

# Vision System FH series

Industry's Fastest Compact Vision System

The Fastest **FH**



» Easy to Integrate in Machines

» Increase Machine Speed

» Perform High-precision Machine Operation

# Industry's Fastest\* Compact Vision System A New Concept in Image Processing That Considers

It's time to move beyond simply increasing the speed of image processing and start seriously shortening Machine cycle time. This is the concept that gave birth to OMRON's FH-series Vision System and its best-in-the-industry speed.

Manufacturing Machines are operated through the interaction of sensors, PLCs, servomotors, and other devices. Vision Systems measure positions and perform inspections, and the results are used to control the operation of Machines. The demand for faster, more precise Vision System operation is the primary requirement. The FH-series Vision System provides higher speed and precision for Machine cycle time and is loaded with all of the performance required to move Machines quickly and at high precision into a compact Controller for embedding into Machine. And even though the Camera/communications interfaces, image processing algorithms, and other features of this complete image processing system are built into one housing, the flexibility of a PC-based image processing system is also provided to help increase efficiency in the frequent reuse of Machine designs and in design changes.

\*Based on OMRON investigation in May 2013.



**Shorter Machine Cycle Times**

Logic  
control



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# Machine Cycle Time

## Increase Machine Speed >> p4



- **High-speed Response to Execution Instructions from a PLC**

A high-speed image bus and 4-core processing increase the speed at every step, from image input to data output.

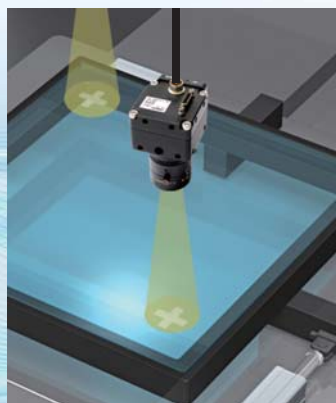
- **Multiple camera inspections provide total judgement results**

Calculations are easy to set for the results from four parallel tasks.

- **Quickly Outputting Measurement Results to a PLC**

You can output results to an NJ-series Machine Automation Controller on an EtherCAT communications cycle of 500  $\mu$ s.

## Perform High-precision Machine Operation >> p8



- **Measurements for Out-of-focus or Rotated Images**

The new Shape Search III processing item provides superior stability.

- **No Worker-dependence in Calibration Accuracy**

Vision master calibration is provided.

## Easy to Integrate in Machines >> p10



- **Shared Machine Interface**

Microsoft® .NET is supported.

- **Display Only Required Menu Commands on the Operation Interface**

User interface customization is supported.

- **Fast Support for Additional Measurement Needs**

Complete processing item libraries are provided.

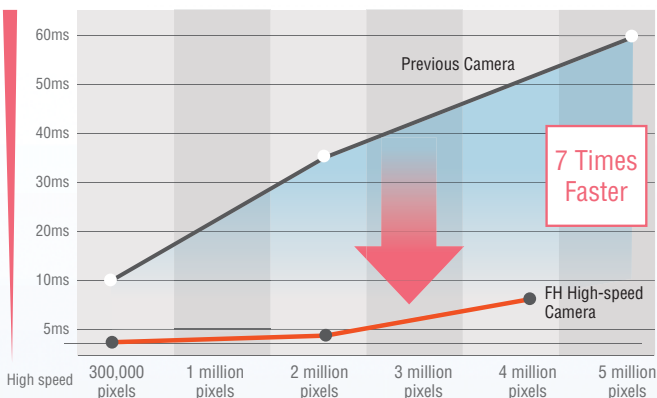


## Process Higher-resolution Images without Increasing the Machine Cycle Time



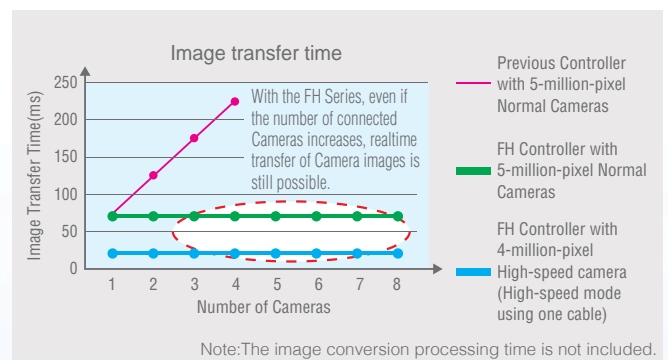
### High-speed Image Input **Fastest: 3.3 ms**

Camera resolution, driven by higher expectations for quality, continues to increase. OMRON has greatly reduced the input time and image transfer time to provide high-speed processing to match the speed of Machine applications for high-resolution images. Even with more Cameras and higher resolution, high-speed image input will contribute to increasing throughput.



### Realtime Image Transfer

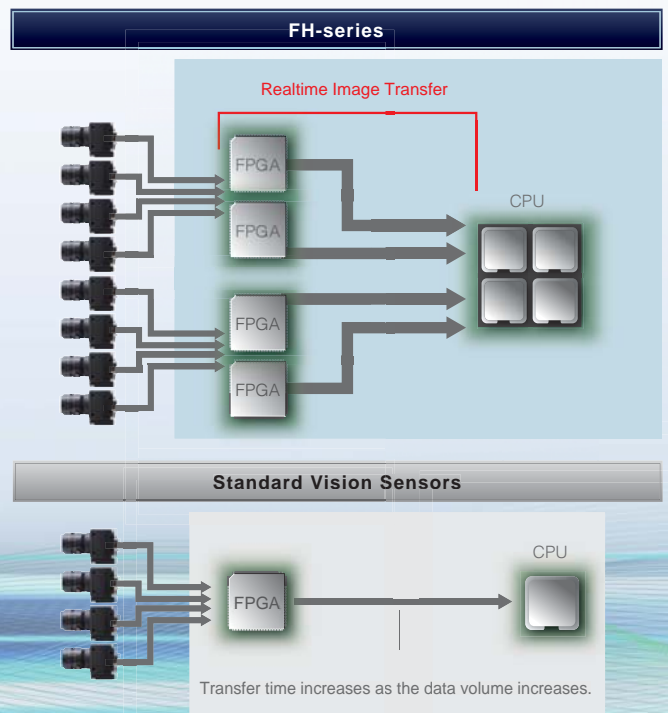
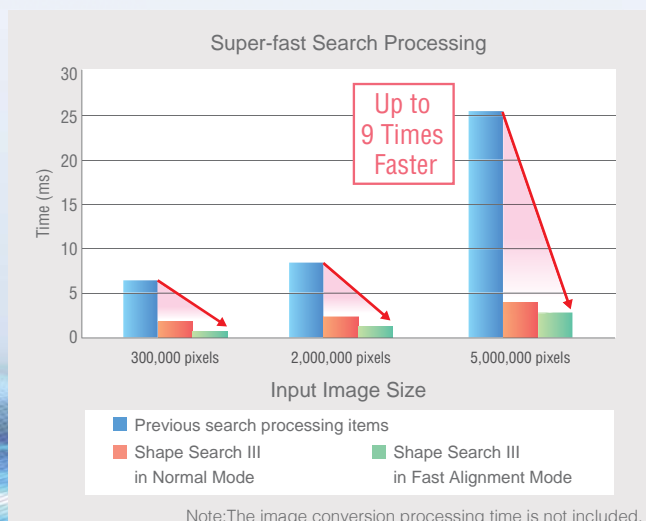
High-resolution Cameras capture large amounts of data, which can make a bottleneck out of the transfer speed time in addition to the image input time. An FH-series Controller provides a faster, multi-line image bus to enable realtime transfer of large amounts of image data for high-resolution Cameras or multiple Cameras. If high-precision measurements were sacrificed due to speed, the FH Series returns your precision without increasing cycle time.



### Ultra-high-speed Searching **Shape Search III**



New technology makes search algorithms nine times faster than before. Even for unstable image conditions, including light interference, overlapping shapes, gloss, and incomplete images, stable searching is possible without reducing speed, resulting in a increased stability.



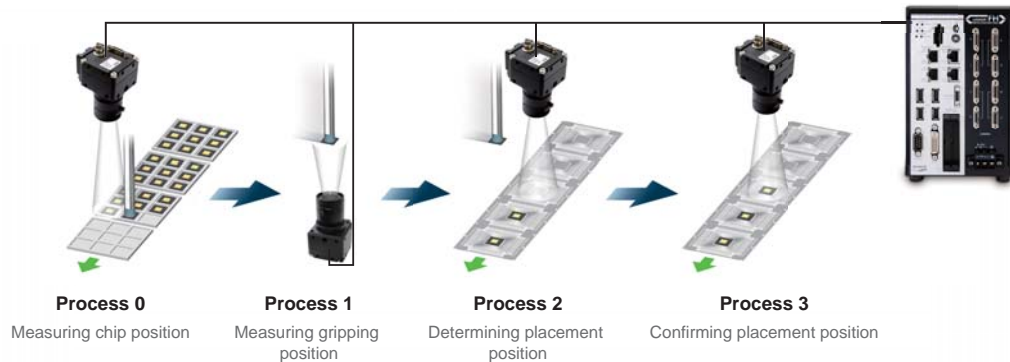


## Four-core CPU\* to Meet High-speed Demands for Different Machines

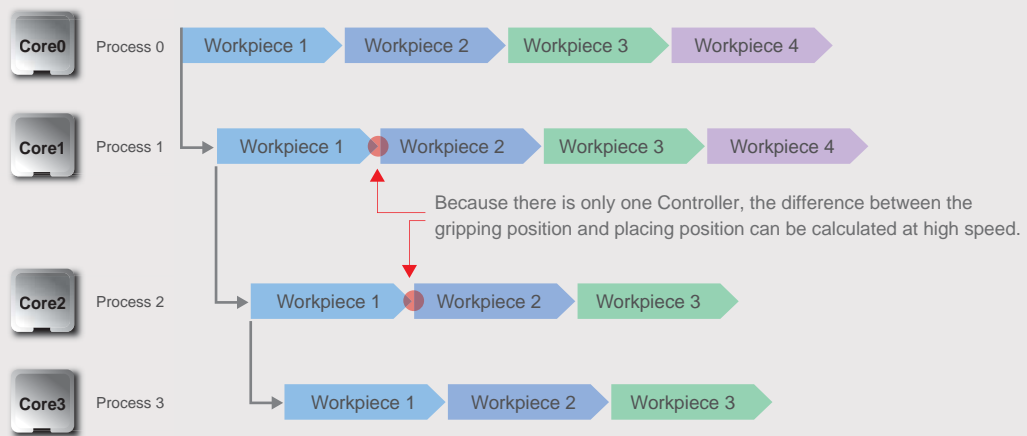
\*for high speed controllers only

### Case1 Perform Calculations for Multiple Cameras without Delay

Even when the measurement results of sequential operations are dependent on the speed of the independent action, parallel processing allows high speed performance without any dwell time. The measurement results from four cores can be easily calculated on one Controller to achieve continuous interaction without any special programming.

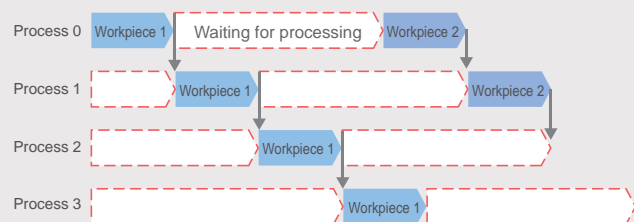


### Measuring the Next Workpiece without Waiting Time



### Frequently Waiting for Processing with a Standard Vision Sensor

The lack of the ability for standard Vision Sensors to handle parallel processing creates waiting time everywhere. If the Machine cycle time cannot be increased, a Controller must be added for each process to perform parallel processing, increasing costs.



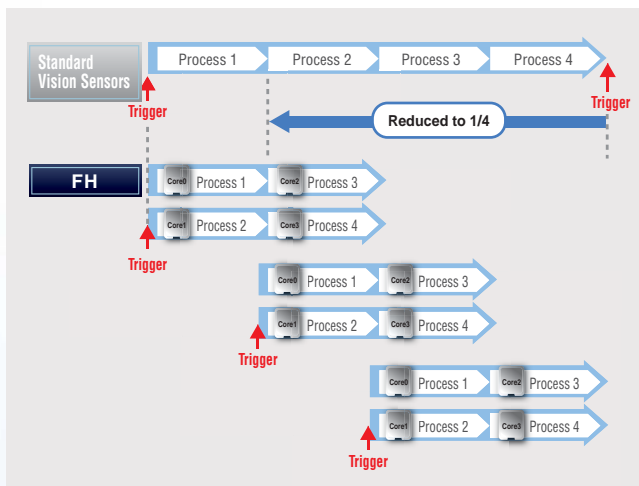
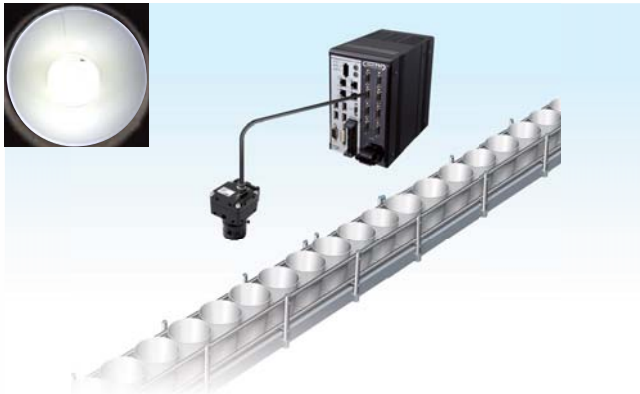
## Four-core CPU\* to Meet High-speed Demands for Different Machines

\*for high speed controllers only

### Case2 Machine Cycle Time Reduced to 1/4\* of Previous Time

Four cores process triggers, so the trigger interval can be 1/4th\* of previous models.

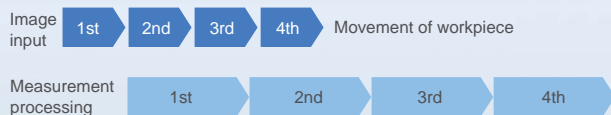
\*In-house comparison.



#### Multi-input Function Continuous High-speed Image Capture

### Higher Speed from Advanced Image Capture and Parallel Measurements

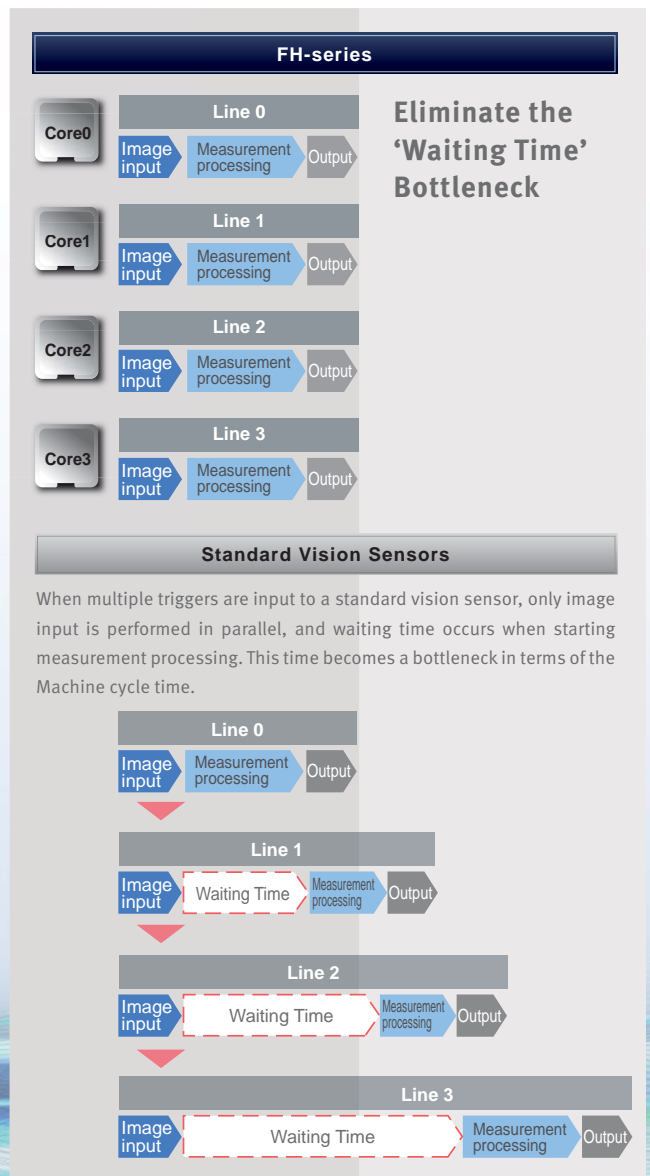
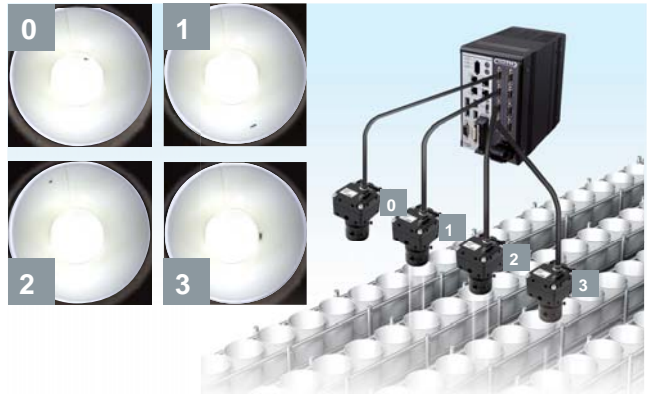
Each camera has its own image buffer for storing image data that is separate from the main memory used for measurement processing. This allows for up to 256 frames of continuous high-speed image capture even while the main memory is processing measurement data.



\*The number of images that can be captured depends on the Controller and the Camera that is connected to it. Refer to the user's manual for details.

### Case3 Process Multiple Lines in Parallel without Any Waiting Time

Four controllers are compressed into one without increasing the line cycle time. You can greatly reduce costs for processes that involve many lines.



# Fast Output of Measurement Results to Reduce Machine Cycle Time

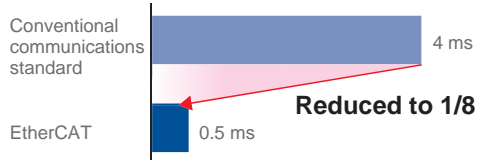
## EtherCAT Machine Control Network

EtherCAT is a high-speed open network that is ideal for Machine control. You can use EtherCAT to connect to NJ-series Machine Automation Controllers and motion control G5-series Servomotors and Servo Drives to increase the control speed over everyday communications protocols from workpiece detection to starting axis motion.

### ■ Features

- Communications cycle as low as 500  $\mu$ s
- Motion control that is synchronized with the communications cycle

### Communications Cycle



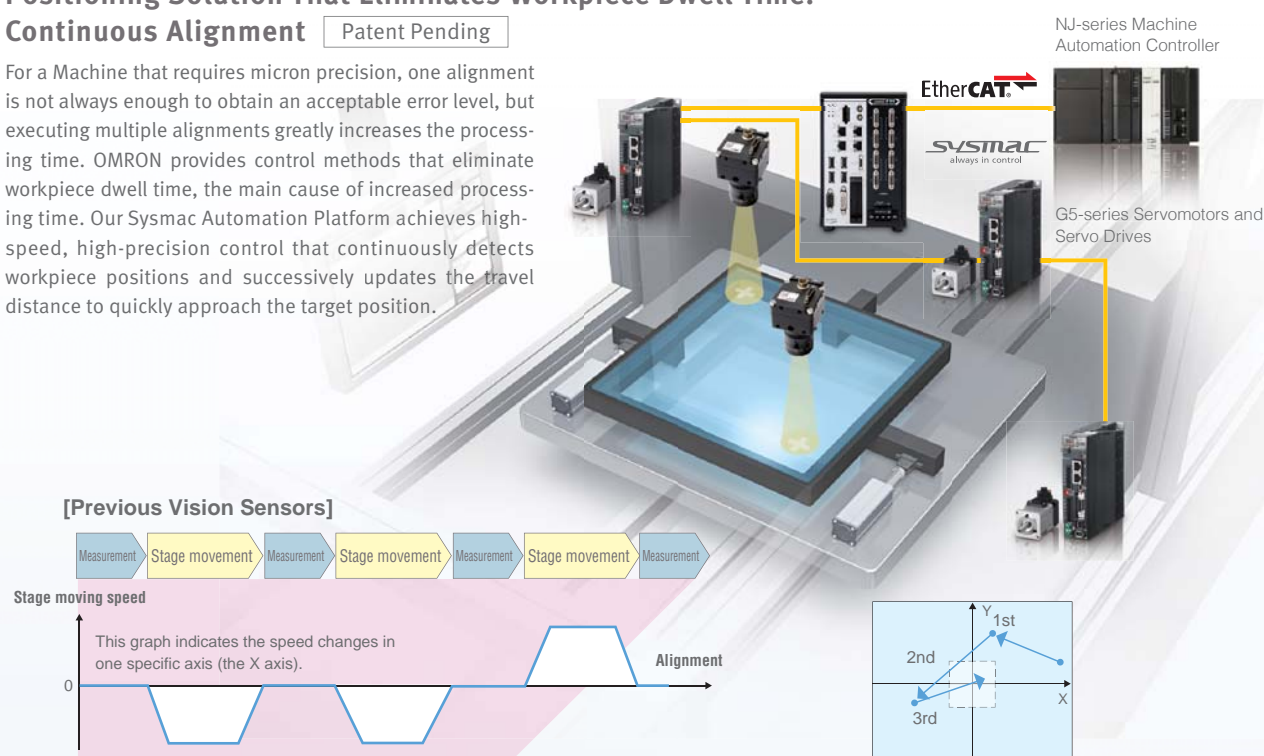
### Time from Trigger Input to Producing Measurement Results



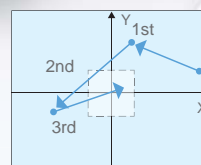
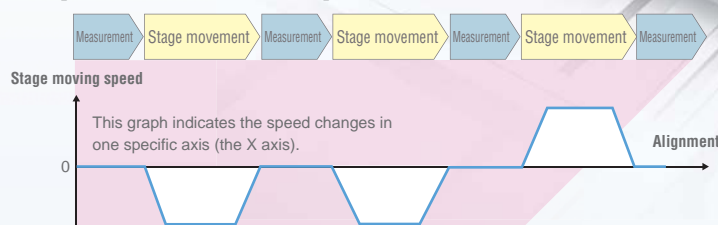
Note: The times given above are typical times. They depend on parameter settings.

## Positioning Solution That Eliminates Workpiece Dwell Time: Continuous Alignment Patent Pending

For a Machine that requires micron precision, one alignment is not always enough to obtain an acceptable error level, but executing multiple alignments greatly increases the processing time. OMRON provides control methods that eliminate workpiece dwell time, the main cause of increased processing time. Our Sysmac Automation Platform achieves high-speed, high-precision control that continuously detects workpiece positions and successively updates the travel distance to quickly approach the target position.

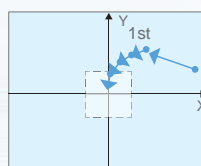
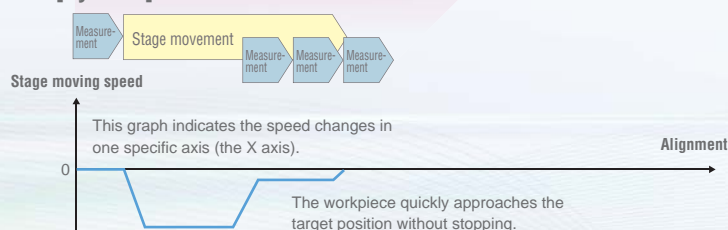


### [Previous Vision Sensors]



The dotted box indicates the target precision range.

### [Sysmac]



The dotted box indicates the target precision range.

Note: Please ask your OMRON representative for details.

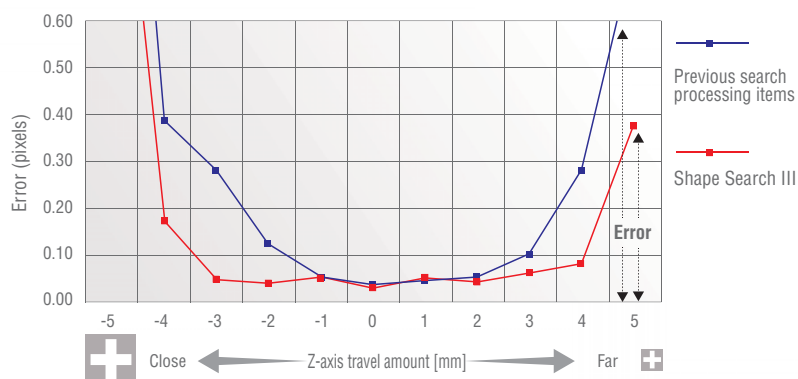
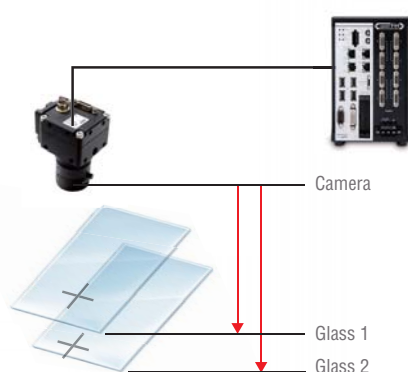


# The High-precision Image Processing Required for Positioning Shape Search III



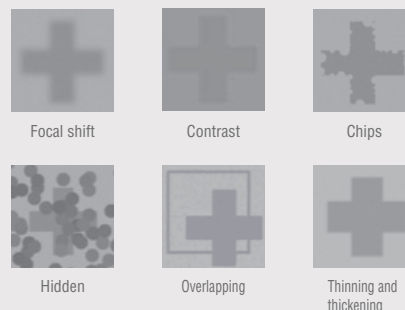
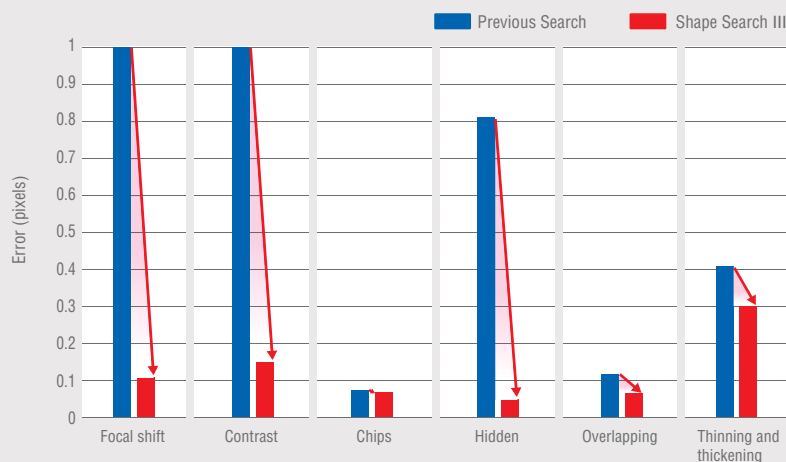
## Low-error Position Detection Even with Blurry Images

Over the years, OMRON has perfected techniques to search for and match templates at high speed. From these techniques Shape Search III provides advanced robustness, which is critical on FA sites. When measuring lamination of glass or other processes where the distance to the workpiece from the Camera varies, size differences and focal shifts can occur. Even in cases like this, the new Shape Search III algorithm detects positions with limited error.



## Stable Searching with Limited Error Even under Adverse Conditions

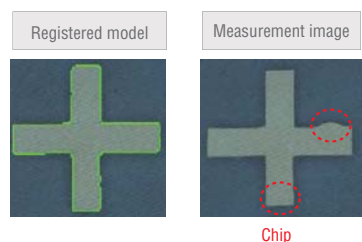
Stable searching is possible even under the following adverse conditions, which occur far too often in actual measurement applications.



## Visualization of Comparisons Enables Easy Setup of High-precision Searching

Patent Pending

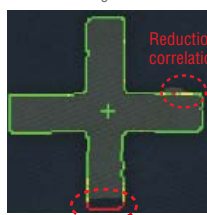
Advanced searching is accompanied by many parameters that must be tuned to match the application. However, it is difficult for the person making the settings to see the internal process. Extensive time is required to make the most of tool performance. With Shape Search III, you can visualize comparisons between the model data and a part of the measurement object to easily see when comparisons are not matched well for the inspection. Visualization of the comparison level, allows for parameters to be adjusted simply to obtain the best performance.



Deformation

Chip

You can see at a glance the difference between the registered model and measurement image.



Reduction in correlation



No reduction

You can adjust a parameter called the Acceptable Distortion Level to enable measurements without reducing the correlation even if there is distortion. You can easily adjust this parameter while monitoring the comparison.

