RIFTEK
Sensors & Instruments

LASER SCANNERS

RF625 Series

User's manual

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Contents

1. Safety precautions

- Use supply voltage and interfaces indicated in the scanner specifications.
- In connection/disconnection of cables, the scanner power must be switched off.
- Do not use scanners in locations close to powerful light sources.
- To obtain stable results, wait about 20 minutes after scanner activation to achieve uniform scanner warm-up.
- Scanners must be grounded.

2. CE compliance

The scanners have been developed for use in industry and meet the requirements of the following Directives:

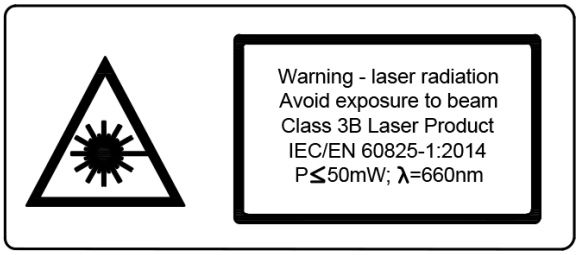
- EU directive 2014/30/EU. Electromagnetic compatibility (EMC).
- EU directive 2011/65/EU, “RoHS“ category 9.

3. Laser safety

The scanners correspond to the 2M or 3B safety classes according to IEC/EN 60825-1:2014.

3.1. Class 3B scanners

The scanners make use of a semiconductor laser. Maximum output power is 50 mW. The scanners belong to the 3B laser safety class. The following warning label is placed on the scanner housing:



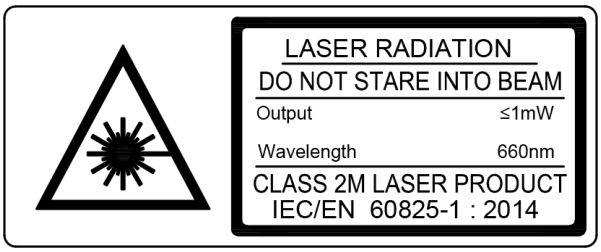
The following safety measures should be taken while operating the scanners:

- Do not target laser beam to humans.
- Avoid staring into the laser beam through optical instruments.
- Mount the scanner so that the laser beam is positioned above or below the eyes level.
- Mount the scanner so that the laser beam does not fall onto a mirror surface.
- Use protective goggles while operating the scanner.
- Avoid staring at the laser beam going out of the scanner and the beam reflected from a mirror surface.
- Do not disassemble the scanner.
- Use the laser deactivation function in emergency.

NOTE. Class 3B scanners are supplied only as OEM products. All responsibility for compliance with the requirements of laser safety is borne by the consumer.

3.2. Class 2M scanners

The scanners make use of a c.w. 660 nm or 405 nm wavelength semiconductor laser. Maximum output power is 1 mW. The scanners belong to the 2M laser safety class. The following warning label is placed on the scanner housing:



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

- Do not target laser beam to humans.
- Do not disassemble the scanner.
- Avoid staring into the laser beam.

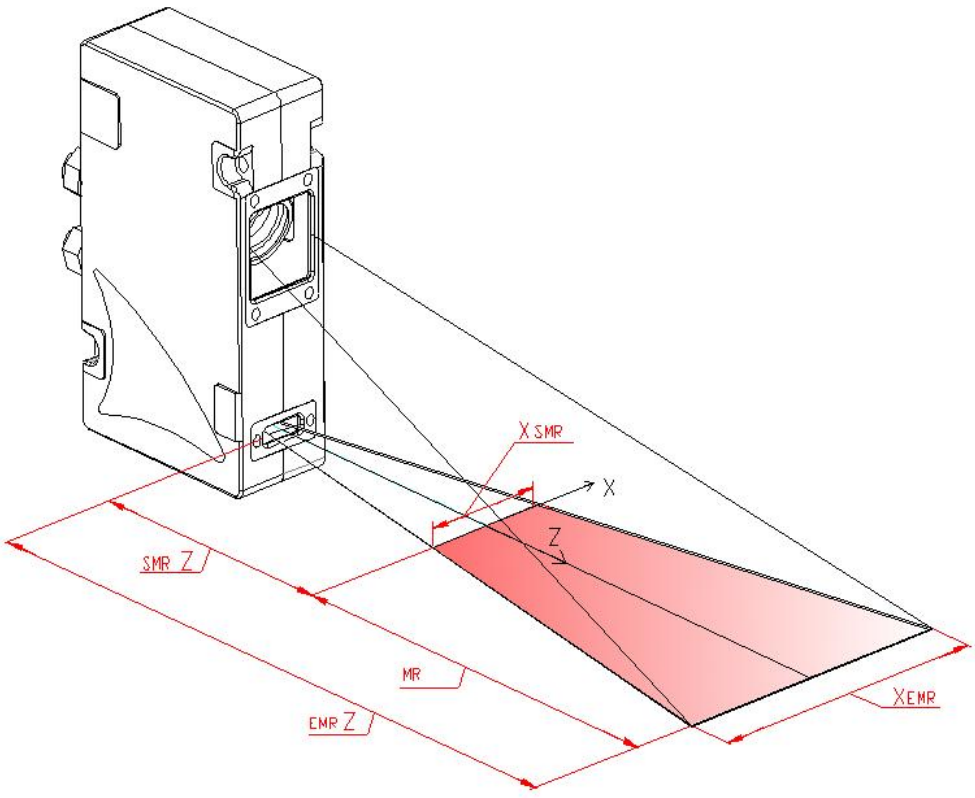
4. General information

Laser scanners are intended for non-contact measuring and checking of surface profile, position, displacement, dimensions, sorting and sensing of technological objects, 3D scanning.

5. Structure and operational principle

Operation of the scanners is based on the principle of optical triangulation (see Figure).

Radiation of a semiconductor laser is formed by a lens in a line and projected to an object. Radiation scattered from the object is collected by the lens and directed to a two-dimensional CMOS image sensor. The image of object outline thus formed is analyzed by a FPGA and signal processor, which calculates the distance to the object (Z-coordinate) for each point of the set along the laser line on the object (X-coordinate). Scanners are characterized by base distance (beginning of the range), SMR, for Z-coordinate, measuring range (MR) for Z-coordinate, measuring range for X-coordinate at the beginning of Z (Xsmr) and measuring range for X-coordinate at the end of Z (Xemr).



6. Configurations

The Series is divided into 3 groups:

- a group of scanners in a compact housing (compact line);
- a group of scanners in a standard housing (standard line);
- a special version of scanners, which consists of scanners with increased base distance, wide-range scanners and special scanners.

Scanners can work in two modes: with the frequency of 249 Hz and with the frequency of 491 Hz (in the full working range). In addition, you can use the ROI function, which allows to increase the working frequency up to 1840 Hz.

Scanners are available in the following versions:

- based on red laser, 660 nm;
- based on blue lasers (BLUE version), 405 or 450 nm;
- based on infrared laser (IR version), 808 nm.

We use different lasers due to a wide range of applications. For example, the use of blue lasers instead of red ones is optimal for the control of shiny materials, high-temperature objects and organic materials.

The use of scanners with different laser wavelengths in one measurement system allows to avoid the scanners mutual influence and greatly simplifies the system construction. Scanners with IR lasers are intended to be used under conditions of strong solar radiation.

Scanners can be equipped with the Air Knife system, air cooling system, heating system, removable protective windows, protective housing, robot cable (see p. 28).

Technical characteristics of the scanners can be changed for a specific task. Use a special form to make order (see p. 29.1).

Scanners are supplied with the following set of synchronization channels (all channels can be TTL or RS422):

- BASIC – one synchronization input, none synchronization output. Basic synchronization is included in the standard power cable. The synchronization input type is External. The measurement synchronization is also available.
- ENC – synchronization by the encoder signals (three synchronization inputs, none synchronization output). This requires one additional 8-pin synchronization cable for RS422, and one additional 4-pin synchronization cable for TTL. The following synchronization types are available: External, Encoder, StepDir. The measurement synchronization is also available.
- STEPDIR – two synchronization inputs, none synchronization output. This requires one additional cable. The synchronization input type is StepDir. The External and Encoder synchronization types are also available.
- INOUT – one synchronization input, one synchronization output. This requires one additional 4-pin cable. The synchronization input type is External (the measurement synchronization is also available); the synchronization output type is Custom Frequency.
- FULLSYNC – three synchronization inputs and two synchronization outputs. The type of synchronization inputs and outputs is SterDir. The synchronization channels can be TTL only.

7. Basic technical data

7.1. Specification

Sampling rate and accuracy	
Nominal sampling rate	248 profiles/s (standard mode), 491 profiles/s (mode of increased frequency)
Maximal sampling rate	1875 profiles/s
Linearity (measurement error), Z axis	±0.1% of the range (±0.05% for scanners with the range 17/6-7/8)
Linearity (measurement error), X axis	±0.2% of the range
Interface	
Digital	Ethernet IPv4
Synchronization inputs/outputs	RS422
Synchronization inputs	up to 3 channels
Synchronization outputs	up to 2 channels
Power supply	15…30 V
Environmental resistance	
Enclosure rating	IP67
Vibration	20g/10...1000Hz, 6 hours for each of XYZ axes
Shock	30g/6 ms
Operating ambient temperature	0…+40°C (-20…+40°C for scanners with in-built heater; -20…+120°C for scanners with in-built heater and cooling system)
Storage temperature	-20…+70°C
Relative humidity	5-95% (no condensation)
Housing/windows material	aluminum/glass
Laser lifetime	
Red (660 nm)	50000 hours
Blue (405, 450 nm)	50000 hours
Infrared (808 nm)	50000 hours

7.2. Working ranges and dimensions

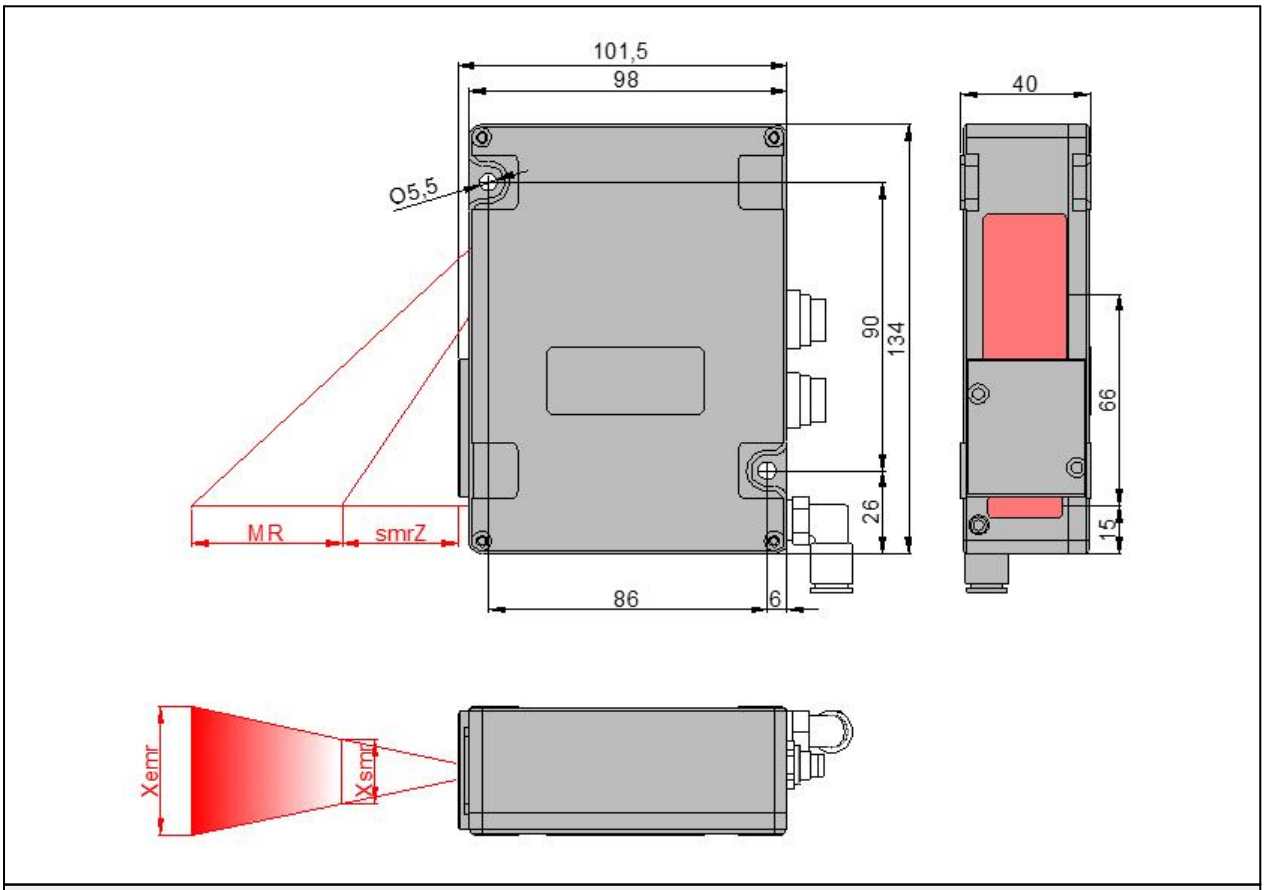
Range	MR, mm	SMR, mm	EMR, mm	Xsmr, mm	Xemr, mm	Laser	Size, mm	Weight, g	Housing version
40/5-6/7	5	40	45	6	7	Class 2M	30x120x88	400	Compact
35/10-10/12	10	35	45	10	12				
55/10-10/11	10	55	65	10	11				
30/25-18/26	25	30	55	18	26				
65/25-17/23	25	65	90	17	23				
55/50-27/45	50	55	105	27	45				
65/65-29/54	65	65	130	29	54				
90/50-23/35	50	90	140	23	35				
75/95-34/67	95	75	170	34	67				
140/110-43/68	110	140	250	43	68	Class 2M or 3B	40x98x134	500	Standard
125/200-60/130	200	125	325	60	130				
100/250-75/180	250	100	350	75	180				
140/250-70/155	250	140	390	70	155				

Range	MR, mm	SMR, mm	EMR, mm	Xsmr, mm	Xemr, mm	Laser	Size, mm	Weight, g	Housing version
17/6-7/8	6	17	23	7	8	Class 2M	52x104x122	590	Special
90/10-9/10	10	90	100	9	10	Class 2M	49x84x162	1000	
240/20-14/16	20	240	260	14	16	Class 2M	50x98x144	1000	
175/250-115/230	250	175	425	115	230	4 W, 808 nm, Class 3B	66x171x235	2000	
165/300-130/240	300	165	465	130	240	Class 2M or 3B	48x106x219	1100	
240/290-200/320	290	240	530	200	320	Class 2M or 3B	50x125x360	3000	
450/650-190/420	650	450	1100	190	420	Class 3B	50x110x300	3000	
1050/165-85/100	165	1050	1215	85	100	Class 3B	54x216x598	3600	
425/990-330/960	990	425	1415	330	960	Class 3B	48x198x480	2500	
540/1400-340/980	1400	540	1940	340	980	Class 3B	48x210x415	3000	

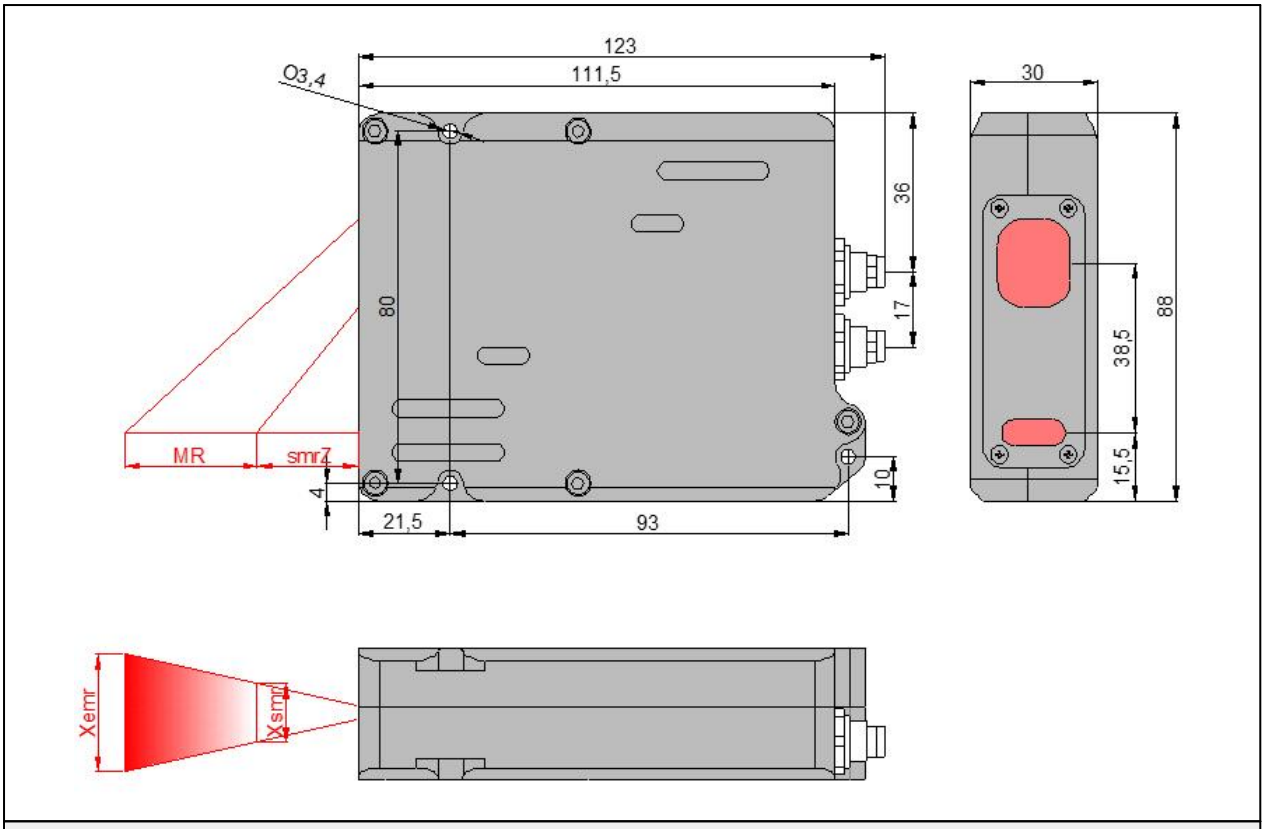
Detailed CAD documentation (2D and 3D) is available here:
https://riftek.com/media/documents/rf625/RF625_2D_CAD.dwg
https://riftek.com/media/documents/rf625/RF625_3D_CAD.zip

The scanner housing is made of anodized aluminum. The front panel of the housing has two windows: the output window and the window for receiving radiation reflected from the object under control. The housing also contains mounting holes. Scanners are equipped with two connectors and can be equipped with fittings for the air cooling system.

