TRIOPTICS

TRIOPTICS GMBH · OPTISCHE INSTRUMENTE

PrismMaster®

The ultimate tool for angle measurements



PrismMaster

Absolute Line

Compact Line

Comparison Line

PrismMaster®
The ultimate tool for angle measurements

GENERAL DESCRIPTION

The PrismMaster® is widely recognized as the most accurate and most versatile line of equipment for measurement of prisms, polygons, wedges, windows and other plane optical components.

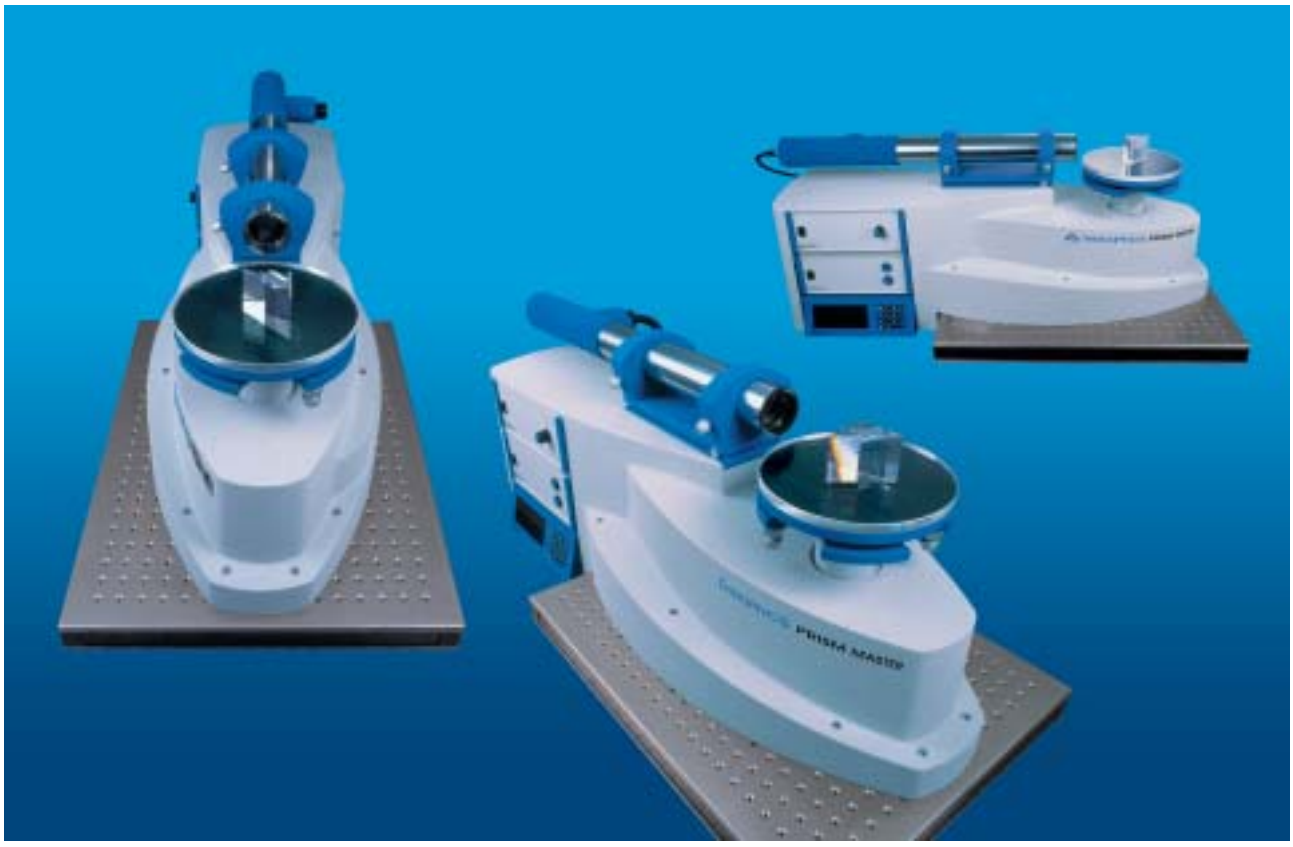
Not only that the PrismMaster® equipment line establishes a new standard for accuracy and reliability but it also offers the industry's largest selection of instruments and accessories.
The PrismMaster® system includes three basic lines of equipment:

PrismMaster®-Absolute Line

These instruments feature accurate and absolute measurements of prisms angles from 0° to 360°either in reflection or in transmission. It incorporates an ultra-accurate air bearing rotary table and a high precision rotary encoder with accuracy in the subarcsec range. The system also includes an electronic autocollimator mounted on a tiltable base. The rotary air bearing and the electronic autocollimator provide absolute angle indication of any angle between 0°and 360°.

PrismMaster® Series

The rotation of the table is done manually. The fine rotary adjustment is accomplished using a precision micrometer.



PrismMaster®-Mot Series

PrismMaster®-MOT Series

These instruments are equipped with ultra precision drive for fully automated measurement of optical components.

PrismMaster®-Accuracy Class

includes instruments with rotary encoder with an accuracy of 0.5 arcsec and resolution of 0.36 arcsec.

