Panasonic®

MACHINE VISION SYSTEM

IMAGECHECKER®
PV240
User's Manual

WME-PV240-OP-01

2015.4 | panasonic.net/id/pidsx/global

Before Reading This Manual

Thank you for purchasing the IMAGECHECKER PV240.

This manual describes information on the hardware such as how to install and wire and the software such as how to set the functions. Read this User's Manual carefully before use.

Safety Precautions

To ensure that you use this product correctly, read this User's Manual thoroughly before use. Make sure that you fully understand the product and information on safe.

WARNING

Critical situations that could lead to user's death or serious injury are assumed by mishandling of the product:

- Do not use this product in areas with inflammable gas. It could lead to an explosion.
- Exposing this product to excessive heat or open flames could lead to damage to the lithium battery or other electronic parts.
- Do not store a lens in the locations subject to direct sunlight. It could lead to smoke generation.
- Do not look at the sun through a lens. It could lead to blindness.
- Always take precautions to ensure the overall safety of your system, so that the whole system remains safe in the event of failure of this product or other external factor.

CAUTION

Critical situations that could lead to user's injury or only property damage are assumed by mishandling of the product:

- Do not dismantle or remodel the product. It could lead to excessive exothermic heat or smoke generation.
- Do not touch the terminal while turning on electricity. It could lead to an electric shock.
- Do not allow foreign matters such as liquid, flammable materials, metals to go into the inside of the product. It could lead to excessive exothermic heat or smoke generation.
- Do not bend the cables forcibly, place a heavy object on them or bring them close to a thermal appliance. It could lead to an electric shock or smoke generation.
- To prevent excessive exothermic heat or smoke generation, use this product at the values less than the maximum of the characteristics and performance that are assured in these specifications.
- Use the external devices to function the emergency stop and interlock circuit.
- Connect the wires or connectors securely. The loose connection could lead to excessive exothermic heat or smoke generation.
- Do not undertake construction (such as connection and disconnection) while the power supply is on. It could lead to an electric shock.

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Chapter 1

Alignment

1.1 Menu

The followings are specific menus for Alignment function. For information on other menus, refer to PV200 User's Manual.

SETUP MENU

- **TYPE** — Alignment
  - Stage Setting ▸p.52
    - Stage Type — UVW / XYTheta(YXTheta) / XThetaY / YThetaX / XTheta
    - Theta Axis — Rotation / Straight Line
    - Theta Axis Length (mm)
    - UVW Pin Position (mm)
    - Stage Direction Automatic Judgement — No / Yes
    - Stage +XY Direction
      - Direction1(->^)
      - Direction2(<-^)
      - Direction3(->v)
      - Direction4(<-v)
    - Stage +Theta Direction — CW / CCW
    - Stage MAX Distance
  - Calibration ▸p.165
    - Stage Movement
    - Rotation Point Adj.
  - Alignment ▸p.156
    - TRIG Type
      - Mark Sync. Execution
      - Mark Async. Execution
    - Retry
    - Target Cross Drawing — No / Yes
    - Arrowhead of stage direction — No / Top Left / Bottom Left / Top Right / Bottom Right
    - Display Inspection Time — Inspection Time / Alignment Time
    - Options
      - Target Position — Mark Detection / Center of Display
      - Display Data R/W — Fixed / Free
      - Display Total Judgement — No / Yes
      - Checksum — No / Yes

- **INSPECTION** — Alignment
  - Checkers Setting ▸p.162
    - Comment
    - Calibration Checker
      - Mark0
      - Mark1
    - Common Object
    - Target Checker
      - Mark0
      - Mark1
    - Object Checker
      - Mark0
      - Mark1
  - Calibration ▸p.166
    - Checker
      - Mark0
      - Mark1
    - Calibration Data
      - Show details — Display Global Coordinate
      - Manual Setting
    - Rotation Point Adj.
      - Mark0
      - Mark1
  - Target
    - Checker
      - Mark0

```
                                        ▸p.182 │                          └ Mark1
                                               ├ Display Coordinates      ─ Camera Coordinates /
                                                                          Stage Coordinates
                        │                      ├ Register coordinates of target
                        │                      │     ├ Display Coordinates
                        │                      │     ├ Coordinates of Detected Target
                        │                      │     ├ Register coordinates of target
                        │                      │     ├ Coordinates of Registered Target
                        │                      │     ├ Stage Coordinates Offset
                        │                      │     ├ Target Coordinates Offset
                        │                      └ Coordinates of Registered Target
                        ├ Object               ┬ Checker                  ┬ Mark0
                        ▸p.192                   │                          └ Mark1
                                                 ├Display Coordinates       ─ Camera Coordinates /
                                                                            Stage Coordinates
                        │                      └ Detect Coordinates Offset ┬ Mark0
                        │                                                  └ Mark1
                        └ Judgement            ┬ Change Base              ┬ Center
                        Limits
                        ▸p.198                   │                          ├ Mark0
                                                 │                          └ Mark1
                                                 ├ Threshold of Change Judgement
                                               ├ Threshold value for Mark Deviation
                                               └ Threshold value for pitches between marks(mm)

ENVIRONMENT ─ Input/Output ┬ Print Screen      ┬ Destination              ─ SD Card / Ethernet
                           │ ▸p.40             ├ Overwrite                ─ Yes / No
                           │                   └No. of folders            ─ 1 to 1000
                           └ Command           ┬ Format                   ─Command / Data
                           Com. Log
                             ▸p.152            ├ Polling view             ─ No / Yes
                                               ├ Keep logs                ─ No / Yes
                                               ├ Overwrite                ─ No / Yes
                                               ├ No. of Folders           ─ 1 to 1000
                                               └ New log file (type select) ─ Yes / No
```

RUN MENU

```
OPERATION   ┬ Select Type
            ├ Reset Statistics
            ├ Start RUN Mode
            ├ Stop RUN Mode
            └ To SETUP Menu

VIEW        ┬ Data R/W
            ├ Message                    ▸p.12
            ├ Window Transparency (RUN MENU)
            └ Command Communication Log  ▸p.152

LAYOUT      ─ LAYOUT

TOOL        ┬ Eject SD Card
            ├ Save Setting Data
            ├ Save Image Memory
            ├ Clear Image Memory
            └ Information
```

OBJECT
- Mark0 ▸p.45
- Mark1

F1 (Select Window)
- Screen 0 - 1
  - Select Camera
  - Switch Disp. — Memory/Live / Trapezoid Adju / NG Image / Slice Level / Grayscale/Color / Grayscale Conv. / Extracted Color / Extraction Display Mode / Grayscale Preprocess
  - Display Patterns — Area / Scan Direction/ Detect Position / Display Condition / Geometry Calculation / Character/Figure Drawing / Marker Display / Coordinate Axis / Arrowhead of stage direction
  - Scroll
  - Magnification
  - Full Screen
- Data R/W 0 - 1
- Message
- Print Screen View

F2
- Switch Layout

1.2 Main Settings

Flow of Setup

1.	**Setting Stage**	Chapter 3
2.	**Setting Communication** (Necessary for exchanging or controlling stage information.)	Chapter 4
3.	**Setting Alignment Function** (Creating the base for conducting steps 4 to 7)	Chapter 5
4.	**Setting Calibration** (Creating the coordinates for conducting steps 5 to 7)	Chapter 6
5.	**Setting Target** (Setting the target position for positioning)	Chapter 7
6.	**Setting Object** (Setting objects for positioning)	Chapter 8
7.	**Setting Judgement Criteria** (Judging whether or not positioning is appropriate)	Chapter 9

Chapter 2

Basic Operation

2.1 About Windows

2.1.1 RUN Menu and SETUP Menu

PV240 has two windows; RUN menu for performing inspections and SETUP menu for making settings such as inspection conditions.
In this section, the screen structure dedicated to PV240 is described. For details of the standard screen structure of PV200, refer to "Chapter 3 Basic Operation" - "3.1 About Windows" of PV200 User's Manual.

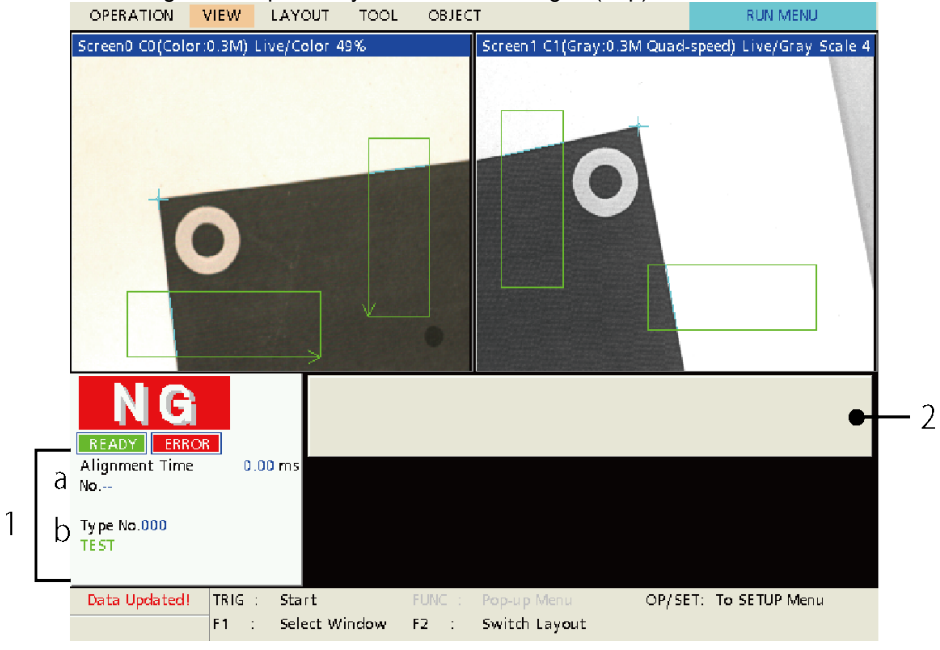
Example of RUN Menu

The specialized window layout for Alignment function can be selected in PV240.
Specialized layout for Alignment: Preset Layout No. 10 "Hor.Align-2(Top)"
Normal layout: Preset layouts Nos. 0 to 6
Full screen layout: Preset layout Nos. 7 to 9

Note

For information on how to select layouts, set display items and adjustments, refer to "Chapter 5 Setting of Operation and RUN Menu" - "5.3. Setting display in RUN Menu" of PV200 User's Manual.

When selecting PV240 special layout No. 10 "Hor.Align-2(Top)"



1	**Information display area**	**a**	Area No. and comment	Displays the source area number of the current setting data or comment information.
		b	Type information	Displays the current type and comment.
2	**Alignment message**		Displays the situation of PV240 or an error message when executing Calibration or Alignment. For details of error numbers to be displayed when errors occur, refer to page 151 or PV200 User's Manual. To switch the display of this window, select "VIEW" > "Message" in the main menu. To change the display position, press the F1 key and select "Message" in the window select menu. Press the FUNC key and select "Move" from the pop-up menu.	
3	**OBJECT**		OBJECT is the menu to register object positions manually. It is used when object marks cannot be detected at the time of alignment. (See page 45.)	
	Others		For details of display contents of the screen window and information display area, see page 158.	

2.1.2 Operation by Pressing TRIG Key in RUN Menu (Manual Alignment)

Manual Alignment is to execute Alignment with the TRIG key of the keypad.

Using Manual Alignment detects two mark objects (moving marks for positioning) and calculates deviation and stage adjustment amounts. (For details of the amount of deviation, refer to page 199.)

The target position used for this operation (target position to which the object moves) is the target registered position right before the execution of Manual Alignment. Manual Alignment calculates the amount of deviation between this position and a detected object position.

For executing Alignment, it is necessary to register Calibration, Coordinates of target and Object Checker in advance.

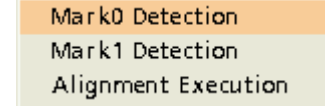
The procedure of Manual Alignment varies according to the setting of "TYPE" > "Alignment" > "Alignment" > "TRIG Type".

When TRIG Type is "Mark Sync. Execution"

Two object marks are detected by pressing the TRIG key. Alignment is executed once based on the detected positions.

When TRIG Type is "Mark Async. Execution"

Pressing the TRIG key displays the menu for selecting "Mark0 Detection", "Mark1 Detection" and "Alignment Execution". To execute Alignment, the positions of two marks should be set in advance.
Each operation is executed as below.



Mark0: Detects the object mark0.
Mark1: Detects the object mark1.
Alignment Execution: Executes Alignment with the mark0 and mark1 detected in advance.

2.2 Select Menu

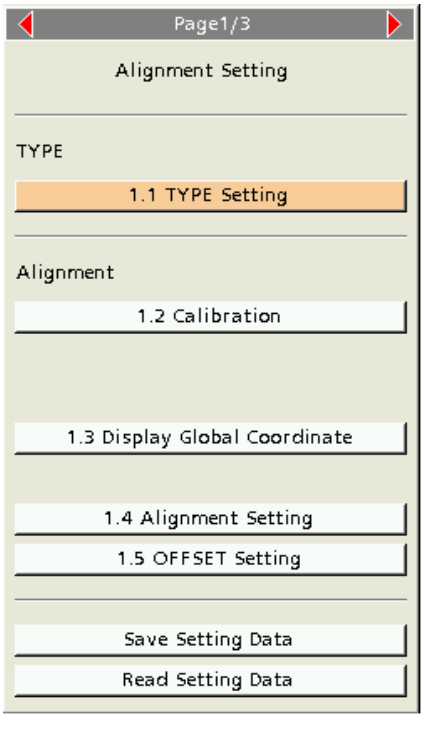
Select Menu is the function to create a special menu by registering frequently used operations and setting items as buttons.
Creating a special menu can reduce the number of setting processes and limit a range where an operator can use.

Note

- In PV240, the following two select menus can be set for each type.
  (1) "Engineering Menu" specialized for the setting items of Alignment
  (2) "User Menu" for customizing the menu from an empty state for normal users
  For details, refer to “2.2.1 Engineering Menu and User Menu” on page 17.
- For details of how to set Select Menu and standard registrable items in PV200, refer to the "Select Menu" chapter of PV200 User's Manual.

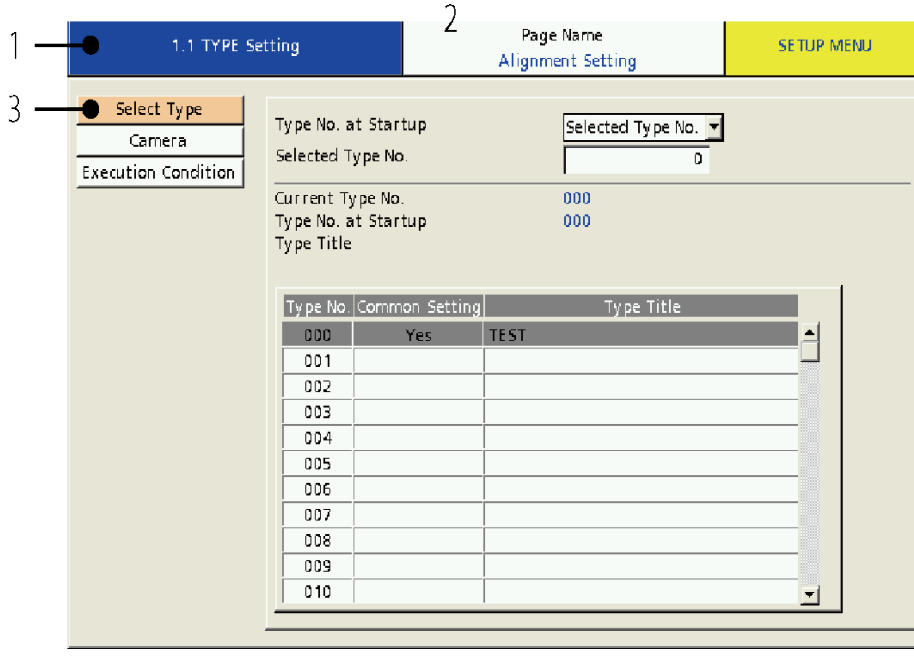
Appearance of Select Menu Window

First hierarchy of Select Menu



1	Page number	The currently-displayed page number and the total of pages are displayed.
2	Page switchable mark	By tilting the ENTER key left/right, you can switch the page. These marks are displayed when other pages exist.
3	Menu hierarchy number and button name	Hierarchy number on the page of Select Menu and button name are displayed. Hierarchy numbers are displayed only for Preset Menu. Items which are added to Select Menu using Assign Menu function are not displayed.

Second hierarchy of Select Menu



1	The Select Menu item currently selected is displayed.
2	The page name currently selected is displayed.
3	Select Menu items currently selected are composed of these buttons.
4	Display window according to menu contents. It can be switched with buttons.

Adding Items to Select Menu

Items registered in Select Menu can be changed or added. For details, refer to the "Select Menu" chapter of PV200 User's Manual.

Note

Top items of the preset engineering menu mentioned later can be assigned to Select Menu. However, items under the top items cannot be assigned. For details, refer to “2.2.2 Selecting Engineering/User Menu” on page 20.

Registrable Items in Select Menu

The followings are specialized items for PV240 that can be registered by "Set Button in Select Menu.

```
TYPE
  ├Alignment
    ├ Stage Setting
    ├ Calibration
    └ Alignment

INSPECTION
  ├Alignment
    └ Specify No. (000 Fixed)
      ├Checkers Setting
      │ ├ Comment
      │ ├ Calibration Checker, Common Object
      │ ├ Target Checker
      │ └ Object Checker
      │
      ├Calibration
      │ ├ Calibration Checker
      │ ├ Calibration data, Show details
      │ │   └Display Global Coordinate *
      │ ├ Calibration Data, Manual setting
      │ ├ Rotation Point Adj. (Mark0, Mark1)
      │ └ Display Global Coordinate
      │
      ├Target
      │ ├ Target Checker
      │ ├ Display Coordinates
      │ ├ Coordinates of Registered Target **
      │ └ Register coordinates of target
      │
      ├Object
      │ ├ Object Checker
      │ └ Display Coordinates
      │   Detect Coordinates Offset
      │
      └Judgement Limits
        ├ Change Base
        ├ Threshold of Change Judgement
        ├ Threshold value for Mark Deviation
        └ Threshold value for pitches between marks

Preset
  ├Type Setting
  ├Calibration
  ├Display Global Coordinate
  ├Alignment Setting
  ├Offset Setting
  ├Device Setting
  ├Communication Setting
  └Environment Setting
```

*Registrable by Assign Menu
(Assign Menu: Items in the pop-up menu displayed by pressing the FUNC key in a corresponding menu.)

**Only registrable by "TYPE" > "Select Menu". Unregistrable by Assign Menu.

2.2.1 Engineering Menu and User Menu

What is Engineering Menu?

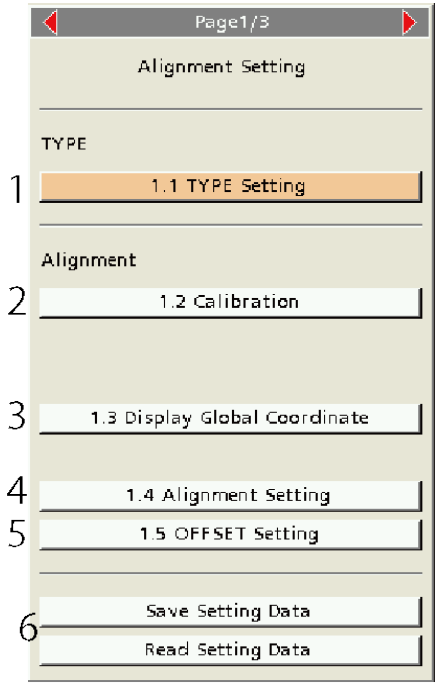
Engineering Menu is the specialized Select Menu for Alignment setting items considering the operations for introducing or maintaining PV240. Engineering Menu has been already registered as preset menu, and it will be automatically applied by selecting "Engineering" in Select Menu under TYPE.

Note

Items registered in Select Menu can be changed or added. For details, refer to the "Select Menu" chapter of PV200 User's Manual.

Items of Engineering Menu (Presets)

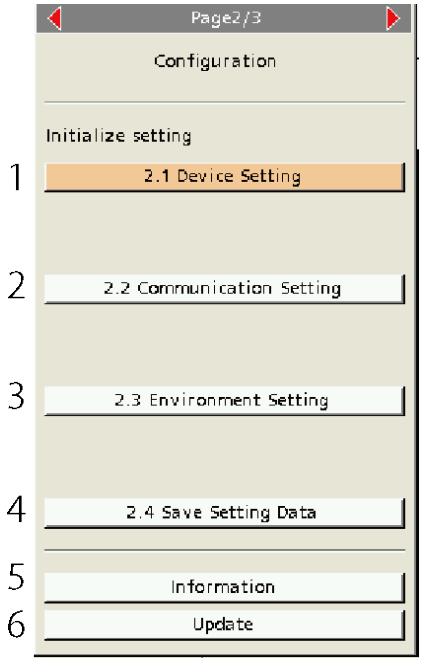
Page 1/3 Alignment Setting



1	**TYPE Setting** To display the menus for Select Type, Camera and Execution Condition. ・Select Type, Camera, Execution Condition settings
2	**Calibration <Special menu *>** To display the menu for Calibration. ・Stage Setting, Calibration, Checker setting
3	**Display Global Coordinate** Global coordinates created by the calibration setting can be confirmed.
4	**Alignment Setting** To display the menus in "INSPECTION" > "Alignment". The settings for mark detection and base position required for Alignment can be specified. ・Checkers setting, Target, Object, Judgement Limits ・Others
5	**OFFSET Setting <Special menu *>** Offset values required for executing Alignment are input. ・Stage Coordinates Offset, Target Coordinates Offset ・Detect Coordinates Offset
6	**Save Setting Data, Read Setting Data**

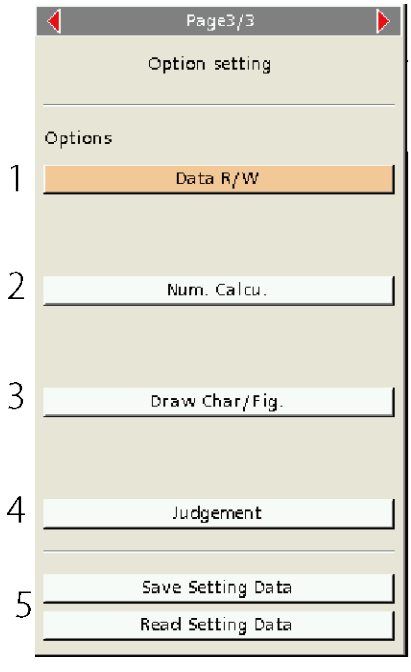
*: The menu configuration is specialized for Engineering Menu. As for special menus, see page 16.

Page 2/3 Configuration



1	**Device Setting** To set the device information on PV240. ・Network, Calendar, Language ・Camera Setting, Initialize * For selecting language, set "Preset Menu" in "TYPE" > "Select Menu".
2	**Communication Setting** To set communication setting for external control. ・PLC Communication, Parallel, Parallel Output, Serial
3	**Environment Setting** To make settings relating to input/output such as General Output and Image Output. ・Startup Setting, General Output, Image Output ・Alignment Result Output, Save Image Memory, Print Screen ・SD Card Setting, Command Communication Log
4	**Save Setting Data** To save setting data.
5	**Information**
6	**Update**

Page 3/3 Option setting



1	**Data R/W** To display the setting menu for Data R/W.
2	**Numerical Calculation** To display the setting menu for Numerical Calculation.
3	**Draw Character/Figure** To display the registration menu for Draw Character/Figure.
4	**Judgement** To display the menu for Judgement.
5	**Save Setting Data, Read Setting Data**

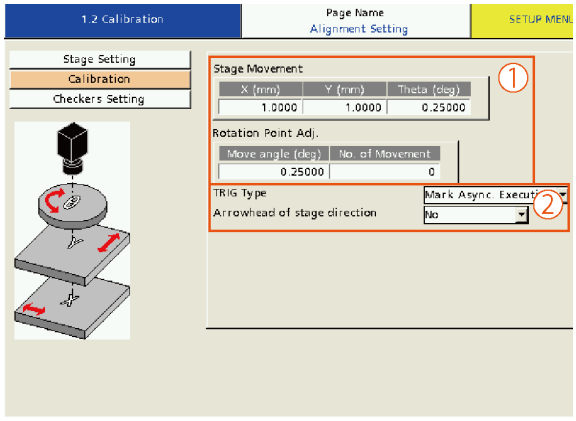
▶ Note

The top items of Engineering Menu (Presets) can be assigned to Select Menu. For details, refer to “Assign Engineering Menu (Presets) Items to Select Menu.”.

Special Menu (Specialized Menu Configuration for Engineering Menu)

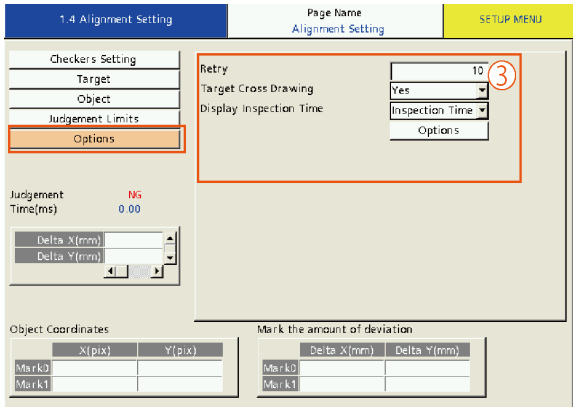
As it is the specialized Select Menu for Alignment setting items, some menu items are different from the normal menu window of PV240. This section describes some of those menu items.

Example 1. "1.2 Calibration" > "Calibration"



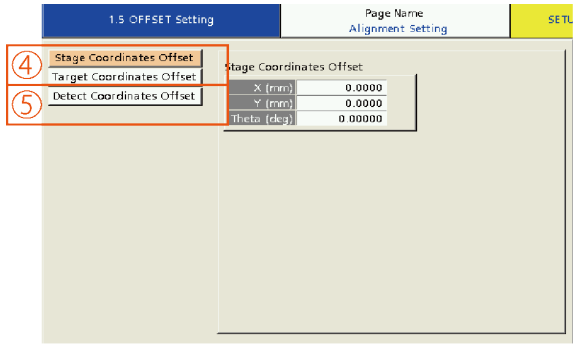
①	Select items from "TYPE" > "Alignment" > "Calibration".
②	Select items from "TYPE" > "Alignment" > "Alignment".

Example 2. "1.2 Calibration" > "Options"



③	Select items from "TYPE" > "Alignment" > "Alignment".

Example 2. "1.3 Offset Setting"



④	Select items from "INSPECTION" > "Alignment" > "Alignment Checker 000" > "Target" > "Detect Coordinates Offset".
⑤	Select items from "INSPECTION" > "Alignment" > "Alignment Checker 000" > "Object".

What is User Menu?

User Menu is the select menu for customization which is mounted as a standard function of PV200. All the items are empty by default. Add items as necessary.

Note

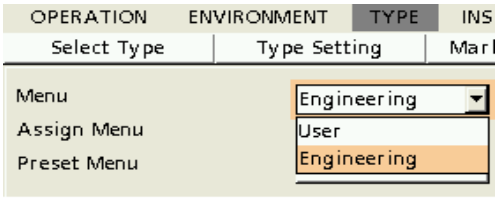
For details of the procedures for changing and adding items of Select Menu, refer to the "Select Menu" chapter of PV200 User's Manual.

2.2.2 Selecting Engineering/User Menu

1. Select "TYPE" > "Select Menu".

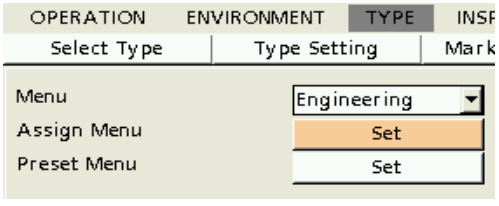
2. Select "Engineering" or "User" in "Assign Menu".

Select "Engineering" to register the dedicated preset menu automatically. Select "User" to register an empty select menu.



4. To change or add menu items, customize the menu by "Assign Menu".

For details of the procedures for changing and adding items of Select Menu, refer to the "Select Menu" chapter of PV200 User's Manual.



2.2.3 Referring to Engineering/User Menu

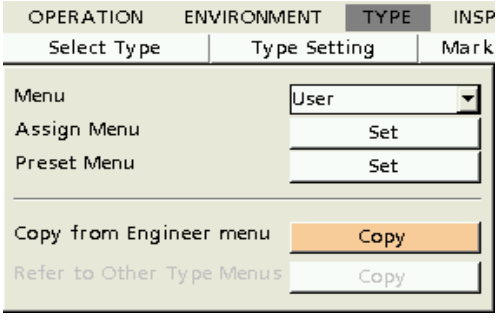
Referring to Engineering/User Menu of the Same Type

Select Menu items can be copied between Engineering and User Menus of the same type. Use this function to copy the customized engineering or user menu to the other.

1. Select "TYPE" > "Select Menu".

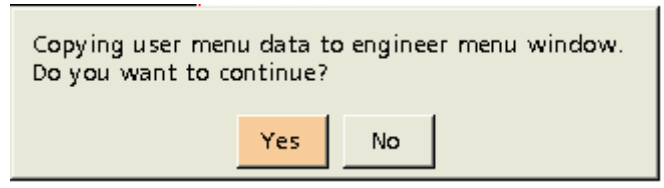
2. Select either menu in "Assign Menu" as destination, and press "Copy from Engineering (User) menu".

When "Engineering" is selected, the button "Copy from user menu" is displayed. When "User" is selected, the button "Copy from Engineering menu" is displayed.



3. **Select [Yes] when this message appears.**

The right figure shows the message when Engineering menu is copied to User menu.



Referring to Engineering/User Menu of Other Types

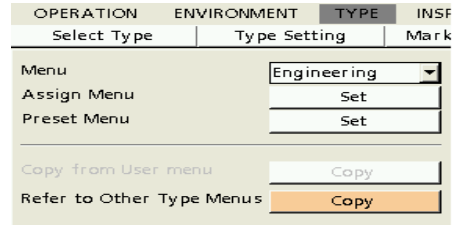
The engineering/user menu that has been set for another type can be copied to the type currently selected.

