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FATEC

Mitsubishi Programmable Controllers Training Manual Vision Sensor Basic Course

SAFETY PRECAUTIONS

(Always read these instructions before using the products.)

When designing the system, always read the relevant manuals and give sufficient consideration to safety.

During the exercise, pay full attention to the following points and handle the product correctly.

[EXERCISE PRECAUTIONS]

⚠WARNING

- Do not touch the terminals while the power is on to prevent electric shock.
- Before opening the safety cover, turn off the power or ensure the safety.

⚠CAUTION

- Follow the instructor's direction during the exercise.
- Do not remove the module of the demonstration machine or change wirings without permission.
  Doing so may cause failures, malfunctions, personal injuries and/or a fire.
- Turn off the power before mounting or removing the module.
  Failure to do so may result in malfunctions of the module or electric shock.
- When the demonstration machine (such as X/Y table) emits abnormal odor/sound, press the "Power switch" or "Emergency switch" to turn off.
- When a problem occurs, notify the instructor as soon as possible.

REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision date	*Manual number	Description
August 2020	SH(NA)-082348ENG-A	First edition

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CONTENTS

INTRODUCTION

Functions and specifications of a hardware and software used in the system (to help users acquire the knowledge required for inspection, measurement, and identification using a vision sensor)

RELEVANT MANUALS

Manual name [manual number]	Description	Available form
Vision Sensor VS70 User's Manual [SH-081889ENG]	Functions, installation methods, system configuration, and required hardware components of the vision sensor VS70	e-Manual PDF
Vision Sensor Connection Guide [BCN-P5999-0861]	Procedures for connecting a vision sensor to a MELSEC programmable controller to control a vision system through a CC-Link IE Field Network Basic connection, an SLMP connection, or an I/O connection	e-Manual PDF
Vision Sensor VS Series Setting Guide [BCN-P5999-1065]	Installation, connection methods, and setting procedure of In-Sight Explorer	e-Manual PDF

Point

e-Manual refers to the Mitsubishi Electric FA electronic book manuals that can be browsed using a dedicated tool.

e-Manual has the following features:

- Required information can be cross-searched in multiple manuals.
- Other manuals can be accessed from the links in the manual.
- The hardware specifications of each part can be found from the product figures.
- Pages that users often browse can be bookmarked.
- Sample programs can be copied to an engineering tool.

TERMS

Unless otherwise specified, this manual uses the following terms.

Term	Description
Engineering tool	A tool for setting, programming, debugging, and maintaining programmable controllers. A generic term for the GX Works2, GX Works3, and MELSOFT Navigator
Exposure time	In photographing by a camera, the time that imager type being exposed to the light through the lens after the shutter is opened.
FTP	An abbreviation for File Transfer Protocol. This protocol is used to transfer data files over a network.
Future (target object)	A target object in an image
GX Works3	The product name of the software package, SWnDNC-GXW3, for the MELSEC programmable controllers (n indicates the version.)
In-Sight Explorer	A configuration tool for a vision sensor manufactured by Cognex Corporation.
Job	A program controlling vision created with the configuration tool for the vision sensor.
OCRMax™	A high performance OCR (Optical Character Recognition) tool which provides high text-reading ability and high-speed processing capability. OCRMax is available to recognize or verify the unrecognizable characters in other OCR technologies (such as character variations, text skew, and proportional fonts).
PatMax RedLine™	A location tool for high-speed pattern matching, which has been improved based on PatMax technology, to locate parts and features. PatMax RedLine is designed to detect a target object in runs 10 times faster than PatMax, with no loss of search accuracy on high-resolution images.
PatMax®	A feature location tool (patented technology authorized by the United States) which Cognex Corporation developed by utilizing advanced geometric pattern matching technology. Objects can be found reliably and accurately despite changes in angle, size, and shading.
ReadIDMax®	A tool to read barcodes with high-accuracy. By using 1DMax™ and 2DMax™, up to 128 barcodes can be read at one time regardless of the position of the barcodes in the screen. 1DMax: A 1-D barcode reading algorithm optimized for omnidirectional barcode reading. 2DMax: A 2-D code reading algorithm that provides reliable code reading despite code quality, printing method, or the surface that the codes are marked on.
SLMP	An abbreviation for Seamless Message Protocol. This protocol is used to access an SLMP-compatible device or a programmable controller connected to an SLMP-compatible device from an external device.
Vision sensor VA70	A generic term for the VS70M-600-E, VS70M-600-ER, VS70M-800-E, VS70M-800-ER, VS70M-802-E, and VS70M-802-ER

1 VISION SENSORS

Vision sensors are hardware with applications that convert, recognize, and measure image information.
Developed for applications such as inspection, measurement, identification at production sites, they are small and can be operated via network connection or on a stand-alone basis.

1.1 Features

Integrated

These standalone vision sensors integrate a CPU with personal computer level performance and image processing tools in a compact camera.

High flexibility

The lighting and lens configuration can be changed freely to meet the requirements of the application.

iQSS support

The total cost of design, start-up, operation, and maintenance can be reduced by automatic detection of connected devices and tool interaction functions.

Linkage with a programmable controller

Vision sensors support SLMP and CC-Link IE Field Network Basic. A vision sensor can be started and the state of the vision sensor can be monitored by assigning devices to control and monitor the vision sensor and turning the devices on or off. The parameters of vision sensors can also be changed using the same method.

FTP support

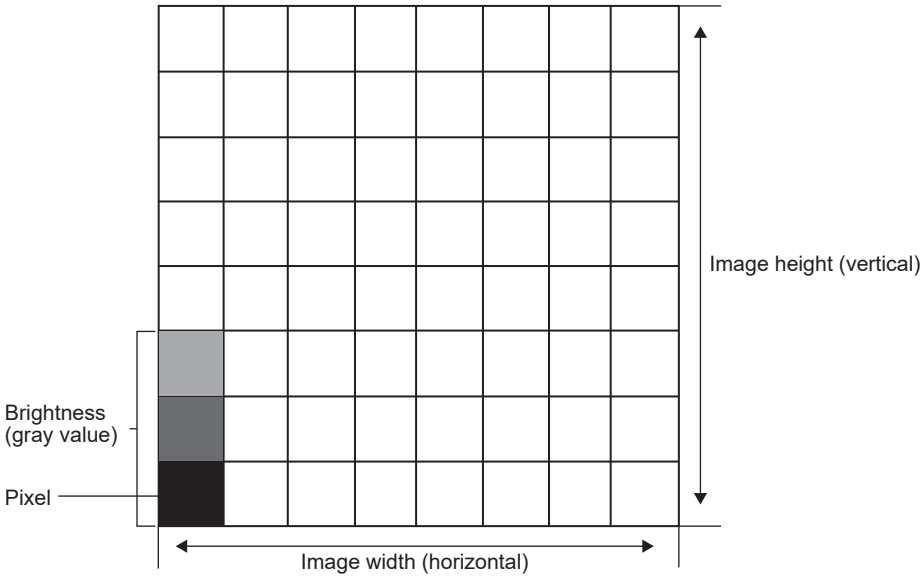
Vision sensor inspection images can be transferred to GOTs and host systems to enable traceability combining recognition results and recognition images.

Simple setup on a personal computer

In-Sight Explorer (vision sensor configuration tool) is an interface in which images play a central role and enables easy configuration of the vision sensor.
Furthermore, inspection configuration is program-free, and target characteristics in images can be selected by pointing and clicking, allowing configuration to be completed quickly.

1.2 Image Definition

An image defined by a vision sensor is the digitization of light information into data of 256 levels of fixed size.
Images are classified into binary images, grayscale images, and color images according to the type of display color and gradation.
Each image is two-dimensional, but the digital amount of pixels that structure the image and their properties vary.

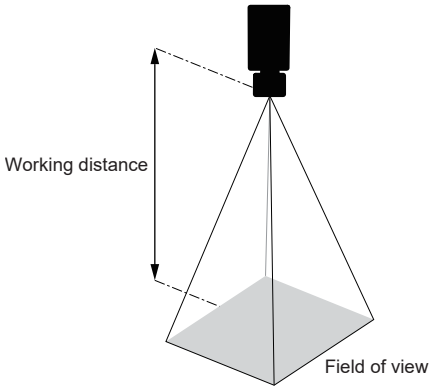


Name	Description
Pixel	Any of the smallest discrete elements that collectively constitute an image. The size of an image is expressed as the number of horizontal pixels × the number of vertical pixels, for example 512 pixels (H) × 480 pixels (V).
Brightness (gray value)	The brightness of a pixel in a grayscale image. Also called the gray value.
Gradation	In digital images, a numerical value that indicates the degree of shading of each pixel. When inputting an image from a sensor, for black and white input, the brightness of each pixel is 8 bits (256 levels), and for R, G, B (red, green, blue) color input, each component is A/D converted into an 8-bit value.

1.3 About the Lens

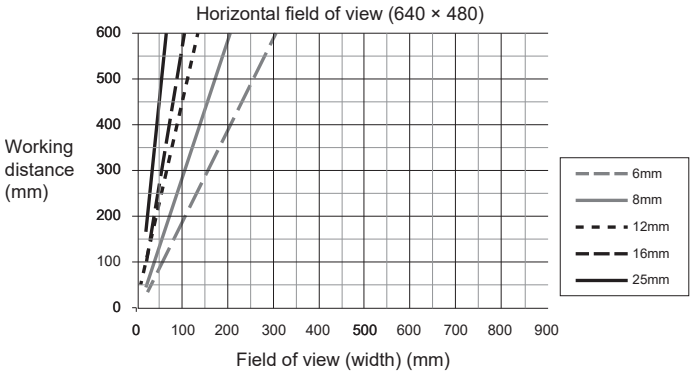
Working distance and field of view

The distance from the lens tip to the inspection target is called the working distance, and the area that the vision sensor can see at that distance is called the field of view.
The greater the working distance, the larger the field of view.

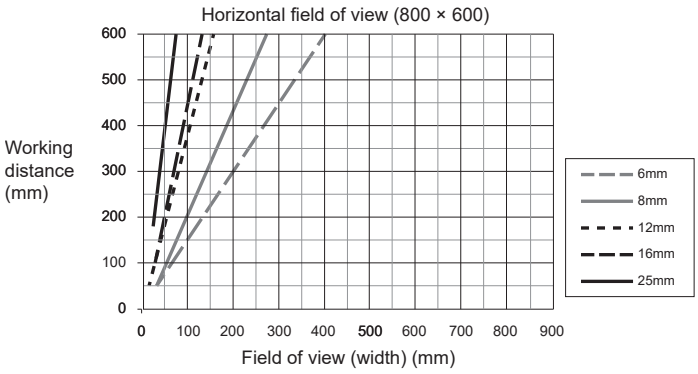


The following shows the horizontal field of view when an S-mount/M12 lens accessory is attached to a vision sensor of the VS70 series.

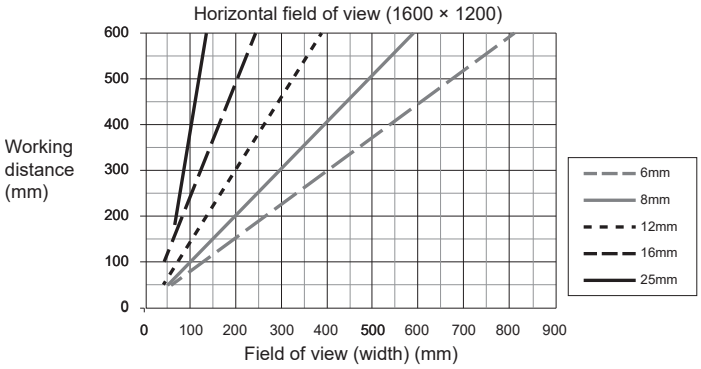
- VS70M-600-E, VS70M-600-ER, VS70M-800-E, VS70M-800-ER



- VS70M-600-E, VS70M-600-ER, VS70M-800-E, VS70M-800-ER



• VS70M-802-E, VS70M-802-ER

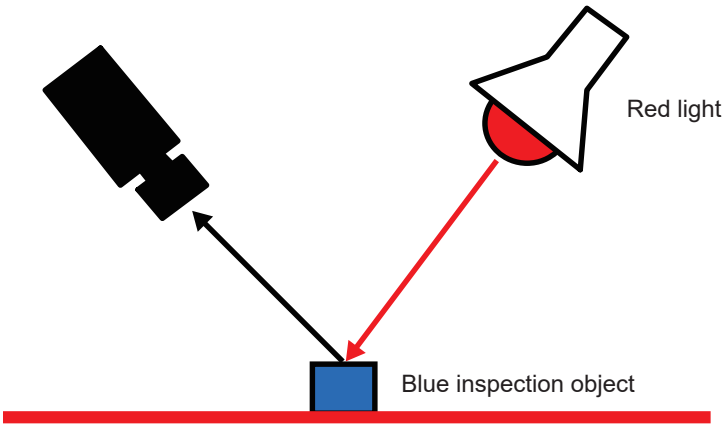


Point

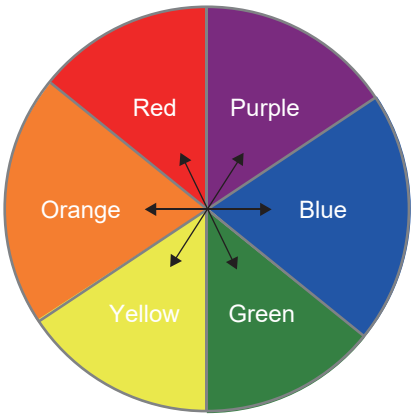
The horizontal field of view is completely mapped on the image sensor.

1.4 Color Lighting and Filters

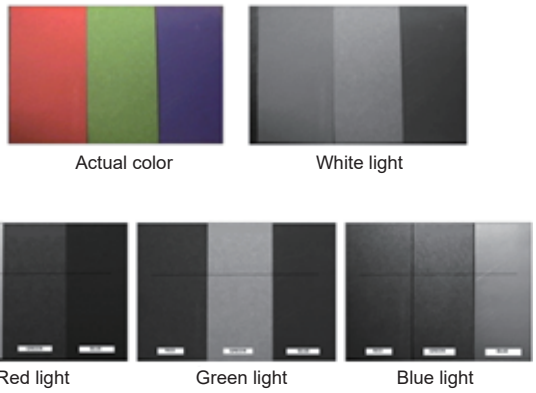
When a monochrome camera is used, the object to be measured can be imaged more clearly by highlighting the characteristics of the inspection target or removing unnecessary colors through the use of color lighting and color filters according to the inspection target.



When the target object is illuminated with complementary light in the hue circle, the object appears dark, and when the same color or a similar color to that of the target object is applied, the object appears bright. For example, when the target is illuminated with red light, red workpieces appear bright, and green workpieces appear dark.



Hue circle



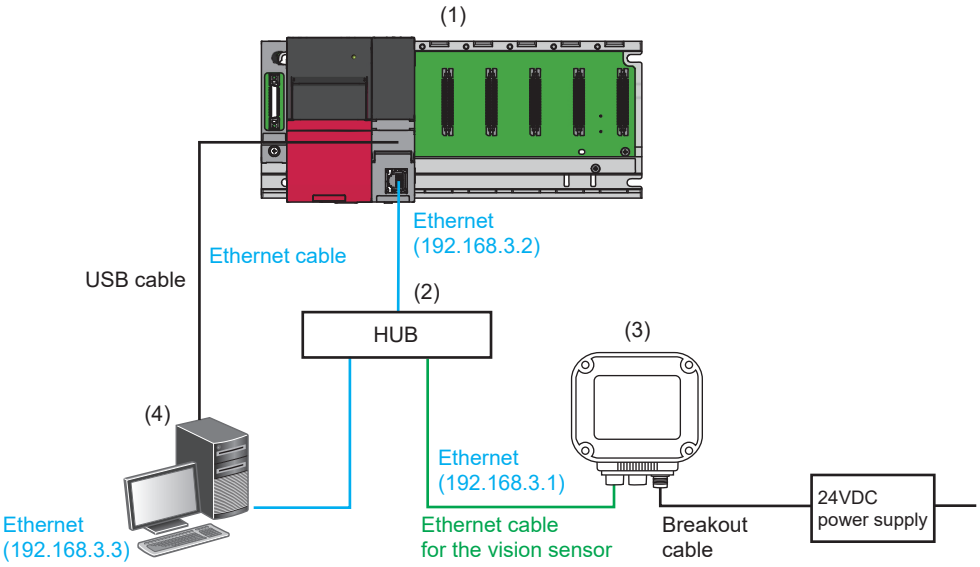
The table below shows the advantages and general applications of the lighting colors used.

Lighting color	Advantage	General application
White	Visualization of all wavelengths except black	For determining colors with a color camera
Red	Low cost and high brightness	All-round general use
Blue	High scattering rate and enables visualization of small objects	For detecting small defects

2 DEMONSTRATION MACHINE

2.1 System Configuration of Demonstration Machine

This section describes the system configuration of the demonstration machine.



Device/software			Model name/description
(1)	Programmable controller system	Main base unit	R35B
		Power supply module	R61P
		CPU module	R08CPU
(2)	Industrial switching hub		NZ2EHG-T8N
(3)	Vision sensor	Vision sensor VS70	VS70M-802
		Autofocus module	ISAF-7000-8MM-ME
		Light cover with LED ring light	ISLM-7000-WHI-ME
(4)	Personal computer		• Microsoft® Windows® 10 Professional (64-bit) • Microsoft® Windows® 7 Professional, Service Pack 1 (64-bit) • Microsoft®Windows®Server 2016
	Engineering tool	GX Works3	SWnDND-GXW3 (n indicates the version.)
	Vision sensor configuration tool	In-Sight Explorer	Version 5.6.2*1

*1 The software version used for the training is "5.6.2".

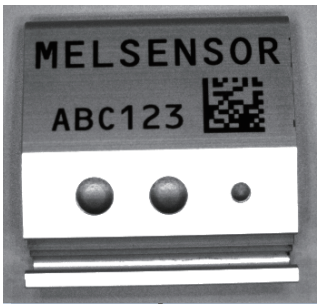
Workpiece type

There are two types of workpieces used in the training, "SN:B806MD43W" and "*SN:B806ME 43W*", and the processing of each workpiece differs partially.

In "☞ Page 41 TRAINING 1 CONFIGURING In-Sight Explorer", check how these differences are detected.

SN:B806MD43W

Front



Rear

Side

SN:B806ME 43W

Front

Rear

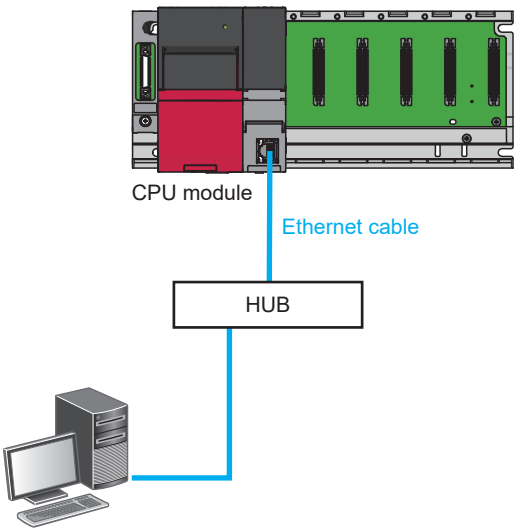
Side

2.2 Wiring of Demonstration Machine

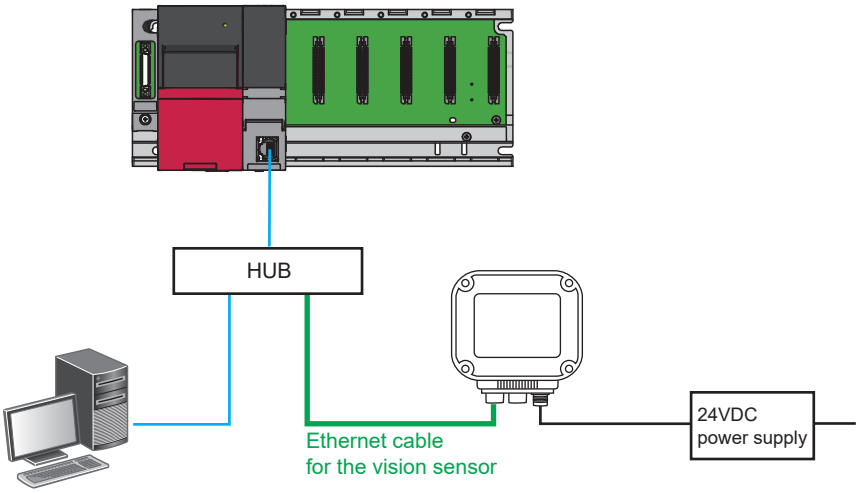
This section describes the wiring of the demonstration machine.

1. Connect the following devices to a hub using Ethernet cables.

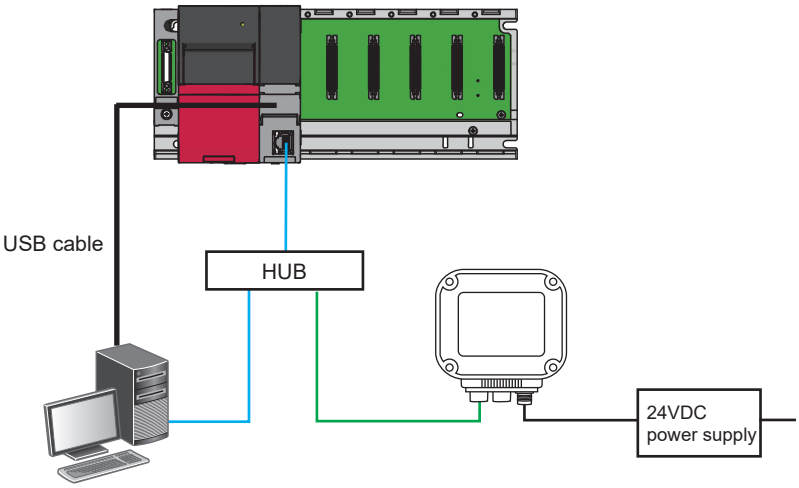
- CPU module
- Personal computer



2. Next, connect the vision sensor and the hub with the dedicated Ethernet cable of the vision sensor.



3. Finally, connect the CPU module and personal computer with a USB cable.



Vision sensor connection and wiring

This section describes the procedure for connecting and wiring the vision sensor.

Operating procedure

1. Check that the 24VDC power supply switch is turned off.
2. Connect the I/O or serial wires to an appropriate device (for example, a programmable controller).
3. Connect 24VDC (red wire) and GND (black wire) of the breakout cable to the corresponding terminals of the power supply.
4. Connect the M12 connector of the breakout cable to the power and I/O connector of the vision sensor.
5. Turn on the 24VDC power switch.

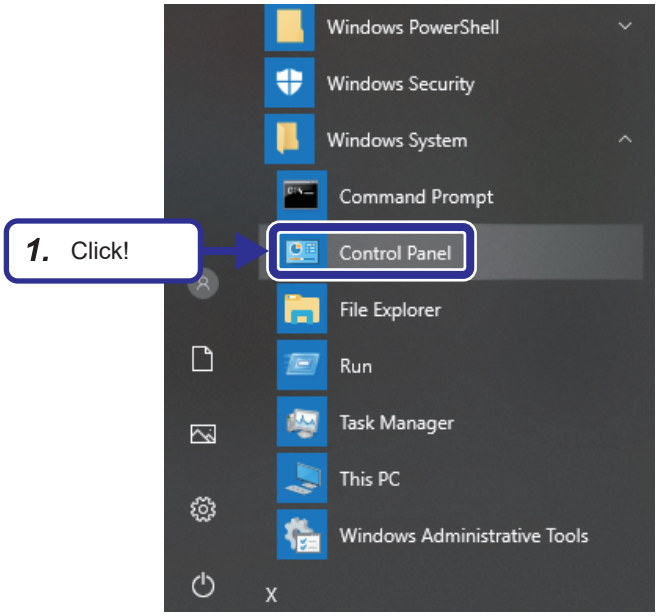
Precautions

- When connecting the vision sensor and the programmable controller, power on the vision sensor and the programmable controller at the same time or first power on the programmable controller.
- Unused wires should be disconnected or protected with insulation. Be careful not to cause a short-circuit with the 24VDC wire.
- The cable is designed to fit the keyway of the connector of the vision sensor. It may be damaged if forcible connection is attempted.

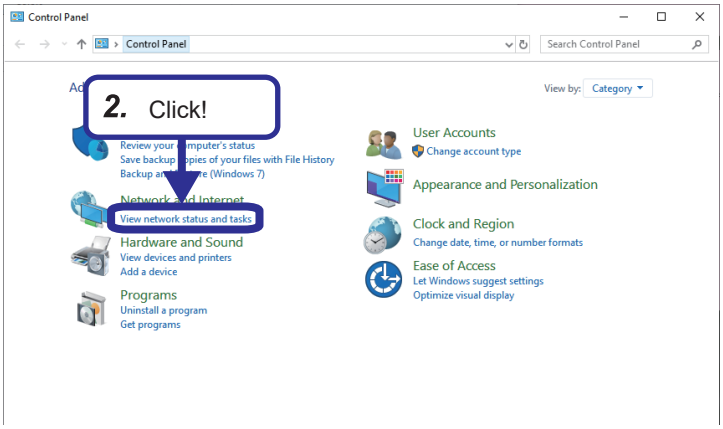
2.3 Settings Before Exercise

Set the TCP/IP setting as described in "☞ Page 13 System Configuration of Demonstration Machine".

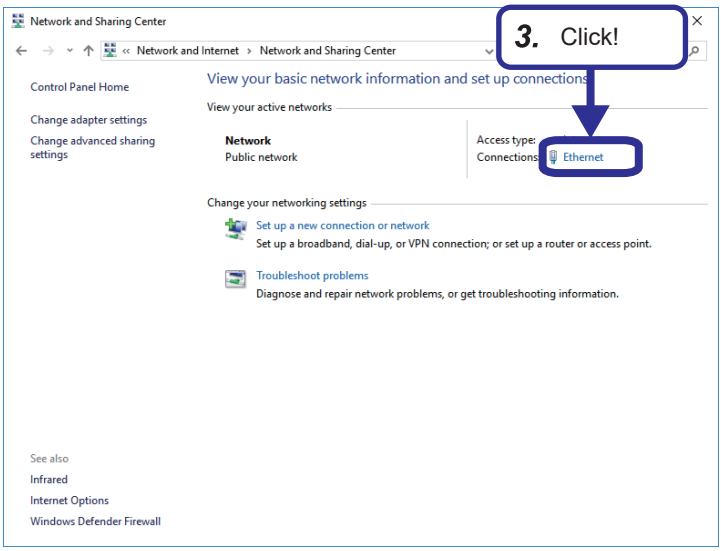
Operating procedure



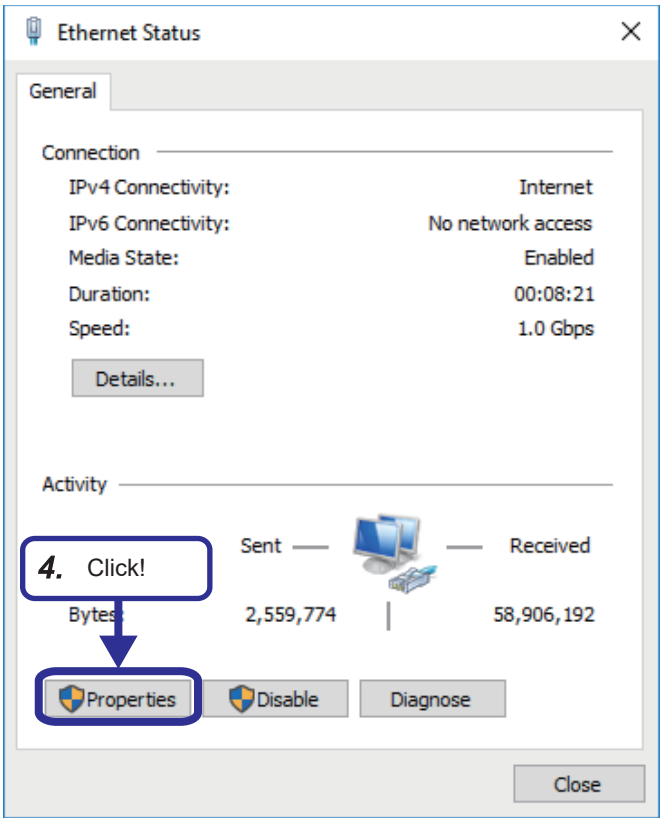
1. From the Windows® start menu, click [Windows System] ⇨ [Control Panel].



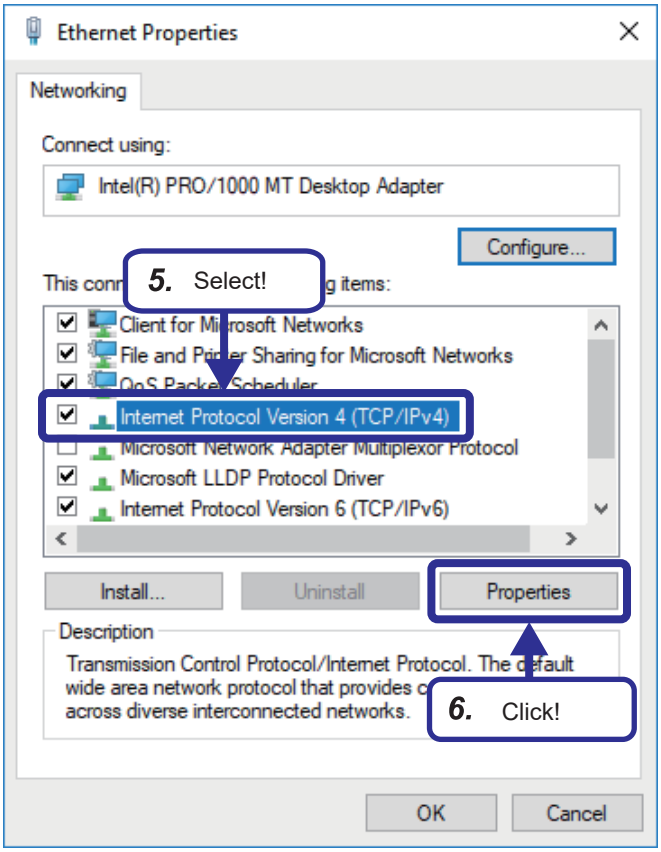
2. The "Control Panel" dialog box appears. Click "Network and Internet".



3. Click "Ethernet".

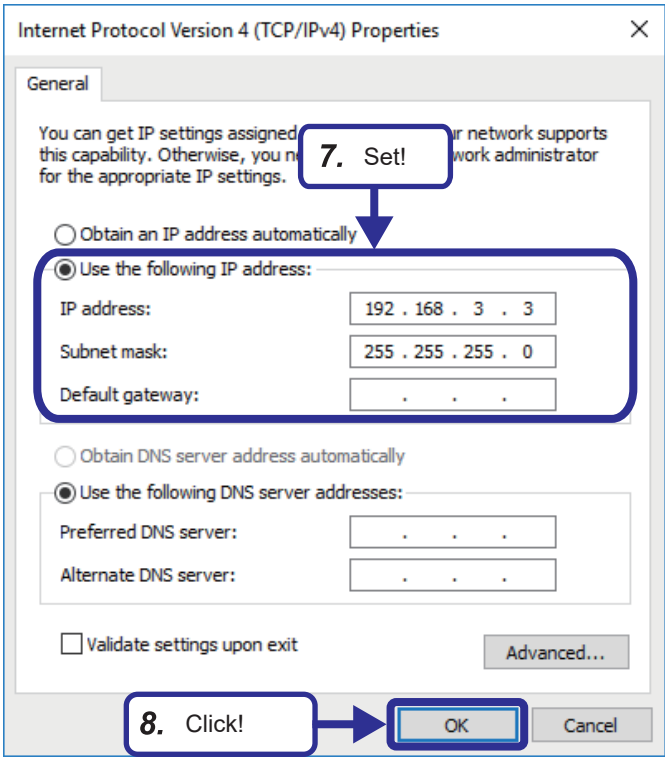


4. Click the [Properties] button.



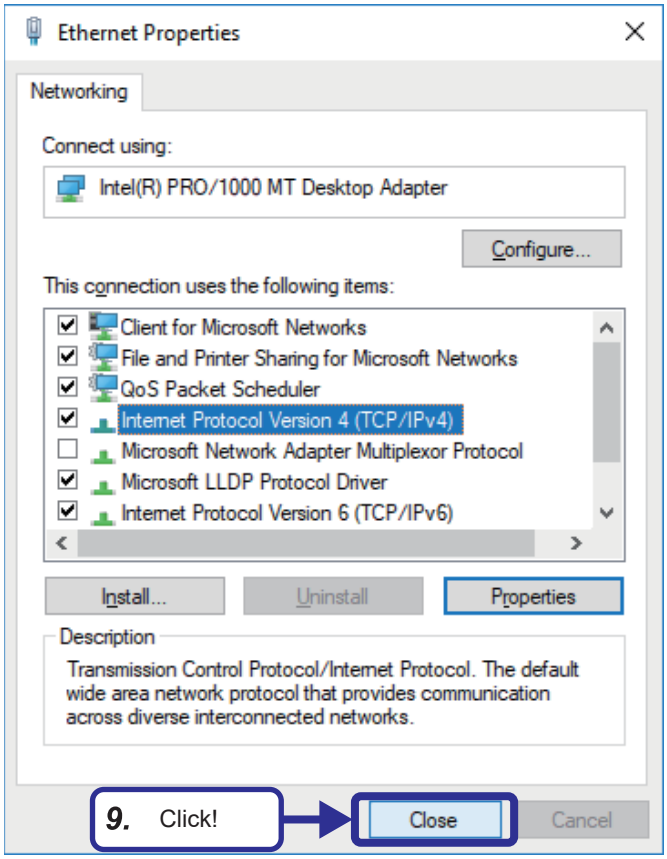
5. Select "Internet Protocol Version 4 (TCP/IPv4)".

6. Click the [Properties] button.

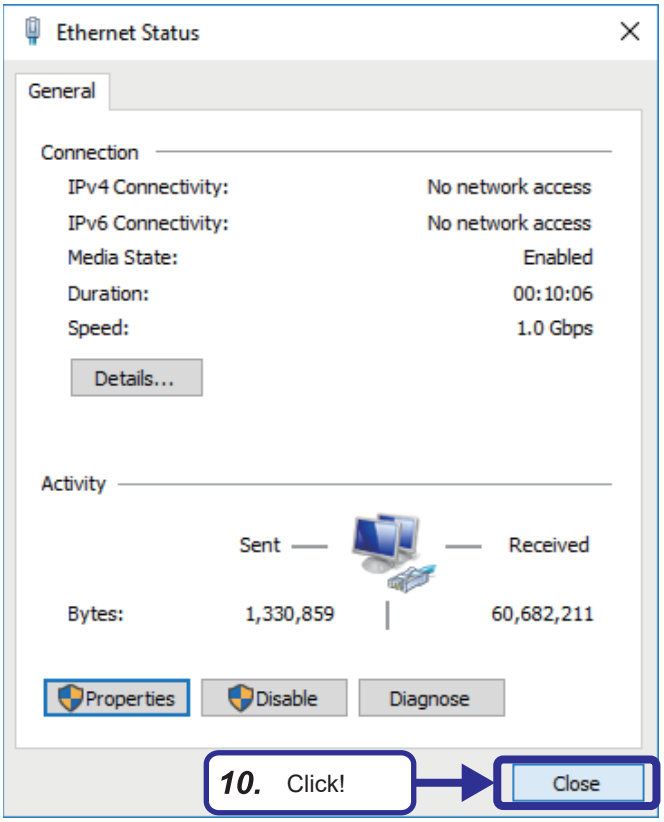


7. Select "Use the following IP address" and set the following.
[Setting details]
IP address: 192.168.3.3
Subnet mask: 255.255.255.0

8. Click the [OK] button.



9. Click the [Close] button.



10. Click the [Close] button.

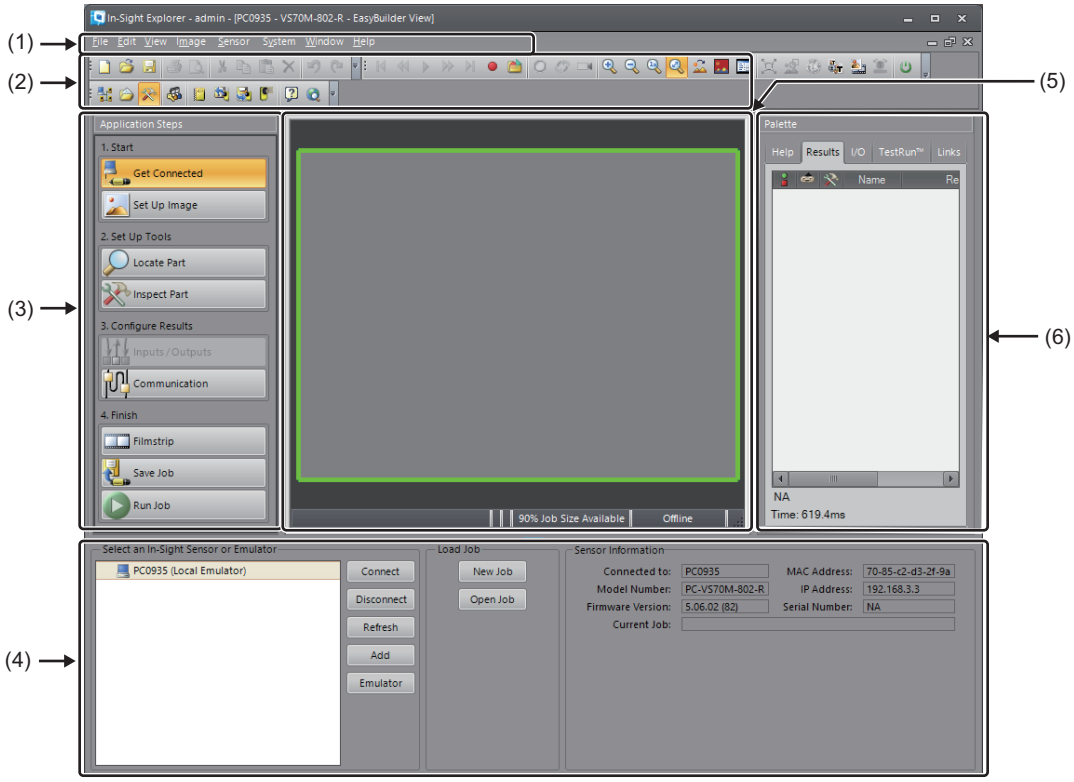
3 OVERVIEW OF In-Sight Explorer

In-Sight Explorer (vision sensor configuration tool) is an interface in which images play a central role and enables easy configuration of the vision sensor.

3.1 In-Sight Explorer

EasyBuilder

EasyBuilder is the name of the development environment for In-Sight Explorer.
The EasyBuilder graphical user interface (GUI) is mainly consisted of images.
It is designed to allow vision applications to be configured simply by making settings according to "Application Steps".
The EasyBuilder GUI consists of the following six components.



(1) Menu bar
(2) Tool bars (Standard, EasyBuilder, Explorer)
(3) Application Steps
(4) Settings pane
(5) EasyBuilder View
(6) Palette

Function list

The main functions of the vision sensor set in In-Sight Explorer are displayed.

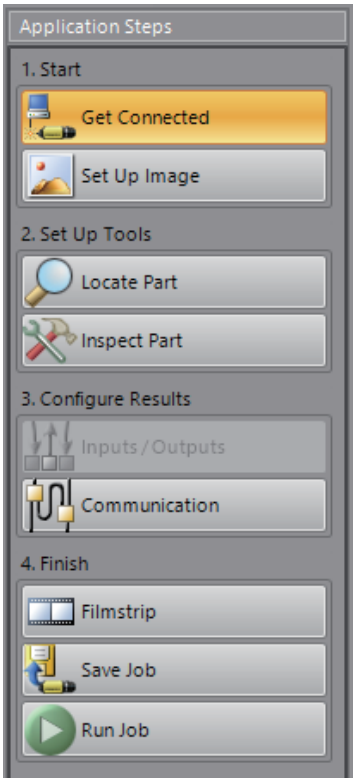
Function name	Description
Application Steps	The settings required to use the vision sensor are displayed in the setting order to allow easy setting. ☞ Page 23 Definition of Application Steps
1. Start	Selects the vision sensor to be set, and specifies the image for setting the judgment conditions.
Get Connected	Selects the vision sensor to be set and connects it.
Set Up Image	Specifies the image to be used to set the judgment conditions. Import the image to be shown on the vision sensor or specify an image file saved on the personal computer.
2. Set Up Tools	Sets the judgment conditions for the images captured by the vision sensor.
Locate Part	Sets for judging whether there is a location that matches the set features.
Location Tools	Sets the features.
Inspect Part	Sets for judging whether the set features are satisfied. The shape and quantity of products can be inspected.
Presence/Absence Tools	Sets for judging the presence or absence of features.
Measurement Tools	Sets for measuring the distance, diameter, angle, and dimensions of a feature.
Counting Tools	Sets for counting the number of features.
Identification Tools	Sets for identifying and verifying a feature and color.
Geometry Tools	Sets for creating a geometrical figure.
Math & Logic Tools	Performs arithmetic operations, statistical processing, tool grouping using multiple tool results.
Plot Tools	Sets for creating and placing conditionally enabled graphics.
Image Filter Tools	Sets for enhancing an image or image region for image analysis.
Defect Detection Tools	Sets for detecting defects in an inspection target.
Calibration Tools	Sets for creating a calibration that can be shared among jobs.
3. Configure Results	Sets an output method for the judgment results of the images that were acquired.
Inputs/Outputs	Sets the input and output data.
Communication	Sets for communications between a vision sensor and an external device such as a programmable controller according to the specified method.
4. Finish	Saves the settings and checks the operations.
Filmstrip	Allows the operator to check the images saved in the personal computer, the images saved in the vision sensor, and the results of capture.
Save Job	Saves the settings to a vision sensor.
Run job	The vision sensor operates based on the settings in prior steps. The operation can also be checked.
iQ Sensor Solution functions	The iQ Sensor Solution function can be performed using an engineering tool. For details on the iQ Sensor Solution functions, refer to the following manual. 📖 iQ Sensor Solution Reference Manual
Automatic detection of connected devices	A function for detecting connected vision sensors
Linkage with dedicated tools (association with properties)	A function for starting In-Sight Explorer from an engineering tool

Definition of Application Steps

[Application Steps] is an interface designed to complete the settings for one job by making settings in order from step 1 to step 4.

After a job is configured, these steps can be re-accessed in any order, allowing the operator to change or fine-tune the job parameters until the desired results are achieved.

From the [Application Steps] pane, any step of EasyBuilder can be easily accessed with one click.



1. Get Connected

Set the vision sensor network setting and connect with In-Sight Explorer.

☞ Page 41 Connection with the Vision Sensor

2. Set Up Image

Set the trigger type settings and image import settings, and then run calibration.

☞ Page 45 Importing an image
☞ Page 47 Calibration

3. Locate Part

Add and set tools to locate the part.

☞ Page 50 Configuring Location Tools

4. Inspect Part

Add and set tools for inspection.

☞ Page 54 Configuring Inspection Tools

5. Input/Output settings

Set the I/O module connection settings and the input/output operation settings.

☞ Page 134 Input/Output

6. Communication settings

Set communication settings for connecting to a programmable controller.

☞ Page 95 TRAINING 2 COMMUNICATIONS BETWEEN A PROGRAMMABLE CONTROLLER AND VISION SENSOR

7. Other settings

Set filmstrips, jobs to be loaded at startup, and online mode.

☞ Page 39 Filmstrip
☞ Page 105 Saving the job

Tool list

The following table shows the details of tools that can be set in In-Sight Explorer.