PrismMaster® HR –Ultra Accuracy Class

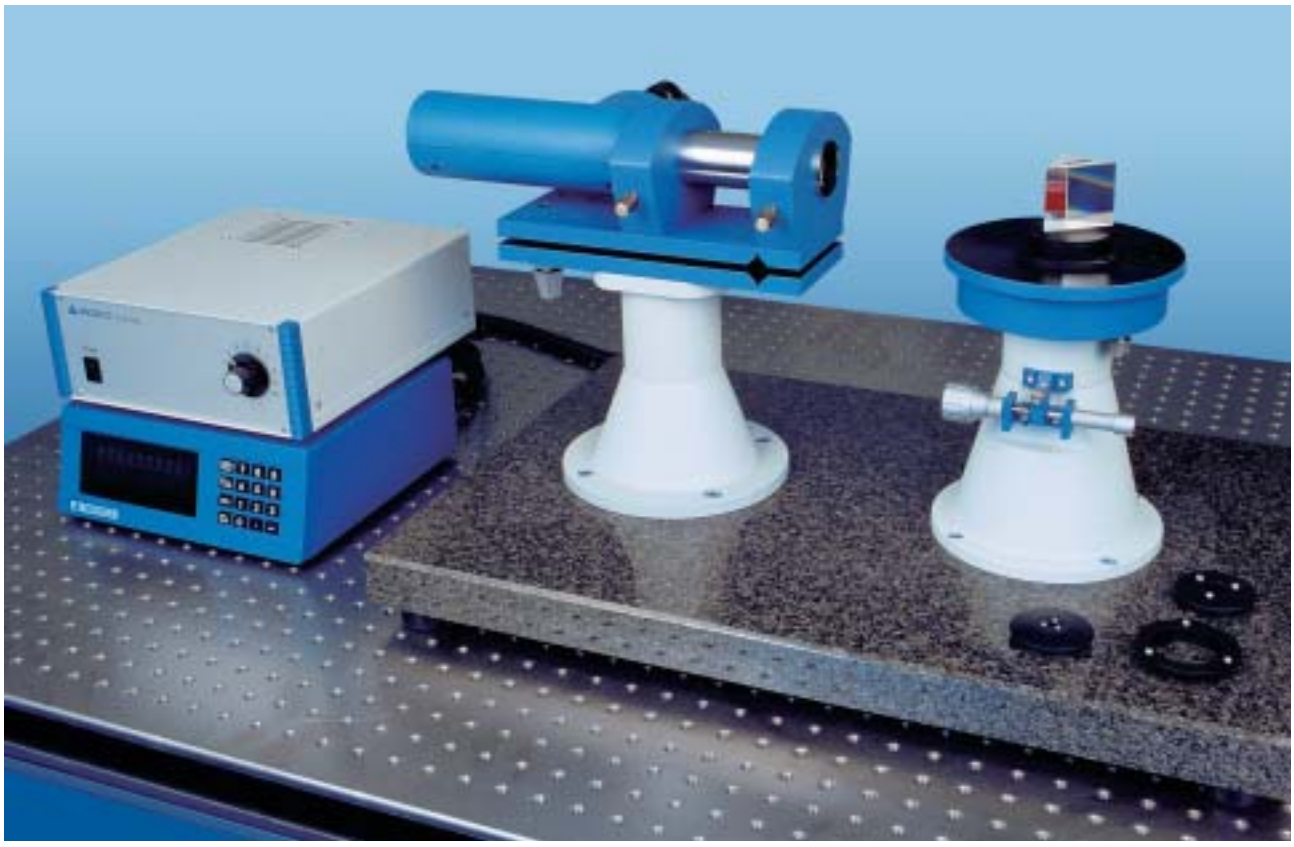
includes a specially selected encoder having a resolution of 0.036arcsec and total systematic error of less than 0.2arcsec.

PrismMaster®-Compact Line

This instrumentation line is an absolute angle measuring instrument as well. However, it is equipped with a precision mechanical rotary table. Dimensions of the rotary table and of the autocollimators are smaller, the accuracy of the angular encoder is in the arcsec range. The applications are related to the measurement of small optical components, micro-prisms, etc. Otherwise, the features and measuring principle are similar with the Absolute Line

PrismMaster®-C 200

is equipped with precision mechanical table and a rotary encoder in the accuracy class. The large and stable sample table is suitable for measurement of optical components with large dimensions.



PrismMaster®-Compact Line

PrismMaster® Compact Series

These instruments are intended to be used for measurement of small components as endoscopes, telecom or crystal prisms. The rotary encoder has an accuracy of 5 arcsec. The autocollimators mounted on these instruments have shorter focal lengths enabling measurement of components with larger tolerances. The rotation of the table is done manually.

