Operating Manual
MELOS 530

Ident.-No. 235 603

Version: 10/2005

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1. Warranty and Limitation of Liability

1.1 Maintenance

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 readjusted according to the technical instructions.

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

1.2 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).

Safety Remarks

This equipment must only be used following the operating manual and it is designed for use according to the operating manual.

The year of manufacturing and the serial number of the equipment is documented on the identification label.

Keep the operating manual for later use.

EC Conformity Certificate

The EC conformity certificate is attached to this operating manual.

2. Introduction

The measuring combination MELOS 530 is the optimum solution for the comfortable and fast determination of positive and negative effective focal lengths, back focal lengths as well as radii.

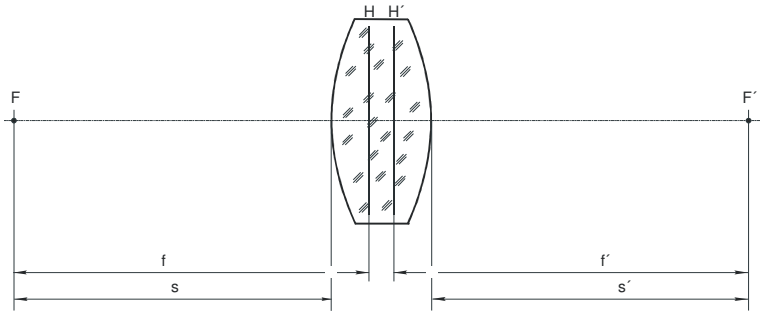
The main features of the instrument are:

- **Fast switching between the different measurement modes**. Due to an improved set-up, no time consuming change of the measuring system is necessary.
- **Direct reading of the measurement results on a stand-alone control unit**. All calculations necessary for the evaluation of positive and negative effective focal length measurements are carried out on the control unit. Results can be stored in a table and transferred to a computer for e.g. documentation purposes at a later time. The user is supported by the integrated help function. It allows even the inexperienced user to quickly get familiar with the use of the instrument.
- **Precise adjustment of the image planes**, by monitor display of the reticle image.
- **Full control over the measurement process** by manual adjustment of the image planes and reticles.

3. Description of the Measurement Principles

3.1 General remarks

In case of small aberrations an optical system can be described by its cardinal points and the corresponding planes. These points are the front and rear focal point (F and F') and the principal points (see Fig. 1). The *focal points* are those points at which light rays parallel to the optical axis are brought to a common focus. If the rays entering and emerging from the system are extended until they intersect, the intersection points define a surface which is called the *principal plane*. The corresponding points on the optical axis are called *principal points* (H and H').



H, H´	Principal planes
F, F´	Focal points
f, f´	Focal lengths
s, s´	Back focal lengths

Fig. 1: Definition of the cardinal points of a lens

The *effective focal length f'* of an optical system is the distance from the principal to the corresponding focal point F´. For angles u<4° it can be regarded as a scaling factor between the incidence angle *u* to the optical axis of the parallel light beam and the lateral position *y'* of the focus to which the beam is brought in the focal plane:

$$u = \frac{y'}{f'} \qquad \text{Eqn. (1)}$$

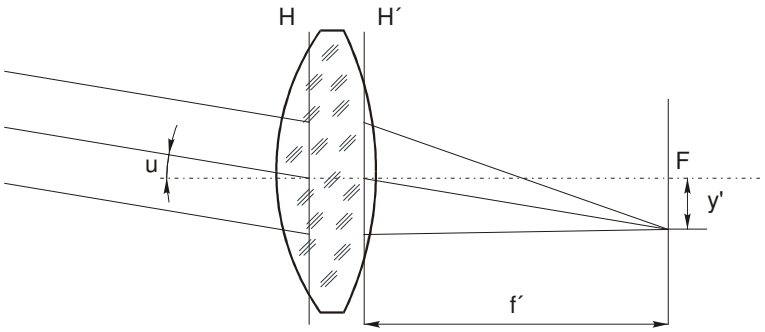


Fig. 2: Interpretation of effective focal length as scaling factor

The *back focal length s'* is defined as the distance from the vertex of the last surface to the rear focal point.

3.2 Measurement of effective focal lengths

The measurement principle of the positive focal lengths measurement is based on the above mentioned scaling property between incidence angle and lateral displacement of the focus position. In the MELOS 530 a calibrated reticle is projected to infinity by a measuring collimator (see Fig. 3). The lens under test is inserted in the emerging beam of the collimator. It produces an image of the reticle in its rear focal plane which is usually located after the last surface of the lens. The size y' of the image is determined solely by the known size of the reticle itself y, the known focal length f_{CO} of the collimator objective lens and the focal length of the lens under test f'_{TL}:

$$f_{TL} = \frac{y'}{y} f'_{CO} \qquad \text{Eqn. (2)}$$

In the MELOS 530 the size of the reticle image is measured with a autocollimating microscope, consisting of an autocollimator and a microscope objective.

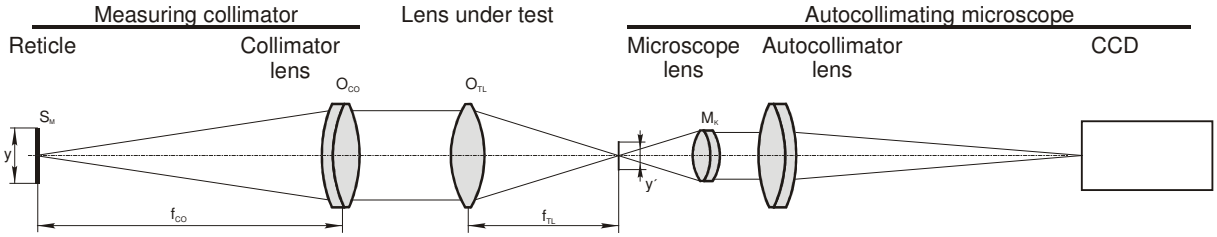


Fig. 3: Measurement set-up for positive focal length measurement.

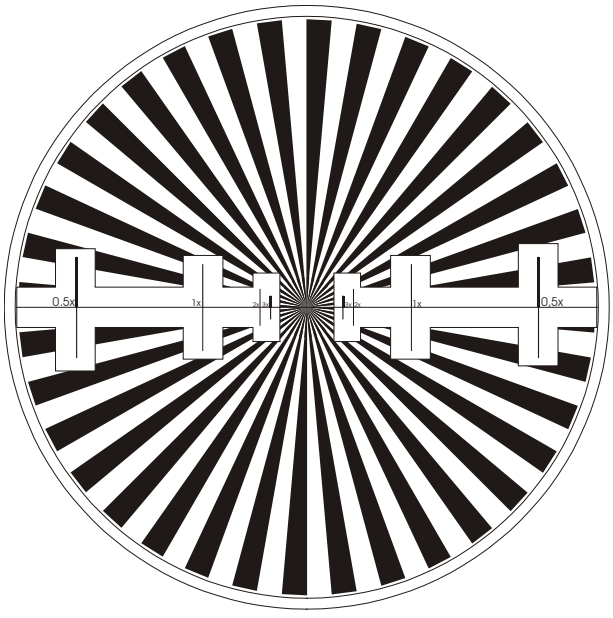


Fig. 4: Calibrated reticle for effective focal length measurement

The measurement of negative focal lengths uses the same principle as positive focal lengths measurement (see Fig. 3). In case of negative lens the rear focal point is

located in front of the last surface of the lens (see Fig.5). Therefore the autocollimating microscope has to be equipped with a front objective that has a longer working distance than the negative back focal length of the lens under test.

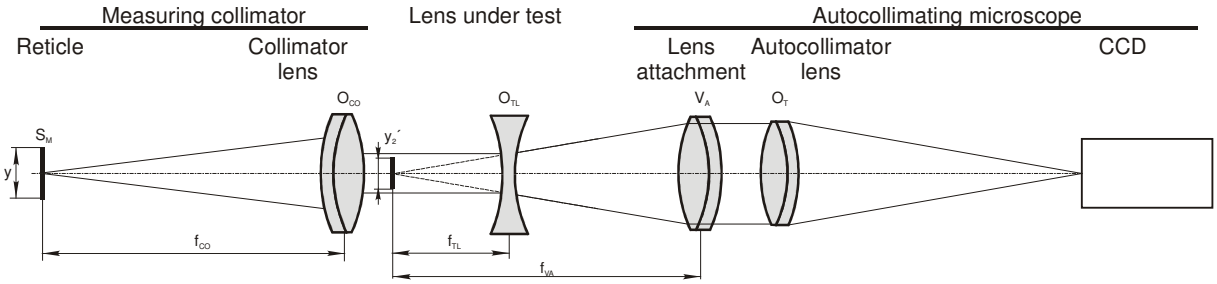


Fig. 5: Measurement set-up for measurement of negative focal length.

