LAMINATED TUBES GEOMETRY MEASUREMENT SYSTEM

RF092-13/50 Series

User's manual

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1. Safety precautions

- Use supply voltage and interfaces indicated in the system specifications.
- In connection/disconnection of cables, the system power must be switched off.
- Do not use the system in locations close to powerful light sources.
- The system must be grounded.

2. Electromagnetic compatibility

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

- EN 55022:2006 Information Technology Equipment. Radio disturbance characteristics. Limits and methods of measurement.
- EN 61000-6-2:2005 Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments.
- EN 61326-1:2006 Electrical Equipment for Measurement, Control, and Laboratory Use. EMC Requirements. General requirements.

3. Laser safety

The sensors make use of c.w. 660 nm and 405 nm wavelength semiconductor lasers. The maximum output power is 4.8 mW. The sensors belong to the 3R laser safety class according to IEC 60825-1:2007. The following warning label is placed on the sensor body:
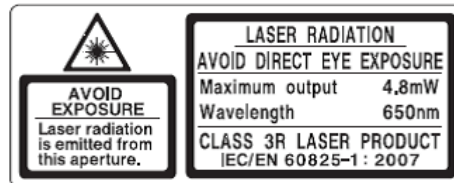
The following safety measures should be taken while operating the system:
- Do not target a laser beam to humans.
- Avoid staring into a laser beam through optical instruments.
- Mount the system so that a laser beam is positioned above or below the eyes level.
- Use protective goggles when operating the system.
- Avoid staring into a laser beam.
- Do not disassemble the sensors.

4. General information

The system is designed for contactless scanning and geometrical parameters measurement of laminated tubes, made of PBL and ABL foil.

The system calculates the following parameters:
- tube length;
- average outer diameter;
- maximum outer diameter;
- average foil thickness;
- average foil thickness at tube seam;
- seam width.

5.   Basic technical data

Parameter		Value
Diameter measurement range		13...50 mm
Diameter measurement accuracy		±10 μm
Foil thickness range		0,05…0,5 mm
Foil and weld thickness measurement accuracy		±5 μm
Tube length measurement accuracy		±0,1 mm
Light source		red semiconductor laser, 660 nm wavelength
		blue semiconductor laser, 405 nm wavelength
Output power		<5 mW
Laser safety class		3R (IEC60825-1:2007)
Output interface		Ethernet
Power supply		24 V DC
Power consumption		<30 W
Environmental resistance	Vibration	20 g / 10…1000 Hz, 6 hours for each of XYZ axes
	Shock	30 g / 6 ms
	Permissible ambient light	30000 lx
	Relative humidity	5-95 % (no condensation)
	Operating ambient temperature	0…+45°C
	Storage temperature	-20…+70°C
Housing material		aluminum
Weight (without cable)		8000 gram

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

6.   Example of item designation when ordering

RF092-Dmin/Dmax
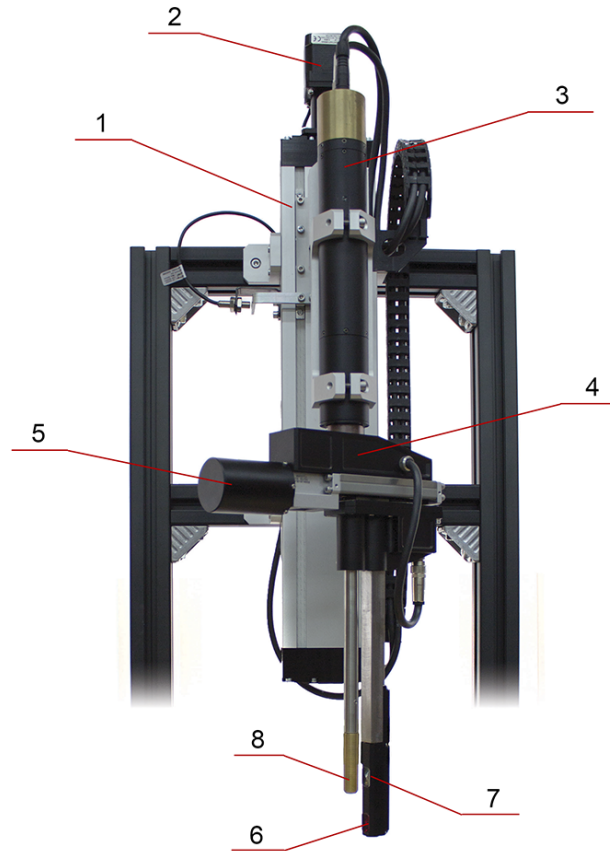
Symbol	Description
Dmin	Minimum measurement diameter, mm
Dmax	Maximum measurement diameter, mm

