Leuze electronic

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SMART SENSOR BUSINESS

RSL 430 RSL 440

UDP specification

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We reserve the right to
make technical changes

SAFE CONFIGURATION AND OPERATION

Original operating instructions

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1 About this document

The safety sensors of series RSL 430 and RSL 440 can send data to any IP address via *User Datagram Protocol* (UDP). This document describes the format of the UDP data.

1.1 Document target group

The document is aimed at developers who receive UDP data and process it further in appropriate target systems.

1.2 Other applicable documents

An MS Visual Studio project is available in addition to these specifications:

- RSL400_UPD (VS2008)
  The software for the RSL400_UDP project can be found on the product page for the safety sensor under the *Downloads* tab.
- Project scope:
  C/C++ header for UDP data formats
  Demo program which receives UDP data and displays it in text form.

1.3 Used symbols and signal words

Table 1.1: Warning symbols and signal words

NOTICE	Signal word for property damage Indicates dangers that may result in property damage if the measures for danger avoidance are not followed.

Table 1.2: Other symbols

	Symbol for tips Text passages with this symbol provide you with further information.
	Symbols for action steps Text passages with this symbol instruct you to perform actions.

Table 1.3: Terms and abbreviations

IP address	Network address, which is based on the Internet Protocol (IP)
UDP	User Datagram Protocol; user data segment protocol

1.4 Downloading configuration software *Sensor Studio* from Internet

↳ Call up the Leuze home page: **www.leuze.com**.

↳ Enter the type designation or part number of the safety sensor as the search term.

↳ The configuration software *Sensor Studio* can be found on the product page for the safety sensor under the *Downloads* tab.

2 Configuring the safety sensor

In order to send UDP data, you must configure the safety sensor accordingly.

Prerequisites:

- Safety sensor RSL 430 or RSL 440 mounted and connected correctly (see *Original operating instructions* of the safety sensor)
- Configuration and diagnostic software *Sensor Studio* (see Chapter 4 in the *Original operating instructions* of the safety sensor)
- Device manager (DTM) *LeSafetyCollection* (see Chapter 4 in the *Original operating instructions* of the safety sensor)
- Safety sensor RSL 430 or RSL 440 connected to the PC correctly (see *Original operating instructions* of the safety sensor)

↳ Create a configuration project using *Sensor Studio* with a connection to the safety sensor (see Chapter 9 in the *Original operating instructions* of the safety sensor).

↳ Select **SETTINGS > Data telegrams**.

