

# Non-contact 3D Measuring System Hyper Quick Vision WLI Series

Catalog No. E14001



**Mitutoyo**

# Coordinate Measurement and Non-contact 3D Measurement in a Single System



# Advanced High Precision Dual Head Measuring System equipped with White Light Interferometer (WLI) Optical Head

## Non-contact 2D/3D measurement with high precision and high resolution

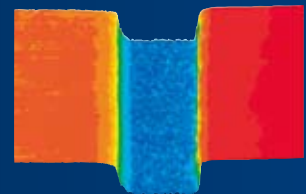
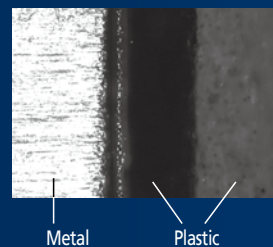
White light interferometer (WLI optical head) applied to vision measuring systems enables a wide range of powerful measurements, from 2D measurement of coordinates and dimensions, surface analysis in microscopic areas, depth measurement of small-diameter holes, and to high-precision 3D measurement of wiring dimensions on a printed circuit board.



## Capable of handling a wide variety of measurement surfaces

WLI method can handle a wide variety of measurement surfaces including diffusing surfaces and mirrored surfaces.

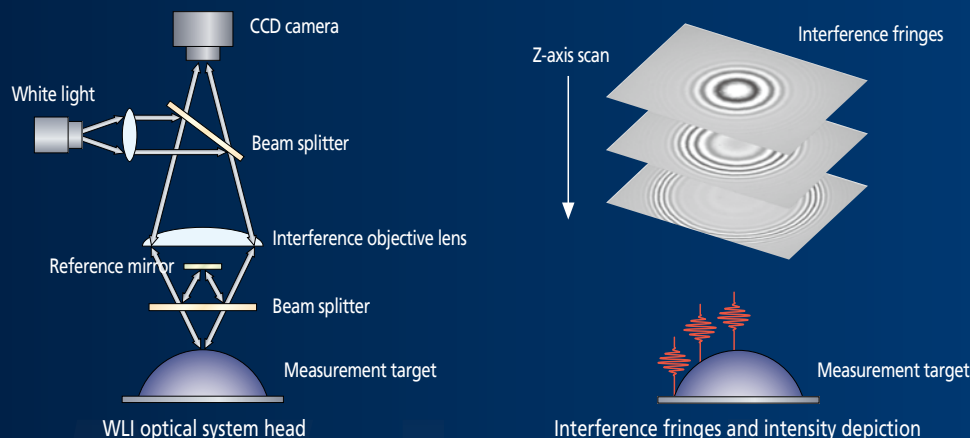
Using Mitutoyo's proprietary algorithm, WLI can also handle surfaces with large brightness differences, e.g., where plastic and metal coexist in mixed states.



## Principle of WLI measurement

A white light is split into two beams, one for the reference mirror within the interference objective lens and the other for the measurement sample. When the interference objective lens is swept in the Z-direction, white interference fringes are generated only in the area of the measurement sample that is focused.

The three dimensional shape of the object being measured is calculated by detecting the peak position of the interference fringe intensity at each pixel position of the CCD camera.



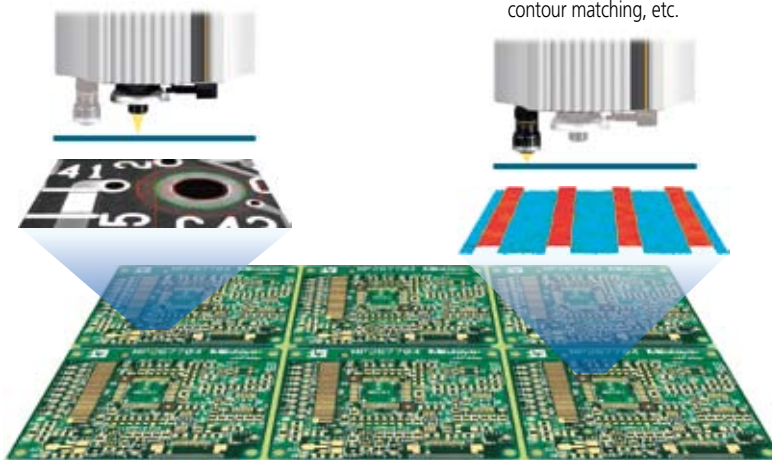
# Top Performance Presented by Continuously Evolving Vision Measuring Function and Advanced WLI Optical Head

## High-efficiency measurement achieved by a single machine performing two roles

Coordinate dimension measurement has inherited all of the proven vision measuring functions of Quick Vision. Switches to 3D measurements without setup changes following vision measurement. Seamlessly continuous measurement is made possible by Quick Vision's automatic control.