Note

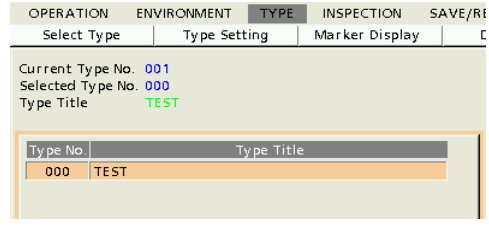
Executing "Copy" copies both Engineering and User menus to an arbitrary type. It is not possible to copy only either of the menus.

1. **Select "TYPE" > "Select Menu".**

2. **Press "Copy" in "Refer to Other Type Menus".**

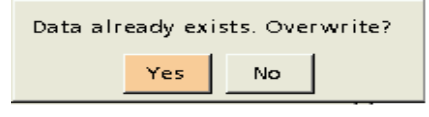


3. **Select the type number you want to copy.**



4. **Select [Yes] when the message confirming overwriting appears.**

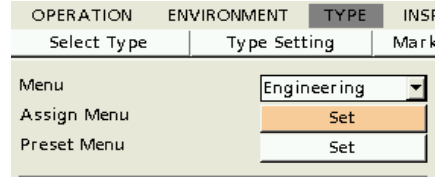
Now, copying the menu is complete.



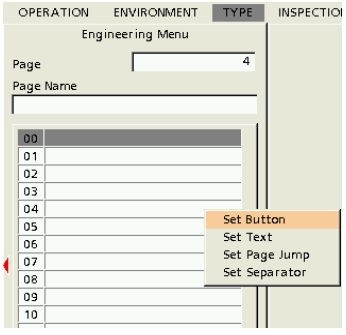
Assign Engineering Menu (Presets) Items to Select Menu

1. **Select "TYPE" > "Select Menu".**

2. **Press "Set" for "Assign Menu".**



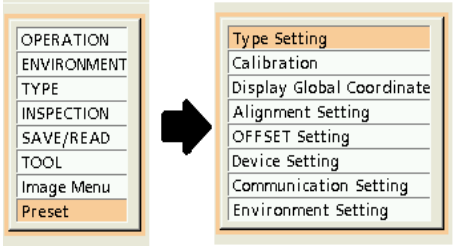
3. **Select "Page" and "Item No.", and press "Set Button".**



4. **Press “Unset” button.**

5. **Select "Preset" from the list of registered data.**

6. **Select items you want to register as buttons from the list.**



Note

Items under the top items cannot be assigned to the menu.

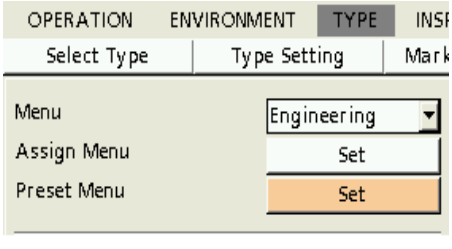
2.2.4 Applying Preset Menu (Engineering Menu) Again

Preset Menu (Engineering Menu) is automatically generated when creating a type. However, for applying preset menus again to the select menu which has been edited once or for using preset menus after switching language, the following setting is required. (At the time of switching language, the display of the item names in the normal menu is switched to the selected language, however, the item names in the select menu are not switched. The items set in the preset menu will be displayed properly by reading the preset menu again after switching the language.)

Reading Preset Menu

1. **Select "TYPE" > "Select Menu".**

2. **Select "Set" in "Preset Menu".**

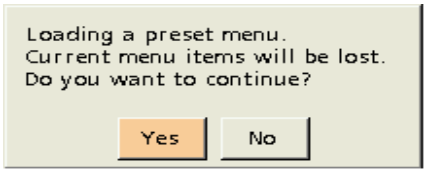


3. **Select "Yes" in the confirmation window.**

Select "Yes" to set Preset Menu to the initial setting.

Note

If current select menu items are not set, the confirmation message does not appear.



2.3 Result Output and Image Output to SD Card

PV240 can output inspection results and inspection images to external devices.

Inspection results can be output to an Ethernet, RS232-C serial interface or SD memory card using PLC communication or general purpose communication. For details of the result output via Ethernet and RS232-C, refer to the chapters 4.16.2 and 11 of PV200 User's Manual. For details of the output to an SD memory card, see the following.

2.3.1 Outputting Alignment Result Data

PV240 can output inspection results to an SD memory card.

The following two types are available to output results. Select which otuput is necessary.

Data	Output content	Setting/Output timing
General results:	· Date and time of inspection · Scan Count · Total Judg. · Judgement · Numerical Calculation It is selectable which result is output. (A plurality of result data is selectable.)	Set "Output" to "Yes" for "SD Card" in "ENVIRONMENT" > "Input/Output" > "General Output" menu. Output timing: After execution of inspection
Alignment results:	Results of AAE (Auto alignment execution) and AAS (Auto alignment execution (Simple flow) commands: · Execution date · Judgement · Inspection time · No. of retries · Amount of deviation X · Amount of deviation Y · Amount of deviation Theta · Mark the amount of deviation M0 X, Mark the amount of deviation M0 Y · Mark the amount of deviation M1 X, Mark the amount of deviation M1 Y All the above results are output.	Set "Alignment result output" in "ENVIRONMENT" > "Input/Output" > "Alignment result output" menu. Output timing: After the execution of AAE and AAS commands ▶ Note Other than the above settings, the alignment result following the reception of general-purpose communication command from an external device or PLC communication command [RTD] can be output. However, it can be output only when setting "Output" to "No" for "SD Card" in "General Output". For details of commands, refer to pages 110 and 150.

Results are output to the following folder in either case.

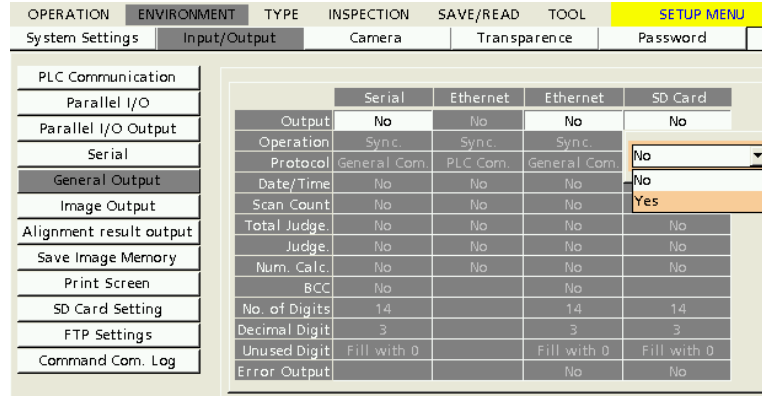
¥ Panasonic-ID SUNX Vision ¥PV240¥Result

Outputting General Results

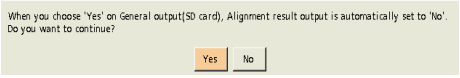
1. **Select "ENVIRONMENT" > "INPUT / OUTPUT" from the menu bar.**

2. **Select "General Output" in "Input/Output" setting window.**

3. **Select "Yes" for "Output" of "SD Card".**



The message appears as the right figure.
Select "Yes".



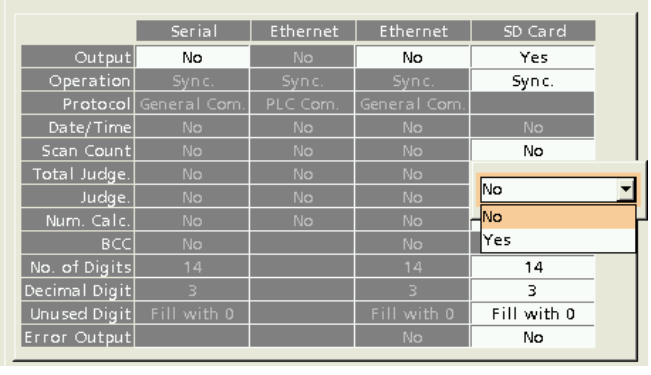
Note

When outputting general results to an SD memory card, alignment data cannot be output.

4. **Set "Yes" for the data to be output among "Date/Time", "Scan Count", "Total Judge.", "Judge." and "Nu. Calc.".**

5. **When running an inspection in RUN Menu by inputting START, the results of the data which are set to "Yes" in the above step 4 are output to an SD card.**

For details, refer to the chapter 4.16.2 of PV200 User's Manual.



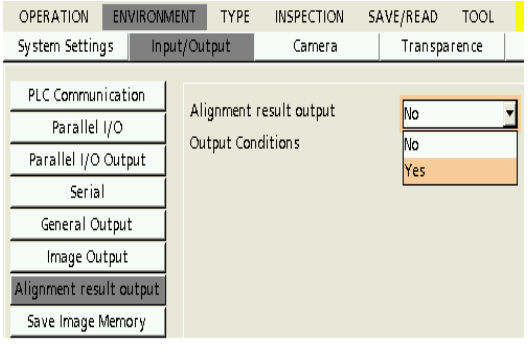
Outputting Alignment Result (Supporting AAE and AAS Commands)

When PV240 receives an auto alignment command (AAE or AAS) and executes it, the result is output.
Output results: Execution date, Judgement, Execution time, No. of retries, Amount of deviation X, Amount of deviation Y, Amount of deviation Theta, Mark the amount of deviation M0 X, Mark the amount of deviation M0 Y, Mark the amount of deviation M1 X, Mark the amount of deviation M1 Y

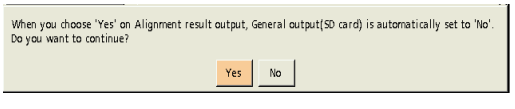
1. **Select "ENVIRONMENT" > "INPUT / OUTPUT" from the menu bar.**

2. **Select "Alignment result output" in "Input/Output" setting window.**

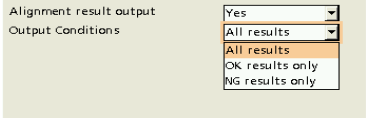
3. **Select "Yes" for "Alignment result output".**



The right message appears at this time.
Select "Yes".



4. **Select Output Conditions.**



"All results" (Default)
Execution results are output regardless of the judgement result of alignment execution.
"OK results only"
Execution results are output when the judgement result of alignment execution is OK.
"NG results only"
Execution results are output when the judgement result of alignment execution is NG.

5. **When running an inspection of Alignment in RUN Menu by inputting START, the result is output when the condition specified in the above step 4 is met.**

The output file name is as below.
YYYYMMDD_ALN_RSLT.txt
YYMMDD :Alignment execution time
When a date is changed, results are output to another file.

Result Data Output Format

Alignment results (Execution date, Judgement, Execution time, No. of retries, Amount of deviation X, Amount of deviation Y, Amount of deviation Theta, Mark the amount of deviation M0 X, Mark the amount of deviation M0 Y, Mark the amount of deviation M1 X, Mark the amount of deviation M1 Y) are output in comma separated data according to the table below.

Result		No. of digits	Output format	Sign	Unit	Example
Execution date		14	Value	No	YYYYMMDDhhmmss	20150121142034
Judgement		2	String	No	No	OK
Execute	Time	14	Value	No	μs	00000054423684
Retry	No. of times	14	Value	No	Times	00000000000003
Amount of deviation	X	14	Value	Yes	0.00001mm	00000000199924
	Y	14	Value	Yes	0.00001mm	00000000100178
	Theta	14	Value	Yes	0.000001 degrees	00000000000270
Mark the amount of deviation M0	X	14	Value	Yes	0.00001mm	00000000199848
	Y	14	Value	Yes	0.00001mm	00000000099984
Mark the amount of deviation M1	X	14	Value	Yes	0.00001mm	00000000200000
	Y	14	Value	Yes	0.00001mm	00000000100372

Output Examples

20150121142034,OK,00000002478668,00000000000000,00000000199956,00000000100106,00000000000170,00000000199976,00000000099984,00000000199936,00000000100228, ←First execution of AAE or AAS

20150121142039,OK,00000002364153,00000000000000,00000000199924,00000000100178,00000000000270,00000000199848,00000000099984,00000000200000,00000000100372, ←Second execution of AAE or AAS

20150121162316,OK,00000054423684,00000000000003,00000000199994,00000000100030,-0000000000060,00000000200031,00000000100072,00000000199957,00000000099988, ←Third execution of AAE or AAS

・・・

2.3.2 Outputting Inspection Images to External Device

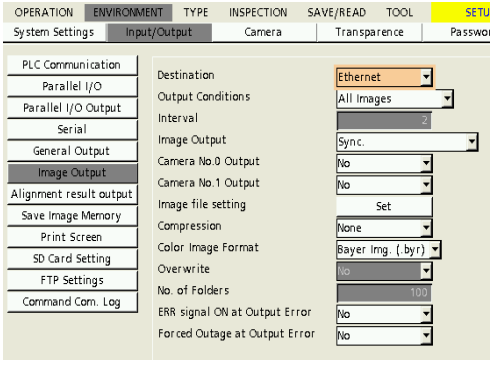
Displaying “Image Output” Setting Window

1. Select “ENVIRONMENT” > “Input/Output” from the menu bar.

2. Select “Image Output” in “Input/Output” setting window.

Selecting Destination

1. Select a “SD Card” or “Ethernet” in “Destination”.



Note

When outputting through Ethernet to a PC, the port number of PV240 is “8602”.
Ver.1.30 or later of the software for image receiving "Image Receiver for PV" needs to be installed in the PC which receives images. Also, to receive compressed images (available from Ver.1.40), Ver.1.50 or later of "Image Receiver for PV" is required.
You can download the Image Receiver from our web site.

http://panasonic.net/id/pidsx

(“Products” > “Machine Vision System” > “PV240” > “Software”)

Downloading the software requires a user information registration.

Outputting to a SD memory card

A folder named as date and time (YYMMDDHHMMSS= year, month, day, hour, minute, second) is created in the following path of a SD memory card and image files are saved in it.

¥ Panasonic-ID SUNX Vision ¥PV240¥Image¥Output¥

Initially, decide the number of folders to save images. When using a SD memory card with PV200, it has a limit that up to 100 files can be saved in per folder. Thus, the specified number of folders by 100 files can be saved. Select either overwriting from older files or terminating image saving when the number of files reaches the saving limits.

1. Select "No. of Folders”.

The default is “10” and the range of available value is “1 to 1000”.

2. Set "Overwrite".

[No] (Default): Terminates image saving.

[Yes]: Deletes the oldest folder and all images stored in the folder and creates a new folder to continue saving when the number of folders reaches the limit or the space of a SD memory card is used up.

Outputting through Ethernet interface

When the PC has an error, such as uninvoked Image Receiver and disconnection of cables, images cannot be output correctly. Set the operation of PV200 in such case.

When "Output Conditions" is set to "Command Reception", two items described below cannot be selected. In this case, if outputting an image failed, ERROR signal will be output.

1. Set [ERR signal ON at Output Error].

To turn on the ERROR signal when an error occurs, select “Yes”. (Default: No)

2. Set [Forced Outage at Output Error].

[No] (Default):	Continues the inspection.
[Yes]:	Terminates the inspection. Confirm the connection following the displayed message. When outputting Synchronously, images can be resent.

Specifying a Camera Image to Output

You can set images to output or not by a camera.

Note

This setting is not allowed when "Output conditions" is set to "Alignment output". This setting is depend on the camera settings of the Alignment-checker.

1. Select “Yes” in "Camera No.0 Output" of “Image Output”.

Doing so makes setting that an inspection image of camera No.0 is output.

2. In the same way, set a Camera No. to “Yes” to output its image.

Selecting Output Condition

Other than outputting by an inspection, images can be output when the specified conditions are fulfilled.

1. Select a condition to output images in “Output Condition”.

[Alignment output](default)*(a	It outputs images when some alignment commands are executed.This can be set if "Destination" is set to "SD Card".（Refer to page 31.）
[All Images](default):*(b:	Images are output at every inspection.
[NG Judgement]:	To output all images of the cameras which are set to output when the judegment selected in “Image Output” in “Judgment” is NG.Refer to （PV200User’sManual4.13.3）If any condition is not specified, no image is output.
[At Interval]:	Images are output per the specified number of inspections.
[Command Reception]:	Images are output when receiving the certain signal* from external device. * The signal of “Output Latest Image” assigned to one of ASSIGN0-1 and EXTRA0-2.
[Judge. Per Cam.]	To output images when the judegment selected in “Image Output” in “Judgment” for each camera is NG. Refer to（PV200User’sManual4.13.3）. Images are output each time when selecting "No Condition" for "Image Output". If "Destination" is set to "None", no image is output. Judgement formula which is used as output condition can be specified per camera. As only the images of the camera the result of which is NG can be output, the transmission time of images and the image capacity can be reduced.

*a) OutputCondition：Default of Selecting [SD]

*b) OutputCondition： Default of Selecting[Ethernet]

2. Set an interval in “Interval”.

(This is the item to set when you select "At Interval" in Step 1.)
The range of available value is 2 to 10000.
Specifying “10” outputs an image at the first inspection, and then outputs every ten inspections as 11th time, 21st time, 31st time…

Selecting Output Timing

Set the timing to output images in "Image Output".

Select from "Synchronous" (default), "Asyn. (image output first)", and "Asyn. (sequence first)".

There are two settings; to output images every time one inspection is executed, to output images while PV240 is able to output them until the start of the next inspection.Refer to PV200User’sManual6.3.

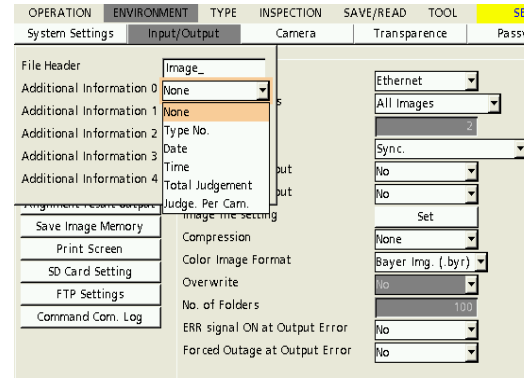
Selecting Additional Information for a File Name

A file name of image consists of the following information. Please see page 31 when "Output conditions" is set to "Alignment output".The setting below is not allowed.

Header:	Up to eight characters can be specified.
Additional information 0-3:	Four types of information can be added.
Type No.:	Type No. (000 - 255) when the image is captured.
Date:	The date (yymmdd) of built-in calendar of PV240 when the image is captured.
Time:	The time (hhmmss) of built-in calendar of PV240 when the image is captured.
Total Judgement:	Total judgement of the image (OK/NG) * Total judgement is other than OK/NG, such as NJ = Unset
Judge. Per Cam. (Result):	Judgement of the image per camera （CJNJ /CJ NG / CJAL） *CJNJ = When "Output Condition" is other than "Judge. Per Cam.” *CJNG = When "Output Condition" is "Judge. Per Cam.” *CJAL = When "Image Output" set in Judgement is "No Condition”
Camera No.:	C0 – C1 (2 digits) Number of the camera which captured the image. (Automatically added)
Scan Count:	Scan count: 7 digits (Automatically added) ▶ Note Scan Count is reset to “0” by turning on the power, switching type, and resetting statistics data. If the file name of the image to be output after reset is the same as the file name that has been output before reset, it will be overwritten. Adding time or type number to the additional information prevents the file names to be the same.)

1. Select "Set" in "Image file setting", and enter "File Header" with the software keyboard.

Default: “Image_”



2. Select an item from five types for “Additional Information 0” to “Additional Information 4”.

Select "None" when no additional information is needed.

Ex.)

File Header: Image_
Additional information 0: Type No. (=50)
Additional information 1: Date (=20101215)
Additional information 2: Total Judgement (=NG)
Additional information 3: Judge. Per Cam. (=NG)
Additional information 4: None
Camera No.0
Scan Count 100

▼

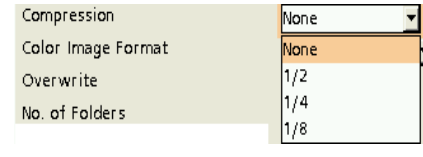
Filename:
Image_050_101215_NG_CJNG_C0_0000100.bmp

▶ Note

Maximum number of digits for a file name is 50.

Selecting Compression Rate of Output Image

1. Select from "None", "1/2", "1/4" and "1/8" in "Compression".



Compression rate	Captured image size	Output image size	Output time
None	• 640 x 480 pixels (*a • 1600 x 1200 pixels • 2048 x 2048 pixels	• 640 x 480 pixels • 1600 x 1200 pixels • 2048 x 2048 pixels	Approx. 1/2 of the case of "None"
1/2	• 640 x 480 pixels (*a • 1600 x 1200 pixels • 2048 x 2048 pixels	• 320 x 240 pixels • 800 x 600 pixels • 1024 x 1024 pixels	Approx. 1/2 of the case of "None”
1/4	• 640 x 480 pixels (*a • 1600 x 1200 pixels • 2048 x 2048 pixels	• 160 x 120 pixels • 400 x 300 pixels • 512 x 512 pixels	Approx. 1/4 of the case of "None”
1/8	• 640 x 480 pixels (*a • 1600 x 1200 pixels • 2048 x 2048pixels	• 80 x 60 pixels • 200 x 150 pixels • 256 x 256 pixels	Approx. 1/8 of the case of "None”

▶ Note

Compressed images can be automatically decompressed and retrieved with PV200 and PVWIN200. However, note that the resolution deteriorates.

*a) When the used camera is 0.3-Meaga Compact Color Camera (ANPVC6030), the image size is 640 x 478 pixels, however, the inspection is performed with an image of 640 x 480 pixels. The missing vertical two pixels are filled with black pixels (Gray level 0). It is the same state as when partial imaging is set with another camera. For the details of Partial Imaging, refer to PV200 User’s Manual.

Selecting a Format to Output Color Images

1. Select "Bayer Img. (.byr)" or "RGB Img. (.bmp)" in "Color Image Format".

What is Bayer Image?

Bayer image is an image saved in the same array as an image sensor of a color camera.
As the file size is small and the time for saving is shortened, you should use Bayer Image to save many images.

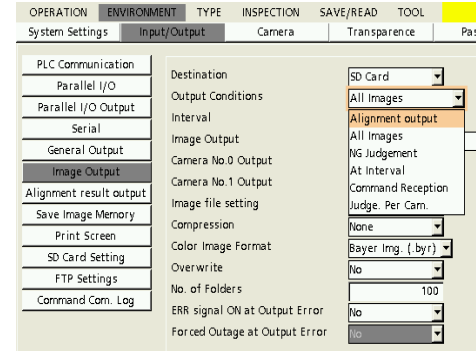
Files saved in this format (.byr) cannot be confirmed with general applications such as a PC.
Bayer images can be confirmed on PV240, PVWIN240 or PVImageConverter. Its files size is smaller than that of RGB image (.bmp).

Note

Using PVImageConverter can convert a bayer image (.byr) to a RGB image (.bmp).

Outputting Images When Executing Alignment Command

When "Output Conditions" is set to "Alignment output", captured images at the time of the execution of special commands for Alignment such as Calibration execution or Alignment execution can be saved in an SD memory card or transmission contents of commands are output to text files with PVWIN240. Images and text files output with this function can be used for simulations of Calibration or Alignment on a computer mounting PVWIN240.



▶ Note

When simulating using images output with this function with PVWIN240, do not change the file names of images or do not edit the images on a computer. The output images have information such as the stage position and offsets at the time of command execution (described on the next page), and this information will be cleared when they are edited on a computer.

[The following items cannot be set.]

- Interval
- Camera No.0 Output, Camera No.1 Output (Depend on the checker settings related to Alignment.)
- Image File Setting (File names are predetermined.)
- Forced Outage at Output Error

List of corresponding commands

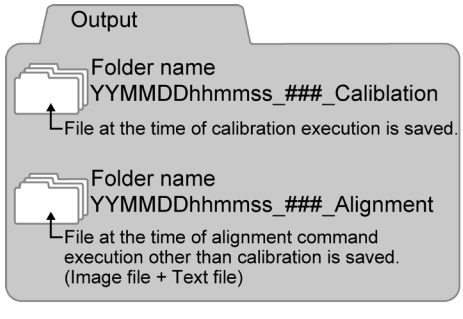
Output Image	CAE (Execute Calibration) AAE (Execute Alignment) AAS (Execute Auto Alignment (Simple flow)) TAG (Get Target Position)	TAR (Request Stage Absolute Position Move) TGG (Get Target Position) OBG (Get Object Position) AOG (Get Deviation/Stage Adjustment Amount)
Outputting Text Data	ACL (Execute Alignment for 1 camera) AZG (Get Stage Adjustment Amount) GDV (Get Deviation)	TGS (Set Target Position) SRP (Move Rotation Center) SCT (Change Threshold of Change Judgement)

Function

- Image data captured when executing a specific command for Alignment is output to an SD memory card.
- As for a command which is not for capturing images, a general-purpose communication command including each parameter is output as text because image data cannot be output.

Output destination folder

Saves images in separate folder for each command in ¥Panasonic-ID SUNX Vision¥PV240¥Image¥Output.

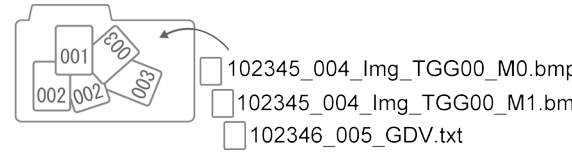


YYMMDDhhmmss :Folder creation time

:Type No. (3 digits)

Max. number of files stored in each folder: 100

YYMMDDhhmmss_###_Alignment



[Timing of folder creation]

A folder is created when executing a command of "List of corresponding command" after executing any of the following events.

- When selecting type (Switching setting data)

- When inserting an SD card
- When starting up
- When completing command CAE (Execute Calibration), AAE (Execute Auto Alignment) or AAS (Execute Auto Alignment (Simple flow))

Files are named according to the following formats when each command is executed.

<table>
<tr><td rowspan="4">Image file

(Output as bitmap or bayer image)</td><td colspan="2">hhmmss_###_Img_Command_Mark.bmp
hhmmss: Time (Hour-Minute-Second)
###: Serial number (The number of executions of alignment command. A number is added to the name of each file in the order of being written to a folder as 001, 002, 003, ... 100.)
Command: Sign such as CAE or AAE. (Mark numbers 00 to 02 are added to CAE, OBG and TGG. 00: Mark0, 1 / 01: Mark0 / 02: Mark1)
Mark: Any of M0, M1 and M0M1
Extension: bmp or byr</td></tr>
<tr><td>Command</td><td>Example of file name</td></tr>
<tr><td>CAE (Execute Calibration)、
AAE (Execute Auto Alignment)
AAS (Execute Auto Alignment (Simple flow))
TAG (Get Target Position)
TAR (Request Stage Absolute Position Move)
TGG (Get Target Position)
OBG (Get Object Position)
AOG (Get Deviation/Stage Adjustment Amount)</td><td>hhmmss_001_Img_CAE00_M0.bmp
hhmmss_001_Img_AAE_M1.bmp
hhmmss_002_Img_AAS_M1.bmp
- - - - - - - - - - - -
- - - - - - - - - - - -
hhmmss_003_Img_TGG00_M0.bmp
hhmmss_004_Img_OBG01_M0.bmp
hhmmss_005_Img_AOG_M0.bmp</td></tr>
<tr><td colspan="2">The following information is added to these images automatically.
・ Information indicating whether or not alignment is held
・ Alignment mark number
・ Current stage position (XYTheta / UVW / UV + Distance between the center of stage and the center of motor axis)
・ Stage offset (Value of parameter added by the transmission of command such as AAE or AAS)</td></tr>
<tr><td rowspan="9">Text file</td><td colspan="2">hhmmdd_###_Str_Command.txt
hhmmss: Time (Hour-Minute-Second)
###: Serial number (The number of executions of alignment command)
Command: Sign such as ACL or AZG</td></tr>
<tr><td>Command</td><td>Example of file name</td></tr>
<tr><td>ACL (Execute Alignment for 1 camera)
AZG (Get Stage Adjustment Amount)
GDV (Get Deviation)
TGS (Set Target Position)
SRP (Move Rotation Center)
SCT (Change Threshold of Change Judgement)</td><td>hhmmss_006_Str_ACL.txt
hhmmss_008_Str_AZG.txt
hhmmss_009_Str_GDV.txt
hhmmss_010_Str_TGS.txt
hhmmss_011_Str_SRP.txt
hhmmss_012_Str_SCT.txt</td></tr>
<tr><td colspan="2">General purpose communication commands received by PV240 are output to these text files. (Even when PV240 receives a command for PLC communication, character strings of general purpose communication command are output to text files.)</td></tr>
<tr><td>Command</td><td>Example of command</td></tr>
<tr><td>ACL(*</td><td>&ACL00+00000000004+00000000005+00000011111¥</td></tr>
<tr><td></td><td>&TAG-00000000001-00000000011-0000000011100¥</td></tr>
<tr><td>AZG</td><td>&AZG+00000000331+00000000332+00000000333+00000000000+0000000000000¥</td></tr>
<tr><td>GDV</td><td>&GDV00+00000000224+00000000225+00000022221¥</td></tr>
<tr><td>TGS</td><td>&TGS01+00004444444+00003335555¥</td></tr>
<tr><td></td><td>&TGS02+00004444444+00003335555¥</td></tr>
<tr><td>SRP</td><td>&SRP10+00000200000-00000200000¥</td></tr>
<tr><td></td><td>&SRP20+00000200000+00000200000¥</td></tr>
<tr><td>SCT</td><td>&SCT00+00001000000+00002000000+00003000000¥</td></tr>
<tr><td colspan="2">*) In the case of ACL, the commands for obtaining a current position and running offset are output in two lines.</td></tr>
</table>

Specifications for each command

The ways of outputting files when each command is executed are as follows.

CAE (Execute Calibration) No Rotation Point Adjustment

Image files are output to the folder :YYMMDDhhmmss_###_ Calibration. Images are output to a new folder when CAE command is executed.