Tool	Setting	Description
Location Tools	PatMaxRedLine™ Pattern	Locates a single pattern using the PatMax RedLine algorithms, and displays the XY coordinates, angle, and score of the pattern.
	PatMax® Pattern	Locates a single pattern using the PatMax algorithms, and displays the XY coordinates, angle, and score of the pattern.
	Pattern	Locates a single pattern, and displays the XY coordinates, angle, and score of the pattern.
	PatMax RedLineRedLine™ Patterns (1-10)	Locates up to 10 patterns using the PatMax RedLine algorithms, and displays the XY coordinates, angle, and score of the patterns.
	PatMax® Patterns (1-10)	Locates up to 10 patterns using the PatMax algorithms, and displays the XY coordinates, angle, and score of the patterns.
	Patterns (1-10)	Locates up to 10 patterns, and displays the XY coordinates, angle, and score of the patterns.
	Edge	Locates linear edges. The XY coordinates of the mid-point of the detected edge, and its angular orientation are returned.
	Edge Intersection	Creates a fixture from the intersection point of two edges, and returns the XY coordinates of the crossing point and the bisect angle.
	Blob	Locates a blob (a single group of dark or light-colored connected pixels), and returns the XY coordinates of the centroid of the found blob.
	Blobs (1-10)	Locates up to 10 blobs (groups of dark or light-colored connected pixels), and returns the XY coordinates of the centroid of the found blobs.
	Circle	Locates a circular edge feature, and returns the diameter and XY coordinates of the center of the circle.
	Compute Fixture	Calculates a fixture location based on mathematical expressions, and returns the XY coordinates and the angle of the fixture. It is required for location tools or inspection tools as inputs.
Presence/Absence Tools	Brightness	Determines whether or not a feature is present based on an average grayscale (brightness) value.
	Contrast	Determines whether or not a feature is present based on the contrast between features.
	PatMaxRedLine™ Pattern	Determines whether or not a pattern is present using the PatMax RedLine algorithm.
	PatMax® Pattern	Determines whether or not a pattern is present using the PatMax algorithm.
	Pattern	Determines whether or not a pattern is present.
	Pixel Count	Determines whether or not a feature is present based on the number of dark or light-colored pixels in a region.
	Blob	Determines whether or not blobs (groups of dark or light-colored connected pixels) are present.
	Edge	Determines whether or not a linear edge is present.
	Circle	Determines whether or not a circular feature is present.
	Sharpness	Defines the relative focus of images acquired by In-Sight Explorer by measuring the degree to which the region includes the smallest resolvable features in a scene.
Measurement Tools	Distance	Measures the distance between any two features (edges, circles, patterns, and/or blobs), and returns the distance in pixels.
	Angle	Calculates the distance between two linear edge features, and returns the angle between the two edges.
	Blob Area	Calculates the surface area of a blob (a single group of dark or light-colored connected pixels), and displays the surface area in pixels.
	Blob Areas (1-10)	Measures the surface area of up to 10 blobs (groups of dark or light-colored connected pixels), and displays the surface area in pixels.
	Circle Diameter	Detects a circular feature, and returns the diameter in pixels.
	Circle Concentricity	Detects two circular features, and returns the distance between the centers of two circles in pixels.
	Measure Radius	Defines a curved edge feature, and returns the radius of the curve.
	Min/Max Points	Measures the position of edges, and determines the edge points that are closest and furthest from either the edge or the region. Creates a best-fit line or circle of the edge feature, and returns the edge points that are closest and furthest from the best-fit line or circle.

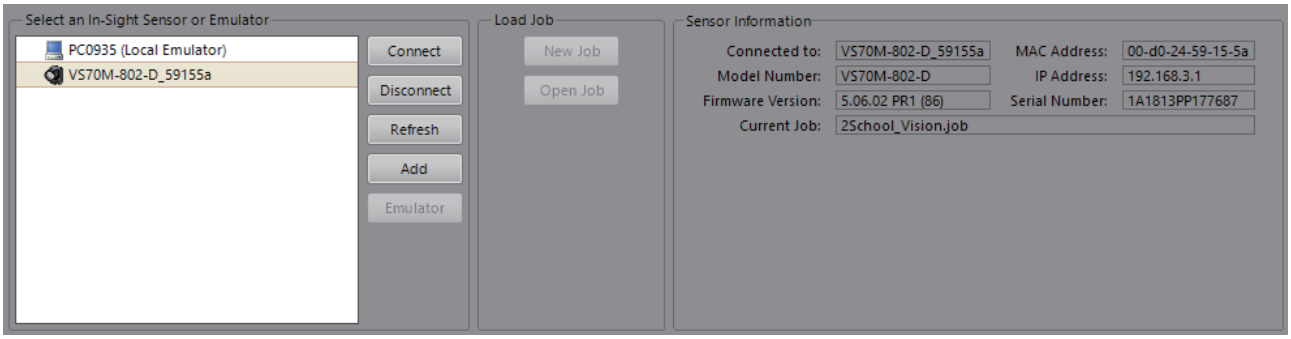
Tool	Setting	Description
Counting Tools	Blobs	Counts the number of blobs (groups of dark or light-colored connected pixels), and returns this number.
	Edge	Counts the number of linear edges, and returns this number.
	Edge Pairs	Counts the number of linear edge pairs, and returns this number.
	PatMaxRedLine™ Pattern	Counts the number of registered patterns in the image using the PatMax RedLine algorithm, and returns this number.
	PatMax® Pattern	Counts the number of registered patterns in the image using the PatMax algorithm, and returns this number.
	Pattern	Counts the number of registered patterns, and returns this number.
Identification Tools	Read 1D Code	Reads and verifies information contained in a single 1D code using ReadIDMax, and displays the decoded information.
	Read 1D Codes (1-20)	Reads and verifies information contained in up to 20 bar codes using ReadIDMax, and displays the decoded information.
	Read 2D Code	Reads and verifies information contained in a single 2D code using ReadIDMax, and displays the decoded information.
	Read 2D Codes (1-20)	Reads and verifies information contained in up to 20 2D codes using ReadIDMax, and displays the decoded information.
	Read Postal Code	Reads and verifies information contained in a single postal code using ReadIDMax, and displays the decoded information.
	Read Text (OCRMAX)	Reads and verifies the text within a region after registering and creating user-defined character fonts. Using the OCRMax algorithm, optical character recognition (OCR) is performed through a process of segmentation and classification against a registered font database tool.
	PatMax RedLineRedLine™ Patterns (1-10)	Determines from a library of registered patterns which pattern best matches the pattern in the image using the PatMax RedLine algorithm, and returns the name of the pattern and its score.
	PatMax® Patterns (1-10)	Determines from a library of registered patterns which pattern best matches the pattern in the image, using the PatMax algorithm, and returns the name of the pattern and its score.
	Patterns (1-10)	Determines from a library of registered patterns which pattern best matches the pattern in the image, and returns the name of the pattern and its score.
Geometry Tools	Point-to-Point: Line	Creates a reference line between any two input features, and returns the XY coordinates of the end-points of the created line.
	Point-to-Point: Mid-Point	Creates a reference line between two input features, and calculates the mid-point between the features. The XY coordinates of the mid-point and its angular orientation are returned.
	Point-to-Point: Distance	Creates two reference lines between two input features and a reference edge or line, and returns the distance between the mid-points of the two created reference lines.
	Perpendicular Line	Creates a reference line perpendicular to another line or edge, and returns the XY coordinates of the end-points of the perpendicular line.
	Line Intersection	Creates a point where two lines or edges intersection, and returns the XY coordinates of the intersection point.
	Bisect Angle	Creates a reference line that defines the bisection angle between two edges or lines, and returns the XY coordinates of the end-points of the line and the bisection angle.
	Line From N Points	Creates a best fit reference line using three to ten input features, and returns the XY coordinates of the end-points of the line.
	Circle From N Points	Creates a best fit circle using three to ten input features, and returns the diameter of the circle.
	Circle-Line Intersection	Creates two points where a line intersects a circle, and returns the XY coordinates of the two points.
	User-Defined Point	Positions a reference point within an image, and returns the XY coordinates of the point.
	User-Defined Line	Creates a reference line within an image, and returns the XY coordinates of the end-points of the line.
	Circle Fit	Creates a best fit circle, and returns the radius of the circle and its center point.
	Line Fit	Creates a best fit line, and returns the start and end points of the line segment.

Tool	Setting	Description
Math & Logic Tools	Math	Creates a mathematical formula to process tool and job data using standard mathematical functions, operations, logic, statistics, and trigonometry, with the use of the [Expression] editor.
	Logic	Creates a logical formula of tool PASS and FAIL signals using the [Expression] editor.
	Trend	Returns maximum, minimum, average, sample, and standard deviation statistics for location tools or inspection tools, over a defined number of samples.
	Statistics	Returns maximum, minimum, average, sample, and standard deviation statistics for location tools or inspection tools.
	Group	Combines a location tool and an inspection tool into a group.
	Sequence	Defines the number of steps for a job requiring multiple image acquisitions or stages in the assembly process.
	Compute Point	Calculates the position of a point on an image based on mathematical expressions.
	Variables	Defines integer, floating point, or string values that can be input to a job from an external device.
Plot Tools	Arc	Plots an arc graphic on an image based on mathematical expressions.
	Circle	Plots a circle graphic on an image based on mathematical expressions.
	Cross	Plots a cross graphic on an image based on mathematical expressions.
	Line	Plots a line graphic on an image based on mathematical expressions.
	Point	Plots a point graphic on an image based on mathematical expressions.
	Region	Plots a region graphic on an image based on mathematical expressions.
	String	Plots a text graphic on an image based on mathematical expressions.
Image Filter Tools	Filter	Filters an image region with a pixel-by-pixel image-enhancement technique (such as thresholding, inverting, equalization, shrinking, expanding, filling, smoothing, or edge enhancement), and outputs a tool image.
	Transform	Filters liner, non-liner, and/or lens distortion from an image region, and applies the transformation from a grid calibration to the image.
	Compare	Filters an image region against a template to represent the normalized difference between the two.
Defect Detection Tools	Surface Flaw	Detects the presence of small flaws based on pixel intensity variations.
	Edge	Creates a best fit line or circle, and determines whether or not there are deviations, such as defects or gaps.
	Edge Pairs	Creates a pair of best-fit line or circle, and determines whether or not there are deviations, such as defects or gaps.
	Edge Width	Measures and verifies that the thickness of a pair of edge is within tolerance.
	Bead Finder	Detects a bead feature (defined by a pair of edges), regardless of shape, by detecting the center of the bead and creating a region that can be used to inspect the width of the bead.
	Bead Tracker	Inspects the location, shape, and width of a beard feature, and determines if the bead is in the correct position, based on a user-defined edge model of a bead feature (defined by a pair of edges).
Calibration Tools	N Point	Creates a calibration that can be exported to share among jobs, using 2 to 16 point pairs.
	Sequential N Point	Creates a calibration that can be exported to share among jobs, using 2 to 16 point pairs and images that are sequentially captured.

For details on each location tool, refer to the following.

📖 EasyBuilder Help

3.2 Get Connected



Select an In-Sight Sensor or Emulator

The available In-Sight sensors and local emulators are displayed.

■Emulator function

In-Sight Explorer has an emulator function.

The emulator allows the addition of tools to jobs and the editing of parameters even when the VS series vision sensor is not on hand.

Images of inspection targets captured with a vision sensor or other cameras and saved to a personal computer can be imported, and the parameters of the location tools and inspection tools can be adjusted, added, and deleted.

Job files created using the emulator can be run on an actual vision sensor by loading the files on a vision sensor.

Load Job

A new job can be created or a saved job can be opened while the sensor is offline.

Sensor Information

Information about the connected sensor and the name of the open job is displayed. If a new job is being created, nothing is displayed in "Current Job" until the job is saved under a new name.

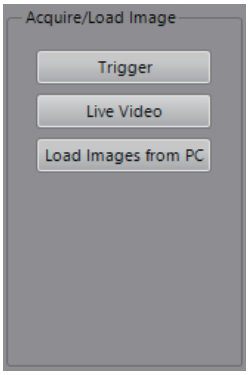
3.3 Set Up Image

In the Set Up Image step, "☞ Page 28 Acquire/Load Image", "☞ Page 29 Edit Acquisition Settings", and "☞ Page 30 Calibration" are possible.

Importing an image

Set the trigger type settings and image import settings.

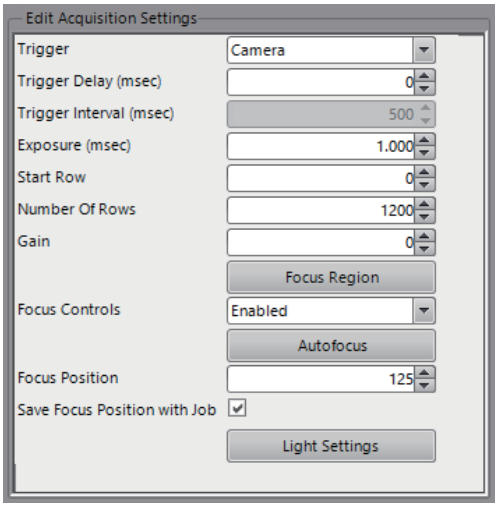
Acquire/Load Image



Item	Description
Trigger	An image is imported from the vision sensor.
Live Video	Sets the vision sensor to live display. The live display is used to adjust lens focus, lens aperture, field of view, and light brightness. ☞ Page 29 Image adjustment tips
Load Images from PC	Opens the record playback options. Images saved to a personal computer can be loaded into PC Filmstrip for inspection.

Edit Acquisition Settings

The image import settings can be used to set online trigger settings exposure time, focus control (when an autofocus lens is used), and lighting settings (with built-in lighting or when external lighting is connected to the vision sensor).



Item		Description
Trigger	Camera	Uses the trigger input of the vision sensor.
	Continuous	Performs continuous capture at specified intervals or at the fastest speed.
	External	Uses general-purpose input for I/O connection.
	Manual	Presses the trigger button of In-Sight Explorer or the F5 key to capture the image.
	Network	When multiple In-Sight cameras are used, images are captured according to the instructions from the first master camera. To use this option, the settings must be adjusted in the spreadsheet view.
	Industrial Ethernet	Uses industrial Ethernet protocol (such as SLMP Scanner or CC-Link IE Field Basic).
Trigger Delay		The delay time from when the camera receives the trigger until the In-Sight vision system starts capturing images can be specified in milliseconds.
Trigger Interval		When this setting is set to "Continuous", the image capture interval can be specified in milliseconds.
Exposure		Set the camera exposure time.
Start Row		Defines the first line transferred from the image sensor to the memory of the In-Sight vision system.
Number Of Rows		Defines the number of lines transferred to the memory of the In-Sight vision system.
Gain		Controls the gain of the amplification stage preceding the analog-to-digital converter.
Focus Region		Used to specify the region of an image. Used to calculate the image focus, which is one of the focus metrics displayed in live mode.
Focus Controls		Specifies whether to enable focus control. Focus control can be used only when the vision system is offline.
Autofocus		Automatically focuses the lens and maximizes image sharpness within a region.
Focus Position		Moves the lens to a specific focus position to capture a new image.
Save Focus Position with Job		Specifies whether to save the focus position in the job and apply it to the lens when the job is reloaded. By default, the [Save Focus Position with Job] checkbox is selected.
Light Settings		Sets this item when using integrated lights or external lights connected to the vision sensor.

Image adjustment tips

Sets the vision sensor in Live Video mode, then adjust the focus of the lens, the field of view, and the light brightness.

The VS70 has an autofocus function that automatically adjusts the focus when the [Autofocus] button in the EasyBuilder view is pressed. The focus position can also be adjusted manually by moving it by hand.

To adjust the camera brightness, change the exposure time and gain of the camera. Increasing the exposure time brightens the captured image, but makes it more susceptible to ambient light.

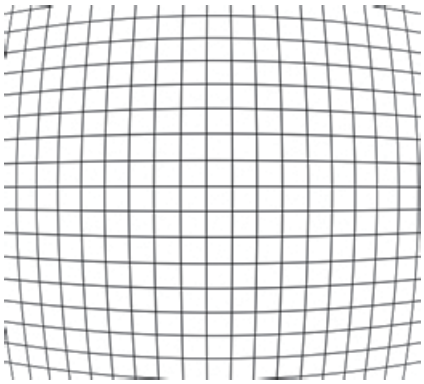
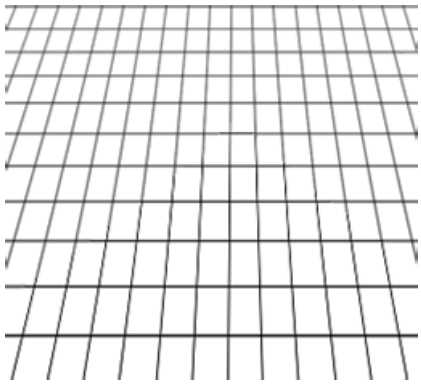
Basically, the exposure time is set to the default, but if the inspection object is moving at the time of capture, shorten the exposure time until the image is not blurred. When the exposure time cannot be adjusted, adjust the brightness of the lighting.

Calibration

Calibration is a function to transform the dimensions that correspond to the measurement surface from pixel units to actual units.

There are two types of calibration: one in which actual workpieces or items with determined dimensions are arranged at the same height as the measurement surface, and one in which patterns defined in advance are arranged on the measurement surface.

Only the latter type can handle lens radial distortion and perspective distortion.

Example of lens radial distortion	Example of perspective distortion
	
Cause As the focal length becomes shorter, the radial distortion becomes stronger. With some high performance lenses, this distortion is small.	Cause Perspective distortion occurs when the camera is set diagonally to the inspection surface.

Calibration types

■Types of calibration

Scale calibration converts pixel coordinates to real-world coordinates. It is useful for inspecting parts and objects by providing real-world measurement results for those inspection targets. However, this method does not correct for distortion.

Grid calibration corrects for radial, barrel, and perspective distortions caused by the lens and mounting method.

It is useful for measurement where higher accuracy results are required and robot guide applications.

Import calibration imports the calibration file created with the N point calibration tool or sequence N point calibration tool, and automatically calibrates the job.

Type		Description
Scale calibration	X/Y scale	Different settings can be made in the horizontal and vertical directions.
	Edge	Can be used when the distance between edges is known.
	X/Y edge	Performs different horizontal and vertical measurements using the detected edges.
	Circle	It is used when the diameter is known.
	9-point	It is based on nine equally spaced circle targets.
Grid calibration	Grid	Generates a map of the image region by importing a grid pattern image using a dot or square checkerboard.
Import calibration		Calibrates according to the content set with the N point calibration tool or sequence N point calibration tool. For details on the N point calibration tool and sequence N point calibration tool, refer to the following. ☞ Page 24 Tool list

3.4 Set Up Tools

This section describes the location tools and inspection tools.

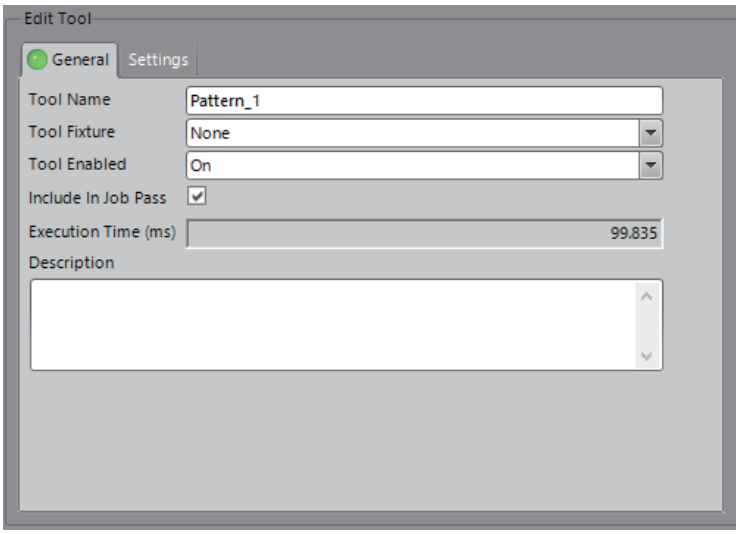
Configuring a tool

Overview of the tool setting pane

The tool setting pane basically has a [General] tab and a [Settings] tab. Depending on the tool, there are tabs to set other advanced parameters.

■[General] tab

This tab is provided for all tools, and it is used to set tool names, whether a tool is active, and whether to include it in the overall judgment.

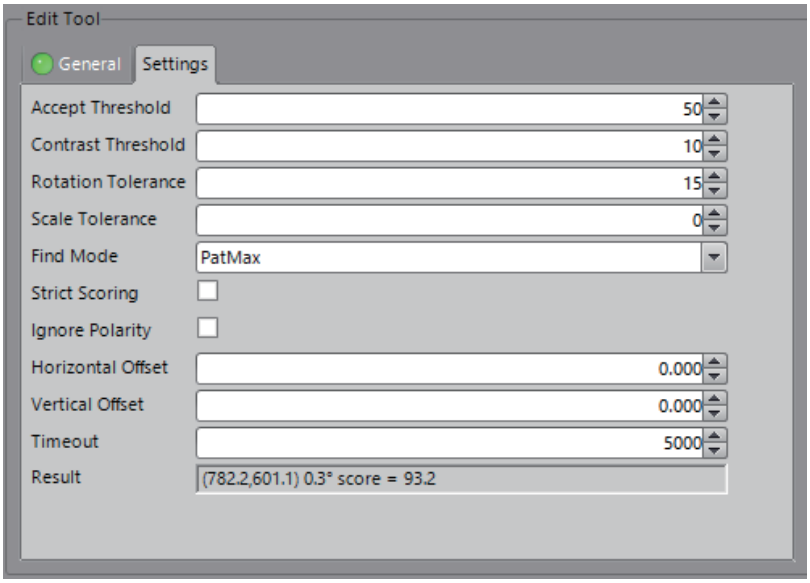


Name	Description
Tool Name	Defines the name of the configuration tool. The number at the end is incremented as tools are added. Change the name of the tool to an appropriate name according to the purpose of the tool.
Tool Fixture	Defines fixtures for tools. Only available if another tool for defining fixtures has already been added.
Tool Enabled	Defines whether the inspection tool can be executed.
Include In Job Pass	Defines whether to include PASS/FAIL of the tool in the job overall PASS/FAIL status.
Execution Time (ms)	Displays the time taken to execute the inspection in milliseconds. The execution time varies greatly depending on various factors (scene complexity, feature appearance position, allowable range setting).

■[Settings] tab

The content differs depending on the tool. In some cases, a special tab may be displayed for each tool such as edge or defect instead of the [Settings] tab. There is also a tool that displays a dialog box to make detailed settings.

Example: Location tool: PatMax Pattern



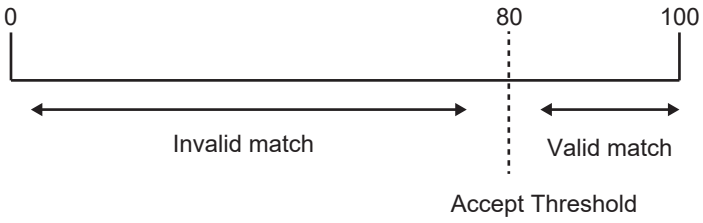
Name	Description
Accept Threshold	Defines the degree to which the detection pattern must be similar to the model pattern, as a value between 0 and 100. If a similarity equal to or greater than the setting value is obtained at the time of detection, a match is determined. Increasing the setting value can shorten the execution time of the tool, but the detection pattern requires correspondingly higher similarity to the model pattern. Reducing the setting value may result in incorrect results being returned, such as erroneous detection of a pattern different from the model.
Contrast Threshold	Specifies the minimum contrast value that must be present in the detection pattern. To be considered valid, the contrast of the detected pattern must be higher than [Contrast Threshold]. A low contrast threshold is used for low contrast images, and a high contrast threshold is used for high contrast images.
Rotation Tolerance	Specifies the allowable angle (0 to ±180 degrees) for which recognition is possible even if the detection pattern is rotated.
Scale Tolerance	Specifies whether to allow detection pattern scale change (within ±10%) based on the size of the model pattern.
Find Mode	Specifies the search mode used for registering and recognizing patterns. Either PatMax or PatQuick can be selected.*1
Strict Scoring	Defines whether missing or occluded features in the detected pattern should be considered in the score compared to the model pattern.
Ignore Polarity	Specifies whether to include the color-converted match features for the model pattern in the detection pattern.
Horizontal Offset	Specifies the horizontal offset in pixels relative to the center coordinates of the detection pattern.
Vertical Offset	Specifies the vertical offset in pixels relative to the center coordinates of the detection pattern.
Timeout	Defines in milliseconds the time that the tool searches for patterns. If the lapsed time exceeds the set time, the search ends and the tool returns FAIL.

*1 For accuracy, PatMax > PatQuick, and for speed, PatMax < PatQuick.

Point

Accept Threshold

The position coordinates of patterns that show a higher score than the setting value are enabled.



Region configuration

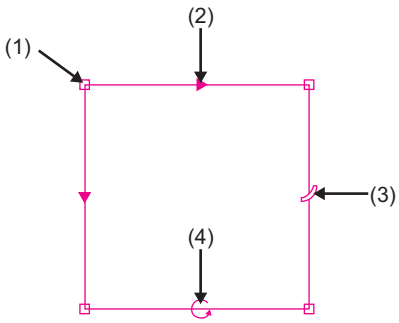
Depending on the tool, the search region and model region may be set. The important features that are always present in passing products are set in the model region. The search region defines the region where features may appear. Regions that have not been set are displayed in magenta.

Regions are set when a tool is added, but they can be set and changed again later.

■Rectangle region

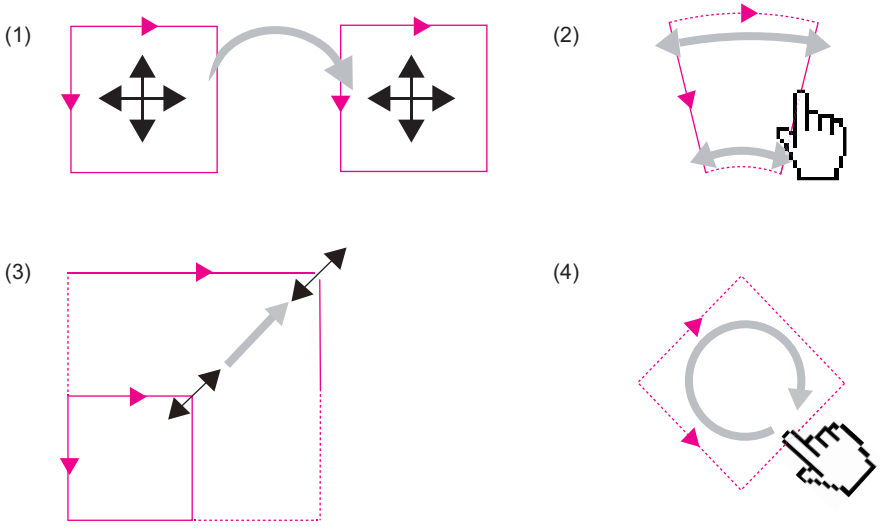
Regions include rectangle, circle, and annulus regions, but the most commonly used regions are rectangle regions.

- Rectangle region legend



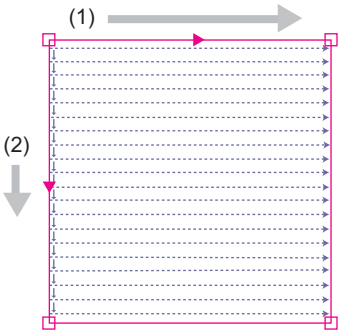
(1) Resizable endpoint boundary: Defines the four corners of the rectangle region. Click on an end-point boundary to resize the region from one of its corners.
(2) Scan direction indicator: Defines which direction the rectangle region will be scanned in for features.
(3) Bend handle: Allows the rectangle region to be bent into an arc or circular shape.
(4) Rotation handle: Allows the region to be rotated 360 degrees.

- Rectangle region mouse operations



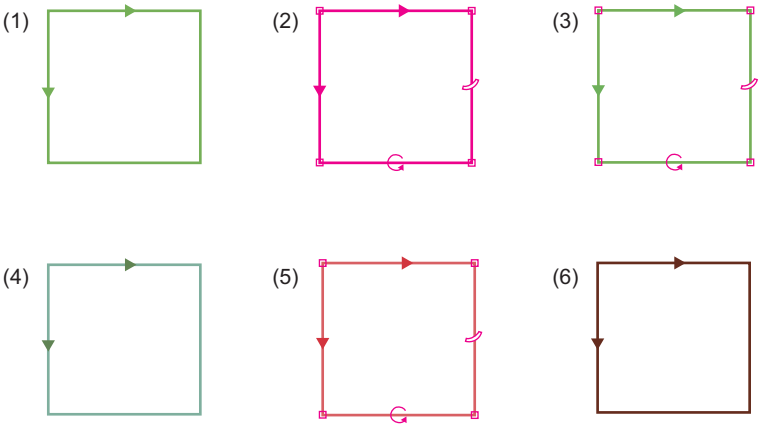
(1) Move: By placing the mouse cursor inside the region, the mouse cursor icon will automatically transform, allowing one to drag the region anywhere within the image.
(2) Bend: By placing the cursor on the bend handle, the mouse cursor icon will automatically transform, allowing one to reshape the rectangular region into a fan shape.
(3) Resize: By placing the mouse cursor over any of the four endpoint boundaries, or along any of the four sides, the mouse cursor icon will automatically transform, allowing one to drag the region to resize it.
(4) Rotate: By placing the mouse cursor on the rotation handle, the mouse cursor icon will automatically transform, allowing one to rotate the region 360 degrees from its current orientation.

• Rectangle region scan direction



(1) Top: Indicates the scan direction in the horizontal direction.
(2) Side: Indicates the scan direction in the vertical direction.

• Rectangle region color codes



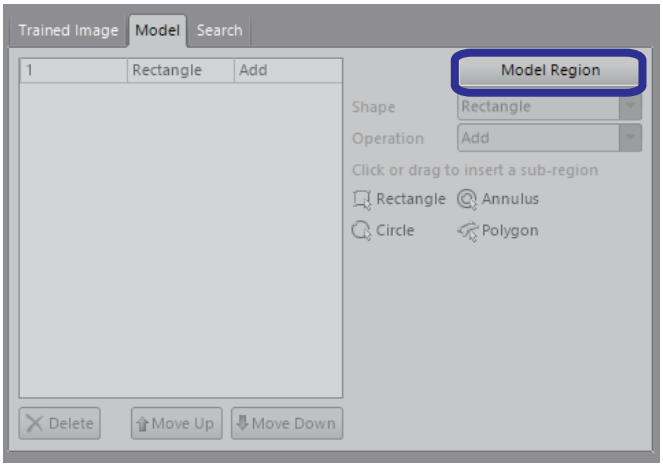
(1) Yellow-green: A newly added, unselected region
(2) Magenta: A selected but not yet set region
(3) Yellow-green: A selected, set and passing region
(4) Green: An unselected, set, and passing region
(5) Red: A selected, set and failing region
(6) Brown: An unselected, set, and failing region

■[Model] and [Search] tabs

For tools that require model registration such as PatMax patterns, each region can be set in the [Model] tab or [Search] tab.

• [Model] tab

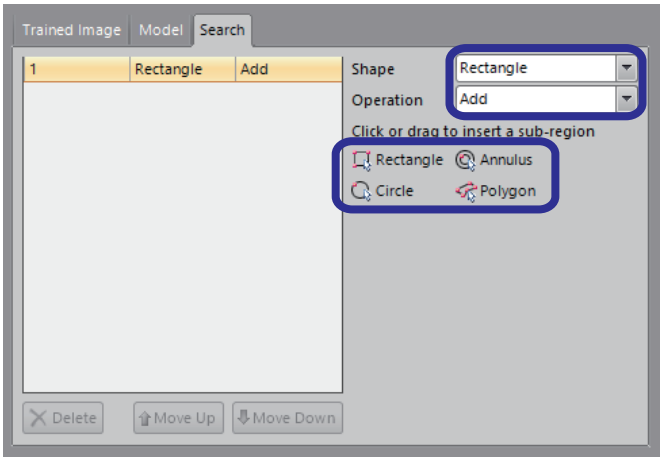
By clicking the [Model Region] button, the model region can be edited.



• [Search] tab

Various search region items can be edited, including "Shape" and "Operation", and sub-regions can be inserted by click operations.

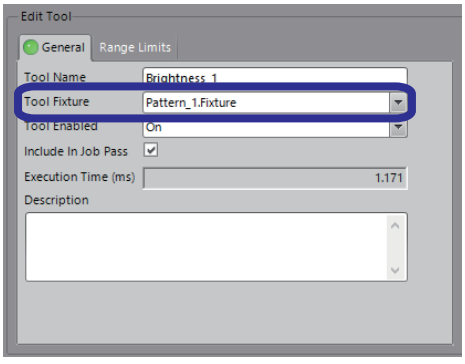
Use "Shape" and "Operation" when adding changes to a selected region.

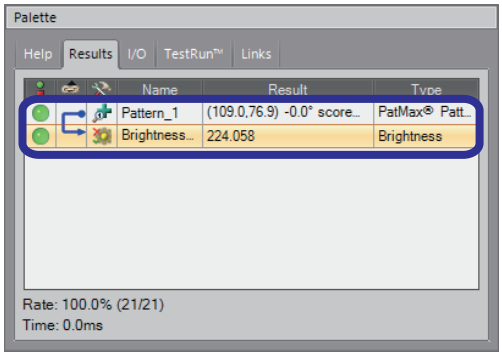


Tool linking

By setting the location of a workpiece with the location tool, the inspection region set by the inspection tool follows the workpiece.

If the inspection tool does not follow the expected location tool, select the location tool to follow on the [General] tab ⇨ "Tool Fixture" of the inspection tool. Which location tool is being used by the selected tool can also be checked from the [Results] tab of the palette.





Locate part

Location tools specify the locations of the features included in the image and outputs their coordinates.
The inspection region can be followed even if the target rotates or moves in the field of view (fixturing).
Fixturing is performed by acquiring information such as the position (x, y) and rotation of the part.
The coordinates can be transmitted and used for robot position control.

Selecting a location tool

Carefully observe the inspection target to determine what type of features are suitable for the inspection purpose and specifications.
In this training, location is performed using a PatMax pattern.
For details on other types of location tool, refer to the following.
☞ Page 24 Tool list

■Location using PatMax pattern

The PatMax pattern tool performs pattern location using the PatMax algorithm based on registered models. The PatMax pattern tool is used for a single pattern location.
Pattern location tools include the PatMax pattern, the PatMax RedLine pattern, and the Pattern tool, all of which are the most accurate inspection tools for detecting registered model patterns.
The use of a registered model is a common feature, but use the PatMax pattern and PatMax RedLine pattern when high accuracy and reliability are required, such as in the cases listed below.

- When it is difficult to control reflections or changes in lighting
- When the pattern to be inspected is similar or shadowed compared with the background pattern
- When patterns overlap or are partially hidden
- When high accuracy is required
- When operating environment conditions require very high levels of stability and reliability

Inspect part

Inspection tools are a group of essential tools for the vision sensor.
EasyBuilder has an interface that makes it easy to set complex inspections.

Types of inspection tool

Inspection tools are grouped by inspection type.

Tool	Description
Presence/Absence Tools	Determines whether or not features are present in the image.
Measurement Tools	Measures the distance, diameter, angle and surface area of features in an image.
Counting Tools	Counts the features included in the image. This tool is also used to check whether the required number is set.
Identification Tools	Identifies predefined features, such as characters included in the inspection region, barcodes, and 2D codes.
Geometry Tools	Creates geometric components (such as lines and arcs) in the image and measure the distance between elements.
Math & Logic Tools	Creates multiple conditions and perform calculations based on PASS/FAIL results.
Plot Tools	Displays figures (such as circles, lines, and points) and character strings on the window.
Image Filter Tools	Emphasizes or remove features as preprocessing for image analysis.
Defect Detection Tools	Determines whether the inspection target or object has defects such as cracks, wrinkles, pits, gaps, or scratches.
Calibration Tools	Creates a calibration that can be shared among jobs. Generally, these tools are used to create jobs for calibration.

The following describes the main inspection tools. For details on other inspection tools, refer to the following.
☞ Page 24 Tool list

Presence/Absence Tools

This tool is used to return presence/absence results about features in an image.
Tools include brightness, contrast, patterns, blobs, and edges, and a PASS/FAIL judgment is made based on the presence of features that satisfy the specified conditions. In this training, inspection will be performed using the brightness and edge tools.

■Brightness

This tool judges whether the average value of the brightness in the region is within the specified range.
This easy-to-use tool processes quickly, and judgment conditions are easy to determine. However, an environment with stable lighting is necessary because the lighting conditions greatly affect the inspection results.

■Edge

This tool determines whether or not a linear edge is present.

Measurement Tools

This tool is used to measure the distance, diameter, angle and surface area of features in an image.
For distance and surface area, the image can be output in actual dimensions instead of pixel units by running calibration. In this training, inspection will be performed using the distance tool.

■Distance

This tool is used to measure the distance between features such as edges and circles, patterns and blobs.

Identification Tools

This tool is used to identify and verify barcodes, 2D codes, symbols, alphanumeric strings, pattern features, and colors in images. In this training, inspection will be performed using the read 2D code identification tool.

■Read 2D code

Use ReadIDMax® to read QR codes and data matrix symbols to recognize and verify information contained in a single 2D code and display the decoded information.

Math & Logic

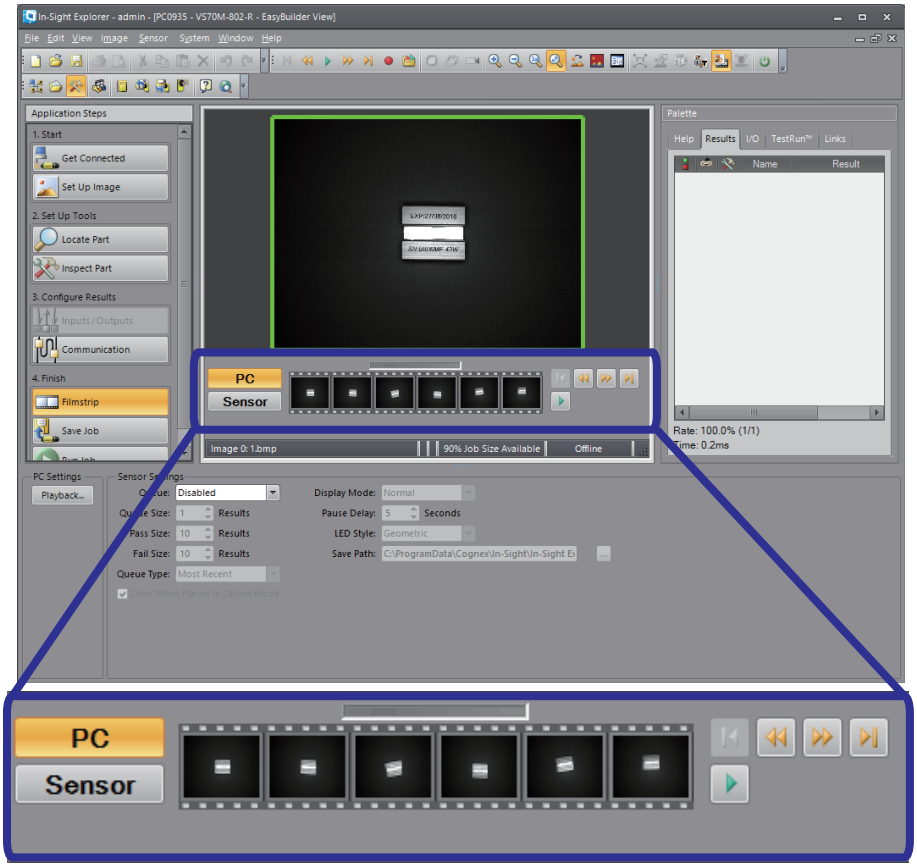
This tool is used to perform calculation processing and statistical processing using output values (such as coordinates, brightness, presence/absence judgment results) of location tools and other inspection tools. In this training, inspection will be performed using the Logic tool.

■Logic

This tool is used to create formulas that process PASS/FAIL data using standard boolean logic operators (AND, OR, NOT).

3.5 Filmstrip

This tool is used to display captured images using an interface that mimics photographic film, or to display images that are sequentially buffered under specified conditions.

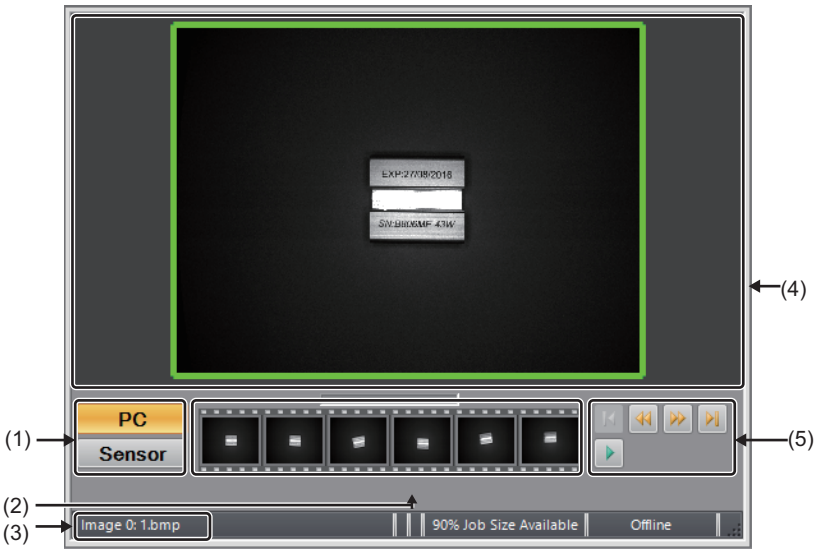


There are two types of filmstrip: PC filmstrip and sensor filmstrip, with the following functions for each.

Name	Description
PC Filmstrip	The images in the folder specified on the "Record/Playback options" window can be displayed in list form so that jobs can be verified while switching images.
Sensor Filmstrip	This function temporarily saves images taken while online in the memory inside the vision sensor according to the queue condition. Select the queue condition from "Disabled", "Pass Results", "Fail Results", and "Separate Pass and Fail Results". The images stored in the queue (image buffer) of the vision sensor under the specified conditions can be displayed in list form so that jobs can be verified while switching images. Because images are stored in the sensor memory, the queue size is limited (from 1 to 20; the maximum number of items that can be saved is limited by the job size).

The following shows the "Filmstrip" window.

When a filmstrip image is clicked, this image is loaded, and the job is run.



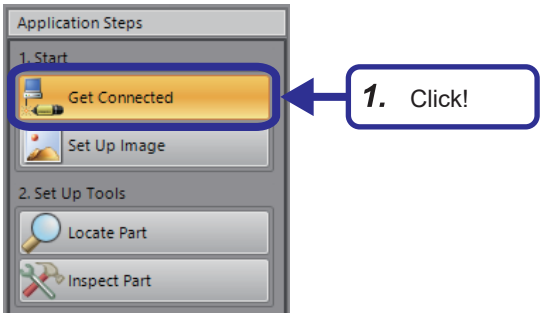
No.	Description
(1)	This icon switches between PC filmstrip and sensor filmstrip.
(2)	This icon switches the displayed image by clicking the image on filmstrip.
(3)	The name of the image file is displayed.
(4)	When the image is switched, PASS/FAIL is judged according to the job.
(5)	Click the image feed button to switch the displayed image.

4 TRAINING 1 CONFIGURING In-Sight Explorer

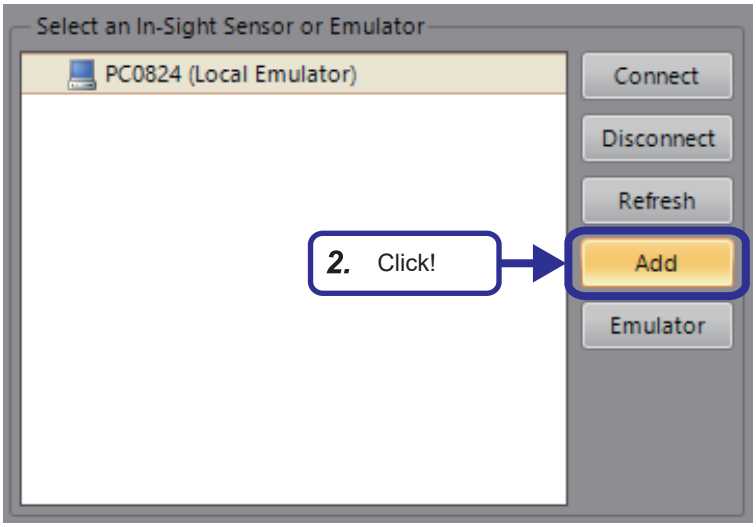
4.1 Connection with the Vision Sensor

Set the vision sensor used in In-Sight Explorer.

