CNC Vision Measuring System
ULTRA Quick Vision

Bulletin No. 2019

ULTRA High Accuracy – X/Y .25+L/1000µm, Z 1.5+2L/1000
Ultra High Resolution = .01µm (.0000004") scales

Mitutoyo

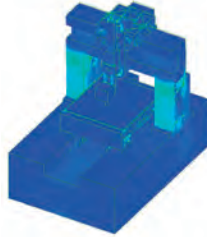**Quick Vision Series — Flagship Model —**
ULTRA Quick Vision

![Mitutoyo]

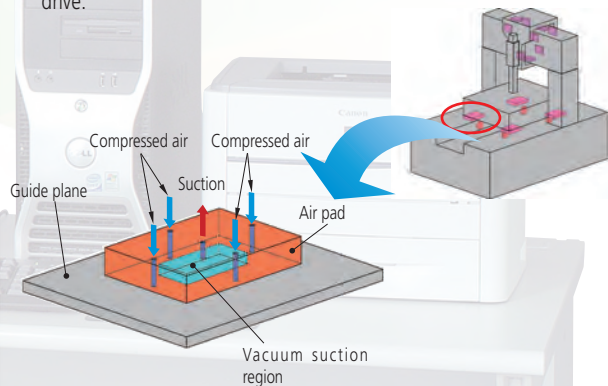# Advanced Technologies Supporting Ultra High-Accuracy Systems

Optimal Structural Design through FEM Analysis

The structural design is optimized through the use of infinite element method (FEM) analysis. This results in maximum rigidity for minimum weight, minimizing deformations due to loading and guaranteeing excellent geometrical accuracy at all times.

Self-Suction Air Pad

If a normal air pad is used for the Y axis, it is necessary to increase the mass of the work stage to obtain appropriate rigidity. ULTRA QV (Quick Vision) employs a special air pad called a self-suction type that floats the air pad with compressed air and also generates an absorption power with a vacuum zone provided under negative pressure at the center of the pad. This achieves greater Y-axis rigidity and stage weight reduction concurrently, thus enabling stable stage drive.

Compressed air   Compressed air

Guide plane   Suction
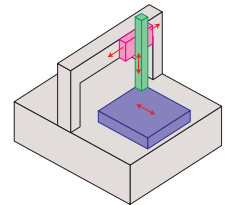
Air pad

Vacuum suction region

Temperature Compensation Function (Option)

The thermometer unit installed in the main body reads temperatures at each axis and calculates the amount of expansion and contraction of the body to compensate the measuring accuracy. This function allows the accuracy to be guaranteed in a wide range of 20°C±2°C. Additionally, the thermometer unit measures in real time, the workpiece temperatures with two sensors, outputting the results in which dimensions are converted to those at 20°C.

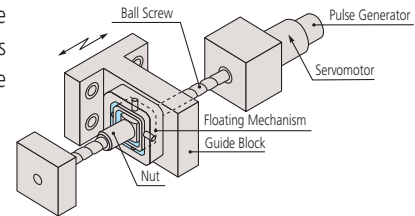## Main Body Structure Appropriate for High-Accuracy Systems

The moving structure of a fixed bridge table employed for ULTRA QV makes the X axis and Y axis completely independent of each other, providing the feature that the moving accuracy of each axis is not easily affected by the other. The X-axis and Y-axis guides apply granite, excellent in abrasion resistance and thermal stability.

Ball Screw Floating Mechanism

ULTRA QV employs high-reliability ball screws in the floating mechanism.
This floating mechanism will minimize the error due to axial fluctuation that adversely affects kinetic performance such as straightness and improve the driving speed.

Ball Screw   Pulse Generator

Servomotor

Floating Mechanism

Guide Block

Nut

High-Accuracy, High-Resolution Scale

The length measuring systems, standard for individual axes, are equipped with a high-resolution linear encoder system with a resolution of 0.01μm, respectively, which Mitutoyo has uniquely developed. This scale uses crystal glass as its material, of which the thermal expansion coefficient nearly equals zero, to minimize the scale expansion and contraction due to change in temperature and offer higher-reliability measurement data.

