User Manual

LDM 301

Firmware Version from 1.1.12

Version 1.2

Dear User,

You are advised to carefully read this User Manual before turning on the LDM 301 Laser Distance Meter 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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Manual version:	V 1.2
Firmware version:	from 1.1.12

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.

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1 General

The LDM 301 Laser Distance Meter has been developed for use in industrial applications. Its purpose is to allow non-contact measurement of distance and speed within a big working range. Short measurement time and no reflector are required to locate any kind of diffusely reflecting target surface.

Available interfaces are RS232, RS422, SSI or Profibus, depending on the particularly requested model. The Laser Distance Meter is designed for easy installation and start. A LED display is located on the back panel to facilitate visual tracking of the current working status during normal operation.

Compact and robust design, easy mechanical attachment, low power consumption, selectable switching outputs and options for specific user settings are the distinguishing features of the LDM 301. Together they create a broad diversity of potential applications in industrial environments.

- Process monitoring in steel works and rolling mills
- Fill-level measurement
- Monitoring of moving objects
- Positioning of cranes and loading equipment
- Measurement of otherwise inaccessible target points, for example, inside of hollow bodies such as tubes or containers
- Position monitoring of road vehicles and ships

Standard LDM 301 delivery includes integral heating, status display and a telescopic sight. The red Laser point of the Pilot Laser is used to aim securely at the measuring point.

Of modular setup, the Distance Meter readily accepts accessories or custom-manufactured modules for specific applications.

The measure principle is based on runtime measurement. Thereby short Laser pulse signals are beamed. The device detects the signal that is reflected by the object and calculates the distance from time delay.

Measure range depends on reflectivity and surface of the target.

2 Safety Notes

2.1 Basic Information

Safety notes and operating advice must be read carefully and followed at any time during practical use of the LDM 301.

There is danger of Laser radiation or electric shock. For necessary repairs, the LDM 301 may not be opened by anyone other than manufacturer personnel, since dangerous high voltage and Laser radiation are generated in the inner parts of the device. Unauthorized intervention will void any claims for warranty.

Specified operating requirements (section 3 Intended Purpose) must be met.

Failure to comply with these safety notes or non-conforming product usage may cause physical injury to the user or damage to the LDM 301. Connectors must not be plugged or unplugged with the LDM 301 in powered state. Remember to turn power off before you begin any kind of work for establishing connections.

2.2 Laser Classification

The LDM 301 is equipped with two Lasers:

Laser for measurement	>	Laser Class 1
Pilot Laser	>	Laser Class 2

2.2.1 Safety Notes Regarding Laser Class 1

The Laser for measurement qualifies as a Class 1 Laser device in accordance with standard EN 60825-1:2003-10. Laser radiation emitted by Class 1 Lasers is entirely harmless to the human eye so eye damage can be ruled out for this category.

2.2.2 Safety Notes Regarding Laser Class 2

The Pilot Laser qualifies as a class 2 Laser device in accordance with standard IEC825-1/DIN EN 60825-1:2001-11 and as a class II device under FDA21 CFR.

In the event of accidental short-time exposure, the human eye is normally protected by its own lid-closing reflex and preventive reaction. The natural lid-closing reflex may however be impaired by the influence of medication, alcohol or drugs. Despite that, one should refrain from directly looking into the Laser beam. Do not point the Laser beam onto people.

Warning: Class 2 Laser Radiation – do not look into the beam!

Figure 1 Warning Hint Laser Class 2

The Pilot Laser can be switched off after device installation using the command PL0 (section 8.3.2 PL – Pilot Laser).

2.3 Electrical Power Supply

For normal operation of the LDM 301, direct voltage supply of 10 V to 30 V is required. For operation with heating, direct voltage of 24 V should be available.

Observe specified limit values for input voltages. Outputs **must not** be used as inputs. All outputs are short-circuit proof. The LDM casing is electrically isolated from the sensor electronics. Immunity to electrostatic discharges (ESD) is 4 kV according to EN 61000-4-2.

2.4 Important Operating Advice

To be able to exploit all capabilities and performance features and achieve a long service life of the system, you should follow all of the following rules:

- The LDM 301 must not be powered up if optical surfaces are found to be misted up or contaminated!
- Optical surfaces must not be contacted with bare hands!
- Use utmost caution when removing dust or dirt from an optical component!
- Prevent shock impacts during operation and transportation of the LDM 301!
- Protect the LDM 301 from overheating!
- Protect the LDM 301 from strong temperature variations.
- The LDM 301 provides splash-proofness and dust-proofness under IP67 internal protection level.

These safety and advisory notes must be read carefully and followed during practical use of the LDM 301.

3 Intended Purpose

3.1 General Product Description

The LDM 301 is a Laser Distance Meter for determining the distance to objects in motion or stationary with centimetre accuracy for:

- natural surfaces with 90% reflectivity in the range of 0.5 m to 300 m,
- reflector surfaces (e.g. Scotchlite 3000x) from 300 m to 3000 m and
- speed measurement in the range of 0 m/s to 100 m/s (at 0.5 m to 700 m distance).

With the help of a red Laser sighting point (Pilot Laser) a given target can be unequivocally identified. The actual range of measurement depends on the reflectivity and the surface quality of a target being measured. The LDM 301 relies on the time-of-flight-measurement principle for operation.

It is available with RS232 or RS422, depending on the Customer's request. Product manufacturing includes the installation of a requested configuration. Once installed, the interface cannot be replaced with another type.

The LDM 301 has two switching outputs and one external trigger input (all of them can be parameterized).

A distance measurement can be triggered:

- via RS232 interface or RS422 interface
- via Profibus DP-V0,
- by an external source (in external trigger mode),
- via SSI.

The LDM 301 is delivered in a stable cardboard box with adequate padding which can also be used for protected transportation of the Laser Distance Meter.

3.2 Conforming Use

- Measurement of distance and speed and output of measured data via RS232 or RS422 interface or SSI or Profibus
- Special measuring functions

- Compliance with environmental requirements, operating temperature and storage temperature
- Operation in industrial environments that meet IP67 internal protection standard requirements (allowing for splashes of water and spray)
- Operation at correct voltage level
- Applying only specified signal levels to data lines.
- Measurement through an optically transparent medium such as glass, optical filters or Plexiglas should be performed with the measuring window function turned on.

3.3 Non-Conforming Use/Error Sources

- Operate the LDM 301 only in accordance with its intended purpose and in a proper working condition.
- Safety devices must not be defeated.
- Information and warning signs must not be removed.
- Repair work on the LDM 301 must be performed by authorized personnel only.
- Do not operate the LDM 301 in an explosive environment.
- In order to obtain precise measurement results, make sure you follow these rules:

- Measurement against the sun or other strong sources of light may lead to faulty readings.
- Measurement of target surfaces with poor reflectance, but otherwise surrounded by a highly reflecting environment, may lead to faulty readings.
- Measurement of strongly reflecting surfaces may lead to faulty readings.
- Measurement through an optically transparent medium such as glass, optical filters, Plexiglass, etc. may lead to faulty readings.
- Do not use bad reflective materials (dark / black surfaces) as target under 10 m.
- Rapidly changing conditions of measurement (e.g. jumps in distance) may lead to faulty readings.