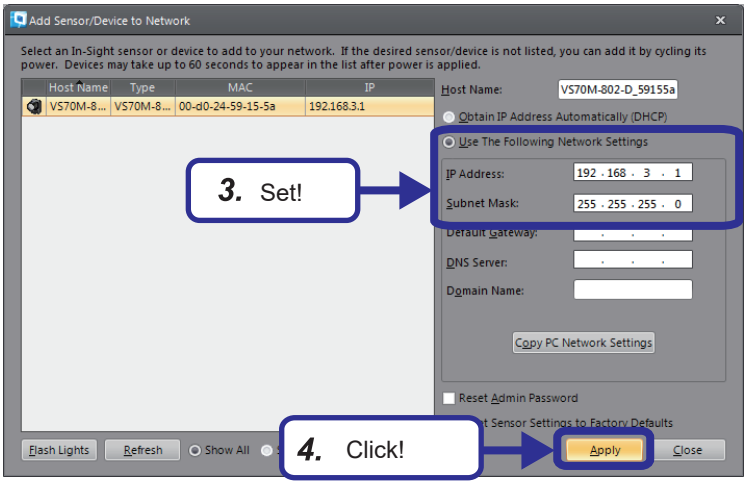
Operating procedure



1. From "Application Steps", click the [Connected] button.



2. Click the [Add] button.

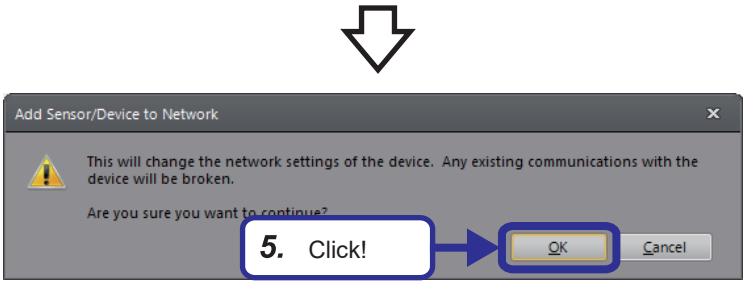


3. On the "Add Sensor/Device to Network" window, select the vision sensor to be connected and set the following.
[Setting details]
Use The Following Network Settings: Selected
IP address: 192.168.3.1
Subnet mask: 255.255.255.0

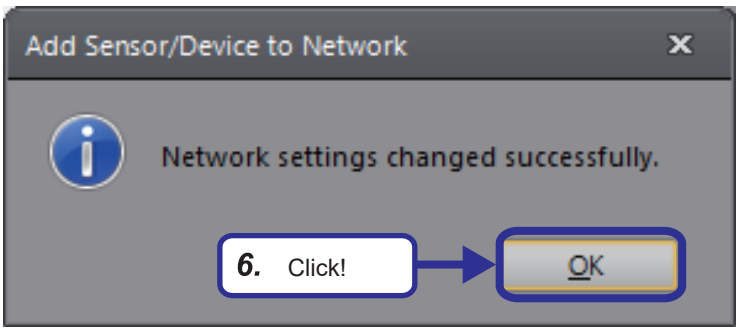
Point

If the personal computer and the vision sensor cannot communicate with each other, such as when the subnet of the IP address is different from the subnet of the local personal computer, a warning mark is displayed on the right side of the IP address. In that case, correct the IP address to an appropriate one.

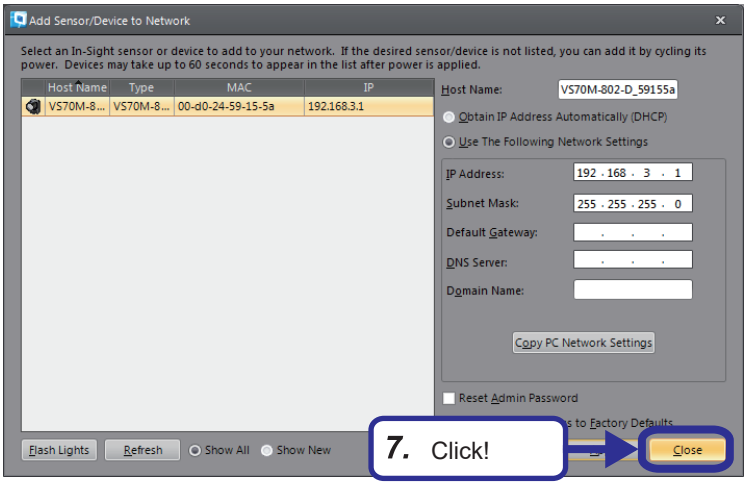
4. Click the [Apply] button.



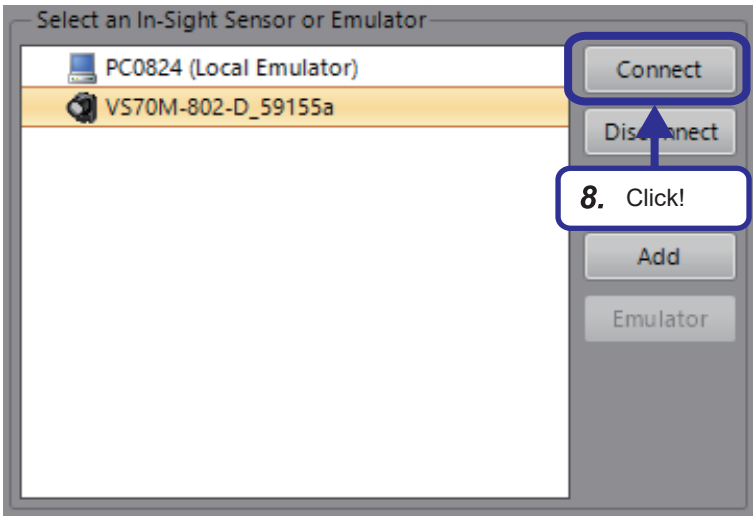
5. Click the [OK] button.



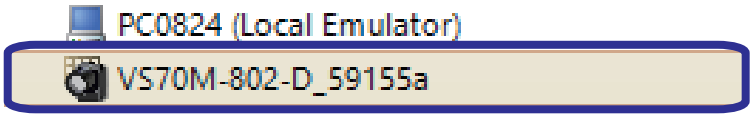
6. Click the [OK] button.



7. Click the [Close] button.



8. Select the vision sensor to be connected, and then click the [Connect] button.



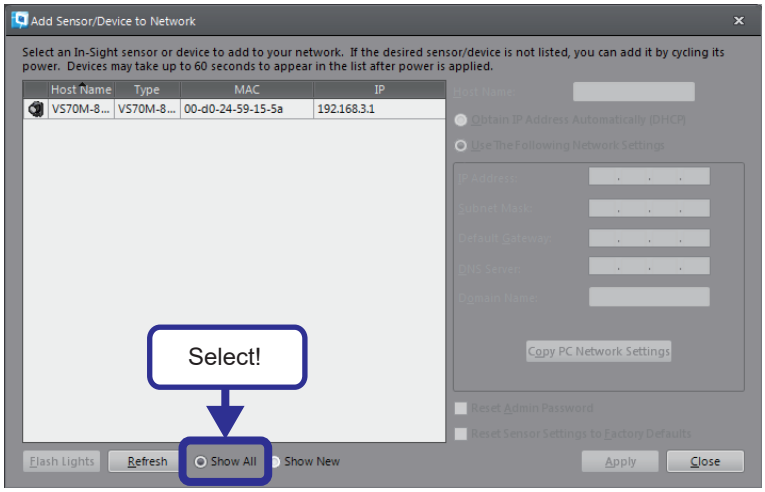
9. An In-Sight Explorer image appears in the background of the icon of the connected vision sensor.
For the emulator, an In-Sight Explorer image appears in the monitor of the personal computer icon.

Icon changes by the status of the connection to the vision sensor or emulator in In-Sight Explorer

Connection target	Not connected	Connected
Vision sensor (shape may differ by model)		
Emulator		

Point

- When the target vision sensor is not displayed in the "Add Sensor/Device to Network" window even though the vision sensor is connected to the network and the power is on, select "Show All".



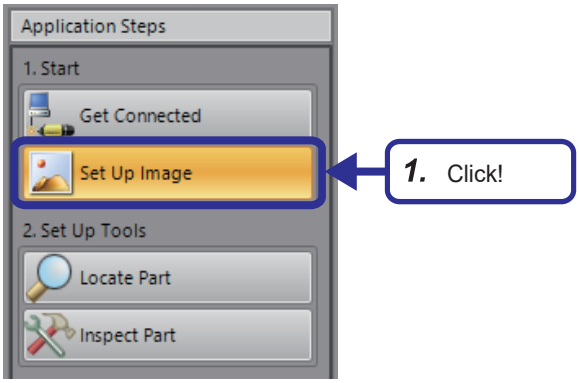
- To change the network settings of a connected vision sensor, open the "Network Settings" window from [Network Settings] under the [Sensor] menu and make the changes.

4.2 Set Up Image

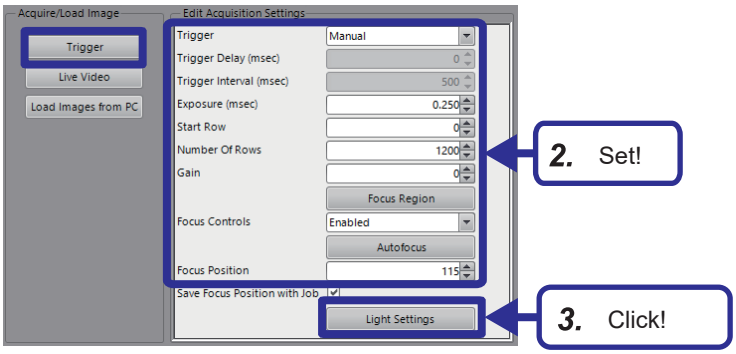
Importing an image

Import an image.

Operating procedure

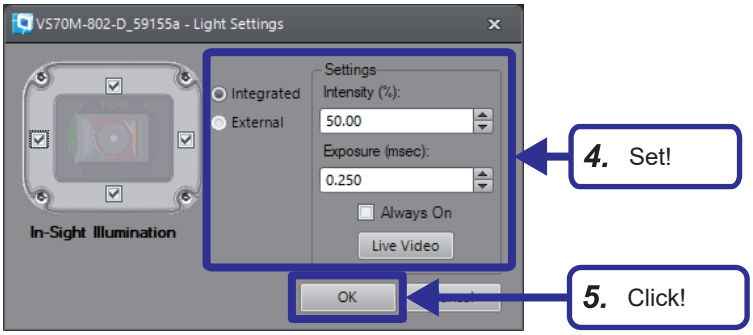


1. From "Application Steps", click the [Set Up Image] button.



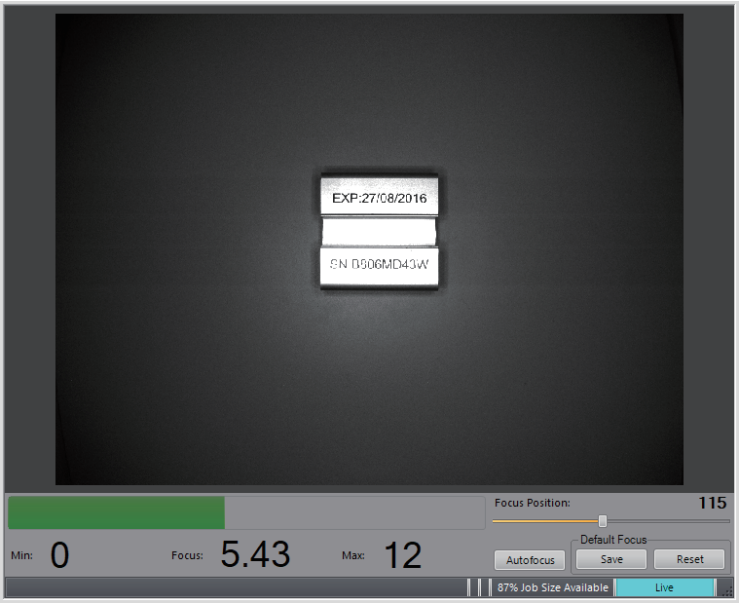
2. Click the [Trigger] button and set the image capture settings as follows.
[Setting details]
Trigger: Manual
Exposure: 0.25
Start Row: 0
Number Of Rows: 1200
Gain: 0
Focus Position: 115

3. Click [Light Settings].



4. Set the lighting setting as follows.
[Setting details]
Integrated: Selected
Intensity: 50.00
Exposure: 0.25

5. Click the [OK] button.

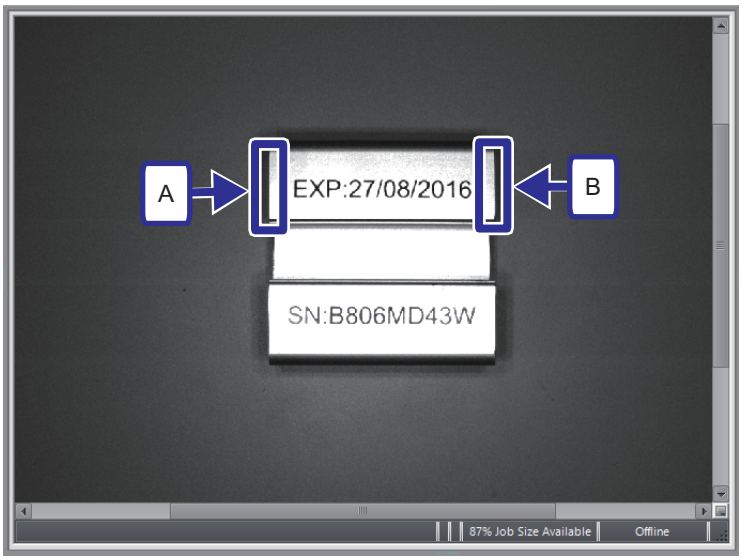


6. Set the "SN:B806MD43W" workpiece.
7. Click the [Live Video] button to set the vision sensor to live display, and check the image to be captured. Click the [Live Video] button again to capture the image.

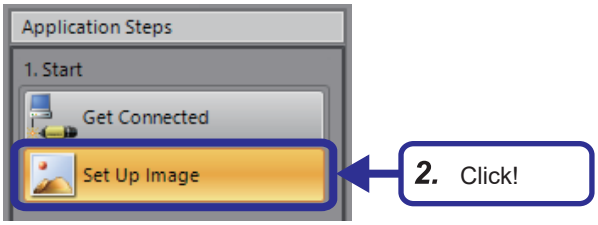
Calibration

The pixel values are displayed as actual measurement values using the edges of the scale calibration.
Since radial distortion and perspective distortion are not taken into account, accuracy is highest when the measurement surface is parallel with the image sensor.

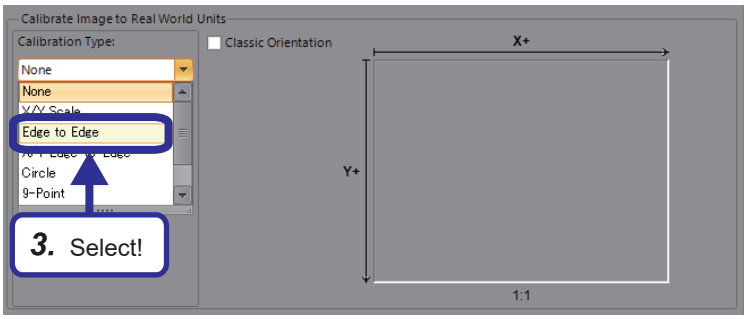
Operating procedure



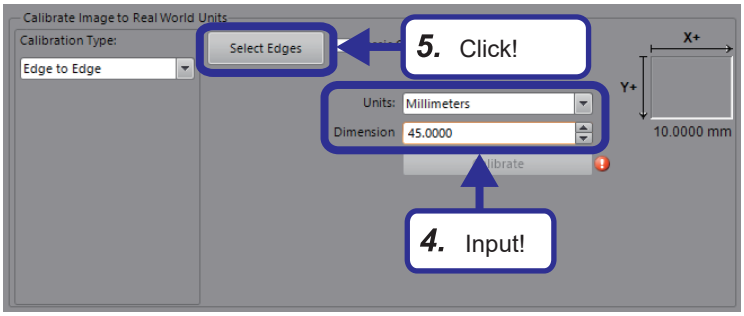
1. For example, the distance between the edges of the captured workpiece indicated by frames A and B is 45mm.



2. From "Application Steps", click the [Set Up Image] button.

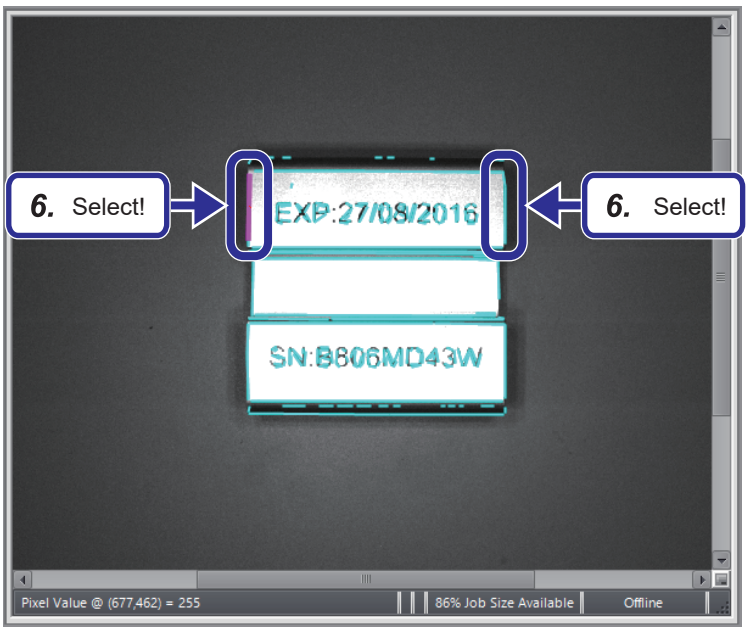


3. For "Calibration Type" in the settings pane, select "Edge to Edge".



4. Check the unit and enter 45 for "Dimension".

5. Click the [Select Edges] button.



6. Click (magnification) on the job display toolbar to magnify the image, and select the edges to be used for calibration.

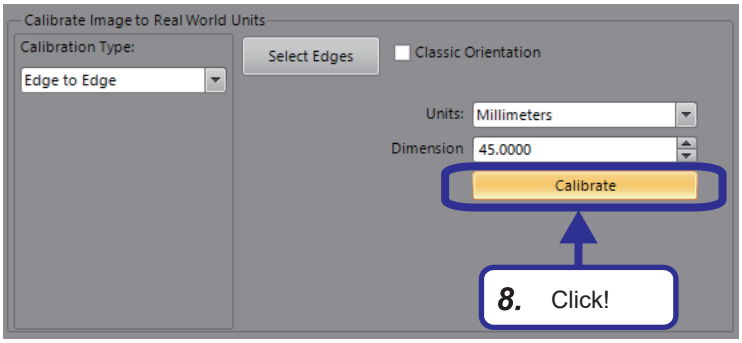
Point

- Smart features are displayed in light blue on the edges and circles detected by EasyBuilder. Clicking one of the features changes its color to magenta.
- If the edges used for calibration are not detected as smart features, the region in which an arbitrary edge is to be detected can be arranged by clearing the "Smart Features" checkbox.

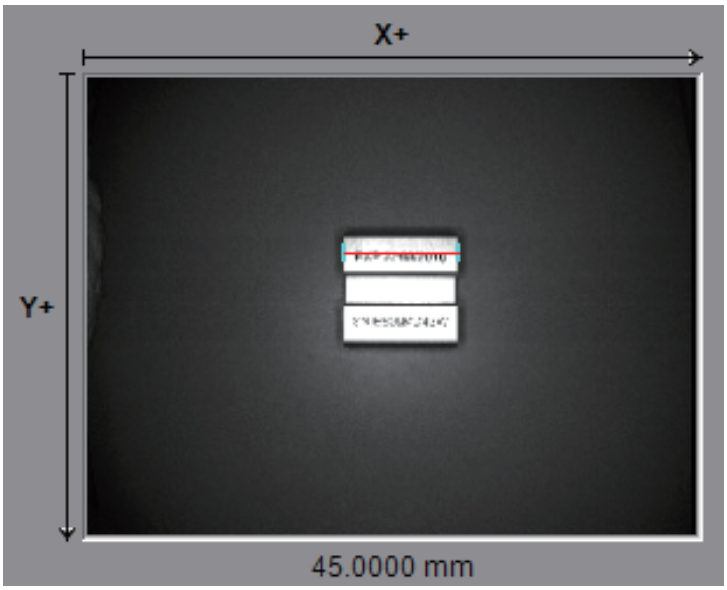
7. Select one of the edges detected by a smart feature and then select the other edge to confirm.

Point

The color of edges that have been selected and entered changes to green.



8. Click the [Calibrate] button.

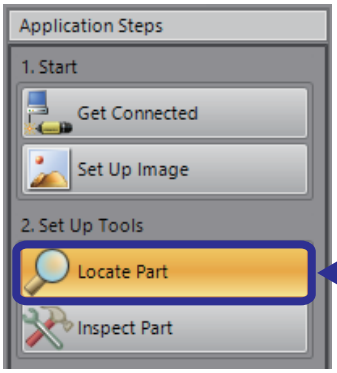


9. When calibration is completed, an image like the one shown on the left appears.
If measurement is performed with the distance measurement tool (☞ Page 58 Measurement tool (distance)), the measurement results are displayed in actual units.

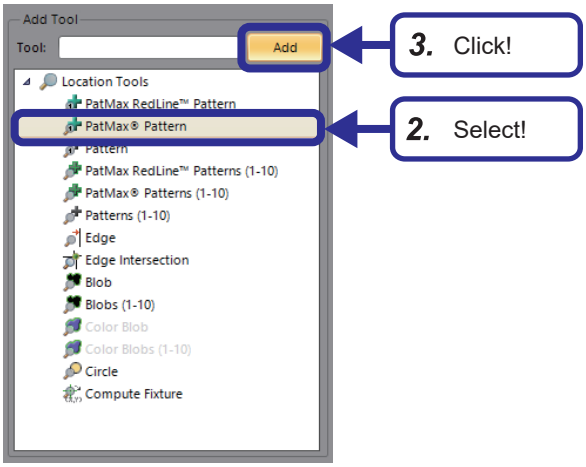
4.3 Configuring Location Tools

Set the location tool pattern.

Operating procedure

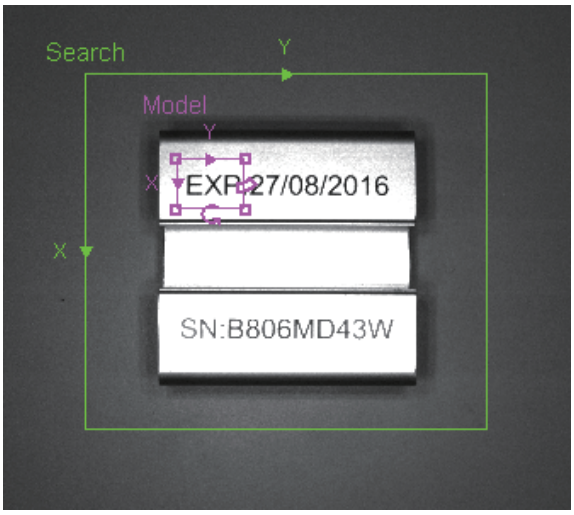


1. From "Application Steps", click the [Locate Part] button.



2. From "Add Tool", select "PatMax® Patterns".

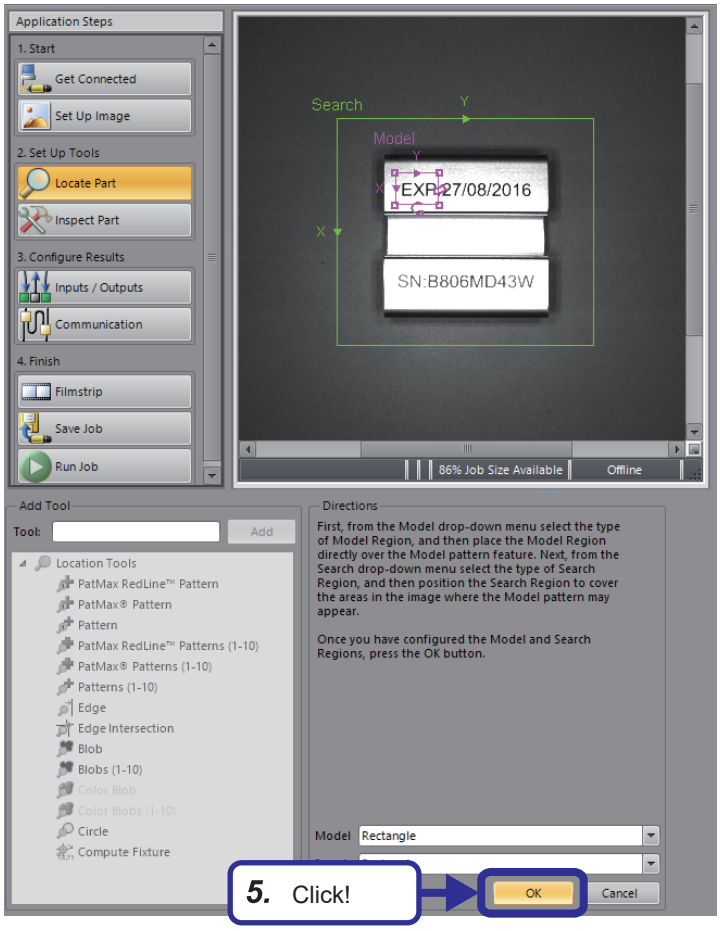
3. Click the [Add] button.



4. Click (magnification) on the job display toolbar to magnify the image, and select the model region and the search region.
Set the model region to "EXP" and set the search region to a region that can accommodate the workpiece even if the orientation of the workpiece changes.

Point

- For the model pattern, select a unique feature that always exists in the inspection target.
- When setting the model region and the search region, the shape can be selected.



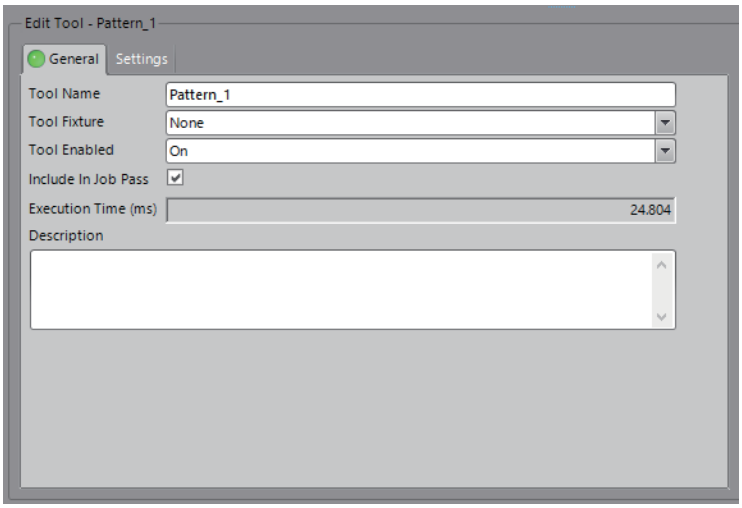
5. Click the [OK] button.

Point

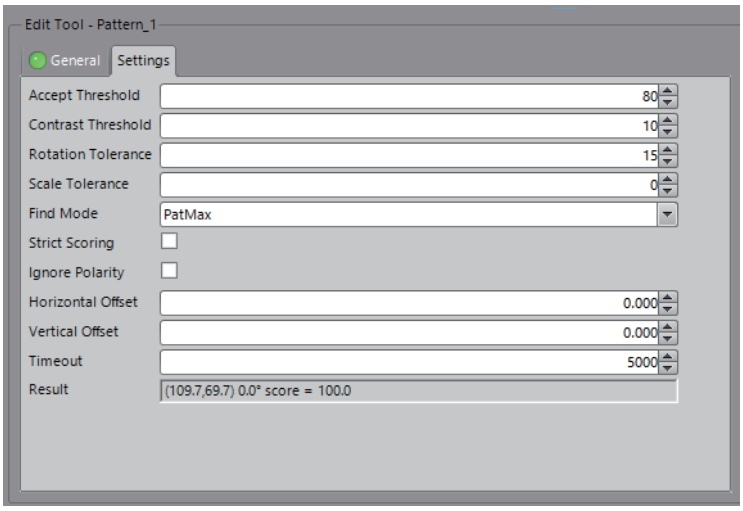
Model region configuration tips

- Select a shape with few common changes in any lot of the inspection target.
- When the pattern of background and workpiece surface areas are erroneously registered as shapes, set a subtraction region to exclude it.
- In a model subject to detection, for example for a cylinder shaped workpiece, the orientation may be determined incorrectly.
  Set the model region so that the proportion of the special region becomes larger within the registered model.
  For details on region settings, refer to the following.
  ☞ Page 33 Region configuration

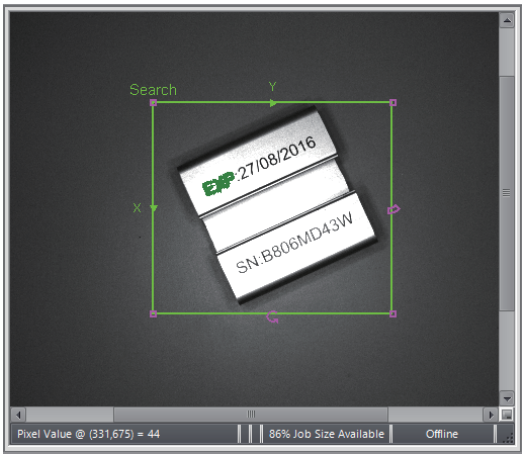
[General] tab



[Settings] tab

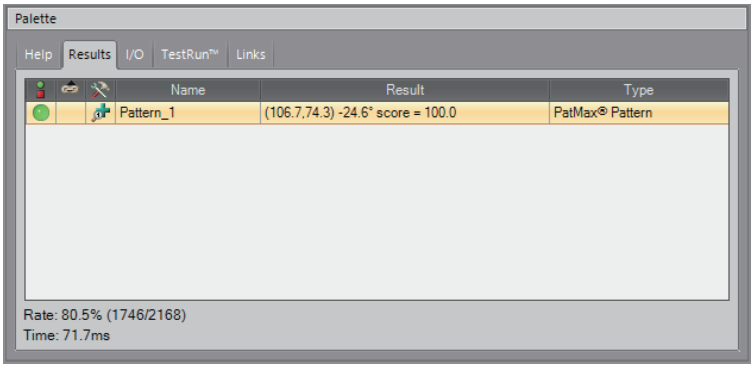


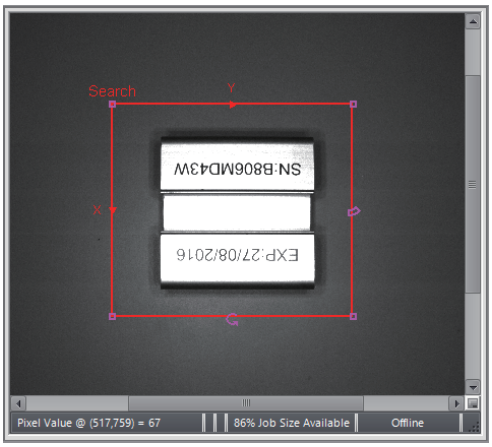
6. Set the parameters as follows.
[General] tab
Tool Name: Pattern_1
Tool Fixture: None
Include In Job Pass: Selected
[Settings] tab
Accept Threshold: 80
Contrast Threshold: 10
Rotation Tolerance: 15
Scale Tolerance: 0
Find Mode: PatMax
Strict Scoring: Not selected
Ignore Polarity: Not selected
Horizontal Offset: 0.000
Vertical Offset: 0.000
Timeout: 5000
For the settings of each tab, refer to the following.
☞ Page 31 Overview of the tool setting pane



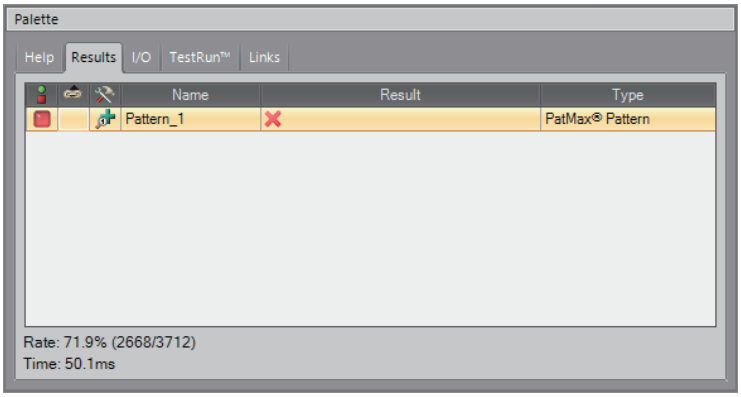
7. Set the workpiece "SN:B806MD43W" diagonally and click (Repeating trigger).
The model pattern is recognized according to the set PatMax pattern.
Move the workpiece and check if the model pattern is recognized.

[PASS]





[FAIL]



8. The location result is displayed on the [Results] tab of the palette.
If the pattern is recognized, the result is PASS.

9. If the orientation of the workpiece "SN:B806MD43W" is reversed, the pattern will not be recognized because it exceeds the allowable rotation value set in the parameters of the PatMax pattern.

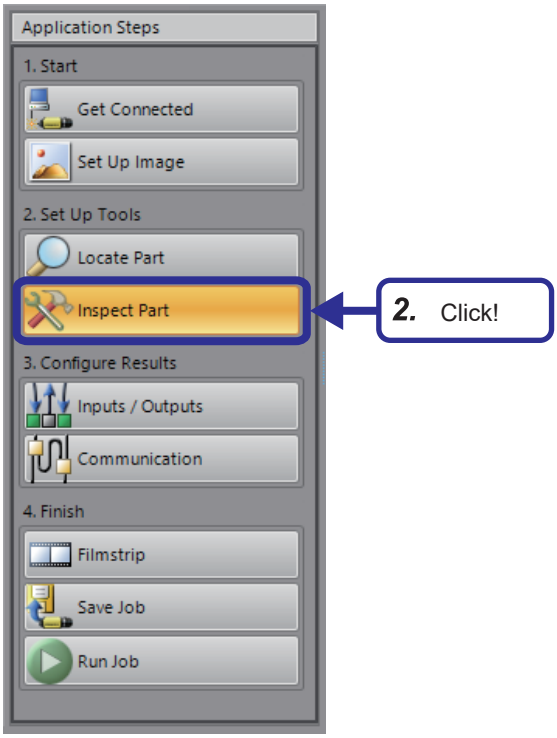
10. The location result is displayed on the [Results] tab of the palette.
If the pattern is not recognized, the result is FAIL.

4.4 Configuring Inspection Tools

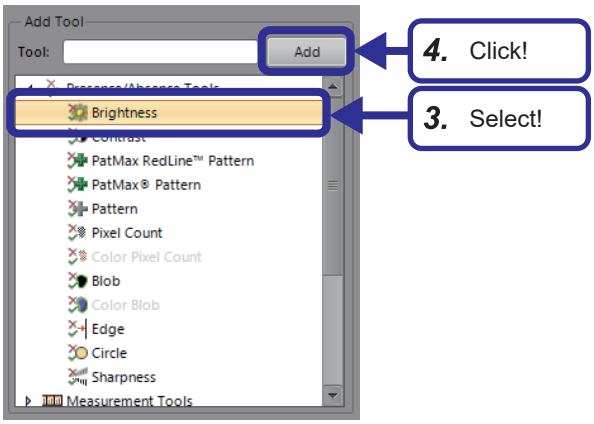
Set the presence/absence tool and the measurement tools.

Presence/absence tool (brightness)

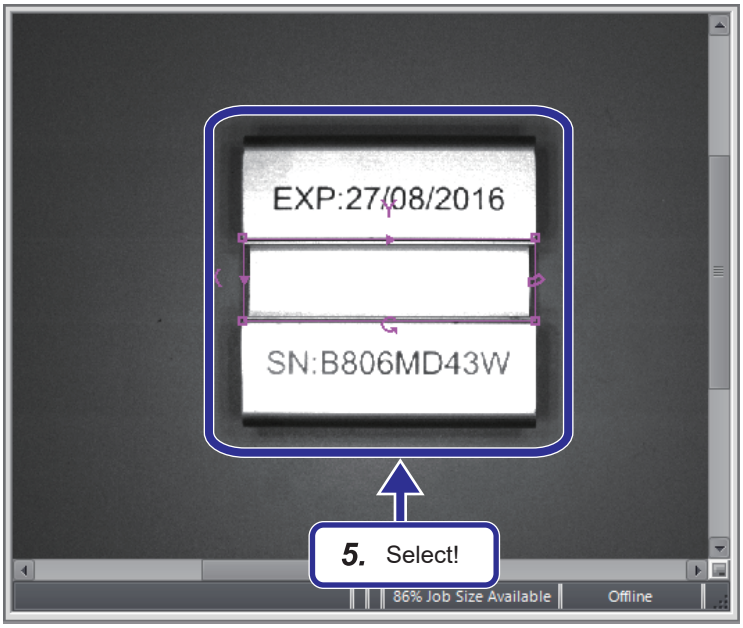
Operating procedure



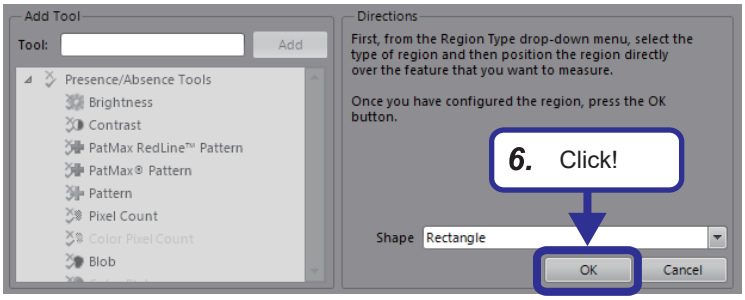
1. Set the workpiece "SN:B806MD43W" and click the [Live Video] button to check the image to be captured. Click the [Live Video] button again to capture the image.
2. From "Application Steps", click the [Inspect Part] button.



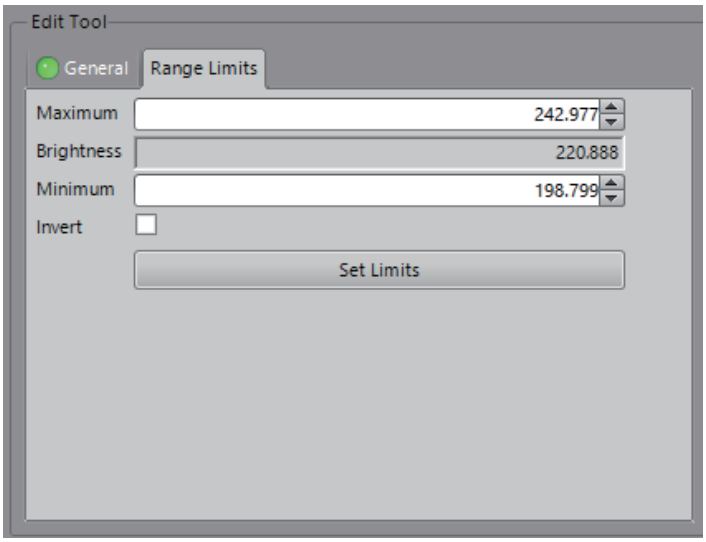
3. From "Add Tool", select [Presence/Absence Tools] ⇨ [Brightness].
4. Click the [Add] button.



5. Click (magnification) on the job display toolbar to magnify the image, and set the region to be inspected.
To calculate the mean value of the brightness of the entire region, set only the necessary range to be measured as the region.



6. Click the [OK] button.



7. If the region is entered, the maximum and minimum of the restricted range are set automatically based on the average value of the brightness in this region.

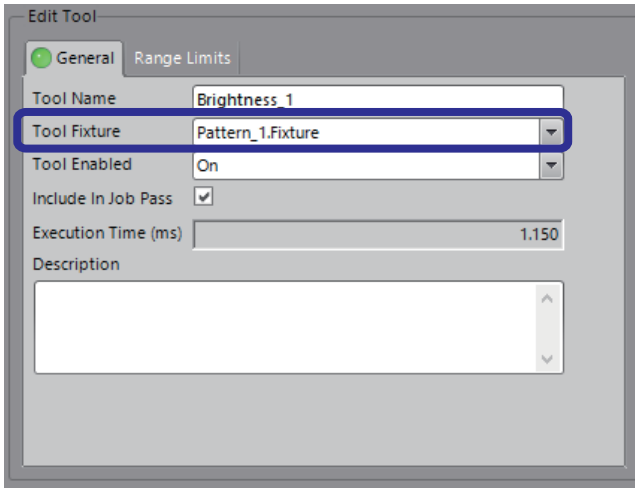
Point

- The PASS judgment state results when a tool is added.
- Adjust the restricted range according to the conditions of the inspection section.

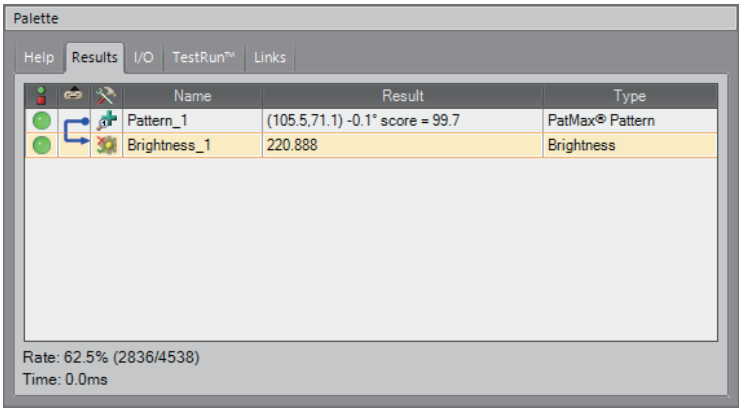
Point

Tool fixtures of a location tool added ahead of time will be automatically set for all the other location tools and inspection tools added subsequently.

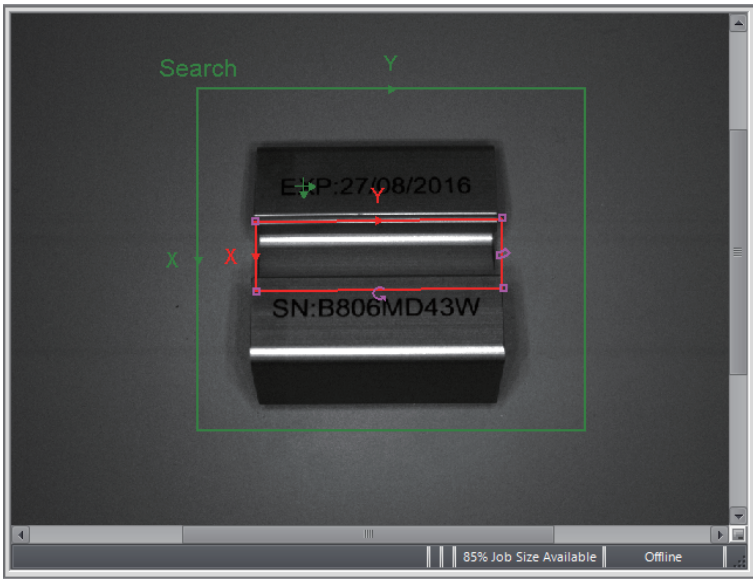
When multiple location tools are being used, set tool fixtures so that intended fixtures are followed.



[PASS]

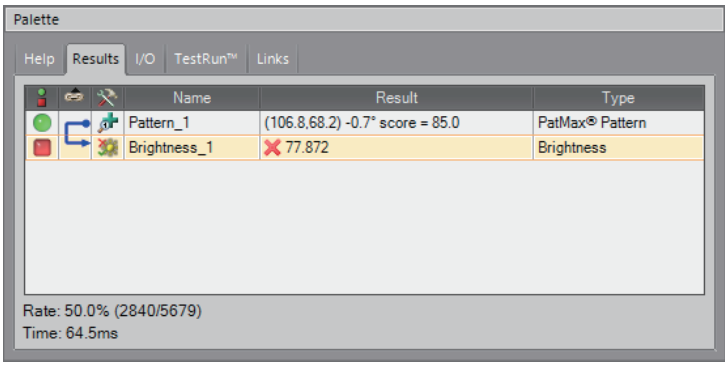


8. The inspection result indicating PASS is displayed on the [Results] tab of the palette.



9. Set the workpiece "SN:B806MD43W" tilted over and click (Repeating trigger).
Move the workpiece and check the brightness result.

