Point Autofocus Probe

(ISO 25178-605)

POINT AUTOFOCUS PROBE
SURFACE TEXTURE MEASURING INSTRUMENT
PF-60

Faster

Easier

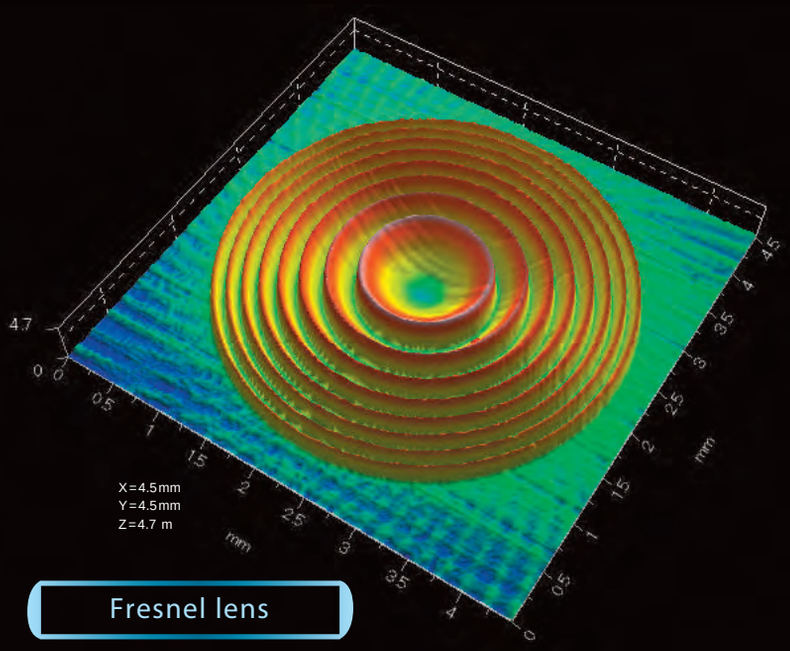
More precise

Mitaka

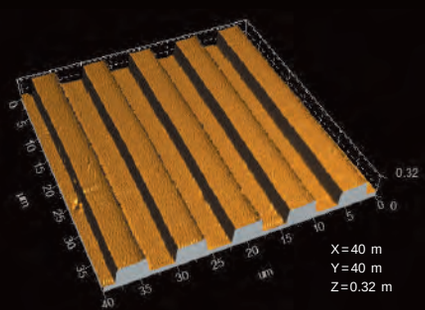
Measure large areas quickly

Large measuring area / high precision measurement

The laser probe with a radius of 0.5μm and the precision XY stage directly measure an area of several tens of millimeters down to the sub-micrometer level (measuring range: XYZ=60mm X 60mm X 10mm, scale resolution: XY=0.1μm, Z=0.01μm)



Fresnel lens

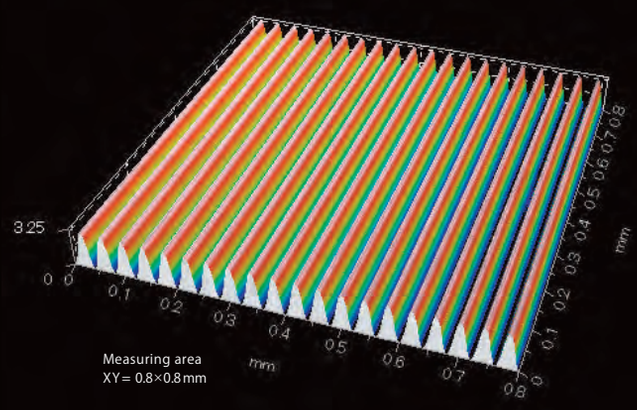


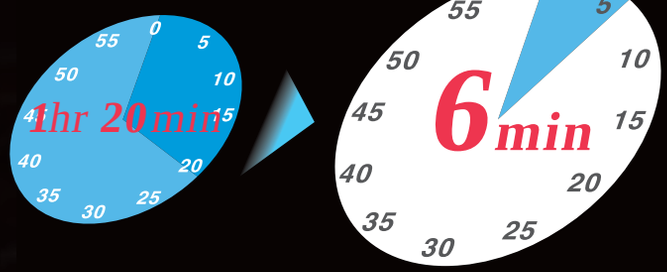
Grating

Fast 3D measurement

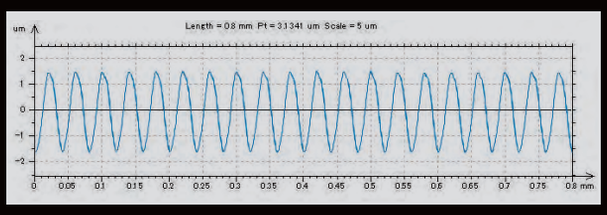
1hour 20 minutes (conventional instruments) ▶ ***6 minutes per 128000 points***

Fast scanning autofocus (AF) function provides large measuring area and high precision measurement





Sinusoidal roughness
NIST certified SRM2074 calibration standard

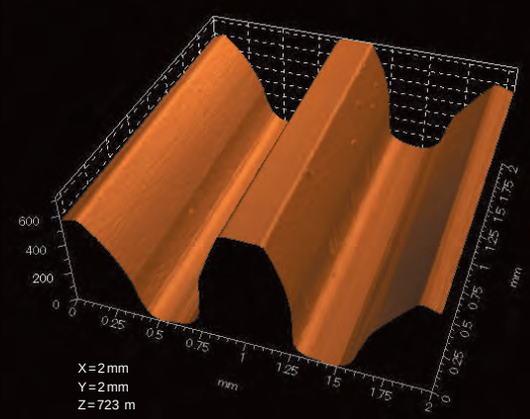


2D measurement: measuring time is only 15 sec. / 8000 points

Higher precision / easier operation

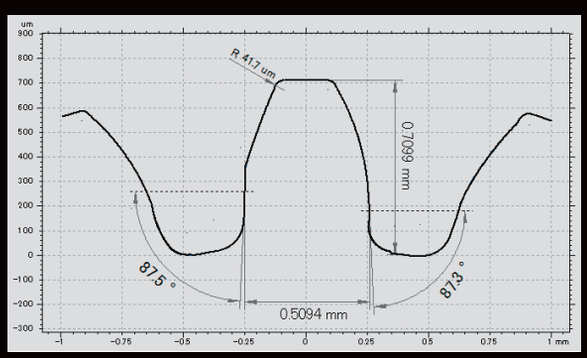
Excellent angle tracking capability

The highly sensitive autofocus sensor captures low levels of light reflected from the surface of the sample and directly measures steep angles and step heights.



Small diameter gear
(module: 0.3)

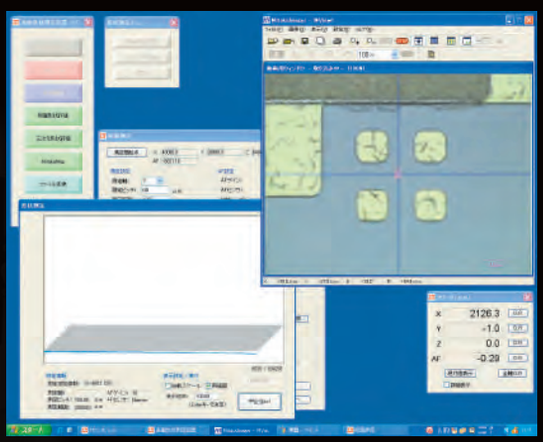
Maximum measurable angle : 87 degrees



Measure visually!