4 Technical Data

Measuring features	
Measuring principle	Laser-pulse-time-of-flight measurement
Measuring range [1]	0.5 m ... 300 m with natural surfaces [2] 0.5 m ... 3000 m on target bound
Measuring accuracy	± 20 mm (measured value output at 100 Hz) ± 60 mm (measured value output at 2 kHz)
Resolution	1 mm
Measuring time	Standard version: 0.5 ms Special version: 0.1 ms
Measuring range velocity [3]	0 ms^{-1} ... 100 ms^{-1}
Measuring time velocity [3]	0.1 s ... 0.5 s

[1] depending on target reflectivity, stray light influences and atmospheric conditions
[2] natural, diffusely reflecting surfaces, do not use bad reflective materials (dark / black surfaces) as target under 10 m
[3] distance range to target: 0.5 m ... 700 m

Laser	
Laser for measurement	Laser classification: **Laser Class 1** under EN 60825-1:2003-10, Laser beam divergence Standard version: 1.7 mrad Special version: 10 mrad, Wavelength 905 nm (infrared, invisible)
Pilot Laser	Laser classification: **Laser Class 2** under IEC 825-1 / EN 60829, Wavelength 635 nm (rot)

Electric power requirements	
Supply voltage	10 V ... 30 V DC
Power consumption	< 5 W (without heating) 11.5 W (with heating, 24 V)

Interfaces/terminals	
Terminals	1x 12-pole (BINDER series 723) M18 2x 5-pole (BINDER series 766) M12 B-encoded
Serial interfaces	RS232 or Option RS422, 9.6... 460.8 kBaud, format: 8N1, ASCII
Profibus (LDM 301 P)	DP-V0 slave | IEC 61158 / IEC 61784 9.6 kBaud ... 12 MBaud, automatic detection, external terminator, slave address selectable via Profibus
SSI (LDM 301 S)	50 kHz ... 1MHz, 25 µs pause 24bit, binary or gray-encoded, adjustable
Digital switching output	2x „high-side-switch“, max. load 0.22 A, short-circuit-proof, adjustable windowing
Analog output	4 mA ... 20 mA current output
Trigger for device synchronization	1 x trigger In/Out, edge and delay selectable, trigger level 3 ... 30 VDC,
Operating modes	Single measurement, continuous measurement, mean value, external triggering (selectable near-field suppression and window functions)

Environmental & operating requirements	
Operating temperature	- 40 °C to + 60 °C
Storage temperature	- 40 °C to + 70 °C
Rel. air humidity	15 % to 90 %
Phys. dimensions (LxWxH)	136 mm x 57 mm x 104 mm
Weight	About 800 g (depending on configuration)
Type of protection	IP67
EMC	EN 61000-6-2, EN 55011

Table 1 Technical Data

5 Product Description

5.1 Configurations/Options

The LDM 301 is available in different configurations. They differ in their terminals and interfaces. The following devices are available:

Name	LDM 301A/RS232	LDM 301A/RS422	LDM 301 P	LDM 301 S
Serial interface	RS232	RS422	RS232	RS232
Analog output	Yes	Yes	Yes	Yes
Profibus	-	-	Yes	-
SSI	-	-	-	Yes

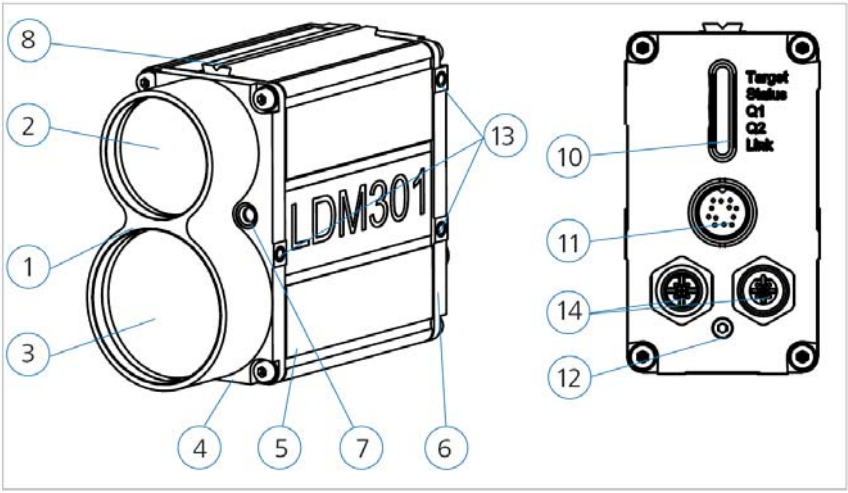
Table 2 Device Configurations

Depending on the measuring task the following options are additionally available:

- Increased maximum measuring frequency,
  10 kHz instead standard 2 kHz
- Laser with increased divergence,
  10 mrad instead standard 2 mrad

5.2 Functional Elements

The casing consists of a robust, corrosion-resistant extrusion-molded aluminum structure with a front cover plate and a back cover plate equally corrosion-resistant. On each lateral side and on the underside of the LDM 301 casing there are three support pads with mounting holes (M4) for mechanical attachment of the LDM 301 (Figure 3).



1	Front tube	8	11 mm-rail
2	Transmitter optics	10	Status display
3	Receiver optics	11	Main connector (M18)
4	Front cover plate	12	Service screw
5	Casing	13	Support pads with M4 x 6
6	Back cover plate	14	optional connectors Profibus or SSI
7	Pilot Laser		

Figure 2 Functional Elements

5.3 Mechanical Integration Requirements

For integration of the LDM 301 Laser Distance Meter, three different versions of mechanical attachment are available.

1. Attachment to a lateral surface: For attachment to a desired one of the two lateral surfaces, the LDM 301 provides three support pads (Figure 3) with mounting holes (M4 x 6).
2. Attachment to casing bottom: Likewise, the LDM 301 provides three support pads (Figure 3) with mounting holes (M4 x 6) for attachment to the bottom face of its casing
3. Attachment via adapter plate (replacement of LDM300C): To replace an LDM300C with an LDM 301, an adapter plate is required. This plate must be screwed to the bottom side of the LDM 301. The adapter plate is specifically shaped and sized to allow the LDM 301 to be attached to the mechanical fixing points of an LDM300C.

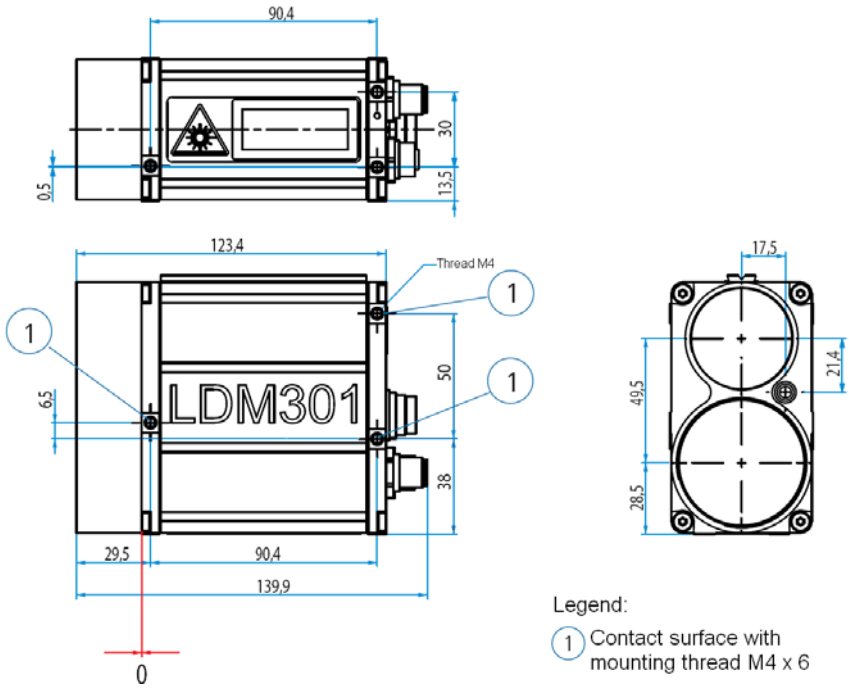


Figure 3 Fitting dimensions LDM 301, zero-point (dimensions in mm)

Zero-point of the LDM 301 is identical with the outer surface plane of the front cover plate.

