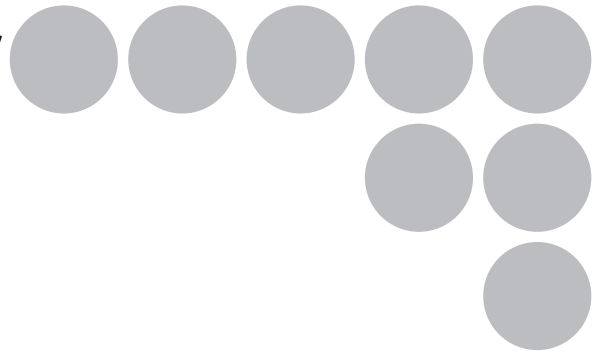


## Specialized Vision Sensor for Positioning

FZM1 Series



## User's Manual

# Introduction

---

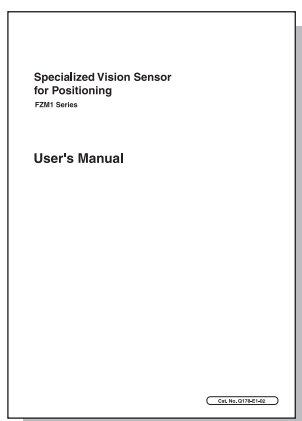
Thank you for purchasing the FZ3 Series.

This manual provides information regarding functions, performance and operating methods that are required for using the FZ3 Series.

When using the FZ3 Series, be sure to observe the following:

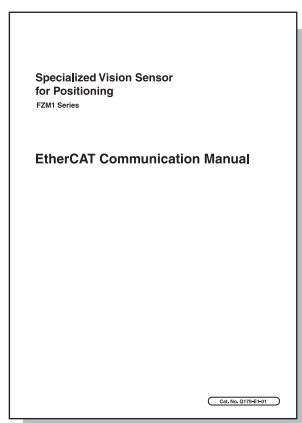
- The FZ3 Series must be operated by personnel knowledgeable in electrical engineering.
- To ensure correct use, please read this manual thoroughly to deepen your understanding of the product.
- Please keep this manual in a safe place so that it can be referred to whenever necessary.

## Manuals Provided with this Product



### User's Manual (this document)

This manual describes information on settings and specifications.



### EtherCAT Communication Manual

This manual provides reference information for when this product performs communications with an external device, such as a PC or a programmable controller, via EtherCAT Communications.

# Contents

---

<b>1</b>	<b>About the FZM1 Specialized Alignment Software .....</b>	<b>1</b>
	1-1 Software Outline .....	1
	1-2 System Configuration .....	2
	1-3 Restrictions and Precautions .....	3
	1-4 Differences with the Standard Product (FZ3) .....	4
<b>2</b>	<b>Basic Setting Procedure .....</b>	<b>5</b>
	2-1 Initial Setting .....	6
<b>3</b>	<b>Calibration and Scene Settings.....</b>	<b>7</b>
	3-1 Calibration Setting .....	7
	Instrument Setting .....	7
	Calibration Setting Window .....	8
	3-2 Calibration Methods .....	14
	Auto Calibration .....	14
	Manual Calibration .....	21
	3-3 Alignment Measurement and Scene Setting .....	25
	3-4 Position Deviation Calculation .....	26
	Setting Flow .....	26
	Parameters .....	26
	Output Setting .....	29
	To Get Measurement Results from an External Source .....	30
<b>4</b>	<b>Specialized Processing Items .....</b>	<b>33</b>
	4-1 EC Corner .....	33
	Setting Flow .....	33
	Region Setting .....	34
	Reference Position .....	35
	Line Extraction .....	35
	Corner Extraction .....	36
	Measurement Parameters .....	38
	Output Parameters .....	39
	To Get Measurement Results from an External Source .....	40
	4-2 EC Cross .....	43
	Setting Flow .....	43
	Region Setting .....	44
	Reference Position .....	45
	Line Extraction .....	45
	Cross Extraction .....	46
	Measurement Parameters .....	48
	Output Parameters .....	49
	To Get Measurement Results from an External Source .....	50

---

4-3	Intersection Coordinates .....	52
	Setting Flow .....	52
	Region Setting .....	53
	Edge Color Specification (Color Camera Only) .....	54
	Reference Position .....	55
	Measurement Parameters .....	55
	Judgement Conditions .....	57
	Output Parameters .....	57
	To Get Measurement Results from an External Source .....	58
4-4	Scan Edge Circle .....	62
	Setting Flow .....	62
	Region Setting .....	63
	Edge Color Specification (Color Camera Only) .....	64
	Ref. Position .....	65
	Measurement Parameters .....	66
	Judgement Conditions .....	67
	Output Parameters .....	68
	To Get Measurement Results from an External Source .....	69
4-5	ECM Search Motion .....	71
	Setting Flow .....	72
	Model Registration .....	72
	Error model registration .....	75
	Region Setting .....	75
	Detection Point .....	75
	Reference Position .....	76
	Measurement Parameters .....	77
	Output Parameters .....	78
	To Get Measurement Results from an External Source .....	79
<b>5</b>	<b>Methods for Connecting and Communicating with External Devices .....</b>	<b>82</b>
5-1	Differences with the Standard Product (FZ3) .....	82
	Command List (Normal) .....	82
	Command List (PLC Link, EtherCAT) .....	83
	Communication Command Details (Normal) .....	85
<b>6</b>	<b>Specialized Functions.....</b>	<b>89</b>
6-1	About User Settings .....	89
	User Settings .....	89
	User Control .....	90
	Security Setting .....	93
6-2	About Force Setting .....	94

## Index

## Manual Revision History

---

# 1 About the FZM1 Specialized Alignment Software

---

This is specialized software based on FZ3 for performing positioning operations in processes such as assembly and picking.

By using the wide range of setting functions that are available with this software, it is easy to perform highly accurate and efficient inspections.

## 1-1 Software Outline

---

The software can be used to perform the following inspections.

### Auto/Manual Calibration

There are 2 calibration methods; auto calibration that is executed when a command is sent from the PLC, and manual calibration for which the movement amount is entered manually. Up to 4 patterns can be saved for the calibration setting values.

### Position Deviation Calculation

This processing item calculates the deviation in the position of the measurement object in accordance with the stage type.

### EC Corner

This processing item detects corners from the cross point of 2 lines that are created by edges. Stable detection can be performed even for images with low contrast or high noise levels.

### EC Cross

This processing item detects cross shapes that are created by edges, such as crosshair marks. Stable detection can be performed even for images with low contrast or high noise levels.

### Intersection Coordinates

This processing item uses the edge points to calculate 2 linear regressions, and calculates the intersection coordinates and the angle formed by the 2 lines.

### Scan Edge Circle

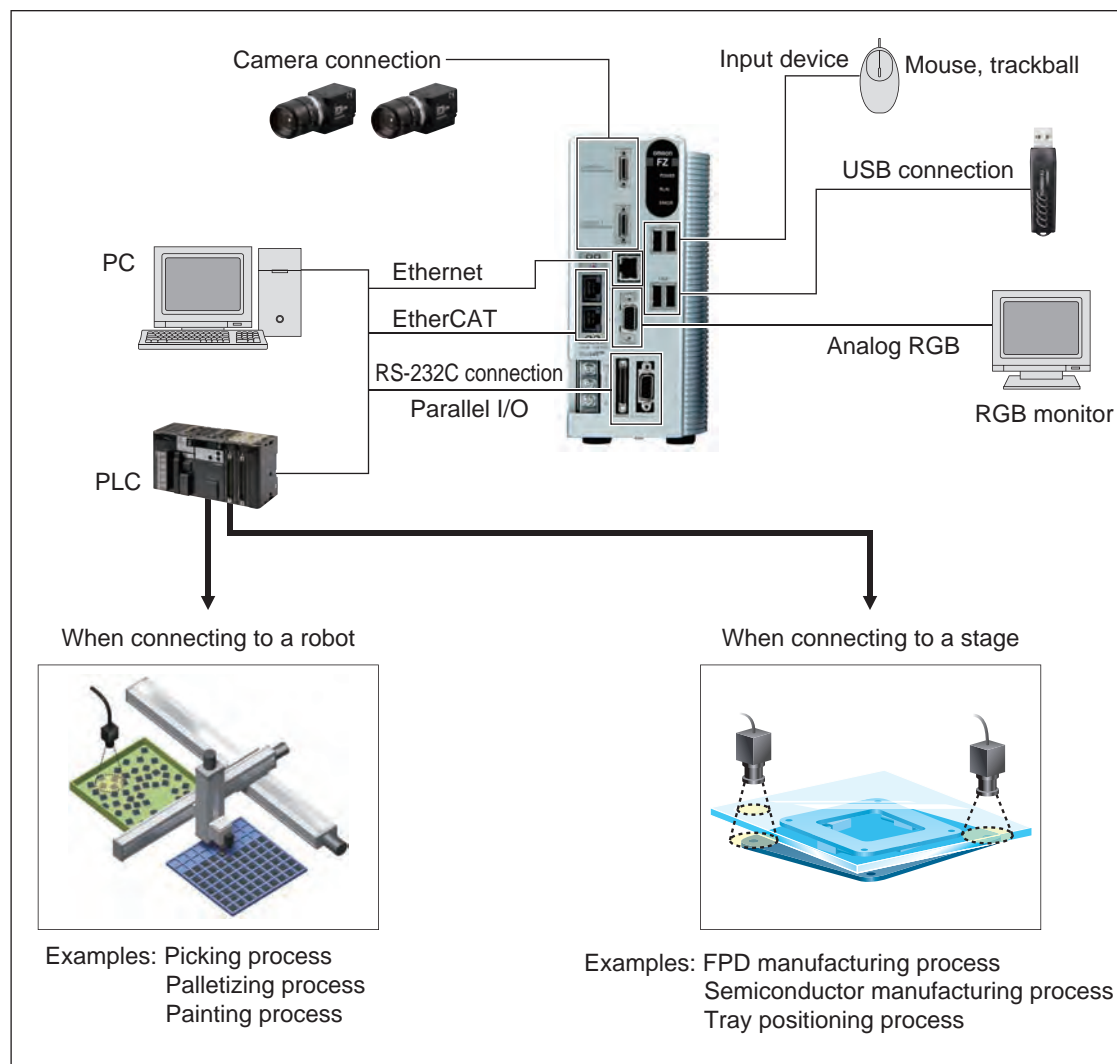
This processing item uses multiple measured edge points to calculate the circle equation, and calculates the center coordinates and radius of the circle.

### ECM Search Motion

This processing item searches the input image for parts having a high degree of similarity to the target mark (model), and detects its correlation value (similarity) and position. Up to 100 can be detected at the same time.

## 1-2 System Configuration

An example of a system configuration that uses the software is shown below.



## 1-3 Restrictions and Precautions

- Compatibility chart for compatible controllers and cameras

Controller	Camera
FZ3-3xx/3xx-10 (Can be used by installing the software.)	Digital camera FZ-SCH/SH/SC/S Small digital camera FZ-SFC/SF/SPC/SP Intelligent camera FZ-SLC15/SLC100 Auto-focus camera FZ-SZC15/SZC100
FZ3-7xx/7xxx-10, FZ4-L35x/L35x-10, 6xx/6xx-10, 7xx/7xx-10 (Can be used by installing the software.)	Digital camera FZ-SCH/SH/SC5M/S5M/SC2M/S2M/SC/S Small digital camera FZ-SFC/SF/SPC/SP Intelligent camera FZ-SLC15/SLC100 Auto-focus camera FZ-SZC15/SZC100
FZM1-350-ECT (The software is installed as standard.)	Digital camera FZ-SCH/SH/SC2M/S2M/SC/S Small digital camera FZ-SFC/SF/SPC/SP Intelligent camera FZ-SLC15/SLC100 Auto-focus camera FZ-SZC15/SZC100

Note: Up to 2 cameras can be connected.

### ● Compatible stages

When connecting to a stage, the software is compatible with the following axis configurations.  
XY, XYθ, θXY, UVW, UVWR

### ● Compatible robots

When connecting to a robot, the software is compatible with robots that can be controlled with the following outputs.  
XY, XYθ

## 1-4 Differences with the Standard Product (FZ3)

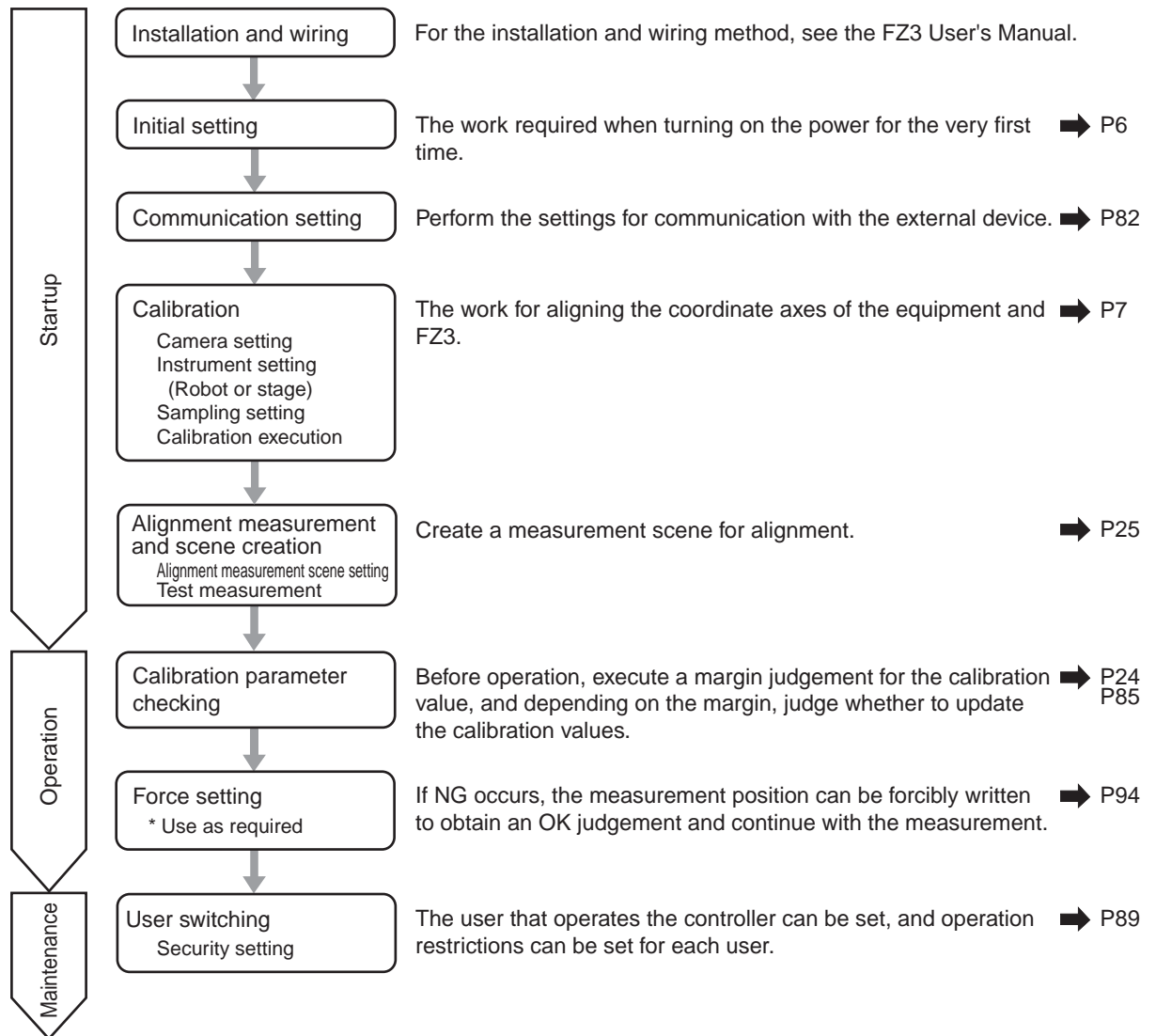
The software is equipped with the following functions.

Function name	Description	Page reference
Instrument Setting	Use to select a stage or a robot as the external device to be controlled by FZ3. A specialized menu for the selected external device can then be used.	P7
Calibration setting	Compared to the calibration settings in the standard product (FZ3), calibration settings can be performed more easily and with higher accuracy. Can be selected with auto or manual operations.	P7
Calculate Scroll	This processing item outputs the movement amount of the external device from the deviation between the reference position and the measurement position.	P26
EC Corner	This processing item is suitable for inspecting corners.	P33
EC Cross	This processing item is suitable for inspecting cross points.	P43
Intersection	This processing item is suitable for calculating the coordinates of cross points.	P52
Scan Edge Circle	This processing item is suitable for measuring the center coordinates and radius of circles.	P62
ECM Search Motion	This function is added to [ECM Search] of FZ3.	P71
Force Setting	When the inspection results are NG, a value can be forcibly entered to obtain an OK judgement and continue with the inspection.	P94
Change User	Users can be set and switched.	P89
Security setting	Operations can be restricted by dividing users with security levels, using the user names and passwords that are set at the user level.	P93



## 2 Basic Setting Procedure

The operation flow when using the software is shown by the flow diagram below.

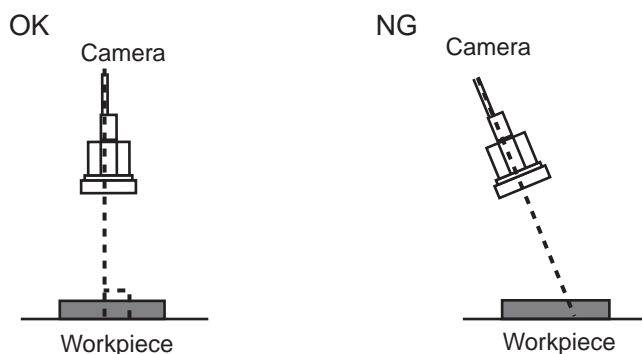


### Important

#### Camera mounting angle

Mount the camera so that the camera lies horizontal with the imaging plane.

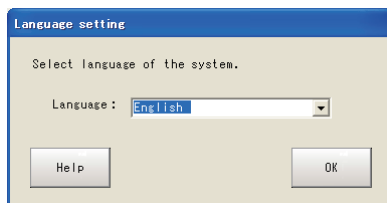
If the camera is not horizontal with the imaging plane, calibration accuracy and positioning accuracy will drop.



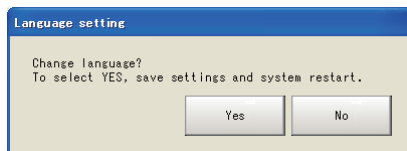
### 2-1 Initial Setting

This section explains about the settings that are required when starting up for the first time.

1. The [Language setting] window is displayed. Select the language to use and tap [OK].

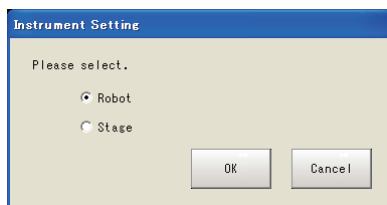


2. If there is no problem in the language setting, tap [Yes].



3. Set the external device.

This can be changed after starting up. For more details, see "Instrument Setting" (P7).

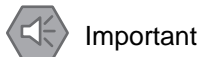
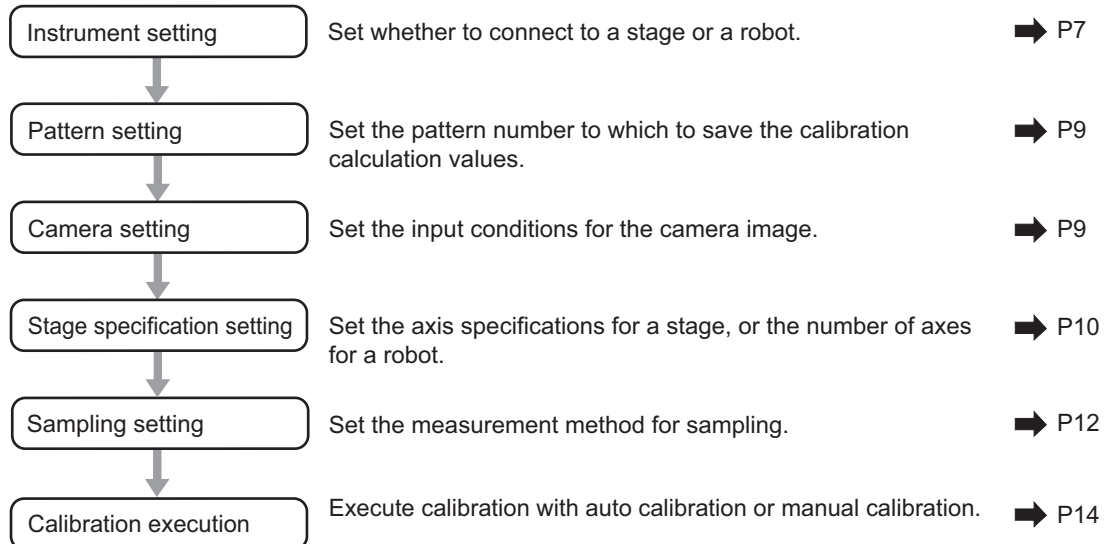


# 3 Calibration and Scene Settings

This section explains about the specialized functions of the software.

## 3-1 Calibration Setting

Perform the calibration setting by following the sequence in the flow diagram below.



**Important**

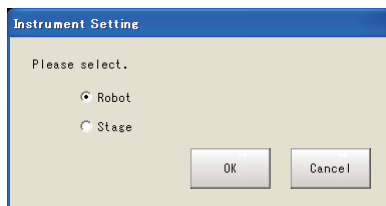
Pattern-specific setting data and created calibration parameters are all retained as part of scene group data.

Accordingly, you can save/load patterns in units of scene groups.  
(Data cannot be saved/loaded in units of patterns.)

## Instrument Setting

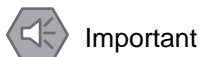
Set the external device as appropriate for the equipment that you will use. A window appropriate for the external device is displayed.

1. In the menu bar, select [System] - [Controller] - [Instrument Setting].



Setting item	Setting value [Factory default]	Description
Instrument Setting	[Robot] Stage	Set the external device as appropriate for the specifications of the equipment that you will use. Robot: When using equipment in which a robot is used Stage: When using equipment in which a stage is used

2. Specify the external device and click [OK].



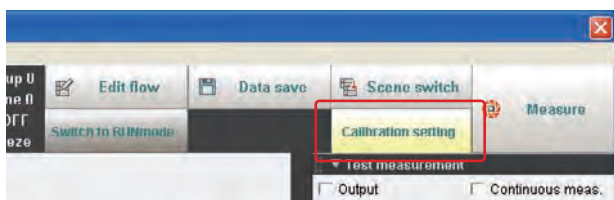
**Important**

After changing settings, save them onto the controller, and then restart the system.

## Calibration Setting Window

Calibration is performed to align the camera references with the device references to enable accurate position inspections.

1. Tap [Calibration setting] that is displayed in the toolbar area.  
The [Calibration setting] window is displayed.



When the instrument setting is "Robot"

**Calibration setting**

Select pattern  
 Pattern 0 [Copy] [Initialize]

Pattern setting  
 Camera setting Robot setting Sampling setting CrossLine setting

Robot setting  
 Robot type: Three axes(XYZ)

Sampling setting  
 Sampling method  
 Camera 0 : Nothing  
 Camera 1 : Nothing

Calib para setting  
☒ Auto calib ☐ Manual calib [Execute]

Camera 0				Camera 1			
A:	1.000000	D:	0.000000	A:	1.000000	D:	0.000000
B:	0.000000	E:	1.000000	B:	0.000000	E:	1.000000
C:	0.000000	F:	0.000000	C:	0.000000	F:	0.000000

[Close]

When the instrument setting is "Stage"

**Calibration setting**

Select pattern  
 Pattern 0 [Copy] [Initialize]

Pattern setting  
 Camera setting Stage setting Sampling setting CrossLine setting

Stage setting  
 Stage type: XY stage  
 R1: 0.0000 θ1: 0.0000  
 R2: 0.0000 θ2: 0.0000  
 R3: 0.0000 θ3: 0.0000  
 R4: 0.0000 θ4: 0.0000

Sampling setting  
 Sampling method  
 Camera 0 : Nothing  
 Camera 1 : Nothing

Calib para setting  
☒ Auto calib ☐ Manual calib [Execute]

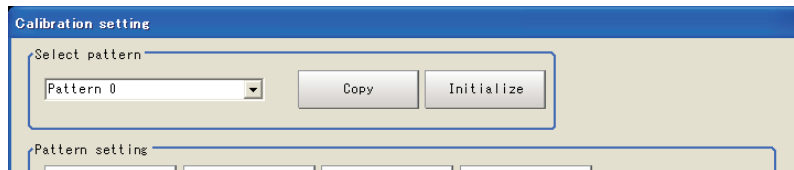
Camera 0				Camera 1			
A:	1.000000	D:	0.000000	A:	1.000000	D:	0.000000
B:	0.000000	E:	1.000000	B:	0.000000	E:	1.000000
C:	0.000000	F:	0.000000	C:	0.000000	F:	0.000000

[Close]

### ● Select pattern

Up to 4 patterns can be saved for calibration calculation values.

#### 1. Select the number of the pattern to save.



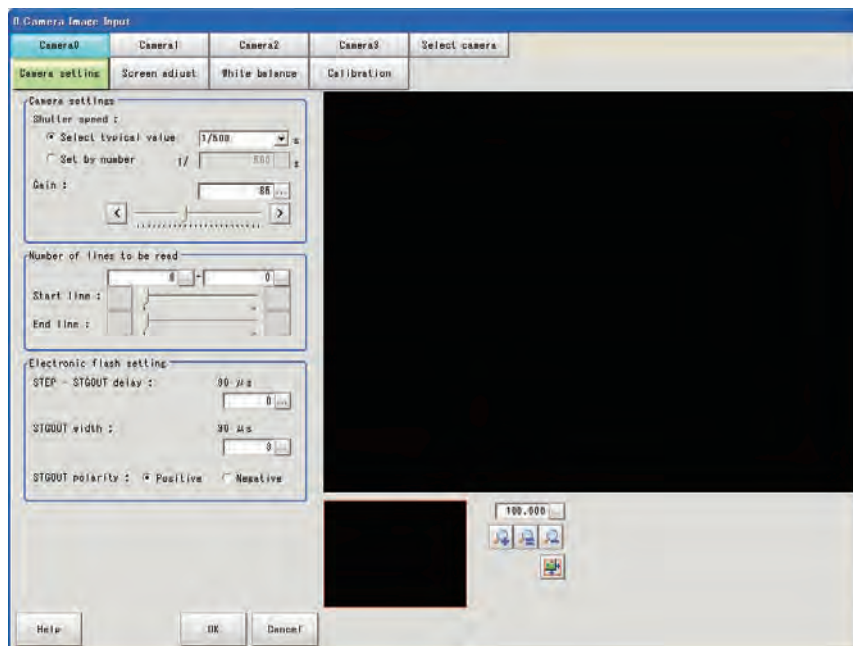
Setting item	Setting value [Factory default]	Description
Select pattern	[Pattern 0] Pattern 1 Pattern 2 Pattern 3	By specifying the pattern numbers that are set here in [Calculate Scroll], different calibration values can be applied in different situations.

### ● Camera setting

#### 1. Tap [Camera setting].

The [Camera Image Input] window is displayed. Set [Camera Image Input].

For more details, see "1. Input image - Camera Image Input" in the FZ3 Processing Items List Manual.