When executing for both Mark0 and Mark1.

Send	&	C	A	E	0	0	¥	(SUM)	CR

Captures images at the origin position and the moving position from the origin by +X, +Y or +Theta for Mark0 and Mark1, and outputs the images.

Output file	HHMMSS_001_Img_CAE00_M0.bmp	Mark0	Origin
	HHMMSS_001_Img_CAE00_M1.bmp	Mark1	Origin
	HHMMSS_002_Img_CAE00_M0.bmp	Mark0	+X
	HHMMSS_002_Img_CAE00_M1.bmp	Mark1	+X
	HHMMSS_003_Img_CAE00_M0.bmp	Mark0	+Y
	HHMMSS_003_Img_CAE00_M1.bmp	Mark1	+Y
	HHMMSS_004_Img_CAE00_M0.bmp	Mark0	+Theta
	HHMMSS_004_Img_CAE00_M1.bmp	Mark1	+Theta
	HHMMSS_005_Img_CAE00_M0.bmp	Mark0	-Theta
	HHMMSS_005_Img_CAE00_M1.bmp	Mark1	-Theta

When executing for Mark0

Send	&	C	A	E	0	1	¥	(SUM)	CR

Captures images at the origin position and the moving position from the origin by +X, +Y or +Theta for Mark0, and outputs the images.

Output file	HHMMSS_001_Img_CAE01_M0.bmp	Mark0	Origin
	HHMMSS_002_Img_CAE01_M0.bmp	Mark0	+X
	HHMMSS_003_Img_CAE01_M0.bmp	Mark0	+Y
	HHMMSS_004_Img_CAE01_M0.bmp	Mark0	+Theta
	HHMMSS_005_Img_CAE01_M0.bmp	Mark0	-Theta

When executing for Mark1

Send	&	C	A	E	0	2	¥	(SUM)	CR

Captures images at the origin position and the moving position from the origin by +X, +Y or +Theta for Mark1, and outputs the images.

Output file	HHMMSS_001_Img_CAE02_M1.bmp	Mark1	Origin
	HHMMSS_002_Img_CAE02_M1.bmp	Mark1	+X
	HHMMSS_003_Img_CAE02_M1.bmp	Mark1	+Y
	HHMMSS_004_Img_CAE02_M1.bmp	Mark1	+Theta
	HHMMSS_005_Img_CAE02_M1.bmp	Mark1	-Theta

CAE (Execute Calibration) with Rotation Point Adjustment

Image files are output to the folder :YYMMDDhhmmss_###_ Calibration. Images are output to a new folder when CAE command is executed. When the number of files exceeds 100, a new folder is output from number 101.

When executing for both Mark0 and Mark1.

Send	&	C	A	E	0	0	¥	(SUM)	CR

Captures images at the origin position and the moving position from the origin by +X, +Y or +Theta for Mark0 and Mark1, and outputs the images.

Output file	HHMMSS_001_Img_CAE00_M0.bmp	Mark0	Origin	
	HHMMSS_001_Img_CAE00_M1.bmp	Mark1	Origin	
	HHMMSS_002_Img_CAE00_M0.bmp	Mark0	+X	
	HHMMSS_002_Img_CAE00_M1.bmp	Mark1	+X	
	HHMMSS_003_Img_CAE00_M0.bmp	Mark0	+Y	
	HHMMSS_003_Img_CAE00_M1.bmp	Mark1	+Y	
	HHMMSS_004_Img_CAE00_M0.bmp	Mark0	+Theta	
	HHMMSS_004_Img_CAE00_M1.bmp	Mark1	+Theta	
	HHMMSS_005_Img_CAE00_M0.bmp	Mark0	-Theta	
	HHMMSS_005_Img_CAE00_M1.bmp	Mark1	-Theta	
	HHMMSS_006_Img_CAE00_M0.bmp	Mark0	Adjustment 1	
	HHMMSS_007_Img_CAE00_M0.bmp	Mark0	Adjustment 2	
	HHMMSS_008_Img_CAE00_M0.bmp	Mark0	Adjustment 3	
	…	Mark0	Adjustment…	
	HHMMSS_099_Img_CAE00_M0.bmp	Mark0	Adjustment 94	
	HHMMSS_100_Img_CAE00_M0.bmp	Mark0	Adjustment 95	
	HHMMSS_001_Img_CAE00_M0.bmp	Mark0	Adjustment 96	Output to a new folder
	HHMMSS_002_Img_CAE00_M0.bmp	Mark0	Adjustment 97	
	HHMMSS_003_Img_CAE00_M0.bmp	Mark0	Adjustment 98	
	HHMMSS_004_Img_CAE00_M0.bmp	Mark0	Adjustment 99	
	HHMMSS_005_Img_CAE00_M0.bmp	Mark0	Adjustment 100	
	HHMMSS_006_Img_CAE00_M1.bmp	Mark1	Adjustment 1	
	HHMMSS_007_Img_CAE00_M1.bmp	Mark1	Adjustment 2	
	…	Mark1	Adjustment…	
	HHMMSS_099_Img_CAE00_M1.bmp	Mark1	Adjustment 94	
	HHMMSS_100_Img_CAE00_M1.bmp	Mark1	Adjustment 95	
	HHMMSS_001_Img_CAE00_M1.bmp	Mark1	Adjustment 96	Output to a new folder
	HHMMSS_002_Img_CAE00_M1.bmp	Mark1	Adjustment 97	
	HHMMSS_003_Img_CAE00_M1.bmp	Mark1	Adjustment 98	
	HHMMSS_004_Img_CAE00_M1.bmp	Mark1	Adjustment 99	
	HHMMSS_005_Img_CAE00_M1.bmp	Mark1	Adjustment 100	

When executing for Mark0

Send	&	C	A	E	0	1	¥	(SUM)	CR

Captures images at the origin position and the moving position from the origin by +X, +Y or +Theta for Mark0, and outputs the images.

Output file	HHMMSS_001_Img_CAE01_M0.bmp	Mark0	Origin	
	HHMMSS_002_Img_CAE01_M0.bmp	Mark0	+X	
	HHMMSS_003_Img_CAE01_M0.bmp	Mark0	+Y	
	HHMMSS_004_Img_CAE01_M0.bmp	Mark0	+Theta	
	HHMMSS_005_Img_CAE01_M0.bmp	Mark0	-Theta	
	HHMMSS_006_Img_CAE01_M0.bmp	Mark0	Adjustment 1	
	HHMMSS_007_Img_CAE01_M0.bmp	Mark0	Adjustment 2	
	…			
	HHMMSS_099_Img_CAE01_M0.bmp	Mark0	Adjustment 94	
	HHMMSS_100_Img_CAE01_M0.bmp	Mark0	Adjustment 95	
	HHMMSS_001_Img_CAE01_M0.bmp	Mark0	Adjustment 96	Output to a new folder
	HHMMSS_002_Img_CAE01_M0.bmp	Mark0	Adjustment 97	
	HHMMSS_003_Img_CAE01_M0.bmp	Mark0	Adjustment 98	
	HHMMSS_004_Img_CAE01_M0.bmp	Mark0	Adjustment 99	
	HHMMSS_005_Img_CAE01_M0.bmp	Mark0	Adjustment 100	

When executing for Mark1

Send	&	C	A	E	0	2	¥	(SUM)	CR

Captures images at the origin position and the moving position from the origin by +X, +Y or +Theta for Mark1, and outputs the images.

Output file	HHMMSS_001_Img_CAE02_M1.bmp	Mark1	Origin	
	HHMMSS_002_Img_CAE02_M1.bmp	Mark1	+X	
	HHMMSS_003_Img_CAE02_M1.bmp	Mark1	+Y	
	HHMMSS_004_Img_CAE02_M1.bmp	Mark1	+Theta	
	HHMMSS_005_Img_CAE02_M1.bmp	Mark1	-Theta	
	HHMMSS_006_Img_CAE02_M1.bmp	Mark1	Adjustment 1	
	HHMMSS_007_Img_CAE02_M1.bmp	Mark1	Adjustment 2	
	…			
	HHMMSS_099_Img_CAE02_M1.bmp	Mark1	Adjustment 94	
	HHMMSS_100_Img_CAE02_M1.bmp	Mark1	Adjustment 95	
	HHMMSS_001_Img_CAE02_M1.bmp	Mark1	Adjustment 96	Output to a new folder
	HHMMSS_002_Img_CAE02_M1.bmp	Mark1	Adjustment 97	
	HHMMSS_003_Img_CAE02_M1.bmp	Mark1	Adjustment 98	
	HHMMSS_004_Img_CAE02_M1.bmp	Mark1	Adjustment 99	
	HHMMSS_005_Img_CAE02_M1.bmp	Mark1	Adjustment 100	

AAE (Execute Auto Alignment)

Image files are output to the folder :YYMMDDhhmmss_###_ Alignment. After outputting an image by AAE command, outputting an image by the next arbitrary alignment command is performed to a new folder.

When using two cameras

Send	&	A	A	E	P1	P2	P3	P4	¥	(SUM)	CR

P1 to P4: Parameters

No. of retries: When setting one or a larger number (The way of succeeding Alignment by one retry.)

	Flow	File name	
Output file	>TGG	HHMMSS_001_Img_TGG00_M0.bmp	Mark0
		HHMMSS_001_Img_TGG00_M1.bmp	Mark1
	AAE		
	TAG	HHMMSS_002_Img_AAE_M0.bmp	Mark0
		HHMMSS_002_Img_AAE_M1.bmp	Mark1
	TAR (1st movement)		
	TAG	HHMMSS_003_Img_AAE_M0.bmp	Mark0
		HHMMSS_003_Img_AAE_M1.bmp	Mark1
	TAR (2nd movement)		
	TAG	HHMMSS_004_Img_AAE_M0.bmp	Mark0
		HHMMSS_004_Img_AAE_M1.bmp	Mark1
	AAE Response		

When using one camera and two marks

No. of retries: When setting one or a larger number (The way of succeeding Alignment by one retry.)

	Flow	File name	
Output file	>TGG	HHMMSS_001_Img_TGG00_M0M1.bmp	Marks0,1
	AAE		
	TAG	HHMMSS_002_Img_AAE_M0M1.bmp	Marks0,1
	TAR (1st movement)		
	TAG	HHMMSS_003_Img_AAE_M0M1.bmp	Marks0,1
	TAR (2nd movement)		
	TAG	HHMMSS_004_Img_AAE_M0M1.bmp	Marks0,1
	AAE Response		

AAS (Execute Auto Alignment (Simple Flow))

Image files are output to the folder :YYMMDDhhmmss_###_ Alignment. After outputting an image by AAS command, outputting an image by the next arbitrary alignment command is performed to a new folder.

Send	&	A	A	S	P1	P2	P3	P4	¥	(SUM)	CR

P1 to P4: Parameters

When using two cameras
No. of retries: When setting one or a larger number (The way of succeeding Alignment by one retry.)

	Flow	File name	
Output file	>TGG	HHMMSS_001_Img_TGG00_M0.bmp	Mark0
		HHMMSS_001_Img_TGG00_M1.bmp	Mark1
	AAS		
	TAG	HHMMSS_002_Img_AAS_M0.bmp	Mark0
		HHMMSS_002_Img_AAS_M1.bmp	Mark1
	TAR (1st movement)		
	(Object detection)	HHMMSS_003_Img_AAS_M0.bmp	Mark0
		HHMMSS_003_Img_AAS_M1.bmp	Mark1
	TAR (2nd movement)		
	(Object detection)	HHMMSS_004_Img_AAS_M0.bmp	Mark0
		HHMMSS_004_Img_AAS_M1.bmp	Mark1
	AAE Response		

When capturing two marks with one view range
No. of retries: When setting one or a larger number (The way of succeeding Alignment by one retry.)

	Flow	File name	
Output file	>TGG	HHMMSS_001_Img_TGG00_M0M1.bmp	Marks0,1
	AAS		
	TAG	HHMMSS_002_Img_AAS_M0M1.bmp	Marks0,1
	TAR (1st movement)		
	(Object detection)	HHMMSS_003_Img_AAS_M0M1.bmp	Marks0,1
	TAR (2nd movement)		
	(Object detection)	HHMMSS_004_Img_AAS_M0M1.bmp	Marks0,1
	AAE Response		

TGG (Get Target Position)

Image files are output to the folder :YYMMDDhhmmss_###_ Alignment.

When capturing two marks

Send	&	T	G	G	0	0	P2	P3	¥	(SUM)	CR

P2, P3: Parameters

When using two cameras

	Flow	File name	
Output file	>TGG	HHMMSS_001_Img_TGG00_M0.bmp	Mark0
		HHMMSS_001_Img_TGG00_M1.bmp	Mark1
	<TGG		

When capturing two marks with one view range

	Flow	File name	
Output file	>TGG	HHMMSS_001_Img_TGG01_M0M1.bmp	Marks0,1
	<TGG		

When capturing one mark only (Mark0)

Send	&	T	G	G	0	1	P2	P3	¥	(SUM)	CR

P2, P3: Parameters

	Flow	File name	
Output file	>TGG	HHMMSS_001_Img_TGG01_M0.bmp	Mark0
	<TGG		

When capturing one mark only (Mark1)

Send	&	T	G	G	0	2	P2	P3	¥	(SUM)	CR

P2, P3: Parameters

	Flow	File name	
Output file	>TGG	HHMMSS_001_Img_TGG02_M1.bmp	Mark1
	<TGG		

OBG (Get Object Position)

Image files are output to the folder :YYMMDDhhmmss_###_ Alignment.

When capturing two marks

Send

&	O	B	G	0	0	¥	(SUM)	CR

When using two cameras

	Flow	File name	
Output file	>OBG	HHMMSS_001_Img_OBG00_M0.bmp	Mark0
		HHMMSS_001_Img_OBG00_M1.bmp	Mark1
	<OBG		

When capturing two marks with one view range

	Flow	File name	
Output file	>OBG	HHMMSS_001_Img_OBG01_M0M1.bmp	Marks0,1
	<OBG		

When capturing one mark only (Mark0)

Send

&	O	B	G	0	1	¥	(SUM)	CR

	Flow	File name	
Output file	>OBG	HHMMSS_001_Img_OBG01_M0.bmp	Mark0
	<OBG		

When capturing one mark only (Mark1)

Send

&	O	B	G	0	2	¥	(SUM)	CR

	Flow	File name	
Output file	>OBG	HHMMSS_001_Img_OBG02_M1.bmp	Mark1
	<OBG		

2.4 Useful functions

2.4.1 Copying the Screen Display (Print Screen)

In almost screens, whether RUN menu or SETUP menu, the contents displayed on the entire screen can be copied and output to a SD card. The images are saved as bitmap.

Destination can be changed to Ethernet to save the images directly into a PC.

1. Display an image to copy.

2. Hold down the FUNC key for two seconds or more.

In the key guide field, a message of “PRINT SCREEN” appears and the screen is copied.
When the message disappears, printing the screen is complete.

▶ Note

If the message does not appear in the key guide area, an image cannot be copied in the current screen. When an image is copied in the full-screen layout, you cannot see the result as the key guide area is not displayed. Note that the copied image may not be saved due to the condition of the destination to output (SD memory card or Ethernet).

About Image File Name

Example of file name: 071215_150848_0.bmp

Saving image file name consists of date; 6-digit (YYMMDD), time; 6-digit (HHMMSS), and image number; 1-digit (N). Between each of the information, “_” (underscore) is inserted.

- Date and Time:
  Calendar data of PV240
- Image number:
  0 to 9. Numbered consecutively within the same second

▶ Note

When print screen command with a file name is received, the file name becomes arbitrary(given file name) and is different from the format above.（Please Refer to Chapter4）

About Image File Format

File format: Bitmap

Image size: 640 x 480 pixels

Color depth: 24 bits

About Save Folder of Image Files

For SD card: ¥Panasonic-ID SUNX Vision¥PV240¥Screen¥ YYYYMMDDHHMMSS

When you run the print screen, folder with executed date is automatically created, and image files are saved in that folder.
Saving folder name consists of date; 8-digit (YYYYMMDD), time; 6-digit (HHMMSS).

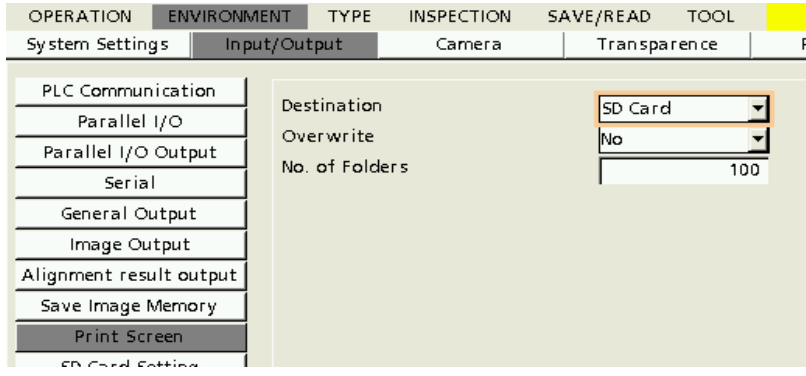
Ex.：20140403110531

▶ Note

The maximum number of print screen files in one folder is 100.
Even though date is changed, a newer folder cannot be created unless a folder is filled with 100 files.

For Ethernet: Specify with Image Receiver.

2.4.2 Changing Saving Conditions of Print Screen



Changing Destination of Image Files

1. Select “ENVIRONMENT” > “INPUT / OUTPUT” > ”Print Screen”from the menu bar.

2. Select "Destination".

SD card (default): Saves in the SD card inserted in PV240.
Ethernet: Outputs to Ethernet. Saves in devices such as a PC connected with an Ethernet cable.

Note
When selecting "Ethernet", "Overwrite" and "No. of Folders" are not selectable.

Setting the Number of Folders

For using an SD memory card, specify the number of storage folders. Up to 100 print screen image files can be saved in one folder.

1. Select "ENVIRONMENT" > “Input/Output” > "Print Screen" from the menu bar.

2. Specify "No. of Folders".

Default: 10
Setting range: 1 to 1000

Setting for Overwriting Print Screen

Select whether or not folders are overwritten when executing Print Screen exceeding the number of folders specified in "No. of Folders".

1. Select "ENVIRONMENT" > “Input/Output” > "Print Screen" from the menu bar.

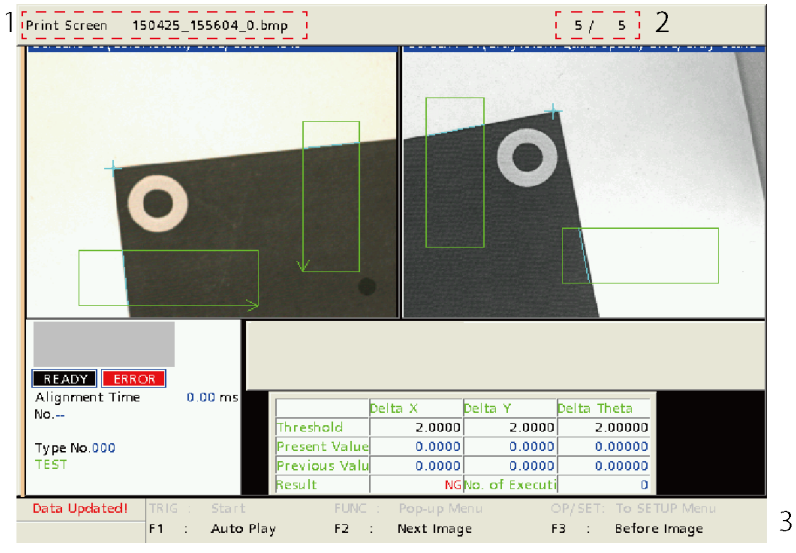
2. Select "Yes" or "No" for "Overwrite".

“Yes”: Deletes the oldest folder automatically, and saves image files into a new folder.
"No": Terminates the output of print screen images. Image files will not be saved after the execution.

2.4.3 Displaying Print Screen Images on Monitor

Captured print screen images and images which meet the following conditions are displayed on the monitor when the operation stops. The print screen images can be displayed and confirmed from a SD card in the PV without a PC. The order of display depends on the file system.

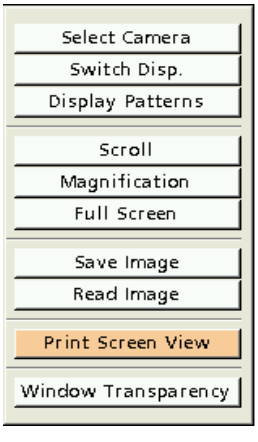
▼Refer to▼
About Save Folder of Image Files, Refer to Chapter 2.4.1 Copying the Screen Display (Print Screen):Page 40



1	**File Name**	Displays the file name of a print screen image.
2	**No. of counts**	Displays the number of images which are currently displayed and the total number of images.
3	**Key guide**	Displays the operation keys when a print screen image is displayed.

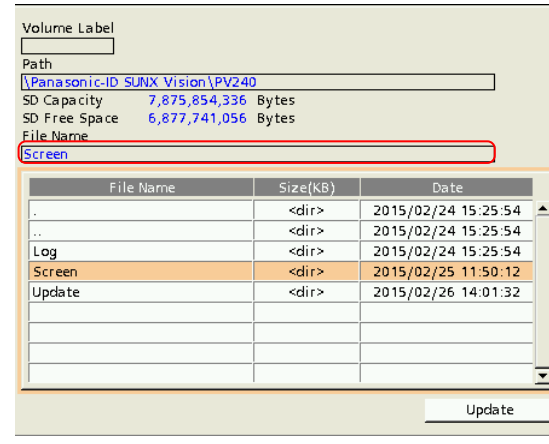
In SETUP menu

1. **Press the F1 key and select "Print Screen View".**



2. Select a folder in which images are saved.

Select a folder from the Screen folder, move the cursor to the image file you want to view, and press the <ENTER> key.



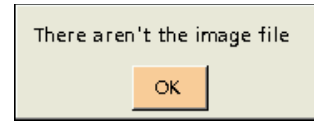
▶ Note

If the file name exceeds maximum number of characters for the text box (indicated red rectangle in the right figure), it will not be displayed properly. Please note if you want to change the file name directly on the PC, or to save a file with its file name by PS command(P101).

3. Print screen images are displayed on the monitor.

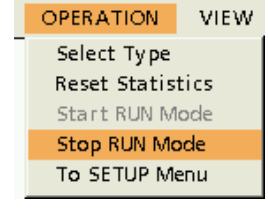
F1 key	Auto play images and stop.The time interval for auto play is two seconds. It will automatically stop after the last image is displayed.
F2 key	Go to the next image.
F3 key	Back to the previous image.
CANCEL key	Exit Print Screen View, and back the "Select Folder" window.

When no print screen image exist in the folder, the right error message appears.

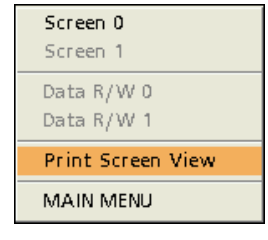


In RUN menu

1. Stop the operation when it is operating. Select "OPERATION" > "Stop RUN Mode" to stop the operation.



2. Press the F1 key and select "Print Screen View".



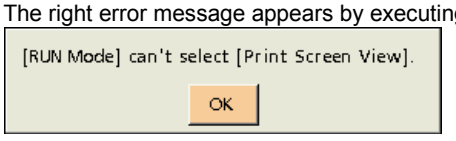
3. Select a folder in which images are saved.

4. Print screen images are displayed on the monitor.

F1 key	Auto play images and stop.
F2 key	Go to the next image.
F3 key	Back to the previous image.
CANCEL key	Exit Print Screen View, and back the "Select Folder" window.

Note

The print screen view is only available when operation stops.
The right error message appears by executing the print screen view during the operation.

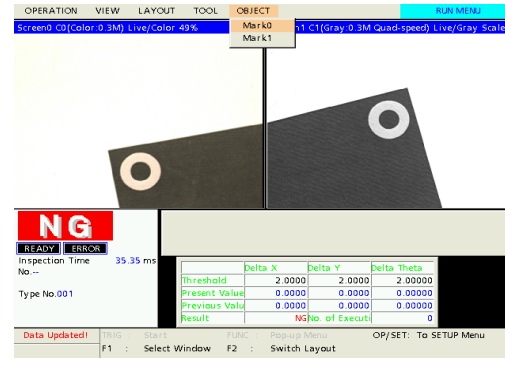


2.4.4 Setting Object Position in RUN Menu (Manual Registration)

Object position is a target mark for Alignment. This is positioned with the target as a target position when executing Alignment. "OBJECT" is used to set the object position manually (with the keypad). The object position specified here is valid for one alignment.

The specified position is the object position for the executed alignment.

Once it is specified, Alignment is automatically executed with the specified object position information. After the execution, the deviation and stage adjustment amounts are calculated.

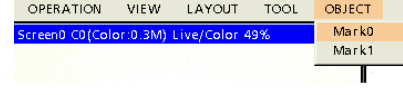


Setting Procedure

1. **Press the TRIG key to capture an image.**

   ▶ Note

   When setting "TYPE" > "Alignment" > "Alignment" > "TRIG Type" >"Mark Async. Execution", select Mark0 or Mark1, which image is captured.

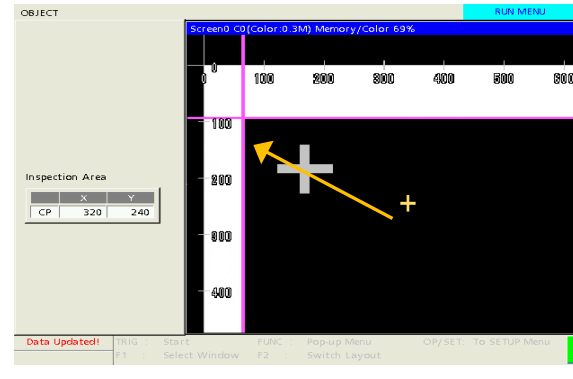


2. **Select "OBJECT".**

3. **Select a mark to register.**

4. **The camera image for the selected mark is displayed. The window becomes a memory display automatically, and the image captured in advance is displayed.**

   Move an orange cross mark to the object position.



   ▶ Note

   When setting "Target Cross Drawing" to "Yes" in "TYPE" > "Alignment" > "Alignment", a cross is displayed at the target position, and it is set as a mark. The cross is displayed in pink for Mark0 and in blue for Mark1.

5. **Pressing the CANCEL key goes back to RUN Menu. The object position of a selected mark is determined at this time. If the other mark is detected at this point, alignment is automatically executed with this data, and the deviation and stage adjustment amounts are calculated.**

6. **After the execution of alignment, move the stage based on the calculated deviation and stage adjustment amounts and perform positioning.**

7. **Once the position is determined, the cursor returns to RUN Menu, and the deviation and stage adjustment amounts are calculated.**
   Move the stage based on the calculated values.

2.5 Difference from Standard PV200

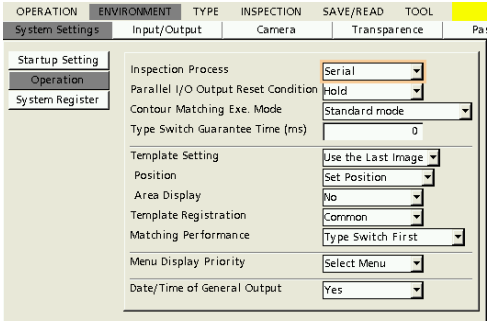
Many functions of PV240 are the same as those of the standard PV200. Therefore, refer to the PV200 User's Manual for information on the common functions. The difference between PV240 and the standard PV200 are as follows.

SETUP Menu

ENVIRONMENT

The specifications of the following items in "ENVIRONMENT" are different from those of PV200.

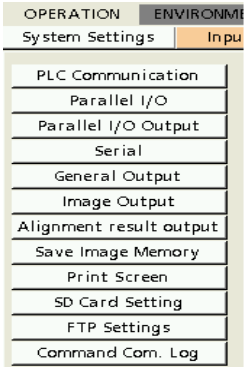
"System Settings" > "Operation"



[Function which is available for PV200 and unavailable for PV240]

- Continuous Inspection

"Input/Output"



[Special functions for PV240]

"Alignment result output"

“Command Com. Log”

Special communication commands for Alignment

[Functions slightly different from those of PV200]

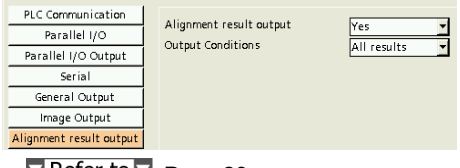
”Image Output”

"Print Screen"

[Function which is available for PV200 and unavailable for PV240]

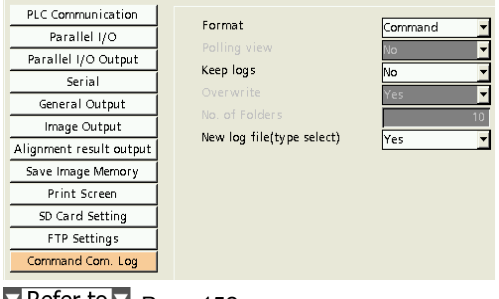
"Serial" > "A Series Compatible"

"Alignment result output" Special menu for PV240



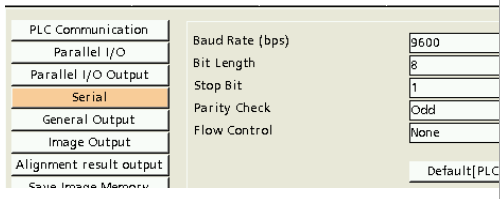
Refer to Page 23

"Command Com. Log" Special menu for PV240



Refer to Page 152

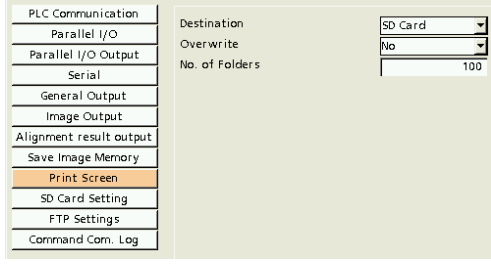
--- “Serial”



[Function which is available for PV200 and unavailable for PV240]

"A Series Compatible"

"Print Screen"



[Special functions for PV240]

“Overwrite” (Yes/No)

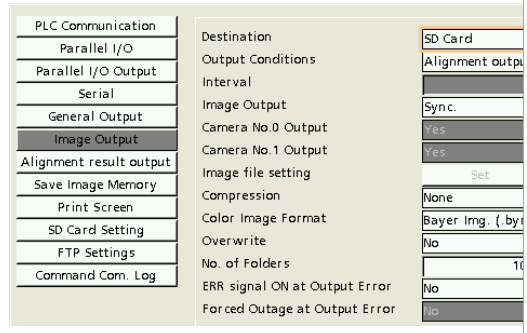
“No. of Folders”

▼Refer to▼ Page 41

[Special communication commands for Alignment]

▼Refer to▼ General communication command: Page 79
PLC communication command: Page 129

"Image Output"



[Special functions for PV240]

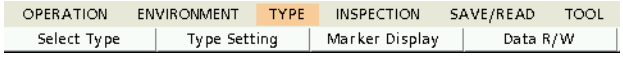
Choice of "Output Conditions": "Alignment output"

▼Refer to▼

Image Output: Page 26

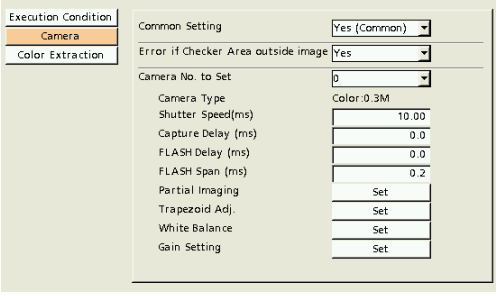
Alignment Output: Page 31

TYPE



The specifications of the following items in "TYPE" are different from those of PV200.

