LASER SCANNERS

LDE25D Series

User's manual

since 1976

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ADVANCED SYSTEMS
FOR AUTOMATION & DIAGNOSTIC

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Certified according to ISO 9001:2008

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.

2. Electromagnetic compatibility

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

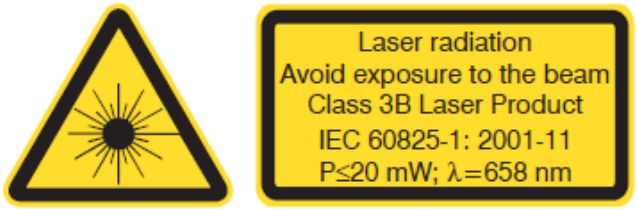
- EN 55022:2006 Information Technology Equipment. Radio disturbance characteristics. Limits and methods of measurement.
- EN 61000-6-2:2005 Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments.
- EN 61326-1:2006 Electrical Equipment for Measurement, Control, and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

3. Laser safety

The scanners correspond to the 2M or 3B safety classes according to IEC 60825-1:2007

3.1. Class 3B scanners

The scanners make use semiconductor laser. Maximum output power is 100 mW. The scanners belong to the 3B laser safety class. The following warning label is placed on the laser body:

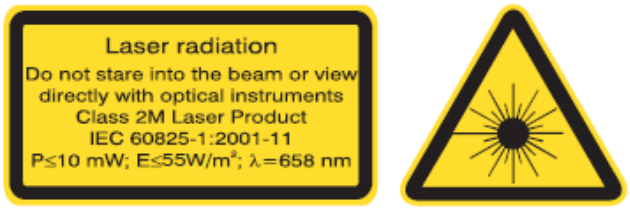


The following safety measures should be taken while operating the scanners:

- 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.

3.2. Class 2M scanners

The scanners make use of an c.w. 660 nm or 405 wavelength semiconductor laser. The sensors belong to the 2M laser safety class. The following warning label is placed on the laser body:



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

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

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.

Two modes of scanners work are possible, with sampling frequency 250 Hz and 500 Hz in the full working range. Scanners support ROI function, which lets to increase working frequency up to 1800 Hz.

Scanners are available in four 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.

The use of blue lasers instead of conventional red ones significantly enhances scanners capabilities, in particular, in control of shiny materials, high-temperature objects and organic materials.

The use of scanners with different laser wavelength in one measurement system avoids scanners mutual influence and greatly simplifies the system construction.

Scanners with power IR laser are intended for use in conditions of large solar radiation.

Available on request is the delivery of scanners with air-blown windows and water/air cooling, inbuilt heater.

Also possible are customized configurations other than those listed below.

5. Structure and operating principle

Operation of the scanners is based on the principle of optical triangulation (Figure 1.). 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).

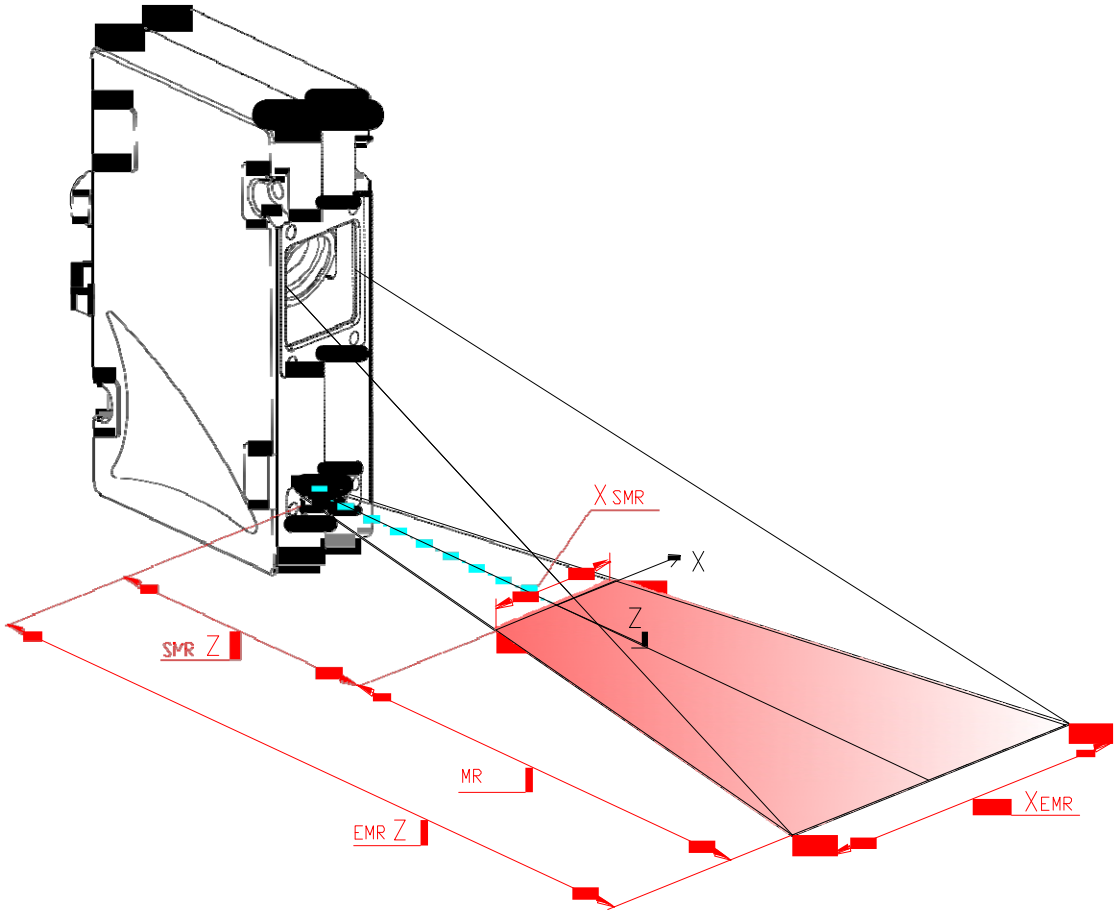


Figure 1

6. Basic technical data

		COMPACT LINE							
LDE25D-		**40/5-6/7**	**35/10-10/12**	**55/10-10/11**	**30/25-18/26**	**65/25-17/23**	**55/50-27/45**	**90/50-23/35**	**75/95-34/67**
Range, Z-axis, mm		5	10	10	25	25	50	50	95
Start of measurement range (SMR), мм		40	35	55	30	65	55	90	75
End of measurement range (EMR), mm		45	45	65	55	90	105	140	170
Range, X-axis, mm	SMR	6	10	10	18	17	27	23	34
	EMR	7	12	11	26	23	45	35	67
Laser		660 nm or 405 nm, Class 2M							
Size, mm		30x88x120							
Weigh, g		400							

		STANDARD LINE					
LDE25D-		**60/35-20/30**	**65/65-35/55**	**140/110-43/68**	**125/200-60/130**	**100/250-75/180**	**140/250-70/155**
Range, Z-axis, mm		35	65	110	200	250	250
Start of measurement range (SMR), мм		60	65	140	125	100	140
End of measurement range (EMR), mm		95	130	250	325	350	390
Range, X-axis, mm	SMR	20	35	43	60	75	70
	EMR	30	55	68	130	180	155
Laser		Class 2M or Class 3B					
Size, mm		50x98x144					

Weigh, g		500							
		SPECIAL LINE							
LDE25D-		**90/10-9/10**	**240/20-14/16**	**175/250 -115/230**	**165/300 -130/240**	**240/290-200/320**	**450/650 -190/420**	**425/990 -330/960**	**540/1400 -330/980**
Range, Z-axis, mm		10	20	250	300	290	650	990	1400
Start of measurement range (SMR), мм		90	240	175	165	240	450	425	540
End of measurement range (EMR), mm		100	260	425	465	530	1100	1415	1940
Range, X-axis, mm	SMR	9	14	115	130	200	190	330	330
	EMR	10	16	230	240	320	420	960	980
Laser		Class 2M		808 nm, Class 3B	Class 3B				
Size, mm		49x84x 162	50x98x 144	66x171x235	48x106x 219	50x125x 360	50x110x 300	48x198x 480	48x210x 415
Weigh, g		1000		2000	1100	3000	2300	2500	3000
Parameters		**FOR ALL LINES**							
Nominal sampling rate		248 profiles/s or 491 profiles/s							
Maximal sampling rate		1800 profiles/s (ROI)							
Linearity, Z axis		±0.1% of the range							
Linearity, X axis		±0.2% of the range							
Resolution, X-axes		80, 160, 320, 640 or 1280 points/profile							
Output interface	Digital	Ethernet							
	Analog	4…20 mA or 0…10 V							
Synchronization inputs		RS422							
Power supply		22…36V							
Power consumption		from 4 W							
Environment resistance	Enclosure rating	IP67							
	Vibration	20g/10…1000Hz, 6 hours, for each of XYZ axes							
	Shock	30 g / 6 ms							
	Operation temperature, °C	-10…+60, (-30…+50 for the sensors with in-built heater), (-30…+120 for the sensors with in-built heater and air cooling housing)							
	Relative humidity	5-95% (no condensation)							
	Storage temperature	-20…+70 , °C							
Housing material		aluminum							

