Mitutoyo

Mitutoyo Quality

# QUICK VISION SERIES

## CNC VISION MEASURING SYSTEM

VISION MEASURING SYSTEMS

Bulletin No. 2118(2)

Mitutoyo

# Quick Vision – Perfect Solutions for Any Purpose

With sophisticated edge detection capabilities, an illumination wizard and advanced user-friendly software, the Quick Vision Series satisfies the demand for compactness, high accuracy and vast performance in the field of non-contact dimensional measurement.

## Continuous Evolution

Mitutoyo has been selling CNC vision measuring machines - including the Quick Vision Series - since the mid-1980s and is proud of its superb delivery record.
Today, measurement professionals expect vision measuring machines to be highly accurate, easy to use, and smaller in size, and Mitutoyo recently relaunched the well-rounded Quick Vision Series to address such demands. The new Quick Vision Series perfectly integrates the advanced optical, sensing, software and vision measuring technologies which Mitutoyo has developed to help customers solve the challenges they face.

## Traceability

Mitutoyo provides traceability across all national standards on a global level. Calibration services are traceable to three main length standards: Laser, End to End and Line types.
Also, being the manufacturer of the most comprehensive range of precision measuring instruments available, Mitutoyo offers a number of measuring instruments traceable to national standards such as coordinate measuring machines, optical measuring instruments, form measuring instruments, and vision measuring machines.

Production of linear scales

Lodine absorption stabilised He-Ne (633 nm) laser for length measurement

## Optical

The optical system employed in the Quick Vision Series is based on optical technology that Mitutoyo has developed over many years. The optical system design is further enhanced with a flat field objective design and optical lens flare reduction.

Design and production of lenses

## Software

### Knowledge-based Software to Control Quick Vision

QVPAK is a software package that is constantly being enhanced. In combination with various other applications, QVPAK delivers multifunctional analysis along with high-speed processing and simple operation.

Kawasaki plant (Japan)

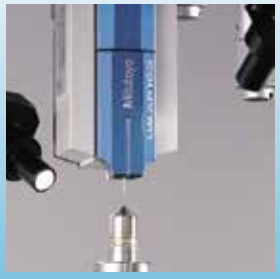
Quick Scope

Quick Image

Functionality

# Lineup of Vision Measuring Systems

Accuracy



UMAP Vision System

Quick Vision Apex
Hyper Quick Vision

Hyper Quick Vision WLI

Quick Vision Active

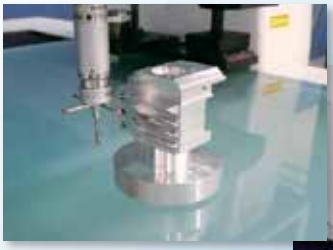
Quick Vision ACCEL

Mitutoyo

# Multi-sensor Design Enhances Functionality for a Flexible Measurement System

## Touch-trigger Probe

Quick Vision Series models can also support touch-trigger probes to provide measurement of workpiece features that cannot be inspected with vision alone. This capability is also useful when extremely precise height measurement is required. (retrofit is also available)

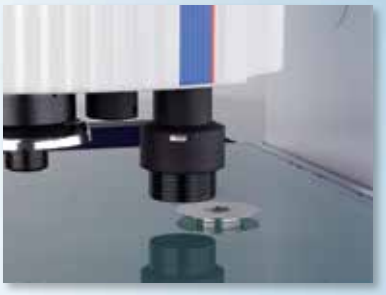


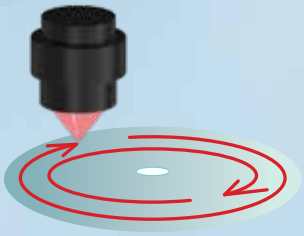
## Magnified Vision

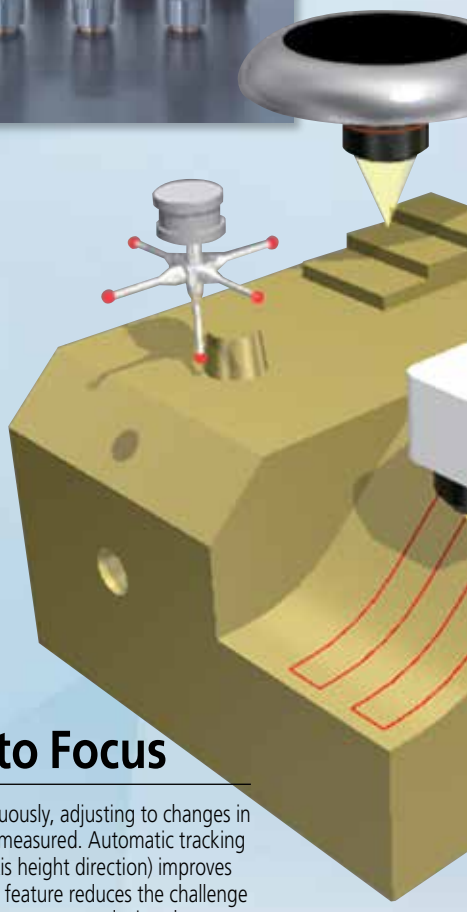
A magnified image is captured by a camera upon which dimensional measurements can be produced using automated edge detection, autofocus and image processing technology.

## Laser Probe

The Quick Vision Series can measure very small steps and curved planes at high speed with a scanning funtion utilizing a non-contact displacement sensor that uses a laser focusing point method.

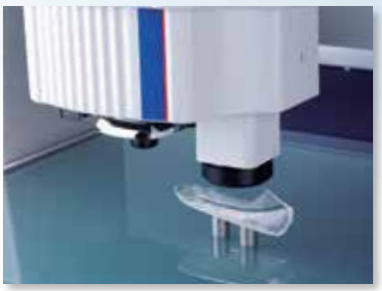


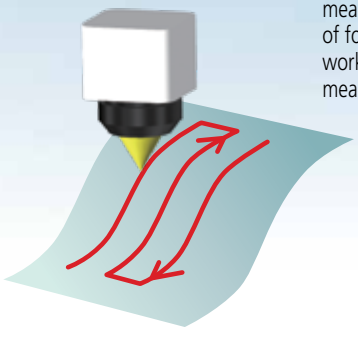




## CPS Probe

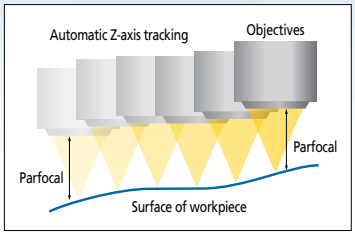
The Quick Vision Series can utilize a wavelength confocal scanning format with a non-contact displacement sensor that uses the epaxial chromatic aberration to measure very small steps and steep curved planes at high speed.





## Tracking Auto Focus

The TAF feature focuses continuously, adjusting to changes in the height of the object being measured. Automatic tracking of surface warpage (in the Z-axis height direction) improves measurement throughput. This feature reduces the challenge of focusing during manual measurement, reducing the workload for measuring system operators. Note: Continuous measurement of displacement is not performed.



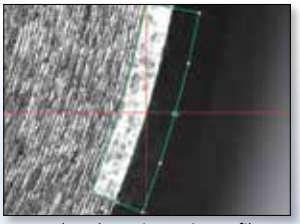
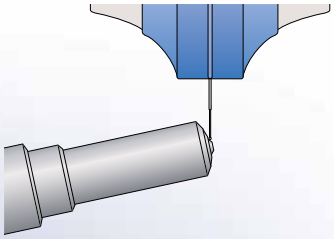


Image edge detection using a filter

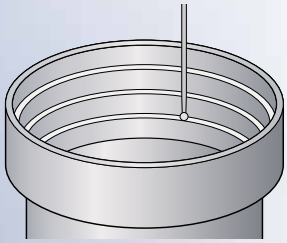
Highly accurate height measurement thanks to image auto focus

## UMAP Probe

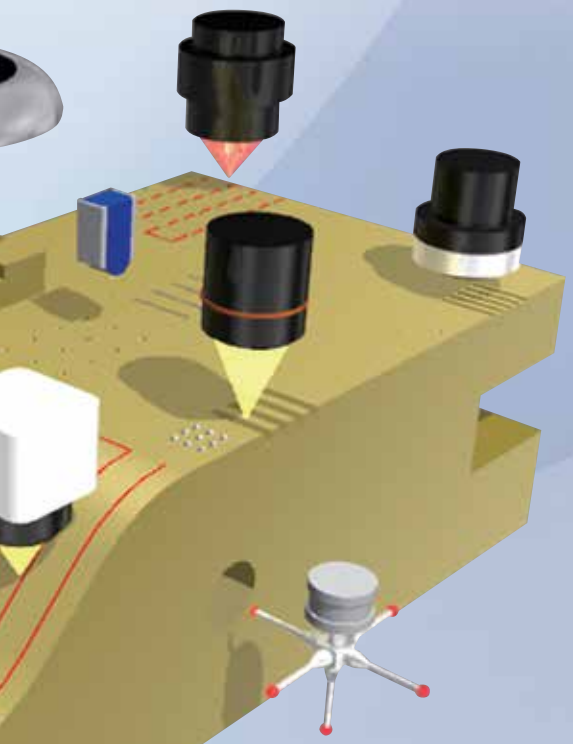
By using an extremely small stylus with a high aspect ratio made possible by our proprietary sensing technology, the Quick Vision Series can perform contact measurements on small or narrow parts.

Measurement of a fuel injection nozzle hole's shape

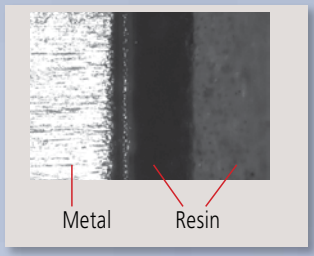


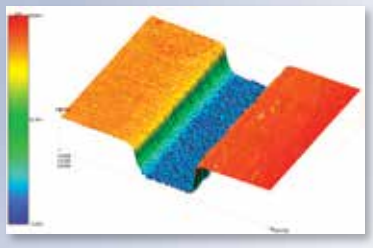
Measurement of a lens barrel's shape



## White Light Interferometer

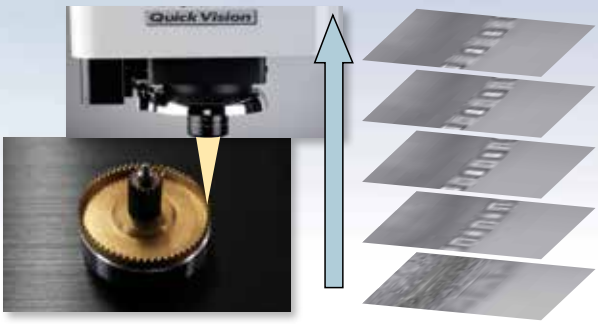
Using a white light interferometer, the Quick Vision Series can perform highly accurate 3D measurements in microscopic areas for surface analysis, small-diameter hole depth, and line and space measurements on circuit boards.

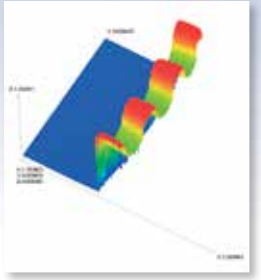



## Points From Focus

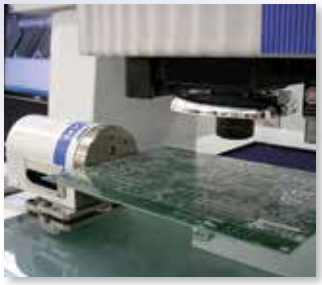
Contrast information can be used to obtain 3D form data from images at different heights that have been taken by the Quick Vision Series.



## QV Index

Using the QV index to rotate the workpiece makes it possible to automatically measure multiple surfaces without having to reorientate the workpiece.

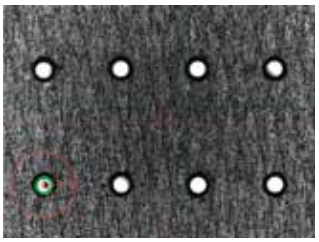


# Main Unit Structure Enables High-accuracy and High-performance 3D Non-contact Measurements

## Quick Vision Series Features

The Quick Vision Series is a non-contact dimension measurement system. It uses its camera to take images magnified by its optical lens and then uses image processing technology to detect the edges of the workpiece.

- The Quick Vision Series uses its optical system to greatly magnify images to measure dimensions of microscopic features found in electronics, semiconductor components, precision machinery and medical equipment components.
- Because the Quick Vision Series performs non-contact measurements, there is no risk of the workpiece being damaged, deformed or stained. In addition to measurements of electronic and semiconductor components that must be kept clean, the Quick Vision Series is also well suited to measure soft resin-molded products and thin press-molded workpieces.
- The Quick Vision Series can perform high-speed measurements of multiple points within the captured image. The image processing technology and high-speed stage control enable high-throughput measurements which makes the Quick Vision Series the optimal solution for workpieces with many features to be measured and for manufacturing process management of mass-produced products.
- The Quick Vision Series uses its image auto focus function and non-contact displacement sensor to perform highly accurate height measurements.

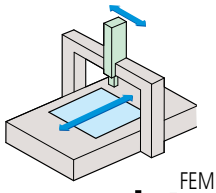


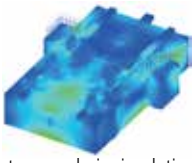
Vision measuring machine

Contact-type measuring machine

## Main Unit Structure Optimized for Highly Accurate Measurements

Structural deformation caused by movement along each axis has been minimized, ensuring the Quick Vision Series performs highly accurate measurements with minimal spatial coordinate distortions across all model sizes.





FEM structure analysis simulation

## Lineup Offers Choice of Measuring Range and Accuracy

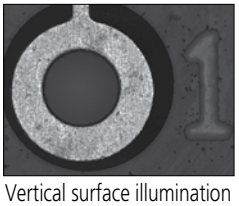
The Quick Vision Series consists of a diverse lineup with models ranging from compact to large format designs and models with general-purpose accuracy to extreme high accuracy. The Quick Vision Series can meet all the varied measurement needs for a wide variety of manufacturing industries.

| Name | Size | Measurement range (mm) |
|---|---|---|
| QV ACTIVE | 202 | 9.84" x 7.87" x 7.87" (250×200×200) |
| | 404 | 15.75" x 15.75" x 9.84" (400×400×250) |
| QV Apex | 302 | 11.81" x 7.87" x 7.87" (300×200×200) |
| Hyper QV | 404 | 15.75" x 15.75" x 9.84" (400×400×250) |
| QV STREAM PLUS | 606 | 23.62" x 25.59" x 9.84" (600×650×250) |
| QV ACCEL | 808 | 31.5" x 31.5" x 5.9" (800×800×150) |
| | 1010 | 39.37" x 39.37" x 5.9" (1000×1000×150) |
| | 1212 | 49.21" x 49.21" x 3.94" (1250×1250×100) |
| | 1517 | 59.06" x 68.9 x 3.94" (1500×1750×100) |

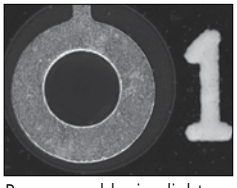
## Highly Functional and Versatile Illumination Unit

- Quick Vision Systems use LEDs for all of their light sources: contour, surface, and programmable ring light.
- Lighting uniformity is achieved at a high level which leads to excellent part program compatibility between multiple QVs.
- LED light sources boast excellent responsiveness which improves measurement throughput.
- LED light sources have a longer life expectancy than halogen types and reduce illumination fluctuations, thereby minimizing any errors caused by changes in light intensity.

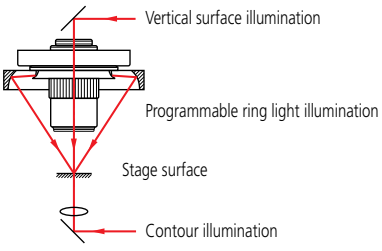
Contour illumination



Vertical surface illumination



Programmable ring light illumination

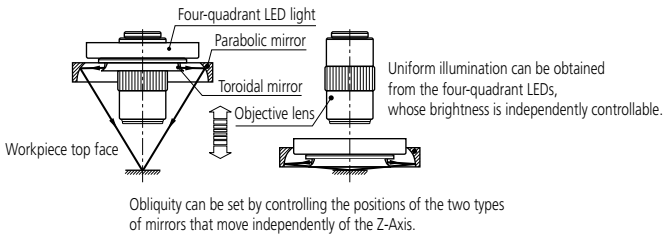


# Highly Functional Lighting for Exceptional Edge Detection and Automatic Measurements

## Programmable Ring Light (PRL)

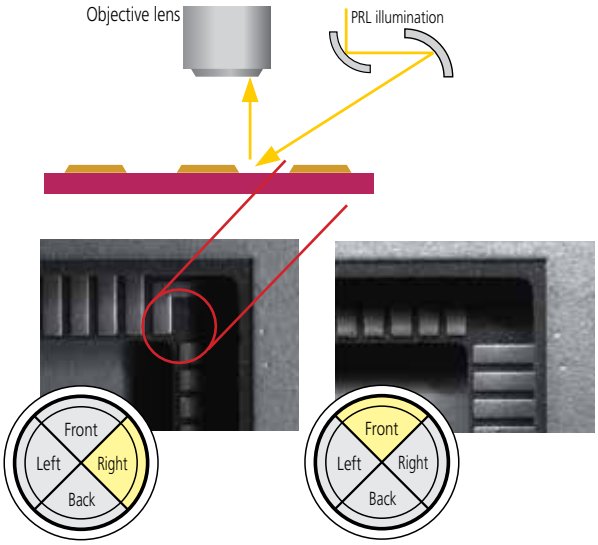
Changing the positions of the two curved mirrors sets the ring light's obliquity to any chosen value between 30° and 80°. This is effective for enhancing the edges of inclined surfaces or very small steps. Furthermore, the PRL light's illumination can be controlled independently in every direction (front and back, right and left). This makes it possible to configure highly variable lighting settings to match measurement locations.






Obliquity can be set by controlling the positions of the two types of mirrors that move independently of the Z-Axis.

Measuring the top and bottom widths of metallisation patterns on an IC package



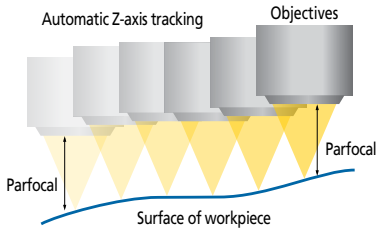

## Tracking Auto Focus (TAF)

The TAF feature focuses continuously, adjusting to changes in the height of the object being measured. Automatic tracking of surface variation and warpage (in the Z-axis height direction) improves measurement throughput. The feature also removes the need of focusing during manual measurement, reducing the work burden for measuring system operators.

Note: Continuous measurement of displacement is not performed.

| | | | | | |
|---|---|---|---|---|---|
| Laser source | Semiconductor laser (peak wavelength: 690nm) | | | | |
| Laser safety | Class 2 (JIS C6802:2011, EN/IEC 60825-1:2007) | | | | |
| Autofocus system | Objective coaxial autofocusing (knife-edge method) | | | | |
| Applicable objectives | QV-HR1X | QV-SL1X | QV-HR2.5X | QV-SL2.5X | QV-HR5X |
| Tracking range * | 0.25" (6.3 mm) (±0.12"/3.15mm) | 0.25" (6.3 mm) (±0.12"/3.15mm) | 0.04" (1 mm) (±0.02"/0.5mm) | 0.04" (1 mm) (±0.02"/0.5mm) | 0.01" (0.25mm) (±0.005"/0.125mm) |

* When using Tracking Auto Focus, be sure to set upper and lower limits in the software to prevent collisions between the objective and the workpiece. The tracking range depends on the surface texture and reflectance of a workpiece.



