Manual

LDS30

Version 2.3

 $\mathsf{C}\,\mathsf{E}$

Dear User,

You are advised to carefully read this User Manual before turning on the Laser Distance Sensor LDS30 for the first time.

This is necessary to ensure that you will be able to use all the capabilities and features provided by your new purchase.

This product is subject to ongoing technological developments.

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Note:

Proper care has been used in compiling this document. No liability will be accepted in the event of damage resulting from the failure to comply with the information contained herein.

Revision history

Manual Version	Date	Changes
2.3	22.07.2016	Measuring Mode FT changed
2.2	07.07.2016	MTBF, SD changed
2.1	15.04.2016	QA changed
2.0	30.03.2016	Resolution changed
1.9	11.11.2015	Changes in command Q1/Q2
		Technical Data changed
1.8	24.09.2015	RS485 deleted
1.7	15.09.2015	Changes in UB command
1.6	05.03.2015	New design

I.   Content

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Used Symbols

Sign warns against emitting visible and invisible laser radiation.

Sign warns against danger of electrical power and of electric shock.

Sign warns against danger.

Sign shows information for use in hazardous environments.

Sign indicates important information regarding device use of the device.

The sign shows protection class 3 (protective extra-low voltage).

Sign indicates degree of protection (IP) of the device.

Sign informs that special guidelines had to be applied for device disposal.

1   General Information

The Laser Distance Sensor LDS30 was developed for industrial applications. It enables non-contact measurement of distances in a large working range and with a high sampling rate up to 30 kHz to almost any diffusely reflecting surface to 30 m and up to 250 m on reflectors. The sensor uses an eye-safe laser radiation at a wavelength of 905 nm (infrared).

It is available as a complete device LDS30A with various interfaces in an IP67 enclosure or as a module LDS30M for system integration. The IP67 model variant is impact and shock resistant and ideally suited for use in harsh industrial environments.

The LDS30A has an RS-232 or RS-422 interface, an analog output and 2 digital outputs. The device is easy to install and operate. The module has just a RS-422 interface with CMOS level.

The LDS30A is characterized by very compact and rugged design, easy mounting, low power, adjustable switching outputs and the ability to set user-specific parameters. This opens up a variety of uses in industrial applications.

- Rapid process monitoring
- Position monitoring
- Level measurement
- Monitoring of object movements
- Positioning of cranes and loading equipment
- Measurement of inaccessible points, for example in cavities, pipes and containers
- Particularly suitable for use in scanners

The LDS30 sensor operates on the basis of time of flight measurement. Short laser pulses are transmitted. The light pulse reflected from the target is detected by the receiver. The distance can be determined by the time shift.
The measurement range depends on the reflectivity and the surface type of the measuring target.

2   Safety advice

2.1   Basic safety advice

Please read the safety and operating advice carefully, and observe the advice when operating the device.

Danger of Laser radiation

Do not open the LDS30, otherwise Laser radiation can be emitted that can cause eye injuries. Please observe all information and guidelines for operating the Laser.

The LDS30 corresponds to Laser class 1 based on the standard IEC 60825-1:2007. The radiation of class 1 Lasers does not imply any danger to the human eye; any injury of the human eye can be excluded.

Danger, electric shock

The LDS30 may only be opened for repair purposes by the manufacturer. If the device is opened arbitrarily without authorization, all warranty claims will expire.

The **operating and storage conditions** have to be observed (see chapter 3). The inobservance of this advice and the adverse use of the device can lead to injuries of the user or to damage of the device.

Connectors may not be plugged or unplugged when voltage is applied. All installation work may only be carried out when no voltage is applied.

The device may only be **operated as intended** and in faultless condition.

Safety installations must not be rendered ineffective.

Safety and warning signs must not be removed.

Protection Class 3, low voltage

The device LDS30 operates with low voltage of DC 10 to 30 volts.

Protection degree: In accordance with the **Protection Degree IP67**, the LDS30A is protected against jet water and dust, and against short submersion into water.

When operating the device under extreme outdoor environmental conditions, the use of additional weather protection is recommended (e.g. a cover plate with a short distance to the LDS30A). Rapid temperature changes can lead to humidity entering the device.

The device is **not shatter-proof**. Do not let the device fall onto the ground, and avoid any shock.

The device is delivered in a solid cardboard box, which is suited for the transport of the device.

The device may **not be used in explosive environments**; otherwise there is the danger of damage to the LDS30 and the surrounding equipment, and of injuries of the user.

2.2   Safety advice for Laser Class 1

The LDS30 is a calls 1 Laser product based on the norm IEC 60825-1:2007. The laser radiation of class 1 Lasers does not imply any danger to the human eye; any injury of the human eye can be excluded

2.3   Advice for operating device

The LDS30 should not be put into operation when optical parts are fogged or dirty. The optical components of the equipment should not be touched with bare hands!

Dust and dirt are removed from the optical components with extreme caution! Cleaning with solvents or mechanical means is not allowed.

The device must be protected against overheating. The device will not be switched off automatically when the operating temperatures are exceeded. The persisting overheating of the device will lead to a reduced lifetime of the laser diode.

The device must be protected from impact.

The device must be protected from extreme temperature fluctuations. When extreme temperature fluctuations are occurring use additional protection housing.

It is not allowed to operate the device in explosive environments.

The device corresponds to the protection degree IP 67, and is protected against jet water and short submersion. Please observe the conditions for the protection degree IP 67, and observe especially the following advice:

- The device must not be exposed to persisting driving rain or high temperature variations.

- If the device is exposed to humidity, the temperature difference between the device and the environment may be ± 5K maximum.

It is necessary to observe the operating and storage conditions.

For the LDS30A use only a supply voltage of 10 V ... 30 V DC (direct current voltage).

The limit values for the input voltage have to be observed. Do not wire inputs as outputs. All outputs are resistant to short circuits. The housing is galvanically separated from the sensor electronics assembly. The interference resistance at electrostatic discharge (ESD) is 4 kV according to IEC 61326-1.

2.4   Norms

The device conforms to the following norms:

IEC 61326-1:2006	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements (IEC 61326-1:2006); German version EN 61326-1:2007
IEC 60825-1:2007	Safety of Laser products – Part 1: equipment classification and requirements
	(IEC 60825-1:2007), Laser Class 1
IEC 61010-1:2001	Safety requirements for electrical equipment for measurement, control and laboratory use - General requirements (IEC 61010-1:2001);
	German version EN 61010-1:2001

2.5 Disposal

For the disposal of the device, special environmental protection guidelines apply. Do not dispose the device with the usual domestic refuse. The manufacturer offers to take back the device after the end of the product life cycle, and to dispose of the product in accordance with the effective environmental protection guidelines. Please note that this service is subject to a charge.

3   Operating conditions

3.1   Electrical installation conditions

For the operation of LDS30A use only a DC voltage of 10 V ... 30 V.

The limit values for the input voltage have to be observed. Do not wire inputs as outputs.

All outputs are short circuit proof.

The housing is galvanically separated from the sensor electronics assembly.

The interference resistance at electrostatic discharge (ESD) is 4 kV according to EN 61326-1.

Table 1 : Electrical installation conditions

Electrical installation conditions of LDS30A	
Supply voltage	10 V ... 30 V DC (direct current voltage)
Power consumption	< 3 W

3.2   Operating and storage conditions

Operating temperature   0 °C … +50 °C

Stroage temperature   -40 °C ... +70 °C

Air humidity   10 % ... 90 % not condensing

The mentioned **operating and storage conditions** have to be observed. When the operating temperatures exceed the permitted values, the device will not be switched off automatically. The continuous overheating of the device will reduce the lifetime of the laser diode.

