EN

LAW

Interface Protocol

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Table of Contents

1. Introduction

This documentation describes the structure and the function of the TCP commands for controlling and configuring the High Performance Distance Sensor LAWxxx.
The commands are send via the port 3000. After opening the port, the sensor transmits data packets without any further prompting.
Further information regarding the header and the data format can be found in section 3.
It is advisable to stop measurement before configuring the parameters.
Upper and lower case letters must be observed.

2. Commands

2.1 General Measuring Commands

2.1.1 Selecting the “Continuous Distance Measurement” Data Format

Command	`set_measure_start<CR>`
Response	Data stream (see section 3.1)
Description	Starts the “Continuous Distance Measurement” data stream (distance data).

2.1.2 Selecting the “Extended Continuous Measurement” Data Format

Command	`set_ext_measure_start<CR>`
Response	Data stream (see section 3.2)
Description	Starts the “Extended Continuous Measurement” data stream (distance, intensity and encoder data).

2.1.3 Selecting the Data Format for Peak Data

Command	`set_peak<CR>`
Response	Data stream (see section 3.3)
Description	A peak is transmitted.

2.1.4 Stopping the Measurement

Command	`set_measure_stop<CR>`
Response	No response
Description	All measurement and transmission of measurement data is stopped.

2.1.5 Reply Mode

Command	`set_reply_echo_activate<CR>` `set_reply_echo_deactivate<CR>`
Response	Only in case of “reply echo activate”: `OK:reply_echo_activate<CR>`
Description	All commands are acknowledged (default setting: mode deactivated).

2.2 Sensor Settings

2.2.1 Setting the IP Address

Command	set_ip_addr=192.168.0.225<CR>
Response	In reply echo mode: OK:ip_addr=192.168.0.225<CR>
Description	The new address becomes active after restarting the sensor.

2.2.2 Setting the Subnet Mask Address

Command	set_netmask_addr=255.255.0.0<CR>
Response	In reply echo mode: OK:net_mask=255.255.0.0<CR>
Description	The new subnet mask becomes active after restarting the sensor.

2.2.3 Setting the Gateway Address

Command	set_gateway_addr=192.168.0.1<CR>
Response	In reply echo mode: OK:gateway_addr=192.168.0.1<CR>
Description	The new gateway address becomes active after restarting the sensor.

2.2.4 Reset the Network Settings to Default Values

Command	set_activate_network_default<CR>
Response	In reply echo mode: OK:activate_network_default<CR>
Description	Reset of IP address, gateway and subnet mask to default values.

2.2.5 Select the Evaluation Method

Command	set_calc_mode=x<CR>
Response	In reply echo mode: OK:calc_mode=x<CR>
Description	The peak evaluation method can be selected with this command. Possible values for “x” include: 2: COG (default setting) 5: Edge

2.2.6 Adjusting the Average Filter

Command	`set_avg_filter_cnt=x<CR>`
Response	In reply echo mode: `OK:avg_filter_cnt=x<CR>`
Description	The rolling average can be generated based on a value between 2 and 1 000. The smaller the selected value, the faster the measured value reacts to jumps. The larger the selected value, the more smoothed the measured value becomes. Possible values for “x” include: 0: off (default setting) 1: off 2 . . 1000

2.2.7 Setting the Output Rate

Command	`set_freq=x<CR>`
Response	In reply echo mode: `OK:freq=x<CR>`
Description	The output rate is set in Hertz (default setting: 10000 Hz). The measured values are compiled individually as an Ethernet data packet at the selected rate. Example: Using the “Extended Continuous Measurement” evaluation method with 150 distance values and a selected output rate of 1000 Hz (corresponds to 1 ms), you get the entire data packet every 150 ms. Possible values for “x” include: 10 . . 30,000

2.2.8 Setting the Sampling Rate

Command	`set_meas_freq=x<CR>`
Response	Im reply echo mode: `OK:meas_freq=x<CR>`
Description	The sampling rate is set in Hertz. Possible values for “x” include: 0: The sampling rate corresponds to the output rate 900 . . 30,000

2.2.9 Setting Regulation of Laser Power and the Sampling Rate

Command	`set_regulator=x<CR>`
Response	In reply echo mode: `OK:regulator=x<CR>`
Description	Regulation of the measuring rate and laser power is set here. Possible values for “x” include: 0: Automatic sampling rate regulation AND laser power regulation (default setting) 1: Automatic sampling rate, laser power manually adjustable 2: Automatic laser power, sampling rate manually adjustable 3: Laser power and sampling rate manually adjustable In case of laser power regulation and sampling rate regulation, the sensor automatically selects the setting which results in the best intensity. Depending on the application, either sampling rate or laser power regulation is preferable. If constant measurement times are desired, automatic laser power regulation should be selected. If constant laser power is desired, sampling rate regulation is more suitable.

