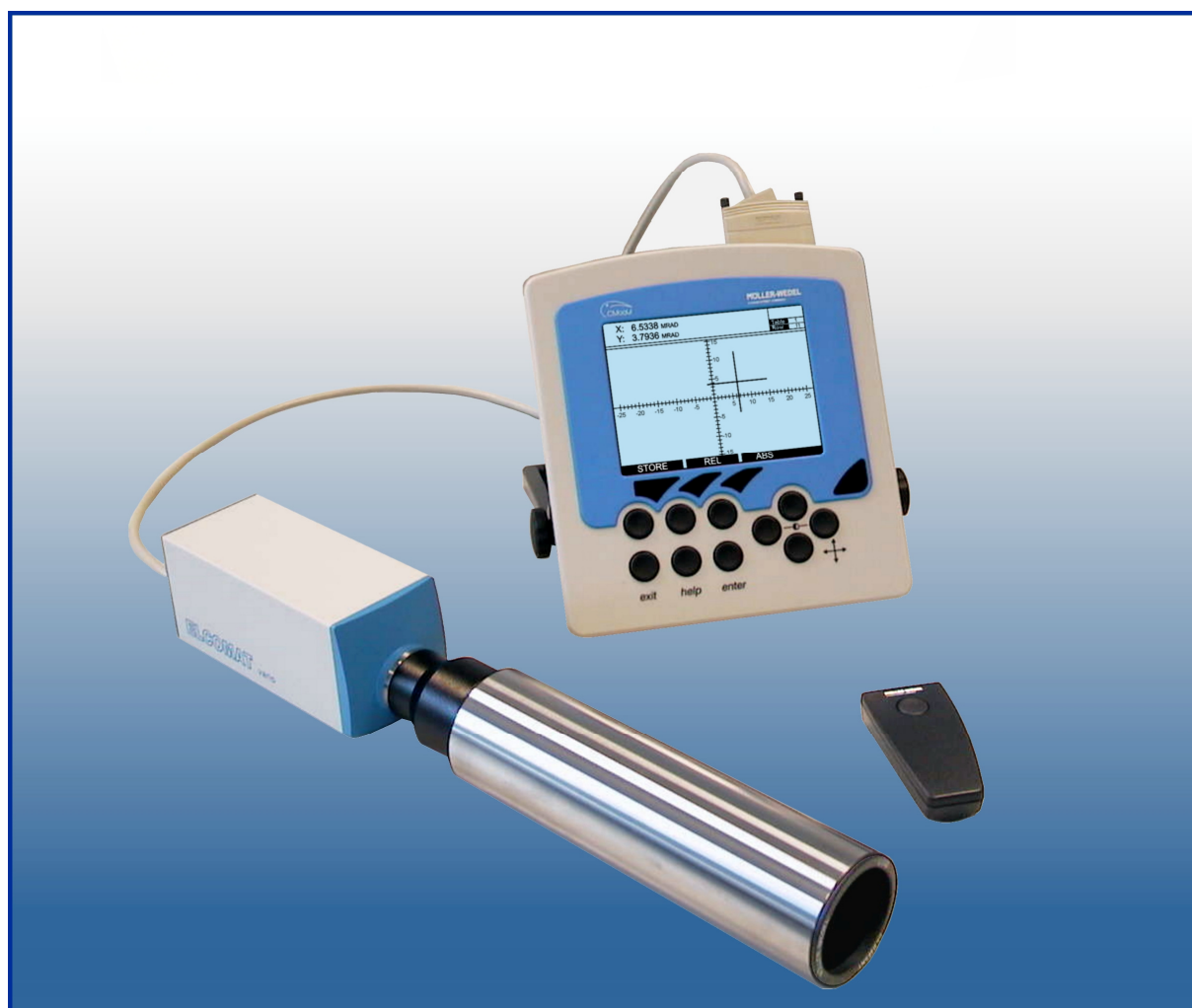


# Instruction Manual

## ELCOMAT vario

Electronic Autocollimator, 2-axis

Valid for Hardware / Software Rev. / SN 6.20



## Table of Contents

1.	IMPORTANT NOTES.....	4
	Liability to Functions and Damage.....	5
2.	INTENDED USE.....	6
3.	FUNCTION DESCRIPTION OF THE INSTRUMENT.....	6
3.1	Description of the ELCOMAT vario.....	6
3.1.1	ELCOMAT vario autocollimation measuring head.....	8
3.1.2	Control unit (Control Unit vario).....	9
4.	ASSEMBLY AND START UP.....	10
4.1	Unpacking and Inspection of the Equipment.....	10
4.2	Assembly of the Equipment.....	11
5.	OPERATION.....	12
5.1	Menu-guided Control Unit.....	12
5.1.1	Mode.....	12
5.1.2	Unit.....	13
5.1.3	GO/NG.....	14
5.1.4	RESOLUTION.....	15
5.1.5	RS-232.....	16
5.1.6	SOUNDS.....	16
5.1.7	IR-CONTROL.....	16
5.1.8	LANGUAGE.....	16
5.2	Operations in Finder, Table, Crossline and Large Digit mode.....	16
5.2.1	Finder Mode.....	16
5.2.2	Zoom-Function in Crossline mode.....	16
5.2.3	Setting REL-ABS.....	17
5.2.4	Storing Of Data in Table.....	17
5.3	RS-232 Protocols.....	18
5.3.1	Compatible Protocol.....	18
5.3.2	Text-Protocol.....	19
5.3.3	RS-232 Pin Definition.....	21
5.4	More Operational Information.....	22
5.4.1	Measuring Conditions.....	22
6.	HINTS TO PERFORM MEASUREMENTS.....	22
6.1	Preparation of measurements.....	22
6.1.1	Alignment of the autocollimator with the electronic alignment aid and the viewfinder prism.....	22
6.1.2	Measuring Procedure.....	23

6.2	General hints .....	24
7.	TECHNICAL DATA .....	25
7.1	Autocollimation Measuring Head .....	25
7.2	Control Unit (CModul) .....	26
7.3	Power Plug .....	27
7.4	Remote Control Unit .....	27
7.5	Dimension, Measuring Range And Accuracy Of ELCOMAT vario .....	28
8.	SPARE PARTS OF THE ELCOMAT VARIO.....	29
9.	MAINTENANCE AND CARE .....	30
10.	WARRANTY.....	30
<b>APPENDIX 1.</b>	<b>MEASURING RANGES AS FUNCTION OF THE DISTANCE</b>	
<b>APPENDIX 2.</b>	<b>GENERAL DESCRIPTION OF AUTOCOLLIMATION PRINCIPLE .....</b>	<b>28</b>
<b>APPENDIX 3.</b>	<b>SIGN CONVENTION FOR ANGLE MEASUREMENT .....</b>	<b>29</b>
<b>APPENDIX 4.</b>	<b>RESETTING THE CONTROL UNIT.....</b>	<b>29</b>
<b>APPENDIX 5.</b>	<b>DESCRIPTION OF TEXTPROTOCOL .....</b>	<b>30</b>
<b>APPENDIX 6.</b>	<b>DESCRIPTION OF THE LASER ATTACHMENT (IDENT. No. 219 757).....</b>	<b>33</b>
<b>APPENDIX 7.</b>	<b>DECLARATION OF CONFORMITY</b>	

## 1. Important Notes



### Safety Remarks

This equipment must only be used following the instruction manual. Please read the instructions first.

- It is only allowed to use the equipment in the intended way.
- The equipment is only for use in clean and dry environment. Also see next paragraph.
- The valid accident prevention regulations of Employer's for Electrical Systems and Operating Materials are to be observed. Special accident prevention regulations may occur out of the specific use of the instrument and have to be considered.
- The year of manufacturing and the serial number of the equipment is documented on the identification label.
- Keep this manual for later use.



### Safety conditions for operating the Equipment

The following conditions are to observe for safe operating of the instrument:

- Only for indoor use. Use only in clean and dry environment. No conductance dirt cover or condensation. Equipment must be adapted to the operating conditions in time to avoid any condensation.
- Operating Temperature 5-40°C.
- Humidity less 80% up to 32°C linear decreasing to 50% at 40°C .
- Height above zero normal not more than 2000m.
- Tolerance of mains voltage not above 10% from nominal value.
- Mains voltage 100-240V~ AC depending on country.
- Operating the equipment in mains, where transient over voltage peaks exceed the common values (more than allowed according to Over Voltage Class III according to EC664) is forbidden.
- It is not allowed to cover power supplies, to short-circuit the output or to pull them by cable. Defect or damaged supplies and cables must be disabled and substituted by original MÖLLER-WEDEL OPTICAL spare parts.
- Power plugs are only allowed to clean with a soft and dry cloth. Before cleaning disconnect them from the main voltage and the equipment.
- Do not short-circuit batteries or accumulators. Do not burn or open. Only use sealed batteries

Additional restrictions in use may result of the measurement application and are listed in the technical data. There you will also find other base data.



## MAINTENANCE AND CARE

Modifications or maintenance must only be carried out by persons explicitly authorised by MÖLLER-WEDEL OPTICAL GmbH.

Only original parts of MÖLLER-WEDEL OPTICAL must be used for maintenance.

After maintenance or technical modifications the equipment must be re-adjusted according to the technical instructions.

In case of technical inquiries the numbers on the relevant parts must be indicated.



Before cleaning or maintenance always disconnect from the mains and other equipment



## Liability to Functions and Damage

If the equipment is modified or repaired by not explicitly authorised persons, in case of improper maintenance (as far as not performed by MÖLLER-WEDEL OPTICAL) or in case of improper handling, any liability of MÖLLER-WEDEL OPTICAL is excluded.



## Accessories

Electrically driven accessories are permitted on the equipment only if its technically safe application is documented by a notified person (relevant certificate must be available).

PCs are permitted if they comply with the EN60950 and the combination is used under the above described conditions.



Optional:

The Laser Finder is classified as Laser Class 2. Please observe the valid security regulations.

## Declaration of Conformity

The declarations according to CE, environment and disposal are attached in the end of the manual.

## 2. Intended Use

The electronic autocollimators of the ELCOMAT vario series of MÖLLER-WEDEL OPTICAL is a complete measuring station for high-precision angle measurement.

It is designed for:

- Quality assurance for machine tools (straightness, parallelism, rectangularity, rotational position uncertainty, flatness)
- Mounting automation (automatic angle adjustment)
- Optics (angular measurement)
- Monitoring of positions (angles).

The equipment must only be operated by technical specialists after proper instruction and according to the operating manual.

The conditions of installation and operation must correspond to the requirements of measuring equipment:

- Low vibration
- Careful handling
- Clean environment
- Avoidance of extreme mechanical stress.

## 3. Function description of the instrument

### 3.1 Description of the ELCOMAT vario

The ELCOMAT vario consists of a newly designed optoelectronic autocollimation head (1.1) with an integrated high resolution CCD-camera, an objective tube (1.2), a special designed control unit with LCD display (1.3) with cable (1.4) , power supply unit (1.5) and remote control (1.6).

