

PSENscan UDP Communication



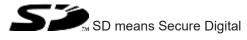
PSEN sensor technology

This document is the original document.

Where unavoidable, for reasons of readability, the masculine form has been selected when formulating this document. We do assure you that all persons are regarded without discrimination and on an equal basis.

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1 Introduction

1.1 About this Manual

This Manual is provided for users seeking advanced technical information, including connection, programming, maintenance and specifications. The operating manual and other publications associated with this product can be downloaded free of charge from the website listed on the back cover of this manual.

1.2 Definition of symbols

Information that is particularly important is identified as follows:



DANGER!

This warning must be heeded! It warns of a hazardous situation that poses an immediate threat of serious injury and death and indicates preventive measures that can be taken.



WARNING!

This warning must be heeded! It warns of a hazardous situation that could lead to serious injury and death and indicates preventive measures that can be taken.



CAUTION!

This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.



NOTICE

This describes a situation in which the product or devices could be damaged and also provides information on preventive measures that can be taken. It also highlights areas within the text that are of particular importance.



INFORMATION

This gives advice on applications and provides information on special features.

2 UDP based Monitoring

Please note that this document applies to the following models of Safety laser scanner:

- PSEN sc L 3.0/5.5 08-12
- PSEN sc M 3.0/5.5 08-12
- PSEN sc M 3.0/5.5 08-17
- PSEN sc ME 5.5 08-17

Master devices (PSEN sc M, PSEN sc ME) can be connected to up to 3 Subscriber devices (PSEN sc S) in a cascade configuration. In this case, the system composed of a Master device and one to three Subscriber devices will be referred to as "cluster".

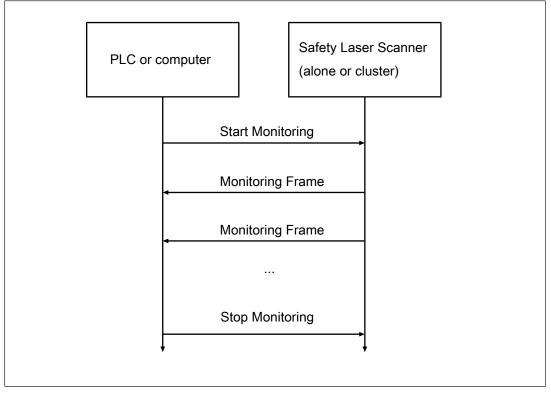


WARNING!

Advanced Measurement data may only be used for general monitoring and control activities. Do NOT use this data for safety-related applications.

3 UDP based Monitoring for Safety laser scanner

Safety laser scanner supports a UDP client-server communication over Ethernet (up to 100Mbps) that allows a PLC or computer (client) to run the Safety laser scanner monitoring function on the Safety laser scanner (server).



Activating the monitoring function makes it possible to receive measurement distance data and information about the status of the Safety laser scanner. Information is sent to the PLC or computer by a continuous flow of UDP packets.

Moreover, if multiple scanner devices are connected to each other as a cluster, the main unit (Master) is responsible for collecting and sending all monitoring frames to the client.

The data sent from the Master device to the client for each complete scan are structured in 6 monitoring frames (see Monitoring Frame (from Device to Client) [13]). If Subscriber devices are connected to the Master device, an additional monitoring frame is sent for each one of them.

3.1 Client Disconnection

As UDP is a connectionless protocol, disconnecting the client from the network (i.e. unplugging the Ethernet cable, or powering off the client) does not result in stopping the monitoring function: if the client's IP has not changed, reconnecting the client to the network allows the monitoring frames to reach the client again. If the client's IP has changed (or the client has been replaced with another one), frames do not reach the client since they are still sent to the previous IP address and port.

4 Command List

Advanced measurement protocol includes the following messages:

- Start request
- Start reply
- Stop request
- Stop reply
- Monitoring frame



NOTICE

Appendix A provides some examples of the available messages described in this chapter.

4.1 Start Request (from Client to Device)

The Start command must be sent to the Safety laser scanner IP address using UDP port 3000. This command provides the device with information to be sent during monitoring.



NOTICE

We recommend that the Start command be sent using PSENscan Configurator (Options > Expanded monitoring). This ensures that the message is correct and that the information requested meets the communication band.

The UDP payload uses the following format. Unless otherwise indicated, the byte order is little endian.

OFFSET	LENGTH	FIELD	DESCRIPTION		
0x00	4	CRC	A CRC32 of all the following fields.		
			See CRC Computation [2] 24]		
0x04	4	SEQ NUM- BER	Sequence number of the message		
0x08	8	RESERVED	Use all zeros		
0x10	4	OP CODE	Operation Code (START 0x35)		
0x14	4	IP	Client IP address. Byte order: big endian.		
0x18	2	PORT	Client communication port		
0x1A	1	DEVICE EN-	Enables or disables the monitoring message on one or more devices ^a .		
		ABLED	Note : The Master device is always active, therefore its default value is (1000).		
0x1B	1	INTENSITY ENABLED	Enables or disables the intensity field on a device ^a .		

OFFSET	LENGTH	FIELD	DESCRIPTION			
0x1C	1	POINT IN SAFETY EN- ABLED	Enables or disables the Point in Safety field, which specifies whether the point of a device lies within the Safety Area ^a .			
0x1D	1	ACTIVE ZONE- SET ENABLED	Enables or disables the field that indicates which Zone set is active on the device ^a .			
0x1E	1	I/O PIN EN- ABLED	Enables or disables the field that shows the configured I/O pins ^a .			
0x1F	1	SCAN COUNTER ENABLED	Enables or disables the scan counter field ^a .			
0x20	1	SPEED EN- CODER EN- ABLED	Enables or disables the field that specifies whether the encoder is active. As the en- coder can only be enabled on the Master device (model Safety laser scanner- PSEN sc ME), this 1-byte mask will be (1111) if the encoder is active, or (0000) if the encoder is not active.			
0x21	1	DIA- GNOSTICS ENABLED	Enables diagnostics on the selected device ^a .			
0x22	2	MASTER START ANGLE	Indicates the start angle of the Master device expressed in tenths of a degree ^b .			
0x24	2	MASTER END ANGLE	Indicates the end angle of the Master device expressed in tenths of a degree °.			
0x26	2	MASTER RESOLU- TION	Indicates the angle resolution of the Master device expressed in tenths of a degree. Example: to sample an angle every 0.1° , this value must be $0.1 \times 10 = 1$			
0x28	2	SUB- SCRIBER 1 START ANGLE	Indicates the start angle of the Subscriber 1 device expressed in tenths of a degree ^b . Note : If the DEVICE ENABLED mask of Subscriber 1 is false (value = 0), this field will have a value = 0.			
0x2A	2 SUB- SCRIBER 1 END ANGLE		Subscriber 1 is folds (value = 0) this field u			

OFFSET	LENGTH	FIELD	DESCRIPTION		
0x2C	2	SUB- SCRIBER 1 RESOLU- TION	Indicates the resolution of the Subscriber 1 device expressed in tenths of a degree. Example: to sample an angle every 5.0° , res- olution value is $5.0 \times 10 = 50$ Note : If the DEVICE ENABLED mask of Subscriber 1 is false (value = 0), this field will have a value = 0.		
0x2E	2	SUB- SCRIBER 2 START ANGLE			
0x1C	1	POINT IN SAFETY EN- ABLED	Enables or disables the Point in Safety field, which specifies whether the point of a device lies within the Safety Area ^a .		
0x1D	1	ACTIVE ZONE- SET ENABLED	Enables or disables the field that indicates which Zone set is active on the device ^a .		
0x1E	1	I/O PIN EN- ABLED	Enables or disables the field that shows the configured I/O pins ^a .		
0x1F	1	SCAN COUNTER ENABLED	Enables or disables the scan counter field ^a .		
0x20	1	SPEED EN- CODER EN- ABLED	Enables or disables the field that specifies whether the encoder is active. As the en- coder can only be enabled on the Master device (model Safety laser scanner-M5- E-1708), this 1-byte mask will be (1111) if the encoder is active, or (0000) if the en- coder is not active.		
0x21	1	DIA- GNOSTICS ENABLED	Enables diagnostics on the selected device ^a .		
0x22	2	MASTER START ANGLE	Indicates the start angle of the Master device expressed in tenths of a degree ^b .		
0x24	2	MASTER END ANGLE	Indicates the end angle of the Master device expressed in tenths of a degree °.		
0x26	2	MASTER RESOLU- TION	Indicates the angle resolution of the Master device expressed in tenths of a degree. Example: to sample an angle every 0.1° , this value must be $0.1 \times 10 = 1$		