2.2.10 Protective Screen Compensation

Command	`set_compensation_activate<CR>` `set_compensation_deactivate<CR>`
Response	No response
Description	Activation/deactivation of protective screen compensation

2.2.11 Setting Laser Power

Command	`set_laser=x<CR>`
Response	In reply echo mode: `OK:laser=x<CR>`
Description	Laser power can be adjusted in 1/10 mW steps. Possible values for “x” include: Auto (default setting) 1: 0.1 mW : : 10: 1 mW This setting is only active in case of manual laser power regulation (see section 2.2.9)

2.2.12 Adjusting Offset

Command	`set_digout_offset=x<CR>`
Response	In reply echo mode: `OK:digout_offset=x<CR>`
Description	A zero-point offset can be entered here as a 16-bit value (default setting: 0.000). Possible values for “x” include: -30,000 ⋮ 30,000 Conversion of digital offset to offset in mm: $Offset[mm] = \frac{x}{65536} \times measuring\ range\ [mm]$

2.2.13 Encoder Reset

Command	`set_clear_encoder<CR>`
Response	In reply echo mode: `OK:clear_encoder<CR>`
Description	This command resets the internal encoder counter to zero.

2.2.14 Encoder Counter Right Shift

Command	`set_enc_right_shift=x<CR>`
Response	In reply echo mode: `OK:enc_rshift=x<CR>`
Description	The scaling factor of the encoder input can be set with this command. Possible values for “x” include: 1: Every 2nd encoder pulse is counted 2: Every 4th encoder pulse is counted (default setting) ⋮ 8: Every 256th encoder pulse is counted

2.2.15 Switching the Laser On/Off

Command	`set_activate_laser<CR>` `set_deactivate_laser<CR>`
Response	In reply echo mode: `OK:activate_laser<CR>` `OK:deactivate_laser<CR>`
Description	The laser is switched on or off by means of TCP commands (default setting: laser on). The pin setting is always dominant and cannot be changed by the input command.

2.2.16 Reset to Default Values

Command	`set_activate_default<CR>`
Response	In reply echo mode: `OK:activate_default<CR>`
Description	Returns all settings to their default values. Exception: network settings.

2.3 I/O Settings

2.3.1 Selecting the Analog Mode

Command	`set_anaout_mode=x<CR>`
Response	In reply echo mode: `OK:anaout_mode=x<CR>`
Description	Selects the analog mode. Possible values for “x” include: 1: 0 to 10 V 8: 4 to 20 mA (default setting)

2.3.2 Setting the Pin Function

Command	`set_usrio1_pin_function=x<CR>`
	`set_usrio2_pin_function=x<CR>`
	`set_usrio3_pin_function=x<CR>`
	`set_usrio4_pin_function=x<CR>`

Response	Im Reply-Echo-Mode (e.g. I/O1): `OK:usr_io1_pin_function=x<CR>`
Description	Sets the pin function. Possible values for “x” include: 1: Switching output 2: External teach-in input for O1 3: External teach-in input for O2 4: External teach-in input for O3 5: External teach-in input for O4 6: Encoder input (I1+I2) 7: Encoder reset input 10: Laser off input

2.3.3 Selecting the Output Mode

Command	`set_usrio1_output_mode=x<CR>`
	`set_usrio2_output_mode=x<CR>`
	`set_usrio3_output_mode=x<CR>`
	`set_usrio4_output_mode=x<CR>`

Response	In reply echo mode (e.g. I/O1): `OK:usr_io1_output_mode=x<CR>`
Description	Sets the output mode. Possible values for “x” include: 1: PNP 2: NPN 3: Push-pull

