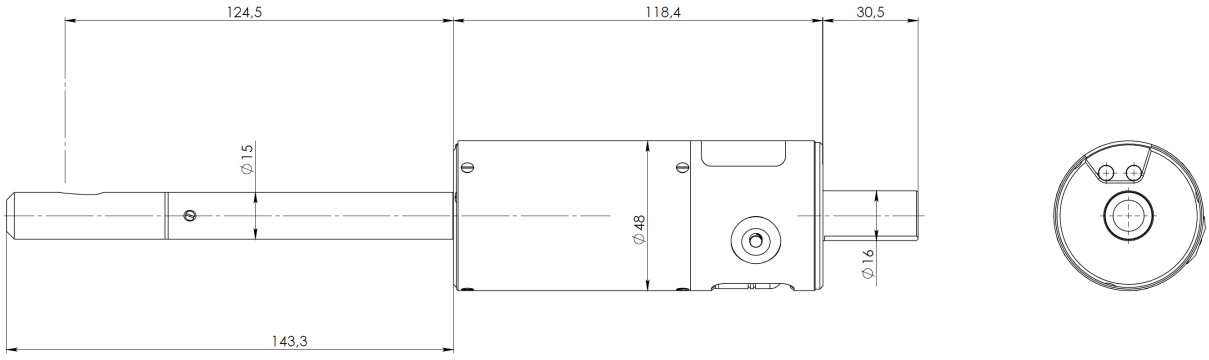


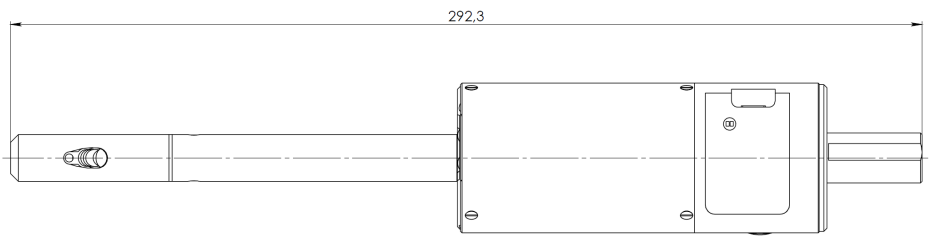
1 - Probe
2 - Housing
3 - Shank
4 - Power button
5 - Wi-Fi antenna
6 - Charger connector
7 - Battery compartment cover
8 - Power indicator
9 - Tablet communication indicator
10 - Optical part of the laser sensor