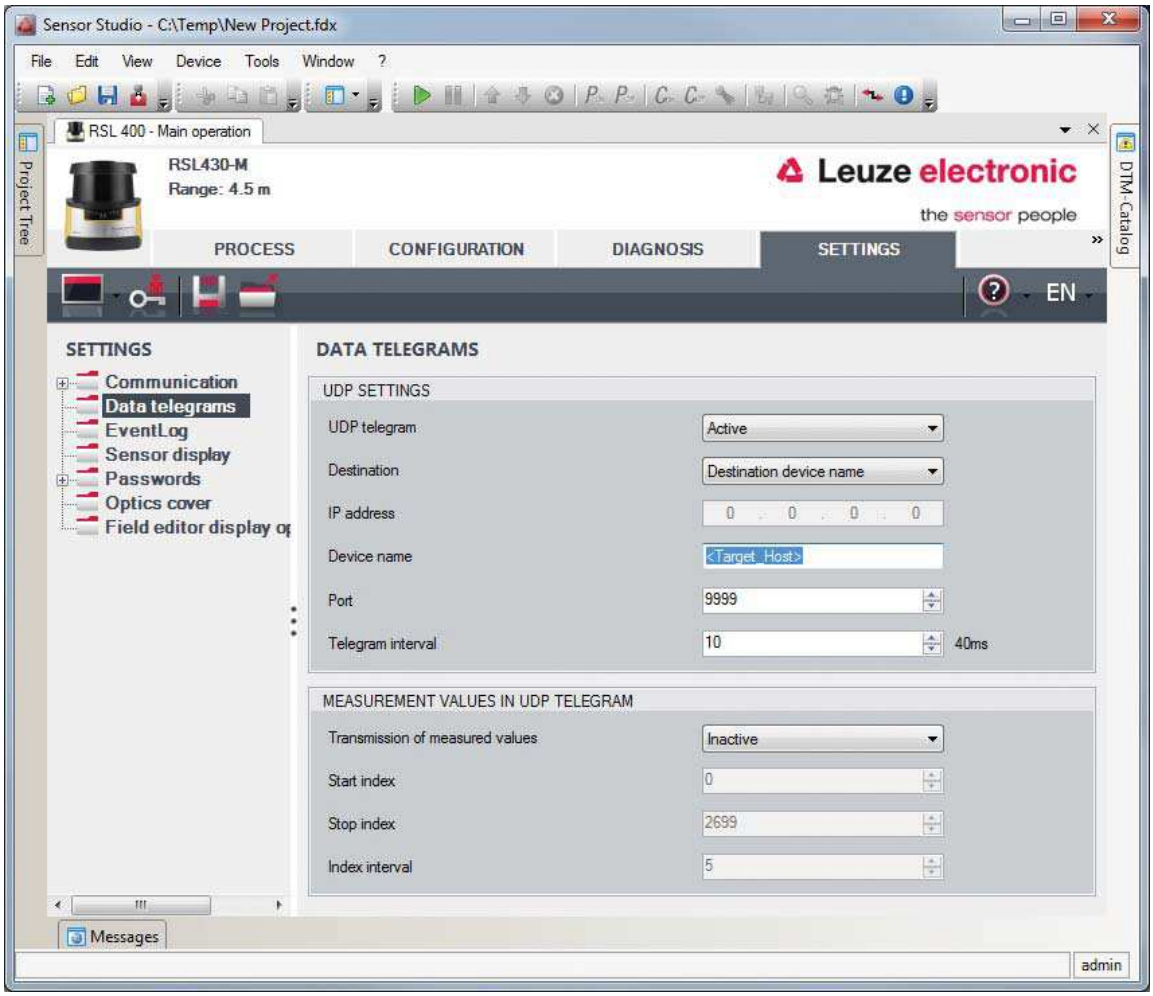

Figure 2.1: UDP settings

↳ Activate the *UDP telegram* in the **UDP settings** dialog.

Specify the device name and the IP address for the target device.

↳ Set the parameters for the data scope in the **Measurement values in UDP telegram** dialog.

↳ Transfer the configuration project to the safety sensor (see Chapter 9.8 in the *Original operating instructions* of the safety sensor).

The first UDP data is sent to the configured target device after the transfer.

3 UDP specification

3.1 System profile

The safety sensor can send process data to any network target for each scan cycle. This process data, relative to the respective scan cycle, is called *System profile*.

The system profile shows the following process data:

- Extended status profile: Status profile and measurement contour description
- Measurement contour
  Transfer of the measurement contour is activated via *Sensor Studio*: Data telegrams > Measurement value in UDP telegram **> Measurement value transmission**.

A complete system profile consists of multiple UDP data packets. The system profile is based on defined data fragments which are configured as components of the telegram definition and status profile (see chapter 2 "Configuring the safety sensor").
This specification describes the integration of data fragments into the system profile.

3.2 Basic design

For internal processing purposes, each UPD data packet is preceded by Header 1 (H1) and Header 2 (H2).

Table 3.1: UDP data packet design

8 bytes	4 bytes	2 bytes	2 bytes	4 bytes	
Header 1	Header 2	ID	Block	Scan	<data>

- The first four bytes of Header 1 specify the total length of the transferred UDP data packet.

Table 3.2: Header 1 design

Total length				Header size	Follow flag	Request ID	
[Lo byte]	…	…	[Hi byte]	8		[Lo byte]	[Hi byte]

- The ID identifies the type of UDP data packet.
- The safety sensor may only send UDP data packets up to a maximum size which is sufficient for most information. If the amount of data exceeds this size, each UDP data packet is designated with an additional block number (0 … 65535).
  This ensures that the UDP data packets can be reconstructed in the correct chronological order.
- A complete system profile consists of multiple UDP data packets. Every UDP data packet contains the scan number. This ensures that the UDP data packets of a system profile are coherent.
  The scan number increases after every scan cycle. After 4294967296 (2^{32}) cycles, the scan number starts again at 0.

3.3 UDP data packets for system profile

The system profile shows the following process data:

- Extended status profile: status profile plus measurement contour description
- Measurement contour

The safety sensor normally sends the UDP data packets as follows:

H1/H2	ID	Block	Scan	Extended status profile

Optional UDP data packets:

H1/H2	ID	Block	Scan	Measurement contour, 1st fragment

H1/H2	ID	Block	Scan	Measurement contour, 2nd fragment

…

H1/H2	ID	Block	Scan	Measurement contour, nth fragment

3.3.1 Extended status profile

The measurement contour description is send in addition to the status profile with the extended status profile.

