FH-Series
Vision System

OMRON

AI-based defect detection that exceeds the ability of expert inspectors

sysmac
always in control

A better option for inspections requiring high sensitivity

Meeting sensory inspection needs amid heightened product quality demands

Manufacturers face pressure to improve processes where highly detailed visual inspection is required to assure product quality. It's important to reliably identify subtle defects even on flexible lines producing a wide range of items. This tedious, slow, and error prone inspection step can now be improved with the latest machine vision and artificial intelligence technologies that can recognize intricate object features and can quickly learn pass/fail inspection criteria. While many AI solutions faces challenges with large amounts of image data, specialized hardware and engineering expertise, Omron is now offering an easy to implement and reliable AI machine vision technology helping enable its use in a wide variety of applications.

AI

AI reproduces human sensibility and experience

To solve these challenges, Omron developed new defect detection AI that reproduces the techniques of skilled inspectors. This AI is now part of the FH Vision System.

Barriers to automation

1 Defect detection dependent on human senses

2 Inspection criteria dependent on workers' expertise

3 Shortage of engineers who examine automation

AI Solutions

1 Page: 4
AI captures defects with human-like sensitivity

2 Page: 6
AI accepts good products with the precision of an experienced inspector

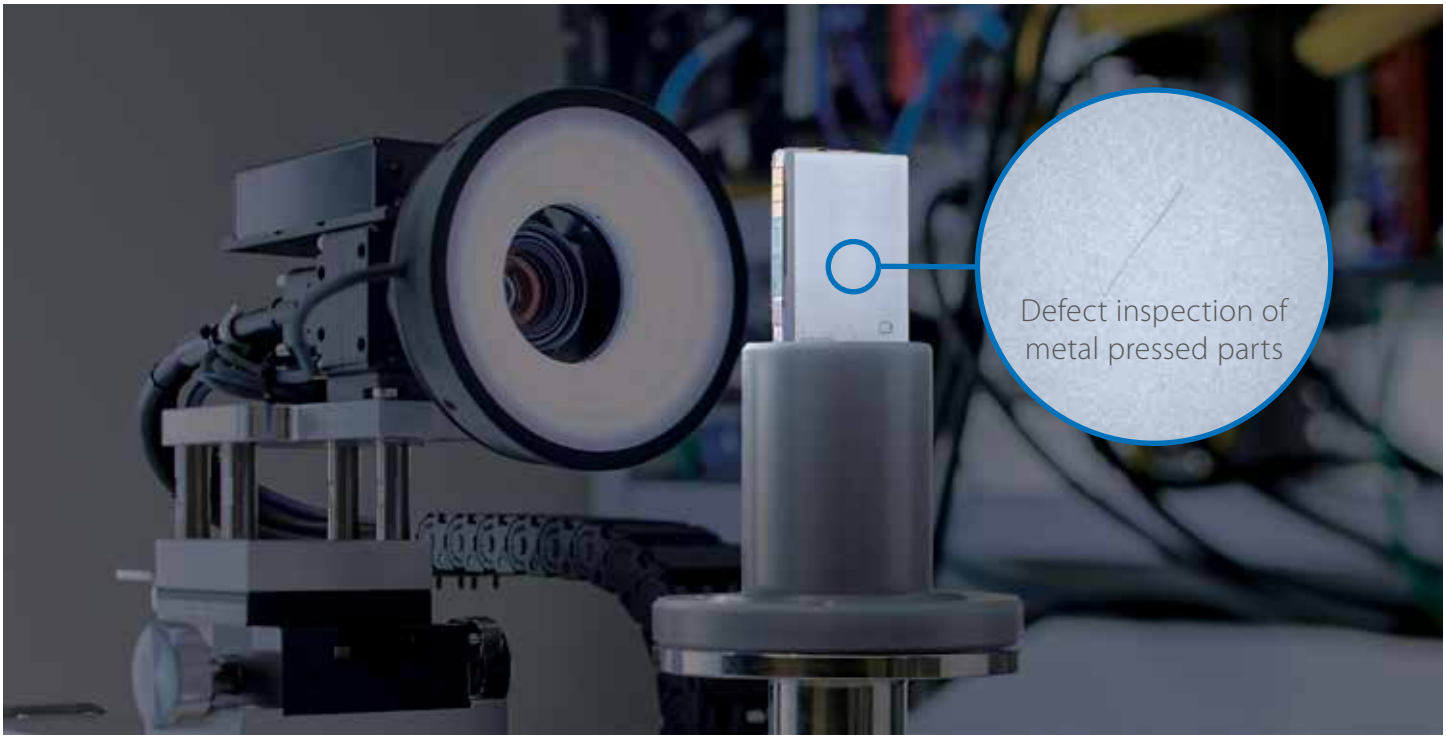
3 Page: 8
No special environment is required

AI captures defects with human-like sensitivity

Defect detection tasks that rely on human sensibility are a challenge to automate. Fortunately, powerful new AI technology can match the skills and capabilities of experienced inspectors.

The latest capabilities of the FH Vision System include a new AI-based image filter that reproduces the technique that skilled inspectors use to identify a defect on any product background. Scratches and blemishes that were once difficult to capture can now be identified even without the use of samples or adjustment.

Automating human vision-based inspection with the FH Series



Captured image

Previous detection image
Cannot separate a scratch from noise

Detection image
Can detect a scratch only

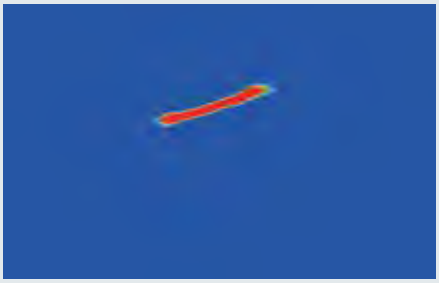
AI reproduces human expertise through learned criteria

AI Scratch Detect Filter[1]

The AI Scratch Defect Filter learns by means of images in which human inspectors noticed defects. Whereas previous inspection methods found the unexpected size, shape or color of a particular defect to be a barrier to automation, AI successfully extracts abnormalities by judging their features without definition. The learned data facilitates defect detection on processed surfaces and other uneven backgrounds that previously posed an insurmountable challenge.

Captured image

Extracted scratch (internal image)

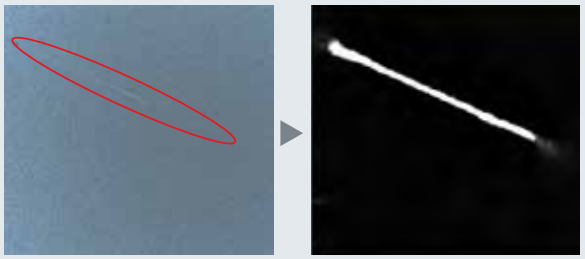


1. The FH-UMAI1 Scratch Detect AI Software Installer is required to use AI Scratch Detect Filter.

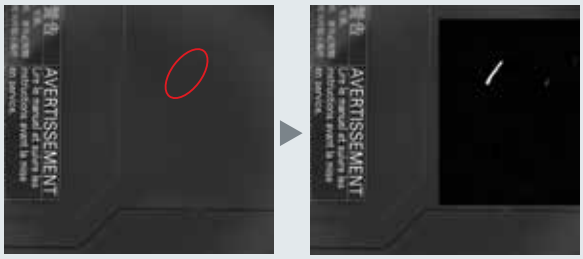
Automatic detection of various defects without definition and learning

Regardless of material type, color, or size, defects can be extracted reliably without previously required definition and adjustment.

