User Manual

VLM 320

Firmware Version 1.02

Version 1.0

ASTECH

Angewandte Sensortechnik

Notes

The information contained in this manual has been thoroughly researched and prepared. Nevertheless, we cannot assume liability for omissions or errors of any nature whatsoever. We would, however, be grateful for your comments or suggestions.

We shall not accept any claims for damages, except for those resulting from intent or gross negligence.

As this product is available in several designs, there might be deviations between the descriptions and instructions in hand and the product supplied.

We reserve the right to make technical changes, which serve to improve the product, without prior notification. Thus, it cannot be assumed that subsequent versions of a product will have the same features as those described here.

Registered trade marks are the property of their manufacturers.

VLM 320 – User Manual V1.0d

VLM 320 series from hardware version 2010, firmware version from V1.02

Printed: 08 December 2010

ASTECH GmbH, Schonenfahrerstr. 5, 18057 Rostock, Germany

Internet www.astech.de E-mail info@astech.de

Telephone +49 (0)381 / 44073-0 Fax +49 (0)381 / 44073-20

Contents

Figures

Tables

About this manual

Commands and functions are printed in italics. Upper and lower case writing is used to improve legibility:

e.g. *S2On* (command used to initiate output to the serial interface S2).

The abbreviated input notations recommended for commands are printed in bold letters:

e.g. ***S1F****ormat* (command for the programming of the serial interface 1).

Designations are enclosed in single quotes:

e.g. 'SW1' (switch SW1).

The following symbols are used:

n	Integer	s	Character string
f	Floating point number	[ ]	optional
c	Character		

The following abbreviations are used for measurements:

V	Velocity	N	Object counter
L	Length	R	Measuring rate

The following symbols are used to emphasise particularly important instructions:

Caution!

Note!

Information!

1 Introduction

The VLM 320 measuring device for velocity and length is suitable for taking measurements on a wide variety of materials. The VLM 320 is a very versatile device and can be used in connection with many different process automation applications. Typical uses include the length measurement of materials that come in lengths and the cutting control or subsequent checking of sheet metal, profiles and tubes. The VLM 320 is used together with rewinders, calanders and extruders, as well as with roll trains and temper mills.

The VLM 320 operates optically without contact and implements the physical principle of a spatial filter via the use of a CCD sensor: An image of the optically resolvable material surface structures is produced on the CCD sensor. The sensor converts the movement directly into a frequency from which the velocity of the movement will be calculated. An internal integration unit calculates the length. The integration unit is controlled by an external signal (start/stop signal through trigger input).
The velocity calculation and the length integration are based on the positive or negative sign. The direction can be controlled by an external signal. An automatic direction detection device is available as an option.

The output signals are generated by a processor. The VLM 320 can be connected to an existing control and process data acquisition system. All inputs and outputs are opto-insulated. The unit comes with a RS 232 ports serving as programming interfaces (serial interfaces 1). Optionally a second interface is available (RS232, RS422 or RS485 as serial interface 2).

The VLM 320 basic model is equipped with an AB3 interface card featuring four outputs: one error output for the output of fatal errors, two programmable pulse outputs (phases A and B), and a fourth output used for the status signal. This output is programmable. There are three inputs (standby mode, direction and trigger control).

Additional serial interfaces, an analog output, various high-resolution pulse outputs and a number of bus interfaces are available as options (interface cards).

The system is encased in an IP 65 casing. It is powered with 230 V AC. The device is also available for 24 V DC power.

The VLM 320 is based on the well-established VLM 250 model. It combines the features of the VLM 250 with a number of additional advantages:

- Significantly improved signal processing and firmware with high-performance ASIC and a 32-bit processor, providing greater numerical resolution and calculation accuracy and also a higher processing rate.
- All devices come with internal length measurement function and sliding averaging for velocity up to 32x.
- The minimum update rate is 0.2 ms.
- The two serial interfaces are equivalent and bus addressable.
- Pulse outputs with improved resolution of 5 ns.
- Real-time clock, synchronisation function and intelligent light barrier controller (light barrier AND function for two barrier) as standard integrated features.
- New power supply (PS) and new analog signal processing (ASP) for improved reliability and lower power consumption.

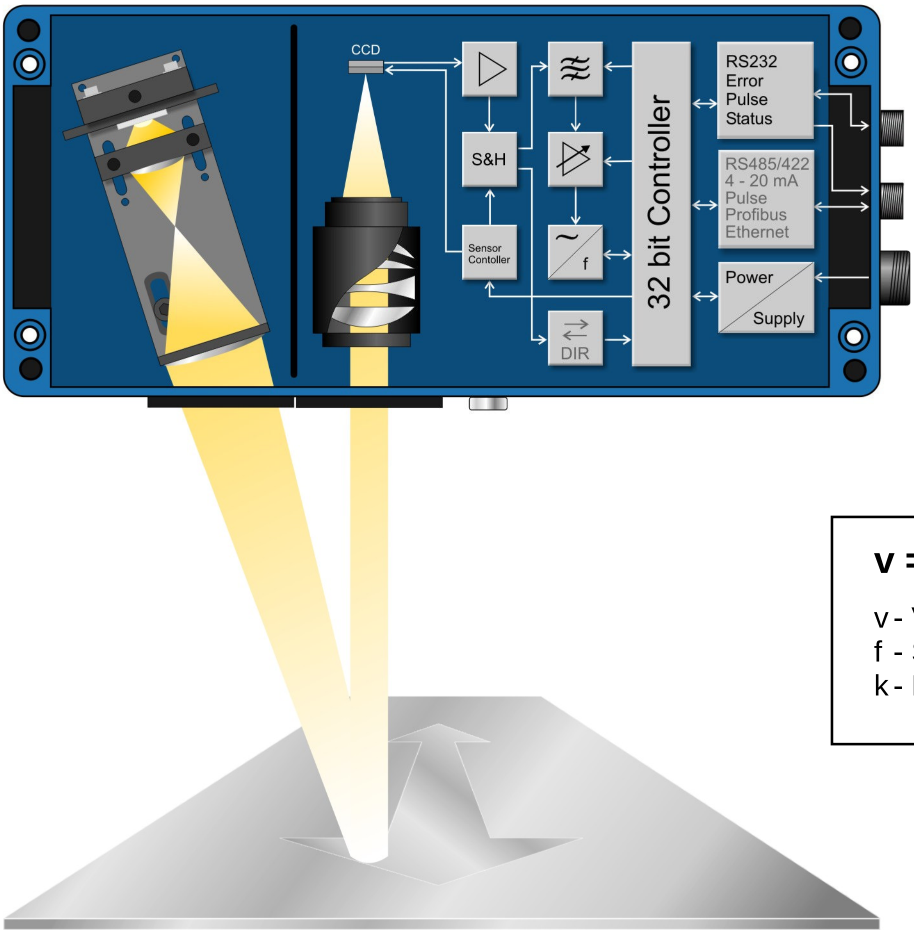
2 Function

2.1 Physical principle

The VLM 320 operates optically and contact-free and implements the principle of the spatial filter by means of a CCD sensor. Spatial filter is the generic term used to describe a measuring principle for the non-contact determination of the velocity and length of moving materials. The spatial filter function is based on the filtering effect of grid-like structures (grid modulation).

The function of the VLM 320 can be described as follows:

The lens is oriented towards the moving measuring object, whereby the measuring object is reproduced on the CCD sensor. The CCD sensor is operated as an optical grid (no image pickup). To illuminate the measuring object, a white light source is used. This allows a maximum surface independence. External light is effectively suppressed with this method. Due to the grid modulation, the movement of the object generates a frequency, which is proportional to its velocity, i.e. the structure of the measuring object (brightness contrast) generates a signal. This signal is generally referred to as a burst. These bursts are evaluated by the system, i.e. the signal frequency is measured, and the velocity is calculated based on this frequency.
There are several control circuits that enable automatic adjustment to a wide range of materials (material surface structure and brightness).



$v = f \bullet k$

v - Velocity
f - Signal frequency
k - Device constant

Fig. 1 Design of the VLM 320

2.2 Evaluation

The signal frequency (burst frequency) is evaluated by the VLM 320's electronic evaluation system. It generates a short-time frequency measurement by evaluating the individual periods. The velocity is calculated by multiplying the frequency with the device constant and the calibration factor. By integrating the velocity, the length of the object can be determined. The integration unit can be controlled by an external signal (trigger).
The device also calculates the measuring rate, which can be used for the optimisation of the device installation and the monitoring of the measuring function.

2.3 Interfaces

The VLM 320 is equipped with various opto-insulated interfaces (some of which are optional). The measured values can be output through the serial interfaces to a PC, a process control unit (PLC) or a printer. The device also comes with a number of pulse outputs for connection to counters. It can also be configured for optional analog output.

The standard version includes the following interfaces (AB3 interface card):

- RS 232 (serial interface S1, programming interface)
- Output for fatal errors
- High-resolution pulse outputs with A/B phase
- Status signal output
- Input for standby mode, directional signal and trigger signal

On request, the system can be equipped with the following optional interfaces (interface cards):

- Second serial interface S2 on IF1 interface card (RS 232, RS 422/RS 485)
- IF1 analog output (4 to 20 mA or 0 to 20 mA)
- IF3 series interface card with two high-resolution pulse outputs and optional analog output
- ECC2 shaft encoder coupling with optional serial interface S2 (RS232 or RS485)
- Ports for network connection via IFPROFI (Profibus DP) or IFETHER (UDP/IP, TCP/IP)

All interfaces are extremely flexible (programmable scaling and output time) and can be easily configured.

2.4 Configuration

All settings can be made through one of the two serial interfaces S1 and S2 (optionally), using a PC and a terminal program. The user-friendly VLMTERM terminal program is provided free of charge. The individual commands of the VLM 320 are described in chapter 9 Programming.
The set parameters can be protected with a password. Any changes made are lost after switching off the device, unless they were saved with the password-protected **Store* command.

3 Device models

The device is available in various models of the VLM 320 series, which are compatible with each other both electrically and as regards their connections. Most of the optional equipment (interface cards, mounting accessories, etc.) can be used with all models.
The device VLM 320 A, VLM 320 D, VLM 320 L and VLM 320 V differ from each other as regards the measuring range, working distance and distance variance, as they feature different optical and signal processing equipment.

All devices of the VLM 320 series are suitable for use in **highly dynamic processes** (minimum update rate of 0.2ms), can be synchronised with each other (for high-precision dynamic **differential velocity measurements**) and come with **internal length calculation**. Option /h has been specifically designed for use on glowing surfaces.

⚠	Do not operate the measuring devices at velocities that are above the range specified in the data sheet, as this could result in inaccurate readings. Please note that the maximum permissible velocity is directly affected by the *Direction* parameter. The *Vmax* parameter must thus be adjusted to match the actual maximum plant velocity. A safety margin of 10% is already taken into account in the device.

3.1 VLM 320 A

The VLM 320 A devoice have a working distance of 185±7.5 mm. It is designed as a universal unit and allows for **measurements on a wide range of different materials**. The device can be automatically adjusted within a very wide range to the reflection, colour and structure of the material surface.
By altering the *DIRECTION* parameter (see chapter 9.1.6 *Direction* command), the working distance range, i.e. the range, in which the material to be measured must be located, can be extended. The extended working distance range of the VLM 320 A is 185±15 mm.

3.2 VLM 320 D

The VLM 320 D has been specially developed for **metal surfaces** and is configured to cater for a large distance variance. Their working distance is 240±15 mm. In addition, they offer excellent reproducibility of ≤ 0.025 %.
Device VLM 320 D allow for the measurement of **velocities of less than 0.008 m/s** (0.48 m/min).
The VLM 320 D device can, if necessary, be configured for a large distance variance range of ±30 mm (see chapter 9.1.6 *Direction* command).

3.3 VLM 320 L

The devices VLM 320 L have a working distance of 170±7.5 mm. They are primarily used for the **measurement of low velocities**, as they cater for a **minimum speed of 0.004 m/s** (0.24 m/min).
The VLM 320 L device can, if necessary, be configured for a large distance variance range of ±10 mm (see chapter 9.1.6 *Direction* command).

3.4 VLM 320 V

Also available is the special VLM 320 V model with FB2L filter for velocities of 0.001 m/s (0.06 m/min) to 1.5 m/s (90 m/min). Apart from the minimum and maximum velocities, this model is identical with the VLM 320 L.

3.5 Option /h for VLM 320 series

Based on the previously named devices, the /h option has been specifically designed for the measuring of **glowing tubes, wires and profiles** in steel, copper, brass, etc.
The option/h features a optical adaptation for use on glowing surfaces. The models can however also be used for measurements on other materials.
Depending on the actual ambient conditions, it might be necessary to provide forced cooling (e.g. CB5 cooling and protecting case and AC5 blowing air supply unit).

3.6 Overview of device models

	VLM 320 A	VLM 320 D	VLM 320 L	VLM 320 V
Working distance and range	**185±7.5 mm**	**240±15 mm**	**170±7.5 mm**	**170±7.5 mm**
Extended working range *)	**185±15 mm**	**250±30 mm**	**170±10 mm**	**170±10 mm**
Measuring range	**0.6 to 1500 m/min** (0.01 to 25 m/s)	**0.48 to 900 m/min** (0.008 to 15 m/s)	**0.24 to 180 m/min** (0.004 to 3 m/s)	**0.06 to 90 m/min** (0.001 to 1.5 m/s)
with extended working range *)	**1.2 to 3000 m/min** (0.02 to 50 m/s)	**0.96 to 1800 m/min** (0.016 to 30 m/s)	**0.48 to 360 m/min** (0.008 to 6 m/s)	**0.12 to 180 m/min** (0.002 to 3 m/s)
Uncertainty of measurement DIN 1319 / ISO 3534	**< 0.025 % at standard working distance** (< 0.05 % within standard working distance range and < 0.2 % within extended working range)			
Reproducibility DIN 1319 / ISO 3534	**< 0,025 %**			
Internal length measuring range	**400 km**			
Averaging and update rate	from 0.2 ms with additional sliding averaging (1x to 32x)			
Optional automatic direction detection	yes			
Material	Almost all surfaces	Metallic surfaces	Metallic and other surfaces	Almost all surfaces
Application	Universal	Universal	Low velocity	Very low velocity

Table 1 Device models

*) VLM 320 parameter *DIRECTION 4 ... 8*

4 Technical data

Velocity measuring range 1) 2)	0.001 to 50 m/s, corresponding to 0.06 to 3000 m/min (depending on individual device type)
Working distance 2)	170, 185 or 240 mm (depending on individual device type)
Length measuring range (internal)	400 km
Detector / principle of measurement	CCD sensor / spatial filter
Illumination	White light, LED
Programming interface 3)	RS 232 (opto-insulated)
Opto-insulated outputs 3)	OUT0, OUT1, OUT2, OUT3
Function	OUT0: VLM error OUT1, OUT2: Pulse output with 2 phases, shaft encoder emulation OUT3: Signal status
Frequency of pulse output	0.2 Hz - 25 kHz (2 phases, resolution 5 ns) (also available with 2 additional high-resolution pulse outputs, see below)
Type / max. output current	PNP / 40 mA with AB3, with optional AB4 active push/pull 24V ±20 mA
Opto-insulated inputs 3)	IN0, IN1, IN2
Function	IN0: Standby IN1: External directional signal IN2: Trigger signal (for signals 0/24 V, 0/20 mA or ±20 mA, R_i approx. 1 kohm)
Voltage level	> 8 V for HIGH (for IN1 and IN2 switchable to > 3 V)
Input current	approx. 20 mA at 24 V
Power supply	230 V / 50 Hz optional 24 V / DC (20 to 30 V)
Power consumption	< 20 W
Temperature range	0 to 50 °C
Protection class	IP 65
Weight	approx. 5.8 kg
EMC 4)	Industrial standard in compliance with CE
Housing dimensions without connections 2)	360 mm x 160 mm x 90 mm

Options

- Analog IF1 output 4 to 20 mA or 0 to 20 mA (16-bit resolution, opto-insulated)
- Different digital IFI interfaces (RS485/RS422, RS232, opto-insulated)
- IF-PROFI (Profibus DP) network connection, IF-ETHER (UDP/IP and TCP/IP)
- High-resolution pulse output IF3 0.2 Hz to 25 kHz, IF3-PP 0.2 Hz to 50 kHz and IF3-5V 0.2 to 2 MHz (2 x 2 phases, resolution 5 ns)
- Light barriers, direction detection, various counters and displays
- Mounting accessories, linear units, protective casing, blowing device

1) parameterisable with FB2 through *VMax*
2) standard model; other versions available on request
3) max. voltage 50 V/DC, 36 V/AC
4) tested by an accredited institution

5 Installation

The device must be installed at right angles to the direction of movement of the object to be measured (see drawing in the appendix chapter 10.10, special versions are available on request). The standard direction of movement (forward) is defined as the direction from the casing base to the casing cover (other versions available on request). The direction of movement (plus sign meaning "forward") is indicated with an arrow at the device.

> The device can be installed in plus or minus direction. The *Direction* parameter must be set accordingly (see chapter 9 Programming!

The device does not need to be opened for installation. It is secured with four M6 hexagon socket screws.
It working distance (distance between lens window and material surface) specified by the manufacturer must be adhered to at all times (see type label of VLM 320).

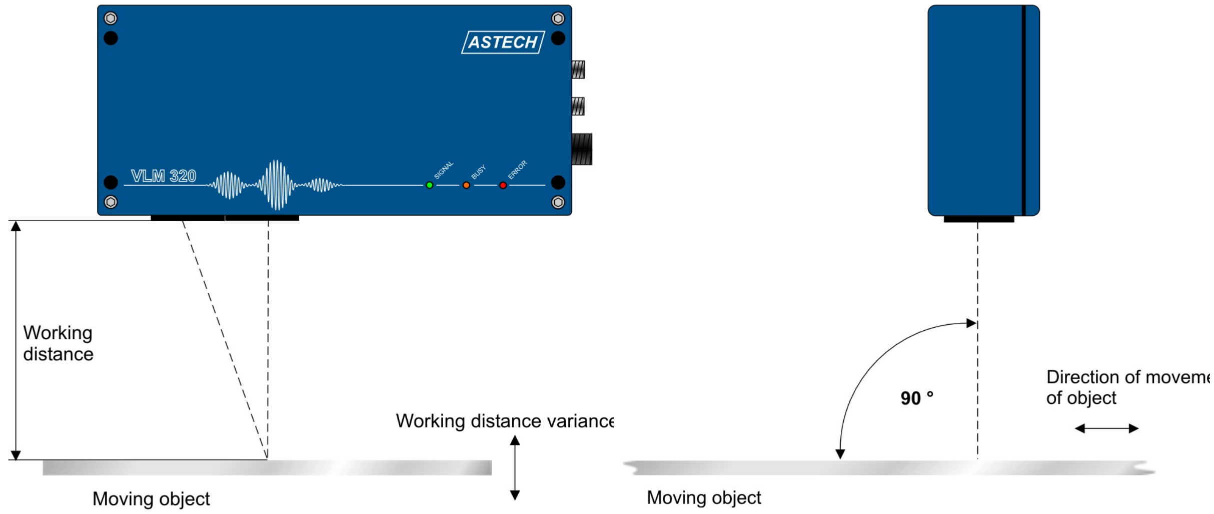
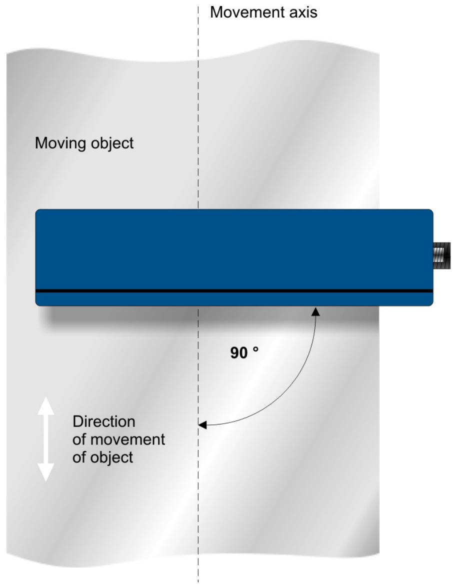


Fig. 2 Working distance and alignment relative to material surface



Angular alignment with max. tolerance of ± 1°

Fig. 3 Alignment to velocity vector

> The device must be installed at right angles to the direction of movement of the material
> **with a maximum tolerance of ±1°**. If the alignment tolerance is exceeded, measurements might be incorrect.

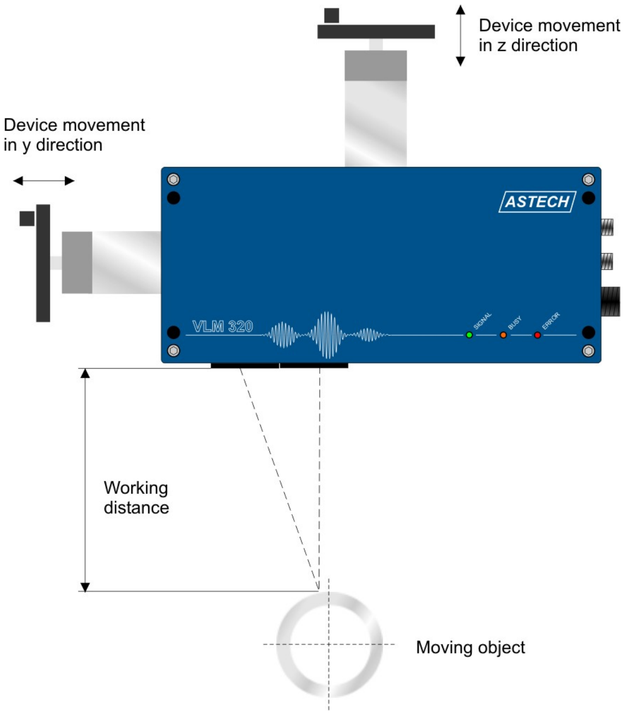


Fig. 4 VLM 320 with LJ2 linear unit

By installing optional linear units, the working distance can be adjusted to cater for changing distances to the material (LJ1 for one axis) or for curved surfaces as found in pipes, wires and profiles (LJ2 for two axes).

