Manual

LDM42A

Version 3.5

CE

Dear User,

You are advised to read this User Manual carefully before powering on the LDM42A Laser distance measuring sensor for the first time.

This is necessary to ensure that you will be able to utilize all the capabilities and features which your new acquisition provides.

This technology is subject to continuously ongoing development.

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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 failure to comply with the information contained herein.

Revisions history

Manual Version	Date	Changes
3.5	25.09.2026	LDM42A only
3.4	08.01.2016	Fig. 10 updated, MTBF E19 added
3.3	16.03.2015	New design

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I. Content

II. List of Figures

III. List of Tables

1 General

The LDM42A is an opto-electronic Laser sensor device for contact-less distance measurements. It can be easily integrated in complex measurement and control systems.

The LDM42A performs over a distance range from 0.1 m to 150 m with pinpoint accuracy. The measurement frequency is variable up to 50 Hz. The LDM42A is made for outdoor use even under harsh environmental conditions and high amounts of ambient light. For target surfaces with less reflection the usage of high reflective foils and reflectors is recommended.

The sensor uses a comparative phase measurement principle. It emits modulated Laser light which is diffusely reflected back from the target with a certain shift in phase to be compared with a reference signal. The amount of the phase shift determines the distance to the target with millimeter accuracy.

Parameterization and data logging are done via serial interface and a PC program.

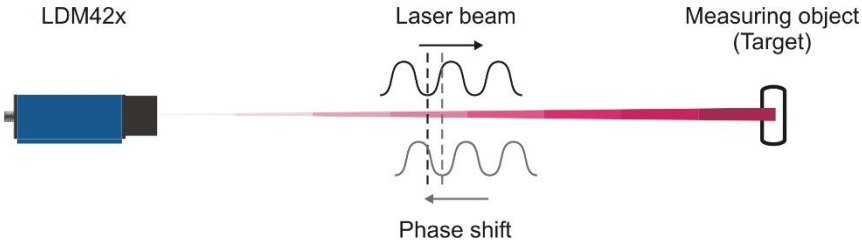


Figure 1: Measurement principle

Special performance features are:

- Provides high accuracy and great reach under extreme outdoor temperatures.
- Works in a wide range of operating voltages from 10 V= to 30 V= from an on-board vehicle supply point, an industrial direct voltage supply net or a DC power supply unit.
- Features consistently low power consumption of <1.5 W[1] (without I_{Q1}).
- Up to 30 m reach for distance measurement, with potential for more than 100 m reach if additional reflectors[2] are mounted onto the target (depending on reflectance and environmental conditions).
- Visible Laser beam for easier sighting.
- Serial interface to control measuring functions and commands as well as output of measured values to a PC or a laptop.
- Switching output and analog output can be parameterized separately.
- Switching output with adjustable limit and hysteresis.
- Measured values can be displayed in meters, decimeters, centimeters, feet and inches due to.
- Option for remote triggering of a measurement from an external trigger device.[3]

[1] inactive internal heating for devices with internal heating (Option -h)
[2] e.g. 3M, self-adhesive foil white non glossy or foil 3290 for longer distances
[3] Trigger function is not available for devices with internal heating (LDM42A-h)

2 Safety Instructions

2.1 General Safety Instructions

These safety and operating instructions should be carefully read and followed during practical work with the LDM42A.

There is danger of Laser radiation or electrical shock.

For necessary repair work, the LDM42A may not be opened by anyone other than manufacturers personnel. Unauthorized intervention into the inner product space will void any warranty claims.

Compliance with all specified operating conditions is necessary.

Failure to observe advisory notes or nonconforming product usage may cause physical injury to the user or material damage to the LDM42A.

Cable connectors must not be plugged or unplugged under voltage. Remember to turn voltage supply off before you begin working on cable connections.

2.2 Intended & Conforming Use

- Measurement of distances
- Special measuring functions
- Compliance with prescribed temperatures for operation/storage
- Operation at correct voltage level
- Application of specified signal levels to the appropriate data lines

2.3 Non-conformal use

- Do not operate the LDM42A in any other way than described under "Intended & Conforming Use" above and only in a proper working condition.
- Safety devices must not be defeated or otherwise rendered ineffective.
- Information and warning signs must not be removed.
- Repair work on the LDM42A must not be carried out by anyone other than authorized personnel.
- It's not allowed to use the LDM42A in hazardous environments without certified protection equipment.
- Measurements with the LDM42A pointing directly towards the sun or other strong light sources may produce faulty results.
- Measurements of targets with poor surface reflectance in a strongly reflecting environment may also result faulty measurements.
- Measurements of strongly reflecting surfaces may deliver faulty results.
- Measurements performed through transparent optical media, for example glass, optical filters, Plexiglas, etc. may equally produce incorrect results.
- Measurement on translucent objects (materials allow light to pass through, but are not transparency, e.g. polystyrene, wax, different plastics etc.) can give a too large measured value, since also light is reflected by deeper layers.
- Rapidly changing measuring conditions are likely to falsify the result of measurement.

2.4 Laser Classification

The LDM42A is a Class 2 laser product according to norm EN60825-1:2014.

Figure 2: Warning Sign Laser Radiation Class 2

The Laser power is limited to maximum 1 mW. The Laser radiation is visible but harmless under expectable conditions.

Although, please follow these advices when using the LDM42A:

- Do not stare into the beam exit of the LDM42A
- Do not open the housing of the LDM42A by your own
- Do not observe the laser beam with optical instruments
- Do not direct the Laser beam onto persons.

The sensor can be used without any additional safety protection.

2.5 Electric Supply

Use only 10 V to 30 V DC (direct voltage) for LDM42A operation. Use only the specially designated connector terminal for voltage supply.

Specified signal levels must not be exceeded, in order to guarantee correct data communication.

2.6 Important Operating Advice

To make full use of the system's inherent performance capabilities and achieve a long service life, you should always follow these operating rules:

- Do not turn the module on if there is fogging or soiling on its optical parts.
- Do not touch any of the module's parts with bare hands.
- Proceed with care when removing dust or contamination from optical surfaces!
- Prevent shock impacts during transport and use of LDM42A.
- Prevent overheating of the LDM42A.
- Prevent major temperature variances during LDM42A operation.
- In accordance with IP65 internal protection standards, the LDM42A is designed to be splash proof and dustproof.
- Read these safety and operating instructions with due care and follow them in practical use.

3 Technical Data

Table 1: Technical Data

Measurement range [4]	0.1 m … 150 m total 0.1 m … 30 m on almost any natural surfaces Over 100 m achievable depending on the degree of reflection of surfaces
Measurement uncertainty[5]	±2 mm under defined measuring conditions ±3 mm (+15 °C … +30 °C) ±5 mm (-10 °C … +50 °C)
Resolution	0.1 mm, free scalable, standard 1 mm
Reproducability[6]	0.5 mm
Measurement time	0.1 s … 6 s adjustable or automatic in mode DT 0.1 s, fixed, in mode DW on white surface 20 ms in mode DX on white surface
Max. movement speed	4 m/s in measurement mode DX
Max. acceleration	2.5 m/s² in measurement mode DX
Laser divergence	0.6 mrad
Beam diameter	< 11 mm in 10 m < 35 mm in 50 m < 65 mm in 100 m
Laser classification	Laser class 2 acc. to DIN EN 60825-1:2014 (650 nm, red)
Supply voltage	10 V … 30 V DC
Power consumption	Ca. 1.5 W in measurement mode Ca. 25.7 W with optional heating[7]
Operating temperature	-10 °C … +50 °C -40 °C … +50 °C with optional heating[4)]
Storage temperature	-40 °C … +70 °C
Serial interface[8]	RS232 or RS422, max. baud rate 115.200, ASCII, Parameterization, control of measurement modes, display of measured values, device information and errors
Digital output	High-side switch, maximum load 0.5 A Programmable switching threshold and hysteresis