Conventional glass scale

Ultra high-accuracy crystallized glass scale

Ultra high-accuracy glass scales are manufactured at the underground laboratory of Mitutoyo Kiyohara Production Department.
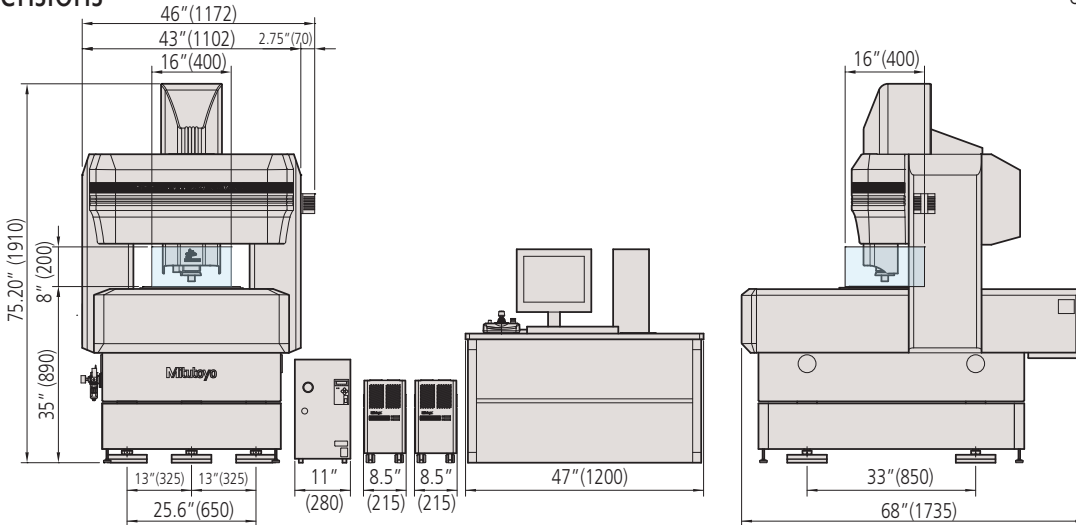
Air Server (Standard)

To avoid the adverse effect of supplied air temperature on the measuring system structure, the air server supplies air always maintained at a constant temperature.

Specifications

Dimensions

Unit: Inch (mm)

Specifications

Model No.		ULTRA QUICK VISION 404 PRO	
Order No.		**363-511-1A**	**363-517-1A** (equipped with LAF)
Range	X x Y x Z	16" x 16" x 8" (400x400x200mm)	
Magnification change system		Programmable power turret (selectable from among magnifications of 1X, 2X, and 6X)	
Resolution / Scale unit		0.01µm / Linear Encoder[*4]	
High-sensitivity CCD Camera		B&W	
Illumination (PRL: Programmable Ring Light)	Surface	Halogen	
	Contour	Halogen	
	PRL	Halogen	
Accuracy[*1] (20°C±0.2°C)	E_{1XY}	(0.25+L/1000)µm	
	E_{1Z} (50mm stroke)[*2]	(1.0+2L/1000)µm	
	E_{1Z} (Full stroke)	(1.5+2L/1000)µm	
	E_{2XY} plane	(0.5+2L/1000)µm	
Accuracy assurance environments[*3]	Temperature range	20±0.2°C	
	Temperature variation	0.5°C/1H	
	Temperature gradient	1°C/m	
Repeatability within the visual field		3σ=0.2µm	
Repeatability of auto-focus		σ=0.4µm	
Repeatability of laser auto-focus		—	σ=0.4µm
Stage glass size		19.4" x 21.7" (493x551mm)	
Max. stage loading		88lb (40kg)	
Dimensions (W x D x H)		46" x 68" x 75.2" (1172x1735x1910mm)	
Mass		4464lb (2025kg)	
Used air pressure		0.4MPa[*5]	
Supplied air flow rate		150L/min[*6]	

*1: Accuracy when measured at the center of the video screen and in the middle of measuring stroke on a plane using the 5X objective and 1X tube lens

*2: Specified only for factory shipping inspection.

*3: Accuracy assurance environments in the case where no temperature compensation is performed.
Those in the case where temperature compensation is performed are as follows.
• Accuracy-assured temperature range: 20±2°C
• Temperature variation: 0.5°C/H
• Temperature gradient: 1°C/m

*4: Thermal expansion coefficient: (0±0.02)X10^{-6}/K

*5: An air source is required to maintain the original air pressure between 0.5 and 0.9MPa.

*6: Indicates the flow rate under normal conditions.