# Converting Measurement Results to Output User Units

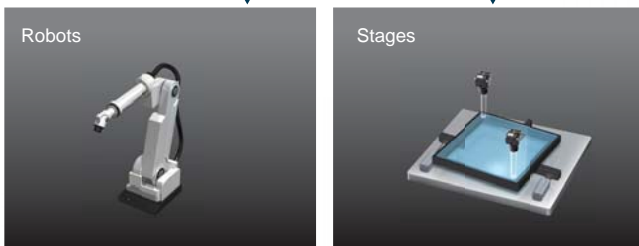
## Support for the Main Stages and Robots Used for 2D Positioning

The FH Controllers contain special setup displays for the stages and robots that are commonly used on FA sites. You just fill in the settings to easily output axis travel amounts for stages and robots.

User Interface Example



Application Examples

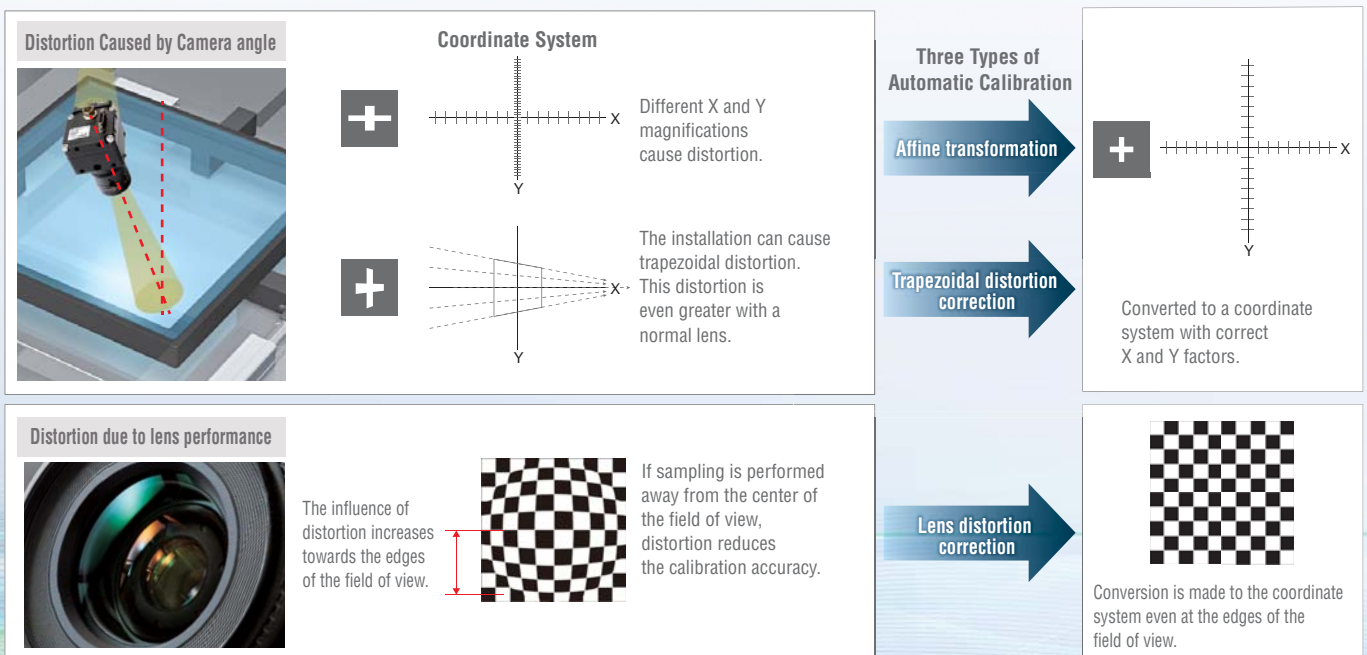


| Item                  |     |                                    |                                 |                              |
|-----------------------|-----|------------------------------------|---------------------------------|------------------------------|
| Stages                | XY  |                                    |                                 |                              |
|                       | XYθ | θ axis: Direct drive               | Camera axis movement: None      |                              |
|                       |     |                                    | Camera axis movement: X axis    |                              |
|                       |     |                                    | Camera axis movement: Y axis    |                              |
|                       |     | θ axis: Linear drive               | Camera axis movement: XY axes   |                              |
|                       |     |                                    | Camera axis movement: None      |                              |
|                       |     |                                    | Camera axis movement: X axis    |                              |
|                       | θXY | θ axis: Direct drive               | Camera axis movement: Y axis    |                              |
|                       |     |                                    | Camera axis movement: XY axes   |                              |
|                       |     |                                    | θ axis: Linear drive            | Camera axis movement: None   |
|                       |     |                                    |                                 | Camera axis movement: X axis |
|                       |     | Camera axis movement: Y axis       |                                 |                              |
|                       |     | Camera axis movement: XY axes      |                                 |                              |
|                       |     | UVW                                | Direct fulcrum motion           |                              |
|                       |     | Rotary fulcrum motion              |                                 |                              |
|                       |     | UVWR                               | Direct fulcrum motion           |                              |
| Rotary fulcrum motion |     |                                    |                                 |                              |
| 3 axes                |     |                                    |                                 |                              |
| Robots                |     | 4 axes                             | Control method: Fixed positions |                              |
|                       |     | Control method: Measured positions |                                 |                              |

## Vision Master Calibration for High-precision Positioning Even with Normal Lenses

To perform high-precision positioning, the coordinate system must be accurately aligned between image processing and the stage or robot. Calibration is used to achieve this. Normally trial and error in the actual application environment is necessary, which requires experience in moving sampling points and a experience with the influence of minor tilt in the Camera installation, the influence of lens distortion, and other factors. With an FH Controller, all you need to do is set a minimum number of conditions. Movement patterns for the sampling points are automatically calculated to optimize the stage/robot axis travel ranges, imaging processing field of view, and other factors, and the required axis travel amounts are sent to the PLC. By moving the system according to the instructions, optimum sampling is achieved and the coordinate systems for image processing and the stage/robot are accurately aligned. Correction coefficients are simultaneously calculated for Camera tilt and lens distortion. If you use the calibration conversion parameters that are made with this function, you can easily achieve high-precision positioning even for normal lenses with high distortion rates.

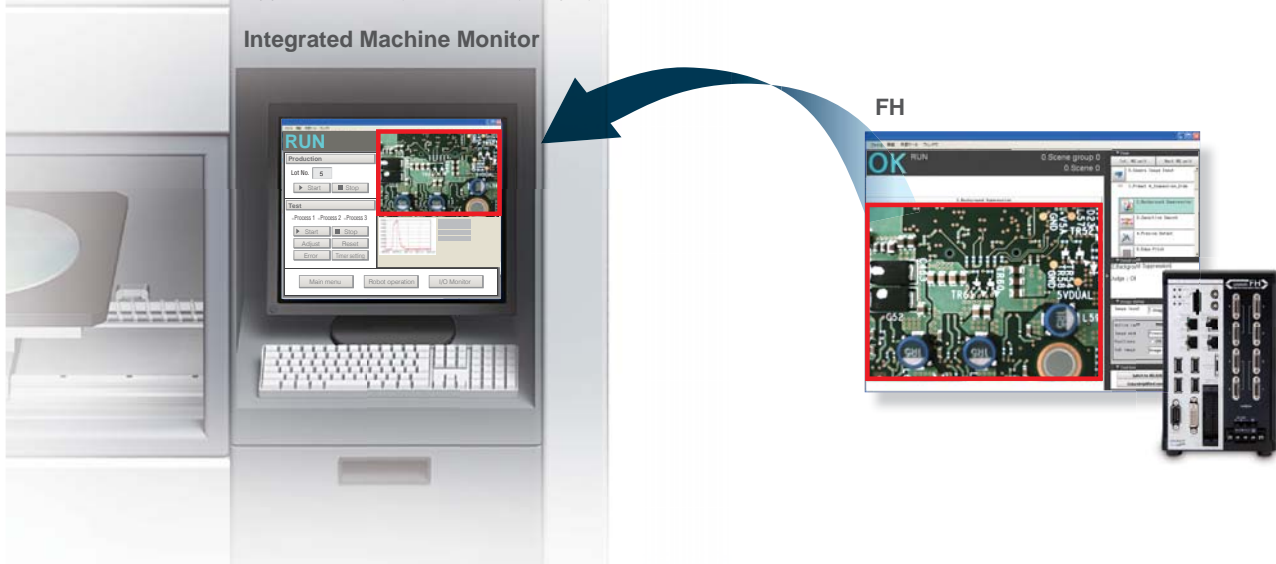
> Page 15: Setup Flow for Vision Master Calibration



## Easily Connect the Components That Configure the Machine

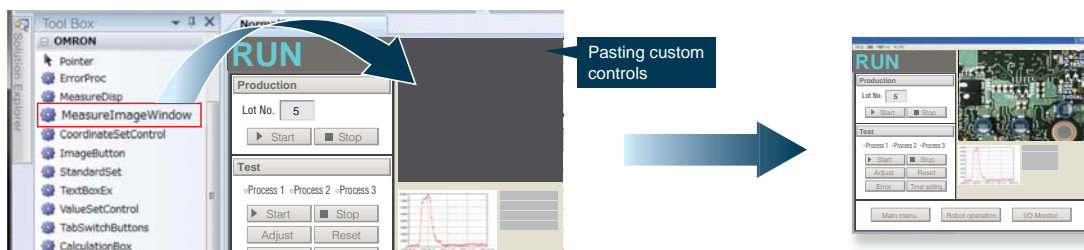
### Easy Integration into an Machine Monitor Support for .NET User Interface Controls

Custom .NET controls are supported so that you can easily display FH Controller measurement images and measurement results on a Machine PC.



#### Easy Customization

- ① Custom controls for FH measurement images and measurement results are laid out on Microsoft Visual Studio®.
- ② Instead of writing the program code from scratch to build interfaces, you can easily build the interfaces simply by pasting custom controls.



### Output to HMI or High-resolution Monitor



Microsoft® Visual Studio® is a registered trademark of Microsoft Corporation.



## Design the Connected Components with One Software Application

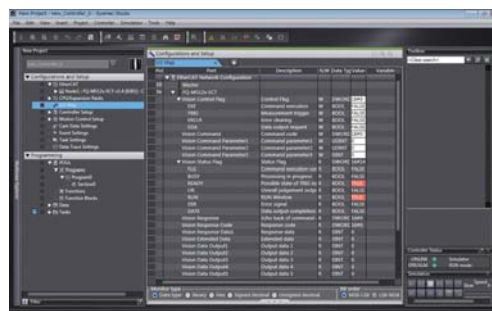
### Develop Machine Control Programs with One Software Application: Sysmac Studio

Use the Automation Software Sysmac Studio to set up all of the slaves connected via EtherCAT. Simulate and debug motion control, logic, drives, and sensing on an integrated platform to reduce the work required for Machine design.



### Minimize Commissioning and Adjustment Work with Simulations

Integrated simulations linked to an NJ-series Machine Automation Controller lets you verify the NJ-series program logic. You can directly edit the EtherCAT I/O map to send measurement commands to FH-series Vision Sensors.



## Easy Setup with Program Scalability

### Customize Original Operation Interfaces

#### Show only the buttons you need

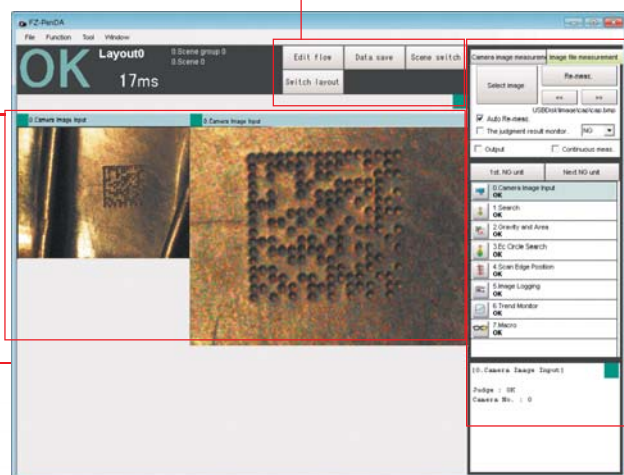
Choose from our library of buttons and position them anywhere on-screen to best support your daily operation, without 'screen clutter'.

#### Arrange the Interface Elements Flexibly

You can flexibly change the image display composition to display an entire image, enlarge part of an image, or display images from different Cameras.

#### Nine screen layout

Up to 9 screens can be stored depending on the application or user classification.



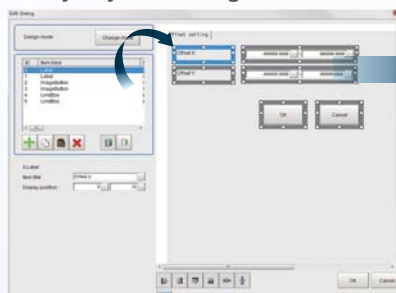
#### Move windows freely

Drag and drop windows where you want. You can also change the box size and delete.

### Hide Unnecessary Adjustment Commands

With only menu operations on the Controller, you can customize the setting displays in dialog boxes for processing items. For example, you can set up the interface to hide any parameters from the operator.

#### Freely Lay Out Dialog Box Contents



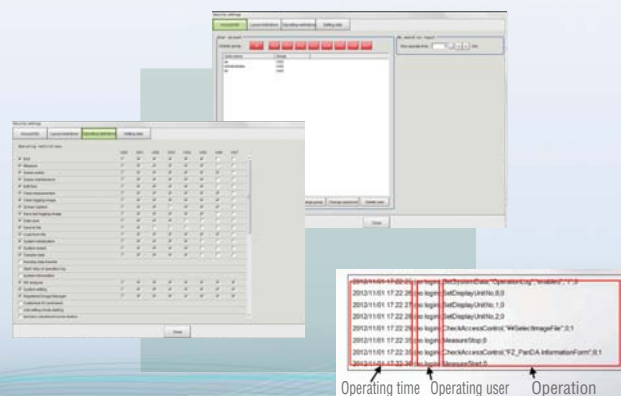
#### Completed



Only a parameter required for daily operation can be displayed.

### Completely Different Operation Interfaces for the Designer and Operator

Accounts can be used to keep completely different operation interfaces for the designer and the operator. You can set up to eight levels of security for up to 50 items for each account. You can record operation logs for each account to enable smoothly isolating problems when troubleshooting.

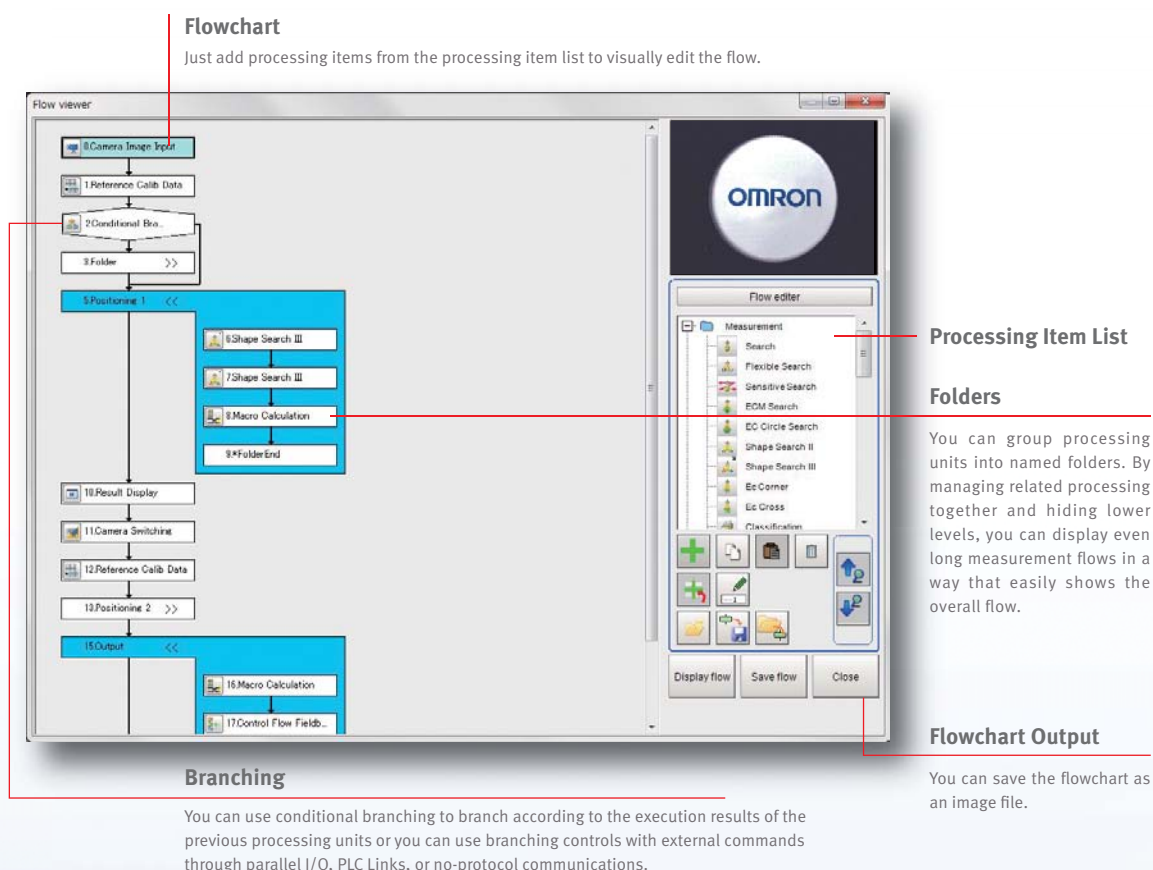


## Flow Viewer Builds the Measurement Process with Flow Chart Programming

Just add any of the large variety of processing items to the measurement flow to build the basic program for image processing.

All processing items have menus for easy setup and adjustment.

Easily build the best imaging processing for each application to smoothly complete testing and adjustments without programming.



»Page 25: Controlling Flow Branching Conditions from an External Device.

## Easy Multi-language Support: Change between 9 Languages

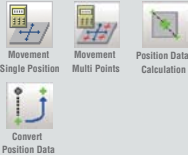
You can change display messages between nine different languages: English, Chinese (traditional or simplified), German, French, Italian, Spanish, Korean, and Japanese. You can display the best language for the user for applications in other countries.





# High-precision Alignment Library

Alignment Calculations



Four specialized types of alignment calculations are supported. These can be combined to easily execute alignments that require complex calculations on previous systems models or computers.

## Movement Single Position

The axis movement that is required to match the measured position angle to the reference position angle is calculated.

## Convert Position Data

The position angle after the specified axis movement is calculated.

## Movement Multi Points

The axis movements that are required to match the measured position angles to the corresponding reference position angles are calculated.

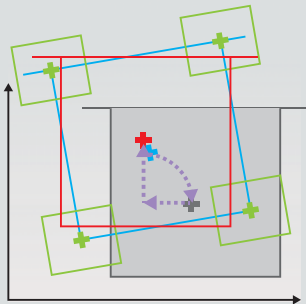
## Position Data Calculation

The specified position angle is calculated from the measured position.

## Available Alignment Methods

### Position Angle Alignment

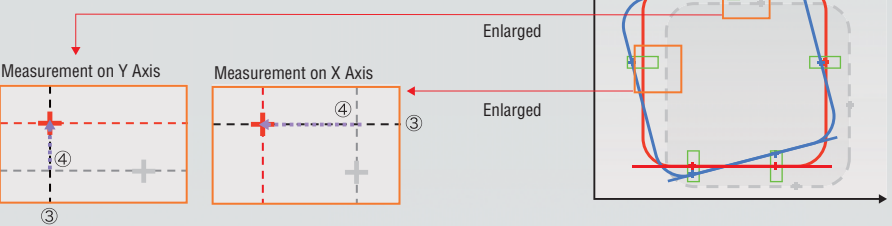
Offsets are suitable for aligning the positions of workpieces with different sizes. Position angle alignment allows the use of offsets to achieve flexible positioning.



- 1 The Position Data Calculation processing item is used to calculate the position and angle to use in the axis movement based on measurement results (shown in green).
- 2 The rotational movement on the  $\theta$  axis is calculated as the reference angle minus the measured angle.
- 3 The measurement position is rotated by the rotational movement for the  $\theta$  axis (gray).
- 4 The reference positions X and Y minus the measured positions X and Y after rotation are used as the X-axis movement and Y-axis movement.

### Alignment with Side Measurements

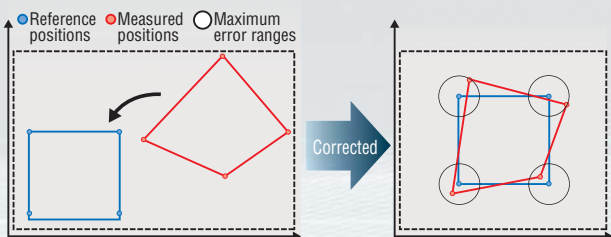
This alignment method measures the sides of the workpiece. You can even use it without alignment marks and when workpiece corners cannot be measured. This method is suitable for positioning workpieces with round corners.



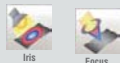
- 1 The angle is calculated from the side where two points are measured. The rotational movement on the  $\theta$  axis is calculated as the reference angle minus the measured angle.
- 2 The measurement position is rotated by the rotational movement for the  $\theta$  axis (gray).
- 3 A straight line that goes through the positions calculated in step 2 and that has the same direction as the reference angle (for the X axis) is calculated. (The direction on the Y axis is the reference angle plus  $90^\circ$ .)
- 4 The intersecting point between the straight line calculated in step 3 and the same axis as the measure direction that goes through the reference position is calculated.
- 5 The difference between the reference point and the intersecting point calculated in step 4 is the movement in the measurement direction. The above calculations are performed for each point and the average values are used as the X-axis movement and Y-axis movement.

### Corresponding Point Alignment

The axis movements from the measured positions to the reference positions are calculated based on relational position information. This method is suitable for aligning all points within certain distances so that small deviations in the distances do not result in continuity failures, such as they can when aligning electronic substrates.

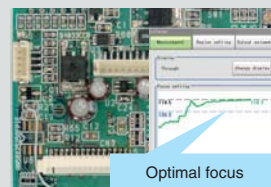
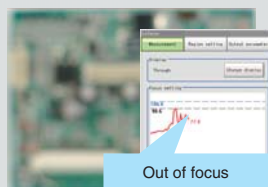


## Setup Aids



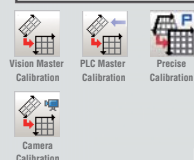
## Optimum Focus and Aperture Settings

Until now, focus and brightness settings were adjusted according to experience and intuition. But now they can be evaluated numerically and visually on graphs. This allows quick verification of optimum focus and aperture settings to eliminate inconsistencies in settings caused by worker differences so that you can achieve even higher levels of measurement accuracy.



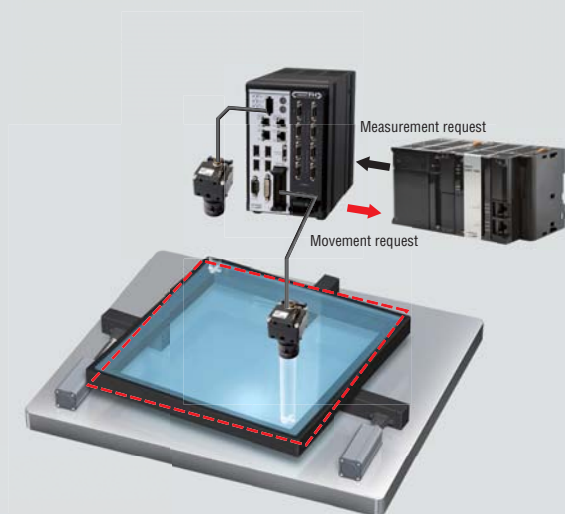
- Camera installation and setup are easy.
- Errors can be generated when the focus or aperture changes.
- You can determine the numerical values for the focus and aperture for the master workpiece so that essentially anyone can reproduce the same conditions.

## Calibration



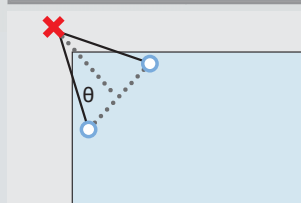
## Vision Master Calibration

With Vision Master Calibration, the FH-series Vision System automatically calculates the movement patterns for sampling points to optimize the stage/robot axis travel ranges, imaging processing field of view, and other factors, and the required axis movements are sent to the PLC. By moving the system accordingly, optimum sampling is achieved and the coordinate systems for image processing and the stage/robot are accurately aligned. Correction coefficients are simultaneously calculated for Camera tilt and lens distortion. If you use the calibration conversion parameters that are made with this function, you can easily achieve high-precision positioning even for normal lenses with high distortion rates.



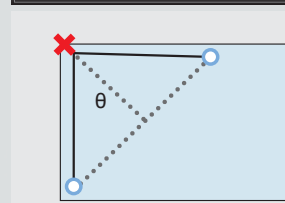
## Precise Rotational Position Estimation

### Previous Methods



The sampling points are picked at random, so the rotational range is not sufficient.

### FH Series



The FH-series Vision System automatically extracts sampling points in the field of view to ensure a large rotational angle in the  $\theta$  direction on the stage and sends movement requests to the PLC. Parallel movement and rotational movement are combined to achieve the optimum calculations from information on many rotational sampling points.

## Automatically Calculated Calibration Data

Both affine transformation parameters and distortion correction parameters are calculated at the same time.

### Affine Transformation

Camera and stage magnification

Stage axis perpendicularity

Camera and stage rotation

### Distortion Correction

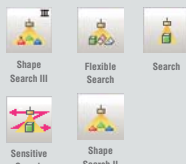
Distortion Correction

Lens distortion correction

## Inspection and Measurement Process Library

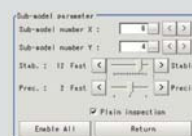
### Search

A complete array of search tools are provided to meet an array of requirements. Minute difference detection is supported without false detection.



#### Sensitive Search

This allows the recognition of very subtle differences that cannot be detected through ordinary search processes, by dividing the registered model image into several regions and carefully matching them. Delicate threshold setting is not required saving time in the registration process.

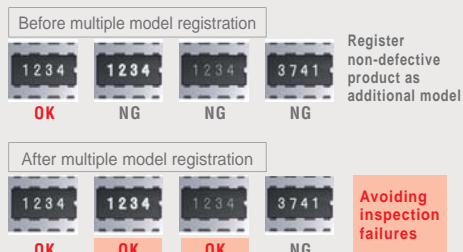


Different conditions for dividing the model image can be set.

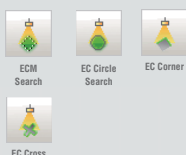
#### Flexible Search

When inspecting workpieces with some variations in shape, these characteristics are sometimes recognized erroneously as defects. Flexible Search ensures accurate searches regardless of some variations in print quality or shape, by registering several images of non-defective products as models. It helps you decrease your inspection failure rate by rejecting defective products only.

#### Inspection of characters on IC chips



### EC



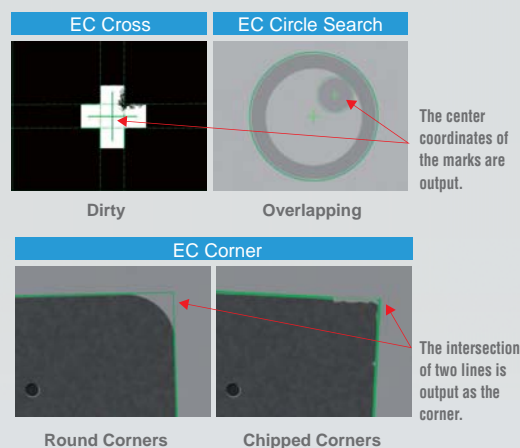
These processing items use EC (edge codes) for superior performance even under poor conditions.

#### EC Cross, EC Circle Search

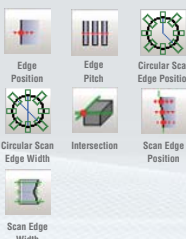
The alignment marks commonly used in manufacturing of LCD panels and PCBs can be precisely detected. Accurate detection is possible even if the marks are dirty or partially hidden. The output coordinates give the center of the cross or circle. There is no need to set the output coordinates, so inconsistent precision caused by worker differences is eliminated.

#### EC Corner

Two straight lines are detected to output the point of intersection between them as the corner. Stable detection is possible even for rounded corners or when the edge is broken. This is ideal for glass plates, LCDs and other objects on which alignment marks cannot be printed.



### Edges



These processing items let you measure positions, widths, and the number of edges from edge extraction.

#### Circular Scan Edge Position

You can measure the center coordinates, diameter, and radius of a round workpiece without performing any calculations simply by drawing one measurement region.

Center coordinates Radius

#### Circular Scan Edge Width

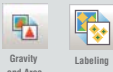
You can measure the center coordinates, width, and thickness of a ring-shaped workpiece without requiring additional calculation.

Width and thickness Center coordinates



## Areas

These processing items let you measure sizes, center of gravity positions, and the number of objects.