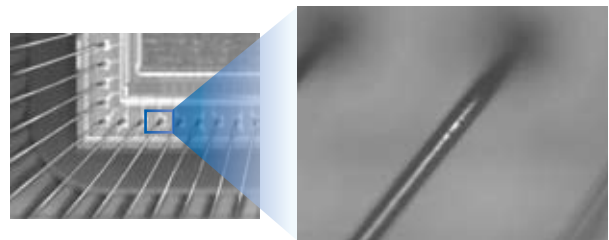
Vision measurements of coordinates, pitch, diameter, width, angle, etc.

3D measurements of surface analysis, cross-sectional dimensions, steps, contour matching, etc.



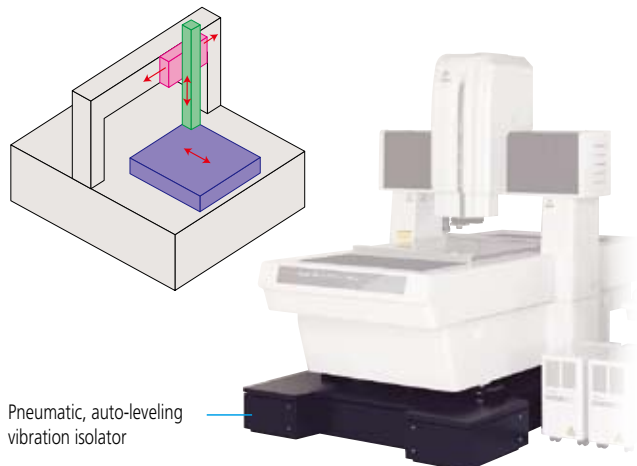
## Easy targeting of measurement position

Offset amount of vision optical head and WLI optical head is calibrated with high accuracy. Switching to high-magnification WLI optical head after positioning with vision optical head of low magnification and a wide field of view does not lose sight of the targeted area, thus guaranteeing a highly efficient measurement.



## Advanced-design platform culminating from Mitutoyo's high accuracy technology

Main frame structure boasting a large stage and high accuracy is achieved by structure having a fixed bridge and a translation stage providing mutually independent X-axis and Y-axis movements, which are advantageous for achieving high accuracy. For added stability of measurement, a pneumatic auto-leveling vibration isolator is provided as a standard structure. Unique design principle of Quick Vision series guarantees superb vibration isolation performance. Achieves high precision measurement for a wide range of applications, from long dimensions of large workpieces to minute dimensions.



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### Hyper Quick Vision WLI404