3.3 Measurement of back focal lengths

For measurement of back focal lengths the distance between the rear focal point and the last surface is measured. As with focal length measurement, the specimen is illuminated with the beam from the measuring collimator and produces a reticle image in its rear focal plane.

The measurement of back focal length is carried out in two steps (see Fig.6). First the autocollimating microscope is moved to the focal plane, where the reticle image is located. Then the autocollimating microscope is moved such that the last surface is located in its focus. The distance between these two positions is the back focal length.

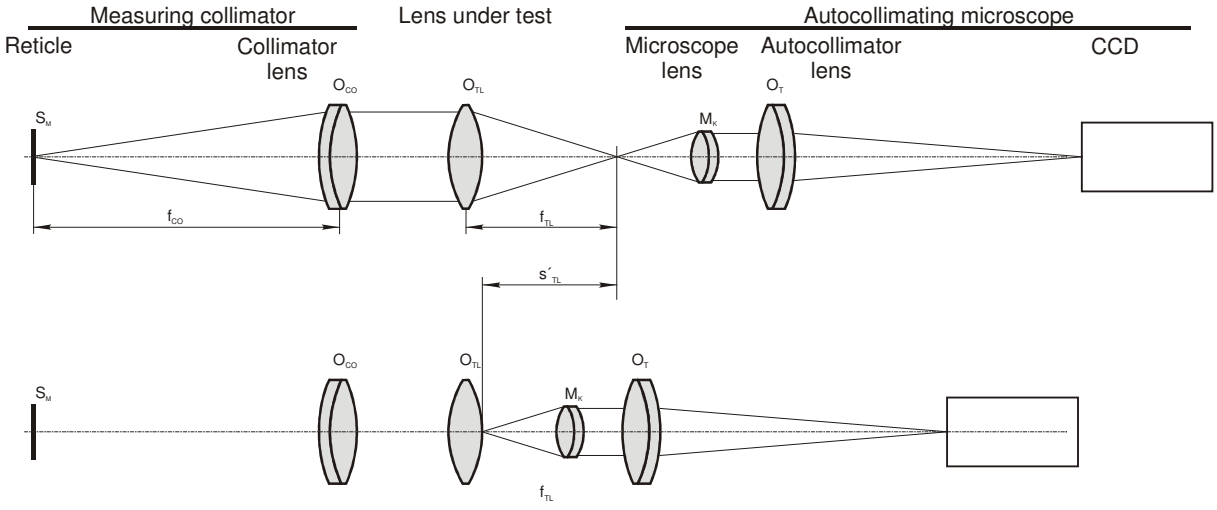


Fig. 6: Measuring principle of back focus measurement.

In case of lenses with negative focal length the back focal is measured from the last surface, as well. In this case the rear focus is located in front of the last surface, therefore the back focal length is negative.

3.4 Measurement of radii

The radius is defined as the distance between the surface and its centre of curvature. The distance can be measured directly with an autocollimating microscope. It produces autocollimation images in the vertex and in the centre of curvature of the surface of the specimen. The vertical distance *R* between these two points is the radius, which is to be measured.

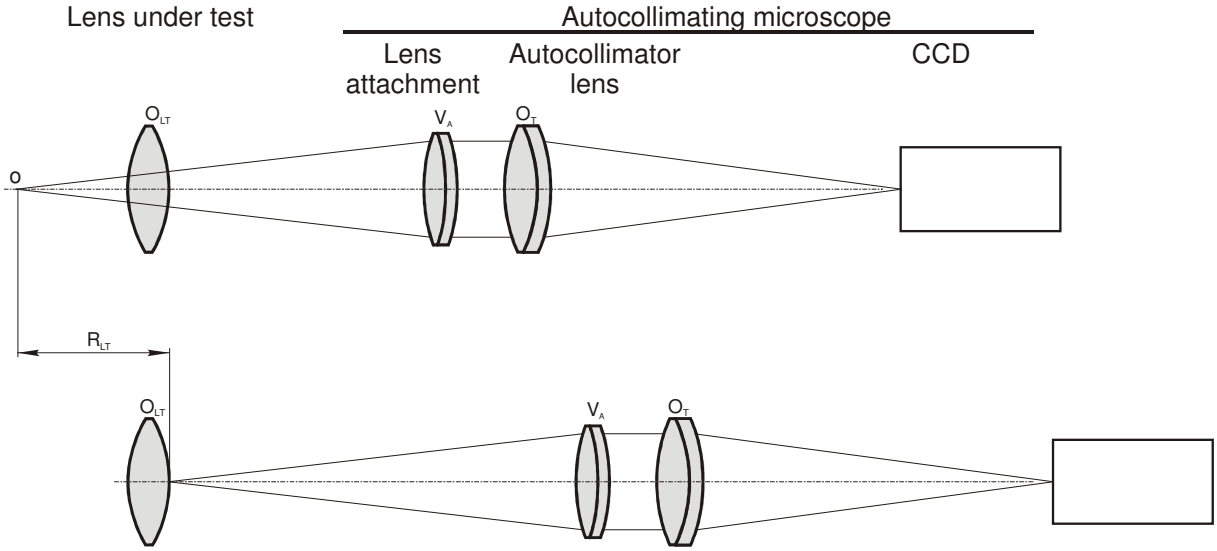


Fig. 7: Measuring principle of radius measurement.

4. Description of Main Assemblies

The MELOS 530 consists of the following parts:

1. Stand with measuring collimator 235 601
   a) Granite base with stand
   b) Mechanical diaphragm set
   c) Measuring collimator K200/40 with calibrated reticle for measurement

2. Focus module 235 630
   a) Autocollimator AKG 200/40/14.7
   b) Microscope objective revolver with three microscope objectives: 2: 1, 5: 1 and 10: 1
   c) Intelligent control unit
   d) TV-set

Only combinations 2-5:

3. Set of Attachment Achromats:
   - f=50 mm, Ø10.5 mm, F# 4.8 221 048
   - f=90 mm, Ø16.0 mm, F# 5.6 221 051
   - f=140 mm, Ø28.0 mm, F# 5.0 221 053
   - f=200 mm, Ø28.0 mm, F# 7.1 221 055
   - f=300 mm, Ø28.0 mm, F# 10.7 221 059
   - f=500 mm, Ø28.0 mm, F# 17.9 221 063
   - f=600 mm, Ø28.0 mm, F# 21.4 221 067

Only combinations 3-5:

4. X-Y translation stage 235 680

In the following the control elements of the base unit and the control unit are described.

4.1 Vertical stand, focus module and XY-translation stage

Components and control elements of the vertical stand with focus module:

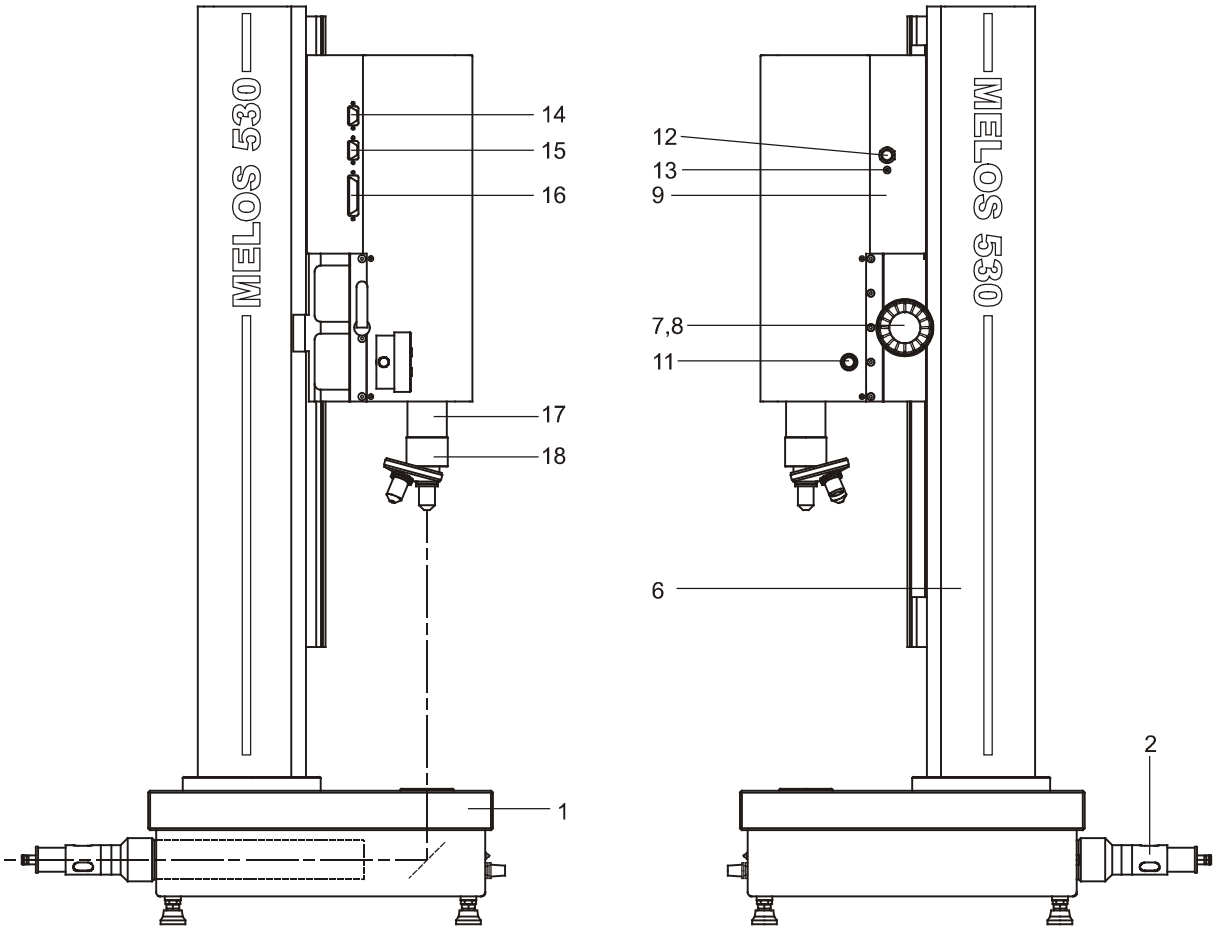


Fig. 8:

1. Granite base
2. Adapter sleeve for illumination
6. Adjustable height stand with integrated measurement system
7. Vertical course adjustment knob
8. Vertical fine adjustment knob
9. Focus module
12. Brightness control knob for autocollimator
13. Autocollimator illumination indicator
14. Socket for vertical measurement system
15. Socket for digital gauge
16. Socket for display module
17. Autocollimator objective tube
18. Microscope revolver

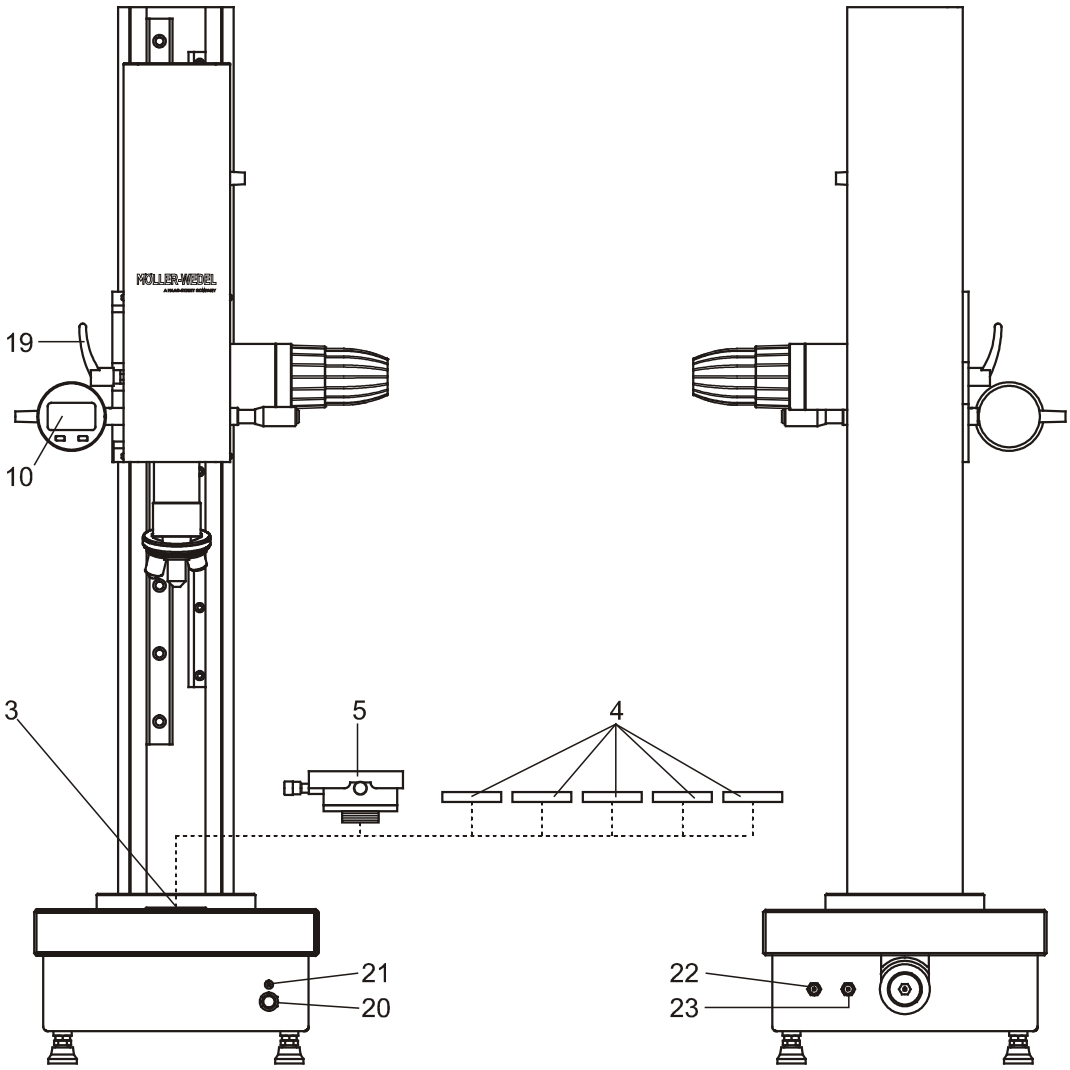


Fig. 9 Vertical stand with focus module (front and rear view)

3. Diaphragm holder
4. Diaphragm plates
5. X-Y translation stage
10. Digital measuring gauge for measurement of horizontal translation
19. Fixing knob for focus module
20. Brightness control for measuring collimator
21. Collimator illumination indicator
22. Socket for connection of power supply
23. Socket for connection of LED illumination

The granite base (1) contains the measuring collimator K200/40 with the calibrated reticle for measurement. The measuring beam exits the granite base at the diaphragm holder (3) in vertical direction. The diameter of the measuring beam can

be controlled by choosing different diaphragms (4). The diaphragm is put into the fitting of the granite plate. For radius measurement the diaphragm is removed and the X-Y-translation stage (5) is fixed in the thread of the granite plate.

The stand (6) is equipped with a vertical course and fine adjustment (7, 8). The measurement (9) head is attached to the slide of the vertical stand. The measuring head contains the autocollimator with TV-camera and the horizontal translation stage with digital gauge (10) for horizontal displacement measurement. On the right side of the head there is the horizontal adjustment knob (11) and the combined on/off switch and brightness control (12) for autocollimator illumination. The indicator (13) displays the on/off state of the illumination.

The sockets for the connection of the vertical (14) and horizontal (15) measurement systems and the control unit (16) are located on the left of the measuring head.

The end of the autocollimator objective tube (17) protrudes at the bottom of the measuring head. The microscope objective revolver (18) and the attachment achromats are screwed directly to the end of the objective tube.

4.2. Intelligent Control Unit

The control unit contains a microprocessor which does the necessary calculations for focal and radius measurements and displays measured data on the LCD display.

The control unit is shown in Fig. 9. The LCD-Display permits easy reading of the data and menu-guided programs, even under poor lighting conditions.

Operation is controlled via a keypad with ten keys.

The individual programs can be called up with six program keys on the control unit. A detailed presentation of the program is given in section 6.2 on page 20ff.