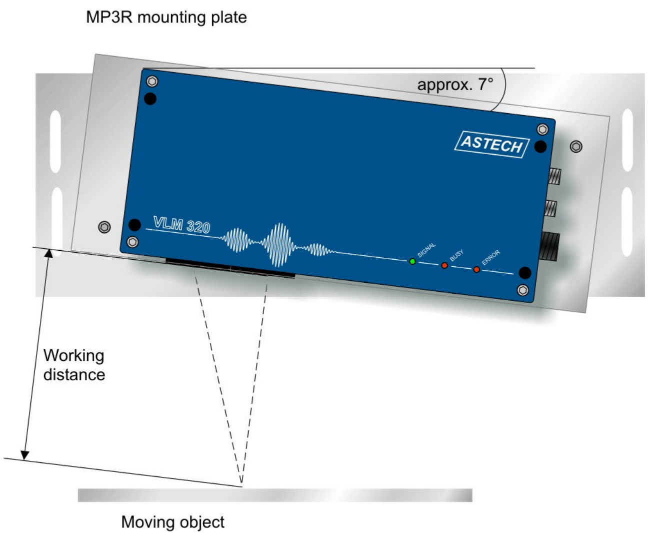


Fig. 5 VLM 320 with MP3R mounting plate

If the device is installed on an MP3R mounting plate, it can be tilted relative to the velocity vector without causing vectoral measuring errors. Tilting is necessary in the case of measurements on highly reflective materials and some plastic surfaces.

For measurements on reflective or curved surfaces, we recommend optimising the alignment by means of the *TestQuality* command. This is done after the device has been powered and is connected with a programming cable to a PC (see chapter 9.1.27 *TestQuality* command). In such cases, the measuring rate value should be as high as possible in movement; or with still stand output value should be 2/3 of the highest value (reflection).

6 Device connection

The VLM 320 is equipped with screwed device connections. It comes with an earthing screw terminal, a port for the programming interface, a connection for the signalling lines (inputs and outputs) and a connection for the power supply. Two additional signalling line connections are available on request.

Plug connectors must not be connected or disconnected while the unit is powered. All connections must be established while the device is not powered!

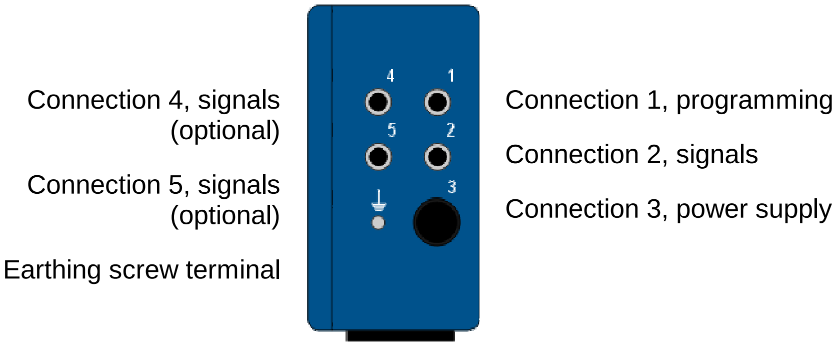


Fig. 6 VLM 320 device connections

6.1 Power supply and earthing

The standard VLM 320 model is designed for 230 V / 50 Hz AC power supply. Units for 24 V DC (20 – 30 V) power supply are available on request. The device is powered through device connection 3.
A mains cable with a removable plug with earthing contact is included in deliveries to Germany. All terminals in the cable connectors are screwed (exception: DSUB9 at programming cable). It is the responsibility of the operator to wire the terminals according to the applicable rules and regulations.

Before connecting the VLM 320 to the power supply, a connection has to be established between the earthing screw terminal and the device holder. To do this, use the earthing cable included in the delivery. The device holder must also be low-resistance earthed!

Missing or insufficient earthing of the measuring device can cause malfunctions or damage to the electronics in the event of surge!

6.2 Signal lines

The device includes an interface card (AB3) with screwed terminals as standard. It can be fitted with an optional interface card (IF1, IF3, etc.[1]) with screwed terminals that can be accessed by removing the casing cover. Prior to opening the casing, always disconnect the device from the power supply. There are a range of options for the assignment of the connections. As these assignments might have been modified by the manufacturer or the operator, they should be checked prior to connection.

As a rule, all signal connections (device connections 1, 2, 4 and 5) must be established with shielded plugs and cables. The programming cable (device connection 1) must be disconnected once programming has been completed. Ensure that the shielding is earthed. Suitable plugs and cables can be purchased from the manufacturer.
The device connections 4 and 5 are optional connections. Device connections that are not in use must be protected against dirt by means of dummy plugs.

> The device connections 2, 4 and 5 are wired according to customer specifications. Please note that they might not be reverse polarity protected. A wiring diagram is enclosed with every shipped device!

The pin assignments of the device connections can be found in the appendix (chapter 10.6).

Ensure that the potential differences between the output and input signals to the protective earthing conductor (PE) are less than 42 V. We recommended connecting the GND wire of the system voltage to the earth or the PE conductor via a potential equalisation device.

> The protective circuits integrated on the adapter and interface cards are triggered at voltage differences of > 42 V between the signals or to the protective earthing conductor. The protective circuits might be triggered in the event of a surge, resulting in the short-term failure of the respective signal!

[1] The interface cards of the older IF2-series are detected and also supported by the VLM 320.

6.3 Serial interfaces

6.3.1 RS 232 interface (AB3, IF1, ECC2)

The RS 232 interface is used for serial data exchange between two devices. As almost all computers are equipped with an RS 232 interface (COM1, COM2), the VLM 320 features an (electrically insulated) RS 232 interface for configuration purposes.
As it is electrically insulated, the RS 232 interface is also suitable for use in industrial environments.
The interface supports full duplex data transmission, which means that the connected devices can simultaneously send and receive data.
Only TxD, RxD and GND signals are used. The data transmission is controlled by means of the XON/XOFF protocol (software handshake). If the receiver is not ready to receive data, it sends an XOFF signal to the sender, which then interrupts transmission. If the receiver is ready again to receive data, it sends an XON signal, and the sender resumes data transmission.

RS 232 physical transmission parameters:

Maximum cable length	15 m (30 m with special low-capacity cable)
Maximum send level	± 15 V
Minimum send level	± 5V
Minimum receive level	± 3 V
Load resistance	3 to 7 kohm
Load capacity	≥ 2500 pF

6.3.2 RS 422 interface (IF1-RS422, IF3-RS422)

The RS 422 interface is used for serial data exchange over great distances. With the VLM 320, the RS 422 interface is used to transmit measuring values. If large distances need to be bridged, it might be useful to convert the programming interface (RS 232) to RS 422.
The interface supports full duplex data transmission, which means that the connected devices can simultaneously send and receive data.
A maximum of 10 RS 422 receivers can be connected to a single sender. Serial data are transmitted as voltage differences between the two wires in a cable.

RS 422 physical transmission parameters:

Maximum cable length	1200 m, depending on cable type and transmission rate
Maximum transmit level	± 5 V
Minimum transmit level	± 2V
Minimum receive level	± 200 mV
Load resistance	1x 120 ohm at the cable end (receiver termination)

It is of course also possible to transmit encoder pulses via an RS 422 interface, as the standard only specifies the levels, impedance, etc, but not the type of data. The IF3-5V interface card thus provides 2 pulse channels, with 2 phases each, in accordance with the RS 422 standard (with the maximum transmit level ± 5 V).

6.3.3 RS 485 interface (IF1, ECC2)

The RS 485 interface is used for serial data exchange over great distances. The interface supports only half-duplex communication, which means that only one of the connected devices can send data at a time. A maximum of 32 devices can be connected to the RS 485 interface. Serial data are transmitted as voltage differences between the two wires in a cable.

RS 485 physical transmission parameters:

Maximum cable length	1200 m, depending on cable type and transmission rate
Maximum send level	± 5 V
Minimum send level	± 1.5 V
Minimum receive level	± 200 mV
RS 485 load resistance	120 ohm each on both cable ends (termination) and one “receiver open-circuit fail-safe” circuit

In the VLM 320, the S2 interface can be operated as an RS 485 interface (half-duplex). With half-duplex operation it is necessarily to set the parameter *H* in the command *S2Interface* (see chapter 9.6.3 *S1Interface* command).If there are more as one sender in the system, addressing must be used (see chapter 9.6.6 *S1Address* command).

6.4 AB3 interface card

The terminal panel of the AB3 interface card contains the connections for the serial interface 1 (programming interface) 'RxD', 'TxD' and 'GND' and the inputs/outputs 'IN0' to 'IN2' and 'OUT0' to 'OUT3'. Terminals 'BR1' and 'BR2' are connected with each other and can be used as a bridge.

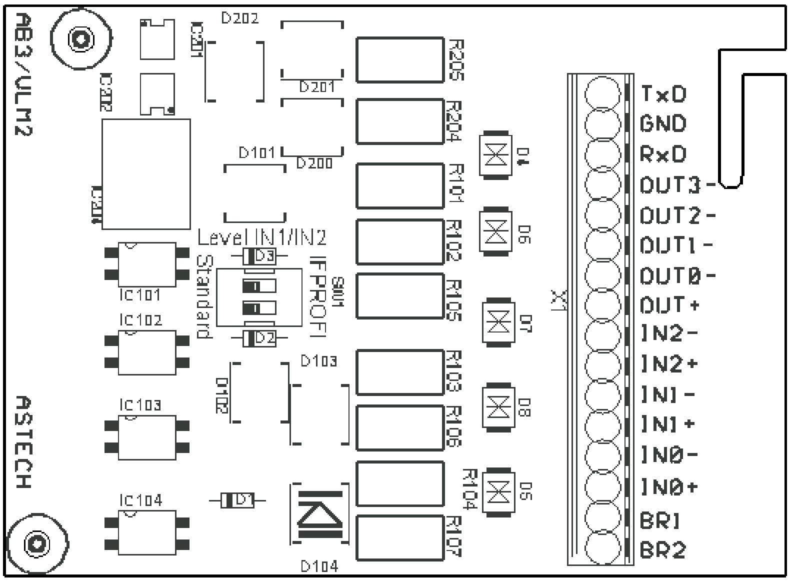


Fig. 7 AB3 interface card

6.4.1 Serial interface 1

Serial interface 1 is an RS 232 interface. It serves as the programming interface of the device. In addition, it can be used for data transfer. It includes opto-insulated 'RxD', 'TxD' and 'GND' connections (device connection 1).
The baud rate, protocol type and parity are set with the *S1Interface* command. The format is pre-set to 8 data bits and 1 stop bit. Default parameter settings: 9600 baud, no parity and XON/XOFF protocol.

6.4.2 Outputs 'OUT'

The three outputs 'OUT0' to 'OUT3' of the AB3 interface card are electrically insulated with optical couplers. They are transistor outputs sharing a collector connection.

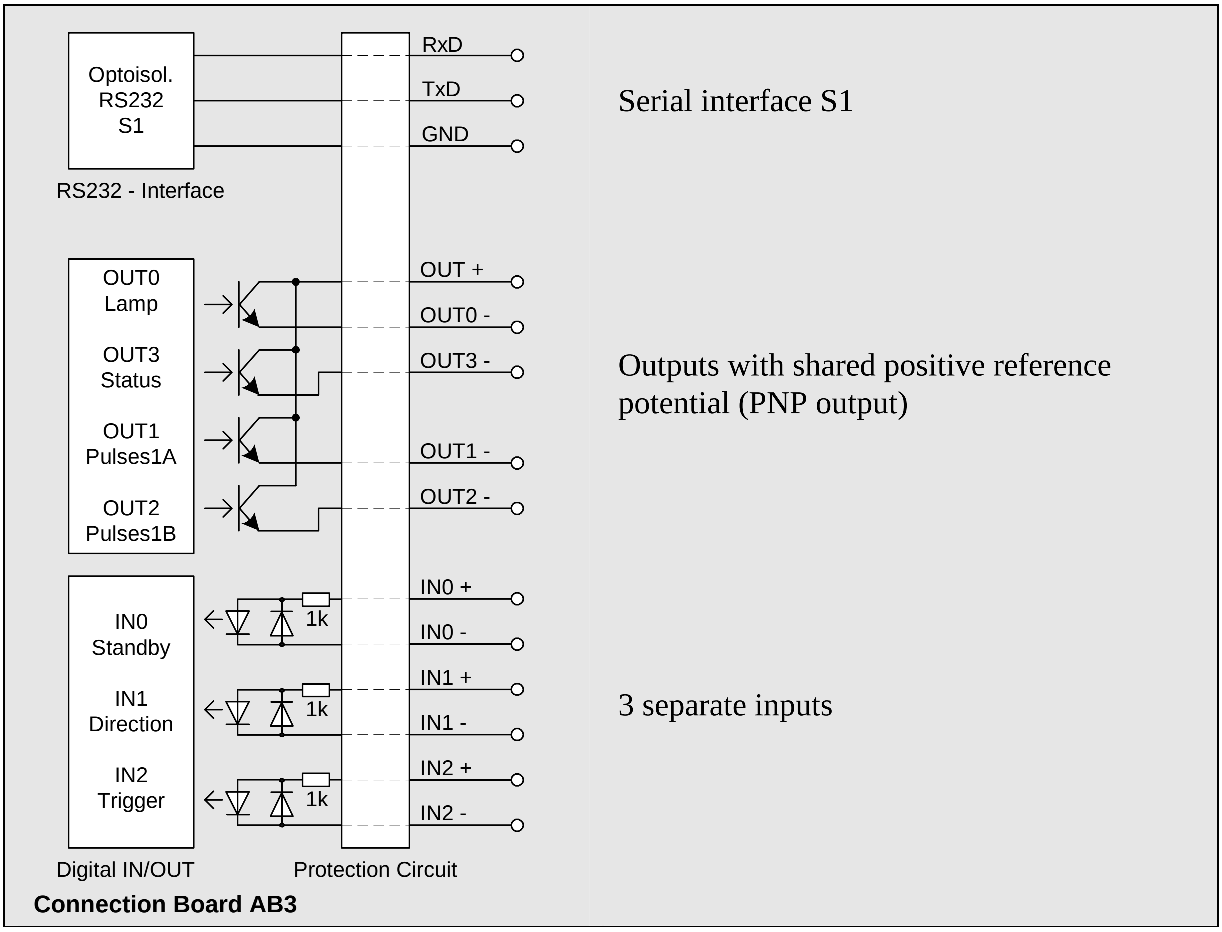


Fig. 8 General design of AB3 interface card

The shared OUT+ connection is normally powered from an external source with 10 to 30 V (e.g. 24 V). The load at the outputs OUT0- to OUT3- is connected to 0 V of the power supply connection.

The output transistors can generate a maximum current of 40 mA each. If an external voltage of 24 V is to be used, install 1.2 kohm load resistors to achieve 20 mA. The load might consist of an optical coupler (see Fig. 9). The outputs OUT0 to OUT3 are short-circuit proof and surge-proof.

For high-ohmic inputs, an additional load resistor (e.g. 1.2 kohm) must be connected in parallel to the input.

Output 'OUT0' is used for the signalling of fatal errors. In this case the measuring function of the device will be switched off automatically.

A 90° phase-shifted clock signal is made available at the pulse outputs 'OUT1' (phase A) and 'OUT2' (phase B) (see chapter 9.4 Pulse output through first pulse output).

By default, output'OUT3' (status) indicates that there are measuring values; the function of the output corresponds to that of the 'SIGNAL' LED on the front panel of the device. If the LED is green, 'OUT3' is switched through. The output can be programmed with either the *Minrate* command or the ECC control.

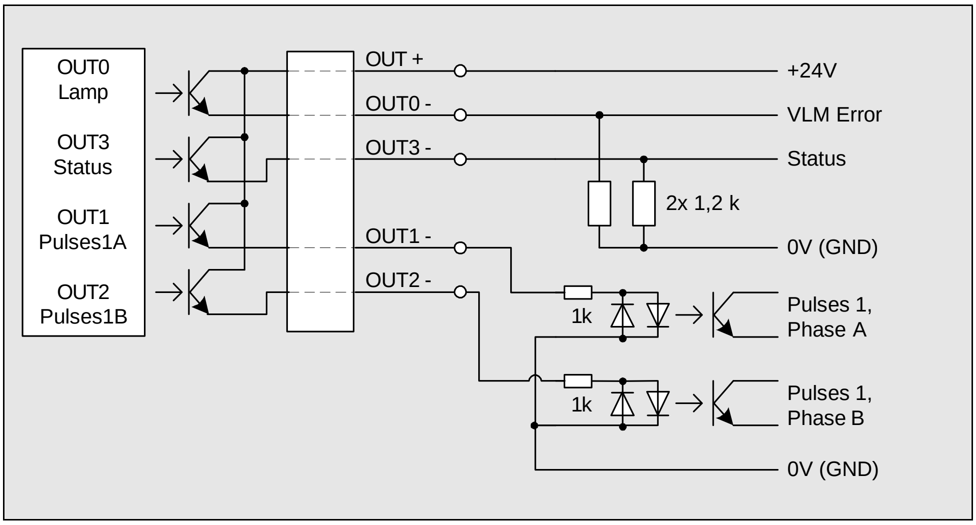


Fig. 9 Wiring example for the outputs of the AB3[2]

AB 4-PP interface card with push-pull outputs

Instead of the AB 3 card, an AB 4-PP card can be installed in the VLM 320.
The outputs OUT0, OUT1, OUT2 and OUT3 feature push-pull drivers and provide ±20 mA per output at a 24 V level.

[2] The example shows wiring with passive load resistors and optical couplers.

6.4.3 Inputs 'IN0', 'IN1' and 'IN2'

The inputs 'IN0' (standby), 'IN1' (external directional input) and 'IN2' (trigger) on the AB3 interface card are electrically insulated by optical couplers. An input current of -40 to +0.3 mA or an input voltage of < +2 V corresponds to the L level; an input current of +5 to +40 mA or a voltage of > +10 V corresponds to the H level. Using the switch, the H level for 'IN1' and 'IN2' can be reduced to > +3 V (required for use of IFPROFI).

> ⚠ The maximum input frequency must not exceed 10 Hz at 'IN0' and 'IN1', and 500 Hz at 'IN2'. The mark-space ratio must be 1 : 1.
>
> The input signals must be completely bounce-free. The use of relay contacts is forbidden!

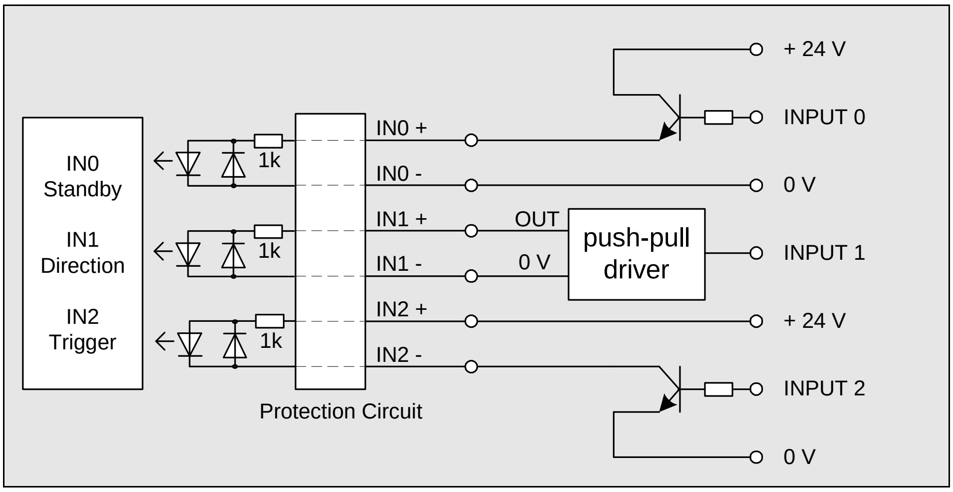


Fig. 10 Wiring example for the inputs of the AB3[3]

6.4.3.1 Input 'IN0'

A H level at this input switches the device to standby mode. This function corresponds to the **Standby* command (see chapter 9.10.5 **Standby* command).

6.4.3.2 Input 'IN1'

The input for the directional signal can be activated at H or L level. It is programmed with the *Direction* command (see chapter 9.1.6 *Direction* command). The connection of an external directional transducer to 'IN1' should be given preference over internal direction detection (option FB2DIR).

The VLM 320 comes with an integrated function for the connection of two light barriers. This function can be activated with the *Trigger* parameter (see chapter 9.1.29 *Trigger* command). If this function is activated, input 'IN1' is not used for direction detection but as a light barrier input.

6.4.3.3 Input 'IN2'

Input 'IN2' is the trigger input and is used to control the length calculation. It is programmed by means of the *Trigger* parameter (see chapter 9.1.29 *Trigger* command) (H or L level or edge) and implements the start and stop of the device-internal length integration unit. The output channels are synchronised to the trigger (the *S1OUTPUT 1* parameter for example switches the data output of the serial S1 interface to be synchronised with the trigger).

[3] The example shows connections to PNP, push-pull and NPN outputs.

In models with synchronised average (see chapter 9.1.1 *Average* command), input 'IN2' is not used for triggering but for the synchronisation signal.
The VLM 320 comes with an integrated function for the connection of two light barriers. This function can be activated with the *Trigger* parameter (see chapter 9.1.29 *Trigger* command). If this function is enabled, input 'IN2' is used as the input for the start light barrier.

6.5 IF1interface card

The optional IF1 interface card provides an additional interface, depending on its components (serial interface 2: RS 232 with handshake signals, RS 422/RS 485 opto-insulated) and/or analog output (16-bit resolution, 4 to 20 mA or 0 to 20 mA).