[FAIL]



10. If the brightness value in the region is lower than the maximum/minimum value of the restricted range, a FAIL occurs.
The inspection result indicating FAIL is displayed on the [Results] tab of the palette.

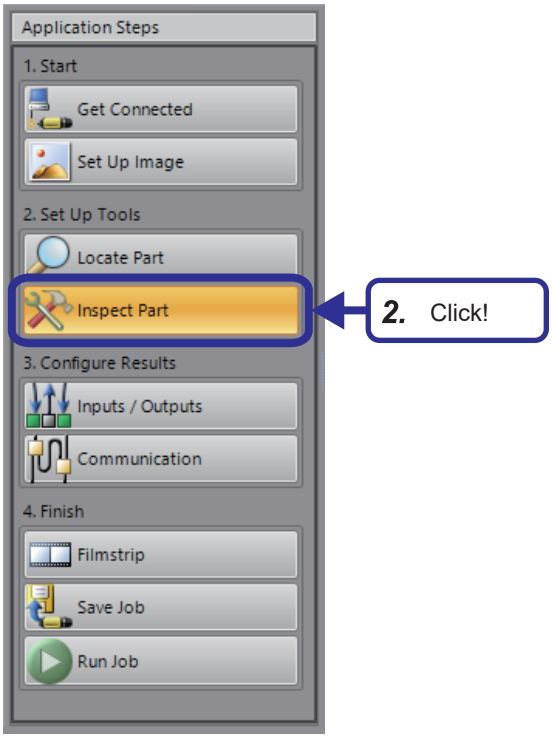
Measurement tool (distance)

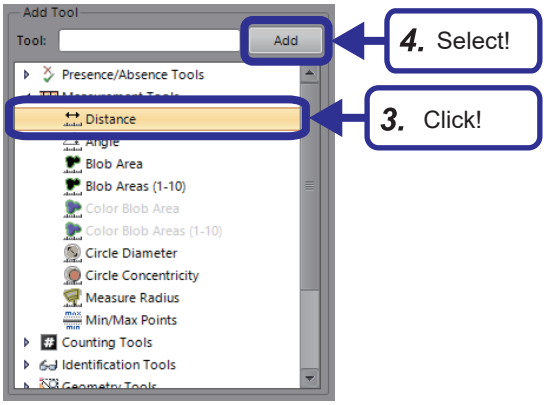
The width of the "SN:B806MD43W" workpiece to be used differs from that of " *SN:B806ME 43W* ".
Therefore, the difference can be checked by the inspection result of the measurement tool (distance).

SN:B806MD43W

SN:B806ME 43W

Operating procedure



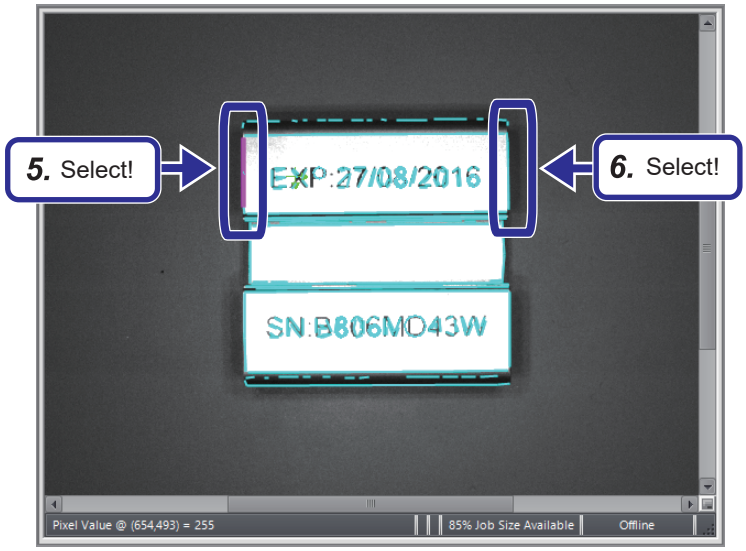


1. Set the workpiece "SN:B806MD43W" straight and click the [Live Video] button to check the image to be captured. Click the [Live Video] button again to capture the image.

2. From "Application Steps", click the [Inspect Part] button.

3. From "Add Tool", select [Measurement Tools] ⇨ [Distance].

4. Click the [Add] button.

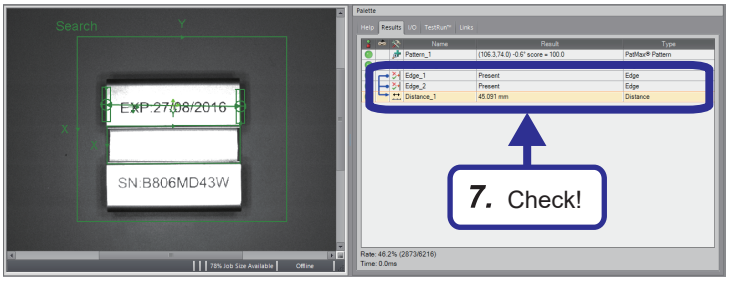


5. Click (magnification) on the job display toolbar to magnify the image, and select a feature from the smart features.

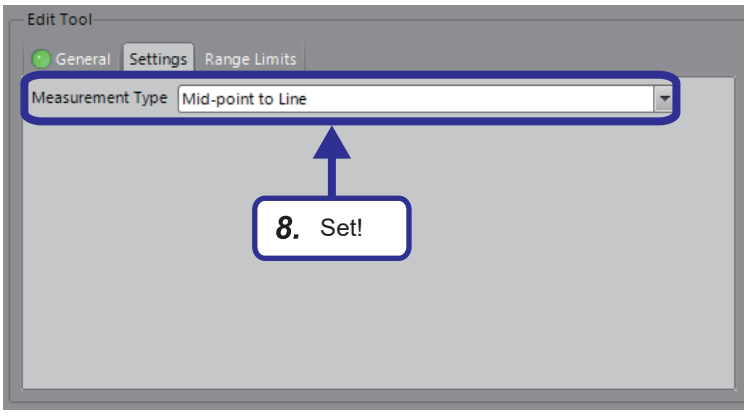
Point

Smart features are displayed in light blue on the edges and circles detected by EasyBuilder.

6. Select the second feature from the smart features.



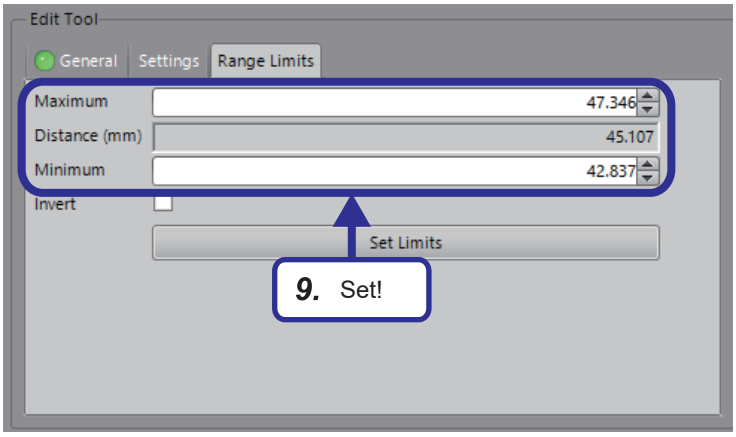
7. If a second smart feature is selected, two edge tools (presence/absence tools) are created, and a distance tool to measure the interval of these edge tools is added.



8. From the [Settings] tab in the tool editing window of Distance_1, Select "Mid-point to Line".

Point

When "Mid-point to Line" is selected, the perpendicular distance between the midpoint of the first selected edge and the line of the edge selected next is measured.

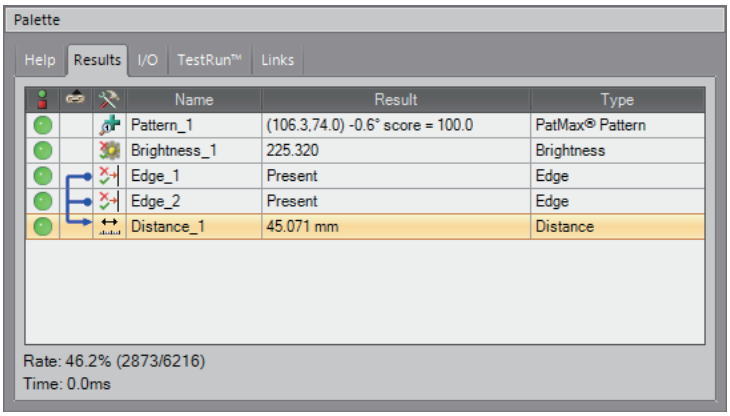


9. From the [Range Limits] tab, set the range in which the inspection would result in PASS.

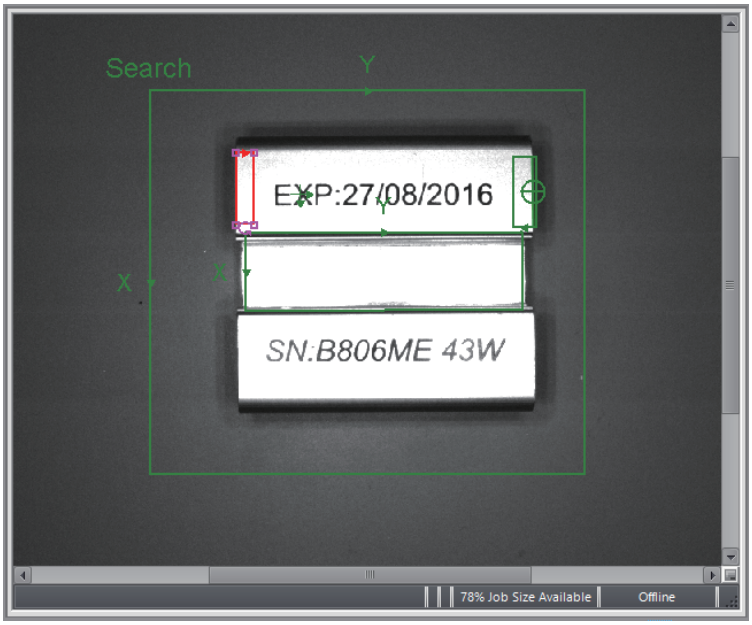
Point

When the calibration is performed, the results and range limits are displayed in units determined by calibration.

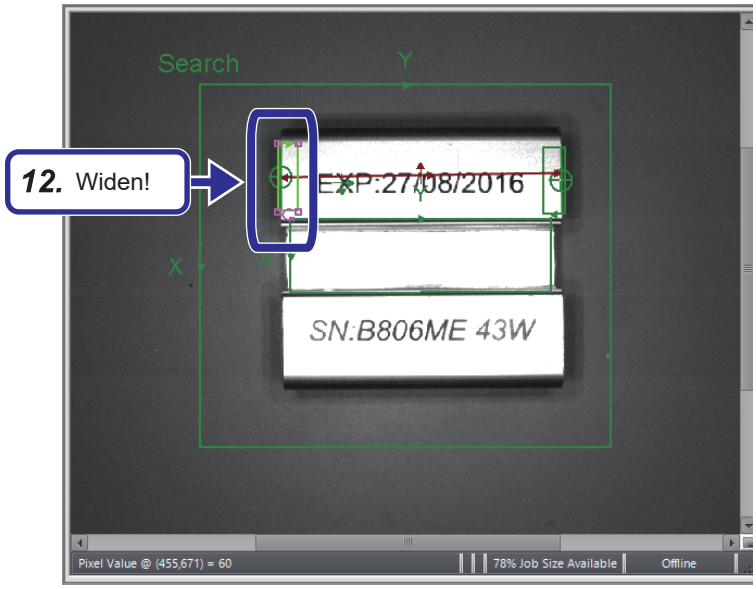
[PASS]



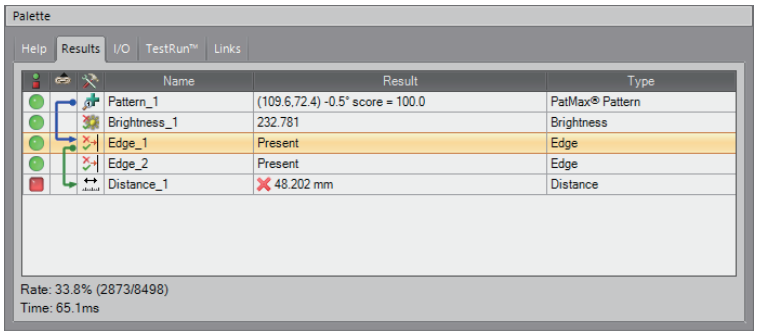
10. The inspection result indicating PASS is displayed on the [Results] tab of the palette.



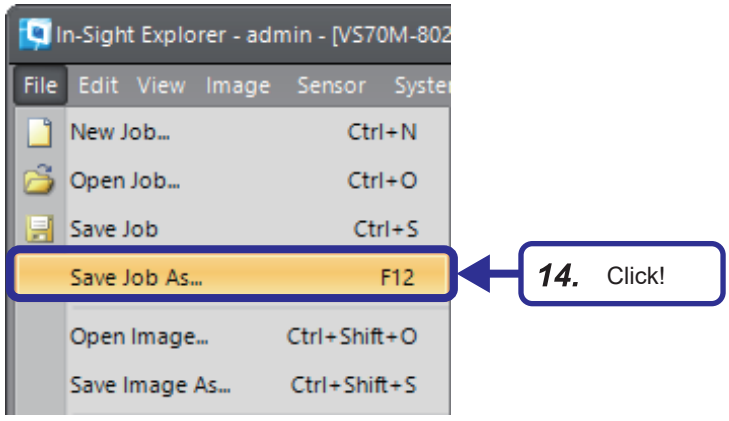
11. Set the workpiece "*SN:B806ME 43W*" and click (Repeating trigger). Move the workpiece and when the position is confirmed, click the Repeating trigger again.



12. Since the inspection region of the edge tool is not detected because it is off the edge, expand the inspection region.



13. The width of the " *SN:B806ME 43W* " workpiece is larger than that of "SN:B806MD43W" and exceeds the range for inspection PASS set on the [Range Limits] tab, resulting in FAIL.
The FAIL inspection result is displayed on the [Results] tab of the palette.



14. From the menu, click [File] ⇨ [Save Job As] and save the job to vision sensor with the following name.
File name: 1School_Vision.job
The saved job is used in "☞ Page 95 TRAINING 2 COMMUNICATIONS BETWEEN A PROGRAMMABLE CONTROLLER AND VISION SENSOR".

4.5 Training 1

Provide training 1 with the following procedure.

1. Create a new job from the In-Sight Explorer menu.
2. In [Set Up Image] in "Application Steps", capture the side of the "SN:B806MD43W" workpiece, and then perform edge calibration.
3. In [Locate Part] in "Application Steps", set the pattern region.
4. In [Inspect Part] in "Application Steps", add the edge for the presence/absence tool and the distance for the measurement tool.
5. Check the results of the presence/absence tool and measurement tool.

Item	Training 1 settings
Get Connected	Vision sensor
Set Up Image	Acquire/load image: Trigger(workpiece direction/side) Calibration: Edge
Locate Part	PatMax® Pattern
Inspect Part	Edge, Distance

Workpiece differences

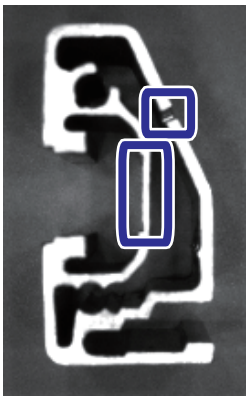
The "SN:B806MD43W" workpiece to be used and " *SN:B806ME 43W* " differ in the following items.

- Presence/absence of edge
- Thickness of workpiece

Therefore, the difference can be checked by the inspection results of the presence/absence tool (edge) and the measurement tool (distance).

SN:B806MD43W

SN:B806ME 43W

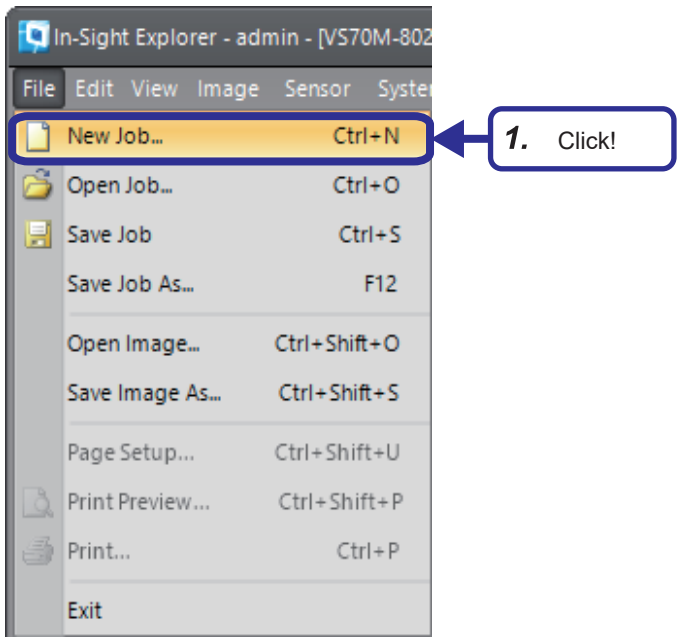


Configuring In-Sight Explorer

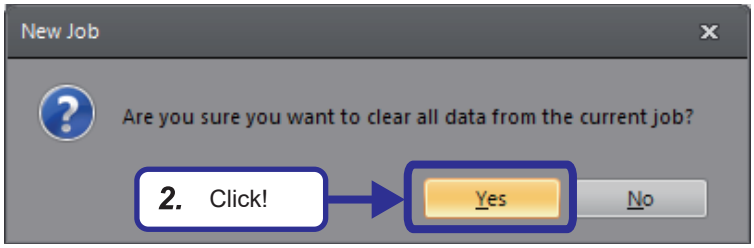
Create a new job

This section describes how to create a new job.

Operating procedure



1. From the In-Sight Explorer menu, click [File] ⇨ [New Job].

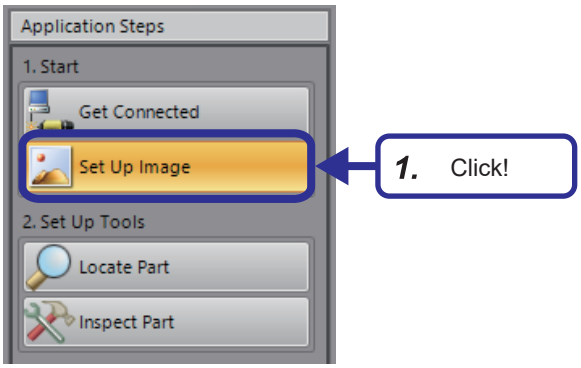


2. Click the [Yes] button.

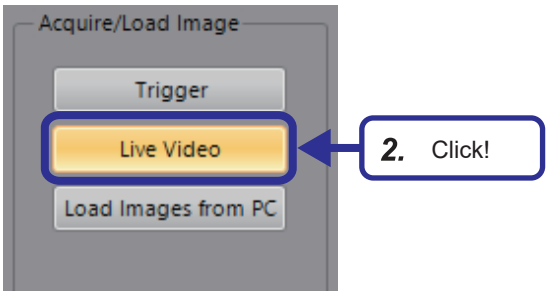
Importing an image

With the same operation as "☞ Page 45 Set Up Image", capture the side of the "SN:B806MD43W" workpiece.

Operating procedure



1. From "Application Steps", click the [Set Up Image] button.



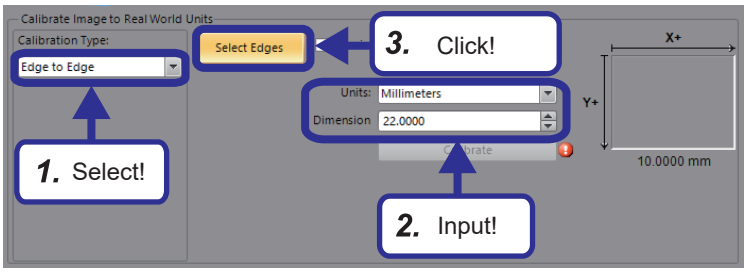
2. From "Application Steps", click the [Live Video] button to check the image to be captured.

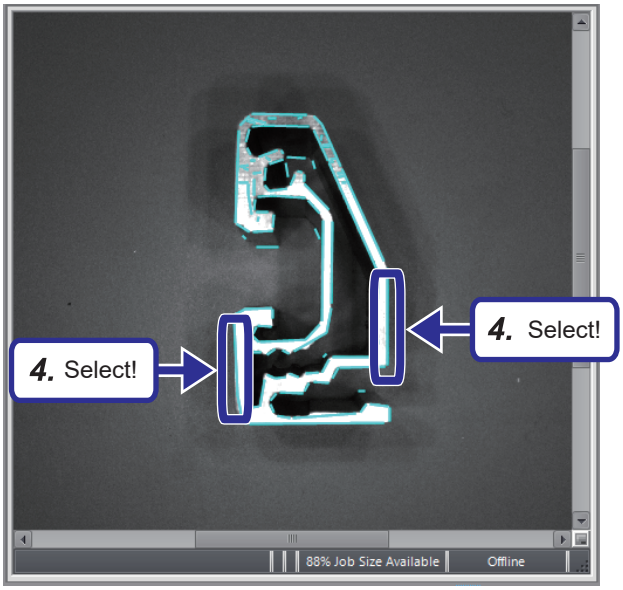
3. Click the [Live Video] button again to capture the image.

Calibration

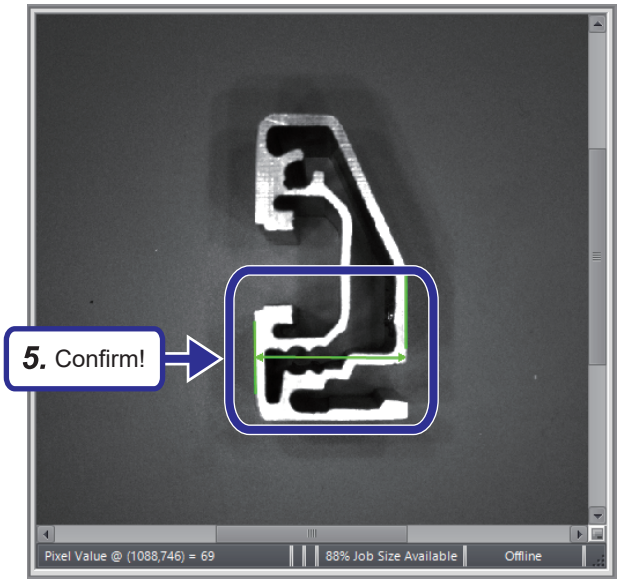
With the same operation as "☞ Page 47 Calibration", set edge calibration for the captured image.

Operating procedure

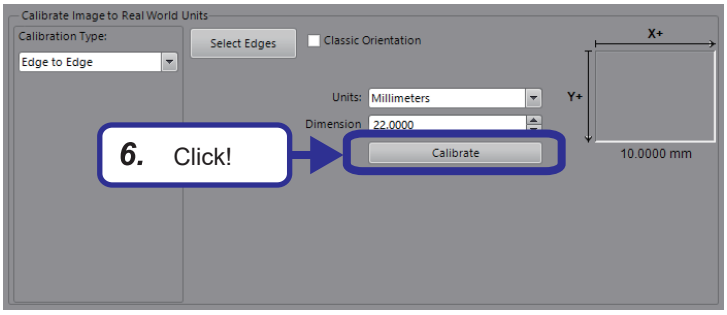




1. For Calibration Type, select "Edge to Edge".
2. Check the unit and enter 22 for "Dimension".
3. Click the [Select Edges] button.
4. Click (magnification) on the job display toolbar to magnify the image, and select the edges to be used for calibration.



5. Select one of the edges detected by a smart feature and then select the other edge to confirm.

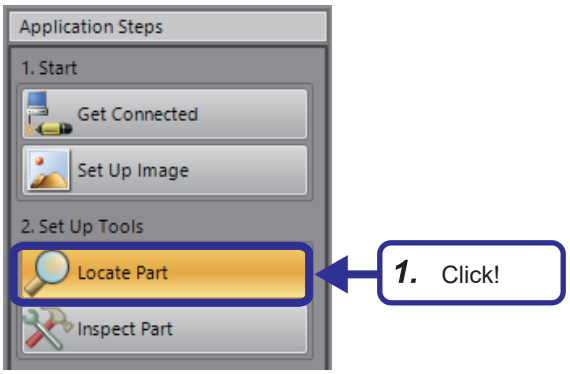


6. Click the [Calibrate] button.

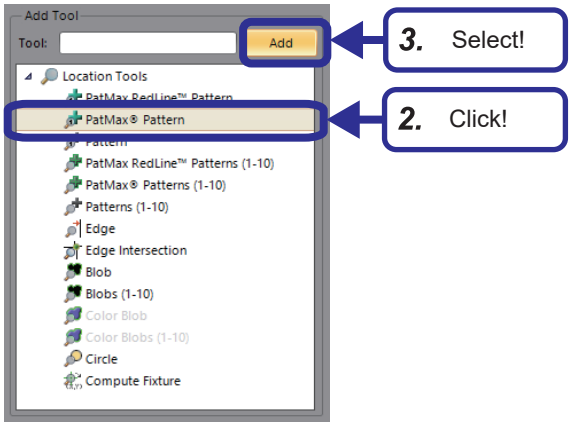
Configuring location tools

With the same operation as "☞ Page 50 Configuring Location Tools", set the pattern for the captured image.

Operating procedure

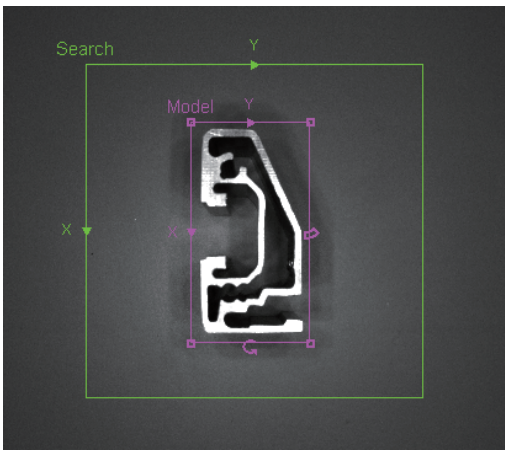


1. From Application Steps, click the [Locate Part] button.

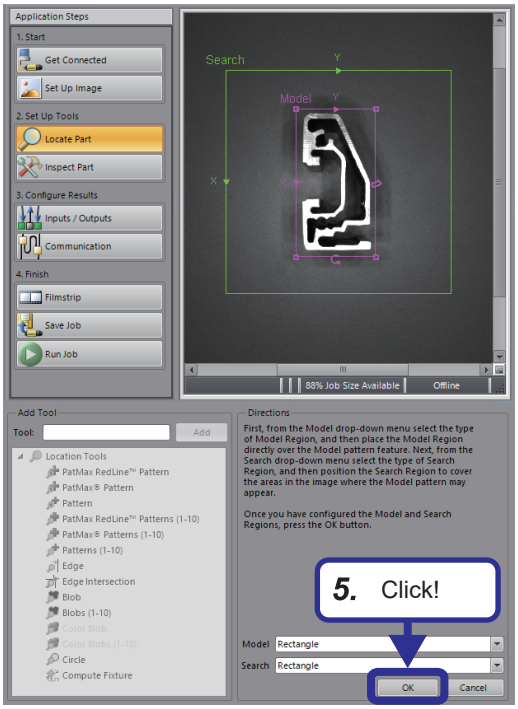


2. From "Add Tool", select "PatMax® Pattern".

3. Click the [Add] button.

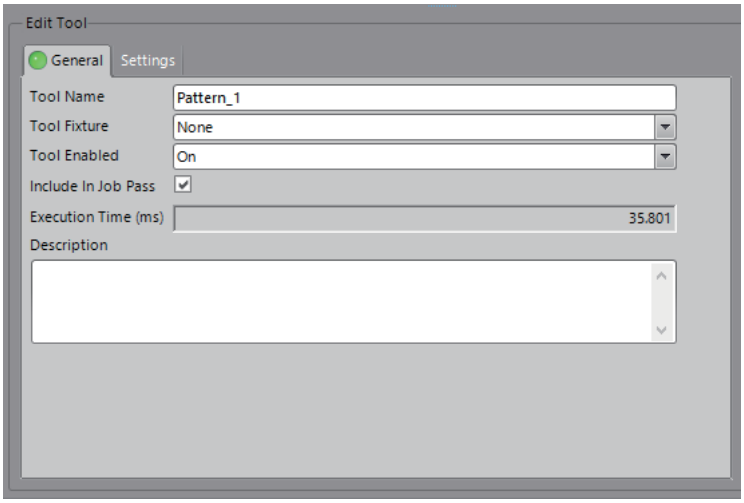


4. Click (magnification) to magnify the image, and change the model region and the search region according to the image.

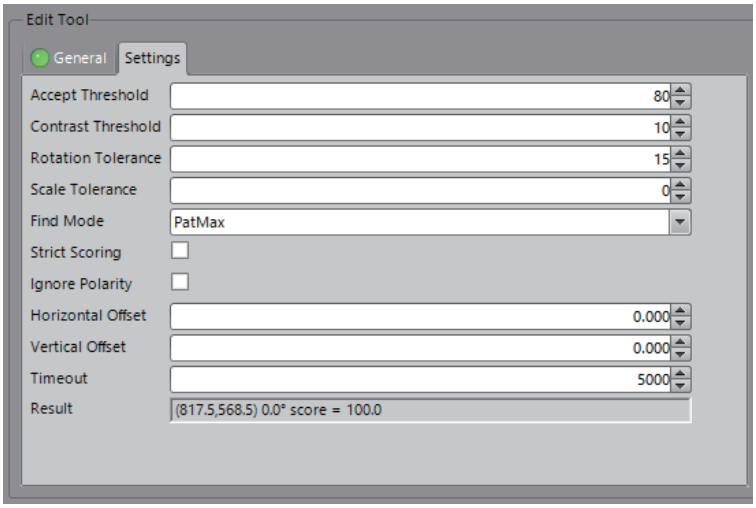


5. Click the [OK] button.

[General] tab



[Settings] tab



6. Set the parameters as follows.

[General] tab

Tool Name: Pattern_1

Tool Fixture: None

Tool Enabled: ON

Include In Job Pass: Selected

[Settings] tab

Accept Threshold: 80

Contrast Threshold: 10

Rotation Tolerance: 15

Scale Tolerance: 0

Find Mode: PatMax

Strict Scoring: Not selected

Ignore Polarity: Not selected

Horizontal Offset: 0.000

Vertical Offset: 0.000

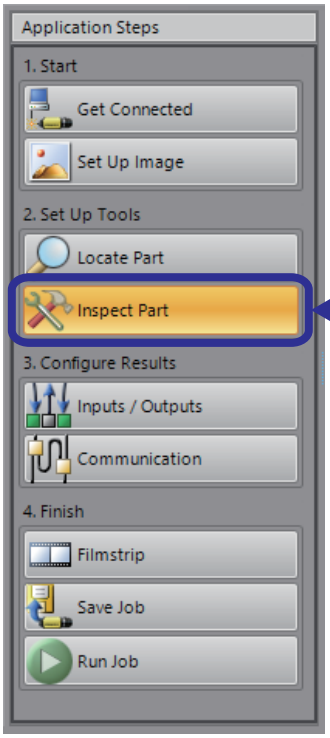
Timeout: 5000

Configuring inspection tools

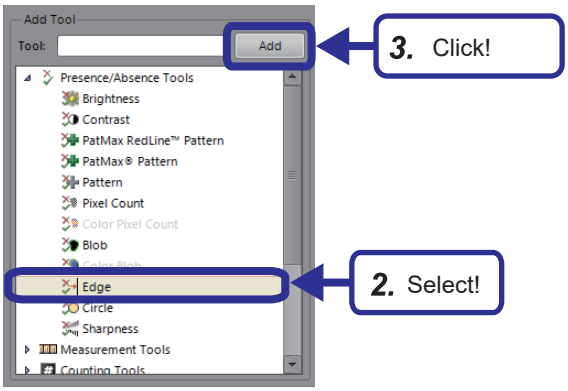
Set the edge for the presence/absence tool and the distance for the measurement tool.

■Presence/absence tool (edge)

Operating procedure

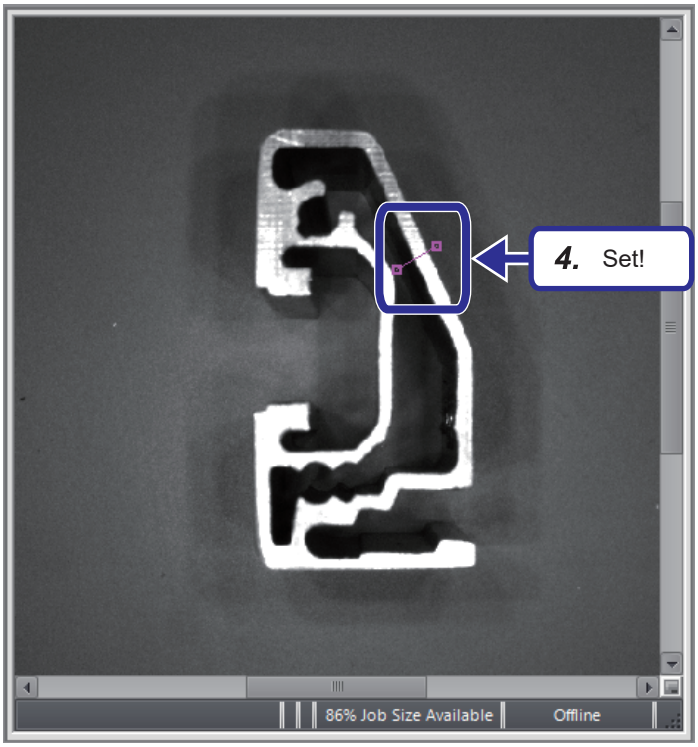


1. From "Application Steps", click the [Inspect Part] button.

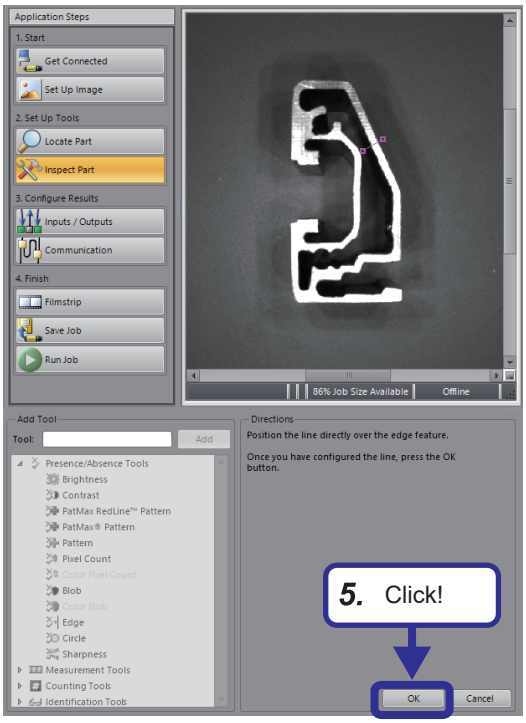


2. From "Add Tool", select [Presence/Absence Tools] ⇨ [Edge].

3. Click the [Add] button.

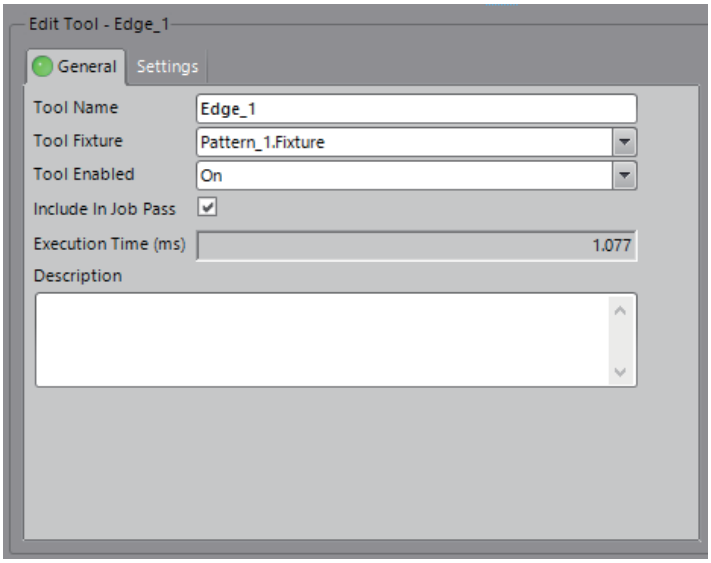


4. Click (magnification) on the job display toolbar to magnify the image, and set the straight line as shown in the image on the left.

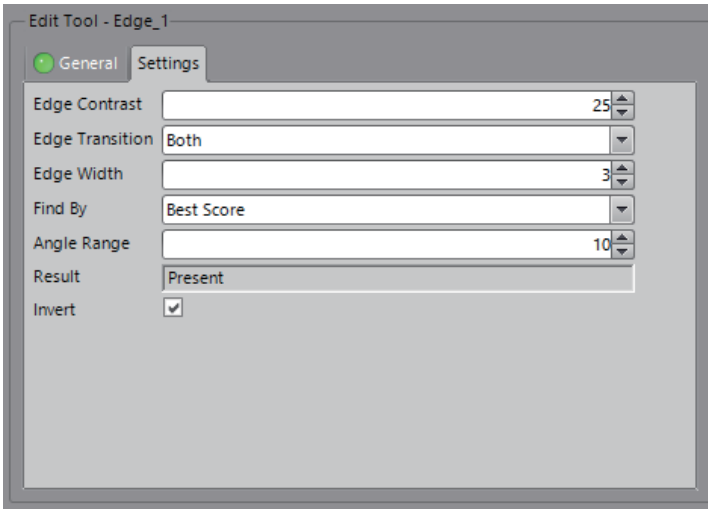


5. Click the [OK] button.

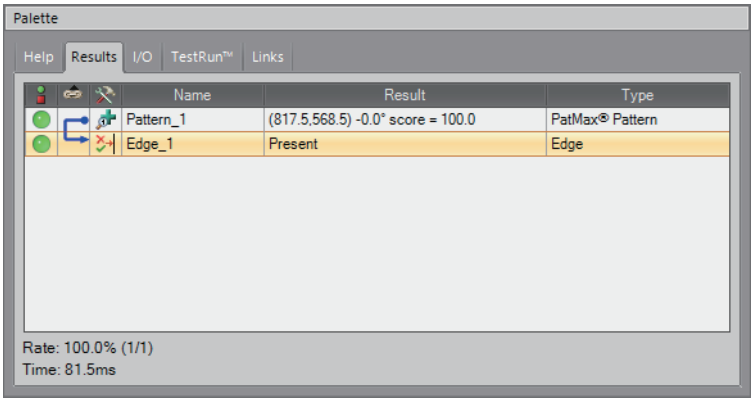
[General] tab



[Settings] tab



[PASS]



6. Set the parameters as follows.

[General] tab

Tool Name: Edge_1

Tool Fixture: Pattern_1.Fixture

Tool Enabled: ON

Include In Job Pass: Selected

[Settings] tab

Edge Contrast: 25

Edge Transition: Both

Edge Width: 3

Find By: Best Score

Angle Range: 10

Invert: Selected

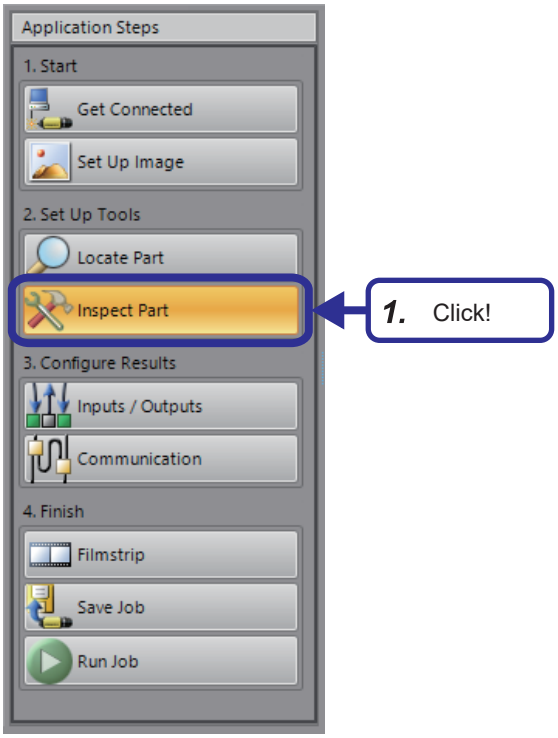
Point

If no edge is found, the result is FAIL, but if the "Invert" check box is selected, the result is PASS.

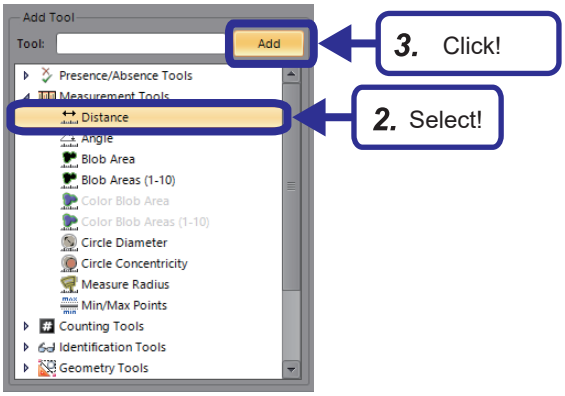
7. The inspection result indicating PASS is displayed on the [Results] tab of the palette.

■Measurement tool (distance)

Operating procedure

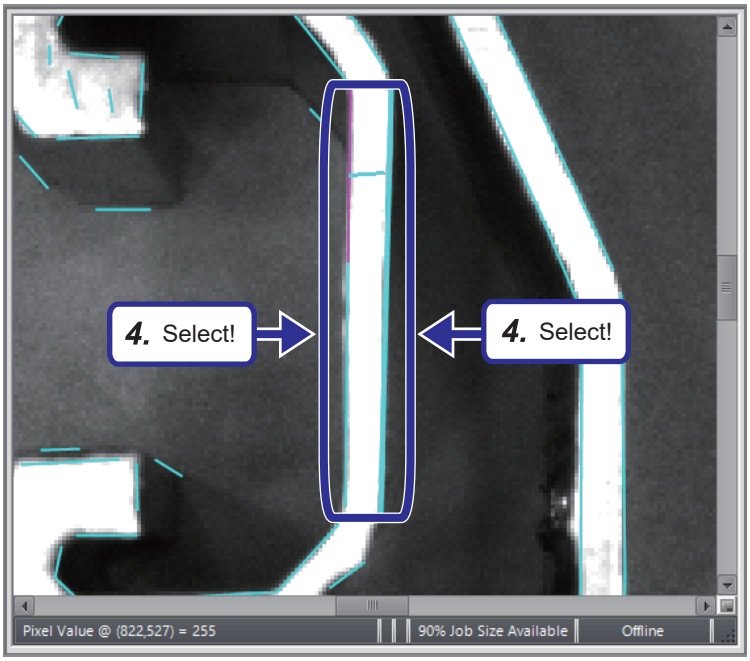


1. From "Application Steps", click the [Inspect Part] button.

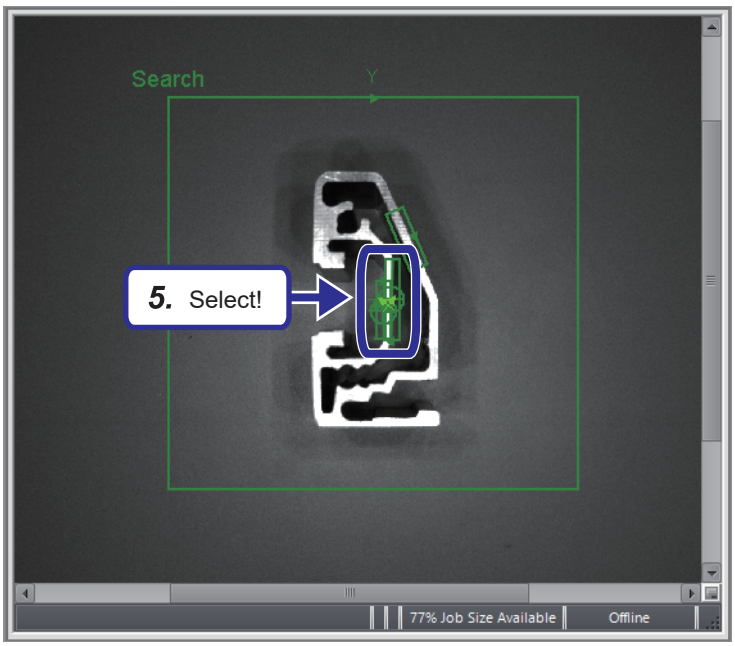


2. From "Add Tool", select [Measurement Tools] ⇨ [Distance].

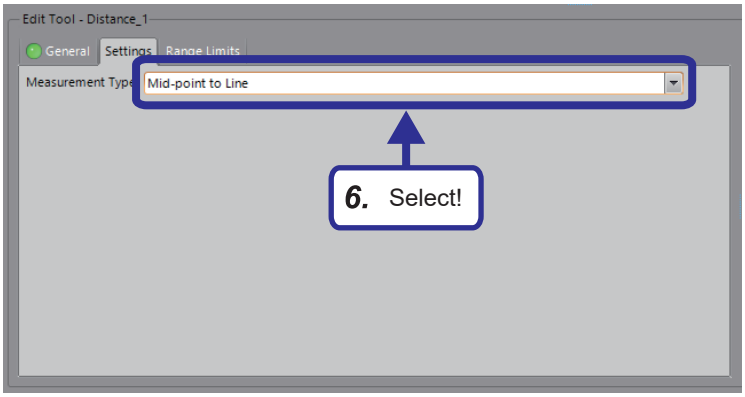
3. Click the [Add] button.



