



**NEW** CV Series Vision Systems



**More Speed. More Resolution.  
More Solutions.**

Introducing the Most Versatile Machine Vision Systems in the Industry

**VISION SYSTEM GENERAL CATALOG**

# The Evolution of KEYENCE Machine Vision Systems

KEYENCE has been an innovative leader in the machine vision field for more than 20 years. Its high speed and high performance machine vision systems have been continuously improved upon and now allow for even greater usability and stability when solving today's most difficult applications. The new CV-5000 Series is built upon years of experience and includes numerous innovations that have helped make KEYENCE a true industry leader. KEYENCE is committed to introducing new cutting-edge products that go beyond the expectations of its customers.



CAD Series  
LED illumination units,  
lenses, etc.



XV Series



The first image  
processing sensor.



VX Series



CV-300 Series



CV-100 Series



CV-500 Series



CV-700 Series

## 1980s

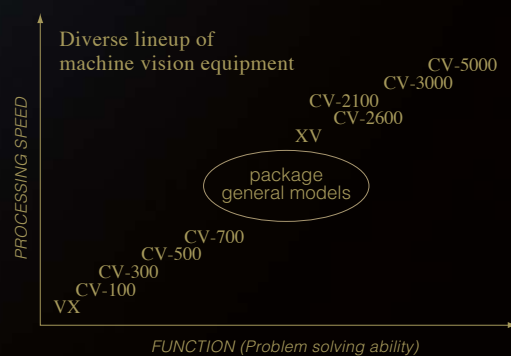
General-purpose image processing device is developed.

## 1990s

KEYENCE becomes the first company in the industry to introduce complete, low cost visual inspection systems. These general purpose sensors created a new market for user friendly vision systems.

## 2000

KEYENCE introduces the industry's first 2 camera, built-in monitor, all-in-one compact vision solution.



## 2003

High-speed general-purpose vision system incorporating twin processors and digital transfer camera is released.

## 2004

Package featuring 2 megapixels is released.

## 2005 to 2008

The CV-3000 and CV-5000 raise the bar for machine vision performance with 4 camera connectivity, unmatched speed, and the industry's most user friendly programming interface.

## 2009 and beyond

As the machine vision market expands, KEYENCE will use its vast experience and knowledge to continue to provide the industry with the most advanced technology available.

# Product Overview

## Ultra High-Speed, Multi-Camera Vision Systems

### CV-5000 Series NEW ▷ P. 08

11x 5MEGA  
DIGITAL

eXpandable  
CONTROLLER

3+1  
Processor

A.C.E.II  
COLOR

Multi  
Camera  
System 4



Multi-Camera Series ▷ P. 10

Expandable Controller Architecture ▷ P. 13

Ultra High-Speed Processing and  
New Color Extraction Engine, A.C.E.II ▷ P. 14

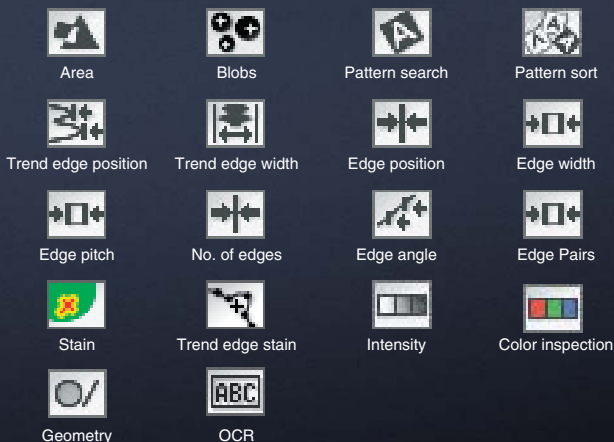
Defect Detection Solutions ▷ P. 16

Statistical Processing and  
Communication Software ▷ P. 23

Multiple Interface Options and  
Dimensions ▷ P. 26

### Wide array of inspection tools

CV-5000 Series models have a wide array of inspection tools to provide solutions to almost any inspection. These eighteen tools enable users to select the optimum inspection method, including the ability to set simultaneous inspections for a single trigger input.



## All-in-One Image Processing

# CV-700 Series ▶ P.32



Detecting flaws or pinholes on sheet material



Detecting LCD segments

## Features

- Advanced color Shade-Scale processing
- Controller with built-in monitor and 2-camera connection
- High-speed search and 360 degree rotation adjustment
- High-accuracy sub-pixel processing
- Large-capacity memory card available

## Comprehensive menus

Menus are available for nearly every in-line need. Up to eight different inspection modes can be combined in a single program.



Presence/absence



Outer edge



Inner edge



Gap Pitch



Center Pitch



Flaw detection



Point sensor



Count



No. of edges



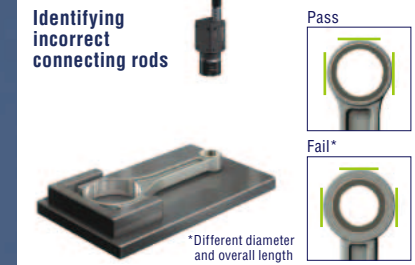
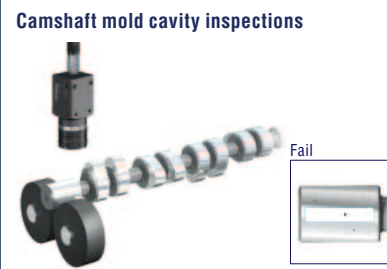
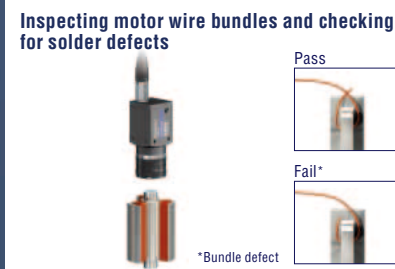
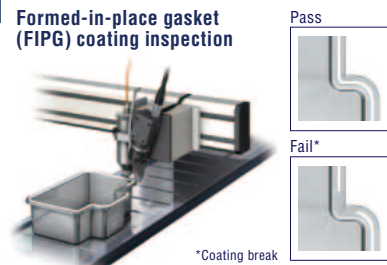
Position/angle

# Applications

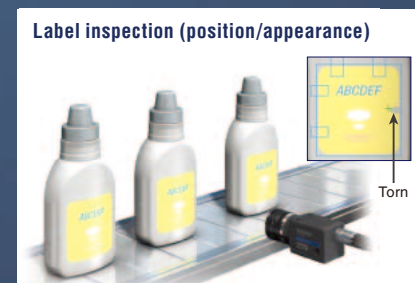
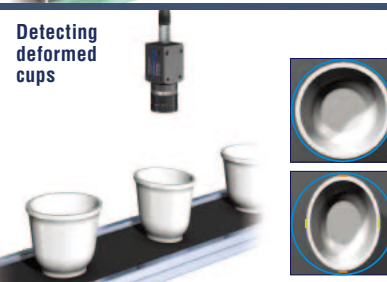
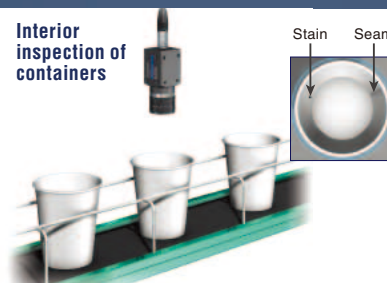
## Part identification / Defect inspection

## Measurement /

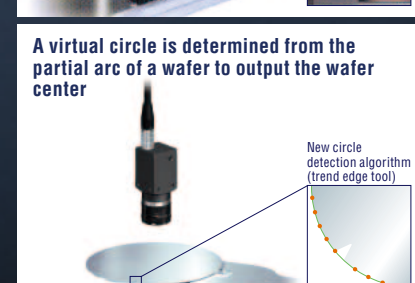
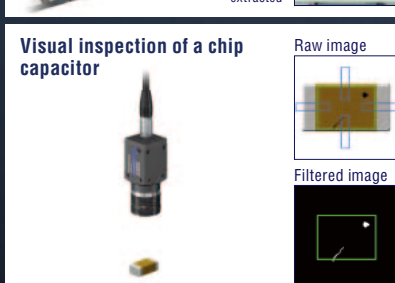
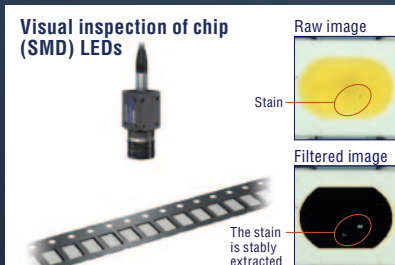
### Automotive / Metal



### Food, Pharmaceutical & Others



### Electrical / Electronic

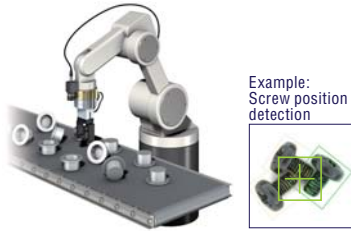


## Positioning

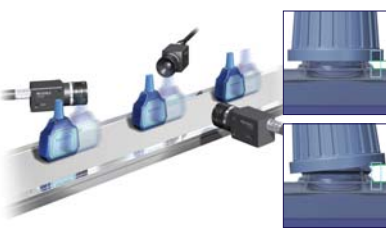
### Detecting bead positions



### Random picking of bushing parts by robots



### Checking improperly closed caps



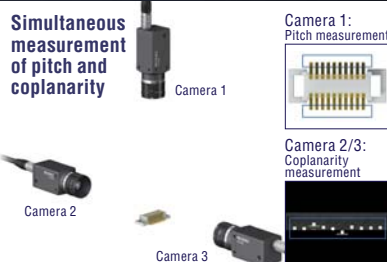
### Checking the liquid level



### Dimensional/ Visual inspection of capacitors



### Simultaneous measurement of pitch and coplanarity



## Color inspection / OCR / Counting

### Detecting incorrectly assembled fuse boxes



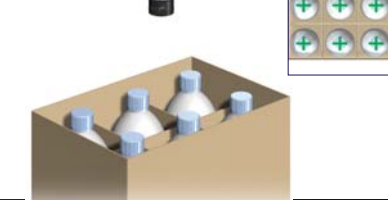
### Detecting amount of grease applied to parts



### Inspection of expiration dates



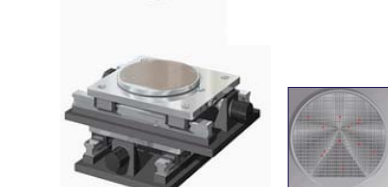
### Counting items in a carton



### Character recognition of part numbers



### Detecting BAT marks with red ink



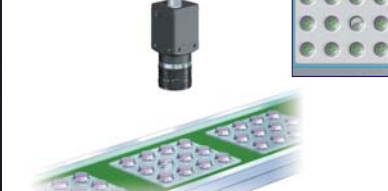
### Detecting wrong gears



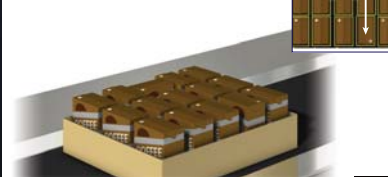
### Checking for missing O-rings or O-ring misalignment during EGR valve assembly



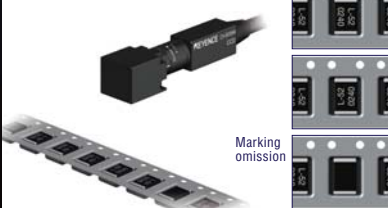
### Counting the number of tablets



### Type/ Orientation differentiation of drink boxes



### Checking orientation through embossed tape



### Checking the wafer position in a rack



Automotive / Metal

Food, Pharmaceutical & Others

Electrical / Electronic

HISTORY

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APPLICATIONS

CV-5000 SERIES

CV-700 SERIES

# CV-5000 Series

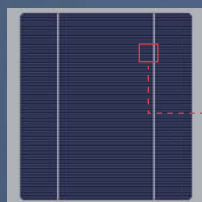
The industry's most state-of-the-art problem solving tool is now even better.

Introducing the new CV-5000 Series, relentless in its ability to solve challenging applications.

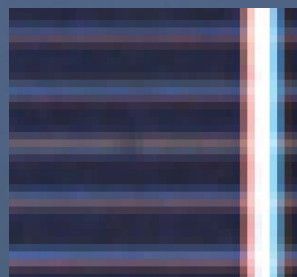
**BEST RESOLUTION IN ITS CLASS** Ultra high-definition image processing is now available for any production line

11x high-speed, 5 million-pixel camera **11x 5MEGA DIGITAL** ▷ P. 10

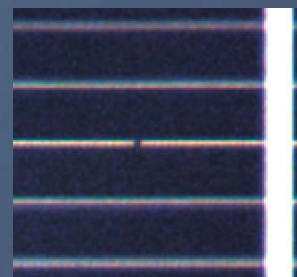
The 11x high-speed camera transfers ultra high-definition, 5 megapixel images (2432 x 2050 pixels) in 61.2 ms (16.3 times/sec). High-speed production lines can now harness the benefits of high-precision image processing. The new CV-5000 Series accepts up to four 5 million-pixel cameras and transfers the images simultaneously, enabling high-definition inspections of up to 20 million pixels.



Broken pattern detected in a solar battery electrode



Conventional 310,000 pixel-camera  
Defect cannot be recognized.



5 million pixel-camera  
The broken pattern is clearly visible.

**FASTEST IN ITS CLASS** High-speed, parallel processing system

3+1 processor technology **3+1 Processor** ▷ P. 14

The 3 + 1 parallel processing architecture addresses the heavy processing needs required by high-volume 5 million pixel-images, color processing, and advanced algorithms that perform complex numeric operations.



**WIDE RANGE OF CAMERA SELECTIONS**

Users can select the camera best suited for the application

Fourteen different camera types **Multi Camera System 4** ▷ P. 11

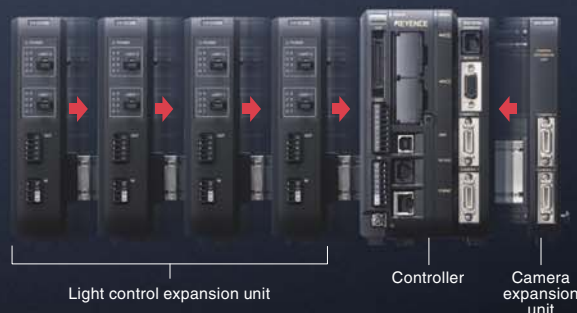
Users can select the optimum camera for their application from the industry's most extensive lineup of 5 million-pixel, 2 million-pixel, and ultra compact cameras. Each camera type is available in color or monochrome models. The CV-5000 Series can simultaneously run up to four different camera types making multi-camera applications more cost efficient.



**INDUSTRY FIRST** Controller-based illumination control

Introducing an expandable controller architecture **eXpandable CONTROLLER** ▷ P. 13

This architecture allows users to increase the flexibility of their systems using expansion units, which includes the camera expansion unit and the light control expansion unit. By limiting the functionality to the essentials, users can meet their requirements, reduce costs, and still maintain the flexibility to upgrade in the future.





**BEST IN ITS CLASS** Solutions for sophisticated defect inspection applications

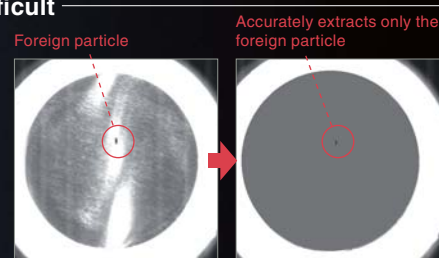
## New defect detection algorithms for tackling difficult applications ▸ P. 16

Several new algorithms have been added to detect foreign objects or burrs on irregularly shaped profiles. These new algorithms also filter out glare or other background noise so that only the flaws are emphasized.

### Applications previously considered difficult



Detection of minute flaws along the profile



Particle detection on backgrounds with glare and other shade variations

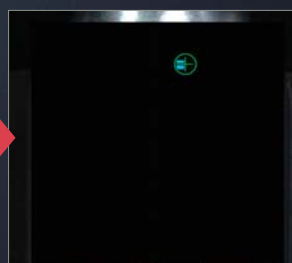
**BEST IN ITS CLASS** Reliable detection under poor conditions

## New image enhancement processing ▸ P. 15, 17

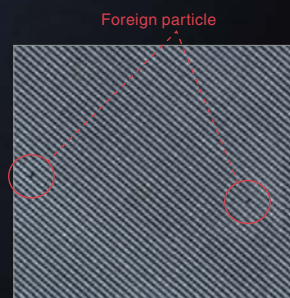
Significant advances were made to preprocessing functions that eliminate conditional changes caused by workpiece variation. The newly equipped Fine Color Processing function directly processes full-color information to reliably extract defects from backgrounds with pattern or illumination variations.



Foreign particle detection on a rounded metal surface



Isolates the foreign particles by cancelling out the metal reflections



Foreign particle detection on diagonal striped background

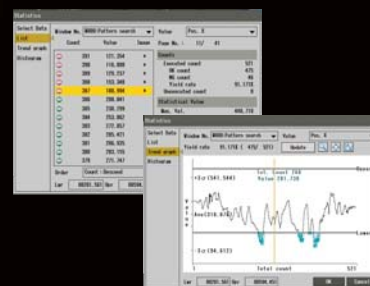
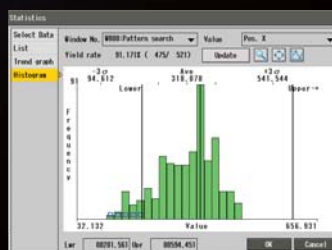


Removes the striped pattern and reveals only the foreign particle

**BEST IN ITS CLASS**

## Full range of statistical and image archive functions ▸ P. 23

CV-5000 Series controllers come with built-in statistical functions that let the user view the inspection results in real-time. The on-board image archive can store up to 1023 past inspection images that can be reviewed at a later time. Combining these two features allows for detailed analysis of product result trends and failure conditions, making it easier than ever for users to fine tune their program tolerance and settings to improve yield rates.