5.4 Connector Pin Assignments

Depending on the implemented configuration version of the various LDM 301 models, different terminal facilities are available for connections. All models share the same type of main connector port.

5.4.1 Main Connector Port (M18)

The main connector port (Figure 2, no. 11) includes the terminal points for voltage supply, for serial data communication (RS232 or RS422), for the two switching outputs (Q1 and Q2), one analog output (QA) and for one trigger input (TRIG). A shielded cable must be used for connection. This cable is included in delivery.

white	A	TxD / RX+
brown	B	RxD / RX-
green	C	TRIG
yellow	D	QA
grey	E	n.c. / TX-
pink	F	n.c. / TX+
blue	G	VCC
red	H	n.c.
black	J	GND
violet	K	Q2
grey/pink	L	GND
red/blue	M	Q1

Figure 4 Terminal diagram of main connector port

Attention: Heed cable colours: **blue – VCC and gray/pink – GND**! Please use only high quality shielded cable.

Pin	Colour code of cable	RS232	RS422	Description
A	White	TxD	RX+	RS232 send data / RS422 receive data +
B	Brown	RxD	RX-	RS232 receive data / RS422 receive data -
C	Green	TRIG	TRIG	Trigger input
D	Yellow	QA	QA	Analog output (4 … 20 mA)
E	Grey	n.c.	TX-	RS422 send data -
F	Pink	n.c.	TX+	RS422 send data +
G	Blue	VCC	VCC	Supply voltage
H	Red	n.c.	n.c.	not connected
J	Black	GND	GND	GND
K	Violet	Q2	Q2	Switching output Q2
L	Grey/pink	GND	GND	GND
M	Red/blue	Q1	Q1	Switching output Q1

Table 3 Pin assignments of main connector port

5.4.2 SSI-Port (M12)

Connection to the SSI interface is accomplished via a 5-pole, B-encoded M12 male connector. Shielded cables should be used for connection..

Figure 5 Connection diagram SSI

5.4.3 Profibus Port (M12)

Profibus connection is via B-encoded 5-pole M12 connectors. Shielded cabling should be used.

Figure 6 Profibus-IN connection diagram

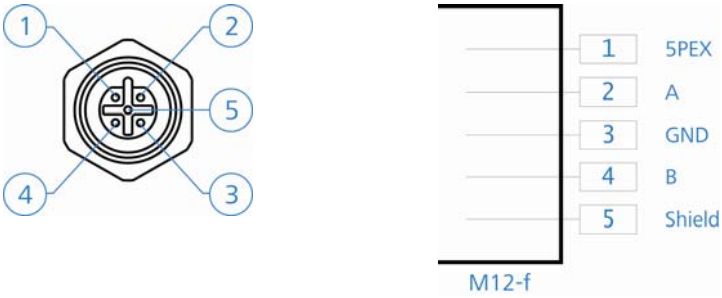


Figure 7 Profibus-OUT connection diagram

5.5 Status Display

Figure 8 Status display

LED	Function	Display	Status
Target	Reflectivity	Off Red blinking Red Yellow Green Green blinking	No signal Very weak signal Weak signal Signal available Good signal Very good signal
Status	Readiness for action	Off Red Green	No operating voltage Technical defect, operating voltage supplied Ready for action
Q1	Switching output 1	Off Yellow	Off Operating voltage supplied
Q2	Switching output 2	Off Yellow	Off Operating voltage supplied
Link	Status interface	Off Red Yellow Green	No field bus Profibus error Operating voltage supplied, Profibus inactive Operating voltage supplied, Profibus working

Table 4 Status display – functions

5.6 Pilot Laser

The Pilot Laser (Figure 3, no. 7) is intended to support alignment to a given target point during start-up action of the LDM 301. It qualifies as a Class 2 Laser device and operates at 635 nm (red) in the visible range. The Pilot Laser is not aligned to emit in a direction parallel with the measurement Laser. Instead, its beam intersects with that of the measurement Laser at a distance of 75 m.

Figure 9 shows the tolerance on Pilot Laser position in relation to the invisible measurement Laser as a function of the distance to an object being measured:

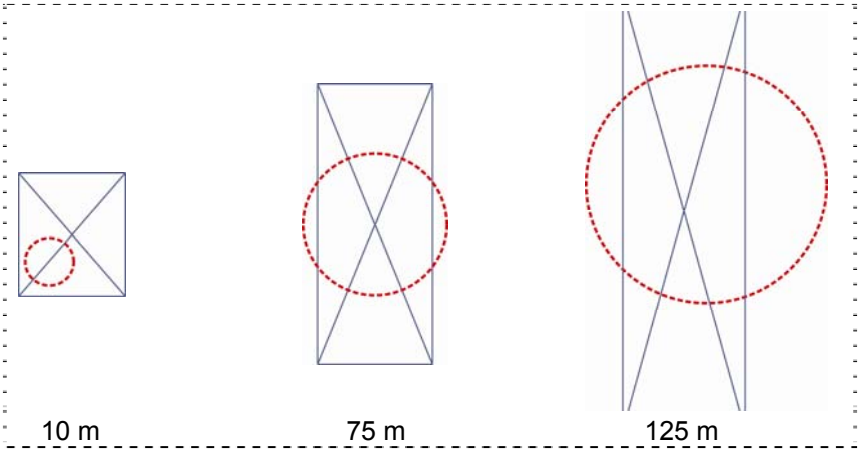


Figure 9 Pilot Laser position tolerance relative to measurement Laser

5.7 Accessories

5.7.1 Connection Case

A connection case with integrated terminal strip and accessories is optional available.

5.7.2 Protection Case

A stainless steel protection case with integrated terminal strip and accessories is optional available.

5.7.3 Software LDMTool

A software demo version of the LDMTool is in the scope of delivery. By purchasing a license number the full version can be activated. Parameterization and numerical measure value display via the integrated terminal are fully supported by the demo version.

6 Interface Description

For interfacing, the LDM 301 provides different connectors depending on the specification (5.1 Configurations/Options). A main connector port (Figure 3, no. 11) with RS232 or RS422 interface and an additional SSI interface (Figure 4, no. 3) or a Profibus interface (Figure 4, no. 4, 5), depending on the customer`s request.

6.1 RS232 or RS422 Interface

6.1.1 Communication Protocol

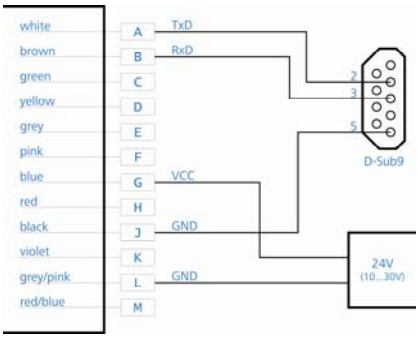
- Interface settings: asynchronous, 8 data bits, no parity, 1 stop bit
- Communication protocol format/syntax: 7-bit ASCII
- Proprietary communication protocol
- Commands are case-sensitive (no distinction between small lettering and capital lettering)
- Period “.” (0x2E) serves as decimal separator for output of numbers
- Enter (0x0D) is used as command (send command) termination character
- With multi-value parameters, space (0x20) is used between each two values
- A parameterization command with new parameters triggers a response command with these parameters
- A parameterization command 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 is quitted via “?” (0x3f)