RF609-10/20. Overall dimensions



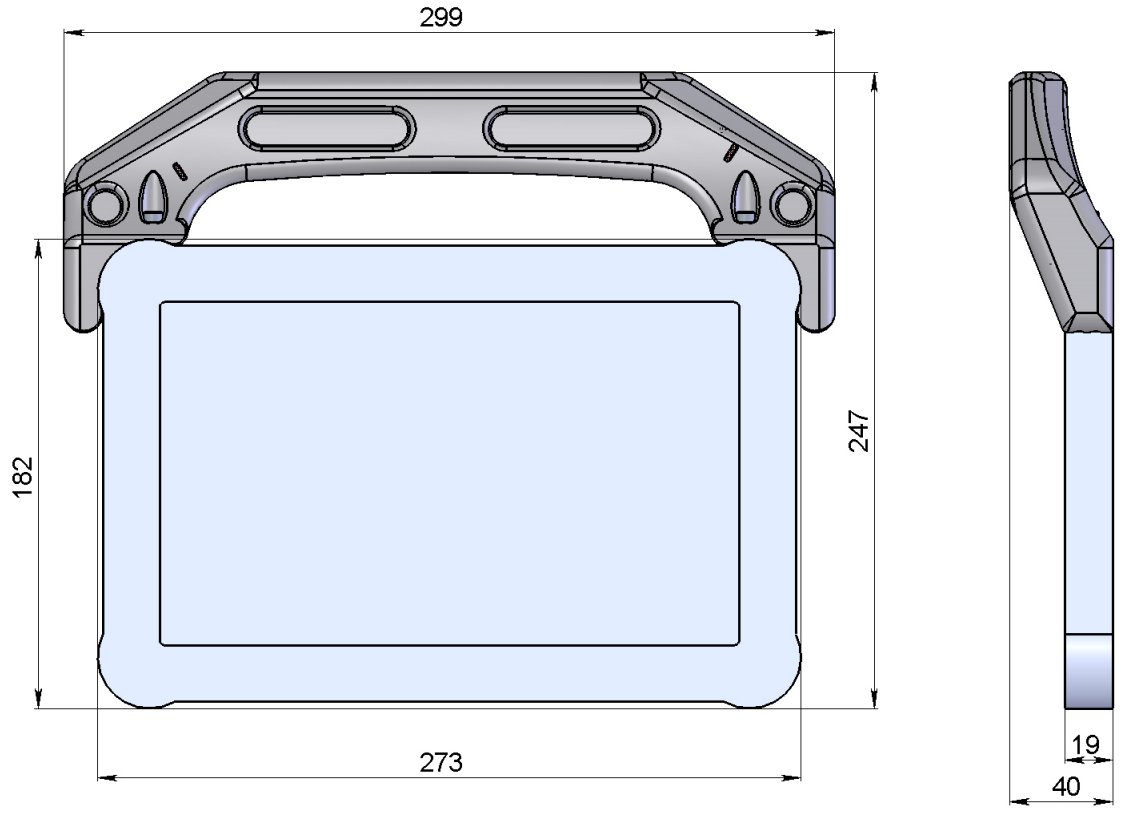


RF609-16/45. Overall dimensions

8.2. Tablet

Main characteristics of the industrial tablet:

Component	Parameter	Value
Architecture	CPU	Intel cherry trail Z8350, 1.44Ghz-1.92GHz
	OS	Windows 10 pro
	RAM/ROM	4GB+64GB
Display	Size	10.1"
	Resolution	1920x1200
Touch panel	Touch type	Capacitive
Interfaces	Type-A	USB2.0 x1
	Type-A	USB.0 x1
	MicroUSB	x1
	RJ45 Ethernet	10/100/1000M x1
	DB9 RS232	9-pin serial port x1
	DC power interface	DC 12V 2A x1
Protection	Degree of protection	Waterproof IP65, but in fact is IP67 design. Drop 1.2m, 6 sides
	Certification standards	Military 810G. EU CE, US FCC
	Operating temperature	-20°C...60°C
Built-in battery	Battery type	Built-in removable Li-ion Polymer Battery
	Rated capacity	10500 mAh
Dimensions	see the figure below	



9. Example of item designation when ordering

RF013-IDmin/IDmax-L

Symbol	Description
IDmin/IDmax	Measuring range, mm.
L	Hole depth range, mm.

NOTE. The diameter measurement error depends on the operating range of the probe and is specified separately.

10. Operating procedure

10.1. Data preparation

Before starting work, it is necessary to prepare a drawing of the tube sheet in accordance with these instructions:

1. The tube sheet drawing must be in DWG or DXF format.
2. Make sure that the controlled holes in the drawing file are represented as circles (CIRCLE type).
3. Copy the drawing file to the hard drive of the tablet. To do this, use a USB drive and a standard file manager.

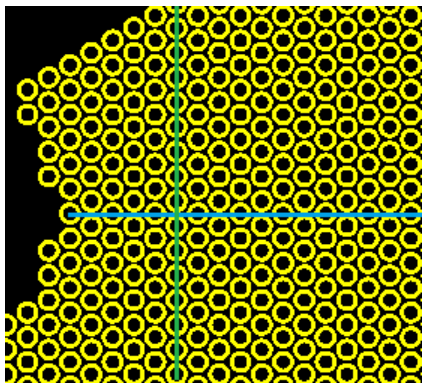
10.2. Machine preparation

To prepare the machine for operation, follow the steps:

1. Select the probe that will be used to inspect the holes. The RF609-10/20 probe is designed to inspect holes with a diameter of 10 to 16 mm. The RF609-15/45 probe is designed to inspect holes with a diameter of 20 to 45 mm. To inspect holes with a diameter of 16 to 20 mm, you can use both RF609-10/20 and RF609-15/45.
2. Bind the position of the calibration ring to the machine coordinate system. When using the RF609-10/20 sensor, the calibration ring with a diameter of 14 mm should be used. When using the RF609-16/45 sensor, it is necessary to use the calibration ring with a diameter of 32 mm.
3. Select how to measure the holes by choosing one of the following options:
   a.  - From right to left, starting from the bottom row.
   b.  - From left to right, starting from the bottom row.
   c.  - From right to left, starting from the top row.
   d.  - From left to right, starting from the top row.
   e.  - From bottom to top, starting from the left column.
   f.  - From top to bottom, starting from the left column.
   g.  - From bottom to top, starting from the right column.

h.  - From top to bottom, starting from the right column.