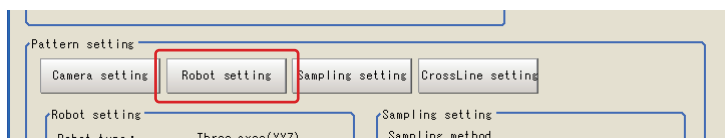
#### ● Stage specification setting

For a stage, set the axis specifications and rotation direction.

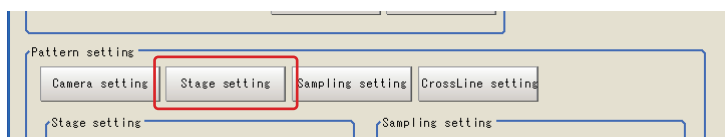
For a robot, set the number of robot axes.

##### 1. Tap [Robot setting] or [Stage setting] button.

For a robot

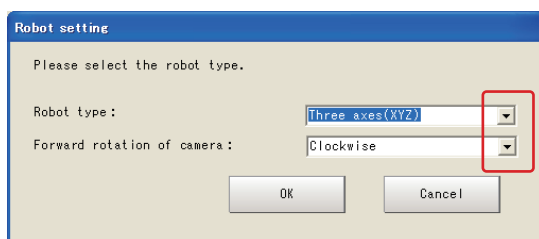


For a stage



##### 2. Set the corresponding specifications.

For a robot



Setting item	Setting value [Factory default]	Description
Robot type	[Three axes(XYZ)] Four axes(XYZR)	Set as appropriate for the specifications of the robot that will be used.
Forward rotation of camera	[Clockwise] Counterclockwise	Specify whether the workpiece will turn clockwise or counterclockwise on the camera when the workpiece is turned in + $\theta$ direction using an external device.

For a stage

Setting item	Setting value [Factory default]	Description
Stage type	[XY stage] XYθ stage θXY stage UVW stage UVWR stage	Set as appropriate for the axis specifications of the stage that will be used.
Forward rotation of camera	[Clockwise] Counterclockwise	Specify whether the workpiece will turn clockwise or counterclockwise on the camera when the workpiece is turned in + θ direction using an external device.
UVWR parameter (Enabled only when the stage type is UVW or UVWR.)		For details, see below.

R1 to R4, θ1 to θ4

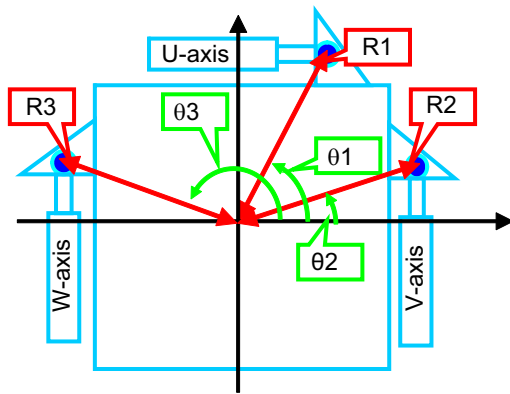
R1 to R4 are distances from the rotation center of the stage to the actuator pins of U/V/W(/R)-axes when each axis is at its origin (movement amount of each axis is 0).

θ1 to θ4 are angles at respective pin positions when each axis is at its origin and the stage coordinate X-axis angle is 0. Set an appropriate value by assuming that the direction of rotation from X-axis forward direction to Y-axis forward direction on the stage coordinate system represents the forward (+) direction.

$$R = \sqrt{(\text{Actuator pin X coordinate} - \text{Rotation center X coordinate})^2 + (\text{Actuator pin Y coordinate} - \text{Rotation center Y coordinate})^2}$$

$$\theta = \tan^{-1} \left( \frac{\text{Actuator pin Y coordinate} - \text{Rotation center Y coordinate}}{\text{Actuator pin X coordinate} - \text{Rotation center X coordinate}} \right)$$

Set R as a length (in mm) and θ in degrees.



Vertical direction

As for the directions of U/V/W(/R)-axes, set which direction each axis will move with respect to the stage coordinate system when the axis is moved in forward direction. Axis directions on the camera coordinate system have nothing to do with this setting.

Example: Assume that when the U-axis is moved in forward direction, the axis moves in Y-axis forward direction on the stage coordinate system. In this case, the axis direction of the U-axis is "Y-axis forward direction."

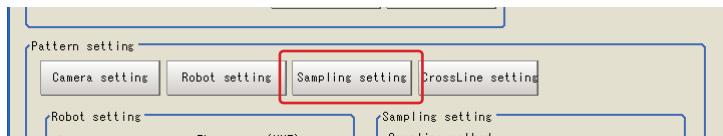
#### 3. After completing the settings, tap [OK].

### ● Sampling setting

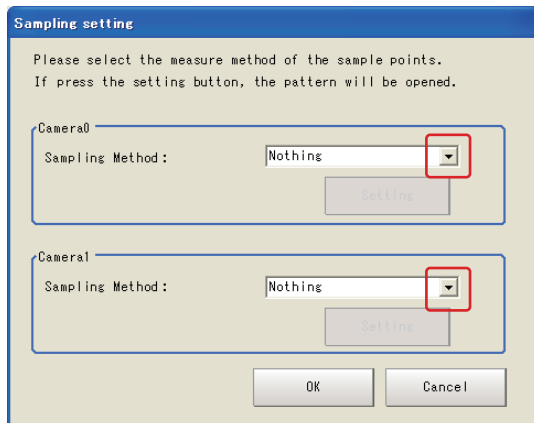
Select the processing item to be performed when calibration is executed.

#### 1. Tap [Sampling setting].

The [Sampling setting] window is displayed.



#### 2. Set the sampling method for each camera.



Setting item	Setting value [Factory default]	Description
Sampling Method	[Nothing] Search Intersection ECM Search EC Corner EC Cross EC Circle Search	Select the processing item for performing sampling measurement.

#### 3. After completing the settings, tap [OK].

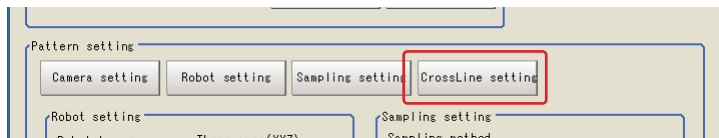


### ● Crossline setting

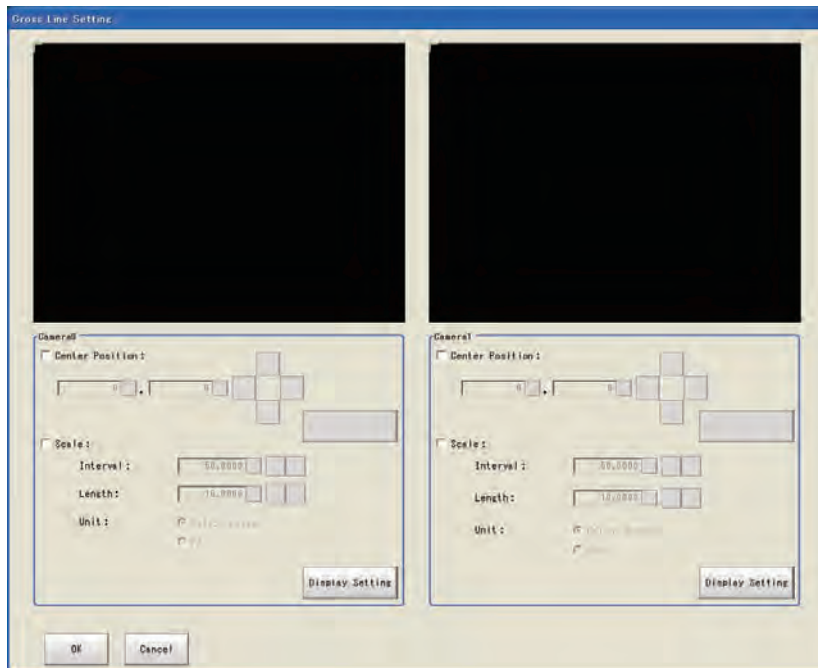
Set the crosslines and memory width to be displayed on the window.  
Set as required.

#### 1. Tap [CrossLine setting].

The [CrossLine Setting] window is displayed.



#### 2. Set the following display settings as required.



Setting item	Setting value [Factory default]	Description
Center Position	[Unchecked] Checked	Set the center coordinate for the crosslines. The setting methods are as follows. <ul style="list-style-type: none"> <li>• Tap the screen directly</li> <li>• Enter the coordinate values</li> <li>• Set with the crosshair cursor</li> </ul>
Scale	[Unchecked] Checked	Set conditions such as the scale intervals and units.
Interval	0.0000 to 9999.9999 [50.0000]	
Length	0.0000 to 9999.9999 [10.0000]	
Unit	[Calib. param] Pix	

## 3-2 Calibration Methods

This section explains about auto calibration and manual calibration.



### Important

In this calibration, position information needed to calculate calibration parameters is obtained using the stage/robot.

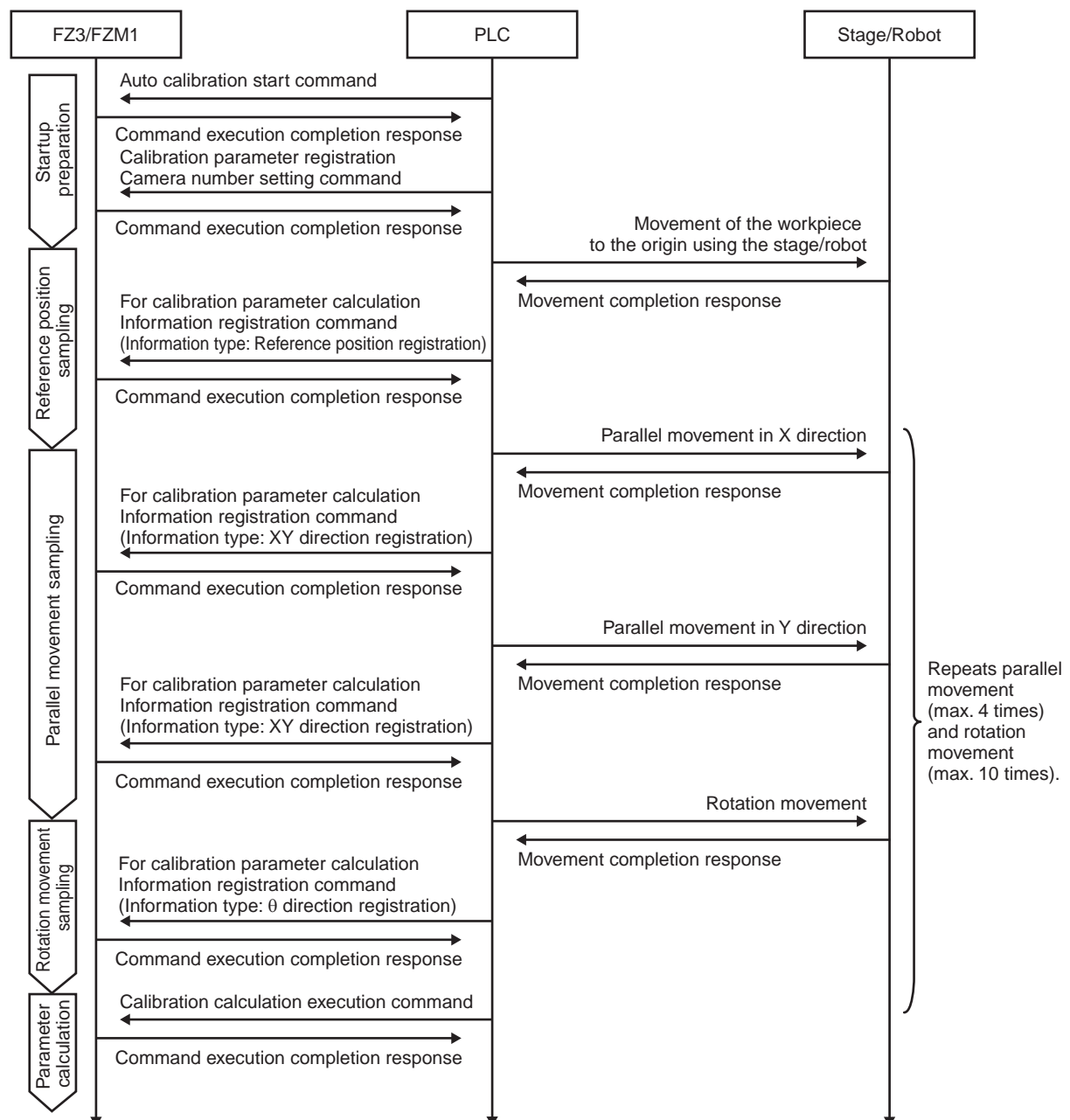
Note that if the stage/robot cannot move the sampling target accurately, calibration accuracy may drop.

### Auto Calibration

When a sequence that repeats "Object movement"→"Amount of movement to FZ3 and sampling instruction" is set on the PLC, and finally a calibration calculation command is executed, the calibration value is determined on FZ3. An outline is shown below. For details of commands, see "Command List (Normal)" (P82).

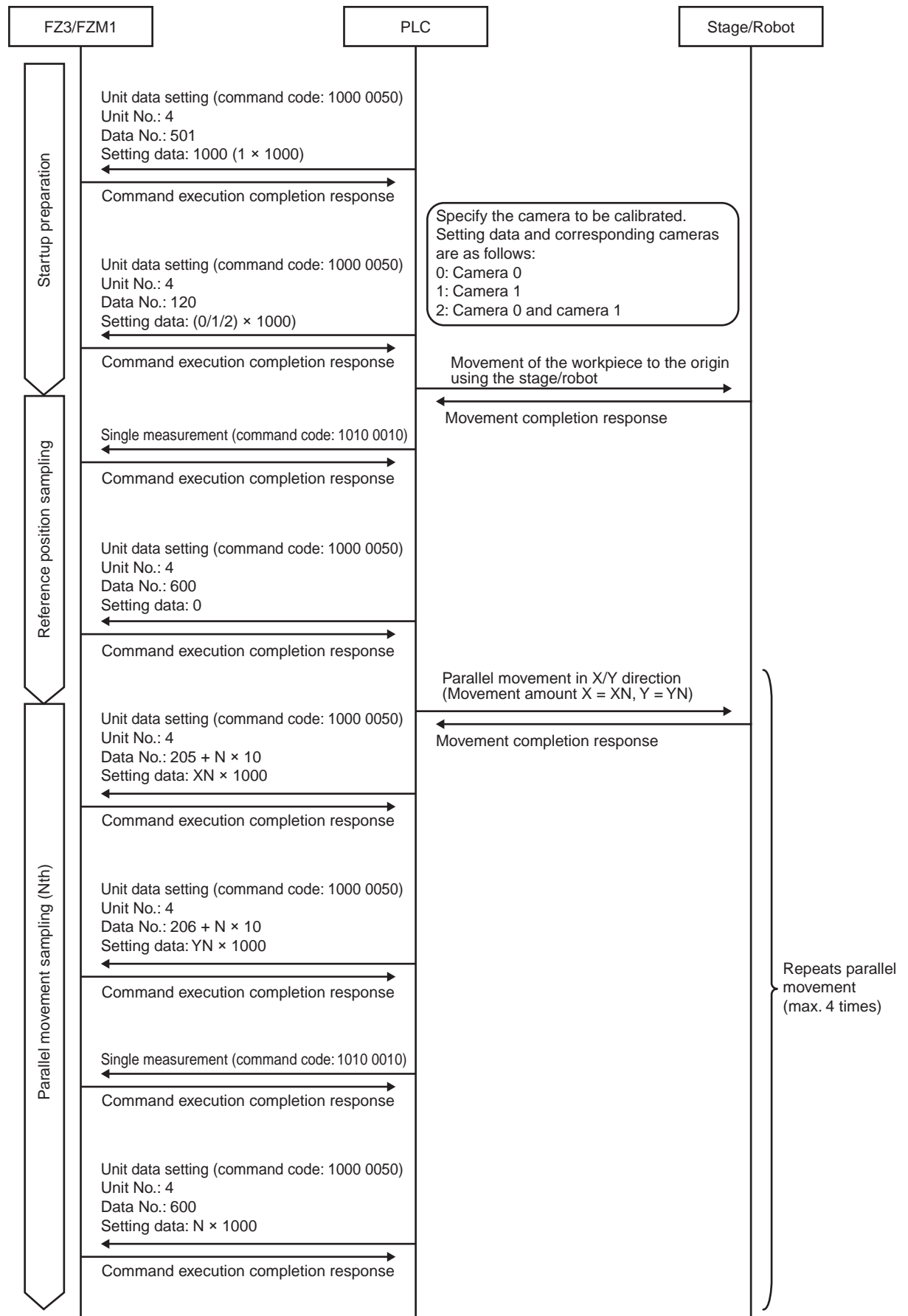
For serial communication (Non-procedure)

For the specialized commands sent from the PLC to FZ3/FZM1, see "Command List (Normal)" (P82).

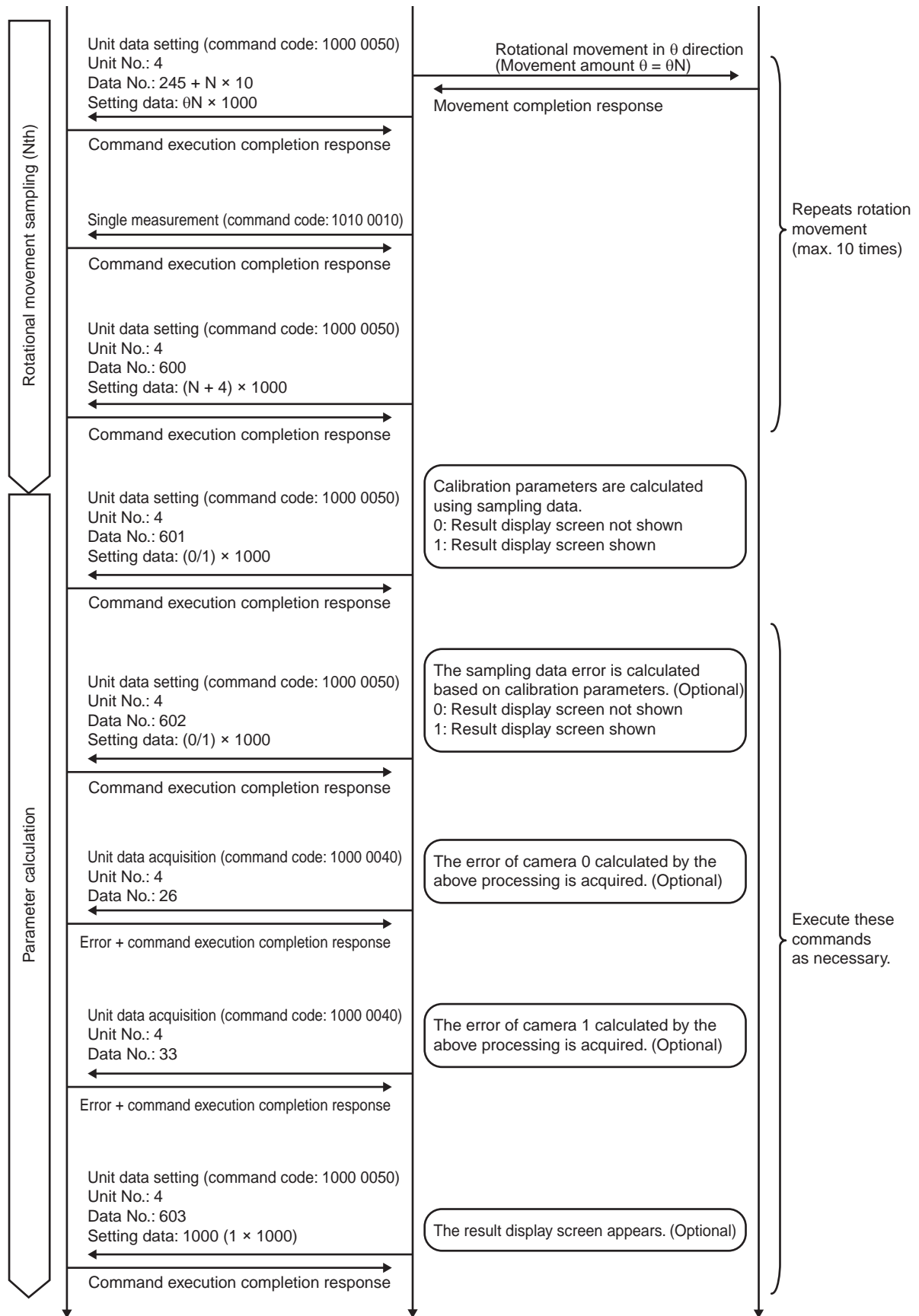


## For PLC Link

Two commands are sent from the PLC to FZ3/FZM1, including unit data setting (command code: 1000 0050) and unit data acquisition (command code: 1000 0040).

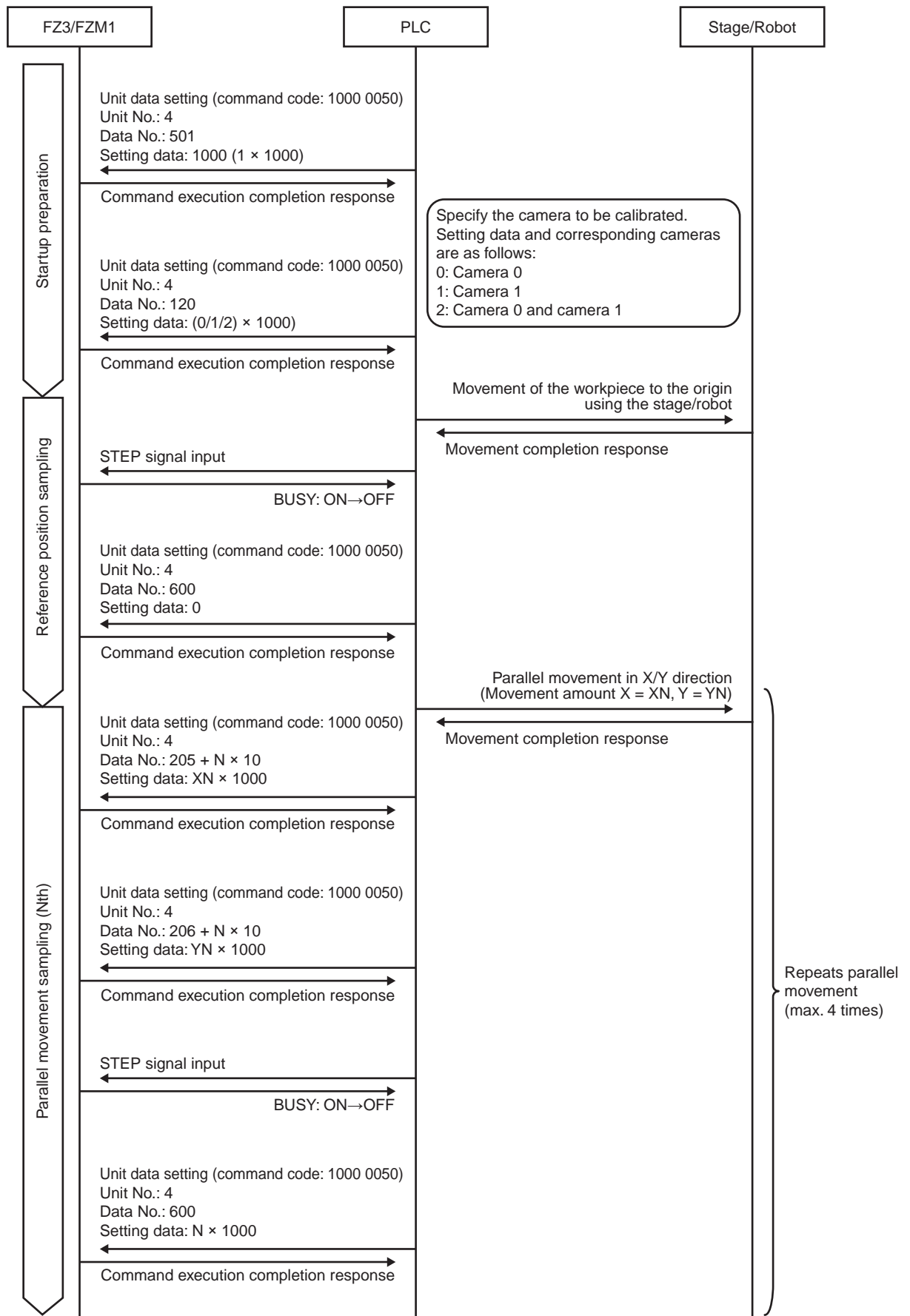


### 3 Calibration and Scene Settings

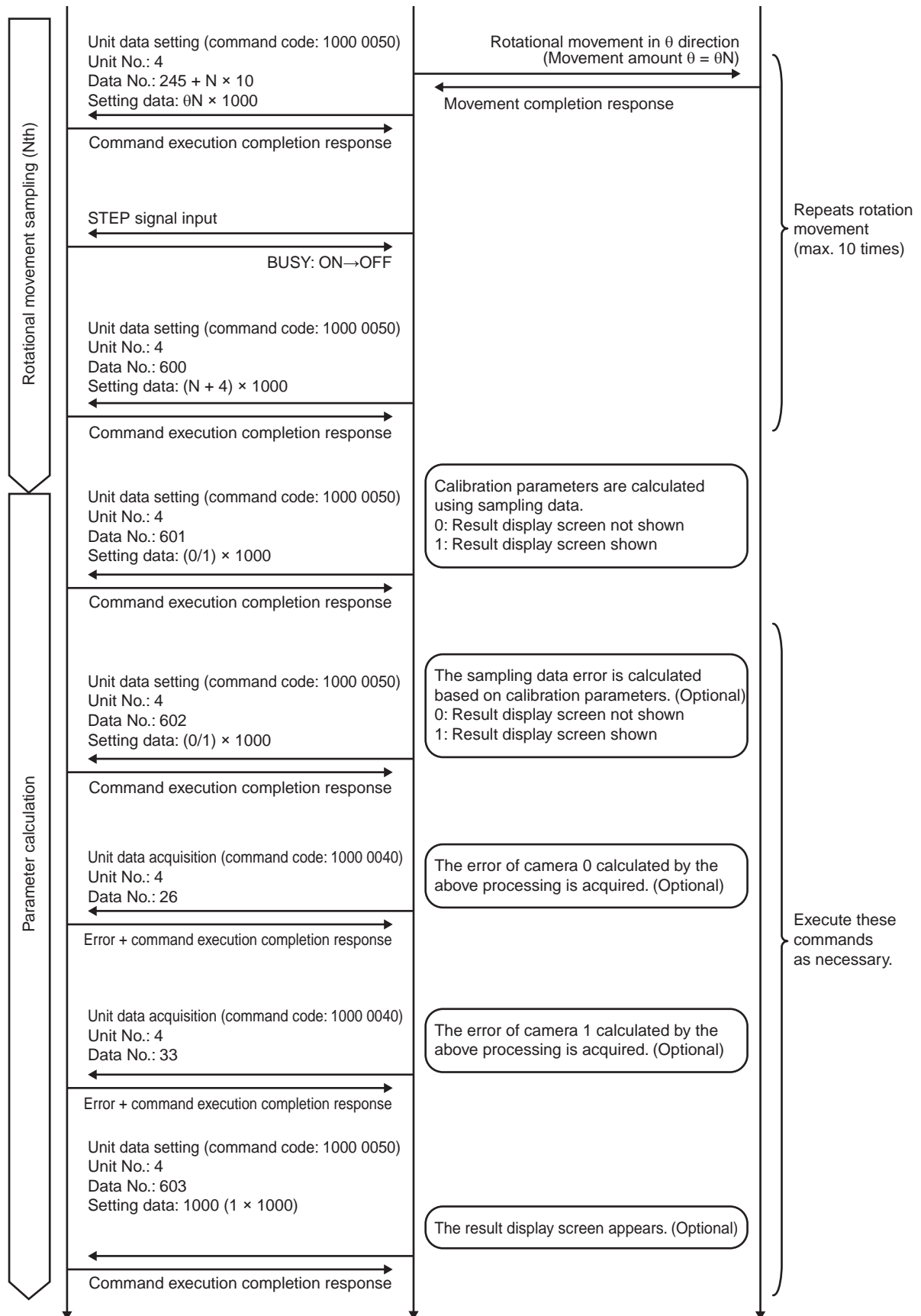


## For EtherCAT

Two commands are sent from the PLC to FZ3/FZM1, including unit data setting (command code: 1000 0050) and unit data acquisition (command code: 1000 0040).