Command group	Command	Description	Standard(s)	Range(s)
Operation mode	DM	Single distance measurement	-	-
	DT	Continuous distance measurement	-	-
	DF	Single distance measurement with external triggering	-	-
	VM	Single speed measurement	-	-
	VT	Continuous speed measurement	-	-
Status	TP	Internal device temperature in °C	-	-
	PA	All-parameter display	-	-
	HW	Hardware diagnosis	-	-
Setup parameter	PR	Reset to factory settings	-	-
	DR	Triggers a cold start	-	-
	ASs	Autostart function	DT	ID, ID?, DM, DT, DF, VM, VT, TP, HW, PA, MF, TD, SA, SF, MW, OF, SE, Q1, Q2, QA, BR, SD, TE, BB, AB, SC, PL, AS
	MFx	Measuring frequency [Hz]	2000	1 … 2000
	TDx y	External trigger delay [ms] and trigger level [edge]	00.00 0	0 … 300.00 0 or 1
	SAx	Mean value	200	1…30000
	SFx	Scale factor	1	± 0.001 … 10
	MWx y	Measuring window at beginning and end	0 5000.000	± float 32 ± float 32
	OFx	Distance offset end	0.000	± float 32

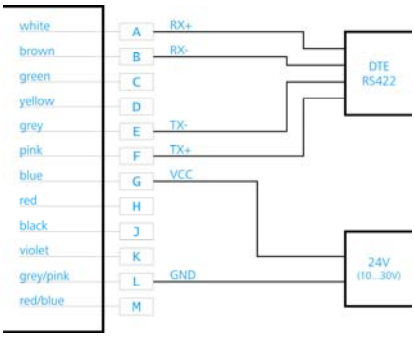
Command group	Command	Description	Standard(s)	Range(s)
	SO	Single distance measurement and acceptance as distance offset	-	-
	SEx	Error mode for Q1, Q2 and QA	1	0 ... 2
	QAx y	Analog output with lower and upper limit	0 50.000	± float 32 ± float 32
	Q1w x y z	Q1 switching output with trigger threshold, switching range, hysteresis and switching state	2.000 5000 0.100 1	± float 32 ± float 32 ± float 32 0 or 1
	Q2 w x y z	Q2switching output with trigger threshold, switching range, hysteresis and switching state	4.000 5000 0.100 1	± float 32 ± float 32 ± float 32 0 or 1
	BRx	Baud rate	115200	9600, 19200, 38400, 57600, 115200, 230400 or 460800
	SDx y	Output format of serial interface	0 0	0 … 2 0 … 3
	TEx	Terminating character for output via serial interface	0	0 … 9
	SCx	SSI format	0	0 … 1
	PLx	Pilot Laser	0	0…3
	BBx	Field bus baud rate	0	0
	AB	Bus address	0	0

Table 5 Command summary table

6.1.2 Wiring



Wiring RS232 to D-Sub9



Wiring RS422 to RS422 unit

Figure 10 Wiring serial interface

6.1.3 Q1 and Q2 Switching Outputs

The purpose of Q1 and Q2 is to represent distance readings as logic operation data. They report events of positive or negative excession of a preset switching range with a certain amount of hysteresis.

Accordingly, they are perfectly suited for direct reprocessing of monitored quantities such as filling level or for detection of objects. Parameter settings are made via the serial interface. The command to achieve this is Q1w_x_y_z (where "_" is equivalent to space (0x20)).

Value	Description	Specification
w	Trigger threshold	
x	Switching range	x ≥ 0; x ≥ y
y	Hysteresis	y ≥ 0
z	Switching state	z = 0 or1

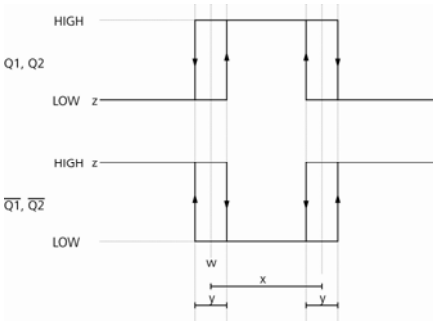


Figure 11 Switching characteristics of LDM 301

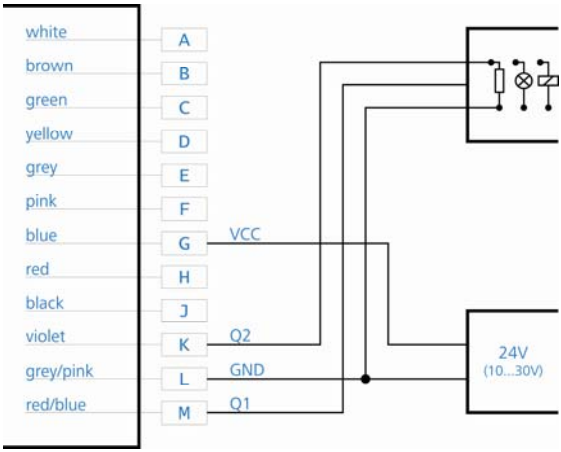


Figure 12 Example of LDM 301 switching output wiring

6.1.4 Analog Output QA

The analog output allows standardized analog data transfers from or to a remote location over greater distances using a two-wire transmission line. The current which is injected into this line at levels from 4 mA to 20 mA is proportional to the measured distance within a selectable distance interval. Parameter settings can be made via the serial interface.

The command to achieve this is QAx_y (where "_" is equivalent to space (0x20)). Parameter settings for current output in the event of measurement failure can be made using the command SEx.

Value	Description	Specification
x	Lower limit	x ≠ y
y	Upper limit	y ≠ x

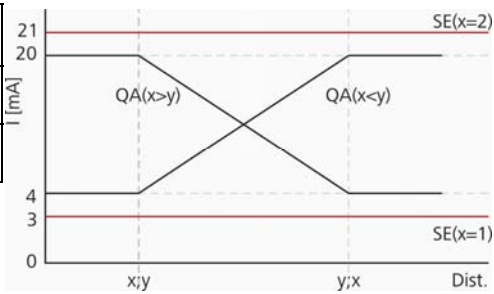


Figure 13 Signal diagram of LDM 301 analog output

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

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

$x > y$ $\quad QA\,[mA] = 20\,mA - 16 \cdot \frac{Dist. - y}{x - y} \cdot mA$

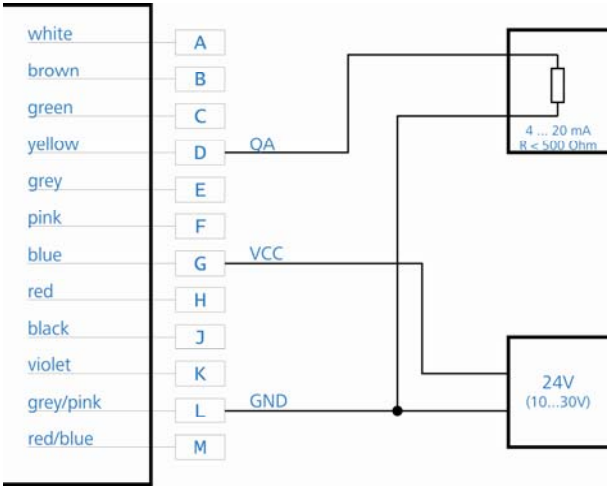


Figure 14 Example of LDM 301 analog output wiring

6.1.5 Trigger Input

The trigger input allows a single distance measurement to be triggered by an external signal that is applied as a voltage pulse. Selectable parameter settings are a value for delay in triggering (Trigger Delay) and the edge on which triggering is to occur (Trigger Level).

Parameter settings for trigger input can be made via the serial interface. The command to achieve this is TDx_y (where "_" is equivalent to space (0x20)). The trigger function is enabled in DF measuring mode.