The sides (right, left, top, bottom) are determined by the drawing of the tube sheet. A row is a sequence of holes whose centers are located on the same horizontal line. A column is a sequence of holes whose centers are located on the same vertical line. In the figure below, the blue line indicates holes belonging to one row, and the green line indicates holes belonging to one column.

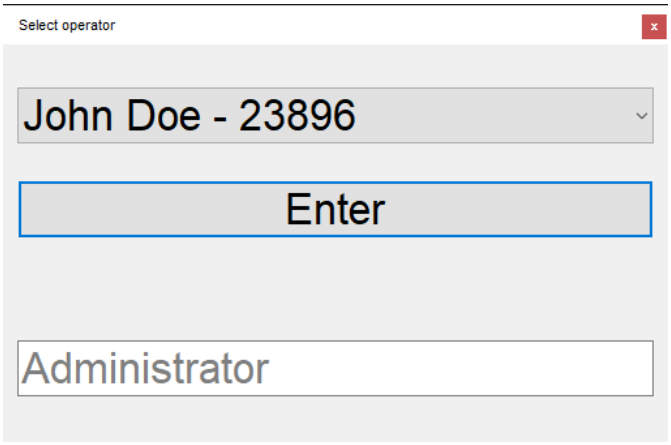


4. Specify the rotation speed of the machine and the feed rate of the sensor. These parameters are specified during the system setup process.
5. Write two programs for the machine:
   a. Calibration program. The machine must insert the rotating sensor into the calibration ring, push it through at the specified feed rate, and then pull it out.
   b. Measurement program. For each hole it is necessary to:
      i. move the rotating sensor to the hole,
      ii. insert the sensor into the hole at the specified feed rate,
      iii. pull the sensor out of the hole.
6. Install the probe simulator corresponding to the sensor used on the machine and debug the machine programs, checking the measurement process for compliance with the selected algorithm.

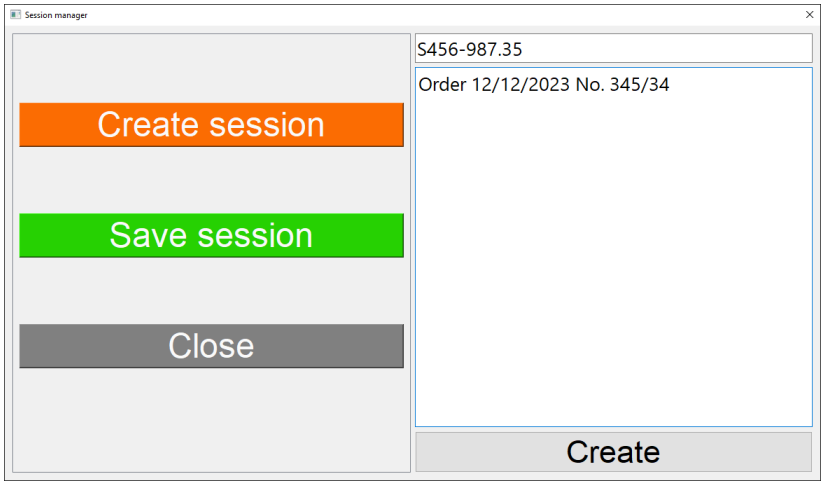
10.3. Measurement

Follow these steps to make measurements:

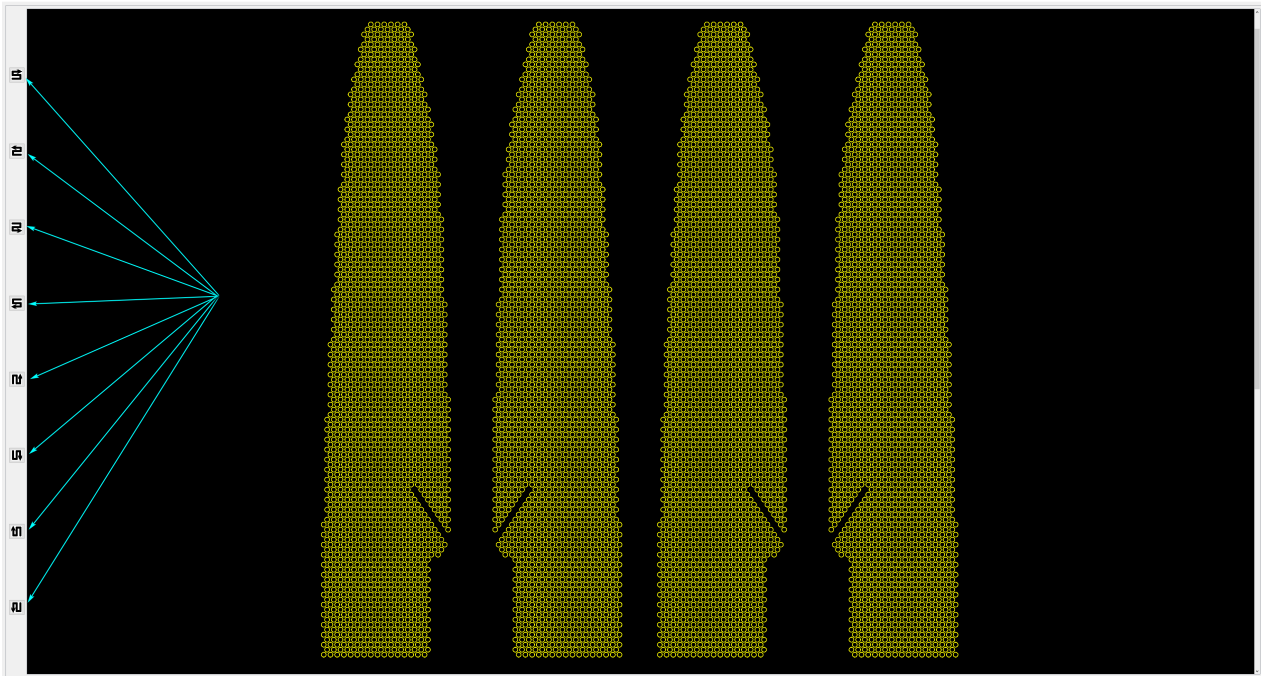
1. Charge the sensor battery or install a new one.
2. Charge the tablet battery or connect the tablet to AC power.
3. Install the probe on the machine.
4. Prepare the machine for calibration and measurement programs.
5. Turn on the probe.
6. Turn on the tablet and wait for the software to load.
7. Select your name from the drop-down list or enter the administrator password:



8. Create a new measurement session or select the existing one from the list:

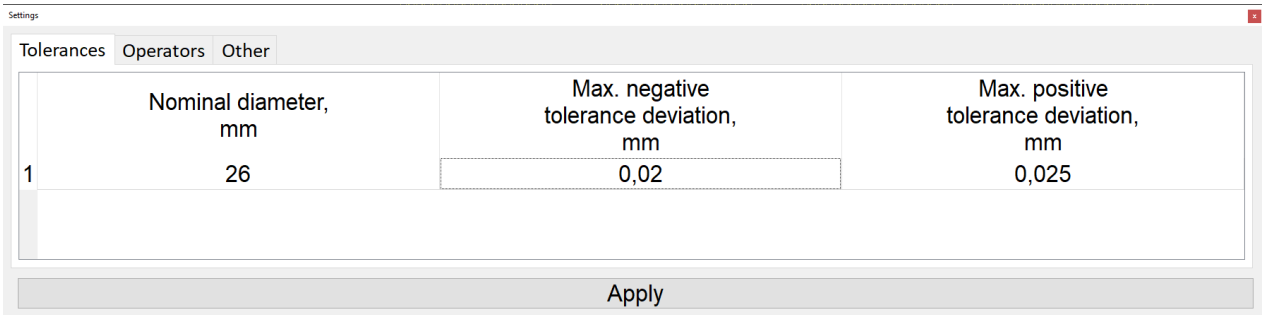


9. Select the drawing file.
10. In the window with the image of the tube sheet, select the measurement algorithm.



11. Select the probe and specify the number of the hole from which the measurement begins.

12. Specify the tolerances if necessary. To do this, click the **Settings** button and set the nominal diameter and tolerances.