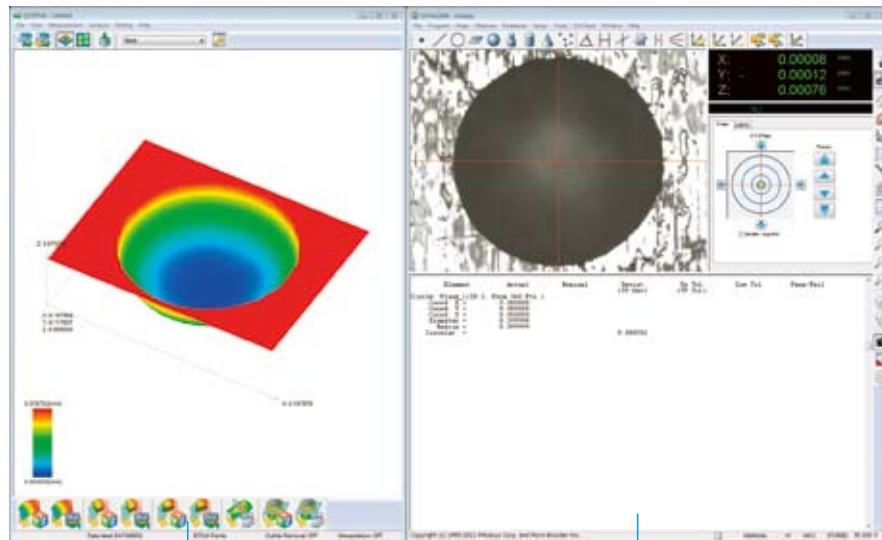
### Hyper Quick Vision WLI606





# Software

Powerfully supporting high functionality and measurement efficiency



3D data-synthesizing software  
**QV3DPAK**

System-controlling main software  
**QVPAK2000**

## QVPAK2000

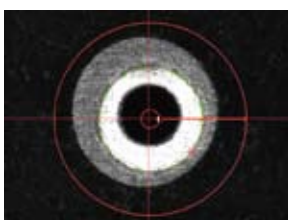
A function for acquiring interference fringes is added to QVPAK Software having high functionality and universal application capabilities for vision measuring systems.

The measurement procedure program prepared by QVPAK2000 automatically controls the coordinates and dimensions in vision measurement, 3D data synthesis in WLI measurement, data output, and shape/evaluation analysis software (optional) thus providing a highly efficient measurement system.

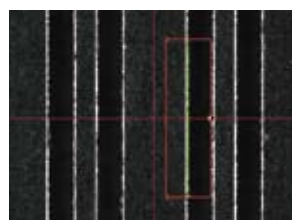
### Examples of computational capabilities



### Versatile vision measurement



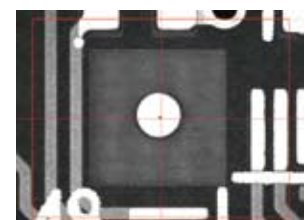
Circular tool



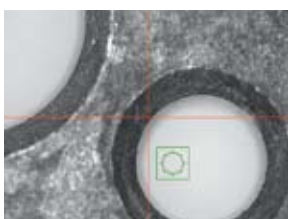
Line tool



Auto trace tool



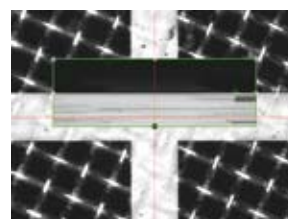
Pattern search tool



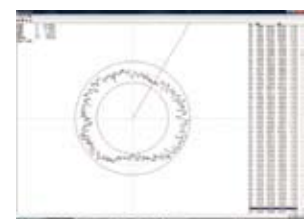
AI illumination tool  
(automatic compensation of light)



Multi point AF



Various filters



Geometric deviation drawing

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## QV3DPAK

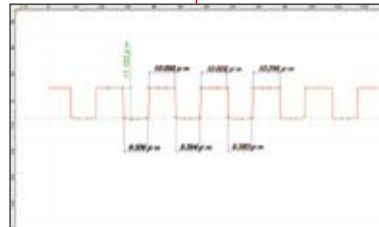
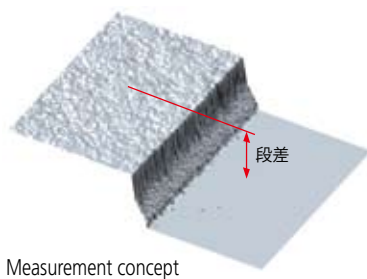
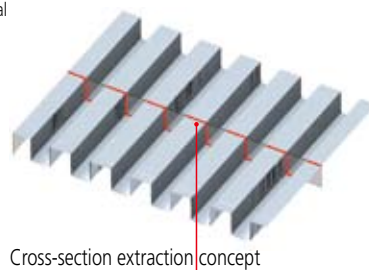
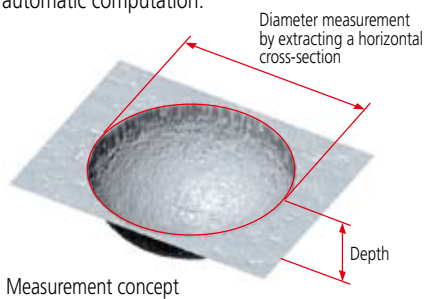
Synthesizes three dimensional shape data from interference fringes to display shapes or outputs point cloud data to external sources.

Point cloud data can be used for generating surfaces, as well as for outputting height, ID and OD dimensions.

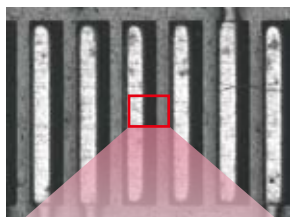
Also, 3D data can be transferred to the shape/evaluation analysis software (optional) to implement shape measurement and surface analysis.