Example: RF092-13/50 – Laminated Tubes Geometry Measurement System RF092, diameter measurement range - 13...50 mm

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7. Structure and operational principle

The system structure is shown in Figure 1:

Figure 1. The system structure

Linear translation stage 1 with stepper motor 2 carries rotation module 3 with in-built motor and encoder (not shown). Multi-position linear translation module 4 with motor 5 is placed on the rotation module. Module 4 carries three triangulation laser sensors 6-8. Laser sensor 8 is intended for scanning of tube inner surface, laser sensors 6 and 7 are intended for scanning of tube outer surface. Measurement lines of sensors 7 and 8 are aligned. To eliminate the influence of sensors on each other under control of semi-transparent films, sensor 7 contains a blue laser and sensor 8 – a red one.

The system operates as follows.

The tube (not shown) is placed in the measurement position under laser sensors by such a way that the tube axis coincide with rotation axis of rotation module 3.

To get required accuracy, the measurement range of laser sensors must not exceed 9 mm. Depending on the tube diameter, module 4 places sensors in the required control position.

Linear translation stage 1 lets down laser sensors. During the translation, sensor 6 determines the tube edge position (it is a start of tube length measurement) and then sensors 7, 8 determine the same edge.

After registration of tube upper edge, linear translation stage 1 lets down laser sensors and sensor 6 measures the tube length. The system translates sensors into position of tube shape control (10 mm from the edge).

Module 3 rotates module 4 with sensors. Sensors measure distances to tube inner and outer surfaces. The data are transmitted to PC where foil thickness, weld parameters and tube shape are calculated.

Sensors are raised to upper position and measurement cycle repeats for the next tube.