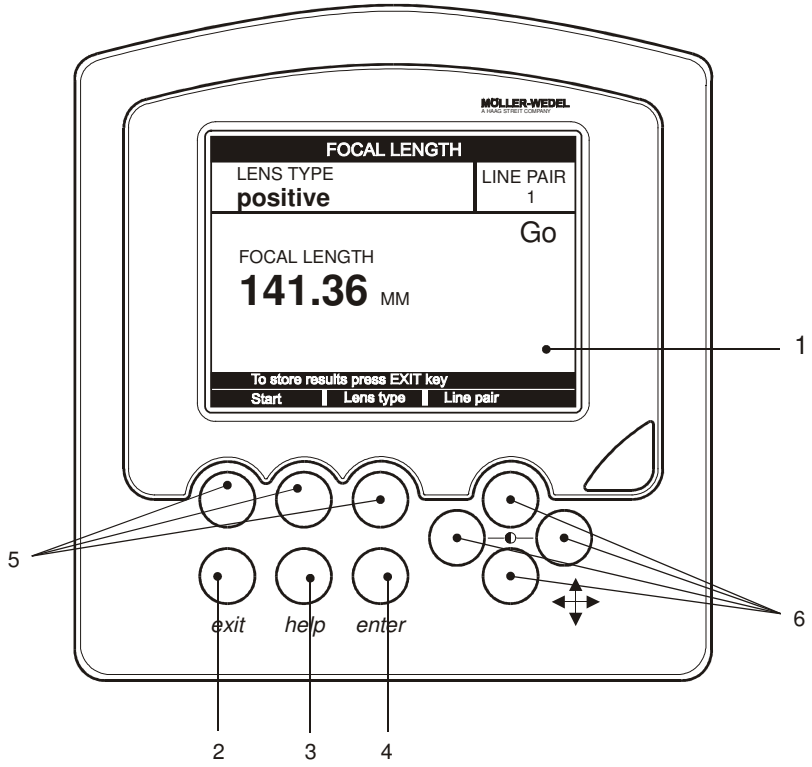


Fig. 9: Control unit (Control Unit MELOS 530)

1. LCD-display
2. EXIT key
3. HELP key
4. ENTER key
5. Function keys
6. Cursor keys (left and right for contrast control)

On the top of the control unit there are the power switch, the power connector socket, the connector socket for measuring head and connector socket for a computer (see Fig. 10).

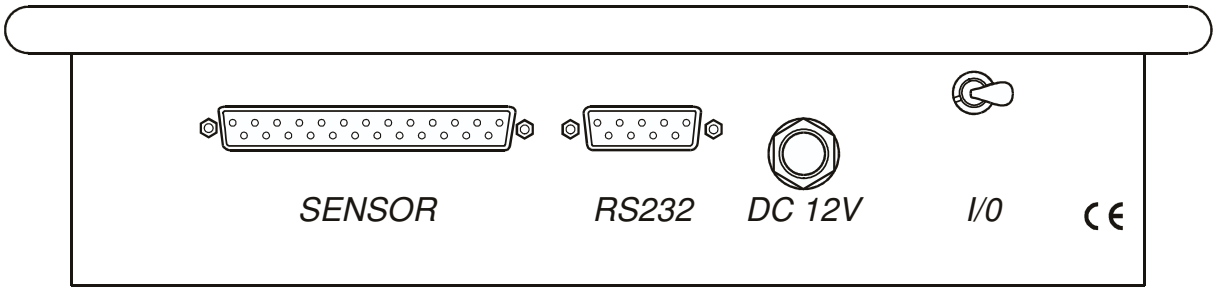


Fig. 10: Top of control unit

The Base Unit Seven-In-One is to be connected with the control unit. The RS 232 interface is for connection with a PC to be used for reading table data direct into a computer and read-out of the currently measured values.

Voltage:

For power supply use only the power pack supplied by MÖLLER-WEDEL OPTICAL. The power plug unit switches automatically from 115V / 50-60Hz to 230V / 50-60Hz.

5. Assembly

5.1 Unpacking and Inspection of the Equipment

The equipment is shipped in a stable storage case. This case is designed for storage and transport. Unpack the equipment carefully. Mechanical stress should be avoided.

☞ **Immediately on receipt the equipment should be inspected for completeness.**

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

5.2 Assembly of the Equipment

1. Connect the digital gauge with the measuring head (no. 15 in Fig. 8): insert the flat optical connector into the slit on top of the measurement gauge. The flat optical connector side of the plug with the LED must point to the front of the instrument.
2. Connect the monitor with the control unit with the BNC-cable. Use the BNC-connector on the left side of the unit. Switch the monitor to low impedance.
3. Connect the measuring head (no. 16 in Fig. 8) with the control unit with the SubD-connector cable (SENSOR-plug in Fig. 9).
4. Plug the power supply into the 5V/12V-connector (Fig. 9) of the control unit.
5. Connect the light conducting fibre to the cold light source and insert the illumination adapter into the collimator sleeve on the rear of the base (see Fig. 8).
6. Connect the cold light source to mains supply.

6. Operation

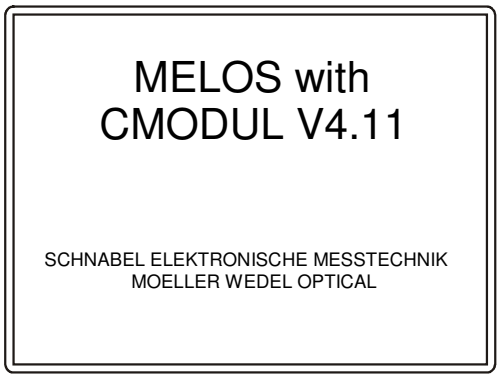
Due to the modular structure of the integrated microprocessor system, the MELOS 530 is simple to operate and is clearly structured. Visual guidance via the On-Screen-Display is provided to guide the operator through the operating program and to draw his attention to any faults or operating errors that can occur.

Nevertheless experience of the user in measurement of focal length is of advantage in the use of the instrument.

The following sections give detailed instructions for handling the MELOS 530.

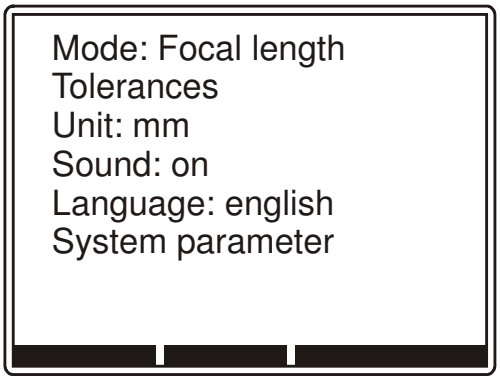
6.1 Menu-guided Control Unit

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



The LCD-screen shows the information about the current software version.

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



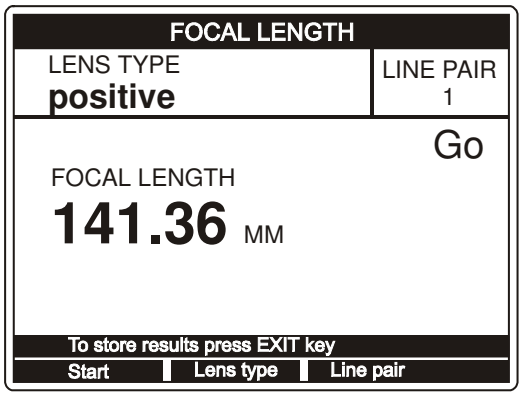
Press the HELP key under the key bar of the monitor for more information.

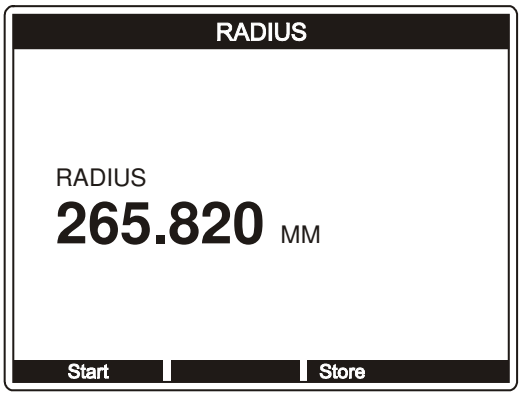
Use arrow keys to change either **Mode, Tolerances, Unit, Sound, Language** or **System parameter** settings. To end the main menu press the exit key

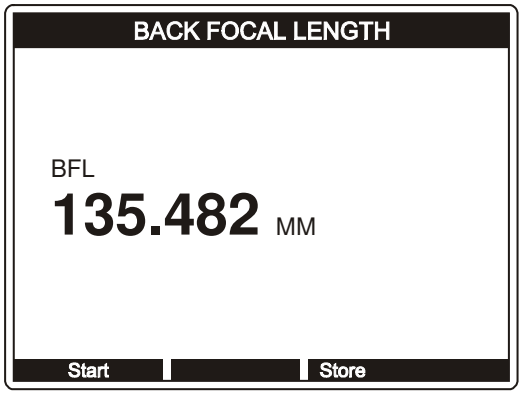
☞ **In case the control unit doesn't react on key strokes or beeps continuously, the unit probably has to be reset. See Annex 1 for further details.**

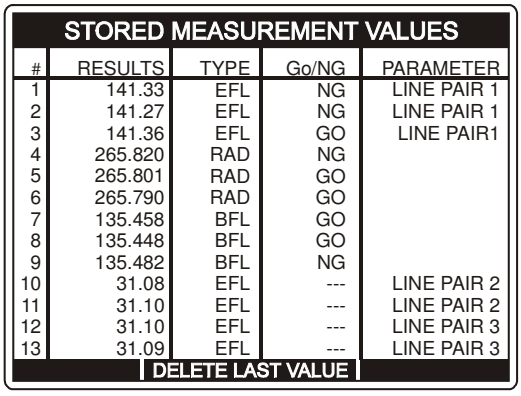
Mode

By pressing the ENTER key switch between the different measuring modes **Focal length, Radius, Back focus** and **Table**.