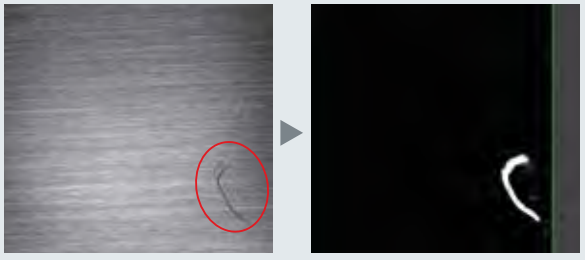
Scratch on sandblasted metal



Scratch on resin products



Black scratch on hairline finish



White scratch on shaded hairline finish

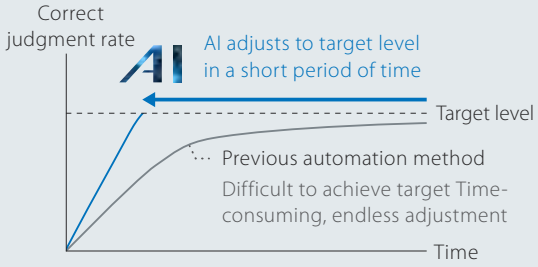
AI accepts good products with the precision of an experienced inspector

Sensory inspection requires a certain tolerance for variations that don't pass a certain threshold.

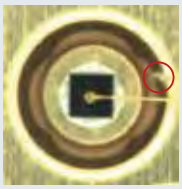
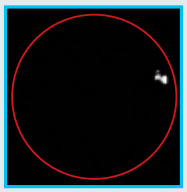
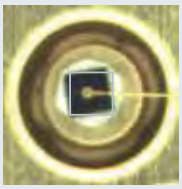
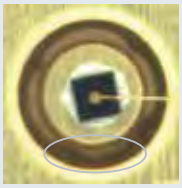
Determining what variations are acceptable is a key capability of expert inspectors and poses a challenge for automated inspection systems.

The FH Series can determine acceptable variation tolerances.

Omron's AI Fine Matching tool learns from the image data of non-defective products to quickly acquire the "expertise" that inspectors develop over the course of many years. This reduces costs and boosts productivity through automation.



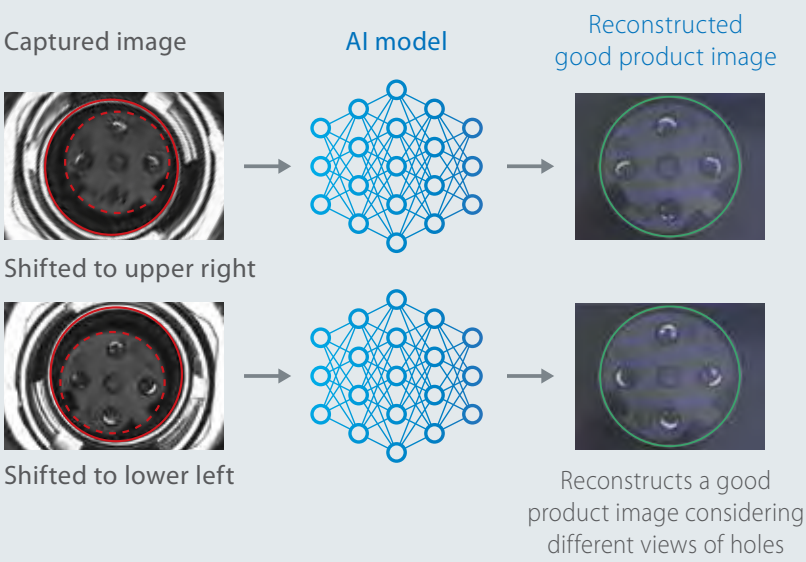
Target inspection level: Reduce overdetection

Contamination inspection of LED modules	Captured image	Difference image: Previous automation method Detects position differences, not foreign materials, as defects	Difference image: AI Detects foreign materials only and ignores position differences
Defective product With foreign materials		 Overdetection	 Detects foreign material only
Non-defective product Position difference of die		 Overdetection	 Judges as non-defective product
Non-defective product Position difference and light variation of surrounding part		 Overdetection	 Judges as non-defective product

AI reduces overdetection

AI Fine Matching

AI Fine Matching identifies a future that is not included in good products as a defect.
AI learns images of good products with variations, and generates an AI model.
Every time an inspection is carried out, AI reconstructs a model that is presumed to be a good product.
AI extracts a difference between the reconstructed good product image and a captured image to identify a defect, reducing overdetection.



AI makes it easy to avoid overdetection

PATENT PENDING[1]

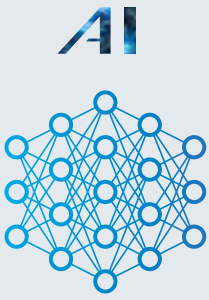
Three quick steps on the settings screen guide the user through the process of creating the good product model with the minimum number of images.

1 Prepare images

Although standard AI processing requires a huge number of images for learning, the FH Series requires only 100 to 200 images.

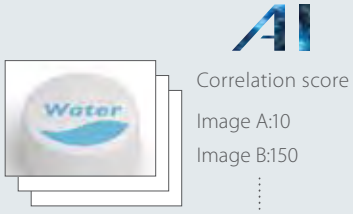
2 Create model

The system suggests images to learn, helping to complete the good product model.



3 Check results

Test is automatically performed using images prepared in Step 1. You don't need to adjust parameters for differential inspections.



When a good product is judged as defective, AI gives each image a correlation score to visualize the degree of overdetection. This facilitates selecting images that need to be learned to reduce overdetection.

1. "Patent pending" means that we applied for a patent in Japan, and "Patented" means that we obtained a patent in Japan. (as of May 2020)

No special environment is required

With the FH Series, there's no need for high-end hardware or specialized engineers who can configure the system to suit your needs. Our general-purpose vision system makes it easier than ever to introduce AI into production sites.

Vision controller with AI functionality

Artificial intelligence has traditionally required a high-end environment, but our lightweight creative solution comes in the form of user-friendly processing items that have been integrated into our popular FH Series hardware.

No special hardware for AI required

It used to be difficult to introduce AI technology to many inspection processes because of its hardware requirements. The FH Series does not require special hardware, facilitating the introduction of this technology. The FH Series does not require special hardware, facilitating introduction.

No AI engineer required

In order to reliably use AI technology in processes, the engineer used to have not only image processing skills but also programming and maintenance skills. With the FH Series, however, you can use AI technology just like operating a standard vision sensor. No dedicated AI engineer is required.

