mm FDRF605 Series

Valid for sensors with serial numbers 11000 and higher

Certified according to ISO 9001:2008

■ Contents

1. Safety precautions

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

2. Electromagnetic compatibility

The sensors 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 sensors make use of an c.w. 660 nm wavelength semiconductor laser. Maximum output power is 1 mW. The sensors belong to the 2 laser safety class. The following warning label is placed on the laser body:
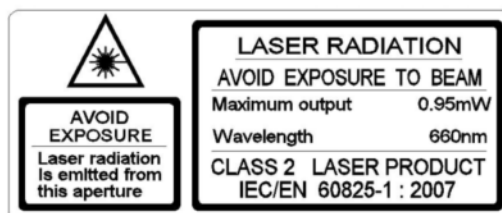
The following safety measures should be taken while operating the sensor:

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

4. General information

The sensors are intended for non-contact measuring and checking of position, displacement, dimensions, surface profile, deformation, vibrations, sorting and sensing of technological objects as well as for measuring levels of liquid and bulk materials. The series includes 4 sensors with the measurement range, from 50 to 500 mm and the base distance from 25 to 105 mm. Custom-ordered configurations are possible with parameters different from those shown below.

5. Basic technical data

FDRF605-	25/50	45/100	65/250	105/500
Base distance X, mm	25	45	65	105
Measurement range, mm	50	100	250	500
Linearity, %	±0.1 of the range			

Resolution, %		0.02 of the range
Temperature drift		0,02% of the range/ ^{0}C
Max. sampling frequency, Hz		2000
Light source		red semiconductor laser, 660 nm wavelength
Output power, mW		≤0,95 mW
Laser safety Class		2 (IEC60825-1)
Output interface	digital	RS232 (max. 460,8 kbit/s) or RS485 (max. 460,8 kbit/s)
	analog	4...20 mA (500 Ω load) or 0...10 V
Synchronization input		2,4 − 5 V (CMOS, TTL)
Logic output		programmed functions, NPN: 100 mA max; 40 V max for output
Power supply, V		24 (9 ...36)
Power consumption, W		1,5..2
Environment resistance	Enclosure rating	IP67 (for sensors with cable connector only)
	Vibration	20g/10...1000Hz, 6 hours, for each of XYZ axes
	Shock	30 g / 6 ms
	Operation temperature, °C	-10...+60
	Permissible ambient light, lx	7000
	Relative humidity	35-85%
	Storage temperature, °C	-20...+70
Housing material		aluminum
Weight (without cable), gram		60

6.   Example of item designation when ordering

FDRF605-X/D-SERIAL-ANALOG-IN-AL- CC(R)-M

Symbol	Description
X	Base distance (beginning of the range), mm
D	Measurement range, mm
SERIAL	Type of serial interface: RS232 - 232, or RS485 - 485
IN	Trigger input (input of synchronization) presence
AL	Programmed signal, which has triple purpose. It can be used as 1) logical output (indication of the presence of an object in the operating range) 2) line of mutual synchronization of two and more sensors 3) line of hardware zero setting
CC(R)	Cable gland - CG, or cable connector - CC (Binder 702, IP67) Note 1: R option − robot cable
M	Cable length, m

Example. FDRF605-105/500-232-I-IN-CG-3 −base distance − 105 mm, range − 500 mm, RS232 serial port, 4...20mA analog output, trigger input is available, cable gland, 3 m cable length.

7.   Structure and operating principle

Operation of the sensors is based on the principle of optical triangulation (Figure 1.). Radiation of a semiconductor laser 1 is focused by a lens 2 onto an object 6. Radiation reflected by the object is collected by a lens 3 onto a linear CMOS array 4. A signal processor 5 calculates the distance to the object from the position of the light spot on the array 4.
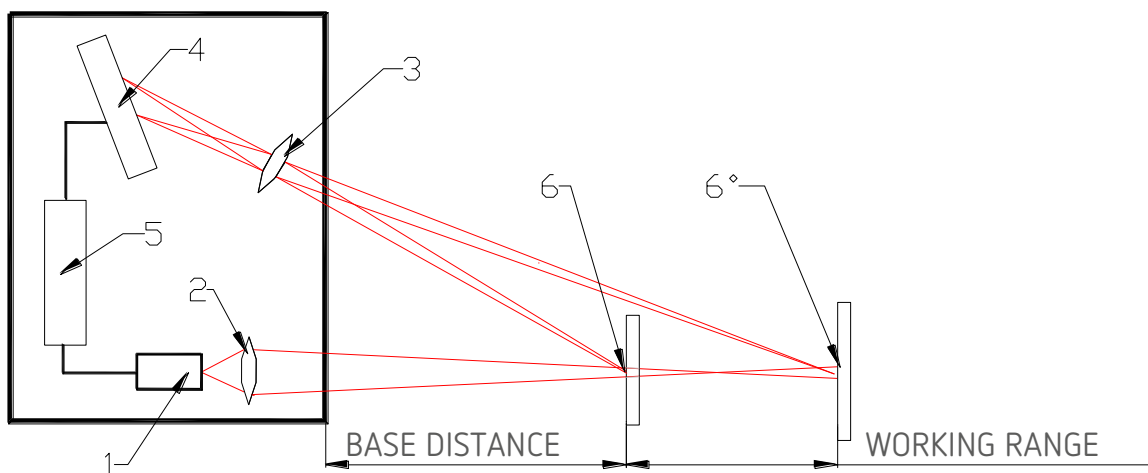
Figure 1

