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User Manual

# VLM500

Version 2.2



**ASTECH**  
Angewandte Sensortechnik

## Remarks

The information provided in the manual on hand have been carefully investigated and processed. Still, we cannot assume any kind of liability regarding completeness or mistakes. However, we are always grateful to get feedback and proposals.

Claims for damages are, except in the case of premeditation or negligence, in principle excluded.

As a series of versions of this product is available, deviations from the manual on hand might occur, if applicable.

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VLM500 – User Manual V2.2

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## I. Table of Content

1	General information .....	9
1.1	Information on how to work with this manual .....	9
1.2	Safety instructions .....	9
1.3	Introduction .....	10
2	Function .....	11
2.1	Physical principle.....	11
2.2	Evaluation .....	12
2.3	Interfaces and parametrization .....	12
3	Device models .....	13
3.1	VLM500A.....	13
3.2	VLM500D.....	13
3.3	VLM500L .....	13
3.4	VLM500E .....	13
3.5	Option /h for VLM500 series.....	14
3.6	Summary of device models.....	14
4	Operation instructions.....	15
5	Assembly.....	17
6	Connection.....	19
6.1	Current supply and grounding .....	19
6.2	Signal lines.....	19
6.3	USB Interface .....	20
6.4	RS-232 Interface.....	20
6.5	RS-422 Interface.....	21
6.6	RS-485 Interface.....	21
7	Interface cards .....	22
7.1	I232 – Interface RS-232 .....	23
7.2	I4U4 – Interface RS-422, RS-485, 4-wire cable.....	23
7.3	I4U2 – Interface RS-485, 2-wire cable.....	23
7.4	IUSB – Interface USB .....	24
7.5	IAUN – Interface Analog Output .....	24
7.6	IOPL – Interface Input-Output Positive Logic.....	25
7.7	IPPL – Interface Pulse Output Positive Logic.....	27
7.8	IPPU – Interface Input-Output Push Pull Universal.....	27
7.9	IFPB – Interface Fieldbus Profibus .....	29

---

7.10	IFPN – Interface Fieldbus Profinet .....	33
7.11	IFFE – Interface Fieldbus FastEthernet.....	36
7.12	ILBC – Interface Light Barrier Control .....	38
7.13	ILECC – Interface Encoder Connection Control.....	38
8	Maintenance.....	39
8.1	Window.....	39
8.2	Illumination .....	40
9	Programming.....	42
9.1	VLMTool.....	42
9.2	Command Input .....	43
9.3	General Commands.....	43
9.4	Analog output .....	54
9.5	ECC Control .....	56
9.6	Pulse output via first pulse output.....	57
9.7	Pulse output via the second and third pulse output.....	58
9.8	Output via the first serial interface.....	59
9.9	Output via the second serial interface.....	62
9.10	Commands for the light barrier controller LBC9-CA .....	63
9.11	Offline Measurement.....	64
9.12	Test Commands.....	66
9.13	Service commands .....	69
9.14	System Commands.....	72
9.15	Read commands.....	78
9.16	Special Applications .....	79
10	Technical Data .....	80
11	Annex.....	81
11.1	List of commands .....	81
11.2	Programming examples .....	87
11.3	Error messages.....	88
11.4	Meaning of the light diodes .....	91
11.5	Units of the output values .....	91
11.6	Terminal assignment.....	91
11.7	Plug connector .....	93
11.8	Article numbers.....	95
11.9	Dimensional and installation drawings.....	96
12	Conformity declaration.....	97

## II. Commands of the VLM500

### General commands

The command <i>Amax</i> .....	43
The command <i>Average</i> .....	43
The command <i>Calfactor</i> .....	44
The command <i>Clock</i> .....	44
The command <i>Controlhold</i> .....	44
The command <i>Date</i> .....	44
The command <i>Direction</i> .....	44
The command <i>Error</i> .....	45
The command <i>Errorlevel</i> .....	45
The command <i>Fmax</i> .....	45
The command <i>Help</i> .....	45
The command <i>Holdtime</i> .....	45
The command <i>Info</i> .....	46
The command <i>Lengthoffset</i> .....	46
The command <i>Minrate</i> .....	46
The command <i>Mode</i> .....	46
The command <i>Number</i> .....	47
The command <i>Parameter</i> .....	47
The command <i>Post</i> .....	47
The command <i>REM</i> .....	47
The command <i>Seltrigger</i> .....	48
The command <i>Serialnumber</i> .....	48
The command <i>SID</i> .....	48
The command <i>Signalerror</i> .....	48
The command <i>Start</i> .....	48
The command <i>Stop</i> .....	48
The command <i>Temperature</i> .....	48
The command <i>Terminal</i> .....	49
The command <i>Tracking</i> .....	49
The command <i>Trigger</i> .....	50
The command <i>Vmax</i> .....	52
The command <i>Vmin</i> .....	52
The command <i>Window</i> .....	52

### Analog output

The command <i>AO</i> .....	54
The command <i>AOMax</i> .....	55
The command <i>AOMin</i> .....	55
The command <i>AOOn</i> .....	55
The command <i>AOSync</i> .....	55
The command <i>AOValue</i> .....	55

### ECC control

The command <i>ECC</i> .....	56
The command <i>ECCOn</i> .....	56
The command <i>ECCR1</i> .....	56
The command <i>ECCR2</i> .....	56
The command <i>ECCV1</i> .....	56
The command <i>ECCV2</i> .....	56

### Pulse output

The command <i>PO1</i> .....	57
The command <i>PO1ECC</i> .....	57
The command <i>PO1Factor</i> .....	57
The command <i>PO1Hold</i> .....	57
The command <i>PO1On</i> .....	58
The command <i>PO1Output</i> .....	58
The command <i>PO1Sync</i> .....	58
The command <i>PO1Value</i> .....	58

### Output via serial interface

The command <i>SO1</i> .....	59
The command <i>SO1Address</i> .....	59
The command <i>SO1Format</i> .....	59
The command <i>SO1Interface</i> .....	61
The command <i>SO1On</i> .....	61
The command <i>SO1Sync</i> .....	62
The command <i>SO1Time</i> .....	62

**Light barrier controller LBC9-CA**

The command <i>LBC</i> .....	63
The command <i>LBCD1</i> .....	63
The commands <i>LBCD2</i> to <i>LBCD8</i> .....	63
The command <i>LBCOn</i> .....	63

**Offline measurement**

The command <i>OFF</i> .....	64
The command <i>OFFLine</i> .....	64
The command <i>OFFFactor</i> .....	64
The command <i>OFFMeasure</i> .....	64
The command <i>OFFSync</i> .....	64
The command <i>OFFRead</i> .....	64
The command <i>OFFTime</i> .....	65
The command <i>OFFValue</i> .....	65

**Test commands**

The command <i>TestAO</i> .....	66
The command <i>TestFilter</i> .....	66
The command <i>TestIO</i> .....	67
The command <i>TestMeasure</i> .....	67
The command <i>TestPS</i> .....	67
The command <i>TestQuality</i> .....	68
The command <i>TestTComp</i> .....	68

**Service commands**

The command <i>ListError</i> .....	69
The command <i>Password</i> .....	69
The command <i>Restart</i> .....	69
The command <i>Restore</i> .....	69
The command <i>Simulation</i> .....	70
The command <i>Standby</i> .....	70
The command <i>Store</i> .....	70
The command <i>Update</i> .....	70

**Systems commands**

The command <i>Amplifier</i> .....	72
The command <i>Bw</i> .....	72
The command <i>Calibrate</i> .....	73
The command <i>Constant</i> .....	73
The command <i>Controltime</i> .....	73
The command <i>Epsilon</i> .....	74
The command <i>Exposure</i> .....	74
The command <i>Expmax</i> .....	74
The command <i>Expmin</i> .....	75
The command <i>Illumination</i> .....	75
The command <i>Illmax</i> .....	75
The command <i>Illmin</i> .....	75
The command <i>OED</i> .....	75
The command <i>Periodcount</i> .....	76
The command <i>Permax</i> .....	76
The command <i>Permin</i> .....	76
The command <i>Rateinterval</i> .....	76
The command <i>TComp</i> .....	77
The command <i>TMax</i> .....	77
The command <i>Senslevel</i> .....	77
The command <i>SetAuto</i> .....	77
The command <i>Type</i> .....	78
The command <i>Video</i> .....	78

### III. List of figures

Figure 1: Structure of a VLM500 .....	11
Figure 2: Working distance and alignment towards the measurement object surface .....	17
Figure 3: Alignment towards the velocity vector .....	17
Figure 4: VLM500 with linear unit LJ2 .....	18
Figure 5: VLM500 with mounting plate RMPL1 .....	18
Figure 6: VLM500 Device connections .....	19
Figure 7: TERM board.....	22
Figure 8: Output circuit of the IAUN card .....	25
Figure 9: Connection example for the IOPL card outputs .....	25
Figure 10: Circuitry of the IOPL card inputs .....	26
Figure 11: Connection example for the IPPL pulse card in slot 4 .....	27
Figure 12: Profinet HTML status page .....	33
Figure 13: HTML status page .....	37
Figure 14: Windows of the VLM500.....	39
Figure 15: Exchange of the light source .....	41
Figure 16: Program VLMTool .....	42
Figure 17: Screen text Command <i>Post</i> .....	47
Figure 18 : Active length measurement or active trigger signal depending on the command <i>Trigger</i> .....	50
Figure 19 : Single part measurement with VLM500 and two light barriers .....	51
Figure 20: Simplified operating principle of the averaging processor with 8 cycles .....	53
Figure 21: Examples for analog output .....	54
Figure 23: Screen text of the command <i>LBC</i> .....	63
Figure 24: Screen text of command <i>TestAO</i> .....	66
Figure 25: Screen text of command <i>TestFilter</i> .....	66
Figure 26: Screen text command <i>TestIO</i> .....	67
Figure 27: Screen text of command <i>TestMeasure</i> .....	67
Figure 28: Screen text of command <i>TestPS</i> .....	68
Figure 29: Screen text of command <i>TestQuality</i> .....	68
Figure 30: Screen text of command <i>TestTComp</i> .....	68
Figure 30: Assembly instruction for shielded plug connectors connections 1, 2, 4 and 5 .....	93
Figure 31: Assembly instruction for shielded plug connectors connection 3 (24 V DC) .....	93
Figure 32: Assignment of the plug connector (Display on the plug page) .....	94
Figure 33: Dimensional and installation drawings for different versions (in mm).....	96

### IV. List of tables

Table 1: Device models .....	14
Table 2: Meaning of the light emitting diodes .....	15
Table 3: I232.....	23
Table 4: I4U4 .....	23
Table 5: I4U2 .....	23
Table 6: IUSB .....	24
Table 7: Output ranges of the analog outputs .....	24
Table 8: IAUN .....	25
Table 9: IOPL .....	26
Table 10: IPPL.....	27
Table 11: IP5V .....	28
Table 12: IPPP.....	28
Table 13: Available Profibus modes in the VLM500.....	30
Table 14: Technical data of the IFPB .....	32
Table 15: Pin assignment of the connector.....	32
Table 16: Internal assignment of IFPB.....	32
Table 17: VLM500 Profinet modes.....	34
Table 18: Pin assignment of the Profinet connector.....	35

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Table 19: Internal assignment of IFPN .....	35
Table 20: Technical data of the IFFE .....	37
Table 21: Pin assignment of the Ethernet connector .....	37
Table 22: IFFE .....	37
Table 23: ILBC.....	38
Table 24: IECC.....	38
Table 25: Specification for replacement window .....	39
Table 26: Direction setting .....	45
Table 27: Parameter for Tracking.....	49
Table 28: Trigger type .....	50
Table 29: Logical state diagram of light barrier controller in Trigger 4.....	51
Table 30: Example for the analog output (AOMin = 0 and AOMax = 100).....	54
Table 31: Meaning of the parameter of <i>PO1Hold</i> .....	58
Table 32: Parameter for formatting the output.....	59
Table 33: Format specifications of the individual parameters of the output to S1 .....	60
Table 34: Setting of the RS-232 Interface .....	61
Table 35: Meaning of the parameter of OFFValue.....	65
Table 36: Meaning of the parameters of Amplifier.....	72
Table 37: Meaning of the parameters of <i>Bw</i> .....	72
Table 38: Parameter of SetAuto.....	77
Table 39: Read commands.....	78
Table 40: General commands .....	81
Table 41: Commands for analog output .....	82
Table 42: Commands for ECC control .....	82
Table 43: Commands for pulse output 1.....	82
Table 44: Commands for pulse output 2.....	83
Table 45: Commands for pulse output 3.....	83
Table 46: Commands for serial interface 1 .....	83
Table 47: Commands for serial interface 2 .....	84
Table 48: Commands for the light barrier controller LBC9-CA.....	84
Table 49: Commands for the serial offline measurement .....	85
Table 50: Test commands .....	85
Table 51: Read commands .....	85
Table 52: Service commands.....	86
Table 53: System commands .....	86
Table 54: Example for programming a print log .....	87
Table 55: Example for programming the pulse input .....	88
Table 56: Error list .....	88
Table 57: Meaning of the light diodes .....	91
Table 58: Measuring values with units and their resolution.....	91
Table 59: Device connection #1 .....	91
Table 60: Device connection #3, Current supply 24V/DC .....	92
Table 61: Article numbers .....	95



# 1 General information

## 1.1 Information on how to work with this manual

Commands and functions are displayed in italics. The use of upper case and lower case letters serves for improving the readability:

e.g. *SO2On* (Command for switching on the output at the serial interface S2).

The abbreviated form recommended for the input is additionally displayed in bold letters in the syntax:

e.g. **SO1Format** (Command for programming the serial interface 1).

Names are enclosed in inverted commas:

e.g. 'SW1' (Switch SW1).

The following signs are used:

n	Integral number	s	String
f	Floating point number	[ ]	Optional
c	Sign		

The following acronyms are used for the measurement parameters:

V	Velocity	N	Object counter
L	Length	R	Measuring rate

## 1.2 Safety instructions

These safety and operating instructions should be carefully read and followed during practical work with the device. Compliance with all specified operating conditions is necessary. Failure to observe advisory notes or nonconforming product usage may cause material damage to the VLM500 or lead to wrong measurement results. Cable connectors must not be plugged or unplugged under voltage. Remember to turn voltage supply off before you begin working on cable connections.

A light emitting diode (LED) is used as the light source for the VLM500. The LED classification is subject to the potential photobiological hazard according EN/IEC 62471 named "Photobiological safety of lamps and lamp systems". They are not classified according EN 60825 "Safety of laser products". The lamp of the VLM500 is classified to the risk group RG-2 (moderate risk) according to the manufacturer. That means that the lamp represents no hazard due to the natural reaction to look away from bright light sources. The following advice should be considered anyhow.



Do not stare at operating lamp. It may be harmful to the eye.

## 1.3 Introduction

The measuring device for velocity and length VLM500 is suited for measurements on different materials. The scope of applications of the VLM in process automation is an extremely wide one. Typical applications are length measurement of web-type materials and the cutting control or post-control of sheets, profiles and tubes. The VLM500 is, among others, used with rewinders, calenders and extruders as well as with rolling mills and skin pass mills.

The VLM500 works contact-free optically and implements the physical principle of the spatial filter on the basis of a CCD sensor: Optically resolvable structures of the material surface are displayed on the CCD sensor. This converts the movement directly into a frequency from which the velocity is calculated. A consecutive internal integration calculates the length. The internal integration can simply be controlled via an external signal (Start/Stop via the input: Trigger).

The calculation of the velocity and the integration of the length are implemented signed. The direction can be controlled via an external signal. An automatic direction detection is optionally available.

The generation of the output signals is taken over by a processor. The VLM500 can be connected to an existing control system or process data acquisition unit. All inputs and outputs are optoisolated. A RS232, USB, RS485 or RS422 interface can be used as a programming interface. A second interface is possible too (RS232, USB, RS422 or RS485 as serial interface 2).

The basic version of the VLM500 is equipped with a programming interface. Further interfaces and inputs or outputs are optional for adapting the measuring device to all occurring requirements. Interfaces such as RS232, RS485 or field bus are implemented via different interface cards. This also applies for all inputs and outputs, for example trigger and direction.

Additional serial interfaces, an analogue output, different high-resolution pulse outputs and different bus systems are optionally available (extension card).

The device is located in an IP 65 housing. The current supply is done with a 24 VDC.

The VLM500 is an advancement of the well-known VLM320. Essential innovations of the VLM500 compared to the forerunner model are:

- Both serial interfaces are equivalently usable and bus addressable,
- Completely revised interface concept,
- USB interface,
- Compatible with the new LBC9-CA box,
- More compact housing.

## 2 Function

### 2.1 Physical principle

The VLM500 works contact-free optical and implements the spatial filter principle on the basis of a CCD sensor. Spatial filter is a generic term of a measurement principle for contact-free determination of velocity and length of moving materials. The spatial filter is based on the filtering effect of grid-shaped structures (grid modulation).

The function of the VLM500 can be described in a simplified way as follows:

The lens is aligned to the moving measurement object; the measurement object is displayed to the CCD line. The CCD line is operated as an optical grid (no image taking). A white light source is used for illuminating the measurement object. Thus, maximum surface independence is reached. Extraneous light is effectively suppressed by the procedure. Due to the grid modulation a frequency proportional to the velocity is generated when the object is moved, i.e. the measurement object structure (brightness contrast) generates a signal. This signal is in the following referred to as "burst". These bursts are evaluated by the device, i.e. the signal frequency is measured and the velocity is calculated out of this.

Several control circuits allow automated adaptation to a wide variety of materials (surface structure and brightness of the material)

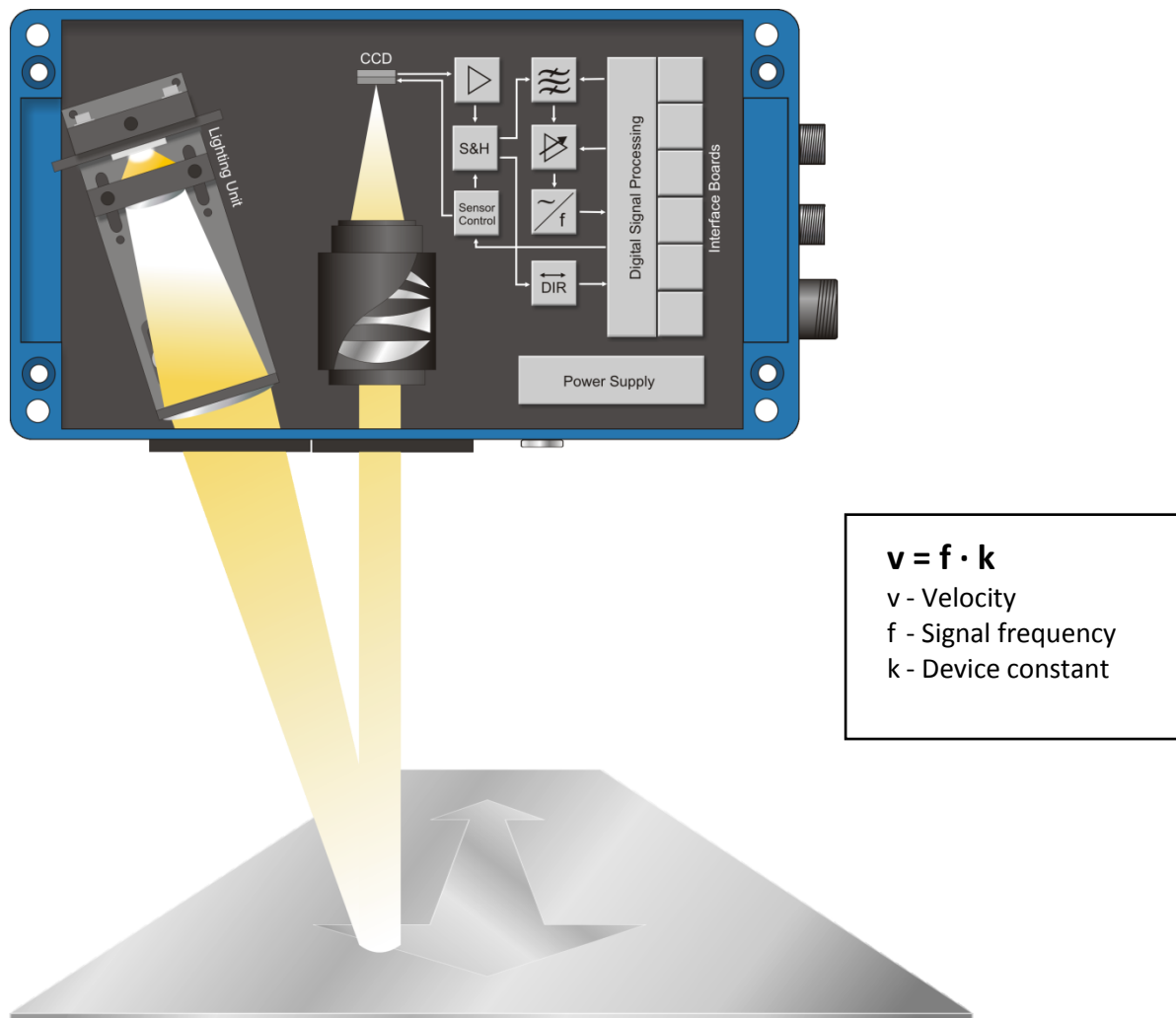


Figure 1: Structure of a VLM500

## 2.2 Evaluation

The frequency of the signals (bursts) is determined by the evaluation electronics of the VLM500. It implements a short-term frequency measurement by individual period evaluation. The velocity is calculated by multiplying the frequency with the device constant and the calibration factor. The length of the object can be calculated by time integration of the velocity. The integration can be controlled via an external signal (trigger). Length measurements up to two million kilometers<sup>1</sup> are possible.

Furthermore, a measurement rate is calculated. It can be used for optimizing the device mounting and monitoring the measurement function.

## 2.3 Interfaces and parametrization

The VLM500 has different optional optoisolated interfaces. The measurement values can be sent to a PC, the process control unit (PLC) or a printer via serial interfaces. Different pulse outputs are available for connecting counters. Furthermore, an optional analog output is possible. The interfaces are implemented by different connection boards, which are placed on the TERM board.

All pulse interfaces are characterized by a high flexibility (programmable scaling and output time) and can be easily configured.

All settings can be made with a PC and a terminal program via one of the two optional programming interfaces SO1 or SO2 (USB, RS-232, RS-485, USB, Profibus, Profinet, or Ethernet with protocol Telnet). The comfortable terminal program VLMTTool is available for free. The single commands of the VLM500 are described in chapter 9 Programming.

The adjusted parameters can be protected by a password. Possibly made changes are discarded after the device was switched off if they were not saved with the password protected command *Store*.

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<sup>1</sup> Exceeding the two million kilometers resets the counter to zero.

### 3 Device models

Different device models of the VLM500 series are available, which are electrically- and connection-compatible. Most options (interface cards, assembly accessories etc.) can be used for all models.

The differences in measurement range, working distance and distance variance result from the used optics and the signal processing of the devices VLM500A, VLM500D and VLM500L.

**All** devices of the VLM500 series are suitable for **highly dynamic processes** (minimum update rate of 0.2ms), can be synchronized with each other (**for the highly precise and dynamic difference velocity measurement**) and have an internal length calculation. The option /h for glowing surfaces is available.



The measuring devices must not be operated out of the velocity range specified in the data sheet, otherwise no proper functioning can be guaranteed. We kindly ask you to consider the parameter *Mode*, as it directly effects on the maximum permissible velocity. The parameter *Vmax* must be set according to the actual maximum plant velocity. A reserve of 10 % was already considered in the device.

#### 3.1 VLM500A

The VLM500A implements a working distance of 185 mm ± 15 mm. It is designed as universal device and allows measurements on very different materials. The device can automatically adapt to reflection, color and structure of the material surface in an extremely wide range.

By changing the parameter *MODE* (see page 46, The command *Mode*), the working distance range can be expanded, i.e. the range where the material to be measured must be located. The extended working distance range of the VLM500A is 185 mm ± 15 mm.

#### 3.2 VLM500D

The VLM500D is specifically designed for application on metallic surfaces and a large distance variance. The device implements a working distance of 240 mm ± 15 mm and is characterized by a high reproducibility of ≤ 0,025 %.