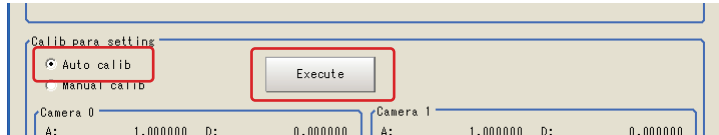
### 3 Calibration and Scene Settings



**Important**

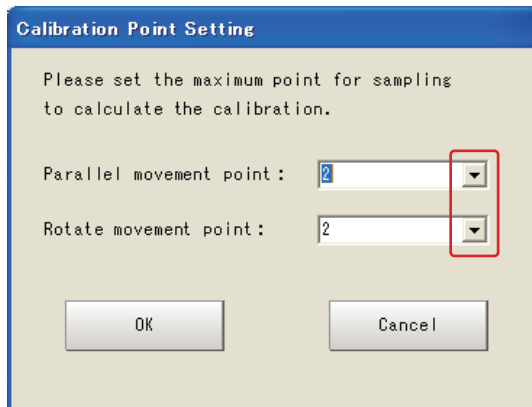
Before executing auto calibration, complete the settings for external communication with the PLC (P82).

**1. Select [Auto calib] and tap [Execute].**



**2. Set the number of sampling points and tap [OK].**

Make sure that the number of sampling points that are set here and the number of sampling points to be executed are the same.



Setting item	Setting value [Factory default]	Description
Parallel movement point	[2], 3, 4	Set the maximum number of points for parallel movement that will be sampled in the calibration.
Rotate movement point*1	[2], 3, 4, 5, 6, 7, 8, 9, 10	Set the maximum number of points for rotation movement that will be sampled in the calibration.

\*1 Setting is only possible for the following stages.

Robot: 4 axes (XYZR)

Stage: XYθ, θXY, UVW, UVWR

### 3. Execute auto calibration on the PLC.

The movement amounts for the object are displayed.

The measurement values on the camera are displayed.

Auto Calibration							
Parameter Setting							
	Real DistanceX	Real DistanceY	Real Distanceθ	Camera0 X	Camera0 Y	Camera1 X	Camera1 Y
Standard Pos.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Parallel shift Pos. 1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Parallel shift Pos. 2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Rotation Pos. 1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Rotation Pos. 2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000



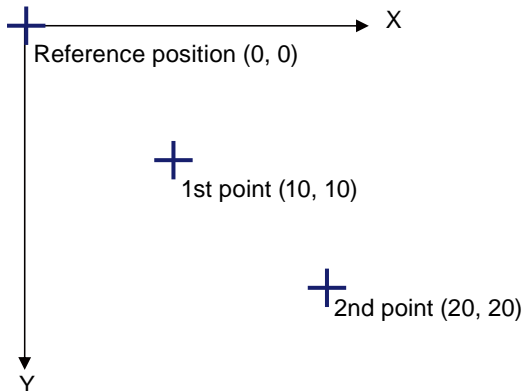
#### Important

The actual parallel movement of the position must not occur along a straight line that passes the reference position.

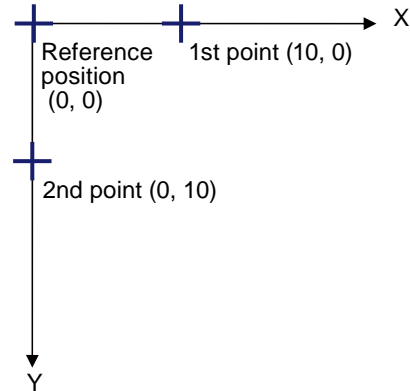
(If the movement occurs along a straight line, an attempt to register the calibration values will fail.)

Examples:

- NG case: Reference position (0, 0) fixed, 1st point (10, 10), 2nd point (20, 20)



- OK case: Reference position (0, 0) fixed, 1st point (10, 0), 2nd point (0, 10)



After sampling is complete, the calibration values are registered by the [Calibration calculation] command.

Calibration setting	
Calibration parameter calculation succeeded.	
Camera 0	
A: -7.490384	D: -0.150959
B: -0.043475	E: 0.009118
C: 0.000000	F: 0.000000
Deflection: 0.000086	
Camera 1	
A: -0.039280	D: -0.016119
B: -0.051065	E: -0.026182
C: 0.000000	F: 0.000000
Deflection: 0.000062	
Close	



#### Important

-1 is displayed if no error value is calculated.



**Note****Error**

- The error is used to check for abnormal calibration parameters.
- If the position relationship of the external device and camera has changed for reasons such as "The mounting position of the camera has shifted without someone's knowledge," the error increases. (The amount of change in error is proportional to the amount of change in this position relationship.)
- By comparing the error calculated when calibration parameters were created, against the current error, it can be confirmed that the position relationship has not changed.
- The error is calculated using the formula below.

$$(\text{Error}) = \frac{1}{n} \sum_{i=1}^n \sqrt{(x_{ri}' - x_{ri})^2 + (y_{ri}' - y_{ri})^2}$$

Parallel movement sampling data (camera X, camera Y) after calibration conversion = (xri, yri)

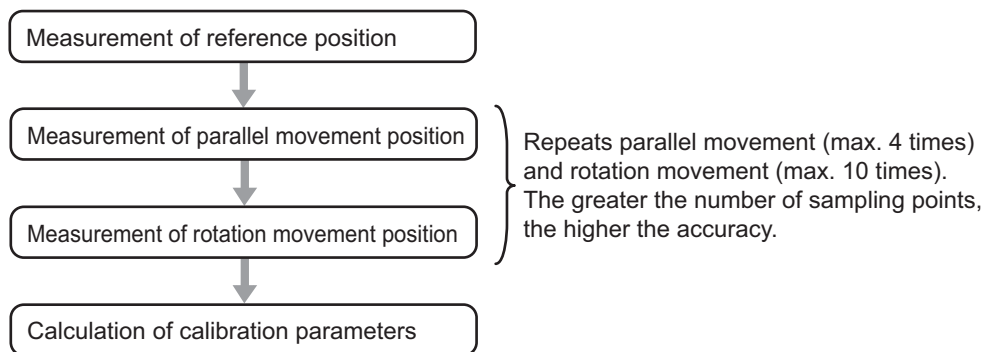
Parallel movement sampling data (actual X movement amount, actual Y movement amount) = (xri', yri')

Number of parallel movement points = n

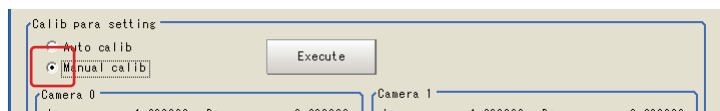
## Manual Calibration

Manually enter the object position, and then execute measurement at that position to perform sampling. After repeating for several points, execute the calibration parameter calculation to determine the calibration values.

An outline is shown below.

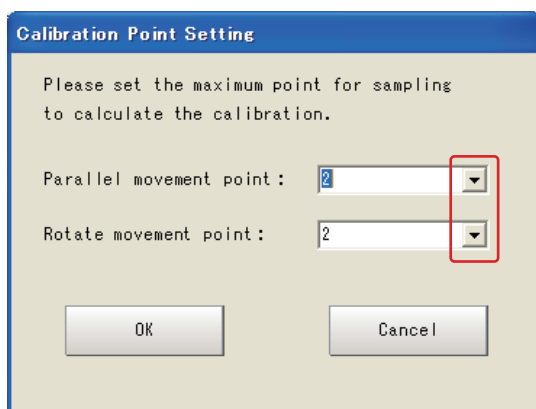


### 1. Select [Manual calib] and tap [Execute].




### 3 Calibration and Scene Settings


#### 2. Set the number of sampling points and tap [OK].



**Calibration Point Setting**

Please set the maximum point for sampling to calculate the calibration.

Parallel movement point :  

Rotate movement point :  

Setting item	Setting value [Factory default]	Description
Parallel movement point	[2], 3, 4	Set the maximum number of points for parallel movement that will be sampled in the calibration.
Rotate movement point <sup>*1</sup>	[2], 3, 4, 5, 6, 7, 8, 9, 10	Set the maximum number of points for rotation movement that will be sampled in the calibration.

\*1 Setting is only possible for the following stages.

Robot: 4 axes (XYZR)

Stage: XYθ, θXY, UVW, UVWR

#### 3. Set the target camera.

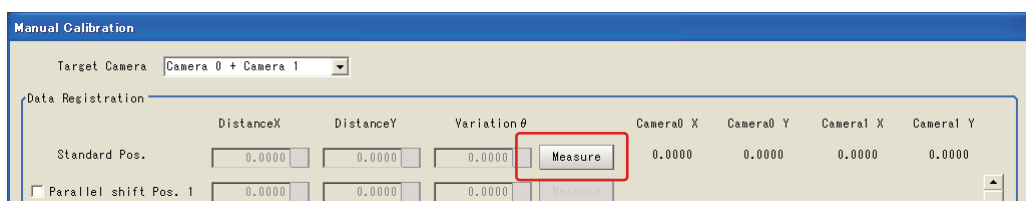


Target Camera

Setting item	Setting value [Factory default]	Description
Target Camera	Camera 0 Camera 1 [Camera 0 + Camera 1]	Set the target camera for manual calibration.

#### 4. Measure the reference position.

Tap [Measure] while the object is in the reference position.



**Manual Calibration**

Target Camera

Data Registration

	DistanceX	DistanceY	Variationθ		Camera0 X	Camera0 Y	Camera1 X	Camera1 Y
Standard Pos.	<input type="text" value="0.0000"/>	<input type="text" value="0.0000"/>	<input type="text" value="0.0000"/>	<input type="button" value="Measure"/>	0.0000	0.0000	0.0000	0.0000
<input type="checkbox"/> Parallel shift Pos. 1	<input type="text" value="0.0000"/>	<input type="text" value="0.0000"/>	<input type="text" value="0.0000"/>	<input type="button" value="Measure"/>				

### 5. Measure the sampling position.

Move the object, select the check box for the parallel movement position or rotation movement position, and enter the movement amount for the object.

When [Measure] is tapped, the measurement values from the camera are displayed.

This step is executed for the set number of times.



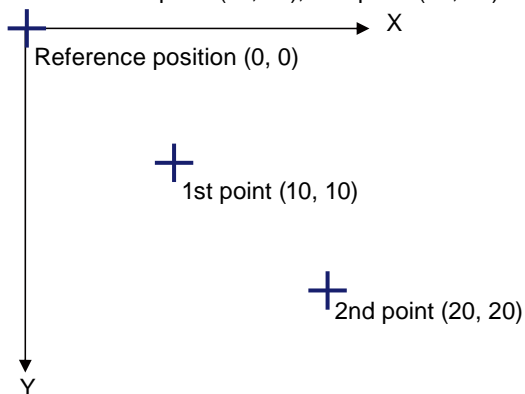
#### Important

The actual parallel movement of the position must not occur along a straight line that passes the reference position.

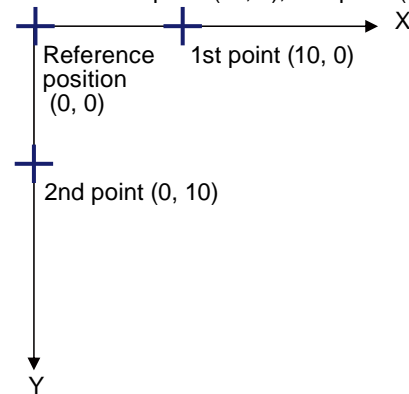
(If the movement occurs along a straight line, an attempt to register the calibration values will fail.)

Examples:

- NG case: Reference position (0, 0) fixed,  
1st point (10, 10), 2nd point (20, 20)



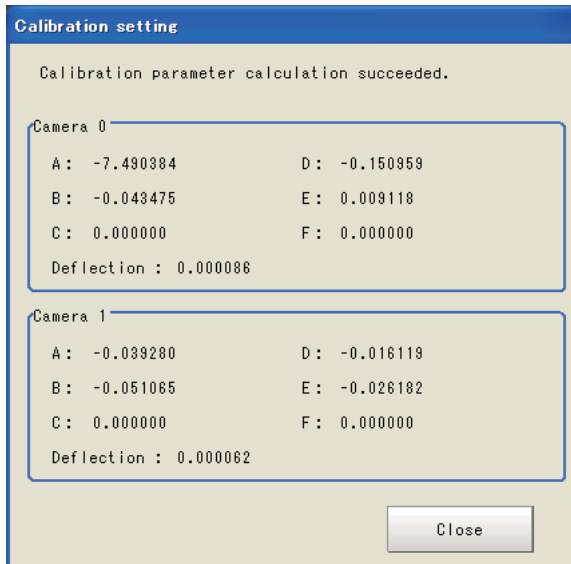
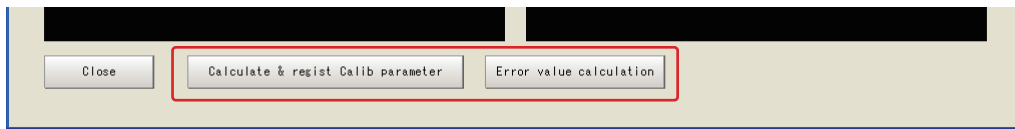
- OK case: Reference position (0, 0) fixed,  
1st point (10, 0), 2nd point (0, 10)



#### 6. Tap [Calculate & regist Calib parameter].

The parameters are calculated from the sampling values and registered.

Tap [Error value calculation] to calculate the calibration error value only. (The calibration parameters are not updated.)



#### Important

-1 is displayed if no error value is calculated.



#### Note

##### Error

- The error is used to check for abnormal calibration parameters.
- If the position relationship of the external device and camera has changed for reasons such as "The mounting position of the camera has shifted without someone's knowledge," the error increases. (The amount of change in error is proportional to the amount of change in this position relationship.)
- By comparing the error calculated when calibration parameters were created, against the current error, it can be confirmed that the position relationship has not changed.
- The error is calculated using the formula below.

$$(\text{Error}) = \frac{1}{n} \sum_{i=1}^n \sqrt{(x_{ri}' - x_{ri})^2 + (y_{ri}' - y_{ri})^2}$$

Parallel movement sampling data (camera X, camera Y) after calibration conversion = (x<sub>ri</sub>, y<sub>ri</sub>)

Parallel movement sampling data (actual X movement amount, actual Y movement amount) = (x<sub>ri</sub>', y<sub>ri</sub>')

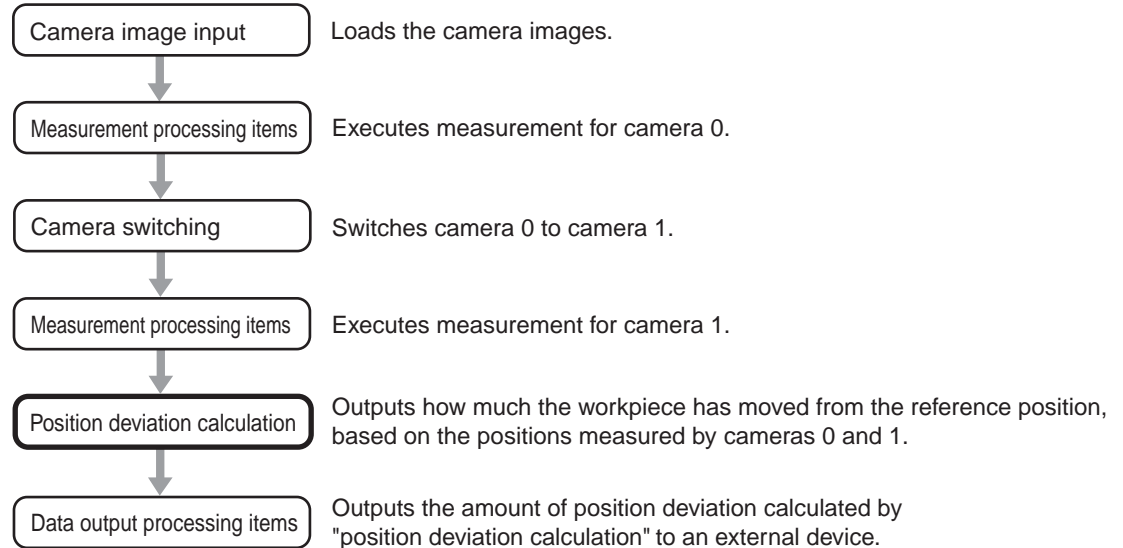
Number of parallel movement points = n

### 3-3 Alignment Measurement and Scene Setting

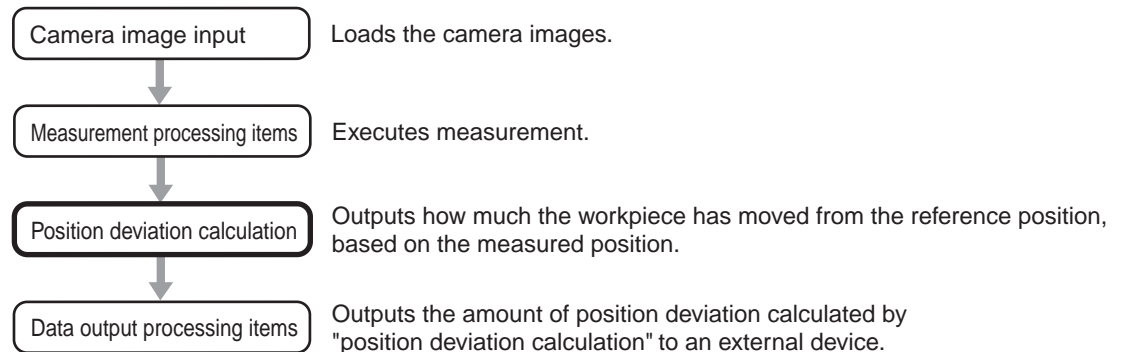
A scene in which the amount of deviation of workpiece position is measured is explained. The basic configuration is shown below.

#### Sample inspection flow

##### •When using 2 cameras



##### •When using 1 cameras



#### Important

- When the movement amount of the external device is output, a value calculated by multiplying -1 to the movement amount of each axis calculated by "position deviation calculation" is output.
- Measure the amount of position deviation with the robot/stage at the origin  $(X, Y, \theta) = (0, 0, 0)$ . Operation of position deviation amount measurement is not guaranteed when the robot/stage is not at the origin  $(X, Y, \theta) \neq (0, 0, 0)$ .

### 3-4 Position Deviation Calculation

The deviation between the measurement object position and the reference position that was registered during setting is calculated in order to calculate a movement amount appropriate for the external device. By outputting this movement amount to the external device, the measurement object can be moved to the registered reference position.

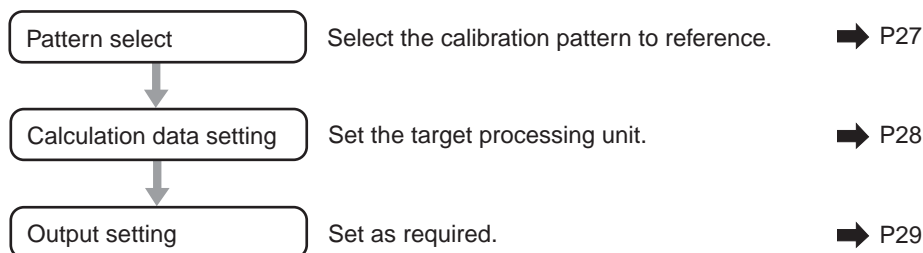


#### Important

- Calibration must be performed before using [Calculate Scroll].
- Do not insert more than one [Calculate Scroll] into a single scene. If you want to perform [Calculate Scroll] multiple times, first divide the scene.

### Setting Flow

The setting for the position deviation calculation is shown by the flow diagram below.

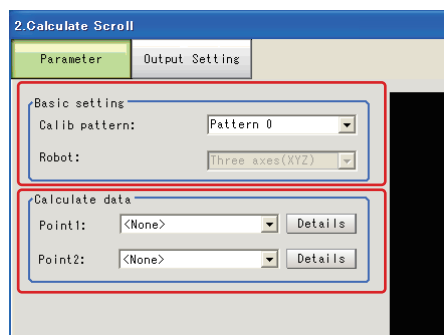


### Parameters

Select the calibration pattern to be referenced, and the measurement processing unit with which to acquire "Reference position/measured position data" used in the calculation of position deviation amount.

The movement amount needed to move the workpiece to the reference position of the processing unit set here is output.

#### For a robot



## For a stage



### Important

The reference position of the selected measurement processing unit can be set on the measurement processing unit setting screen. For the setting method, see the Processing Item List Manual.

## ● Setting method

1. In the [Basic setting] area, set the following parameters.

Setting item	Setting value [Factory default]	Description
Calib pattern	[Pattern 0] Pattern 1 Pattern 2 Pattern 3	Set the calibration pattern to reference. Reference: P9

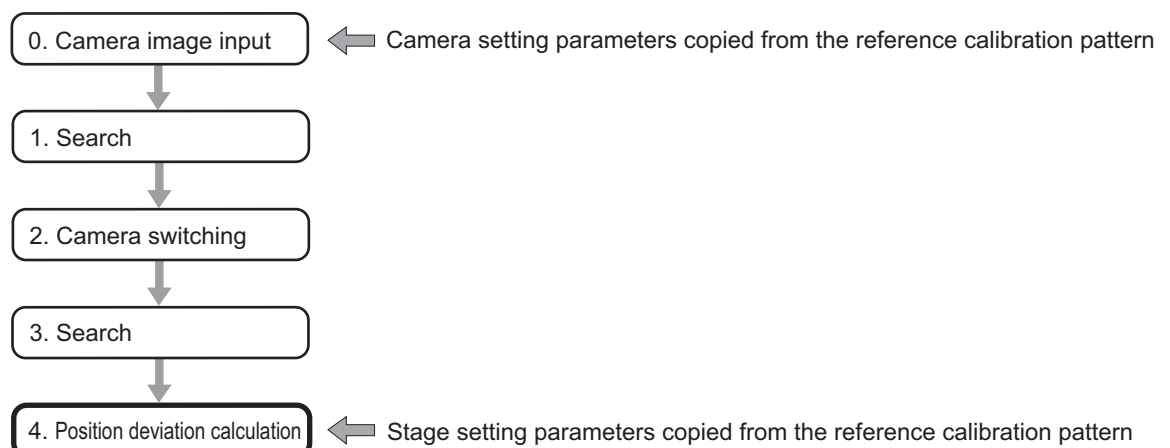


### Important

The camera settings (shutter speed, etc.) corresponding to the selected calibration pattern are copied to the camera image input step in the flow.

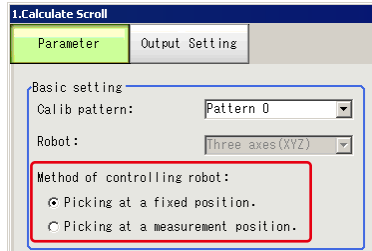
To change the settings of the camera image input step in the flow, change the camera settings corresponding to the selected calibration pattern.

Also note that the camera settings are copied only to the most recent camera image input.



#### 2. Select the robot control method.

(This is applicable only when the robot was selected by an external device.)



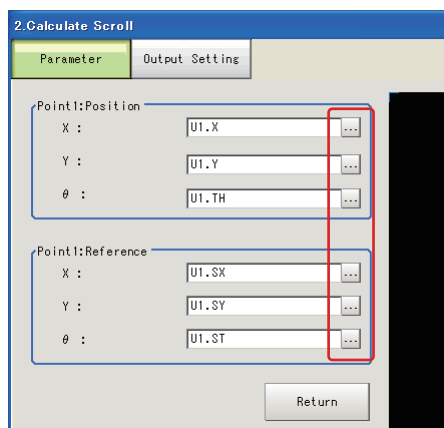
The above setting varies depending on the stage "after the workpiece is grabbed until it is moved" in which position adjustment is performed.

Setting item	Setting value [Factory default]	Description
Method of controlling robot	[Picking at a fixed position.]	Use this setting if you want to control the robot based on FZM1 measurement result in such a way that the robot tries to grab the same position of the workpiece every time and places the grabbed workpiece at the specified position. Examples: 1) The position measurement is performed by the FZM1. 2) The workpiece is grabbed. (The robot tries to grab the same position of the workpiece regardless of the measurement result.) 3) The robot moves based on the FZM1 measurement result. (The workpiece position is adjusted here.) 4) The workpiece is placed at the specified position.
	Picking at a measurement position.	Use this setting if you want to control the robot in such a way that the robot tries to grab the same position of the workpiece every time based on FZM1 measurement result and places the grabbed workpiece at the specified position. Examples: 1) The position measurement is performed by the FZM1. 2) The robot moves based on the FZM1 measurement result. (The position with respect to the workpiece is adjusted before the workpiece is grabbed.) 3) The workpiece is grabbed. 4) The workpiece is placed at the specified position.

#### 3. In the [Calculate data] area, select the target processing unit.

Tap [Details] as required to perform advanced settings.

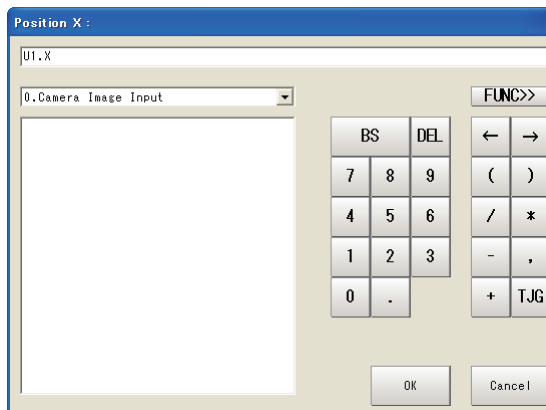
The advanced setting window is displayed.





#### 4. Tap [...] as required to set an expression.

For more details on expressions, see "4. Support Inspection and Measurement - Calculation" in the FZ3 Processing Items List Manual.

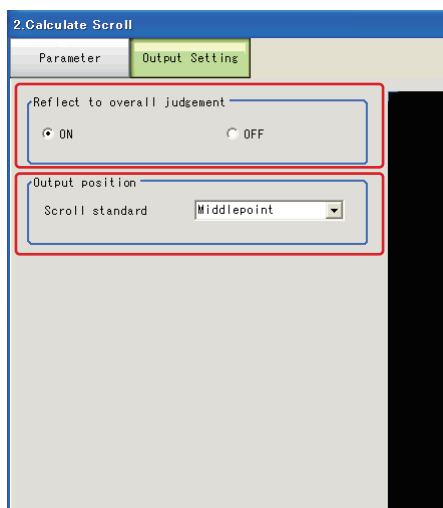


#### Important

To input a value in the expression, input the value in pix.

## Output Setting

Set how to handle the data when outputting the measurement results to the external device.



#### General Information

Normally, the factory default value will be used for this item.  
Do not change this setting unless there is a particular reason.