8.   Dimensions and mounting

8.1.   Overall and mounting dimensions

Overall and mounting dimensions of the sensor are shown in Figure 2 and 3. Sensor package is made of anodized aluminum. The front panel of the package has output window: The package also contains mounting holes.
Sensors are equipped by cable gland or connector.
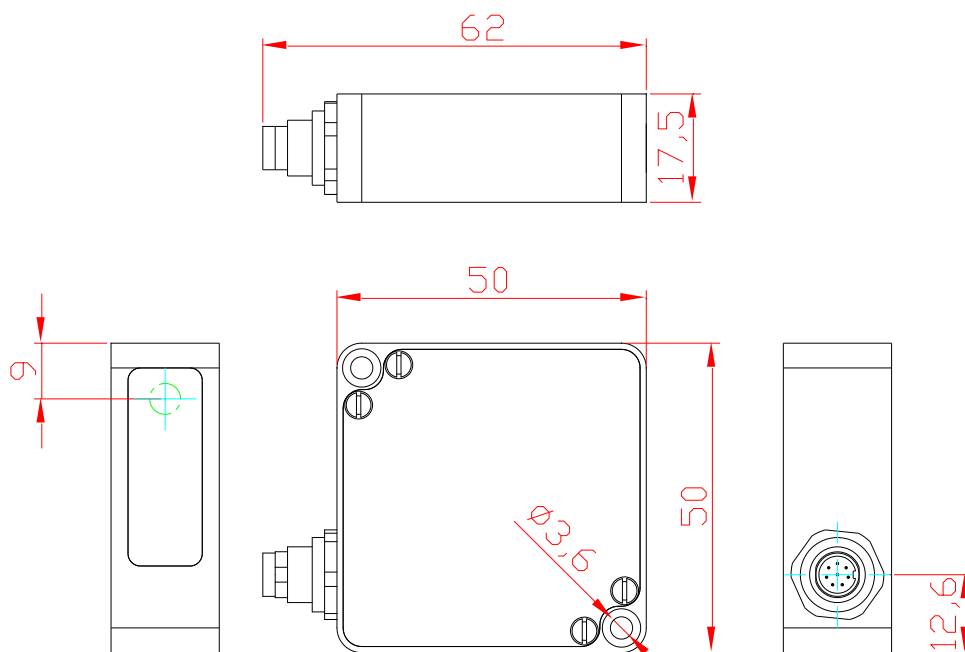
Figure 2. Sensor with connector
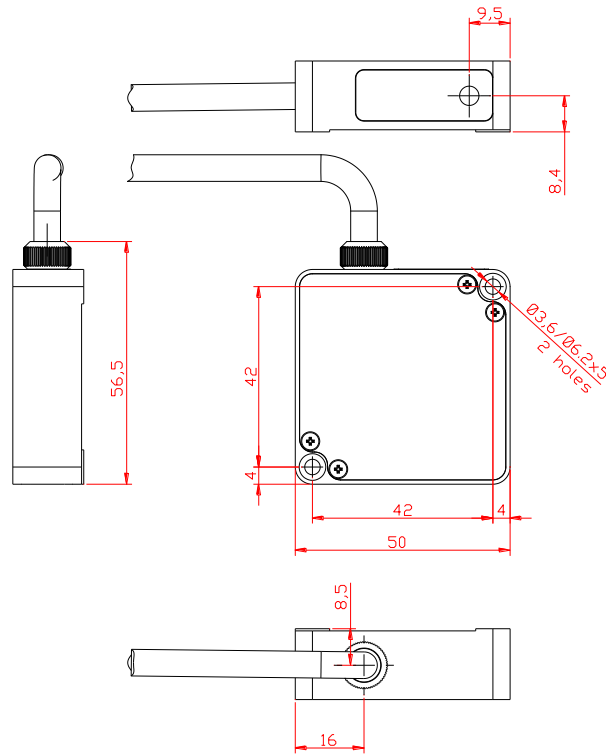
Figure 3. Sensor with cable gland

8.2. Overall demands for mounting

The sensor 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. Designation of connector contacts

View from the side of connector contacts used in the sensor is shown in the following figures.

Binder 702 Series, #09-0427-80-08
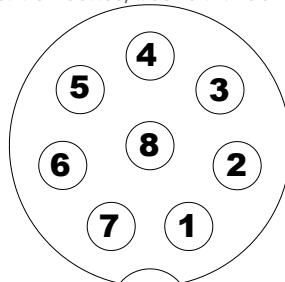
Designation of contacts is given in the following tables:

Connector

Model of the sensor	Pin number	Assignment
232-U/I-IN-AL	1	IN
	2	Gnd (power supply)
	3	TXD
	4	RXD
	5	Gnd (common for signals)
	6	AL
	7	U/I
	8	Power supply U+
485-U/I-IN-AL	1	IN
	2	Gnd (power supply)
	3	DATA+
	4	DATA-
	5	Gnd (common for signals)
	6	AL
	7	U/I
	8	Power supply U+

9.2. Cables

Designation of cable wires is given in the table below:

Model of the sensor	Pin number		Assignment	Wire color
232-U/I-IN-AL	free lead	-	Power U+	Red
	free lead	-	Gnd (power supply)	Brown
	DB9	2	TXD	Green
	DB9	3	RXD	Yellow
	free lead	-	U/I	Blue
	free lead	-	IN	White
	free lead	-	AL	Pink
	DB9	5	Gnd (Common for signals)	Grey
485-U/I-IN-AL	free leads		Power U+	Red
			Gnd (power supply)	Brown
			DATA+	Green
			DATA-	Yellow
			U/I	Blue
			IN	White
			AL	Pink
			Gnd (common for signals)	Grey

10. Configuration parameters

The nature of operation of the sensor depends on its configuration parameters (operation modes), which can be changed by transmission of commands through serial port RS232 or RS485. The basic parameters are as follows:

10.1. Time limit for integration

Intensity of the reflected radiation depends on the surface characteristic of objects under control. Therefore, output power of the laser and the time of integration of radiation incident onto the CMOS-array are automatically adjusted to achieve maximum measurement accuracy.

Parameter "time limit for integration" specifies maximum allowable time of integration. If the radiation intensity received by the sensor is so small that no reasonable result is obtained within the time of integration equal to the limiting value, the sensor transmits a zero value.

Note 1. The measurement frequency depends on the integration time of the receiving array. Maximum frequency (2 kHz) is achieved for the integration time ≤106 μs (minimum possible integration time is 10 μs). As the integration time increases above 106 μs, the result updating time increases proportionally.

Note 2. Increasing of this parameter expands the possibility of control of low-reflecting (diffuse component) surfaces; at the same time this leads to reduction of measurement frequency and increases the effects of exterior light (background) on the measurement accuracy. Factory setting of the limiting time of integration is 3200 us.

Note 3. Decreasing of this parameter lets to increase measurement frequency, but can decrease measurement accuracy.