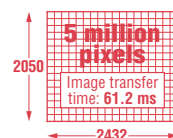
# 5 million-pixel, ultra high-speed cameras

[ FASTEST IN THE INDUSTRY ]

## High-speed 5 million-pixel camera series

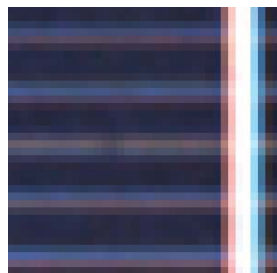
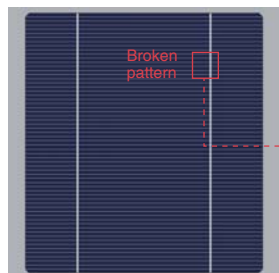


KEYENCE 11x high-speed cameras transfer 2432 x 2050 pixels in just 61.2 ms. This high-speed transfer rate delivers the benefits of high-definition image processing to high-throughput production lines. Now previously impossible inspections can be performed with a single camera. For example, it is possible to detect extremely minute defects on standard sized parts, or larger parts can be captured and inspected in detail with a single camera. In addition, the camera size is unobtrusive, making it easy to mount almost anywhere.



## Reliably detect micro defects

### Pattern breaks in solar battery electrodes



#### ■ 310,000 pixels

Lines are out of focus and cannot be detected.



#### ■ 2 million pixels

Broken pattern is out of focus and lacks clarity for an accurate inspection. The image requires a smaller field of view.



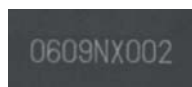
#### ■ 5 million pixels

Lines appear sharp and the break can be accurately detected.

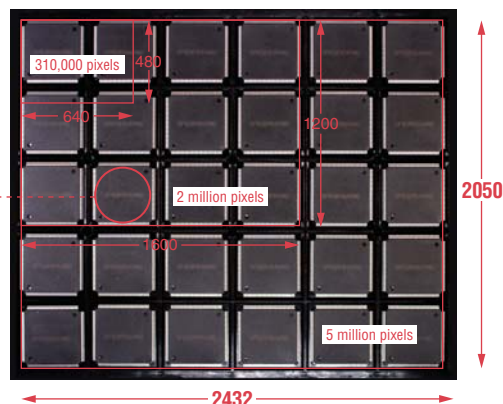
## Capture the entire image in one shot with a wider field of view

### Field of view comparisons with existing cameras

To maintain the resolution needed for print inspections...

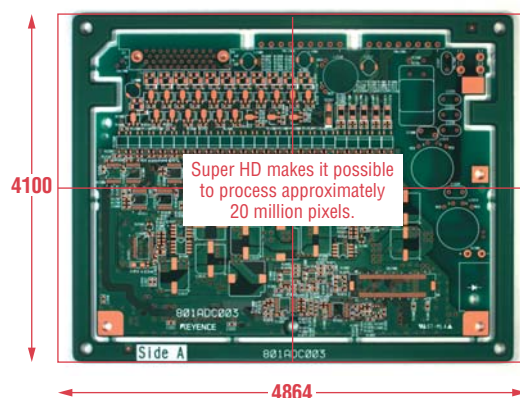


A 5 million-pixel camera can inspect the entire image at once while maintaining the resolution needed for inspection.



#### ■ 20 million-pixel simultaneous process

Process up to 20 million pixels by connecting four 5 million-pixel cameras. All four cameras capture and transfer simultaneously.



# Extensive Camera Lineup

## [ WIDE RANGE OF CAMERA SELECTIONS ] Select the camera best suited for the application

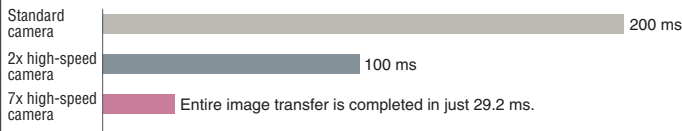
The CV-5000 Series has a vast array of camera options to allow the user to carefully select the optimum camera based on their application needs. Whether the application calls for high precision color measurement with a 5 megapixel camera, ultra-fast processing with a 7x high speed camera, or mounting within a compact enclosure, the CV-5000 Series camera lineup can provide a solution.

### 7x high-speed cameras

The 7x CCD cameras of the CV-5000 Series are the fastest in their class, easily supporting high-speed lines and continuously moving targets. Images can be rapidly transferred without compression, solving inspection applications previously impossible with machine vision equipment. The 2 million-pixel camera models can complete processing in about the same amount of time as conventional 310,000-pixel models, enabling high-resolution inspection without reducing product cycle times.

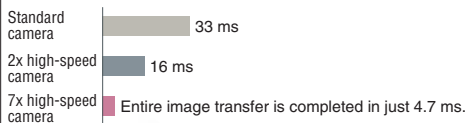
#### [ FASTEST IN ITS CLASS ] ■ 2 million-pixel cameras NEW

For inspections that demand both high-resolution and high-speed processing.



#### [ FASTEST IN ITS CLASS ] ■ 310,000-pixel cameras

For applications with priority on processing time. Transfers 640 x 480 pixels in 4.7 ms.



### 2x high-speed cameras

#### ■ 2 million-pixel cameras

Driven by a 2 million-pixel color CCD, these cameras transfer all 2 million pixels in 59 ms. Each model is highly effective for minute defect inspections, or dimension measurements that demand high-resolution.

Color type  
**CV-200C**  
Monochrome type  
**CV-200M**

**MEGA**  
DIGITAL



#### ■ 310,000-pixel cameras

The 310,000-pixel cameras use a 2x high-speed progressive-drive CCD to enable transfer of 640 x 480 pixels (310,000 pixels) in 16 ms, supporting a wide range of applications.

Color type  
**CV-035C**  
Monochrome type  
**CV-035M**

**HI-SPEED**  
DIGITAL

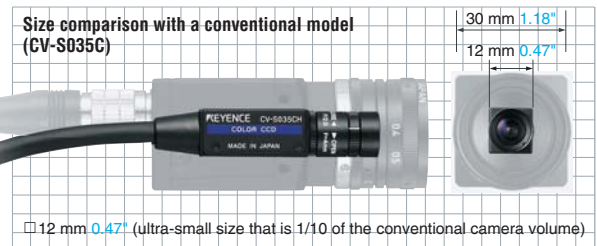


#### [ SMALLEST IN THE INDUSTRY ] ■ Ultra-compact cameras

Compact cameras with the same high performance as other CV-5000 Series cameras. Their small size enables installation in tight spaces normally reserved for photoelectric sensors. A 12-mm (0.47") wide, 310,000-pixel type and the industry's smallest 17-mm (0.67") wide, 2 million-pixel type are available. Different resolutions can be selected for different detection tasks. Side view attachments are also available.



#### Size comparison with a conventional model (CV-S035C)



2 million-pixel  
color type  
**CV-S200C**

2 million-pixel  
monochrome type  
**CV-S200M**

310,000-pixel  
color type  
**CV-S035C**

310,000-pixel  
monochrome type  
**CV-S035M**



**SUPER-SMALL**  
DIGITAL

**ULTRA-SMALL**  
DIGITAL

## [ INDUSTRY FIRST ]

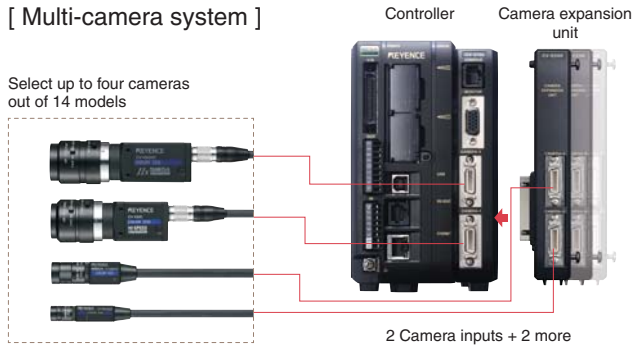


# Simultaneous Acquisition Multi-Camera System

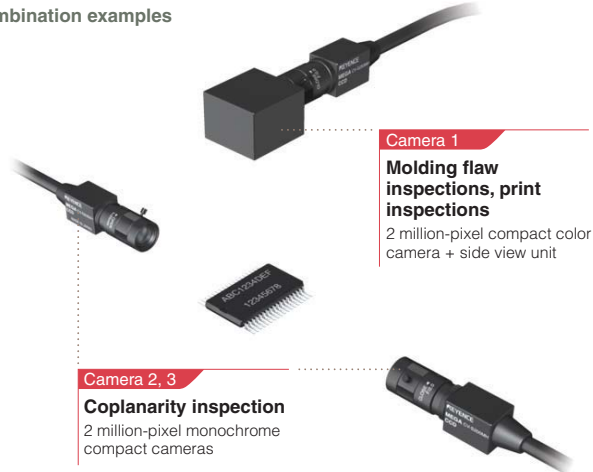
The CV-5000 Series allows simultaneous use of several different cameras selectable from a lineup of 14 different models. Users can select and combine the cameras best suited to the detection task, such as using a monochrome camera on camera 1 and a color camera on camera 2. Up to four cameras can be connected by adding the camera expansion unit.\* The system runs all four cameras simultaneously (acquisition and processing), including the data-intensive 5 million-pixel color camera. The multi-camera system provides users with a flexible upgrade path to cope with future additions or changes in their inspection needs.

\* The camera expansion unit can be connected to the CV-5702(P) and CV-5502(P).

## [ Multi-camera system ]



## Combination examples



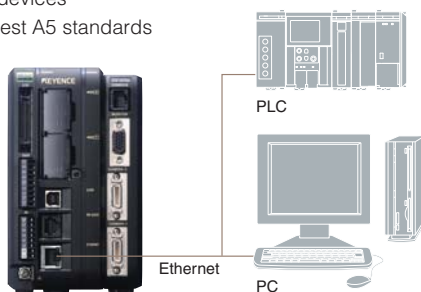
When using multiple cameras to inspect simultaneously, the ability to select cameras best suited for the inspection provides cost efficiencies for the overall system.

## [ NEW ] EtherNet/IP capable

It is possible to input/output values and controls by using the Ethernet port.

- Communication available via implicit and explicit messaging.
- Up to 128 connected devices
- Meets Conformance Test A5 standards

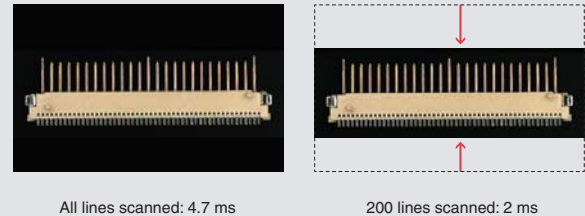
## Built-in Ethernet Port



## Partial image scanning

The Partial Image Scanning function significantly reduces image transfer time by transferring only the selected area of an image.

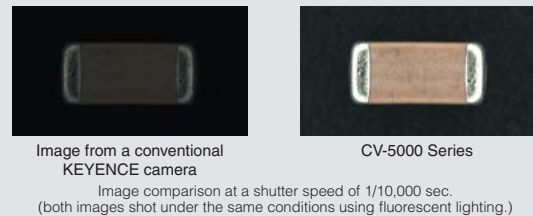
## Image transfer time comparison: For the CV-H035C



## Gain adjustments help increase contrast

The CV-5000 Series controllers are equipped with a camera gain adjustment feature that allows up to 81 levels of sensitivity. When capturing images using high shutter speeds, an increased gain provides more light for brighter images without the need for costly strobe light equipment. Applying span offset processing, which also supports individual adjustments for the R, G, and B components of CCD data sampled at 10 bits, the shade difference in low contrast images is expanded and reliable image processing is possible.

## Effects of increased sensitivity



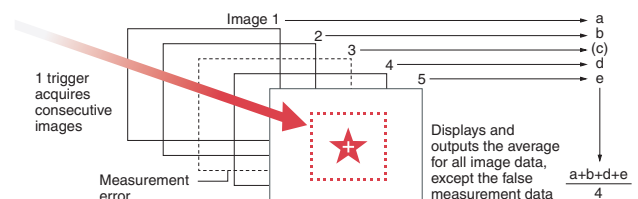
## Effects of span shifting



## Multi-image acquisition mode

This mode consecutively acquires and processes images using only a single trigger input. The data is averaged to provide consistent results for images that appear out of focus either due to the condition of the workpiece, or variation caused by vibration in the production line. A useful feature of this mode is the Exclusion function (patent pending) that removes false measurement data. (\* The maximum and minimum values of the results after processing multiple images can also be output.)

## [ Processing method of the Multi-image acquisition mode ]



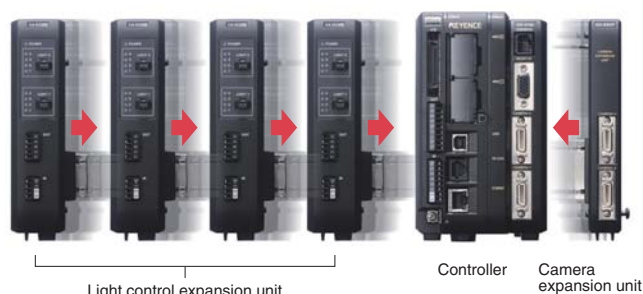
# New controller architecture achieves unparalleled functionality

Enhanced specifications at an efficient cost

**[ WORLD'S FIRST ]**

## “Expandable” controller architecture

The new CV-5000 Series offers two expansion units as add-ons to the main controller: a camera expansion unit and a light control expansion unit. This architecture allows users to control costs by selecting only units which are necessary without losing the flexibility to adapt to future changes.



Easily control lighting without extra wiring

**[ WORLD'S FIRST ]**

## LED light control expansion unit

Each light control expansion unit is equipped with two light terminals. The CV-5000 can control up to 4 expansion units allowing for a total of 8 lamps\* to be utilized simultaneously. The controller's camera configuration menu has built-in dimmer controls and configurable lighting patterns. This provides users with complete control of illumination without separate wiring and PLC-based programming. For example, it is possible to set a lamp to strobe with each trigger input, thus extending the life of the lamp. Light intensity can also be altered through the CV user interface and external command controls.

\* As long as the total power consumption of the lamps does not exceed the rated power capacity, additional lamps can be connected by using the optional splitter cable. For example, the user can connect up to sixteen 10 W lamps.

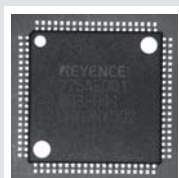


## Application examples using the light control expansion unit

### ■ Lamp switching (multi-pattern lighting)

Simultaneous printing, dimensional, and orientation inspections

Low angle lighting is used for printing and dimensional inspections, while coaxial lighting is used to detect orientation. Each trigger input automatically switches between the lamps to perform all the inspections without using a PLC. Each setting can be programmed with up to four lighting patterns.



Coaxial lighting enhances the visibility of the orientation marks in the corners.



Low angle lighting enhances the printing and leads.

### ■ Light intensity presets for each program number

Automatic light intensity adjustment based on product

If the color and reflection ratios change based on the type of product being inspected, and if the product moves continuously without stopping, there may be no opportunity to adjust the light intensity without affecting the brightness of the acquired image. In this case, the desired light intensity level for each program number can be set so that it automatically changes based on the specific target properties. This will allow for uninterrupted changeovers without the need for manual adjustment.

Light Intensity: 127



For products with low reflection ratios, light intensity is a key.

Without changing the light intensity



Light Intensity: 127

Color appears saturated on parts with high reflection ratio.

Product Changeover

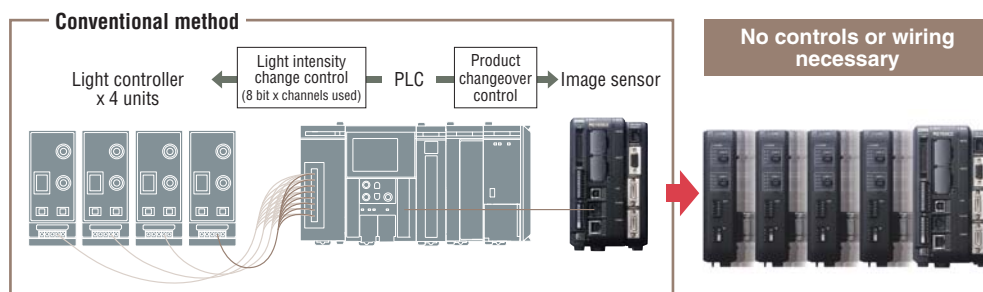


Light Intensity: 80

By presetting the optimum light intensity for this product, the changeover is easily completed.

## No controls or wiring necessary

Product changeovers often require an adjustment in the light intensity to match the reflection properties of the product. Conventionally, this was done by a PLC which would change the light intensity settings on the light controller during product changeovers. However, with the CA-DC20E, it is possible to preset and register the appropriate light intensity for each inspection in the controller, without any extra wiring or complicated controls.