High precision measurement with easy operations

The objective changer (with a slide mechanism) switches between a low power objective for observation and a high power objective for measurement in a single step operation



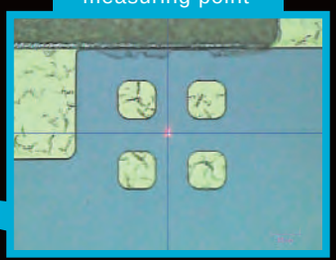
Monitor the sample while measuring

Wide- eld observation

5X objective

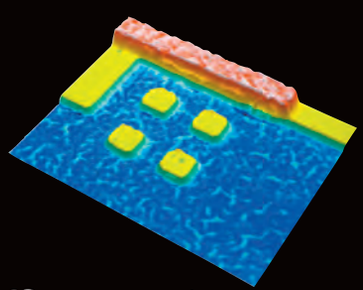
- eld of view (3.2×2.4mm)
- sample microencoder

Positioning of the measuring point



100X objective

- eld of view (0.16×0.12 mm)
- measuring spot alignment mark

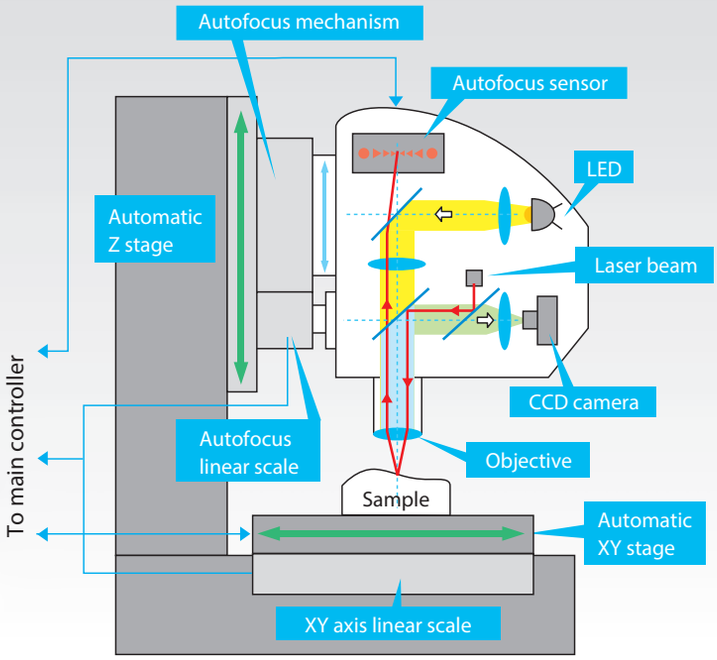


3D measurement

- measuring area: XY = 160×120
- measuring pitch: X = 1 m, Y=1 m

ISO approved Mitaka measuring method

We proposed our measuring principle to the International Standards Organization (ISO) as a non-contact measuring method. Our principle has been included in ISO 25178-6:2010 - Classi cation of methods for areal surface texture - under the name “Point Autofocus Pro ling” (ISO 25178-605: Point autofocus probe).



Measuring principle

Overview

The PF-60 consists of an autofocus laser beam microscope (AF microscope) and a high precision XY scanning stage. The AF microscope measures height in the Z axis and the XY stage moves the sample in order to obtain XYZ coordinate values for 2D and 3D measurements.

Scanning XY stage

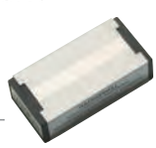
The PF-60 drives the high-precision XY stage to obtain the coordinate values in its full range of movement (60mm x 60mm). There is no need to stitch measured data since the PF-60 has no measuring limits (such as a restricted field of view) and hence provides high precision measurement of a large area.

Point autofocus probe

The laser beam incorporated in the AF microscope passes through the objective (indicated by the red line in the above diagram) and forms a laser spot on the surface of the sample as a “probe” with a radius of 0.5µm.
The reflected laser beam from the sample surface passes through the objective again and forms an image on the autofocus sensor (AF sensor). The AF sensor detects the laser spot displacement in real time and adjusts the AF microscope back to the in-focus position (the laser spot forms its image at the center of the AF sensor).

High correlation with the international standards for roughness measurement

Point autofocus profiling (PAP) has a high correlation with roughness standard materials for stylus instruments and obtains reliable data.



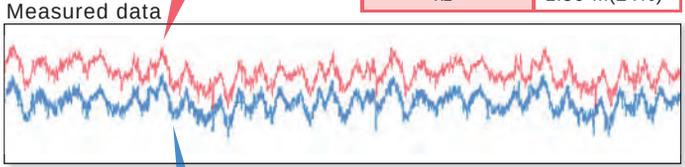
- Roughness standard TypeD1 (ISO5436-1)
- Calibration PTB (Germany)
- Measurement methodstylus
- Tip radius 5 m
- Measured length (ln)4mm
- Cuto value(c): 0.8mm

(Stylus tip radius R=5 m)

PTB inspection result

Roughness parameters	PTB
Ra	0.227 m(±3%)
Rz	1.50 m(±4%)

Measured data



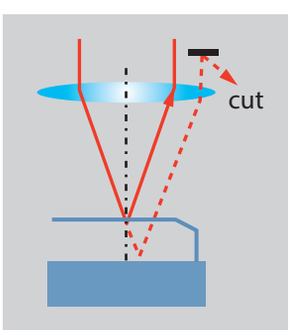
PF-60 measurement

(PAP laser spot radius R=0.5 m)

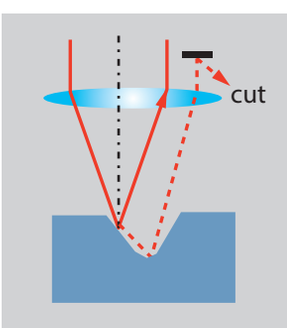
Roughness parameters	PF-60
Ra	0.228 m
Rz	1.56 m

Autofocus optical sytem cuts ghost and stray light

The autofocus optical system cuts out unnecessary light to achieve targetted measurement.



Transmissive surface

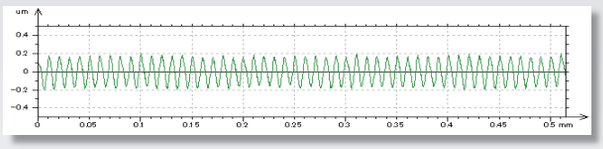


Secondary re ection of a Vee-groove

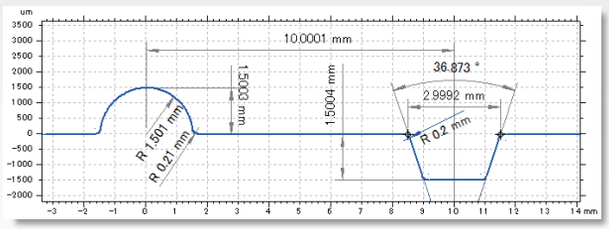
Surface texture measuring functions

2D roughness & contour

Ra = 0.104 Sm = 10(m) Roughness standard(Rubert)
Measured data Ra=0.101, Sm=10(m)
Scanning speed 300 m/S

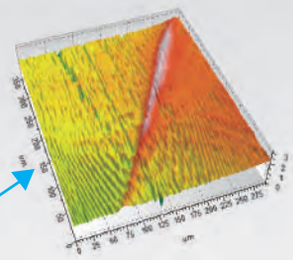


Measuring result for the contour standard

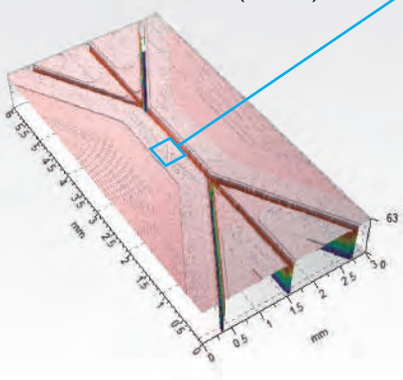


Surface topography & areal roughness

Areal roughness of the sealed part



Medical microchannel(silicon)