PrismMaster®-Compact MOT Series

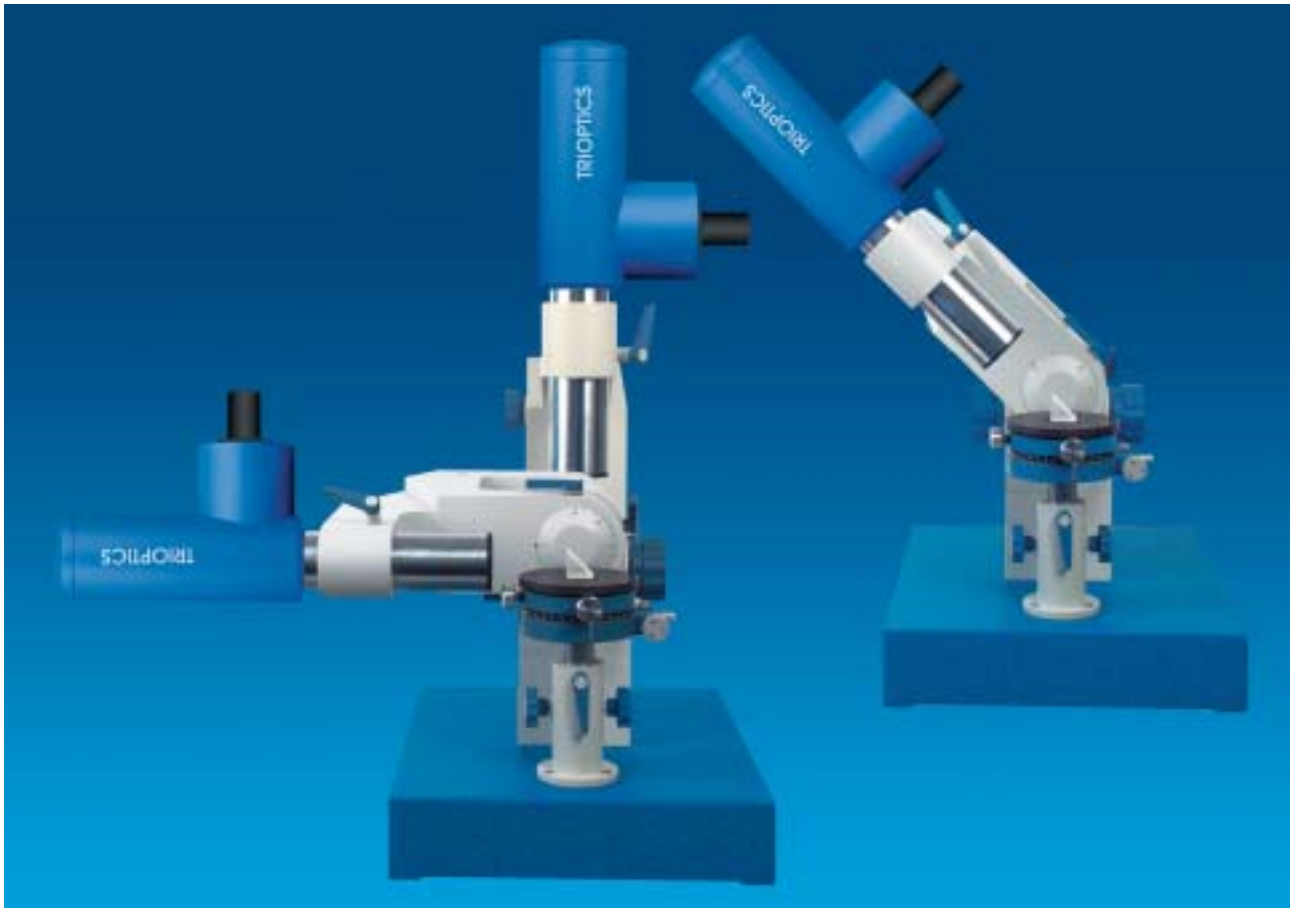
These instruments are equipped with ultra precision drive for fully automated measurement of optical components.

PrismMaster®-Comparison Line

The Comparison Line includes precision angle measurement instruments –also known as Comparison Goniometers - primarily used to measure prisms and other plano optical components in production environment.

These instruments can measure any angles, however, using a reference prism with a known angle. The first reference measurement is done using the master prism. Further measurements are made relatively to the angle of the master prisms.

The results are given as a difference to the master prism or as absolute value of the measured angle. An exception are the 90°-prisms angles which can be measured absolutely without the need of a master prism.



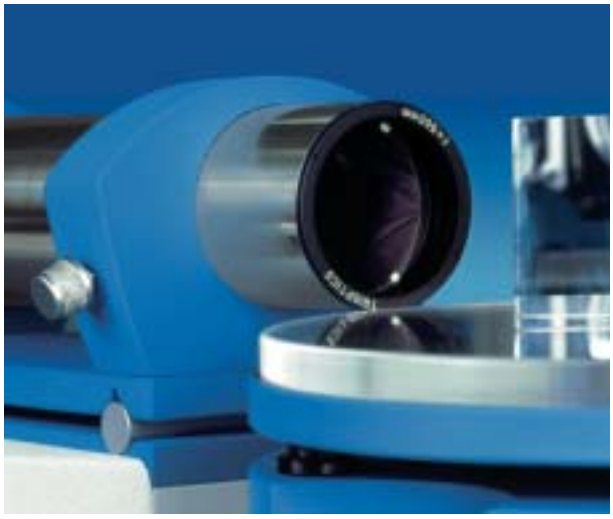
PrismMaster®-Comparison Line

PrismMaster®-Absolute Line

SYSTEM COMPONENTS

Precision Rotary Table

The absolute goniometers included in the PrismMaster® product line are equipped with either a precision mechanical rotary table or with an ultra-accurate air bearing rotary table.
The precision mechanical tables with axial and radial run out errors of 1-2 µm are recommended for applications where the accuracy required is less than 2 arcsec.



Tilt table and Autocollimator

For applications where ultra-accurate measurements in sub-arcsec range are required, only the air bearing tables with axial and radial run out under 0.05µm are recommended.

Rotary Encoder

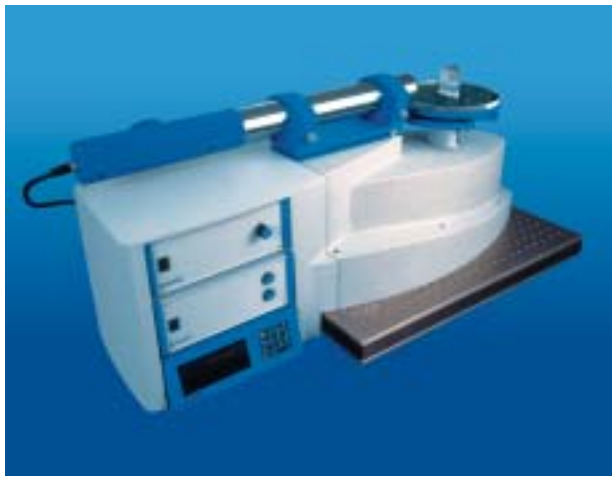
The rotary encoders are precisely mounted into the rotary tables in order to provide absolute angle indication over 360°. The encoders integrated into the TRIOPTICS goniometers are high precision Heidenhain encoders specially selected for this use. The encoders are available in different accuracy classes.

