

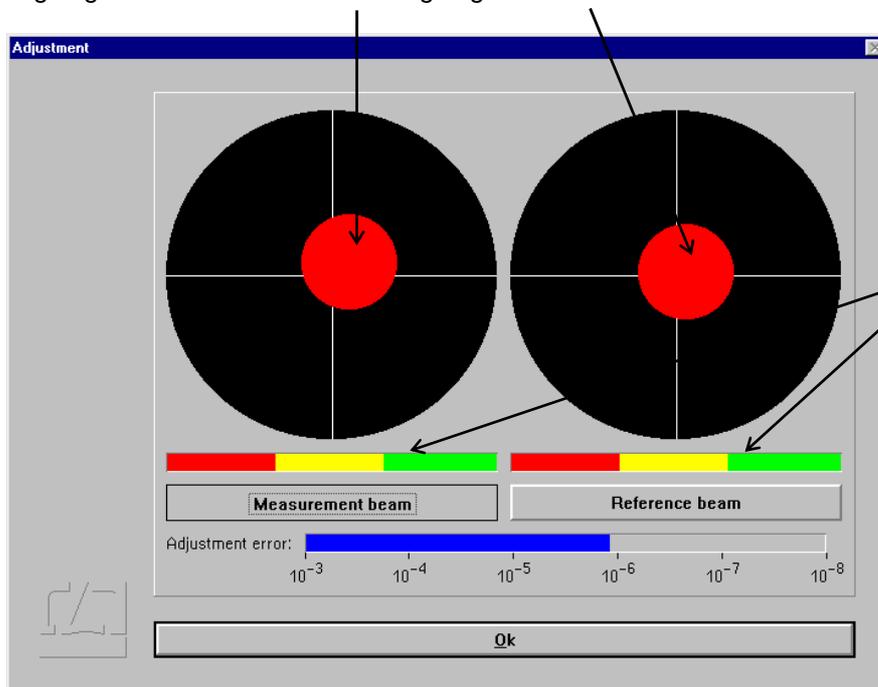
I 2.5 Measurement procedure

I 2.5.1 Laser aligning aid

The laser head of the ZLM 500 contains two quadrant detectors. This feature allows alignments to be made and aligning errors to be estimated even over great distances.

Click the  button to open the "Alignment" window.

The upper two fields in this window indicate the positions of the re-entering measurement and reference beams. In a standard setup, the left-hand figure represents the measurement beam, and the right-hand one the reference beam. When aligning the laser, try to keep the two red spots at the centers of the crosshairs throughout the distance traveled. See the Basic Equipment manual for the aligning elements to be used for aligning the laser head.

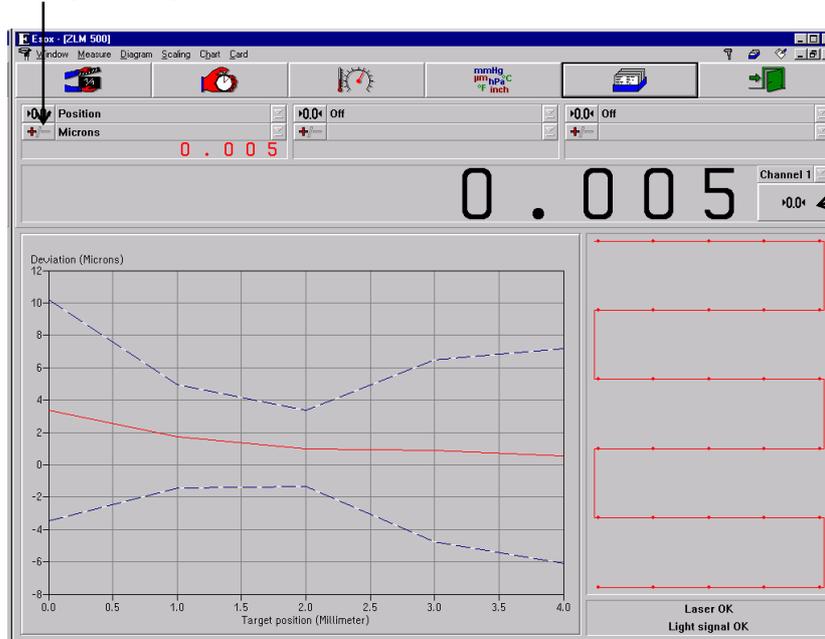


Whenever the beam passes an optical element, a slight portion of the light energy will get lost. The two intensity display bars indicate whether the light intensities of the measurement and reference beams are sufficient for the system to operate without errors. If one of the bars extends into the red range only, the respective beam is too weak.