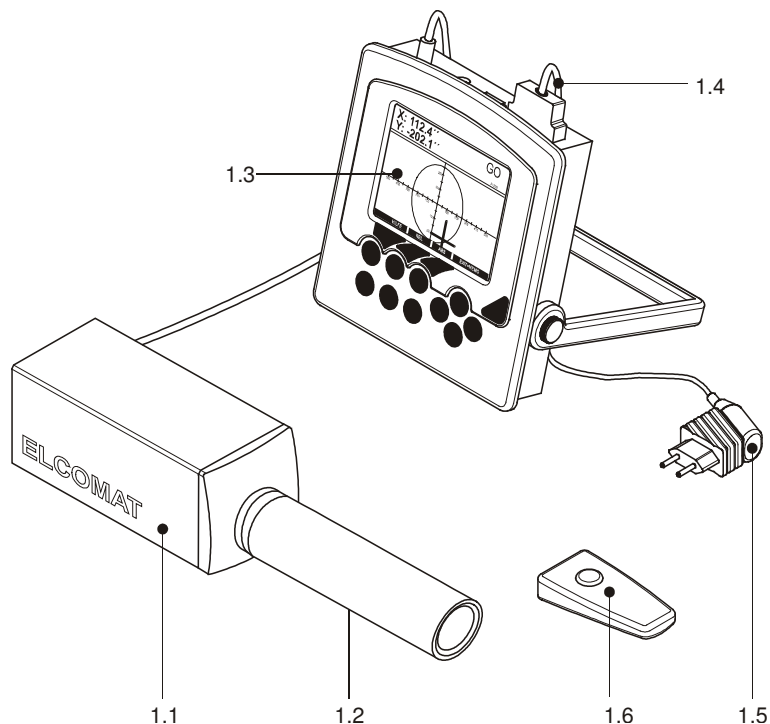


Fig. 1 ELCOMAT vario with CModul

The basic principle of the ELCOMAT vario is shown in Fig. 2.

An LED (Fig. 2.1) illuminates a reticle (Fig. 2.2) in the object plane of the collimator objective (Fig. 2.3). The illuminated reticle is reflected onto a mirror (Fig. 2.4) and the image is formed on a light sensitive receiver (Fig. 2.5).

The electronic autocollimator ELCOMAT vario makes measurements of very small angle changes in arcsec. The ELCOMAT vario measures in two axis, azimuth and elevation, simultaneously. The sign convention for these angle measurements is described in appendix 3. The measurements are all made in non-contact manner, working in a spectral range which is visible to human eye.

The equipment features fully electronic operation via a CCD-chip sensor. It has a highly advanced 32-bit microelectronic unit for accurate evaluation and display of the measurement signals with a high degree of reliability.

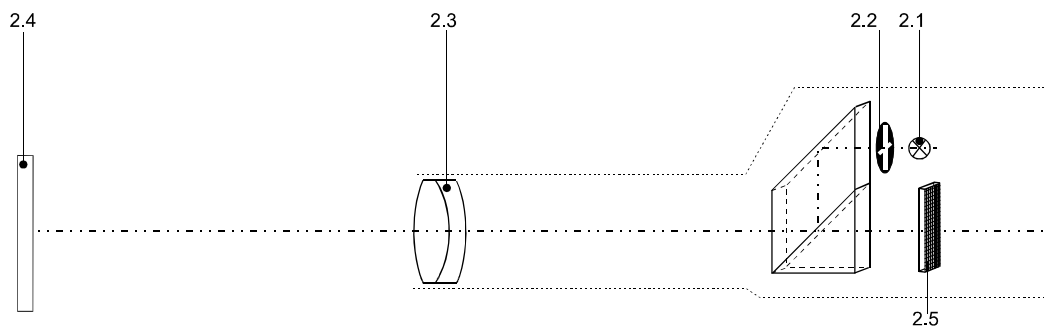


Fig. 2: Basic principle of ELCOMAT vario

The control unit (CModul) enables to operate the ELCOMAT vario precisely and make the full system easy to handle. The microprocessor in the control unit allows precise and easy operation of the complete measuring system. The control unit contains the following functions:

- Display of crosshairs for quick measurement and alignment
- Display digital readout of angular data
- Display functions of measured data
- Data manipulation
- RS-232 and USB Computer interface
- Brightness and contrast control of the display
- Control of LED brightness
- IR-receiver for remote control

### 3.1.1 ELCOMAT vario autocollimation measuring head

Fig. 3 shows the autocollimation measuring head .

The autocollimation measuring head is connected with the control unit via the cable.

All electronic autocollimators from MÖLLER-WEDEL OPTICAL are checked and calibrated individually. A computer controlled calibration, in connection with a highly developed reference system, takes account of all systematic errors that occur in the specific system, e.g. the lens, the autocollimation head and the CCD element.

Each instrument is shipped with its own test certificate, which documents the absolute accuracy of the instrument.

The ELCOMAT vario should have its calibration checked regularly.

The inspections depend on how the autocollimator is used; but the calibration intervals should not be greater than 36 months.

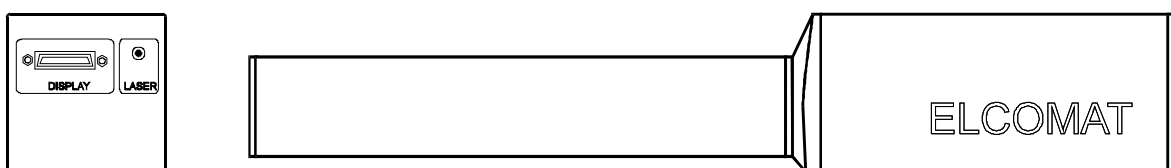


Fig. 3: ELCOMAT vario autocollimation measuring head

On the rear of the optical head there are connectors for the cable from the control unit and laser attachment.



**Use only the cable delivered from MÖLLER-WEDEL OPTICAL!**

### 3.1.2 Control unit (Control Unit vario)

The control unit contains a microprocessor which displays angular data on the LCD display as well as software for special measurement tasks.

The control unit is shown in Fig. 4. The LCD-Display permits easy reading of the data and menu-guided programs, even under poor lighting conditions.

Operation is effected via a keypad with 10 keys.

The individual programs can be called up with 6 program keys on the control unit. A detailed presentation of the program is given further on.

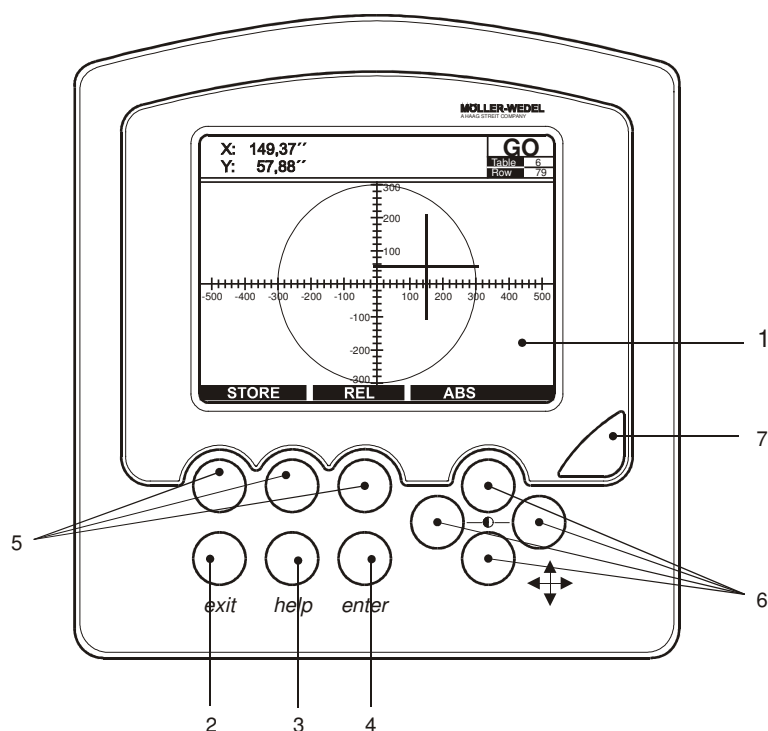


Fig. 4: Control unit (Control Unit vario)

4.1	LCD-display	4.5	Function keys
4.2	EXIT key	4.6	Arrow keys (left and right for contrast control)
4.3	HELP key	4.7	IR-receiver for remote control
4.4	ENTER key		

On the rear of the control unit there are the power switch, the power connector socket, the connector socket for autocollimation measuring head and connector socket for a computer or a printer. (see Fig. 5)

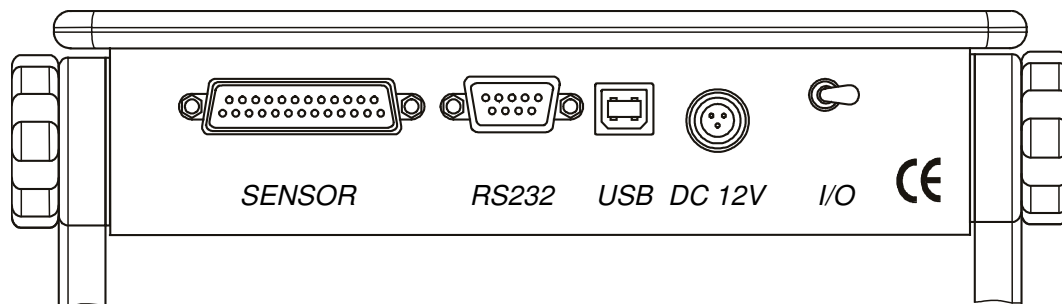


Fig. 5: Rear of control unit

The ELCOMAT vario measuring head is to be connected with the control unit.

The RS 232 interface is for connection with a PC to be used for reading data direct into a computer.

The control unit also offers connection via USB-port. In order to establish the connection connect PC and control unit with the USB cable. The operating system then asks for the driver of the USB-device. Choose manual installation and insert the INCOLINK-CD. The driver can be found in the folder "USB". After installation the ELCOMAT appears as an additional serial port on the PC and the data can be read out as described in section 5.3.

**Important Notice:**

It is not possible to use RS232 and USB-connection at the same time.

**Voltage**

For power supply use only the power supply unit supplied by MÖLLER-WEDEL OPTICAL.

The power supply unit switches over automatically from 230 V/50/60 Hz to 115 V/50/60 Hz.

## 4. Assembly and Start Up

### 4.1 Unpacking and Inspection of the Equipment

The equipment is shipped in a stable storage case. This case is designed for storage and transport.

Mechanical stress should be avoided.

The scope of delivery of the ELCOMAT vario consists of:

- Autocollimation measuring head (AK)
- Control unit (*fig. 3*)
- RS 232 Connection cable display-computer
- USB Connection cable display-computer
- Protection cap for objective lens
- Operating manual
- Measuring protocol

- ☞ **Immediately on receipt the equipment should be inspected for completeness**
- ☞ **The seal at the bottom of the autocollimation measuring head has to be inspected for any damage**

In case of claims the manufacturer or the local representative should immediately be informed.

#### **4.2 Assembly of the Equipment**

Insert the autocollimator into the adjustable holder or into the fixture D65/D40. Clamping or loosening can be done with the clamping knob or with the aid of the fixing screws depending on type of the holder / fixture.

Place the control unit in a stable position. Connect the cable from the autocollimation head to the control unit.

Connect the cable from the transformer to the power plug of the control unit.



**Use only the original power plug by MÖLLER-WEDEL OPTICAL.**

Remove lens cap from objective tube.

## 5. Operation

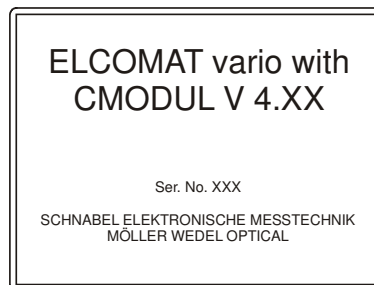
Due to the modular structure of the integrated microprocessor system, the autocollimator is simple to operate and is clearly structured. It does not require any specific prior knowledge of the operator.