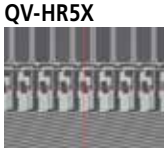
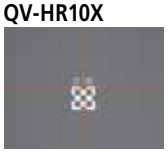
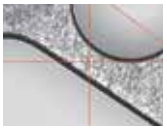
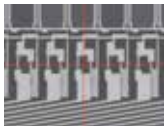
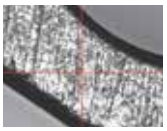
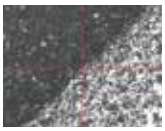
# Powerful Vision Optics Incorporate Mitutoyo's High Performance Lenses For Greater Optical Flexibility

## Programmable Power Turret

The QV's programmable power turret has excellent magnification repeatability which makes it suitable for highly accurate measurements.
Furthermore, the rich lineup of objectives contains lenses with magnifications ranging from 0.5X to 25X, making it possible to select the optimal optical system to match the measurement target feature.
It is easy to install new objective lenses any time by using the optional calibration chart and compensation chart.
Additional objectives can be purchased at a later date.

Various objective lenses for the QVs

Objective Lenses

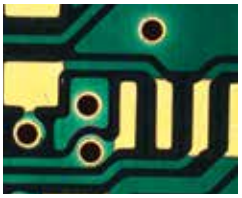
| QV-HR1X | QV-HR2.5X | QV-HR5X | QV-HR10X |
|---|---|---|---|
|  PPT1X Field of view: 6.27 x 4.70 mm |  PPT1X Field of view: 2.49 x 1.86 mm |  PPT1X Field of view: 1.24 x 0.93 mm |  PPT1X Field of view: 0.62 x 0.47 mm |
|  PPT2X Field of view: 3.13 x 2.35 mm |  PPT2X Field of view: 1.24 x 0.93 mm |  PPT2X Field of view: 0.62 x 0.47 mm |  PPT2X Field of view: 0.31 x 0.23 mm |
|  PPT6X Field of view: 1.04 x 0.78 mm |  PPT6X Field of view: 0.41 x 0.31 mm |  PPT6X Field of view: 0.20 x 0.15 mm |  PPT6X Field of view: 0.10 x 0.07 mm |

| | Monitor magnification*1,*3 | 15X | 29X | 58X | 72X | 87X | 144X | 173X | 290X | 430X | 580X | 720X | 870X | 1440X | 1730X | 4300X |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Field of view (mm) | 12.54x9.4 | 6.27x4.7 | 3.13x2.35 | 2.49x1.86 | 2.09x1.56 | 1.24x0.93 | 1.04x0.78 | 0.62x0.47 | 0.41x0.31 | 0.31x0.23 | 0.25x0.18 | 0.20x0.15 | 0.12x0.09 | 0.10x0.07 | 0.04x0.03 |
| PRO model programmable power turret | 0.5X objective lens | | | | | | | | | | | | | | | |
| | 1X objective lens | | | | | | | | | | | | | | | |
| | 2.5X objective lens | | | | | | | | | | | | | | | |
| | 5X objective lens | | | | | | | | | | | | | | | |
| | 10X objective lens*2 | | | | | | | | | | | | | | | |
| | 25X objective lens*2 | | | | | | | | | | | | | | | |

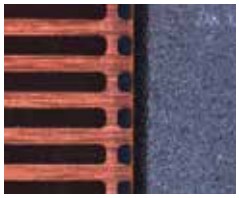
*1: With QVPAK version 13 or later, the size of the video window can be changed. Monitor magnification shown in the above table is a reference value at the same display magnification when using **56 cm** / 22-inch wide LCD monitor.
*2: When the 10X objective lens or 25X objective lens is used in combination with the 2X or 6X magnification of the power turret, the brightness may be insufficient depending on the workpiece.
*3: For the PRO3 models, the monitor magnifications are 1.34 times and the field of view are approximately 0.75 times those of the PRO model.

## Color Camera Specifications That Improve the Observation Function (PRO3 Model)

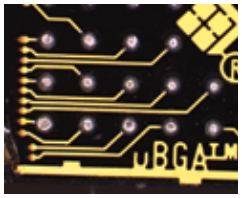
To improve the observations, Mitutoyo offers the PRO3 model equipped with a high-resolution color CCD camera. The CCD camera enables the PRO3 to perform highly accurate measurements without a decrease in the resolution of the screen.



Printed Circuit Board



QFP Package Leads



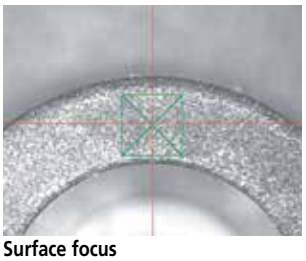
IC Package

LCD Color Filter

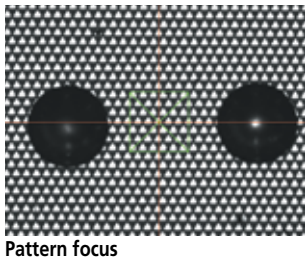
Resin-molded Products

# High-performance Multi-autofocus

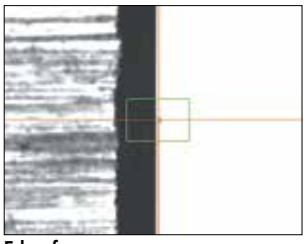
The QV Series is equipped with a high-performance standard image autofocus function. Image autofocus is used to assure high accuracy measurement. Thanks to the availability of various autofocus tools, the optimal focus for each surface texture and measured feature can be selected which makes it possible to perform highly reliable height measurements. Furthermore, the autofocus operates at high speed, increasing total measurement throughput.



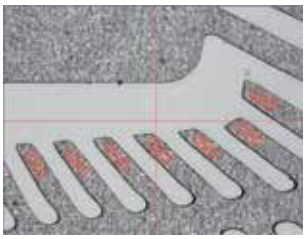
**Surface focus**
Use image autofocus to measure the height of a chosen area, making it possible to perform stable height measurements that are minimally affected by the roughness of machined and other similar surfaces.



**Pattern focus**
Use autofocus on low-contrast transparent objects such as film, glass and mirrored surfaces by projecting a pattern in the light path onto the object surface. (Apex Series)



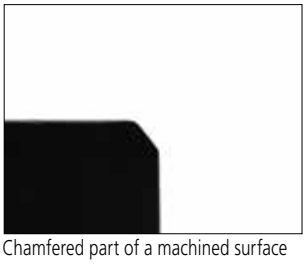
**Edge focus**
Edge focus is suited to focusing edges that have been chamfered or that have a corner radius. Using this focus tool prior to performing edge detection improves edge detection reproducibility.



**Multi-point autofocus**
Use multi-point autofocus to set multiple focus positions, sizes and angles to arbitrary values. Use this tool to obtain multiple sets of height information with a single focus operation, making it possible to perform highly efficient height and flatness measurements.

Resin-molded product

IC package



Chamfered part of a machined surface

PCB Label

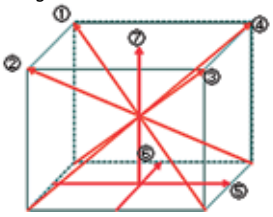
# Accuracy Conforms to ISO10360-7

The accuracy specifications of some models in the Quick Vision Apex Series confrom to ISO10360-7. Contact Mitutoyo for details on applicable models.

**Guaranteed Accuracies**

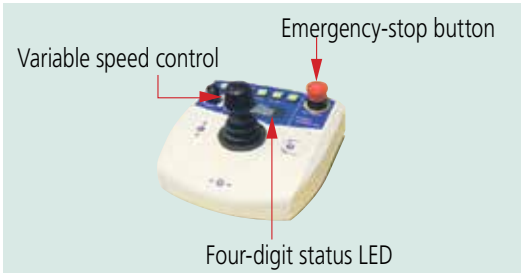
- Length measurement error $E_{U,MPE}$
- Probing error $P_{F2D,MPE}$

Length measurement error E




# Multi-function Control Box

This multi-function control box was developed for maximum ease of use.



Mitutoyo

# Compact CNC Vision Measuring System
# QV Active

QV Active 202

QV Active 404

## QV Active

- The edge detection capability and functions of the measurement software QVPAK are as powerful as those of the higher model QV Apex. This enables the QV Active to surpass the conventional image of a compact model.
- Each lighting unit employs long-life white LEDs with low power consumption. The LED light sources boast excellent responsiveness which improves measurement throughput.
- QV Active is equipped with a high resolution CMOS camera system that achieves high accuracy and high-resolution color images.
- While the QV Active is a compact model, it has a more-than-adequate Z-axis stroke of 200 mm.
- A Mitutoyo developed zoom optical system with interchangeable objectives offers maximum workpiece measurement flexibility.

### Specifications

| Model | | QV-L202Z1L-D | QVT1-L202Z1L-D | QV-L404Z1L-D | QVT1-L404Z1L-D |
|---|---|---|---|---|---|
| Measuring range (X×Y×Z) | | 9.84" x 7.87" x 5.91" (250 x 200 x 150 mm) (250×200×118: when a 1X objective lens is used) | | 15.75" x 15.75" x 7.87"(400 x 400 x 200 mm) (400×400×168: when a 1X objective lens is used) | |
| Touch probe equipped | | No | Yes | No | Yes |
| Resolution | | 0.1µm | | | |
| Scale type | | Linear encoder | | | |
| Observation unit type | | Zoom (8 positions) | | | |
| Image sensor | | Color CMOS camera | | | |
| Illumination Unit | Co-axial Light | White LED | | | |
| | Transmitted Light | White LED | | | |
| | PRL | 4-quadrant fixed white LED | | | |
| Accuracy*1 | $E_{1X}$, $E_{1Y}$ | (2+3L/1000) µm | | | |
| | $E_{1Z}$ | (3+5L/1000) µm | | | |
| | $E_2$ | (2.5+4L/1000) µm | | | |
| | Accuracy guaranteed with optics specified | Objective lens 1.5X and 3.5X Zoom ratio | | | |
| Touch-probe measuring accuracy*1 | $E_{1X}$, $E_{1Y}$, $E_{1Z}$ | — | (2.4+3L/1000) µm | — | (2.4+3L/1000) µm |
| Accuracy guaranteed temperature range | | 20±1°C | 18 - 23°C | 20±1°C | 18 - 23°C |
| Size of stage glass | | 12.24" x 10.59" (311×269mm) | | 18.35" x 18.9" (466×480mm) | |
| Maximum stage loading*2 | | 22 lbs. (10 kg) | | 44 lbs. (20 kg) | |
| Dimensions (WxDxH) | | 22.44" x 30.2" x 33.27" (570×767×845mm) | | 30.55" x 51.3" x 39.53" (776×1303×1004mm) | |
| Mass (including machine stand) | | 342 lbs. (155kg) | | 714 lbs. (324kg) | |
| Temperature compensation function | | — | Manual | — | Manual |

*1 Inspected to a Mitutoyo standard. L = measured length (mm)
*2 Does not apply for unbalanced or concentrated loads.

# Standard CNC Vision Measuring System
# QV Apex

QV Apex 302PRO

## QV Apex

- QV Series standard models range in size from compact to large.
- A model equipped with the tracking focus function that allows continuous focusing in response to change in workpiece height is also available. This results in improved measurement throughput.
- The lineup, including the PRO3 models equipped with a color CCD camera, satisfies a wide range of demands (optional).
- The QV Apex 404 and QV Apex 606 X-axis and Y-axis drive speeds reach 400 mm/second. This greatly contributes to throughput improvement particularly for workpieces that involve a large range of travel.
- The accuracy of this model (Apex type only) conforms to ISO10360-7:2011 (specifications on request)

### Specifications

| Model | | QV Apex 302 | | | | QV Apex 404 | | | | QV Apex 606 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Optical system | | PRO | | PRO3 | | PRO | | PRO3 | | PRO | | PRO3 | |
| Tracking Auto Focus device | | — | ● | — | ● | — | ● | — | ● | — | ● | — | ● |
| Measuring range | X-axis | 11.81″ / 300mm | | | | 15.75″ / 400mm | | | | 23.62″ / 600mm | | | |
| | Y-axis | 7.87″ / 200mm | | | | 15.75″ / 400mm | | | | 25.59″ / 650mm | | | |
| | Z-axis | 7.87″ / 200mm | | | | 9.84″ / 250mm | | | | 9.84″ / 250mm | | | |
| Resolution of scale / Scale type | | 0.1μm/Linear Encoder | | | | | | | | | | | |
| Observation Unit*1 | | PPT1X-2X-6X | | | | | | | | | | | |
| Imaging Device | | B&W CCD | | 3CCD Color | | B&W CCD | | 3CCD Color | | B&W CCD | | 3CCD Color | |
| Illumination Unit*2 | Co-axial light | White LED | | | | | | | | | | | |
| | Transmitted Light | White LED | | | | | | | | | | | |
| | PRL | White LED | | | | | | | | | | | |
| Accuracy*3 | $E_{1X}$, $E_{1Y}$ | (1.5+3L/1000)μm | | | | | | | | | | | |
| | $E_{1Z}$ | (1.5+4L/1000)μm | | | | | | | | | | | |
| | $E_{2XY}$ | (2+4L/1000)μm | | | | | | | | | | | |
| Operating Temperature range | Ambient temperature | 20±1˚C | | | | | | | | | | | |
| | Temperature variation | 2˚C / 8H | | | | | | | | | | | |
| Stage glass size | | 15.71″ x 10.67″ (399 x 271mm) | | | | 19.41″ x 21.69″ (493 x 551mm) | | | | 27.44″ x 29.84″ (697 x 758mm) | | | |
| Maximum stage loading*4 | | 44 lbs. (20kg) | | | | 88 lbs. (40kg) | | | | 110 lbs. (50kg) | | | |
| Main unit external dimensions | | 37.44″ x 33.82″ x 41.06″ ( 951 x 859 x 1043mm) | | | | 55.39″ x 40.43″ x 54.37″ ( 1407 x 1027 x 1381mm) | | | | 78.15″ x 51.54″ x 61.81″ ( 1985 x 1309 x 1570mm) | | | |
| Main unit mass (including the sub-base) | | 794 lbs. (360kg) | | | | 1276 lbs. (579kg) | | | | 3197 lbs. (1450kg) | | | |

*1 The specific combination of 1X, 2X and 4X or 1X, 2X, 4X and 6X is available by custom order.
*2 The color LED lighting or halogen lighting specification is available by custom order.
*3 Determined by Mitutoyo's inspection method. L is the measured length (mm).
The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Middle magnification of the tube lens.
*4 An excessively biased or concentrated load is excluded.
* The Laser Auto Focus (LAF) specification is available by custom order.

Mitutoyo

# High-accuracy CNC Vision Measuring System
# Hyper QV

Hyper QV 404PRO

## Hyper QV

- The Hyper QV is a highly accurate model equipped with a high-resolution/accuracy scale.
- A lineup similar to the QV Apex containing models that range in size from compact to large means a model ideally suited for the size of the workpiece can be selected.
- The model equipped with the tracking focus function allowing continuous focusing in response to change in workpiece height is also available. This results in improved measurement throughput.
- 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, thus guaranteeing the stated accuracy specification applies over the temperature range 18 to 23°C for stable measurement results.
- The accuracy of this model conforms to ISO10360-7:2011 (specifications on request).

### Specifications

| Model | | Hyper QV 302 | | Hyper QV 404 | | Hyper QV 606 | |
|---|---|---|---|---|---|---|---|
| Optical system | | PRO | | | | | |
| Tracking Auto Focus device | | — | ● | — | ● | — | ● |
| Measuring range (X×Y×Z) | | 11.81″×7.87″×7.87″ (300×200×200mm) | | 15.75″×15.75″×9.84″ (400×400×250mm) | | 23.62″×25.59″×9.84″ (600×650×250mm) | |
| Resolution of scale / Scale type | | 0.02μm/linear encoder | | | | | |
| Observation unit *1 | | PPT1X-2X-6X | | | | | |
| Imaging device | | B&W CCD | | | | | |
| Illumination unit *2 | Co-axial light | White LED | | | | | |
| | Transmitted light | White LED | | | | | |
| | PRL | White LED | | | | | |
| Accuracy *3 | $E_{1X}$, $E_{1Y}$ | (0.8+2L/1000)μm | | | | | |
| | $E_{1Z}$ | (1.5+2L/1000)μm | | | | | |
| | $E_{2XY}$ | (1.4+3L/1000)μm | | | | | |
| Operating temperature range | Ambient temperature | 18 ~ 23°C | | | | | |
| | Temperature variation | 0.5°C/1H and 1°C/24H | | | | | |
| Stage glass size | | 15.71″ × 10.67″ (399×271mm) | | 19.41″ × 21.69″ (493×551mm) | | 27.44″ × 29.84″ (697× 58mm) | |
| Maximum stage loading *4 | | 44 lbs. (20kg) | | 88 lbs. (40kg) | | 110 lbs. (50kg) | |
| Main unit external dimensions | | 37.44″ × 33.82″ × 41.06″ (951×859×1043mm) | | 55.39″ × 40.43″ × 54.37″ (1407×1027× 381mm) | | 78.15″ × 51.54″ × 61.81″ (1985×1309× 570mm) | |
| Main unit mass (including the sub-base) | | 794 lbs. (360kg) | | 1276 lbs. (579kg) | | 3197 lbs. (1450kg) | |
| Temperature compensation function | | automatic | | | | | |

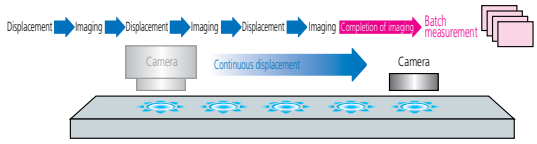
*1 The specific combination of 1X, 2X and 4X or 1X, 2X, 4X and 6X is available by custom order.
*2 The color LED lighting or halogen lighting specification is available by custom order.
*3 Determined by Mitutoyo's inspection method. L is the measured length (mm).
The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Middle magnification of the tube lens.
*4 An excessively biased or concentrated load is excluded.
* The Laser Auto Focus (LAF) specification is available by custom order.

# Non-stop CNC Vision Measuring System
# QV STREAM PLUS

QV STREAM PLUS 606PRO

## QV STREAM PLUS

- The QV STREAM PLUS is an innovative vision measuring machine that acquires images without stopping the stage. This is accomplished by synchronizing the main unit's X-axis and Y-axis traversal with strobe illumination.
  Conventional vision measuring machines repeat the displacement, stop, measurement and displacement cycle which restricts throughput.
  In contrast, the QV STREAM PLUS realizes non-stop vision measurement (stream mode) by eliminating acceleration, deceleration and stop times. Consequently, this dramatically reduces the overall measurement time.
- The model equipped with the tracking focus function that allows continuous focusing in response to change in workpiece height is also available. This results in improved measurement throughput.
- The lineup is similar to the QV Apex range. The models range in size from compact to large. Hence, there is always one that ideally suits the workpiece to be measured.




