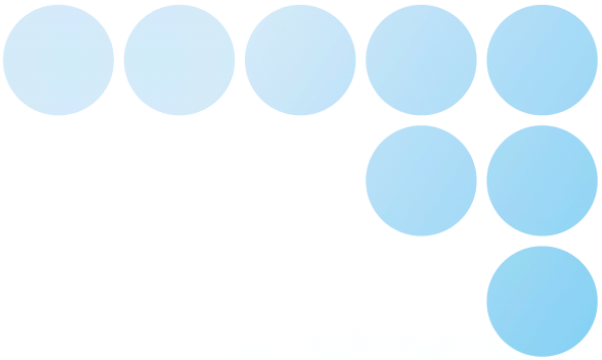
OMRON

Vision Sensor

FH/FHV Series



Robot Vision Application Construction Guide

OMRON Corporation Edition

Man. No. Z403-E1-03

TABLE OF CONTENTS

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Introduction

Thank you for purchasing the FH/FHV.

This manual provides information regarding functions, performance, and operating methods that are required for using the FH/FHV Series product. When using the FH/FHV Series product, be sure to observe the following:

- The FH/FHV Series product must be operated by personnel knowledgeable in electrical engineering.
- To ensure correct use, please read this manual thoroughly to deepen your understanding of the product.
- Please keep this manual in a safe place so that it can be referred to whenever necessary.

This Manual does not contain safety information and other details that are required for actual use of a FH/FHV Series Controller. Thoroughly read and understand the manuals for all of the devices that are used in this Manual to ensure that the system is used safely. Review the entire contents of these materials, including all safety precautions, precautions for safe use, and precautions for correct use.

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c) there shall be filed by or against Licensee application for bankruptcy, dissolution, liquidation, compositions or company reorganization

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End

Regulations and Standards

The FH/FHV Vision Sensor Controllers do not conform to laws and regulations relating to the safety of industrial robot application.

When you use the FH/FHV Vision Sensor Controllers in robot systems that use industrial robots, be sure to verify the conformance to laws and regulations relating to the safety of industrial robot application. Take measures to ensure safety as required.

Safety Precautions

●Symbols and the meanings for safety precautions described in this manual.

In order for the product to be used safely, the following indications are used in this book to draw your attention to the cautions. The cautions with the indications describe the important contents for safety.

⚠WARNING	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.

⚠CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.

●Meaning of Alert Symbols.

The following alert symbols are used in this manual.

	General Prohibition Indicates general prohibitions, including warnings, for which there is no specific symbol.
	General Caution Indicates general cautions, including warnings, for which there is no specific symbol.
	Electrical Hazard Indicates the possible danger of electric shock under specific conditions.
	Explosion Hazard Indicates the possible danger of explosion under specific conditions.
	Laser Radiation Hazard Indicates the possible danger of laser radiation or light.
	High Temperature Caution Indicates the possible danger of injury by high temperature under specific conditions.
	The filled circle symbol indicates operations that you must do. The specific operation is shown in the circle and explained in the text. This example shows a general precaution for something that you must do.

Precautions for Correct Use

Precautions on what to do and what not to do to ensure proper operation and performance.

Additional Information

Additional information to read as required.
This information is provided to increase understanding or make operation easier.

●Alert statements in this Manual

The following alert statements apply to the products in this manual. Each alert statement also appears at the locations needed in this manual to attract your attention.

⚠WARNING	
This product must be used according to this manual or Instruction sheet. Failure to observe this may result in impairment of functions and performance of the product.	
This product is not designed or rated for ensuring safety of persons. Do not use it for such purposes.	
Never connect the AC power supply with this product. When the AC power supply is connected, it causes the electric shock and a fire.	
A lithium battery is built into the Controller and may occasionally combust, explode, or burn if not treated properly. Dispose of the Controller as industrial waste, and never disassemble, apply pressure that would deform, heat to 100°C or higher, or incinerate the Controller.	
Since camera that can be connected with this product emits a visible light that may have an adverse effect on the eyes, do not stare directly into the light emitted from the LED. If a specular object is used, take care not to allow reflected light enter your eyes.	
Do not touch the terminals while the power supply is ON. Doing so may result in electrical shock.	

Please take external safety measures so that the system as a whole should be on the safe side even if a failure of a Sensor Controller or an error due to an external factor occurred. An abnormal operation may result in serious accident.	
Please take fail-safe measures on your side in preparation for an abnormal signal due to signal conductor disconnection and/or momentary power interruption. An abnormal operation may result in a serious accident.	

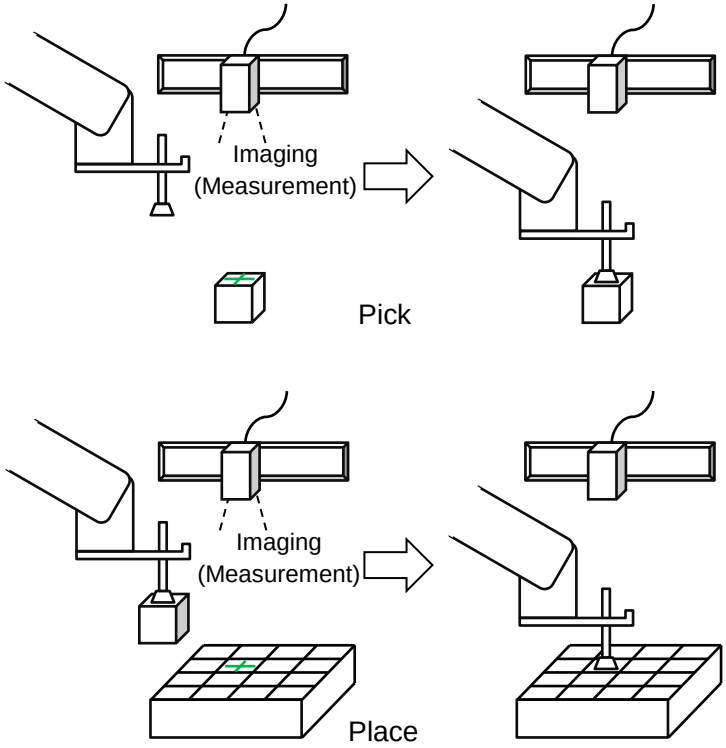
⚠CAUTION	
Danger of burns. Do not touch the case while the LED is ON or just after power is turned OFF, since it remains extremely hot.	

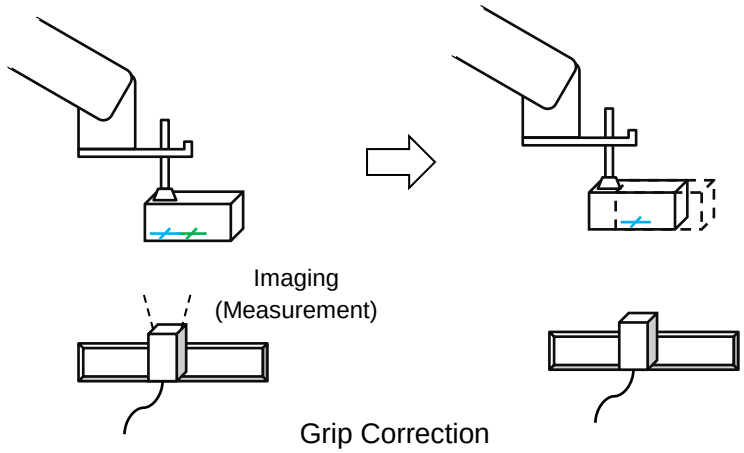
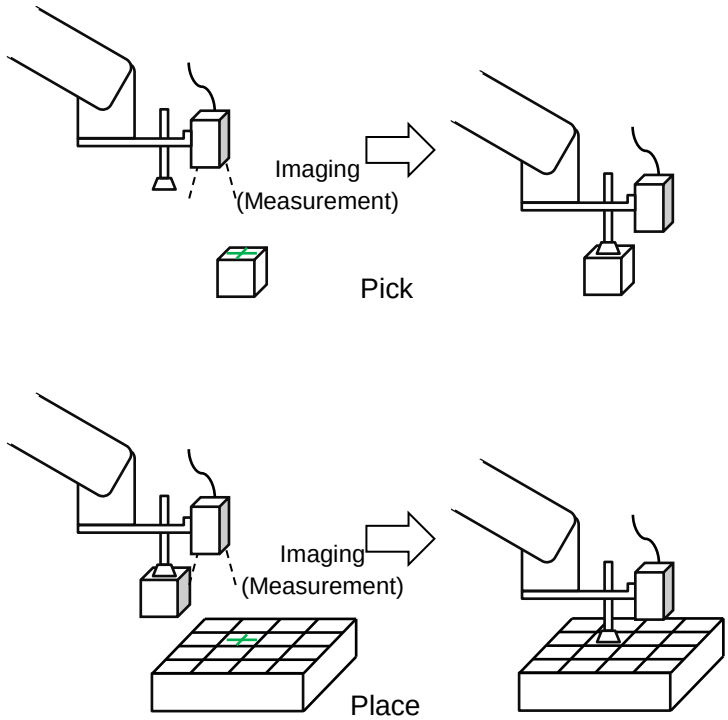
1. Overview

1.1. Overview

This document describes procedures for connections and settings required for constructing robot vision applications by connecting your robot controller to the Vision Sensor FH/FHV (hereafter referred to as Vision Sensor).
Utilizing this document at startup can reduce man-hours to connect the Vision Sensor to your robot controller, set the Vision Sensor, and create robot programs.

Robot Vision applications described in this document are as follows.

Application	Description
Pick/Place with a fixed camera	In a robot vision system with a fixed camera mounted, the robot can pick and place a workpiece. The Vision Sensor measures the target workpiece for Pick/Place and outputs a robot position for Pick/Place to the robot controller. 
Grip Correction with a fixed camera	In a robot vision system with a fixed camera mounted, a position deviation from the reference position of a picked workpiece can be corrected. The Vision Sensor measures the workpiece, calculates

	an amount of the position deviation from the reference position, and outputs a robot position compensated from the reference position for the workpiece position to the robot controller.  When combining the Grip Correction and Place, the Vision Sensor outputs a placing position considering positioning deviation to the robot controller.
Pick/Place with an on-hand camera	In a robot vision system with a camera mounted on the robot hand, the robot can pick and place a workpiece. 

1.2. Target Readers

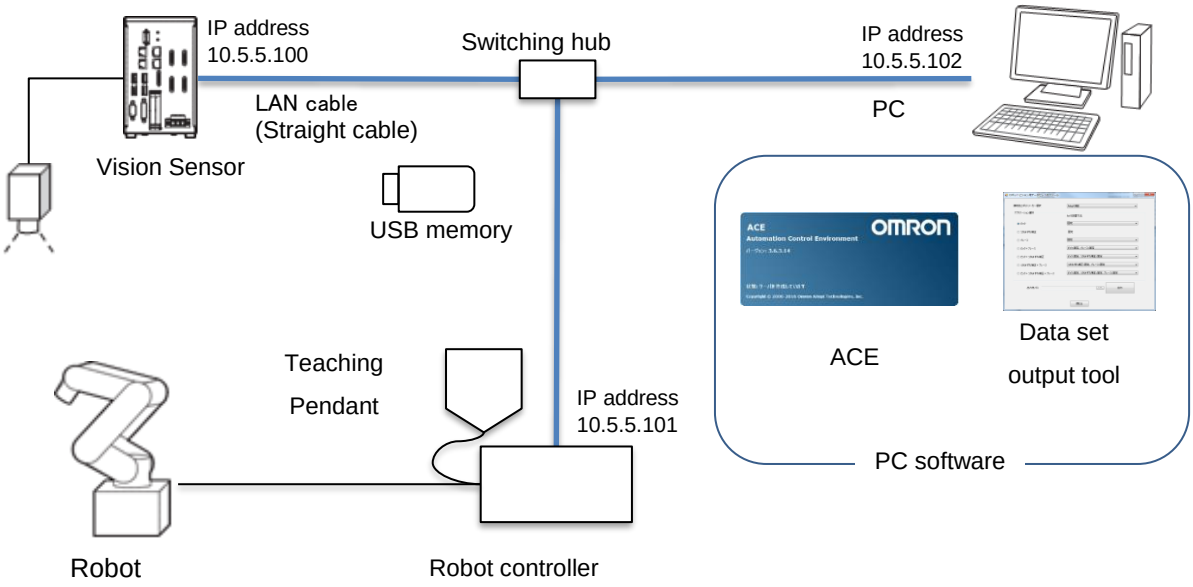
Target readers for this document are who are responsible for connecting the Vision Sensor and the robot controller, executing calibration between a camera and a robot using the robot control by the Vision Sensor, and construct robot vision applications. Additionally, the readers need to have understood the use and implementation methodology for robot programs of the targeted robot controller.

2. System Configuration

This chapter describes the system configuration and target devices to construct robot vision applications.

2.1. When using Vision Sensor FH Series

2.1.1. System Configuration



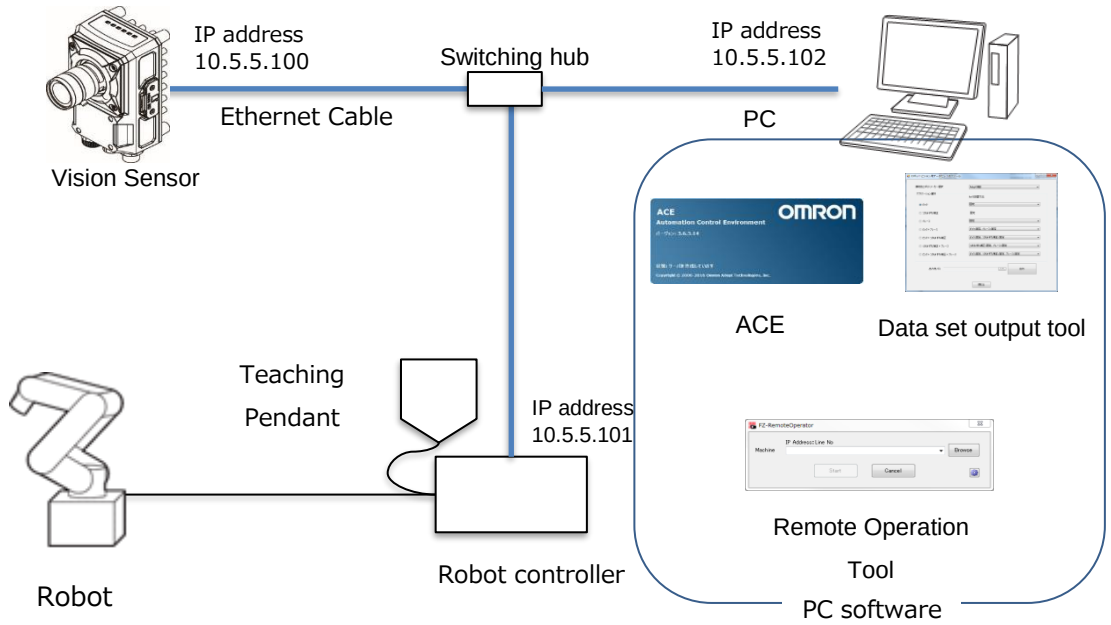
2.1.2. Target Devices

Device name	Manufacturer	Name	Model	Remarks
Vision Sensor	OMRON	Vision Sensor FH Series	FH-□050-□□	Ver. 6.21 or later
Robot controller	OMRON	Robot controller SmartController EX	19300-000	
Robot	OMRON	Vertical multi-joint robot Viper 650	1720□-36000 1720□-36020 1720□-36010	
		Viper 850	1720□-38000 1720□-38020 1720□-38010	
Teaching pendant	OMRON	Teaching pendant T20	10046-010	

PC software	OMRON	Data set output tool for Robot vision	–	Please contact us for how to obtain it.
	OMRON	Software Automation Control Environment (ACE)	–	Ver. 3.7 or later
Switching hub	OMRON	Industrial switching hub	W4S1-□□□	Recommended product
USB memory	OMRON	USB memory	FZ-MEM2G FZ-MEM8G	Recommended product

2.2. When using Vision Sensor FHV Series

2.2.1. System Configuration



2.2.2. Target Devices

Device name	Manufacturer	Name	Model	Remarks
Vision Sensor	OMRON	Vision Sensor FHV Series	FHV7□-M□□□-C FHV7□-C□□□-C	Ver. 6.21 or later
Ethernet Cable	OMRON	Ethernet Cable	FHV-VNB □M FHV-VNLB □M	
Robot controller	OMRON	Robot controller SmartController EX	19300-000	

Robot	OMRON	Vertical multi-joint robot Viper 650	1720□-36000 1720□-36020 1720□-36010	
		Viper 850	1720□-38000 1720□-38020 1720□-38010	
Teaching pendant	OMRON	Teaching pendant T20	10046-010	
PC software	OMRON	Data set output tool for Robot vision	–	Please contact us for how to obtain it.
	OMRON	Software Automation Control Environment (ACE)	–	Ver. 3.7 or later
Switching hub	OMRON	Industrial switching hub	W4S1-□□□	Recommended product
USB memory	OMRON	USB memory	FZ-MEM2G FZ-MEM8G	Recommended product

Precautions for Correct Use

Do not use any device except mentioned above for each device of the system configuration.

Additional Information

This document does not provide operations, installation, and wiring methods for each device.
For details, refer to manuals noted in Chapter 8 Reference Information.

3. Startup Procedures

This chapter describes the work flow, preconditions, and what can be achieved by Startup Procedures in each chapter.

3.1. Work Flow

Please follow the flow below for constructing robot vision applications

4 Creating data set for the robot vision

▼

5 Connecting the Vision Sensor and the robot Controller

▼

6 Setting the Vision Sensor

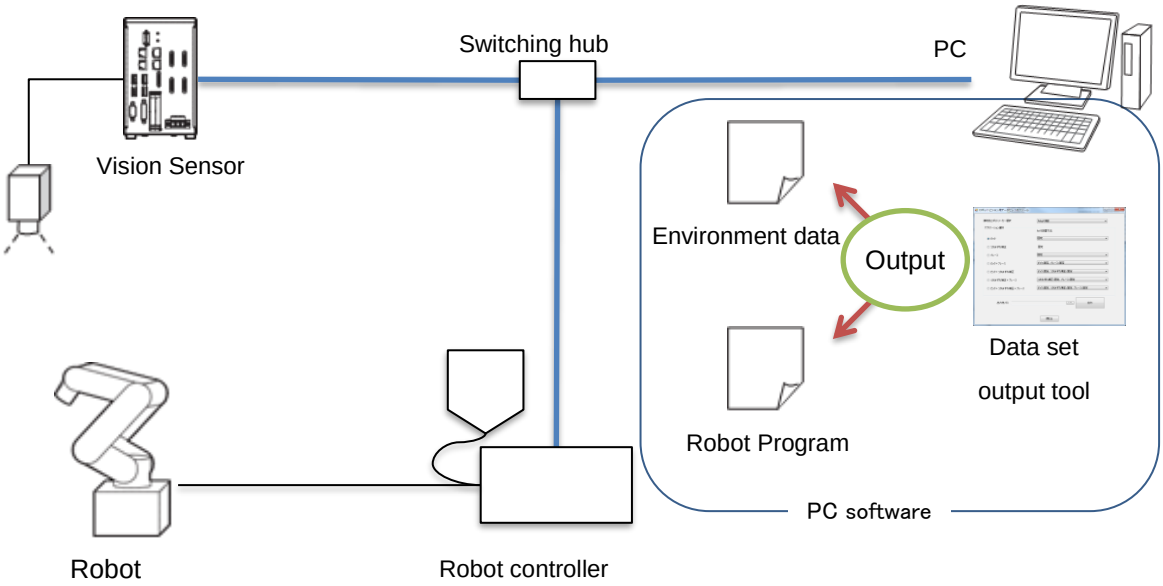
▼

7 Designing robot programs

3.2. What You Can Obtain by This Startup Procedure

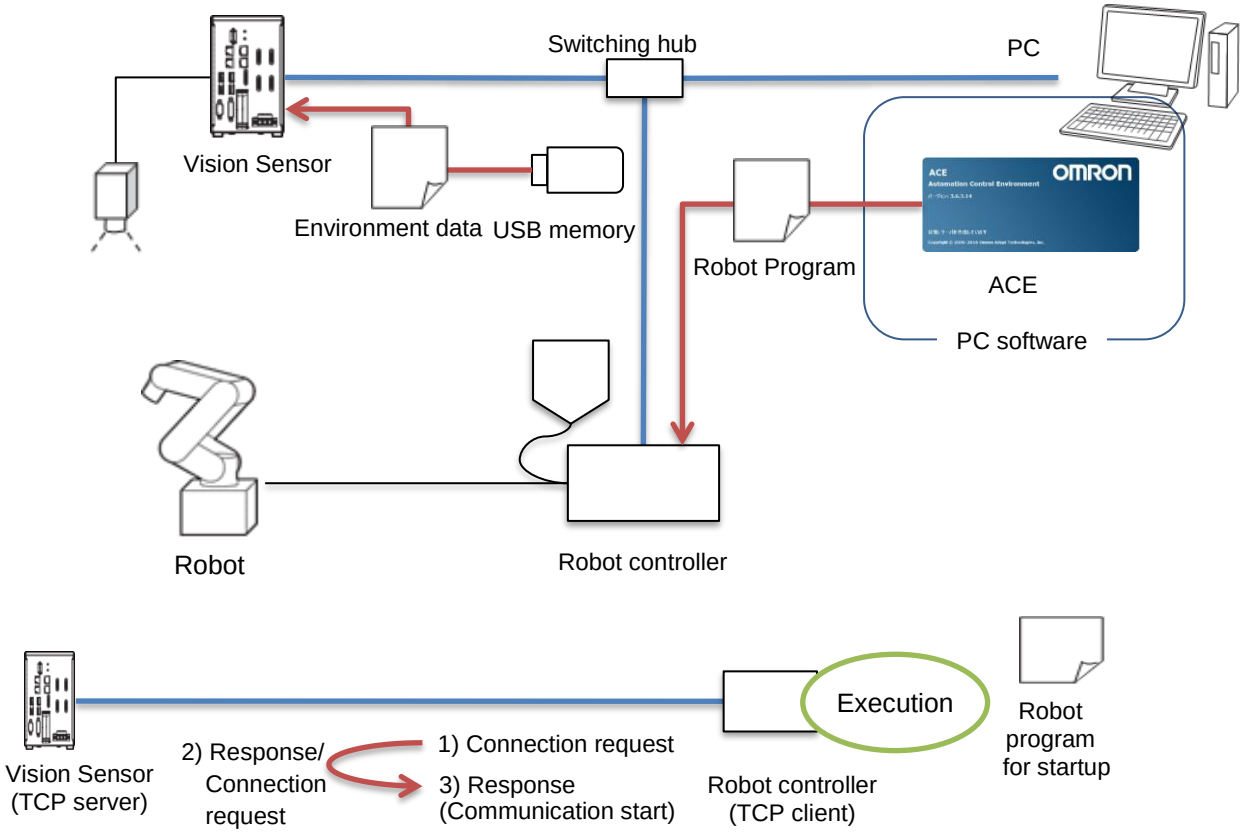
3.2.1. Creating Data for the Robot Vision

When following the procedures in Chapter 4, you can create robot programs (sample programs) for the robot controller and data (environment data) for the Vision Sensor corresponding to the type of robot vision applications and camera mounting method.



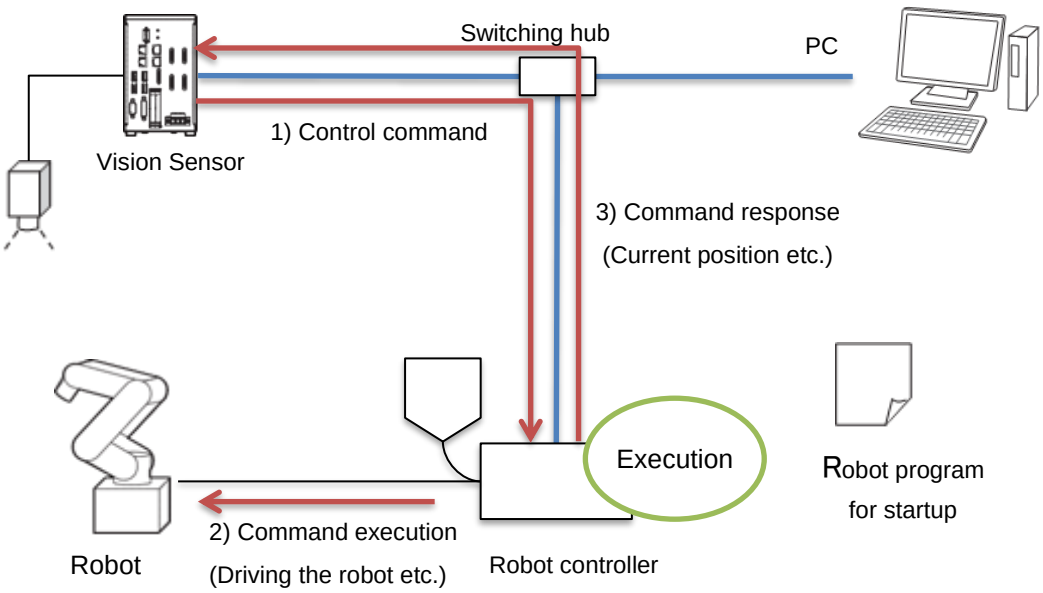
3.2.2. Connecting Vision Sensor and Robot Controller

When following the procedures in Chapter 5, you can complete necessary settings for communications by loading environment data to the Vision Sensor and robot programs to the robot controller. Additionally, executing a robot program for startup establishes TCP/IP connection between the Vision Sensor as a server and the robot controller as a client.



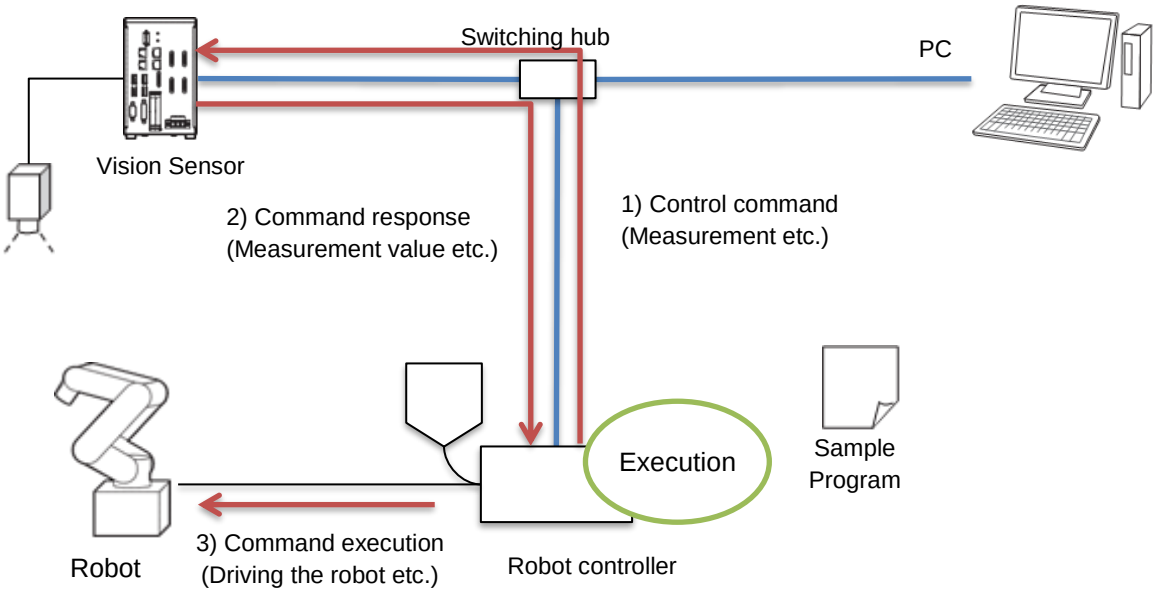
3.2.3. Setting Vision Sensor

When following the procedures in Chapter 6, you can complete settings for the Vision Sensor required for application construction, calibration between camera and robot, and controlling the robot such as driving robot by the Vision Sensor's operation. Additionally, you can check the setting results of the Vision Sensor by actually moving the robot.