"Type Setting" > "Camera"



[Functions which are available for PV200 and unavailable for PV240]

Camera Trigger

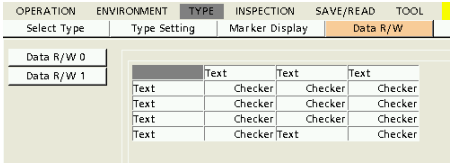
Calibration (This is different from the calibration in PV240.)

▼Refer to▼ Page 163

[Functions slightly different from those of PV200]

White Balance
(In PV240, each RGB gain is set in the range of 1.00 to 3.00. "Offset" is not available.)

"Data R/W"

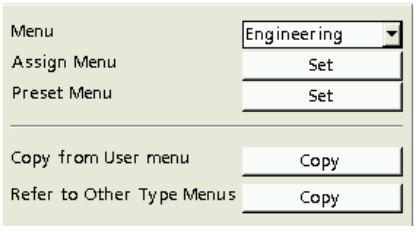


[Special functions for PV240]

"Presets" is provided. (Values have been set in Data R/W in advance.)

▼Refer to▼ Page 208

"Select Menu"

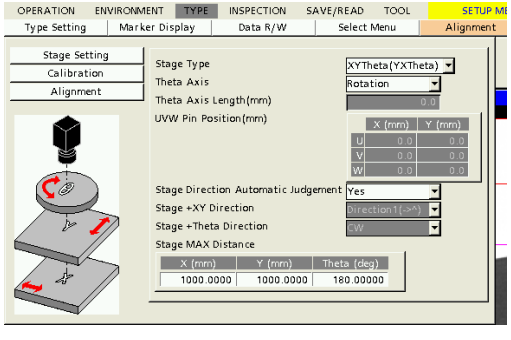


[Functions slightly different from those of PV200]

Preset Menu is provided in which functions frequently used for Alignment have been registered as buttons to improve operability of PV240. Also, two types of select menus can be created and used.

▼Refer to▼ Page 14

"Alignment" Special menu for PV240



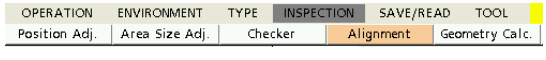
▼Refer to▼

Stage Setting: Page 54

Calibration: Page 165

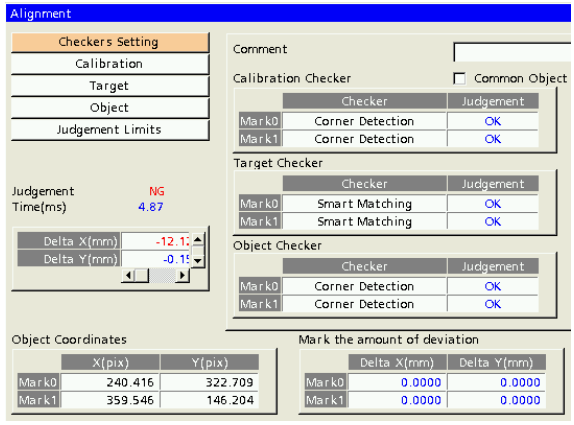
Alignment: Page 156

INSPECTION



A special menu for PV240, "Alignment" is available in "INSPECTION".

"Alignment" Special menu for PV240



Setting for conducting inspections of Alignment

▼Refer to▼

Checker Setting: Page 162

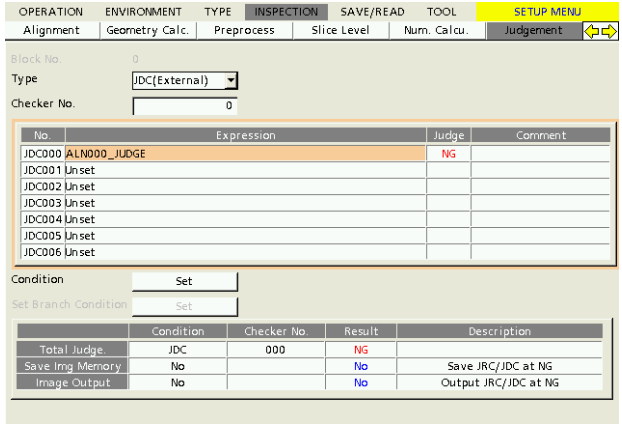
Calibration: Page 166

Target: Page 182

Object: Page 192

Judgement Limits: Page 198

“Judgement”



[Functions slightly different from those of PV200]

The following expression is automatically set in JDC000 when a type is created.

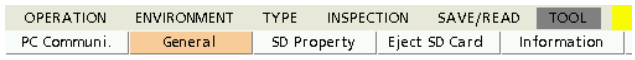
JDC000 = ALN000_JUDGE

Condition: JDG and Checker No.000 is automatically set in "Total Judge." when a type is selected. They can be changed as necessary.

▼Refer to▼

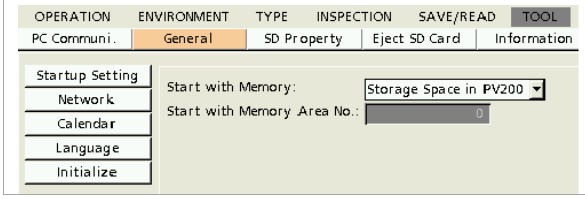
Pages 157, 204

TOOL



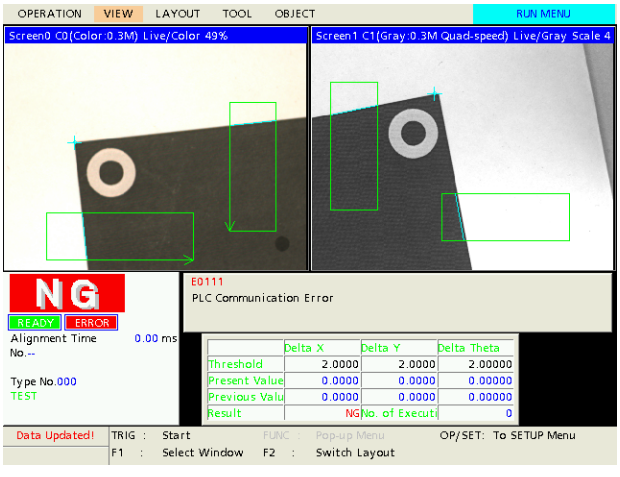
A special menu for PV240, "Alignment" is available in "TOOL".

"General"



"Account Setting" equipped with the standard PV200 is not available for PV240.

RUN Menu



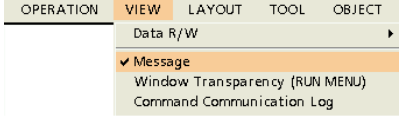
In RUN Menu, there are special functions for PV240 "OBJECT" in the menu bar and some special items in "VIEW" and "LAYOUT".

[Functions which are available for PV200 and unavailable for PV240]

"DEBUG"

"Account"

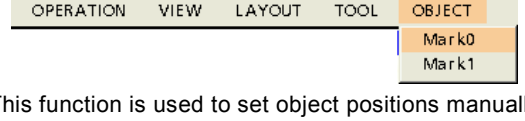
"VIEW"



"Message" is a special function for PV240. It is used to switch the window display showing alignment messages.

▼Refer to▼ Page 12

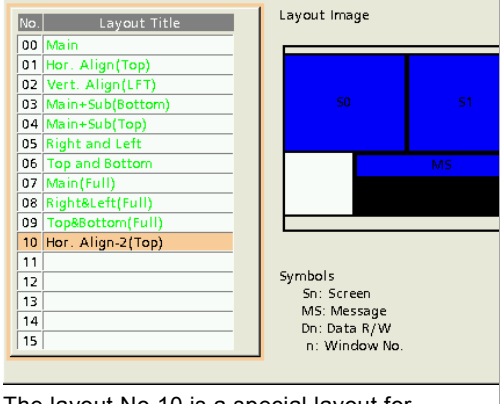
"OBJECT" Special function for PV240



This function is used to set object positions manually.

▼Refer to▼ Page 45

"LAYOUT"



The layout No.10 is a special layout for Alignment.

▼Refer to▼ Page 12

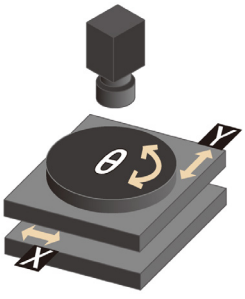
Chapter 3

Stage Setting

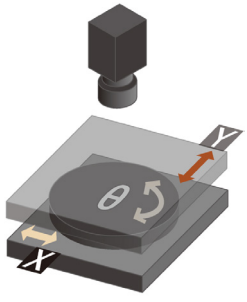
3.1 Supported Stages

PV240 supports the following five types of stages.

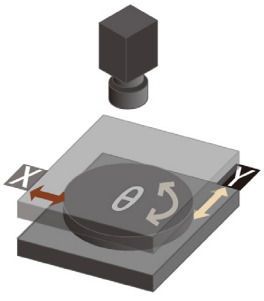
XYTheta Stage



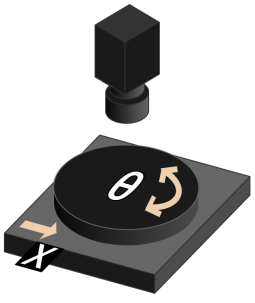
XThetaY Stage



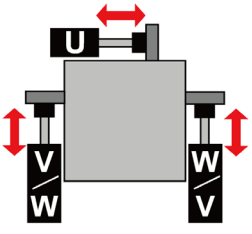
YThetaX Stage



XTheta Stage



UVW Stage



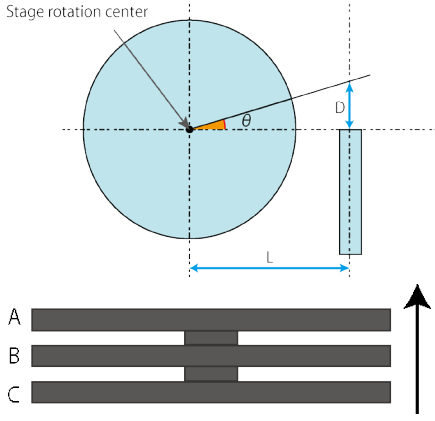
XYTheta, XThetaY, YthetaX and XTheta stages correspond to the following stage configurations.

XYTheta, XThetaY, YThetaX and XTheta Stages

	XYTheta Stage	XThetaY Stage	YThetaX Stage	XTheta Stage
A	Theta Stage	Y Stage	X Stage	Theta Stage
B	Y Stage	Theta Stage	Theta Stage	-
C	X Stage	X Stage	Y Stage	X Stage

* X Stage and Y Stage can be replaced.

Line Theta Stage



Calculates the motor movement amount in the case of Theta rotation by setting the distance between the centers of the stage rotation and the motor axis (L).

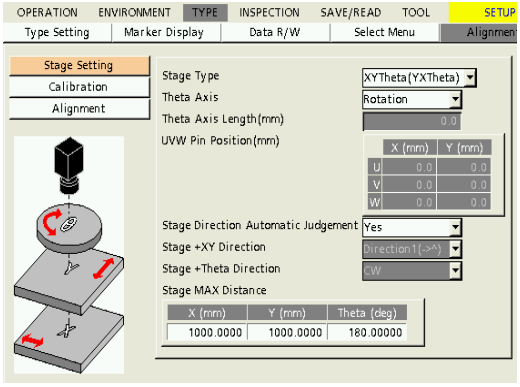
	XYTheta Stage	XThetaY Stage	YThetaX Stage
A	Line Theta Stage	Y Stage	X Stage
B	Y Stage	Line Theta Stage	Line Theta Stage
C	X Stage	X Stage	Y Stage

	XTheta Stage
A	Line Theta Stage
B	-
C	X Stage

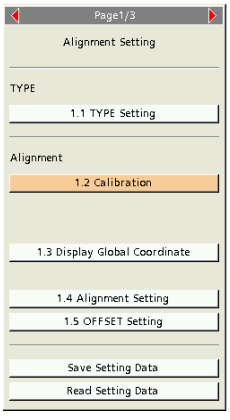
* X Stage and Y Stage can be replaced.

3.2 Setting Stages

Set the items related to the stage types and the specifications. This setting is made from "TYPE" > "Alignment" > "Stage Setting" in Normal Menu. In Engineering Menu, it is made from "Calibration" on the top page.



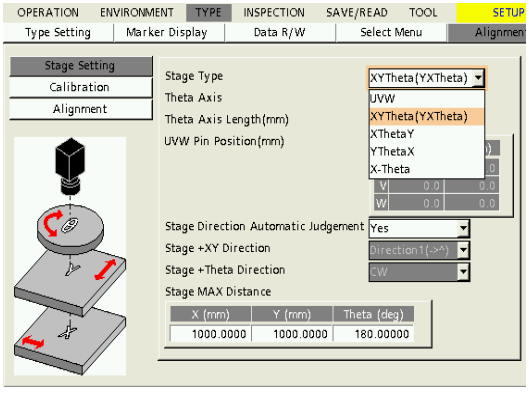
Normal Menu



Engineering Menu

3.3 Selecting Stage Type

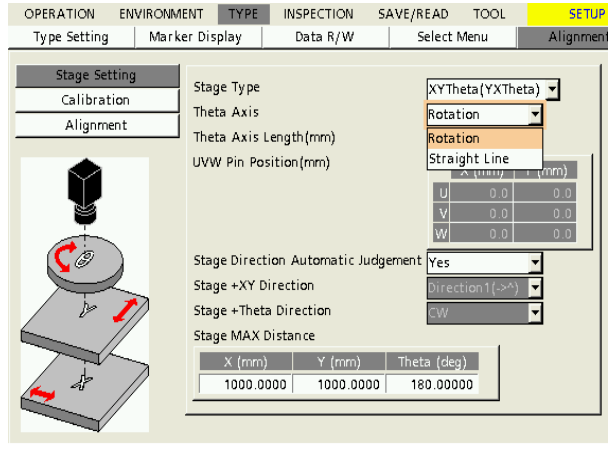
Select a type of stages to be used for Alignment.



Used stage	Stage type	Necessary setting in "Stage Setting" menu
UVW Stage	UVW Stage	Set "UVW Pin Position (mm)".
XYTheta (YXTheta) Stage	XYTheta Stage	Select "Rotation" for "Theta Axis".
XYTheta (YXTheta) Line Theta Stage		Select "Straight Line" for "Theta Axis", and set "Theta Axis Length (mm)".
XThetaY Stage	XThetaY Stage	Select "Rotation" for "Theta Axis".
XTheta Y Line Theta Stage		Select "Straight Line" for "Theta Axis", and set "Theta Axis Length (mm)".
YThetaX Stage	YThetaX Stage	Select "Rotation" for "Theta Axis".
YThetaX Line Theta Stage		Select "Straight Line" for "Theta Axis", and set "Theta Axis Length (mm)".
XTheta Stage	XTheta Stage	Select "Rotation" for "Theta Axis".
XTheta Line Theta Stage		Select "Straight Line" for "Theta Axis", and set "Theta Axis Length (mm)".

3.4 Setting Theta Axis

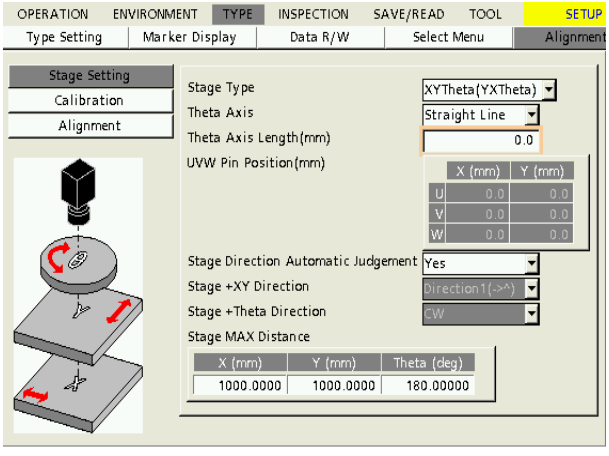
The setting for Theta Axis is to distinguish Rotation Stage or Line Theta Stage. This setting is required for converting the Theta adjustment amount calculated by PV240 to movement amount data.

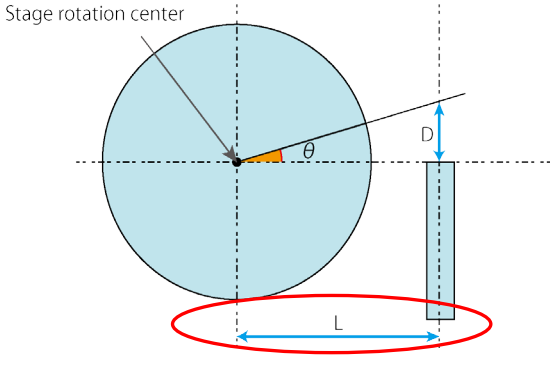


Used stage	"Theta Axis" setting
XYTheta (YThetaX) Stage XThetaY Stage YThetaX Stage XTheta Stage	Select "Rotation".
XYTheta (YThetaX) Line Theta Stage XTheta Y Line Theta Stage YThetaX Line Theta Stage XTheta Line Theta Stage	Select "Straight Line".

3.5 Setting Theta Axis Length (mm)

For using Line Theta Stage, set the distance between the centers of stage rotation and motor axis as "Theta Axis Length". This setting is required for converting the Theta adjustment amount calculated by PV240 to movement amount data.

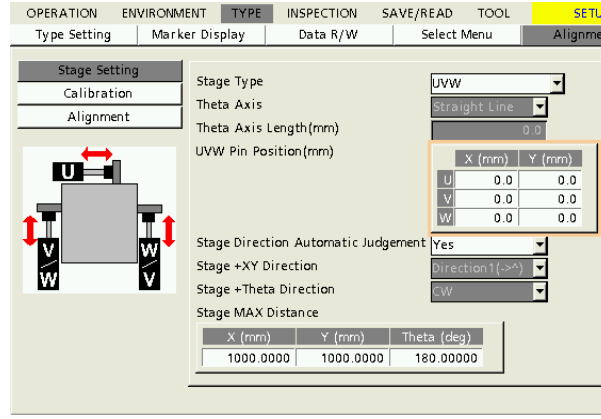


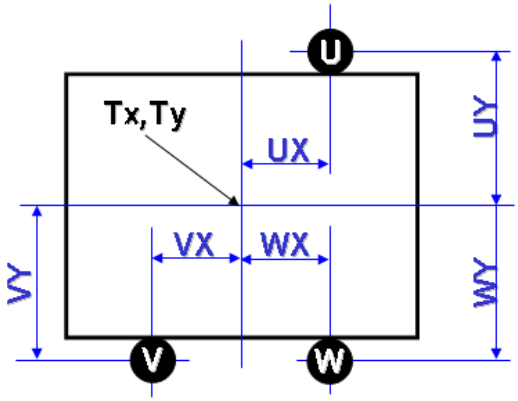


The distance between the centers of stage rotation and motor axis (L) is the value of "Theta Axis Length".

3.6 Setting UWV Pin Position (mm)

These values should be input for converting the XYTheta adjustment amounts calculated by PV240 to UVW axes.





■Example

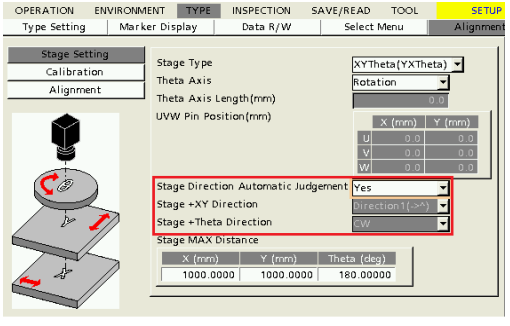
Condition
U axis coordinate: (100, 200)
V axis coordinate: (-100, -200)
W axis coordinate: (100, -200)
* The stage center (Tx, Ty) is considered as (0, 0).

Input value
UVW pin position UX=100
UVW pin position UY=200
UVW pin position VX=-100
UVW pin position VY=-200
UVW pin position WX=100
UVW pin position WX=-200

3.7 Setting Stage Operation Direction

The operation direction of stages should be specified for performing alignment in the right direction.

The specified items are "Stage +XY Direction" and "Stage +Theta Direction".



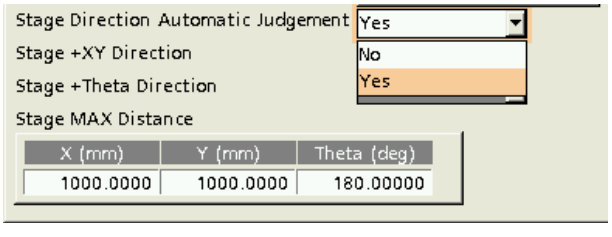
These positive direction of XY axes and rotation direction can be distinguished automatically by Calibration when global coordinates are established, however, they can be specified directly by setting the menu as necessary.

Set whether or not they are automatically distinguished at the time of Calibration in the following "Stage Direction Automatic Judgement". Refer to Chapter 3.7.1. For details of the operation directions of stages, refer to page 60.

3.7.1 Stage Direction Automatic Judgement

This item is set to distinguish the positive direction of XY axes of stages or rotation direction automatically when global coordinates are created by Calibration.
(Confirm the rotation direction by "Display Global Coordinate" after the execution of Calibration just to make sure. If the rotation direction is inappropriate, change the setting of rotation direction.)

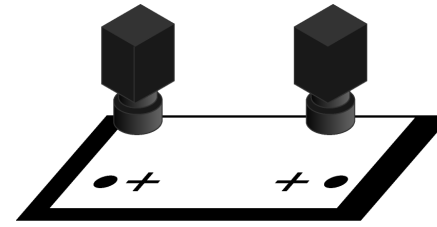
When setting "Stage Direction Automatic Judgement" to "No", "Stage +XY Direction" and "Stage +Theta Direction" should be specified. Refer to Chapter 3.7.2.



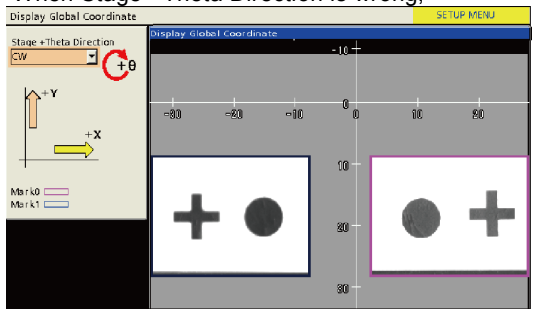
Procedure for Setting a Correct Stage Direction

1. **Set "Stage Direction Automatic Judgement" to "Yes".**
2. **Set a large angle as much as possible for "Stage MAX Distance" ("TYPE" > "Alignment" > "Calibration" > Theta of "Stage MAX Distance"). (For details of the setting procedure, see "6.2.1 Stage Movement" on page 165.)**
3. **Start Calibration.**
   (For details of the execution of Calibration, see the following pages.
   The execution by a controller: Pages 81, 84, 132, 133. The manual execution: Page 168)
   PV240 distinguishes the positive direction of XY axes of the stage and rotation direction while executing Calibration.
4. **After the completion of Calibration, confirm whether the current stage direction and camera layout is correct by "Display Global Coordinate".**
5. **When images are displayed by "Display Global Coordinate" (camera image), and if the axis direction or how to be photographed is not correct (if marks displayed by Display Global Coordinate or images captured with cameras differ from the actual layout of the objects), recheck the settings and execute Calibration again.**

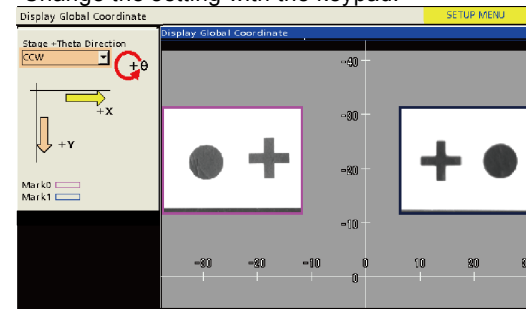
In the left figure, each camera captures a circle and a cross.
The figures below show cases of the global coordinate display when the setting of "Stage +Theta Direction" is wrong and when it is correct.



When Stage +Theta Direction is wrong;



Change the setting with the keypad.



Note

For details of "Stage +XY Direction" and "Stage +Theta Direction", refer to the next page "Operation Directions of Stages".

Operation Directions of Stages

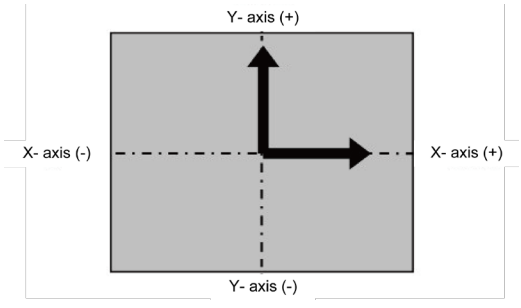
When setting "Stage Direction Automatic Judgement" to "No", set the operation direction based on the following concept. When setting it to "Yes", PV240 automatically judges the direction based on the following concept.

[For XYTheta Stage, Line Theta Stage)

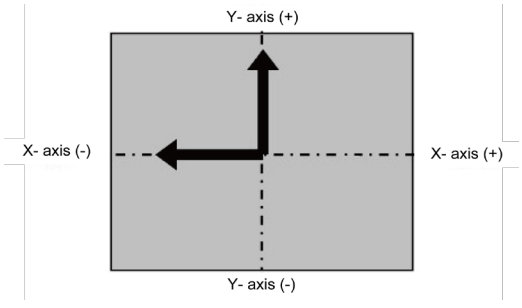
1. Give a driving pulse for "moving in the positive direction" to the X-axis motor, and check in which way left or right the X-axis stage moves.
2. Give a driving pulse for "moving to the positive direction" to the Y-axis motor, and check in which way left or right the Y-axis stage moves.
3. Give a driving pulse for "moving to the positive direction" to the Theta-axis motor, and check in which way clockwise or counterclockwise the Theta-axis stage moves.
4. Select "Stage +XY Direction" and "Stage +Theta Direction" from the directions confirmed in the above steps 1, 2 and 3.

Operation Directions of Stages

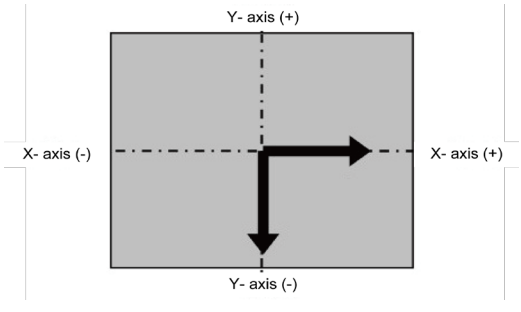
Direction1 (->^)



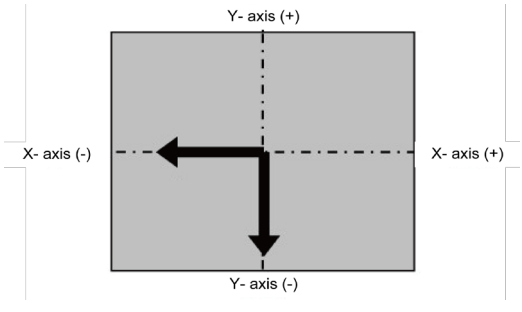
Direction2 (<-^)



Direction3 (->v)



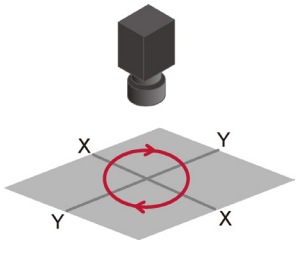
Direction4 (<-v)



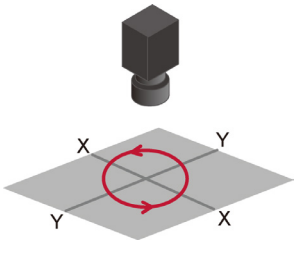
Rotation directions of Stages

Set the rotation direction of the stage to be used in "Stage +Theta Direction". It is not related to the positive and negative directions of XY axes. It is determined by the stage and the mounting position of a camera. The figures below show the case when a camera is mounted above the stage.