Measurements of velocities lower than 0.003 m/s (0.18 m/min) with a special filter board are possible. The VLM500D can be configured for an extended working range of 240 mm ± 30 mm if required (see page 46, The command *Mode*).

#### 3.3 VLM500L

The device VLM500L has a working distance of 185 mm ± 10 mm. It is mainly used for measuring lower velocities. The possible minimum velocity amounts to 0.004 m/s (0.24 m/min).

The VLM500L can be configured for an extended working range of 185 mm ± 15 mm if required (see page 46, The command *Mode*).

#### 3.4 VLM500E

The device VLM500E has a working distance of 330 mm ± 30 mm. It is mainly used for measuring medium velocities. The possible minimum velocity amounts to 0.01 m/s (0.60 m/min).

### 3.5 Option /h for VLM500 series

Based on the aforementioned devices, the option /h was development for measurements on **glowing tubes, wires and profiles** made of steel, copper and brass etc.

The option /h implements an optical adjustment to measurements on glowing surfaces. Measurements on not-glowing surfaces are still possible.

Sufficient cooling is needed, depending on the environmental conditions (e.g. Cooling and Protection housing CPC1 with scavenging air supply AC5).

### 3.6 Summary of device models

Table 1: Device models

	VLM500A	VLM500D	VLM500L	VLM500E
Nominal distance and working range	(185 ± 7.5) mm (185 ± 15) mm	(240 ± 15) mm (240 ± 30) mm	(185 ± 7.5) mm (185 ± 10) mm	(330 ± 30) mm (330 ± 30) mm
Extended working range				
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)	0,60 to 2000 m/min (0,01 to 33 m/s)
- in 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)	1,00 to 2700 m/min (0,016 to 45 m/s)
- with special filter FB2V	0.36 to 210 m/min (0.006 to 3.5 m/s)	0.30 to 180 m/min (0.005 to 3 m/s)	0.06 to 90 m/min (0.001 to 1.5 m/s)	0,41 to 270 m/min (0,007 to 4,5 m/s)
- in extended range and FB2V	0.72 to 420 m/min (0.012 to 7 m/s)	0.72 to 330 m/min (0.012 to 5.5 m/s)	0.12 to 180 m/min (0.002 to 3 m/s)	0,82 to 540 m/min (0,014 to 9,0 m/s)
Measurement uncertainty DIN 1319 / ISO 3534	±0,025 % for reference distance (±0,05 % in working distance range and ±0,2 % in extended working range)			
Reproducibility DIN 1319 / ISO 3534	±0,025 %			
internal Length measurement range	2.000.000 km			
Information and update	From 0.2 ms additional simple to 32fold floating average			
Optional automated direction recognition	Yes			
Material	Nearly all surfaces	Metallic surfaces	Metallic and other surfaces	Metallic and other surfaces
Application	Universal	Universal	Low velocity	Universal

\*) VLM500 see page 46, The command *Mode*

## 4 Operation instructions

After implemented programming, the VLM500 works autonomously and requires little maintenance. The maintenance is restricted to cleaning the windows if needed and exchanging the LED light source (see chapter 8, Maintenance).

Different commands can be used for diagnosis purposes during operation (see chapter 9, Programming).

Furthermore, operation modes are indicated via light emitting diodes (LED) that have the following meaning:

**Table 2: Meaning of the light emitting diodes**

LED	Color	Meaning
Signal LED	Green	Signal available or good, also see <i>Minrate</i> and <i>ECCOn</i>
	Red	No signal available or not exceeding the determine threshold value, also see <i>Minrate</i> and <i>ECCOn</i>
	Yellow	Signal available or good, but VMIN not reached
Busy LED	Yellow	Command processing, also during calibration, simulation, offline measurements and standby Flashes during standby mode
Error LED	Red	Flashes permanently in case of fatal errors or flashes briefly in case of critical errors (see Annex Chapter 11.3, Error messages)
Forward LED	Green	Direction of movement of the measuring object is adjusted to forward or recognized <sup>2</sup> (from VLM500 bottom to lid) see also <i>Direction</i>
Backward LED	Green	Direction of movement of the measuring object is adjusted to forward or recognized <sup>2</sup> (from lid to VLM500 bottom) see also <i>Direction</i>

### Signal LED

In case of moving measurement objects and sufficient signal quality, the LED lights green. It lights yellow if a signal is available but the minimum velocity is not reached. If non condition is met the LED lights red. A red signal LED may have different reasons:

1. No measuring object available, Measuring object outside the working range of the VLM500,
2. Measurement object does not move or is outside the velocity range,
3. Measurement object does not have sufficient structure,
4. Measuring object too bright - Sensor is permanently overdriven, see page 67, The command *TestMeasure*,
5. Windows dirty (see chapter 8, Maintenance),
6. Measurement rate too low (only with activated rate monitoring, see page 46, The command *Minrate*)
7. Velocity or measuring rate outside the permissible range (only with activated ECC function, see chapter 9.5, ECC Control).

The output 'STATUS' is switched as the signal LED. As soon as it lights green, 'STATUS' is switched on. When the signal LED is yellow, 'STATUS' is switched off.

<sup>2</sup> For option Automated Direction Recognition only

**Busy LED**

This LED lights yellow when commands are processed (see chapter 9, Programming) or during offline measurements (see chapter 9.11). The LED flashes when the standby mode is activated either by command input or by an external logic signal at the standby input.

**Error LED**

If the red Error LED lights permanently, a technical defect has occurred. If it lights briefly or permanently during operation, parameters are wrongly set or transfer errors have occurred. In all cases, the reason should be determined and removed with a PC and the command *Error* as errors with the measurement results may occur otherwise.

The Signal LED and the Busy LED lights yellow and the Error LED red during the initialization after switching on the device or after the command *Restart*.

**Forward LED**

The Forward LED lights green if the set direction of movement of the measurement object is Forward, i.e. from VLM500 bottom to lid (see page 44, The command *Direction*). In case of automated direction recognition, this LED displays that a forward movement of the measurement object was recognized. The movement direction (plus means forward) is marked by an arrow on the device.

**Backward LED**

The Backward LED lights green if the set direction of movement of the measurement object is Backwards, i.e. from VLM500 lid to bottom (see page see page 44, The command *Direction*). In case of automatic direction recognition, this LED displays that a backwards movement of the measurement object was recognized. The movement direction (minus means backwards) is marked by an arrow on the device



## 5 Assembly

The assembly is done transversally to the direction of movement of the measuring object (see drawing in the annex chapter 11.9; special versions are possible). The standard direction of movement (forward) is determined as from housing bottom to housing lid (special versions are possible). The movement direction (plus means forward) is marked by an arrow on the device.



The assembly can be made in positive and in negative direction. Only the parameter *Direction* must be set accordingly (see programming)!

It is not necessary to open the device for assembly. The VLM500 is fastened with four M6 hexagon socket bolts.

The working distance stated by the manufacturer (the distance between the lens window to material surface) and workspace must be strictly observed (see type sign at the VLM500).

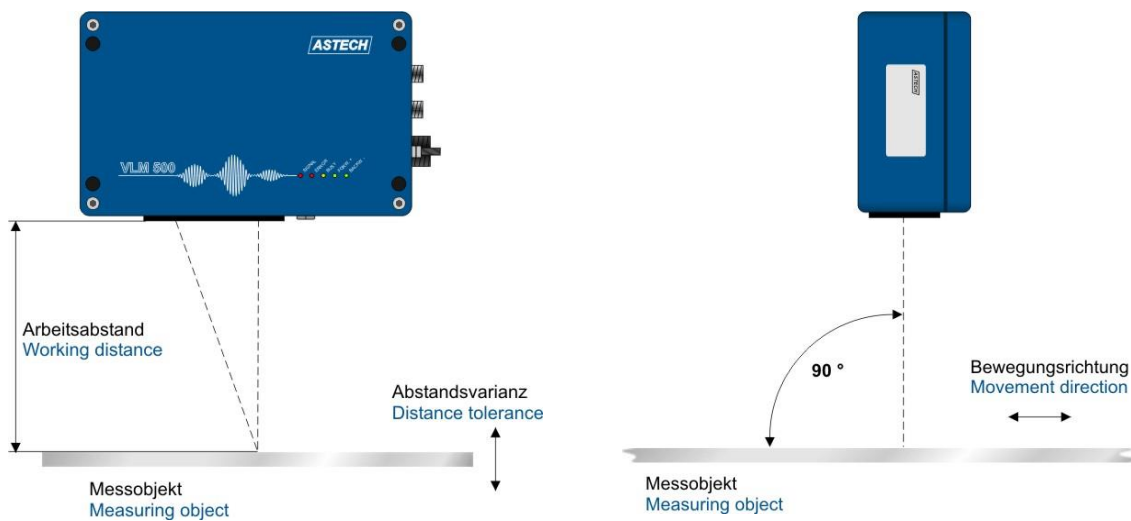
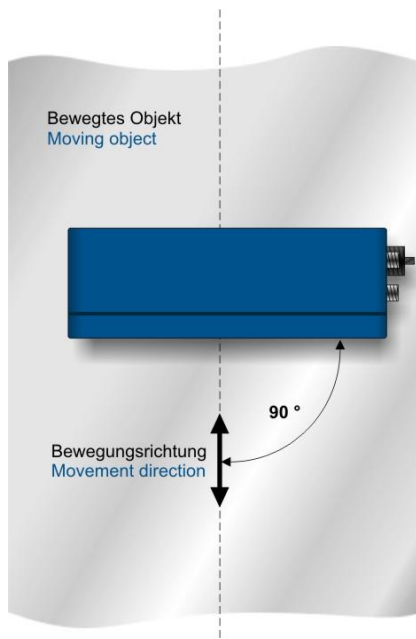


Figure 2: Working distance and alignment towards the measurement object surface

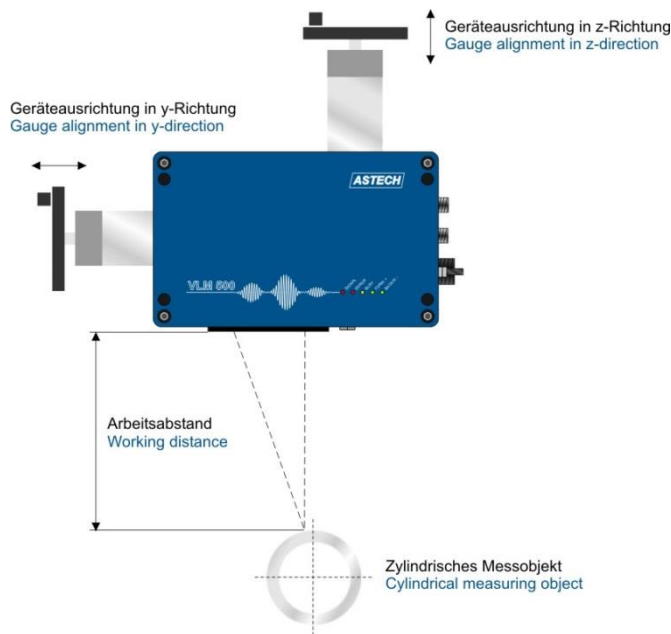


Angular orientation with maximum tolerance of  $\pm 1^\circ$

Figure 3: Alignment towards the velocity vector

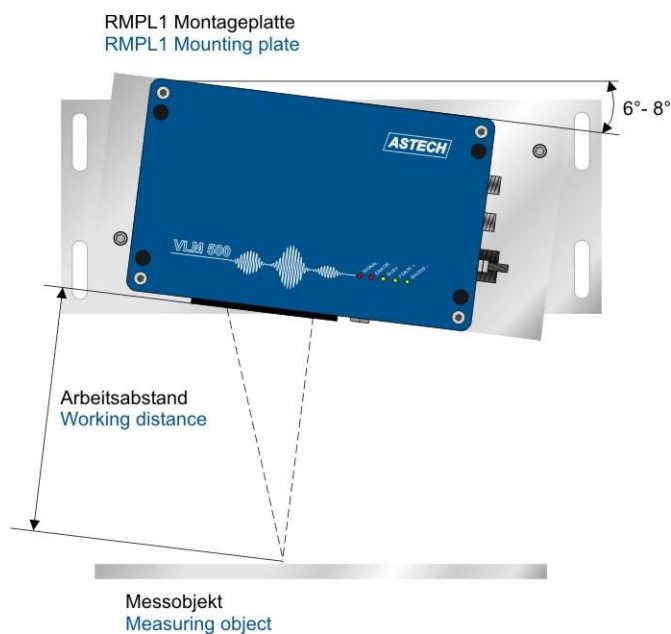


The assembly is made rectangular from the material's direction of movement with a maximum tolerance of  $\pm 1^\circ$ . If the alignment is not made with the stated tolerance, measuring errors may occur.



Optional linear units also allow an adjustment in case of changing material distances (LJ1 for one axis) or for round surfaces as e.g. pipes, wires and profiles (LJ2 for two axes).

Figure 4: VLM500 with linear unit LJ2



A tilt around the velocity sector is possible if the mounting plate RPL1 is used. No vectorial measurement error occurs from this. The tilt is needed for measurements on highly-reflective materials and some plastic surfaces.

Figure 5: VLM500 with mounting plate RMPL1

An optimization of the alignment in case of reflecting or convex surfaces makes sense after the current supply, the programming cable and a PC were connected with the command *TestQuality* (see page 68, The command *TestQuality*). There should be a maximum measurement rate in the movement; or the output value during standstill should reach about 2/3 of the maximum value (reflection).

## 6 Connection

The VLM500 has screwable device connectors. A grounding screw, a connector for the programming interface, a connector for signal lines (inputs and outputs) and a current supply connector are available. Two more connectors for signal lines are optional.



Plug connectors must not be plugged in or disconnected when under voltage. All connection works must be carried out in dead-voltage state!

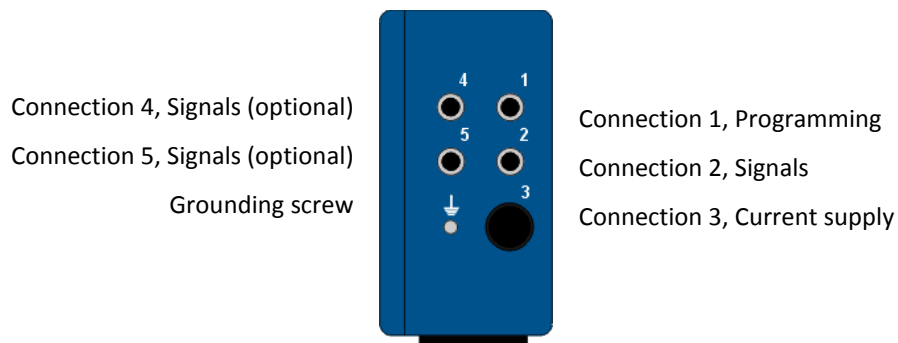


Figure 6: VLM500 Device connections

### 6.1 Current supply and grounding

The VLM500 is manufactured and delivered with a 24 V DC power supply (20 to 30 V). The supply is done via device connection 3.

All clamps in the connector plugs (except of DSUB9 at the programming cable) are screwable. The user is responsible for establishing the connection in accordance with the valid regulation.

Before the device is connected to the current supply, a connection must be established between grounding bolt and the device holder by using the enclosed grounding cable. The device holder must be earthed via a low impedance, too!



A missing or insufficient grounding of the measuring device may result into malfunctions or damages of the electronic assembly in case of overvoltages!

### 6.2 Signal lines

There is a circuit board (TERM board) with a bolt clamping field in the device. It is accessible after removing the housing lid. The device must be principally disconnected from the current supply before opening the housing. There are several options for assigning the connections. As the assignment can be changed by the manufacturer as well as by the user it must be checked before establishing the connection.

For transferring signals (device connections 1, 2, 4 and 5), shielded plugs and cables must always be used. The cable for programming (device connection 1) must be removed after successful programming. The shielding must always be grounded. Plug and cable can be purchased from the manufacturer.

The device connection 4 and 5 are optional. Not wired device connections must be protected with blind stoppers against penetration of dirt.



The wiring of the device connections 1, 2, 4 and 5 is made according to customer specification. They might (depending on the model) not be protected against permutation. A wiring diagram is enclosed to every device at the time of delivery!

The assignments of the device connections are displayed in the annex (chapter 11.6).

It must be considered that the potential differences of the input and output signals to and from the protective conductor (PE) are lower than 42 volts. It is recommended to connect the GND cable of the plant voltage via a potential equalization with the ground or the PE conductor.



The protective circuits integrated on the connection and interface cards respond to voltage differences > 42 Volt between the signals or towards the protective circuit. The discharging of overvoltage can result into an activation of the protective circuit and, thus, into a short-term dropout of the relevant signal!

### 6.3 USB Interface

The VLM500 can be parameterized via a computer with the aid of the galvanically isolated USB interface. Furthermore, the interface can be used for data recording.

The signals '5V', 'D-', 'D+' and 'GND' are used. The USB interface is an internal RS-232 interface (virtual COM port) which is transferred to USB with a chip manufactured by the company FTDI.

### 6.4 RS-232 Interface

The RS-232-interface (galvanically isolated) serves for parameterizing and data recording via computer at the VLM500. The RS-232-interface as COM port is integrated at computers or can be refitted via an external USB/RS-232 converter.

Due to the galvanic isolation, the RS-232 interface is also suitable for industrial environments.

The interface allows full duplex operation, i.e. the participant can send and receive data from other participants at the same time.

Only the signals TxD, RxD and GND are used. The data transmission is controlled via the XON/XOFF protocol (software handshake), i.e. if the receiver is not ready to receive it sends the signal XOFF to the sender that, thereupon, interrupts the sending. As soon as the receiver is ready again, it sends the XON signal. Thereupon, the sender continues the transmission.

Physical transmission parameters RS-232

Maximum wire length	15 m (30 m with low-capacity special cable)
Maximum sending level	±15 V
Minimum sending level	±5 V
Minimum reception level	±3 V
Load resistance	3 to 7 kOhm
Load capacity	≥ 2500 pF

## 6.5 RS-422 Interface

The RS-422 interface serves for serial data transmission over larger distances. At the VLM500, the RS-422 interface is used for programming and transmitting measuring values. Furthermore, it might be useful to change the programming interface (RS-232) for RS-422 to bridge distances.

The interface enables full duplex operation, i.e. a participant can send and receive data from a second participant at the same time.

Ten RS-422 recipients maximum can be connected to a sender. The serial data are transferred as voltage difference between the two wires of a cable.

Physical transmission parameter RS-422:

Maximum wire length	1200 m depending on cable and transmission rate
Maximum sending level	$\pm 5$ V
Minimum sending level	$\pm 2$ V
Minimum reception level	$\pm 200$ mV
Load resistance	1x 120 Ohm at the end of the wire (recipient termination)

Pulses can also be transferred via a RS-422 interface. This is possible because the standard determines level, impedances etc. only, but not the type of data. The interface card IP5V for instance, provides pulse output channels with two phases each according to RS-422 standard with a maximum sending level of  $\pm 5$  V.

## 6.6 RS-485 Interface

The RS-485 interface serves for serial data transmission over longer distances. The interface allows only half duplex operation, i.e. only one participant each can send. 32 participants maximum can be connected. The serial data are transferred as voltage difference between the two wires of a cable.

Physical transfer parameter RS-485:

Maximum wire length	1200 m depending on cable and transmission rate
Maximum sending level	$\pm 5$ V
Minimum sending level	$\pm 1,5$ V
Minimum reception level	$\pm 200$ mV
Load resistance RS-485	120 Ohm each on both ends of the wire (termination) and a „receiver-open-circuit-fail-save“ circuit

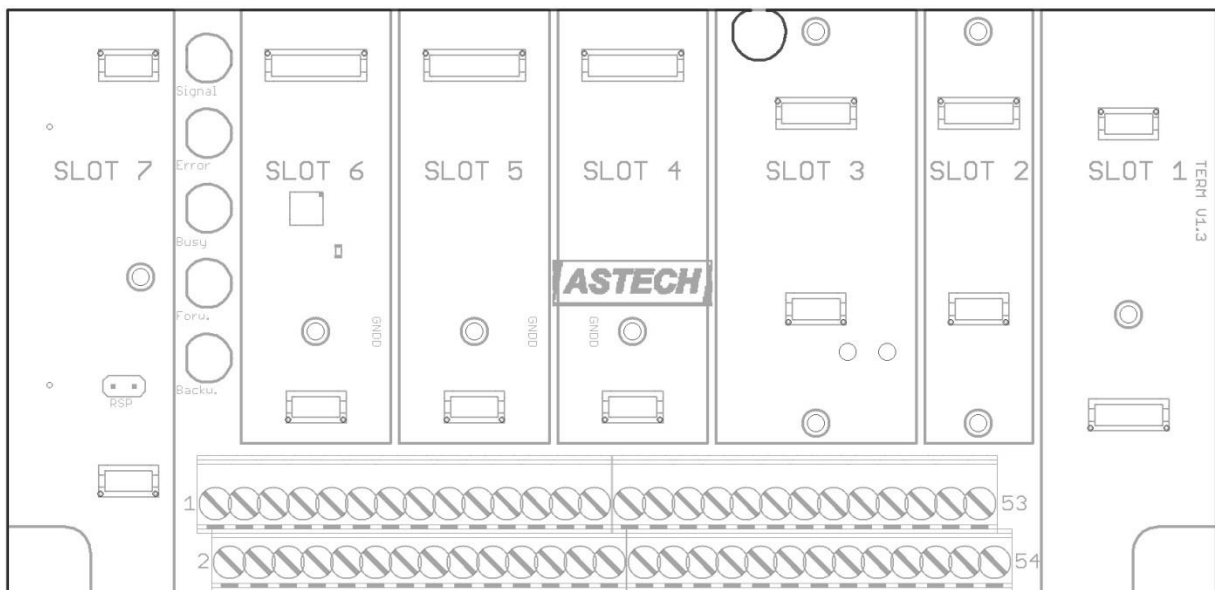
At the VLM500, the S2 interface can be operated as RS-485 (half duplex operation). The half-duplex operation must be obligatory be set via the parameter H in the command *SO2Interface* (see page 61, The command *SO1Interface*). If several participants shall send, the addressing must be used (see page 59, The command *SO1Address*).

## 7 Interface cards

The VLM500 can, if necessary, be provided with different interface cards that are plugged on the TERM Board. There are seven slots (slot 1 to slot 7) in total available for different interface cards. A screw terminal block with 54 connections (see Figure 7) is located on the TERM Board. According to which cards are used, the connections have different meaning.

Slot 2 is dedicated to the 1<sup>st</sup> serial interface of the VLM. The 2<sup>nd</sup> serial interface of the VLM is assigned to slot 3. The VLM500 can be provided with three pulse outputs. The following connections apply here:

1. Pulse output: Slot 4 (Determination of the outputs: OUT1, OUT2)
2. Pulse output: Slot 5 (Determination of the outputs: OUT3, OUT4)
3. Pulse output: Slot 6 (Determination of the outputs: OUT5, OUT6).



**Figure 7: TERM board**

In addition to the connections that connect an interface card with a flange cable, there are connections that are bridged to the screw terminal block. This enables the distribution of a signal (e.g. ext. voltage for the pulse outputs) to several connections. The following pins are bridged: 53 and 54, 24 and 25, 16 and 17 and also 8 and 9.

Pins 1, 3 and 5 carry 24 V potential with the concerning ground on pins 2 and 4. It has to do with the same potential with which the VLM is supplied externally. This voltage can be used, for example, to supply the OpenCollector connections.

The interface cards are described in the following sections. It is depicted in one table each which slot the card can be used in and which dedicated connection of the screw terminal block is used.

## 7.1 I232 – Interface RS-232

The interface card I232 provides a serial interface according to RS-232 standard. It is used for programming the device and can also be used for data transmission. The optically isolated connections 'RxD', 'TxD' and 'GND' are available. An I232 card can be inserted in the slot 2 or 3. Up to two of these interface cards can be used.

**Table 3: I232**

Signal	Connection	
	Slot 2	Slot 3
RxD	41	37
TxD	40	36
GND	38	34

The setting of baud rate, protocol type and parity is made through the command *SO1Interface* or *SO2Interface*. The format is preset to 8 data bits and 1 stop bit. The standard parameters are 9600 bauds, no parity and XON/XOFF Protocol.