I 2.5.2 Synchronizing the displays

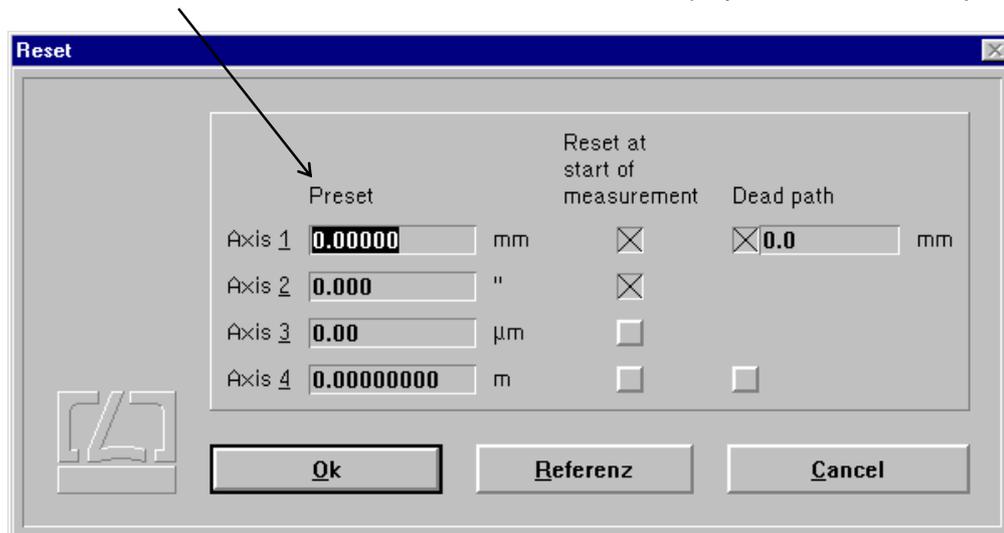
Normally, at least one channel of the laser interferometer measures a quantity that is also displayed by the object tested, although at a different level of accuracy. Before you can start a measurement, make sure that the numerical displays of the laser interferometer and the object under test are in synchronism.

First check, for each channel where the respective quantity is available also on the object, whether object travel in positive direction increases the readout of the laser interferometer. If necessary, change the sign of the interferometer display.



Then move the object to the first nominal position. Click on the **0.0** button or select "Reset" in the "Measure" menu to open the "Reset" dialog box.

In the "Preset" text boxes, enter the current readouts displayed on the tested object.



If you select "Encoder, channel ..." as data acquisition triggering event under "Scan type" in the "Parameters" dialog box, you can enter the preset values for the position at which the scale system triggers a reference pulse. The click the **Referenz** button; the program now waits for a reference pulse coming from the scale. Take care to ensure in this case that the "Reset at start of measurement" buttons are off, since otherwise the preset values will be displayed again at the start of the measurement.

I 2.5.3 Starting the measurement

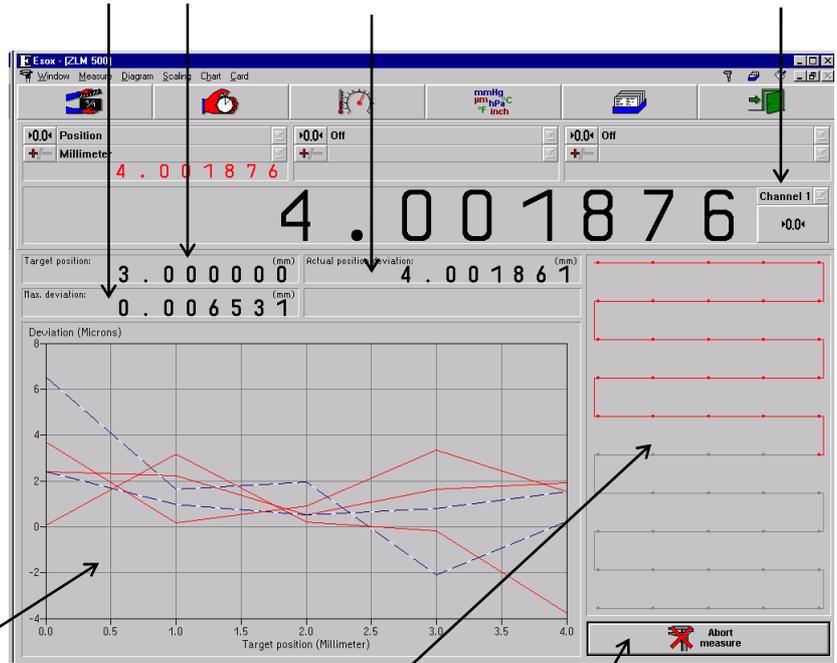
You can start a measurement by opening the "Measure" menu and choosing the "Start measure" option or by clicking the  button.

The screen now presents additional displays for the channel selected in the large numerical display field.

Depending on the channel selected, the following information can be displayed:

- Current deviation,
- Target position,
- Minimum dwell time for the data acquired so far (in automatic measurement only),
- Maximum deviation for the data acquired so far.

Minimum dwell time and maximum deviation tell you whether any problems were encountered during measurement.

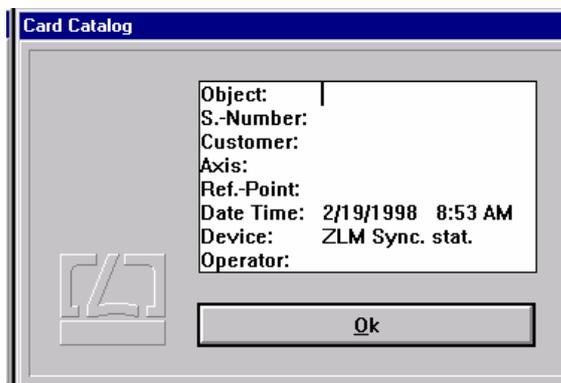


The diagram shows the position data so far measured in the channel selected.