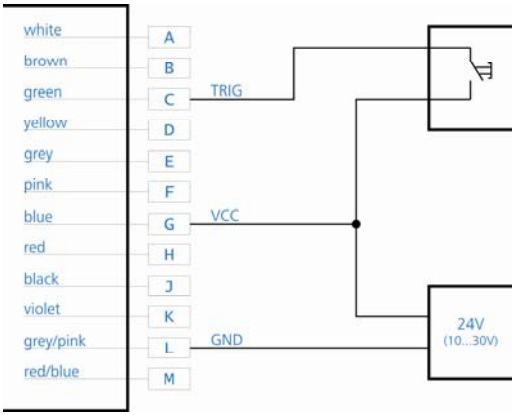


Figure 15 Example of LDM 301 trigger input wiring

6.2 SSI Interface

6.2.1 Specification

Optionally, the LDM 301 can be equipped with an SSI data interface (SSI=Synchronous Serial Interface). At the request of an SSI clock generator a distance measurement cycle will start, sending related data which are present at the shift register bit-by-bit to a controller. Depending on the length and quality of selected data lines, actual transfer rates may range from 50 kHz to 1 MHz with 25 µs pause time between two bit sequences.

The data length is 24 bits plus one validity bit The format can be binary or gray-encoded. For parameter settings via the serial interface, the SCx command is available.

SCx x=0...binary, 25 bits (24 bits plus 1 validity bit)

x=1...gray, 25 bits (24 bits plus 1 validity bit)

Bit sequence:

24	23	.....	2	1	0
MSB		Bits 1 – 24 distance depending on preset scale factor		LSB	*)

*) Bit 0: Validity bit

6.2.2 Electrical Connection

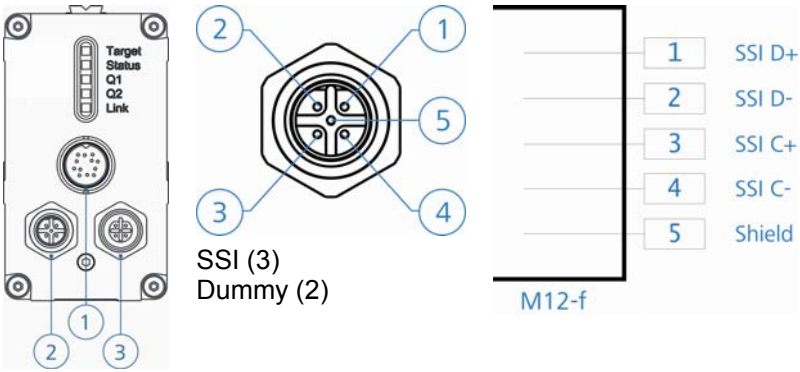


Figure 16 Connection diagram M12 connector

6.3 Profibus Interface

6.3.1 ID Number

The LDM 301 has the ID number 0AA2 (hex).

6.3.2 Connection Requirements

The LDM 301 may be connected to any kind of Profibus DP structure, the requirement being that the selected Profibus DP master is capable of sending a parameterization telegram, and the master's pertaining editing tool (typically, editing software) will support the representation of parameters that are contained in the respective device master file (GSD file.

6.3.3 GSD File

The GSD file is named LDM30AA2.GSD. A GSD file includes the two files LDM301.dib and LDM301.bmp. These are intended for representation of the LDM 301 in the editing tool. For integration of these files, please consult the special editing tool.

6.3.4 Slave Address

To facilitate multiple-participant bus communication, the Profibus slave address can be set in a range of 0 to 125. A desired address can be set via the Profibus, using the SSA command. For information on how to

change the slave address via the editing tool, you should consult the special editing tool documentation. Address 4 is set in as-shipped state of the LDM 301.

The slave address is permanently maintained in the EEPROM. It will also be preserved in the event of a voltage failure. Where more than one slave (LDM 301) are to share a common Profibus, the various slaves must be connected one after the other and be assigned different addresses.

6.3.5 Bus Termination

For LDM 301 operation, an external bus terminator must be installed. Voltage supply of 5 V required for the terminator is available at Profibus-OUT. This 5 V supply is electrically isolated from general voltage supply (VCC) and rated for a current load up to 100 mA.

The terminating resistor is available as an accessory item.

6.3.6 Baud Rate

The LDM 301 has its own device for automatic detection of the following baud rates: 9.6 / 19.2 / 93.75 / 187.5 / 500 k baud and 1.5 / 3 / 6 / 12 MBaud.

6.3.7 Segment Length

The maximum allowed segment length between to Profibus participants depends on the selected baud rate. The following rules on segment lengths must be fulfilled:

Baud rate [baud]	Segment length [m]
9.6 k – 93.75 k	1200
187.5 k	1000
500 k	400
1.5 M	200
3 M – 12 M	100

Table 6 Pofibus baud rate versus segment length

To comply with these segment rules, use of cable type A is strongly recommended. Distinguishing features of cable type A are:

Parameter	Wert
Wave resistance	135 ... 165 Ohm
Capacitance per unit length	< 30 pf/m
Loop resistance	< 110 Ohm/km
Cable wire diameter	> 0.64 mm
Cable wire cross-section	> 0.34 mm²

Table 7 Pofibus cable features

6.3.8 Electrical Connection

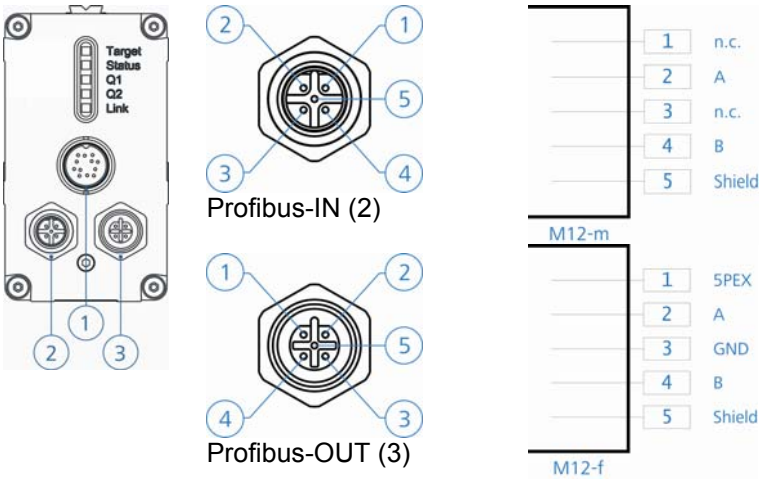


Figure 17 Connection diagram M12 connector

6.3.9 Profibus-Parameter

A PB master uses the GSD file to edit parameters for the slave. It must send these at least once to the slave in order to enable the slave to operate in cyclic data exchange mode. Because the slave has been programmed with adequate tolerance, it can be operated with only 7-

byte standard PB parameters (i.e. involving no specific user profile parameters). .

Class 2 function:	Selects slave type according to encoder profile
Commissioning Diagnostics:	Sends more than six standard diagnose bytes (16 bytes for class 1 slave, 77 bytes for class 2 slave)
Measure Mode:	Operating (trigger) mode of Laser (DF, DT)
Trigger Delay and Level:	Transfers values directly to command TDx (only for DF external)
Averaging:	Transfers value to command SAn (number of values for averaging)
Measuring Frequency:	Number of measurement cycles per second (1 to 2000 or to 1000, respectively). Is transferred to command MFnn.
Offset:	A measured value can be assigned a certain offset (corrective value). This value will not be transmitted to the Laser Distance Meter. Instead, it is processed in the very PB assembly.
Scale Factor:	Available scaling factors from -10.0 to +10.0 Up to five post-comma digits can be processed
Error Mode:	Selects distance value in the event of an error.
Pilot Laser:	Turns Pilot Laser on, off or into blinking mode.
Measuring Window:	Defines starting point and end point of measuring window.
Diagnostic Interval:	0: sets output of diagnostic data in the case of alarms only 1 to 10000: sets output of diagnostic data at intervals of n x 100ms.
Alarm 1/2:	Sets switching threshold for output n in distance units. Is transferred to command Qn.
Active Range Alarm 1/2:	+/- range for switching outputs in distance units. Is transferred to command Qn.
Hysteresis Alarm 1/2:	+/- hysteresis for switching outputs in distance units. Is transferred to command Qn.
Active Range Level Alarm 1/2:	0 or 1 for switching outputs in active range. Is transferred to command Qn.

