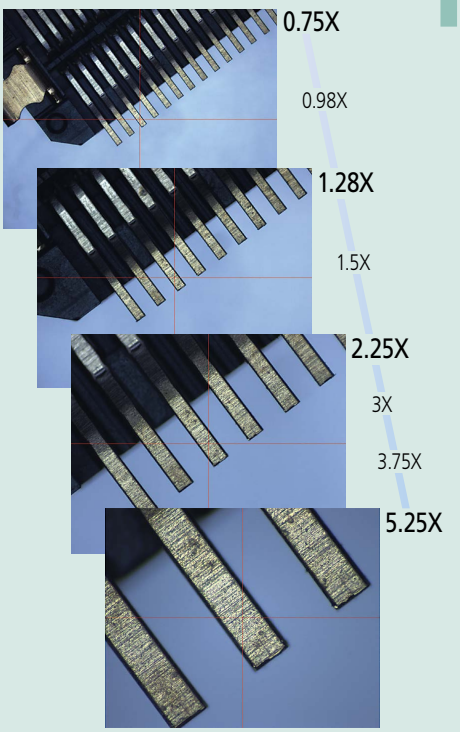
QV Active
CNC Vision Measuring System

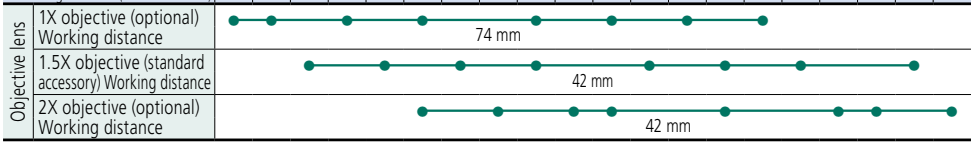
- Cost effective, multifunction, CNC Vision Measuring System.
- Usability has been improved by adopting a color camera and 8-step zoom optics.
- The zoom ratio of 7X (14X at maximum by changing the fixed-magnification objective lens) enables a wide range of inspection from wide view measurement at low magnification to micro-measurement at high magnification.
- The 74 mm maximum working distance (1X optional objective) promotes safe working by reducing the risk of collision, and allows greater freedom in fixture design.

QV Active 404



From wide view measurement to micro-measurement

Optical magnification		0.5X	0.65X	0.75X	0.85X	0.98X	1X	1.28X	1.3X	1.5X	1.7X	2X	2.25X	2.5X	3X	3.5X	3.75X	4X	5X	5.25X	7X
View field (mm)	Horizontal (H)	13.60	10.46	9.07	8.00	6.94	6.80	5.31	5.23	4.53	4.00	3.40	3.02	2.72	2.27	1.94	1.81	1.70	1.36	1.30	0.97
	Vertical (V)	10.80	8.31	7.20	6.35	5.51	5.40	4.22	4.15	3.60	3.18	2.70	2.40	2.16	1.80	1.54	1.44	1.35	1.08	1.03	0.77
Total magnification (on the monitor)		13.20	17.10	19.80	22.40	25.80	26.40	33.70	34.30	39.50	44.80	52.70	59.30	65.90	79.10	92.30	98.90	105.50	131.80	138.40	184.50

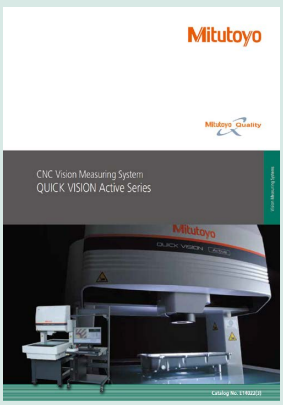


Note: The total magnification indicates the magnification on the monitor when the size of the **QVPAK** video window is 178.8×143.0 mm (default).

SPECIFICATIONS

Model No.		QV Active 202	QV Active 404
Type		Standard model	Standard model
Measuring range (X×Y×Z)		250×200×150 mm (250×200×118 mm: when 1X objective is used)	400×400×200 mm (400×400×168 mm: when 1X objective is used)
Observation unit		Zoom unit (8 positions)	
Imaging device		Color CMOS camera	
Vision measuring accuracy*	E_{1X}, E_{1Y}	(2 + 3L/1000) µm	
	E_{1Z}	(3 + 5L/1000) µm	
	E_2	(2.5 + 4L/1000) µm	
	Accuracy guaranteed with optics specified	Objective: 1.5X, Optical magnification: 5.25X	
Accuracy guaranteed temperature		20±1 °C	20±1 °C

* Inspected to a Mitutoyo standard. L=length between two arbitrary points (mm)



Refer to the **QUICK VISION Active** Series Brochure (**E14022**) for more details.

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SMS Smart Measuring System

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PROPRIETARY INSPECTION CERTIFICATE

QV APEX Pro/QV HYPER Pro CNC Vision Measuring System

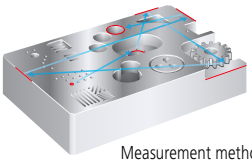
- Equipped with a strobe light and the newly developed StrobeSnap function, **QUICK VISION Pro** models deliver high-speed, high-accuracy measurements.
- The STREAM function is an optional upgrade to improve productivity by up to five times.

QV APEX 404 Pro

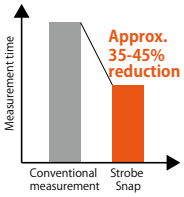
QV HYPER 302 Pro

StrobeSnap

All the **QUICK VISION Pro** models are equipped with a strobe light, and the newly developed vision measuring function "StrobeSnap" delivers measurements with both high throughput and high accuracy. Regardless of the continuity of measuring positions, measuring time can be shortened by about 35 to 45% for most measurement samples.



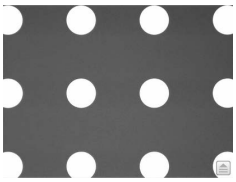
Measurement method



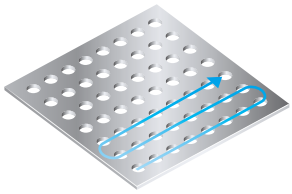
Note: Comparison with old specifications using our demo sample

STREAM function (optional)

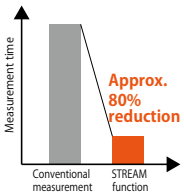
The STREAM function provides an amazingly high throughput, due to the non-stop measurement where the camera motion and the strobe light are synchronized.
It can shorten measuring time more than StrobeSnap on account of continuous element measurement as shown in the following conceptual image of measurement.



XY=0.2 mm pitch, 626
Measured with a field of view of 0.62×0.47 mm
STREAM measurement 36 sec.



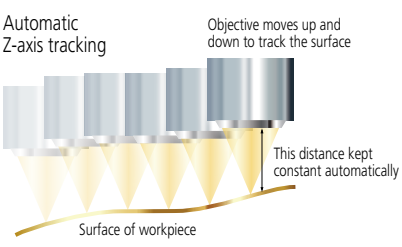
Measurement method



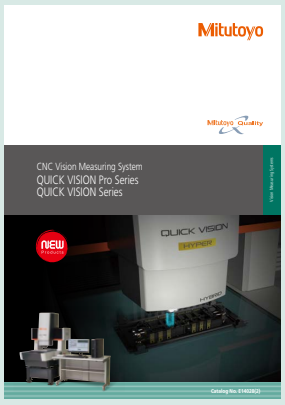
Note: Comparison with old specifications using our demo sample

Tracking Auto Focus (TAF)

Laser emitted from the objective lens enables automatic focusing.
The system automatically keeps the object in focus according to its shape, eliminating the task of focus adjustment and increasing measurement throughput.