[4] Dependent on target reflectance, influence of extraneous light and atmospheric

[5] Statistical spread 95 %, Measurement on planar, vertical white surface at standstill or in continuous, + 15 °C … +30 °C

[6] Dependent on target reflectance, influence of extraneous light and atmospheric

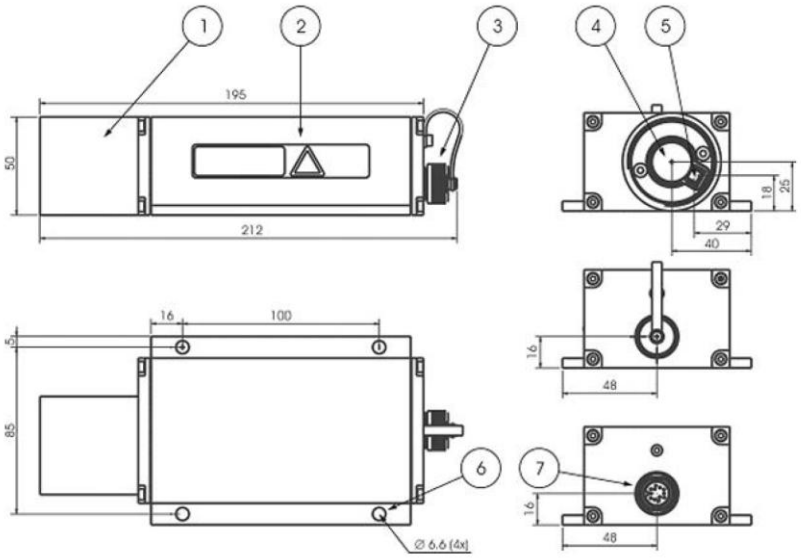
[7] Please specify optional heating when placing the order (-h)

[8] Please specify option RS422 when placing the order (-RS422)

Digital input	External trigger, 3 V … 24, programmable delay
Analog output	4 mA to 20 mA, Programmable distance range, adjustable reaction on error (3 mA, 21 mA or last valid measured value)
Housing material	Aluminum, powder-coated
Size	195 mm × 96 mm × 50 mm
Size	198 mm × 96 mm × 50 mm
Weight	800 g
Protection class	IP 65
Shock resistant	10 g / 6 ms (DIN ISO 9022-3-31-01-1)
MTBF	30000 hours @ 25 °C
Mounting	4 drill holes for M6 screws, 100 mm x 85 mm

4 Mechanical Mounting Conditions

The casing consists of a rugged, corrosion-resistant extruded aluminum profile with front-side and rear-side covers also in corrosion-resistant design. Four mounting holes are provided in the base plate for mechanical attachment of the LDM42A.



1 Light protection tube at front cover
2 Casing
3 Protective cover for flange-mount connector
4 Receiver optics
5 Sender optics
6 Mechanical mounting holes (4x)
7 12-pole M18-flange-mount connector (Binder Serie 723)

Figure 3: Dimensional drawing

To protect the sensor's optical surfaces from dust, physical contact, mechanical impacts, etc., the casing has a protection tube attached to it. Optionally different protection windows and optical filters are available. Please note that measurement cannot be guaranteed to function correctly if the equalizer tube is removed by unqualified action!

The interface connector is located on the back cover. Interface cables with different lengths are available.

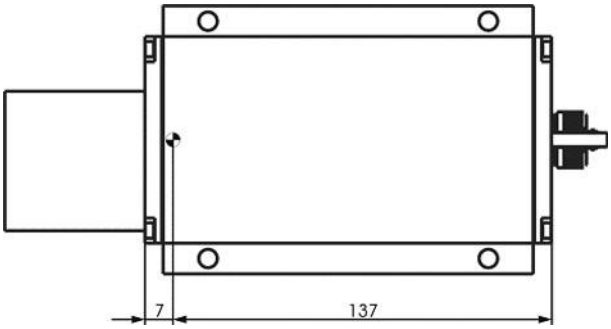


Figure 4: Offset against zero-edge

The LDM42A's zero-point is located 7 mm behind the outer surface of the front cover or 137 mm before the back cover outside face respectively. This zero-point has been introduced for constructional design reasons. It can be compensated with the help of parameter OF.

5 Electrical Connection

5.1 Connector Terminal

Located on the back cover is a connector terminal. A 12-pole round-type (flange-mount) series 723 connector from Binder has been selected for this purpose. It is sealed against the casing to comply with IP 65 requirements. This connector type guarantees optimized screening and a high IP degree.

The required counterpart is a cable jack (series 423 from Binder) with grading ring.

Interface cables with different length are available (standard 2 m, optionally 5 or 10 m). Under RS232 C or RS422 norm it's possible to extend the length with a high-quality screened cable.

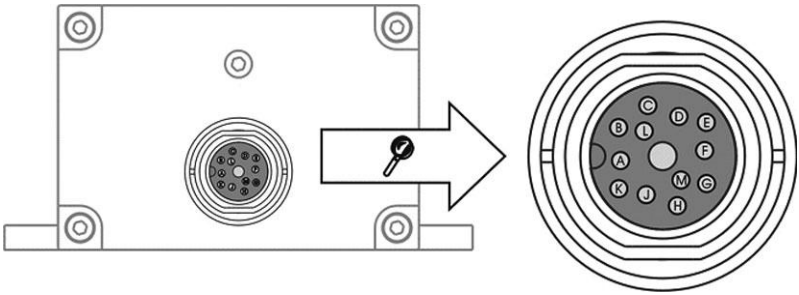


Figure 5: LDM42A pole assignments

5.2 Interface Cable

Caution: The cable end is exposed! The user is responsible to take precautions that will prevent any kind of shorts! The cable shield has to be connecting to earth with low resistance.

Figure 6: Interface cable with connector

Interface cable wiring assignments are as follows[9]:

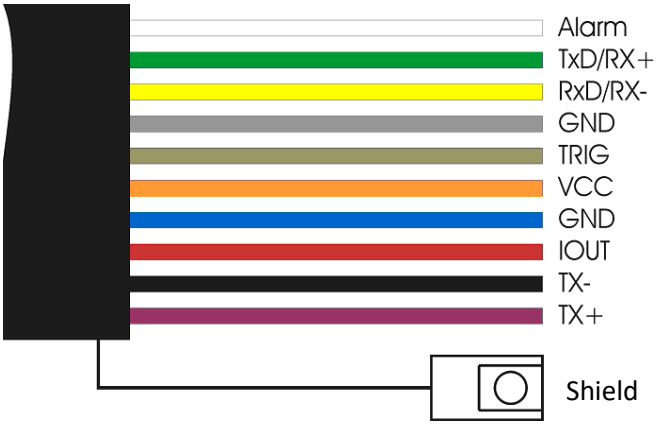


Figure 7: Interface cable color codes

[9] TRIG is not connected in devices with internal heating (LDM42A-h)

Table 2: Pin assignment connector and interface cable

Pin	Color	Assignment	Function RS232	Function RS422
A	Green	TxD / RX+	RS232 send data	RS422 receive data+
B	Yellow	RxD / RX-	RS232 receive data	RS422 receive data-
C[10]	Brown	TRIG	External trigger input	External trigger input
D	Red	IOUT	Analog output	Analog output
E	Black	TX-	RS422 Send data -	RS422 Send data -
F	Violet	TX+	RS422 Send data +	RS422 Send data +
G[11]	orange	VCC	Supply voltage	Supply voltage
H	White	ALARM	Digital switching output	Digital switching output
J	Grey	GND	Ground potential	Ground potential
L	blue	GND	Ground potential	Ground potential

GND wires are connected to an internal collective ground point. They provide the reference potential for all voltage values quoted below.