## Applications

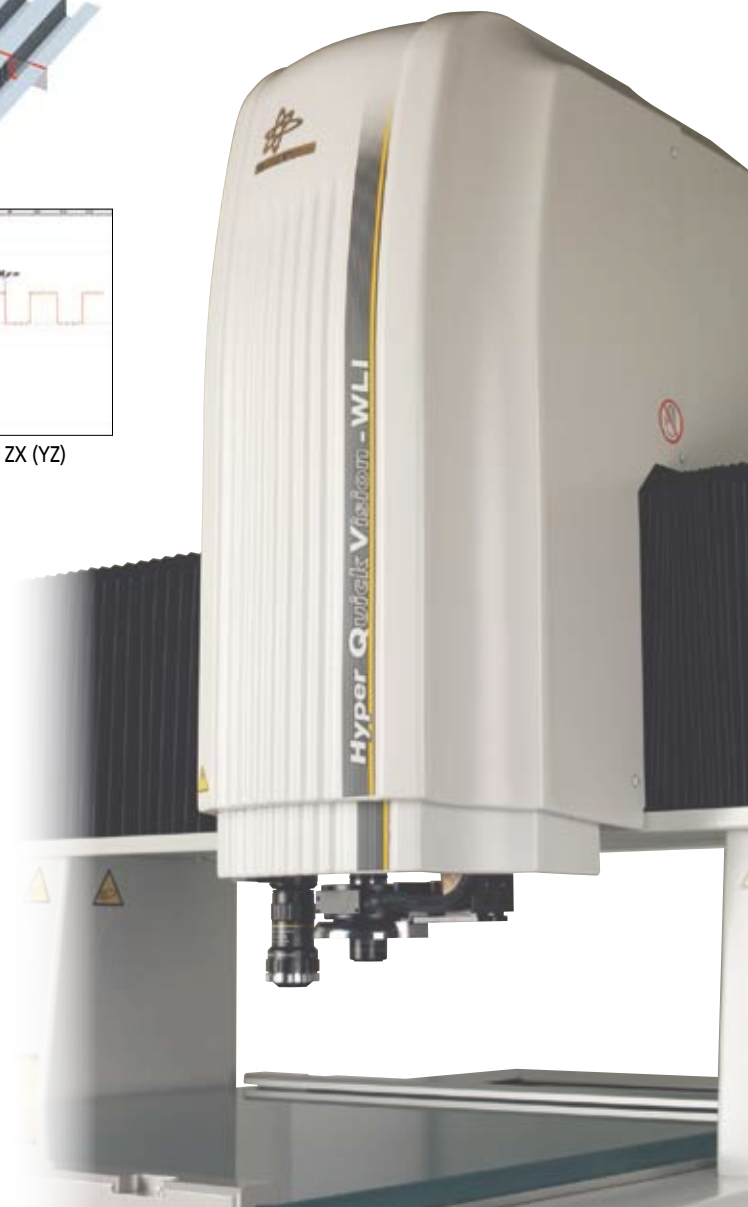
Enables you to switch from inaccurate visual inspections to accurate measurements based on automatic computation.



Analysis of contour shape from ZX (YZ)  
cross-section extraction  
Use of FORMPAK-QV (optional)



Surface analysis based on 3D data  
Use of FORMTRACEPAK-PRO (optional)



# Optional Software

## Shape evaluation and analysis software FORMPAK-QV

Performs design value cross-referencing and shape analysis based on shape data obtained using QV's Auto Trace Tool and WLI optical head.

### Contour cross-referencing function

- Preparation of statistical data  
CAD data conversion, master work conversion, function designation, text file conversion, aspheric design value preparation
- Design value referencing  
Normal direction referencing, axial direction referencing, best fit referencing
- Result display  
Result listing, error line chart, error development diagram, error coordinate value display function, analysis result display