## 7.2 I4U4 – Interface RS-422, RS-485, 4-wire cable

The interface card I4U4 provides a serial 4-wire interface according to RS-422 or RS-485 standard. It is used for programming the device and can also be used for data transmission. The optically isolated connections 'R+/A', 'R-/B', 'T+/Y' and 'T-/Z' are available. An I4U4 card can be inserted in slot 2 or 3. Up to two of these interface cards can be used.

**Table 4: I4U4**

Signal	Connection	
	Slot 2	Slot 3
R+/A	41	37
R-/B	40	36
T+/Y	39	35
T-/Z	38	34

Settings of baud rate, protocol type and parity are set by the command *SO1Interface* or *SO2Interface* like in I232.

## 7.3 I4U2 – Interface RS-485, 2-wire cable

The interface card I4U2 provides a serial 2-wire interface according to the RS-485 standard. It is used for data transmission to e.g. counters. The optically isolated connections 'R+/T+/A' and 'R-/T-/B' are available. An I4U2 card can be inserted in slot 2 or 3. One of this interface cards can be used.

**Table 5: I4U2**

Signal	Connection	
	Slot 2	Slot 3
R+/T+/A	41	37
R-/T-/B	40	36

The settings of baud rate, protocol type and parity are set by the command *SO1Interface* or *SO2Interface*.

## 7.4 IUSB – Interface USB

The interface card IUSB provides an USB interface. It is used just like the interface cards I232, I4U2 and I4U4 for programming the device and for data transmission. Here the optically isolated connections '5V', 'D-', 'D+', 'D' and 'GND' are available. An IUSB card can be inserted in slot 2 or 3. Up to two of these interface cards can be used.

**Table 6: IUSB**

Signal	Connection	
	Slot 2	Slot 3
5V	41	37
D-	40	36
D+	39	35
GND	38	34

The interface card IUSB includes an integrated circuit (FT230X) from Future Technology Devices International (FTDI). This chip provides a virtual serial port on the connected PC. This allows a communication like a VLM500 equipped with an I232 interface board. To ensure the communication a special driver from FTDI needs to be installed. This driver is stored on the USB bar which is part of the scope of delivery.

Windows needs to be started entirely. Then the ZIP-file „IUSB\_driver\_FTDI.zip“ from the USB bar needs to be unzipped to a known folder on a hard disk drive of the PC. Now the VLM500 can be connect to the PC. First connect the one end of the cable to the VLM and after that connect the other end to the PC. Windows now should detect a new hardware component. In the manual installation of the driver the folder to where the ZIP-file was extracted before needs to be entered. After the installation the entry „USB Serial Converter“ can be found in the device-manager of Windows. After that Windows detects another hardware component named “USB Serial Port”. Again the path of the ZIP-File content needs to be entered in the manual installation. After the complete installation a new COM-port is visible in the device-manager of Windows. This one needs to be selected when the software VLMTTool or another terminal program is used.

Note: For the installation of the driver the VLM500 does not need to be switched on. The FT230X is USB-powered and allows the installation of the driver.



If the VLMTTool is installed, the user is asked to install the IUSB-driver as well. Those users having an IUSB-board, we recommended you to install the driver at this point. Keep in mind to connect the VLM to the PC after the installation of the driver package. This prevents from driver error issues.

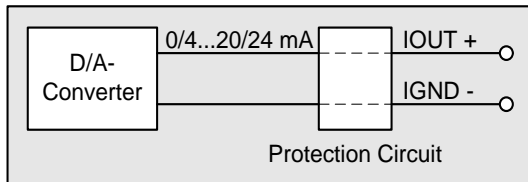
## 7.5 IAUN – Interface Analog Output

The IAUN interface card provides an optically isolated analog output (current interface) with 16 bit resolution. There are three designs (see Table 7).

**Table 7: Output ranges of the analog outputs**

Interface card	Output range
IA00	0 mA to 20 mA
IA04	4 mA to 20 mA
IA40	0 mA to 24 mA





**Figure 8: Output circuit of the IAUN card**

One IAUN card can be inserted into slot 7.

**Table 8: IAUN**

Signal	Connection
	Slot 7
0...20 / 4 ... 20 / 0 ... 24 mA	7
GND	6

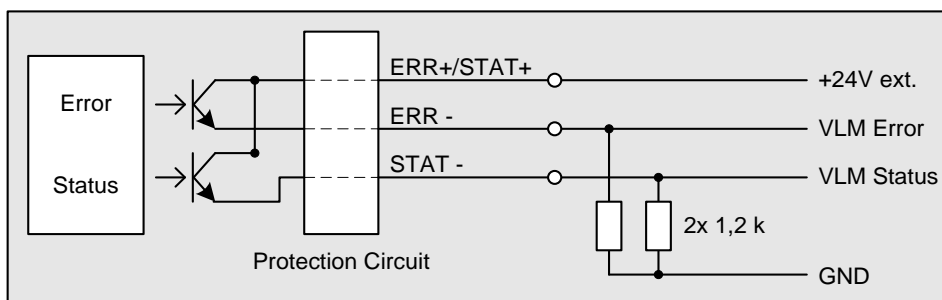
## 7.6 IOPL – Interface Input-Output Positive Logic

The expansion card IOPL provides the inputs and outputs (Trigger 1, Standby, Direction, Status, Error) of VLM. The connections are isolated galvanically (optocoupler) from VLM500. The standby input can be used as well as a trigger input (Trigger 2). Therefore the parameter SELTRIGGER needs to be activated.

### Outputs

The outputs are implemented as transistor outputs with a common collector terminal. The plus connection is generally used with an external voltage supply of 10 V to 30 V. On a negative connection (e.g. ERR-) a load to 0 volt of the external power supply is connected.

The output transistors can drive a max. current of 30 mA each. If an external voltage of 24 V is used and should a load current of 20 mA flow, then a load resistance of 1.2 kOhm is set. The load can also be an optocoupler from the side of the user.



**Figure 9: Connection example for the IOPL card outputs**

### Inputs

Generally: An input current of -40 mA to +0.3 mA or an input voltage < +2 V correspond to a LOW level and a current of +5 mA to +40 mA or a voltage of > +10 V correspond to a HIGH level.

The input for the direction signal Direction can be HIGH- or LOW active. The programming takes place over the command *Direction* (see Page 45, The command Direction).

The input for the standby signal is HIGH active.

The trigger input 'TRI1' serves to control the length calculation. It is programmed through the parameter *Trigger* (see Page 52, The command Trigger) (HIGH- or LOW level or edge) and realizes the Start or Stop of the

device internal length integration. Furthermore the output channels can be synchronized to the Trigger (e.g. Parameter *SO1SYNC 1* switches the data output of the serial interface S1 on Trigger synchronous).

### Using the Standby input as a second trigger input (TRI2)

A second light barrier can be connected to Trigger input 'TRI2'. Thereby a length measurement over two light barriers is possible. The light barrier connected to TRI1 functions fixedly as START light barrier, the one on TRI2, on the other hand, fixedly as STOP light barrier. This function is activated over the parameter *Trigger* (see Page 50, The command *Trigger*).



The maximum input frequency must not be exceeded with TRI1, TRI2 and DIR 500 Hz. The duty cycle must hereby be 1:1. The input signal must be absolutely bounce-free. The use of relay contacts is not allowed!

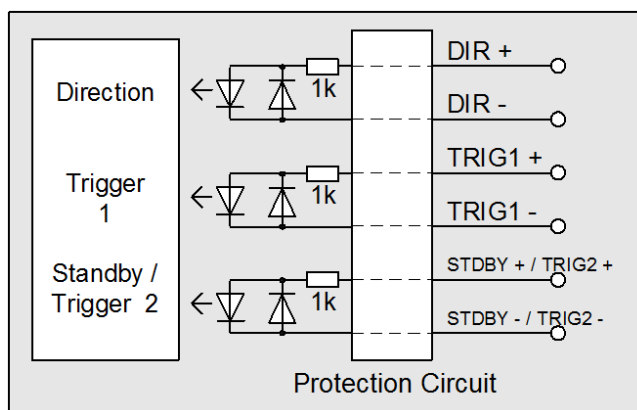


Figure 10: Circuitry of the IOPL card inputs

One IOPL card can be inserted into Slot 1.

Table 9: IOPL

Signal	Connection
	<b>Slot 1</b>
DIR+	52
DIR-	51
TRI1+	50
TRI1-	49
STANDBY+/TRI2+	48
STANDBY-/TRI2-	47
ERR+/STAT+	46
ERR-	45
STAT-	44

## 7.7 IPPL – Interface Pulse Output Positive Logic

The expansion card IPPL provides a high-resolution pulse output with two phases in a frequency range of 0.2 Hz to 25 kHz. The resolution and the maximum error are 8 ns each. A cable with a maximum length of 50 m can be connected to this connection.

The two outputs are isolated galvanically by optocouplers. The output is scalable. A 90° out-of-phase clock is provided. The transistors of the octocouplers can drive a max. current of 30 mA each. The manufacturer recommends a current of about 20 mA. With an external applied voltage of 24 volt the load resistances should be 1.2 kOhm each, in order to reach a load current of 20 mA. The load can also be an optocoupler. The outputs are protected against short circuit and overvoltage.

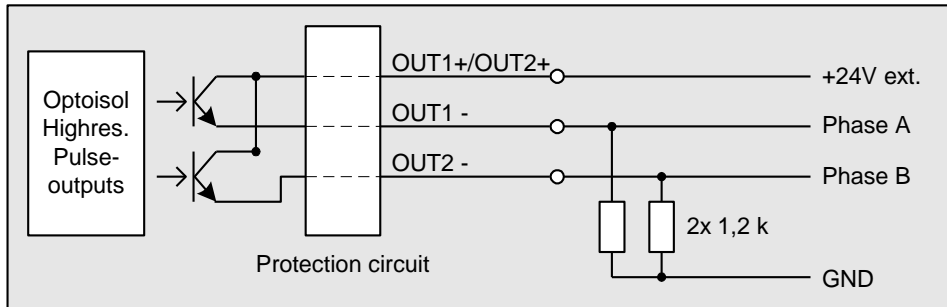


Figure 11: Connection example for the IPPL pulse card in slot 4

An IPPL card can be plugged up to three times in the VLM in the slots 4, 5 and 6.

Table 10: IPPL

Signal	Connection		
	Slot 4	Slot 5	Slot 6
Phase 1 +	31 (OUT1+)	23 (OUT3+)	15 (OUT5+)
Phase 1 -	30 (OUT1-)	22 (OUT3-)	14 (OUT5-)
Phase 2 +	29 (OUT2+)	21 (OUT4+)	13 (OUT6+)
Phase 2 -	28 (OUT2-)	20 (OUT4-)	12 (OUT6-)

## 7.8 IPPU – Interface Input-Output Push Pull Universal

The expansion card IPPU provides a high-resolution pulse output with two phases (90° phase shift) in a frequency range of 0.2 Hz to 4 MHz. The resolution and the maximum error are 8 ns each. The output resistance is 200 Ohm. The maximum output current is  $\pm 100$  mA per channel. The outputs are provided with a switch-off fuse in case of a thermal overload (e.g. due to excessive current). The outputs are isolated galvanically by optocouplers, but possess the same ground potential. The maximum cable length in asymmetrical operation (ground potential O-GND) is 200 m or 500 m in output frequencies below 50 kHz.

There are two variants of these interface cards.

## IP5V

The outputs are executed as 5 V driver stages. No external power supply is required. An IP5V card can be plugged up to three times in the VLM in the slots 4, 5 and 6.

**Table 11: IP5V**

Signal	Connection		
	Slot 4	Slot 5	Slot 6
Phase 1	31 (OUT1)	23 (OUT3)	15 (OUT5)
Phase 1 negated	30 (/OUT1)	22 (/OUT3)	14 (/OUT5)
Phase 2	29 (OUT2)	21 (OUT4)	13 (OUT6)
Phase 2 negated	28 (/OUT2)	20 (/OUT4)	12 (/OUT6)
O-GND	26	18	10

The cards can drive RS-422 outputs with a 100 Ohm terminating resistor. Thus, the pickup occurs symmetrically between OUTx and /OUTx. The connection O-GND is not connected. In using pair-twisted and shielded cable (e.g. CAT5), the maximum cable length for the RS-422 is 500 m.

## IPPP

The driver stages of the outputs are provided with an additional voltage ( $V_{ext}$ ) between +12V and +30V that also determine the voltage level of the pulse. This auxiliary voltage is fed externally over a cable and is connected by connection flange with the screw terminal strip. Alternatively, the VLM supply voltage (24V) can be used. In this case, a cable bridge must be put on the screw terminal strip. An IPPP card can be plugged up to three times in the VLM in the slots 4, 5 and 6.

**Table 12: IPPP**

Signal	Connection		
	Slot 4	Slot 5	Slot 6
Phase 1	31 (OUT1)	23 (OUT3)	15 (OUT5)
Phase 1 negated	30 (/OUT1)	22 (/OUT3)	14 (/OUT5)
Phase 2	29 (OUT2)	21 (OUT4)	13 (OUT6)
Phase 2 negated	28 (/OUT2)	20 (/OUT4)	12 (/OUT6)
$V_{ext}$	27	19	11
O-GND	26	18	10



The outputs of the expansion card IPPU are protected against ESD. Do not connect an external voltage to the input. This will destroy the according input. Voltages > +30V on  $V_{ext}$  (IPPP) are prohibited.

## 7.9 IFPB – Interface Fieldbus Profibus

The interface card IFPB enables the connection of the measuring devices of the VLM Series to a Profibus-DP Master. The card supports bus rates of up to 12 MBaud (auto-detect). The slave address is set over the bus (e.g. Siemens PG or any master with SET\_SLAVE\_ADD\_REQ). The last device on the bus is provided with a terminal resistance. The connection takes place over two standardized circular connectors M12 B coding (IEC 60947-5-2, e.g. company binder). A connector and a terminating resistor can be ordered separately. The parameter setting of the measuring device VLM takes place over an I232 or IUSB Interface (connection 1). The VLM parameter to be adjusted can be taken from Table 13.

Dependent of the selected Profibus mode the device outputs the velocity, the measuring rate the length, the error codes and temperature as well as the illumination and the exposure to the Profibus Master. The VLM error number provided as well to the Profibus user diagnosis. Furthermore a status byte indicates the state of the physical ERROR and STATUS outputs and the direction of the object being measured.

With the Control byte (Profibus OUT) several events (Trigger, Standby) can be programmed.



The output of the velocity is always unsigned! The information about the direction is stored in the status byte (Device status).

### Configuration

The interface card IFPB is configured as DP standard slave. The IFPB determines, by means of the amount of the Profibus input bytes, which mode is used by the first parameter setting after turning on the VLM. The modes 1 to 6 output binary data on the Profibus. The cyclic communication between master and slave is only established, when the available modes (see Table 13) correspond with the modes in the master. Hence the correct GSD-File needs to be loaded into the master repository. The interface card behaves as a DP standard slave. The data are read consistently as block from the master (e.g. Siemens S7: SFC 14 "DPRD\_DAT", read consistent data, out a DP standard slave).



It is important to note that the parameter setting of VLM corresponds with the used mode (see Table).

### User diagnosis

The VLM error numbers are output as a 2 byte user diagnosis (length and error code, meaning see manual of error codes). In case of errors in the assembly IFPB, 4 byte diagnosis is returned (lengths, error codes of VLM, error codes of IFPB and system error codes of IFPB).



Due to compatibility reasons to older Profibus-Versions of the IFPB-interface, the error code is still provided in the Profibus user diagnosis.

**Table 13: Available Profibus modes in the VLM500**

Mode	Profibus IN (IFPB Output)	VLM Parameter SO2FORMAT	VLM Parameter SO2TIME <sup>2)</sup>	Profibus Configuratio n	Profibus Configuratio n bytes
<b>M1</b>	16 Bit counter, 32 Bit velocity, 16 Bit measuring rate <sup>1)</sup>	Z	≥ 12 ms	8 Byte IN, 1 Byte OUT	151 32 (0x97 0x20)
<b>M2</b>	16 Bit counter, 32 Bit velocity, 16 Bit measuring rate, 32 Bit Integral of the velocity, 32 Bit 1 ms timer <sup>1)</sup>	Z	≥ 17 ms	16 Byte IN, 1 Byte OUT	215 32 (0xD7 0x20)
<b>M3</b>	16 Bit counter, 32 Bit velocity, 16 Bit measuring rate, 8 Bit Illumination, 8 Bit Exposure <sup>1)</sup>	Z I:H:2 E:H:2	≥ 17 ms	10 Byte IN, 1 Byte OUT	153 32 (0x99 0x20)
<b>M4</b>	16 Bit counter, 32 Bit velocity, 16 Bit measuring rate, 32 Bit length <sup>1)</sup>	Z L:H	≥ 15 ms	12 Byte IN, 1 Byte OUT	155 32 (0x9B 0x20)
<b>M5</b>	16 Bit counter, 32 Bit velocity, 16 Bit measuring rate, 32 Bit length <sup>1)</sup> , 8 Bit Illumination, 8 Bit exposure	Z L:H I:H:2 E:H:2	≥ 20 ms	14 Byte IN, 1 Byte OUT	157 32 (0x9D 0x20)
<b>M6</b>	16 Bit counter, 32 Bit velocity, 16 Bit measurement rate, 32 Bit length <sup>1)</sup> 8 Bit VLM – error code 8 Bit device status 8 Bit device temperature	Z L:H U:H:2 H:H:2	≥ 20 ms	15 Byte IN, 1 Byte OUT	158 32 (0x9E 0x20)

<sup>1)</sup> Scaling: Velocity in 0.00001 m/s; Length in 0.0001 m; Rate in 0.1%; all absolute values!

<sup>2)</sup> With every change of the Bytes Profibus OUT, additional 3 ms are needed  
Example: synchronous task (SO2SYNC 1) for every edge of TRI1 +3 ms, i.e. +6 m

### Device status

When using mode 6, one byte of the data stream contains the status of the device. The byte is as follows:

Bit 7 - 4	Bit 3	Bit 2	Bit 1	Bit 0
reserved	Sign of length	Direction (Sign of speed)	Status of output STATUS	Status of output ERROR
	0 ... positive 1 ... negative	0 ... positive 1 ... negative		

## Profibus OUT

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Enable	Restore	Restore	Clear <sup>1)</sup>	Trigger 1	Standby	Direction	Standby
Restore	Bit 1	Bit 0			Trigger 2		

Bit 0 activates standby mode of the VLM500

Bit 1 sets the direction (see The Command *Direction*)

Bit 2 activates standby mode of the VLM500 / sets the length measurement externally

Bit 3 sets the length measurement externally

Bit 4 clears the error list

Bit 5-7 controls the loading of a parameter set

<sup>1)</sup> Transition 0 to 1 deletes Error and Diagnosis data (see The Command *Error*)

### Loading of a parameter set

To load (restore) a parameter set bits 5 and 6 must be set to select the parameter number. Setting bit 7 activates the restoring process.

Example: load parameter set 2: Profibus Out: 110XXXXX (X = don't care)

Subsequent to that bit 7 needs to be reset to 0.

### Standby via Profibus

To activate the standby mode, bit 2 must be set to 1. In case the parameter Seltrigger is set to 1, bit 0 must be set 1 to activate the standby mode.

### Parameter for VLM

<i>SO2ON 1</i>	(mandatory)
<i>SO2INTERFACE 57600 N</i>	(mandatory)
<i>SO2FORMAT Z</i>	(see Table 13)
<i>SO2SYNC 0</i>	(e.g. synchronous)
<i>SO2TIME 20</i>	(see Table 13)
<i>AVERAGE 20</i>	(mostly like <i>SO2TIME</i> )

### Version information

IFPB Hardware	as of V1.1
IFPB Script	as of version 1.3
GSD-File	revision 1.2
VLM500 Firmware	as of V1.27R6

## Pin Assignment

**Table 14: Technical data of the IFPB**

Field bus ID	Settable via bus (is saved on the card)
ID-Number	0x2079 (8313)
Field bus baud rate	U to 12 MBaud (Autodetect)
Bus connection	External via pluggable termination resistor
Feld bus connection	2x circular connector M12x1 B coding IEC 60947-5-2

**Table 15: Pin assignment of the connector**

Pin	Profibus DP Out	Profibus DP In
1	+UB	-
2	A	A
3	GND	-
4	B	B

One IFPB card can be inserted into slot 3.

**Table 16: Internal assignment of IFPB**

Signal	Connection
	Slot 3
5V	37
A	36
0V	35
B	34
A	33
B	32



## 7.10 IFPN – Interface Fieldbus Profinet

The interface card IFPN connects measuring devices of the VLM500 series with Profinet networks. This allows a communication between evaluation units and the measuring device over long distances by using standardized network components.

The Current Measuring Values can be output permanently and trigger-synchronous. Furthermore, it is possible to control the trigger signals (TRI1 and TRI2), the direction signal (DIR) and Standby via Profinet.

The IFPN provides a HTML page with status information via the measuring device which can be accessed by means of the http protocol via every web browser.

### Communication

- Settings of the internal serial interface VLM500 (S2)
  - Serial interface S2 of the VLM must be set to determined parameters
  - *SO2ON 1* (mandatory)
  - *SO2INTERFACE 57600 N* (mandatory)
  - *SO2FORMAT Z L:H* (see Table 13)
  - *SO2SYNC 0* (e.g. synchronous)
  - *SO2TIME 20* (see Table 13)
  - *AVERAGE* (mostly like *SO2TIME*)
- HTTP
  - Status information via HTTP (Port 80) available via browser
  - call IP address of the VLM500 via http://
  - VLM500 responds to HTML page


<b>Sensor Page</b>		
<b>PROFINET IO Configuration</b>		
Device Name:	vlm-pn	
Vendor ID	797	
Device ID	4097	
<b>IP Configuration</b>		
IP Address:	192.168.0.52	
Subnet Mask:	255.255.255.0	
MAC Address:	00-14-11-6F-69-AC	
Gateway Address:	192.168.0.1	
Sensor Page:	V1.0	

Figure 12: Profinet HTML status page

## Configuration

The configuration of the IFPN is done via the Profinet IO Controller. Interface specific parameters such as the IP address to be used, the subnet mask, the gateway, the name or the mode can be changed.



The output of the velocity is always unsigned! When using mode 6 the direction information can be taken from the device status byte.

**Table 17: VLM500 Profinet modes**

Mode	Profinet IN (IFPN output)	VLM Parameter SO2FORMAT	VLM Parameter SO2TIME
<b>M1</b>	16 Bit counter, 32 Bit velocity, 16 Bit measurement rate <sup>1)</sup>	Z	≥ 12 ms
<b>M2</b>	16 Bit counter, 32 Bit velocity, 16 Bit measurement rate, 32 Bit Integral of the velocity, 32 Bit 1 ms timer <sup>1)</sup>	Z	≥ 17 ms
<b>M3</b>	16 Bit counter, 32 Bit velocity, 16 Bit measurement rate, 8 Bit Illumination, 8 Bit Exposure <sup>1)</sup>	Z I:H:2 E:H:2	≥ 17 ms
<b>M4</b>	16 Bit counter, 32 Bit velocity, 16 Bit measurement rate, 32 Bit length <sup>1)</sup>	Z L:H	≥ 15 ms
<b>M5</b>	16 Bit counter, 32 Bit velocity, 16 Bit measurement rate, 32 Bit length, 8 Bit Illumination, 8 Bit Exposure <sup>1)</sup>	Z L:H I:H:2 E:H:2	≥ 20 ms
<b>M6</b>	16 Bit counter, 32 Bit velocity, 16 Bit measurement rate, 32 Bit length <sup>1)</sup> 8 Bit VLM – error code 8 Bit device status 8 Bit device temperature	Z L:H U:H:2 H:H:2	≥ 20 ms

<sup>1)</sup> Scaling: Velocity in 0.00001 m/s; Length in 0.0001 m; Rate in 0.1%; all absolute values!