7. Example of item designation when ordering

LDE25D.(COLOR)-SMR/MR-Xsmr/Xemr-ENC-ANALOG-OUT-M(90X)(R)-H-AK-EW-AC

Symbol	Description
(COLOR)	Red 660 – without symbol, Blue 405 nm or 450 nm – Blue, IR 808 nm - IR
SMR	Start of measurement range for Z, mm
MR	Measurement range for Z, mm
Xsmr	X-range at beginning of Z, мм
Xemr	X-range at the end of Z, mm
ENC	Encoder inputs
ANALOG	Two analog outputs, 0…10V or 4…20mA
OUT	Output for scanners mutual synchronization
M(90X)(R)	M- Cable length, m, 90X - 90(X) option – angle cable connector R – robot cable option
H	Inbuilt heating
AK	Air knife option
EW	Removable protective windows option
AC	Cooling option

Example. LDE25D.BLUE-65/35-20/30-232-3 – scanner with blue laser, start of measurement range for Z - 65 mm, Z-range – 35 mm, X-range at beginning of Z mm – 20 mm, X-range at the end of Z – 30 mm, cable length - 3 m.

8. Dimensions and mounting

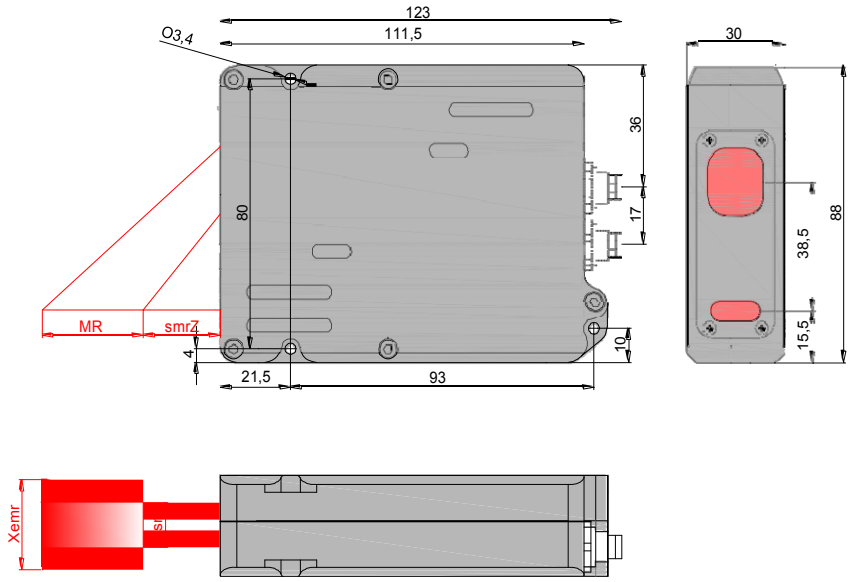
8.1. Overall and mounting dimensions

Overall and mounting dimensions of the scanners are shown in Figures below. Scanner package is made of anodized aluminum. Detailed CAD documentation is available here:

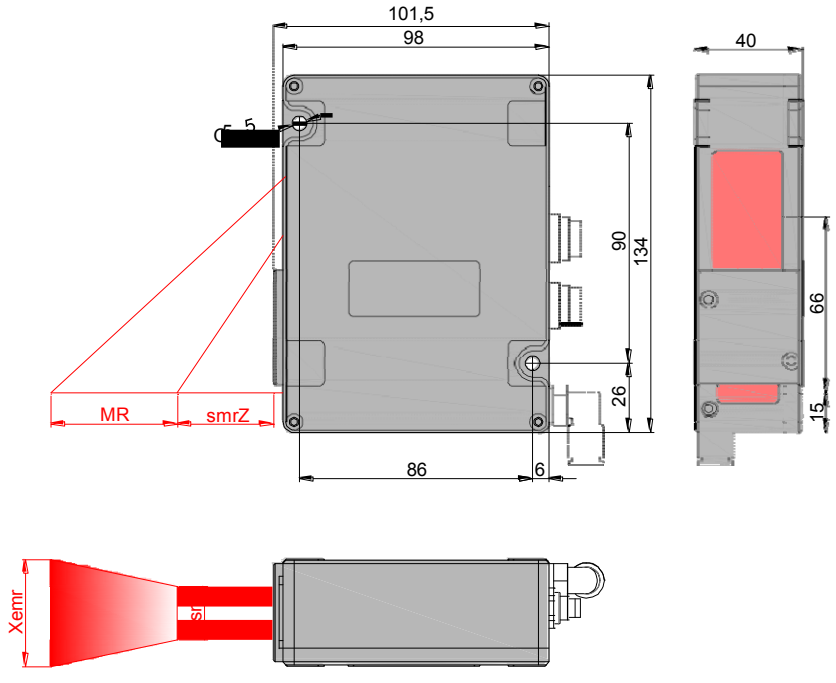
https://riftek.com/media/documents/rf625/RF625_2D_CAD.dwg
https://riftek.com/media/documents/rf625/RF625_3D_CAD.zip

The front panel of the package has two windows: one is output, the other for receiving radiation reflected from the object under control. The package also contains mounting holes. Scanners are equipped by two connectors and can be equipped by fittings for air/water cooling system.

8.2. Compact line



8.3. Standard line



8.4. Special line

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

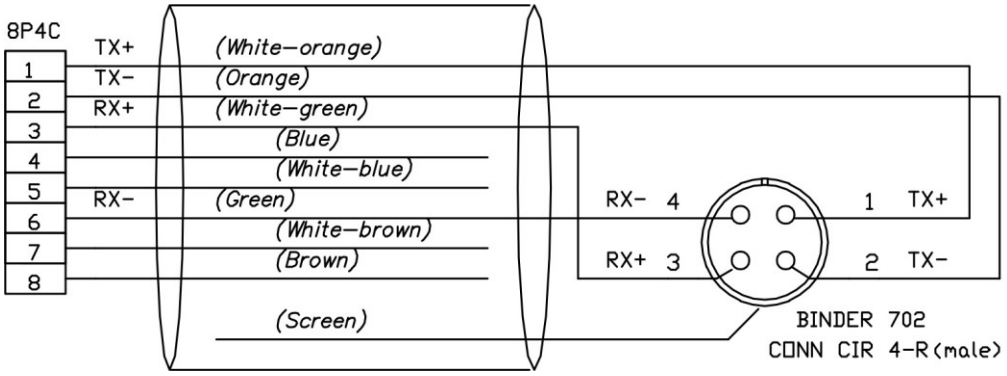
8.5. Overall demands for mounting

The scanner is positioned so that of object under control should place in this working range. 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.

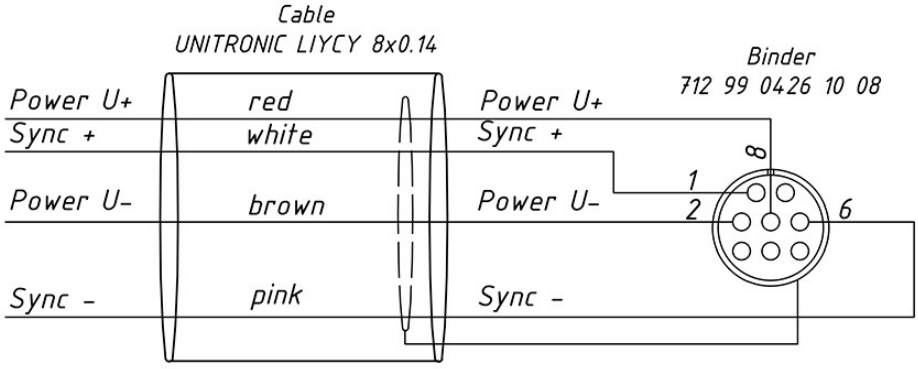
9. Connection

9.1. Ethernet cable



Contacts #	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 housing

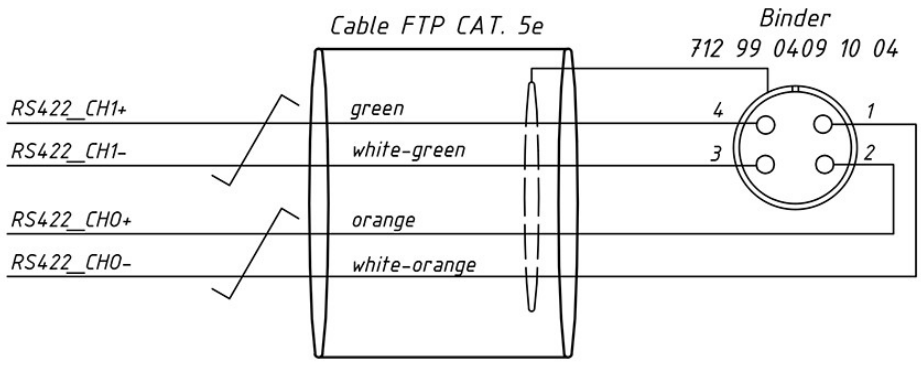
9.2. Interfaces and power cable



Binder 702 pins	Assignment	Wire color	Description
1	Sync A	White	Differential trigger input RS422
6	Sync B	Pink	
8	Power U+	Red	Power supply: 9..30V, consumption: 4,8..7,7W
2	Power U-	Brown	

9.3. Encoder cable or encoder + mutual synchronozation output

Scanners with encoder inputs are equipped by the third connector. Cable configuration can be changed depending on scanner configuration.

