MULTISENSOR INNER DIAMETER MEASUREMENT SYSTEM

RF040-100/150-Wi-Fi Series

User's manual

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Multisensor Inner Diameter Measurement System. RF040-100/150-Wi-Fi Series

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1. **Safety precautions**
   - Use supply voltage and interfaces indicated in the system specification.
   - In connection/disconnection of cables, the system power must be switched off.
   - 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).

3. **Laser safety**
   The sensors of the system make use of an c.w. 660 nm wavelength semiconductor lasers. Maximum output power is 1 mW. The system belongs to the 2 laser safety class according to IEC/EN 60825-1:2014. The following warning label is placed on the system body:

   ![Laser Safety Warning Label]

   The following safety measures should be taken while operating the system:
   - Do not target the laser beam to humans.
   - Avoid staring into the laser beam.
   - Do not disassemble the system.

4. **General information**
   The system is designed for non-contact measurement of the inner diameter of pipes. The system is intended to be used in production as a quality control tool.
5. **Basic technical data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter measurement range, mm</td>
<td>100...150</td>
</tr>
<tr>
<td>Measurement error, mm</td>
<td>±0.05</td>
</tr>
<tr>
<td>Number of measurements per second</td>
<td>500</td>
</tr>
<tr>
<td>Light source</td>
<td>red semiconductor laser, 660 nm wavelength</td>
</tr>
<tr>
<td>Output power, mW</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Laser safety class</td>
<td>2 (IEC60825-1)</td>
</tr>
<tr>
<td>Interface</td>
<td>Wi-Fi, USB</td>
</tr>
<tr>
<td>Power supply, V</td>
<td>3.7 V, Li-ion battery, 5400 mAh</td>
</tr>
<tr>
<td>Continuous operation time, hours</td>
<td>4</td>
</tr>
<tr>
<td>Environmental resistance</td>
<td></td>
</tr>
<tr>
<td>Enclosure rating</td>
<td>IP67</td>
</tr>
<tr>
<td>Vibration</td>
<td>20 g / 10...1000 Hz, 6 hours for each of XYZ axes</td>
</tr>
<tr>
<td>Shock</td>
<td>30 g / 6 ms</td>
</tr>
<tr>
<td>Permissible ambient light, lx</td>
<td>30000</td>
</tr>
<tr>
<td>Relative humidity, %</td>
<td>5-95 (no condensation)</td>
</tr>
<tr>
<td>Operating ambient temperature, °C</td>
<td>0...+45</td>
</tr>
<tr>
<td>Storage temperature, °C</td>
<td>-20...+70</td>
</tr>
<tr>
<td>Housing material</td>
<td>aluminum</td>
</tr>
<tr>
<td>Weight (without cable), gram</td>
<td>1500</td>
</tr>
</tbody>
</table>

**NOTE.** Technical characteristics of the system can be changed for a specific task.

6. **Example of item designation when ordering**

RF040-Dmin/Dmax-Wi-Fi

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dmin</td>
<td>Minimum diameter, mm.</td>
</tr>
<tr>
<td>Dmax</td>
<td>Maximum diameter, mm.</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>Wi-Fi - interface, battery powered.</td>
</tr>
</tbody>
</table>

**Example:** RF040-100/150-Wi-Fi – Multisensor Inner Diameter Measurement System RF040, measurement range - 100...150 mm, battery powered, Wi-Fi - interface.

7. **Structure and operating principle**

The operation of the system is based on measuring the coordinates of the inner surface of the hole by point laser triangulation sensors.

The system contains 6 point laser triangulation sensors located around the circumference of the measuring head housing (see Figure 1).

![Figure 1. The system with six laser sensors](image)
The system operates as follows. The measuring head is placed inside the hole and sequentially moves to the required control positions by a special movement module or robot. Laser sensors measure the distance to the inner surface. The software calculates the inner diameter.

Overall and mounting dimensions, as well as the main components of the system are shown in Figure 2.

![Figure 2](image)

**Figure 2. Overall and mounting dimensions**

Designations: 1 - power button; 2 - interface/charger connector; 3 - connector cover; 4 - Wi-Fi antenna; 5 - conical landing for installing the system into equipment.

8. **Complete set to be supplied**

The system comes in the special protective case that eliminates the possibility of damage to the system during transportation.
Figure 3 shows the main components of the system:

Figure 3. The main components of the system
Designations: 1 - laser head; 2 - calibration ring; 3 - Wi-Fi module; 4 - data cable; 5 - charger.