3.2.4. Designing Robot Programs

Described in the following figure, when following the procedures in Chapter 7, you can understand an implementation methodology for robot programs to control the Vision Sensor such as switching scenes or executing measurements by running robot programs in the robot controller described in the following figure.



Precautions for Correct Use

The implementation procedures for robot programs noted in Chapter 7 are a reference. You should design, implement, and test actual operated robot programs based on the used environment and robot applications.

3.3. Preconditions

The following conditions shall be satisfied.

The installation, wiring, and operation verification for each device have been finished.

The robot controller is in auto mode and the high-power is turned on.

Additional Information

This document does not provide operations, installation, and wiring methods for each device.

For details, refer to manuals noted in Chapter 8 Reference Information.

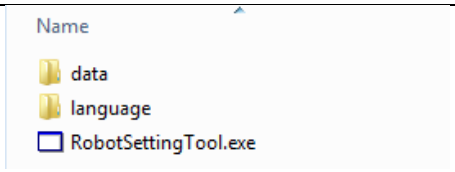
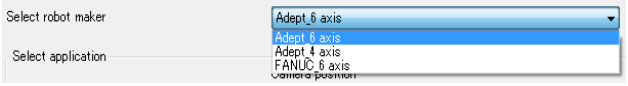
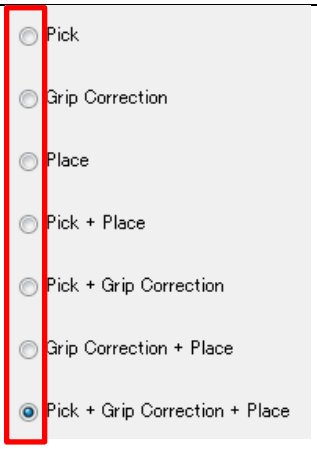
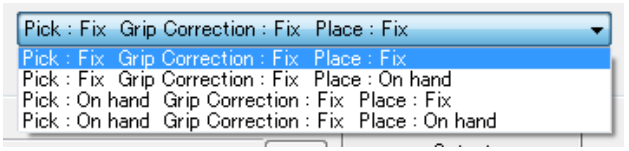
4. Creating Data Set for Robot Vision

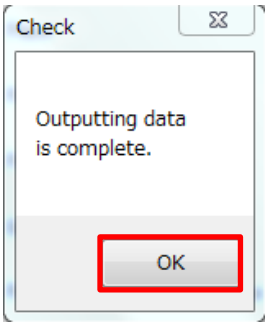
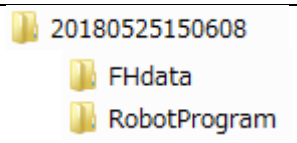
This chapter describes procedures to create robot programs (sample program) for the robot controller and data (environment data) for the Vision Sensor to construct robot vision applications.
Please follow the flow below for the settings.

4.1	Creating data set	Select the robot manufacturer to connect, application type to construct, and camera mounting method to output a data set for the robot vision.

4.1. Creating Data Set

Follow the procedures below to create a data set for the robot vision.

1	Launch the output tool for the data set for the robot vision.	
2	Select a robot manufacturer to connect from the combo box.	
3	Select an application to construct by clicking the radio button at the left of the application name. Select a camera mounting method from the combo box at the right.	 

4	Click [Output] after selecting the output path for the data set. Click [OK] when the “Check” dialog is displayed after the data set was output.	 
5	Check that a folder was created with a name of “year, month, day, hour, minute, and second” in the specified output path and there are “FHdata” and “RobotProgram” in it.	

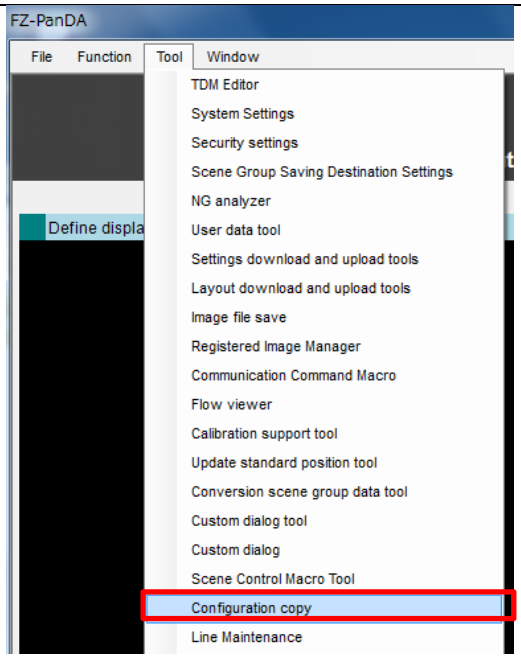
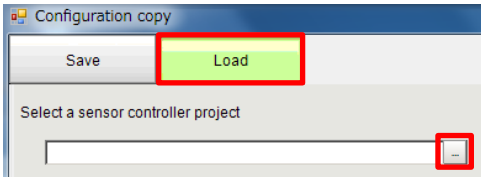
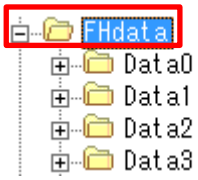
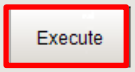
5. Connecting Vision Sensor to Robot Controller

This chapter describes procedures to connect the Vision Sensor to the robot controller. Please follow the flow below for the settings.

5.1	Setting communications for the Vision Sensor	To reflect the communication settings, load the environment data created by the data set output tool for the robot vision, and then restart the Vision Sensor.
▼		
5.2	Setting communications for the robot controller	To modify the communication settings for the robot controller, connect the PC (ACE) and the robot controller. Modify the default IP address of the robot controller with PC (ACE) according to the communication settings in the Vision Sensor.
▼		
5.3	Connecting and checking the Vision Sensor and the robot controller	Check the connection status of Ethernet using PING command. Run a robot program for startup to establish the TCP/IP connection between the Vision Sensor and the robot controller. Check the communication status by sending and receiving commands.

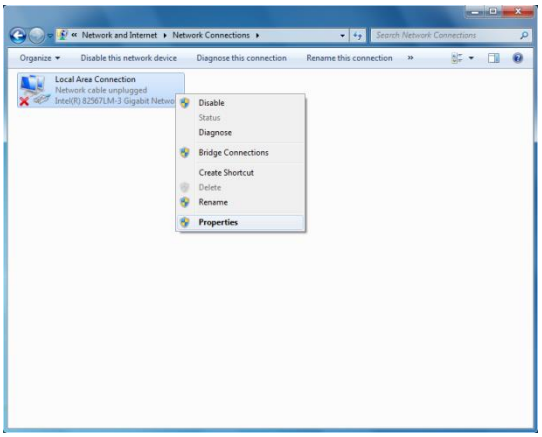
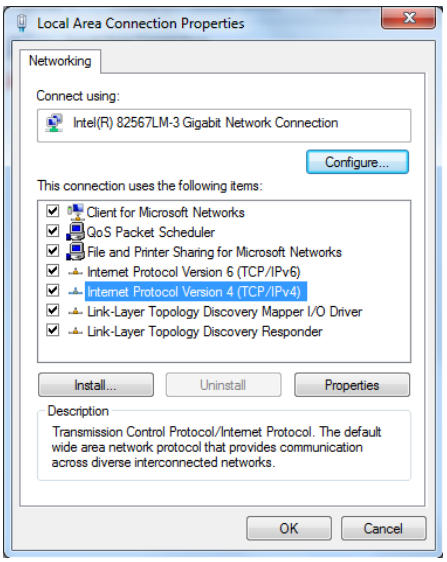
5.1. Setting Communications for Vision Sensor

Please follow the procedures below to set the communications for the Vision Sensor.

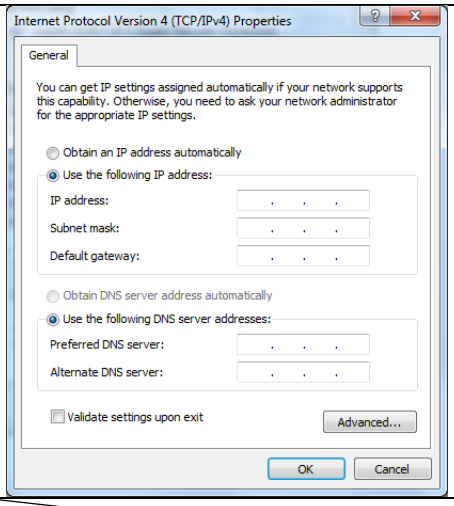
1	Select [Tool] - [Configuration copy] in the menu bar.	
2	Select “Select a sensor controller project” in the [Load] tab. Select the FHdata folder in the folder outputted by using the data set output tool for the robot vision.	 
3	Click [Execute] to restart it.	

5.2. Setting Communications for Robot controller

Please follow the procedures below to set the communications for the robot controller.

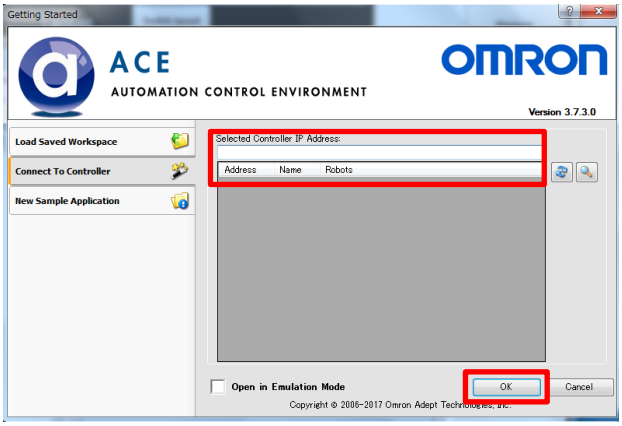
1	Press [MENU] on the teaching pendant to display the right figure (HOME1 window). Select [Next>] - [Next>] - [Maint] - [Info] and then refer to the IP address for the robot controller on the SYSTEM INFORMATION window.	
2	Connect the PC and the robot controller with LAN cables.	
3	With right-click, select [Network and Sharing Center] - [Change adapter settings] from the control panel of the PC and open the property for a network adapter connecting the robot controller. The dialog shown on the right will be displayed, select [Internet protocol version 4 (TCP/IPv4) and open the property.	 

The dialog shown on the right will be displayed, set the IP address and the subnet mask for the PC so that the IP address and network part of the referred robot controller are the same but the host part is different.

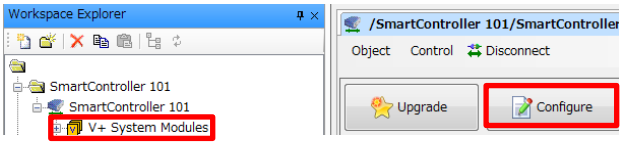


4 Launch ACE.

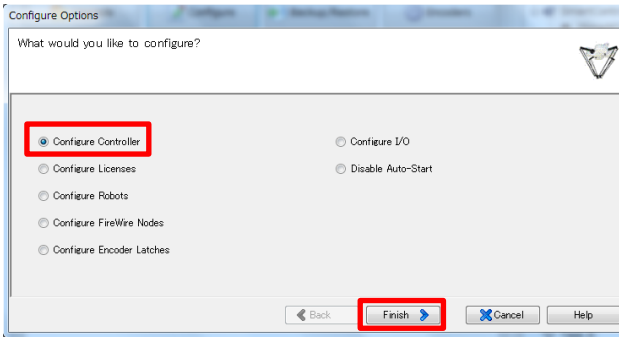
5 Enter the IP address of the robot controller and click [OK].

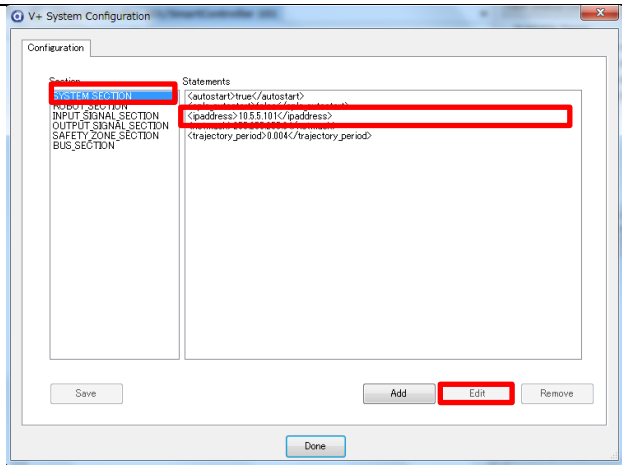
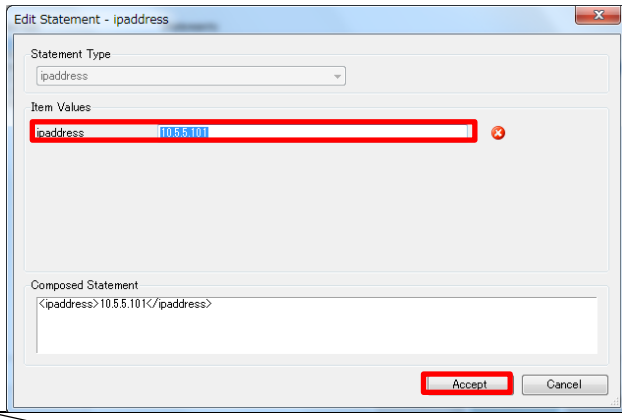
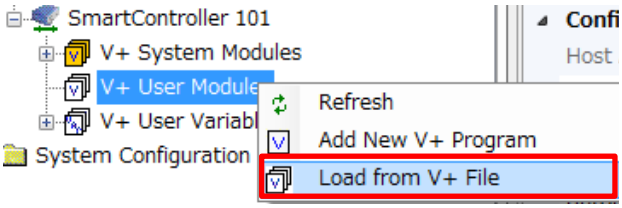
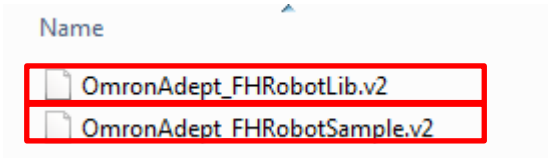


6 Select “SmartController” in the Workspace Explorer and click [Configure].



The right dialog will be displayed, select “Configure Controller” and click [Finish].



	The right dialog will be displayed, select “SYSTEM SECTION” in the “Section” area and “ipaddress” in the “Statements” area and click [Edit].	
	The right dialog will be displayed, change the ipaddress and click [Accept]. Set the IP address not to overlap with other devices.	
7	Change the IP address of the PC again based on the changed one for the robot controller.	
8	Reconnect to the robot controller.	
9	Right-click “V+ User Module” in the Workspace Explorer and select “Load from V+ File”. Select a robot program in the folder outputted by using the data set output tool for the robot vision.	 

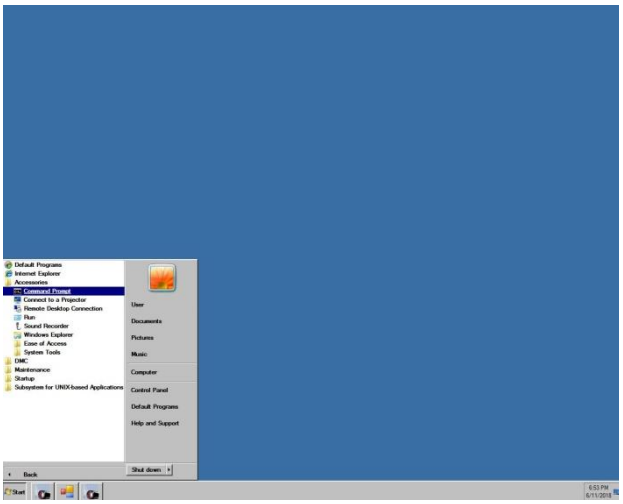
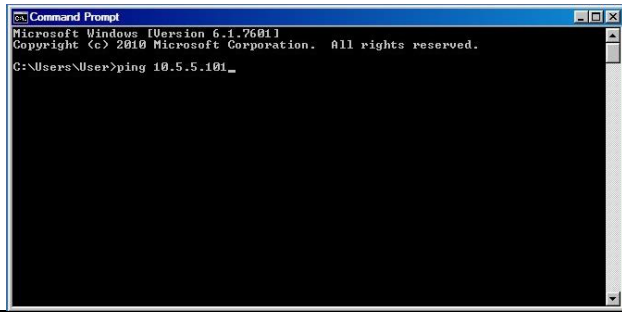
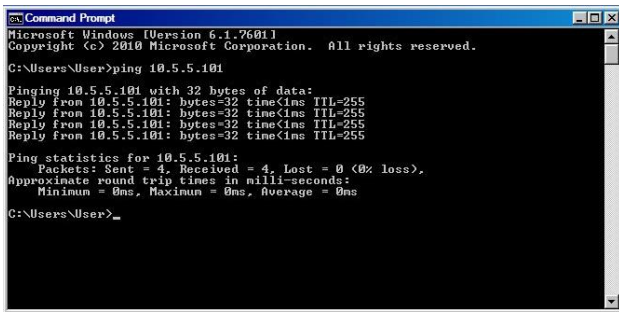
Additional Information

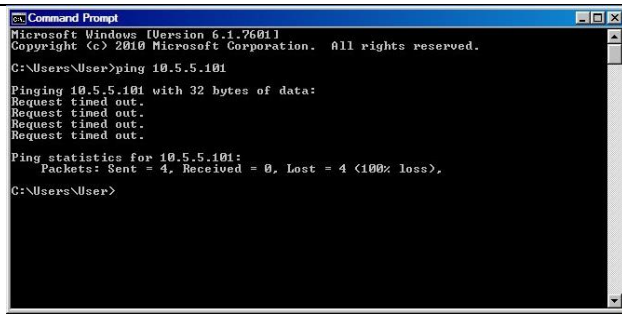
This document does not provide operation, installation, and wiring methods for each device.
For details, refer to manuals noted in Chapter 8 Reference Information.

5.3. Connecting and Checking Vision Sensor and Robot Controller

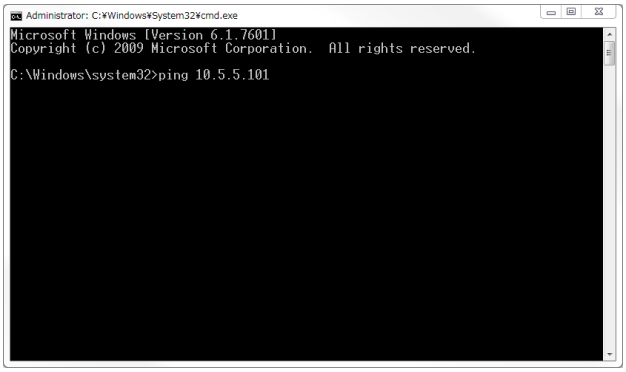
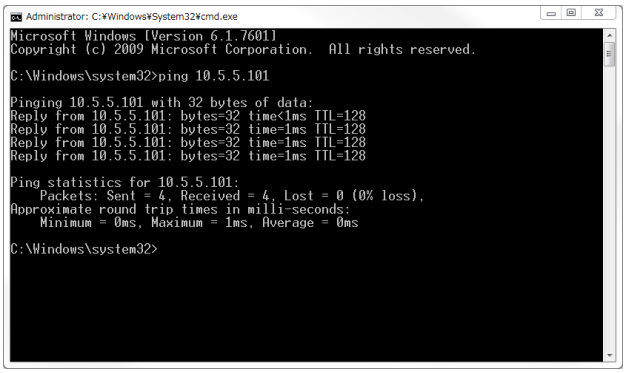
Follow the procedures below to connect the Vision Sensor and the robot controller and to check the connection status.

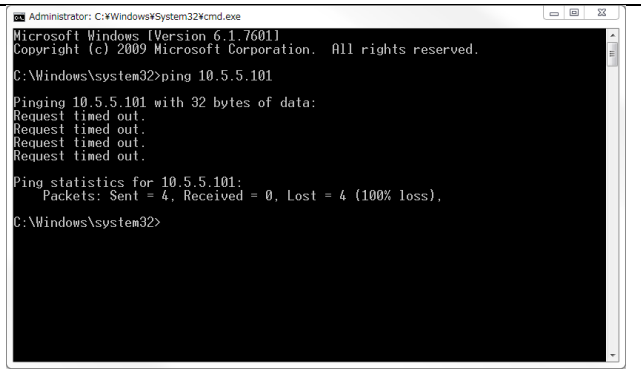
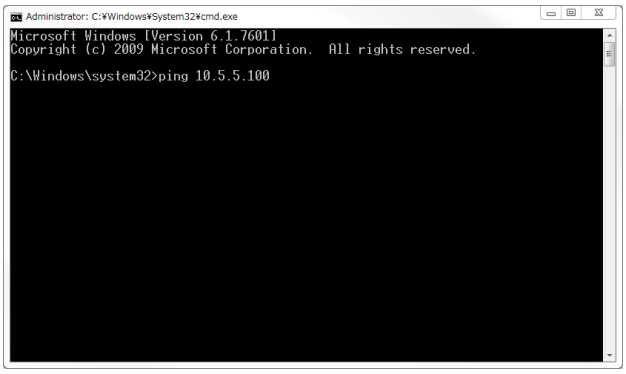
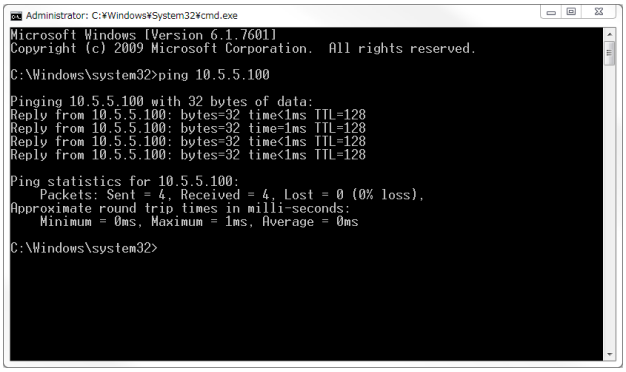
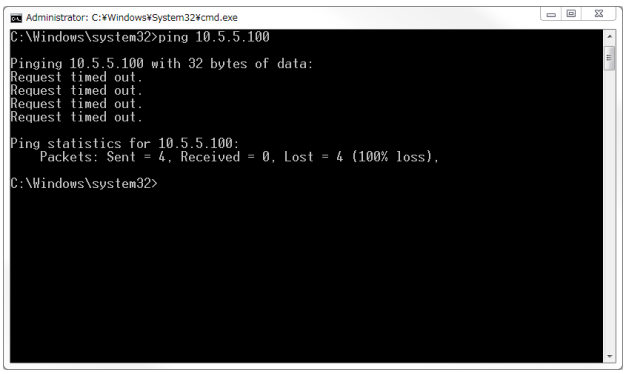
5.3.1. Verifying Ethernet Communication (FH Series Vision Sensor)

1	Connect the Vision Sensor and the robot controller with LAN cables.	
2	(Operation of the Vision Sensor) Move the mouse cursor to lower left of the window to display [Start]. Select [Start] - [All Programs] - [Accessories] - [Command Prompt] to launch [Command Prompt].	
3	(Operation of the Vision Sensor) Execute PING command to the IP address of the robot controller.	
4	(Operation of the Vision Sensor) When 32-byte data could be successfully sent/received four times as shown in the figure on the right, that means that the communications have been established and the wiring and settings of Ethernet is correctly done.	

	When 32-byte data cannot be sent/received four times and PING command timed out, check whether or not the robot controller is turned on, the wiring was correctly done, or communication settings are correct.	

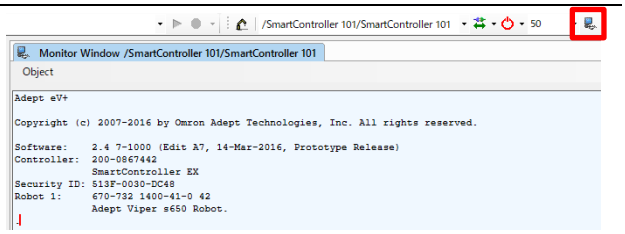
5.3.2. Verifying Ethernet Communication (FHV Series Vision Sensor)

1	Connect the vision sensor, robot controller and PC by LAN cables.	
2	(Operation of the PC) Press the [R] key while pressing and holding the [Windows] key to display the "Run with file name" window. Type "cmd" and press the OK button to launch the [Command Prompt] window.	
3	(Operation of the PC) Execute PING command to the IP address of the robot controller.	
4	(Operation of the PC) When 32-byte data could be successfully transmitted/received four times like the right figure, that means that the communications have been established and the wiring and settings of Ethernet is correctly done.	

	When 32-byte data cannot be transmitted/received four times and PING command timed out, check whether or not the robot controller is turned on, the wiring was correctly done, or communication settings are correct.	
5	(Operation of the PC) Execute PING command to the IP address of the Vision Sensor.	
6	(Operation of the PC) When 32-byte data could be successfully transmitted/received four times like the right figure, that means that the communications have been established and the wiring and settings of Ethernet is correctly done. When 32-byte data cannot be transmitted/received four times and PING command timed out, check whether or not the robot controller is turned on, the wiring was correctly done, or communication settings are correct.	 

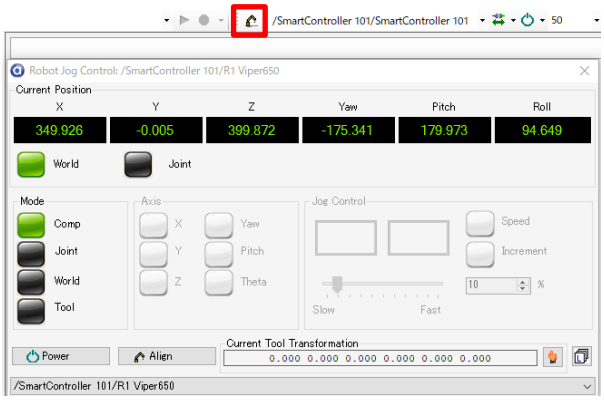
5.3.3. Verify Commands Sent/Received

(Operation of ACE)
Click an icon enclosed in red square on the right figure to display the monitor window.