## Device status

When using mode 6, one byte of the data stream contains the status of the device. The byte is as follows:

Bit 7 - 4	Bit 3	Bit 2	Bit 1	Bit 0
reserved	Sign of length	Direction (Sign of speed)	Status of output STATUS	Status of output ERROR
	0 ... positive 1 ... negative	0 ... positive 1 ... negative		

## Control byte

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Enable	Restore	Restore	Clear <sup>1)</sup>	Trigger 1	Standby	Direction	Standby
Restore	Bit 1	Bit 0			Trigger 2		

Bit 0 activates standby mode of the VLM500

Bit 1 sets the direction (see The Command *Direction*)

Bit 2 activates standby mode of the VLM500 / sets the length measurement externally

Bit 3 sets the length measurement externally

Bit 4 clears the error list

Bit 5-7 controls the loading of a parameter set

<sup>1)</sup> Transition 0 to 1 deletes Error and Diagnosis data (see The Command *Error*)

## Loading of a parameter set

To load (restore) a parameter set bits 5 and 6 must be set to select the parameter number. Setting bit 7 activates the restoring process.

Example: load parameter set 2: 110XXXXX (X = don't care)

Subsequent to that bit 7 needs to be reset to 0.

## Standby via Profinet

To activate the standby mode, bit 2 must be set to 1. In case the parameter Seltrigger is set to 1, bit 0 must be set 1 to activate the standby mode.

## Connection

**Table 18: Pin assignment of the Profinet connector**

Pin	Profinet
1	T+
2	R+
3	T-
4	R-

An IFPN card can be inserted into slot 3.

**Table 19: Internal assignment of IFPN**

Signal	Connection
	Slot 3
T+	37
R-	36
T-	35
R+	34

## 7.11 IFFE – Interface Fieldbus FastEthernet

The interface card IFFastEthernet (IFFE) connects measuring devices of the VLM500 series with Ethernet networks. This enables a communication between evaluation units and the measuring device over long distances by using standardized network components.

By using the network protocol TCP/IP and telnet, the Ethernet interface can be used like the serial interface of the device as long as there is an active connection. The known command syntax is used for setting the parameters.

The current measuring values can be output permanently and trigger-synchronous. With appropriate wiring it is possible to control the trigger signals (TRI1 and TRI2) via Ethernet.

The IFFE provides, in addition to the Telnet server, a HTML page with status information via the measuring device which can be accessed by means of the http protocol via every web browser

A very helpful function when setting up and monitoring the VLM500 with Ethernet interface is the search for measuring devices that exist in the network via a determined UDP broadcast.

### Communication

- Setting up the internal serial interface VLM500 (S2)
  - Serial interface SO2 of the VLM must be adjusted to determined parameters
  - Parameter: *SO2Interface 115200 X N D*
  - For permanent data output see The Command *SO2ON*
- UDP
  - Search for devices in the network via broadcast telegram
  - Reading out device type, serial number, IP address and connection status
  - List port with VLM500 = 33300
  - Identification for ASTECH devices = 0x05
  - Response data: Type, Version, Serial number, IP address, MAC address, Connection status
- TELNET
  - Connection oriented 8Bit-ASCII communication via TCP/IP
  - Connection establishment caused by the Client
  - List port = 23
  - Command syntax as on serial interface
  - Use of conventional Telnet-Client program possible (e.g. Ethertool, Hyperterm)
  - One connection per time minimum
- HTTP
  - Status information via HTTP (Port 80) accessible via browser
  - Dial IP address of the VLM500 via http://
  - VLM500 responds to HTML page


<b>Sensor Page</b>		
Type:	VLM500A V1.06	
S/N:	0500/0010/15	
IP Address:	192.168.0.52	
Subnet Mask:	255.255.255.0	
MAC Address:	00-14-11-84-E7-7B	
Ethernet Software and Firmware:	1.0 / 1.06	
Sensor Page:	V1.1	
Make a connection to the Telnet server on port 23. Use the commands from the sensor manual or enter the configuration mode by typing a hash (#).		

Figure 13: HTML status page

## Configuration

The configuration of the IFFE is done in a separate configuration mode. Interface specific parameters as the IP address to be used or the subnet mask can be used via simple commands here. Furthermore, it is possible to protect the adjusted parameters against unauthorized access by using a password.

The mechanical connection to the housing is a circular connector M12, 4-pole, D-coded binder series 715.

Table 20: Technical data of the IFFE

<b>Network type</b>	<b>FastEthernet 10BaseT/100BaseTX</b>
Connections	Circular connector M12, 4 pole, D-coded binder series 715
Protocols	TCP/IP, Telnet, UDP, http
Functions	Auto-MDI/MDI-X, Auto-Negotiation (Full-duplex and Half-duplex)

Table 21: Pin assignment of the Ethernet connector

Pin	Ethernet
1	T+
2	R+
3	T-
4	R-

One IFFE card can be inserted into the slot 3.

Table 22: IFFE

Signal	Connection
	Slot 3
T+	37
R-	36
T-	35
R+	34

## 7.12 ILBC – Interface Light Barrier Control

The VLM500 can be connected to the light barrier controller LBC9-CA. Up to nine light barriers (1x start light barrier, 8x stop light barrier) can be connected to the LBC9-CA. Thus, very precise length measurements can be made even for longer distances. Additional information on the light barrier controller is provided in the LBC9-CA documentation.

The LBC9-CA outputs the BCD-coded number of the stop light barrier and a trigger signal. For the further process of this information, an ILBC interface card must be inserted into the VLM500. This provides 5 inputs that process the signals of the LBC9-CA. An ILBC card can be inserted either into slot 4, 5 or 6 in the VLM.

**Table 23: ILBC**

Signal	Connection		
	Slot 4	Slot 5	Slot 6
TRI	31	23	15
LBO	30	22	14
LB1	29	21	13
LB2	28	20	12
LB3	27	19	11
GND	26	18	10

The length measurement principle (in case of single item measurement) with a LBC9-CA is based on a reduced total length measurement. The required length measurement of the VLM can be reduced with the aid of the light barriers and, thus, measurement errors can be reduced. Still, this requires knowledge of the distance between the light barriers (stop light barrier to start light barrier each). These distances are programmed in the VLM with the *LBCDx* command (9.10, Commands for the light barrier controller LBC9-CA) and added to the actual (shortened) length measurement and output at the corresponding interfaces of the length value.

## 7.13 IECC – Interface Encoder Connection Control

The optional IECC interface card allows for the connection of an external shaft encoder or a second VLM500 velocity measuring device. If the actual value drops below the set velocity or measuring rate, the externally applied encoder or VLM500 pulses will be used instead of the internal calculated signals. The external pulse signal is connected according Table 24. The externally applied signal is fed through the device to a pulse interface IPPL or IPPU. Hence a pulse interface is always necessary for the IECC function. With dedicated commands the switching thresholds for velocity or measurement rate can be programmed.

An IECC-board can be inserted into the slot 4 or 5 or 6.

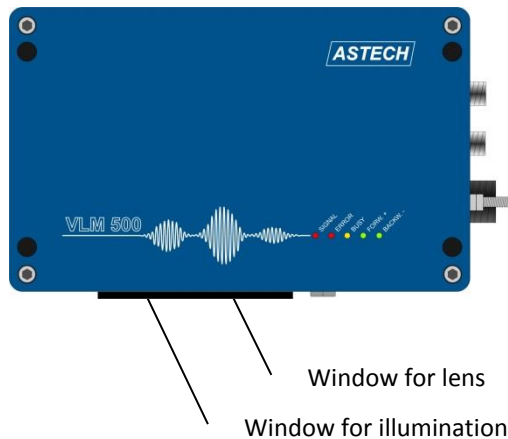
**Table 24: IECC**

Signal	Anschluss		
	Slot 4	Slot 5	Slot 6
IN1+	31	23	15
IN1-	30	22	14
IN2+	29	21	13
IN2-	28	20	12

## 8 Maintenance

### 8.1 Window

The VLM500 works optically. It is dependent on seeing the measurement object. Thus, it is necessary to check the window in regular intervals and clean it, if necessary. The cleaning should be made with a soft, lint-free cloth and customary glass cleaner.



**Figure 14: Windows of the VLM500**

Damaged windows must be exchanged. The device must be disassembled from the plant and cleaned for this. The window exchange must take place in a clean environment only. The four hexagon socket screws (wrench opening 2.0 mm) must be unfastened. The window can be lifted from the sealing with a flat screwdriver. The inner side of the window and the lenses must not be touched! The new window must be fastened with four bolts.

**Table 25: Specification for replacement window**

Device	Replacement window objective	Replacement window light
Measuring device VLM500 /h	OW4	OW3
Stainless steel window as option	OW5	OW5
All other VLM500	OW2	OW2



Use the correct replacement windows, the original sealing and the original bolts only.

The windows OW 2 and OW 3 are made of special glass with high transmission. The window OW 4 reflects infrared radiation. The windows OW 3 and OW 4 have a higher temperature resistance. The optional window OW 5 is resistant against oil, petrol and kerosene and mechanically more resistant than standard windows OW 2.

Furthermore, special plastic windows are available that, for instance, can be used in food industry fields due to their breakage safety.

If the windows must often be cleaned or wear out fast, possible safety measures must be taken (e.g. blowing device PA2 or cooling and protection housing CB5 with air generation AC5).

All article numbers are deposited in the Annex (see chapter 11.8, Article numbers).

## 8.2 Illumination

### Lamps LED

A special LED with luminous efficiency is used in the VLM500. Still, the brightness decreases with increasing operation time. The average decrease is 70 percent after 50,000 hours at 80 °C chip temperature according to manufacturer statement.

The LED is aligned and fixed on an aluminum block. The block is guided through two register pins and fastened with a hexagon socket screw (3 mm). The electrical contacting is made with two plug connectors. Thus, the exchange can be implemented quickly and easily.

### General remarks

The illumination source can be bought at the dealer or directly at the manufacturer. The article number is printed in the lid of the VLM500 housing, on the light source packaging and in the annex. See chapter 11.8, Article numbers). The information must imperatively be observed when exchanging the light source.



Light sources not yet assembled are very sensitive. We kindly ask you to handle them with extreme care. The lens must not be touched or damaged. Light sources that have not been installed yet are very sensitive!

New light sources must be stored in original manufacturer packaging only. Take the light source out of the packaging just before installation.

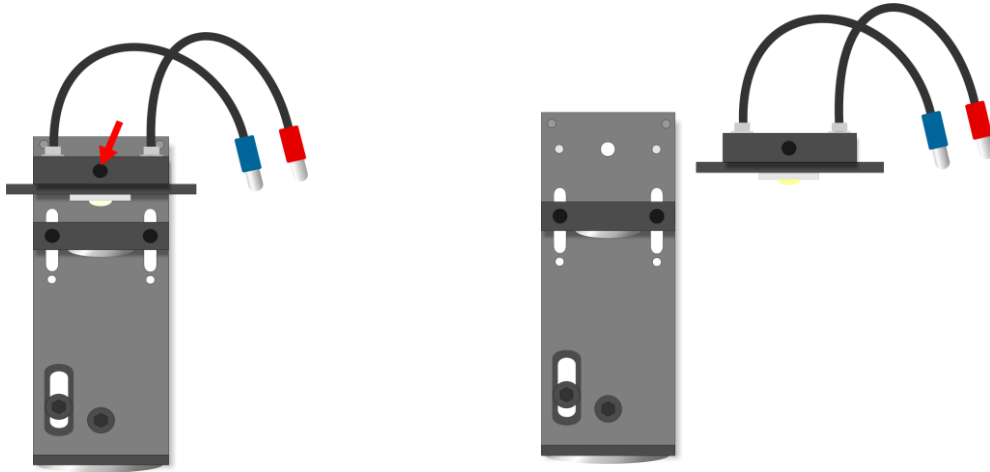


We kindly ask you to consider that no components on circuit boards are damaged when opening the lid. No dirt must get inside the device!



**Information on exchanging the LED light source**

1. The device must be cleaned outside before exchanging the light source. Under particularly adverse circumstances, the device should be taken out of the device to carry out the exchange at a cleaner place.
2. After separating the device from the current supply, the four hexagon socket screws must be unfastened and the housing lid of the VLM500 must be removed.
3. The two plug connectors and the hexagon socket screw (see arrow) must be unfastened. Afterwards, the old block can be removed.
4. The new block must be cautiously inserted, no tilting must occur! The glass of the new light source must not be touched!
5. Afterwards, the socket screw must be fastened and the plug connector must be plugged together up to stop, to ensure that the contacts are fully isolated by the protection caps. The cables must not be placed on the optical path of the illumination unit!
6. The device must be closed properly and the current supply connection must be reestablished afterwards.



Illumination unit with assembled LED and fastening bolt (arrow)

Illumination unit with disassembled LED

**Figure 15: Exchange of the light source**

## 9 Programming

### 9.1 VLMTTool

For programming the VLM500 the first programming interface is used. Therefore, said device's interface is connected to a Windows PC serial or USB port through an interface cable. Hereinafter, the first serial interface of the VLM500 is deemed in the manual for the programming. Alternately, the second serial interface can be also be used for this. This is equal with respect to the first interface and has the same range of functions; only the Firmware Update is not possible. Only commands such as *SO1On* must be matched to *SO2On*. An optional interface card with RS-232, USB or Ethernet must be installed in order to use the second interface.

Install the Program VLMTTool for Windows (for XP to Windows 10) from the USB stick included in the delivery or from the Internet: <http://astech.de/download.html>. The Program starts with 9600 bauds, no parity and with XON/XOFF Software Protocol (9600, 8N1, XON/XOFF).

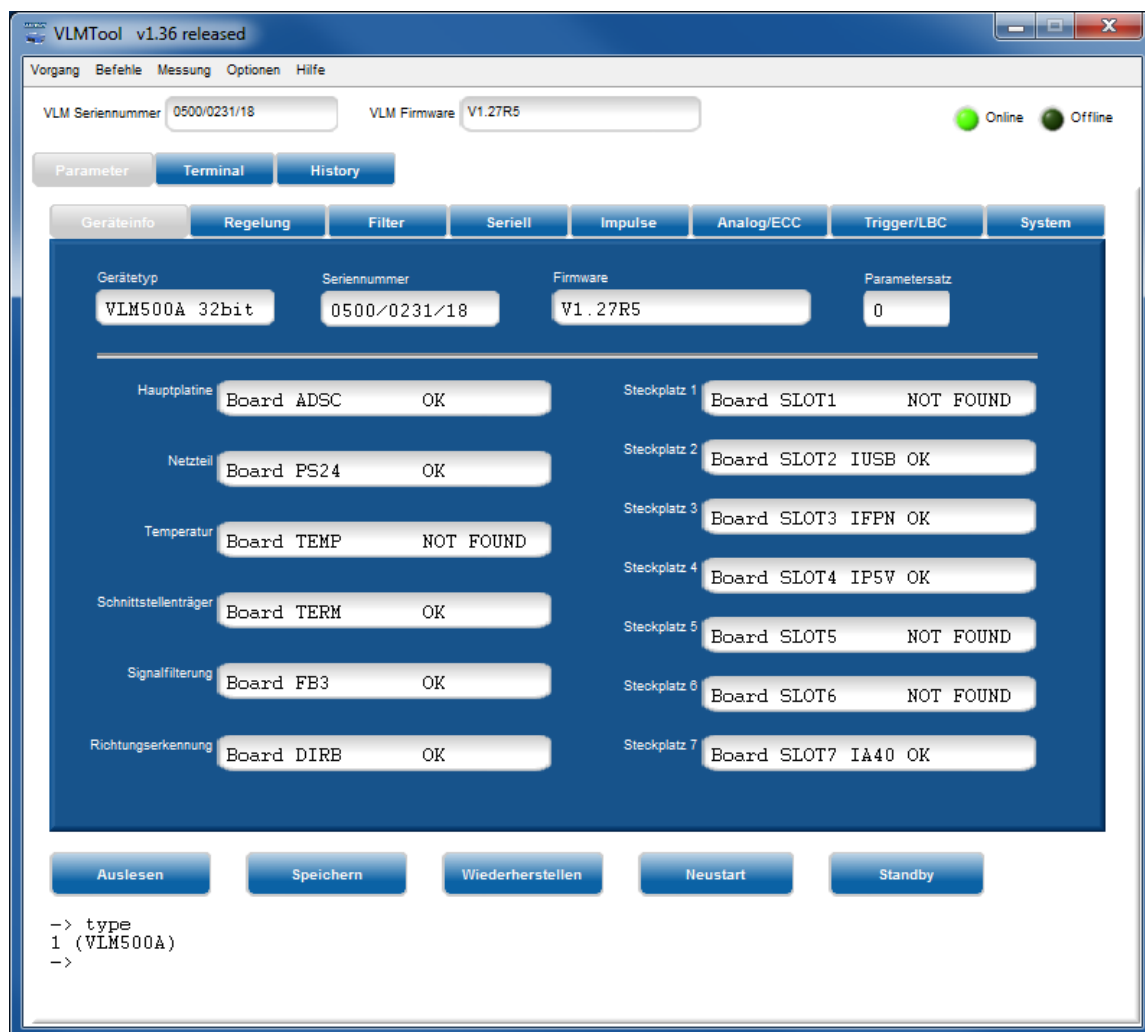


Figure 16: Program VLMTTool

If the setting of the serial interface tallies with that of the terminal program, the serial number and the Firmware version will be displayed above the program window.

The connection to the device is made and the programming can begin. The input of commands can take place through the parameter mask or through the terminal function of the VLMTTool. More information for handling the VLMTTool can be obtained from the corresponding documentation.

## 9.2 Command Input

There are many characters to enter until the syntax is clear. Characters to be entered for a command are at least printed in bold type in the following command documentation.

The VLM500 does not distinguish between lower- and uppercase characters with the commands. Parameters are separated by spaces. The decimal point is used to separate pre-decimal and decimal places. When entering commands without parameters, the current value of the parameter is displayed. All commands described here are listed again in the Annex (see chapter 11.1). The default setting specified there can already be customized ex factory where applicable.



The data transmission is stopped at the respective serial interface during the attention handling of the commands! This state is signaled by the yellow BUSY LED.

If the changed parameters are not saved with the command *Store*, they are lost when the device is turned off.

## 9.3 General Commands

### The command *Amax*

The command is used for setting the parameters for the maximum allowed acceleration with which the VLM velocities can be processed. The value is only important for the Tracking modes 5 and 6.

Syntax: ***Amax*** [f]            (f = 0.0 ... 10.0 or 0)    Unit: m/s<sup>2</sup>

### The command *Average*

The command is used for setting the averaging time for the velocity and measuring rates calculation. The internal calculation of the length is independent from the set averaging time! In the time set by *Average*, all accruing signals (bursts) are compressed to an average value. The mean value can then be output in the respective interfaces. The command without parameter returns the averaging time

The value should be chosen as large as the process dynamics allows. The usual values are 5 to 50 ms (100 to 250 ms for the VLM500L).

A too long average leads to a delayed reaction on velocity changes. With very strong velocity changes, signal failures can happen in rare cases. If the *Average* is too short, the measured value fluctuates more strongly on the contrary. Hence vibrations from the measurement object or the measuring device are visible in the signal curve.

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

Furthermore, the parameter *Window* (see page 52) offers a floating averaging up to 32 values.

**External clock:** Setting "average 0" allows an externally triggered output and calculation of the velocity values. This is useful for differential speed measurements with two VLM500. See also chapter 9.16 for more information.

## The command *Calfactor*

With this command it is possible to enter a calibration factor manually or display it. The value of the calibration factor is usually close to one. The factory setting is 1.000000. The use of the calibration factor for scaling an output channel is not permitted. Therefore, the respective parameters of the respective interfaces are used.

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

Calculation of the calibration factor from the length indicated by VLM500 or velocity and the actual values:

$$\text{NewCalibrationFactor} = \text{OldCalibrationFaktor} * \frac{\text{ActualValue}}{\text{DisplayedValue}}$$

## The command *Clock*

The time of the real-time clock is indicated and set with *Clock*. The input of the seconds is optional here. *Clock* without parameter returns the time in format hh:mm:ss.

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

## The command *Controlhold*

The command allows the freezing of the control loops for adjustment to the brightness of the material surface dependent on the trigger state (see page 50, The command *Trigger*). There are different application fields:

### Example of single part measurement

The control loops for the time are locked with *Controlhold 1* in which no part is located in the measuring window (*Trigger* inactive), that is, the valid values for exposure time and lighting brightness at the end of a part are held until the beginning of the next part. If the individual parts have different colors or surface properties, then *Controlhold* should be switched off.

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

## The command *Date*

The date of the real-time clock is displayed and set with *Date*. *Date* without parameters returns the date in format dd.mm.yy.

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

## The command *Direction*

The source for the direction switching is set with this command. If the movement direction of the measuring object and the direction specified in *Direction Plus (+)* in the device by an arrow coincide, thus it is defined as forward. *Direction* is not allowed in devices without the optional direction recognition!



Faulty measurements occur in incorrectly adjusted direction. The error can increase with increasing velocity!

Syntax: **Direction** [n] (n = 0 ... 3, a)

**Table 26: Direction setting**

n	Meaning
0	Forward
1	Backwards
2	External to 'DIR' -40 to 0,3 mA: Forward +5 to +40 mA: Backwards
3	External to 'DIR' -40 to 0,3 mA: Backwards +5 to +40 mA: Forward
a	Automatically, double lattice constant (only devices with direction recognition, optional)

### The command *Error*

The last five error codes that occurred are displayed with the command (see Chapter 11.3, Error messages). The code 'E00 No ERROR' means that no errors have occurred. Critical errors are removed from the list after invoking the command. On the contrary, fatal errors at 'E40' are saved because the device must be repaired or the user's intervention is required.

Syntax: *Error*

### The command *Errorlevel*

The command changes the switching performance of the error output 'ERROR'.

Syntax: *Errorlevel* [n] (0, 1)

0 = 'ERROR' active (interconnected) if the device is OK, passive (open) during fatal errors

1 = 'ERROR' active during fatal errors, passive if the device is OK

If the VLM500 is switched off, the output 'ERROR' is always passive (open).

### The command *Fmax*

This command returns the maximum allowed measuring frequency of VLM500. The value serves only the information and is calculated from *Vmax* and other parameters.

Syntax: *Fmax*

### The command *Help*

A help text is displayed through the command in which the commands are listed and briefly commented. The output appears page by page and can be cancelled with 'Escape' (ESC). The output is resumed with any other key.

Syntax: *Help* or ?

### The command *Holdtime*

If a signal failure occurs during a measuring process, a duration can be specified with this command in which the last recorded velocity value is kept on the corresponding interface. If the signal turns out longer than *Holdtime*, then null is returned. A second optional parameter of this command allows giving a reaction time [n2]. In using the reaction time, 'STATUS' turns on already according to *Holdtime* shortened by the reaction



The use of *Mode 1* can be useful in order to match the optical resolution of the device to the surface structure of the measuring object. Thus a higher signal rate can be achieved with rough structures (e.g. rough steel, timber, paper). At higher velocities they are absolutely necessary in part.

Syntax: **Mode** [n] (n = 0 - single grid, 1 - double grid)

### The command *Number*

The object counter is used in measuring individual parts for counting parts.

When entering a parameter, the object counter is set to the value n. Without addition, the current count is returned. Switching off the device sets the counter to zero. Every trigger event increases the object counter by one (see Page 48, The command *Trigger*).

Syntax: **Number** [n] (0 ... 65535)

### The command *Parameter*

The command lists the current setting of all parameters. Only the general parameters are displayed with the parameter 'C'.

Syntax: **Parameter** [c]

### The command *Post*

The command *Post* (power-on-self-test) starts a self-test of the device and shows the found modules. The basic boards are always listed. They are represented as 'Board xxxxx NOT FOUND' in case of an error. Optional equipping, however, is only displayed if an errorless communication with the module could be produced. *Post D* gives out an overview of all hardware options.

```
-> post
Board ADSC          OK
Board PS24          OK
Board TEMP          OK
Board TERM          OK
Board SLOT1 IO5V OK
Board SLOT2 I232 OK
Board SLOT3 IUSB OK
Board SLOT4 IP5V OK
Board SLOT5 IP5V OK
Board SLOT7 IA04 OK
```

**Figure 17: Screen text Command *Post***

Syntax: **Post** [c]

### The command *REM*

All following characters are ignored. *REM* serves for inserting command lines into parameter files that can be send to the measurement device for programming the VLM500 via the programming interface.