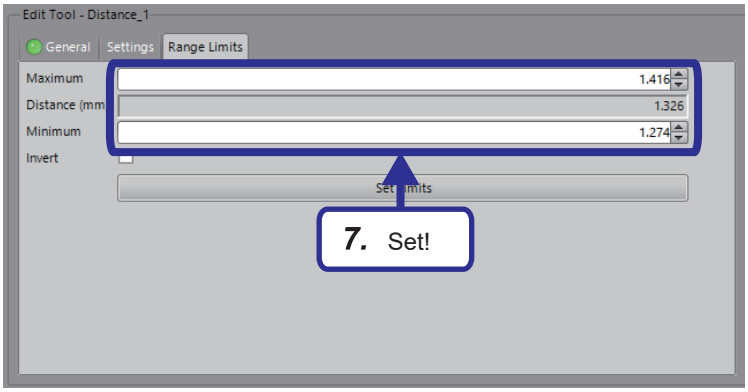
4. Click (magnification) on the job display toolbar to magnify the image, and select the left and right edges from the smart features.



5. If a second smart feature is selected, two edge tools (presence/absence tools) are created, and a distance tool to measure the interval of these edge tools is added.

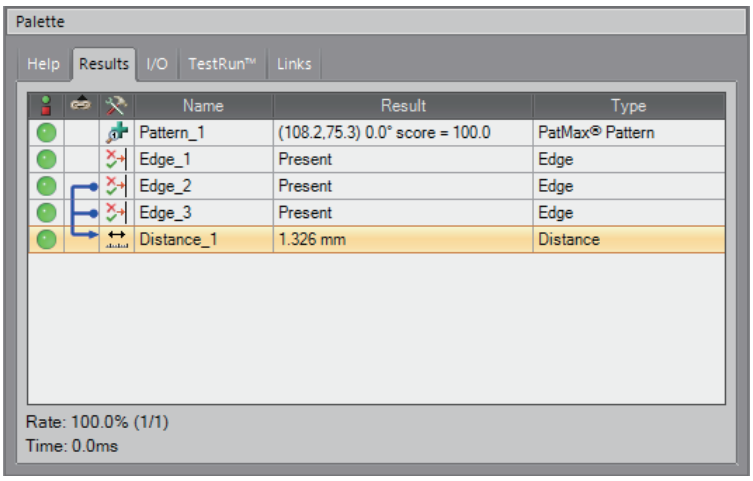


6. From the [Settings] tab in the tool editing window of Distance_1, Select "Mid-point to Line".



7. From the [Range Limits] tab, set the range in which the inspection would result in PASS.

[PASS]



8. The inspection result indicating PASS is displayed on the [Results] tab of the palette.

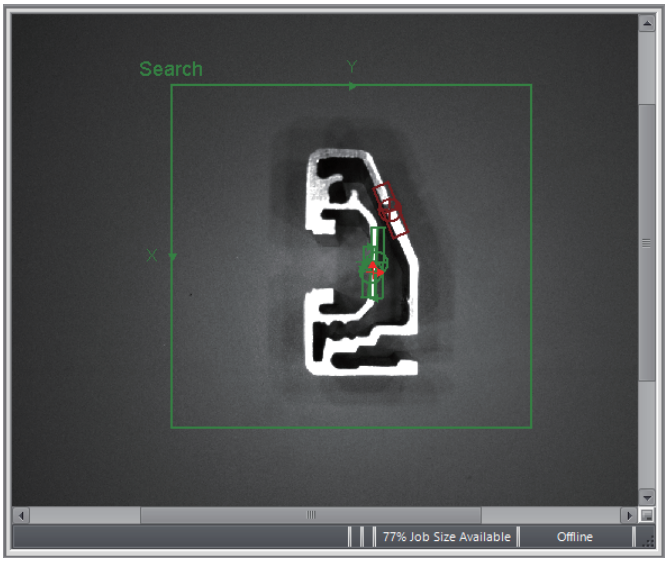
Result verification

Check the result after the configuration is completed.

Inspection results

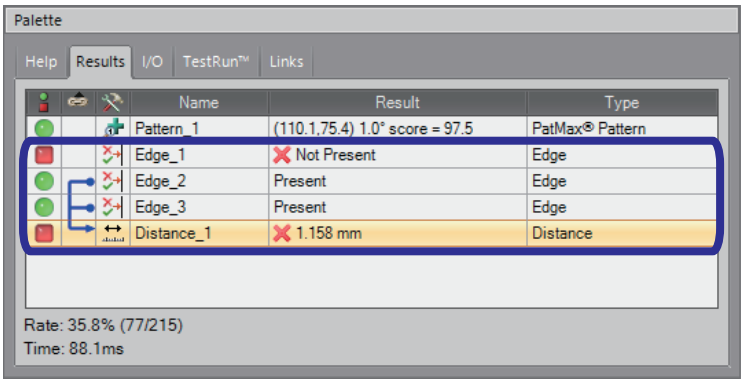
Check the judgment results of the set tools.

Operating procedure



1. Click (Repeating trigger) on the job display toolbar.
2. Set the side of the "*SN:B806ME 43W*" workpiece.

[FAIL]



3. The FAIL inspection result is displayed in the palette.
   For the "*SN:B806ME 43W*" workpiece, the judgment result is FAIL because an edge is detected on the straight line for which the presence/absence tool (edge) was set.
   Moreover, even within the range for which the distance for the measurement tool was set, the judgment result is FAIL because the distance is short.

4.6 Training 2

Provide training 2 with the following procedure.

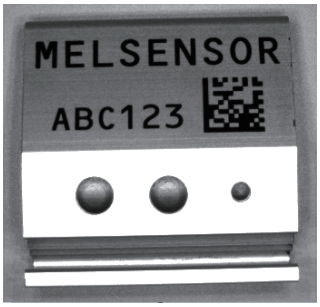
1. Create a new job from the In-Sight Explorer menu.
2. In [Set Up Image] in "Application Steps", capture the surface (2D code printing surface) of the "SN:B806MD43W" workpiece.
3. In [Inspect Part] in "Application Steps", add the read 2D code identification tool.
4. Check the results of the identification tools.

Item	Training 2 settings
Get Connected	Vision sensor
Set Up Image	Acquire/load image: Trigger (workpiece direction/front) Calibration: None
Locate Part	None
Inspect Part	Read 2D code

Workpiece differences

The 2D code of the "SN:B806MD43W" workpiece to be used and "*SN:B806ME 43W*" differ.
Therefore, the difference can be checked by the inspection result of the identification tool (read 2D code).

SN:B806MD43W



SN:B806ME 43W

Configuring In-Sight Explorer

Create a new job

With the same operation as "☞ Page 63 Create a new job", create a new job.

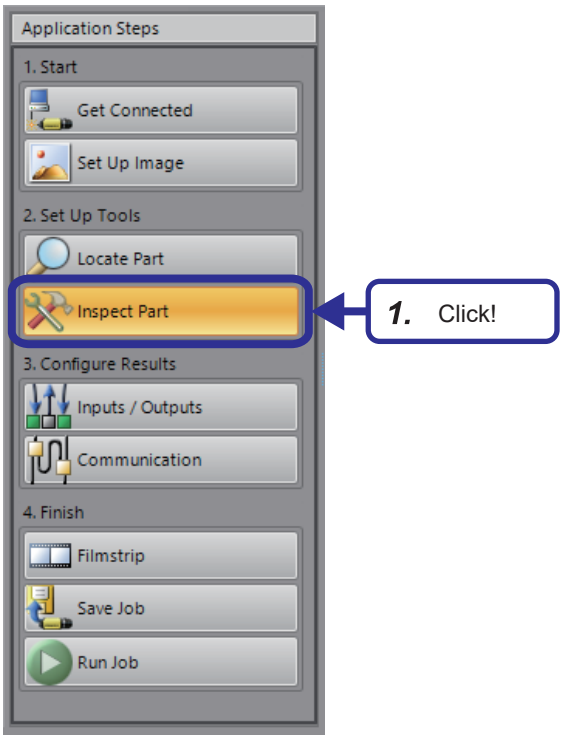
Importing an image

With the same operation as "☞ Page 45 Set Up Image", capture the surface (2D code printing surface) of the "SN:B806MD43W" workpiece.
No calibration is provided in this training.

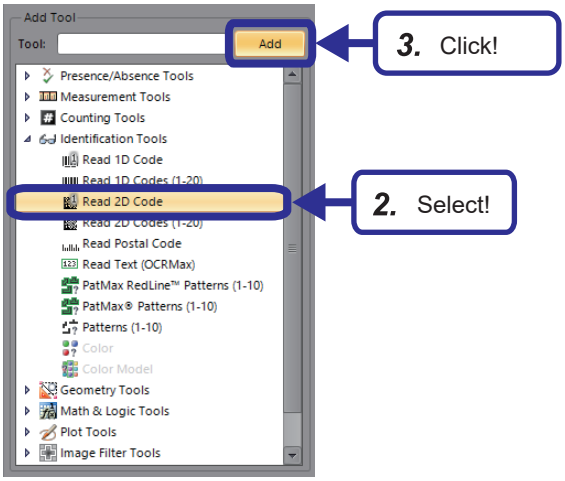
Configuring inspection tools

Set the read 2D code identification tool.

Operating procedure

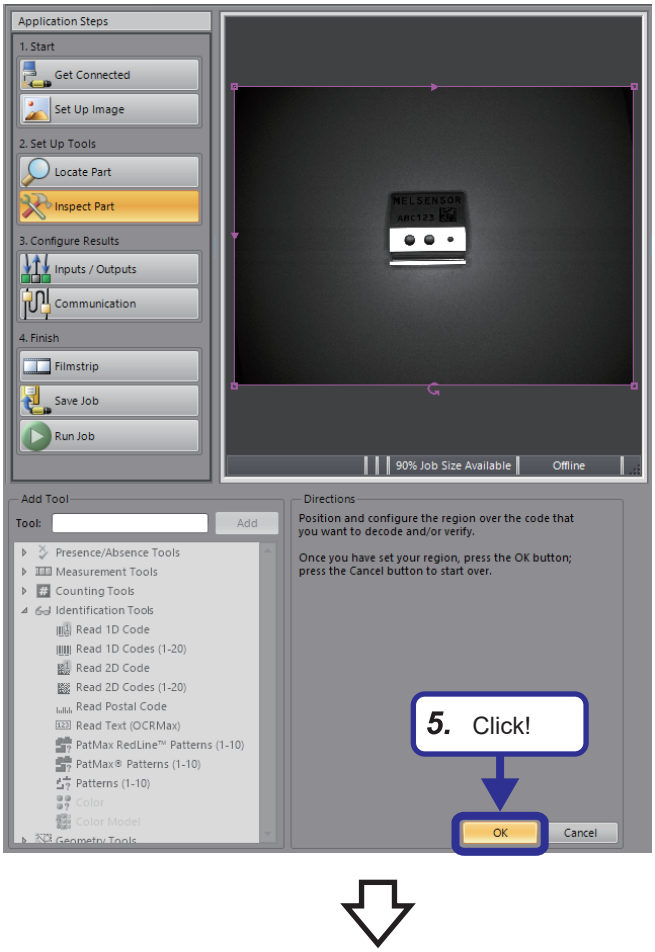


1. From "Application Steps", click the [Inspect Part] button.



2. From "Add Tool", select [Identification Tools] ⇨ [Read 2D Code].

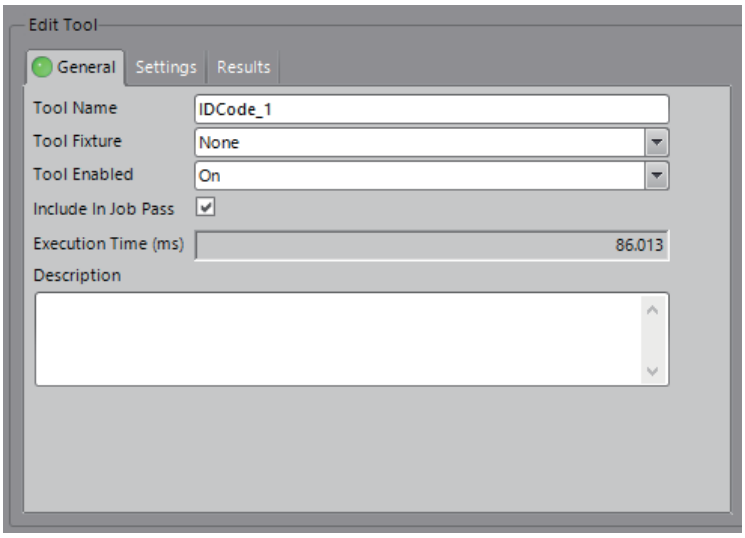
3. Click the [Add] button.



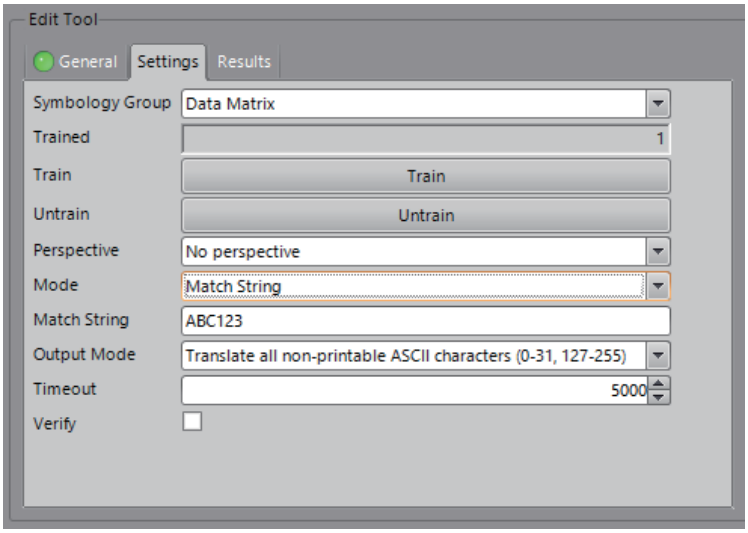
4. Click (maximize) on the region of the job display toolbar to magnify the image, and set the inspection region.

5. Click the [OK] button.

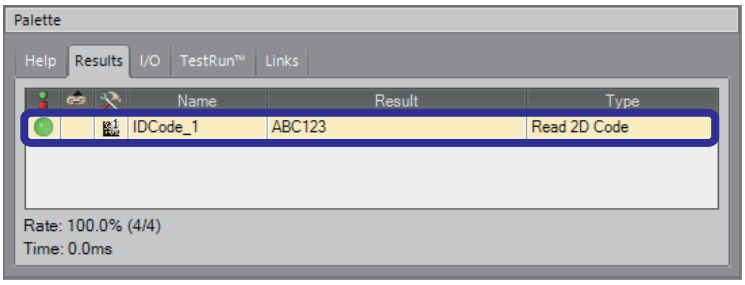
[General] tab



[Settings] tab



[PASS]



6. Set the parameters as follows.
[General] tab
Tool Name: ID Code_1
Tool Fixture: None
Tool Enabled: ON
Include In Job Pass: Selected
[Settings] tab
Symbology Group: Data Matrix
Perspective: No perspective
Mode: Match String
Match String: ABC123
Output Mode: Translate all non-printable ASCII characters (0-31, 127-255)
Timeout: 5000

7. The read QR code "ABC123" is displayed in ID code_1 on the [Results] tab of the palette, and the result is PASS.

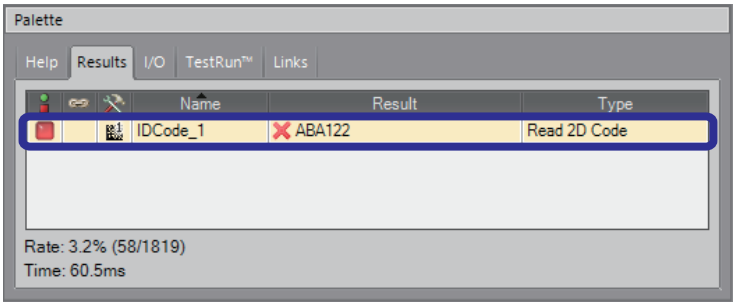
Result verification

Check the result after the configuration is completed.

Inspection results

Check the judgment results of the set tools.

Operating procedure



1. Click (Repeating trigger) on the job display toolbar.
2. Set the surface (2D code printing surface) of the " *SN:B806ME 43W* " workpiece.
3. The read QR code "ABA122" is displayed in ID code_1 on the [Results] tab of the palette.
   The result is FAIL because it does not match the match string set in the parameters.

4.7 Training 3

Provide training 3 with the following procedure.

1. Create a new job from the In-Sight Explorer menu.
2. From the In-Sight Explorer menu, display a filmstrip.
3. In [Set Up Image] in "Application Steps", load an image with perspective distortion and perform grid calibration.
4. In [Set Up Image] in "Application Steps", load an image of the workpiece taken at an angle, and in [Inspect Part] in "Application Steps", add the transformation for the image filter tool.
5. In [Locate Part] in "Application Steps", set the pattern region again.
6. In [Inspect Part] in "Application Steps", add the brightness for the presence/absence tool, add the distance for the measurement tool, and add the logic for the operation & logic tool.
7. Check if the perspective distortion of the loaded image was corrected by the image filter tool, and check the results of the operation & logic tool.

Item	Training 3 setting
Get Connected	Vision sensor
Set Up Image	Acquire/load image: Load images from PC (workpiece direction/rear) Calibration: Grid
Locate Part	PatMax® Pattern
Inspect Part	Brightness, Distance, Logic, Transform

Configuring In-Sight Explorer

Create a new job

With the same operation as "☞ Page 63 Create a new job", create a new job.

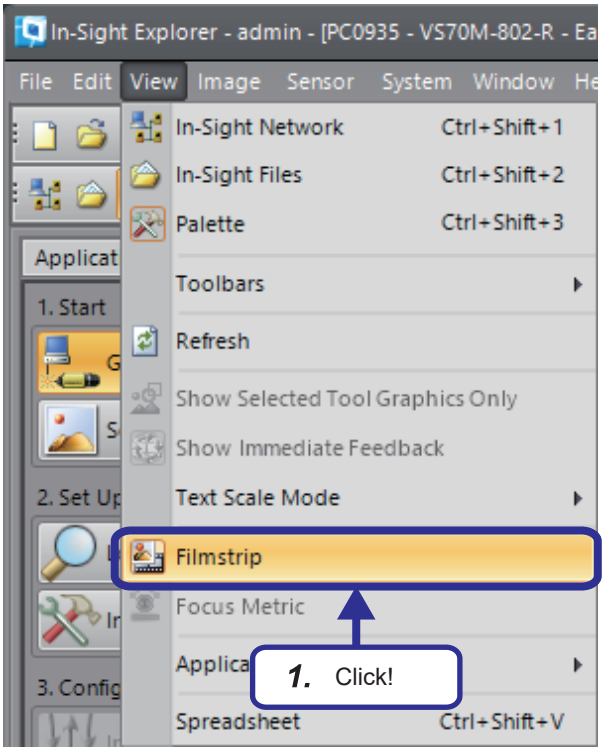
Displaying a filmstrip

This section describes how to display a filmstrip.

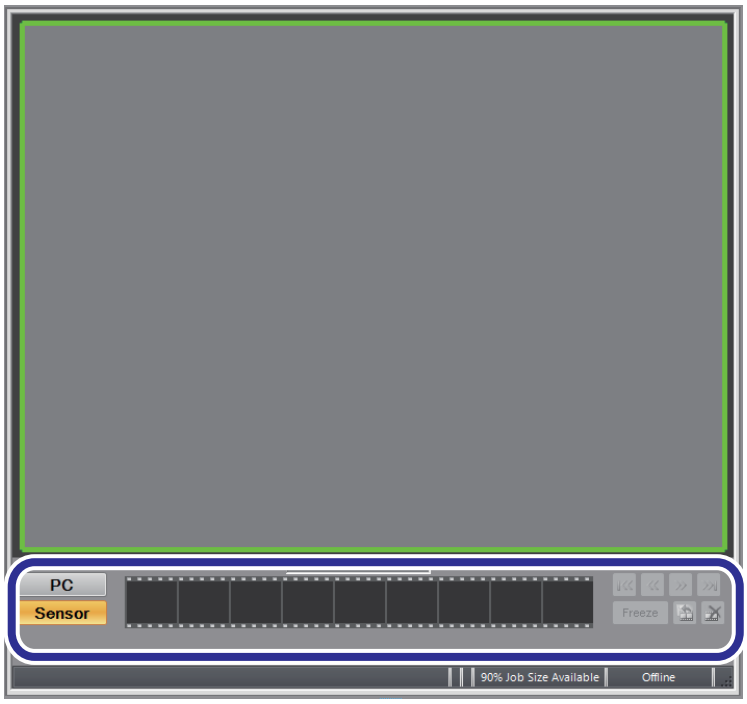
For details on the filmstrip, refer to the following.

☞ Page 39 Filmstrip

Operating procedure



1. From the In-Sight Explorer menu, click [View] ⇨ [Filmstrip].

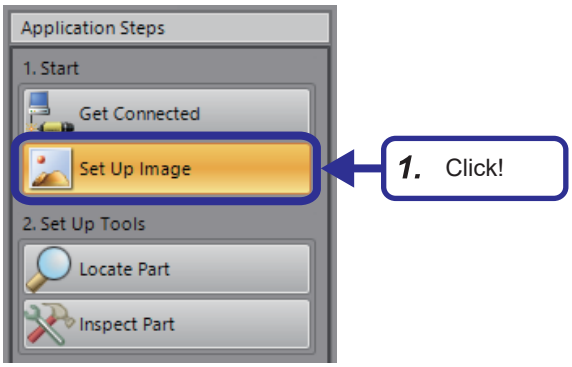


2. A filmstrip appears in the Easy Builder view.

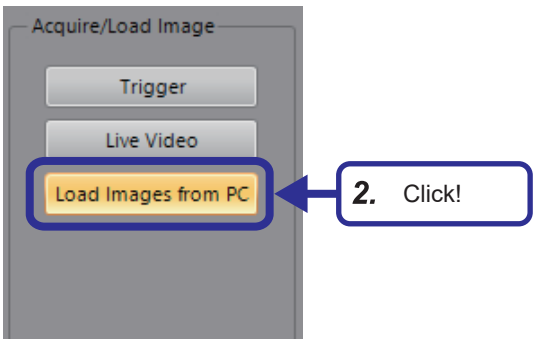
Load image (Grid Graphic)

Load a prepared image. In this training, we will use a grid graphic that has already been captured.

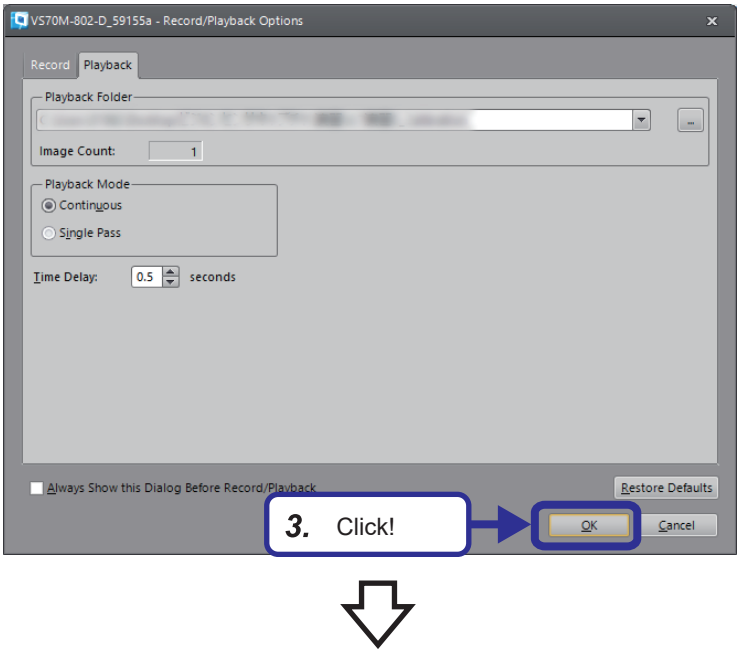
Operating procedure



1. From "Application Steps", click the [Set Up Image] button.



2. From "Application Steps", click the [Load Images from PC] button.



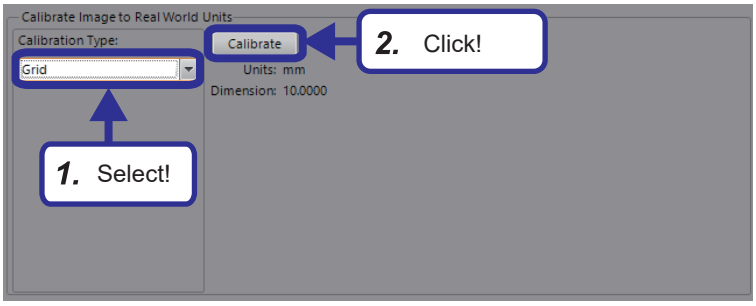
3. Specify the target folder that contains the grid.bmp files, and then click the [OK] button.

4. The images in the folder are displayed in the filmstrip.
For details on the filmstrip, refer to the following.
☞ Page 39 Filmstrip

Grid calibration

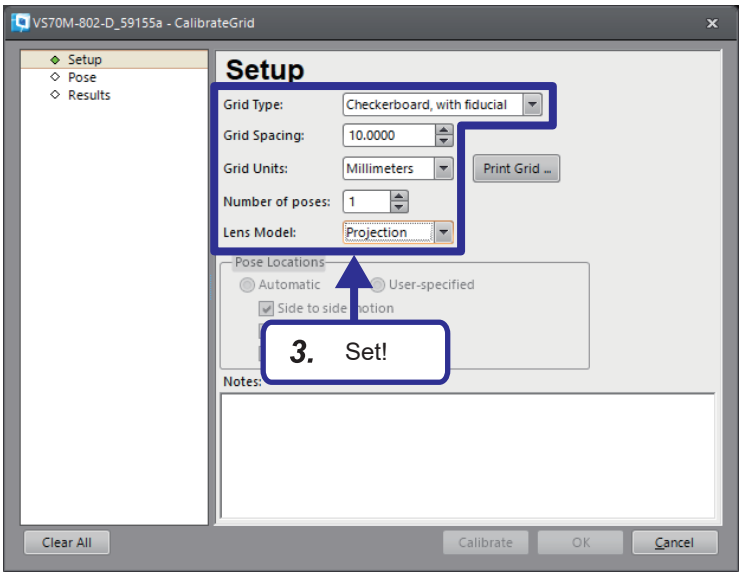
Calibration using a grid is done by presenting a defined grid graphic to the camera and performing calibration to achieve non-linear calibration of radial distortion and perspective distortion.
The grid graphic used for calibration can be printed from In-Sight Explorer, but if it is to be used for location that requires high accuracy, prepare a calibration plate.
In this section, the procedure is described on the assumption that an image file of a grid graphic that has already been captured will be used.

Operating procedure

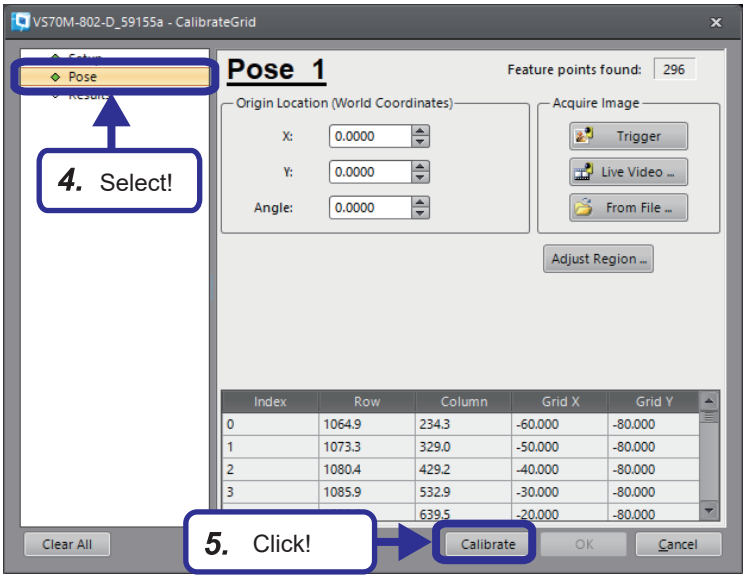


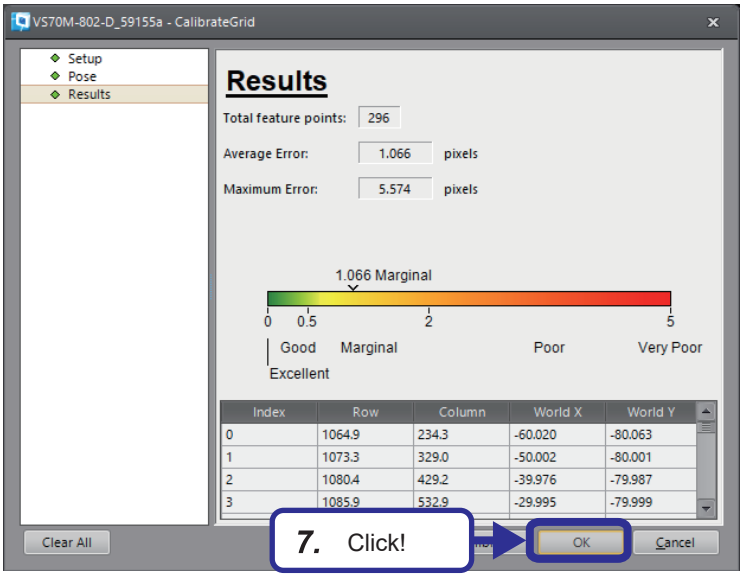
1. For "Calibration Type", select "Grid".

2. Click the [Calibrate] button.



3. Set the grid settings and lens model as follows.
[Setting details]
Grid Type:
Checkerboard, with fiducial
Grid Spacing: 10.0000
Grid Unis: Millimeters
Lens Model: Projection





4. Select "Pose".
5. Click the [Calibrate] button.

6. The total number of detected feature points, the average error, and the maximum error are displayed, and the calibration state is displayed in the scale ranging from "Excellent" to "Very Poor".
   The average error is the average value of the pixel distance from the location in which the feature point was expected to be to the coordinates at which the feature point was actually detected.
7. Click the [OK] button.

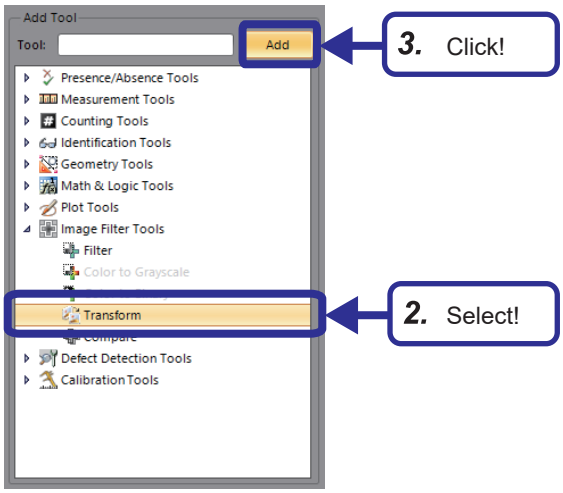
Loading an image (workpiece)

With the same operation as "☞ Page 83 Load image (Grid Graphic)", load a prepared image.
In this training, we will use an image (work.bmp) of the workpiece captured diagonally.

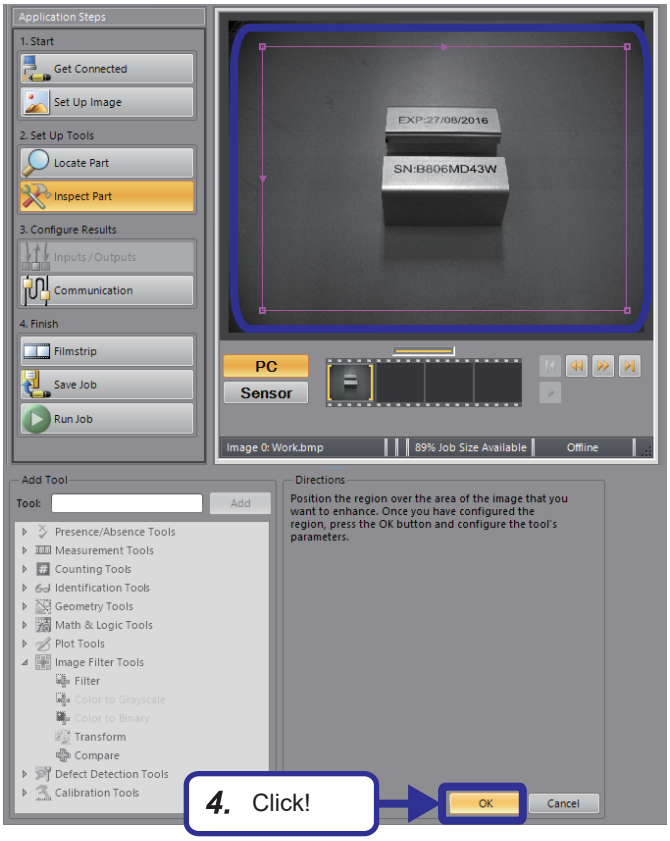
Transform

When grid calibration has been performed, it is necessary to perform [Transform] in the image filter tool.
From a captured image, an image in which radial distortion and perspective distortion have been eliminated can be generated.
This function can be utilized for inspection that depends on the shapes subject to inspection, such as identification tools and presence/absence tools.

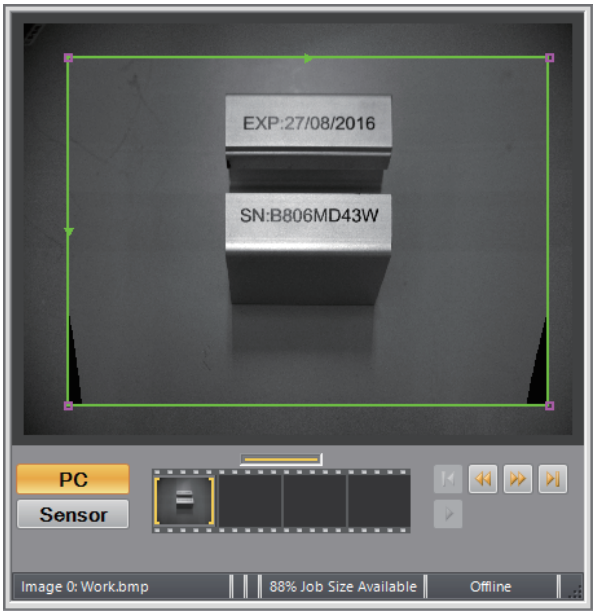
Operating procedure



1. From "Application Steps", click the [Inspect Part] button.
2. From "Add Tool", select [Image Filter Tools] ⇨ [Transform].
3. Click the [Add] button.



4. Select the range in which the workpiece will fit, and click the [OK] button.
   By setting a grid, the transformed image can be checked according to the calibration results.



5. Check that calibration has been applied.
☞ Page 93 Result verification

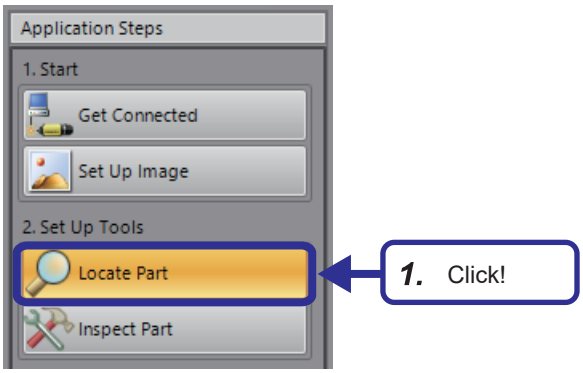
Point

If transform is used, the workpiece may not fit within the display region.
In that case, set a number less than 1 to "Image Scale" in the [Settings] tab of [Transform] so that the workpiece fits in the frame.

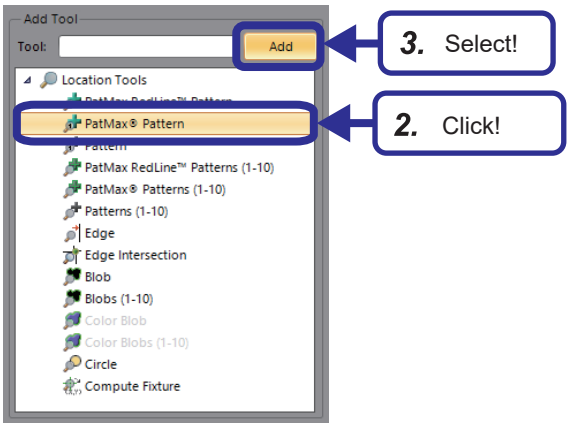
Configuring location tools

With the same operation as "☞ Page 50 Configuring Location Tools", set the pattern for the captured image.

Operating procedure

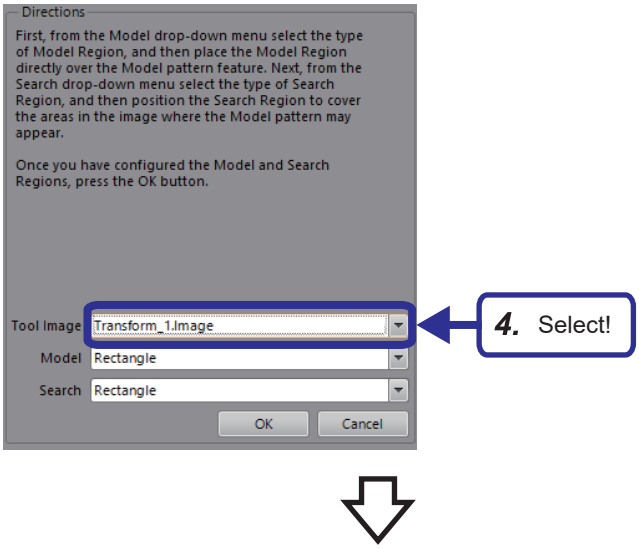


1. From "Application Steps", click the [Locate Part] button.

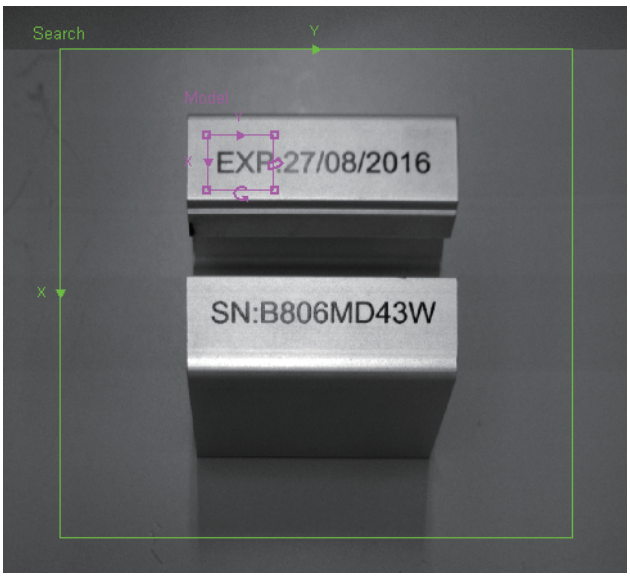


2. From "Add Tool", select "PatMax® Pattern".

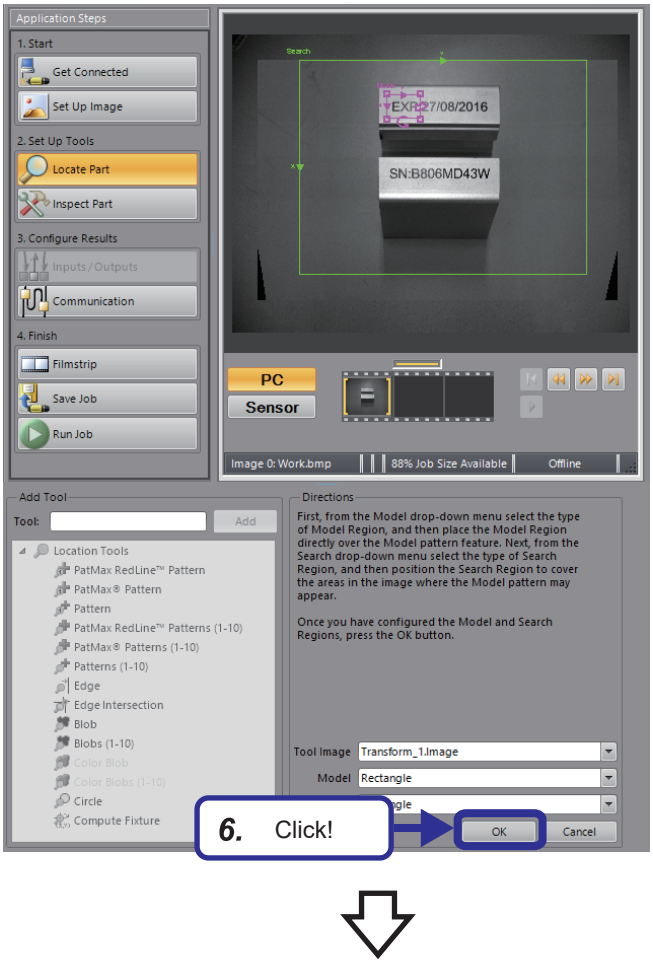
3. Click the [Add] button.



4. Select "Transform_1.Image" for the tool image.

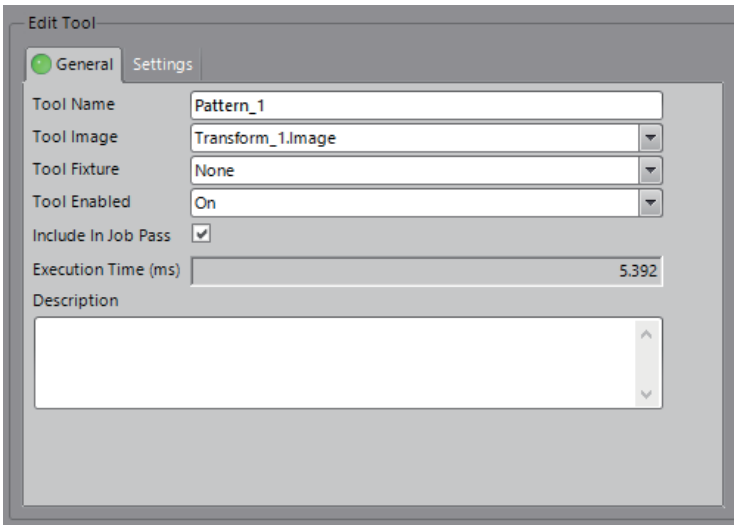


5. Change the model region and the search region according to the image.
Set the model region to "EXP" and the search region to a region that can accommodate the workpiece.