## Specifications

| Model | | QV STREAM PLUS 302 | | QV STREAM PLUS 404 | | QV STREAM PLUS 606 | |
|---|---|---|---|---|---|---|---|
| Optical system | | PRO | | | | | |
| Tracking Auto Focus device | | — | ● | — | ● | — | ● |
| Measuring range (X×Y×Z) | | 11.81 × 7.87″ × 7.87″(300×200×200mm) | | 15.75″ × 15.75″ × 9.84″(400×400×250mm) | | 23.62″ × 25.59″ × 9.84″(600×650×250mm) | |
| Resolution of scale / Scale type | | 0.1μm/linear encoder | | | | | |
| Observation unit*1 | | PPT1X-2X-6X | | | | | |
| Imaging device | | B&W CCD | | | | | |
| Illumination unit*2 | Co-axial light*3 | Color LED | | | | | |
| | Transmitted light | Blue LED | | | | | |
| | PRL*3 | Color LED | | | | | |
| Accuracy*4 | $E_{1X}$, $E_{1Y}$ | (1.5+3L/1000)μm | | | | | |
| | $E_{1Z}$ | (1.5+4L/1000)μm | | | | | |
| | $E_{2XY}$ | (2+4L/1000)μm | | | | | |
| Operating temperature range | Ambient temperature | 20±1˚C | | | | | |
| | Temperature variation | 2˚C / 8H | | | | | |
| Stage glass size | | 15.71″× 10.67″(399×271mm) | | 19.41″× 21.69″(493 x 551mm) | | 27.44″× 29.84″(697×758mm) | |
| Maximum stage loading*5 | | 44 lbs. (20kg) | | 88 lbs. (40kg) | | 110 lbs. (50kg) | |
| Main unit external dimensions | | 37.44″× 33.82″×41.06″ (951×859×1043mm) | | 55.39″×40.43″×54.37″ (1407×1027×1381mm) | | 78.15″×51.54″× 61.81″ (1985×1309×1570mm) | |
| Main unit mass (including the sub-base) | | 794 lbs. (360kg) | | 1276 lbs. (579kg) | | 3197 lbs. (1450kg) | |

*1 The specific combination of 1X, 2X and 4X or 1X, 2X, 4X and 6X is available by custom order.
*2 Only one of the illumination functions (reflected, transmitted, and PRL illumination) can be set in STREAM mode.
The 4-way PRL illumination can be set to the entire lighting (4-direction lighting) or single-direction lighting.
*3 Enable to use cyan only while using STREAM mode.
*4 Determined by Mitutoyo's inspection method. L is the measured length (mm).
The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Middle magnification of the tube lens.
*5 An excessively biased or concentrated load is excluded
* The Laser Auto Focus (LAF) specification is available by custom order.

Mitutoyo

# Large CNC Vision Measuring System
# QV ACCEL

QV ACCEL 1212PRO

QV ACCEL 808PRO

## QV ACCEL

- The QV ACCEL is a moving-bridge type vision measuring machine. Because the stage remains stationary, the fixtures used to hold workpieces in place can be simplified, leading to a reduction in the amount of work required to create these fixtures. In addition, the QV ACCEL is suited to measurements of workpieces with short life cycles as well as thin and light-weight workpieces.
- The QV ACCEL is optimal for measurements of printed circuit boards whose density and resolution continue to increase, as well as metal masks and screen plates. The QV ACCEL is also optimal for measurements on glass circuit boards, film and other components of display panels.
- By using highly functional edge detection and image auto focus, the QV ACCEL can perform highly accurate height measurements.
  The QV ACCEL is standard-equipped with a pattern focus function that can be used to perform image auto focusing even on transparent objects such as film and glass.
- The model equipped with the tracking focus function that allows continuous focusing in response to change in workpiece height delivers improved measurement throughput and is also available.

### Specifications

| Model | | | QV ACCEL 808 | | QV ACCEL 1010 | | QV ACCEL 1212 | |
|---|---|---|---|---|---|---|---|---|
| Optical system | | | PRO | PRO3 | PRO | PRO3 | PRO | PRO3 |
| Measuring range (X×Y×Z) | | | 31.5" × 31.5"× 5.90" (800×800×150mm) | | 39.37" × 39.37" × 5.90"(1000×1000×150mm) | | 49.21" × 49.21"× 3.94" (1250×1250×100mm) | |
| Resolution of scale / Scale type | | | 0.1μm/linear encoder | | | | | |
| Observation unit *1 | | | PPT1X-2X-6X | | | | | |
| Imaging device | | | B&W CCD | Color CCD | B&W CCD | Color CCD | B&W CCD | Color CCD |
| Illumination unit *2 | Co-axial light | | White LED | | | | | |
| | Transmitted light | | White LED | | | | | |
| | PRL | | White LED | | | | | |
| Accuracy *3 | $E_{1X}$, $E_{1Y}$ | | (1.5+3L/1000)μm | | | | (2.2+3L/1000)μm | |
| | $E_{1Z}$ | | (1.5+4L/1000)μm | | | | (2.5+5L/1000)μm | |
| | $E_{2XY}$ | | (2.5+4L/1000)μm | | | | (3.5+4L/1000)μm | |
| Repeatability *3 | Short dimension | XY axis | 3σ=0.2μm | | | | | |
| | Long dimension | | 3σ=0.7μm | | | | 3σ=1.5μm | |
| Operating temperature range | Ambient temperature | | 20±1˚C | | | | | |
| | Temperature variation | | 2˚C/8H | | | | | |
| Stage glass size | | | 34.76" × 37.72"(883×958mm) | | 46.69" × 46.69"(1186 × 1186mm) | | 56.69" × 56.69"(1440×1440mm) | |
| Maximum stage loading *4 | | | 22 lbs. (10kg) | | 66 lbs. (30kg) | | 66 lbs. (30kg) | |
| Main unit external dimensions | | | 58.07" x 73.23" x 62.13" (1475×1860×1578mm) | | 75.28" x 84.29" x 63.11" (1912×2141×1603mm) | | 85.28" x 93.31" x 61 (2166×2370×1554mm) | |
| Main unit mass | | | 5666 lbs. (2570kg) | | 6504 lbs. (2950kg) | | 7937 lbs. (3600kg) | |

*1 The specific combination of 1X, 2X and 4X or 1X, 2X, 4X and 6X is available by custom order.
*2 The color LED lighting or halogen lighting specification is available by custom order.
*3 Determined by Mitutoyo's inspection method. L is the measured length (mm).
The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Low magnification of the tube lens.
*4 An excessively biased or concentrated load is excluded.
* The Laser Auto Focus (LAF) specification is available by custom order.

# Ultra-high Accuracy CNC Vision Measuring System
# ULTRA QV 404

ULTRA QV 404PRO

## ULTRA QV 404

- The ULTRA QV 404 is an ultra-precise CNC vision measuring machine that realizes a measurement accuracy of $E_1XY$: (0.25 + L/1000)µm.
- To improve the maneuverability of each axis, Mitutoyo uses aerostatic bearings developed in our highly accurate 3D measuring machines as the guidance systems for the X-, Y- and Z-axes.
- 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, guaranteeing the stated accuracy specification applies over the temperature range of 19 to 23°C for stable measurement results.
- The model equipped with the tracking focus function allowing continuous focusing in response to change in workpiece height is also available. This results in improved measurement throughput.
- The accuracy of this model conforms to ISO10360-7:2011 (specifications on request).

## Specifications

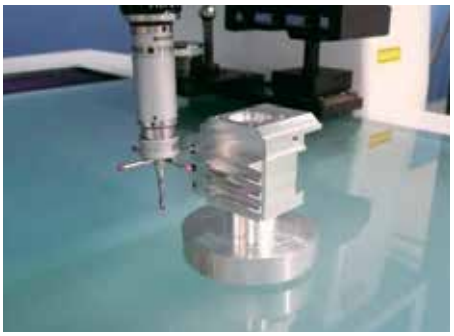
| Model | | ULTRA QV 404 | |
|---|---|---|---|
| Optical system | | PRO | |
| Tracking Auto Focus device | | — | ● |
| Measuring range (X×Y×Z) | | 15.75" x 15.75" x 7.87" (400×400×200mm) | |
| Resolution of scale / Scale type | | 0.01µm / linear encoder | |
| Observation unit *1 | | PPT1X-2X-6X | |
| Imaging device | | B&W CCD | |
| Illumination unit | Co-axial light | Halogen | |
| | Transmitted light | Halogen | |
| | PRL | Halogen | |
| Accuracy *2 | $E_{1X}$, $E_{1Y}$ | (0.25+L/1000)µm | |
| | $E_{1Z}$ (50mm stroke) *3 | (1+2L/1000)µm | |
| | $E_{1Z}$ (Full stroke) | (1.5+2L/1000)µm | |
| | $E_{2XY}$ | (0.5+2L/1000)µm | |
| On-screen repeatability | | 3σ=0.2µm | |
| Auto focus repeatability | | σ=0.4µm | |
| Operating temperature range | Ambient temperature | 19 ~ 23°C | |
| | Temperature variation | 0.5°C/1H and 1°C/24H | |
| Stage glass size | | 19.41" x 21.69" (493x551mm) | |
| Maximum stage loading *4 | | 88 lbs. (40kg) | |
| Main unit external dimensions | | 46.14" x 68.31" x 75.2" (1172×1735×1910mm) | |
| Main unit mass (including the sub-base) | | 4740 lbs. (2150kg) | |
| Operating air pressure | | 0.4 MPa*5 | |
| Required air flow rate | | 300L/min(ANR)*6 | |
| Temperature compensation function | | automatic | |

*1 The specific combination of 1X, 2X and 4X or 1X, 2X, 4X and 6X is available by custom order.
*2 Determined by Mitutoyo's inspection method. L is the measured length (mm). The optical condition for accuracy assurance is to be QV-5X + Middle magnification of the tube lens.
*3 Verified at shipment from factory.
*4 An excessively biased or concentrated load is excluded.
*5 Air supply pressure to be in range 0.5 - 0.9MPa.
*6 Indicates the flow rate under normal conditions.
* The Laser Auto Focus (LAF) specification is available by custom order.

NOTE: A start-up system (relocation detection sensor) is an integral security feature of machines of this series and will disable their operation if subject to relocation or strong vibration. Please be advised to contact your nearest Mitutoyo Service Centre as soon as possible or in advance of such circumstance.

# QV TP Series CNC Vision Measuring System Equipped with a Touch/Trigger Probe

QV TP Apex 302PRO



## QV Touch-Trigger Probe

- The QV TP Series enables non-contact measurements and contact measurements on the same machine. This is achieved using a camera for non-contact measurements and a touch-trigger probe for contact measurements.
- The QV TP Series supports measurements of 3D workpieces such as press-molded products, resin-molded products and machined products that could not be measured with conventional image processing alone.
- The QV TP Series is equipped with a probe module change rack making it possible to switch between vision measurement and touch trigger probe measurement during a sequence of automatic measurements. Furthermore, storing the characteristics of different styli makes it possible to perform measurements on multiple surfaces.
- The accuracy of these models (excluding QV ACCEL type) conforms to ISO10360-7:2011 (specifications on request).

## Specifications

**QV TP ACTIVE**

| Model | | QV TP 202 | QV TP 404 |
|---|---|---|---|
| Optical system | | Active | Active |
| Measuring range by vision probe *1 (X×Y×Z) | | 9.84" x 7.87" x 5.9" (250×200×200 mm) | 15.75"x 15.75"x 7.78" (400x400x200 mm) |
| Measuring range by touch probe *1 (X×Y×Z) | | 7.24" x 7.87" x 7.87" (184×200×150 mm) | 15.75"x 15.75"x 6.61" (400x400x168 mm) |
| Resolution of scale / Scale type | | 0.1µm / linear encoder | 0.1µm / linear encoder |
| Observation unit *2 | | Zoom (8 positions) | Zoom (8 positions) |
| Imaging device | | Color (CMOS) camera | Color (CMOS) camera |
| Illumination unit | Co-axial light | White LED | White LED |
| | Transmitted light | White LED | White LED |
| | PRL | 4-quadrant fixed white LED | 4-quadrant fixed white LED |
| Measuring accuracy *3 (Vision) | $E_{1X}$, $E_{1Y}$ | (2+3L/1000)µm | (2+3L/1000)µm |
| | $E_{1Z}$ | (3+5L/1000)µm | (3+5L/1000)µm |
| TP measuring accuracy *3 | $E_{1X}$, $E_{1Y}$, $E_{1Z}$ | (2.4+4L/1000)µm | (2.4+4L/1000)µm |
| Operating temperature range | Ambient temperature | 18 ~ 23˚C | 18 ~ 23˚C |
| | Temperature variation | 0.5˚C/1H and 1˚C/24H | 0.5˚C/1H and 1˚C/24H |
| Stage glass size | | 12.28" x 10.59" (311×269 mm) | 18.34" x 18.89" (466x480 mm) |
| Maximum stage loading *4 | | 22 lbs. (10kg) | 44.09 lbs. (20 kg) |
| Main unit external dimensions | | (570x767x845 mm) | 30.55" x 51.29" x 39.52" (776x1303x1004 mm) |
| Main unit mass (including the sub-base) | | 341.72 lbs. (155kg) | 714.30 lbs. (324kg) |
| Temperature compensation function | | manual | manual |

*1 Measuring range is smaller than the dimension in the specifications table above when the machine is equipped with module change rack, master ball and calibration ring.
*2 The specific combination of 1X, 2X and 4X or 1X, 2X, 4X and 6X is available by custom order.
*3 Determined by Mitutoyo's inspection method. L is the measured length (mm).
The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Middle magnification of the tube lens.
*4 An excessively biased or concentrated load is excluded.
* The Laser Auto Focus (LAF) specification is available by custom order.

# Specifications

## QV TP Apex

| Model | | QV TP Apex 302 | | QV TP Apex 404 | | QV TP Apex 606 | |
|---|---|---|---|---|---|---|---|
| Optical system | | PRO | PRO3 | PRO | PRO3 | PRO | PRO3 |
| Measuring range by vision probe *1 (X×Y×Z) | | 11.81" x 7.87" x 7.87" (300×200×200mm) | | 15.75" x 15.75" x 9.84" (400×400×250mm) | | 23.62" x 25.59" x 9.84" (600×650×250mm) | |
| Measuring range by touch probe *1 (X×Y×Z) | | 9.21" x 7.87" x 7.87" (234×200×200mm) | | 13.15" x 15.75" x 9.84" (334×400×250mm) | | 21.02" x 25.59" x 9.84" (534×650×250mm) | |
| Resolution of scale / Scale type | | 0.1µm/linear encoder | | | | | |
| Observation unit *2 | | PPT1X-2X-6X | | | | | |
| Imaging Device | | B&W CCD | 3CCD Color | B&W CCD | 3CCD Color | B&W CCD | 3CCD Color |
| Illumination unit *3 | Co-axial light | White LED | | | | | |
| | Transmitted light | White LED | | | | | |
| | PRL | White LED | | | | | |
| Measuring accuracy *4 (Vision) | $E_{1X}$, $E_{1Y}$ | (1.5+3L/1000)µm | | | | | |
| | $E_{1Z}$ | (1.5+4L/1000)µm | | | | | |
| | $E_{2XY}$ | (2+4L/1000)µm | | | | | |
| TP measuring accuracy *4 | $E_{1X}$, $E_{1Y}$, $E_{1Z}$ | (1.8+3L/1000)µm | | | | | |
| Operating temperature range | Ambient temperature | 18 ~ 23˚C | | | | | |
| | Temperature variation | 0.5˚C/1H and 1˚C/24H | | | | | |
| Stage glass size | | 15.71" x 10.67" (399×271mm) | | 19.41" x 21.69" (493×551mm) | | 27.44" x 29.84" (697×758mm) | |
| Maximum stage loading *5 | | 44.09 lbs. (20kg) | | 88.18 lbs. (40kg) | | 110.23 lbs. (50kg) | |
| Main unit external dimensions | | 33.82" x 37.44" x 63.35" (859×951×1609mm) | | 40.43" x 55.39" x 70" (1027×1407×1778mm) | | 51.54" x 78.15" x 70.63" (1309×1985×1794mm) | |
| Main unit mass (including the sub-base) | | 794 lbs. (360kg) | | 1276 lbs. (579kg) | | 3197 lbs. (1450kg) | |
| Temperature compensation function | | manual | | | | | |

*1 Measuring range is smaller than the dimension in the specifications table above when the machine is equipped with module change rack, master ball and calibration ring.
*2 The specific combination of 1X, 2X and 4X or 1X, 2X, 4X and 6X is available by custom order.
*3 The color LED lighting or halogen lighting specification is available by custom order
*4 Determined by Mitutoyo's inspection method. L is the measured length (mm).
The optical condition for accuracy assurance is to be (QV HR2.5X or QV SL2.5X) + Middle magnification of the tube lens.
*5 An excessively biased or concentrated load is excluded.
* The Laser Auto Focus (LAF) specification is available by custom order.
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## Hyper QV TP

| Model | | Hyper QV TP 302 | | Hyper QV TP 404 | | Hyper QV TP 606 | |
|---|---|---|---|---|---|---|---|
| Optical system | | PRO | | | | | |
| Tracking Auto Focus device | | — | ● | — | ● | — | ● |
| Resolution of scale / Scale type | | 0.02µm/linear encoder | | | | | |
| Measuring accuracy *1 (Vision) | $E_{1X}$, $E_{1Y}$ | (0.8+2L/1000)µm | | | | | |
| | $E_{1Z}$ | (1.5+2L/1000)µm | | | | | |
| | $E_{2XY}$ | (1.4+3L/1000)µm | | | | | |
| TP measuring accuracy *1 | $E_{1X}$, $E_{1Y}$, $E_{1Z}$ | (1.7+3L/1000)µm | | | | | |
| Operating temperature range | Ambient temperature | 18 ~ 23˚C | | | | | |
| | Temperature variation | 0.5˚C/1H and 1˚C/24H | | | | | |
| Maximum stage loading *2 | | 33 lbs. (15kg) | | 66 lbs. (30kg) | | 88 lbs. (40kg) | |
| Temperature compensation function | | automatic | | | | | |

*1 Determined by Mitutoyo's inspection method. L is the measured length (mm).
The optical condition for accuracy assurance is to be (QV HR2.5X or QV SL2.5X) + Middle magnification of the tube lens.
*2 An excessively biased or concentrated load is excluded.
Note: For other specifications, refer to QV TP Apex.

## QV TP ACCEL

| Model | | | QV TP ACCEL 808 | | QV TP ACCEL 1010 | | QV TP ACCEL 1212 | | QV TP ACCEL 1517 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Optical system | | | PRO | PRO3 | PRO | PRO3 | PRO | PRO3 | PRO | PRO3 |
| Measuring range by vision probe *2 (X×Y×Z) | | | 31.5" x 31.5" x 5.9" (800×800×150mm) | | 39.37" x 39.37" x 5.9" (1000×1000×150mm) | | 49.21" x 49.21" x 3.94" (1250×1250×100mm) | | 59.06" x 68.9" x 3.94" (1500×1750×100mm) | |
| Measuring range by touch probe *2 (X×Y×Z) | | | 28.9" x 31.5" x 5.9" (734×800×150mm) | | 36.77" x 39.37" x 5.9" (934×1000×150mm) | | 46.61" x 49.21" x 3.94" (1184×1250×100mm) | | 56.46" x 68.9" x 3.94" (1434×1750×100mm) | |
| Measuring accuracy *1 (Vision) | $E_{1X}$, $E_{1Y}$ | | (1.5+3L/1000)µm | | | | (2.2+3L/1000)µm | | | |
| | $E_{1Z}$ | | (1.5+4L/1000)µm | | | | (2.5+5L/1000)µm | | | |
| | $E_{2XY}$ | | (2.5+4L/1000)µm | | | | (3.5+4L/1000)µm | | | |
| TP measuring accuracy *1 | $E_{1X}$, $E_{1Y}$, $E_{1Z}$ | | (1.8+3L/1000)µm | | (3+4L/1000)µm | | (6+7L/1000)µm | | | |
| Repeatability *1 | Short dimension | XY axis | 3σ=0.2µm | | | | | | | |
| | Long dimension | | 3σ=0.7µm | | | | 3σ=1.5µm | | | |
| Operating temperature range | Ambient temperature | | 18 ~ 23˚C | | | | | | | |
| | Temperature variation | | 0.5˚C/1H and 1˚C/24H | | | | | | | |
| Temperature compensation function | | | automatic | | | | | | | |

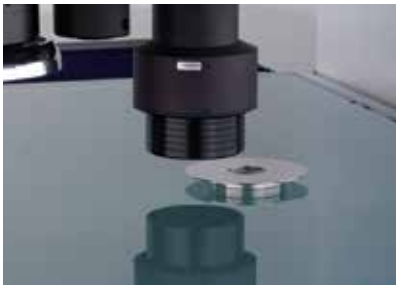
*1 Determined by Mitutoyo's inspection method. L is the measured length (mm).
The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Low magnification of the tube lens.
*2 Measuring range is smaller than the dimension in the specifications table above when the machine is equipped with module change rack, master ball and calibration ring.
Note: For other specifications, refer to QV ACCEL.