PrismMaster®-Accuracy Class includes instruments with rotary encoder with an accuracy of 0.5 arcse and resolution of 0.36 arcsec.

PrismMaster®-Ultra-Accuracy Class-the top of the line- includes a specially selected encoder having a resolution of 0.036arcsec and total systematic error of less than 0.2arcsec. Moreover, the calibration curve of this encoder is stored in our software and the errors are subtracted from the measurement data , so that the-remaining error is far beyond the standard accuracy of 0.2arcsec.

Electronic Autocollimator

Unlike other goniometers, which are using visual autocollimators, the PrismMaster® is equipped with a computerised autocollimator featuring a resolution of 0.01arcsec. The electronic autocollimators integrate a high resolution CCD-sensor with precision optics and provide outstanding performance and stability.



PrismMaster®-Mot Series

The electronic measuring head of the autocollimator is compatible with all Trioptics objective tubes. The compatibility with objective tubes of different focal lengths leads to a variable measuring range and accuracy performance. In this way the

autocollimators respond optimally to different customer requirements and can cover a large range of application.

Rotation Drive

To position the rotary table at the required angle the PrismMaster® series are equipped either with manual micrometer fine adjustment or precision rotation drive for fully automated measuring procedure.

PrismMaster® Series

The rotation of the table is done manually. The fine rotary adjustment is accomplished using a precision micrometer.

positioning of the rotary table. The software features automated zero positioning, constant or variable measurement steps, selectable rotation speed, multiple measurements etc.

Attachment for Measurement in Transmission Mode

The normal operation mode of the PrismMaster® is the **Measurement in Reflection Mode** of the outer angles of prisms, polygons, wedges, etc. This is by far the most important application related to angle measurement of plano optics.



PrismMaster®- Series

PrismMaster®-MOT Series

These instruments are equipped with ultra precision drive for fully automated measurement of optical components. The rotation drive enables automatic positioning of any face of a polygons or prisms with an extremely high accuracy. The rotation drive features a smooth and vibration free

However, there is an need to measure the deflection angle through prisms or wedges. This parameter known also as angle of deviation is the angle through a ray of light is deviated by a refracting surface or prism.

The attachment for **Transmission Mode** is modularly built and uses either a mirror to reflect back the deflected beam or a colli-



Attachment for Transmission Mode

mator to send the beam through the refracting prism. The use of the mirror is advantageous since this set up has a double sensitivity. However, for other applications the use of a collimator is the preferred choice.

Accessories for Measurement of Pyramidal Errors

Especially the **PrismMaster®-Absolute Line** provides outstanding capabilities for measurement of pyramidal errors with unsur-



Wobble Minimizing Kit

passed accuracy. The air bearing rotary table with axial run out errors under 0.05µm and the innovative software compensating for alignment errors set a new standard for performance in pyramidal errors measurement.

The pyramidal error is differently defined and understood by optical manufacturers. The most common definition equals the pyramidal error with the lack of parallelism between the edges (or the line of intersection) formed by the faces of a prism.

Other optical manufacturers understand the pyramidal error as a deviation of the parallelism of the faces of a prism or polygon taking as reference the base of the prism or polygon.

The software package supplied with PrismMaster® covers both definitions and offers alternative measurement methods.

When the tolerances are indicated with respect to a base reference surface it is necessary to align this surface perfectly perpendicular to the rotation axis of the rotary table. This can be done with the **Wobble Minimizing Kit** consisting of an optomechanical assembly to be mounted on the autocollimator barrel and a software module.

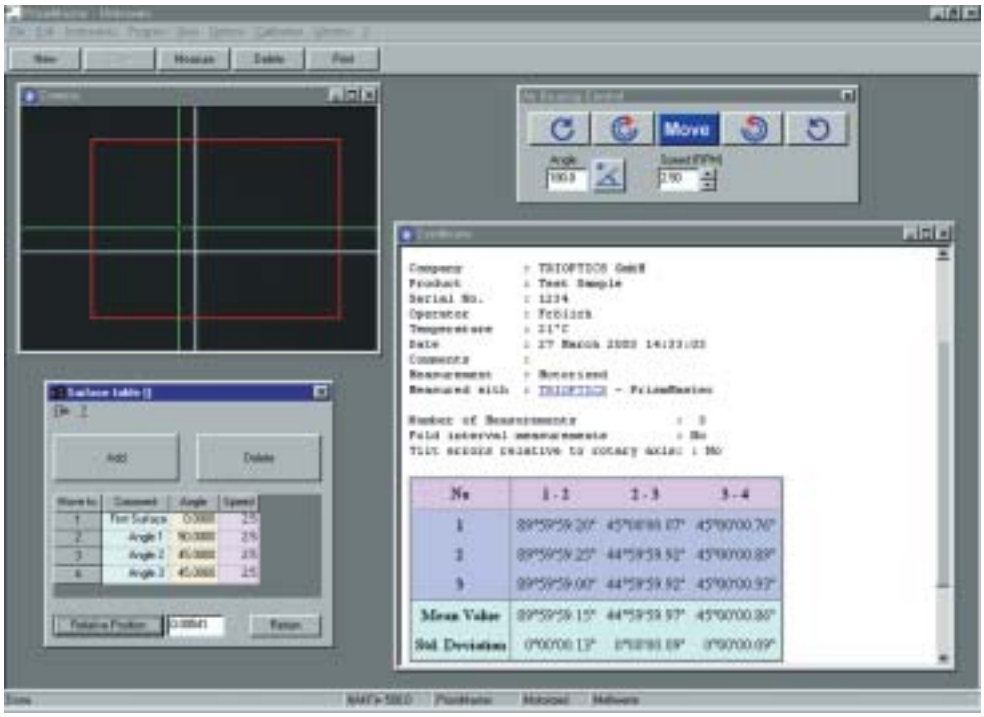
Software

The advanced software is designed to work under all Windows operating systems and fulfils the need of the optical shop for easy, intuitive operation. It offers a high level of speed and accuracy and provides consistent, reliable results.