2.3.4 Setting the Output Function

Command	set_usrio1_output_function=x<CR> set_usrio2_output_function=x<CR> set_usrio3_output_function=x<CR> set_usrio4_output_function=x<CR>
Response	In reply echo mode (e.g. I/O1): OK:usr_io1_output_function=x<CR>
Description	Configures the output function. Possible values for "x" include: 1: Normally open (NO) 2: Normally closed (NC)

2.3.5 Teaching the Switching Distance (Teach-in)

Command	set_usrio1_teach_in=x<CR> set_usrio2_teach_in=x<CR> set_usrio3_teach_in=x<CR> set_usrio4_teach_in=x<CR>
Response	In reply echo mode (e.g. I/O3): OK:usr_io3_switch_dist_mm=87.614<CR>
Description	A function by means of which the sensor is caused to automatically calculate and save future settings based on momentarily acquired values by pressing a button or applying a control signal. **NOTE!** The pin function of the respective output must be configured as a switching output.

2.3.6 Selecting the Teach-In Mode

Command	set_usrio1_teach_mode=x<CR> set_usrio2_teach_mode=x<CR> set_usrio3_teach_mode=x<CR> set_usrio4_teach_mode=x<CR>
Response	In reply echo mode (e.g. I/O1): OK:usr_io1_teach_mode=x<CR>
Description	Sets the teach-in mode. Possible values for "x" include: 1: Foreground teach-in (default setting) 2: Window teach-in Foreground teach-in: Teach-in is performed while the sensor is aligned to the object. The teach-in distance is set automatically, so that the sensor switches as soon as the distance between the sensor and the object is less than or equal to the previously taught in distance. Window teach-in: There are two switching points in the case of window teach-in. The distance between the two switching points is the window width. The sensor switches when the object is within the window.

2.3.7 Setting the Switching Point

Command	`set_usrio1_switch_dist_mm=x<CR>`
	`set_usrio2_switch_dist_mm=x<CR>`
	`set_usrio3_switch_dist_mm=x<CR>`
	`set_usrio4_switch_dist_mm=x<CR>`

Response	In reply echo mode (e.g. I/O1): `OK:usr_io1_switch_dist_mm=x<CR>`
Description	The switching point is shifted to the entered distance. In the case of foreground teach-in, this is the teach-in distance (see section 2.3.6), while in the case of window teach-in, it is the distance to the middle of the window. The value selected for “x” must lie within the working range. Example: 22.123 (specified in mm) **NOTE!** Decimal points must be used for non-whole numbers - not decimal commas.

2.3.8 Setting Hysteresis

Command	`set_usrio1_hysteresis_mm=x<CR>`
	`set_usrio2_hysteresis_mm=x<CR>`
	`set_usrio3_hysteresis_mm=x<CR>`
	`set_usrio4_hysteresis_mm=x<CR>`

Response	In reply echo mode (e.g. I/O1): `OK:usr_io1_hysteresis_mm=x<CR>`
Description	Hysteresis describes the distance between the switch-on and switch-off points. Possible values for “x” include: 0 : : Measuring range/4 Example: 0.030 (specified in mm) **NOTE!** Decimal points must be used for non-whole numbers - not decimal commas.

2.3.9 Setting Switching Reserve

Command	set_usrio1_switch_res_mm=x<CR> set_usrio2_switch_res_mm=x<CR> set_usrio3_switch_res_mm=x<CR> set_usrio4_switch_res_mm=x<CR>
Response	In reply echo mode (e.g. I/O1): OK:usr_io1_switch_res_mm=x<CR>
Description	Switching reserve describes the clearance between the teach-in distance and the sensor's switching point. Switching reserve ensures reliable object detection even in the case of slightly fluctuating distances between the objects and the sensor. Possible values for "x" include: 0 . . . Measuring range/4 Example: 0.120 (specified in mm) Switching reserve can only be set for foreground teach-in. **NOTE!** Decimal points must be used for non-whole numbers - not decimal commas.

2.3.10 Setting Window Width

Command	set_usrio1_window_size_mm=x<CR> set_usrio2_window_size_mm=x<CR> set_usrio3_window_size_mm=x<CR> set_usrio4_window_size_mm=x<CR>
Response	In reply echo mode (e.g. I/O1): OK:usr_io1_window_size_mm=x<CR>
Description	Sets the window width (see section 2.3.6 → window teach-in). The entered value must be smaller than the sensor's measuring range. Example: 0.100 (specified in mm) **NOTE!** Decimal points must be used for non-whole numbers - not decimal commas.