3.3   Appropriate use

The device is intended for the following applications:

Distance measurement and output of measured data via RS-232 or RS-422 interface, analogue output and digital outputs.

It should be noted:

- Operation with correct supply voltage,

- Compliance with environmental conditions, the operating and storage temperature,

- Protection of windows against fogging and soiling,

- Using data lines with specified signal levels,

- Observing of guidelines in this manual.

Measurement through optically transparent material

Measurement through optically transparent materials such as glass, optical filters, acrylic glass etc. can lead to erroneous measurement results. When measuring through optically transparent material, use the function "measurement window". By using this function due to setting a fixed measurement range, a wrong measurement - caused by an optical medium in front of the laser - may be avoided. Please take care that the surface of the medium is clean and clear.

3.4   Improperly use – error sources

The device may only be used when the safety advice described in chapter 2 is observed. The non-observance of the safety advice can lead to damages of the device or to injuries of the eyes.

To achieve correct measurement results, avoid the following error sources:

- Measurement against the sun or other intense light sources
- Measurement onto low reflective target surfaces in highly reflective environments
- Measurements onto highly reflective surfaces (mirror)
- Measurements through glass, optical filter, Plexiglas or other transparent materials can lead to measurement errors
- Two or more LDS30A may not be aligned in "frontal view" because the devices interact each other
- Operation and storage of the device under conditions that do not conform with the specifications

The operating temperatures have to be observed. The overheating of the device has to be avoided in any case. When the operating temperatures are exceeded, the device is not switched off automatically. Persisting overheating of the device leads to a reduced lifetime of the laser diode.

4   Device description

4.1   General device description

The Laser distance measurement device LDS30 is made for distance measurement onto static and moving objects with a precision down to the centimeter:

- Measurement within 0.2 m ... 30 m onto natural surfaces with reflectance > 10%

- Measurement onto reflectors (e.g. Scotchlite 3000x) at distances between 0.2 m and 250 m.

Serial interfaces

The LDS30A is equipped with either RS-232 or with RS-422 interface. The interface configuration will be made during assembly. The interface cannot be changed retroactively.

Outputs

The LDS30A has two switching outputs and an analogue output (4 mA ... 20 mA). All outputs are to be parameterized.

Module version

The LDS30M module just has a RS-422 interface with CMOS level and no other interfaces.

The module is also available as set with interface board, optionally with RS-232 or RS-422. Due to this, interface and outputs regarding the LDS30A are realized.

4.2   Technical Data

Table 2 : Technical data

Measurement properties	
Measurement principle	Laser pulse - Time of flight measurement
Measurement range [1] onto target board [2] for target reflectance >10 %	0.2 m ... 250 m 0.2 m ... 30 m
Measurement accuracy [3]	± 5 cm
Repeatability	± 2 cm
Measurement resolution	1 cm
Maximum measurement rate	30 kHz in FT mode 15 kHz in DT mode
Maximum output rate binary data output ASCII-coded data output	30 kHz in FT mode 10 kHz in DT mode 4 kHz in DT mode

Laser	
Laser protection class	Laser Class 1, IEC 60825-1:2007
Laser wavelength	905 nm (infrared)
Laser divergence	3 mrad × 1 mrad

Environmental and application conditions	
Operating temperature	0 °C ... +50 °C (standard) -20 °C … +50 °C (option –c)
Storage temperature	-40 °C ... +70 °C
Air humidity	10 % ... 90 %, non-condensing

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[1] depends on the reflection properties of the target, ambient light influence and atmospherically conditions

[2] e.g.. Scotchlite Cube 3000x

[3] for single measurement, 1 Sigma

Data LDS30A (IP 67 Device)

Serial interface	RS-232 or RS-422 [4] 9600 … 921600 Baud, 8N1, ASCII
Analogue output	4 … 20 mA Load resistance $\leq 500\ \Omega$
Switching output	2x "High-Side-switch", load up to 0.2 A
Supply voltage	10 VDC … 30 VDC
Power consumption (max.)	3 W
EMC	IEC 61000-6-2 and IEC 55011
Shock / Vibration	DIN ISO 9022-3
MTBF	44,000 h, 24/7
Weight / Protection	approximately 125 g / IP 67
Dimensions (LxWxH)	86 mm × 45 mm × 45 mm (incl. connector)
Options	Connection cable (1.5; 3; 5; 10 m), adjustment bracket, connectors, computer cable, Software LDMTool

Data LDS30M (Module)

Serial interface	RS-422, CMOS level 3,3 V 9600 … 921600 Baud, 8N1, ASCII
Supply voltage	6.5 VDC … 7.0 VDC
Power consumption (max.)	2.5 W
Weight / Protection	approximately 50 g / non
Dimensions (LxWxH)	40 mm × 40 mm × 40 mm (approx.)

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[4] Ordering information LDS30A/RS-232 or LDS30A/RS-422 (see order codes on chapter 11)

4.3   Mechanical integration requirements

The LDS30A can be fixed with 2 screws M4x50 (screw length according counterpart). The mounting screws are not included.
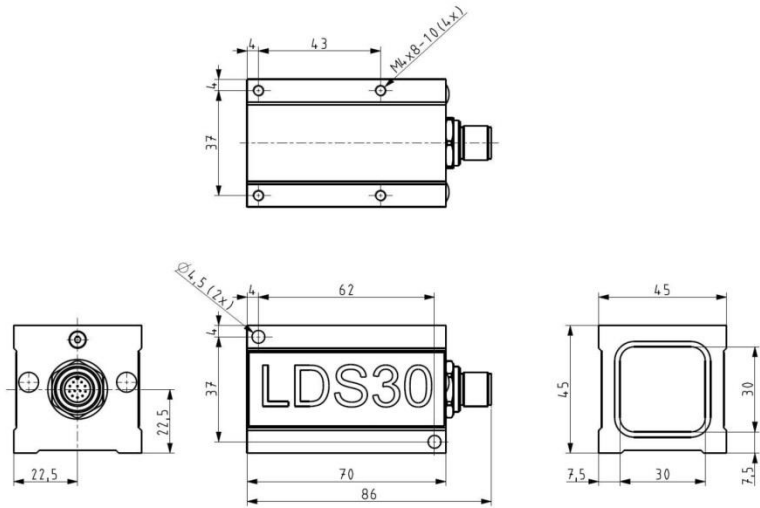
Figure 1 : Installation and mounting LDS30A (in mm)