6.3.10 Diag Common

General diagnostic data fully comply with the standard profile. They are updated with each Profibus diagnosing request. The use of “Diag Common” data presumes availability of class 2 functionality and a commissioning diagnostic function. In the case of errors (Enn), an alarm message will be transmitted as Extended Diagnosis containing the full set of diagnostic data.

In order to have the current temperature and operating time values displayed, Diagnostic Interval must be set to a value unequal “0”. A

Diagnostic Interval setting of 100 will cause a 10 sec updating of data. Please note that the Laser Distance Meter must register and transfer a temperature value in DF modes as a precondition for temperature output. This means that temperatures will not be transmitted unless values were recorded.

6.3.11 Diag Alarm

Alarm messages by the Laser Distance Meter are output once in the form of EXT.DIAG. Active alarms are marked by X instead of - Alarms are counted, but never saved.

E98 shows problems in communication with the Laser Distance Meter. Errors are reported as Ext.Diag on occurrence. This is followed by an attempt to re-trigger the Laser. As a result, permanently repeating errors will positively increment the content of the related error counter.

6.4 Start Up

6.5 Preparative Action before Installation

- Remove LDM 301 packing with utmost caution
- Check for completeness of scope of delivery
- Inspect Laser Distance Meter and accessory items for visible damage
- Inspect connector terminals and cabling for visible damage

6.6 Checklist on Installation Work

The table below contains a proposal for LDM 301 start-up work. It does not claim to be complete. To provide specific user cabling is the responsibility of the user and assumed to be available. It is also the user's responsibility to make application-adapted parameter settings of the Profibus (optional), notably, of the slave address.

No.	Working step
1	Unpack LDM 301, inspect for visible damage
2	Mechanically fix LDM 301 in working position, use three M4 threaded holes of one of three available mounting pads of the LDM 301 (5.3 Mechanical Integration Requirements)
3	Insert connector in main connection port and screw connector firmly on. Make sure you do this in power-off state!
4	Install and firmly screw Profibus and SSI connectors (optional)
5	Turn on voltage supply. Status LED must light green
6	Make LDM 301 parameter settings via RS232/RS422
7	Direct LDM 301 onto target, using the sight pointer or additional sighting device on 11mm-rail
8	Select distance measurement mode
9	Trigger distance measurement (Laser turns on, measurement cycle is launched via Profibus or SSI)
10	Use visible Laser (Pilot Laser) to sight a given target
11	Lock the LDM 301
12	Final visual inspection

Table 8 Start up LDM 301

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

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 3.1 or higher (Figure 18).

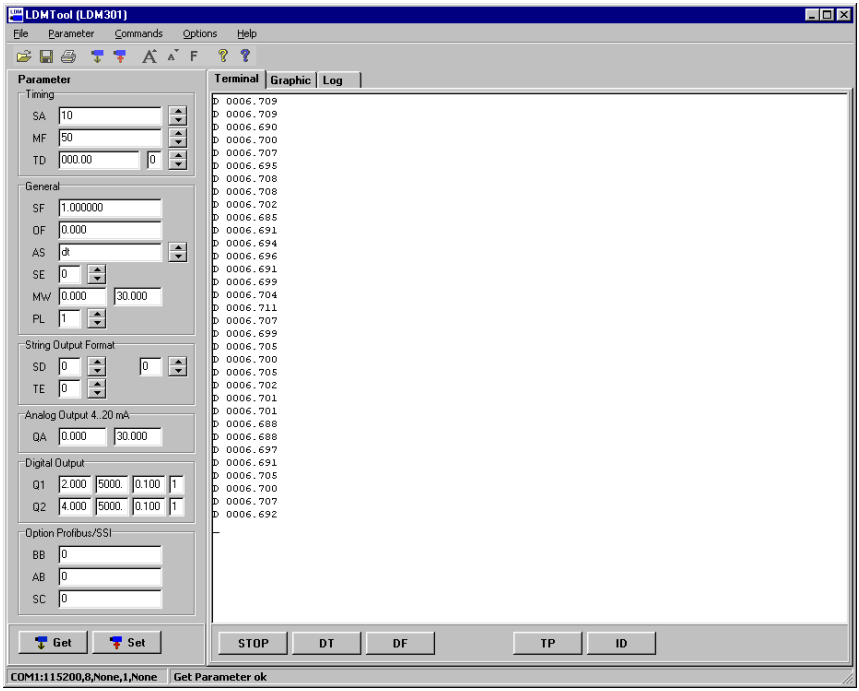


Figure 18 Program LDMTool

7 Measurement

7.1 Identification

7.1.1 ID – Identification

In response to an ID command, the LDM 301 outputs its manufacturing data in this order: product type, firmware version, firmware data, firmware time, fabrication number, date of manufacture and time of manufacture.

Example:

LDM 301 1.2.2(R) 03.07.2007 11:31 060001 11.04.2007 08:56

8 ID? – Online Help

On triggering an ID? command, the user will be displayed an overview of all available operations and parameters. These are explained in the following sections.

```
Operation Mode
  DM[Enter]..................single distance
  DT[Enter]..................continuous distance internal trigger
  DF[Enter]..................continuous distance external trigger
  VM[Enter]..................single velocity
  VT[Enter]..................continuous velocity internal trigger
Status
  TP[Enter]..................internal temperature [°C]
  HW[Enter]..................hardware status
  PA[Enter]..................display parameter
Setup Parameter
  AS[Enter]/ASxyz[Enter].....display/set autostart command
  PL[Enter]/PLx[Enter]........display/set pilot laser
  PR[Enter]..................reset parameter
  DR[Enter]..................reset device
  SF[Enter]/SFx[Enter]........display/set scale factor
  OF[Enter]/OFx[Enter]........display/set user offset
  SO[Enter]..................set user offset from distance
  MW[Enter]/MWx y[Enter].....display/set measure window
  MF[Enter]/MFx[Enter]........display/set measure frequency
  SA[Enter]/SAx[Enter]........display/set average value
  TD[Enter]/TDx y[Enter].....display/set trigger delay level
  SE[Enter]/SEx[Enter]........display/set error mode
  Q1[Enter]/Q1w x y z[Enter]..display/set digital output Q1
  Q2[Enter]/Q2w x y z[Enter]..display/set digital output Q2
  QA[Enter]/QAx y[Enter].....display/set analog output QA
  BR[Enter]/BRx[Enter]........display/set baud rate RS232/422
  SD[Enter]/SDx y[Enter].....display/set data format RS232/422
  TE[Enter]/TEx[Enter]........display/set terminator RS232/422
  BB[Enter]/BBx[Enter]........display/set baud rate bus
  AB[Enter]/ABx[Enter]........display/set address bus
  SC[Enter]/SCx[Enter]........display/set SSI format
```

Figure 19 Online help (command ID?)

8.1 Operation Mode

8.1.1 DM – Single Distance Measurement

The LDM 301 performs exactly one measurement, on completion of which it will wait for next instructions.

The time a measurement cycle requires depends on the number of SA measurement value settings and the preset measuring frequency (MF).

8.1.2 DT – Continuous Distance Measurement

The LDM 301 performs continuous distance measurement until halted by a special command (RS232/RS422: Escape = 0x1B).

The output rate of measured values depends on the number of SA measuring value settings and the preset measuring frequency (MF).

8.1.3 DF – Single Distance Measurement with External Trigger

The LDM 301 must be transferred to DF operating mode. It will then perform exactly one measurement cycle on receipt of an external trigger signal and wait in DF mode for the next trigger event to arrive.