The same effect as *REM* is achieved by the signs ';' (Semicolon), 'S/N' and '->'. Thus it is possible to return the parameter setting read out with the command *Parameter* to the device.

Syntax: **REM** [s]

### The command *Seltrigger*

With this command the standby input can be used as a second trigger input.

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

### The command *Serialnumber*

With this this command, the serial number of the device is displayed.

Syntax: *Serialnumber*

### The command *SID*

This command displays which serial interface was used for the entry (1 for S1, 2 for S2).

Syntax: *SID*

### The command *Signalerror*

Error handling is controlled with this command in case of signal failures during an active length measurement or calibration.

If a signal failure occurs during the current length measurement, a critical error is generated when error handling is activated (see chapter 11.3, Error messages). If there is a signal failure during calibration (see page 73, The command *Calibrate*) parameter 1 returns an error and the velocity or length calibration is interrupted.

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

### The command *Start*

The effect of the command *Start* depends on the command *Trigger* (see page 50, The command *Trigger*) which defines if a single part measurement or a continuous measurement takes place. The integration of the length is started with single part measurement beginning at the length value zero. The integration of the length is stopped with continuous measurement and restarted simultaneously.

Syntax: *Start*

### The command *Stop*

The effect depends on the command *Trigger* (see page 50, The command *Trigger*). The integration of the length is only stopped with the single part measurement.

Syntax: *Stop*

### The command *Temperature*

Two temperatures are displayed in °C from inside the device. As soon as 75 °C is exceeded the Error 'E31 Over temperature detected!' is activated (see chapter 11.3, Error messages).

Syntax: *Temperature*



## The command *Terminal*

The command with parameter returns an overview of the current terminal assignment of the respective SLOT. Without parameter, the terminal assignments of all SLOTS are displayed.

Syntax: *Terminal*

## The command *Tracking*

The command *Tracking* defines the type of adjustment of the signal processing to the current velocity.

Syntax: *Tracking* [n] (n = 0 ... 6, Standard is 2)



Attention should be paid for the correct operation of the measuring device that the direction via the command *Direction* and the maximum plant velocity via the command *Vmax* are set correctly.

The standard is *Tracking 2*. **This *Tracking 2* is suitable for almost all measurement tasks** and is chosen in case of doubt. For special use please take the setting for Tracking from the Table.

**Table 27: Parameter for Tracking**

n	Meaning	Typical use
0	Broadband signal processing	<u>Special uses</u> , e.g. measurement with extremely higher acceleration.
1	the velocity at $V_{max} / 8$ takes place, up to this point broadband	<u>Continuous measuring with very high acceleration from zero</u> (measuring device accelerated very fast from zero; only for special machining line)
2	tracks the velocity at zero	<u>Single part measuring or continuous measuring but with normal or slow acceleration from zero</u> <b>Suitable for most measuring tasks</b> (Measuring object runs with velocity greater than zero one or accelerates from zero)
3	tracks the velocity at $V_{max} / 8$ , additional search function for bad signals	<u>Continuous measuring for structurally poor, non-metallic surfaces with very high acceleration from zero</u> (only for special machining line for non-metallic surfaces)
4	tracks the velocity at zero, additional search function for bad signals	<u>Continuous processes for structurally poor, non-metallic surfaces with or without start from zero</u> (Measuring object runs with velocity greater than zero one or accelerates slowly from zero; e.g. belt conveyors for plastics and coated materials, rewinder for paper or extruder)
5	Like Tracking 1. Additionally: <ul style="list-style-type: none"> <li>- tracks a dynamic adjustment of the amount of the minimum period for a valid Burst <sup>1)</sup></li> <li>- tracks an increase of the broadband if Holdtime begins to expire <sup>2)</sup></li> <li>- tracks the use of soft Epsilon values in the lower velocity range <sup>3)</sup></li> </ul>	<u>Continuous measurement with extremely high accelerations and delays</u> (measuring device accelerated very fast from zero; only for special machining line)
6	Like Tracking 2. Additionally:	<u>Single part measurement or continuous measurement</u>

n	Meaning	Typical use
-	tracks a dynamic adjustment of the amount of the minimum period for a valid Burst <sup>1)</sup>	<u>with extreme accelerations and delays</u> (only for special machining lines)
-	tracks an increase of the broadband if Holdtime begins to expire <sup>2)</sup>	
-	tracks the use of soft Epsilon values in the lower velocity range <sup>3)</sup>	

<sup>1)</sup> this measure is used if the parameter *Permin* (see page 76) is set accordingly

<sup>2)</sup> this measure is used if the parameter *AMAX* (see page 43) is set

<sup>3)</sup> this measure is used if the parameter *Epsilon* (see page 74) is set accordingly

### The command *Trigger*

The command *Trigger* is used for specifying the type of trigger signals together with a length measurement. The object counter increases by one (see page 47, The command *Number*) in every trigger event.

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

**Table 28: Trigger type**

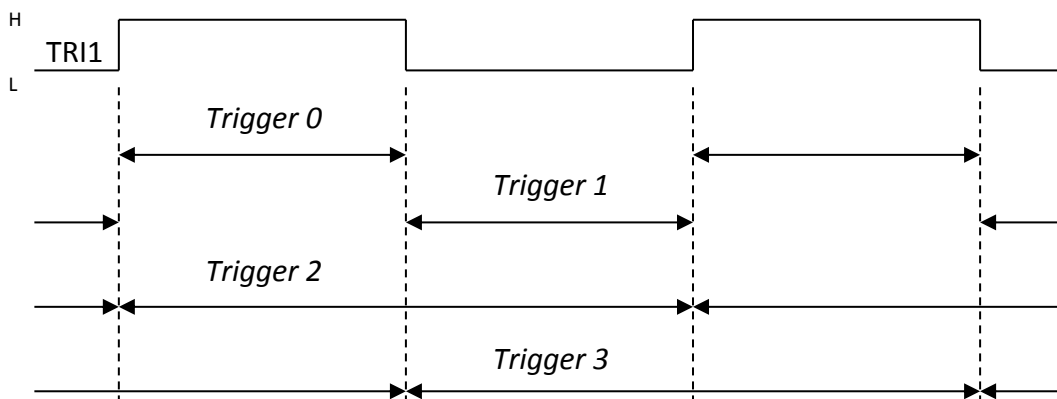
n	Trigger event at	Current level at Input	Use
0	H Level	high: +5 to +40 mA:	single part measuring
1	L Level	low: -40 to +0,3 mA	single part measuring
2	L/H Edge	low/high edge	continuous measuring
3	H/L Edge	high/low edge	continuous measuring
4	AND Function	high: +5 to +40 mA:	single part measuring with 2 light barriers
5	AND Function, inverted level	low: -40 to +0,3 mA	single part measuring with 2 light barriers

Single part:

If the signal changes to the active level, the length measuring is started and stopped in the next level change.

Continuous measuring:

It is measured continuously. A trigger edge stops the measuring and triggers the next measuring simultaneously.

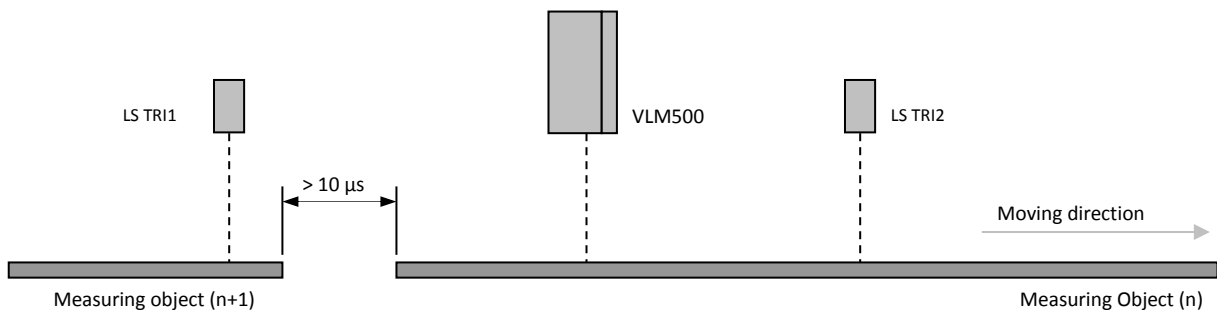


**Figure 18 : Active length measurement or active trigger signal depending on the command *Trigger***

The concerned output channel is updated simultaneously with a stop of the length measurement by trigger synchronous (see commands *AOSync*, *PO1Sync*, *PO2Sync*, *PO3Sync*, *SO1Sync* and *SO2Sync*).

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

The integrated light barrier controller function generates a trigger signal by the combination of two light barrier signals (LS) for controlling the length measurement of individual objects. An interference-free function is guaranteed by the logical connection of level and edge detection. The measuring objects must be greater than the light barrier distance and always move from Stop (LS TRI1) to Start (LS TRI2) light barriers. The VLM500 must be placed between both light barriers. The distance of both light barriers to one another is also added to the measured length value (see page 59, The command *SO1Format*).



**Figure 19 : Single part measurement with VLM500 and two light barriers**

Table 29 shows the complete state overview for the trigger setting 4. Should *Trigger* be set to 5, then all levels of this Table have to be inverted.

**Table 29: Logical state diagram of light barrier controller in Trigger 4**

State	Stop LS (TRI1)*	Start LS (TRI2)*	Prerequisite	Action
1	L	L	-	-
2	L → H	L	-	-
3	H	L	-	-
4	H	L → H	State 3	Start of length measurement
5	H	H	State 4	Length measurement running
6	H → L	H	State 5	Stop of length measurement
7	L	H	-	-
8	L → H	H	-	-
9	H	H	-	-
10	H	H → L	-	-
11	L	H → L	-	-

L = low: -40 to +0.3 mA

H = high: +5 to +40 mA

**Programming of the distance of the light barriers**

The distance of the two light barriers must be known. The distance is programmed with the command *SO1Format*. When the length value is outputted via a communication interface the distance is added automatically.

Example 1: To add a distance of 1.53m to the length value the user needs to program SO1Format I+1.53. Where "I" stands for the length value.

Example 2: To add a distance of 2.31m to a Hex-coded output (e.g. Profinet on S2): SO2Format I+2.31:h

### The command *Vmax*

The maximum plant velocity is set with the command *Vmax* in m/s. It is required, for the best possible functioning, that the value for ***Vmax corresponds exactly to the actualities of the situation***. It should be set neither too high nor too low since otherwise the automatic adjustments do not work properly.

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



Attention should be paid for the correct operation of the measuring device that the direction over the command *Direction* and the maximum plant velocity over the command *Vmax* are set correctly. *Vmax* is entered without a sign.



The measuring device may not be operated above the velocity range mentioned in the data sheet, otherwise the proper function cannot be guaranteed. Please note the parameter *Mode* since it affects immediately the maximum allowed velocity. The parameter *Vmax* is set according to the actual maximum plant velocity. A reserve of approx. 10 % is already considered in the device.

### The command *Vmin*

The command sets the velocity up to the device suppresses the output (to fieldbus, analog output, pulse output) of the velocity. If the value of VMIN is undershot during a running measurement, the outputs will be closed regardless the value of Holdtime (see 45, The command *Holdtime*). The value is in m/s without a sign. The signal LED lights yellow, when the VLM500 detects a velocity but VMIN is still undershot. If VMIN is set to zero, this functionality is turned off. The standard value is 0.

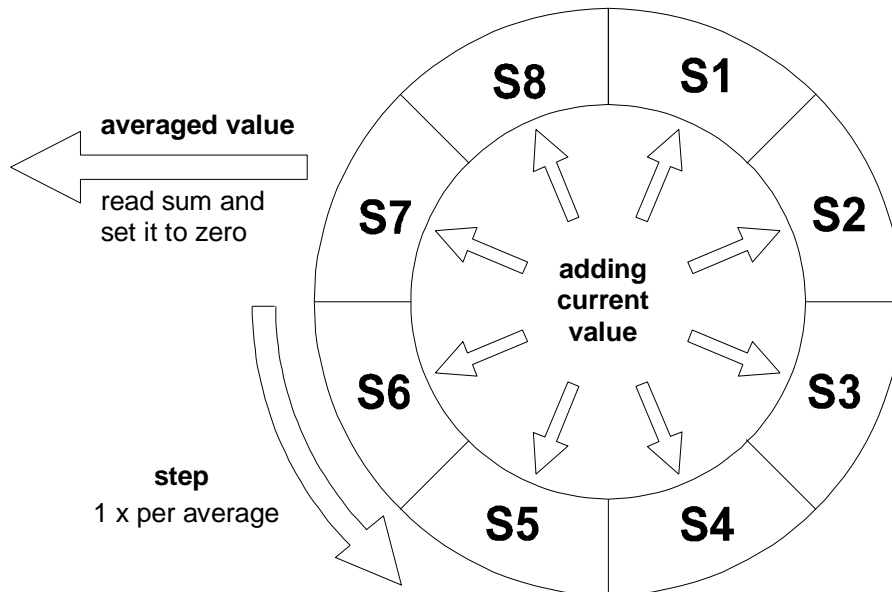
Syntax: ***Vminx*** [f]            (n = 0 ... 100.00 m/s)



While entering a value for VMIN, the device checks if the value is greater or lower than VMAX. If necessary, is puts out an error message.

### The command *Window*

The parameter Window was implemented for highly dynamic velocity measurements in production process and for feedback control problems. This calculates the weighed moving average according to signal quality over the frequency of the individual burst. A ring memory with 2 to 32 averaging cycles is used (see Figure 20). The duration of a cycle is represented in Figure 20 as a section and corresponds to the averaging time *Average*. The incoming single values are added asynchronously, the outcome is read synchronously once per *Average*. Thereby, a high refresh rate of up to 32 times can be achieved to the outputs against the normal average.



**Figure 20: Simplified operating principle of the averaging processor with 8 cycles<sup>3</sup>**

The averaging time (see page 43, The command *Average*) is chosen as high as the desired updating time for the fastest used output channel.

The sliding averaging can be switched off with the command *Window 1*.

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

<sup>3</sup> *Window 8*, that is 8 sliding windows (sum S1 to S8)

## 9.4 Analog output

An analog current value can be output with an analog output (optional extension card IAUN). A digital/analog converter is used. The range for the output of the measured values is set with the commands *AOMin* and *AOMax*. *ANMin* sets the value with which the minimum current value is output. *AOMax* applies accordingly to the maximum value.

Example: The following value pairs result from *AOMin* = 0 and *AOMax* = 100:

**Table 30: Example for the analog output (*AOMin* = 0 and *AOMax* = 100)**

Current value	<i>AOValue V</i> Velocity	<i>AOValue R</i> Measuring rate	<i>AOValue Q</i> Signal quality in movement	<i>AOValue Q</i> Signal quality during standstill
4 mA	0 m/s	0	Measuring rate = 0	little reflection
12 mA	50 m/s	50	Measuring rate = 50	medium reflection
20 mA	100 m/s	100	Measuring rate = 100	a lot of reflection

The lowest current value is output if the actual measuring value is lower than *AOMin* and the highest current value is output if it is greater than *AOMax*. The output value is parameterizable (see page 55, The command *AOValue*). The output is updated either after achieving *Average* or after a Trigger event (see page 55, The command *AOSync*).

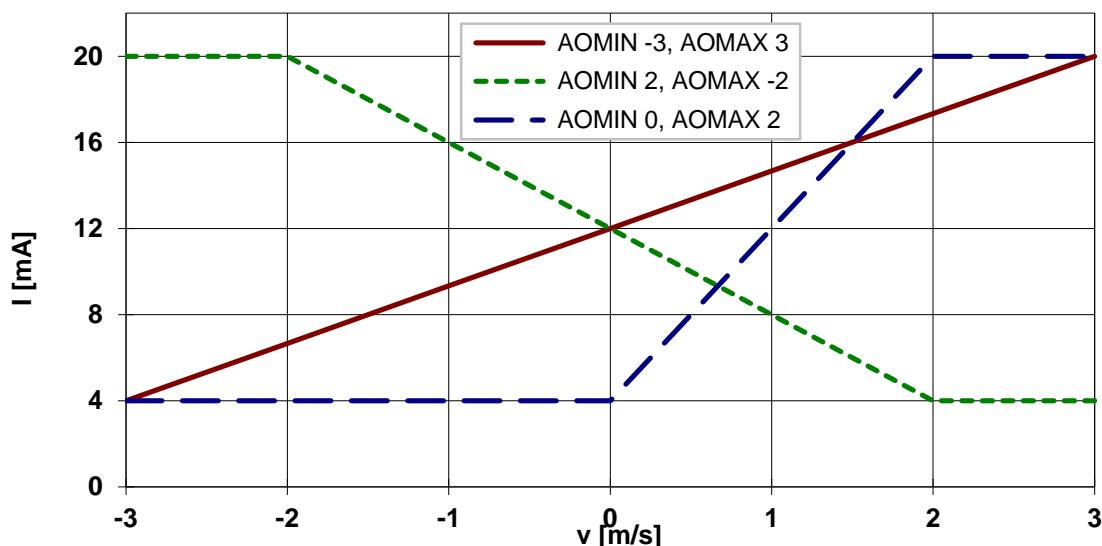
### The command *AO*

This command shows all parameters of the analog output.

Syntax: *AO*

### Example for analog output

The output 4 to 20 mA in a velocity range of -3 to +3 m/s with different values for *AOMIN* and *AOMAX* is represented in the following diagram. The velocity at the analog output is given out (*AOValue V*).



**Figure 21: Examples for analog output**



Currents lower or higher than the range determined by the hardware (e.g. 4 to 20 mA) are not possible. If e.g. the output value exceeds *AOMAX*, the maximum current value is put out.

### The command **AOMax**

The maximum value for analog outputs is determined with this command.

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



Depending on the adjusted direction (*Direction*) it may be necessary to adjust the value for **AOMAX** for a negative value, if the device is assembled backwards to the direction of movement. Use the command **Test** to check the sign.

### The command **AOMin**

With this command, the minimum value for analog output can be set.

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

### The command **AOOn**

With this command, the analog output is switched in or off.

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

### The command **AOSync**

With this command is specified if the output value is updated synchronously with the indicated time interval *Average* (see page 43, The command *Average*), during a trigger event (see page 50, The command *Trigger*) or during every burst.

Syntax: **AOSync**[n] (n = 0 - average-, 1 – trigger- synchron)

### The command **AOValue**

With this command is determined if the Velocity, the measuring rate or the signal quality shall be output.

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

If option **AOValue Q** is set, the measuring rate (like at **AOValue R**) is output during the measurement and in case of signal failure or standstill of the measuring object the product (Quality) out of light brightness and exposure time (Exposure) at the analog output (see page 68, The command *TestQuality*). This function can be used as alignment aid for pipe and wire applications.

## 9.5 ECC Control

The ECC Control allows monitoring measurement rate and velocity by hysteresis. The ECC control is an extension of the measuring rate monitoring (see page 46) it is needed when using the extension card IECC. The card IECC allows connecting an external rotary encoder or a second velocity measuring device VLM500. If a selectable velocity or measuring rate is undercut, the pulse output is switched to rotary encoder or the second measuring device. The switching back takes place as soon as velocity and measuring rate are higher than two other adjustable values again. The checking of velocity and measuring rate is implemented after the averaging time was reached (see page 43, The command *Average*). The switching is done via the status signal 'ERROR'. When *Holdtime* has expired, the status signal is switched off immediately. When using the ECC control, *Average* should be set to 10 ms to ensure a fast switching (*Average 5*, *Windows 4* or similar are also useful).

### The command *ECC*

This command displays of all parameters of the ECC control.

Syntax: *ECC*

### The command *ECCOn*

With this command, the ECC control is switched in or off. The measuring rate monitoring (see page 46) is automatically deactivated when the ECC control is activated.

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

### The command *ECCR1*

With this command, the minimum measuring rate for switching to an external device is determined. Usual value are 3 to 10. The value must be lower than *ECCR2*.

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

### The command *ECCR2*

With this command, the measuring rate for switching back is determined. Usual values are 8 to 20. The value must exceed *ECCR1*.

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

### The command *ECCV1*

With this command, the minimum velocity amount for switching to the external device is determined. Usual values are 0.05 to 0.2 m/s. The value must be lower than *ECCV2*.

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

### The command *ECCV2*

With this command, the velocity (amount) for switching back again is determined. Usual values are 0.1 to 0.3 m/s. The value must exceed *ECCV1*.

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



## 9.6 Pulse output via first pulse output

During the pulse output, two clock sequences A and B (maximum deviation of the phase  $\pm 10^\circ$ ) displaced for  $90^\circ$  with a duty cycle of 1:1 at the outputs OUT1 and OUT2 are provided. The phase shift can be controlled by the direction input 'DIR' or the optional internal direction recognition of  $+90^\circ$  to  $-90^\circ$ .

The output is updated either after reaching *Average* or after a trigger event (see page 58, The command *PO1Sync*).

### The command *PO1*

Display of all pulse output parameters.

Syntax: *PO1*

### The command *PO1ECC*

With this command, the switching of the ECC control of the first pulse output is switched in or off.

Syntax: *PO1ECC* [n]                    (n = 0 - off, 1- on)

### The command *PO1Factor*

With this command, a scaling factor can be adjusted. At factor 1, 100 Hz are output if the velocity amounts to 0.1 m/s or the measuring rate amounts to 100 (see page 58, The command *PO1Value*). For the velocity, the value, thus, corresponds to pulse **per millimeter**.

Syntax: *PO1Factor* [f]    (n = -2500.0 ... 2500.0,  $\neq 0$ )

The minimum possible output frequency for the pulse output amounts to 0.2 Hz. If the output value is lower, no pulses are output! The maximum possible output frequency depends on the installed interface boards and their output wiring (limit frequency).

### The command *PO1Hold*

The command allows freezing the first pulse output depending on the inputs DIRECTION or TRIGGER 1, irrespective of a current measurement or a signal dropout. Furthermore, a hold time between 1.0 s and 25.5 s can be adjusted in a pattern of 100 ms. This allows holding the last valid measuring value at the first pulse output in case of signal dropout over a hold time in addition to *Holdtime* (see page 45, The command *Holdtime*). Still, the output, different from the control via the inputs DIR or TRI1, must be updated as soon as new measuring values are available.

Syntax: *PO1Hold* [n]                    (n = 0 ... 4, 10 ... 255)

**Table 31: Meaning of the parameter of *PO1Hold***

n	Holding pulse output	Current level
0	Off	-
1	at H level to DIR	high: +5 to +40 mA
2	at H level to DIR	low: -40 to +0.3 mA
3	at H level to TRI 1	high: +5 to +40 mA
4	at L level to TRI 1	low: -40 to +0.3 mA
10...255	for 1.0 s ... 25.5 s in 100 ms steps	-

### The command *PO1On*

With this command, the pulse output is switched on or off.

Syntax: *PO1On* [n] (n = 0 - off 1 - on)



For minimizing the processor load, unused output channels must be principally switched off!

### The command *PO1Output*

With this command, the output type of the second phase of the first pulse output is determined.

Syntax: *PO1Output* [n] (n = 0 - A+B, 1 - A+DIRECTION)

### The command *PO1Sync*

With this command is determined if the output value is updated synchronously with the given time interval *Average* (see page 43, The command *Average*) or during a trigger event (see page 50, The command *Trigger*).

Syntax: *PO1Sync* [n] (n = 0 - average-, 1 – trigger- synchronous)

### The command *PO1Value*

With this command is determined if the velocity, the measuring rate or the signal quality are output.

Syntax: *PO1Value* [c] (c = 'V', 'R', 'Q')

If option *PO1Value Q* is set, the measuring rate (like at *PO1Value R*) is output during the measurement and in case of signal failure or standstill of the measuring object the product (Quality) out of light brightness and exposure time (Exposure) at the pulse output (see page 68, The command *TestQuality*). This function can be used as alignment aid for pipe and wire applications.

## 9.7 Pulse output via the second and third pulse output

An additional pulse output each with 2 phases each (A, B) is provided with the optional interface cards (IPPL, IP5V, IPPP). They correspond with the first pulse output regarding resolution and minimum output frequency. The parameter setting also corresponds to those of the pulse output mentioned in chapter 9.6. 'PO1' must be replaced by 'PO2' for OUT 3/4 or 'PO3' for OUT 5/6 here.

