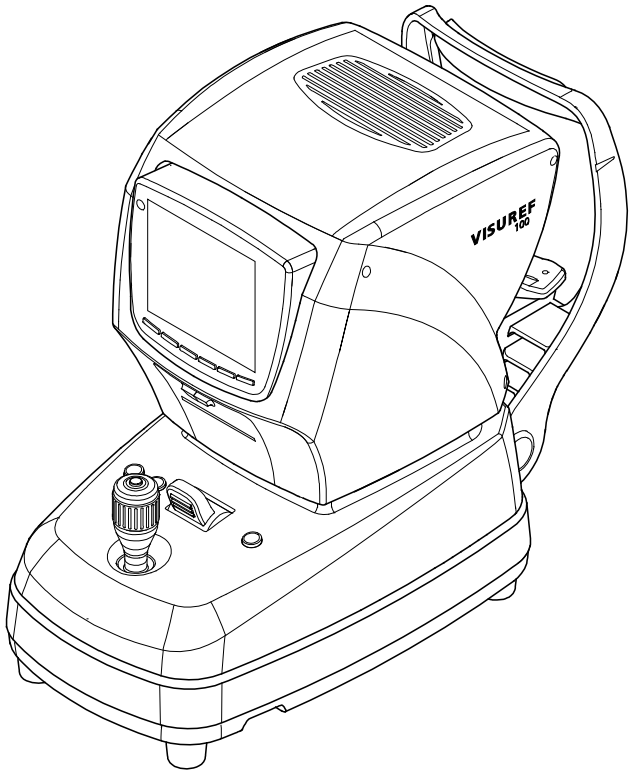
VISUREF 100
Autorefractor/Keratometer

Documentation set

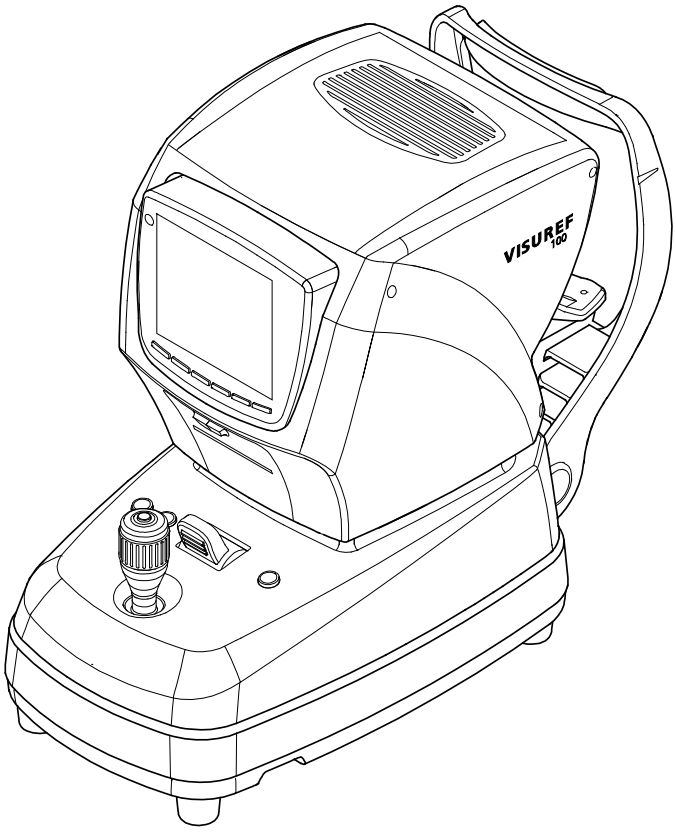


ZEISS

Contents

VISUREF 100
Autorefractor/Keratometer

User Manual



ZEISS

Contents

Notes on the user manual

Purpose and availability of documentation

This user manual describes the safety precautions, functions, usage, performance parameters and care and maintenance measures of the VISUREF 100.

Correct operation of the system is imperative for its safe and successful function. You should therefore ensure that you are thoroughly familiar with this user manual before setting up and using the VISUREF 100 for the first time.

The user manuals and other documentation enclosed with the VISUREF 100 should be kept accessible to users at all times to ensure that the information required for use of the VISUREF 100 is readily available.

Questions and comments

If you have any questions or comments concerning this user manual or the VISUREF 100, please contact ZEISS Service or your local dealer. (Contact details see reverse).

Explanation of symbols used

The symbols used in this user manual refer to important safety information which may warn against possible health risks or fatal injuries and contain useful notes. Whenever you see these symbols, read the accompanying information carefully and observe all safety notes and information in this user manual and on device labels.

WARNING

Indicates a hazardous situation which could result in death or serious injury if the appropriate safety precautions are not heeded.

CAUTION

Indicates a hazardous situation which could result in minor or moderate injury if the appropriate safety precautions are not heeded.

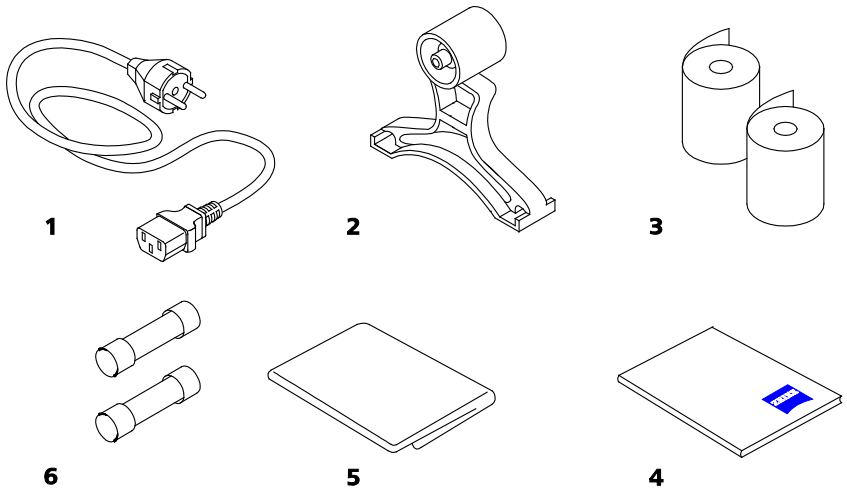
CAUTION - PROPERTY DAMAGE

Indicates possible device damage if the appropriate safety precautions are not heeded.

☞ Information, hints and advice for better understanding of the instructions to be observed in the operation of the device.

Package check list

The VISUREF 100 basic device is supplied with the parts shown in the following figure.



1 Power supply cable
2 Test eye
3 Printer paper (1 roll installed when delivered)
4 Documentation set
5 Dust cover
6 2 fuses (see section *Technical data*, page 62)

Fig. 1 Package check list

Country-specific information and labels

Classification/Manufacturer's declaration

WARNING - GENERAL HAZARDS

This device may only be set up, operated and used for the specified purpose and according to national regulations, consistent with the applicable industry standards and occupational safety and accident prevention regulations. Further notes on classification are to be found in section *Technical data*, page 62 and following.

This device complies with EU Medical Device Directive 93/42/EEC (MDD).

CE 0297

UMDNS No.: 13-313 (Refractometer, ophthalmic)

12-811 (Ophthalmometer)

This declaration shall be rendered invalid if changes are made to the product without the manufacturer’s authorization.

Further notes on electromagnetic compatibility are to be found in section *Electromagnetic compatibility*, page 64 and following.

The product is RoHS-compliant according to Directive 2011/65/EU.

Intended Use

An autorefractor/keratometer is used to determine the refractive and keratometric properties of the human eye. The measured values are used to assist opticians and eye care professionals in the process of prescribing eyeglasses and contact lenses.

Intended user profile

CAUTION - RISK OF OPERATING ERRORS

This device may only be installed, operated, used and maintained by persons who have been properly trained or who have the required knowledge and experience to do so. Please also adhere to the national qualification guidelines applicable in your country.

Disposal of the product

CAUTION - RISK OF ENVIRONMENTAL POLLUTION

Packaging materials should be retained for future relocation or repair.

If you decide to dispose of the packaging material, submit it to a recognized collection system for recycling.

The device contains electronic components. At the end of its lifetime, the device and its integrated batteries should be disposed of in accordance with the relevant national regulations.

Disposal of the product within the EU

In accordance with applicable EU guidelines and national regulations at the time at which the product was brought onto the market, the product specified on the consignment note is not to be disposed of via the domestic waste disposal system or communal waste disposal facilities.

For further information on disposing of this product please contact your local dealer or the manufacturer or its legal successor company. Please read the latest internet information provided by the manufacturer.

Where the product or its components are resold, the seller must inform the buyer that the product must be disposed of in accordance with the currently applicable national regulations.

External labels

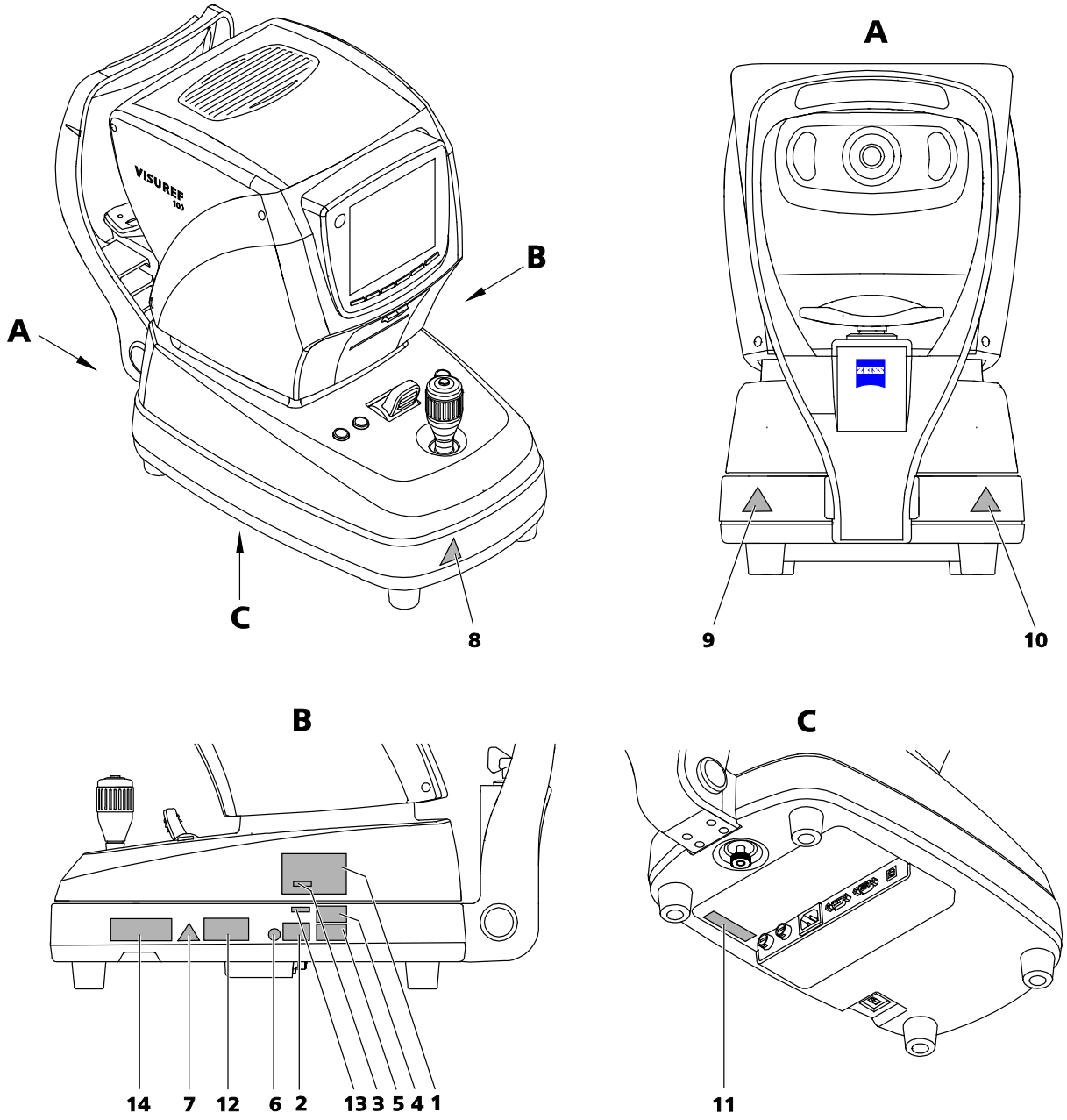
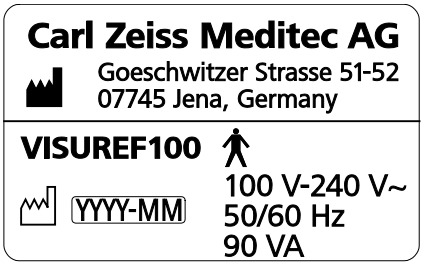
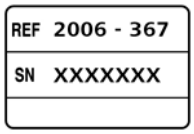


Fig. 2 Labels on the VISUREF 100

Item	Label	Explanation
1		VISUREF 100 type plate Manufacturer Date of manufacture Application part type B
2		VISUREF 100 identification label **REF** Catalogue number/part number **SN** Serial number
3		Sign with date of manufacture
4		CE approval label and disposal advise for EU
5		Sign with UL approval for USA and Canada
6		Information label "Observe user manual!"
7		Warning sign "Risk of electric shock"
8		Crushing hazard sign
9		Hand hazard sign
10		Hand hazard sign
11	Made in Korea	Country of origin label

Item	Label	Explanation
12		Approval label for Brazil
13	Not applicable	Not applicable
14	Not applicable	Not applicable

Performance specifications

Functional description

Measurement functions

In addition to the usual refractometric and keratometric measurements, this instrument also enables measurement of corneal diameters and the base curve of contact lenses.