This operating mode must be terminated with the help of a special command (RS232/RS422: Escape = 0x1B).

Trigger events must be applied to the external trigger input (6.1.5 Trigger Input).

The interval between two single measurements depends on the number of preset SA measurement values, the setting for measurement frequency (MF) and the setting for trigger delay (TD).

8.1.4 VM – Single Speed Measurement

The LDM 301 performs 25 single measurement cycles, on completion of which it will use the 25 single readings to calculate a resulting speed.

The length of time, which measurement requires, depends on the number of preset SA measurement values and the setting for measurement frequency (MF).

8.1.5 VT – Continuous Speed Measurement

The LDM 301 performs continuous measurement in packages of 25 single measurement cycles. This measuring mode must be halted with a special command (RS232/RS422: Escape = 0x1B).

The time interval between single measurements depends on the preset number of SA measurement value and the setting for measurement frequency (MF).

8.2 Status

8.2.1 TP – Internal LDM Temperature

The LDM 301 outputs its internal temperature via the serial interface and the Profi-bus. Temperature values are output in degrees Celsius (°C).

8.2.2 PA – All-Parameter Display

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

Example:

```
measure frequency[MF]            2000hz
trigger delay/level[TD]          0.00msec 0
average value[SA]                20
scale factor[SF]                 1.000000
measure window[MW]               -5000.000 5000.000
distance offset[OF]              1.000
error mode[SE]                   1
digital out[Q1]                  20.000 10.000 1.000 1
digital out[Q2]                  1.000 30.000 0.500 1
analog out[QA]                   1.000 300.000
RS232/422 baud rate[BR]          115200
RS232/422 output format[SD]      dec (0), value (0)
RS232/422 output terminator[TE]  0Dh 0Ah (0)
SSI output format[SC]            bin (0)
visier pointer[PL]               2
autostart command[AS]            ID
```

Figure 20 Display parameter (command PA)

8.2.3 HW – Hardware Diagnosis

Outputs a specific LDM list of characteristics and measured quantities.

8.3 Setup Parameter

Parameter settings can be made via this serial interface.

0x0D as termination character will cause the command to be transmitted to the LDM 301.

For commands with one parameter, the parameter can be defined either directly or separated by space (0x20). For commands including several parameters, each two parameters must be separated by space (0x20).

8.3.1 AS – Autostart Function

This function defines how the LDM 301 will behave after a cold start. Once a cold start was triggered, the LDM will automatically perform this command and transmit related data via the serial interface.

Query:	AS
Set:	ASs
Parameter value range s:	ID, ID?, DM, DT, DF, VM, VT, TP, HW, PA, MF, TD, SA, SF, MW, OF, SE, Q1, Q2, QA, BR, SD, TE, BB, AB, SC, PL, AS
Standard:	DT

8.3.2 PL – Pilot Laser

PLx defines parameter settings for Pilot Laser behaviour.

Query:	PL
Set:	PLx
Parameter value range x:	0, 1, 2, 3 (Table 9 Pilot Laser PLx, values of parameter x)
Standard:	0

x	Pilot Laser behaviour
0	Off
1	On
2	Blinking (2 Hz)
3	Blinking (5 Hz)

Table 9 Pilot Laser PLx, values of parameter x

8.3.3 PR – Reset to Factory Settings

Resets all parameters to their factory settings except for the baud rate. We recommend not using this command. The device has to be reprogrammed afterwards (auto start, scaling of analog output etc.).

Parameter for firmware version 1.1.16:

```
measure frequency[MF] ..... 2000(max2000)hz
trigger delay/level[TD] ..... 0.00msec 0
average value[SA] ..... 20
scale factor[SF] ..... 1.000000
measure window[MW] ..... -5000.000 5000.000
distance offset[OF] ..... 0.000
error mode[SE] ..... 1
digital out[Q1] ..... 0.000 0.000 0.000 1
digital out[Q2] ..... 0.000 0.000 0.000 1
analog out[QA] ..... 1.000 300.000
RS232/422 baud rate[BR] ..... 115200
RS232/422 output format[SD] ..... dec (0), value (0)
RS232/422 output terminator[TE] ..... 0Dh 0Ah (0)
SSI output format[SC] ..... bin (0)
visier pointer[PL] ..... 2
autostart command[AS] ..... ID
```

Figure 21 Reset parameter (command PR)

8.3.4 DR – Trigger Cold Start

DR performs a cold start of the LDM 301, simulating an actual voltage break situation. This command may prove useful after changes in the auto start command.

8.3.5 SF – Scale Factor

SFx allows a measured output value to be scaled via parameter settings for a scale.

Query:	SF
Set:	SFx
Parameter value range x:	-10 … -0.001 and 0.001 … 10; resolution: 0.000001
Standard:	1.000000

8.3.6 OF – Offset

OF parameterizes a user-adapted offset x which is added to the measured value.

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

The LDM 301 performs no plausibility check on a preset offset value. Accordingly, correct parameterization is the user's responsibility!

8.3.7 SO – Set Offset

SO performs one single distance measurement, then sets it as –OF (offset). Function SO can only be carried out. It does not represent a parameter in the actual sense of the word.

SO can be used for zeroing of applications, systems, processes, etc..

8.3.8 MW – Measuring Window

Parameterizes a metrological range by definition of a starting point x and an end point y as limits for output of measured values.

Examples of measurement window application:

- Masking out sources of interference before or behind a selected range for measurement
- Definition of a desired range for measurement

A target which is detected before or behind a preset measurement window will create an invalid measured value output.

Query:	MW
Set:	MWx y
Parameter value range x:	float32; resolution: 0.001
Parameter value range y:	float32; resolution: 0.001

Standard:	0.000 ... 5000.000

The LDM 301 performs no check for plausibility of a preset measurement window. For this reason, it is the user's responsibility to ensure correct parameterization!

8.3.9 MF – Measurement Frequency [Hz]

MF parameterizes the number x of individual pulses to be emitted per second.

Query:	MF
Set:	MFx
Parameter value range x:	-1 … 2000; resolution: 1
Standard:	2000

For example, MF1000 means that 1000 individual pulses will be emitted each second. The time to measure and, hence, the transmission of a measured result via the serial interface additionally depend on the setting for parameter SA.

Examples:

MF1000, SA1000:
measuring time = 1 s (1 measured value per second at serial interface)

MF2000, SA1000:
measuring time = 0.5 s (2 measured values per second at serial interface)

MF2000, SA20000:
measuring time = 10 s (1 measured value at serial interface every 10 s)

8.3.10 SA – Average

SA parameterizes the number of single measured values to be averaged for a result. SA is directly dependent on MF. (8.3.9 MF – Measurement Frequency [Hz]

Query:	SA
Set:	SAx
Parameter value range x:	1 … 30000; resolution: 1
Standard:	200

8.3.11 TD – External Trigger Delay [ms] & Level [Edge]

TD parameterizes LDM behaviour in external trigger mode (DF).

- x designates the delay in triggering a single measurement, in units of a millisecond.
- y designates the edge on arrival of which measurement will be triggered.
- 0 means that measurement is triggered on a falling edge (high-to-low transition).
- 1 means that measurement is triggered on a rising edge (low-to-high transition).

Query:	TD
Set:	TDx y
Parameter value range x:	0 … 300.00 msec; resolution: 0.01 msec
Parameter value range y:	0 or 1
Standard:	0.00 msec 0

If TD x trigger events must have been received before a measurement is output.

8.3.12 SE – Error Mode

Parameterizes the behaviour of the two switching outputs Q1 and Q2 and that of the analog output QA in the event of failure to measure plus the state on completion of a single distance measurement.