OFFSET	LENGTH	FIELD	DESCRIPTION		
0x28	2	SUB- SCRIBER 1 START ANGLE	Indicates the start angle of the Subscriber 1 device expressed in tenths of a degree ^b . Note : If the DEVICE ENABLED mask of Subscriber 1 is false (value = 0), this field will have a value = 0.		
0x2A	2	2 SUB- SCRIBER 1 END ANGLE SUB- SCRIBER 1 END ANGLE If the DEVICE ENABLED mask of Subscriber 1 is false (value = 0), this fin have a value = 0.			
0x2C	2	SUB- SCRIBER 1 RESOLU- TION	Indicates the resolution of the Subscriber 1 device expressed in tenths of a degree. Example: to sample an angle every 5.0° , res- olution value is $5.0 \times 10 = 50$ Note : If the DEVICE ENABLED mask of Subscriber 1 is false (value = 0), this field will have a value = 0.		
0x2E	2	2 SUB- SCRIBER 2 START ANGLE Indicates the start angle of the Subs device expressed in tenths of a degr Note: If the DEVICE ENABLED mas Subscriber 2 is false (value = 0), this have a value = 0.			
0x30	2	SUB- SCRIBER 2 END ANGLE	Indicates the end angle of the Subscriber 2 device expressed in tenths of a degree °. Note : If the DEVICE ENABLED mask of Subscriber 2 is false (value = 0), this field will have a value = 0.		
0x32	2	SUB- SCRIBER 2 RESOLU- TION	Indicates the resolution of the Subscriber 2 device expressed in tenths of a degree. Example: to sample an angle every 5.0° , res- olution value is $5.0 \times 10 = 50$ Note : If the DEVICE ENABLED mask of Subscriber 2 is false (value = 0), this field will have a value = 0.		
0x34	2	SUB- SCRIBER 3 START ANGLE	Indicates the start angle of the Subscriber 3 device expressed in tenths of a degree ^b . Note : If the DEVICE ENABLED mask of Subscriber 3 is false (value = 0), this field will have a value = 0.		

OFFSET	LENGTH	FIELD	DESCRIPTION
		SUB-	Indicates the end angle of the Subscriber 3 device expressed in tenths of a degree $^{\circ}$.
0x36	2	SCRIBER 3 END ANGLE	Note : If the DEVICE ENABLED mask of Subscriber 3 is false (value = 0), this field will have a value = 0.
			Indicates the resolution of the Subscriber 3 device expressed in tenths of a degree.
0x38	2	SUB- SCRIBER 3	Example: to sample an angle every 5.0°, resolution value is 5.0 x 10 = 50
		RESOLU- TION	Note : If the DEVICE ENABLED mask of Subscriber 3 is false (value = 0), this field will have a value = 0.
TOTAL	58 BYTES	1	

- a. ▶ 1-byte mask. Only the last 4 bits (little endian) are used, each of which represents a device. For example, (1000) only enables the Master device, while (1010) enables both the Master and the second Subscriberdevice.
- b. ► The start angle must have a minimum value of 0 degrees and must not exceed the end angle.
- c. ► The end angle must have a maximum value of 275 degrees and must not be less than the start angle.

4.2 Start Reply (from Device to Client)

The UDP uses the following format. Unless otherwise indicated, the byte order is little endian.

OFFSET	LENGTH	FIELD	DESCRIPTION		
0x00	4	CRC	A CRC32 of all the following fields.		
			See CRC Computation [4] 24]		
0x04	4	RESERVED	-		
0x08	4	OP CODE	Operation Code (START 0x35).		
0x0C	4	RES CODE	Operation result. If the message is accepted, the returned value is 0x00. If the message is refused, the returned value is 0xEB. If the CRC is not correct, the device will not send any message.		
TOTAL	16 BYTES	1	·		

4.3 Stop Request (from Client to Device)

The Stop command must be sent to the Safety laser scanner IP address using UDP port 3000.

The UDP uses the following format. Unless otherwise indicated, the byte order is little endian.

OFFSET	LENGTH	FIELD	DESCRIPTION		
0x00	4	CRC A CRC32 of all the following fields.			
		See CRC Computation [
0x04	12	RESERVED	Use all zeros		
0x10	4	OP CODE	Operation Code (START 0x36).		
TOTAL	20 BYTES				

4.4 Stop Reply (from Device to Client)

The UDP uses the following format. Unless otherwise indicated, the byte order is little endian.

OFFSET	LENGTH	FIELD	DESCRIPTION		
0x00	4	CRC A CRC32 of all the following fields.			
			See CRC Computation [24]		
0x04	4	RESERVED -			
0x08	4	OP CODE	E Operation Code (START 0x36).		
0x0C	4	RES CODE Operation result. If the message is accepted to the returned value is 0x00. If the message is accepted to the returned value is 0x00. If the message is accepted to the returned value is 0xF7. If the CRC is not correct, the device will not set any message.			
TOTAL	16 BYTES				

4.5 Monitoring Frame (from Device to Client)

Monitoring frames are sent by the Safety laser scanner after a Start command. Monitoring frames are sent to the IP address and UDP port specified by the Start command itself.

Each monitoring frame is always composed of:

- 6 messages for the Master device
- 1 message for each Subscriber device

Each message is composed of the following elements:

- ▶ The same information is always stored in the first 19 bytes.
- ▶ The remaining bytes are variable in number and depend on the configuration sent with the Start command. Each configuration sent with the Start command will prompt the system to send data in the monitoring frame. For more information on decoding additional information, refer to Additional Information [□ 16].
- ▶ The end of the message is given by either the length or the end message header ID with LEN 0.



NOTICE

Measurement data are always included in the frame (they are not optional).

The UDP uses the following format. Unless otherwise indicated, the byte order is little endian.

OFFSET	LENGTH	FIELD	DESCRIPTION		
0x00	4	DEVICE STATUS	Bit mask representing the device status (see Device Status [14]		
0x04	4	OP CODE	Constant 0xCA.		
0x08	4	WORKING MODE	Online = 0x00 Offline = 0x01 Offline test = 0x02		
0x0C	4	TRANSAC- TION TYPE	PSENscan Configurator monitoring transac- tion = 0x05.		
0x10	1	SCANNER ID	Scanner identification: 0 = master/stan- dalone [13] = subscribers.		
0x11	2	FROM THETA	From Theta angle.		
0x13	2	RESOLU- TION	Angle resolution selected during the config- uration phase. The value is expressed in tenths of degree.		

OFFSET	LENGTH	FIELD	DESCRIPTION
0x15	Variable	ADDITIONAL INFORMA- TION	Additional information that depends on start configuration.

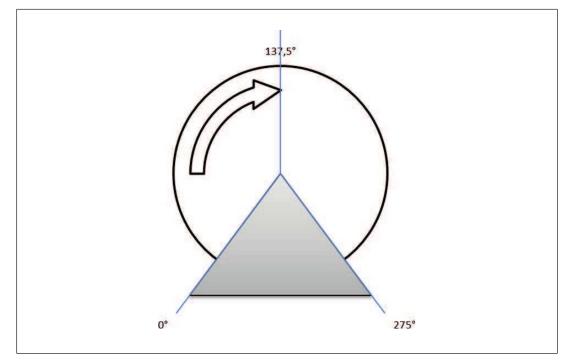
4.5.1 Device Status

The Device Status bitmask can be decoded according to the following table:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
OSSD1	OSSD2	OSSD3	WARN1	WARN2	REF_PT S	-	-

4.5.2 FromTheta

The following diagram shows the reference system of the "FromTheta" field:



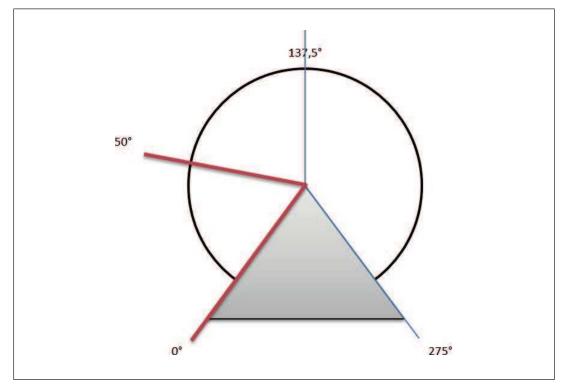
The formula to be used to compute the angular region interested by the measures of a frame is:

Start angle = "FromTheta" /10 [degrees]

End angle = ("FromTheta" + ("Resolution" * "Number of Samples")) /10 [degrees]

E.g.: a frame with "FromTheta" equal to 0, "Resolution" equal to 1 and "Number of Samples" equal to 500 covers the angular region from 0 to 50°.