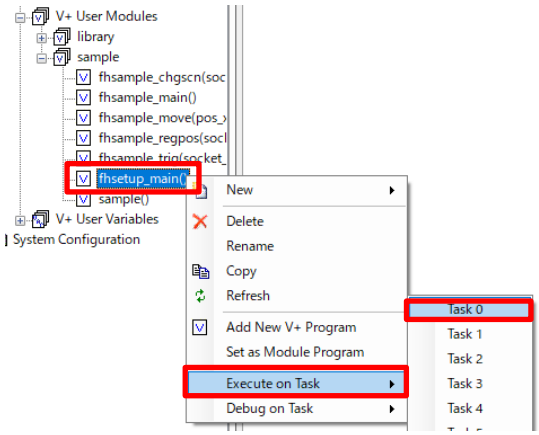
1

Click an icon enclosed in red square on the right figure to display the robot jog operation dialog.



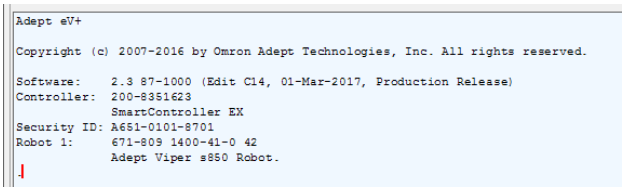
2

(Operation of ACE)
Right-click [V+ User Module] – [sample] – [fhsetup_main()] from the Workspace Explorer and select [Execute on Task] – [Task 0].

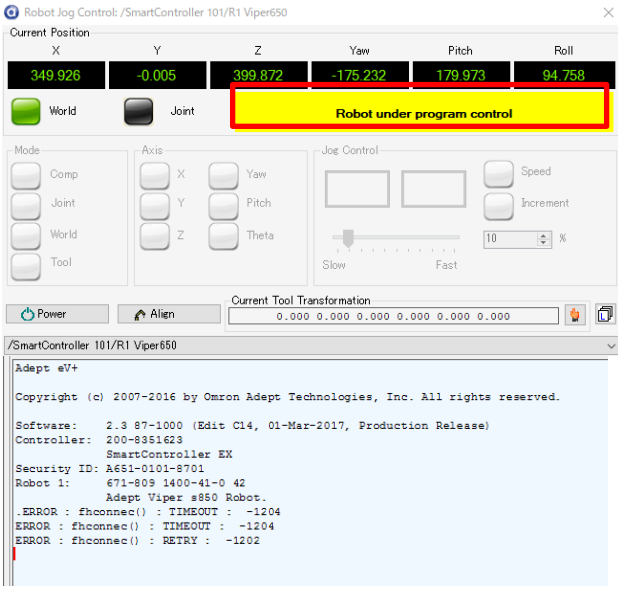


3

(Operation of the Vision Sensor and ACE)
As shown in the figure on the right, when nothing is displayed on the ACE's monitor window but "Robot under program control" is displayed on the robot jog operation dialog, and then the Vision Sensor and the robot controller are successfully connected.



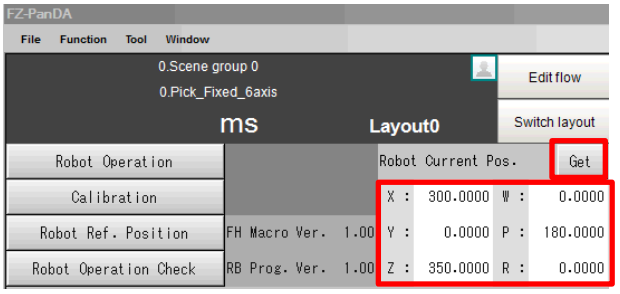
Like shown on the right figure, if an error message is displayed on the ACE's monitor window, the connection has failed. Check the wiring and others.

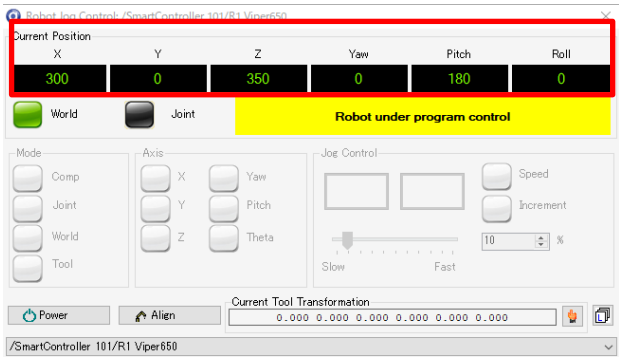


4

(Operation of the Vision Sensor and ACE)

Like shown on the right figure, when [Get] is clicked on the Main Window of the Vision Sensor and the current position of the robot on ACE's monitor window is displayed at the same position on the Main Window of the Vision Sensor, sending/receiving commands between them have been succeeded.





* Correspondence relation of notation

Vision Sensor	ACE
W	yaw
P	pitch
R	roll

Additional Information

This document does not provide operation, installation, and wiring methods for each device.
For details, refer to manuals noted in Chapter 8 Reference Information.

6. Setting Vision Sensor

This chapter describes by each application type, the setting procedures for the Vision Sensor required for constructing robot vision applications.

Application	Where to find
Pick/Place with a fixed camera	Chapter 6.2
Grip Correction with a fixed camera	Chapter 6.3
Pick/Place with an on-hand camera	Chapter 6.4

6.1. Overview

The settings for the Vision Sensor use a special data set for robot vision applications. By loading the environment data according to the procedures in Chapter 5, scene group data and user dialog data are loaded. Thereby, you can start the setting without designing measurement flow from scratch. Additionally, with jog operation and auto-calibration of robot by user dialog, and controlling robot by operation of the Vision Sensor, the design man-hour can be reduced.

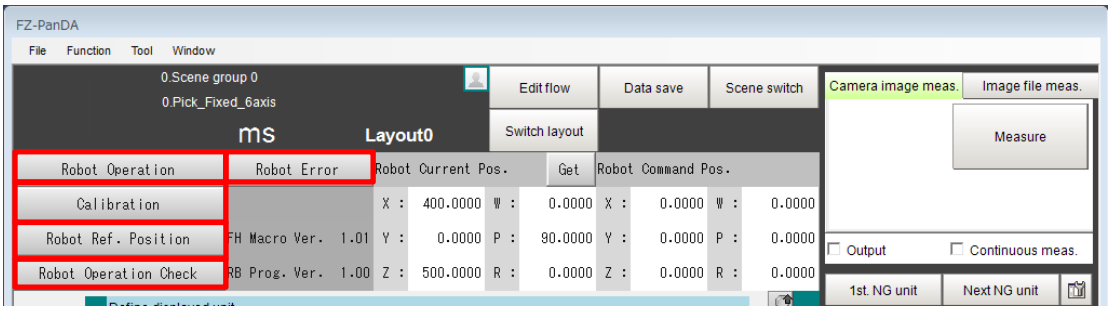
6.1.1. Scene Data Configuration

Scene data is assigned to fixed scene per application. When setting it, switch scenes with reference to the following.

No.	Scene name	Description
0.	Pick	Perform Pick
1.	Grip Correction	Perform Grip Correction
2.	Place	Perform Place
	・ ・ ・	
125.	Calibration and Place	Calibrate a camera to be used in Place
126.	Calibration and Grip Correction	Calibrate a camera to be used in Grip Correction
127.	Calibration and Pick	Calibrate a camera to be used in Pick

6.1.2. User Dialog

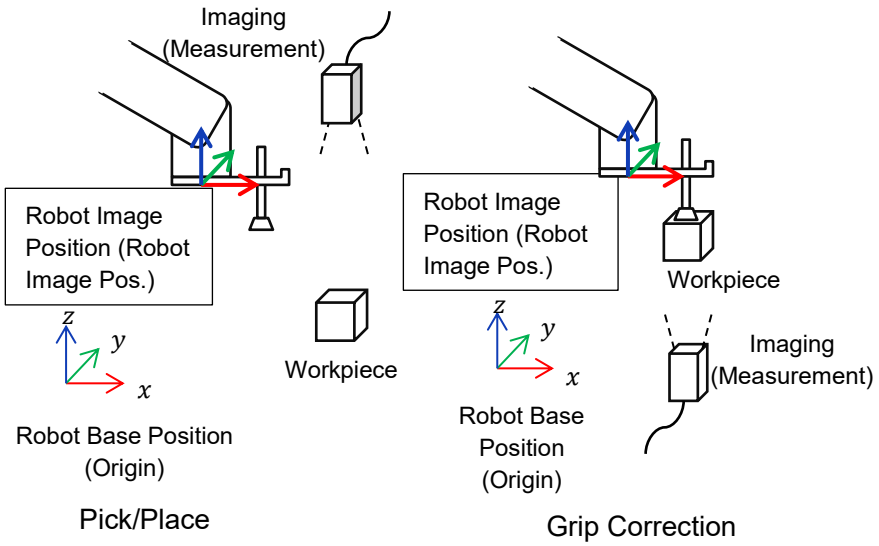
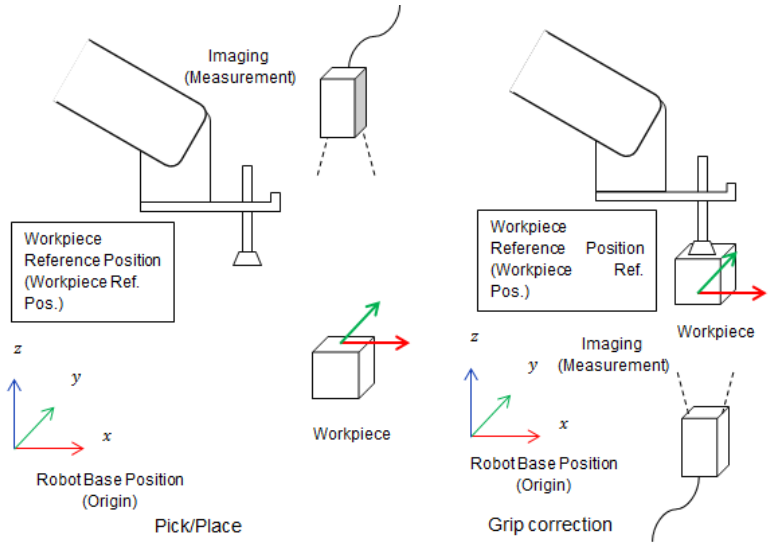
On the Main Window of the Vision Sensor, launch buttons for the user dialog are arranged like below.

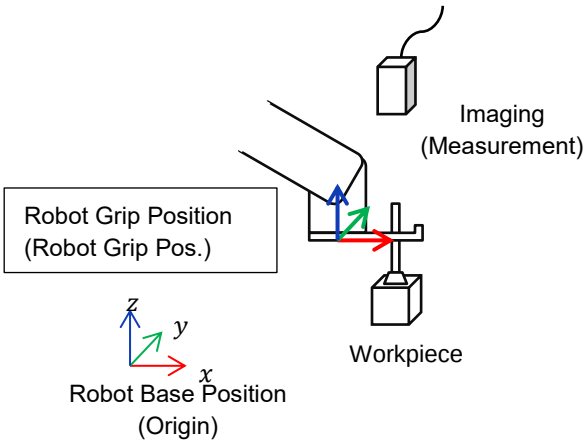
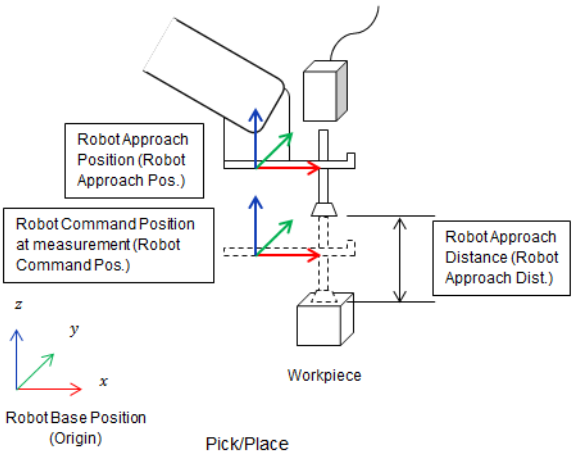


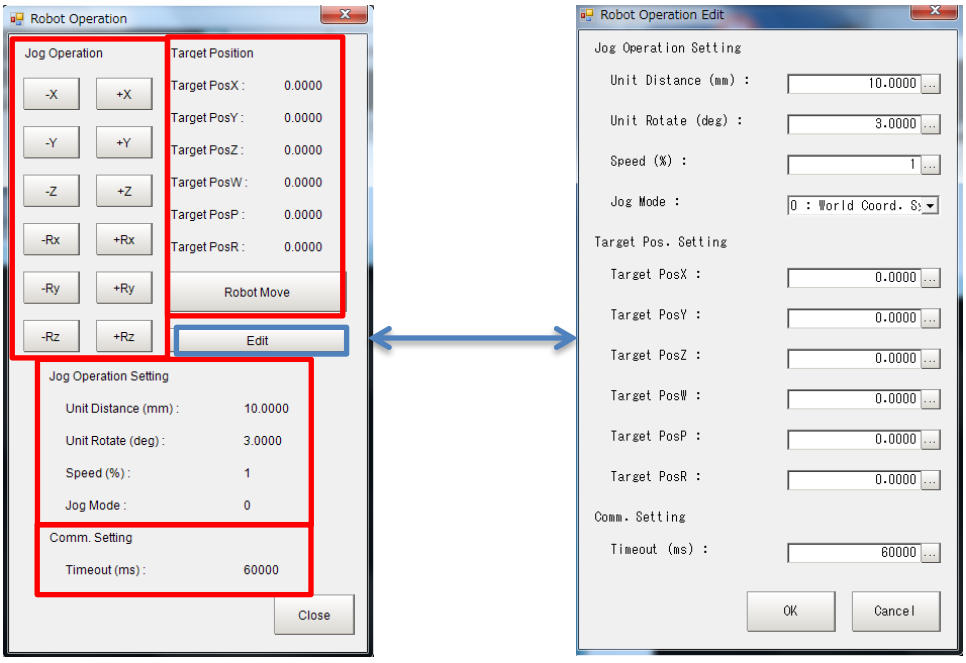
Dialog name	Description
Robot Operation	Sets the jog operation, target position movement, and operation speed and so on.
Calibration	Calibrates a camera and the robot automatically with operations of the Vision Sensor.
Robot Ref. Position	Registers the reference position of a workpiece and the robot needed to correctly operate the robot with robot vision applications.
Robot Operation Check	Checks the setting results of the Vision Sensor by the robot moved actually.
Robot Error	You can check for an error caused by an operation in the above dialog.

Terms used in this dialog are defined as follows.

Term	Description
Robot Reference Position (Robot Ref. Position)	Generic name for the reference position of a workpiece and the robot needed to correctly operate the robot with robot vision applications. This consists of Robot Image Position, Workpiece Reference Position, Robot Grip Position, and Robot Approach Distance. By registering these, the command position to operate the robot at executing measurements is correctly output.

Robot Image Position (Robot Image Pos.)	This is the robot reference position when imaging (measuring) workpieces. 
Workpiece Reference Position (Workpiece Ref. Pos.)	This is the workpiece reference position needed to operate the robot. For Pick and Place, this is the reference position of a workpiece for calculating the relative positional relationship between the workpiece and the robot. For Grip Correction, this is the reference position for calculating an amount of grip deviation. 

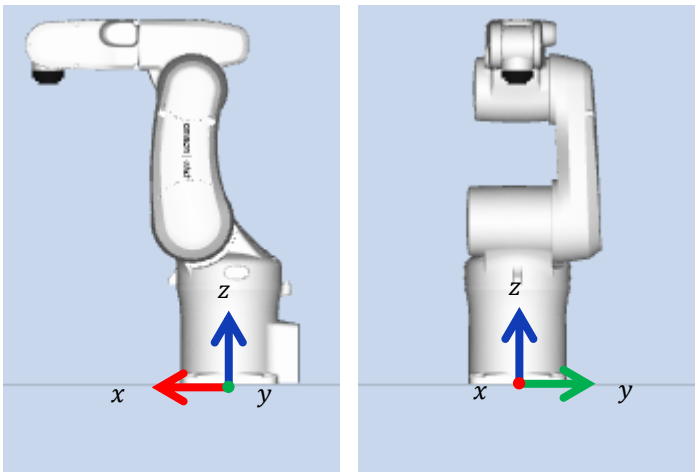
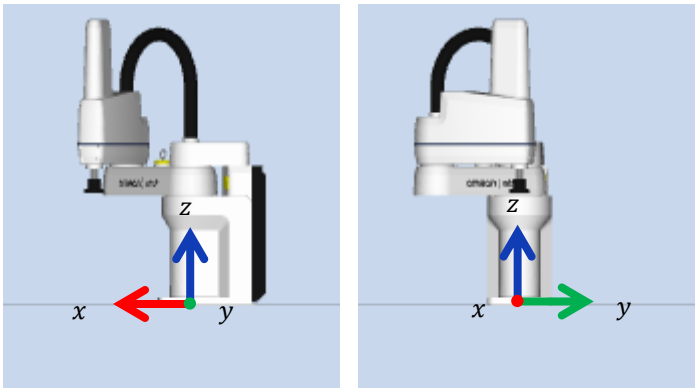
Robot Grip Position (Robot Grip Pos.)	This is the reference position of the robot at picking or placing a workpiece. This is the robot position when the robot gripped the workpiece located in its reference position. In the case of Pick and Place, this is the reference position on the robot side to calculate the relative positional relationship between the workpiece and the robot.  Pick/Place
Robot Approach Distance (Robot Approach Dist.)	In measurement, this is an offset distance from the robot movement position output to robot to a position (robot approach position) offset to Z-axis direction in the world coordinate system. This needs to be set so that the robot hand does not interfere with a workpiece when picking or placing it. 
Robot Command Position at measurement (Robot Command Pos.)	This is a movement position of the robot that is output to it at measurement. This is calculated from workpiece positions measured with the Vision Sensor and each position registered as the robot operation reference position.

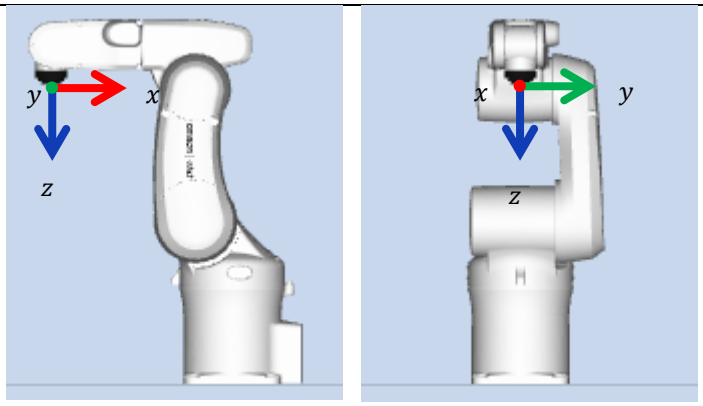
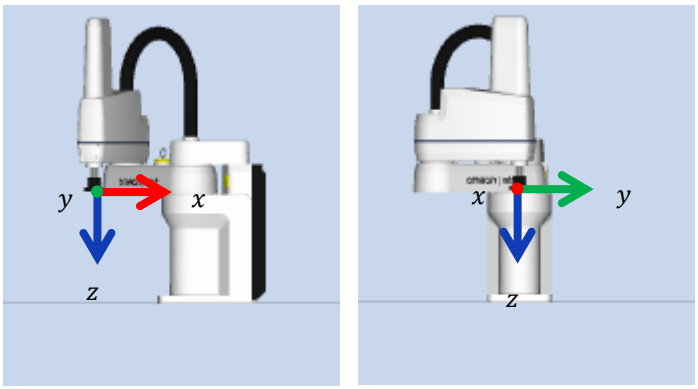


Robot Operation Dialog　　Robot Operation Setting Dialog

In the robot operation dialog, the following items are possible to do using basic functions for operating the robot by operations of the Vision Sensor.

Function	Description
Jog operation	Execute the jog operation of the robot. By clicking [Jog operation], the robot is operated according to the settings in the jog operation setting. * The robot will not operate even if you are holding down the [Jog operation].
Target position movement	The robot performs the jog operation to the position set as a target position. The movement amount with one-click action follows the setting value of the jog operation setting. * The robot will not operate even if you are holding down the [Jog operation].
Jog operation setting	In the jog operation and target position movement, the unit distance, unit rotate, speed, jog mode per one-click action can be set. In the jog mode, “World coordinate system” or “Tool coordinate system” can be selected.

	* For each coordinate system, the orientation of each axis differs depending on the robot manufacturer and axis configuration. For the detailed definition of the coordinate systems, please refer to the manual of your robot. [World coordinate system] The base of the robot is the reference position in this coordinate system. The jog operation with [Rx], [Ry], or [Rz] rotates the robot around X-axis, Y-axis, and Z-axis respectively. In the case of 4-axis robot, [Rx] and [Ry] are not supported.  6-axis robot  4-axis robot [Tool coordinate system] The flange position and posture of the robot is the reference position in this coordinate system. The jog operation with [Rx], [Ry], or [Rz] rotates the robot around X-axis, Y-axis, and Z-axis respectively. In the case of 4-axis robot, [Rx] and [Ry] are not supported.

	 6-axis robot  4-axis robot
Communication settings (Comm. setting)	The timeout for communications between the Vision Sensor and the robot controller can be set.

⚠WARNING

Clicking [Jog operation] or [Robot move] drives the robot.
Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

⚠CAUTION

When the robot moves to Z-axis direction, check its motion by visual observation and not by camera image.

Precautions for Correct Use

Even if the robot controller changes the reference position from the flange of the tool coordinate system, it will not be reflected to the jog operation setting of the Vision Sensor.

These features are only available in a connection status that is established between the Vision Sensor and the robot controller with TCP no-procedure protocol invoked by steps in Chapter 5.3.

External trigger inputs or communications with outside will be disabled when operating the robot.

Operations except for the Main Window of the Vision Sensor such as opening setting screens for processing units is not executed.

If communications was disconnected during operations of the user dialog, operations of the Vision Sensor may be unavailable for the time period (initial value: 60,000 [ms]) set in the communication timeout in the communication setting. Please change the value as necessary.

6.2. Pick/Place with Fixed Camera

In the case of Pick/Place with a fixed camera, first calculate the relative positional relationship between the workpiece position and the actual robot position according to the workpiece reference position and the robot grip position. Second, output to the robot controller the robot command position o or picking or placing he measured workpiece.

Precautions for Correct Use

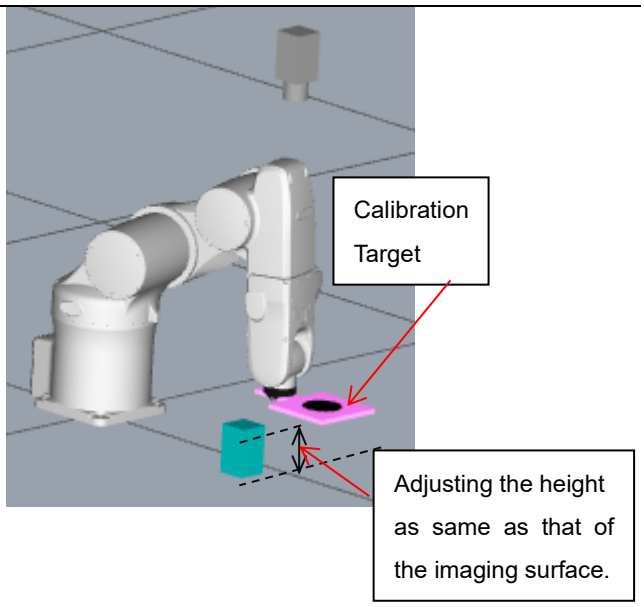
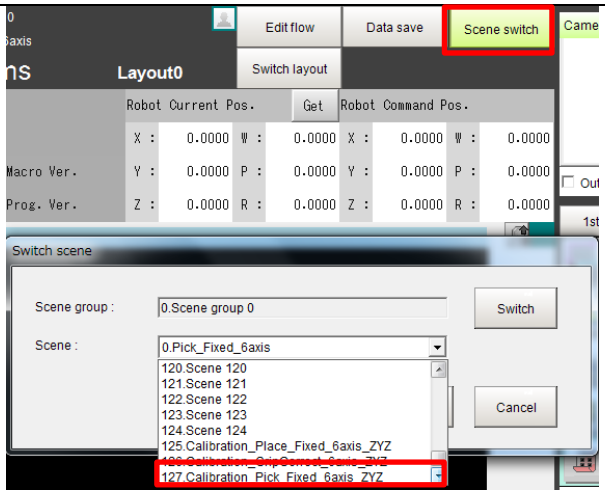
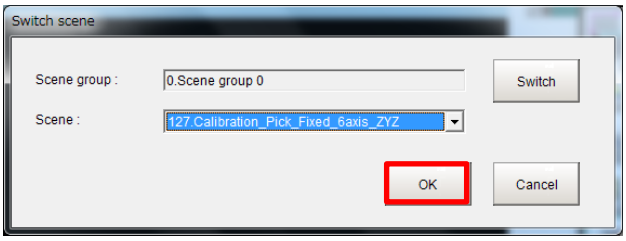
When selecting “Grip Correction + Place” or “Pick + Grip correction + Place” in Chapter 4.1, output a position considering an amount of deviation calculated in Grip Correction at Place.

Please follow the flow below for the settings.

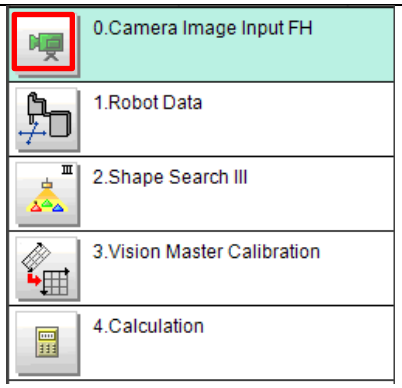
6.2.1	Setting Calibration	Set a scene for the Vision Sensor calibration to execute. Perform settings related to camera, target, and calibration operation.
▼		
6.2.2	Executing and Checking Calibration	Check the results after executing the calibration with operations of the Vision Sensor to handle data in the robot base coordinate system.
▼		
6.2.3	Setting Applications	Set a scene for applications of the Vision Sensor to pick or place a workpiece. Register the reference position of the robot operation and set a camera and workpiece.
▼		
6.2.4	Checking Application Operations	To check the correctness of the settings, check whether or not the robot actually moves to the Pick/Place position with operations of the Vision Sensor.
▼		
6.5	Backing up Settings	Back up the setting results of the Vision Sensor done in this Chapter.

6.2.1. Setting Calibration

Follow the procedures below to set a scene for Calibration.

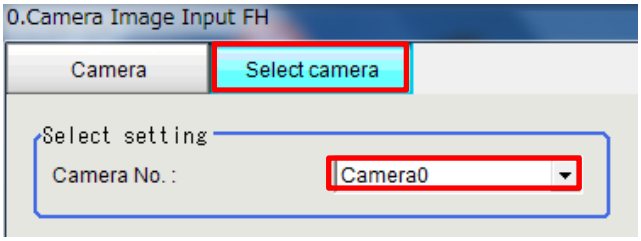
1	Prepare a calibration target and mount it to the robot. The target should have sufficient strength not to shift or deform by operations of the robot. The target should have a mark such as pattern or shape which the Shape Search III processing unit can detect. Adjust the Z-axis direction so that the imaging surface of a workpiece for Pick/Place and the target are the same height.	
2	Click [Scene switch] on the Main Window of the Vision Sensor. Select target scenes. The target scenes are as follows. Pick: 127 Calibration_Pick_Fixed_xx_xxx Place: 125 Calibration_Place_Fixed_xx_xxxxxx_xxx Click [OK] to switch scenes.	 