## 9.8 Output via the first serial interface

### The command *SO1*

Displays all parameters at the serial interface 1.

Syntax: *SO1*

### The command *SO1Address*

It is possible to switch the addressability for the serial interface on or off with this command. As soon as an address is set, the VLM500 is only manageable over it. This enables to connect several measuring devices to a serial bus (e.g. RS-422 or RS-485).

Syntax: *SO1Address* [n] (n = 0 - off, 10 ... 99 - on)

With addressability enabled, the VLM500 can only be addressed with the following syntax '*::#command parameter*'. *##* stands for the address. The VLM500 confirms a processed command with the characters ACK (06H).

The following input string results for querying the maximum velocity with address 15:

```
:15vmax
```

In order to deactivate the addressability the following string needs to be sent to the VLM: *:15so1a 0*.

### The command *SO1Format*

In addition of the programming, data output can also take place via the first serial interface. The transmission format can be given within wide limits. The output ensues in ASCII. The individual parameters can be separated by spaces, commas or periods. However, the separators between the parameters can also be omitted.

Syntax: *SO1Format* [s] (s - parameter string, max. 42 characters)

**Table 32: Parameter for formatting the output**

Parameter	Meaning
'...'	Inserts the string enclosed in quotation marks
0...9	Numbers (0 to 255) that are not enclosed in quotation marks are interpreted as ASCII Code and output as the corresponding ASCII character
C	Inserts the current time (e.g. 12:50:28)
D	Inserts the current date (e.g. 31.12.2010)
E	Inserts the exposure (0 to 14)
F	Inserts the measuring frequency in Hz
H	Inserts the temperature of the first temperature sensor in °C
I	Inserts the lamp intensity (0 to 30)
J	STANDBY, TRIGGER 1 and DIR as number in BCD coding (STDBY=2 <sup>2</sup> , TRIG1=2 <sup>1</sup> , DIR=2 <sup>0</sup> )
L	Inserts the length in m
N	Inserts the status of the object counter (0 to 65535)
Q	Inserts the product (0 to 100) from lamp intensity and exposure time (see page 68, The command <i>TestQuality</i> )
R	Inserts the measuring rate (0 to 100)

Parameter	Meaning
S <sup>4</sup>	Inserts several fixed hexadecimal values in succession: Velocity in m/s * 100000 (24 bits = sign + 6 nibbles) <SPACE> Measuring rate * 10 (12 bits = 3 nibbles)
T	Disables the standard identifier CR LF of the output string
U	STATUS, ERROR and direction in BCD- coding (direction=2 <sup>2</sup> , STATUS=2 <sup>1</sup> , ERROR=2 <sup>0</sup> )
V	Inserts the velocity in m/s
X	Inserts the last error number (see page 45, The command <i>Error</i> )
Z	Same as S with 2 additional nibbles for last error numbers



The hexadecimal output is preferred if values faster than 20 ms should be given in time grid (see page 62, The command *SO1Time*) since the conversion requires considerably less computing time in hexadecimals. The format S or Z is always used in a time grid < 10 ms.

**Table 33: Format specifications of the individual parameters of the output to S1**

Format	Meaning
a+x	Adds the value a (V, L, F, ...) with the offset x
a*x	Multiplies the value a (V, L, F, ...) with x
a:H[:n]	Returns the value a (V, L, F, ...) as hexadecimal number with n characters <sup>5</sup>
a:n[:m]	Returns the value a (V, L, F, ...) as formatted number with n places and m decimal places

All format specifications from Table 33 can be arbitrarily combined with one another and can only be used on numerical parameters (excluded e.g. special string S and Z, date, time, ...). The multiplication and division calculation applies over the addition and subtraction calculation.

Without format specification the output is left-aligned and the leading zeros are suppressed except in hexadecimal output. They are filled with spaces in format specifications. Should the value exceed the possible number of digits by format specifications, the output is expanded to the required number of digits. The decimal point and possibly an existing sign (only with negative numbers) also occupy a place.

If numbers are used in format string that are not enclosed in quotation marks then they are interpreted as ASCII Code and output as corresponding ASCII characters. Here every ASCII Code must be separated by a space, comma or period.

Example:

*SO1Format 72 97 108 108 111* for string 'Hello' and CR LF

*SO1Format v 13 10* for velocity and twice CR LF

The standard identifier of the output string is CR LF (13 10 or 0DH 0AH). It can be disabled with the parameter T and it is possible to define the identifier at the end of the format string. The position of the parameter T for disabling the identifier is not relevant. A self-defined identifier must always be at the end of the format string.

<sup>4</sup> The special format S carries out a fast output of the velocity and measuring rate.

<sup>5</sup> The hexadecimal output in the format a:H:n takes place with signs (minus signs or spaces) and n decimal places. Every byte requires 2 decimal places. Without the parameter n, 9 characters for 4 bytes and the sign are returned (32 bit number). Leading zeros are not suppressed.

Examples:

<code>SO1Format v ' m/s'</code>	Velocity and string m/s, CR LF
<code>SO1Format v, ',r</code>	Velocity, SPACE, measuring rate, CR LF
<code>SO1Format v 20 r</code>	Velocity, SPACE, measuring rate, CR LF
<code>SO1Format v*60,' m/min',l,' m'</code>	Velocity, m/min, length, m, CR LF
<code>SO1Format l*10+12.345</code>	Length in dm + offset (specified in dm)
<code>SO1Format s t l:h 10</code>	For special format s, long hexadecimal and LF
<code>SO1Format '#rat'r t42</code>	for string '#rat', measuring rate and characters '*'

## The command **SO1Interface**

The serial interface is configured with the command `SO1Interface`. There is the setting of baud rate, protocol type, parity and directionality. The setting can take place individually for each parameter or simultaneously for all parameters. The order of the parameters does not matter. Unspecified parameters are not changed. The format is set with eight data bits and a stop bit. With parity enabled, the eight data bit is replaced by the parity bit. A parity error is indicated for example by 'E11 SO1 input error (parity)' and a buffer overflow by 'E11 SO1 input error (overflow)' (see chapter 11.3, Error messages).

Syntax: `SO1Interface [n] [c] [c] [c]` (n = baud rate, c = protocol, parity, ...)

The following values are possible for the baud rate:

n: 9600; 19200; 38400; 57600; 115200

**Table 34: Setting of the RS-232 Interface**

C	Description
<b>Protocol type</b>	
'.'	No protocol
'X'	Software protocol (XON / XOFF Codes)
<b>Parity</b>	
'N'	No parity
'O'	Odd parity
'E'	Even parity
<b>Directionality</b>	
'D'	Duplex (RS-232, RS-485)
'H'	Half-duplex (RS-485, RS-422)

According to the attached interface type (I4U2 or I4U4) the VLM500 sets the directionality to half or full duplex automatically. Furthermore when an I232 or IUSB is attached the device sets to full duplex automatically.

## The command **SO1On**

The data output on the serial interface is switched on or off with this command. Data output is interrupted during the command input and processing!

Syntax: `SO1On [n]` (n = 0 - off, 1 - on)

### The command **SO1Sync**

With this command it is defined whether the output value is sent synchronously to a selectable time interval (see page 62, The command *SO1Time*) or by a trigger event (see page 50, The command *Trigger*).

Syntax: **SO1Sync** [n] (n = 0 - time-, 1 - trigger- synchronous)

### The command **SO1Time**

The time interval in ms is defined with this command in which the data is output to the interface S1.

All accumulated values (bursts) are averaged with the velocity measurement during the averaging time (see page 43, The command *Average*) The data is then output equivalently with the time set by *SO1Time*.

Syntax: **SO1Time** [n] (n = 1 ... 65535) Unit: ms

## 9.9 Output via the second serial interface

Programming or data output can take place over the second serial interface (optional expansion cards IUSB, I232, I4U4, I4U2) as over the serial interface 1. All commands apply accordingly, only that 'SO1' is replaced by 'SO2'.

## 9.10 Commands for the light barrier controller LBC9-CA

The following commands are only valid using the light barrier controller LBC9-CA. You can find further information for this accessory at [www.astech.de](http://www.astech.de).

### The command *LBC*

Displays all parameters of the LBC control.

```
-> lbc
LBCD1      1.2345
LBCD2      2.3456
LBCD3      3.4567
LBCD4      4.5678
LBCD5      5.6789
LBCD6      6.7890
LBCD7      7.8901
LBCD8      8.9012
LBCON      0
```

Figure 22: Screen text of the command *LBC*

Syntax: *LBC*

### The command *LBCD1*

The command *LBCD1* sets the distance of the first STOP light barrier to START light barrier in meters.

Syntax: *LBCD1* [n] (n = 0 ... 999.9999) Unit: m

### The commands *LBCD2* to *LBCD8*

The commands *LBCD2*, *LBCD3*, *LBCD4*, *LBCD5*, *LBCD6*, *LBCD7* and *LBCD8* set the respective distances of the second, third, fourth, fifth, sixth, seventh and eighth STOP light barrier to START light barrier in meters.

Syntax: *LBCD[x]* [n] (x = number of the STOP light barrier, n = 0 ... 999.9999) Unit: m

### The command *LBCON*

The command *LBCON* switches on or off the offset detection of an external LBCPP. If the offset detection is switched on, then the active STOP light barrier is registered by a trigger and by the inserted ILBC Board and the corresponding offset is added up to the output value of the serial output.

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

## 9.11 Offline Measurement

### The command *OFF*

Displays all parameters for the Offline Measurement.

Syntax: *POFF*

### The command *OFFLine*

The measuring values are not sent (as previously described) to an interface in the operating mode *OFFLine* but are written in the internal storage. The operating mode is used for creating velocity and time curves and for recording very fast processes.



No actualization of the output channels takes place during the offline measurement, that is, pulse, analog and serial outputs are not possible!

The Offline measurement is started with the command *OFFLine*. The optional parameter T causes that a trigger event is maintained (see page 50, The command *Trigger*). The maximum amount of records depends on the set data format (see page 65, The command *OFFValue*). The BUSY-LED (yellow) glows during the measurement. The measured data are overwritten only by a renewed Start. They are lost by power failure. A premature cancellation is possible with ESC. An error message is displayed by cancellation with ESC or by full storage (refer chapter 11.3, Error messages).

Syntax: *OFFLine* [c]                      (c = 'T' - Wait for Trigger)

### The command *OFFFactor*

A scaling factor can be set with this command. E.g. a velocity measurement (*OFFValue V*) of the value 60 can be used for output in m/min. The scaling factor is considered first by the output with *OFFRead*, only the raw values without factor are stored!

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

### The command *OFFMeasure*

The duration of the offline measurement is set in seconds with this command.

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

### The command *OFFSync*

With this command is set if a measured value is stored synchronously to a selectable time interval (see page 65, The command *OFFTime*), by a trigger event (see page 50, The command *Trigger*) or by every burst.

Syntax: *OFFOutput* [n]                      (n = 0 - average-, 1 - trigger-, 2 - burst synchronously)

### The command *OFFRead*

The measured data are sent to the serial Interface 1 with this command after an offline measurement. The format is secure in reading; the time is issued in ms from the beginning of the measurement and the value or the values with maximum resolution. The numbers are separated by a semicolon. A line break (CR LF) follows



after the value. If no measurement has yet started, an error message is displayed by an attempt to read (chapter 11.3, Error messages).

Syntax: **OFFRead**

In case of a premature abort with ESC, an error message is displayed (chapter 11.3, Error messages).

### The command **OFFTime**

The time interval is set with this command during which the data is saved (see page 64, The command **OFFSync**).

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

### The command **OFFValue**

With this command is set whether the measuring frequency, length, object counter, measuring rate or velocity.

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

**Table 35: Meaning of the parameter of OFFValue**

c	Description	max. record count
'S'	Velocity and measuring rate	29126
'V'	Velocity	32767
'L'	Length	32767
'R'	Measuring rate	52427
'F'	Frequency	32767
'N'	Object counter	32767

## 9.12 Test Commands

When using the VLMTool the test commands are shown as separate windows with indicators and gauges representing the test results.

### The command *TestAO*

A row of values is displayed that gives information about the function of the analog output. The following values are constantly displayed: velocity, measuring rate, output current in percentage and load (LOAD). If no load (500 Ohm maximum) is connected or no interface card with analog output is installed, then the value for LOAD is 0. The refresh of the display is every 250 ms. The data output is interrupted during the test commands!

The abort takes place with ESC; otherwise the command is finished automatically after 60 seconds. The automatic cancellation can be stopped by indicating the parameter C.

```
-> TESTAO
AOON          1
AOMIN         0.000
AOMAX         100.000
AOOUTPUT      0
AOVALUE       V
  V(m/s) Rate IOUT(%) LOAD
  0.105   99   0.10   0
```

**Figure 23: Screen text of command *TestAO***

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

### The command *TestFilter*

A row of parameters and values is displayed that have effects on the filter board or give information about their function. The following values are displayed: frequency, velocity, measuring rate, center frequency of the filter board, broadband, conditions: bandpass/upper low pass/upper low pass and anti-alias field. The refresh of the display is every 250 ms. The data output is stored during the test command!

The abort takes place with ESC; otherwise the command is finished automatically after 60 seconds. The automatic cancellation can be stopped by indicating the parameter C.

```
-> TESTFILTER
Tracking      2
Exposure      5      auto
Expmin        0      auto
Expmax        5      auto
Permin        8      auto
Amp           2      auto
Bwmin         20 %   auto
Epsilon       5.0 %
Filter 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
```

**Figure 24: Screen text of command *TestFilter***

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

### The command **TestIO**

A row of values is displayed that give information about the function of the system. The following values are displayed: velocity, length, measuring rate, the outputs TRI1, TRI2, DIR, STBY and also the outputs ERR and STAT.

The refresh of the display is every 250 ms. The data output is interrupted during the test command!

The abort takes place with ESC; otherwise the command is finished automatically after 60 seconds. The automatic abort can be stopped by indicating the parameter C.

```
-> TESTIO
  V (m/s)          L (m)  RATE  TRI1  TRI2  DIR  STBY  ERR  STAT
-99.999 -99999.999   99    0    0    0    0    0    1
```

Figure 25: Screen text command **TestIO**

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

### The command **TestMeasure**

A row of values is displayed that give information about the function of the system. The following values are permanently displayed: frequency, velocity, length, measuring rate, number of periods, exposure time, lamp intensity, overexposure, underexposure and FIFO fill level.

The refresh of the display is every 250 ms. The data output is locked during the test command!

The abort takes place with ESC; otherwise the command is finished automatically after 60 seconds. The automatic cancellation can be stopped by indicating the parameter C.

```
-> TESTMEASURE
  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
```

Figure 26: Screen text of command **TestMeasure**

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

### The command **TestPS**

A row of values is displayed that give information about the function of the power supply and illumination (LED). The following values are constantly displayed: LED brightness, LED current, LED voltage, 12 V and -12 V supply voltage. The refresh of the display is every 250 ms. The data output is interrupted during the test command!

The abort takes place with ESC; otherwise the command is finished automatically after 60 seconds. The automatic cancellation can be stopped by indicating the parameter C.









We strongly recommend the use of the program VLMT00L for installing a Firmware. An update can be carried out quickly and safely with the command 'Action | Update Firmware'. Only the selection of the update file is required.

The commands *Update* and *Exit* are used in addition of the commands for changing the baud rate in the boot loader. The command *Update* starts the update of the VLM500 firmware. After calling the command the user is prompted to transfer the new firmware. Therefore, a special firmware file is required that can be obtained from the dealer or manufacturer. The content of this file must be transferred as ASCII character by character (e.g. in VLMT00l). Thereby, it should be noted that no impermissible characters are transferred, by keyboard input, for example; since this can lead to error output and cancellation of the routine. As soon as the transfer of the file is finished, the device starts the update automatically for the new Firmware. The VLM500 may in no case be shut down or interrupted during this process. If everything is passed through without errors the device can be restarted with the command *Exit*. The new version number of the Firmware must then appear in the subsequent info output.

An update of the respective serial flash of the FPGA takes place by indicating a parameter on the main motherboard or on the auxiliary board. The content of this file must be transferred as ASCII character by character (e.g. in VLMT00l). The VLM500 may not be switched off during the update. The VLM500 restarts automatically after the completion of the process.



If the update fails and thereby the Firmware is damaged, the device will not start anymore. In this case, contact the manufacturer.

An update of the fieldbus module behaves different than a flash update described before. After executing the command "update f" all functions of the VLM500 are interrupted and a direct serial communication channel from the fieldbus module to the connected host PC is established. The VLMT00l must be closed to free the serial port of the host PC. After that the update program "Wingate" provided by Deutschmann Automation GmbH & Co. KG, needs to be started in order to update the script. Wingate can be downloaded from the website of the manufacturer (<http://www.deutschmann.de/en/support/?kat=4&pkat=3>). For more information about the usage of Wingate refer to the relevant documentation. After the update of the fieldbus module the VLM must be restarted.

## 9.14 System Commands



Changes of the parameters listed here should only be made on instruction by trained service staff members or the manufacturer. The default settings ex factory are adjusted to the device and the field of operation and should not be change in normal case!

### The command *Amplifier*

With this command, the maximum amplification of the measuring signal can be set. For *Amplifier a*, an automatic control depending on the signal strength takes place.

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

**Table 36: Meaning of the parameters of Amplifier**

N	Amplification
0	1x
1	1...2x
2	1...4x
3	1...8x
A	Automatic



The parameter should be left to the setting automatic. Failures or error messages can happen with the incorrect setting of the parameter.

### The command *Bw*

This command determines the filter bandwidth of the filterboard and, thus, the possible signal tracking (acceleration) of the VLM500. Still, the parameter *Tracking* (see page 49, The command *Tracking*) is mainly decisive and should be prior used. The bandwidth is indicated in percent related to the current measuring frequency. The value 'a' sets the bandwidth to automatic.

To enable higher acceleration than specified in the technical data, an adaptation can be carried out by trained service.

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

**Table 37: Meaning of the parameters of Bw**

n	Bandwidth	Installed filter board	Mode
0	Automatic	20%	FB3 (VLM500 A/D/L/E)
		25%	FB3 (VLM500 A/D/L/E)
		25%	FB2V (VLM500 A/D/L/E)
10	10%	-	-
50	50%	-	-



The parameter should be left to the setting automatic. Failures or error messages can happen with the incorrect setting of the parameter.



## The command *Calibrate*

A calibration of the velocity or length is carried out with this command. Only figures are used, that is, negative velocity or length values are converted to positive. The progress of the measurement is displayed in percentage during the calibration; the BUSY display (yellow) glows. A cancellation can be made with ESC. The new calibration factor is displayed after completion of the measurement. The value must be saved with *Store* like all other changes of the parameter!

The calibration factor is calculated according to the following formula:

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

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

Parameter: c - 'V' = Velocity calibration  
 'L' = Length calibration  
 n - Calibration duration in seconds (for velocity calibration)  
 Number of measuring objects (for length calibration)  
 f - Nominal value in m/s (for velocity calibration)  
 Nominal value in m (for length calibration)

*Signalerror* can be set to 1 in order to increase the certainty of the calibration; thus velocity 0 is forbidden. It is also possible to set a minimum measuring rate via *Minrate*. Should this value come below, an error message ensues (see chapter 11.3, Error messages).

## The command *Constant*

The command returns the system constant. This constant contains several calculation factors for the velocity that results from different lenses and magnification factors. The default setting is made ex works and is not changeable.

Syntax: **Constant**

## The command *Controltime*

The VLM500 has automatic control for the exposure time (see page 74, The command *Exposure*) for highly reflecting or changing surfaces and lamp intensity (see page 75, The command *Illmax* and page 75, The command *Illmin*). If a measurement object is too dark, then the device can be underloaded. This has effects on the signal quality, but does not interrupt the measurement. If, however, the VLM500 is overloaded, thus signals could no longer be received and it results into a measurement failure. To prevent this, several mechanisms were implemented that react before an overload and down-regulate the lamp intensity, for example.

When measuring on surfaces that show strong distinctions in their quality and after a bright spot must be blocked this parameter *Controltime* specifies how much time must pass until the VLM500 attempts again to increase the lamp intensity and exposure time. The standard value is 0.1 seconds.

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



### The command *Expmin*

This command sets the minimum value of the exposure time of the CCD line (see page 74, The command *Exposure*) that can be accepted by its automatic control. The minimum adjustable value depends directly on the maximum object velocity *Vmax* and thus also on *Mode*. The lower the selected velocity, the greater the minimum value for *Expmin*. In setting *Expmin auto* the minimum allowed *Expmin* is used automatically. The value must be smaller than or equal to *Expmax* in fixed values.

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



The parameter should be left to the setting automatic.  
Failures or error messages can happen with the incorrect setting of the parameter.

### The command *Illumination*

This command controls the intensity of the LED illumination. The setting *Illumination a* allows an automatic control whose limits are set by *Illmax* and *Illmin*.

Syntax: **Illumination** [n] (n = 0 ... 30 – fixed, a – automatic)



The parameter should be left to the setting automatic.  
Failures can happen through overloading and underloading by the incorrect setting of the parameter.

### The command *Illmax*

This command sets the maximum value of the LED intensity (see page 75, The command *Illumination*) that can be accepted by its automatic control. The value must be greater than or equal to *Illmin*.

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



The parameter should be left to the setting 30.  
Failures are possible by underloading in incorrect setting of the parameter.

### The command *Illmin*

This command sets the minimum value of the LED intensity (see page 75, The command *Illumination*) that can be accepted by its automatic control. The value must be smaller than or equal to *Illmax*.

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



The parameter should be left to the setting 0.  
Failures are possible by overloading in incorrect setting of the parameter.

### The command *OED*

This command controls the function of the quick overexposure detection.

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



The fast overloading detection should only be switched on, if bright measuring objects enter in the measuring window (e.g. single part measurement in test facility for pipes and profiles of stainless steel). If the guide is not good, do not turn on the detection!

### The command *Periodcount*

This command controls the function of period counting type. Counting can be achieved by scanning a full period (full sine wave) or by scanning a half period (half sine wave).

Syntax: **Periodcount** [n] (n = 0, 1)

n = 0 - full period

n = 1 - half period



The parameter should be left to the setting 0.

### The command *Permax*

This command sets the maximum number of periods that a burst can have before it is broken down in partial bursts or periods. *Permax 0* forces a reduction in single periods, if possible, in order to reach a maximum dynamics.

Syntax: **Permax** [n] (n = a – dynamics, 16, 32, 64, 128, 240 - fixed)



The parameter should be generally left to the setting a (dynamics).

### The command *Permin*

This command sets the minimum amount of periods that a burst must have in order to be used for the other velocity calculation. The setting *Permin a* allows an automatic control based on the maximum velocity of *Vmax*.

The command can be fed with a second optional value. This second value can only be used if Tracking 5 or 6 is set as filter principle (see page 49, The command *Tracking*). It returns the minimum number of periods that a burst must have if the dynamic minimum periods adjustment is made by Tracking 5 or 6. The input of the second value is only then possible if the first is set to automatic!

Syntax: **Permin** [n1] [n2] (n = 2 ...15 – fixed, a - Automatic)

(n2 = 2...15 – fixed)



The parameter should be left to the setting automatic.

Failures or error messages can happen with the incorrect setting of the parameter.

### The command *Rateinterval*

A quality criterion for the measurement results is the so called 'Rate'. The better the spatial filter signals are, the higher is the rate. For the calculation of the rate an average value is used. The length of the average is set by the command *Rateinterval*.

Syntax: **Rateinterval** [f] (f = 5 ...100) unit: ms



Keep in mind, that the higher *Rateinterval* is, the unlikelier is the chance to recognize sudden changes in the rate induced by process changes. In normal cases the value should be left unchanged.

### The command *TComp*

The command displays the value for the temperature compensation in PPM/K. The deviation of the current temperature from the reference temperature and the value of *TComp* are directly included into the velocity calculation. The presetting is made ex works and is not changeable.

Syntax: *TComp*

### The command *TMax*

The command displays the maximum reached temperatures in the housing. The data is time-stamped.