Laser source	Semiconductor laser (peak wavelength: 690 nm)
Laser safety	Class 2 (JIS C6802: 2014, EN/IEC 60825-1: 2014)
Auto focus system	Objective co-axial autofocusing (knife-edge method)



Refer to the **QUICK VISION** Series Brochure (**E14028**) for more details.

SPECIFICATIONS

QV APEX Pro

Items \ Model No.		QV APEX 302 Pro	QV APEX 404 Pro	QV APEX 606 Pro
Measuring range (X×Y×Z)		300×200×200 mm	400×400×250 mm	600×650×250 mm
Observation unit		Programmable power turret 1X-2X-6X		
Imaging device		B&W CMOS		
Vision measuring accuracy*	E_{UX}/E_{UY}, MPE	(1.5 + 3L/1000) μm		
	E_{UXY}, MPE	(2.0 + 4L/1000) μm		
	E_{UZ}, MPE	(1.5 + 4L/1000) μm		

QV HYPER Pro (Specifications other than as quoted in the table are the same as the QV APEX Pro specifications.)

Items \ Model No.		QV HYPER 302 Pro	QV HYPER 404 Pro	QV HYPER 606 Pro
Imaging device		B&W CMOS		
Vision measuring accuracy*	E_{UX}/E_{UY}, MPE	(0.8 + 2L/1000) μm		
	E_{UXY}, MPE	(1.4 + 3L/1000) μm		
	E_{UZ}, MPE	(1.5 + 2L/1000) μm		

* L=length between two arbitrary points (mm)

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QV ACCEL
Large CNC Vision Measuring System

- This is a vision measuring machine with moving-bridge type main unit structure suitable for measuring large, thin workpieces.
- **QV ACCEL 1212** (range: 1250×1250×100 mm) and **QV ACCEL 1517** (range: 1500×1750×100 mm) are available to special order.
- As the stage is immobile on the moving-bridge structure, you can use a simple method to fix a workpiece.

QV ACCEL 808

SPECIFICATIONS

Items \ Model No.			QV ACCEL 808	QV ACCEL 1010
Measuring range (X×Y×Z)			800×800×150 mm	1000×1000×150 mm
Observation unit			Programmable power turret 1X-2X-6X	
Imaging device			B&W CCD (1/2 in)	
Vision measuring accuracy*	E_{1X}, E_{1Y}		(1.5 + 3L/1000) µm	
	E_{1Z}		(1.5 + 4L/1000) µm	
	E_{2XY}		(2.5 + 4L/1000) µm	
Repeatability*	Short dimension	X, Y axis	$3\sigma \leq 0.2$ µm	
	Long dimension		$3\sigma \leq 0.7$ µm	
Tracking auto focus device			Optional	

* Inspected to a Mitutoyo standard. L=length between two arbitrary points (mm)

Refer to the **QUICK VISION** Series Brochure (**E14028**) for more details.

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ULTRA QV
Ultra-High Accuracy CNC Vision Measuring System

ULTRA QV 404

- Ultra-high accuracy CNC vision measuring machine with measuring accuracy of E_{1XY} (0.25 + L/1000) µm.
- Our proprietary high-resolution (Resolution: 0.01 µm) and high-accuracy low-expansion glass scales are used on the X, Y and Z axes.
- The main unit utilizes a highly rigid moving Y-axis table with a fixed bridge. The base is made of high stability granite.
- This model is standard-equipped with an automatic temperature compensation function that uses a temperature sensor on the main unit of the measuring machine and a temperature sensor for the workpiece.

SPECIFICATIONS

Items \ Model No.		ULTRA QV 404
Measuring range (X×Y×Z)		400×400×200 mm
Observation unit		Programmable power turret 1X-2X-6X
Imaging device		B&W CCD (1/2 in)
Vision measuring accuracy*1	E_{1X}, E_{1Y}	(0.25 + L/1000) µm
	E_{1Z} (Full stroke)	(1.5 + 2L/1000) µm (Range 200 mm)
	E_{1Z} (50 mm stroke)*2	(1.0 + 2L/1000) µm (Range 10 to 60 mm)
	E_{2XY}	(0.5 + 2L/1000) µm
Tracking auto focus device		Optional

*1 Inspected to a Mitutoyo standard. L=length between two arbitrary points (mm)
*2 Verified at shipment from factory.

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PROPRIETARY INSPECTION CERTIFICATE

Hyper QVWLI
Non-contact 3D Measuring System

Hyper QVWLI 606

- **Hyper QVWLI** is a high-accuracy dual 3D measurement system consisting of **QV** and a white light interferometer.
- You can perform 3D surface texture analysis from 3D data captured by the WLI optical system. You can also perform dimension measurement and cross-section measurement at a specific height using the 3D data.

SPECIFICATIONS

Items \ Model No.		Hyper QVWLI 302	Hyper QVWLI 404	Hyper QVWLI 606
Measuring range (X×Y×Z)	Vision measuring area	300×200×190 mm	400×400×240 mm	600×650×220 mm
	WLI measuring area*1	215×200×190 mm	315×400×240 mm	515×650×220 mm
WLI optical head unit				
View field (H×V)		5X lens: approx. 0.64×0.48 mm/10X lens: approx. 0.32×0.24 mm/ 25X lens: approx. 0.13×0.10 mm/50X lens: approx. 0.064×0.048 mm		
Z repeatability		2σ≤ 0.08 µm		
Vision optical head unit				
Observation unit		Programmable power turret 1X-2X-6X		
Imaging device		B&W CCD (1/2 in)		
Vision measuring accuracy*2	E_{1X}, E_{1Y}	(0.8 + 2L/1000) µm		
	E_{1Z}	(1.5 + 2L/1000) µm		
	E_{2XY}	(1.4 + 3L/1000) µm		

*1 Movable range of **WLI** optical head.
*2 Inspected to a Mitutoyo standard. L=length between two arbitrary points (mm)

Refer to the **QUICK VISION** Series Brochure (**E14028**) for more details.

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QV TP Active/QV TP Pro
CNC Vision Measuring System equipped with a Touch Trigger Probe

Non-contact and contact measurement on one machine

- **QV** touch-trigger probe unit enables both vision measurement and touch-trigger probe measurement.