### Microscopic shape analysis

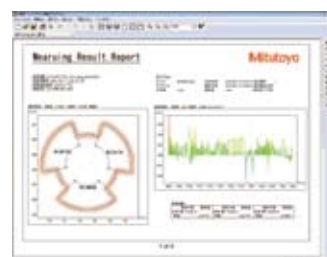
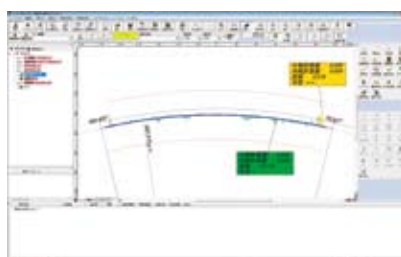
- Analysis items: point measurement, line measurement, circle measurement, distance measurement, cross point measurement, angle measurement, origin measurement, axial rotation
- Computational items: maximum value, minimum value, mean value, standard deviation, area

### Report preparation function

Measurement report, error line chart, error development diagram

### Other functions

- Recording/execution of analysis procedure
- External output function  
CSV-format output, ASC output
- Fairing process
- Quadratic curve fitting function
- Quasi-roughness analysis function



## Shape evaluation and analysis software FORMTRACEPAK-PRO

Software for conducting analysis process based on point cloud data obtained via WLI optical head.

If a two-dimensional analysis does not provide sufficient and reliable results, the software provides a three-dimensional evaluation and analysis method.

### Major functions

#### Three-dimensional display

Capable of wireframing, shading, contouring, setting up of color setting free for contour fill, and illumination setting, and allows the user to freely rotate, enlarge, shrink, or move the analysis target.

#### Trend compensation, filter process

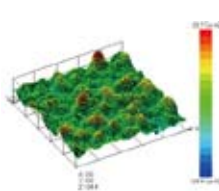
Capable of trend compensation using planes, spheres, cylindrical surfaces, and polyhedrons. Filter process can be chosen from one-dimensional digital filter and two-dimensional digital filter for each profile.



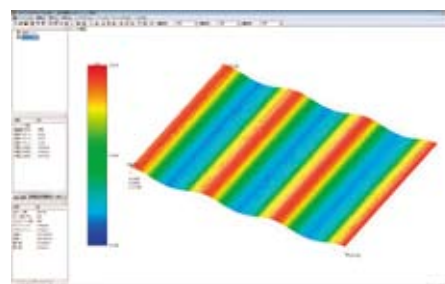
Shading display



Example of cross-section analysis



Wireframe display



### Rich functions for digitization and graphical display of surface shapes

Capable of evaluation of wear and oil sump using relative load curves and area distribution curves.

Spectral analysis, analysis of cross-sectional areas and volumes, calculation of tilt angles of peaks and valleys, and histogram calculation of number of peaks and valleys.

### Rich feature-extraction functions based on measurement data

Capable of slope intensification, simultaneous analysis of peaks and valleys of cross section, and extraction of arbitrary cross-sections.

Other optional software for Quick Vision is also available.  
For details, please refer to the catalog for the Quick Vision series.



# Hardware Options

## Objective lens

### QV objective lens



Objective Lens	Code No.	PPT Magnification	Monitor Magnification	Field of View (mm)	Operating Distance*1 (mm)
QV-SL0.5×*2	02AKT199	1×	14×	12.54×9.4	30.5
		2×	28×	6.27×4.7	
		6×	83×	2.09×1.56	
QV-HR1× QV-SL1×	02AKT250 02ALA150	1×	28×	6.27×4.7	40.6 52.5
		2×	55×	3.13×2.35	
		6×	165×	1.04×0.78	
QV-HR2.5× QV-SL2.5×	02AKT300 02ALA170	1×	69×	2.5×1.88	40.6 60
		2×	138×	1.25×0.94	
		6×	415×	0.41×0.31	
QV-5×	02ALA420	1×	138×	1.25×0.94	33.5
		2×	276×	0.62×0.47	
		6×	829×	0.2×0.15	
QV-HR10×*2 QV-10×	02AKT650 02ALG010	1×	276×	0.62×0.47	20 30.5
		2×	553×	0.31×0.23	
		6×	1672×	0.1×0.07	
QV-25×*2*3	02ALG020	1×	961×	0.25×0.18	13
		2×	1382×	0.12×0.09	
		6×	4147×	0.04×0.03	

Monitor magnification shown here is that of Size 24 Liquid Crystal Display (resolution WUXGA).

\*1 PRL lighting unit can be shorter than the operating distance due to the operating position of the Programmable Ring Light (PRL) depending on the location of PRL.

\*2 Illumination can be insufficient in some cases depending on the workpiece.

\*3 There is a limitation to the operating position of PRL.