## Defects

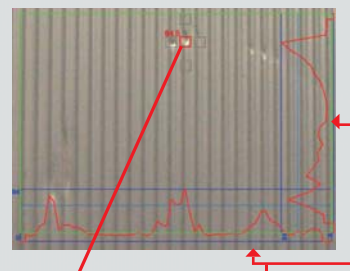
These processing items are ideal for external appearance inspections for damage, foreign matter, etc.

### Inspections of Scratches and Dirt

Subtle scratches and dirt can be detected with more fine-tuned conditions compared to conventional inspections. Since you can clearly distinguish defects to be detected from the background, the failure detection rate can be decreased. Profiles of defects and comparison elements can be displayed on the screen in real time. You can adjust by confirming the settings and detection results on the image. Fine parameters for defect detection allow fine settings at the pixel level.



Scratch detection profile displayed on the screen [Patent Pending]



#### Comparison element display

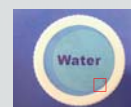
Intervals and sizes of comparing elements are displayed.

#### Profile display

Defects of each direction for detection are displayed as wave profiles.

#### Fine Matching

It is useful for detecting scratches, chipped edges or subtle dirt in complex backgrounds.



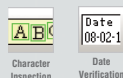
#### Defect

It is useful for detecting scratches and dirt in plain backgrounds.



## Character Inspections/OCR

These processing items provide the functions that are required for character inspections of dates, lot numbers, etc.



## Codes

These processing items can read bar codes and 2D codes from Camera images.

Printing quality evaluation based on ISO standards is supported.

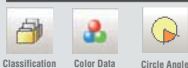
Applicable standards: ISO/IEC 15415 (The data matrix standard in ECC 200 is supported) and ISO/IEC 15416

You can output judgements of the code quality according to the printing quality standards that are defined in the standard.



## Special Processing

Custom functions are also provided in these convenient processing items.



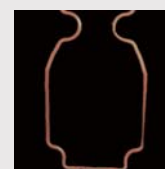
### Automatic Extraction of Complex Measurement Region Shapes

Measurement regions are no longer restricted to combinations of rectangles and circles. You can freely set the shape according to the outline of the workpiece. It's easy to set the measurement regions. Just specify one portion of the region to extract, and a continuous region with a similar color is extracted automatically. You can set precise regions for measurements even for scratch inspections or labeling on workpieces with complex shapes. This method to set measurement regions can be used for Gravity and Area, Color Data, Labeling, Defect, and Precise Defect processing items.

Specify part of the area to extract as the measurement region.

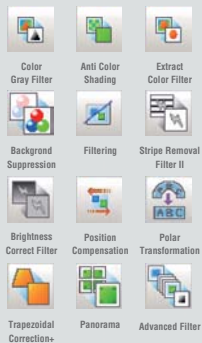


The region with a similar color to the specified area is extracted automatically.



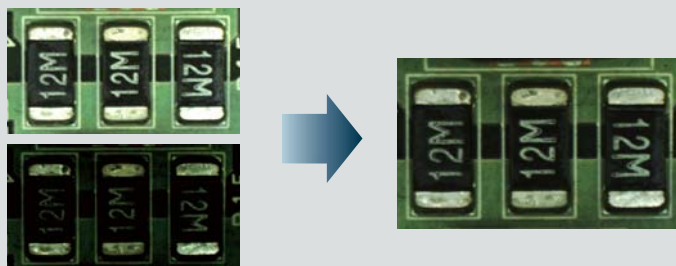
# Image Filter Library

## Compensate Images



## Calculations between Images

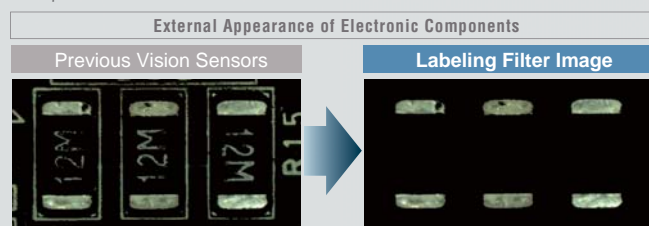
You can perform arithmetic operations, bit operations, averaging, or maximum/minimum operations between two images.



Example: You can get the average of two images that were taken under different imaging conditions.

## Labeling Filter

This filter uses label processing to output an extracted image that contains only the specified characteristic labels.



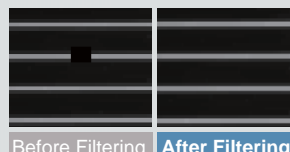
Extraction is possible only with color or brightness information.

Extraction of labels with specified areas or shapes is possible.

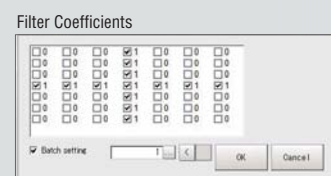
## Custom Filter

You can set the mask coefficients as required for these filters. The mask size can be up to  $21 \times 21$ . You can more flexibly set image smoothing, edge extractions, dilation, and erosion.

Example:  
Dilation/Erosion in One Direction



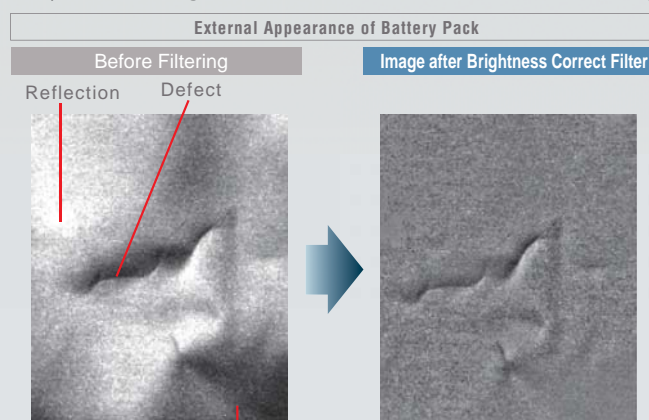
Before Filtering    **After Filtering**



You can set the filter coefficients as required.

## Brightness Correct Filter

These filter cut out uneven lighting and changes in brightness caused by workpiece surface irregularities to make characteristic features stand out clearly.



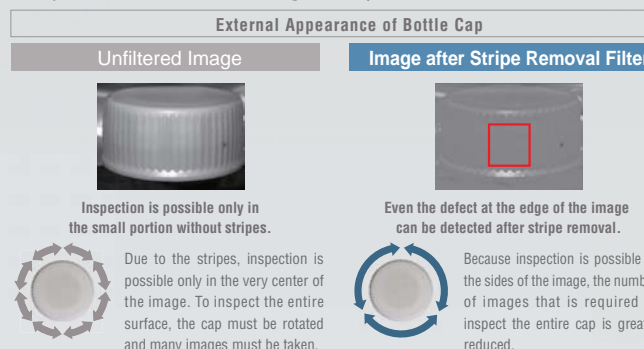
Shadow

The wavy inconsistencies are judged as defects.

Uneven areas are removed  
so that only the defect  
appears in the inspection.

## Stripe Removal Filter II

The stripped pattern is filtered out so that only required aspects are shown clearly. Vertical, horizontal, and diagonal stripes can be removed.



Inspection is possible only in the small portion without stripes.

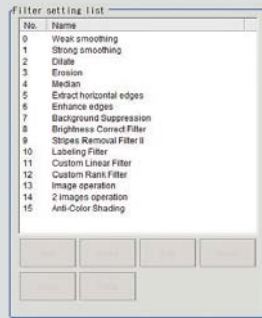
Due to the stripes, inspection is possible only in the very center of the image. To inspect the entire surface, the cap must be rotated and many images must be taken.

Even the defect at the edge of the image can be detected after stripe removal.

Because inspection is possible to the sides of the image, the number of images that is required to inspect the entire cap is greatly reduced.

## Advanced Filter

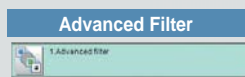
The image filter library has been condensed into one processing item. This allows you to easily set complex filtering as required for external inspections.



You set up to 16 of the 24 different filters.



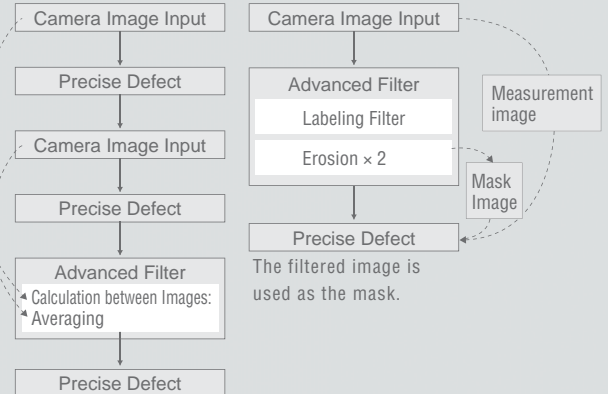
Units were added for each filter.



Many different filter functions can be set with just one processing unit.

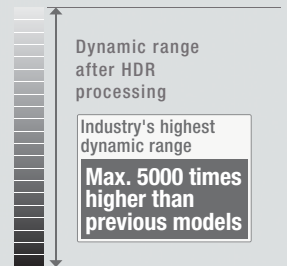
The average image is obtained from multiple images.

### Application Flow Example



## High Dynamic Range to Easily Combine Images

To simply combine images, you must set the imaging conditions and create the images that you want to obtain. With OMRON's high dynamic range function, all you need to do is to set the upper and lower brightness images on a graph of the image brightness distribution to make the adjustments.



## What is Real Color Sensing?



Patented

In order to secure stable measurements in different inspection environments, FH Series feature Omron's proprietary Real Color Sensing processing, in addition to the conventional color image processing.

### Color Segmentation Processing



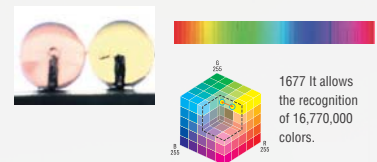
Color images taken by the camera are processed after being converted into black and white pixels. The color extracted is represented as white, and the other colors as black. Based on minimum information, high speed processing is possible. Since color data is limited only to brightness, however, it takes a long time to make optical adjustments for extracting color features.

### Color Image Processing



Color images are converted into 256 levels of black-and-white brightness and the contrasts of specific colors is enhanced. More precise, stable results can be produced compared to color segmentation. However, this method has difficulty in capturing subtle variations in color because all colors are converted into black-and-white brightness levels. Therefore, it is difficult to detect subtle changes in images with low contrast.

### Real Color Sensing



Different colors are represented as different positions in the 3D RGB space. Subtle variations in color can be recognized by representing them as distances between different color pixels comprising this space. Thus, scratches and dirt can be detected accurately even in images with low contrast.



Edges are detected reliably even when the contrast between the background and subject is low.





# Utility Library

Macro/  
Macro Calculation



**Macro**

Macros let you easily achieve flow control that normally requires complex programming from the user interface. Improvements to the setup from the user interface provides ease of selection and modification of the programming process.

2.Macro

Macro Outline

Macro Editor

Reference Variable List

| Reference | Type | Parameter 0 | Parameter 1 | Value   |
|-----------|------|-------------|-------------|---------|
| SEARCH    | Unit | 1           | Search      | 0       |
| FUNCTION  | Unit | 1           | Search      | 0.00000 |
| LABEL     | Unit | 1           | Labeling    | 0       |

Function Guidance

IO modules-control station

Free Input

Array Index

Free Input

Array Index

1 Select the process to use

2 Set the parameters

3 Insert the process

Registered images

| Index | Image Name | Image Type | Image Path |
|-------|------------|------------|------------|
| 1     | Image 1    | Image      | ...        |
| 2     | Image 2    | Image      | ...        |
| 3     | Image 3    | Image      | ...        |
| 4     | Image 4    | Image      | ...        |
| 5     | Image 5    | Image      | ...        |
| 6     | Image 6    | Image      | ...        |
| 7     | Image 7    | Image      | ...        |
| 8     | Image 8    | Image      | ...        |
| 9     | Image 9    | Image      | ...        |
| 10    | Image 10   | Image      | ...        |
| 11    | Image 11   | Image      | ...        |
| 12    | Image 12   | Image      | ...        |
| 13    | Image 13   | Image      | ...        |
| 14    | Image 14   | Image      | ...        |
| 15    | Image 15   | Image      | ...        |
| 16    | Image 16   | Image      | ...        |
| 17    | Image 17   | Image      | ...        |
| 18    | Image 18   | Image      | ...        |
| 19    | Image 19   | Image      | ...        |
| 20    | Image 20   | Image      | ...        |

Variables can be used in macros to access processing item data and system data.

For example, it would previously have been long and complicated to change the set parameters of a processing item for each product model. With a Macro Calculation processing item, the flow is shorter and setting changes are easy to achieve.

Previous Vision Sensors

FH/FZ5-series Macros

Easy to change

1.Macro Calculation

2.Labeling

Just enter the values of the variables to update the parameters.

' Branching for each product model  
Select INDEX@  
Case 0  
ExtCond0@ = 1 ' Area  
ExtParam0@ = 0  
ExtParam1@ = 10000  
Case 1  
ExtCond0@ = 4 ' Elliptic major axis  
ExtParam0@ = 0  
ExtParam1@ = 100  
Case 2  
ExtCond0@ = 7 ' Rectangle width  
ExtParam0@ = 0  
ExtParam1@ = 200  
End Select

## Macro Calculation

You can create expressions that require multiple lines in one processing item. In addition to making calculations, you can also make judgements based on the calculation results of the processing items.

Macro Calculation

Macro Editor

Example 1: Multiline Expression

DET# = A0@ \* B1@ - A1@ \* B0@ ' Calculates intersection  
CX# = (B0@ \* C1@ - B1@ \* C0@) / DET# ' X coordinate of intersection  
CY# = (A1@ \* C0@ - A0@ \* C1@) / DET# ' Y coordinate of intersection

Example 2: Calculations to Drive Branching or Loops

Max# = 0  
For i# = 0 To 10  
If (Max # < value#(I#)) Then  
Max# = value#(I#)  
EndIf  
Next  
RESULTDATA#(0) = Max#

Judgement condition for calculation results

Macro Editor

## User Data



### Ideal for Managing Inspection Standards and for Statistical Analysis of Inspection Results

Shared data used within scene groups as constants and variables in the measurement flow can be set as user data. With the shared data, you can use the measurement flow in many new ways, including standard values, conditional branching flags, and counters.

#### Application Example 1 Unified Management of Judgment Values

When setting up complex scene data, such as the data required for inspection of many different models, you can unify management of important judgment values for inspections to easily manage and then adjust them later. Also, if you isolate in advance the settings that are critical to inspection performance (and normally known only to the designer) as user data, the locations that require adjustment can be clarified so that the user can more easily make adjustments.

#### Application Example 2 Statistical Information on Productivity Indices

User data can be used as variables that can be read and written in the inspection flow. It can also be used for counters for the number of inspected workpieces or the number of NG workpieces. Math functions can be used to calculate failure rates and display them onscreen so that productivity can be checked at any time.

#### Adjustment of All User Data in a List

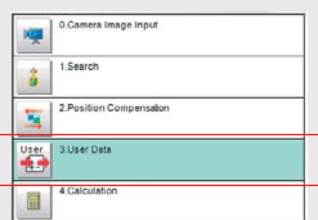
| No. | Data    | Comment                   |
|-----|---------|---------------------------|
| 0   | 60.0000 | Mark 1-A Search Judgement |
| 1   | 60.0000 | Mark 1-B Search Judgement |
| 2   | 80.0000 | Mark 2-A Search Judgement |
| 3   | 80.0000 | Mark 2-B Search Judgement |
| 4   | 0.0000  | NG Counter                |
| 5   | 0.0000  |                           |
| 6   | 0.0000  |                           |
| 7   | 0.0000  |                           |
| 8   | 0.0000  |                           |
| 9   | 0.0000  |                           |

#### Indices Displayed Onscreen with the Result Display Function

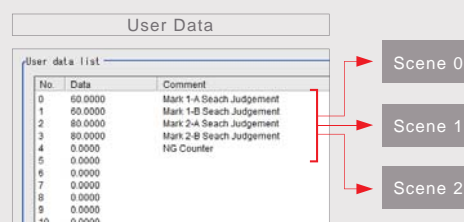


### Application Method

All you have to do is set a User Data processing item in the inspection flow.



The data that is set as user data is used as shared constants and variables in different scenes.



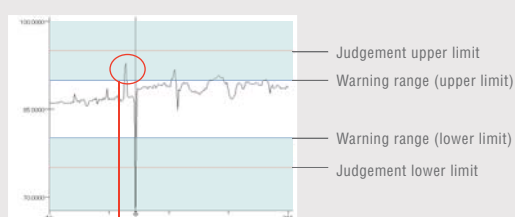
## Trend Monitor



### Results Analysis with Trend Monitors

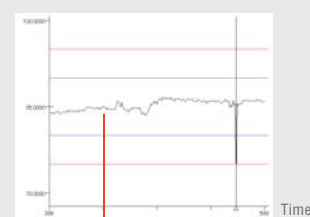
You can graph trends in measurement values to output warnings before failures occur. This helps provide feedback to earlier processes to prevent NGs in advance and to analyze the causes of NGs.

#### Prevent High Defect Rates in Advance



You can set the warning range to output warnings before failures become frequent to provide feedback to earlier processes.

#### Cause Analysis when Defects Occur

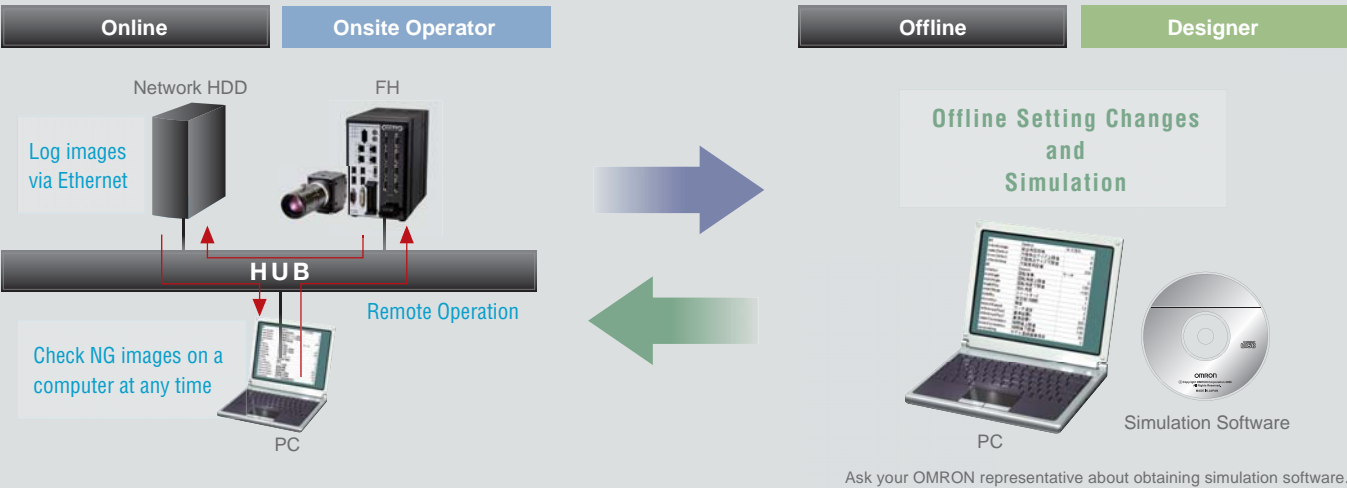


The 100,000 most recent measurement values are stored.

# Operation and Analysis

## Optimum Operation both Online and Offline

Connections to a network hard disk drive or network computer enables a wide range of operation possibilities. You can log measurement images longterm, or you can perform verifications and adjustments on a computer without stopping the FH-series Vision System.



## New Operation Schemes through Network Applications

- 1

Daily Monitoring
- You can store NG image in a network HDD to check the NG images every day on a computer without reducing measurement performance. Or you can start simulation software on your computer to remeasure and analyze NG images.
- 2

Periodic Adjustments and Inspection Adjustments
- The non-stop adjustment function lets you change Controller settings without stopping the production line. With remote operation, you can perform operations without going onsite.
- 3

Handling Unstable Inspections or Measurement Failure
- The user sends the programmer the image data, setting data, and parameter settings. The programmer can use the simulation software on the computer to check the process and change the settings with the simulation software. The altered scene data can be returned to the user and loaded to the system to complete the adjustments. This enables modifications without requiring the programmer to be on site.
- 4

Adding Inspections or Making Changes for New Models
- Based on the images to be inspected, settings are made on the simulation software on a PC running simulation software. The scene data is sent to the user to easily add the new settings.

## Ideal for History Management

CSV files allow you to easily understand the parameter settings. Also, you can easily change any of the settings.

1

Comparisons

If you save the basic settings, you can easily extract any differences in settings caused by changes made incorrectly.

Standard settings

Current parameter settings

|                  |            |      |      |
|------------------|------------|------|------|
| #1               | Defect     | キズ汚れ | 0    |
| overallJudge     | 総合判定処理     |      | 0    |
| upperDefect      | 欠陥検出サイズ上限値 |      | 6    |
| lowerDefect      | 欠陥検出サイズ下限値 |      | 6    |
| criticalValue    | 欠陥度判定値     |      | 100  |
| #5               | Search     | サーチ  | 200  |
| rotation         | 回転有無       |      | 0    |
| startAngle       | 回転角度上限値    |      | 180  |
| endAngle         | 回転角度下限値    |      | -180 |
| angleSkip        | 読み角度       |      | 5    |
| smartMode        | スマートモード    |      | 1    |
| intensity        | 安定度(相関)    |      | 1.2  |
| accuracy         | 精度         |      | 2    |
| searchSpeed      | サーチ速度      |      | 3    |
| referencePosX    | 基準座標X      |      | 320  |
| referencePosY    | 基準座標Y      |      | 240  |
| upperCorrelation | 相関値上限値     |      | 100  |
| lowerCorrelation | 相関値下限値     |      | 50   |
| baseSetting      | モデル登録画像保存  |      | 0    |

2

Remote Adjustment

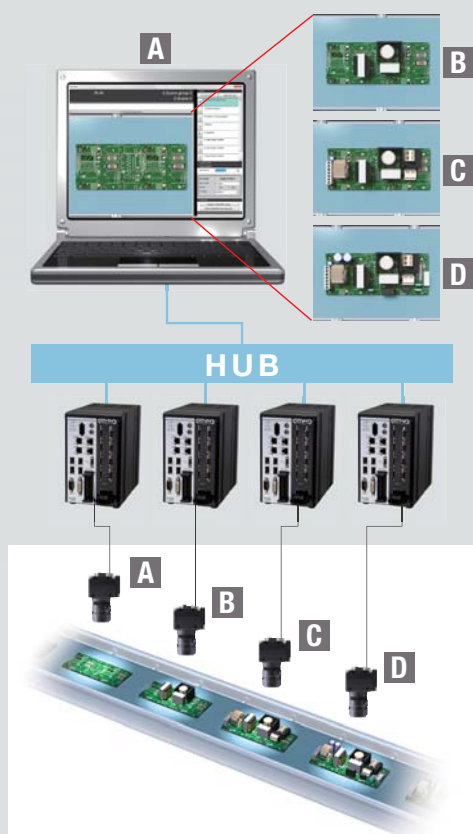
You can attach CSV files to email and upload settings to the FH-series Vision System to easily make adjustments from remote locations when problems occur.



## Remote Operation Centralizes Monitoring and Adjustment of multiple controllers

You can check the status and adjust the settings of multiple units on one computer.

This enables efficient adjustment of Camera images when commissioning a system and application of test adjustment results.



### Application Example 1

## Operating Several FH from One Location

- 1 When commissioning an installation from one location you can adjust the camera for all the controllers located along the line. There's no need to go to and from each Controllers, and you can compare Camera images under various conditions to adjust them.
- 2 If setting changes are necessary to add a new model, you can do all the required work at the same time without making trips to all of the Controllers.
- 3 You can easily balance the thresholds between Controllers when increasing inspection stability through testing at the production line.

### Application Example 2

## Display images from multiple controllers

- 1 Space savings with a single monitor installation.
- 2 Single location programming for multiple controllers facilitates adjustments and reduces programmer movement.

Note: Ask your OMRON representative about obtaining simulation software for a computer.

## Saving and Using Measurement Images

### Save Images Directly in JPEG or BMP Format

You can easily view images on a computer or attach them to reports. With BMP files, you can measure them again on the Vision controller.

### Restricting the Areas of Saved Images

By restricting the areas that are saved, file sizes are smaller so you can continue to log even more files.



### Save Both Filtered and Unfiltered Images

You can save both the filtered images that were actually measured and the raw images taken directly from the Camera. You can therefore tell if an NG was caused by the input image or by the filter settings.

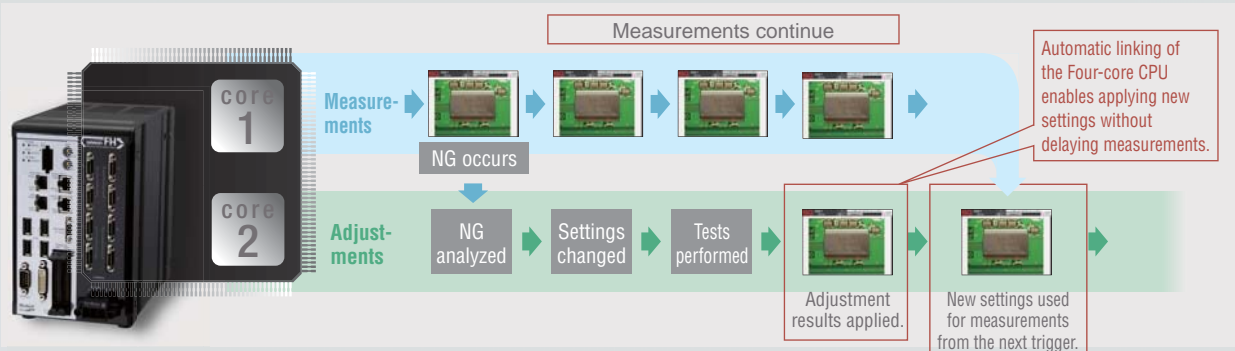


# Utilities That Don't Stop Your Machines

## Making Confirmations and Adjustments without Stopping Production

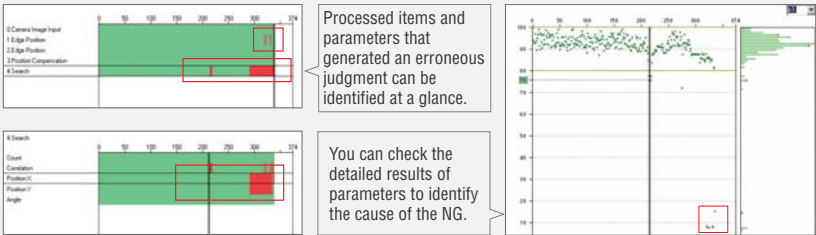
Non-stop adjustment

Parallel processing on Four-core CPU not only speeds up measurements, but it enables parallel processing of measurements and adjustments. Automatic distributed processing means that measurements are not delayed when adjustments are applied.



## Doubly effective when combined with the Non-stop adjustment mode NG analyzer

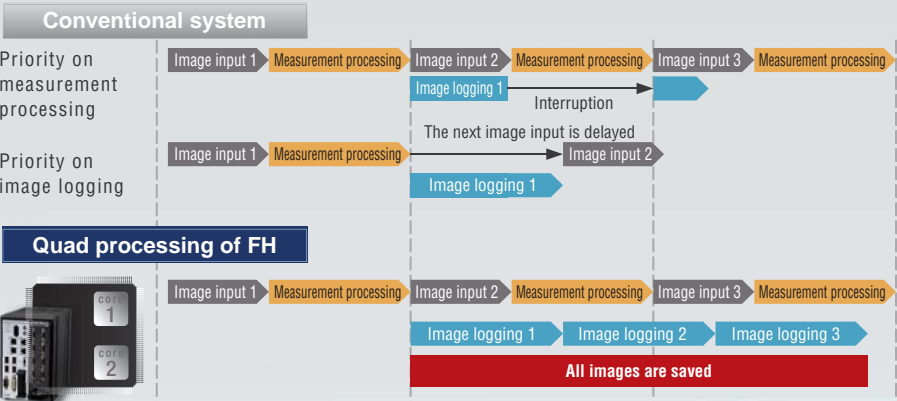
You can display in a structured manner a graph showing the results measured at once on logging images. This lets you identify the cause of a given NG much more quickly. You can also measure all images again after changing a given setting, to check the reliability of the new setting. Adjustment and troubleshooting has never been so quick, simple and reliable.



## Save All Images Even during Measurements

High speed logging

The Four-core CPU can also perform parallel processing of measurements and image logging, with high-speed connection to a high-capacity hard disk (2terabytes). Trend analysis of saved images, quickly isolates NG's and facilitates countermeasures.



\*1 All images can be saved under the following conditions:

- 300,000-pixel camera x 1 unit . Measurement time: 33 ms
- Images can be saved continuously for approx. one week when a 2-terabyte HDD is used (based on 8 hours of operation a day).