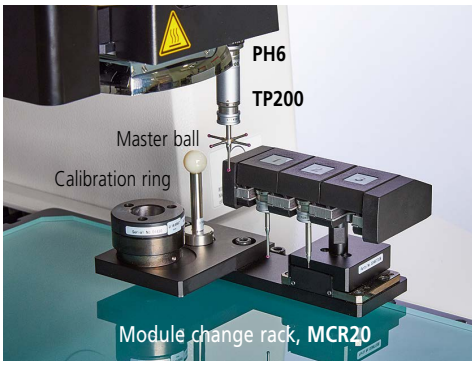
3D workpiece measurement

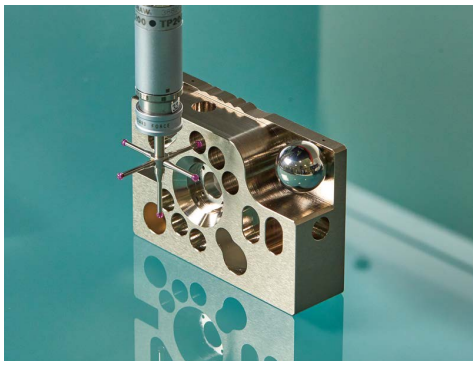
- Enables 3D measurement of workpieces, such as press-molded products, plastic-molded products, and machined products, that until now could not be measured with image processing alone.

Module change rack available

- Using the module change rack enables switching between vision measurement and touch probe measurement during an automatic measuring sequence.

QV TP HYPER 404 Pro





SPECIFICATIONS WITH TOUCH-TRIGGER PROBE OPTIONS MOUNTED

Items \ Model No.		QV TP Active 202	QV TP Active 404
Measuring range*1 (X×Y×Z)	Vision	250×200×150 mm	400×400×200 mm
	Common to Touch-trigger Probe	184×200×150 mm	334×400×200 mm
Measuring accuracy*2 (Touch-trigger probe)	E_{1X}, E_{1Y}, E_{1Z}	(2.4 + 3L/1000) µm	(2.4 + 3L/1000) µm

Items \ Model No.		QV TP APEX 302 Pro	QV TP APEX 404 Pro	QV TP APEX 606 Pro	QV TP HYPER 302 Pro	QV TP HYPER 404 Pro	QV TP HYPER 606 Pro
Measuring range*1 (X×Y×Z)	Vision	300×200×200 mm	400×400×250 mm	600×650×250 mm	300×200×200 mm	400×400×250 mm	600×650×250 mm
	Common to Touch-trigger Probe	234×200×200 mm	334×400×250 mm	534×650×250 mm	234×200×200 mm	334×400×250 mm	534×650×250 mm
Measuring accuracy*2 (Touch-trigger probe)	E_X, $_{MPE}$/E_Y, $_{MPE}$/ E_Z, $_{MPE}$	(1.8 + 3L/1000) µm			(1.7 + 3L/1000) µm		

*1 When a module change rack, a master ball, and a calibration ring are mounted, the measurement ranges are smaller than those in the table. Other specifications are the same as those for **QV Active**, **QV APEX Pro**, and **QV HYPER Pro**. Please contact our sales office for more details.

*2 L=length between two arbitrary points (mm)

Refer to the **QUICK VISION** Series Brochure (**E14028**) for more details.

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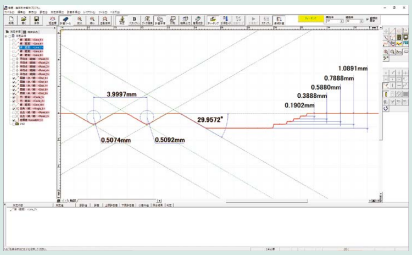
QVH4 Pro

CNC Vision Measuring System equipped with Non-contact displacement sensor

- This dual system with a non-contact displacement sensor has a scanning function that enables measurement of minute height differences and 3D shapes.
- The non-contact displacement sensor (CPS probe) uses the wavelength confocal method.
- The LED used as the light source of the displacement sensor has an auto-brightness control function that enables seamless measurement of materials with different reflectivity.

Example of 3D form comparison



QVH4 HYPER 606 Pro

Features: QVH4 Pro

- Enables detection of high inclination angles for both mirror and diffused surfaces.
- The automatic lighting adjustment function allows for high accuracy measurements.
- Surface roughness or thickness measurement of thin and transparent objects such as film.

COMMON SPECIFICATIONS

Items	Model No.	QVH4 APEX 302 Pro	QVH4 APEX 404 Pro	QVH4 APEX 606 Pro	QVH4 HYPER 302 Pro	QVH4 HYPER 404 Pro	QVH4 HYPER 606 Pro
Measuring range (X×Y×Z)	Vision	300×200×200 mm	400×400×250 mm	600×650×250 mm	300×200×200 mm	400×400×250 mm	600×650×250 mm
	Non-contact displacement sensor	176×200×200 mm	276×400×250 mm	476×650×250 mm	176×200×200 mm	276×400×250 mm	476×650×250 mm
Vision measuring accuracy*1	$E_{UX}/E_{UY, MPE}$	(1.5 + 3L/1000) µm			(0.8 + 2L/1000) µm		
	$E_{UXY, MPE}$	(2.0 + 4L/1000) µm			(1.4 + 3L/1000) µm		
	$E_{UZ, MPE}$	(1.5 + 4L/1000) µm			(1.5 + 2L/1000) µm		
Displacement sensor measuring accuracy*1*2	E_{1Z}	(1.5 + 4L/1000) µm			(1.5 + 2L/1000) µm		

*1 L=length between two arbitrary points (mm) *2 Inspected to a Mitutoyo standard.

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CLASS 1 LASER PRODUCT

Safety precautions regarding QV HYBRID TYPE1

This product uses a low-power invisible laser (780 nm) for measurement. The laser is a CLASS 1 EN/IEC 60825-1 device. A warning and explanation label, as shown above, is attached to the product as appropriate.

QV HYBRID TYPE1

CNC Vision Measuring System equipped with Non-contact displacement sensor

- This dual system with a non-contact displacement sensor has a scanning function that enables measurement of minute height differences and 3D shapes.
- The double-pinhole technique is used as the detection method of the displacement sensor. It is less directional compared with the knife-edge and triangulation techniques.
- The small laser spot with diameter of about 2 µm makes it possible to measure minute shapes.

Features: QV HYBRID TYPE1

- The focusing point method minimizes the difference in the measuring face reflectance and achieves high measurement reproducibility.
- Capable of measuring detailed shapes in high resolution.

COMMON SPECIFICATIONS

Items	Model No.	QVH1 Apex 302	QVH1 Apex 404	QVH1 Apex 606	Hyper QVH1 302	Hyper QVH1 404	Hyper QVH1 606
Measuring range (X×Y×Z)	Vision	300×200×200 mm	400×400×250 mm	600×650×250 mm	300×200×200 mm	400×400×250 mm	600×650×250 mm
	Non-contact displacement sensor	180×200×200 mm	280×400×250 mm	480×650×250 mm	180×200×200 mm	280×400×250 mm	480×650×250 mm
Vision measuring accuracy*	E_{1X}, E_{1Y}	(1.5 + 3L/1000) µm			(0.8 + 2L/1000) µm		
	E_{1Z}	(1.5 + 4L/1000) µm			(1.5 + 2L/1000) µm		
	E_{2XY}	(2.0 + 4L/1000) µm			(1.4 + 3L/1000) µm		
Displacement sensor measuring accuracy*	E_{1Z}	(1.5 + 4L/1000) µm			(1.5 + 2L/1000) µm		

* Inspected to a Mitutoyo standard. L=length between two arbitrary points (mm)