The module LDS30M has to be fastened with 4 screws M2.5. The screw length is determined by the counterpart.
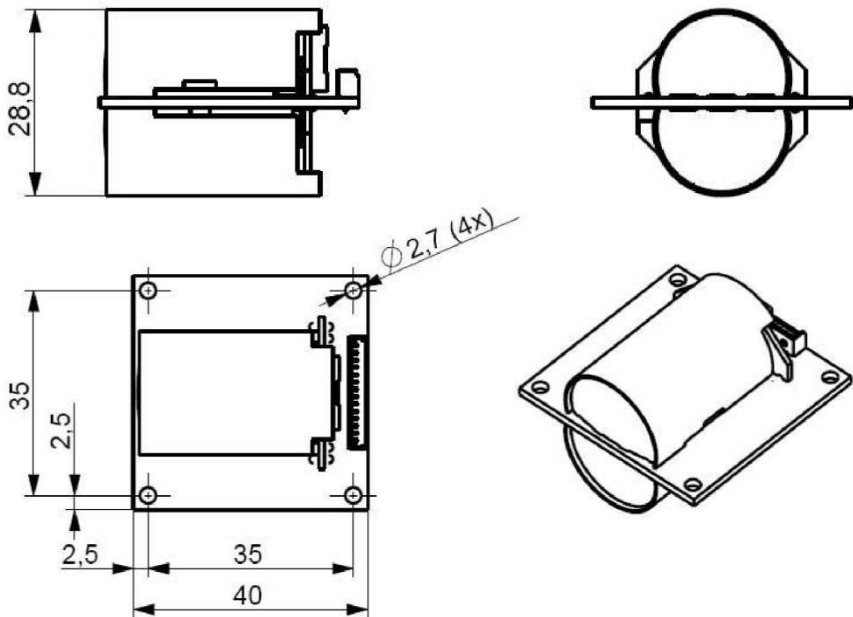
Figure 2 : Installation and mounting LDS30M (in mm)

⚠ Avoid any tension to the PCB caused by module fixing.

⚠ Zero point will be set by commands OF or SO!

4.4   Dimensions of laser spot

If the LDS30A will be mounted so that the laser diode is located vertically above the receiver APD (cover with laser warning label above), the laser spot at the target has the following sizes:

Table 3 : Dimensions of laser spot

Distance	Size horizontal	Size vertical
0,2 m	15 mm	5 mm
5 m	20 mm	20 mm
27 m	30 mm	100 mm
100 m	100 mm	300 mm
150 m	150 mm	450 mm
200 m	200 mm	600 mm
250 m	250 mm	750 mm

4.5   Connector pin assignments

The device is connected via interface cable. Various cable lengths are available.

Connector LDS30A

Table 4 : Pin assignment LDS30A

Pin	Color code	Signal	Meaning
1	brown	Q1	Switching output Q1
2	**blue**	**GND$_{Power}$**	**GND of supply voltage**
3	white	TxD	RS-232 transmission data
4	green	TX+	RS-422 transmission data +
5	pink	RX-	RS-422 receiving data -
6	yellow	TX-	RS-422 transmission data -
7	black	Q2	Switching output Q2
8	gray	RX+	RS-422 receiving data +
9	**red**	**VCC**	**Supply voltage 10...30 VDC**
10	violet	RXD	RS-232 receiving data
11	gray/pink	QA	Analog output signal
12	red/blue	GND$_{Signal}$	GND, analog output signal

⚠️ The cable shield has to be connected to GND_{Power} (Pin 2, blue). GND_{Power} is connected internally to GND_{Signal}. Open and unused cable leads must be insulated. For cable extension only high quality shielded cables has to be used.

There is a reverse polarity protection and an overvoltage protection is guaranteed up to 42 VDC.
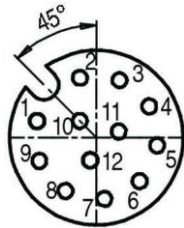
Figure 3 : Interface cable socket top view

Connector LDS30M

The device is connected via a 14-pin connector.

Table 5 : Pin assignment connector LDS30M

Pin	Signal	Meaning
1	**VCC**	**Supply voltage +6.5 ... 7 VDC**
2	**VCC**	**Supply voltage +6.5 ... 7 VDC**
3	**GND_{Power}**	**GND**
4	**GND_{Power}**	**GND**
5	RX-	RS-422 RX data -
6	RX+	RS-422 RX data +
7	TX-	RS-422 TX data -
8	TX+	RS-422 TX data +
9	BOOT	Boot pin for firmware update
10	SA2	Signal for driver High-Side-Switch 2
11	$DATA_{in}$	Current output signal for DAC data input
12	SA1	Signal for driver High-Side-Switch 1
13	SCK	Current output DAC clock signal (clock)
14	CS	Current output signal for DAC CS → LATCH

There is no internal reverse polarity protection!

Power supply of DC 6.5V ... 7.0 V has to be observed!
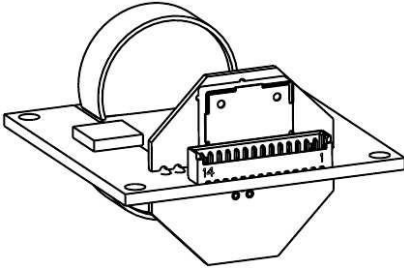
Figure 4 : Connector LDS30M

The type of the counterpart for the LDS30M connector is:

Molex PicoBlade™ Conncetor System Part-No. 51021-1400

5   Interface description

5.1   Serial interface RS-232

The RS-232 serial interface can be used for data transfer and configuration of the LDS30. The cable length is limited to 15 m. The cable length has to be shorter at baud rates of 115200 or higher. For these baud rates, we recommend only the use of the RS-422 model and the connection with 2 twisted pairs with shield.
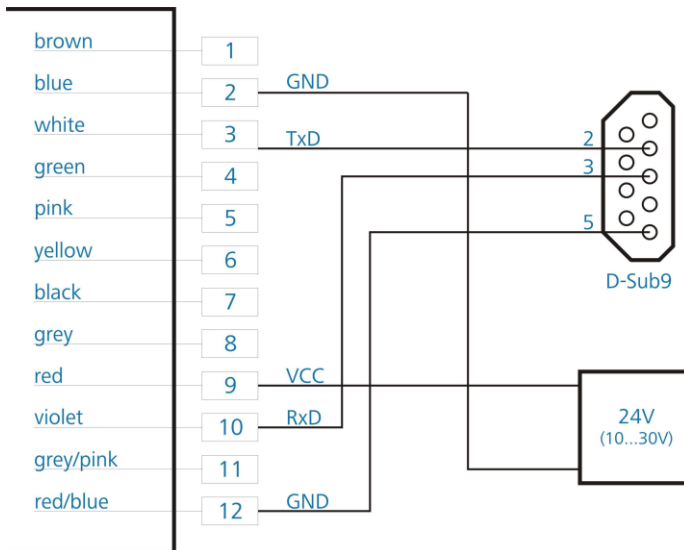
Figure 5 : RS-232 Interface of LDS30A

5.2   Serial interface RS-422

The RS-422 serial interface can be used for data transfer and configuration of the LDS30 like the RS-232. Cable length depends on the baud rate and the line quality; up to 300 m length is possible. Use only high-quality cable with 2 twisted pairs and shielding.
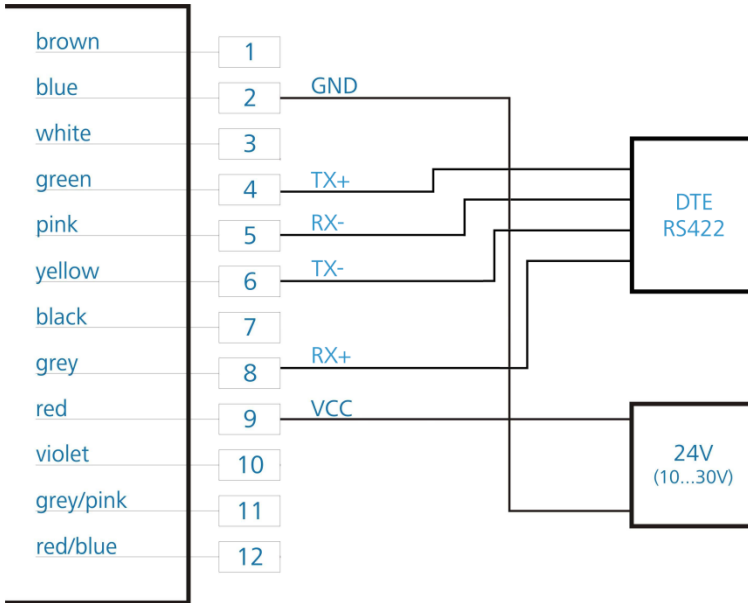
Figure 6 : RS-422 Interface of LDS30A

The sensor can not be addressed, therefore it is not bus compatible. A bus coupling (e.g. Profibus, Ethernet) is possible by converters.

