LASER DISTANCE AND LEVEL METER
LD90-3
USER'S MANUAL

Version 9/01 CE
Rev. 05-09-2001 (S 5.1)
Rev. 18-09-2001 (S 5.1)
Rev. 13-03-2002 (S 5.1)
Rev. 19-03-2002 (S 5.1)
Rev. 24-11-2005 (S 5.1)
Rev. 16-06-2006

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CONTENTS

Dear Customer!

We congratulate you on the purchase of the *RIEGL* LD90-3. You are now the owner of a high quality, optoelectronic measuring instrument. The instrument is easy to operate.
However, we would ask you to take the time to carefully work through these operating instructions - especially the chapters 2 to 4 - before using the instrument.

1 Short-form Description and Specifications

See next pages.

LASER DISTANCE, LEVEL and SPEED SENSOR

LD90-3

- ***Industrial distance and speed sensing***
- ***Collision avoidance for cranes and vehicles***
- ***Level measurement in silos***
- ***Laser altimeter***
- ***Sensor for ship docking***

Key features

- Accurate & dynamic measurement of distance and speed
- Excellent performance and reliability; lightweight and stable metal housing
- Short high-energy infrared light pulses provide excellent interference immunity
- Measurements are fast offering update rates as high as 200 Hz
- Measurements can be taken through glass windows into sealed containers
- Narrow measurement beam with very low divergence provides excellent spatial resolution
- Measurements can be taken to almost any surface regardless of the incident beam angle or surface characteristics
- Measurements are unaffected by the temperature of the material surface and of temperature gradients in the medium between the sensor and the target surface

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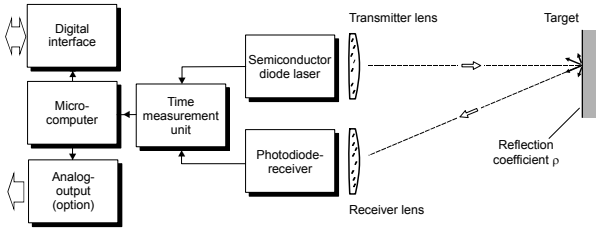
RIEGL
LASER MEASUREMENT SYSTEMS

Principle of operation

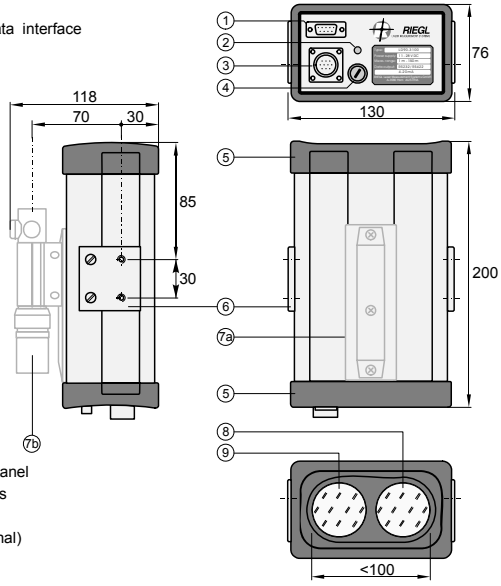
An electrical pulse generator periodically drives a semiconductor laser diode sending out infrared light pulses, which are collimated and emitted by the transmitter lens. Via the receiver lens, part of the echo signal reflected by the target hits a photodiode which generates an electrical receiver signal.

The time interval between the transmitted and received pulses is counted by means of a quartz-stabilised clock frequency. The result is fed into the internal microcomputer which processes the measured data and prepares it for the various data outputs.



Elements of operation and dimensional drawings

(1) 9pole socket for RS232/RS422 data interface
(2) LED "POWER ON"
(3) 10pole socket for power supply, optional analog outputs, and switching output
(4) Fuse holder



(5) Rubber-armoured front and rear panel
(6) Mounting plates with 2xM6 threads on both sides of the instrument
(7a) Mounting for aiming device (optional)
(7b) Telescope (optional)
(8) Receiver lens
(9) Transmitter lens

General technical data *RIEGL* LD90-3

Data interfaces

RS232 & RS422 (selectable, standard for all types)

Baud rate selectable between 150 Bd and 19200 Bd, further 38.4 kBd and 115.2 kBd

Available data output options (not for all types)

Analog current	4-20 mA [1], not galvanically isolated, resolution 16 Bit, linearity 1 ‰ of full scale
Voltage output	0-10 V [1], not galvanically isolated, resolution 12 Bit
Switching output	2 x PNP transistor driver [2] built-in thermal and short-circuit protection switching current 200 mA max. switching voltage = supply voltage

Power supply

Standard	11-28 Volts DC, approx. 10 Watt built-in protecting circuitry for over-voltage and reverse polarity
Option 220 V AC	external power supply module VNG95

Temperature range

Operation	-10° C to +50° C
Storage	-20° C to +60° C

Physical data

Dimensions	200 x 130 x 76 mm (L x W x H)
Weight	approx. 1.5 kg
Protection class	IP64

Aiming device (optional)

Telescope or red semiconductor-laser beampointer to be mounted on top of the instrument

1) Operating range selectable via serial interface
2) Switching points adjustable via serial interface

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LD90-3100HS

High-Speed distance meter for robotics applications, automatic anti-collision systems, etc.

Measuring range depending on the reflection coefficient **ρ** of the target								
good, diffusely reflecting targets, **ρ** ≥80%					up to 150 m [1]			
bad, diffusely reflecting targets, **ρ** ≥10%					up to 50 m [1]			
Reflecting foil [2] or plastic cat´s-eye reflectors					> 1000 m			
Minimum distance, typically					1 m			
Accuracy [3]	typically ±15 mm, in the worst case ±50 mm							
Measuring time (ms or s) [4]	5ms	10ms	20ms	50ms	0.1	0.2	0.5	1
Statistical deviation (mm) [5]	±30	±20	±15	±10	±7	±5	±3	±2
Resolution (mm) [5][6]	20	20	10	10	5	5	2	2
Divergence of the infrared measuring beam [7]	1.8 mrad							

Eye safety class according to IEC60825-1:1993+A1:1997+A2:2001

The following clause applies for instruments delivered into the United States:
Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

CLASS 1 LASER PRODUCT

1) typical values for average conditions. In bright sunlight, the operational range is considerably shorter than under an overcast sky. At dawn or at night the range is even higher.
2) reflecting foil 3M 3000X or equivalent, minimum dimensions 0.45 x 0.45 m²
3) standard deviation, plus distance depending error ≤20 ppm
4) selectable via RS232/RS422
5) depending on measuring time
6) chosen automatically by the internal microprocessor
7) 1 mrad corresponds to 10 cm beamwidth per 100 m of distance

Selectable data processing modes

The characteristics of the instrument can be adapted to the actual measurement situation by choosing between four different data processing programs:

The program FAST enables the quickest possible measurement at undisturbed conditions simply by averaging the single-pulse distance values which are acquired within the selected measuring time.

The program STANDARD provides a very useful clutter suppression: occasional echo signals caused not by the target itself but by backscattering of particles between target and instrument (e.g. clouds of material in a dusty silo, or raindrops and snowflakes in free air) are eliminated and not taken into account.

The program MAXIMUM DISTANCE is optimized for undisturbed level measurements in a silo at the cost of a slightly higher acquisition time.

The program MINIMUM DISTANCE is ideal for measurements to small targets which are not easy to aim at, as it eliminates background echoes.

General technical data and dimensions as given in our general data sheet LD90-3 series.

Data sheet *RIEGL* LD90-3100HS, 08/06/2006

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LD90-3300

Powerful distance and speed meter for long ranges and/or badly reflecting targets:
Height-of-flight measurements on planes or helicopters, tide gage in hydrography, level measurement in large coal silos, etc.

Measuring range depending on the reflection coefficient **ρ** of the target	
good, diffusely reflecting targets, **ρ** ≥80%	up to 400 m [1]
bad, diffusely reflecting targets, **ρ** ≥10%	up to 120 m [1]
Reflecting foil [2] or plastic cat´s-eye reflectors	> 1000 m
Minimum distance, typically	2 m

Distance measurement:

Accuracy [3]	typically ±50 mm							
Measuring time (ms or s) [4]	10ms	20ms	50ms	0.1	0.2	0.5	1	2
Statistical deviation (cm) [5]	±10	±7	±5	±3	±2	±1.5	±1	±0.7
Resolution (cm) [5][6]	10	10	5	5	2	2	1	1

Speed measurement:

Measuring range	0 to ±30 m/s
Accuracy	±0.5 m/s
Measuring time, typically [4]	0.5 s
Divergence of the infrared measuring beam [7]	1.6 mrad

Eye safety class according to IEC60825-1:1993+A1:1997+A2:2001
The following clause applies for instruments delivered into the United States:
Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

LD90-3300HR

High-Range version of LD90-3300 for use in ship-docking systems, for scanner applications, etc.

Measuring range depending on the reflection coefficient **ρ** of the target	
good, diffusely reflecting targets, **ρ** ≥80%	up to 500 m [1]
bad, diffusely reflecting targets, **ρ** ≥10%	up to 150 m [1]
Reflecting foil [2] or plastic cat´s-eye reflectors	> 1000 m
Minimum distance, typically	5 - 10 m

Distance measurement:

Accuracy [3]	typically ±50 mm							
Measuring time (ms or s) [4]	10ms	20ms	50ms	0.1	0.2	0.5	1	2
Statistical deviation (cm) [5]	±10	±7	±5	±3	±2	±1.5	±1	±0.7
Resolution (cm) [5][6]	10	10	5	5	2	2	1	1

Speed measurement:

Measuring range	0 to ±30 m/s
Accuracy	±0.5 m/s
Measuring time, typically [4]	0.5 s
Divergence of the infrared measuring beam [7]	1.6 mrad

Eye safety class according to IEC60825-1:1993+A1:1997+A2:2001
The following clause applies for instruments delivered into the United States:
Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

1) typical values for average conditions. In bright sunlight, the operational range is considerably shorter than under an overcast sky. At dawn or at night the range is even higher.
2) reflecting foil 3M 3000X or equivalent, minimum dimensions 0.45 x 0.45 m²
3) standard deviation, plus distance depending error ≤20 ppm
4) selectable via RS232/RS422
5) depending on measuring time
6) chosen automatically by the internal microprocessor
7) 1 mrad corresponds to 10 cm beamwidth per 100 m of distance

Selectable data processing modes

The characteristics of the instrument can be adapted to the actual measurement situation by choosing between four different data processing programs:

The program FAST enables the quickest possible measurement at undisturbed conditions simply by averaging the single-pulse distance values which are acquired within the selected measuring time.

The program STANDARD provides a very useful clutter suppression: occasional echo signals caused not by the target itself but by backscattering of particles between target and instrument (e.g. clouds of material in a dusty silo, or raindrops and snowflakes in free air) are eliminated and not taken into account.

The program MAXIMUM DISTANCE is optimized for undisturbed level measurements in a silo at the cost of a slightly higher acquisition time.