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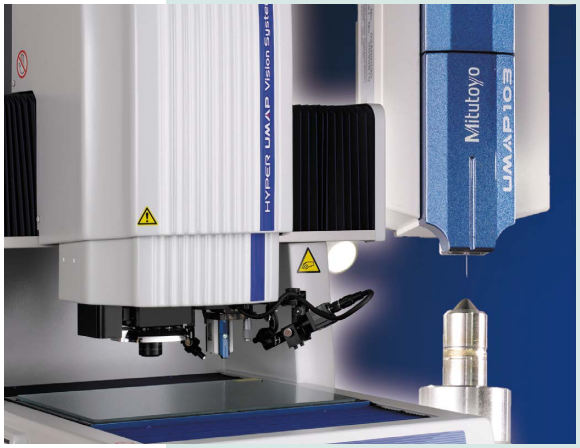
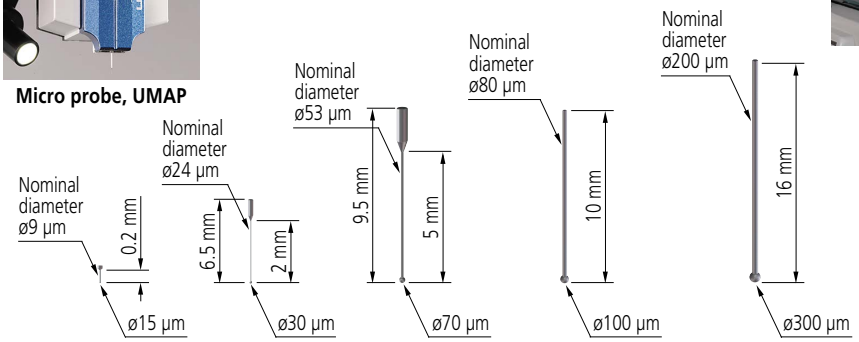
UMAP Vision System TYPE2
Micro Form Measuring System

Ultrasonic Micro Probe UMAP

Contact measurement of a small hole's diameter and its section or contour is possible, which is difficult with a conventional Vision Measuring System or CMM. Capable of high accuracy, sophisticated, non-contact and contact measurement on one machine. With a minimum measuring force of 1 µN, it is not only less likely to mark workpiece surfaces, but also enables measurement of workpieces that are highly susceptible to deformation.



Micro probe, UMAP



UMAP 101 Stylus
ø15 µm

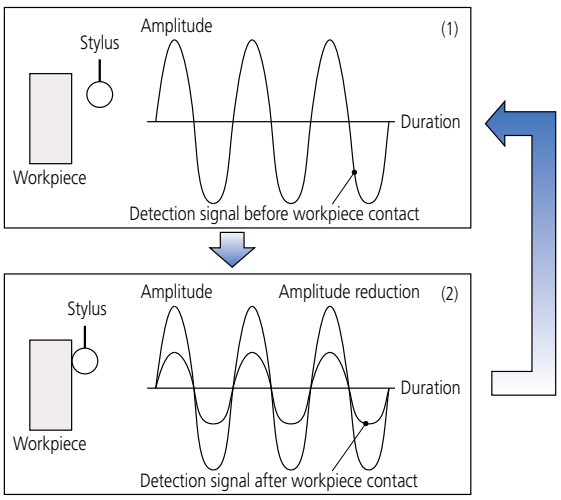
UMAP 103 Stylus
ø30 µm

UMAP 107 Stylus
ø70 µm

UMAP 110 Stylus
ø100 µm

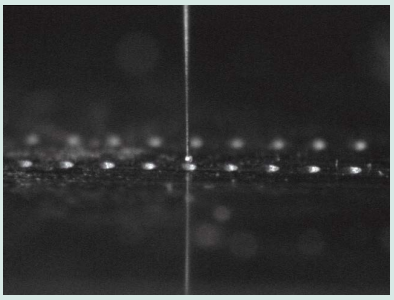
UMAP 130 Stylus
ø300 µm

Detection of surface principle

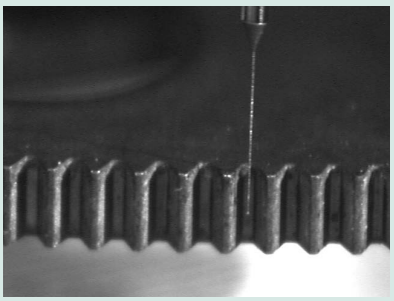


(1) In this drawing, the stylus is vibrating with micro amplitude. If it does not come into contact with the workpiece the vibration state is maintained.
(2) As the stylus comes into contact with the workpiece surface the vibration amplitude decreases as the contact increases. When the decreasing amplitude falls below a certain level, a touch-trigger signal is generated.

Typical applications



Contour measurement of a ø0.125 mm hole

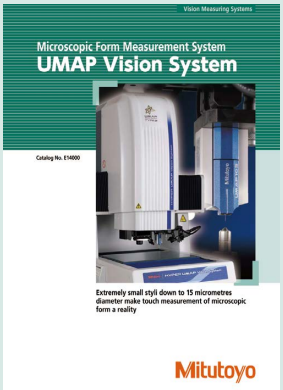


Measuring form of micro gear teeth

SPECIFICATIONS

Items	Model No.		TYPE2 Hyper UMAP 302	TYPE2 ULTRA UMAP 404
Measuring range (common to vision and **UMAP**)	X axis×Y axis		185×200 mm	285×400 mm
	Z axis	**UMAP 101/103**	175 mm	
		UMAP 107/110	180 mm	
		UMAP 130	185 mm	
Vision measuring accuracy*	E_{1X}, E_{1Y}		(0.8 + 2L/1000) µm	(0.25 + L/1000) µm
	E_{1Z}		(1.5 + 2L/1000) µm	
Repeatability	**UMAP 101/103/107**		σ=0.1 µm	σ=0.08 µm
	UMAP 110/130		σ=0.15 µm	σ=0.12 µm

* Inspected to a Mitutoyo standard. L=length between two arbitrary points (mm)



Refer to **UMAP Vision System** Brochure (**E14000**) for more details.

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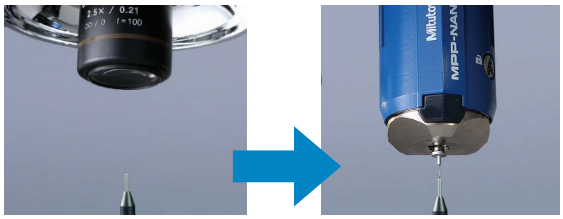
Data Management Software by Mitutoyo

PROPRIETARY INSPECTION CERTIFICATE

Vision Measuring Machine with Micro-Form Scanning Probe MiSCAN Vision System

- Hybrid measuring machine with vision head and scanning probe (**MPP-NANO**, **SP25M**).
- Newly developed **MPP-NANO** probe on which styli as small as 125 µm diameter can be mounted achieves autonomous 3D scanning of fine detail. The highly proven **SP25M** scanning probe is also supported.
- Using the observation camera, the approach to the workpiece for **MPP-NANO** stylus where visual confirmation is difficult can be easily performed while also checking for dirt and scratches on the workpiece.
- Using the same vision head as the **QUICK VISION** Series, the best-selling vision measuring system, high level performance can be provided in vision measurement.