5.3   Q1/Q2 – Digital switching output

Q1 and Q2 supply distance readings as logic operation data. They output events of positive or negative exceeding of a preset switching range with hysteresis.

Accordingly, they are perfectly suited for direct processing of monitored quantities such as filling level or for object detection. Parameter settings are made via serial interface.
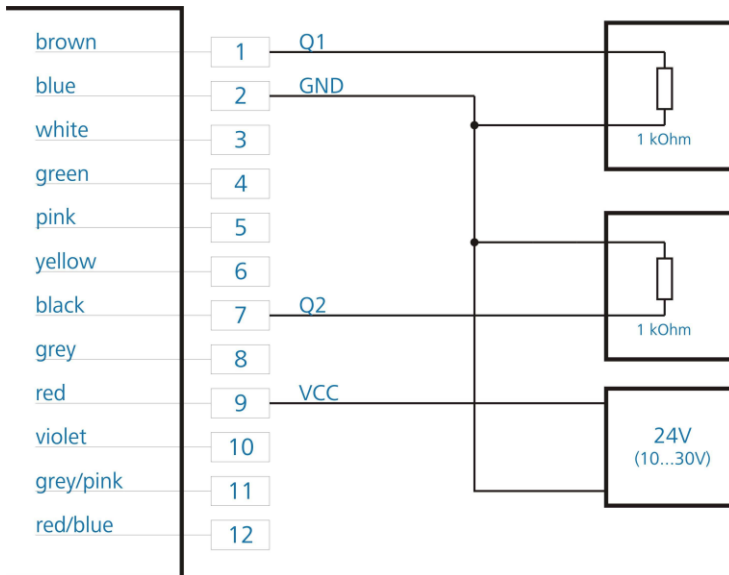
Figure 7 : Digital switching output Q1 and Q2 LDS30

⚠️ A load resistance >150 Ohms must be connected to GND$_{Power}$ at the switch output (max. 30 V operating voltage. 0.2 A max. load current). It is important that the load current of 0.2 A will not be exceeded.

Parameters will be set via the serial interface. The command is Q1w_x_y_z or Q2w_x_y_z ("_" means space (0x20)).

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Name	Description	Range
w	Switching threshold	-9999,999 ... +9999,999
x	Switching range	x ≥ 0; x ≥ y
y	Hysteresis	y ≥ 0
z	Switching level Q resp. /Q	z = 0 or 1
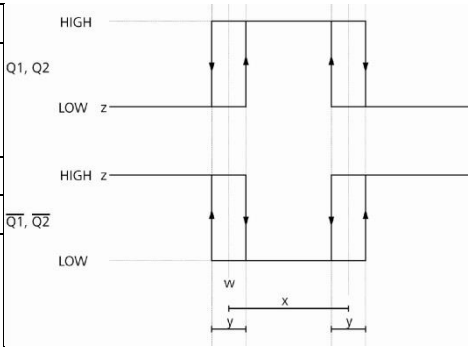
Figure 8 : Switching behavior of digital outputs

LOW = 0   U < 1 V
HIGH = 1   U = operating voltage– 1 V

⚠ There is no integrated plausibility check of the settings of Q1 and Q2.

5.4   QA – Analog output

The analog output enables the normed, analog transmission of distance data across large distances using a two-wire line. The current of 4 mA to 20 mA impressed in the line is proportional to the measured distance within an adjustable distance interval. Parameterization is done via the serial interface.

Properties of the analog output:

- Measuring value output range 4 mA ... 20 mA
- Indication in case of an error: 3 mA or 21 mA (selectable via the parameter SE)
- Resolution: 16 bit DA-converter
- Load ≤ 500 Ohm/0,5W

Value	Description	Specification
x	Lower Limit	x ≠ y
y	UpperLimit	y ≠ x
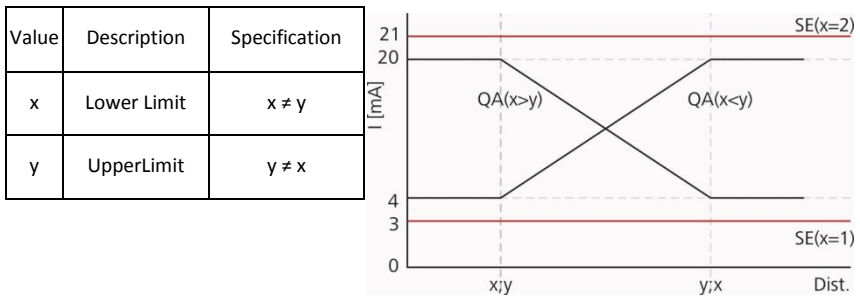
Figure 9 : Signal diagram of LDS30 analog output

The value of output current (mA) is calculated as follows:

x < y
$$QA[mA] = 4\ mA + 16 * \frac{Dist.-x}{y-x} * mA$$

x > y
$$QA[mA] = 20\ mA + 16 * \frac{Dist.-x}{x-y} * mA$$

Figure 10 : Behavior of analog current output

There is no plausibility check of the settings of the analog output QA in the LDS30.
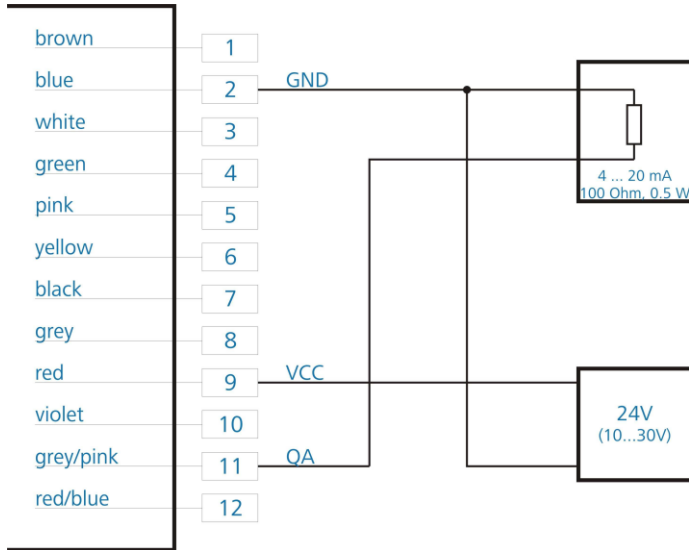
Figure 11 : Wiring analog output QA of LDS30A

For current-to-voltage conversion a load resistance ≤ 500 Ohm between output QA and GND_{Signal} is necessary. Normally, a measuring resistor of 100 ohms / 0.01 % / 0.5 W is used.