Click the “0. Camera Image Input FH” icon on the Main Window of the Vision Sensor to open the setting screen.
* When using the FHV Series Smart Camera Vision Sensor, delete the "0. Camera Image Input FH" unit and in its place set "Camera Image Input FHV" as Unit 0.



3

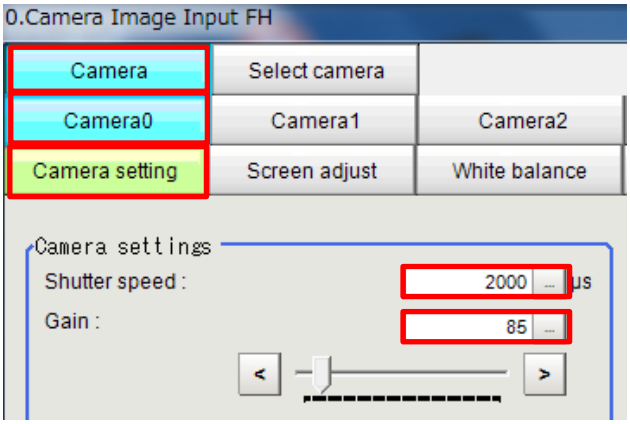
Check the set “Camera No.” by clicking [Select camera] tab.
* Change the camera number based on the actual environment.



Select the set camera number tab on the “Camera” tab.

Adjust the focus and iris of the camera while watching the image displayed.

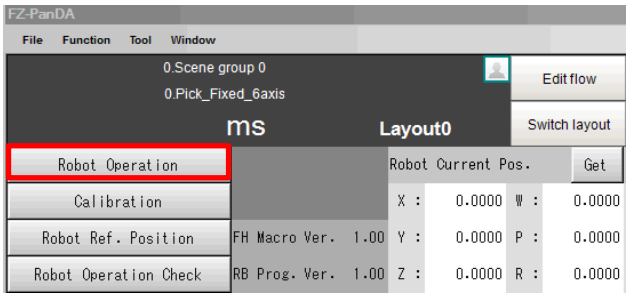
Adjust the shutter speed and gain of the camera on the “Camera settings” area.



4

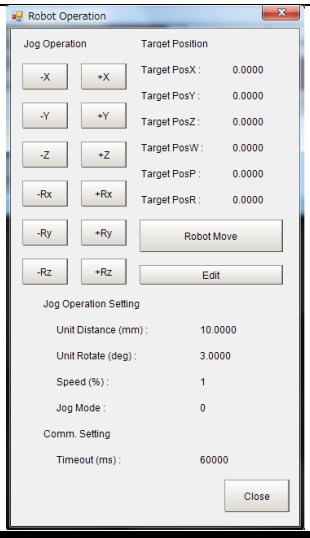
Change the image mode to “Through” on the “Image Window Setting” dialog on the Main Window of the Vision Sensor to display the camera image.

Click [Robot Operation] on the Main Window of the Vision Sensor to open the “Robot Operation” dialog.



On the “Robot Operation” dialog, operate the robot to move the calibration target close to the center of the field of view.

* After checking the position, return the image mode from “Through” to “Freeze”.



⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

⚠CAUTION

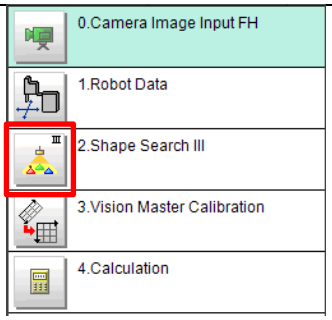
When the robot moves to Z-axis direction, check its motion by visual observation and not by camera image.

Precautions for Correct Use

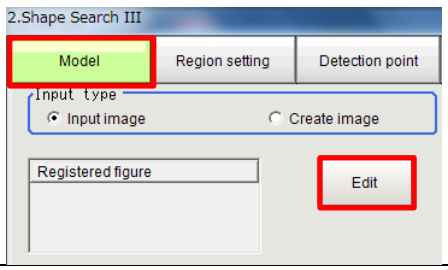
Adjust the Z-axis direction so that the calibration target will be the same height as the imaging surface of a workpiece for Pick/Place.

5

Click the “2. Shape search III” icon on the Main Window of the Vision Sensor to open the setting screen.



Select a registering figure by clicking [Edit] on the [Model] tab.

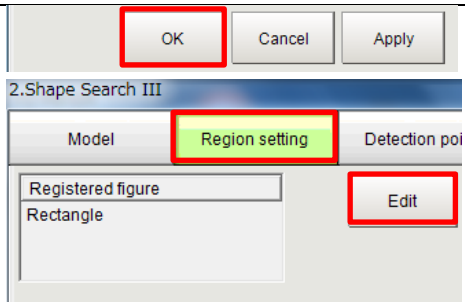


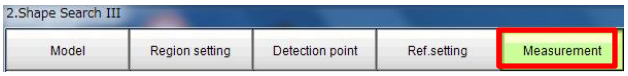
Register it as a model by clicking [OK] after fitting the registering figure on the calibration target.

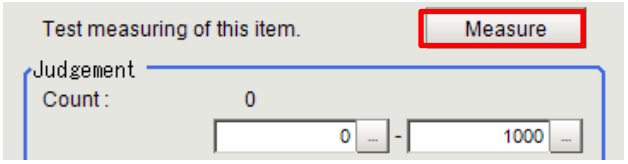
Click [Edit] on the [Region setting] tab to set the measurement region according to the field of view for a camera to use. Click [OK] after setting.

Click [Measurement] on the [Measurement] tab and check that the “Count” becomes one.

* If it does not become one, the settings are not proper. Therefore execute the model registration again.

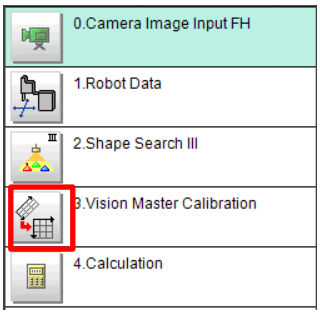




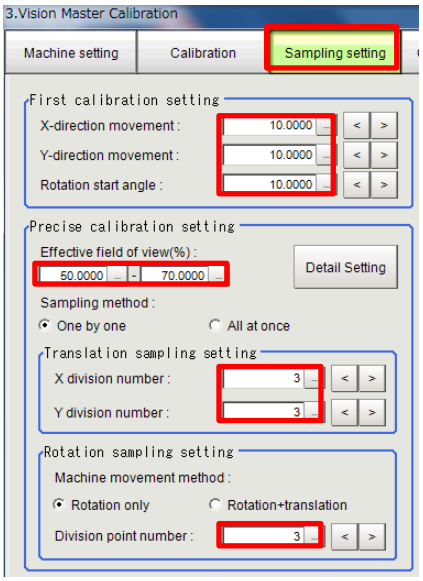


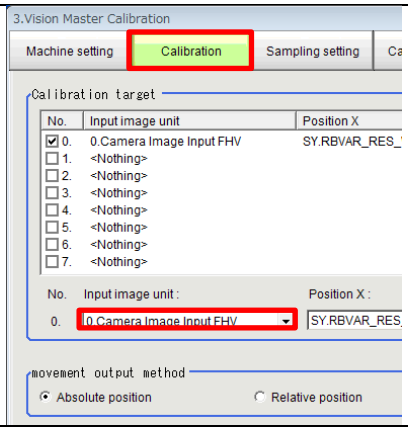
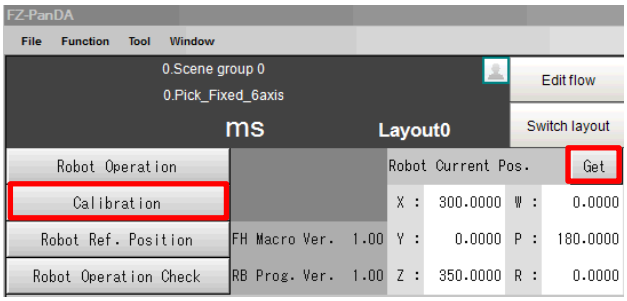
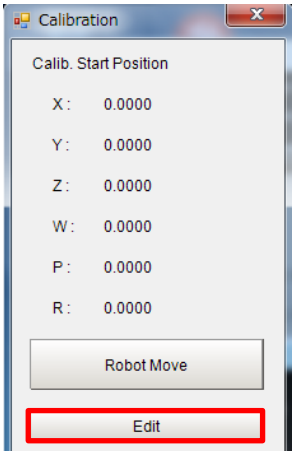
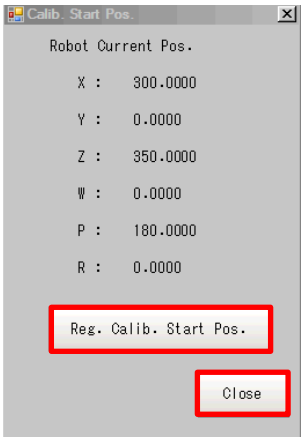
6

Click the “3. Vision Master Calibration” icon on the Main Window of the Vision Sensor to open the setting screen.



Select the [Sampling setting] tab and set “First calibration setting”, “Effective field of view”, “Translation sampling setting”, “Detection point number” according to the actual environment.



	* When using the FHV Series Smart Camera Vision Sensor, select the "Calibration" tab and in the field for "Image Input" select "Camera Image Input FHV".	
7	Click [Get] on the Main Window of the Vision Sensor to get the current position of the robot. Click [Calibration] to open the “Calibration” dialog. Click [Edit] in the “Calibration” dialog to open the “Calib. Start Pos.” dialog. Check that the dialog displays the current position of the robot and click [Reg. Calib. Start Pos.]. After clicking [Close], check that the “Calib. Start Position” in the “Calib. Start Pos.” dialog has been updated.	  

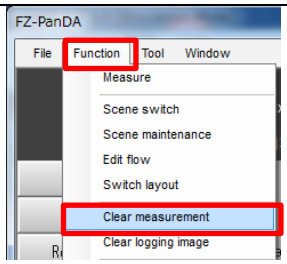
⚠WARNING

An operation of the dialog will automatically set values to Scene and System variables previously set in the scenes loaded by the environment copy feature in Chapter 5.1. Do not directly set the values by TDM editor or setting screens for processing items.
If proceeding to the following steps without registering the calibration start position, the robot would produce unexpected motion. Please be sure to register the position.

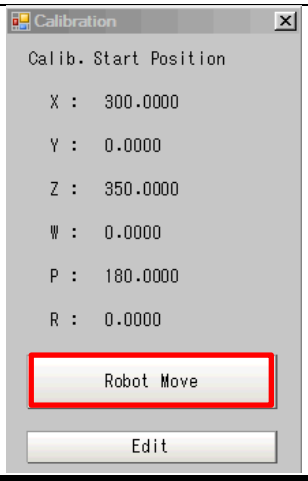
6.2.2. Executing and Checking Calibration

Follow the procedures below to execute and check the calibration.

1 Select [Function] - [Clear measurement] on the Main Window menu to clear the previous measurement results.



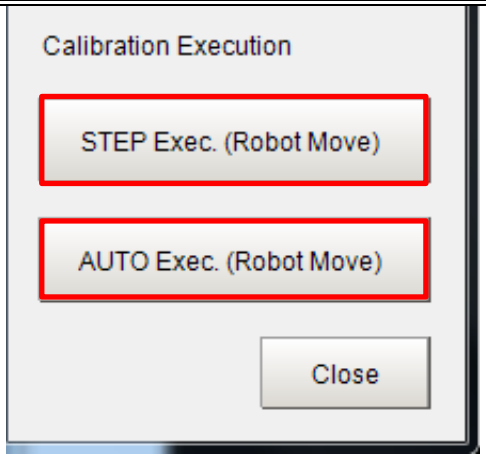
2 Click [Robot Move] in the "Calibration" dialog to move the robot to the calibration start position.



⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

3 In the "Calibration" dialog, clicking [STEP Exec. (Robot Move)] for the number of sampling points set at step 6 in Chapter 6.2.1 or clicking [Auto Exec. (Robot Move)] will execute the calibration.



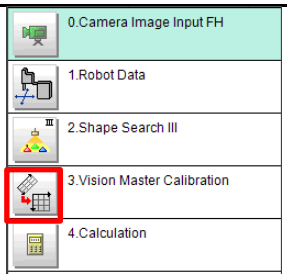
* If stopping this motion on the way, the target measurement may not have been executed correctly. Review the camera settings, model registration, and environment of lightings.

⚠WARNING

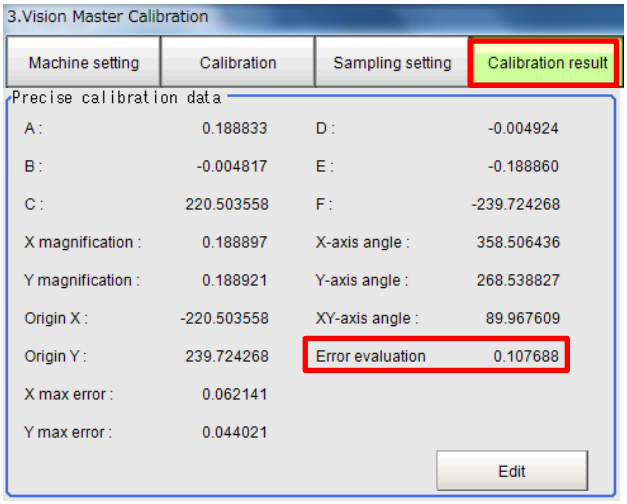
- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

4

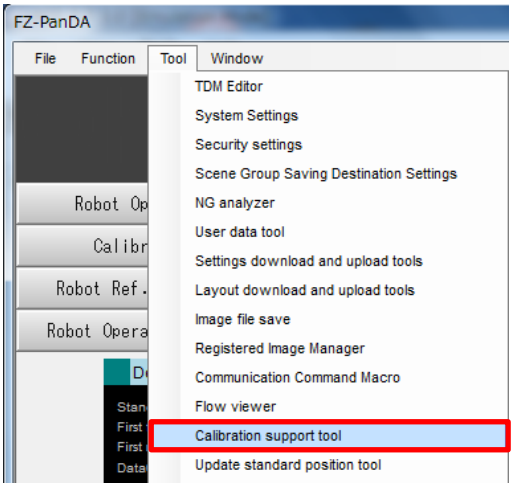
Click the "3. Vision Master Calibration" icon on the Main Window of the Vision Sensor to open the setting screen.



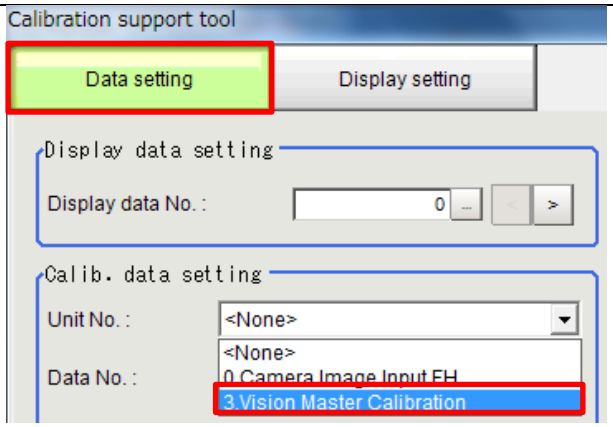
Select the [Calibration result] tab to check whether or not the "Error evaluation" has converged within the accuracy required.



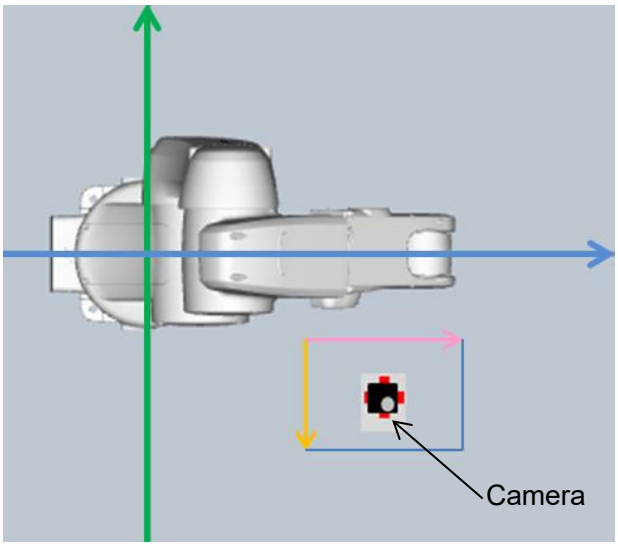
Select [Tool] - [Calibration support tool] from the menu bar.



In the [Data setting] tab, set the unit No. to the “3. Vision Master Calibration” to check the relationship between the camera and robot coordinate systems got from the calibration.

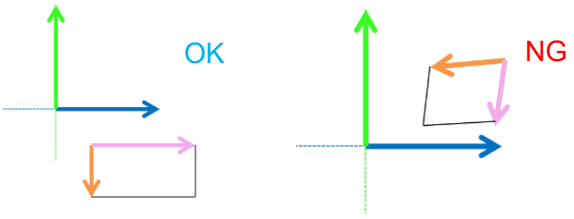


* Regarding the robot base coordinate system shown on the right figure, set the “Rotation” at the “Standard axis” on the “Display setting” tab in the “Calibration support tool” to “Anticlockwise”.



If the relation such as directions and camera coordinate origin position between the camera and the robot base coordinate systems is the same as the actual system configuration, the calibration has succeeded.

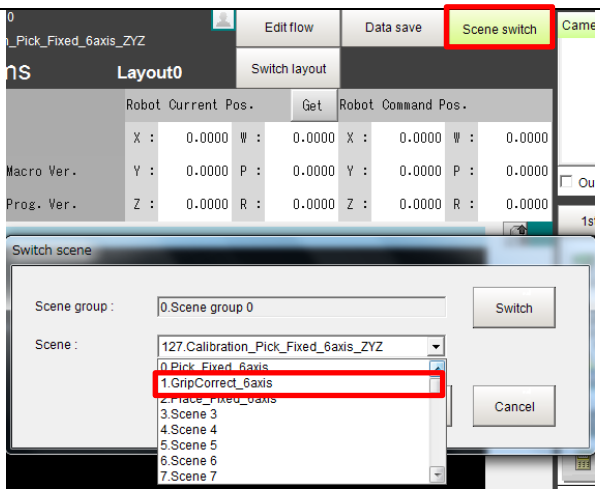
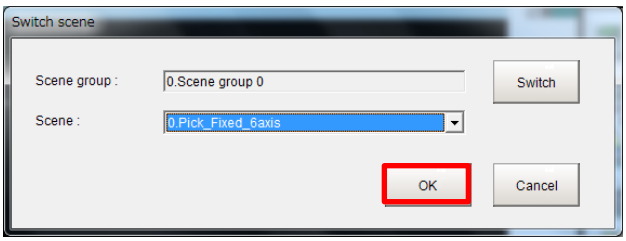
* Like the NG example, if the relation between the camera and the robot base coordinate systems is different, the calibration has failed. Review the camera settings, model registration, and environment of lightings and then execute the calibration again.

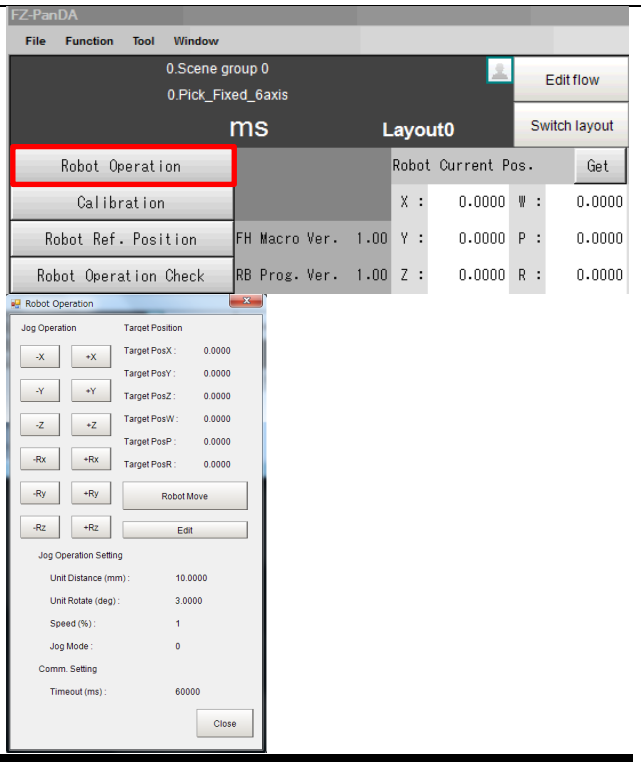


	* When using the FHV Series Smart Camera Vision Sensor, you can use the Simulation Software to load a settings data file that has been saved for backup. This will allow you to launch the "Calibration Support Tool" from the "Tool" menu. For additional information on backing up settings data, please refer to Section 6.5	
5	Remove the calibration target from the robot.	

6.2.3. Setting Applications

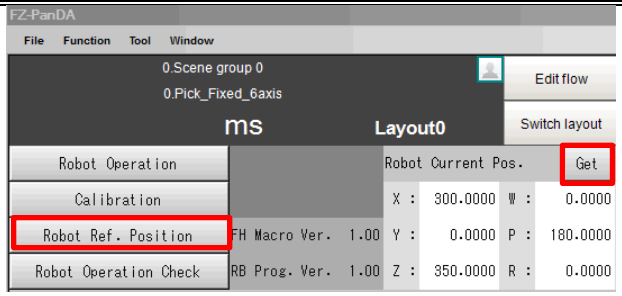
Follow the procedures below to set a scene for applications.

1	Click [Scene switch] on the Main Window of the Vision Sensor. Select target scenes. The target scenes are as follows. Pick: 0 Pick_Fixed_x x Place: 2 Place_Fixed_x x Click [OK] to switch scenes.	 

2	Check that the check box for “Output” is not checked. The serial data for the measurement value is not output until the Vision Sensor setting is completed. Place a check in the check box when executing a robot sample program described in Chapter 7.	
3	Click [Robot operation] on the Main Window of the Vision Sensor to open the “Robot Operation” dialog. Move the robot to a position to image (measure) a workpiece for Pick/Place on the “Robot Operation” dialog.	

⚠WARNING

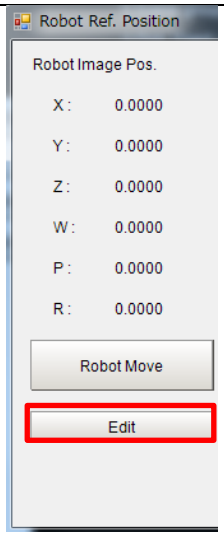
- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

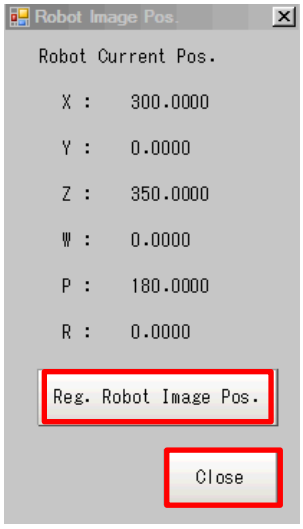
4	Click [Get] on the Main Window of the Vision Sensor to get the current position of the robot. Click [Robot Ref. Position] on the Main Window of the Vision Sensor to open the “Robot Ref. Position” dialog.	

Click [Edit] on the “Robot Ref. Position” dialog to open the “Robot Image Pos.” dialog.

Click [Reg. Robot Image Pos.] on the “Robot Image Pos.” dialog to register the current position of the robot.

After clicking [Close], check that the “Robot Image Pos.” on the “Robot Ref. Position” dialog has been updated.



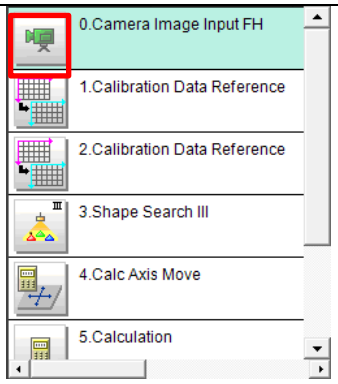


⚠WARNING

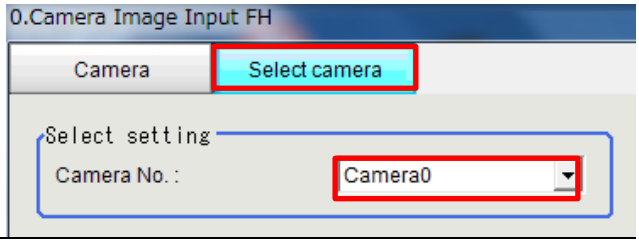
An operation of the dialog will automatically set values to Scene and System variables previously set in the scenes loaded by the environment copy feature in Chapter 5.1. Do not directly set the values by TDM editor or setting screens for processing items.
If application operations are performed without registering the “Robot Image Pos.”, the robot would produce unexpected motion. Please be sure to register the position.

5 Place a workpiece for Pick/ Place into the field of view.

6 Click the “0. Camera Image Input FH” icon on the Main Window of the Vision Sensor to open the setting screen.
* When using the FHV Series Smart Camera Vision Sensor, delete the "0. Camera Image Input FH" unit and in its place set "Camera Image Input FHV" as Unit 0.

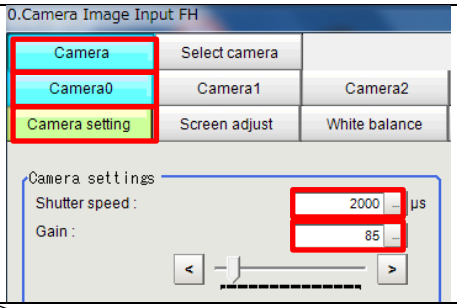


Check the set “Camera No.” by clicking [Select camera] tab.
* Change the camera number based on the actual environment.



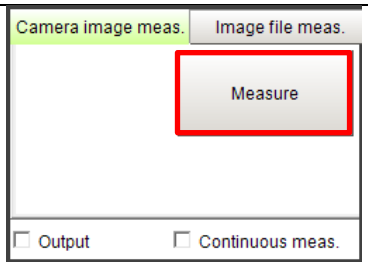
Select the set camera number tab on the “Camera” tab.

Adjust the shutter speed and gain of the camera on the “Camera settings” area.

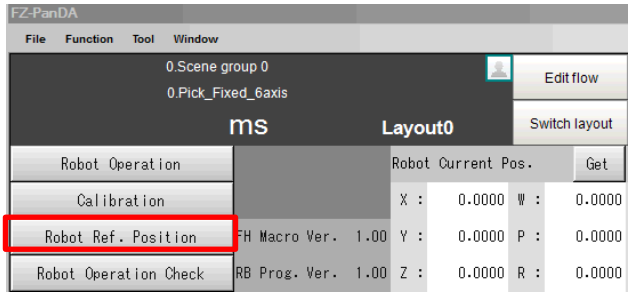


7 Register a workpiece as a model for Pick/Place on Shape Search III by operations as same as those at step 5 in Chapter 6.2.1.

Select [Camera image meas.] on the Main Window of the Vision Sensor and detect a workpiece position for Pick/Place with clicking [Measure].