2.3.11 Setting Input Load

Command	set_usrio1_input_load=x<CR> set_usrio2_input_load=x<CR> set_usrio3_input_load=x<CR> set_usrio4_input_load=x<CR>
Response	In reply echo mode (e.g. I/O1): OK:usr_io1_input_load=x<CR>
Description	Sets the input load. Possible values for “x” include: 1: Input load active (2 mA; default setting) 2: Input load inactive

2.3.12 Setting the Input Function

Command	set_usrio1_input_function=x<CR> set_usrio2_input_function=x<CR> set_usrio3_input_function=x<CR> set_usrio4_input_function=x<CR>
Response	In reply echo mode (e.g. I/O1): OK:usr_io1_input_function=x<CR>
Description	Configures the input function. Possible values for “x” include: 1: Operating voltage active (pending tasks are executed when input voltage is on, default setting) 2: Operating voltage inactive (pending tasks are executed when input voltage = 0 V)

2.3.13 Setting Packet Length

Command	set_packet_size=x<CR>
Response	In reply echo mode: OK:packet_size=x<CR>
Description	The desired number of distance values per packet can be selected here. Possible values for “x” include: In the event of continuous measurement: 1 : : 450 In the event of extended continuous measurement: 1 : : 150 The entered value remains valid until the data format is changed. The values are then reset to the default values (150/450).

2.4 Query Commands

2.4.1 Querying the IP Address

Command	`get_ip_addr<CR>`
Response	Example: `OK:ip_addr=192.168.0.225<CR>`
Description	The IP address is read out.

2.4.2 Querying the Subnet Mask Address

Command	`get_net_mask<CR>`
Response	Example: `OK:net_mask=255.255.0.0<CR>`
Description	The subnet mask address is read out.

2.4.3 Querying the Gateway Address

Command	`get_gateway<CR>`
Response	Example: `OK:gateway_addr=169.254.150.1<CR>`
Description	The gateway address is read out.

2.4.4 Querying the MAC Address

Command	`get_mac_address<CR>`
Response	Example: `OK:mac_address=0007ABF00CAB<CR>`
Description	The MAC address is read out.

2.4.5 Querying the Hardware Version

Command	`get_hwversion<CR>`
Response	Example: `OK:hw_version=3.0.0<CR>`
Description	The hardware version is read out.

2.4.6 Querying the Description

Command	`get_description<CR>`
Response	`OK:description=High_Performance_Distance_Sensor<CR>`
Description	The description is read out. Blanks are replaced by underlines!

2.4.7 Querying the Manufacturer

Command	`get_manufacturer<CR>`
Response	`OK:manufacturer=wenglor_sensoric_GmbH<CR>`
Description	The manufacturer is read out. Blanks are replaced by underlines!

2.4.8 Querying the Order Number

Command	`get_name<CR>`
Response	Example: `OK:name=PNBC005<CR>`
Description	The order number is read out.

2.4.9 Querying the Serial Number

Command	`get_serial<CR>`
Response	Example: `OK:serial=001020<CR>`
Description	The serial number is read out.

2.4.10 Querying the Product Version

Command	`get_pversion<CR>`
Response	Example: `OK:pversion=1.0.0<CR>`
Description	The product version is read out.

2.4.11 Querying the Setting for the Evaluation Mode

Command	`get_calc_mode<CR>`
Response	Example: `OK:calc_mode=2<CR>`
Description	The selected evaluation method is read out. Possible values include: 2: COG 5: Edge

2.4.12 Querying the Average Filter

Command	`get_avg_filter_cnt<CR>`
Response	Example: `OK:avg_filter_cnt=345<CR>`
Description	The average filter is read out. Possible values include: 0: off 1: off 2 ⋮ 1000

2.4.13 Quering the Output Rate

Command	`get_freq<CR>`
Response	Example: `OK:freq=26667<CR>`
Description	The output rate is read out. Possible values include: 10 . . . 30,000 The output rate is read out in Hertz.