Clockwise



Counterclockwise

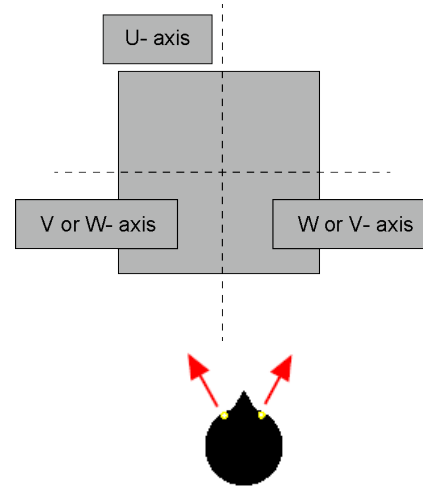


[For UVW Stage]

1. Confirm where the motor driving U axis (or pin position) is located, which of four sides of the stage. As shown in the left figure, set "Stage +XY Direction" considering the positional relation that its side becomes the upper side.

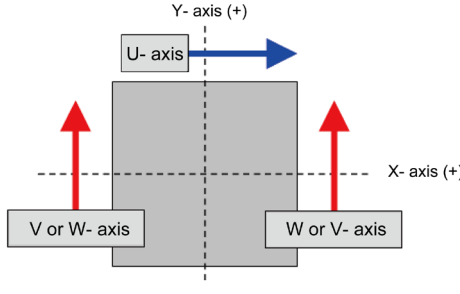
2. Give a driving pulse for "moving to the positive direction" to the U-axis motor, and check in which way left or right the Y-axis stage moves.

3. Give driving pulses for "moving to the positive direction" to the V and W axes (the pulses of V and W axes are the same direction at this time), and check in which way upward or downward the V and W axes move.

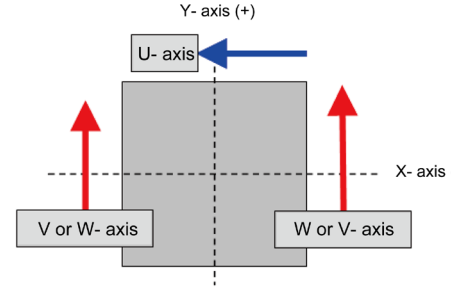


4. Select "Stage +XY Direction" and "Stage +Theta Direction" from the directions confirmed in the above steps 2 and 3.

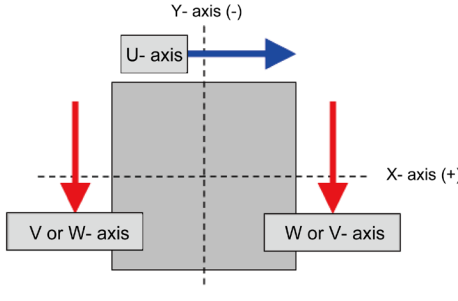
Direction1 (->^)



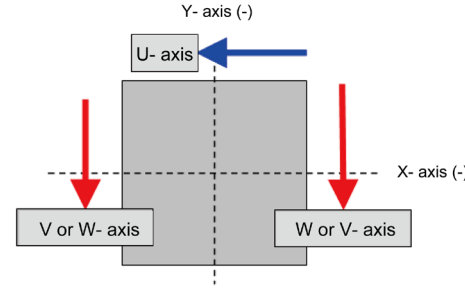
Direction2 (<-^)



Direction3 (->v)



Direction4 (<-v)

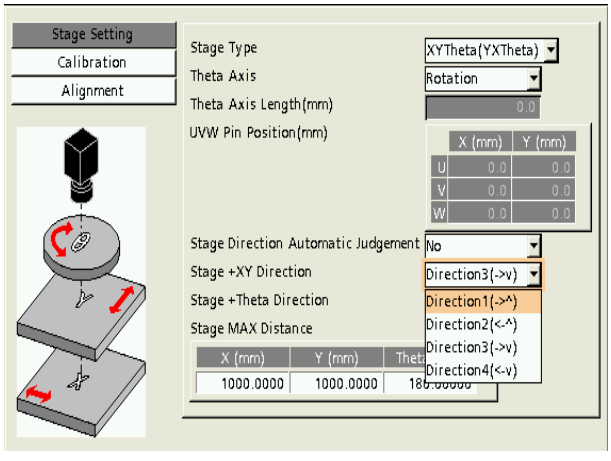


3.7.2 Setting Stage +XY Direction and Stage +Theta Direction

The operation direction of stages should be specified for performing alignment in the right direction. These items are selectable when "Stage Direction Automatic Judgement" is set to "Yes". For information on the concept of operation directions, refer to page 60, Operation Directions of Stages.

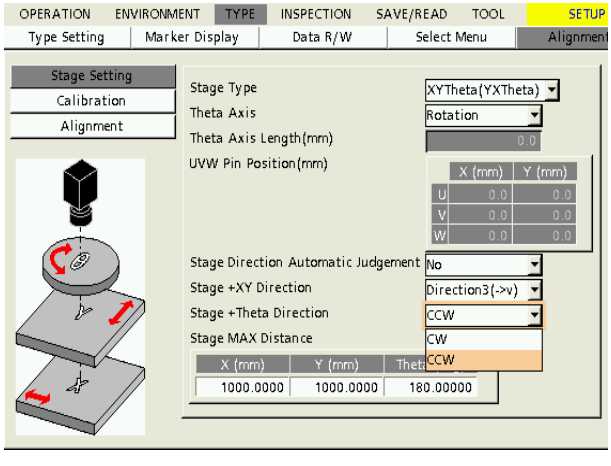
Stage +XY Direction

Specify the positive direction of the XY axes on the stages.



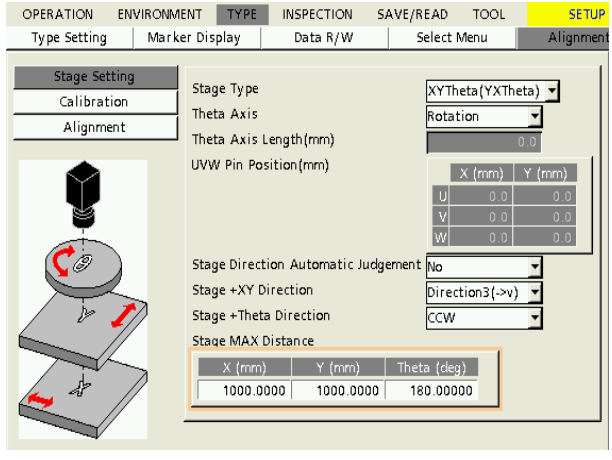
Stage +Theta Direction

Specify the rotation direction of the stages.



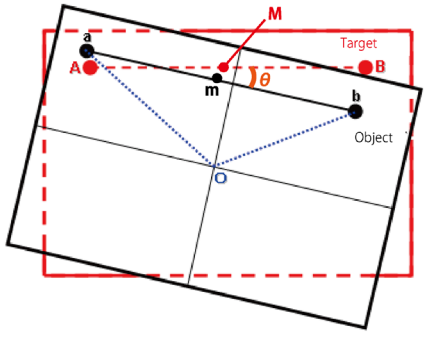
3.8 Setting Stage MAX Distance

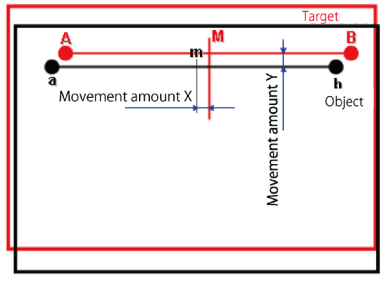
When the movement amount calculated by PV240 exceeds the stage movement amount during the execution of alignment, an error is output if the value is larger than the specified value, and the alignment operation can be cancelled.



Default
X (mm): 1000.0000 mm
Y (mm): 1000.0000 mm
Theta (degree): 180.00000 degrees

Concept of Stage Control



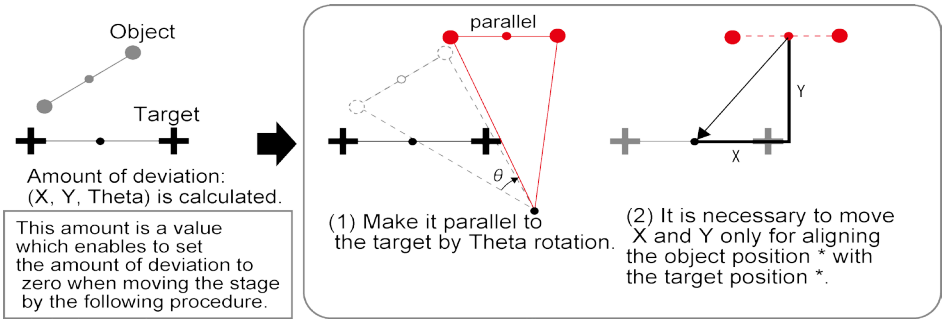


- When the middle point between targets is (M) and the middle point between objects is (m), the angle that the object line (ab) becomes parallel to the target line (AB) is the stage movement amount Theta.
- The stage rotates with the stage rotation center as an axis, and the distances until the middle point between objects (m) matches the middle point between targets (M) are the stage movement amount (X) and the stage movement amount (Y).

3.9 Stage Adjustment Amount (Absolute Value)

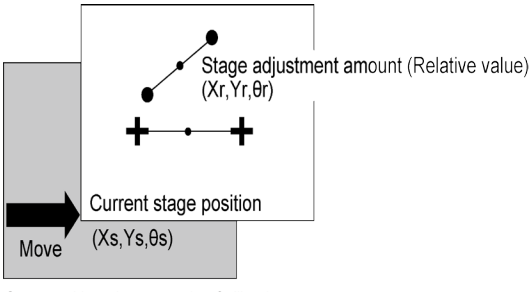
PV240 calculates the absolute value of stage adjustment amount according to the following procedure.

STEP1: The stage adjustment amount obtained from the calculated amount of deviation is used as a relative value.



STEP2: The value which is the above stage adjustment amount (relative value) plus the stage current value is used as an absolute value.

Corresponding commands*: TAG: Get Stage Current Position
TAR: Request Stage Absolute Position Move
AZG: Get Stage Adjustment Amount
AOG: Get Deviation/Stage Adjustment Amount



Stage position when executing Calibration

Stage adjustment amount (X, Y, Theta) is an absolute position.

Stage adjustment amount
= Stage current position + Stage adjustment amount
(Relative value)
= (Xs,Ys,Thetas) + (Xr,Yr,Thetar)

* The absolute position is the coordinate values including the current stage position.

Note

* Commands are the instructions for controlling PV240 with external devices. The list of commands by general purpose communication is described on page 77, and the list of commands by PLC communication is described on page 128.
** For details of "Amount of deviation", refer to page 199 which describes judgement conditions.

Chapter 4

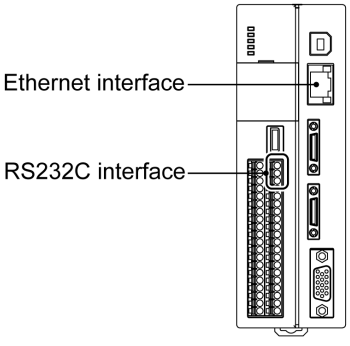
Communication Setting

4.1 Communication Port and Protocol

PV240 is provided with the following communication ports.

- COM port: RS-232C interface
- Ethernet port: Ethernet interface

There are two types of protocols for each communication port, "General Communication " and "PLC Communication". The communication details differ depending on the protocols. Use one of them according to your purpose.



4.1.1 RS-232C Interface

Using COM port, PV240 communicates with the external device through RS-232C. Outputting inspection result data and sending/receiving control commands can be performed.Make the settings for RS232C interface from the following items.

Setting of communication condition	“ENVIRONMENT” > “Input/Output” > “Serial”
Setting of serial output	“ENVIRONMENT” > “Input/Output” > “General Output” > "Serial" column
Setting of PLC communication	“ENVIRONMENT” > “Input/Output” > “PLC Communication”
Setting when selecting "PLC Communication" - "Command Read Type" - "Parallel Input"	“ENVIRONMENT” > “Input/Output” > “Parallel I/O” > "ASSIGN0-1/EXTRA0-2" > Read PLC Communication Command

▶ Note

For PLC communication, either RS-232C interface or Ethernet interface must be selected.

Communication Specification of RS-232C

Communication method		Full duplex
Synchronous method		Asynchronous
Baud rate *1)		1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps (Factory default: 9600)
Transmission code		ASCII
Transmission format	Bit length	7-bit, 8-bit (Factory default: 8-bit)
	Stop bit	1-bit, 2-bit (Factory default: 1-bit)
	Parity check	None/Odd/Even (Factory default: Odd)
	Flow control	None/Soft Flow (Factory default: None)
	Delimiter	CR

*1) When Baud Rate is "115200 bps", the communication may not be carried out stably in accordance with the device to communicate with. In the case, set Baud Rate to "57600 bps" or lower.

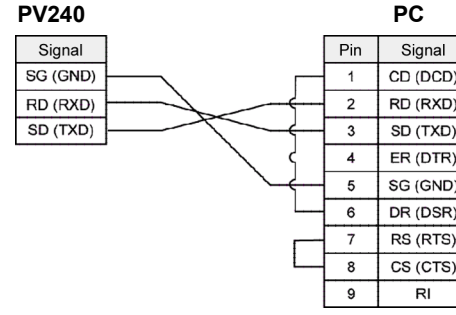
▼Refer to▼

About Baud rate, Transmission code,Refer to PV200User’sManual.

Connecting with a PC or a PLC

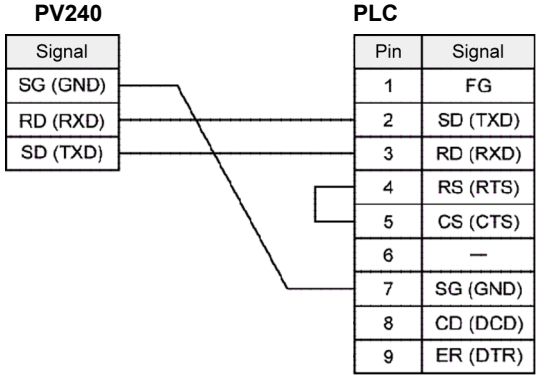
Connecting with a PC

The arrangement of the cables is shown on the right.

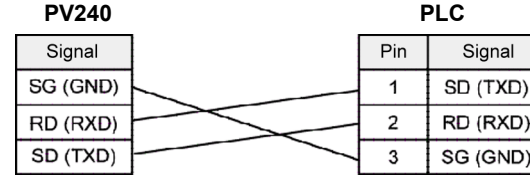


Connections with Panasonic PLC

FP2 CCU



FP0 /FP0R/ FP7



4.1.2 Ethernet Interface

Ethernet communication is performed with an external device. Outputting inspection result data and sending/receiving Control commands can be performed. PV240 can communicate with the designated setting software PVWIN240. By using "Image Receiver for PV", image data can be also output.

Make the settings for Ethernet interface from the following items.

Setting of network	"TOOL" > "General" > "Network"
Setting of Ethernet output	“ENVIRONMENT” > “Input/Output” > “General Output” > "Ethernet" column
Setting of PLC communication	“ENVIRONMENT” > “Input/Output” > “PLC Communication”
Setting when selecting "PLC Communication" - "Command Read Type" - "Parallel Input”	“ENVIRONMENT” > “Input/Output” > “Parallel I/O” > "ASSIGN0-1/EXTRA0-2" > Read PLC Communication Command
Setting software "PVWIN240"	All the settings except the network setting are set with PVWIN240.
Image output	“ENVIRONMENT” > “Input/Output” > “Image Output”
Print screen	“ENVIRONMENT” > “Input/Output” > “Print Screen”

Note

- Note that incorrect setting of the connection to the existing LAN might cause malfunction in the devices on the network. Consult your network administrator before connecting.
- One PV240 cannot be operated by multiple PCs on the network.
- Depending on the network condition, delay might be caused in the communication. It is advisable to use I/O interface or RS-232C interface for the operation that requires speedy response such as inspection trigger input.
- For PLC communication, either RS-232C interface or Ethernet interface must be selected.

Communication Specification of Ethernet

Item	Specifications
Connector	RJ-45
Media	10BASE-T / 100BASE-TX / 1000BASE-T

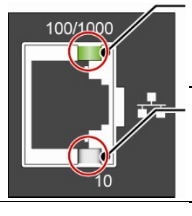
Note

According to the network adapter of your PC, 1000BASE-T communication may not be available.
When you use Ethernet communication with 1000BASE-T, please check the maximum frame size (which is the data size that can be sent or received in one communication) available in the network environment. In some cases, the network adapter complying with 1000BASE-T also requires a setting change. For details including how to set, please contact a manufacturer of network adapters.

About Baud Rate

PV240 automatically adjusts the baud rate according to the speed of the device to communicate. (Auto negotiation)You can know the current baud rate by the position and color of LED of Ethernet port that lights when communicating.

Ethernet Port



LED	Color	Baud Rate
Upper	Green	100 megabits
	Orange	1000 megabits (1 gigabit)
Lower	Yellow	10 megabits

About Port Number

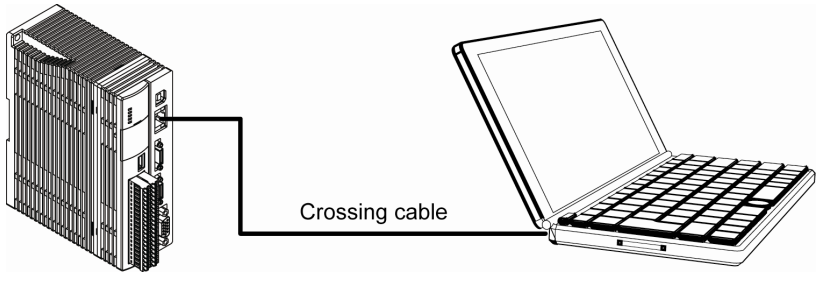
Port number differs depending on protocol and communication data.

General Purpose Communication – Data Output:	8601
General Purpose Communication – Command send/receive	8604
PLC Communication – Data Output: Command send/receive	1 – 65534 (Except 8600 – 8699, 9090)
Image output	8602

Connecting PV240 with PC

Communicating between a PV240 and a PC

Connect them with a commercially available crossing cable. (STP crossing cable of category 5e or more is recommended.)

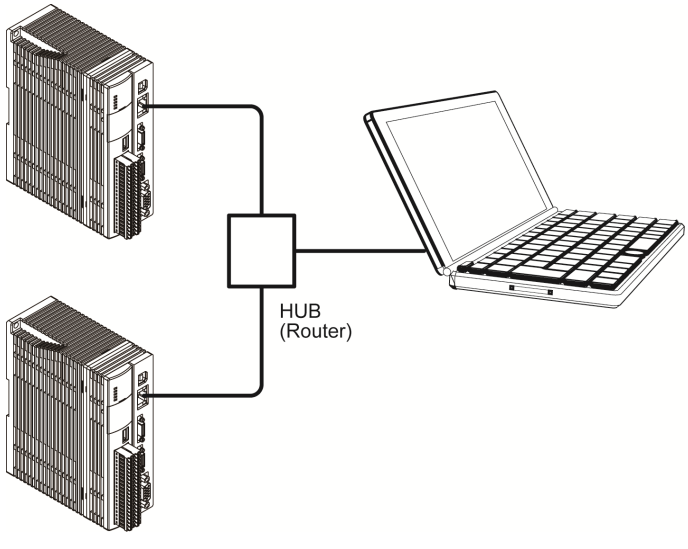


Communicating between a PV240 and Multiple PCs

Connect them with a commercially available straight cable (STP straight cable of category 5e or more is recommended.) through a hub or a router, which supports 1000BASE-T, 100BASE-TX, and 10BASE-T.

Note

Do not use the same IP addresses for the PV240 and the PC on the network.



4.1.3 Protocol

The following two protocols are available for PV240.

General Communication :	This method communicates with external devices according to the protocol specified in PV240. As data is sent and received using ASCII strings, there is no restriction on external devices, however, a communication program for PV240 should be created in the external devices. Using this method enables to output inspection results, control PV240, read and change the setting values of PV240.
PLC COMMUNICATION :	This method communicates with a PLC according to the protocol of the destination PLC. Although usable PLC units are limited, communication can be easily performed by reading or writing specified registers. Inspection results are written in a specified register of PLC. Also, PV240 can be controlled or the setting values can be read and changed by writing commands into another specified register. Unlike General communication, only integers can be read and written. Two methods are available for the timing of reading commands, "Polling" and "Parallel Input". "Polling" checks whether commands are written in the register of PLC or not in a specified “Polling Time”. The response speed is slower than that of "Parallel Input". The time such as the time of inspection or image output gets longer because the polling process is performed even during the inspection.

Note

For PLC communication, either RS-232C interface or Ethernet interface must be selected.

The pattern 1 in the table below shows the condition when PLC communication is selected for RS-232C interface. In this case, PLC communication cannot be used for Ethernet interface. Although the result output of RS-232C interface is limited to PLC communication, the control command can be also accepted through General communication.

The pattern 2 in the table below shows the condition when PLC communication is selected for Ethernet interface. In this case, PLC communication cannot be used for RS-232C interface. Even when PLC communication is selected for Ethernet interface, General communication can be used for both result output and control command. Note that, however, the output port is different from that of PLC communication.

	RS-232C Interface				**Ethernet Interface**			
	General Communication		**PLC Communication**		**General Communication**		**PLC Communication**	
	Result output	Control command	Result output	Control command	Result output	Control command	Result output	Control command
Pattern 1	N/A	A	A	A	A	A	N/A	N/A
Pattern 2	A	A	N/A	N/A	A	A	A	A

A: Available. It is also OK not to use.

N/A: Not available

4.2 General Communication

4.2.1 Overview and Communication Specifications

This method communicates with external devices according to the protocol specified in PV200.
Use General Communication for communicating with a PLC other than the PLCs applicable for PLC Communication or PC. RS232C interface and Ethernet interface can be used simultaneously. (In some cases, they cannot be used simultaneously.Refer to 4.1.3 Protocol for details.)
The following communications are available with General Communication.

・General output

When accepting an inspection start signal (parallel input including reinspection signal, control command by communication or TRIG input by keypad) in RUN menu, after the inspection, the inspection results that are set to be output (Date and Time, Scan count, Total judgement, Judgement, Numerical calculation) and BCC are output using ASCII strings, and CR is output at the end of data strings. The following two output methods are available; Outputs data separated with comma and outputs data in fixed digits (unused digits filled with zeros) according to a specified output digits (For Scan count and Numerical calculation results only. For Total judgement, it is one digit. For Judgement, it depends on a set judgement formula.).

Numerical calculation results are output as integer omitting the decimal point by specifying digits after decimal point you want to output in advance.
(e.g. When setting "Decimal digit" to "2" for "12.345", it is rounded and output as "1235".)
The date and time at the time of the execution of inspections can be output to Ethernet interface or SD card, and date and time can be added to the header of general output.
These settings are common to all destination devices.

ASCII strings to be output vary depending on the specified settings. Create a program to read data on the external device according to the output strings.

For information on the settings to use this function, refer to PV200 User's Manual "Selecting Destination and Output Data".

A function to resend general output is not available.

・Control command

Using this function enables to control PV240, read and change the setting values (including decimal point). (In PLC communication, only integers can be read and changed.)

For the details of the control and commands to be used, refer to PV200 User's Manual .

Even when performing general output and control command using PLC communication, PV240 can accept all the general communication commands.

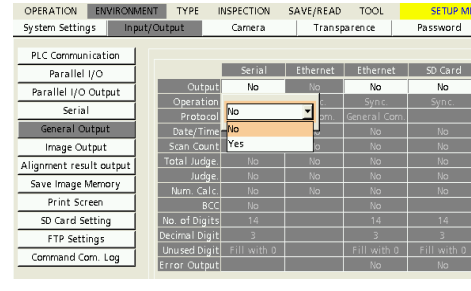
4.2.2 Setting General Communication

Set only "General Output" for the setting of general communication. The condition to set for "Control command" using general communication is the setting of communication port only.

Displaying General Output Setting Window

1. Select "ENVIRONMENT" > "Input/Output" from the menu bar.

2. Select "General Output" in "Input/Output" setting window.



Selecting Destination and Output Data

1. Select a data destination in “Output”.

You can select multiple interfaces as destinations.

Note

Both "Serial" and "Ethernet" can be selected for the general output using general communication as the figure below. However, for PLC communication, either “Serial” or “Ethernet” can be selected.

	Serial	Ethernet	Ethernet	SD Card
Output	Yes	Yes	Yes	No
Operation	Sync.	Sync.	Sync.	Sync.
Protocol	General Com.	PLC Com.	General Com.	
Date/Time	Yes	Yes	Yes	Yes
Scan Count	Yes	Yes	Yes	Yes
Total Judge.	Yes	Yes	Yes	Yes
Judge.	Yes	Yes	Yes	Yes
Num. Calc.	Yes	Yes	Yes	Yes
BCC	No		No	
No. of Digits	14		14	14
Decimal Digit	3		3	3
Unused Digit	Fill with 0		Fill with 0	Fill with 0
Error Output			No	No

2. To output Date and Time, select “Yes”.

Note the followings when the destination is "Serial" or "Ethernet (PLC) Communication",
"Date/Time of General Output" is need to set "Yes".

3. To output Scan Count/ Total Judgement/ Judgement/ Numerical Calculation, select “Yes”.

4. To output BCC (block check code), select “Yes”.

Specifying Digit Number of Output Data

In general communication, real numbers (values including after decimal point) can be output. Set the digit number of integer and after decimal point.

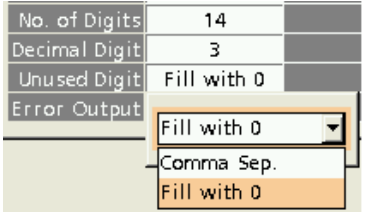
1. Specify total digits of integer part and after decimal point in “No. of Digits”.

2. In “Decimal Digit”, specify digits for after decimal point used from the digits set in step 1.

The outputs specified in "No. of Digits" are "Scan Count" and "Numerical Calculation" only. If you set “No. of Digits” = 14 (default) and “Decimal Digit” =3 (default), the value consisting of 11-digit integer and 3-digit decimal number is output. If you set “Decimal Digit” = 2 or 1, the value is rounded.

Note

When the value exceeding the specified digits is processed, the value is output as “0”.



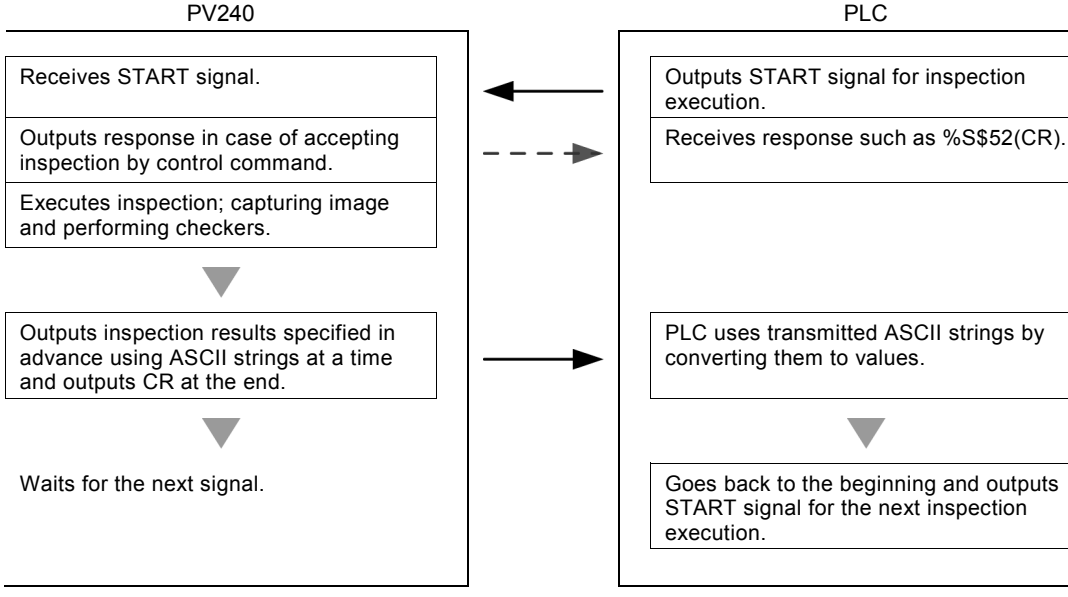
3. Set "Unused Digit".

If the digit number of the data is less than the output digit number you have set, select a handling of unused digit.

Comma Separated:	Unused digits are deleted. Multiple data are output in different number of digits. Data are separated with a comma (",") before being output.
Filled with '0' (default):	Unused digits are filled with “0”. Although the data become longer, multiple data are output in the same number of digits.

4.2.3 Outputting Data through General Communication

Data Output Flaw



About Data that can be Output

When PV240 executes inspection, the data set to output are output in the following order.

1. Date and Time
2. Scan Count
3. Total Judgement
4. Judgement result:
5. Numerical Calculation:
6. BCC

Up to 1000 points combining judgements and numerical calculations.

The settings for the above output items 1 to 6 (Output; "Yes" / "No") are common to all the destinations (Serial / Ethernet / SD Card).

In the following cases, the data of Judgement and Numeric Calculation are not output to PLC.

- PV sets data to output, but no data exist.
- The setting data exist, but data are set to not to be output.

Output format of Date and Time:

Output Data	• Date: YY/MM/DD (2-digit of year/ 2-digit of Month/ 2-digit of Day) Total eight characters • Time: HH:MM:SS(2-digit of Hour/2-dgit of Minute/2-digit of Second) Total eight characters • Sixteen characters or seventeen characters (when setting "Unused Digit" to "Comma Separated" are output regardless of output digits.
Number of Data	1 However, when "Unused Digit" is "Comma Separated", a comma is put between date and time.

Output format of Scan count:

Output Data	1 to 2147483647	
Number of Data	1	
Values to be Output	Normal	1 to 2147483647
	Overflow	2147483647
	When exceeding the specified "No. of Digits".	0

Output format of Total Judgement:

Output Data	1 / 0 / E (1 character)	
Number of Data	1	
Values to be Output	OK	1
	NG	0
	Error	E
	Unset	E

Output format of Judgement data:

Output Data	Outputs one judgement data with one character (1 / 0 / E) Once all data are output, output will be terminated regardless of output digits.	
Number of Data	Up to 1000	
Values to be Output	OK	1
	NG	0
	Error	E
	Unset	Data are not output.