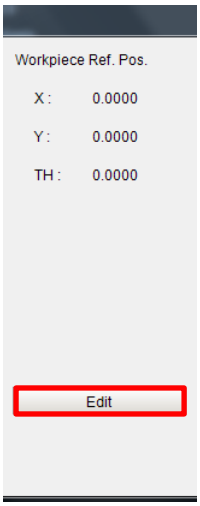


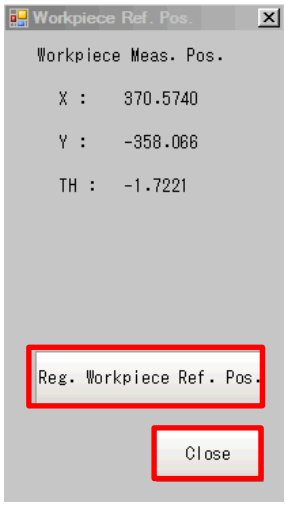
Click [Robot Ref. Position] on the Main Window of the Vision Sensor to open the “Robot Ref. Position” dialog.



8 Click [Edit] on the “Robot Ref. Position” dialog to open the “Workpiece Ref. Pos.” dialog.

Click [Reg. Workpiece Ref. Pos.] on the “Workpiece Ref. Pos.” dialog to register the measurement position of the workpiece.





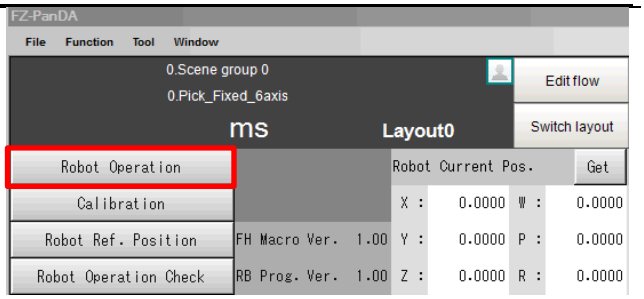
After clicking [Close], check that the “Workpiece Ref. Pos.” on the “Robot Ref. Position” dialog has been updated.

⚠WARNING

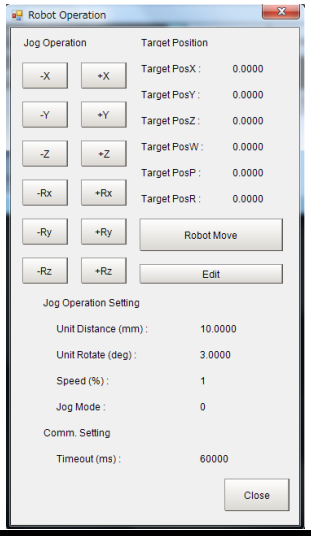
An operation of the dialog will automatically set values to Scene and System variables previously set in the scenes loaded by the environment copy feature in Chapter 5.1. Do not directly set the values by TDM editor or setting screens for processing items.
If application operations are performed without registering the “Workpiece Ref. Pos.”, the robot would produce unexpected motion. Please be sure to register the position.

9

Click [Robot operation] on the Main Window of the Vision Sensor to open the “Robot Operation” dialog.



Move the robot to a position to grip a workpiece for Pick/Place on the “Robot Operation” dialog.



⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

⚠CAUTION

When the robot moves to Z-axis direction, check its motion by visual observation and not by camera image.

10

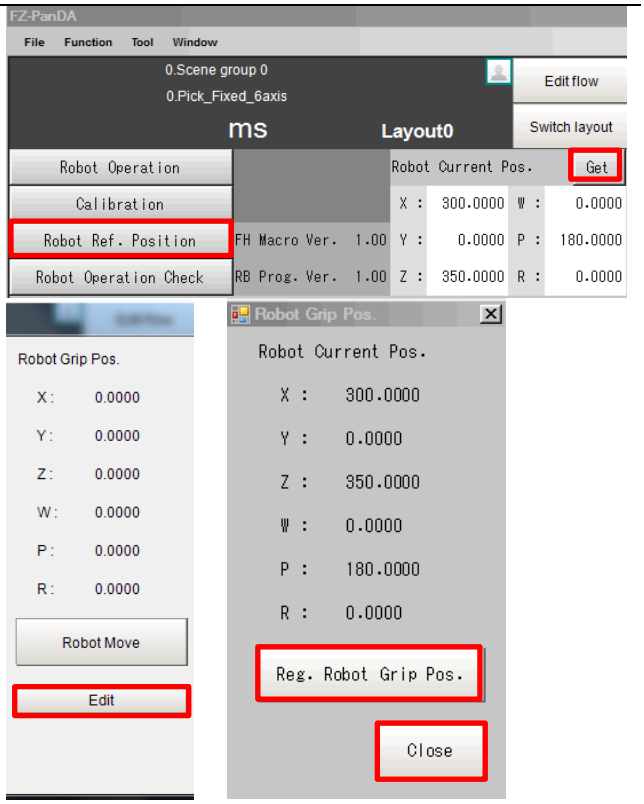
Click [Get] on the Main Window of the Vision Sensor to get the current position of the robot.

Click [Robot Ref. Position] on the Main Window of the Vision Sensor to open the “Robot Ref. Position” dialog.

Click [Edit] on the “Robot Ref. Position” dialog to open the “Robot Grip Pos.” dialog.

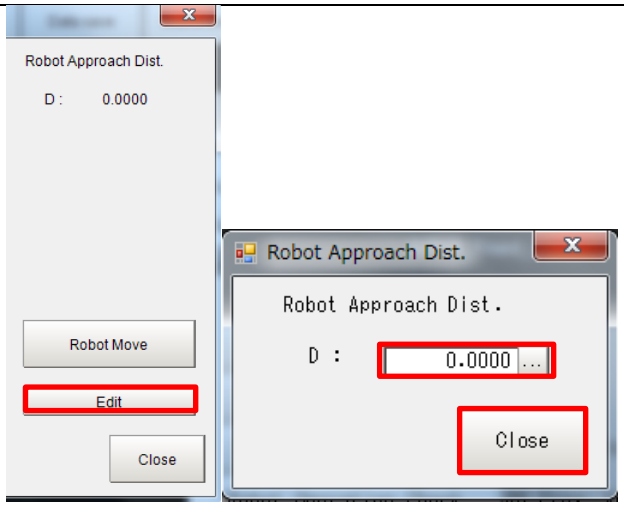
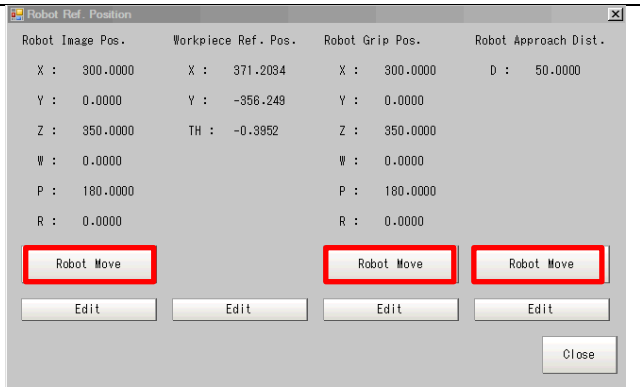
Click [Reg. Robot Grip Pos.] on the “Robot Image Pos.” dialog to register the current position of the robot.

After clicking [Close], check that the “Robot Image Pos.” on the “Robot Ref. Position” dialog has been updated.



⚠WARNING

An operation of the dialog will automatically set values to Scene and System variables previously set in the scenes loaded by the environment copy feature in Chapter 5.1. Do not directly set the values by TDM editor or setting screens for processing items.
If application operations are performed without registering the “Robot Grip Pos.”, the robot would produce unexpected motion. Please be sure to register the position.

11	Click [Edit] for “Robot Approach Dist.” on the “Robot Ref. Position” dialog to open the “Robot Approach Dist.” dialog. Set the robot approach distance on the “Robot Approach Dist.”. After clicking [Close], check that the “Robot Approach Dist.” on the “Robot Ref. Position” dialog has been updated.	
12	Click [Robot Move] of the “Robot Image Pos.” on the “Robot Ref. Position” dialog to check that the robot moves to the imaging position registered. Click [Robot Move] of the “Robot Grip Pos.” on the “Robot Ref. Position” dialog to check that the robot moves to the grip position registered. Click [Robot Move] of the “Robot Approach Dist.” on the “Robot Ref. Position” dialog to check that the robot moves toward + Z direction by a value set in “Robot Approach Dist.” from the robot gripping position.	

* If the robot produced unexpected motion, please register the robot approach distance again.

⚠WARNING

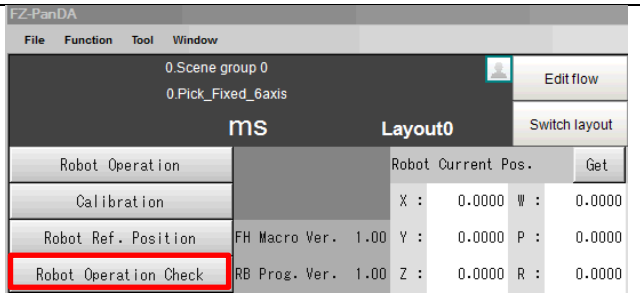
- These operations drive the robot.
- Operate the robot in the whereby pressing the [Emergency stop] button can stop its motion anytime.

6.2.4. Checking Application Operations

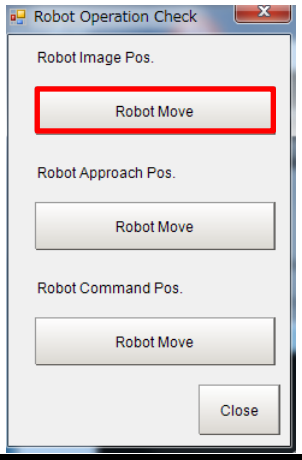
Follow the procedures below to check that scenes for applications are operable.

1

Click [Robot Operation Check] on the Main Window of the Vision Sensor to open the “Robot Operation Check” dialog.



Click [Robot Move] of the “Robot Image Pos.” on the “Robot Operation Check” dialog and move the robot to the imaging position.

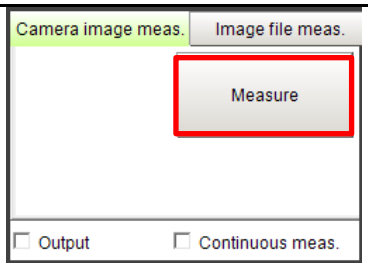


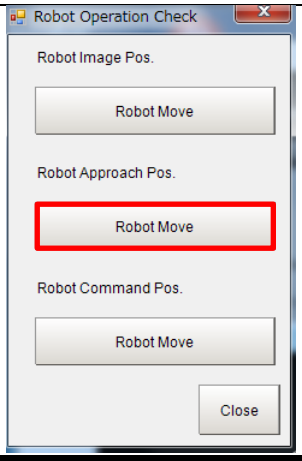
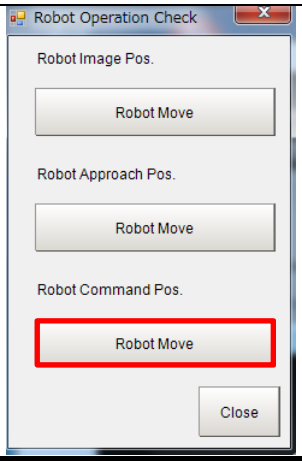
⚠WARNING

- These operations drive the robot.
- Operate the robot in the whereby pressing the [Emergency stop] button can stop its motion anytime.

2

Select [Camera image meas.] on the Main Window of the Vision Sensor and detect a workpiece position for Pick/Place with clicking [Measure].



3	Click [Robot Move] of the "Robot Approach Pos." on the "Robot Operation Check" dialog and move the robot to the approach position.	
	⚠WARNING • These operations drive the robot. • Operate the robot in the whereby pressing the [Emergency stop] button can stop its motion anytime.	
4	Click [Robot Move] of the "Robot Command Pos." on the "Robot Operation Check" dialog and move the robot to the command position.	
	⚠WARNING • These operations drive the robot. • Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime. • Check the measurement results before operating the robot. The robot may produce unexpected motion. • Change positions and angles of the workpiece for Pick/Place to check the operation sufficiently.	
5	Stop the robot program launched by procedures in chapter 5.3.	

6.3. Grip Correction with Fixed Camera

For Grip Correction with a fixed camera, calculate a grip deviation amount from the workpiece reference position of a measured workpiece, and outputs to the robot controller the robot command position to correct the grip deviation amount.

Precautions for Correct Use

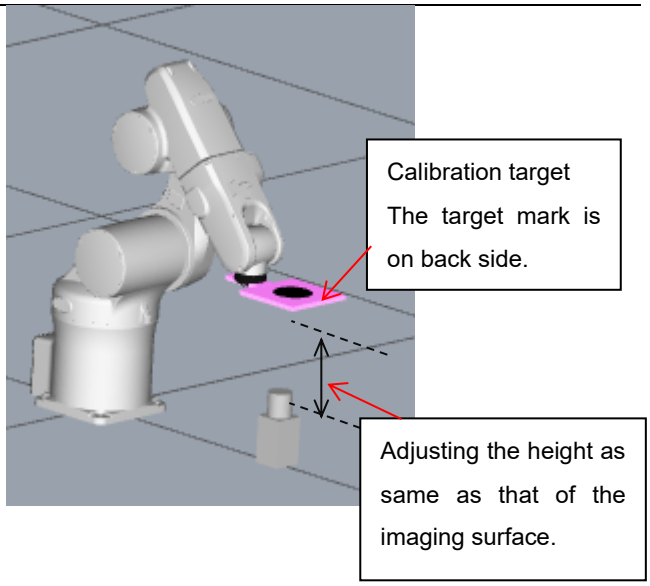
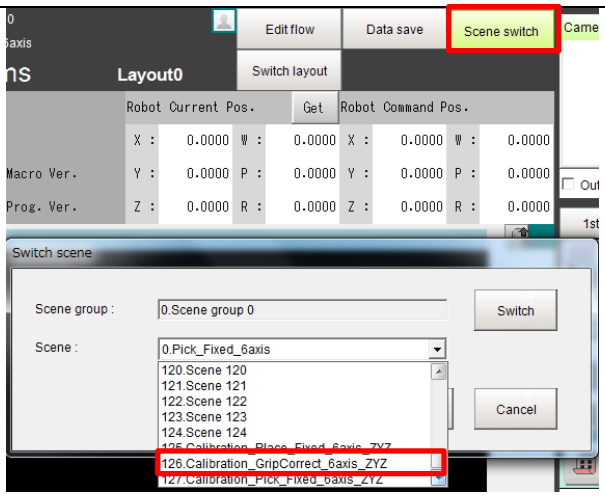
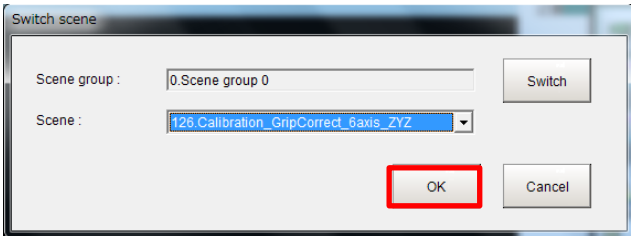
When you would like to relatively move the robot to a Place position fixed from the Grip Correction, first correct the position deviation with the grip correction and then move the robot to the Place position relatively.

Please follow the flow below for the settings.

6.3.1	Setting Calibration	Set a scene for the Vision Sensor calibration to execute. Perform settings related to camera, target, and calibration operation.
▼		
6.3.2	Executing and Checking Calibration	Check the results after executing the calibration with operations of the Vision Sensor to handle data in the robot base coordinate system.
▼		
6.3.3	Setting Applications	Set a scene for applications of the Vision Sensor for the Grip Correction. Register the reference position of the robot operation and set a camera and workpiece.
▼		
6.3.4	Checking Application Operations	To check the correctness of the settings, check whether or not the robot actually moves to the Grip Correction position with operations of the Vision Sensor.
▼		
6.5	Backing up Settings	Back up the setting results of the Vision Sensor performed in this Chapter.

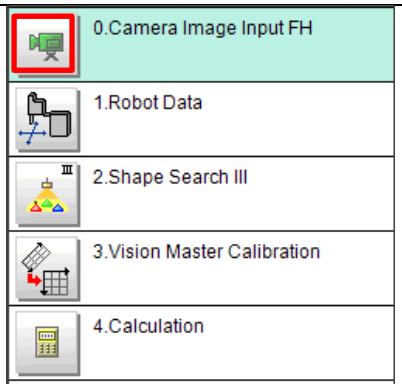
6.3.1. Setting Calibration

Follow the procedures below to set a scene for Calibration.

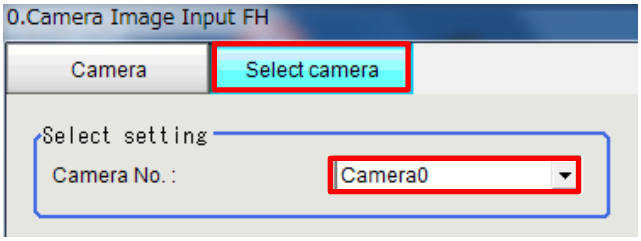
1	Prepare a calibration target and mount it to the robot. The target should have sufficient strength not to shift or deform by operations of the robot. The target should have a mark such as pattern or shape, which the Shape Search III processing unit can detect. Adjust the Z-axis direction so that the imaging surface of a workpiece for Grip Correction and the target are the same height.	
2	Click [Scene switch] on the Main Window of the Vision Sensor. Select the target scene, 126 Calibration and Grip correction_xx_xxx Click [OK] to switch scenes.	 

3

Click the “0. Camera Image Input FH” icon on the Main Window of the Vision Sensor to open the setting screen.
* When using the FHV Series Smart Camera Vision Sensor, delete the "0. Camera Image Input FH" unit and in its place set "Camera Image Input FHV" as Unit 0.



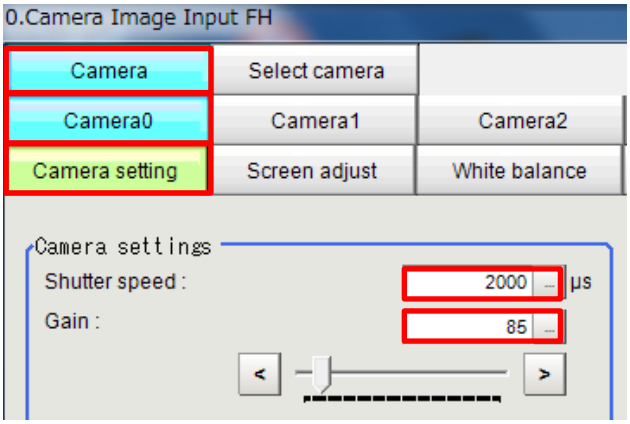
Check the set “Camera No.” by clicking [Select camera] tab.
* Change the camera number based on the actual environment.



Select the set camera number tab on the “Camera” tab.

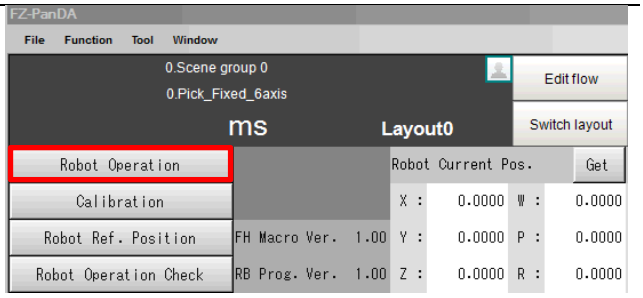
Adjust the focus and iris of the camera while watching the image displayed.

Adjust the shutter speed and gain of the camera on the “Camera settings” area.

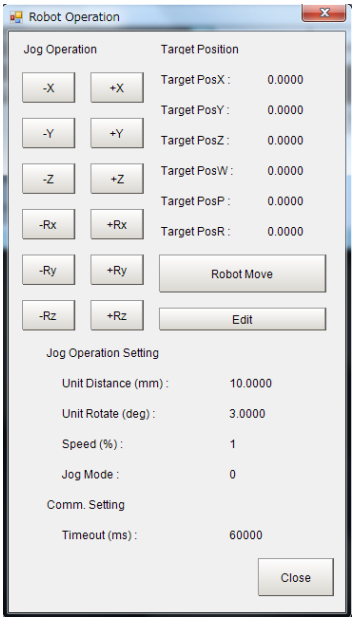


4

Change the image mode to “Through” on the “Image Window Setting” dialog on the Main Window of the Vision Sensor to display the camera image.



Click [Robot Operation] on the Main Window of the Vision Sensor to open the “Robot Operation” dialog.



On the “Robot Operation” dialog, operate the robot to move the calibration target close to the center of the field of view.

* After checking the position, return the image mode from “Through” to Freeze”.

⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

⚠CAUTION

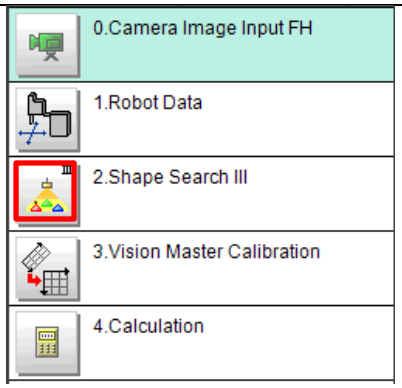
When the robot moves to Z-axis direction, check its motion by visual observation and not by camera image.

Precautions for Correct Use

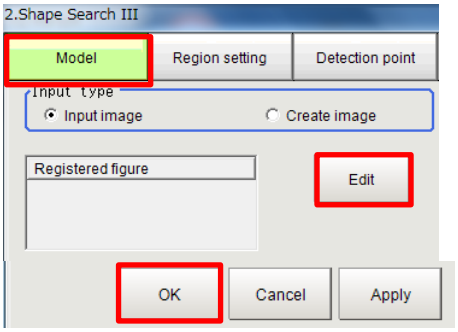
Adjust the Z-axis direction so that the calibration target will be the same height as the imaging surface of a workpiece for Grip Correction.

5

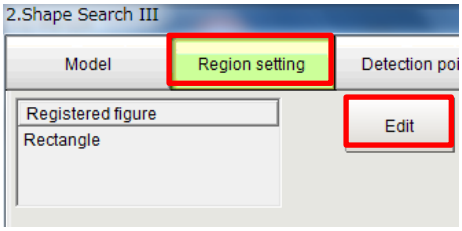
Click the “2. Shape search III” icon on the Main Window of the Vision Sensor to open the setting screen.



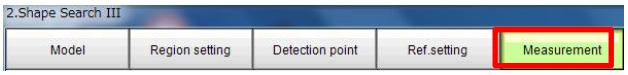
Select a registering figure by clicking [Edit] on the [Model] tab.
Register it as a model by clicking [OK] after fitting the registering figure to the calibration target.



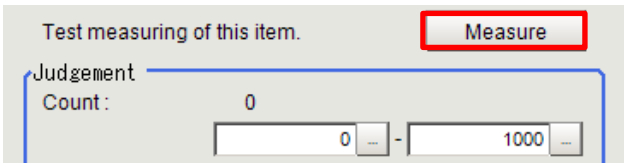
Click [Edit] on the [Region setting] tab to set the measurement region according to the field of view for a camera to use. Click [OK] after the setting.

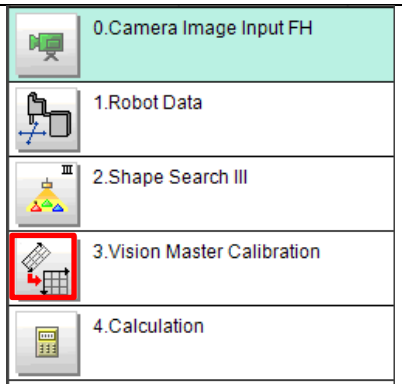
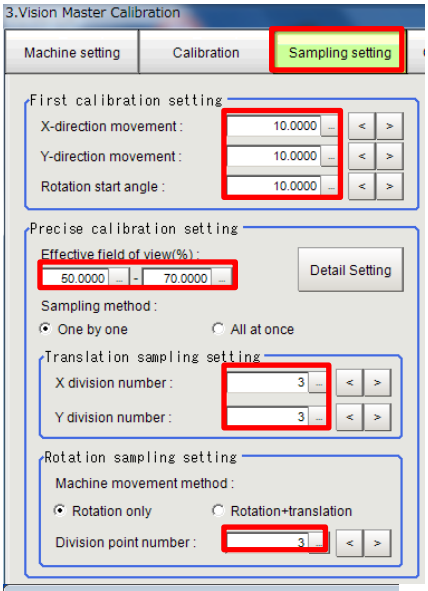
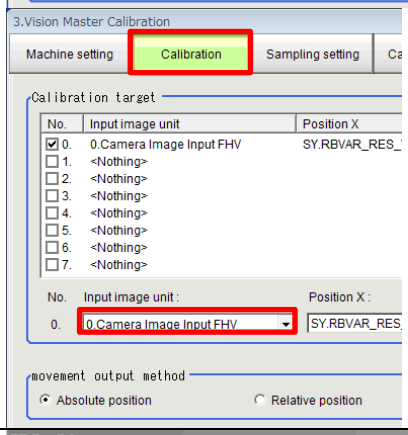
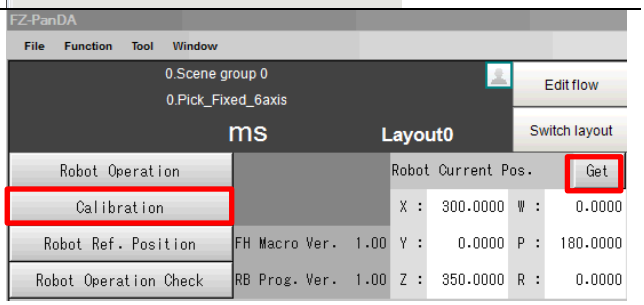


Click [Measurement] on the [Measurement] tab and check the “Count” becomes one.



* If it does not become one, the settings are not proper. Therefore execute the model registration again.

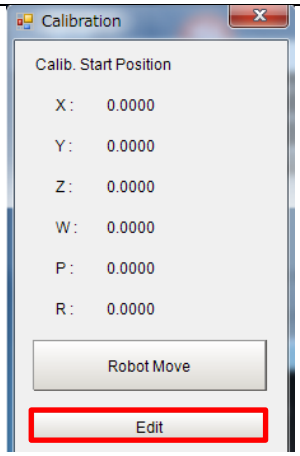


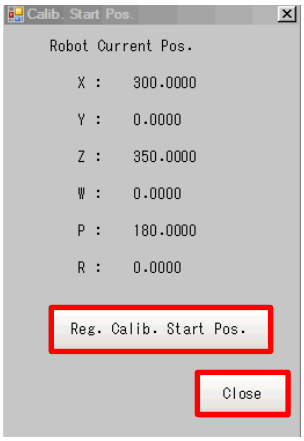
6	Click the “3. Vision Master Calibration” icon on the Main Window of the Vision Sensor to open the setting screen. Select the [Sampling setting] tab and set “First calibration setting”, “Effective field of view”, “Translation sampling setting”, “Division point number” according to the actual environment. * When using the FHV Series Smart Camera Vision Sensor, select the "Calibration" tab and in the field for "Image Input" select "Camera Image Input FHV".	  
7	Click [Get] on the Main Window of the Vision Sensor to get the current position of the robot. Click [Calibration] to open the “Calibration” dialog.	