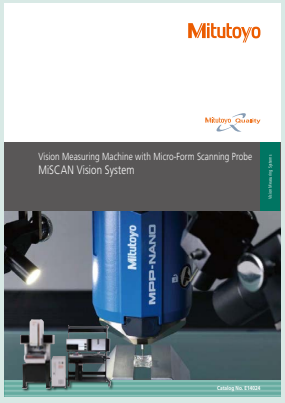
Precise positioning by monitoring the image

Measurement using **MPP-NANO** stylus

SPECIFICATIONS

Items \ Model No.			Hyper MVS 302	Hyper MVS 404	MVS Apex 404
Measuring range (X×Y×Z)	Vision measuring area		300×200×200 mm	400×400×250 mm	
	MPP-NANO/**SP25M**		175×200×200 mm	275×400×250 mm	
Imaging device			B&W CCD camera		
Observation unit			Programmable power turret 1X-2X-6X		
Illumination unit			Co-axial light, Transmitted light, PRL (programmable ring light)		
Contact type probe			**MPP-NANO**/**SP25M**	**SP25M** only	
Measuring accuracy*	E_{1X}/E_{1Y}		(0.8 + 2L/1000) µm		(1.5 + 3L/1000) µm
	E_{1Z}		(1.5 + 2L/1000) µm		(1.5 + 4L/1000) µm
	E_{2XY}		(1.4 + 3L/1000) µm		(2.0 + 4L/1000) µm
	MPP-NANO	$E_{0, MPE}$	(1.9 + 4L/1000) µm	—	
	SP25M	$E_{0, MPE}$	(1.9 + 4L/1000) µm		(2.5 + 6L/1000) µm
Scanning accuracy	**MPP-NANO**		0.6 µm	—	
	SP25M	MPE_{THP}	2.5 µm		2.7 µm
Probing accuracy	**MPP-NANO**		0.6 µm	—	
	SP25M	$P_{FTU, MPE}$	1.9 µm		2.2 µm
Repeatability (σ)	**MPP-NANO**		0.05 µm	—	
Accuracy guaranteed temperature	Ambient temperature		18 to 23 °C		
	Temperature variation		0.5 °C/1 H and 1 °C/24 H		

* Vision measuring accuracy using a **QV-HR 2.5X** objective and 2X tube lens.



Refer to the **MiSCAN Vision System** Brochure (**E14024**) for more details.

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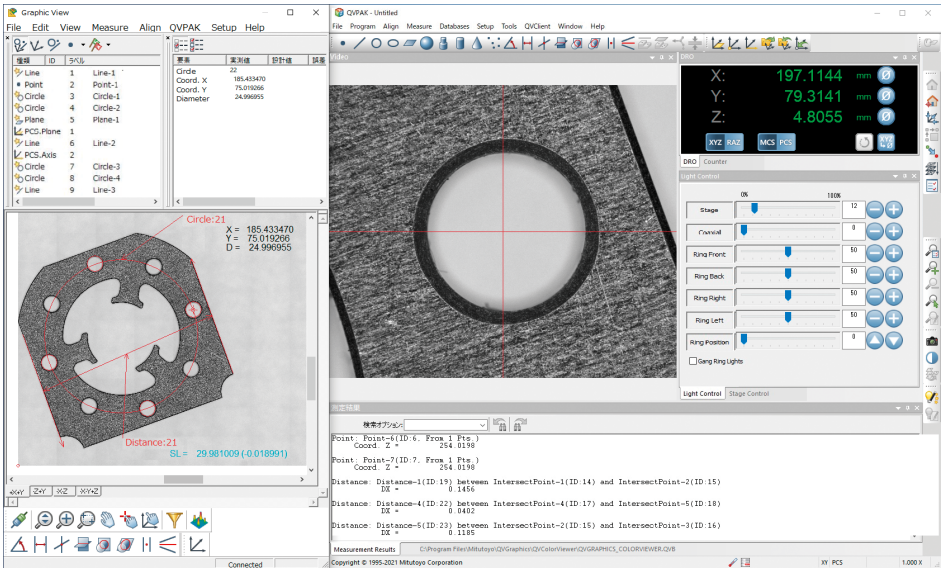
Mitutoyo

MeasurLink® ENABLED
Data Management Software by Mitutoyo

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
VISION

QVPAK
Data Processing Software for QUICK VISION

- The X, Y, and Z position data is detected from the measurement data gathered by the **QUICK VISION** system and the arithmetic processing of coordinates and dimensions is performed immediately.



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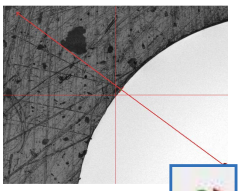
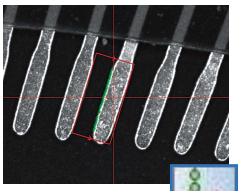
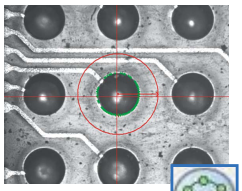
Edge Detection Tools



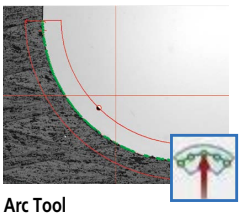
Simple Tool
This is a basic tool for detecting one point.



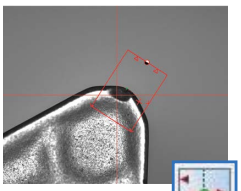
Box Tool
This tool detects linear edges with a minimum of one pixel interval. Compared to the simple tool, the Box tool can perform averaging and remove abnormal points, which enables stable measurements.



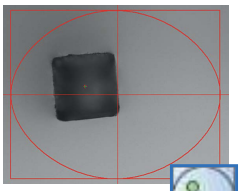
Circle Tool
This tool detects circular edges with a minimum of one pixel space. Edges can be specified easily with a single click.



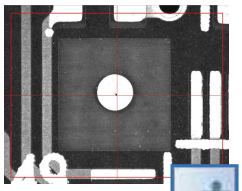
Arc Tool
This tool is suited to detection of arcs and corner radii.



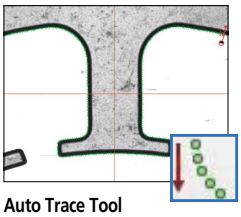
Maximum / Minimum Tool
This tool detects the maximum or minimum point within the range.



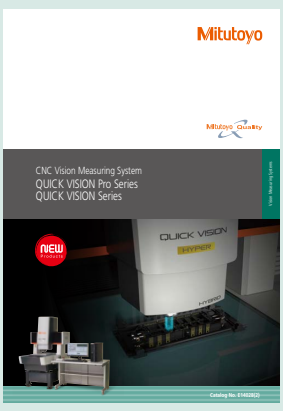
Area Centroid Tool
This tool detects the position of a form's centroid, and is suited to the positioning of different forms.



Pattern Search Tool
This tool performs pattern matching to detect a position, and is optimal for positioning alignment marks and similar tasks.



Auto Trace Tool
This is a shape-measuring tool that automatically tracks a contour with input consisting only of a start point and end point.