### WLI interference objective lens



Objective Lens	Code No.	Interference Method	Monitor Magnification	Field of View*1 (mm)	Operating Distance (mm)
QV WLI A-10×	02ALT630	Mirror	540×	0.32×0.24	12.6
QV WLI A-25×	02ALT670	Mirror	1350×	0.13×0.10	4.7

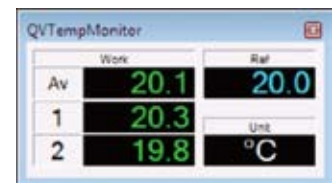
Monitor magnification shown here is that of Size 24 Liquid Crystal Display (resolution WUXGA).

\*1 Tube lens 2X is provided as a standard equipment. Also, the field of view may be smaller than those shown here due to pixel calibration.

## Temperature compensation unit

Measurement result can always be outputted as values converted at standard temperature of 20°C, even if the ambient temperature is 23°C. The compensation calculation is based on the thermal expansion factor of the workpiece and temperature data provided by sensors placed at X, Y, and Z-axis scales and the workpiece.

- Temperature compensation of machine frame
- Temperature compensation of workpiece



## Calibration

### Tilt compensation jig for WLI optical head

Enables to compensate the mounting posture of WLI optical head. It helps to achieve measurement of the highest accuracy by compensating the tilting error of WLI optical head.



### Interference fringe adjustment jig

Enables to adjust the focusing position of WLI interference objective lens with the position where interference fringes occur. It is used in combination with the calibration chart.



Interference adjustment jig

Calibration chart

### Calibration chart (for vision optical head & WLI optical head)

Used for pixel size compensation of CCDs and for compensating auto-focusing accuracy and optical axis offset at various magnifications of variable magnification PPT/zooming.

Note: There are some limitations to the function of each lens. Please contact one of our sales offices for details.

### QV compensation chart (for vision optical head)

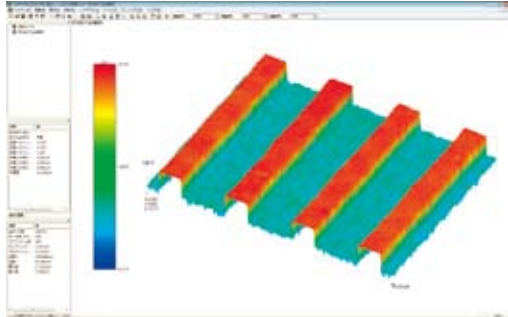


Glass chart designed for "in-screen compensation" to compensate for the distortion occurring in the screen caused by the optical system and for "auto-focusing compensation" to minimize auto-focusing fluctuations caused by the object's pattern and texture.

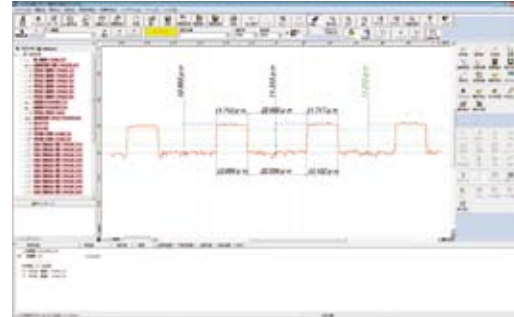
Note: There are some limitations to the function of each lens. Please contact one of our sales offices for details.