The positions already measured are shown in red.

Click this button if you want to abort the measurement.

After a successful measurement, the measured values are saved on a card of the card file. For this purpose, a dialog box "Card Catalog" is displayed, containing already entries for the measuring instrument used and the date and time of the start of the measurement. You can type in the remaining items via the keyboard.



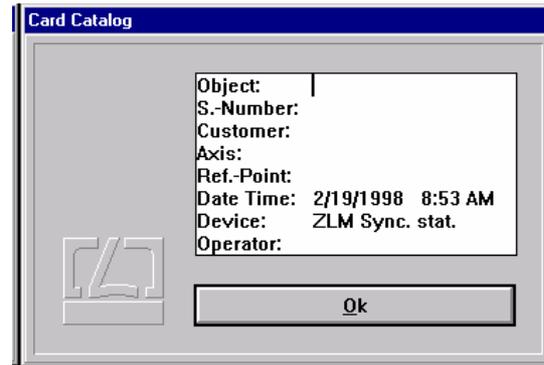
Annex II contains the list of special function keys and key combinations for typing in text boxes.

Additionally, the following keys can be used:

-  - moves the text cursor to the next entry of the file card in the same line.
-  - moves the text cursor down to the next entry of the file card.
-  - moves the text cursor up to the previous entry of the file card.

On clicking the  button, the file card is created. Filing of file cards is handled by the "Cardfile" program module (see Section K).

If a card already exists, the program provides the possibility to overwrite this card with new measured values.



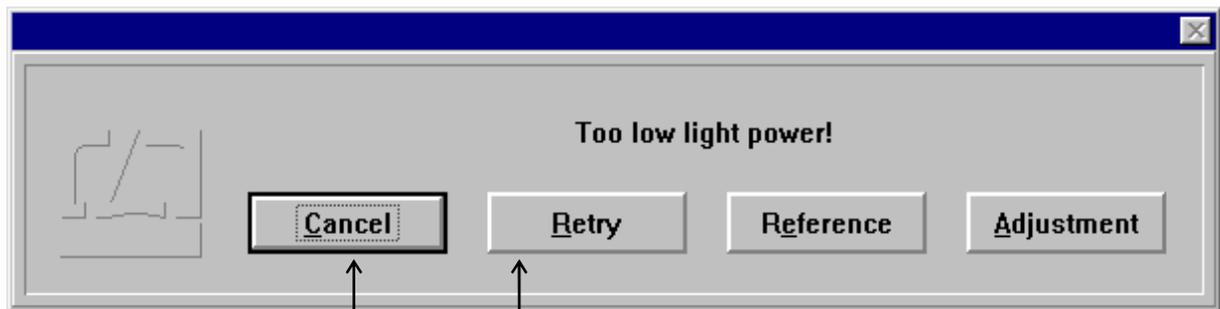
I 2.5.4 Errors occurring during a measurement

By clicking the  button you can abort a measurement. If by that time a sufficient number of readings have been taken to make an analysis meaningful, you have the option to save the readings already taken.

In the following cases the program stops the measurement before all readings have been taken:

- The laser is unstable or becomes unstable while the measurement is running.
- The light power at the receiver is too low or becomes too low while the measurement is running.
- An error occurred during the measurement and you have selected the option of having it reported by a message (see section I 2.4.2 - Parameter setting for measurement data acquisition).

If the program stops the measurement, a dialog box is displayed, which describes the error that occurred.

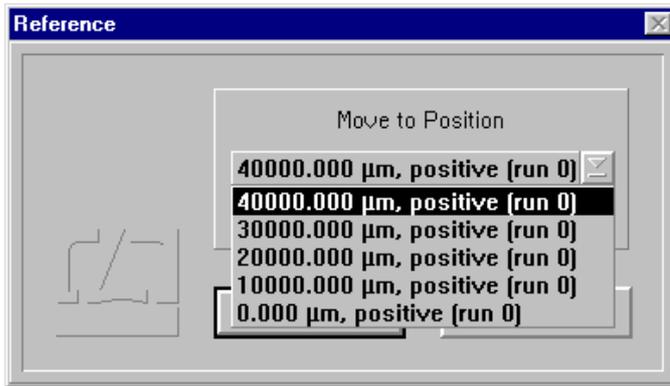


You can either abort the measurement or ignore the error.

In case of measurements that take a long time it seems reasonable to continue a measurement even if a serious error occurs. It may happen, e.g. that the laser beam is interrupted just before the last reading in a many hours' measurement job is to be taken.

In such a case, click the  button to make sure that the laser is still properly aligned. The click the  button.

In case of a beam interruption it is to be assumed that the display of the laser interferometer is no longer correct. It is therefore necessary to re-reference the displayed value to the readings taken so far.



To do this, select a position that has already been measured. Travel to this position in the same manner as when you first measured this position.

Then click the button.