Visual guidance via the On-Screen-Display is provided to guide the operator through the operating program and to draw his attention to any faults or operating errors that can occur.

The following sections give detailed instructions for handling the ELCOMAT vario.

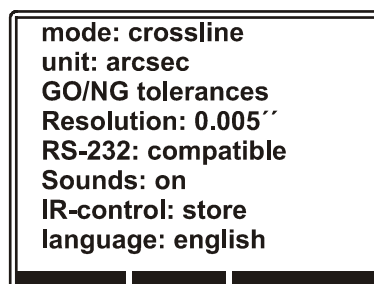
### 5.1 Menu-guided Control Unit

After connecting the autocollimation head to the control unit and switching on, the LCD display shows:



The monitor shows the information about the current software version and the focal length of objective tube to be used.

After several seconds the display switches to another display, showing the last used mode. Start with pressing the knob ENTER. The display shows:



Press the HELP key under the key bar of the monitor for more information.

Use arrow keys to change either MODE, UNITS, GO/NG tolerances, RESOLUTION, RS-232, IR, SOUNDS or LANGUAGE-settings.

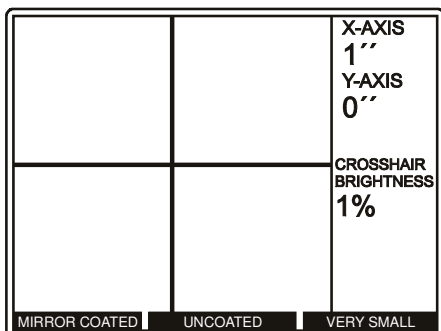


**In case the control unit doesn't react on key strokes or beeps continuously, you probably have to reset the unit. See Annex 4 for further details.**

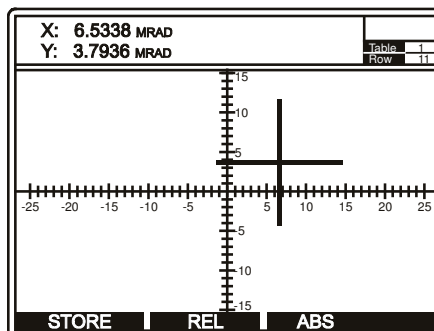
#### 5.1.1 Mode

By pressing the ENTER key switch between finder mode and the different display

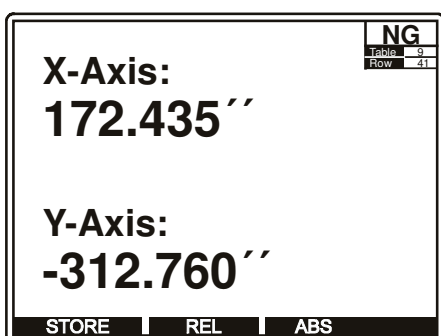
modes CROSSLINE , LARGE DIGITS and TABLE.



finder-mode



crossline-mode



large digits mode

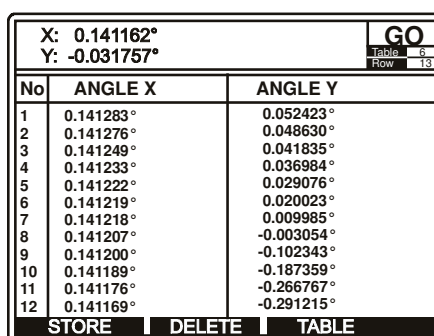
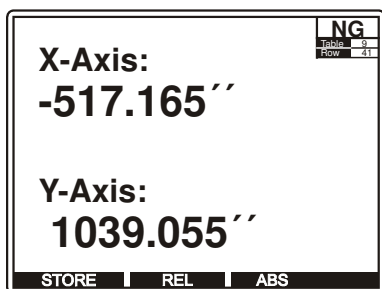


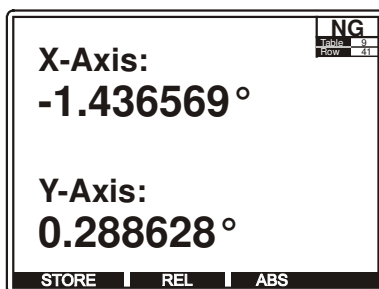
table-mode

### 5.1.2 Unit

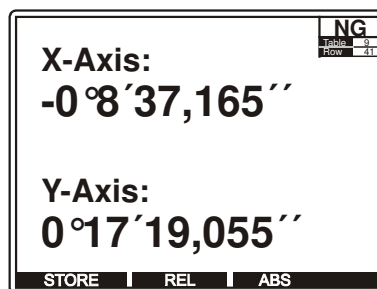
By pressing the ENTER key switch between the angular units "ARCSEC", "DEG", "MILLIRAD", DEG °MIN' SEC", DEGREE °, μm/m. Select the resolution you need.



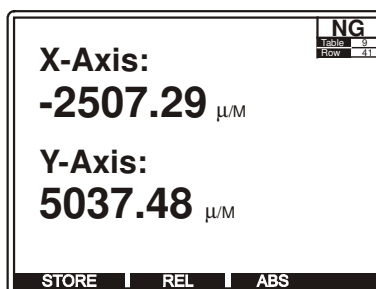
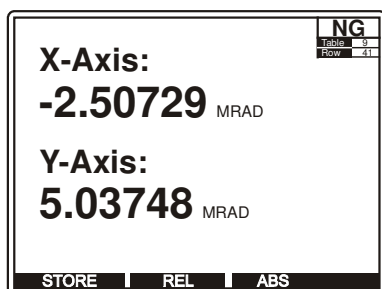
ARCSEC



DEGREE



DEG ° Min' ARCSEC"

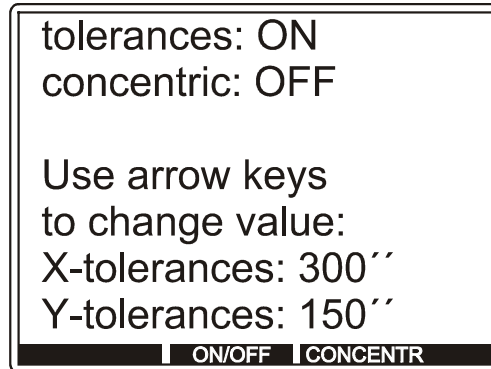


MILLIRADIAN

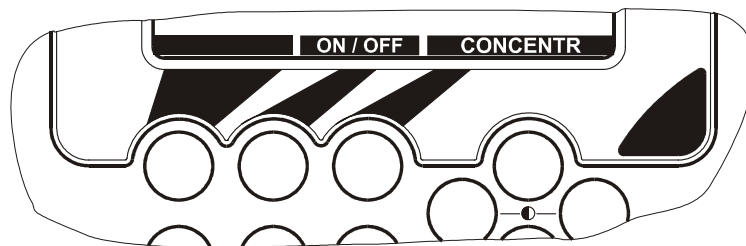
μm

### 5.1.3 GO/NG

Go to the main menu. Move the cursor to Go/NoGo tolerances.  
Press the ENTER key. A new menu occurs:



For activating the tolerance field on the display press the button below the ON/OFF field of the key bar. For deactivating the tolerance field display mode press again the ON/OFF key.

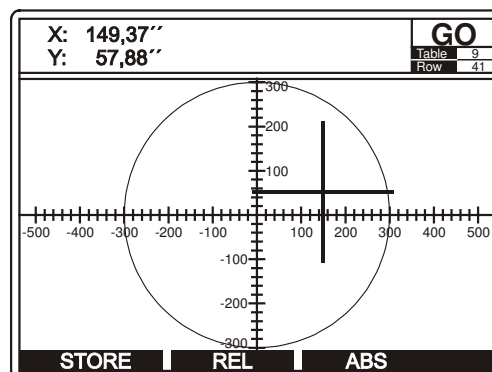
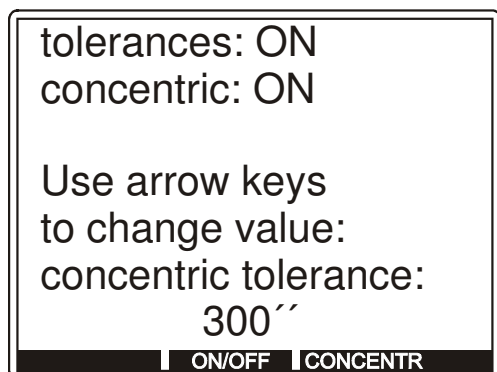


Pressing the right function key, indicated in the key bar by CONCENTRIC, the form of the tolerance field can be changed from concentric to rectangular field or otherwise. The selected form of tolerance field is indicated by:

concentric: ON or  
concentric: OFF

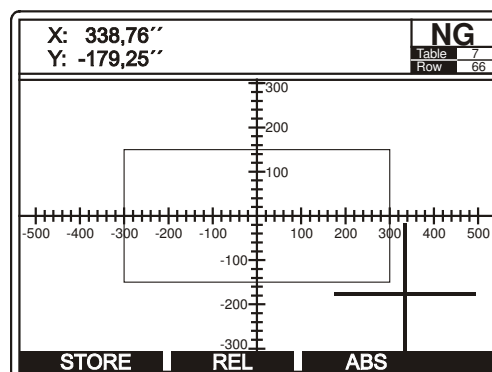
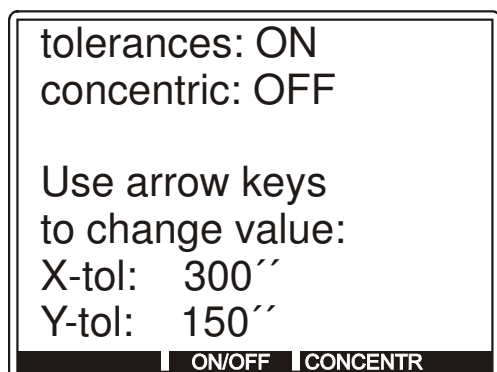
When using concentric tolerance field use LEFT/RIGHT arrow keys to increase/decrease the tolerance field.

To leave the tolerance setting menu press EXIT key. Now the display shows the actual numerical value and the position of the signal in Cartesian system with tolerance concentric field



When using rectangular tolerance field use the LEFT/RIGHT arrow keys to change the tolerance in X-direction and the UP/DOWN arrow keys to change the tolerance in Y-direction.

To leave the tolerance setting menu press EXIT key. The display shows the actual numerical value as the position of the signal in Cartesian system with tolerance rectangular field.



If the angle value is within the tolerance, the display shows **GO** in the upper right corner of screen, otherwise- **NG**.

#### 5.1.4 RESOLUTION

The resolution settings are valid for all mode of displays. By pressing the ENTER key the resolution can be changed in steps of 0.005", 0.01", 0.02", 0.05", 0.1", 0.5", 1", 2", 5", 10". To leave menu press EXIT key.

### **5.1.5 RS-232**

Pressing the ENTER key changes output format at the RS-232 interface:

OFF	no use of RS-232
COMPATIBLE	compatible to the old-ELCOMAT evaluation unit.
TEXT	Text output.

See RS-232-section for detailed description of the output formats. To leave menu press EXIT key.

### **5.1.6 SOUNDS**

By pressing the ENTER key the sound can be toggled ON and OFF. If turned ON, the control unit beeps, when the signal moves in and out of the measurement range or when a value is stored into the table. To leave menu press EXIT key.