# Measurement Examples

## Semiconductor package substrate

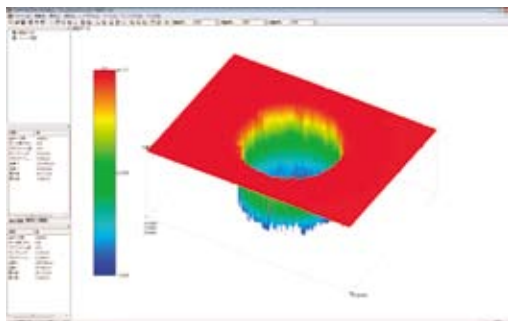


Surface analysis



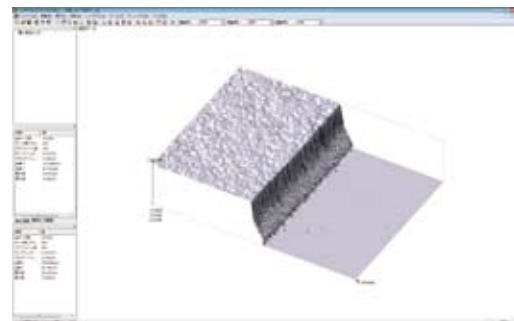
Cross-sectional shape measurement

## Laser-machined hole



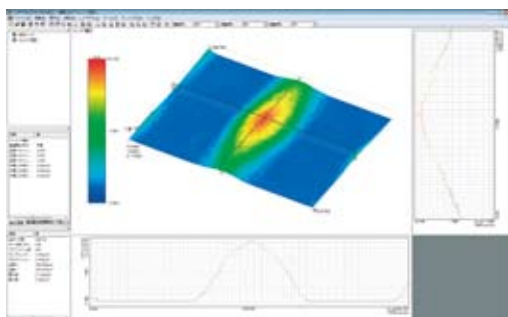
ID and depth measurements

## Metal thin film



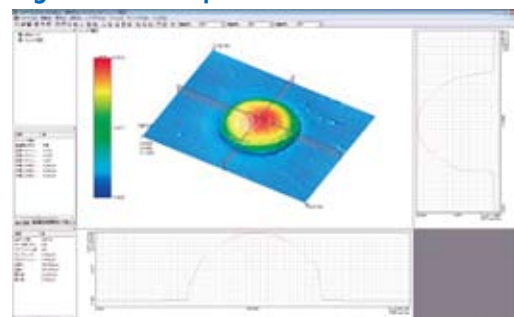
Surface analysis, and step measurement

## Pole



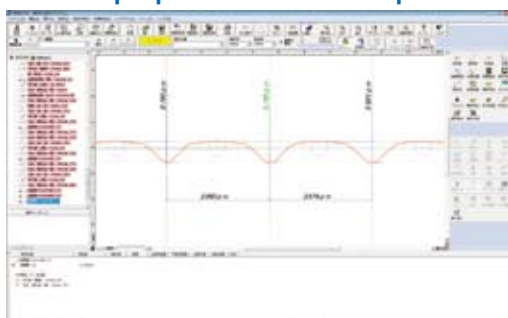
Cross-sectional shape measurement

## Light induction plate



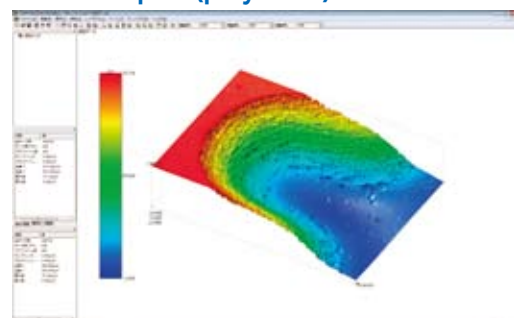
Coordinate-position, OD, and height measurements

## Microscopic precision machined part



Cross-sectional shape measurement

## Electronic part (polyimide)



Surface analysis, step, and cross sectional measurements

# Specifications

Name			Hyper Quick Vision WLI 404		Hyper Quick Vision WLI 606	
Model			QVD1-H404P1L-C	QVD1-H404P1N-C	QVD1-H606P1L-C	QVD1-H606P1N-C
Code No.			363-701-1	363-702-1	363-711-1	363-712-1
WLI optical head unit						
Measurement range *1 (X×Y×Z)			315×400×240 mm		515×650×240 mm	
Variable magnification device			2X			
Imaging device			B& W CCD camera			
Illuminating device      Vertical epi-illumination			Halogen lamp			
Z-axis scanning range *2			170μm			
Repeatability accuracy                      Z-axis			2σ≤0.2 μm			
Vision optical head unit						
Measurement range (X×Y×Z)			400×400×240 mm		600×650×240 mm	
Variable magnification device			Programmable power turret PPT 1X-2X-6X			
Imaging device			B & W CCD camera			
Illuminating device	Vertical epi-illumination		Color LED	Halogen lamp	Color LED	Halogen lamp
	Transmission illumination		White LED	Halogen lamp	White LED	Halogen lamp
	Program control		Color LED	Halogen lamp	Color LED	Halogen lamp
	Ring Light					
Vision measuring accuracy *3	E1 x,y		(0.8+2L/1000) μm			
L: Distance between arbitrarily selected	E1z		(1.5+2L/1000) μm			
two points [mm]	E2xy		(1.4+3L/1000) μm			
Main unit						
Guide method			Linear hard bearing			
Minimum display unit/length measuring unit			0.01 μm/linear encoder			
Size of loading glass			493 × 551 mm		697×785 mm	
Maximum mass of workpiece (excluding eccentric or concentrated load)			25 kg		35 kg	
External physical dimensions of main unit			1027×1407×1781 mm		1309×1985×1792 mm	
Mass of main unit (excluding vibration isolator)			1160 kg		2275 kg	
Installation environment condition						
Accuracy-guaranteed environment	Temperature condition	Range	20±0.3℃			
		Fluctuation	0.5℃/1H			
		Slope	1° C/m (height/horizontal direction)			
	Vibration condition	Max. amplitude ≤ 2 μm at frequency of 10 Hz or lower				
		70 dB or lower				
Pneumatic pressure used			0.4 MPa			
Power source voltage			AC100～240V			