Refer to the **QUICK VISION** Series Brochure (**E14028**) for more details.

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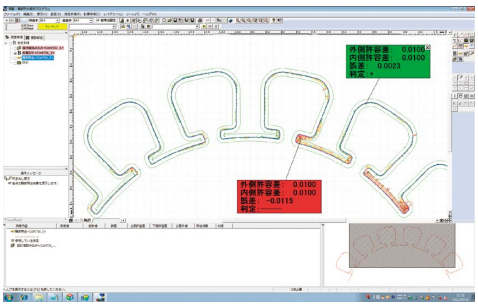
Application software (Optional)

Form assessment / analysis software
FORMTRACEPAK-AP

Verification of designed value and form analysis are performed on the basis of the contour data obtained via the **QV** auto trace tool, non-contact displacement sensor, PFF, and WLI.

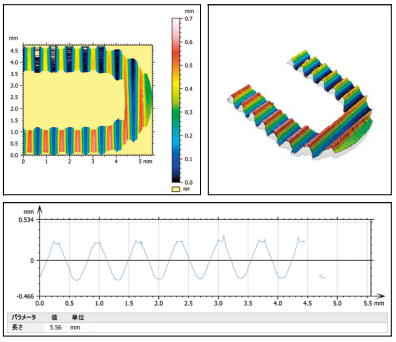


FORMTRACEPAK-PRO

This software performs 3D form analysis from the data obtained via the non-contact displacement sensor of the **QV HYBRID** Series.

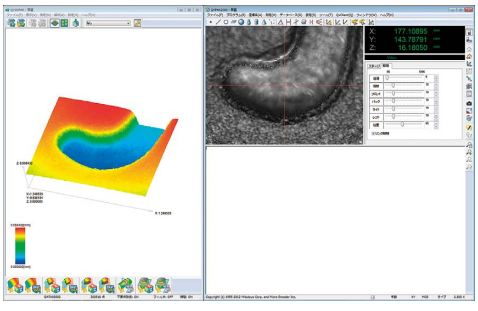
MCubeMap

Allows you to analyze parameters compliant with JIS B681-2: 2018 (ISO25178-6: 2010), such as Sa, Sq and other height parameters from the 3D data captured by **QVWLI**.



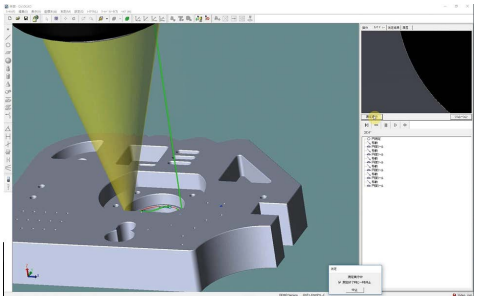
QV3DPAK

This software generates 3D forms from the PFF (Points From Focus) or WLI (White Light Interferometer) data.



Measurement support software
QV3DCAD

QV3DCAD uses 3D CAD models to easily create **QVPAK** part program both online and offline.



Offline teaching software
EASYPAG-PRO

This software creates **QVPAK** measurement procedure programs using 2D CAD data.

Statistical processing software
MeasurLink®

This software enables statistical arithmetic processing of measurement results.

External control software
QVEio

Allows you to externally control or output the operating status of a **QV** connected to a PLC or PC.

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PROPRIETARY INSPECTION CERTIFICATE

QS-L/AFC
Manual Vision Measuring System

- Manual vision measuring system with a high speed, high-definition auto focus 3-megapixel camera.
- A 4-quadrant high-intensity LED ring light provides excellent observation performance.
- The newly designed zoom unit and interchangeable objectives achieve a maximum magnification ratio of 14X. Viewing possibilities extend from low magnification wide view measurement to high magnification micro-measurement.

QS-L3017Z/AFC

Auto focus image

From wide view measurement to micro-measurement

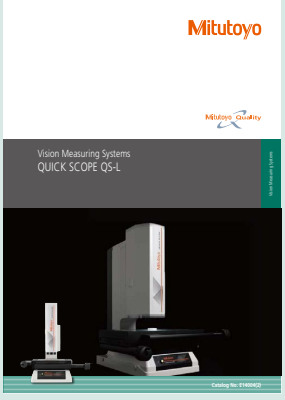
Optical magnification		0.5X	0.65X	0.75X	0.85X	0.98X	1X	1.28X	1.3X	1.5X	1.7X	2X	2.25X	2.5X	3X	3.5X	3.75X	4X	5X	5.25X	7X
View field (mm)	Horizontal (H)	13.2	10.2	8.8	7.8	6.8	6.6	5.2	5.1	4.4	3.9	3.3	2.9	2.6	2.2	1.8	1.7	1.7	1.3	1.2	0.9
	Vertical (V)	9.9	7.7	6.6	5.9	5.1	5.0	3.9	3.8	3.3	2.9	2.4	2.2	2.0	1.6	1.4	1.3	1.2	1.0	1.0	0.7
Total magnification (on the monitor)		20	26	30	34	39	40	51	52	60	68	79.3	89	99.3	119	138.7	149	158.7	198.7	208	277.3
Objective lens	1X objective (optional) Working distance	74 mm																			
	1.5X objective (standard accessory) Working distance	42 mm																			
	2X objective (optional) Working distance	42 mm																			

Note: The total magnification indicates the magnification on the monitor when the size of the **QSPAK** video window is 252.7×214.9 mm (default).

SPECIFICATIONS

Model No.		QS-L2010Z/AFC	QS-L3017Z/AFC	QS-L4020Z/AFC
Drive method		Auto focus equipped, X, Y axis: manual; Z axis: motor-operated		
Measuring range (X×Y×Z)		200×100×150 mm	300×170×150 mm	400×200×150 mm
Resolution/Scale unit		0.1 µm/Linear encoder		
Vision measuring accuracy*1*2	X axis, Y axis	(2.2 + 0.02L/1000) µm		
	Z axis	(4.5 + 0.006L/1000) µm		
Accuracy guaranteed temperature		20±1 °C		
Observation unit*3		7X zoom (8 steps) interchangeable objective lenses (1X objective 0.5X - 3.5X; 1.5X objective 0.75X - 5.25X; 2X objective 1X - 7X)		
Image detection method		3 megapixel, CMOS color camera (1/2 in)		
Illumination	Transmitted light	White LED		
	Co-axial light	White LED		
	Ring light	4-quadrant white LED		

*1 Inspected to a Mitutoyo standard. L=length between two arbitrary points (mm)
*2 3X lens magnification or greater
*3 1X and 2X objective lenses are optional



Refer to the **QUICK SCOPE QS-L** Brochure (**E14004**) for more details.