Output format of Numerical Calculation:

Values to be output are integers. When setting "Decimal Digit", the integer part and the digit after decimal point that is rounded to the specified decimal place is output without the decimal point.

Example: In case of numerical calculation result is 123.456;
When setting "Decimal Digit" to "2", 12346 is output by rounding it to two decimal place.

Output Data	Outputs one numerical calculation output as one data. -2147483648 to 2147483647	
Number of Data	Numerical Calculation: Up to 1000	
Values to be Output	Normal	Calculation results: -2147483648 to +2147483647
	Overflow or when exceeding the specified "No. of Digits".	0 ("0" is output only for the appropriate numerical calculation results.))
	Error	0
	Unset	Data are not output.

Output format of BCC:

BCC is output subsequent to previous data. When "Unused Digits" is set to "Comma Separated", commas are put between each data for separation. However, the last data and BCC are output without separation. If you want to read the last data separated with comma, output one extra data next to it.

Output Data	00 ~ FF (2 characters)
Number of Data	1
Values to be Output	Obtains an Exclusive OR from the ASCII code of all characters from the first character of output string to the string right before BCC. The obtained Exclusive OR is expressed in hexadecimal and two characters are output regarding four bits as one character.

Example of General Output

Refer to For details of output to SD card, refer to PV200 User's Manual.

Output Data:	Date:	2010/12/15
	Time:	09:25:48
	Scan Count:	1234 times
	Total Judgement:	OK
	Judgement:	JDC000 = OK, JDC001 = unset, JDC002 = NG
	Numerical Calculation:	CAC000 = 215.8, CAC001 = unset, CAC002 = -368.0

Output Condition 1:	Date and Time:	Output
	No. of Digits:	6
	Decimal Digit:	1
	Unused Digit:	Filled with '0'
	BCC:	Output

Output destination="Serial"

0	0	1	2	3	4	1	1	0	0	0	2	1	5	8	-	0	3	6	8	0	BCC	CR
Scan Count						Total Judge.	Judge-ment	Numerical Calculation 0							Numerical Calculation 2						2-digit Block Check Code	

Output destination="Ethernet (General Communication)"

1	0	/	1	2	/	1	5	0	9	:	2	5	:	4	8	0	0	1	2	3	4	1	1	0
Date								Time								Scan Count						Total Judge.	Judgement	

0	0	2	1	5	8	-	0	3	6	8	0	BCC	CR
Numerical Calculation 0						Numerical Calculation 2						2-digit Block Check Code	

Note

Judgement JDC001 and Numeric Calculation CAC001 are not output because they are unset.

Output Condition 2:	Date and Time:	Output
	No. of Digits:	6
	Decimal Digit:	1
	Unused Digit:	Deleted
	BCC:	Output

Output destination = "Serial"

1	2	3	4	,	1	,	1	,	0	,	2	1	5	8	,	-	3	6	8	0	BCC	CR
Scan Count					Total Judge.		Judge.		Judge.		Numerical Calculation0					Numerical Calculation 2					2-digit Block Check Code	

Output destination=”Ethernet (General Communication)”:

1	0	/	1	2	/	1	5	,	0	9	:	2	5	:	4	8	,	1	2	3	4	,	1	,	1	,	0	,
Date									Time									Scan Count					Total Judge.		Judge.		Judge.	Date

2	1	5	8	,	-	3	6	8	0	BCC	CR
Numerical Calculation 0					Numerical Calculation 2					2-digit Block Check Code	

4.2.4 List of Commands for Genral Communication

The commands described in this chapter are the common commands for the ports to control PV240 with RS-232C interface and Ethernet interface through general communication.

Note

Port number of Ethernet interface to send/ receive commands for PV240 is “8604”.

List of Alignment Commands

	Command	Refer to	Description
Request Stage Current Position	**TAG**	80	Obtains the coordinate of the stage current position.
Request Stage Absolute Position Move	**TAR**	81	Specifies the movement amount of stage absolute position. It is specified with the absolute position (stage coordinate system) of XYTheta or UVW.
Execute Calibration	**CAE**	82	Starts a calibration sequence.
Execute Auto Alignment	**AAE**	86	Starts an auto alignment sequence. Target running offsets are specified.
Execute Auto Alignment (Simple Flow)	**AAS**	**88**	Starts an auto alignment sequence. Target running offsets are specified. Obtaining the stage current position (TAG) at the time of retry is omitted, and the execution time is shorter than AAE command.
Get Target Position	**TGG**	90	When "Target Position" is set to "Mark Detection", a detected mark position is registered as the target position. When "Target Position" is set to "Center of Display", the center position of the display is registered as the target position.
Get Object Position	**OBG**	**91**	Detects object marks.
Reset, Cancel Alarm	**ARR**	**92**	Turns off the parallel I/O error flag. Clears an error message on the screen.
Execute Aligment for 1 camera	**ACL**	**93**	Executes an alignment sequence once at an obtained object position.
Get Deviation	**GDV**	**95**	Obtains the amount of deviation between the target position and object position
Get Stage Adjustment Amount	**AZG**	**96**	Obtains the adjustment amount (absolute value) based on the current position (absolute value).
Set Target Position (Specify Camera Coordinate)	**TGS**	**98**	Specifies camera coordinates and registers the position.
Move Rotation Center	**SRP**	**99**	Moves the rotation center for alignment calibration.
Print Screen	**PS**	**100**	Obtains print screen images of screens.
Save Print Screen in Image Memory	**PSM**	102	Saves print screen images in the dedicated image memory.
Save Print Screen in SD	**SSM**	103	Saves print screen images saved in the dedicated image memory to an SD card, and clears data within the image memory.
Get Distance between Target/Object Marks	**GML**	104	Obtains the distance between target marks and the distance between object marks.
Change Camera Shutter Speed	**CSH**	105	Changes the shutter speed of a camera.
Change Threshold of Change Judgement	**SCT**	106	Changes the threshold of change judgement of X, Y and Theta.
Get Deviation/Stage Adjustment Amount	**AOG**	107	Obtains the current value, and returns the adjustment amount plus the amount of deviation after the detection of an object.
Set Object Position	**OBS**	108	Assigns the coordinate of an object position directly instead of the detected position by the checker when executing Alignment.
Output Alignment Result Data	**RTD**	110	Saves the latest result of the execution of Alignment to an SD card.

Note

*1: Both reading and writing cannot be executed when PV240 stops.
*2: It cannot be executed when you select “TOOL” > "General", "Setting Help", or "Update".

4.3 Details of General Communication Commands

Command (Response) Composition

The configurations of general communication commands and command responses are as follows.

&	**Command**	**P1(R1)**	**P1(R1)**	…	**¥**	**Checksum**	**CR**

&	Start code; "&" of ASCII characters
Command	Command (Response); Composed of three ASCII characters.
P1,P2 (R1,R2)	Command parameter (Response parameter) Parameter values are expressed as decimal values using ASCII characters. The number of digits and the range of values differ according to commands. There is no delimiter between parameters.
¥	Terminate code; "¥" of ASCII characters
Checksum	When "Checksum" is set to "Yes", the sum of all the ASCII characters between the start code and the terminate code is calculated, and the lower one-byte value is added as hexadecimal two-digit values using ASCII characters. (Checksum is specified from "TYPE" > "Alignment" > "Alignment" > "Options" > "Checksum".)
CR	Terminate code 0DH (Carriage return)

Checksum

Unlike the normal BCC, the sum of all the ASCII character codes of a command and command parameter is calculated, and the lower one-byte value is expressed as hexadecimal two-digit values using ASCII characters.

Example) In the case of Reset Alarm command

&	**A**	**R**	**R**	**¥**
	41H	**52H**	**52H**	

▼The lower two bytes of addition result▼

E5H

Command composition including checksum

&	**A**	**R**	**R**	**¥**	**E**	**5**
					Checksum	

Request Stage Current Position

Obtains the request of the stage current position.

Send	**&**	**T**	**A**	**G**	**¥**	**(SUM)**	**CR**				
Receive	**&**	**T**	**A**	**G**	**R1**	**R2**	**R3**	**R4**	**¥**	**(SUM)**	**CR**

Parameter

R1	[For XYTheta Stage, Line Theta Stage) X-axis absolute value (12 digits, sign + or - as the head) [1/10000 mm units] [For UVW Stage] U-axis absolute value (12 digits, sign + or - as the head) [1/10000 mm units]
R2	[For XYTheta Stage, Line Theta Stage) Y-axis absolute value (12 digits, sign + or - as the head) [1/10000 mm units] [For UVW Stage] V-axis absolute value (12 digits, sign + or - as the head) [1/10000 mm units]
R3	[For XYTheta Stage] Theta-axis absolute value (12 digits, sign + or - as the head) [1/100000 degree units] [For UVW Stage] W-axis absolute value (12 digits, sign + or - as the head) [1/10000 mm units] [For Line Theta Stage] Stroke absolute value (12 digits, sign + or - as the head) [1/10000 mm units] Communication is performed with the value converted from theta to the amount of movement.
R4	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error

Communication behavior

Host		**PV240**
Obtains stage current position.	←	Sends TAG command.
Sends TAG response.	→	Receives response.

Request Stage Absolute Position Move

Specifies the movement amount of stage absolute position.
It is specified with the absolute position (stage coordinate system) of XYTheta or UVW.

Send	**&**	**T**	**A**	**R**	**P1**	**P2**	**P3**	**¥**	**(SUM)**	**CR**

Receive	**&**	**T**	**A**	**R**	**R1**	**¥**	**(SUM)**	**CR**

Parameter

P1	[For XYTheta Stage, Line Theta Stage) X-axis absolute value (12 digits, sign + or - as the head) [1/10000 mm units] [For UVW Stage] U-axis absolute value (12 digits, sign + or - as the head) [1/10000 mm units]
P2	[For XYTheta Stage, Line Theta Stage) Y-axis absolute value (12 digits, sign + or - as the head) [1/10000 mm units] [For UVW Stage] V-axis absolute value (12 digits, sign + or - as the head) [1/10000 mm units]
P3	[For XYTheta Stage] Theta-axis absolute value (12 digits, sign + or - as the head) [1/100000 degree units] [For UVW Stage] W-axis absolute value (12 digits, sign + or - as the head) [1/10000 mm units] [For Line Theta Stage] Stroke absolute value (12 digits, sign + or - as the head) [1/10000 mm units] Communication is performed with the value converted from theta to the amount of movement.
R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error

Communication behavior

Host		**PV240**
Moves stage absolute position.	←	Sends TAR command.
Sends response.	→	Receives response.

Execute Calibration

Starts a calibration sequence.

Send	**&**	**C**	**A**	**E**	**P1**	**¥**	**(SUM)**	**CR**
Receive	**&**	**C**	**A**	**E**	**R1**	**¥**	**(SUM)**	**CR**

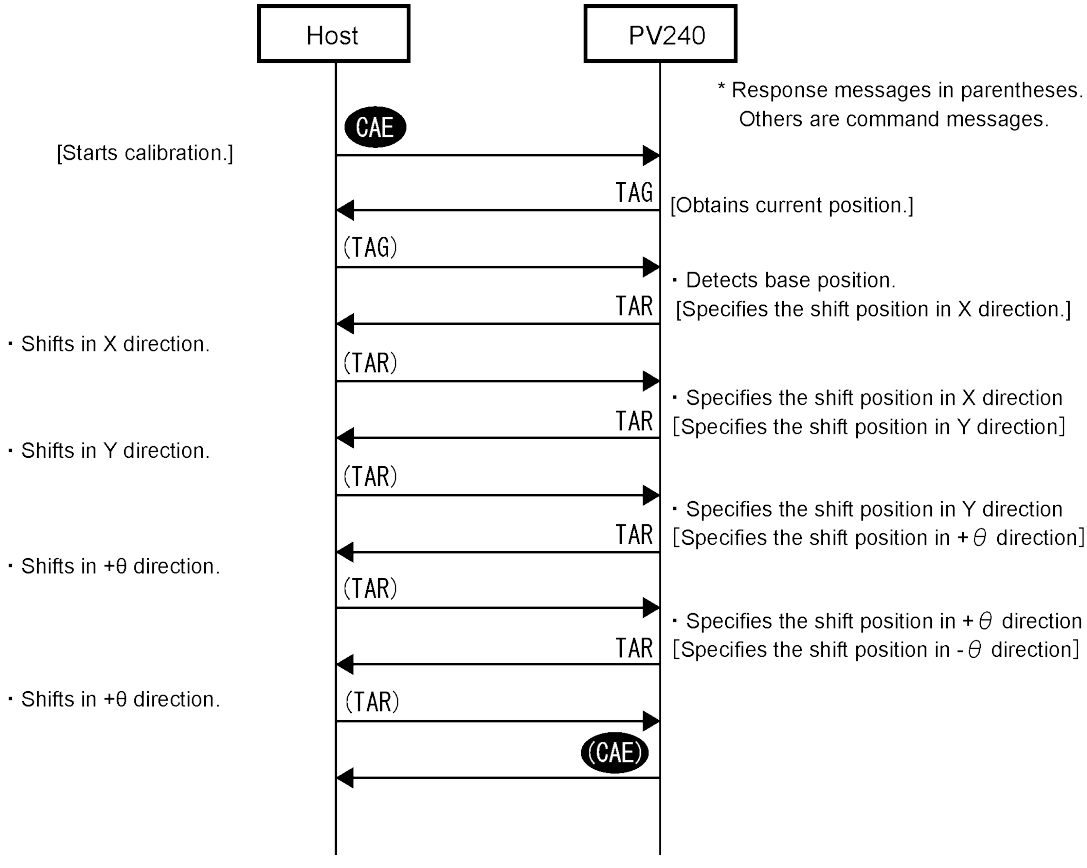
Parameter

P1	Mark No. 00: Mark0 and Mark1 01: Mark0 02: Mark1
R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 11: Specified mark unregistered 14: Calibration failed 22: Mark0 undetected 23: Mark1 undetected

Communication behavior

Host		**PV240**
Sends CAE command.	→	
Gets the current stage position.	←	Sends TAG command.
Sends TAG response.	→	Detects the base position in X direction. (Executes mark detection.)
Shifts in X direction.	←	Sends TAR command.
Sends TAR response.	→	Detects the shift position in X direction. (Executes mark detection.)
Shifts in Y direction.	←	Sends TAR command.
Sends TAR response.	→	Detects the shift position in Y direction. (Executes mark detection.)
Shifts in +Theta direction.	←	Sends TAR command.
Sends TAR response.	→	Detects the shift position in +Theta direction. (Executes mark detection.)
Shifts in -Theta direction.	←	Sends TAR command.
Sends TAR response.	→	
	←	Sends CAE response.

CAE Command Flow



Execute Calibration (with Rotation Point Adjustment)

Performs Rotation Point Adjustment after a calibration sequence.

Send	**&**	**C**	**A**	**E**	**P1**	**¥**	**(SUM)**	**CR**	
Receive	**&**	**C**	**A**	**E**	**R1**	**R2**	**R3**	**¥**	**(SUM)**	**CR**

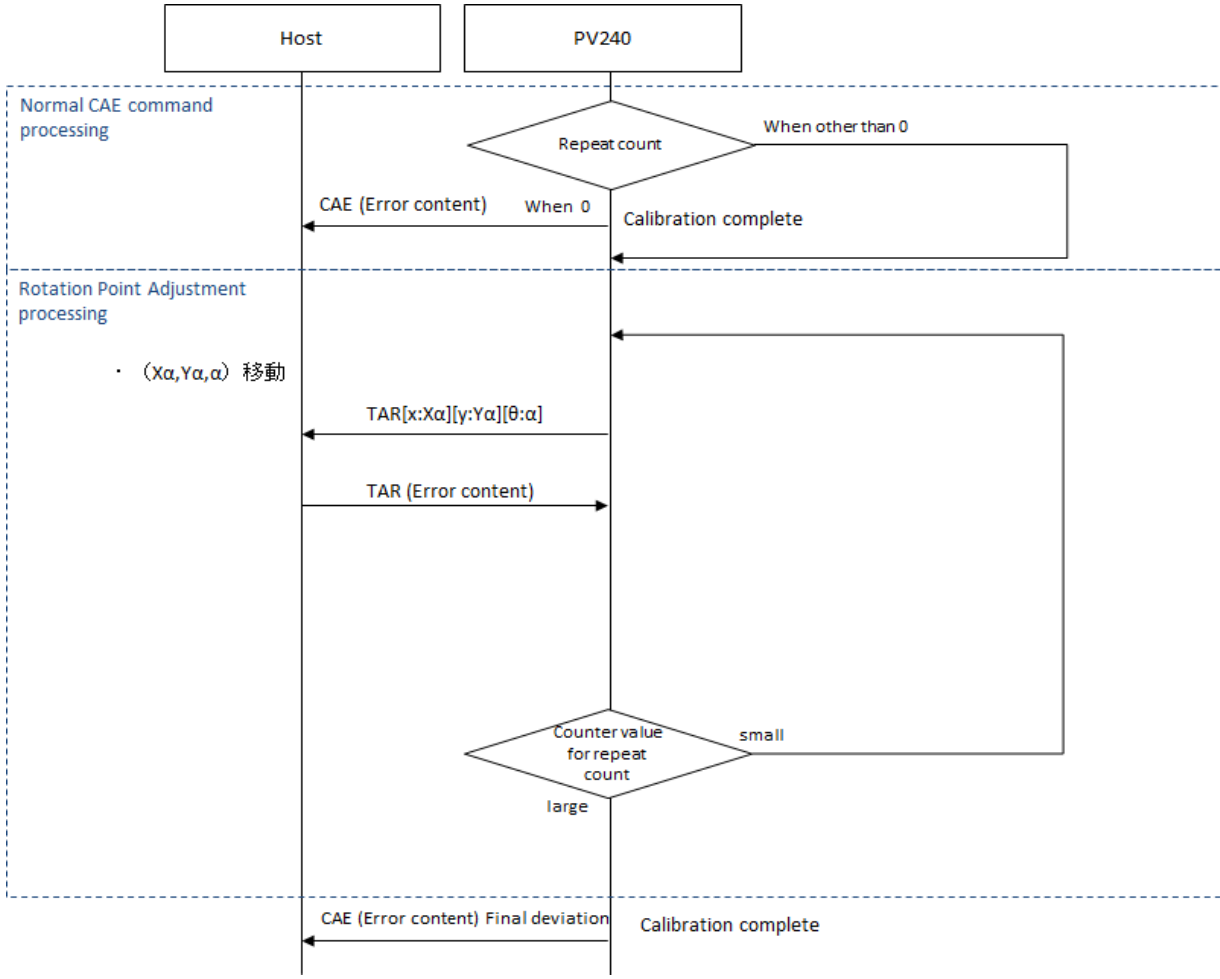
Parameter

P1	Mark No. (2 digits) 00: Mark0 and Mark1 01: Mark0 02: Mark1	
R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 15: Calibration unset 22: Mark0 undetected 23: Mark1 undetected	60: Alignment checker unregistered 61: Calibration checker unregistered 64: Sequence error 66: Inexecutable due to the PV not in RUN mode
R2	Final deviation (12 digits, sign + as the head) The smallest deviation in the repeat processing (Final deviation) * Final deviation of Mark0 when specifying Mark No.00 and Mark No.01. Final deviation of Mark1 when specifying Mark No.02.	
R3	Final deviation (12 digits, sign + as the head) The smallest deviation in the repeat processing (Final deviation) * Final deviation of Mark1 when specifying Mark No.00. This item is not added when specifying Mark No.01 and Mark No.02.	

Communication behavior

Host		**PV240**
		1. When the number of retries is 0, sends CAE response. When it is other than 0, goes to step 2.
Moves X, Y Theta.	←	2. Sends TAR command.
Sends TAR response.	→	Calculates the adjusted rotation point position.
Calibration complete	←	When the counter is smaller than the number of retires, goes to step 2. When it is larger, sends CAE response.

CAE Command Flow (with Rotation Point Adjustment)



* For details of Rotation Point Adjustment, refer to 6.3.5 Rotation Point Adjustment (Calibration Data) on page 174.

Execute Auto Alignment

Starts an alignment sequence. This command is used for capturing two object marks simultaneously.

▶ Note

When the timing of capturing the object mark0 is different from that of capturing the mark1, use ACL command.

Send	**&**	**A**	**A**	**E**	**P1**	**P2**	**P3**	**P4**	**¥**	**(SUM)**	**CR**

Receive	**&**	**A**	**A**	**E**	**R1**	**¥**	**(SUM)**	**CR**

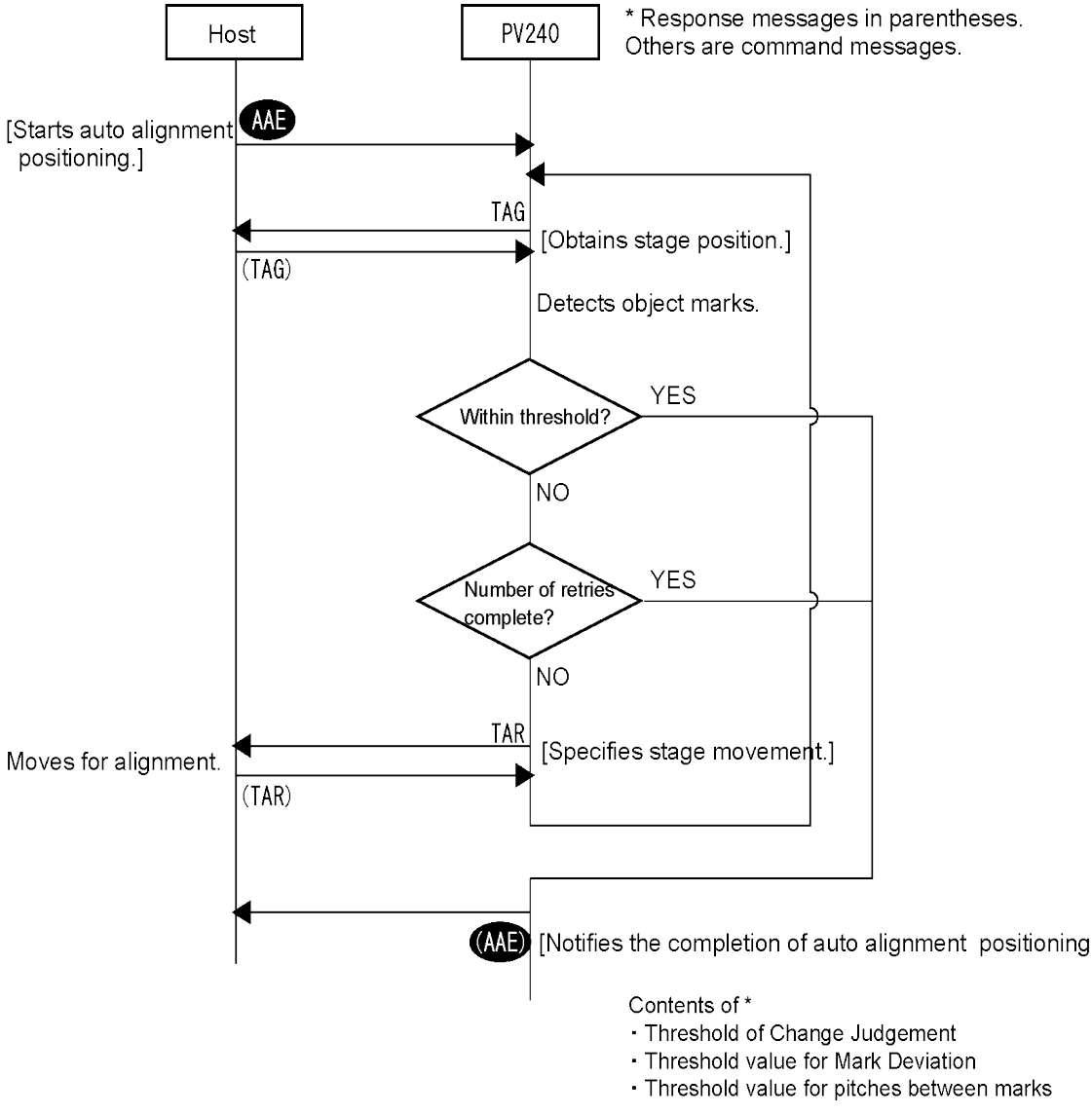
Parameter

P1	X-axis offset value (12 digits, sign + or - as the head) [1/10000 mm units]
P2	Y-axis offset value (12 digits, sign + or - as the head) [1/10000 mm units]
P3	Theta-axis offset value (12 digits, sign + or - as the head) [1/100000 degree units]
P4	Reserved (2 digits): 00 fixed
R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 11: Specified mark unregistered 14: Alignment calculation failed 15: Calibration unset 20: Alignment retry error 21: Target position outside screen error 22: Mark0 undetected 23: Mark1 undetected 25: Mark pitch incorrect 34: X: Movement threshold error 35: Y: Movement threshold error 36: Theta: Movement threshold error 37: XY: Movement threshold error 38: XTheta: Movement threshold error 39: YTheta: Movement threshold error 40: XYTheta: Movement threshold error

Communication behavior

Host		**PV240**
Sends AAE command.	→	
Gets the current stage position.	←	1. Sends TAG command.
Sends TAG response.	→	2. When within deviation threshold, goes to step 5 below.
		3. When exceeding the number of retries, goes to step 5 below.
Moves stage.	←	4. Sends TAR command.
Sends TAR response.	→	Goes to the above step 1.
Complete	←	5. Sends AAE response.

AAE Command Flow



Execute Auto Alignment (Simple Flow)

Starts an auto alignment sequence. Target running offsets are specified. Obtaining the stage current position (TAG) at the time of retry is omitted, and the execution time is shorter than AAE command. This command is used for capturing two object marks simultaneously.

▶ Note

When the timing of capturing the object mark0 is different from that of capturing the mark1, use ACL command.

Send	**&**	**A**	**A**	**S**	**P1**	**P2**	**P3**	**P4**	**¥**	**(SUM)**	**CR**

Receive	**&**	**A**	**A**	**S**	**R1**	**¥**	**(SUM)**	**CR**

Parameter

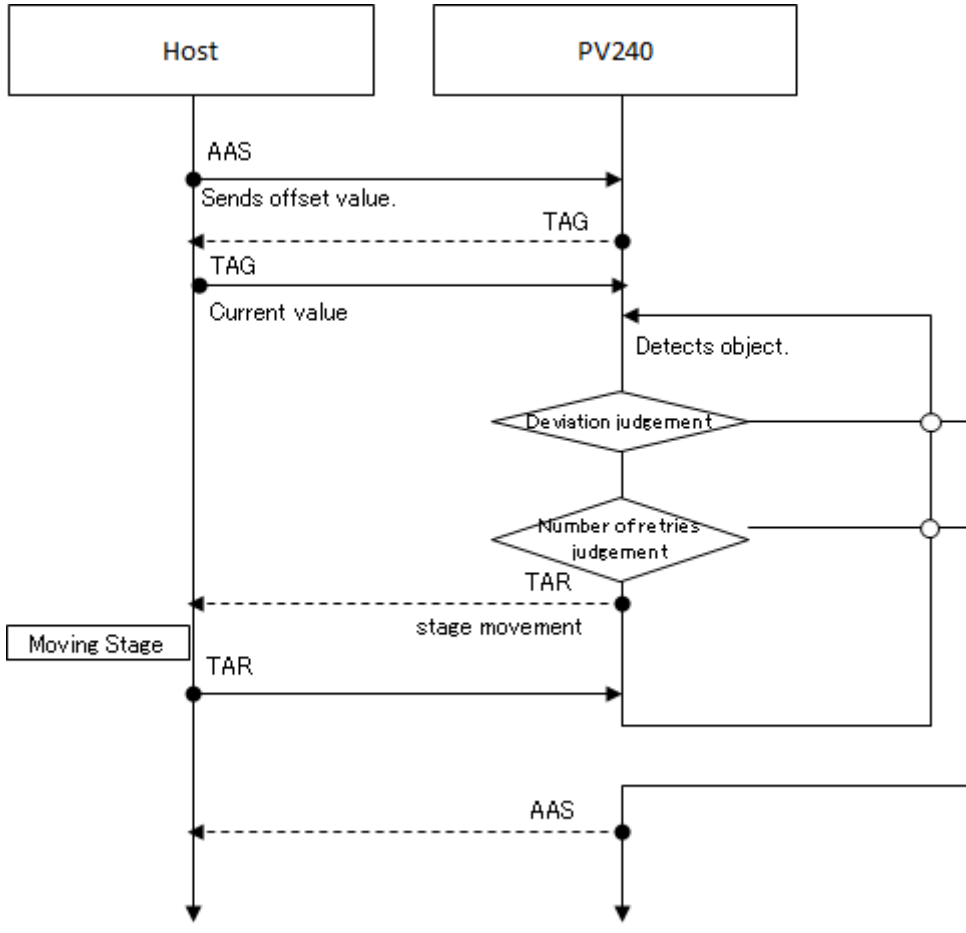
P1	Reserved (2 digits): 00 fixed
P2	X-axis offset value (12 digits, sign + or - as the head)
P3	Y-axis offset value (12 digits, sign + or - as the head)
P4	Theta-axis offset value (12 digits, sign + or - as the head)

R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 15: Calibration unset 17: Target coordinate unregistered 20: Number of alignment retries exceeded 21: Target position out of the screen 22: Mark0 undetected 23: Mark1 undetected 25: Mark pitch incorrect 34: Movement threshold error (X) 35: Movement threshold error (Y) 36: Movement threshold error (Theta) 37: Movement threshold error (X, Y) 38: Movement threshold error (X, , Theta) 39: Movement threshold error (Y, Theta) 40: Movement threshold error (X, Y, Theta) 60: Alignment checker unregistered 61: Calibration checker unregistered 63: Object checker unregistered 64: Sequence error 66: Inexecutable due to the PV not in RUN mode

Communication behavior

Host		**PV240**
Sends AAS command.	→	
	←	1. Sends TAG command.
Sends TAG response.	→	2. When within deviation threshold, goes to step 5 below.
		3. When exceeding the number of retries, goes to step 5.
Moves stage.	←	4. Sends TAR command.
Sends TAR response.	→	Goes to the above step 2.
Complete	←	5. Sends AAS response.