The program MINIMUM DISTANCE is ideal for measurements to small targets which are not easy to aim at, as it eliminates background echoes.

General technical data and dimensions as given in our general data sheet LD90-3 series.

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RIEGL LD90-3100HS-HT high-temperature distance meter

The LD90-3100HS-HT is a laser distance meter optimized for very hot and glowing targets in steel plants, rolling mills, foundries etc. Transmitter and receiver optics are equipped with narrow-band optical filters to avoid disturbances of the measurement caused by the radiation of light and heat from the hot target surface. If necessary the front side can be equipped with an additional protection tube, which can be flushed with nitrogen or compressed air to keep the lenses clean.

The **technical data** can, to a considerable extent, be influenced by the environmental conditions, especially by the following parameters:

- Surface temperature and reflection characteristics of the target
- Distance of the target
- Angle of the measurement beam with respect to the surface of the target
- Optical attenuation of the gases between target and instrument

LD90-3100HS-HT

High-Speed,
High Temperature
distance meter

Measurement range depending on the surface temperature and the reflection coefficient of the target

liquid steel, temperature up to 1450 °C	3 m to 7 m
glowing slabs, temperature up to 1200 °C	2 m to 10 m
other targets, temperature up to 800 °C	2 m to 100 m

Accuracy, typically [1]					±15 mm
Measuring time (s) [2]	0.05	0.1	0.2	0.5	1
Statistical deviation (mm) [3]	±20	±15	±10	±7	±5
Resolution (mm) [3][4]	10	5	5	2	2

Diameter of the infrared measuring beam: approx. 30 mm at 10 m, approx. 150 mm at 50 m

Eye safety class according to IEC60825-1:1993+A1:1997+A2:2001: laser class 3R

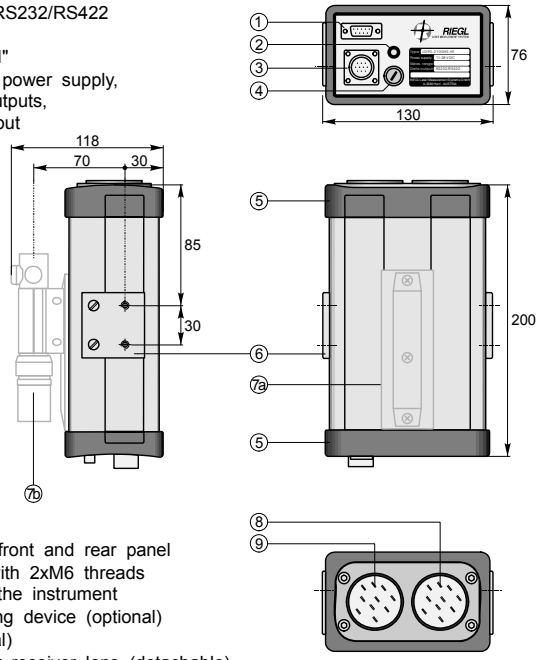
The following clause applies for instruments delivered into the United States:
Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

Temperature range (case temperature)	
Operation	-10 °C to +50 °C
Storage	-20 °C to +60 °C
Dimensions (L x W x H)	200 x 130 x 76 mm
Weight	approx. 1.5 kg
Protection class	IP64

1) standard deviation
2) selectable via RS232/RS422
3) depending on measuring time
4) choosen automatically by the internal microprocessor

Dimensional drawings of *RIEGL* LD90-3100HS-HT

(1) 9pole socket for RS232/RS422 data interface
(2) LED "POWER ON"
(3) 10pole socket for power supply, optional analog outputs, and switching output
(4) Fuse holder



(5) Rubber-armoured front and rear panel
(6) Mounting plates with 2xM6 threads on both sides of the instrument
(7a) Mounting for aiming device (optional)
(7b) Telescope (optional)
(8) Protecting filter for receiver lens (detachable)
(9) Protecting filter for transmitter lens (detachable)

Other parameters as given in our general data sheet LD90-3 series.

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2 Safety and Reliability

Contents:

* **General Safety**
  EN61010 (3 pages)

* **Electromagnetic Compatibility**
  EN61326 (2 pages)

* **Laser Safety**
  IEC60825-1:2001 (5 pages)

GENERAL SAFETY — EN 61010-1

LD90-3 meets or exceeds the requirements of the following European Standard: **EN 61010-1:2001** *Safety requirements for electrical equipment for measurement, control, and laboratory use* Part 1: *General Requirements*

Note the following explanations and important instructions:

Temperature: The unit is specified for a temperature range of -10 °C to +50 °C (operation) and -20 °C to +60 °C (no operation). Therefore, it is especially important that:
The **housing temperature** should always lie between -10°C and +50 °C when the instrument is switched on.

Sunlight: The ***LD90-3*** makes use of the optical time-of-flight technique to determine the distance to the object in question. For this purpose it comprises sensitive optical, electric and mechanical components. Thus the ***LD90-3*** requires appropriate handling:

Direct sunlight or a similarly intensely radiating source of light in axial direction of the lenses (in other words, in the direction of the longitudinal axis of the instrument) must be avoided. It is also important to avoid direct sunlight when mounting or dismounting the instrument. Looking directly at the sun or its immediate surroundings **is not permitted** with the ***LD90-3***, because of the **danger** to the **eyes** (when the optional telescope is used) and to the **sensitive electrooptic components**!

Altitude: The unit is specified for an altitude up to 2000m (operation).

Relative Humidity: The unit is specified for a relative humidity of 80% at or below +31°C; linearly decreasing to 50% at +40°C.

Enclosure: The instrument ***LD90-3*** is water resistant on the outside but must not however be subjected to rain or dripping water or submerged under water. Moreover it has to be protected against chemical influences.
The rubber fittings can be cleaned from time to time with a cleaning product specially intended for rubber (e.g. Sonax plastic and rubber cleaner).
The lenses should be treated with the care customarily due to optical instruments and, only when absolutely necessary, should they be gently cleaned using a suitable lens cleaning fluid (e.g. pure ethylene alcohol).

Never apply mechanical force or shock to the lenses or to the housing itself!
As with other optical instruments, the ***LD90-3*** should be protected from being shaken or knocked.

Mounting: For fulfilling the high dynamic demands according to EN 61010-1 (sub-clause 8.3) the instrument has to be shock proof mounted. The lenses as well as the rear panel assembly do not provide any harm in case of being damaged. Therefore, they were excepted for the tests of strength and shock described in EN 61010-1 (sub-clause 8.1 and 8.2).
If the instrument is mounted on both sides, please note that it must not be twisted or constricted in any way.
When mounting the instrument do not under any circumstances use force. Never use rough tools e.g. a hammer or chisel even if the fitting is not good.
In case of doubt, the after sale service centre of the manufacturer will be pleased to advise, free of charge, on how to best mount the instrument.

Power Supply: Before operating the ***LD90-3***, make sure that its case is properly grounded.
The DC-power supply has to fulfil the requirements for 'Limited Circuit' according to EN 61010-1 and the requirements for 'SELV' circuits according to EN 60950.
The power supply cable is to be connected with a suitable DC-power supply with a maximum voltage of 28 VDC. The negative pole of the supply voltage has to be grounded.
The positive pole of the DC power supply has to be protected, also by a fuse 1 A time lag (T 1 A, according to EN 60127 and IEC 60127), in order to avoid an excessive current over the GND input wire in case of a false polarity connection of the distance meter with the power supply.
The current drain capacity of the power supply must be at least three times the rated current of the fuse, so the fuse can be activated reliably if necessary.
The negative power supply input pole is directly connected to the instrument's housing. This should be remembered when connecting it to other instruments..

The instrument **must never** be connected to 110, 230, or 400 V AC! Opening the instrument is unacceptable due to the danger presented by the high voltages, and must therefore be avoided at all costs.

Data and Control Inputs and Outputs: The control inputs and the serial interface of the laser distance meter may be connected only to equipment fulfilling the requirements for 'SELV' circuits according to EN 60950.

ANY USE OF THE ***LD90-3*** IN CONTRADICTION TO THE INSTRUCTIONS AS GIVEN IN THE HANDBOOK CAN BE DANGEROUS AND IS, THEREFORE, STRICTLY FORBIDDEN!

ELECTROMAGNETIC COMPATIBILITY[1] EN61326

LD90-3 meets or exceeds the requirements of the following European Standards:

EN 61326 + A1 + A2 + A3: 2004

Electrical equipment for measurement, control and laboratory use - EMC requirements; (IEC 61326:1997 + A1:1998 + A2:2000 + Corrigendum 2002)

WARNING:
The ***LD90-3*** is a class A equipment intended for industrial environment. Therefore, it **must not** be used in residential, commercial and light industry environment.

The labeling of the ***LD90-3***, which is affixed on the side of the housing of the instrument, meets the requirements of the commission's guideline 89/336/EWG:

CE

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1) The tests have been run using typical (default) instrument parameter settings. The tests have been performed using original *RIEGL* data and power supply cables, powered with 16 V DC provided by a PbGel-Powerpack.

To maintain emission requirements when connecting to the I/O interface of the LD90-3 use only a high-quality shielded data interface cable. The cable shield must have low impedance connections to both connector housings.

Any changes or modifications to the standard equipment not expressly approved by *RIEGL* as well as any non-observance of the directions for installation may cause harmful interference and void the authorization to operate this equipment.

The following table lists the applied basic standards and the performance criteria (see also definition below) for the evaluation of the immunity test results:

CISPR 16-1 Edition 2.1: 2002

Specification for radio disturbance and immunity measuring apparatus and methods; Part 1: Radio disturbance and immunity measuring apparatus

CISPR 16-2 Edition 1.2: 2002

Specification for radio disturbance and immunity measuring apparatus and methods; Part 2: Methods of measurement of disturbances and immunity

EN 61000-4-2 + A1 + A2 : 2002

Electromagnetic compatibility (EMC); Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test (IEC

61000-4-2:1995 + A1:1998 + A2:2001)
Performance Criterion B

EN 61000-4-3 + A1: 2004

Electromagnetic compatibility (EMC); Part 4-3: Testing and measurement techniques - Radiated, radio frequency, electromagnetic field immunity test (IEC 61000-4-3:2002 + A1:2002)
Performance Criterion A

EN 61000-4-4 + A1 + A2: 2002

Electromagnetic compatibility (EMC); Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test (IEC 61000-4-4:1995 + A1:2000 + A2:2001)
Performance Criterion B

EN 61000-4-5 + A1: 2002

Electromagnetic compatibility (EMC); Part 4-5: Testing and measurement techniques - Surge immunity test (IEC 61000-4-5:1995 + A1:2001)
Performance Criterion C

EN 61000-4-6 + A1: 2002

Electromagnetic compatibility (EMC); Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio frequency fields (IEC 61000-4-6:1996 + A1:2000)
Performance Criterion A

Definition of the performance criteria and acceptable degradations:

Performance Criterion A: during testing, normal performance within defined limits

- increased statistical standard deviation up to 5 times the nominal value, distance depending error increased up to five times the nominal value;
- reduced maximum range;
- inaccuracy of analog outputs up to five times the nominal value in addition to range error (if optional ANALOG OUTPUTS are available);

Nominal values to be found in chapter 1 "Short-Form Description and Specifications".