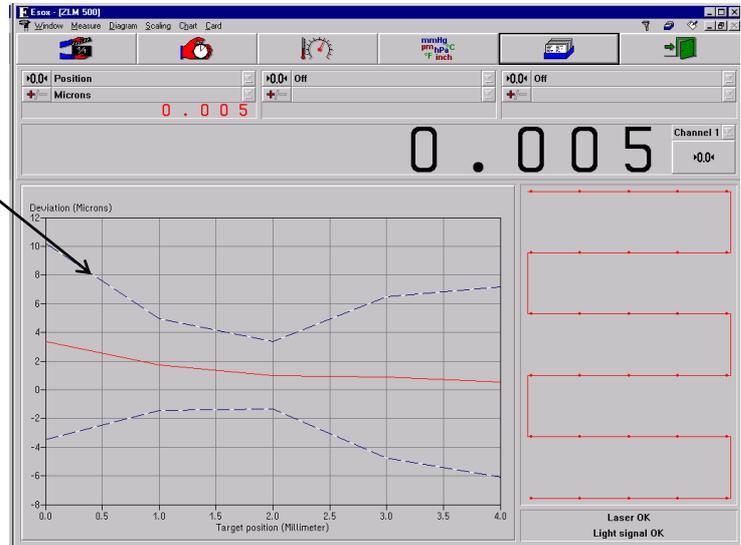
The program then compares the "old" reading with the "new" one and corrects the display accordingly.

I 2.6 Analysis of a measurement

For analysing the measurements you can select between the diagrams and parameters according to the standard applied. Also available are tabulated measurement data.

After completion of a successful measurement, the bottom left portion of the screen shows a large diagram which constitutes a button.

A click on this button, or selection of the "Diagram" item in the "Diagram" menu, opens the analysis mode window.



I 2.6.1 Controls for diagram handling

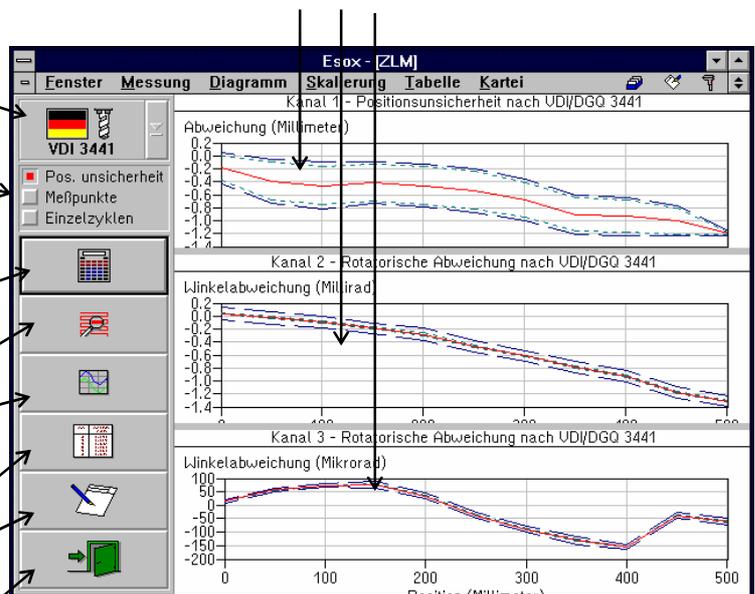
After calling a diagram the measurement program window is completely changed. Most of the screen area is now occupied by a diagram.

Use the drop-down list box to select the standard applicable.

In the box below this, you can select the type of diagram to be displayed.

The buttons below this are intended for:

- Displaying the parameters
- Selection of the measured data to be included in the analysis
- Autoscaling
- Opening a table of measured data
- Compilation of a record
- Quitting the diagram presentation



To move from one button to the next, press the  key.

In addition to these controls, you can also use some submenu items of the "Diagram", "Scaling" and "Table" main menus.

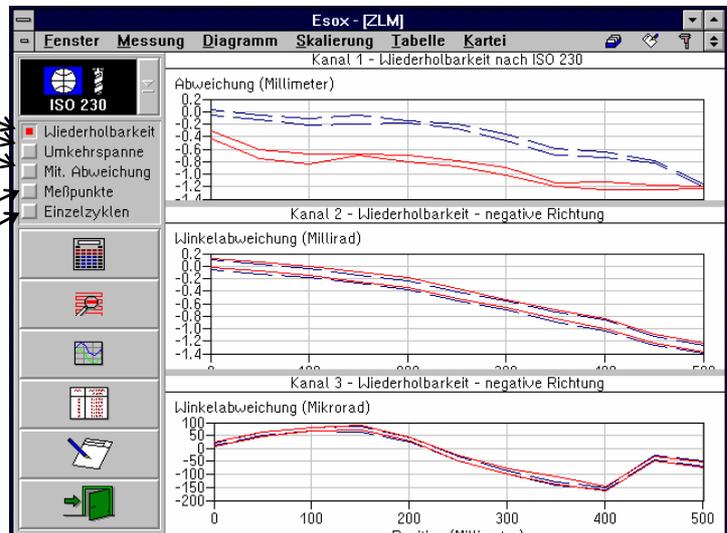
I 2.6.2 Selection of standard and type of diagram

The standards "VDI/DGQ 3441", "VDI/VDE 2617" and "NMTBA" only specify one diagram each for the analysis of position measurements, whereas "ISO 230" provides for three diagrams for the statistical analysis of position measurements. None of the standards quoted is concerned with the statistical analysis of angle and straightness measurements. The "ZLM Stat" program, by contrast, presents and computes angle and straightness diagrams and parameters, analogously to the diagrams and parameters of a position measurement.