### Issues

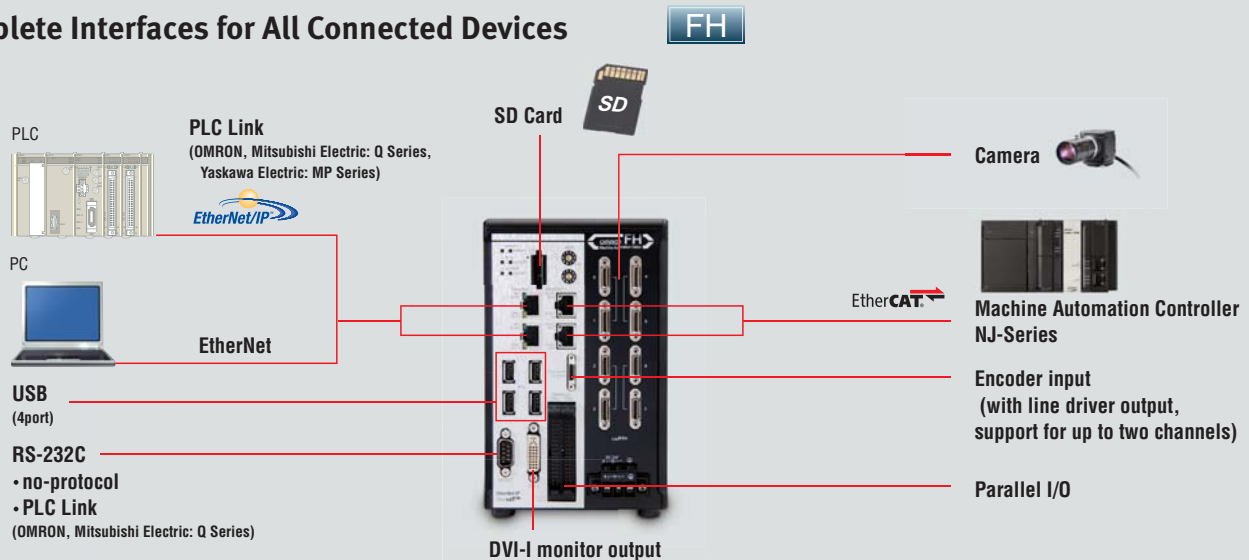
Since logging was not possible during measurement, the user had to choose either measurement or logging. Accordingly, not all images could be saved or image input triggers had to be delayed depending on the measurement trigger intervals.

### Resolution

Measurement and image logging are processed completely in parallel. As a result, you can save all images.

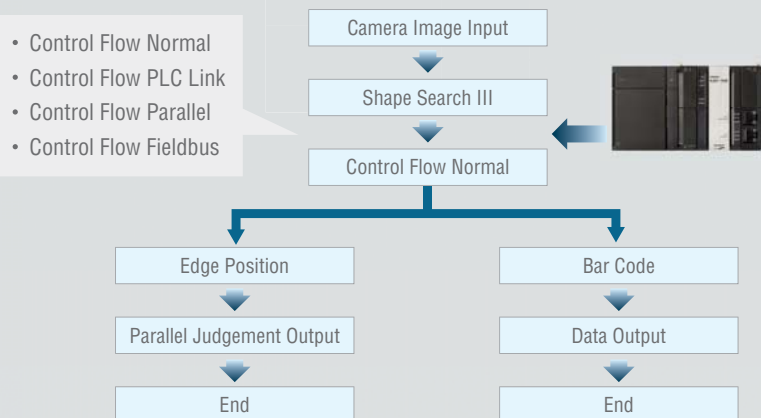
# Seamless Communications with Peripheral Devices

## Complete Interfaces for All Connected Devices



## Controlling Flow Branching Conditions from an External Device

You can control branching by using commands and signal inputs from external devices as branching conditions for the measurement flow.

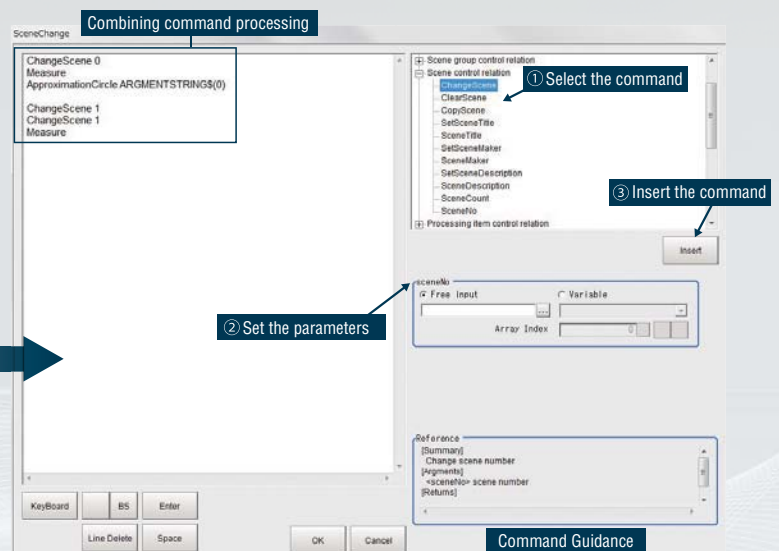


## Customized Communications Commands

You can shorten the communications time by using commands for complex controls or by shortening multiple commands. You can also define how the Vision System responds to the communications commands. For example, you can define one command to change both a scene and perform measurements.

| No.                                   | BUSV. On | Command name | Function name |
|---------------------------------------|----------|--------------|---------------|
| <input checked="" type="checkbox"/> 0 | True     | SceneChange  | FUNC_0000     |
| <input type="checkbox"/> 1            | True     | CMD0001      | FUNC_0001     |
| <input type="checkbox"/> 2            | True     | CMD0002      | FUNC_0002     |
| <input type="checkbox"/> 3            | True     | CMD0003      | FUNC_0003     |
| <input type="checkbox"/> 4            | True     | CMD0004      | FUNC_0004     |
| <input type="checkbox"/> 5            | True     | CMD0005      | FUNC_0005     |
| <input type="checkbox"/> 6            | True     | CMD0006      | FUNC_0006     |
| <input type="checkbox"/> 7            | True     | CMD0007      | FUNC_0007     |
| <input type="checkbox"/> 8            | True     | CMD0008      | FUNC_0008     |
| <input type="checkbox"/> 9            | True     | CMD0009      | FUNC_0009     |

You can define up to 256 commands



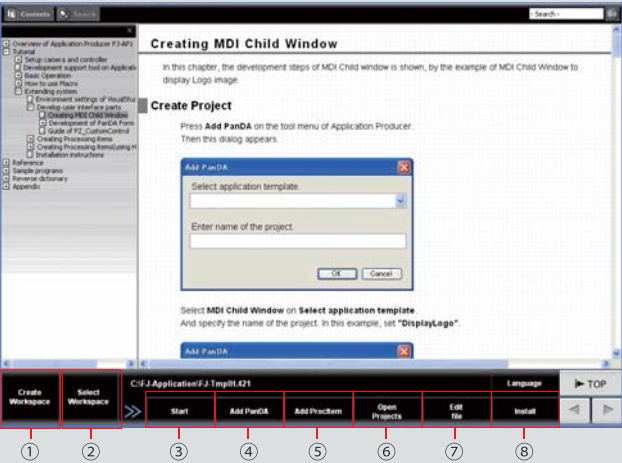


# Options for More Power Customization

## Application Producer provides a Development Environment to Build and Simulate Applications

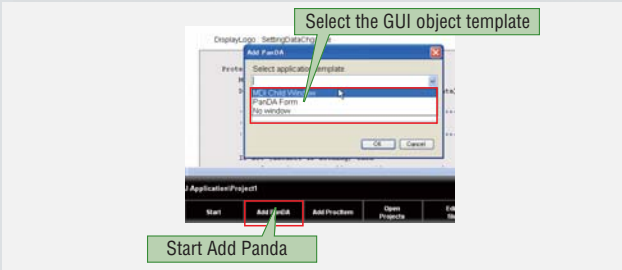
You can further customize the standard controller features of the FH-series Vision System. In Application Producer custom control units allow development of original interfaces with Microsoft® Visual Studio®. The software command reference helps create original processing items, and more.

Application Producer Main Window

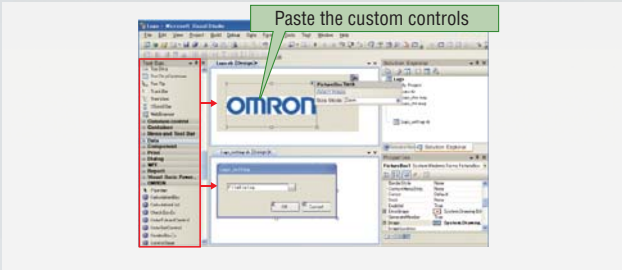


- ① Create workspaces.
- ② Select and change between workspaces.
- ③ Start the program in the selected workspace.
- ④ Create and add GUI objects.
- ⑤ Create and add processing items.
- ⑥ Open Microsoft® Visual Studio® projects.
- ⑦ Open setup files.
- ⑧ Create installation files.

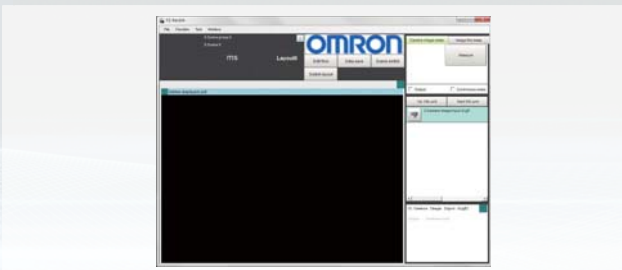
### Customization Example: GUI Customization



Start Add Panda and select the template that will serve as a base for customization. Selecting an interface template as a base first greatly reduces the work that is required compared with programming interfaces from scratch.



The Application Producer will automatically generate a project file from the selected template so that you can open it in Microsoft® Visual Studio.® You can develop interfaces just by dragging FH-series custom controls and Windows-based controls.



Instead of writing the program code from scratch to build an interface, you can easily build the interface simply by pasting custom controls. You can immediately check and debug the operation of the GUI objects that you add.

MEMO

# Vision System FH-Series

## Easier to Embed in Machine, Shorter Machine Cycle Times

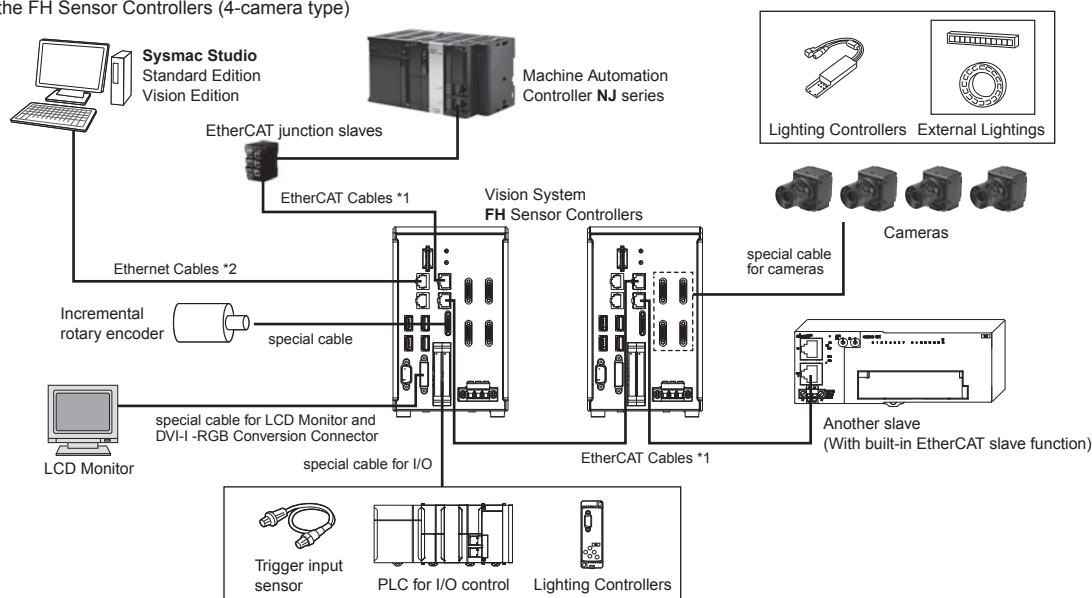
- Calculations are easy to set for the results from four parallel tasks.
- Synchronous control of devices connected via EtherCAT is possible.
- The new Shape Search III processing item enables fast, precise, and stable measurements.
- Microsoft® .NET is supported to share machine interface with PC.
- User interface customization is supported.



## System configuration

### EtherCAT connections for FH series

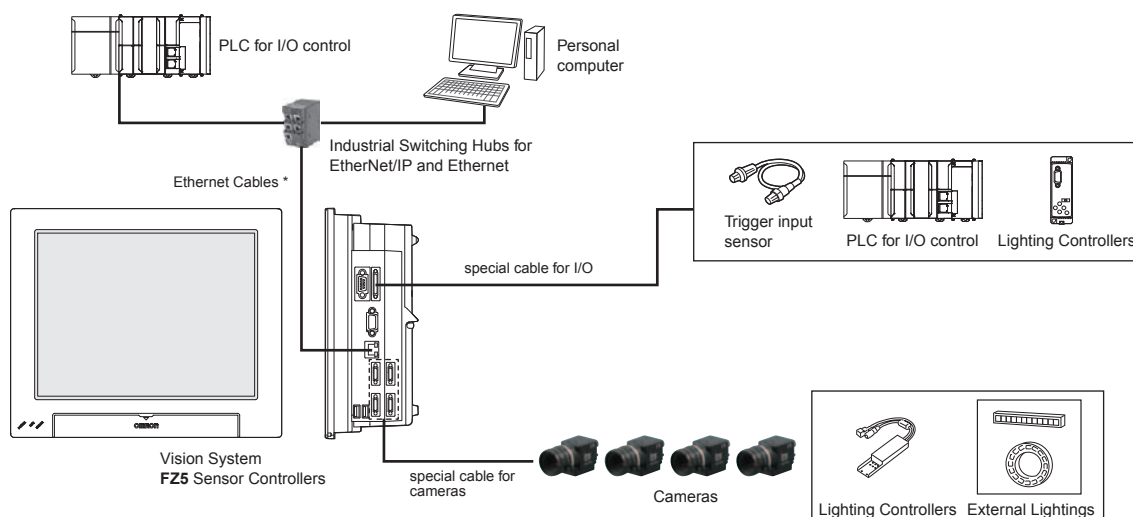
Example of the FH Sensor Controllers (4-camera type)



\*1. To use STP (shielded twisted-pair) cable of category 5 or higher with double shielding (braiding and aluminum foil tape) for EtherCAT and RJ45 connector.  
\*2. To use STP (shielded twisted-pair) cable of category 5 or higher for Ethernet and RJ45 connector.

### EtherNet/IP, No-protocol Ethernet and PLC Link Connections for FZ5 series

Example of the FZ5 Sensor Controllers (4-camera type)




\* To use Straight or cross STP (shielded twisted-pair) cable of category 5 or higher for Ethernet and RJ45 connector.





## Ordering Information








## FH Series Sensor Controllers

| Item  |                      | CPU                             | No. of cameras | Output  | Model      |
|---|----------------------|---------------------------------|----------------|---------|------------|
|  | Box-type controllers | High-speed Controllers (4 core) | 2              | NPN/PNP | FH-3050    |
|   |                      |                                 | 4              | NPN/PNP | FH-3050-10 |
|   |                      |                                 | 8              | NPN/PNP | FH-3050-20 |
|   |                      | Standard Controllers (2 core)   | 2              | NPN/PNP | FH-1050    |
|   |                      |                                 | 4              | NPN/PNP | FH-1050-10 |
|   |                      |                                 | 8              | NPN/PNP | FH-1050-20 |






## FZ5 Series Sensor Controllers

| Item  |                                 | CPU                    | No. of cameras | Output | Model       |
|---|---------------------------------|------------------------|----------------|--------|-------------|
|  | Controllers integrated with LCD | High-speed Controllers | 2              | NPN    | FZ5-1100    |
|   |                                 |                        |                | PNP    | FZ5-1105    |
|   |                                 |                        | 4              | NPN    | FZ5-1100-10 |
|   |                                 |                        |                | PNP    | FZ5-1105-10 |
|   |                                 | Standard Controllers   | 2              | NPN    | FZ5-600     |
|   |                                 |                        |                | PNP    | FZ5-605     |
|   |                                 |                        | 4              | NPN    | FZ5-600-10  |
|   |                                 |                        |                | PNP    | FZ5-605-10  |
|  | Box-type controllers            | Lite Controllers       | 2              | NPN    | FZ5-L350    |
|   |                                 |                        |                | PNP    | FZ5-L355    |
|   |                                 |                        | 4              | NPN    | FZ5-L350-10 |
|   |                                 |                        |                | PNP    | FZ5-L355-10 |













## Cameras

| Item  | Descriptions  | Color / Monochrome  | Image read time | Model     |
|---|---|---|-----------------|-----------|
|  | High-speed CMOS Cameras (Lens required)<br>For FH Series only                       | 4 million pixels  | Color           | FH-SC04   |
|   |   |   |                 | FH-SM04   |
|   |   | 2 million pixels  | Color           | FH-SC02   |
|   |   |   |                 | FH-SM02   |
|   |   | 300,000 pixels  | Color           | FH-SC     |
|   |   |   |                 | FH-SM     |
|  | Digital CCD Cameras (Lens required)   | 5 million pixels<br>(When connecting FZ5-6□ or FZ5-L35□, up to two cameras can be connected.) | Color           | FZ-SC5M2  |
|   |   |   |                 | FZ-S5M2   |
|   |   | 2 million pixels  | Color           | FZ-SC2M   |
|   |   |   |                 | FZ-S2M    |
|   |   | 300,000 pixels  | Color           | FZ-SC     |
|   |   |   |                 | FZ-S      |
|  | High-speed CCD Cameras (Lens required)  | 300,000 pixels  | Color           | FZ-SHC    |
|   |   |   | Monochrome      | FZ-SH     |
|  | Small Digital CCD Cameras (Lenses for small camera required)                        | 300,000-pixel flat type   | Color           | FZ-SFC    |
|   |   |   | Monochrome      | FZ-SF     |
|   |   | 300,000-pixel pen type  | Color           | FZ-SPC    |
|   |   |   | Monochrome      | FZ-SP     |
|  | Intelligent Compact CMOS Cameras (Camera + Manual Focus Lens + High power Lighting) | Narrow view   | Color           | FZ-SQ010F |
|   |   | Standard view   | Color           | FZ-SQ050F |
|   |   | Wide View (long-distance)   | Color           | FZ-SQ100F |
|   |   | Wide View (short-distance)  | Color           | FZ-SQ100N |
|  | Intelligent CCD Cameras (Camera + Zoom, Autofocus Lens + Intelligent Lighting)      | Wide View   | Color           | FZ-SLC100 |
|   |   | Narrow view   | Color           | FZ-SLC15  |
|  | Autofocus CCD Cameras (Camera + Zoom, Autofocus Lens)                               | Wide View   | Color           | FZ-SZC100 |
|   |   | Narrow view   | Color           | FZ-SZC15  |

## Cameras Peripheral Devices

| Item  | Descriptions   |                              | Model               |
|---|--|------------------------------|---------------------|
| —   | External Lighting  | —                            | <b>FL Series</b>    |
|  | Lighting Controller<br>(Required to control external lighting from a Controller) | For FL-Series                | <b>FL-TCC1</b>      |
|  | Intelligent Camera Diffusion Plate   | Wide field of vision         | <b>FZ-SLC100-DL</b> |
|   |  | Narrow field of vision       | <b>FZ-SLC15-DL</b>  |
|  | For Intelligent Compact Camera   | Mounting Bracket             | <b>FQ-XL</b>        |
|  |  | Mounting Brackets            | <b>FQ-XL2</b>       |
|  |  | Polarizing Filter Attachment | <b>FQ-XF1</b>       |
| —   | Mounting Bracket for FZ-S□   |                              | <b>FZ-S-XLC</b>     |
|   | Mounting Bracket for FZ-S□2M   |                              | <b>FZ-S2M-XLC</b>   |
|   | Mounting Bracket for FZ-S5M□2  |                              | <b>FZ-S5M-XLC</b>   |
|   | Mounting Bracket for FZ-SH□  |                              | <b>FZ-SH-XLC</b>    |

## Cables

| Item  | Descriptions  |  | Model                      |
|---|---|--|----------------------------|
|  | Camera Cable<br>Cable length: 2 m, 5 m, or 10 m *2  |  | <b>FZ-VS</b>               |
|  | Bend resistant Camera Cable<br>Cable length: 2 m, 5 m, or 10 m *2   |  | <b>FZ-VSB</b>              |
|  | Right-angle Camera Cable *1<br>Cable length: 2 m, 5 m, or 10 m *2   |  | <b>FZ-VSL</b>              |
|  | Long-distance Camera Cable<br>Cable length: 15 m *2   |  | <b>FZ-VS2</b>              |
|  | Long-distance Right-angle Camera Cable<br>Cable length: 15 m *2   |  | <b>FZ-VSL2</b>             |
|  | Cable Extension Unit<br>Up to two Extension Units and three Cables can be connected. (Maximum cable length: 45 m *2)  |  | <b>FZ-VSJ</b>              |
|  | Monitor Cable<br>Cable length: 2 m or 5 m (When you connect a LCD Monitor FZ-M08 to FH sensor controller, please use it in combination with a DVI-I -RGB Conversion Connector FH-VMRGB.)  |  | <b>FZ-VM</b>               |
|  | DVI-I -RGB Conversion Connector<br>For <b>FH Series only</b>  |  | <b>FH-VMRGB</b>            |
|  | Parallel I/O Cable<br>Cable length: 2 m or 5 m, For <b>FZ Series only</b>   |  | <b>FZ-VP</b>               |
|  | Parallel I/O Cable for Connector-terminal Conversion Unit<br>Cable length: 2 m or 5 m, For <b>FZ Series only</b><br>Connector-Terminal Block Conversion Units can be connected<br>(Terminal Blocks Recommended Products: OMRON XW2R-J50G-T, XW2R-E50G-T, XW2R-P50G-T) |  | <b>FZ-VPX</b>              |
|  | Parallel I/O Cable *3<br>Cable length: 2 m or 5 m, For <b>FH Series only</b>  |  | <b>XW2Z-S013-2/-S013-5</b> |
|  | Encoder Cable for line-driver<br>Cable length: 1.5 m, For <b>FH Series only</b>   |  | <b>FH-VR</b>               |

\*1 This Cable has an L-shaped connector on the Camera end.






\*2 The maximum cable length depends on the Camera being connected, and the model and length of the Cable being used. For further information, please refer to the "Cameras / Cables" table.

When a high-speed CMOS camera FH-S\_02/-S\_04 is used in the high speed mode of transmission speed, two camera cables are required.

\*3 2 Cables are required for all I/O signals.

## Recommended EtherCAT and EtherNet/IP Communications Cables

Use Straight STP (shielded twisted-pair) cable of category 5 or higher with double shielding (braiding and aluminum foil tape) for EtherCAT.  
Use Straight or cross STP (shielded twisted-pair) cable of category 5 or higher for EtherNet/IP.

| Item  | Descriptions                          |  |                              |                                       | Model                             |
|---|---------------------------------------|--|------------------------------|---------------------------------------|-----------------------------------|
|  | For EtherCAT<br>*1                    | Standard type Cable with Connectors on Both Ends (RJ45/RJ45)<br>Wire Gauge and Number of Pairs: AWG27, 4-pair Cable, Cable Sheath material: LSZH *2,<br>Cable color: Blue, Yellow, or Green,<br>Cables length: 0.2m, 0.3m, 0.5m, 1m, 1.5m, 2m, 3m, 5m, 7.5m, 10m, 15m, 20m |                              |                                       | XS6W-6LSZH8SS□CM-Y *3             |
|  |                                       | Rugged type Cable with Connectors on Both Ends (RJ45/RJ45)<br>Wire Gauge and Number of Pairs: AWG22, 2-pair Cable<br>Cables length: 0.3m, 0.5m, 1m, 2m, 3m, 5m, 10m, 15m   |                              |                                       | XS5W-T421-□MD-K *3                |
|  |                                       | Rugged type Cable with Connectors on Both Ends (M12/RJ45)<br>Wire Gauge and Number of Pairs: AWG22, 2-pair Cable<br>Cables length: 0.3m, 0.5m, 1m, 2m, 3m, 5m, 10m, 15m  |                              |                                       | XS5W-T421-□MC-K *3                |
|  |                                       | Rugged type Cable with Connectors on Both Ends (M12 L/RJ45)<br>Wire Gauge and Number of Pairs: AWG22, 2-pair Cable<br>Cables length: 0.3m, 0.5m, 1m, 2m, 3m, 5m, 10m, 15m  |                              |                                       | XS5W-T422-□MC-K *3                |
| --  | For EtherCAT *1<br>and<br>EtherNet/IP | Wire Gauge and Number of<br>Pairs: AWG24, 4-pair Cable   | Cables                       | Hitachi Cable, Ltd.                   | NETSTAR-C5E<br>SAB 0.5 × 4P<br>*4 |
| --  |                                       |  |                              | Kuramo Electric Co.                   | KETH-SB *4                        |
| --  |                                       |  |                              | SWCC Showa Cable Systems<br>Co.       | FAE-5004 *4                       |
| --  |                                       | Wire Gauge and Number of<br>Pairs: AWG22, 2-pair Cable   | RJ45 Connec-<br>tors         | Panduit Corporation                   | MPS588-C *4                       |
| --  |                                       |  | Cables                       | Kuramo Electric Co.                   | KETH-PSB-OMR *5                   |
| --  |                                       |  |                              | Nihon Electric Wire&Cable<br>Co.,Ltd. | PNET/B *5                         |
|  |                                       |  | RJ45 Assem-<br>bly Connector | OMRON                                 | XS6G-T421-1 *5                    |
| --  | For EtherNet/IP                       | Wire Gauge and Number of<br>Pairs: 0.5 mm, 4-pair Cable  | Cables                       | Fujikura Ltd.                         | F-LINK-E 0.5mm × 4P<br>*6         |
| --  |                                       |  | RJ45 Connec-<br>tors         | Panduit Corporation                   | MPS588 *6                         |

**Note:** Please be careful while cable processing, for EtherCAT, connectors on both ends should be shield connected and for EtherNet/IP, connectors on only one end should be shield connected.

\*1 The FH series supports the EtherCAT communication. It cannot be used in FZ series.

\*2 The lineup features Low Smoke Zero Halogen cables for in-cabinet use and PUR cables for out-of-cabinet use.











\*3 For details, refer to Cat.No.G019.

\*4 We recommend you to use above cable for EtherCAT and EtherNet/IP, and RJ45 Connector together.

\*5 We recommend you to use above cable for EtherCAT and EtherNet/IP, and RJ45 Assembly Connector together.

\*6 We recommend you to use above cable For EtherNet/IP and RJ45 Connectors together.

## Peripheral Devices

| Item  | Descriptions   |        |  |                                | Model     |
|---|--|--------|--|--------------------------------|-----------|
|  | LCD Monitor<br>For Box-type Controllers  |        |  |                                | FZ-M08    |
|  | USB Memory   | 2 GB   |  |                                | FZ-MEM2G  |
|   |  | 8 GB   |  |                                | FZ-MEM8G  |
|  | SD Card<br>For FH Controller only  | 2 GB   |  |                                | HMC-SD291 |
|   |  | 4 GB   |  |                                | HMC-SD491 |
|  | VESA Attachment<br>For installing the LCD integrated-type controller   |        |  |                                | FZ-VESA   |
|  | Desktop Controller Stand<br>For installing the LCD integrated-type controller  |        |  |                                | FZ-DS     |
|  | Display/USB Switcher   |        |  |                                | FZ-DU     |
| --  | Mouse Recommended Products<br>Driverless wired mouse<br>(A mouse that requires the mouse driver to be installed is not supported.) |        |  |                                | —         |
|  | EtherCAT junction slaves<br>For FH series  | 3 port | Power supply voltage:<br>20.4 to 28.8 VDC<br>(24 VDC -15 to 20%) | Current consumption:<br>0.08 A | GX-JC03   |
|  |  | 6 port |  | Current consumption:<br>0.17 A | GX-JC06   |
|  | Industrial Switching Hubs for EtherNet/IP and Ethernet   | 3 port | Failure detection: None  | Current consumption:<br>0.22 A | W4S1-03B  |
|  |  | 5 port | Failure detection: None  |                                | W4S1-05B  |
|   |  | 5 port | Failure detection: Supported                                     |                                | W4S1-05C  |

## Automation Software Sysmac Studio

Please purchase a DVD and licenses the first time you purchase the Sysmac Studio. DVDs and licenses are available individually. The license does not include the DVD.

| Product  | Specifications  | Number of Model Standards licenses | Media  | Model                |
|--|---|------------------------------------|--------|----------------------|
|  |   |                                    |        |                      |
| Sysmac Studio<br>Standard Edition<br>Ver.1.□□  | The Sysmac Studio provides an integrated development environment to set up, program, debug, and maintain NJ-series Controllers and other Machine Automation Controllers, as well as EtherCAT slaves.<br>Sysmac Studio runs on the following OS.<br>Windows XP (Service Pack 3 or higher, 32-bit version) / Vista (32-bit version) / 7 (32-bit/64-bit version) | -- (Media only)                    | DVD *1 | <b>SYSMAC-SE200D</b> |
|  |   | 1 license                          | —      | <b>SYSMAC-SE201L</b> |
|  |   | 3 license                          | —      | <b>SYSMAC-SE203L</b> |
|  |   | 10 license                         | —      | <b>SYSMAC-SE210L</b> |
|  |   | 30 license                         | —      | <b>SYSMAC-SE230L</b> |
|  |   | 50 license                         | —      | <b>SYSMAC-SE250L</b> |
| Sysmac Studio<br>Vision Edition<br>Ver.1.□□ *2 | Sysmac Studio Vision Edition is a limited license that provides selected functions required for FH-series/<br>FQ-M-series Vision Sensor settings.   | 1 license                          | —      | <b>SYSMAC-VE001L</b> |

**Note:** 1. Site licenses are available for users who will run Sysmac Studio on multiple computers. Ask your OMRON sales representative for details.  
2. Sysmac Studio version 1.07 or higher supports the FH Series. Sysmac Studio does not support the FZ5 Series.