If input signals are applied to an output port, this may damage the LDM42A!
Do not connect the current output IOUT (red) to the power supply (10 V … 30 V). This will destroy the interface board!

For data communication via RS232, you are recommended to use cable 4 (grey, GND) for signal ground and cable 7 (blue, GND) for supply ground!

The limiting values of voltages, load rates and logic levels are in accordance with RS232 and RS232 standard requirements.

All outputs are protected against steady short-circuit currents.

[10] Trigger function is not available for devices with internal heating (LDM42A-h)
[11] In case of interface cable with length of 10m the color of pin G, VCC can also be pink.

5.3 Shield and Grounding

The cable shield must be grounded with low resistance. For cable extension use only high-quality shielded cable e.g. type „10XAWG224CULSW “.

Carrier base and control box should be having equal potential. Potential differences are reason for electrical current and can cause EMC problems (no correct measurement function or switch off/on of the gauge necessary).

If no potential equalization is possible, mount the LDM42A isolated (3) from the carrier base (use Nylon screwing and washers).

Use screened cable, e.g. “10XAWG224CULSW“, remember to extend also the cable screen (1). Connect screen to power supply reference potential GND on cable end (2).

For integration with vehicles use also this isolated mounting.

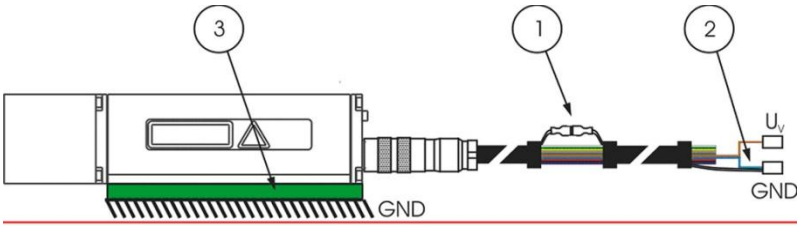


Figure 8: Isolated Mounting

5.4 Termination of RS232

RxD and TxD data lines should be kept as short as possible in all cases, because they tend to have an interference emitting and interference receiving effect, notably, when in open state. Especially in environments with strong spurious radiation there may be faults that may in some cases require a reset (turning the LDM42A off and on again). In cases where no RS232 interface communication is required after parameterization, you should provide for a termination wiring as shown in Figure 9.

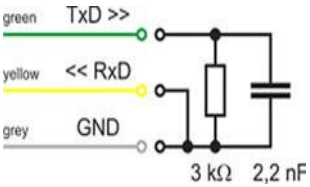


Figure 9: Termination for open RS-232

Make sure you leave no data line end open. It will be highly sensitive to interferences (EMC).

A terminator circuit should be installed when the RS232 is unconnected. This circuit must be provided by the customer (see diagram on the left)

Please keep the RS232 norm. The maximal cable length of the RS232 is 15 m. Use alternatively a RS422 connection (shielded twisted pair cable, maximum 300 m, termination resistor 100 Ω).

5.5 Limiting Values for Voltages

Input voltages:

Table 3: Input voltages

Terminal point	Voltage	Comment
VCC	30 V	Pole-reversal-protected
TxD	±13.2 V	Short-circuit-proof
RxD	±25 V	Short-circuit-proof
TX+	±14 V	Short-circuit-proof
TX-	±14 V	Short-circuit-proof
RX+	±14 V	Short-circuit-proof
RX-	±14 V	Short-circuit-proof
TRIG[12]	±25 V	Short-circuit-proof

Output voltages:

Table 4: Output voltages

Terminal point	Voltage	Comment
TxD	±5.4 V	± 5 V at 3 kΩ load
TX+, TX-	≥ 2 V	differentially at 2 x 50 Ω load
Alarm	≥ VCC – 2 V	Level depending on VCC

All outputs are sustained-short-circuit-proof to ground (GND).

Caution: Do not connect the current output IOUT (red) to the power supply (10 ... 30 V). This will destroy the interface board!

[12] Trigger function is not available for devices with internal heating (LDM42A-h)

6 Start up

Make sure that all cable ends are protected against short circuit effects before you turn on power supply!

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

For starting up a PC with RS232 or RS422 data interface and a terminal program are required. We recommend the Windows program LDMTOOL Version 5.0 or higher.

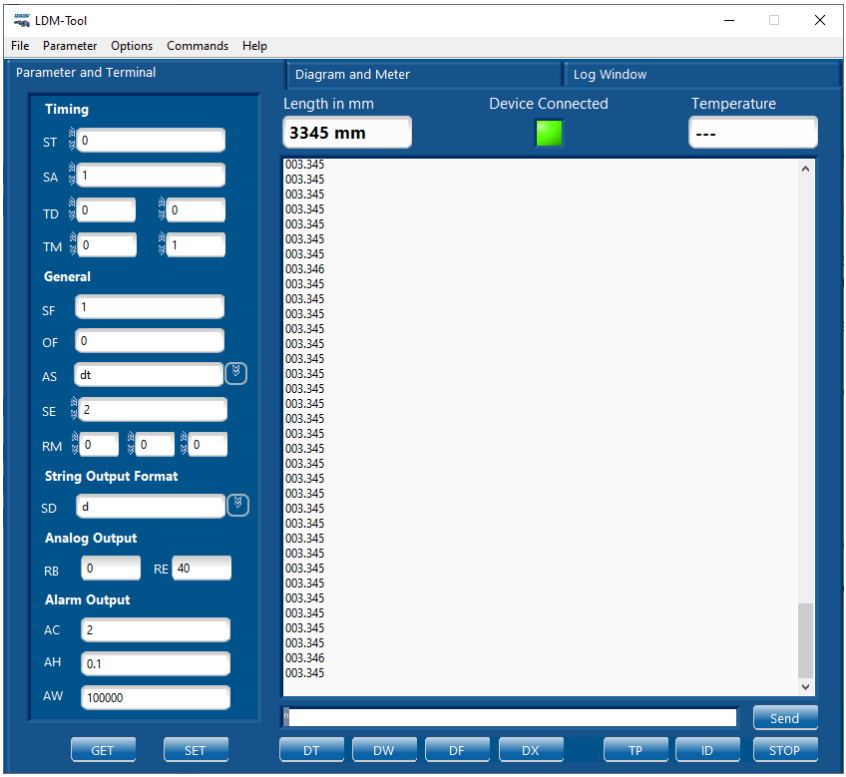


Figure 10: Program LDMTool

As part of preparative actions, the LDM42A must be properly installed in the designated working site, oriented onto the target and kept in a stable position. The target to be measured should preferentially have a homogeneous, bright surface.

Alignment of the LDM42A is facilitated by a Laser beam[13] that is visible and can easily be turned on at the PC.

Operating voltage supply must be connected to the corresponding ends of the interface cable. A pole-reversal protection is integrated to prevent the destruction of electronic components.

[13] depending on ambient light and target conditions

7 Commands and Parameter

7.1 General

The LDM42A can be parameterized very easy by a PC as long as it is equipped with a serial interface RS232 and/or RS422 according to the attached LDM42A. A suitable programming cable is necessary. The use of USB to serial converters is also possible. The parameterization is usually done by PC-based terminal program like HyperTerm or the more device specific LDMTool

All settings are stored permanently even if the device will be disconnected from power supply.