Use these buttons to select which diagram you want to be shown.

The first buttons correspond to the diagrams specified by the standards.

A click on the last two buttons lets you display the measured point data individually, or connected by lines.



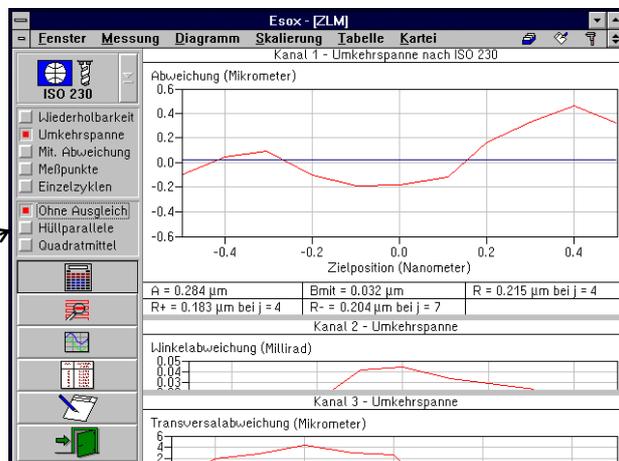
If you select the "Readings" button, the program supplies a diagram for angle and straightness measurements that conforms to the respective standard but does not contain any statistical information.

Selection between diagram types can also be made with the following items in the "Diagram" menu:

- "Position uncertainty" (not with ISO 230)
- "Repeatability" (with ISO 230 only)
- "Backlash" (with ISO 230 only)
- "Average deviation" (with ISO 230 only)
- "Readings"
- "Cycles"

See section I 1.3 - "Standard analysis procedures" for an explanation of the curves shown in the diagrams, and the equations for their calculation.

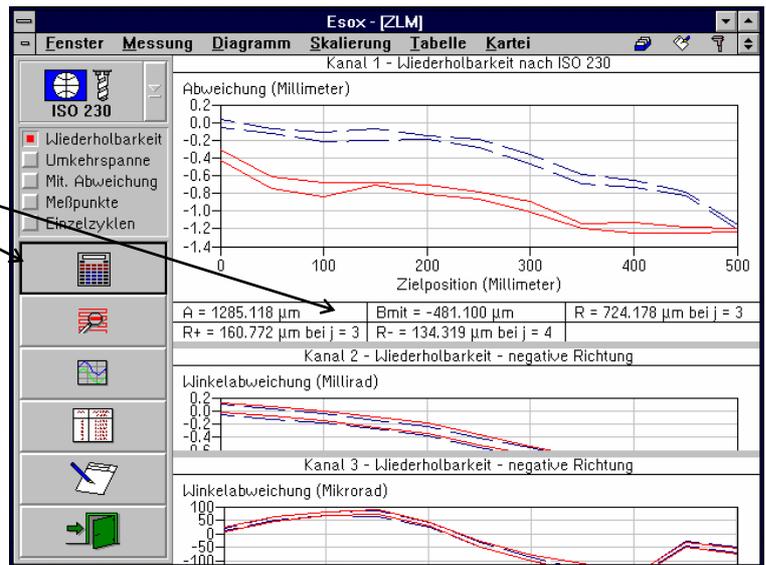
If a transverse deviation was measured with at least one measuring axis (straightness measurement), you will find an option for curve fitting (see section I 1.1 "Parameters"). For standard analysis, you ought to choose the "Envelope parallels" button.



I 2.6.3 Parameters

By clicking the  button you can display the parameters below the diagram. The button will lock. Click it again to remove the parameter display.

Parameter display can also be activated by selecting the "Parameters" item in the "Diagram" menu.



The symbols stand for the following parameters:

Position measurement		
VDI / DGQ 3441 and VDI / VDE 2617	P Pa Bmax Bave Psmax Psave	Position uncertainty Position deviation Maximum reversal span (backlash) Average reversal span (backlash) Maximum position spread Average position spread
ISO 230	A Bave R R+ R-	Position uncertainty (Accuracy) Average backlash Maximum position spread (Repeatability) Maximum position spread (Repeatability), positive travel direction Maximum position spread (Repeatability), negative travel direction
NMTBA	P Pa Psmax Psave O	Position uncertainty Position deviation Maximum position spread Average position spread Offset