Click [Edit] in the calibration dialog to open the “Calib. Start Pos.” dialog.

Check that the dialog displays the current position of the robot and click [Reg. Calib. Start Pos.].

After clicking [Close], check that the “Calib. Start Position” in the “Calib. Start Pos.” dialog has been updated.





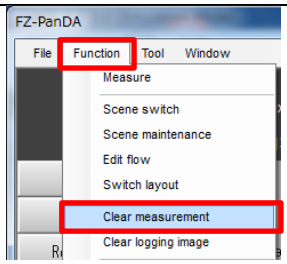
⚠WARNING

An operation of the dialog will automatically set values to Scene and System variables previously set in the scenes loaded by the environment copy feature in Chapter 5.1. Do not directly set the values by TDM editor or setting screens for processing items.
If proceeding to the following steps without registering the calibration start position, the robot would produce unexpected motion. Please be sure to register the position.

6.3.2. Executing and Checking Calibration

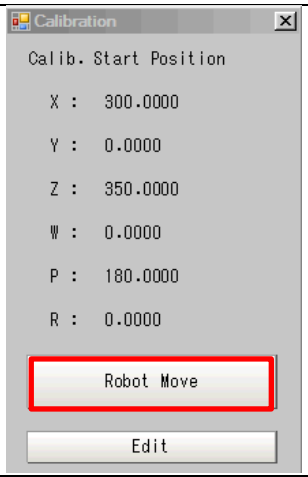
Follow the procedures below to execute and check the calibration.

1 Select [Function] - [Clear measurement] on the Main Window menu to clear the previous measurement results.



2

Click [Robot Move] in the “Calibration” dialog to move the robot to the calibration start position.



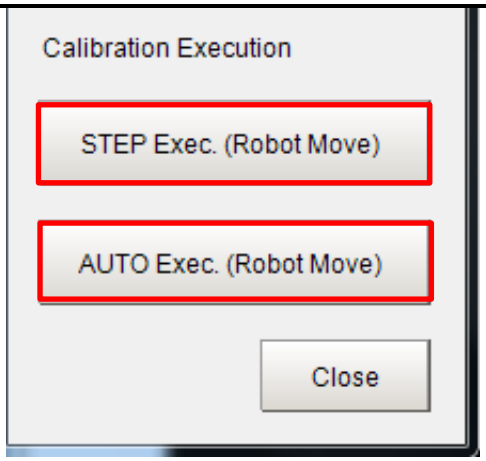
⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

3

In the “Calibration” dialog, clicking [SETP Exec. (Robot Move)] for the number of sampling points set at step 6 in Chapter 6.3.1 or clicking [Auto Exec. (Robot Move)] will execute the calibration.

* If stopping this motion on the way, the target measurement may not have been executed correctly. Review the camera settings, model registration, and environment of lightings.

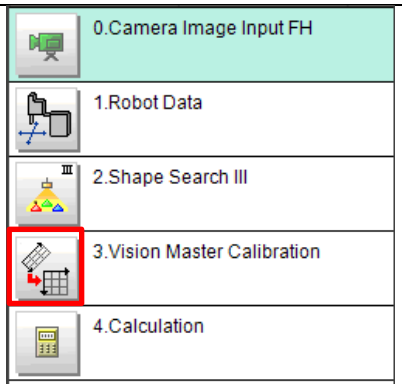


⚠WARNING

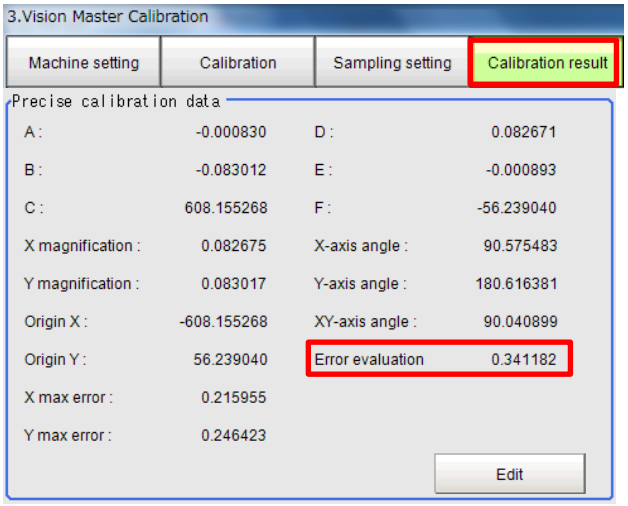
- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

4

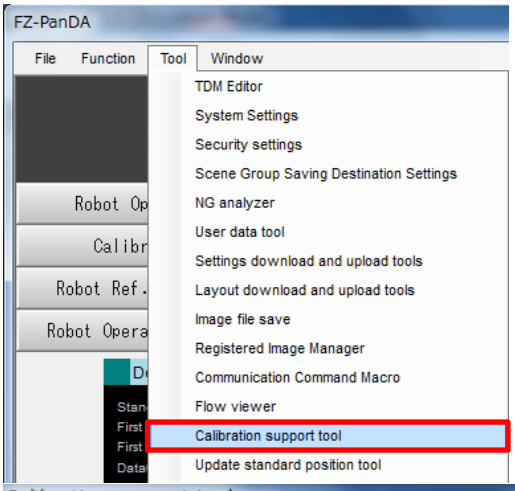
Click the “3. Vision Master Calibration” icon on the Main Window of the Vision Sensor to open the setting screen.



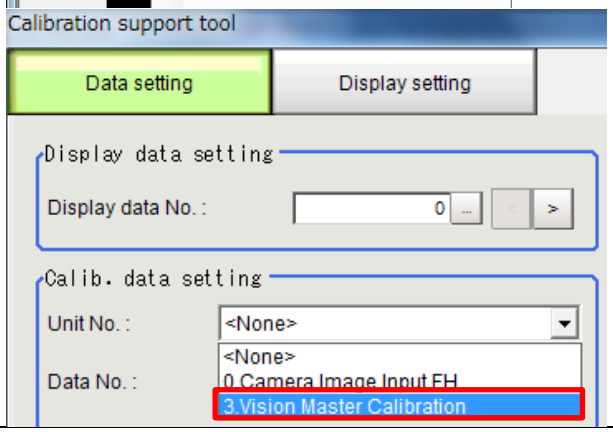
Select the [Calibration result] tab to check whether or not the “Error evaluation” has converged within the accuracy required.



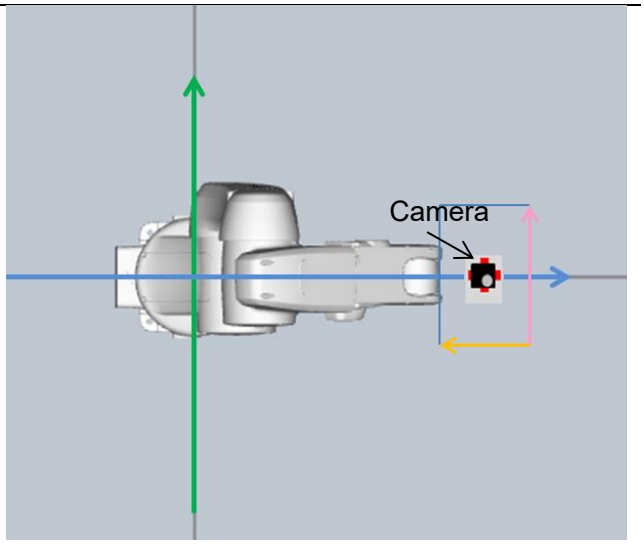
Select [Tool] - [Calibration support tool] from the menu bar.



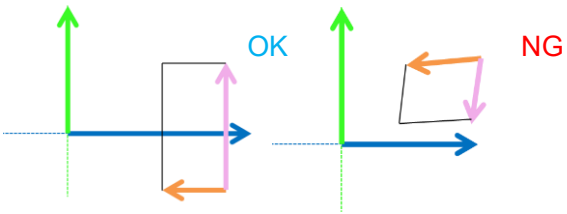
In the [Data setting] tab, set the unit No. to the “3. Vision Master Calibration” to check the relationship between the camera and robot coordinate systems got from the calibration.



* Regarding the robot base coordinate system shown on the right figure, set the “Rotation” at the “Standard axis” on the “Display setting” tab in the “Calibration support tool” to “Anticlockwise”.



If the relation such as directions and camera coordinate origin position between the camera and the robot base coordinate systems is the same as the actual system configuration, the calibration has succeeded.



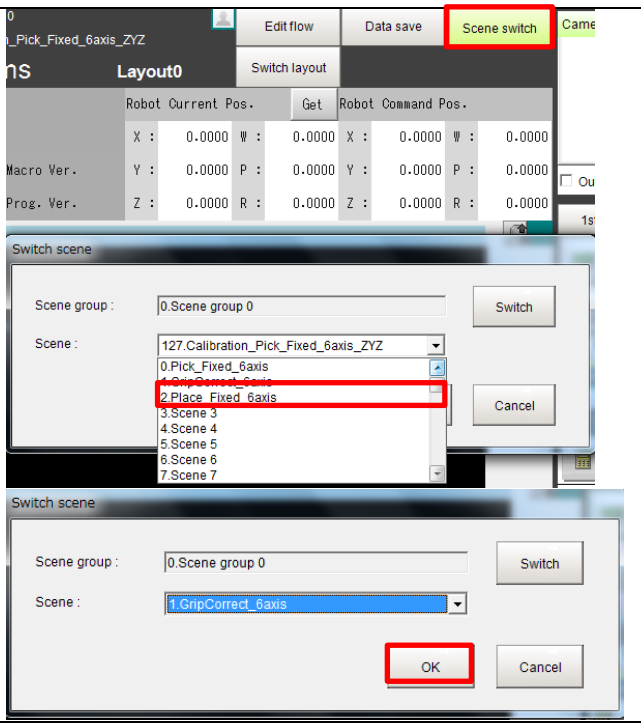
* Like the NG example, if the relation between the camera and the robot base coordinate systems is different, the calibration has failed. Review the camera settings, model registration, and environment of lightings and then execute the calibration again.

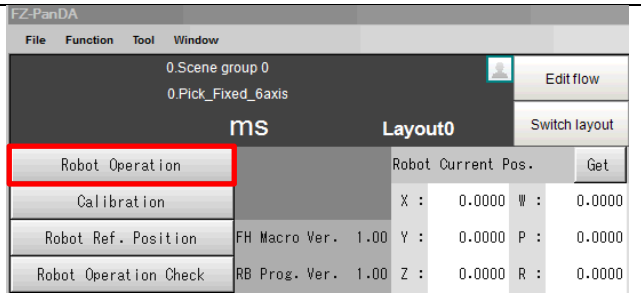
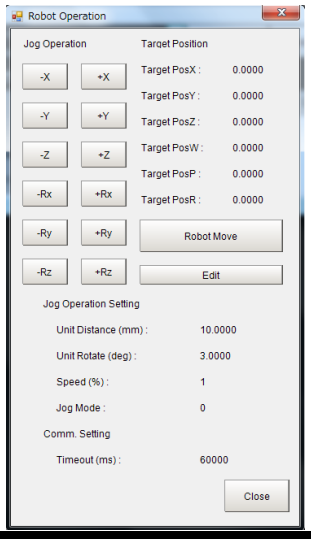
* When using the FHV Series Smart Camera Vision Sensor, you can use the Simulation Software to load a settings data file that has been saved for backup. This will allow you to launch the "Calibration Support Tool" from the "Tool" menu. For additional information on backing up settings data, please refer to Section 6.5

5	Remove the calibration target from the robot.

6.3.3. Setting Applications

Follow the procedures below to set a scene for applications.

1	Click [Scene switch] on the Main Window of the Vision Sensor. Select the target scene, 1 Grip correction_XX . Click [OK] to switch scenes.	

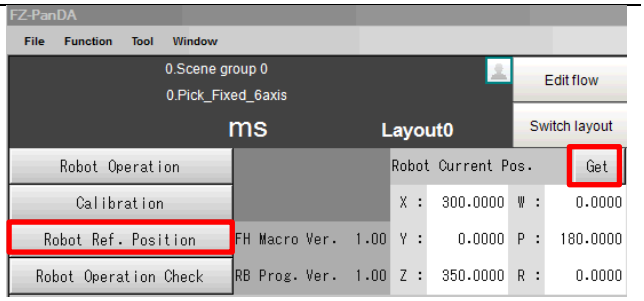
2	Check that the check box for “Output” is not checked. The serial data for the measurement value is not output until the Vision Sensor setting is completed. Place a check in the check box when executing a robot sample program described in Chapter 7.	
3	Click [Robot Operation] on the Main Window of the Vision Sensor to open the “Robot Operation” dialog.	
	With a workpiece ideally gripped, move the robot to a position to image (measure) the workpiece for the Grip Correction on the “Robot operation” dialog.	

⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

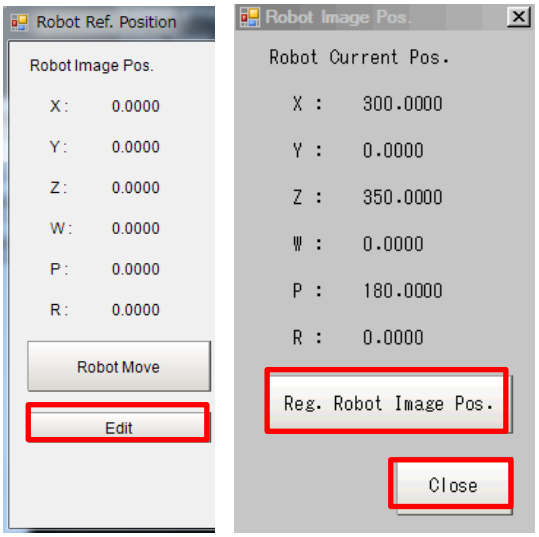
4

Click [Get] on the Main Window of the Vision Sensor to get the current position of the robot.



Click [Robot Ref. Position] on the Main Window of the Vision Sensor to open the “Robot Ref. Position” dialog.

Click [Edit] of “Robot Image Pos.” on the “Robot Ref. Position” dialog to open the “Robot Image Pos.” dialog.



Click [Reg. Robot Image Pos.] on the “Robot Image Pos.” dialog to register the current position of the robot.

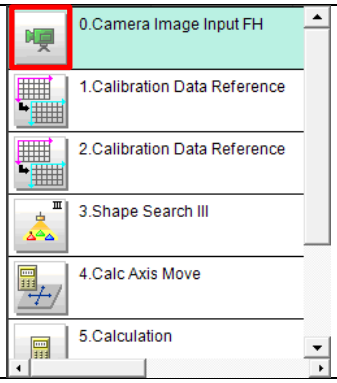
After clicking [Close], check that the “Robot Image Pos.” on the “Robot Ref. Position” dialog has been updated.

⚠WARNING

An operation of the dialog will automatically set values to Scene and System variables previously set in the scenes loaded by the environment copy feature in Chapter 5.1. Do not directly set the values by TDM editor or setting screens for processing items.
If application operations are performed without registering the “Robot Image Pos.”, the robot would produce unexpected motion. Please be sure to register the position.

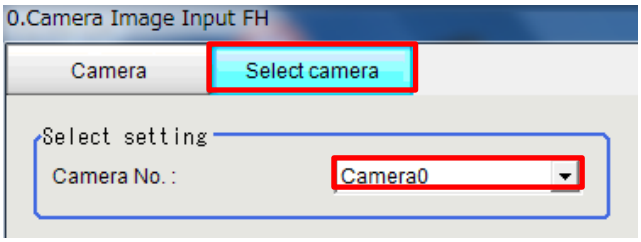
5

Click the “0. Camera image input FH” icon on the Main Window of the Vision Sensor to open the setting screen.



* When using the FHV Series Smart Camera Vision Sensor, delete the "0. Camera Image Input FH" unit and in its place set "Camera Image Input FHV" as Unit 0.

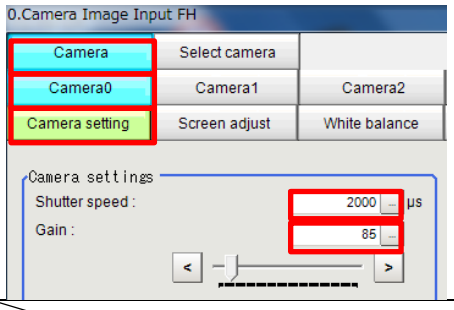
Check the set “Camera No.” by clicking [Select camera] tab.



* Change the camera number based on the actual environment.

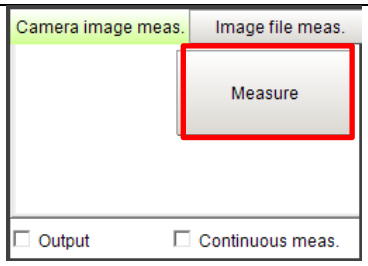
Select the set camera number tab on the “Camera” tab.

Adjust the shutter speed and gain of the camera on the “Camera settings” area.

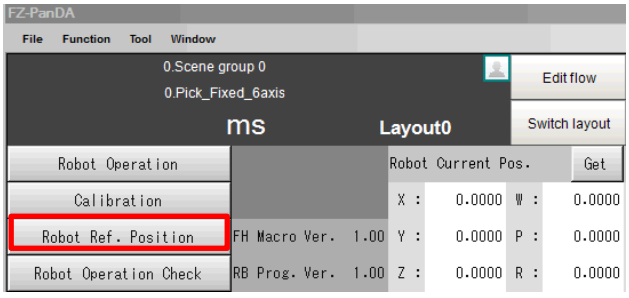


6 Register a workpiece as a model for Grip Correction by operations as same as those at step 5 in Chapter 6.3.1.

Select [Camera image meas.] on the Main Window of the Vision Sensor and detect a workpiece position for Grip Correction with clicking [Measure].



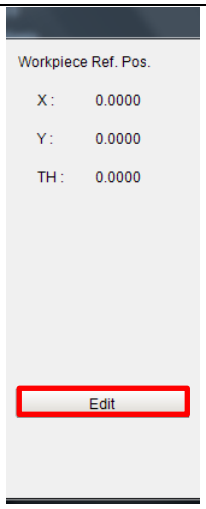
7 Click [Robot Ref. Position] on the Main Window of the Vision Sensor to open the “Robot Ref. Position” dialog.

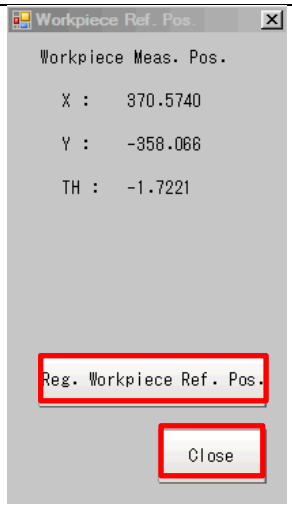


Click [Edit] on the “Robot Ref. Position” dialog to open the “Workpiece Ref. Pos.” dialog.

Click [Reg. Workpiece Ref. Pos.] on the “Workpiece Ref. Pos.” dialog to register the measurement position of the workpiece.

After clicking [Close], check that the “Workpiece Ref. Pos.” on the “Robot Ref. Position” dialog has been updated.





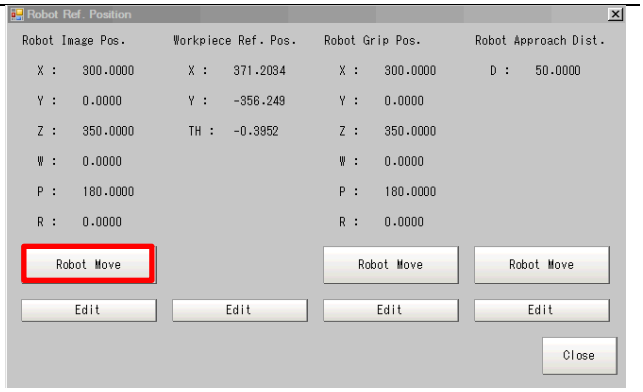
⚠WARNING

An operation of the dialog will automatically set values to Scene and System variables previously set in the scenes loaded by the environment copy feature in Chapter 5.1. Do not directly set the values by TDM editor or setting screens for processing items.
If application operations are performed without registering the “Workpiece Ref. Pos.”, the robot would produce unexpected motion. Please be sure to register the position.

8

Click [Robot Move] of the “Robot Image Pos.” on the “Robot Ref. Position” dialog to check that the robot moves to the imaging position registered.

* If the robot produced unexpected motion, please register the workpiece reference position again.



⚠WARNING

- These operations drive the robot.

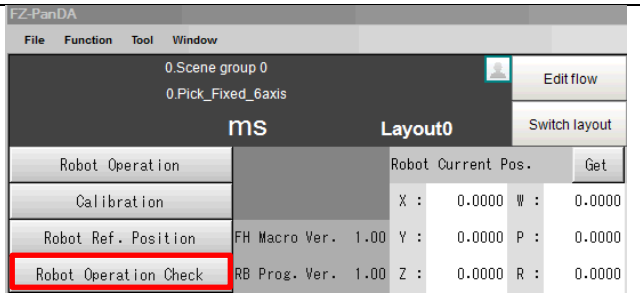
Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

6.3.4. Checking Application Operations

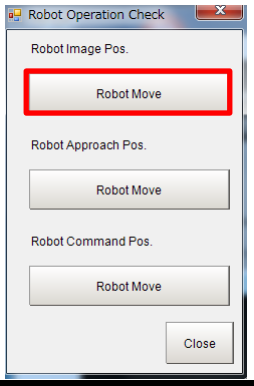
Follow the procedures below to check that scenes for applications are operable.

In advance, let the robot gripping a workpiece.

Click [Robot Operation Check] on the Main Window of the Vision Sensor to open the “Robot Operation Check” dialog.



1 Click [Robot Move] of the “Robot Image Pos.” on the “Robot Operation Check” dialog and move the robot to the imaging position.

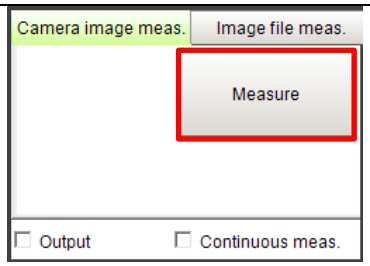


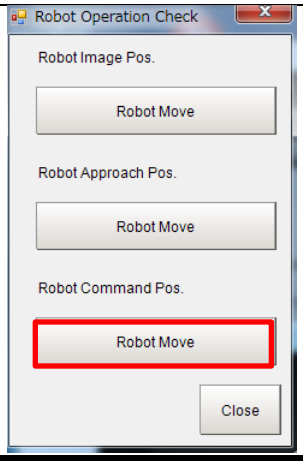
⚠WARNING

- These operations drive the robot.

Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

2 Select [Camera image meas.] on the Main Window of the Vision Sensor and detect a workpiece position for Grip Correction with clicking [Measure].



3	Click [Robot Move] of the "Robot Command Pos." on the "Robot Operation Check" dialog and move the robot to the command position.  	**⚠WARNING** • These operations drive the robot. • Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime. • Check the measurement results before the robot operation. The robot may produce unexpected motion. • Change positions and angles of the workpiece for Grip Correction to check the operation sufficiently.
4	Stop the robot program launched by procedures in Chapter 5.3.	

6.4. Pick/Place with On-hand Camera

In the case of Pick/Place with an on-hand camera, first calculate the relative positional relationship between the workpiece position and the actual robot position according to the workpiece reference position and the robot grip position. Second, output to the robot controller the robot command position for picking or placing the measured workpiece.

Precautions for Correct Use

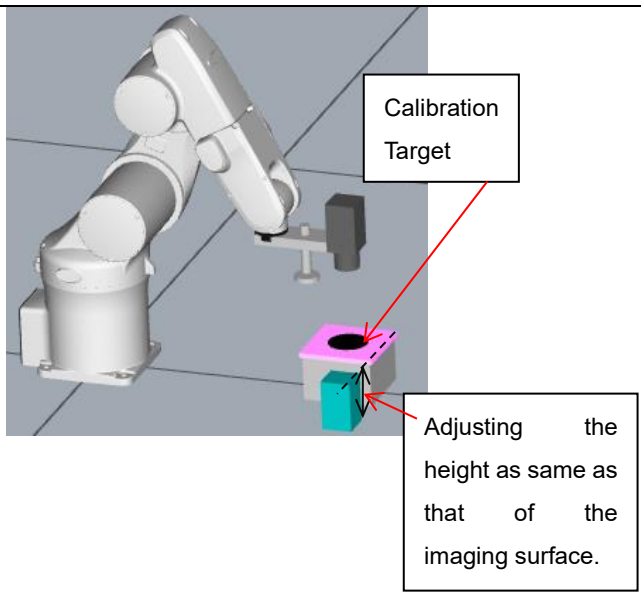
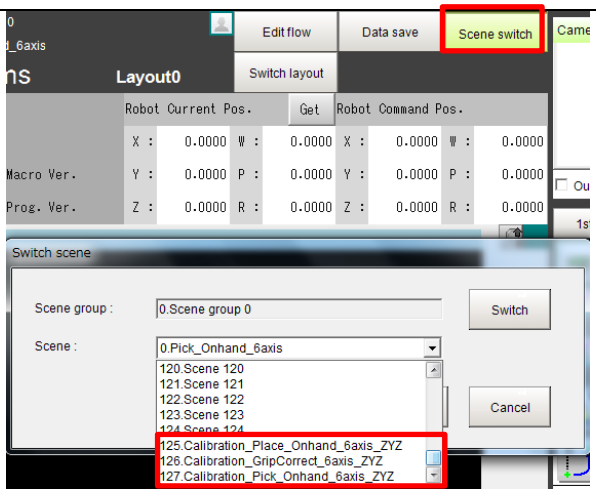
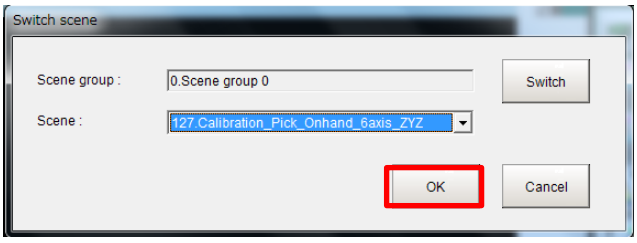
When selecting “Grip Correction + Place” or “Pick + Grip Correction + Place” in Chapter 4.1, output a position considering an amount of deviation calculated in Grip Correction at Place.

Please follow the flow below for the settings.

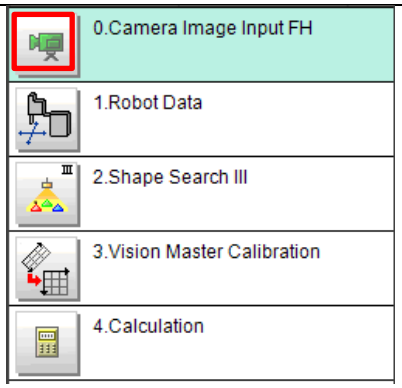
6.4.1	Setting Calibration	Set a scene for the Vision Sensor calibration to execute. Perform settings related to camera, target, and calibration operation.
▼		
6.4.2	Executing and Checking Calibration	Check the results after executing the calibration with operations of the Vision Sensor to handle data in the robot base coordinate system.
▼		
6.4.3	Setting Applications	Set a scene for applications of the Vision Sensor to pick or place a workpiece. Register the reference position of the robot operation and set a camera and workpiece.
▼		
6.4.4	Checking Application Operations	To check the correctness of the settings, check whether or not the robot actually moves to the Pick/Place position with operations of the Vision Sensor.
▼		
6.5	Backing up Settings	Back up the setting results of the Vision Sensor done in this Chapter.