Dioptric range

The VISUREF 100 covers a wide measurement range from -25 D to +22 D so that even a patient with strong refractive errors can be measured.

User interface

The convenient user interface provides a large 6.4" color LCD screen with a simple and easy-to understand user interface.

Illumination for observation

This illumination option allows to observe the eye or contact lens surface. The system saves up to two images of each eye.

Service life

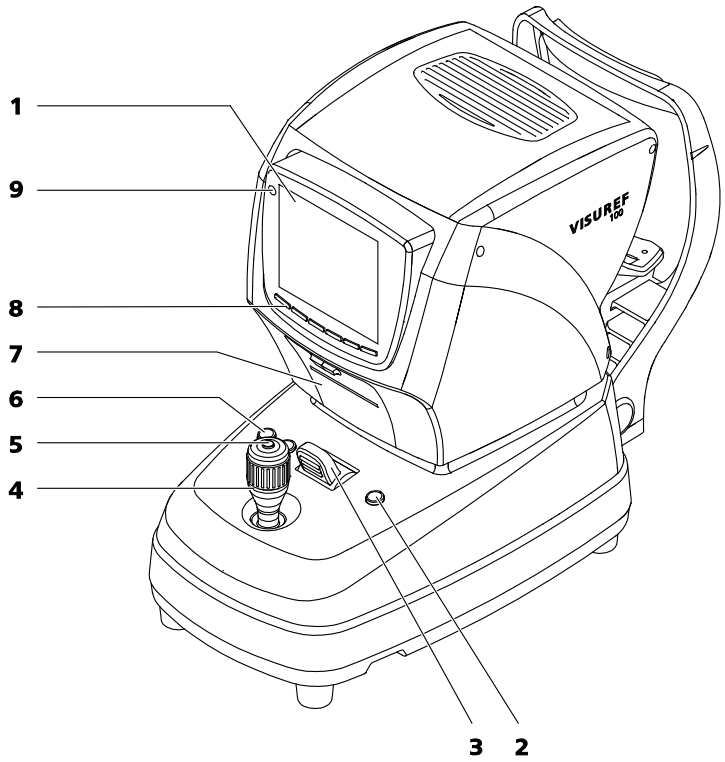
WARNING - GENERAL HAZARDS

The development, production and maintenance of this device, together with associated risks, are based on an expected service life of seven years.

Modifications to the product or failure to follow the manufacturer's instructions may substantially reduce the expected service life and significantly increase the risks associated with the use of this device.

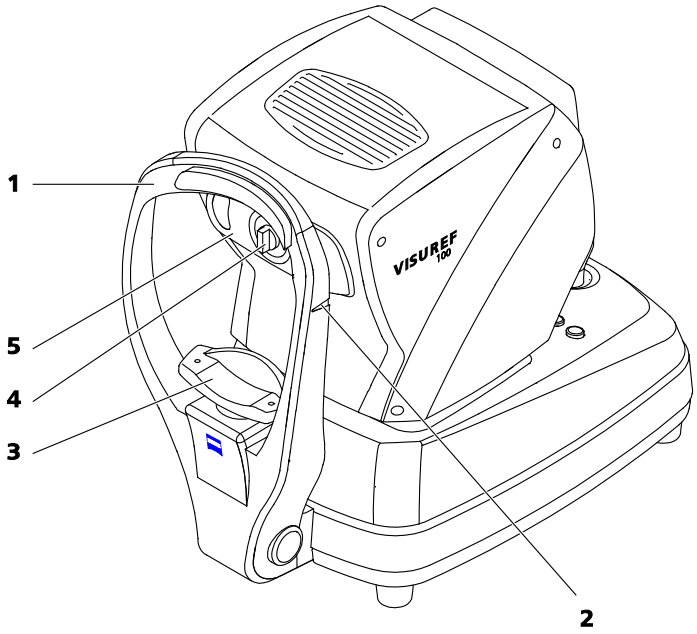
It is the responsibility of the institution operating this product to follow the manufacturer's instructions and to decide on the risk/benefit ratio on reaching the expected service life.

Description of the instrument



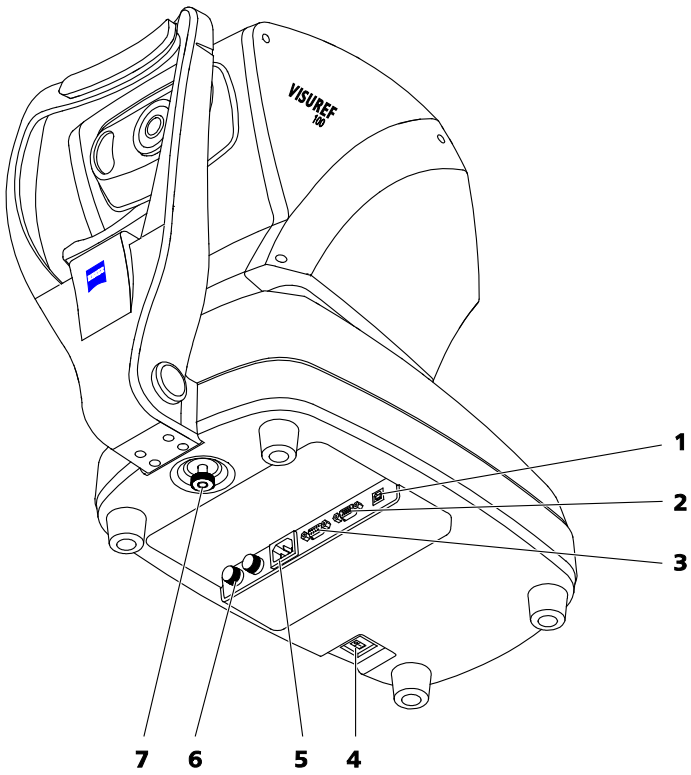
1 LCD monitor
2 Print button to start printing
3 Stage locking lever
4 Joystick
5 Measurement button
6 Buttons for chin rest height adjustment
7 Printer cover
8 Function keys **F1** to **F6** (from left to right)
9 Status LED (continuously lit - device switched on, flashing - screen saver activated)

Fig. 3 VISUREF 100 - View from user side



1 Forehead rest
2 Reference mark for optimum eye level of patient
3 Chin rest
4 Dust cap
5 Measurement window

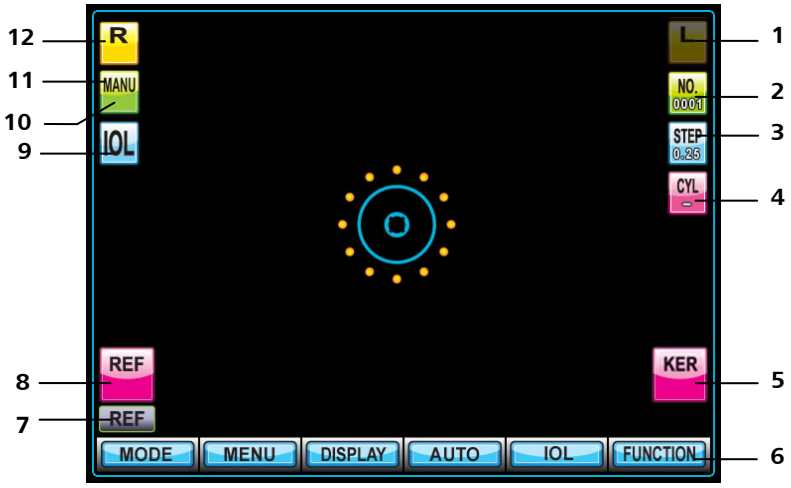
Fig. 4 VISUREF 100 - View from patient side



1 USB port (for service only)
2 RS232 port
3 Connection for external video equipment
4 Power switch
5 Power input socket
6 Fuses
7 Stage clamping screw to lock the stage during transportation

Fig. 5 VISUREF 100 - Bottom side

User interface



1 Left eye symbol (not selected)
2 Patient ID
3 Increment
4 Cylinder units
5 Number of saved measurements in **KER** measurement mode for the selected eye
6 Assignment of function keys **F1** to **F6** (from left to right)
7 Selected measurement mode
8 Number of saved measurements in **REF** measurement mode for the selected eye
9 **IOL** icon (will only be shown if IOL function key has been pressed)
10 Number of remaining measurements (in automatic mode only)
11 Symbol for automatic/manual measurement release (**AUTO**/**MANU**)
12 Right eye symbol (selected)

Fig. 6 User interface

Function key assignment

The assignment of the functions for the function keys depends on the selected measurement mode (see section *Measurement modes*, page 31).

Assignment of function keys in main measurement modes

After starting the user interface or after each change of measurement modes, the functions in the main measurement modes (**REF**, **KER**, **RK**, **CLBC**) are assigned as follows:

Function key	Symbol	Functional description
F1	**MODE**	Change the measurement mode
F2	**MENU**	Open the **User setting** menu
F3	**DISPLAY**	Display measured data
F4	**AUTO/ MANU**	Selection of manual or automatic measurement release
F5	**IOL**	Activation when measuring patients with cataracts or intraocular lenses (**REF**, **RK**)
F6	**FUNCTION**	Switch to additional settings and functions

When switching by using the **FUNCTION** key, the functions are assigned as follows:

Function key	Symbol	Functional description
F1	**VD**	Switch the corneal vertex distance (**REF**, **RK**)
	D	Change the keratometer unit from mm (R1, R2) to D (K1, K2) (**KER**, **CLBC**)
F2	**STEP**	Button to switch step value in D, (**REF**, **RK**)
F3	**CYL**	Switching the cylinder units (-, +, +/-), (**REF**, **RK**)
F4	**SIZE**	Change to pupil diameter measurement mode
F5	**ILLUM**	Change to measurement mode for the examination of the cornea
F6	**RETURN**	Return to previously selected main measurement mode

Assignment of function keys in SIZE measurement mode

When switching to the **SIZE** measurement mode, the functions are assigned as follows:

Function key	Symbol	Functional description
F1		Not assigned
F2	**MENU**	Open the **User setting** menu
F3	**CLEAR**	Delete the measurement values for corneal size
F4	**DATA**	Select the first or second measurement of the currently measured eye. The value will be overwritten with the next measurement.
F5		Not assigned
F6	**RETURN**	Return to the previous main measurement mode.

On pressing function keys or the measurement key, the assignment of function keys may change. The current assignment of function keys is described in chapter *Size measurement of pupil and cornea (SIZE)* (page 37 and following).

Assignment of function keys in ILLUM measurement mode

After switching to the **ILLUM** measurement mode, the functions are assigned as follows:

Function key	Symbol	Functional description
F1	**SET**	Open menu to set the parameters in ILLUM measurement mode.
F2	**CLEAR**	Delete all saved images
F3	**IMAGELIST**	Display list of all saved images
F4	**MSR**	Turn MSR mode on or off. In this mode, an additional refractometry is performed.
F5	**IOL**	Activation when measuring patients with cataracts or intraocular lenses (**REF**, **RK**)
F6	**RETURN**	Return to the previous main measurement mode.

On pressing function keys or the measurement key, the assignment of function keys may change. The current assignment of function keys is described in chapter *Examination of the cornea (ILLUM)* on page 39 and following.