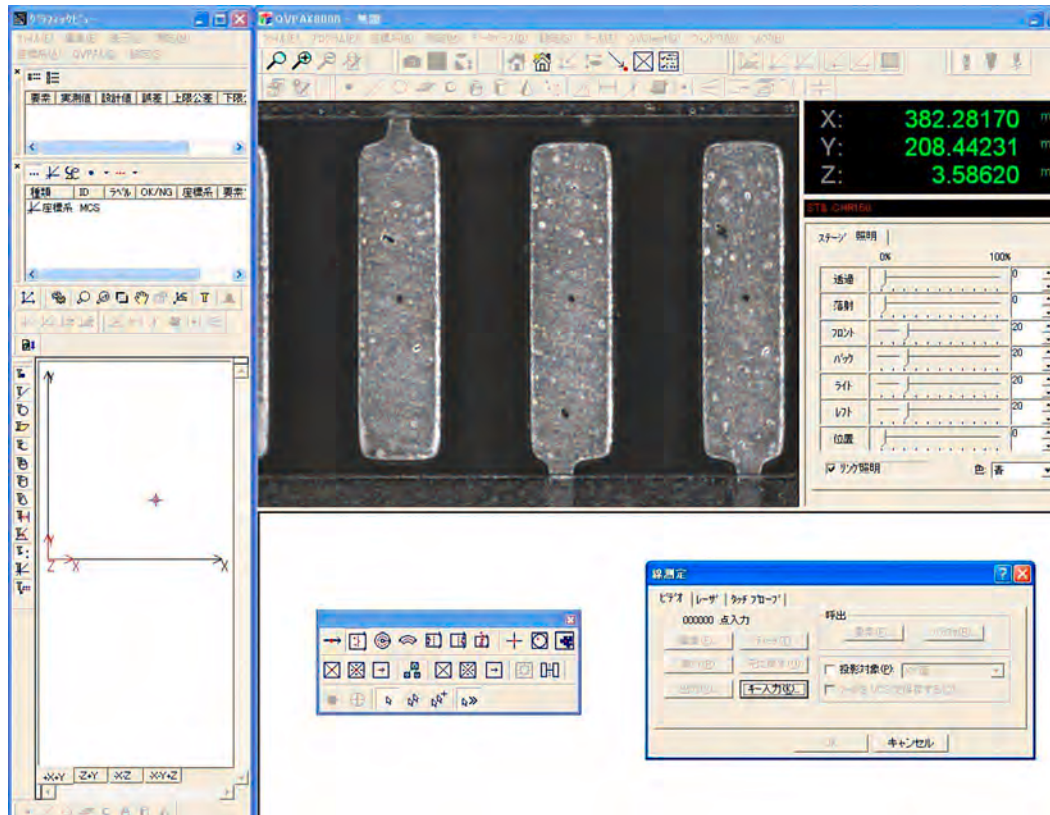# "Ultra-High Accuracy" Measurement Achieved by Mitutoyo's "ULTRA" Quick Vision

The Ultimate Flagship Machine Newly Redesigned with Increased Speed and Higher Accuracy Mitutoyo has Now Attained the Summit of Vision Measurement
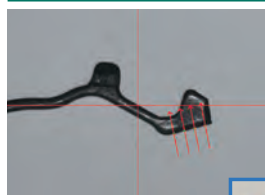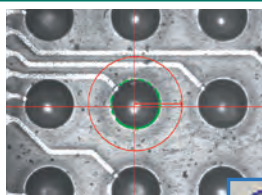
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Software
QVPAK Intuitive Software with Advance Features
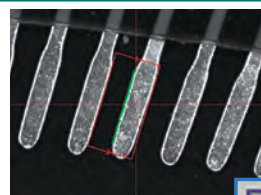## The Most Powerful Vision Software of any Manufacturer

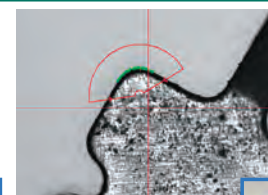## ■ The most diverse set of measuring tools available for edge detection

One-Click Point Tool
This is a basic tool for capturing one point.

One-Click Circle Tool
This tool is appropriate for capturing a full feature circle.

One-Click Line Tool
This tool is appropriate for capturing a line feature.

One-Click Arc Tool
This tool is appropriate for capturing an arc and the radius of a corner.