2.4.14 Quering the Sampling Rate

Command	`get_meas_freq<CR>`
Response	Example: `OK:meas_freq=26667<CR>`
Description	The sampling rate (inverse value of exposure time) is read out. Possible values include: 900 . . . 30,000 The sampling rate is read out in Hertz.

2.4.15 Quering Regulation of Laser Power and the Sampling Rate

Command	`get_regulator<CR>`
Response	Example: `OK:regulator=0<CR>`
Description	The settings for laser power and sampling rate are read out. Possible values include: 0: Automatic sampling rate regulation AND laser power regulation 1: Automatic sampling rate, laser power manually adjustable 2: Automatic laser power, sampling rate manually adjustable 3: Laser power and sampling rate manually adjustable

2.4.16 Quering Laser Power

Command	`get_laser<CR>`
Response	Beispiel: `OK:laser=10<CR>`
Description	Laser power is read out in 1/10 mW. Possible values include: 1: 0.1 mW . . . 10: 1 mW

2.4.17 Quering the Encoder Right Shift Setting

Command	`get_enc_rshift<CR>`
Response	Example: `OK:enc_rshift=2<CR>`
Description	The scaling factor of the encoder input is read out. Possible values include: 1: Every 2nd encoder pulse is counted 2: Every 4th encoder pulse is counted ⋮ 8: Every 256th encoder pulse is counted

2.4.18 Quering the Analog Mode

Command	`get_anaout_mode<CR>`
Response	Example: `OK:anaout_mode=1<CR>`
Description	The analog output setting is read out. Possible values include: 1: 0-10 V 8: 4-20 mA

2.4.19 Quering the Pin Function

Command	`get_usrio1_pin_function<CR>`
	`get_usrio2_pin_function<CR>`
	`get_usrio3_pin_function<CR>`
	`get_usrio4_pin_function<CR>`

Response	Example: `OK:usr_io1_pin_function=1<CR>` Example: `OK:usr_io2_pin_function=1<CR>` Example: `OK:usr_io3_pin_function=4<CR>` Example: `OK:usr_io4_pin_function=5<CR>`
Description	The pin function setting is read out. Possible values include: 1: Switching output 2: External teach-in input for O1 3: External teach-in input for O2 4: External teach-in input for O3 5: External teach-in input for O4 6: Encoder input (I1+I2) 7: Encoder reset input 10: Laser off input

2.4.20 Quering the Output Mode

Command	get_usrio1_output_mode<CR> get_usrio2_output_mode<CR> get_usrio3_output_mode<CR> get_usrio4_output_mode<CR>
Response	Example: OK:usr_io1_output_mode=1<CR> Example: OK:usr_io2_output_mode=1<CR> Example: OK:usr_io3_output_mode=1<CR> Example: OK:usr_io4_output_mode=1<CR>
Description	The output mode is read out. Possible values include: 1: PNP 2: NPN 3: Push-pull

2.4.21 Quering the Output Function

Command	get_usrio1_output_function<CR> get_usrio2_output_function<CR> get_usrio3_output_function<CR> get_usrio4_output_function<CR>
Response	Example: OK:usr_io1_output_function=1<CR> Example: OK:usr_io2_output_function=1<CR> Example: OK:usr_io3_output_function=1<CR> Example: OK:usr_io4_output_function=1<CR>
Description	The output function is read out. Possible values include: 1: Nomally open 2: Normally closed

2.4.22 Quering Switching Distance

Command	get_usrio1_switch_dist_mm<CR> get_usrio2_switch_dist_mm<CR> get_usrio3_switch_dist_mm<CR> get_usrio4_switch_dist_mm<CR>
Response	Example: OK:usr_io1_switch_dist_mm=75.5<CR> Example: OK:usr_io2_switch_dist_mm=63.1<CR> Example: OK:usr_io3_switch_dist_mm=60.0<CR> Example: OK:usr_io4_switch_dist_mm=98.4<CR>
Description	The switching distance is read out.