7.2 Transmission protocoll

The LDM42A serial transmission protocol is like

<CC><Space><P1><Space><P2><Space><P3><CR>
where

<CC>	Command
<Space>	Space (20h)
<P1>	Parameter 1
<P2>	Parameter 2
<P3>	Parameter 3
<CR>	Control character CR (0Dh)

Parameters are given as:

- Integer or decimal numbers
- Letters

Additional properties of the communication protocol are:

- Command entries are not case-sensitive. This means that small and capital lettering can be used for commands.
- Any command must be terminated by a carriage return character <CR> (hexadecimal 0D).
- Decimal numbers have to be entered with a period (hexadecimal 2E) as separator.
- There is a distinction between commands for parameters and commands which start a distance measurement or temperature measurement
- Parameter commands are used to either set or query the current parameter value
- Querying is done with the parameter command in simple format, e.g. (for alarm center parameters):

  AC<CR>
- For parameter setting, a new value must be added after the command with no delimitation sign in between, for example:

  AC20.8[Enter] the alarm center will be set to 20.8.

7.3 Commands for measurements

DM – single distance measurement

Command DM<CR>

Input parameter SD, SE, SF, ST, OF

DM mode triggers a single measurement (single shot) and then waits for next command.

DT – distance tracking

Command DT<CR>

Input parameter SA, SD, SE, SF, ST, OF

DT mode can be chosen for distance measurement of different kinds of surfaces (varying reflectance). In this type of distance tracking mode, the LDM42A uses internal algorithms to continuously evaluate the quality of the Laser radiation signal that is coming back. This may cause longer measuring times in the case of poor reflectance or sudden jumps in distance.

The minimum time to measure is 100 ms, the maximum time is 6 s. If the measuring signal fails to reach a specified quality within six seconds, an error message is output. The time to measure may also be limited by setting the ST parameter to a desired value. ESC stops the measurement.

DS – distance tracking (<7 m)

Command DS<CR>

Input parameter SA, SD, SE, SF, ST, OF

Operation in DS mode makes sense where different types of surfaces have to be measured at **close range up to 7 m**. Compared to DT measuring mode, it allows a higher measurement rate. Within the range from 0.1 m to 0.5 m, measuring accuracy is restricted (± 4 mm). Measuring time (time to measure) can be limited via ST parameter settings. ESC stops the measurement.

DW – distance tracking with target board (10 Hz)

Command	DW<CR>
Input parameter	SA, SD, SE, SF, ST, OF

DW mode performs at a steady measuring rate of 10 Hz. As a necessary precondition for measured values to be stable, a white target board must be placed at the selected object. There must be no sudden jumps in distance greater than 16 cm within the measuring field! ESC stops the measurement.

DX – distance tracking with target board (50 Hz)

Command	DX<CR>
Input parameter	SA, SD, SE, SF, OF

DX mode performs at a steady measuring rate of 50 Hz. As a necessary precondition for measured values to be stable, a white target board must be placed at the selected object.

This measurement mode is intended in the first place for objects performing homogeneous motion up to 4 m/s. For higher rates of measurement, preceding measured values will be included in the process to calculate a currently measured value. There must be no sudden jumps in distance greater than 16 cm within the measuring field!

Caution: To prevent transmission problems, please use minimum 9600 baud for serial data rate in DX Mode!

DF – distance measurement with external trigger[14]

Command	DF<CR>
Input parameter	SD, SE, SF, ST, OF, TD, ST, SA, RM

DF mode allows to initiate a measurement by an external trigger pulse.

Initially, after selecting this mode, the operator does not receive any response. As soon as the trigger pulse has been detected, the LDM42A will send data and switches to digital and/or analog output.

Settings for trigger delay and trigger slope can be defined via parameter TD.

TP – internal temperature [°C]

TP queries the value of the inner LDM42A temperature.

Note: In tracking mode, the inner temperature may exceed the surrounding temperature level by as much as 10 K.

[14] Trigger function is not available for devices with internal heating (LDM42A-h)

7.4 Commands for parameter setup

ID – Device information and online help

Command ID<v><CR>

Parameter <v> 0 – complete output incl. help
1 – shortened output without help

The command ID returns the device type, serial number and firmware version as well as a help text about available commands and their parameters. The output text depends on the connected device type and firmware version

```
LDM42, SN 200001, V 20.95
DT[Enter].....distance tracking
DS[Enter].....distance tracking 7m
DW[Enter].....distance tracking with cooperative target (10Hz)
DX[Enter].....distance tracking with cooperative target (50Hz)
DF[Enter].....distance measurement with external trigger
DM[Enter].....distance measurement
TP[Enter].....internal temperature [°C]
SA[Enter] / SAxx[Enter]..display/set average value [1..20]
SD[Enter] / SDxx[Enter]..display/set display format [d/h/s]
ST[Enter] / STxx[Enter]...display/set measure time [0..25]
SF[Enter] / SFx.x[Enter]..display/set scale factor
SE[Enter] / SEx[Enter]....display/set error mode [0/1/2]
                          0..Iout=const., ALARM=const.
                          1..Iout: 3mA @RE>RB, 21mA @RE<RB, ALARM: OFF@AH>0,  ON@AH<0
                          2..Iout: 21mA @RE>RB, 3mA @RE<RB, ALARM:  ON@AH>0, OFF@AH<0
AC[Enter] / ACx.x[Enter].....display/set ALARM center
AH[Enter] / AHx.x[Enter].....display/set ALARM hysteresis
AW[Enter] / AWx.x[Enter].....display/set ALARM width
RB[Enter] / RBx.x[Enter].....display/set distance of Iout=4mA
RE[Enter] / REx.x[Enter].....display/set distance of Iout=20mA
RM[Enter] / RMx y.y z[Enter]...remove measurement
TD[Enter] / TDx y[Enter].....display/set trigger delay [0..9999ms] trigger level [0/1]
TM[Enter] / TMx y[Enter].....display/set trigger mode [0/1] trigger level [0/1]
BR[Enter] / BRxxxx[Enter].....display/set baud rate [2400..115200]
AS[Enter] / ASdd[Enter].....display/set autostart command [DT/DS/DW/DX/DF/DM/TP/LO/ID]
OF[Enter] / OFx.x[Enter].....display/set distance offset
SO[Enter].....set current distance to offset (offset = - distance)
LO[Enter] / LOx[Enter].....laser on (x=0/1 permanent echo off/on)
LF[Enter] / LFx[Enter].....laser off (x=0/1 permanent echo off/on)
TL[Enter] / TLx y[Enter].....display/set laser temperature limits
PA[Enter].....display settings
PR[Enter].....reset settings
```

Figure 11: Device information and help text

SA – Sliding Average

Command	SA<n><CR>
Parameter <n>	Number of measurements considered for averaging
Value range	1 … 20
Default	1 (no averaging)

SA determines the way of average calculation from 1 to 20 measured distance values. Calculation is based on this formula:

$$x = \frac{x_1 + x_2 + x_3 + \ldots + x_{n(20)}}{n}$$

SD – Output format

Command	SD<f>
Parameter <f>	Output format on the serial data interface
Value range	d – decimal s – decimal with signal strength h – hexadecimal
Default value	d

SD selects the output format of measured values via the serial interface. The value range for the signal quality is 0 … 4000. Generally a higher value means a better receiver signal for the current measurement.

Table 5: Output format

Parameter	Output	Format
d	decimal	xxx.xxx<CR><LF> x=0…9
s	decimal with signal quality	xxx.xxx<SPACE>yyyyyy<CR><LF> x=0…9; y=0…9
h	hexadecimal	<SPACE>xxxxxx<CR><LF> x=0…F

SD affects all commands which provide a distance value output.

An output value is calculated from a given measured distance value (in mm), multiplied by the scale factor SF.

Negative distance values are output in two's complement notation.