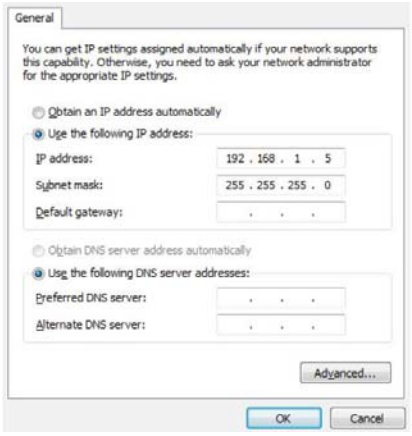


10. Connection settings

All scanners are shipped with the following default network configuration:

- IP address – 192.168.1.100.
- Subnet mask: 255.255.255.0

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:



Connect scanner to PC. Connect power supply to the scanner. Within 25 second after powering, scanner's firmware is booting. Two flashes of scanner's laser are an indication of booting finish.

11. Parameterization program

11.1. Function

Parameterization software is intended for:

- Testing and demonstration of work of LDE25D series scanners;
- Setting of the scanners parameters;

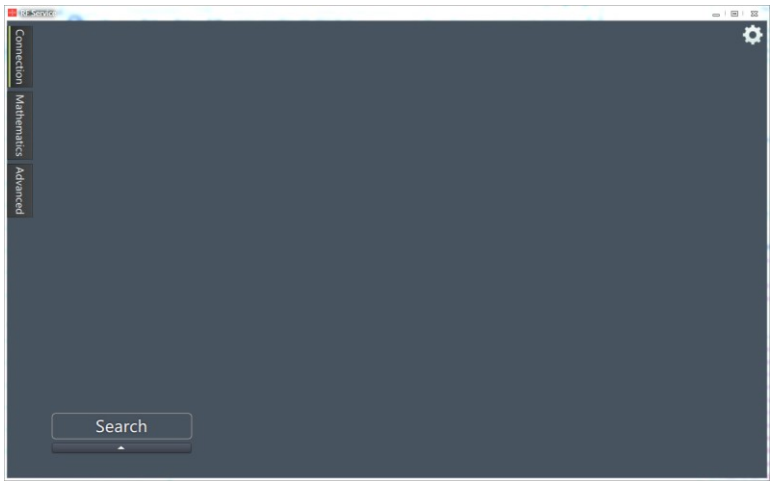
- Reception and gathering of the scanner data signals
- Scanner firmware update

The program is available for download from the following link: https://riftek.com/media/documents/rf625/SP.zip

11.2. The main window of program

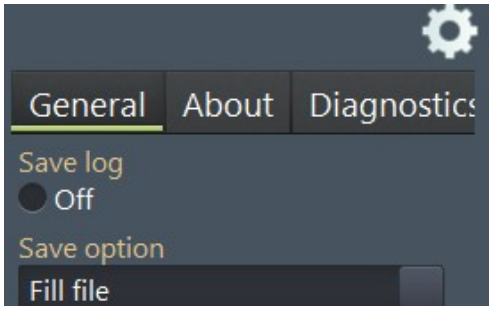
Once the program is started, the working window emerges. The buttons of operational panels are placed on the left edge of main window. Buttons assignment:

Button	Function
Search	Scanners connection (active by default)
Mathematics	Profiles tracking and measurements
Advanced	Parameterization of software output protocols to external devices

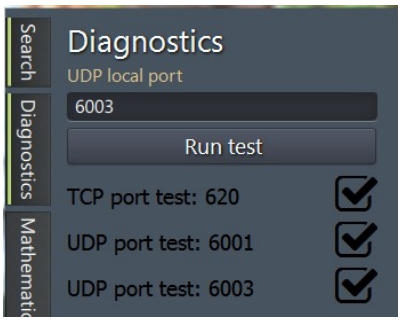


In the upper right corner of the window is an icon for activation of different instrumentation panels. Pressure of icon calls up the next panels:

Panel	Function
General	Profiles saving into the file (active by default)
About	Information panel
Diagnostic	PC diagnostic for access to ports



If you need to tests ports availability, activate **Diagnostics** panel and press **Run test**:



12. Ethernet interface

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

12.1. UDP protocol

UDP protocol is used:

- for detection of scanner in a network.
- for transmission of result on 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 6001 port. Besides that, if TCP connection is active such a packet is transmitted on 62500 reserve port.

12.2. TCP protocol

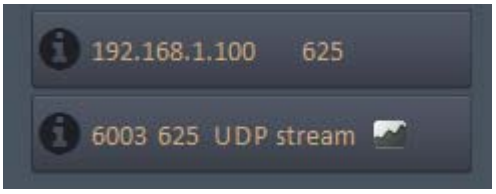
This protocol is used:

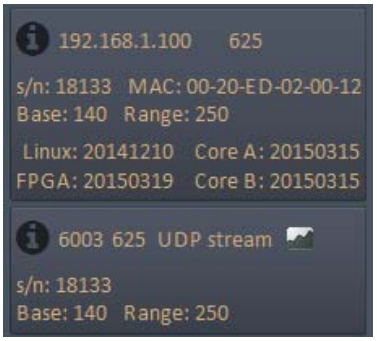
- for configure and check the main functions of the scanner.
- for request/transmit data

13. Search for scanners in the network

When connected to network and powered, the scanner communicates broadcast information packet to 255.255.255.255 address, UDP:6001 with periodicity of one time in 2 seconds. The packet contains IP-address of the scanner, its serial number and other information.

To start the search the scanner (scanners) in the network press **Search** key in the bottom left corner of main window. After the end of search the program activates two panels of TCP-connection and UDP-stream for every detected scanner. Press "I" icon if you want to see scanner parameters.