At the end of the end angle the formula changes to: (end_angle-1)/10 degrees



4.5.3 Additional Information

The "Additional Information" field is variable in content and size. It consists of a vector of the following structures:

HeaderID	HeaderLENinbytes	Payload
(1 byte)	(2 bytes)	(variable length)

The following tables show how the client can decode all possible structures:

I/O PIN		
ID	Length	Payload
0x01	62	Area representing the state of the cluster input and output pins (see I/O Pin State [4] 19])

SCAN COUNTER		
ID Length		Payload
0x02	4	Counter indicating the number of rounds that the motor has performed since power-up. It can be used as a timestamp for the data of the same frame.

ZONE SET		
ID Length Payload		Payload
0x03	1	Zone set currently active on the cluster. The zone set number is 0-based (i.e. "Zone set 0" refers to the first zone set).

DIAGNOSTICS		
ID	Length	Payload
0x04	40	Area representing diagnostics fault errors (see Diagnostics [🛄 22])

MEASURES		
ID	Length	Payload
0x05	Variable	An array of little endian 16-bit unsigned integers representing distances in millimeters. The actual number of samples is given by "Length" divided by two.

INTENSITY		
ID	Length	Payload
0x06	Variable	An array of 16-bit unsigned integers representing the received normalized signal intensities. The actual number of samples is given by "Length" di- vided by two.



NOTICE

The two most significant bits (15 and 14) represent the channel, while the others (13:0) represent the intensity, as illustrated in the table below.

	Byte 1		Byte 1	Byte 0
	15	14	13 12 1	1 10 9 8 7 6 5 4 3 2 1 0
	Cha	nnel		Energy Data
Diffusive	0	0		
Auxiliary	0	1		
Reflective	1	0		
Intensity data	1	1		
not avail- able				

ENCODER		
ID Length Payload		Payload
0x07	4	Two 16-bit unsigned integers representing speeds in cm/s read from the encoders. Byte or- der is big endian. This value is expressed in cm/ s.

POINT IN SAFETY		
ID Length Payload		Payload
0x08	Variable	A bitmask representing all points for which a measure has been requested. If the point is falling in the active safety area, then bit=1, otherwise bit=0.

FRAME END BEFORE STANDARD LENGTH		
ID Length Payload		Payload
0x09	0	Field that identifies the end of the frame
		(no more data available).

!

NOTICE

I/O PIN, DIAGNOSTICS, and SCAN COUNTER messages are repeated on every frame, if active.



NOTICE

Encapsulated messages are ordered according to their enumeration. For example, if I/O PIN and MEASURES are active, the message will first indicate the I/O PIN data.

4.5.4 I/O Pin State

The input state area is split into two sections: physical inputs and logical inputs.

Since inputs may change at a frequency higher than the message transmission, the physical input section consists of three identical records that store the last three sets of input values. Each record is described by the following table:

LENGTH	FIELD	DESCRIPTION
4	RESERVED	-
10	PHYSICAL INPUT	Byte array representing the physical input values
	SIGNALS	(see below)

The physical input signals array can be decoded according to the following tables. Bytes from 0 to 5 are unused. Byte 9 is unused, as well.

Byte 6:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Zone set	Zone set	Zone set	Zone set	Zone set	Zone set	Zone set	Zone set
Switching Input 8	Switching Input 7	Switching Input 6	-	Switching Input 4	Switching Input 3	Switching Input 2	Switching Input 1

Byte 7:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Override	Override	Muting 12	Muting 11	Muting	Restart 1	-	Reset
12	11			Enable 1			

Byte 8:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
EDM 2	Override	Override	Muting 22	Muting 21	Muting	Restart 2	EDM 1
	22	21			Enable 2		

The logical input section is described by the following table:

LENGTH	FIELD	DESCRIPTION
4	RESERVED	-
8	LOGICAL INPUT	Byte array representing the physical input values.
	SIGNALS	

Byte 0: indicates the enabled Zone Set in the Safety Laser Scanner (from zone 0 to zone 69).

Bytes from 1 to 3 are not used.

Byte 4:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Zone set	Zone set	Reserved	Override	Override	Reserved	Muting 2	Muting 1
Switching	Switching		2	1		Activated	Activated
Input 2	Input 1		Activated	Activated			

Byte 5:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Reserved		Zone set	Zone set	Zone set	Zone set	Zone set	Zone set
	tivated	Switching Input 8	U U	Switching Input 6	j u	Switching Input 4	Switching Input 3

Byte 6:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Correct activation sequence of Muting 2 Pins		Restart 2 Activated	Reserved	activation sequence	Correct activation sequence of Muting 1 Pins	Enable 1	Restart 1 Activated

Byte 7:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BITO
Re- served	Correct activation se- quence of Override 2 Pins						

Zone Set Switching bits in bytes 4 and 5 are the values of the physical zone set switching inputs of the active Zone Set in the Safety Laser Scanner.

Muting 1 Activated, Muting 2 Activated, Override 1 Activated and Override 2 Activated bits in byte 4 indicate when the specific function is "on" or "off".

Reset Activated, Restart 1 Activated, Restart 2 Activated, Muting Enable 1 Activated and Muting Enable 2 Activated bits in bytes 5 and 6 are set when the corresponding pins are considered valid and stable from the device.

Bit 2, Bit 3, Bit 7 of byte 6 and Bit 0 of byte 7 indicate when the sequences of pins of muting and override functions are valid according to the product requirements.

The output section is described by the following table:

LENGTH	FIELD	DESCRIPTION
4	RESERVED	-
4	OUTPUTS	Bitmask representing output values (see below).

The output bitmask can be decoded according to the following tables.

BIT31	BIT30	BIT29	BIT28	BIT27	BIT26	BIT25	BIT24
-	-	-	REFERENCE POINTS VIOLATION	-	-	-	-

BIT23	BIT21	BIT21	BIT20	BIT19	BIT18	BIT17	BIT16
-	-	-	-	-	-	-	-

BIT15	BIT14	BIT13	BIT12	BIT11	BIT10	BIT9	BIT8
-	-	-	-	-	-	-	-

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Warn- ing 2 in- trusion	Warn- ing 1 in- trusion	-	Safety 3 intru- sion	INTERLOCK 2	Safety 2 intrusion	INTERLOCK 1	Safety 1 intru- sion

These bits are the cumulative intrusions of all the devices of which the Safety Laser Scanner network is composed (it is the Safety Laser Scanner system status).



NOTICE

Once the monitoring function is active, the configuration can be modified by sending a Stop command first, and then a new Start command with the new configuration.

4.5.5 Diagnostics

The following table shows the structure of the diagnostic payload:

LENGTH	FIELD	DESCRIPTION
4	RESERVED	-
36	DIAGNOSTIC	Byte array representing diagnostic information
	INFORMATION	(see below).

In the diagnostic information field, each device (starting from the master) is assigned with 9 bytes. Those bytes can be decoded according to the following tables, in which:

Bit =1: Error; Bit = 0 No error.

Byte 0:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
OSSD1 Overcur- rent / Short cir- cuit	Short cir- cuit at least between two OSSDs	Integrity check problem on any OSSD	Internal error	Internal error	Internal error	Internal error	Internal error

Byte 1:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Window	Power						OSSD2
cleaning alarm	supply problem	Network	Dust cir-	Internal	Internal	-	Overcur-
	p	problem	cuit fail-	error	error		rent /
			ure				Short cir-
							cuit

Byte 2:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Measure problem	Internal error	Internal error	Internal error	Incoher ence data	Zone: in- valid in- put transition or integ- rity	Zone: in- valid in- put con- figurat- ion / con- nection	Window cleaning warning

Byte 3:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Internal communi- cation problem	Internal error	Internal error	Generic error	Display commu- nication problem	Internal error	Internal error	Tempera ture measure- ment problem

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Internal error	Internal error	EDM2 Er- ror	EDM1 Er- ror	Con- figura- tion error	Out of range er- ror	Tempera- ture range er- ror	Internal error

Byte 4:

Byte 5:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
-	-	-	-	Internal error	Internal error	Encoder: generic error	Encoder: Out of Range

Bytes from 6 to 8 are not used.



NOTICE

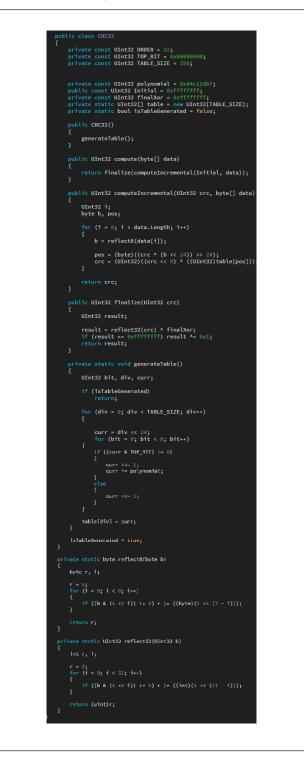
Once the monitoring function is active, the configuration can be modified by sending a Stop command first, and then a new Start command with the new configuration.