NOTE: A start-up system (relocation detection sensor) is an integral security feature of machines of this series and will disable their operation if subject to relocation or strong vibration. Please be advised to contact your nearest Mitutoyo Service Centre as soon as possible or in advance of such circumstance.

Mitutoyo

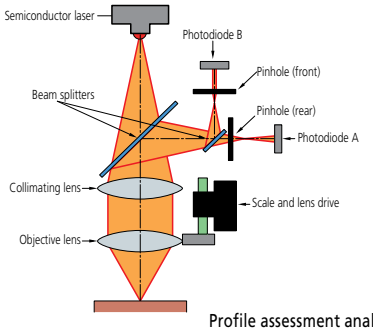
# Non-contact Laser Probe-equipped CNC Vision Measuring System QV HYBRID TYPE 1

Hyper QV HYBRID TYPE 1 404PRO



## QV HYBRID TYPE 1

- The QV HYBRID TYPE 1 is a hybrid measuring machine that has a vision measurement function and also can use the scanning function of its non-contact displacement sensor to measure very small steps and curved surfaces at high speeds.
- Mitutoyo's proprietary double-pinhole technique is used for the displacement sensor's detection method. Compared to the knife-edge and triangulation techniques, this method has the advantage of lower laser directivity.
- Because a focusing point method is used, the QV HYBRID TYPE 1 has the advantage that it is minimally affected by factors such as the color of the workpiece.
- The small laser spot diameter of approximately 2µm makes it possible to perform measurements with high horizontal resolution.
- The displacement sensor alone has a wide measuring range of ±0.5 mm which makes it possible to perform form measurements with a wide dynamic range. For displacements outside this range, scanning can be performed by moving the Z-axis.
- The accuracy of these models (excluding QV ACCEL and QV STREAM PLUS Type) conforms ISO10360-7:2011 (specifications on request).

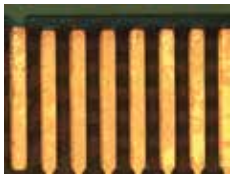



### Applications

#### Viewer Function

The QV HYBRID Series comes standard with the viewer function, allowing you to easily set filter parameters and calculation items for laser scanning measurement while visual inspection is in progress.

Workpiece: printed circuit board

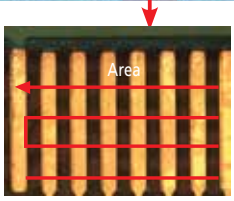


Prior confirmation with viewer

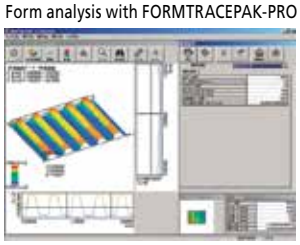
Profile assessment analysis with FORMPAK-QV

#### A Variety of Laser Scanning Tools

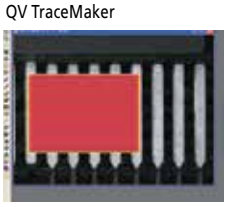
A variety of scanning tools including line, cross, circle and area are provided as standard for both Type 1 and 4.




Form analysis with FORMTRACEPAK-PRO



QV TraceMaker



Trace route creation from image

This tool can create a trace route from a captured image. It is appropriate for measurement of complicated areas.

# Specifications

## QV HYBRID TYPE 1 Apex

| Model | | QVH1 Apex 302 | | QVH1 Apex 404 | | QVH1 Apex 606 | |
|---|---|---|---|---|---|---|---|
| Optical system | | PRO | PRO3 | PRO | PRO3 | PRO | PRO3 |
| Measuring range by vision probe (X×Y×Z) | | 11.81" x 7.87" x 7.87" (300×200×200mm) | | 15.75" x 15.75" x 9.84" (400×400×250mm) | | 23.62" x 25.59" x 9.84" (600×650×250mm) | |
| Measuring range by displacement sensor (X×Y×Z) | | 7.08" x 7.87" x 7.87" (180×200×200mm) | | 11.02" x 15.75" x 9.84" (280×400×250mm) | | 18.9" x 25.59" x 9.84" (480×650×250mm) | |
| Resolution of scale / Scale type | | 0.1µm / linear encoder | | | | | |
| Observation unit *1 | | PPT1X-2X-6X | | | | | |
| Imaging device | | B&W CCD | 3 CCD Color | B&W CCD | 3 CCD Color | B&W CCD | 3 CCD Color |
| Illumination unit *2 | Co-axial light | White LED | | | | | |
| | Transmitted light | White LED | | | | | |
| | PRL | White LED | | | | | |
| Measuring accuracy *3 (Vision) | $E_{1X}$, $E_{1Y}$ | (1.5+3L/1000)µm | | | | | |
| | $E_{1Z}$ | (1.5+4L/1000)µm | | | | | |
| | $E_{2XY}$ | (2+4L/1000)µm | | | | | |
| Displacement sensor measuring accuracy *3 | $E_{1Z}$ | (1.5+4L/1000)µm | | | | | |
| Displacement sensor | Detecting range of probe itself | ±0.5mm | | | | | |
| | Vertical resolving power | 10nm | | | | | |
| | Spot diameter | About ø2µm | | | | | |
| | Working distance (including the collision sensor) | 5mm | | | | | |
| Operating temperature range | Ambient temperature | 20±1°C | | | | | |
| | Temperature variation | 2°C/8H | | | | | |
| Stage glass size | | 15.71" x 10.67" (399×271mm) | | 19.41" x 21.69" (493×551mm) | | 27.44" x 29.84" (697×758mm) | |
| Maximum stage loading *4 | | 44.09 lbs. (20kg) | | 88.18 lbs. (40kg) | | 110.23 lbs. (50kg) | |
| Main unit external dimensions | | 33.82" x 37.44" x 63.35" (859×951×1609mm) | | 40.43" x 55.39" x 70" (1027×1407×1778mm) | | 51.54" x 78.15" x 70.63" (1309×1985×1794mm) | |
| Main unit mass (including the sub-base) | | 815 lbs. (370kg) | | 1299 lbs. (589kg) | | 3219 lbs. (1460kg) | |

*1 The specific combination of 1X, 2X and 4X or 1X, 2X, 4X and 6X is available by custom order.
*2 The color LED lighting or halogen lighting specification is available by custom order.
*3 Determined by Mitutoyo's inspection method. L is the measured length (mm). The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Middle magnification of the tube lens.
*4 An excessively biased or concentrated load is excluded.

## Hyper QV HYBRID TYPE 1

| Model | | Hyper QVH1 302 | Hyper QVH1 404 | Hyper QVH1 606 |
|---|---|---|---|---|
| Optical system | | PRO | PRO | PRO |
| Resolution of scale / Scale type | | 0.02µm / linear encoder | | |
| Measuring accuracy *1 (Vision) | $E_{1X}$,$E_{1Y}$ | (0.8+2L/1000)µm | | |
| | $E_{1Z}$ | (1.5+2L/1000)µm | | |
| | $E_{2XY}$ | (1.4+3L/1000)µm | | |
| Displacement sensor measuring accuracy *1 | $E_{1Z}$ | (1.5+2L/1000)µm | | |
| Operating temperature range | Ambient temperature | 18 ~ 23°C | | |
| | Temperature variation | 0.5°C/1H and 1°C/24H | | |
| Temperature compensation function | | automatic | | |
| Maximum stage loading *2 | | 33 lbs. (15kg) | 66 lbs. (30kg) | 88 lbs. (40kg) |

*1 Determined by Mitutoyo's inspection method. L is the measured length (mm). The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Middle magnification of the tube lens.
*2 An excessively biased or concentrated load is excluded. Other specifications are the same as those of the QVH1 Apex. For details, refer to above table.

## QV STREAM PLUS HYBRID TYPE 1

| Model | | QVH1 STREAM 302 | QVH1 STREAM 404 | QVH1 STREAM 606 |
|---|---|---|---|---|
| Optical system | | PRO | PRO | PRO |
| Imaging device | | B&W CCD | | |
| Illumination unit | Co-axial light | Color LED | | |
| | Transmitted light | Blue LED | | |
| | PRL | Color LED | | |
| Measuring accuracy*1 (Vision) | $E_{1X}$,$E_{1Y}$ | (1.5+3L/1000)µm | | |
| | $E_{1Z}$ | (1.5+4L/1000)µm | | |
| | $E_{2XY}$ | (2+4L/1000)µm | | |
| Displacement sensor measuring accuracy*1 | $E_{1Z}$ | (1.5+4L/1000)µm | | |
| Operating temperature range | Ambient temperature | 20±1°C | | |
| | Temperature variation | 2°C/8H | | |

*1 Determined by Mitutoyo's inspection method. L is the measured length (mm). The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Middle magnification of the tube lens. Other specifications are the same as those of the QVH1 Apex. For details, refer to above table.

## QV ACCEL HYBRID TYPE 1

| Model | | QVH1 ACCEL 808 | | QVH1 ACCEL 1010 | | QVH1 ACCEL 1212 | | QVH1 ACCEL 1517 | |
|---|---|---|---|---|---|---|---|---|---|
| Optical system | | PRO | PRO3 | PRO | PRO3 | PRO | PRO3 | PRO | PRO3 |
| Measuring range by vision probe (X×Y×Z) | | 31.5" x 31.5" x 5.9" (800×800×150mm) | | 39.37" x 39.37" x 5.9" (1000×1000×150mm) | | 49.21" x 49.21" x 3.93" (1250×1250×100mm) | | 59.06" x 68.9" x 3.93" (1500×1750×100mm) | |
| Measuring range by displacement sensor (X×Y×Z) | | 26.77" x 31.5" x 5.9" (680×800×150mm) | | 34.65" x 39.37" x 5.9" (880×1000×150mm) | | 44.49" x 49.21" x 3.93" (1130×1250×100mm) | | 54.33" x 68.9" x 3.93" (1380×1750×100mm) | |
| Measuring accuracy *1 (Vision) | $E_{1X}$,$E_{1Y}$ | (1.5+3L/1000)µm | | | | (2.2+3L/1000)µm | | | |
| | $E_{1Z}$ | (1.5+4L/1000)µm | | | | (2.5+5L/1000)µm | | | |
| | $E_{2XY}$ | (2.5+4L/1000)µm | | | | (3.5+4L/1000)µm | | | |
| Displacement sensor measuring accuracy*1 | $E_{1Z}$ | (2.5+4L/1000)µm | | | | (3.5+5L/1000)µm | | | |
| Displacement sensor | Detecting range of probe itself | ±0.5mm | | | | | | | |
| | Vertical resolving power | 10nm | | | | | | | |
| | Spot diameter | about ø2µm | | | | | | | |
| | Working distance (including the collision sensor) | 5mm | | | | | | | |
| Operating temperature range | Ambient temperature | 20±1°C | | | | | | | |
| | Temperature variation | 2°C/8H | | | | | | | |

*1 Determined by Mitutoyo's inspection method. L is the measured length (mm). The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Low magnification of the tube lens. Other specifications are the same as those of the QV ACCEL. For details, refer to page 14.

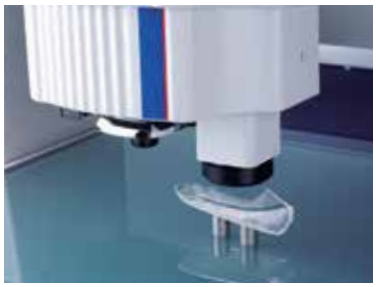
NOTE: A start-up system (relocation detection sensor) is an integral security feature of machines of this series and will disable their operation if subject to relocation or strong vibration. Please be advised to contact your nearest Mitutoyo Service Centre as soon as possible or in advance of such circumstance.

CLASS 1 LASER PRODUCT

**Safety Precautions for Laser Beam**
These systems uses a low-power invisible laser beam (780 nm) which corresponds to Class 1 (invisible light) of JIS C 6802 "Safety Standard of Laser Radiation Products". The class 1 laser warning label as shown above is attached to the main unit.

# QV HYBRID TYPE 4 CNC Vision Measuring System Equipped with Non-contact Scanning Sensor

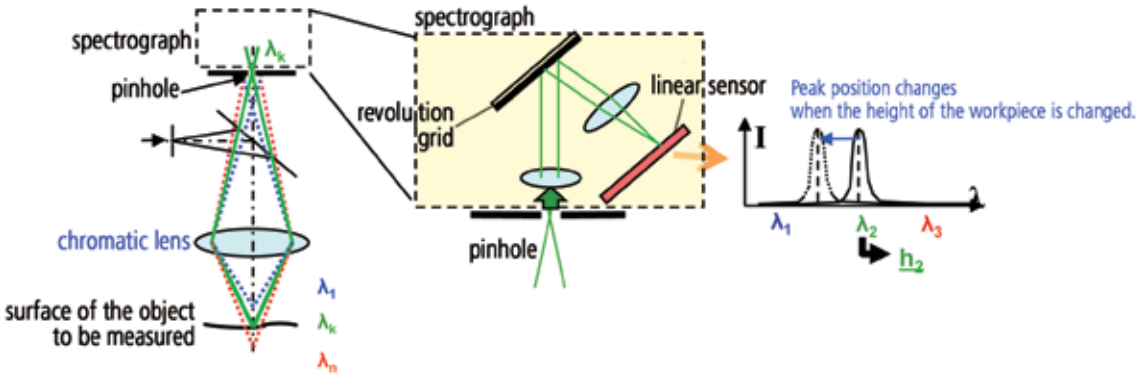
Hyper QV HYBRID TYPE 4 606PRO



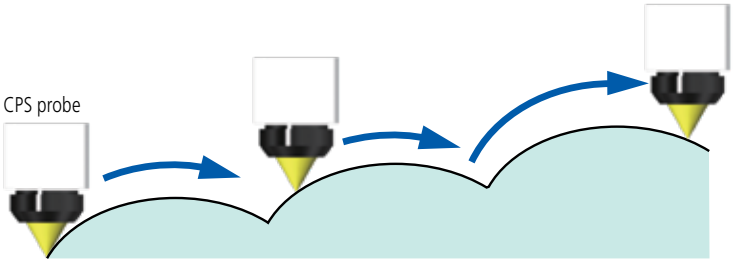

## QV HYBRID TYPE 4

- QV HYBRID TYPE 4 is equipped with CPS (Chromatic Point Sensor) that employs the confocal method. This method uses the axial chromatic aberration to detect Z-axis direction position.
- The QV HYBRID TYPE 4 is a hybrid measuring machine that has a vision measurement function and can use the scanning function of its non-contact displacement sensor to measure very small steps and curved surfaces at high speeds.
- The displacement sensor detection method employs the wavelength confocal method that uses the axial chromatic aberration of the white light source.
  The sensor itself has a wide measuring range and high inclined-surface-following performance for both mirrored and diffusive surfaces.
- Auto-brightness control and the use of LEDs as light sources allows the QV HYBRID TYPE 4 perform measurements that are minimally affected by reflectivity variations on the workpiece.
- The heights of two surfaces within the measuring range can be detected simultaneously making it possible to support measurements of the thickness of thin, transparent objects.
- The accuracy of this model conforms to ISO10360-7:2011 (specifications on request).

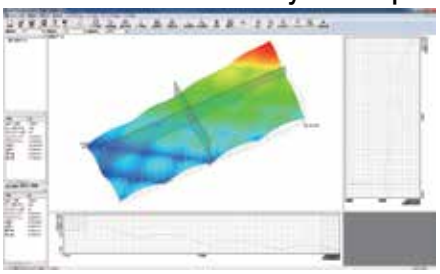
**Measurement principle**



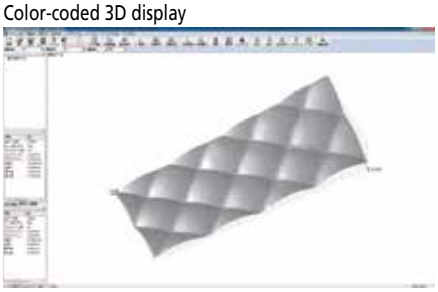
### Scanning Measurement with Automatic Movement of the Z-axis




### FORMTRACEPAK-PRO Analysis Example



Color-coded 3D display



Shaded display

## Specifications

### QV HYBRID TYPE 4 Apex

| Model | | QVH4 Apex 302 | QVH4 Apex 404 | QVH4 Apex 606 |
|---|---|---|---|---|
| Optical system | | PRO | PRO | PRO |
| Measuring range by vision probe (X×Y×Z) | | 11.81" x 7.87" x 7.87" (300×200×200mm) | 15.75" x 15.75" x 9.84" (400×400×250mm) | 23.62" x 25.59" x 9.84" (600×650×250mm) |
| Measuring range by displacement sensor (X×Y×Z) | | 6.93" x 7.87" x 7.87" (176×200×200mm) | 10.87" x 15.75" x 9.84" (276×400×250mm) | 18.74" x 25.59" x 9.84" (476×650×250mm) |
| Resolution of scale / Scale type | | 0.1µm / linear encoder | | |
| Observation unit *1 | | PPT1X-2X-6X | | |
| Imaging device | | B&W CCD | B&W CCD | B&W CCD |
| Illumination unit *2 | Co-axial light | White LED | | |
| | Transmitted light | White LED | | |
| | PRL | White LED | | |
| Measuring accuracy *3 (Vision) | $E_{1X}$,$E_{1Y}$ | (1.5+3L/1000)µm | | |
| | $E_{1Z}$ | (1.5+4L/1000)µm | | |
| | $E_{2XY}$ | (2+4L/1000)µm | | |
| Displacement sensor accuracy | $E_{1Z}$ | (1.5+4L/1000)µm | | |
| Displacement sensor | Detecting range of probe itself | ±0.6mm | | |
| | Vertical resolving power | 25nm | | |
| | Spot diameter | about ø4µm | | |
| | Working distance (including the collision sensor) | 21.0mm | | |
| Operating temperature range | Ambient temperature | 20±1°C | | |
| | Temperature variation | 2°C/8H | | |
| Stage glass size | | 15.71" x 10.67" (399×271mm) | 19.41" x 21.69" (493×551mm) | 27.44" x 29.84" (697×758mm) |
| Maximum stage loading *4 | | 44 lbs. (20kg) | 88 lbs. (40kg) | 110 lbs. (50kg) |
| Main unit external dimensions | | 33.82" x 37.44" x 23.98" (859×951×1609mm) | 40.43" x 55.39" x 70" (1027×1407×1778mm) | 51.54" x 78.15" x 70.63" (1309×1985×1794mm) |
| Main unit mass (including the sub-base) | | 815 lbs. (370kg) | 1299 lbs. (589kg) | 3219 lbs. (1460kg) |

*1 The specific combination of 1X, 2X and 4X or 1X, 2X, 4X and 6X is available by custom order.
*2 The color LED lighting or halogen lighting specification is available by custom order.
*3 Determined by Mitutoyo's inspection method. L is the measured length (mm). The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Middle magnification of the tube lens.
*4 An excessively biased or concentrated load is excluded.