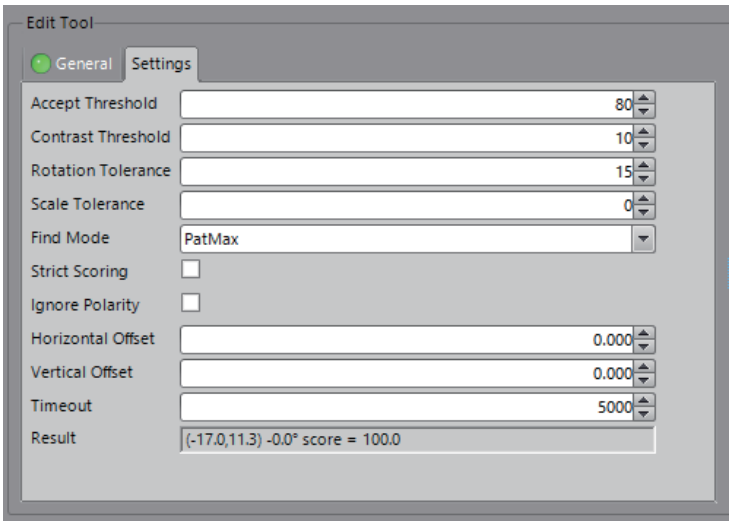


6. Click the [OK] button.

[General] tab



[Settings] tab



7. Set the parameters as follows.

[General] tab

Tool Name: Pattern_1

Tool Image: Transform_1.Image

Tool Fixture: None

Tool Enabled: ON

Include In Job Pass: Selected

[Settings] tab

Access Threshold: 80

Contrast Threshold: 10

Rotation Tolerance: 15

Scale Tolerance: 0

Find Mode: PatMax

Strict Scoring: Not selected

Ignore Polarity: Not selected

Horizontal Offset: 0.000

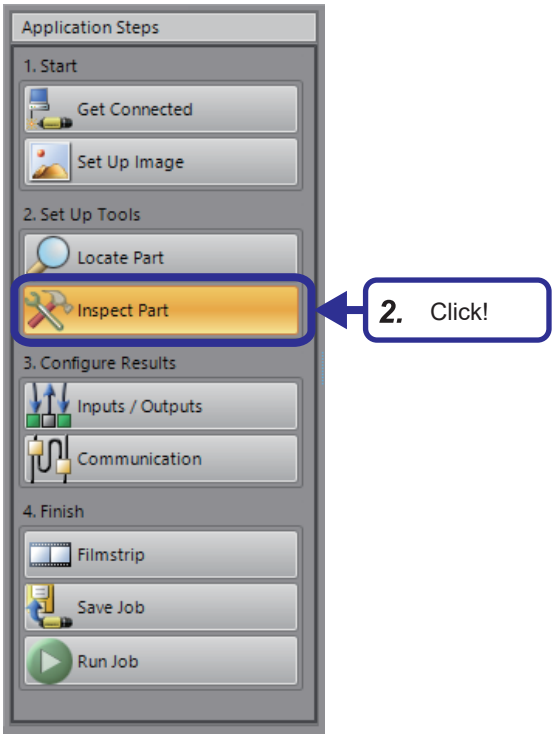
Vertical Offset: 0.000

Timeout: 5000

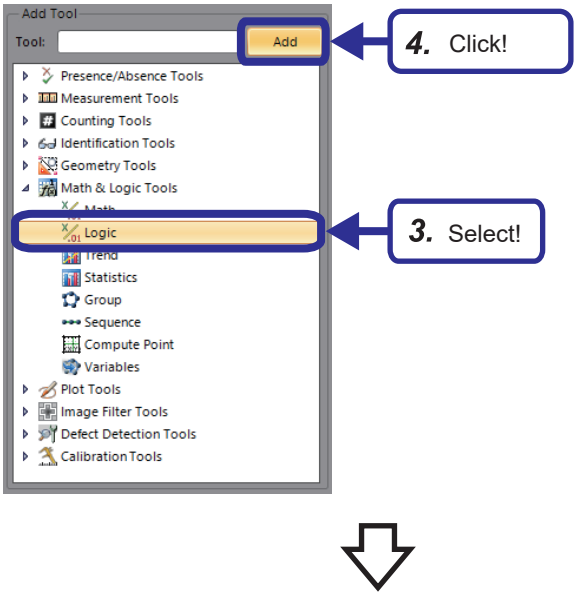
Configuring inspection tools

Set the transformation for the image filter tool and the logic for the operation & logic tool. With the same operation as "☞ Page 54 Configuring Inspection Tools", set the brightness for the presence/absence tool and the distance for the measurement tool, and add an inspection tool that gives a PASS result when both inspection results are PASS.

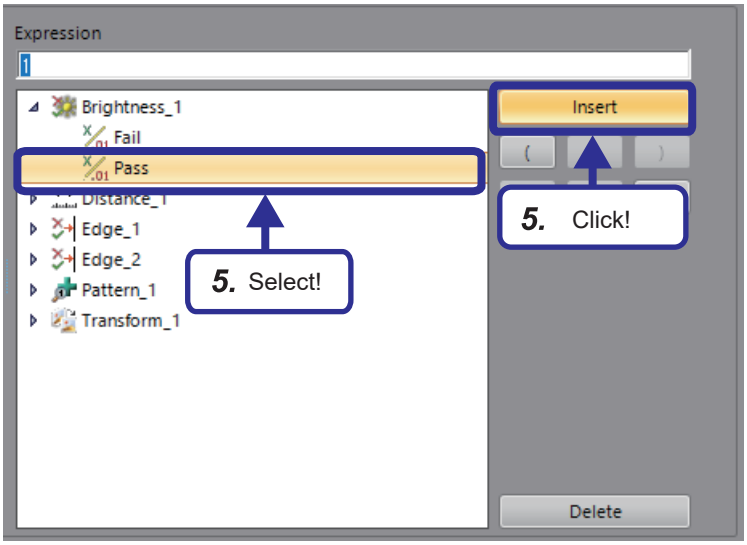
Operating procedure



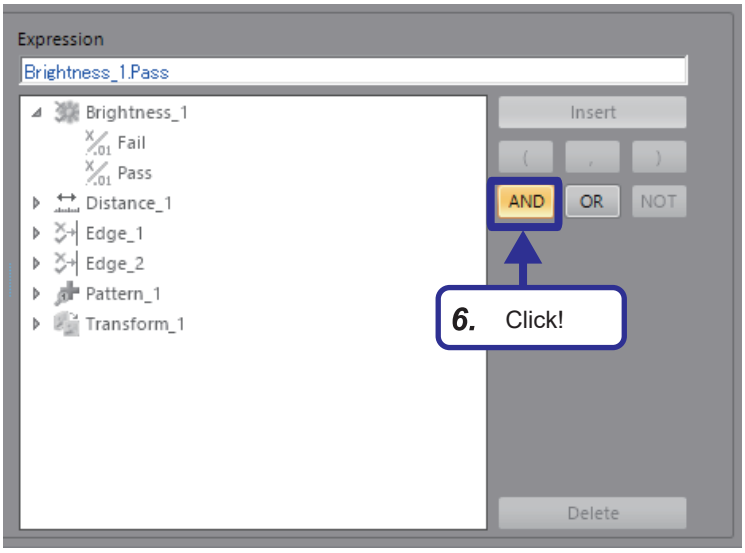
1. With the same operation as "☞ Page 54 Configuring Inspection Tools", set the brightness for the presence/absence tool and the distance for the measurement tools. While setting, select "Transform_1.Image" for the tool image.
2. From "Application Steps", click the [Inspect Part] button.



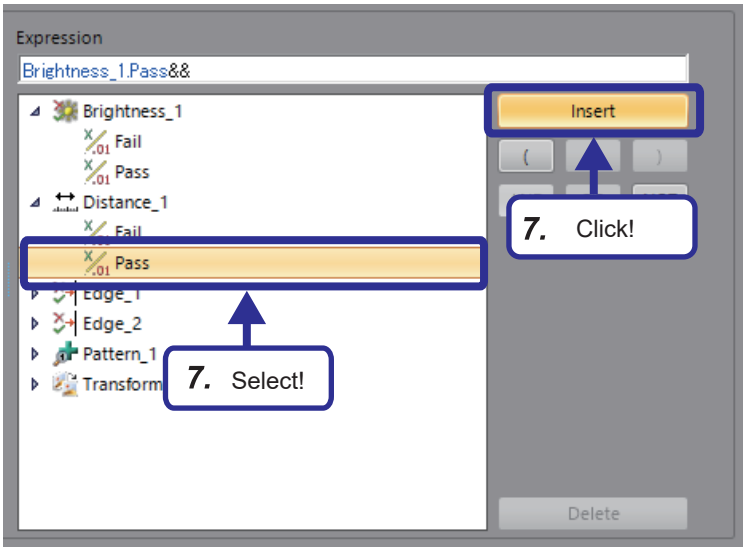
3. From "Add Tool", select [Math & Logic Tools] ⇨ [Logic].
4. Click the [Add] button.



5. Select "Pass" for the brightness of the presence/absence tool, and then click the [Insert] button.



6. Click the [AND] button.



7. Select "Pass" for the distance of the measurement tool, and then click the [Insert] button.

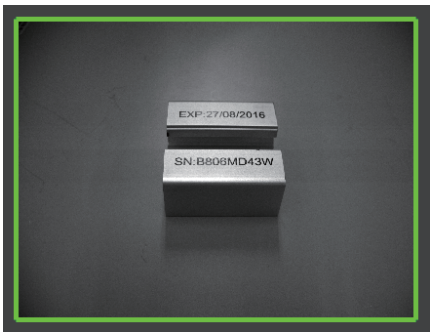
Result verification

Check the result after the configuration is completed.

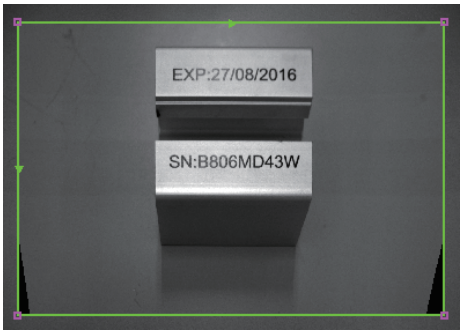
Grid calibration

Check that the skewed image has been corrected.

[Before conversion]



[After conversion]

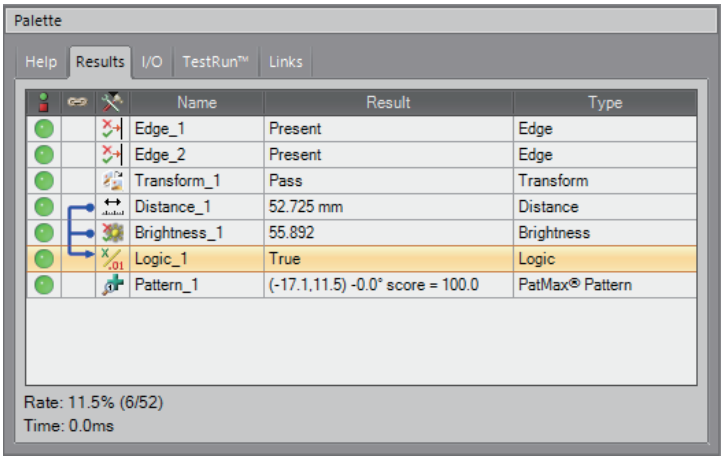


Inspection results

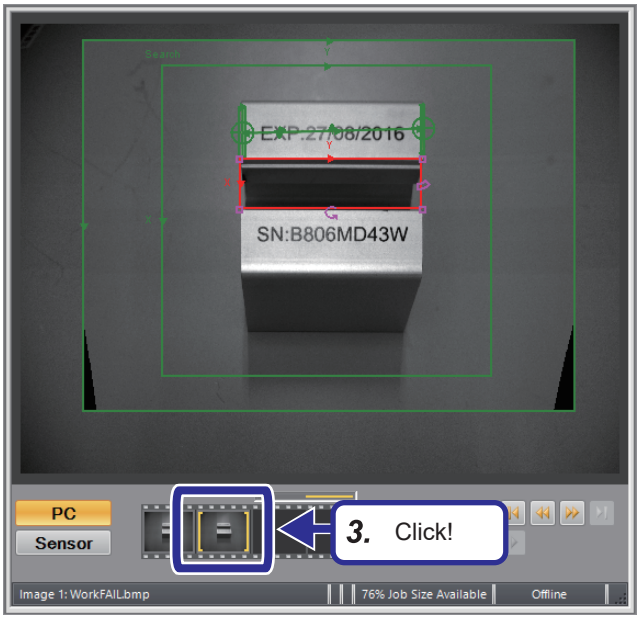
Check the judgment results of the set tools.

Operating procedure

[PASS]



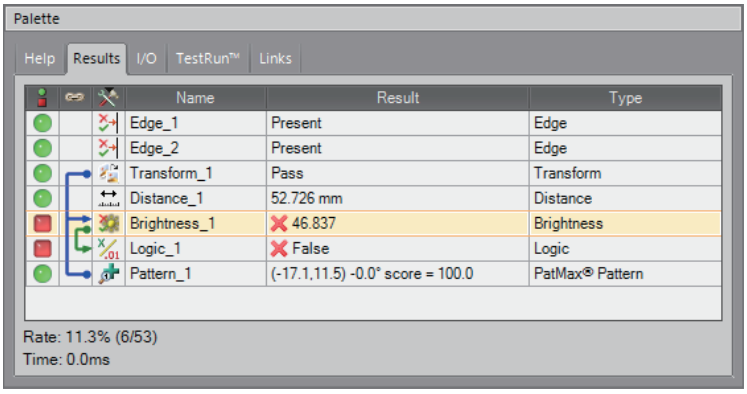
1. The PASS inspection result is displayed in the palette.



2. Save the "WorkFAIL.bmp" in the folder where work.bmp is saved.

3. Switch to the "WorkFAIL.bmp" image in the filmstrip.

[FAIL]



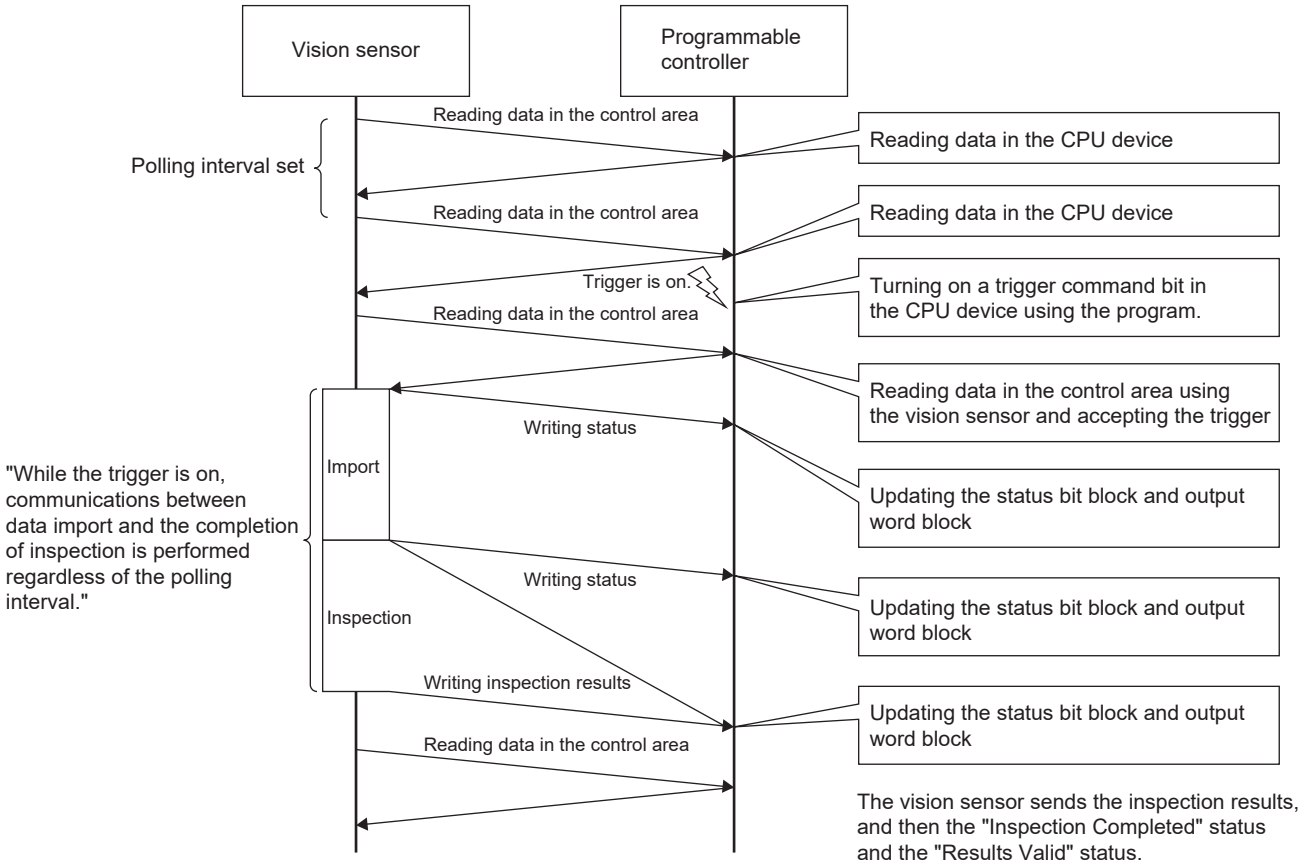
4. The FAIL inspection result is displayed in the palette.
The brightness of the "WorkFAIL.bmp" exceeds the range for inspection PASS set on the [Range Limits] tab, so the result for Brightness is FAIL. As a result, the result for "Distance" is PASS, but since the result for "Brightness" is FAIL, the result for "Logic" is False.

5 TRAINING 2 COMMUNICATIONS BETWEEN A PROGRAMMABLE CONTROLLER AND VISION SENSOR

This chapter describes the procedure for connecting vision sensor VS70 to a programmable controller and controlling the vision sensor with the SLMP scanner connection.
By connecting the vision sensor to devices such as a programmable controller, server, or personal computer, the parameters of the vision sensor can be changed and detailed information on inspection results can be sent.

5.1 Basic Operations for an SLMP Scanner Connection

Basic operation process for an SLMP scanner connection



Basic operations for an SLMP scanner connection

In an SLMP scanner connection, a vision sensor reads the control bit block from a programmable controller in the polling interval set with In-Sight Explorer, and processing according to the change of the bit information in the control bit block is performed.
The status of the processing is written to the corresponding bit in the status bit block.
To control a vision sensor in this way, a programmable controller device is assigned to each defined data block (such as the control bit block), and control is performed using those devices.

Data block	Description
Control bit block	This block is used to execute control commands (such as trigger) to a vision sensor, using bit information. The vision sensor is controlled by turning on and off the devices set to the control bit block by a programmable controller.
Status bit block	This block indicates the status of a vision sensor, which can be checked in bit information.
Input word block	This block is used to input application data (including parameters for inspection) from a programmable controller, using word information.
Output word block	This block is used by a vision sensor to output application data (including inspection results) to a programmable controller, using word information.
String command word block	This block is used to set commands (string commands) to control a vision sensor, using word information.
String command result word block	This block is used to output the results controlled by commands, using word information.

Data block

The following shows the details of six data blocks defined to control a vision sensor.

- Control bit block

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Set Offline	Reserved		Execute Command	Inspection Results Ack	Buffer Results Enable	Trigger	Trigger Enable
Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
Reserved							
Bit 23	**Bit 22**	**Bit 21**	**Bit 20**	**Bit 19**	**Bit 18**	**Bit 17**	**Bit 16**
Reserved				Clear Exposure Complete	Clear Error	Initiate String Command	Set User Data
Bit 31	**Bit 30**	**Bit 29**	**Bit 28**	**Bit 27**	**Bit 26**	**Bit 25**	**Bit 24**
Soft Event 7	Soft Event 6	Soft Event 5	Soft Event 4	Soft Event 3	Soft Event 2	Soft Event 1	Soft Event 0

- Status bit block

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Online	Offline Reason			Missed Ack	Reserved	Trigger Ack	Trigger Ready
Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
Error	Command Failed	Command Completed	Command Executing	Results Valid	Results Buffer Overrun	Inspection Completed	System Busy
Bit 23	**Bit 22**	**Bit 21**	**Bit 20**	**Bit 19**	**Bit 18**	**Bit 17**	**Bit 16**
Reserved			Job Pass	Exposure Complete	String Command Error	String Command Ack	Set User Data Ack
Bit 31	**Bit 30**	**Bit 29**	**Bit 28**	**Bit 27**	**Bit 26**	**Bit 25**	**Bit 24**
Soft Event Ack 7	Soft Event Ack 6	Soft Event Ack 5	Soft Event Ack 4	Soft Event Ack 3	Soft Event Ack 2	Soft Event Ack 1	Soft Event Ack 0

- Input word block

Word 0	Word 1	Word 2..
Command	Reserved	User Data

- Output word block

Word 0	Word 1	Word 2	Word 3	Word 4	Word 5..
Current Job ID	Error Code	Acquisition ID	Inspection ID	Inspection Result Code	Inspection Results

- String command word block

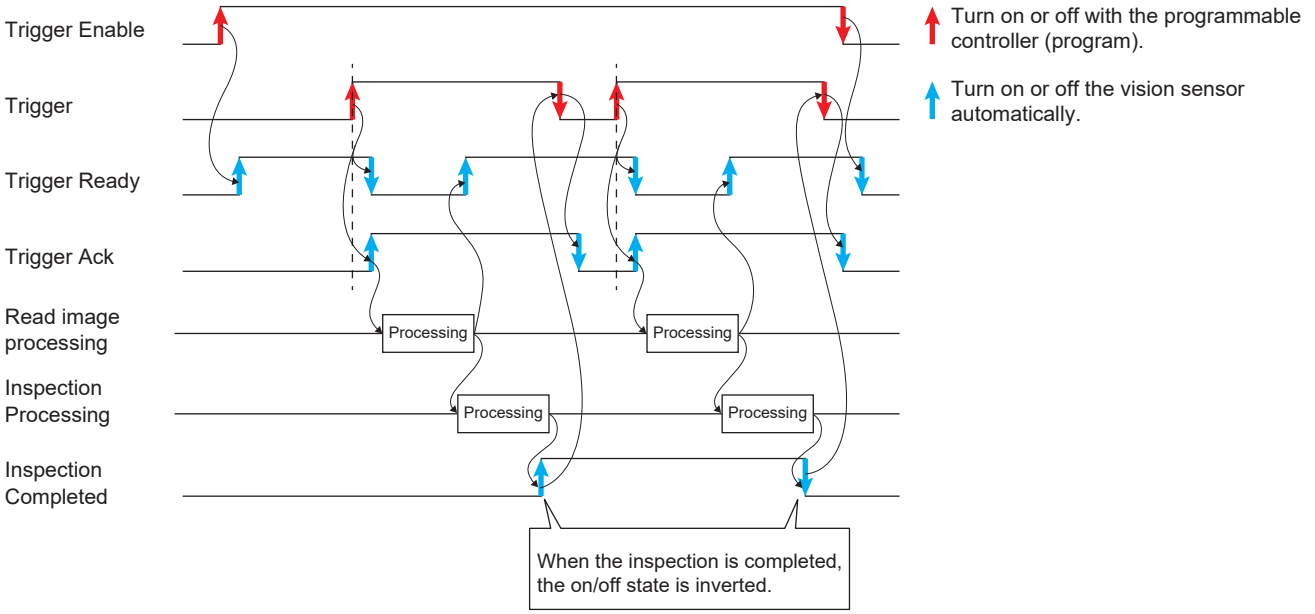
Word 0	Word 1..
String Command Length	String Command

- String command result word block

Word 0	Word 1	Word 2..
Result Code	String Command Result Length	String Command Result

Timing chart of SLMP scanner connection

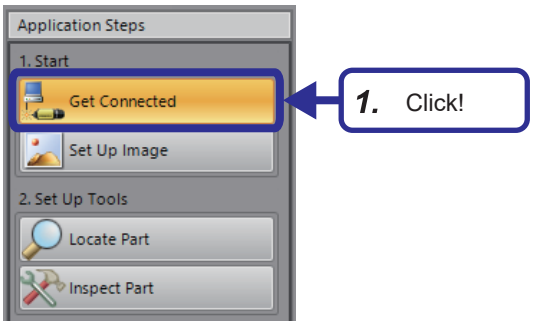
A timing chart when the "Trigger" control bit block is turned on by using a programmable controller is shown below.
To enable the trigger from a programmable controller, turn on "Trigger Enable" of the control bit block.
After "Trigger Ready" of the status bit block has been turned on by turning on "Trigger Enable", when "Trigger" of the control bit block is turned on from the programmable controller, the status of the vision sensor is output to "Trigger Ack" and "Inspection Completed" in the status bit block.
The status of 'Inspection Completed' is inverted (toggled) at the completion of an inspection.



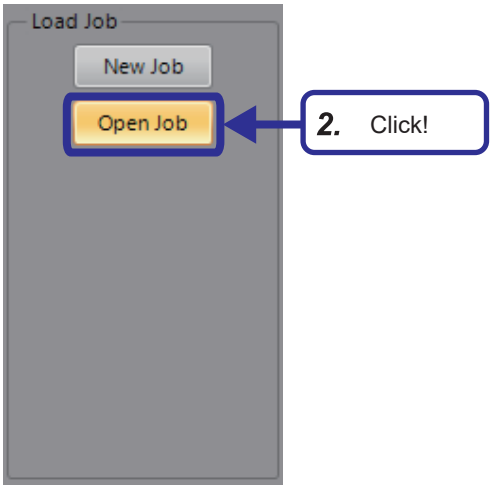
5.2 Changing a Job

Open "1School_Vision.job" created in "☞ Page 41 TRAINING 1 CONFIGURING In-Sight Explorer" and change some of the settings.

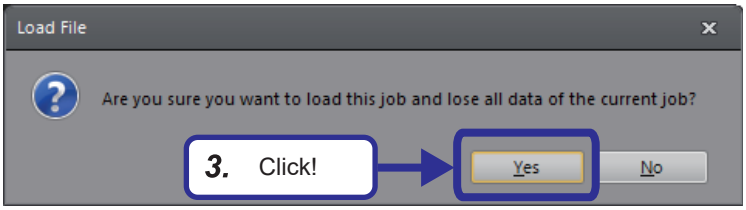
Operating procedure



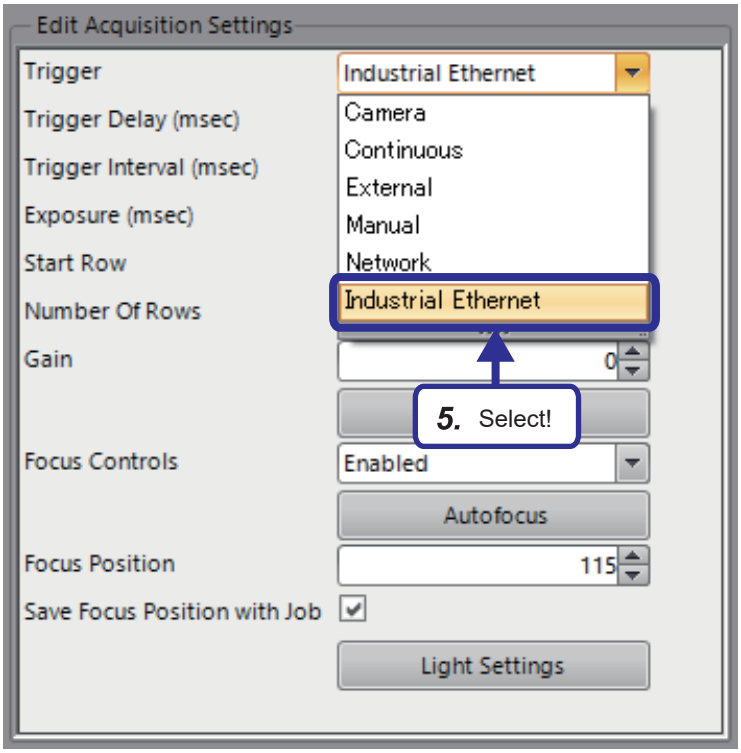
1. From "Application Steps", click the [Get Connected] button.



2. Click the [Open Job] button to open "1School_Vision.job".



3. Click the [Yes] button.



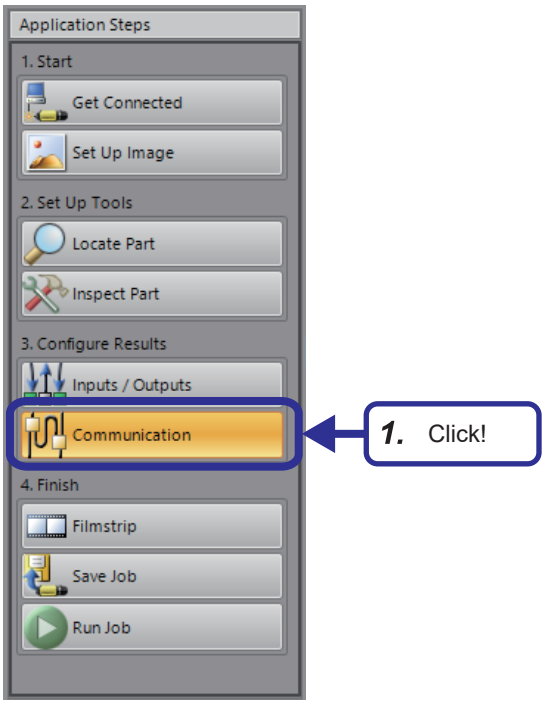
4. From "Application Steps", click the [Set Up Image] button.

5. Set the image capture settings as follows.
[Setting details]
Trigger: Industrial Ethernet

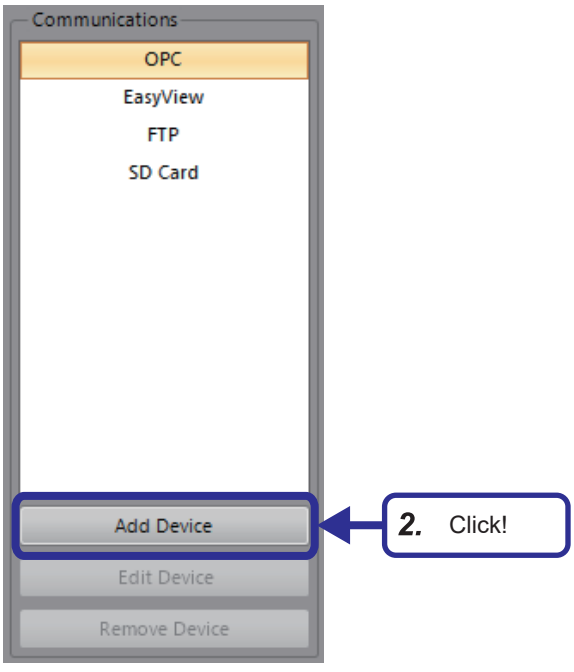
5.3 SLMP Scanner Communication Settings of Vision Sensor

This section describes how to connect to the iQ-R series programmable controller using the SLMP scanner communication function.

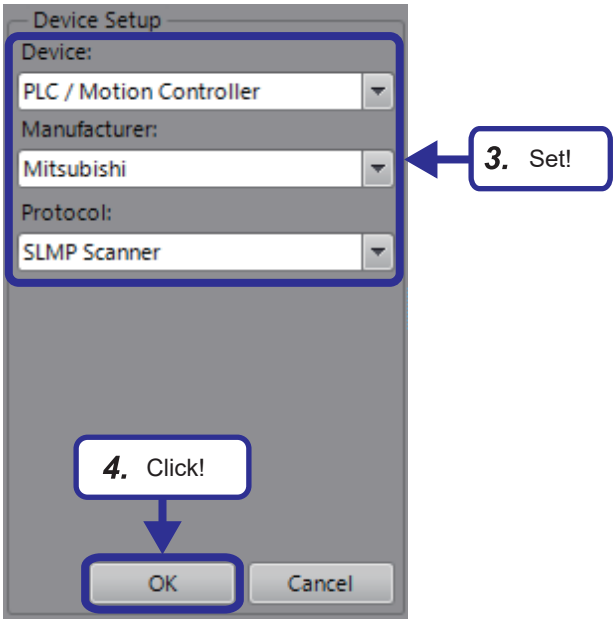
Operating procedure



1. From "Application Steps", click the [Communication] button.

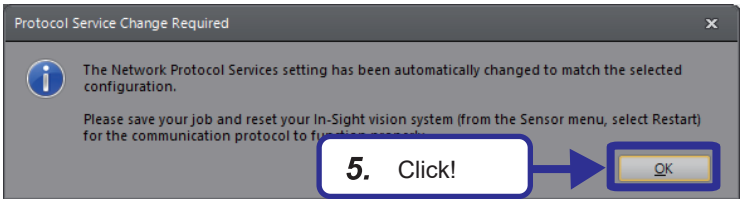


2. Click the [Add Tool] button under "Communications".

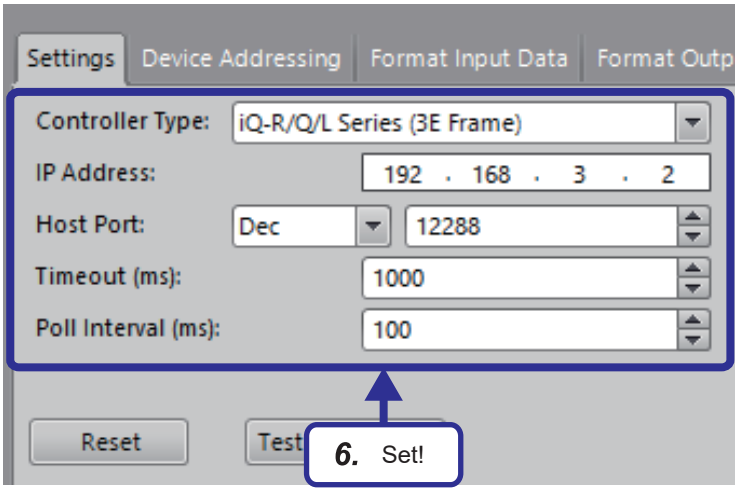


3. Set the device setting as follows.
[Setting details]
Device: PLC/Motion Controller
manufacturer: Mitsubishi
Protocol: SLMP Scanner

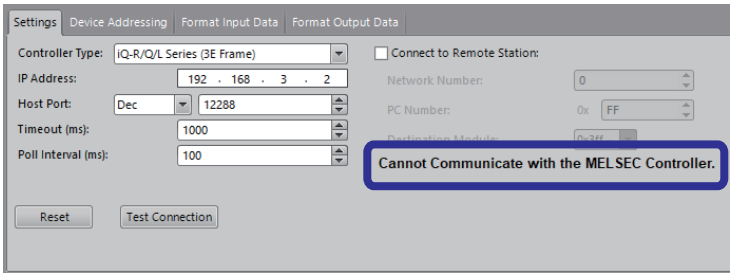
4. Click the [OK] button.



5. When the "Protocol Service Change Required" window is displayed, click the [OK] button.



6. Select the [Settings] tab and make the following settings.
[Setting details]
Controller Type: iQ-R/Q/L Series (3E Frame)
IP Address: 192.168.3.2
Host Port: 12288
Timeout (ms): 1000
Poll Interval (ms): 100



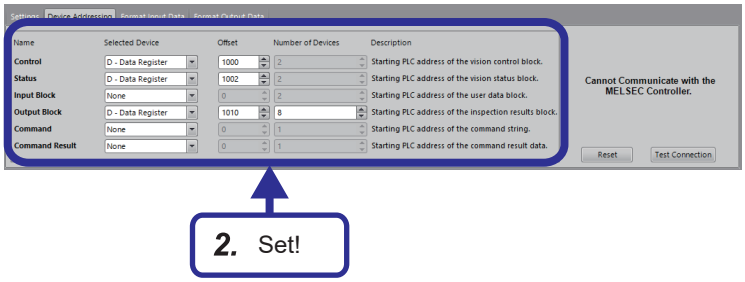
7. At this stage, since the IP address of the programmable controller has not been set, a message indicating that communication with the programmable controller is not possible is displayed.

Point

- SLMP response from a programmable controller may be delayed due to online operation to the programmable controller, connections are disconnected in some cases. Therefore, ensure a sufficient margin for the timeout time.
- Shortening the polling interval also shortens the interval to monitor the programmable controller status.

Assigning devices

Assign the programmable controller devices to "☞ Page 97 Data block" of the vision sensor.

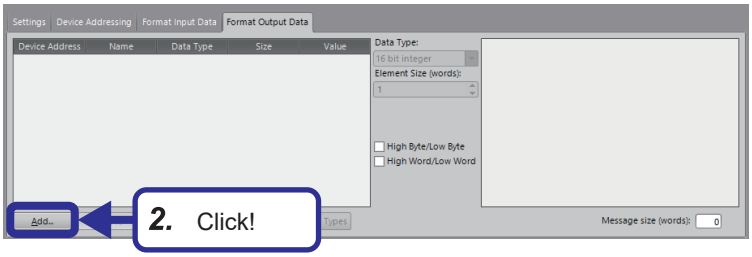


1. Select the [Device Addressing] tab.
2. Set a selected device, offset, and the number of devices to each of the six data blocks.

■Device address specification

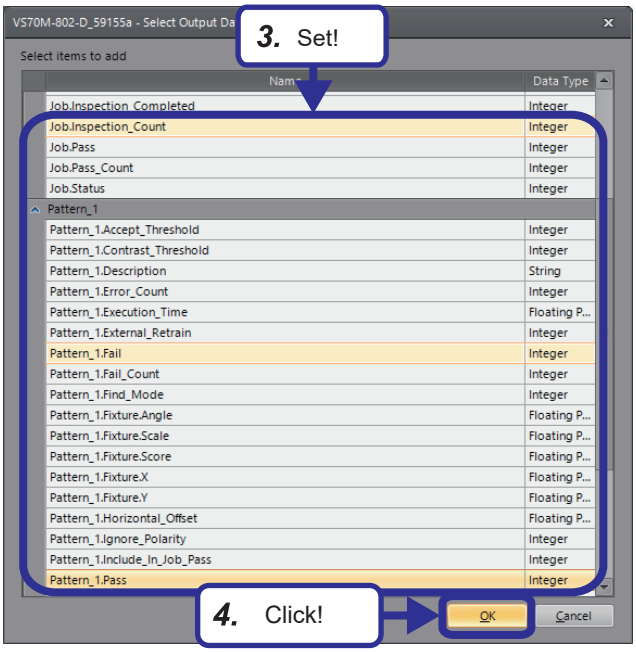
Name	Selected device	Offset	Number of devices
Control	D-Data Register	1000	2
Status	D-Data Register	1002	2
Input Block	None	0	2
Output Block	D-Data Register	1010	8
Command	None	0	1
Command Result	None	0	1

Outputting to the programmable controller



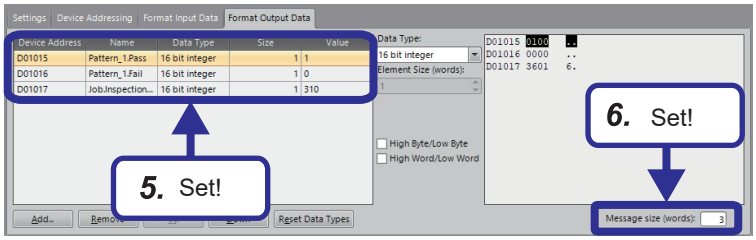
1. Select the [Format Output Data] tab.

2. Click the [Add] button.



3. While pressing the [Ctrl] key on the keyboard, select "Pattern_1.Inspection result (Pass or Fail)" and "Job.Inspection_Count".

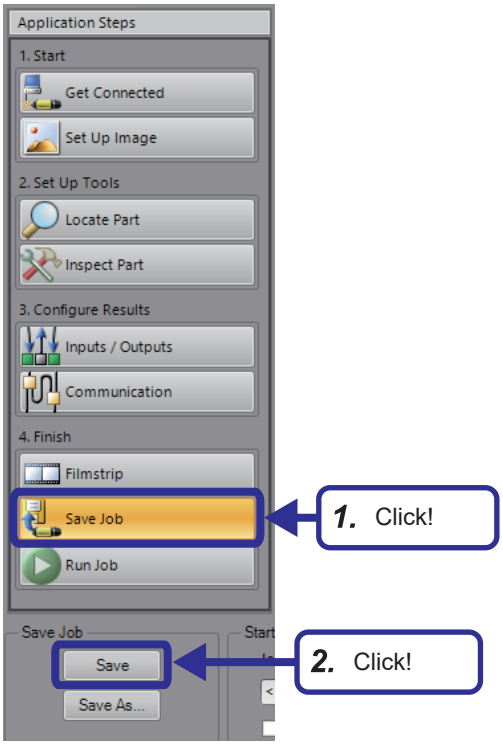
4. Click the [OK] button.



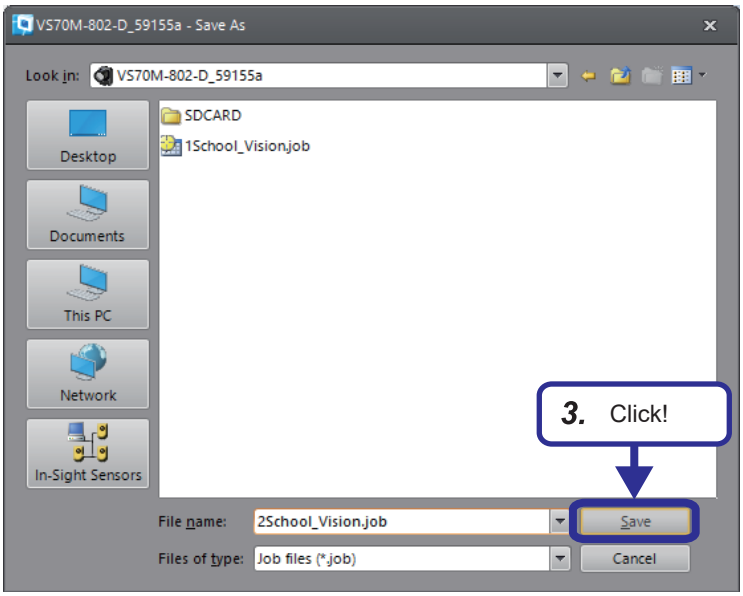
5. Use the [Up] and [Down] buttons to set the device addresses as follows.
D01015: pattern_1.Pass
D01016: Pattern_1.Fail
D01017: Job.Inspection

6. Message size (words): 3

Saving the job



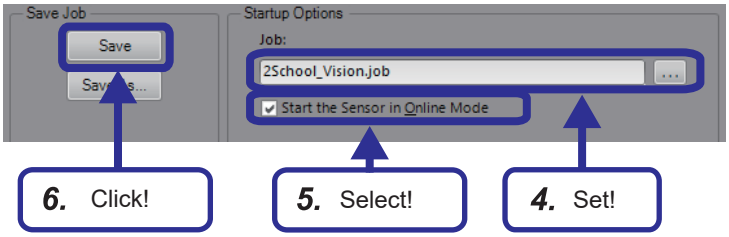
1. From "Application Steps", click the [Save Job] button.
2. Click the [Save As] button.