### ● Setting method

#### 1. Set the following parameters as required.

Setting item	Setting value [Factory default]	Description
Reflect to overall judgement	[ON] OFF	Enables choosing whether or not the judgement results of this processing unit is reflected in the scene overall judgement.
Output position		
Scroll standard	[Middlepoint] Point1 Point2	Select the points to use in the deviation amount calculation.

2. After completing all the settings, tap [OK].

## To Get Measurement Results from an External Source

### ● Measurement results for which output is possible (calculation)

The following values can be output using processing items related to results output. It is also possible to reference measurement values from expressions and other processing units.

Data name	Character string	Description
Overall judgement result	JG	The judgement result for the unit. 1: OK 0: Not yet measured -1: NG
Measurement position X	X	The X coordinate of the measurement object.
Measurement position Y	Y	The Y coordinate of the measurement object.
Measurement position $\theta$	TH	The rotation angle of the measurement object.
Reference position X	SX	The X coordinate of the reference position.
Reference position Y	SY	The Y coordinate of the reference position.
Reference position $\theta$	ST	The rotation angle of the reference position.
Movement amount X	MX	The position deviation between the reference position and the X-axis of the measurement object.
Movement amount Y	MY	The position deviation between the reference position and the Y-axis of the measurement object.
Movement amount $\theta$	MT	The position deviation between the reference position and the rotation direction of the measurement object.
Movement amount U	MU	The position deviation between the reference position and the U-axis of the measurement object.
Movement amount V	MV	The position deviation between the reference position and the V-axis of the measurement object.
Movement amount W	MW	The position deviation between the reference position and the W-axis of the measurement object.
Movement amount R	MR	The position deviation between the reference position and the R-axis of the measurement object.

### ● External Reference Tables

No.	Data name	Set/Get	Data range
0	judgement condition	Get only	0: No judgement (not yet measured) 1: judgement result OK -1: judgment result NG
20	Measurement position X	Get only	—
21	Measurement position Y	Get only	—
22	Measurement position $\theta$	Get only	—
23	Reference position X	Get only	—
24	Reference position Y	Get only	—
25	Reference position $\theta$	Get only	—
26	Movement amount X	Get only	—

No.	Data name	Set/Get	Data range
27	Movement amount Y	Get only	–
28	Movement amount $\theta$	Get only	–
29	Movement amount U	Get only	–
30	Movement amount V	Get only	–
31	Movement amount W	Get only	–
32	Movement amount R	Get only	–
103	Reflect to overall judgement	Set/Get	0: ON 1: OFF
120	Reference calibration pattern (Calib pattern)	Set/Get	0: Scene 32   1: Scene 33 2: Scene 34   3: Scene 35
121	Stage	Set/Get	For a robot 0: 3 axes (XYZ)   1: 4 axes (XYZR) For a stage 0: XY   1: XY $\theta$ 2: $\theta$ XY 3: UVW   4: UVWR
130	UVWR parameter R1	Set/Get	-99999.9999 to 99999.9999
131	UVWR parameter R2	Set/Get	-99999.9999 to 99999.9999
132	UVWR parameter R3	Set/Get	-99999.9999 to 99999.9999
133	UVWR parameter R4	Set/Get	-99999.9999 to 99999.9999
134	UVWR parameter $\theta$ 1	Set/Get	-99999.9999 to 99999.9999
135	UVWR parameter $\theta$ 2	Set/Get	-99999.9999 to 99999.9999
136	UVWR parameter $\theta$ 3	Set/Get	-99999.9999 to 99999.9999
137	UVWR parameter $\theta$ 4	Set/Get	-99999.9999 to 99999.9999
140	UVWR parameter U-axis polarity	Set/Get	0: X-axis positive 1: X-axis negative 2: Y-axis positive 3: Y-axis negative
141	UVWR parameter V-axis polarity	Set/Get	0: X-axis positive 1: X-axis negative 2: Y-axis positive 3: Y-axis negative
142	UVWR parameter W-axis polarity	Set/Get	0: X-axis positive 1: X-axis negative 2: Y-axis positive 3: Y-axis negative
143	UVWR parameter R-axis polarity	Set/Get	0: X-axis positive 1: X-axis negative 2: Y-axis positive 3: Y-axis negative
163	Camera display number	Set/Get	0: Camera 0 1: Camera 1 2: Camera 0 + 1
166	Output position scroll standard	Set/Get	0: Mid-point between point 1 and point 2 1: Point 1 2: Point 2
1000	Camera 0 crossline display flag	Set/Get	0: Not Visible   1: Visible
1001	Camera 0 crossline display center coordinate X	Set/Get	0 to 9999
1002	Camera 0 crossline display center coordinate Y	Set/Get	0 to 9999

### 3 Calibration and Scene Settings

No.	Data name	Set/Get	Data range
1003	Camera 0 scale display flag	Set/Get	0: Not Visible 1: Visible
1004	Camera 0 scale interval	Set/Get	0 to 9999.9999
1005	Camera 0 scale line length	Set/Get	0 to 9999.9999
1006	Camera 0 scale unit	Set/Get	0: Calibration parameter 1: pix
1007	Camera 0 line type	Set/Get	0: Solid 1: Dot
1008	Camera 0 line width	Set/Get	1 to 10
1009	Camera 0 line color	Set/Get	0: OK Color 1: NG Color 2: Arbitrary color
1010	Camera 0 line color R	Set/Get	0 to 255
1011	Camera 0 line color G	Set/Get	0 to 255
1012	Camera 0 line color B	Set/Get	0 to 255
1020	Camera 1 crossline display flag	Set/Get	0: Not Visible 1: Visible
1021	Camera 1 crossline display center coordinate X	Set/Get	0 to 9999
1022	Camera 1 crossline display center coordinate Y	Set/Get	0 to 9999
1023	Camera 1 scale display flag	Set/Get	0: Not Visible 1: Visible
1024	Camera 1 scale interval	Set/Get	0 to 9999.9999
1025	Camera 1 scale line length	Set/Get	0 to 9999.9999
1026	Camera 1 scale unit	Set/Get	0: Calibration parameter 1: pix
1027	Camera 1 line type	Set/Get	0: Solid 1: Dot
1028	Camera 1 line width	Set/Get	1 to 10
1029	Camera 1 line color	Set/Get	0: OK Color 1: NG Color 2: Arbitrary color
1030	Camera 1 line color R	Set/Get	0 to 255
1031	Camera 1 line color G	Set/Get	0 to 255
1032	Camera 1 line color B	Set/Get	0 to 255
5007	Measurement result output	Get only	0 to 1

## 4 Specialized Processing Items

The specialized processing items in the software are as follows.

New processing item	Reference
Calculate Scroll	P26
EC Corner	P33
EC Cross	P43
Intersection	P52
Scan Edge Circle	P62
ECM Search Motion	P71

### 4-1 EC Corner

This processing item is suitable for detecting corners.

It detects the cross point of 2 lines that are created by edges, such as the corner of a square workpiece. By specifying conditions such as length, direction and edge strength, the desired corner can be detected.

Position compensation can be executed based on the detected corner coordinates.

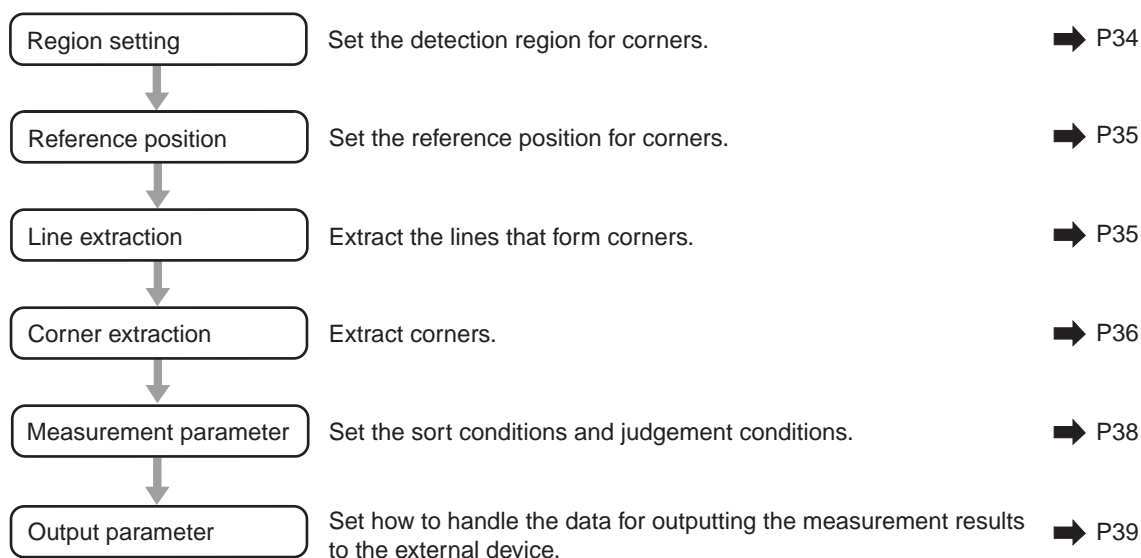


#### Important

This processing item includes a process that shortens the processing time from the second time that is performed. For this reason, when measuring the same image, the processing time the first time after starting up the controller may be longer than the processing time for the subsequent times.

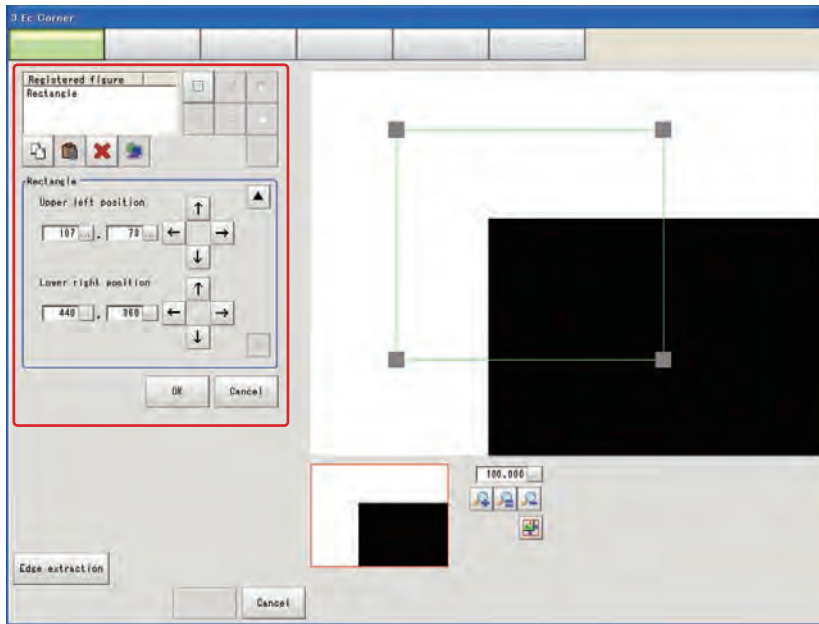
### Setting Flow

The setting for the EC corner is shown by the flow diagram below.



### Region Setting

Set the area for performing the inspection.



1. Use the drawing tools to specify the measurement region.
2. In the figure setting area, tap [OK].  
The measurement region is registered and displayed in the image display area.
3. Tap [Edge extraction] and check the edge extraction image.  
If there is a break in the outline of the measurement object or there are too many edges, adjust the edge level.  
For more details, see "8. Appendixes - Measurement Mechanism" - "Edge Detection Measurement" in the FZ3 User's Manual.

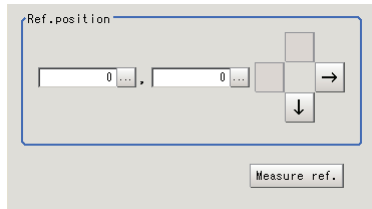


Setting item	Setting value [Factory default]	Description
Mask size	3 × 3 [5 × 5] 7 × 7 9 × 9	Select the range of pixels which are used to extract the edge. With a larger mask size, search is less affected by variation in pixels.
Edge level	0 to 1000 [100]	Adjust the edge extraction level when the edge is hard to see due to low contrast with the background or when unnecessary background noise should be removed.

## Reference Position

When the measurement region is set, this position is automatically set at the same time as the reference position. This item can be used to change the reference position to any desired position. This is handy for measuring the position deviation from a certain position.

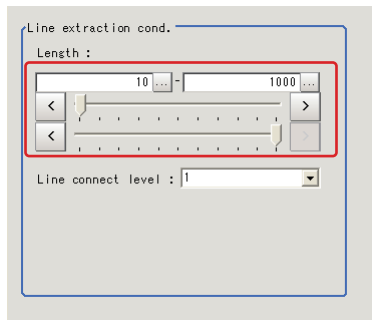
1. **Tap the position to be set as the reference position.**
2. **Make fine adjustments using numeric value inputs or the arrow buttons as required.**  
To re-measure on the displayed image and set the reference position, tap [Measure ref.].



## Line Extraction

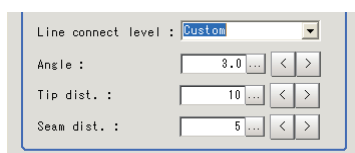
Set the conditions for extracting lines.

1. **Set the following items as required.**



Setting item	Setting value [Factory default]	Description
Length	5 to 4000 [10] to [4000]	Set the length of the edges to use as the extraction target.
Line connect level	[1] 2 3 4 5 Custom	Set how much to connect the fragmented lines from the lines that were detected by edge extraction. The higher the value, the easier it is to connect.

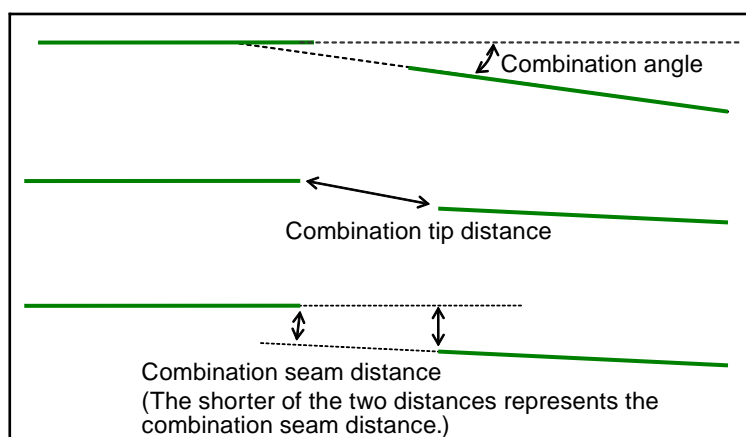
2. **When the line connection level is set to [Custom], set the following items as required.**



Setting item	Setting value [Factory default]	Description
Angle	0.0 to 30.0 [3.0]	Specify the angle range when connecting 2 lines. With larger values, 2 lines with different inclinations can be connected. (Unit: °)

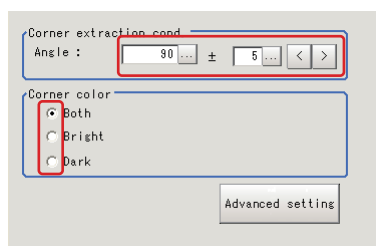
## 4 Specialized Processing Items

Setting item	Setting value [Factory default]	Description
Tip dist.	0 to 1000 [10]	Specify the distance between vertexes when connecting 2 lines. With larger values, lines that are further away can be connected. (Unit: pix)
Seam dist.	0 to 1000 [5]	Specify the conditions when connecting 2 lines for the nearest distance between one line when it is extended and the vertex of the other line. With larger values, lines that deviate perpendicularly from each other can be connected. (Unit: pix)



### Corner Extraction

Set the conditions for extracting corners.



#### 1. Set the following items as required.

Setting item	Setting value [Factory default]	Description
Corner extraction cond.		
Angle	10 to 350 [90]	Set the range for the corner angle.
±	0 to 180 [5]	Set the margin range for the angle.
Corner color	[Both] Bright Dark	Set the relationship between bright and dark for the corner and background.



## 2. When [Advanced setting] is tapped, the following conditions can be set.

Line 0 cond.

Length : [ 10 ] - [ 1000 ]

Angle : [ 0 ] ± [ 180 ] < >

Overrun : [ -10 ] - [ 10 ]

Line 1 cond.

Length : [ 10 ] - [ 1000 ]

Angle : [ 0 ] ± [ 180 ] < >

Overrun : [ -10 ] - [ 10 ]

Corner fusion

☒ Length

☐ Dist. from corner

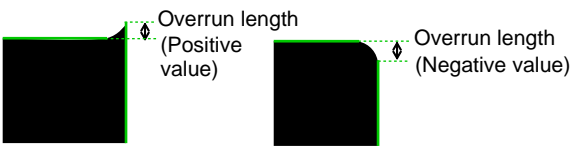
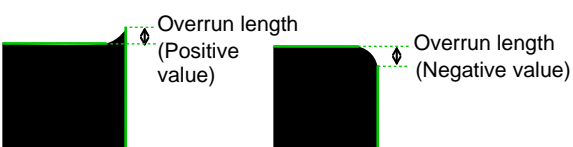
☐ Corner angle

Dist. : [ 10.0000 ] < >

Direction : [ 5.0000 ] < >

Angle : [ 5.0000 ] < >

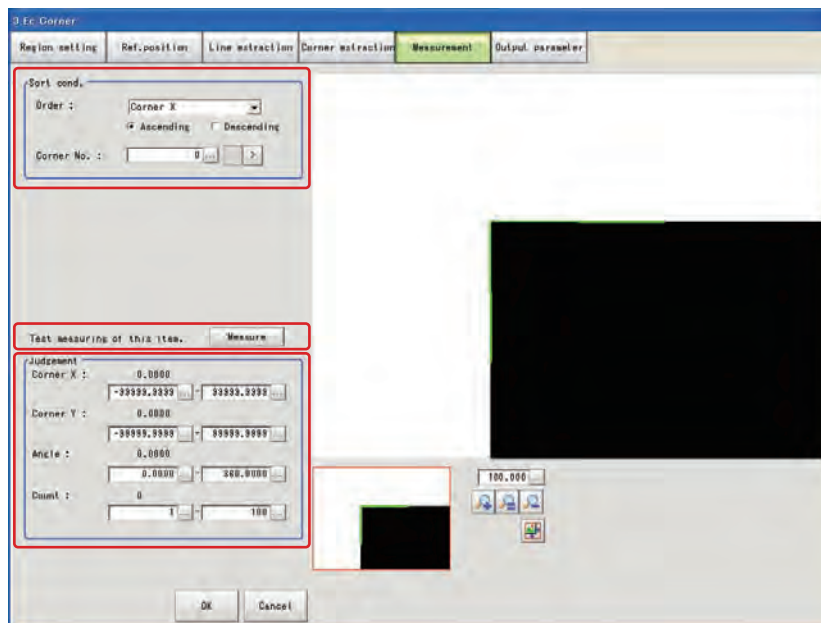
Return

Setting item	Setting value [Factory default]	Description
Line 0 cond.		
Length	5 to 4000 [10] to [4000]	Length condition for extracting line 0 (clockwise left side as seen from the cross point).
Angle	[0] to 359	Angle condition for extracting line 0 (clockwise left side as seen from the cross point).
Overrun	-1000 to 1000	Specify the length range used to specify whether the tips of two straight lines constituting the corner run through the corner or do not reach the corner (unit: pix). If they run through the corner, the overrun length becomes positive. If they do not reach the corner, the overrun length becomes negative. 
Line 1 cond.		
Length	5 to 4000 [10] to [4000]	Length condition for extracting line 1 (clockwise right side as seen from the cross point).
Angle	[0] to 359	Angle condition for extracting line 1 (clockwise right side as seen from the cross point).
Overrun	-1000 to 1000	Specify the length range used to specify whether the tips of two straight lines constituting the corner run through the corner or do not reach the corner (unit: pix). If they run through the corner, the overrun length becomes positive. If they do not reach the corner, the overrun length becomes negative. 
Corner fusion		

Setting item	Setting value [Factory default]	Description
Corner fusion	[Length] Dist. from corner Corner angle	<p>If two out of all detected corners meet all three conditional relationships of "fusion distance," "fusion line angle range" and "fusion corner angle range" fuse them into one corner according to the following priorities:</p> <p>Priority on straight line length: Keep the corner associated with the longer total length of the two straight lines constituting the corner.</p> <p>Priority on distance from intersection: Keep the corner associated with the smaller total overrun of the two straight lines.</p> <p>Priority on corner angle: Keep the corner whose angle formed by the two straight lines is closer to the corner condition "angle range."</p>
Dist.	0 to 1000 [10.0]	Straight distance between corners (unit: pix).
Direction	0 to 20 [5.0]	Difference between the angles formed by the two straight lines constituting the respective corners (unit: °)
Angle	0 to 20 [5.0]	Corner angle difference (unit: °)

### Measurement Parameters

Set the sort conditions and judgement conditions for corners.



1. In the [Sort cond.] area, set the following items as required.

Setting item	Setting value [Factory default]	Description
Order	[Corner X] Corner Y Length	Set the sorting method for the measurement results.
	[Ascending] Descending	
Corner No.	[0] to 99	Enter the number of the corner for which to output data.

2. After changing the measurement parameters, tap [Measure] and check that the window display accurately reflects the settings.

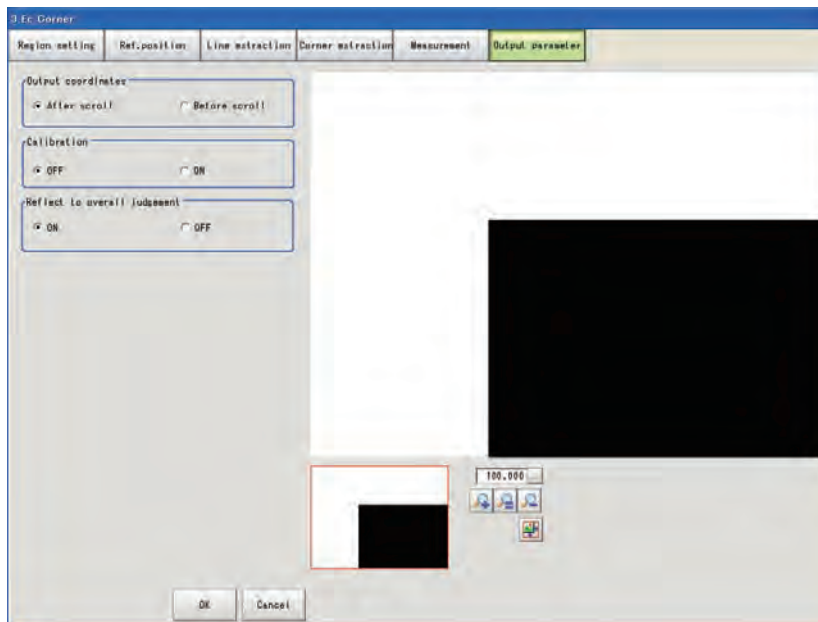


3. In the [Judgement] area, set the judgement conditions.

Setting item	Setting value [Factory default]	Description
Corner X	-99999.9999 to 99999.9999	Set the X coordinate range of corners that are judged to be OK.
Corner Y	-99999.9999 to 99999.9999	Set the Y coordinate range of corners that are judged to be OK.
Angle	0.0000 to 360.0000	Set the corner angles that are judged to be OK.
Count	1 to 100	Set the number of detections of corners that are judged to be OK.

## Output Parameters

Set how to handle the data when outputting the measurement results to the external device.



### General Information

Normally, the factory default value will be used for this item.  
Do not change this setting unless there is a particular reason.

### ● Setting method

#### 1. Set the following parameters as required.

Setting item	Setting value [Factory default]	Description
Output coordinates	[After scroll] Before scroll	As measurement results, select whether to output coordinate values to external devices before or after the position compensation is applied.
Calibration	[OFF] ON	Select whether to reflect the calibration in the values output to the external device as measurement results. ON: Output coordinate values that have been converted to the actual dimensions. OFF: Output the camera coordinate values.
Reflect to overall judgement	[ON] OFF	Enables choosing whether or not the judgement results of this processing unit is reflected in the scene overall judgement.

#### 2. After completing all the settings, tap [OK].

## To Get Measurement Results from an External Source

### ● Measurement results for which output is possible (calculation)

The following values can be output using processing items related to results output. It is also possible to reference measurement values from expressions and other processing units.

Setting item	Setting value [Factory default]	Description
Judge	JG	The judgement result for the unit. 1: OK 0: Not yet measured -1: NG
CornerX	X	Corner coordinate XY.X
CornerY	Y	Corner coordinate XY.Y
Angle	TH	Angle
Count	CT	Number of detections
Ref.Position	SX	The X coordinate of the reference position.
Ref.Position	SY	The Y coordinate of the reference position.
Corner0X	X0	Corner coordinates XY data group [0].X
Corner0Y	Y0	Corner coordinates XY data group [0].Y
Angle0	TH0	Corner angle data group [0]
Line0angle0	DIRL0	Calculated from the corner detailed information [0]
Line1angle0	DIRR0	Calculated from the corner detailed information [0]
Corner1X	X1	Corner coordinates XY data group [1].X
Corner1Y	Y1	Corner coordinates XY data group [1].Y
Angle1	TH1	Corner angle data group [1]
Line0angle0	DIRL1	Calculated from the corner detailed information [1]
Line1angle1	DIRR1	Calculated from the corner detailed information [1]
:		
Corner99X	X99	Corner coordinates XY data group [99].X
Corner99Y	Y99	Corner coordinates XY data group [99].Y

Setting item	Setting value [Factory default]	Description
Angle99	TH99	Corner angle data group [99]
Line0angle99	DIRL99	Calculated from the corner detailed information [99]
Line1angle99	DIRR99	Calculated from the corner detailed information [99]

External Reference Tables

Setting item	Data name	Set/Get	Range
0	Judge	Get only	0: No Judgement (not yet measured) 1: Judgement result OK -1: Judgement result NG
5	Count	Get only	0 to 100
6	Corner coordinate XY.X	Get only	-99999.9999 to 99999.9999
7	Corner coordinate XY.Y	Get only	-99999.9999 to 99999.9999
8	Angle	Get only	0 to 360
9	Reference position X coordinate	Get only	-99999.9999 to 99999.9999
10	Reference position Y coordinate	Get only	-99999.9999 to 99999.9999
101	Output coordinate	Set/Get	0: After scroll 1: Before scroll
102	Calibration	Set/Get	0: OFF 1: ON
103	Reflect to overall judgement	Set/Get	0: ON 1: OFF
120	Edge extraction level	Set/Get	0 to 1000
121	Filter size	Set/Get	0:3 × 3 1:5 × 5 2:7 × 7 3:9 × 9
122	Line length lower limit	Set/Get	5 to 1000
123	Line length upper limit	Set/Get	5 to 1000
124	Combination angle	Set/Get	0.0 to 30.0
125	Combination tip distance	Set/Get	0 to 1000
126	Combination seam distance	Set/Get	0 to 1000
127	Line 0 condition length range lower limit	Set/Get	5 to 1000
128	Line 0 condition length range upper limit	Set/Get	5 to 1000
129	Line 1 condition length range lower limit	Set/Get	5 to 1000
130	Line 1 condition length range upper limit	Set/Get	5 to 1000
131	Line 0 condition line angle	Set/Get	0 to 359
132	Line 0 condition line angle range	Set/Get	0 to 180

## 4 Specialized Processing Items

Setting item	Data name	Set/Get	Range
133	Line 1 condition line angle	Set/Get	0 to 359
134	Line 1 condition line angle range	Set/Get	0 to 180
135	Formed angle	Set/Get	10 to 350
136	Formed angle range	Set/Get	0 to 180
137	Line 0 condition overrun range lower limit	Set/Get	-1000 to 1000
138	Line 0 condition overrun range upper limit	Set/Get	-1000 to 1000
139	Line 1 condition overrun range lower limit	Set/Get	-1000 to 1000
140	Line 1 condition overrun range upper limit	Set/Get	-1000 to 1000
141	Detection object color	Set/Get	0: Both 1: Dark 2: Bright
149	Sort condition	Set/Get	0: Cross point X 1: Cross point Y 2: Length
150	Sort order	Set/Get	0: Ascending 1: Descending
151	Cross No.	Set/Get	0 to 99
155	Corner fusion ON/OFF	Set/Get	0: OFF 1: ON
156	Fusion distance	Set/Get	0 to 1000
157	Fusion line angle range	Set/Get	0 to 20
158	Fusion corner angle range	Set/Get	0 to 20
159	Corner fusion condition	Set/Get	0: Length 1: Distance from corner 2: Corner angle
160	Judgement condition corner X lower limit	Set/Get	-99999.9999 to 99999.9999
161	Judgement condition corner X upper limit	Set/Get	-99999.9999 to 99999.9999
162	Judgement condition corner Y lower limit	Set/Get	-99999.9999 to 99999.9999
163	Judgement condition corner Y upper limit	Set/Get	-99999.9999 to 99999.9999
164	Judgement condition angle lower limit	Set/Get	0 to 360
165	Judgement condition angle upper limit	Set/Get	0 to 360
166	Judgement condition number of detections lower limit	Set/Get	0 to 100

Setting item	Data name	Set/Get	Range
167	Judgement condition count upper limit	Set/Get	0 to 100
168	Reference position X	Set/Get	0 to 9999
169	Reference position Y	Set/Get	0 to 9999
171	Line connection level	Set/Get	0: 1 1: 2 2: 3 3: 4 4: 5 5: Custom
10000+N N=0 to 99	Measurement coordinate	Get only	-99999.9999 to 99999.9999
10100+N N=0 to 99)	Measurement coordinate	Get only	-99999.9999 to 99999.9999
10200+N (N=0 to 99)	Formed angle N	Get only	0 to 360

## 4-2 EC Cross

This detects cross shapes that are created by edges, such as crosshair marks.