4.6 CRC Computation

The following CRC32 is used to detect accidental changes to raw data while exchanging frames between client and server:

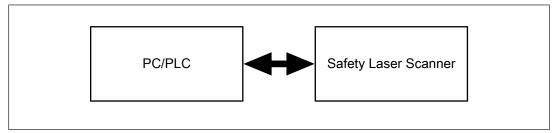
PARAMETER	VALUE
Order	32
Polynomial	0x04C11DB7
Initial Value	0xFFFFFFF
Final XOR Value	0xFFFFFFF

Source code example:



5 Data Processing Time

The time to process data for UDP command communications is as follows.



The communication time between the Safety laser scanner and other devices (i.e. PLC or computer) differs depending on your communication environment.

The time elapsed from the acquisition by the Safety laser scanner of the first measure contained in a frame and the expedition of the corresponding UDP frame depends on the actual scanner and on the number of connected Safety laser scanner devices. Please refer to the following table.

SCANNER ID VALUE	NO SUB- SCRIBER CON- NECTED	1 SUBSCRIBER CONNECTED	2 SUB- SCRIBERS CONNECTED	3 SUB- SCRIBERS CONNECTED
0 (Master)	2 ms	2 ms	2 ms	2 ms
1 (Subscriber #1)	NA	30 + 2 ms	30 + 2 ms	30 + 2 ms
2 (Subscriber #2)	NA	NA	30 + 4 ms	30 + 4 ms
3 (Subscriber #3)	NA	NA	NA	30 + 6 ms

6

Distance Accuracy vs. Target Reflectivity

Considering a distance range from 0 to 5500 mm, the following table shows how distance measurement accuracy is affected by target's reflectivity:

TARGET REFLECTIVITY	TYPICAL DISTANCE ERROR
1.8 %	± 30 mm
18 %	± 24 mm
90 %	± 21 mm
1000 %	± 12 mm

7 Protocol Examples

The following examples are based on firmware version 3.1.0 assuming that the cluster is always composed of 1 Master and 3 Subscriber devices.

7.1 Monitoring started via PSENscan Configurator

7.1.1 Start request

Figure 1 shows a start command request performed by the PSENscan Configurator software.

0000	00	07	be	03	e1	31	10	65	30	f9	16	49	08	00	45	00
0010	00	56	fc	d7	00	00	80	11	00	00	c0	a8	00	64	c0	a8
0020	00	0a	d3	e5	0b	b8	00	42	82	12	56	e3	c2	ff	6b	01
0030	00	00	00	00	00	00	00	00	00	00	35	00	00	00	c0	a8
0040	00	64	e4	d3	0f	00	00	0f	Øf	0f	00	0f	00	00	be	0a
0050	ð 1	00	00	00	be	0a	05	00	00	00	be	0a	05	00	00	00
0060	be	0a	05	00												

Fig.: 1 - Start request

The colors used in the figure have the following meaning:

- Black: CRC of the command (format: little endian)
- Gray: sequence number (format: little endian)
- Brown: reserved (empty)
- Red: operation code (format: little endian; in this example, the operation code 0x35 identifies the start command)
- Green: IP address of the receiver client (format: big endian; in this example, the IP address is 192.168.0.100)
- Blue: port number (format: big endian; in this example, the port number is 58579)
- Pink: enabled bit (in this example, zone set, I/O, scan counter, and diagnostics are enabled on four devices). Measures are enabled by default.
- Purple: each slot represents the start angle, stop angle, and resolution for each device. Each value is 2-byte long and expressed in tenth of degree. The format is little endian:
 - Master (first slot): start angle is 0, stop angle is 2750 (0x0ABE), resolution is 1
 - Subscribers (second, third, and fourth slots): start angle is 0, stop angle is 2750, resolution is 5.

7.1.2 Start reply

Figure 2 shows a start command response.

0000	10	65	30	f9	16	49	00	07	be	03	e1	31	0 8	00	45	00
0010																
0020														2e	6b	01
0030	00	00	35	00	00	00	00	00	00	00	00	00				

Fig.: 2 - Start reply

The colors used in the figure have the following meaning:

- Black: CRC of the command (format: little endian)
- Gray: sequence number (format: little endian)
- Red: operation code (format: little endian)
- Green: operation result (in this case all zeros mean no error)

7.1.3 Monitoring frame created by the Master device

The Master device divides its 275° into six zones: five zones of 50° each and the last zone of 25°. Each zone corresponds to a different frame (the Master device needs a total of six frames to transfer a complete set of measures).

Figure 3 shows the Master frame for the first zone (0 - 50°).

0000		10	65	30	f9	16	49	0 0	07	b	e 0	3 e	13	1 (8 (90 4	45 (90	01d0	90	93	0	9 9	30	0 9	93 e	90 9	3	00 9	93 (90 S	id e	0 9	d e	90 9	d 03	BaØ	01	c3	01	c3 (01	cc Ø	1 ce	e e	1 c	e e	1 c	e 0	1 be	0	L b	f
0010		84	97	90	20	90	00	80	11	b	47	7 c	0 a	8 (00	a	c0 i	a8	01e0	90	92	0	9 9	c 0	0 8	38 G	90 9	2	00 9	92 (90 9	le 0	0 8	88 6	90 9	2 03	3b0	01	bf	01	bf (01	c8 0	1 c9	e e	1 c	9 e	1 b	f 0	1 c	0	L b	f
0020		80	64	97	dØ	d3	e4	04	83	3	7 c	2 [0	0 0	0 (0 0	0	ca I	80	01f0	90	88	8 06	9 9	20	08	88 6	90 9	2	00 9	e (90 S	2 0	0 9	92 6	90 9	2 03	3c0	01	c9	01	c9 (01	c9 0	1 c9	e e	1 d	3 6	1 d	13 0	1 be	0	L b	e,
0030		00	99	99	90	90	00	05	60	0	9 0	0	0 0	0 (0	91 (80	21)	0200	90	92	0	9 9	c 0	0 9	e e	90 9	2	00 9	92 (90 9	lc e	0 9	92 6	90 9	2 03	3d0	01	c8	01	b4 (01	c8 0	1 be	e e	1 c	1 0	1 d	7 0	1 04	0	L b	1
0040	- (3f (88	32	37	39	00	00	00	0	0 0	9 0	0 0	0 (00	90 1	80	80	0210	90	92	0	9 9	10	09	91 6	90 e	1	00 (a (90 e	0 0	10 e	0 0	90 e	0 03	BeØ	01	b1	01	ea (01	e8 0	1 e4	1 6	1 e	76	1 e	9 0	1 e!	6 03	L e	17
0050		32	38	30	90	90	00	00	60	0	9 0	9 0	0 0	0 (00	0	32 3	37	0220	90	ee	00	ð e	0 0	0 e	9 6	90 e	9	00 (0	90 e	9 0	10 e	9 6	90 d	f 03	8 f Ø	01	e5	01	e7 (01	ed Ø	1 f1	L e	1 e	4 e	1 e	a 0	1 f(9 03	L e	e
0060		38 (90	90	90	90	00	00	60	0	9 0	9 6	0 0	0 (00	90 (80 (80	0230	90	df	00	ð a	50	0 e	8 6	90 d	f	00 (8 (90 e	8 6	10 e	8 6	90 e	8 04	100	01	ee	01	ed (01	ef Ø	1 f1	1 0	1 e	e Ø	1 e	f 0	1 f:	8 03	L e	e.
0070																				90	de	0	ð f	20	0 d	de 6	90 d	e	00 (le (30 d	le Ø	10 e	27 6	30 d	e 04	410	01	f9	01	ef (01 ·	f1 0	1 ec	1 6	1 f	2 6	1 f	4 0	1 e8	8 03	L e	a
0880	1	<u> 2</u>	0 5	99	3e	7d	00	60	03)@	20	3 e	00	4	29 (90	90 (90	0250	90	d4	00	9 d	40	0 d	13 6	90 f	d	90 ·	64 (90 H	4 0	10 e	a (90 e	1 04	120	01	f6	01	f5 (01	ef Ø	1 f8	3 e	1 e	de	1 f	5 0	1 f4	0	l fi	0
0090		00																	0260																90 f		430	01	f7	01	f4 (01 ·	f0 0	1 e6	5 6	1 e	9 6	1 e	6 0	1 e	: 0:	L e	25
00a0																			0270																		140	01	e8	01	ed (01	eb Ø	1 fe	9 e	1 f	з е	1 b	9 0	1 b9	0	L c	3
00b0																			0280																90 f		450	01	c3	01	cb (01	cb Ø	1 b8	36	1 b	8 6	1 c	2 0	1 c2	2 03	L bi	8
00c0																			0290																90 f		160	01	af	01	a5 (01	9c 0	1 90	: e	19	c e	18	8 0	1 7	= 0:	L 7	'5
0000																			02a0																		170	01	6c	01	58 (01	58 0	1 45	5 6	10	8 6	10	8 0	1 08	8 03	l f	f
																			02b0																		180	60	f5	60	f5 (60 ·	f5 0	0 fs	5 6	0 e	Ьē	0 e	b 0	0 ea	0	9 e	a
00f0																																					190						f4 0	10 f4	1 e	0 f	4 6	0 f	e 0	0 f	1 00	3 3	b
																			02d0																		1a0	01	09 [00	00 (00											
0110																																																					
0120																																																					
0130																			0300																91 a																		
0140																																																					
0150																																																					
0160																																																					
0170																																																					
																			0350																																		
0190																																																					
01a0																			0370																91 9																		
01b0																																																					
01c0		90 :	9d	90	9d	90	9d	60	93	0	8 6	9 0	0 9	36	90 9	93 (80 I	89	0390	01	90	1 01	l a	60	1 a	a6 6	31 b	9	01 I	00 (31 (:3 0	91 C	:36	31 C	с																	