Overall and mounting dimensions of the scanners are shown in Figures below.



Standard version



Compact version

8. Overall demands for mounting

The scanner should be positioned so that the object under control was placed in the working range of the scanner. In addition, no foreign objects should be allowed to stay on the path of the incident and reflected laser radiation.

Where objects to be controlled have intricate shapes and textures, the incidence of mirror component of the reflected radiation to the receiving window should be minimized.

ATTENTION!
The scanner must be grounded. Static electricity may cause the failure of electronic components.

9. Cables

Depending on the scanner configuration, contents of delivery may include different types of cables: power cables, Ethernet cables, encoder and synchronization cables.

The basic scanner version is shipped with two cables: the power cable with lines of connecting one external synchronization channel and the Ethernet cable.

Scanners with encoder synchronization inputs or with the synchronization input/output are also shipped with the encoder and synchronization cable.

For scanners with a lot of synchronization channels and with analog outputs, the documentation on interface cables is provided before shipping.

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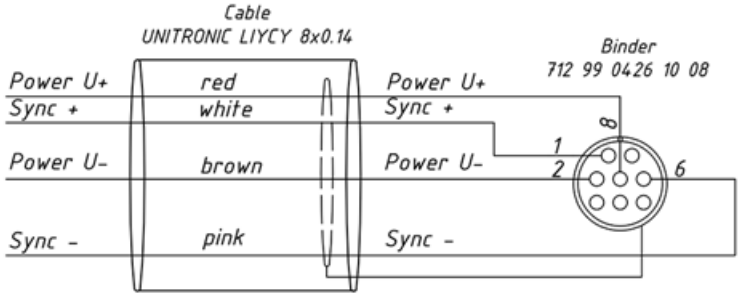
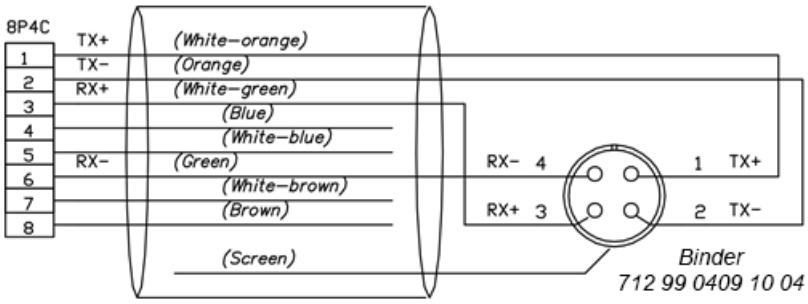
9.1. Power cable



Binder 702 pins	Assignment	Wire color	Description
1	Sync +	White	Differential trigger input RS422
6	Sync -	Pink	
8	Power U+	Red	Power supply: 12..32V, consumption: 4,8..7,7W
2	Power U-	Brown	

NOTE. The power cable configuration depends on the scanner configuration and may differ from the given above.

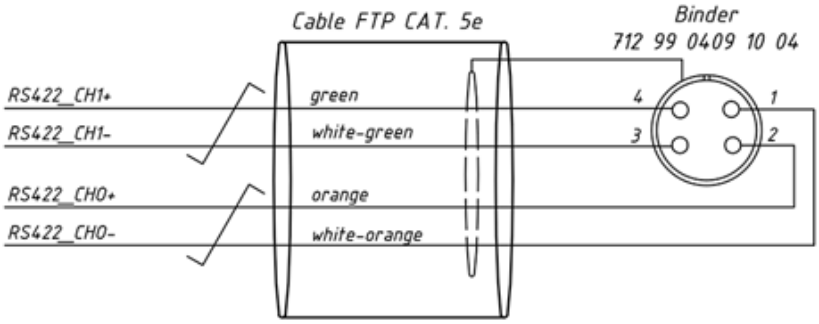
9.2. Ethernet cable



#	Assignment	Wire color	Description
1	TX+	White-orange	Transmit data Ethernet +
2	TX-	Orange	Transmit data Ethernet –
3	RX+	White-green	Receive data Ethernet +
4	-	Blue	
5	-	White-blue	
6	RX-	Green	Receive data Ethernet -
7	-	White-brown	
8	-	Brown	
shield			Connected to the housing

NOTE. The twisted pair cable 100Base-T4 is used to transmit data. The maximum length is 200 meters.

9.3. Encoder and synchronization cable



NOTE. Scanners with encoder input have an additional connector. The cable configuration depends on the scanner configuration and may differ from the given above.

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10. Ethernet interface

The scanner is supposed to function with two types of protocols, namely, UDP and TCP/IP.

10.1. UDP protocol

UDP protocol is used:

- for detection of scanner in a network;
- for transmission of result on a configurable port, by default 6003;
- for emergency control of scanner: reset current connections, reboot, laser (scanner) ON/OFF. For emergency control it is necessary to send broadcast packet with scanner S/N and command code.

NOTE. Transmission of UDP packets with measurement results is accompanied by periodic transmission (one time in 2 seconds) of information packet on port 6001. Besides that, if the TCP connection is active, such a packet is transmitted on reserve port 62500.

10.2. TCP protocol

TCP protocol is used:

- for configure and check the main functions of the scanner;
- for request/transmit data.

NOTE. When the TCP connection is active, the scanner doesn't send data over UDP.

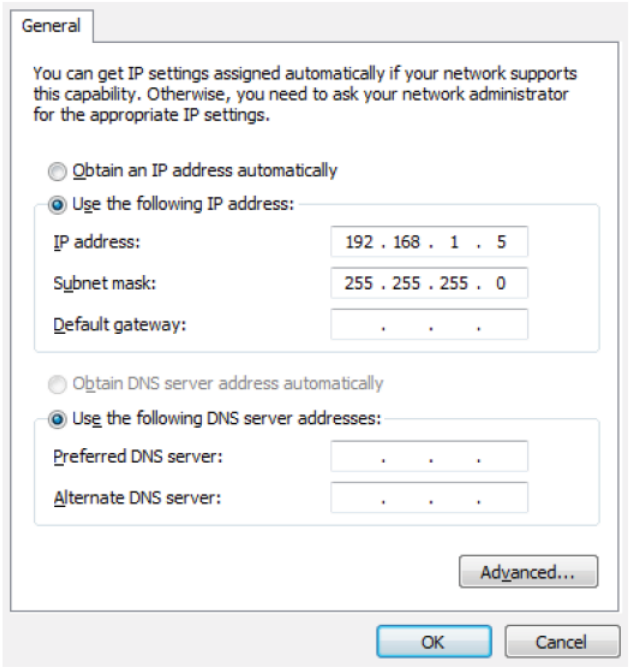
11. Network setting and the first connection

11.1. Network setting

All scanners are shipped with the following default network configuration:

- IP address: 192.168.1.100
- Subnet mask: 255.255.255.0
- Reserved IP address: 192.168.1.235 (set when scanner settings are reset to factory settings)

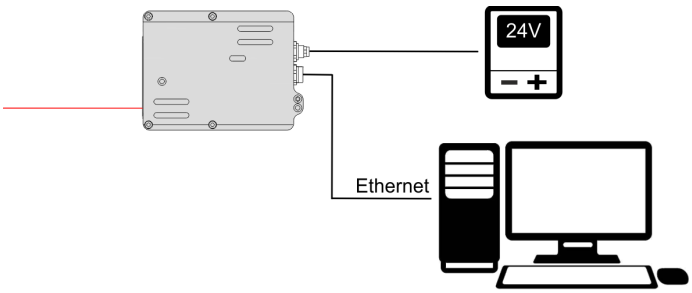
Since the initial state of the laser scanner is configured to run in the 192.168.1.* address space, configure your PC's network card, for example, as follows:



11.2. The first connection

- Perform network settings according to the preceding paragraph.
- Connect the scanner to a PC or to a network switch.
- Connect a power supply to the scanner. The network indicator of the switch port (or PC port), to which the scanner is connected, must light up.

Within 25 second after powering, scanner's firmware is booting. Two flashes of scanner's laser are an indication of booting finish.



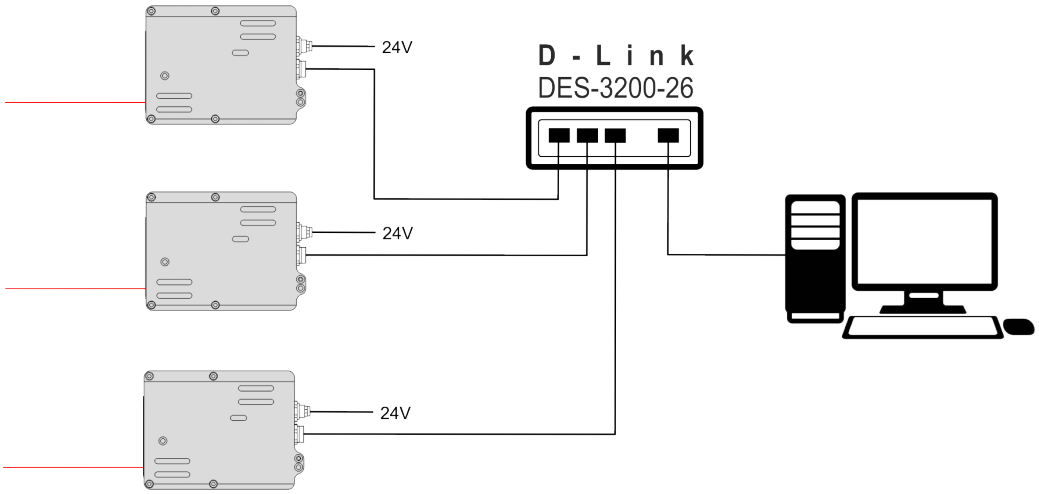
The scanner is ready to work.

11.3. Several scanners on a network

Because of a big broadcast traffic, generated by the scanner, the dedicated broadcast segment is recommended to use when planning the network topology of the scanners connection.

NOTE. For a mutual work of several scanners in the L2 Ethernet segment, use the network switch with the function of limiting the broadcast domain. If you ignore this requirement, the scanners work will be unstable.

The following figure illustrates the possible network configurations to connect several scanners on the example of using the network switch D-Link DES-3200-26.



11.3.1. Network switch setting. Basic configuration

A basic configuration is a group of scanners connected to a Host PC (HPC):

1. HPC connects to the Company's network, using the Fast Ethernet (`fe0`) network interface, and gets a private address of the Company's network (in this example, 172.16.0.100/24).
2. HPC connects to the network switch with connected scanners to switch port 25 (SP25), using the Gigabit Ethernet network interface (`ge1`).
3. For a group of scanners, the administrator dedicates a private range of IPv4-addresses (RFC1918), which is unique within the Company's network (in this example, 192.168.0.0/28).
4. HPC assigns the IPv4-address to the interface `ge1` from the range of addresses for a group of scanners.
5. Scanners connect to the switch ports 1-24 (SP1-SP24).
6. When each of the scanners is connected to the switch and to the power supply (see p. 11.2), the unique IPv4-addresses will be assigned from the dedicated range by a service program (see p. 19).
7. The switch is configured by using a command line (access is through the console port or SSH\Telnet).

```
config traffic_segmentation 1-24 forward_list 25
config traffic_segmentation 25-26 forward_list all
```

Setting is complete.

11.3.2. Network switch setting. Advanced configuration

Advanced configuration with two and more groups of scanners (in this example, GS1 and GS2) connected to two and more HPC (in this example, HPC1 and HPC2):

1. HPC1 connects to the Company's network, using the Fast Ethernet (`fe0`) network interface, and gets a private address of the Company's network (in this example, 172.16.0.100/24).
2. HPC2 connects to the Company's network, using the Fast Ethernet (`fe0`) network interface, and gets a private address of the Company's network (in this example, 172.16.0.101/24).
3. HPC1 connects to the network switch with connected scanners, using the network interface Gigabit Ethernet (`ge1`), to switch port 25 (SP25).
4. HPC2 connects to the network switch with connected scanners, using the network interface Gigabit Ethernet (`ge2`), to switch port 26 (SP26).

5. For groups of scanners (GS1 and GS2), the administrator dedicates two private ranges of IPv4-addresses (RFC1918), which are unique within the Company's network (in this example, 192.168.0.0/28 and 192.168.0.16/28).
6. IPv4 addresses are assigned for interfaces `ge1` and `ge2` from the range of addresses for GS1 and GS2.
7. The switch is configured by using a command line (access is through the console port or SSH\Telnet).

```
# Delete default VLAN
config vlan default delete 1-26
# Create VLAN for GS1
create vlan VLAN101 tag 101
config vlan VLAN101 add untagged 1-10,25 advertisement disable
# Create VLAN for GS2
create vlan VLAN102 tag 102
config vlan VLAN102 add untagged 11-24,26 advertisement disable
# Configure selected switch ports
config port_vlan 1-10,25 gvrp_state disable ingress_checking enable
acceptable_frame admit_all pvid 101
config port_vlan 11-24,26 gvrp_state disable ingress_checking
enable acceptable_frame admit_all pvid 102
# Set the limiting of the broadcast domain within selected VLAN
config traffic_segmentation 1-24 forward_list 25
config traffic_segmentation 25-26 forward_list all
```

8. GS1 scanners connect to the switch ports 1-10.
9. When each of the GS1 scanners is connected to the switch and to the power supply (see p. 11.2), the unique IPv4-addresses will be assigned by HPC1 from the dedicated range 192.168.0.0/28.
10. GS2 scanners connect to the switch ports 11-24.
11. When each of the GS2 scanners is connected to the switch and to the power supply (see p. 11.2), the unique IPv4-addresses will be assigned by HPC2 from the dedicated range 192.168.0.16/28.

Setting is complete.

12. Software and resources

The scanner comes with a software package, which is also available on the RIFTEK's web site.

The package includes software tools that allow to implement three ways of working with the scanner:

1) Via a service program.
Windows x64:
https://riftek.com/media/documents/software/lamia/LamiaInstaller_win_x86_64.zip
Linux x64:
https://riftek.com/media/documents/software/lamia/LamiaInstaller_linux_x86_64.zip
2) Via a software developed by the customer, using the provided SDK (Software Development Kit).
Download link: http://riftek.com/media/rit/SDK/RFDevice_SDK.zip
RFDevice SDK includes the detailed description of all functions of the library and the examples of programs in different languages (c++, c#, Pascal) ported to various platforms (Windows, Linux, .NET), and also the examples of using the libraries in different environments (MATLAB, LABVIEW).
3) Via a software developed by the customer, which implements the scanner protocols. Information about using these options of working with the scanner is given in this User's Manual.

The following tools are also available to download:

- Scanner firmware: https://riftek.com/media/rit/fw/Firmware.zip

The current version is not compatible with the scanners manufactured before January 1, 2015. You can upgrade such scanners to the latest version by using the special upgrade tool: http://riftek.com/downloads/RF625_upgrade_to_D.zip

- RF625 Emulator. This application simulates behavior of a laser scanner (RF625) and can be used for software development without using a real scanner.

Download link: https://riftek.com/media/rit/Emulator/RF625Emulator.zip

13. Service program

13.1. System requirements

The main requirements for using **Riftek Lamia**:

- Operating system Windows 7 and later.
- Video card and video card drivers, which support OpenGL 2.1 and later.

13.2. Installation

Download links are given in p. 12.

To start the installation process, you need to run the setup file:

- LamiaInstaller_win_x86_64.exe, or
- LamiaInstaller_linux_x86_64.exe

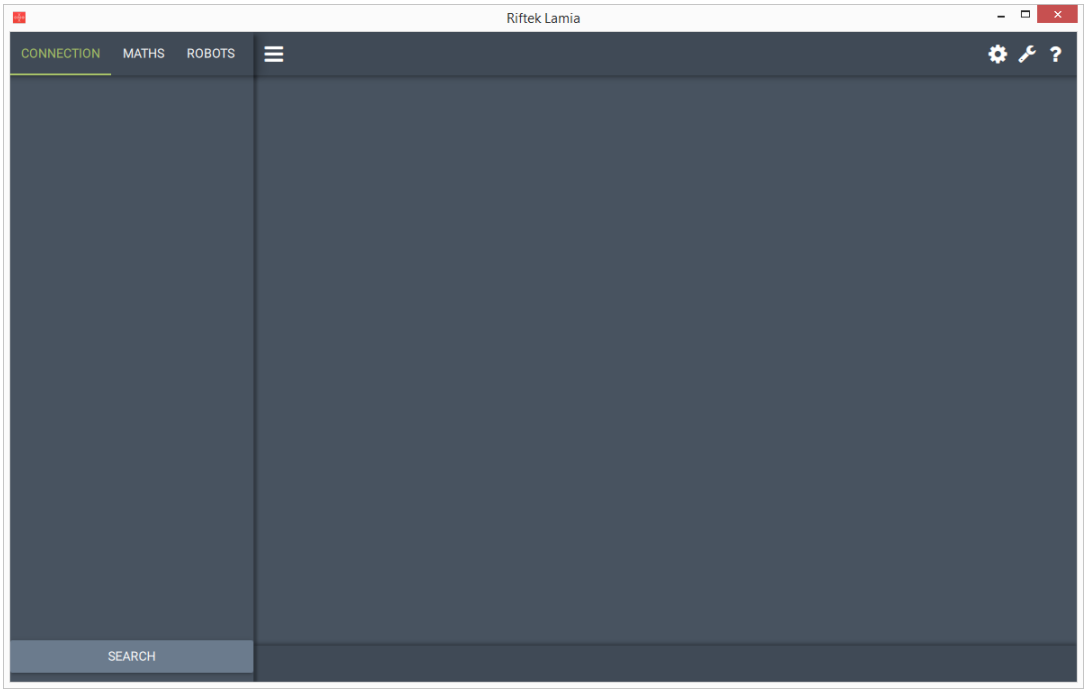
When you run the setup file, the welcome window of the Setup Wizard appears:

To continue with the installation, click **Next >**.