Installation

Notes on installation and use

WARNING - GENERAL HAZARDS

Do not store or operate the device in ambient conditions other than those specified (see section *Technical data* on page 62 and following).

The device should be set up so that the power cable can be disconnected from the power supply quickly and easily without any tools.

WARNING - HAZARD DUE TO ELECTROMAGNETIC RADIATION

When connecting external devices to the interfaces of the device, the operator must meet the requirements defined in IEC 60601-1-2.

WARNING - RISK OF ELECTRIC SHOCK

When connecting external devices to the interfaces of the device, the operator must meet the safety requirements defined in IEC 60601-1-1 or IEC 60601-1:2005, chapter 16 (medical electrical systems)!

Do not use additional extension cables or portable multiple sockets.

To avert the risk of an electric shock this device may only be connected to a power supply with a protective earth conductor.

Ensure that the power supply plug is suitable and certified for the local connection. If the supplied power cable must be replaced, the following minimum specifications must be adhered to:

- Protective earth conductor resistance maximum 0.1 Ohm
- Local certification of the power cable for connection to medical devices
- Device plug C13 conforming to IEC 60320
- Cross-section at least 0.75 mm²/AWG 18
  Hospital Grade design for specific countries (e.g. USA, Canada)
  (For cables > 2.5 m the cross-section must be increased to 1.5 mm²).

WARNING - FIRE HAZARD

The device is not suitable for operation in explosion risk areas (e.g. combustible mixture of anesthetic, cleaning or disinfecting agents with air, oxygen or nitrous oxide).

Do not store alcohol and other flammable vapors and liquids in the vicinity of this equipment.

CAUTION - DANGER FROM FALLING PARTS

When selecting a suitable table, ensure that the combination of table and instrument is stable up to an angle of tilt of 10°. Furthermore, the table must be designed for 4 times the weight of the device configuration. If the table is on castors, these must have a locking device.

CAUTION - PROPERTY DAMAGE

Do not store or use this device in damp rooms. Do not expose the device to water splashes, dripping water or sprayed water.

Unpacking and installing the device

- Open the box and make sure that all the accessories (Fig. 1) are present.
- Connect the power cable into the socket at the bottom of the body.
- Install the device on a level, steady table which is not susceptible to vibration.
- Make sure that the power switch is turned off. Then plug the power cable into an electrical outlet.

WARNING - RISK OF ELECTRIC SHOCK

Be sure to turn off the power switch before connecting to or disconnecting from a power supply.

- Release the stage locking by turning the stage clamping bolt (**7**, Fig. 5) on the bottom of the device counterclockwise (**A**, Fig. 7). Now press the lever to the front (**B**, Fig. 7) to unlock the stage (**3**, Fig. 3).

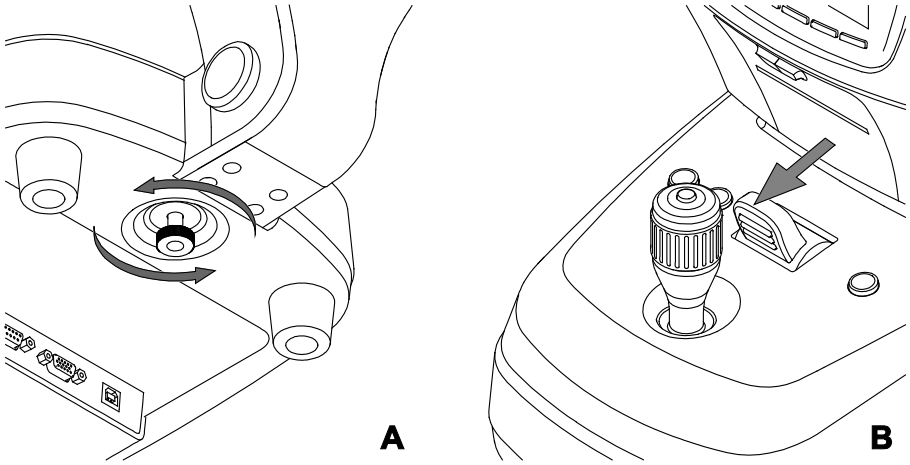


Fig. 7 Releasing the stage locking

- Remove the protective film from the display.

Daily use

WARNING - GENERAL HAZARDS

Prior to using the device, the user must ensure that it is in a good condition and fully functioning. Furthermore, the user must follow the instructions in the user manual.

The following inspections must be carried out each working day prior to use:

- Visual inspection of the housing, exterior markings, user manual, accessories and power cable to ensure that they are present and intact. If parts are missing or damage is visible, the device should not be used and should be taken out of service.

WARNING - RISK OF ELECTRIC SHOCK

Please take care that the following operational requirements are met before using the device each time:

- Use the power cable supplied with the device. The device will be powered through the instrument table.
- The power plug must be inserted into a power outlet that has an intact protective ground connection.
- All cables and plugs may be used only if they are in perfect working condition.

Switching on

- Turn on the power switch and make sure that the instrument is functioning properly.

☞ Do not turn off the instrument before finishing initialization. It may cause motor movement error.

- Check that printing paper is properly inserted. Insert new paper if needed (refer to section *Inserting printer paper*, page 54).
- Check that the chin rest height control is working properly.
- Check that the stage locking system (**3**, Fig. 3) has been released.
- Check that the dust cap (**4**, Fig. 4) has been removed.

Operation of the device

CAUTION - GENERAL HAZARDS

The patient should not touch the instrument with his/her hands. In particular, the instrument should not be used as a support or an aid for standing up.

Do not operate the device with wet hands.

CAUTION - RISK OF PINCHING

Take precautions to ensure fingers and hands are not trapped when lifting the device.

Ensure that no parts of the body (fingers, hands) or objects are trapped beneath the device when lowering it.

Do not place hand or fingers under the chin rest. This could result in damage or injury.

CAUTION - RISK OF FALSE DIAGNOSIS

Avoid direct and lateral light incidence to the front of the instrument or eye being examined. The best results will be obtained when the examination room is slightly darkened (about 55 lux to 100 lux).

Ensure that the front lens of the objective is clean. If necessary, clean the front lens (see section *Care and cleaning*, page 56). A smudged objective may lead to incorrect measurements.

Temperature fluctuations will cause vapor condensation on the protective glass in the measurement window and on optical parts inside the instrument. In this case, wait about 40 min until the condensation disappears before performing measurements.

General information

☞ Use appropriate chin rest paper.

☞ Handle the device with care. Do not drop the instrument and protect it from any impact.

☞ Do not use outdoors. The instrument is designed to be used only indoors.

☞ Do not use the device in humid or dusty environments.

Measurements with the test eye

Practice measurement by using the test eye before measuring patient's eyes.

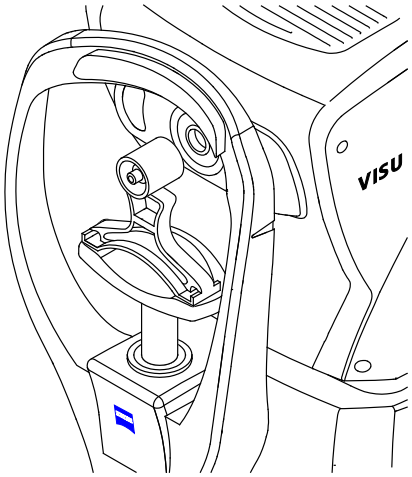
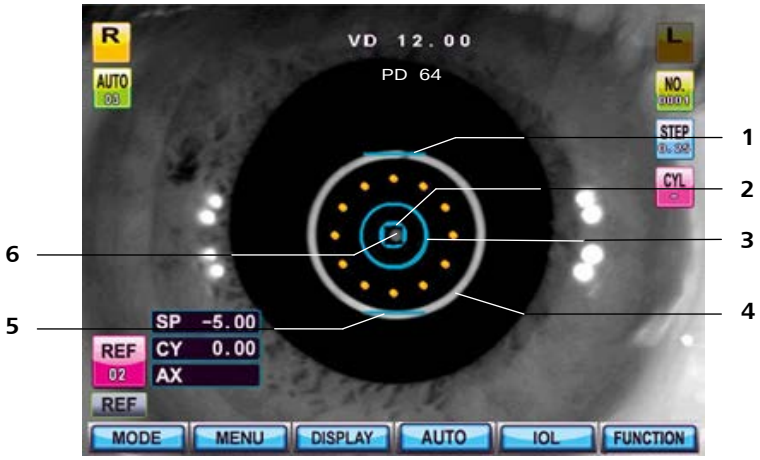


Fig. 8 Test eye

- Place the test eye in the center of the chin rest.
- Make sure the stage is moving freely.
- Switch to **REF** or **RK** mode by pressing the **MODE** function button.



1 Upper blue line (will be displayed when focusing is correct)
2 Inner ring mark
3 Outer ring mark
4 Kerato ring
5 Lower blue line (will be displayed as long as there are still automatic measurements to be performed)
6 Bright dot (center of pupil)

Fig. 9 Kerato ring image

- Adjust the height of the chin rest so that the test eye is level with the reference marking for optimum eye level (**2**, Fig. 4).
- Look at the monitor and move the joystick until you see an image of the test eye.
- Move the joystick towards or away from the test eye until a bright dot (**5**, Fig. 9) appears near the center.
- Focus on the test eye by moving the joystick forward and backward so that the kerato ring image (**4**, Fig. 9) is displayed clearly on the monitor. As soon as the test eye is adjusted a blue line (**1**, Fig. 9) will appear above the outer ring mark.

Manual measurement

- **MANU** is shown in the top left corner of the display to indicate the manual mode.
- Press the measurement button on top of the joystick. If the measurement has failed the message **RETRY** appears on the screen. In this case readjust with the joystick and repeat this step.
- Check whether the measured diopter value corresponds to the specification of the test eye. The diopter value is shown in the bottom area of the eye.

Automatic measurement

- Press the **AUTO** button.
- The **MANU** icon in the top left corner of the screen is switched to **AUTO**.
- Automatic measurement begins when the eye is well focused.

☞ Due to the tolerances of the test eye and the normal tolerances for objective refraction, the reading on the VISUREF 100 may differ from the value printed for the test eye.

Printing

Press the print button to start printing (**2**, Fig. 3).

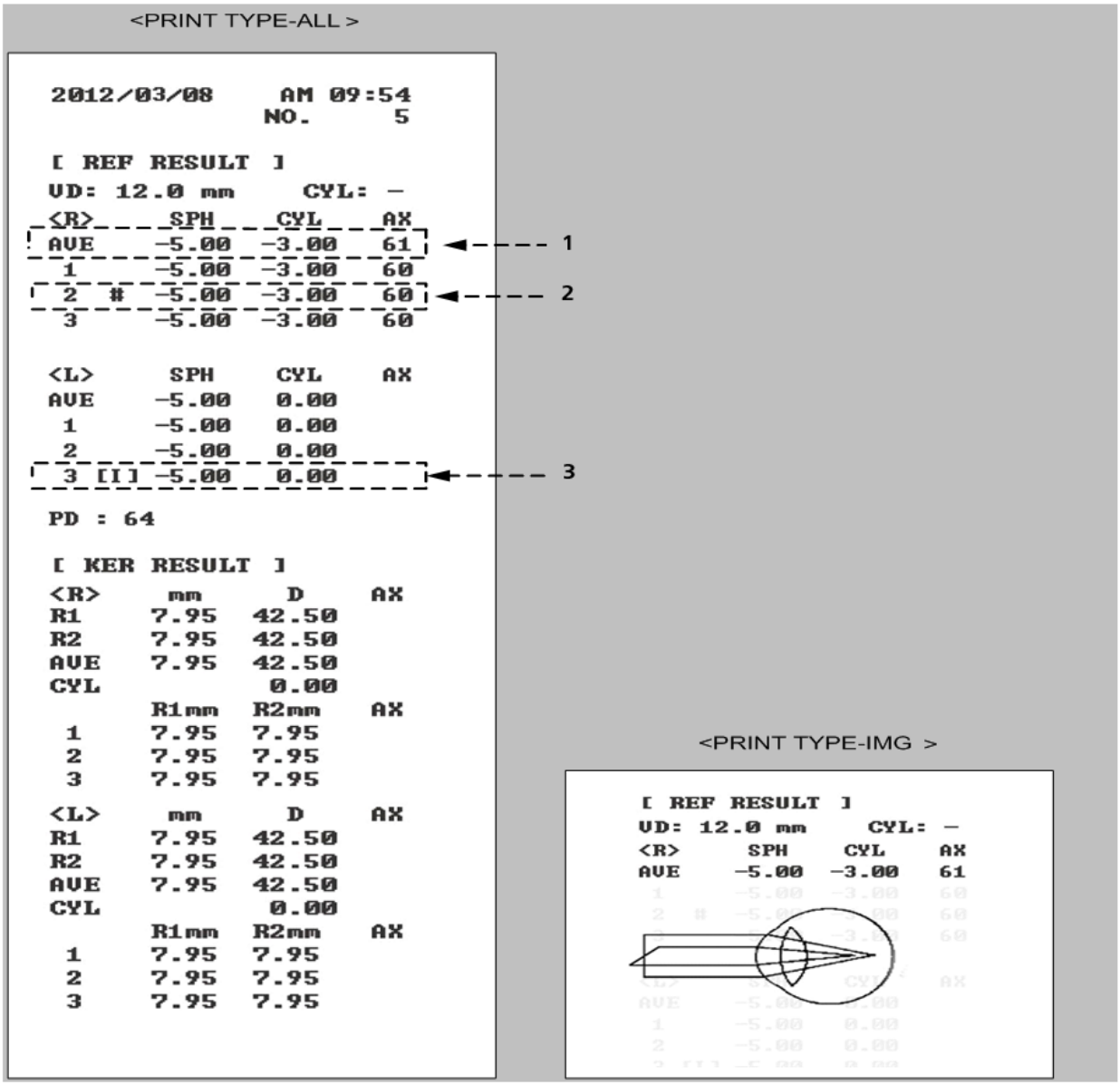
If the print preview is switched on (see section *Measurement settings*, page 45), the measurement results will be displayed first. Press the print button again to start printing (**2**, Fig. 3).