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

Pattern Search
This tool captures the position of a pattern that has been registered beforehand. It is optimal for positioning the alignment mark.

Area Centroid Tool
This tool evaluates the position of a feature's centroid. It is appropriate for capturing the center of a feature.
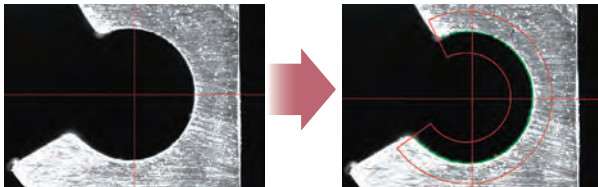

Auto Trace Tool
This is a form measuring tool that can autonomously track an unknown feature.
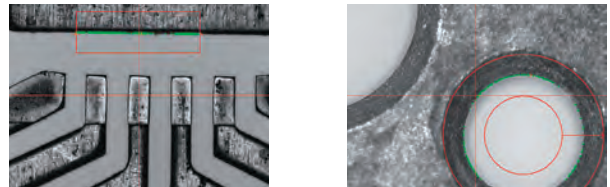
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One-click Measuring Tool Set-up

The tool size, orientation, and threshold value of a measuring tool are automatically set with one click of the mouse.
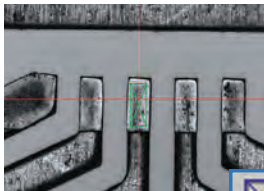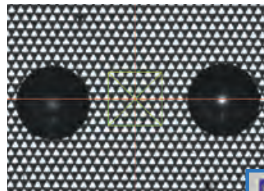

Outlier Removal of Abnormal Points

Abnormal points such as dust, burrs, and cracks are removed. The removal threshold detection level can be set arbitrarily.
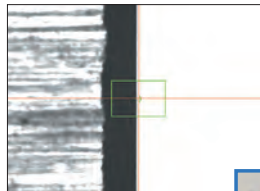

Various Auto-focus Methods are Standard Equipment

Surface Focus Tool
This is a general vision focusing tool.

Pattern Focus Tool
This focusing tool is optimal for transparent or low-contrast surfaces.

Edge Focus Tool
This is a tool for focusing on a beveled edge.
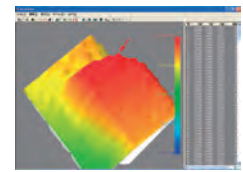
Multi-point auto-focus

Targeting the auto-focus tool (surface and pattern) on separate areas allows multiple heights (1344 points at max.) to be measured. Maximum and minimum heights as well as the average height can be found.

Example of individual layout of focus tools

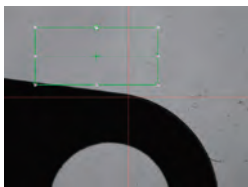Example of multiple-height measurement
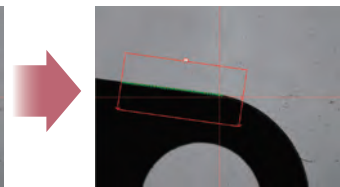
Example of display with the QV graphics

Industry First, Smart Recovery Function

Depending on the unevenness of workpieces and the condition of alignment, an edge detection error or auto-focus error may result during part program execution.

The Smart Recovery function corrects the illumination condition or the position and angle of a tool to automatically perform remeasurement.
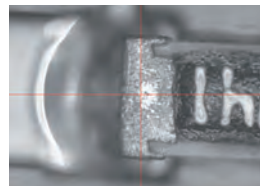

Noisy edge

Brightness analysis
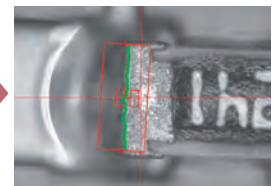
Enhanced Edge Detection Capability

The capability of detecting a noisy edge has increased by analyzing modest changes in brightness and differences in texture on the target surface.