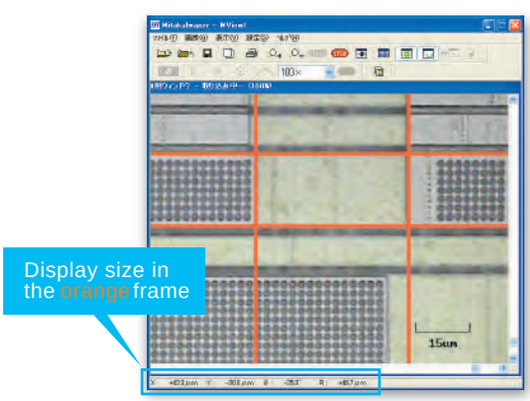


ISO 25178		
Height Parameters		
Sz	3.2665	m
Sa	0.2167	m
Sq	0.2779	m
Ssk	0.6995	
Sku	5.6783	

Various auxiliary functions

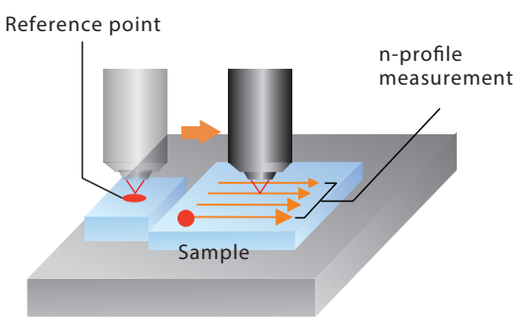
Image capture

The image capture function displays the scale and saves images within the measuring software environment. It facilitates positioning over the measuring area, makes it possible to observe the sample surface during measurement, and provides size measurement within the field of view.



Temperature correction software

This software ensures that, even when the PF-60 is installed in a non-temperature-controlled room, it maintains measuring accuracy at the sub-micrometer level.



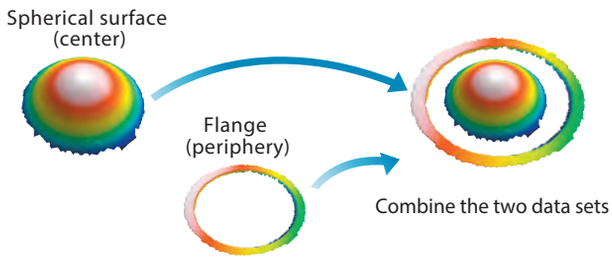
Mask measurement

Mask measurement provides three types of 3D measurement: inner circle measurement, outer circle measurement and doughnut measurement.
This function reduces total measuring and assessment time by selecting a restricted measuring area.

Inner circle Outer circle Doughnut

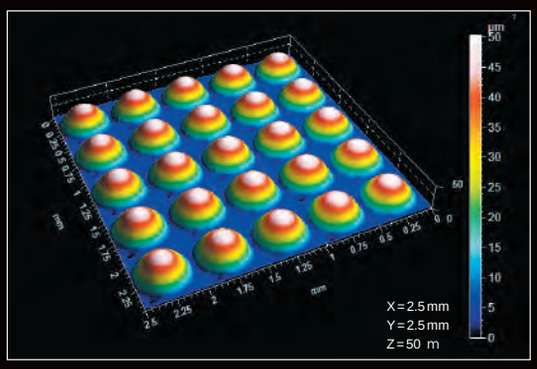
Patching

Patching increases vertical range virtually by combining sets of 3D data that are measured at different heights with respect to the same XY stage coordinate system.

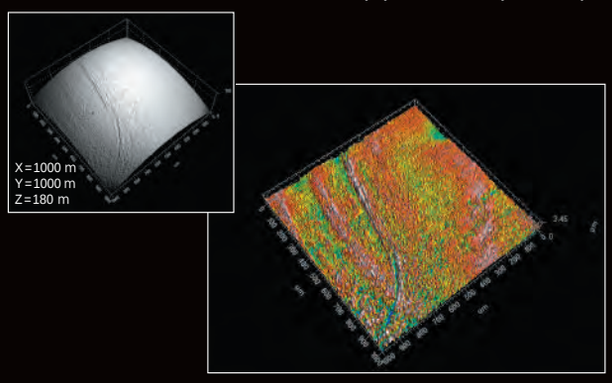


Surface Texture Measurement comes in 3D

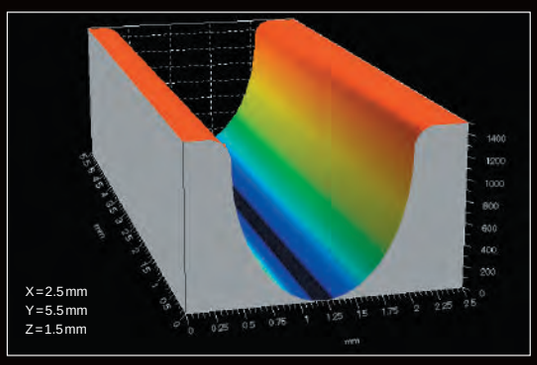
Microlens arrays (optical component)



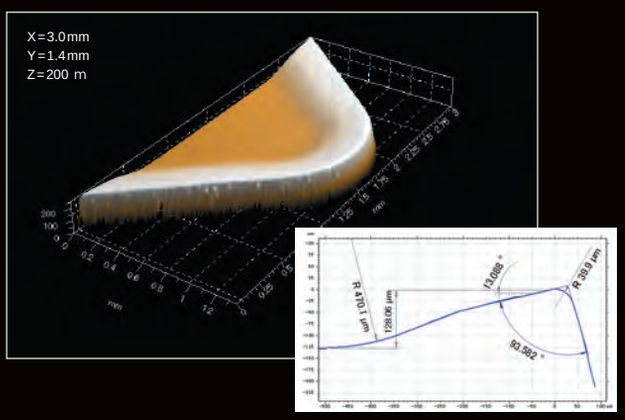
Surface defect of a LED lens (optical component)



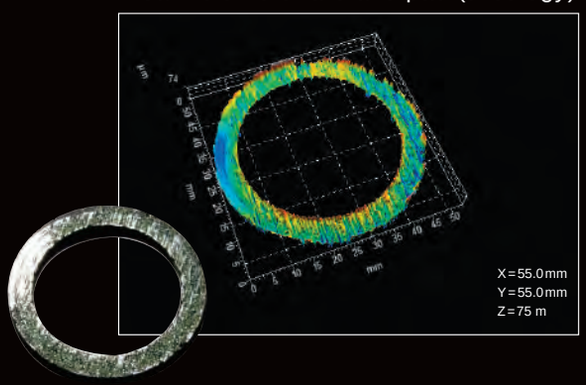
Precision molding die



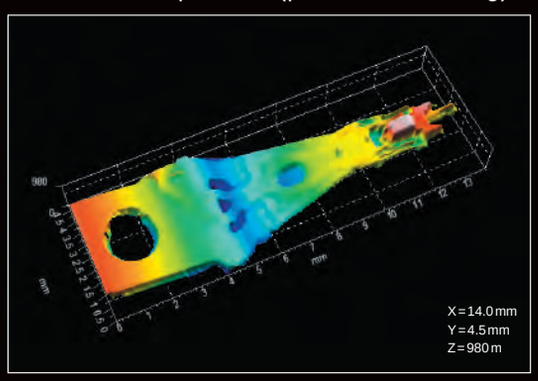
Tip of a turning tool



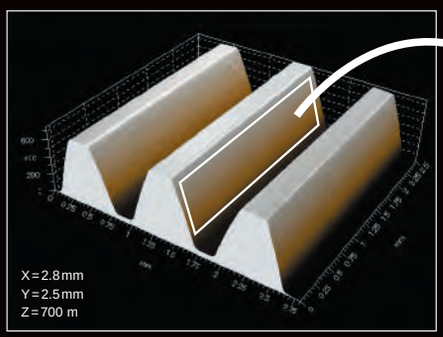
Wear volume of a brake pad (tribology)