CAUTION - PROPERTY DAMAGE

If auto cutting mode is switched on, do not pull the paper before it cuts. This may cause a paper jam.

☞ After printing, former measurement results will be cleared automatically before starting the next measurement.

☞ Records on thermal paper may be spoiled by heat. If the results are to be kept for a long period, make a copy.



1 AVE: Average value of measured values
2 #: Unreliable result, repeat measurement
3 [I]: Measurement with activated **IOL** function

Fig. 10 Example of a printout

☞ Measurement results marked with "OUT" are outside the measuring range.

Measuring a patient's eye

CAUTION - RISK OF INJURY

Pull the refractometer away from the patient when moving right or left to avoid injuring the face.

CAUTION - RISK OF PINCHING

Do not place hand or fingers under the chin rest. This could result in damage or injury.

Selecting measurement mode

- Press the **MODE** button repeatedly until the desired measurement mode appears (see section *Measurement modes*, page 31).

- Press **IOL** button when measuring a patient who has an IOL. The **IOL** icon will appear (**9**, Fig. 6).

- Select the measurement release mode (**MANU/AUTO**).

Regulating the patient's eye level

- Ask the patient to place his/her chin on the chin rest and lean the forehead against the forehead rest.
- Using the height adjustment buttons of the chin rest (**6**, Fig. 3), adjust the height of patient's eyes by using the reference mark (**2**, Fig. 4).

Focusing

- Move the stage to the left side and focus on the right eye of the patient.
- Instruct the patient to relax and look at the red-colored part in the center of target balloon.
- Ask the patient to open his/her eye until the kerato ring images (Fig. 9) are focused.
- Use the joystick to move the bright dot in the center of the pupil into the inner ring mark.
- Move the joystick forward and backward to focus the kerato ring image.

Manual measurement (MANU)

- Press the measurement button (**5**, Fig. 3). The measurement result will be displayed on the screen.

☞ The measurement result will be displayed according to the settings of the functions **VD**, **CYL** and **KERATO** (see section *Measurement settings*, page 45).

Automatic measurement (AUTO)

- The measurement starts automatically when in good focus. The number of remaining measurements is indicated below the **AUTO** icon (**10**, Fig. 6).

Continuous measurement

- Perform a series of consecutive measurements in automatic mode.
- The latest data will be displayed after each measurement release.

- Press **DISPLAY** and then **CLEAR** to delete previous data.

Measuring the other eye

- Move the joystick to the other side.
- The icons for the selected eye are highlighted in the display section.
- Repeat the steps *Focusing* and *Measurement* for the second eye.
- The pupil distance (PD) value will be displayed after the measurement.

Printing

- Press the print button to start printing (**2**, Fig. 3). The printout may vary depending on the user settings.

Measurement modes

VISUREF 100 provides the following main measurement modes:

- Refractometry (**REF**)
- Keratometry (**KER**)
- Keratometry and Refractometry (**RK**)
- Measuring the contact lens base curve (**CLBC**)

By pressing the **MODE** function button you can switch between the main measurement modes.

Additionally, the following measurement modes are available:

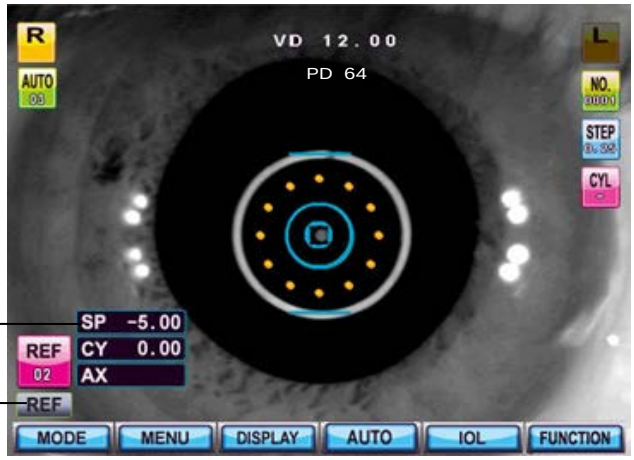
- Corneal size measurement (**SIZE**)
- Pupil and cornea examination (**ILLUM**)

Both measurement modes **SIZE** and **ILLUM** can be accessed from any main measurement mode by pressing the **FUNCTION** button using the **SIZE** and **ILLUM** function keys.

Refractometry (REF)

A refractometry can be performed in the **REF** measurement mode.

Prepare the measurement as described in the section *Measuring a patient's eye*, page 28 ff. The assignment of functions to function keys is described on page 18.

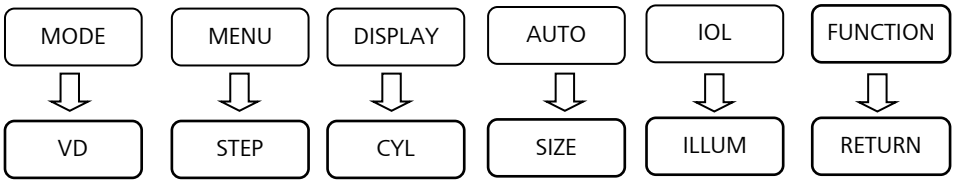


1 Measurement results for the selected eye
2 Display of **REF** measurement mode

Fig. 11 **REF** measurement mode screen

FUNCTION

The measurement parameters can be set by pressing the **FUNCTION** key. After pressing the **FUNCTION** key, the assignment of the function keys will be changed as follows:



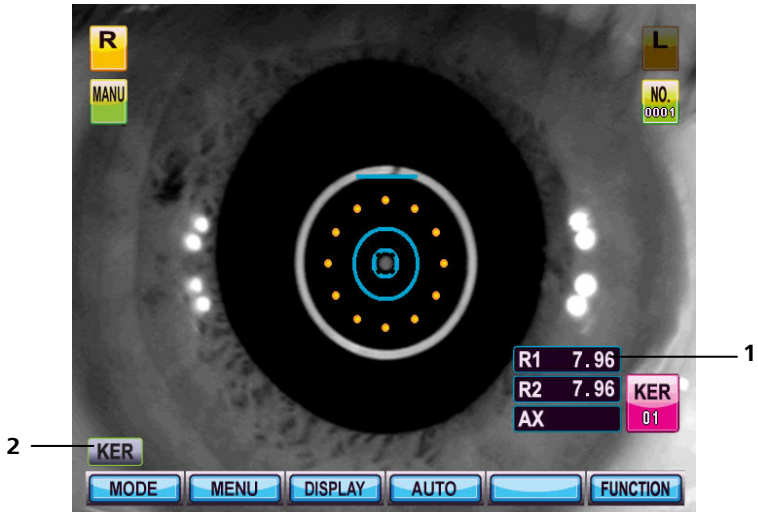
RETURN

Pressing the **RETURN** key restores the original assignment of function keys.

Keratometry (KER)

A keratometry can be performed in the **KER** measurement mode.

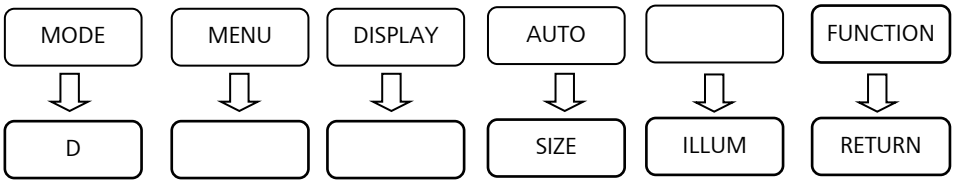
Prepare the measurement as described in section *Measuring a patient's eye*, page 28 ff. The assignment of functions to function keys is described on page 18.



1 Measurement results for the selected eye
2 Display of **KER** measurement mode

Fig. 12 **KER** measurement mode screen

The measurement parameters can be set by pressing the **FUNCTION** key. After pressing the **FUNCTION** key, the assignment of the function keys will be changed as follows:



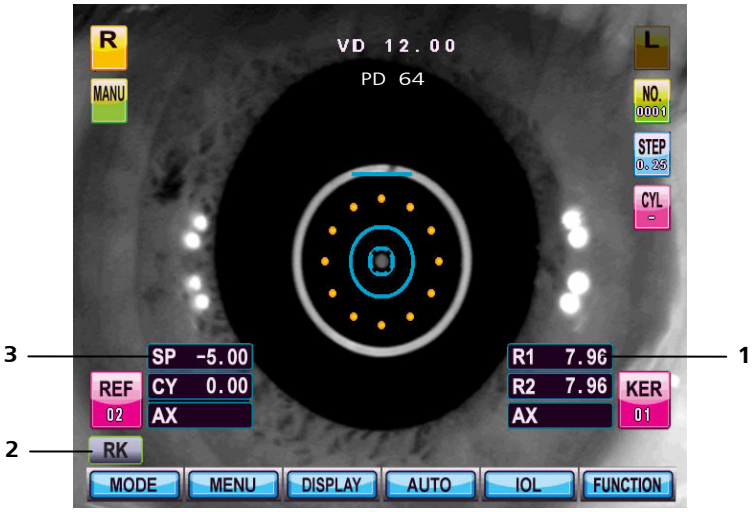
Pressing the **RETURN** key restores the original assignment of function keys.

Press the **D** button to switch the keratometry unit from mm (R1, R2) to D (K1, K2).

RK measurement mode

A combined refractometry and keratometry can be performed in the **RK** measurement mode.

Prepare the measurement as described in section *Measuring a patient's eye*, page 28 ff. The assignment of functions to function keys is described on page 18.

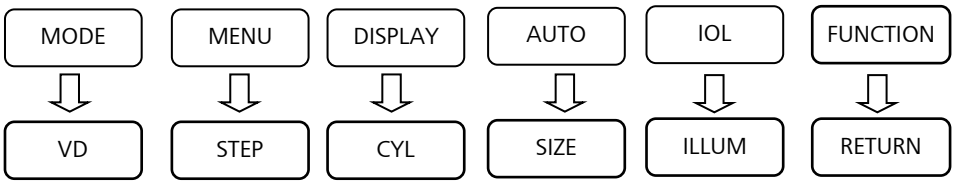


1 Measurement results for the selected eye (keratometry)
2 Display of **RK** measurement mode
3 Measurement results for the selected eye (refractometry)

Fig. 13 **RK** measurement mode screen

FUNCTION

The measurement parameters can be set by pressing the **FUNCTION** key. After pressing the **FUNCTION** key, the assignment of the function keys will be changed as follows:

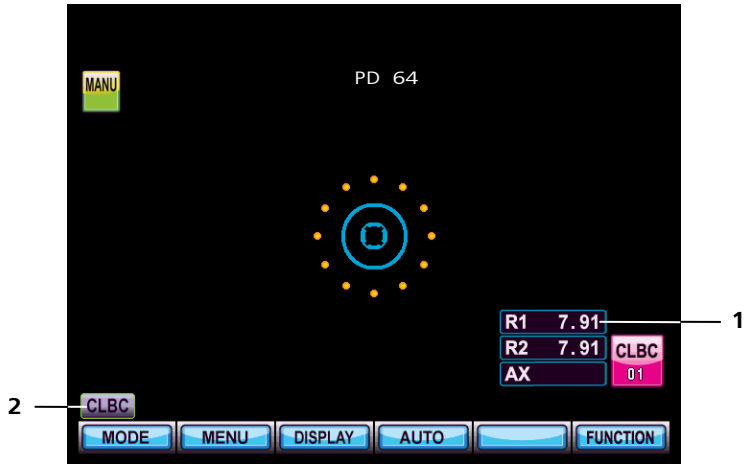


RETURN

Pressing the **RETURN** key restores the original assignment of function keys.