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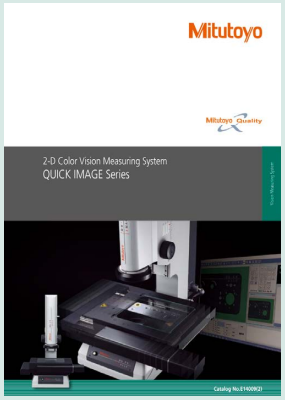
Quick Image
Non-contact 2D Vision Measuring System

- This series of manual 2D vision measuring machines offers high-efficiency measurement by employing a telecentric optical system that has a deep focal depth and a wide view monitor.
- The stitching function enables the entire display of a large workpiece so that highly accurate and speedy measurement can be performed.
- A model equipped with a motorized stage has been added to the series to offer easy and comfortable stage operation.
- A single click enables multiple measurements in one display. A batch measurement can be applied to multiple workpieces in the display after executing a pattern search based on the workpiece position.
- This series is equipped with a 3-megapixel color camera. Even with low magnification, high repeatability can be obtained.
- The choice of five stage sizes makes it easy to choose a machine to suit the user's application.
- The video window automatically displays the measurement data, which enables quick verification.



Refer to the **QUICK IMAGE** Series Brochure (**E14009**) for more details.

QI-C2017D

A motorized stage

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SPECIFICATIONS

		Manual stage model					Motorized stage model		
Model No.	0.2X	**QI-A1010D**	**QI-A2010D**	**QI-A2017D**	**QI-A3017D**	**QI-A4020D**	**QI-C2010D**	**QI-C2017D**	**QI-C3017D**
	0.5X	**QI-B1010D**	**QI-B2010D**	**QI-B2017D**	**QI-B3017D**	**QI-B4020D**			
Measuring range (X×Y)		100×100 mm	200×100 mm	200×170 mm	300×170 mm	400×200 mm	200×100 mm	200×170 mm	300×170 mm
Effective stage glass size		170×170 mm	242×140 mm	260×230 mm	360×230 mm	440×232 mm	242×140 mm	260×230 mm	360×230 mm
Maximum stage loading *		Approx. 10 kg		Approx. 20 kg		Approx. 15 kg	Approx. 10 kg	Approx. 20 kg	
Main unit mass		Approx. 65 kg	Approx. 69 kg	Approx. 150 kg	Approx. 158 kg	Approx. 164 kg	Approx. 72 kg	Approx. 153 kg	Approx. 161 kg

* Does not include extremely offset or concentrated loads

Model No.			**QI-A / QI-C**	**QI-B**
View field			32×24 mm	12.8×9.6 mm
Measurement mode			High resolution mode / Normal mode *1	
Travel range (Z axis)			100 mm	
Vision measuring accuracy	Measurement accuracy within the screen *2	High resolution mode	±2 µm	±1.5 µm
		Normal mode	±4 µm	±3 µm
	Repeatability within the screen (±2σ) *3	High resolution mode	±1 µm	±0.7 µm
		Normal mode	±2 µm	±1 µm
	Measurement accuracy (E_{1XY}) *2		±(3.5 + 0.02L) µm L=arbitrary measuring length (mm)	
Monitor magnification *4			7.6X	18.9X
Optical system	Magnification (Telecentric Optical System)		0.2X	0.5X
	Depth of focus	High resolution mode	±0.6 mm	±0.6 mm
		Normal mode	±11 mm	±1.8 mm
	Working distance		90 mm	
Camera			3 megapixel, CMOS color camera (1/2 in)	
Illumination		Transmitted light	Green LED telecentric illumination	
		Co-axial light	White LED	
		Ring light	4-quadrant white LED	
Power supply			AC100 to 240 V 50/60 Hz	
Accuracy guaranteed temperature			20±1 °C	

*1 Patent registered (Japan)
*2 Inspected to Mitutoyo standards by focus point position.
*3 The measuring accuracy is guaranteed to be accurate within the depth of focus.
*4 For 1X digital zoom (when using a 22-inch-wide monitor)

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Quick Guide to Precision Measuring Instruments

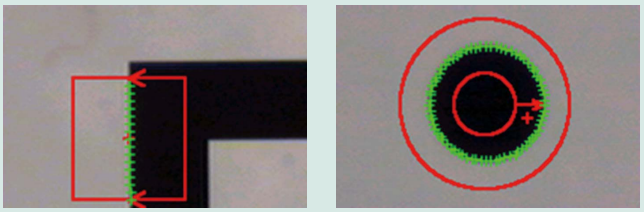
Vision Measuring Machines

Vision Measurement

Vision measuring machines mainly provide the following processing capabilities.

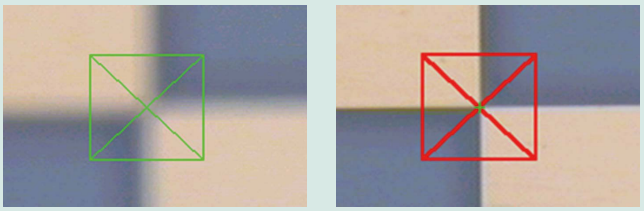
- **Edge detection**

  Detecting/measuring edges in the XY plane



- **Auto focusing**

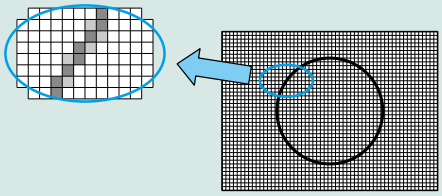
  Focusing and Z-axis measurement



- **Pattern recognition**

  Alignment, positioning, and inspecting a feature

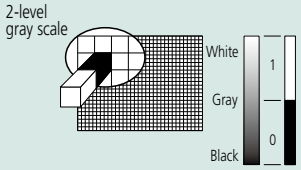
Image Storage



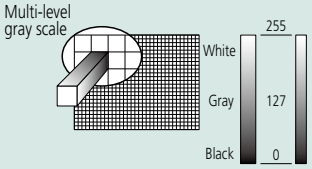
An image is comprised of a regular array of pixels. This is just like a picture on fine plotting paper with each square solid-filled differently.

Gray Scale

A PC stores an image after internally converting it to numeric values. A numeric value is assigned to each pixel of an image. Image quality varies depending on how many levels of gray scale are defined by the numeric values. The PC provides two types of gray scale: two-level and multi-level. The pixels in an image are usually displayed as 256-level gray scale.



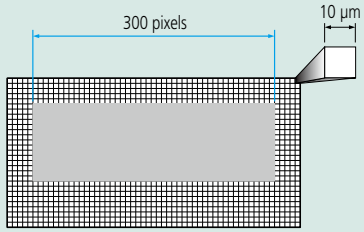
Pixels in an image brighter than a given level are displayed as white and all other pixels are displayed as black.



Each pixel is displayed as one of 256 levels between black and white. This allows high-fidelity images to be displayed.

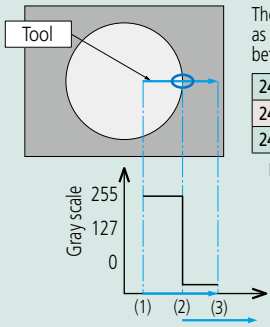
Dimensional Measurement

An image consists of pixels. If the number of pixels in a section to be measured is counted and is multiplied by the size of a pixel, then the section can be converted to a numeric value in length. For example, assume that the total number of pixels in the lateral size of a square workpiece is 300 pixels as shown in the figure below.
If a pixel size is 10 µm under imaging magnification, the total length of the workpiece is given by 10 µm×300 pixels=3000 µm=3 mm.