AAS Command Flow



Get Target Position

When "Target Position" is set to "Mark Detection", a detected mark position is registered as the target position.
When "Target Position" is set to "Center of Display", the center position of the display is registered as the target position.

Send	**&**	**T**	**G**	**G**	**P1**	**¥**	**(SUM)**	**CR**
Receive	**&**	**T**	**G**	**G**	**R1**	**¥**	**(SUM)**	**CR**

Parameter

P1	Mark number 00: Mark0 and Mark1 01: Mark0 02: Mark1
R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 11: Specified mark unregistered 15: Calibration unset 22: Mark0 undetected 23: Mark1 undetected

Communication behavior

Host		**PV240**
Sends TGG command.	→	Detects target mark.
Receives response.	←	Sends TGG response.

Get Object Position

Detects object marks.

Send	**&**	**O**	**B**	**G**	**P1**	**¥**	**(SUM)**	**CR**
Receive	**&**	**O**	**B**	**G**	**R1**	**¥**	**(SUM)**	**CR**

Parameter

P1	Mark number 00: Mark0 and Mark1 01: Mark0 02: Mark1
R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 11: Specified mark unregistered 15: Calibration unset 22: Mark0 undetected 23: Mark1 undetected

Communication behavior

Host		**PV240**
Sends OBG command.	→	Executes object mark detection.
Receives response.	←	Sends OBG response.

Reset, Cancel Alarm

Turns off the parallel I/O error flag.
Clears an error message on the screen.

Send	**&**	**A**	**R**	**R**	**¥**	**(SUM)**	**CR**

Receive	**&**	**A**	**R**	**R**	**R1**	**¥**	**(SUM)**	**CR**

Parameter

R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error

Communication behavior

Host		**PV240**
Sends ARR command.	→	Turns off error signal and deletes error message.
Receives response.	←	Sends ARR response.

▶ Note

When a command error occurs, turn off the ERROR signal and clear the error message by sending the alarm reset command.

Execute Alignment for 1 Camera (with Target Offsets)

Executes an alignment sequence once by this command after obtaining two object positions. Target offsets can be specified.
This command is used when the timing of capturing object marks is different between Mark0 and Mark1, in such a case that one object mark is captured after moving a camera after the other mark was captured. (It is not related to "TYPE" > "Type Setting" > Capture Delay".) Use AAE or AAS command for capturing two object marks simultaneously.

Send	**&**	**A**	**C**	**L**	**P1**	**P2**	**P3**	**P4**	**¥**	**(SUM)**	**CR**

Receive	**&**	**A**	**C**	**L**	**R1**	**R2**	**¥**	**(SUM)**	**CR**

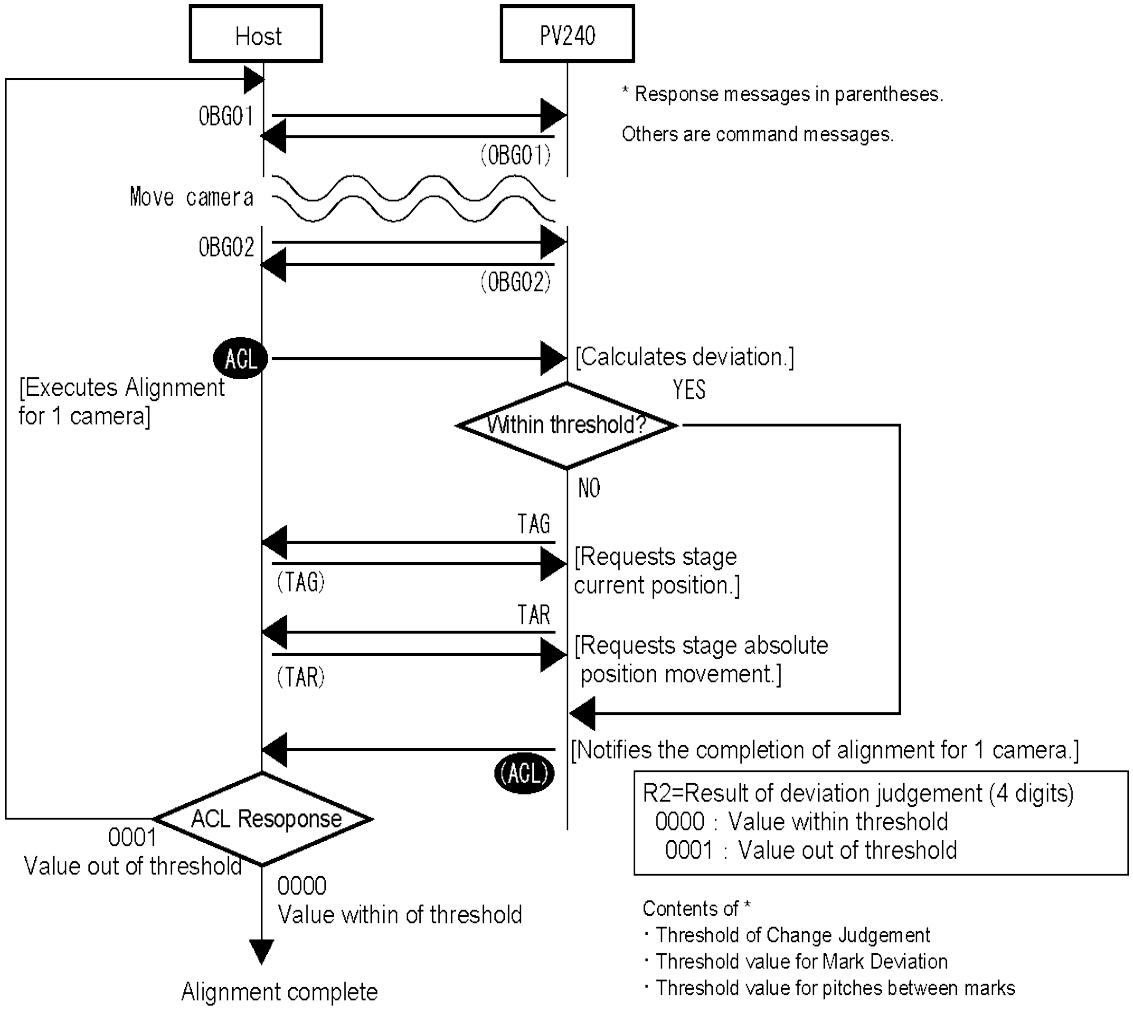
Parameter

P1	Reserved (2 digits): 00 fixed
P2	X-axis offset value (12 digits, sign + or - as the head) [1/10000 mm units]
P3	Y-axis offset value (12 digits, sign + or - as the head) [1/10000 mm units]
P4	Theta-axis offset value (12 digits, sign + or - as the head) [1/100000 degree units]

R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 11: Specified mark unregistered 14: Alignment calculation failed 15: Calibration unset 21: Target position outside screen error 22: Mark0 undetected 23: Mark1 undetected 25: Mark pitch incorrect 34: X: Movement threshold error 35: Y: Movement threshold error 36: Theta: Movement threshold error 37: XY: Movement threshold error 38: XTheta: Movement threshold error 39: YTheta: Movement threshold error 40: XYTheta: Movement threshold error
R2	Result (4 digits) 0000: End within threshold 0001: End out of threshold * A value returned to "Result" at the time of error occurrence is not determined. Sometimes, 0000 is returned.

Host		**PV240**
(Target and object have been detected.) Sends ACL command.	→	Calculates deviation. When it is out of judgement threshold: Goes to step 1. When it is within judgement threshold: Goes to step 2.
Gets the current stage position.	←	1. Sends TAG command.
Sends TAG response.		Receives response.
Moves stage.		Sends TAR.
Sends TAR response.		Receives response. Goes to step 2.
ACL complete. If ended with values out of thresholds, re-detects the object and re-executes ACL.		Sends ACL response.

ACL Command Flow



Get Deviation (with Target Offsets)

Gets the difference between the currently detected target position and object position. Target offsets can be specified.

Send	**&**	**G**	**D**	**V**	**P1**	**P2**	**P3**	**P4**	**¥**	**(SUM)**	**CR**
Receive	**&**	**G**	**D**	**V**	**R1**	**R2**	**R3**	**R4**	**¥**	**(SUM)**	**CR**

Parameter

P1	Reserved (2 digits): 00 fixed
P2	X-axis offset value (12 digits, sign + or - as the head) [1/10000 mm units]
P3	Y-axis offset value (12 digits, sign + or - as the head) [1/10000 mm units]
P4	Theta-axis offset value (12 digits, sign + or - as the head) [1/100000 degree units]

R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 15: Calibration unset 21: Target position outside screen error
R2	X amount of deviation (12 digits, sign + or - as the head) [1/10000 mm units]
R3	Y amount of deviation (12 digits, sign + or - as the head) [1/10000 mm units]
R4	Theta amount of deviation (12 digits, sign + or - as the head) [1/100000 degree units]

Communication behavior

Host		**PV240**
(Target and object have been detected.) Sends GDV command.	→	Calculates deviation.
Receives response.	←	Sends response.

Get Stage Adjustment Amount (Absolute Value)

Obtains the adjustment amount (absolute value) based on the current position (absolute value).

Send	&	A	Z	G	P1	P2	P3	P4	P5	P6	¥	(SUM)	CR

Receive	&	A	Z	G	R1	R2	R3	R4	¥	(SUM)	CR

Parameter

P1	Stage current value (Axis #1 absolute value) (12 digits, sign + or - as the head)
P2	Stage current value (Axis #2 absolute value) (12 digits, sign + or - as the head)
P3	Stage current value (Axis #3 absolute value) (12 digits, sign + or - as the head)
P4	Stage current value (Axis #4 absolute value) (12 digits, sign + or - as the head)
P5	Stage current value (Axis #5 absolute value) (12 digits, sign + or - as the head)
P6	Reserved (2 digits): 00 fixed

R1	Stage adjustment amount (Axis #1 absolute value) (12 digits, sign + or - as the head)
R2	Stage adjustment amount (Axis #2 absolute value) (12 digits, sign + or - as the head)
R3	Stage adjustment amount (Axis #3 absolute value) (12 digits, sign + or - as the head)
R4	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 11: Specified mark unregistered 14: Alignment calculation failed 15: Calibration unset 17: Target unregistered 22: Mark0 undetected 23: Mark1 undetected

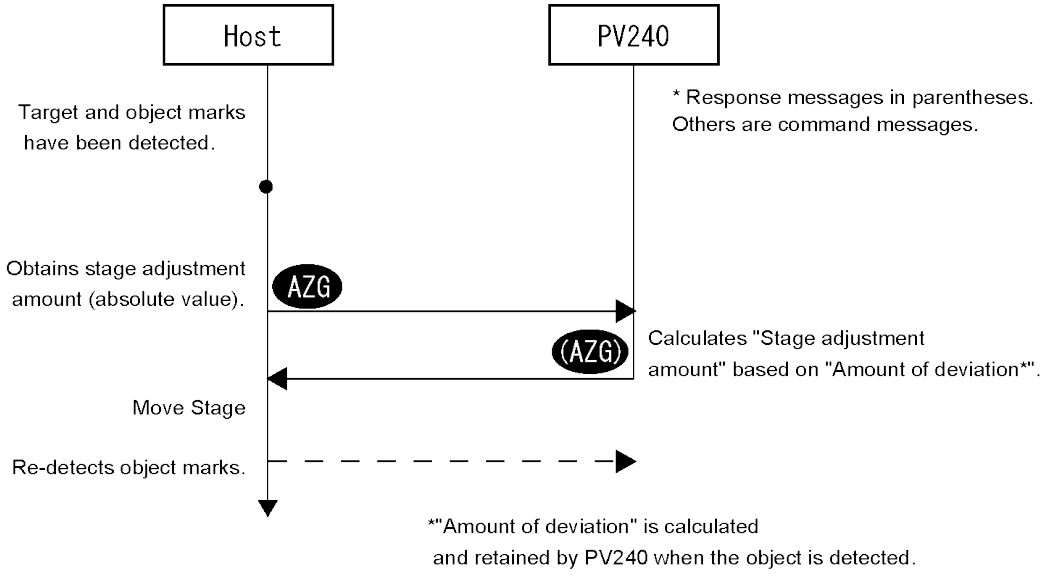
Behavior of axes and input units

	XYTheta Stage	**Line Theta Stage**	**UVW Stage**
Axis #1 absolute value	X-axis position [1/10000 mm]		U-axis position [1/10000 mm]
Axis #2 absolute value	Y-axis position [1/10000 mm]		V-axis position [1/10000 mm]
Axis #3 absolute value	Theta-axis position [1/100000 degree]	Stroke position [1/10000 mm]	W-axis position [1/10000 mm]
Axis #4 absolute value	(0 fixed)		
Axis #5 absolute value			

Communication behavior

	Host		**PV240**
(1)	Target and object have been detected.		
(2)	Sends AZG command.	→	Calculates stage adjustment amount.
	(Stage moves on PLC side.) Returns to the above (1) after re-executing object detection.	←	Sends AZG response.

AZG Command Flow



Set Target Position (Specify Camera Coordinate)

Specifies camera coordinates and registers the target position.

Send	**&**	**T**	**G**	**S**	**P1**	**P2**	**P3**	**¥**	**(SUM)**	**CR**

Receive	**&**	**T**	**G**	**S**	**R1**	**¥**	**(SUM)**	**CR**

Parameter

P1	Mark No. (2 digits) 00: Unavailable 01: Mark0 02: Mark1
P2	X-axis camera coordinate (12 digits, sign + or - as the head) [1/10000 pixel units]
P3	Y-axis camera coordinate (12 digits, sign + or - as the head) [1/10000 pixel units]

R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 66: Inexecutable due to the PV not in RUN mode

Communication behavior

Host		**PV240**
Sends TGS command.	→	Obtains target position form parameter.
Receives response.	←	Sends TGS response.

Move Rotation Center

Moves the rotation center for alignment calibration.

Send	**&**	**S**	**R**	**P**	**P1**	**P2**	**P3**	**P4**	**¥**	**(SUM)**	**CR**

Receive	**&**	**S**	**R**	**P**	**R1**	**¥**	**(SUM)**	**CR**

Parameter

P1	Mark No. (1 digit) 1: Mark0 2: Mark1
P2	Reserved (1 digit): (00 fixed)
P3	X-axis movement (12 digits, sign + or - as the head) [1/10000 mm units]
P4	Y-axis movement (12 digits, sign + or - as the head) [1/10000 mm units]

R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 15: Calibration unset 64: Sequence error 66: Inexecutable due to the PV not in RUN mode

Communication behavior

Host		**PV240**
Sends SRP command.	→	rotation center X = Current rotation center + X-axis movement rotation center Y = Current rotation center + X-axis movement
Receives response.	←	Sends SRP response.

Print Screen

It is output into the place specified from “ENVIRONMENT” > “Input/Output” > “Print Screen” -> “Destination”. This command cannot specify the destination.

Send

%	P	S	BCC	CR

BCC = 26 or **

Receive

%	P	S	BCC(02)	CR

Error (ERROR signal = ON)

%	P	S	!	Error code (3-digit)	BCC	CR

Error code

200	Operation is stopped
265	• No SD memory card is attached or cannot be accessed. • Capacity of the SD memory card is used up. • The SD memory card is write-protected. • "Write When Cover is Open" is set to "Disable", and the cover is open. • Ethernet communication cannot be established (with connection problems such as cable unconnected or disconnection) • Image Receiver is not activated.

Communication behavior

Host		PV240
Sends PS command.	→	When receiving the command, "PRINT SCREEN" is displayed in the message display area.
Receives response.	←	Sends PS response.

Note

The file name format of a print screen image saved by PS command is different from that saved with the keypad. Information such as an alignment result or the amount of deviation is indicated in the file name.
It is possible to confirm alignment information on the display of the list of files without opening each file.

File name saved by PS command	yymmdd_hhmmss_n_r_xxxxxx.xxxx_yyyyyy.yyyy_tttttt.ttttt.bmp yymmdd: Date hhmmss: Time n: File number r: Alignment result (OK: 1, NG: 0) xxxxxx.xxxx: Amount of deviation X (4 digits after the decimal point) yyyyyy.yyy: Amount of deviation Y (4 digits after the decimal point) tttttt.tttt: Amount of deviation Theta (5 digits after the decimal point)
Example of file name	140409_113246_0_0_0.0000_0.0000_0.00000.bmp
File name saved with the keypad	yymmdd_hhmmss_n.bmp

For information on the procedure for saving print screen images with the keypad, see "3.2.5 Copying the Screen Display (Print Screen)" of PV200 User's Manual.

Print Screen (Specify File Name)

Saves print screen images with arbitrary file names.

Note

This command cannot be used when operation is stopped. Although it is possible to save print screen images with the keypad when operation is stopped, file names cannot be specified.

Send

%	P	S		N	A	M	E	=	Arbitrary string	BCC	CR

Receive

%	P	S	$	BCC	CR

Error (Error signal = ON)

%	P	S	!	Error code (3-digit)	BCC	CR

Error code

200	Cannot be executed as operation is stopped.
265	• No SD memory card is attached or cannot be accessed. • Capacity of the SD memory card is used up. • The SD memory card is write-protected. • "Write When Cover is Open" is se to "Disable", and the cover is open. • Ethernet communication cannot be established (with connection problems such as cable unconnected or disconnection) • Image Receiver is not activated or stops.
266	Parameter does not begin with "NAME=". Or, character string with more than 199 characters is specified.

Communication behavior

Host		PV240
Sends PS command.	→	When receiving the command, "PRINT SCREEN" is displayed in the message display area.
Receives response.	←	Sends PS response.

Note

- A string exceeding 199 characters cannot be saved as a file name.
  If a file name exceeds the number of characters that can be displayed in the text box in the folder display window, it is not displayed correctly. Take care when saving print screen images with arbitrary names by PS command, etc, or when changing a file name directly on a PC.
- The following symbols cannot be used for file names. If these symbols are used, the name is registered skipping these characters.
  ¥ / : , ; * ? " < > |
- The name of an image file saved by the normal PS command differs from that saved by this command.

File name saved by PS (Specify file name) command	yymmdd_hhmmss_n_r_xxxxxx.xxxx_yyyyyy.yyyy_tttttt.ttttt.bmp yymmdd: Date hhmmss: Time n: File name + File number r: Alignment result (OK: 1, NG: 0) xxxxxx.xxxx: Amount of deviation X (4 digits after the decimal point) yyyyyy.yyy: Amount of deviation Y (4 digits after the decimal point) tttttt.tttt: Amount of deviation Theta (5 digits after the decimal point)
Example of file name (when file name is "ABC")	140409_113246_ABC0_0_0.0000_0.0000_0.00000.bmp

Save Print Screen in Image Memory

Saves print screen images in the dedicated image memory.

Note

- Up to ten images can be held in the memory. (Images after the 11th image will be discarded.)

Send

%	P	S	M	BCC	CR

BCC=6B or **

Receive

%	P	S	M	BCC(6B)	CR

Error (Error signal = ON)

%	P	S	M	!	Error code (3-digit)	BCC	CR

Error code

200	Cannot be executed as operation is stopped.
265	• Image data was discarded because the number of saved images exceeds the limit (10 images). • No SD memory card is attached or cannot be accessed. • Capacity of the SD memory card is used up. • The SD memory card is write-protected. • "Write When Cover is Open" is se to "Disable", and the cover is open. • Ethernet communication cannot be established (with connection problems such as cable unconnected or disconnection) • Image Receiver is not activated or stops.

Communication behavior

Host		PV240
Sends PSM command.	→	Saves images in the dedicated image memory for print screen.
Receives response.	←	Sends PSM response.

Save Print Screen in SD

Saves print screen images to an SD card from the dedicated image memory, and deletes data in the image memory.

Send

%	S	S	M	BCC	CR

BCC=6B or **

Receive

%	S	S	M	BCC(68)	CR

Error (Error signal = ON)

%	S	S	M	!	Error code (3-digit)	BCC	CR

Error ode

200	Cannot be executed as operation is stopped.
265	• No SD memory card is attached or cannot be accessed. • Capacity of the SD memory card is used up. • The SD memory card is write-protected. • No image is saved in the dedicated image memory. • "Write When Cover is Open" is se to "Disable", and the cover is open.

Communication behavior

Host		PV240
Sends SSM command.	→	Saves images within the dedicated image memory for print screen to an SD card, and deletes the images within the memory.
Receives response.	←	Sends SSM response.

Get Distance between Target/Object Marks

Obtains the distance between target marks and the distance between object marks.

Send	**&**	**G**	**M**	**L**	**¥**	**(SUM)**	**CR**

Receive	**&**	**G**	**M**	**L**	**R1**	**R2**	**R3**	**¥**	**(SUM)**	**CR**

R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 66: Inexecutable due to the PV not in RUN mode
R2	Distance between target marks 0 and 1 (12 digits, sign + or - as the head) [1/10000 mm units]
R3	Distance between object marks 0 and 1 (12 digits, sign + or - as the head) [1/10000 mm units]

Communication behavior

Host		**PV240**
(Target marks 0, 1 and object marks 0, 1 have been detected.) Sends GML command.	→	Calculates the distance between target marks 0 and1, and the distance between object marks 0 and 1.
Receives response.	←	Sends GML response.

Change Camera Shutter Speed

Changes the shutter speed of a camera.

Send	**&**	**C**	**S**	**H**	**P1**	**P2**	**¥**	**(SUM)**	**CR**

Receive	**&**	**C**	**S**	**H**	**R1**	**¥**	**(SUM)**	**CR**

Parameter

P1	Camera No. (1 digit)
P2	Shutter speed [1/100 msec units] (6 digits) 0.3-Mega Compact Gray Camera (ANPVC5030): 0.10 msec to 500 msec Cameras other than the above: 0.03 msec to 1000 msec

R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 15: Calibration unset 66: Inexecutable due to the PV not in RUN mode

Communication behavior

Host		**PV240**
Sends CSH command.	→	Stops operation when receiving the command and restart the operation after completing the command. "Data Updated!" is displayed in the message area.
Receives response.	←	Sends CSH response.

Set Threshold of Change Judgement

Changes the thresholds of change judgement of X, Y and Theta which are used as the judgement condition of Alignment checker.

▶ Note

This command cannot be used when operation is stopped.

Send	&	S	C	T	P1	P2	P3	P4	¥	(SUM)	CR

Receive	&	S	C	T	R1	¥	(SUM)	CR

Parameter

P1	Reserved (2 digits): 00 fixed
P2	Threshold of change judgement X (+Sign: 1 digit, 11-digit value: Always 0 as a head) [1/10000 mm units] +00000000000 mm to +09999999999 mm
P3	Threshold of change judgement Y (+Sign: 1 digit, 11-digit value: Always 0 as a head) [1/10000 mm units] +00000000000 mm to +09999999999 mm
P4	Threshold of change judgement Theta (+Sign: 1 digit, 11-digit value: Always 0 as a head) [1/100000 degree units] +00000000000 mm to +09999999999 mm

R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 60: Alignment checker unregistered

Communication behavior

Host		**PV240**
Sends SCT command.	→	Changes the threshold of change judgement of X, Y and Theta.
Receives response.	←	Sends SCT response.

Get Deviation/Stage Adjustment Amount

Obtains the current value from PLC, and returns the adjustment amount plus the amount of deviation after the detection of an object.

Send	**&**	**A**	**O**	**G**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**¥**	**(SUM)**	**CR**
Receive	**&**	**A**	**O**	**G**	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**¥**	**(SUM)**	**CR**

Parameter

P1	Reserved (1 digit): 00 fixed
P2	Stage current value (Axis #1 absolute value) (12 digits, sign + or - as the head)
P3	Stage current value (Axis #2 absolute value) (12 digits, sign + or - as the head)
P4	Stage current value (Axis #3 absolute value) (12 digits, sign + or - as the head)
P5	Offset value X (12 digits, sign + or - as the head) [1/10,000mm units]
P6	Offset value Y (12 digits, sign + or - as the head) [1/10,000mm units]
P7	Offset value Theta (12 digits, sign + or - as the head) [1/100,000 degree units]

R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 03: Command parameter error 11: Specified mark unregistered 22: Mark0 undetected 23: Mark1 undetected
R2	X amount of deviation (12 digits, sign + or - as the head) [1/10,000mm units]
R3	Y amount of deviation (12 digits, sign + or - as the head) [1/10,000mm units]
R4	Theta amount of deviation (12 digits, sign + or - as the head) [1/100,000 degree units]
R5	Stage adjustment amount (Axis #1 absolute value) (12 digits, sign + or - as the head)
R6	Stage adjustment amount (Axis #2 absolute value) (12 digits, sign + or - as the head)
R7	Stage adjustment amount (Axis #3 absolute value) (12 digits, sign + or - as the head)

Behavior of axes and input units

	XYTheta Stage	**Line Theta Stage**	**UVW Stage**
Axis #1 absolute value	X-axis position [1/10000 mm]		U-axis position [1/10000 mm]
Axis #2 absolute value	Y-axis position [1/10000 mm]		V-axis position [1/10000 mm]
Axis #3 absolute value	Theta-axis position [1/100000 degree]	Stroke position [1/10000 mm]	W-axis position [1/10000 mm]

Communication behavior

Host		**PV240**
Sends AOG command.	→	Executes object mark detection.
Receives response.	←	Sends AOG response.

Set Object Position

Assigns the coordinate of an object position directly instead of the detected position by the checker, and executes alignment once.

Send

&	O	B	S	P1	P2	P3	P4	P5	¥	(SUM)	CR

Receive

&	O	B	S	R1	¥	(SUM)	CR

Error (Error signal = ON)

Parameter

P1	Mark No. (2 digits, 00: Both, 01: Mark0, 02: Mark1)
P2	Object* X coordinate value (Camera coordinate value) (12 digits, sign + as the head (sign - is unavailable) [1/10000 pixel units]
P3	Object* Y coordinate value (Camera coordinate value) (12 digits, sign + as the head (sign - is unavailable) [1/10000 pixel units]
P4	Object* X coordinate value (Camera coordinate value) (12 digits, sign + as the head (sign - is unavailable) [1/10000 pixel units]
P5	Object* Y coordinate value (Camera coordinate value) (12 digits, sign + as the head (sign - is unavailable) [1/10000 pixel units]

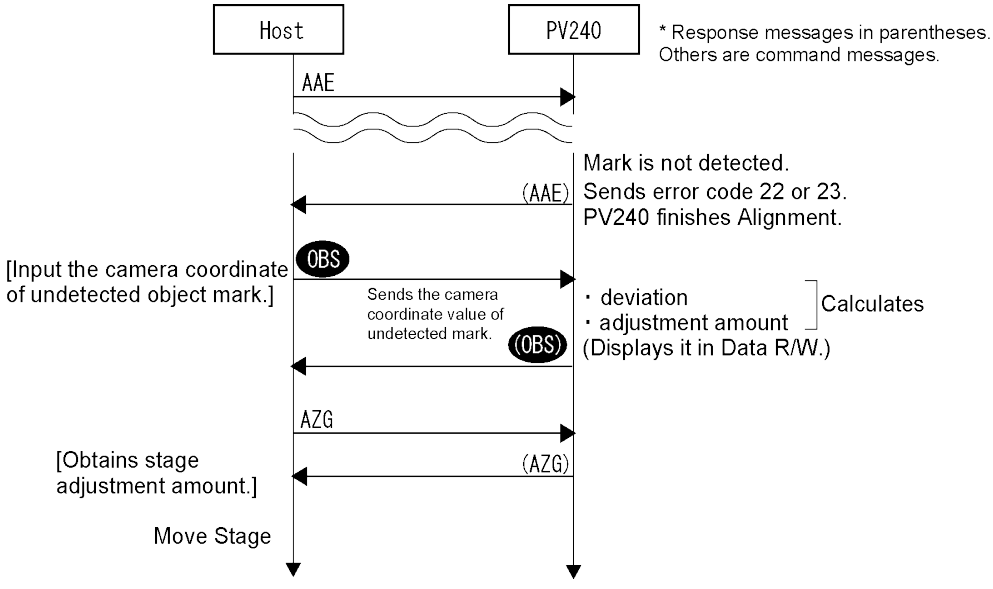
*) For specifying 00 for parameter P1, input the coordinate of Mark0 in P2 and P3, and the coordinate of Mark1 in P4 and P5. For specifying 01 for P1, input the coordinate of Mark0 in P2 and P3, and input the coordinate +00000000000 in P4 and P5 respectively. For specifying 02 for P1, input the coordinate of Mark1 in P2 and P3, and input the coordinate +00000000000 in P4 and P5 respectively.

R1	Error (2 digits) 00: Normal end 02: Checksum error 03: Command parameter error 14: Alignment calculation failed 15: Calibration data unregistered 17: Target coordinate unregistered 60: Alignment checker unregistered 61: Calibration checker unregistered 63: Object checker unregistered 64: Sequence error 66: Inexecutable due to the PV not in RUN mode Error (Error signal = ON)

Communication behavior

Host		PV240
Sends AAE and AAS commands.	→	Object undetected.
Receives AAE and AAS responses.	←	Sends AAE and AAS responses with error codes 22 and 23.
Sends OBS command.	→	Calculates the amount of deviation and stage adjustment amount. Displays the stage adjustment amount in Data R/W.
Receives response.	←	Sends OBS response.
Sends AZG command.	→	Receives AZG command.
Moves stage.	←	Sends AZG response with the stage adjustment amount.

OBS Command Flow



Output Alignment Result Data

Saves the latest result of the execution of alignment to an SD card.
For using this function, set "Output" for SD Card to "No" in "ENVIRONMENT" > "Input/Output" > "General Output".
This function is used to output the latest alignment result held by PV240 to an SD card when the following RTD command is received regardless of the settings of "Alignment result output" and "Output Conditions" in "ENVIRONMENT" > "Input/Output" > "Alignment result output".