2.4.23 Quering the Teach-in Mode

Command	get_usrio1_teach_mode<CR> get_usrio2_teach_mode<CR> get_usrio3_teach_mode<CR> get_usrio4_teach_mode<CR>
Response	Example: OK:usr_io1_teach_mode=2<CR> Example: OK:usr_io2_teach_mode=1<CR> Example: OK:usr_io3_teach_mode=1<CR> Example: OK:usr_io4_teach_mode=2<CR>
Description	The teach-in mode is read out. Possible values include: 1: Foreground teach-in 2: Window teach-in

2.4.24 Quering Hysteresis

Command	get_usrio1_hysteresis_mm<CR> get_usrio2_hysteresis_mm<CR> get_usrio3_hysteresis_mm<CR> get_usrio4_hysteresis_mm<CR>
Response	Example: OK:usr_io1_hysteresis_mm=0.120<CR> Example: OK:usr_io2_hysteresis_mm=0.035<CR> Example: OK:usr_io3_hysteresis_mm=1.200<CR> Example: OK:usr_io4_hysteresis_mm=0.850<CR>
Description	Hysteresis is read out in mm.

2.4.25 Quering Switching Reserve

Command	get_usrio1_switch_res_mm<CR> get_usrio2_switch_res_mm<CR> get_usrio3_switch_res_mm<CR> get_usrio4_switch_res_mm<CR>
Response	Example: OK:usr_io1_switch_res_mm=0.188<CR> Example: OK:usr_io2_switch_res_mm=1.672<CR> Example: OK:usr_io3_switch_res_mm=0.267<CR> Example: OK:usr_io4_switch_res_mm=0.350<CR>
Description	The clearance between the teach-in distance and the sensor's switching point is read out in mm.

2.4.26 Quering Window Width

Command	get_usrio1_window_size_mm<CR> get_usrio2_window_size_mm<CR> get_usrio3_window_size_mm<CR> get_usrio4_window_size_mm<CR>
Response	Example: OK:usr_io1_window_size_mm=12.755<CR> Example: OK:usr_io2_window_size_mm=10.200<CR> Example: OK:usr_io3_window_size_mm=14.850<CR> Example: OK:usr_io4_window_size_mm=16.465<CR>
Description	Window width is read out in mm.

2.4.27 Quering Input Load

Command	get_usrio1_input_load<CR> get_usrio2_input_load<CR> get_usrio3_input_load<CR> get_usrio4_input_load<CR>
Response	Example: OK:usr_io1_input_load=1<CR> Example: OK:usr_io2_input_load=1<CR> Example: OK:usr_io3_input_load=1<CR> Example: OK:usr_io4_input_load=1<CR>
Description	Input load status is read out. Possible values include: 1: Input load active (2 mA) 2: Input load inactive

2.4.28 Quering the Input Function

Command	get_usrio1_input_function<CR> get_usrio2_input_function<CR> get_usrio3_input_function<CR> get_usrio4_input_function<CR>
Response	Example: OK:usr_io1_input_function=1<CR> Example: OK:usr_io2_input_function=1<CR> Example: OK:usr_io3_input_function=1<CR> Example: OK:usr_io4_input_function=1<CR>
Description	The input function is read out. Possible values include: 1: Operating voltage active 2: Operating voltage inactive (= 0 V active)

2.4.29 Quering the Input Status

Command	(e.g. I/O1): get_usr_io1<CR>
Response	Example: OK:usr_io1=1<CR>
Description	Reads out the input status at the pin. Possible values: 0 and 1

2.4.30 Quering the Input/Output Status of All Inputs/Outputs

Command	get_usr_allinputs<CR>
Response	OK:usr_io_allinputs=0110<CR>
Description	Reads out the status of all inputs/outputs in the following order: IO4, IO3, IO2 and IO1. Possible values are 0 and 1. The following applies to the example included above: IO4: 0 (inactive) IO3: 1 (active) IO2: 1 (active) IO1: 0 (inactive)

2.4.31 Quering Packet Length

Command	get_packet_size<CR>
Response	OK:packet_size=120<CR>
Description	The number of measured values per data format is read out. Possible values include: In the event of continuous measurement: 1 . . . 450 In the event of extended continuous measurement: 1 . . . 150

3. Header and Data Format

After opening port 3000, the sensor transmits data packets in the selected data format (exception: peak data, see section 3.3).

The following data formats are possible:

- Continuous distance measurement (default setting)
- Extended continuous measurement
- Peak data

The header and the data are distributed to two TCP/IP packages of roughly the same size. In the case of a header with 94 bytes and a data volume of 900 bytes (for a total of 994 bytes), the first package contains 496 bytes and the second package 498. The header is always at the beginning of the package and is followed by the data.