Advanced edge filtering capabilities including texture, brightness and morphology.
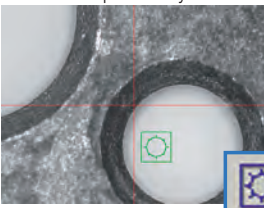
Noisy edge

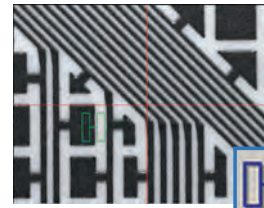Brightness analysis

Edge of Screen

Morphological Filter

Patented, Automated Lighting Tools

This tool can automatically set the optimal light intensity adjustment and light intensity correction at procedure creation time, thereby increasing detection repeatability.
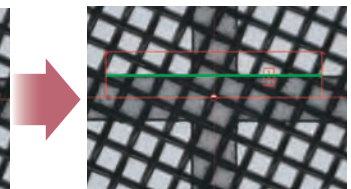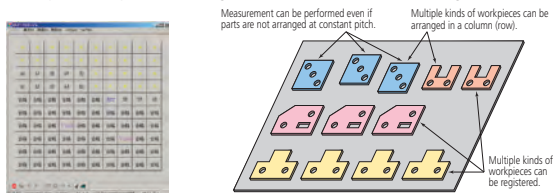

Brightness Tool

Dual Area Contrast Tool

Application Software (Option)

▇ Automatic Measurement Management Software

QV Part Manager

QV Part Manager is the execution program management software for multiple workpieces arranged on the measurement stage.
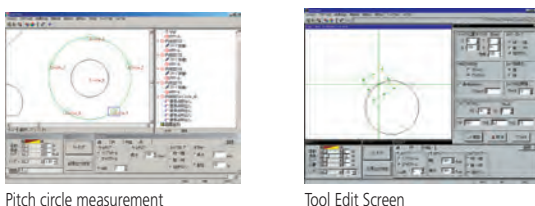
Measurement can be performed even if parts are not arranged at constant pitch.

Multiple kinds of workpieces can be arranged in a column (row).

Multiple kinds of workpieces can be registered.

▇ Offline Teaching

EASYPAG   [DXF] [IGES]

EASYPAG creates measurement part programs for QVPAK using 2D CAD data. It reduces the number of man-hours for creating part programs, thus allowing a decrease in lead time.

Pitch circle measurement   Tool Edit Screen

PAGPAK   [DXF] [IGES] [CSV] [NC Data] [EXcelon data] [Gerber data]
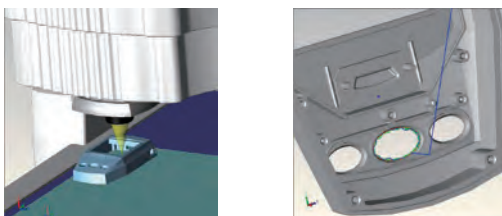
PAGPAK is the offline teaching software for creating QVPAK part programs using NC data, CAD data and Gerber data.

▇ Online Teaching

QV 3DCAD-OnLine

QV 3DCAD allows the machine to travel to the position specified on a 3DCAD model and execute measurement. This drastically improves the operability and part program creation efficiency compared with operations under joystick control.
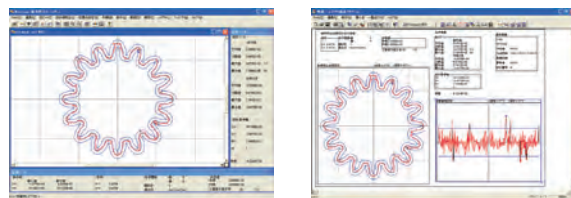
▇ Form Evaluation and Analysis Software

FORMPAK-QV

FORMPAK-QV performs contour tolerancing and form analysis from form data obtained with the QV Auto Trace tool and laser probe.

▇ Measuring Support

CAD Option

CAD Option displays CAD data on the Graphic window to enhance ease of measurement.
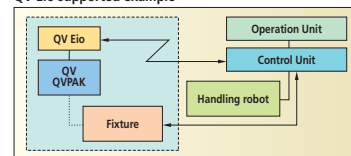
MeasurLink®

A real-time display of measurement results and statistical analysis on the shop floor, with data saved in a database. Includes SPC and statistical analysis, data filtering and reporting systems for complete control of your manufacturing processes. MeasurLink includes modules for shop floor data collection, QC room data analysis and reporting, gage R&R studies, and gage tracking.

QV Eio
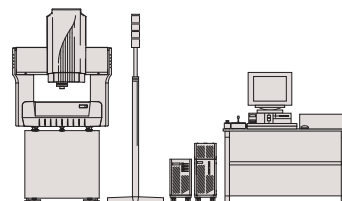
Facilitates external control interface between a PC and QVPAK.