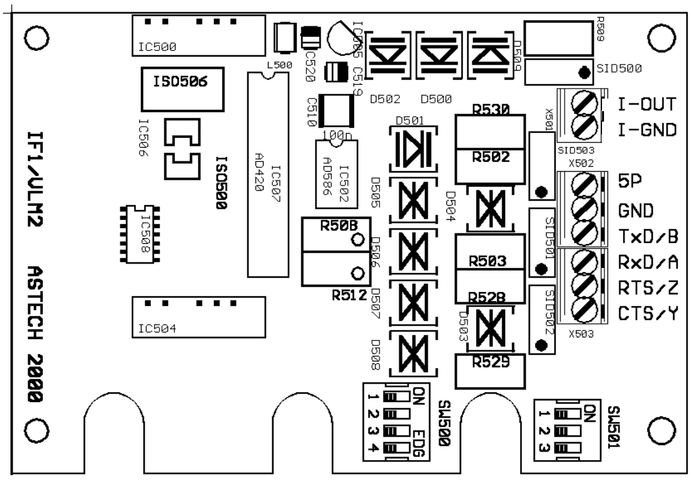


Fig. 11 IF1 interface card

The DIL switches are used to switch over between RS 485 and RS 422 and to switch the terminating resistors. There are no DIL switches with the RS 232 option.

> Please note that the RS 485 interface must be terminated at both cable ends with 120 ohm and that the RS 422 interface must be terminated with 100 ohm at the last receiver.

Positions of 4x DIL switch (RS485/422)	SW500-1	SW500-2	SW500-3	SW500-4
RS 485 with receiver open-circuit fail-safe[4]	ON	ON	ON	ON
RS 485 without receiver open-circuit fail-safe[5]	ON	ON	OFF	OFF
RS 422 with receiver open-circuit fail-safe[4]	OFF	OFF	ON	ON
RS 422 without receiver open-circuit fail-safe	OFF	OFF	OFF	OFF

Positions of 3x DIL switch (termination)	SW501-1	SW501-2	SW501-3
RS 485 with 120 ohm terminating resistor	OFF	ON	OFF
RS 485 without termination[5]	OFF	OFF	OFF
RS 422 with 120 ohm terminating resistor in receiver	ON	OFF	OFF
RS 422 without termination	OFF	OFF	OFF

Table 2 Position of the IF1 DIL switch

[4] only from IF1 version 4.0
[5] default settings

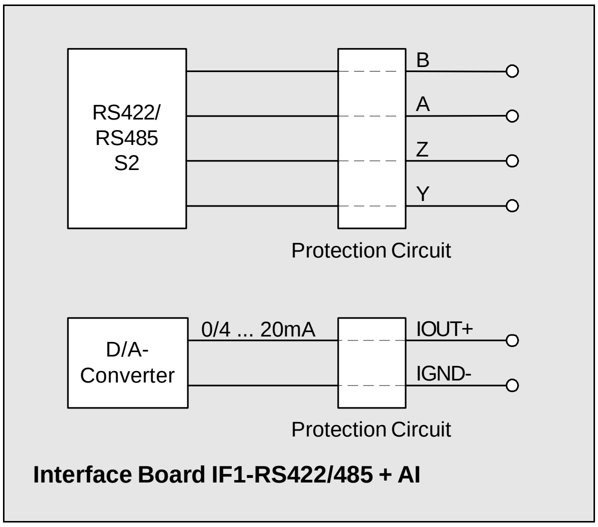


Fig. 12 Principle wiring diagram of IF1-RS422 with analog output option

6.6 IF3 interface card

The optional IF3 interface card provides two high-resolution pulse outputs with 2 phases each and a frequency range of 0.2 Hz to 25 kHz. Resolution and maximum error are 5 ns. The maximum cable length is 50 m. The card can be equipped with an optional opto-insulated analog output (16-bit resolution, 4 to 20 mA or 0 to 20 mA).

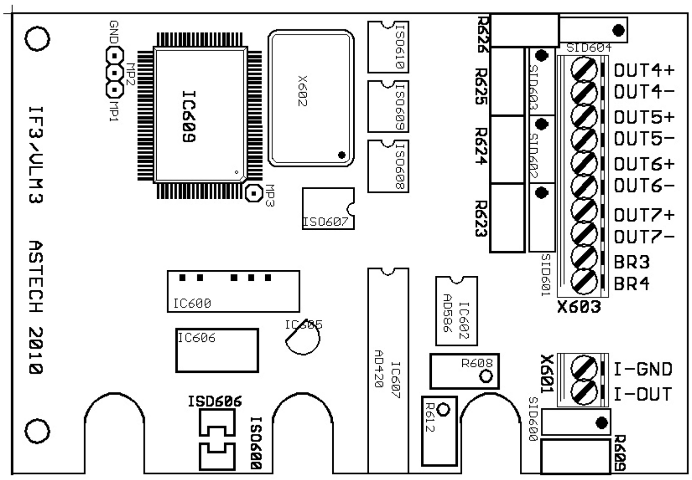


Fig. 13 IF3 interface card

The four outputs 'OUT4' to 'OUT7' are electrically insulated by optical couplers. The outputs OUT4/5 and OUT6/7 can be scaled independently (see chapter 9.4 Pulse output). NPN transistors are used. The necessary external voltage is 24 V. The outputs provide a 90° phase-shifted clock signal.

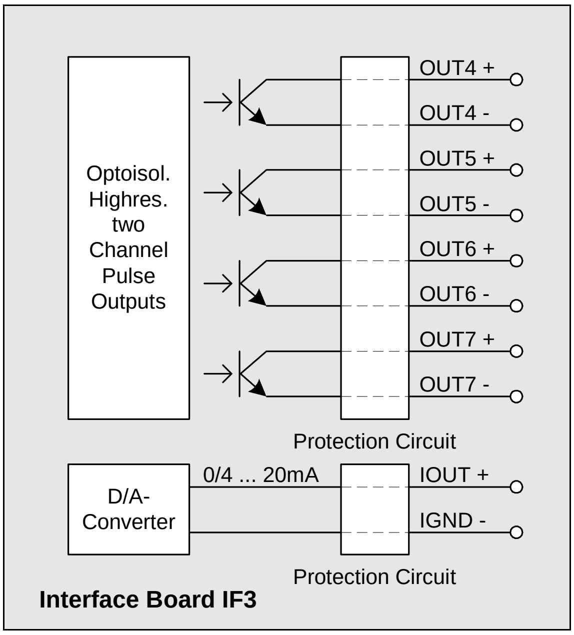


Fig. 14 Principle circuit diagram of IF3 with analog output option

6.7 IF3-PP interface card

The optional IF3-PP interface card provides two high-resolution pulse outputs with 2 phases each and a frequency range of 0.4 Hz to 50 kHz. Resolution and maximum error are 5 ns. The card can be equipped with an optional opto-insulated analog output (16-bit resolution, 4 to 20 mA or 0 to 20 mA).

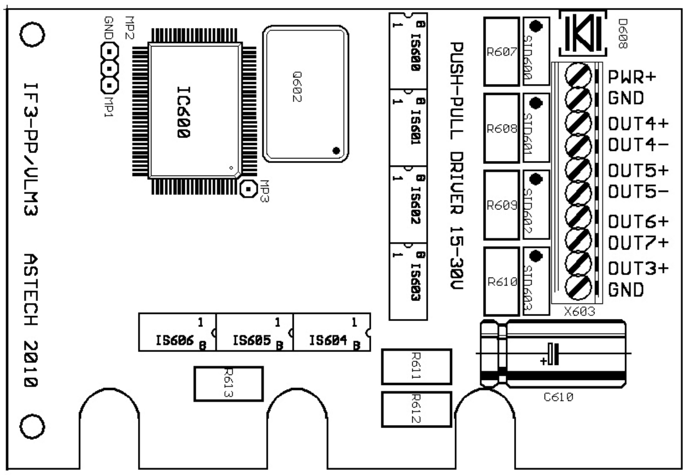


Fig. 15 IF3/PP interface card

The seven outputs 'OUT3' to 'OUT7' are electrically insulated by optical couplers. The outputs are designed as push-pull driver stages (HP3120A driver). The maximum output current is ±100 mA per channel. The maximum cable length is 200 m. The necessary external voltage is +15 to +30 V. OUT4+ is the pulse output A2, OUT4- is /A2, OUT5+ is B2, OUT5- is /B2, OUT6+ is A3 and OUT7+ is B3. The card also includes the status output OUT3 (see chapters 6.4.2 Outputs 'OUT' and 9.4 Pulse output). The card requires an **external supply voltage of 15 to max. 30 V**.

> ⚠ The outputs of the IF3-PP interface card is only short-circuit protected to GND. Connection to the operating voltage can result in the destruction of the respective channel!

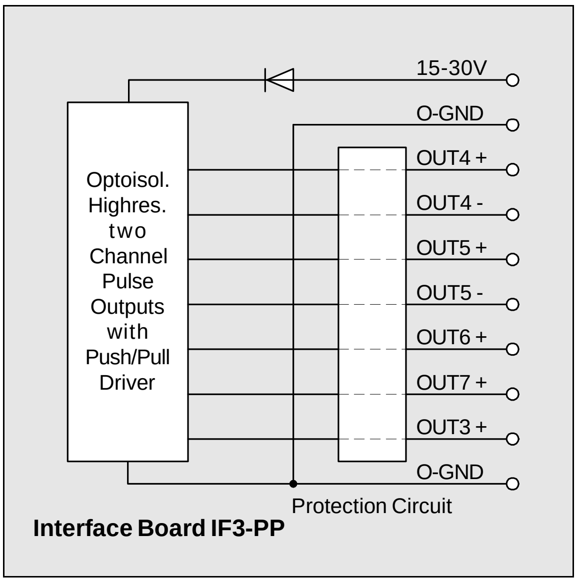


Fig. 16 Principle circuit diagram of IF3-PP interface card

6.8 IF3-5V interface card

The optional IF3-5V interface card provides two high-resolution pulse outputs with 2 phases each and a frequency range of 0.2 Hz to 2MHz. Resolution and error: 5 ns. In addition, it can be equipped with an opto-insulated analog output (16-bit resolution, 4 to 20 mA or 0 to 20 mA).
The eight outputs 'OUT4' to 'OUT7' are electrically insulated by optical couplers, but have the same reference potential. The outputs OUT4/5 and OUT6/7 can be scaled independently. The outputs provide a 90° phase-shifted clock signal (see also programming instructions for pulse output in chapter 9.5 Pulse output through second and third pulse output).
The outputs are designed as 5 V driver stages (74ACT04 interface driver). OUT4+ is the pulse output A2, OUT4- is /A2, OUT5+ is B2, OUT5- is /B2, OUT6+ is A3, etc. The maximum output current is ± 24 mA per channel. The maximum cable length for asymmetrical operation (reference potential O-GND) is 200 m; for output frequencies below 50Hz, it is 500 m.
The card can be used to drive RS 422 inputs with a 100 ohm terminating resistor. In this case, the pick-off is symmetrical between OUT+ and OUT-, while the O-GND is not connected. When using twisted pair shielded cables (e.g. CAT5), the maximum cable length for RS 422 is 500 m.

> ⚠ The outputs of the IF3-5V interface card are protected against ESD but not against high voltage. A connection to a voltage >5V will destroy the relevant output.

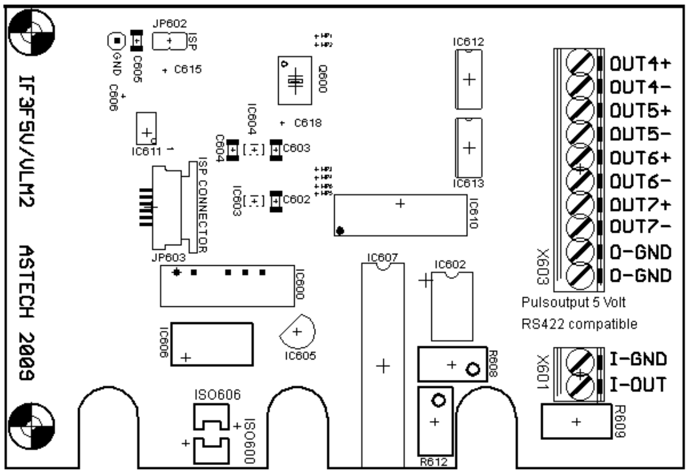


Fig. 17 IF3-5V interface card

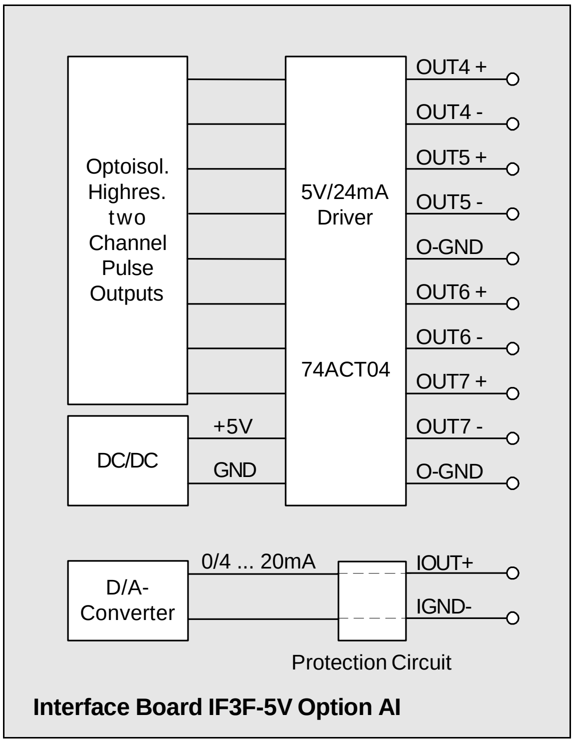


Fig. 18 Principle circuit diagram of IF3-5V with analog output option

6.9 IF-PROFI and IF-ETHER interface card

The optional IF-PROFI interface card allows for direct connection to Profibus DP. The IF-ETHER interface card provides a 10 Mbit Ethernet connection with UDP/IP and TCP/IP protocol.
Please refer to the additional information included with the cards and provided on the internet at www.astech.de.

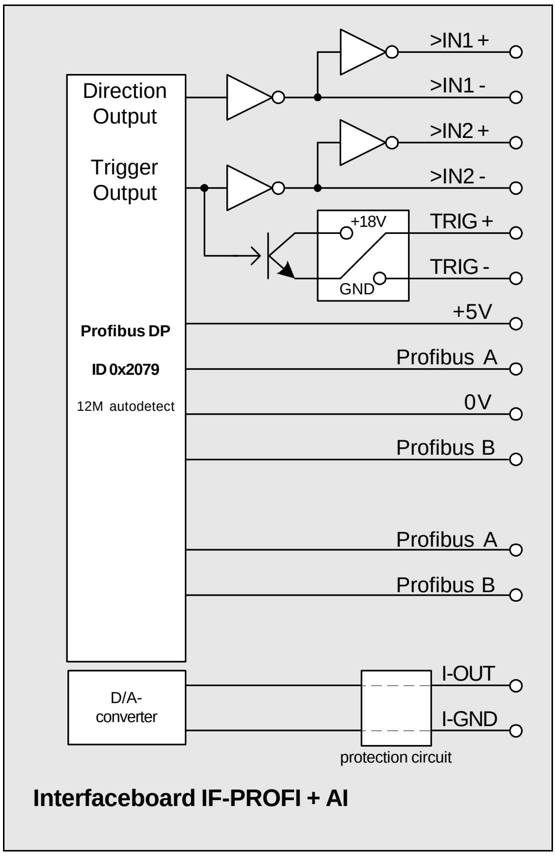


Fig. 19 Principle circuit diagram of IFPROFI

6.10 ECC2 interface card

The optional ECC2 interface card allows for the connection of an external shaft encoder or a second VLM 320 velocity measuring device. If the actual value drops below the set velocity or measuring rate, the pulse output is switched over to the shaft encoder or the second measuring device respectively. The two outputs 'COU1' and 'COU2' are electrically insulated by optical couplers. As regards function and programming, they correspond to the outputs 'OUT1' and 'OUT2' (default setting DIL switch output). The criteria for switching over are programmable (see chapter 9.3 ECC control). The switch-over is triggered by the status signal, which can be picked up parallel to 'OUT3' to indicate the measuring device that is active.
A direction signal is generated from the phasing of the 'INC' inputs. This signal can picked up through the lateral terminal and connected through the 'IN1' input of the AB3 interface card.
The DIL 'output' switch controls the output 'COU2'. The options here are phase B or direction output.
In addition, the second serial interface (S2 as RS232 or RS485) can be installed.

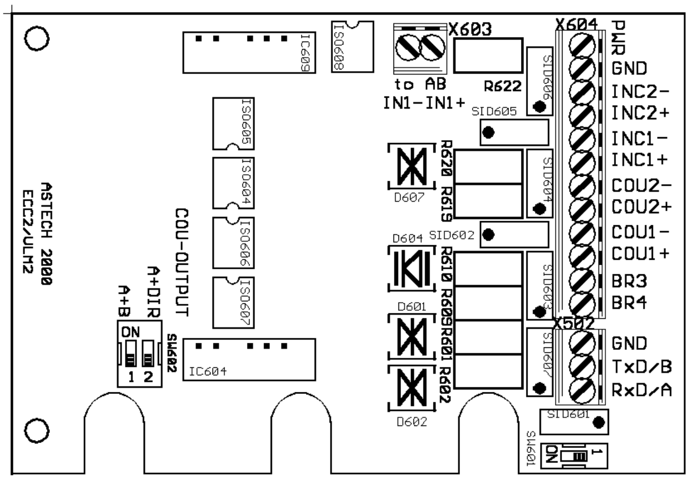


Fig. 20 ECC2 interface card

Position of DIL switch - termination (with RS 485 option)	SW601.1
RS 485 with 120 ohm terminating resistor (default configuration)	ON
RS 485 without termination	OFF

Position of DIL switch - output	SW602.1	SW602.2
Phase A and phase B (default configuration)	ON	OFF
Phase A and direction	OFF	ON

Table 3 Position of DIL ECC2 switch

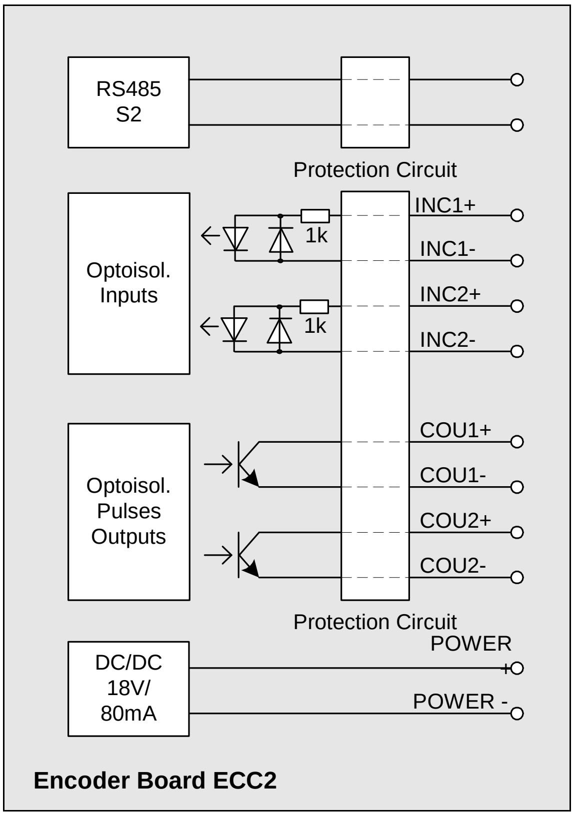


Fig. 21 Principle circuit diagram of ECC2 with RS 485 option

Note: When using the IF1 or IF3 interface cards, the function of the ECC2 interface card can be realised by an ECC1 designed as an independent device (IP65). The ECC1 allows for the switch-over function described above. It also provides a power supply of 24 V, for example for the shaft encoder. The ECC1 is controlled by the 'OUT3' status output.

7 Operating instructions

When fully programmed, the VLM 320 operates autonomously and requires only minimum maintenance. If required, maintenance is limited to the cleaning of the windows and the replacement of the LED light source (see chapter 8 Maintenance).
During operation, a number of commands such as the *Test* and *Error* are available for diagnostic purposes (see chapter 9 Programming).
The actual operating modes are indicated by LEDs as follows:

LED	Colour	Description
Signal LED	green	Signal exists or is good, see also *Minrate* and *ECCOn*
Signal LED	red	No signal or signal below defined threshold, see also *Minrate* and *ECCOn*
Signal LED	yellow	Device is being initialised
Busy LED	yellow	Command is being processed; LED also on during calibration, simulation, standby and offline measurement
Error LED	red	Flashes continually in the event of a fatal error or flashes short in the event of a critical error (see appendix chapter 10.3 Error messages)

Table 4 LED signals

Signal LED
While the object to be measured is moving and the signal quality is good, the LED is on in green. Otherwise, it is on in red. A red LED signal can have a number of causes:

1. No measuring object; measuring object outside the VLM 320 working range
2. Measuring object not moving or movement outside of velocity range
3. Measuring object not sufficiently structured
4. Measuring object too bright - sensor is overload, see command *Test* (chapter 9.1.24)
5. Window dirty (see chapter 8 Maintenance)
6. Measuring rate too low (only if measuring rate monitoring is activated; see chapter 9.1.12 *Minrate* command)
7. Velocity or measuring rate outside the permissible range (only if ECC function is activated, see chapter 9.3 ECC control)

The 'OUT3' (status) output is switched together with the signal LED. If the LED is green, 'OUT3' is switched through.

Busy LED
While a command is being processed (see chapter 9 Programming) or if an offline measurement is being performed (see chapter 9.8 Offline measurement) the LED is on in yellow.

Error LED
If the error LED is continuously flashing in red, there is a technical fault. If it flashes at short intervals or continuously during operation, certain parameters are incorrectly set or there are data transmission errors. In all cases, identify the cause of the error from the PC with the *Error* command and eliminate it, as it is otherwise likely that the measuring results are incorrect.

During initialisation after the device has been switched on or after a **Restart* command, the signal and busy LED is on in yellow and the error LED is red.

8 Maintenance

8.1 Window

The VLM 320 is an optical device. This means that the object to be measured must be "seen" by the device. Regularly check the windows and clean them, if necessary. The windows should be cleaned with a soft, lint-free cloth and a conventional glass cleaner.