# Fastest processing platform in the industry

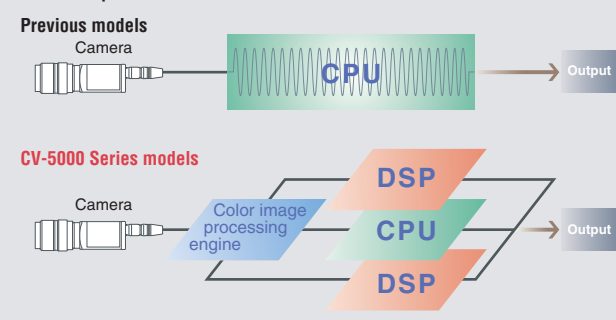
## 3 + 1 Processor System: Ultra high-speed, parallel processing



CV-5000 Series models are driven by a high-speed color image processing engine (A.C.E. II). In addition, the high-speed RISC (Reduced Instruction Set Computer) CPU is supplemented by two DSP's (Digital Signal Processors) designed specifically for image processing. CV-5000 Series models use these four processors to attain the fastest processing speed available in the industry. The CPU and DSP's are the latest technology, achieving twice the speed of the KEYENCE CV-3000 Series models.



### Comparison of processing by CV-5000 Series models and previous models

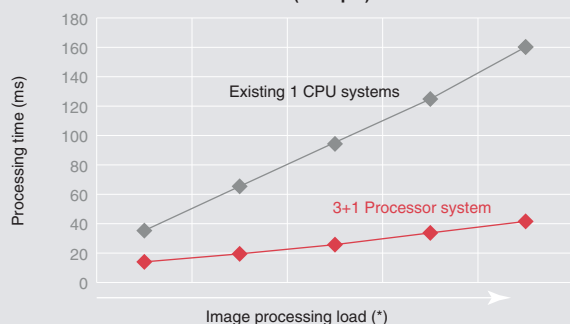


CV-5000 Series models share image processing tasks among multiple processors to achieve higher processing speeds.

## ■ Comparing the “3 + 1” processing system to a single CPU

The greater the image processing load (\*), the more apparent the difference between the 3 + 1 parallel processing system and a single CPU system becomes. The 3 + 1 processing system is an example of the on-site stability concept of the CV-5000 Series. It allows users to optimize settings for stable performance in production-line environments without significantly increasing processing time.

Relation between image processing load and processing time (Example)



### \* Image processing loads

The following factors increase image processing loads:

- Detailed parameter settings for searches and stain inspections
- Adding image enhancement functions
- Increasing camera pixels
- Increasing inspection windows

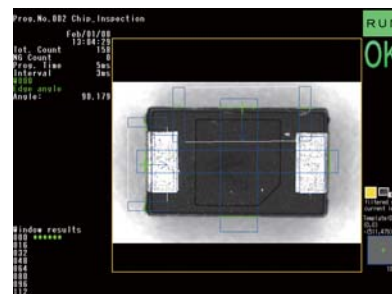
## ■ High-speed processing examples

### Chip component surface inspection

A CV-5000 Series model\* completes processing with a 3-ms trigger interval.

### Processing tasks

Using a 240 line partial image, the CV-5000 Series performs position compensation and color intensity processing while inspecting for defects, edge pitch, edge angle, and edge width.



### Product cap surface inspection

A CV-5000 Series model\* completes processing with a 12-ms trigger interval.

### Processing tasks

The 7x high-speed 310,000-pixel color camera captures full-screen images and carries out several product assessments. Defect inspection, difference processing (Pattern cancelling) color intensity processing, 360° rotary position compensation, and edge position compensation provide the most comprehensive and accurate inspection of products available.



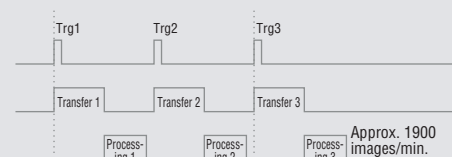
\* CV-5500 combined with a CV-H035C

## Double buffers

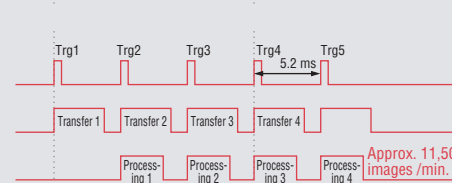
The CV-5000 Series models are equipped with double-buffered memory, allowing the unit to be triggered while processing the previous image. This allows for inspection times of 5.2 ms (approximately 11,500 images/minute) for full-screen image acquisition.

(\* Assuming a 4-ms image processing time using the CV-H035C)

### Existing method



### Double buffered CV-5000 Series



## Fan-less design

In spite of the ultra high-speed processing, the CV-5000 Series models feature a fan-less design based on heat dissipation technology. A fan is a service-life component, and not using one translates into longer hours of reliable continuous operation. In addition, this design is particle emission-free, making the CV-5000 Series suitable for clean-room environments.

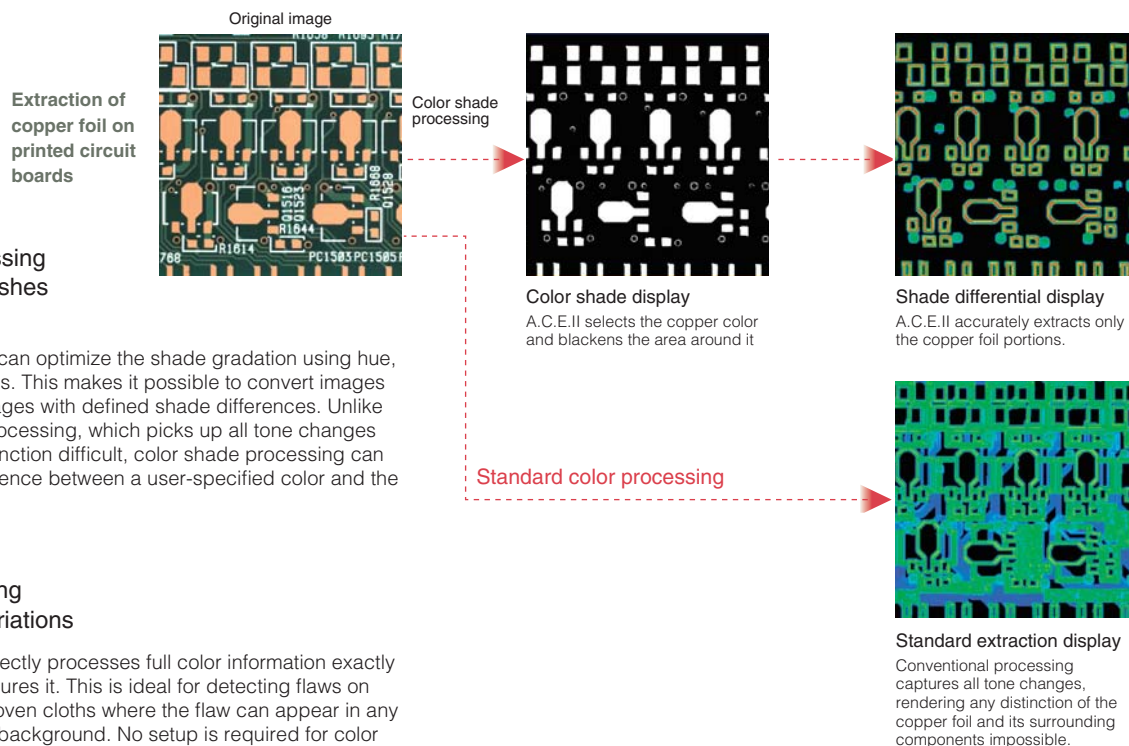
# New color processing highlights difficult to see defects

[ NEW ]

## New color extraction engine, A.C.E.II



The CV-5000 Series models are equipped with a new color extraction engine. The A.C.E.II (Advanced Color extraction Engine II) uses the HSB color model (closest color model to the human sensory system) to attain high color extraction performance that stabilizes previously unstable color processing schemes. CV-5000 Series models also feature "fine color processing" to extract color information exactly the way the camera captures it. This technology significantly broadens the range of color processing applications previously accomplished by machine vision systems.



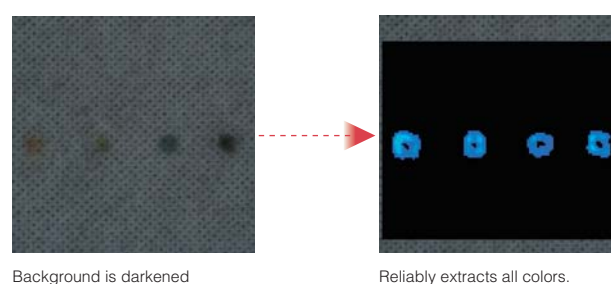
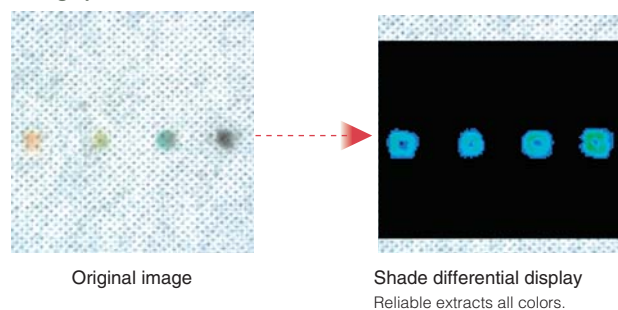
### ■ Color shade processing accurately distinguishes a specific color

Color shade processing can optimize the shade gradation using hue, saturation, and brightness. This makes it possible to convert images with low contrast into images with defined shade differences. Unlike conventional full color processing, which picks up all tone changes and makes pass/fail distinction difficult, color shade processing can optimize the shade difference between a user-specified color and the background.

### ■ Fine color processing Detects all color variations

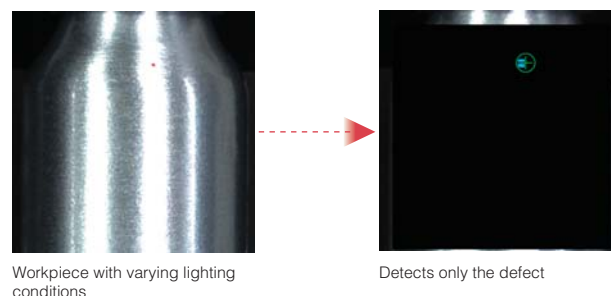
Fine color processing directly processes full color information exactly as the color camera captures it. This is ideal for detecting flaws on sheets, films, and non-woven cloths where the flaw can appear in any color with respect to the background. No setup is required for color extraction, allowing users to complete the inspection with one simple operation.

#### Foreign particle detection on a non-woven cloth



### ■ Glare removal

The newly added Intensity Cancellation function solves a common problem of detecting changes when using full color processing on color images. This function delivers stable detection performance to field applications by ignoring glare and lighting variations on the target background, and detecting only the area where hue and saturation differences exist.



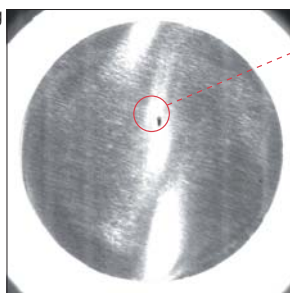
# Surface defect detection

KEYENCE Machine Vision Systems have continually evolved by providing reliable solutions to inspection challenges. We have devoted countless hours of research and development to provide inspection solutions that represent the most demanding requirements. The CV-5000 Series models are equipped with advanced defect detection algorithms that eliminate many of the instabilities normally associated with surface appearance inspections.

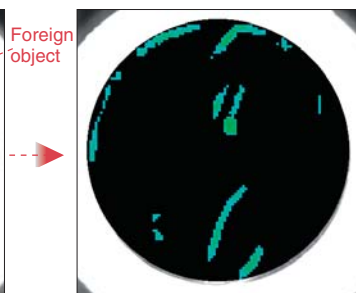
Isolates defects for detection on shaded backgrounds

**[ FIRST IN ITS CLASS ]** Real-time shade correction (patent pending)

Real-time shade correction isolates defects, even when the background has shadow-like gradations. This filter enables inspections not possible before by cancelling shadows that even lighting techniques could not remove. Unlike commonly used shading correction filters that apply the same correction to all images, this correction adapts in real time to constantly changing shades.

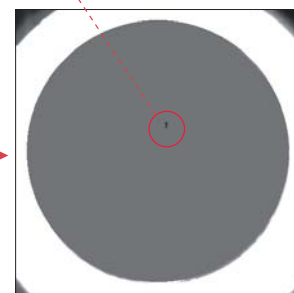


**Original image**  
Inspections are difficult due to inconsistent glare on each workpiece.



**Conventional method (no real-time shade correction, stain mode stability display)**  
Erroneously detects areas of glare as defects.

Accurately extracts only the foreign object



**Real-time shade correction**  
Shaded areas on the background are cancelled, revealing only the foreign object. Repeatedly extracts only the foreign object, even if the glare has a different shape for each image.

**Application Example: Surface inspection of curved surfaces on metal**



Normally, the dent in this image could not be detected because of the random glare and granular texture of the metal.



The image enhancement filter extracts only the dent.



The same workpiece with a line-like scratch.



Cancels glare and isolates the scratch.

Powerful features for detecting burrs or flaws on profiles

**[ FIRST IN ITS CLASS ]** Trend Edge Defect Detection (patent pending)

This tool extracts the profile from the edge of a workpiece and uses it to recognize large differences such as burrs or flaws. In addition to geometrical shapes such as circles and straight lines, the tool also recognizes complex contours, such as ovals and free-form curves.

**Detecting burrs and flaws in resin molded parts**

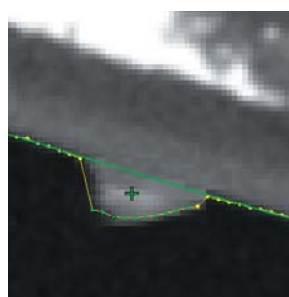
**Profile trace image**

Trend edge detects the profile of the workpiece and automatically generates reference model lines (the green line in this image) consisting of free-form curves.

**Original image**



**Burr detection**



The burr generates a difference in the distance from the reference line, which allows the tool to detect it.

**Flaw detection**



The tool reliably detects even the most subtle nicks along the profile, a defect otherwise considered difficult to detect.

## Powerful defect extraction using original algorithms

### [ MOST EXTENSIVE AND POWERFUL IN ITS CLASS ] Image Enhancement Preprocessing Filters

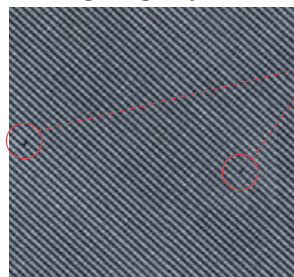
The CV-5000 Series features 18 preprocessing filters that highlight otherwise obscure defects. Users can combine up to 13 preprocessing filters in a single window.

**NEW**

#### ■ Softening filter (patent pending)

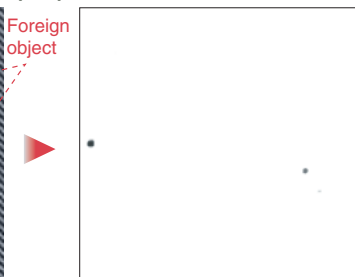
Softening reduces fine patterns and noise in the background. The softening effect is individually adjustable in the X and Y directions. This filter can be applied to a wide range of applications, including part counting inspections.

#### Detecting foreign objects on a striped pattern



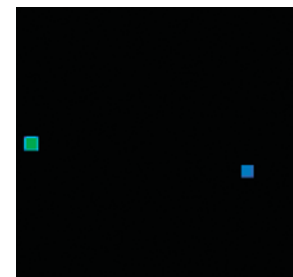
**Original image**

This inspection would have been impossible because of the diagonal stripe pattern.



**Softening filter + real-time shade correction**

Striped background removed, allowing extraction of only the foreign objects.



**Stain detection**

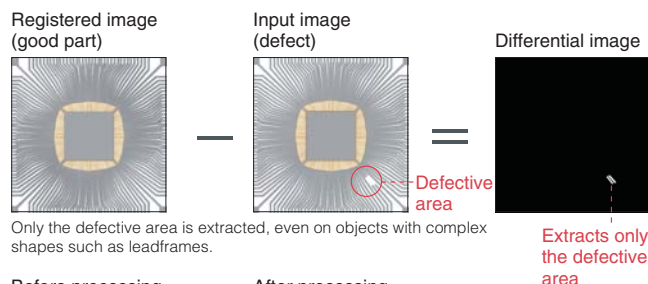
Reliable detection of foreign objects.

#### ■ Differential inspection

The differential process inspects defects by ignoring patterns in the background. Users can choose from two processing methods to suit the application.

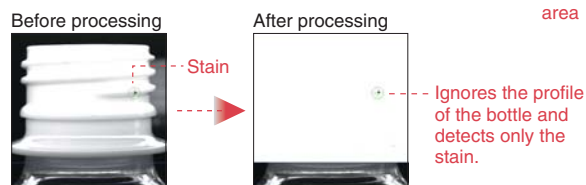
##### Differential processing with a registered image

This method extracts only the differences found by comparing the acquired image to a preregistered master image. The level of difference that determines a defect is adjustable to account for individual part variation.



##### Real-time differential processing

This method analyzes acquired images in real time. The process ignores the background and searches for minute variations within the image, without using a master image.



#### Inspecting bottle openings

Reliably captures burrs and flaws along distorted circles and free-formed lines.