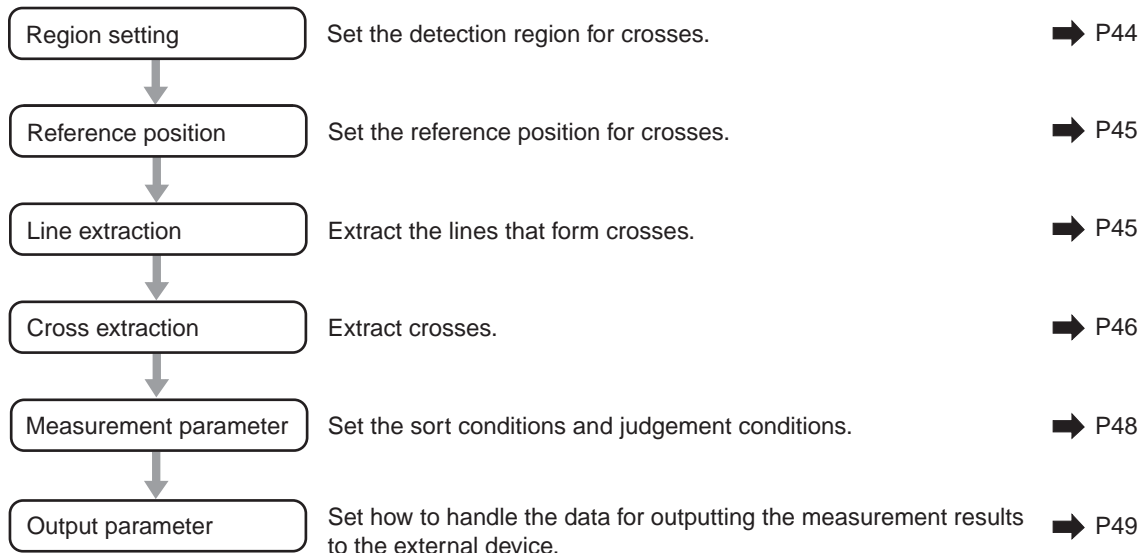


### Important

This processing item includes a process that shortens the processing time from the second time that is performed. For this reason, when measuring the same image, the processing time the first time after starting up the controller may be longer than the processing time for the subsequent times.

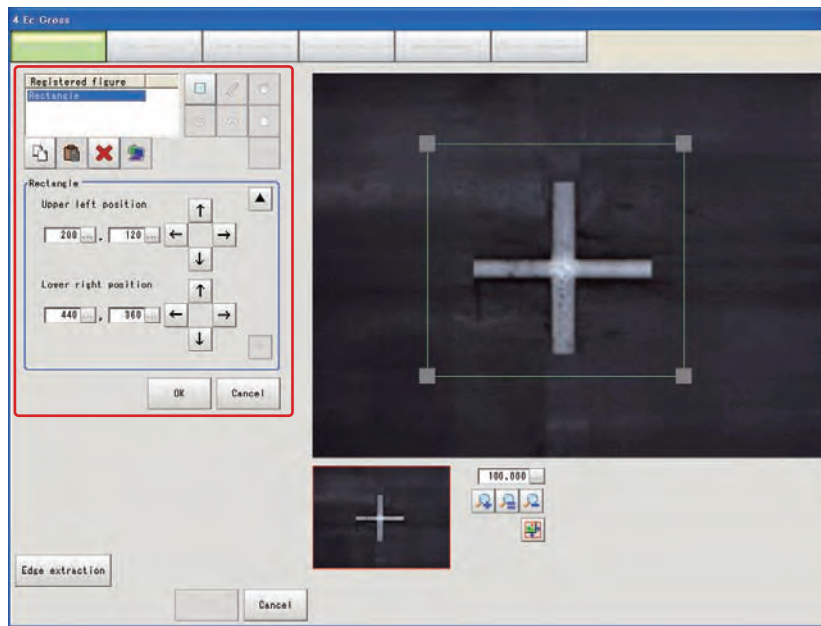
## Setting Flow

The setting for the Ec cross is shown by the flow diagram below.

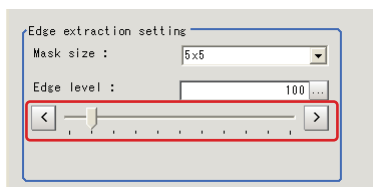


### Region Setting

Set the area for performing the inspection.



1. Use the drawing tools to specify the measurement region.
2. In the figure setting area, tap [OK].  
The measurement region is registered and displayed in the image display area.
3. Tap [Edge extraction] and check the edge extraction image.  
If there is a break in the outline of the measurement object, adjust the edge level.  
For more details, see "8. Appendixes - Measurement Mechanism" - "Edge Detection Measurement" in the FZ3 User's Manual.



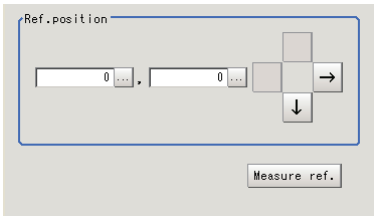
Setting item	Setting value [Factory default]	Description
Mask size	3 × 3 [5 × 5] 7 × 7 9 × 9	Select the range of pixels which are used to extract the edge. With a larger mask size, search is less affected by variation in pixels.
Edge level	0 to 1000 [100]	Adjust the edge extraction level when the edge is hard to see due to low contrast with the background or when unnecessary background noise should be removed.



## Reference Position

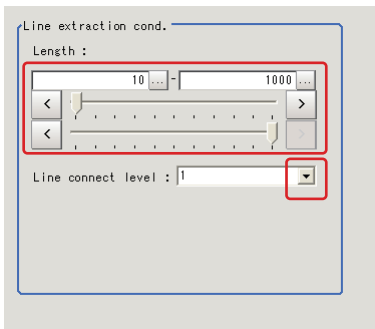
When the measurement region is set, this position is automatically set at the same time as the reference position. This item can be used to change the reference position to any desired position. This is handy for measuring the position deviation from a certain position.

1. **Tap the position to be set as the reference position.**
2. **Make fine adjustments using numeric value inputs or the arrow buttons as required.**  
To re-measure on the displayed image and set the reference position, tap [Measure ref.].



## Line Extraction

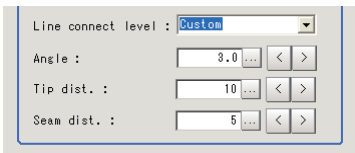
Set the extraction conditions for the line sections that will form the cross.



1. **Set the following items as required.**

Setting item	Setting value [Factory default]	Description
Length	5 to 4000 [10] to [4000]	Set the length of the edges to use as the extraction target.
Line connect level	[1] 2 3 4 5 Custom	Set how much to connect the fragmented lines from the lines that were detected by edge extraction. The higher the value, the easier it is to connect.

2. **When the line connection level is set to [Custom], set the following items as required.**



Setting item	Setting value [Factory default]	Description
Angle	0.0 to 30.0 [3.0]	Specify the angle range when connecting 2 lines. With larger values, 2 lines with different inclinations can be connected. (Unit: °)

Tip dist.	0 to 1000 [10]	Specify the distance between vertexes when connecting 2 lines. With larger values, lines that are further away can be connected. (Unit: pix)
Seam dist.	0 to 1000 [5]	Specify the conditions when connecting 2 lines for the nearest distance between one line when it is extended and the vertex of the other line. With larger values, lines that deviate perpendicularly from each other can be connected. (Unit: pix)

### Cross Extraction

Set the conditions for intersecting the lines.

1. In the [Line 0 cond.][Line 1 cond.][Cross brightness] area, set each item.

Setting item	Setting value [Factory default]	Description
Line 0 cond. Line 1 cond.		
Length	5 to 4000 [10] to [4000]	Set the length of the parallel lines.
Width	1 to 1000 [10] to [100]	Set the width of the parallel lines.
Cross brightness	[Both] Bright Dark	Set the relationship between light and dark for the cross and background.

2. When [Advanced setting] is tapped, the following conditions can be set.

Advanced cond.

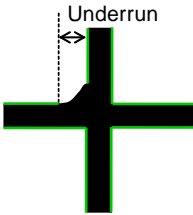
Underrun0 :  ~

Underrun1 :  ~

Detection line count :  <

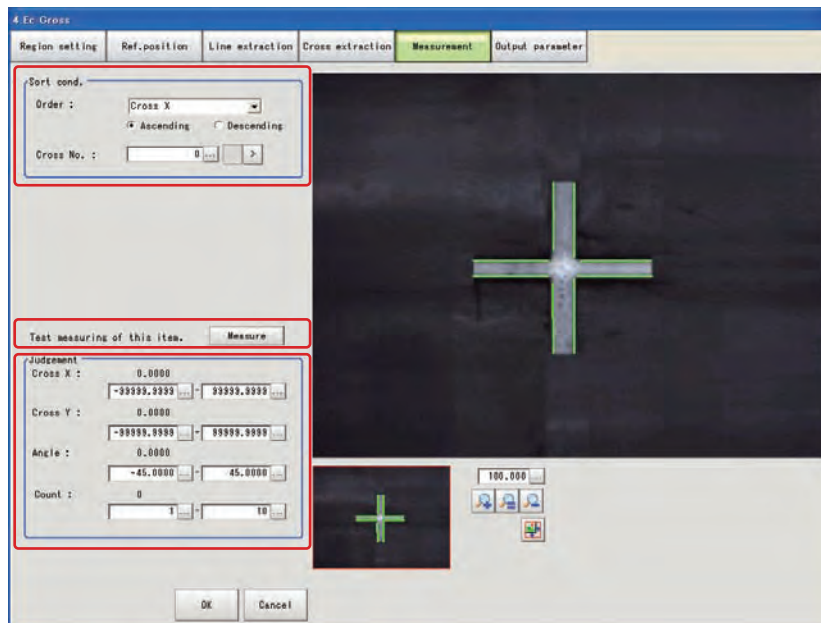
Return

Setting item	Setting value [Factory default]	Description
Underrun0	[0] to [1000]	Specify the degree of allowance when the intersection of the cross is rounded or pointing or is hidden due to external disturbance. Specify the range in which the cross is recognized when the cross does not reach the intersection (unit: pix).
Underrun1		
Detection line count	2 3 [4]	Set the number of parallel lines to be judged as a cross.



## Measurement Parameters

Set the sort conditions and judgement conditions for crosses.



1. In the [Sort cond.] area, set each item.

Setting item	Setting value [Factory default]	Description
Sort cond.	[Cross X] Cross Y Length	Set the sorting method for the measurement results when there are multiple cross points.
	[Ascending] Descending	
Cross No.	[0] to 9	Enter the number of the cross for which to output data.

2. After changing the measurement parameters, tap [Measure] and check that the window display accurately reflects the settings.

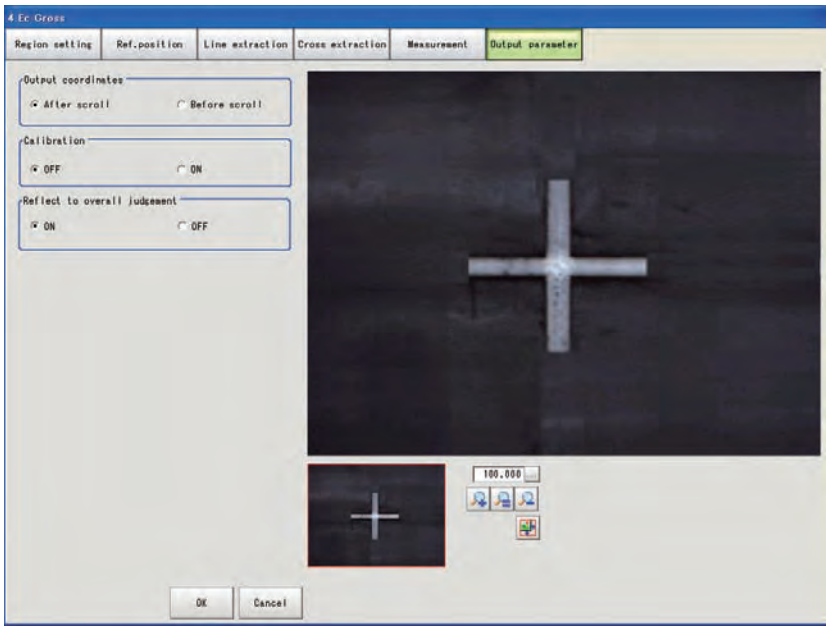


3. In the [Judgement] area, set the judgement conditions.

Setting item	Setting value [Factory default]	Description
Cross X	-99999.9999 to 99999.9999	Set the X coordinate range of crosses that are judged to be OK.
Cross Y	-99999.9999 to 99999.9999	Set the Y coordinate range of crosses that are judged to be OK.
Angle	-45.0000 to 45.0000	Set the cross angles that are judged to be OK.
Count	1 to 100	Set the number of detections for crosses that are judged to be OK.

## Output Parameters

Set how to handle the data when outputting the measurement results to the external device.



### General Information

Normally, the factory default value will be used for this item.  
Do not change this setting unless there is a particular reason.

### Setting method

1. Set the following parameters as required.

Setting item	Setting value [Factory default]	Description
Output coordinates	[After scroll] Before scroll	As measurement results, select whether to output coordinate values to external devices before or after the position compensation is applied.
Calibration	[OFF] ON	Select whether to reflect the calibration in the values output to the external device as measurement results. ON: Output coordinate values that have been converted to the actual dimensions. OFF: Output the camera coordinate values.
Reflect to overall judgement	[ON] OFF	Enables choosing whether or not the judgement results of this processing unit is reflected in the scene overall judgement.

2. After completing all the settings, tap [OK].

## To Get Measurement Results from an External Source

### ● Measurement results for which output is possible (calculation)

The following values can be output using processing items related to results output. Measurement values from the processing unit, such as expressions, can also be referenced.

Data name	Character string	Description
Judge	JG	The judgement result for the unit. 1: OK 0: Not yet measured -1: NG
Cross X	X	Cross coordinate XY.X
Cross Y	Y	Cross coordinate XY.Y
Angle	TH	Angle
Count	CT	Number of detections
Reference coordinate	SX	Reference position coordinate XY.X
Reference coordinate	SY	Reference position coordinate XY.Y
Reference angle	ST	Reference angle
Cross 0 X	X0	Cross coordinates XY data group [0].X
Cross 0 Y	Y0	Cross coordinates XY data group [0].Y
Angle 0	TH0	Calculated from the cross detailed information group [0]
Cross 1 X	X1	Cross coordinates XY data group [1].X
Cross 1 Y	Y1	Cross coordinates XY data group [1].Y
Angle 1	TH1	Calculated from the cross detailed information group [1]
:		
Cross 9 X	X9	Cross coordinates XY data group [9].X
Cross 9 Y	Y9	Cross coordinates XY data group [9].Y
Angle 9	TH9	Calculated from the cross detailed information group [9]

### ● External Reference Tables

No.	Data name	Set/Get	Range
0	Judge	Get only	0: No judgement (not yet measured) 1: Judgement result OK -1: Judgement result NG
5	Number of detections	Get only	0 to 100
6	Cross coordinate X	Get only	-99999.9999 to 99999.9999
7	Cross coordinate Y	Get only	-99999.9999 to 99999.9999
8	Angle	Get only	0 to 360
9	Reference position X coordinate	Get only	-99999.9999 to 99999.9999
10	Reference position Y coordinate	Get only	-99999.9999 to 99999.9999
101	Output coordinate	Set/Get	0: After scroll 1: Before scroll
102	Calibration	Set/Get	0: OFF 1: ON

No.	Data name	Set/Get	Range
103	Reflect to overall judgement	Set/Get	0: ON 1: OFF
120	Edge extraction level	Set/Get	0 to 1000
121	Filter size	Set/Get	0: 3 × 3 1: 5 × 5 2: 7 × 7 3: 9 × 9
122	Line length lower limit	Set/Get	5 to 1000
123	Line length upper limit	Set/Get	5 to 1000
124	Combination angle	Set/Get	0.0 to 30.0
125	Combination tip distance	Set/Get	0 to 1000
126	Combination seam distance	Set/Get	0 to 1000
127	Parallel line 0 condition length range lower limit	Set/Get	5 to 1000
128	Parallel line 0 condition   length range upper limit	Set/Get	5 to 1000
129	Parallel line 1 condition   length range lower limit	Set/Get	5 to 1000
130	Parallel line 1 condition   length range upper limit	Set/Get	5 to 1000
138	Detection line count	Set/Get	2 to 4
139	Parallel line 0 condition Underrun range lower limit	Set/Get	0 to 1000
140	Parallel line 0 condition Underrun range upper limit	Set/Get	0 to 1000
141	Parallel line 1 condition Underrun range lower limit	Set/Get	0 to 1000
142	Parallel line 1 condition Underrun range upper limit	Set/Get	0 to 1000
143	Parallel line 0 condition Min. width	Set/Get	1 to 1000
144	Parallel line 0 condition Max. width	Set/Get	1 to 1000
145	Parallel line 1 condition Min. width	Set/Get	1 to 1000
146	Parallel line 1 condition Max. width	Set/Get	1 to 1000
148	Detection object color	Set/Get	0: Both 1: Dark 2: Bright
156	Sort condition	Set/Get	0: Cross X 1: Cross Y 2: Length
157	Sort order	Set/Get	0: Ascending 1: Descending
158	Cross No.	Set/Get	0 to 9
162	Fusion distance	Set/Get	0 to 1000

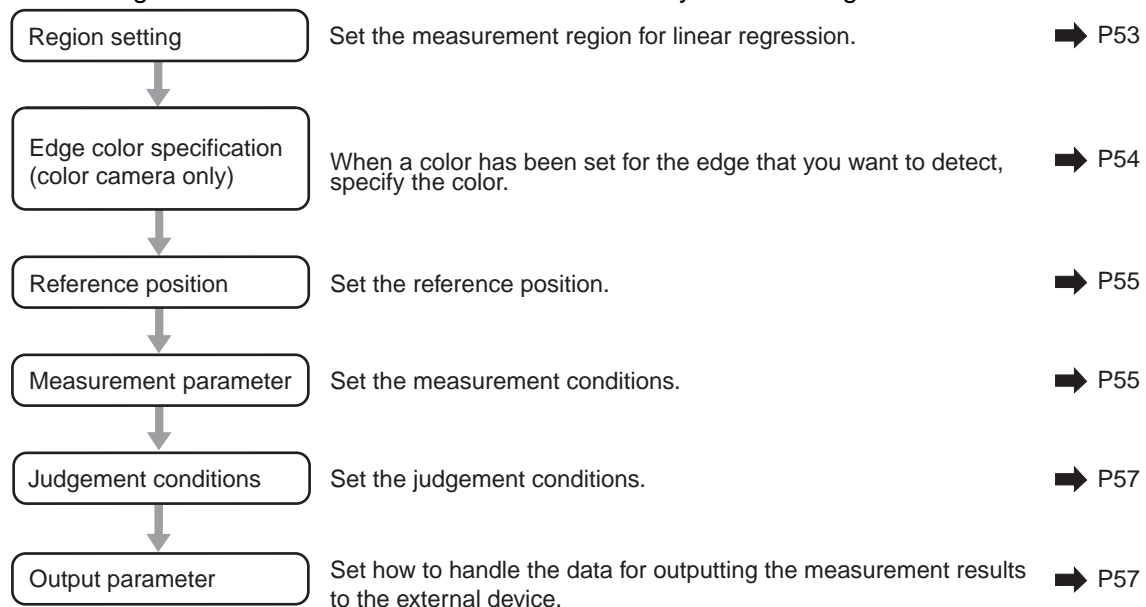
No.	Data name	Set/Get	Range
163	Judgement condition cross X lower limit	Set/Get	-99999.9999 to 99999.9999
164	Judgement condition cross X upper limit	Set/Get	-99999.9999 to 99999.9999
165	Judgement condition cross Y lower limit	Set/Get	-99999.9999 to 99999.9999
166	Judgement condition cross Y upper limit	Set/Get	-99999.9999 to 99999.9999
167	Judgement condition angle lower limit	Set/Get	-45 to 45
168	Judgement condition angle upper limit	Set/Get	-45 to 45
169	Judgement condition count lower limit	Set/Get	0 to 10
170	Judgement condition count upper limit	Set/Get	0 to 10
171	Reference position X	Set/Get	0 to 9999
172	Reference position Y	Set/Get	0 to 9999
174	Line connection level	Set/Get	0: 1 1: 2 2: 3 3: 4 4: 5 5: Custom
10000 + N (N = 0 to 9)	Measurement coordinate	Get only	-99999.9999 to 99999.9999
10100 + N (N = 0 to 9)	Measurement coordinate	Get only	-99999.9999 to 99999.9999
10200 + N (N = 0 to 9)	Formed angle N	Get only	-45 to 45

### 4-3 Intersection Coordinates

The edge points are used to calculate 2 linear regressions, and the center coordinate and angle are calculated from each cross point.

#### Setting Flow

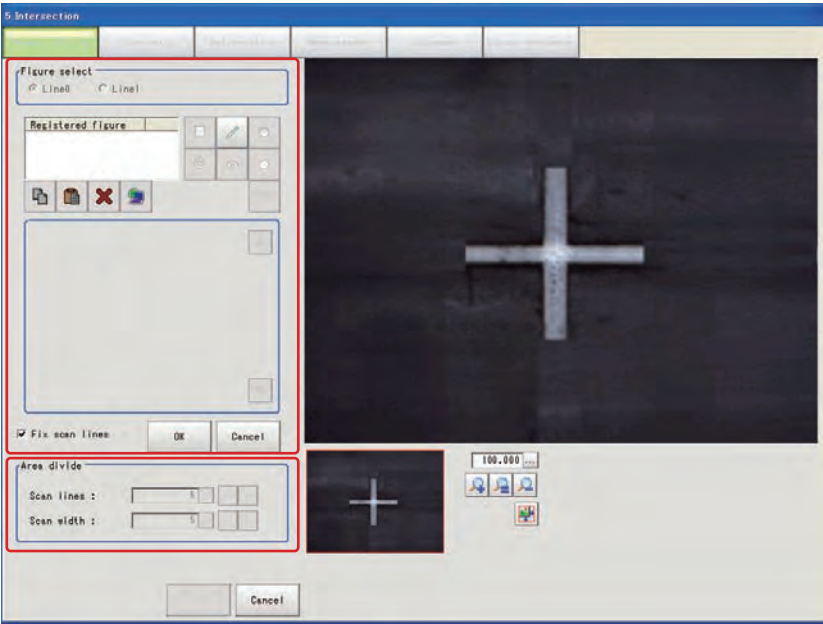
The setting for the intersection coordinates is shown by the flow diagram below.






# Region Setting

Set the area for performing the inspection.



1. **Use the drawing tools to specify the measurement region.**  
To change the number of area divisions according to the measurement range, uncheck the check box.  

2. **In the figure setting area, tap [OK].**  
The measurement region is registered and displayed in the image display area.
3. **In the [Area divide] area, set the number of divisions and the width.**  
By default, the number of area divisions is 5 and the area width is 5.
4. **The area is divided evenly.**

Scan area when the number of area divisions is 1



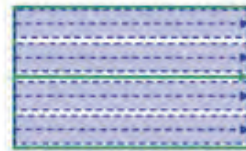
Scan area when the number of area divisions is 2



Scan area when the number of area divisions is 3



Scan area when the number of area divisions is 4



## Note

Enable or disable can be set for each divided area. Tap on a divided area to display the following window.

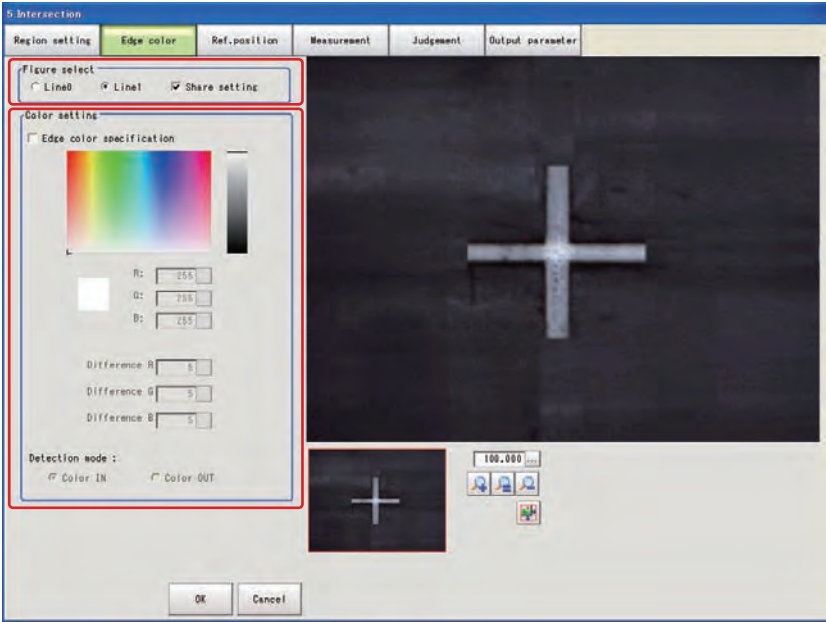


5. In the [Figure select] area, select [Line1] and set the region with the same procedure as line 0.

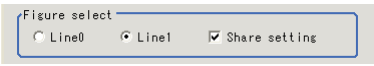


Edge Color Specification (Color Camera Only)

This item selects the color of the edges to be detected.  
If the target color changes, this setting is not necessary. If the color is not specified, positions in the measurement region where the color changes drastically are detected as an edge.