Follow the guidelines in dialog boxes of the Setup Wizard.

13.3. Main window

The main window of **Riftek Lamia**:



Working panels:

Button	Assignment
CONNECTION	Search for scanners and connection (see topics 15 and 16). Parameters setting (see topic 18).
MATHS	Seam tracking and measurement.
ROBOTS	Protocols for communication with industrial robots. This panel is not available under the **Free** license.

In order to hide / show the left panel, click .

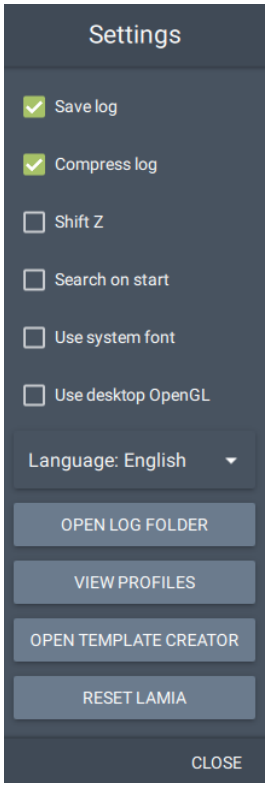
Additional settings:

Button	Assignment
	The "Settings" window: language selection, log, and so on (see topic 13.4.1).
	The "Tools" window: emergency requests (see topic 13.4.2).
	The "About" window: information about the program, license activation (see topic 13.4.3).

13.4. Program settings

13.4.1. "Settings" window

To open the **Settings** window, click in the toolbar. The **Settings** window:

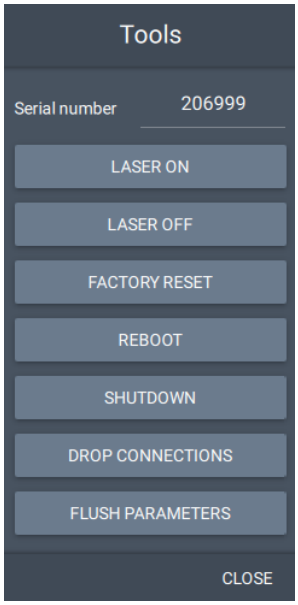


The description of program settings:

Item	Description
Save log	Save profiles to the log files.
Compress log	Compress the log files.
Shift Z	This option shifts the obtained profile down for the half of the Z range. Always enable this option before connection to the special scanners with the inverted Z coordinate.
Search on start	Start the search for the scanners automatically when you run the software.
Use system font	Use the operating system font. **Attention!** It is necessary to restart the software in order for the changes to take effect.
Use desktop OpenGL	Accelerate the speed of rendering of widgets.**Attention!** It is necessary to restart the software in order for the changes to take effect.
Language	Select the application language: English or Russian. **Attention!** It is necessary to restart the software in order for the changes to take effect.
OPEN LOG FOLDER	Open the folder with log files.
VIEW PROFILES	Open the Profile Viewer program (see topic 13.5).
OPEN TEMPLATE CREATOR	Open the Template Creator program. This button will appear when you purchase Template Creator.
RESET LAMIA	Reset all program settings: delete all user settings, log files and deactivate the license. **Attention!** It is necessary to restart the software in order for the changes to take effect.

13.4.2. "Tools" window

To open the **Tools** window, click in the toolbar. The **Tools** window:



Emergency requests are intended to be used, when you cannot connect to the scanner over TCP for some reason. Emergency requests do not need the active TCP connection with the scanner.

In order to send the command to the scanner, enter its serial number into the **Serial number** field, and click the button.

Button	Assignment
LASER ON	Switch on the laser.
LASER OFF	Switch off the laser.
FACTORY RESET	Reset all settings to the factory values.
REBOOT	Reboot the scanner.
SHUTDOWN	Shutdown the scanner.
DROP CONNECTIONS	Drop all active connections.
FLUSH PARAMETERS	Save parameters to the nonvolatile memory of the scanner.

13.4.3. "About" window

13.4.3.1. Information about the program

To view information about **Riftek Lamia**, click in the toolbar. The **About** window:

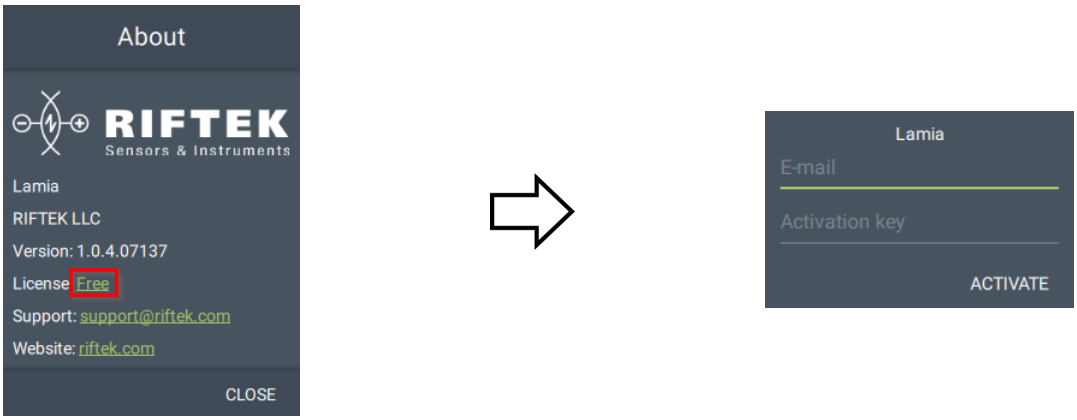
The **About** window shows the following information:
- software name;
- company's name;
- software version;
- license type;
- email of the technical support;
- company's web-site.

When you activate the license, the following additional information will appear:
- customer's email;
- serial numbers of the scanners listed in the License Agreement.

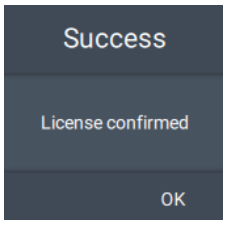
13.4.3.2. License activation

> License activation requires an active Internet connection.

Click on the link with the current license type in order to open the license activation window:



Next, enter your email and activation key, and click **ACTIVATE**.
Once the activation is successful, the following message will appear:



After activating the license, the license type in the **About** window will be changed.

13.5. Log

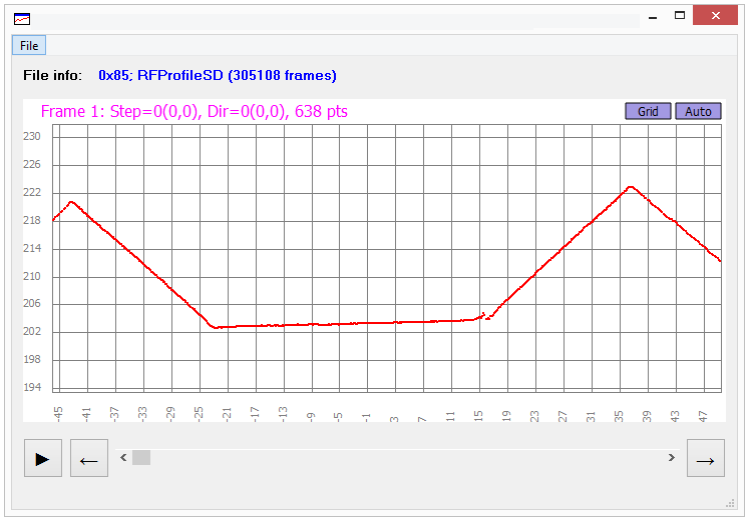
Click  in order to open the **Settings** window.

When the **Save log** option is selected, the log file will be automatically created when you start the measurements. To compress log files, select **Compress log**.

Log files are stored to the user's directory (for example, C:\Users\<User>\AppData\Roaming\RIFTEK LLC\Lamia\saved-data). To view the folder with log files, use the **OPEN LOG FOLDER** button.

The files extension is BIN (BINZ for compressed files). The file name consists of a serial number, device model, network parameters and time of the start of recording.

In order to view the log files, open the **Profile Viewer** program by clicking the **VIEW PROFILES** button. To open the log file in this program, click **File > Open** and select a file.



Log files can be converted to CSV. To do this, click **File > Export to CSV**.

Data are written to the log file only in the **Profile** mode.

13.6. Keyboard shortcuts

Alt + 1	Show the **Connection** panel.
Alt + 2	Show the **Maths** panel.
Alt + 3	Show the **Robots** panel.
Ctrl + B	Switch to the **Background maths** mode.
Ctrl + F	Start the search for devices.
Ctrl + H	Hide the tab bar and left panel.
Ctrl + Q	Quit the program.
Ctrl + W	Drop the TCP connection.
Ctrl + Shift + O	Open the **Settings** window.
F1	Open the **About** window.
F11	Switch to the full screen mode.

14. Use of SDK

All functions are described in the documentation for RFDevice SDK, included in the RFDevice SDK set.

When working with RFDevice SDK, you need to execute the following method before you call the function for the first time or before you create a new device object:

```
RFDevice::Initialize void)
```

Upon completion of the work with RFDevice SDK, you need to execute the following method:

```
RFDevice::Cleanup (void)
RFDevice::GetVersionString ()
```

15. Search for scanners on the network

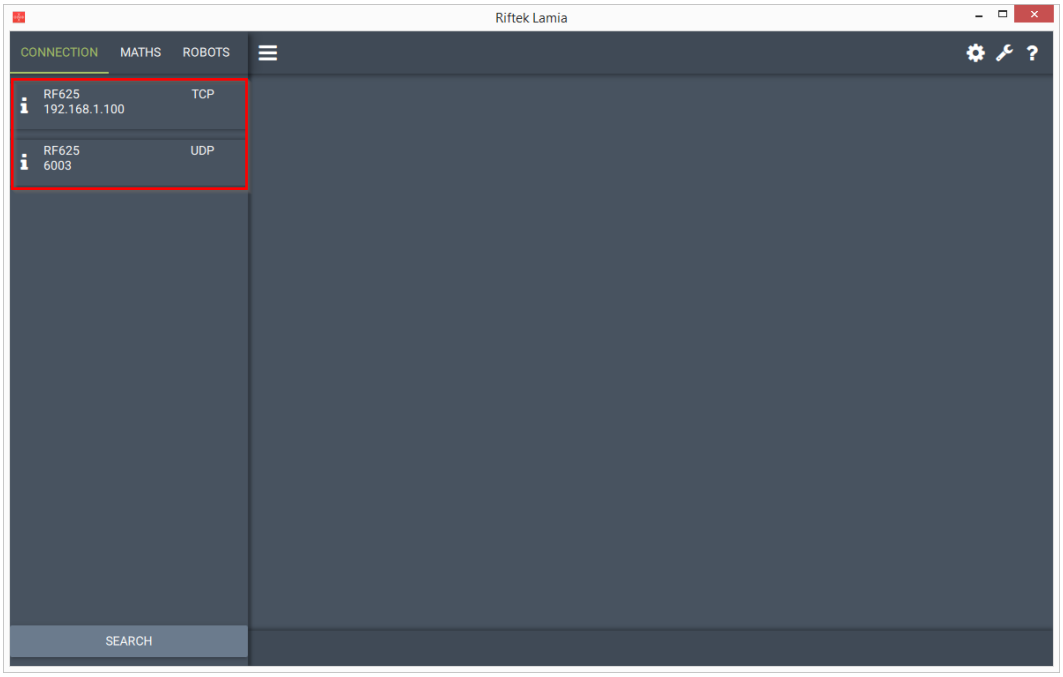
15.1. Service program

When connected to the network and powered, the scanner communicates the broadcast information packet (to address 255.255.255.255, UDP port 6001) with periodicity of one time in two seconds. The packet contains IP-address of the scanner, its serial number, MAC-address and other information. The Scanner Detection Protocol is described in topic 27.1.

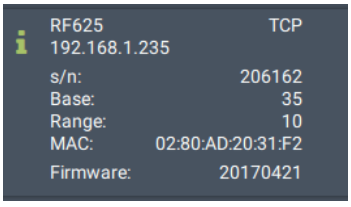
To start the search for scanners on a network, click the **SEARCH** button in the bottom left corner of the program window, or use the keyboard shortcut **Ctrl + F**. In addition, you can enable the **Search on start** option in the **Settings** window to start the search for scanners automatically when you run the program (see topic 13.4.1).

If the program does not detect the scanner:
- Check the cables and power supply.
- Click the **Drop connections** button (see topic 13.4.2).
- Add exceptions or disable the firewall.
- Reboot the scanner.

Upon completion of the search, the program activates two panels for every detected scanner: TCP connection and UDP stream.



In the TCP panel, you can see the series (RF625) and IP address of the scanner. In the UDP panel, you can see the series and the UDP port number of the scanner. For more information about the scanner, click the "i" icon.



Information about the scanner:

s/n	Serial number.
Base	Base distance.
Range	Measurement range.
MAC	MAC-address.
Firmware	Firmware version.

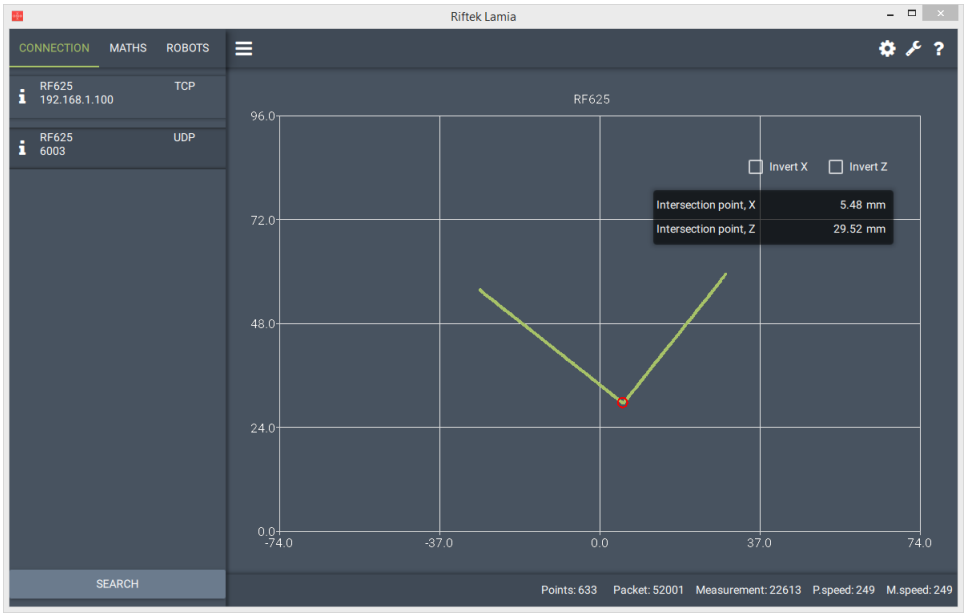
15.2. RFSDK

```
vector<RFDevice::RF625DDevice *> vRF625;
//Create RFLanDetector object
RFDevice::RFEthernetDetector ld;
//Execute search for device type 625 (RF625) for 3 seconds
//RF625 sends UDP information packet each 2 seconds so 3 seconds
//must be enough to catch all of them
int nRF625 = ld.Search(625, 3);
//Now nRF625 holds a quantity of detected RF625
//Create list of RF625Device objects for all found devices
for (i=0; i<nRF625; i++)
{
	RFDevice::RF625DDevice *p = new RFDevice::RF625DDevice(ld[i]);
	if (p)
	{
		vRF625.push_back(p);
	}
	else
	{
	// Failed to construct RF625DDevice
	}
	}
nRF625 = vRF625.size();
```

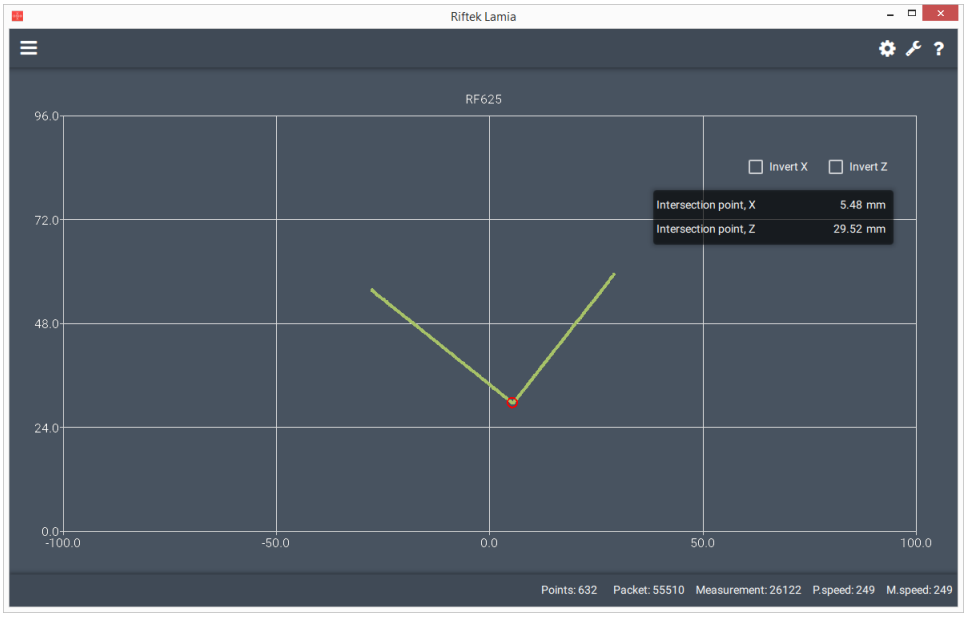
16. Scanner connection and receiving a profile

16.1. Service program. UDP-stream

Clicking on the UDP panel requests the UDP stream from corresponding scanner and activates the visualization panel, in which the obtained profile is displayed.



To hide the **Connection** panel, click ☰ or use the keyboard shortcut **Ctrl+H**.



By moving the object or the scanner, observe changes in the profile. Zooming is performed by rotating the mouse wheel. To move the profile, press the left mouse key, and drag.