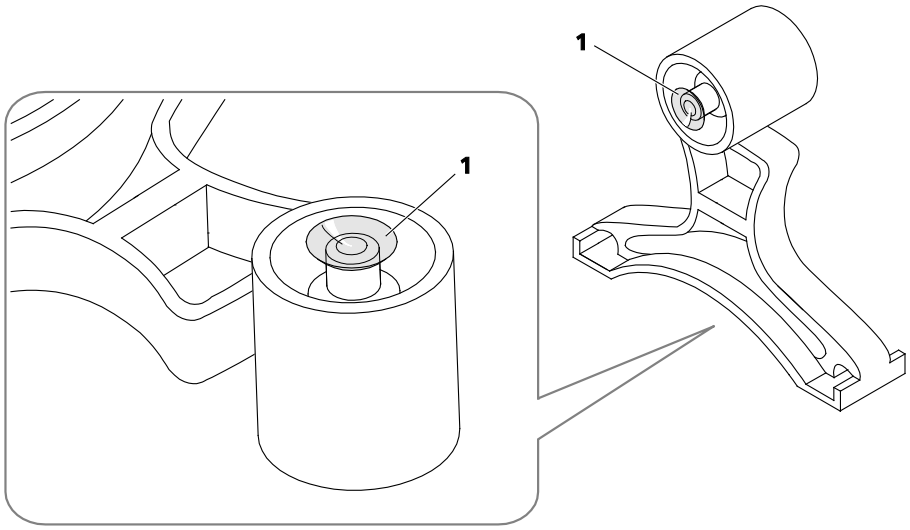
CLBC measurement mode

The base curve of contact lenses can be measured in CLBC measurement mode.



1 Measurement result
2 Display of **CLBC** measurement mode

Fig. 14 **CLBC** measurement mode screen



1 Contact lens

Fig. 15 Attach contact lens

- Moisten the rear surface of the test eye and insert the contact lens (Fig. 15).

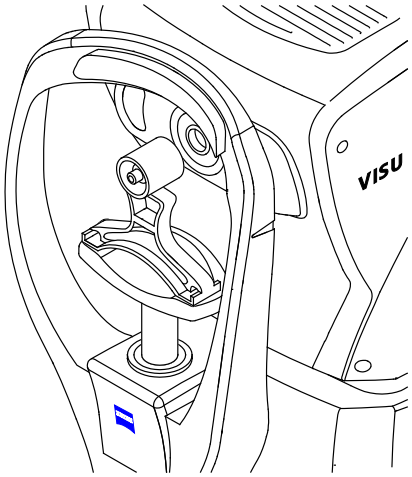
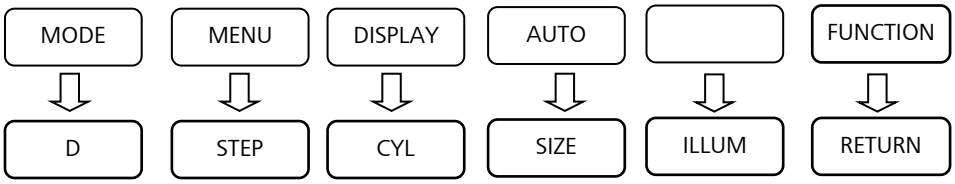


Fig. 16 Test eye

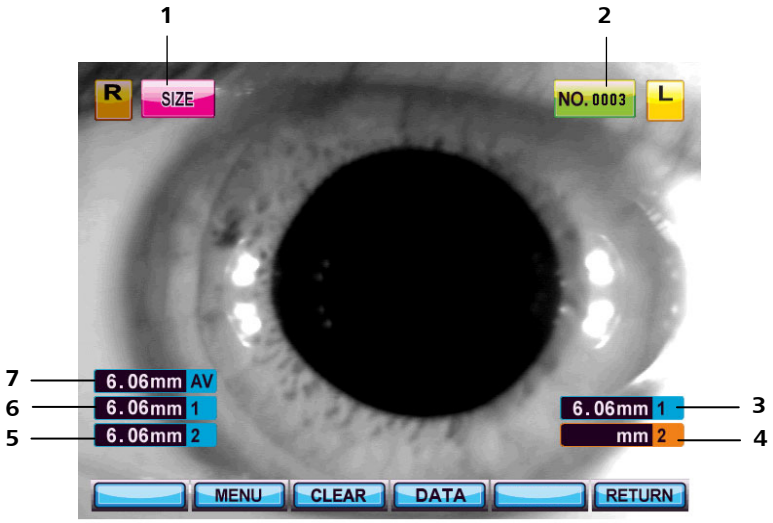
- Place the test eye in the center of the chin rest (Fig. 16).
- Perform the measurement as described in section *Measurements with the test eye*, page 25 ff. The assignment of functions to function keys is described on page 18.



Size measurement of pupil and cornea (SIZE)

The diameters of the cornea and pupil can be measured in SIZE measurement mode.

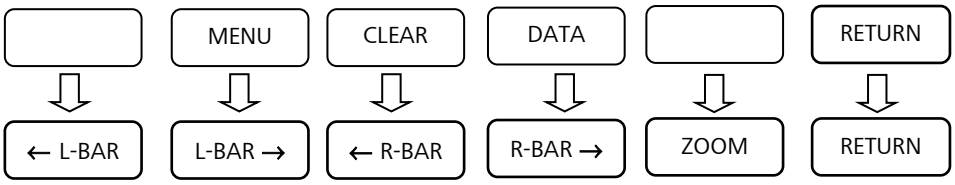
- Prepare the measurement as described in section *Measuring a patient's eye*, page 28 ff. The assignment of functions to function keys is described on page 19.
- In one of the main measurement modes, press the **FUNCTION** key and then **SIZE** to switch on the **SIZE** measurement mode. The **SIZE** screen will be shown together with the live image of the eye (Fig. 17).

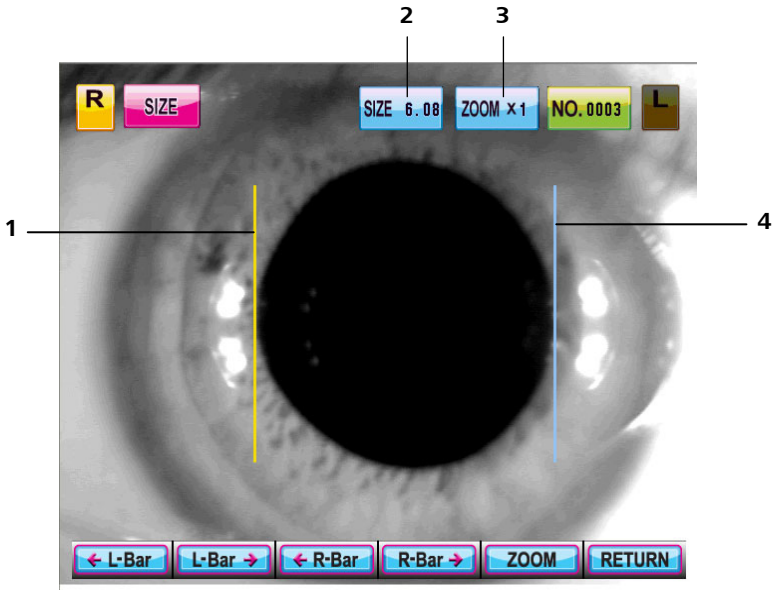


1 **SIZE** measurement mode
2 Patient ID
3 Measurement 1 for left eye
4 Measurement 2 for left eye
5 Measurement 2 for right eye
6 Measurement 1 for right eye
7 Mean value for right eye

Fig. 17 **SIZE** measurement mode screen

- Press the measurement button (**5**, Fig. 3) of the joystick to perform the measurement.
- After the measurement button on the joystick has been pressed, the image will freeze and a yellow and blue measurement line will appear. (Fig. 18). The function key assignment changes as follows:

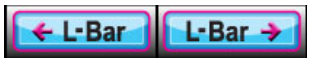




1 Yellow measurement line
2 Diameter of pupil or cornea (in mm)
3 Set zoom
4 Blue measurement line

Fig. 18 **SIZE** measurement mode screen after pressing the measurement button

- Press the **ZOOM** function key to enlarge the image (2x or 3x).



- Move the yellow line to the left side of the pupil/cornea using ← **L-Bar** and **L-Bar** →.

- Move the blue line to the left side of the pupil/cornea using ← **R-Bar** and **R-Bar** →.

  The resulting diameter (which is the distance between both lines) in mm will be shown in the **SIZE** icon (**2**, Fig. 18) on the screen.

- Press the measurement button (**5**, Fig. 3) on the joystick to save the value and return to the **SIZE** screen displaying the live image of the eye (Fig. 17).

- Press the **RETURN** function key to return to the main measurement menu.

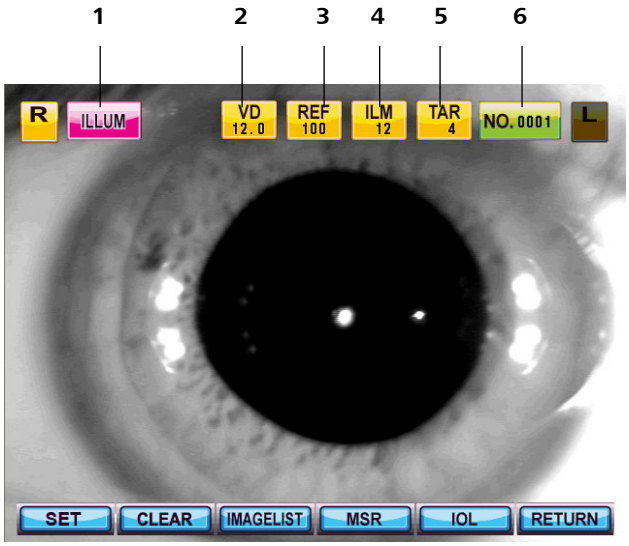
☞ Proper measurement of the corneal curvature will not be possible if the focus is on the iris.

Two measurements can be performed for each eye (**3** and **4** or **5** and **6**, Fig. 17). After the second measurement, a mean value (**AV**) is shown (**7**, Fig. 17).

Examination of the cornea (ILLUM)

The ILLUM measurement mode enables checking for cataracts or scratches on the lens/cornea.

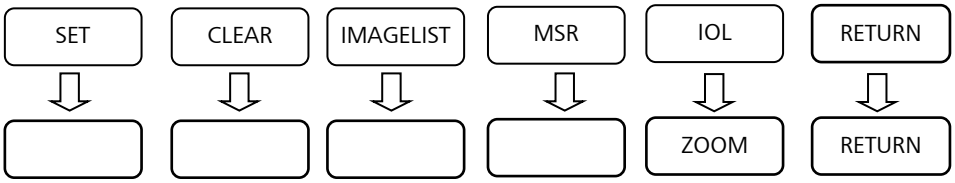
- Prepare the measurement as described in section *Measuring a patient's eye*, page 28 ff. The assignment of functions to function keys is described on page 19.
- In one of the main measurement modes, press the **FUNCTION** key and then **ILLUM** to switch on the **ILLUM** measurement mode. The **ILLUM** screen will be shown together with the live image of the eye (Fig. 19).