Examples:

Distance = 4.996 m, SF1

dec: 004.996<CR><LF>

hex: <SPACE>001384<CR><LF>

(= 4996 mm × SF1)

dec+sig: 004.996_000005<CR><LF>

(bad signal quality)

dec+sig: 004.996_000985<CR><LF>

(good signal quality)

Distance = 4.,996 m, SF10

dec: 049.960<CR><LF>

hex: _00C328<CR><LF>

(= 49960 = 4996 mm × SF10)

dec+sig: 049.960_000005<CR><LF>

Error case

dec/hex: E15<CR><LF>

(see 10 Error Codes)

ST –Measurement time

Command	ST<t><CR>
Parameter <t>	Measurement time
Value range	0…25
Default value	0

Measurement time is directly conditional on the selected measuring mode. As a general rule, one may say: the poorer the reflectance of the surface of a particular target, the more time the LDM42A will require to determine the distance with specified accuracy. For example, if error message E15 is output because of poor reflectance and insufficient time to measure, this latter setting must be increased.

Basically, the greater the time setting is the more time will be available for measurement and the lower the resulting measuring rate.

An exception there from is zero-value. In this case, the LDM42A automatically picks the smallest possible time value for measurement!

ST is effective in measurement modes DT, DF and DM.

The measuring time setting option can also be used to modify the measuring rate, for example, in order to restrict the data volume or for synchronization purposes. Measuring time can only be set as an approximate value, because the underlying principle of measurement is subject to certain variances that cannot be accounted for:

DT measuring mode → measuring time= ST x 280 ms (except ST = 0)

DS measuring mode → measuring time = ST x 170 ms (except ST = 0)

Example:

The target distance is 25 m, but the target's reflectance is not ideal. With a measuring time setting of ST 2, E15 will be output following measurement. The user must increase the time (ST > 2) or set auto (ST 0) to measure in this case!

One should work in DW or DX measuring mode where stable measuring times are required.

SF –Scale factor

Command	SF<f.f><CR>
Parameter <f.f>	Scaling factor for the measured distance value
Value range	unlimited
Default value	1

SF multiplies a calculated distance value with a user-selectable factor for changes in resolution or outputs in a different unit of measure. The scale factor may also be negative.

The scale factor influences the output of measurement results, offset (OF), Alarm Centre (AC), Alarm Hysteresis (AH), Range Begin (RB) and Range End (RE)!

Table 6: Examples for Scale factor

Scale factor	Resolution	Output	Output Unit
SF1	1 mm	012.345	m
SF10	0.1 mm	123.450	dm
SF1.0936	0.01 yard	013.500	yard
SF3.28084	0.01 feet	040.501	feet
SF0.3937	1 inch	004.860	100 inch
SF-1	1 mm	-12.345	m

Following a change in the scale factor, the settings for digital and/or analog output and offset must be matched accordingly!

SE –Error mode

Command	SE<e><CR>
Parameter <e>	Behavior of the outputs in case of error
Value range	0,1,2

Default value 2

SE allows you to configure the behavior of the digital switching output (Q1) and/or the analog output following an error message (E15, E16, E17). Depending on the particular LDM42A application environment, error messages have to be handled in different ways.

Available setting options are 0, 1 and 2 with the following effects in the case of an error:

Table 7: Meaning of SE

SE	Digital switching output (Alarm)	Analog output (4 -20 mA)
0	State of latest valid measurement will be kept	Outputs current of last valid measurement will be kept
1	Positive alarm hysteresis = LOW Negative alarm hysteresis = HIGH	RE >RB: Current =3 mA RE <RB: Current =21 mA
2	Positive alarm hysteresis = HIGH Negative alarm hysteresis = LOW	RE >RB: Current =21 mA RE <RB: Current =3 mA

AC –Alarm center

Command AC<b.b><CR>

Parameter <b.b> Begin of active range of Q1

Value range unlimited

Default value 2

AC sets the beginning of the distance range for which the switching output Q1 will be turned active. The length of this active range can be set using the AW parameter.

AC must be selected with respect to the current scale factor SF. (see 8.3 Digital Switching Output (Alarm)).

AH – Alarm hysteresis

Command	AH<h.h><CR>
Parameter <h.h.>	Alarm hysteresis
Value range	unlimited
Default value	0.1

AH set the switching hysteresis at the beginning and the end point of the active range of the switching output Q1. AH must be selected with respect to current sale factor SF.

The mathematical sign of AH can be used to set an active state logic level:

Positive sign <+>	active range is HIGH-active.
Negative sign <->	active range is LOW-active.

No sign setting means positively-signed

AW –Alarm width

Command	AW<l.l><CR>
Parameter <l.l>	Size of the active range of Q1
Value range	unlimited
Default	10000 (active for the rest of the measurement range)

AW sets the length of the active range starting at AC. There are the following constraints:

- AW has to be selected with respect to the current scale factor SF.
- AW is always equal or greater than 0 (zero).
- AW is always equal or greater than |AH| (the amount of AH).

RB – Begin of analog output range (QA)

Command	RB<d.d><CR>
Parameter <d.d>	Distance value for QA = 4 mA
Value range	unlimited
Default value	0

RB (Range Begin) defines the distance value where the analog output will show 4 mA. (see 8.4 Analog Output)

- RB has to be selected with respect to the current scaling factor SF.
- RB can be smaller or greater than RE!
- In the event of an error, the output value will correspond to the current setting of parameter SE.

RE – End of analog output range (QA)

Command	RE<d.d><CR>
Parameter <d.d>	Distance value for QA = 20 mA
Value range	unlimited
Default value	40

RE (Range End) defines the distance value where the analog output QA shows 20 mA. (see 8.4 Analog Output)

- RE has to be selected with respect to the current scale factor SF.
- RE can be greater or smaller than RB!
- In the event of a fault, the output value will correspond to the current that was set via parameter SE.
- For distance values out of the range between RB and RE the analog output QA will show the nearest current limit (4 mA or 20 mA)

RM – Remove measurement

Command	RM<x> <y.y> <z><CR>
Parameter <x>	Number of considered distance values for correction algorithm
Value range <x>	0…10
Default value <x>	0
Parameter <y.y>	Permitted value range
Value range <y.y>	unlimited
Default value <y.y>	0
Parameter <z>	Permitted number of measured distance values out of the permitted distance range (“out-of-tolerance values”). In case of subsequently measured out-of-tolerance values, the most recently corrected value will be included in the correction calculation for the next out-of-tolerance value.
Value range <z>	0…100
Default value <z>	0

RM is intended to facilitate settings for a range of expected distance values.

Values which are found to be outside of this expected range will be corrected until matching the most recently valid measured values.

RM is only effective in DT mode

The use of RM parameter settings should be restricted to suitable applications only.