### Hyper QV HYBRID TYPE 4

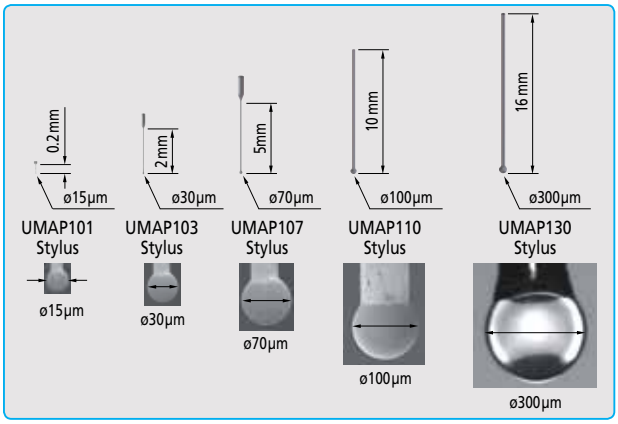
| Model | | Hyper QVH4 302 | Hyper QVH4 404 | Hyper QVH4 606 |
|---|---|---|---|---|
| Optical system | | PRO | PRO | PRO |
| Resolution of scale / Scale type | | 0.02µm / linear encoder | | |
| Measuring accuracy*1 (Vision) | $E_{1X}$,$E_{1Y}$ | (0.8+2L/1000)µm | | |
| | $E_{1Z}$ | (1.5+2L/1000)µm | | |
| | $E_{2XY}$ | (1.4+3L/1000)µm | | |
| Displacement sensor accuracy | $E_{1Z}$ | (1.5+2L/1000)µm | | |
| Operating temperature range | Ambient temperature | 18 ~ 23°C | | |
| | Temperature variation | 0.5°C/1H and 1°C/24H | | |
| Temperature compensation function | | automatic | | |
| Maximum stage loading*2 | | 33 lbs. (15kg) | 66 lbs. (30kg) | 88 lbs. (40kg) |

*1 Determined by Mitutoyo's inspection method. L is the measured length (mm). The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + Middle magnification of the tube lens.
*2 An excessively biased or concentrated load is excluded. Other specifications are the same as those of the QVH4 Apex.For details,refer to the table above.

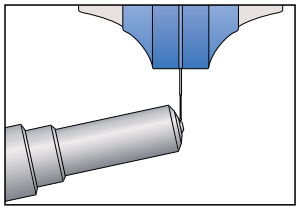
NOTE: A start-up system (relocation detection sensor) is an integral security feature of machines of this series and will disable their operation if subject to relocation or strong vibration. Please be advised to contact your nearest Mitutoyo Service Centre as soon as possible or in advance of such circumstance.

# Microscopic Form Measurement System
# UMAP Vision System TYPE 2

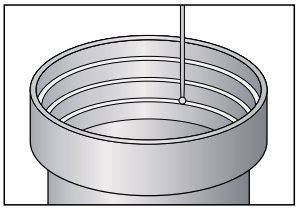

## Stylus Lineup




## Measurement Examples



Measurement of the shape of the holes in a fuel injection nozzle



Measurement of the shape of a lens barrel

# UMAP Vision System TYPE 2

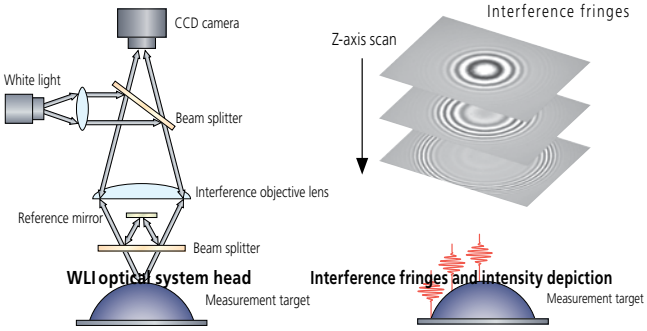
- The UMAP Vision System is equipped with an ultra-low force probe and uses Mitutoyo's proprietary sensing technology. The utilization of extremely small styli with high aspect ratios (styli with a diameter between 15µm and 300µm) makes dimension measurements of microscopic forms possible. These measurements cannot be made using conventional contact measurement sensors.

## Specifications

| Model | | | Hyper UMAP 302 | ULTRA UMAP 404 |
|---|---|---|---|---|
| Optical system | | | PRO | |
| Measuring range (X×Y×Z) | | | 11.81" x 7.87" x 7.87" (300×200×200mm) | 15.75" x 15.75" x 7.87" (400×400×200mm)<br>Effective measuring range on glass surface:<br>14.17" x 15.75" x 7.87" (360×400×200 mm*1) |
| Effective measuring range (common between images and UMAP103) | | | 7.28" x 7.87" x 6.89" (185×200×175mm) | 11.22" x 15.75" x 7.87" (285×400×175mm) |
| Resolution of scale / Scale type | | | 0.02µm/Linear Encoder | 0.01µm/Linear Encoder |
| Observation unit *2 | | | PPT1X-2X-6X | |
| Imaging device | | | B&W CCD | |
| Illumination unit | Co-axial light | | White LED | Halogen |
| | Transmitted light | | White LED | Halogen |
| | PRL | | White LED | Halogen |
| Measuring accuracy*3 | Vision | $E_{1X}$, $E_{1Y}$ | (0.8+2L/1000)µm | (0.25+L/1000)µm |
| | | $E_{1Z}$ (50mm stroke) *4 | — | (1+2L/1000)µm |
| | | $E_{1Z}$ (full stroke) | (1.5+2L/1000)µm | (1.5+2L/1000)µm |
| | | $E_{2XY}$ | (1.4+3L/1000)µm | (0.5+2L/1000)µm |
| | | Optical condition for accuracy assurance | QV-HR2.5X or QV-SL2.5X + Middle magnification tube lens | QV-5X + Middle magnification tube lens |
| | UMAP | $E_{1X}$, $E_{1Y}$ (UMAP 110) *5 | (1.7+3L/1000)µm | (1.5+3L/1000)µm |
| UMAP repeatability*3 | UMAP101, 103, 107 | | σ=0.1µm | σ=0.08µm |
| | UMAP110, 130 | | σ=0.15µm | σ=0.12µm |
| Operating temperature range | Ambient temperature | | 18 ~ 23°C | 19 ~ 23°C |
| | Temperature variation | | 0.5°C/1H and 1°C/24H | |
| Maximum stage loading *6 | | | 33 lbs. (15kg) | 88 lbs. (40kg) |
| Operating air pressure | | | 0.4MPa | |
| Required air flow rate | | | — | 300L/min (ANR) |
| Temperature compensation function | | | automatic | |

*1 Effective measuring range when contour light is used.
*2 The specific combination of 1X, 2X and 4X or 1X, 2X, 4X and 6X is available by custom order.
*3 Determined by Mitutoyo's inspection method. L is measured length (mm).
*4 Verified at shipment from factory.
*5 The assured accuracy of UMAP is specific to that of UMAP110 in the case of a measuring speed of 10µm/s.
*6 An excessively biased or concentrated load is excluded.
* The Laser Auto Focus (LAF) specification is available by custom order.

# Non-contact 3D Measuring System
# Hyper QV WLI




## Hyper QV WLI

- The Hyper Quick Vision WLI is Mitutoyo's leading, highly accurate dual-head measurement system equipped with a white light interferometer (WLI) optical head.
- Equipping a vision measuring machine with a WLI head enables the machine to perform measurements ranging from 2D coordinate and dimension measurements to highly accurate 3D measurements on microscopic areas in applications such as surface analysis, small-diameter hole depth and circuit board wiring dimensions.

### Principle of WLI Measurement

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 for the area of the measurement sample that is in focus. The 3D 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.

## Specifications

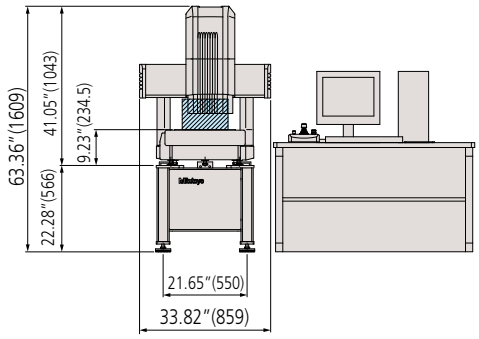
| Model | | Hyper QV WLI 302 | Hyper QV WLI 404 | Hyper QV WLI 606 |
|---|---|---|---|---|
| Optical system | | | PRO | |
| WLI optical head unit | | | | |
| Measuring range *1 (X×Y×Z) | | 8.46" x 7.87" x 7.48" (215×200×190mm) | 12.4" x 15.75" x 9.45" (315×400×240mm) | 20.28" x 25.59" x 8.66" (515×650×220mm) |
| Imaging device | | | B&W CCD | |
| Illumination unit | Co-axial Light | | Halogen | |
| Z-axis scanning range *2 | | | 170µm | |
| Z-axis repeatability | | | 2σ≤0.08µm | |
| Vision optical head unit | | | | |
| Measurement range (X×Y×Z) | | 11.81" x 7.87" x 7.48" (300×200×190mm) | 15.75" x 15.75" x 9.45" (400×400×240mm) | 23.62" x 25.59" x 8.66" (600×650×220mm) |
| Resolution of scale / Scale type | | | 0.01µm / linear encoder | |
| Observation unit | | | PPT 1X-2X-6X | |
| Imaging device | | | B&W CCD | |
| Illumination unit | Co-axial light | | While LED | |
| | Transmitted light | | While LED | |
| | PRL | | While LED | |
| Measuring accuracy *3 | $E_{1X}$, $E_{1Y}$ | | (0.8+2L/1000)µm | |
| | $E_{1Z}$ | | (1.5+2L/1000)µm | |
| | $E_{2XY}$ | | (1.4+3L/1000)µm | |
| Operating temperature range | Ambient temperature | | 20±1°C | |
| | Temperature variation | | 0.5°C/1H | |
| Stage glass size | | 15.71" x 10.67" (399×271mm) | 19.41" x 21.69" (493×551mm) | 27.44" x 30.91" (697×785mm) |
| Maximum stage loading*4 | | 33 lbs. (15kg) | 55 lbs. (25kg) | 77 lbs. (35kg) |
| Main unit external dimensions | | 33.82" x 37.4" x 63.23" (859×950×1606mm) | 40.43" x 55.39" x 70.12" (1027×1407×1781mm) | 51.54" x 78.15" x 70.55" (1309×1985×1792mm) |
| Main unit mass (including the sub-base) | | 1080 lbs. (490kg) | 2557 lbs. (1160kg) | 5015 lbs. (2275kg) |
| Operating air pressure | | | 0.4Mpa | |
| Temperature compensation function | | | automatic | |

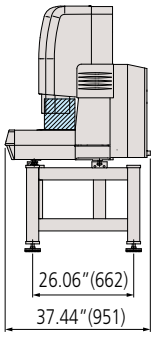
*1 Movable range of WLI optical head. Three dimensional shape measurement using WLI is allowed within one field of vision.
*2 In case of standard mode. Applicable to max. 200µm by modifying scan pitch.
*3 Determined by Mitutoyo's inspection method. L is measured length (mm).
The optical condition for accuracy assurance is to be (QV-HR2.5X or QV-SL2.5X) + middle magnification of the tube lens.
*4 An excessively biased or concentrated load is excluded.
* Hyper QV WLI is not compatible with the Easy Editor function of QVPAK.

# Dimensions

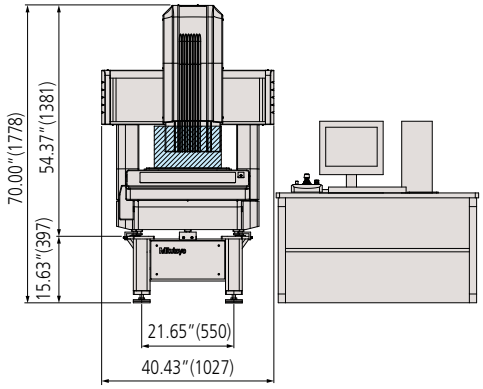
## QV302

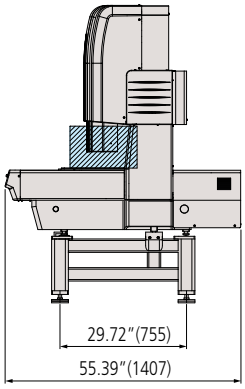
Unit: Inch(mm)



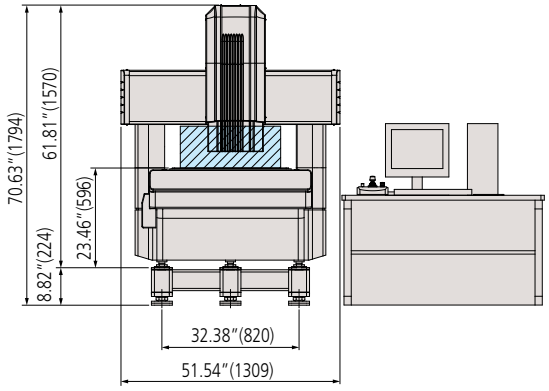



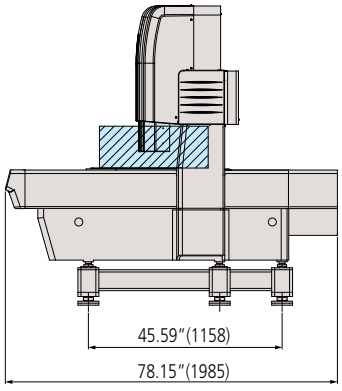

## QV404




## QV606

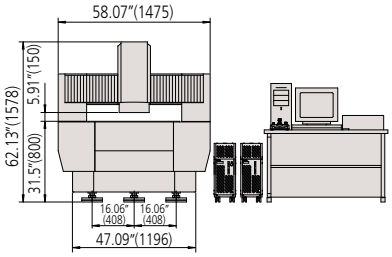


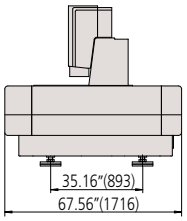




For more information about dimensions of the PC table, please contact your local Mitutoyo sales office.

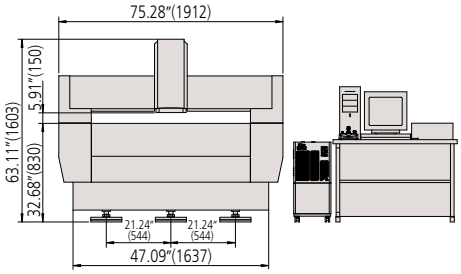
## QV ACCEL808

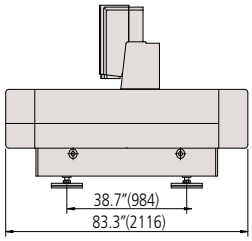
Unit: Inch(mm)



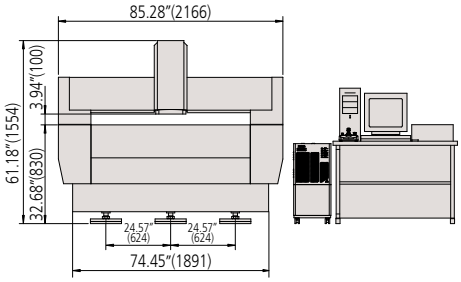



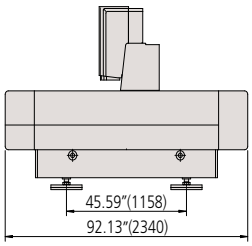

## QV ACCEL1010



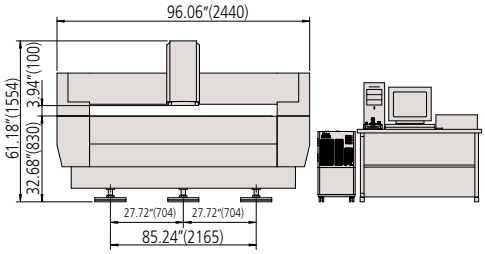



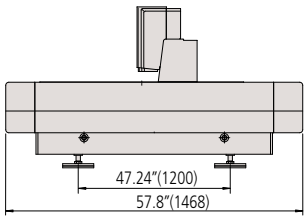

## QV ACCEL1212




## QV ACCEL1517



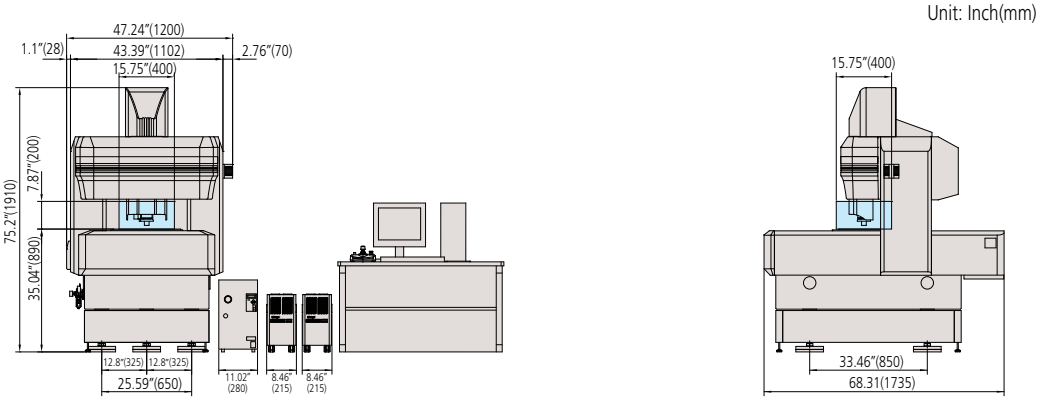




For more information about dimensions of the PC table, please contact your local Mitutoyo sales office.

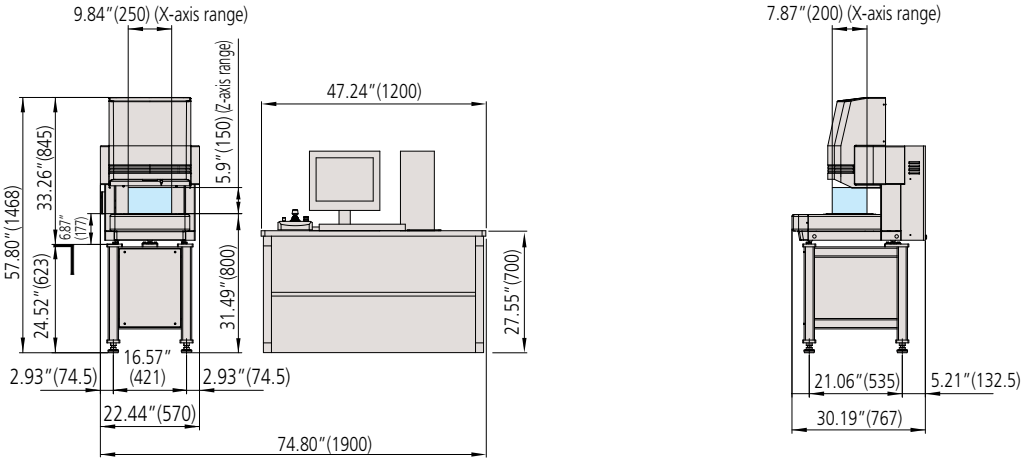
# Dimensions

## ULTRA QV

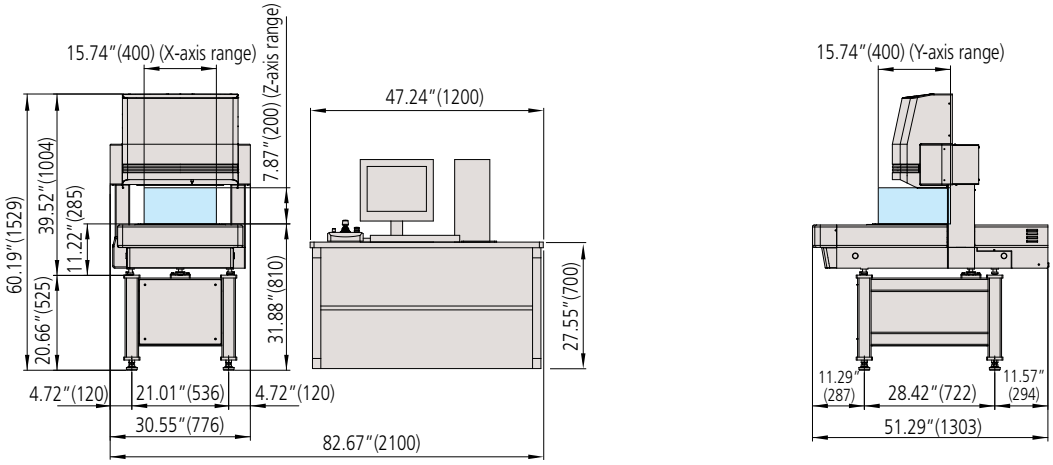
Unit: Inch(mm)




## Quick Vision Active 202




## Quick Vision Active 404




For more information about dimensions of the PC table, please contact your local Mitutoyo sales office.