1. In the [Figure select] area, specify the line to set.



2. In the [Color setting] area, select the [Edge color specification] check box.

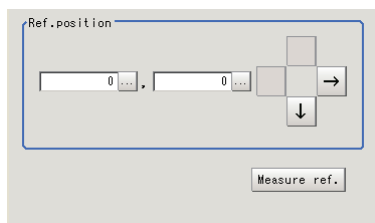
3. This item selects the color to be detected as edges.

Setting method	Description
Image display area	Specify a region on the image that includes the target color. The average color of the specified region is registered.
Color chart	Tap the reference color on the color chart to specify it. The RGB values for the specified color are displayed at the bottom.
RGB	The color to be detected is set with the RGB values.
Difference RGB	This sets the allowable color difference for detecting the edge, using the specified color as the reference. The larger the difference values, the larger the color range that is used to detect the edge.
Detection mode	<p>Specified color IN: The position where a color other than the specified color changes to the specified color is detected as the edge.</p> <p>Specified color OUT: The position where the specified color changes to a color other than the specified color is detected as the edge.</p> <div><div></div><div></div></div> <p>For "Specified color IN"      For "Specified color OUT"</p>

## Reference Position

When the measurement region is set, this position is automatically set at the same time as the reference position. This item can be used to change the reference position to any desired position. This is handy for measuring the position deviation from a certain position.

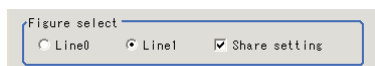
1. **Tap the position to be set as the reference position.**
2. **Make fine adjustments using numeric value inputs or the arrow buttons as required.**  
To re-measure on the displayed image and set the reference position, tap [Measure ref.].



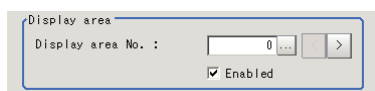
## Measurement Parameters

Set the measurement conditions for the intersection coordinates.

1. **In the [Figure select] area, specify the line to set.**

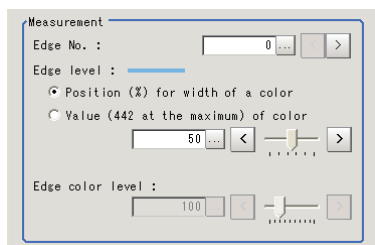


2. **In the [Display area], set the area number if the area is enabled.**



3. **In the [Measurement] area, set each item as required.**

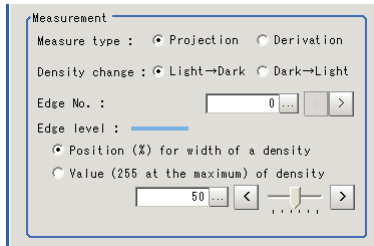
For color cameras



Setting item	Setting value [Factory default]	Description
Edge No.	0 to 99 [0]	Specify the edge number used to extract edges. Edge numbers are assigned to detected edges starting from 0 and in the direction from the start point (the arrow) to the end point (the arrow point) in the selected area.
Edge level	<ul style="list-style-type: none"> <li>Position (%) for width of a color 0 to 100 [50]</li> <li>Value (442 at the maximum) of color 0 to 442 [20]</li> </ul>	Set a color difference level with which the edge is detected. For more details, see "8. Appendixes - Measurement Mechanism" - "Edge Detection Measurement" in the FZ3 User's Manual.
Edge color level	0 to 442 [100]	This emphasis level can be set only if the edge color to detect is specified.

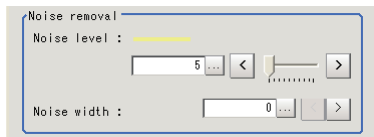
## 4 Specialized Processing Items

For monochrome cameras



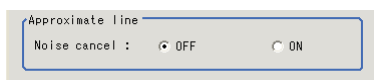
Setting item	Setting value [Factory default]	Description
Measure type	[Projection] Derivation	As the measurement type, specify either projection or derivation.
Density change	[Light→Dark] Dark→Light	Set whether a black-to-white change or a white-to-black change should be recognized as a density change in the specified area.
Edge No.	0 to 99 [0]	Specify the edge number used to extract edges. Edge numbers are assigned to detected edges starting from 0 and in the direction from the start point (the arrow) to the end point (the arrow point) in the selected area.
Edge level	<ul style="list-style-type: none"> <li>Position (%) for width of a density 0 to 100 [50]</li> <li>Value (255 at the maximum) of density 0 to 255 [20]</li> </ul>	Set the density change level to be detected as edges. For more details, see "8. Appendixes - Measurement Mechanism" - "Edge Detection Measurement" in the FZ3 User's Manual.

### 4. Set each item in the [Noise removal] area as required.



Setting item	Setting value [Factory default]	Description
Noise level	0 to 442 [5]	When detection is affected by noise, increase this value.
Noise width	0 to 9999 [0]	Set the width for judging noise. When detection is affected by noise, increase this value.

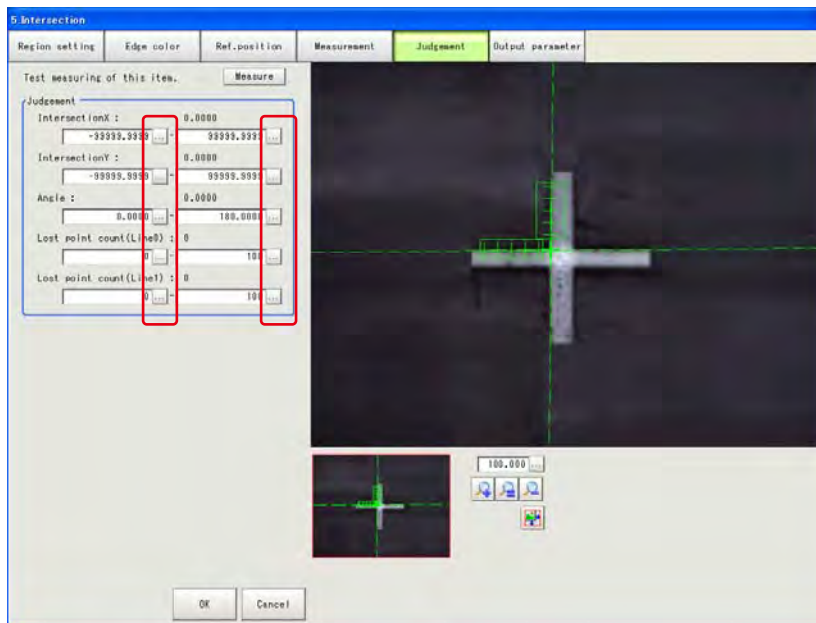
### 5. In the [Approximate line] area, specify the points to use in the linear regression calculation.



Setting item	Setting value [Factory default]	Description
Noise cancel	[OFF] ON	Select the [ON] check box to remove the measurement points with the largest deviation before calculating the linear regression.

## Judgement Conditions

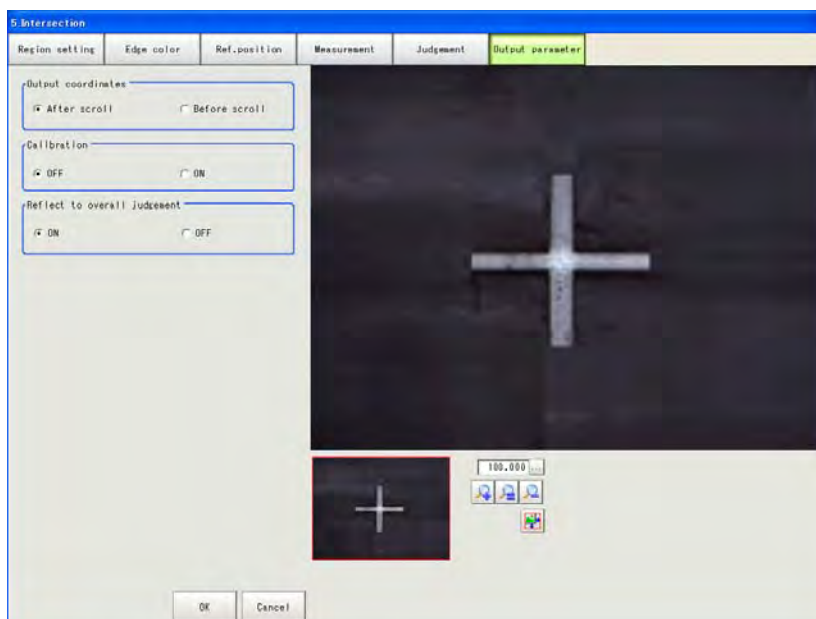
Set the range of positions that are judged to be OK.



Setting item	Setting value [Factory default]	Description
IntersectionX	-99999.9999 to 99999.9999	Set the X coordinate range of cross points that are judged to be OK.
IntersectionY	-99999.9999 to 99999.9999	Set the Y coordinate range of cross points that are judged to be OK.
Angle	0.0000 to 180.0000	Set the angles formed by the 2 lines that are judged to be OK.
Lost point count(Line0)	0 to 100	Set the number of lost points that is judged to be OK.
Lost point count(Line1)		

## Output Parameters

Set how to handle the data when outputting the measurement results to the external device.





### General Information

Normally, the factory default value will be used for this item.  
Do not change this setting unless there is a particular reason.

### ● Setting method

1. Set the following parameters as required.

Setting item	Setting value [Factory default]	Description
Output coordinates	[After scroll] Before scroll	As measurement results, select whether to output coordinate values to external devices before or after the position compensation is applied.
Calibration	[OFF] ON	Select whether to reflect the calibration in the values output to the external device as measurement results. ON: Output coordinate values that have been converted to the actual dimensions. OFF: Output the camera coordinate values.
Reflect to overall judgement	[ON] OFF	Enables choosing whether or not the judgement results of this processing unit is reflected in the scene overall judgement.

2. After completing all the settings, tap [OK].

## To Get Measurement Results from an External Source

### ● Measurement results for which output is possible (calculation)

The following values can be output using processing items related to results output. Measurement values from the processing unit, such as expressions, can also be referenced.

Data name	Character string	Description
Overall judgement result	JG	The judgement result for the unit. 1: OK 0: Not yet measured -1: NG
Intersection coordinate X	X	-99999.9999 to 99999.9999
Intersection coordinate Y	Y	-99999.9999 to 99999.9999
Angle	TH	0 to 180
Reference coordinate X	SX	0 to 99999.9999
Reference coordinate Y	SY	0 to 99999.9999
Line 0 peak edge position X	PEEKX0	0 to 99999.9999
Line 0 peak edge position Y	PEEKY0	0 to 99999.9999
Line 0 bottom edge position X	BOTTOMX0	0 to 99999.9999
Line 0 bottom edge position Y	BOTTOMY0	0 to 99999.9999
Line 0 average edge position X	AVEX0	-1 to 99999.9999
Line 0 average edge position Y	AVEY0	-1 to 99999.9999
Line 0 maximum long distance	PMAXD0	-1 to dist (X_MAX, Y_MAX)
Line 0 minimum long distance	PMIND0	-1 to dist (X_MAX, Y_MAX)
Line 0 maximum short distance	BMAXD0	-1 to dist (X_MAX, Y_MAX)

Data name	Character string	Description
Line 0 minimum short distance	BMIND0	-1 to dist (X_MAX, Y_MAX)
Line 0 deviation	DEV0	-1 to dist (X_MAX, Y_MAX)
Line 0 line angle	LINETH0	-180 to 180
Line 0 lost point	LOST0	0 to 100
Line 0 line component A	A0	-99999.9999 to 99999.9999
Line 0 line component B	B0	-99999.9999 to 99999.9999
Line 0 line component C	C0	-99999.9999 to 99999.9999
Line 1 peak edge position X	PEEKX1	0 to 99999.9999
Line 1 peak edge position Y	PEEKY1	0 to 99999.9999
Line 1 bottom edge position X	BOTTOMX1	0 to 99999.9999
Line 1 bottom edge position Y	BOTTOMY1	0 to 99999.9999
Line 1 average edge position X	AVEX1	-1 to 99999.9999
Line 1 average edge position Y	AVEY1	-1 to 99999.9999
Line 1 maximum long distance	PMAXD1	-1 to dist (X_MAX, Y_MAX)
Line 1 minimum long distance	PMIND1	-1 to dist (X_MAX, Y_MAX)
Line 1 maximum short distance	BMAXD1	-1 to dist (X_MAX, Y_MAX)
Line 1 minimum short distance	BMIND1	-1 to dist (X_MAX, Y_MAX)
Line 1 deviation	DEV1	-1 to dist (X_MAX, Y_MAX)
Line 1 line angle	LINETH1	-180 to 180
Line 1 lost point	LOST1	0 to 100
Line 1 line component A	A1	-99999.9999 to 99999.9999
Line 1 line component B	B1	-99999.9999 to 99999.9999
Line 1 line component C	C1	-99999.9999 to 99999.9999

#### ● External Reference Tables

No.	Data name	Set/Get	Range
0	Judge	Get only	0: No judgement (not yet measured) 1: Judgement result OK -1: Judgement result NG
1	Intersection coordinate X	Get only	-99999.9999 to 99999.9999
2	Intersection coordinate Y	Get only	-99999.9999 to 99999.9999
3	Angle	Get only	0 to 180
4	Reference coordinate X	Get only	0 to 99999.9999
5	Reference coordinate Y	Get only	0 to 99999.9999
10	Line 0 peak edge position X	Get only	0 to 99999.9999
11	Line 0 peak edge position Y	Get only	0 to 99999.9999
12	Line 0 bottom edge position X	Get only	0 to 99999.9999
13	Line 0 bottom edge position Y	Get only	0 to 99999.9999
14	Line 0 average edge position X	Get only	-1 to 99999.9999
15	Line 0 average edge position Y	Get only	-1 to 99999.9999
16	Line 0 maximum long distance	Get only	-1 to dist (X_MAX, Y_MAX)

## 4 Specialized Processing Items

No.	Data name	Set/Get	Range
17	Line 0 minimum long distance	Get only	-1 to dist (X_MAX, Y_MAX)
18	Line 0 maximum short distance	Get only	-1 to dist (X_MAX, Y_MAX)
19	Line 0 minimum short distance	Get only	-1 to dist (X_MAX, Y_MAX)
20	Line 0 deviation	Get only	-1 to dist (X_MAX, Y_MAX)
21	Line 0 line angle	Get only	-180 to 180
22	Line 0 lost point	Get only	0 to 100
23	Line 0 line component A	Get only	-99999.9999 to 99999.9999
24	Line 0 line component B	Get only	-99999.9999 to 99999.9999
25	Line 0 line component C	Get only	-99999.9999 to 99999.9999
30	Line 1 peak edge position X	Get only	0 to 99999.9999
31	Line 1 peak edge position Y	Get only	0 to 99999.9999
32	Line 1 bottom edge position X	Get only	0 to 99999.9999
33	Line 1 bottom edge position Y	Get only	0 to 99999.9999
34	Line 1 average edge position X	Get only	-1 to 99999.9999
35	Line 1 average edge position Y	Get only	-1 to 99999.9999
36	Line 1 maximum long distance	Get only	-1 to dist (X_MAX, Y_MAX)
37	Line 1 minimum long distance	Get only	-1 to dist (X_MAX, Y_MAX)
38	Line 1 maximum short distance	Get only	-1 to dist (X_MAX, Y_MAX)
39	Line 1 minimum short distance	Get only	-1 to dist (X_MAX, Y_MAX)
40	Line 1 deviation	Get only	-1 to dist (X_MAX, Y_MAX)
41	Line 1 line angle	Get only	-180 to 180
42	Line 1 lost point	Get only	0 to 100
43	Line 1 line component A	Get only	-99999.9999 to 99999.9999
44	Line 1 line component B	Get only	-99999.9999 to 99999.9999
45	Line 1 line component C	Get only	-99999.9999 to 99999.9999
101	Output coordinate	Set/Get	0: After position compensation 1: Before position compensation
102	Calibration	Set/Get	0: OFF 1: ON
103	Reflect to overall judgement	Set/Get	0: ON 1: OFF
120	Reference coordinate X	Set/Get	0 to 99999.9999
121	Reference coordinate Y	Set/Get	0 to 99999.9999
122	Share setting (edge color specification)	Set/Get	0: Not shared 1: Shared
123	Share setting (measurement parameters)	Set/Get	0: Not shared 1: Shared
124	Selected line number	Set/Get	0: Line 0 1: Line 1
130	Intersection X coordinate upper limit	Set/Get	-99999.9999 to 99999.9999
131	Intersection X coordinate lower limit	Set/Get	-99999.9999 to 99999.9999
132	Intersection Y coordinate upper limit	Set/Get	-99999.9999 to 99999.9999



No.	Data name	Set/Get	Range
133	Intersection Y coordinate lower limit	Set/Get	-99999.9999 to 99999.9999
134	Angle upper limit	Set/Get	0 to 180
135	Angle lower limit	Set/Get	0 to 180
136	Lost point (line 0) upper limit	Set/Get	0 to 100
137	Lost point (line 0) lower limit	Set/Get	0 to 100
138	Lost point (line 1) upper limit	Set/Get	0 to 100
139	Lost point (line 1) lower limit	Set/Get	0 to 100
200	Edge color specification	Set/Get	0: No color specification 1: With color specification
201	Edge color R	Set/Get	0 to 255
202	Edge color G	Set/Get	0 to 255
203	Edge color B	Set/Get	0 to 255
204	Difference R	Set/Get	0 to 127
205	Difference G	Set/Get	0 to 127
206	Difference B	Set/Get	0 to 127
207	Edge detection mode	Set/Get	0: Specified color IN 1: Specified color OUT
208	Edge No.	Set/Get	0 to 99
209	Edge level	Set/Get	0 to 100
210	Noise level	Set/Get	0 to 442
211	Noise width	Set/Get	0 to 9999
212	Edge color enhancement level	Set/Get	0 to 442
213	Monochrome edge detection mode	Set/Get	0: Light→Dark 1: Dark→Light
214	Edge level absolute value	Set/Get	0 to 442
215	Edge level specification method	Set/Get	0: % 1: Absolute value
216	Scan lines	Set/Get	1 to 100
217	Scan width	Set/Get	1 to 1000
218	Display area	Set/Get	0 to 99
219	Noise cancel	Set/Get	0: OFF 1: ON
220	Measure type	Set/Get	0: Projection 1: Differential
221	Fix scan lines	Set/Get	0: Not fixed 1: Fixed
250	Edge color specification	Set/Get	0: No color specification 1: With color specification
251	Edge color R	Set/Get	0 to 255
252	Edge color G	Set/Get	0 to 255
253	Edge color B	Set/Get	0 to 255
254	Difference R	Set/Get	0 to 127

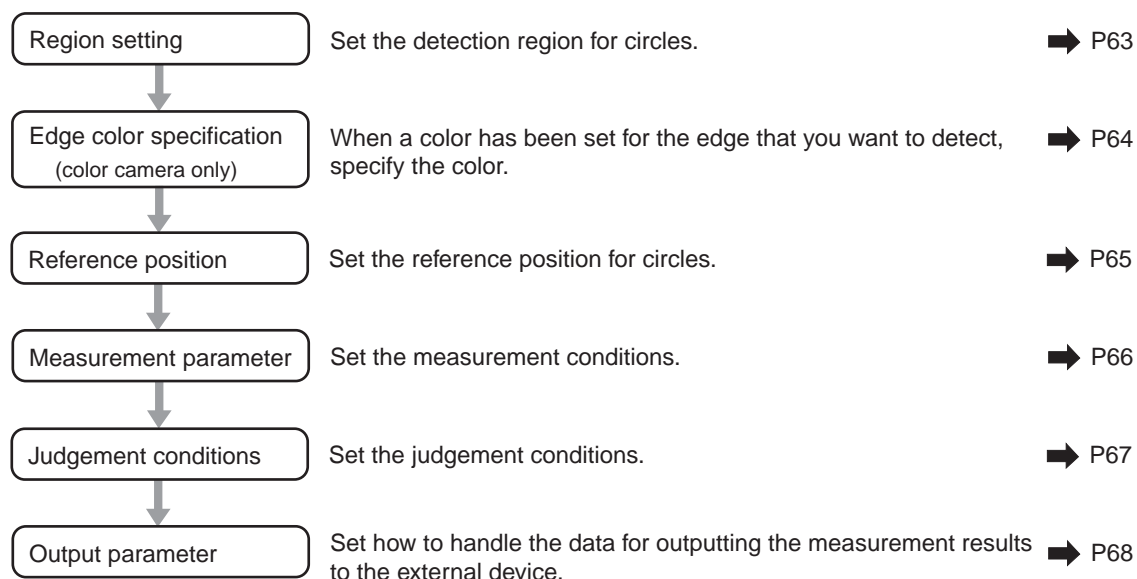
No.	Data name	Set/Get	Range
255	Difference G	Set/Get	0 to 127
256	Difference B	Set/Get	0 to 127
257	Edge detection mode	Set/Get	0: Specified color IN 1: Specified color OUT
258	Edge No.	Set/Get	0 to 99
259	Edge level	Set/Get	0 to 100
260	Noise level	Set/Get	0 to 442
261	Noise width	Set/Get	0 to 9999
262	Edge color enhancement level	Set/Get	0 to 442
263	Monochrome edge detection mode	Set/Get	0: Light→Dark 1: Dark→Light
264	Edge level absolute value	Set/Get	0 to 442
265	Edge level specification method	Set/Get	0: % 1: Absolute value
266	Scan lines	Set/Get	1 to 100
267	Scan width	Set/Get	1 to 1000
268	Display area	Set/Get	0 to 99
269	Noise cancel	Set/Get	0: OFF 1: ON
270	Measure type	Set/Get	0: Projection 1: Differential
271	Fix scan lines	Set/Get	0: Not fixed 1: Fixed

### 4-4 Scan Edge Circle

Multiple measured edge points are used to calculate the circle equation, and calculate the center coordinates and radius of the circle.

#### Setting Flow

The setting for the scan edge circle is shown by the flow diagram below.

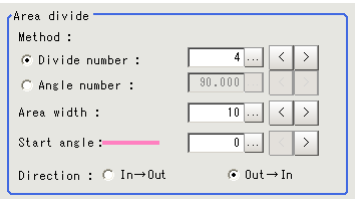


## Region Setting

Set the area for performing the inspection.

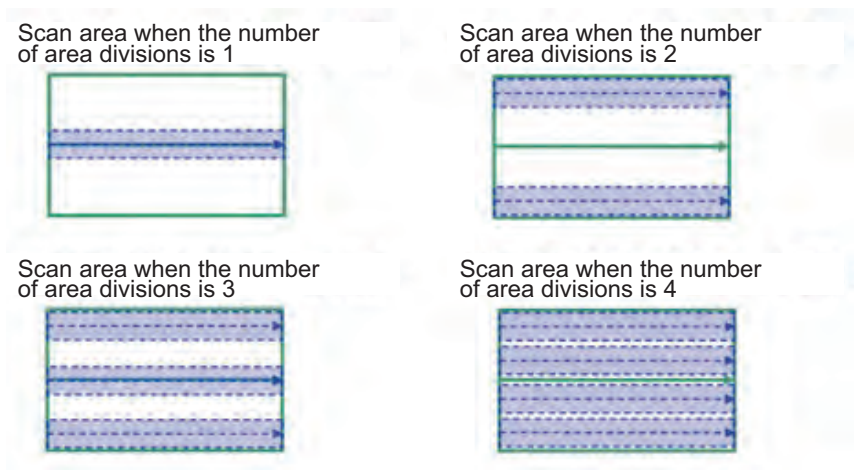


1. **Use the drawing tools to specify the measurement region.**  
The measurement region is registered and displayed in the image display area. Use the circumference tool to adjust areas such as the width as required.
2. **In the [Area divide] area, set the number of divisions and the width.**



Setting item	Setting value [Factory default]	Description
Method	[Divide number] Angle number	Set the division method.
Area width	1 to 1000 [5]	Set the area width for the divisions.
Start angle	[0] to 359	Set the division start angle.
Direction	[Out→In] In→Out	Set the measurement direction.

3. The area is divided evenly.



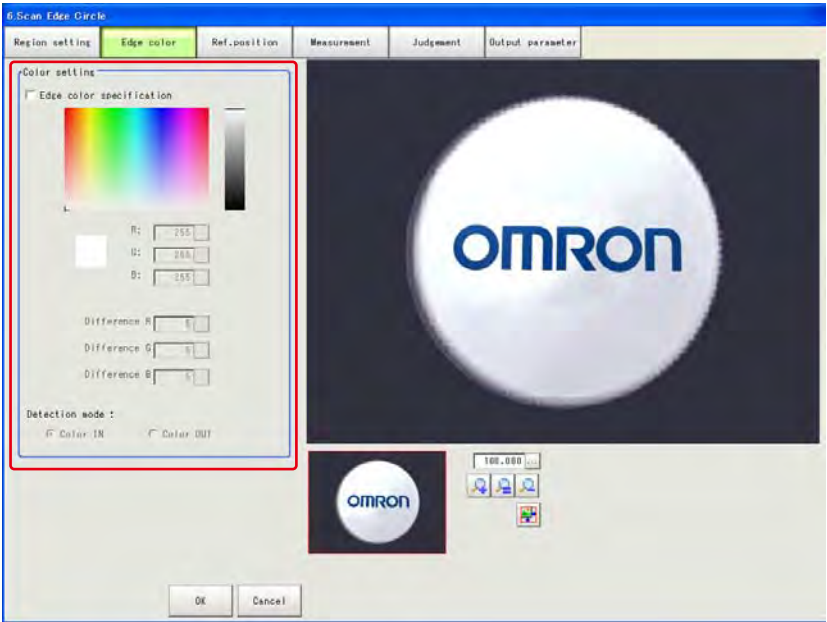
Note

Enable or disable can be set for each divided area. Tap on a divided area to display the following window.



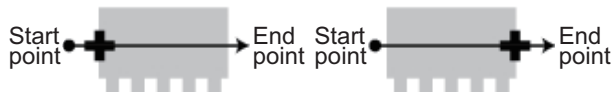
Edge Color Specification (Color Camera Only)

This item selects the color of the edges to be detected.  
If the target color changes, this setting is not necessary. If the color is not specified, positions in the measurement region where the color changes drastically are detected as an edge.



- 1. In the [Color setting] area, select the [Edge color specification] check box.
- 2. This item selects the color to be detected as edges.

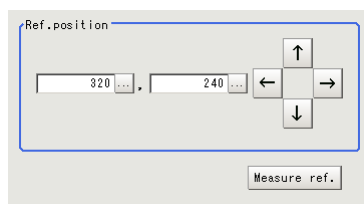
Setting method	Description
Image display area	Specify a region on the image that includes the target color. The average color of the specified region is registered.

Color chart	Tap the reference color on the color chart to specify it. The RGB values for the specified color are displayed at the bottom.
R • G • B	The color to be detected is set with the RGB values.
Difference R • G • B	This sets the allowable color difference for detecting the edge, using the specified color as the reference. The larger the difference values, the larger the color range that is used to detect the edge.
Detection mode	<p>Specified color IN: The position where a color other than the specified color changes to the specified color is detected as the edge.</p> <p>Specified color OUT: The position where the specified color changes to a color other than the specified color is detected as the edge.</p> <div style="text-align: center;">  </div>

## Ref. Position

When the measurement region is set, this position is automatically set at the same time as the reference position. This item can be used to change the reference position to any desired position. This is handy for measuring the position deviation from a certain position.

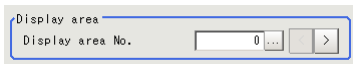
- 1. Tap the position to be set as the reference position.**
- 2. Make fine adjustments using numeric value inputs or the arrow buttons as required.**  
To re-measure on the displayed image and set the reference position, tap [Measure ref.].