The software powering the PrismMaster® is the heart of the system and integrates the TRIOPTICS long experience and efforts in ultra-accurate angle measurement. The multiple window design allows the operator to select the windows of interest, to place these on the monitor in the preferred position and to store the selection for further use.

The most comprehensive applications software related to prisms and polygon measurement includes modules for measur ment in reflection or transmission mode, for automated or manual measurement process, for measurement of pyramidal errors in different modes.

For the fully automated measurement of prisms and polygons, a set up table allows the operator to establish the measurement sequence, the number of angles to be measured and the speed of the measurement. The software lets the operator customize and automate the measurement process and save the process data for further use.



The operator handles most of the tasks with the easy to use interface. Many options can be activated in order to adapt the measuring procedure to the sample properties, so that even sample with anti-reflex coating, very small components or other difficult sample can be measured fast and reliable.

The Measurement Certificate provides data in different units (arcsec, µrad, degree-min-arcsec, etc) and statistical evaluation of the results.

OPERATION

Since the **PrismMaster®** is using a electronic, software controlled autocollimator no precise, difficult and time consuming alignment procedures are necessary. The tilt table is simply rotated until the autocollimator is approximately square to the first surface of the prism or polygon. A precise and difficult setting of the autocollimator perpendicularly to the prism surface is not more necessary. The operator is simply rotating the table until the reflected image of the autocollimator appears on the PC-monitor within a defined range area.

The same procedure is repeated to obtain a reading from the second surface of the prism. The tiresome and difficult visual alignment becomes obsolete.

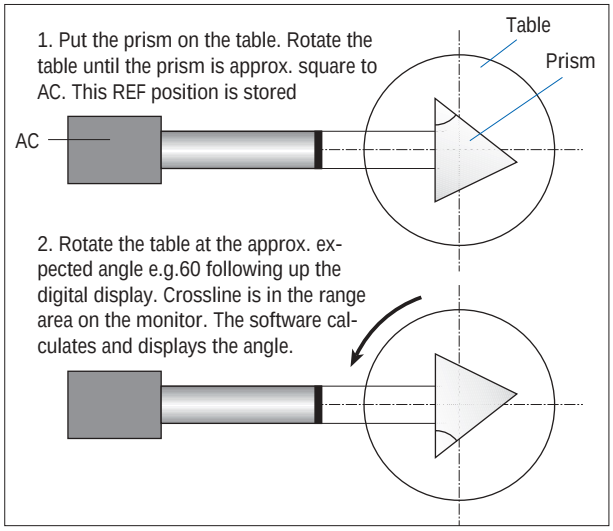
When the PrismMaster® is equipped with an automated rotary drive, the operator just gives the values of the expected (or design) values in the set up table. The PrismMaster® will automatically measure the required angle.

This is not only incomparably easier and comfortable for the operator, but very important for the overall accuracy of the instrument. In other goniometers the overall accuracy - even when using an accurate encoder - is decisively limited by the ability of the operator to visually and repeatedly align th autocollimator perfectly square to the sample surface. This ability is normally limited at +/- one cross line thickness. Tacking for example an autocollimator with focal length of 300 mm and a cross line thickness of 10µm, the angular error corresponding to 10µm is 3.5 arcsec. Certainly this error can be reduced

repeating the measurement several times and calculating the main value, however, this is inefficient and dependent on the ability and the degree of tiredness of the operator.

Measurement in reflection mode

The measurement starts using the mouse or pressing a PCkey. The position of the autocollimator reticle and of the rotary encoder is automatically recorded. Following up the angle indication on the digital display, the table is rotated until the reflected image on the second surface of the prism appears on the monitor within the range area. This range area is designated by a red coloured rectangle on the PCMonitor. A mouse click completes the measurement and the angle value is displayed on the monitor.



Measurement in Reflection Mode

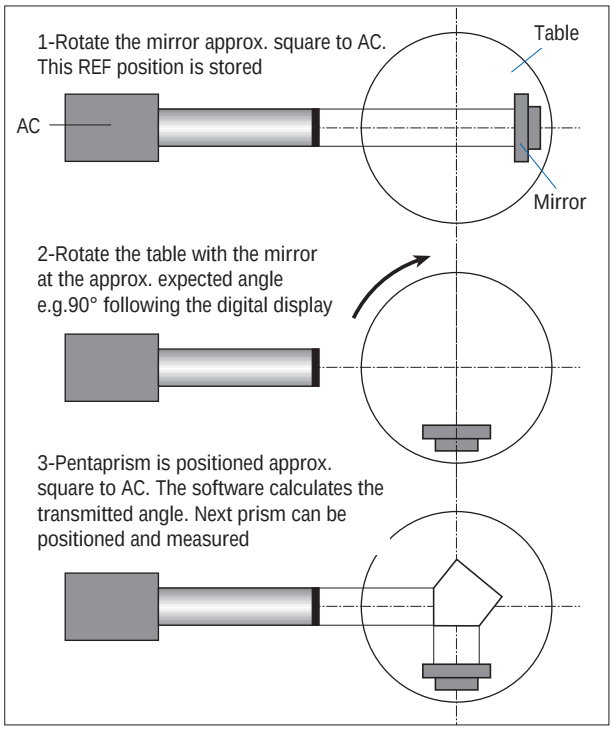
Measurement in transmission mode

For measurements in transmission mode the PrismMaster® uses a tilt able mirror (or a collimator) in conjunction with the computerised autocollimator. The mirror is attached to the rotation axis of the goniometer.