**Original image**



**Enlarged image**



Stable detection, even when the camera is mounted at an angle.

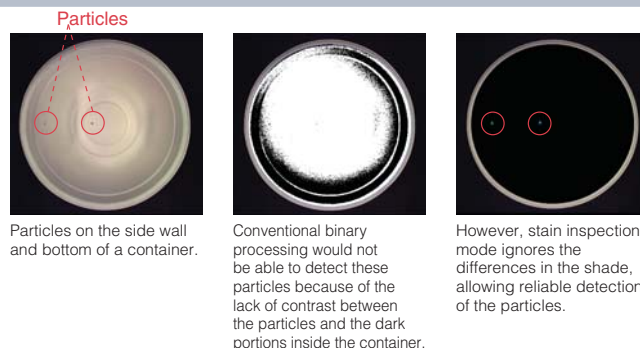
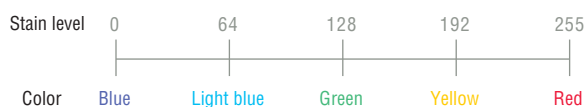
## Introducing the newest standard in surface inspection [ MOST POWERFUL IN ITS CLASS ] Stain inspection tool

The Stain inspection tool searches for scratches and stains by comparing them against the surrounding shade level. Compared to binary processing, this mode has greater tolerance against varying conditions, making it ideal for surface inspections on production lines where individual variation of parts and light intensity fluctuations otherwise present problems. The defect distribution display allows optimized tuning by providing a quick visualization of how the image processor sees the defect.

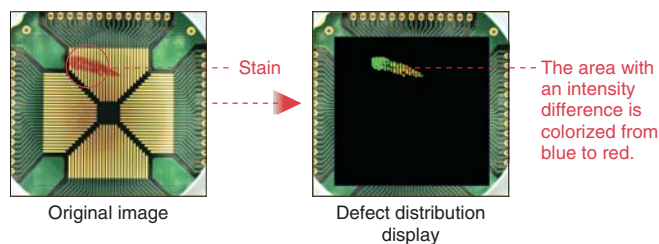
### ■ Defect Distribution Display Function [patent pending]

Using the colors blue, green, yellow, and red, the defect distribution display assigns a color to defects according to the intensity difference between it and the surrounding area. This provides a visual understanding of the difference between intended and unintended defect regions.

#### Relation between stability display color and stain level (guideline)



#### Bad mark detection on PCBs

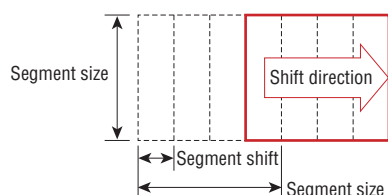


The defect distribution display appears in real-time so that users can intuitively maximize the difference between intended and unintended areas of inspection.

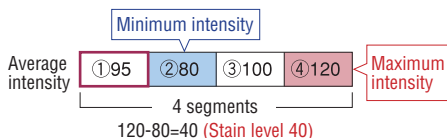
The algorithm of the stain inspection tool equipped on the KEYENCE CV Series.

### ■ Stain extraction method

① The stain inspection tool measures the average intensity of specified areas (segments) and then shifts by 1/4 the area of the segment size.

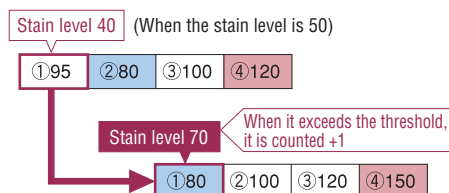


② It determines the difference between maximum and minimum intensity of 4 segments, including a standard segment (①95 in the figure below). The difference is considered the stain level of a standard segment.



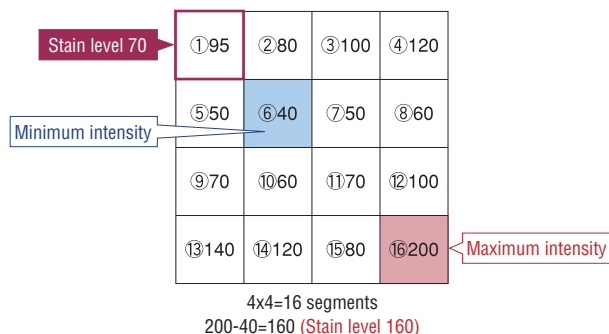
③ When the stain level exceeds the preset threshold, the standard segment is counted as a stain. The number of times the preset threshold is exceeded in a measured area is called the "Stain Area".

It repeats ① to ③ constantly shifting the standard segment within the measured area.



### When X and Y directions are specified as the detection direction

The difference between the maximum and minimum intensity of 16 segments in both the X and Y directions are calculated using the standard segment as a reference.



# Measurement Solutions

Measure profiles using only a single inspection tool

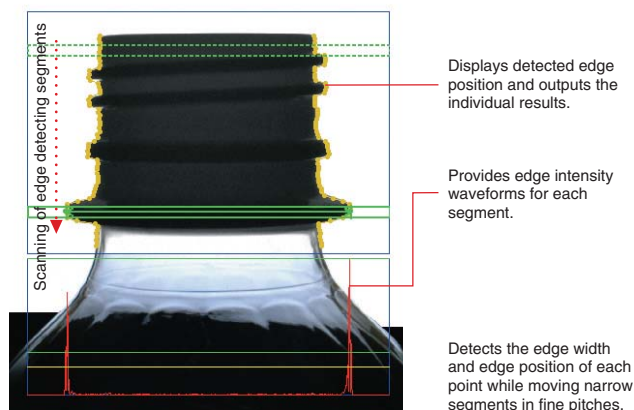
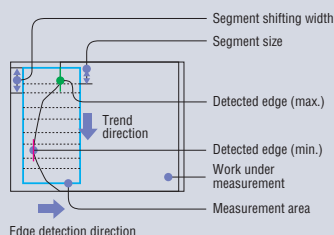
**[ MOST POWERFUL IN ITS CLASS ]** Trend Edge Function (patent pending)

The Trend Edge tool detects edges at user-specified distances within the inspection area, and outputs the max, min, and average of all the data from each measured point. Previously, this required multiple windows and calculation settings, but now the same inspection can be done by configuring a single inspection setting. The measurements obtained can also be used to draw approximated lines and virtual circles.

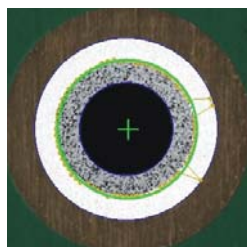
## Inspection theory

Trend edge detects the width and position of edges while moving across narrow segments at fine pitches.

- To increase position detection accuracy  
--- make the segment size smaller.
- To reduce processing time  
--- increases the shifting width (travel distance) within the segment.
- Trend direction refers to  
--- the direction to move within the segment.



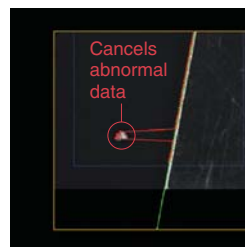
## ■ Circle Detection function



### Detecting through-hole centers

Trend edge can calculate the center and diameter of a hole by drawing a virtual circle along multiple edge positions around a through hole. Abnormal edge positions are removed before drawing the virtual circle to allow for reliable measurements.

## ■ Line Detection function



### Detecting the position of glass substrate edges

Trend edge can draw a virtual straight line along edge positions of a substrate's edge. As with the circle detection, line detection also cancels abnormal edge positions.

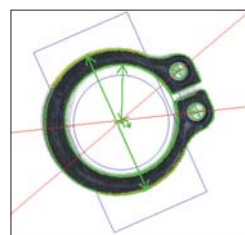
Measure a variety of geometric shapes

**[ MOST EXTENSIVE IN ITS CLASS ]** Geometric dimensional measurement

CV-5000 Series models can measure a variety of geometric dimensions based on position data obtained through edge detection and pattern searches.

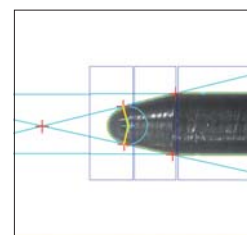
## Measureable items

- 2-point distance • Angle of line between 2 points • Circle radius • Circle center
- Average angle • Lines • Intersections • Point-to-line distance • Line angle
- 2-line intersection • Perpendicular line between points and lines • Bisect
- Middle point



### Dimensional measurement of a molded part

Measures concentricity and angles formed by lines through the centers of the large and small holes.



### Dimensional measurement of a metal part

Measures tip radius, angle, and outer diameter.

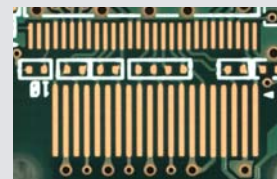
Measure dimensions with even greater accuracy by using a 5 megapixel camera.

Assuming a 50-mm 1.97" field of view in the X axis -> approx. repeatability accuracy  $\pm 1 \mu\text{m} \pm 0.04 \text{ Mil}$  (Typical example, FOV of 50 mm 1.97"  $\approx 2430 \text{ pixels} \times \pm 0.05 \text{ pixels}$  (repeatability accuracy)  $\approx \pm 1 \mu\text{m} \pm 0.04 \text{ Mil}$ )



### Enlarged image using a 310,000-pixel camera

Enlarged image causes blurry edges, rendering the target unsuitable for precision measurements.



### Enlarged image using a 5,000,000-pixel camera

Profiles in the object are crisp allowing precision measurements.

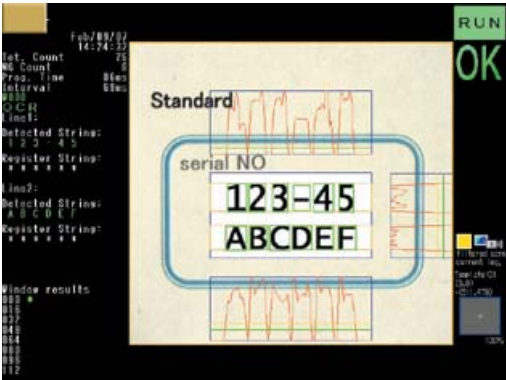
# Character Recognition

## OCR Function

CV-5000 Series models are OCR capable. Simply register the characters and specify the area of inspection. OCR supports alphanumeric, user-defined characters, and also features an automatic calendar for date and lot number inspection without daily registering or setting changes.

### Printing inspection for consumption dates

Automatically extracts one character at a time to recognize characters.



#### Automatic calendar support

Provides functionality of dedicated OCR devices such as offsetting, tolerance adjustment, and zero-suppressing.

#### Selectable extraction method

Allows selection between automatic or fixed extraction. Automatic extraction also features a user-specified extraction ratio.

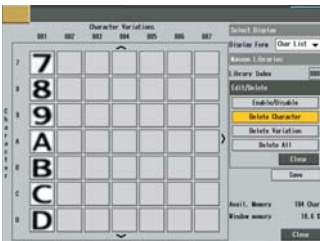
#### **NEW** Date encryption support

Recognizes and determines pass/fail of encrypted dates by converting characters according to an encryption table.

#### Recognition level reporting

Outputs character recognition level per character for quick identification of print quality problems.

### Batch library registration screen



Allows registration of 20 user-defined characters (symbols, etc.), in addition to standard alphanumeric characters.

Effortless registration simultaneously saves characters in the program library.

### Examples of reliable detection by using preprocessing filters

The differential filter and color shade processing can be used to isolate the background from the printing. This allows reliable inspection even when the background changes.

Original image



After processing (real-time differential)

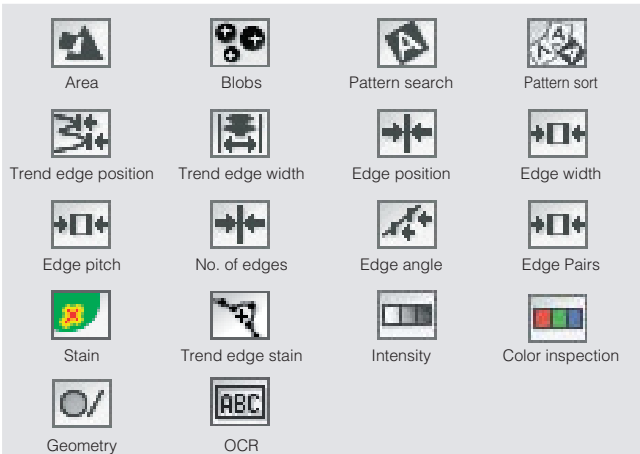


Cancels background to isolate printing.

# Other Inspection Tools

## Wide array of inspection tools (Eighteen tools)

CV-5000 Series models have a wide array of inspection tools to provide solutions to almost any inspection. These tools enable users to select the optimum inspection method, including the ability to set simultaneous inspections for a single trigger input.



### Typical inspection tools

#### Color inspection

Distinguishes colors by digitizing hue, saturation, and brightness for greater color-detection accuracy. Unlike conventional color detection where color is distinguished by the size of the extracted area of color, the CV-5000 Series models actually reference the digital value.

LED lighting inspection



#### Part count

Counts parts by using the blob tool allowing inspection of the center point, perimeter length, and circularity of each part found.

Counting terminals



### Other Features

#### Conditional branching

Each inspection window can be configured to execute based on the results of another window or numeric operation.

#### Command memory

Features memory for 1,000 commands. The memory is programmable during operation by an external input or the console, and can be referenced by numerical operations.

#### Auto-adjusting inspection areas

Inspection areas (rectangles, circles) can be created in real-time with edge position detection or numeric operations.

#### Scaling

Pixels can be scaled to the dimensions of the field of view.

#### Individual triggers, strobe light support

Individual trigger input allows sequential image acquisition using multiple cameras. Individual strobe outputs are also supported.

#### Compatibility with CV-3000 Series settings

Setting files for our CV-3000 Series are upward-compatible.

# Reliable and Easy On-Site Operation

## Reduces light disturbances for highly reliable inspections

Automatically corrects for variations in light intensity in order to provide consistent illumination.

By saving a reference image acquired under optimal lighting conditions, the controller can monitor the light intensity each time it acquires and processes an image. An automatic digital gain adjustment corrects the light intensity to match the original reference image for less measurement variation over the life of the light source.

Reference image



The light intensity of this image becomes the reference. By registering it before the inspection, the controller can correct the light intensity for images that deviate from this reference by a given amount.

Acquired image



The acquired image before correction.

Corrected image



Based on the difference in light intensity detected in the acquired image compared to the registered reference image, the controller corrects the light intensity within the inspection area.

### [ BEST IN ITS CLASS ]

## Wide array of image enhancement filters

CV-5000 Series controllers are loaded with a wide array of filters to remove noise and isolate or otherwise enhance detection areas. In addition to the Expansion, Shrink, and Sobel filters, a total of 18 filters can be used, including preprocessing filters for binary color conversion and color shade processing.

Original image



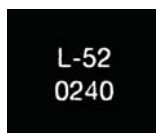
Shrink



Sobel



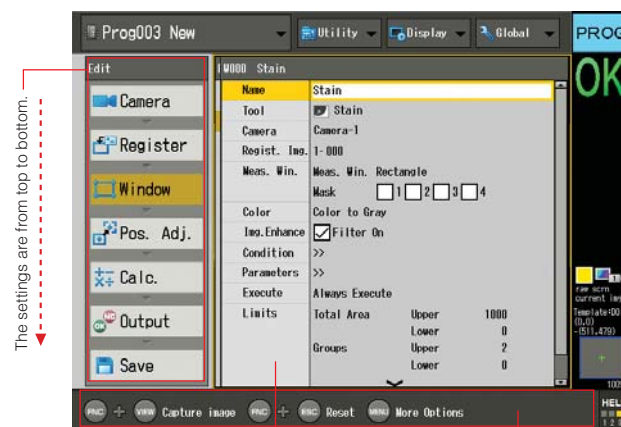
Real-time differential



Apply 13 layers out of 18 available filters in any combination.

## KEYENCE Vision Flow menu

KEYENCE has further improved its vision flow menu to ensure a user-friendly setup. This intuitive menu flows from top to bottom, guiding users through the simple setup procedures.



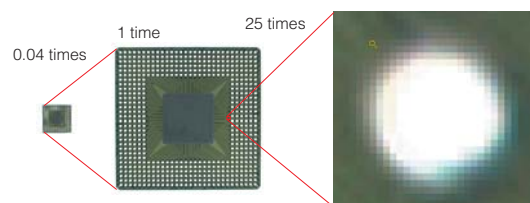
The settings are from top to bottom.

Preview display enables the user to understand window settings at a glance.

Help display assists in key operations.

## Zoom Display function

The Zoom Display function enables users to continuously zoom the display screen from 0.04 times to 25 times. This function can be used regardless of the operation status or programming menu.



### Other functions

#### Image capturing

Allows on-demand image capturing to the removable SD memory card (bitmap format).

#### File management

Allows users to copy files on the SD card or format a new card without using a PC.