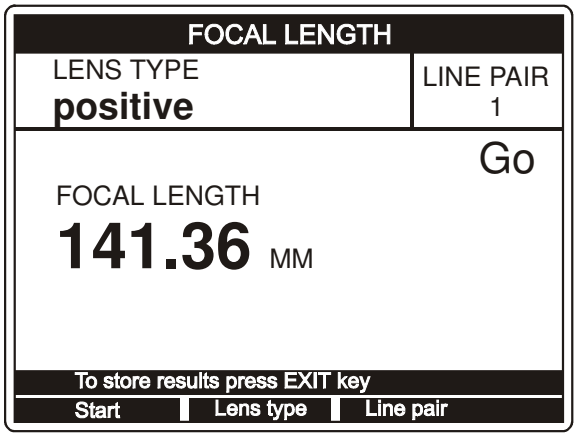
STORED MEASUREMENT VALUES

#	RESULTS	TYPE	Go/NG	PARAMETER
1	141.33	EFL	NG	LINE PAIR 1
2	141.27	EFL	NG	LINE PAIR 1
3	141.36	EFL	GO	LINE PAIR1
4	265.820	RAD	NG	
5	265.801	RAD	GO	
6	265.790	RAD	GO	
7	135.458	BFL	GO	
8	135.448	BFL	GO	
9	135.482	BFL	NG	
10	31.08	EFL	---	LINE PAIR 2
11	31.10	EFL	---	LINE PAIR 2
12	31.10	EFL	---	LINE PAIR 3
13	31.09	EFL	---	LINE PAIR 3

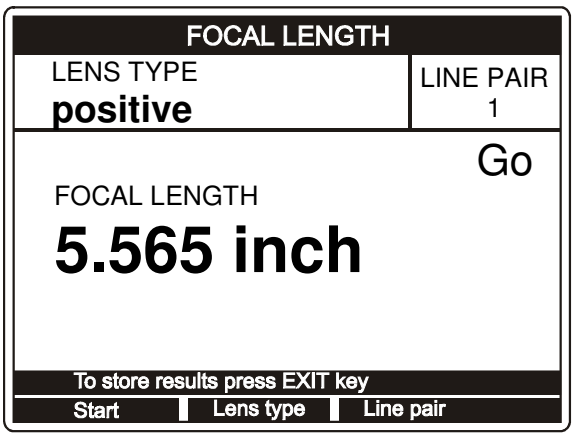
DELETE LAST VALUE

Unit

By pressing the ENTER key switch between the length units **mm**, **inch**.



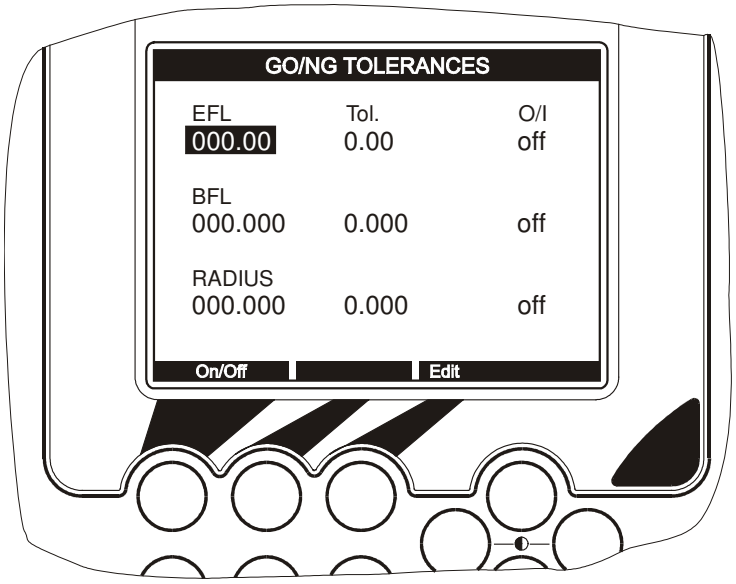
mm



Inch

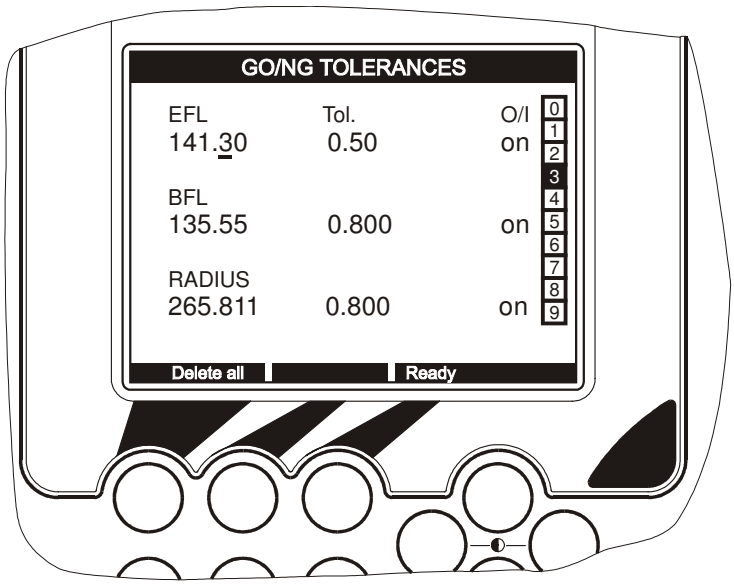
Tolerances

Go to the main menu. Move the cursor to **Tolerances**.
Press the ENTER key. A new menu occurs:



The first column shows the nominal value for the measurement modes. The second column shows the maximum allowed deviation from the measurement to the nominal value. The third column shows whether the tolerance is switched on or off for the specific measurement mode.

For activating the tolerance field on the display move the cursor with the up/down button to the measurement mode and press the button below the **On/Off** field of the key bar. For deactivating the Go/NG tolerance display press again the **On/Off** key.



In order to change the tolerance values move the cursor to the corresponding row/column and press the button below **Edit**. The small bar below the number shows the position of the cursor. Move the cursor with the left and right button to the digit that is to be changed. Change the value with the up and down button. All values can be set to zero with the button below **Delete all**. When finished, quit with the **Ready** button. Return to the main menu by pressing the **ENTER**-button.

SOUNDS

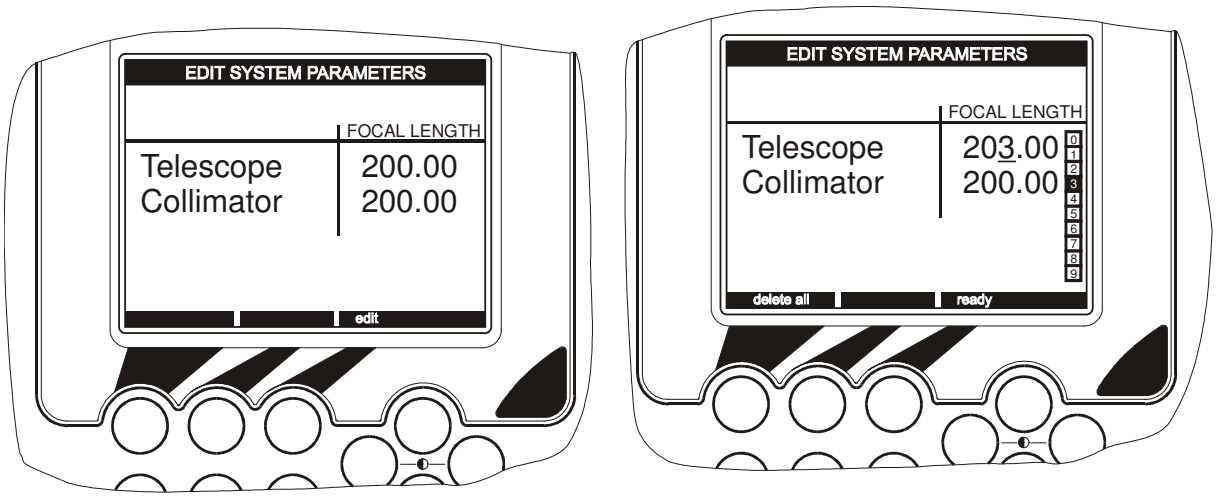
By pressing the **ENTER** key the sound can be toggled **On** and **Off**. If turned **On**, the control unit beeps, when a value is stored into the table. To leave menu press **EXIT** key.