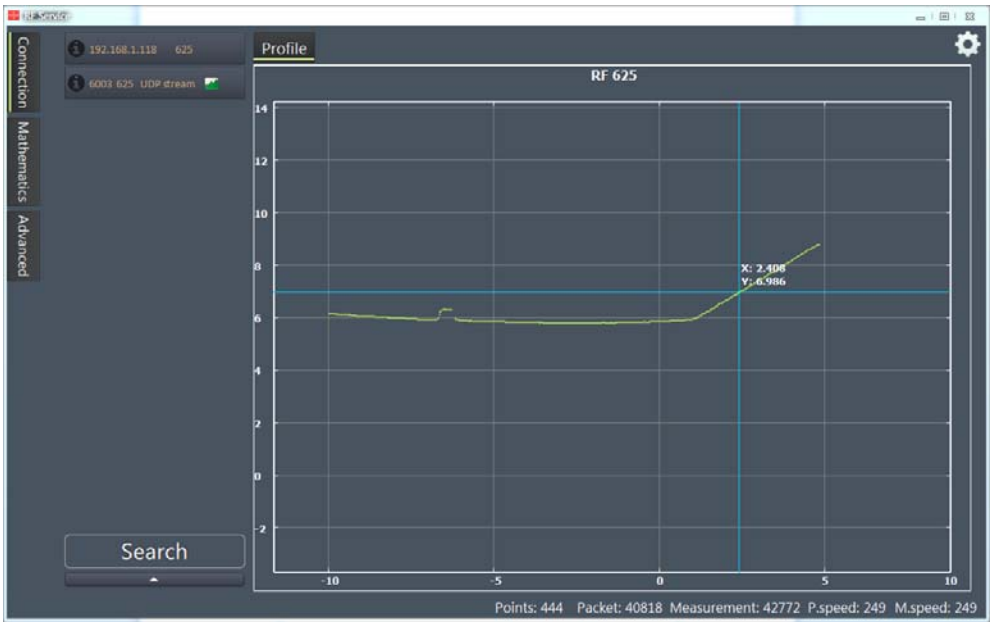




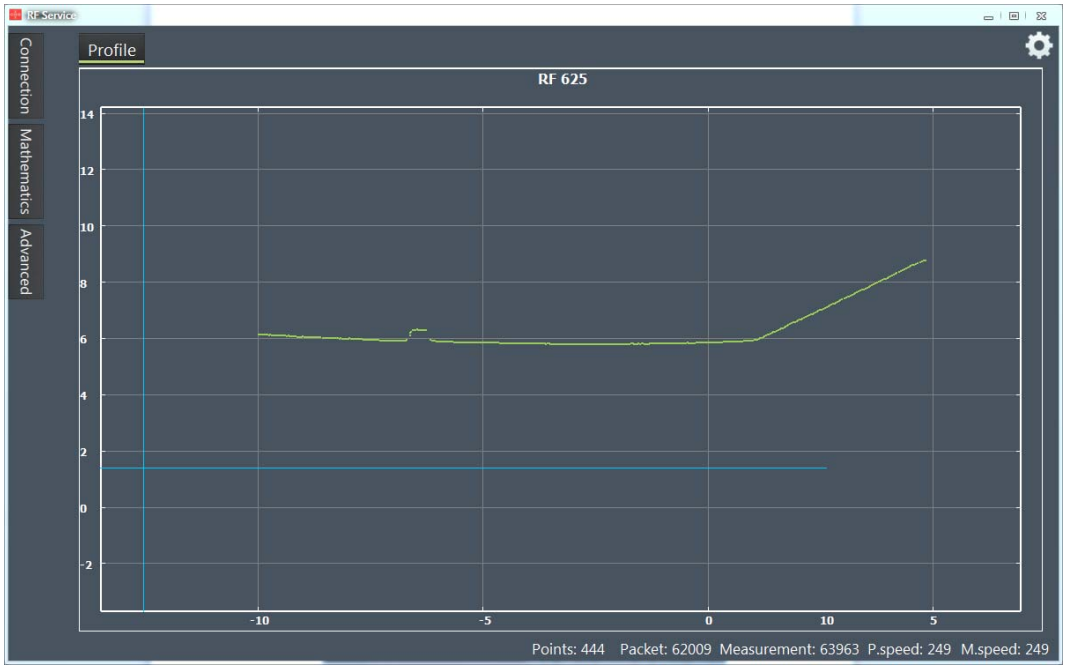
14. Connection to scanner.

14.1. UDP-stream

Clicking of  icon on UDP-stream panel requests UDP stream from corresponding scanner and activates **Profile** panel. Obtained profile is displayed in graphical form.



By pressing the **Connection** button, you can hide the panel of scanners connection and expand the **Profile** panel for the entire window:



By moving the object or the scanner, observe changes in the profile.
Zooming is done by rotating the mouse wheel, moving image - by pressing mouse right key. The program can be run on a computer with a touch screen.

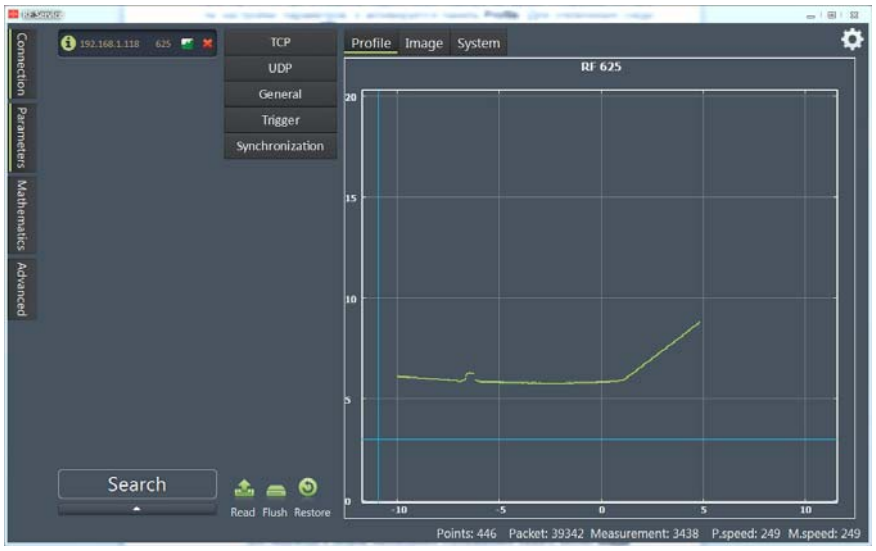
The status line in the lower part of the window shows:

Points – quantity of valid points in profile
Packet – quantity of received packets
Measurement – quantity of received profiles
P.speed – speed of packets receiving
M.speed – speed of measurement

To disable UDP-stream press  icon

14.2. TCP/IP connection

To connect scanner by TCP/IP protocol click corresponding panel. Once the connection is successful, program shows the button **Parameters** (the button is intended for activation/deactivation parameters setting panels), scanner parameters settings panels and activates **Profile** panel. (To disable connection press  icon).



By pressing the **Connection** and **Parameters** buttons, you can hide the corresponding panels and expand the **Profile** panel for the entire window.

15. Image viewing

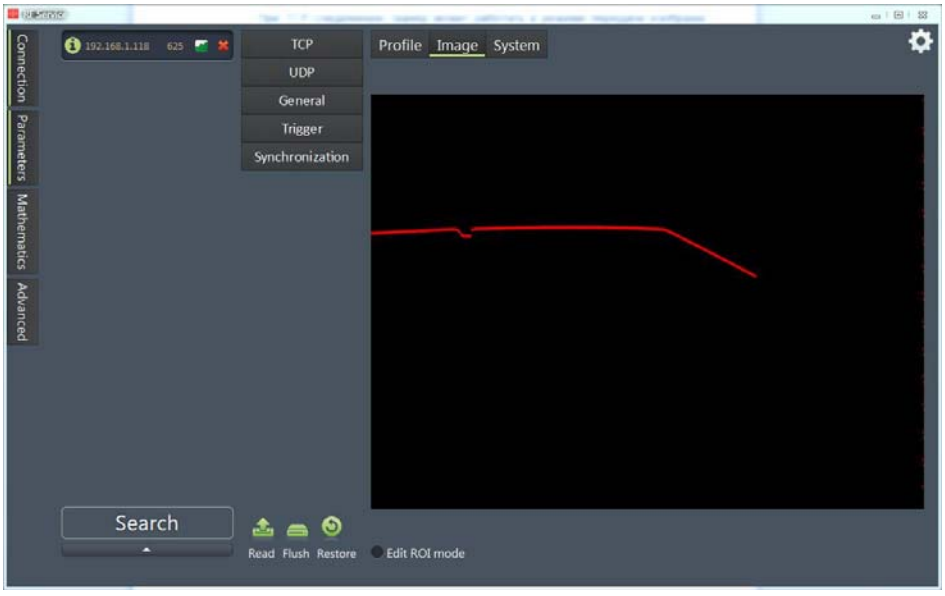
With TCP-connection scanner can operate in image transmission mode.

In this mode, the scanner can transmit:

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

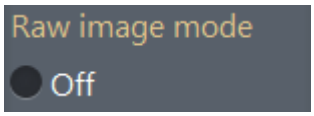
The image transmission rate is about 10 frames/second. This mode is used in manual tuning of the scanner.

To switch to image observation mode, press **Image** button.

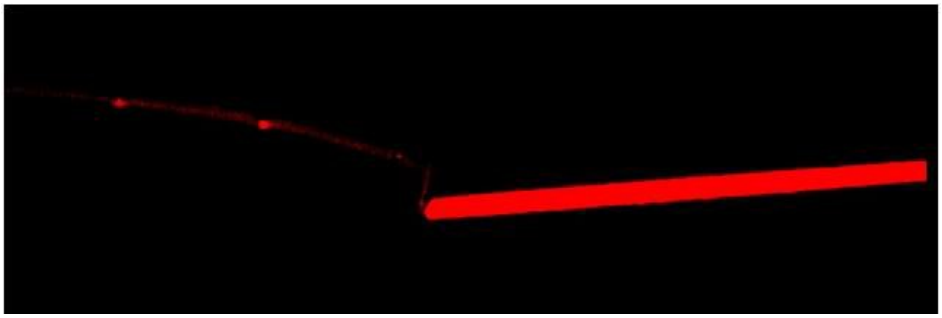


By moving the object or the scanner, observe changes in the image.