FH-5550/5050
High-speed, Large-capacity Controller

Intel® Core™ i7 processor

Outstanding processing speed

Ultra-high-speed CPU

4 times faster[1] than our previous models

Large-capacity RAM

10 times larger[1] than our previous models

1 Machine control network
Cycle: 125 µs

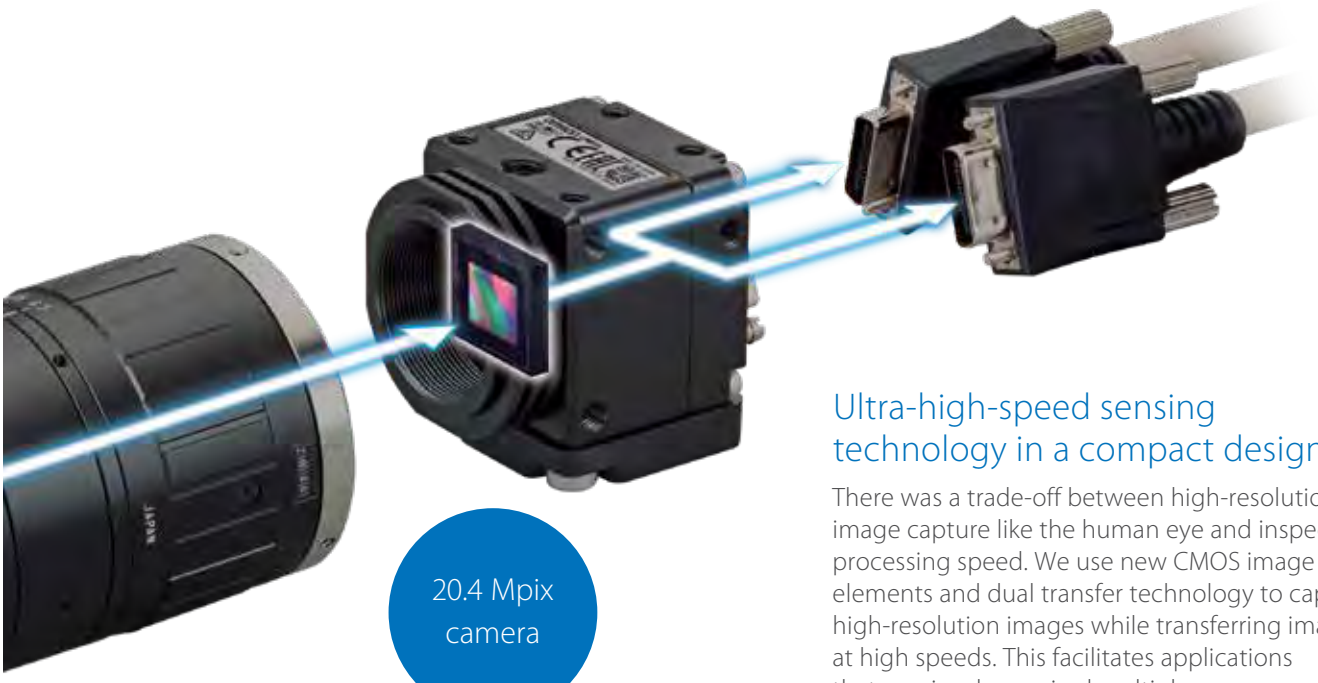
EtherCAT®

2 Data output
High-speed interface: USB 3.0

1. The FH-5550 Controller is compared with the FH-3050 Controller.

High-resolution cameras

We offer a range of cameras that can capture high-resolution images suitable for sensory inspection at high speeds.



20.4 Mpix camera

Ultra-high-speed sensing technology in a compact design

There was a trade-off between high-resolution image capture like the human eye and inspection processing speed. We use new CMOS image elements and dual transfer technology to capture high-resolution images while transferring images at high speeds. This facilitates applications that previously required multiple cameras or a mechanism to move a camera.

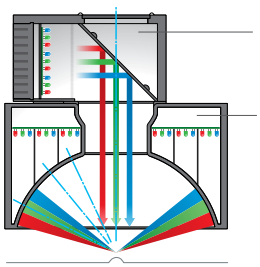
MDMC light with flexible lighting patterns

This light can be adjusted to defects by combining the illumination colors and angles like humans do. Even if new objects or inspection items are added after installation, there is no need to add or change the light—just change the illumination pattern. The illumination patterns can be registered as settings, facilitating duplicating production lines.

MDMC[2] Light

Illumination structure

You can choose the best pattern by combining illumination directions x full color RGB x 128 brightness levels of 13 blocks.



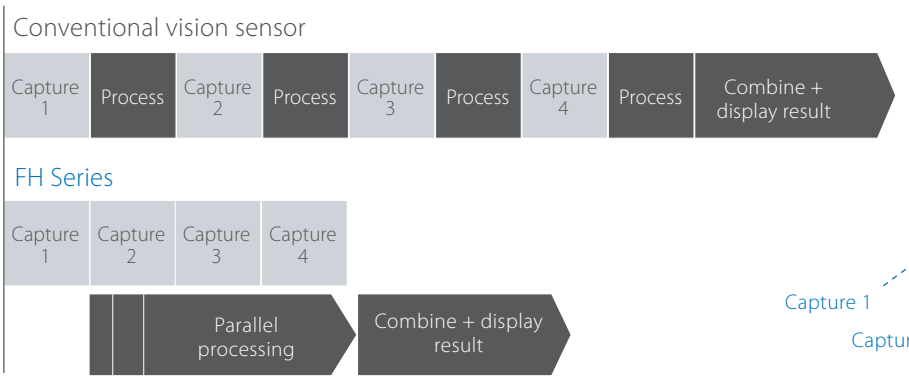
2. MDMC…Multi-Direction Multi-Color

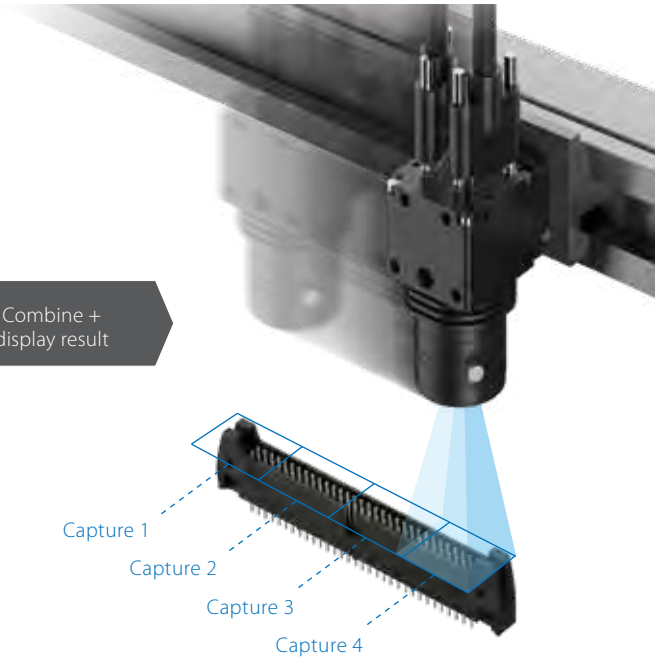
Software for flexible automation

Flexible image capture

Multi-Trigger Imaging captures long objects at high speeds

The Multi-Trigger Imaging function can capture images and process them in parallel, leveraging the speed of the multi-core processor to capture long objects at high speeds.