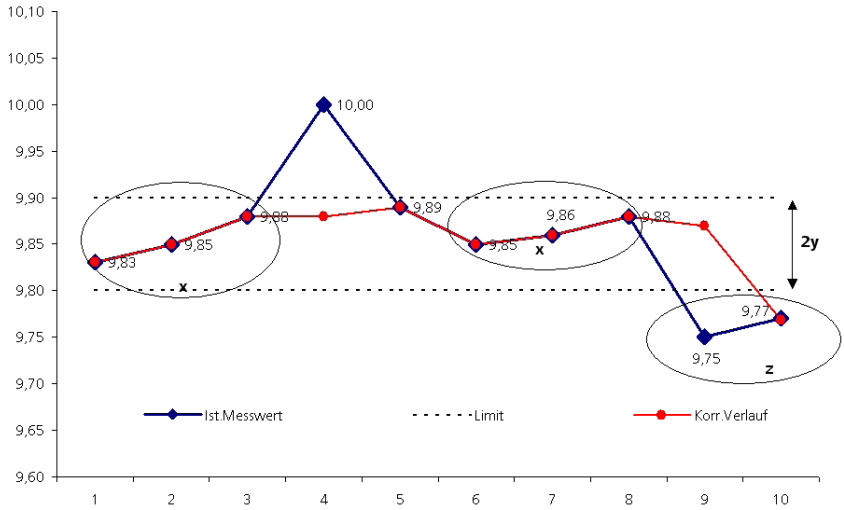


Figure 12: Measurement correction with RM

TD – Trigger delay and logic[15]

Command	TD<x> <y><CR>
Parameter <x>	Time for delay between trigger event and start of measurement
Value range <x>	0 … 9999
Default value <x>	0
Parameter <y>	Logic of trigger input
Value range <y>	0 for falling slope (high-low)
	1 for rising slope (low-high
Default value <y>	1

TD determines the behavior of the trigger input for measuring mode DF only.

[15] Trigger function is not available for devices with internal heating (LDM42A-h)

Example TD1000 0<CR> means a trigger delay of 1 second after a falling slope on the trigger input.

HO –Temperature for heating on[16]

Command	HO<u><CR>
Parameter <u>	Lower temperature threshold in °C for internal heating
Value range	-40 … +70
Default	3

If the internal temperature of the LDM42A gets below this value, the heating will be switched on.

HF – Temperature for heating off [16]

Command	HF<o><CR>
Parameter <o>	Upper temperature threshold in °C for internal heating
Value range	-40 … +70
Default value	12

If the internal temperature rises above this value the active heating will be switched off.

[16] Only for devices with internal heating (LDM42A-h)

TM – Autostart trigger [17]

Command	TM<x> <y><CR>
Parameter <x>	Autostart-Trigger ein- bzw. ausschalten
Value range <x>	0 – Trigger function disabled
	1 – Trigger function enabled
Default value	0
Parameter <y>	Logic of trigger input
Value range <y>	0 – Trigger active at LOW-level
	1 – Trigger active at HIGH-level
Default value	1

TM sets the auto-start trigger function which allows to control the auto-start command that was set via parameter AS by the external trigger input. All starting modes which are selectable via AS can be launched and stopped by external triggering. These are: DS/DT/DW/DX/DF/DM/TP/LO/ID.

For the autostart trigger function the trigger signal has to be applied permanently.

Examples:

a) ASDT
TM1 1
Trigger signal = H → DT is performed
Trigger signal = L → DT is stopped

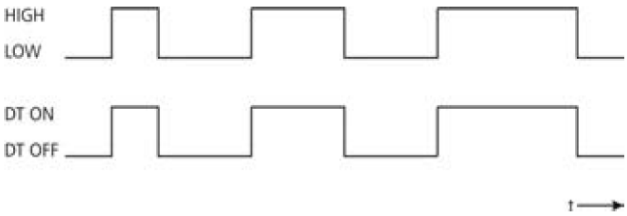


Figure 13: Trigger level = 1

[17] Trigger function is not available for devices with internal heating (LDM42A-h)

b) ASDM
TM1 0
Trigger signal=H → no change in state
Trigger signal=L → DM active, i.e. one measurement is triggered

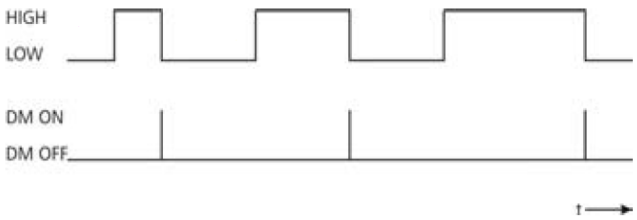


Figure 14: Trigger level = 0

BR – Baud rate of the serial interface

Command	BR<b><CR>
Parameter <b>	Baudrate der seriellen Schnittstelle
Value range	[2400; 4800; 9600; 19200; 38400; 57600; 115200]
Default value	9600

Faulty entries will be rounded to the nearest baud rate. A fixed data format of eight data bits, no parity and one stop bit is used. Standard setting is 9600 baud.

AS – Autostart command

Command	AS<f><CR>
Parameter <f>	Command, which will be started at power on
Value range	[DT;DS;DW;DX;DF;DM;TP;LO;ID]
Default value	DT
Example	If ASDT has been parameterized, the LDM42A will begin with distance tracking after power on.

OF – display/set distance offset

Command	OF<o.o><CR>
Parameter <o.o>	Offset
Value range	unlimited
Default value	0

With the help of OF (offset) the user may define the location of the zero-point of the application. For details on the position of the module's zero-point, refer to section 4.

OF must be selected so it is properly matched to the currently valid scale factor setting (SF). OF may also take on negative values.

SO – set current distance to offset

Command	SO<CR>

On SO the LDM42A performs a distance measurement and saves the measured reading as offset value with inverted mathematical sign (OF).

LO – Laser on

Command	LO<b><CR>
Parameter <b>	option, confirmation of the command on/of
Value range	0 – no confirmation
	1 – confirmation after command was received
Default value	0

LO turns the Laser on without performing any measurements. This function can be used for laser alignment or functional testing of the LDM42A.

LF – laser off

Command	LF<b><CR>
Parameter <b>	option, confirmation of the command on/off
Value range	0 – no confirmation
	1 – confirmation after command was received
Default value	0

LF turns the Laser off if it was activated by LO before.

LF stops also any active continuous measurement mode.

TL – Temperature limits

Command	TL<min> <max><CR>
Parameter <min>	Lower temperature limit
Value range	unlimited
Default value	-12
Parameter <max>	Upper temperature limit
Value range	unlimited
Default value	60
Answer	<min> <max> <min-ever> <max-ever><CR><LF>

TL defines the allowed inner temperature range where measurements are performed. If this temperature range will be exceeded the LDM42A sends an error message.

Without any parameters, this command retrieves the reached maximum temperatures ever.

PA – display settings

Command PA<CR>

PA lists all parameters in a table. The output depends on the connected type of LDM42A

Example:

```
average value[SA].................1
display format[SD]................d
measure time[ST]..................0
scale factor[SF]..................1
error mode[SE]....................2
ALARM center[AC]..................2
ALARM hysteresis[AH]..............0.1
ALARM width[AW]...................100000
distance of Iout=4mA [RB].........0
distance of Iout=20mA [RE]........40
remove measurement [RM]...........0 0 0
trigger delay, trigger level[TD]..0 0
```

```
trigger mode, trigger level[TM]...0 1
baud rate[BR].....................9600
autostart command[AS].............dt
distance offset[OF]...............0
laser on echo [LO]................1
laser off echo [LF]...............1
temperature limits [TL]...........-13  61  -13.0
61.0
```

PR – reset settings

Command PR<CR>

PR resets all parameters (except baud rate). After this a new configuration of the LDM42A is necessary

Example

```
average value[SA].................1
display format[SD]................d
measure time[ST]..................0
scale factor[SF]..................1
error mode[SE]....................1
ALARM center[AC]..................1000
ALARM hysterese[AH]...............0.1
ALARM width[AW]...................100000
distance of Iout=4mA [RB].........1000
distance of Iout=20mA [RE]........2000
remove measurement [RM]...........0 0 0
trigger delay, trigger level[TD]..0 0
trigger mode, trigger level[TM]...0 1
baud rate[BR].....................9600
autostart command[AS].............ID
distance offset[OF]...............0
```

Use instead of PR the "Set Standard" command from Windows program LDMTool.

8 Interface Connection

The LDM42A provides one serial port of either RS232 **or** RS422 depending on the version (see label). For devices with RS232, the RS422 transmission lines (TX +, TX-) are also available. They can be used to observe the measurement data by a second processing unit.