10.2. Sampling mode

This parameter specifies one of the two result sampling options in the case where the sensor works in the data stream mode:

· Time Sampling;

· Trigger Sampling.

With **Time Sampling** selected, the sensor automatically transmits the measurement result via serial interface in accordance with selected time interval (sampling period).

With **Trigger sampling** is selected, the sensor transmits the measurement result when external synchronization input (IN input of the sensor) is switched and taking **the division factor** set into account.

10.3. Sampling period

If the Time Sampling mode is selected, the 'sampling period' parameter determines the time interval in which the sensor will automatically **transmit** the measurement result. The time interval value is set in increments of 0.01 ms. **For example**, for the parameter value equal to 100, data are transmitted through bit-serial interface with a period of 0,01*100 = 1 ms.

If the Trigger Sampling mode is selected, the 'sampling period' parameter determines the division factor for the external synchronization input. For example, for the parameter value equal to 100, data are transmitted through bit-serial interface when each 100th synchronizing pulse arrives at IN input of the sensor.

Note 1. It should be noted that the 'sampling mode' and 'sampling period' parameters control only the transmission of data. The sensor operation algorithm is so built that measurements are taken at a maximum possible rate determined by the integration time period, the measurement results is sent to buffer and stored therein until a new result arrives. The above-mentioned parameters determine the method of the readout of the result form the buffer.

Note 2. If the bit-serial interface is used to receive the result, the time required for data transmission at selected data transmission rate should be taken into account in the case where small sampling period intervals are used. If the transmission time exceeds the sampling period, it is this time that will determine the data transmission rate.

10.4. The point of zero

This parameter sets a zero point of absolute system of coordinates in any point within the limits of a working range. You can set this point by corresponding command or by connecting AL input to the ground line (this input must preliminarily be set to mode 3). When the sensor is fabricated, the base distance is set with a certain uncertainty, and, if necessary, it is possible to define the point zero more accurately.

10.5. Line AL operation mode

This line can work in one of the four modes defined by the configuration parameter value:

· mode 1: indication of run-out beyond the range ("0" − object is beyond the range (beyond the selected window in the range), "1" − object is within the range (within the selected window in the range);
· mode 2: mutual synchronization of two or more sensors;
· mode 3: hardware zero-set line;
· mode 4: hardware laser switch OFF/ONN

In the **"Indication of run-out beyond the range"** mode, logical "1" occurs on the AL line if an object under control is located within the working range of the sensor (within the selected window in the range), and logical "0" occurs if the object is absent in the working range (within the selected window). For example, in such mode this line can be used for controlling an actuator (a relay) which is activated when the object is present (absent) within the selected range (Fig.4.1).

The **"Mutual synchronization"** mode makes it possible to synchronize measurement times of two and more sensors. It is convenient to use this mode to control one object with several sensors, e.g., in the measurement of thickness. On the hardware level, synchronization of the sensor is effected by combining AL lines (Fig.4.2.).

In the **"Hardware zero-set"** mode connection AL input to the ground potential sets beginning of coordinates into current point (Fig.4.3.).

In the **"Hardware laser switch OFF/ON"** mode connection AL input to the ground potential switch laser ON/OFF (Fig.4.3)

Out of the range indication
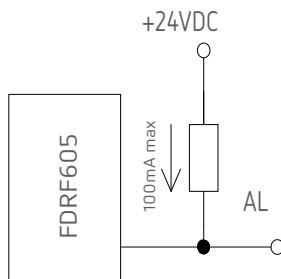
Mutual synchronization
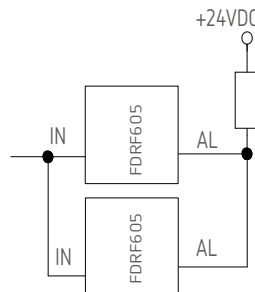
Hardware zero-set/
Hardware laser ON/OFF
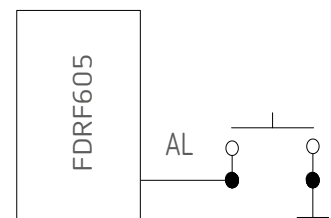
Figure 4.1

Figure 4.2

Figure 4.3

10.6. Time lock of the result

If the sensor does not find out object or if the authentic result cannot be received, zero value is transferred. The given parameter sets time during which is transferred the last authentic result instead of zero value.

10.7. Method of results averaging

This parameter defines one of the two methods of averaging of measurement results implemented directly in the sensor:

· Averaging over a number of results
· Time averaging

When **averaging over a number of results** is selected, sliding average is calculated.

When **time averaging** is selected, the results obtained are averaged over the time interval chosen.

10.8. Number of averaged values/time of averaging

This parameter specifies the number of source results to be averaged for deriving the output value or time of the averaging .

The use of averaging makes it possible to reduce the output noise and increase the sensor resolution.

Averaging over a number of results does not affect the data update in the sensor output buffer.

In case of time averaging, data in the output buffer are updated at a rate equal to the averaging period.

Note. Maximum parameters value is 127.

10.9. Factory parameters table

The sensors are supplied with the parameters shown in the table below:

Parameter	Value
Time limit for integration	3200 (3,2 ms)
Sampling mode	time
Sampling period	5000 (5 ms)
Point of zero	Beginning of the range
Line AL operation mode	1
Time lock of the result	5 ms
Method of results averaging	Over a number of results
Number of averaged values	1

The parameters are stored in nonvolatile memory of the sensor. Correct changing of the parameters is carried out by using the parameterization program supplied with the sensor or a user program.

11. Description of RS232 and RS485 interfaces

11.1. RS232 port

The RS232 port ensures a "point-to-point" connection and allows the sensor to be connected directly to RS232 port of a computer or controller.

11.2. RS485 port

In accordance with the protocol accepted and hardware capability, the RS485 port makes it possible to connect up to 127 sensors to one data collection unit by a common bus circuit.

11.3. Modes of data transfer

Through these serial interfaces measurement data can be obtained by two methods:
·   by single requests (inquiries);
·   by automatic data streaming (stream).

11.4. Configuration parameters

11.4.1. Rate of data transfer through serial port

This parameter defines the rate of data transmission via the bit-serial interface in increments of 2400 bit/s. For example, the parameter value equal to 4 gives the transmission rate of 2400*4 = 9600 bit/s.