Please do not use the analog output for fast processes with high distance changes.

The typical settling time for a jump between 4 mA and 20 mA will be 2.5 ms (max. 3 ms).

6   Start-up LDS30A

6.1   Preparation of start-up

- Remove the packaging of the LDS30A

- Check scope of delivery for completeness

- Check device and accessories for damages

- Check connections and cables for damages

6.2   Start-up checklist

The following table shows an example procedure for commissioning the LDS30A. The table raises no claim of being complete. The application-specific wiring is required. The user is responsible for the installation of the application-specific wiring.

Table 6 : Start-up LDS30A

Nr.	Work step
1	Unpack the LDS30 and check for damages.
2	Mount LDS30A with 4 x M4 threaded holes or with two holes of 4.5 mm (see 4.3).
3	Plug-in interface cable only if there is no voltage impressed; bolt the cable tightly.
4	Switch-on supply voltage and check current consumption
5	Parameterize LDS30A with PC program LDMTool via RS-232 or RS-422.
6	Align LDS30A to the target, using a **refection foil and the signal strength display**.
7	Fix the LDS30A
8	Program auto start parameter AS (e.g. command AS DT)
9	Start distance measurement (e.g. command DT)
10	Read out and save parameter to disk

Before switching on the power supply make sure that all cable ends are protected against short circuits!

Connect cable terminals as required for the particular operating mode. To prevent short circuits, seal unused cable ends!

For starting-up, a PC with RS-232 or RS-422 data interface and a terminal program are required. We recommend the Windows program LDMTool Version 4.8 or higher (see Figure 17 Program LDMTool).

RS-232 to USB converter are available optionally.
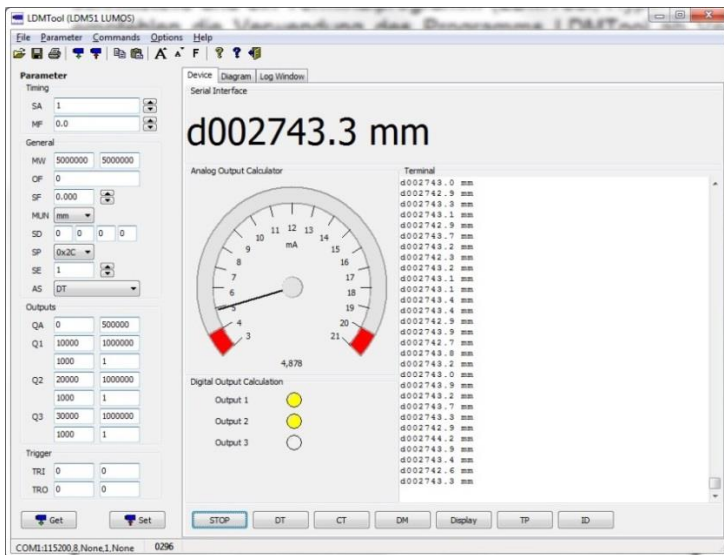
Figure 12 : Program LDMTool

7   Description of commands

7.1   Overview of commands

Table 7 : Overview of commands

Command-Class	Command	Description	Standard(s)	Range(s)
Operation Mode	DM	Single distance measurement	-	-
	DT	Distance tracking	-	-
	FT	Fast distance tracking	-	-
Status	TP	Device temperature in °C	-	-
	PA	Display of all parameters	-	-
	HW	Hardware diagnostics	-	-
Setup Parameter	PR	Reset to factory settings	-	-
	DR	Triggers a cold start	-	-
	ASs	Autostart function	DT	ID, ID?, DM, DT, FT, HW, PA, MF, SA, MW, OF, SE, Q1, Q2, QA, BR, SD, TE
	MFx	Measuring frequency [Hz]	15000	1 … 15000
	GNx	Receiver gain	0	0 … 3
	SAx	Average	1500	1…30000
	MWx y z	Measurement window with lower and upper limit	0 270.000	± float 32 ± float 32

Command-Class	Command	Description	Standard(s)	Range(s)
		Error output outside of MW	0	0 = enabled, 1 = disabled
	OFx	Distance offset	0.000	± float 32
	SO	Single distance measurement and set as distance offset	-	-
	SEx	Error mode for Q1, Q2 and QA	1	0 … 2
	QAx y	Analog output with lower and upper limit	0 1.000	± float 32 ± float 32
	Q1w x y z	Q1 switch output: switching threshold, switching range, switching hysteresis and state level	*0.000* *1.000* *0.500* *1*	-9999,999 … + 9999,999 0.001 … + 9999,999 0.000 … + 9999,999 0 or 1
	Q2w x y z	Q2 switch output: switching threshold, switching range, switching hysteresis and state level	0.000 1.000 0.500 1	-9999,999 … + 9999,999 0.001 … + 9999,999 0,000 … + 9999,999 0 or 1
	BRx	Baud rate	115200	9600, 19200, 115200, 230400, 460800, 921600
	SDx y	Serial port output format	0 0	0 … 2 0 … 3
	UBx	Unit for binary output	10000	0.001 … float32, resolution 0.001
	TEx	Serial interface output terminator	0	0 … 9

7.2   Transmission protocol RS-232 and RS-422

- Interface settings: asynchronous, 8 data bits, no parity,
  1 stop bit
- Transmission protocol format/syntax: 7-bit-ASCII
- Proprietary communication protocol
- Commands are case-insensitive (No distinction between lower and upper case)
- Period "." (0x2E) serves as decimal separator for output of numbers.
- Enter (0x0D) is used as command (send command) termination character
- With mulit-value parameters, space (0x20) is used to separate values
- As parameterization command with new parameters triggers a response command with these parameters
- A parameterization command with without new parameters triggers a response command with (most recent) parameters.
- A parameterization command with parameters out of valid setting ranges triggers a response command with (most recent) parameters
- An unknown command and a faulty parameter format are quitted with "?" (0x3f)

7.3   Operating modes

DM – Individual distance measurement

The LDS30 carries out exactly one measurement and waits for new commands.

The duration of the measurement depends on the number of the set measuring values SA and the preset measuring frequency MF.

$$\text{Measuring time in seconds} = SA / MF$$

Sample response to the input of DM (SD0 3):

D<SPACE>0002.935<SPACE>21.1<SPACE>57.8<CR><LF>

Output format	=	decimal (D)
Distance value	=	2,935 m
Signal quality	=	21,1
Temperature	=	57,8 °C

DT –Distance tracking

Continuous distance measurement stopped by certain command (RS-232/RS-422: Escape = 0x1B).

The output rate of the measurement depends on the number of set measurement values SA and the set measurement frequency MF:

$$\text{Measurements per second} = MF / SA$$

The maximum output data rate depends on the output format and the selected measurement rate. With binary output the maximum output rate is 10 kHz

The maximum output rate with ASCII-coded output and different values for SA at MF = 15.000 can be seen in Figure 13.