The mirror is rotated until the mirror is approximately square to the autocollimator i.e. the reflected image is seen on the monitor within the range area. This reference position is recorded.

The tilt table is rotated at the expected deflection angle following the angular indication of the digital display (for manual instruments) or using the automated rotation drive.

The sample is placed on a separate tilt and rotation table and positioned so that the reflected image goes through the prism and returns to the autocollimator. Since the beam is reflected by the mirror a double measurement sensitivity results.



Measurement in Transmission Mode

ADVANTAGES

- extremely quick and easy measurement procedure since the sample does not need to be perfectly square to the autocollimator axis
- significantly increased accuracy due to:
- the use of the computerised autocollimator instead of the visual autocollimator
- the use of the air bearing with a radial run out of 0.05µm which allows the encoder to deliver highest accuracy
- measurement accuracy is not dependent on the operator qualification or tiredness
- it enables the measurement of small or anti-reflex coated samples since the HR-CCD is able to process weak images
- double measurement sensitivity in transmission mode
- dramatically improved accuracy for pyramidal error due to the extremely small axial run out of the air bearing (0.05 µm)
- advanced software under WINDOWS® platform with full capabilities to store, export, print out the data and produce measurement

PrismMaster®-Absolute Line

BASIC INSTRUMENT	PrismMaster	PrismMaster HR	PrismMaster MOT	PrismMaster HR MOT
PrismMaster®-Absolute Line Automated Angle Measuring Station with Air Bearing Rotary Table	**5-100-00**	**5-100-01**	**5-101-00**	**5-101-01**
• Ultra-precision, high stiffness air bearing , radial and axial run out 0.05µm	•	•	•	•
• Air control unit incl. air filter, air drying unit, pressure control, complete air supply connections to air supply net or compressor. Required pressure 5-6 bar, 50 litre/min	•	•	•	•
• Angle Digital Display Unit with RS 232 com puter interface	•	•	•	•
• Rotary fine adjustment with micrometer screw	•	•		
• Automated, vibration free rotation drive			•	•
• Rotation drive controller unit			•	•
• Tilt table with two orthogonal tilt axes				
• Electronic Autocollimator, EFL 500mm, Aperture 50mm equipped with HR-CCD-Sensor, software controlled, Resolution 0.01arcsec., Repeatability: ±0.05 arcsec	•	•	•	•
• Adjustable Autocollimator-Stand	•	•	•	•
• Fiber optic illumination unit with fiber optic guide, including power supply . Illumination intensity continuously adjustable	•	•	•	•
• 32 bit-Frame Grabber	•	•	•	•
• Software package under WINDOWS® incl. sub-modules for prism, wedge and til measurement	•	•	•	•
• Granite Table or Breadboard	•	•	•	•

Ordering Information

BASIC INSTRUMENT	PrismMaster	PrismMaster HR	PrismMaster MOT	PrismMaster HR MOT
RESOLUTION AND ACCURACY				
• Rotary encoder resolution	0.36 arcsec	0.036arsec	0.36 arcsec	0.036 arcsec
• Rotary encoder absolute accuracy	0.5 arcsec	0.2 arcsec	0.5 arcsec	0.2arcsec
• Autocollimator resolution	0.01 arcsec	0.01 arcsec	0.01 arcsec	0.01 arcsec
• Autocollimator absolute accuracy	0.1 arcsec	0.1 arcsec	0.1 arcsec	0.1 arcsec
• Overall system accuracy				
° Single measurement	1 arcsec	0.5 arcsec	1 arcsec	0.5 arcsec
° Multiple measurement	0.5 arcsec	> 0.2 arcsec	0.5 arcsec	>0.2 arcsec
• Attachment for measurement of prisms in **transmission mode**. It includes adjustable two axes mirror, swivel holder with tilt and rotation table and software module	**5-200-15**			
• Attachment for measurement of **pyramidal errors.**It includes tube mounted deflection mirror and software module	**5-200-20**			
SPECIFICATION				
Instrument				
• Measuring range :	0-360°			
• Diameter of the tilt table	200mm			
• Measurement mode:	Reflection and Transmission Mode			
• Software runs under	Windows® Platform			
• Programms language:	Free selectable in German and English			
• System requirements:	Pentium IV with PCI bus, 128MB			
Air bearing				
• Air bearing axial run out	0.05µm			
• Air bearing radial run out	0.05µm			
• Diameter:	200mm			
• Air consum:	35 l/min			
Autocollimator:				
• EFL	500mm			
• Free aperture :	50mm			
• HR-CCD	1/3” or 1/2”			