Note. The maximum transmission rate for RS232/RS485 interface is 460,8 kbit/s.

11.4.2. Net address

This parameter defines the network address of the sensor equipped with RS485 interface.

Note. Network data communications protocol assumes the presence of 'master' in the net, which can be a computer or other information-gathering device, and from 1 to 127 'slaves' (RF60x Series sensors) which support the protocol.

Each 'slave' is assigned a unique network identification code − a device address. The address is used to form requests or inquiries all over the net. Each slave receive inquiries containing its unique address as well as '0' address which is broadcast-oriented and can be used for formation of generic commands, for example, for simultaneous latching of values of all sensors and for working with only one sensor (with both RS232 port and RS485 port).

11.4.3. Factory parameters table

Parameter	Value
Baud rate	9600 bit/s
Net address	1
Mode of data transfer	request

11.5. Interfacing protocol

11.5.1. Serial data transmission format

Data message has the following format:

1 start-bit	8 data bits	1 even bit	1 stop-bit

11.5.2. Communication sessions types

The communications protocol is formed by communication sessions, which are only initiated by the 'master' (PC, controller). There are two kinds of sessions with such structures:
1) "request", ["message"] — ["answer"], **square brackets include optional elements**
2) "request" — "data stream" — ["request"].

11.5.3. Request

"Request" (INC) — is a **two-byte message**, which fully controls communication session. The 'request' message is the only one of all messages in a session where **most significant bit is set at 0**, therefore, it serves to synchronize the beginning of the session. In addition, it contains the device address (ADR), code of request (COD) and, optional, the message [MSG].

"Request" format:

Byte 0		Byte 1					[Bites 2...N]
INC0(7:0)		INC1(7:0)					MSG
0	ADR(6:0)	1	0	0	0	COD(3:0)	

11.5.4. Message

"Message'' is data burst that can be transmitted by 'master' in the course of the session.

All messages with a "message" burst contain 1 in the most significant digit. Data in a message are transferred in tetrads. When byte is transmitted, lower tetrad goes first,

and then follows higher tetrad. When multi-byte values are transferred, the transmission begins with lower byte.

The following is the format of two 'message' data bursts for transmission of byte:

DAT(7:0)									
Byte 0					Byte 1				
1	0	0	0	DAT(3:0)	1	0	0	0	DAT(7:4)

11.5.5. Answer

"Answer" is data burst that can be transmitted by 'slave' in the course of the session.

All messages with a message burst contain 1 in the most significant digit. Data in a message are transferred in tetrads. When byte is transmitted, lower tetrad goes first, and then follows higher tetrad. When multi-byte values are transferred, the transmission begins with lower byte.

When 'answer' is transmitted, the message contains:

· SB-bit, characterizes the updating of the result. If SB is equal to "1" this means that the sensor has updated the measurement result in the buffer, if SB is equal to "0" - then non-updated result has been transmitted (see. Note 1, p.10.3.). SB=0 when parameters transmit;

· two additional bits of cyclic binary batch counter (CNT). Bit values in the batch counter are identical for all sendings of one batch. The value of batch counter is incremented by the sending of each burst and is used for formation (assembly) of batches or bursts as well as for control of batch losses in receiving data streams.

The following is the format of two 'answer' data bursts for transmission of byte:

DAT(7:0)								
Byte 0				Byte 1				
1	SB	CNT(1:0)	DAT(3:0)	1	SB	CNT(1:0)	DAT(7:4)

11.5.6. Data stream

'Data stream' is an infinite sequence of data bursts or batches transmitted from 'slave' to 'master', which can be interrupted by a new request. In transmission of 'data stream' one of the 'slaves' fully holds data transfer channel, therefore, when 'master' produces any new request sent to any address, data streaming process is stopped. Also, there is a special request to stop data streaming.

11.5.7. Request codes and list of parameters

Request codes and list of parameters are presented in Chapter 13.

12. Analog outputs

Changing of the signal at analog output occurs in synchronism with the changing of the result transferred through the bit-serial interface

12.1. Current output 4...20 mA

The connection scheme is shown in the figure. The value of load resistor should not be higher than 500 Om. To reduce noise, it is recommended to install RC filter before the measuring instrument. The filter capacitor value is indicated for maximum sampling frequency of the sensor (9,4 kHz) and this value increases in proportion to the frequency reduction.

10 kOm

Blue

FDRF605

500 Om

5 nF

Voltmeter

Grey
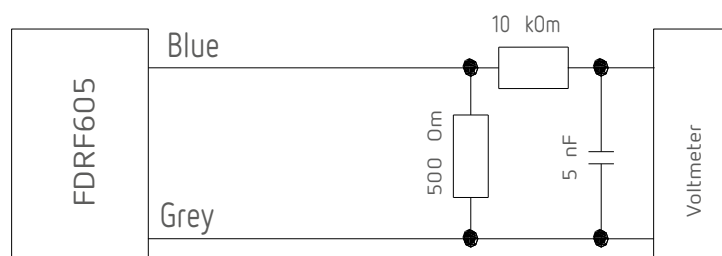
12.2. Voltage output

The connection scheme is shown in the figure. To reduce noise, it is recommended to install RC filter before the measuring instrument. The filter capacitor value is indicated for maximum sampling frequency of the sensor (9,4 kHz) and this value increases in proportion to the frequency reduction.

10 kOm

Blue

FDRF605

5 nF

Voltmeter

Grey

12.3. Configuration parameters

12.3.1. Range of the analog output.

While working with the analog output, resolution can be increased by using the 'Window in the operating range' function which makes it possible to select a window of required size and position in the operating range of the sensor within which the whole range of analog output signal will be scaled.
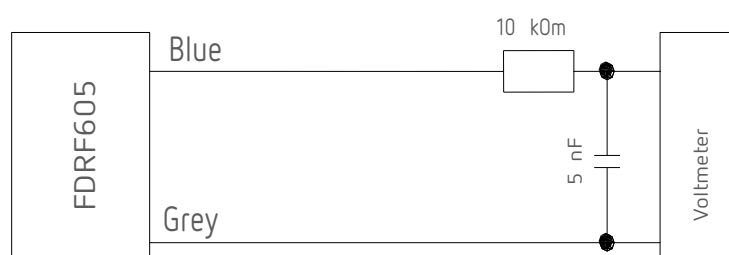
If the beginning of the range of the analog signal is set at a higher value than the end value of the range, this will change the direction of rise of the analog signal.