Performance Criterion B: during testing, temporary degradation or loss of function or performance which is self-recovering

- loss or heavy degradation of functionalities during testing with self-recovering after finishing the test;

Performance Criterion C: during testing, temporary degradation or loss of function or performance which requires operator intervention or system reset occurs

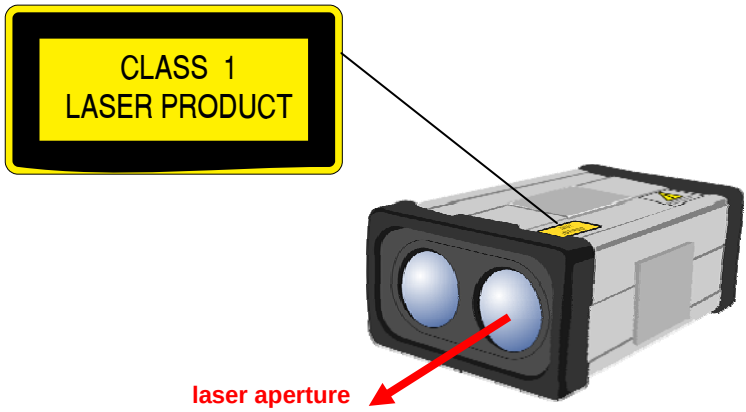
- loss or heavy degradation of functionalities during testing with self-recovering after finishing the test; a system reset may occur;
- loss or heavy degradation of functionalities which require simple user intervention, e.g. replacement of a fuse, switching the device Off and On, restoration of settings;

The laser instruments **LD90-3** are classified as **Class 1** laser products in compliance with the International Eye safety regulation **IEC60825-1:1993+A1:1997+A2:2001** (abbreviated subsequently as IEC60825-1:2001) and the European eye safety regulation **EN60825-1:1994+A1:2002+A2:2001** *Safety of Laser Products, Equipment Classification, Requirements and User's Guide*.

The following clause applies for instruments delivered into the United States: Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

***Class 1**: Lasers that are safe under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing.* (IEC60825-1:2001, sub-clause 8.2)

The labelling of the **LD90-3**, which is affixed on the top of the housing of the instrument, meets the requirements of the above standard (IEC60825-1:2001, sub-clause 5.1 and 5.2):



Radiation output and standard information (IEC60825-1:2001, Sub-clause 5.8):

Max. average output	180 µW
Pulse duration approx.	15 ns
Wavelength	905 nm
Standard	IEC60825-1:2001

CAUTION! The invisible laser radiation inside the instrument may exceed the accessible emission limits of laser class 1, thus **never open the instrument's housing**! Do not operate evidently damaged instruments! If the instrument is handled incompetently, the manufacturers absolve themselves from honoring any guarantee or insurance whatsoever.

Aligning the infrared laser instrument **LD90-3** with the lenses of CCD-cameras or infrared night vision devices can result in damage to them and is therefore not permitted.

For class 1 laser products:
DO NOT UNNECESSARILY LOOK INTO THE TRANSMITTER LENS!

DO NOT UNNECESSARILY POINT THE TRANSMITTER LENS AT PEOPLES EYES!

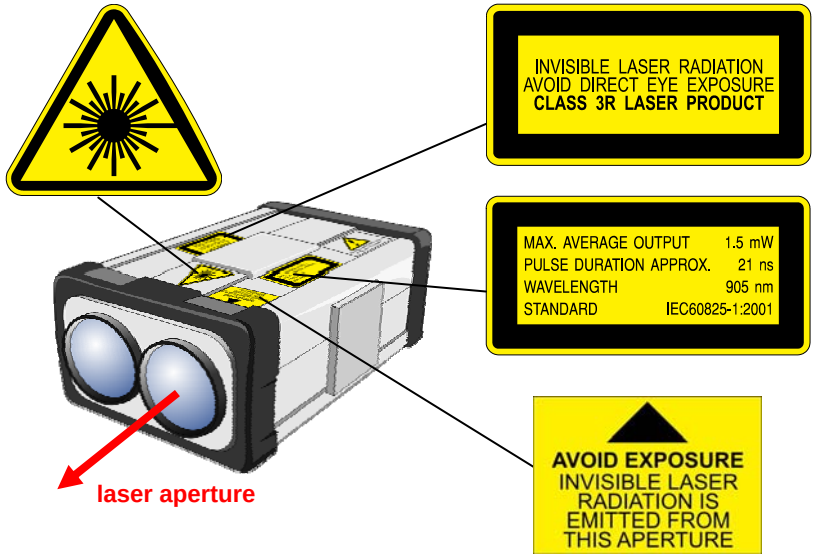
CAUTION!
Use of controls or adjustments or performance of procedures other than those specified in this manual may result in hazardous radiation exposure.

The laser instrument **LD90-3100HS-HT** is classified as **Class 3R** laser product in compliance with the International Eye safety regulation **IEC60825-1:1993+A1:1997+A2:2001** (abbreviated subsequently as IEC60825-1:2001) and the European eye safety regulation **EN60825-1:1994+A1:2002+A2:2001** *Safety of Laser Products, Equipment Classification, Requirements and User's Guide*.

The following clause applies for instruments delivered into the United States: Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

***Class 3R**: Lasers that emit in the wavelength range from 302,5 nm to 10^6 nm where direct intrabeam viewing is potentially hazardous but the risk is lower than for Class 3B lasers, and fewer manufacturing requirements and control measures for the user apply than for Class 3B lasers. The accessible emission limit is within five times the AEL of Class 2 in the wavelength range from 400 nm to 700 nm and within five times the AEL of Class 1 for other wavelengths. (*IEC60825-1:2001, Sub-clause 8.2)

The labeling of the **LD90-3100HS-HT**, which is affixed on the top of the housing of the instrument, meets the requirements of the above standard (IEC60825-1:2001, Sub-clause 5.1, 5.4, 5.7, and 5.8):



Radiation output and standard information
(IEC60825-1:2001, Sub-clause 5.8):

Max. average output	1.5 mW
Pulse duration approx.	21 ns
Wavelength	905 nm
Standard	IEC60825-1:2001

The standard IEC60825-1:2001, Sub-clause 3.60, defines a nominal ocular hazard distance (**NOHD**) as the distance at which the beam irradiance or radiant exposure equals the appropriate corneal maximum permissible exposure (MPE).
The nominal ocular hazard distance (NOHD) for the **LD90-3100HS-HT** is less than **1 m**.

CAUTION!

Direct intrabeam viewing is potentially hazardous from distances below the nominal ocular hazard distance (NOHD).

Never point the LD90-3100HS-HT directly at people's eyes within distances below the NOHD!

Never look into the beam exiting aperture from distances below the nominal ocular hazard distance!

The invisible laser radiation inside the instrument may exceed the accessible emission levels compared to the levels outside the instrument's housing, thus never open the instrument's housing!

Do not operate evidently damaged instruments! If the instrument is handled incompetently, the manufacturers absolve themselves from granting any guarantee or insurance whatsoever.

Aligning the infrared laser instrument ***LD90-3100HS-HT*** with the lenses of CCD-cameras or infrared night vision devices can result in damage to them and is therefore not permitted.

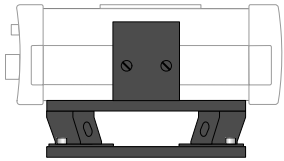
Some means are available to switch off the infrared laser beam:
- via hardware: disconnection of the laser safety lock line on the standard connection cable with ground
- via hardware: disconnection of the delivered 50Ω terminal resistor with the BNC-socket on the safety-box on the "connection cable for instruments with laser class 3R/3B"
- via software: setting the command "laser off" via serial data interface

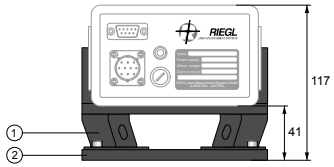
CAUTION!
Use of controls or adjustments or performance of procedures other than those specified in this manual may result in hazardous radiation exposure.

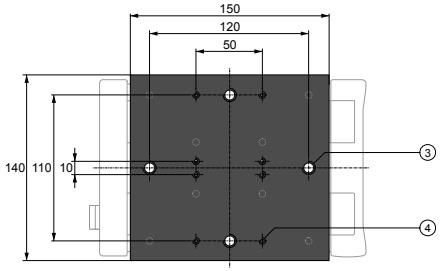
3 Preparing for Measurement

3.1 Mounting Instructions

- **Shockproof mounting:**

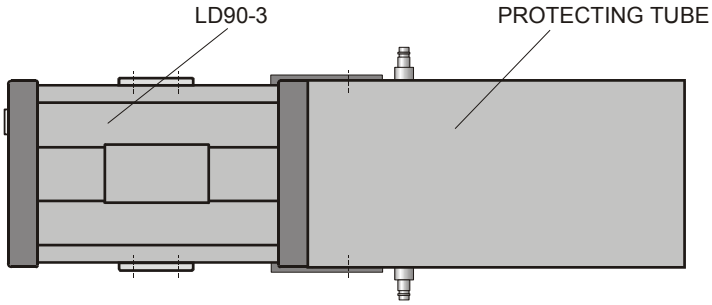




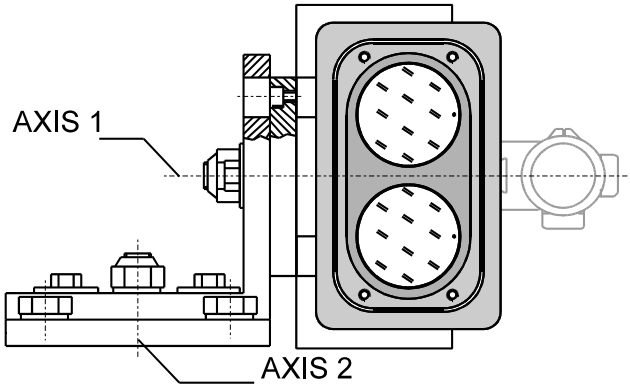


(1) Shock absorbing rubber elements (4x)
(2) Mounting plate with threads
(3) 4 x M10 threads, 8 mm deep
(4) 8 x M5 threads, 8 mm deep

- **LD90-3 equipped with protecting tube (optional accessory):**

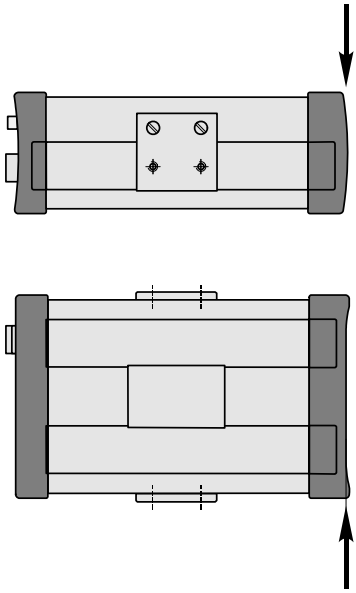


- **Use of the adjustable mounting base (optional accessory):**

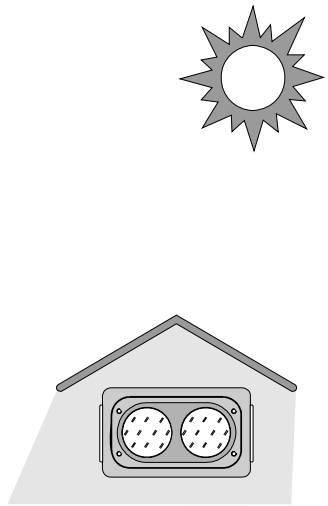


This dual axes mounting base is well suited for exact aiming at a distant target, e.g., a retroreflector.