3. Enter "2School_Vision.job" and click the [Save] button.

Point

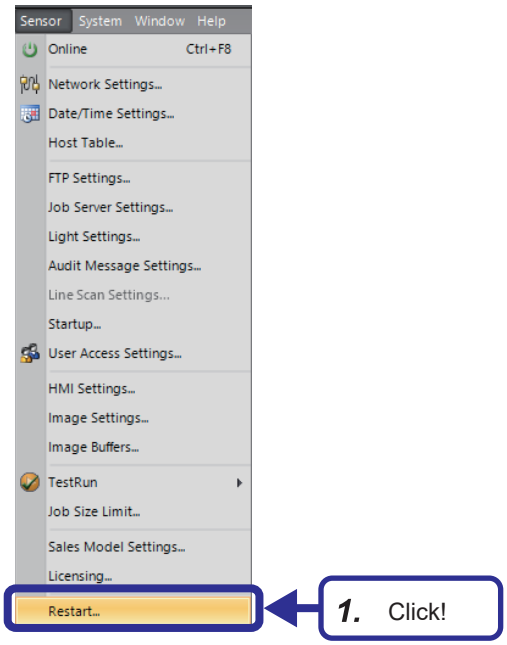
- For the file location to be used as the save destination, select the vision sensor set for In-Sight sensor.
- The running job can be changed (loaded) by prefixing a numeric value to a file name. ☞ Page 125 Changing (loading) jobs

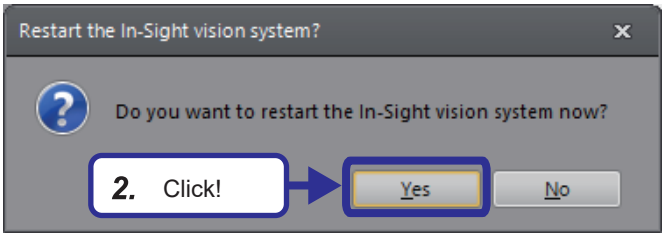


4. Set the file name saved in Step 3. in "Job" in "Startup Options".
5. Select the "Start the Sensor in Online Mode" check box.
6. Click the [Save] button.

Restarting the vision sensor

Restart the vision sensor.





1. From the In-Sight Explorer menu, select [Sensor] ⇨ [Restart].

2. Click the [Yes] button.

5.4 Setting a Programmable Controller

Set the parameters of a programmable controller in GX Works3.

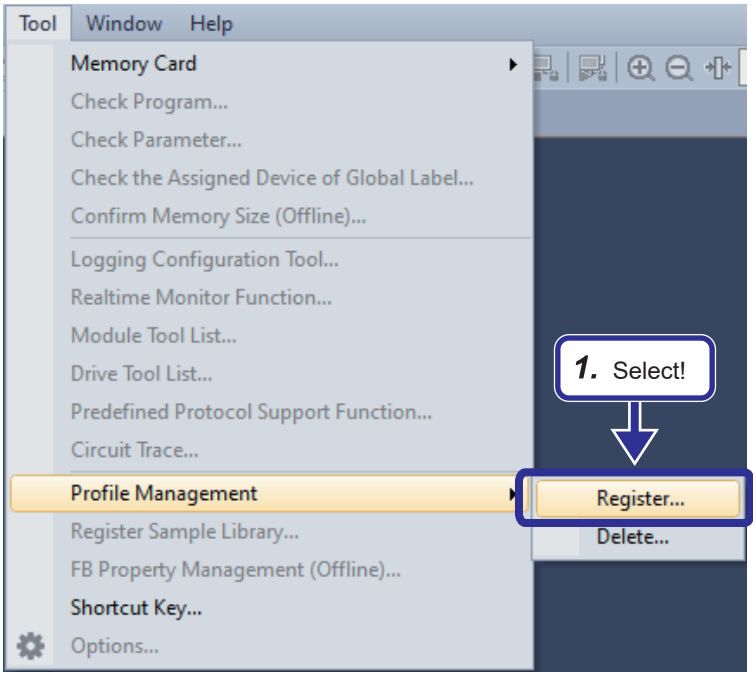
Registering a profile

Register the profile of a vision sensor in GX Works3.

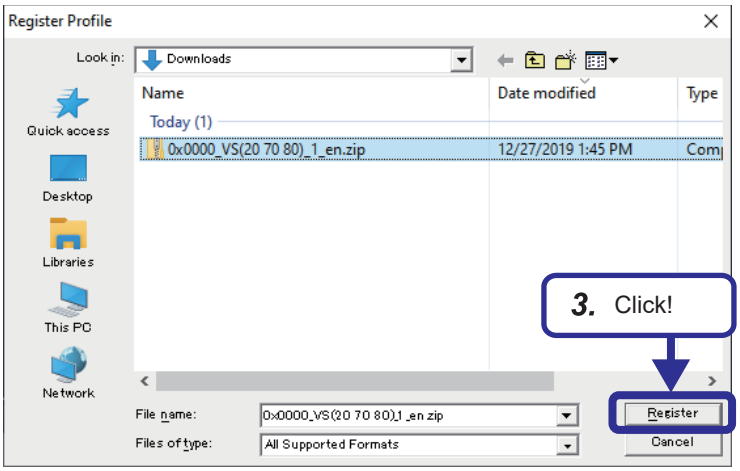
Point

Profiles need to be registered while the GX Works3 project is closed.

Operating procedure



1. From the GX Works3 menu, select [Tool] ⇨ [Profile Management] ⇨ [Register].



2. Select a profile.

Point

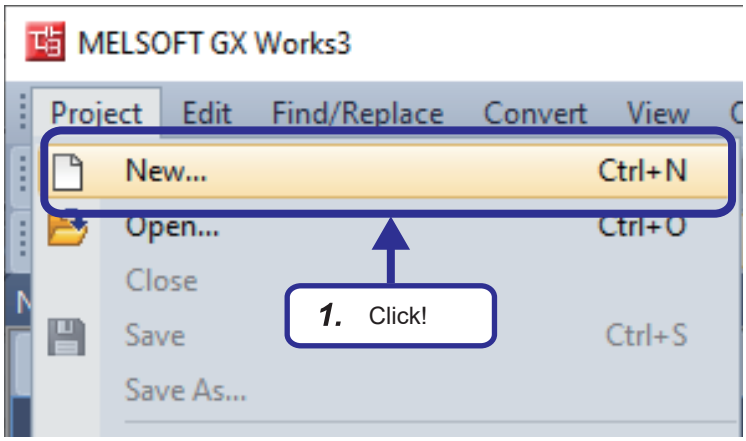
To download a vision sensor profile, please consult your local Mitsubishi representative.

3. Click the [Register] button.

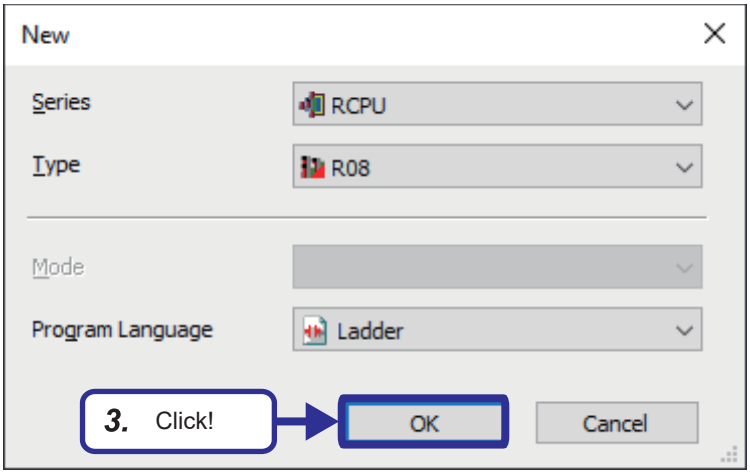
Creating a project

Create a project.

Operating procedure

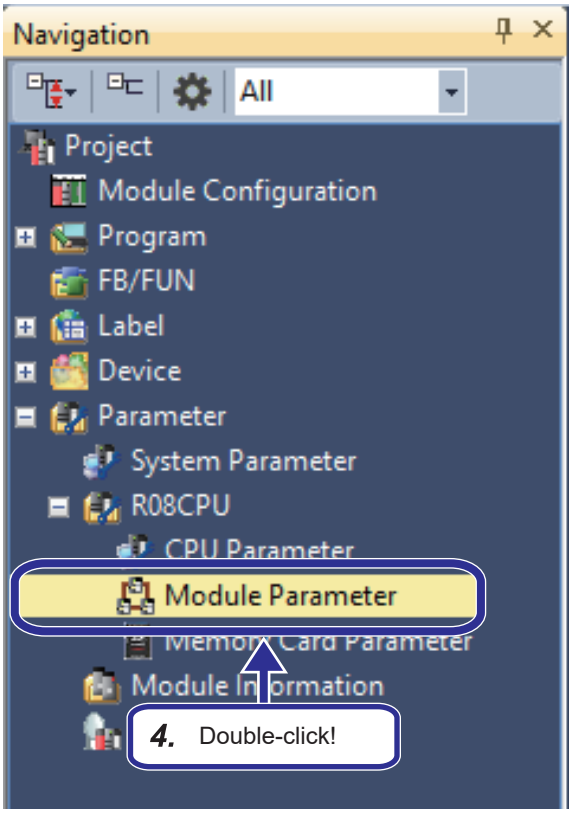


1. Open GX Works3 and create a new project.

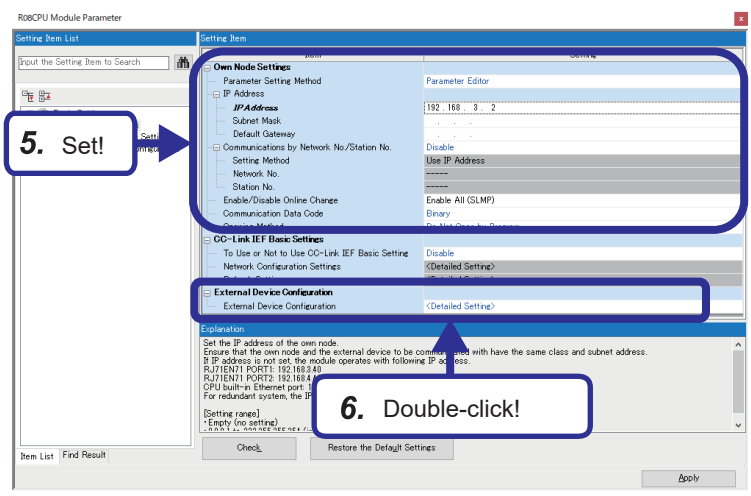


2. A new window is displayed, so set the CPU model, operation mode, and programming language as follows.
[Setting details]
Series: RCPU
Type: R08
Program Language: Ladder

3. Click the [OK] button.

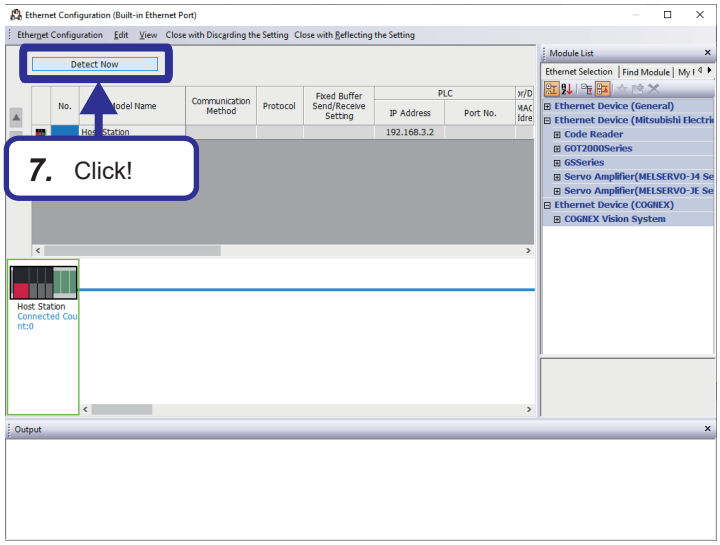


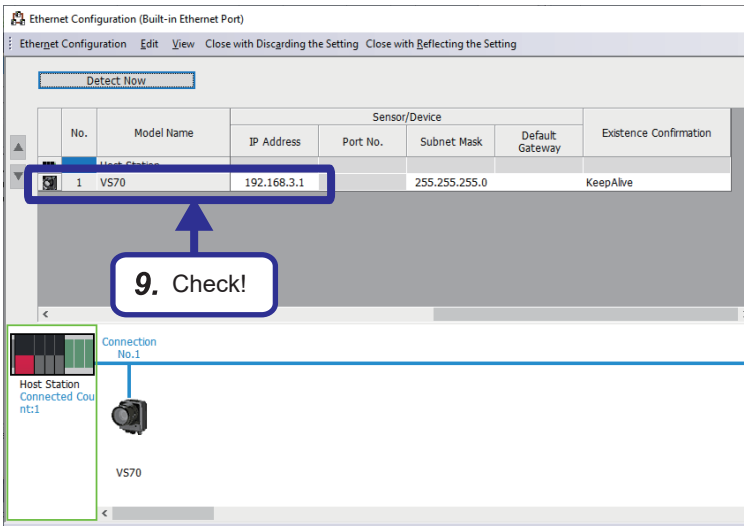
4. In the "Navigation" window, double-click [Module Parameter] located under [Parameter] ⇨ [R08CPU].



5. Set the setting items as follows.
[Setting details]
IP Address: 192.168.3.2
Enable/Disable Online Change:
Enable All (SLMP)
Communication Data Code: Binary

6. Double-click [External Device Configuration].

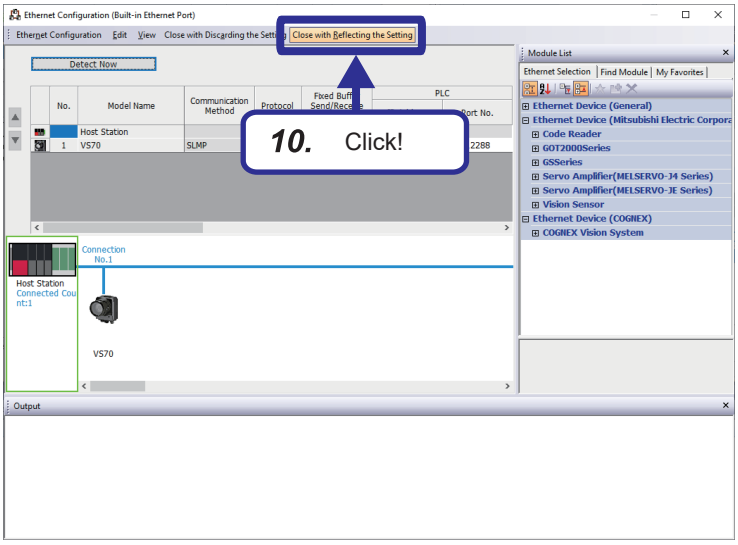




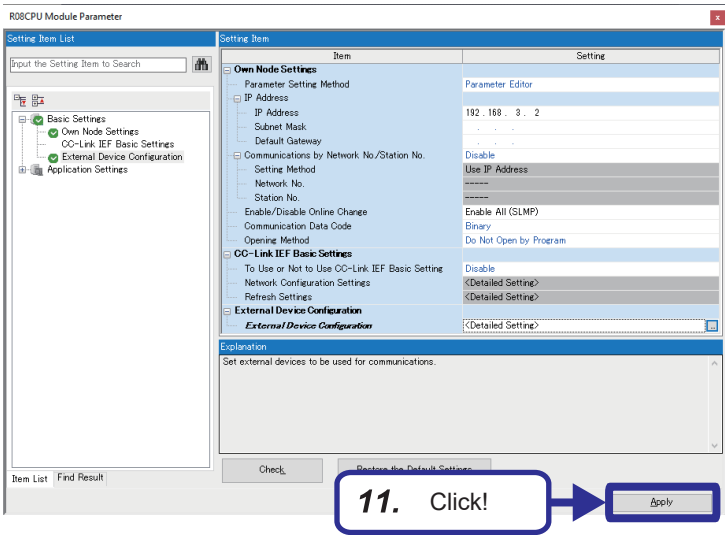
7. Click the [Detect Now] button.

8. Click the [OK] button.

9. The connected vision sensor is displayed.
Check that the "IP Address" of "Sensor/Device" is set as follows.
[Setting details]
192.168.3.1



10. Click the [Close with Reflecting the Setting] button.
For details on the automatic detection of connected device function, refer to "☞ Page 132 iQ Sensor Solution".



11. Click the [Apply] button.

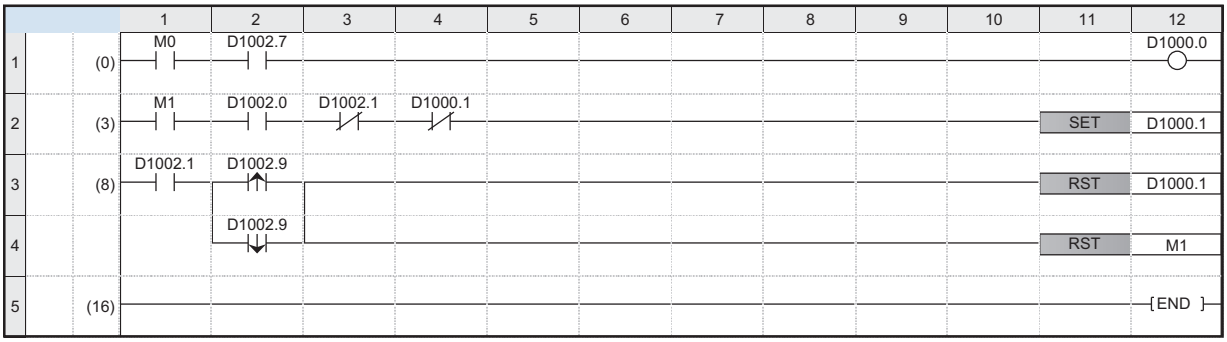
Sequence program

This program captures images by enabling the trigger of the vision sensor.

Devices to be used

Signal	Signal name	Description
D1002.0	Trigger Ready	The reception status of "Trigger enable" (D1000.0) is stored. • On: Trigger is enabled. • Off: Trigger is disabled
D1002.1	Trigger Ack	The reception status of "Trigger" (D1000.1) is stored. • On: With trigger • Off: Without trigger
D1002.7	Online	The online status of a vision sensor is stored. • On: Online • Off: Offline
D1002.9	Inspection Completed	This signal is inverted (toggled) at the completion of an inspection of a vision sensor.
D1000.0	Trigger enable	"Trigger" (D1000.1) is enabled while this signal is on.
D1000.1	Trigger	By turning this signal off and on, an image capture is started.
M0	Online command	"Trigger enable" (D1000.0) turns on to set a vision sensor to online while this signal is on.
M1	Trigger command	By turning this signal off and on, "Trigger" (D1000.1) is turned on, and an image capture is started.

Program example



(0): Set the vision sensor to online.
(3): Trigger the request to start the image capture to the vision sensor.
(8): The process when image capture processing of the vision sensor is completed

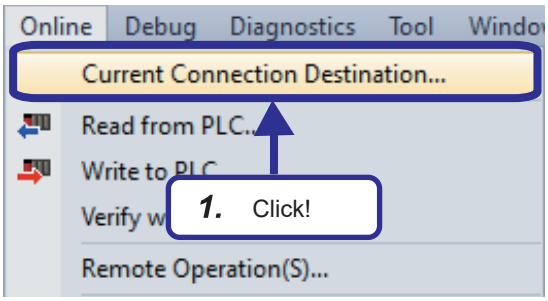
Precautions

- To check "Inspection Completed" (D1002.9), perform an interlock with "Trigger Ack" (D1002.1).
- This training does not include programming. When writing a program to a CPU module, write the pre-programmed project "School_Vision.gx3".

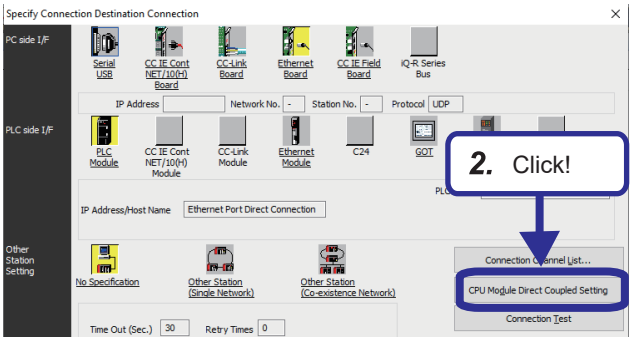
Specifying the connection destination

Specify the connection destination.

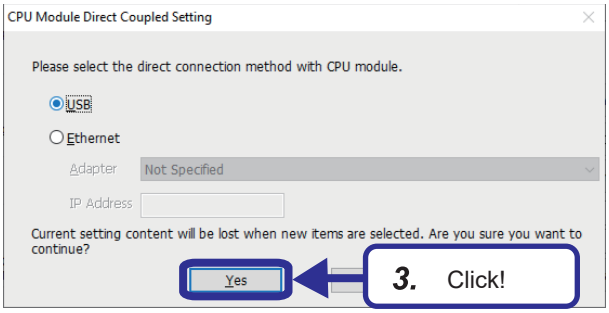
Operating procedure



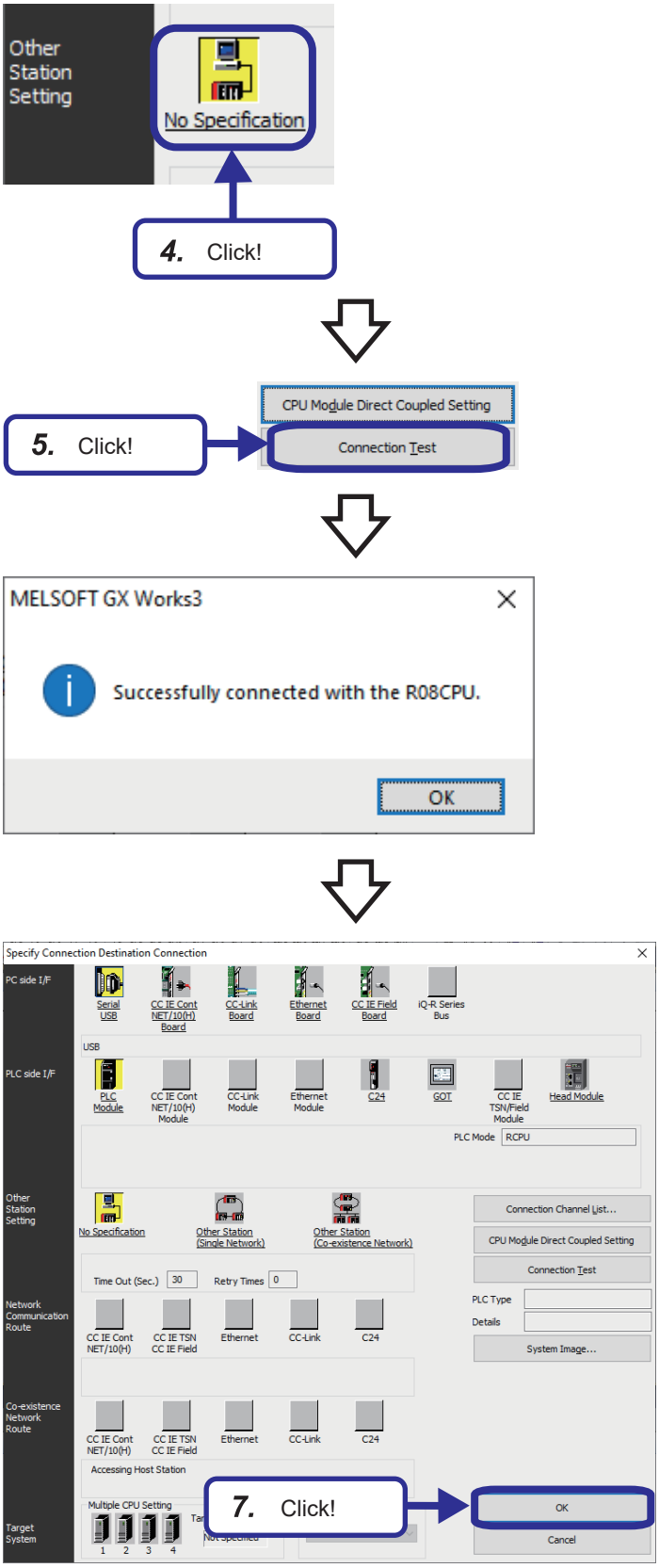
1. From the menu of the engineering tool, select [Online] ⇨ [Current Connection Destination].



2. Click the [CPU Module Direct Coupled Setting] button on the "Specify Connection Destination Connection" window.
The "CPU Module Direct Coupled Setting" dialog box appears.



3. Select a direct communication method with a CPU module, and click the [Yes] button.



4. Click "No Specification" in the other station setting.

5. Click the [Connection Test] button.

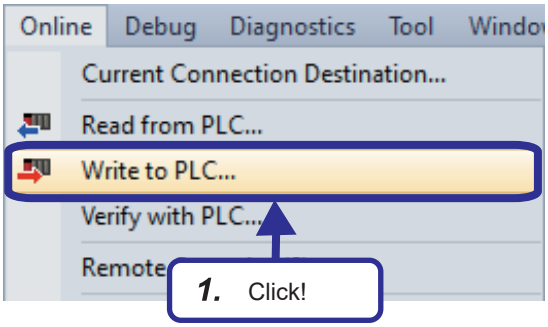
6. Check that the connection to the CPU module has been successfully established.

7. Click the [OK] button.

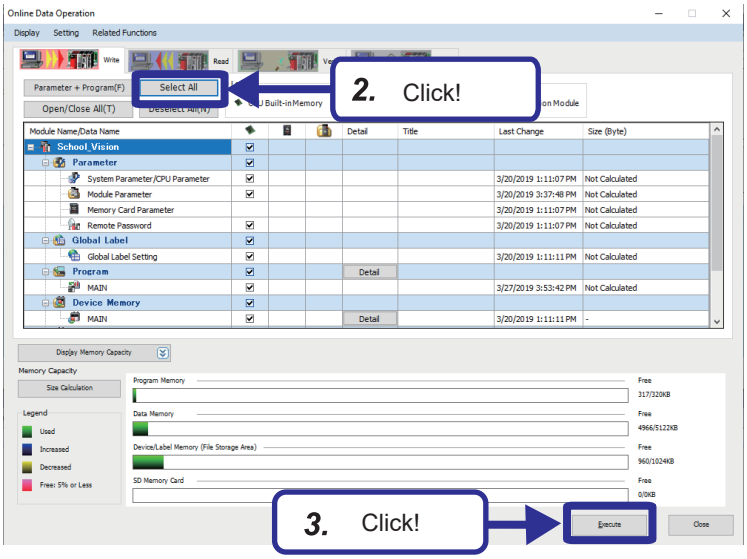
Writing program to the CPU module

In the project "School_Vision.gx3", the parameter settings and programming have been already completed to meet this exercise.

Write "School_Vision.gx3" to the CPU module.

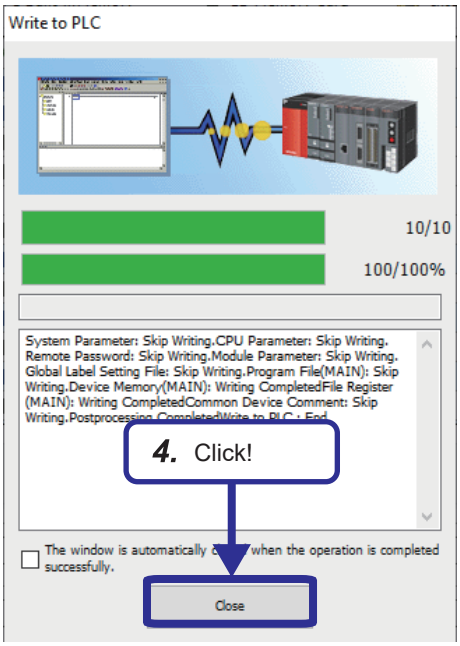


1. From the menu of the engineering tool, select [Online] ⇨ [Write to PLC].



2. When the online data operation dialog is displayed, click the [Select All] button.

3. Click the [Execute] button.



4. The "Write to PLC" dialog box appears. When writing the parameters is completed, "Writing Completed" is displayed. Click the [Close] button.

5. Reset the programmable controller to RUN.

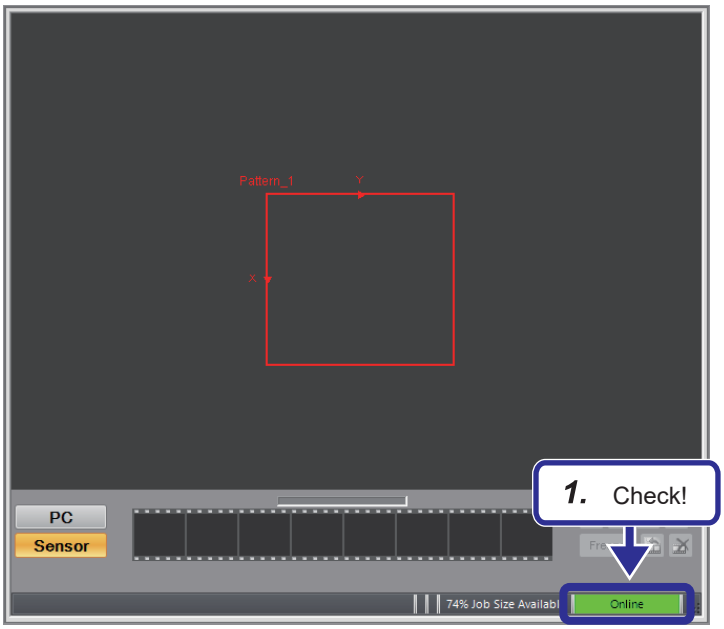
5.5 Checking Operations

Check the operation by controlling the vision sensor using the programmable controller.

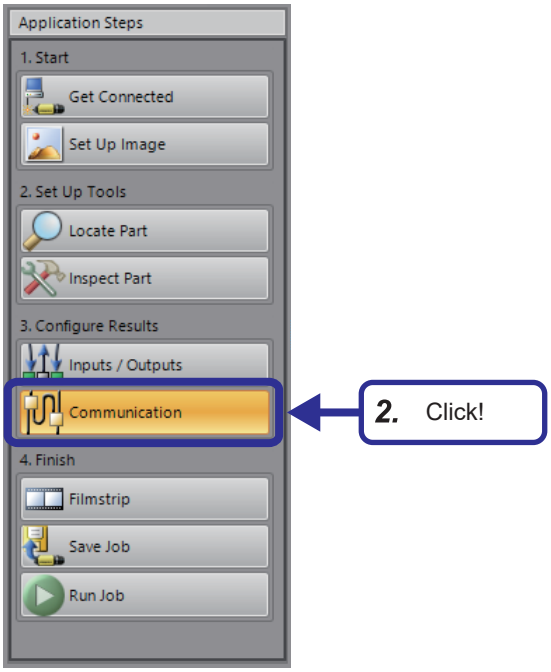
Placing the vision sensor online

Place the vision sensor online and start the communication with the programmable controller.

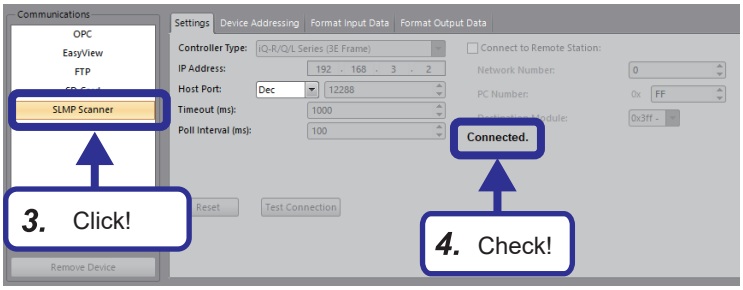
Operating procedure



1. Check that the status is online.



2. From "Application Steps", click the [Communication] button.



3. Click "SLMP Scanner".

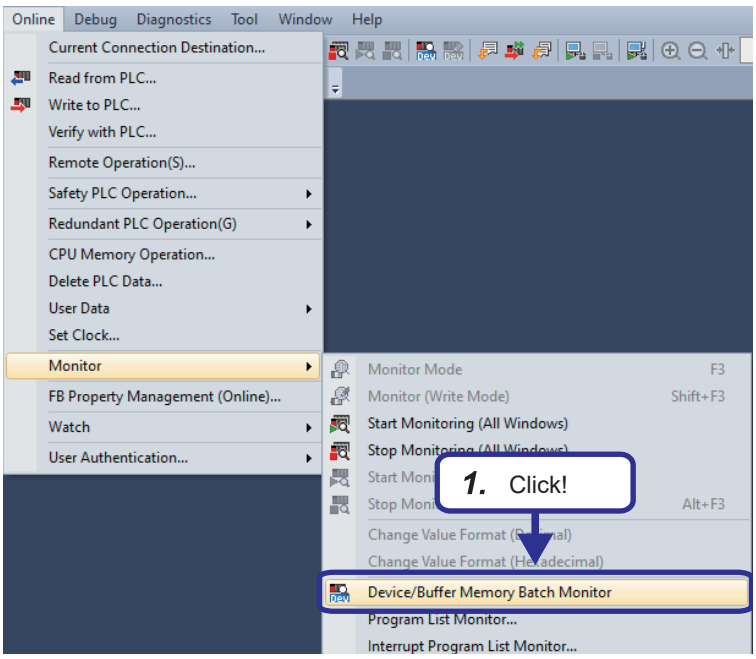
4. Check that "Connected" is displayed.

Enabling a trigger on the vision sensor

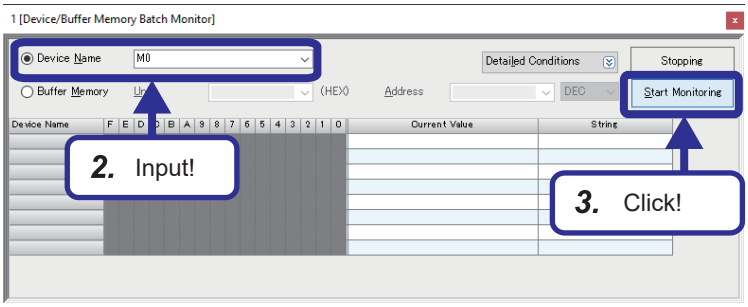
Using a sequence program, enable a trigger on the vision sensor to acquire the inspection results.

Program operation

Operating procedure

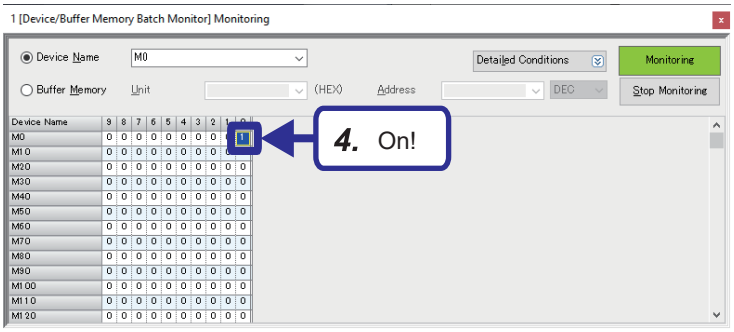


1. From the menu of the engineering tool, select [Online] ⇨ [Monitor] ⇨ [Device/Buffer Memory Batch Monitor].

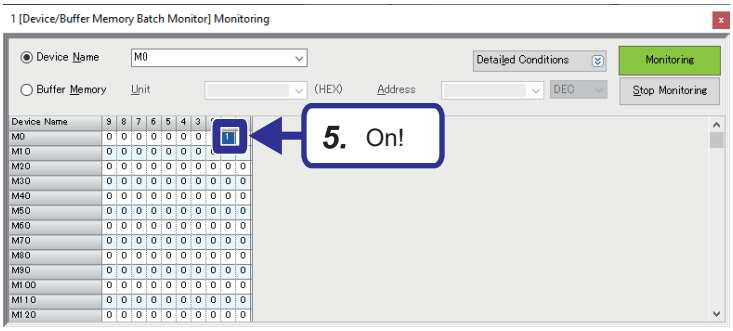


2. Enter "M0" for the device name.

3. Click the [Start Monitoring] button.



4. Turn "M0" ON to turn "Trigger enable" (D1000.0) ON.

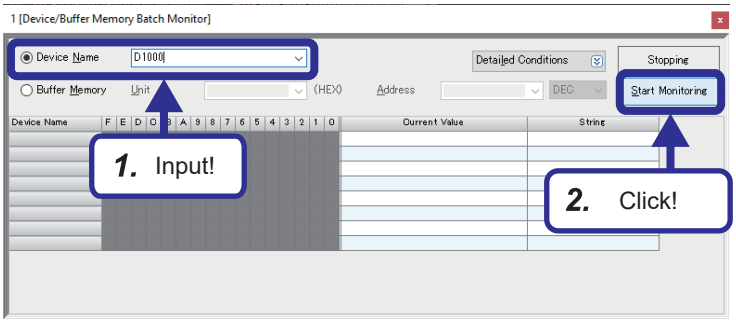


5. Turn "M1" ON to turn "Trigger" (D1000.1) ON.

Checking inspection results

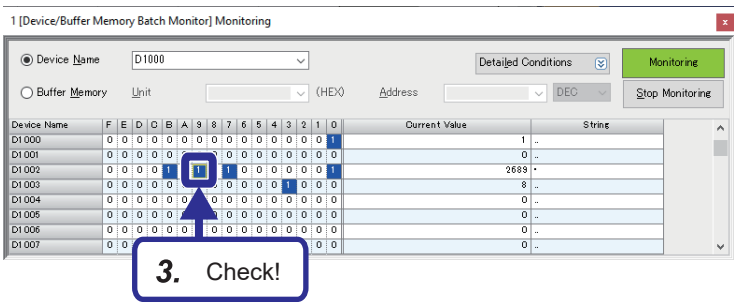
Check the inspection results.

Operating procedure

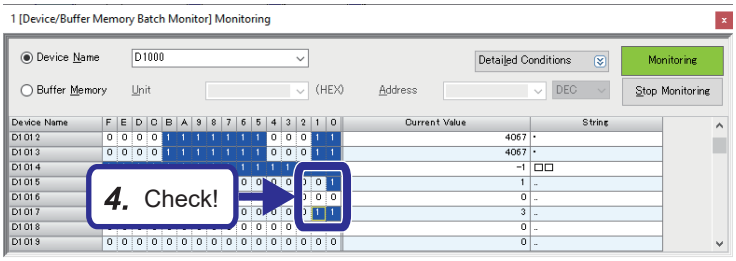


1. Enter "D1000" for "Device Name".

2. Click the [Start Monitoring] button.



3. Check that the status of "Inspection Completed" (D1002.9) is inverted (toggled).



4. Check the following.

"Job PASS" (D1015.0):

This signal is turned on when the set target object exists in the captured image.

"Job FAIL" (D1016.0):

This signal is turned on when the set target object does not exist in the captured image.

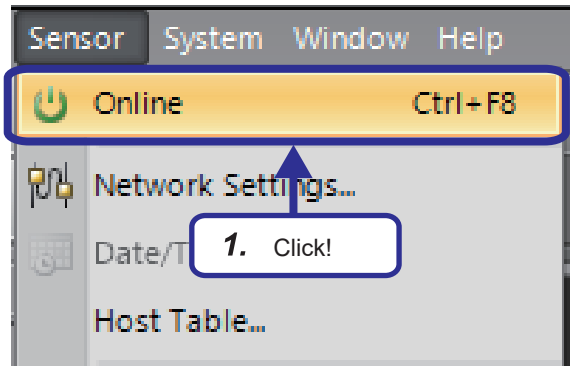
"Job.Inspection"(D1017):

The number of triggers is stored.

Changing a recognition parameter

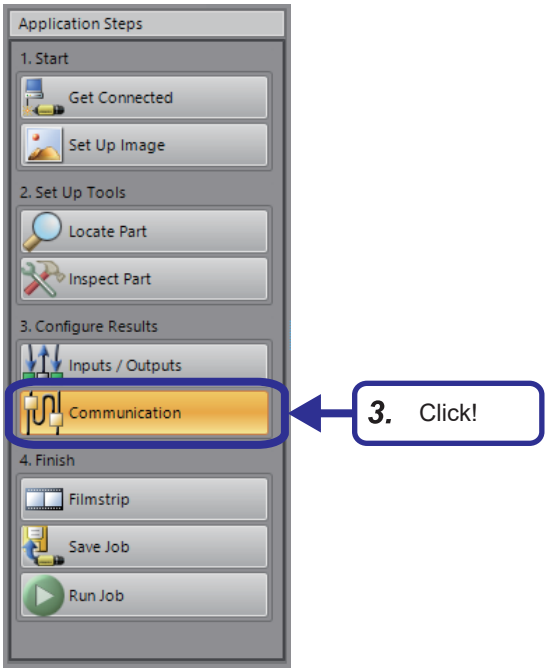
Change the rotation tolerance of the location tool pattern to ±90°.

Operating procedure

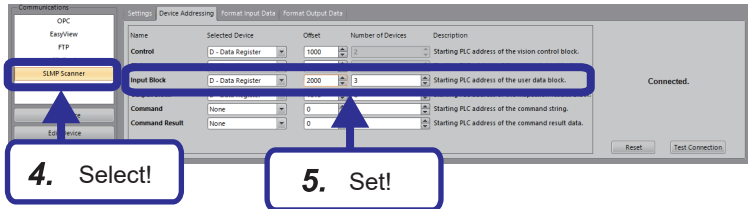


1. From the menu, select [Sensor] ⇨ [Online] and switch the vision sensor offline.

2. Click the [Yes] button.

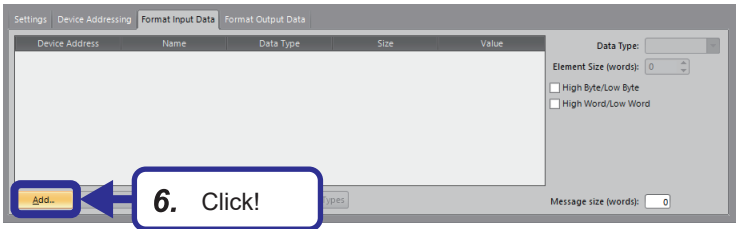


3. From "Application Steps", click the [Communication] button.

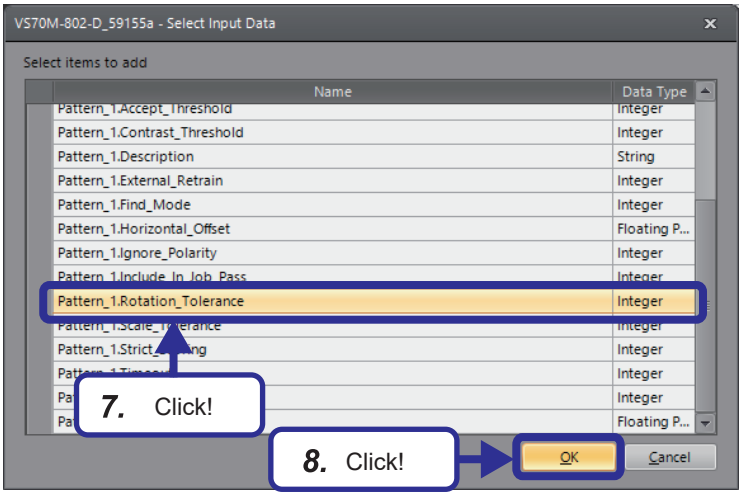


4. Click "SLMP Scanner" under "Communications".

5. Set the device of "Input Device" on the [Device Addressing] tab as follows.
[Setting details]
Selected Device: D-Data Register
Offset: 2000
Number if Devices: 3

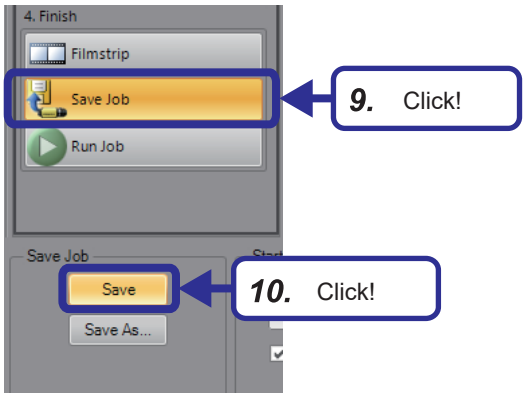


6. Select the [Format Input Data] tab, and click the [Add] button.



7. From the "Select Input Data" window, select "Pattern_1.Rotation_Tolerance".

8. Click the [OK] button.



9. From "Application Steps", click the [Save Job] button.

10. Click the [Save] button.

11. Set the vision sensor to online.

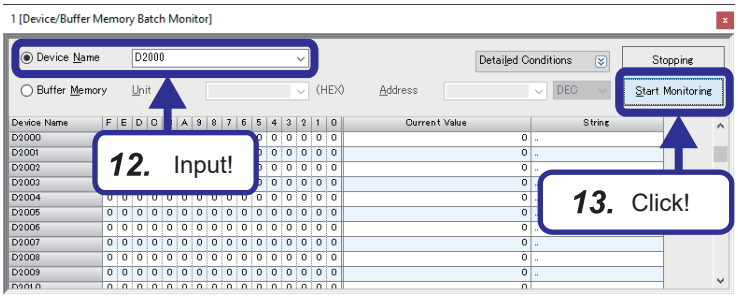
Point

To change parameter values, parameter items need to be added to the list in the [Format Input Data] tab in advance.