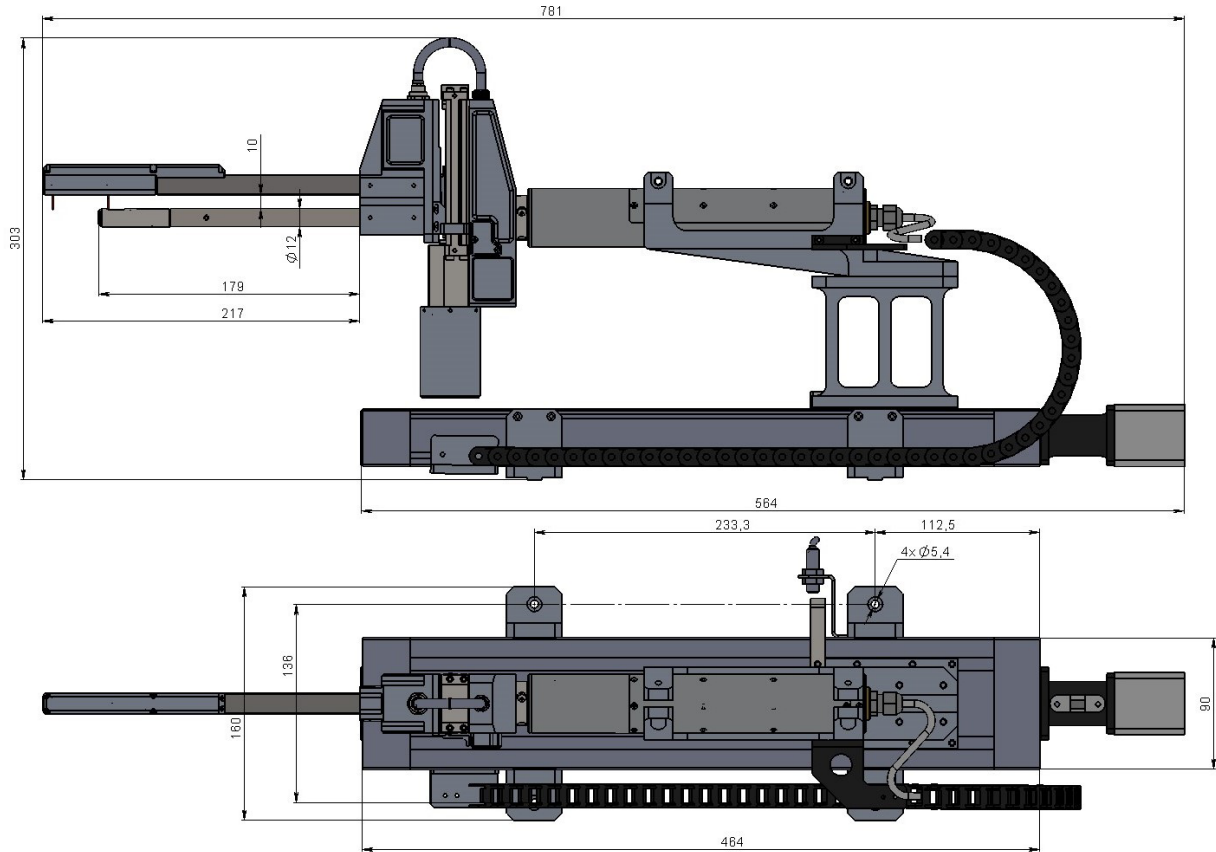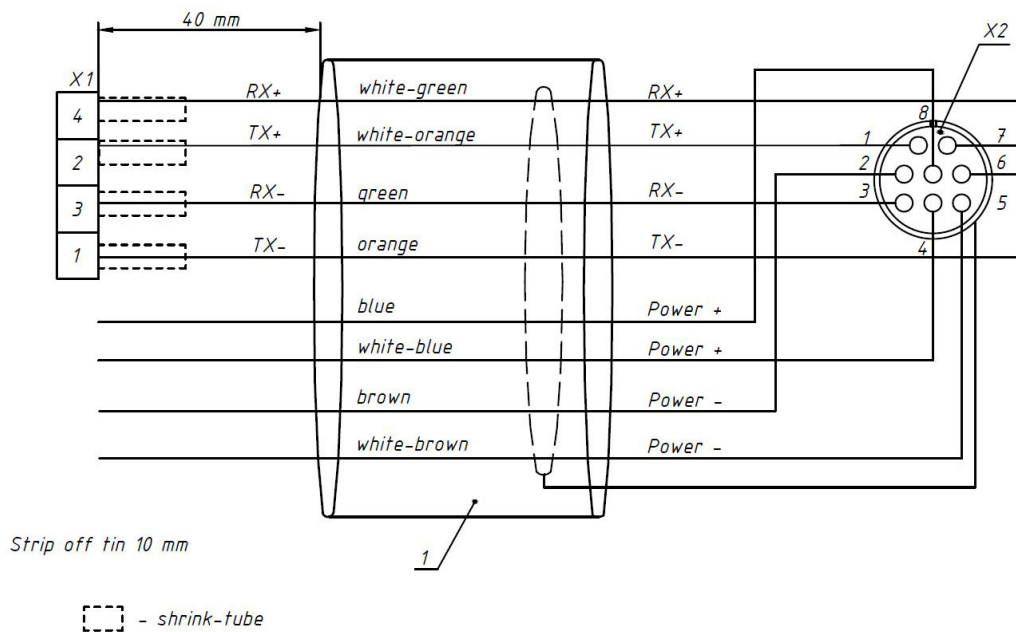Overall and mounting dimensions are shown in Figure 2.

Figure 2. Overall and mounting dimensions

8. Connection

8.1. Ethernet cable

Designations:

X1	B4B-ZR
X2	BINDER 09 0426 10 08
1	LAPP CABLE ETHERLINE FD P BK CAT.5e

Assignment:

Pin number	Assignment	Wire color	Note
1	TX+	White-orange	Transmit data Ethernet +
6	TX-	Orange	Transmit data Ethernet -
7	RX+	White-green	Receive data Ethernet +
3	RX-	Green	Receive data Ethernet -
8	Power+	Blue	Power supply: 24 V DC
4	Power+	White-blue	Power consumption: <30 W
2	Power-	Brown	
5	Power-	White-brown	