LANGUAGE

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

SYSTEM PARAMETER

In the system parameter menu the **Telescope focal length** and **Collimator focal length** can be set. Move the cursor the value that is to be changed and use the procedure described under tolerances (section 0) to change the value. The value of the **Telescope focal length** is not used in this version of the instrument. The **Collimator focal length** is used for the effective focal length calculation. The correct value of the collimator focal length can be found in the calibration certificate of the MELOS 530. Return to the main menu by pressing the **ENTER**-button.



6.2 Features of the measuring modes

Focus measuring mode features

The screen display for focal length measurement is shown in Fig. 11. The **LENS TYPE**-field denotes whether **positive** or **negative** lenses are tested. The lens type can be changed by pressing the button associated to **Lens type**. The **LINE PAIR**-field shows the selected line pair number of the reticle, that is used for focal length measurement. Another line pair can be chosen to by pressing the button associated to **Line Pair**. The measurement result is display in the **FOCAL LENGTH**-field. If tolerance is switched on, GO or NG is display in the upper right corner, depending, whether the measurement result lies inside or outside the tolerance interval. The button associated to **Start** begins a new measurement at the current horizontal position. The measurement result can be stored at any time by pressing the **EXIT** button.

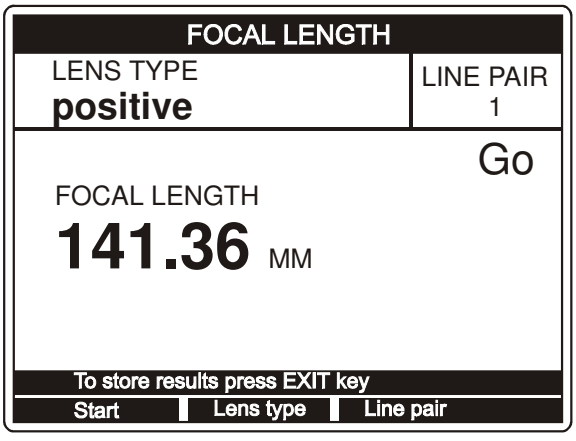


Fig. 11: Focal length measurement display

Back focus measuring mode features

The screen display for focal length measurement is shown in Fig. 12. The measurement result is displayed in the **BFL**-field. If tolerance is switched on, GO or NG is displayed in the upper right corner, depending, whether the measurement result lies inside or outside the tolerance interval. The button associated to **Start** begins a new measurement at the current horizontal position. The measurement result can be stored at any time by pressing the button associated to **Store**.

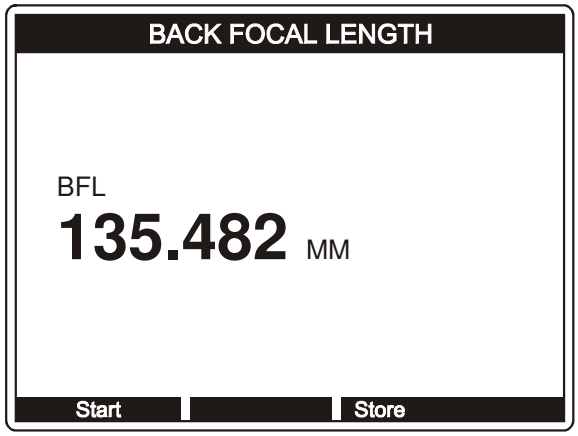


Fig. 12: Back focal length measurement display

Radius measuring mode features

The screen display for radius measurement is shown in Fig. 13. The measurement result is displayed in the **RADIUS**-field. If tolerance is switched on, GO or NG is displayed in the upper right corner, depending, whether the measurement result lies inside or outside the tolerance interval. The button associated to **Start** begins a new measurement at the current vertical position. The measurement result can be stored at any time by pressing the button associated to **Store**.

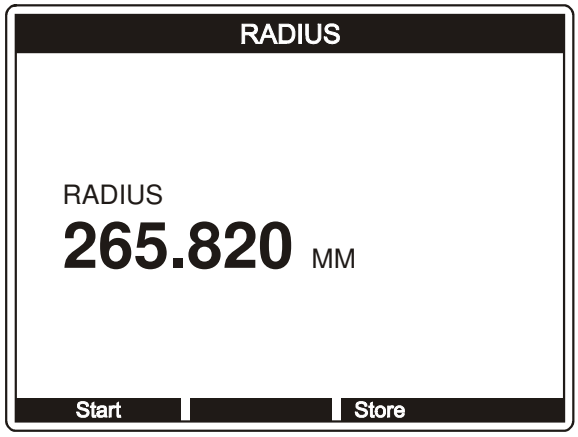


Fig. 13: Radius measurement display

Table mode features

Each time the store key is pressed in a measurement mode the value is stored in a table in consecutive numbering. Up to 400 values can be stored in the table. Besides the value itself, the type, the Go/NG state and additional parameters are stored, as well. The screen display for the table mode is shown in Fig. 14. The first column (**#**) shows the number of the measurement value. The second column (**RESULTS**) displays the value itself. The resolution is depending on the measurement mode and on the line pair in EFL measurement. For effective focal length it is 12.5 µm (LP 0.5x), 25 µm (LP 1x), 50 µm (LP 2x), or 75 µm (LP 3x). For radius and back focus it is 0.001 mm. The third column (**TYPE**) denotes the type of the measurement. The types are: "EFL" (effective focal length), "BFL" (back focal length) and "RAD" (radius). The fourth column (**Go/NG**) shows "Go" or "NG" when tolerance is switched on or "---". In the last column (**PARAMETER**) additional measurement parameters are displayed. These are the line pairs used for effective focal length measurement.

STORED MEASUREMENT VALUES

#	RESULTS	TYPE	Go/NG	PARAMETER
1	141.33	EFL	NG	LINE PAIR 1
2	141.27	EFL	NG	LINE PAIR 1
3	141.36	EFL	GO	LINE PAIR1
4	265.820	RAD	NG	
5	265.801	RAD	GO	
6	265.790	RAD	GO	
7	135.458	BFL	GO	
8	135.448	BFL	GO	
9	135.482	BFL	NG	
10	31.08	EFL	---	LINE PAIR 2
11	31.10	EFL	---	LINE PAIR 2
12	31.10	EFL	---	LINE PAIR 3
13	31.09	EFL	---	LINE PAIR 3

DELETE LAST VALUE

Fig. 14: Table mode display

The last value of the table can be deleted with the button below **DELETE LAST VALUE**. The whole table can be deleted by pressing the four cursor keys simultaneously. Please keep in mind that after deletion, there is no way to recover the values.

6.3 RS-232 reading

The control unit can be connected to a computer via RS-232.

The following parameters are used for RS232 communication:

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

The communication is controlled by a special protocol, the so called text protocol. The control unit acknowledges three different commands from the computer and answers them with one of five messages depending on the command and the measurement mode. The details of the protocol structure are described in the following section.

Protocol structure

With the text protocol the Control Unit MELOS is receiving and sending ASCII characters (Code<128), only. Every received command or transmitted message consists of one line of text . Each message is concluded with a linefeed (0D hex).

A text line consists of 4, 5 or 7 text fields, separated from each other by blanks (20 hex). The last text field is followed by the linefeed (0D hex). The first text field at the beginning of the line specifies the type of message.

Acknowledged Commands

The messages can be controlled by the following three commands. All commands consists of one character only (please note that the commands are case sensitive) and are followed by a linefeed.

Command	Result
b	Sends message of type 30, 31 or 32 (depending on the active measurement mode, efl, bfl or radius values, see below).
t	Sends the table. The header message of type 6 of table 1 will be sent in any case, even if the table is empty.
d	Sends messages of type 8 (device information)

Transmitted Messages from Control Unit

1. Current effective focal length (message type 30)

Field name:	Type field	Status	Measurement value
Example	30	220	172.54

Description:

Status: This field consists of three numbers in the format "abc". The meaning of the numbers is:

a-> current line pair here
1 -> line pair 0.5x
2 -> line pair 1x
3 -> line pair 2x
4 -> line pair 3x

b-> tolerance status:
0 -> tolerance off
1 -> value outside tolerance interval
2 -> value inside tolerance interval

c-> unit of the measurement value (corresponds with selected unit):
0 -> mm
1 -> inch

2. Current back focal length (message type 31)

Field name:	Type	Status	Measurement value
Example	31	20	219.852

Description:

Status: This field consists of two numbers in the format "ab". The meaning of the numbers is:

a-> tolerance status:
0 -> tolerance off
1 -> value outside tolerance interval
2 -> value inside tolerance interval

b-> unit of the measurement value (corresponds with selected unit):
0 -> mm
1 -> inch

3. Current radius (message type 32)

Field name:	Type	Status	Measurement value
Example	32	11	6.964

Description:

Status: This field consists of two numbers in the format "ab". The meaning of the numbers is:

a-> tolerance status:
0 -> tolerance off
1 -> value outside tolerance interval
2 -> value inside tolerance interval

b-> unit of the measurement value (corresponds with selected unit):
0 -> mm
1 -> inch

4. Table header (message type 6), transmitted before data of a table will be transmitted

Field Name:	Type	Total no. of tables	No. of current table	No. of rows	No. of columns
Example:	6	1	1	15	5

Description:

Total no. of tables: Since there is only one table in the Control Unit MELOS this value here is always one.