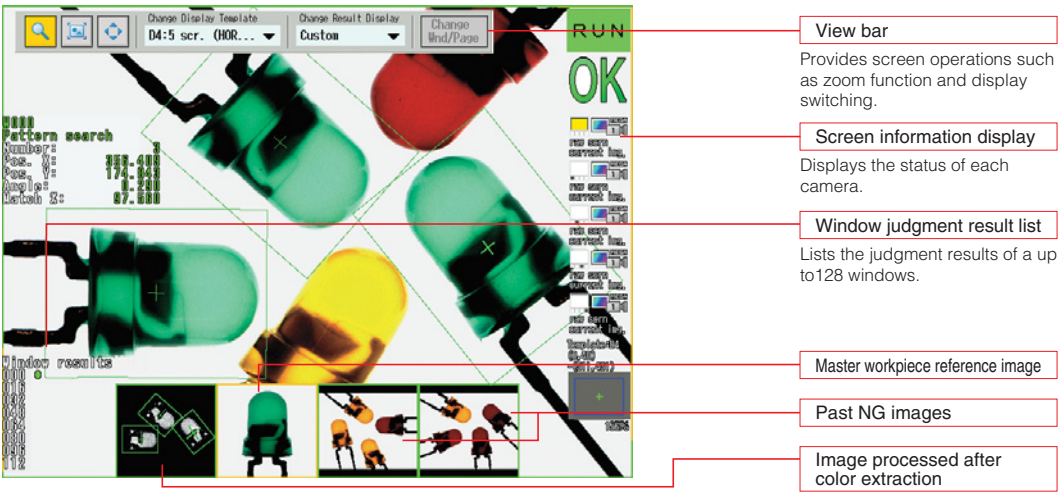
#### I/O communication monitor

Displays the I/O signal status during setup and operation.

# Operator-friendly display options

## SVGA monitor output

KEYENCE has adopted a high-resolution SVGA (800 x 600 pixels) monitor output for superior image quality. This function enables the user to quickly monitor the operational status of the inspection at an extensive level. Multiple inspection images can be monitored simultaneously, eliminating the need to switch the screens on the remote console.

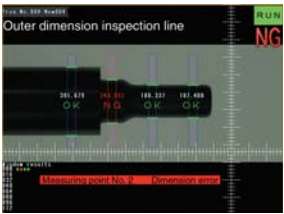


## Selectable screen display formats NEW

Choose from nine available screen display formats to match the user's application needs. Display cameras and display contents can be chosen per screen, making it possible to view current images on the main screen while viewing past NG images and registered images on subscreens.

## Custom Display function NEW

The Custom Display function enables flexible creation of user-defined displays such as the judgment results or measured values of only specified inspection windows. With this function, the user can also create and display custom text and graphics.



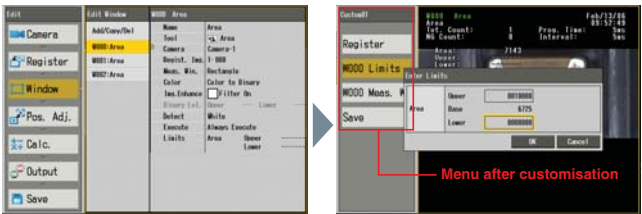
Example of custom display

## Administrator mode/operator mode (password enabled)

The administrator mode/ operator mode enables management of operational changes with the use of passwords. This prevents unauthorised changes to the system. Combining this function with the custom menu permits only specific functions to be accessed in operator mode.

## Custom menu NEW

The custom menu displays only necessary menu items. For example, the normal menu view can be reduced to only display settings for color extraction and limit setup. This will help to simplify programming and prevent unauthorised system tampering.

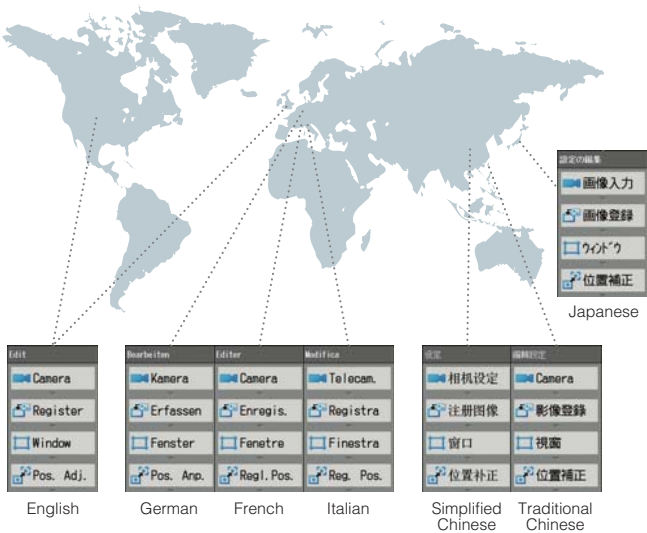


In the past, it was possible to alter all the items in setting menus. For this reason, there was a risk that unauthorised users might alter items mistakenly.

After the display menu is customized, only the items required for daily operation are displayed, so operators can easily understand the settings. This reduces the risk that operators will perform an incorrect operation.

## Multi language support NEW

Multi language support in 7 languages: English, German, French, Italian, Simplified Chinese, Traditional Chinese, and Japanese.





# Real time data acquisition with PC Simulator

## MULTI-LINE DATA ACQUISITION

KEYENCE unique software packages offer simultaneous real-time data acquisition of both measurement results and captured images from up to 8 controllers. The following versions of CV-H software are available:

1. CV-H1NE – Dedicated data acquisition software for CV-2100(P)
2. CV-H3N – Dedicated data acquisition software for CV-3002(P)/3502(P) with optional PC Simulator function
3. CV-H5N – Dedicated data acquisition software for CV-5002(P)/5502(P)/5702(P) with optional PC Simulator function

## Data and image collection

Measurement values collected on the CV controller can be output via RS232, Ethernet, or USB.

The acquired data can be simultaneously displayed and saved onto an external hard drive.

Captured images that are transferred to a PC can be sorted by their OK/NG status based on the measurement results. The images are then displayed in real time and saved to a specified folder.

## Transfer and backup programs on a PC

Programs created on the CV controller can be easily transferred and saved on a PC. If the contents of the controller get erased, the saved files can be quickly reloaded to the vision system, reducing downtime.

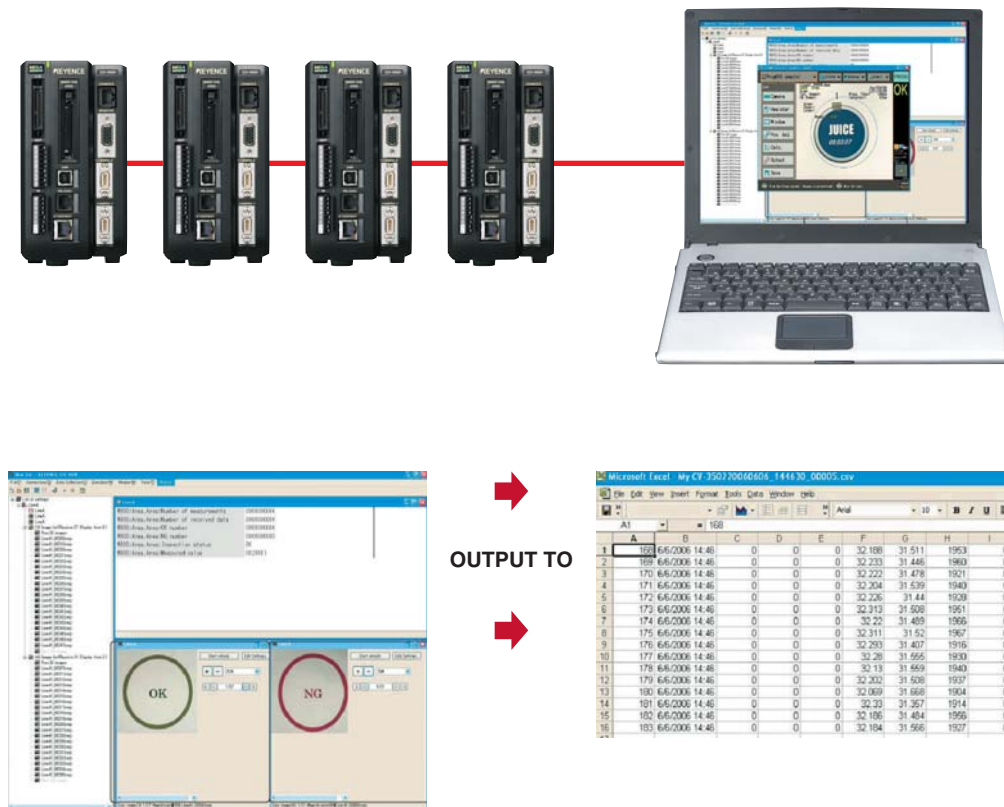
If record keeping is essential, all program properties and settings can be output to an Excel\* spreadsheet and saved for future reference.

## Advanced Data logging

A time-based data log can be set to collect data from various shifts or product runs. Specific pieces of measurement data can also be tied to the corresponding image that was saved on the PC for easy reference.

Data can also be output to a pre-existing Excel\* spreadsheet, making the CV data simple to integrate into existing reports.

\*Excel is a registered trademark of Microsoft Corporation, U.S.A.



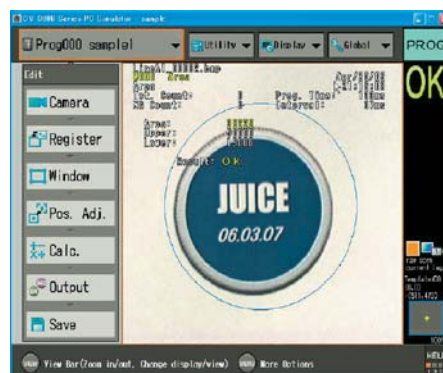
Data is both displayed and saved in real time

# CV-H5N PC Simulator Function

## CV SIMULATOR

KEYENCE has added the option of remotely programming the CV from a desktop PC. The CV-H5N PC simulator is designed to precisely mimic the operations of the CV-5002(P)/5502(P)/5702(P) machine vision controllers. All that is needed is a .bmp or .jpg image and it is ready to program!

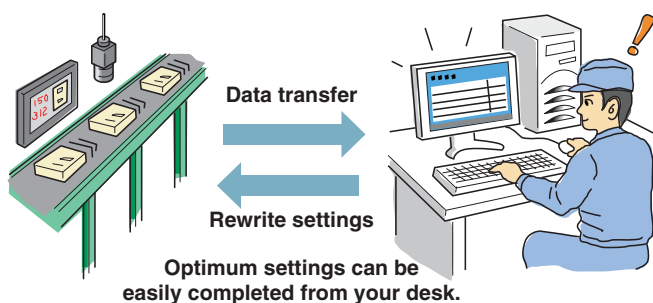
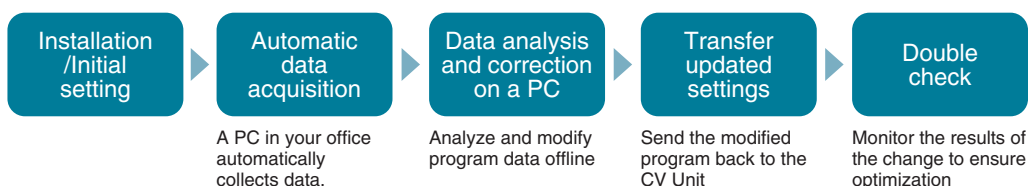
- Choose to program/troubleshoot directly online (CV controller) or remotely (PC Simulator), providing optimal flexibility
- Transfer programs & images in real time to make remote, offline modifications to an existing CV-5000 Series controller
- Manage CV programs from anywhere in the world!



Both Software Tools in One Package  
EXAMPLE OF EFFICIENT OPERATION

### Operations with data collection and PC Simulator

Only one step  
on-site



# Multiple Interface Options for Seamless Integration

## [ FIRST IN THE INDUSTRY ]

### Save to mass-storage twin SD cards

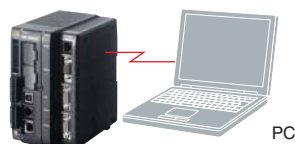
First in the industry to support the SDHC standard (\*). There are 2 available slots for SD cards. With a total capacity of 8GB, a large amount of configuration files and failed screen data can be saved at high speeds.



\*Reading SDHC standard SD cards via a PC requires a dedicated card reader (commercially available).

### USB 2.0 connector

USB 2.0 allows for quick transfer of image data and settings from your PC. No setup necessary. Ready to use on-site.



### Illumination control expansion unit

This connector is for the illumination control expansion unit CA-DC20E.

Expansion unit  
CA-DC20E



### Camera connector

The camera cable connection is recessed to minimize dead space when mounted inside control cabinets.



### Camera expansion unit connector

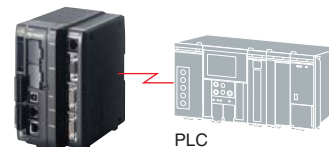
Connects the camera expansion unit CV-E500 when 3 or 4 cameras are used.



Camera expansion unit CV-E500

### RS-232C communication

Enables a PLC link with PLCs made by other manufacturers. Communicates directly with PLC data memory without additional ladder programs.

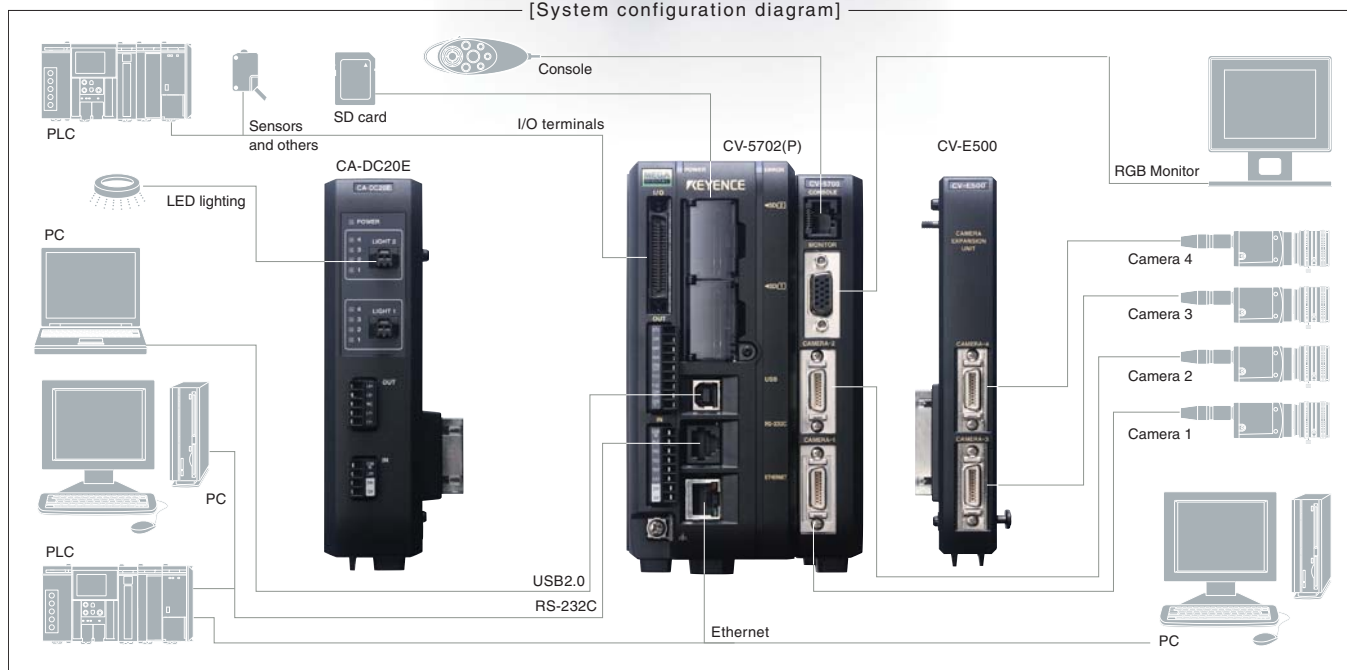


### EtherNet/IP Communication

EIP communication is enabled through the Ethernet port so that data can easily be sent to Rockwell PLCs, or other EIP devices.



## [System configuration diagram]



# Product Lineup

## Controllers

High-speed, high-capacity controller with 5,000,000-pixel camera support  
**CV-5702(P)**



High-speed, high-capacity controller  
**CV-5502(P)**



310,000-pixel dedicated controller  
**CV-5002(P)**



Camera expansion unit  
**CV-E500**



LED light control expansion unit  
**CA-DC20E**



## Accessories

Communication software  
**CV-H5N**



Windows XP Professional/ Home Edition, SP2 or later  
Windows 2000 Professional SP4 or later  
Windows Vista (Ultimate Business, Home, Premium, Home Basic)  
Windows 7 (Home Premium, Professional, Ultimate, Enterprise)

Console (included)  
**OP-84231**



## 5 megapixel cameras

11x high-speed Color camera  
**CV-H500C**



11x high-speed Monochrome camera  
**CV-H500M**

## 2 megapixel cameras

7x high-speed Color camera  
**CV-H200C**



7x high-speed Monochrome camera  
**CV-H200M**

Color camera  
**CV-200C**



Monochrome camera  
**CV-200M**

Ultra-compact Color camera  
**CV-S200C**



Ultra-compact Monochrome camera  
**CV-S200M**

## 310,000 pixel cameras

7x high-speed Color camera  
**CV-H035C**



7x high-speed Monochrome camera  
**CV-H035M**

Color camera  
**CV-035C**



Monochrome camera  
**CV-035M**

Ultra-compact Color camera  
**CV-S035C**



Ultra-compact Monochrome camera  
**CV-S035M**

# Options

## Camera Cables

### Camera cables



L-type connector

| Type                             | Connector shape | Cable length |             |              |               |               |                      |
|----------------------------------|-----------------|--------------|-------------|--------------|---------------|---------------|----------------------|
|                                  |                 | 1 m<br>3.3'  | 3 m<br>9.8' | 5 m<br>16.4' | 10 m<br>32.8' | 17 m<br>55.8' | Extension cable      |
| Standard-speed camera cable      | Straight        | CA-CN1       | CA-CN3      | CA-CN5       | CA-CN10       | CA-CN17*      | —                    |
|                                  | L-type          | —            | CA-CN3L     | CA-CN5L      | CA-CN10L      | CA-CN17L*     | —                    |
| Standard high flex robot cable   | Straight        | —            | CA-CN3R     | CA-CN5R      | CA-CN10R      | CA-CN17R*     | CA-CN7RE (7 m 23.0') |
| High-speed camera cable          | Straight        | —            | CA-CH3      | CA-CH5       | CA-CH10       | —             | —                    |
|                                  | L-type          | —            | CA-CH3L     | CA-CH5L      | CA-CH10L      | —             | —                    |
| High-speed high flex robot cable | Straight        | —            | CA-CH3R     | CA-CH5R      | CA-CH10R      | —             | —                    |

\* Cables cannot be used with 2 Mega pixel cameras.