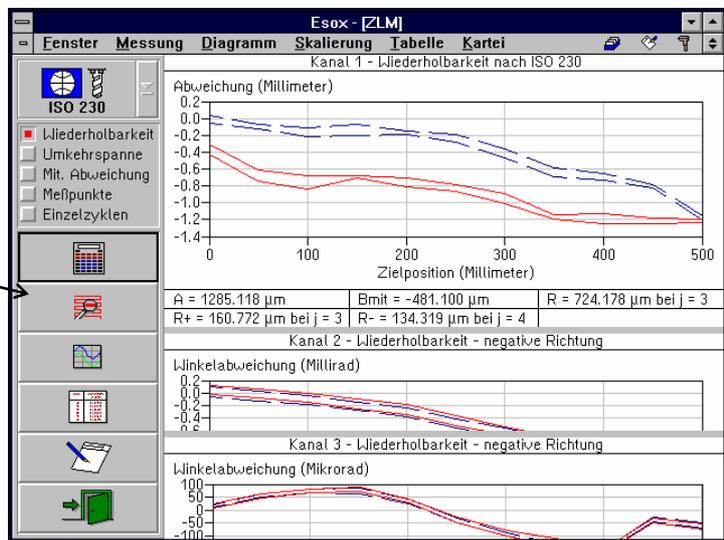
Angle measurement			
Quantities in angle measurement		Analogous quantity in position measurement	
Au	Angle uncertainty	P	Position uncertainty
Aa	Angle deviation	Pa	Position deviation
Bmax	Maximum backlash	Bmax	Maximum backlash
Bave	Average backlash	Bave	Average backlash
Asmax	Maximum angle spread	Psmax	Maximum position spread
Asave	Average angle spread	Psave	Average position spread
A	Rotatory deviation (acc. to VDI/VDE 2617: R)		

Straightness measurement			
Quantities in straightness measurement		Analogous quantity in position measurement	
Tu	Transversal position uncertainty	P	Position uncertainty
Ta	Transversal position deviation	Pa	Position deviation
Bmax	Maximum backlash	Bmax	Maximum backlash
Bave	Average backlash	Bave	Average backlash
Tsmax	Maximum transversal position spread	Psmax	Maximum position spread
Tsave	Average transversal position spread	Psave	Average position spread
S	Straightness deviation (acc. to VDI/VDE 2617: G)		

See section I 1.2 "Standard analysis procedures" for the equations for computing the parameters.

I 2.6.4 Selection of the measured data to be included in the analysis

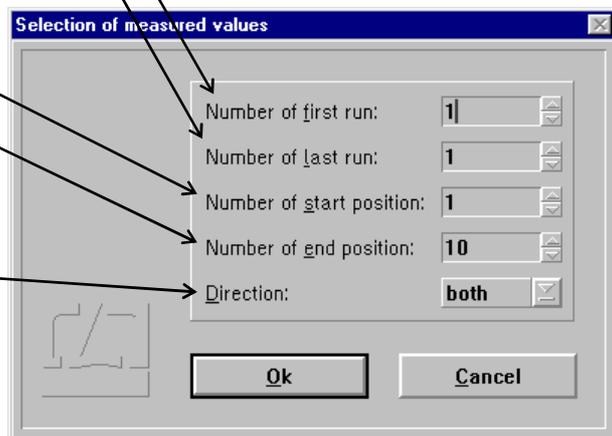
If you want to analyse a partial range rather than all of the data measured, click the  button or activate the "Select positions/Cycles" item in the "Diagram" menu to open a selection dialog.



The "Selection of measured values" dialog box permits you to enter the numbers of the first and the last of the cycles you want to include in the analysis. The n-th cycle means all data measured with the respective position travelled to for the n-th time from the positive direction, or for the n-th time from the negative direction.

After you change the default settings in the "Start position number" and "End position number" boxes, the analysis will only include the data measured at positions whose numbers lie between the selected limits.

In bidirectional measurements, the data measured in one of the two travel directions can be excluded from the analysis.



I 2.6.5 Zooming and scrolling of the visible diagram segment

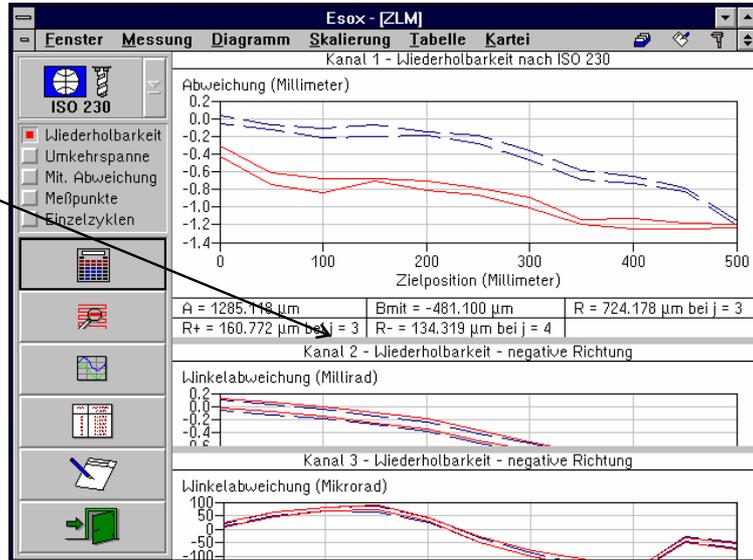
For zooming the diagram segment shown on the screen, use the mouse.



Move the mouse cursor to a corner of the section of the diagram you want to magnify. Press the left mouse button and keep it depressed. Move the mouse until the movable frame encloses the diagram section of interest. Release the mouse button.

After pressing the **right mouse button** the full diagram is displayed again.