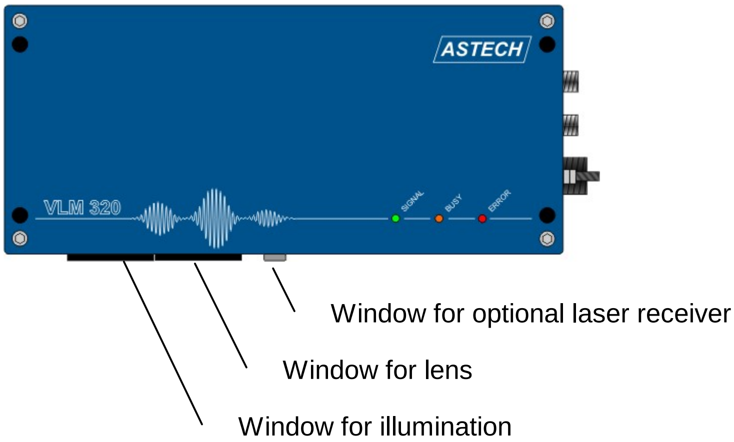


Fig. 22 VLM 320 windows

Replace damaged windows without delay. To do this, you must remove the device from the plant and clean it. The window must only be replaced in a clean environment. Unscrew the 4 hexagon socket screws (key size 2.0). Using a flat screwdriver, lift the window from the seal. Do not touch the inside of the window or the lens! Secure the new window with the 4 screws. Before inserting them, clean the screws and apply a little screw lubricant to the threads.

Device	Replacement window for lens	Replacement window for lighting
VLM 320 /h measuring device	OW 4	OW 3
Stainless steel window (optional)	OW 5	OW 5
all other VLM 320 models	**OW 2**	**OW 2**

Table 5 Order codes for replacement windows

⚠ Use only the correct replacement windows and the original seal and the original screws.

The OW 2 and OW 3 windows are made from special glass with extra high transmission. The OW 4 window reflects infrared light. The OW 3 and OW 4 windows have an increased temperature resistance. The optional OW 5 window is resistant against oil, petrol and kerosene and are more resistant against mechanical impact that the standard window OW 2.

We also provide plastic windows that are shatter-proof and therefore particularly suitable for use in food processing, etc.

If the windows need to be frequently cleaned or if they wear quickly, they might need to be protected by suitable measures (e.g. PA2 blowing device or CB5 cooling and protecting casing with AC5 air generation).

All product numbers are listed in the appendix (see chapter 10.9 Part numbers).

8.2 Illumination

8.2.1 LED light source

The VLM 320 using a especially high power LED. Over time, the LED looses some of its brightness. According to the manufacturer, a drop in brightness to 70 % occurs after 50,000 operating hours at a chip temperature of 80 °C. We therefore recommend **replacing the LED every 20,000 operating hours**.

The LED is aligned and secured on an aluminium block. The aluminium block is inserted between two set pins into the VLM 320 and held with a hexagon socket screw (3 mm). The electrical contacts are established through two plug-type connectors. This allows for easy replacement of the LED.

8.2.2 General notes

The lamps must be purchased either from your dealer or directly from the manufacturer. For the product number, refer to the casing lid of the VLM 320, the lamp packaging or the appendix (see chapter 10.9 Part numbers). Always strictly follow the **instructions for the replacement of the lamp**.

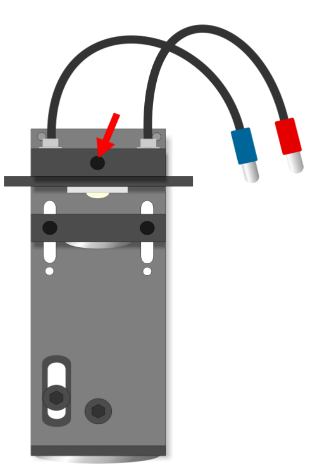
> ⚠ When not installed, the lamps are extremely delicate and can be easily damaged. Please handle the lamps with extreme care. Do not touch or damage the lens!

New lamps must be stored in their original packaging. Do not remove the lamp from the packaging until just before you are about to install it.

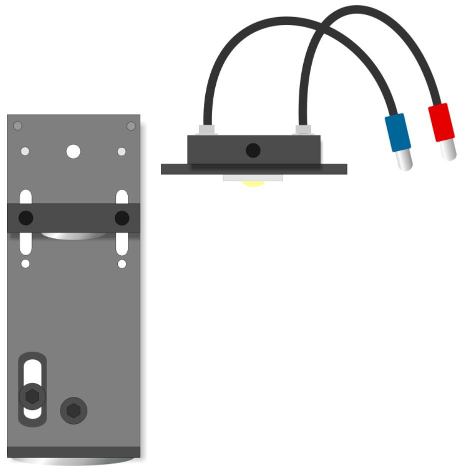
> ⚠ When the cover is open, ensure that no damage is caused to the components on the circuit boards. Protect the inside of the device against dust and dirt!

Instructions for the replacement of the LED

1. **Before changing the lamp, clean the outside of the device.** If the device is operated in a environment that is not clean, remove the device and bring it to a clean room before changing the lamp.
2. First **disconnect the device from the power supply** and then unscrew the four hexagon socket screws and remove the cover from the VLM 320.
3. Disconnect the two plug-type connectors and the hexagon socket screw (see red arrow). Remove the old aluminium block from the device (caution: block might be hot!).
4. Carefully insert the new lamp block. Prevent jamming! **Do not touch the glass of the new lamp!**
5. Tighten the hexagon socket screw and push in the plug-type connectors to the stop so that the contacts are fully covered by the protective caps. Ensure that no cables are located in the path of the light beam!
6. Close the cover of the device proper and after reconnect the device to the power supply.



Lighting unit with installed LED and securing screw (arrow)



Lighting unit, LED removed

Fig. 23 LED change

9 Programming

To program the device, we recommend using the programming interface of the VLM 320 (default: connection 1, serial interface 1, RS 232). To program the device, connect an interface cable to the interface of the device and to the serial port of the PC. The instructions in this manual assume that the first serial interface of the VLM 320 is used for programming. Alternatively, you can use the second serial interface, which is equivalent to the first interface and offers the same functionality. With the second serial interface, you must however adjust commands accordingly (e.g. from *s1on* to *s2on*).

Install the VLMTERM terminal program for Windows (XP to Windows 7) from the CD included in the scope of delivery or from Internet: download.astech.de. The program operates with 9600 baud, no parity and with XON/XOFF software protocol (9600, 8N1, software).

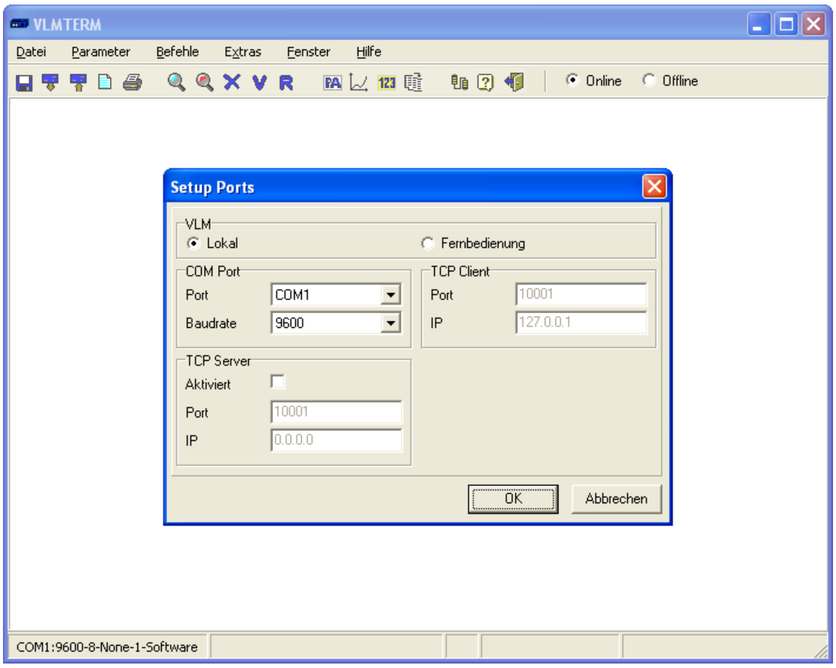


Fig. 24 VLMTERM program

If the settings of the serial interface correspond to those of the terminal program, the VLM 320 responds with the following message on the display after switching on:

VLM 320 ...
(C) by ASTECH Rostock ...
ROM-DATE ...
S/N ...
Board ...
->

If data transfer to the serial interface 1 is activated, this window is not displayed (see chapter 9.6.1 *S1On* command). The above details can however be called up at any time with the *Info* and *POST* commands.

The connection to the device has now been established and the unit is ready for programming. Commands can be entered in abbreviated format. Enter as many characters as are necessary for a unique syntax. In relation to commands, the VLM 320 does not differentiate between upper and lower case letters. Parameters must be separated by spaces. The units and decimals of numerical values are separated by the decimal point. If a command is entered without an optional parameter, the current parameter value is displayed. All commands described here are also listed in the appendix (see chapter 10.1). The default values specified in the appendix might be factory-set.

> ⚠ While the command is being processed the data transmission to the respective serial interface is stopped! This status is indicated by the yellow BUSY LED.

If new or changed parameter values are not saved with the **Store* command, the new values are lost when the device is switched off.

9.1 General commands

9.1.1 *Average* command

This command is used to set the averaging time for the velocity and measuring rate calculation. The internal length calculation is performed independently from the set averaging time! During the time set with the *Average* command, all occurring signals (bursts) are compressed into an average value. The average value can then be output at the respective interfaces. The command without parameter indicates the averaging time.
The entered value should be as large as is permissible for the respective process dynamics. Standard values are 5 to 50 ms (100 to 250 ms for VLM 320 L and V models).
If *Average* is set to a very high time value, the device responds very slowly to changes in velocity. If the changes in velocity are very marked, the signal might fail in rare cases. If *Average* is set to a very short time, the measured value fluctuates more, so that for example vibrations of the object to be measured or of the measuring device affect the signal curve.

Syntax: ***Average*** [f] (f = 0.2 ... 10000 or 0 for external input) Unit: ms

The *Windows* parameter (see chapter 9.1.31 *Window* command) allows for sliding averaging across 2 to 32 values. The sliding averaging function is deactivated with *Windows 1*.

<u>Difference Velocity Measurement</u>

E.g. driven two or more VLM 320 with the same clock, it is possible to perform highly accurate and dynamic difference velocity measurement.
Therefore *Average 0* allows the synchronisation of the averaging processor and thus the entire system by means of an external signal. To do this, connect a cycle frequency of 30 to 500 Hz to the trigger input (IN2). The *Average* parameter must be set to 0 and the value for *Trigger* must be set to 0 (see chapter 9.1.29 *Trigger* command).
The commands *INC1Output 1*, *S1Output 1*, etc. are used to configure the externally synchronised output of the velocity value.
If two or more VLM 320 devices are for example actuated with the same cycle rate, it is possible to carry out extremely accurate and dynamic differential velocity measurements.

The following conditions must be observed:

- The parameterisation must be the same for all devices. The devices must be mounted in the same direction of movement and equipped with a high-resolution pulse output (IF3 or higher interface card) or a fast serial output.
- Serial communication always requires external synchronisation.
- If directional switch-over is required, it is performed by means of an external signal (*Direction*≤ 3).

Programming example with IF3 pulse output for difference velocity measurement

Average 0	(external synchronisation)
Window 8	(8 windows)
Trigger 0	(H active)
Direction 1	(devices mounted in direction opposite to movement)
Minrate 10	(programming of monitoring output)
INC2On 1	(high-resolution pulse output 2 switched on)
INC2Factor 10	(factor 10 pulses/mm for pulse output 2)
INC2Output 1	(updating of pulse output synchronised with trigger)

The 24 V cycle rate at the 'IN2' input allows for a maximum synchronisation frequency of 500 Hz (2 ms). A cycle rate of 100 to 300 Hz is recommended. The 'OUT 3' output is used as a monitoring output and is controlled by the *Minrate* parameter (see chapter 9.1.12 *Minrate* command). All other outputs that are not required must be switched off.

9.1.2 *Calfactor* command

With this command, a calibration factor can be displayed or entered manually. The value of the calibration factor is usually close to 1. The default factor value is 1.000000. The calibration factor must not be used for the scaling of an output channel. To do this, use the respective interface parameters.

Syntax: ***Calf**actor* [f] (n = 0.950000 ... 1.050000)

Calculation of the calibration factor, based on the length or velocity indicated on the VLM 320 and the actual values:

$$NewCalibrationFactor = OldCalibrationFactor * \frac{ActualValue}{DisplayedValue}$$

9.1.3 *Chold* command

This command is used to freeze the control circuits for adjustment to the brightness of the material surface relative to the trigger status (see chapter 9.1.29 *Trigger* command). Possible applications:

Example of single part measurement:
With the *Chold 1* command, the control circuits are frozen for the time period during which no part is detected in the measuring window (trigger inactive). This means that the values for lighting time and brightness that apply to the end of one part are maintained until the beginning of the next part. If the individual parts have different colours or surface properties, *Chold* should be deactivated.

Syntax: ***Ch**old* [n] (n=0 - off, 1 - on)

9.1.4 *Clock* command

The *Clock* command is used to display and adjust the time (real-time clock). *Clock* without parameter returns the time in format hh:mm:ss.

Syntax: ***Clock*** [hh:mm:[ss]]

9.1.5 *Date* command

The *Date* command is used to display and adjust the date (real-time clock). *Date* without parameter returns the date in format dd.mm.yy.

Syntax: ***Date*** [dd.mm.yy]

9.1.6 *Direction* command

This command determines the signal source for directional switch-over. If the direction of movement of the measuring object and the direction specified by the arrow on the device coincide, the movement is defined as forward. For devices without optional directional detection, *Direction 4* is not permissible!

> ⚠ If a direction is incorrectly set, measurements might be corrupted. This error might become more frequent with greater velocities!

Codes 5, 6, 7 and 8 have the same function as codes 0, 1, 2 and 3 (see Table 6). Please note that the velocity range and the technical data change with *Direction 4* to *Direction 8* (see chapter 3 Device models).
Codes 5, 6, 7 and 8 can be useful to adjust the optical resolution of the device to match the surface of the measured object. It is thus possible to achieve higher signal rates for coarse surface structures (e.g. rough steel, timber, paper). At high velocities, it is often necessary to make this adjustment.

Syntax: ***Direction*** [n] (n = 0 ... 8)

n	Description
0	forward
1	back
2	External to 'IN1' -40 to + 0.3 mA: forward +5 to +40 mA: back
3	External to 'IN1' -40 to +0.3 mA: back +5 to +40 mA: forward
4	Automatic, double grid constant (only in device with optional direction detection)
5	As 0, forward, double grid constant (see above)
6	As 1, back, double grid constant
7	As 2, external to 'IN1', external, double grid constant
8	As 3, external to 'IN1', external negated, double grid constant

Table 6 Direction adjustment

9.1.7 *Error* command

This command allows you to call up the error codes of the last five errors (see chapter 10.3 Error messages). Code 'E00 No ERROR' indicates that there is no error. After the command is called up, critical errors are removed from the list. Fatal errors from 'E40' are however saved, as the device must be repaired or operator interference is required.

Syntax: ***Error***

9.1.8 *Fmax* command

This command returns the maximum permissible measuring frequency of the VLM 320. The value is for information only and is calculated from *Vmax* and other parameters.

Syntax: ***Fmax***

9.1.9 *Help* command

This command returns a help text containing a list of all commands with short explanations. The help texts are displayed page by page and the screen can be exited by pressing 'Escape' (ESC). If any other key is pressed, the next page is displayed.

Syntax: ***Help*** or ***?***

9.1.10 *Holdtime* command

This command is used to set the hold time, which is the time that is to be skipped after signal failures so that the last velocity value is output through the respective interfaces with the adjusted time. If the signal fails for longer than the set, the output is zero. After *Holdtime* has lapsed, a signal failure is indicated by the red signal LED.

Normally, the value for *Holdtime* should be greater or equal to *Average*. Common values for *Holdtime* are 50 to 1000 ms.

If internal length measurement is used, *Holdtime* must be below the minimum time difference between two single parts!

Syntax: ***Holdtime*** [n] (n = 10 ... 65535) Unit: ms

9.1.11 *Info* command

This command returns the device code with software version and serial number, corresponding to the information displayed when the device is switched on. To view additional information regarding the identified assemblies (starting with the board), use command *Post* (see chapter 9.1.15 *Post* command).

Syntax: ***Info***

9.1.12 *Minrate* command

The *Minrate* command with a parameter value of more than 0 is used to activate the measuring rate monitoring function. *Minrate* without parameter returns the set value.
If the set measuring rate drops below this value, the signal red LED is on and the OUT3 (status) output is opened (see chapter 6.4.2 Outputs 'OUT').
The *Minrate* command can for example be used to program a dirt check of the windows. Useful values for *Minrate* are 5 to 20. The measuring rate is always monitored after the time set with the *Average* command. In the event of low velocities, ensure that the *Average* is not set too low. Note that the OUT3 output is also open in the case of a material standstill or if no material is located within the measuring window area. In these cases, the red signal LED is on.

When switching on the ECC control (see chapter 9.3.1 *ECCOn* command), the measuring rate monitoring function is deactivated with *Minrate*.

Syntax: ***M****inrate* [n] (n = 0 - off, 1 ... 99 - on)

9.1.13 *Number* command

The object counter is used to measure individual parts for the parts count.
If a parameter is entered here, the object counter is set to value n. Without parameter value input, the current counter reading is returned. Switching off the unit resets the counter to zero. Each trigger event increments the object counter by one (see chapter 9.1.29 *Trigger* command).

Syntax: ***N****umber* [n] (0 ... 65535)

9.1.14 *Parameter* command

Lists the current settings of the general parameters. If system mode is actuated (see chapter 9.11 Commands in system mode), the parameters named in chapter 9.11 (Commands in system mode) are also listed. For an overview of the settings of the individual output channels, use the separate commands (*PAN*, *PINC1*, *PINC2*, *PINC3*, *PS1*, *PS2*).

Syntax: ***Par****ameter*

9.1.15 *Post* command

The *Post* (power-on-self-test) command starts the self-test of the device and lists the assemblies that are found during this process. The basic boards are always included in the list. In the event of a board failure the command returns 'Board: xxxxx   NOT FOUND'. Optional assemblies are however only listed, if proper communication could be established with these components.

```
-> post
Board: EEPROM    FOUND
Board: DSP       FOUND
Board: RTC       FOUND
Board: T-Sens1   FOUND
Board: ASP       FOUND
Board: FB2       FOUND
Board: PS        FOUND
->
```

Fig. 25 Screen text of *Post* command

Syntax: ***Pos****t*

9.1.16 *Readpara* command

This command reads out the parameter settings of the device. The following commands are automatically executed: *Serialnumber*, *Parameter*, *PINC1*, *PINC2*, *PINC3*, *PAN*, *PECC*, *POFF*, *PS1* and *PS2*. The command is used by the VLMTERM program in order to read the parameters (menu option 'Read parameters'). The stored parameter file can be used for reconfiguration, as the parameters can be written to the measuring devices with the 'Write parameters' command, thus facilitating the fast configuration of the VLM 320 (subsequently, values must be saved with**Store*).

Syntax: ***Re****adpara*

9.1.17 *REM* command

All following characters are ignored. *REM* is used to insert comment lines into parameter files, which can be sent via the programming interface to the measuring device to program the VLM 320.
The characters *';'* (semicolon), *'S/N'* and *'->'* have the same function as *REM*. It is thus possible to send parameter settings read by means of the *Readpara* command back to the device.

Syntax: ***REM*** [s]

9.1.18 *Serialnumber* command

This command is used to display the serial number of the device.

Syntax: ***Ser****ialnumber*

9.1.19 *SID* command

The command returns the serial interface that is currently used for input (1 for S1, 2 for S2).

Syntax: ***SID***

9.1.20 *Signalerror* command

This command controls the error handling in the event of a signal failure during an active length measurement or during calibration.
If a signal failure occurs during the running length measurement and with error handling is active, a critical error is generated (see chapter 10.3 Error messages).
If there is a signal failure during calibration (see chapter 9.11.3 *Calibrate* command), parameter 1 returns an error and the velocity or length calibration is aborted.

Syntax: ***Sig****nalerror* [n] (n = 0 – off, 1 – on)

9.1.21 *Start* command

The effect of the *Start* command depends on the *Trigger* command (see chapter 9.1.29 *Trigger* command), which determines whether an individual part measurement or a continuous measurement is performed. For the measuring of individual parts, the length integration is started from length value zero. With continuous measurement, the length integration is stopped and restarted.

Syntax: ***Sta****rt*

9.1.22 *Stop* command

The effect of this command depends on the *Trigger* command (see chapter 9.1.29 *Trigger* command). Length integration is only stopped in the case of an individual part measurement.

Syntax: ***Sto****p*

9.1.23 *Temperature* command

The temperature inside the device in °C is returned. If the temperature exceeds 75 °C, error 'E31 Over temperature detected!' is triggered (see chapter 10.3 Error messages). If a second temperature sensor is installed in the device, its temperature reading in °C is returned on a second line.