Fig.: 3 - Master frame 1

The colors used in the figure have the following meaning:

- Black: device status (format: little endian)
- Orange: operation code (format: little endian; in the example, the operation code 0xCA identifies a monitoring frame command)
- Gray: working mode
- Red: transaction type (format: little endian; in the example, the transaction type is 5)
- > Yellow: scanner ID (Master is equal to zero)
- Green: from theta (start angle of this frame; format: little endian)
- Blue: resolution (format: little endian)
- Purple: header ID (see Table 1 for the list of IDs and data requested)
- Brown: payload length (+ 1) in bytes of the corresponding ID (format: little endian). In the example, this field is 0x3F = 63. This means that 63 must be added to the current position to move to the start of the next header ID.

The frame format does not change between zones, but values can. In particular, "from theta" values change according to the start angle value of the relevant frame.

In the example shown in Figure 3, the "from theta" value is as follows:

- Hex 0x0000 (decimal 0) for the first frame
- Hex 0x01F4 (decimal 500) for the second frame
- ▶ Hex 0x03E8 (decimal 1000) for the third frame
- Hex 0x05DC (decimal 1500) for the fourth frame
- Hex 0x07D0 (decimal 2000) for the fifth frame
- Hex 0x09C4 (decimal 2500) for the sixth frame

HEADER VALUE	DESCRIPTION	PAYLOAD LENGTH
0x01	I/O data	0x003F
0x02	Scan counter	0x0005
0x03	Zone set	0x0002
0x04	Diagnostics	0x0029
0x05	Measures	0x039E
0x09	End of frame	0x0000

Table 1: Header and payload

7.1.4 Monitoring frame from Subscriber device

Differently from the Master, a Subscriber device does not divide its 275° into six zones, but it can send all 275° values through a single frame (the maximum resolution it can support is 0.5 degrees, which is why a single frame for each scan is enough to send all data).

Figure 4 shows a Subscriber frame:

0000	1	.0 6	5	0	f9	16	49	9 0	0 0	97	be	03	3 e	13	1 (98	0 0	45	00	01	dØ I	90	9d	00	a	3 (90	9b	0	0 9	8	00	99	0	0	92	00	99	0	9 8 1	03a	0	90	90	0 0	00	00	9 00	9 00	9 00		80 (30	00	60	66	96	0	0 1	00
0010																						90	91	00	9 9	2 (90	8f	0	08	f	00	8f	0	0	8c	00	8d	0	9 94	03b	0	90	90	0 0	00	06	9 00	9 00	9 06	3	80 (30	60	60	66	66	0	0 1	00
0020																				01	FØ	90	8e	00	8 6	8 (90	86	0	08	8	00	89	0	0	8a	00	80	00	9 7 1	030	0	90	90	0 0	00	66	9 00	9 00	9 00	3	80 (30	00	00	66	96	0	0 1	66
0030	e	0 0	0	0	90	00	00	0	56	90	00	0	<u>)</u> 0	3 (0 (30	05	00	01	02	80	90	81	00	8 6	9 (90	80	0	07	e	00	7b	0	0	7b	0 0	84	00	9 7a	030	0	90	90	0 0	66	06	9 00	9 00	9 06	3	90 (30	00	60	66	66	0	0 1	96
0040	6	fe	0	2	37	39	00	9 0	0 6	90	96	00	ه و	9 6	0 (90	0 0	66	00	02	10	90	7e	00	37	8 (90	7c	0	07	8	0 0	7a	0	0	77	0 0	75	6 06	9 6f	03e	0	90	90	0 0	00	00	9 00	9 00	9 06	3	80 (30	00	00	66	66	0	0 1	96
0050																				02		90	73	00	37	e (90	70	0	07	7	0 0	78	0	0	72	0 0	6e	90	9 6Ł	03f									9 06									-	
0060																				02		90	6f	00	97	5 (90	71	. 0	07	0	0 0	73	0	0	71	0 0	6f	00	9 76	040									9 06										
																				024						-					-				-					9 06										9 06										
																				02																				9 06										9 06									-	
																				02																					043									9 06										
																				02																					044									9 06									-	
																				02						-					-				-					9 00		-								9 06										
			-	-						-				_						02						-									-					9 08										9 06										
			-	-										_						02						-					-									9 00										9 00							-		-	-
00e0			_	_										_	-	-										-					-				-					9 06										9 06										
00f0				-																0.00															÷.,					9 00										9 00									-	
				_																02						-					-		-		-					9 00		-								9 06										
0110 0120			-	-										_												-					-				-					9 06 9 06	04b) 00) 00										
														-						02						-					-									9 06										9 06									-	
		_		_	-									_		-				03						-					-				-					3 00										9 06										
0150																																			÷					9 00										000									-	
0160		-		_																						-					-				-					9 00										00		80	~				50		· ·	~
0170			-	-										_	-																									9 00		•				~	~	- 0.												
0180																										-					-									9 00																				
0190				_	-		_		_					_			_									-					-				-					000																				
																				03						-														9 00																				
01b0																															-		-		-					0 00																				
01c0																														00																														



The colors used in the figure have the following meaning:

- Black: device status
- Orange: operation code
- Gray: working mode
- Red: transaction type
- Yellow: scanner ID
 - First subscriber equal to one
 - Second subscriber equal to two
 - Third subscriber equal to three
- Green: from theta (start angle of this frame)
- Blue: resolution
- Purple: header ID (the data transferred is the same as the Master device, see Table 1 Monitoring frame created by the Master device [4230] for the list of IDs and data requested)
- Brown: payload length of the corresponding ID

7.2 Full Angle Monitoring

7.2.1 Start request

Figure 5 shows a custom start command request:

0000	00	07	be	03	e1	31	10	65	30	f9	16	49	08	00	45	00
0010	00	56	a6	08	00	00	80	11	00	00	c0	a8	00	64	c0	a8
0020	00	0a	dc	eb	Øb	b8	00	42	82	12	96	26	d0	b9	00	00
0030	00	00	00	00	00	00	00	00	00	00	35	00	00	00	c0	a8
0040	<u>00</u>	64	2e	16	0f	00	00	be	0a							
0050	02	00	00	00	be	0a	0a	00	00	00	be	0a	0a	00	00	00
0060	be	0a	0a	00)											

Fig.: 5 - Start request

The colors used in the figure have the following meaning:

- Black: CRC of the command
- Gray: sequence number
- Brown: reserved (empty)
- Red: operation code
- Green: IP address of the receiver client
- Blue: port number
- Pink: enabled bit (in this case all data types are enabled on four devices)
- Purple: each slot represents the start angle, stop angle, and resolution for each device. Each value is 2-byte long and expressed in tenth of degree:
 - Master (first slot): start angle is 0, stop angle is 2750, resolution is 2
 - Subscribers (second, third and fourth slots): start angle is 0, stop angle is 2750, resolution is 10

The start command response is the same as the one described in Start reply [29].