## Extension Cables

Camera cables may be extended up to 51 m (167.3') or 31 m (101.7'). The maximum extension length varies according to the camera model.



The dedicated extension cable is necessary in order to connect a repeater to a camera or a repeater to a repeater.

Amplifier for extension cables  
**CA-CNX10U**  
(for standard cameras)  
**CA-CHX10U**  
(for high-speed cameras)



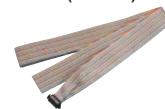
### Extension cables (camera to amplifier)

| Type                             | Cable length |            |            |
|----------------------------------|--------------|------------|------------|
|                                  | 3 m 9.8'     | 10 m 32.8' | 17 m 55.8' |
| Standard-speed camera cable      | CA-CN3X      | CA-CN10X   | CA-CN17X   |
| Standard high flex robot cable   | CA-CN3RX     | CA-CN10RX  | CA-CN17RX  |
| Standard L-type cable            | CA-CN3LX     | CA-CN10LX  | CA-CN17LX  |
| High-speed camera cable          | CA-CH3X      | CA-CH10X   | —          |
| High-speed high flex robot cable | —            | CA-CH10RX  | —          |

Cables must be used with dedicated amplifier.

## Parallel I/O & Data Output Cables

Parallel I/O cable  
**OP-51657 (3 m 9.8')**



1Gbps Ethernet cable  
**OP-66843 (3 m 9.8')**

USB cable  
**OP-66844 (2 m 6.6')**

RS-232C communication cable  
**OP-26487 (2.5 m 8.2')**



RS-232C cable conversion connector  
**OP-26486: 9 pins**  
**OP-26485: 25 pins**



## LED Lighting Cables

Y split cable  
**CA-D1W (1 m 3.3')**



Connector to terminal  
**OP-84457 (1 m 3.3')**



Standard cable  
**CA-D2 (2 m 6.6')**  
**CA-D5 (5 m 16.4')**

High flex robot cable  
**CA-D3R (3 m 9.8')**  
**CA-D5R (5 m 16.4')**  
**CA-D10R (10 m 32.8')**  
**CA-D17R (17 m 55.8')**

## Accessories

Monitor cable  
**OP-66842 (3 m 9.8')**  
**OP-87055 (10 m 32.8')**



SD card  
**CA-SD4G: 4GB (SDHC)**  
**CA-SD1G: 1GB**  
**OP-87133: 512MB**



# Specifications

## Controller

| Model                                                                   |                                                                                           | NPN<br>PNP                                                                                                                                                                                                                                                                                                                                                                                                                                     | CV-5702<br>CV-5702P                                                                                                                                                                                                                                                                                                                                                                                                       | CV-5502<br>CV-5502P                                                                                                                                                                                                                                                                                                                                               | CV-5002<br>CV-5002P                                                                                                                                                                                                                                 |  |
|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| No. of pixels                                                           | When CV-H500C and CV-H500M are connected                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 5,000,000-pixel mode: 2432 (H) x 2050 (V), about 4,990,000-pixels                                                                                                                                                                                                                                                                                                                                                         | —                                                                                                                                                                                                                                                                                                                                                                 | —                                                                                                                                                                                                                                                   |  |
|                                                                         | When CV-200C/CV-S200C/CV-H200C/CV-200M/CV-S200M and CV-H200M are connected                |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2,000,000-pixel mode: 1600 (H) x 1200 (V), about 1,920,000 pixels<br>1,000,000-pixel mode: 1024 (H) x 960 (V), about 980,000 pixels                                                                                                                                                                                                                                                                                       | 2,000,000-pixel mode: 1600 (H) x 1200 (V), about 1,920,000-pixels<br>1,000,000-pixel mode: 1024 (H) x 960 (V), about 980,000 pixels                                                                                                                                                                                                                               | —                                                                                                                                                                                                                                                   |  |
|                                                                         | When CV-035C/CV-S035C/CV-H035C/CV-035M/CV-S035M and CV-H035M are connected                |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 310,000-pixel mode: 640 (H) x 480 (V), about 310,000 pixels<br>240,000-pixel mode: 512 (H) x 480 (V), about 240,000 pixels                                                                                                                                                                                                                                                                                                | 310,000-pixel mode: 640 (H) x 480 (V), about 310,000 pixels<br>240,000-pixel mode: 512 (H) x 480 (V), about 240,000 pixels                                                                                                                                                                                                                                        | 310,000-pixel mode: 640 (H) x 480 (V), about 310,000 pixels<br>240,000-pixel mode: 512 (H) x 480 (V), about 240,000 pixels                                                                                                                          |  |
|                                                                         | Camera input                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2 color/monochrome cameras (Support for CV-H500C/CV-H200C/CV-200C/CV-S200C/CV-035C/CV-S035C/CV-H035C/CV-H500M/CV-H200M/CV-200M/CV-S200M/CV-035M/CV-S035M and CV-H035M possible mixed connection)<br>Connecting expansion unit CV-E500 provides 2-point expansion and connection of up to 4 points                                                                                                                         | 2 color/monochrome cameras (Support for CV-H200C/CV-200C/CV-S200C/CV-035C/CV-S035C/CV-H035C/CV-H200M/CV-200M/CV-S200M/CV-035M/CV-S035M and CV-H035M possible mixed connection)<br>Connecting expansion unit CV-E500 provides 2-point expansion and connection of up to 4 points.                                                                                  | 2 color/monochrome cameras (support for CV-035C/CV-S035C/CV-H035C/CV-035M/CV-S035M and CV-H035M possible mixed connection)                                                                                                                          |  |
| Main processor for image processing                                     |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | DSP (high-speed type)                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                   | DSP                                                                                                                                                                                                                                                 |  |
| No. of registered settings                                              |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Up to 1000 settings, separately, for SD card 1 and SD card 2 (depends on memory card capacity and setting), supports external changeover                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Number of screens that can be registered                                |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1000 screens max./setting (depends on memory card capacity), can be compressed and saved, supports registration of position adjusted images                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Internal memory capacity                                                |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | SD card slot x 2 (SDHC support) OP-84232 (256MB: Standard equipment on the SD1 slot of the CV-5502(P)/5002(P)), CA-SD1G (1GB: Standard equipment on the SD1 slot of the CV-5702(P)), CA-SD4G (4GB: SDHC) support                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Window setting                                                          | Measurement area, Mask area                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Measurement: 128 windows/program Mask: 4 areas/window                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Area shape (depending on the inspection mode to be used, some area shapes are restricted) |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Rectangle, rotating rectangle, circle, ellipse, ring, arc, polygon (up to 12 angles), Auto-adjusting rectangle, Auto-adjusting circle                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Color extraction function (valid only when a color camera is connected) |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Color binary, color shade, grey, RGB grey (color corresponds to numeric value specification with HSB values) 1:n copy supported                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Measurement tool                                                        | Area measurement                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Area (color binary, monochrome binary)                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Position detection                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Pattern search (support of multiple detections), pattern sort, edge position, trend edge position, blob (gravity center position)                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Inspection mode                                                                           | Edge tool                                                                                                                                                                                                                                                                                                                                                                                                                                      | Edge width, edge pitch, No. of edges, edge angle, pair edge, trend edge width                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         |                                                                                           | Feature inspection                                                                                                                                                                                                                                                                                                                                                                                                                             | Blob (No. of labels, gravity, principal axis angle, area, ferret diameter, circumference length, degree of circularity)                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         |                                                                                           | Stain/inspection                                                                                                                                                                                                                                                                                                                                                                                                                               | Stain detection (support of differential stain detection through combined use with the differential filter, detection of multiple positions through grouping (hole-filling enable/disable selectable), and stability display, support for directly measuring color images with fine color)                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         |                                                                                           | Sorting                                                                                                                                                                                                                                                                                                                                                                                                                                        | Pattern sort (256 types max.)                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         |                                                                                           | Shade inspection                                                                                                                                                                                                                                                                                                                                                                                                                               | Shade inspection, color inspection (valid only when a color camera is connected)                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         |                                                                                           | Geometry                                                                                                                                                                                                                                                                                                                                                                                                                                       | Display of points, lines, and circle areas where the operation result can be cited                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Character recognition                                                   |                                                                                           | OCR (2 lines maximum, 20 characters/line) Supports date/time encryption function                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Trend edge defect                                                       |                                                                                           | Appearance inspection using a line, circle, arc, or freeform reference model line                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Continuous capture function                                             |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1-to-32-times continuous capture processing (maximum value, minimum value, average value), possible exclusion of the measurement error value from the measurement result                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Execution condition setting function                                    |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Enables you to set execution or non-execution that works with the measurement judgment results (OK/NG) of other optional windows per measurement window.                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Image capturing setting function                                        | Processing area setting function                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Enables you to specify a 980,000-pixel area (1024 (H) x 960 (V)) in any position as the processing area within 1,920,000 pixels (1,000,000-pixel mode). Enables you to specify a 240,000-pixel area (512 (H) x 480 (V)) or 310,000-pixel area (640(H) x 480 (V)) in any position as the processing area within 320,000 pixels.*1                                                                                          |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Scan mode (valid only when a monochrome camera is connected)                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Progressive/interlace switching                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Capturing start/end line setting function                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Enables you to set any capturing start/end line within the image capturing range (for interlace, this specification is made in units of 2 lines). Note, you must specify at least 100 lines when using CV-H200C/H200M.                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Correction functions                                                    | Position adjustment                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Batch/individual adjustments (up to 128 settings), X, Y, 180° rotation                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Camera gain adjustment                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Camera sensitivity adjustment, offset adjustment, span adjustment (supports settings in 16 tone levels; also supports RGB individual settings when a color camera is connected)                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | White balance adjustment (valid only when a color camera is connected)                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Manual setting with white paper                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Image inversion function                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Support of left/right inversion for image capture                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Filter function                                                                           | Count                                                                                                                                                                                                                                                                                                                                                                                                                                          | 9-time repetition for the same type, 13 levels (for binary and difference, 1 level/window)                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Calculation function                                                    | Numerical operation                                                                       | No. of settings                                                                                                                                                                                                                                                                                                                                                                                                                                | 128 calculation /program                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         |                                                                                           | Type                                                                                                                                                                                                                                                                                                                                                                                                                                           | Four arithmetic operations, arithmetic function, comparison operator, geometric calculation function, coordinate conversion function, conversion function, logical operator, journalizing function, system function, time axis operation function                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Command memory                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1000 rewritable command memories are installed from the external devices and console during operation.                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Statistics analysis                                                     |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | No. of Statistical items                                                                                                                                                                                                                                                                                                                                                                                                  | Up to 20000 data points (support of batch save to memory card) Maximum value, minimum value, average value, deviation (3σ), OK/NG count in total judgment                                                                                                                                                                                                         |                                                                                                                                                                                                                                                     |  |
| Support functions                                                       | Screen save (valid when monochrome and color cameras are connected)                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Internal memory: Up to 1023 screens/1020 screens (240,000-pixel mode)<br>Up to 511 screens/509 screens (310,000-pixel mode)<br>Up to 255 screens/253 screens (1,000,000-pixel mode)<br>Up to 127 screens/124 screens (2,000,000-pixel mode)<br>Up to 50 screens/47 screens (500,000-pixel mode).<br>(Maximum value when one monochrome camera and one color camera are connected and the accumulation condition is "All") | Internal memory: Up to 511 screens/508 screens (240,000-pixel mode)<br>Up to 255 screens/253 screens (310,000-pixel mode)<br>Up to 127 screens/124 screens (1,000,000-pixel mode)<br>Up to 63 screens/60 screens (2,000,000-pixel mode).<br>(Maximum value when one monochrome camera and one color camera are connected and the accumulation condition is "All") | Internal memory: Up to 511 screens/508 screens (240,000-pixel mode)<br>Up to 255 screens/253 screens (310,000-pixel mode).<br>(Maximum value when one monochrome camera and one color camera are connected and the accumulation condition is "All") |  |
|                                                                         |                                                                                           | Programming aid functions                                                                                                                                                                                                                                                                                                                                                                                                                      | Display aid                                                                                                                                                                                                                                                                                                                                                                                                               | Enables you to perform screen display zoom, edge differentiation waveform display, profile display, stain stability display, operation by OCR extraction projection display, and defect level waveform display of trend edge defects during setup or operation.                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         |                                                                                           | Batch move                                                                                                                                                                                                                                                                                                                                                                                                                                     | Enables you to collectively move selected windows in X and Y directions during setup.                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Display template setting function                                                         | No. of display templates                                                                                                                                                                                                                                                                                                                                                                                                                       | 10 patterns/setting (of the 10 patterns, 4 patterns are the specified values) Possible external switching                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         |                                                                                           | No. of screens that can be displayed simultaneously                                                                                                                                                                                                                                                                                                                                                                                            | Enables you to simultaneously display up to 5 screens (when 5-screen horizontal splitting or 5-screen vertical splitting is selected).                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Hold image                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Past images (NG images) can be displayed as hold images (up to 3 times before). The measurement result and measurement time can also be referenced (depending on the camera connection status, the displayable count changes from 0 to 3 times).                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         |                                                                                           | Screen customization function                                                                                                                                                                                                                                                                                                                                                                                                                  | No. of customized screens                                                                                                                                                                                                                                                                                                                                                                                                 | 10 screens/program, character string : Measured value, judgment result, optional character, fixed character, figure, active character                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                     |  |
|                                                                         | Custom menu function                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                           | Enables you to create a shortcut menu to an optional setting screen (20 menus/program).                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                     |  |
| Operation rewrite function                                              |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Enables you to rewrite upper- and lower-limit tolerances and command memories during operation. Supports light dimmer control during operation (when CA-DC20E is connected)                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Memory card save function (SD2 slot only)                               |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Supports measured values, judgment results, NG count, measurement images (can be compressed and saved), saved images (can be compressed and saved), capture images, statistics analysis data, settings (settings can also be saved to the SD1 slot) and direct save during inspection operation                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Others                                                                  |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Image capture function, password function, retest function, file management function, I/O monitor, RS-232C monitor (with the log save function)                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Interface                                                               | Control input                                                                             | External trigger input                                                                                                                                                                                                                                                                                                                                                                                                                         | 2 points, simultaneous 2-camera capturing or individual capturing selectable, EV support, input rating: 26.4 V max., 3 mA min. Individual trigger delays can be set (from 0 to 999 ms) for each trigger input.<br>Simultaneous capturing of up to 4 cameras or individual capturing selectable<br>(If CV-E500 is not connected, up to 2 monochrome or color cameras can be simultaneously captured.)                      |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         |                                                                                           | Control input                                                                                                                                                                                                                                                                                                                                                                                                                                  | 18 points, input rating: 26.4 V max., 2 mA min.                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Control output                                                                            | Universal output                                                                                                                                                                                                                                                                                                                                                                                                                               | 27 points (including 2 FLASH output points that work with an external trigger), NPN open collector, 50 mA max. (30 V max.)                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         |                                                                                           | Total comparator output                                                                                                                                                                                                                                                                                                                                                                                                                        | 1 point, NPN open collector, 50 mA max. (30 V max.) Hold time setting available                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Monitor output                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Analog RGB output, SVGA 800 x 600 (24-bit color, 60 Hz)                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Run indicator                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                | LED display that works with power supply/ERROR output                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Communication port                                                      |                                                                                           | RS-232C (maximum baud rate: 115200 bps)/Ethernet (1000BASE-T/100BASE-TX/10BASE-T)/USB (USB2.0 HI-SPEED supported)<br>Numerical value/output, image data (compressed output available), control I/O available, simultaneous use of 3 ports available                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | PLC link                                                                                  | Numerical input/output data using the RS-232 or Ethernet port and control I/O. Simultaneous use of the Ethernet (TCP/IP) and USB ports available. Supported PLCs: A*/Q/L series of Mitsubishi Electric Corporation; SYSMAC C series** and CS1/CJ1/CJ2 series of Omron Corporation; MP900 series** and MP2000 series of YASKAWA Electric Corporation. Connection via link unit and used exclusively from EtherNet/IP and RS-232C (no protocol). |                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Display language                                                        |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Japanese/English/German selectable                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Illumination control                                                    |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | LED light ON/OFF control (12 V, 24 V) and dimmer control supported when optional Light Controller Unit CA-DC20E is connected. Connect up to 2ch/controller, max. 4 controllers. Supports multiple lighting pattern function.                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Rating                                                                  | Power supply voltage                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 24 VDC ±10%                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Current consumption                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2.4 A (2-camera connection and maximum load), 3.2 A (4-camera connection and maximum load)                                                                                                                                                                                                                                                                                                                                | 2.2 A (2-camera connection and maximum load)                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                     |  |
| Environmental resistance                                                | Ambient temperature                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2-camera connection: 0 to 50°C 32 to 122°F 1,000,000-pixel or higher camera connection: 0 to 45°C 32 to 113°F 4-camera connection: 0 to 45°C 32 to 113°F                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
|                                                                         | Relative humidity                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                | 35 to 85%, No condensation                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |
| Weight                                                                  |                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                | Approx. 1250 g                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                     |  |

\*1: Not selectable when CV-H035C/CV-H035M is connected as the pixel area is 310,000 (640 (H) x 480 (V)). \*2: Only the RS-232C port is supported.