### **5.1.7 IR-CONTROL**

Pressing the ENTER key the IR-control detection can be toggled between the settings STORE, SET-ZERO and OFF. If switched to STORE, the unit stores the current value in the table. If switched to SET-ZERO, the unit enter relative measuring mode and is set to zero at the current position. If turned OFF, the IR-control-signal is ignored. To leave menu press EXIT key.

### **5.1.8 LANGUAGE**

With the language menu, the display language can be switched from English to German and vice versa.

## **5.2 Operations in Finder, Table, Crossline and Large Digit mode**

### **5.2.1 Finder Mode**

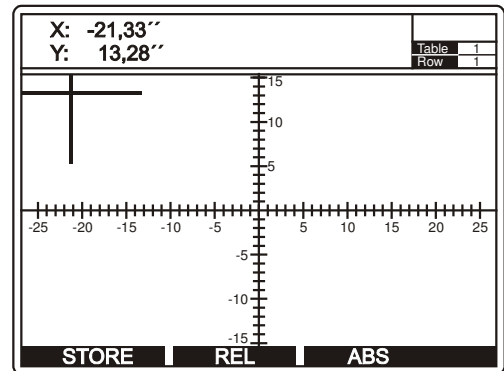
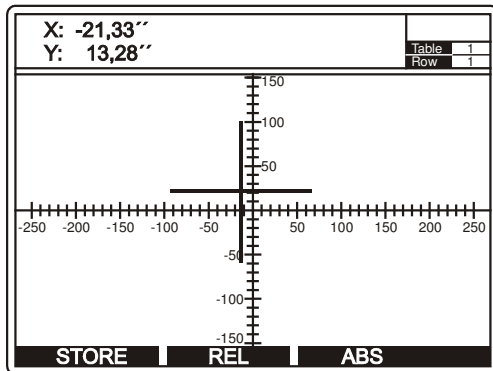
The finder mode can be used for quick alignment of the autocollimation image. In contrary to the other display modes a simplified evaluation procedure is used here, which allows a faster but also less accurate detection of the reticle image. In order to make the detection faster, the automatic brightness control of the autocollimator is switched off as well. Therefore the type of the reflector has to be specified prior to alignment to set the brightness manually. When measuring against a high reflecting mirror, press "mirror coated", when measuring against uncoated glass surface press "uncoated" and when measuring against a small mirror (diam. <7mm mirror coated or <15mm uncoated) press "very small".

### **5.2.2 Zoom-Function in Crossline mode**

Press arrow keys up/down.

The UP-arrow key allows the operator to enlarge the display. Magnifications are 1x, 2x, 5x, 10x, 20x, 50x, 100x, 200x. This mode is very effective during fine adjustment.

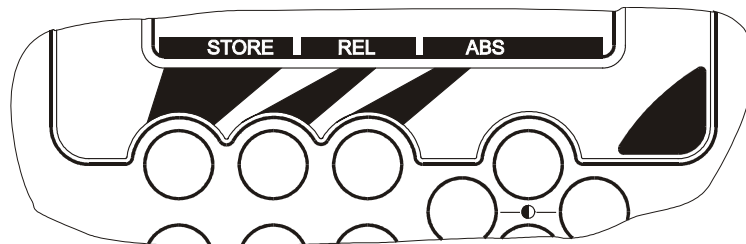
The DOWN-arrow key decreases the magnification set before.



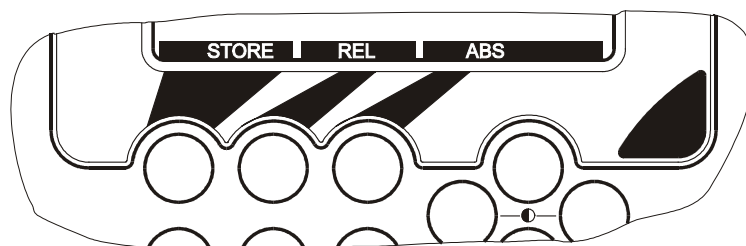
### 5.2.3 Setting REL-ABS

The ABS key gives absolute value of measured angle with respect to the optical axis of the autocollimator (reference measurement).

The REL key sets the current value of measured angle at zero and further measurements will be with respect to this new zero (relative measurement). This mode is indicated by **R** in the upper left corner of the screen.



### 5.2.4 Storing Of Data in Table



Pressing the STORE key or the remote control button during the measurement allows to store the current angle value if for IR the STORE function was activated. The stored values are shown in the TABLE mode.

X: 0.141162°		GO Table 6 Row 13
Y: -0.031757°		
No	ANGLE X	ANGLE Y
1	0.141283°	0.052423°
2	0.141276°	0.048630°
3	0.141249°	0.041835°
4	0.141233°	0.036984°
5	0.141222°	0.029076°
6	0.141219°	0.020023°
7	0.141218°	0.009985°
8	0.141207°	-0.003054°
9	0.141200°	-0.102343°
10	0.141189°	-0.187359°
11	0.141176°	-0.266767°
12	0.141169°	-0.291215°
STORE		DELETE
		TABLE

The no. of the current table and that of the next storage row are shown in the upper right corner of the display. Up to 10 table with up to 200 data values can be used for data storage.

To scroll through the table use UP/DOWN arrow keys. Pressing the DELETE key deletes the last value. By pressing the table key (rightmost key) together with the UP- and DOWN-arrow key different table can be chosen for data storage.

### 5.3 RS-232 Protocols

Two protocols are implemented in the Control Unit. They are two kind of protocol types: the compatible type (working with in the same mode as with the formerly used control unit ident-no. 219 700) and the new text protocol type.

#### 5.3.1 Compatible Protocol

When the compatible mode is chosen, the ELCOMAT vario sends continuously X- and Y-angle values via the RS-232 interface.

The following parameters are used:

Data format: 8N1 (8 data bit, no parity, 1 stop bit)

Baud rate: 2400 baud

Handshake: No handshake signals used. No XON/XOFF.

##### 5.3.1.1 Data Block Structure

The measured values are transmitted in blocks of each 8 byte 25 times/second.

Block architecture:	<u>Byte no.</u>	<u>Function</u>
	0	0x2 (STX)
	1	x-byte 0
	2	x-byte 1
	3	x-byte 2
	4	y-byte 0
	5	y-byte 1
	6	y-byte 2
	7	0x3 (ETX)

Following formulas are used to calculate the angle values X and Y:

$$(x\text{-byte } 0 + x\text{-byte } 1 \times 256 + x\text{-byte } 2 \times 65536)/100 = X \text{ (arcsec)}$$

$$(y\text{-byte } 0 + y\text{-byte } 1 \times 256 + y\text{-byte } 2 \times 65536)/100 = Y \text{ (arcsec)}$$

Check every data block to make certain that the bytes STX and ETX are in the correct position because the values 0x2 and 0x3 may occur in the measurement information as well.

### 5.3.2 Text-Protocol

In Text-mode the control unit sends and receives messages in ASCII code (<128). Every message consists of one row of text concluded with a linefeed (0x0D).

The following parameters are used for RS232 communication:

Data format:                   8N1 (8 data bit, no parity, 1 stop bit)  
Baud rate:                     19200 baud

#### 5.3.2.1 Text protocol structure

To understand the structure of the text protocol type first the description is made with examples. The summary of this chapter is attached as appendix 4 to this operation manual.

With the text protocol mode the Control Unit vario is receiving and sending only ASCII signs (Code<128). Every of received or transmitted message consists of one line of text . Each message is concluded with a linefeed (0D hex). The Control Unit vario can receive seven different messages (commands).

A text line consists of 4, 5 or 6 text fields, separated from each other by blanks (20 hex). The last text field is followed by the linefeed (0D hex). The first text filed at the beginning of the line specifies the type of message.

##### 5.3.2.1.1.1 Transmitted Messages

1. Relative angle values (as shown in the LCD-display approx. 1/25 seconds for EL-COMAT vario)

Message field	Type field	Status	Meas. value X	Meas. value Y
Example	1	103	321.445	-23.180

2. Absolute measured angle values, transmitted after every measurement

Message field	Type field	Status	Meas. value X	Meas. value Y
Example	3	003	-12.855	-123.105

3. Single measured relative angle value (as shown at the display), transmitted once

only

Message field	Type field	Status	Meas. value X	Meas. value Y
Example	2	103	321.445	-23.180

4. Single measured absolute angle values, transmitted once only

Message field	Type field	Status	Meas. value X	Meas. value Y
Example	4	003	-12.855	-123.105

5. Head of table, transmitted before data of a table will be transmitted

Mess. field	Type field	No. of tables	actual transmitted	No. of lines	No. of columns
Example	6	10	2	15	2

6. Line of table, transmitted as many times, as the number of lines of table

Mess. field	Type field	act. Table	act. line	Value(row1)	Wert(row2)
Example 1	5	2	12	343.110	-99.200
Example 2	5	2	13	343.125	*

Example 2-value of row2 is not determined

7. Device information

Mess. field	Type field	Ser.No.	Day	Month	Year	Focal length
Example	8	423	12	1	2001	300

Day, months, year - date of calibration

Status consists of three digits ABC:

A - Relative/Absolute angle values

0 The message contents absolute angle values (in respect to the optical axes)

1 The message contents relative angle values

B - Events

0 no event

1 Infrared remote control signal detected

2 EXIT key of Control Unit vario was pressed in one of the three display modes

C - Validity of measurement

- 0 x and y invalid
- 1 x valid, y invalid
- 2 x invalid, y valid
- 3 x and y valid

Measuring value X, Measuring value Y

The angle measurement values are in arcsec, the fractions after the decimal point are separated by a decimal point, not by a comma.

### Received messages (commands)

The messages can be controlled by the following commands. All of commands consists of one character only (consider use of capital letter/use of small initial letters) and are limited by a linefeed.

Command	Result
s	Stops transmission of messages of type 1,3,5,6
r	sends messages of type 2(relative measurement, once only), stops messages of type 1 and 3
R	Permanent (continuously) sends messages of type 1 (relative angle values)
a	Sends message of type 4 (absolute angle values, once only), stops messages of type 1 and 3
A	Sends permanently (continuously) messages of type 3 (absolute angle values)
t	Sends all tables, consisting of at least one row. The header message of type 6 of table 1 will be sent in any case, even if this table is empty.
d	Sends messages of type 8 (device information)

### 5.3.3 RS-232 Pin Definition

ELCOMAT vario 9-pin plug		Computer 9-pin plug	
pin-no.	description	pin-no.	description
2	TXD	2	RXD
3	RXD	3	TXD
5	GND	5	GND

## 5.4 More Operational Information

### 5.4.1 Measuring Conditions

The reflectance of the basic mirror of 30 mm diameter should amount to at least 4 %. This corresponds to the reflection of an uncoated surface of glass.

For a mirror coated surface (reflectance at a wave length of 660 nm at least 80 %) the diameter of the autocollimation mirror should at least amount to 7 mm.

The optical quality of the surface of the mirror (flatness) should, if possible, be better than  $\lambda/8$  (at  $\lambda=660\text{nm}$ ).

If the flatness is worse, this may affect the measuring accuracy.

During all measurements the distance between autocollimator and basic mirror should be kept as short as possible. This will reduce the effect of air streaks and improve the temporal stability of the measurement values.

The effect of air streaks can also be minimised by shielding the beam path (e.g. by a tunnel with styrofoam walls).

After each new installation and prior to start up, the ELCOMAT vario should be in 'thermal balance'.

To achieve optimal measuring accuracy and steadiness, it is recommended to start the measurements only about 30 minutes (for a measurement during a short time period), better even after 60 minutes (if a long-time measurement should be done) after switching on the unit.