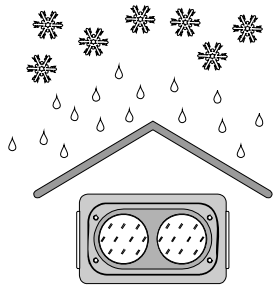
- **The reference plane is at the front panel of the instrument:**



- **Shielding against environmental influences:**



LD90-3 in shadow behind sunshield



LD90-3 under a roof against rain, dripping water and snow fall

3.2 Preparing the Power Supply

- The power supply cable is to be connected to a suitable DC power supply with a minimum voltage of 11 VDC and maximum voltage of 28 VDC.
- The negative pole of the supply voltage has to be grounded.
- Although the instrument's positive pole of the power supply cable is internally protected by a fuse (F 1 A, see also chapter 3.3), the **positive pole of the power supply unit** has also to be protected by a fuse rated 1 A time lag (T 1 A, according to IEC 60127 and EN 60127). This additional fuse is necessary to protect the power supply unit and the power supply cables as well as the instrument in case of wrong electrical connections!
- In case that several instruments are connected to one power supply, each instrument has to be protected separately, i.e. one fuse per instrument is required.
- The current drain capacity of the power supply must be at least three times the rated current of this fuse, in order to ensure that the internal voltage converter can start properly and the fuse can be blown reliably if necessary (for example, in the case of false polarity).
- The DC-power supply itself has to fulfill the requirements of EN 61010-1. Furthermore, it has to fulfill the requirements for 'Energy Limited Circuit' according to EN 61010-1 and the requirements for 'SELV' circuits according to EN 60950.
- When using a long power supply cable, the drop of voltage should be considered when adjusting the supply voltage. The negative pole of the supply voltage should be connected to ground near the instrument.
- The internal resistance of the power supply must be low enough for the supply voltage not to fall short below the minimum voltage of the instrument.

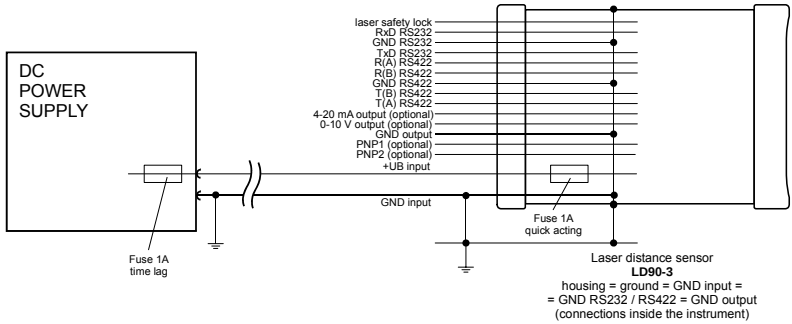
  For electromagnetic compatibility, use only original *RIEGL* power supply cables and low-noise power supply units, which meet the relevant EMC requirements of the European Union and are carrying the CE sign.

3.3 Fuse

The instrument's fuse holder carries a glass tube fuse rated **1A quick acting** (F 1 A, according to IEC 60127 and EN 60127). The fuse holder can be opened and closed by means of a coin used like screw driver.

3.4 Internal Grounding Scheme

- Between the LD90-3 and the supply voltage on the one hand, and the control inputs (laser safety lock) and data outputs (serial interface) on the other hand, is no isolation but a direct connection between all ground terminals. Details are shown by the following scheme:



- The connections between the ground terminals and the housing, which are within the instrument, are not suitable to drain off potential differences. Therefore, further ground connections have to be provided during installation.
- For details on the grounding of the optional analog outputs and the optional transistor switching outputs, please refer to chapter 6 and 7.
- The control inputs, analog and digital outputs, and the serial interface of the laser distance meter may be connected only to equipment fulfilling the requirements for 'SELV' circuits according to EN 60950.

3.5 Laser Safety Lock

The measurement laser can be switched on and off via the RS232/RS422-interface (commands ^N (like O**N**) and ^F (like OF**F**), see 9.2 and 9.3).
After switching the LD90-3 on, the laser is also switched on.

The following points are important:

- If no measurement has to be carried out for a longer time, (e.g. some hours or during the night) in the interest of **increasing the lifetime of the laser diode,** the laser should be switched off.
- It is recommended not to switch the laser off for short stand-by times, because the laser needs some time to warm-up and stabilize when switched on again (see therefore the next chapter).

3.6 Accuracy of Measurement

After power up, the LD90-3 needs some time to reach specified working conditions and to guarantee the full accuracy.
It takes max. 20 minutes, for temperatures around 20 degree Celsius 10 minutes typically.

3.7 Short Guidance for a Fast Start-Up

- Provide a suitable power supply (Please read chapter 3.2 - "Preparing the Power Supply"). Adjust it to a typical value of 12 V DC or 24 V DC.

- Connect the instrument to a PC via plug for data interface. Use a cable such as is used for connecting two PCs (Null modem).

- On your PC, start a program for communicating with the LD90-3 (e.g. a terminal emulation as supported by Microsoft Windows). Adjust the communication parameters of the program to the following:

  4800 Baud (the baud rate can be changed by the user via a software command. 4800 baud is the default value)
  8 data bits
  No parity
  1 Stop bit

- Align the LD90-3 to a diffusely reflecting target (e.g. a white wall) at a distance of about 2 to 20 m. Pay attention to the minimum distance of the instrument (see therefore the specifications).

- Now switch on the power supply. The serial data output should issue the messages

  ```
  m#LD90-3#
  mSELFCHCK
  ```

  then automatically determines the range values of the format

  ```
  r12.3
  ```

  - as an example for a range of 12.3 meter - should be issued.
  The message

  ```
  m........
  ```

  instead indicates that the device is not aligned to target with sufficient reflection, therefore no measurement is possible.

4 What to Know for a Good Measurement

4.1 Measurement Results

For all instrument types the RANGE as well as a SIGNAL AMPLITUDE are available measurement results. Furthermore some instrument types are equipped with a SPEED MEASUREMENT feature. Note that speed measurement mode must be enabled first and that for measurement tasks where no speed value is needed it is recommended to disable the speed measurement mode.

RANGE is the distance between the instrument's front and a target. An offset enables the user to adapt the value to different mounting situations and thereby vary the zero plane of the measurement. A range value is a fixed point number and can be measured in units of meter or feet or yards.

AMPLITUDE is a quality value for the strength of the received signal available for all types. The amplitude value is within a range between 0 and 255 where 0 means minimum and 255 means maximum signal strength. The value is scaled near-logarithmic. The current value depends on the reflectivity and the distance of the target as well as on the absorption of the medium between instrument and target.

Note that under environmental conditions providing high electromagnetic irradiance, the amplitude output signal can be disturbed or distorted. In worst case, this may lead to range errors as large as specified in chapter 2 "Electromagnetic Compatibility", Performance Criterion A.

SPEED is the radial speed component of the moving target with respect to the measuring instrument. The value is a fixed point number and can be measured in kilometers per hour or meters per second or miles per hour.

For instruments with SPEED OPTION only!

4.2 Selecting the Appropriate Program

The LD90-3 provides four programs, suited to different measurement situations (see chapter 8.1).

PROGRAM FAST: For quick measurements without disturbance; it simply averages all range values during measuring time.

PROGRAM STANDARD: Enables the most probable target and eliminates short disturbances caused by light rain, minor dust occurrence, etc.

PROGRAM MAX.DIST: Determines the greatest distance to the target detected during the measuring time. Compared with program STANDARD, program MAX.DIST eliminates disturbances lasting nearly the whole measuring time (level measurement with high dust occurrence).

PROGRAM MIN.DIST: Determines the nearest target detected during the measuring time. It is useful for measurement to targets which are not easy to aim at (lamppost, telegraph line, etc.), as it eliminates all measured values to targets in the background (wall of a house).

When using the LD90-3 under environmental conditions providing electric, electrostatic and/or electromagnetic disturbances, the program STANDARD has to be used in the interest of achieving the highest possible reliability of measurement. The programs FAST, MAX.DIST, MIN.DIST must not be used!

4.3 Measurement to Badly Reflecting Targets

The period needed for measurement is equivalent to the selected nominal measuring time only in the case of good reflection conditions of the target. For targets which are badly reflecting (dark surface, targets at long distances), several echo signals are not strong enough to be detected by the LD90-3 (signal dropout) and the measuring time gets longer. If, after a period of twice the nominal measuring time, the measurement is not completed, it is interrupted. Additionally, the maximum time - until the measurement is abandoned - can be extended up to a hold time x set via the parameter Hx (x = time in 0.1 seconds) (see chapter 8.5).

4.4 Selective Measurement to Targets with Definite Reflection Characteristics

Each range value is associated with a value of the signal quality (amplitude). The range of possible amplitude values is between amplitude 0 - weak signal - and amplitude 255 - strong signal. By definition of an amplitude window, range values with amplitudes outside the defined window can be excluded.

Example: Measurement to reflectors (strong amplitude values), excluding diffusely reflecting targets (low amplitude values) (see chapter 8.16).

5 Data Communication via RS232/RS422

5.1 Communication Parameter

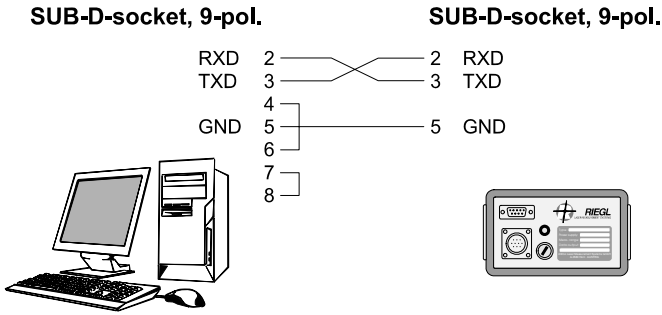
The LD90-3 provides serial communication with adjustable mode RS232 or RS422 (see chapter 8.9). It is pre-adjusted in the factory to RS232, but can be changed by the user.

The baud rate is pre-adjusted to 4800 baud, but can be changed within in the range 150 - 115200 baud (see chapter 8.8.1).