\*1 The same media is used for both the Standard Edition and the Vision Edition.

\*2 With the Vision Edition, you can use only the setup functions for FH-series/FQ-M-series Vision Sensors.

## Development Environment










Please purchase a DVD and licenses the first time you purchase the Sysmac Studio. DVDs and licenses are available individually. The license does not include the DVD.

| Product              | Specifications   | Number of Model Standards licenses | Media | Model          |
|----------------------|--|------------------------------------|-------|----------------|
|                      |  |                                    |       |                |
| Application Producer | Software components that provide a development environment to further customize the standard controller features of the FH Series.<br>System requirements:<br>• CPU: Intel Pentium Processor (SSE2 or higher)<br>• OS: Windows 7 Professional (32bit) or Enterprise (32bit) or Ultimate (32bit)<br>• .NET Framework: .NET Framework 3.5 or higher<br>• Memory: At least 2 GB RAM<br>Available disk space: At least 2 GB<br>• Browser: Microsoft® Internet Explorer 6.0 or later<br>• Display: XGA (1024 × 768), True Color (32-bit) or higher<br>• Optical drive: CD/DVD drive<br>The following software is required to customize the software:<br>Microsoft® Visual Studio® 2010 Professional or<br>Microsoft® Visual Studio® 2008 Professional | -- (Media only)                    | CD    | <b>FH-AP1</b>  |
|                      |  | 1 license                          | —     | <b>FH-AP1L</b> |











## Lenses

### C-mount Lens for 1/3-inch image sensor (Recommend: FZ-S□/FZ-SH□/FH-S□)

| Model                      | 3Z4S-LE SV-0614V  | 3Z4S-LE SV-0813V  | 3Z4S-LE SV-1214V  | 3Z4S-LE SV-1614V  | 3Z4S-LE SV-2514V  | 3Z4S-LE SV-3518V  | 3Z4S-LE SV-5018V   | 3Z4S-LE SV-7527V  | 3Z4S-LE SV-10035V   |
|----------------------------|---|---|---|---|---|---|--|---|---|
| Appearance/Dimensions (mm) |  |  |  |  |  |  |  |  |  |
| Focal length               | 6 mm  | 8 mm  | 12 mm   | 16 mm   | 25 mm   | 35 mm   | 50 mm  | 75 mm   | 100 mm  |
| Brightness                 | F1.4  | F1.3  | F1.4  | F1.4  | F1.4  | F1.8  | F1.8   | F2.7  | F3.5  |
| Filter size                | M27.0 P0.5  | M25.5 P0.5  | M27.0 P0.5  | M27.0 P0.5  | M27.0 P0.5  | M27.0 P0.5  | M30.5 P0.5   | M30.5 P0.5  | M30.5 P0.5  |
| Maximum sensor size        | 1/3 inch  | 1/3 inch  | 1/3 inch  | 1/3 inch  | 1/3 inch  | 1/3 inch  | 1/3 inch   | 1/3 inch  | 1/3 inch  |
| Mount                      | C mount   |   |   |   |   |   |  |   |   |

### C-mount Lens for 2/3-inch image sensor (Recommend: FZ-S□2M/FZ-S□5M2/FH-S□02) (3Z4S-LE SV-7525H and 3Z4S-LE SV-10028H can also be used for FH-S□04)

| Model                      | 3Z4S-LE SV-0614H  | 3Z4S-LE SV-0814H  | 3Z4S-LE SV-1214H  | 3Z4S-LE SV-1614H  | 3Z4S-LE SV-2514H  | 3Z4S-LE SV-3514H  | 3Z4S-LE SV-5014H   | 3Z4S-LE SV-7525H  | 3Z4S-LE SV-10028H   |
|----------------------------|---|---|---|---|---|---|--|---|---|
| Appearance/Dimensions (mm) |  |  |  |  |  |  |  |  |  |
| Focal length               | 6 mm  | 8 mm  | 12 mm   | 16 mm   | 25 mm   | 35 mm   | 50 mm  | 75 mm   | 100 mm  |
| Brightness                 | F1.4  | F1.4  | F1.4  | F1.4  | F1.4  | F1.4  | F1.4   | F2.5  | F2.8  |
| Filter size                | M40.5 P0.5  | M35.5 P0.5  | M27.0 P0.5  | M27.0 P0.5  | M27.0 P0.5  | M35.5 P0.5  | M40.5 P0.5   | M34.0 P0.5  | M37.5 P0.5  |
| Maximum sensor size        | 2/3 inch  | 2/3 inch  | 2/3 inch  | 2/3 inch  | 2/3 inch  | 2/3 inch  | 2/3 inch   | 1 inch  | 1 inch  |
| Mount                      | C mount   |   |   |   |   |   |  |   |   |

### C-mount Lens for 1-inch image sensor (Recommend: FH-S□04)

(3Z4S-LE SV-7525H with focal length of 75 mm and 3Z4S-LE SV-10028H with focal length of 100 mm are also available.)

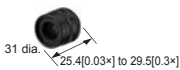

| Model                      | 3Z4S-LE VS-1214H1   | 3Z4S-LE VS-1614H1   | 3Z4S-LE VS-2514H1   | 3Z4S-LE VS-3514H1   | 3Z4S-LE VS-5018H1   |
|----------------------------|---|---|---|---|---|
| Appearance/Dimensions (mm) |  |  |  |  |  |
| Focal length               | 12 mm   | 16 mm   | 25 mm   | 35 mm   | 50 mm   |
| Brightness                 | F1.4  | F1.4  | F1.4  | F1.4  | F1.8  |
| Filter size                | M35.5 P0.5  | M30.5 P0.5  | M30.5 P0.5  | M30.5 P0.5  | M40.5 P0.5  |
| Maximum sensor size        | 1 inch  | 1 inch  | 1 inch  | 1 inch  | 1 inch  |
| Mount                      | C mount   |   |   |   |   |



### Lenses for small camera


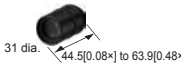
| Model                      | FZ-LES3   | FZ-LES6   | FZ-LES16  | FZ-LES30  |
|----------------------------|---|---|---|---|
| Appearance/Dimensions (mm) |  |  |  |  |
| Focal length               | 3 mm  | 6 mm  | 16 mm   | 30 mm   |
| Brightness                 | F2.0  | F2.0  | F3.4  | F3.4  |


# FH-Series

## Vibrations and shocks resistant C-mount Lens for 2/3-inch image sensor (Recommend: FZ-S□/FZ-S□2M/FZ-S□5M2/FZ-SH□/FH-S□/FH-S□02)

| Model                          | 3Z4S-LE<br>VS-MC15-□□□□□ *1   |       |       |                  |      |      |                  |      |     | 3Z4S-LE<br>VS-MC20-□□□□□ *1   |       |       |                  |      |      |                  |      |     |
|--------------------------------|---|-------|-------|------------------|------|------|------------------|------|-----|---|-------|-------|------------------|------|------|------------------|------|-----|
| Appearance/<br>Dimensions (mm) |  |       |       |                  |      |      |                  |      |     |  |       |       |                  |      |      |                  |      |     |
| Focal length                   | 15 mm   |       |       |                  |      |      |                  |      |     | 20 mm   |       |       |                  |      |      |                  |      |     |
| Filter size                    | M27.0<br>P0.5   |       |       |                  |      |      |                  |      |     | M27.0<br>P0.5   |       |       |                  |      |      |                  |      |     |
| Optical magnification          | 0.03 ×  |       |       | 0.2 ×            |      |      | 0.3 ×            |      |     | 0.04 ×  |       |       | 0.25 ×           |      |      | 0.4 ×            |      |     |
| Iris Range *2                  | Maximum aperture  | F5.6  | F8    | Maximum aperture | F5.6 | F8   | Maximum aperture | F5.6 | F8  | Maximum aperture  | F5.6  | F8    | Maximum aperture | F5.6 | F8   | Maximum aperture | F5.6 | F8  |
| Depth of field (mm)            | 183.1   | 512.7 | 732.4 | 4.8              | 13.4 | 19.2 | 2.3              | 6.5  | 9.2 | 110.8   | 291.2 | 416.0 | 3.4              | 9.0  | 12.8 | 1.5              | 3.9  | 5.6 |
| Maximum sensor size            | 2/3 inch  |       |       |                  |      |      |                  |      |     |   |       |       |                  |      |      |                  |      |     |
| Mount                          | C Mount   |       |       |                  |      |      |                  |      |     |   |       |       |                  |      |      |                  |      |     |

| Model                          | 3Z4S-LE<br>VS-MC25N-□□□□□ *1  |       |       |                  |      |      |                  |      |     | 3Z4S-LE<br>VS-MC30-□□□□□ *1   |       |       |                  |      |      |                  |      |     |
|--------------------------------|---|-------|-------|------------------|------|------|------------------|------|-----|---|-------|-------|------------------|------|------|------------------|------|-----|
| Appearance/<br>Dimensions (mm) |  |       |       |                  |      |      |                  |      |     |  |       |       |                  |      |      |                  |      |     |
| Focal length                   | 25 mm   |       |       |                  |      |      |                  |      |     | 30 mm   |       |       |                  |      |      |                  |      |     |
| Filter size                    | M27.0<br>P0.5   |       |       |                  |      |      |                  |      |     | M27.0<br>P0.5   |       |       |                  |      |      |                  |      |     |
| Optical magnification          | 0.05 ×  |       |       | 0.25 ×           |      |      | 0.5 ×            |      |     | 0.06 ×  |       |       | 0.15 ×           |      |      | 0.45 ×           |      |     |
| Iris Range *2                  | Maximum aperture  | F5.6  | F8    | Maximum aperture | F5.6 | F8   | Maximum aperture | F5.6 | F8  | Maximum aperture  | F5.6  | F8    | Maximum aperture | F5.6 | F8   | Maximum aperture | F5.6 | F8  |
| Depth of field (mm)            | 67.2  | 188.2 | 268.8 | 3.2              | 9.0  | 12.8 | 1.0              | 2.7  | 3.8 | 47.1  | 131.9 | 188.4 | 8.2              | 22.9 | 32.7 | 1.1              | 3.2  | 4.6 |
| Maximum sensor size            | 2/3 inch  |       |       |                  |      |      |                  |      |     |   |       |       |                  |      |      |                  |      |     |
| Mount                          | C Mount   |       |       |                  |      |      |                  |      |     |   |       |       |                  |      |      |                  |      |     |

| Model                          | 3Z4S-LE<br>VS-MC35-□□□□□ *1   |      |      |                  |      |     |                  |      |     | 3Z4S-LE<br>VS-MC50-□□□□□ *1   |      |       |                  |      |      |                  |      |     |
|--------------------------------|---|------|------|------------------|------|-----|------------------|------|-----|---|------|-------|------------------|------|------|------------------|------|-----|
| Appearance/<br>Dimensions (mm) |  |      |      |                  |      |     |                  |      |     |  |      |       |                  |      |      |                  |      |     |
| Focal length                   | 35 mm   |      |      |                  |      |     |                  |      |     | 50 mm   |      |       |                  |      |      |                  |      |     |
| Filter size                    | M27.0<br>P0.5   |      |      |                  |      |     |                  |      |     | M27.0<br>P0.5   |      |       |                  |      |      |                  |      |     |
| Optical magnification          | 0.26 ×  |      |      | 0.3 ×            |      |     | 0.65 ×           |      |     | 0.08 ×  |      |       | 0.2 ×            |      |      | 0.48 ×           |      |     |
| Iris Range *2                  | Maximum aperture  | F5.6 | F8   | Maximum aperture | F5.6 | F8  | Maximum aperture | F5.6 | F8  | Maximum aperture  | F5.6 | F8    | Maximum aperture | F5.6 | F8   | Maximum aperture | F5.6 | F8  |
| Depth of field (mm)            | 2.8   | 8.4  | 11.9 | 2.2              | 6.5  | 9.2 | 0.6              | 1.7  | 2.5 | 33.8  | 75.6 | 108.0 | 6.0              | 13.4 | 19.2 | 1.3              | 2.9  | 4.1 |
| Maximum sensor size            | 2/3 inch  |      |      |                  |      |     |                  |      |     |   |      |       |                  |      |      |                  |      |     |
| Mount                          | C Mount   |      |      |                  |      |     |                  |      |     |   |      |       |                  |      |      |                  |      |     |

| Model                          | 3Z4S-LE<br>VS-MC75-□□□□□ *1   |      |      |                  |      |      |                  |      |     |
|--------------------------------|---|------|------|------------------|------|------|------------------|------|-----|
| Appearance/<br>Dimensions (mm) |  |      |      |                  |      |      |                  |      |     |
| Focal length                   | 75 mm   |      |      |                  |      |      |                  |      |     |
| Filter size                    | M27.0<br>P0.5   |      |      |                  |      |      |                  |      |     |
| Optical magnification          | 0.14 ×  |      |      | 0.2 ×            |      |      | 0.62 ×           |      |     |
| Iris Range *2                  | Maximum aperture  | F5.6 | F8   | Maximum aperture | F5.6 | F8   | Maximum aperture | F5.6 | F8  |
| Depth of field (mm)            | 17.7  | 26.1 | 37.2 | 9.1              | 13.4 | 19.2 | 1.3              | 1.9  | 2.7 |
| Maximum sensor size            | 2/3 inch  |      |      |                  |      |      |                  |      |     |
| Mount                          | C Mount   |      |      |                  |      |      |                  |      |     |

- \*1 Insert the iris range into □□□□□ in the model number as follows.  
F=aperture: blank  
F=5.6: FN056  
F=8: FN080
- \*2 F-number can be selected from maximum aperture, 5.6, and 8.0.

## Extension Tubes

| Lenses   | For C mount Lenses *  | For Small Digital CCD Cameras  |
|----------|---|--|
| Model    | <b>3Z4S-LE SV-EXR</b>   | <b>FZ-LESR</b>   |
| Contents | Set of 7 tubes<br>(40 mm, 20 mm, 10 mm, 5 mm, 2.0 mm, 1.0 mm, and 0.5 mm)<br>Maximum outer diameter: 30 mm dia. | Set of 3 tubes<br>(15 mm, 10 mm, 5 mm)<br>Maximum outer diameter: 12 mm dia. |

\* Do not use the 0.5-mm, 1.0-mm, and 2.0-mm Extension Tubes attached to each other. Since these Extension Tubes are placed over the threaded section of the Lens or other Extension Tube, the connection may loosen when more than one 0.5-mm, 1.0-mm or 2.0-mm Extension Tube are used together. Reinforcement is required to protect against vibration when Extension Tubes exceeding 30 mm are used.

# Ratings and Specifications (Sensor Controllers)

## FH Sensor Controllers

| Type                  |                                      |   | High-speed Controllers (4 core)  |  |                | Standard Controllers (2 core) |                |                |             |
|-----------------------|--------------------------------------|---|--|--|----------------|-------------------------------|----------------|----------------|-------------|
| Model                 |                                      | NPN   | FH-3050  | FH-3050-10   | FH-3050-20     | FH-1050                       | FH-1050-10     | FH-1050-20     |             |
|                       |                                      | PNP   |  |  |                |                               |                |                |             |
| Main functions        | Controller type                      |   | Box-type controllers   |  |                |                               |                |                |             |
|                       | High-grade Processing items          |   | No   |  |                |                               |                |                |             |
|                       | No. of Cameras                       |   | 2  | 4  | 8              | 2                             | 4              | 8              |             |
|                       | Connected Camera                     |   | Can be connected to all cameras. (FZ-S series/FH-S series)   |  |                |                               |                |                |             |
|                       | Processing resolution (FZ-S)         | When connected to a intelligent compact camera  | 752 (H) × 480 (V)  |  |                |                               |                |                |             |
|                       |                                      | When connected to a 300,000-pixel camera  | 640 (H) × 480 (V)  |  |                |                               |                |                |             |
|                       |                                      | When connected to a 2 million-pixel camera  | 1600 (H) × 1200 (V)  |  |                |                               |                |                |             |
|                       |                                      | When connected to a 5 million-pixel camera  | 2448 (H) × 2044 (V)  |  |                |                               |                |                |             |
|                       | Processing resolution (FH-S)         | When connected to a 300,000-pixel camera  | 640 (H) × 480 (V)  |  |                |                               |                |                |             |
|                       |                                      | When connected to a 2 million-pixel camera  | 2040 (H) × 1088 (V)  |  |                |                               |                |                |             |
|                       |                                      | When connected to a 4 million-pixel camera  | 2040 (H) × 2048 (V)  |  |                |                               |                |                |             |
|                       | No. of scenes                        |   | 128  |  |                |                               |                |                |             |
|                       | Number of logged images *1           | When connected to a intelligent compact camera  | Connected to 1 camera(Color): 232, Connected to 2 camera(Color): 116<br>Connected to 3 camera(Color): 77, Connected to 4 camera(Color): 58<br>Connected to 5 camera(Color): 46, Connected to 6 camera(Color): 38<br>Connected to 7 camera(Color): 33, Connected to 8 camera(Color): 29   |  |                |                               |                |                |             |
|                       |                                      | When connected to a 300,000-pixel camera (FZ-S/FH-S)  | Connected to 1 camera(Color): 270, Connected to 1 camera(Monochrome): 272<br>Connected to 2 camera(Color): 135, Connected to 2 camera(Monochrome): 136<br>Connected to 3 camera(Color/Monochrome): 90<br>Connected to 4 camera(Color): 67, Connected to 4 camera(Monochrome): 68<br>Connected to 5 camera(Color/Monochrome): 54<br>Connected to 6 camera(Color/Monochrome): 45<br>Connected to 7 camera(Color/Monochrome): 38<br>Connected to 8 camera(Color): 33, Connected to 8 camera(Monochrome): 34 |  |                |                               |                |                |             |
|                       |                                      | When connected to a 2 million-pixel camera (FH-S)   | Connected to 1 camera(Color/Monochrome): 37, Connected to 2 camera(Color/Monochrome): 18<br>Connected to 3 camera(Color/Monochrome): 12, Connected to 4 camera(Color/Monochrome): 9<br>Connected to 5 camera(Color/Monochrome): 7, Connected to 6 camera(Color/Monochrome): 6<br>Connected to 7 camera(Color/Monochrome): 5, Connected to 8 camera(Color/Monochrome): 4  |  |                |                               |                |                |             |
|                       |                                      | When connected to a 2 million-pixel camera (FZ-S)   | Connected to 1 camera(Color/Monochrome): 43, Connected to 2 camera(Color/Monochrome): 21<br>Connected to 3 camera(Color/Monochrome): 14, Connected to 4 camera(Color/Monochrome): 10<br>Connected to 5 camera(Color/Monochrome): 8, Connected to 6 camera(Color/Monochrome): 7<br>Connected to 7 camera(Color/Monochrome): 6, Connected to 8 camera(Color/Monochrome): 5   |  |                |                               |                |                |             |
|                       |                                      | When connected to a 4 million-pixel camera (FH-S)   | Connected to 1 camera(Color/Monochrome): 20, Connected to 2 camera(Color/Monochrome): 10<br>Connected to 3 camera(Color/Monochrome): 6, Connected to 4 camera(Color/Monochrome): 5<br>Connected to 5 camera(Color/Monochrome): 4, Connected to 6 camera(Color/Monochrome): 3<br>Connected to 7 camera(Color/Monochrome): 2, Connected to 8 camera(Color/Monochrome): 2   |  |                |                               |                |                |             |
|                       |                                      | When connected to a 5 million-pixel camera (FZ-S)   | Connected to 1 camera(Color/Monochrome): 16, Connected to 2 camera(Color/Monochrome): 8<br>Connected to 3 camera(Color/Monochrome): 5, Connected to 4 camera(Color/Monochrome): 4<br>Connected to 5 camera(Color/Monochrome): 3, Connected to 6 camera(Color/Monochrome): 2<br>Connected to 7 camera(Color/Monochrome): 2, Connected to 8 camera(Color/Monochrome): 2  |  |                |                               |                |                |             |
|                       | Operation                            |   | Mouse or similar device  |  |                |                               |                |                |             |
|                       | Settings                             |   | Create series of processing steps by editing the flowchart (Help messages provided).   |  |                |                               |                |                |             |
| External interface    | Serial communications                |   | RS-232C: 1 CH  |  |                |                               |                |                |             |
|                       | EtherNet communications              |   | No-protocol (TCP/UDP) 1000BASE-T   |  |                |                               |                |                |             |
|                       | EtherNet/IP communications           |   | 1 port   | 2 port   | 2 port         | 1 port                        | 2port          | 2port          |             |
|                       | EtherCAT communications              |   | Ethernet port baud rate: 1 Gbps (1000 BASE-T)  |  |                |                               |                |                |             |
|                       | EtherCAT communications              |   | EtherCAT protocol (100BASE-TX)   |  |                |                               |                |                |             |
|                       | Parallel I/O                         | (In the 2-line random trigger mode)<br>17 inputs (STEP0/ENCTRIG_Z0, STEP1/ENCTRIG_Z1, ENCTRIG_A0 to 1, ENCTRIG_B0 to 1, DSA0 to 1, DI0 to 7, DI_LINE0)<br>37 outputs (RUN0 to 1, READY0 to 1, BUSY0 to 1, OR0 to 1, ERROR0 to 1, GATE0 to 1, STGOUT0/SHTOUT0, STGOUT1/SHTOUT1, STGOUT2 to 7, DO0 to 15, ACK)<br>(In the 5-line to 8-line random trigger mode)<br>19 inputs, STEP0 to 7, DI_LINE0 to 2, DI0 to 7)<br>34 outputs (READY0 to 7, BUSY0 to 7, OR0 to 7, ACK, ERROR, STGOUT/SHTOUT0 to 7) |  |  |                |                               |                |                |             |
|                       |                                      | RS422-A line driver level. Phase A/B: single-phase 4MHz (multiplying phase difference of 1MHz by 4 times), Phase Z: 1MHz  |  |  |                |                               |                |                |             |
|                       | Encoder interface                    |   | DVI-I output IF × 1ch  |  |                |                               |                |                |             |
|                       | Monitor interface                    |   | 4 channels (supports USB 1.1 and 2.0)  |  |                |                               |                |                |             |
|                       | SD card interface                    |   | SDHC card of Class4 or higher rating is recommended.   |  |                |                               |                |                |             |
| Ratings               | Power supply voltage                 |   | 20.4 to 26.4 VDC   |  |                |                               |                |                |             |
|                       | Current consumption (at 24.0 VDC) *2 | When connected to a intelligent compact camera, intelligent or autofocus camera   | Connected to 2 cameras   | 5.0 A max.   | 5.4 A max.     | 6.4 A max.                    | 4.7 A max.     | 5.0 A max.     | 5.9 A max.  |
|                       |                                      | When connected to a 300,000-pixel camera, 2 million-pixel camera, 4 million-pixel camera or 5 million-pixel camera  | Connected to 4 cameras   | —  | 7.0 A max.     | 8.1 A max.                    | —              | 6.5 A max.     | 7.5 A max.  |
|                       |                                      |   | Connected to 8 cameras   | —  | —              | 11.5 A max.                   | —              | —              | 10.9 A max. |
|                       |                                      |   | Connected to 2 cameras   | 4.1 A max.   | 4.2 A max.     | 5.2 A max.                    | 3.6 A max.     | 3.7 A max.     | 4.5 A max.  |
|                       |                                      |   | Connected to 4 cameras   | —  | 4.8 A max.     | 5.6 A max.                    | —              | 4.3 A max.     | 5.0 A max.  |
|                       |                                      | Connected to 8 cameras  | —  | —  | 6.8 A max.     | —                             | —              | 6.2 A max.     |             |
| Insulation resistance |                                      | Between DC power supply and controller FG: 20 MΩ or higher (rated voltage 250 V)  |  |  |                |                               |                |                |             |
| Operation Environment | Noise Immunity                       | Fast transient burst  | DC Power Supply  | Direct infusion: 2 KV Pulse rising: 5 ns Pulse width: 50 ns<br>Burst continuation time: 15 ms/0.75 ms Period: 300 ms Application time: 1 min |                |                               |                |                |             |
|                       |                                      |   | I/O line   | Cramp: 1 KV Pulse rising: 5 ns Pulse width: 50 ns<br>Burst continuation time: 15 ms/0.75 ms Period: 300 ms Application time: 1 min           |                |                               |                |                |             |
|                       | Ambient temperature range            |   | Operating: 0 to 50 °C<br>Storage: -20 to 65 °C (with no icing or condensation)   |  |                |                               |                |                |             |
|                       | Ambient humidity range               |   | Operating and storage: 35% to 85% (with no condensation)   |  |                |                               |                |                |             |
|                       | Ambient atmosphere                   |   | No corrosive gases   |  |                |                               |                |                |             |
|                       | Grounding                            |   | Type D grounding (100Ω or less grounding resistance) Conventional type 3 grounding   |  |                |                               |                |                |             |
|                       | Degree of protection                 |   | IEC60529 IP20  |  |                |                               |                |                |             |
| Dimensions            | Dimensions                           |   | 190 × 115 × 182.5 mm   |  |                |                               |                |                |             |
|                       | Weight                               |   | Approx. 3.2 kg   | Approx. 3.4 kg   | Approx. 3.4 kg | Approx. 3.2 kg                | Approx. 3.4 kg | Approx. 3.4 kg |             |
|                       | Case materials                       |   | Cover: zinc-plated steel plate, side plate: aluminum (A6063)   |  |                |                               |                |                |             |
| Accessories           |                                      |   | Controller (1) / user manual (one Japanese and one English versions) / Instruction Installation Manual (1) / Power supply terminal block connector (1) / Ferrite core (2, FH-3050 and FH-1050), 4 (FH-3050-10 and FH-1050-10), and 8 (FH-3050-20 and FH-1050-20)   |  |                |                               |                |                |             |

\*1 The image logging capacity changes when multiple cameras of different types are connected at the same time.

\*2 The current consumption when the maximum number of cameras supported by each controller are connected.  
If a strobe controller model is connected to a lamp, the current consumption is as high as when an intelligent camera is connected.