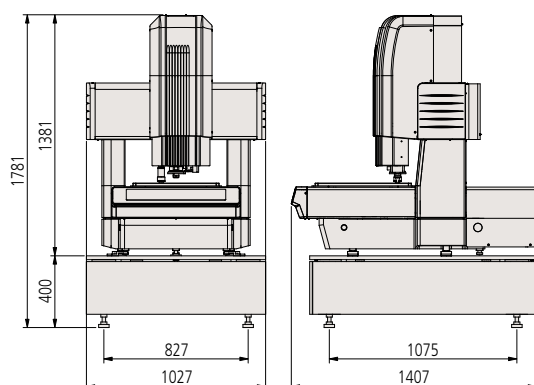
\*1 Movable range of WLI optical head. Three dimensional shape measurement using WLI is allowed within one field of vision.

\*2 In case of standard mode. Applicable to max. 200 μm by modifying scan pitch.

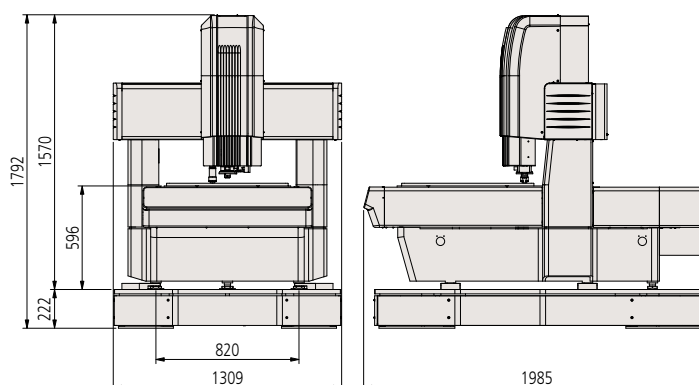
\*3 Accuracy when the proximity of the center of the video screen is measured at the middle of the measurement stroke within one plane using the objective lens 2.5X+PPT1X.

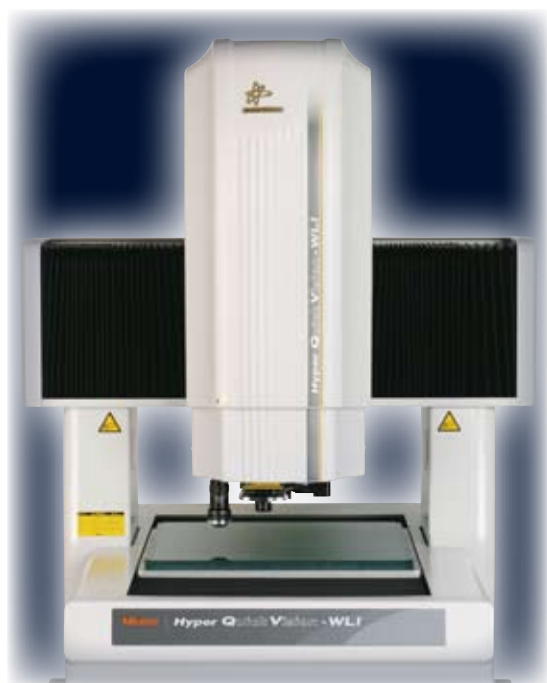
## External view dimension chart

### Hyper Quick Vision WLI 404



### Hyper Quick Vision WLI 606





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Vision Measuring Systems

Form Measurement

Optical Measuring

Sensor Systems

Test Equipment and  
Seismometers

Digital Scale and DRO Systems

Small Tool Instruments and  
Data Management

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