Output rate
[distance values /s]

SD 0 0 ■SD 0 1 □SD 0 2 □SD 0 3
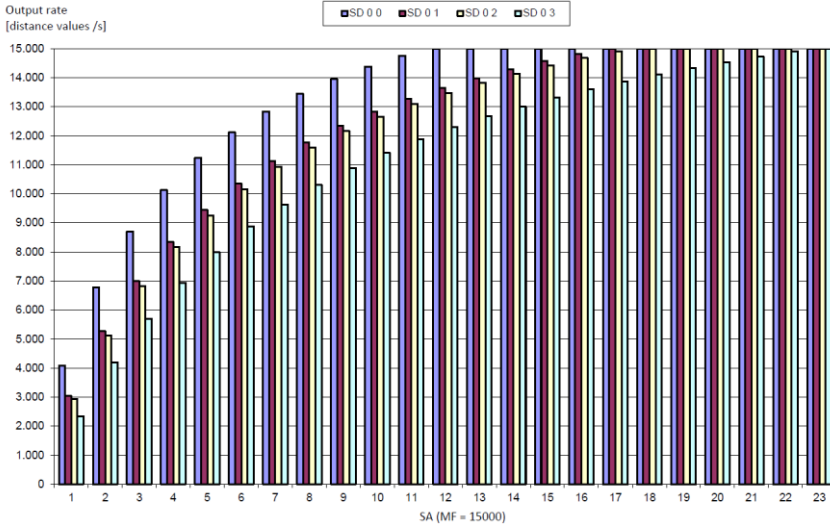
SA (MF = 15000)

Figure 13 : Maximum output rate at MF = 15.000

FT – Fast Distance Tracking

In fast distance tracking mode measurements are performed at a frequency of 30 kHz.

Measured data can be output in binary format only. The baud rate has to be set to 921600 baud!

⚠️ Caution: Some computer cannot handle baud rates >115200.

If you set by the command BR921600 the baud rate, no communication will be possible without a compatible interface. The baud rate cannot be reset to a lower value without a proper hardware!

The current measurement can be terminated with the character ESC = 0x1B.

⚠️ Distances >160 m causes incorrect distance measurements while using the FT distance measurement mode.

The following parameters are fixed in the FT mode:

>   Measurement frequency: MF 30000 Hz
>   Average values SA 1
>   Output format SD binary (distance value, 2 bytes)

Parameter UB (Unit for binary output) will be used and can be parameterized. Please note the maximum distance range! The manually set parameter MF / MW / SA / SE / QA / Q1 / Q2 / SD / TE not will be used.

⚠ Analog output and the switching outputs are not active.

Explanation of the binary output format for the distance value:

2 Byte, MSB = Bit 7
MSB of Byte 1 is always **1**
MSB of Byte 0 is always **0**
Data in each byte = Bit 6 … Bit 0
Coding: complement on two
Conversion binary to decimal: ***1/100**

Binary structure:

	Byte 1 Distance								Byte 0 Distance							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Data	1	x	x	x	x	x	x	x	0	x	x	x	x	x	x	x

Example:

Distance value	**1** 0 0 0 0 0 1 0 **0** 1 0 1 0 0 1 0	**:100** = 3.38m

Figure 14 : Binary data output in mode FT

7.4   Identification commands

ID – Identification

The LDS 30 responds to the command ID by showing its manufacturing data, like type, firmware version, etc.

Example: LDS30 1.4.0 01.02.2012 12:00 SN 110001 10.01.2012 14:33
            (Type, firmware version, or other - information may vary)

ID? — Online help

By entering the command ID? the user will obtain an overview of all available operations and parameters described in the following sections.

Operation Mode
DM[Enter]…..………………....   single distance
DT[Enter]…..…………............   continuous distance
FT[Enter]……...........................   fast continuous distance
Status
TP[Enter]…..…………………   internal temperature ['C]
HW[Enter…..……………………   hardware status
PA[Enter]……...........................   display parameter
Setup Parameter
PR[Enter]……...………………   reset parameter
DR[Enter]………………………..   reset device
AS[Enter]/ASs[Enter]………….   display/set autostart command
MF[Enter]/MFx[Enter]…...........   display/set measure frequency
GN[Enter]/GNx[Enter]...............   display/set receiver gain
SA[Enter]/SAx[Enter]………….   display/set average value
MW[Enter]/MWx y z[Enter]….....   display/set measure window
OF[Enter]/OFx[Enter]………….   display/set distance offset
SO[Enter]……………………….   set current distance to offset
SE[Enter]/SEx[Enter]……….....   display/set error mode
Q1 [Enter]/Q1w x y z[Enter]…..   display/set digital out Q1
Q2[Enter]/Q2w x y z[Enter]……   display/set digital out Q2
QA[Enter]/QAx y[Enter]…...…..   display/set analog out QA
BR[Enter]/BRx[Enter]….....…..   display/set baud rate RS-422
SD[Enter]/SDx y[Enter]............   display/set output format RS-422
UB[Enter]/UBx[Enter]...............   display/set unit for binary output [in mm]
TE[Enter]/TEx[Enter]...............   display/set terminator RS-422

Figure 15 : Output of the ID? command

7.5   Status commands

TP – internal temperature

The LDS30 outputs its internal devices temperature via serial interface. The temperature unit is degree Celsius (° C).

Example: TP 044.1

⚠️ The internal device temperature does not correspond to the specified operating temperature! The ambient temperature (operating temperature) has to be kept. There is no automatic shutdown of the LDS30 in case of crossing the temperature range limits.

PA – Parameter setting

A list of all parameters is output via the serial interface.

Example:

```
measure frequency[MF]................    15000(max15000)Hz
average value[SA].......................    1500
measure window[MW]..................    -270.000 270.000 0
distance offset[OF]......................    0.000
error mode[SE]...........................    1
digital out[Q1]..............................    2.000 1.000 0.050 1
digital out[Q2]..............................    2.000 1.000 0.050 1
analog out[QA].............................    0.000 1.000
receiver gain[GN]...................    0
RS-422 baud rate[BR]....................    115200
RS-422 output format[SD].............    dec (0), value (0)
unit for binary output[UB]..............    10.000
RS-422 output terminator[TE]….....    0Dh 0Ah (0)
autostart command[AS]................    DT
```

Figure 16 : Output of the PA command

HW – Hardware status

A device-specific list of characteristics and measurement variables will be shown. Explanation of the items in the hardware status:

Item	Meaning
Error Code	Error message
Temp extern	Temperature in electronic environment
Temp intern	Temperature controller board, internal
Ref intern	Reference voltage controller, internal
Clock Ratio	Crystal generators, control reference number

Example:

```
Error code .........   0000
Temp extern …..   52.7°C (max 52.9°C)
Temp intern …...   58.0°C (max 59.2°C)
Ref intern ….......   1209mV
Clock Ratio ….....   1635
```

Figure 17 : Data output of command HW

7.6   Command for parameter setup

Parameters are set via serial interface. The command will be transferred to the LDS30 with the final character 0x0D.

If commands have only one parameter, the parameter will be inserted directly or separated by a blank space (0x20).

If commands have several parameters, these parameters will be separated by a blank space (0x20).

AS – Auto start function

The auto start function defines the behavior of the LDS30 after a cold start. After the start, the LDS30 carries out the set commands automatically and sends the data via the serial interface.

Query:	AS
Set:	Ass
Value range parameter s:	ID, ID?, DM, DT, FT, HW, PA, MF, SA, MW, OF, SE, Q1, Q2, QA, BR, SD, TE
Standard:	DT

The total time between switching on the supply voltage and the output of the first measured value is max. 750 ms.

BR – Baud rate

BR enables the adjustment of the serial baud rate x.

There is no cold start necessary after changing the baud rate!

Query:	BR
Set:	BRx
Range of parameter x:	9600, 19200, 115200, 230400, 460800, 921600
Standard:	115200

⚠️ Setting a very high baud rate implies a risk. Some computers cannot support baud rates >115200.