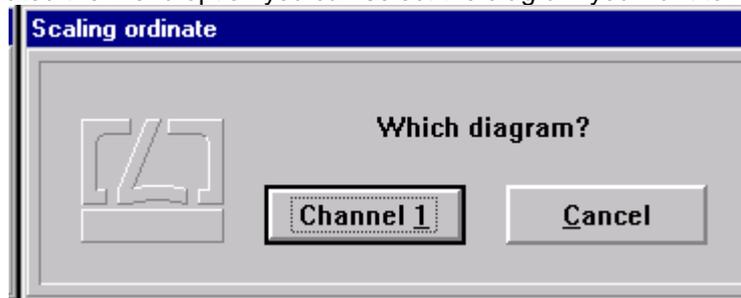
Especially with low-resolution monitor screens it may happen that parts of a diagram remain invisible. Use these horizontal bars to shift the diagrams vertically. To do this, put the mouse pointer on the bar. Press the left mouse button and hold it, dragging the bar up or down to the desired position. Then release the mouse button.



I 2.6.6 Rescaling the diagram axes

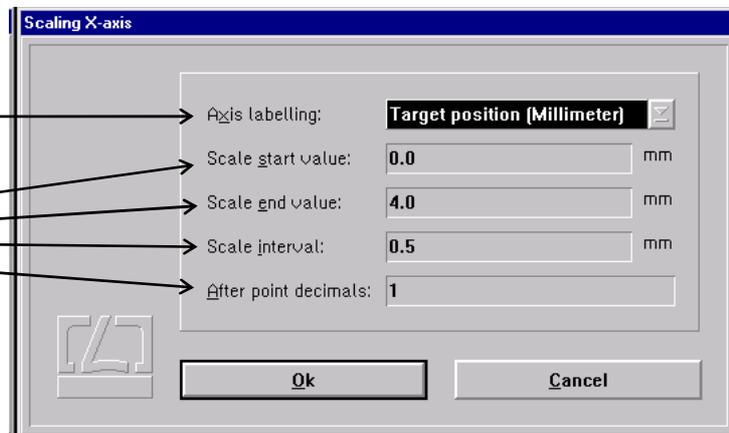
When the diagram presentation is started, the program automatically scales the diagram axes. If you want to change the unit of measurement or the coordinate scales, use the options "**Abscissa scaling**" or "**Ordinate scaling**" in the "**Scaling**" menu. Such a change will only remain valid until the visible diagram segment is changed by zooming or scrolling.

After you have activated the menu option you can select the diagram you want to rescale.



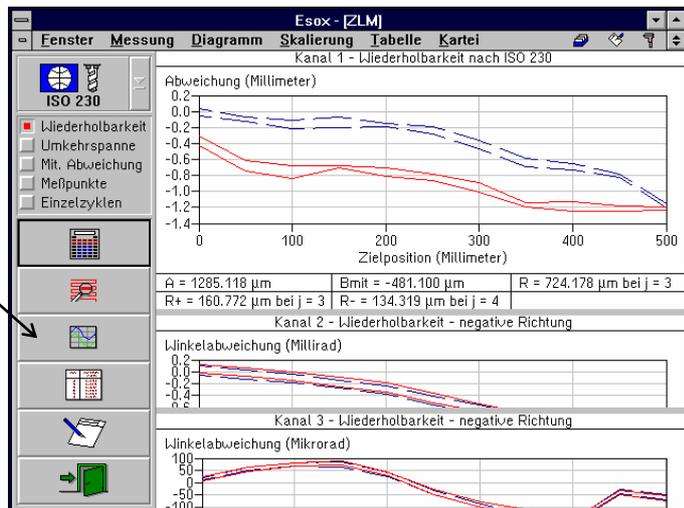
The list box "**Unit**" can be opened to change the unit.

In the four input boxes below this you can specify the required scaling.

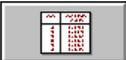


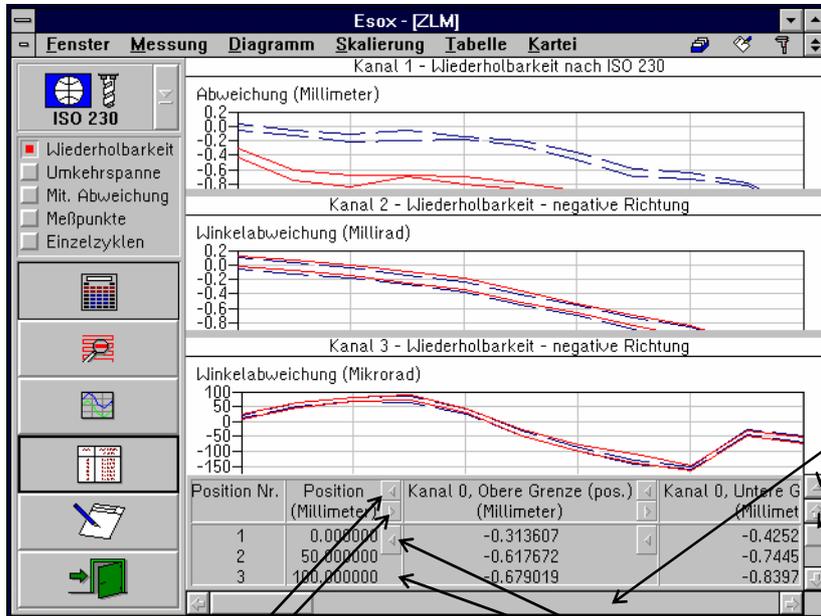
Automatic scaling (scaling same as when the diagram presentation is started) can be released

- with the  button,
- with the "**Autoscaling**" item of the "**Scaling**" menu, or
- by clicking the right mouse key on the diagram.