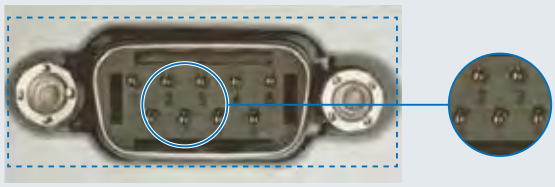
Camera Image Input HDR optimizes contrast

Camera Image Input HDR helps create optimized HDR images under variable ambient conditions. Once you specify the optimum area to capture on the image, the FH Series automatically adjusts the shutter speed while capturing images and combining the images.

Adjusts brightness to suit your specified area

Optimized for the entire field of view

While the contrast around the pins is low, reduced reflection enables capturing a clear image of the entire connector.

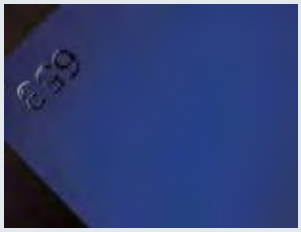


Optimized for the connector

Although reflection occurs at the surrounding part, a clear image of the pins can be captured.

Detects low-contrast defects in high-contrast mode

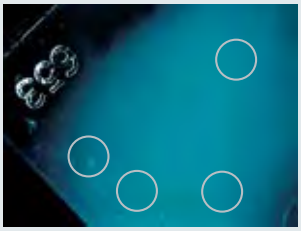
Previously



Low contrast makes the surface appear uniform.

▶

HDR high-contrast image



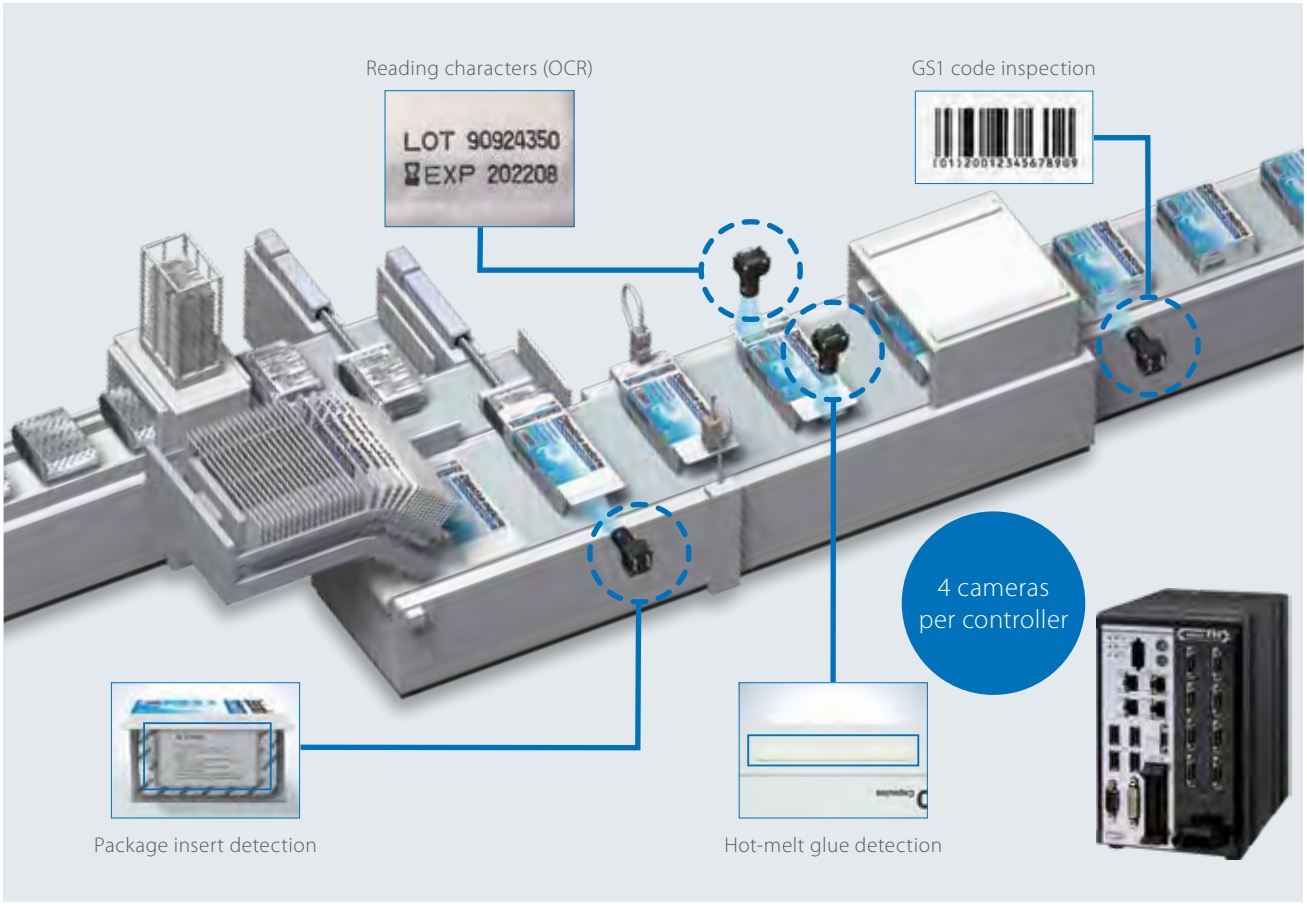
Increased contrast reveals many scratches and blemishes.

Parallel processing for different inspections

Multi-Line Random-Trigger inspects at up to four different timings

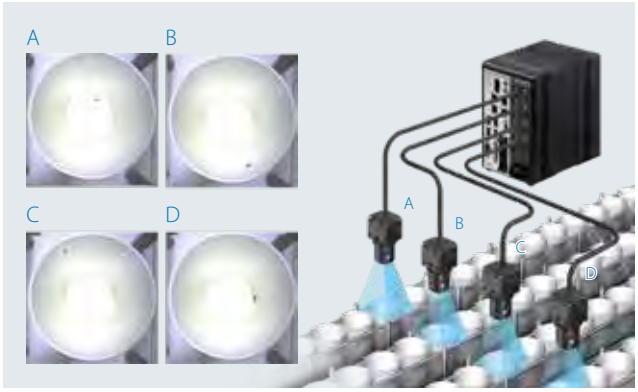
A single controller can perform inspections at different points at different timings. Controllers installed for each process can be integrated into one, reducing initial costs and saving space.

Packaging process of pharmaceuticals



Contamination inspection of beverage containers

A single controller that can control each line saves initial costs and space.



Appearance inspection of rechargeable battery cells

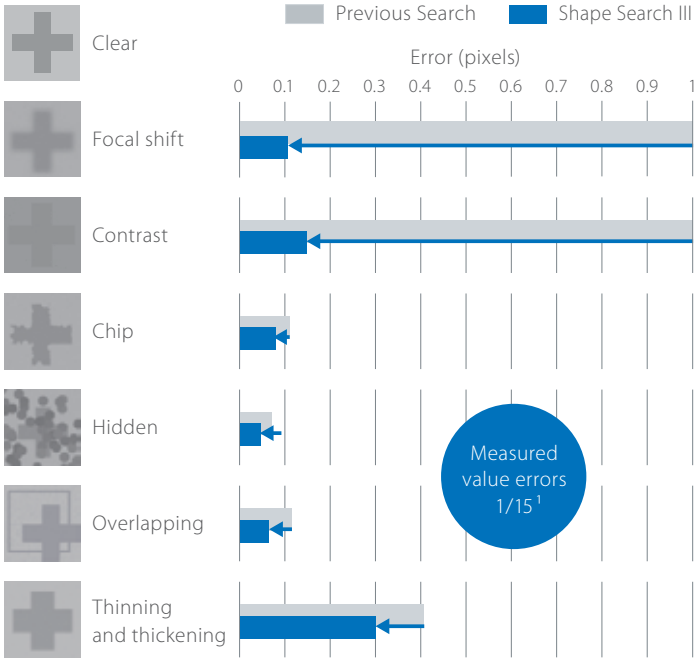
Four cameras can be connected to one controller, enabling simultaneous inspection of dents and scratches from four directions.