QV Eio supported example

- QV Eio
- QV QVPAK
- Operation Unit
- Control Unit
- Handling robot
- Fixture

QV Eio-PC

QVPAK can be controlled from an external PC via RS-232C. QV status can be output using an external I/O board.

QV Eio-PC usage example (System using PATLITE)

QV-JMP Export

Outputs QVPAK measurement results to JMP SPC software.

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Application Hardware

Objects

Objective	Turret lens mag.	Monitor mag.	View Field	Working distance
QV-SL0.5X	1X	15X	12.54 x 9.4	30.5mm
	2X	30X	6.27 x 4.7	
	6X	90X	2.09 x 1.56	
QV-SL1X QV-HR1X	1X	30X	6.27 x 4.7	52.5mm 40.6mm
	2X	60X	3.13 x 2.35	
	6X	180X	1.04 x 0.78	
QV-HR2.5X QV-SL2.5X	1X	75X	2.5 x 1.88	40.6mm 60mm
	2X	150X	1.25 x 0.94	
	6X	450X	0.41 x 0.31	
QV-5X	1X	150X	1.25 x 0.94	33.5mm
	2X	300X	0.62 x 0.47	
	6X	900X	0.2 x 0.15	
QV-10X QV-HR10X	1X	300X	0.62 x 0.47	30.5mm 20mm
	2X	600X	0.31 x 0.23	
	6X	1800X	0.1 x 0.07	
QV-25X	1X	750X	0.25 x 0.18	13mm
	2X	1500X	0.12 x 0.09	
	6X	4500X	0.04 x 0.03	

The monitor magnification and field of view values are for the PRO machine.

QV-10X, QV-25X: Depending on the workpiece the illumination may be insufficient at a turret lens magnification of 2X and 6X.

QV-25X: The PRL illumination is restricted in its usable position.

Calibration glass chart & Compensation glass chart

Calibration Glass Chart

This is a chart for calibration of CCD pixel sizes and offsets between power turrets.
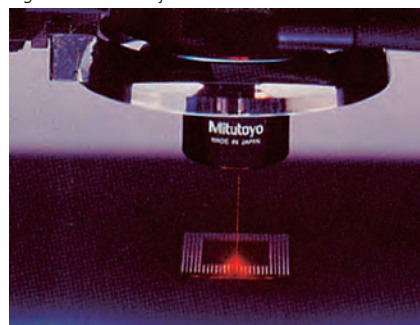

Compensation Glass Chart

This is a glass chart of "on-screen compensation" for compensating on-screen distortions an optical system has an "auto-focus compensation" for reducing auto-focus variations resulting from the difference in pattern and texture of an object.

Laser Auto-Focus (Factory-installed Option)

This hardware allows high-speed focusing or height measurement in a microscopic region with the objective transmission TTL laser.
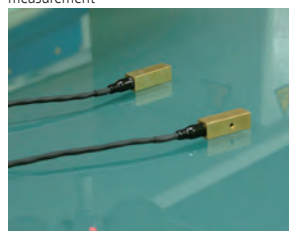

Objective	QV-5X *1
Laser	Visible-light laser wavelength: 690 (nm)
Laser spot diameter	3µm
Repeatability	σ=0.4µm or less
Laser safety	Class 1 laser product

*1: The QV-5X lens is supplied as standard for an LAF-equipped system.

Temperature Compensation Unit (Factory Option)

This unit detects temperatures with the main body temperature sensors attached to each axis and two sensors dedicated to a workpiece. The unit finally outputs data converted to dimensions at 20°C after calculating the expansion and contraction quantities of each main body and workpiece.
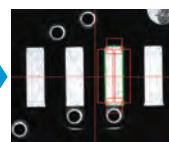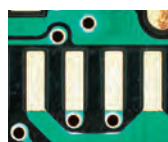
It is also possible to output dimensions at a reference temperature of 23°C used in electric and electronics industry although 20°C is generally assumed as the reference temperature at measurement

RGB color Filtering unit

The color filtering function can be added to the vertical reflected illumination or programmable ring light in Quick Vision models that use a halogen light source. This function enhances the visibility of low-reflection surfaces on colored workpieces, facilitating edge detection. This function can also be retrofitted to a conventional Quick Vision. In addition, a yellow filter enables vision measurement in the yellow light region, which provides high sensitivity.

Red filter used

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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