## Camera (CV-H500C/H500M/H200C/H200M)

| Model                    | Camera (CV-H500C/CV-H500M) *3                                                                                                                                                                                                                                                                  | Camera (CV-H200C/CV-H200M) *3                                                                                                                                                                                                                                                                  |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Image receiving element  | 2/3-inch color CCD image receiving element, 11x high-speed reading using, square-pixel, 5,050,000 pixels (CV-H500C)<br>2/3-inch monochrome CCD image receiving element, 11x high-speed reading using, square-pixel, 5,050,000 pixels (CV-H500M) Unit cell size: 3.45 x 3.45 µm 0.14 x 0.14 Mil | 1/1.8-inch color CCD image receiving element, 7x high-speed reading using, square-pixel, 2,010,000 pixels (CV-H200C)<br>1/1.8-inch monochrome CCD image receiving element, 7x high-speed reading using, square-pixel, 2,010,000 pixels (CV-H200M) Unit cell size: 4.4 x 4.4 µm 0.17 x 0.17 Mil |
| Number of valid pixels   | 4,990,000 pixels 2432 (H) x 2050 (V)                                                                                                                                                                                                                                                           | 1,920,000 pixels 1600 (H) x 1200 (V) *4                                                                                                                                                                                                                                                        |
| Scanning system          | Progressive (61.2 ms)<br>Interlace: CV-H500M only (40.3 ms)                                                                                                                                                                                                                                    | Progressive (29.2 ms: 2,000,000-pixel mode 24.2 ms: 1,000,000-pixel mode)<br>Interlace: CV-H200M only (16.1 ms: 2,000,000-pixel mode 13.6 ms: 1,000,000-pixel mode)                                                                                                                            |
| Pixel transfer frequency | 130 MHz (65 MHz x 2 ch)                                                                                                                                                                                                                                                                        | 82 MHz (41 MHz x 2 ch)                                                                                                                                                                                                                                                                         |
| Transfer system          | Digital serial transfer                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                |
| Electronic shutter       | 1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000, 0.05 msec to 9000 msec can be set with numeric values                                                                                                                                                         |                                                                                                                                                                                                                                                                                                |
| Lens mount method        | C mount                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                |
| Environmental resistance | Ambient temperature                                                                                                                                                                                                                                                                            | 0 to 40°C 32 to 104°F                                                                                                                                                                                                                                                                          |
|                          | Relative humidity                                                                                                                                                                                                                                                                              | 35 to 85%, No condensation                                                                                                                                                                                                                                                                     |
| Weight                   | Approx. 130 g (not including lens)                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                |

\*3: Only the high-speed camera cable can be used.

\*4: In 1,000,000-pixel mode, 980,000 pixels (1024 x 960) serve as the processing area.

## Camera (CV-H035C/H035M)

| Model                    | Camera (CV-H035C/CV-H035M) *5                                                                                                                                                                                                                                                        |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Image receiving element  | 1/3-inch color CCD image receiving element, 7x high-speed reading using square-pixel, 340,000 pixels (CV-H035C)<br>1/3-inch monochrome CCD image receiving element, 7x high-speed reading using square-pixel, 340,000 pixels (CV-H035M) Unit cell size: 7.4 x 7.4 µm 0.29 x 0.29 Mil |
| Number of valid pixels   | 310,000 pixels 640 (H) x 480 (V) *6                                                                                                                                                                                                                                                  |
| Scanning system          | Progressive (4.7 ms)<br>Interlace: CV-H035M only (2.5 ms)                                                                                                                                                                                                                            |
| Pixel transfer frequency | 80 MHz 40 MHz x 2ch                                                                                                                                                                                                                                                                  |
| Transfer system          | Digital serial transfer                                                                                                                                                                                                                                                              |
| Electronic shutter       | 1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000, 0.05 msec to 9000 msec can be set with numeric values.                                                                                                                                              |
| Lens mount method        | C mount                                                                                                                                                                                                                                                                              |
| Environmental resistance | Ambient temperature                                                                                                                                                                                                                                                                  |
|                          | Relative humidity                                                                                                                                                                                                                                                                    |
| Weight                   | Approx. 120 g (not including lens)                                                                                                                                                                                                                                                   |

\*5: Only the high-speed camera cable can be used.

\*6: In 310,000-pixel mode, 310,000 pixels (640 x 480) serve as the processing area. In 240,000-pixel mode, 240,000 pixels (512 x 480) serve as the processing area.

## Camera (CV-200C/200M/S200C/S200M)

| Model                    | Camera (CV-200C/CV-200M) *7                                                                                                                                                                                                                                              | Camera (CV-S200C/CV-S200M) *7                                                                                                                                                                                                                                              |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Image receiving element  | 1/1.8 -inch color CCD image receiving element, square-pixel/all-pixel reading, 2,010,000 pixels (CV-200C)<br>1/1.8 -inch monochrome CCD image receiving element, square-pixel/all-pixel reading, 2,010,000 pixels (CV-200M) Unit cell size: 4.4 x 4.4 µm 0.17 x 0.17 Mil | 1/1.8 -inch color CCD image receiving element, square-pixel/all-pixel reading, 2,010,000 pixels (CV-S200C)<br>1/1.8 -inch monochrome CCD image receiving element, square-pixel/all-pixel reading, 2,010,000 pixels (CV-S200M) Unit cell size: 4.4 x 4.4 µm 0.17 x 0.17 Mil |
| Number of valid pixels   | 1,920,000 pixels 1600 (H) x 1200 (V) *8                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                            |
| Scanning system          | Progressive (58.5 ms: 2,000,000-pixel mode, 47.6 ms: 1,000,000-pixel mode)<br>Interlace: CV-200M only (32.7 ms: 2,000,000-pixel mode, 27 ms: 1,000,000-pixel mode)                                                                                                       | Progressive (58.5 ms: 2,000,000-pixel mode, 47.6 ms: 1,000,000-pixel mode)<br>Interlace: CV-S200M only (32.7 ms: 2,000,000-pixel mode, 27 ms: 1,000,000-pixel mode)                                                                                                        |
| Pixel transfer frequency | 40 MHz                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                            |
| Transfer system          | Digital serial transfer                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                            |
| Electronic shutter       | 1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000, 0.05 msec to 9000 msec can be set with numeric values.                                                                                                                                  |                                                                                                                                                                                                                                                                            |
| Lens mount method        | C mount                                                                                                                                                                                                                                                                  | Special mount (M15.5 P0.5 male)                                                                                                                                                                                                                                            |
| Environmental resistance | Ambient temperature                                                                                                                                                                                                                                                      | Head: 0 to 40°C 32 to 104°F, relay unit: 0 to 40°C 32 to 104°F (however, 35°C 95°F max. in partial capturing 50 lines or lower)                                                                                                                                            |
|                          | Relative humidity                                                                                                                                                                                                                                                        | 35 to 85%, No condensation                                                                                                                                                                                                                                                 |
| Weight                   | Approx. 110 g (not including lens)                                                                                                                                                                                                                                       | Head: Approx. 210 g (including the cable, not the lens), relay unit: Approx. 70 g                                                                                                                                                                                          |

\*7: The CA-CN17 camera cable (17 m) 55.8' and the CA-CN17R high-flex camera cable (17 m) 55.8' cannot be used.

\*8: In 1,000,000-pixel mode, 980,000 pixels (1024 x 960) serve as the processing area.

## Camera (CV-035C/035M/S035C/S035M)

| Model                    | Camera (CV-035C/CV-035M)                                                                                                                                                                                                                                                             | Camera (CV-S035C/CV-S035M) *9                                                                                                                                                                                                                                                          |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Image receiving element  | 1/3 -inch color CCD image receiving element, 2x high-speed reading using square-pixel, 350,000 pixels (CV-035C)<br>1/3 -inch monochrome CCD image receiving element, 2x high-speed reading using square-pixel, 350,000 pixels (CV-035M) Unit cell size: 7.4 x 7.4 µm 0.29 x 0.29 Mil | 1/3 -inch color CCD image receiving element, 2x high-speed reading using square-pixel, 350,000 pixels (CV-S035C)<br>1/3 -inch monochrome CCD image receiving element, 2x high-speed reading using square-pixel, 350,000 pixels (CV-S035M) Unit cell size: 7.4 x 7.4 µm 0.29 x 0.29 Mil |
| Number of valid pixels   | 320,000 pixels 656 (H) x 492 (V) *10                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                        |
| Scanning system          | Progressive (16 ms)<br>Interlace: CV-035M only (8.8 ms)                                                                                                                                                                                                                              | Progressive (16 ms)<br>Interlace: CV-S035M only (8.8 ms)                                                                                                                                                                                                                               |
| Pixel transfer frequency | 24.5 MHz                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                        |
| Transfer system          | Digital serial transfer                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                        |
| Electronic shutter       | 1/15, 1/30, 1/60, 1/120, 1/240, 1/500, 1/1000, 1/2000, 1/5000, 1/10000, 1/20000, 0.05 msec to 9000 msec can be set with numeric values.                                                                                                                                              |                                                                                                                                                                                                                                                                                        |
| Lens mount method        | C mount                                                                                                                                                                                                                                                                              | Special mount (M10.5 P0.5 male)                                                                                                                                                                                                                                                        |
| Environmental resistance | Ambient temperature                                                                                                                                                                                                                                                                  | Head: 0 to 50°C 32 to 122°F, relay unit: 0 to 40°C 32 to 104°F                                                                                                                                                                                                                         |
|                          | Relative humidity                                                                                                                                                                                                                                                                    | 35 to 85%, No condensation                                                                                                                                                                                                                                                             |
| Weight                   | Approx. 100 g (not including lens)                                                                                                                                                                                                                                                   | Head: Approx. 160 g (including the cable, not the lens), relay unit: Approx. 70 g                                                                                                                                                                                                      |

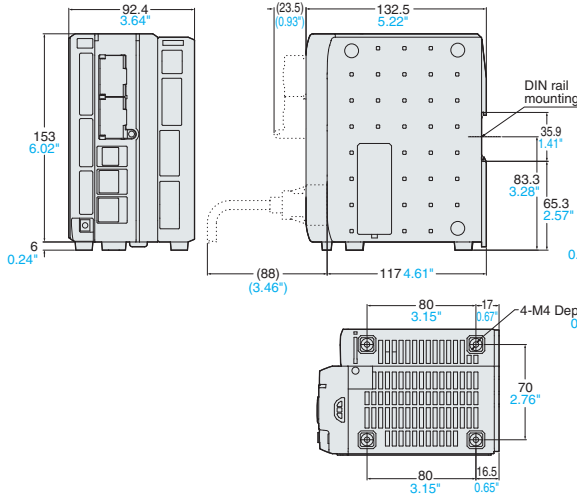
\*9: The CA-CN17 camera cable (17 m) 55.8' and the CA-CN17R high-flex camera cable (17 m) 55.8' cannot be used.

\*10: In 310,000-pixel mode, 310,000 pixels (640 x 480) serve as the processing area. In 240,000-pixel mode, 240,000 pixels (512 x 480) serve as the processing area.

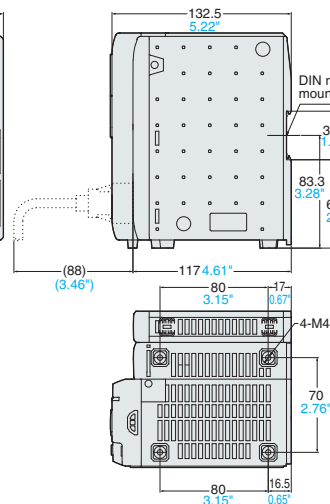
# Dimensions

Unit : mm inch

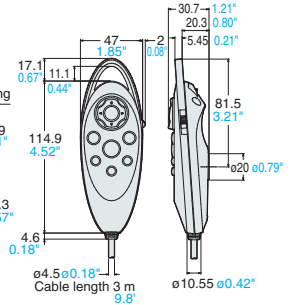
## Controller CV-5702(P)/CV-5502(P)/CV-5002(P)



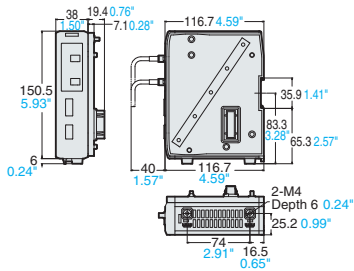
## When camera expansion unit CV-E500 is installed (CV-5702(P)/CV-5502(P) only)



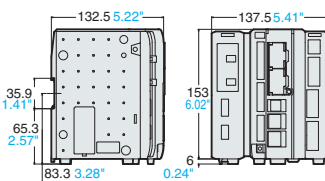
## Console



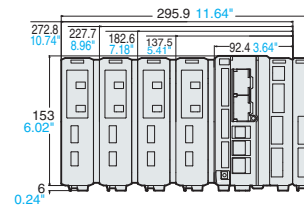
## Light Expansion Unit CA-DC20E



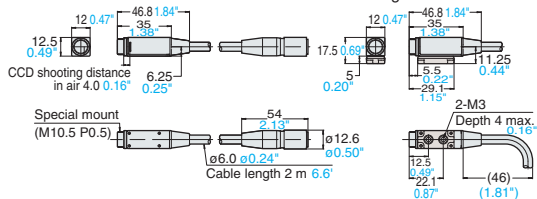
## CV-5002(P) + CA-DC20E



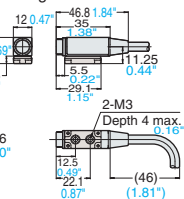
## CV-5702(P) + CV-E500 + CA-DC20E (4 units)



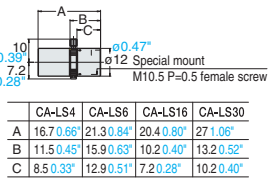
## Camera CV-S035CH/CV-S035MH



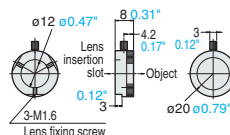
## When using a mounting bracket



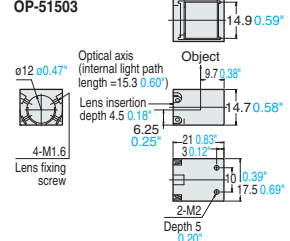
## Lens CA-LSx



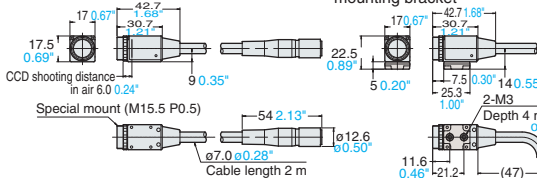
## Polarization filter OP-51502



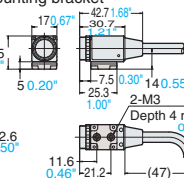
## Side viewer attachment OP-51503



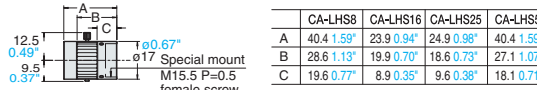
## Camera CV-S200CH/CV-S200MH



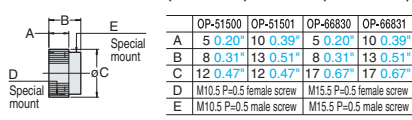
## When using a mounting bracket



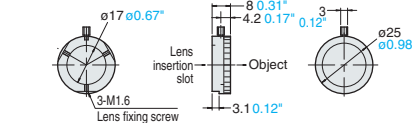
## Lens CA-LHSx



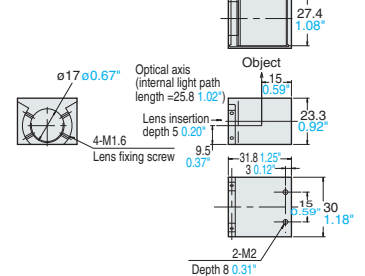
## Close-up ring OP-51500 (5 mm 0.20")/ OP-51501 (10 mm 0.39")/ OP-66830 (5 mm 0.20")/ OP-66831 (10 mm 0.39")



## Polarization filter OP-66832



## Side viewer attachment OP-66833



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# All-in-One Image Processing CV-700 Series



## Features

- Color and Grayscale processing for any application
- Built-in monitor and 2 camera connectivity for easy integration
- Simple touch panel user interface

## Simple, Straightforward Programming Designed for Easy Operation

Simple Programming helps for quick and efficient on-site operation, reducing set-up costs.



## The All-in-One Design Saves Space and Reduces Wiring

The CV-751 comes standard with a built-in 5.5" TFT color monitor and an array of on-board I/O options, such as discrete, analog, and RS-232 communications. The system can be configured via a remote console or a built-in touch panel.