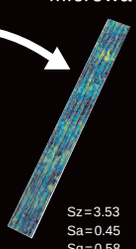
HDD head suspension (precision blanking)



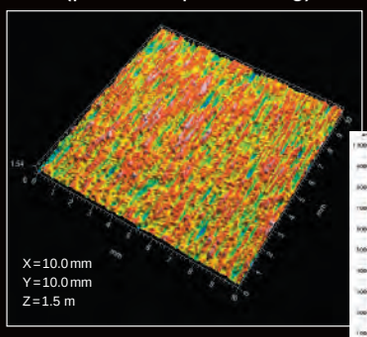
Tooth ank roughness of a precision gear (precision processing)



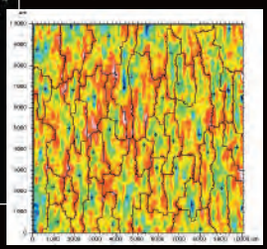
Microwaves



Grinding work surface (precision processing)

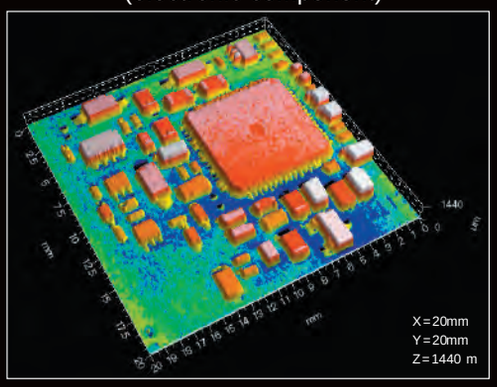


Lubricant oil analysis by motifs analysis function

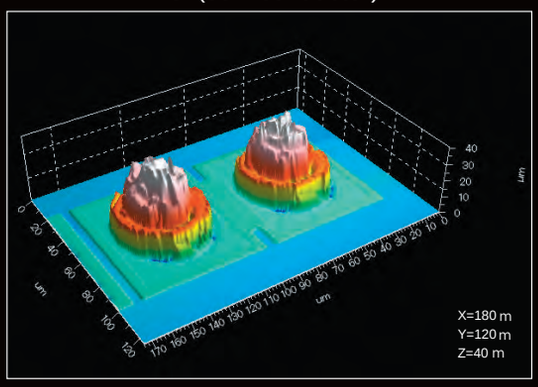


Perfect solution for measuring all kinds of surface topography

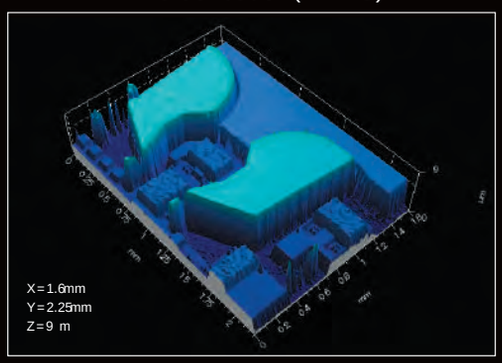
High-density mounting board
(electronic component)



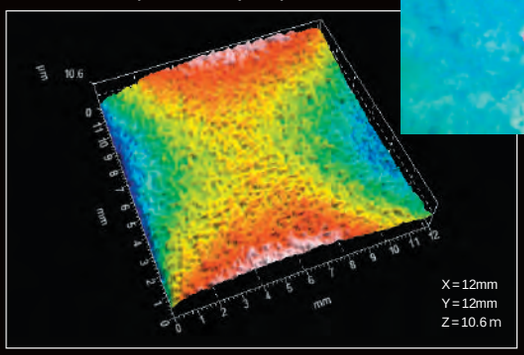
BGA(semiconductor)



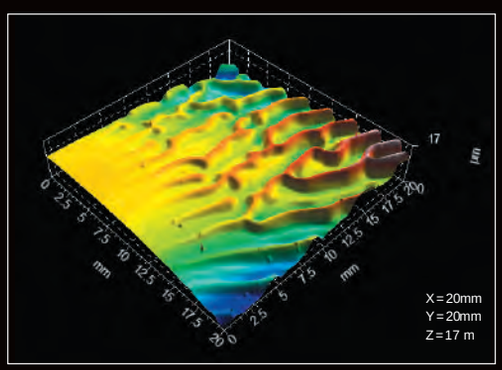
Microencoder (MEMS)



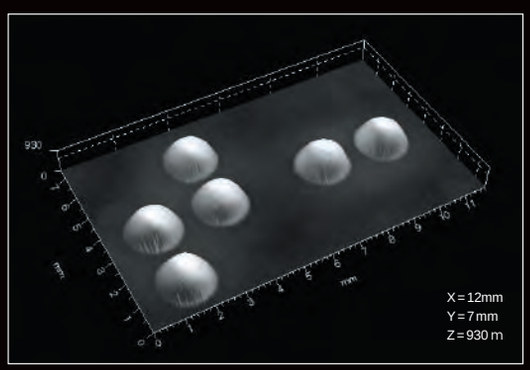
Flatness of a ceramic substrate
(sintered part)



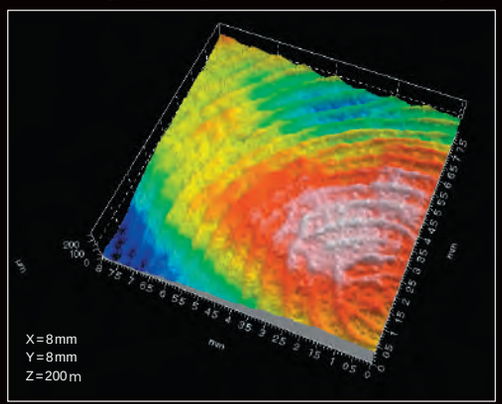
Flow marks (ow lines) of a molding



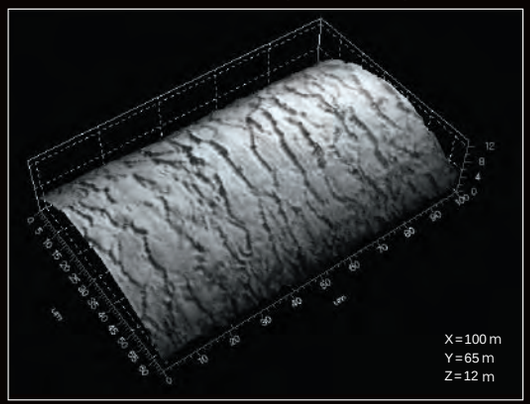
Braille (welfare)



Fingerprint (medical & cosmetics)