7.2.2 Monitoring frame created by the Master device

Figure 6 shows the Master frame for the second zone (50 - 100°):

0000	10 65 30	f9 1	5 49 e	0 07	be Ø	3 e1	31	08 0	0 45	00 01d	07	b2 0	7 bc	07 a9	07 9	f 07	b2 e	07 c9	07 c	:3 07 b	C 03a0	6a	87	6a 87	7 89	89 4	8 8a	5d	89 a	b 87	7b	49 6	0 48
0010	04 c4 0a	9a 0	9 00 8	0 11	a9 d	0 c0	a8	00 O	a c0	a8 01e	07	bb 0	7 b6	07 b8	8 07 b	1 07	b2 @	7 ad	07 a	6 07 9	b 03be	32	46	dd 45	5 d4	45 c	d 47	b7	4a b	of 49	70	46 d	8 48
0020	00 64 0	d0 1	5 2e 0	4 b0	59 9	7 00	00	00 0	ca	00 01f	07	92 0	786	07 66	07 5	d 07	43 e	7 25	07 e	94 07 e	4 03c6	be	49	b8 48	3 c5	48 b	f 48	9f	48 7	'e 48	8 b0	48 c	4 48
0030	00 00 00	00 0	0 00 0	5 00	00 0	0 00	F4	01 0	2 00	01 020	06	5 cb 0	6 bf	06 b3	06 a	d 06	be 0	6 05	07 4	18 07 2	8 03de	c3	48	0c 84	1 24	84 1	6 84	3c	84 4	6 84	22	84 1	e 84
0040	Bf 00 39	39 3	9 00 G	0 00	00 0	0 00	00	00 0	0 00	00 021	07	51 0	7 57	07 7e	07 7	9 07	7d 0	7 7a	07 7	7c 07 7	8 03e6	62	84	9b 84	1 b1	84 f	b 84	06	85 6	6 8	5 f2	85 5	b 86
0050	39 39 31	00 0	a ee e	0 00	00 0	0 00	00	00 O	0 39	38 022	07	7d 0	7 75	07 79	07 7	2 07	74 0	7 71	07 7	73 07 7	2 03f6	be	86	ba 87	7 47	88 b	f 89	8e	89 c	5 87	c8	85 1	3 89
0060	39 00 00	00 0	9 00 e	0 00	00 0	0 00	00	00 O	0 00	00 023	07	73 0	7 6e	07 69	07 7	1 07	6a 0	7 68	07 E	59 Ø7 G	8 0400	f7	48	0f 47	7 e3	46 d	9 47	85	47 b	e 49	8d	89 e	f 8a
0070	00 00 00	00 0	9 00 e	0 00	00 0	0 00	00	14 0	0 00	00 024	07	66 0	7 65	07 62	07 6	b 07	67 0	7 66	07 5	5d 07 6	2 0410	c8	89	ba 89	9 b6	89 b	5 89	b8	89 b	9 89	bf	89 c	3 89
0080	02 05 06	24 4	4 02 0	003	02 0	00 00	04	29 0	0 00	00 025	07	5c 0	7 60	07 63	07 50	d 07	62 0	97 5d	07 5	5a 07 5	c 0420	b4	89	c6 89	o cc	89 c	5 89	d4	89 d	2 8	da	89 d	0 89
0090	00 00 00	00 0	9 00 C	0 00	00 0	0 00	00	00 O	0 00	00 026										4b 09 4		e0	89	df 89	∂db	89 e	c 89	ee	89 f	a 89	fd	89 f	d 89
	00 00 00										09	59 0	9 5b	0 9 50	: 09 54	6 09	5c 0	19 5a	09 5	68 09 5	9 0440	06	8a	02 8a	a 07	8a 0	4 8a	1c	8a 2	9 88	ı 2e	8a 3	la 8a
00b0	00 00 00	00 0	9 00 e	5 f 5	01 1	a 02	12	02 0	d 02	18 028	09	55 0	9 5a	09 58	8 09 54	4 09	59 e	9 57	0 9 5	58 09 5	6 0450	45	8a -	4d 8a	a 5f	8a 5	c 8a	6b	8a 8	81 88	84	8a 7	'd 4a
00c0	02 11 02	13 0	2 13 e	2 d6	01 2	2 02	50	02 d	d 03											64 09 5		03	49	bf 16	5 13	88 7	5 89	4e	89 e	a 89	03	89 e	1 89
																				36f5 6							0 88						
00e0	07 b3 07	9d Ø	7900	7 b9	07 a	a 07	cb	07 c	5 07	d7 02b										37 de 4		f6	88	ec 88	3 ea	88 e	7 88	ee	88 e	9 88	8 e9	88 f	⁵ b 88
																				46 71 4							6 88						
	07 47 04																			16 1f 4							00 0						
																				96 33 4							0 00						
	08 c5 08																			13 52 4				00 OG	9 00	00 0	0 00	99	99 e	00 00	00	99[6	9 00
																				13 30 4		00	00										
	05 3d 05																			0c b1 0													
	00 20 00																			0c b8 6													
	0a ad 0a																			11 fd 4	-												
																				9b 1f 6													
																				C 1b 6													
	04 ea 04																			f eb e													
	04 30 04																			d 3e 4													
	04 0c 04																			lc 33 4													
01c0	04 28 04	45 0	4 82 e	4 8a	64 9	3 04	83	07 a'	9 07	a9 039	72	2 86 0	0 89	68 89	7d 8	9 b5	8b 7	'6 8c	52 8	8c 86 8	a												

Fig.: 6 - Master frame 2

The colors used in the figure have the following meaning:

- Black: device status
- Orange: operation code
- Gray: working mode
- Red: transaction type
- Yellow: scanner ID (Master is equal to zero)
- Green: from theta (start angle of this frame, 0x1F4 equals 500)
- ▶ Blue: resolution (0x02)
- Purple: header ID (see Table 2 for the list of IDs and data requested)
- Brown: payload length of the corresponding ID

Table 2 - Header and payload

HEADER VALUE	DESCRIPTION	PAYLOAD LENGTH
0x01	I/O data	0x003F
0x02	Scan counter	0x0005
0x03	Zone set	0x0002
0x04	Diagnostics	0x0029
0x05	Measures	0x01F5
0x06	Intensity	0x01F5
0x07	Encoder	0x0005
0x08	Point in safety	0x0021
0x09	End of frame	0x0000

7.2.3 Monitoring frame from Subscriber device

Figure 7 shows the Subscriber frame:

0000																				01d	9 6	94 2	2b I	64	09	04	l e	d(3 3 (d	03	ad	03	94	03	77	03	68	03a	7	a 8	72	a 44	3 0	1 89	9 e	c 88	3е	e 8	8 f	c 8	88	3c 8	39 F	99 (89
0010																		сØ		01e	9 6	3 3 4	le i	03	2e	03	31	e (93 G	33	03	f4	02	f1	02	eØ	02	cb	03b	9 0	28	9 0	8	э <u>6</u> :	1 1:	1 5	b 88	3 2	78	8 2	8 8	8 2	25 8	38 2	24 (88
0020																		ca		01f	9 6	92 (:3	02	a2	0	2 5	9 (92 5	5b	02	61	02	6b	02	6a	02	6e	03c	3 2	58	82	2 8	3 2/	d 8	8 2	a 88	3 2	78	8 2	6 8	8 2	2d 8	38 2	21 (88
0030	Ę	90	00	96	0	9 6	0 0	8	05	60	0	0 0	.0 F	32	90	00	0a	60	01	020	9 6	92 6	<u>55</u>	02	5e	02	21	3 (92 6	bd	02	00	02	0 9	02	02	02	fa	03d	3 1	88	80	8	3 10	0 8	8 d	7 88	3 f	58	8 d	7 8	7 5	58 8	38 3	3f 4	4
0040	l	3f	00	36	3	5 3	7 (90	00	60	0	0 6	.0 f) 0	90	0 0	60	60	60	021	9 6	91 1	f9 (01	fb	01	ιf	f	91 f	4	01	02	02	12	02	0f	02	fd	03e	9	8 מ	70	7 8	3 c)	8 8	50	e 87	/ 6	38	77	'f 8	7 c	:0 8	37 7	26 (8
0050		36	35	38	0	9 6	0 (90	0 0	60	0	0 0	.0 F) 0	90	0 0	60	36	35	022	9 6	91 (31	02	ed	01	Ld	9 (31 (15	01	d4	01	d2	01	d1	. 01	. d6	03f	6	58	89	1 8	3 b/	8 8	8 a	c 88	3 1	48	94	8 8	93	3a 8	39 5	i6 f	8
0060							-											60		023																		. e5	040	3	98	99	e 89	3 8	7 89	9 1	1 8a	a 8	18	95	f 8	<i>9</i> €	28 8	39 🕇	4 (8
0070																		60		024		91 (18	01	bf	01	L 8	3 (31 2	2d	01	c9	0 0	81	60	55	66	36	041	e 6	58	9 f	F 8	9 1	78	a 5	0 8a	a 4	b 8	a 2	3 8	a f	fe 8	38 6	52 8	8
0080																		60		025	9 6	0	34	0 0	49	00	9 6	0 0	90 G	57	00	41	0 0	6a	0 0	fc	00) 1e	042	3	48	a 5	8 6	a 5e	e 8a	a 9	0 8a	a 6	a 8	a 1	b 8	a t)8 8	39 (:0 (89
0090							-											60		026	9 6	91 7	77	01	da	01	Lс	2 (91 9	93	01	ad	01	6b	01	сс	01	. 75	043	3	48	a 5	9 8	a 34	e 8a	a 3	c 8a	а З	f 8	a 3	e 8	a 2	23 8	3a 3	34 8	8
00a0																		60		027																		1 1d	044	3 4	d 8	a d	2 8	Эса	a 89	9 a!	9 89) c	c 8	9 b	98	9 1	10 8	39 4	lc f	8
00b0																		01		028	9 6	92 9) 4	01	4 1	01	Le	d (30 8	34	00	8f	0 0	b9	0 0	24	01	. e5	045	9 6	d 8	96	2 8) 50	0 8	94	7 89) e	98	8 a	2 8	8 8	a7 8	38 e	2 8	8
00c0							_					_	_					01		029																		96	046) е	58	8 e	F 81	3 0	5 89	9 2	a 89) 4	d 8	95	98	9 6	ie 8	39 7	/8 /	8
00d0							-			_	_		-					60		02a) f4	047	8	d 8	92	c 89	9 80	0 81	8 1	c 88	3 e	48	7 e	4 8	73	31 8	38 4	19 1	8
00e0											-	-						60		02b	9 6	90 1	ř1 (0 0	ea	00	e 6	3 (30 e	2	00	e4	0 0	dc	0 0	dd	00) d6	048	Э с	88	70	7 8	5 e4	4 4	8 1	1 49) 8	94	87	'd 4	8 7	/d 8	34 E	ib 1	8
00f0							-						-					60		02c	•																	cb	049	9 5	a 4	82	5 43	7 5	c 44	6 a	a 46	i o	44	8 d	18	53	3f 8	36 b)a /	8
0100																		60		02d																		06	04a	3	18	58	e 41	3 e!	5 43	7 f	a ff	- 2	c 4	11	5 4	2 d	i5 4	12 5	52 /	4
0110																		60		02e									59 4										04b								a 47									
0120													-					60		02f		_																43	04c	3	58	5 f	8 0	5 al	6 8	54	b 48	s f	d 4	7 f	64	7 b	ж 4	47 3	\$2.8	8
0130				-							_							01		030																		48	04d								0 8a									
0140																		ea		031																		. 48	04e								7 89									
0150				_			-					-	-					06		032				_					-										04f								4 89									
0160																		0 8		033		-									_			_	_	_	_	86	050								a 8a									
0170																		68		034																			051		_	~					0 00									
0180																		09		035																	_	48	052								0 00			0 0	0 0	0 6	3 0 e	10 6	10 f	0
0190								-			_		-					09		036																		42	053	9 0	9 0	0 0	9 0	3 8	0 0	90	0 00	1 0	0							
01a0																		07		037																		42																		
01b0			_		_		-			_								66	_	038																		49																		
0100		ð6	cd	05	8	9 6	5 4	13	05	68	0	5 0	86	34	88	64	82	64	55	039	9 1	e 4	1 6	5a	48	36	5 0	e	cc 4	7	db	47	dd	47	f8	47	ed	85																		

Fig.: 7 - Subscriber 3 frame

The colors used in the figure have the following meaning:

- Black: device status
- Orange: operation code
- Gray: working mode
- Red: transaction type
- > Yellow: scanner ID (in this case the second Subscriber has value equal to 0x02)
- Green: from theta (start angle is equal to 0x00)
- Blue: resolution (0x0A)
- ▶ Purple: header ID (the data transferred is the same as the Master, see Table 2 Monitoring frame created by the Master device [□ 34] for the list of IDs and data requested)
- Brown: payload length of the corresponding ID

7.3 Partial Angle Monitoring

It is possible to request not only full angle data, but also partial angle data. In this example, the monitoring data request in the range 70 - 230° will be analyzed.

7.3.1 Start request

Figure 8 shows a custom start command request:

0000	00	07	be	03	e1	31	10	65	30	f9	16	49	0 8	00	45	00
0010	00	56	a6	18	00	00	80	11	00	00	c0	a8	00	64	c0	a8
0020	00	0a	c1	12	0b	b8	00	42	82	12	ee	8b	98	8b	07	00
0030																
0040	00	64	2e	16	0f	bc	02	fc	08							
0050	02	00	bc	02	fc	08	0a	00	bc	02	fc	08	0a	00	bc	02
0060	fc	08	0a	00												

Fig.: 8 - Start request

The colors used in the figure have the following meaning:

- Black: CRC of the command
- Gray: sequence number
- Brown: reserved (empty)
- Red: operation code
- Green: IP address of the receiver client
- Blue: port number
- Pink: enabled bit (in this case all data types are enabled on four devices)
- Purple: each slot represents the start angle, stop angle, and resolution for each device. Each value is 2-byte long and expressed in tenth of degree:
 - Master (first slot): start angle is 700, stop angle is 2300, resolution is 2
 - Subscribers (second, third and fourth slots): start angle is 700, stop angle is 2300, resolution is 10

7.3.2 Monitoring frame created by Master device

In this case, the Master frame will be received as in Table 3: the first and last frames are outside the angle range requested and all header IDs are present except for the payload of measure related data (measure, intensity and point in safety), for which the header ID length is equal to one.

The second and fifth frames contain measure related data of only a part of the sector. The third and fourth frames contain measure related data of the entire sector.

FRAME NUMBER	I/O PIN	SCAN COUNT ER	ZON E SET	DIA- GNOSTIC S	MEAS- URE	INTENS- ITY	EN- CODER	POINT IN SAFETY
1	х	x	х	х			х	
2	х	х	х	х	х	x	х	х
3	х	х	х	х	х	x	х	х
4	х	х	х	х	х	x	х	х
5	х	х	х	х	х	x	х	х
6	х	х	х	х			Х	

 Table 3: Master frame content

Figure 9 and Figure 10 show the Master frame for the first (0 - 50°) and sixth (250 - 275°) frames. The behavior described above can be observed (only header ID highlighted in purple).

0000	10	65	30	f9	16	49	00	07	be	03	e1	31	08	00	45	00
0010	00	bc	0f	fc	00	00	80	11	a8	76	c0	a8	00	0a	c0	a8
0020	00	64	07	dØ	16	2e	00	a8	5c	69	00	00	00	00	са	00
0030	00	00	00	00	00	00	05	00	00	00	00	00	00	02	00	01
0040	3f	00	31	35	36	00	00	00	00	00	00	00	00	00	00	00
0050	31	35	37	00	00	00	00	00	00	00	00	00	00	00	31	35
0060	35	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0070	00	00	00	00	00	00	00	00	00	00	00	00	14	00	00	00
0080	02	05	00	af	66	04	00	03	02	00	00	04	29	00	00	00
0090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00a0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00b0	00	00	00	00	00	00	05	01	00	06	01	00	07	05	00	00
00c0	00	00	00	08	01	00	09	00	00	00						

Fig.: 9 - Master frame 1

0000	10	65	30	f9	16	49	00	07	be	03	e1	31	0 8	00	45	00
0010	00	bc	10	02	00	00	80	11	a8	70	c0	a8	00	0a	c0	a8
0020	00	64	07	d0	16	2e	00	a8	4f	a4	00	00	00	00	са	00
0030	00	00	00	00	00	00	05	00	00	00	00	c4	0 9	02	00	01
0040	3f	00	31	35	36	00	00	00	00	00	00	00	00	00	00	00
0050	31	35	37	00	00	00	00	00	00	00	00	00	00	00	31	35
0060	38	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0070	00	00	00	00	00	00	00	00	00	00	00	00	14	00	00	0 0
0080	02	05	00	bØ	66	04	00	03	02	00	00	04	29	00	00	0 0
0090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00a0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00b0	00	00	00	00	00	00	05	01	00	06	01	00	07	05	00	00
00c0	00	00	00	08	01	00	09	00	00	00						

Fig.: 10 - Master frame 6

Figure 11 shows the second frame (50 - 100°), where the data requested corresponds to a part of the sector. The start angle is not 500, but 700.