PrismMaster®-Compact Line

BASIC INSTRUMENT	PrismMaster C-200	PrismMaster Compact	PrismMaster Compact MOT
	5-100-05	5-106-00	5-106-01
PrismMaster®-Compact Line Automated Angle Measuring Station with Mechanical Rotary Table			
• Stable large sample table diameter 200mm	•		
• Compact sample table diameter 150/100mm.		•	•
• Angle Digital Display Unit with RS 232 computer interface	•	•	•
• Rotary encoder accuracy class (0.5 arcsec)	•		
• Rotary encoder with accuracy 5 arcsec		•	•
• Rotary fine adjustment with micrometer screw	•	•	
• Automated, vibration free rotation drive			•
• Rotation drive controller unit			•
• Electronic Autocollimator, EFL 300mm, Aperture 50mm equipped with HR-CCD-Sensor, software controlled, Resolution 0.01arcsec., Repeatability: +/-0.2 arcsec	•		
• Electronic Autocollimator, EFL 150mm, Aperture 30mm equipped with HR-CCD-Sensor, software controlled, Resolution 0.01arcsec., Repeatability: +/-0.5 arcsec		•	•
• Adjustable Autocollimator-Stand	•	•	•
• Fiber optic illumination unit with fiber optic guide, including power supply . Illumination intensity continuously adjustable	•	•	•
• 32 bit-Frame Grabber	•	•	•
• Software package under WINDOWS® platform incl. submodules for prism, wedge and tilt measurement	•	•	•
• Granite Table or Breadboard	•	•	•
RESOLUTION AND ACCURACY			
• Rotary encoder resolution	0.36 arcsec	0.36arsec	0.36 arcsec
• Rotary encoder absolute accuracy	0.5 arcsec	5 arcsec	5 arcsec
• Autocollimator resolution	0.01 arcsec	0.1 arcsec	0.1 arcsec
• Autocollimator absolute accuracy	1 arcsec	1.7 arcsec	1.7 arcsec
• Overall system accuracy			
° Single measurement	1.5 arcsec	7.5 arcsec	7.5 arcsec
° Multiple measurement	0.6 arcsec	5 arcsec	5 arcsec

PrismMaster®-Compact Line

BASIC INSTRUMENT	PrismMaster C-200	PrismMaster Compact	PrismMaster Compact MOT
SPECIFICATION			
Instrument			
• Measuring range : 0-360°		0-360°	
• Diameter of the tilt table	200 mm	100/150 mm	100/150 mm
• Measurement mode:		Reflection and Transmission Mode	
• Software runs under		Windows® platform	
• Program language:		free selectable in German and English	
• System requirements:		Pentium IV, PCI bus , 128MB	
Precision Rotary Table			
• Axial run out:		less 3 µm	
Autocollimator:			
• EFL	300mm	150mm	150mm
• Free aperture : 50mm	50mm	30mm	30mm
• HR-CCD		1/3" or 1/2"	

PrismMaster®-Comparison Line

DESCRIPTION

The Comparison Goniometer is a precision angle measurement instrument primarilly used to measure prisms and other plano optical components in production environment. This instrument usually needs a reference prism with a known angle. The first reference measurement is done using the master prism. Further measurements are made relatively to the angle of th master prisms. The results are given as difference to the master prism or as absolute value of the measured angle. 90°-prisms angles can be measured absolutely without mthe need of a master prism.

The system includes an autocollimator mounted on stand with a swivel arm and a collimator in the ground plate. The autocollimator image is taken by a high resolution CCD-camera and further processed via frame t-vorne PA1801 grabber, PC and specific software. Measurements are made in reflection for outer prism angles and in transmission for internal deviation angles. The PC-controlled Comparison Goniometer features high accuracy and extremly short measurement time . A prism measurement takes just the time to press a key of the PC. Being accurate, extremly fast and nonexpensive, the Comparison Goniometer is perfectly suited for production environment and larger quantities of pieces.



Comparison Goniometer

SYSTEM COMPONENTS

STAND WITH SWIVEL ARM

The stand is equipped with a hand wheel for convenient and quick swivelling of the arm with the autocollimator holder. On the left side a locking lever allows for fixing the autocollimator in a position nearly square to the prism surface to be



Swivel arm with sample table

checked. A disk placed in the front of the swivel axis and divided in degrees helps finding the desired angular position.

A knob placed on the right upper side of the stand enables the accurate fine adjustment with arcsec sensitivity. A second lever is used to lock the arm with the autocollimator in a stable working position.

TILT AND ROTARY TABLE

The sample to be measured is placed on a combination tilt and rotary table with fine adjustment facilities. To accommodate di- ferent sample sizes this assembly can be adjusted in the height and locked in the working position. A device with interchangeable 3 ball supports of different sizes is firmly fixed on the table. The positioning of the samples on the 3 ball supports



Tilt and rotation table with height adjustment

ensures the necessary repeatability. This device has in addition a mount where a mirror could be firmly mounted for measurement in transmission (double pass) of parallel plates or wedges with small angles.