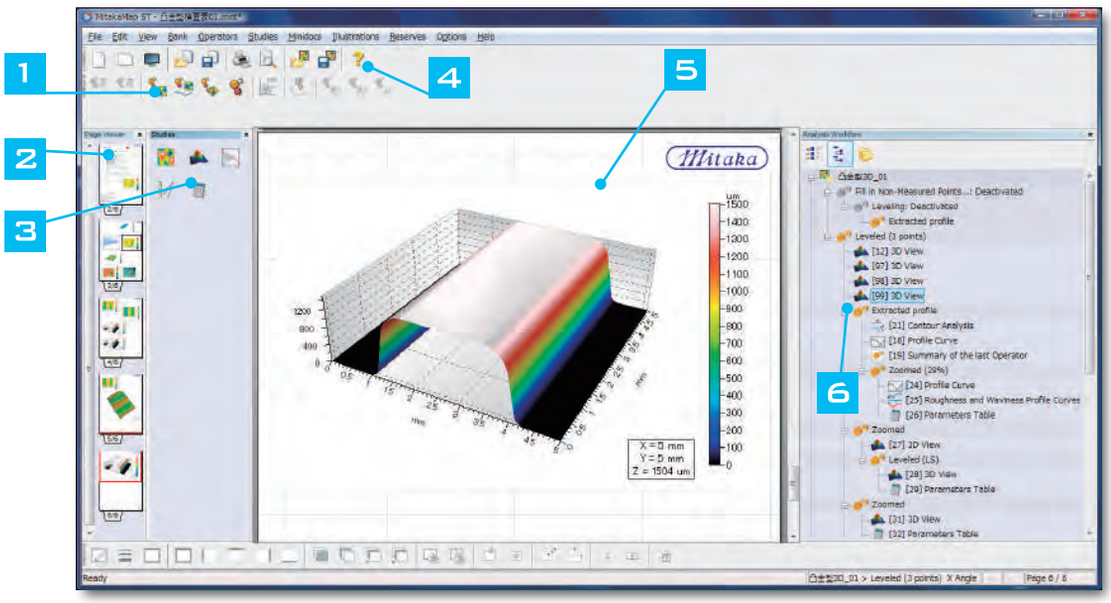
Human hair (cosmetics)



3D Surface Texture Analysis Software

MitakaMap ST

Interactive and user-friendly software complete with powerful online help. Advanced analysis is carried out by applying straightforward operations to measurement data.



1 **Minidocs**
Automatic analysis by insertion of pre-defined sequences of analysis steps

2 **Page viewer**
Fast navigation to every page in the analysis report

3 **Studies**
Icons for analytical studies applicable to the selected data set

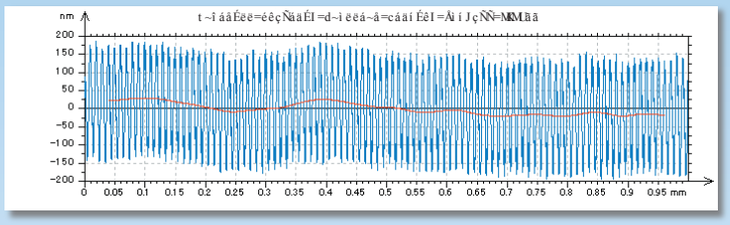
4 **Online help**
Detailed descriptions of all studies and operators

5 **Document page**
Current page in the analysis report

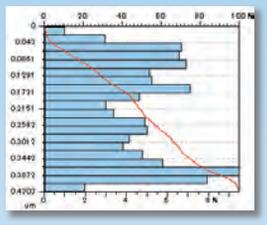
6 **Analysis workflow**
Tree view of all analysis steps in the report

2D surface texture analysis

■ Primary profile (P-parameter) ■ Roughness (R-parameter) ■ Waviness (W-parameter)



Abbott-Firestone curve



Result: Roughness: Ra=0.102, Rz=0.331, Rsm=10.0 (μm) Waviness: Wz=0.041 (μm)

Standard parameter

(ISO 4278/JIS B 0601, ASME B46.1)

- Height (peak and valley): Rz, Ra, Rp, Rv, Rc, Rq, Rsk, Rsq
- Spacing: Rsm, Rdq
- Material ratio: Rmr, Rdc
- Peak: Rpc

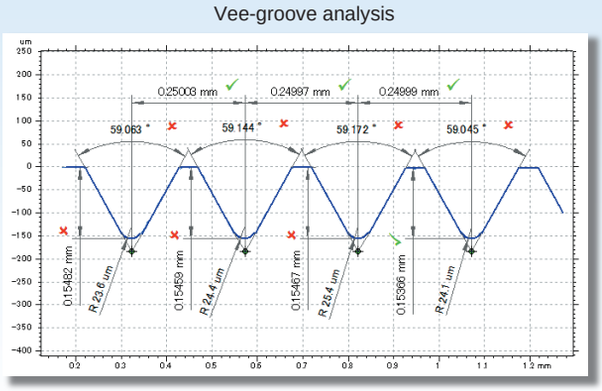
Extensive filter types ■ Gaussian Iter ■ Double Gaussian Iter ■ Spline Iter ■ Robust Gaussian Iter ■ 2RC-ISO ■ 2RC-PC

Profile analysis

Contour analysis

Automatic calculation of width, height, curvature and distance.
The tolerance limit function is a perfect solution for quality control of precision parts.

Vee-groove analysis



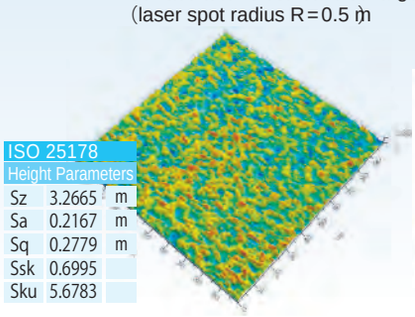
Areal surface texture analysis

Parameters defined in ISO 25178 are pre-installed.

Standard parameters

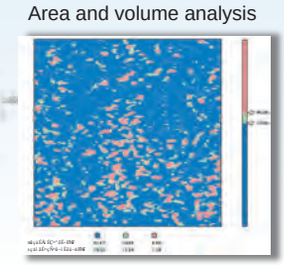
■ Height: Sz, Sa, Sp, SV, Sq, Ssk, Sku, ISO 4278-2, ASME B46.1, EUR15178N
■ Flatness: FLTt, FLTp, FLTv, FLTq (ISO 12781)

Surface after electrical discharge machining
(laser spot radius R = 0.5 mm)



ISO 25178		
Height Parameters		
Sz	3.2665	m
Sa	0.2167	m
Sq	0.2779	m
Ssk	0.6995	
Sku	5.6783	