## Measurement Parameters

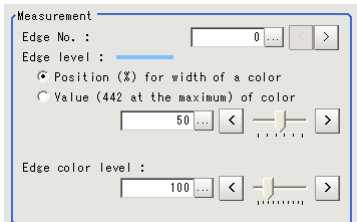
Set the measurement conditions for the circle.

1. In the [Display area] area, specify the area number to set.



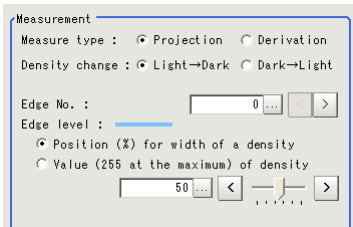
2. In the [Measurement] area, set each item as required.

For color cameras



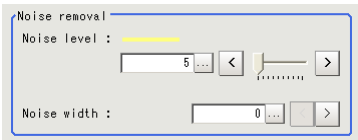
Setting item	Setting value [Factory default]	Description
Edge No.	0 to 99 [0]	Specify the edge number used to extract edges. Edge numbers are assigned to detected edges starting from 0 and in the direction from the start point (the arrow) to the end point (the arrow point) in the selected area.
Edge level	<ul style="list-style-type: none"> <li>• Position (%) for width of a color 0 to 100 [50]</li> <li>• Value (442 at the maximum) of color 0 to 442 [20]</li> </ul>	Set a color difference level with which the edge is detected. For more details, see "8. Appendixes - Measurement Mechanism" - "Edge Detection Measurement" in the FZ3 User's Manual.
Edge color level	0 to 442 [100]	This emphasis level can be set only if the edge color to detect is specified.

For monochrome cameras



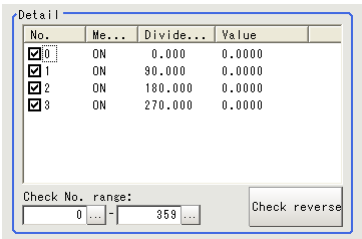
Setting item	Setting value [Factory default]	Description
Measure type	[Projection] Derivation	As the measurement type, specify either projection or derivation.
Density change	[Light→Dark] Dark→Light	Set whether a black-to-white change or a white-to-black change should be recognized as a density change in the specified area.
Edge No.	0 to 99 [0]	Specify the edge number used to extract edges. Edge numbers are assigned to detected edges starting from 0 and in the direction from the start point (the arrow) to the end point (the arrow point) in the selected area.
Edge level	<ul style="list-style-type: none"> <li>• Position (%) for width of a density 0 to 100 [50]</li> <li>• Value (255 at the maximum) of density 0 to 255 [20]</li> </ul>	Set the density change level to be detected as edges. For more details, see "8. Appendixes - Measurement Mechanism" - "Edge Detection Measurement" in the FZ3 User's Manual.

3. In the [Noise removal] area, set each item as required.



Setting item	Setting value [Factory default]	Description
Noise level	For color cameras 0 to 442 [5] For monochrome cameras 0 to 255 [5]	When detection is affected by noise, increase this value.
Noise width	0 to 9999 [0]	Set the width for judging noise. When detection is affected by noise, increase this value.

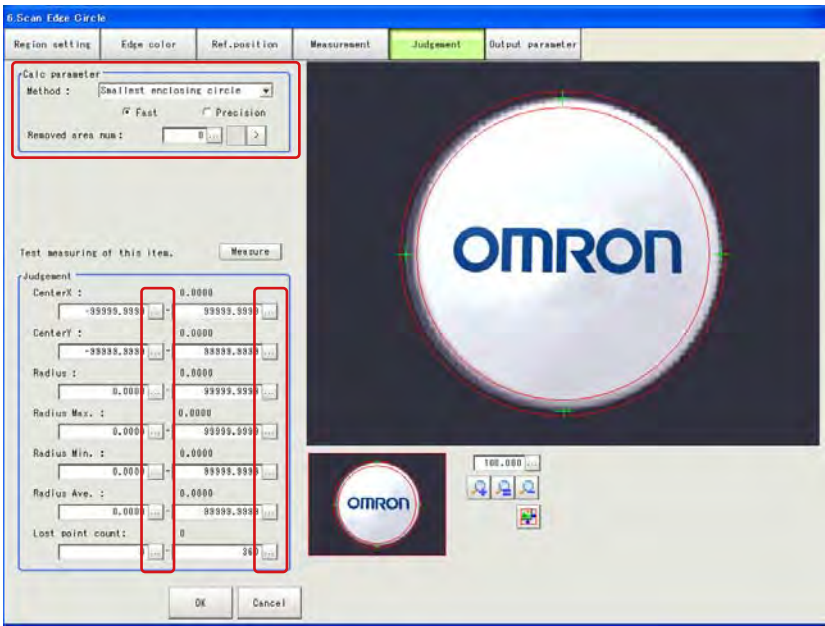
4. In the [Detail] area, set enable or disable for the region as required.



Setting item	Setting value [Factory default]	Description
Check No. range:	0 to 359	Specify the area numbers for which to perform batch reversing of the enable or disable setting. Tap [Check reverse] to reverse the check box settings of the areas within the range.

Judgement Conditions

Set the range of circles that are judged to be OK.



1. In the [Calc parameter] area, set the calculation method as required.

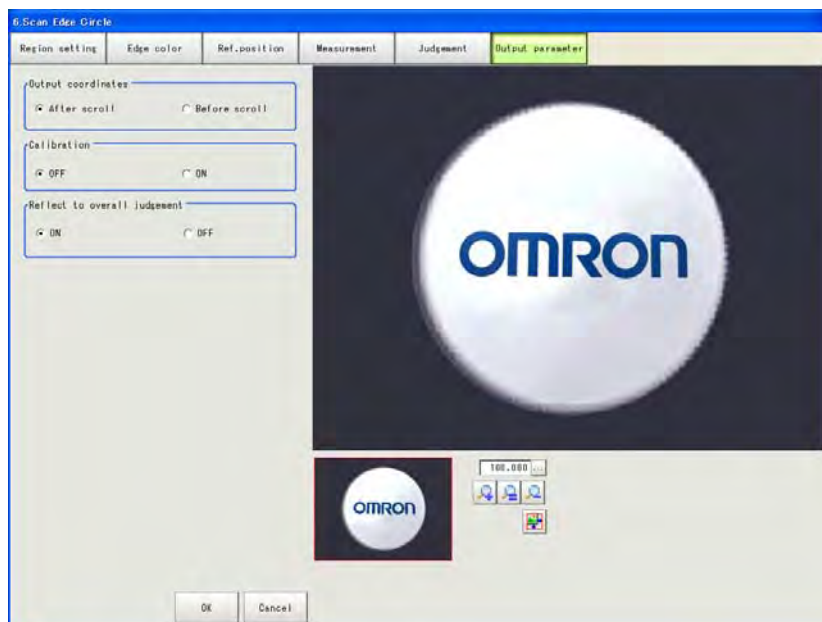
Setting item	Setting value	Description
Method	[Smallest enclosing circle] Approximation circle	Select settings for the circle calculation method.
	[Fast] Precision	
Removed area num	[0] to 360	Set the number of areas to remove.

2. Set the judgement conditions as required.

Setting item	Setting value	Description
CenterX	-99999.9999 to 99999.9999	Set the range of center coordinate Xs that are judged to be OK.
CenterY	-99999.9999 to 99999.9999	Set the range of center coordinate Ys that are judged to be OK.
Radius	0 to 99999.9999	Set the range of radiuses that is judged to be OK.
Radius Max.	0 to 99999.9999	Set the maximum radius that is judged to be OK.
Radius Min.	0 to 99999.9999	Set the minimum radius that is judged to be OK.
Radius Ave.	0 to 99999.9999	Set the average radius that is judged to be OK.
Lost point count	0 to 360	Set the number of lost points that is judged to be OK.

## Output Parameters

Set how to handle the data when outputting the measurement results to the external device.



### General Information

Normally, the factory default value will be used for this item.  
Do not change this setting unless there is a particular reason.



### ● Setting method

#### 1. Set the following parameters as required.

Setting item	Setting value [Factory default]	Description
Output coordinates	[After scroll] Before scroll	As measurement results, select whether to output coordinate values to external devices before or after the position compensation is applied.
Calibration	[OFF] ON	Select whether to reflect the calibration in the values output to the external device as measurement results. ON: Output coordinate values that have been converted to the actual dimensions. OFF: Output the camera coordinate values.
Reflect to overall judgement	[ON] OFF	Enables choosing whether or not the judgement results of this processing unit is reflected in the scene overall judgement.

#### 2. After completing all the settings, tap [OK].

## To Get Measurement Results from an External Source

### ● Measurement results for which output is possible (calculation)

The following values can be output using processing items related to results output. It is also possible to reference measurement values from expressions and other processing units.

Data name	Character string	Description
Overall judgement result	JG	The judgement result for the unit. 1: OK 0: Not yet measured -1: NG
CenterX	X	The center X coordinate of the calculation result.
CenterY	Y	The center Y coordinate of the calculation result.
Radius	R	The radius of the calculation result.
Maximum radius	MAXR	The maximum radius of the calculation result.
Minimum radius	MINR	The minimum radius of the calculation result.
Average radius	AVER	The average radius of the calculation result.
Lost point count	LOST	The number of lost points.
Reference coordinate X	SX	Reference coordinate X.
Reference coordinate Y	SY	Reference coordinate Y.
Maximum radius area number	MAXNO	The area number for the maximum radius.
Minimum radius area number	MINNO	The area number for the minimum radius.

### ● External Reference Tables

No.	Data name	Character string	Range
0	Judge	Get only	0: No judgement (not yet measured) 1: Judgement result OK -1: Judgement result NG
1	CenterX	Get only	-99999.9999 to 99999.9999
2	CenterY	Get only	-99999.9999 to 99999.9999
3	Radius	Get only	0 to 99999.9999

## 4 Specialized Processing Items

No.	Data name	Character string	Range
4	Maximum radius	Get only	0 to 99999.9999
5	Minimum radius	Get only	0 to 99999.9999
6	Average radius	Get only	0 to 99999.9999
7	Lost point count	Get only	0 to 360
8	Reference coordinate X	Get only	0 to 99999.9999
9	Reference coordinate Y	Get only	0 to 99999.9999
10	Maximum radius region number	Get only	0 to 359
11	Minimum radius region number	Get only	0 to 359
101	Output coordinate	Set/Get	0: After scroll 1: Before scroll
102	Calibration	Set/Get	0: OFF 1: ON
103	Reflect to overall judgement	Set/Get	0: ON 1: OFF
120	Start angle	Set/Get	0 to 359
121	Division method	Set/Get	0: Scan lines 1: Skipping angle
122	Scan lines	Set/Get	3 to 360
123	Skipping angle	Set/Get	1 to 180
124	Scan width	Set/Get	1 to 1000
125	Removed area number	Set/Get	0 to 360
126	Reference position X	Set/Get	0 to 99999.9999
127	Reference position Y	Set/Get	0 to 99999.9999
128	Circle calculation method	Set/Get	0: Smallest enclosing circle 1: Approximation circle
129	Enclosing circle calculation method	Set/Get	0: Fast 1: Precision
130	Edge profile display area	Set/Get	0 to 359
131	Measurement direction	Set/Get	0: Out→In 1: In→Out
132	Center coordinate X upper limit	Set/Get	-99999.9999 to 99999.9999
133	Center coordinate X lower limit	Set/Get	-99999.9999 to 99999.9999
134	Center coordinate Y upper limit	Set/Get	-99999.9999 to 99999.9999
135	Center coordinate Y lower limit	Set/Get	-99999.9999 to 99999.9999
136	Radius upper limit	Set/Get	0 to 99999.9999
137	Radius lower limit	Set/Get	0 to 99999.9999
138	Maximum radius upper limit	Set/Get	0 to 99999.9999
139	Maximum radius lower limit	Set/Get	0 to 99999.9999

No.	Data name	Character string	Range
140	Minimum radius upper limit	Set/Get	0 to 99999.9999
141	Minimum radius lower limit	Set/Get	0 to 99999.9999
142	Average radius upper limit	Set/Get	0 to 99999.9999
143	Average radius lower limit	Set/Get	0 to 99999.9999
144	Lost point count upper limit	Set/Get	0 to 360
145	Lost point count lower limit	Set/Get	0 to 360
200	Edge color specification	Set/Get	0: No color specification 1: With color specification
201	Edge color R	Set/Get	0 to 255
202	Edge color G	Set/Get	0 to 255
203	Edge color B	Set/Get	0 to 255
204	Difference R	Set/Get	0 to 127
205	Difference G	Set/Get	0 to 127
206	Difference B	Set/Get	0 to 127
207	Edge detection mode	Set/Get	0: Specified color IN 1: Specified color OUT
208	Edge No.	Set/Get	0 to 99
209	Edge level	Set/Get	0 to 100
210	Noise level	Set/Get	0 to 442
211	Noise width	Set/Get	0 to 9999
212	Edge color enhancement level	Set/Get	0 to 442
213	Monochrome edge detection mode	Set/Get	0: Light→Dark 1: Dark→Light
214	Edge level absolute value	Set/Get	0 to 442
215	Edge level specification method	Set/Get	0: % 1: Absolute value
216	Measurement type	Set/Get	0: Projection 1: Differential

## 4-5 ECM Search Motion

When detecting multiple objects or objects with numerous angles, using ECM search enables high-speed measurement. Up to 100 can be detected at the same time.

In a normal search, image pattern models are used that look at the color and light/dark information, but in ECM Search Motion, models are used that look at the outline information. This enables stable search to be performed even for images with low contrast or high noise levels.

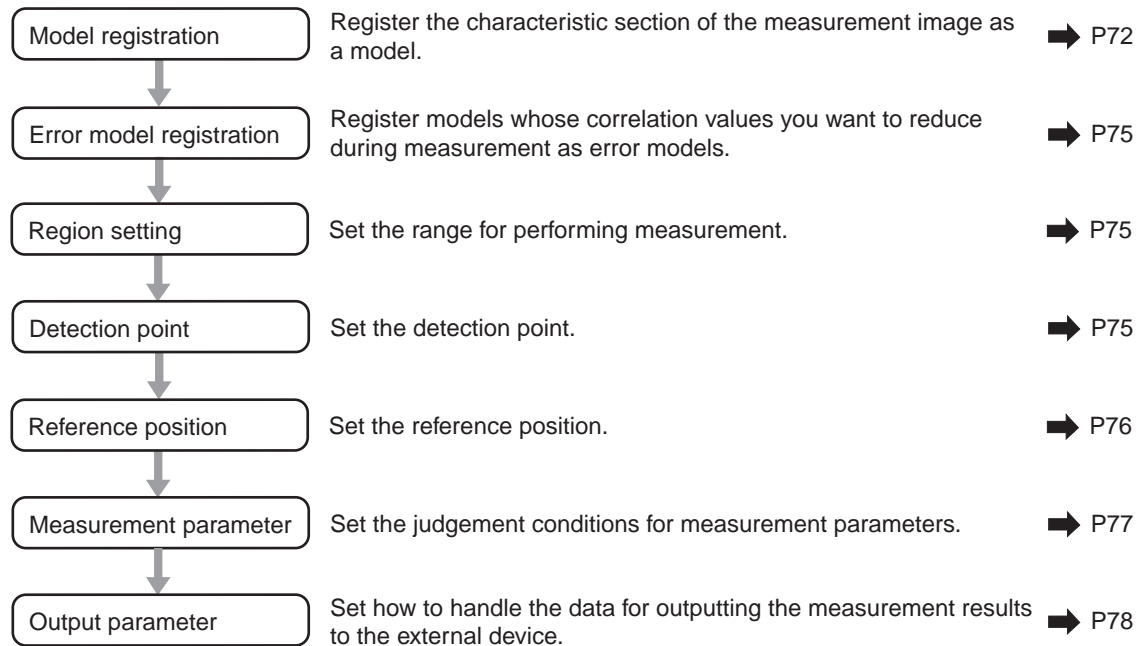


### Important

This processing item includes a process that shortens the processing time from the second time that is performed. For this reason, when measuring the same image, the processing time the first time after starting up the controller may be longer than the processing time for the subsequent times.

### Setting Flow

The setting for ECM Search Motion is shown by the flow diagram below.



### Model Registration

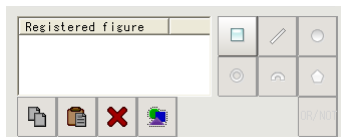
Register the pattern characteristic from the measurement object image as a model. In ECM Search Motion, only the outline information of the image is registered.



#### Important

In ECM Search Motion, 6 pixels at each end of an image cannot be registered as a part of the model.

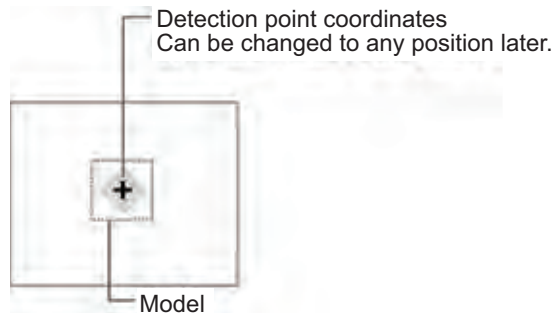
If a model is re-registered, the error model is deleted. When re-registering a model, also register the error model.



1. **Use the drawing tools to specify the model registration range.**
2. **In the figure setting area, tap [OK].**  
The model is registered.
3. **Tap [Edge extraction] and check the edge extraction image.**  
If there is a break in the outline of the measurement object, adjust the edge level. Also, change the reduction ratio as required.
4. **If there is unnecessary outline information in the model, tap [Mask register] to set the mask.**
5. **To check the model display, tap [Display model].**  
The registered model is displayed in the image display area.

**Note**

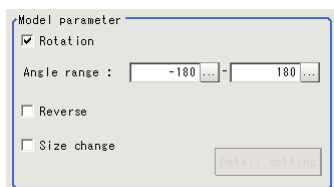
When a model is registered, the center coordinate of the model is registered as the detection point coordinate. A detection point is a point output as a measurement value.



### ● Changing model parameters

Model parameter values can be changed as needed to address unstable measurement results or to increase the processing speed. Normally, the factory default value will be used.

After changing a setting, check whether measurement can be done properly by performing an actual measurement.

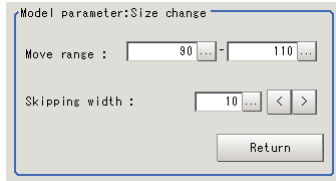


#### 1. In the [Model parameter] area, set a value for each item.

Setting item			Setting value [Factory default]	Description
Rotation			[Checked] Unchecked	When the measurement object is rotating, select the [Rotation] check box and specify how many degrees the model created rotates each time and through what range of angles. A smaller skipping angle increases stability, but slows down the processing. The forward direction is clockwise.
Angle range	Upper limit value		-180 to [180]	
	Lower limit value		[-180] to 180	
Reverse			Checked [Unchecked]	Specify whether to allow the reverse of light and dark for the model.
Size change			Checked [Unchecked]	Specify whether to allow size change for the model. When the check box is selected, tap [Detail setting] to select the setting.

### 2. When the [Size change] check box is selected, tap [Detail setting].

The [Model parameter:Size change] area is displayed.



Setting item	Setting value [Factory default]	Description
Move range (%)	50 to 150 [90,110]	Specify the move range in which to change the model size.
Skipping width (%)	1 to 99 [10]	Specify the skipping percentage within the move range by which to change models being created. A smaller skipping width increases accuracy, but slows down the processing.

### 3. Tap [Return].

The [Model parameter] area is displayed.

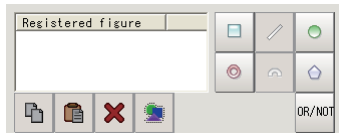
#### ● Mask any unnecessary items

By registering a mask, the part you do not want included in the model is excluded.

#### 1. Tap [Mask register].



#### 2. Draw the mask figure using the drawing tools.



#### 3. Tap [OR/NOT].

The mask figure is displayed in red.

#### 4. In the figure setting area, tap [OK].

#### ● Adjusting the edge level

In ECM Search Motion, processing is performed for the edge extraction image. Change this item as necessary when the edge is not extracted or is extracted along with noise.



#### Important

During model registration, as much of the edge is extracted as possible, and the entire edge of the model is registered while deleting defects such as noise with [Mask register]. On the other hand, when measuring, even if the edge has skips, an image with the noise suppressed makes it possible to search the model stably. To set separate edge extraction conditions for model registration and for measuring, after registering the model, change the edge extraction conditions.

1. In the item tab area, tap [Edge extraction].
2. In the [Edge extraction setting] area, set each item.

Setting item	Setting value [Factory default]	Description
Mask size	3 × 3 [5 × 5] 7 × 7 9 × 9	Select the range of pixels which are used to extract the edge. With a larger mask size, search is less affected by variation in pixels.
Edge level	0 to 1000 [400]	Adjust the edge extraction level when the edge is hard to see due to low contrast with the background or when unnecessary background noise should be removed.
Reduction	10 to 100 [50]	Set the percentage to which the input image and the model image are reduced during a search. The smaller the image is reduced, the faster the processing becomes, but search results may be unstable with a smaller image.

## Error model registration

By registering in advance an image pattern in which the characteristic sections are similar (for example, "P" and "R") as an error model, the correlation values can be lowered to prevent measurement mistakes. Only one error model can be registered.

1. **Display the error model image.**

Register the error model with the same procedure as for model registration.



Important

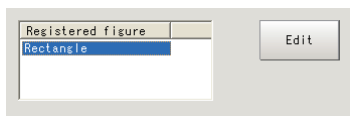
If a model is re-registered, the error model is deleted. Register error models when re-registering a model.

## Region Setting

Specify the model search range with [Rectangle].

Instead of measuring the entire input image, narrowing the measurement area shortens the processing time.

1. **Tap [Edit].**



The figure setting area is displayed.

2. **Specify the model search range.**

The rectangle covering the entire screen is set. Adjust the size and position of the rectangle.

3. **Tap [OK].**

The range to measure is registered.

## Detection Point

Specify a position in the model that should be used as the detection coordinates during measurement. Usually, the center position of the set model is registered as the detection point. This function is used to change to any desired position.



Note

After changing the detection point coordinates to another position, re-registering the model will change it back to the center coordinates of the model.

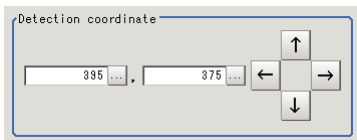
1. Tap the position to use as the detection point.



### Note

Enlarging the image display makes it easier to tap.

2. Make fine adjustments using numeric value inputs or the arrow buttons as required.



## Reference Position

When the measurement region is set, this position is automatically set at the same time as the reference position. This item can be used to change the reference position to any desired position. This is handy for measuring the position deviation from a certain position.

1. Tap the position to use as the reference position.



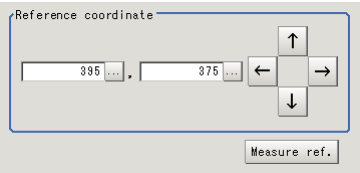
### Note

Enlarging the image display makes it easier to tap.

2. Make fine adjustments using numeric value inputs or the arrow buttons as required.



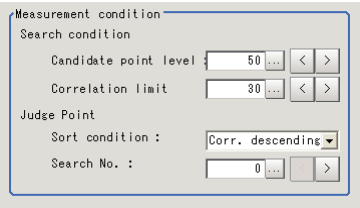
To re-measure on the displayed image and set the reference position, tap [Measure ref.].



Measurement Parameters

This item specifies the judgement condition for measurement results. Specify the criteria to judge the measurement result if the X and Y coordinates and the correlation values with the model are OK.

1. In the [Measurement condition] area, set each item.



Setting item	Setting value [Factory default]	Description
Search condition		
Candidate point level	0 to 100 [50]	Specify the threshold value with which to detect candidate points in a rough search. Specify a smaller value for candidate point level when model search results are unstable.
Correlation limit	0 to 100 [30]	Set the correlation value to detect.
Judge Point		
Sort condition	[Corr. descending] Corr. ascending X descending X ascending Y descending Y ascending	Specify the conditions by which the search number is re-assigned.
Search No.	[0] to 99	Input the search number for outputting the data.



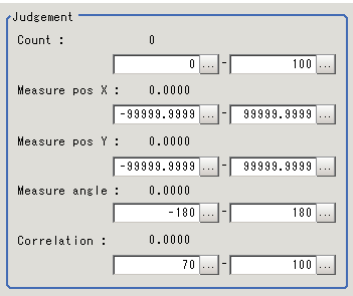
Important

If you want to change measurement parameters after registering a model, it is necessary to re-register the model.

2. When the setting has been changed, tap [Measurement] in the "Detail" area to verify whether measurements can be made correctly.



3. Set the judgement conditions as required.





### Important

The value beside each item are measurement results of the displayed image. Take these values into consideration to determine the upper and lower limit values.

Setting item	Setting value	Description
Count	0 to 100	Specify the number of detections to be judged as OK.
Measurement coordinate X	-99999.9999 to 99999.9999	Specify the range of X-axis shifting that is judged to be OK.
Measurement coordinate Y	-99999.9999 to 99999.9999	Specify the range of Y-axis shifting that is judged to be OK.
Measure angle	-180 to 180	Specify the range of angles that are judged to be OK.
Correlation	0 to 100	Specify the range of correlation values that are judged to be OK.

## Output Parameters

Set how to handle the data when outputting the measurement results to the external device.

Output coordinates

☒ After scroll
 ☐ Before scroll

Calibration

☒ OFF
 ☐ ON

Reflect to overall judgement

☒ ON
 ☐ OFF



### Important

Normally, the factory default value will be used for this item.  
Do not change this setting unless there is a particular reason.

### ● Setting method

#### 1. Set the following parameters as required.

Setting item	Setting value [Factory default]	Description
Output coordinates	[After scroll] Before scroll	As measurement results, select whether to output coordinate values to external devices before or after the position compensation is applied.
Calibration	[OFF] ON	Select whether to reflect the calibration in the values output to the external device as measurement results. ON: Output coordinate values that have been converted to the actual dimensions. OFF: Output the camera coordinate values.
Reflect to overall judgement	[ON] OFF	Enables choosing whether or not the judgement results of this processing unit is reflected in the scene overall judgement.

#### 2. After completing all the settings, tap [OK].

## To Get Measurement Results from an External Source

### ● Measurement results for which output is possible (calculation)

The following values can be output using processing items related to results output. It is also possible to reference measurement values from expressions and other processing units.