## FZ5 Sensor Controllers

| Type                                       |   |                        | High-speed Controllers  |                | Standard Controllers  |                | Lite Controllers  |  |
|--|---|------------------------|---|----------------|---|----------------|---|--|
| Model                                      |   | NPN                    | FZ5-1100  | FZ5-1100-10    | FZ5-600   | FZ5-600-10     | FZ5-L350  | FZ5-L350-10  |
|  |   | PNP                    | FZ5-1105  | FZ5-1105-10    | FZ5-605   | FZ5-605-10     | FZ5-L355  | FZ5-L355-10  |
| Controller type                            |   |                        | Controllers integrated with LCD   |                |   |                |   | Box-type controllers   |
| High-grade Processing items                |   |                        | No  |                |   |                |   |  |
| No. of Cameras                             |   |                        | 2   | 4              | 2   | 4              | 2   | 4  |
| Connected Camera                           |   |                        | Can be connected to FZ-S series.<br>(Can not be connected to FH-S series.)  |                | Can be connected to FZ-S series. (Can not be connected to FH-S series. When connecting 5 million-pixel cameras, up to two cameras can be connected.)  |                |   |  |
| Processing resolution                      | When connected to a intelligent compact camera      |                        | 752 (H) × 480 (V)   |                |   |                |   |  |
|  | When connected to a 300,000-pixel camera            |                        | 640 (H) × 480 (V)   |                |   |                |   |  |
|  | When connected to a 2 million-pixel camera          |                        | 1600 (H) × 1200 (V)   |                |   |                |   |  |
|  | When connected to a 5 million-pixel camera          |                        | 2448 (H) × 2044 (V)   |                |   |                |   |  |
| No. of scenes                              |   |                        | 32  |                |   |                |   |  |
| Number of logged images *1                 | When connected to a intelligent compact camera      | Connected to 1 camera  | 232   |                | 214   |                |   |  |
|  |   | Connected to 2 cameras | 116   |                | 107   |                |   |  |
|  |   | Connected to 3 cameras | 77  |                | 71  |                |   |  |
|  |   | Connected to 4 cameras | 58  |                | 53  |                |   |  |
|  | When connected to a 300,000-pixel camera            | Connected to 1 camera  | Color camera: 270, Monochrome Camera: 272   |                | Color camera: 250, Monochrome Camera: 252   |                |   |  |
|  |   | Connected to 2 cameras | Color camera: 135, Monochrome Camera: 136   |                | Color camera: 125, Monochrome Camera: 126   |                |   |  |
|  |   | Connected to 3 cameras | Color camera: 90, Monochrome Camera: 90   |                | Color camera: 83, Monochrome Camera: 84   |                |   |  |
|  |   | Connected to 4 cameras | Color camera: 67, Monochrome Camera: 68   |                | Color camera: 62, Monochrome Camera: 63   |                |   |  |
|  | When connected to a 2 million-pixel camera          | Connected to 1 camera  | Color camera: 43, Monochrome Camera: 43   |                | Color camera: 40, Monochrome Camera: 40   |                |   |  |
|  |   | Connected to 2 cameras | Color camera: 21, Monochrome Camera: 21   |                | Color camera: 20, Monochrome Camera: 20   |                |   |  |
|  |   | Connected to 3 cameras | Color camera: 14, Monochrome Camera: 14   |                | Color camera: 13, Monochrome Camera: 13   |                |   |  |
|  |   | Connected to 4 cameras | Color camera: 10, Monochrome Camera: 10   |                | Color camera: 10, Monochrome Camera: 10   |                |   |  |
|  | When connected to a 5 million-pixel camera          | Connected to 1 camera  | Color camera: 16, Monochrome Camera: 16   |                | Color camera: 11, Monochrome Camera: 11   |                |   |  |
|  |   | Connected to 2 cameras | Color camera: 8, Monochrome Camera: 8   |                | Color camera: 5, Monochrome Camera: 5   |                |   |  |
|  |   | Connected to 3 cameras | Color camera: 5, Monochrome Camera: 5   |                | —   |                |   |  |
|  |   | Connected to 4 cameras | Color camera: 4, Monochrome Camera: 4   |                | —   |                |   |  |
| Operation                                  |   |                        | Touch pen, mouse, etc.  |                |   |                |   | Mouse or similar device  |
| Settings                                   |   |                        | Create series of processing steps by editing the flowchart (Help messages provided).  |                |   |                |   |  |
| Serial communications                      |   |                        | RS-232C/422A : 1 CH   |                |   |                |   | RS-232: 1CH  |
| EtherNet communications                    |   |                        | Ethernet 100BASE-TX/10BASE-T  |                |   |                |   | Ethernet 1000BASE-T/100BASE-TX/10BASE-T  |
| EtherNet/IP communications                 |   |                        | Ethernet port baud rate: 100 Mbps (100Base-TX)  |                |   |                |   |  |
| Parallel I/O                               |   |                        | (When used in Multi-line random-trigger mode)<br>17 inputs (RESET, STEP0/ ENCTRIG_Z0, STEP1/ENCTRIG_Z1, DSA0 to 1, ENCTRIG_A0 to 1, ENCTRIG_B0 to 1, DI0 to 7),<br>29 outputs (RUN/BUSY1, BUSY0, GATE0 to 1, OR0 to 1, READY0 to 1, ERROR, STGOUT0 to 3, DO0 to 15)<br>(When used in other mode)<br>13 inputs (RESET, STEP0/ ENCTRIG_Z0, DSA0, ENCTRIG_A0, ENCTRIG_B0, DI0 to 7),<br>26 outputs (RUN, BUSY0, GATE0, OR0, READY0, ERROR, STGOUT0 to 3, DO0 to 15)<br>* STGOUT 2 to 3 only for camera 4 ch type |                | 13 inputs (RESET, STEP0/ ENCTRIG_Z0, DSA0, ENCTRIG_A0, ENCTRIG_B0, DI0 to 7),<br>26 outputs (RUN, BUSY0, GATE0, OR0, READY0, ERROR, STGOUT0 to 3, DO0 to 15)<br>* STGOUT 2 to 3 only for camera 4 ch type |                | 11 inputs (RESET, STEP, DSA, and DI0 to 7),<br>26 outputs (RUN, BUSY, GATE, OR, READY, ERROR, STGOUT 0 to 3, and DO 0 to 15)<br>* STGOUT 2 to 3 only for camera 4 ch type |  |
| Monitor interface                          |   |                        | Integrated Controller and LCD 12.1 inch TFT color LCD (Resolution: XGA 1,024 × 768 dots)  |                |   |                |   | Analog RGB video output, 1 channel (Resolution: XGA 1,024 × 768 dots)                      |
| USB interface                              |   |                        | 4 channels (supports USB 1.1 and 2.0)   |                |   |                |   | 2CH (supports USB1.1/2.0)  |
| Power supply voltage *2                    |   |                        | 20.4 to 26.4 VDC  |                |   |                |   |  |
| Current consumption (at 24.0 VDC) *3       | When connected to a intelligent compact camera      |                        | 5.0 A max.  | 7.5 A max.     | 5.0 A max.  | 7.5 A max.     | 4.0 A max.  | 5.5 A max.   |
|  | When connected to a intelligent or autofocus camera |                        |   |                |   |                |   |  |
|  | When connected to a 300,000-pixel camera            |                        |   |                |   |                |   |  |
|  | When connected to a 2 million-pixel camera          |                        | 3.7 A max.  | 4.9 A max.     | 3.7 A max.  | 4.9 A max.     | 2.6 A max.  | 2.9 A max.   |
| When connected to a 5 million-pixel camera |   |                        |   |                |   |                |   |  |
| Ambient temperature range                  |   |                        | Operating: 0 to 45 °C for low cooling fan speeds, 0 to 50 °C for high cooling fan speeds<br>Storage: -20 to 65 °C (with no icing or condensation)   |                |   |                |   | Operating: 0 to 45 °C, 0 to 50 °C<br>Storage: -20 to 65 °C (with no icing or condensation) |
| Ambient humidity range                     |   |                        | Operating and storage: 35% to 85% (with no condensation)  |                |   |                |   |  |
| Weight                                     |   |                        | Approx. 3.2 kg  | Approx. 3.4 kg | Approx. 3.2 kg  | Approx. 3.4 kg | Approx. 1.8 kg  |  |
| Accessories                                |   |                        | Touch pen (one, inside the front panel), Instruction Manual, 6 mounting brackets  |                |   |                |   | Instruction Manual   |

\*1 The image logging capacity changes when multiple cameras of different types are connected at the same time.

\*2 Do not ground the positive terminal of the 24-VDC power supply to a Lite Controller.

If the positive terminal is grounded, electrical shock may occur when an SG (0-V) part, such as the case of the Controller or Camera, is touched.

\*3 The current consumption when the maximum number of cameras supported by each controller are connected.

If a strobe controller model is connected to a lamp, the current consumption is as high as when an intelligent camera is connected.



## Ratings and Specifications (Cameras)

### High-speed CMOS cameras

| Model                                  | FH-SM  | FH-SC          | FH-SM02  | FH-SC02         | FH-SM04                    | FH-SC04         |
|--|--|----------------|--|-----------------|----------------------------|-----------------|
| Image elements                         | 1/3-inch CMOS image elements   |                | 2/3-inch CMOS image elements   |                 | 1-inch CMOS image elements |                 |
| Color/Monochrome                       | Monochrome   | Color          | Monochrome   | Color           | Monochrome                 | Color           |
| Effective pixels                       | 640 (H) × 480 (V)  |                | 2040 (H) × 1088 (V)  |                 | 2040 (H) × 2048 (V)        |                 |
| Pixel size                             | 7.4 (μm) × 7.4 (μm)  |                | 5.5 (μm) × 5.5 (μm)  |                 | 5.5 (μm) × 5.5 (μm)        |                 |
| Shutter function                       | Electronic shutter;<br>Shutter speeds can be set from 20 μs to 100 ms.       |                | Electronic shutter;<br>Shutter speeds can be set from 25 μs to 100 ms. |                 |                            |                 |
| Partial function                       | 1 to 480 lines   | 2 to 480 lines | 1 to 1088 lines  | 2 to 1088 lines | 1 to 2048 lines            | 2 to 2048 lines |
| Frame rate (image read time)           | 308 fps (3.3 ms)   |                | 219 fps (4.6 ms) *   |                 | 118 fps (8.5 ms) *         |                 |
| Lens mounting                          | C mount  |                |  |                 |                            |                 |
| Field of vision, installation distance | Selecting a lens according to the field of vision and installation distance  |                |  |                 |                            |                 |
| Ambient temperature range              | Operating: 0 to 40 °C, Storage: -25 to 65 °C (with no icing or condensation) |                |  |                 |                            |                 |
| Ambient humidity range                 | Operating and storage: 35% to 85% (with no condensation)                     |                |  |                 |                            |                 |
| Weight                                 | Approx.105 g   |                | Approx.110 g   |                 |                            |                 |
| Accessories                            | Instruction manual   |                |  |                 |                            |                 |

\* For high speed frame rate, 2 pieces of FZ-VS-\_M cables are required.

### Digital CCD Cameras

| Model                                     | FZ-S  | FZ-SC | FZ-S2M  | FZ-SC2M | FZ-S5M2   | FZ-SC5M2 |
|---|---|-------|---|---------|---|----------|
| Image elements                            | Interline transfer reading all pixels,<br>1/3-inch CCD image elements             |       | Interline transfer reading all pixels,<br>1/1.8-inch CCD image elements           |         | Interline transfer reading all pixels,<br>2/3-inch CCD image elements |          |
| Color/Monochrome                          | Monochrome  | Color | Monochrome  | Color   | Monochrome  | Color    |
| Effective pixels                          | 640 (H) × 480 (V)   |       | 1600 (H) × 1200 (V)   |         | 2448 (H) × 2044 (V)   |          |
| Pixel size                                | 7.4 (μm) × 7.4 (μm)   |       | 4.4 (μm) × 4.4 (μm)   |         | 3.45 (μm) × 3.45 (μm)   |          |
| Shutter function                          | Electronic shutter; select shutter speeds from 20 μs to 100 ms                    |       |   |         |   |          |
| Partial function                          | 12 to 480 lines   |       | 12 to 1200 lines  |         | 12 to 2044 lines  |          |
| Frame rate<br>(image read time)           | 80 fps (12.5 ms)  |       | 30 fps (33.3 ms)  |         | 16 fps (62.5 ms)  |          |
| Lens mounting                             | C mount   |       |   |         |   |          |
| Field of vision,<br>installation distance | Selecting a lens according to the field of vision and installation distance       |       |   |         |   |          |
| Ambient temperature<br>range              | Operating: 0 to 50 °C<br>Storage: -25 to 65 °C<br>(with no icing or condensation) |       | Operating: 0 to 40 °C<br>Storage: -25 to 65 °C<br>(with no icing or condensation) |         |   |          |
| Ambient humidity range                    | Operating and storage: 35% to 85% (with no condensation)                          |       |   |         |   |          |
| Weight                                    | Approx. 55 g  |       | Approx. 76 g  |         | Approx. 140 g   |          |
| Accessories                               | Instruction manual  |       |   |         |   |          |

### Small CCD Digital Cameras

| Model                                  | FZ-SF   | FZ-SFC | FZ-SP              | FZ-SPC |
|--|---|--------|--------------------|--------|
| Image elements                         | Interline transfer reading all pixels, 1/3-inch CCD image elements  |        |                    |        |
| Color/Monochrome                       | Monochrome  | Color  | Monochrome         | Color  |
| Effective pixels                       | 640 (H) × 480 (V)   |        |                    |        |
| Pixel size                             | 7.4 (μm) × 7.4 (μm)   |        |                    |        |
| Shutter function                       | Electronic shutter; select shutter speeds from 20 μm to 100 ms  |        |                    |        |
| Partial function                       | 12 to 480 lines   |        |                    |        |
| Frame rate (image read time)           | 80 fps (12.5ms)   |        |                    |        |
| Lens mounting                          | Special mount (M10.5 P0.5)  |        |                    |        |
| Field of vision, installation distance | Selecting a lens according to the field of vision and installation distance   |        |                    |        |
| Ambient temperature range              | Operating: 0 to 50 °C (camera amp)<br>0 to 45 °C (camera head)<br>Storage: -25 to 65 °C (with no icing or condensation) |        |                    |        |
| Ambient humidity range                 | Operating and storage: 35% to 85% (with no condensation)  |        |                    |        |
| Weight                                 | Approx. 150 g   |        |                    |        |
| Accessories                            | Instruction manual, installation bracket,<br>Four mounting brackets (M2)  |        | Instruction manual |        |

## High-speed CCD Cameras

| Model                                  | FZ-SH  | FZ-SHC |
|--|--|--------|
| Image elements                         | Interline transfer reading all pixels, 1/3-inch CCD image elements             |        |
| Color/Monochrome                       | Monochrome   | Color  |
| Effective pixels                       | 640 (H) × 480 (V)  |        |
| Pixel size                             | 7.4 (μm) × 7.4 (μm)  |        |
| Shutter function                       | Electronic shutter; select shutter speeds from 1/10 to 1/50,000 s              |        |
| Partial function                       | 12 to 480 lines  |        |
| Frame rate (image read time)           | 204 fps (4.9ms)  |        |
| Field of vision, installation distance | Selecting a lens according to the field of vision and installation distance    |        |
| Ambient temperature range              | Operating: 0 to 40 °C<br>Storage: -25 to 65 °C (with no icing or condensation) |        |
| Ambient humidity range                 | Operating and storage: 35% to 85% (with no condensation)                       |        |
| Weight                                 | Approx. 105 g  |        |
| Accessories                            | Instruction manual   |        |

## Intelligent Compact CMOS Cameras

| Model                        | FZ-SQ010F   | FZ-SQ050F              | FZ-SQ100F               | FZ-SQ100N               |
|------------------------------|---|------------------------|-------------------------|-------------------------|
| Image elements               | 1/3-inch CMOS image elements  |                        |                         |                         |
| Color/Monochrome             | Color   |                        |                         |                         |
| Effective pixels             | 752 (H) × 480 (V)   |                        |                         |                         |
| Pixel size                   | 6.0 (μm) × 6.0 (μm)   |                        |                         |                         |
| Shutter function             | 1/250 to 1/32,258   |                        |                         |                         |
| Partial function             | 8 to 752 lines  |                        |                         |                         |
| Frame rate (image read time) | 60 fps  |                        |                         |                         |
| Field of vision              | 7.5 × 4.7 to 13 × 8.2 mm  | 13 × 8.2 to 53 × 33 mm | 53 × 33 to 240 × 153 mm | 29 × 18 to 300 × 191 mm |
| Installation distance        | 38 to 60 mm   | 56 to 215 mm           | 220 to 970 mm           | 32 to 380 mm            |
| LED class *                  | Class 2   |                        |                         |                         |
| Ambient temperature range    | Operating: 0 to 50 °C<br>Storage: -25 to 65 °C  |                        |                         |                         |
| Ambient humidity range       | Operating and storage: 35% to 85% (with no condensation)  |                        |                         |                         |
| Weight                       | Approx. 150 g   |                        | Approx. 140 g           |                         |
| Accessories                  | Mounting bracket (FQ-XL), polarizing filter attachment (FQ-XF1), instruction manual and warning label |                        |                         |                         |

\* Applicable standards: IEC62471-2

## Intelligent CCD Cameras, Autofocus CCD Cameras

| Model                        | FZ-SLC100  | FZ-SLC15          | FZ-SZC100           | FZ-SZC15          |
|------------------------------|--|-------------------|---------------------|-------------------|
| Image elements               | Interline transfer reading all pixels, 1/3-inch CCD image elements             |                   |                     |                   |
| Color/Monochrome             | Color  |                   |                     |                   |
| Effective pixels             | 640 (H) × 480 (V)  |                   |                     |                   |
| Pixel size                   | 7.4 (μm) × 7.4 (μm)  |                   |                     |                   |
| Shutter function             | Electronic shutter; select shutter speeds from 1/10 to 1/50,000 s              |                   |                     |                   |
| Partial function             | 12 to 480 lines  |                   |                     |                   |
| Frame rate (image read time) | 80 fps (12.5 ms)   |                   |                     |                   |
| Field of vision *2           | 13 to 100 mm *1  | 2.9 to 14.9 mm *1 | 13 to 100 mm *1     | 2.9 to 14.9 mm *1 |
| Installation distance        | 70 to 190 mm *1  | 35 to 55 mm *1    | 77.5 to 197.5 mm *1 | 47.5 to 67.5 mm   |
| LED class *3 (lighting)      | Class 2  |                   | —                   |                   |
| Ambient temperature range    | Operating: 0 to 50 °C<br>Storage: -25 to 65 °C (with no icing or condensation) |                   |                     |                   |
| Ambient humidity range       | Operating and storage: 35% to 85% (with no condensation)                       |                   |                     |                   |
| Weight                       | Approx. 670 g  | Approx. 700 g     | Approx. 500 g       |                   |
| Accessories                  | Instruction Sheet and hexagonal wrench   |                   |                     |                   |

\*1 Tolerance: ±5% max.

\*2 The length of the visual field is the lengths along the Y axis.

\*3 Applicable standards: IEC62471-2

## Ratings and Specifications (LCD Monitor, Cable)

### LCD Monitor

| Model                     | FZ-M08   |
|---------------------------|--|
| Size                      | 8.4 inches   |
| Type                      | Liquid crystal color TFT   |
| Resolution                | 1,024 × 768 dots   |
| Input signal              | Analog RGB video input, 1 channel  |
| Power supply voltage      | 21.6 to 26.4 VDC   |
| Current consumption       | Approx. 0.7 A max.   |
| Ambient temperature range | Operating: 0 to 50 °C; Storage: -25 to 65 °C (with no icing or condensation) |
| Ambient humidity range    | Operating and storage: 35 to 85% (with no condensation)                      |
| Weight                    | Approx. 1.2 kg   |
| Accessories               | Instruction Sheet and 4 mounting brackets                                    |

### Camera Cables

| Model                            | FZ-VS (2 m)  | FZ-VSB (2 m)  | FZ-VSL (2 m)  |
|----------------------------------|--|---------------|---------------|
| Shock resistiveness (durability) | 10 to 150 Hz single amplitude 0.15 mm 3 directions, 8 strokes, 4 times |               |               |
| Ambient temperature range        | Operation and storage: 0 to 65 °C (with no icing or condensation)      |               |               |
| Ambient humidity range           | Operation and storage: 40 to 70%RH (with no condensation)              |               |               |
| Ambient atmosphere               | No corrosive gases   |               |               |
| Material                         | Cable sheath, connector: PVC   |               |               |
| Minimum bending radius           | 69 mm  | 69 mm         | 69 mm         |
| Weight                           | Approx. 170 g  | Approx. 220 g | Approx. 170 g |

### Monitor Cable

| Model                     | FZ-VM  |
|---------------------------|--|
| Vibration resistiveness   | 10 to 150 Hz single amplitude 0.15 mm 3 directions, 8 strokes, 4 times       |
| Ambient temperature range | Operation: 0 to 50 °C; Storage: -20 to 65 °C (with no icing or condensation) |
| Ambient humidity range    | Operation and storage: 35 to 85%RH (with no condensation)                    |
| Ambient atmosphere        | No corrosive gases   |
| Material                  | Cable sheath: heat-resistant PVC Connector: PVC                              |
| Minimum bending radius    | 75 mm  |
| Weight                    | Approx. 170 g  |

### Cable Extension Unit

| Model                     | FZ-VSJ   |
|---------------------------|--|
| Power supply voltage *1   | 11.5 to 13.5 VDC   |
| Current consumption *2    | 1.5 A max.   |
| Ambient temperature range | Operating: 0 to 50 °C; Storage: -25 to 65 °C (with no icing or condensation) |
| Ambient humidity range    | Operating and storage: 35 to 85% (with no condensation)                      |
| Maximum Units connectable | 2 Units per Camera   |
| Weight                    | Approx. 240 g  |
| Accessories               | Instruction Sheet and 4 mounting screws                                      |

\*1 A 12-VDC power supply must be provided to the Cable Extension Unit when connecting the Intelligent Camera, the Autofocus Camera, the Intelligent Compact Camera, the Strobe Controller, or the Lighting Controller.

\*2 The current consumption shows when connecting the Cable Extension Unit to an external power supply.

### Long-distance Camera Cables

| Model                            | FZ-VS2 (15 m)  | FZ-VSL2 (15 m) |
|----------------------------------|--|----------------|
| Shock resistiveness (durability) | 10 to 150 Hz single amplitude 0.15 mm 3 directions, 8 strokes, 4 times |                |
| Ambient temperature range        | Operation and storage: 0 to 65 °C (with no icing or condensation)      |                |
| Ambient humidity range           | Operation and storage: 40 to 70%RH (with no condensation)              |                |
| Ambient atmosphere               | No corrosive gases   |                |
| Material                         | Cable sheath, connector: PVC   |                |
| Minimum bending radius           | 93 mm  |                |
| Weight                           | Approx. 1600 g   |                |

### Parallel Cable

| Model                     | FZ-VP  | FZ-VPX        |
|---------------------------|--|---------------|
| Vibration resistiveness   | 10 to 150 Hz single amplitude 0.15 mm 3 directions, 8 strokes, 4 times       |               |
| Ambient temperature range | Operation: 0 to 50 °C; Storage: -20 to 65 °C (with no icing or condensation) |               |
| Ambient humidity range    | Operation and storage: 35 to 85%RH (with no condensation)                    |               |
| Ambient atmosphere        | No corrosive gases   |               |
| Material                  | Cable sheath: heat-resistant PVC Connector: resin                            |               |
| Minimum bending radius    | 75 mm  |               |
| Weight                    | Approx. 160 g  | Approx. 180 g |

Note: FZ-VP/FZ-VPX is only for the FZ series. The FH series can use XW2Z-S013-2/-S013-5.

### Encoder Cable

| Model                     | FH-VR  |
|---------------------------|--|
| Vibration resistiveness   | 10 to 150 Hz single amplitude 0.1 mm 3 directions, 8 strokes, 10 times         |
| Ambient temperature range | Operation: 0 to 50 °C; Storage: -10 to 60 °C (with no icing or condensation)   |
| Ambient humidity range    | Operation and storage: 35 to 85%RH (with no condensation)                      |
| Ambient atmosphere        | No corrosive gases   |
| Material                  | Cable Jacket: Heat, oil and flame resistant PVC Connector: polycarbonate resin |
| Minimum bending radius    | 65 mm  |
| Weight                    | Approx. 104 g  |

## FH-Series

### Cameras / Cables Connection Table

| Type of camera   | Model            | Cable length | High-speed CMOS cameras * |  |  |  |  |
|--|------------------|--------------|---------------------------|--|--|--|--|
|  |                  |              | 300,000-pixel             | 2 million-pixel                              |  | 4 million-pixel                              |  |
|  |                  |              | FH-SM/SC                  | FH-SM02/SC02                                 |  | FH-SM04/SC04                                 |  |
|  |                  |              | —                         | High speed mode of transmission speed select | Standard mode of transmission speed select | High speed mode of transmission speed select | Standard mode of transmission speed select |
| Camera Cables<br>Right-angle camera cables                           | FZ-VS<br>FZ-VSL  | 2 m          | Yes                       | Yes  | Yes  | Yes  | Yes  |
|  |                  | 5 m          | Yes                       | Yes  | Yes  | Yes  | Yes  |
|  |                  | 10 m         | Yes                       | No   | Yes  | No   | Yes  |
| Bend resistant camera cables   | FZ-VSB           | 2 m          | Yes                       | Yes  | Yes  | Yes  | Yes  |
|  |                  | 5 m          | Yes                       | Yes  | Yes  | Yes  | Yes  |
|  |                  | 10 m         | Yes                       | No   | Yes  | No   | Yes  |
| Long-distance camera cable<br>Long-distance right-angle camera cable | FZ-VS2<br>FZVSL2 | 15 m         | Yes                       | No   | Yes  | No   | Yes  |

\* High-speed CMOS camera is only for the FH series.

| Type of camera   | Model            | Cable length | Digital CCD cameras |                 |                 | Small digital CCD cameras<br>Pen type / flat type | High-speed CCD cameras | Intelligent compact CMOS cameras | Intelligent CCD cameras<br>Autofocus CCD cameras |
|--|------------------|--------------|---------------------|-----------------|-----------------|---|------------------------|----------------------------------|--|
|  |                  |              | 300,000-pixel       | 2 million-pixel | 5 million-pixel |   |                        |                                  |  |
|  |                  |              | FZ-S/SC             | FZ-S2M/SC2M     | FZ-S5M2/SC5M2   | FZ-SF/SFC<br>FZ-SP/SPC                            | FZ-SH/SHC              | FZ-SQ□                           | FZ-SLC□<br>FZ-SZC□                               |
| Camera Cables<br>Right-angle camera cables                           | FZ-VS<br>FZ-VSL  | 2 m          | Yes                 | Yes             | Yes             | Yes   | Yes                    | Yes                              | Yes  |
|  |                  | 5 m          | Yes                 | Yes             | Yes             | Yes   | Yes                    | Yes                              | Yes  |
|  |                  | 10 m         | Yes                 | Yes             | No              | Yes   | Yes                    | Yes                              | No   |
| Bend resistant camera cables   | FZ-VSB           | 2 m          | Yes                 | Yes             | Yes             | Yes   | Yes                    | Yes                              | Yes  |
|  |                  | 5 m          | Yes                 | Yes             | Yes             | Yes   | Yes                    | Yes                              | Yes  |
|  |                  | 10 m         | Yes                 | Yes             | No              | Yes   | Yes                    | Yes                              | No   |
| Long-distance camera cable<br>Long-distance right-angle camera cable | FZ-VS2<br>FZVSL2 | 15 m         | Yes                 | Yes             | No              | Yes   | Yes                    | Yes                              | No   |

## EtherCAT Communications Specifications

| Item                          |        | Specifications  |
|-------------------------------|--------|---|
| Communications standard       |        | IEC61158 Type 12  |
| Physical layer                |        | 100 BASE-TX (IEEE802.3)   |
| Modulation                    |        | Base band   |
| Baud rate                     |        | 100 Mbps  |
| Topology                      |        | Depends on the specifications of the EtherCAT master.   |
| Transmission Media            |        | Twisted-pair cable of category 5 or higher (double-shielded straight cable with aluminum tape and braiding) |
| Transmission Distance         |        | Distance between nodes: 100 m or less   |
| Node address setting          |        | 00 to 9   |
| External connection terminals |        | RJ45 × 2 (shielded) IN: EtherCAT input data, OUT: EtherCAT output data                                      |
| Send/receive PDO data sizes   | Input  | 56 to 280 bytes/line (including input data, status, and unused areas) Up to 8 lines can be set. *           |
|                               | Output | 28 bytes/line (including output data and unused areas) Up to 8 lines can be set. *                          |
| Mailbox data size             | Input  | 512 bytes   |
|                               | Output | 512 bytes   |
| Mailbox                       |        | Emergency messages, SDO requests, and SDO information   |
| Refreshing methods            |        | I/O-synchronized refreshing (DC)  |

\* This depends on the upper limit of the master.

## Version Information

### FH Series and Programming Devices

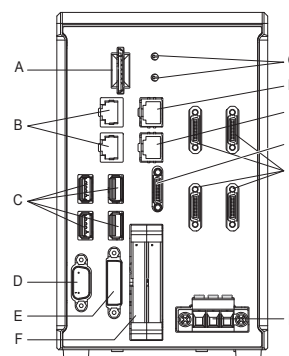
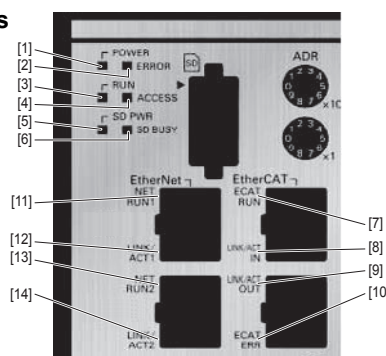
| FH Series                    | Required Programming Device                   |                    |
|------------------------------|---|--------------------|
|                              | Sysmac Studio Standard Edition/Vision Edition |                    |
|                              | Ver.1.06                                      | Ver.1.07 or higher |
| FH-3050 (-□)<br>FH-1050 (-□) | Not supported                                 | Supported          |

Note: 1. The auto-update to Sysmac Studio version 1.07 will be available soon.  
2. Sysmac Studio does not support the FZ5 Series.