The additional communication parameters are:

1 Start bit
8 Data bits
No parity
1 Stop bit

Data cable configuration for RS232:



For achieving electromagnetic compatibility, use original *RIEGL* data cable for communications only!

5.2 Programming Mode / Measurement Mode

After power up the instrument starts with measurement mode. In the programming mode, measurement parameters are adjusted and saved if desired. The programming mode is started with a ^P from the measurement mode and finished with a Q<Cr> (like quit). Measurements are carried out in the measurement mode.

5.3 Data Format

5.3.1 Data Format in Programming Mode

The ASCII data string from the measurement device has a constant length of 8 characters, followed by <Cr> or <Cr><Lf>. In the programming mode the first character always is a

* when the device is ready for receiving a command and when the last command could be interpreted correctly.
? when the last command could not be interpreted.
= when the value of a parameter was requested.

Example:

Command	Reply		Meaning
"T1"<Cr>	"*T1	"<Cr><Lf>	Measurement time T1
".T"<Cr>	"=T1	"<Cr><Lf>	Meas. time = T1

This example assumes that the separator <Cr><Lf> is selected. Please note that the reply string is always filled up with blanks to a constant length of 8 characters.

5.3.2 Data Format in Measurement Mode

The ASCII data string has variable length and is delimited by <Cr> or <Cr><Lf> respectively. The parts and kind of information included in the string can be set by the user.

The data string is parted into separate blocks. The first character within the block is a block identifier.

The following block identifiers are used:

r Range
s Speed, (instruments with speed measurement only)
a Amplitude, signal strength
m Message, status information
- Reserved for future expansion. The characters following are not necessarily data characters.

The length of the block depends on the kind of information and is not constant. If the character following the identifier is a "+" , a "-" or a ASCII-digit, the data block represents a number (e.g. the range in meters or the speed in km/h). If it is a letter, it represents status information.

Example:

It is assumed that the output of range, speed and amplitude is activated:

```
"r123.4;s-12;a138"<Cr><Lf>
```

If only status information is given (e.g. supply voltage too low), no measurement value is available.

```
"mLO BATT "<Cr><Lf>
```

6 Optional Analog Outputs

For instruments with OPTIONAL CURRENT OUTPUT or OPTIONAL VOLTAGE OUTPUT only!

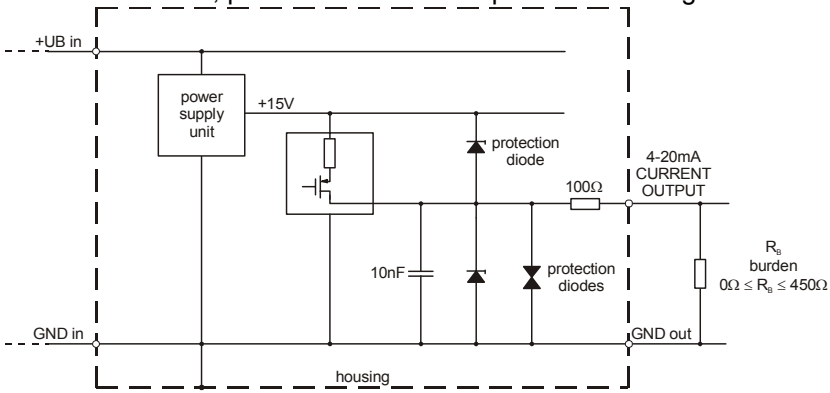
Two optional analog outputs are available:

- **Current output with a range of 4 mA to 20 mA.**
- **Voltage output with a range of 0 V to 10 V.**

This output provides the following features:

- The output is an ACTIVE current loop. This means that
  - o Only PASSIVE loads may be connected.
  - o No additional external power supply is to be provided.
- The load has to be connected between the lines CURRENT OUTPUT and GND out.
- The maximum total resistance (including cable resistance) of the load is 450 Ω.

For further details, please refer to the simplified circuit diagram:



Please note the following restrictions:

- Connecting any external power to the CURRENT OUTPUT may damage it and is, therefore, strictly forbidden.
- The negative poles of the current output (GND out) and the power supply (GND in) are not galvanically isolated and connected to the instrument's housing.

Adjustment of the outputs can be made via software commands by setting the distances for 4 mA and 20 mA and/or the distances of 0 V to 10 V. The software commands are described in chapter 8.17 and 8.18.
In addition to the output of distance measurement results, the LD90-3 also provides status messages.
Status messages can be coded to user defined analog values (0-20 mA or 0-10V). For this purpose, status messages are grouped as follows:

- **NO TARGET**- status value group: No measurement possible, no target or target out of specified amplitude limit ("m……..")
- **MESSAGE** - status value group: Internal selfcheck message, Programming mode etc.
- **WARNING** - status value group: Range value overflow / underflow, laser is off
- **ERROR** - status value group: Hardware error detected or bad environmental conditions (temperature/voltage out of range)

Set the desired analog output value for each of these groups (see also chapter 8.17 and 8.18).

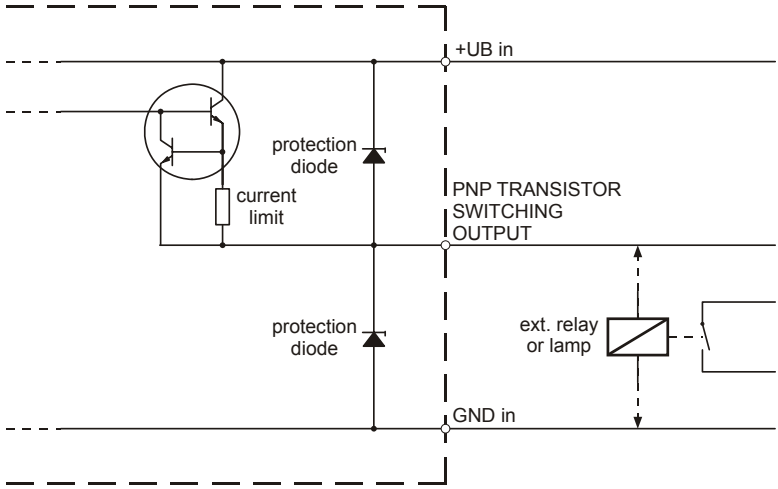
See chapter 10.3 (the command summary - status and error messages table) for the different types of status and error messages.
Usually for MESSAGE status output the measurement can be continued. A WARNING and/or NO TARGET indicates that no measurement result is available (no target, out of range, laser off), but eventually measurement can be continued. For an ERROR status value measurement should be stopped and the reason causing the ERROR should be checked.

7 Optional Switching Outputs

For instruments with
OPTIONAL SWITCHING OUTPUT only!

The LD90-3 is equipped with two PNP transistor switching outputs useful for switching external devices corresponding to measured values (e.g. alarm outputs if the range exceeds a certain limit).
Each switching output is provided to drive a load (e.g. a relay) against GND in. It behaves functionally similar to a PNP transistor with open collector output. The output state "high" means that the output is switched to approx. *UB in – 1.5 Volt. The output state "low" means that the output is switched to high impedance. The load will pull the output down to GND in.

Simplified circuit diagram



Adjustment of the switching thresholds can be made independently for each switching output via software commands.

In addition to the output of distance measurement results, the LD90-3 also provides status messages.
Status messages can be coded to user defined switching output low (0) or high (1). For this purpose, status messages are grouped as follows:

- **NO TARGET**- status value group: No measurement possible, no target or target out of specified amplitude limit (m……)
- **MESSAGE** - status value group: Internal selfcheck message, Programming mode etc.
- **WARNING** - status value group: Range value overflow / underflow, laser is off
- **ERROR** - status value group: Hardware error detected or bad environmental conditions (temperature/voltage out of range)

Set the desired switching output value for each of these groups (see also chapter 8.19).

8 Adjustment of Parameters

8.1 Measurement Program - Range Measurement

Command: P**x**

Reply: *P**x**

x means:

0 FAST, simply averaging

1 STANDARD

2 MAX.DIST

3 MIN.DIST

When using the LD90-3 under environmental conditions providing electrical, electrostatic and/or electromagnetic disturbances, only the program STANDARD has to be used in the interest of achieving the highest possible reliability of measurement. The programs FAST, MAX.DIST, MIN.DIST must not be used!

8.2 Unit - Range Measurement

Command: U**x**

Reply: *U**x**

x means:

0 Meter

1 Feet

2 Yard

The conversion factor is: 1 meter = 3.28084 feet
or 1 meter = 1.0936 yards

Note that this command changes the unit for every command, which is connected with the range measurement. Therefore all settings described in meters, can also be done in feet or yards (e.g. =1.00 can be 1 m or 1 ft or 1 yd).

8.3 Measurement Time and Resolution - Range Measurement

Command: T**x**
Reply: *T**x**
x means:

x	Meas. time	Resolution in mm | 1/1000 feet | 1/1000 yard						Meas. time	**x**
		LD90-3300 LD90-3300HR			**LD90-3100HS LD90-3100HS-HT**				
0	10 ms	100	200	100	20	50	20	5 ms	0
1	20 ms	100	200	100	20	50	20	10 ms	1
2	50 ms	50	100	50	10	20	10	20 ms	2
3	0.1 s	50	100	50	10	20	10	50 ms	3
4	0.2 s	20	50	20	5	10	5	0.1 s	4
5	0.5 s	20	50	20	5	10	5	0.2 s	5
6	1.0 s	10	20	10	2	5	2	0.5 s	6
7	2.0 s	10	20	10	2	5	2	1.0 s	7

In the interest of achieving the highest possible reliability of measurement and the lowest possible statistical deviation, choose the measurement time always as long as possible. That means: Do not use an unnecessarily short measurement time!

8.4 Speed Measurement

For LD90-3300 and LD90-3300HR only!

8.4.1 Speed Measurement Activation

Command: SA**x**
Reply: *SA**x**

x means: 0 Range measurement
1 Speed (and range) measurement

If no speed value is desired, range measurement (with the proper measurement program) should be selected.

8.4.2 Unit - Speed Measurement

Command: SU**x**
Reply: *SU**x**

x means: 0 m/s
1 km/h
2 mph

8.4.3 Measurement Time - Speed Measurement

Command: ST**x**
Reply: *ST**x**

x means:

x	Meas. time	Resolution in m/s | km/h | mph
0	0.25 s	0.5 | 1 | 1
1	0.3 s	0.5 | 1 | 1
2	0.4 s	0.1 | 0.5 | 0.5
3	0.5 s	0.1 | 0.5 | 0.5

8.5 Hold Time

Command: H**x**

Reply: *H**x**

x means:

x = 0 to 100 (x times 0.1 seconds)

For badly reflecting targets, the effective measurement time could be twice the nominal measuring time. By selecting a hold time which is longer than twice the nominal measuring time, the effective maximum measuring time can be set to up to 10 seconds.