15.1. Image filtering.

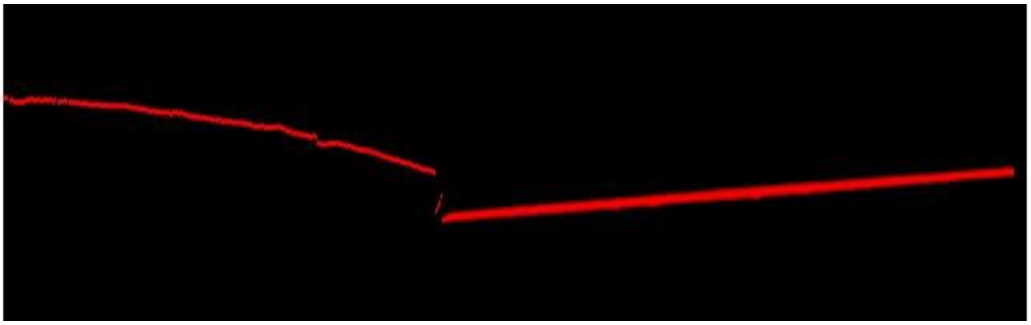


To select type of image activate **General** panel. The **Raw image mode** checkbox on this panel is intended to select the type of image displayed in the **Image** panel and used to extract the profile. When the box is unchecked, the filtered image is used. An example of the imaged without filtering:



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: Use unfiltered image only to configure scanner parameter settings.

The same image, but after filtering (**Raw image mode** checkbox is cleared) is shown below:



Note: Always use this mode to obtain profile.

16. Control of the scanner parameters

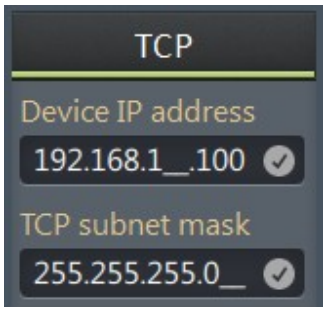
To change parameter it is necessary to activate corresponding panel, to write new parameter and to press **Enter** or  icon. All changes are made in RAM and will be lost when restarting the scanner.

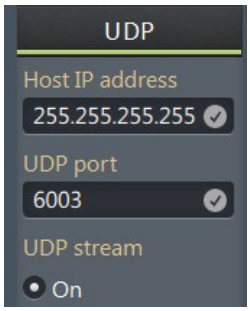
- **Flash** button
  To save new parameters in nonvolatile memory of scanner press **Flash.** Only for such a case, with any subsequent activation of the scanner it will work in the configuration you have selected.
- **Restore** button**.**
  To restore scanner factory parameters press **Restore** button.
- **Read** button**.**

If you changed the parameter, but didn't write it into RAM, then restore the original value by pressing the **Read** button.

17. Interface parameters setting

To change parameters of interface activate corresponding panels:





Write required parameters. Check-box **UDP-stream** disables/enables of UDP-packets transmittance.

18. Common parameters setting

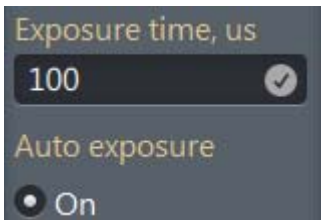
Clicking on **General** panel opens access to setting of different parameters.

18.1. "Laser Output Power" parameter

This parameter allows one 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 1…255.

Note: this parameter is not valid for scanners with power IR lasers.

18.2. "Integration Time" parameter and "Auto exposure" mode



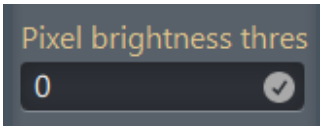
The intensity of the reflected light entering the scanner depends on the properties of the surface of the object under control. In turn, the value of electric signal generated by the CMOS image sensor of the scanner depends on the time of accumulation of radiation (integration time). Therefore, in order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

- Integration time is selected 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. The integration time for 250 Hz scanners can't be more than 4000 us and for 500Hz Hz mode – 2000 us

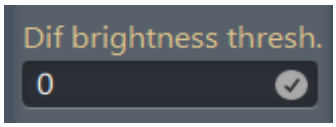
- Mode "Autoexposure" is selected. In this mode, scanner automatically adjusts and sets optimal integration time. .

18.3. "Profile detection level" parameter



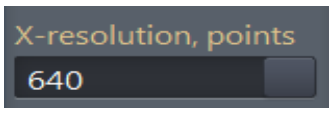
The parameter controls the level of profile detection on the image. Parameter increasing allows decreasing of image noise influence on the profile extraction. By default value is "0".

18.4. "Level of secondary filtering" parameter



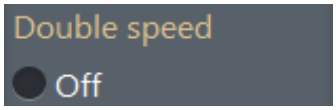
The parameter controls of image filter parameter. Parameter increasing lets to decrease image noise influence on the profile extraction. By default value is "0".

18.5. Point quantity for X coordinate.



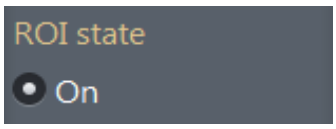
The parameter controls the number of points along X-coordinate. Possible values – 80, 160, 320, 640 or 1280. By default value is 1280.

18.6. "Double speed" parameter



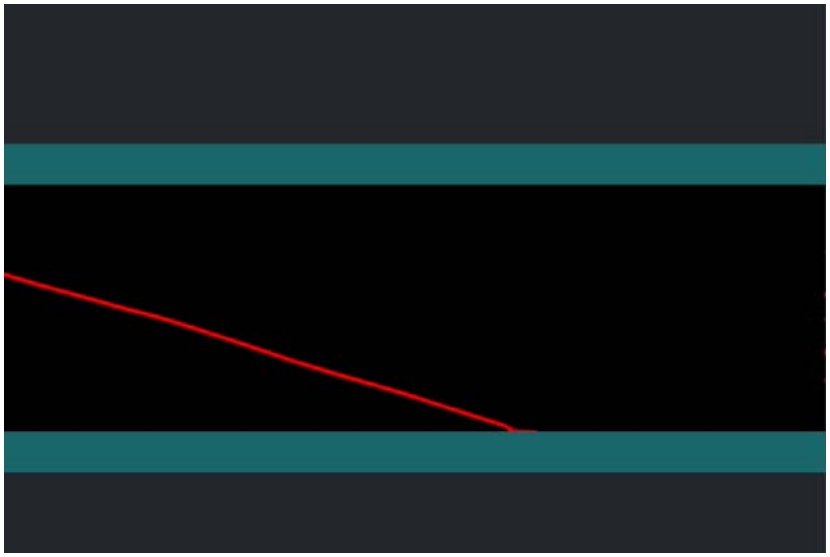
This parameter switches scanner into 500 Hz mode.

18.7. "ROI" parameter



This parameter controls the size of active area of CMOS-array. By default, active area covers entire area of the sensor. Active area size decreasing allows increasing scanner speed due to decreasing of reading time of image. Resizing is possible in Z-direction only and is specified in the CMOS-sensor coordinates.

To change active area size activate Image panel, activate the mode of image edit (in the bottom part of the window) and move limiters by mouse



18.7.1. Active area size and scanner speed.

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

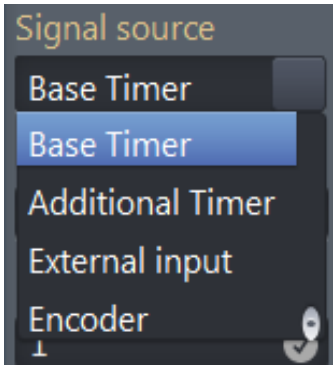
Size, pixels	Speed, profiles/s	Maximal possible integration time, us
480	250	4000
416	288	3472
352	341	2932
288	416	2403
224	535	1869
160	750	1333
128	937	1066
64	1875	533

18.7.2. Scanner speed and resolution for X

Relationship between 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	1800
160	250	500	1800
320	250	500	1800
640	250	500	-
1280	250	-	-

19. Trigger control parameters



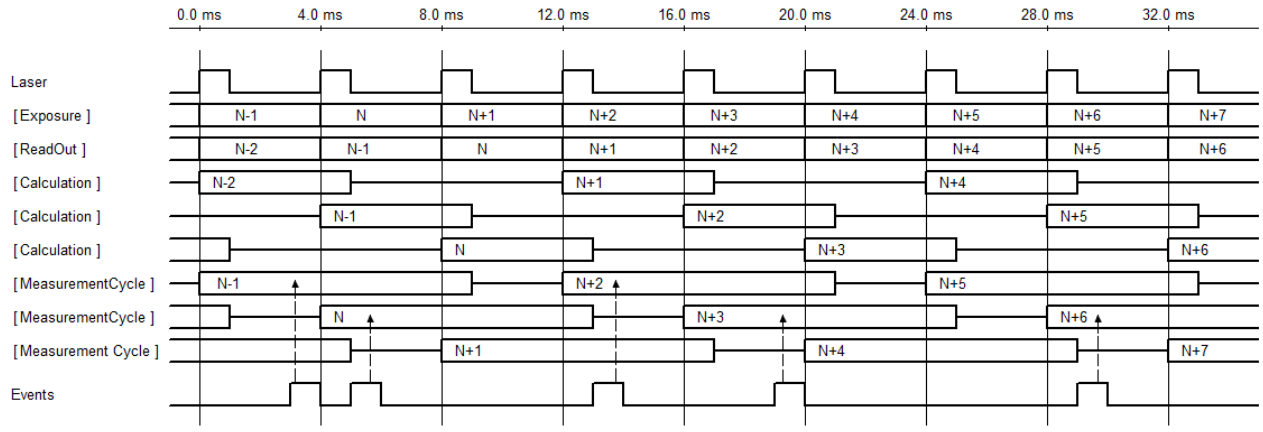
Trigger is an event which induces result transmittance from scanner. The result (Cartesian coordinates) is transmitted by UDP-packet or by TCP-request. There may be several sources of trigger:

- Base timer
- Additional timer
- External input
- Encoder
- TCP-request
- A combination of the above events

19.1. 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 conveyor 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 of 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



19.2. "Additional timer frequency" parameter

This parameter controls frequency of additional timer which is a source of events.