Software for flexible automation

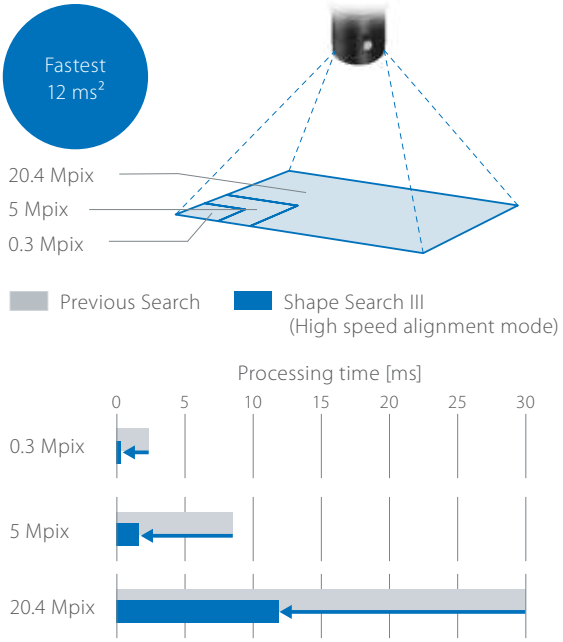
High-speed, high-precision positioning

Shape Search III is robust against shape variations

High-precision and robust positioning is possible even under the adverse conditions, such as changes in environments and materials.

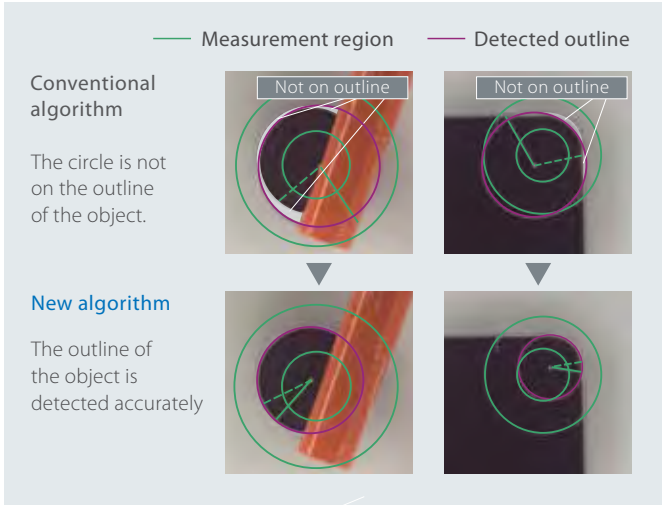


A 20.4 Mpix camera can search a positioning mark in as fast as 12 ms*2, and a 5 Mpix camera, widely used for alignment applications, in as fast as 2 ms.



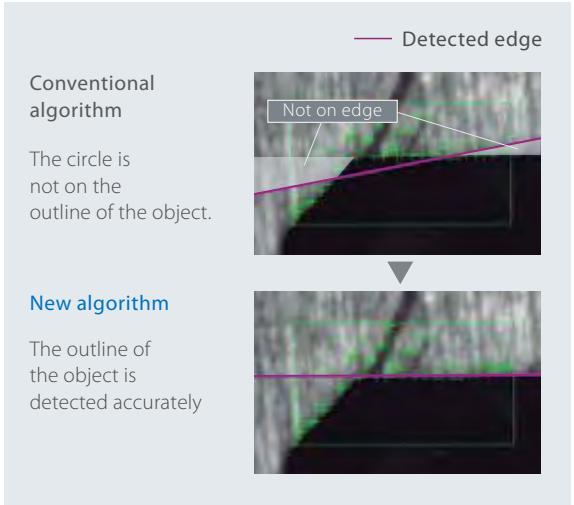
Circular Scan Edge Position accurately estimates the center and radius of a circle

The new algorithm accurately detects a whole circle from a part of the circle.



Scan Edge Position removes noise to detect edges

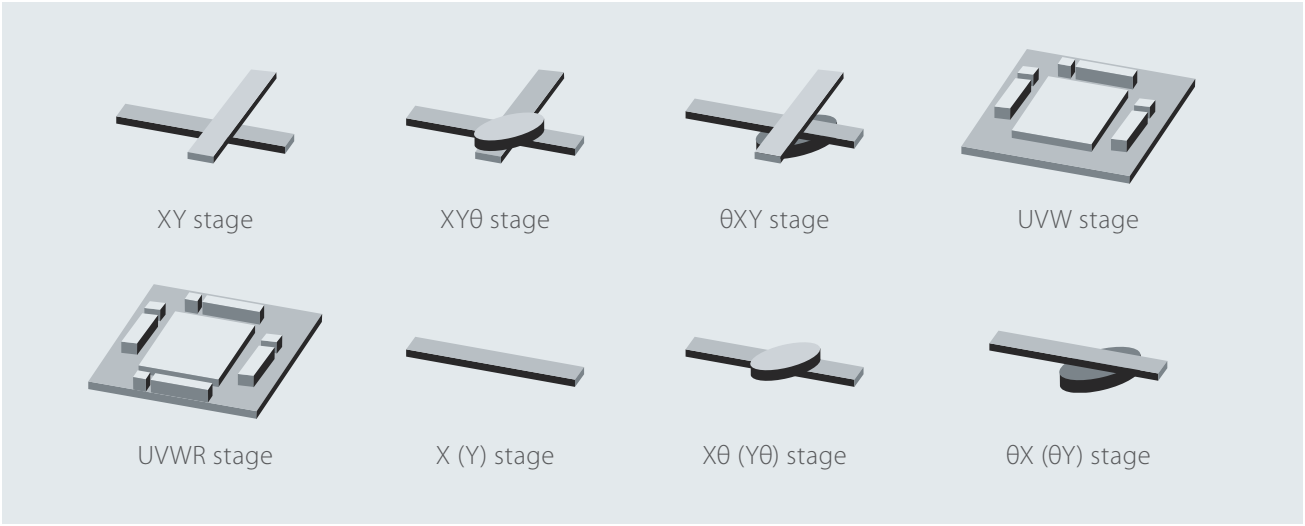
This algorithm accurately estimates lines even when the edges are unclear due to variations in objects or disturbance.



1. The value measured under our specified conditions is provided for reference.
2. The value measured under our specified conditions is provided for reference. 20.4 Mpix camera.

Stage Data calculates for various stages

The popular single axis + θ axis stages as well as UVW stages can be used. The use of the same axis for both handling and positioning simplifies machine configuration.