Example:
adjusted nominal measuring time = 0.5 seconds
H0.....max. effective measuring time 1 second
(twice measuring time)
H20.....max. effective measuring time 2 seconds

8.6 Distance Offset (Adjustment of the Reference Plane)

Command: O**x**

Reply: *O**x**

x means:

The offset serves to adjust the range displayed to the specific mounting position (adjustable between -9999 and 9999 cm).

The distance offset should be adjusted prior to adjusting other distance depending parameters (e.g. IL, IH, UL, UH, RL, RH).

Example:
O-100 means that the displayed range is reduced by 100 cm.

8.7 Data String Format

Command: F**x**

Reply: *F**x**

x means:

0 special case for compatibility to other instruments of *RIEGL*

1 range output

2 speed output

3 range and speed output

4 amplitude output

5 range and amplitude output

6 speed and amplitude output

7 range, speed and amplitude output

Example:

Command	Reply		Meaning
^P	<*	><Cr><Lf>	Programming mode
<F5><Cr>	<*F5	><Cr><Lf>	String format F5
<Q><Cr>	<*Q	><Cr><Lf>	Quit PROG-Mode
			.
	<r12.3;a103><Cr><Lf>		Measurement value

8.8 Serial Baud Rate, Parity and Separator

8.8.1 Baud Rate:

Command: CB**x**
Reply: *CB**x**

x means:

0	150 Bd	5	4800 Bd
1	300 Bd	6	9600 Bd
2	600 Bd	7	19.2 kBd
3	1200 Bd	8	38.4 kBd
4	2400 Bd	9	115.2 kBd

Note that it is necessary to save parameters permanently by command “W” and to reset the instrument to activate new values of CB.

When using the LD90-3 under environmental conditions providing electrical, electrostatic and/or electromagnetic disturbances, data communication with high baud rates may result in communication errors. In this case set the baud rate to a lower value.

8.8.2 Parity:

Command: CP**x**
Reply: *CP**x**

x means:

0	no	3	mark
1	even	4	space
2	odd		

Note: "mark" is identical with "no parity, 2 stop bits“

Note that it is necessary to save parameters permanently by command “W” and to reset the instrument to activate new values of CP.

8.8.3 Separator:

Command: CS**x**

Reply: *CS**x**

x means:

0 Data string finishes by Carriage Return (<Cr>)

1 Data string finishes by Carriage Return + Line Feed (<Cr>+<Lf>)

Note that it is necessary to save the parameter permanently by command "W" and to reset the instrument to activate new values of CS.

8.9 Serial Mode

Command: CM**x**

Reply: *CM**x**

x means:

0 RS232

1 RS422

Note that it is necessary to save the parameter permanently by command "W" and to reset the instrument to activate new values of CM.

8.10 Trigger Mode

Command: A**x**

Reply: *A**x**

x means:

0 External: Start of a single measurement by an external signal on trigger input line on the connection cable (see chapter 11 ”Pinning and cables”) Signal TTL, >10 µs, trigger on positive edge (only available for instruments without optional voltage and switching output)

1 Serial: Start of a single measurement by command ^X via serial communication

2 Free: After finishing a measurement, a new measurement is started immediately (free running without trigger)

8.11 Parameter Query

Command: .**Y**

Reply: **=Yx**

Y and **x** mean:

Request for the actual value **x** of the parameter **Y**.

Example:

Command	Reply		Meaning
".T"<Cr>	"=T5	"<Cr><Lf>	Measurement time T5
".O"<Cr>	"=O-0123	"<Cr><Lf>	Offset -123 cm
".SU"<Cr>	"=SU0	"<Cr><Lf>	Speed measurement unit m/s

8.12 Set User Parameters to Default

Command: DEFAULT

Reply: *DEFAULT

All user parameters are set to standard values:

P1	Program *STANDARD*
U0	Unit range *meter*
T5	Range measurement time *T5*
SA0 [1)]	*Range measurement*
SU1 [1)]	Unit speed *km/h*
ST2 [1)]	Speed measurement time *ST2*
H0	Hold time *0 (twice measuring time)*
A2	Trigger mode *FREE*
O0	Offset *0*
F1	Data string *range*
CS1	RS232/RS422 separator *<Cr><Lf>*
IL0 [2)]	Analog current output *4 mA at 0 meter*
IH2000 [2)]	Analog current output *20 mA at 20 meter*
IST0 [2)]	Analog current output *no target status 0 mA*
ISE0 [2)]	Analog current output error *status 0 mA*
ISW0 [2)]	Analog current output warning *status 0 mA*
ISM0 [2)]	Analog current output message *status 0 mA*
UL0 [3)]	Analog voltage output *0 V at 0 meter*
UH1000 [3)]	Analog voltage output *10 V at 10 meter*
UST0 [3)]	Analog voltage output *no target status 0 V*
USE0 [3)]	Analog voltage output error *status 0 V*
USW0 [3)]	Analog voltage output warning *status 0 V*
USM0 [3)]	Analog voltage output message *status 0 V*
RL400 [4)]	Switching outputs *low at 4 meter*
RH500 [4)]	Switching outputs *high at 5 meter*
RST0 [4)]	Switching output *no target status set low*
RSE0 [4)]	Switching output error *status set low*
RSW0 [4)]	Switching output warning *status set low*
RSM0 [4)]	Switching output message *status set low*
AL0	Amplitude window *minimum 0*
AH255	Amplitude window *maximum 255*

[1)] for instruments with speed measurement only
[2)] for instruments with optional current output only
[3)] for instruments with optional voltage output only
[4)] for instruments with optional switching output only

Baud rate (CB), parity (CP), separator (CS), and serial mode (CM) are not changed!

The tests for EMC according to the requirements of the EU have been performed using default parameter settings. In case of any disturbances of the instrument's functionalities due to electromagnetic influences, use default settings.

8.13 New Start

Command: RESET

Reply:

Is equivalent to switching the instrument off and on.

8.14 Saving, Write to EEPROM

Command: W

Reply: *W

All parameters discussed in this chapter are stored to an internal non-volatile memory. After switching the LD90-3 off and on again, it continues working with the parameters saved.

The instrument responds to the command after the data is saved (i.e. not immediately).

8.15 Quit Programming Mode

Command: Q

Reply: *Q

This command finishes programming mode and the instrument returns to measurement mode.

8.16 Signal Amplitude Window

Command:	AL**x**	AH**x**
Reply:	*AL**x**	AH**x**

ALx means: amplitude minimum, window limit low
AHx means: amplitude maximum, window limit high

Signal strength x, adjustable between 0 and 255

To selectively detect only targets of a certain signal strength, an amplitude window can be defined:

Example:

Only targets equipped with reflectors with high signal strength shall be detected; bad, diffusely reflecting targets shall be excluded.

Adjustment e.g. AL80 and AH255 (values with amplitude A<80 are excluded)

With adjustment AL0 and AH255 all targets without any exclusion are detected.

8.17 Analog Current Output - Adjustment (optional)

For instruments with
OPTIONAL CURRENT OUTPUT only!

8.17.1 Setting the range value corresponding to 4mA output

Command: IL**x**

Reply: *IL**x**

x means the range value between 0 and 65535. The unit is 1/100 m or 1/100 feet or 1/100 yd, according to the setting of parameter U (see chapter 8.2).

8.17.2 Setting the range value corresponding to 20mA output

Command: IH**x**

Reply: *IH**x**

x means the range value between 0 and 65535. The unit is 1/100 m or 1/100 feet or 1/100 yd, according to the setting of parameter U (see chapter 8.2).

8.17.3 Analog current output - No target status value

Command: IST**x**

Reply: *IST**x**

x means the value of the analog current output issued, if no measurement is possible.
Adjustable between 0 and 200 (x 0.1 mA). For adjustments in range [201..255], the analog current output is not changed (last issued value is kept).

8.17.4 Analog current output – Error status value

Command: ISE**x**

Reply: *ISE**x**

x means the value of the analog current output issued, if an error is detected.
Adjustable between 0 and 200 (x 0.1 mA). For adjustments in range [201..255], the analog current output is not changed (last issued value is kept).

8.17.5 Analog current output – Warning status value

Command: ISW**x**

Reply: *ISW**x**

x means the value of the analog current output issued, if a warning message is issued.
Adjustable between 0 and 200 (x 0.1 mA). For adjustments in range [201..255], the analog current output is not changed (last issued value is kept).

8.17.6 Analog current output - Message status value

Command: ISM**x**

Reply: *ISM**x**

x means the value of the analog current data output issued for messages, which are not of type "no target message", “warning” or “error” (e.g. while in programming mode)
Adjustable between 0 and 200 (x 0.1 mA). For adjustments in range [201..255], the analog current output is not changed (last issued value is kept).

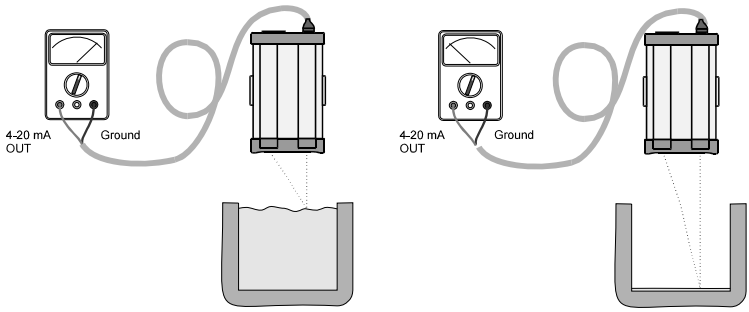
For achieving electromagnetic compatibility, use original *RIEGL* analog output cables only!

Example level measurement:

The filling level in a silo has to be measured.

Mounting position of the LD90 is 12 m above bottom of the silo:
100% filled at a level of 10 m.
empty = 4 mA, full = 20mA.
Therefore: Empty corresponds to 12 m, full corresponds to 2 m

The output value shall be unchanged when no measurement is available.



Command	Reply
"IL1200"<Cr>	"*IL1200 "<Cr><Lf>
"IH200"<Cr>	"*IH200 "<Cr><Lf>
"ISM255"<Cr>	"*ISM255 "<Cr><Lf>
"IST255"<Cr>	"*IST255 "<Cr><Lf>
"ISE255"<Cr>	"*ISE255 "<Cr><Lf>
"ISW255"<Cr>	"*ISW255 "<Cr><Lf>

For achieving electromagnetic compatibility, use original *RIEGL* analog output cables only!

8.18 Analog Voltage Output - Adjustment (optional)

For instruments with
OPTIONAL VOLTAGE OUTPUT only!

8.18.1 Setting the range value corresponding to 0 V output

Command: UL**x**

Reply: *UL**x**

x means the range value between 0 and 65535. The unit is 1/100 m or 1/100 feet or 1/100 yd, according to the setting of parameter U (see chapter 8.2).

8.18.2 Setting the range value corresponding to 10 V output

Command: UH**x**

Reply: *UH**x**

x means the range value between 0 and 65535. The unit is 1/100 m or 1/100 feet or 1/100 yd, according to the setting of parameter U (see chapter 8.2).