The status line in the lower part of the window shows:

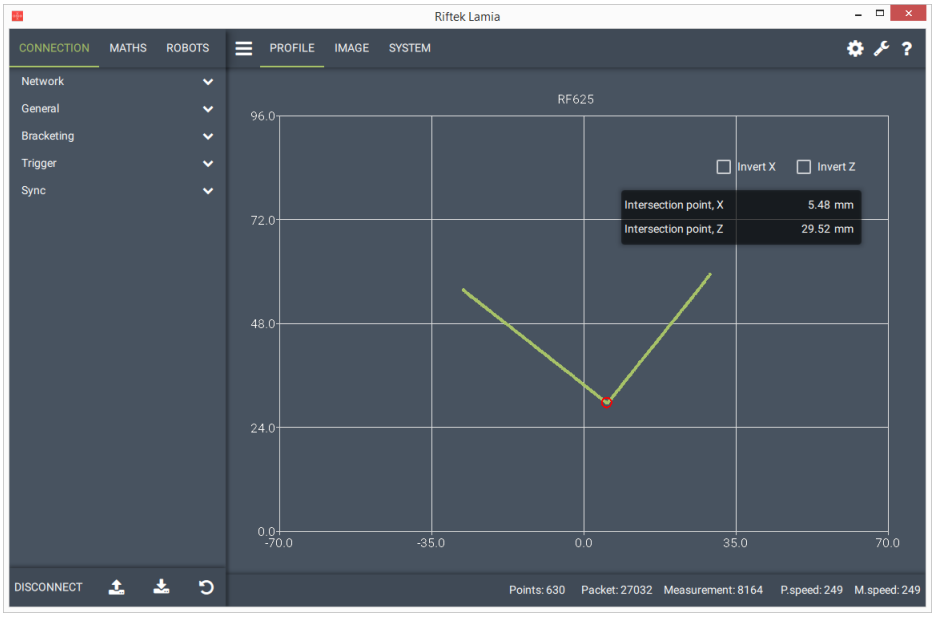
Points	Quantity of valid points in a profile.
Packet	Quantity of received packets.
Measurement	Quantity of received profiles.
P.speed	Packet reception rate.
M.speed	Speed of measurement.

If the status line shows "No data...", check whether the **UDP stream** option is enabled (network parameters).

To disable UDP stream, click on the UDP panel.

16.2. Service program. TCP/IP Connection

To connect to the scanner over TCP, click on the TCP panel. Once the connection is established, the program shows the panels for parameters setting, and activates the panels **Profile**, **Image** and **System**.



In order to hide the **Connection** panel, click or use the keyboard shortcut **Ctrl+H**.

To disable the TCP connection, click **DISCONNECT**.

If you can not connect to the scanner over TCP:
- Make sure that the network settings are correct.
- Make sure that the scanner and your PC are in the one subnet. If not, you need to change the subnet on your PC.
- Reboot the scanner.

16.3. RFSDK. Scanner connection/disconnection

`RF625Device::Connect ( )`
Connect to the scanner over TCP.
The RF625Device object must be created with indicating the valid parameter *LPUDP_DEVINFOBLOCK_PC*.

`RF625Device::Connect (LPUDP_DEVINFOBLOCK_PC lpDevBlock )`
Connect to the scanner over TCP.

`RF625Device::UDPConnect ( USHORT usUDPPort, LPCSTR szLocalIPAddress = NULL )`
Connect to the scanner over UDP.
The optional parameter *szLocalIPAddress* is a string containing the IP address of the network interface from which the connection is performed.

`RF625Device::UDPConnect ( LPCSTR szLocalIPAddress = NULL )`
Connect to the scanner over UDP.
The RF625Device object must be created with indicating the valid parameter *LPUDP_DEVINFOBLOCK_PC*.

`RF625Device::UDPDisconnect ()`
Disconnect the scanner (UDP).

`RF625Device::Disconnect ()`
Disconnect the scanner (TCP).

16.4. RFSDK and control protocol. Profile receiving

Control protocol	TCP: GetResult : 0x01
SDK	- **GetResult** (void * lpBuffer) Read the packet to the buffer (TCP). - **GetNormalizedResult** (float OUT * lpPointsBuffer, USHORT OUT * lpCount, USHORT * lpMeasureCnt = NULL, USHORT * lpPacketCnt = NULL) Read the packet that was recalculated in the float array (lpPointsBuffer). lpCount receives a quantity of profile points, and optional parameters to receive the measurement number and the packet number. - **UDPGetResult** (void * lpBuffer) Read the packet to the buffer (UDP). - **UDPGetNormalizedResult** (float OUT * lpPointsBuffer, USHORT OUT * lpCount, USHORT * lpMeasureCnt = NULL, USHORT * lpPacketCnt = NULL) Read the packet that was recalculated in the float array (lpPointsBuffer). lpCount receives a quantity of profile points, and optional parameters to receive the measurement number and the packet number.

The data packet structure is described in p. 27.

17. Image receiving

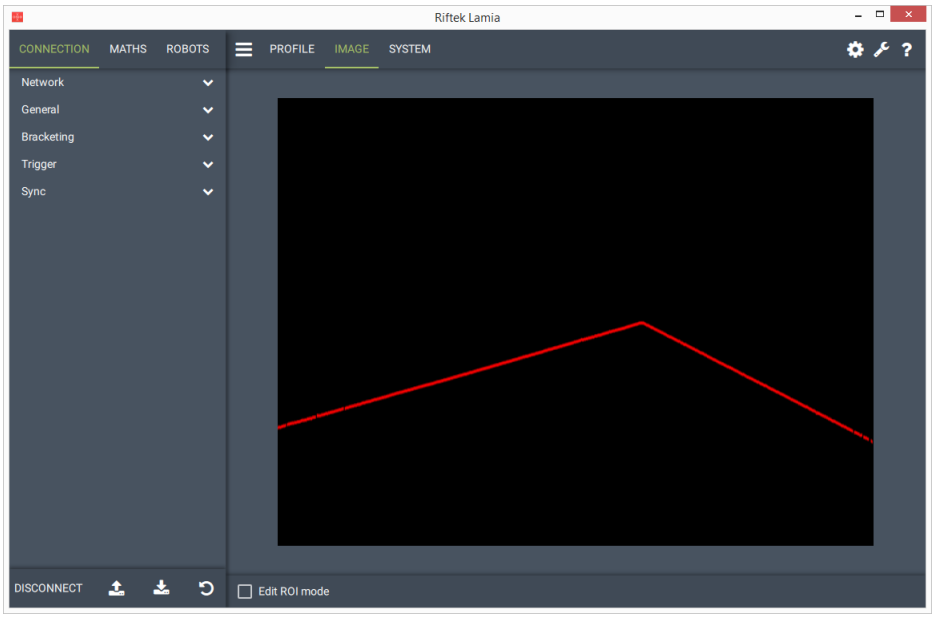
17.1. Service program

With TCP connection the scanner can operate in the image transmission mode. In this mode, the scanner can transmit:

- the laser line image on the object surface, generated by CMOS-sensor, or
- the processed image after the digital filtering. This image is used for extracting the profile.

The image transmission rate is about 10 frames/second. This mode is used in manual tuning of the scanner.

To switch to the image observation mode, click the **Image** button.



By moving the object or the scanner, observe changes in the image.

17.2. RFSDK and control protocol

Control Protocol	GetImage : 0x02 GetImageBuffer : 0x03	By the *GetImage* request, the scanner switches to the mode of transmitting the current image, which was formed before the request. A full frame size of the image equals to 512*640+1 byte.
SDK	**GetImage** (void * lpBuffer) Read a raw array containing the values of pixels.	By the *GetImageBuffer* request, the scanner sends in response a part of the image with size of 32768+1 byte. Thus, in order to collect a full image, you must send the *GetImageBuffer* request 10 times. For each request, the *Offset* value is incremented by 32768 +1 (starting with zero for the first packet), the *Size* equals to 32768 +1 (for all requests). The first byte of the packet is the counter of the image frame part.

18. Parameters setting procedure

18.1. Service program

In order to change parameters, connect to the scanner over TCP, activate the panel, write a new value into the field, and press the **Enter** key. All parameters except network parameters are applied immediately after pressing the **Enter** key. For the network parameters to take affect after changing, you need to click  and reboot the scanner.

All changes are made in RAM and will be lost when you reboot the scanner. Always save them to the nonvolatile memory before you reboot the scanner.

Buttons assignment:

	Read parameters from RAM.
	Save parameters to the nonvolatile memory of the device. **Note**. Only for such a case, with any subsequent activation of the device it will work in the configuration you have selected.
	Restore the factory (default) values of parameters.

18.2. RFSDK and control protocol

18.2.1. Reading and writing parameters

Reading parameters are performed by one request (*ReadParams*), in response to which the scanner sends the packet with settings of 512 bytes (see p. 27.3). All settings are available for editing and their values are described in this User's Manual.

Writing parameters to the scanner are performed by the command *WriteParams*. All settings, excepting the network settings, are applied immediately. Network settings are applied after rebooting the scanner.

All settings are stored in RAM and will be lost when restarting the scanner, or when power is turned off. In order to save settings to a non-volatile memory, use the command *FlushParams* (see p. 18.2.3).

The first two bytes of settings is the settings version. The older firmware versions do not support the functions introduced in the latest versions.

Control protocol	ReadParams (0x04) WriteParams (0x05)
Settings packet	-
SDK	- **ReadParams** ( ) Read user parameters. - **ReadParams** (void * lpBuffer) Read user parameters to the buffer. - **ReadParamsToFile** (const char * szFileName) Save user parameters to a file. - **WriteParams** ( ) Write user parameters to the RAM of the sensor. - **WriteParams** (void * lpBuffer) Write user parameters from the buffer to the RAM of the sensor. - **WriteParamsFromFile** (const char * szFileName) Write user parameters from the file to the RAM of the sensor.

18.2.2. Restoring default parameters

Control protocol	FlushParams (0x06) with additional parameter = 1
SDK	**FlushParams** (BOOL bDefault = TRUE)

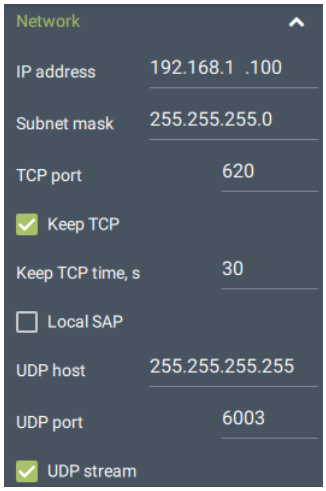
18.2.3. Saving parameters to the non-volatile memory

Control protocol	FlushParams (0x06)
SDK	**FlushParams** (BOOL bDefault = FALSE)

19. Interface settings

19.1. Service program

In order to set the interface parameters, connect to the scanner over TCP and activate the **Network** panel.



Parameter	Factory value	Description
IP address	192.168.1.100	TCP/IP address of the scanner.
Subnet masc	255.255.255.0	Subnet masc of the scanner.
TCP port	620	Port to which the scanner sends data packets over TCP (must be open on the receiving PC).
Keep TCP	On	Keep the TCP connection during specified time, when the communication is lost.
Keep TCP time, s	30	Time of keeping the TCP connection (seconds).
Local SAP	Off	Local SAP (Service Advertising Protocol).
UDP host	255.255.255.255	IP address to which the packets are sent, when the UDP data stream is enabled.
UDP port	6003	Port to which the packets are sent over UDP.
UDP stream	On	Transmit data over UDP.

When you change the network settings, it is necessary to write them to the nonvolatile memory, and to reboot the scanner for the changes to take effect.

19.2. RFSDK and settings packet. TCP connection

19.2.1. IP address

Control protocol	-
Settings packet	ucTCPAddress[4] (16-13)
SDK	- **GetDeviceIPAddress** ( ) Get the scanner IP address as array of 4 bytes. - **SetDeviceIPAddress** (BYTE ucValue[4]) Set the scanner IP address as array of 4 bytes. It is necessary to call *WriteParams ( )* to apply settings. - **GetHumanReadableDeviceIPAddress** ( ) Get the scanner IP address as a string.

19.2.2. Subnet mask

Control protocol	-
Settings packet	ucTCPSubnetMask[4] (20-17)
SDK	- **GetNetworkMask** ( ) Get the network mask of the scanner as array of 4 bytes. - **SetNetworkMask** (BYTE ucValue[4]) Set the network mask of the scanner as array of 4 bytes. It is necessary to call *WriteParams ( )* to apply settings. - **GetHumanReadableNetworkMask** ( ) Get the network mask of the scanner as a string.

19.2.3. TCP port

Control protocol	-
Settings packet	wTCPPort (30-29)
SDK	- **GetDevicePortNumber** ( ) Get the TCP port number of the scanner. - **SetDevicePortNumber** (WORD usPort) Set the TCP port number of the scanner. It is necessary to call *FlushParams ( )* to apply settings.

19.2.4. Keeping TCP connection

Control protocol	-
Settings packet	wKeepTCPTime (45-44) ucKeepTCP (46)
SDK	- **GetKeepTCPEnabled** ( ) Get the state value (TRUE = enabled). - **GetKeepTCPTime** ( ) Get the current value of time. – **SetKeepTCP** (BOOL bEnable, WORD wTime = 0) Enable/disable the function and set the time. It is necessary to call *WriteParams ( )* to apply settings.

19.3. RFSDK and settings packet. UDP connection

19.3.1. UDP host

This parameter specifies the IP address of the network interface, to which the calculations data will be sent by UDP.

Control protocol	-
Settings packet	ucUDPAddress[4] (24-21)
SDK	- **GetHostIPAddress** ( ) Get the host IP address that receives data over UDP (it may be broadcast) as array of 4 bytes. **SetHostIPAddress** (BYTE ucValue[4]) Set the host IP address that receives data over UDP (it may be broadcast) as array of 4 bytes. It is necessary to call *WriteParams ( )* to apply settings. - **GetHumanReadableHostIPAddress** ( ) Get the host IP address as a string.

19.3.2. UDP port

This parameter specifies the destination port on the data receiver.
The default port is **6003**.
Tip: If there are multiple scanners on the network, use the unique port for each of them.

Control protocol	-
Settings packet	wUDPPort (26-25)
SDK	- **GetHostPortNumber** ( ) Get the UDP port number of the host. - **SetHostPortNumber** (WORD wValue) Set the UDP port number of the host that receives data over UDP. It is necessary to call *WriteParams ( )* to apply settings.

19.3.3. UDP stream

This parameter determines whether the data transmission is enabled over UDP.
Values: Enabled (1) and Disabled (0).
When the UDP stream is enabled, the scanner transmits results to the specified network address.

Control protocol	-
Settings packet	ucUDPStream (55)
SDK	- **GetUDPStreamEnabled** ( ) Get the state value. - **SetUDPStream** (BOOL bEnable) Enable/disable the UDP data stream. It is necessary to call *WriteParams ( )* to apply settings.

20. Image quality settings

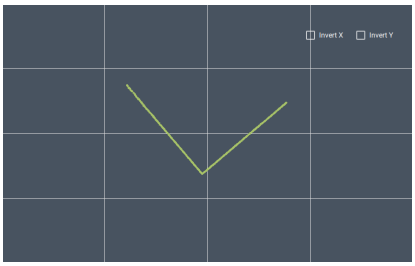
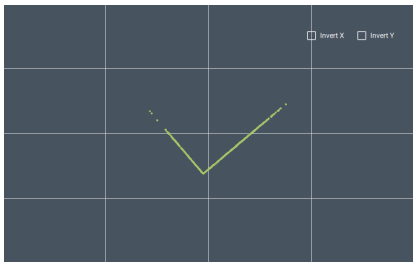
Connect to the scanner over TCP and activate the **General** panel.

20.1. "Laser level" parameter

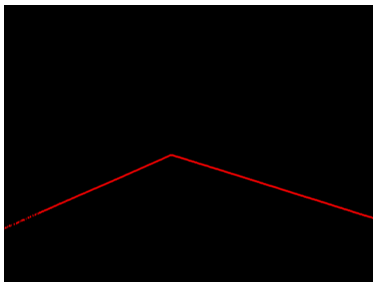
This parameter allows to adjust the output power of laser radiation in order to obtain optimal results in the measurement of objects with different reflectivity.

The output power is adjusted manually based on the quality of the image obtained from the image sensor in the image transmission mode, as well as based on analysis of the resulting profile quality. Possible values are in the range of 0…255 (0 – shutdown, 255 – full power). Dependence between a real power and the set power is non-linear.

NOTE. This parameter is not valid for scanners with power IR lasers.

Laser level is low	Laser level is optimal
	

The same profile in the **Image** mode:



Depending on the scanner configuration, the profile in the **Image** mode may be inverted by Z axis.

20.1.1. RFSDK and settings packet

Control protocol	-
Settings packet	ucLaserLevel (2)
SDK	- **GetLaserLevel** ( ) Get the current value of the laser level. - **SetLaserLevel** (BYTE ucValue) Set the laser level value into the block of user settings. It is necessary to call *WriteParams ( )* to apply settings.

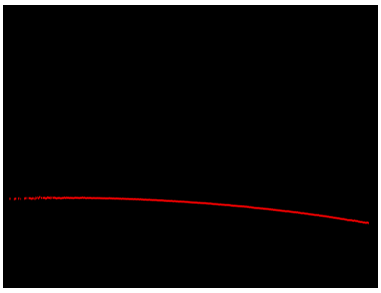
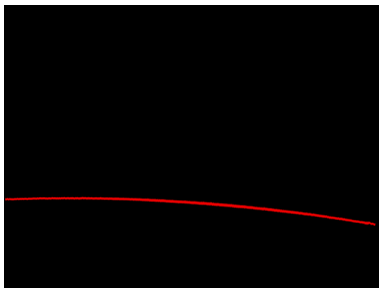
20.2. "Exposure time" parameter

The intensity of the reflected light entering the scanner depends on the properties of the surface of the object under control. In turn, the value of electric signal generated by the CMOS image sensor of the scanner depends on the time of accumulation of radiation (integration time). Therefore, in order to obtain optimum signal, it is necessary to set optimal integration time of the image sensor.

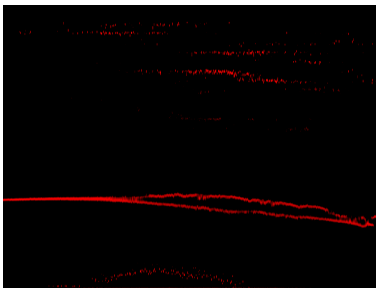
Exposure time is set manually based on visual analysis of the quality of the image obtained from the image sensor in the image transmission mode, and on analysis of the quality of the resulting profile.

NOTE 1. The exposure time is adjusted in the range of 0...3600 us for 250 Hz scanners and 0...1912 us for 500 Hz scanners. In the ROI mode the exposure time is limited by ROI parameters (the maximum possible exposure time is getting less with reducing ROI parameters).