19.3. "Divider" parameter

This parameters set division factor for the next events:

- Additional timer
- External input
- Encoder

Event frequency decreases according to the fixed "Divider" parameter. Parameter range is 1…255.

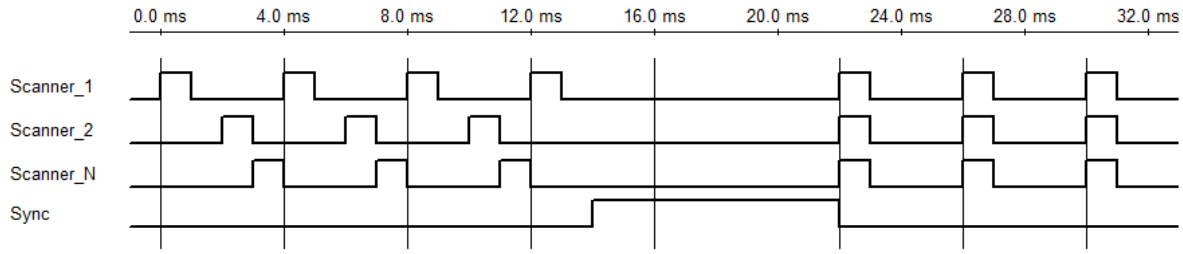
19.4. Events processing

Event/transmittance mode	UDP-stream	TCP-request
Base timer Frequency of base timer is equal of frequency of image frames (250Hz, 500Hz, or ROI)	The onset of each event corresponds exactly to the beginning of the frame. Scanner automatically sends the UDP-package when the event occurs. Examples: 250 Hz scanner, packet transmittance frequency = 250 Hz, for 500 Hz scanner, packet transmittance frequency = 500 Hz	Scanner sends result by TCP-protocols for every request. The result itself changes corresponding to events frequency.. If a new request arrives, but result is not changed, the zero value is transferred.
Additional timer + Divider. The value of additional timer can be set in the range of 0…2000 Hz.	Scanner automatically sends the UDP-package when the event occurs. Example: 250 Hz scanner, additional timer frequency = 100 Hz, divider = 1, packet transmittance frequency = 100 Hz, divider = 10, packet transmittance frequency – 10 Hz	
External input signal + Divider	Scanner automatically sends the UDP-package when the event occurs. Events frequency has to be less than scanner working frequency. Minimal frequency is not limited.	
Encoder + Divider		

20. Synchronization of operation of several scanners

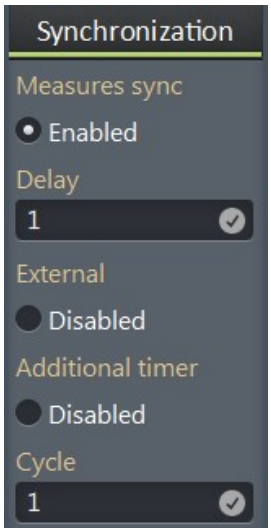
Where measurements are made by several scanners, it is often necessary to ensure synchronous measurement operations, in order, for example, to combine profiles obtained from different parts of the moving object into a single profile. To achieve synchronous operation of the scanners it is necessary to:

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 stops 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 be no 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 support synchronous working of the scanners it is necessary to perform the synchronization cycle start periodically according to previous point
3) interpret correctly frame numbers and packet numbers received from scanners.

Pressing of **Synchronization** panel opens access to synchronization parameters settings



20.1. Synchrosignal source

Possible sources of synchronization signal:

- External generator
- One scanner in the group of scanners – "master-scanner"

20.2. Connection and settings

20.2.1. External generator

To synchronize cycle start of several scanners it is necessary to:

- combine synchronization inputs of all scanners;
- for every scanner set the mode External;
- feed the synchronization pulse;
- restore synchronization periodically.

20.2.2. "Master-scanner"

To synchronize cycle start of several scanners it is necessary to:

- connect Synchronization output of "master-scanner" and synchronization inputs of other scanners;
- for "master-scanner" set "Additional timer" mode;
- Set synchronization restore period for "master-scanner" – **Cycle** field
- Set the **External** mode for the rest scanners;

20.2.3. "Synchronization delay" parameter

For every scanner (besides "master scanner") delay time of reaction setting to synchronization impulse is available (zero by default). Measurement cycle beginning will be delayed for this value.

20.2.4. Frame and packets numbers

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

21. Optimal settings

Optimal setting of the scanner means such selection of the values of its main parameters that allows one to obtain a correct profile. Setting is affected by sequential checking of the image quality and the resulting profile for different parameter settings of the scanner.

22. System panel

System panel is intended for emergency operation with scanners, firmware upgrade and control of scanner hardware condition. The panel is available when TCP/IP – connection is active. For panel activation press **System** button.

22.1. Emergency control.

To send command of emergency control press **Reboot** for scanner reboot and **Shutdown device** for reset current connections.

22.2. Frimware upgrade

To upgrade scanner firmware press **Upgrade firmware** and select corresponding file.

23. RFSDK Library

To work with the laser scanner, we offer a RFSDK library which is available for free download on the manufacturer's company website.

RFSDK contains API to work with all products of our company, documentation on classes and methods, examples and wrappers for various program languages.

RFSDK allows users to develop their own software products without going into details of data communication protocol for the scanner.

Software	Description	Link
Service program (parameterization program)	User software for work with LDE25D scanners, parameter setting, and data acquisition	https://riftek.com/media/documents/rf625/SP.zip
LDE25 Device Software Development Kit	Designed for work with all LDE series devices. Includes: • Support of MSVC and BorlandC for Windows, Linux, Wrapper C#, Wrapper Dephi. • Examples for C#, Delphi, LabView, Mathlab	https://riftek.com/media/documents/software/RFDevice_SDK.zip
Firmware	Includes: • Firmware for LDE25D scanner	https://riftek.com/media/documents/rf625/Firmware.zip

24. Warranty policy

Warranty assurance for the Laser triangulation sensors LDE25D - 24 months from the date of putting in operation; warranty shelf-life - 12 months

25. The next update

Update	Date
Description of tracking and measurement functions	May 2015
Description of connections to external devices (robots)	May 2015
Analog outputs description	May 2015

26. Appendix 1. Packages format.

26.1. Scanner detection package format

When connected to network and powered, the scanner communicates broadcast information packet to 255.255.255.255 address, UDP:6001 with periodicity of one time in 2 seconds.

26.1.1. Structure _UDPI_RFDEVICEINFOBLOCK_ :

```
typedef struct _UDPI_RFDEVICEINFOBLOCK_
{
        unsigned short      usDeviceType;
```

```
        unsigned char    ucIP[4];
        unsigned char    ucMAC[6];
        unsigned char    ucInfo[256];
} tUDPI_RFDeviceInfoBlock;
```

26.1.2. Massive ucInfo description:

Type	Bytes	Description	Note
Byte[200]	199-0	The first 200 bytes from FactCfgArea massive	See point 12.4.3.
Byte	200	Analog output	Valid values: 0, 1, 2, 3 = no, voltage, current, voltage and current
Byte	201	I/O synchronization	Valid values: 0, 1 = no, yes
Byte	202	bConnected	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	int_timme_value_in	System time of scanner work
Word	229-228	image_vcc	CMOS-sensor power supply
Word	231-230	image_icc	CMOS-sensor current
Word	233-232	fpga_vcc	FPGA power supply
Word	235-234	fpga_icc	FPGA current
Word	237-236	total_vcc	System power supply
Word	239-238	total_icc	System current
Word	241-240	bf609_vcc	Processor power supply
Word	243-242	bf609_icc	Processor current
Word	245-244	ddr2_vcc	RAM power supply
Word	247-246	ddr2_icc	RAM current
Word	249-248	bf_temp_LOC	Processor internal temperature
Word	251-250	bf_temp_EXT	Processor external temperature
Word	253-252	fpga_temp	FPGA temperature
Word	255-254	air_temp	The temperature inside scanner