Syntax: ***Tem****perature*

9.1.24 *Test* command

This command returns a number of values that provide information about the system's functionality. The following values are displayed: velocity, length, measuring rate, inputs IN0, IN1, IN2 and lighting.
The display is updated every 250 ms. During the test procedure, the data output is blocked!
The procedure can be aborted with ESC; otherwise the command terminates automatically after 60 seconds. Automatic termination can be prevented by specifying the *C* parameter.

```
-> TEST
  V(m/s)       L(m) RATE IN0 IN1 IN2 EXPOSURE
 -99.999 -99999.999   99   0   1   0        3
->
```

Fig. 26 Screen text of *Test* command

Syntax: ***Test*** [c] (c = 'C')

9.1.25 *TestAN* command

This command returns a number of values that provide information about the functionality of the analog output. The following values are displayed: velocity, measuring rate, output current in % and load (LOAD). If no load (max. 500 ohm) is connected or if there is no interface card with analog output, the value for Load is 0.
The display is updated every 250 ms. During the test procedure, the data output is blocked!
The procedure can be aborted with ESC; otherwise the command terminates automatically after 60 seconds. Automatic termination can be prevented by specifying the *C* parameter.

```
  🖹  TESTAN
ANON         1
ANMIN        0.000
ANMAX        100.000
ANOUTPUT     0
ANVALUE      V
  V(m/s) Rate IOUT(%) LOAD
   0.105   99    0.10    0
->
```

Fig. 27 Screen text of *TestAN* command

Syntax: ***TestA****N* [c] (c = 'C')

9.1.26 *TestPS* command

This command returns a number of values that provide information about the functionality of the power adapter and the lamp. The following values are displayed: lamp brightness, current to lamp, voltage at lamp, 12 V and -12 V power supply. If a fatal error has occurred (see chapter 10.3 Error messages), the display is not updated any longer and only the last measured values are displayed. If no suitable power adapter has been installed or if no such power adapter has been detected, error 'E21 Not supported by power supply' is returned instead of the values.
The display is updated every 250 ms. During the test procedure, the data output is blocked!
The procedure can be aborted with ESC; otherwise the command terminates automatically after 60 seconds. Automatic termination can be prevented by specifying the *C* parameter.

```
-> TESTPS
 LA  I(A)  U(V) 12P(V) 12N(V)
 30  0.70  3.18  11.95 -12.01
->
```

Fig. 28 Screen text of *TestPS* command

Syntax: ***TestP****S* [c] (c = 'C')

9.1.27 *TestQuality* command

The system returns a bar chart, indicating the measuring rate of the signal with which the current measurement is being processed (see chapter 9.9 Read commands – R). In the event of a standstill, the product (quality) of the lamp brightness multiplied with the exposure time is output. This product can for example be used to align the VLM 320 in tube and wire applications. The length of the bar should thereby maximum in movement (measuring rate) and with still stand it should be 2/3 of its maximum value (reflection). This ensures that a sufficient amount of light is reflected by the object to be measured to the VLM 320.
A similar function is available with the analog output with quality output (see chapter 9.2.5 *ANValue*).
The display is updated every 250 ms. During the test procedure, the data output is blocked!
The procedure can be aborted with ESC; otherwise the command terminates automatically after 60 seconds. Automatic termination can be prevented by specifying the *C* parameter.

```
-> TESTQUALITY
0   10   20   30   40   50   60   70   80   90   100
OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO
->
```

Fig. 29 Screen text of *TestQuality* command

Syntax: ***TestQ****uality* [c] (c = 'C')

9.1.28 *Tracking* command

The *Tracking* command determines the type of adjustment of the signal processing to the current velocity. It is only effective in devices equipped with a FB2 or higher filter board (whether a FB2 filter board is installed can be seen when the device is switched on or by generating an assembly list with the *Post* command).

Syntax: ***Tracking*** [n] (n = 0 ... 4)

> For proper functioning of the measuring device, ensure that the settings for direction made with the *Direction* command and the maximum plant velocity configured with the *VMax* command are correct.

Default settings: *Tracking 1*. Default setting ***Tracking 1* is suitable for most measuring tasks**. If in doubt, always choose this configuration. For special applications, please refer to the table to determine the appropriate value for *Tracking*.

n	Description	Typical application
0	Broadband signal processing	**Special applications** such as individual part measuring with very high acceleration
1	Tracks the velocity from *VMax / 8*; up to this point: broadband	**Continuous measurement with fast acceleration from zero** suitable for most measuring tasks (e.g. conveyor units for metals)
2	Tracks the velocity from zero	**Individual part measuring or continuous measuring with slow acceleration from zero** (measuring object enters the measuring range at a velocity greater than zero, or is slowly accelerated from zero)
3	Tracks the velocity from VMax / 8; with additional search function for poor signals	**Continuous measuring for barely structured, non-metallic surfaces with fast acceleration from zero** (e.g. conveyor plants for plastics or coated materials, paper reeling machines)
4	Tracks the velocity from zero; with additional search function for poor signals	**Continuous processes for barely structured, non-metallic surfaces** (measuring object moves in with velocity greater than zero or is slowly accelerated from zero), e.g. extruders, paper machines)

Table 7 Parameters for *Tracking*

9.1.29 *Trigger* command

The *Trigger* command is used to specify the type of the trigger signal in conjunction with length measurement. Each trigger event increments the object counter by one (see chapter 9.1.13 *Number* command).

Syntax: ***Trig**ger* [n] (n = 0 ... 5)

n	Trigger event at	Current level to 'IN2'	Application
0	H level	high: +5 to +40 mA	Individual part measurement
1	L level	low: -40 to +0.3 mA	Individual part measurement
2	L/H edge	low/high edge	Continuous measurement
3	H/L edge	high/low edge	Continuous measurement
4	AND function	high: +5 to +40 mA	Individual part measurement with 2 light barriers
5	AND function, inverted levels	low: -40 to +0.3 mA	Individual part measurement with 2 light barriers

Table 8 Trigger types

Individual part: If the signal changes to the active level, the length measurement is started and then stopped at the next level change.

Continuous measurement:
Measurements are made continuously. A trigger edge stops the measurement and simultaneously triggers the next measurement.

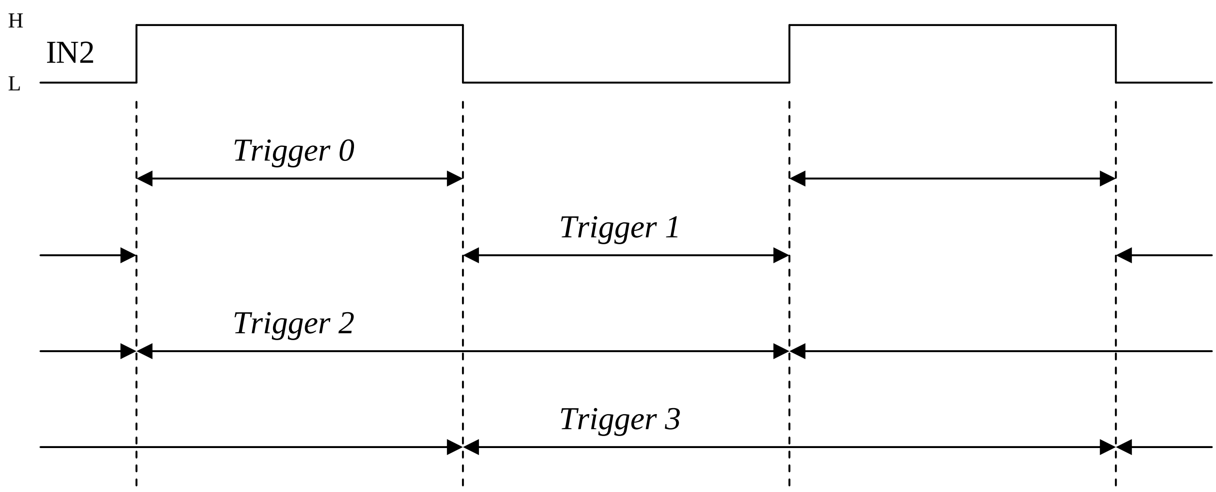


Fig. 30 Active length measurement or active trigger signal depending on command *Trigger*

If trigger synchronous output is chosen, the respective output channel is updated when the length measurement is stopped (see commands *ANOutput*, *INC1Output*, *INC2Output*, *INC3Output*, *S1Output* und *S2Output*)

Light barrier controller function for individual part measurement with two barriers:

The integrated light barriers (LB) function generates a trigger signal for the control of the length measurement of individual parts. This is done by combining the two light barrier signals. This logical linking of the level and edge detection ensures trouble-free operation. The objects to be measured must be larger than the distance between the light barriers and must always move from the stop (LB INI1) to the start (LB IN2) light barrier. The VLM 320 must thereby be positioned between the two light barriers. The distance between the light barriers must be added to the measured length (see chapter 9.6.2 *S1Format* command).

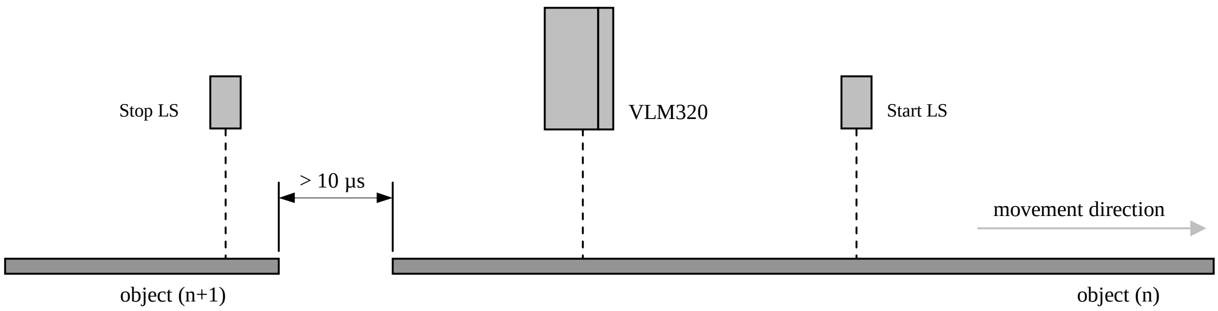


Fig. 31 Individual part measurement with the VLM 320 and two light barriers

Status	Stop LB (IN1)*	Start LB (IN2)*	Precondition	Action
1	L	L	-	-
2	L → H	L	-	-
3	H	L	-	-
4	H	L → H	Status 3	Start of length measurement
5	H	H	Status 4	Length measurement in progress
6	H → L	H	Status 5	Stop of length measurement
7	L	H	-	-
8	L → H	H	-	-
9	H	H	-	-
10	H	H → L	-	-
11	L	H → L	-	-

Table 9 Logical status diagram of light barrier controller with trigger 4

* L = low: -40 to + 0.3 mA
H = high: +5 to +40 mA

Table 9 shows the status diagram for the settings of trigger 4. Should the *Trigger* be set to 5, all levels in the table must be inverted.

9.1.30 *Vmax* command

The *VMax* command is used to set the maximum plant velocity in m/s. For optimised operation, the value for ***VMax* must be adjusted to the precise actual conditions**. It should neither be too high or too low, as the automatic adjustments can otherwise not be made properly.

Syntax: ***V**max* [f] (n = 0.01 ... 100.00 m/s)

> For proper functioning of the measuring device, ensure that the settings for direction made with the *Direction* command and the maximum plant velocity configured with the *VMax* command are correct.

In devices with FB1 filter board (*Post* command shows no FB2), the maximum frequency of the filter board is returned after a new value for *Vmax* and *Direction* has been entered. This value can also be called up with the *Fmax* command (see chapter 9.1.8 *Fmax* command). If the displayed frequency does not correspond to that printed on the FB1 board, adjust *Vmax* until the two frequencies are the same.

> Do not operate the measuring devices at velocities that are above the range specified in the data sheet, as this could result in inaccurate measurements. Please note that the maximum permissible velocity is directly affected by the *Direction* parameter. The *Vmax* parameter must thus be adjusted to match the actual maximum plant velocity. A safety margin of approximate 10 % is already taken into account in the device.

9.1.31 *Window* command

The *Window* parameter has been implemented for highly dynamic velocity measurements in production processes and for control tasks. It calculates the weighted sliding average across the frequency of the individual bursts, based on the signal quality. A FIFO memory with 4 or 32 averaging cycles is used (see Fig. 32). In Fig. 32, the cycle time is displayed as a section and corresponds to the *Average* averaging time. The incoming individual values are asynchronously added, and the result is synchronously read out once per *Average*. With this approach, an update rate that is up to 32 times higher than that with standard averaging can be achieved at the outputs.

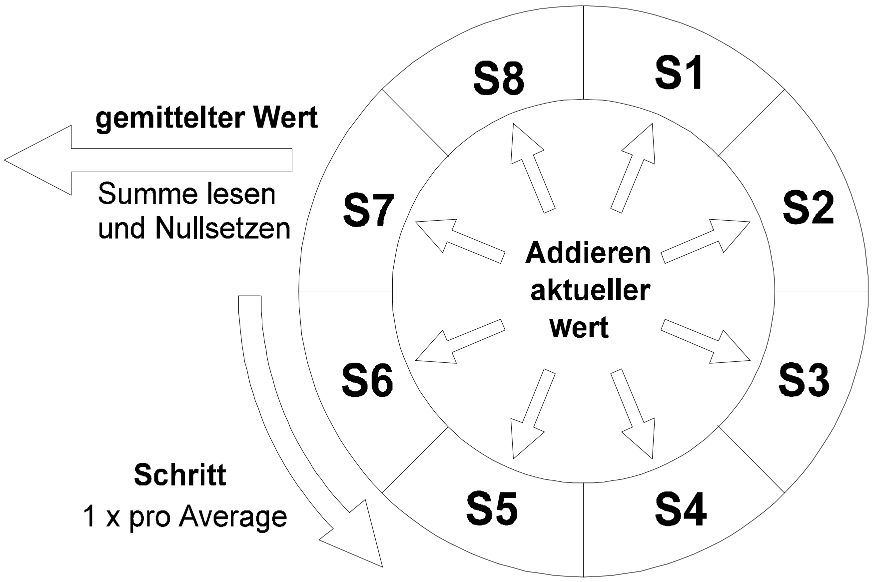


Fig. 32 Simplified operating principle of the averaging processor with 8 cycles[6]

The chosen averaging time (see chapter 9.1.1 *Average* command) must be correspond to the desired update rate for the fastest output channel used in the process.

Sliding averaging can be disabled with the *WINDOW 1* command.

Syntax: *Window* [n] (n = 1 ... 32)

[6] *Windows 8*, i.e. 8 sliding windows (totals S1 to S8)

9.2 Analog output

With analog output (optional IF1/IF3 interface card with AI option), an analog current value can be output. A digital/analog converter with 16-bit resolution is used for this purpose. The range for the output of measuring values is set with the *ANMin* and *ANMax* commands. *ANMin* determines the value at which the minimum current value is output. *ANMax* determines the value at which the maximum current value is output.
Example: with *ANMin = 0* and *ANMax = 100*, the following value pairs are calculated:

Current	*ANValue V* Velocity	*ANValue R* Measuring rate	*ANValue Q* Signal quality in motion	*ANValue Q* Signal quality at standstill
4 mA	0 m/s	0	measuring rate = 0	less reflection
12 mA	50 m/s	50	measuring rate = 50	medium reflection
20 mA	100 m/s	100	measuring rate = 100	strong reflection

Table 10 Example of analog output (*ANMin = 0* and *ANMax = 100*)

If the actual measuring value is less than *ANMin*, the lowest current value is output; if it is greater than *ANMax*, the highest current value is output. The value to be output is programmable (see chapter 9.2.5 *ANValue* command). The output is updated either after *Average* is reached or after a trigger event (see chapter 9.2.4 *ANOutput* command).

9.2.1 *ANOn* command

This command switches analog output on or off.

Syntax: ***ANOn*** [n] (n = 0 – off, 1 – on)

9.2.2 *ANMin* command

This command is used to adjust the minimum value for analog output.

Syntax: ***ANMin*** [f] (n = -1000.0 ... 1000.0)

9.2.3 *ANMax* command

This command is used to adjust the maximum value for analog output.

Syntax: ***ANMax*** [f] (n = -1000.0 ... 1000.0)

H	Depending on the set direction (*Direction*), it is necessary to set *ANMAX* to a negative value, if the device is mounted in opposite direction to that of the movement. Use the *Test* command to check whether the value is positive or negative.

9.2.4 *ANOutput* command

This command is used to specify whether the output value is updated in synchronisation to the set time period *Average* (see chapter 9.1.1 *Average* command), or whether it is updated with a trigger event (see chapter 9.1.29 *Trigger* command) or every burst.

Syntax: ***ANOutput*** [n] (n = 0 – average synchronous, 1 – trigger synchronous, 2 – burst synchronous)

9.2.5 *ANValue* command

This command is used to specify whether the velocity, the measuring rate or the signal quality is to be output.

Syntax: ***ANValue*** [c] (c = 'V', 'R', 'Q')

If option *ANValue Q* is set, the measuring rate is output during the measurement (as with *ANValue R*). In the event of a signal failure or standstill of the object to be measured, the product (quality) of the lamp brightness and the exposure time is output at the analog output (see chapter 9.1.27 *TestQuality* command). This function can be used as an alignment tool for pipe and wire measurements.

9.2.6 *PAN* command

Return of all analog output parameters.

Syntax: ***PAN***

9.2.7 Example of analog output

In the diagram below, output 4 to 20 mA is shown across a velocity range of -3 to +3 m/s at different values for *ANMIN* and *ANMAX*. The velocity is output to the analog output (*ANValue V*).

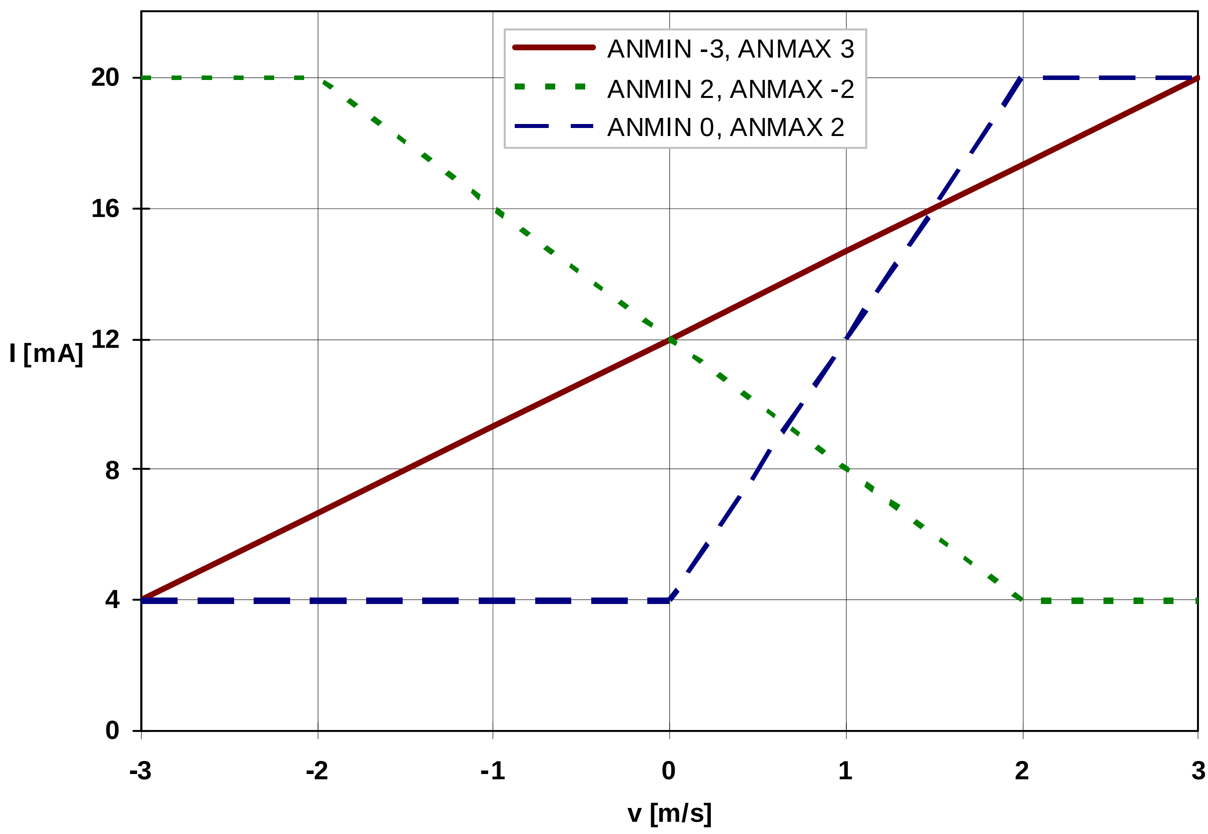


Fig. 33 Example of analog output

⚠	Currents that are outside the range determined by the hardware (e.g. 4 to 20 mA) are not possible. If the value to be output exceeds *ANMAX*, the maximum current value is output.

9.3 ECC control

The ECC control allows for the monitoring of the measuring range and velocity with hysteresis. The ECC control is thus an add-on to the measuring rate monitoring function (see 9.1.12 *Minrate* command). It is required when using the ECC2 interface card or the external ECC1 switched-over assembly.
The ECC2 card or the external ECC1 assembly allow for the connection of an external shaft encoder or a second VLM 320 velocity measuring device. If the actual values are below the set velocity or measuring rate, the pulse output is switched over to the shaft encoder or the second measuring device. As soon as the velocity or measuring range are again above two other set values, the system is switched back.
The velocity and measuring rate are checked after the averaging time has been reached (see 9.1.1 *Average* command). The switch-over is using status output ‘OUT3’. If the *Holdtime* has lapsed, the status signal is switched instantly. For operation with ECC control, *Average* should be set to 10 ms in order to ensure a fast switch-over (*Average 5, Windows 4* or similar are also useful).

9.3.1 *ECCOn* command

This command is used to switch the ECC control on or off. Upon activation of ECC control, the measuring rate monitoring function is automatically deactivated (see 9.1.12 *Minrate* command).

Syntax: ***ECCOn*** [n] (n = 0 – off, 1 – on)

9.3.2 *ECCR1* command

This command determines the minimum measuring rate at which switch-over to the external device occurs. Standard values are 3 to 10. The value must be smaller than *ECCR2*.

Syntax: ***ECCR1*** [n] (n = 0 ... 99)

9.3.3 *ECCR2* command

This command determines the measuring rate, at which switching back occurs. Standard values are 8 to 20. The value must be greater than *ECCR1*.

Syntax: ***ECCR2*** [n] (n = 0 ... 99)

9.3.4 *ECCV1* command

This command determines the minimum velocity at which switch-over to the external unit occurs. Standard values are 0.05 to 0.2 m/s. The value must be smaller than *ECCV2*.

Syntax: ***ECCV1*** [f] (n = 0.0001 ... 99.9999) Unit m/s

9.3.5 *ECCV2* command

This command determines the velocity (value), at which switching back occurs. Standard values are 0.1 to 0.3 m/s. The value must be greater than *ECCV1*.

Syntax: ***ECCV2*** [f] (n = 0.0001 ... 99.9999) Unit m/s

9.3.6 *PECC* command

Display of all parameters of the ECC control.