8.1 Serial Interface RS232

Initially, RS232 communication interfaces purely functioned as PC communication ports. They have become the established standard tool for serial data transmission over short cable lengths. With greater transmission lengths, the interface is highly susceptible to interferences, notably, in the vicinity of strong electromagnetic noise emitters.

Therefore, it should only be used for LDM42A configuration.

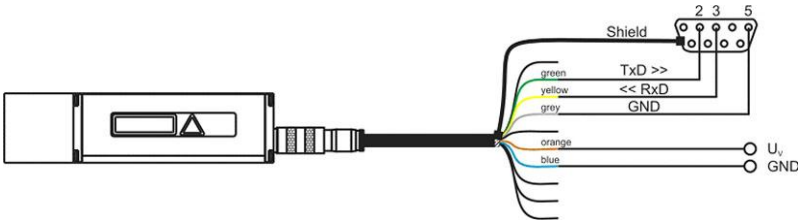


Figure 15: RS232 wiring

8.2 Serial Interface RS422

For configuration purposes and permanent data transmissions over a greater length, the RS422 can be used. This type of interface is insusceptible to interference and noise influences and qualifies for industrial use. Where twisted cable pairs are involved, transmissions lengths up to 300 m can be handled.

Figure 16: RS2422 wiring

Since a standard PC typically includes no RS422 communication port it's recommended to use an RS422 interface card or an RS422-to-USB converter for communication.

8.3 Digital Switching Output (Alarm)

With the help of a user-selectable distance threshold, the switching output can be set to monitor object positions or conditions.

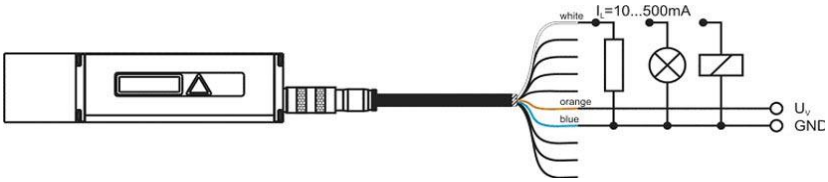


Figure 17: Wiring diagram of digital switching output

For example, using the digital switching output, an object which was selected for measurement can be monitored for excision of a threshold value. To do this, parameter settings for a measurement window are required. Settings for this window can be made via the three parameters: Alarm Center (AC), Alarm Hysteresis (AH) and Alarm Width. The range which will be subject to monitoring begins at AC and ends at AC+AW. Switching transitions can be set via parameter AH.

The logic state of the switching output follows from the mathematical sign of AH.

In the case of a positive AH, the output switches

- with increasing distance:

  - from LOW to HIGH if the distance is greater than (AC ±AH/2)
  - from HIGH to LOW if the distance is greater than (AC+AW+AH/2)

- with decreasing distance:

  - from LOW to HIGH if the distance is smaller than (AC +AW-AH/2)
  - from HIGH to LOW the distance is smaller than (AC-AH/2)

In the case of a negative AH, the output switching pattern will be inverse.

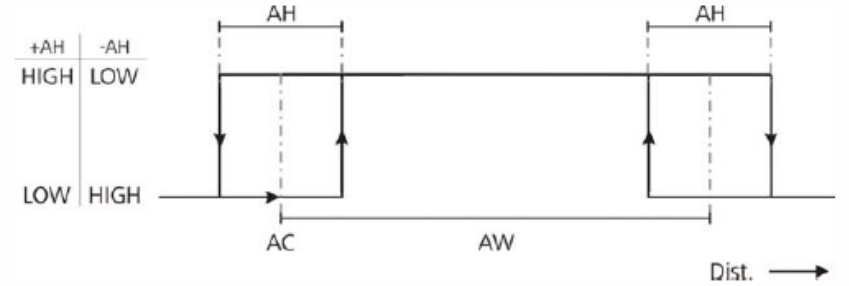


Figure 18: Switching behavior of digital output

Example:

A moving object is assumed to be monitored within a window of 10 m to 11 m with a hysteresis of 0.2 m.

AC10
AH0.2
AW1

Distance (m) increases →										
	9.8	9.9	10.0	10.1	10.2	...	11.0	11.1	11.2	11.3
+AH	L	L	L	H	H	H	H	L	L	L
-AH	H	H	H	L	L	L	L	H	H	H

Distance (m) decreases →										
	11,3	11,2	11,1	11,0	10,9	10,8	...	10,0	9,9	9,8
+AH	L	L	L	L	H	H	H	H	H	L
-AH	H	H	H	H	L	L	L	L	L	H

L = LOW, H = HIGH

How the switching output behaves if an error message occurs (E15, E16, E17, E18) can be defined by the parameter SE. (see section 7.4)

8.4 Analog Output

The purpose of the analog output is to allow transmission of analog measured values via a 4…20mA interface.

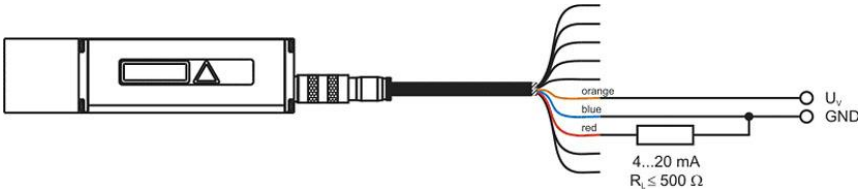


Figure 19: Wiring diagram of analog output

The current is proportional to the measured target distance. This applies within a distance interval that is marked by the two limiting parameters “Range Begin“ (RB) and “Range End“ (RE). RE may be greater or smaller than RB.

The output current value is calculated according to this equation:

$$\text{RE} > \text{RB}: \quad I_{OUT}\,[\text{mA}] = 4\ \text{mA} + 16 \cdot \left(\frac{\text{Distanz} - \text{RB}}{\text{RE} - \text{RB}}\right) \cdot \text{mA}$$

$$\text{RE} < \text{RB}: \quad I_{OUT}\,[\text{mA}] = 20\ \text{mA} - 16 \cdot \left(\frac{\text{Distanz} - \text{RE}}{\text{RB} - \text{RE}}\right) \cdot \text{mA}$$

Current out of distance range:

	Distance = RB	**Distance = RE**
RE > RB	4 mA	20 mA
RB > RE	20 mA	4 mA

Example:

RB	RE	0 m	2 m	4 m	6 m	8 m	10 m	11 m
2 m	10 m	4 mA	4 mA	8 mA	12 mA	16 mA	20 mA	20 mA

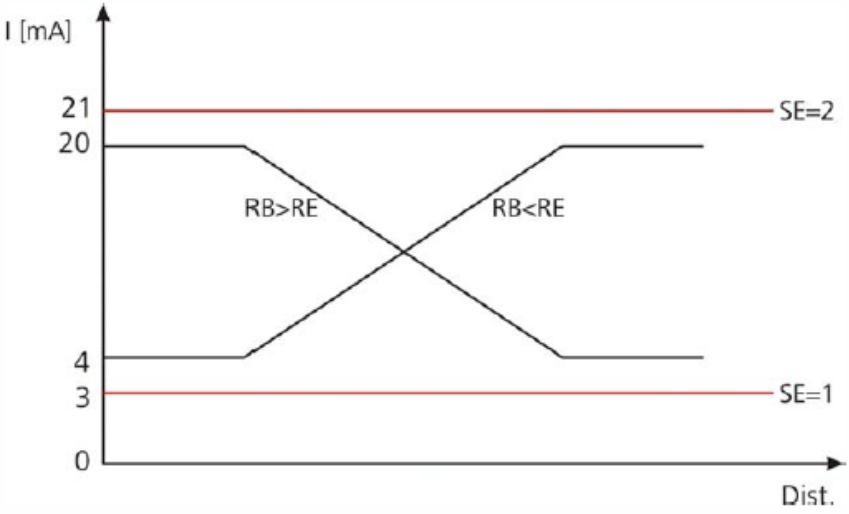


Figure 20:Output current diagram for RE > RB and RE < RB

To manage the behavior of the analog output in case of an error message (E15, E16, E17, E18), appropriate settings can be with parameter SE (see section 7.4)

8.5 Trigger Input[18]

The trigger input is intended for triggering a distance measurement with an external signal that is applied as a voltage pulse between 3 V and 24 V. This input is used only in trigger mode DF.