# Optional Hardware / Objective Lenses

## Calibration Chart and QV Compensation Chart

### Calibration Chart

A calibration chart is used to compensate for the pixel size of the CCD chip and for the auto focus accuracy and optical axis offset at each magnification of the variable magnification unit (PPT).

### QV Compensation Chart*

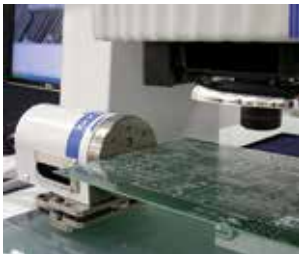
This glass chart is used to perform compensation for distortions within the screen caused by the optical system as well as auto focus compensation which reduces auto focus variations that are caused by differences between the workpiece pattern and texture.

* There are limitations on what functions can be used, depending on the lens. For details, contact your Mitutoyo sales office.

## QV Index

Consecutive measurements of the sides and bottom of a workpiece can be made without having to perform re-fixturing. This leads to a decrease in the production costs related to fixturing, thus making for an improvement in measurement efficiency.

- Supported models: QV302, 404, 606
- Supported QVPAK versions: 7.356 and later



| Item | Specifications |
|---|---|
| Maximum workpiece size | ø5.51" (140 mm) (Max) |
| Maximum faceplate loading | 4.4 lbs. (2 kg) (Max) |
| Resolution | 0.1˚ |
| Rotational positioning accuracy | ±0.5˚ |
| Rotational speed | 10 r.p.m. |
| External dimensions (W×D×H) | 4.64" x 5.90" x 4.13" (118x150x105 mm) |

## QV Objective Lenses

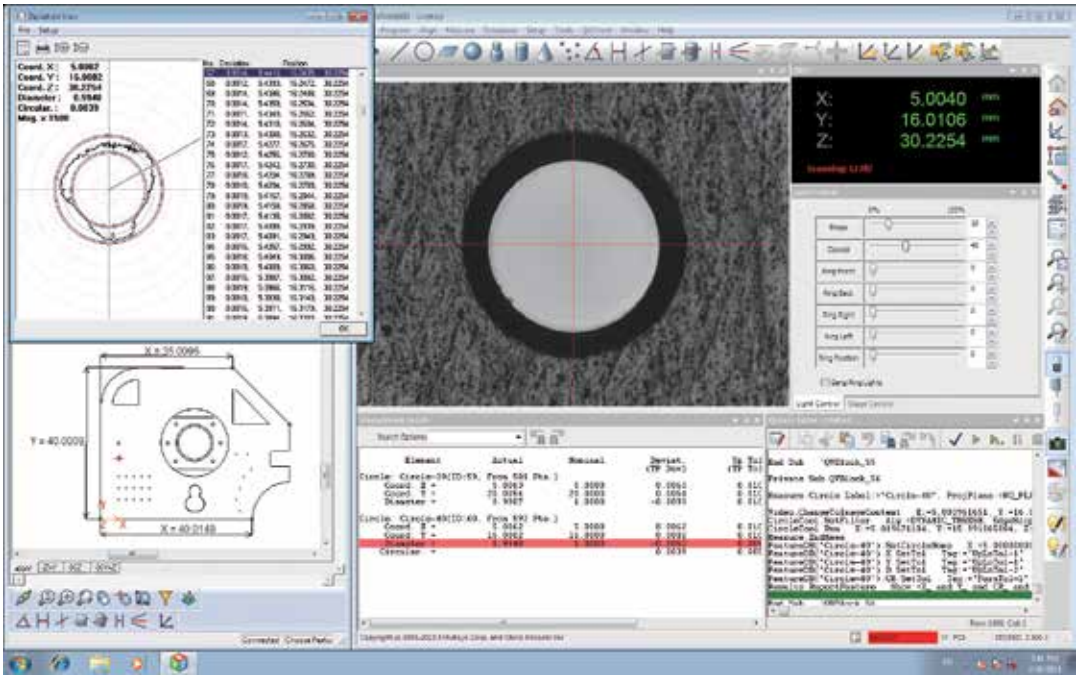
**QV Objective Lenses**

| Objective lens | | QV-SL0.5×* | QV-HR1× | QV-SL1× | QV-HR2.5× | QV-SL2.5× | QV-HR5x | QV-HR10×* | QV-10×* | QV-25×* |
|---|---|---|---|---|---|---|---|---|---|---|
| Order no. | | 02AKT199 | 02AKT250 | 02ALA150 | 02AKT300 | 02ALA170 | 02AWD010 | 02AKT650 | 02ALG010 | 02ALG020 |
| Optical magnification | | 0.5X | 1X | | 2.5X | | 5X | 10X | | 25X |
| Working distance | | 1.20" (30.5 mm) | 1.6" (40.6 mm) | 2.06" (52.5 mm) | 1.6" (40.6 mm) | 2.36" (60 mm) | 0.78" (20 mm) | 0.78" (20 mm) | 1.20" (30.5 mm) | 0.51" (13 mm) |
| PRO model imaging FOV [ (H) mm x (V) mm] | Turret 1× | 12.54×9.4 | 6.27×4.7 | | 2.49×1.86 | | 1.25×0.94 | 0.62×0.47 | | 0.25×0.18 |
| | Turret 2× | 6.27×4.7 | 3.13×2.35 | | 1.24×0.93 | | 0.62×0.47 | 0.31×0.23 | | 0.10×0.07 |
| | Turret 6× | 2.09×1.56 | 1.04×0.78 | | 0.41×0.31 | | 0.2×0.15 | 0.10×0.07 | | 0.04×0.03 |
| PRO3 model imaging FOV [(H) mm x (V) mm] | Turret 1× | 9.4×7.04 | 4.7×3.52 | | 1.87×1.41 | | 0.93×0.7 | 0.46×0.34 | | 0.18×0.14 |
| | Turret 2× | 4.7×3.52 | 2.35×1.76 | | 0.09×0.7 | | 0.47×0.35 | 0.23×0.17 | | 0.09×0.07 |
| | Turret 6× | 1.56×1.17 | 0.78×0.59 | | 0.31×0.24 | | 0.16×0.12 | 0.08×0.06 | | 0.03×0.02 |

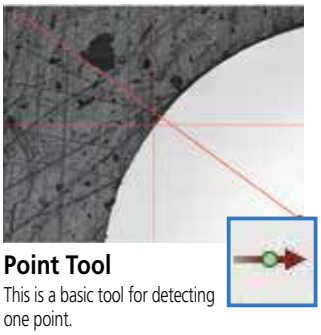
* When the QV-SL 0.5X, QV-HR 10X, QV-10X, or QV-25X objective lens is used, some limitations may occur, e.g. the insufficient illumination depending on the workpiece.

High-performance QV objective lenses

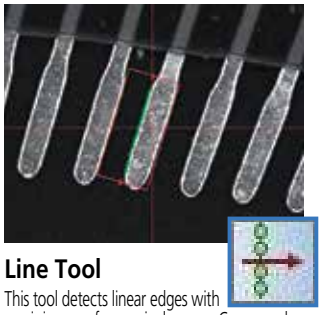
# Software
# Secure Edge Detection by Advanced Image Processing



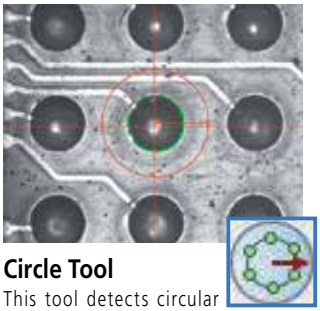

## Edge Detection Tools



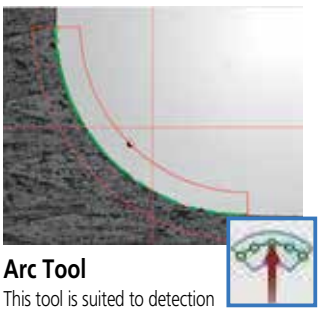
### Point Tool
This is a basic tool for detecting one point.



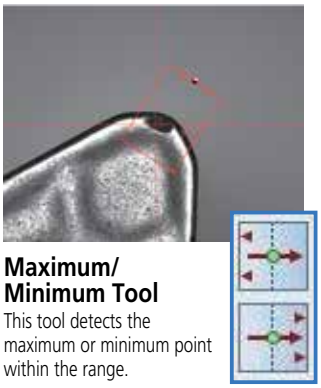
### Line Tool
This tool detects linear edges with a minimum of one pixel space. Compared to the point tool, the line tool can perform averaging and remove abnormal points which enables stable measurements.



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

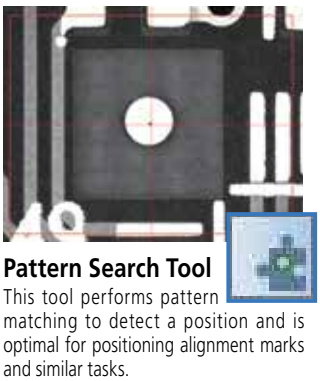


### Arc Tool
This tool is suited to detection of arcs and corner radii.

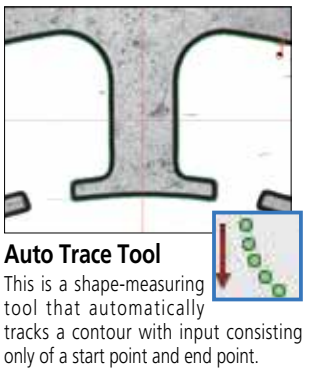


### Maximum/ Minimum Tool
This tool detects the maximum or minimum point within the range.

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

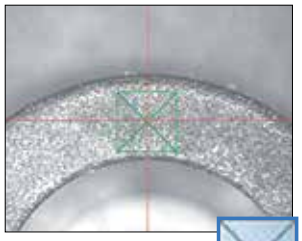


### Pattern Search Tool
This tool performs pattern matching to detect a position and is optimal for positioning alignment marks and similar tasks.



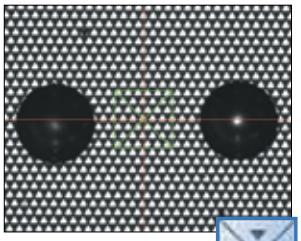
### Auto Trace Tool
This is a shape-measuring tool that automatically tracks a contour with input consisting only of a start point and end point.

# Equipped With Powerful Autofocus Functions As Standard



### Surface Focus Tool

Image autofocus can be performed on a chosen area specified with the mouse. Highly accurate height measurements that are minimally affected by surface roughness can be performed even on objects such as resin-molded products and machined surfaces.

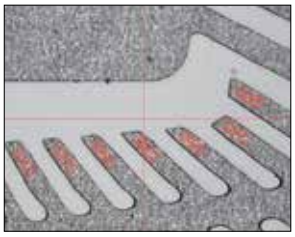


### Pattern Focus Tool

Even low-contrast mirrored surfaces and transparent objects can be brought into focus by the use of pattern focus, which projects a pattern within the light path onto the workpiece surface. This is useful when performing height measurements of flexible printed circuit boards and film.

### Edge Focus Tool

This is the optimal tool for focusing chamfered parts.

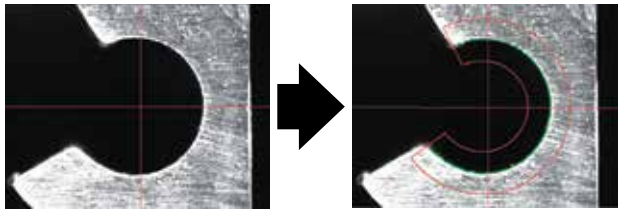


### Multi-point Autofocus

Multi-point autofocus can be used to set multiple focus positions, sizes and angles to chosen values. This tool can be used to obtain multiple sets of height information with a single focusing operation which makes it possible to perform highly efficient height and flatness measurements.

# One-click Measuring Tool Setup

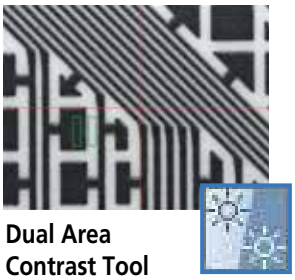
The tool size, orientation and threshold of a measuring tool are automatically set with one click of the mouse in the vicinity of the measurement location.



# AI Illumination Tools

There are two tools: the dual area contrast tool, which can adjust the light intensity to the optimal value, and the brightness tool which automatically compensates the light intensity – both at program creation time.
These tools stabilize the light intensity during repeat measurements increasing edge detection repeatability and reducing the occurrence of edge detection errors caused by light intensity fluctuations.

### Brightness Tool

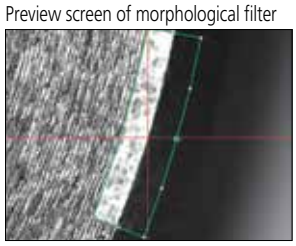


### Dual Area Contrast Tool

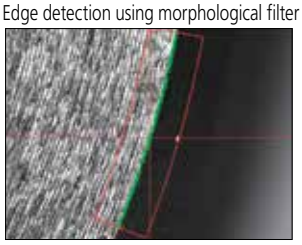
# Increase in Edge Detection Capability

Workpieces that have been machined often have optically 'noisy' surfaces produced by cutter marks and marks caused by abrasive blasting of outer surfaces. There are times when conventional image processing alone is not enough to perform accurate measurements when such noise is present. QVPAK's filter function removes this noise to make highly accurate measurements possible.

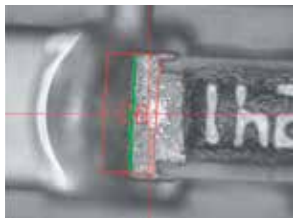
Preview screen of morphological filter



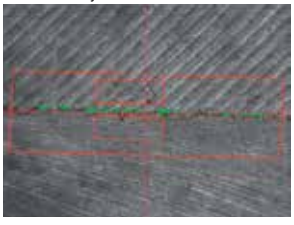
Edge detection using morphological filter



Brightness analysis

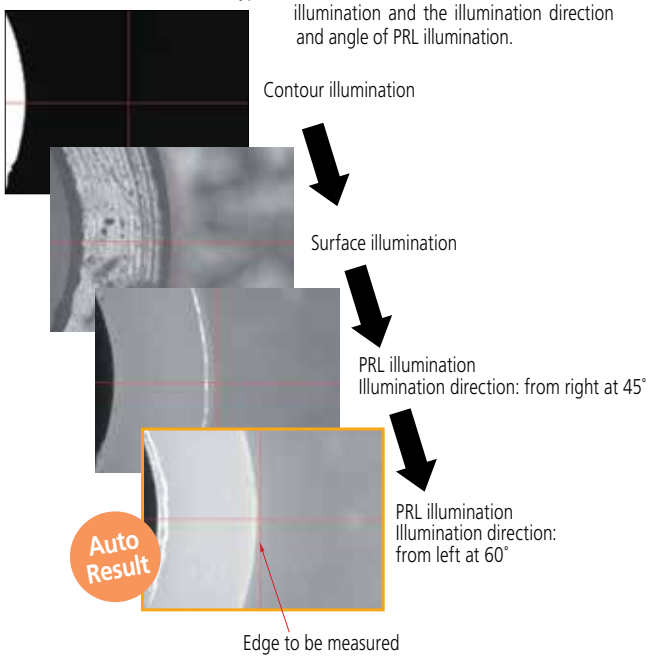


Texture analysis

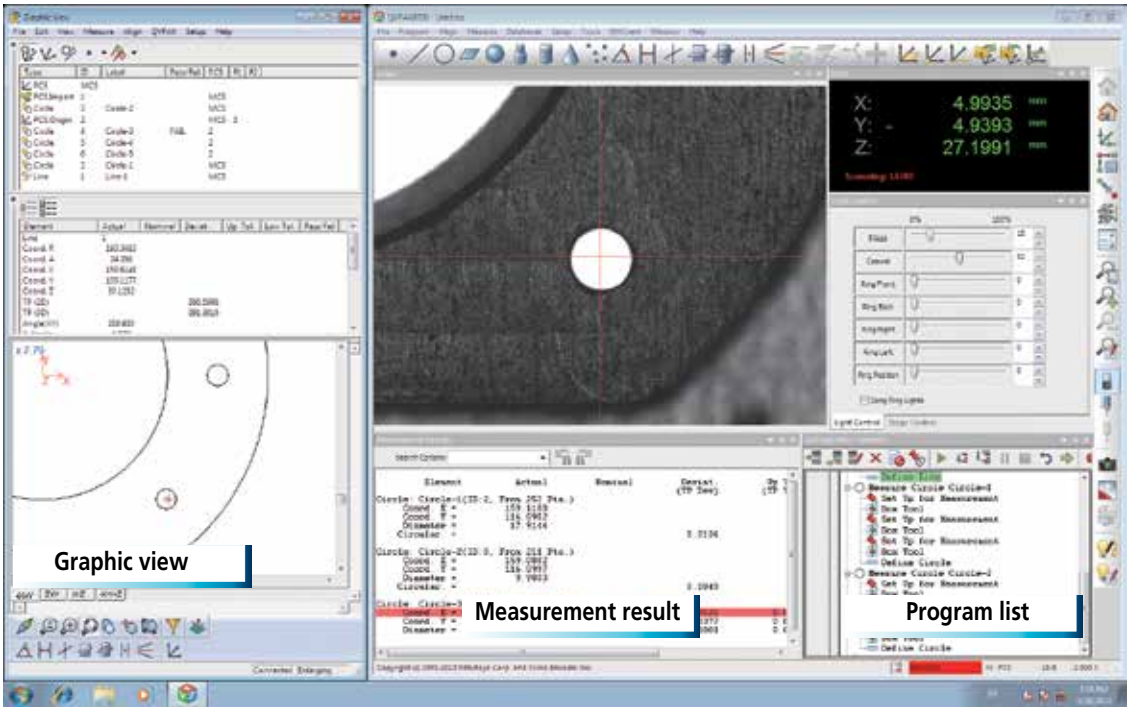


# Illumination Wizard

This tool automatically sets the optimal illumination conditions from among multiple combinations of illumination types such as contour illumination and surface illumination and the illumination direction and angle of PRL illumination.