Robot Setting Tool simplifies connecting robots

Communication programs to connect robots from various vendors and FH flowcharts required for robot applications are provided free of charge. You can quickly set up robot vision applications.

Applications

Pick

Offset compensation

Place

Combination

Simple set-up steps

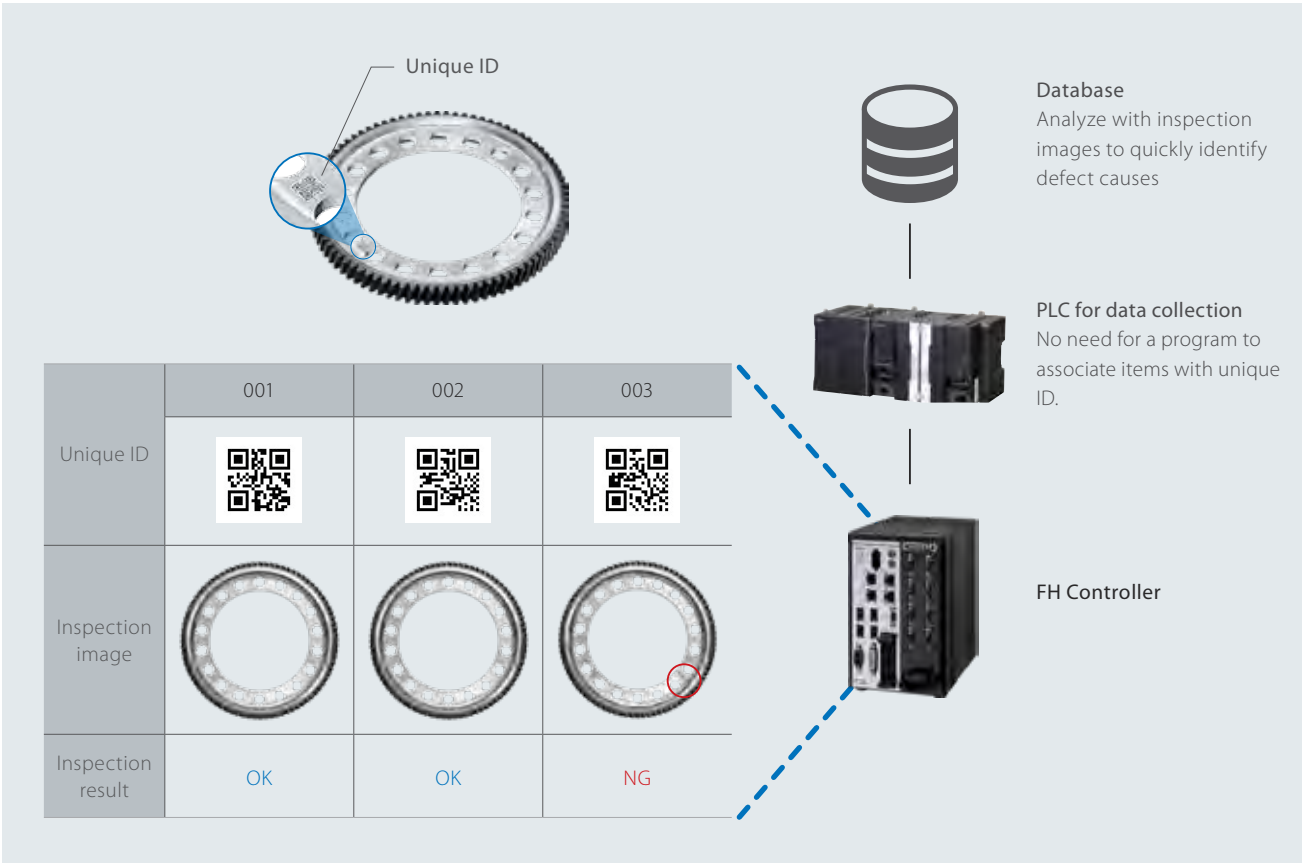
Obtain robot program and flowchart	You can download the verified robot communication programs from the following URL:http://www.omron-cxone.com/fh
↓	
Calibrate	There is no need to create a program for robot calibration. Move the robot for calibration from the FH Series.
↓	
Check operations	You don't need to create a robot program for verification. Set the coordinates of the robot and check robot operations from the FH Series.

Software for flexible automation

Unique identification and quality control

Unique ID associated with inspection image and result

The FH Series can associate a unique ID with the inspection image and result, and then output them to the host device. You can immediately find required inspection images and quickly identify causes of fails.

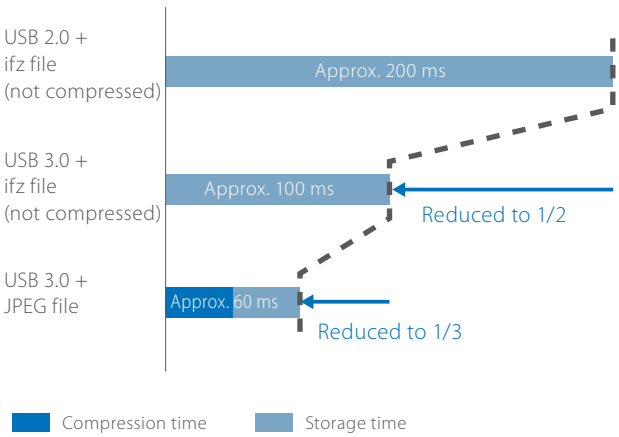


High-speed image storage

The amount of inspection image data required for defect cause analysis can be so large that conventional controllers are unable to store it given their storage time and capacity constraints.

The high-speed, large-capacity controller has USB 3.0 ports and the improved algorithm to compress image data at high speeds, enabling all images to be stored to meet increasing needs in quality control.

The times in the right figure provided for reference only and their accuracy
cannot be guaranteed. They are measured under the following conditions:
- FH-5050 Controller
- 5 Mpix monochrome images
- Size of converted JPEG file: 0.6 MB



2D Code II provides powerful code reading

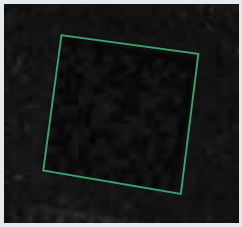
Recognition rate 2 times[1]

3 times faster[1]

The FH Series incorporates a dedicated algorithm for reliable and fast 2D code reading even under variable ambient brightness or adverse conditions such as after processing or washing.

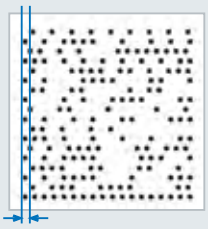
Changing ambient brightness

Chips due to reflection

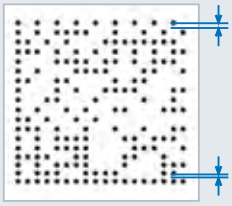


Low contrast

Poor printing quality in high-speed line

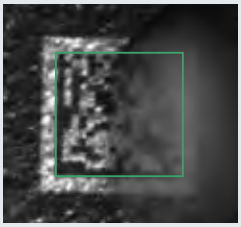


Variations in start positions

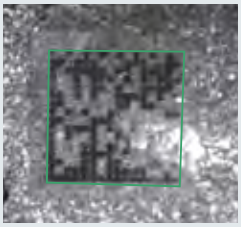


Uneven line spacing

After processing or washing

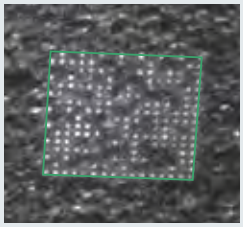


Waterdrops and oil stains



Scratched damage

Poor printing quality on coarse surface



Molding variations of forged object

Print Quality Grading Function

· ISO/IEC 15415
· ISO/IEC TR29158

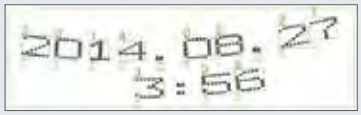
OCR reliably reads difficult-to-read characters

OCR can reliably read characters printed too close to each other or on curved surfaces. Also plus signs can be read.