H1/H2	ID	Block	Scan	Status profile	Measurement contour description

- ID: 1
- Block: consecutive block numbers (0 … 65535)
- Scan: consecutive scan numbers (0 … 4294967295)
- Data: see table 3.3 and see table 3.4
- Data length: fixed
  20 bytes (Frame) + 20 bytes (status profile) + 8 bytes (measurement contour description)

Only type 1 of the status profile is used when sending UDP data. Future extensions require a new type of status profile.

All measurement contour description fields are filled in with *Zero* if measurement value transmission is inactive (no measurement contour).

Status profile

Table 3.3: Status profile design

Byte	Bit	Signal	Value “0”	Value “1”	Default	Description
0	-	-	-	-	1	Type (variant) of status profile. Extensions require a new type of status profile.
1	-	OP-MODE	-	-	1	Operating mode • 1: Safety mode • 2: Simulation mode
Messages and OSSDs						

Byte	Bit	Signal	Value “0”	Value “1”	Default	Description
2	7	ERROR	Off	Message	0	Collective message: Error with switch-off
	6	ALARM	Off	Message	0	Collective message: Warning without switch-off (also window warning)
	5	SCREEN	Off	Message	0	Contamination display for optics cover: Warning and switch-off
	4	EDM	Off	Message	-	EDM collection error
	3	FIELD PAIR	Off	Message	-	Collective message: Fault detected by field pair selection monitoring
	2	E-STOP	Off	Message	-	Error with OSSD linkage / E-Stop monitoring
	1	A-OSSD	Off	On	0	OSSD state, protective function A
	0	B-OSSD	Off	On	0	OSSD state, protective function B
E-Stop, parking and reflectors						
3	7	Status-Input-SE	Off	On	0	Status of the inputs E-Stop SE1 and SE2
	6	Mode-PARK	Off	Parked	0	Park request fulfilled
	5	RFL-SEG-1	Off	Reflector detected	0	Reflector area 1
	4	RFL-SEG-2	Off	Reflector detected	0	Reflector area 2
	3	RFL-SEG-3	Off	Reflector detected	0	Reflector area 3
	2	RFL-SEG-4	Off	Reflector detected	0	Reflector area 4
	1	Reserved	-	-	-	-
	0	Reserved	-	-	-	-
Electrical signals on the safety sensor connection						
4	7	F1	-	-	-	Control input, input group 0
	6	F2	-	-	-	Control input, input group 0
	5	F3	-	-	-	Control input, input group 0
	4	F4	-	-	-	Control input, input group 0
	3	F5	-	-	-	Control input, input group 0
	2	F6	-	-	-	Control input, input group 1
	1	F7	-	-	-	Control input, input group 1
	0	F8	-	-	-	Control input, input group 1

Byte	Bit	Signal	Value “0”	Value “1”	Default	Description
5	7	F9	-	-	-	Control input, input group 1
	6	F10	-	-	-	Control input, input group 1
	5	RES1	-	-	-	Start input, protective function A
	4	RES2	-	-	-	Start input, protective function B
	3	EA1	-	-	-	EDM input, protective function A
	2	EA2	-	-	-	EDM input, protective function B
	1	EA3	-	-	-	-
	0	EA4	-	-	-	-
6	7	SE1	-	-	0	Linkage input
	6	SE2	-	-	0	Linkage input
	5	PNP-NPN	NPN	PNP	0	PNP/NPN changeover
	4	A1	-	-	-	Output
	3	A2	-	-	-	Output
	2	A3	-	-	-	Output
	1	A4	-	-	-	Output
	0	MELD	-	-	-	Output
7	-	Reserved	-	-	-	-
8 … 11	31 … 0	SE1	-	-	Value	Consecutive numbering of scans. Resetting to 0 by switching off
Protective function A						
12	7	A-ACTIVE	Off	Active	0	Protective function A is active or configured
	6	A-WF-VIO	Violation	Free	0	Status of active warning field; protective function A
	5	A-PF-VIO	Violation	Free	0	Status of active protective field; protective function A
	4	A-RES	Off	Active	0	Start/restart interlock active Start Request A
	3	A-CLEAR	Off	On	0	Internal signal OSSD A
	2	Reserved	-	-	-	-
	1	Reserved	-	-	-	-
	0	Reserved	-	-	-	-
Field pair selection A						
13	7 … 4	A-BANK-SEL	-	-	0	Selected bank A Numbers 1 … 10
	3 … 0	A-PAIR-SEL 1	-	-	0	First selected field pair A Numbers 1 … 10