I 2.6.7 Tables

By clicking the  button while a diagram is displayed, a table with the measured data can be displayed in addition. The clicked button will lock. Click it again to remove the table.



Button for **maximizing** the table

Scroll bars for shifting the visible portion of the table

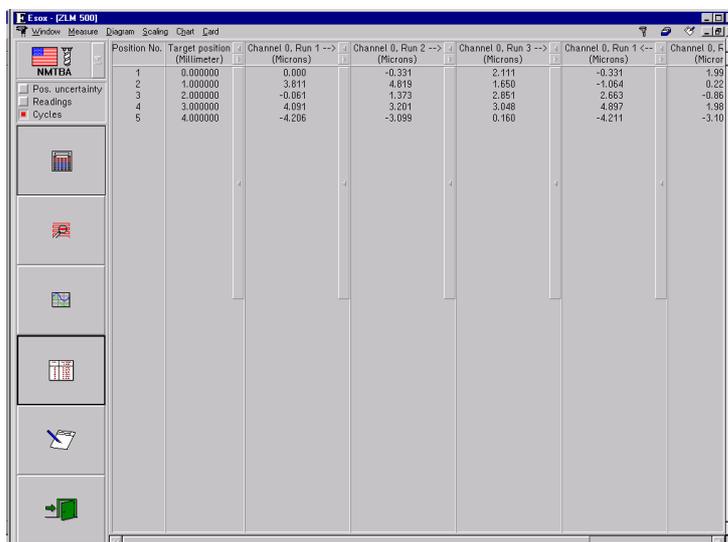
Click these buttons to select the unit of measurement.

Click these buttons to select the number of decimal places.

The table may occupy either the bottom right portion (normal size) or the entire right portion (maximum size) of the program window. In the second case, the diagram is hidden behind the table. For switching between normal-size and maximized presentation of the table, click the button at the top of the right table margin.

The functions described above are accessible with the keyboard as well, if you select, in the "Table" menu, the options

- ### "No table",
- ### "Small table" or
- ### "Big table"



Button for switching back to normal-size presentation of the table

I 2.6.8 Compiling a record (document)

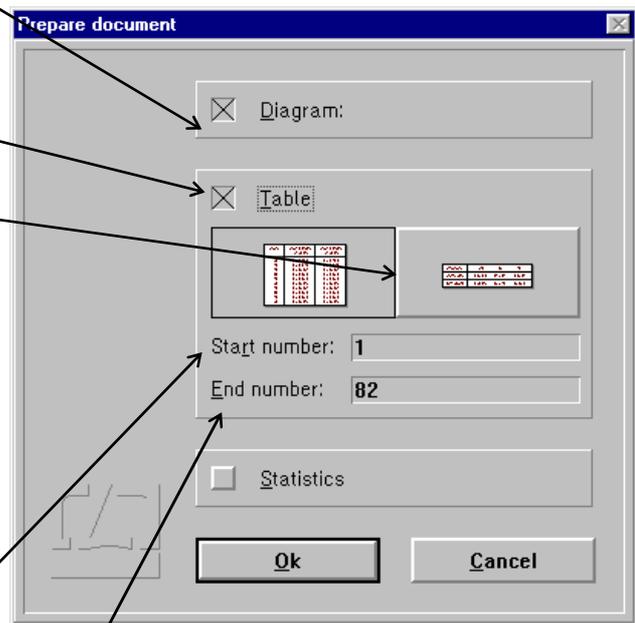
The "Document" part of the program serves for printing the record and for compiling the record contents. It is there that the arranging of the record contents and the printing of the record are carried out, rather than in the measuring program. Diagrams, tables and statistical data can be transferred from the measuring program to the "Document" program module. For further information on the "Document" program module, see section L - Program module "Document"

Click the  button or call the "Prepare document" option of the "Diagram" menu to display the "Prepare document" dialog box.

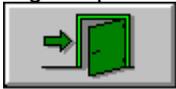
If the "Diagram" switch is activated (), the diagram displayed on the screen immediately before the "Prepare document" dialog box was called is transferred to the "Document" program module.

If the "Table" switch is activated, the buttons  and  can be clicked to select between horizontal and vertical arrangement of measured data in the table. In case of horizontal arrangement, the table is split up and transferred to the "Document" program module in the form of several tables if all the measured data do not fit into one line. When recording a table, please mind that a printed text page has about 60 lines. If a great number of readings have been taken, you should select which of them to be transferred into a table.

For this you can use the "Start number" and "End number" input boxes. If the number of measured data between the first and last readings entered exceeds 1000, the program will restrict the table to 1000 readings.



I 2.6.9 Exiting the diagram presentation

To exit the diagram presentation, activate the  button or choose the "End diagram" option of the "Diagram" menu.