Touching characters

Curved character string including plus sign

NEW

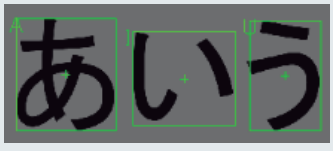


Curved character strings

Character Inspection reads special fonts

Character Inspection recognizes special fonts and non-alphanumeric characters based on pattern search using the dictionary set up by the user.

Special fonts



Japanese characters

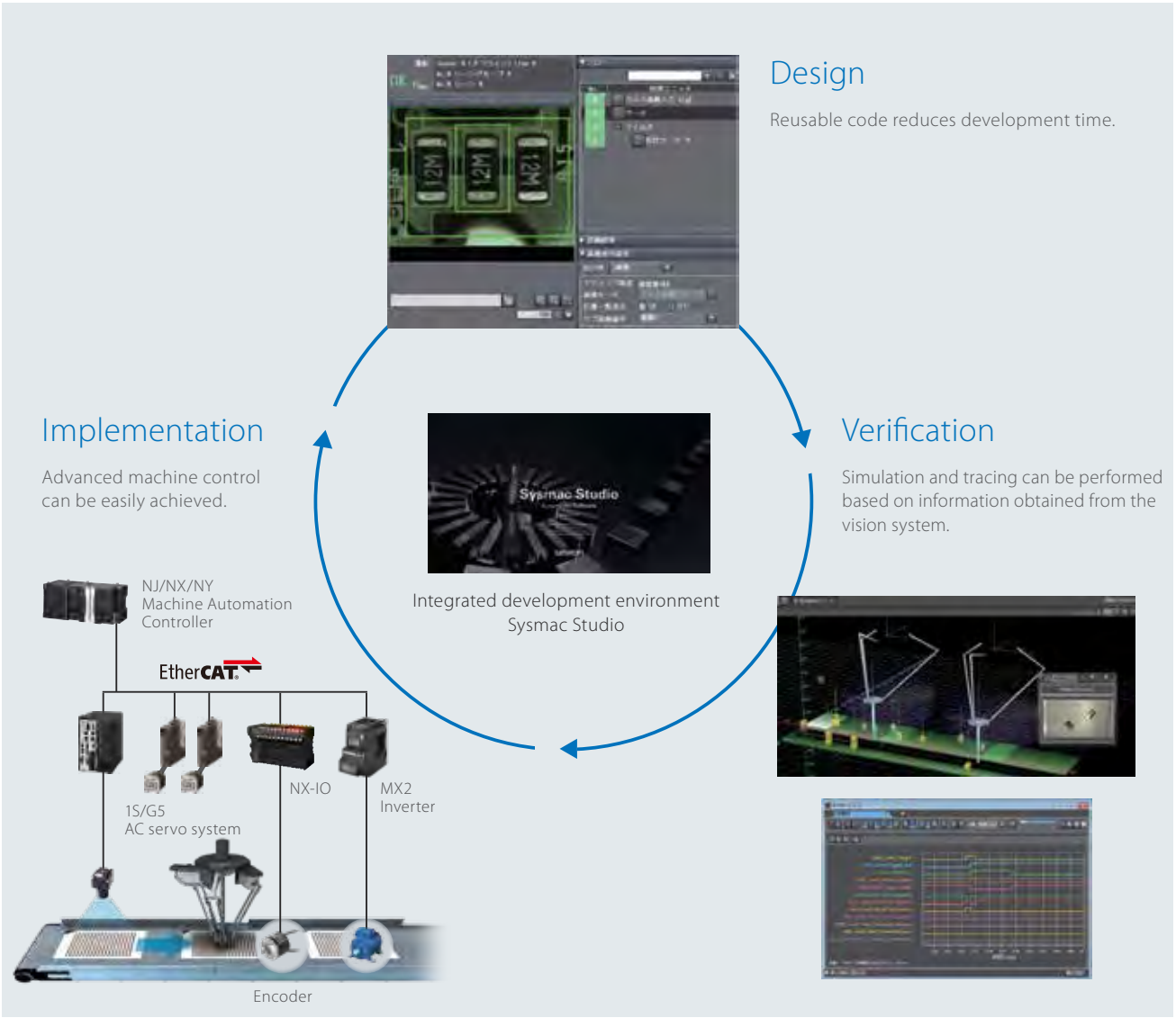
1. The average value measured under our specified conditions is provided for reference.

Software for flexible automation

Design interface for quick setup

Integrated development environment Sysmac Studio

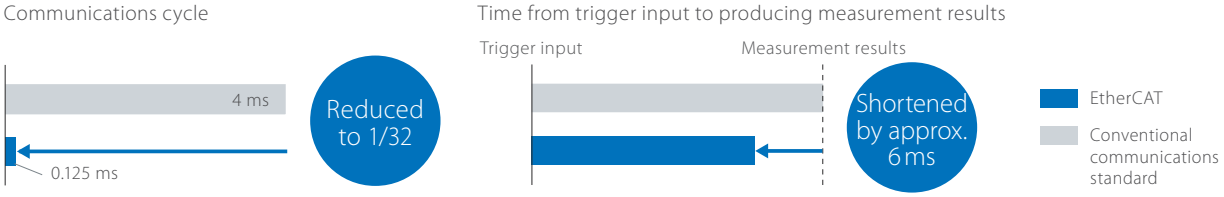
Sysmac Studio is a unique environment that integrates logic, motion and drives, robotics, safety, visualization,and information technologies in a single project, thus reducing the learning curve and the intra-operative software costs.



EtherCAT® for high-speed data transfer to control various devices

Data communications cycle: 125 µs

You can use EtherCAT® to connect NJ/NX Machine Automation Controllers and 1S/G5 AC Servo System to increase the control speed of everyday communications protocols from position detection to starting axis motion.