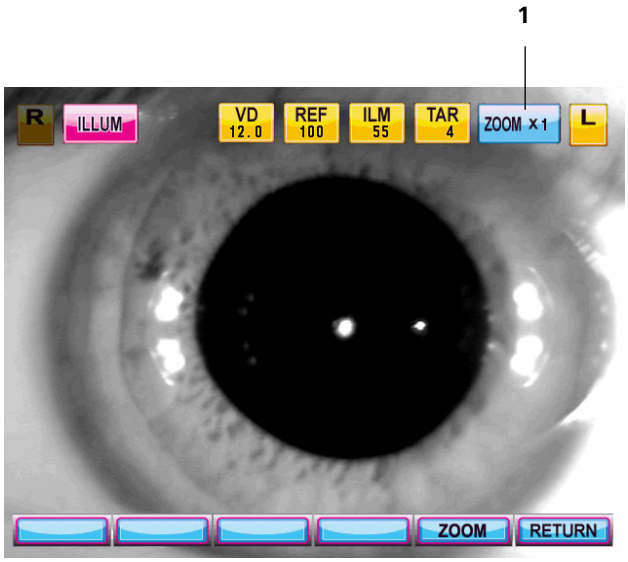


1 **ILLUM** measurement mode
2 **VD** parameter display (corneal vertex distance)
3 **REF** parameter display (illumination intensity for ambient illumination)
4 **ILM** parameter display (illumination intensity for reference illumination)
5 **TAR** parameter display (illumination intensity for target image)
6 Patient ID

Fig. 19 **ILLUM** measurement mode screen

- Press the measurement button (**5**, Fig. 3) of the joystick to perform the measurement.
- After the measurement button on the joystick has been pressed, the image will freeze (Fig. 20). The function key assignment changes as follows:



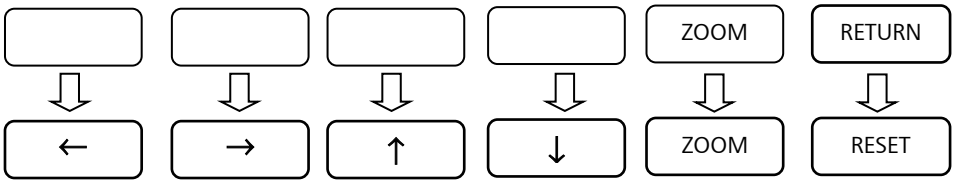


1 Set zoom

Fig. 20 **ILLUM** measurement mode screen after pressing the measurement button

ZOOM

- Press the **ZOOM** function key to enlarge the image (2x). An enlarged part of the image will be displayed.
- After pressing the **ZOOM** key, the assignment of the function keys will be changed as follows:



- Using the four arrow keys you can change the image displayed.
- Using the **RESET** function key you can reset the image position to the original position.

ZOOM

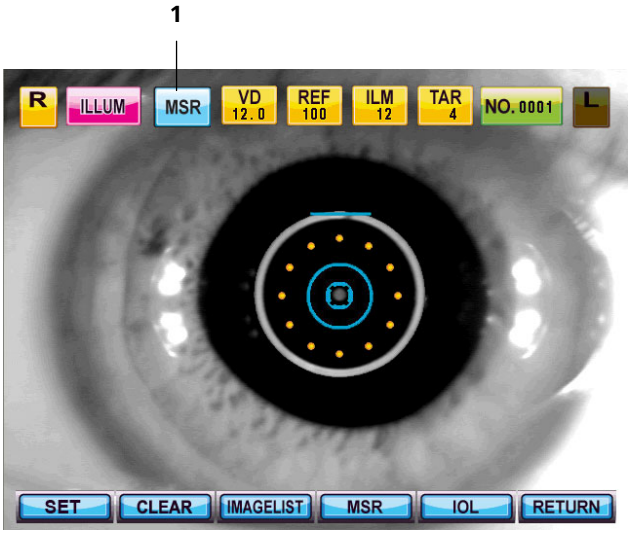
- When pressing the **ZOOM** key again, you can return to the overall view (Fig. 20). Then the function keys **F1** to **F4** have not function.
- Press the measurement button of the joystick to save the image. A message appears if you want to save or not. Confirm with **YES** or by pressing the measurement button again. For each eye up to two images can be saved in the image list. Select **NO** if you do not want to save the image.

RETURN

- Press the **RETURN** button if you do not want to save the image.

Refractometry in ILLUM measurement mode (MSR function key)

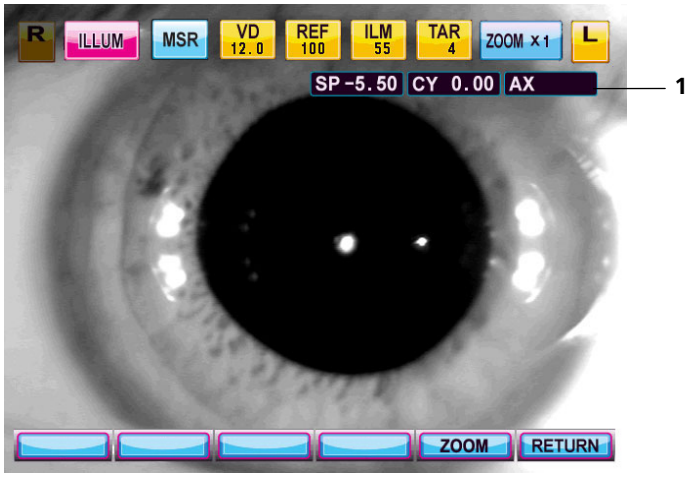
You can perform a refractometry in the **ILLUM** measurement mode using the **MSR** function key. After pressing the **MSR** function key, the **MSR** icon and the kerato ring are displayed on the screen.



1 **MSR** mode

Fig. 21 **MSR** measurement mode screen

- Prepare the measurement as described in section *Measuring a patient's eye*, page 28 ff.
- Press the measurement button (**5**, Fig. 3) of the joystick to perform the measurement.



1 Display of measurement result

Fig. 22 **MSR** mode screen after measurement

The measurement result (**1**, Fig. 22) will be shown together with the live image of the eye.

Image list (IMAGELIST function key)

In **ILLUM** measurement mode press the **IMAGELIST** function key to switch to the list of saved images

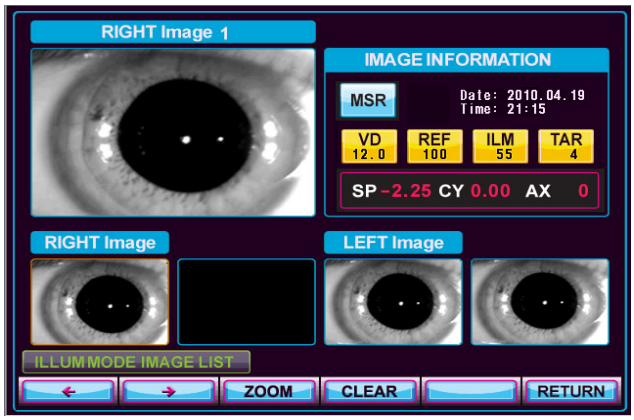


Fig. 23 Image list

- Press the arrow buttons to select a specific image.
  The image information appears for the selected image.

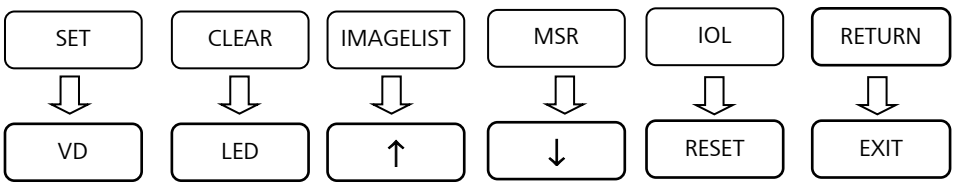
- Press the **ZOOM** button to enlarge the selected image.

- Press the **CLEAR** button to delete the selected image.

- Press the **RETURN** button to exit the image list.

Parameter setting in ILLUM measurement mode (SET function key)

Using the **SET** function key to change to the following parameter setting menus: **VD** (corneal vertex distance), **REF** (illumination intensity for ambient illumination), **ILM** (illumination intensity for reference illumination) and **TAR** (illumination intensity for target image). The function key assignment changes as follows:



- Press the **VD** function key to change the corneal vertex distance.
- Press the **LED** function key to change the value for the **REF**, **ILM** and **TAR** parameters. Press the **LED** button repeatedly until the desired parameter is highlighted.

- The selected value will be highlighted. Press the arrow keys to change the value.

- Press **RESET** button to reset all values to the default values.
- Press **EXIT** function key to exit the parameter setting menu.

Display measured data

You can switch from all main measurement modes to the display mode by pressing **DISPLAY** button. A list of the measured values is displayed.

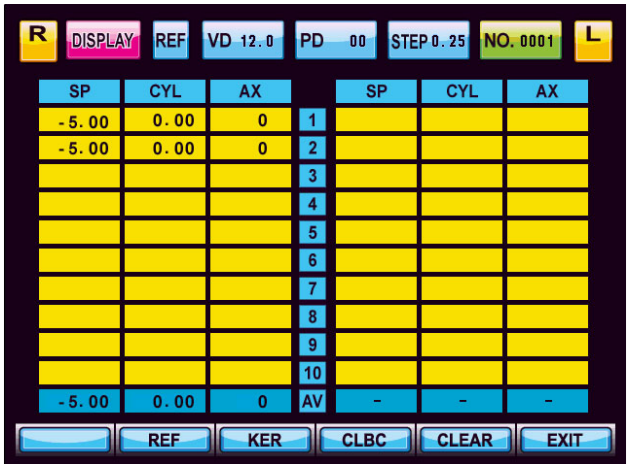


Fig. 24 Display of measurement data

- Select the **REF**, **KER** or **CLBC** function keys to display refractometry, keratometry or contact lens base curve data.

- Press the **CLEAR** function key to delete all data and return to the main measurement menu.

- Press the **EXIT** function key to terminate the display mode.

User settings

You can switch from all main measurement modes to the user settings by pressing **MENU** button.

- Browse through the four pages of the user settings by pressing the **PAGE** function key.

- Select the parameters (lines) to be changed by pressing the up and down arrow keys.

- Select the new values by pressing the left or right arrow keys.

Measurement settings (MEASURE)

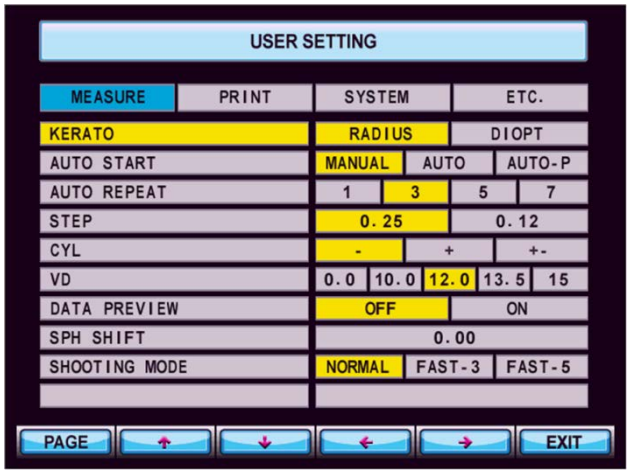


Fig. 25 Measurement settings

KERATO	Select indication style of keratometry
RADIUS	Corneal curvature radius in mm
DIOPT	Corneal refraction in D
AUTO START	
MANUAL	Manual measurement release
AUTO	Automatic measurement release
AUTO-P	Automatic measurement and printing
AUTO REPEAT	
1/3/5/7	Number of automatic measurements
STEP	
0.25/0.12	Step size for refractometry (in D)

CYL	
-/+/+-	Set the cylinder notation
VD	
0.0/10.0/12.0/ 13.5/15	Enter corneal vertex distance (in mm)
DATA PREVIEW	
OFF	Switch off print preview
ON	Switch on print preview
SPH SHIFT	
-2.0/…/+2.0	Compensate spherical diopters (in D) (step size 0.125 D)
SHOOTING MODE	
NORMAL	Pressing the measurement button releases a measurement
FAST-3	Pressing the measurement button releases three consecutive measurements
FAST-5	Pressing the measurement button releases five consecutive measurements

Printer setup (PRINT)

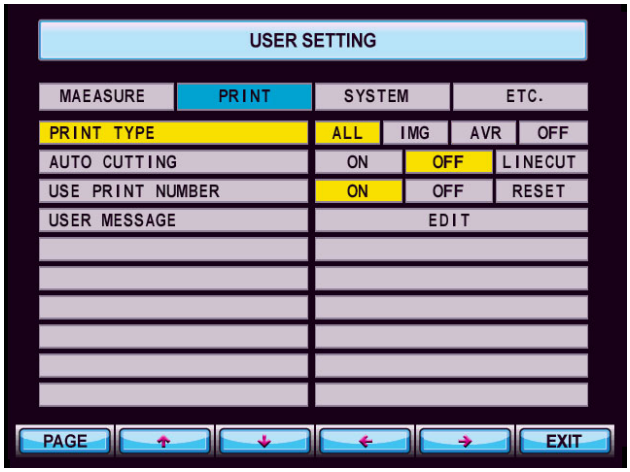


Fig. 26 Print settings

PRINT TYPE	
ALL	Print all data.
IMG	Print average values and additionally a small image illustrating the refractive error of the measured eye.
AVR	Print only average values.
OFF	Printing is not activated.
AUTO CUTTING	
ON	After each printout the paper will be cut off automatically.
OFF	The paper will not be cut off.
LINECUT	The paper will not be cut off. After each printout a line is drawn to separate the printouts.
USE PRINT NUMBER	
ON	The printouts are numbered consecutively.
OFF	The printouts will not be numbered.
RESET	The numbering will be reset to 1.
USER MESSAGE	
EDIT	A window with a text field opens to enter a user-defined text. This text will be printed on each printout beneath the data.