NOTE 2. The laser is turned on only during the exposure time in all scanners, excepting the models with the external laser control.

The exposure time is too low (the profile is not completely visible)	The exposure time is optimal
	

The exposure time is too high:



20.2.1. RFSDK and settings packet

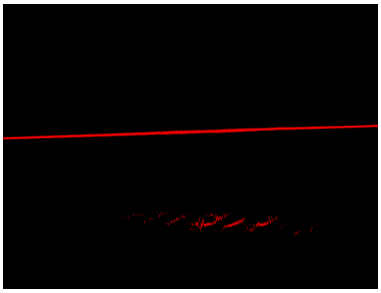
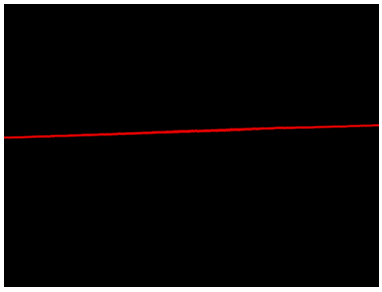
Control protocol	-
Settings packet	wExposureTime (4-3)
SDK	- **GetExposureTime** ( ) Get the current value of the exposure time. - **SetExposureTime** (WORD wValue) Set the exposure time value into the block of user settings. It is necessary to call *WriteParams ( )* to apply settings.

21. Profile extraction quality settings

Connect to the scanner over TCP and activate the **General** panel.

21.1. "Brightness threshold" parameter

This parameter controls the level of profile detection on the image. Increasing this parameter allows to decrease the influence of image noise. By default, value is "0". The range of values: 0..255. When the value is 255, the image is not processed.

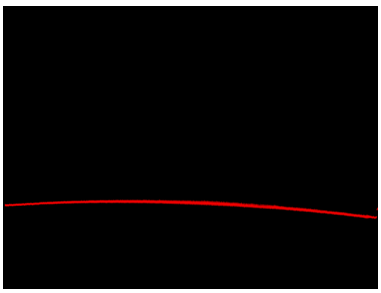
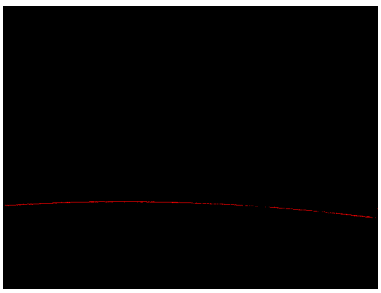
Profile detection level = 0	Profile detection level = 170
	

21.1.1. RFSDK and settings packet

Control protocol	-
Settings packet	ucPixelBrightnessThres (32)
SDK	- **GetPixelBrightnessThreshold** ( ) Get the current value of the profile detection level. - **SetPixelBrightnessThreshold** (BYTE ucValue) Set the value of the profile detection level.

21.2. "Dif brightness threshold" parameter

This parameter controls the image filter parameter. Increasing this parameter allows to decrease the image noise influence on the profile extraction. By default, value is "0". The range of values: 0..255.

Dif brightness thresh = 0	Dif brightness thresh = 200
	

21.2.1. RFSDK and settings packet

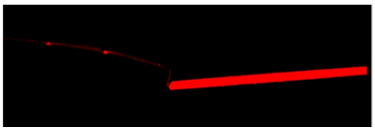
Control protocol	-
Settings packet	ucDifBrightnessThres (33)
SDK	- **GetDifBrightness** ( ) Get the *Dif brightness thresh* value. - **SetDifBrightness** (BYTE ucValue) Set the *Dif brightness thresh* value.

21.3. "Raw image" parameter

21.3.1. Service program

The **Raw image** option is intended to select the type of image displayed in the **Image** panel and used to extract the profile.

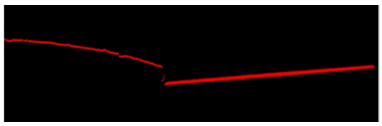
When the option is selected, the image without filtering is used. An example of the image without filtering:



In this image, a complex object has a curved section featuring low reflectivity (poorly developed image) and a straight section with a high reflectivity (a saturated image). If this image is used to extract the profile, the profile at the first section will be obtained with coordinates missing, while that of the second section with a significant error.

NOTE 1. Use unfiltered image only to configure scanner parameters.

The same image, but after filtering (**Raw image** is not selected) is shown below:



NOTE 2. Always use this mode to obtain the profile.

21.3.2. RFSDK and settings packet

Control protocol	-
Settings packet	ucRawImageMode (34)
SDK	- **GetEnabledRawImageMode** ( ) Get the value of the mode state (TRUE = enabled). - **SetEnableRawImageMode** (BOOL bEnable) Enable/disable the raw image mode.

22. Additional settings

Connect to the scanner over TCP and activate the **General** panel.

22.1. "Double speed" parameter

This parameter switches the scanner into 500 Hz mode. In the normal mode the scanner processes all rows of the CMOS-array per 4 ms. In the DHS mode the scanner processes the CMOS-array per 2 ms that doubles the frequency of measurements with increasing the error up to 0.2% at Z.

22.1.1. RFSDK and settings packet

Control protocol	-
Settings packet	ucDHSEnable (36). Values: 500Hz =1; 250Hz=0
SDK	- **GetEnableDHS** ( ) Get the value of the mode state (TRUE = enabled). - **SetEnableDHS** (BOOL bEnable) Enable/disable the double speed mode. It is necessary to call *WriteParams ( )* to apply settings.

22.2. "ROI state" parameter

The ROI (region of interest) parameter controls the active area size of CMOS-array.

By default, active area covers entire area of the sensor. Active area size decreasing allows to increase the scanner speed due to decreasing of reading time of the image.

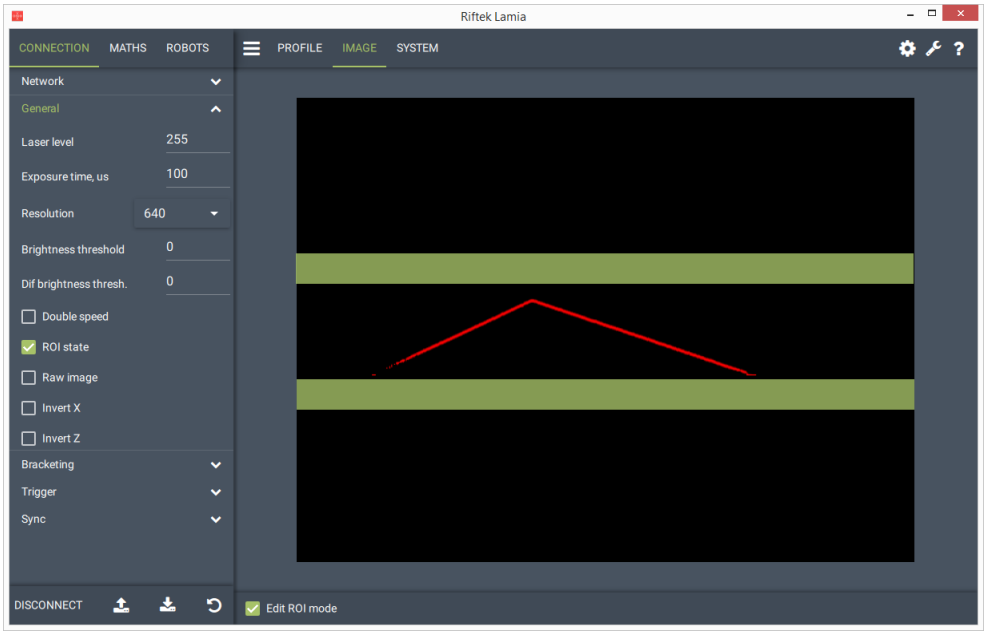
Resizing is possible in Z-direction only and is specified in the CMOS-sensor coordinates.

ROI is defined by two parameters:

- **Position** – can be set in the range of 0...416 with the step of 32.
- **Height** – can be set in the range of 64...480 with the step of 64.

Thus, the minimum height of ROI is 64 pixels.

To change the active area size, activate the **Image** panel, select the **Edit ROI mode** (in the bottom part of the window), and move limiters by mouse. To apply settings, select the **ROI state** option on the **General** tab.



22.2.1. RFSDK

Control protocol	-
Settings packet	-
SDK	– **GetROIEnabled** ( ) Get the value of the mode state (TRUE = enabled). – **GetUpperBoundary** ( ) Get the current value of the upper boundary of the window. – **GetWindowHeight** ( ) Get the current value of the window height. – **SetROI** (BOOL bEnable, WORD wUpperBoundary = 0, WORD wWindowHeight = 0, BYTE ucAP = 0, BYTE ucAH = 0) bEnable – enable/disable the ROI mode. If the mode is enabled, it is necessary to set the parameters: wUpperBoundary (the upper boundary of the window), wWindowHeight (window height). Parameters ucAP and ucAH are reserved, and must be equal to 0. It is necessary to call *WriteParams ( )* to apply settings. – **SetUpperBoundary** (WORD wValue) Set the value of the upper boundary of the window. It is necessary to call *WriteParams ( )* to apply settings. – **SetWindowHeight** (WORD wValue) Set the value of the window height. It is necessary to call *WriteParams ( )* to apply settings.

22.2.2. Active area size and scanner speed

Relationship between the scanner speed and the sensor active size is shown in Table:

Size, pixels	Speed, profiles/s	Maximal possible integration time, us
480	250	4000
416	288	3472
352	341	2932
288	416	2403
224	535	1869
160	750	1333
128	937	1066
64	1875	533

22.3. "Resolution" parameter

This parameter sets the quantity of profile points along the X coordinate, for which the calculation of the coordinate value must be performed. Values: 80, 160, 320, 640, 1280. By default, the value is 640.

The CMOS sensor of the scanner contains 640 columns. When the resolution is 640, all columns will be processed. The resolution of 1280 points is achieved by interpolation of the image in adjacent columns. Reducing the resolution is performed by reducing the quantity of processed columns, and allows to reduce the quantity of points in the profile, and thereby to facilitate the data transfer at high frequencies of the scanner.

22.3.1. RFSDK and settings packet

Control protocol	-
Settings packet	ucInterpolation (35)
SDK	- **SetInterpolation** (BYTE ucType) Set the value of the X-resolution. ucType: 0, 1, 2, 3, 4. 0 : 80, 1 : 160, 2 : 320, 3 : 640, 4 : 1280. It is necessary to call *WriteParams ( )* to apply settings. - **GetInterpolation** ( ) Get the value of the X-resolution.

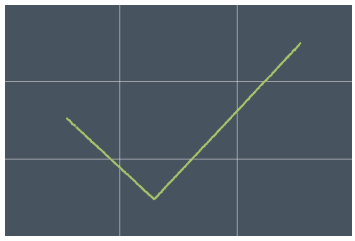
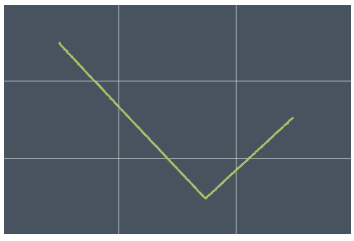
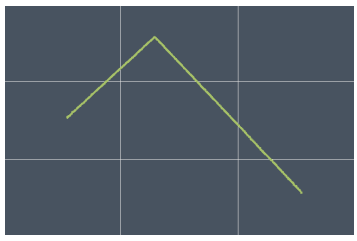
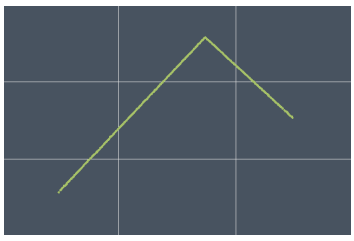
22.3.2. Scanner speed and resolution for X

Relationship between the scanner speed and the number of points for X-coordinate is shown in Table:

Points quantity	250Hz Mode, Hz	500Hz Mode, Hz	ROI, Hz
80	250	500	1875
160	250	500	1875
320	250	500	1875
640	250	500	-
1280	250	-	-

22.4. Inverting of the scanner axes

Options **Invert X** and **Invert Z** allows to change the direction of coordinate axes of the scanner.

Source profile	"Invert X" is enabled
	
"Invert Z" is enabled	**"Invert X" and "Invert Z" are enabled**
	

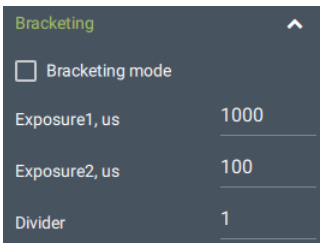
22.4.1. RFSDK and settings packet

Control protocol	-
Settings packet	invertXZ (59) &0x01 – Invert X, &0x02 – Invert Z
SDK	– **GetXInverted** ( ) Get the state of the 'Invert X' option (0 – disabled, ≠0 – enabled). – **GetZInverted** ( ) Get the state of the 'Invert Z' option (0 – disabled, ≠0 – enabled). – **SetXInverted** (BOOL value) Enable/disable the 'Invert X' option. It is necessary to call *WriteParams ( )* to apply settings. – **SetZInverted** (BOOL value) Enable/disable the 'Invert Z' option. It is necessary to call *WriteParams ( )* to apply settings.

23. Exposure bracketing

23.1. Service program

Connect to the scanner over TCP and activate the **Bracketing** panel.



Parameter	Factory value	Description
Bracketing mode	Off	The mode of receiving profiles using different exposure settings. When enabled, the scanner applies two exposure values alternately. Switching occurs when a clock signal appears, for each signal multiple of N (where N is the number of measurements per one exposure value). Example: Custom frequency = 50 Hz, Divider = 1 => switching 50 times per second, each frame with exposure 1 and exposure 2 alternately. Custom frequency = 100 Hz, Divider = 4 => switching 25 times per second, 4 frames with exposure 1 and exposure 2 alternately.
Exposure1, us	1000	1st exposure value for bracketing mode.
Exposure2, us	100	2nd exposure value for bracketing mode.
Divider	1	The division factor for the current frequency (applied only for the bracketing mode).

The **Bracketing** mode works only when you connect to the scanner over UDP.

23.2. RFSDK

Control protocol	-
Settings packet	-
SDK	– BOOL **SetEnableStrobe** (BOOL bEnable) Enable / Disable the bracketing mode (TRUE = enabled). – BOOL **SetStrobeExposureValues** (WORD wValue1, WORD wValue2) Set exposure values (wValue1 - exposure 1, wValue2 - exposure 2). – BOOL **SetStrobeFrameInterval** (BYTE ucFrames) Set the divider value.

24. Trigger control parameters

24.1. Signal sources

The trigger is an event that induces the result transmission from the scanner. The result (Cartesian coordinates) is transmitted by UDP-packet or by TCP-request.

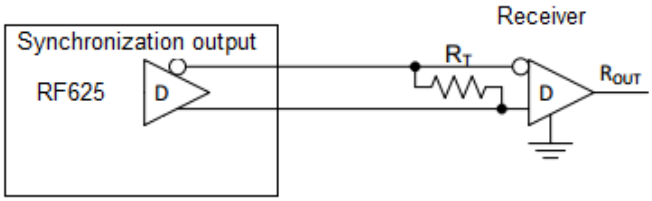
Signal sources (triggers):

1) Maximum frequency. The scanner sends data with the maximum allowed frequency: 249 Hz - for the "Maximum frequency" signal source, 491 Hz - in the DHS mode, or with a frequency according to the region of interest (ROI).
2) Custom frequency. The user sets the synchronization frequency. In accordance with the set frequency, the scanner calculates the current measurement and returns the result by the TCP request or in the UDP data stream. In this mode the first output channel and the first input channel will be switched on automatically.
3) External input. The scanner sends the next frame, if a signal was received within 4 ms. Synchronization on the rising edge is triggered.
4) Encoder. It is advisable to connect only one channel of the encoder, since the scanner does not implement the direction tracking. A zero mark needs to be connected separately, and it will reset only the packets counters.
5) Step/Dir. The packet is sent by Step (Dir is written to the packet parameters).
6) TCP-request.
7) Combination of events listed above.

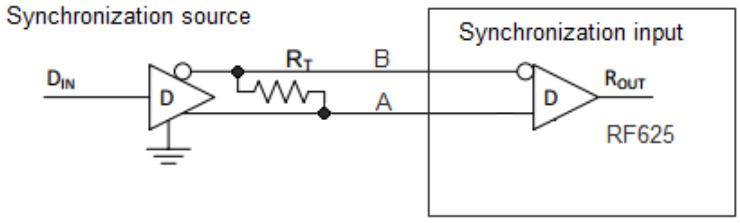
24.2. External inputs/outputs

Four external channels are available: 3 input channels (Input Channel 0...2), 1 output channel (Output Channel 0). Each channel is a differential line with three states that meets the requirements of TIA/EIA-422-B and the recommendations of ITU V.11.