26.1.3. Massive FactCfgArea first 200 bytes description

Type	Bytes	Description	Notes
Byte	0	Modification	
Byte[3]	3-1	Serial number	Example: S/N=345 Massive [3, 4, 5]
Byte[2]	5-4	SMR (beginning of the range for Z)	Example: SMR = 280 Massive [28, 0]
Byte[2]	7-6	MR (measurement range for Z)	Example: MR = 350 Massive [35, 0]
Byte[2]	9-8	Xsmr	Example: Xsmr = 300 Massive [30, 0]
Byte[2]	11-10	Xemr	Example: Xemr = 400 Massive [40, 0]
Byte[2]	13-12	Koeff	Example: Koeff = 0.64 Massive [0, 64]
Byte[2]	15-14	Error	
Byte[4]	19-16	Linux version	Example: 3.16.32-23 Massive [3, 16, 32, 23]
Byte	20	Laser wavelength	0 – 660, 1 – 405, 2- 450, 3- 808
Byte[4]	24-21	Core A version	Example: 3.16.32-23 Massive [3, 16, 32, 23]
Byte[4]	28-25	Core B version	Example: 3.16.32-23 Massive [3, 16, 32, 23]

Byte[4]	32-29	FPGA version	Example: 3.16.32-23 Massive [3, 16, 32, 23]
Byte	33	Synchronization	0 – OFF, 1 – ON
Byte	34	Analog output	0 – OFF, 1 – ON
Byte[2]	36-35	Customer ID	
Byte[4]	40-37	Autoexposure data	
Byte[88]	128-41	Reserved	
Byte	129	CMD_SETTINGS	
Byte	130	CMD_FRAMEHEIGHT	Frame height
Byte[23]	153-131	CMD_CORRELATOR_WR_CONVOLUTION_COEFF[23]	Image filter coefficients
Byte[2]	155-154	CMD_CORRELATOR_BLACK_LEVEL[2]	
Byte	156	CMD_CORRELATOR_LENGTH_SHORT	
Byte	157	CMD_CORRELATOR_LENGTH_LONG	
Byte[3]	160-158	CMD_CORRELATOR_PDCOEFF_SHORT[3]	
Byte[3]	163-161	CMD_CORRELATOR_PDCOEFF_LONG[3]	
Byte	164	CMD_CORRELATOR_BYPASS_MODE	
Byte[2]	166-165	CMD_SENSOR[2]	
Byte[2]	168-167	CMD_SENSOR_FOT[2]	
Byte[3]	171-169	CMD_FRAME_RATE[3]	
Byte[2]	173-172	CMD_INTEGRATION[2]	
Byte	174	CMD_FRAME_SYNC_SRC	
Byte	175	CMD_FRAME_CNTR_RST_SRC	
Byte[2]	177-176	CMD_LASER_UART_TX[2]	
Byte[3]	180-178	CMD_LASER_UART_RX[3]	
Byte[3]	183-181	CMD_LASER_UART_BAUD[3]	
Byte[2]	185-184	CMD_SYSTEM_UART_TX[2]	
Byte[3]	188-186	CMD_SYSTEM_UART_RX[3]	
Byte[3]	191-189	CMD_SYSTEM_UART_BAUD[3]	
Byte[3]	194-192	CMD_SYSTEM_XCK_PERIOD[3]	
Byte	195	LASER_LOW_LIMIT	
Byte	196	LASER_HI_LIMIT	
Byte	197	CMD_SELECT_FILTER_CONFIG	
Byte[59]	256-198	Reserved	

26.2. Data packet

Data package structure is the same for UDP and TCP protocols and has the following form:

Type	Bytes	Description	Note
ushort	1-0	Frame number	Cyclic counter. The counter value is incremented for every video-frame is used for control of the sequence of measurements.
ushort	3-2	Package number	Cyclic counter. The counter value is incremented after transition of each packet and is used for control of packets loss.
int32	7-4	System time of package sending (in microseconds)	Cyclic time counter
byte	8	Protocol release number	
byte	9	0xff	Separator
ushort	10-11	Quantity of points [N]	Number of valued points on the profile
N*short	(12 + N*2 - 1) – 12	X values	Normalized X-coordinates of **valued** points in the scanner coordinate system,

			sequentially, starting from the maximum negative value.
N*short	(12 + N*2*2 — 1) – (12 + N*2)	Z values	Z-coordinates of the profile
short	(S+2-1) – S, where S=12 + N*2*2	8	Separator S=S+2
byte	S+1	1	Separator S=S+1
3*byte	(S+3-1) – S	Serial number	S=S+3
uint16_t	(S+2-1) – S	User XEMR	S=S+2
uint16_t	(S+2-1) – S	User ZDiap	S=S+2
uint16_t	(S+2-1) – S	Check sum CRC-16	

26.3. Configuration parameters packet

Packet of parameters is transmitted at TCP/IP connection

26.3.1. _USER_PARAMS_ structure

```
typedef struct _USER_PARAMS_
        {
                uint16_t  config_version_u16;          // 0
                uint8_t   laser_level_u8;              // 2
                uint16_t  exposure_time_u16;           // 3
                uint16_t  wnd_top_u8;                  // 9
                uint16_t  wnd_height_u8;               // 10
                uint16_t  ext_sync_signal_u16;         // 11
                uint16_t  ext_sync_divider_u16;        // 13
                uint8_t   tcp_ip_address_u8[4];        // 17
                uint8_t   tcp_subnet_mask_u8[4];       // 21
                uint8_t   udp_ip_address_u8[4];        // 25
                uint16_t  udp_port_u16;                // 29
                uint16_t  udp_frequency_u8;            // 31
                uint16_t  tcp_port_u16;                // 33
                uint8_t   auto_exposure_u8;            // 36
                uint8_t   pixel_brightness_thres_u8;   //37
                uint8_t   dif_brightness_thres_u8;     // 38
                uint8_t   raw_image_u8;                // 39
                uint8_t    interpolation_u8;           // 40
                uint8_t   dhs_enable_u8;               // 41
                uint8_t   analog_enable_u8;            // 41
                uint16_t  syncChannels;
                uint8_t    measureSync;
                uint16_t  delaySync;
                uint8_t    divSync;
                uint16_t  keepTCPTime;
                uint8_t   keepTCP;
                uint8_t   filter;
                uint8_t   smooth;
                uint16_t  filterParam;
                uint16_t  smoothParam;
                uint8_t   ap;
                uint8_t   ah;
                uint8_t   wUDP;
                uint8_t   wAVE;
                uint8_t   dcA;
                uint8_t   dcB;
                uint8_t          __reserved_1[463];          // 75: 0-padding
```

```
} USER_PARAMS;
```

In SDK:

```
#pragma pack(push, 1)
  typedef struct _RF625DHS_PARAMETERS_
  {
        WORD   wConfigVersion;          // 0 : 2
        BYTE   ucLaserLevel;            // 2 : 1
        WORD   wExposureTime;           // 3 : 2
        WORD   wWindowTop;              // 5 : 2
        WORD   wWindowHeight;           // 7 : 2
        WORD   wExtSyncSignal;          // 9 : 2
        WORD   wExtSyncDivider;         // 11 : 2
        BYTE   ucTCPAddress[4];         // 13 : 4
        BYTE   ucTCPSubnetMask[4];      // 17 : 4
        BYTE   ucUDPAddress[4];         // 21 : 4
        WORD   wUDPPort;                // 25 : 2
        WORD   wUDPFrequency;           // 27 : 2
        WORD   wTCPPort;                // 29 : 2
        BYTE   ucAutoExposure;          // 31 : 1
        BYTE   ucPixelBrightnessThres;  // 32 : 1
        BYTE   ucDifBrightnessThres;    // 33 : 1
        BYTE   ucRawImageMode;          // 34 : 1
        BYTE   ucInterpolation;         // 35 : 1
        BYTE   ucDHSEnable;             // 36 : 1
        BYTE   ucAnalog;                // 37 : 1
        WORD   wSyncChannels;           // 38 : 2
        BYTE   ucMeasureSync;           // 40 : 1
        WORD   wDelaySync;              // 41 : 2
        BYTE   ucDivSync;               // 43 : 1
        WORD   wKeepTCPTime;            // 44 : 2
        BYTE   ucKeepTCP;               // 46 : 1
        BYTE   ucFilter;                // 47 : 1
        BYTE   ucSmooth;                // 48 : 1
        WORD   wFilterParam;            // 49 : 2
        WORD   wSmoothParam;            // 51 : 2
        BYTE   ucAP;                    // 53 : 1
        BYTE   ucAH;                    // 54 : 1
        BYTE   ucUDPStream;             // 55 : 1
        BYTE   ucAveraging;             // 56 : 1
        BYTE   ucDropCountersExt;       // 57 : 1
        BYTE   ucDropCountersInt;       // 58 : 1
        BYTE   ucReserved[512-59];      // 59 : 0-padding
  } RF625DHS_PARAMETERS, *LPRF625DHS_PARAMETERS;
#pragma pack(pop)
```