More than one parameter item can be selected.

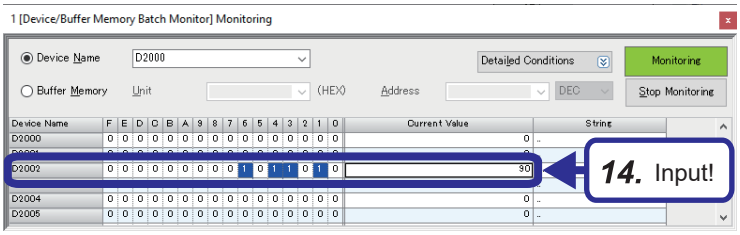
Set the number of devices of "Input Block" according to the number (size) of parameters.

When the number of devices is small, a warning mark is displayed next to "Message size (words)".

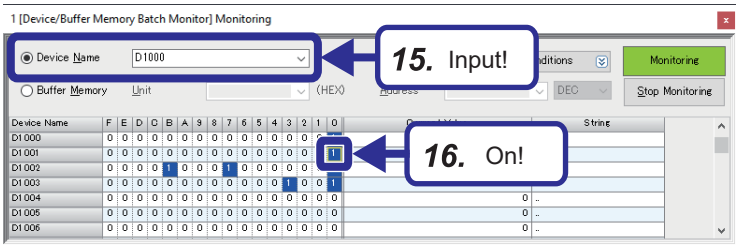


12. Enter "D2000" for the device name of the device/buffer memory batch monitor of GX Works3.

13. Click the [Start Monitoring] button.

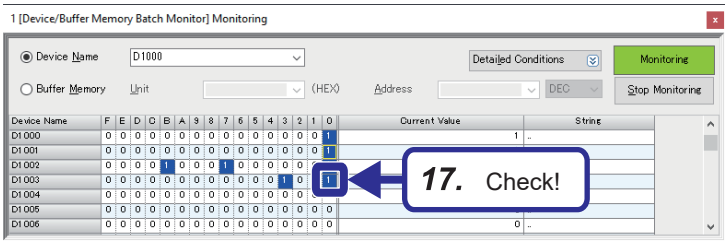


14. Enter "90" as the current value of "User Data" (D2002) in the input word block.

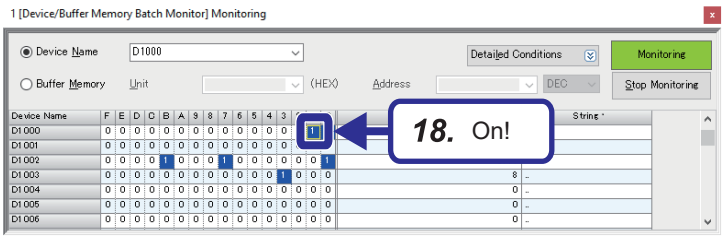


15. Enter "D1000" for the device name.

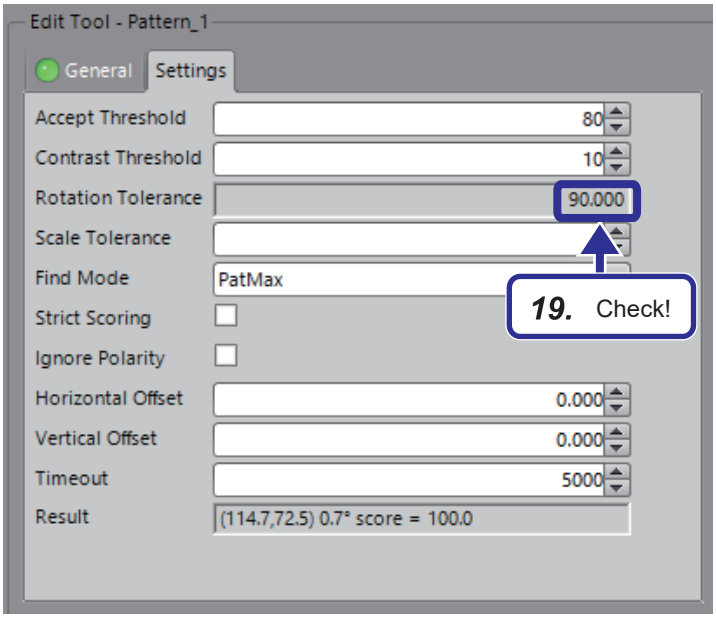
16. Turn on "Set User Data" (D1001.0) in the control bit block.



17. When the settings are completed, "Set User Data Ack" (D1003.0) of the status bit block is turned on.
After "Set User Data Ack" (D1003.0) turns on, turn "Set User Data" (D1001.0) off.



18. Turn on "Trigger" (D1000.1) of the control bit block.

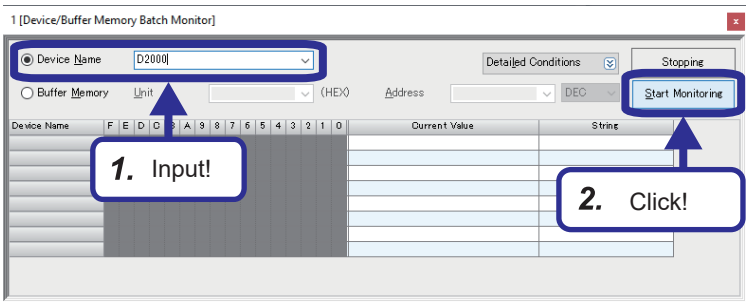


19. Check that the value of "Rotation Tolerance" on the [Settings] tab has been changed.

Changing (loading) jobs

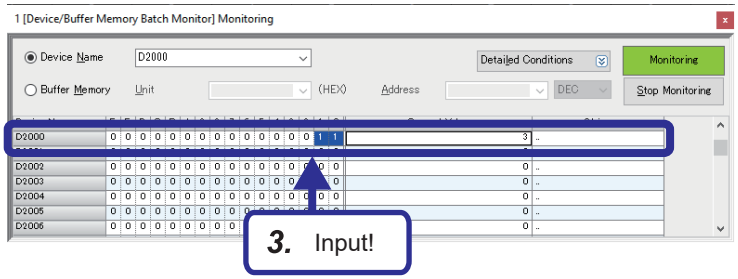
This section describes how to load the job file "3School_Vision.job".
The number "3" prefixed to the file name is the ID number. By setting this ID number to "Command" (D2000) of the input word block, the job ("3School_Vision") can be loaded.

Operating procedure

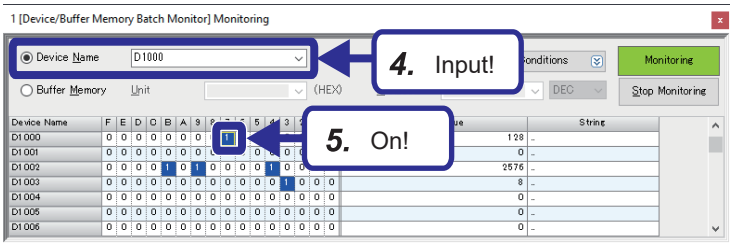


1. Enter "D2000" for the device name of the device/buffer memory batch monitor of GX Works3.

2. Click the [Start Monitoring] button.

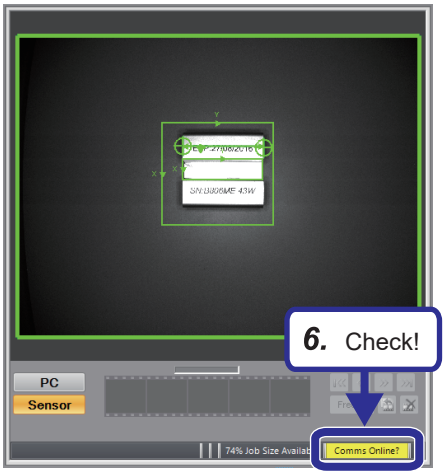


3. Enter "3" as the current value of D2000.



4. Enter "D1000" for the device name.

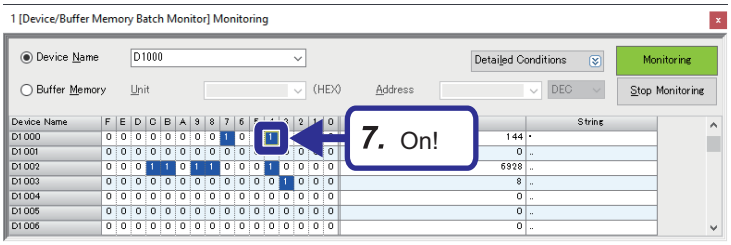
5. Turn on "Set Offline" (D1000.7) of the control bit block to set the vision sensor to offline.



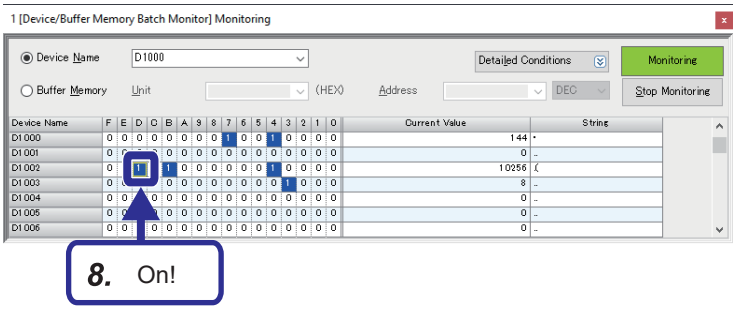
6. Check that the online/offline status of In-Sight Explorer is as shown on the left.

Point

If "Comms Online?" is displayed, the In-Sight vision system has been set to online mode by the EasyBuilder user interface, but the vision system remains offline due to the communication protocol (such as ProfiNET, EtherNet/IP, native mode).



7. Turn on "Execute Command" (D1000.4) of the control bit block to load a job.



8. When loading of the job is completed, "Command Completed" (D1002.D) of the status bit block is turned on.

9. When "Command Completed" (D1002.D) turns on, turn off "Execute Command" (D1000.4) and "Set Offline" (D1000.7).

Point

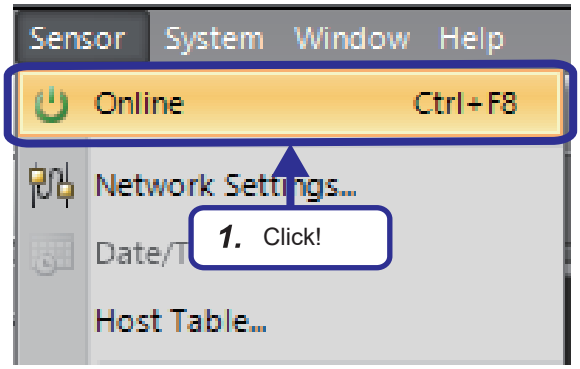
To load a job, the file name of the job must begin with an ID number.
When loading a job, set the vision sensor to offline.

Controlling the vision sensor by using native mode commands

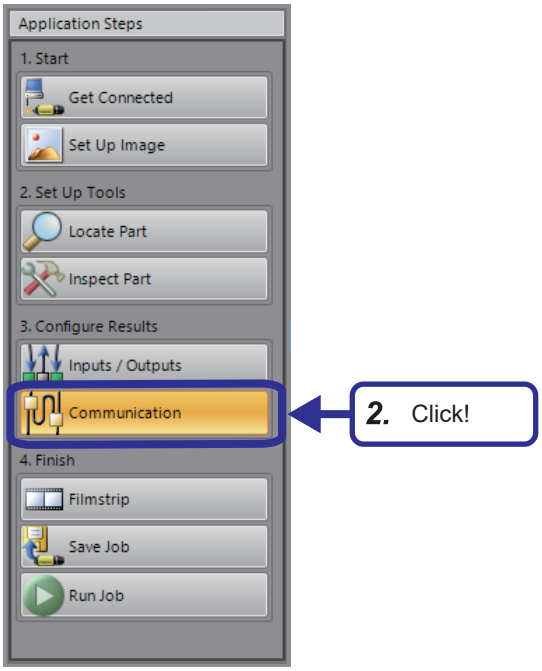
The vision sensor can be controlled by using native mode commands.
As an example, send the native mode command "GF (Get File)" using a sequence program to acquire the file name of the job in use.

Setting the vision sensor

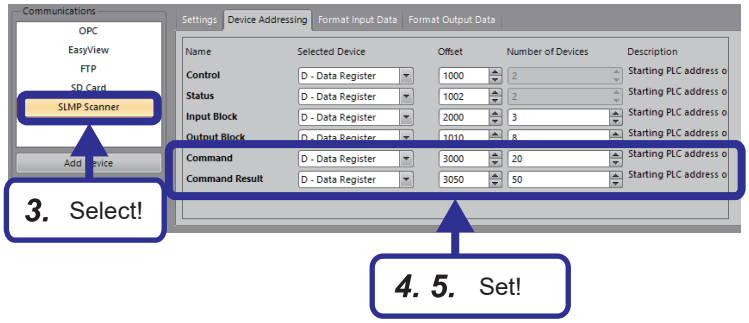
Operating procedure



1. Set the vision sensor to offline with In-Sight Explorer.



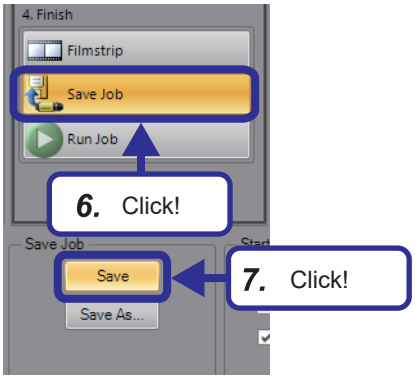
2. From "Application Steps", click the [Communication] button.



3. Click "SLMP Scanner" under "Communications".

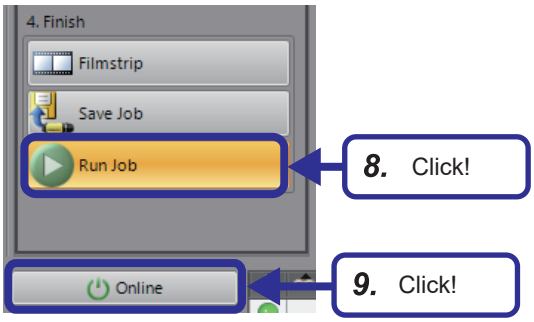
4. Set the device of "Command" on the [Device Addressing] tab as follows.
[Setting details]
Selected Device: D-Data Register
Offset: 3000
Number of Devices: 20

5. Set the device of "Command Result" as follows.
[Setting details]
Selected Device: D-Data Register
Offset: 3050
Number of Devices: 50



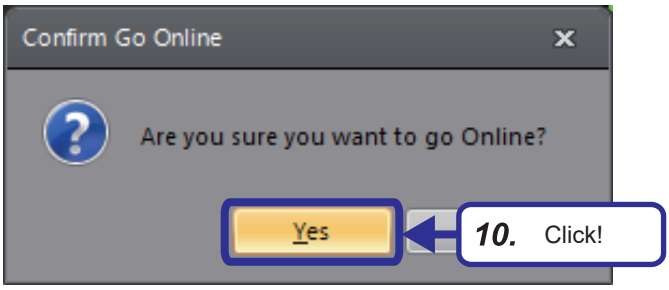
6. From "Application Steps", click the [Save Job] button.

7. Click the [Save] button.



8. From "Application Steps", click the [Run Job] button.

9. Click the [Online] button to switch to online.



10. Click the [Yes] button.

Point

Set the number of devices of "Command" according to the length (size) of the character string of the command.

Set the number of devices of "Command Result" according to the size of the data to be acquired.

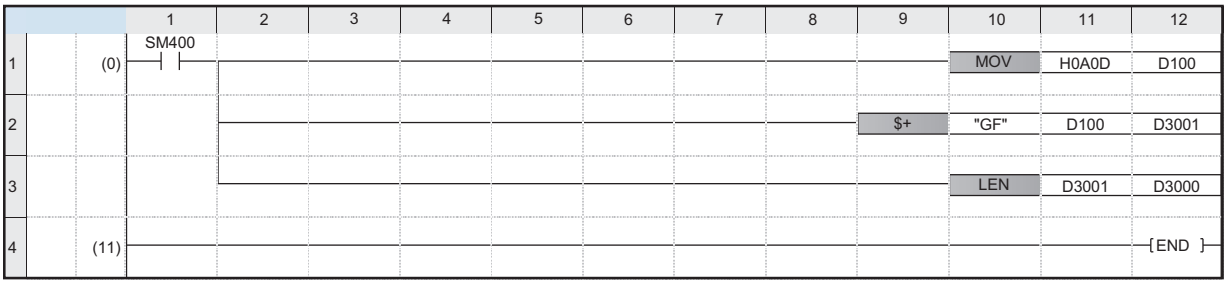
Sequence program

This program stores native commands in data blocks.

■Devices to be used

Signal	Signal name	Description
D3000	String command length	The length of the native mode command is stored.
D3001	String command	The native mode commands processed by the vision system is stored.
D100	Newline code temporary storage area	Sets the newline code (CRLF).
SM400	Always on	The status is always on.

■Program example

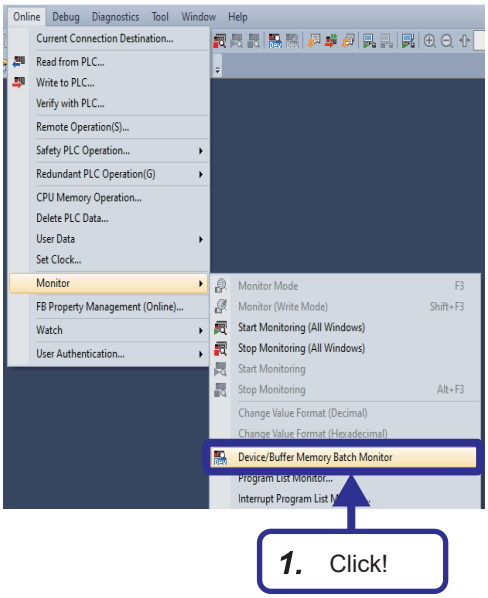


(0): The native mode command and its character string length are stored on the device.

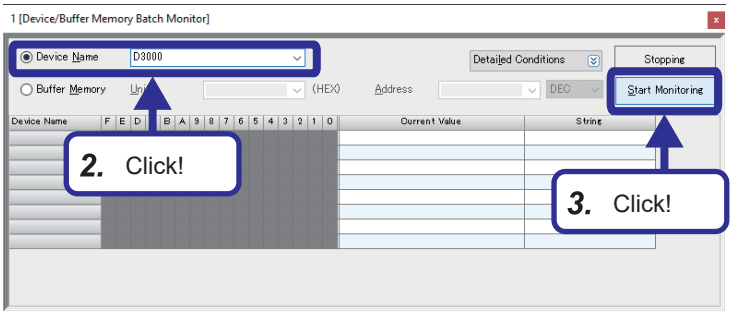
Program operation

Send the native mode command "GF" to acquire a file name.

Operating procedure

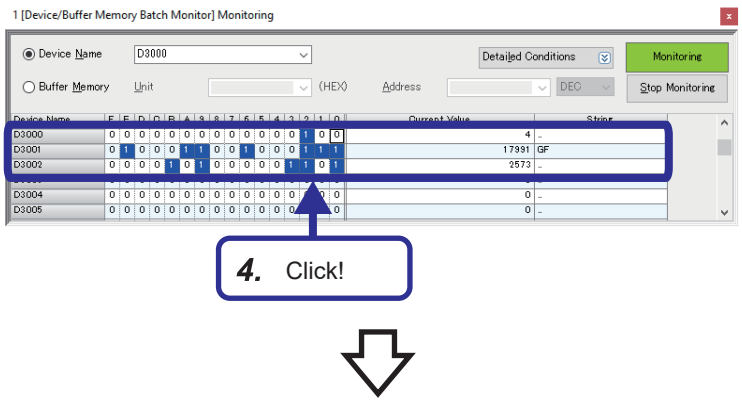


1. From the menu of the engineering tool, select [Online] ⇨ [Monitor] ⇨ [Device/Buffer Memory Batch Monitor].

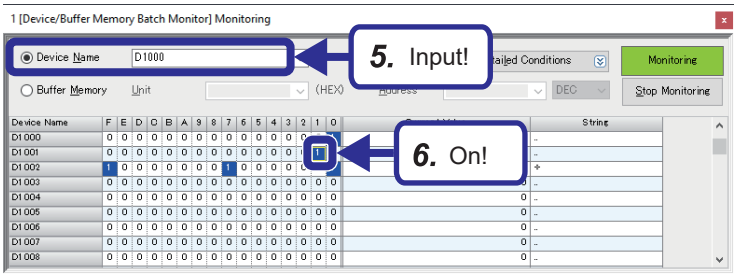


2. Enter "D3000" for the device name.

3. Click the [Start Monitoring] button.

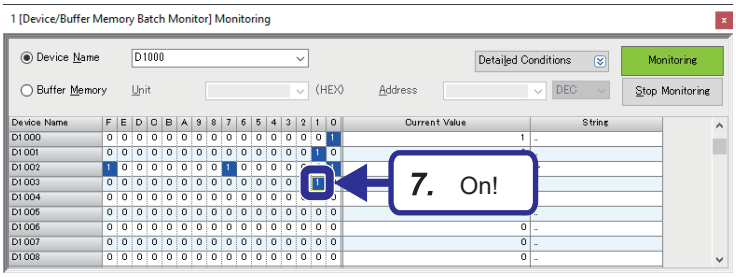


4. Check that the settings are as follows.
[Setting details]
D3000: 4 (character string length)
D3001: "GF" (native mode command)
D3002: 2573 (newline code CRLF)

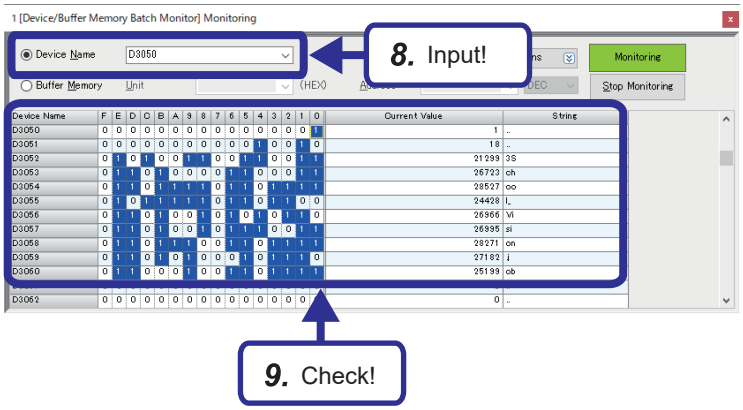


5. Enter "D1000" for the device name.

6. Turn on "Initiate String Command" (D1001.1) of the control bit block.



7. "String Command Ack" (D1003.1) of the status bit block is turned on. Once "String Command Ack" (D1003.1) turns on, turn off "Initiate String Command" (D1001.1).



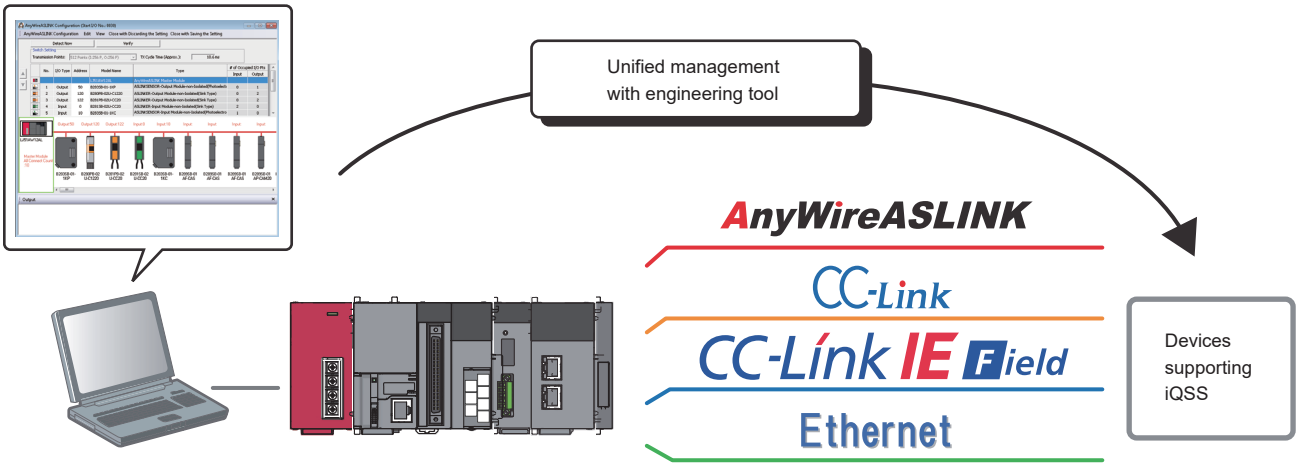
8. Enter "D3050" for the device name.

9. The following information of the character string command result word block can be obtained.
[Content]
"Result Code" (D3050): "1" (normal execution)
"String Command Result Length" (D3051): 18 (length of file name character string)
"String Command Result" (D3052 to D3060): "3School_Vision.job" (file name)

APPENDICES

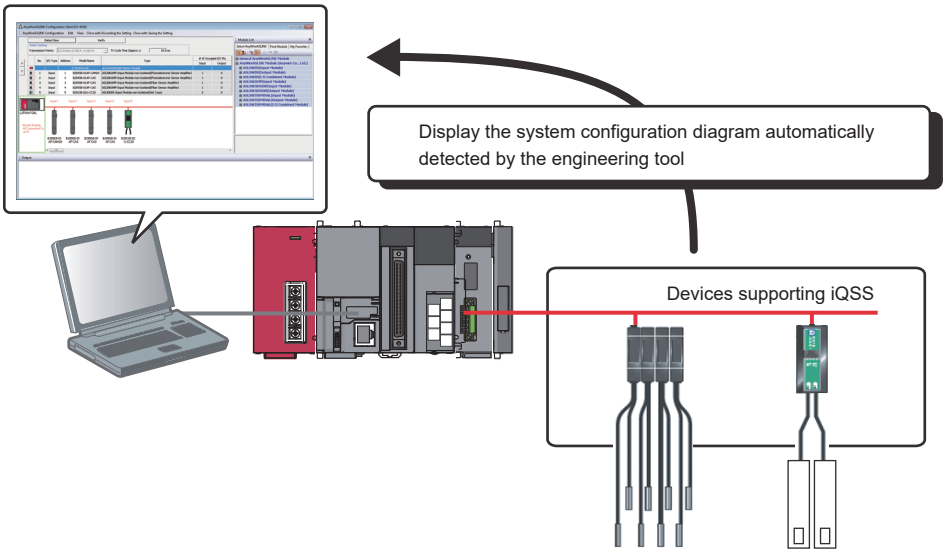
Appendix 1 iQ Sensor Solution

iQ Sensor Solution is a solution that manages both partner product devices and programmable controllers with an engineering tool.
By sharing design information such as system design and programming for the entire control system, the efficiency of system design and programming can be improved, and the total cost of design, start-up, operation, and maintenance can be reduced.
By performing the functions of an engineering tool supporting iQ Sensor Solution, iQ Sensor Solution can save and restore the information of devices supporting iQSS connected to each network.



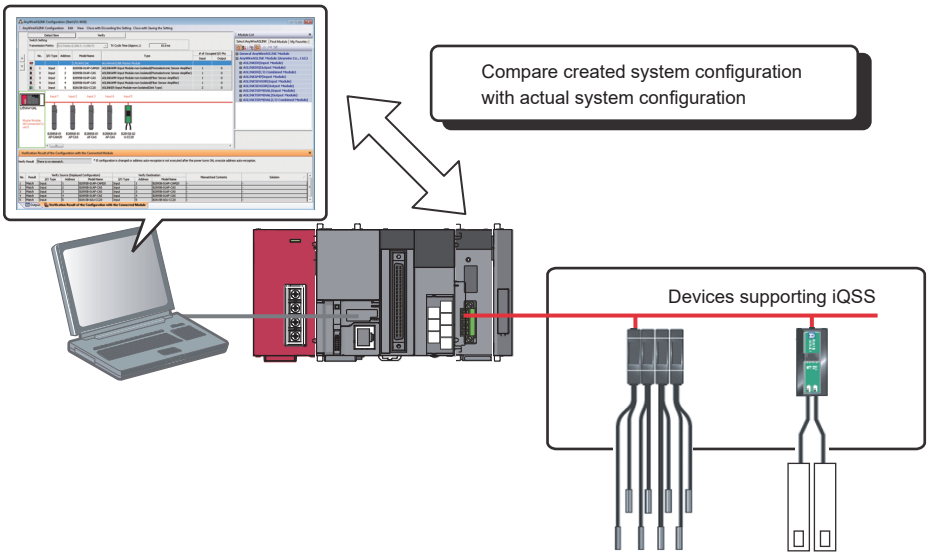
Automatic detection of connected devices

A system configuration diagram can be automatically generated on an engineering tool through detection of devices supporting iQSS in the actual system configuration.
This reduces the man-hours required for the creation of a system configuration diagram at system start-up.



Monitoring of sensors and devices

The status of devices supporting iQSS connected in the actual system configuration can be monitored on a single window.
The status and details of the devices supporting iQSS can be checked in the monitoring information window.



iQ Sensor Solution functions of vision sensor

The following lists the vision sensors supporting iQSS that can be used on the Ethernet and the iQ Sensor Solution functions.
The iQ Sensor Solution functions are specified by the following.

Type	Model	iQ Sensor Solution function					
		❶	❷	❸	❹	❺	❻
Vision sensor	VS20M-11F310, VS20M-12F410, VS20M-13F410, VS20C-12F410, VS20C-13F410, VS70M-600-E, VS70M-600-ER, VS70M-800-E, VS70M-800-ER, VS70M-802-E, VS70M-802-ER, VS80M-100-E, VS80M-200-E, VS80M-200-ER, VS80M-202-E, VS80M-202-ER, VS80M-400-E, VS80M-400-ER, VS80M-402-E, VS80M-402-ER	○	—	—	—	○	—

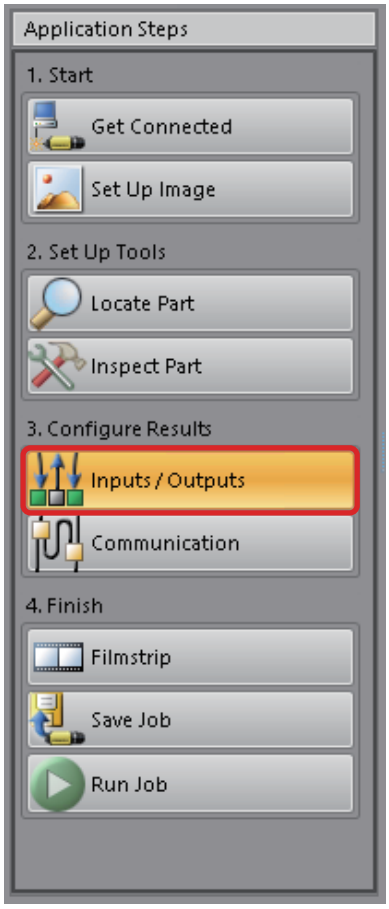
❶ Automatic detection of connected device
❷ Verification of connected devices and configurations
❸ Reflection of the communication setting
❹ Sensor parameter read/write
❺ Sensor/device monitor
❻ Data backup/restoration

A

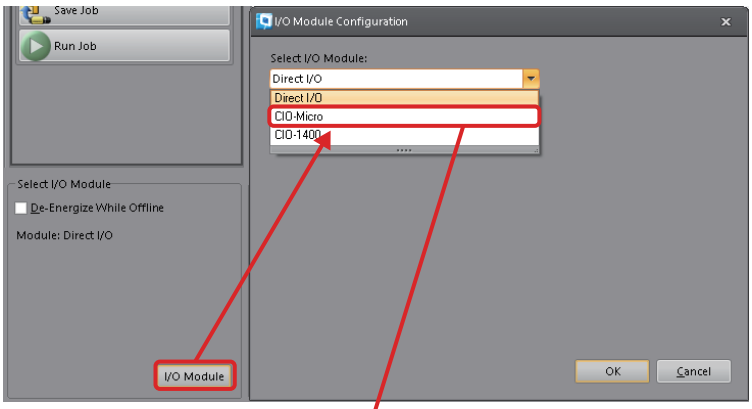
Appendix 2 Input/Output

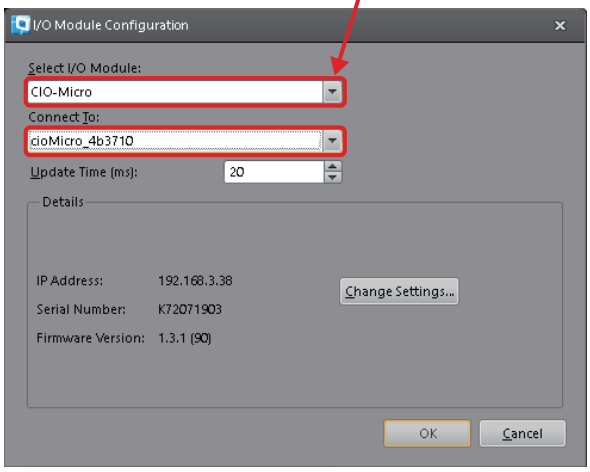
This setting is used when inputting signals to control the camera or outputting a PASS/FAIL or execution completion signal for a job.
When the I/O function is used, refer to the following because the hardware configuration differs depending on the model.
EasyBuilder Help Input/Outputs

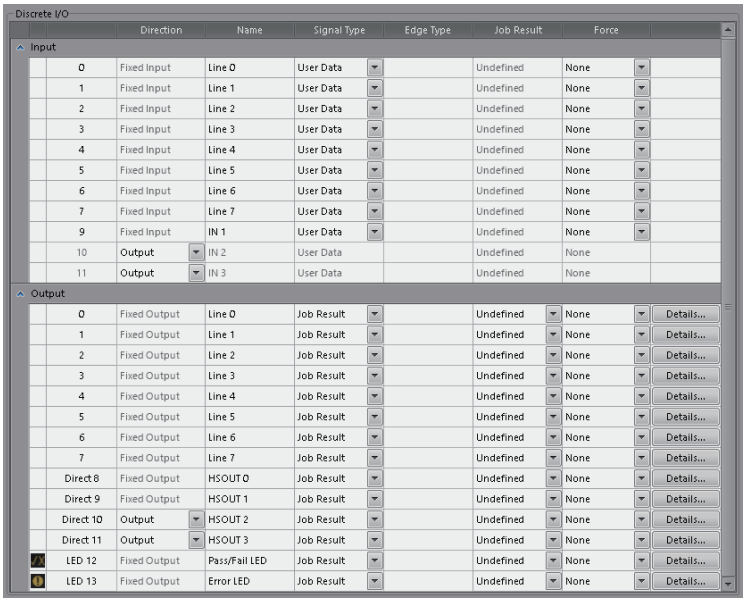
Operating procedure



1. Click the [Inputs/Outputs] button in "Application Steps" to open the "Discrete I/O" setting window.







2. When connecting an I/O module, connect the module and the vision sensor, and select the I/O module with the I/O module powered on.

3. When the I/O module is connected, the "Discrete I/O" setting window is displayed. The items to be set differ depending on the signal type.

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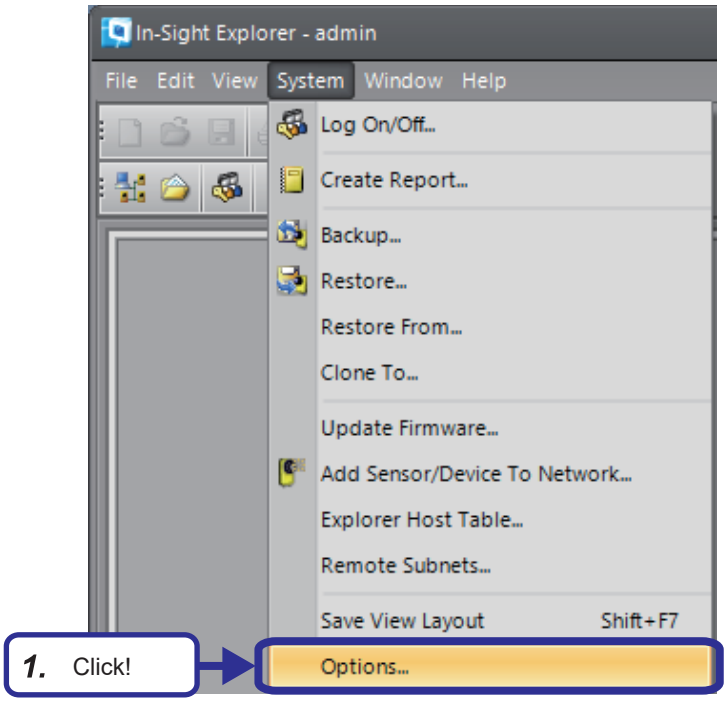
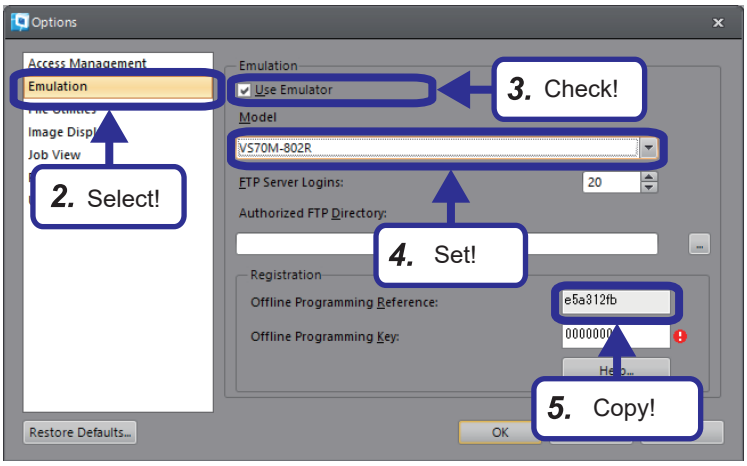
Appendix 3 Setting and Connection of Emulator Function

Locating and inspection can be performed using only the emulator function without using a vision sensor. Set for using the emulator function and perform key registration for offline programming.

Operating procedure



1. From the In-Sight Explorer menu, select [System] ⇨ [Options].

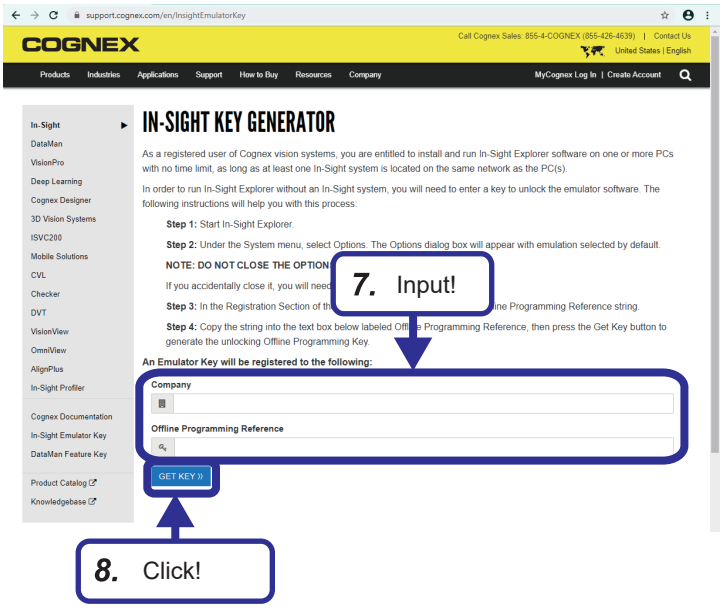


2. In the "Options" window, select [Emulation].

3. Check that "Use Emulator" is selected.

4. Set "Model" to "VS70M-802R".

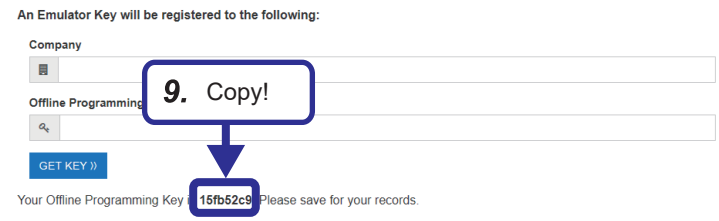
5. Copy "Offline Programming Reference".



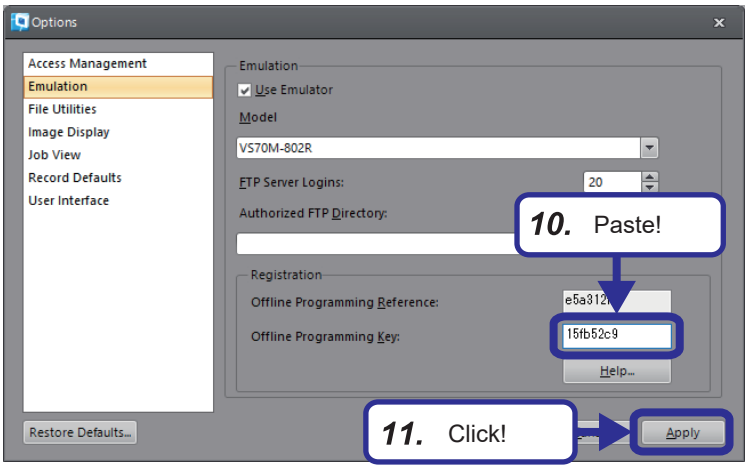
6. Access the following site from an Internet browser.
"support.cognex.com/en/InsightEmulatorKey"

7. The "IN-SIHGT KEY GENERATOR" page opens. Enter the company name in "Company" under "An Emulator Key will be registered to the following:", and paste the number copied in the procedure ***5.*** into "Offline Programming Reference".

8. Click the [GET KEY] button.



9. Copy the offline programming key that is displayed.



10. Paste the number copied in the procedure ***9.*** into "Offline Programming Key:".

11. Click the [Apply] button.

12. In-Sight Explorer restarts.

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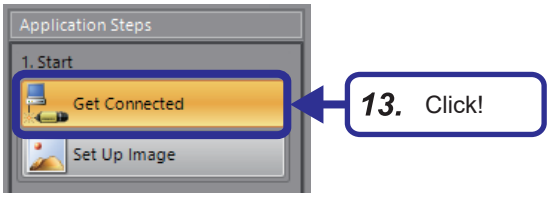
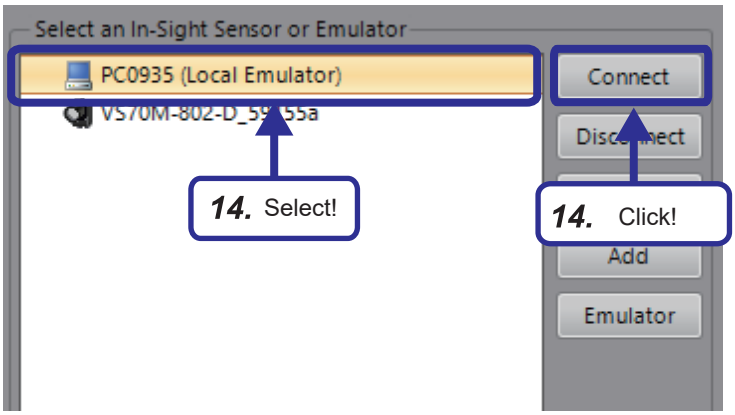
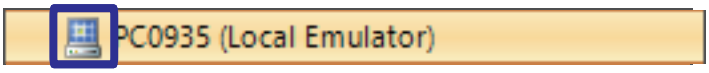


13. From "Application Steps", click the [Get Connected] button.



14. Select an emulator and click the [Connect] button.



15. The image of In-Sight Explorer is displayed in the monitor part of the personal computer icon.

Precautions

If In-Sight Explorer is started before the offline programming key has been entered, Error 6001 or Error 6047 may be displayed.

The acquisition of offline programming keys is possible only with a personal computer that can connect to the Internet.

When executing a job on the emulator, the execution time of the job displayed in In-Sight Explorer is different from the execution time of the job on the actual device.

Mitsubishi Programmable Controllers Training Manual
Vision Sensor Basic Course

MODEL	SCHOOL-R-VS-E
MODEL CODE	13JW59
SH(NA)-082348ENG-A(2008)MEE	

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