The data layout is described in the following tables. The respective data format is identified by means of the “Data Format” field.

Example: If a value of 4470 appears in the “Data Format” field, this corresponds to continuous distance measurement.

Each data packet is laid out so that the header is transmitted first. This is followed by the actual data (see table below). The data can be identified and allocated on the basis of the indentification value.

All values are little-endian, i. e. the least significant byte comes first.

In the case of zero-terminated strings, the entry ends with the first “0”. The last value must be a ‘0’ at the latest, i. e. one less byte is available for the entry. All zero-terminated strings are read out in ASCII code.

3.1 Continuous Distance Measurement

This data format should be used for processes which do not require an encoder.
All measured distance values are transmitted uninterruptedly.

Designation	Offset [bytes]	Length [bytes]	Type	Read-out/Comment
Data format	0	4	unsigned int	4470
Internal	4	24		
Order number (zero-terminated)	28	12	string	LAW-10*
Serial number (zero-terminated)	40	12	string	001000*
Software version (zero-terminated)	52	10	string	V2.11*
Operating time counter in ms	62	4	unsigned int	1467*
Measuring range lower limit in mm	66	2	unsigned short	25*
Measuring range in mm	68	2	unsigned short	10*
Laser power in 0.1 mW	70	2	unsigned short	1...10
Sampling rate in Hz	72	2	unsigned short	900...30,000
Temperature in the sensor in °C	74	1	unsigned char	35*
Evaluation method	75	1	unsigned char	2, 5
Laser power/sampling rate regulation	76	1	unsigned char	0...3
EncRightShift	77	1	unsigned char	0...8
Status (see section 3.4.1)	78	1	unsigned char	0...255
Internal	79	8		
I/Ox status, laser (see section 3.4.2)	87	1	unsigned char	0...255
Output rate in Hz	88	2	unsigned short	10...30,000
Average filter	90	2	unsigned short	0...1000
Offset	92	2	signed short	–30,000...+30,000
Number of distance values per packet	94	2	unsigned short	1...450
Distance 1 (see section 3.4.3) Distance 2 : : Distance 450	96 98 : : 994	2		0...65,535

*) Example values

3.2 Extended Continuous Measurement (Distance, Intensity, Encoder)

This data format should be selected when an encoder is used in the application.
In this case, intensity and the encoder value (encoder counter in the LAW Sensor) are transmitted for each individual measurement in addition to distance values. This makes it possible to obtain an actual position value synchronous to the distance values.

Designation	Offset [bytes]	Length [bytes]	Type	Read-out/Comment
Data format	0	4	unsigned int	4480
Internal	4	24		
Order number (zero-terminated)	28	12	string	LAW-10*
Serial number (zero-terminated)	40	12	string	001000*
Software version (zero-terminated)	52	10	string	V2.11*
Operating time counter in ms	62	4	unsigned int	1467*
Measuring range lower limit in mm	66	2	unsigned short	25*
Measuring range in mm	68	2	unsigned short	10*
Laser power in 0.1 mW	70	2	unsigned short	1...10
Sampling rate in Hz	72	2	unsigned short	900...30,000
Temperature in the sensor in °C	74	1	unsigned char	35*
Evaluation method	75	1	unsigned char	2, 5
Laser power/sampling rate regulation	76	1	unsigned char	0...3
EncRightShift	77	1	unsigned char	0...8
Status (see section 3.4.1)	78	1	unsigned char	0...255
Internal	79	8		
I/Ox status, laser (see section 3.4.2)	87	1	unsigned char	0...255
Output rate in Hz	88	2	unsigned short	10...30,000
Average filter	90	2	unsigned short	0...1000
Offset	92	2	signed short	–30,000...+30,000
Number of distance, intensity and encoder values per packet	94	2	unsigned short	1...150
Distance 1 (see section 3.4.3) Intensity 1 (see section 3.4.4) Encoder 1 (see section 3.4.5) ⋮ Distance 150 Intensity 150 Encoder 150	96 98 100 ⋮ 990 992 994	6	unsigned short	 0...65,535 0...4,095 0...65,535

*) Example values

3.3 Peak Data

This data format is suitable for diagnosis purposes.
All 1024 pixel intensities of the sensor's CMOS line array are transmitted.
This data format is not retained after a restart. The sensor is automatically reset to the previously selected format.