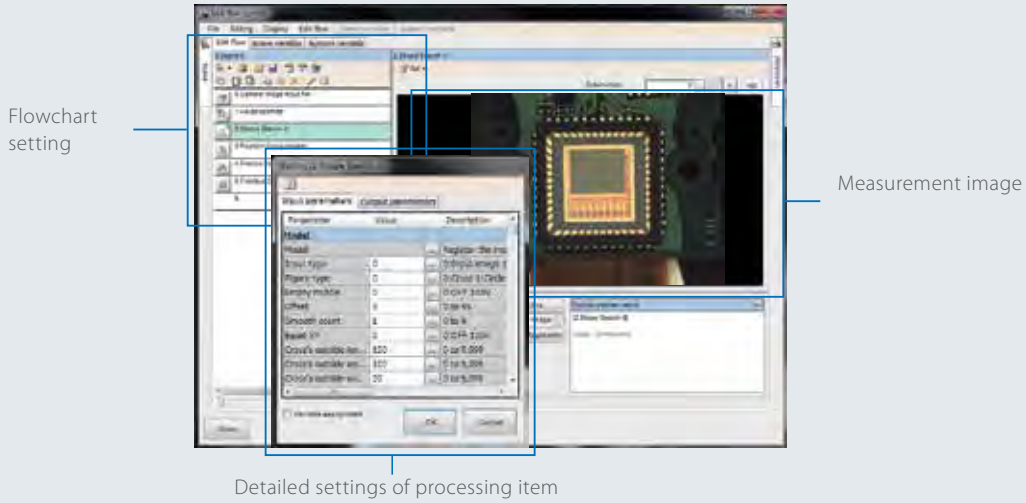
Note: The times given above are typical times. They depend on parameter settings.

Total Design Management Editor simplifies complex processing design

This design interface includes pre-installed screens for all phases, from design through to setting and operation. Just select processing items and determine the order to manage variables. Time-consuming calculations and inputs are no longer required.

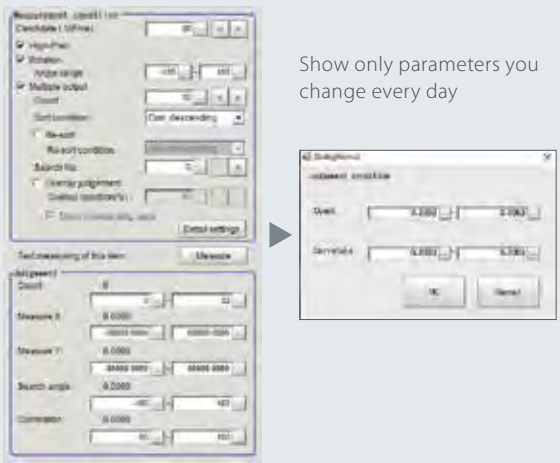
Easy setting
All the common settings of multiple scenes can be made at once. Simplified inspection flowcharts reduce setting errors and prevent from forgetting to change settings.

Efficient setting
To inspect aligned parts, the FH Series can repeat the same measurements while shifting the measurement region within the same image. This reduces setting times.



Customizable user interface simplifies operations at production sites

Showing only necessary screens for production makes the interface easier to use. Screen layout can be customized just by selecting and placing objects, without programming.



Select the best combination for your application

Software assets can be shared between controllers. This allows you to install devices with the capabilities you need, anywhere you need them.

Cameras

Choose the right camera to suit your required number of pixels. Easy-to-use cameras with built-in light are also available.

No. of pixels	High-speed camera	Standard camera	Rolling shutter camera	Camera with built-in light
20.4 Mpix[1]	--	--	FH-S□21R	--
12 Mpix	FH-S□X12	--	--	--
5 Mpix	FH-S□X05	FZ-S□5M3	FH-S□05R	--
2 Mpix	FH-S□02	FZ-S□2M	--	--
0.4 Mpix/ 0.3 Mpix	FH-S□X	FZ-S□	--	FZ-SQ□□□□

1. 20.4 Mpix Cameras can be used with the FH-5x50/2050-series Controllers.

Controllers

Select a controller based on the required processing speed and network.

	Series	CPU	Perform
High-speed, Large-capacity Controller	FH-5550 Series	Intel® CoreTM i7 processor 4 cores	★★★★
High-speed Controller	FH-5050 Series	Intel® CoreTM i7 processor 4 cores	★★★★
Standard Controller	FH-2050 Series	Intel® Celeron® processor 2 cores	★★★
Lite Controller	FH-L550 Series	Intel® Atom® processor 2 cores	★

★: The more starts, the higher the performance.

Lights

Omron offers a complete line-up of lights required for image processing. The use of the camera-mount lighting controller allows you to control lighting conditions from the FH Controller, making system configuration simple.

External lighting controller

Description	LED	High-brightness LED
Camera-mount Lighting Controller	FLV-TCC	FL-TCC
Bar Light	FLV-BR	FL-BR
Direct Ring Light	FLV-DR	FL-DR
Low Angle Ring Light	FLV-DL	–
Coaxial Light	FLV-CL	–
Shadowless Light	FLV-FR/FP/FS/FQ	–
Spot Light	FLV-EP	–
Direct Back/Edge Type Light	FLV-DB/FB	–
Dome Light	FLV-DD	–
Photometric Stereo Light[1]	–	FL-PS

1. The FL-TCC Camera-mount Lighting Controller cannot be used. Use the FLV-TCC1PS Lighting Controller for Photometric Stereo Light.

Built-in lighting controller

Description	Model
MDMC Light	FLD-MD

Refer to the Vision Accessory Catalog (Cat. No. Q198) for details.

Camera cables

The cable line-up includes bend-resistant cables and right-angle cables. Use the FZ-VSJ Cable Extension Unit for cable extensions.

Description	Model
Camera Cable	FZ-VS□ □□M
Right-angle Camera Cable	FZ-VSL□ □□M
Bend-resistant Camera Cable	FZ-VSB3 □□M
Bend-resistant Right-angle Camera Cable	FZ-VSLB3 □□M
Cable Extension Unit	FZ-VSJ

ance	Memory	No. of connectable cameras	Fieldbus
★	RAM 32 GB, ROM 64 GB	8 max.	PROFINET, EtherNet/IP™, EtherCAT
★	RAM 8 GB, ROM 32 GB	8 max.	PROFINET, EtherNet/IP™, EtherCAT
	RAM 8 GB, ROM 32 GB	8 max.	PROFINET, EtherNet/IP™, EtherCAT
	RAM 4 GB, ROM 4 GB	4 max.	PROFINET, EtherNet/IP™

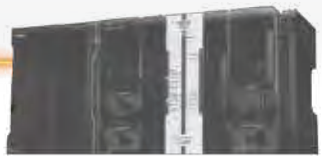
Optional product (sold separately)	Model
Scratch Detect AI Software Installer*	FH-UMAI1

* This product can be installed on the FH-5☐50-series Controller (version 6.40 or later).

Application producer

This development environment enables you to customize FH functions. It includes sample codes and wizards that will help you develop your own interfaces and processing items.

Description	Model
DVD for installation	FH-AP1
Software license	FH-AP1L



EtherCAT

EtherNet/IP

PROFINET

Touch panel monitor

The touch panel monitor is optimized for the operation of the FH Series.

Description	Model
Touch Panel Monitor 12.1 inches	FH-MT12
DVI-Analog Conversion Cable for Touch Panel Monitor	FH-VMDA ☐☐
USB Cable for Touch Panel Monitor	FH-VUAB ☐☐

RS-232C cables for long-distance connections are also available.
Refer to Ordering Information for details.

Sysmac Studio

The development environment for the Sysmac platform allows you to configure and simulate the FH Series on your PC.

Automation Software
Sysmac Studio

Description	Model
DVD for installation	SYSMAC-SE200D
Software license (Vision Edition)	SYSMAC-VE001L

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Software
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