Byte	Bit	Signal	Value “0”	Value “1”	Default	Description
14	7 … 4	A-PAIR-SEL 2	-	-	0	Second selected field pair A Numbers 1 … 10
	3 … 0	A-PAIR-SEL 3	-	-	0	Third selected field pair A Numbers 1 … 10
Output signals A						
15	7	A-WF-VIO-SEG-1	Violation	Free	0	Status of active warning field segment Protective function A
	6	A-WF-VIO-SEG-2	Violation	Free	0	Status of active warning field segment Protective function A
	5	A-PF-VIO-SEG-1	Violation	Free	0	Status of active protective field segment Protective function A
	4	A-PF-VIO-SEG-2	Violation	Free	0	Status of active protective field segment Protective function A
	3	A-FP-SEL-1	Violation	Free	0	Defined field pair selected Protective function A
	1	Reserved	-	-	-	-
	0	Reserved	-	-	-	-
Protective function B						
16	7	B-ACTIVE	Off	Active	0	Protective function B is active or configured
	6	B-WF-VIO	Violation	Free	0	Status of active warning field; protective function B
	5	B-PF-VIO	Violation	Free	0	Status of active protective field; protective function B
	4	B-RES	Off	Active	0	Start/restart interlock active Start request B
	3	B-CLEAR	Off	On	0	Internal signal OSSD B
	2	Reserved	-	-	-	-
	1	Reserved	-	-	-	-
	0	Reserved	-	-	-	-
Field pair selection B						
17	7 … 4	B-BANK-SEL	-	-	0	Selected bank B Numbers 1 … 10
	3 … 0	B-PAIR-SEL 1	-	-	0	First selected field pair B Numbers 1 … 10

Byte	Bit	Signal	Value “0”	Value “1”	Default	Description
18	7 … 4	B-PAIR-SEL 2	-	-	0	Second selected field pair B Numbers 1 … 10
	3 … 0	B-PAIR-SEL 3	-	-	0	Third selected field pair B Numbers 1 … 10
Output signal B						
19	7	B-WF-VIO-SEG-1	Violation	Free	0	Status of active warning field segment Protective function B
	6	B-WF-VIO-SEG-2	Violation	Free	0	Status of active warning field segment Protective function B
	5	B-PF-VIO-SEG-1	Violation	Free	0	Status of active protective field segment Protective function B
	4	B-PF-VIO-SEG-2	Violation	Free	0	Status of active protective field segment Protective function B
	3	B-FP-SEL-1	Violation	Free	0	Defined field pair selected Protective function B
	1	Reserved	-	-	-	-
	0	Reserved	-	-	-	-

Measurement contour description

Table 3.4: Measurement contour description design

Byte	Bit	Value range	Description
0 … 1	15 … 0	0 … 2699 0 ≤ **Start index** < Stop index	Start index
0 … 3	15 … 0	0 … 2699 Start index < **Stop index** ≤ 2699	Start index
4 … 5	15 … 0	1, 4, 8	Resolution
6 … 7	15 … 0	-	Reserved

The total number of scanning beams is calculated according to the following formula:

$$n = 1 + \text{ceil}\left(\frac{\text{Stop index} - \text{Start index}}{\text{Resolution}}\right)$$

n [-] = total number of scanning beams

The ceil(n) function determines the smallest integer that is greater than equal to the value n.

3.3.2 Measurement contour

The measurement contour is transferred via multiple UDP packets according to the configuration.
The expected number of values can be calculated using the measurement contour description. The measurement contour can be reconstructed in its entirety and in the correct chronological order with this result and the block number.

H1/H2	ID	block	Scan	Measurement contour, nth fragment

- ID: 6
- Block: consecutive (0 … 655356)
- Scan: consecutive (0 … 4294967295)

Table 3.5: Data

Measurement contour value 1		Measurement contour value 2		Measurement contour value …		…
Distance [mm]		Distance [mm]		Distance [mm]		…
[Lo byte]	[Hi byte]	[Lo byte]	[Hi byte]	[Lo byte]	[Hi byte]	…

The distance can be in the range of 0 … 65535 mm
The expected data length results from the following equation:

$$n = H1 - Frame$$

n [-] = data length
H1 [-] = total length of Header 1
Frame [-] = 20 bytes

The expected number of beams (measurement contour values) results from the following equation:

$$n = \frac{H1 - Frame}{2}$$

n [-] = number of beams
H1 [-] = total length of Header 1
Frame [-] = 20 bytes

The total number of scanning beams (number of measurement contour values) of all associated values of a measurement contour (of a scan cycle) must correspond to the calculated number of beams (see chapter "Measurement contour description").