26.3.2. Description

Type	Bytes	Name	Name in SDK	Description
uint16_t	1-0	config_version_u16	wConfigVersion	Configuration version
uint8_t	2	laser_level_u8	ucLaserLevel	Laser output power level. Range: from 1 to 255
uint16_t	4-3	exposure_time_u16	wExposureTime	Exposure time (integration time). Range: 1..3600 microseconds
uint16_t	6-5	wnd_top_u8	wWindowTop	Window top border for ROI, from 0 to 225. By default - 0.

uint16_t	8-7	wnd_height_u8	wWindowHeight	Window height for ROI, from 31 to 255. By default 255.
uint16_t	10-9	ext_sync_signal_u16	wExtSyncSignal	External synchronization. 0 – OFF 1 – ON 2 – synchronization of cycle start
uint16_t	12-11	ext_sync_divider_u16	wExtSyncDivider	External trigger divider, from 1 to 256
uint8_t[4]	16-13	tcp_ip_address_u8[4]	ucTCPAddress[4]	IP device address. By default 0.0.0.0
uint8_t[4]	20-17	tcp_subnet_mask_u8[4]	ucTCPSubnetMask[4]	Network musk. By default 0.0.0.0
uint8_t[4]	24-21	udp_ip_address_u8[4]	wUDPPort	Host IP address. By default 255.255.255.255
uint16_t	26-25	udp_port_u16	wUDPFrequency	Host UDP port. By defaylt 6003.
uint16_t	28-27	udp_frequency_u8	wTCPPort	UDP frequency
uint16_t	30-29	tcp_port_u16	wTCPPort	TCP/IP port
uint8_t	31	auto_exposure_u8	ucAutoExposure	Autoexposure 0 – OFF (By default) 1 – ON
uint8_t	32	pixel_brightness_thres_u8	ucPixelBrightnessThres	Profile detection level
uint8_t	33	dif_brightness_thres_u8	ucDifBrightnessThres	Distance between pixels threshold
uint8_t	34	raw_image_u8	ucRawImageMode	Image Raw mode
uint8_t	35	interpolation_u8	ucInterpolation	Profile interpolation
uint8_t	36	dhs_enable_u8	ucDHSEnable	Double speed 0 — OFF 1 — ON
uint8_t	37	analog_enable_u8	ucAnalog	Analog output 0 — OFF 1 - ON
uint16_t	39-38	syncChannels	wSyncChannels	Synchronization channels
uint8_t	40	measureSync	ucMeasureSync	Synchronization of measurements 0 — OFF 1 — ON
uint16_t	42-41	delaySync	wDelaySync	Delay of synchronization
uint8_t	43	divSync	ucDivSync	Synchronization divider
uint16_t	45-44	keepTCPTime	wKeepTCPTime	Time of TCP connection retention
uint8_t	46	keepTCP	ucKeepTCP	TCP connection retention 0 — NO 1 — YES
uint8_t	47	filter	ucFilter	Filter 0 — OFF 1 — ON
uint8_t	48	smooth	ucSmooth	Smoothing
uint16_t	50-49	filterParam	wFilterParam	Filter parameters
uint16_t	52-51	smoothParam	wSmoothParam	Smoothing parameters
uint8_t	53	ap	ucAP	
uint8_t	54	ah	ucAH	
uint8_t	55	wUDP	ucUDPStream	
uint8_t	56	wAVE	ucAveraging	Averaging
uint8_t	57	dcA	ucDropCountersExt	
uint8_t	58	dcB	ucDropCountersInt	
uint8_t	520-59	__reserved_1[463]	ucReserved[512-59]	Reserved

26.4. RF_COMMAND_PACKET

The command package has the next structure:

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


where:

Command – request code
AttachSize – attached data. If the size = 0, there are no data
Offset – data offset
Size – data size

26.4.1. Request codes

Request	Request code	Note (unless otherwise indicated, Attachsize=0, Offset=0, Size=0)	Example	Name in SDK
GetResult	0x01	Inquiring of result Answer - data packet	Example 1	RF625CMD_GetResult
GetImage	0x02	Inquiring of image. Scanner switches into "Image transmission" mode. On GetImageBuffer request scanner will begin to transmit an image. After transmitting the image scanner exits the mode.	Example 2	RF625CMD_GetImage
GetImageBuffer	0x03	Receiving the image. Full frame size = 512 * 640 bytes. On GetImageBuffer request scanner sends a part of image with size of 32768 bytes. So, to collect full image it is necessary to send GetImageBuffer request 10 times. For every request a value of Offset is incremented to 32768 (beginning from zero for the first package), Size = 32768 (for the all requests)		RF625CMD_GetImageBuffer
ReadParams	0x04	Inquiring of scanner configuration parameters. Answer - configuration parameters packet	Example 3	RF625_ReadParams
WriteParams	0x05	Inquiring of configuration parameters downloading. After this request configuration parameters have to be transmitted into the scanner		RF625_WriteParams
FlushParams	0x06	Storing current parameters to FLASH-memory (Offset=0), Current parameters which were recorded by Writeparams command will be saved as default parameters;		RF625CMD_FlushParams

		or Recovery from FLASH-memory (Offset=1). Default parameters will be recovered as current parameters		
Reboot	0x14	Inquiring of scanner reboot		RF625CMD_Reboot
UpgradeFW	0x15	Firmware update AttachSize = FW file size, bytes		RF625CMD_UpgradeFW
Shutdown	0x16	Inquiring of scanner shutdown		RF625CMD_Shutdown
GetAutoExposure	0x17	Inquiring of current integration time		RF625_GetAutoExposure
Disconnect	0x19	Inquiring of TCP session completion		RF625CMD_Disconnect
GetExtends	0x20	Inquiring of scanner hardware status. Answer – hardware packet condition. Size is 15*2 bytes. If current mode is not profile transmittance, packet will consist of 15 of two bytes values 0x0FFD.		RF625_GetExtends
GetPixels	0x81	Read pixels		RF625_GetPixels
ReadFactoryParams	0x82	Inquiring of factory parameters. Answer – FactCfgArea packet, size 1024 bytes		
WriteFactoryParams	0x83	Inquiring of factory parameters transmittance into scanner. After this request factory parameters has to be transmitted into scanner, it is FactCfgArea packet of 1024 bytes		
FlushFactoryParams	0x84	Storing factory parameters to FLASH-memory (Offset=0), current factory parameters written by WriteFactoryParams will be stored as default parameters or restored from FLASH (Offset=1), default parameters will be restored as current parameters.		
ReadFactoryTables	0x85	Inquiring of look-up tables. Answer – packet with calibration table. Size and offset – in command packet.		
WriteFactoryTables	0x86	Inquiring of look-up tables transmit Calibration tables has to be transmitted into scanner (640*15*2 bytes). Answer – "OK" (2 bytes)		
FlushFactoryTables	0x87	Storing factory parameters to FLASH-memory (Offset=0), current tables, written by WriteFactoryTables, will be saved as by default ones		
SetAnalogOut	0x8B	Analog output ON Answer – one byte, 0x8B.		
SendSPI	0x8C	Inquiring of SPI parameters transmit. After this request packet (4 bytes) of SPI parameters has to be transmitted.		RF625_SendSPI
SpeedTest	0x8E	Data transfer speed test. After this request packet with random data is transmitted to scanner.		

		Answer - 60*1024 bytes packet. Speed measurement has to be done by client software		
ReadFpgaParams	0x8F	Inquiring of FPGA parameters. Answer – FpgaCfgArea packet		
WriteFpgaParams	0x90	Inquiring of FPGA parameters into RAM. AttachSize=1024		
FlushFpgaParams	0x91	Storing FPGA parameters to FLASH memory (Offset=0), current FPGHA parameters written by Writeparams, will be saved as default parameters or restored from FLASH (Offset=1).		
RF625CMD_CreateRecovrPart	0x92	Back-up creation in special section		

26.5. Emetgency UDP-package

Emergency UDP-package is transmitted in case of failure in trance command by TCP-protocol. Broadcast package with size of 256 is transmitted to 62533 port.

```
typedef struct _UDPI_RFDEVICEEMERGENCYBLOCK_ {
        uint32_t serialnumber;
        uint16_t what;
}   tUDPI_RFDeviceEmergencyBlock;
```

In **SDK**:

```
#pragma pack(push, 1)
        typedef struct _RF625DHS_EMERGENCY_BLOCK_
        {
                DWORD        dwSerialNumber;        // 0 : 4
                WORD  dwCommand;              // 4 : 2
                BYTE    ucReserved[256-6];      // 6
        } RF625DHS_EMERGENCY_BLOCK, *LPRF625DHS_EMERGENCY_BLOCK;
        // 256 bytes
#pragma pack(pop)
```

Allowable values for what:

- 0x06 – Scanner reboot;
- 0x07 – Scanner OFF;
- 0x08 – Scanner network disconnection;

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