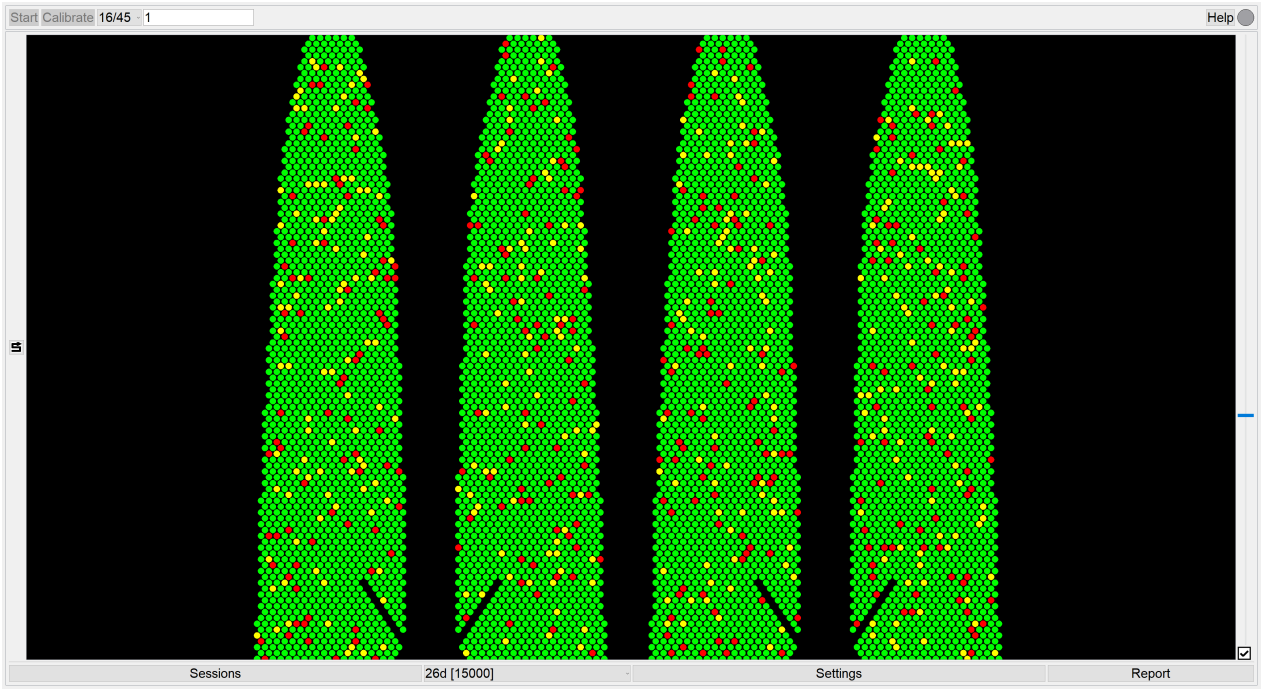


13. Before starting measurements, calibrate the probe:
    a. Tap the **Calibrate** button on the tablet screen. The program will enter calibration mode and the **Stop** button will appear instead of the **Calibrate** button.
    b. Run the calibration program on the machine and wait for it to complete.
    c. Tap the **Stop** button on the tablet screen.
    d. After completing the calculations, the tablet program unlocks the **Start** button.

14. Do the following:
    a. Tap the **Start** button on the tablet screen.
    b. Start the scanning program on the machine.
    c. During scanning, the program displays the measurement results in a color code in real time, and the round indicator in the upper right corner of the window turns green when the hole wall enters the field of view of the sensor.
    d. Wait for the machine program to complete.
    e. Tap the **Stop** button on the tablet screen.

15. The measurement results are displayed on the tablet screen in a color code:
    a. Green - Hole diameter is within tolerances.
    b. Yellow - Hole diameter is less than nominal (out of tolerances).

c. Red - Hole diameter is greater than nominal (out of tolerances).



16. To generate a report, click the **Report** button and save the report. The report is saved in Microsoft XLSX format.
17. If you need to continue measuring or measure the holes again, follow steps 1-16.

11. Technical support

Technical assistance related to incorrect operation of the system and problems with settings is provided free of charge. Requests for technical assistance should be addressed at support@riftek.com, or by phone +375-17-3573657.

12. Warranty policy

Warranty assurance for the system – 24 months from the date of delivery.

13. Revisions

Date	Revision	Description
10.03.2024	1.0.0	Starting document.

14. Distributors

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