0000	10	65	30	f9	16	49	00	07	be	03	e1	31	08	00	45	00	01d0	09	59	09	56	09	59	09	55	09	51	09	5d	09	5f	09	6
0010	03	27	Of	fd	00	00	80	11	a6	0a	cØ	a8	00	0a	c0	a8	01e0	09	5c	09	5d	09	06	2d	01	fa	ff	fa	ff	d7	Ød	87	0
0020	00	64	07	dØ	16	2e	03	13	06	b4	00	00	00	00	ca	00	01f0	55	42	05	43	90	44	42	4d	14	46	7b	4d	45	4c	70	4
0030	00	00	00	00	00	00	05	00	00	00	00	bc	02	02	00	01	0200	37	86	df	88	9b	89	7a	89	68	8b	81	8c	6b	8c	ca	8
0040	3f	00	31	35	36	00	00	00	00	00	00	00	00	00	00	00	0210	71	87	1c	87	57	89	5b	8a	87	89	d3	87	9b	49	83	4
0050	31	35	37	00	00	00	00	00	00	00	00	00	00	00	31	35	0220	5c	46	dc	45	dc	45	20	47	c6	4a	26	4a	7b	46	d3	4
0060	35	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	0230	aØ	49	2c	49	c5	48	dØ	48	9e	48	90	48	b 8	48	d1	4
0070	00	00	00	00	00	00	00	00	00	00	00	00	14	00	00	00	0240	ce	48	cd	48	11	84	27	84	09	84	29	84	2a	84	16	8
0080	02	05	00	af	66	04	00	03	02	00	00	04	29	00	00	00	0250	44	84	8e	84	8e	84	d9	84	03	85	62	85	dd	85	48	8
0090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	0260	88	86	c3	87	3a	88	b9	89	8e	89	15	88	19	85	27	8
00a0							_	00								00		63	49	52	47	e9	46	e3	47	63	47	3a	49	5d	89	09	8
00b0	00	00	00	00	00	00	05	2d	01	34	ea	34	ea	7b	0a	c1	0280	b 6	89	b1	89	b8	89	ad	89	b4	89	bf	89	bØ	89	b4	8
00c0	0a	17	05	d4	04	63	04	ea	04	Ød	04	94	04	48	04	35	0290	b7	89	cb	89	cf	89	c4	89	ce	89	dØ	89	ce	89	cd	8
00d0	04	2e	04	2a	04	23	04	23	04	31	04	2b	04	27	04	10	02a0	d3	89	e7	89	e4	89	eØ	89	ec	89	fa	89	f1	89	f5	8
00e0								06										fc	89	ff	89	08	8a	04	8a	1d	8a	21	8a	25	8a	3f	8
00f0																	02c0	48	8a	54	8a	4d	8a	59	8a	65	8a	82	8a	8e	8a	4d	4
0100																	02d0	0a	49	6e	16	af	14	54	89	5f	89	17	89	fc	88	f9	8
0110	-	_	-	-				bf			-	_				-	0200	f9	88	e9	88	ea	88	ee	88	ef	88	f1	88	ec	88	eb	8
0120																	02 1 0	f2	88	e7	88	e2	88	f9	88	ef	88	ed	88	fØ	88	ec	8
0130																	0300					-			88			1000	1000				
0140																	0310						100.000		00			100000		1000			
0150																	0320		-				00	00	00	00	00	00	00	00	00	00	0
0160																	0330	00	09	00	00	00											
0170			-	_		-	-	67	-	_	-			-	-																		
0180		-	-			-	-	5a			-		-																				
0190	-						-	5c					-			_																	
01a0								48																									
01b0		-								_						_																	
01c0	09	59	09	5b	09	55	09	51	09	5a	09	50	09	59	09	59																	

Fig.: 11 - Master frame 2

7.3.3 Monitoring frame from Subscriber device

Figure 12 shows the Subscriber 1 frame. The start angle is not zero, but 700.

```
0000 10 65 30 f9 16 49 00 07 be 03 e1 31 08 00 45 00 01d0 00 d7 00 7f 01 36 ea 36 ea e1 01 ba 01 a6 01 b0
0010 03 50 10 04 00 00 80 11 a5 da c0 a8 00 0a c0 a8 01e0 01 09 02 34 ea 34 ea 34 ea 34 ea 34 ea ed 01 30
0020 00 64 07 d0 16 2e 03 3c 93 0f 00 00 00 00 ca 00
                                                 01f0 01 e2 00 d8 00 dc 00 86
                                                                            00 06 41 01 fa ff fa ff
                                                 0200 fa ff 21 44 96 42 5a 44
                                                                            a0 44 83 43 50 41 fa ff
0030
     00 00 00 00 00 00 05 00
                          00 00 01 bc 02 0a 00 01
                                                                            ee 41 63 43 0e 43 9c 88
0040 3f 00 31 35 39 00 00 00
                           00 00 00 00 00 00 00 00
                                                 0210 fa ff 19 04 c8 03 2c 41
0050 31 35 37 00 00 00 00 00
                           00 00 00 00 00 00 31 35
                                                 0220 9b 47 dd 47 b6 88 e9 88
                                                                            04 89 26 89 4a 89 5f 89
0230 8a 89 5a 48 81 88 9e 88 95 88 92 88 8f 88 97 88
0070
     00 00 00 00 00 00 00 00 00 00 00 00 14 00 00 00
                                                 0240 88 88 94 88 96 88 89 88
                                                                            8e 88 89 88 78 88 7d 88
0080 02 05 00 93 66 04 00 03 02 00 00 04 29 00 00 00
                                                 0250 66 88 63 88 68 88 5d 88
                                                                            7c 88 1a 86 61 86 5a 88
                                                 0260 40 46 61 88 a8 87 f7 86
                                                                            12 87 69 87 9f 87 d2 87
0090
     0270 fe 87 3b 88 72 88 94 88
00a0
                                                                            a6 88 b7 88 06 89 57 89
00b0
     00 00 00 00 00 00 05 41 01 34 ea 34 ea 34 ea cf
                                                 0280 6d 89 ea 85 2f 89 4f 89
                                                                            93 89 98 89 57 89 ec 89
0000
     00 4b 01 59 00 61 00 14
                           01 bf 01 34 ea 34 ea 61
                                                 0290
                                                      47 89 4b 89 c3 89 e0 89
                                                                            9c 89 02 8a 0a 8a 1e 8a
0000
     08 92 08 f9 01 8d 01 09 01 2a 01 34 07 08 07 23 02a0
                                                      5b 8a 4b 8a 0b 8a d6 89
                                                                            51 89 4f 8a ef 89 29 8a
                                                                            e6 89 45 8a 54 8a 55 8a
00e0
     08 d6 07 d3 07 c5 07 c6 07 b8 07 b6 07 b1 07 f7
                                                 02b0 7d 8a 82 8a 42 8a f5 89
00f0 07 9a 09 a9 09 ac 09 aa 09 a4 09 b2 09 a6 09 a5 02c0 56 8a 47 8a 2c 8a 48 8a
                                                                            49 8a 8f 89 e8 89 b6 89
0100 09 ab 09 ae 09 b2 09 b9 09 bd 09 c8 09 cc 09 d1 02d0 e6 89 e4 89 8b 89 8c 89
                                                                            ba 89 c5 89 d5 89 d4 89
0110 09 dc 09 da 09 9c 06 62 06 1d 06 e9 05 0a 06 14 02e0 87 89 68 89 f0 89 02 8a
                                                                            f6 89 f1 89 f5 89 ea 89
0120 06 f2 06 b1 06 70 06 22 06 e9 05 aa 05 6f 05 42 02f0 ea 89 c7 89 77 89 a6 88
                                                                            0e 87 74 48 7c 47 7e 48
0130 05 20 05 f4 04 d1 04 b0 04 8c 04 6b 04 50 04 45
                                                 0300 c9 85 7b 48 0a 46 f6 45
                                                                            1e 46 69 46 fa 44 ac 44
     04 19 04 ff 03 ef 03 cd 03 b6 03 a6 03 9b 03 7f
0140
                                                 0310 e6 44 f0 43 e6 43 b6 41 65 03 40 02 2c 41 2c 41
     03 6e 03 65 03 51 03 3e
                          03 33 03 25 03 26 03 1a
                                                 0320 49 41 2f 41 2c 41 fa ff
                                                                            fa ff fa ff fa ff fa ff
0150
0160 03 0a 03 08 03 b5 02 a9
                          02 ad 02 b7 02 c9 02 ca
                                                 0330 2c 41 ef 42 81 44 06 46 e2 47 5e 48 07 05 00 00
0170
     02 c1 02 bc 02 86 02 7f
                          02 7a 02 6f 02 70 02 6c
                                                0340 00 00 00 08 15 00 00 00 00 00 00 04 70 ee 07 00
0190 02 64 02 4b 02 4a 02 4a 02 45 02 4a 02 51 02 67
01a0 02 69 02 68 02 6e 02 6d 02 70 02 71 02 70 02 74
01b0 02 71 02 76 02 7c 02 fc 01 ef 01 f3 01 87 02 0f
01c0 02 c2 01 2e 01 cb 00 9a 00 cc 00 c2 00 c3 00 fe
```

Fig.: 12 - Subscriber 1 frame

Support

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