Note. If the beginning of the range of the analog signal is set at a higher value than the end value of the range, this will change the direction of rise of the analog signal.

12.3.2. Analog output operation mode.

When using 'window in the operating range' function, this mode defines the analog output operation mode.

Analog output can be:

· in the window mode or
· in the full mode.

"Window mode". The entire range of the analog output is scaled within the selected window. Outside the window, the analog output is "0".

"Full mode". The entire range of the analog output is scaled within the selected window (operating range). Outside the selected window, the whole range of the analog output is automatically scaled onto the whole operating range of the sensor (sensitivity range).

12.4. Factory parameters table

Range of the analog output	Measuring range of sensor
Analog output operation mode	Window

13. Request codes and list of parameters

13.1. Request codes table

Request code	Description	Message (size in bytes)	Answer (size in bytes)	
01h	Device identification	—	− device type − firmware release − serial number − base distance − range	(1) (1) (2) (2) (2)
02h	Reading of parameter	- code of parameter (1)	- value of parameter	(1)
03h	Writing of parameter	- code of parameter (1) - value of parameter (1)	—	
04h	Storing current parameters to FLASH-memory	- constant AAh (1)	- constant AAh	(1)
04h	Recovery of parameter default values in FLASH-memory	- constant 69h (1)	- constant 69h	(1)
05h	Latching of current result	—	—	
06h	Inquiring of result	—	- result	(2)
07h	Inquiring of a stream of results	—	- stream of results	(2)
08h	Stop data streaming	—	—	

13.2. List of parameters

Code of parameter	Name	Values
00h	Sensor ON	1 — laser is ON, measurements are taken (default state); 0 — laser is OFF, sensor in power save mode
01h	Analog output ON	1/0 — analog output is ON/OFF; if a sensor has no analog output, this bit will remain in 0 despite all attempts of writing 1 into it.

02h	Averaging, sampling and AL output control	x,x,M,C,M1,M0,R,S – control byte which determines averaging mode – bit M, CAN interface mode - bit C, logical output mode - bit M1, analog output mode - bit R, and sampling mode - bit S;
		bites x – do not use;
		bit M:
		    0 — quantity sampling mode (by default);
		    1 — time sampling mode

		bit C:
		    0 – request mode of CAN interface (by default);
		    1 – synchronization mode of CAN interface.
		bit M1 and M0:
		    00 – out of the range indication (by default):
		    01 – mutual synchronization mode.
		    10 – hardware zero set mode
		    11 – laser turn OFF/ON
		bit R:
		    0 – window mode (default);
		    1 – full range.
		bit S:
		    0 – time sampling (default)
		    1 – trigger sampling.

03h	Network address	1...127 (default — 1)
04h	Rate of data transfer through serial port	1...192, (default — 4) specifies data transfer rate in increments of 2400 baud; e.g., 4 means the rate of 42400=9600baud. (NOTE: max baud rate = 460800)
05h	Reserved	
06h	Number of averaged values	1...128, (default — 1)
07h	Reserved	
08h	Lower byte of the sampling period	1) 10...65535, (default — 500)

09h	Higher byte of the sampling period	the time interval in increments of 0.01 ms with which sensor automatically communicates of results on streaming request (priority of sampling = 0); 2) 1...65535, (default — 500) divider ratio of trigger input with which sensor automatically communicates of result on streaming request (priority of sampling = 1)
0Ah	Lower byte of maximum integration time	2...65535, (default — 200) specifies the limiting time of integration by CMOS-array in increments of 1mks
0Bh	Higher byte of maximum integration time	
0Ch	Lower byte for the beginning of analog output range	0...4000h, (default — 0) specifies a point within the absolute range of transducer where the analog output has a minimum value
0Dh	Higher byte for the beginning of analog output range	
0Eh	Lower byte for the end of analog output range	0...4000h, (default — 4000h)) specifies a point within the absolute range of transducer where the analog output has a maximum value
0Fh	Higher byte for the end of analog output range	
10h	Time lock of result	0...255, specifies of time interval in increments of 5 m
11...16h	Reserved	
17h	Lower zero point	0...4000h, (default — 0) specifies beginning of absolute coordinate system.
18h	Higher byte zero point	

13.3. Notes

- · All values are given in binary form.
- · Base distance and range are given in millimeters.
- · The value of the result transmitted by a sensor (D) is so normalized that 4000h (16384) corresponds to a full range of the sensor (S in mm), therefore, the result in millimeters is obtained by the following formula:

$$X=D*S/4000h \text{ (mm)}   (1).$$

- · On special request (05h), the current result can be latched in the output buffer where it will be stored unchanged up to the moment of arrival of request for data transfer. This request can be sent simultaneously to all sensors in the net in the broadcast mode in order to synchronize data pickup from all sensors.
- · When working with the parameters, it should be borne in mind that when power is OFF the parameter values are stored in nonvolatile FLASH-memory of the sensor. When power is ON, the parameter values are read out to RAM of the sensor. In order to retain these changes for the next power-up state, a special command for saving current parameter values in the FLASH-memory (04h) must be run.
- · Parameters with the size of more than one byte should be saved starting from the high-order byte and finishing with the low-order byte.

13.4.   Examples of communication sessions

1) Request "Device identification".
Condition: device address —1, request code − 01h, device type — 61, firmware release — 88 (58h), serial number — 0402 (0192h), base distance — 80mm (0050h), measurement range — 50 (0032h), packet number — 1.