Data name	Character string	Description
Judge	JG	The judgement result for the unit. 1: OK 0: Not yet measured -1: NG
Correlation value CR	CR	Correlation value
Measurement coordinate X	X	Measurement position X coordinate
Measurement coordinate Y	Y	Measurement position Y coordinate
Measurement angle TH	TH	Measurement angle
Count CT	CT	Number of detections
Reference coordinate X	SX	Reference position X coordinate
Reference coordinate Y	SY	Reference position Y coordinate
Reference angle ST	ST	Reference angle
Detection point coordinate X	RX	Detection point X coordinate
Detection point coordinate Y	RY	Detection point Y coordinate
Correlation value CR NN	CR NN	Value of detected correlation value NN (NN = 0 to 99)
Measurement coordinate X NN	X NN	Value of detected measurement coordinate XNN (NN = 0 to 99)
Measurement coordinate Y NN	Y NN	Value of detected measurement coordinate YNN (NN = 0 to 99)
Measurement angle TH NN	TH NN	Value of detected measurement angle THNN (NN = 0 to 99)

### ● External Reference Tables

No.	Data name	Set/Get	Range
0	Judge	Get only	0: No judgement (not yet measured) 1: Judgement result OK -1: Judgement result NG
4	Count	Get only	0 to 100
5	Correlation value	Get only	0 to 100
6	Measurement coordinate X	Get only	-99999.9999 to 99999.9999
7	Measurement coordinate Y	Get only	-99999.9999 to 99999.9999
8	Measurement angle	Get only	-180 to 180
11	Reference coordinate X	Get only	0 to X_PMAX
12	Reference coordinate Y	Get only	0 to Y_PMAX
13	Reference angle	Get only	-180 to 180
14	Detection point coordinate X	Get only	0 to X_PMAX

## 4 Specialized Processing Items

No.	Data name	Set/Get	Range
15	Detection point coordinate Y	Get only	0 to Y_PMAX
101	Output coordinate	Set/Get	0: After scroll 1: Before scroll
102	Calibration	Set/Get	0: OFF 1: ON
103	Reflect to overall judgement	Set/Get	0: ON 1: OFF
110	Detection correlation value	Set/Get	0 to 100
112	Reduction ratio	Set/Get	10 to 100
120	Mask size	Set/Get	0: 3 × 3 1: 5 × 5 2: 7 × 7 3: 9 × 9
121	Edge extraction level	Set/Get	0 to 1000
122	Detection point coordinate X	Set/Get	0 to X_PMAX
123	Detection point coordinate Y	Set/Get	0 to Y_PMAX
124	Reference coordinate X	Set/Get	0 to X_PMAX
125	Reference coordinate Y	Set/Get	0 to Y_PMAX
126	Upper limit value of correlation value	Set/Get	0 to 100
127	Lower limit value of correlation value	Set/Get	0 to 100
128	Upper limit value of measurement coordinate X	Set/Get	-99999.9999 to 99999.9999
129	Lower limit value of measurement coordinate X	Set/Get	-99999.9999 to 99999.9999
130	Upper limit value of measurement coordinate Y	Set/Get	-99999.9999 to 99999.9999
131	Lower limit value of measurement coordinate Y	Set/Get	-99999.9999 to 99999.9999
132	Upper limit value of the measurement angle	Set/Get	-180 to 180
133	Lower limit value of the measurement angle	Set/Get	-180 to 180
134	Number of detections upper limit	Set/Get	0 to 100
135	Number of detections lower limit	Set/Get	0 to 100
138	Rotation setting	Set/Get	0: No rotation 1: With rotation
139	Lower limit value of the rotation angle	Set/Get	-180 to 180
140	Upper limit value of the rotation angle	Set/Get	-180 to 180
142	Size change setting	Set/Get	0: No size change 1: With XY change
143	Upper limit value of the size change	Set/Get	50 to 150
144	Lower limit value of the size change	Set/Get	50 to 150
145	Size change skipping	Set/Get	1 to 99

No.	Data name	Set/Get	Range
146	Black and white reverse setting	Set/Get	0: OFF 1: ON
150	Candidate point level	Set/Get	1 to 100
151	Search No.	Set/Get	0 to 99
152	Sort condition	Set/Get	0: Correlation value descending 1: Correlation value ascending 2: X coordinate descending 3: X coordinate ascending 4: Y coordinate descending 5: Y coordinate ascending
1000 + 4N (N = 0 to 99)	Correlation value of search number N	Get	0 to 100
1001 + 4N (N = 0 to 99)	Measurement coordinate of search number N	Get	-99999.9999 to 99999.9999
1002 + 4N (N = 0 to 99)	Measurement coordinate of search number N	Get	-99999.9999 to 99999.9999
1003 + 4N (N = 0 to 99)	Measurement angle of search number N	Get	-180 to 180

# 5 Methods for Connecting and Communicating with External Devices

For an explanation of communication with external devices such as a PC or programmable controller, see "6. Methods for Connecting and Communicating with External Devices" in the FZ3 User's Manual.

## 5-1 Differences with the Standard Product (FZ3)

The following specialized commands have been added in this manual:

- Auto Calibration
- About Force Setting

Target communication module		Addition of commands	Applicable manual
Parallel I/O		No	"Ch.6 Methods for Connecting and Communicating with External Devices" on FZ3 Series User's Manual (Z290-E1-04)
Normal	Ethernet (UDP)	Yes	
	Ethernet (TCP)		
	RS-232C		
PLC link	Ethernet (UDP)	Yes	
	Ethernet (TCP)		
	RS-232C		
EtherCAT		Yes	FZM1 Series EtherCAT Communication Manual (Q179-E1-01)

For the standard commands, see the applicable manual.

### Command List (Normal)

This section explains about the commands that have been added to this software and are used in serial communication normal methods such as RS-232C/422: Normal and Ethernet: Normal (UDP).

Command name	Command name	Return value	Argument 1	Argument 2	Argument 3	References
CALIBSTT	Start auto calibration	–	–	–	–	P85
SETCLBIF	Register information for calibration calculation	–	Information type	Movement amount 1	Movement amount 2	P85
SETPERMT	Set the number of the camera for calibration parameter registration	–	Target camera	–	–	P86
CALCCLBP	Perform calibration calculation	Error value	Calculation mode	–	–	P87
POSCHG	Change measurement position	–	Camera number	–	–	P87
MDATOUT	Measurement result output	–	–	–	–	P88

## Command List (PLC Link, EtherCAT)

This section explains about the commands used to perform calibration with the PLC link and EtherCAT.

To execute each command, set the standard unit data setting command and unit data acquisition command parameters.

For details of commands, see "6. Methods for Connecting and Communicating with External Devices" in the FZ3 User's Manual (Z290-E1-04) or FZM1 Series EtherCAT Communication Manual (Q179-E1-01).

Function and description	Used command	Unit data No.	Data No.	Setting data
Auto calibration start Executes auto calibration.	Unit data setting	4	501	1000
Information registration for calibration calculation Specifies that this is the XXth sampling.	Unit data setting	4	600	Specify the point you want to register as a value multiplied by 1000. Reference position sampling: 0 Parallel movement sampling (1st point): 1000 (1 × 1000) Parallel movement sampling (2nd point): 2000 (2 × 1000) : Parallel movement sampling (4th point): 4000 (4 × 1000) Parallel movement sampling (1st point): 5000 (5 × 1000) : Parallel movement sampling (10th point): 14000 (14 × 1000)  Sampling point clear: 99000 (99 × 1000)
Set the number of the camera for calibration parameter registration Specifies the camera used for calibration.	Unit data setting	4	120	0000: Camera 0 1000: Camera 1 2000: Camera 0 + 1
X-direction movement amount registration Specifies the movement amount in X direction at the Nth point. (N = 1 to 4)	Unit data setting	4	215 + (N-1)*10	Specify the movement amount after multiplying it by 1000.
Y-direction movement amount registration Specifies the movement amount in Y direction at the Nth point. (N = 1 to 4)	Unit data setting	4	216 + (N-1)*10	Specify the movement amount after multiplying it by 1000.
θ-direction movement amount registration Specifies the rotation angle at the Nth point. (N = 1 to 10)	Unit data setting	4	255 + (N-1)*10	Specify the movement amount after multiplying it by 1000.

## 5 Methods for Connecting and Communicating with External Devices

Function and description	Used command	Unit data No.	Data No.	Setting data
Calibration parameter calculation execution Calculates the calibration parameters based on the acquired data.	Unit data setting	4	601	0
Calculates the error from the sampling results based on the calibration parameters.	Unit data setting	4	602	0
Obtains the error for camera 0.	Unit data acquisition	4	26	–
Obtains the error for camera 1.	Unit data acquisition	4	33	–
Displays the calibration parameters and error on the FZM1.	Unit data setting	4	603	1000
Measurement position change camera specification Specifies the camera that will perform About Force Setting.	Unit data setting	Unit No. for Position Deviation Calculation in flow	600	About Force Setting camera No.: Camera 0: 0 Camera 1: 1000 (1 × 1000)
Measurement position change execution Executes About Force Setting.	Unit data setting	Unit No. for Position Deviation Calculation in flow	5000	1000 (1 × 1000)
Measurement result output  After the movement amount is recalculated by Position Deviation Calculation using the new measurement position following the position change by About Force Setting, data output processing of the output unit at the beginning of the flow is executed. [Note] Set beforehand in the beginning output unit the movement amount by Position Deviation Calculation which will be used for About Force Setting.	Unit data setting	Unit No. for Position Deviation Calculation in flow	5007	0

The calibration unit number is fixed to 4.



## Communication Command Details (Normal)

### ● CALIBSTT (Start calibration)

Enters a condition where auto calibration can be executed.

Calibration cannot be performed unless this command is executed to enter the auto calibration start condition. If the auto calibration setting screen is not displayed, the command is not accepted and ER is returned.

In the calibration start condition (CALIBSTT command already performed), ER is returned.

(Command format)

C	A	L	I	B	S	T	T	$C_R$
---	---	---	---	---	---	---	---	-------

(Response format)

When processed correctly

O	K	$C_R$
---	---	-------

When not processed correctly

E	R	$C_R$
---	---	-------

### ● SETCLBIF (Register information for calibration calculation)

Performs measurement for the current camera image and registers the information to use in the calibration parameter calculation.

If a reference position has been registered, discard all the calibration calculation information that has been previously registered, and then set the reference position again.

If the XY direction/ $\theta$  direction has been registered, set the calculation information by adding it to the calibration calculation information that has been previously registered.

By repeatedly executing this command, multiple items of XY direction/ $\theta$  direction movement information can be registered.

If you try to perform registration for more than the specified number of points, the command is not accepted and ER is returned.

The command is not accepted and ER is returned unless the status is the calibration start condition (CALIBSTT command already performed) and the calibration target camera has been set (SETPERMT command already performed).

For the XY stage, reference position registration and  $\theta$  direction registration are disabled, and ER is returned.

(Command format)

S	E	T	C	L	B	I	F	SP	Information type	SP	Movement amount 1	SP	Movement amount 2	$C_R$
---	---	---	---	---	---	---	---	----	------------------	----	-------------------	----	-------------------	-------

(Response format)

When processed correctly

O	K	$C_R$
---	---	-------

When not processed correctly

E	R	$C_R$
---	---	-------

(Parameters explanation)

Parameters	Description
Information type	Specify the information type for calculation. 0: Register reference position (do not set movement amount) 1: Register XY direction (set X direction shift amount for movement amount 1 and Y direction shift amount for movement amount 2) 2: Register XY direction (set X direction shift amount for movement amount 1 and Y direction shift amount for movement amount 2) 3: Register $\theta$ direction (set $\theta$ direction shift amount for movement amount 1 and do not set for movement amount 2) 9: Discard calibration calculation information (do not set movement amount) The discarded information is the registered position information and calibration target camera.
Movement amount 1	Specify the shift amount for the X direction and the shift amount for the $\theta$ direction. (-9999.9999 to 9999.9999) When the information type is 1: X direction shift amount When the information type is 2: X direction shift amount When the information type is 3: $\theta$ direction shift amount When the information type is other than the above: None
Movement amount 2	Specify the shift amount for the Y direction. (-9999.9999 to 9999.9999) When the information type is 1: Y direction shift amount When the information type is 2: Y direction shift amount When the information type is other than the above: None

### ● SETPERMT (Set calibration target camera)

When registering calibration information, first specify a camera for which to enable information registration.

The registration availability flag is only enabled when registering the X direction, Y direction or  $\theta$  direction.

The command is not accepted and ER is returned unless the status is the calibration start condition (CALIBSTT command already performed).

(Command format)

**SETPERMT SP Target camera C<sub>R</sub>**

(Response format)

When processed correctly

**OK C<sub>R</sub>**

When not processed correctly

**ER C<sub>R</sub>**

(Parameters explanation)

Parameters	Description
Target camera	Use a Bit to specify the camera for which to register calibration information. 0: Camera 0 1: Camera 1 2: Camera 0 + camera 1

## ● CALCCLBP (Perform calibration calculation)

Calculates the calibration parameters based on the calibration parameter calculation information that is currently set.

The calibration parameters of the calculation result are retained in the buffer area of the system.

When these calibration parameters are applied to [Camera Image Input] in a scene, the calibration parameter writing command is used.

The command is not accepted and ER is returned unless the status is the calibration start condition (CALIBSTT command already performed).

(Command format)

**C A L C C L B P** SP Calculation mode  $C_R$

(Response format)

When processed correctly

Calibration margin  $C_R$

**OK**  $C_R$

When not processed correctly

**ER**  $C_R$

(Parameters explanation)

Parameters	Description
Calculation mode	0: Calculate calibration + error value 1: Calculate error value
Calibration error value	The error value for the actual coordinate using the calculated calibration parameters is returned. (0.000000 to 9999999.9999) When 2 cameras are used, 2 error values are returned with a "," separator. The first is the error value for camera 0 and the second is for camera 1.

## ● POSCHG (Start changing the measurement position)

Displays the [Force Setting] window and starts the measurement position changing process.

If not, the command will not be accepted and ER will be returned.

(Command format)

**P O S C H G** SP Camera number  $C_R$

(Response format)

When processed correctly

**OK**  $C_R$

When not processed correctly

**ER**  $C_R$

(Parameters explanation)

Parameters	Description
Camera number	Specify the number of the camera for which to change the measurement position. 0: Camera 0 1: Camera 1



### Important

---

Even if this command is executed, the process for switching the camera image display is not performed.

The coordinates that are displayed after the command is sent use the camera coordinate system.

Also, calibration conversion is performed for the changed search coordinates before they are saved as search coordinates.

---

### ● MDATOUT (Measurement result output)

Recalculates the values that are assigned to [Calculate Scroll] in the flow, before executing data output again.

(Command format)

M	D	A	T	O	U	T	C <sub>R</sub>
---	---	---	---	---	---	---	----------------

(Response format)

When processed correctly

O	K	C <sub>R</sub>
---	---	----------------

When not processed correctly

E	R	C <sub>R</sub>
---	---	----------------



### Important

---

Output is not available when [Output to external device] is set to OFF in the ADJUST window.

---

# 6 Specialized Functions

This software also has the following specialized functions.

## 6-1 About User Settings

The security level can be set with the user names and passwords that are set at the user level.

### User Settings

1. In the menu bar, select **[System] - [Controller] - [Change User]**.  
In this window, perform settings such as changing the security level or password.  
The current security level is displayed in the upper left.



#### Note

After starting FZ3, operation starts at security level 0.  
In the factory default, the following initial values are registered for the user information.  
When using the user control function, first change settings such as the user name and password, and then execute [Save data].

Security level	User name	Initial password
4	superadmin	omron
1	admin	omron
0	user	omron



#### Important

The user information that is initially registered cannot be deleted. (Even if the information is deleted, it is registered again automatically.)

### ● Logging in

1. Enter the user name and password.

2. Tap **[Login]**.

When the user name and password match, the [Change user] window closes and the display returns to the special screen. The system now operates at the security level that is set for the logged in user.



### Note

The security level is retained until login for another user is performed or the power is turned OFF. After startup, operation starts at security level 0.

### ● Editing the password

#### 1. Enter the current password and tap [Edit].

When the user name and password match, the following [Edit Account Information] window opens.

The 'Edit Account Information' window has a blue title bar. It contains three input fields: 'UserName' with the text 'admin', 'New password' (empty), and 'SecurityLevel : 1'. At the bottom are 'OK' and 'Cancel' buttons.

#### 2. Tap [...] and enter a new password.

#### 3. After entering, tap [OK].

The [Edit Account Information] window closes and the display returns to the special screen. After changing the password, execute [Save data].



### Note

Set a string of 4 to 16 characters for the user name and password, using "0" to "9", "A" to "Z" and "a" to "z".

## User Control

Users can be added, changed or deleted. This function can only be used by users with security level 4.

#### 1. Enter the user name and password of a user with security level 4.

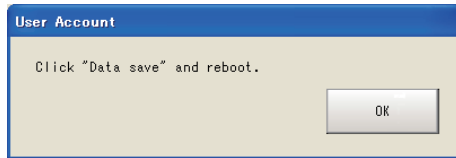
The 'Change User' window has a blue title bar. It shows 'SecurityLevel : 1'. There are input fields for 'UserName' (containing 'superadmin') and 'Password' (masked with dots). To the right of the password field is an 'Edit' button. At the bottom are 'Login', 'Cancel', and 'User Account' buttons.

#### 2. Tap [User Account].

When the user name and password match, the following [User Account] window is displayed. Select the button for the information that you want to change.

The 'User Account' window has a blue title bar. It contains three buttons: 'Add. Account', 'Edit. Account', and 'Del. Account'. At the bottom right is an 'OK' button.

3. After changing the setting, tap [OK].  
The following message is displayed. Tap [OK].



4. Tap [OK] to return to the special screen. Execute [Save data].



#### Important

Set a string of 4 to 16 characters for the user name and password, using "0" to "9", "A" to "Z" and "a" to "z".

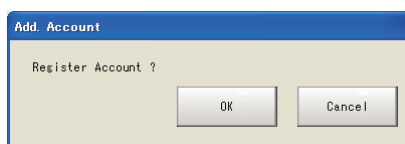
### ● Adding an account

1. In the [User Account] window, tap [Add. Account].  
The following [Add. Account] window is displayed.

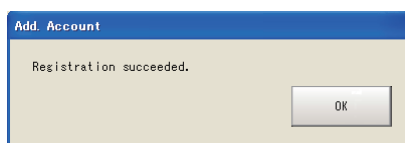
2. Enter the following items.

Setting item	Setting item
UserName	Enter the user name that you want to add.
Password	Enter the password for the added user.
SecurityLevel	Select the security level for the added user. [0], 1, 4

3. Tap the [Regist.] button.  
The following message is displayed. If there is no problem, tap [OK].



4. If the account is added successfully, the following message is displayed. Tap [OK].  
The display returns to the [User Account] window.



#### Note

The same user name as an already-registered user cannot be registered.  
Up to 100 accounts can be registered.

### ● Editing an account

A user account can be edited.

1. In the [User Account] window, tap [Edit. Account].  
The [Edit. Account] window is displayed.

2. Enter the following required items and change the security level.

Setting item	Description
UserName	Select the target user name. All the set user names are displayed.
Password	Enter the password for the user to be edited.
SecurityLevel	Select the security level for the user to be edited. [0], 1, 4

3. Tap [Edit].  
The following message is displayed. If there is no problem, tap [OK].

4. Tap [OK].

The [Edit. Account] window closes and the display returns to the [User Account] window. After editing the account, execute [Save data].

### ● Deleting an account

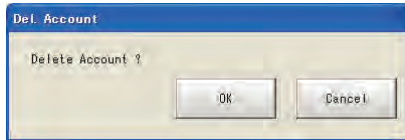
1. In the [User Account] window, tap [Del. Account].  
The following [Del. Account] window is displayed.

2. Tap [▼] to the side of [UserName] and select the user name to delete.

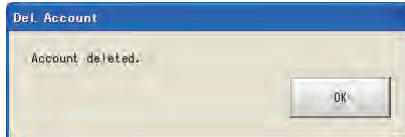


**3. Tap [Delete].**

The following message is displayed. If there is no problem, tap [OK].

**4. If the account is deleted successfully, the following message is displayed. Tap the [OK] button.**

The display returns to the [User Account] window.



## Security Setting

Set the operation range for each user.

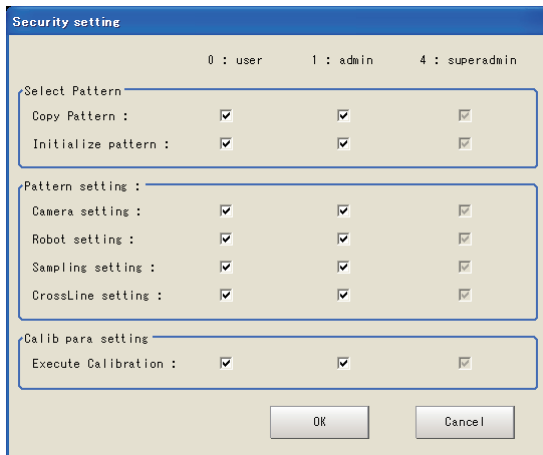


### Important

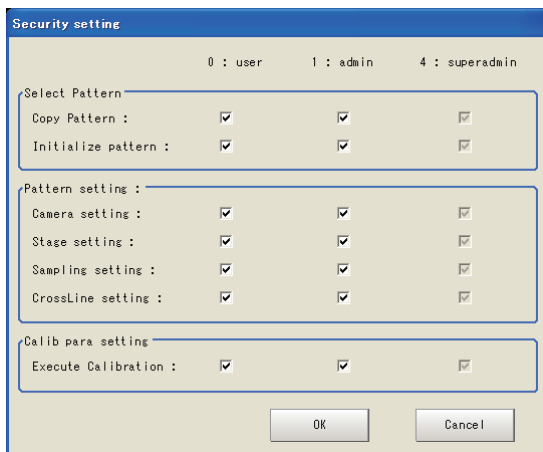
This operation is possible when logged in as a user with security level 4.

**1. In the menu bar, select [System] - [Controller] - [Security setting].**

For a robot



For a stage



2. Set the security as required.
3. Tap [OK].

### 6-2 About Force Setting

If detection cannot be performed correctly during alignment measurement, the coordinates can be entered manually to continue with the process.



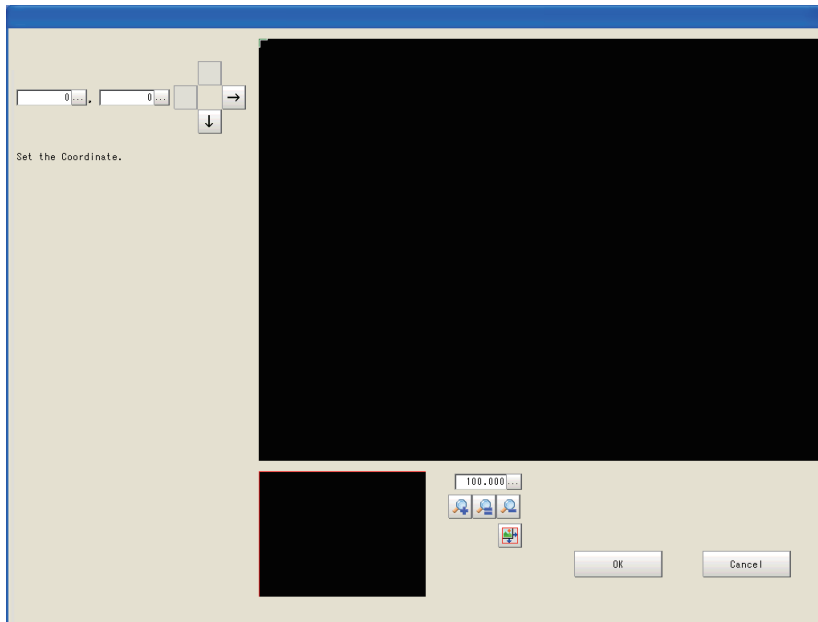
#### Important

To start About Force Setting, a Position Deviation Calculation processing item must be present in the flow.

**1. If detection cannot be performed correctly, start at either of the following times.**

- When starting with serial communication (Normal)  
Execute "POSCHG".
- When starting with PLC link  
Set the number of the camera for which the measurement position will be changed in external reference data 600 of the position deviation calculation, and set 1 in external reference data 5000 of the position deviation calculation.

When the force setting starts, the following window is displayed.



**2. Specify the coordinates with the following method.**

- Click the window that displays the image.
- Specify the coordinate values in the number boxes in the upper left.
- Move the coordinates with the arrow keys in the upper left. (The coordinates move by 1 pixel at a time.)

**3. Tap [OK].**

The movement amount in [Calculate Scroll] is recalculated with the value set in **2**.



#### Important

Even if the expression for Position Deviation Calculation is edited, recalculation will use the setting value by ignoring the expression.

# Index

## A

Adding an account .....	91
Alignment measurement .....	25
Area division .....	53, 63
Auto calibration .....	14

## C

CALCCLBP (Perform calibration calculation) .....	87
Calibration error value .....	24, 87
Calibration setting .....	7
CALIBSTT (Start calibration) .....	85
Candidate point level .....	77
Change user .....	89
Changing the password .....	90
Check No. range: .....	67
Combination angle .....	35, 45
Combination seam distance .....	36, 46
Combination tip distance .....	36, 46
Communication command .....	85
Corner color .....	36
Corner fusion .....	37
Cross brightness .....	46
CrossLine setting .....	13

## D

Deleting an account .....	92
Density change .....	56, 66
Detection correlation value .....	77
Detection line count .....	47

## E

EC Corner .....	33
EC Cross .....	43
ECM Search Motion .....	71
Edge color enhancement level .....	55, 66
Edge extraction .....	34, 44, 72, 75
Edge level .....	55, 56, 66
Edge No. ....	55, 56, 66
Editing an account .....	92
Error model registration .....	75

## F

Force setting .....	94
Forward rotation of camera .....	11

## I

Instrument setting .....	7
Intersection coordinates .....	52

## L

Line connect level .....	35
--------------------------	----

Line connection level .....	45
Login .....	89

## M

Manual calibration .....	21
Mask registration .....	74
MDATOUT (Measurement result output) .....	88
Measurement type .....	56, 66
Move range .....	74

## N

Noise level .....	56, 67
Noise width .....	56, 67

## O

Overrun range .....	37
---------------------	----

## P

Password .....	89
Pattern select .....	9
POSCHG (Start changing the measurement position) .....	87
Position deviation calculation .....	26

## R

Reference calibration pattern .....	27
Robot setting .....	10
Robot type .....	10

## S

Sampling method .....	12
Sampling setting .....	12
Scan edge circle .....	62
Scene setting .....	25
Scroll standard .....	29
Security setting .....	93
SETCLBIF (Register information for calibration calculation) .....	85
SETPERMT (Set calibration target camera) .....	86
Size change .....	73
Skipping width .....	74
Stage setting .....	10
Stage type .....	11

## T

Target camera .....	22
---------------------	----

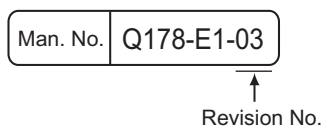
## U

Underrun distance .....	47
User account .....	90
User control .....	90
UVWR parameter .....	11

# Manual Revision History

---

The manual revision symbol is an alphabet appended at the end of the manual number found in the bottom left-hand corner of the front or back cover.



Rev. No.	Rev. Date	Revision Contents
01	Apr. 2010	First print
02	Feb. 2011	Correction of error in writing/Addition of detailed explanation
03	Jul. 2012	Compatible controllers are changed.

**OMRON Corporation      Industrial Automation Company**  
Tokyo, JAPAN

**Contact: [www.ia.omron.com](http://www.ia.omron.com)**

***Regional Headquarters***

**OMRON EUROPE B.V.**

Wegalaan 67-69-2132 JD Hoofddorp  
The Netherlands

Tel: (31)2356-81-300/Fax: (31)2356-81-388

**OMRON ELECTRONICS LLC**

One Commerce Drive Schaumburg,  
IL 60173-5302 U.S.A.

Tel: (1) 847-843-7900/Fax: (1) 847-843-7787

**OMRON ASIA PACIFIC PTE. LTD.**

No. 438A Alexandra Road # 05-05/08 (Lobby 2),  
Alexandra Technopark,  
Singapore 119967

Tel: (65) 6835-3011/Fax: (65) 6835-2711

**OMRON (CHINA) CO., LTD.**

Room 2211, Bank of China Tower,  
200 Yin Cheng Zhong Road,  
PuDong New Area, Shanghai, 200120, China

Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

**Authorized Distributor:**

© OMRON Corporation 2009 All Rights Reserved.  
In the interest of product improvement,  
specifications are subject to change without notice.

**Cat. No. Q178-E1-03**

Printed in Japan