If the baud rate is set by command BR460800, communication is no longer possible without a compatible interface, i.e. the baud rate cannot be reset to a lower value without hardware that supports this baud rate!

We recommend the use of a suitable USB interface converter (RS-232 to USB converter or RS-422 to USB converter that supports the appropriate baud rate) and baud rates of 230400, 460800, 921600 for parameter setting and reset to a lower baud rate.

PR – Parameter reset

All parameters are reset to factory settings, except the baud rate! We <u>do not recommend to use this command</u>. Afterwards the device must be programmed new (auto start, scaling analogue and output etc.).

Example:

```
measure frequency[MF]      10000(max 15000)hz
average value[SA] ...................1000
measure window[MW]...............-270.000 270.000 0
distance offset[OF]...................0.000
error mode[SE] ........................1
digital out[Q1] ..........................0.000 1.000 0.050 1
digital out[Q2] ..........................0.000 1.000 0.050 1
analog out[QA]..........................0.000 1.000
receiver gain[GN]……………0
RS-232/422 baud rate[BR]........115200
RS-232/422 output format[SD]..dec (0), value (0)
unit for binary output[UB]....... ...10.000
RS-232/422 output terminator[TE]      0Dh 0Ah (0)
autostart command[AS] ............ID
```

Figure 18 : Reset to factory settings by command PR

DR – Release of cold start

DR carries out a cold start of the LDS30 and actually simulates an interruption of the supply voltage. This command is useful for a test if "Autostart"-command was changed for example.

MW – Measurement window

The LDS30 outputs only measurement results inside the set measurement window, starting with x and ending with y.

The measurement window is used e.g. for:

- Blanking out interfering objects before and behind a measurement range
- Setting an specific measurement range

The object detection in front of or behind a measurement window will result in either the output of an error message output or no output at all, according to the settings of parameter z of MW.

Query:	MW
Set:	MWx y z
Range of parameter x:	float32; resolution: 0.001
Range of parameter y:	float32; resolution: 0.001
Range of parameter z:	0, 1
Standard	-270.000 270.000 0

There is no plausibility test of the set measurement window; the user itself is responsible for correct parameter setting!

MF – Measuring frequency [Hz]

Command MF sets the number x of single measuring pulses per second.

Query:	MF
Set:	MFx

Range of parameter x:	0.0 … 15000; Resolution: 1
Standard:	15000

For example: MF10000 means that 10.000 single measurement pulses per second are sent. The measuring time and the transmission of the measurement result via a serial interface also depend on the parameter SA (averaging, see page 45):

Output time in seconds = SA / MF

OF – Offset

With OF, the user-specific offset x will be parameterized. This value will be added to the measurement value.

Query:	OF
Set:	OFx
Parameter value range x:	float32; resolution: 0.001
Standard:	0.000

There is no plausibility test of the set offset; the user itself is responsible for correct parameter setting!

SO – Set Offset

With the command SO, a single distance measurement is carried out and the result will be set as OF (Offset). SO can only be executed, in this way, it is not a parameter in the strict sense. SO is used for the zero-adjustment onto the current distance.

SA – Average value

SA sets the number x of all single measurements to be averaged for one measurement output. SA is directly related to MF (see also page 44):

Output time in seconds = SA / MF
          or
Output frequency in Hz = MF / SA

Query:	SA
Set:	SAx
Range of Parameter x:	1 … 30000; resolution: 1
Standard:	1500

The dispersion of the measured values can be reduced by calculating the mean value:

$$\sigma_{SA} = \frac{\sigma_1}{\sqrt{SA}}$$

The following applies:

σ_{SA} Dispersion after mean value calculation

σ_1 Dispersion of single measured value (approx. 5 cm)

SA   Number of averaged single measurements

Table 8 : Scattering of distance measurement

f [Hz] = MF	SA	Output frequency [Hz]	σ_{SA} [cm]
15000	1	15000	5
15000	10	1000	1.6
15000	100	500	.5
15000	1000	15	0.2
15000	1500	10	0.13

SE – Error Mode

SE sets the behavior x of switching outputs Q1 and Q2 and of analogue output QA in case of faulty measurements as well as the state after carrying out a single distance measurement. The switching behavior of Q1 and Q2 depends on parameter z (logical behavior, see page).

Query:	SE
Set:	SEx
Range of	0, 1, 2 (Table 9 : Error Mode SEx, meaning of parameter

parameter x: x)

Standard: 1

Table 9 : Error Mode SEx, meaning of parameter x

x	Q1, Q2 (z=0)	Q1, Q2 (z=1)	QA
0	Last value	Last value	Last value
1	High	Low	3 mA
2	Low	High	21 mA

⚠ There is no plausibility check of the preset error mode. The user itself is responsible for correct parameter setting!

Q1/Q2 – Switching output

Q1/Q2 parameterizes the behavior of the switching outputs:

w   begin of measurement range within the output swichtes
x   length of measurement range within the output switches
y   hysteresis and
z   logical behavior

Query:	Q1 or Q2
Set:	Q1w x y z / Q2w x y z
Switching threshold w:	-9999.999 ... +9999.999
Switching range x:	+0.001 ... +9999.999; x > 0; x > y
Switching hysteresis y:	0.000 ... +9999.999; y ≥ 0
Switching state z:	0 or 1
Standard:	0.000 1.000 0.050 1

⚠ There is no plausibility check of Q1 and Q2. The user itself is responsible for correct parameter setting!

GN – Receiver Gain

GN parameterizes the gain of the received input signal in 4 steps.

Query:	GN
Set:	GNx
Range x:	0, 1, 2, 3
Standard:	0

The best setting for most applications is receiver gain step 0.

Advantages of GN > 0:	Measurements on bad reflecting surfaces are possible
Disadvantages of GN >0:	More disturbances lead to decreased accuracy

QA – Analog output

QA sets the behavior of the analog output QA (see chapter 5.4).

The lower limit x and the upper limit y of the 4 to 20 mA current range are controlled by QA. The lower limit may be smaller or may be larger than the upper limit. Accordingly the current range is reserved.

Settings of equal limits will be ignored and not stored.

Query:	QA
Set:	QAx y
Range of parameter x:	float32; resolution: 0.001
Range of parameter y:	float32; resolution: 0.001
Standard:	0 1.000

⚠ There is no plausibility check of QA. The user itself is responsible for correct parameter setting!

The measurement window MW is also valid for the analog output (see page 44).

SD – Output format serial interface

SD sets the format x and content y of the output string of the serial interface for distance and speed measurements. The format can be decimal (ASCII), hexadecimal (ASCII) or binary.

Query:	SD
Set:	SDw x y
Range of parameter w:	0, 1, 2
Range of parameters x,y,z:	0, 1, 2, 3 (see Table 10)
Standard:	0 0 0 0

Table 10 : Serial output format SDy, meaning of parameter y

y	SD0 y Decimal	SD1 y Hexadecimal	SD2 y Binary
0	Measurement value	Measurement value	Measurement value
1	Measurement value, Signal strength	Measurement value, Signal strength	Measurement value, Signal strength
2	Measurement value, Temperature	Measurement value, Temperature	Measurement value, Temperature
3	Measurement value, Signal strength, Temperature	Measurement value, Signal strength, Temperature	Measurement value, Signal strength, Temperature

⚠️ The output format SD1 (hexadecimal) is not available in firmware version 1.4.0!