The request format:

Byte 0		Byte 1					[Bytes 2...N]
\multicolumn{2}{l	}{INC0(7:0)}	\multicolumn{5}{l	}{INC1(7:0)}	MSG
0	ADR(6:0)	1	0	0	0	COD(3:0)	

Request from "Master"

Byte 0								Byte 1							
INC0(7:0)								INC1(7:0)							
0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1
01h								81h							

The following is the format of two 'answer' data bursts for transmission of byte DAT(7:0):

DAT(7:0)															
Byte 0								Byte 1							
1	0	CNT(1:0)		DAT(3:0)				1	0	CNT(1:0)		DAT(7:4)			

Answer of "Slave":

Device type:

DAT(7:0)															
Byte 0								Byte 1							
1	0	0	1	0	0	0	1	1	0	0	1	0	1	1	0
91h								96h							

Firmware release

DAT(7:0)															
Byte 0								Byte 1							
1	0	0	1	1	0	0	0	1	0	0	1	0	1	0	1
98h								95h							

Serial Number

DAT(7:0)															
Byte 0								Byte 1							
1	0	0	1	0	0	1	0	1	0	0	1	1	0	0	1
92h								96h							

DAT(7:0)															
Byte 0								Byte 1							
1	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0
91h								90h							

Base distance

DAT(7:0)															
Byte 0								Byte 1							
1	0	0	1	0	0	0	0	1	0	0	1	0	1	0	1
90h								95h							

DAT(7:0)															
Byte 0								Byte 1							
1	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0
90h								90h							

Measurement range

DAT(7:0)															
Byte 0								Byte 1							
1	0	0	1	0	0	1	0	1	0	0	1	0	0	1	1
92h								93h							

DAT(7:0)															
Byte 0								Byte 1							
1	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0
90h								90h							

Note: as bust number =1, then CNT=1

2) Request "Reading of parameter".

Condition: device address —1, request code – 02h, code of parameter — 05h, value of parameter — 04h, packet number — 2.
Request ("Master") — 01h;82h;
Message ("Master") — 85h, 80h;
Answer ("Slave") — A4h, A0h

3) Request "Inquiring of result".
Condition: device address — 1, result — 02A5h, packet number — 3.
Request ("Master") — 01h;86h;
Answer ("Slave") — B5h, BAh, B2h, B0h
Measured distance (mm) (for example, range of the sensor= 50 mm):
$$X = 677(02A5h) * 50 / 16384 = 2.066 \text{ mm}$$

4) Request "writing sampling regime (trigger sampling)".
Condition: device address – 1, request code – 03h, code of parameter – 02h, value of parameter – 01h.
Request ("Master") – 01h, 83h;
Message ("Master") – 82h, 80h, 81h, 80h;

5) Request: "writing the divider ration"
Condition: divider ration – 1234=3039h, device address – 1, request code – 03h, code of parameter – 09h (first or higher byte), value of parameter – 30h
Request ("Master") – 01h, 83h
Message ("Master") – 89h, 80h, 80h, 83h
and for lower byte, code of parameter – 08h, value of parameter – 39h
Request ("Master") – 01h, 83h
Message ("Master") – 88h, 80h, 89h, 83h

14.   Parameterization program

## 14.1. Function

The FDRF60X-SP-2.0 software is intended for:
1) Testing and demonstration of work of FDRF605 series sensors;
2) Setting of the sensor parameters;
3) Reception and gathering of the sensor data signals

14.2. Program setup

Start file RF60Xsetup.exe and follow instructions of the installation wizard

14.3. Obtaining connection to sensor

Once the program is started, the pop-up window emerges:
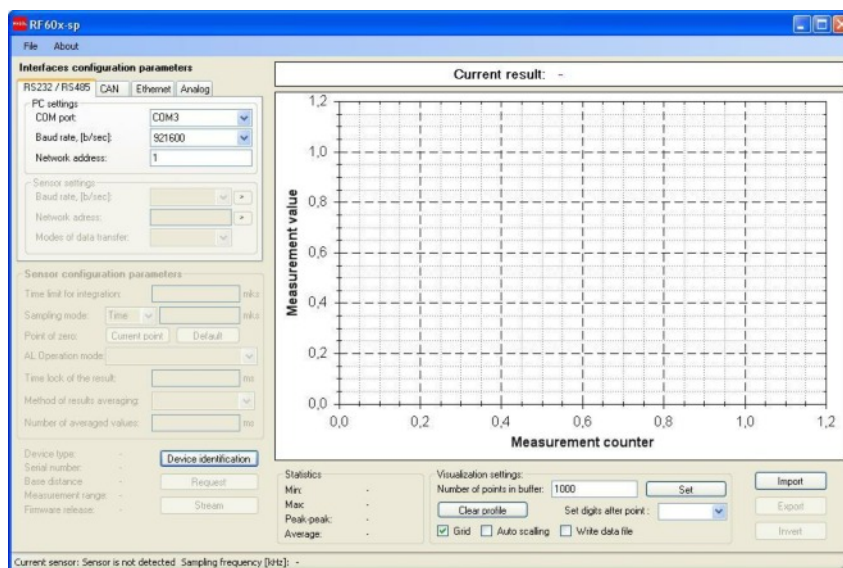
To obtain connection, go to **RS232/RS485 PC settings** in the **Interface configuration parameters** panel:

· select COM-port whereto the sensor is connected (logical port if the sensor is connected via USB-adapter)
· select transmission rate (Baud rate) at which the sensor will work
· select the sensor network address, if necessary
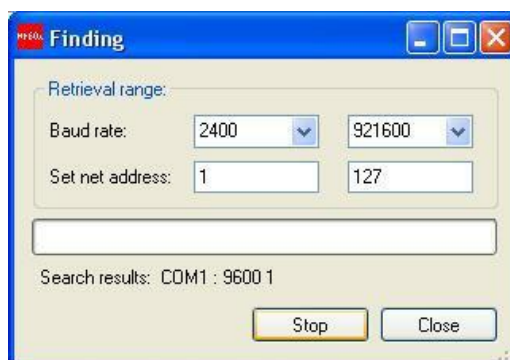· press the **Device identification** button.