8.2. Cable for motor and limit switch
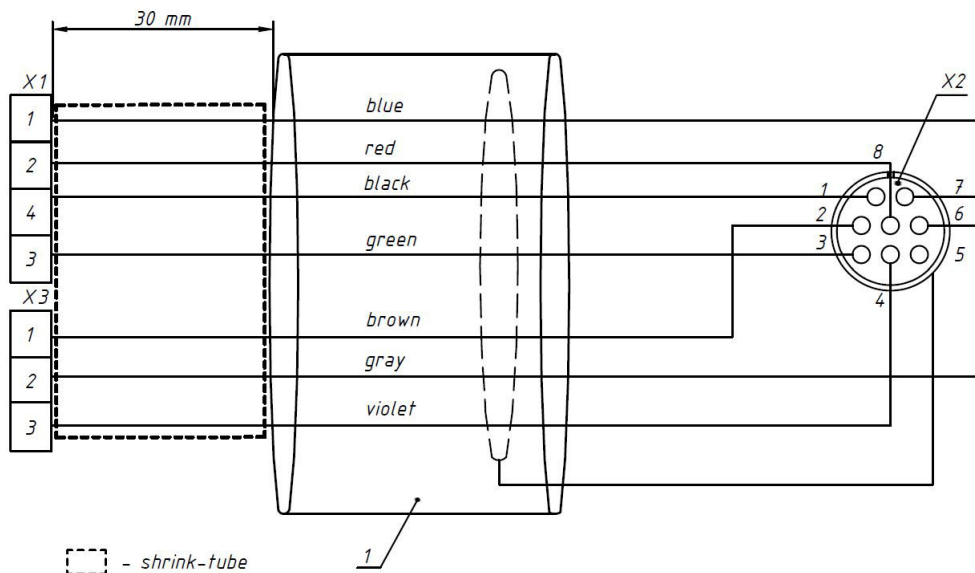
Designations:

X1	B4B-Zr
X2	BINDER 620 99 9225 00 08
X3	B3B-ZR
1	ÖLFLEX ROBOT 900 DP 12x0.14

9. Network setting

All systems are shipped with the following default network configuration: IP address of the system – 192.168.0.3.

Configure your PC's network card in the following address space: 192.168.0.X. Connect system directly to PC or through network switch.

10. Indended use

10.1. Preparation for use

The preparation involves the following steps:
- Visual inspection.
- Installation and connection.
- Switching the system.
- Calibration.

10.1.1. Visual inspection

- Check the system for completeness and absence of damage.
- Check the cables and ground wire.
- Check the condition of output windows and, if necessary, wipe them with a soft cloth.

10.1.2. Installation and connection

- Install the system.
- Make electrical connections (see Par. 8).

10.1.3. Switching the system

Feed power to the system – 24 V DC.

10.1.4. Calibration

The calibration procedure must be performed for each type of tubes to be measured.

In order to perform the calibration, place the tube into the control position and start the calibration using your software application. After successful calibration, place the tube of another type and perform the same procedure. Calibration data are written to the file **cbrdb.ini**.

> **ATTENTION!**
> The calibration procedure must be repeated every month.

10.2. Operating the system

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

11. Software

The provided software includes the SDK library that allows to develop software applications according to specific tasks.

11.1. 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**).

11.2. SDK library

Class name: **rf096112**.
Description of class members:

`Setup(remote_ip, remote_port, local_port, local_port)`
Set network parameters. Must be called before connecting to the device.
Returns: void.
Normal parameters: b"192.168.0.3", 6008, 6004 (customizable).

`Connect()`
Try to connect and read the device parameters stored in flash.
Returns: boolean; "True" on success.

`Disconnect()`
Close connection sockets.
Returns: void.

`Calibrate(sampleName)`
Run the calibration procedure.
`sampleName`: a name of calibration sample. Calibration samples data are stored in "cbrdb.ini" file.
On success, the calibration values are stored to "cbrdb.ini" file to appropriate section.
On failure, returns "False" and moves the system to the park state.
Returns: boolean; "True" on success.

`Measure(pos, results, angle)`
Run the measurement procedure.
`pos`: a nominal diameter of tube in millimeters (c_float).
`results`: a pointer to the results array, (c_float*6)().
`angle`: starting measurement angle in encoder step units (10..8192).
On failure, returns "False" and moves the system to the park state.
Returns: boolean; "True" on success.

`Park()`
Return system mechanical parts to their initial positions (move carriage to top, remove calibration pad).
Returns: boolean; "True" on success.
Warning: function returns without waiting for all movements finished.

`Check()`
Performs the hardware check.
Returns: c_uchar
Result is a byte containing 1's for parts passed its test according to the table:
Bit 0: Linear motion motor
Bit 1: Calibration pad
Bit 2: Laser control
Bit 3: Angular motion
Bit 4: Carriage positioning
So if all tests are passed, the result value is 31 dec (00011111 bin).

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12. Warranty policy

Warranty assurance for the Laminated Tubes Geometry Measurement System RF092-13/50 Series – 24 months from the date of putting in operation; warranty shelf-life – 12 months.

13. List of changes

Date	Version	Description
29.09.2017	1.0.0	Starting document.