The output format and the baud rate determine the maximum output rate of the measured values. If the measuring frequency becomes too high, results of some measurements will not be outputted.

Explanation binary output format

Distance value:

2 Byte, MSB = Bit 7
MSB of Byte 1 is always **1**
MSB of Byte 0 is always **0**
Measurement data = Bit 6 ... Bit 0 of each Byte
Coding: Two's compliment
Scaling factor from binary to decimal values: ***1/100**

Binary Structure:

	Byte 1 Distance								Byte 0 Distance							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Data	**1**	x	x	x	x	x	x	x	**0**	x	x	x	x	x	x	x

Signal strength:

1 Byte
MSB = Bit 7
MSB of Byte 0 is always **0**
Measurement Data = Bit 6 ... Bit 0
Scaling factor from binary to decimal values: ***2**

Binary Structure:

	Byte 0 Signal						
Bit	7	6	5	4	3	2	1
Data	**0**	x	x	x	x	x	x

Temperature:

1 Byte
MSB = Bit 7
MSB of Byte 0 is always **0**
Measurement Data = Bit 6 ... Bit 0
Conversion from binary to decimal values: **-40**

Binary Structure:

	Byte 0 Temperature						
Bit	7	6	5	4	3	2	1
Data	0	x	x	x	x	x	x

Example:

Distance	**1** 0 0 0 0 0 1 0	**0** 1 0 1 0 0 1 0	**:100** = 3,38m
Signal	0 0 0 0 1 0 1 1		***2** = 22
Temperature	0 1 0 1 1 1 0 1		**-40** = 53*C

Figure 19 : Binary data output at SD2 3

UB – Unit for binary output format

UB sets the scaling factor for the binary output format.

Query:	UB
Set:	UBx
Value range x:	0.001 … float32; resolution 0.001
Standard:	10.000

UB influences all outputs in binary format independent from the current measurement frequency. The value for UB means the distance for one bit of the binary output format.

Example:	UB 0.001 = 1 µm / bit
	UB 10.000 = 10 mm / bit = 1 cm / bit
	Binary distance value = Distance (mm) / UB

TE – Terminator of the serial interface

TE is used to set the terminator for the output of measured values in the ASCII format (also see command SD).

Query:	TE
Set:	TEnn
Range of parameter x:	0 … 9; (Table 11)
Standard:	1

Table 11 : Termination character(s) TEx, meaning of parameter x

x	0	1	2	3	4	5	6	7	8	9
Hexcode	0x0D 0x0A	0x0D	0x0A	0x02	0x03	0x09	0x20	0x2C	0x3A	0x3B
Description	CR LF	CR	LF	STX	ETX	Tabu-lator	Space	Komma	Colon	Semi-colon

When an invalid character is entered, it will not be set. The current separator will be kept instead.

8   Maintenance

8.1   Maintenance by the user

Please note:

- Dust on optical glass surfaces (transmitter and receiver optics) can be removed with a blower brush. Don't clean glass surfaces using cleaning agents containing organic solvents. In case of heavy pollution, please contact the manufacturer.

- Isopropyl alcohol is suitable for cleaning the device. Do not use any solvents.

- Do not open the device, otherwise the warranty obligations shall cease to apply.

- Do not loose any screws of the device.

8.2   Firmware update

Firmware updates of the sensor electronics of the LDS30 may only be done by the manufacturer.

8.3   Repair

In case of necessary repair, send the device to your dealer or to the manufacturer. Ensure the safe packaging and provide information about the conditions of use (application, installation, environment, etc.)

9   Malfunction and error messages

Table 12 : Malfunction

Error	Cause	Action for removal
No data via RS-232 or RS-422	Faulty interface configuration	Check interface configuration
Device error (Ext. Diagnosis)	Hardware problems	Send LDS30 for repair, Contact technical support

Table 13 : Error codes

Code	Cause	Action for removal
DE02	No target	Observe measurement distance
DE04	Hardware Error	Send LDS30 for repair, Contact technical support
DE06	Operating temperature range exceeded	Environmental temperature increase or decrease
DE10	Laser diode voltage too low (This Error is always sent by serial interface if the switched off while measuring)	Restart the device

10   Accessories (Options)

10.1   RS-232 cable for LDS30A/RS-232

For parameter setting an optional programming cable is available to link the LDS30 with a PC (COM port, RS-232). The use of the PC software LDMTool is recommended.

Table 14 : Pin assignment of programming cable PC sided

Pin SUB-D 9 F	Color code	Meaning SUB-D 9 F (RS-232, PC COM)
Shield	-	Cable shield
3	brown	TxD
2	white	RxD
5	blue	GND

Table 15 : Pin assignment of programming cable LDS30 sided

Pin LDS30	Color code	Meaning LDS30
Shield	-	Cable shield
3	white	TxD
10	violet	RxD
2	blue	GND
9	red	VCC (+10 V … +30 V DC)
L	grey/pink	GND

⚠ Please use only high quality shielded cable.

RS-232 cable: **TxD and RxD have to be crossed**.

10.2   Connection box TCBS30A

A junction box with built-in terminal block and accessories is available optionally.

10.3   Adjustment bracket JW51x

The adjustment bracket enables the alignment of the device to the target. It allows a rotation of ±5° in two axes.

10.4   Software LDMTool from version 4.8

A demo version of the software LDMTool is included in the delivery. By purchasing a license number, the software becomes a full-version. Parameter setting and numerical display of measured vales are available also with the demo version (see Figure 12 : Program LDMTool).

11   Part numbers

Table 16 : Part numbers

Part-No.	Name
10-2050-00	LDS30A-RS-232
10-2051-00	LDS30A-RS-422
10-2034-00	LDS30M (Module)
10-2043-00	LDS30M + Interface board with RS-232
10-2043-01	LDS30M + Interface board with RS-422
11-2000-00	Power Supply 24V, 1A, Euro 1m
11-0001-00	USB-RS-232 Interface converter; 0.2m; max. 460800 Baud
12-2001-02	Junction box for LDS30A
12-2018-00	Adjustable mounting bracket for LDS30A
12-2026-00	Protective housing for LDS30A
15-2001-00	RS-232 cable D-SUB9F/Terminal., 2m
15-2006-00	Interface cable LDS30A, 1,5m
15-2006-01	Interface cable LDS30A, 3m
15-2006-02	Interface cable LDS30A, 5m
15-2006-03	Interface cable l LDS30A, 10m
12-2010-00	Reflective foil matt white, A4
12-2011-00	Highly reflective foil silver, A4
11-0006-00	ASTECH USB Stick (Documentation and Software)
17-2000-00	License number for PC Software LDMTool

Note: Several sensors are available as packages including sensor, cable, manual and software (Set).

12   EG Declaration of conformity

$C \epsilon$

We herewith declare, represendted by the signatories, that the following designated product

Laser distance sensor

LDS30A

agrees with the Directive of Electromagnetic Compatibility 2004/108/EG.

The following harmonized standards were considered:

IEC 61326-1:2005	Electrical equipment for measurement, control and laboratory use, EMC requirements Part1: General requirement (IEC 61326-1:2005); German Version EN 61326-1:2006
IEC 60825-1:2007	Safety of Laser products - Part 1: Equipment classification and requirements (IEC 60825-1:2007); German Version EN 60825-1:2007; Laser Class 1

Rostock, 5. August 2014

ASTECH Angewandte Sensortechnik GmbH

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