Area and volume analysis

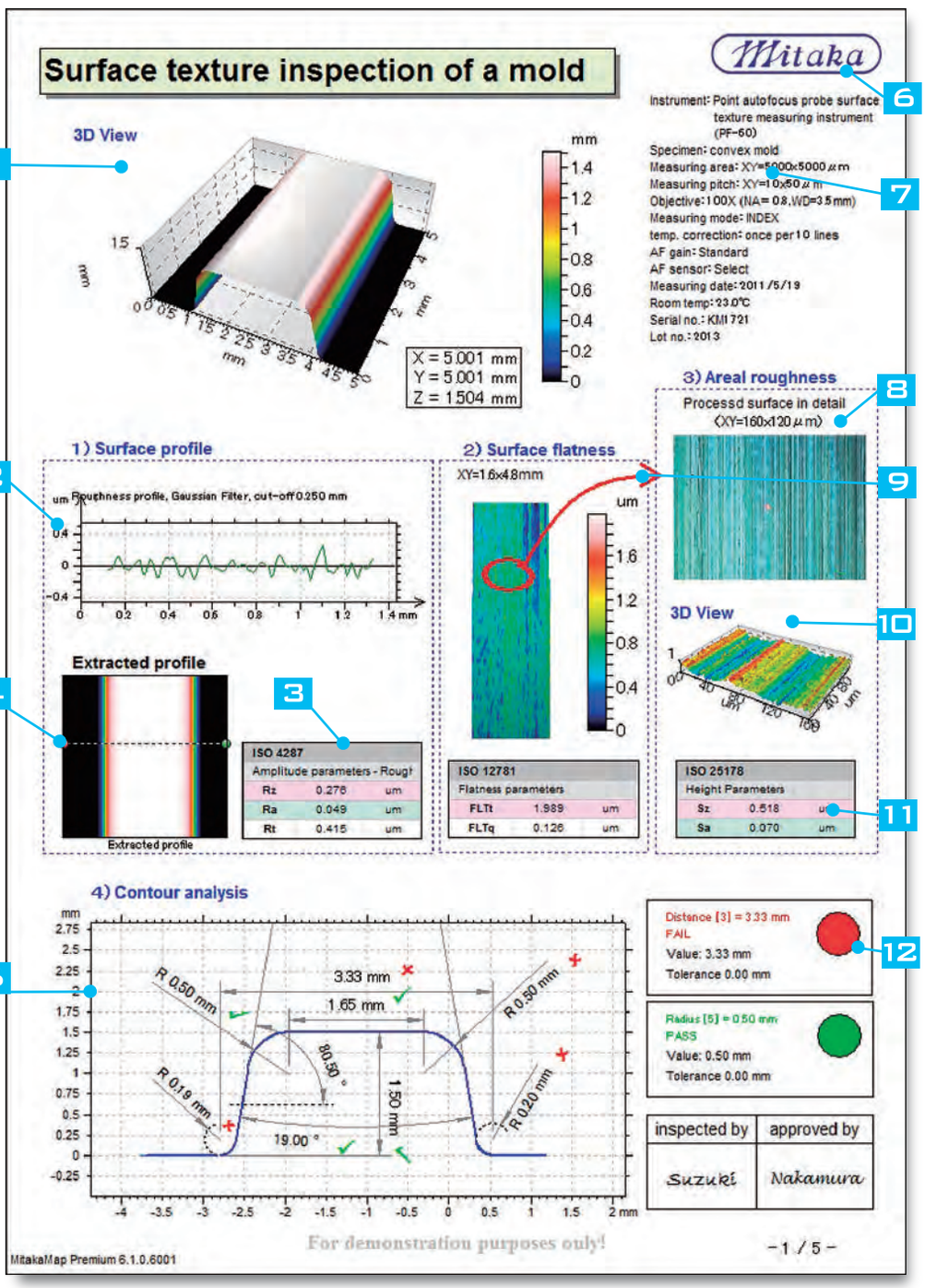


MitakaMap ST Automatic Analysis Tools

Surface metrology reports include comprehensive analysis results

Inspection report creation

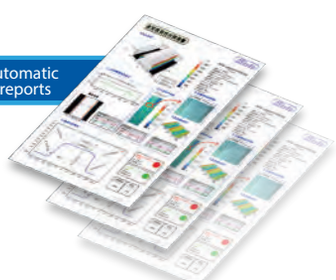
Reports containing analytical studies are created frame by frame in an intuitive desktop publishing environment.
Headers, company logos, etc. on a master page are repeated on all pages of a report.



1. Measured result(1)
The best visualization of data after leveling, removing noise, etc.
2. Part of the roughness pro le after ltering of a primary pro le extracted from the surface
3. Calculation of required parameters (selected from a family of parameters)
4. Selection of the pro le for analysis (by dragging the black dotted line)
5. Contour analysis of the extracted primary pro le.
Automatic PASS/FAIL function is available with pre-de ned tolerance limits.
6. Insertion of company logo
7. Identity card with information about the measurement
8. Microscope image of the workpiece pasted into the document
9. Framed borders for emphasis
10. Measured result (2)
3D View of surface texture
11. Colored cells for emphasis
12. PASS/FAIL test results

Batch processing of data

Creating automatic inspection reports



Prepare an inspection report on a single data set and use it as a template for analyzing all similar data sets.

Supporting 10 languages

MitakaMap supports 10 languages, facilitating global cooperation.

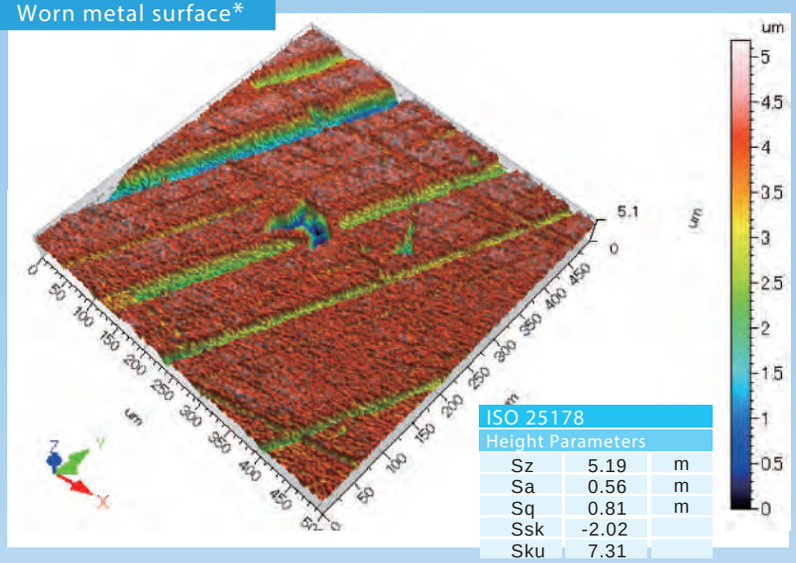
[Supported languages]

- Japanese
- English
- French
- German
- Italian
- Chinese
- Korean
- Spanish
- Polish
- Brazilian Portuguese

MitakaMap XT Expert

MitakaMap XT is available as an upgrade to MitakaMap ST (standard software) and contains parameters required for R&D and specialized applications. It also provides extended quantitative analysis of surface texture.

Worn metal surface*



ISO 25178 Height Parameters		
Sz	5.19	m
Sa	0.56	m
Sq	0.81	m
Ssk	-2.02	
Sku	7.31	

Additional functions

2D advanced surface texture analysis

- ISO, JIS and other 2D parameters (ten point height of the roughness pro le (RzJIS ,etc.)
- Frequency spectrum (FFT) analysis
- Fractal analysis
- Morphological lter ing

2D automotive analysis

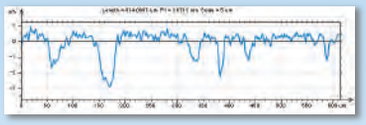
- R&W motifs analysis (ISO 12085)
- Graphical study of Rk parameters (ISO 13565)
- Rk pro le

3D advanced surface texture analysis

- Additional 3D parameters de ned in ISO 25178 (spatial, hybrid, and functional volume)
- Graphical study of Sk parameters
- Graphical study of volume parameters
- Peak distribution
- Frequency spectrum (FFT) analysis
- Averaged power spectrum density
- Fractal analysis
- Measurement of a wrinkle
- Vectorization of the micro-valleys network
- Texture direction, isotropy