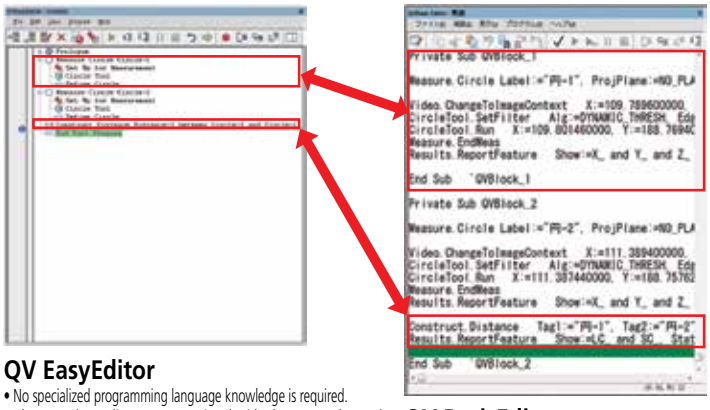
# Software
# Equipped with the EasyEditor, QVPAK is the Most User-friendly and Powerful Version Ever




## Highly Powerful Software: Sophisticated, Intelligent and Easy to Use

QVPAK has evolved into the most powerful version yet with both QV EasyEditor which is easy to operate and requires no specialized knowledge, and QV BasicEditor, which boasts all the functions necessary to satisfy software developers.

Program creation example: measuring the distance between two circles



### QV EasyEditor

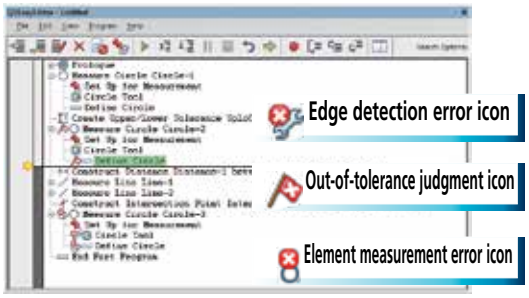
- No specialized programming language knowledge is required.
- The procedure adjustments associated with changes to the workpiece form can be done easily.
- Edge detection tool corrections can be made from the video window.
- Mistakes during program creation can be fixed on the spot.
- Errors during repeat execution can also be fixed on the spot easily.

### QV BasicEditor

- Both sub-routines, which have arguments and return values, and local variables can be used which makes QV Basic Editor suited to high-level programming.
- All flow control statements, such as IF, THEN and ELSE, can be used.
- Data can be read from and written to text files.
- User-designed dialog boxes can be created.

## Quick Problem-tackling With Error Icons and Auto-scroll Function

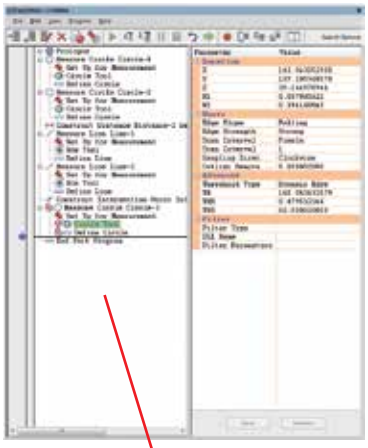
Error icons are displayed in the program list making it possible to quickly identify the areas that need to be fixed.

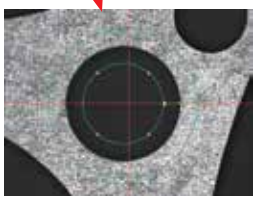



The program list, measurement result and graphic view are linked through the auto-scroll function. This is useful in identifying the areas that need to be fixed in the program.
On the measurement result window, out-of-tolerance measurement results are highlighted in red clearly identifying problems.

## Easy Program Correction Fixes Errors During Recording Mode and Part Program Execution (Automatic Error Recovery)

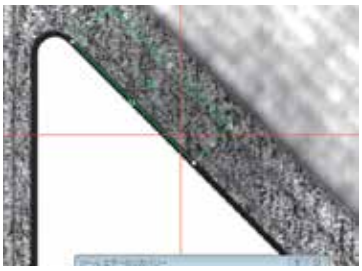
It's easy to insert, delete and change procedures, even during recording mode.



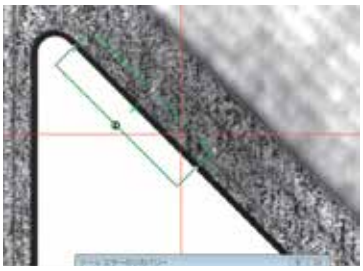


Editing tools

If an edge detection error or auto-focus error occurs during part program execution, error recovery mode can be used to update the program.



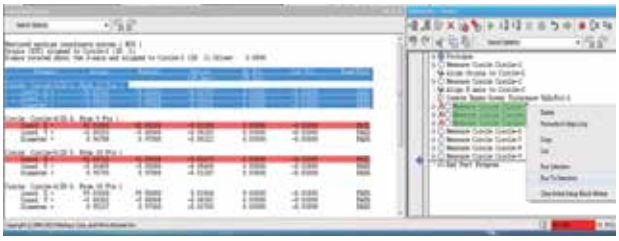
An error occurs during program execution due to an issue such as a mistake during program creation or a workpiece design change.



The details corrected in error recovery mode are updated.

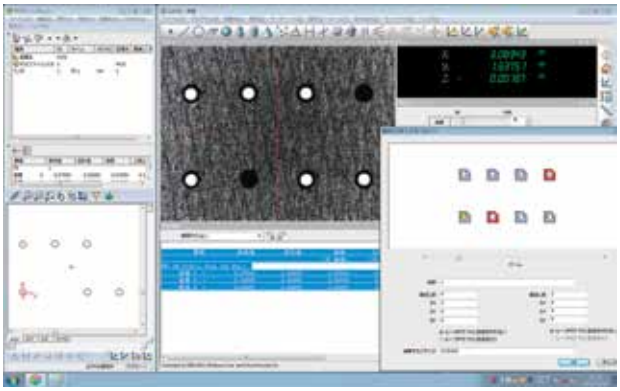
## Partial Execution of Measurement Programs

It is even possible to reduce the measurement time of part programs that have a large number of elements by partially executing the program.
This function is effective in identifying the cause of failures as it makes it possible to execute only the parts of a program that are failing such as the parts in which out-of-tolerance values are present.

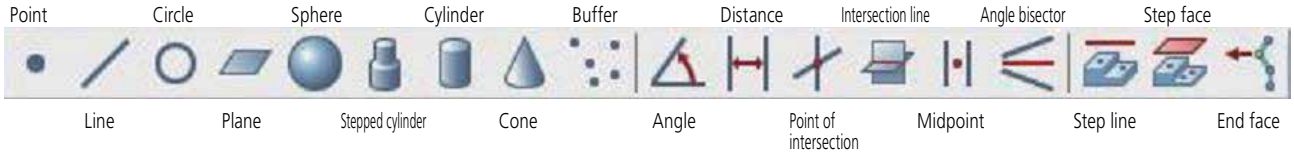


## Repeated Execution (Step and Repeat) Can Easily Be Programmed

The repeat command can be effortlessly set on the graphic display. Furthermore, even if parts of the workpiece are missing, steps can be deleted easily.



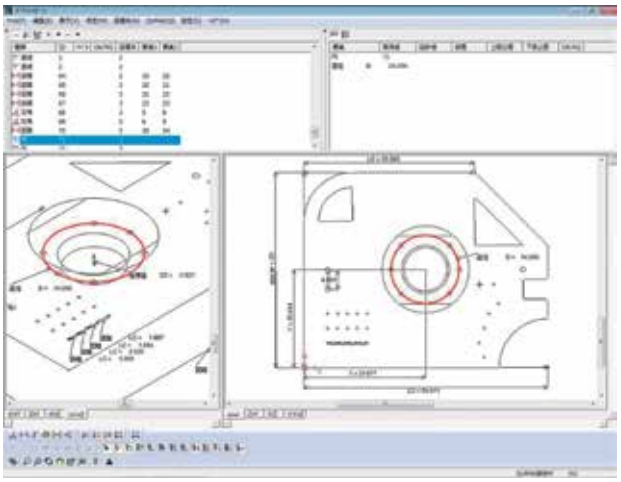
### Calculation Function Examples



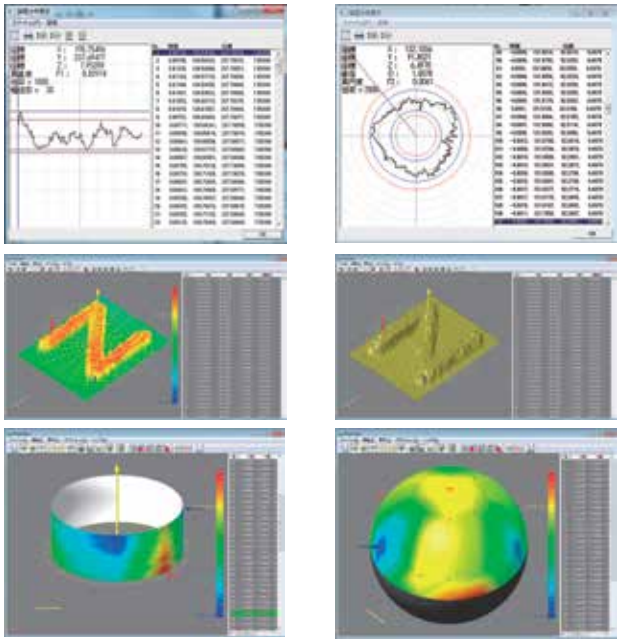
# Software
# Powerful Software Solutions Simplify Operability

## QVGraphics

This feature can perform calculations between elements and PCD measurements by selecting diagrams with the mouse as well as be used for reports of measurement results.
In addition, effective use of the graphics functions is useful in checking the coordinate system of the workpiece, checking for any forgotten measurements and making editing part programs easier.



Furthermore, QVGraphics has a function for drawing geometric deviations of lines, circles, planes, cylinders and spheres.



## Image Composition

This standard function combines multiple images of surfaces at different heights to create a complete focal point image in focus over a wide range.

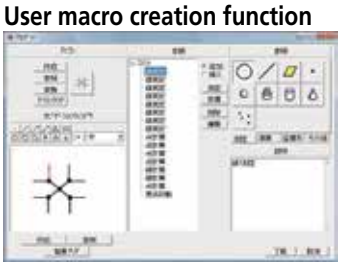
Original data

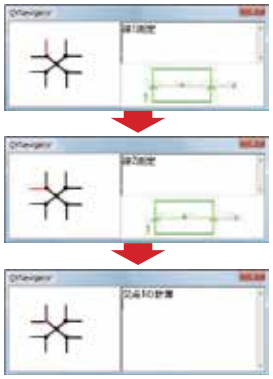
Image data after composition

## QVNavigator

This function provides a guided navigation for the procedures for calculations between elements and for coordinate system setup patterns. The user macro creation function can be used to freely customize even complex patterns. Also, part programs can be registered together with workpiece images which improves the operability of repeat measurements.

**User macro creation function**





**Part Program Registration Example**

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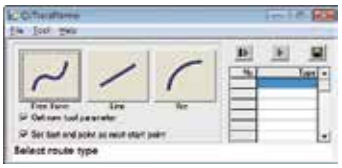
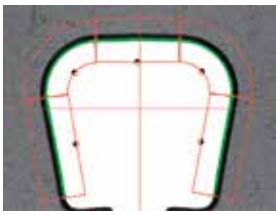
Mitutoyo

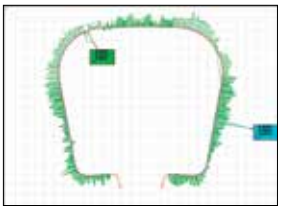
## QVTracePlanner

QVTracePlanner is an application software that uses edge detection to measure contour forms. This software can easily generate trace routes, even for forms that have varying heights and for forms that require multiple illumination conditions. Furthermore, after measurements are complete, FormTracePak AP (optional) can start and automatically perform analysis which achieves seamless operability.





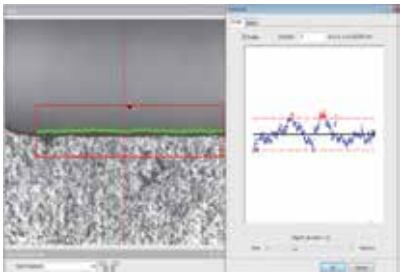
Trace route image generated by QVTracePlanner
(The actual operations are performed by executing one tool at a time.)



Actual example of FORMPAK-QV analysis

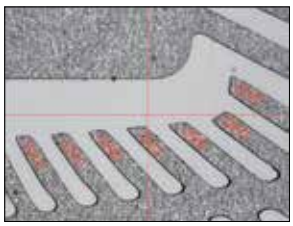
## Function for Removal of Abnormal Points at the Element Level

In addition to removing abnormal points per tool, they can also be removed from specific elements. Even when measurements are being performed on multiple screens, the abnormal point removal settings can easily be configured while viewing the graphic screen.



## Multi-point Autofocus

The autofocus tool has been subdivided. Chosen sizes, positions and angles can be set for multiple auto-focus tools.
Multiple data points can be obtained with a single focus operation. It is possible to not only perform efficient height measurements but also determine the maximum point, minimum point and average point from the acquired data.



## Help Function

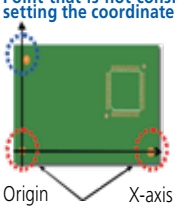
The Help function has been enhanced by help of a great number of graphics. Operators can conduct searches by topics and quickly find matching solutions to their queries.

## Best Fit Function

The best fit function considers items such as the skew and elasticity of the workpiece and then sets the coordinate system accordingly. Multiple elements determine origin and reference axes. Hence, measurements can be performed with a coordinate system that is more optimized than with conventional coordinate system settings.

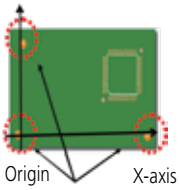
**Conventional Coordinate System Setting**

**Point that is not considered when setting the coordinate system**




The origin and the axis are determined to be separate elements.

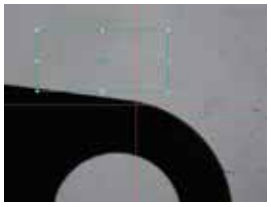
**Coordinate System Setting Using Best Fit**



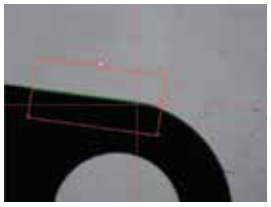

The coordinate system is set so that the alignment mark position offset errors are minimised.

## Smart Recovery Function

When edge detection or autofocus errors (which are caused by variations in the workpieces or setting errors) occur, the smart recovery function automatically corrects illumination conditions and tool position, and then performs the measurement again.



The workpiece is not located at the conventional measurement position.



The tool is automatically corrected, and the measurement is then performed again.

# Optional Software

## Form Evaluation and Analysis Software

### FORMTRACEPAK AP

FormTracePak AP performs tolerancing and form analysis from data obtained with the QV's auto-trace tool, non-contact displacement sensor, QV-WLI and PFF.

**Contour Tolerancing Function**

- Design data creation
  CAD data conversion, master workpiece conversion, function specification, text file conversion and aspherical surface design value creation
- Tolerancing
  Normal vector direction tolerancing, axial direction tolerancing and best-fit tolerancing
- Result display
  Result list display, error graph, error developed view, error coordinate display function and analysis result display

**Microscopic Form Analysis**

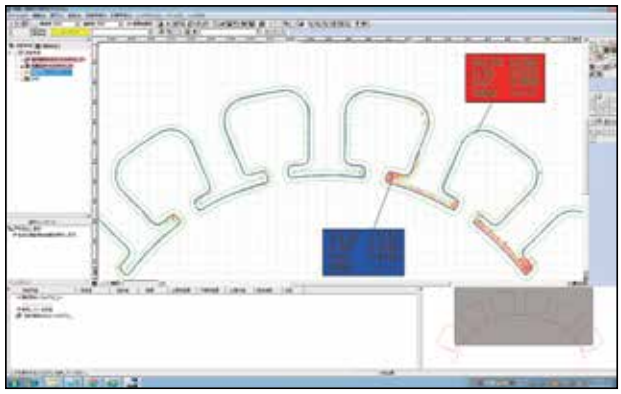
- Analyzed items: point measurement, line measurement, circle measurement, distance measurement, intersection measurement, angle measurement, origin setting and axial rotation
- Calculated items: maximum, minimum, average, standard deviation and area

**Report Creation Function**

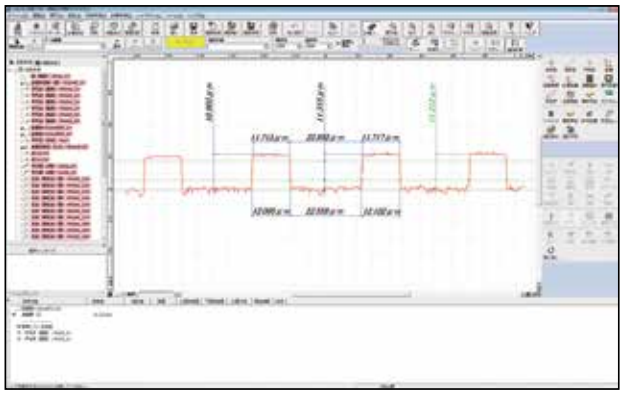
- Measurement result, error graph and error developed view

**Other Functions**

- Recording and executing analysis procedures
- External output function:
  CSV format, ASCII and text
- Fairing processing
- Quadratic curve fitting function
- Pseudo-roughness analysis function



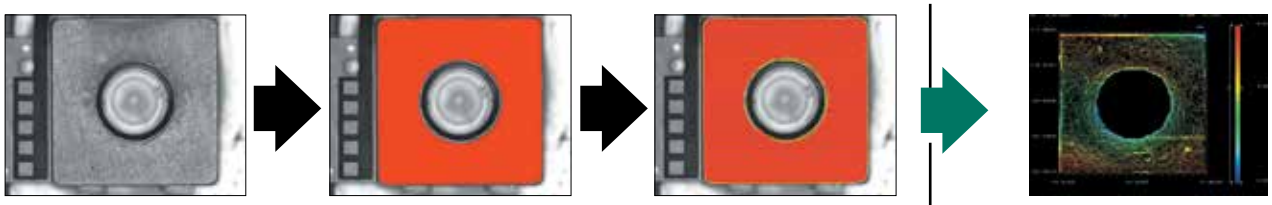
Tolerancing example



Example of using QV-WLI to perform line and space and thickness measurements on a printed circuit board

### QVTraceMaker

QVTraceMaker is a software application that creates scanning routes for the non-contact displacement sensor based on the images acquired by QuickVision. Using this software together with FORMTRACEPAK-PRO and MSHAPE-QV makes it possible to perform highly accurate 3D form measurements.
Automatic image composition outside the field of view can be performed when acquiring images which makes it possible to create wide-area trace routes and enables the easy creation of trace routes of complicated and unusual form areas.



Target area image composition

Measuring area specification

Trace condition setup

MSHAPE-QV evaluation example

# FORMTRACEPAK-PRO

FORMTRACEPAK-PRO is a software application that performs 3D analysis processing on the data obtained with the non-contact displacement sensor, QV-WLI and PFF.