6.4.1. Setting Calibration

Follow the procedures below to set a scene for Calibration.

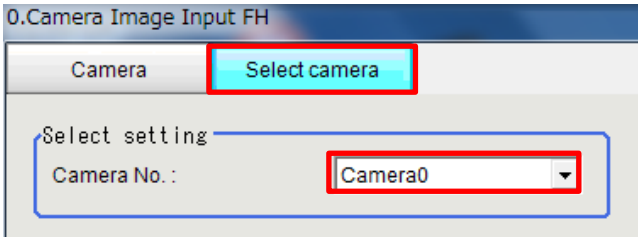
1	Prepare a calibration target and locate it as same as the height of the imaging surface of a workpiece. The target should have sufficient strength not to shift or deform by operations of the robot. The target should have a mark such as pattern or shape which the Shape Search III processing unit can detect.	
2	Click [Scene switch] on the Main Window of the Vision Sensor. Select target scenes. The target scenes are as follows. Pick: 127 Calibration_Pick_On-hand_xx_xxx Place: 125 Calibration_Place_On-hand_xx_xxx Click [OK] to switch scenes.	 

Click the “0. Camera image input FH” icon on the Main Window of the Vision Sensor to open the setting screen.
* When using the FHV Series Smart Camera Vision Sensor, delete the "0. Camera Image Input FH" unit and in its place set "Camera Image Input FHV" as Unit 0.



3

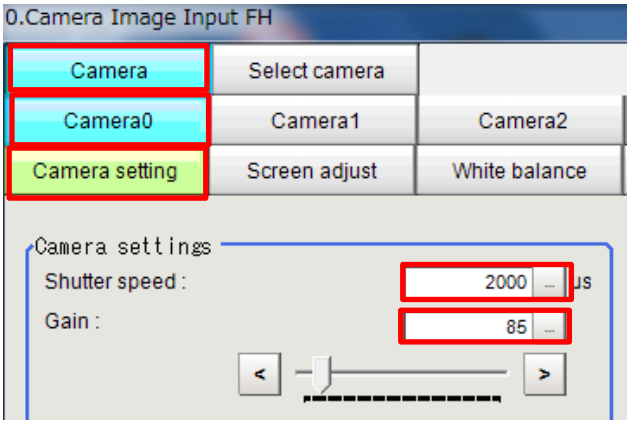
Check the set “Camera No.” by clicking [Select camera] tab.
* Change the camera number based on the actual environment.



Select the set camera number tab on the “Camera” tab.

Adjust the focus and iris of the camera while watching the image displayed.

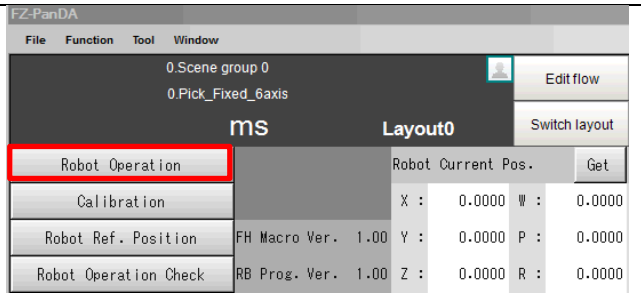
Adjust the shutter speed and gain of the camera on the “Camera settings” area.



4

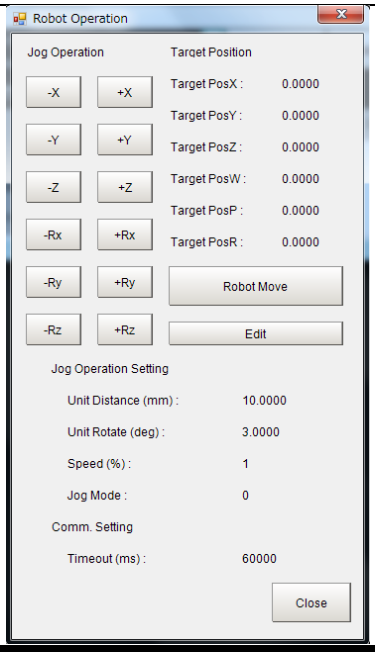
Change the image mode to “Through” on the Image Window Setting dialog in the Main Window of the Vision Sensor to display the camera image.

Click [Robot Operation] on the Main Window of the Vision Sensor to open the “Robot Operation” dialog.



On the “Robot Operation” dialog, operate the robot to move the calibration target close to the center of the field of view.

* After checking the position, return the image mode from “Through” to Freeze”.



⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

⚠CAUTION

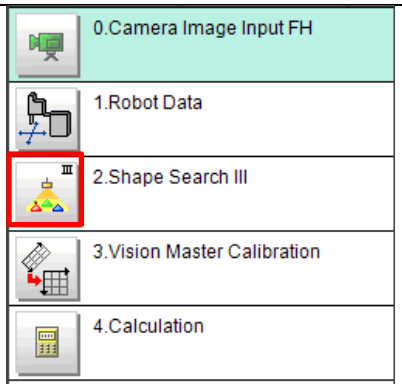
When the robot moves to Z-axis direction, check its motion by visual observation and not by camera image.

Precautions for Correct Use

Adjust the Z-axis direction so that the calibration target will be the same height as the imaging surface of a workpiece for Pick/Place.

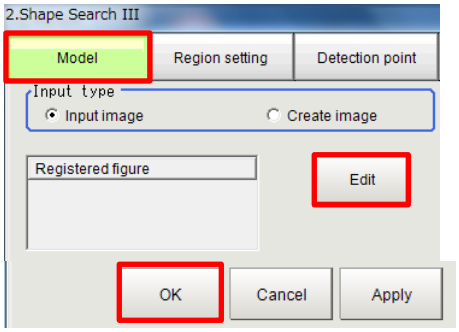
5

Click the “2. Shape search III” icon on the Main Window of the Vision Sensor to open the setting screen.

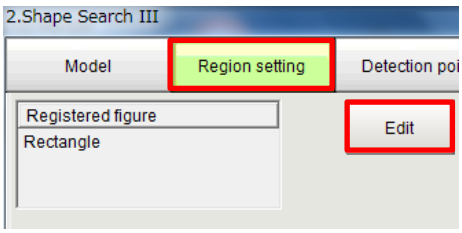


Select a registering figure by clicking [Edit] on the [Model] tab.

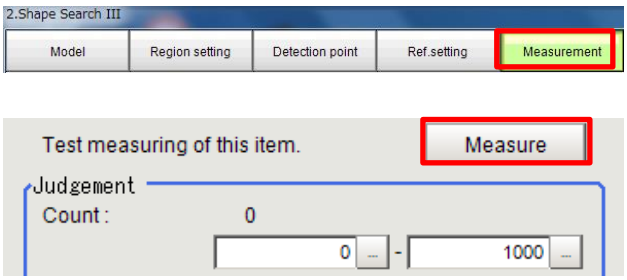
Register it as a model by clicking [OK] after fitting the registering figure to the calibration target.

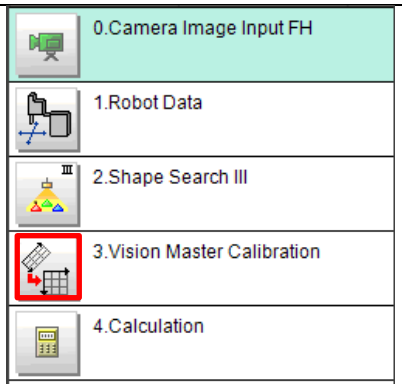
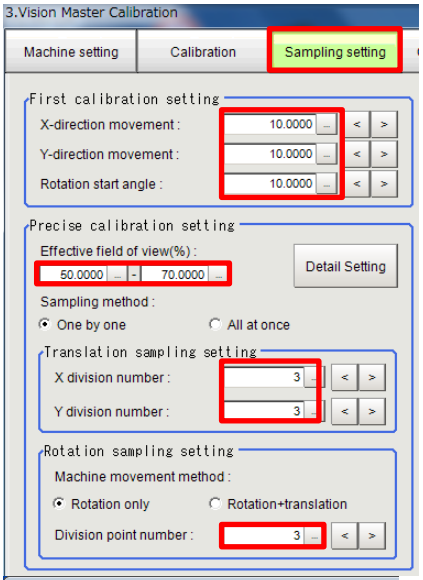
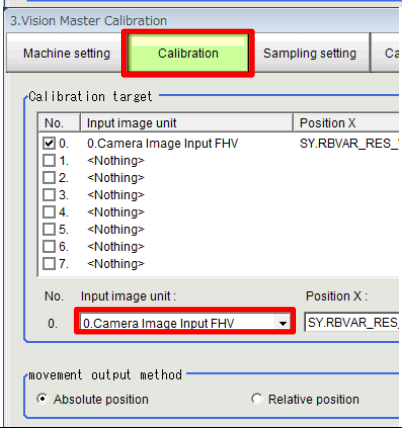
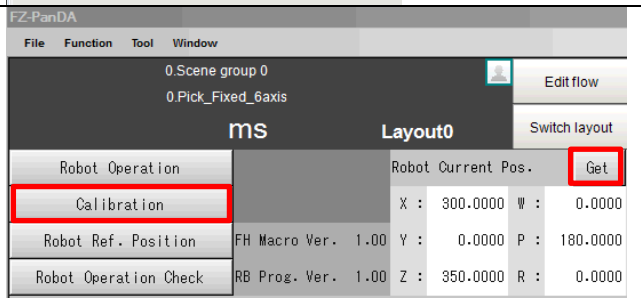


Click [Edit] on the [Region setting] tab to set the measurement region according to the field of view for a camera to use. Click [OK] after the setting.

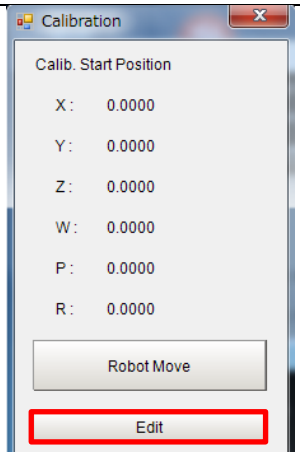


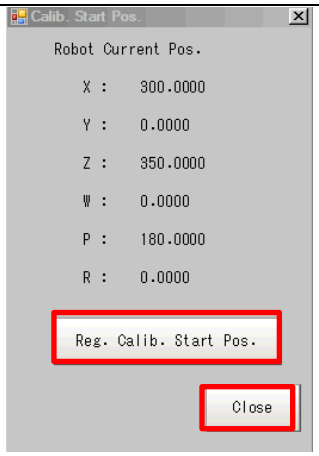
Click [Measurement] on the [Measurement] tab and check the “Count” becomes one.
* If it does not become one, the settings are not proper, so execute the model registration again.



6	Click the “3. Vision Master Calibration” icon on the Main Window of the Vision Sensor to open the setting screen. Select [Sampling setting] tab and set “First calibration setting”, “Effective field of view”, “Translation sampling setting”, “Division point number” according to the actual environment. * When using the FHV Series Smart Camera Vision Sensor, select the "Calibration" tab and in the field for "Image Input" select "Camera Image Input FHV".	  
7	Click [Get] on the Main Window of the Vision Sensor to get the current position of the robot. Click [Calibration] to open the “Calibration” dialog. Click [Edit] in the calibration dialog to open the “Calib. Start Pos.” dialog.	

Check that the dialog displays the current position of the robot and click “Reg. Calib. Start Pos.”





After clicking [Close], check that the “Calib. Start Position” in the “Calib. Start Pos.” dialog has been updated.

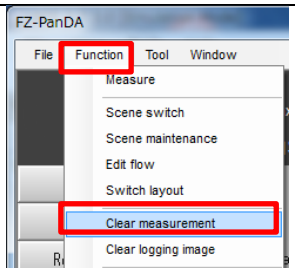
⚠WARNING

An operation of the dialog will automatically set values to Scene and System variables previously set in the scenes loaded by the environment copy feature in Chapter 5.1. Do not directly set the values by TDM editor or setting screens for processing items.
If proceeding to the following steps without registering the calibration start position, the robot would produce unexpected motion. Please be sure to register the position.

6.4.2. Executing and Checking Calibration

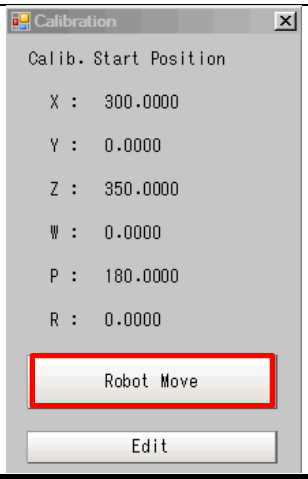
Follow the procedures below to execute and check the calibration.

1 Select [Function] - [Clear measurement] on the Main Window menu to clear the previous measurement results.



2

Click [Robot Move] in the “Calibration” dialog to move the robot to the calibration start position.



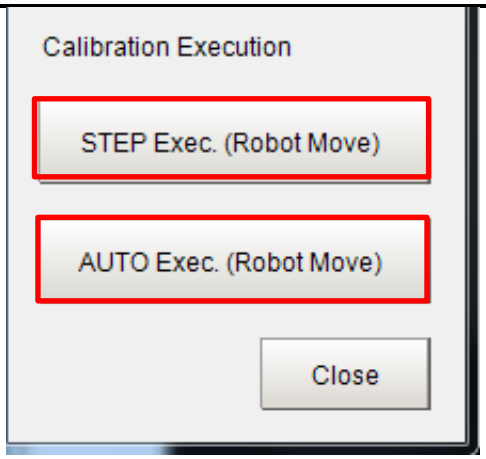
⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

3

In the “Calibration” dialog, clicking [SETP Exec. (Robot Move)] for the number of sampling points set at step 6 in Chapter 6.4.1 or clicking [Auto Exec. (Robot Move)] will execute the calibration.

* If stopping this motion on the way, the target measurement may not have been executed correctly. Review the camera settings, model registration, and environment of lightings.

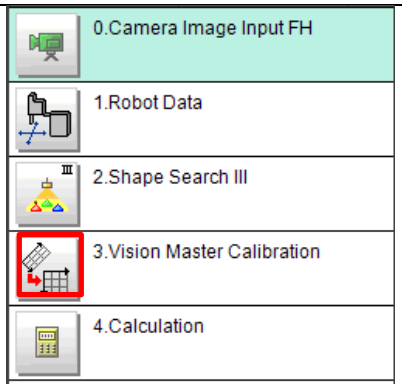


⚠WARNING

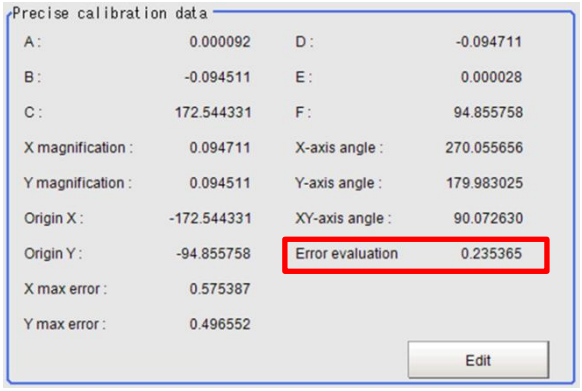
- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

4

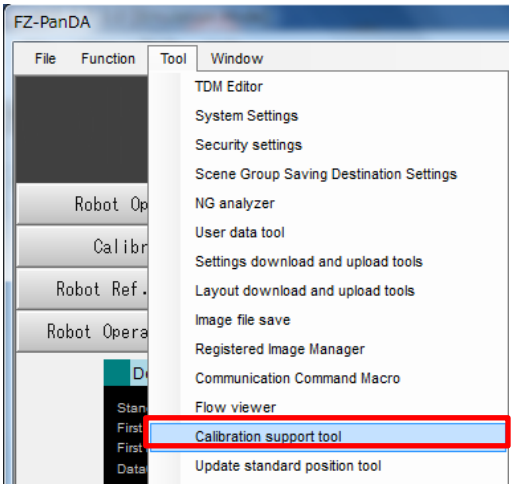
Click the “3. Vision Master Calibration” icon on the Main Window of the Vision Sensor to open the setting screen.



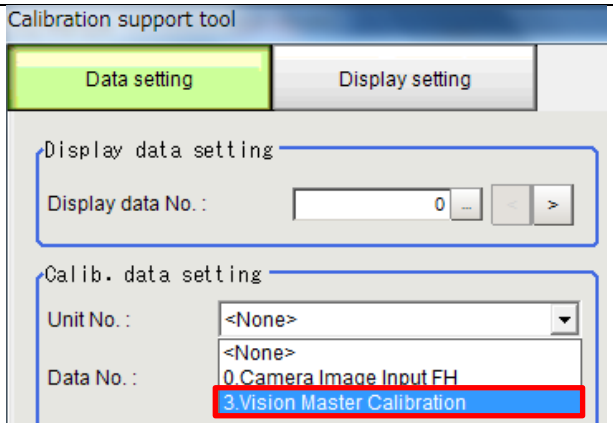
Select [Calibration result] tab to check whether or not the “Error evaluation” has converged within the accuracy required.



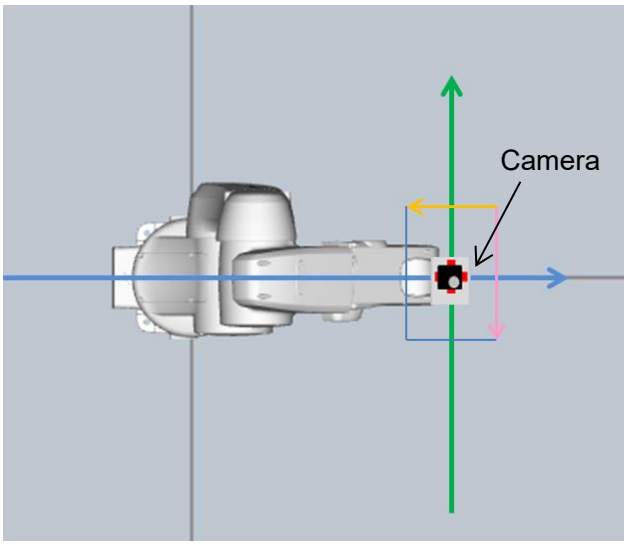
Select [Tool] - [Calibration support tool] from the menu bar.



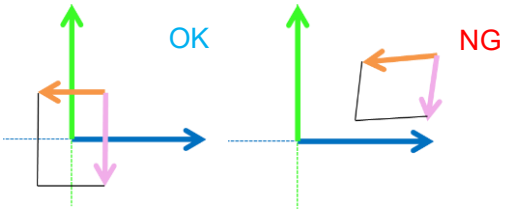
In the [Data setting] tab, set the unit No. to the “3 Vision Master Calibration” to check the relationship between the camera coordinate system and robot coordinate system got from the calibration.



* Regarding the robot base coordinate system shown on the right figure, set the “Rotation” at the “Standard axis” on the “Display setting” tab in the “Calibration support tool” to “Anticlockwise”.



If the relation such as directions and camera coordinate origin position between the camera and the robot flange coordinate systems is same as the actual system configuration, the calibration has succeeded.

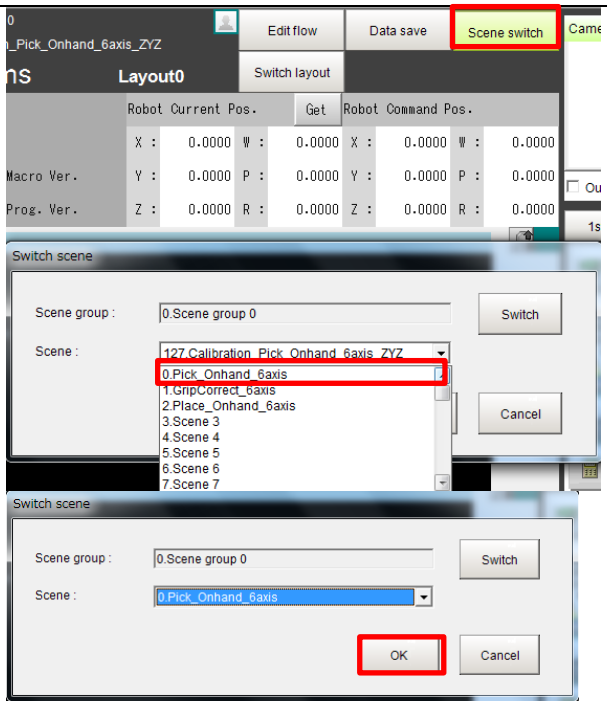
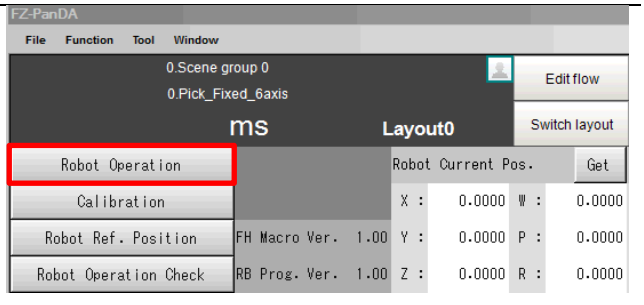


* Like the NG example, if the relation between the camera and the robot flange coordinate systems is different, the calibration has failed. Review the camera settings, model registration, and environment of lightings and then execute the calibration again.

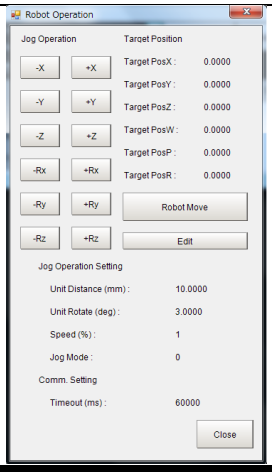
	* When using the FHV Series Smart Camera Vision Sensor, you can use the Simulation Software to load a settings data file that has been saved for backup. This will allow you to launch the "Calibration Support Tool" from the "Tool" menu. For additional information on backing up settings data, please refer to Section 6.5	
5	Remove the calibration target from the robot.	

6.4.3. Setting Applications

Follow the procedures below to set a scene for applications.

1	Click [Scene switch] on the Main Window of the Vision Sensor. Select target scenes. The target scenes are as follows. Pick: 0. Pick_On-hand_xx Place: 2. Place_On-hand_xx Click [OK] to switch scenes.	
2	Check that the check box for “Output” is not checked. The serial data for the measurement value is not output until the Vision Sensor setting is completed. Place a check in the check box when executing a robot sample program described in Chapter 7.	
3	Click [Robot Operation] on the Main Window of the Vision Sensor to open the “Robot Operation” dialog.	

Move the robot to a position to image (measure) the workpiece for Pick/Place on the “Robot operation” dialog.



⚠WARNING

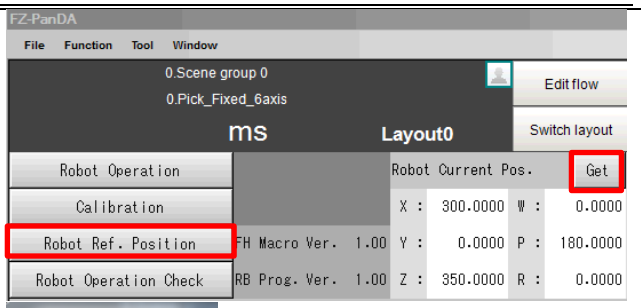
- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

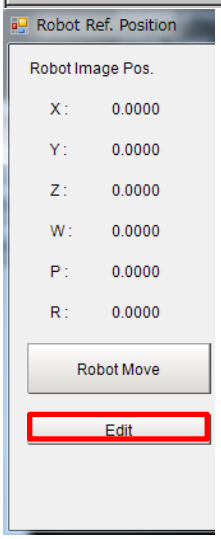
4

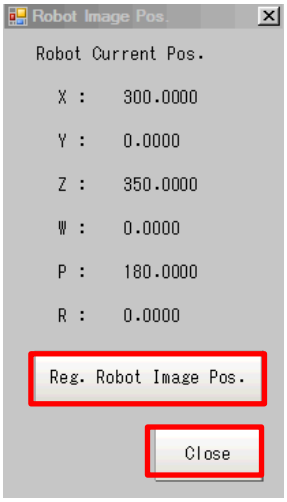
Click [Get] on the Main Window of the Vision Sensor to get the current position of the robot.

Click [Robot Ref. Position] on the Main Window of the Vision Sensor to open the “Robot Ref. Position” dialog.

Click [Edit] of “Robot Image Pos.” on the “Robot Ref. Position” dialog to open the “Robot Image Pos.” dialog.







Click [Reg. Robot Image Pos.] on the “Robot Image Pos.” dialog to register the current position of the robot.
After clicking [Close], check that the “Robot Image Pos.” on the “Robot Ref. Position” dialog has been updated.

⚠WARNING

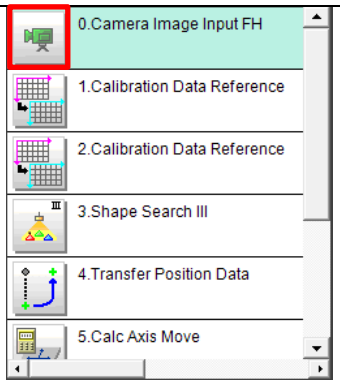
An operation of the dialog will automatically set values to Scene and system variables previously set in the scenes loaded by the environment copy feature in Chapter 5.1. Do not directly set the values by TDM editor or setting screens for processing items.
If application operations are performed without registering the “Robot Image Pos.”, the robot would produce unexpected motion. Please be sure to register the position.

5

Place a workpiece for Pick/Place into the field of view.

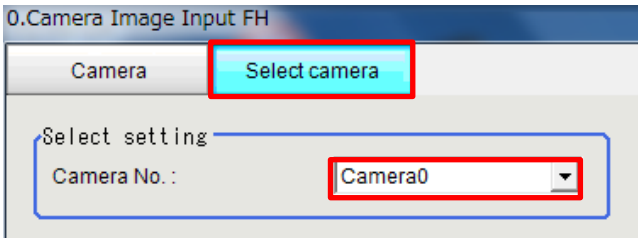
6

Click the “0. Camera image input FH” icon on the Main Window of the Vision Sensor to open the setting screen.
* When using the FHV Series Smart Camera Vision Sensor, delete the "0. Camera Image Input FH" unit and in its place set "Camera Image Input FHV" as Unit 0.



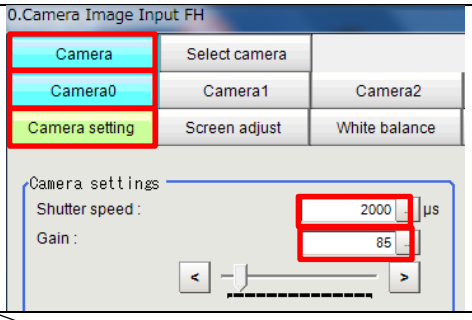
Check the set “Camera No.” by clicking [Select camera] tab.

* Change the camera number based on the actual environment.