Adding a user-defined text (USER MESSAGE) to the printout

Fig. 27 Add a user-defined text to the printout

- Move to the desired character by using the arrow keys.
- Select the desired character by pressing the **SELECT** function key.
- Press the **BACK** function key to delete the last character.
- Press the measurement button on the joystick (**5**, Fig. 3) to delete the whole text.
- Press **EXIT** function key to exit the user setting menu.
- The question "Do you want to save?" is displayed. Press **YES** to save the current text or **NO** to revert to the previous message.

System setup (SYSTEM)

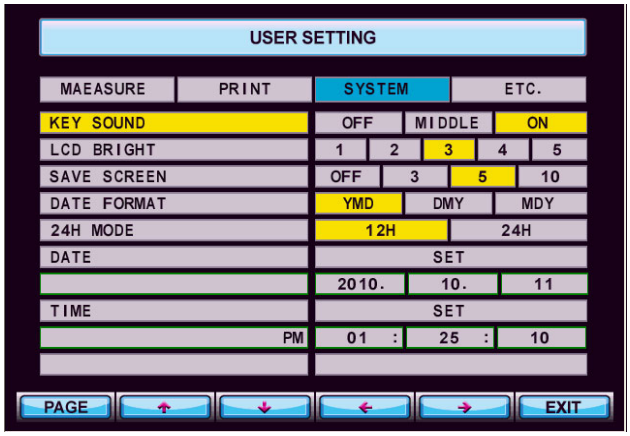


Fig. 28 System settings

KEY SOUND	
OFF	Switch off the sound for pressing a key.
MIDDLE	Set the sound for pressing a key to medium volume.
ON	Switch on the sound for pressing a key.
LCD Bright	
1/2/3/4/5	Set brightness of display from low (**1**) to high (**5**).
SAVE SCREEN	
OFF	Switch off screen saver
3/5/10	Set time (in min) until screen saver will be activated
DATE FORMAT	Set display format of date
YMD	Year, month, day
DMY	Day, month, year
MDY	Month, day, year
24H MODE	Display format of time
12H/24H	Display time in 12 h or 24 h mode
DATE	Set present date
SET	Choose year, month or day with left and right arrow keys. Choose year, month or day with up and down arrow keys. Pressing a right or left arrow key repeatedly will allow you to exit the setting mode.

TIME	Set present time
SET	Choose PM/AM, hour, minute, or second with right or left arrow keys. Change PM/AM, hour, minute, or second with up or down arrow keys. Pressing a right or left arrow key repeatedly will allow you to exit the setting mode.

Other settings (ETC.)

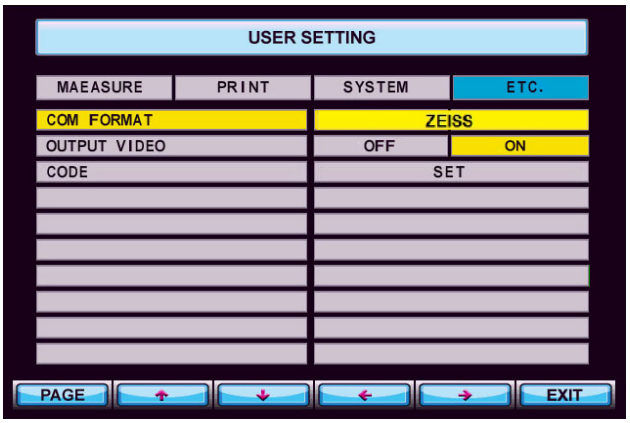


Fig. 29 Other settings

COM FORMAT	
ZEISS	Transmission format when communicating with external equipment via the serial port.
OUTPUT VIDEO	
OFF	Turn off display output to external video.
ON	Turn on display output to external video.
CODE	
SET	Service mode will be switched on. For ZEISS Service.

Shutting down

Switching off the instrument

WARNING - GENERAL HAZARDS

If one of the following events should occur, switch the instrument off immediately at the power switch and disconnect the cable from the power supply.

- Electric shock
- Penetration of substances
- Smoke, sparks or strange noises
- Faults that cannot by remedied according to the descriptions in this user manual.

Label the instrument clearly as being out of service and report the problem to the ZEISS Service.

CAUTION - RISK OF ELECTRIC SHOCK

Be sure to unplug if the system is not used for a longer period of time.

- Switch off the instrument at the power switch (**4**, Fig. 5).
- Use the supplied cover to protect the device from dust when not in use.

Maintenance and care

WARNING - GENERAL HAZARDS

The system may only be opened, put into operation, modified and repaired by the manufacturer's customer service technicians or specialists expressly authorized in writing by Carl Zeiss Meditec. If in doubt, insist on seeing the written authorization or contact Carl Zeiss Meditec directly.

The manufacturer is not liable for damage caused by unauthorized tampering with the device(s). Such actions will render any warranty claims invalid.

Fault remedy

Error messages when switching on

Message	Possible cause	Remedy
FOG MOTOR FAIL	Internal error	Turn off the power switch and turn on again after 10 seconds. If the message reappears, contact ZEISS Service.
SHUT MOTOR FAIL		

Error messages when measuring

Message	Possible cause	Remedy
RETRY	Alignment of the eye is incorrect.	Measure after aligning the pupil and the alignment mark properly.
	Eyelid or eyelashes are covering the pupil.	Ask the patient to open his or her eyes wide.
	The pupil is smaller than the outer alignment mark.	The smallest pupil which can be measured is 2.0 mm. Do not expose patient's eyes to direct sunlight or excessively bright indoor lights to prevent contraction of the pupil.
	The patient has an eye disease like cataract.	Observe the eye in **SIZE** Mode. If the cataract is not severe, measurement can be performed in the **IOL** mode.
	Patient has an IOL (intra-ocular lens) implanted.	Measure in the **IOL** mode.

Message	Possible cause	Remedy
RETRY	The Mire image is oddly shaped because of tears.	Instruct the patient to open and close his or her eyes several times and measure again.
	The Mire image is not clear because the cornea is dry.	
	The patient has strong irregular astigmatism or corneal disease.	The patient's eye cannot be measured.
AGAIN	Measurement result is not reliable.	Repeat the measurement.
OUT+ OUT-	Data was outside valid measurement range.	Measurement result is out of range. Repeat the measurement.

Error messages when printing

Message	Possible cause	Remedy
NO PAPER	The printer is out of paper.	Replace printer paper.
FOG MOTOR FAIL	Fog motor movement is unstable.	Turn the instrument off and on. If 'FOG MOTOR FAIL' message is displayed, please contact the ZEISS Service.

Replacing the fuses

WARNING - RISK OF ELECTRIC SHOCK

The device must be switched off and disconnected from the power supply before being cleaned or serviced.

WARNING - RISK OF ELECTRIC SHOCK

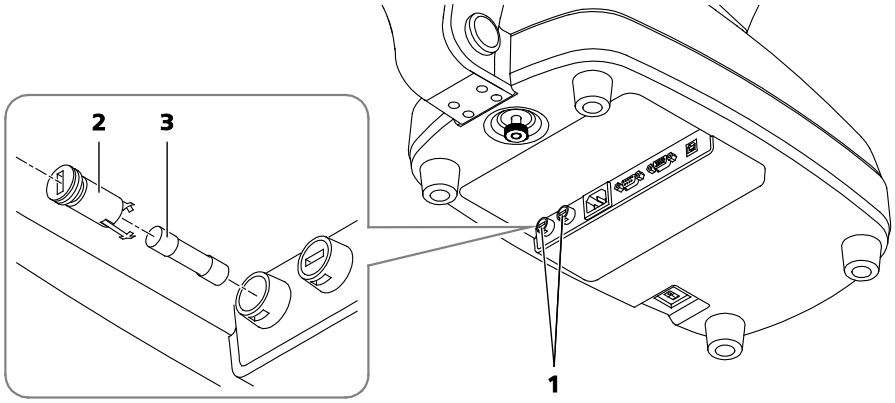
Internal fuses may only be changed by service staff specially trained in maintenance and service work.

Opening up the casing while the unit is turned on exposes the operator to the risk of a fatal electric shock.

WARNING - RISK OF ELECTRIC SHOCK

Before changing the fuses, disconnect the device from the power supply to prevent the risk of serious injury or death. Replace the fuses in the power input module with fuses which conform with the specifications in section *Technical data* on page 62 of this user manual.

- Disconnect the device from the power supply.
- Loosen the fuse carrier with the blown fuse (**1**, Fig. 30) by turning with a screwdriver and pull it forwards out of the device.
- Remove the blown fuse (**3**, Fig. 30).
- Insert the new fuse in accordance with the specifications into the fuse carrier (**2**, Fig. 30).
- Re-insert the fuse carrier into the device and turn the screwdriver to fix the carrier.

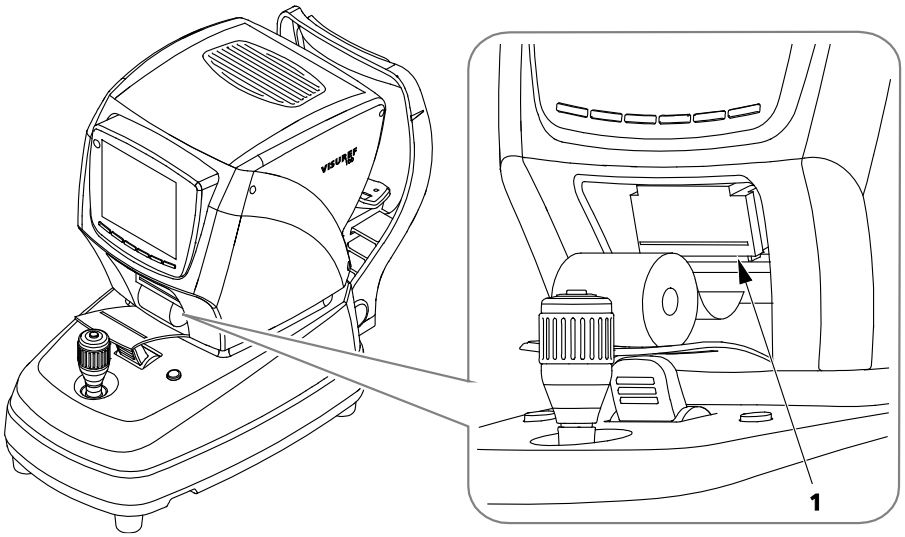


1 Fuse carrier in device
2 Fuse carrier
3 Fuse

Fig. 30 Replacing the fuses

Inserting printer paper

If a red line appears on the paper, or if NO PAPER is displayed on the bottom of the screen, please replace printer paper.



1 Printer paper insert slit

Fig. 31 Inserting printer paper

- Turn the joystick clockwise to lift up the upper part of the body case.
- Open the printer cover.
- Install the paper roll so that the printable side of the paper (which is smoother and shinier than the other side) faces upwards when fed through to the printer assembly.
- Feed the printer paper from below into the slit of the black printer unit, and then push it up gently. The printer will automatically pull the paper up if it is correctly fed.
- Insert the end of paper (which comes out from the printer) into the slit of the printer cover, then close the cover.
- If necessary, carefully pull out the end of paper.

Maintenance

Care and cleaning

WARNING - RISK OF ELECTRIC SHOCK

Prevent moisture from penetrating the instrument or keyboard. Disconnect the power cable from the power supply before cleaning or disinfecting the device.