## Components and Functions

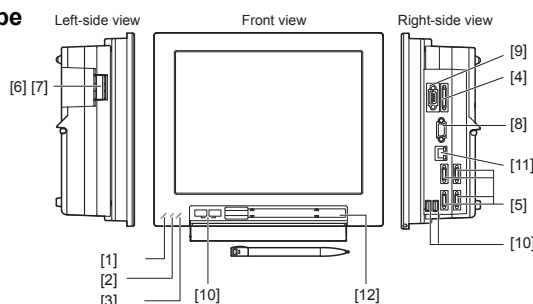
### Example of the FH Sensor Controllers BOX type (4-camera type)



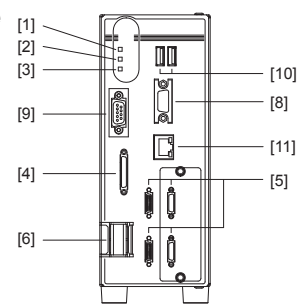
|      | Name                       | Description   |
|------|----------------------------|---|
| [1]  | POWER LED                  | Lit while power is ON.  |
| [2]  | ERROR LED                  | Lit when an error has occurred.   |
| [3]  | RUN LED                    | Lit while the controller is in Measurement Mode.  |
| [4]  | ACCESS LED                 | Lit while the memory is accessed.   |
| [5]  | SD POWER LED               | Lit while power is supplied to the SD card and the card is usable.                      |
| [6]  | SD BUSY LED                | Blinks while the SD memory card is accessed.  |
| [7]  | EtherCAT RUN LED           | Lit while EtherCAT communications are usable.   |
| [8]  | EtherCAT LINK/ACT IN LED   | Lit when connected with an EtherCAT device, and blinks while performing communications. |
| [9]  | EtherCAT LINK/ACT OUT LED  | Lit when connected with an EtherCAT device, and blinks while performing communications. |
| [10] | EtherCAT ERR LED           | Lit when EtherCAT communications have become abnormal.                                  |
| [11] | EtherNet NET RUN1 LED      | Lit while EtherNet communications are usable.   |
| [12] | EtherNet NET LINK/ACK1 LED | Lit when connected with an EtherNet device, and blinks while performing communications. |
| [13] | EtherNet NET RUN2 LED      | Lit when EtherNet communications are usable.  |
| [14] | EtherNet NET LINK/ACK2 LED | Lit when connected with an EtherNet device, and blinks while performing communications. |

|   | Name                                      | Description  |
|---|---|--|
| A | SD memory card installation connector     | Install the SD memory card. Do not plug or unplug the SD card during measurement operation. Otherwise measurement time may be affected or data may be destroyed.                                       |
| B | EtherNet connector                        | Connect an EtherNet device.  |
| C | USB connector                             | Connect a USB device. Do not plug or unplug it during measurement operation. Otherwise measurement time may be affected or data may be destroyed.  |
| D | RS-232C connector                         | Connect an external device such as a programmable controller.  |
| E | DVI-I connector                           | Connect a monitor.   |
| F | I/O connector (control lines, data lines) | Connect the controller to external devices such as a sync sensor and PLC.  |
| G | EtherCAT address setup volume             | Used to set a node address (00 to 99) as an EtherCAT communication device.   |
| H | EtherCAT communication connector (IN)     | Connect the opposed EtherCAT device.   |
| I | EtherCAT communication connector (OUT)    | Connect the opposed EtherCAT device.   |
| J | Encoder connector                         | Connect an encoder.  |
| K | Camera connector                          | Connect cameras.   |
| L | Power supply terminal connector           | Connect a DC power supply. Wire the controller independently on other devices. Wire the ground line. Be sure to ground the controller alone. Perform wiring using the attached power supply connector. |

### Example of the FZ5 Sensor Controllers LCD-integrated type (4-camera type)



### Example of the FZ5-Lite Sensor Controllers LCD-integrated type (4-camera type)



|      | Name                                      | Description   |
|------|---|---|
| [1]  | POWER LED                                 | Lit while power is ON.  |
| [2]  | RUN LED                                   | Lit while the controller is in Run Mode.  |
| [3]  | ERROR LED                                 | Lit when an error has occurred.   |
| [4]  | I/O connector (control lines, data lines) | Connect the controller to external devices such as a sync sensor and PLC.   |
| [5]  | Camera connector                          | Connect cameras.  |
| [6]  | Power                                     | Connect a DC power supply. Wire the power supply unit independently of other devices. After wiring, replace the terminal cover.   |
| [7]  | Ground terminal                           | Connect the ground wire. Make sure that the controller is grounded with a separate ground wire.   |
| [8]  | Monitor connector (analog RGB)            | Connect a monitor. (Provided with Lite controller type only)  |
| [9]  | RS-232C/RS-422 connector                  | Connect an external device such as a personal computer or PLC.  |
| [10] | USB connector                             | Connect a track ball, mouse and USB memory. A total of four USB ports are provided and any of them can be used. However, when connecting two or more USB memories, do not connect them to adjacent ports. Doing so may cause the USB memories to come into contact, resulting in malfunction or damage. |
| [11] | EtherNet connector                        | Connect the controller to a personal computer.  |
| [12] | Touch pen (holder)                        | A touch pen is stored. (Provided with the LCD integrated type only)   |

## Processing Items

| Group                     | Icon | Processing Item             | Corresponding Page in the Catalog   |
|---------------------------|------|-----------------------------|---|
| Inspections / Measurement |      | Search                      | P16   |
|                           |      | Flexible Search             | P16   |
|                           |      | Sensitive Search            | P16   |
|                           |      | ECM Search                  | P16   |
|                           |      | EC Circle Search            | P16   |
|                           |      | Shape Search II             | P16   |
|                           |      | Shape Search III            | P16   |
|                           |      | EC Corner                   | P16   |
|                           |      | Ec Cross                    | P16   |
|                           |      | Classification              | P17   |
|                           |      | Edge Position               | P16   |
|                           |      | Edge Pitch                  | P16   |
|                           |      | Scan Edge Position          | P16   |
|                           |      | Scan Edge Width             | P16   |
|                           |      | Circular Scan Edge Position | P16   |
|                           |      | Circular Scan Edge Width    | P16   |
|                           |      | Intersection                | P16   |
|                           |      | Color Data                  | P17   |
|                           |      | Gravity and Area            | P17   |
|                           |      | Labeling                    | P17   |
|                           |      | Label Data                  |   |
|                           |      | Defect                      | P17   |
|                           |      | Precise Defect              | P17   |
|                           |      | Fine Matching               | P16   |
|                           |      | Character Inspect           | P17   |
|                           |      | Date Verification           | P17   |
|                           |      | Model Dictionary            |   |
|                           |      | 2DCode *2                   | P17   |
|                           |      | Barcode *1                  | P17   |
|                           |      | Circle Angle                | P17   |
|                           |      | Glue Bead Inspection        | P17   |
| Image Capturing           |      | Camera Image Input          |   |
|                           |      | Camera Image Input FH       | This is a processing item specific to the FH Sensor Controller to input images from high-speed cameras. |

| Group                               | Icon | Processing Item             | Corresponding Page in the Catalog  |
|-------------------------------------|------|-----------------------------|--|
| Image Capturing                     |      | Camera Image Input HDR      | Create high-dynamic range images by acquiring several images with different conditions.  |
|                                     |      | Camera Image Input HDR Lite | HDR function for FZ-SQ□ Intelligent Compact Cameras.   |
|                                     |      | Camera Switch               | To switch the cameras used for measurement. Not input images from cameras again.   |
|                                     |      | Measurement Image Switching | To switch the images used for measurement. Not input images from camera again.   |
|                                     |      | Position Compensation       | Used when positions are differed. Correct measurement is performed by correcting position of input images.   |
| Correcting Images                   |      | Filtering                   | Used for processing images input from cameras in order to make them easier to be measured.   |
|                                     |      | Background Suppression      | To enhance contrast of images by extracting color in specified brightness.   |
|                                     |      | Brightness Correct Filter   | Track brightness change of entire screen and remove gradual brightness change such as uneven brightness.   |
|                                     |      | Color Gray Filter           | Color image is converted into monochrome images to emphasize specific color.   |
|                                     |      | Extract Color Filter        | Convert color image to color extracted image or binary image.  |
|                                     |      | Anti Color Shading          | To remove the irregular color/pattern by uniformizing max.2 specified colors.  |
|                                     |      | Stripes Removal Filter II   | Remove the background pattern of vertical, horizontal and diagonal stripes.  |
|                                     |      | Polar Transformation        | Rectify the image by polar transformation. Useful for OCR or pattern inspection printed on circle.   |
|                                     |      | Trapezoidal Correction      | Rectify the trapezoidal deformed image.  |
|                                     |      | Machine Simulator           | How the alignment marks would move on the image when each stage or robot axis is controlled can be checked.  |
|                                     |      | Image Subtraction           | The registered model image and measurement image are compared and only the different pixels are extracted and converted to an image.   |
|                                     |      | Advanced filter             | Process the images acquired from cameras in order to make them easier to measure. This processing item consolidates existing image conversion filtering into one processing item and adds extra functions. |
|                                     |      | Panorama                    | Combine multiple image to create one big image.  |
|                                     |      | Macro                       | Advanced arithmetic processing can be easily incorporated into workflow as macro processing items.   |
|                                     |      | Macro Calculation           | This function is convenient when the user wants to calculate a value using an original calculation formula or change the set value or system data of a processing item.                                    |
| Assisting inspections / measurement |      | Calculation                 | Used when using the judge results and measured values of Proctem which are registered in processing units.   |
|                                     |      | Line Regression             | Used for calculating regression line from plural measurement coordinate.   |
|                                     |      | Circle Regression           | Used for calculating regression circle from plural measurement coordinate.   |
|                                     |      | Precise Calibration         | Used for calibration corresponding to trapezoidal distortion and lens distortion.  |
|                                     |      | User Data                   | Used for setting of the data that can be used as common constants and variables in scene group data.   |
|                                     |      | Set Unit Data               | Used to change the Proctem data (setting parameters, etc.) that has been set up in a scene.  |
|                                     |      | Get Unit Data               | Used to get one data (measured results, setting parameters, etc.) of Proctem that has been set up in a scene.  |
|                                     |      | Set Unit Figure             | Used for re-setting the figure data (model, measurement area) registered in an unit.   |
|                                     |      | Get Unit Figure             | Used for get the figure data (model, measurement area) registered in an unit.  |
|                                     |      | Trend Monitor               | Used for displaying the information about results on the monitor, facilitating to avoid NG and analyze causes.   |
|                                     |      | Image Logging               | Used for saving the measurement images to the memory and USB memory.   |
|                                     |      | Image Conversion Logging    | Used for saving the measurement images in JPEG and BMP format.   |
|                                     |      | Data Logging                | Used for saving the measurement data to the memory and USB memory.   |
|                                     |      | Elapsed Time                | Used for calculating the elapsed time since the measurement trigger input.   |
|                                     |      | Wait                        | Processing is stopped only at the set time. The standby time is set by the unit of [ms].   |

| Group                               | Icon | Processing Item           |   | Corresponding Page in the Catalog |
|-------------------------------------|------|---------------------------|---|-----------------------------------|
| Assisting inspections / measurement |      | Focus                     | Focus setting is supported.   | P15                               |
|                                     |      | Iris                      | Focus and aperture setting is supported.  | P15                               |
|                                     |      | Parallelize               | A part of the measurement flow is divided into two or more tasks and processed in parallel to shorten the measurement time. This processing item is placed at the top of processing to be performed in parallel.  |                                   |
|                                     |      | Parallelize Task          | A part of the measurement flow is divided into two or more tasks and processed in parallel to shorten the measurement time. This processing item is placed immediately before processing to be performed in parallel between Parallelize and Parallelize End. |                                   |
|                                     |      | Statistics                | Used when you need to calculate an average of multiple measurement results.   |                                   |
|                                     |      | Reference Calib Data      | Calibration data and distortion compensation data held under other processing items can be referenced.  |                                   |
|                                     |      | Position Data Calculation | The specified position angle is calculated from the measured positions.   | P14                               |
|                                     |      | Stage Data                | Sets and stores data related to stages.   |                                   |
|                                     |      | Robot Data                | Sets and stores data related to robots.   |                                   |
|                                     |      | Vision Master Calibration | This processing item automatically calculates the entire axis movement amount of the control equipment necessary for calibration.   | P15                               |
|                                     |      | PLC Master Calibration    | Calibration data is created using a communication command from PLC.   | P15                               |
|                                     |      | Convert Position Data     | The position angle after the specified axis movement is calculated.   | P14                               |
|                                     |      | Movement Single Position  | The axis movement that is required to match the measured position angle to the reference position angle is calculated.  | P14                               |
|                                     |      | Movement Multi Points     | The axis movements that are required to match the measured position angles to the corresponding reference position angles are calculated.   | P14                               |
|                                     |      | Detection Point           | Obtains position/angle information by referring to the coordinate values measured with the Measurement Processing Unit.   |                                   |
|                                     |      | Camera Calibration        | By setting the camera calibration, the measurement result can be converted and output as actual dimensions.   | P15                               |
|                                     |      | Data Save                 | The set data can be saved in the controller main unit or as scene data. The data is held even after the FH/FZ power is turned off.  |                                   |

| Group                             | Icon | Processing Item           |  | Corresponding Page in the Catalog |
|-----------------------------------|------|---------------------------|--|-----------------------------------|
| Branching processing              |      | Conditional Branch        | Used where more than two kinds of products on the production line need to be detected separately.                  |                                   |
|                                   |      | End                       | This Procltem must be set up as the last processing unit of a branch.  |                                   |
|                                   |      | DI Branch                 | Same as Procltem "Branch". But you can change the targets of conditional branching via external inputs.            |                                   |
|                                   |      | Control Flow Normal       | Set the measurement flow processing into the wait state in which the specific no-protocol command can be executed. |                                   |
|                                   |      | Control Flow PLC Link     | Set the measurement flow processing into the wait state in which the specific PLC Link command can be executed.    |                                   |
|                                   |      | Control Flow Parallel     | Set the measurement flow processing into the wait state in which the specific parallel command can be executed.    |                                   |
|                                   |      | Control Flow Fieldbus     | Set the measurement flow processing into the wait state in which the specific Fieldbus command can be executed.    |                                   |
| Outputting results                |      | Selective Branch          | Easily branch to multiple destinations.  |                                   |
|                                   |      | Data Output               | Used when you need to output data to the external devices such as PLC or PC via serial ports.                      |                                   |
|                                   |      | Parallel Data Output      | Used when you need to output data to the external devices such as PLC or PC via parallel ports.                    |                                   |
|                                   |      | Parallel Judgement Output | Used when you need to output judgement results to the external devices such as PLC or PC via parallel ports.       |                                   |
|                                   |      | Fieldbus Data Output      | Outputs data to an external device, such as a Programmable Controller, through a fieldbus interface.               |                                   |
| Displaying results on the monitor |      | Result Display            | Used for displaying the texts or the figures in the camera image.  |                                   |
|                                   |      | Display Image File        | Display selected image file.   |                                   |
|                                   |      | Display Last NG Image     | Display the last NG images.  |                                   |

\*1 Bar Codes that can be read : JAN/EAN/UPC (including add-on codes), Code 39, Codabar (NW-7), ITF (Interleaved 2 of 5), Code 93, Code 128, GS1-128, GS1 DataBar (RSS-14 / RSS Limited / RSS Expanded), Pharmacode

\*2 2D Codes that can be read : Data Matrix (ECC200), QR Code

\*1 Bar Codes that can be read : JAN/EAN/UPC (including add-on codes), Code 39, Codabar (NW-7), ITF (Interleaved 2 of 5), Code 93, Code 128, GS1-128, GS1 DataBar (RSS-14 / RSS Limited / RSS Expanded), Pharmacode

\*2 2D Codes that can be read : Data Matrix (ECC200), QR Code

## Dimensions

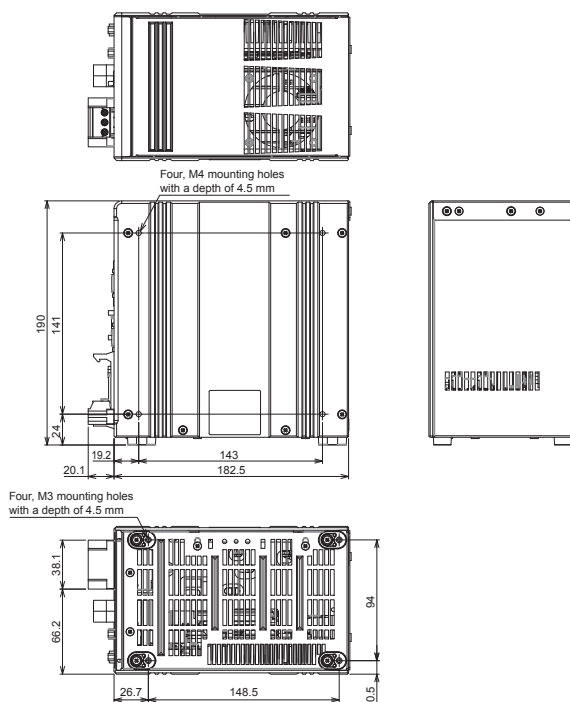
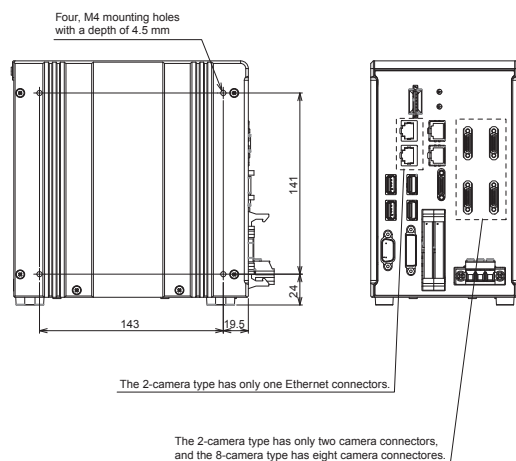
(Unit: mm)

### Series Sensor Controllers

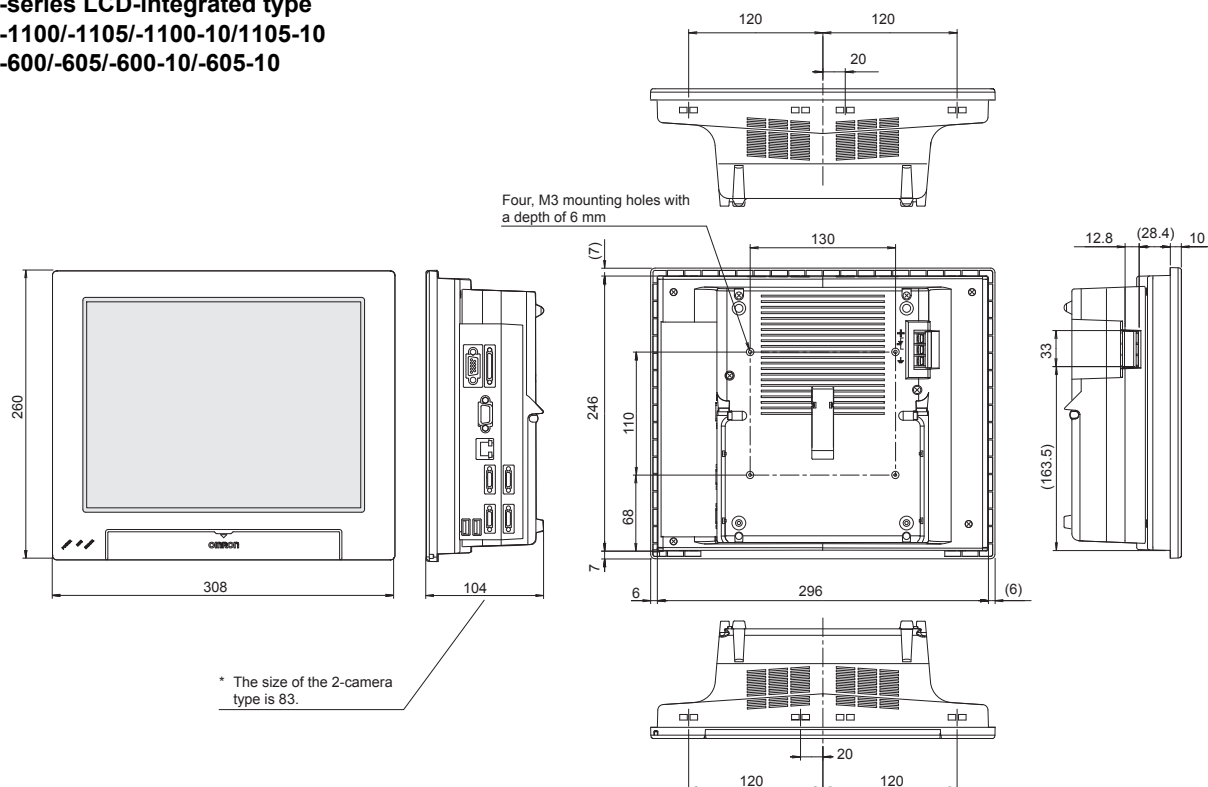
#### FH-series Box-type

#### FH-3050/-3050-10/-3050-20

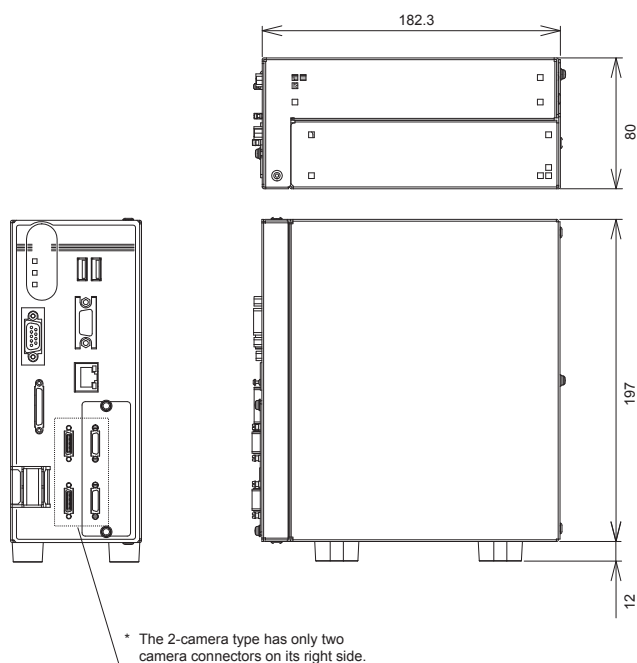
#### FH-1050/-1050-10/-1050-20



## FZ5-series LCD-integrated type FZ5-1100/-1105/-1100-10/1105-10 FZ5-600/-605/-600-10/-605-10



## FZ5-series Lite Box-type FZ5-L350/-L355/-L350-10/-L355-10



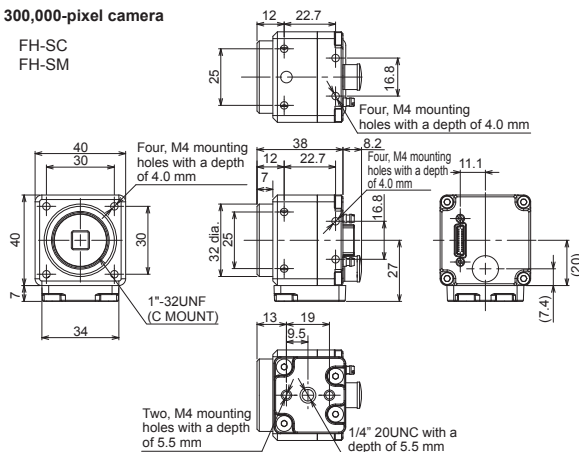


## Cameras

### High-speed CMOS Camera

300,000-pixel camera

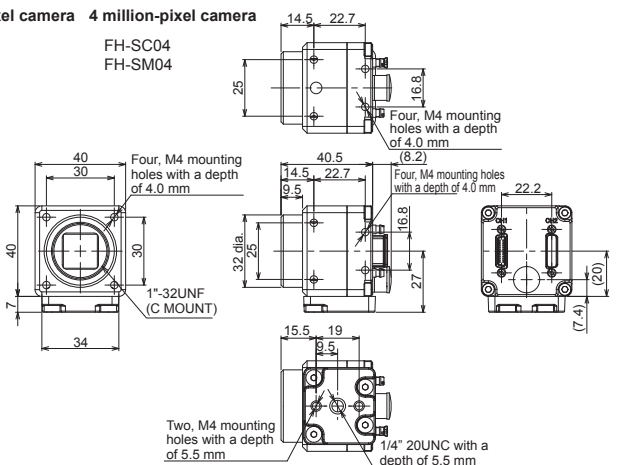
FH-SC  
FH-SM



2 million-pixel camera 4 million-pixel camera

FH-SC02  
FH-SM02

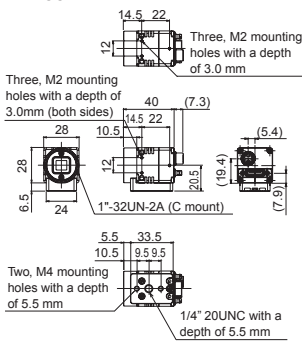
FH-SC04  
FH-SM04



### Digital CCD Cameras

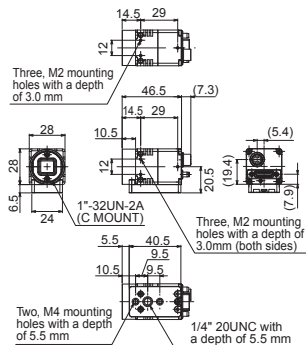
300,000-pixel camera

FZ-S  
FZ-SC



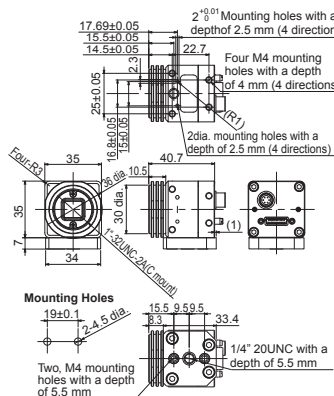
2 million-pixel camera

FZ-S2M  
FZ-SC2M



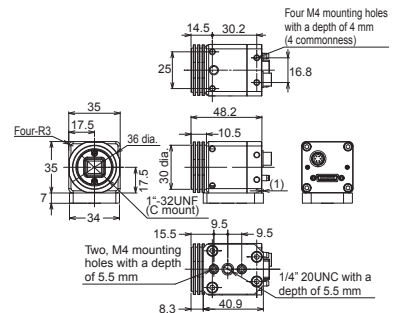
5 million-pixel camera

FZ-S5M2  
FZ-SC5M2



### High-speed CCD Camera

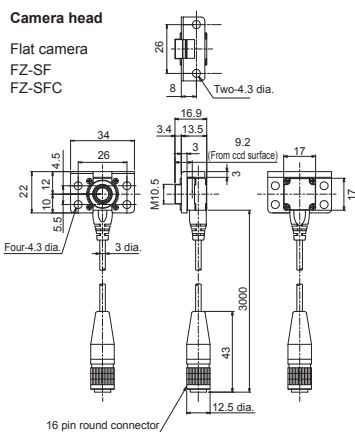
FZ-SH  
FZ-SHC



### Small digital CCD cameras

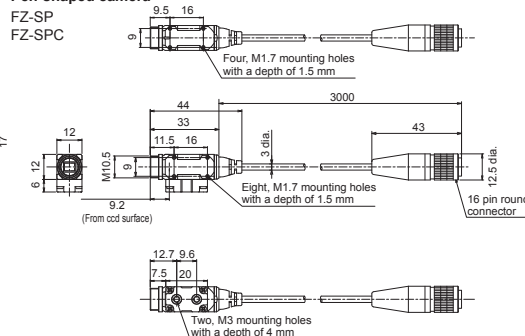
Camera head

Flat camera  
FZ-SF  
FZ-SFC



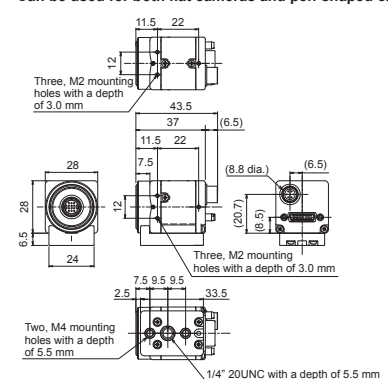
Pen-shaped camera

FZ-SP  
FZ-SPC



Camera amplifier

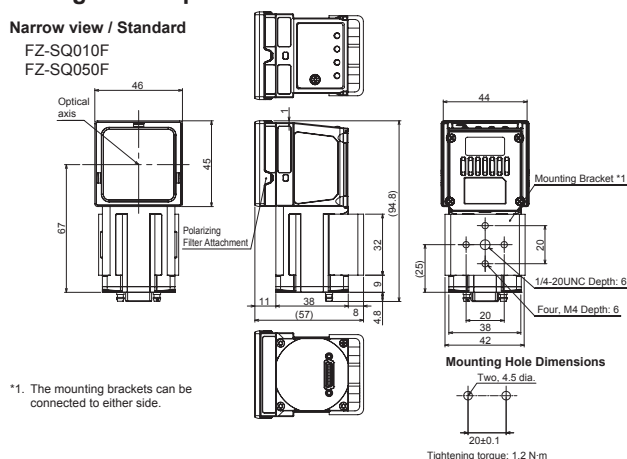
Can be used for both flat cameras and pen-shaped cameras