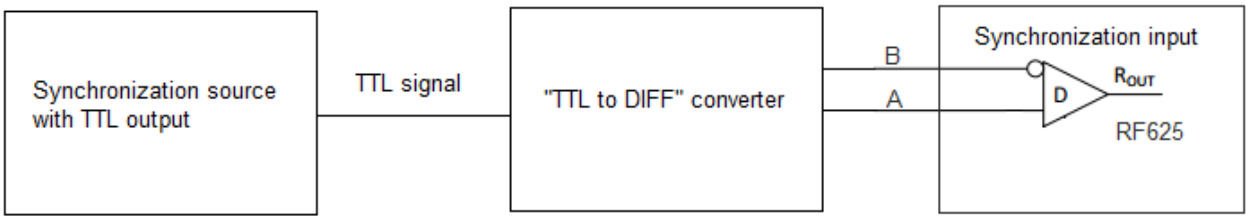
The connection of output channels to an external receiver with a differential input (RT resistor has resistance of 80..120 ohm):



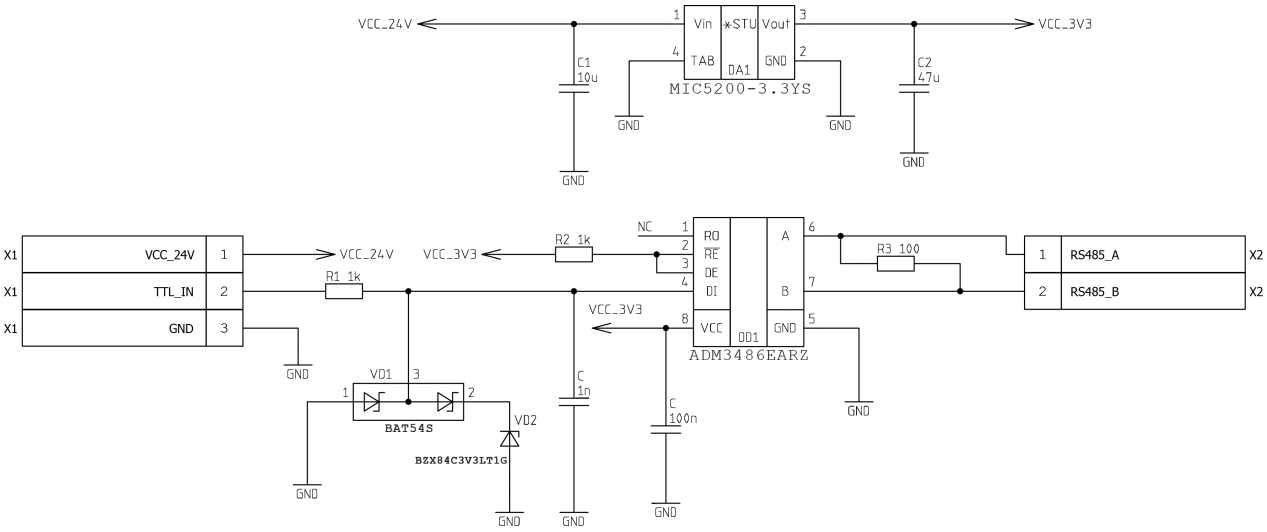
The connection of input channels to an external source with a differential output (RT resistor has resistance of 80..120 ohm):



The connection of the input channel to an external source having the TTL output:



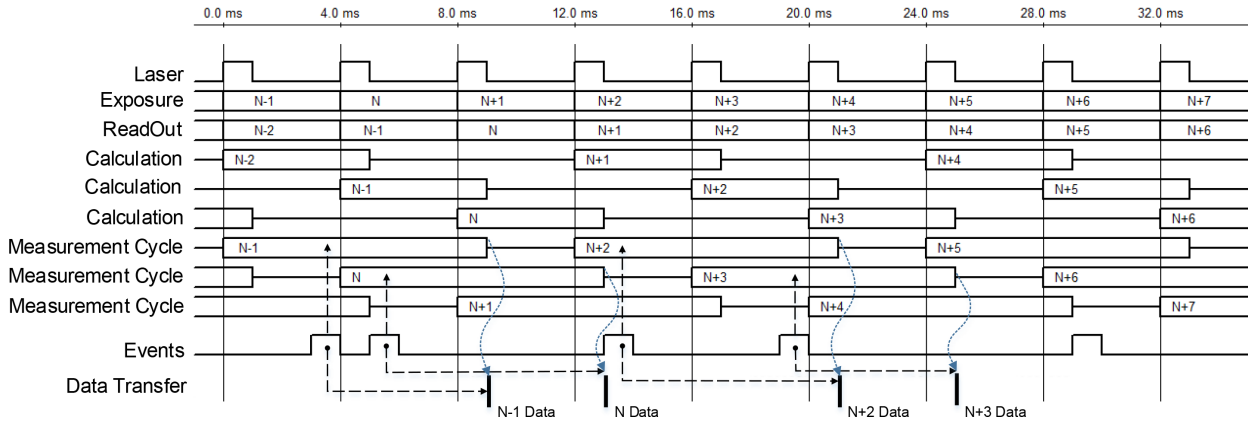
An example of the TTL-Diff converter:



24.3. Time cycles

The operation algorithm of the scanner is built in such a way that image reading and processing (profile extraction) are taken continuously in pipeline mode without stopping the CMOS image sensor. The pipeline mode is explained by diagram on which are marked:

- 4 ms frame period for 250 Hz scanner (2 ms for 500 Hz scanner)
- (N-1), N… – numbers of image frames
- Laser – laser light time, which is equal to the CMOS sensor integration time
- Exposure – cycles of image sensor exposure
- ReadOut – cycles of image reading
- Calculations – cycles of calculations of corresponding frames
- MeasurementCycle – full measurement cycles
- Events – events and corresponding measurement cycles numbers
- Data transfer – the data transfer cycles and corresponding events



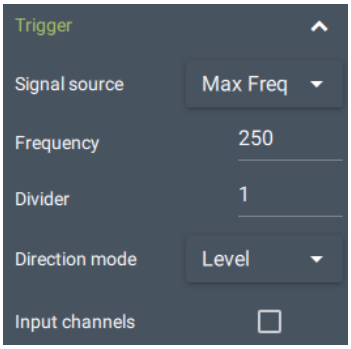
As seen from the chart, three measurement cycles are performed simultaneously. The transmitted result corresponds to the measurement cycle, the beginning of which is closest to the event.

24.4. Events processing

Event / Transmittance mode	UDP-stream	TCP-request	External inputs/outputs
Maximum frequency Frequency is equal to the frequency of image frames (249Hz, 491Hz, or ROI).	The onset of each event corresponds exactly to the beginning of the measuring cycle. Scanner automatically sends the UDP-package with results, when the event occurs. **Examples:** for 250 Hz scanner, packet transmittance frequency = 249 Hz; for 500 Hz scanner, packet transmittance frequency = 491 Hz. In the ROI mode the values depend on ROI parameters.	Scanner sends result over TCP for every request. The result is changed in accordance with the events frequency. If the new request arrives, but result is not changed, the zero value will be transmitted.	It is possible to program one of output channels to transmit the signal.
Custom frequency + Divider The value of custom frequency can be set in the range of 0…250 Hz.	Scanner automatically sends the UDP-package, when the event occurs. **Examples:** custom frequency = 100 Hz, divider = 1, packet transmittance frequency = 100 Hz; when divider = 10, packet transmittance frequency = 10 Hz.		
Trigger signal at the external input of the scanner + Divider	Scanner automatically sends the UDP-package, when the event occurs. The events frequency depends on the divider value and has to be less than scanner working frequency. The minimum frequency is not limited. The user can program the value of the event execution delay. If the sync signal at the external input is absent more than 1 second, the CMOS is stopped, and at the first input sync signal, the CMOS will be run again.		It is possible to program one of *Input channels (0..3)* as the input channel.
Encoder signal + Divider	Scanner automatically sends the UDP-package, when the event occurs. Events are the voltage swings of two quadrature channels of the encoder with the set divider value. Measurements are performed at the custom frequency. The reverse is processed the same as the direct step.		It is possible to program the channels, which are connected to the encoder, as the input channels.
Step/Dir signal	Events – Step. The Step counter corresponds to the measurements counter. The Dir counter is located in the extended area of data packet.		-

24.5. Service program

Connect to the scanner over TCP and activate the **Trigger** panel.



Parameter	Factory value	Description
Signal source	Max. frequency	The event which induces the result transmittance from the scanner: Max frequency, Custom frequency, External Input, Encoder, StepDir.
Frequency	250	The frequency for the "Custom frequency" signal source. The range of values: 0…250 Hz.
Divider	1	The division factor for all signal sources except "Max. frequency" and "Encoder". The range of values: 1…255.
Direction mode	Level	The mode of "StepDir" signal source: Level, Edge, Counter.
Input / Output channels	-	Scanner synchronization channels

24.6. RFSDK

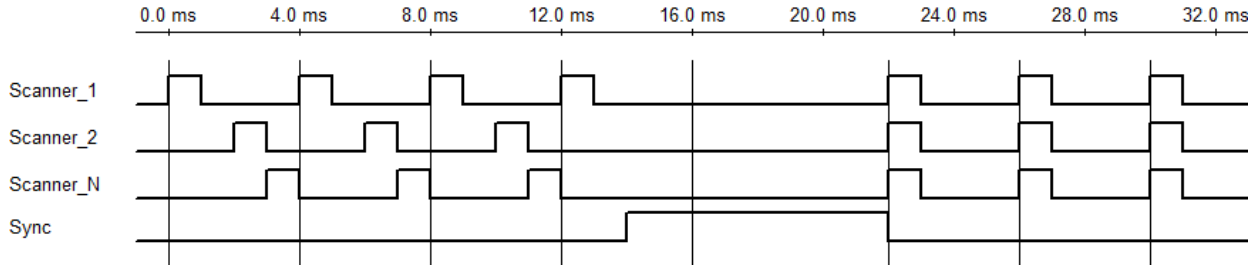
Control protocol	-
Settings packet	-
SDK	– **GetSyncType** ( ) Get the current value of the signal source (0 – max frequency, 1 – custom frequency, 2 – external input, 3 – encoder, 4 – stepdir). – **GetSyncChannels** ( ) Get the current value of the synchronization channels. – **GetSyncMeasure** ( ) Get the state of the measurement synchronization mode (0 – disabled, 1 – enabled). – **GetSyncFreq** ( ) Get the current value of the frequency of additional timer. – **GetSyncDelay** ( ) Get the current delay time (milliseconds). – **GetSyncDivider** ( ) Get the current value of the divider. – **SetSync** (WORD wType, WORD wChannels, BYTE ucMeasureSync, WORD wFreq, WORD wDelay, BYTE ucDivider) Set synchronization parameters. *wType*: signal source (0 – max frequency, 1 – custom frequency, 2 – external input, 3 – encoder, 4 – stepdir). *wChannels*: synchronization channel (0..3). *ucMeasureSync*: synchronization of measurements (0 – disabled, 1 – enabled). *wFreq*: frequency for the "Custom frequency" signal source. *wDelay*: delay (microseconds). *ucDivider*: divider. It is necessary to call *WriteParams ( )* to apply settings.

25. Synchronization of multiple scanners

25.1. Synchronization of measurements

Where measurements are made by several scanners, it is often necessary to ensure synchronous measurement operations, in order, for example, to combine profiles obtained from different parts of the moving object into a single profile. To achieve synchronous operation of the scanners, it is necessary to:

1) ensure synchronization of the start time of measurement cycles of scanner by feeding of synchronization impulse on synchronization inputs of the scanners. When high level occurs at the synchronization input, the scanners complete, and then stop internal cycles, and reset the frame counter. By the wave-fall of the synchronization pulse (transition to low level) all scanners simultaneously start the cycles of measurement. Duration of the synchronization pulse should not be less than the duration of the scanner time cycle.

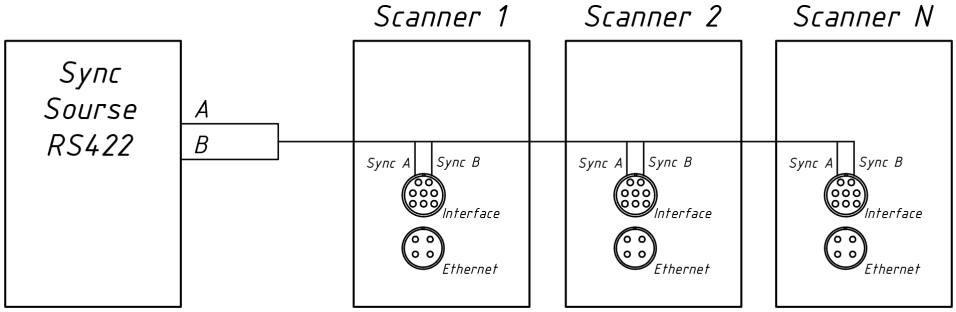


2) eliminate or reduce asynchronous behavior of measurement cycles of scanners during long time (long-term synchronization), which is caused by frequency instability of the internal oscillators of the scanners. The actual duration of the scanner time cycle depends on the frequency of scanner's internal oscillator, and, for example, with the oscillator instability of ± 50 ppm mistiming of frames of two scanners can reach one frame after 40 s or 10,000 frames. To keep the synchronous work of the scanners, it is necessary to perform periodically the synchronization of the cycle beginning in accordance with the previous point.
3) interpret correctly the frame numbers and packet numbers received from the scanners (see p. 25.3).

25.2. Clock signal source

The clock signal source is an external generator.
To synchronize the beginning of cycles of multiple scanners, it is necessary to:

- combine the synchronization inputs of all scanners;
- select the synchronization channels for every scanner;
- feed the clock pulse;
- restore the synchronization periodically.



Constraints of the clock pulse:
1) scanners are synchronized by the level;
2) to reset, it is needed to keep the level for at least 4 ms;
3) after resetting, wait at least 13 ms in order to receive the first profile. The minimum clock signal frequency for resetting is 1/17 ms = 58.8 Hz. The recommended minimum frequency is 50 Hz (with that frequency, 1 or 2 measurements will be received).

25.3. Numbers of frames and packets

Frame and packet numbers transmitted in data packets make it possible to compare profiles obtained from different scanners with synchronized cycle start, and to combine them correctly into a single profile.

The scanner data packet contains two counters: the measurement counter and the packet counter. The packet counter is incremented with the each sent packet of measurements, the measurement counter is incremented with each measurement.

25.4. Separation of laser beams of multiple scanners

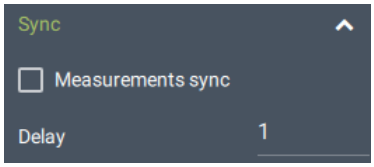
There are two ways to separate the laser beams of the scanners when they can "see" each other's beams during the synchronization of measurements:

- Use scanners with laser beams of different wavelengths, or
- Set the **Delay** parameter for one of them.

NOTE. Synchronization with delay will put constraints on the exposure time. For example, if you set the exposure time of 1800 us for both scanners, they will not see each other for 9 seconds.

25.5. Service program

Connect to the scanner over TCP and activate the **Sync** panel.



Parameter	Factory value	Description
Measurements sync	Off	Synchronization of measurements of multiple scanners.
Delay	1	Delay time of reaction to the clock pulse (in microseconds). The measurement cycle beginning will be delayed for this value.

To synchronize measurements of multiple scanners, you must enable **Measurements sync** and set the **Delay** parameter.

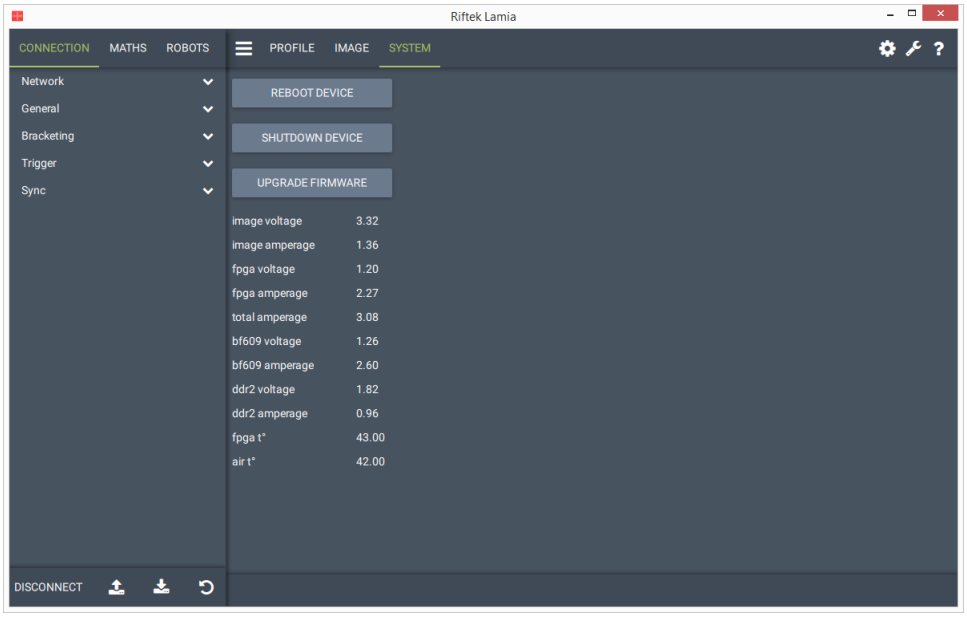
25.6. RFSDK and settings packet

Control protocol	-
Settings packet	ucMeasureSync (40)
SDK	– **GetSyncType** ( ) Get the current value of the signal source (0 – max frequency, 1 – custom frequency, 2 – external input, 3 – encoder, 4 – stepdir). – **GetSyncChannels** ( ) Get the current value of the synchronization channels. – **GetSyncMeasure** ( ) Get the state of the measurement synchronization mode (0 – disabled, 1 – enabled). – **GetSyncFreq** ( ) Get the current value of the frequency of additional timer. – **GetSyncDelay** ( ) Get the current delay time (milliseconds). – **GetSyncDivider** ( ) Get the current value of the divider. – **SetSync** (WORD wType, WORD wChannels, BYTE ucMeasureSync, WORD wFreq, WORD wDelay, BYTE ucDivider) Set synchronization parameters. *wType*: signal source (0 – max frequency, 1 – custom frequency, 2 – external input, 3 – encoder, 4 – stepdir). *wChannels*: synchronization channel (0..3). *ucMeasureSync*: synchronization of measurements (0 – disabled, 1 – enabled). *wFreq*: frequency for the "Custom frequency" signal source. *wDelay*: delay (microseconds). *ucDivider*: divider. It is necessary to call *WriteParams ( )* to apply settings.

26. Diagnostic, emergency commands and firmware upgrade

In order to activate the **SYSTEM** panel, connect to the scanner over TCP and click **SYSTEM**. This panel displays parameters of the scanner hardware condition and contains the buttons for:

- emergency commands (**REBOOT DEVICE** and **SHUTDOWN DEVICE**),
- firmware upgrade (**UPGRADE FIRMWARE**).



26.1. Scanner hardware diagnostic

The diagnostic provides information about condition of the basic electric circuit nodes of the scanner. This information displays on the **System** panel. The scanner condition packet is described in p. 27.3.3.

26.1.1. RFSDK and control protocol

Control protocol	GetExtends (0x20)
Settings packet	-
SDK	**GetExtends** (void * lpBuffer) Get the current values of the scanner state into the buffer.

26.2. Emergency commands

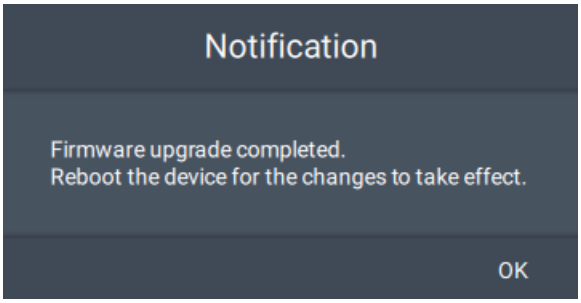
The correct shutdown and reboot are necessary for the file system safety. Always use the **REBOOT DEVICE** button to reboot the scanner, and the **SHUTDOWN DEVICE** button to reset the current connections.