The room temperature should be constant ( $\pm 1^\circ\text{C}$ ). Altering the temperature by  $1^\circ\text{C}$  may cause an incorrect measurement of  $0.1''-0.2''$ .

The total mechanical set-up should be distortion-free and nearly without vibrations.

## 6. Hints to perform measurements

### 6.1 Preparation of measurements

#### 6.1.1 Alignment of the autocollimator with the electronic alignment aid and the viewfinder prism

Carefully shift the autocollimator into the base support.

Locate a base mirror on the surface to be tested in front of the autocollimator with only little space.

The image of the autocollimator may be caught quickly and simply with the Crossline mode. The signal is detected in height and side within a range of ca.  $0.8^\circ$ .

In most case no crosshair is displayed at first. In this case the image of the autocollimator of both axes is located outside the pull-in range of the unit. For finding the autocollimation signal of the X-axis, the base mirror should slightly be turned.

After alignment of the X-axis perform the same alignment procedure for the Y-axis.

 **PLEASE MAKE SURE THAT YOU ARE IN THE ABSOLUTE MODE  
ROUGHLY IN THE MIDDLE OF THE MEASURING RANGE .**

A low refraction factor or a very small mirror may cause poor signal intensities as

well.

During all measurements it is necessary that after moving the base mirror it should be illuminated as completely as possible through the collimator beam splitter. Rough alignment of the autocollimator head in its support relative to the measuring plane is performed via laser attachment or viewfinder prism and/or LCD-display (see accessories).

Further on the fine alignment should be done.

To perform this, the base mirror is rotated around one axis and the angle deviation has to be observed in the 2nd co-ordinate (image erection test). In case of precise rotation around one axis the angle value of the second axis must not deviate. As this deviation is effected by incorrect erection of the autocollimator axes, related to the measuring surface, it is an error of second order only minimising is required (rotation by 2000 arc seconds allows a distortion of the second axis by 10 arc seconds).

As soon as the ELCOMAT vario is exactly aligned, it has to be fixed with the locking screw(s) located at the support.

☞ **The screws should only be tightened slightly and carefully!**

The autocollimator should be aligned such, that the expected measuring values are located, if possible, symmetrically relative to the optical axis. The indicated angle data should therefore amount to nearly zero in absolute measuring mode.

### **6.1.2 Measuring Procedure**

After proper alignment you may start measurement.

- ☞ **Prior to the measurements please check whether an autocollimation image is available and whether measuring values for all positions of the base mirror are available, too!**
- ☞ **If angle measurements are intended on long distances, first the reflector should be aligned in the maximum distance. Then move it into direction of the autocollimator. If the measuring signal remains in the measuring area, it is no problem to measure from the autocollimator to the reflector.**

Select :

- Display mode,
- Units,
- Go/NG tolerances if needed,
- Resolution,
- RS-232,
- Sounds,
- IR-control and
- Language using the main menu of the control unit.

Press EXIT to leave the menu and to switch to the measuring display (see 5.1.1).

Pressing ENTER button or using the IR-remote control to read measurement.

In case of a relative measurement should be done, press the REL function key (mid of function keys (Fig. 4.5)). To switch into the absolute mode press the right function key (Fig. 4.5)

Storage of data as well as data transfer via RS-232 are described in chapters 5.1.5 and 5.3.)

The sign convention for the angle measurement is described in annex 3.

## 6.2 General hints

### Quality of mirror

For autocollimation measurements only mirrors of high grade flatness are suitable. Mirror dia. 63 mm should have a flatness of 0.080 microns. The measuring accuracy will deteriorate when using mirrors of lesser flatness tolerance.

### Air Turbulence

Turbulence of air between autocollimator and mirror lead to spurious deflection of the light bundle. This reduces the accuracy of the measuring result.

### Distance between the autocollimator and the mirror

The angle display and the measuring accuracy are independent of the distance between the autocollimator and the mirror. With increasing this distance only the measuring range will decrease.

Theoretical measuring range as function of the distance between the autocollimator and the mirror are in appendix 1.

### Temperature equalisation

Even slight temperature differences within optical components leads to stress which will reduce the accuracy of angular measurements. For the highest accuracy measurements we recommend that the autocollimator as well as the part under test be allowed to come to thermal equilibration for 24 hours prior to making measurements.

## 7. Technical Data

### 7.1 Autocollimation Measuring Head

Lens:	free aperture	D40	18 mm (F=90 mm), 28 mm (F=140, 200, 300, 500 mm)
		D65	50 mm
		D105	78 mm

focal length (nominal)	90 mm
	140 mm
	200 mm
	300 mm
	500 mm
	1100 mm

Light source:	high performance LED wavelength 660 nm
---------------	---

Detector:	imaging device	interline transfer CCD
	number of effective pixels	756 (H)x581 (V)
	imaging area	8.8x6.6 mm
	power supply	12 VDC from control unit
	current consumption	210 mA approx.

Storage temperature and humidity:	-20 °C to 60 °C, RH 90% or less
--------------------------------------	---------------------------------

Operating temperature and humidity:	15 °C to 25 °C, RH 85% or less
--	--------------------------------

Full specification temperature and humidity:	20 °C to 25 °C, RH 50% to 70%
---	-------------------------------

Dimensions (without objective tube): 190 x 70 x 70 mm (overall)

Weight (without objective tube): 1.2 kg

Adjustment and alignment aid: Laser attachment (option)

## 7.2 Control Unit (CModul)

Control unit with clearly structured software modules ensures rapid acquisition of data.

- Software controlled online compensation of systematic errors is effected by a high-speed numerical algorithm.
- Alphanumerical and graphical display of measurement data via LCD-display.
- „Digital eyepiece“ shows the position of the mirror direction in a Cartesian system.
- Contrast setting via keypad.

Power supply. According to indications on nameplate of power supply

Standard interfaces: Computer interface, serial RS-232 as 9-pin D-sub-miniature socket

Computer interface, USB-socket type b

Interface to autocollimator: 25-pin SUB-D plug: for control of CCD-lines, to modulate LED, outputs +5V/200 mA, +18V, additional CMOS in- and outputs

Power supply: +12VDC/0.7A from external power plug, total power consumption less 8.4W

Operation conditions: -10 °C...40 °C, RH <85%

Storage conditions: -20 °C...60 °C, at -20 °C storage time less 48 hours at 60 °C storage time less 168 hours RH <85%

### Connections:

25 pins SUB-D plug to autocollimator

9 pin SUB-D socket RS 232	PIN	Function	IN/OUT
	2	TxD	o
	3	RxD	i
	5	GND	

2 pin socket +12VDC / GND power supply

Dimensions: 230 mm x 210 mm x 35 mm

Weight: 1.4 kg

### 7.3 Power Plug

Input: 115-230 VAC (93.5-265 VAC)  
60Hz-50Hz  
0.5A  
Automatically

Output: 12 VDC / 0.83A

EMC: EMC confirmed

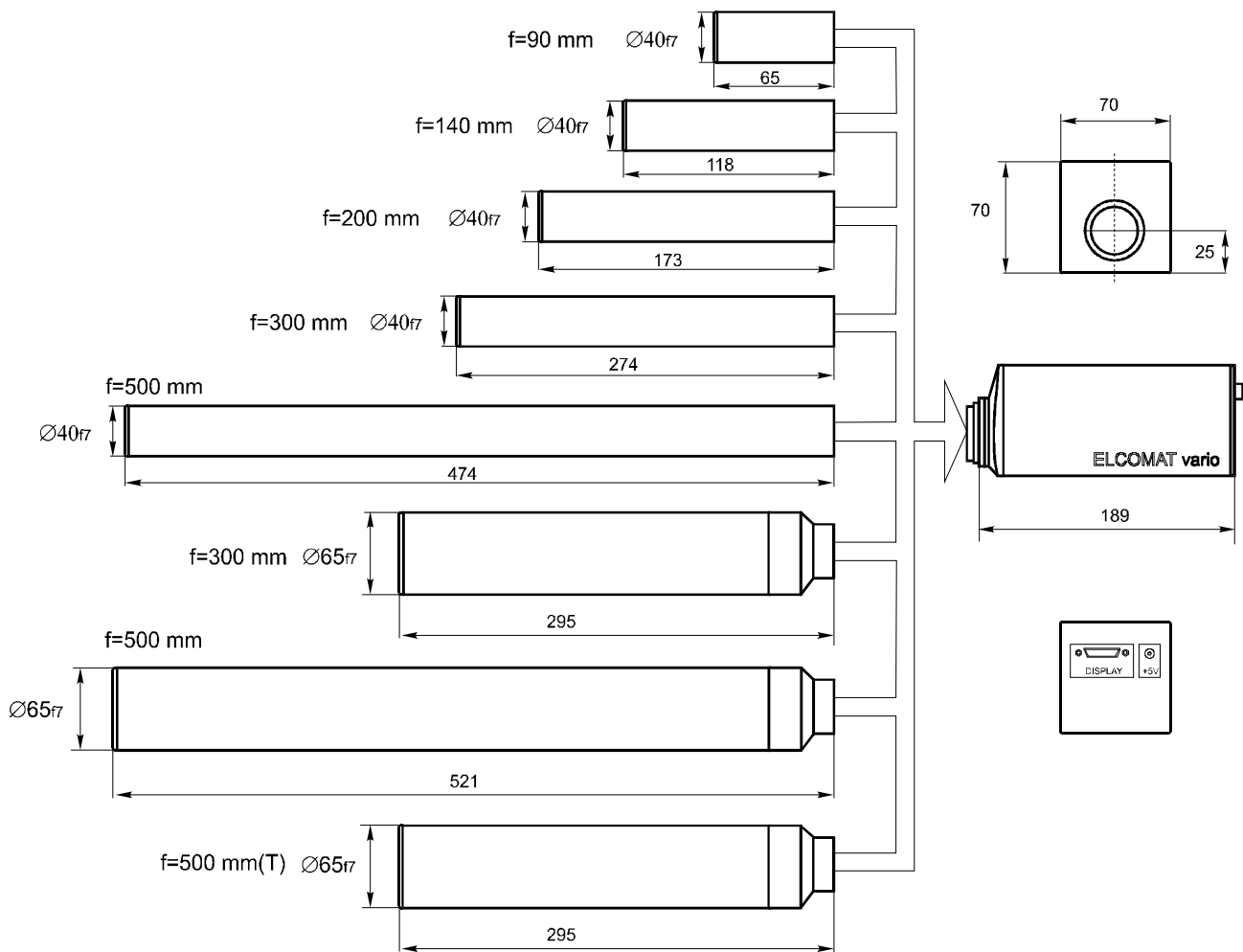
### 7.4 Remote Control Unit

Power supply: 3 VDC (2 x Micro-battery LR03)

Working distance: up to 10 m

Dimension: 118 mm x 57 mm x 26 mm

## 7.5 Dimension, Measuring Range And Accuracy Of ELCOMAT vario



Part no.	Description	Measuring range (arcsec)		Accuracy in arcsec (arcsec)
		in X	in Y	
229 801	ELCOMAT vario 90/D40	9000	6120	± 3.0
229 802	ELCOMAT vario 140/D40	5900	4180	± 2.0
229 803	ELCOMAT vario 200/D40	3760	2520	± 1.5
229 804	ELCOMAT vario 300/D40	2520	1800	± 0.8
229 805	ELCOMAT vario 500/D40	1440	1140	± 0.4
229 806	ELCOMAT vario 300/D65	2520	1800	± 0.8
229 807	ELCOMAT vario 500/D65	1440	1140	± 0.4
229 808	ELCOMAT vario 500T/D65	1440	1140	± 0.4

- The measuring range corresponds to a distance between autocollimation measuring head and mirror of 100 mm.