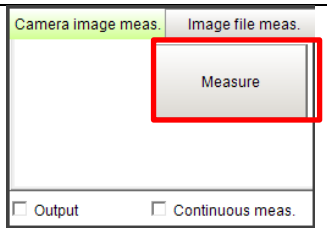
Select the set camera number tab on the “Camera” tab.

Adjust the shutter speed and gain of the camera on the “Camera settings” area.

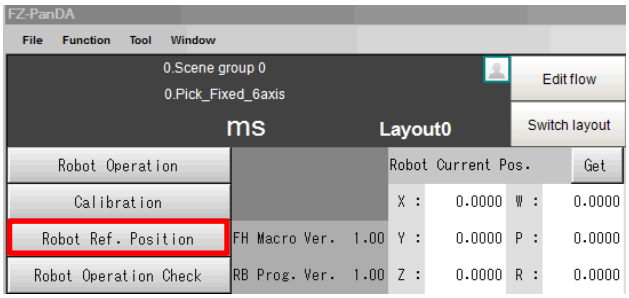


7 Register a workpiece as a model for Pick/Place on Shape Search III by operations as same as those at step5 in Chapter 6.4.1

Select [Camera image meas.] on the Main Window of the Vision Sensor and detect a workpiece position for Pick/Place with clicking [Measure].

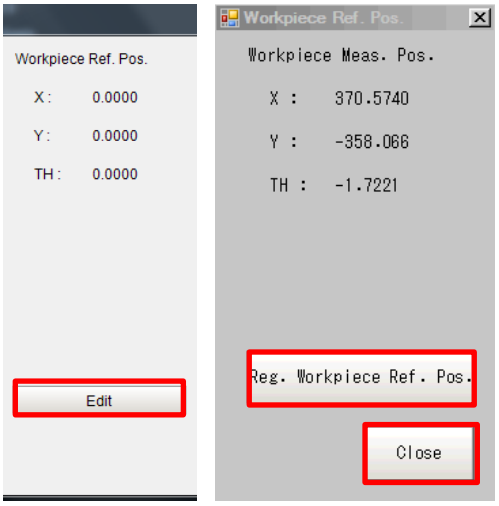


Click [Robot Ref. Position] on the Main Window of the Vision Sensor to open the “Robot Ref. Position” dialog.



8 Click [Edit] on the “Robot Ref. Position” dialog to open the “Workpiece Ref. Pos.” dialog.

Click [Reg. Workpiece Ref. Pos.] on the “Workpiece Ref. Pos.” dialog to register the measurement position of the workpiece.



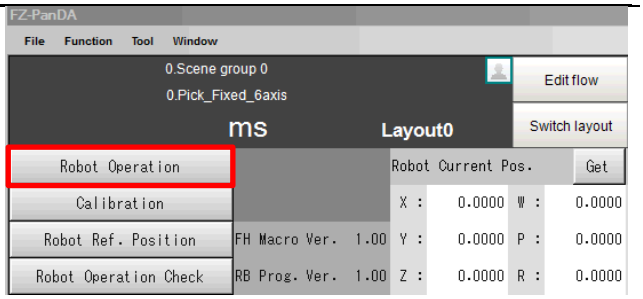
After clicking [Close], check that the “Workpiece Ref. Pos.” on the “Robot Ref. Position” dialog has been updated.

⚠WARNING

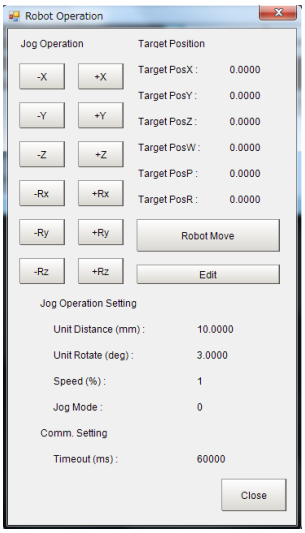
An operation of the dialog will automatically set values to Scene and System variables previously set in the scenes loaded by the environment copy feature in Chapter 5.1. Do not directly set the values by TDM editor or setting screens for processing items.
If application operations are performed without registering the “Workpiece Ref. Pos.”, the robot would produce unexpected motion. Please be sure to register the position.

9

Click [Robot Operation] on the Main Window of the Vision Sensor to open the “Robot Operation” dialog.



Move the robot to a position to grip the workpiece for Pick/Place on the “Robot Operation” dialog.



⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

⚠CAUTION

When the robot moves to Z-axis direction, check its motion by visual observation and not by camera image.

10

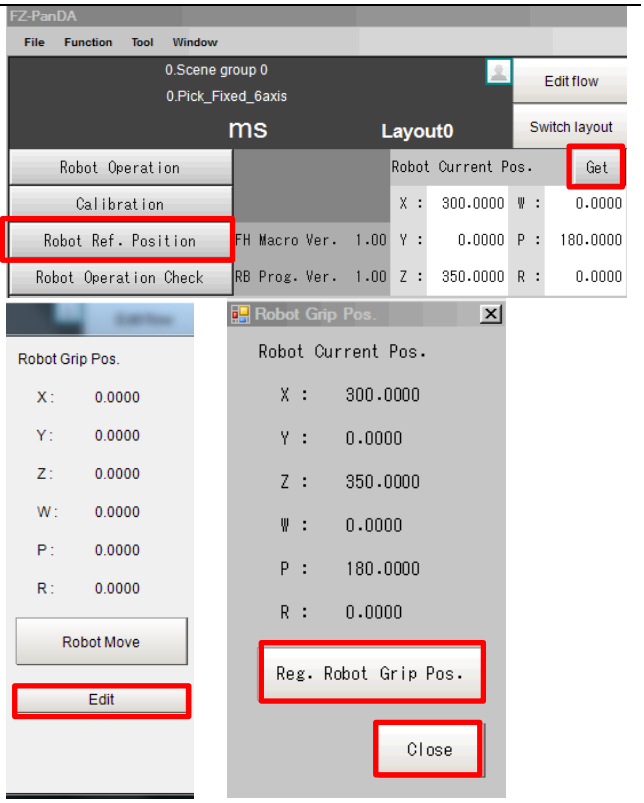
Click [Get] on the Main Window of the Vision Sensor to get the current position of the robot.

Click [Robot Ref. Position] on the Main Window of the Vision Sensor to open the “Robot Ref. Position” dialog.

Click [Edit] on the “Robot Ref. Position” dialog to open the “Robot Grip Pos.” dialog.

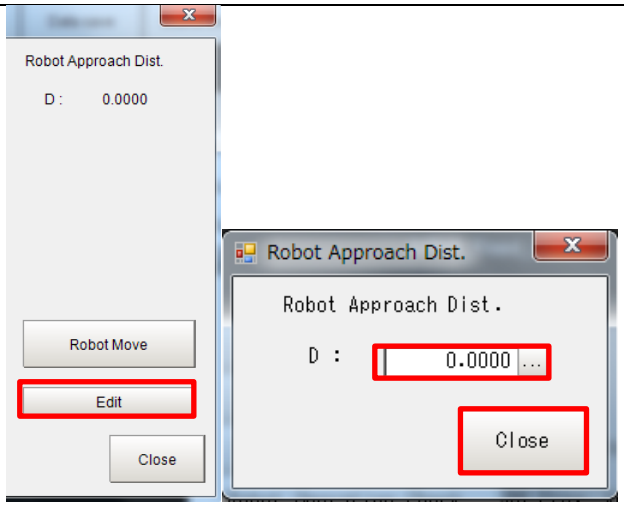
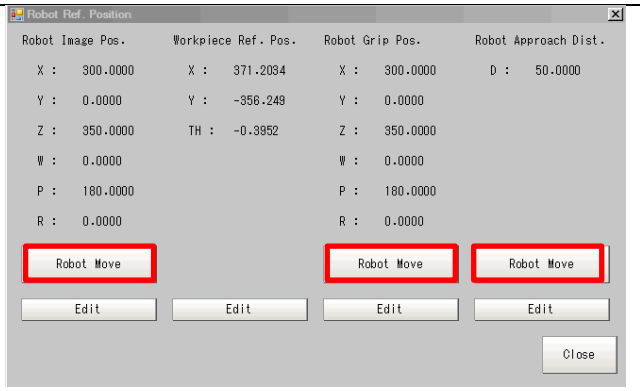
Click [Reg. Robot Grip Pos.] on the “Robot Grip Pos.” dialog to register the current position of the robot.

After clicking [Close], check that the “Robot Grip Pos.” on the “Robot Ref. Position” dialog has been updated.



⚠WARNING

An operation of the dialog will automatically set values to Scene and System variables previously set in the scenes loaded by the environment copy feature in Chapter 5.1. Do not directly set the values by TDM editor or setting screens for processing items.
If application operations are performed without registering the “Robot Grip Pos.”, the robot would produce unexpected motion. Please be sure to register the position.

11	Click [Edit] of “Robot Approach Dist.” on the “Robot Ref. Position” dialog to open the “Robot Approach Dist. ” dialog. Set the robot approach distance on the “Robot Approach Dist.”. After clicking [Close], check that the “Robot Approach Dist.” on the “Robot Ref. Position” dialog has been updated.	
12	Click [Robot Move] of the “Robot Image Pos.” on the “Robot Ref. Position” dialog to check that the robot moves to the imaging position registered. Click [Robot Move] of the “Robot Grip Pos.” on the “Robot Ref. Position” dialog to check that the robot moves to the grip position registered. Click [Robot Move] of the “Robot Approach Dist.” on the “Robot Ref. Position” dialog to check that the robot moves to + Z direction for the value set in “Robot Approach Dist.” from the robot gripping position.	

* If the robot produced unexpected motion, please register the robot approach distance again.

⚠WARNING

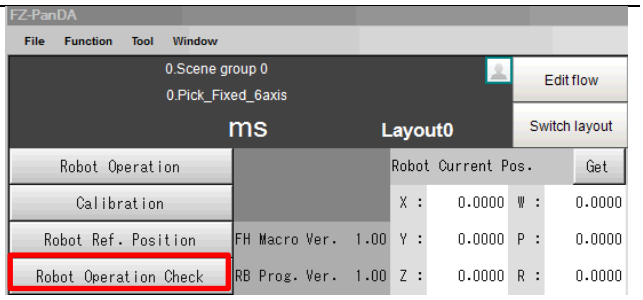
- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

6.4.4. Checking Application Operations

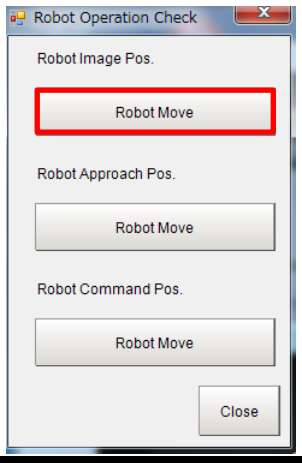
Follow the procedures below to check that scenes for applications are operable.

1

Click [Robot Operation Check] on the Main Window of the Vision Sensor to open the “Robot Operation Check” dialog.



Click [Robot Move] of the “Robot Image Pos.” on the “Robot Operation Check” dialog and move the robot to the imaging position.

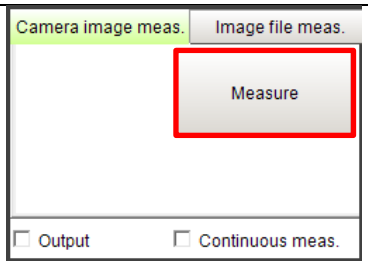


⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

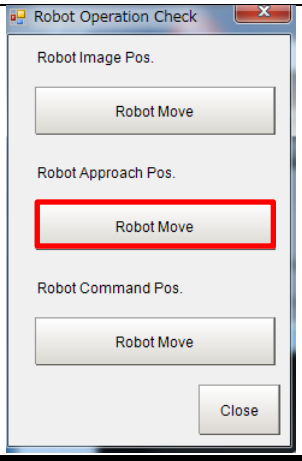
2

Select [Camera image meas.] on the Main Window of the Vision Sensor and detect a workpiece position for Pick/Place with clicking [Measure].



3

Click [Robot Move] of the "Robot Approach Pos." on the "Robot Operation Check" dialog and move the robot to the approach position.

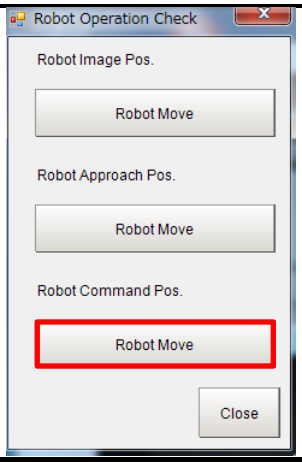


⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

4

Click [Robot Move] of the "Robot Command Pos." on the "Robot Operation Check" dialog and move the robot to the command position.



⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.
- Check the measurement results before the robot operation. The robot may produce unexpected motion.
- Change positions and angles of the workpiece for Pick/Place to check the operation sufficiently.

5	Stop the robot program launched by procedures in Chapter 5.3.	

6.5. Backing up Settings

When backing up the settings of the Vision Sensor done in Chapter 6.2, 6.3, and 6.4 into an external storage, use the configuration copy feature.

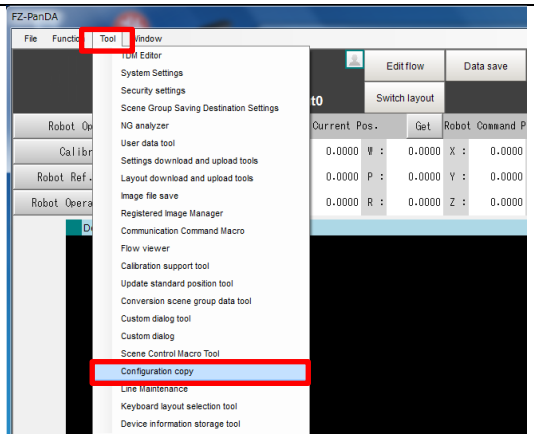
Precautions for Correct Use

Saving an individual scene or individual scene groups cannot back up all of settings done in Chapter 6. Be sure to use the configuration copy feature.

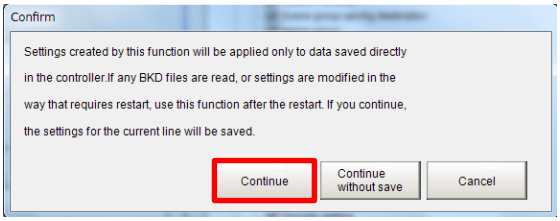
Follow the procedures below to back up the settings.

1

Select [Tool] - [Configuration copy] on the Main Window of the Vision Sensor to open the “Configuration copy” screen.



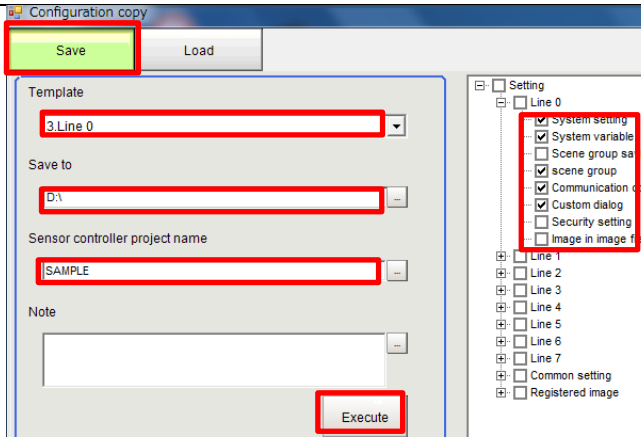
A “Confirm” dialog is displayed. Click [Continue].



2

In the [Save] tab on the “Configuration copy” screen, Set the “3. Line 0” for a template setting. Set the destination device to the “Save to” and the project name for the backup to the “Sensor controller project name”.

For selecting saving items shown on the right, place a check to the following items only.



	☑ System setting ☑ System variable ☑ Scene group ☑ Communication command macro ☑ Custom dialog Click [Execute] to save the settings.

7. Designing Robot Programs

This chapter describes design examples of robot programs to construct applications using a sample program (fhsample_main()).

Precautions for Correct Use

The implementation procedures for robot programs noted in this chapter are a reference. You should design, implement, and test actually operating robot programs based on your specific environment and applications.
In the Main Window or "Layout setup" of the Vision Sensor, check that the "Output" of the current layout is ON. If the setting were OFF, the Vision Sensor will not output measurement values.

The sample program (fhsample_main()) is implemented with the following procedures.

7.1	Connecting the Vision Sensor to the robot controller	Declare internal variables and initialize external variables. Set IP addresses and port numbers as arguments of a connection function to the Vision Sensor and execute the function.
▼		
7.2	Switching scenes on the Vision Sensor	Set a switching destination scene number as arguments of a scene switching command execution sample function and execute the function.
▼		
7.3	Moving the robot to the robot image position	Read the robot imaging position from the Vision Sensor, set it as arguments of a robot motion sample function and execute the function.
▼		
7.4	Executing measurements on the Vision Sensor and Getting the measurement results	Execute a current position registration command execution sample function and a measurement command execution sample function. Set the measurement results to variables.
▼		

7.5	Moving the robot to the robot approach position at measurement	Read the robot approach distance from the Vision Sensor and add the reading to the measurement results. Set it as arguments of a robot motion sample function and execute the function.
7.6	Moving the robot to the robot command position at measurement	Set the measurement results as arguments of a robot motion sample function and execute the function.
7.7	Disconnecting the Vision Sensor from the robot controller	Execute a disconnection function to the Vision Sensor.

7.1. Connecting Vision Sensor to Robot Controller

For connecting the Vision Sensor to the Robot Controller, follow the procedures below.

1

* Omitted (Refer to the source code)

Declare internal variables.

2

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; (2)Initialaize global variables
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
CALL fhdefglobal()
err_scene_no = -1000 ;Scene No. error
min_scene_no = 0       ;Mim scene No.
max_scene_no = 127     ;Max scene No.

socket_no = 0
err_no = success
TYPE "Initialization Done."
```

Initialization function for external variables

Execute the initialization function (fhdefglobal) for external variables.

3

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; (1)Set the network configuration
;    You have to configure the following communication settings.
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
$ip_address = "10.5.5.100"
$port_no = "9876"
retries_connect = 2 ;times
timeout_connect = 4 ;sec
retries_connect = 2 ;times
timeout_connect = 4 ;sec
```

IP address

Port number

Set the IP address and the port number of the Vision Sensor to the variables. (When changing those from the default.)

4	```
	;;;
	; (2)Connect to the FH server
	;;;
	WHILE bconnected == 0 DO
	    CALL fhconnect($ip_address, $port_no, retries_connect, timeout_connect, socket_no, err_no)
	    ; Error check
	    IF err_no <> success THEN
	        TYPE "ERROR: fhsample_main(): Connection failed. Exit:", err_no
	        GOTO 11
	    END
	END
	TYPE "Connection Done."
	``
	Connection function with the Vision Sensor (FH server)
	Set the variables as arguments for the connection function (fhconnect) to the Vision Sensor (FH server) and execute it.

7.2. Switching Scenes on Vision Sensor

For a processing to switch scenes on the Vision Sensor, follow the procedures below.

1	``` ;;; ; (1)Change the scene of the FH ; You have to select a scene No. for your application. ; 0 : Workpiece picking scene ; 1 : Grasp adjustment scene ; 2 : Workpiece picking scene ;;; scene_no = 0 ``` Scene number Set a scene number for the switching destination to a variable. For scene numbers for each application, refer to the following. Pick: Scene 0 Grip Correction: Scene 1 Place: Scene 2

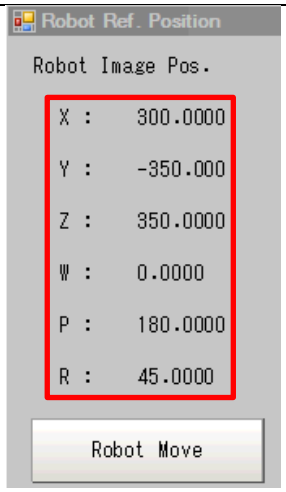
2	```
	CALL fhsample_chgscn(socket_no, retry_count, time_out, scene_no, err_no)
	; Error check
	IF err_no <> success THEN
	    TYPE "ERROR: fhsample_main(): Connection failed. Exit:", err_no
	    GOTO 10
	END
	TYPE "Change scene No. Done."
	``
	Scene switching command execution sample function
	Set the variables as arguments to the scene switching command execution sample function (fhsample_chgscn) to the Vision Sensor and execute it.

7.3. Moving Robot to Robot Image Position

For a processing to move the robot to the robot image position, follow the procedures below.

1

Click [Robot Ref. Position] on the Main Window of the Vision Sensor to refer to the set robot image position.



2

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; (2)Move the robot to the imaging position
;     You have to configure the following robot position for your application.
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
std_img_pos_x = 300
std_img_pos_y = -350
std_img_pos_y = 350
std_img_pos_y = 0
std_img_pos_y = 180
std_img_pos_y = 45
```

Set the robot imaging position to the variables.

Set the referenced robot image position to the variables.

3

```
;!!!!!!!!! CAUTION !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
; The following function drives a robot motion immediately.
; Confirm the settings before execution.
;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
CALL fhsample_move(std_img_pos_x, std_img_pos_y, std_img_pos_z, std_img_pos_w,
std_img_pos_p, std_img_pos_r)
```

Robot motion sample function

```
; Error check
IF err_no <> success THEN
    TYPE "ERROR: fhsample_main():The robot position is out of range :", err_no
    GOTO 10
END
TYPE "Move to the imaging position Done."
```

Set the variables as arguments for the robot motion sample function (fhsample_move) and execute it.

⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

7.4. Executing Measurements on Vision Sensor and Getting Measurement Results

For a processing to execute measurements on the Vision Sensor and to get the measurement results, follow the procedures below.

1

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; (3)Register the current position of the robot to the FH before measurement
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
CALL fhsample_chgscn(socket_no, retry_count, time_out, scene_no, err_no)

; Error check
IF err_no <> success THEN
    GOTO 10
END
TYPE "Register the current robot position Done."
```

Current position registration command execution sample function

Before executing measurements, execute the current position registration command execution sample function (fhsmaple_regpos) to the Vision Sensor.

2

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; (4)Execute measurement and get the measurement results of the FH
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
CALL fhsample_chgscn(socket_no, retry_count, time_out, scene_no, err_no)

; Error check
IF err_no <> success THEN
    TYPE "ERROR: fhsample_main(): Measure on the Vision controller failed:", err_no
    GOTO 10
END
```

Measurement command execution sample function

Execute the measurement command execution sample function (fhsmaple_trig) to the Vision Sensor.

3

```
; Measurement results
res_cmd_pos_x = param [0]
res_cmd_pos_x = param [1]
res_cmd_pos_x = param [2]
res_cmd_pos_x = param [3]
res_cmd_pos_x = param [4]
res_cmd_pos_x = param [5]
TYPE "Measurement Done"
```

Set the measurement results to the variables.

7.5. Moving Robot to Robot Approach Position at Measurement.

For a processing to move the robot to the robot approach position at measurement, follow the procedures below.

1

By the procedures in Chapter 7.4, check that the measurement results are stored in the variables

2

Click [Robot Ref. Position] on the Main Window of the Vision Sensor to refer to the set robot approach distance.

3

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; (5)Move the robot to the approach position
;     You have to configure the following robot approach distance for your application.
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
std_appro_dist = 30
```

Set the robot approach distance to the variable.

```
res_appro_pos_x = res_cmd_pos_x
res_appro_pos_x = res_cmd_pos_x
res_appro_pos_z = res_cmd_pos_z+std_appro_dist
res_appro_pos_x = res_cmd_pos_x
res_appro_pos_x = res_cmd_pos_x
res_appro_pos_x = res_cmd_pos_x
```

Add the robot approach distance to the measurement results.

Set the referenced robot approach distance to the variable and add the robot approach distance to the measurement results acquired at step 3 in Chapter 7.4.

4

```
;!!!!!!!!! CAUTION !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
; The following function drives a robot motion immediately.
; Confirm the settings before execution.
;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
CALL fhsample_move(res_appro_pos_x, res_appro_pos_y, res_appro_pos_z,
res_appro_pos_w, res_appro_pos_p, res_appro_pos_r)
```

Robot motion sample function

```
; Error check
IF err_no <> success THEN
    TYPE "ERROR: fhsample_main():The approach position is out of range :", err_no
    GOTO 10
END
TYPE "Move to the approach position Done."
```

Set the variable as arguments for the robot motion sample function (fhsample_move) and execute it.

⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

7.6. Moving Robot to Robot Command Position at Measurement

For a processing to move the robot to the robot command position at measurement, follow the procedures below.

1 By the procedures at step 3 in Chapter 7.4, check that the measurement results are stored in variables.

2

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; (6)Move the robot to the measuring position.
;     You have to edit this section for your application.
;     e.g: Adding an end effector control, depart path motion, etc.
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

;!!!!!!!!! CAUTION !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
; The following function drives a robot motion immediately.
; Confirm the settings before execution.
;!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
CALL fhsample_move(res_cmd_pos_x, res_cmd_pos_y, res_cmd_pos_z, res_cmd_pos_w,
res_cmd_pos_p, res_cmd_pos_r)
```

Robot motion sample function

```
; Error check
IF err_no <> success THEN
    TYPE "ERROR: fhsample_main(): The measuring robot position is out of range :", err_no
    GOTO 10
END
TYPE "Move to the measuring position Done."
```

Set the variables as arguments for the robot motion sample function (fhsample_move) and execute it.

⚠WARNING

- These operations drive the robot.
- Operate the robot in the state whereby pressing the [Emergency stop] button can stop its motion anytime.

7.7. Disconnecting Vision Sensor from Robot Controller

For a processing to disconnect the Vision Sensor from the Robot Controller, follow the procedures below.

1

```
10     ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
       ; 4. Example: Finalization sequence
       ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
       ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
       ; (1)Disconnect from the FH server
       ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
       WHILE bconnected == 1 THEN
           CALL fhclose(socket_no, err_no)
       END
       TYPE "Disconnection Done"
 11
       TYPE "EXIT Program"
```

Disconnection function to the Vision Sensor (FH server)

Execute the disconnection function to the Vision Sensor.

8. Reference Information

Man. No.	Model	Manual name
I599-E	Vertical multi-joint robot, Viper 650/850 eMB-60R	User's manual
I601-E	Teaching pendant T20	User's manual
I602-E	Robot controller, SmartController EX	User's manual
I603-E	Automation control environment (ACE)	Operation manual
I604-E	eV+ language	User's manual
I590-E	Robot	Robot Safety Guide

Man. No.	Model	Manual name
Z365	Vision Sensor FH/FHV series	User's manual
Z342	Vision Sensor FH/FHV series	User's manual Communication settings
3102269-4B	FH-2[][][](-[][])/FH-5[][][](-[][])	Image Processing System Instruction Sheet
9607479-9B	FH-1[][][](-[][])/FH-3[][][](-[][])	Image Processing System Instruction Sheet
9606631-1B	FH-L550/L550-10	Image Processing System Instruction Sheet
3129404-0C	FHV7[]-[][][][]-C	Smart Camera Instruction Sheet

9. Revision History

Revision Symbol	Revision Date	Description
A	July 2018	First Edition
B	November 2018	Add Vision Sensor FHV Series
C	November 2019	Add support for FH/FHV Series version 6.21

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