9. Overall demands for mounting
The system is positioned so that the object under control has to be placed within the working range of the system. The axis of the system should be parallel to the axis of the hole.

10. Indended use

10.1. Preparation for use
The preparation involves the following steps:
- Visual inspection.
- Installation and connection.
- Calibration.

10.1.1. Visual inspection
- Check the system for completeness and absence of damage.
- Check the cable.
- Check the condition of output windows and, if necessary, cleanse them with a soft lint-free cloth.
10.1.2. **Installation and connection**

- Remove cover 3 from connector 2 (see Figure 2) and connect the charger to the laser module.
- Charge the laser module for 6 hours.
- Connect the Wi-Fi module to the PC via the USB port of the computer.
- Install the laser module on a movement system or a robot (NOTE: as an option, the system can be fixed and the objects to be measured are placed in the control area by the robot).
- Press the power button.
- After 5 seconds, the connection between the laser module and the Wi-Fi module must be established. Connection indicator - red LED on Wi-Fi module. The system is ready to operate.

10.1.3. **Calibration**

Calibrate the system as described in par. 11.4.1. The system must be calibrated only once. There is no need to repeat the calibration procedure.

10.2. **Operating the system**

The measurement process is fully automated and the work with the system is reduced to the work with the software.

11. **Software**

11.1. **General information**

The software is intended for:
- Testing and demonstration of the system.
- Setting parameters.
- Calibration.
- Measurement.

The software includes:
- SDK library.
- RF040 Test Program.

11.2. **System requirements**

- Operating system Windows 7 and later.
- Microsoft Visual C++ Runtime Redistributable for Windows 64-bit. Shipped with the package (you need to run vcredist_x64.exe).

11.3. **SDK library**

**SDK contents:**

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rf040.dll</td>
<td>Dynamic-link library.</td>
</tr>
<tr>
<td>rf040.h</td>
<td>C header file. Refer to this file to understand the SDK functions. There is the detailed description for each of them.</td>
</tr>
<tr>
<td>rf040.lib</td>
<td>LIB file to link DLL to the project.</td>
</tr>
</tbody>
</table>
SDK usage scenario:

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Call <code>connect()</code> to connect to the system.</td>
</tr>
<tr>
<td>2</td>
<td>Call <code>switchSensor(true)</code> to switch on the system.</td>
</tr>
<tr>
<td>3</td>
<td>Call <code>calibrate()</code> to run the calibration, or <code>getCalibratedMeasures()</code> to get calibration data.</td>
</tr>
<tr>
<td>4</td>
<td>Call <code>getMeasures(result_array)</code> to run the measurement process.</td>
</tr>
<tr>
<td>5</td>
<td>Call <code>switchSensor(off)</code> to switch off the system - optional.</td>
</tr>
<tr>
<td>6</td>
<td>Call <code>disconnect()</code> to disconnect from the system - optional, called from destructor.</td>
</tr>
</tbody>
</table>

11.4. RF040 Test Program

After starting the program, the following window appears:

```
Enter port name: com1
Connecting to com1
Ok
What to do?
[1] Calibrate
[0] Exit
Enter option (0-2):
```

Type "COM1" in the **Enter port name** line. If the connection is successful, select the operation mode by entering "1" (calibration) or "2" (measurement) or "0" (exit the program).

11.4.1. Calibration

It is necessary to calibrate the system before starting the measurement process. The system must be calibrated only once. There is no need to repeat the calibration procedure.

The calibration must be done using the special calibration ring supplied with the system. The diameter of the calibration ring is set programmatically by parameter "param D0".

When the message "Place ring #0 and press enter" appears, place the laser module inside the calibration ring and press the **Enter** key to start the calibration process.

Calibration is performed in 10 positions. Thus, it is necessary to change the position of the calibration ring every time before pressing the **Enter** key.
11.4.2. Measurement

When the system is calibrated, you can start the measurement process. To start the measurement process, press the Enter key. The program will display the calculated values:

![Measurement values](image)

12. Warranty policy

Warranty assurance for the Multisensor Inner Diameter Measurement System RF040-100/150-Wi-Fi – 24 months from the date of putting in operation; warranty shelf-life – 12 months.

13. List of changes

<table>
<thead>
<tr>
<th>Date</th>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.01.2020</td>
<td>1.0.0</td>
<td>Starting document.</td>
</tr>
</tbody>
</table>
14. Distributors

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