## 8. Spare Parts of the ELCOMAT vario

219 800	Autocollimation measuring head (consists of)	1	1	1	1	1	1	1	1
219 801	EI-AK eyepiece								
219 809	Control unit								
773 130 14	Remote control								
773 110 02	Control unit								
773 110 03	Power plug								
773 130 15	Cabel head-control unit								
211 210	Objective tube f=90 D40	1							
211 220	Objective tube f=140 D40		1						
211 230	Objective tube f=200 D40			1					
211 240	Objective tube f=300 D40				1				
211 250	Objective tube f=500 D40					1			
211 301	Objective tube f=300 D65						1		
211 310	Objective tube f=500 D65							1	
211 330	Objective tube f=500T D65								1
219 767	Laser attachment D40	1	1	1	1	1			
219 757	Laser attachment D65						1	1	1
121 033 50	Cabel head-laser	1	1	1	1	1	1	1	1
135 312 12	Case	1	1	1	1	1	1	1	1

## 9. MAINTENANCE AND CARE

No special maintenance is required for the ELCOMAT vario when operated in clean environment.

The painted, anodised, and chromium plated surfaces may be cleaned with a damp cloth and a soft detergent. Do not use acetone or comparable solvents.



Power Plugs are only allowed to clean with a soft and dry cloth. Before cleaning disconnect them from the main voltage and the equipment.

Carefully remove the dust from the objective of the measuring head using a brush. If this is not sufficient, a clean cloth made of linen may be used.



Pollution or finger prints on the lens surface can be removed with a mixture of ether and ethanol (ratio 8:1). **Be careful! The solvents are inflammable!**

The instrument should regularly be sent to the manufacturer to check the calibration state. The inspection intervals mainly depend on the environmental influences and handling of the autocollimator, but they should not exceed 24 months.

## 10. Warranty

12 month after delivery. Also refer to the general purchase and delivery conditions of MÖLLER-WEDEL OPTICAL GmbH.

## **APPENDIX 1**

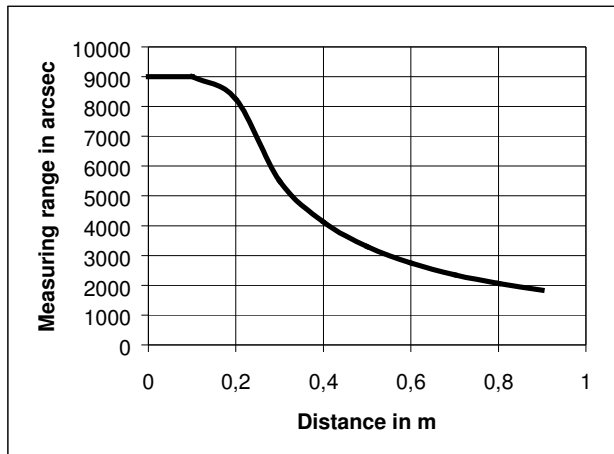
### **MEASURING RANGE AS FUNCTION OF DISTANCE AUTOCOLLIMATOR – REFLECTOR**

## Measuring range ELCOMAT vario 90/D40 (theoretical)

(The ELCOMAT vario 90/D40 is temporarily not available)

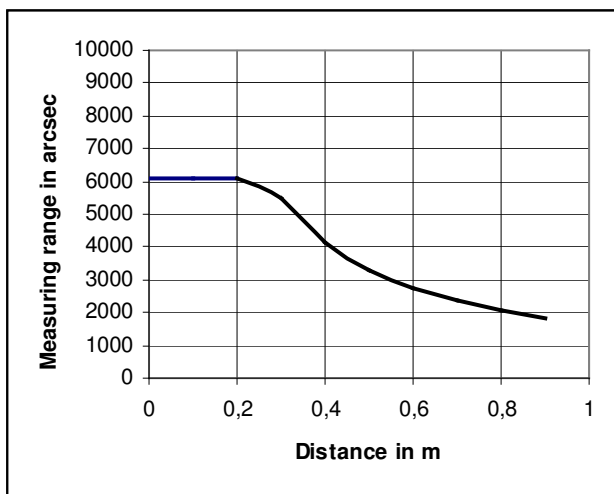
X-Axis:

Distance in m	Measuring range in arcsec
0	9000
0,1	9000
0,2	8240
0,3	5490
0,4	4120
0,5	3290
0,6	2740
0,7	2350
0,8	2060
0,9	1830



Y-Axis:

Distance in m	Measuring range in arcsec
0	6120
0,2	6120
0,3	5490
0,4	4120
0,5	3290
0,6	2740
0,7	2350
0,8	2060
0,9	1830



## Measuring range ELCOMAT vario 140/D40 (theoretical)

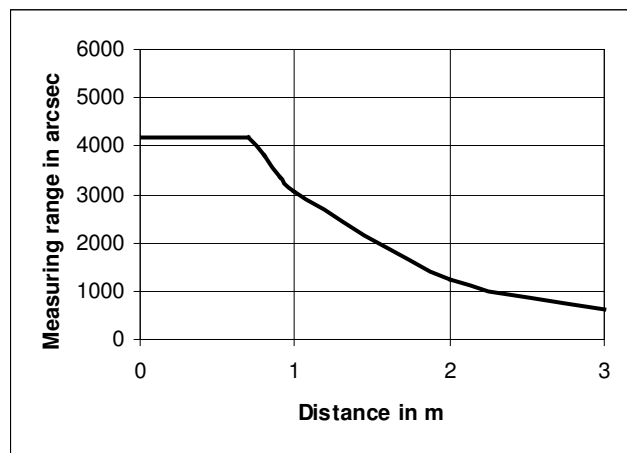
X-Axis:

Distance in m	Measuring range in arcsec
0	5900
0,3	5900
0,4	5600
0,5	5040
0,6	4600
0,7	4040
0,8	3400
0,9	2960
1	2660
2	990
3	400



Y-Axis:

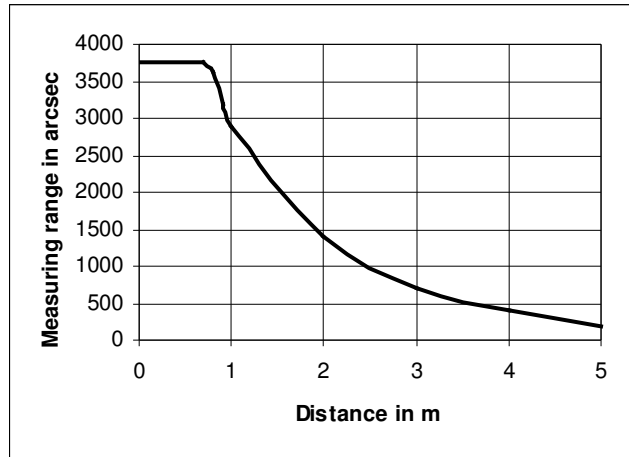
Distance in m	Measuring range in arcsec
0	4180
0,6	4180
0,7	4040
0,8	3400
0,9	2960
1	2660
2	990
3	400



## Measuring range ELCOMAT vario 200/D40 (theoretical)

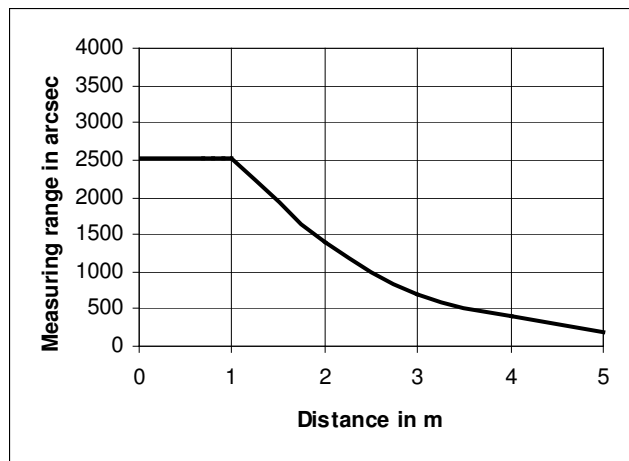
X-Axis:

Distance in m	Measuring range in arcsec
0	3760
0,7	3760
0,8	3610
0,9	3200
1	2880
2	1140
3	700
4	400
5	200



Y-Axis:

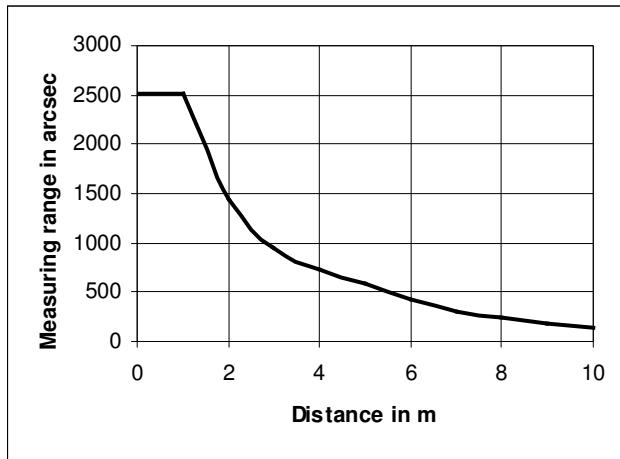
Distance in m	Measuring range in arcsec
0	2520
1	2520
2	1140
3	700
4	400
5	200



## Measuring range ELCOMAT-vario 300/D40 (theoretical)

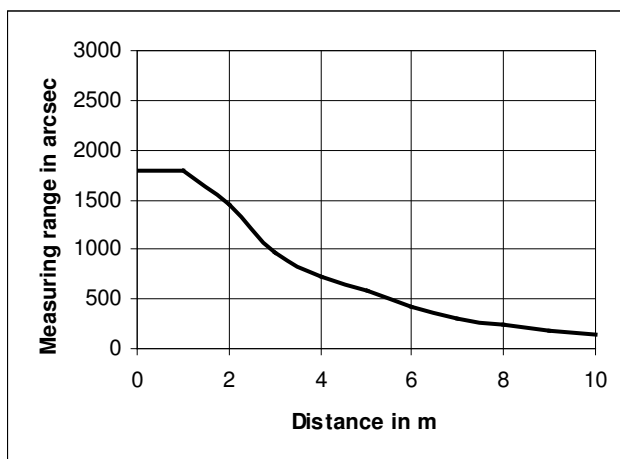
X-Axis:

Distance in m	Measuring range in arcsec
0	2520
1	2520
2	1440
3	960
4	720
5	570
6	420
7	300
8	240
9	180
10	140



Y-Axis:

Distance in m	Measuring range in arcsec
0	1800
1	1800
2	1440
3	960
4	720
5	570
6	420
7	300
8	240
9	180
10	140



## Measuring range ELCOMAT vario 300/D65 (theoretical)

X-Axis:

Distance in m	Measuring range in arcsec
0	2520
2	2520
3	1700
4	1260
5	970
6	770
7	640
8	540
9	390
10	300



Y-Axis:

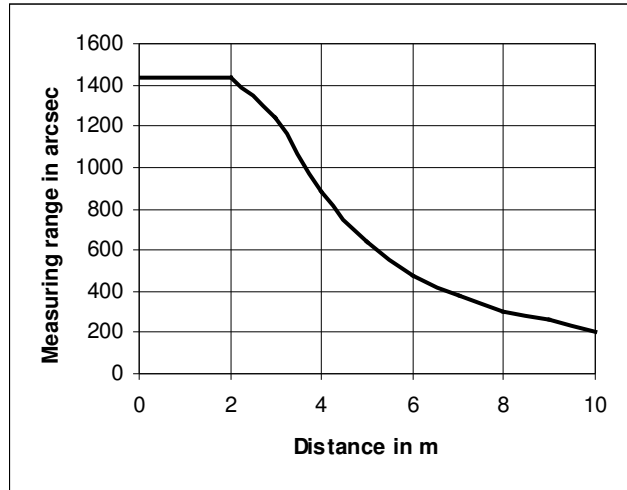
Distance in m	Measuring range in arcsec
0	1800
2,5	1800
3	1700
4	1260
5	970
6	770
7	640
8	540
9	390
10	300



## Measuring range ELCOMAT vario 500/D40 (theoretical)

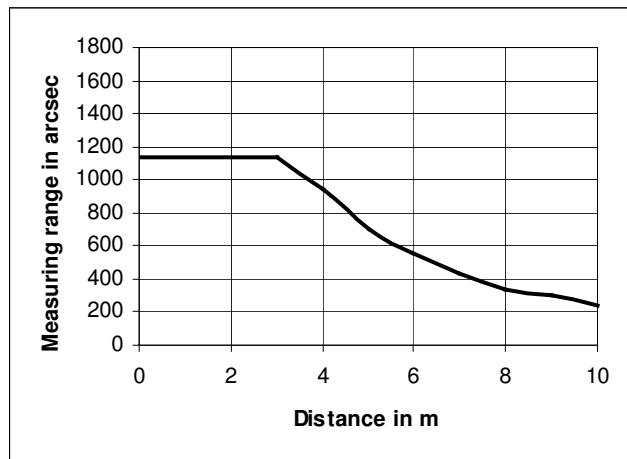
X-Axis:

Distance in m	Measuring range in arcsec
0	1440
2	1440
3	1240
4	880
5	640
6	480
7	380
8	300
9	260
10	200



Y-Axis:

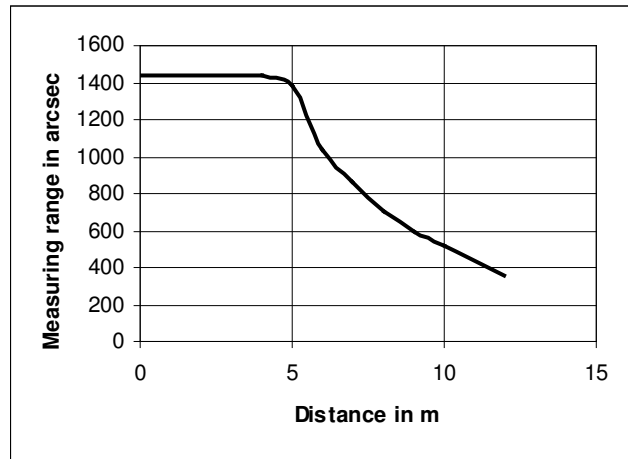
Distance in m	Measuring range in arcsec
0	1140
3	1140
4	880
5	640
6	480
7	380
8	300
9	260
10	200



## Measuring range ELCOMAT vario 500/D65 and ELCOMAT vario 500T/D65 (theoretical)

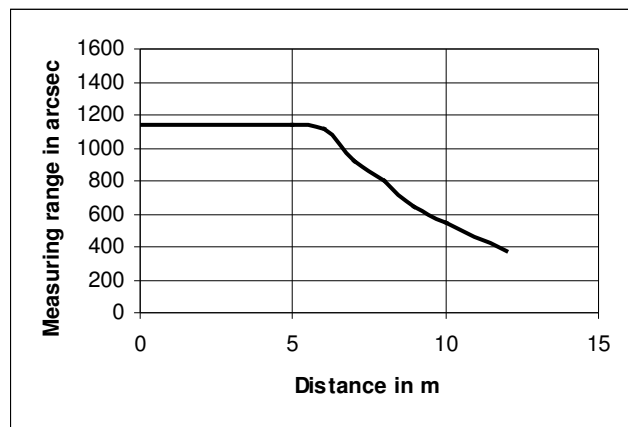
X-Axis:

Distance in m	Measuring range in arcsec
0	1440
4	1440
5	1380
6	1040
7	860
8	700
9	600
10	520
12	360



Y-Axis:

Distance in m	Measuring range in arcsec
0	1140
5	1140
6	1120
7	860
8	700
9	600
10	520
12	360



## APPENDIX 2

### GENERAL DESCRIPTION OF AUTOCOLLIMATION PRINCIPLE

The autocollimator projects the image of a reticle in a parallel beam (collimated light) onto the mirror, which reflects the beam back into the autocollimator. This is the autocollimation image. If the mirror is perpendicular to the optical axis, the beam is reflected back into itself.

If the mirror is tilted through the angle  $\alpha$ , the reflected beam falls into the lens at an angle  $2\alpha$ . Depending on the inclination of the reflected beam, the autocollimation image is displaced to a greater or lesser degree.

The displacement of the autocollimation image in x- and y-direction provides a measure of the angular displacement of the mirror.

Autocollimation means parallel light. The measuring result is independent on the distance.

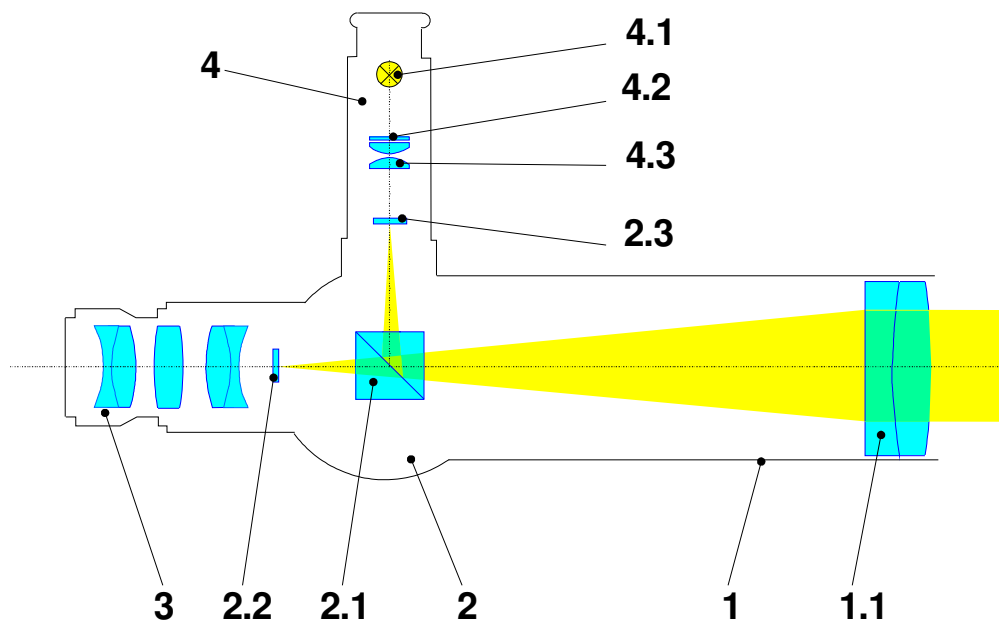


Figure : Basic design of a visual autocollimator

1. Objective tube with achromatic objective 1.1
2. Autocollimation head with beam splitting cube 2.1, eyepiece reticle 2.2 and collimator reticle 2.3
3. Eyepiece
4. Illumination with bulb 4.1, filter glass 4.2 and condenser 4.3

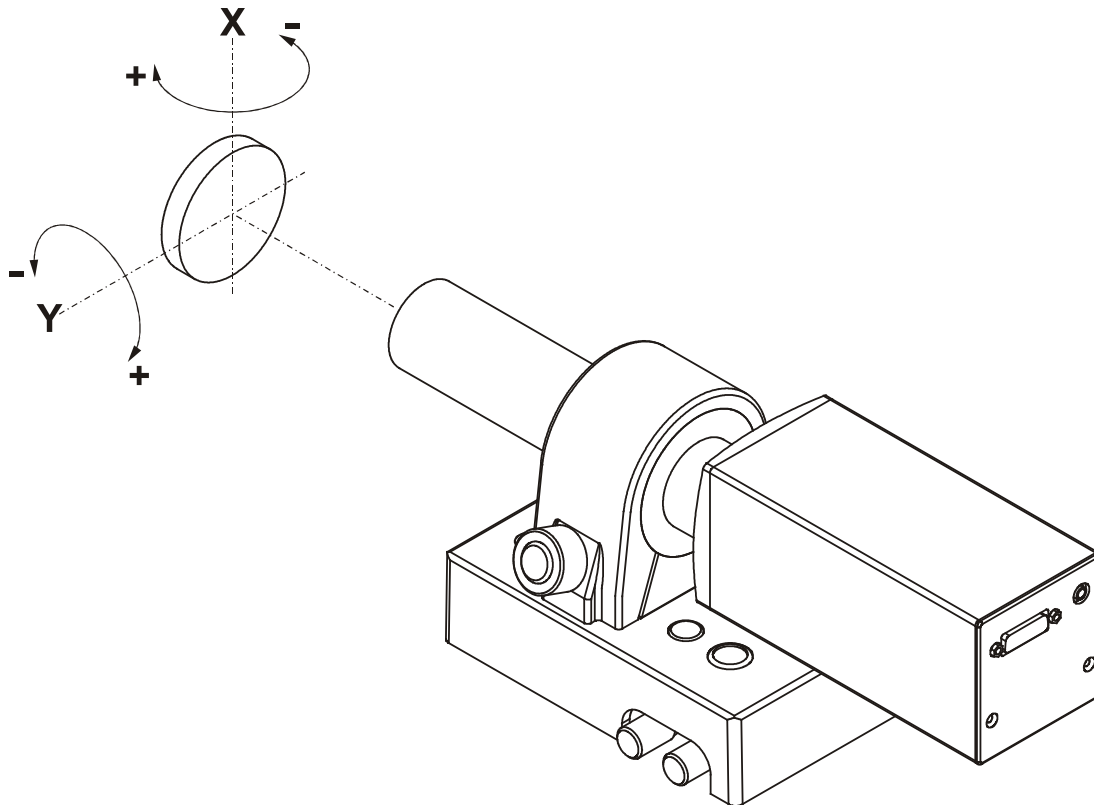
The visual autocollimators are set to infinity at visible wavelength  $\lambda=546 \text{ nm}$ .

As the light source of the ELCOMAT vario is an LED and the ELCOMAT vario is set to infinity at visible wavelength of  $660 \text{ nm}$ .

## APPENDIX 3

### SIGN CONVENTION FOR ANGLE MEASUREMENT

The angles are displayed according to the sign convention shown in the figure below:



## APPENDIX 4

### Resetting the Control Unit

In case the control unit display can't be switched on, doesn't react on key presses or beeps continuously, you can try to reinitialise the unit. For this purpose you have to switch off with the power switch at the rear of the instrument. Then press and hold the four arrow-buttons. Now switch on the instrument and release the buttons. The instrument is reinitialised. Please note, that all data included those stored in the tables are erased in this procedure. If the error-condition still remains, contact MÖLLER-WEDEL OPTICAL.