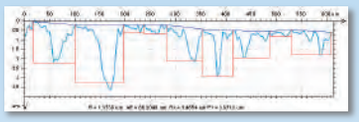
Primary pro le at right angle to the groove*

Flat surface with deep aws



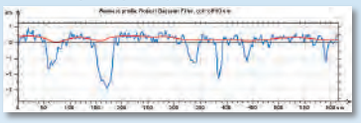
Motifs analysis JIS B0631 (ISO 12085)

Analyzing curves between peaks



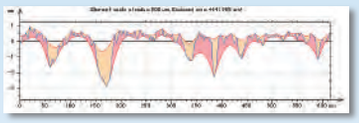
Robust Gaussian lter*

Impervious to scratches and steep asperity



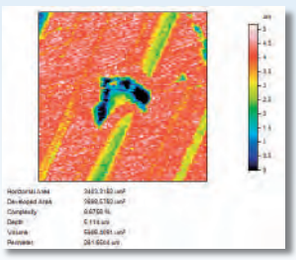
Morphological lter JIS B0610

Waviness extracted by morphological dilation



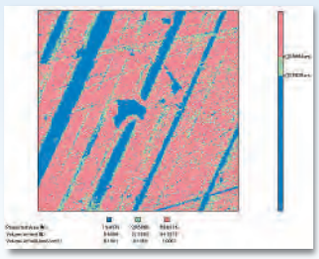
Measurement of a wrinkle

Individual analysis of surface scratches and wrinkles



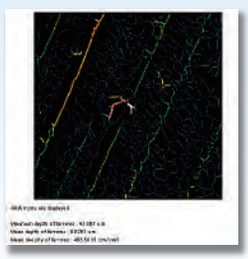
Section (standard speci cation)

Dividing the measured area by height & calculating area and volume



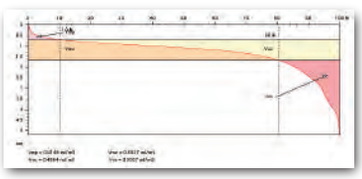
Vectorization of the micro-valleys network

Calculating the depth and position of every furrow to analyze the depth distribution and the mean density of the furrows



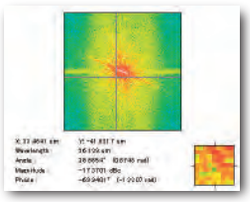
Graphical study of volume parameter

Visualizing proportions of peaks, valleys and cores / kernels



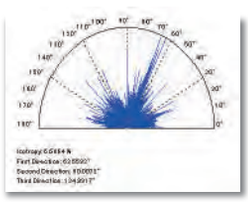
Frequency spectrum

FFT analysis of a surface



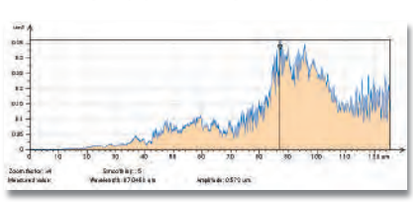
Texture direction

Direction of scratches and furrows



Averaged power spectrum density

Studying the relationship between wavelength (X) and roughness (Y)

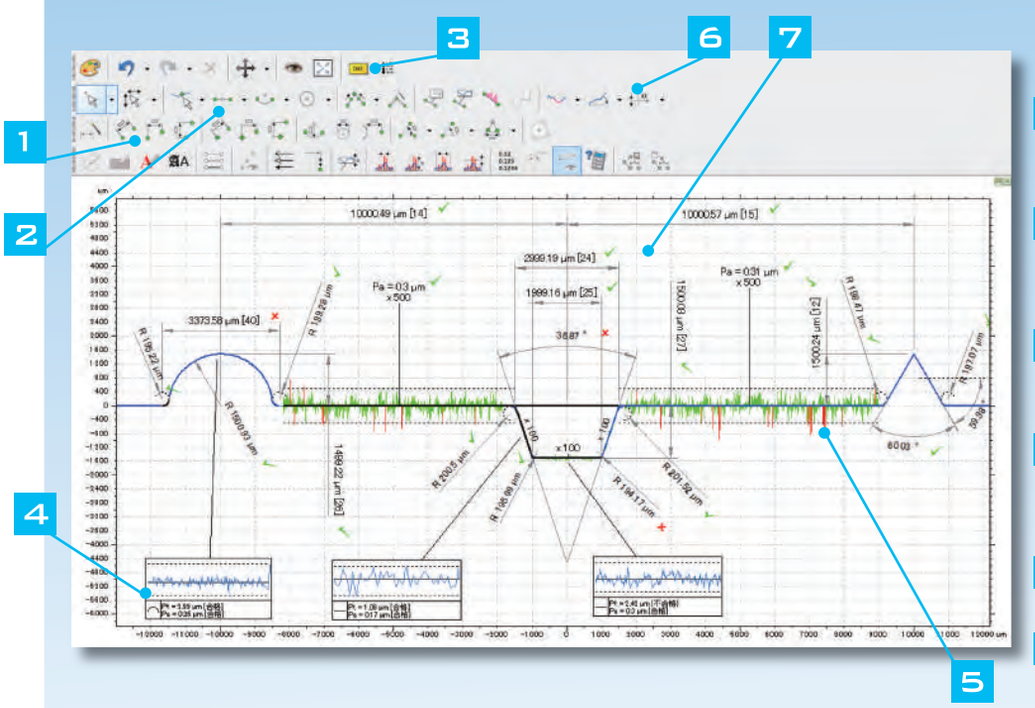


*also available in ST

Advanced Contour Module

Additional operators and studies for Contour Analysis (standard) and Advanced Contour Analysis (optional module) provide powerful dimensional and form deviation analysis

Example of form deviation analysis



1 **Analysis tools**
Tools for width, distance, height, radius, diameter, angle of intersection, horizontal angle, angle of an arc, etc.

2 **Creating segments**
Associating segments (lines and arcs) with a measured pro le for dimensional analysis

3 **DXF input**
Loading CAD data (DXF) in order to compare the measured pro le with design speci cations

4 **Residue tool**
Graphical study of form deviations of straight lines and arcs(Pz,Pa,Pq, etc.,

5 **Deviation tool**
Viewing magni ed form deviation graphics and highlighting out of tolerance data points in red

6 **Coordinate conversion tools**
Changing leveling position and the origin

7 **Analysis window**
Analysis space for scaling a pro le, positioning dimension lines and numeric results

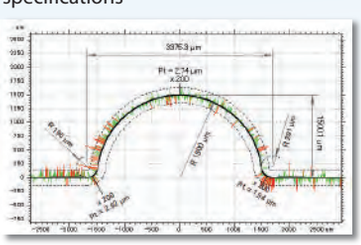
Batch processing of data

Tabulating the analysis results and automatically displaying deviations from pre-defined tolerances

Parameter	Value	Lower limit	Upper limit	Pass or Fail
Radius [2]	1500.89 um	1498 um	1502 um	Pass
Radius [3]	199.28 um	195 um	205 um	Pass
Radius [4]	200.5 um	195 um	205 um	Pass
Radius [5]	198.99 um	195 um	205 um	Pass
Radius [6]	194.17 um	195 um	205 um	Fail
Radius [7]	201.52 um	195 um	205 um	Pass
Radius [8]	198.47 um	195 um	205 um	Pass
Radius [9]	197.07 um	195 um	205 um	Pass
Distance [12]	1500.24 um	1498 um	1501 um	Pass
Distance [14]	10000.49 um	9999 um	10001 um	Pass