## Intelligent Compact CMOS Cameras

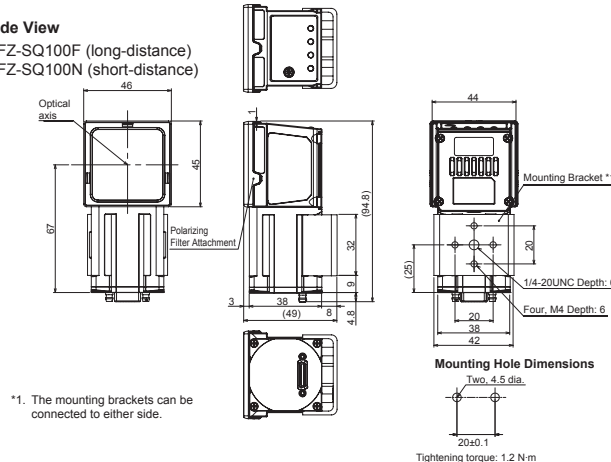
### Narrow view / Standard

FZ-SQ010F  
FZ-SQ050F



### Wide View

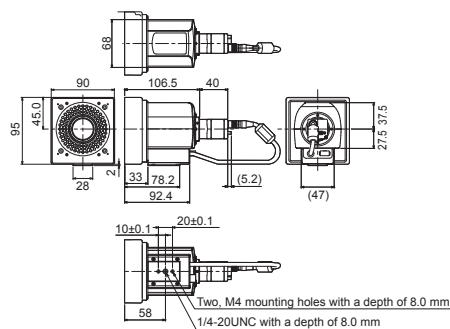
FZ-SQ100F (long-distance)  
FZ-SQ100N (short-distance)



## Intelligent CCD Camera

FZ-SLC15

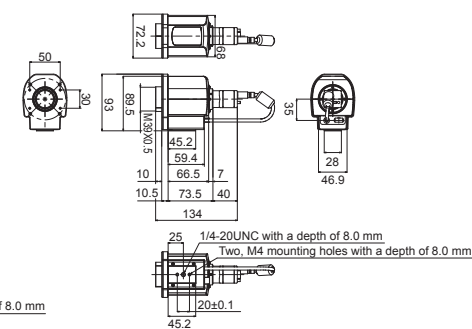
FZ-SLC100



## Autofocus CCD Camera

FZ-SZC15

FZ-SZC100

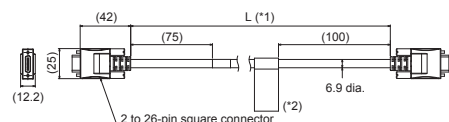


## Cables

### Camera Cable

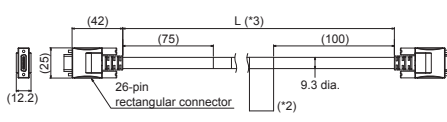
#### Camera Cable

FZ-VS



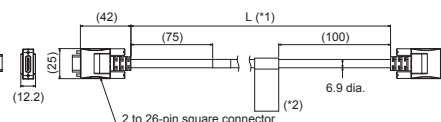
#### Long-distance Camera Cable

FZ-VS2



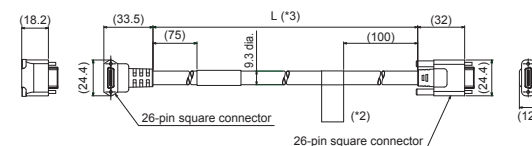
#### Bend resistant Cable

FZ-VSB



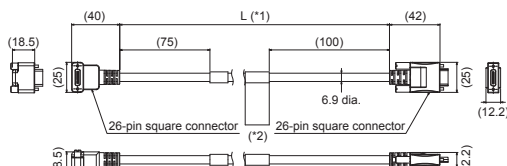
#### Long-distance Right-angle Camera Cable

FZ-VSL2



#### Right-angle Camera Cable

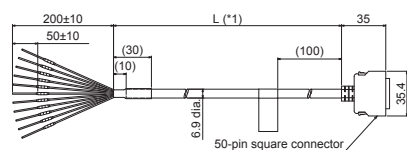
FZ-VSL



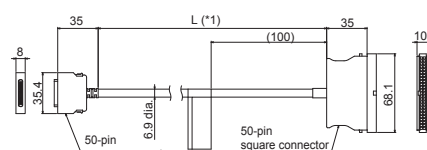
- \*1. Cable is available in 2m/5m/10m.
- \*2. Each camera cables has polarity. Please ensure that the name plate side of the cable is connected to the controller.
- \*3. Cable is available in 15m.

## Parallel Cable

FZ-VP



FZ-VPX

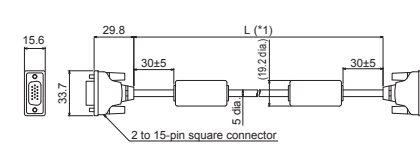


\*1. cable is available in 2m/5m.

\*1. cable is available in 2m/5m.

## Monitor Cable

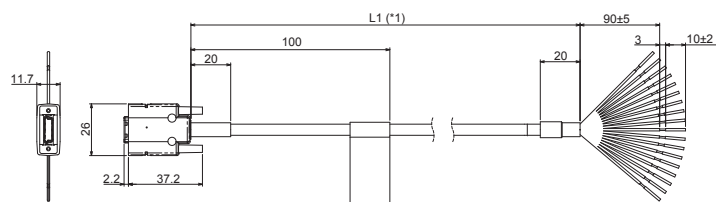
FZ-VM



\*1. cable is available in 2m/5m.

## Encoder Cable

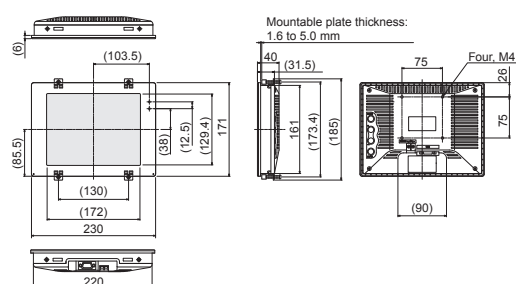
FH-VR



\*1. Cable is available in 1.5 m.

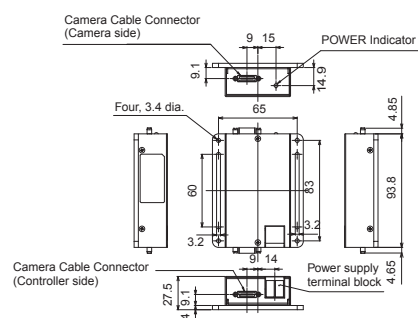
## LCD Monitor

FZ-M08



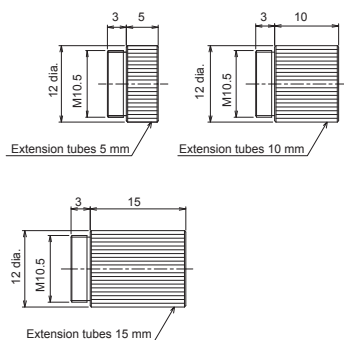
## Camera Cable Extension Unit

FZ-VSJ



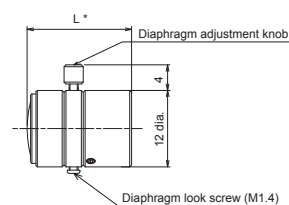
### Extension Tubes for Small Camera

FZ-LESR



## Lens for Small Camera

## FZ-LES Series

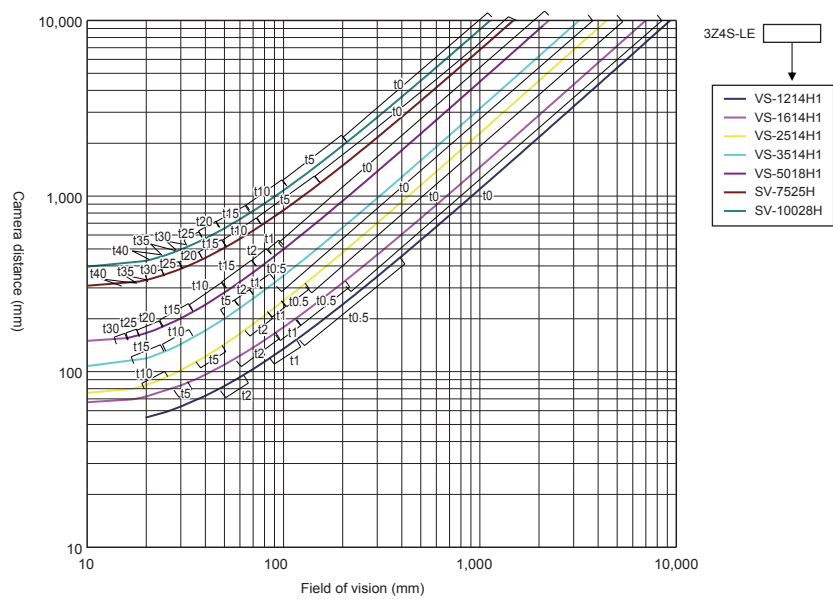


\* Overall length is available in 16.4mm/19.7mm/23.1mm/25.5mm.

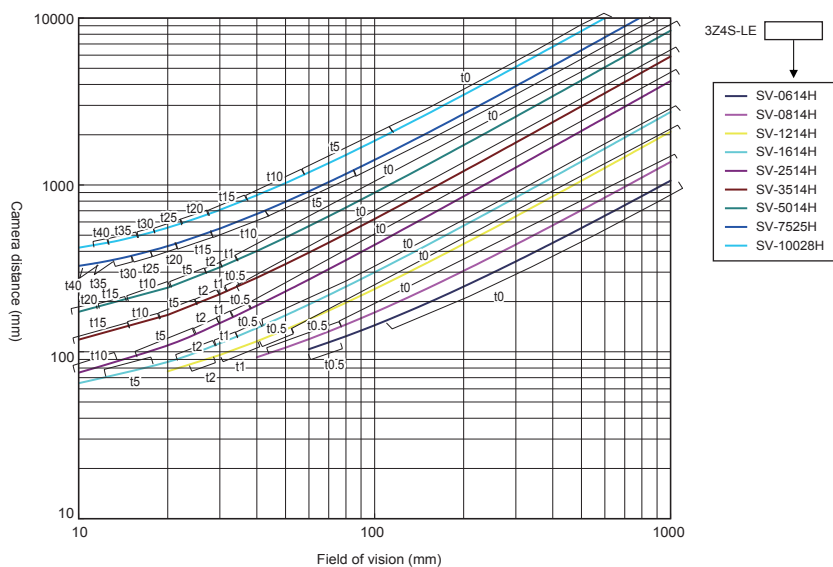
# FH-Series

## Optical Chart

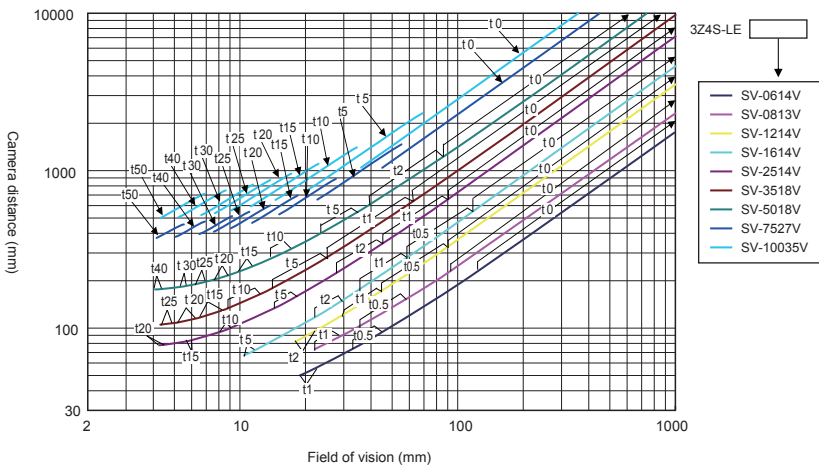
High-speed CMOS Camera FH-S□04, 4 million-pixel



High-speed CMOS Camera FH-S□02, 2 million-pixel

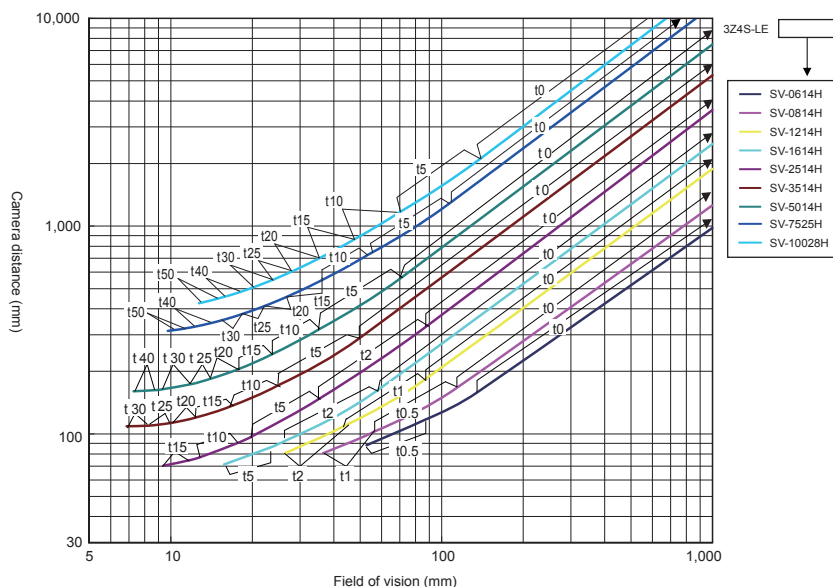


High-speed CMOS Camera FH-S□, High-speed CCD Camera FZ-SH□, Digital CCD Camera FZ-S□  
300,000-pixel

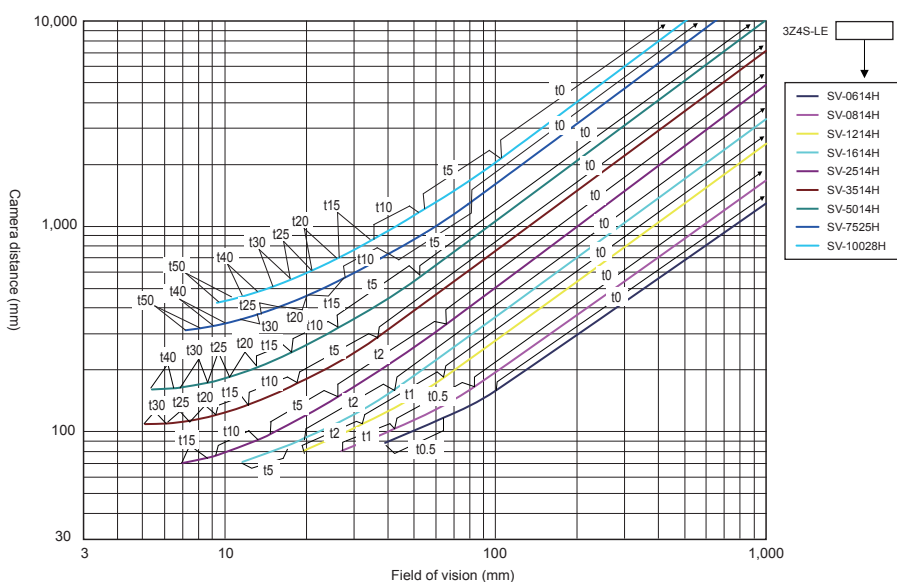




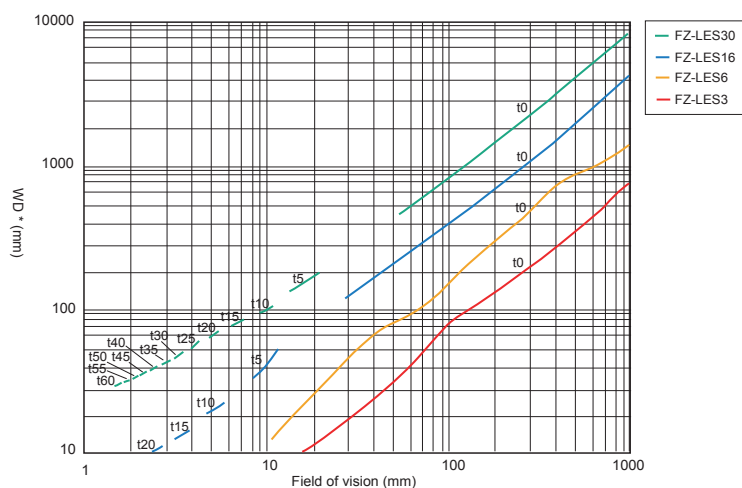
## Digital CCD Camera FZ-S□5M2, 5 million-pixel



## Digital CCD Camera FZ-S□2M, 2 million-pixel

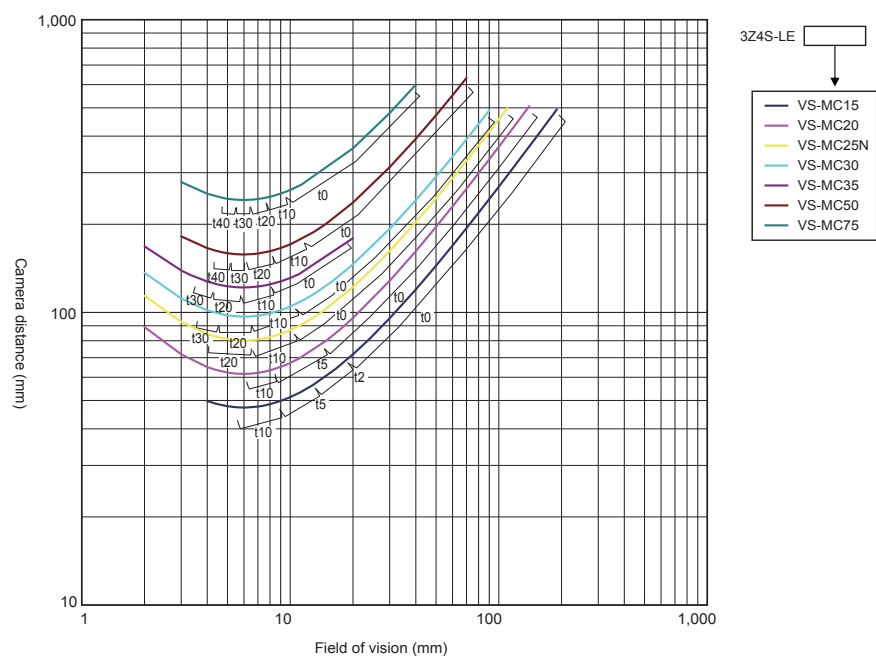


## Small Digital CCD Cameras FZ-SF□, FZ-SP□, 300,000-pixel

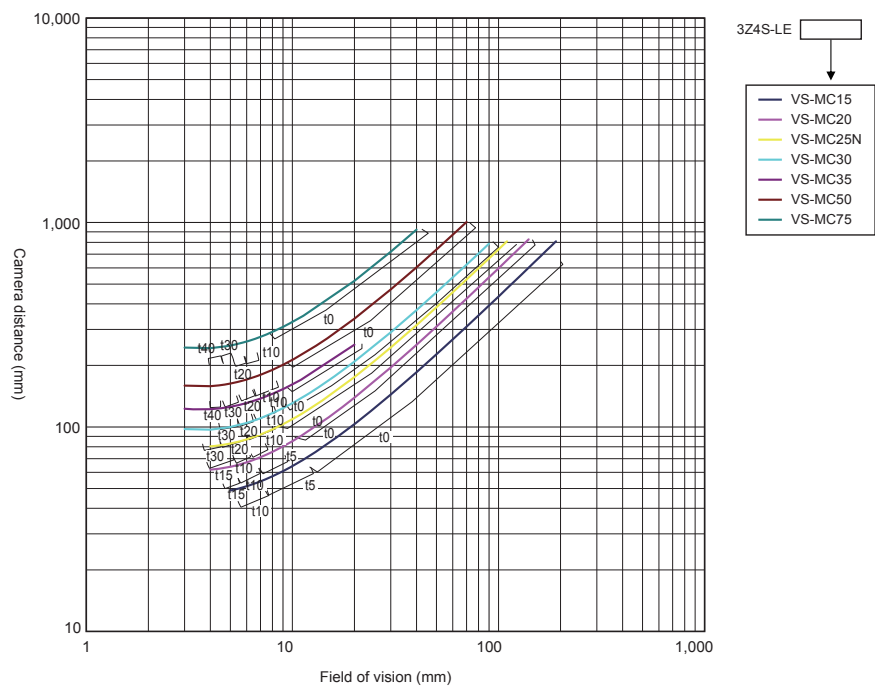


\* The vertical axis represents WD, not installation distance.

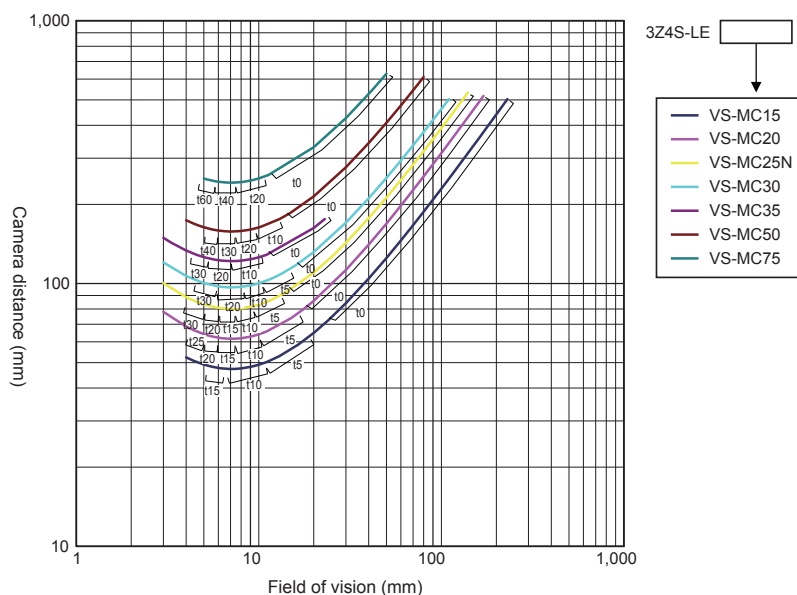
High-speed CMOS Camera FH-S□02, 2 million-pixel (Vibrations and shocks resistant)



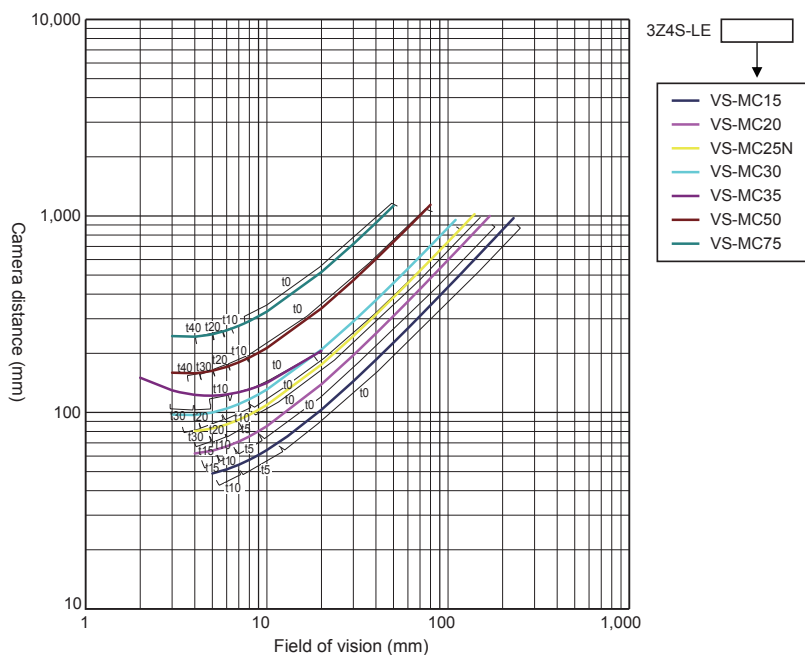
High-speed CMOS Camera FH-S□, High-speed CCD Camera FZ-SH□, Digital CCD Camera FZ-S□  
300,000-pixel (Vibrations and shocks resistant)



# Digital CCD Camera FZ-S□5M2, 5 million-pixel (Vibrations and shocks resistant)

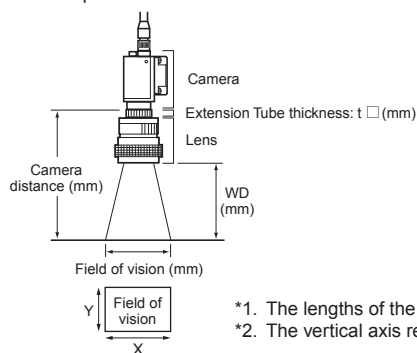


# Digital CCD Camera FZ-S□2M, 2 million-pixel (Vibrations and shocks resistant)



## Meaning of Optical Chart

The X axis of the optical chart shows the field of vision (mm) (\*1),  
and the Y axis of the optical chart shows the camera installation distance (mm) (\*2).

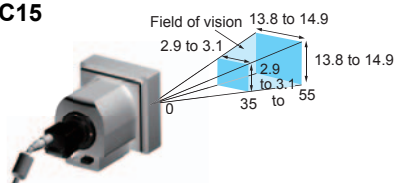


- \*1. The lengths of the fields of vision given in the optical charts are the lengths of the Y axis.
- \*2. The vertical axis represents WD for small cameras.

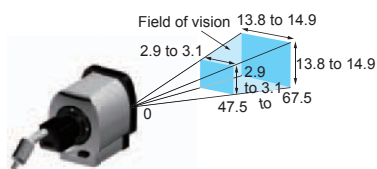
## Intelligent CCD Cameras, Autofocus CCD Cameras

### • Narrow View

#### FZ-SLC15

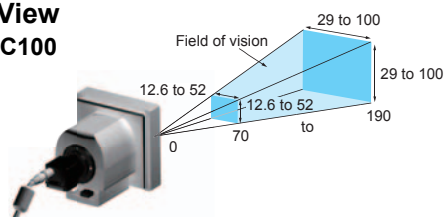


#### FZ-SZC15

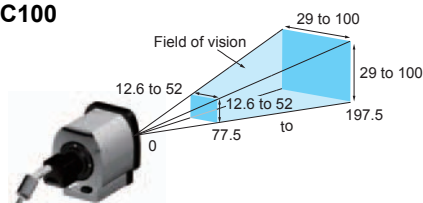


### • Wide View

#### FZ-SLC100



#### FZ-SZC100

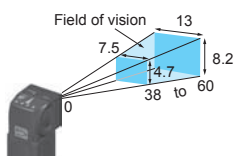


\* Field of Vision of Intelligent Cameras and Autofocus Cameras  
The images displayed on the monitor will be rectangular images of 640×480 pixels.  
The valid processing area for measurements is the 480×480-pixel area in the middle.  
The above figures show the dimensions of the middle 480×480 pixels.

## Intelligent Compact Cameras

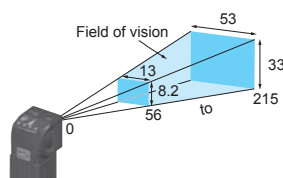
### • Narrow View

#### FZ-SQ010F



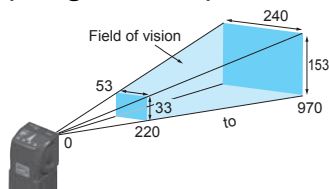
### • Standard

#### FZ-SQ050F



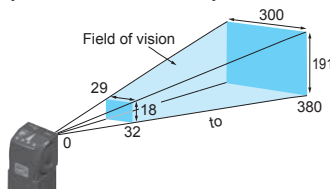
### • Wide View (Long-distance)

#### FZ-SQ100F



### • Wide View (Short-distance)

#### FZ-SQ100N



## Related Manuals

| Man.No. | Model number | Manual  |
|---------|--------------|---|
| Z340    | FH/FZ5       | Vision System FH/FZ5 Series User's Manual                             |
| Z341    | FH/FZ5       | Vision System FH/FZ5 Series Processing Item Function Reference Manual |
| Z342    | FH/FZ5       | Vision System FH/FZ5 Series User's Manual for Communications Settings |
| Z343    | FH           | Vision System FH Series Operation Manual for Sysmac Studio            |



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