COLLIMATOR

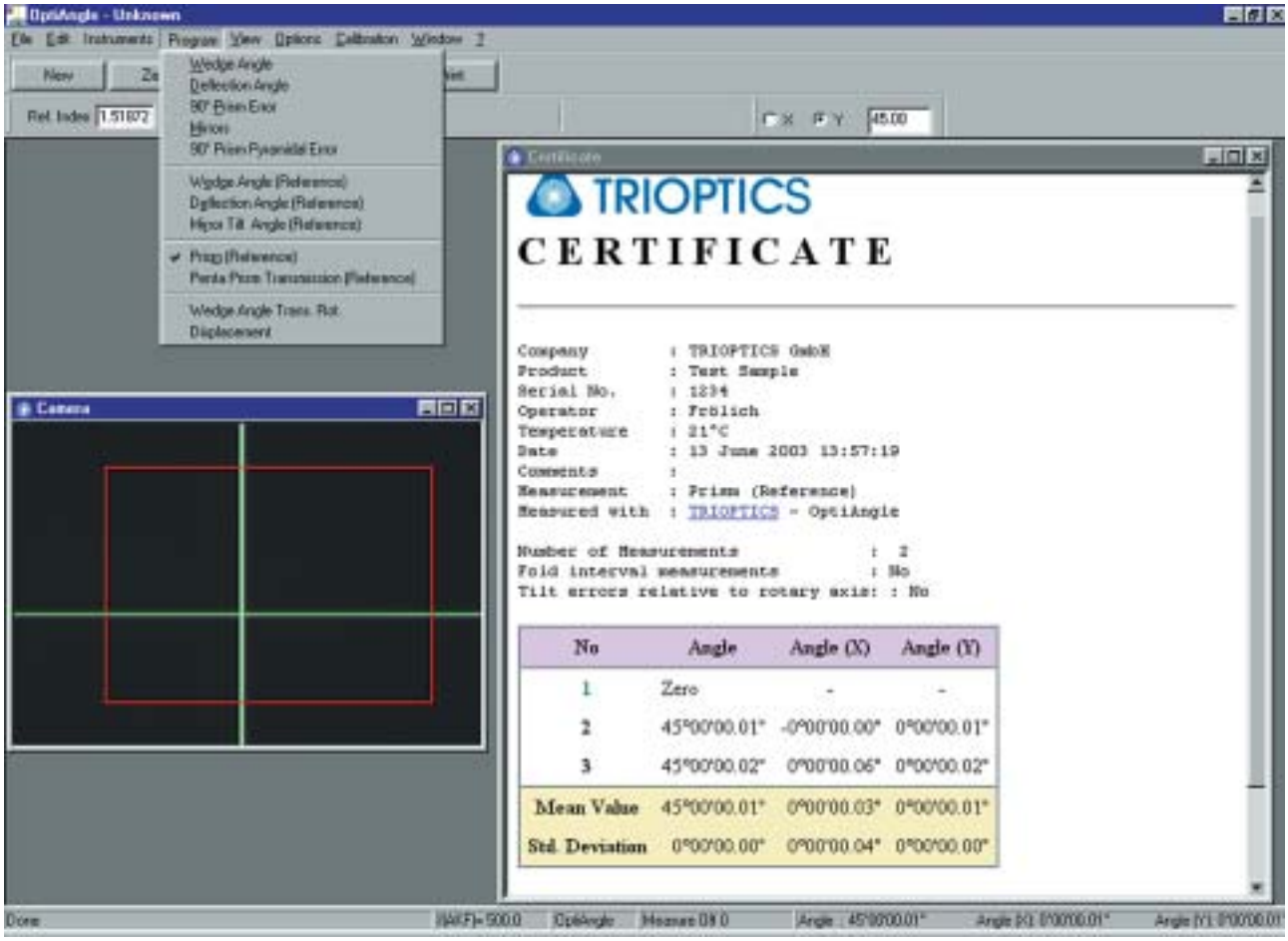
In the stand base is mounted a collimator with deflection mirror at 45° for measurement of internal angle deviation through prisms (e.g. pentaprisms).

The autocollimator and collimator are interchangeable so that the required focal length or aperture can be selected according to the requirements (accuracy, field of view, etc) of the measurement.

APPLICATIONS

The Comparison Goniometer can be used for angle measurements of any plano optics in production quantities with high speed and consistent accuracy:

- any prism angles
- wedge angle
- 90°-angle of prisms
- parallelism of plane plates
- deviation angle through wedges and prisms
- pentaprisms angle
- mirror tilt



ADVANCED SOFTWARE

The user-oriented software has been developed to really meet the requirements of an easy, quick and errorless measurement:

- the software package runs under Windows
- platform in German and English. The measurement results can be displayed in different units: arcsec, arcmin, µrad.
- real time monitor display of the autocollimator image
- it enables the measurement of small or antireflex coated samples
- it features automatic measurement sequence with free selectable parameters
- extremely fast measurement: 1 sec.
- high reproducibility of the measurement results irrespective of the operator's qualification
- measurement of high speed rotating
- it provides a statistic evaluation of the measurements including mean value and standard deviation.
- automatic calibration procedure by me ans of a calibrated sample. The calibration can be checked at customer site
- certificate of measurement can be stored or printed out
- storage, loading or export of files for further processing
- mirrors or disks

TRIOPTICS
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PrismMaster®-Comparison Line

SPECIFICATION

STAND

- Swivel range: 0°-90°left side,90°-45° right side
- Dimensions and weight: height: 600mm, stand base: 480x360mm weight: approx. 40 Kg.
- Tilt and rotation table: diameter 110mm, tilt ±2°, rotation 360°/±2.5°, sensitivity 5 arcsec



PrismMaster®-Comparison Line

INSTRUMENT

- Measuring Range: 0°-360°
- Master prism: required (except 90°angle)
- Standard equipment: Electronic Autocollimator, EFL 300mm, Aperture 50mm. Collimator EFL 150mm, Aperture 30mm
- Resolution: 0.01 arcsec
- Accuracy: +/-1 arcsec
- Measurement Mode: Reflection and Transmission

ORDERING INFORMATION

4-100-05	COMPARISON GONIOMETER, complete, incl. stand, elctronic autocollimator with high resolution CCD-Sensor, collimator in base, tilt and rotation table, software and frame grabber board, cold light fibre optics illumination.
4-300-51	Complete calibration device incl. calibration wedge, accuracy ±1 arcsec
3-300-110	Support base (to be mounted on table)
3-300-111	3 ball support D 10mm
3-300-113	3 ball support D 25mm
3-300-115	3 ball support D 50mm
3-300-117	3 ball support D 75mm

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