No. of current table: Since there is only one table in the Control Unit MELOS this value is always one.

No. of rows: The number of rows (=measurement value) that are stored in the table. The table header is followed by a sequence of **messages of type 5**, one for each table row. In case there are no measurement values (No. of

rows=0), no rows are sent after the table header.

No. of columns: No. of columns. This value is always five since there are five columns in the table.

5. Row of table (message type 5), transmitted for each row of the table

Field Name:	Type	No. of cur. table	No. of cur. row	Value	Unit	Mode	Tol.	Param.
Example:	5	1	37	32,46	mm	EFL	---	LP1

Description:

No. of current table: Since there is only one table in the Control Unit MELOS this value is always one.

No. of current row: Number of the row (= no. of the measurement value) that is currently transmitted.

Value: The stored measurement value in the currently selected measurement unit.

Unit: Currently selected measurement unit ("mm" or "in").

Mode: Measurement mode of the value ("EFL", "BFL", or "RAD").

Tolerance: Description whether the value is inside ("Go") or outside ("NG") the tolerance interval. When tolerance is switched off, "---" is transmitted.

Parameter: During effective focal length measurement the field contains the number of the line pair used for measurement ("LP0.5", "LP1", "LP2", or "LP3"). In the other measurement modes "---" is transmitted.

6. Device information (message type 8)

Field Name:	Type	Device name	Version No.
Example:	8	MELOS	4.11

Description of the fields:

Device name: MELOS

Version: Current software version of the control unit.

RS-232 Pin Definition

Control Unit 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

7. Notes on Practical Implementation of Measurements

Before the procedures for carrying out EFL, BFL and radius measurements are described, a general remark referring to all measurement modes is given: Due to technical reasons, the digital gauge of the horizontal measurement system cannot be switched off by the control unit. We recommend switching it off manually after switching off the control unit in order to increase battery lifetime.

7.1 Procedure for effective focal lengths measurement

For a description of the measurement principle see also 3.2 on page 7.

Here are some general remarks on the measurement of effective focal length:

- The pattern on the calibrated reticle is shown in Fig. 4 on page 7. Each line pair corresponds with a certain field angle. The full field angles of the line pairs are:

Line pair	0.5x	1x	2x	3x
Full field angle	4.58°	2.29°	1.15°	0.76°

  If the lens has no distortion the focal length is independent of the field angle. In this case the following combinations are recommended:

Focal length measurement range	Line pair	Microscope objective magnification
5 mm - 30 mm	0.5x	10:1
30 mm - 200 mm	1x	5:1
200 mm - 500 mm	2x or 3x	2:1

  This measurement gives the highest accuracy in the focal length measurement. If the test lens exhibits strong distortion, the measurement values of the effective focal length can vary with the field angle. In this case choose the line pair with the smallest field angles (3x) in order to get the on-axis focal length.

- A similar rule applies to the choice of the diaphragm. In general the largest diaphragm should be chosen. Stopping down to a unnecessary extend should be avoided due to greater definition in focus depth.
  If the lens has strong spherical aberrations the image can be blurred. In this case the diaphragm must be selected such that the image is adequately sharp.
  The diameters of the diaphragms are: 5 mm, 10 mm, 20 mm, and 28 mm.

- For rapid location of the reticle image proceed as follows:
  Raise the measuring head from bottom position. First focus on to the granular structure of the ground-glass image. The ground-glass image itself lies close to the collimator reticle. Shift measuring head slowly further upwards. The image of the scale-plate of the collimator should appear.

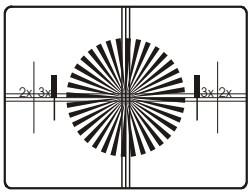
- In the pair of lines used for focal length measurement both lines should appear equally sharp. The tested lens can be correspondingly adjusted by displacement on the plate.

- Image brightness should not be too high during measurement. For control of brightness use the control knob of the cold light source. In case the brightness is

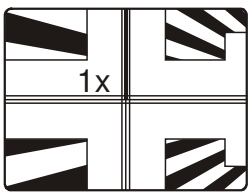
to high, use instead of the cold light source the LED-illumination.

Positive effective focal lengths measurement

1. Switch on the control unit, TV-monitor, and collimator illumination. Make sure that the illumination of the autocollimating microscope is switched off (no. 12 in Fig. 8 on page 11).
2. Set the Control Unit in Effective Focal Length Measuring mode (see 0 on page 17) and set lens type to positive (see 6.2.1 on page 19).
3. Screw the microscope objective revolver onto the end of the autocollimator tube (see no. 18 in Fig. 8 on page 11).
4. If installed, remove the X-Y translation stage. Put an appropriate diaphragm on the beam exit hole of the granite plate. See the general remarks under 7.1 for the proper choice of the diaphragm.
5. Place object to be tested on to the diaphragm. For single lenses the side with the larger curvature should face the collimator and in the case of optical systems the side with the longest image back focal length. In case of doubt image quality is decisive.
6. Move measuring head vertically until the reticle of the collimator appears focussed on the monitor.
7. Move the measuring head roughly to the centre in horizontal direction.
8. Adjust the lens so that the Siemens star is centred on the TV-Monitor and the horizontal line is lying directly above or under the horizontal double line.

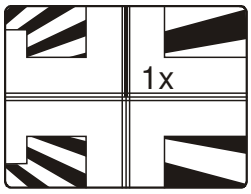


9. Readjust the height for maximum image sharpness.
10. Move the measuring head horizontally to one line of the line pairs 0.5x, 1x, 2x or 3x. See the general remarks under 7.1 for the proper choice of the line pair.



11. Set the line pair in the control unit (see 0 on page 20).
12. Choose a microscope object by turning the revolver such that the image of the line fits between the double line of the reticle of the autocollimating microscope. See the general remarks under 7.1 for the proper choice of the microscope objective.
13. Adjust the line to the centre of the double line.

14. Start the measurement by pressing the Start button (see 6.2 on page 20).
15. Move the measuring head horizontally to the other line of the line pair and centre it between the double line.



16. The control unit displays the effective focal length of the tested lens.

Negative effective focal lengths measurement

1. Switch on the control unit, TV-monitor, and collimator illumination. Make sure that the illumination of the autocollimating microscope is switched off (no. 12 in Fig. 8 on page 11).
2. Set the Control Unit in Effective Focal Length Measuring mode (see 6.1 on page 17) and set lens type to negative (see 6.2 on page 20).
3. Screw an attachment achromat onto the end of the autocollimator tube (no. 17 in Fig. 8 on page 11). The focal length of the achromat should be at least 30 mm longer than the negative focal length of the test lens. If the focal length of the specimen is not known, make a first measurement with a long focal length achromat in order to get a rough estimate for the focal length and repeat the measurement with an appropriately chosen achromat.

The steps 4. to 16. are the same as described in section 7.1.1 for positive focal length measurement. Please note that the image of the reticle is lying below the test lens.

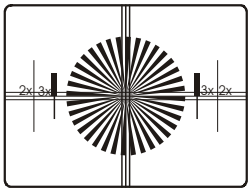
7.2 Procedure for back focal lengths measurement

For a description of the measurement principle see also 3.3 on page 8.

Back focal lengths measurement for positive lenses

1. Switch on the control unit, TV-monitor, and collimator illumination. Make sure that the illumination of the autocollimating microscope is switched off (no. 12 in Fig. 8 on page 11).
2. Set the Control Unit in Back Focal Length Measuring mode (see 6.1 on page 17).
3. Screw the microscope objective revolver onto the end of the autocollimator tube (no. 18 in Fig. 8 on page 11).
4. If installed, remove the X-Y translation stage. Put an appropriate diaphragm on the beam exit hole of the granite plate. See the general remarks under 7.1 for the proper choice of the diaphragm.
5. Place object to be tested on to the diaphragm.