Syntax: ***PE****CC*

9.4 Pulse output through first pulse output

For the pulse output, two clock sequences A and B that are phase-shifted by 90° (max. deviation of phase ± 10°) with a mark-space ratio of 1:1 at the output at OUT1 and OUT2 are available. These outputs are electrically insulated by optical couplers. The phase shift can be set by the 'IN1' directional input or the internal direction detection to +90° or -90°.
The output is updated when the *Average* is reached or after a trigger event (see chapter 9.4.3 *INC1Output* command).

9.4.1 *INC1On* command

This command switches analog output on or off.

Syntax: ***INC1On*** [n] (n = 0 – off, 1 – on)

⚠	In order to minimise the micro processor load, switch off output channels that are not used!

9.4.2 *INC1Factor* command

This command is used to set a scaling factor. With factor 1, 100 Hz is output, provided that the velocity is 0.1 m/s or the measuring rate is 100 (see 9.4.4 *INC1Value* command). For velocity, the value is therefore **pulses per millimetre**.

Syntax: ***INC1F**actor* [f] (n = -2500.0 ... 2500.0, <> 0)
The minimum permissible output frequency for the pulse output is 0.2 Hz. If the value to be output is smaller than 0.2 Hz, no pulses are output! The maximum possible output frequency varies, depending on the output assignment and on whether AB or IF boards are installed (cut-off frequency). For details, refer to the data sheet.

9.4.3 *INC1Output* command

This command is used to specify whether the output value is updated in synchronisation to the set time period *Average* (see chapter 9.1.1 *Average* command), or whether it is updated with a trigger event (see chapter 9.1.29 *Trigger* command) or every burst.

Syntax: ***INC1O**utput* [n] (n = 0 – average synchronous, 1 – trigger synchronous, 2 – burst synchronous)

9.4.4 *INC1Value* command

This command is used to specify whether the velocity, the measuring rate or the signal quality is to be output.

Syntax: ***INC1V**alue* [c] (c = 'V', 'R', 'Q')

If option *INC1Value Q* is set, the measuring rate is output during the measurement (as with *INC1Value R*). In the event of a signal failure or standstill of the object to be measured, the product (quality) of the lamp brightness and the exposure time is output at the analog output (see chapter 9.1.27 *TestQuality* command). This function can be used as an alignment tool for pipe and wire measurements.

9.4.5 *INC1Hold* command

This command is used to freeze the first pulse output, depending on the input IN1 or IN2, for the period during which no part is detected in the measuring window.

Syntax: ***INC1H****old* [n] (n = 0 ... 4)

n	Hold pulse output	Current level to 'IN2'
0	off	-
1	with H level to IN1	high: +5 to +40 mA
2	with L level to IN1	low: -40 to +0.3 mA
3	with H level to IN2	high: +5 to +40 mA
4	with L level to IN2	low: -40 to +0.3 mA

Table 11 Parameter values of *INC1Hold*

9.4.6 *PINC1* command

Display of all pulse output parameters.

Syntax: ***PINC1***

9.5 Pulse output through second and third pulse output

With the optional interface cards of the IF3 series, two additional pulse outputs with 2 phases (A, B) each are available. The resolution and minimum output frequency of these outputs correspond to that of the first pulse output. They are parameterised in the same way as the pulse output described in chapter 9.4. 'INC1' must be substituted with 'INC2' for OUT 4/5 or 'INC3' for OUT 6/7.

9.6 Output via first serial interface

9.6.1 *S1On* command

This command switches the data output at the first serial interface on or off. Data output is interrupted during command input and processing!

Syntax: ***S1On*** [n] (n = 0 – off, 1 – on)

9.6.2 *S1Format* command

Apart from programming, the first serial interface can also be used for the output of data. The transfer format can be preset within wide limits. Data is output in ASCII format. The individual parameters can be separated either with spaces, commas or full stops. Separators between the parameters are not mandatory and may be omitted.

Syntax: ***S1F****ormat [s]* (s – parameter string, max. length 42 characters)

Parameter	Description
'...'	Inserts the string enclosed in apostrophes
0...9	Numerical values (0 to 255) that are not enclosed in apostrophes are interpreted as ASCII codes and the respective ASCII character is output
B	Inserts the value periods/16 since the last trigger event
C	Inserts the current time (e.g. 12:50:28)
D	Inserts the current date (e.g. 31.12.2010)
E	Inserts the exposure level (0 to 14)
F	Inserts the measuring frequency in Hz
H	Inserts the temperature from the first temperature sensor in °C
I	Inserts the lamp brightness (0 to 30)
L	Inserts the length in m
N	Inserts the object counter value (0 to 65535)
P	Inserts the number of periods since the last trigger event
Q	Inserts the product (0 to 100) of the lamp brightness and the exposure time (see chapter 9.1.27 *TestQuality* command)
R	Inserts the measuring rate (0 to 100)
S[7]	Inserts several, fixed hexadecimal values in one block: Velocity in m/s * 100000 (24 bits = sign + 6 nibbles) <SPACE> Measuring rate * 10 (12 bits = 3 nibbles)
T	Disables the default end identifier CR LF of the output string
V	Inserts the velocity in m/s
X	Inserts the last error number (see chapter 9.1.7 *Error* command)
Z	Same as S, with additional 2 nibbles for last error number

Table 12 Parameters for the formatting of output

[7] Special format S ensures fast output of the velocity and measuring rate

H	Hexadecimal output is preferred, if values are to be output at a rate that is faster than 20 ms (see chapter 9.6.5 *OFFRead* command), as the conversion to hexadecimal digits requires considerably less computation time. With a time base < 10 ms, always use only format S or Z.

Format	Description
a+x	Adds the value a (V, L, F, ...) to the offset x
a*x	Multiplies the value a (V, L, F, ...) with x
a:H[:n]	Outputs the value a (V, L, F, ...) as a hexadecimal value with n digits[8]
a:n[:m]	Outputs the value a (V, L, F, ...) as a formatted numerical value with n digits and m decimals

Table 13 Formats of individual parameters for output to S1

All formats shown in Table 13 can be freely combined and apply only to numerical parameters (i.e. not to special strings S and Z, date, time, etc).

Without format indication, the output is left-aligned. Leading zeros are suppressed, except in the case of hexadecimal output. If a specific format is chosen, blanks are filled with spaces. If the value exceeds the possible number of digits of the format specifications, additional digits are added as required. The decimal point and the - sign (negative values only) also count as digits

If the format string contains numerical values that are not enclosed in apostrophes, they are interpreted as ASCII code and the respective ASCII character is output. Each ASCII code must thereby be separated from the others with a space, comma or full stop.

Examples:

's1format 72 97 108 108 111'	for String 'Hallo' and CR LF
's1format v 13 10'	for velocity and twice CR LF

The standard end identifier of the output string is CR LF (13 10 or 0DH 0AH). This end identifier can be disabled with parameter 'T', which can also be used to define an end identifier at the end of the format string. The position of parameter 'T' for disables the default end identifier is not relevant. The customised end identifier must however always be located at the end of the format string.

Examples:

s1format v ' m/s	velocity and string m/s, CR LF
s1format v,' ',r	velocity, SPACE, measuring rate, CR LF
s1format v 20 r	velocity, SPACE, measuring rate, CR LF
*s1format v*60,' m/min',l,' m'*	velocity, m/min, length and m, CR LF
's1format s t l:h 10'	for special format s, length hexadecimal and LF
's1format '#rat'r t42'	for string '#rat', measuring rate and sign '*'

8 Hexadecimal output in format a:H:n is complete with sign (minus sign or space) and includes n decimals. Every byte requires two decimal digits. Without parameter n, 9 characters for 4 bytes and the - sign are output (32-bit number). Leading zeros are not suppressed.

9.6.3 *S1Interface* command

The *S1Interface* command is used to configure the serial interface. This configuration includes the baud rate, the type of protocol, the parity and the directionality. The parameters can be set individually or globally. The sequence of the parameters is thereby not relevant. Parameters for which no value is entered remain unchanged. The format is 8 data bits and 1 stop bit. If parity is enabled, the 8th data bit is replaced by the parity bit. A parity error is indicated by a message such as"E11 S1 input error (parity)". A buffer overflow is indicated with a message such as "E11 S1 input error (overflow)" (see chapter 10.3 Error messages).

Syntax: ***S1I****nterface* [n] [c] [c] [c] (n = baud rate, c = protocol, parity, ...)

The following baud rates are supported:
n: 9600; 19200; 38400; 57600; 115200

c	Description
Type of protocol	
'-'	No protocol
'X'	Software protocol (XON/XOFF codes)
Parity	
'N'	No parity
'O'	Odd parity
'E'	Even parity
Directionality	
'D'	Duplex (RS 232, RS 422)
'H'	Half-duplex (RS 485)

Table 14 Configuration of RS 232 interface

9.6.4 *S1Output* command

This command is used to specify whether the output value is updated in synchronisation to the set time period (see chapter 9.6.5 *S1Time* command), or whether it is updated with a trigger event (see chapter 9.1.29 *Trigger* command) or every burst.

Syntax: ***S1Ou****tput* [n] (n = 0 – average synchronous, 1 – trigger synchronous, 2 – burst synchronous)

9.6.5 *S1Time* command

This command determines the time interval in ms, in which the data is to be output at interface S1.
During the velocity measurement, all values (bursts) occurring during the averaging time are averaged (see chapter 9.1.1 *Average* command). The data is then output at equal intervals that correspond to the time set with *S1Time*.

Syntax: ***S1T****ime* [n] (n = 1 ... 65535) Unit: ms

9.6.6 *S1Address* command

This command is used to switch addressing for serial interface 1 on or off. As soon as an address is entered, the VLM 320 can only be accessed through this address. This allows users to connect several measuring devices to a serial bus (e.g. RS 422 or RS 485).

Syntax: ***S1A****ddress* [n] (n = 0 – off, 1 ... 99 – on)

If addressing is enabled, the VLM 320 can only be addressed with the following syntax: '*:## command parameter*', whereby ## is the address. The VLM 320 acknowledges the execution of the command with ACK (06H).

With address 0, each device can be addressed irrespective of the actual set address.

With address 5, the following input string is required for maximum velocity:
:05vmax

9.6.7 *PS1* command

Display of all parameters of serial interface 1.

Syntax: ***PS1***

9.7 Output via serial interface 2

Serial interface 2 (optional interface card IF1 or ECC2) can be used for programming or the output of data in the same way as serial interface 1. All commands apply accordingly, provided that parameter 'S1' is replaced with 'S2'.

Do not enter commands at both interfaces at the same time!

⚠	If the S2 interface is configured as RS485 by hardware, directionality must be set to half-duplex by using parameter *H* for *S2Interface*, as the output string is otherwise interpreted as commands.

9.8 Offline measurement

9.8.1 *OFFLine* command

In *OFFLine* mode, the measuring values (as described above) are not output to an interface, but written to the internal memory. This operating mode is used to create the velocity/time curves and to accommodate very fast processes.

> During offline measurement, the output channels are not updated, i.e. pulse, analog and serial outputs are not possible!

Offline measurement is started with the *OFFLine* command. With the optional 'T' parameter, the system waits for a trigger event (see chapter 9.1.29 *Trigger* command). The maximum number of records depends on the preset data format (see chapter 9.8.7 *OFFValue* command). During the measurement, the BUSY LED (yellow) is on. The measured data is only overwritten upon a restart. In the event of a power failure, the measurements are lost. The process can be aborted with ESC. Abort with ESC or a full memory results in an error message (see chapter 10.3 Error messages).

Syntax: ***OFFL****ine* [c] (c = 'T' – wait for trigger)

9.8.2 *OFFFactor* command

This command is used to set a scaling factor. It is thus for example possible to use value 60 for the output of a velocity measurement (*OFFValue V*) in m/min. The scaling factor is only applied upon output with *OffRead*. Only the raw data without factor are stored!

Syntax: ***OFFF****actor* [f] (n = -2500.0 ... 2500.0, <> 0)

9.8.3 *OFFMeasure* command

This command is used to set the duration of the offline measurement in seconds.

Syntax: ***OFFM****easure* [n] (n = 1 ... 65535) Unit: s

9.8.4 *OFFOutput* command

This command is used to specify whether the measured value is saved in synchronisation to a chosen time period (see chapter 9.8.6 *OFFTime* command), or whether it is saved with a trigger event (see chapter 9.1.29 *Trigger* command) or every burst.

Syntax: ***OFFO****utput* [n] (n = 0 – average synchronous, 1 – trigger synchronous, 2 – burst synchronous)

9.8.5 *OFFRead* command

This command outputs the measured data after an offline measurement to serial interface 1. The reading format is fixed, i.e. the time from the start of the measurement in ms and the value(s) are output with maximum resolution. The figures are separated by a semicolon. The value is followed by a line break (CRLF). If no measurement has yet been started, a read attempt causes an error message (10.3 Error messages).

Syntax: ***OFFR****ead*

In the case of premature abort with ESC, an error message is output (see 10.3 Error messages).

9.8.6 *OFFTime* command

This command is used to specify the time interval in ms during which the data is saved (see chapter 9.8.4 *OFFOutput* command).

Syntax: ***OFFT****ime* [n] (n = 2 ... 65535) Unit: ms

9.8.7 *OFFValue* command

This command is used to specify whether the measuring frequency, the length, measuring rate or velocity or number of objects is to be measured.

Syntax: ***OFFV****alue* [c] (c = 'F', 'L', 'N', 'R', 'S', 'V')

c	Description	Max. number of records
'S'	Velocity and measuring rate	29126
'V'	Velocity	32767
'L'	Length	32767
'R'	Measuring rate	52427
'F'	Frequency	32767
'N'	Object counter	32767

Table 15 Parameters of *OFFValue*

9.8.8 *POFF* command

Display of all parameters for offline measurement.

Syntax: ***POF****F*

9.9 Read commands

The read commands serve for the asynchronous reading of measuring values. These commands are processed at a very fast rate by the command interpreter. All read commands consist of a letter and are executed after CR (0AH). The value is output with fixed formatting (see below) and terminated with CR LF (0DH 0AH).

Command	Return value	Unit	Decimals	Example
B	Number of bursts	-	0	1235
D	FIFO level	-	0	2
E	Exposure time	-	0	12
F	Frequency of the last burst	Hz	2	1234.56
I	Lamp brightness	-	0	24
L	Length	m	4	1234.5678
P	Number of periods	-	0	12
R	Measuring rate	-	0	45
V	Velocity	m/s	5	-1.23456
X	Number of the last error	-	0	32

Table 16 Read commands

9.10 Service commands

These commands should only be used by users with in-depth knowledge of the VLM 320 as they directly affect the measuring process and parameterisation.

9.10.1 ***Password** command

The **Store* system command is password-protected. The password can be changed with the **Password* command. The password consists of up to eight characters, including letters, numbers, special and space characters. When keyed in, these characters are displayed as asterisks. The password is not case-sensitive. Password protection can be disabled by leaving the field blank when asked to enter a new password and confirming with 'Enter'. The entry can be aborted with 'ESC'. Three failed attempts to enter the password result in message 'Illegal use!'. You must then wait 60 seconds before entering the next command.
The default password is '**WEGA**'.

Syntax: ***P****assword*

9.10.2 ***Restart** command

This command initiates a restart of the device. The parameters are reset to the values last saved by the **Store* command.

Syntax: ***Resta****rt*

9.10.3 ***Restore** command

The command is used to load the parameters last saved with the **Store* command. Any recent, not yet saved changes are lost.

Syntax: ***Resto****re*

9.10.4 ***Simulation** command

This command is used to simulate the velocity and measuring rate at the outputs of the measuring device. The command interrupts any running measurement! During the simulation run, the device works according to the parameters set for the individual interfaces. It also responds to external trigger signals and calculates the lengths on the basis of the set velocity. The parameter for velocity must be specified. The second parameter for the measuring rate is optional.
To abort simulation press ESC.

Syntax: ***Si****mulation* f [n] (f = -100.0 ... 100.0; velocity in m/s)
(n = 0 ... 100; measuring rate)

9.10.5 ***Standby** command

This command is used to set the device to standby mode. The measuring function is terminated and the light source is switched off.
The commands corresponds to a H level at input 'IN0'.
To abort standby mode, press ESC.

Syntax: **** Standby***

9.10.6 ***_Store_ command**

This command saves the current parameter settings. These settings remain stored when the device is switched off. After switching on the device or executing the **Restore* command, the last saved settings are loaded. The command is password-protected (see chapter 9.10.1 **Password* command).

Syntax: ***Store***

9.10.7 ***_System_ command**

This command activates the system mode (see chapter 9.11 Commands in system mode). Observe the explanations at the beginning of this chapter!
This command is password-protected with password '**SYSTEM**'. The command must be written out.

Syntax: ***System***

9.10.8 ***_Update_ command**

This command changes the system over to the boot loader. In the boot loader, you can update the firmware of the device. The boot loader provides instructions for the necessary steps. The command must be written out.

A special, device-specific file is required for this purpose (update file, extension *.hex), which can only be generated by the manufacturer based on the device serial number.

Syntax: ***Update***

H	For the loading of a new firmware version, we recommend using the VLMTERM program. With the command 'File | Update Firmware', the update can be completed safely and quickly. All you need to do is select the correct update file.

9.11 Commands in system mode

The commands described in this chapter are only available in system mode. To set the device to system mode, use the **System* command (see 9.10.7 **System* command) and enter the system password.

The change of the parameters listed here should only be made at the direction of a trained service technician or the manufacturer. The default settings are factory tuned to the device and the application and should not be changed normally!

9.11.1 *Amplifier* command

This command is used to adjust the maximum amplification of the measuring signal. With *Amplifier* 4, the amplification is automatically adjusted based on the signal strength.

Syntax: ***Amplifier*** [n] (n = 0 ... 3 – fixed, 4 – automatic)

n	Amplification
0	1x
1	1...2x
2	1...4x
3	1...8x
4	Automatic

Table 17 Parameters of *Amplifier*

The parameter should be left on the automatic setting.
In case of wrong setting of the parameter measurement failures or faulty measurements are possible.

9.11.2 *Bw* command

This command is used to define the filter bandwidth of FB2 and thus the signal tracing (acceleration) of the VLM 320. As a rule, the *Tracking* parameter is however superseding these settings (see chapter 9.1.28 *Tracking* command) and should be used for adjustment. The bandwidth is expressed in % of the current measuring frequency. Value 0 sets the bandwidth to automatic.
To allow higher acceleration than stated in the technical data an adjustment by a trained service is possible.

Syntax: ***Bw*** [n] (n = 10 ... 75 – fixed, 0 – automatic)

n	Bandwidth	Built-in filter board	Direction
0	Automatic 20% 25% 25%	FB2 (VLM 320 A/D/L) FB2 (VLM 320 A/D/L) FB2V (VLM 320 V)	0...3 4...8 -
10	10%	-	-
50	50%	-	-

Table 18 Parameters of *Bw*

The parameter should be left on the automatic setting.
In case of wrong setting of the parameter measurement failures or faulty measurements are possible.

9.11.3 *Calibrate* command

This command is used to calibrate the velocity or length. For the calibration, positive figures are applied, i.e. negative velocity or length values are converted into positive values. During calibration, the progress of the measurement is indicated in % and the busy LED is on in yellow. Press the ESC key to abort the process. After the measurement has been completed, the new calibration factor is shown. As all other changed values, this parameter value must be saved with **Store*.

The calibration factor is calculated according to the following formula:

$$CalibrationFactor = \frac{SetValue}{ActualValue}$$

Syntax: ***Cali**brate* c, n, f (c = 'V', 'L')
(n = 1 ... 65535)
(f = 0.0001 ... 10000)

Parameters:
c - 'V' = velocity calibration
'L' = length calibration
n - Duration of calibration in seconds (for velocity calibration)
Number of objects to be measured (for length calibration)
f - Set value in m/s (for velocity calibration)
Set value in m (for length calibration)

In order to improve the accuracy of the calibration, set *Signalerror* to 1; this ensures that the velocity cannot be 0. *Minrate* can be used to specify the minimum measuring rate. If the actual value is below the minimum measuring range, an error message is generated (see chapter 10.3 Error messages).

9.11.4 *Constant* command

This command returns the system constant. This constant contains various calculation factors for the velocity, which are required for the various lenses and visualisation scales. The constant is factory-set and cannot be changed.

Syntax: ***Cons**tant*

9.11.5 *Controltime* command

For highly reflective or changing surfaces, the VLM 320 comes with an automatic control mechanism for the exposure time (see chapters 9.11.14 *Rmax* command and 9.11.15 *Rmin* commands) and lamp brightness (see chapters 9.11.10 *Lmax* command and 9.11.11 *Lmin* command). If the object to be measured is too dark, the device settings might be too low. This affects the signal quality but does not result in an abort of the measurement. If the VLM 320 settings are too high, signals cannot be received and the measurement fails. To prevent this, a number of mechanisms have been implemented that respond even before the failure occurs, for example by reducing the lamp brightness.
If surfaces with areas that differ greatly as regards their properties are measured, and if the settings had to be lowered after measuring a bright area, the *Controltime* parameter indicates the time that must lapse before the VLM 320 attempts to control down. The default setting is 0.1 second.

Syntax: ***Cont**roltime* [f] (f = 0.01 ... 1.00) Unit: s

9.11.6 *Epsilon* command

The frequency generated in the VLM 320, due to the principle of measurement (see chapter 2.1 Physical principle), is evaluated. The individual periods are tested for plausibility. If the individual periods are valid they are combined into a burst and it is measured the periods time. From this the frequency is calculated and then converted into a velocity value.
The *Epsilon* parameter indicates the deviation in % for each period to the previous one that is acceptable for a burst to be included in the calculation. The higher the *Epsilon* parameter is set, the greater the tolerance for poor signals for signal processing. If the value is to high faulty measurements are possible!

Syntax: ***Ep****silon* [f] (f = 0.787 ... 50.0 – fixed, 0 – automatic) Unit: %

⚠	The parameter should be left on the automatic setting. In case of wrong setting of the parameter measurement failures or faulty measurements are possible.

9.11.7 *FB2Type* command

It displays the type of the installed filter Boards FB2.