Designation	Offset [bytes]	Länge [bytes]	Type	Read-out/Comment
Data format	0	4	unsigned int	4450
Internal	4	24		
Order number (zero-terminated)	28	12	string	LAW-10*
Serial number (zero-terminated)	40	12	string	001000*
Software version (zero-terminated)	52	10	string	V2.11*
Operating time counter in ms	62	4	unsigned int	1467*
Measuring range lower limit in mm	66	2	unsigned short	25*
Measuring range in mm	68	2	unsigned short	10*
Laser power in 0.1 mW	70	2	unsigned short	1...10
Sampling rate in Hz	72	2	unsigned short	900...30,000
Temperature in the sensor in °C	74	1	unsigned char	35*
Evaluation method	75	1	unsigned char	2, 5
Laser power/sampling rate regulation	76	1	unsigned char	0...3
EncRightShift	77	1	unsigned char	0...8
Status (see section 3.4.1)	78	1	unsigned char	0...255
Internal	79	8		
I/Ox status, laser (see section 3.4.2)	87	1	unsigned char	0...255
Distance in digits	88	2	unsigned short	0...65,535
Intensity in digits	90	2	unsigned short	0...4,095
Encoder value in digits	92	2	unsigned short	0...65,535
Number of intensity values per packet	94	2	unsigned short	1,024
Intensity pixel 1 Intensity pixel 2 : : Intensity pixel 1024	96 98 : : 2142	2	unsigned short	0...4,095

*) Example values

3.4 Description of the Measurement Data

3.4.1 Status

The status is represented as a 7-bit value:

7	6	5	4	3	2	1	0

Bit 0: Out of range error: intensity or distance is outside of the valid working range
Bit 1: Internal peak memory overflow error
Bit 2: Sensor FIFO overflow: CPU processing is unable to keep up with the measurement data
Bit 3...7: = 0

3.4.2 I/Ox and Laser Status

The statuses of the inputs/outputs and the laser are represented as 7-bit values

7	6	5	4	3	2	1	0

Bit 0: Status of I/O1
Bit 1: Status of I/O2
Bit 2: Status of I/O3
Bit 3: Status of I/O4
Bit 7: Laser status: 1 = On; 0 = Off

3.4.3 Distance in Bits

Distance is represented as a 16-bit value:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit 0...15: Measured distance value (0...65,535)

The following formula is used to obtain the value displayed on the website:

Measured value in mm = (distance in bits × sensor measuring range in mm / 65,536) + lower working range limit in mm

Example (LAW-100): Measured value = 35,721 × 100 mm / 65,536 + 90 mm = **144.5 mm**

3.4.4 Intensity Value

The intensity value is represented as a 16-bit value:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit 0 to 11: Intensity value (=peak value; 0...4095)
Bit 12: Reserved (=0)
Bit 13: Reserved (=0)
Bit 14: Error bit: intensity too low or too high
Bit 15: Error bit: distance outside of working range

The following formula for converting the digital value into a percentage is used to obtain the signal strength displayed on the website:

Signal strength as percentage = intensity value/16

If the intensity value is higher than 1600 the signal strength is limited to 100 %.

3.4.5 Encoder Value

The encoder value is represented as a 16-bit value:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit 0 to 15: Encoder value (0...65,535)

A converted value in mm cannot be provided here because conversion depends on the utilized encoder and how it is installed.

4. Change Log

Version	Date	Description / Modification	Hardware/Firmware Version
1.0.0	25.01.16	First version of documentation	PNBC Hardware: 3.3.0 PNBC Firmware: 3.42.2
1.1.0	28.09.17	• Section 1.2.8: Value “Auto” removed; Value “=output rate” changed to “0” • Section 1.4.19: Value “8” changed to “10” • In data format tables laser power changed to 0.1 mW • New: section 1.2.4 • New: section 1.2.10	PNBC Hardware: 3.4.0 PNBC Firmware: 3.50.1
1.1.1	11.04.2018	Layout redesign	PNBC Hardware: 3.4.0 PNBC Firmware: 3.50.1
1.1.2	28.08.2018	Supplementary Description of the Header and the Data Format	PNBC Hardware: 3.4.0 PNBC Firmware: 3.50.1