6. Move measuring head vertically until the reticle of the collimator appears focussed on the monitor.



7. Move the measuring head roughly to the centre in horizontal direction.
8. Adjust tested lens so that the Siemens star is in the centred on the TV-Monitor.
9. Readjust the height for maximum image sharpness.
10. Press the Start button on the control unit (see 6.2 on page 21).
11. Move the measuring head downwards until you see an image from dust particles of the test lens surface. For checking, you can use a small piece of paper and put it directly on top of the surface. You should be able to see the paper on the monitor as well. Alternatively, you can use step 6. of the radius measurement mode (sect. 7.3) to adjust the autocollimating microscope to the surface. In this case you have to switch off the collimator illumination and switch on the illumination of the autocollimating microscope.
12. The control unit displays the back focal length of the tested lens. You can store the results by pressing the store button on the control unit.

Back focal lengths measurement for negative lenses

1. Switch on the control unit, TV-monitor, and collimator illumination. Make sure that the illumination of the autocollimating microscope is switched off (no. 12 in Fig. 8 on page 11).
2. Set the Control Unit in Back Focal Length Measuring mode (see 6.1 on page 17).

3. Screw an attachment achromat onto the end of the autocollimator tube (no. 17 in Fig. 8 on page 11). The focal length of the achromat should be at least 30 mm longer than the negative focal length of the test lens. If the focal length of the specimen is not known, make a first measurement with a long focal length achromat in order to get a rough estimate for the focal length and repeat the measurement with an appropriately chosen achromat.

The steps 4. to 12. are the same as described in section 7.2 for positive back focal length measurement. Please note that the image of the reticle is lying below the specimen. Instead of moving downwards from the focal position (step 11. in section7.2) you have to move upwards in order to get an image of the surface.

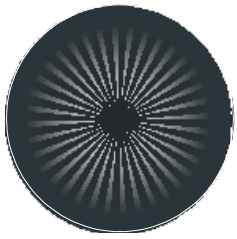
7.3 Measurement procedure for radii measurement

For a description of the measurement principle see also 3.4 on page 9.

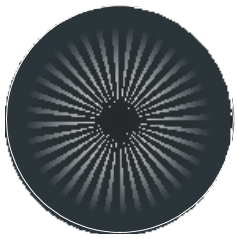
1. Switch on the control unit, TV-monitor, and autocollimating microscope

illumination. Make sure that the collimator illumination is switched off (no. 12 in Fig. 8 on page 11).

2. Set the Control Unit in Radius Measuring mode (see 6.1 on page 17).
3. If installed, remove the diaphragm and insert the X-Y translation stage into the beam exit hole.
4. Screw the appropriate attachment achromat onto the end of the autocollimator tube (no.17 in Fig. 8 on page 11). The attachment achromat should be chosen according to the following two rules:
   a) This rule applies only to convex curvature: Choose the focal length of the attachment such that it is at least 20 mm larger than the radius of the test surfaces.
   b) Choose the attachment achromat with the smallest possible F-Number. (This rule applies to convex and concave surfaces).
5. Put the specimen on the X-Y translation stage and centre it roughly with respect to the measuring head
6. Move the measuring head vertically until you get an autocollimation image from the surface. You can check the correct setting by putting a small piece of paper on the surface. An image of the reticle (Siemens star) should appear on it.



7. Move the measuring head vertically (upwards for concave and downwards for convex surfaces) until you get a second autocollimation image in the centre of curvature of the surface.



8. Fine adjust the centring of the surface with X-Y screws until the illuminated area is centred on the Siemens star image on the monitor.
9. Press the Start button on the control unit (see 6.2 on page 20).
10. Move the measuring head to the autocollimation image on the surface (step 6).
11. The control unit displays the radius of the surface. You can store the results by pressing the store button on the control unit. Because of technical terms the shown radius is independent of the sign from the curvature always positive.

8. Technical data

8.1 Stand with measuring collimator

Stand:	Adjustment range:	530 mm
	Fine adjustment resolution:	1 µm
Integrated vertical measurement system:	Measurement range:	530 mm
	Resolution:	1 µm
	Accuracy:	3 µm
Measuring Collimator:	Objective focal length:	200 mm
	Objective diameter:	28 mm
	Illumination type:	LED
	Illumination wavelength:	525 nm
	Reticle:	combined Porro/ Siemens star
Dimensions:	W x H x L: 330 mm x 840 mm x 350 mm	
Weight:	35 kg	

8.2 Focus module

Integrated horizontal measurement system:	Measurement range:	18 mm
	Resolution:	1 µm
	Accuracy:	3 µm
	Battery type:	Lithium battery CR 2032
Autocollimation microscope:	Objective focal length:	200 mm
	Objective diameter:	28 mm
	Illumination type:	LED
	Illumination wavelength:	525 nm
	Collimator reticle:	Siemens star
	Eyepiece reticle:	double cross
Effective focal lengths measurement:	Positive focal length range:	5 mm ... 500 mm
	Negative focal length range:	-5 mm ... -580 mm
	Free aperture:	28 mm
	Maximum specimen diameter:	200 mm
	Reproducibility:	0.04% ... 0.2 %
	Accuracy:	0.3 %

Back focal lengths measurement:	Positive back focus range:	2 mm ... 530 mm
	Negative back focus range:	-2 mm ... -480 mm
	Free aperture:	28 mm
	Maximum specimen diameter:	200 mm
	Reproducibility:	0.02% ... 0.2 %
	Accuracy:	0.3 %
Measurement of radii:	Positive radius range:	2 mm ... 530 mm
	Negative radius range:	-2 mm ... -480 mm
	Free aperture:	28 mm
	Maximum specimen diameter:	200 mm
	Reproducibility:	0.02% ... 0.2 %
	Accuracy:	0.3 %

8.3 Intelligent Control Unit (Control Unit MELOS)

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

- Online calculation of effective focal lengths, back focal lengths and radii.
- Alphanumerical display of measurement data via LCD-display.
- Contrast setting via keypad.

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

Interface to autocollimator: 25-pin SUB-D plug:
for interfacing with the MELOS sensors,
outputs +5V/200 mA, +12V,
additional CMOS in- and outputs

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	out
3	RxD	in
5	GND	

2 pin socket 12VDC / GND power supply

Dimensions: W x H x L: 210 mm x 230 mm x 35 mm
Weight: 1.4 kg

8.4 Power Plug

Input:	115-230 VAC (93.5-265 VAC) 50Hz-60Hz 0.25A-0.15A Automatically
Output:	12 V= 0.7 A
EMC:	EMC confirmed

9. MAINTENANCE AND CARE

No special maintenance is required for the MELOS 530 when operated in clean environment. Nevertheless, the beam exit of the granite base should be covered when the instrument is not being used (use diaphragm with smallest opening).

If necessary the following cleaning/maintenance steps may be carried out:

1. Clean deflecting mirror in base-plate only by blowing with dry air.
2. Grease column lightly, but do not grease groove!
3. Remove dust from eye-lens of ocular by blowing or wiping. The shadows caused can be very disturbing.
4. The painted, anodised, and chromium plated surfaces may be cleaned with a damp cloth and a soft detergent.
5. Carefully remove the dust from the lens surfaces using a brush. If this is not sufficient, a clean linen cloth may be used.
6. Pollution or finger prints on the lens surfaces can be removed with a mixture of ether and ethanol (ratio 8:1). Be careful! The solvents are inflammable!

The MELOS 530 performance can be tested by using the attachment achromats as test pieces.

10. Warranty

12 months after delivery.

More details:
Refer to the general purchase and delivery conditions of
MÖLLER-WEDEL OPTICAL GmbH.

ANNEX 1

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 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.

CE

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

MELOS 530 Kombination 6
MELOS530 combination 6

MELOS 530
Ident-Nr. / *P/N*
235 606
und den Systemkomponenten / *and system components*

ab Serien-Nr. / *S/N 101 and higher*

folgenden Richtlinien enspricht :	73 / 23 / EWG 93 / 68 / EWG 89 / 336 / EWG	*corresponds to the Directives :*	*73 / 23 / EEC* *93 / 68 / EEC* *89 / 336 / EEC*

Angewendete Normen / *Relevant harmonized standards :*

EN 61010 -1	Sicherheitsbestimmungen für elektrische Meß-, Steuer-, Regel- und Laborgeräte, Teil 1 *Safety requirements for electrical equipment for measurement, control and laboratory use, part 1*
EN 61000-6-4	Elektromagnetische Verträglichkeit (EMV); Fachgrundnorm Störaussendung; Teil 6-4 *Electromagnetic compatibility (EMC); generic emission standard; part 6-4*
EN 61000-6-2	Elektromagnetische Verträglichkeit (EMV); Fachgrundnorm Störfestigkeit; Teil 6-2 *Electromagnetic compatibility (EMC); generic immunity standard; part 6-2*

Wedel, den 20.01.2005

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Dr. Schlewitt
Geschäftsführer/ *Managing Director*

.....
i.A. S.Ruhland
Qualitätswesen / *Quality department*