26.2.1. RFSDK and control protocol

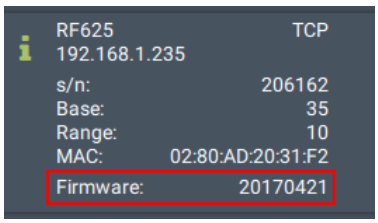
Control protocol	Reboot (0x14) Shutdown (0x16)
Settings packet	-
SDK	- **Reboot** ( ) Reboot the scanner. - **PowerOff** ( ) Shutdown the scanner.

26.3. Firmware upgrade

To upgrade the scanner firmware, click **UPGRADE FIRMWARE**, and select a file. Upon successful firmware upgrade, the following message appears:



Next, it is necessary to click **REBOOT DEVICE** to reboot the scanner.
To view the current firmware version, click "**i**" on the connection panel:



26.3.1. RFSDK and control protocol

Control protocol	UpgradeFW (0x15)
Settings packet	-
SDK	**UpgradeFW** (const char *szFilename) Upgrade the scanner firmware.

27. Network protocols

Network protocols are the only way to receive the measurement data from the scanner and to change its parameters. All protocols are implemented on the basis of the IPv4 stack.

There are two groups of protocols: protocols based on TCP and protocols based on UDP. The TCP based protocols: scanner control protocol, measurements data transfer protocol. The UDP based protocols are intended to transmit data at the set frequency, to detect the scanner on the network, and to sent emergency commands.

The list of connections, used in RF625 scanners					
Connection	**Customi-zable**	**Port**	**Customi-zable**	**Work period**	**Description**
Scanner Detection Protocol					
Dispatch to address 255.255.255.255	No	UDP:6001	No	It works always and switches off only during an active TCP connection	The packet with information about the scanner is sent every 2 seconds. See p. 27.1.
Dispatch to address 255.255.255.255	No	UDP:62500	No	It works always	
Dispatch to a broadcast address of the scanner network interface	Yes	UDP:62501	No	It works always and switches off only during an active TCP connection	

Scanner Control Protocol					
Customizable IP address of the scanner	Yes	TCP:620	Yes	It works always only in the connection standby mode	See paragraphs 27.2 and 27.3
Measurements Data Transfer Protocol					
Customizable Host IP address	Yes	UDP:6003	Yes	It works always and switches off only during an active TCP connection	See p. 27.2.
Emergency Control Protocol					
Waiting for the broadcast packet	No	UDP:62533	No	It works always	See p. 27.4.

27.1. Scanner detection protocol

When connected to the network and powered, the scanner communicates the broadcast information packet to 255.255.255.255 address, UDP:6001 with periodicity of one time in two seconds.

```
_UDPI_RFDEVICEINFOBLOCK_ :
      typedef struct _UDPI_RFDEVICEINFOBLOCK_
      {
            unsigned short      usDeviceType;
            unsigned char       ucIP[4];
            unsigned char       ucMAC[6];
            unsigned char       ucInfo[256];
      }   tUDPI_RFDeviceInfoBlock;
```

Description of the **ucInfo** structure		
Type	**Size, byte**	**Description**
Byte	0	Service information
Byte	3-1	Serial number of the device
Word	5-4	Base distance, mm
Word	7-6	Measurement range. Z axis, mm
Word	9-8	Measurement range. Xsmr, mm
Word	11-10	Measurement range. Xemr, mm
Word	13-12	Bringing the coordinates, mm
Word	15-14	Invalid values
Dword	19-16	Linux version
Byte	20	Laser color
Uint	24-21	CoreA version
Uint	28-25	CoreB version
Uint	32-29	FPGA version
Byte	199-33	Reserved
Byte	200	Valid values: 0, 1, 2, 3 = no, voltage, current, voltage and current
Byte	201	Valid values: 0, 1 = No, Yes
Byte	202	TCP connection is established
Word	221-220	User-defined UDP port
Word	223-222	Customer ID
Word	225-224	User-defined TCP port
Word	227-226	Reserved
Word	229-228	CMOS-sensor power supply

Word	231-230	CMOS-sensor current
Word	233-232	FPGA power supply
Word	235-234	FPGA current
Word	237-236	System power supply
Word	239-238	System current
Word	241-240	CPU power supply
Word	243-242	CPU current
Word	245-244	RAM power supply
Word	247-246	RAM current
Word	249-248	CPU internal temperature
Word	251-250	CPU external temperature
Word	253-252	FPGA temperature
Word	255-254	Air temperature inside the scanner

27.2. Measurements data transfer protocol

The measurements transfer without the active TCP connection is performed over UDP according to updating the data by the basic or additional timer (internal synchronization) or by external sync signal.

The measurements transfer is performed on a customizable IP address and port of the host (see p. 19).

When the TCP connection is active, the data transfer is performed by request GetResult, based on TCP (see p. 27.3).

Data packet structure		
Type	**Address, byte**	**Description**
ushort	1..0	Measurement number
ushort	3..2	Packet number
int	7..4	System time of package sending (in microseconds)
byte	8	Protocol version number
byte	9	0xFF
ushort	11..10	Quantity of points [N]
N*sizeof(short)	(12 + N*2 - 1) .. 12	Values X
N*sizeof(unsigned short)	(12 + N*2*2 — 1) .. (12 + N*2)	Values Z
short	(12 + N*4 + 1) .. (12 + N*4)	Size of additional parameters (see below). Nowadays it equals to 8.
byte	12 + N*4 + 2	Types of additional parameters: 1 - common information 2 - math calculations
3*sizeof(byte)	(12 + N*4 + 5) .. (12 + N*4 + 3)	Serial number
uint16	(12 + N*4 + 7) .. (12 + N*4 + 6)	User XEMR
uint16	(12 + N*4 + 9) .. (12 + N*4 + 8)	User ZDiap
uint16	(12 + N*4 + 11) .. (12 + N*4 + 10)	Check sum (CRC-16)

NOTES:

1. Measurement number: a cyclic counter of frames taken and processed (calculated) by the scanner.
2. Packet number: a cyclic counter of the sent measurements.

3. System time of sending the packet. The time stamp is put in the moment of sending the data, the time stamps of the image capture are absent.
4. The number of points in the measurement, for which X and Z coordinates are calculated. This number is always less or equal to the size of the data buffer (80, 160, 320, 640, 1280) and sets the length of the arrays of values X and Z.
5. Values of the X and Z coordinates calculated per one measurement (per one frame). The arrays elements in the respective cells set the coordinate of the calculated point of the obtained measurement in coordinates of the scanner. The points values are transferred as discrete values of the scanner and recalculated into millimeters by the following formula:

```
PointZ(mm) = PointZ_discreete*ZDiap/DiscreeteValue;
PointX(mm) = PointX_discreete*XEMR/DiscreeteValue;
```

The discrete value is contained in the scanner detection packet in *wDiscreteValue*.

27.3. Scanner control protocol

Scanner control protocol is based on TCP. The scanner is always in standby mode of the incoming connection to a customizable port. When the connection by the scanner control protocol is set, then will be stopped the transfer of UDP data and broadcast packets of detecting to ports 6001 and 62501. Scanners are controlled by the control commands (see p. 27.3.1). The available commands are listed in the table of commands. The command *RF625_GetExtends* provides obtaining the data of the scanner condition in a separate packet (see p. 27.3.3). Commands *ReadParams* and *WriteParams* work with the scanner data, which are transmitted within the settings packet (see p. 27.3.4).

27.3.1. Structure of the commands packet

```
typedef struct _RF_COMMAND_PACKET {
    unsigned long               ucCommand;
    unsigned long               ulAttachSize;
    unsigned long               ulOffset;
    unsigned long               ulSize;
}  RF_COMMAND_PACKET, *LPRF_COMMAND_PACKET;
```

Command – The request code
AttachSize – The attached data
Offset – The place from which to read the transmitted attachment
Size – The size of the attachment data, which begin with Offset

27.3.2. Table of commands

Commands Note: Unless otherwise specified, AttachSize=0, Offset=0, Size=0			
Request	**Request code**	**Description**	**Appropriate method in SDK**
GetResult	0x01	Get the measurement result. A packet with measurements will come in response.	RF625CMD_GetResult
GetImage	0x02	Request for the image transfer. The scanner switches into the image transfer mode and starts transfer it by the *GetImageBuffer* request. When the full frame of the image is transmitted, the image transfer mode is switched off.	RF625CMD_GetImage
GetImageBuffer	0x03	Receive the image (a full frame size is 512 * 640 + 1 byte) by the *GetImageBuffer* request. In response, the scanner sends a part of the image having the size 32768 +1 bytes. Thus, to collect the full picture, you need to send the	RF625CMD_GetImageBuffer

		GetImageBuffer request 10 times. For each request, the *Offset* value is incremented to 32768 +1 (beginning from zero for the first packet), *Size* is 32768 +1 (for all requests). The first byte of the packet is a counter of the image frame part.	
ReadParams	0x04	Request for configuration parameters of the scanner. In response, the scanner will send the settings packet (see p. 27.3.4). The size of the settings packet is 512 bytes.	RF625_ReadParams
WriteParams	0x05	Request for download of configuration parameters to the scanner. By this request, configuration parameters must be transmitted to the scanner (see p. 27.3.4). The size of settings packet is 512 bytes.	RF625_WriteParams
FlushParams	0x06	Write the configuration parameters to a non-volatile memory (*Offset* = 0). The current scanner parameters that were written using *WriteParams*, will be saved as the default parameters; or Restore the configuration parameters from a non-volatile memory (*Offset* = 1).	RF625CMD_FlushParams
Reboot	0x14	Reboot the scanner.	RF625CMD_Reboot
UpgradeFW	0x15	Firmware upgrade. *AttachSize* — the FW file size, byte.	RF625CMD_UpgradeFW
Shutdown	0x16	Shutdown the scanner.	RF625CMD_Shutdown
GetAutoExposure	0x17	Get the current value of the integration time.	RF625_GetAutoExposure
Disconnect	0x19	Close the TCP connection to the scanner.	RF625CMD_Disconnect
GetExtends	0x20	Get information about the hardware condition. In response, the scanner will send the packet with information about the hardware condition. The packet size is 15 * 2 bytes. If the profile transfer mode is not a current mode of the scanner, the packet will consist of 15 double-byte values 0x0FFD.	RF625_GetExtends
RF625CMD_CreateRecovrPart	0x92	Create the backup.	RF625CMD_CreateRecovrPart

27.3.3. Scanner condition packet

Scanner condition packet		
Size, byte	**Address**	**Description**
uint16	1-0	System time of the scanner work
uint16	3-2	CMOS-sensor power supply
uint16	5-4	CMOS-sensor current
uint16	7-6	FPGA power supply
uint16	9-8	FPGA current
uint16	11-10	System power supply
uint16	13-12	System current
uint16	15-14	CPU power supply
uint16	17-16	CPU current
uint16	19-18	RAM power supply
uint16	21-20	RAM current

uint16	23-22	CPU internal temperature
uint16	25-24	CPU external temperature
uint16	27-26	FPGA temperature
uint16	29-28	Air temperature inside the housing

27.3.4. Settings packet

Settings packet			
Type	**Address**	**Description**	**Name**
uint16	1-0	Configuration version	wConfigVersion
uint8	2	Laser level (0..255)	ucLaserLevel
uint16	4-3	Exposure time. The range of values: 0..3600 us	wExposureTime
uint16	6-5	The top border of the window (0..224). By default: 0	wWindowTop
uint16	8-7	Window height (31..255). By default: 255	wWindowHeight
uint16	10-9	External synchronization	wExtSyncSignal
uint16	12-11	Divider of the external sync signal (1..256)	wExtSyncDivider
uint8[4]	16-13	Device IP address. By default: 0.0.0.0	ucTCPAddress[4]
uint8[4]	20-17	Subnet mask. By default: 0.0.0.0	ucTCPSubnetMask[4]
uint8[4]	24-21	Host IP address. By default: 255.255.255.255	ucUDPAddress[4]
uint16	26-25	Host UDP port. By default: 6003	wUDPPort
uint16	28-27	UDP frequency	wUDPFrequency
uint16	30-29	TCP/IP port	wTCPPort
uint8	31	Auto exposure	ucAutoExposure
uint8	32	Pixels brightness threshold	ucPixelBrightnessThres
uint8	33	Threshold of the distance between pixels	ucDifBrightnessThres
uint8	34	Filters shutdown mode	ucRawImageMode
uint8	35	Interpolation of the profile	ucInterpolation
uint8	36	DHS	ucDHSEnable
uint8	37	Analog output	ucAnalog
uint16	39-38	Synchronization channels	wSyncChannels
uint8	40	Measurements synchronization	ucMeasureSync
uint16	42-41	Synchronization delay	wDelaySync
uint8	43	Synchronization divider	ucDivSync
uint16	45-44	Time of the TCP connection retention	wKeepTCPTime
uint8	46	TCP connection retention	ucKeepTCP
uint8	47	Filter	ucFilter
uint8	48	Smoothing	ucSmooth
uint16	50-49	Filter parameters	wFilterParam
uint16	52-51	Smoothing parameters	wSmoothParam
uint8	53	ROI auto position	ucAP
uint8	54	ROI auto height	ucAH
uint8	55	UDP-stream status	ucUDPStream
uint8	56	Averaging	ucAveraging
uint8	57	Time to reset counters at an external synchronization	ucDropCountersExt
uint8	58	Time to reset counters at an internal synchronization	ucDropCountersInt
uint8	59	Inverting the profile along the axes X and Z	invertXZ

uint8	60	Activating the information packet for the scanner network	localSAPEnabled
uint8	511-61	Reserved	ucReserved[511-61]

27.4. Emergency control protocol

This protocol is used in a case of impossibility to transmit commands over TCP.

The packet of 256 bytes is transmitted to port 62533. The first bytes of that packet is the following structure:

```
typedef struct _UDPI_RFDEVICEEMERGENCYBLOCK_ {
 uint32_t serialnumber;
 uint16_t what;
 uint32_t value; //
 SHORT_USER_PARAMS shortParams;
} tUDPI_RFDeviceEmergencyBlock;
```

Parameter code	Value
Valid values for **value**:	
0x01	Exposure
0x02	Laser level
0x04	UDP port
0x10	TCP address
0x20	Subnet mask
0x40	UDP address
Valid values for **what**:	
0x06	Reboot the scanner
0x07	Shutdown the scanner
0x08	Switch off the scanner from the network
0x09	Set the laser level
0x0A	Set the exposure time
0x0B	Set the interpolation
0x0C	Turn on the laser
0x0D	Turn off the laser
0x0E	Save user parameters
0x10	Reset user parameters to the default values
0x11	Send the shortened user parameters on the port 62588
0x12	Send to the scanner the shortened user parameters (SHORT_USER_PARAMS) and the parameter code (value) that must be applied

The structure of SHORT_USER_PARAMS:

```
typedef struct _SHORT_USER_PARAMS_
{
 uint8_t what_todo;
 uint8_t laser_level_u8;
 uint16_t exposure_time_u16;
 uint8_t tcp_ip_address_u8[4];
 uint8_t tcp_subnet_mask_u8[4];
 uint8_t udp_ip_address_u8[4];
 uint16_t udp_port_u16;
} SHORT_USER_PARAMS;
```

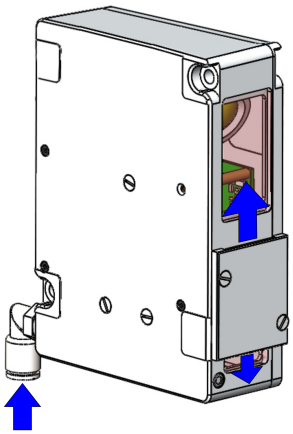
27.5. History of changes of settings packet

FF03:
+ Invert X
+ Invert Z
+ Enable the local broadcast packet
FF04:
+ Step/Dir synchronization
FF05:
+ Zero mark (encoder synchronization)
FF07:
+ Added a double-byte divider of sync signals

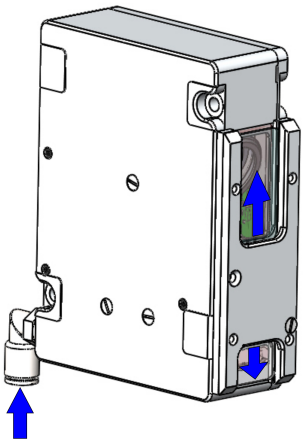
28. Additional options

Scanners can be equipped with the following additional options:

- **Robot cable**. The special flexible cable, which intended to be used in the systems with movable parts.
- **Air Knife system**. The Air Knife system is used to remove the dust, shavings and drops of liquid from the surface of protective windows. The air pressure in the Air Knife system should be of 1..3 atmospheres.



- **Removable protective windows**. Removable windows are used to protect the basic windows from the dust, dirt and shavings.



- **Air cooling system**. With the air cooling system you can use the scanner when the ambient temperature exceeds the operating temperature of the scanner.

- **Heating system**. When the ambient temperature is below the operating temperature of the scanner, the heating system will heat the air inside the housing up to the operating temperature.
- **Protective housing**. In order to use the scanners under harsh industrial conditions, scanners can be equipped with the special protective housing that has the air cooling system and protective windows.

29. Support and order

29.1. Example of designation when ordering

625-(Color)-SMR/MR-XSMR/XEMR-Sync Type-Sync Signal-Sync IN (1..3)-Sync OUT(0..2)-Corner Connector-Cable Type-Cable Length-Heating-AK-EW-AC

Symbol	Description
Color	Red 660 – without symbol, Blue 405 nm or 450 nm – Blue, IR 808 nm – IR
MR	Measurement range for Z, mm
SMR	Start of measurement range for Z, mm
XSMR	X-range at beginning of Z, мм
XEMR	X-range at the end of Z, mm
Sync Type	Synchronization type: BASIC – synchronization by the basic internal timer of the scanner. ENC – synchronization by the encoder signals. STEPDIR – synchronization by the StepDir signals on the external inputs. INOUT – scanners with one sync input and one sync output. FULLSYNC – scanners with three sync inputs and two sync outputs.
Sync Signal	Type of input sync signal: TTL – pulse signal on the one wire referenced to ground. RS422 – differential pair in accordance with the RS422 standard.
Sync IN (1..3)	Synchronization inputs: BASIC – 1 ENC – 3 STEPDIR – 2 INOUT – 1 FULLSYNC – 3
Sync OUT (0..2)	Synchronization outputs: BASIC – 0 ENC – 0 STEPDIR – 0 INOUT – 1 FULLSYNC – 2 (only the 1st channel is supported)
Corner Connector	Angle cable connector 90° – angle of installation Direction – connector direction
Cable Type	Cable type: STANDARD ROBOT – option, robot-cable
Cable Length	Cable length, m
Heating	Inbuilt heating
AK	Air knife option
EW	Removable protective windows option
AC	Cooling option
Example. 625-BLUE-60/35-20/30-BASIC-TTL-1-0-3M – blue laser, start of measurement range for Z - 60 mm, measurement range for Z – 35 mm, X-range at beginning of Z – 20 mm, X-range at the end of Z – 30 mm, sync type BASIC, sync signal TTL, sync in/out 1/0, cable length 3 m.	