Edge Detection

How to actually detect a workpiece edge in an image is described using the following monochrome picture as an example. Edge detection is performed within a given domain. A symbol which visually defines this domain is referred to as a tool. Multiple tools are provided to suit various workpiece geometries or measurement data.



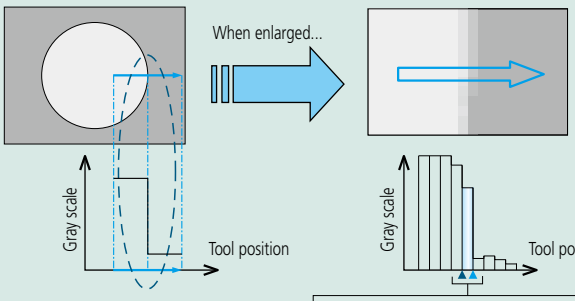
The edge detection system scans within the tool area as shown in the figure at left and detects the boundary between light and shade.

244	241	220	193	97	76	67	52	53	53
243	242	220	195	94	73	66	54	53	55
244	246	220	195	94	75	64	56	51	50

Example of numeric values assigned to pixels on the tool

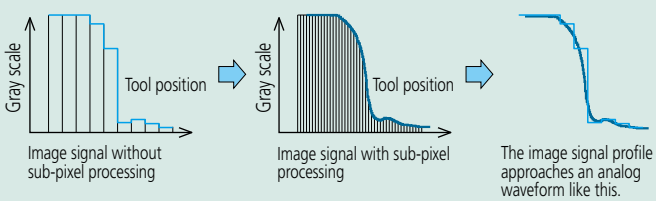
(1) Scan start position
(2) Edge detection position
(3) Scan end position

High-resolution Measurement



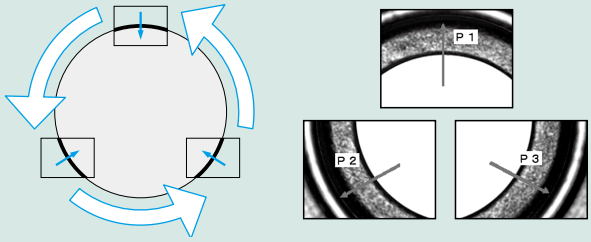
A position the system recognizes as an edge may be in error by up to one pixel width using normal image processing. This will prevent the execution of high-resolution measurement.

To increase the accuracy in edge detection, sub-pixel image processing is used. An edge is detected by determining an interpolation curve from adjacent pixel data as shown below.
As a result, it allows measurement with a resolution better than 1 pixel.



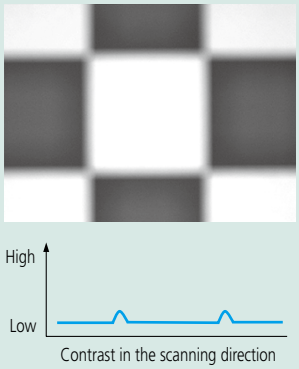
Measurement along Multiple Portions of an Image

Large features that cannot be contained on one screen have to be measured by precisely controlling the position of the sensor and stage so as to locate each reference point within individual images. By this means the system can measure even a large circle, as shown below, by detecting the edge while moving the stage across various parts of the periphery.

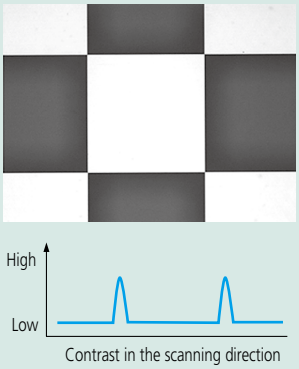


Variation in Contrast Depending on the Focus Condition

Edge contrast is low due to out-of-focus edges.

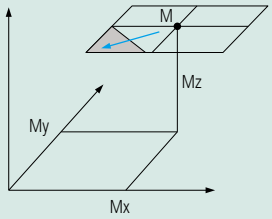


Edge contrast is high due to sharp, in-focus edges.

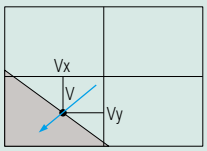


Composite Coordinates of a Point

Machine coordinate system



Vision coordinate system



Measuring machine stage position
M = (Mx, My, Mz)

Detected edge position (from the center of vision)
V = (Vx, Vy)

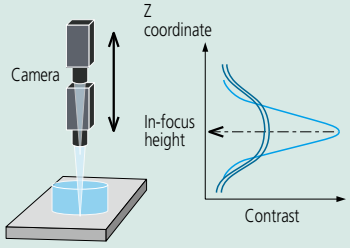
Actual coordinates are given by X=(Mx+Vx), Y=(My+Vy), and Z=Mz, respectively.

Since measurement is performed while individual measured positions are stored, the system can measure dimensions that cannot be included in one screen, without problems.

Principle of Auto Focusing

The system can perform XY-plane measurement, but cannot perform height measurement using only the camera image. The system is commonly provided with the Auto Focus (AF) mechanism for height measurement. The following explains the AF mechanism that uses a common image, although some systems may use a laser AF.

The AF system analyzes an image while moving the camera up and down in the Z axis. In the analysis of image contrast, an image in sharp focus will show a peak contrast and one out of focus will show a low contrast. Therefore, the height at which the image contrast peaks is the just-in-focus height.



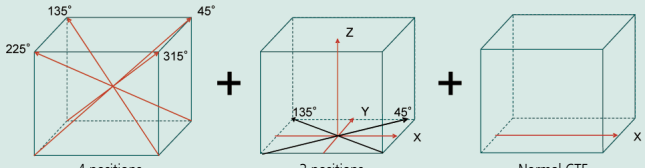
Overview of ISO 10360-7:2011

ISO 10360-7:2011 (Geometrical product specifications (GPS) -- Acceptance and reverification tests for coordinate measuring machines (CMM) -- Part 7: CMMs equipped with imaging probing systems) was published on June 1, 2011.
Some inspection items are listed in ISO 10360-7:2011. The following summarizes the test method for determining length measurement error (E) and probing error (P_{F2D}).

Length measurement error, *E*

Five test lengths in seven different directions within the measuring volume, each length measured three times, for a total of 105 measurements. Four directions are the space diagonal. Remaining three directions are user specified; default locations are parallel to the VMM axes.

When CTE (coefficient of thermal expansion) of the test-length artifact is $< 2\times10^{-6}$/K, additional measurement using an artifact with a normal CTE (8 to 13×10^{-6}/K) is performed.

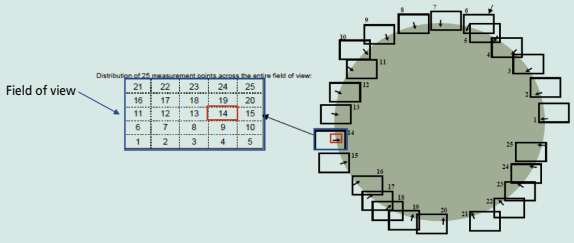


Probing error, P_{F2D}

Measure 25 points distributed evenly around the test circle (14.4° pitch).

Each of the 25 points shall be measured using the specified 25 areas of the field of view.

Calculate probing error as the range of the 25 radial distances (Rmax - Rmin) from the center of the least-square circle.



K

Mitutoyo