Query:	SE
Set:	SEx
Parameter value range x:	0, 1, 2 (Table 10 Set Error Mode SEx, values for parameter x)
Standard:	1

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

Table 10 Set Error Mode SEx, values for parameter x

The LDM 301 performs no plausibility check of a selected error mode. For this reason, correct parameterization is the user's own responsibility!

8.3.13 Q1/Q2 – Switching Output

Q1/Q2 parameterizes the behaviour of switching output Q1 or Q2. (6.1.3 Q1 and Q2 Switching Outputs). Parameterizes a measurement range's starting point w, on reaching of which the output will be triggered, the length x of the measurement range, the hysteresis y and logic behaviour z.

Query:	Q1/Q2
Set:	Q1w x y z/Q2w x y z
Parameter value range w:	float32; resolution: 0.001
Parameter value range x:	float32; resolution: 0.001
Parameter value range y:	float32; resolution: 0.001
Parameter value range z:	0 or 1
Standard:	Q1: 2 5000 0.1 1 Q2: 4 5000 0.1 1

The LDM 301 performs no check for plausibility of QA settings. Accordingly, it's the user's responsibility to ensure correct parameterisation!

8.3.14 QA – Analog output

QA parameterizes the behaviour of the QA analog output (6.1.4 Analog Output QA).

Available for setting are the lower limit x and the upper limit y of a current range from 4 to 20 mA. The lower limit may both be smaller and greater than the upper limit. Accordingly, the current range will reverse.

Inputs of identical limits will be ignored and not accepted.

Query:	QA
Set:	QAx y
Parameter value range x:	float32; resolution: 0.001
Parameter value range y:	float32; resolution: 0.001
Standard:	0 50.000

The LDM 301 performs no check for plausibility of QA settings. For this reason, correct parameter settings are the user's own responsibility!

8.3.15 BR – Baud Rate

BR facilitates conversion to other serial baud rate x. Following a change in the baud rate, a cold start is not necessarily required.

Query:	BR
Set:	BRx
Parameter value range x:	9600, 19200, 38400, 57600, 115200, 230400 or 460800
Standard:	115200

8.3.16 SD – Serial Interface Format

SD parameterizes the format x and content y of serial interface outputs for distance and speed measurement. Available settings for format are decimal (ASCII), hexadecimal (ASCII) and binary.

Query:	SD
Set:	SDx y
Parameter value range x:	0, 1, 2
Parameter value range y:	0, 1, 2, 3 (Table 11 Serial Interface Format SDy, values for parameter y)
Standard:	0 0

Content means that signal strength and/or temperature are available items for output in additional to actual measured value output.

	SD0 y	SD1 y	SD2 y
y	Decimal	Hexadecimal	Binary
0	Measured value	Measured value	Measured value
1	Measured value, signal strength	Measured value, signal strength	Measured value, signal strength
2	Measured value, signal strength, temperature	Measured value, signal strength, temperature	Measured value, signal strength, temperature

Table 11 Serial Interface Format SDy, values for parameter y

8.3.17 TE – Serial Interface Termination Character

TE parameterizes the serial interface termination character for distance and speed measurement.

As a necessary requirement, output format SD0 y must be set.

Query:	TE
Set:	TEx
Parameter value range x:	0 … 9; resolution 1 (Table 12 Serial Interface Term. Char. TEx, values for parameter x)
Standard:	115200

x	0	1	2	3	4	5	6	7	8	9
Hex code	0x0D0A	0x0D	0x0A	0x02	0x03	0x09	0x20	0x2C	0x3A	0x3B
Description	CR LF	CR	LF	STX	ETX	Tab	Space	Comma	Colon	Semi-colon

Table 12 Serial Interface Term. Char. TEx, values for parameter x

8.3.18 SC – Format SSI

SC parameterizes format x of SSI code (6.2 SSI Interface).

Query:	SC
Set:	SCx
Parameter value range x:	0 or 1
Standard:	0

8.3.19 BB – Field Bus Baud Rate

Parameterizes the baud rate for field bus operation.
(currently unsupported)

Query:	BB
Set:	BBx
Parameter value range x:	0
Standard:	0

8.3.20 AB – Bus Address

Parameterizes bus address x of the field bus.
(currently unsupported)

Query:	AB
Set:	ABx
Parameter value range x:	255
Standard:	0

9 Preventive Maintenance & Care

9.1 User Maintenance Actions

Please note:

- Dust on optical glass surfaces (transmitter optics, receiver optics) may be removed using a pneumatic brush. However, do not use cleaners containing organic solvents to wipe surfaces of this kind clean. You are advised to contact the manufacturer in the event of stubborn contamination or soiling.
- Isopropanol is suitable for LDM 301 cleaning. Remember not to use solvents for cleaning.
- You are prohibited from opening the LDM 301. Failure to comply will void any claims for warranty.
- Do not loosen or remove any screw on the LDM 301.

9.2 Software Update

Firmware updates may not be performed by anyone other than manufacturer personnel.

9.3 Preventive Maintenance

In the event of necessary repair work, you should carefully pack, enclose a note stating actual operating conditions (application, connection and environment) and ship the LDM 301 to your competent dealer.

10 Malfunction & Error Messages

10.1 Malfunction

Error	Cause	Action for removal
No data via RS232 or RS422	Faulty interface configuration	Check interface configuration
Device error (external diagnosis)	Hardware problems	Reship LDM 301 for repair, contact technical support

Table 13 Malfunctions

10.2 Error Codes

Code	Cause	Action for removal
E02	No target	Check measuring distance
E04	Laser defect	Reship LDM 301 for repair, contact technical support

Table 14 Error codes

10.3 Error Messages

Error message	Cause	Action for removal
Red status LED of status display lights	Read error message via RS232 or RS422 interface	Reship LDM 301 for repair, contact technical support

Table 15 Error messages

11 PC-Interface Cable (Option)

For parameterization an optional programming is available to link the LDM 301 with a PC (COM port, RS 232). The use of PC software LDMTool is recommended.

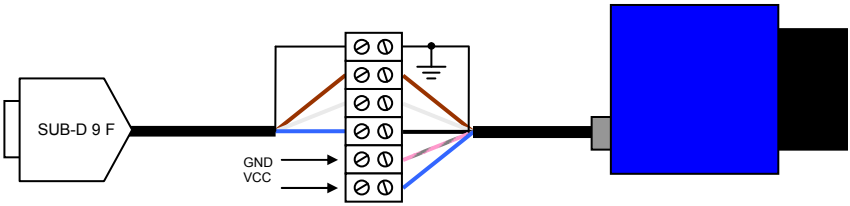


Figure 22 PC-Interface cable with power supply

Nr. SUB-D 9 F	Colour code	Name SUB-D 9 F (RS 232, PC COM)
Shield	-	Cable shield
3	brown	TxD
2	white	RxD
5	blue	GND

Table 16 Connection of programming cable PC sided

Pin LDM 301	Colour code	Name LDM 301
Shield	-	Cable shield
A	white	TxD
B	brown	RxD
J	black	GND
G	blue	VCC (+10 V ... +30 V DC)
L	grey/pink	GND

Table 17 Connection of programming cablLDM301 sided

Attention: Heed cable colours: **blue – VCC and gray/pink – GND**! Please use only high quality shielded cable.
RS 232 Cable: TxD and RxD are necessary to cross.

12 EC Declaration of Conformity

In accordance with the Directive of Electromagnetic Compatibility 89 / 336 / EWG, annex I

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

Laser distance Meter
LDM 301

Agree with the following harmonized standards:

EN 61326:1997 + EN 61326/A1:1998 + EN 61326/A2:2001 + EN 61326/A3:2003 Emission: Class B Immunity in acc. with table 1	Electrical equipment for measurement, control and laboratory use, EMC requirements

Rostock, 2007-04-02
ASTECH Angewandte Sensortechnik GmbH

Volker Ahrendt
President