8.18.3 Analog voltage output - No target status value

Command: UST**x**

Reply: *UST**x**

x means the value of the analog voltage output issued, if no measurement is possible.
Adjustable between 0 and 200 (x 0.05 V). For adjustments in range [201..255], the analog voltage output is not changed (last issued value is kept).

8.18.4 Analog voltage output – Error status value

Command: USE**x**

Reply: *USE**x**

x means the value of the analog voltage output issued, if an error is detected.
Adjustable between 0 and 200 (x 0.05 V). For adjustments in range [201..255], the analog voltage output is not changed (last issued value is kept).

8.18.5 Analog voltage output – Warning status value

Command: USW**x**

Reply: *USW**x**

x means the value of the analog voltage output issued, if a warning message is issued.
Adjustable between 0 and 200 (x 0.05 V). For adjustments in range [201..255], the analog voltage output is not changed (last issued value is kept).

8.18.6 Analog voltage output - Message status value

Command: USM**x**

Reply: *USM**x**

x means the value of the analog voltage data output issued for messages, which are not of type "no target message", “warning” or “error” (e.g. while in programming mode)
Adjustable between 0 and 200 (x 0.05 V). For adjustments in range [201..255], the analog voltage output is not changed (last issued value is kept).

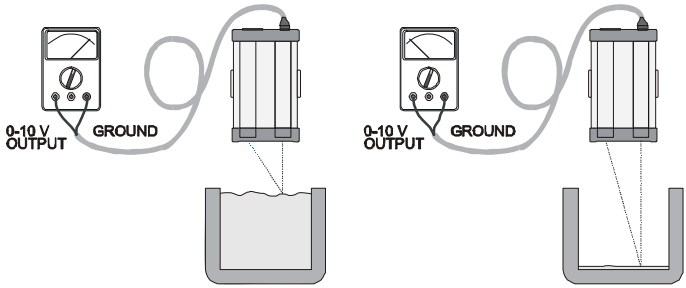
For achieving electromagnetic compatibility, use original *RIEGL* analog output cables only!

Example level measurement:

The filling level in a silo has to be measured.

Mounting position of the LD90 is 12 m above bottom of the silo:
100% filled at a level of 10 m.
empty = 0 V, full = 10 V.
Therefore: Empty corresponds to 12 m, full corresponds to 2 m

The output value shall be unchanged when no measurement is available.



Command	Reply
"UL1200"<Cr>	"*UL1200 "<Cr><Lf>
"UH200"<Cr>	"*UH200 "<Cr><Lf>
"USM255"<Cr>	"*USM255 "<Cr><Lf>
"UST255"<Cr>	"*UST255 "<Cr><Lf>
"USE255"<Cr>	"*USE255 "<Cr><Lf>
"USW255"<Cr>	"*USW255 "<Cr><Lf>

For achieving electromagnetic compatibility, use original *RIEGL* analog output cables only!

8.19 Switching Output - Adjustment (optional)

For instruments with
OPTIONAL SWITCHING OUTPUT only!

8.19.1 Setting the range value for changing output level to low

Command: RN**x**
RL**y**

Reply: *RN**x**
*RL**y**

x means the relay's output number [0…1] and **y** means the range value between 0 and 65535. The unit is 1/100 m or 1/100 feet or 1/100 yd, according to the setting of parameter U (see chapter 8.2).

8.19.2 Setting the range value for changing output level to high

Command: RN**x**
RH**y**

Reply: *RN**x**
*RH**y**

x means the relay's output number [0…1] and **y** means the range value between 0 and 65535. The unit is 1/100 m or 1/100 feet or 1/100 yd, according to the setting of parameter U (see chapter 8.2).

For RL < RH:
If measured range ≤ RL, output is set low.
If measured range ≥ RH, output is set high.
If [RL < measured range < RH], the output keeps the last value (hysteresis).

For RL > RH:
If measured range ≤ RH, output is set high.
If measured range ≥ RL, output is set low.
If [RH < measured range < RL], the output keeps the last value (hysteresis).

For RL = RH:
If measured range < RL (=RH), output is set low.
If measured range > RH (=RL), output is set high.
If measured range =RL(=RH), the output keeps the last value.

8.19.3 Switching output - No target status value

Command: RN**x**
RST**y**

Reply: *RN**x**
*RST**y**

x means the relay's output number [0…1] and **y** means setting output to low (0) or high (1) for the "no target message" (no echo signal).

8.19.4 Switching output - Error status value

Command: RN**x**
RSE**y**

Reply: *RN**x**
*RSE**y**

x means the relay's output number [0…1] and **y** means setting output to low (0) or high (1) for errors.

8.19.5 Switching output – Warning status value

Command: RN**x**
RSW**y**

Reply: *RN**x**
*RSW**y**

x means the relay's output number [0…1] and **y** means setting output to low (0) or high (1) for warnings.

8.19.6 Switching output - Message status value

Command: RN**x**
RSM**y**

Reply: *RN**x**
*RSM**y**

x means the relay's output number [0…1] and **y** means setting output to low (0) or high (1) for all messages, which are not of type "no target message" or "error" or "warning".

For achieving electromagnetic compatibility, use original *RIEGL* analog output cables only!

Example:

The instrument shall indicate a "good range measurement" by setting the switching output 0 to high. A measurement is defined to be a good measurement for range values up to 10 m.

The second switching output 1 shall indicate error and warning situations.

Command	Reply		Meaning
"^P"	"*	"<CR><LF>	programming mode
"RN0"<CR>	"*RN0	"<CR><LF>	select output 0
"RH1000"<CR>	"*RH1000	"<CR><LF>	high up to 10 m
"RL1005"<CR>	"*RL1005	"<CR><LF>	hysteresis of 5 cm
"RSM0"<CR>	"*RSM0	"<CR><LF>	
"RST0"<CR>	"*RST0	"<CR><LF>	
"RSE0"<CR>	"*RSE0	"<CR><LF>	
"RSW0"<CR>	"*RSW0	"<CR><LF>	All situations where no measurement is available set output to low
"RN1"<CR>	"*RN1	"<CR><LF>	select output 1
"RL65534"<CR>	"*RL65534	"<CR><LF>	
"RH65535"<CR>	"*RH65535	"<CR><LF>	low for all ranges up to 655m
"RSM0"<CR>	"*RSM0	"<CR><LF>	low for messages
"RST0"<CR>	"*RST0	"<CR><LF>	low for no target
"RSW1"<CR>	"*RSW1	"<CR><LF>	high for warnings
"RSE1"<CR>	"*RSE1	"<CR><LF>	high for errors
"W"<CR>	"*W	"<CR><LF>	save settings
"Q"<CR>	"*Q	"<CR><LF>	quit programming mode

For achieving electromagnetic compatibility, use original *RIEGL* analog output cables only!

9 Serial Control Commands in Measurement Mode

9.1 Start Programming Mode

Command: ^P (16 dec.)

Reply: *

This command starts the programming mode, if the instrument has been in measurement mode.
The "*" character indicates that the instrument is ready for programming.

9.2 Laser On

Command: ^N (14 dec.)

The measurement laser is activated. Please read therefore the notes in chapter 3.5 for switching the laser off and on.

9.3 Laser Off

Command: ^F (6 dec.)

If a measurement is carried out while the laser is switched off, the message "LAS OFF " is issued.

9.4 Trigger Measurement

Command: ^X (24 dec.)

A measurement is started. If a measurement is already in progress, a ^X affects a retrigger (start of a new measurement without finishing the old). Effective only in mode "Serial". (see 8.10).

9.5 Trigger of RS232/RS422-Data Output, RS232/RS422 Inquiry Mode

Command: ^T or ^S (20 dec. or 19 dec.)

Inquiry of the actual data string is made by ^T or ^S. In the inquiry mode, no output of a measurement string or status string is done without a ^T or ^S. In the programming mode, the inquiry mode is cleared automatically.

9.6 Clear RS232/RS422 Inquiry Mode

Command: ^Q (17 dec.)

9.7 Start Self Check

Command: ^Z

An internal selfcheck, such as is carried out when the instrument is switched on, is started. It checks internal components and specific pulse sequences. Possible errors and warnings are indicated by error messages (see chapter 10.3 - "Status and Error Messages").

Important note: Whenever an error-message is issued, the instrument can be set to the normal measurement mode by sending ^P (programming mode) and "Q <Cr>" (Quit).
However a correct function of the LD90-3 can not be guaranteed.

10 Command Summary

10.1 Commands in Programming Mode

Command	Range	Effect	Page
P**x**	x = 0 to 3	Program range measurement: Fast/Standard/Max.Dist/Min.Dist	39
U**x**	x = 0 to 2	Unit range measurement: meter / feet / yards	39
T**x**	x = 0 to 7	Measurement time - range measurement	40
SA**x** [1])	x = 0 or 1	Speed measurement activation	41
SU**x** [1])	x = 0 to 2	Unit speed measurement: m/s, km/h, mph	41
ST**x** [1])	x = 0 to 3	Measurement time - speed measurement	41
H**x**	x = 0 to 100	Hold time	42
O**x**	x = -9999 to +9999	Adjustment of reference plane	42
F**x**	x = 1 to 7	RS232/RS422-data string format	43
CB**x**	x = 0 to 7	Baud rate	44
CP**x**	x = 0 to 4	Parity	44
CS**x**	x = 0 or 1	Separator	45
CM**x**	x = 0 or 1	Serial mode: RS232 or RS422	45
A**x**	x = 0 to 2	Trigger mode	46
AL**x** AH**x**	x = 0 to 255	Adjustment of an amplitude window	49
.Y	Y = Parameter	Inquiry of the actual parameter	46
DEFAULT		Set user parameters to default	47
RESET		Like switching off and on	48
W		Saving of parameters	48
Q		Finish programming mode	48

1) Instruments with speed measurement only

Commands in Measurement Mode

Command	Effect	Page
^P	Start programming mode	59
^N	Laser on	59
^F	Laser off	59
^X	Start (trigger) a measurement in mode A1	59
^T or ^S	Start RS232/RS422-transmission of the actual data string , inquiry mode	60
^Z	Start internal self check	60
^Q	Clears inquiry mode	60

10.2 Commands in Programming Mode only for Instruments with Optional Current, Voltage or Switching Output

Command	Range	Effect	Page
IL**x**	x = 0 to 65535	Current output: Adjustment of distance for 4 mA	50
IH**x**	x = 0 to 65535	Current output: Adjustment of distance for 20 mA	50
IST**x**	x = 0 to 255	Current output: Value if "no measurement is possible"	50
ISE**x**	x = 0 to 255	Current output: Value for errors detected	51
ISW**x**	x = 0 to 255	Current output: Value for warnings detected	51
ISM**x**	x = 0 to 255	Current output: Value for message outputs	51