If the selected parameters correspond to the parameters of the sensor interface, the program will identify the sensor, read and display its configuration parameters:
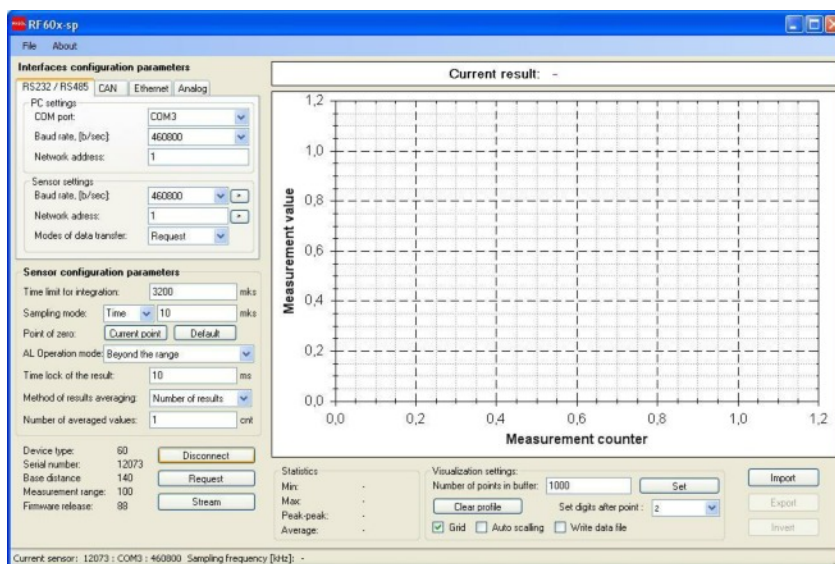
If connection is not established, a prompt will appear asking to make automatic search of the sensor:
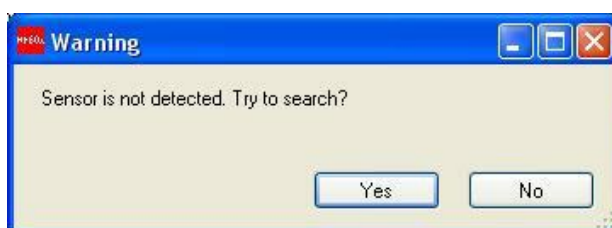
To start search, press the **Yes** button

- set the range of transmission rate search in the Baud rate line
- set the range of network address search in the Net address line
- press the **Search** button

The program will perform automatic search of the sensor by searching over possible rates, network addresses and COM-ports of PC.

14.4. Checking of the sensor operability

Once the sensor is successfully identified, check its operability as follows.
- place an object inside the sensor working range
- by pressing the **Request** button, obtain the result of one measurement on the (**Current result**) indicator. The 06h request type is realized (see par. 13.1).
- pressing the **Stream** button will switch the sensor to the data stream trans-mission mode. The 07h request type is realized (see par. 13.1).
- by shifting the object, observe changes in the readings.
- the status line in the lower part of the window will show current data transmission and refreshing rates.

Pressing of the **Stop stream** button will stop data transmission
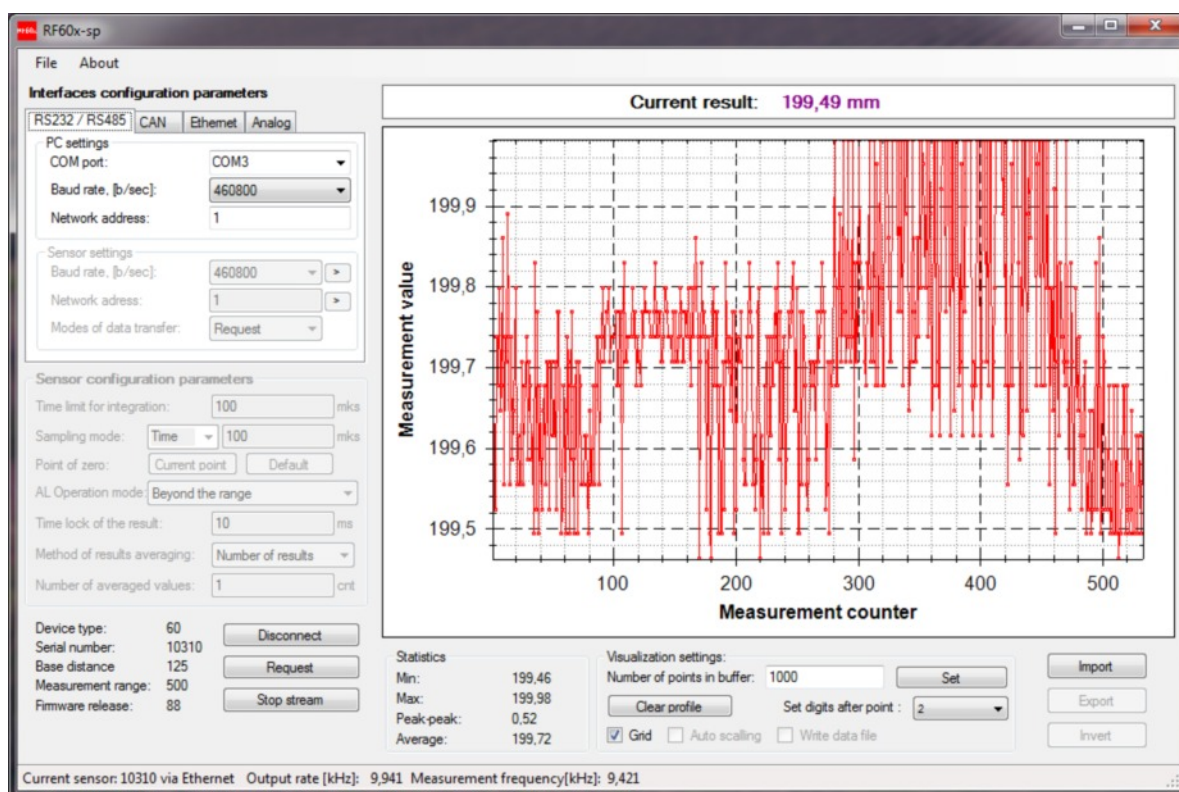
14.5. Display, gathering and scanning of data

Measurement result is displayed in digital form and in the form of oscillogram and is stored in the PC memory.

- the **number of points** displayed along the X co-ordinate can be set in the Number of points in buffer window;
- scaling method along the Y co-ordinate can be set by the **Auto scaling** function;
- turn-on/turn-off of the scaling grid is effected by using the **Grid** function;
- the number of displayed digits after decimal point can be set in the **Set** window;
- to save received data to a file, select (tick) **Write data** file;

Note: the number of points displayed on the graph depends on PC speed and becomes smaller in proportion to the data transmission rate. After the stream is stopped by using the **Stop Stream** button, the graph will display all data received.