Code	Filter board
0	FB2
1	FB2L (VLM 200/250 only)
2	FB2V (VLM 320 only)

Table 19 Output of *FB2Type*

Syntax: ***FB****2Type*

9.11.8 *Inttime* command

This command is used to adjust the exposure time of the CCD sensor. The maximum adjustable value is determined by the maximum object velocity *Vmax* and thus also by *Direction*. The higher the set velocity, the smaller the maximum value for *Inttime*. Setting *Inttime 15* allows for automatic adjustment within a range defined by *Rmax* and *Rmin*.

Syntax: ***Int****time* [n] (n = 0 ... 14 – fixed, 15 – automatic)

When required accuracy better than 0.05% it is necessary to fix *Inttime* on a small value (e.g. 0 or 1, depending on the application). Otherwise, the value 15 (automatic) recommended for maximum material independence.

For glossy materials with structure it can also be useful to set *Inttime* to a small value to prevent a constantly readjustment of Exposure.

9.11.9 *Lamp* command

This command controls the lamp brightness. Setting *Lamp 31* allows for automatic adjustment within a range defined by *Lmax* and *Lmin*.

Syntax: ***La**mp* [n] (n = 0 ... 30 – fixed, 31 – automatic)

⚠	The parameter should be left on the automatic setting. In case of wrong setting of the parameter measurement failures or faulty measurements are possible.

9.11.10 *Lmax* command

This command is used to set the maximum lamp brightness value (see chapter 9.11.9 *Lamp* command) for automatic adjustment. The value must be equal to or greater than *Lmin*.
Syntax: ***Lma**x* [n] (n = 0 ... 30)

⚠	The parameter should be left on 30. In case of wrong setting of the parameter measurement failures or faulty measurements are possible.

9.11.11 *Lmin* command

This command is used to set the minimum lamp brightness value (see chapter 9.11.9 *Lamp* command) for automatic adjustment. The value must be equal to or smaller than *Lmax*.

Syntax: ***Lmi**n* [n] (n = 0 ... 30)

⚠	The parameter should be left on 0. In case of wrong setting of the parameter measurement failures or faulty measurements are possible.

9.11.12 *Pmin* command

This command is used to define the minimum number of periods of a burst to be taken into account for the subsequent calculation of the velocity. Setting *Pmin 0* allows for automatic adjustment based on the maximum velocity *Vmax*.

Syntax: ***Pmi**n* [n] (n = 2 ... 15 – fixed, 0 – automatic)

⚠	The parameter should be left on the automatic setting. In case of wrong setting of the parameter measurement failures or faulty measurements are possible.

9.11.13 *PPM* command

This command returns the value for the temperature compensation in PPM/K. The deviation of the current temperature from the reference temperature and the value *PPM* are used for the calculation of the velocity. The value is factory-set and cannot be changed.

Syntax: ***PPM***

9.11.14 *Rmax* command

This command is used to set the maximum exposure time of the CCD sensor (see chapter 9.11.11 *Inttime* command) for automatic adjustment. The maximum adjustable value is determined by the maximum object velocity *Vmax* and thus also by *Direction*. The higher the set velocity, the smaller the maximum value for *Rmax*. With setting *Rmax 15*, the maximum permissible value for *Rmax* is used. For fixed values, the value must be equal to or greater than *Rmin*.

Syntax: ***Rmax*** [n] (n = 0 ... 14 – fixed, 15 – automatic)

> The parameter should be left on the automatic setting.
> In case of wrong setting of the parameter measurement failures or faulty measurements are possible.

9.11.15 *Rmin* commands

This command is used to set the minimum exposure time of the CCD sensor (see chapter 9.11.11 *Inttime* command) for automatic adjustment. The minimum adjustable value is determined by the maximum object velocity *Vmax* and thus also by *Direction*. The lower the set velocity, the greater the minimum value for *Rmin*. With setting *Rmin 15*, the minimum permissible value for *Rmin* is used. For fixed values, the value must be equal to or smaller than *Rmax*.

Syntax: ***Rmin*** [n] (n = 0 ... 14 – fixed, 15 – automatic)

> The parameter should be left on the automatic setting.
> In case of wrong setting of the parameter measurement failures or faulty measurements are possible.

9.11.16 *SetAuto* command

This command is used to set a number of system parameters to automatic or to the default settings, depending on the parameter (see Table 20). Setting *SetAuto 4* sets *Inttime* to a fixed value, which is applied after 2.5 seconds of adjustment to the current surface properties. Without an parameter *SetAuto 1* is executed.

Syntax: ***SetAuto*** [n] (n = 1 ... 4)

n	Amplifier	Inttime	Lamp	Lmax	Lmin	Pmin	Rmax	Rmin
1	4	15	31	30	0	0	15	15
2		0					15	15
3		15					0.5*max. Rmax	15
4		controlled (2.5s)					-	-

Table 20 Settings of *SetAuto*

9.11.17 *TestFB* command

A number of parameters and values that affect the filter board or indicate its function are displayed. The following values are displayed: Frequency, velocity, measuring rate, mean frequency of filter board, bandwidth, statuses: bandpass/lower lowpass/upper lowpass and anti-alias range.
The display is updated every 250 ms. During the test procedure, the S1 output is blocked!
The procedure can be aborted with ESC; otherwise the command terminates automatically after 60 seconds. Automatic termination can be prevented by specifying the *C* parameter.

```
-> TESTFB
Tracking  1
Inttime   5    auto
Rmin      0    auto
Rmax      5    auto
Pmin      8    auto
Amp       2    auto
Bwmin    20 %  auto
Epsilon   5.0 %
FB type   FB2
Vmax     10.00 m/s    600.0 m/min
Fmax     45.59 kHz
    F(Hz)  V(m/s) RATE   FB(Hz)    BW BP LPL LPH   R
   6033.3   1.415  100   6000.0  57.7  1   0   0   0
->
```

Fig. 34 Screen text of *TestFB* command

Syntax: ***TestF**B* [c] (c = 'C')

9.11.18 *TeSystem* command

This command returns a number of values that provide information about the system's functionality. The following values are displayed: Frequency, velocity, length, measuring rate, number of periods, exposure time, lamp brightness, overexposure, underexposure and FIFO level.
The display is updated every 250 ms. During the test procedure, the data output is blocked!
The procedure can be aborted with ESC; otherwise the command terminates automatically after 60 seconds. Automatic termination can be prevented by specifying the *C* parameter.

```
-> TESYSTEM
    F(Hz)  V(m/s)      L (m) Rate  Periods EX IL O U FIFO
   6033.3   1.415      3.999  100    16956  5 30 0 1    1
->
```

Fig. 35 Screen text of *TeSystem* command

Syntax: ***TeSy**stem* [c] (c = 'C')

9.11.19 *Type* command

This command returns the type of the measuring device.

Syntax: ***T**ype*

9.11.20 **Exit* command

This command is used to exit or disable system mode. To reset the device to system mode, use the **System* command (see 9.10.7 **System* command).

Syntax: ***E**xit*

9.11.21 **Video* command

This command is used to set the operating mode of the CCD sensor to image detection. This function is used for device check up with the manufacturer. A special adapter cable is necessary for connection to an oscilloscope. The measurement function is disabled in this mode!

Syntax: ***V**ideo*

10 Appendix

10.1 Overview of commands

10.1.1 General commands

Command	Description	Unit	Possible values	Default value
***Av**erage*	Averaging time	ms	0 or 0.2 ... 10000	30 ms
***Calf**actor*	Setting of calibration factor	-	0.950000 ... 1.050000	1.000000
***Ch**old*	Holding of control circuits (only for individual part measurement)	-	0 - off 1 - on	0
***Cl**ock*	Display and setting of time	-	hh:mm:ss	-
***Da**te*	Display and setting of date	-	dd.mm.yy	-
***Di**rection*	Direction	-	0 - forward 1 - back 2 - external forward 3 - external back 4 - automatic 5-8 (see text)	0
***Er**ror*	Display of last error	-	-	-
***Fm**ax*	Display of max. frequency	-	-	-
***He**lp* or **?**	Help pages	-	-	-
***Ho**ldtime*	Hold time	ms	10 ... 65535	250 ms
***Inf**o*	Display of software version and serial number	-	-	-
***Minr**ate*	Measuring rate monitoring	-	0 - off, 1 ... 99 - on	0
***N**umber*	Object counter	-	0 ... 65535	0
***Par**ameter*	Display of the general parameters	-	-	-
***Pos**t*	Self-test	-	-	-
***Re**adpara*	Display of all parameter	-	-	-
REM	Comment	-	-	-
***Ser**ialnumber*	Display of serial number	-	-	-
SID	Display of active interface	-	-	-
***Sig**nalerror*	Behaviour in the event of signal failure or standstill	-	0 - no error 1 - error	0
***Star**t*	Start of length integration	-	-	-
***Sto**p*	Stop of length integration	-	-	-

Command	Description	Unit	Possible values	Default value
***Tem**perature*	Display of temperature	-	-	-
Test	Test command	-	-	-
***TestA**N*	Test command for analog output	-	-	-
***TestP**S*	Test command for power adapter	-	-	-
***TestQ**uality*	Test command for signal quality	-	-	-
***Tra**cking*	Type of signal processing	-	0 ... 4 (see text)	1
***Trig**ger*	Trigger	-	0 - H level 1 - L level 2 - L/H edge 3 - H/L edge	0
***Vm**ax*	Max. velocity	-	0.01 ... 100.00	10.0
***W**indow*	Window length	-	1 ... 32	8

Table 21 General commands

10.1.2 Commands for analog output

Command	Description	Unit	Possible values	Default value
ANOn	On/off	-	0 - off 1 - on	0
***ANMi**n*	Minimum value	-	-1000.0 ... 1000.0	0.000
***ANMa**x*	Maximum value	-	-1000.0 ... 1000.0	1.000
***ANOu**tput*	Output control	-	0 - average synchronous 1 - trigger synchronous 2 - burst synchronous	0
***ANV**alue*	Value	-	V - velocity R - measuring rate Q - quality	V
PAN	Display of analog parameters	-	-	-

Table 22 Commands for analog output

10.1.3 Commands for ECC control

Command	Description	Unit	Possible values	Default value
***ECCO**n*	On/off	-	0 - off 1 - on	0
ECCR1	Measuring rate 1	-	0 ... 99	10
ECCR2	Measuring rate 2	-	0 ... 99	20
ECCV1	Velocity 1	m/s	0.0001 ... 99.9999	0.0800
ECCV2	Velocity 2	m/s	0.0001 ... 99.9999	0.1200
***PE**CC*	Display of ECC parameters	-	-	-

Table 23 Commands for ECC control

10.1.4 Commands for output via pulse output 1

Command	Description	Unit	Possible values	Default value
INC1On	On/off	-	0 - off 1 - on	1
INC1Factor	Scaling factor	-	-2500.0 ... 2500.0	1
INC1Output	Output control	-	0 - average synchronous 1 - trigger synchronous 2 - burst synchronous	0
INC1Value	Value	-	V - velocity R - measuring rate Q - quality	V
PINC1	Display of parameters	-	-	-

Table 24 Commands for pulse output 1

10.1.5 Commands for output via pulse output 2

Command	Description	Unit	Possible values	Default value
INC2On	On/off	-	0 - off 1 - on	1
INC2Factor	Scaling factor	-	-2500.0 ... 2500.0	1
INC2Output	Output control	-	0 - average synchronous 1 - trigger synchronous 2 - burst synchronous	0
INC2Value	Value	-	V - velocity R - measuring rate Q - quality	V
PINC2	Display of parameters	-	-	-

Table 25 Commands for pulse output 2

10.1.6 Commands for output via pulse output 3

Command	Description	Unit	Possible values	Default value
INC3On	On/off	-	0 - off 1 - on	1
INC3Factor	Scaling factor	-	-2500.0 ... 2500.0	1
INC3Output	Output control	-	0 - average synchronous 1 - trigger synchronous 2 - burst synchronous	0
INC3Value	Value	-	V - velocity R - measuring rate Q - quality	V
PINC3	Display of parameters	-	-	-

Table 26 Commands for pulse output 3

10.1.7 Commands for output via serial interface 1

Command	Description	Unit	Possible values	Default value
S1On	On/off	-	0 - off 1 - on	0
S1Format	Output format	-	see text	V*60:6:2 'm/min'
S1Interface	Settings for serial interface 1	-	see text	9600 N X D
S1Output	Time or trigger controlled output	-	0 - time 1 - trigger	0
S1Time	Output time	ms	1 ... 65535	500 ms
PS1	Display of S1 parameters	-	-	-

Table 27 Commands for serial interface 1

10.1.8 Commands for output via serial interface 2

Command	Description	Unit	Possible values	Default value
S2On	On/off	-	0 - off 1 - on	0
S2Format	Output format	-	See description	'VL'RT42
S2Interface	Settings for serial interface 2	-	See description	9600 N X D
S2Output	Time or trigger controlled output	-	0 - time 1 - trigger	0
S2Time	Output time	ms	1 ... 65535	500 ms
PS2	Display of S2 parameters	-	-	-

Table 28 Commands for serial interface 2

10.1.9 Commands for offline measurement

Command	Description	Unit	Possible values	Default value
***OFFL**ine*	Starting of offline measurement	-	[T] waiting for trigger	-
***OFFF**actor*	Scaling factor	-	-2500.0 ... 2500.0	1
***OFFM**easure*	Measuring time	s	1 ... 65535	10 s
***OFFO**utput*	Output control	-	0 - average synchronous 1 - trigger synchronous 2 - burst synchronous	0
***OFFR**ead*	Reading of offline data	-	-	-
***OFFT**ime*	Averaging and storing time	ms	2 ... 65535	50 ms
***OFFV**alue*	Value	-	F - frequency L - length N - object counter R - measuring rate S - R + V V - velocity	V
POFF	Display of parameters for offline operation	-	-	-

Table 29 Commands for serial offline measurement

10.1.10 Read commands

Command	Return value	Unit	Decimals	Example
B	Number of bursts	-	0	1235
D	FIFO level	-	0	1
E	Exposure time	-	0	12
F	Frequency of the last burst	Hz	2	1234.56
I	Lamp brightness	-	0	24
L	Length	m	4	1234.5678
P	Number of periods	-	0	12
R	Measuring rate	-	0	45
V	Velocity	m/s	5	-1.23456
X	Number of the last error	-	0	32

Table 30 Read commands

10.1.11 Service commands

Command	Description	Comments
***P**assword*	Setting of password	Default password: 'WEGA'
***Resta**rt*	Restarts device	Interrupts measurement
***Resto**re*	Loading parameters	Interrupts measurement
***Si**mulation*	Simulation f, [n] f - velocity range in m/s n - measuring rate	Interrupts measurement
Standby	Standby mode	Stops measuring function and switches off light source
***Sto**re*	Saving parameters	with password protection, interrupts the measurement for a short time
System	Activation of system mode	-
Update	Updating of firmware	Use the VLMTERM program rather than this command!

Table 31 Service commands

10.1.12 Commands in system mode

Command	Description	Unit	Possible values	Default value
Am_plifier_	Amplification of measuring signal	-	0 ... 3 - fixed 4 - automatic	4
Bw	Bandwidth	%	0 - automatic 10 ... 75 - fixed	0
Cali_brate_	Calibration of c, n, f c - velocity or length n - measuring time in s / quantity f - Calibration value m/s or m		 V, L 1 ... 65535 0.0001 ... 10000	-
Cons_tant_	Display of system constant	-	-	factory default
Cont_roltime_	Control time when settings too low	s	0.01 ... 1.00	0.1
Ep_silon_	Deviation of periods in %	%	0 – automatic 0.787 ... 50.0	0
FB_2Type_	Filter board type	-	-	factory default
Int_time_	Exposure time	-	0 ... 14 - fixed 15 - automatic	15
La_mp_	Lamp brightness	-	0 ... 30 - fixed 31 - automatic	31
Lma_x_	Max. lamp brightness after adjustment	-	0 ... 30	30
Lmi_n_	Min. lamp brightness after adjustment	-	0 ... 30	0
Pm_in_	Min. permissible number of periods	-	0 - automatic 2 ... 15 - fixed	0
PP_M_	Display of temperature compensation	-	-	factory default
Rma_x_	Max. exposure time after adjustment	-	0 ... 14 - fixed 15 - automatic	15
Rmi_n_	Min. exposure time after adjustment	-	0 ... 14 - fixed 15 - automatic	15
Set_Auto_	Set parameters to automatic adjustment	-	1 ... 4 (see text)	-
TestF_B_	Test command for filter board	-	-	-
TeSy_stem_	Test command for system parameters	-	-	-
Ty_pe_	Display device type	-	-	-
****E***_xit_	Deactivation of system mode	-	-	-
****V***_ideo_	Video mode	-	-	-

Table 32 Commands in system mode

10.2 Programming examples

Print log

A production company cuts steel plates. A VLM 320 measuring device with optional laser light barrier and real time clock is used for the final inspection. A print log is to be generated, containing date, time, consecutive numbering with factory identification number and plate length.

A light barrier is connected to the 'IN2' input (trigger input), and the beginning and the end of the plates are detected. After programming a printer with serial interface is connected to interface 1 of the VLM 320.

Command line	Description
Trigger 0	Individual part measurement
S1Interface 9600 N D	Baud rate of printer, no log
S1Output 1	Output at plate end (trigger)
S1Format D ' ' C N:6 '/KW1' L:8:3	Output of date, time, counter, string, length
S1On 1	Switching on
**Store*	Saving with password

Table 33 Example for the programming of a print log

Alternatively, the abbreviated form without space characters can be entered for the format specification:

S1Format D' 'CN:6'/KW1'L:8:3

Pulse output

A wheel with shaft encoder is to be substituted. The shaft encoder produced 2 pulses per millimetre. Due to the process dynamics, a scan frequency of 50 ms is set. The VLM 320 shaft encoder output is connected to the existing process control unit.

Calculation:

Output frequency [in kHz] = factor [1/mm] · velocity [in m/s]

equivalent to:

Pulse number = 1000 · factor [1/mm] · length [m]

Factor = pulse number / (1000 · length [m])
= 2 / (1000 · 0,001)

<u>Factor = 2</u> (direct input of pulses per mm is possible!)

Command line	Description
Average 50	Averaging time 50 ms
INC1Value V	Velocity
INC1Output 0	Update at equivalent time intervals
INC1Factor 2	2 pulses per mm
INC1On 1	Switching on
**Store*	Saving with password

Table 34 Programming example for pulse output

10.3 Error messages

All error messages begin with the letter 'E' and a two-digit error number. From error code 'E10' the last five errors that occurred during operation are cached. The command *Error* lists the numbers and error texts. Short command *X* returns only the last error number.
To set the system to continuous error output from 'E10', enter parameter *X* in the formats according to *S1Format* and *S2Format*.
Certain error texts include brackets with additional information, which is self-explanatory (refer to tables below).

Code	Description	Cause
E00 No ERROR	No error occurred	-
E01 Missing parameter	No or insufficient parameters specified	Incorrect command input
E02 Value out of range	Figure too small or too big	Incorrect command input
E03 Invalid command	Command does not exist	Incorrect command input
E04 Invalid parameter	Parameter invalid	Incorrect command input
E05 No data	No data in memory	Offline measurement
E06 Memory full	Memory full	Too many measuring values during offline measurement
E07 ESC user abort	Abort with ESC	Offline measurement and calibration
E08 Calibration Error	Incorrect calibration	Signal failure during calibration (see 9.1.20 *Signalerror* command)
E09 Illegal Use	Input disabled for 60s	3 incorrect password input attempts
E20 Warning, check DIR and VMAX	Permissible range exceeded	Check settings for *Direction* and *Vmax*; refer to data sheet
E21 Not supported by power supply	Power adapter does not support this function	Command *TestPS*
E25 Output is busy, please try again later!	Command blocked by other interface	Commands requiring an input such as *Test*, *TestAN*, etc. cannot be executed simultaneous at both interfaces S1 and S2

Table 35 Errors occurring during command input and processing

Code	Description	Cause
E10 S1 output error	Error upon S1 output	Output too fast
E11 S1 input error	Parity error, buffer overflow, etc.	Transmission error, see *S1Interface*
E13 S2 output error	Error upon S2 output	Output too fast
E14 S2 input error	Parity error, buffer overflow, etc.	Transmission error, see *S2Interface*
E17 Analog output error	Error upon analog output	Output too fast
E18 Incremental output error	Error upon pulse output	Output too fast
E19 Offline output error	Error during offline measurement	Measurement too fast
E22 Warning, AVERAGE adjusted	Permissible range exceeded	*Average* is corrected automatically
E26 Warning, Signal error during length measurement	Length measurement incorrect	Signal failure during length measurement (see 9.1.20 *Signalerror* command)
E27 Warning, LCA overflow detected!	Measured values lost	Cache capacity for measured values exceeded

Table 36 Errors caused by incorrectly set parameters

Code	Description	Cause
E30 Periods out of range	Error in the signal processing	Invalid number of periods
E33 Watchdog timer reset	Reset by watchdog	Processor crashed (also in the event of overload)
E35 IIC arbitration error detected	I²C bus transmission error	Unknown error on internal I²C bus
E36 Incompatible EEPROM data, standard values stored	Parameter is reset to default value	Data in parameter memory (EEPROM) invalid

Table 37 Critical errors

In most cases, critical errors can only be eliminated by making changes to the program or the operating conditions. The *Error* command removes these errors from the list.

Code	Description	Cause
E31 Over temperature detected!	Internal temperature greater than 75 °C	Switch off the device immediately and allow it to cool down
E32 Lamp out of order detected!	Light source defective	Light source is defective and must be replaced
E40 Error reading EEPROM, service necessary!	EEPROM failure	Fatal error; device must be repaired
E41 Loading ASIC 1 failed, service necessary!	ASIC 1 failed	Fatal error; device must be repaired
E42 Loading ASIC 2 failed, service necessary!	ASIC 2 failed	Fatal error; device must be repaired
E43 Power supply error, service necessary!	Power adapter fault	Fatal error; device must be repaired
E44 Parameter not stored in EEPROM!	Parameters could not be stored	Fatal error; device must be repaired
E99 Unknown error!	Unknown error	Software error

Table 38 Fatal errors, requiring a check of the device

Fatal errors occur if there is a serious hardware fault or failure. The measurement function is turned off in this case. The device must be checked. These errors are not removed from the list with the *Error* command.