Figure 21: Wiring diagram of trigger input

It is for the user to specify a desired delay time and a pulse slope to be selected for synchronization. The distance measurement will always be started with a delay of 5 ms in addition with the programmed trigger delay time.

Having done this, the LDM42A has to be switched to trigger operation mode DF or the autostart-trigger has to be activated.

[18] Trigger function is not available for devices with internal heating (LDM42A-h)

9 List of Commands

Table 8: List of commands

Command	Description
DT	Starts distance tracking
DS	Starts distance tracking (< 7 m)
DW	Starts distance tracking on white target at 10 Hz
DX	Starts distance tracking on white target at 50 Hz (only LDM42A)
DF[19]	Starts remote-triggered single distance measurement (single shot)
DM	Starts single distance measurement (single shot)
TP	Queries inner temperature
SA	Queries / sets floating average value (1...20)
SD	Queries / sets output format (dec/hex/sig)
ST	Queries / sets time to measure (0...25)
SF	Queries / sets scale factor
SE	Queries / sets error mode (0, 1, 2)
AC	Queries / sets alarm center
AH	Queries / sets alarm hysteresis
AW	Queries / sets alarm with
HO[20]	Queries / sets temperature for heating on
HF[20]	Queries / sets temperature for heating off
RB	Queries / sets beginning of range (4 mA)
RE	Queries / sets end of range (20 mA)
RM	Queries / sets removal measurement parameters
TD	Queries / sets trigger delay and level
TM	Queries / sets trigger mode and level
BR	Queries / sets baud rate
AS	Queries / sets auto start
OF	Queries / sets offset
SO	Sets current distance as offset
LO	Turns Laser on (do not use, please use DT)
LF	Turns Laser off
PA	Displays all parameter values
PR	Resets all parameters to standard values (don't use)

[19] Trigger function is not available for devices with internal heating (LDM42A-h)
[20] Only for devices with internal heating (LDM42A-h)

10 Error Codes

Table 9: Error Codes

Code	Description	Action
E15	Reflexes are too weak **or** distance from LDM (front edge) to target is less than 0.1 m	Use white target board[21] **or** increase distance to target
E16	Reflexes are too strong	Use white target board or filter
E17	Too much steady light (e.g. sun) or reflexes are too strong	Use aperture or filter or white target board
E18	DX mode (only LDM42A): reflexes too weak, or distance from LDM (front edge) to target is less than 0.1 m	Use white target board or increase distance to target
E19	DX mode (only LDM42A): Target motion speed > 10 m/s	Reduce motion speed
E23	Inner temperature below allowed minimum (command TL)	Heading necessary
E24	Inner temperature above allowed maximum (command TL)	Cooling necessary
E31	EEPROM checksum error	Necessary to repair
E51	Failed to set avalanche voltage, Reason either too much steady light or hardware error	Check and reduce steady light or necessary to repair
E52	Excessively high Laser current / Laser defect	Necessary to repair
E53	Division by 0	SF must be unequal of zero or necessary to repair
E54	Hardware error, PLL range	Necessary to repair
E55	Other hardware error	Necessary to repair
E61	Invalid command	Correct input
E62	Wrong parameter, wrong command	Check data transmission
E63	SIO overflow	Check data transmission
E64	SIO framing error	Check data transmission

[21] e.g. 3M, self-adhesive foil matte white

11 PC Interface Cable (Option)

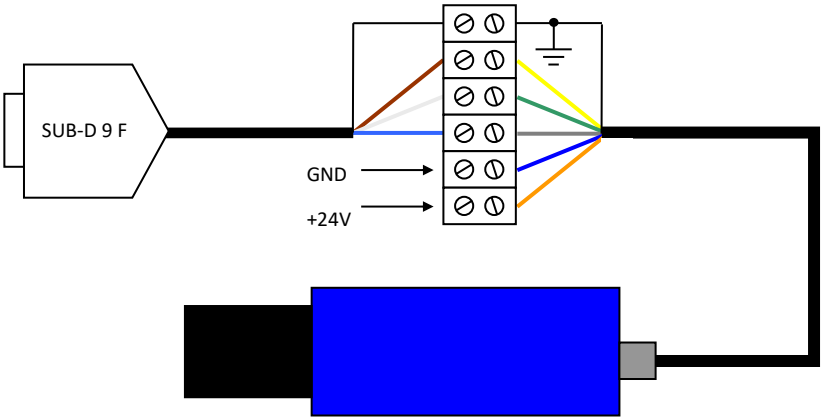


Figure 22: RS232 cable with power supply for LDM42A

Table 10: Pin assignment SUB-D 9 F

Nr. SUB-D 9 F	Color code	Designation SUB-D 9 F (PC COM)
Shield	-	Cable shield
3	brown	TxD
2	white	RxD
5	blue	GND

RS232 cable - TXD and RXD have to be crossed

12 EG Declaration of Conformity

The company ASTECH Angewandte Sensortechnik GmbH in Schonenfahrerstr. 5, 18057 Rostock / Germany, represented by the signatory, herewith declares that the following designated product

Laser Distance Meter LDM42A

Including options -h, -d, -v, -RS422

agree with the following harmonized standard:

2014/30/EU EMC directive

2011/65/EU RoHS directive

Following harmonized standards have been taken in account:

IEC 61326-1	Electromagnetic interference and electromagnetic compatibility (EMC) *including radio interference
EN 50581:2012	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Following additional harmonized standards were taken in account

EN 60825-1:2014	Safety of laser products - Part 1: Equipment classification, requirements and user policy

Rostock, 2020 Juli 07th
ASTECH Angewandte Sensortechnik GmbH

Jens Mirow
General Manager

13 Part Numbers

Table 11: Part Numbers

Part-No.	Name	Description
10-2001-00	LDM42A	Distance meter with RS232 interface
10-2001-01	LDM42A-RS422	Distance meter with RS422 interface
10-2001-02	LDM42A-v	Distance meter with FPM70 gaskets
10-2011-00	LDM42A-h	Distance meter with heating
10-2011-01	LDM42A-RS422-h	Distance meter with RS422 and heating
12-2006-00	PW4-S-10	Protection window standard
12-2030-00	GFW2-10	Gray filter 2x
12-2030-01	GFW4-10	Gray filter 4x
12-2010-00	ARF-w	Reflection foil matte/white, A4
12-2011-00	ARF-s	Highly reflective foil silver, A4
12-2015-00	PT4x-AIR	Protection tube with purging air
15-2000-00	CC4xA-2	Connection cable 2 m
15-2000-01	CC4xA-5	Connection cable 5 m
15-2000-02	CC4xA-10	Connection cable 10 m
15-2000-04	CC4xA-20	Connection cable 20 m
15-2000-06	CC4xA-50	Connection cable 50 m
15-2001-00	SDCO232-2	RS232 cable, D-SUB9F/luster clamp, 2m
17-2000-00	LDMTool	License number for PC software LDMTool