29.2. Technical support

Technical support for issues related to incorrect work of the scanners and to problems with settings is free.

Technical support related to using the scanners is paid. This kind of technical support includes consulting about ways to apply the scanner, and training to work with software tools and libraries.

Technical support for software developed by the customer is paid, and includes the possibility to add new features to software.

Technical support contacts:

- support@riftek.com
- +375-17-2813513

29.3. Warranty policy

Warranty assurance for Laser Scanners RF625 Series – 24 months from the date of putting in operation; warranty shelf-life – 12 months.

Warranty repair is not provided in the following cases:

- mechanical damage caused by impacts or falling from height,
- damage caused by opening the housing, incorrect connection, or absence of grounding.

30. Technical maintenance

The Laser Scanners is virtually maintenance free. As these are optical systems, they are sensitive to dust and sputter on the front windows. Cleaning is best done with a soft cloth. Do not use scratching cleaners or other aggressive media.

It is necessary to remove fingerprints from the windows, because fingerprints cause degradations in the scan profile.

In order to remove fingerprints or grease, clean the windows with 20 % alcohol and soft paper.

31. Troubleshooting

Problem	Cause	Solution
No laser light	No power supply (or less than 15 V)	Check the power supply
	Power cable is not connected	Check the power cable
	Laser level is too low	Run **Riftek Lamia**, connect to the scanner over TCP, activate the **General** panel and check the **Laser level** parameter
	Scanner electronics failure	Contact the technical support
Scanner is not detected on the network	No power supply (or less than 15 V)	Check the power supply
	Ethernet cable or / and power cable are not connected	Check the cables
	Firewall doesn't pass the packages	Add exceptions or disable the firewall
	Scanner is already connected in the other software	Click **DROP CONNECTIONS** (see topic 13.4.2)
	Scanner freezes	Reboot the scanner
	Scanner electronics failure	Contact the technical support

Problem	Cause	Solution
TCP connection cannot be established	Incorrect settings of the PC network card	Check network settings
	IP address of the scanner and IP address of the PC are not in the same subnet	Change the subnet of IP address on your PC in accordance with the scanner subnet
	Ports 6001, 6003 and 62500 are not available	Close applications that use these ports
	Scanner freezes	Reboot the scanner
No profile	The object is beyond the working range of the scanner	Install the object within the working range of the scanner
	ROI mode is enabled and the object is beyond the set ROI area	Connect to the scanner over TCP, activate the **General** panel and check the **ROI state** parameter
No profile + "No data..." message in the lower right corner of the main window	No clock signal, and one of the following signal sources enabled: External In, Encoder, StepDir	Connect to the scanner over TCP, activate the **Trigger** panel and check the **Signal source**
	Scanner needs to be activated (when you update the firmware version from 2015 year to 2016/2017, it is necessary to perform the activation procedure)	Contact the technical support
No UDP panel	**UDP stream** option is disabled	Connect to the scanner over TCP, activate the **Network** panel and enable the **UDP stream** option
Obtaining an incorrect profile	Scanner windows are not clean	Clean the windows as described in topic Technical maintenance
	Incorrect scanner settings	Connect to the scanner over TCP and check settings

32. Annex 1. Synchronization module

32.1. General information

The synchronization module is designed to synchronize the operation of Laser Scanners RF625 Series.

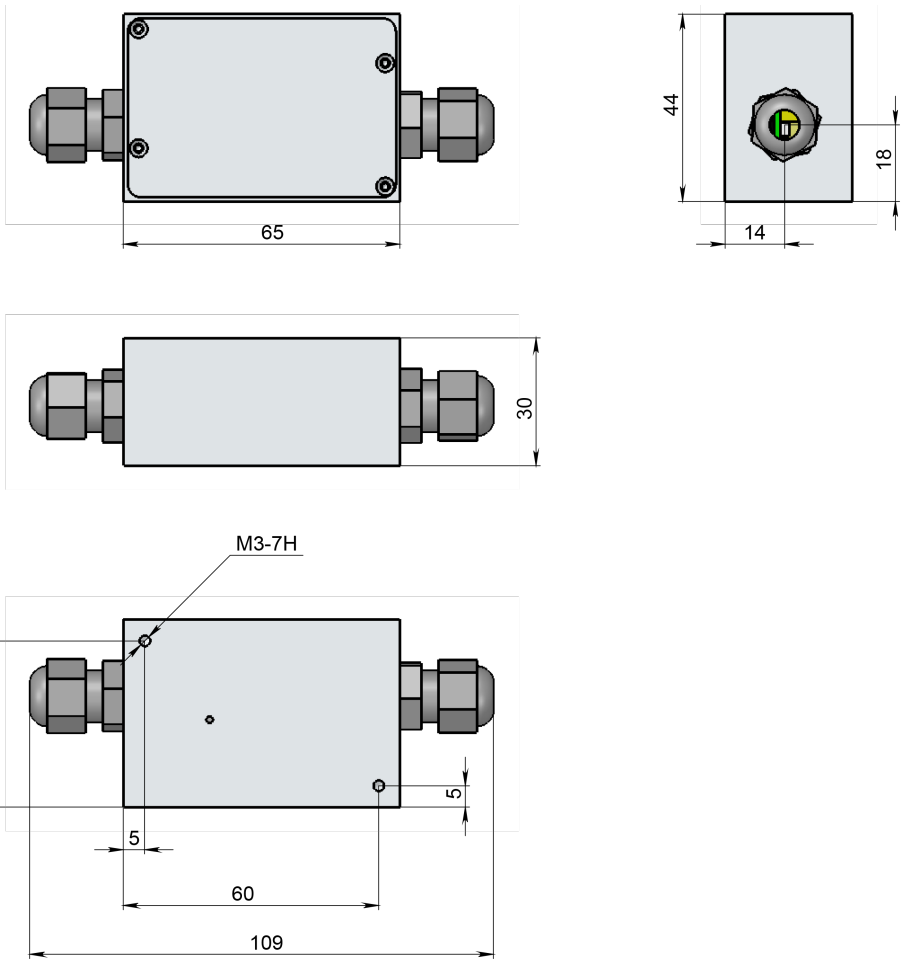
32.2. Basic technical data

Parameter		Value
Output interface		Ethernet
Power supply, V		9…36
Power consumption, W		1
Frequency of sync pulses, Hz		from 0.2 to 100000
Sync outputs	TTL outputs, V	from 0 to 3.3 (pink)
		from 0 to 5 (white)
	Diff outputs, V	15 (white+pink)
Environmental resistance	Operating ambient temperature, °C	0…+40
	Storage temperature, °C	-20…+70
	Relative humidity, %	5-95 (no condensation)
Housing material		aluminum
Weight (without cables), gram		100

32.3. Structure and operational principle

The synchronization module contains a microcontroller STM32F417. The microcontroller changes a logic state at the outputs by means of a timer, and generates a sync signal. The frequency and the duty cycle of the sync signal are changed by changing the values of timer registers.

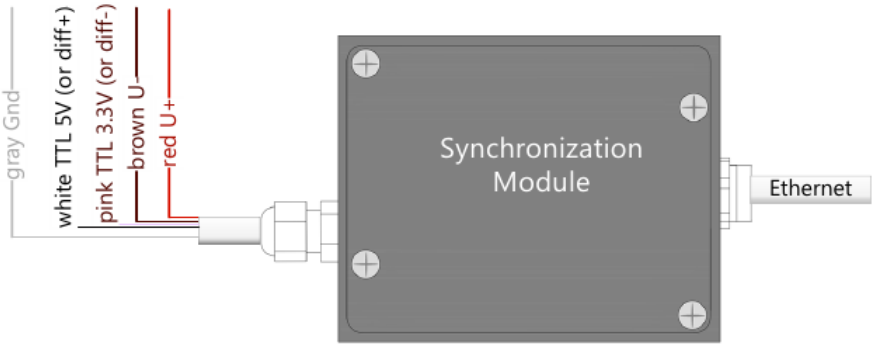
Overall dimensions of the synchronization module are given below.



32.4. Connection

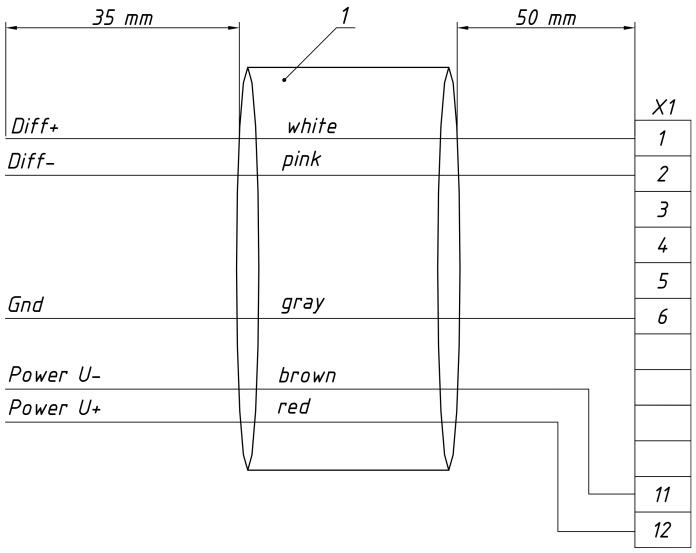
The synchronization module comes with two cables:

- Synchronization cable
- Ethernet cable



32.4.1. Synchronization cable

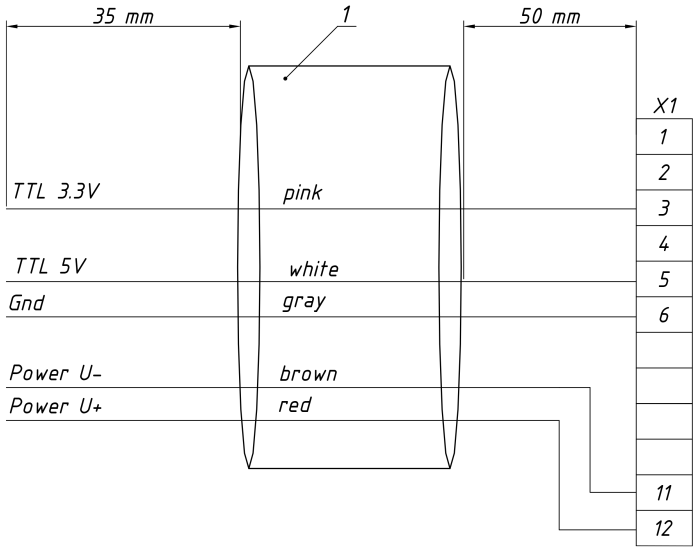
Cable with Diff outputs:



Designation of cable wires is given in the table below:

Wire color	Assignment
Pink	Diff-
White	Diff+
Gray	GND
Brown	Power U-
Red	Power U+

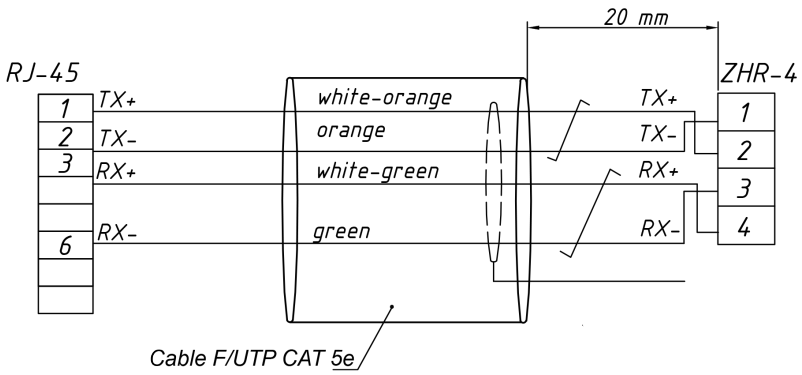
Cable with TTL outputs:



Designation of cable wires is given in the table below:

Wire color	Assignment
Pink	TTL+3.3V
White	TTL+5V
Gray	GND
Brown	Power U-
Red	Power U+

32.4.2. Ethernet cable



Designation of cable wires is given in the table below:

Pin number		Assignment	Wire color
RJ-45	1	TX+	White-orange
RJ-45	2	TX-	Orange
RJ-45	3	RX+	White-green
RJ-45	6	RX-	Green

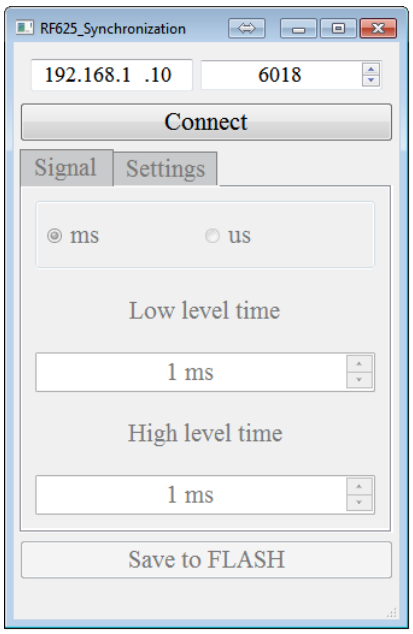
32.5. Service software

32.5.1. System requirements

- Operating system Windows 7 and later.

32.5.2. Connection

When you run a service software, the following window appears:

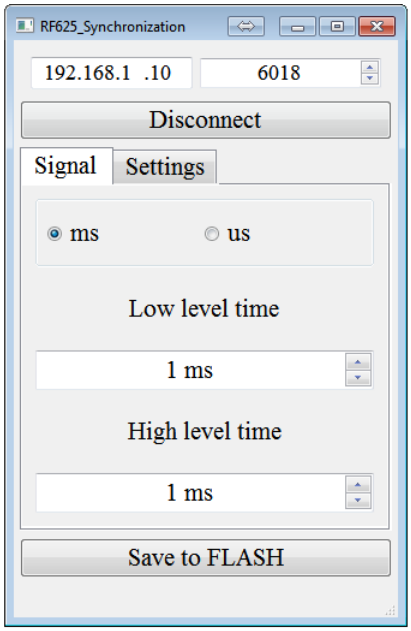


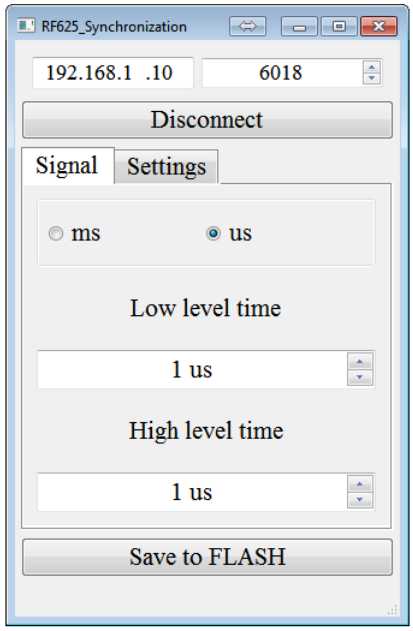
In order to connect to the device, specify its IP address and port, and click **Connect**.

32.5.3. Signal setting

The software allows to set a signal in milliseconds (ms) and microseconds (us).

Select **ms** or **us**, and enter the low and high levels into the fields below. All settings will be applied immediately.

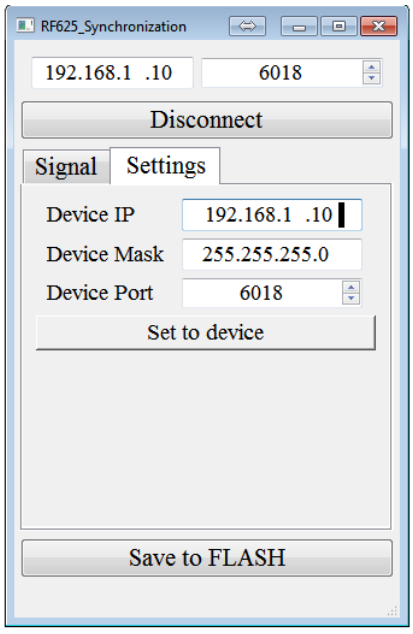




To save settings to the device non-volatile memory, it is necessary to click **Save to FLASH**.

32.5.4. Device parameters

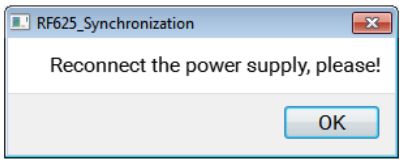
You can change the device parameters in the **Settings** tab.



To apply settings, it is necessary to click **Set to device**.

To save settings to the device non-volatile memory, it is necessary to click **Save to FLASH**.

ATTENTION! When you change the device settings, it is necessary to reconnect the power supply in order for the changes to take effect. You will be notified about it by the following message:



32.6. Warranty policy

Warranty assurance for the Synchronization Module - 24 months from the date of putting in operation; warranty shelf-life - 12 months.

33. List of changes

Date	Version	Description
07.12.2015	2.0.0	Starting document.
06.05.2016	2.1.0	Updated the description of a service program. Added Par. 30.
31.08.2016	2.2.0	Updated the description of a service program. Added the description of synchronization types in Par. 6.
22.09.2016	2.3.0	Updated the description of RFDevice SDK.
02.11.2016	2.3.1	Removed Par. 'Analog outputs'.
22.11.2016	2.3.2	Updated Par. 26 (the backup function was removed from a service program).
10.07.2017	2.4.0	Updated the description of a service program. Added Par. 23, 25.4, 31. Updated Par. 24, 25.
17.11.2017	2.4.1	Added Par. 32.

34. Distributors

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