CAUTION - SURFACE DAMAGE TO THE DEVICE

Use a disinfectant based on aldehyde and/or alcohol. The addition of quarternary compounds is acceptable. To prevent damaging surfaces, disinfecting agents other than those listed below must not be used

The maximum concentrations are:

- For alcohol (tested with 2-propanol): 60 %
- For aldehyde (tested with glutaraldehyde): 2 %
- For quaternary compounds (tested with DDAC): 0.2 %

CAUTION - RISK OF FALSE DIAGNOSIS

Use the supplied cover to protect the device from dust when not in use.

CAUTION - PROPERTY DAMAGE

The national disinfecting regulations must be observed in the choice of disinfectants and disinfection procedures. Please note that some cleaning agents and disinfectants may have an adverse effect on plastic components. Damage caused by such disinfectants is not covered by our warranty. The surfaces of the device have been tested and are guaranteed to resist frequent treatment with alcoholic disinfectants and cleaning agents in the long term.

Do not use aggressive or abrasive cleaning agents.

The outer surfaces of optical componentes (objective) can be cleaned if necessary.

- Remove dust from optical surfaces by using a blower or a clean and grease-free brush.
- Fine cleaning can be done with moist antistatic cleaning tissues. Please follow the instructions on the cleaning cloth packaging.

This will enable you to maintain the high image quality of your product.

Cleaning and disinfection of painted surfaces

All painted surfaces may be cleaned with a damp cloth.

The display should be cleaned with a lightly moistened cloth only.

Do not use aggressive or abrasive cleaning agents.

Use wipe disinfectants for cleaning and disinfecting the instrument casing, chin rest and forehead rest.

Ensure that no moisture penetrates the system during cleaning and disinfection.

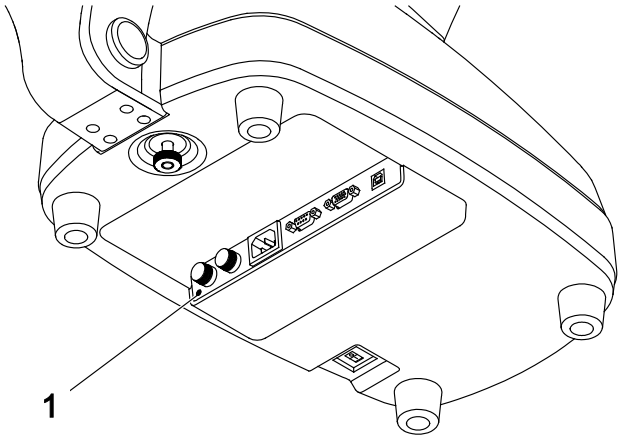
Safety inspections

WARNING - RISK OF ELECTRIC SHOCK

If no legal requirements exist in your country, the device must receive an electrical safety test in accordance with IEC 62353:2007. This test must be performed and documented by specialists disposing of the according know-how.

Please proceed as follows to perform a safety check of the device:

- Check the protective earth conductor resistance. To do this, connect the device to the measuring instrument using the power cable. To perform the measurement, press the measuring tip to the metallic holding plate (**1**, Fig. 32) of the plugs on the bottom of the device. The measured value may not exceed 0.3 Ω.



1 Metallic holding plate of plugs (measuring point)

Fig. 32 Performing an electrical safety inspection

- After successful measurement, the device leakage current must be measured. Preferably, the differential current method should be used. The device should be in operation during the measurement. Press the measuring tip again to the metallic holding plate (**1**, Fig. 32) of the plugs. The measured value may not exceed 0.5 mA.

- Finally, measure the insulation resistance using a test voltage of 500 V. The measured value may not fall below 2 MΩ.

- Note down the measured values.

Optional accessories

WARNING - GENERAL HAZARDS

Use only accessories and spare parts approved by Carl Zeiss Meditec.

A complete up-to-date list of accessories can be obtained from your dealer.

Transport

Transport without packaging

- Switch off the device at the power switch and disconnect the power cable of the device (see section *Shutting down*, page 51).
- Lock the stage using the stage clamping bolt (**7**, Fig. 5) and the lever (**3**, Fig. 3).
- When transporting, lift the bottom of the device with both hands.

CAUTION - PROPERTY DAMAGE

Do not use the forehead rest as a grip for lifting and moving the VISUREF 100 system.

Transport with packaging

- Switch off the device at the power switch and disconnect the power cable of the device.
- Lock the stage using the clamping bolt (**7**, Fig. 5) and the lever (**3**, Fig. 3).
- Protect the device using the supplied plastic bags and foam parts and place it inside the box. Lift the bottom of the device with both hands.
- Seal the box with adhesive tape.
- When transporting the box make sure that it is protected against falling or impact.

CAUTION - RISK OF INJURY

Holding the box by the packing tape or rope may cause injury to your fingers.

CAUTION - RISK OF INJURY

Should the packaging material become damaged or wet, please contact ZEISS Service or your local distributor.

CAUTION - RISK OF INJURY

Take care when cutting the packing tape, as it may snap up and cause injury. Hold the tape on both sides when cutting.

Wear protective gloves when unpacking the device.

Unpack the device on a level surface to prevent slipping.

CAUTION - PROPERTY DAMAGE

Do not place heavy objects (over 20 kg) on the package.

Do not throw or drop from a high distance.

- Make sure the box is always stored and transported upright.

Technical data

Dimensions (W x D x H)	275 mm x 525 mm x 450 mm
Weight	18 kg
Power supply	100 V to 240 V AC ± 10 %, 50/60 Hz
Power consumption	90 VA
Fuses	T2AH 250 V
Protection class	1
Ingress protection rating	IP X0
Device type	B (DIN EN 60601-1)
Optical radiation	Class 1 (EN ISO 15004-2)
Battery type, manufacturer	CR2032, Hitachi Maxell
Storage memory	10 measurement for each eye
Display	TFT LCD color monitor 6.4"
Chin rest	Electrically controlled height adjustment (max. 65 mm)
Internal printer	
Type	Thermal printer
Printing paper	Thermal paper (width 57mm, external diameter of roll 50 mm, surface weight 60 g/m², thickness 59 µm)
Refractomy	
Corneal vertex distance (VD)	0.0, 10.0, 12.0, 13.5, 15.0 mm
Sphere(SPH)	-25.00 D to +22.00 D (VD = 12 mm), in steps of 0.12/0.25 D
Cylinder (CYL)	0.00 D to ±10.00 D, in steps of 0.12 D/0. 25 D
Axis (AX)	0° to 180°, in steps of 1°
Cylinder units	-/+/+-
Pupil distance (PD)	10 mm to 85 mm
Minimum pupil diameter	2 mm
Keratometry	
Curvature radius	5.00 mm to 10.20 mm, in steps of 0.01 mm
Corneal refraction power	33.00 D to 67.50 D, in steps of 0.12 D/0.25 D
Corneal astigmatism	0.00 D to -15.00 D, in steps of 0.12 D/0.25 D
Axis (AX)	0° to 180°, in steps of 1°
Corneal diameter	2.0 mm to 12.0 mm, in steps of 0.1 mm

Measurement precision in accordance with ISO 10342	
Refraction, sphere	better than ±0.25 D
Refraction, cylinder	better than ±0.25 D
Refraction, cylinder axis	better than ±5°
Measurement precision in accordance with ISO 10343	
Keratometry, corneal radius	better than ±0.05 mm
Keratometry, axis	
for radial difference in main sections ≤ 0.3 mm	better than ±4°
for radial difference in main sections > 0.3 mm	better than ±2°

Ambient conditions for intended use

Temperature	+10 °C to +40 °C
Relative humidity	30 % to 90 %
Air pressure	70 kPa to 106 kPa
Shock (without packaging)	10 g/6 ms

Ambient conditions for storage

Temperature	-10 °C to +55 °C
Relative humidity	10 % to 95 %
Air pressure	50 kPa to 106 kPa
Shock	30 g/6 ms (permanent shock: 10 g/6 ms)
Oscillations (sine curve)	10 Hz to 500 Hz, 0.5 g

☞ The device may not be stored in the following conditions:
- In dusty environments
- In the vicinity of salt or sulfur
- Exposed to vibration or shock
- In the vicinity of flammable vapors and liquids
- In direct sunlight

Ambient conditions for transport

Temperature	-40 °C to +70 °C
Relative humidity	10 % to 95 %
Air pressure	50 kPa to 106 kPa
Shock	30 g/6 ms (permanent shock: 10 g/6 ms)
Oscillations (sine curve)	10 Hz to 500 Hz, 0.5 g

Electromagnetic compatibility

Special precautionary measures apply to this device with regard to electromagnetic compatibility (EMC). To avoid electromagnetic disturbances, the device may only be installed, operated and serviced in accordance with the user manual and using the components supplied by Carl Zeiss Meditec.

CAUTION - GENERAL HAZARDS

Portable and mobile RF communications equipment may affect the device. When operating radio devices or components for radio transmission, observe the distances to all system components recommended in this section.

CAUTION - HAZARD DUE TO ELECTROMAGNETIC RADIATION

The VISUREF 100 may not be placed next to or stacked together with other equipment, except in the device configurations described in this user manual. If operation close to or together with other devices is necessary, the VISUREF 100 must be monitored with regard to its proper functioning in this configuration.

Replacement cables may only be purchased at Carl Zeiss Meditec.

The use of accessories, any converters or cables which are not specified in this user manual or have not been purchased as spare parts from Carl Zeiss Meditec can result in increased emissions or reduced immunity of the device.

Guidance and manufacturer's declaration - electromagnetic emissions		
The VISUREF 100 is intended for use in an electromagnetic environment as specified below. The customer or the user of the VISUREF 100 should ensure that it is used only in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	The VISUREF 100 uses RF energy only for its internal functions. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The VISUREF 100 is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/flicker IEC 61000-3-3	Complied	

Guidance and manufacturer's declaration - electromagnetic immunity			
The VISUREF 100 is intended for use in an electromagnetic environment as specified below. The customer or the user of the VISUREF 100 should ensure that it is used only in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines	±2 kV for power supply lines	Mains power quality should be that of typical commercial or hospital environments.
Surge IEC 61000 -4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	±1 kV line(s) to line(s) ±2 kV line(s) to earth	Mains power quality should be that of typical commercial or hospital environments.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	< 5 % U_T (> 95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles < 5 % U_T (95 % dip in U_T) for 5 s	< 5 % U_T (> 95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles < 5 % U_T (95 % dip in U_T) for 5 s	Mains power quality should be that of typical commercial or hospital environments. If the user of the VISUREF 100 requires continued operation during power mains interruptions, it is recommended that the VISUREF 100 be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the a.c. mains voltage prior to application of the test level.			

Guidance and manufacturer's declaration - electromagnetic immunity			
The VISUREF 100 is intended for use in an electromagnetic environment as specified below. The customer or the user of the VISUREF 100 should ensure that it is used only in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
			Portable and mobile RF communications equipment should be used no closer to any part of the VISUREF 100, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance**
Conducted RF IEC 61000-4-6	3 V_{rms} 150 kHz to 80 MHz	3 V	$d = 1.2 \sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	$d = 1.2 \sqrt{P}$ 80 MHz to 800 MHz $d = 2.3 \sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a], should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol: 
Note 1:	At 80 and 800 MHz, the separation distance of the higher frequency range applies.		
Note 2:	These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.		

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To asses the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the VISUREF 100 is used exceeds the applicable RF compliance level above, the VISUREF 100 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the VISUREF 100.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended separation distances between portable and mobile RF communications equipment and the VISUREF 100

The VISUREF 100 is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the VISUREF 100 can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the VISUREF 100 as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	Separation distance according to transmitter frequency m		
	150 kHz to 80 MHz	80 MHz to 800 MHz	800 MHz to 2.5 GHz
	$d = 1.2 \sqrt{P}$	$d = 1.2 \sqrt{P}$	$d = 2.3 \sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.37	0.37	0.74
1	1.2	1.2	2.3
10	3.7	3.7	7.4
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1: At 80 and 800 MHz, the separation distance of the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Abbreviations/Glossary

AX	Axis
CLBC	Contact Lens Base Curvature
CYL	Cylinder
D	Diopter
DDAC	Quaternary ammonium compound for disinfection and cleaning
Fig.	Figure
ILLUM	Illumination
IOL	Intraocular lens
KER	Keratometry (measurement mode)
MSR	Measure
PD	Pupil distance
REF	Refractometry (measurement mode)
RK	Keratometry and Refractometry combination mode (RK)
SPH	Sphere
TAR	Target
VD	Vertex distance

Figures

Index

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