## APPENDIX 5

### Description of Text-Protocol type

The control unit acknowledges 7 different commands and transmits 7 different message types.

#### Transmitted Messages

The transmitted messages consist of one or more text fields, that are separated by blanks (0x20). Each message is concluded with a linefeed (0x0D). The first text field denotes the message type.

The following two tables give an overview over the different message type.

<i>Type</i>	<i>Description</i>	<i>Structure</i>
1	continuous relative measurement	1, <S>, <Vx>, <Vy>
2	single relative measurement	2, <S>, <Vx>, <Vy>
3	continuous absolute measurement	3, <S>, <Vx>, <Vy>
4	single absolute measurement	4, <S>, <Vx>, <Vy>
5	table row data	5, <#CT>, <#CR>, <V1>, ... <Vn>
6	table header	6, 10, <#CT>, <#R>, <#C>
8	device description	8, <S#>, <D>, <M>, <Y>, <F>

The meaning of the text fields is given by the following table:

<i>Text Field</i>	<i>Meaning</i>
<S>	Status
<Vx>/<Vy>	Curr. measurement value in x-and y- direction in arc seconds.
<#CT>	Number of current table
<#CR>	Number of current row
<V1>, ... <Vn>	Values in columns 1 ... n
<#R>	Number of rows in current table
<#C>	Number of columns in current table
<S#>	Serial number of autocollimator
<D>	Day of calibration
<M>	Month of calibration
<Y>	Year of calibration
<F>	Focal length of autocollimator objective

A detailed description of the output formats is given below.

The *message types 1,2,3,4* refer to the current measurement value of the ELCO-

MAT vario. The general structure of these messages is:

<Type>, <S> <Vx>, <Vy>

The values of the text fields are:

<Type>:	1	continuous relative measurement
	2	single relative measurement
	3	continuous absolute measurement
	4	single absolute measurement
<S>:	Status. 3 digits (ABC) describing the meaning of the measurement values:	
	A	0 Absolute measurement values
		1 Relative measurement values
	B	0 no event
		1 IR-Control signal detected
		2 EXIT key pressed
		3 Both
	C	0 x/y invalid
		1 x valid, y invalid
		2 x invalid, y valid
		3 x/y valid
<Vx/Vy>:	Current measurement value in x-and y- direction in arc seconds.	

Please note that the type of data sent by the Control Unit also depends on the setting of the Control Unit. If the unit is set-up in absolute measuring mode, absolute values are always sent, even with messages of type 2 or 4. Therefore it is important to check the status byte A for meaning of the data.

The *message types 5 and 6* refer to the transmission of table data.

At the beginning of *each table transmission a header is sent (type 6)*. Each header has the following structure:

6, 10, <#CT>, <#R>, <#C>

with

6     *Type of message*

10    *Total number of tables stored in the Control Unit.*

<#CT>     *Number of current table to be transmitted following the header*

<#R>     *Number of rows in current table*

*<#C> Number of columns in current table*

*After the header a message of type 5 is sent for each row in the table:*

*5, <#CT>, <#CR>, <V1>, ... <Vn>*

*with*

*5      Type of message*

*<#CT>      Number of current table to be transmitted following the header*

*<#CR>      Number of current row*

*<V1> ... <Vn>      Values in the columns of current row. Undefined values are marked with an asterisk.*

*The message type 8 contains information about the autocollimator. The general structure is:*

*8, <S#>, <D>, <M>, <Y>, <F>*

*with*

*8      Type of message*

*<S#> Serial number of the autocollimator*

*<D> Day of calibration*

*<M> Month of calibration*

*<Y> Year of calibration*

*<F> Focal length of autocollimator objective*

### *Commands*

The messages can be controlled by the following commands (mind the use of small and capital letters):

<i>Command</i>	<i>Description</i>
R	Message of type 1 (continuous relative measurement) is sent.
r	Message of type 2 (single relative measurement) is sent, ends transmission of message type 1 and 3.
A	Message of type 3 (continuous absolute measurement) is sent.
a	Message of type 4 (single relative measurement) is sent, ends transmission of message type 1 and 3.
s	Stops transmission of message of type 1,3,5 and 6.
t	All table are sent, that contain at least one row of data. The header message for table 1 is always transmitted (even when the table is empty).
d	Message type 8 (device information) is transmitted.

**APPENDIX 6****Laser Attachment (Ident. No. 219 767 (D40) / 219 757 (D65))**

The laser attachment is used for easier adjustment of telescopes and autocollimators in relation to plane mirrors or to other plane optical components (prisms, polygons, plane plates).

The laser attachment (8) consists of the laser attachment and a cable for connection to ELCOMAT vario autocollimation head.



Fig. 8: Laser attachment

- Principle of functioning:

The laser beam emitted from a laser diode is reflected at the plane reflector (mirror, polished plane plate or prism). The adjustment of the mirror or autocollimator is performed if the emitted laser beam is imaged in itself.

This is achieved by a relevant tilt of the reflector or the autocollimator. The principle of functioning is shown in fig. 9.

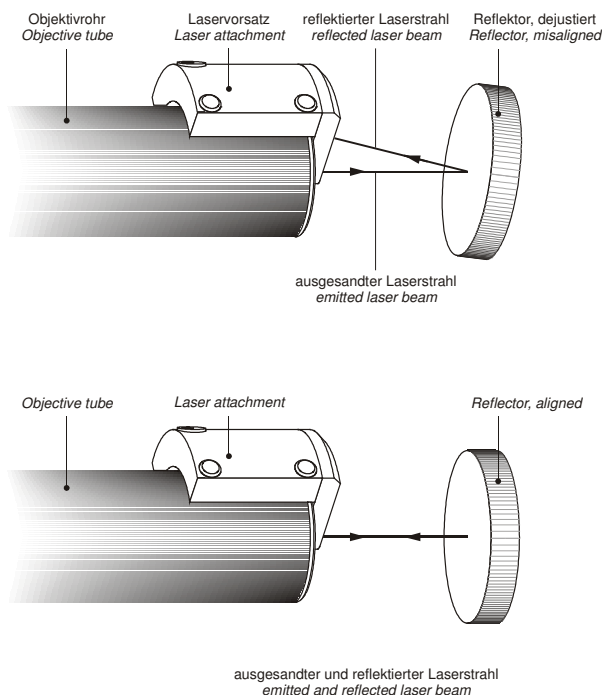


Fig. 9: Principle of functioning of the laser attachment



## EG - Konformitätserklärung Declaration of Conformity

Hiermit erklären wir  
*We herewith confirm*

**MÖLLER - WEDEL OPTICAL GmbH**  
Rosengarten 10  
D-22880 Wedel

daß das Produkt  
*that the device*

**ELCOMAT vario**  
*ELCOMAT vario*

Ident-Nr. / P/N      ab Serien-Nr. / S/N *and higher*  
229 801 ...229 825    125

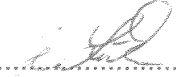
folgenden	73 / 23 / EWG	<i>corresponds</i>	73 / 23 / EEC
Richtlinien entspricht :	93 / 68 / EWG	<i>to the Directives :</i>	93 / 68 / EEC
	89 / 339 / EWG		89 / 336 / EEC

Angewendete Normen / *Relevant harmonized standards :*

EN 61010 -1	Sicherheitsbestimmungen für elektrische Meß-, Steuer-, Regel- und Laborgeräte, Teil 1 <i>Safety requirements for electrical equipment for measurement, control and laboratory use, part 1</i>
EN 50081-1	Elektromagnetische Verträglichkeit ( EMV ); Fachgrundnorm Störaussendung; Teil 1 <i>Electromagnetic compatibility ( EMC ); generic emission standard; part 1</i>
EN 50082-1	Elektromagnetische Verträglichkeit ( EMV ); Fachgrundnorm Störfestigkeit; Teil 1 <i>Electromagnetic compatibility ( EMC ); generic immunity standard; part 1</i>

Wedel, den 17.04.2000

  
.....  
Dr. Schlewitt  
Geschäftsführer/ *Managing Director*

  
.....  
i.A. J. Lücke  
Qualitätswesen / *Quality department*



## Erklärung zu WEEE und RoHS

### *Declaration according to WEEE and RoHS*

Hiermit erklären wir  
*We herewith confirm*

**MOELLER – WEDEL OPTICAL GmbH**  
**Rosengarten 10**  
**D-22880 Wedel**  
**WEEE – Reg. Nr. DE 99474390**

dass unsere Produkte folgenden  
Richtlinien entsprechen  
*that our products corresponds to  
the Directives*

**RoHS** Restriction of Use of Certain Hazardous Substances,  
Directive 2002/96/EC

**WEEE** Waste Electrical and Electronic Equipment, Directive  
2002/96/EC

Angewendete Normen  
*Relevant harmonised standards*

**DIN EN 50914** Kennzeichnung von Elektro- und Elektronikgeräten  
entsprechend Artikel 11(2) der Richtlinie 2002/96/EG  
*Marking of electrical and electronic equipment in accordance with  
Article 11(2) of directive 2002/96/EC*

Die Produkte der Firma MÖLLER-WEDEL OPTICAL GmbH sind, sofern sie in den Anwendungsbereich der WEEE und RoHS Direktive fallen normgerecht entweder auf dem Produkt selbst oder auf dem Garantieschein oder auf der Verpackung gekennzeichnet. Gekennzeichnet wird mit dem Datum des in den Verkehrbringens des Produktes in der Form JJJJ – MM – TT und der Bezeichnung „MÖLLER-WEDEL OPTICAL“ als Handelsmarke und der durchgestrichenen Mülltonne.

Hersteller im Sinne der Direktive ist der zum Zeitpunkt des in den Verkehrbringens autorisierte europäische Vertriebspartner der Firma MÖLLER-WEDEL OPTICAL GmbH des jeweiligen Staates der EU\*. Bei diesem ist die kostenfreie Entsorgung dieses WEEE Produktes möglich, sofern es nach dem 13.08.2005 in der europäischen Union in den Verkehr gebracht wurden und keine andere Vereinbarung getroffen wurde.

Die Produkte sind RoHS konform, da sie nicht von Stoffverboten der RoHS betroffen sind. Sie dürfen verbotene Stoffe enthalten, weil die Produkte in die Kategorie „9. Überwachungs- und Kontrollinstrument – Geräte zum Messen, Wiegen, oder Regeln in Haushalt und Labor“ der WEEE Verordnung fallen.

\*Für Deutschland und alle EU-Länder mit Direktvertrieb ist dieses die Firma MÖLLER-WEDEL OPTICAL GmbH

*The products of the company MÖLLER-WEDEL OPTICAL GmbH are, as far as they fall under the directives WEEE and RoHS are marked in accordance with harmonised standard. They are marked directly on the product or on the warranty certificate or on the packaging. They are marked with the date of being put on the market, the crossed out wheellie bin and with the brand name „MÖLLER-WEDEL OPTICAL“.*

*Manufacturer according to the directives, is the authorised European representative of MÖLLER-WEDEL OPTICAL GmbH at date of first putting the product on the market in the corresponding EC-Country\*. This authorised European representatives will recycle this WEEE Product for free, if it has been put on the market after the 13.08.2005 in the European Community and no alternative agreement was made.*

*The products are RoHS conform, but may contain the restricted substances. The use of the substances is allowed because the products do fell in the WEEE product category “9. Monitoring and Controlling Instruments”.*

*\*For Germany and all countries of the EC with direct marketing this will be MÖLLER-WEDEL-OPTICAL*

Dr. Schlewitt Geschäftsführer / Managing Director