- to work with the image, click the right mouse key on the graph to call the corresponding menu:
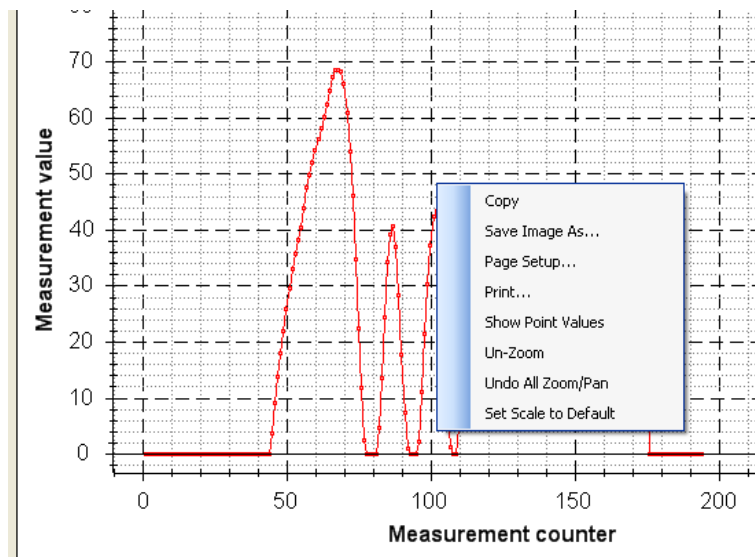

- to move the image, just press the mouse wheel
- to zoom, rotate the mouse wheel
- to save data to a file, press the **Export** button. The program will offer saving of data in two possible formats: internal and Excel.
- to scan or look at previously saved data, press the **Import** button and select the required file.
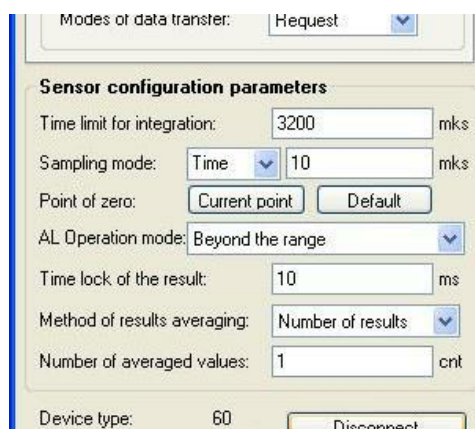
14.6. Setting and saving parameters of the sensor

14.6.1. Setting parameters

Parameterization of the sensor is effected through RS232 or RS485 interfaces. Setting of parameters for all interfaces can be done using the respective tabs on the **Interfaces configuration parameters** panel:
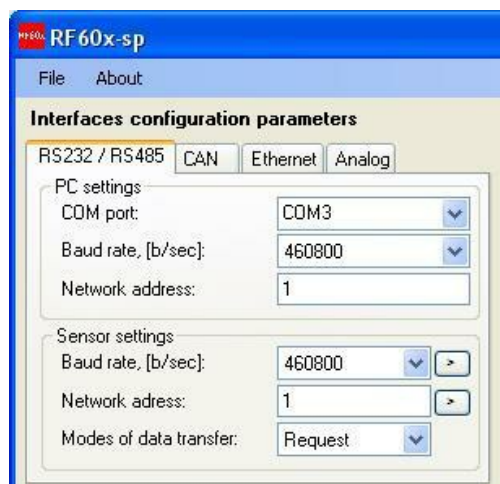
Setting of all configuration parameters of the sensor is possible with the help of the respective panel (Sensor configuration parameters):


14.6.2. Saving parameters

·   after setting one or several parameters as required, it is necessary to write them into the sensor memory, this is done by executing **File>Write parameters.**

Note: a special key is offered for fast writing of parameters of the RS232/RS485   interfaces;

·   perform testing of the sensor operation with new parameters;
·   to store new parameters in nonvolatile memory, execute **File>Write to flash**.
    Now, with any subsequent activation of the sensor it will work in the configuration you have selected.
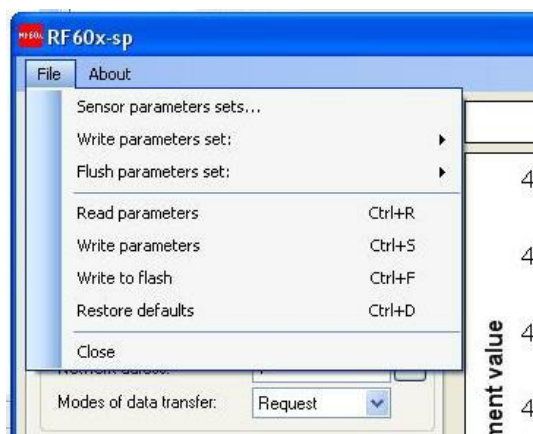
14.6.3. Saving and writing a group of parameters

Parameters of the sensor can be saved to a file. This is done by selecting **File>Write parameters set** and saving the file in the window offered.

To call a group of parameters from a file, select **File>Sensor parameters sets...**, and select the file required. **Note:** these functions are convenient to use if it is necessary to write identical parameters to several sensors.

14.6.4. Recovery of default parameters

To restore the sensor parameters set by default, use File>Restore defaults.

15.   FDRFSDK.

To work with the laser sensors, we offer a FDRFSDK library.

FDRFSDK contains API to work with all products of our company, documentation on classes and methods, examples and wrappers for various program languages. FDRFSDK allows users to develop their own software products without going into details of data communication protocol for the sensor.

Software	Description
Service program (parameter-ization pro-gram)	User software for work with laser sensors, parameter setting, and data acquisition
FDRF Device Software Development Kit	Designed for work with all similar devices. Includes: · Support of MSVC and BorlandC for Windows, Linux, Wrapper C#, Wrapper Dephi. · Examples for C#, Delphi, LabView, Mathlab
Firmware	Includes: · Firmware for FDRF605 sensors

16.   Warranty policy

Warranty assurance for the Laser triangulation sensors FDRF605 - 24 months from the date of putting in operation; warranty shelf-life - 12 months