Syntax: *TMax*

### The command *Senslevel*

This command sets the sensitivity threshold of the periodic time analyzer. This can be required if the measurement object shows a weak surface structure.

Syntax: *Senslevel* [n] (n = 0 ... 3)

n = 0 - very sensitive, for weak measurement signals

n = 3 - less sensitive, strong measurement signals



The parameter should be left to the factory setting.

Failures or error messages can happen with the incorrect setting of the parameter.

### The command *SetAuto*

This command sets some system parameters to automatic dependent on the parameter or to the standard values (see Table 38). The setting *SetAuto 4* sets *Exposure* fixedly to the value that would accept control with the current surface quality after 2.5 seconds. Without parameter *SetAuto 1* is executed.

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

n = 1 - Standard, Release of full control ranges

n = 2 - No exposure time regulation for shiny/bright surfaces

n = 3 - Exposure time regulation limited to half of the range

n = 4 - No exposure time regulation, but determination of the optimum exposure time for the current material

**Table 38: Parameter of SetAuto**

n	Amplifier	Exposure	Illumination	Illmax	Illmin	Permin	Expmax	Expmin
1		auto					auto	auto
2		0					auto	auto
3	auto	auto	auto	30	0	auto	0,5*max. Expmax	auto
4		Fixed after 2.5s					-	-

## The command *Type*

The command displays the type of measuring device.

Syntax: *Type*

## The command *Video*

With this command, the operation mode of the device sensor (CDD line) can be switched to image recording. This function is used for device inspections by the manufacturer. A specific adapter cable is needed for connecting it to an oscilloscope. The measuring function is deactivated in this mode!

Syntax: *Video*

## 9.15 Read commands

Read commands serve for asynchronously reading out measuring values. They are processed particularly fast by the command interpreter. All read commands are inserted with a letter and implemented after the following CR (ODH). The value is put out with fixed formatting (see below) and completed with CR LF (ODH OAH).

Table 39: Read commands

Comm and	Return value	Unit	Decimal places	Example
<i>B</i>	Number of bursts	-	0	1235
<i>D</i>	FIFO filling level	-	0	2
<i>E</i>	Exposure time	-	0	12
<i>F</i>	Frequency of the last burst	Hz	2	1234.56
<i>I</i>	LED intensity	-	0	24
<i>L</i>	Length	m	4	1234.5678
<i>P</i>	Number of periods	-	0	12
<i>R</i>	Measuring rate	-	0	45
<i>V</i>	Velocity	m/s	5	-1.23456
<i>X</i>	Number of the last error	-	0	32

## 9.16 Special Applications

### Differential Velocity Measurements

When two or more VLM500s are triggered with the same external clock, it is possible to carry out high-precision and dynamical differential velocity measurements. The setting *Average 0* allows the synchronization of the device calculation routines, and thereby the whole system. The external clock has to be applied to the trigger input (TRI1) with a frequency from 25Hz up to 500Hz and a balanced duty cycle. Beside *Average 0* the parameter *Trigger* (see page 50, The command *Trigger*) needs to be set to 0 as well. Holdtime mustn't smaller than 50ms.



The value for the parameter Holdtime mustn't be shorter than the period T of the external clock. The lower limit of 25Hz (T = 40ms) allows a minimum Holdtime setting of 50ms. Lower values for Holdtime are inappropriate for this measurement task. The upper limit of 500Hz (T = 2ms) of the external clock results from a practical usage of the velocity signals and the internal data processing.

The commands *PO1SYNC 1*, *PO2SYNC 1*, *PO3SYNC 1*, *SO1SYNC 1* and *SO2SYNC 1* allow the configuration of the externally synchronized output of the velocity values.

The following conditions are to be complied with:

- The parameter setting of the devices is equal. The devices are mounted in equal movement direction and are provided with a high-definition pulse output (expansion cards IP5V or IPPP) or a fast serial output.
- An external synchronization in a serial transmission is absolutely necessary. This counts also for the data output to a field bus (Profinet, Profibus).
- A required direction switching takes place by an external signal (Direction ≤ 2).

Programming example with pulse output IP5V for a differential measurement:

<i>Average 0</i>	(external synchronization)
<i>Window 8</i>	(8 windows sliding average)
<i>Trigger 0</i>	(H level active)
<i>Direction 1</i>	(devices mounted contrary to the movement direction)
<i>Minrate 10</i>	(programming of the monitoring output 'STATUS')
<i>Holdtime 250</i>	(holdtime of 250ms in the event of a dropout)
<i>PO1On1</i>	(high definition pulse output 1 switched on)
<i>PO1Factor 10</i>	(factor 10 pulse/mm for pulse output 1)
<i>PO1Sync 1</i>	(updating of the pulse output synchronized with the trigger)

The output 'STATUS' is used as monitoring output and controlled by the parameter *Minrate* (see page 46). The output of the pulses is trigger synchronized. All other non-required outputs are switched off.

## 10 Technical Data

	VLM500A	VLM500D	VLM500L	VLM500E
Nominal distance and working range <sup>1)</sup>	185 ± 7.5 mm	240 ± 15 mm	185 ± 7.5 mm	330 ± 30 mm
- extended working range <sup>1)</sup>	185 ± 15 mm	240 ± 30 mm	185 ± 10 mm	330 ± 30 mm
Measuring range	0.6 ... 1500 m/min	0.48 ... 900 m/min	0.24 ... 180 m/min	0,60 ... 2000 m/min
- in extended working range	1.2 ... 3000 m/min	0.96 ... 1800 m/min	0.48 ... 360 m/min	1,00 ... 2700 m/min
- with special filter FB2V	0.36 ... 210 m/min	0.30 ... 180 m/min	0.06 ... 90 m/min	0,41 ... 270 m/min
- in extended working range and FB2V	0.72 ... 420 m/min	0.72 ... 330 m/min	0.12 ... 180 m/min	0,82 ... 540 m/min
Measuring uncertainty <sup>2)</sup>	< 0.025 % at nominal working distance < 0.05 % in working range and < 0.2 % in extended working range			
Reproducibility <sup>2)</sup>	< 0.025 %			
Averaging-/Update-Time	> 0.2 ms with additional 1 ... 32 times sliding average			
Length measuring range	Internal length range up to 2,000,000 km			
Detector / principle	CCD sensor / spatial filter with semiconductor grid as reference			
Illumination	White light LED (expected life span: > 5 years <sup>3)</sup> , 70 % brightness after 50,000 hours of operation)			
State indicator (LED in cover plate)	Signal (green), Error signal(red), Communication (yellow), Forward(green), Backward (green)			
Power supply, consumption	24 VDC, max. 25 W			
Temperature range	0 °C ... 50 °C			
Protection class	IP 65			
EMC	Industrial standard in compliance with CE			
Weight, Housing dimensions	approx. 3.3 kg, 260 mm x 160 mm x 90 mm (without connections)			
Programming interface (max. 2)	for parameter setting, data output and firmware update: USB (IUSB), RS-232 (I232), RS-422/RS-485 (I4UN), isolated			
Opto-isolated outputs <sup>4)</sup>	ERROR		Error Signal	
	STATUS		Signal status	
Opto-isolated inputs <sup>5)</sup>	TRIGGER		External trigger signal	
	STANDBY <sup>6)</sup>		Idle mode / Lock	
	DIRECTION		Definition of the directional of the movement	
Pulse output (Encoder)	A/B, 2 phases 90°, resolution 8 ns, 0.2 Hz ... 25 kHz Optionally as Open Collector (IPPL), 5V active (IP5V) <sup>7)</sup> or Push Pull (IPPP) <sup>7)</sup>			
Analog output	Current output, adjustable as 0 ... 20 mA, 0 ... 24 mA, 4 ... 20 mA (IAUN)			
Fieldbus interface	Profibus DP (IFPB), Telnet via FastEthernet (IFFE), Profinet IO (IFPN)			
Standard scope of delivery	VLM500, Power supply cable, Connection cable, positioning aid, USB stick with documentation and software, printed manual			

<sup>1)</sup> Larger working ranges can be offered according to customer demands

<sup>2)</sup> DIN 1319 / ISO 3534, of measured length, test conditions: measuring length 10 m, active tracking, constant conditions in: temperature (20 °C), distance, velocity, illumination.

<sup>3)</sup> Simple replacement by user.

<sup>4)</sup> OpenCollector interface card (IOPL). Connections are isolated and short circuit proof.

<sup>5)</sup> Opto isolated, short circuit proof, max. voltage 50 VDC, 36 VAC

<sup>6)</sup> The standby input can be uses as a second trigger input (TRIGGER 2).

<sup>7)</sup> IP5V and IPPP provide output frequencies up to 4 MHz.



## 11 Annex

### 11.1 List of commands

#### General commands

Table 40: General commands

Command	Meaning	Unit	Possible values	Default setting
<b>Average</b>	Averaging time	ms	0 or 0.2 ... 10000	30 ms
<b>Calfactor</b>	Set Calibration factor	-	0.950000 ... 1.050000	1.000000
<b>Clock</b>	Display and setting time	-	hh:mm:ss	-
<b>Controlhold</b>	Holding the control circuits (only for single item measurements)	-	0 - off 1 - on	0
<b>Date</b>	Displays and setting date	-	dd.mm.yy	-
<b>Direction</b>	Direction	-	0 - forward 1 - backwards 2 - external forward 3 - external backwards a - automatic	0
<b>Error</b>	Display of the last error	-	-	-
<b>ErrorLevel</b>	Behaviour of error output	-	0 - active if OK 1 - active in case of error	0
<b>Fmax</b>	Display maximum frequency	-	-	-
<b>Help oder ?</b>	Help pages	-	-	-
<b>Holdtime [n1]</b>	Hold time	ms	10 ... 65535	250 ms
<b>Holdtime [n2]</b>	Reaction time	ms	9 ... 65534	-
<b>Info</b>	Displays software revision and serial number	-	-	-
<b>Lengthoffset</b>	Sets the offset value for a length mesesurment	m	0 ... 999.9999	0
<b>Minrate</b>	Monitoring measurement rate	-	0 - of, 1 ... 99 - on	0
<b>Mode</b>	Switching grating constant	-	0 - single, 1 - double	0
<b>Number</b>	Object counter	-	0 ... 65535	0
<b>Parameter [c]</b>	Displays all general parameters	-	C - Display all system parameters	-
<b>Post</b>	Self test	-	-	-
<b>REM</b>	Comment	-	-	-
<b>Seltrigger</b>	Use standby input as second trigger input	-	0 - no 1 - yes	0
<b>Serialnumber</b>	Displays serial number	-	-	-
<b>SID</b>	Displays active interface	-	-	-
<b>Signalerror</b>	Behavior in case of signal dropout or standstill	-	0 - no error 1 - error	0
<b>Start</b>	Starting length integration	-	-	-
<b>Stop</b>	Stopping length integration	-	-	-
<b>Temperature</b>	Display of the temperature	-	-	-
<b>Terminal</b>	Display of the terminal assignment	-	-	-
<b>Tracking</b>	Type of signal processing	-	0 ... 6 (see text)	2
<b>Trigger</b>	Trigger	-	0 - H-level 1 - L-level 2 - L/H-edge 3 - H/L-edge 4 - AND connection	0

Command	Meaning	Unit	Possible values (HIGH) of 2 light barriers 5 – AND connection (HIGH) of 2 light barriers	Default setting
<i>Vmax</i>	Maximum velocity	m/s	0.01 ... 100.00	4.0
<i>Vmin</i>	Lower output level	m/s	0 ... 100.00	0
<i>Window</i>	Window length	-	1 ... 32	8

## Commands for Analog Output

Table 41: Commands for analog output

Command	Meaning	Unit	Possible values	Default setting
<i>AO</i>	Display Analog parameter	-	-	-
<i>AOMin</i>	Minimum value	-	-1000.0 ... 1000.0	0.000
<i>AOMax</i>	Maximum value	-	-1000.0 ... 1000.0	1.000
<i>AOOn</i>	On/Off	-	0 - off 1 - on	0
<i>AOSync</i>	Output control	-	0 – average synchronous 1 – trigger synchronous	0
<i>AOValue</i>	Value	-	V - Velocity R – Measuring rate Q - Quality	V

## Commands for ECC control

Table 42: Commands for ECC control

Command	Meaning	Unit	Possible values	Default setting
<i>ECC</i>	Display ECC parameter	-	-	-
<i>ECCOn</i>	On/Off	-	0 - off 1 - on	0
<i>ECCR1</i>	Measuring rate 1	-	0 ... 99	10
<i>ECCR2</i>	Measuring rate 2	-	0 ... 99	20
<i>ECCV1</i>	Velocity 1	m/s	0.0001 ... 99.9999	0.0800
<i>ECCV2</i>	Velocity 2	m/s	0.0001 ... 99.9999	0.1200

## Commands for output via pulse output 1

Table 43: Commands for pulse output 1

Command	Meaning	Unit	Possible values	Default setting
<i>PO1</i>	Display of the parameters	-	-	-
<i>PO1ECC</i>	Switching of ECC control to first pulse output	-	0 - off 1 - on	0
<i>PO1Factor</i>	Scaling factor	-	-2500.0 ... 2500.0	1
<i>PO1On</i>	On/Off	-	0 - off 1 - on	1

<b>PO1Output</b>	Output type of the second phase	-	0 - A+B 1 - A+DIR	0
<b>PO1Sync</b>	Output control	-	0 – average synchronous 1 – trigger synchronous	0
<b>PO1Value</b>	Value	-	V - Velocity R – Measuring rate Q - Quality	V

## Commands for output via pulse output 2

Table 44: Commands for pulse output 2

Command	Meaning	Unit	Possible values	Default setting
<b>PO2</b>	Display of the parameters	-	-	-
<b>PO2ECC</b>	Switching of ECC control to first pulse output	-	0 - off 1 - on	0
<b>PO2Factor</b>	Scaling factor	-	-2500.0 ... 2500.0	1
<b>PO2On</b>	On/Off	-	0 - off 1 - on	1
<b>PO2Output</b>	Output type of the second phase	-	0 - A+B 1 - A+DIR	0
<b>PO2Sync</b>	Output control	-	0 – average synchronous 1 – trigger synchronous	0
<b>PO2Value</b>	Value	-	V - Velocity R – Measuring rate Q - Quality	V

## Commands for output via pulse output 3

Table 45: Commands for pulse output 3

Command	Meaning	Unit	Possible values	Default setting
<b>PO3</b>	Display of the parameters	-	-	-
<b>PO3ECC</b>	Switching of ECC control to first pulse output	-	0 - off 1 - on	0
<b>PO3Factor</b>	Scaling factor	-	-2500.0 ... 2500.0	1
<b>PO3On</b>	On/Off	-	0 - off 1 - on	1
<b>PO3Output</b>	Output type of the second phase	-	0 - A+B 1 - A+DIR	0
<b>PO3Sync</b>	Output control	-	0 – average synchronous 1 – trigger synchronous	0
<b>PO3Value</b>	Value	-	V - Velocity R – Measuring rate Q - Quality	V

## Commands for the output via the serial interface 1

Table 46: Commands for serial interface 1

Command	Meaning	Unit	Possible values	Default setting
<b>SO1</b>	Displays S1 parameters	-	-	-
<b>SO1Format</b>	Output format	-	See text	V*60:6:2 'm/min'
<b>SO1Interface</b>	Setting serial interface 1	-	See text	9600 N X D
<b>SO1On</b>	On/Off	-	0 - off 1 - on	0

Command	Meaning	Unit	Possible values	Default setting
<b>SO1Sync</b>	Output control	-	0 - Time 1 - Trigger	0
<b>SO1Time</b>	Output time	ms	1 ... 65535	500 ms

## Commands for the output via the serial interface 2

Table 47: Commands for serial interface 2

Command	Meaning	Unit	Possible values	Default setting
<b>SO2</b>	Displays S2 parameters	-	-	-
<b>SO2Format</b>	Output format	-	See description	#rat'r:3t42
<b>SO2Interface</b>	Setting serial interface 2	-	See description	9600 N X D
<b>SO2On</b>	On/Off	-	0 - off 1 - on	0
<b>SO2Sync</b>	Output control	-	0 - Time 1 - Trigger	0
<b>SO2Time</b>	Output time	ms	1 ... 65535	500 ms

## Commands for the light barrier controller LBC9-CA

Table 48: Commands for the light barrier controller LBC9-CA

Command	Meaning	Unit	Possible values	Default setting
<b>LBC</b>	Displays Parameter of the LBC control	-	-	-
<b>LBCD1</b>	Distance first STOP to START light barrier	m	0 ... 999.9999	-
<b>LBCD2</b>	Distance second STOP to START light barrier	m	0 ... 999.9999	-
<b>LBCD3</b>	Distance third STOP to START light barrier	m	0 ... 999.9999	-
<b>LBCD4</b>	Distance fourth STOP to START light barrier	m	0 ... 999.9999	-
<b>LBCD5</b>	Distance fifth STOP to START light barrier	m	0 ... 999.9999	-
<b>LBCD6</b>	Distance sixth STOP to START light barrier	m	0 ... 999.9999	-
<b>LBCD7</b>	Distance seventh STOP to START light barrier	m	0 ... 999.9999	-
<b>LBCD8</b>	Distance eight STOP to START light barrier	m	0 ... 999.9999	-
<b>LBCON</b>	Switching in the offset recognition	-	0 - off 1 - on	0

## Commands for offline measurement

Table 49: Commands for the serial offline measurement

Command	Meaning	Unit	Possible values	Default setting
<b>OFF</b>	Display parameter for offline operation	-	-	-
<b>OFFFactor</b>	Scaling factor	-	-2500.0 ... 2500.0	1
<b>OFFLine</b>	Starting the offline measurement	-	[T] waiting for trigger	-
<b>OFFMeasure</b>	Measuring time	s	1 ... 65535	10 s
<b>OFFRead</b>	Reading out offline data	-	-	-
<b>OFFSync</b>	Output control	-	0 – average synchronous 1 – trigger synchronous 2 – burst synchronous	0
<b>OFFTime</b>	Averaging time and storage time	ms	2 ... 65535	50 ms
<b>OFFValue</b>	Value	-	F - Frequency L - Length N – Object counter R – Measuring rate S - R + V V - Velocity	V

## Test commands

Table 50: Test commands

Command	Meaning	Unit	Possible values	Default setting
<b>TestAO</b>	Test of the analog output	-	-	-
<b>TestFilter</b>	Test of the filter board	-	-	-
<b>TestIO</b>	Test of the inputs and outputs	-	-	-
<b>TestMeasure</b>	Test of the measuring function	-	-	-
<b>TestPS</b>	Test of the power supply	-	-	-
<b>TestQuality</b>	Test of the signal quality	-	-	-
<b>TestTComp</b>	Test of the temperature compensation	-	-	-

## Read commands

Table 51: Read commands

Comm and	Return value	Unit	Decimal places	Example
<b>B</b>	Number of Bursts	-	0	1235
<b>D</b>	FIFO filling level	-	0	1
<b>E</b>	Exposure time	-	0	12
<b>F</b>	Frequency of the last burst	Hz	2	1234.56
<b>I</b>	Lamp intensity	-	0	24
<b>L</b>	Length	m	4	1234.5678
<b>P</b>	Number of periods	-	0	12
<b>R</b>	Measuring rate	-	0	45
<b>V</b>	Velocity	m/s	5	-1.23456
<b>X</b>	Number of the last error	-	0	32

## Service commands

Table 52: Service commands

Determination	Meaning	Remark
<i>Password</i>	Set password	Default setting 'WEGA'
<i>Restart</i>	Restarts device	Interrupts measurement
<i>Restore</i>	Load a certain parameter set	Interrupts measurement
<i>Simulation</i>	Simulation f, [n] f - Velocity in m/s n - Measuring rate	Interrupts measurement
<i>Standby</i>	Standby Mode	Stops measuring function and switches the light off
<i>Store</i>	Store parameter to a certain storage place	With password protection, interrupts measurement for a short time
<i>Update</i>	Update of the firmware (only via Interface S1)	Use the program VLMTTool instead of the command!

## System commands

Table 53: System commands

Command	Meaning	Unit	Possible values	Default setting
<i>Amplifier</i>	Signal amplification	-	0 ... 3 - fixed a - Automatic	4
<i>Bw</i>	Bandwidth	%	a - Automatic 10 ... 75	0
<i>Calfactor</i>	Calibration factor	-	0.950000 ... 1.050000	1.000000
<i>Calibrate</i>	Calibration c, n, f c - Velocity or length n - Measuring time in s / Number f - Calibration value m/s o. m		V, L 1 ... 65535 0.0001 ... 10000	-
<i>Constant</i>	Display Ex factory calibration	-	-	Ex factory
<i>Controltime</i>	Control period in case of underload	s	0.01 ... 1.00	0.1
<i>Epsilon [f]</i>	Percent deviation of the periods	%	a - Automatic 0.787 ... 50.0	0
<i>Epsilon [c]</i>	Activation of the 2nd Epsilon table	-	0 - off 1 - on	0
<i>Exposure</i>	Exposure time	-	0 ... 14 - fixed a - Automatic	15
<i>Expmax</i>	Maximum exposure time during control	-	0 ... 14 - fixed a - Automatic	15
<i>Expmin</i>	Minimum exposure time during control	-	0 ... 14 - fixed a - Automatic	15
<i>Illumination</i>	Intensity of the LED	-	0 ... 30 - fest a - Automatic	31
<i>Illmax</i>	max. LED intensity during control	-	0 ... 30	30
<i>Illmin</i>	min. LED intensity during control	-	0 ... 30	0
<i>OED</i>	Fast overexposure recognition	-	0 - off 1 - on	0
<i>Permax</i>	Maximum permissible number of periods	-	a - Dynamic 16, 32, 64, 128 - fixed	0
<i>Permin [n1]</i>	Minimum permissible number of periods	-	a - Automatic 2 ... 15 - fixed	0
<i>Permin [n2]</i>	Minimum permissible number of	-	2 ... 15 - fixed	-

Command	Meaning	Unit	Possible values	Default setting
	periods for dynamic period adaptation			
<i>RateInterval</i>	Average time for rate calculation	ms	5 ... 100	5
<i>TComp</i>	Display Temperature compensation	-	-	Ex factory
<i>TMax</i>	Display the maximum reached temperature	°C	-	-
<i>SensLevel</i>	Sensitivity of the period duration measuring device	-	0 ... 3	1
<i>SetAuto</i>	Setting Parameter to Automatic	-	1 ... 4 (see text)	-
<i>Type</i>	Displays device type	-	-	-
<i>Video</i>	Video mode	-	-	-

## 11.2 Programming examples

### Print protocol

Steel plates are cut in a production plant. A VLM500 measuring device with optional laser light barrier and real-time clock is used for final inspection. A print log with date, time, consecutive number with factory identification number and plate length shall be generated.

A light barrier is connected to the input 'TR11' (trigger input) that detects the start and end of the plate. A printer with serial interface is connected after programming it with interface 1 of VLM500.

Table 54: Example for programming a print log

Command line	Meaning
<i>Trigger 0</i>	Single part measuring
<i>SO1Interface 9600 N D</i>	Baud rate of the printer, no protocol
<i>SO1Sync 1</i>	Output at the end of the plate (trigger)
<i>SO1Format D ' ' C N:6 '/KW1' L:8:3</i>	Output date, time, counter, string, length
<i>SO1On 1</i>	Switch on
<i>Store</i>	Save with password input

The abbreviated notation without spaces would also be possible for specifying the format:

*SO1Format D' 'CN:6'/KW1'L:8:3*

### Pulse output

A wheel with shaft encoder should be substituted. The shaft encoder delivered 2 pulses per millimeter. 50 ms are chosen as sampling frequency due to the process dynamics. The shaft encoder output of the VLM500 is connected to the existing control.