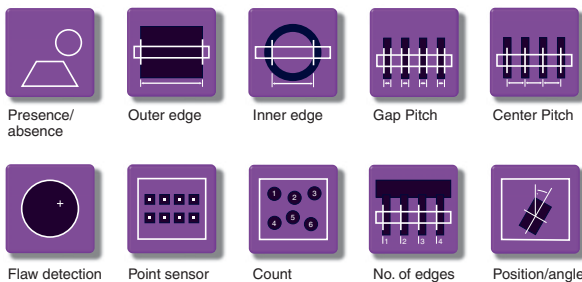
## High-Speed Search & Sub-pixel Measurement

Special ASIC technology ensures accurate measurement by using sub-pixel processing and a fast 360° rotation search.

## Comprehensive menus

Menus are available for nearly every in-line need. Up to 8 different inspection modes can be combined in a single program.

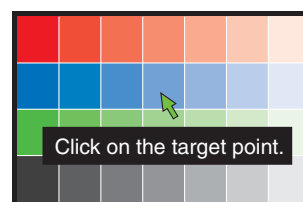
### Applications Menu



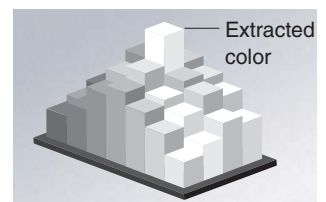
## The principle of color Shade-Scale processing

Color Shade-Scale processing recognizes the differences in hue and intensity of shade levels.

After clicking on a target to extract its color, the entire image is converted to a shade hierarchy with the extracted color as the top level.



Click on the target point for color extraction.



The whole image is converted into a gray shade image with the extracted color as the top level.

# Specifications

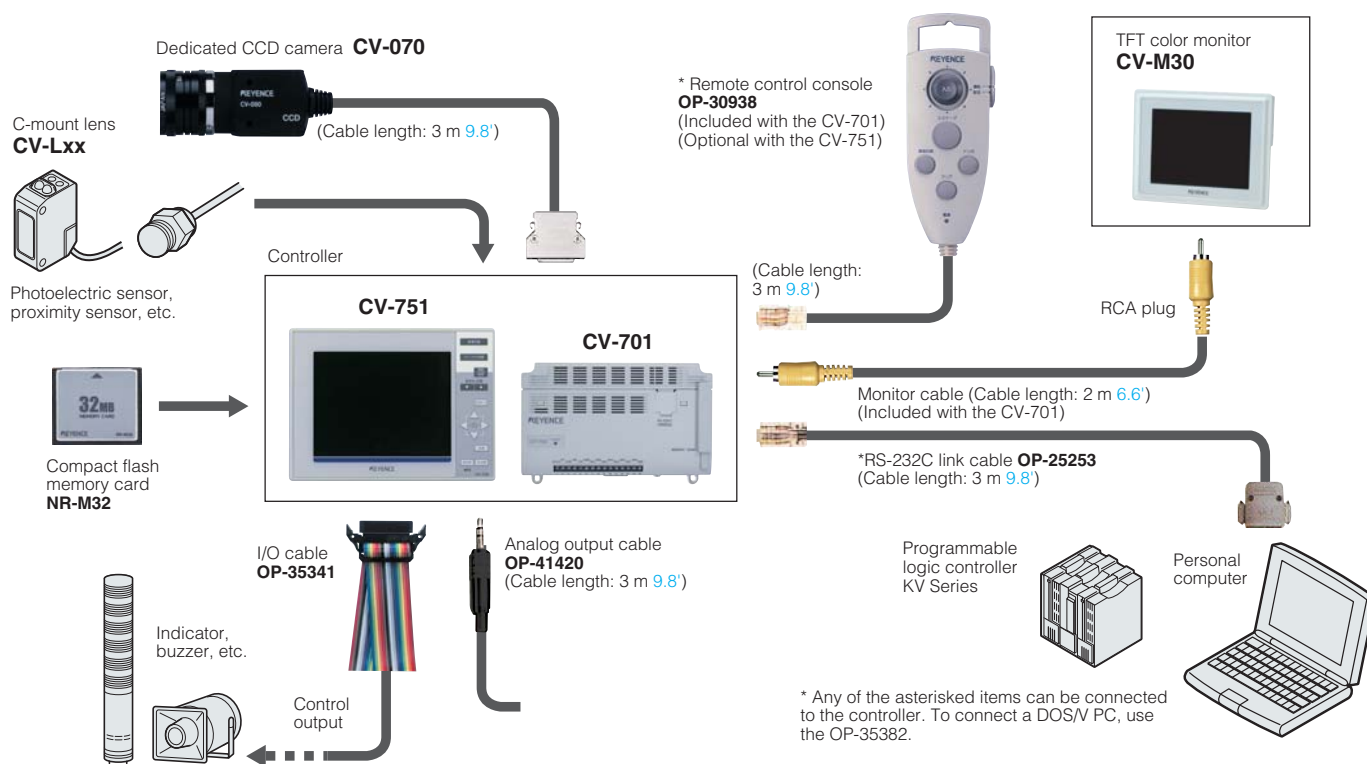
## Controller

| Type                      |                  |                                  | Built-in monitor type                                                                                                        |                                                                                                                                            | Separate monitor type                                                               |  |
|---------------------------|------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--|
| Model                     |                  |                                  | CV-751(P)                                                                                                                    |                                                                                                                                            | CV-701(P)                                                                           |  |
|                           |                  |                                  | * Input with a remote control console (optional) is also available.                                                          |                                                                                                                                            |                                                                                     |  |
|                           |                  |                                  |                                             |                                                                                                                                            |  |  |
| No. of pixels             |                  |                                  | 508 (H) x 480 (V)                                                                                                            |                                                                                                                                            |                                                                                     |  |
| Process cycle             |                  |                                  | 30 c/s (Varies depending on the setting)                                                                                     |                                                                                                                                            |                                                                                     |  |
| Binary level              |                  |                                  | Color binary processing by color extraction or color shade processing<br>Color can be specified individually for each window |                                                                                                                                            |                                                                                     |  |
| Program registration      |                  |                                  | 16 programs (8 programs when two cameras are used) (Programs are externally selectable)                                      |                                                                                                                                            |                                                                                     |  |
| No. of registered screens |                  |                                  | 16 screens (1 screen/program or 2 screens/program)                                                                           |                                                                                                                                            |                                                                                     |  |
| Functions                 | Mode             | Area sensor                      |                                                                                                                              | 8 max./program, Window shape: Circle/square/free square                                                                                    |                                                                                     |  |
|                           |                  | Absolute position detection      |                                                                                                                              | 4/program, Window shape: Square                                                                                                            |                                                                                     |  |
|                           |                  | Relative position detection      |                                                                                                                              | 4/program, Window shape: Square                                                                                                            |                                                                                     |  |
|                           |                  | Inspection mode                  | Width measurement                                                                                                            |                                                                                                                                            | 8/program, Window shape: Square                                                     |  |
|                           |                  |                                  | Pitch measurement                                                                                                            |                                                                                                                                            | 8/program, Window shape: Square                                                     |  |
|                           |                  |                                  | Edge count                                                                                                                   |                                                                                                                                            | 8/program, Window shape: Square                                                     |  |
|                           |                  |                                  | Count                                                                                                                        |                                                                                                                                            | 8/program, Window shape: Square/circle                                              |  |
|                           |                  |                                  | Flaw detection                                                                                                               |                                                                                                                                            | 8/program, Window shape: Square/circle/ring/arc                                     |  |
|                           |                  |                                  | Point sensor                                                                                                                 |                                                                                                                                            | 8/program, 8 points/Window                                                          |  |
|                           |                  |                                  | Center-of-gravity                                                                                                            |                                                                                                                                            | 8/program, Window shape: Square/circle                                              |  |
|                           | Adjustment       | Position adjustment              |                                                                                                                              | Color shade search/Line sensor/Color binary processing<br>(Center of gravity, Major axis inclination, X-/Y-axis direction, ±180° rotation) |                                                                                     |  |
|                           |                  | Illumination adjustment          |                                                                                                                              | 1 illumination adjustment window/program (two when two cameras are connected)                                                              |                                                                                     |  |
|                           |                  | Pre-processing (Filter function) |                                                                                                                              | Expand, Shrink, Median, Average, Edge enhancement,<br>Edge detection, Shading, Lightness-up, Saturation-up, Invert                         |                                                                                     |  |
|                           | Auto-sequence    |                                  | Continuous processing of 4 programs max.<br>(Up to 32 inspections [4 programs x 8 windows] can be continuously processed)    |                                                                                                                                            |                                                                                     |  |
|                           | Data calculation |                                  | Unit conversion and offset                                                                                                   |                                                                                                                                            |                                                                                     |  |
|                           | Screen save      |                                  | 8 screens                                                                                                                    |                                                                                                                                            |                                                                                     |  |
|                           | Setup menu       |                                  | Stores parameters of initial setting                                                                                         |                                                                                                                                            |                                                                                     |  |
| Input                     | Camera input     |                                  | 2                                                                                                                            |                                                                                                                                            |                                                                                     |  |
|                           | Control input    | External trigger                 |                                                                                                                              | 1 (Non-voltage input)                                                                                                                      |                                                                                     |  |
|                           |                  | Program selection                |                                                                                                                              | Data input (x4), 16 programs selectable (Non-voltage input)                                                                                |                                                                                     |  |
|                           |                  | Continuous detection             |                                                                                                                              | Detection continued without an external trigger when the program No. is changed while CONT input is ON. (Non-voltage input)                |                                                                                     |  |
|                           |                  | Screen registration              |                                                                                                                              | 2, Screen is registered by a trigger signal while REC input is ON. (Non-voltage input)                                                     |                                                                                     |  |
|                           |                  | Display/output window selection  |                                                                                                                              | Data input (x3), 8 windows selectable (Non-voltage input)                                                                                  |                                                                                     |  |
| LCD monitor               | Panel            |                                  | TFT 5.5 inch, full color                                                                                                     |                                                                                                                                            | Not provided                                                                        |  |
|                           | Backlight        |                                  | Cold cathode fluorescent tube<br>(Average life: Approx. 40000 hrs)                                                           |                                                                                                                                            | Not provided                                                                        |  |
| Memory card               |                  |                                  | Compact Flash memory                                                                                                         |                                                                                                                                            |                                                                                     |  |
| Video output              |                  |                                  | Conforms to NTSC standards                                                                                                   |                                                                                                                                            |                                                                                     |  |
| RS-232C interface         |                  |                                  | 1 ch, Numerical value output and control input/output (Baud rate: 38400 bps max. selectable)                                 |                                                                                                                                            |                                                                                     |  |
| Control output            |                  | NPN                              | NPN open-collector: 9, 50 mA max. (30 V max.)                                                                                |                                                                                                                                            |                                                                                     |  |
|                           |                  | PNP                              | PNP open-collector: 9, 50 mA max. (30 V max.)                                                                                |                                                                                                                                            |                                                                                     |  |
| Numerical value output    |                  |                                  | Binary 13 bits, 10 mA max. (30 V max.)                                                                                       |                                                                                                                                            |                                                                                     |  |
| Analog output             |                  |                                  | 0 to 4 V output, Output impedance: 100 Ω                                                                                     |                                                                                                                                            |                                                                                     |  |
| Display language          |                  |                                  | English/Japanese selectable                                                                                                  |                                                                                                                                            |                                                                                     |  |
| Power supply voltage      |                  |                                  | 24 VDC±10%                                                                                                                   |                                                                                                                                            |                                                                                     |  |
| Current consumption       |                  |                                  | 1.4 A                                                                                                                        |                                                                                                                                            | 700 mA                                                                              |  |
| Ambient temperature       |                  |                                  | 0 to 40°C 32 to 104°F, No freezing                                                                                           |                                                                                                                                            |                                                                                     |  |
| Relative humidity         |                  |                                  | 35 to 85%, No condensation                                                                                                   |                                                                                                                                            |                                                                                     |  |
| Weight                    |                  |                                  | Controller: Approx. 900 g                                                                                                    |                                                                                                                                            | Controller: Approx. 400 g,<br>Remote control console: Approx. 160 g                 |  |

## Camera

| Type                 | CV-070                                                                        |
|----------------------|-------------------------------------------------------------------------------|
| Image pickup element | 1/3 inch CCD video element, Square-pixel all reading                          |
| Electronic shutter   | 1/30, 1/50, 1/60, 1/100, 1/125, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/10000 |
| Lens mount method    | C mount                                                                       |
| Ambient temperature  | 0 to 40°C 32 to 104°F, No freezing                                            |
| Relative humidity    | 35 to 85%, No condensation                                                    |
| Weight               | Camera: Approx. 310 g (including 3-m 9.8' cable)                              |

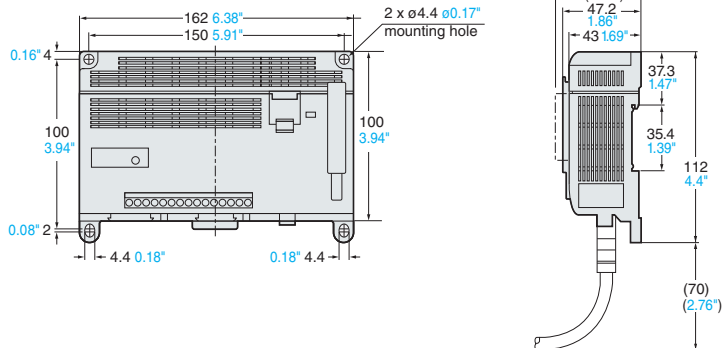
## System Configurations



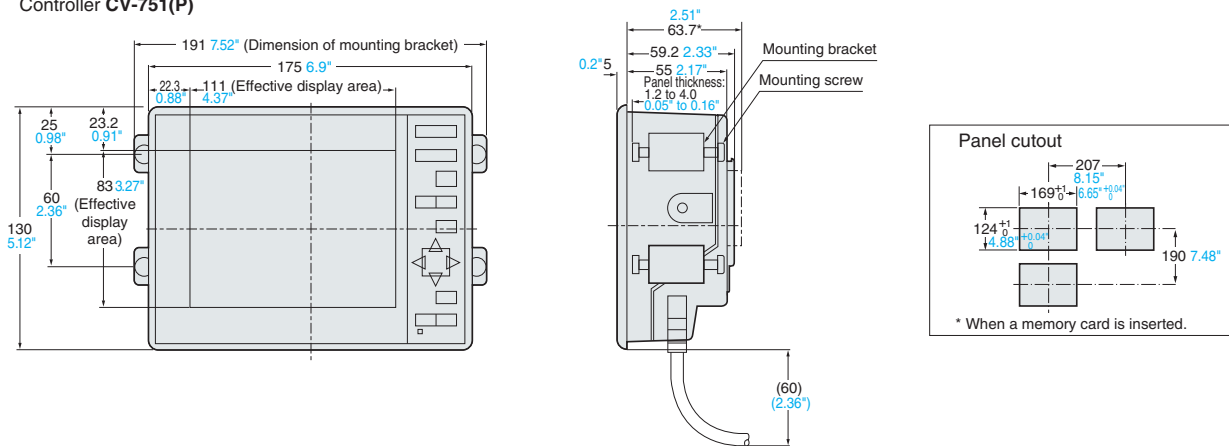
# Dimensions

Unit: mm inch

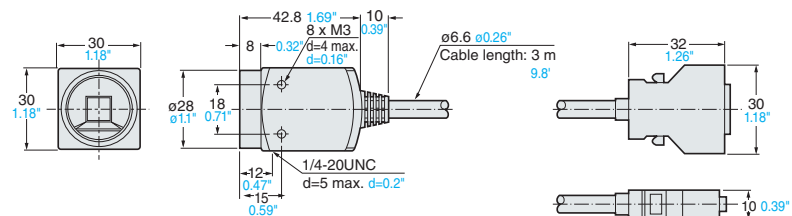
Controller **CV-701(P)**



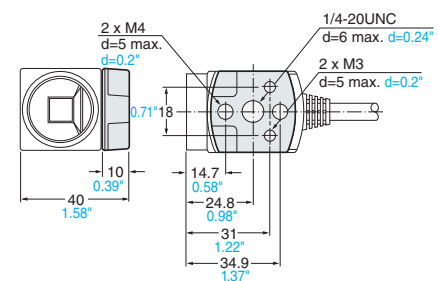
Controller **CV-751(P)**



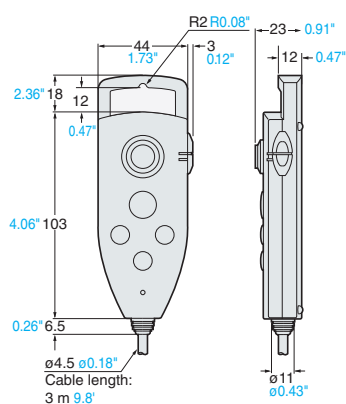
Camera **CV-070**



When the mounting bracket is attached (Accessory)



Remote control console (**OP-30938**)





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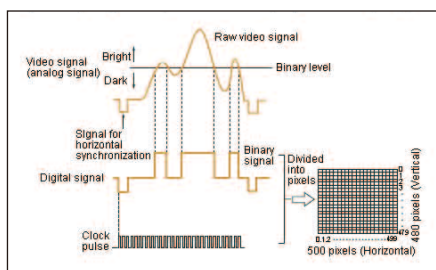
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#### SAFETY INFORMATION

Please read the instruction manual carefully in order to safely operate any KEYENCE product.

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