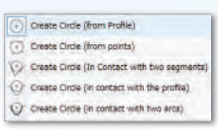
CAD data comparison

Loading CAD data in order to compare measured profiles with design specifications

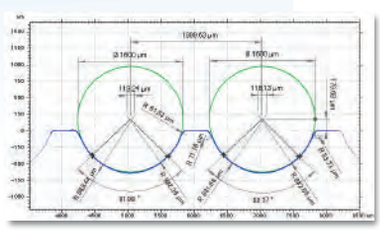


Dimensional analysis of osculating circle

Analyzing contact points and center coordinates with respect to virtual circles

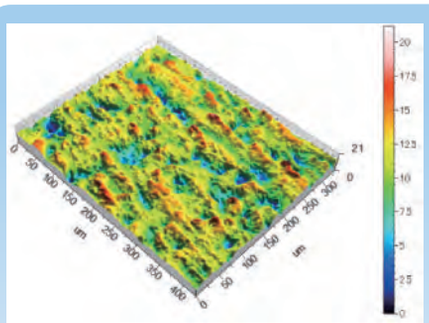


Circle creation menu



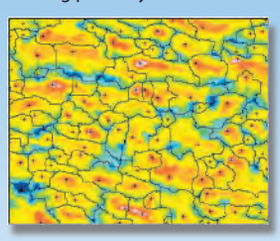
Motifs Analysis

Dividing surface asperity into ridge and course lines in order to extract local peaks and pits for detailed surface observations



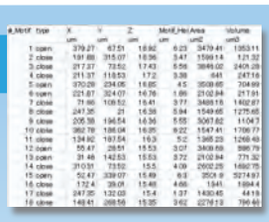
Visualization of motifs

Dividing peaks by course lines



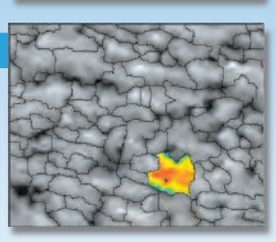
Batch output of analysis result

Numbering all motifs and exporting the full set of numerical results to a text file



Individual analysis

Visualizing an individual motif and generating its specific parameters



[Motif Parameters (Typical parameters)]

- Number of motifs
- Type of Motif
- Height
- Area
- Volume
- Extremum of XYZ
- Nb of neighbors
- Pitch (max/min/mean)
- Co atness
- Perimeter
- Mean diameter (max/min/mean)
- Form factor
- Aspect ratio
- Roundness
- Compactness
- Orientation
- Sphere radius

Height: 2.02 m
Area: 0.004m²
Volume: 867.8 m³

Point Autofocus Probe Surface Texture Measuring Instrument PF-60

Specification

Mechanical Section				
Axes	X axis	Y axis	AF (Z1) axis (for measurement)	Z2 axis (for positioning)
Measuring range	60mm	60mm	10mm	60mm
Positioning resolution	0.1 μm	0.1 μm	0.01 μm	0.1 μm
Scale	Glass Scale	Glass Scale	Glass Scale	Pulse
Accuracy (L=length in mm)	(2+4L/1000)μm	(2+4L/1000) μm	(0.3+0.5L/10) μm	—
Autofocus optical system	Repeatability	σ =0.03 μm (at mirror (specimen) surface)		
	Focus area	φ 1 μm (with 100X objective)		
	Laser	Semiconductor laser (o/p: 1mW Max λ: 635nm class 2)		
	Objective for measurement	100X (WD=3.4mm NA=0.8) obervation mag：approx.1100X (9-in monitor)		
	Objective for positioning	5X (slide mechanism) [field of view]		
	Epi-illumination	Köhler illumination (light source: white LED)		
Other	Dimensions of XY stage	210×210mm		
	Max sample size	70mm (up to 100mm in height with AF unit)		
	Max sample weight	4kg		
	Instrument size (WxDxH)	Mechanical section: 400 × 400 × 450mm		
	Vibration isolator	3 point supporting pad (proper oscillation lateral: 3.5 vertical: 4Hz)		
	Instrument weight	31kg		

Controller	
User interface	Personal computer (OS: Windows)
Drive control	4-axial controller (MSCN-4N)
Power consumption (total)	250W (100V2.5A)

Software

○ 2D/3D surface texture measuring software

■ Profile

■ Areal
(index/ scanning mode)

○ 3D surface texture analysis software (MitakaMap ST)

■ Profile surface analysis texture analysis (ISO 4287)
roughness / waviness / primary profile
height, width, peak, material ratio parameters

■ Areal surface texture analysis (ISO 25178)
Areal height parameters

■ 3D view ■ Animation view
■ Form removal ■ Contour analysis
■ Morphological filters ■ Abbott Curve
■ Distance, Step-height analysis
■ Volume of holes and peaks
■ Minidocs ■ Illustrations
■ 10 languages supported

○ Image Capture (Mitaka Veiwer)

■ reticle/scale display ■ saving images

○ Data export

■ Excel-compatible ASCII text files

Optional software

○ Advanced Contour Module

○Motifs Analysis ○Statistics

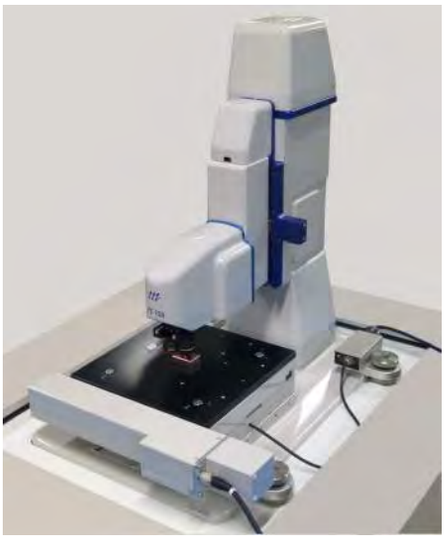
○Upgrade to MitakaMap XT

Other options

○50X objective (WD=10.6mm NA=0.5)

○High NA100 X objective
(WD=0.35mm NA=0.95)

Mitaka Kohki provides a range of point autofocus probe measuring instruments including NH-Series, non-contact 3D measuring instruments, and MLP-2, a 360 degree form measuring instrument. The NH-Series is a perfect solution for measuring dimensions and surface texture and the MLP-2 is ideal for rotative measurement. Mitaka point autofocus systems are widely installed in ultraprecision machining manufacturers, electronic components, optical components and other industrial fields.



Model: PF-150 (6-inch scanning model)
Measuring range: XYZ = 150mm X 150mm X 10mm
Scale resolution: XYZ = 0.1µm, 0.1µm, 0.01µm
Applications: grinding wheels, optical components, molds and dies, etc.

Model: PF-600 (large scanning model)
Measuring range: XYZ = 600mm X 600mm X 10mm
Scale resolution: XYZ = 0.1µm, 0.1µm, 0.01µm
Applications: large optical components, large molds and dies, LCD panels, etc.

Model: NH-3SP (Super precision model)
Measuring range: XYZ = 150mm X 150mm X 10mm
Scale resolution: XYZ = 0.01µm, 0.01µm, 0.001µm
Applications: aspherical lenses, semiconductors, precision molds, etc.

Model: MLP-2 (360-degree measurement model)
Measuring range: XYZ = 120mm X 90mm X 130mm
AF (R) = 40mm, AZ (θ) = 360°
Scale resolution: XYZ = 0.1µm, 0.1µm, 0.1µm
AF (R) = 0.01µm, AZ (θ) = 0.001°
Applications: precision gears, endmills, punches, molds for connectors, etc.

Mitaka

For information only.
Speci cations subject to change
without prior notice.

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