Command	Range	Effect	Page
UL**x**	x = 0 to 65535	Voltage output: Adjustment of distance for 0 V	53
UH**x**	x = 0 to 65535	Voltage output: Adjustment of distance for 10 V	53
UST**x**	x = 0 to 255	Voltage output: Value if "no measurement is possible"	53
USE**x**	x = 0 to 255	Voltage output: Value for errors detected	54
USW**x**	x = 0 to 255	Voltage output: Value for warnings detected	54
USM**x**	x = 0 to 255	Voltage output: Value for message outputs	54
RN**x**	x = 0 to 1	Switching output: number of relay to be adjusted	56
RL**y**	y = 0 to 65535	Switching output: Adjustment for "low"	56
RH**y**	y = 0 to 65535	Switching output: Adjustment for "high"	56
RST**y**	y = 0 to 255	Switching output: Value if "no measurement possible"	57
RSE**y**	y = 0 to 255	Switching output: Value for errors detected	57
RSW**y**	y = 0 to 255	Switching output: Value for warnings detected	57
RSM**y**	y = 0 to 255	Switching output: Value for message outputs	57

10.3 Status and Error Messages

(RS232/RS422 data string format Fx with x > 0 assumed)

RS 232	Meaning	Status*)
"m#LD90-3#"	Power up message	M
"mSELFCHCK"	Internal self check is carried out	M
"m........"	No measurement possible (no target or badly reflecting target)	NT
"m........"	No measurement possible (measurement out of specified amplitude limits)	NT
"mOVERFLOW"	Measurement value (including offsets) too large	W
"mUNDERFLW"	Measurement value (including offsets) less than zero	W
"mLAS OFF "	No measurement is possible because the laser is switched off	W
"mLO BATT "	Supply voltage too low	E
"mHI BATT "	Supply voltage too high	E
"mLO TEMP "	Temperature too low	E
"mHI TEMP "	Temperature too high	E
"mUENI-ERR"	Laser error: Check if the laser safety lock is connected to ground; if yes, internal error	E
"mRAM- ERR"	Internal RAM defect	E
"mEEP- ERR"	Internal EEPROM defect	E
"mIDV- ERR" "mPLL-ERR "	Internal error	E
"mEPCS-ERR"	Internal EEPROM has inconsistent data	E
"mLAS-WRNG"	Warning: Internal test in self check is not possible, as the laser is switched off	W
"sSPEED ? "	Speed block information: Calculation of a speed value	
"*xxxxxxx"	Instrument in programming mode, ready for command	M
"?xxxxxxx"	Command could not be interpreted correctly	M
"=xxxxxxx"	Display of the actual value of a parameter	M

*) STATUS for optional analog outputs and switching output:

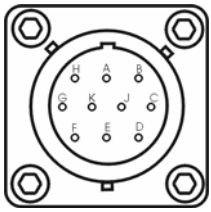
M.....Message status value NT No Target status value

W ....Warning status value E Error status value

11 Pinning and Cables

11.1 Instruments without Optional Analog Output, Instruments with Current Output Only

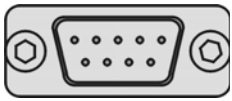
Plug (4), power supply, optional current output



Laser safety lock and GND output are connected in the plug of the connection cable (except -3100HS-HT)

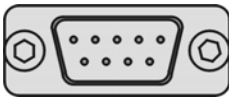
PIN	ASSIGNMENT
A	Laser safety lock
B	4-20 mA output (optional)
C	RS232: RxD data input
D	nc
E	trigger
F	nc
G	RS232: TxD data output
H	GND output
J	GND input
K	+UB 11-28 V DC

Plug (2), RS232



PIN	ASSIGNMENT
1	nc
2	RXD, RS232 data input
3	TXD, RS232 data output
4	nc
5	GND
6	must not be connected *)
7	must not be connected *)
8	must not be connected *)
9	nc

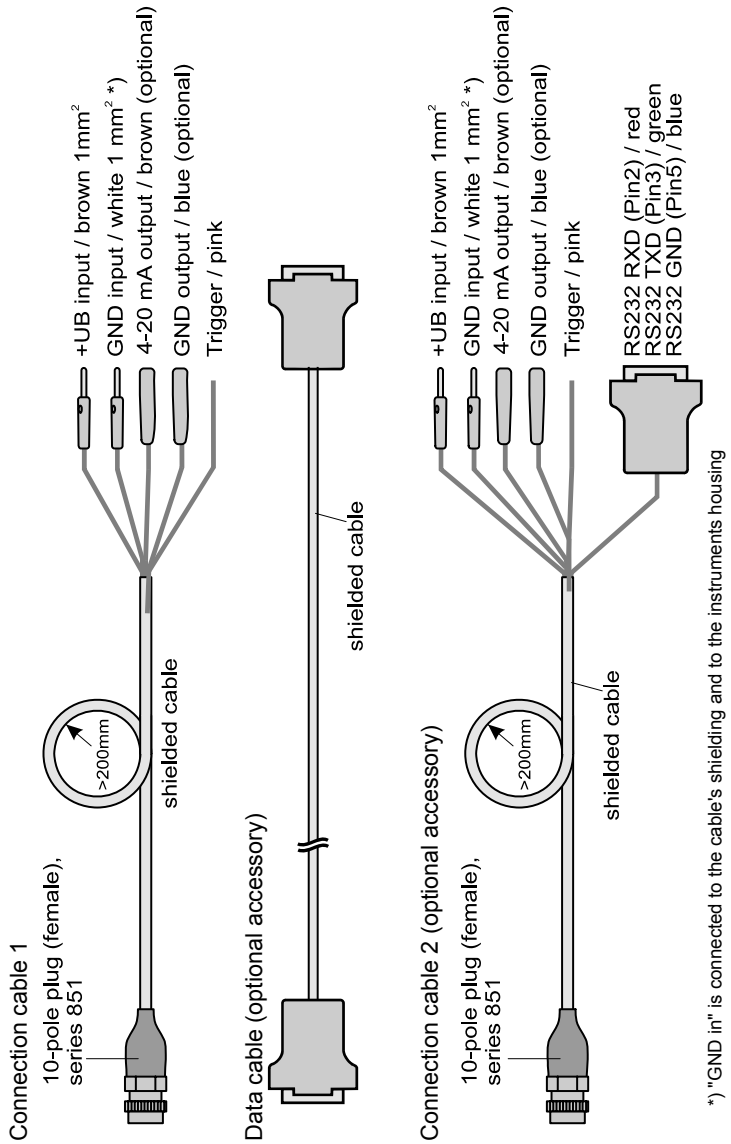
Plug (2), RS422



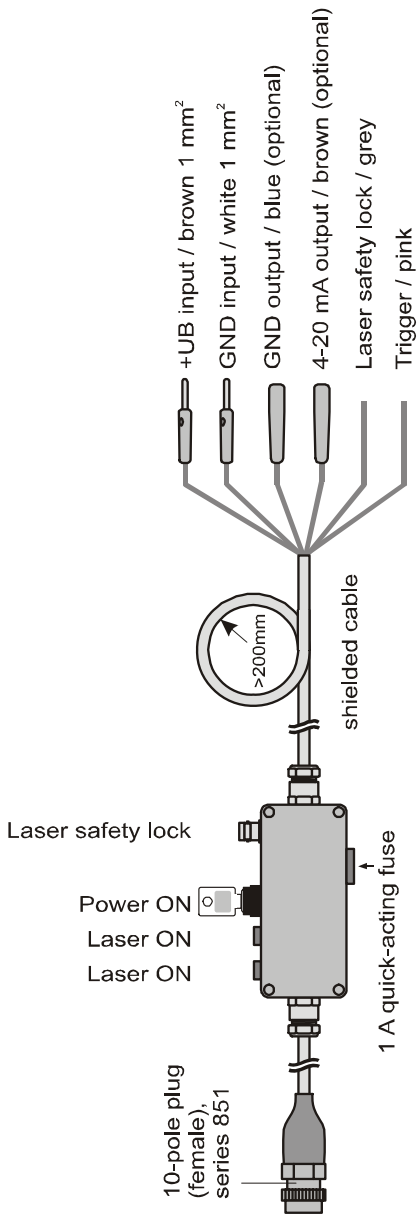
PIN	ASSIGNMENT
1	nc
2	R(A) , RS422 data input
3	must not be connected *)
4	nc
5	GND
6	T(B), RS422 data output
7	T(A), RS422 data output
8	R(B), RS422 data input
9	nc

*) **Important note:** Any use of these pins for whatsoever connections can damage the data output and is, therefore, strictly prohibited!

Connection and/or data cables (length of each cable 3 m)

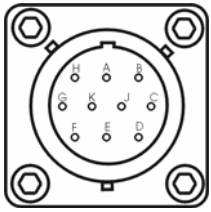


Connection cable for instruments with laser class 3R/3B (length 3m):



11.2 Instruments with Switching Output, Instruments with Switching Output & Current Output & Voltage Output

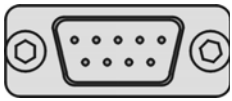
Plug (4), power supply, optional current output



Laser safety lock and GND output are connected in the plug of the connection cable (except -3100HS-HT)

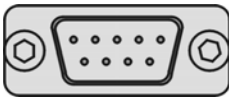
PIN	ASSIGNMENT
A	Laser safety lock
B	4-20 mA output (optional)
C	RS232: RxD data input
D	0-10V output (optional)
E	PNP1 (optional)
F	PNP2 (optional)
G	RS232: TxD data output
H	GND output
J	GND input
K	+UB 11-28 V DC

Plug (2), RS232



PIN	ASSIGNMENT
1	nc
2	RXD, RS232 data input
3	TXD, RS232 data output
4	nc
5	GND
6	must not be connected *)
7	must not be connected *)
8	must not be connected *)
9	nc

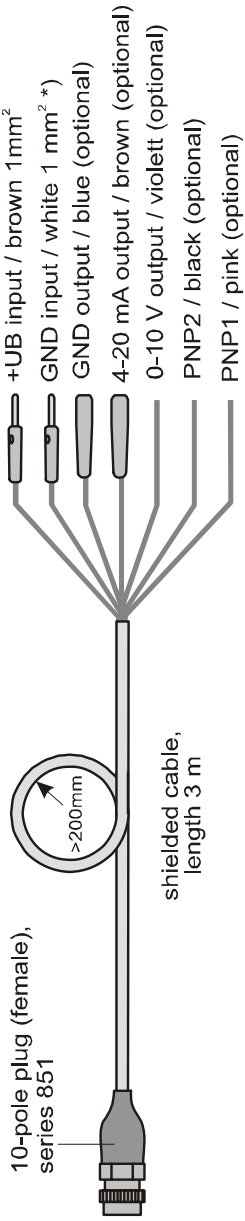
Plug (2), RS422



PIN	ASSIGNMENT
1	nc
2	R(A), RS422 data input
3	must not be connected *)
4	nc
5	GND
6	T(B), RS422 data output
7	T(A), RS422 data output
8	R(B), RS422 data input
9	nc

*) **Important note:** Any use of these pins for whatsoever connections can damage the data output and is, therefore, strictly prohibited!

Connection cables (length of each cable 3 m)



*) Laser safety lock and GND output are connected in the plug of the connection cable

Connection cable for instruments with laser class 3R/3B (length 3m):