Calculation:

$$\text{Output frequency [in kHz]} = \text{factor [1/mm]} \cdot \text{velocity [in m/s]}$$

Equivalent to:

$$\text{Pulse number} = 1000 \cdot \text{factor [1/mm]} \cdot \text{length [m]}$$

$$\begin{aligned} \text{Factor} &= \text{pulse number} / (1000 \cdot \text{length [m]}) \\ &= 2 / (1000 \cdot 0,001) \end{aligned}$$

$$\underline{\text{Factor}} = 2 \quad (\text{i.e. pulses per mm could be entered directly!})$$

**Table 55: Example for programming the pulse input**

Command line	Meaning
<i>Average 50</i>	Averaging time 50 ms
<i>PO1Value V</i>	Velocity
<i>PO1Sync 0</i>	Update at equivalent time intervals
<i>PO1Factor 2</i>	2 pulses per mm
<i>PO1On 1</i>	Switch on
<i>Store</i>	Save with password input

### 11.3 Error messages

All error messages begin with the letter 'E' and a two-digit error number. The last five errors that occurred are cached during the operation from error code 'E10' on. The command *Error* shows the numbers and error texts. The short command *X*, on the contrary, returns only the last error code. Certain critical and fatal errors will be stored permanently and can be retrieved by calling the command *ListError*.

A continuous output of the errors from 'E10' on can take place in the format statements *SO1Format* and *SO2Format* with the parameter *X*.

Critical errors mostly demand a modification of the programming or the use conditions. Activating the command *Error* deletes this error from the list

Fatal errors indicate severe hardware errors. The measuring function is switched off in such a case. The device must be checked. These errors are not deleted from the list by activating the command *Error*.

Further descriptions appear in brackets in some error texts that are self-explanatory in the following table.

**Table 56: Error list**

Code	Meaning	Cause
E00 No ERROR	No error occurred	-
E01 Missing parameter	No or too few parameters specified	Incorrect command input
E02 Value out of range	Number too small or too big	Incorrect command input
E03 Invalid command	Non-existent command	Incorrect command input
E04 Invalid parameter	Parameter not allowed	Incorrect command input
E05 No data	No data in memory	Offline Measurement
E06 Memory full	Memory full	Too many measured values during offline measurement
E07 ESC user abort	Abort by ESC	Offline measurement and calibration
E08 Calibration Error	Faulty calibration	Dropout during the calibration (see The command <i>Signalerror</i> )
E09 Illegal Use	Input disabled for 60 s	Password entered incorrectly 3 times
E10 SO1 output error	Error during S1 output	Output too fast
E11 SO1 input error	Parity error, buffer overflow etc.	Transmission error, see <i>SO1Interface</i>
E12	<i>not in use</i>	
E13 SO2 output error	Error during S2 output	Output too fast
E14 SO2 input error	Parity error, buffer overflow etc.	Transmission error, see <i>SO2Interface</i>
E15 – E16	<i>not in use</i>	
E17 Analog output error	Error during analog output	Output too fast
E18 Incremental output error	Error during pulse output	Output too fast
E19 Offline output error	Error during offline	Measurement too fast



Code	Meaning	Cause
	measurement	
E20 Warning, check MODE and VMAX	Overflow	Check settings of <i>Mode</i> and <i>Vmax</i> , refer to data sheet
E21	<i>not in use</i>	
E22 Warning, AVERAGE adjusted	Value too short chosen for AVERAGE	The internal signal processing is faster than the AVERAGE value
E23 VMAX too large for 'direction a'	VMAX too high for automatic direction detection	DIR is set to auto and VMAX setting is too high for the automatic direction detection
E24 No direction board found	The entered command is not accepted because an automatic direction detection is not installed	Setting DIR to auto is not allowed without an automatic direction detection board (DIRB)
E25 Output is busy, please try again later!	Command blocked by other interface	Commands requiring an input such as <i>Test</i> , <i>TestAO</i> , etc. cannot be executed simultaneously on both interfaces S1 and S2
E26 Warning, Signal error during length measurement	Faulty length measurement	Signal dropout during length measurement (see The command <i>Signalerror</i> )
E27 Warning, FPGA overflow detected!	Measuring values lost	The measuring value cache was exceeded.
E28 External Standby not possible with current TRIGGER setting!	When using the standby input, not all settings of TRIGGER are allowed	TRIGGER was set using two trigger inputs. This can only be achieved, when SELTRIGGER is set.
E29	<i>not in use</i>	
E30 Periods out of range	Error in signal processing	Invalid number of periods
E31 Over temperature detected!	Internal temperature higher than 75 °C	Switch of the device immediately, cooling required
E32 LED voltage error detected!	Light source defect. Too high voltage	Light source is defect and must be replaced Contact service!
E33 Watchdog timer reset	Reset by watchdog	Processor crashed (also during overload)
E34 LED current error detected!	Light source defect. Too high current	Light source is defect and must be replaced Contact service!
E35 I <sup>2</sup> C arbitration error detected	Internal software error	Unknown error on the internal I <sup>2</sup> C-Bus
E36 I <sup>2</sup> C counter level changed	Internal software error	Unknown error on the internal I <sup>2</sup> C-Bus
E37 I <sup>2</sup> C time out occurred	Internal software error	Unknown error on the internal I <sup>2</sup> C-Bus
E38 I <sup>2</sup> C control part reset	Internal software error	Unknown error on the internal I <sup>2</sup> C-Bus
E39 I <sup>2</sup> C initialization of registers	Internal software error	Unknown error on the internal I <sup>2</sup> C-Bus
E40 Error reading PARAMETER, contact vendor!	An error occurred while transferring the parameters from FLASH to RAM	Fatal error, contact your local vendor or the manufacturer
E41 PARAMETER set not existing or set invalid	The parameter set to be loaded does not exist or is invalid	If the set is not existing, it will be created automatically
E42 Wrong PARAMETER version, contact vendor!	The parameter set to be loaded has the wrong version	Fatal error, contact your local vendor or the manufacturer
E43	<i>not in use</i>	
E44 Parameter not stored!	Parameter could not be stored!	Fatal error, device must be repaired
E45 FPGA reset failed!	Faulty reset of the FPGA	Fatal error, device must be repaired
E46 Too high frequency!	Plausibility Error	Measured data are wrong
E47 – E49	<i>not in use</i>	

<b>Code</b>	<b>Meaning</b>	<b>Cause</b>
E50 Analog 12V out of range	The voltage 12V is out of range	24V voltage supply is instable Internal hardware error
E51 Analog 5V out of range	The voltage 5V is out of range	24V voltage supply is instable Internal hardware error
E52 Analog -5V out of range	The voltage -5V is out of range	24V voltage supply is instable Internal hardware error
E53 Analog -12V out of range	The voltage -12V is out of range	24V voltage supply is instable Internal hardware error
E54 Digital 5V out of range	The voltage 5V <sub>dd</sub> is out of range	24V voltage supply is instable Internal hardware error
E55 Digital 1.2V out of range	The voltage 1.2V is out of range	24V voltage supply is instable Internal hardware error
E56 – E59	<i>not in use</i>	
E60 FPGA (ADSC) not found	No availability of signal processor	Internal Hardware error
E61 SRAM not found	No availability of SRAM	Internal Hardware error
E62 FRAM not found	No availability of FRAM	Internal Hardware error
E63 RTC not found	No availability of Real time clock	Internal Hardware error
E64 DAC not found	No availability of digital analog converter	Internal Hardware error
E65 FB not found	No availability of filter board	Internal Hardware error
E66 DTS not found	No availability of digital temperature sensor	Internal Hardware error
E67 TERM not found	No availability of terminal board	Internal Hardware error
E68 – E79	<i>not in use</i>	Internal Hardware error
E80 Non valid hex file	Wrong format	No valid file
E81 Illegal address range	Wrong address range	No valid file
E82 User terminated	Cancellation	Transmission interrupted
E83 Checksum Error	Error checksum calculation	File error
E84 Verification error, no valid program in flash memory	Check after programming failed	Do not switch off the device and do not leave the boot loader! Try again with command <i>Update</i> .
E85 No target device to update found	There is no fieldbus module installed in the VLM, for which an update could be executed	The 'update f' – command was called regardless of an installed fieldbus module
E86 Hex file not valid for this gauge	File is not suitable for this device	No valid file for this device.
E87 Hex file not valid for the selected target	The selected FW-file doesn't correspond to the selected board (ADSC or IPUN)	Wrong file was selected.
E88 - E99 unknown error	Unknown error	Software error

## 11.4 Meaning of the light diodes

Table 57: Meaning of the light diodes

LED	Colour	Meaning
Signal-LED	green	Signal available
	red	Signal quality not good, also see <i>Minrate</i> and <i>ECCOn</i>
	yellow	Signal available, VMIN undershoot
Busy-LED	yellow	Command is processed, also during calibration and offline measurement
	off	No command processing
	flash	During standby mode
Error-LED	red	Shortly on in case of critical errors (see table 53)
	off	No error
Forward-LED	green	Direction alignment set to forward (from housing bottom to lid)
	off	Direction alignment set to backwards
Backward-LED	green	Direction alignment set to backwards (from housing bottom to lid)
	off	Direction alignment set to forward

## 11.5 Units of the output values

Table 58: Measuring values with units and their resolution

Determination	Unit	Value range for task	Max. Resolution
Velocity	1 m/s	$\pm 21474$	0,0001 *)
Length	1 m	$\pm 2,000,000,000$	0,0001 *)
Object counter	1 item	0 .. 65535	1
Measuring rate	none	0 .. 100	0,1 **)

\*) Without format specification, the value is output with three decimal digits during S1- and S2-output. In case of hexadecimal output, the output is given with maximum resolution.

\*\*) Without format specification, the value is output without decimal digits during S1- and S2-output. In case of hexadecimal output, the output is given with maximum resolution.

## 11.6 Terminal assignment

### Device connection 1, RS-232, RS-4xx, USB

The device connection 1 is reserved for the communication boards in slot 2. The terminal assignment is fixed with respect to type of the communication board. The following table shows the according assignment.

Table 59: Device connection #1

Pen number	Colour internal	Assignment			
		RS-232	RS-4xx 2 wire	RS-4xx 4 wire	USB
1	brown	RxD	R+ / T+ / A	R+ / A	5V
2	white	TxD	R- / T- / B	R- / B	D-
3	blue	GND	do not use	T- / Z	GND
4	black	do not use	do not use	T+ / Y	D+
5	grey	do not use	do not use	do not use	do not use

## Device connection 2, 4 and 5

The terminal assignment of the connections 2, 4 and 5 are wired according to customer specification and displayed in the enclosed documents.

## Device connection 3 with current supply 24V/DC

Table 60: Device connection #3, Current supply 24V/DC

Pen number	Color cable	Assignment 24V/DC
3	black 1	0 Volt
4	black 2	24 Volt
PE	green/yellow	Protective Earth



Caution: Ground the device with the grounding cable before connecting it to the current supply.

## 11.7 Plug connector

### Assembly instructions for plug connector connections 1, 2, 4 and 5

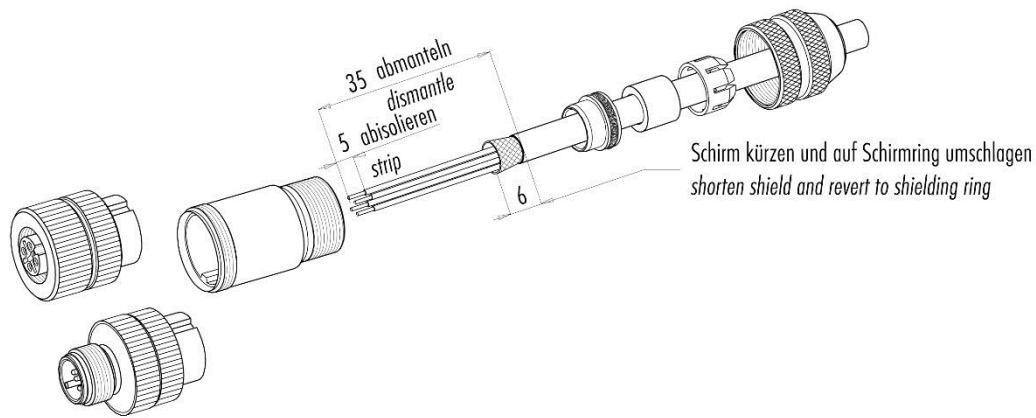


Figure 30: Assembly instruction for shielded plug connectors connections 1, 2, 4 and 5

### Assembly instructions for plug connector connection 3

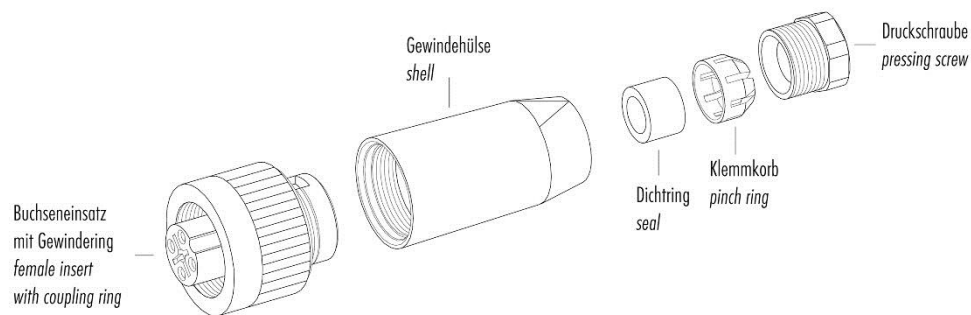


Figure 31: Assembly instruction for shielded plug connectors connection 3 (24 V DC)

**Contact assignment cable plugs and cable boxes**

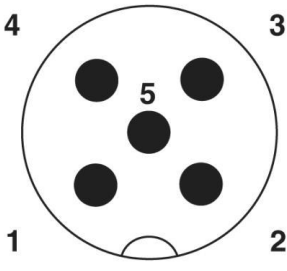
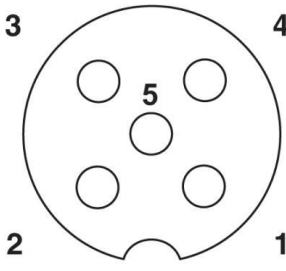
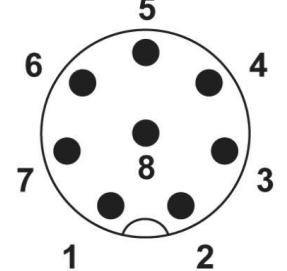
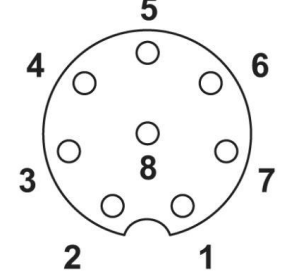
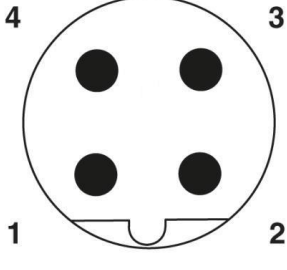
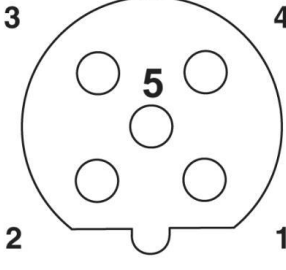
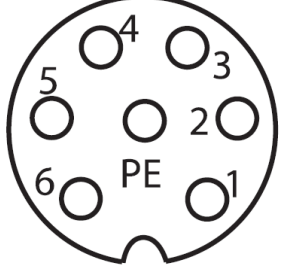
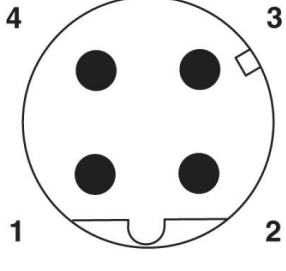
<p><b>Cable plug 5 pole, M12, A coding, USB, RS-232, RS422, RS485</b></p>	<p><b>Cable plug 5 pole, M12, A coding, Different inputs and outputs, e.g. analog output</b></p>
	
<p><b>Cable plug 8 pole, M12, A coding, Pulse output 5V</b></p>	<p><b>Cable box 8 pole, M12, A coding, digital inputs and outputs (IN, OUT)</b></p>
	
<p><b>Cable plug 4 pole, M12, B coding, Profibus output</b></p>	<p><b>Cable box 4 pole, M12 B coding, Profibus input</b></p>
	
<p><b>Cable box 7-polig, RD24, Series 693 Input 24V DC</b></p>	<p><b>Cable plug 4 pole, M12, D-coding Ethernet/Profinet- connection</b></p>
	

Figure 32: Assignment of the plug connector (Display on the plug page)

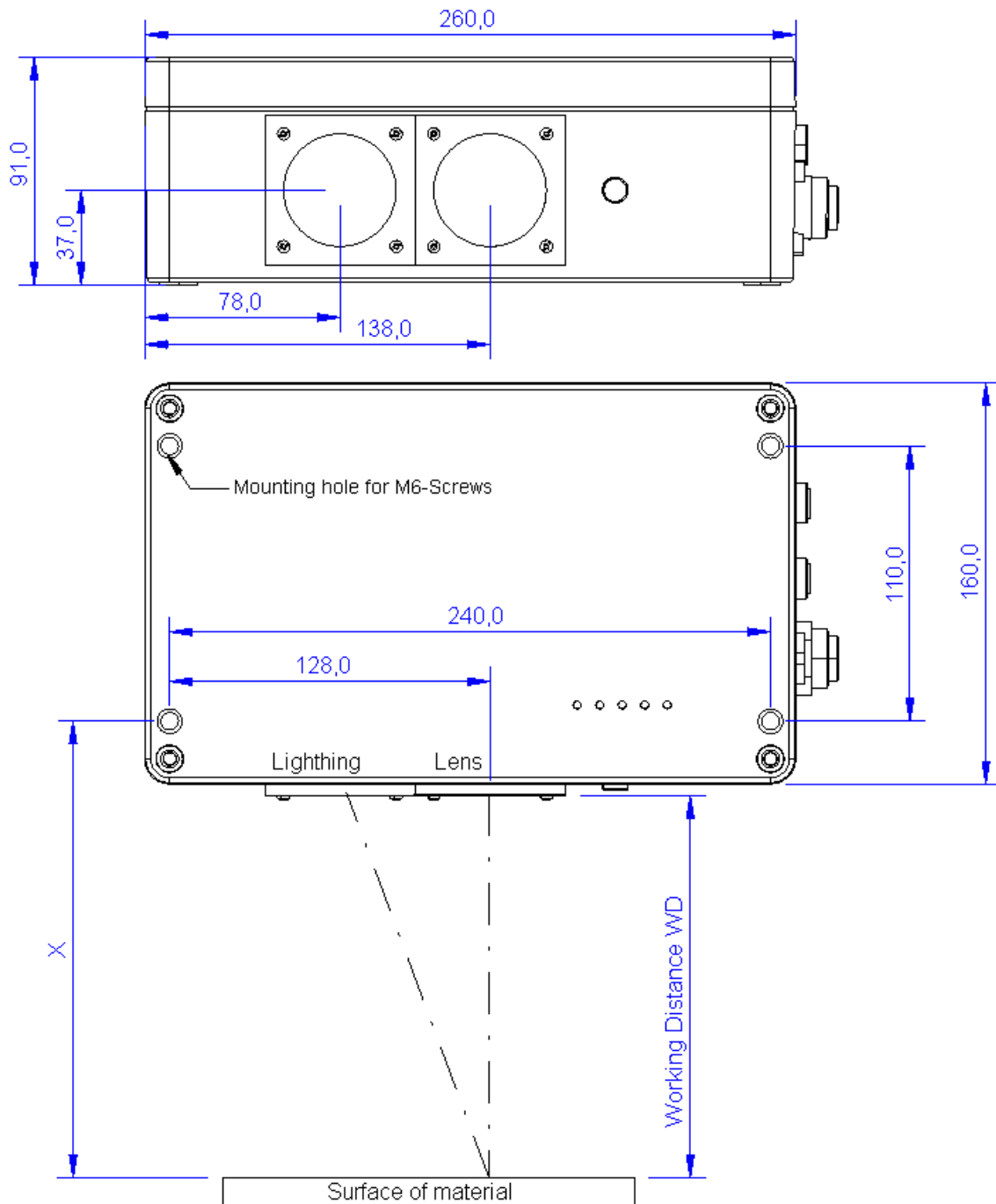
## 11.8 Article numbers

The most common extension cards, connection cables/plugs, replacement windows and replacement lamps are listed in Table 61. Other articles are available, like protective housing, assembly accessories and single sensors without accessories. These must be requested at a trader or the manufacturer if required.

**Table 61: Article numbers**

Article No.	Determination
41-1101-01	VLM500A Set with accessories
41-1103-01	VLM500D Set with accessories
41-1105-01	VLM500L Set with accessories
19-1201-00	Interface card IOPL – Input/Output Positive logic
19-1204-00	Interface card I232 – RS232 interface
19-1205-00	Interface card I4U2 – RS485 as 2 wire line
19-1206-00	Interface card I4U4 – RS485 as 4 wire line
19-1207-00	Interface card IUSB – USB interface
19-1208-00	Interface card IFPB – Profibus DP interface
19-1209-00	Interface card IFFE – Fast-Ethernet interface
19-1210-00	Interface card IFPN – Profinet IO interface
19-1211-00	Interface card IPPL – Pulse output Positive logic
19-1212-00	Interface card IPPP – Pulse output Push-Pull
19-1213-00	Interface card IP5V – Pulse output 5 V
19-1214-00	Interface card IA00 – Analog output 0 mA ... 20 mA
19-1215-00	Interface card IA04 – Analog output 0 mA ... 24 mA
19-1216-00	Interface card IA40 – Analog output 4 mA ... 20 mA
19-1217-00	Interface card ILBC – Connection for light barrier controller LBC9-CA
19-1218-00	Interface card IECC – Rotary encoder switching
19-1042-00	Filter card DIRB for automatic direction detection
19-1000-00	Option for glowing metals (VLM500 /h)
19-1021-00	Option Pressure Compensation Segment
15-0019-00	Programming cable RS-232, 5m
15-0041-00	Programming cable USB, 4.5m
15-0020-00	Connection cable M12F5A-M12F5A, 5m
15-0026-00	Current supply cable 24V, 5m
15-0000-00	Terminating resistor for Profibus
15-0010-00	Cable plug, 5 pole, A-Cod.
15-0011-00	Cable box, 5 pole, A-Cod.
15-0012-00	Cable box, 4 pole, RD24
15-0013-00	Cable box, 7 pole, RD24
15-0014-00	Cable plug Profibus OUT, 4 pole, B-Cod.
15-0015-00	Cable box Profibus IN, 4 pole, B-Cod.
15-0016-00	Cable plug, 8 pole, A-Cod.
15-0017-00	Cable box, 8 pole, A-Cod.
15-0018-00	Cable plug Ethernet, 4-pin, D-coded
15-0021-00	Cable box, 4 pole, RD24, 90°
15-0022-00	Cable box, 7 pole, RD24, 90°
15-0023-00	Cable plug, 5 pole, A-Cod., 90°
15-0024-00	Cable box, 5 pole, A-Cod., 90°
14-0000-00	Replacement lamp LED
14-0002-00	Replacement window OW2 (Standard)
14-0002-01	Replacement window OW2K (Plastic)
14-0003-00	Replacement window OW3 (Heat protection for illumination, VLM500 /h only)
14-0004-00	Replacement window OW4 (Heat protection for objective, VLM500 /h only)
14-0005-00	Replacement window OW5 (Stainless steel)

### 11.9 Dimensional and installation drawings



Device	WD [mm]	X [mm]
A series	185	215
D series	240	270
L series	185	215
E series	330	360

Figure 33: Dimensional and installation drawings for different versions (in mm)



The working distance (WD) is always measured starting at the objective window.



## 12 Conformity declaration

<b>Manufacturer</b>	<b>ASTECH Angewandte Sensortechnik GmbH</b>
<b>Address</b>	18057 Rostock Schonenfahrerstr. 5 Germany
<b>Product name</b>	VLM500
<b>Description</b>	Optical length and velocity measuring device

### Conformity with the following standards

Emitted interference:	EN 61326-1:2013; grid-bound emission EN 61326-1:2013; radiated emission
Interference immunity:	EN 61000-6-2:2005 ESD EN 61000-6-2:2005 EM field EN 61000-6-2:2005 Burst EN 61000-6-2:2005 Surge EN 61000-6-2:2005 line-induced HF field

<b>Place</b>	Rostock
<b>Date</b>	April 2015

ASTECH Angewandte Sensortechnik GmbH



Jens Mirow  
Managing director