Code	Description	Cause
E80 Non valid hex file	Invalid format	File not valid
E81 Illegal address range	Incorrect address range	File not valid
E82 User terminated	Abort	Abort of transmission
E84 Verification error, no valid program in flash memory	Test after programming failed	Do not switch off the device and do not exit the boot loader! Try *Update* command again
E85 Remove boot jumper and try again	Boot jumper still plugged in	Updating is only possible with open boot jumper!
E86 Hex file not valid for this gauge	File not valid for the device	No valid file for this device

Table 39 Boot loader errors

10.4 LED signals

LED	Colour	Description
Signal LED	green	Signal detected
Signal LED	red	Poor signal quality, see also *Minrate* and *ECCOn*
Signal LED	yellow	Device is being initialised
Busy LED	yellow	Command is being processed, even during calibration and offline measurement
Error LED	red	Flashes briefly in the case of a critical error (see Table 36 and Table 37) Flashes constantly in the event of a fatal error (see Table 38)

Table 40 Description of the LED signals

10.5 Units of output values

Command	Unit	Value range for output	Max. resolution
Velocity	1 m/s	± 21474	0.0001 *)
Length	1 m	±214748 (internal: ± 360288)	0.0001 *)
Object counter	1 piece	0 .. 65535	1
Measuring rate	none	0 .. 1000	0.1 **)

Table 41 Measuring values with units and resolution

*) Without format specification, the value is output to the S1 and S2 output with three digits after the decimal point. With hexadecimal output, the maximum resolution is output.

**) Without format specification, the value is output to the S1 and S2 output without decimals. With hexadecimal output, the maximum resolution is output.

10.6 Pin assignment

10.6.1 Device port 1, RS 232

Pin	Colour internal	Assignment
1	brown	RxD (RS 232 interface S1)
2	white	TxD (RS 232 interface S1)
3	blue	GND (RS 232 interface S1)
4	black	GND (test signal), do not use
5	grey	Test signal (analog signal, 50 ohm), do not use

Table 42 Device port #1, RS232

10.6.2 Device ports 2, 4 and 5

The pin assignment of the ports 2, 4 and 5 is customer-specific. For details, refer to the enclosed documentation.

10.6.3 Device port 3 with 230V/AC power supply

Pin	Cable colour	230V/AC assignment
2	brown	Phase [9]
3	blue	Neutral [9]
PE	green/yellow	Protective earthing conductor

Table 43 Device port #3, 230V/AC power supply

10.6.4 Device port 3 with 24/DC power supply

Pin	Cable colour	Assignment 24V/DC
3	black 1	0 V
4	black 2	24 V
PE	green/yellow	Protective earthing conductor

Table 44 Device port #3, 24V/DC power supply

Caution: Before connecting the power, earth the device with the earthing screw and the earthing cable.

[9] Do not confuse the phase and neutral conductor; both conductors are fused.

10.7 Plug connector

10.7.1 Installation instructions for plug connectors plugs 1, 2, 4 and 5

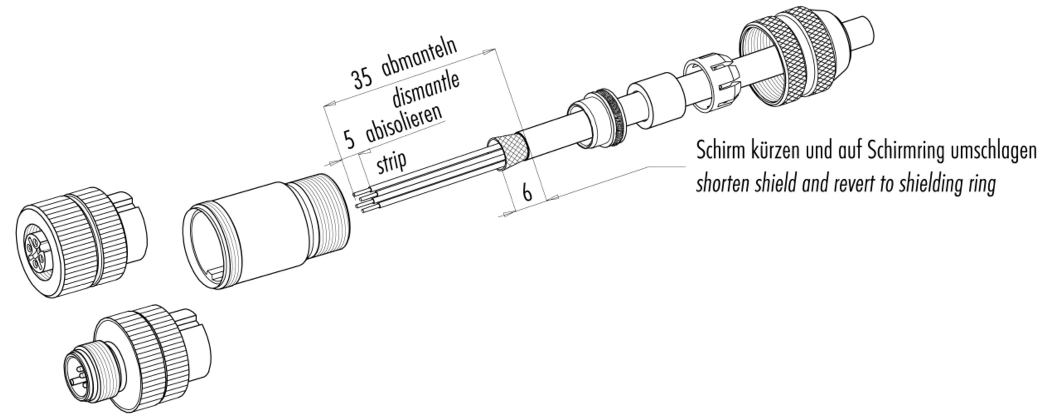


Fig. 36 Installation instructions for plug connectors of connections 1, 2, 4 a. 5

10.7.2 Installation instructions for plug connector of connection 3

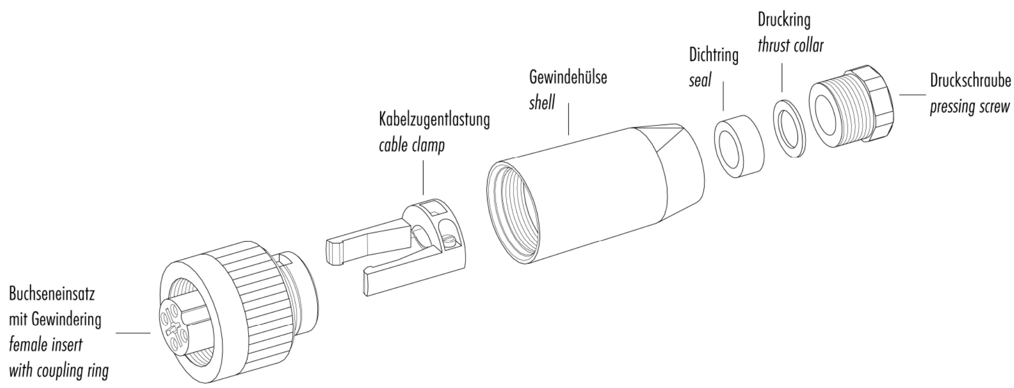


Fig. 37 Installation instructions for plug connector of connection 3 (230V AC)

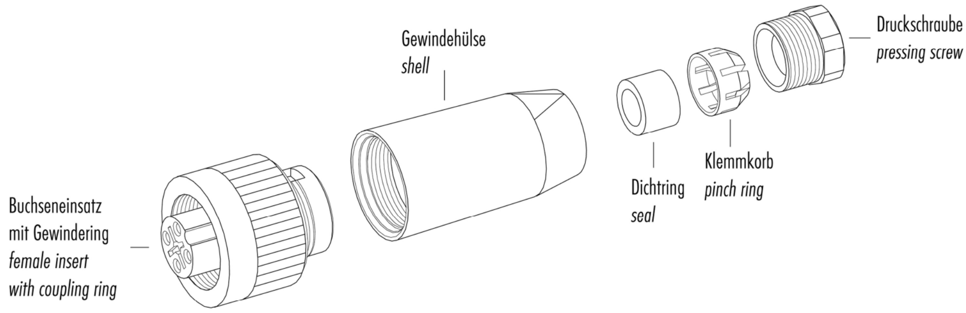
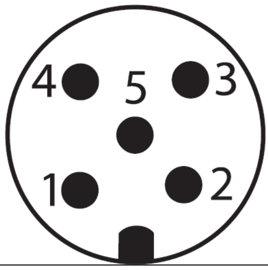


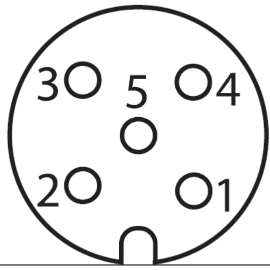
Fig. 38 Installation instructions for plug connector of connection 3 (24V DC)

10.7.3 Pin assignment of cable plugs and sockets

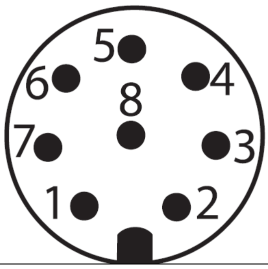
Cable plug, 5-pin, M12 A coding,
e.g. RS232



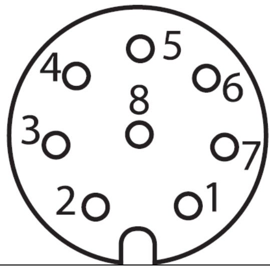
Cable socket, 5-pin, M12 A coding,
e.g. various inputs and outputs



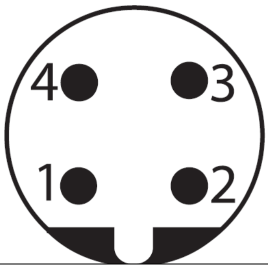
Cable plug, 8-pin, M12 A coding,
e.g. 5 V pulse output



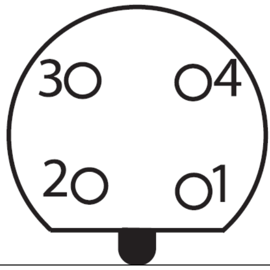
Cable socket, 8-pin, M12 A coding,
(optional for special wiring)



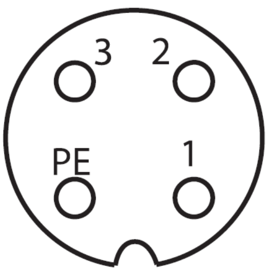
Cable plug, 4-pin, M12 B coding,
e.g. Profibus output



Cable socket, 4-pin, M12 B coding,
e.g. Profibus input



Cable socket 4-pin, RD24, series 693
230VAC input



Cable socket 7-pin, RD24, series 693
24V DC input

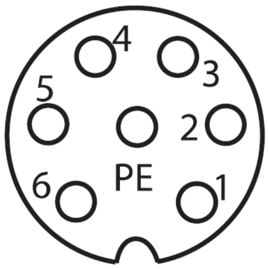


Fig. 39 Assignment of plug connectors (connector side)

10.8 Interface cards

Basic function / Option	RS232, serial interface	RS485 / RS422, serial interface	Analog output, 4...20 mA	Analog output, 0...20 mA	25 kHz pulse, 2 x 2 phases, open collector, 12-24 V	50 kHz pulse, 2 x 2 phases, Status output push-pull, 15-30 V	2 MHz pulse, 2 x 2 phases, balancing, 5 V	Profibus DP	ECC2 shaft encoder controller
without	**IF1-RS232**	**IF1-RS422**	**IF1-AI 4...20 mA**	**IF1-AI 0-20 mA**	**IF3**	**IF3-PP**	**IF3-5V**	**IFProfi**	**ECC2**
RS232 serial interface	-	-	IF1-RS232/ AI, 4...20 mA	IF1-RS232/ AI, 0...20 mA	-	-	-	-	ECC2 / RS232
RS485 or RS422 serial interface	-	-	IF1-RS422/ AI, 4...20 mA	IF1-RS422/ AI, 0...20 mA	-	-	-	-	-
only RS485 serial interface	-	-	-	-	-	-	-	-	ECC2/RS485
Analog output, 4...20mA	IF1-RS232/ AI, 4...20 mA	IF1-RS422/ AI, 4...20 mA	-	-	IF3/ AI, 4...20 mA	IF3-PP/ AI, 4...20 mA	IF3-5V/ AI, 4...20 mA	IFProfi/ AI, 4...20 mA	-
Analog output, 0...20mA	IF1-RS232/ AI, 0...20 mA	IF1-RS422/ AI, 0...20 mA	-	-	IF3/ AI, 0...20 mA	IF3-PP/ AI, 0...20 mA	IF3-5V/ AI, 0...20 mA	IFProfi/ AI, 0...20 mA	-

Table 45 Interface cards

- Function of the standard **AB3** interface card: RS232 interface; PNP: VLM error output, 2-phase passive **25 kHz pulse output** and status output; standby, trigger and direction input.
- As an alternative to the AB3, the device can be equipped with an **AB4**: with active outputs for VLM error, 2-phase 50 kHz pulses, status output (inputs same as for AB3)
- Additional interface cards: IF-ETHER for 10-Mbit Ethernet or according to customer specifications

10.9 Part numbers

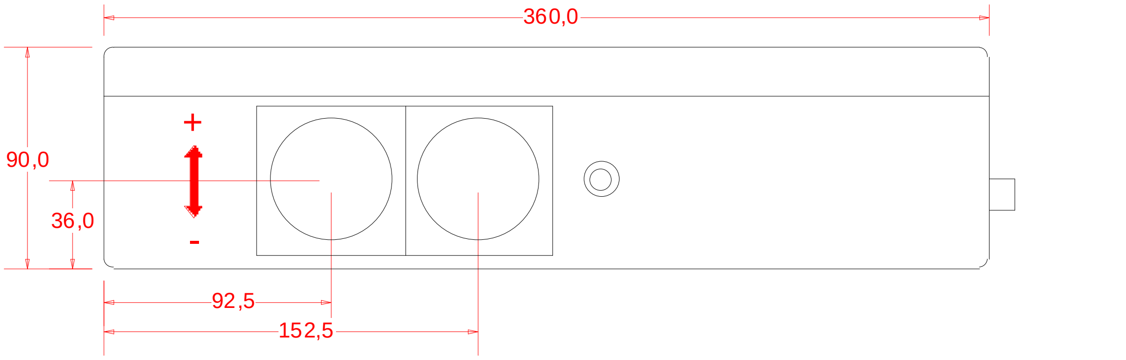
The most common optional interface cards, connecting cables and plugs, replacement windows and replacement lamps are listed in Table 46. Other components such as protective casings, assembly accessories and individual sensors without accessories are also available from the manufacturer. Please contact the manufacturer or your dealer for details.

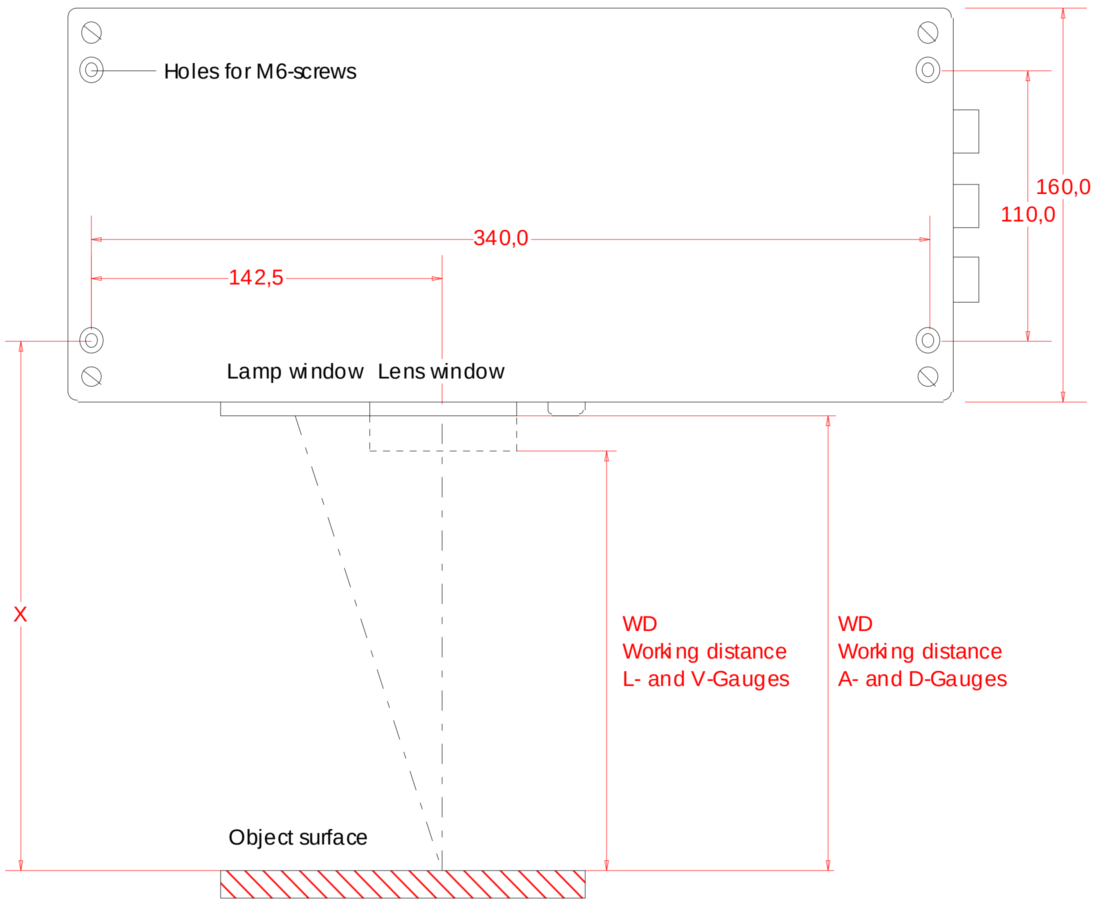
Product no.	Designation
41-1010-00	VLM320A kit with accessories
41-1010-01	VLM320A/24V kit with accessories
41-1011-00	VLM320D kit with accessories
41-1011-01	VLM320D/24V kit with accessories
41-1012-00	VLM320L kit with accessories
41-1012-01	VLM320L/24V kit with accessories
41-1013-00	VLM320V kit with accessories
41-1013-01	VLM320V/24V kit with accessories
19-1002-00	Interface card IF1-AI 4...20mA with analog output
19-1002-01	Interface card IF1-AI 0...20mA with analog output
19-1003-00	Interface card IF1-RS232 with RS232 interface
19-1004-00	Interface card IF1-RS232 with RS232/RS485 interface
19-1005-00	Interface card IF1-RS232/AI 4...20mA with analog output and RS232 interface
19-1005-01	Interface card IF1-RS232/AI 0...20mA with analog output and RS232 interface
19-1006-00	Interface card IF1-RS422/AI 4...20mA with analog output and RS422/RS485 interface
19-1006-01	Interface card IF1-RS422/AI 0...20mA with analog output and RS422/RS485 interface
19-1030-00	Interface card IF2 with passive 25kHz pulse output
19-1030-01	Interface card IF2/AI 4...20mA with passive 25kHz pulse output and analog output
19-1030-02	Interface card IF2/AI 0...20mA with passive 25kHz pulse output and analog output
19-1031-00	Interface card IF3-5V with 5V active 2MHz pulse output
19-1031-01	Interface card IF3-5V/AI 4...20mA with active 5V 2MHz pulse output and analog output
19-1031-02	Interface card IF3-5V/AI 0...20mA with active 5V 2MHz pulse output and analog output
19-1032-00	Interface card IF3-PP with 15-30V active push-pull 50kHz pulse output
19-1032-01	Interface card IF3-PP/AI 4...20mA with 15-30V push-pull 50kHz pulse and analog output
19-1032-02	Interface card IF3-PP/AI 0...20mA with 15-30V push-pull 50kHz pulse and analog output
19-1010-00	Interface card IFProfi with Profibus DP
19-1010-01	Interface card IFProfi/AI 4...20mA with Profibus DP and analog output
19-1010-02	Interface card IFProfi/AI 0...20mA with Profibus DP and analog output
19-1011-00	Interface card ECC2 with shaft encoder controller
19-1011-01	Interface card ECC2/RS232 with shaft encoder controller and RS232 interface
19-1011-02	Interface card ECC2/RS485 with shaft encoder controller and RS485 interface
19-1022-00	Filter card FB2DIR with additional automatic direction detection
19-1023-00	Interface card AB4-PP with active push-pull outputs (optional, replacing AB3)
19-1000-00	Option for glowing metals (VLM 320 /h)
19-1021-00	Option pressure compensation element

Product no.	Designation
15-0019-00	Programming cable RS232, 5m
15-0020-00	Connecting cable M12F5A-M12F5A, 5m
15-0025-00	Power cable 230V, 5m
15-0026-00	Power cable 24V, 5m
15-0000-00	Terminator for Profibus
15-0010-00	Cable plug, 5-pin, A-coded
15-0011-00	Cable socket, 5-pin, A-coded
15-0012-00	Cable socket, 4-pin, RD24
15-0013-00	Cable socket, 7-pin, RD24
15-0014-00	Cable plug Profibus OUT, 4-pin, B-coded
15-0015-00	Cable socket Profibus IN, 4-pin, B-coded
15-0016-00	Cable plug, 8-pin, A-coded
15-0017-00	Cable socket, 8-pin, A-coded
15-0021-00	Cable socket, 4-pin, RD24, 90°
15-0022-00	Cable socket, 7-pin, RD24, 90°
15-0023-00	Cable plug, 5-pin, A-coded, 90°
15-0024-00	Cable socket, 5-pin, A-coded, 90°
11-0001-00	USB to RS232 adapter, 0.2m
14-0000-00	Replacement LED
14-0002-00	Replacement window OW2 (standard)
14-0002-01	Replacement window OW2K (synthetic)
14-0003-00	Replacement window OW3 (heat protection for light source, only for VLM 320 /h)
14-0004-00	Replacement window OW4 (heat protection for lens, only for VLM 320 /h)
14-0005-00	Replacement window OW5 (stainless steel)

Table 46 Part numbers

10.10 Dimensions and installation drawings





Gauge	WD [mm]	X [mm]
A-Series	185	115
D-Series	240	270
L-Series	170	215
V-Series	170	215

Fig. 40 Dimensions and installation drawings of various models (in mm)

Note: the devices VLM 320 L and V the lens window is +15 mm longer. The working distance (WD) is always measured from the lens window. VLM 320 L and V have the same position of the mounting holes as the VLM 320 A.

11 Declaration of Conformity

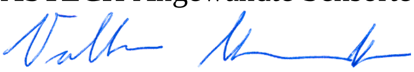
Manufacturer	**ASTECH Angewandte Sensortechnik GmbH**
Address	18057 Rostock Schonenfahrerstr. 5 Germany
Product name	VLM 320
Device description	Optical length and velocity measuring device

Conforming to the following standards

Emission:	EN 61326-1:2006; Conducted emission EN 61326-1:2006; Radiated emission
Interference immunity:	EN 61000-6-2:2005 ESD EN 61000-6-2:2005 Electromagnetic field EN 61000-6-2:2005 Burst EN 61000-6-2:2005 Surge EN 61000-6-2:2005 Conducted disturbances by RF-fields EN 61000-6-2:2005 Power fail
LF phenomena:	IEC 61000-3-2:2005 + A1:2008 + A2:2009: Harmonic current IEC 61000-3-3:2008: Flicker in supply voltage

Place	Rostock
Date	November 2010

ASTECH Angewandte Sensortechnik GmbH



Volker Ahrendt
Managing Director