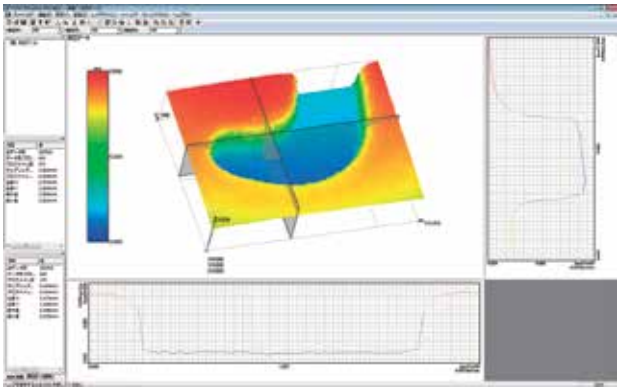
**Main Functions**

- **3D display**
  Wire frame, shading, contour line, contour line filling

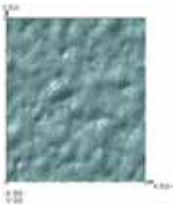
- **Trend compensation and filter processing**
  Trend compensation using flat surfaces, spherical surfaces, cylindrical surfaces, and polyhedrons
  1D and 2D digital filters for each profile

- **Digitization of a rich variety of surface textures**
  Relative load curves and area distribution curves can be used to evaluate wear and oil accumulation areas.
  Spectral analysis, cutoff area and volume analysis, angle of inclination calculations at peaks and valleys and histogram calculations of numbers of valleys can be performed.

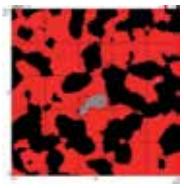
- **Function for extracting features from measurement data**
  Extraction of a chosen cross section, slope enhancement and simultaneous analysis of the peaks and valleys of the cutoff surface can be performed.



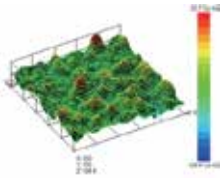
Example of using PFF to measure a molded component



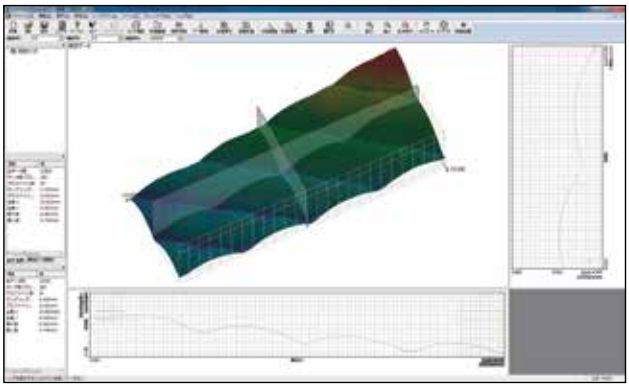
Shading display



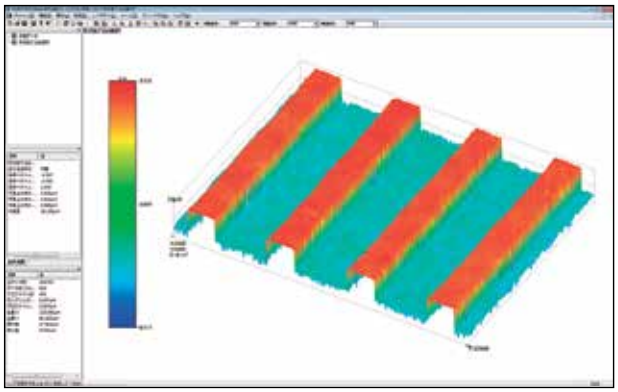
Cutoff surface analysis example



Wire frame display



Example of using QVH4 to perform acrylic lens eye measurements



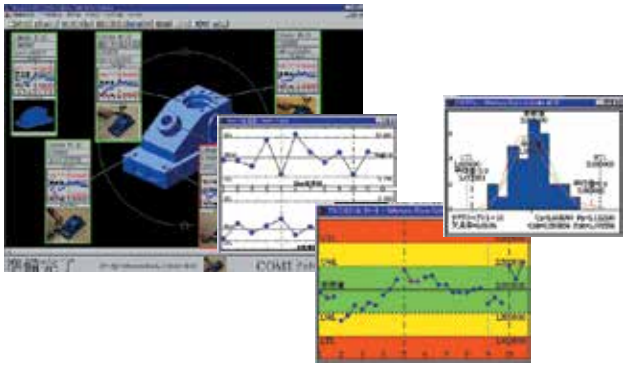
Example of using QV-WLI to perform line and space measurements on a circuit board

# Optional Software

## Inspection Certificate Creation

### MeasurLink®

Many types of statistical calculations can be performed on the measurement results. It is also possible to display control charts in real time.

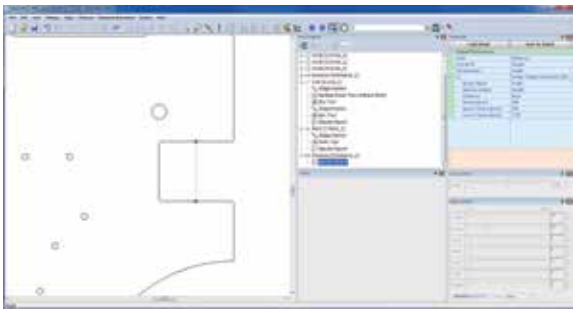


## Offline Teaching Software

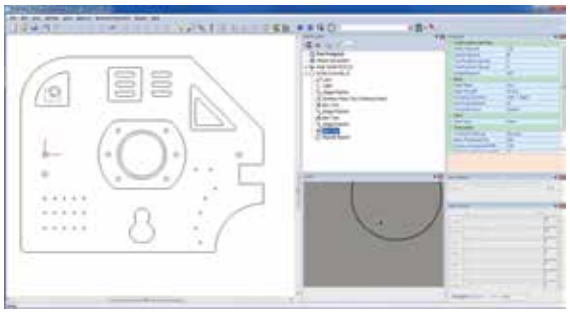
### EASYPAG-PRO

DXF IGES GERBER data

EASYPAG-PRO can use 2D CAD data to create QVPAK part programs offline.
This reduces the number of man-hours required to create part programs which results in a decrease in lead time.



Line-to-arbitrary-point distance measurement

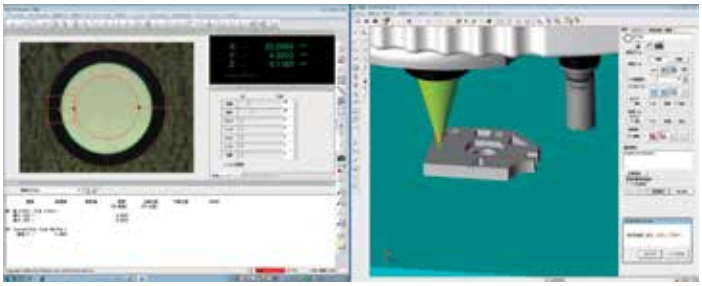


Offline teaching operation display

# Online Teaching Software

## QV3DCAD-OnLine

QV3DCAD-OnLine uses 3D CAD models to easily create QVPAK part programs. QV measurements can be performed by specifying an element in the CAD data. This improves program creation efficiency more than using a joystick to perform teaching.



Primary display: QVPAK　　Secondary display: QV3DCAD-OnLine

### Supported CAD Formats

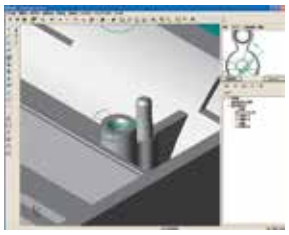
| Format | Supported version |
|---|---|
| SAT | Up to version 19 |
| STEP* | AP203 and AP214 (graphics only) |
| VDAFS* | Up to version 2.0 of VDA-FS |
| IGES* | Up to version 5.3 of IGES |
| CATIA V4* | Version 4.1.9 to version 4.2.4 of CATIA V4 |
| CATIA V5* | Release 2 to 17 of CATIA V5 |
| Pro/E* | Version 16 of Pro/E to WildFire2 and WildFire3 |
| Parasolid* | Version 10 to version 18 of Parasolid |
| Unigraphics* | V11 to V18 of Unigraphics and NX1 to NX7 |
| SolidWorks* | SolidWorks 98 to 2006 |

* optional

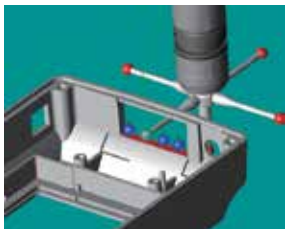
### Online Teaching of Illumination Conditions and Edge Detection Thresholds

QV3DCAD-OnLine can be used to teach correct illumination conditions and edge detection thresholds from actual images. The operation of the created program path can be checked immediately. This minimizes the operation check and program editing work that needs to be performed after the program is completed.


### Simulations and Checks for Interference Provide Accurate Operation



Edge detection tool simulations can be performed from the pseudo-video window.



The interference check function avoids problems caused by the probe or objective lens colliding with the workpiece.

## QV-CAD I/F

DXF　IGES

QV-CAD I/F improves the measurement operability by displaying CAD data in the graphic window.

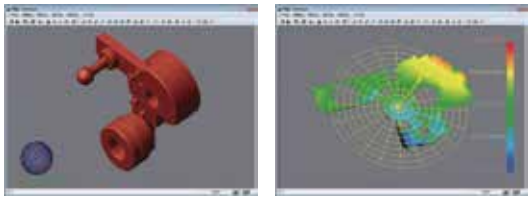
### Features

- A navigation function that uses CAD data (the import function) and a function for generating measurement result data (the export function)
- Design value information can be referenced from CAD data which eliminates the need for key entry of design values during nominal tolerancing.
- The 3D CAD import function can be used to display 3D CAD data and to configure flatness display area settings.

### CAD Export Function

Drawing a graphic of the measurement result　　Generated CAD data

### 3D CAD Import Function



3D CAD data display　　Illustrating flatness using 3D CAD data

# Optional Software

## Points From Focus (Apex Series Only)

### QV3DPAK

QV3DPAK is a software application that composes 3D forms from PFF (points from focus) or WLI (white light interferometer) data.

**Main Functions**

**3D Form Data Composition**

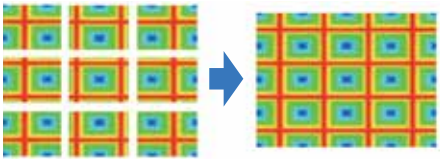
- QV-WLI 3D form data composition
- PFF 3D form data composition
- Form data noise elimination
- Form data Gaussian filter processing

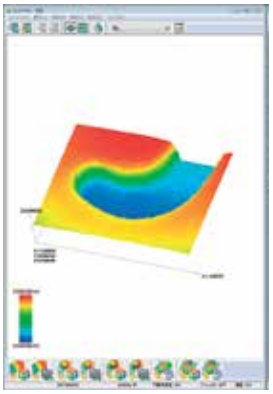
**3D Form Data External Output**

- Transfer of extracted data to QVPAK
- Transfer of extracted data to FORMPAK-QV
- Transfer of extracted data to FORMTRACEPAK-PRO

**3D Profile Stitching**

If a measuring target area cannot be covered with a single FOV (field of view) measurement, this function allows stitching of 3D profile data in multiple FOVs. 3D profile stitching enables an extensive range of measurement and analysis as a high resolving power is maintained.



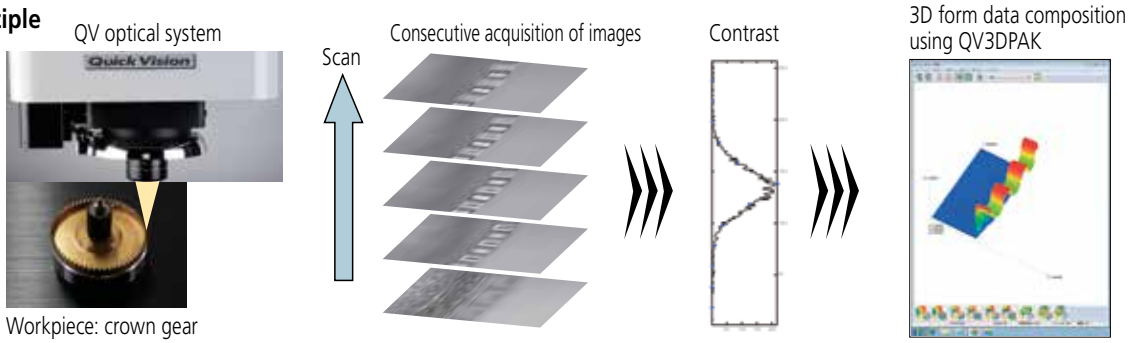


QV3DPAK

## About the PFF (Points From Focus) Function

PFF (points from focus) is an application that can use the image contrast of the Quick Vision Series to perform non-contact 3D form measurements. The Mitutoyo inspection method assures the Z-direction repetition accuracy highly accurate form measurements possible.

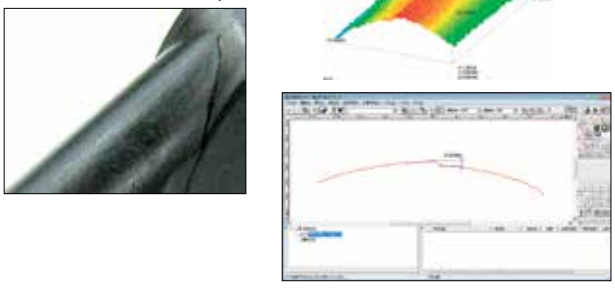
**PFF Principle**



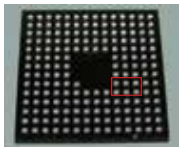

Workpiece: crown gear

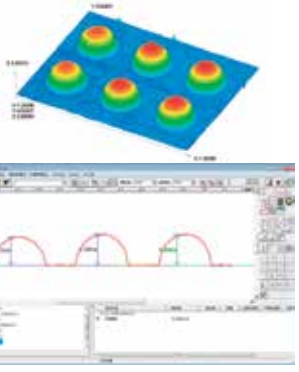
**PFF Measurement Example**

Partition line of a molded product



IC package BGA





**PFF Measurement Performance**

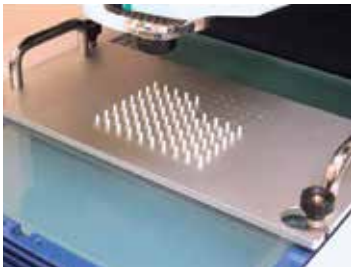
PFF performance is assured when using the Mitutoyo inspection method (the Z-direction repetition accuracy).

| | QV-Apex | Hyper-QV | ULTRA-QV |
|---|---|---|---|
| Z-direction repetition accuracy | 2σ ≤ 1.5 µm | 2σ ≤ 1.5 µm | 2σ ≤ 0.7 µm |
| Optical magnification is assured to be accurate | QV-HR 2.5X + PT2X | QV-HR 2.5X + PT2X | QV-5X + PT2X |

* When using the PFF function, employ the QV3DPAK software and a PFF-compatible objective (described on page 27).
* The PFF-compatible models are the PRO versions of the machines listed in the table above (including TP, HYBRID and UMAP machines).

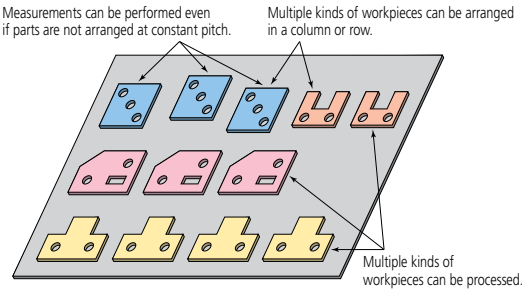
# QVPartManager

QVPartManager is the part program execution management software for multiple workpieces arranged on the measuring stage.
It is possible to create mapped displays of execution conditions and approval/rejection judgment results for each measurement workpiece. A retry function and a pass function are available for use when tolerances are exceeded or when an error occurs. These functions are effective in simplifying operations during repeat execution.



Workpieces arranged on a dedicated fixture

QVPartManager screen




# QVEio

QV Eio is a client application software for performing external control of the QV. To match different uses, three types of this software include: QVEio-PLC, QVEio-PC, and QVEio-Signal.

## QVEio-PLC

QVEio-PLC is software that can perform execution commands sent to the QV from an external source and provide status notifications in response to received commands by way of RS-232C communication with a PLC. Using this software makes it easy to construct a QV automated system such as by making a connection to an automatic conveyance robot.

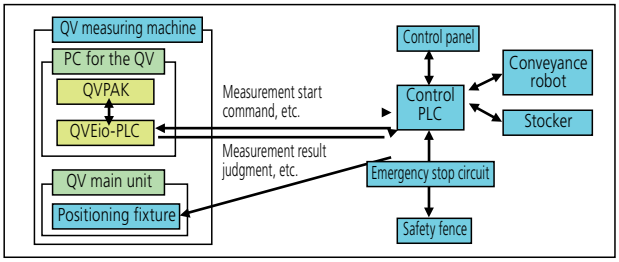
### Main Control Commands

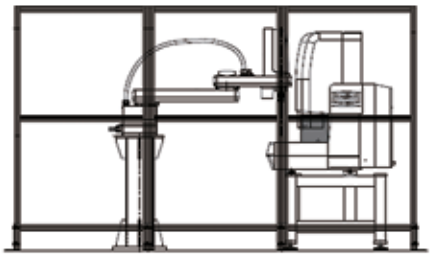
**PLC**
- ABS start command
- Measurement start command
- Measurement stop command
- X-, Y-, Z-axis movement command

**QVEio-PLC**
- ABS complete
- Measurement complete
- Measurement stop complete
- Measurement result judgment (pass or fail)
- X-, Y-, Z-axis movement complete
- Reading or writing device information*

* This function uses QVBasic language commands.

### QVEio-PLC Supported Example



## QVEio-PC

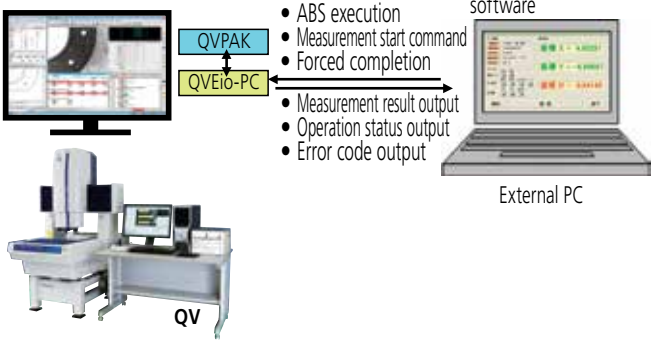
Not only can QVEio-PC be used to perform control through RS-232C communication with an external PC, but it can also be used to output measurement results and the status of errors that occur on the QV. This makes it possible to control the QV efficiently. QVEio-PC is optimal for controlling the QV from a dedicated GUI on an external PC.

### Main Control Commands

**External PC**
- Reading the operation status of the QV
- ABS execution command
- Measurement start command
- Reading measurement result file
- X-, Y-, Z-axis movement command
- Reading stage position information
- Each command

**QVEio-PC**
- Operation status output
- ABS execution in progress or ABS complete
- Measurement in progress or measurement complete
- Measurement result file output
- X-, Y-, Z-axis movement in progress or complete
- Stage position information output
- Error code output

### QVEio-PLC supported example

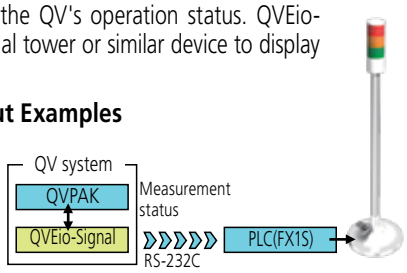



## QVEio-Signal

QVEio-Signal notifies a PLC of the QV's operation status. QVEio-Signal is optimal for using a signal tower or similar device to display the operation status of the QV.

### Measurement Status Output Examples

- Measurement complete (standby)
- Measurement processing in progress
- Error occurrence
- Measurement complete message display
- Emergency stop error occurrence
- Reading or writing bit device data



Coordinate Measuring Machines

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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