Output destination: ¥ Panasonic-ID SUNX Vision ¥PV240¥Result

File name: YYYYMMDD_ALN_RSLT.txt
YYMMDD: Alignment execution time (When a date is changed, results are output to another file.)

Output content
• Execution date • Judgement • Inspection Time (Outputs "----------".) • No. of retries • Amount of deviation X • Amount of deviation Y • Amount of deviation Theta • Mark the amount of deviation M0 X, Mark the amount of deviation M0 Y • Mark the amount of deviation M1 X, Mark the amount of deviation M1 Y All the above results are output. ▶ Note For details of the output format of results, refer to page 25 ”Result Data Output Format”.

Send

&	R	T	D	¥	(SUM)	CR

Receive

&	R	T	D	R1	¥	(SUM)	CR

Error (Error signal = ON, Error number is displayed in the information display area at the same time.)

Parameter

R1	Error (2 digits) 00: Normal end 01: Communication error 02: Checksum error 15: Calibration data unregistered 17: Target coordinate unregistered 61: Calibration checker unregistered 62: Target checker unregistered 63: Object checker unregistered 66: Inexecutable due to the PV not in RUN mode 97: General output SD card output error

Communication behavior

Host		PV240
Sends RTD command.	→	Outputs alignment result.
Receives response.	←	Sends RTD response.

4.4 PLC Communication

4.4.1 Overview and Communication Specifications

This method communicates with a PLC according to the protocol of the destination PLC. Either RS-232C interface or Ethernet interface can be used.
The following communications are available with PV240.

・General output

When accepting an inspection start signal (parallel input including reinspection signal, control command by communication or TRIG input by keypad) in RUN menu, after the inspection, the inspection results that are set to be output, Scan count, Total judgement, Judgement, Numerical calculation) are written to a specified register of PLC as the beginning. Only integers can be written. The PLC does not need a communication program to receive data. For the information of the settings to use this function, refer to PV200 User's Manual.

A function to resend general output is not available.

・Control command

Using this function enables to control PV240, read and change the setting values. Only integers can be read and changed.For the information of the settings to use this function, refer to PV200 User's Manual.
PV240 can accept all the general communication commands even when PLC communication is selected.

Usable PLCs for PLC Communication

The following list shows the PLC models available for PLC communication via a RS232C or Ethernet interface.

Manufacturer	Model (series) name	RS232C	Ethernet
Panasonic Industrial Devices SUNX Co., Ltd.	FP series	Available *1)	Available *2)
	FP2 ET-LAN unit		Available
Mitsubishi Electric Corporation (MELSEC)	A /FX series	Available	
	Q series	Available	Available *3)
	FX series(older ver.) (FX1N)*4)	Available	
	FX-2N series(older ver.) (FX2N, FX3U, FX3UC)*4)	Available	
OMRON Corporation	C series, CV series, CS1 series	Available	
Allen-Bradley	SLC500	Available	
Fuji Electric FA Components & Systems Co., Ltd.	MICREX-SX SPH series	Available	
Yokogawa Electric Corporation	FA-M3/e-RT3		Available
(Standard) MODBUS RTU		Available	

*1) TOOL port, COM port, FP2-MCU (RS232C communication block), FP2-CCU
*2) Applicable unit: FP-X COM5 communication cassette, FP Web Server 2 unit
*3) Applicable unit: CPU with a built-in Ethernet, Ethernet unit (QJ71E71-100) only
*4)For using FX or FX-2N series, it is recommended to use the settings of A/FX series.

Note

- When Baud Rate is "115200 bps", the communication via RS232C interface may not be carried out stably in accordance with PLC to communicate with. In the case, set Baud Rate to "57600 bps" or lower.
- PLC communication via Ethernet interface is performed with UDP/IP.

Specifications of PLCs

Note

In accordance with specification of PLCs, some of the registers in "Usable range" of "Usable device" listed below could not be used. Please confirm the specifications of PLC before use.

Panasonic: FP / Panasonic: FP(ET-LAN unit)

- Protocol: MEWTOCOL
- Usable device

Data output/ Type switch			DT
Data output completion notice		Register*	WR
		Bit	0-15 (0-F)
Control command	Control Register		WR
	Command Input/Output Register		DT

- Sum check: Yes (type: BCC)

Mitsubishi: MELSEC-Q

- Protocol:
  - RS232C interface: “Format 4”, 4C frame compatible for QnA
  - Ethernet interface: 3E frame compatible for QnA
  CPU with a built-in Ethernet port, Ethernet unit (Applicable unit: QJ71E71-100 only)
- Usable device

Data output/ Type switch			D
Data output completion notice		Register*	M
		Bit	Invalid
Control command	Control Register		M ("Specified value" is command start bit, "Specified value +16" is processing bit and "Specified value +17" is error bit.)
	Command Input/Output Register		D

- Make the following setting with PLC.
  When using RS-232C Interface
  - Sum check: Yes (type: BCC)
  - Write at RUN time: "Enable"

  When using Ethernet interface
  - Communication data code: Binary code communication
  - Initial timing setting: Always wait for OPEN
  - Send frame setting: Ethernet(V2.0)
  - Write at RUN time: "Enable"

Mitsubishi: MELSEC-A/FX("Mitsubishi: MELSEC-A" for versions older than Ver.1.3)

- Protocol: “Format 4”, 1C frame compatible for A
- Usable device

Data output/ Type switch			D
Data output completion notice		Register*	M
		Bit	Invalid
Control command	Control Register		M ("Specified value" is command start bit, "Specified value +16" is processing bit and "Specified value +17" is error bit.)
	Command Input/Output Register		D

- Make the following setting with PLC.
  - Sum check: Yes (type: BCC)
  - Modification in RUN mode: Available

Mitsubishi: MELSEC-FX

Note For using FX-series, it is recommended to set PLC type to "Mitsubishi: MELSEC-A/FX".

- CPU: FX1N, Communication adapter: FX1N-232-BD
- Protocol: Special protocol for FX1N
  Register for specifying communication format: Store "0" in D8120. (Reboot the PLC after the setting.)
- Usable device

Data output/ Type switch			D
Data output completion notice		Register*	M
		Bit	Invalid
Control command	Control Register		M ("Specified value x16" is command start bit, "Specified value x16 +16" is processing bit and "Specified value x16 +17" is error bit.)
	Command Input/Output Register		D

- Sum check: Yes
  With PLC, you cannot select to perform sum check. Automatically “Yes” is selected.

Mitsubishi: MELSEC-FX-2N

Note For using FX-2N series, it is recommended to set PLC type to "Mitsubishi: MELSEC-A/FX".

- CPU: FX2N, FX3U, FX3UC
  Communication adapter: FX2N-232-BD, FX3U-232-BD, FX3U-232-ADP
- Protocol: Special protocol for FX2N
  Register for specifying communication format: Store "0" in D8120. (Reboot the PLC after the setting.)
- Usable device

Data output/ Type switch			D
Data output completion notice		Register*	M
		Bit	Invalid
Control command	Control Register		M ("Specified value x16" is command start bit, "Specified value x16 +16" is processing bit and "Specified value x16 +17" is error bit.)
	Command Input/Output Register		D

- Sum check: Yes
  With PLC, you cannot select to perform sum check. Automatically “Yes” is selected.

C, CV, and CS1 series by OMRON Corporation

- Protocol: Host link
- Usable device

Data output/ Type switch			D / DM
Data output completion notice		Register*	CIO / IR
		Bit	0-15 (0-F)
Control command	Control Register		CIO / IR
	Command Input/Output Register		D / DM

- Make the following setting with PLC.
  - Sum check: Yes
  - Station No.: "0"
- Communication is not available when PLC is in "Run" mode. Change to "Monitor" mode to communicate.

MICREX-SX (SPH series) by Fuji Electric FA Components & Systems Co., Ltd.

- Usable device
- Usable device

Data output/ Type switch			%MW3
Data output completion notice		Register*	%MW3
		Bit	0-15 (0-F)
Control command	Control Register		%MW3
	Command Input/Output Register		%MW3

- Sum check: Yes (type: BCC, the calculation method developed by Fuji is used.)

SLC series by Allen-Bradley

- Usable device

Data output/ Type switch			N7 (Only integer registers)
Data output completion notice		Register*	N7 (Only integer registers)
		Bit	0-15 (0-F)
Control command	Control Register		N7 (Only integer registers)
	Command Input/Output Register		N7 (Only integer registers)

- Make the following setting with PLC.
  - Duplicate Detect: OFF
  - ACK Timeout (*20 ms): 20
  - Control Line: NO HANDSHAKING
  - Error Detect: CRC
  - NAK Retries: 3
  - ENQ Retries: 0
  - Embedded Responses: AUTO DETECT

MODBUS RTU

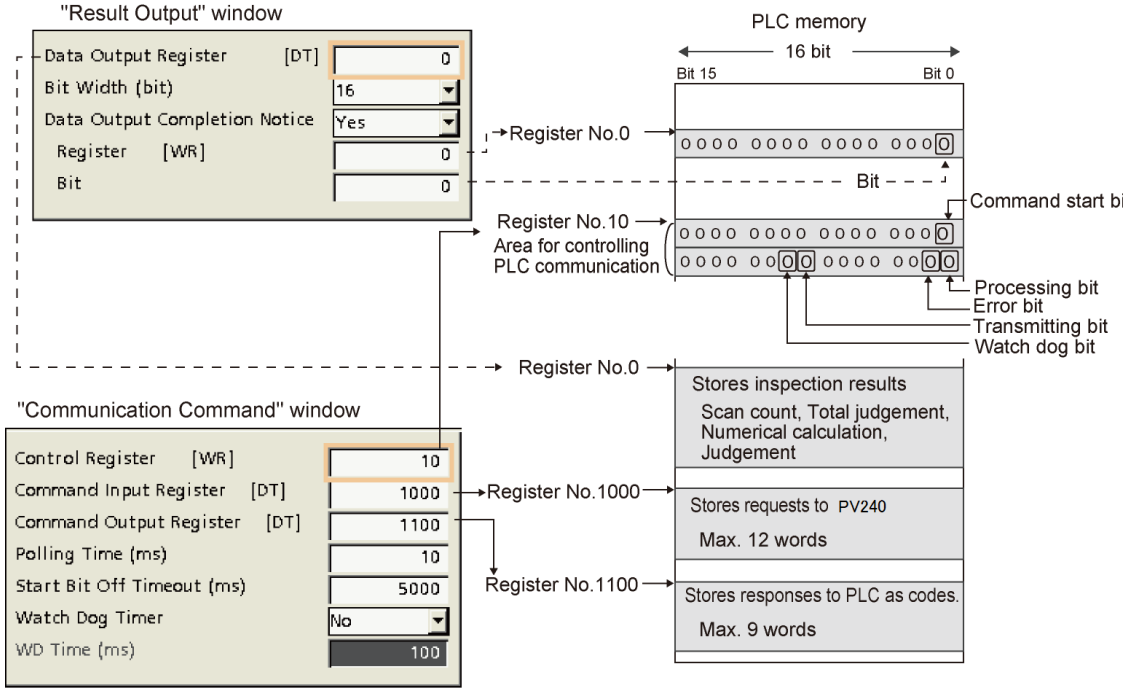
- Usable device

Data output/ Type switch			Holding register
Data output completion notice		Bit	Coil
Control command	Control Register		Coil
	Command Input/Output Register		Holding register

4.4.2 Setting PLC Communication

In PLC communication, commands and results are sent and received using the registers of a PLC to communicate. More than one register area is used for each function. Set register areas as the figure below.

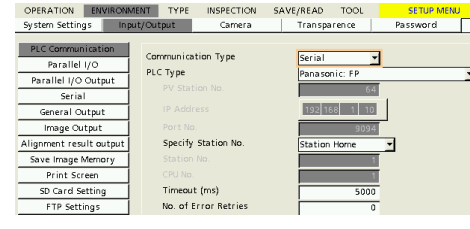
Relation between setting items and PLC registers



PLC Communication Common Setting

This is the common setting for sending and receiving result output and control commands.

1. Select "ENVIRONMENT" > "Input/Output" > "PLC Communication" from the menu bar.



2. Select a communication port in "Communication Type".
Select "PLC Type".

Serial	Communicates with RS-232C interface.
Ethernet	Communicates with Ethernet interface.

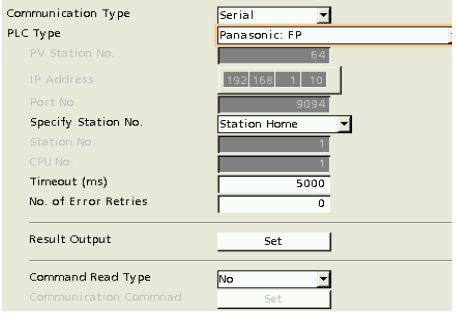
Selectable PLC types differ depending on the communication type.

3. Set time for “Timeout (ms)”.

20 – 20000 msec (default: 5000)

▶ Note

When PV240 writes data in the specified address of PLC, it sends and receives commands and response messages in the dedicated protocol between PV240 and PLC. The value set here is Timeout in the message communication in this case.
If PLC sends no response in the time of Timeout, a timeout error occurs.



4. Set "No. of Error Retries".

0 – 255 (Default: 0)

5. According to the function to be used, set "Result Output" or "Communication Command".

PLC Communication (General) Output Setting

1. Make PLC communication common settings.

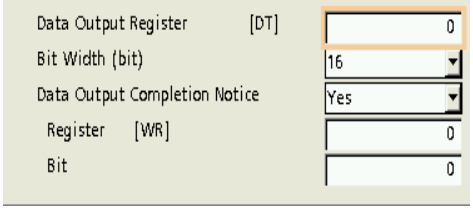
2. Select “ENVIRONMENT” > “Input/Output” > “PLC Communication” > “Result Output” from the menu bar.

3. In “Data Output Register”, specify the first register number of the PLC that PV240 outputs data into.

0 to 99999 are available.

▶ Note

Not all addresses 0 to 99999 can be used in destination PLC. As the address allowed to be written by the external device (PV240) varies depending on PLC, please make sure the address with the instruction manual of PLC.
The number of data registers differ depending on the number of data to be output and "Bit Width". Be sure to set address number not to destroy the contents of registers used for other applications.



4. Select 16-bit or 32-bit to output Scan count and Numerical calculation data in “Bit Width” according to the maximum value of the data to be output.When output data exceeds the value which can be output in the selected Bit Width, "0" is output.

5. To notice to PLC that data output is complete, set “Data Output Completion Notice” to “Yes”.

Specify an address to make the specified bit to “1” and the bit.

Register: 0 - 99999:	It varies according to the PLC used.
Bit: 0 - 15:	Specifying “15” makes the highest order bit "1".

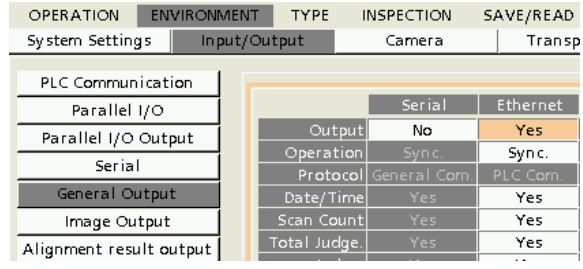
▶ Note

For Mitsubishi PLC, enter interface No. to output register. (Output bit is invalid.)

6. Select “ENVIRONMENT” > “Input/Output” > “General Output” from the menu bar.

7. Set "Output" to "Yes" for the selected communication port, and select "PLC communication" in Protocol.

When the communication port is Ethernet, select the column of PLC communication in advance. For PLC communication, either “Serial” or “Ethernet” can be selected..



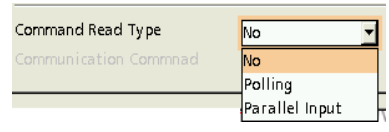
8. Set "Date/Time", "Scan Count", "Total Judgement", "Judgement", and "Numerical Calculation" to "Yes" as necessary.

PLC Communication Control Command Setting

Make PLC communication common settings.

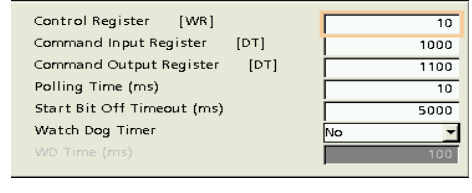
1. Select either "Polling" or "Parallel Input" in "Command Read Type" from "ENVIRONMENT" > "Input/Output" > "PLC Communication".

Select the trigger for PV240 to start reading data from PLC.



No	Not perform command control.
Polling:	Periodically checks whether commands are written in PLC or not, and starts reading the commands once the completion is confirmed. The response speed is slower than that of "Parallel Input". The time such as the time of inspection or image output gets longer because the polling process is performed even during the inspection. Set "Polling Time" and "Start Bit Off Timeout" in step 7. Set "Watch Dog Timer" as necessary.
Parallel Input	Starts reading commands from PLC when the signal is input to PV200 from a parallel input terminal (*). *: Terminal among one of ASSIGN0, 1 and EXTRA 0 to 2 assigned to "PLC Communication Command". (Set in "ENVIRONMENT" > "Input/Output" > "Parallel I/O")

2. Open the "Communication Command" menu.

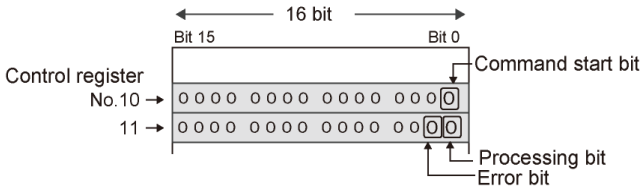


▶ Note

The display of "WR" and "DT" in the menu is different between PLC types.

3. ”Control Register": Specify the start address of the control register to be used for sending and receiving the control command.

According to the bit information of the specified control register, it is used as the command start bit, error bit, processing bit or transmitting bit.
It is used as the watch dog bit when using watch dog timer.
For the information of using the control register.



Example: Control Register = 10

4. "Command Input Register": Specify the start register number in which PLC writes commands for PV240.

There is a command which uses a maximum of twelve words. It is recommended not to use twelve words for other applications.
Please refer to PV200User's Manual for details.

5. "Command Output Register": Specify the start register number in which PV200 writes responses to PLC.

There is a response which uses a maximum of nine words. It is recommended not to use nine words for other applications.
Please refer to PV200User's Manual for details.

6. When "Polling" was selected in step 2, set "Polling Time (ms)" and "Start Bit Off Timeout (ms)".

"Polling Time"	The cycle that PV240 monitors the registers of PLC. The shorter the cycle, the faster the response after a command is written by PLC. However, it affects the execution time as PV240 monitors the PLC registers during inspections. The actual polling frequency may be longer than the frequency set here. The actual polling frequency is displayed in the information area of RUN menu. Please check it.
"Start Bit Off Timeout"	The time until PLC turns off the command start bit after PV240 turns on the command processing bit. The error (E0113) occurs when the command start bit does not turn off within the time set here.

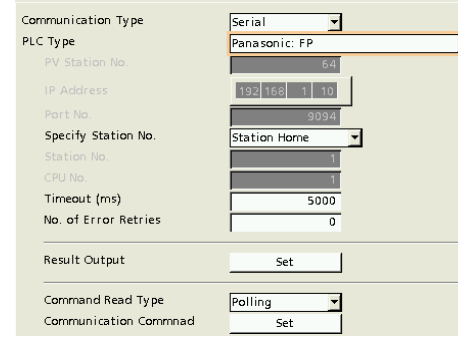
7. When "Polling" was selected in step 2, set " Watch Dog Timer" and "WD Time (ms)"as necessary.

The watch dog timer is to notify that PV240 is in the normal communication status such as no disconnection of the communication cable to PLC. When setting "Watch Dog Timer" to "Yes", the watch dog bit is overwritten during inspection. It affects the execution time or the response time to the command transmitted from PLC.

No	Not activate watch dog timer.
Yes	Activates watch dog timer. "Watch Dog Time" can be set freely, however, the watch dog timer is activated with a period of polling time. Actually, it is activated with a period of the integral multiple of polling time and a longer period of the set watch dog time. For information on the registers used for watch dog, refer to PV200 User's Manual.

When performing PLC communication using RS-232C Interface

1. Make PLC communication common settings.



2. Only when selecting "Panasonic: FP" for PLC Type, set "Specify Station No.".

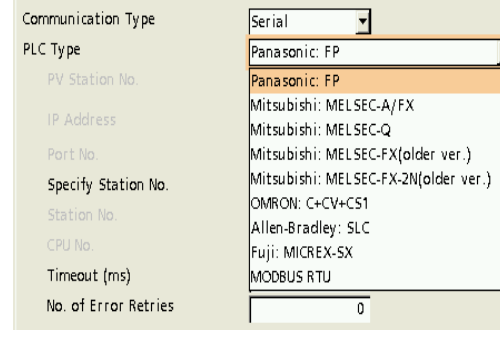
Station Home (Default):
A command which specifies no station number is issued.
Example) %EE#WDD0001 · · · · ·

Specify Station No. (Station No.:1 – 99):
A command for a PLC with the specified station number is issued. Specify the same number of the station number that is set for the PLC to communicate in "Station No.".
Example) When Station No. is 99 %99#WDD0001 · · · ·

When performing PLC communication using Ethernet interface

Note Applicable PLCs are three types.

1. Make PLC communication common settings.



2. Specify the network setting of the selected "PLC Type".

The network setting consists as listed below.
- PV240 station No.
- PLC IP address
- PLC Port No.
- Specify PLC Station No.
- PLC Station No.

Note
Items to be specified vary depending on the selected PLC type. For the detail, refer to steps 3 to 6.

3. Specify the PV240 station No. in "PV Station No.".

Selectable station No.: 1 to 64
Note
Set only when PLC Type is Panasonic: FP (ET-LAN unit)

4. Assign the IP address to the PLC.

5. Specify the port number of the PLC.

Input the same number as the port number set on the PLC to communicate.
When PLC Type is Panasonic: FP
When PLC Type is Panasonic: FP (ET-LAN unit)
Available port No. on PV240: 1 to 32767 (except 8600 to 8699 and 9090)
Default: 9094

When PLC Type is Mitsubishi: MELSEC-Q
Available port No. on PV240: 1 to 65534 (except 8600 to 8699 and 9090)
Default: 5000

6. **Select whether to limit the PLC to communicate by setting "Specify Station No." or not.**

Note

This item is set when PLC Type is Panasonic: FP or Panasonic: FP(ET-LAN unit).

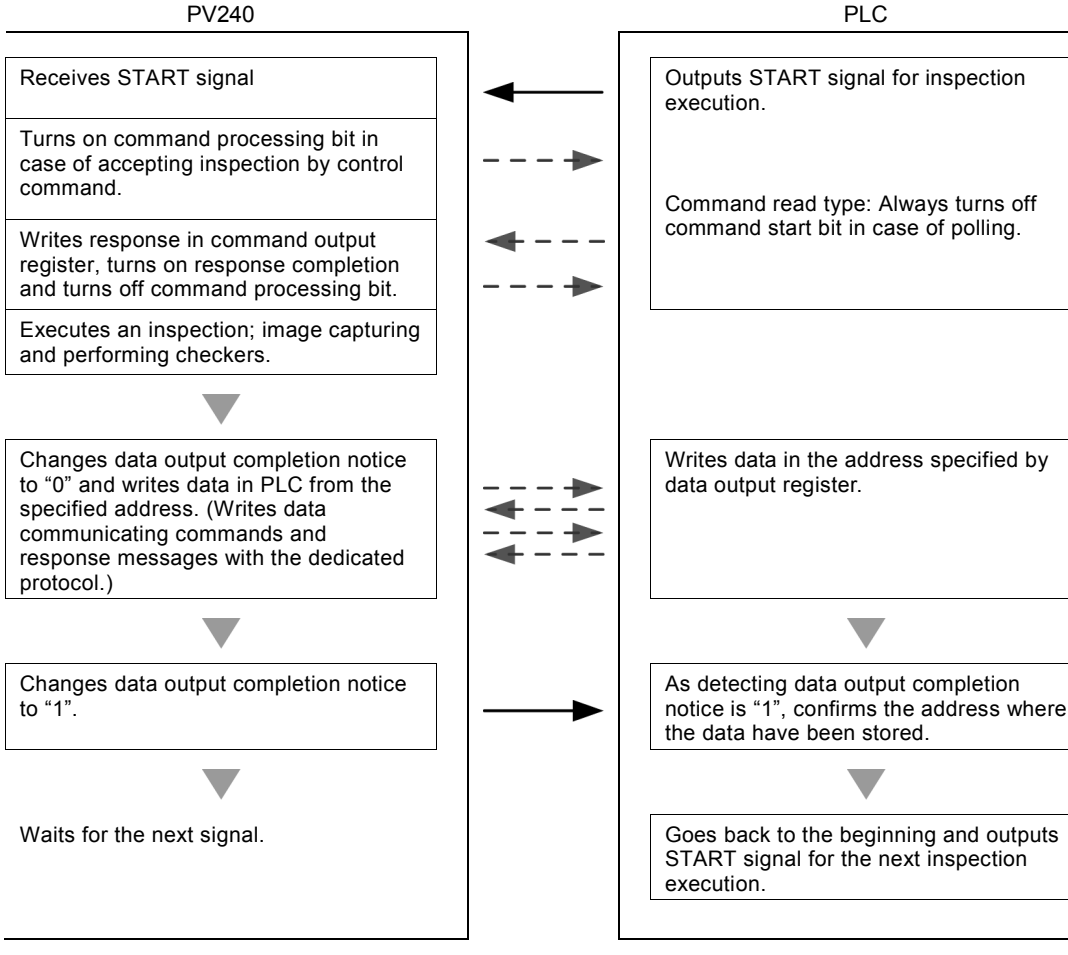
Station Home (Default):	A command which specifies no station number is issued. Example) %EE#WDD0001 .....
Specify Station No. (Station No. 1 - 99)	A command for a PLC with the specified station number is issued. Specify the same number of the station number that is set for the PLC to communicate. Example) When Station No. is 50, %50#WDD0001 .....

When PLC Type is Panasonic: FP
Settable Range: 1 to 99

When PLC Type is Panasonic: FP (ET-LAN unit)
Settable Range: 1 to 64
The number specified in the step 3 "PV Station No." cannot be used.

4.4.3 Outputting Data through PLC Communication

Data Output Flaw



About Data that can be Output

When PV240 executes inspection, the data set to output are output in the following order.

1. Date/Time
2. Scan Count
2. Total Judgement
3. Judgement result:
4. Numerical Calculation:

Up to 1000 points combining judgements and numerical calculations.

In the following cases, the data of Judgement and Numeric Calculation are not output to PLC.

- PV sets data to output, but no data exist.
- The setting data exist, but data are set to not to be output.

Output format of Date/Time:

Output Data	Regardless of output bit width, 3 words (48 bits) are used. Order of output: 1st word; "Year and Month (YYMM)", 2nd word; "Date and Hour (DDH)", 3rd word; "Minute and second (MMSS)". It does not depend on the format of the calendar in PV240. (Output example) 15:26:03 on August 31, 2014 1408 3115 2603 YYMM DDHH MMSS

Output format of Scan count:

Output Data	Differs depending on the setting of Output bit width. • Range (16 bits) between 1 and 32767 • Range (32 bits) between 1 and 2147483647	
Number of Data	1	
Values to be Output	Normal	1 to 2147483647
	Overflow (when exceeding the specified "Bit Width")	0

Output format of Total Judgement:

Output Data	Regardless of output bit width, it is output in the last bit using one word.	
Number of Data	1	
Values to be Output	OK	1 in hexadecimal form (0001 in binary form)
	NG	0 in hexadecimal form (0000 in binary form)
	Error	E in hexadecimal form (1110 in binary form)
	Unset	E in hexadecimal form (1110 in binary form)

Output format of Judgement data:

Output Data	A Judgement is output in 4-bit (digit) unit Four data of Judgement per word from PLC are saved starting with LSB. When the outputting data is other than multiples of four, hexadecimal E is output.	
Number of Data	Up to 1000	
Values to be Output	OK	1 in hexadecimal form (0001 in binary form)
	NG	0 in hexadecimal form (0000 in binary form)
	Error	E in hexadecimal form (1110 in binary form)
	Unset	Data are not output. (But if the Judgement data No.s before and after the unset data No. are set to output, E is output in 16-digit form (1110 in binary form).)

Output format of Numerical Calculation:

The values that can be output are only integers. Actual values with value after decimal point are rounded to whole number and output.

Output Data	Differs depending on the setting of Output bit width. • Range of 16-bit: -32768 to 32767 • Range of 32-bit: -2147483648 to 2147483647	
Number of Data	Numerical Calculation: Up to 1000	
Values to be Output	Normal	Range of specified bit width
	Overflow (when exceeding the specified "Bit Width")	- Range of 16-bit: If the numerical calculation results to be output exceeds the ranges of 16-bit and 32-bit regardless of setting to output or not, all the numerical calculation results are output as "0". - Range of 32-bit: Only the numerical calculation results which exceed the range of 32-bit are output as "0".

	Error	- Range of 16-bit: If an error occurs in any of the set numerical calculation regardless of setting to output or not, all the numerical calculation results are output as "0". - Range of 32-bit: (Only the erroneous numerical calculation result is output as"0".)
	Unset or not output	Data are not output.

Example of General Output

Output Condition - Output Data:

- Date and Time: 15:26:03 on August 31, 2014
- Scan count: 1234 times
- Total Judgement: OK
- Judgement: JDC000=OK, JDC001=unset, JDC002=NG, JDC003 or later=Unset
- Numerical Calculation: CAC000=215.3, CAC001=unset, CAC002=-2184.6, CAC003 or later=Unset

Output Result: Bit Width(bit) = 16 bit, Data Output Register = 500

Data	Register No.	Value (Hex.)	Description																Details
Date/Time	500	1408	Year-Month (Value calculated by subtracting 2000 from Year is displayed.)																
	501	3115	Date-Hour																
	502	2603	Minute-Second																
Scan Count	503	04D2	“1234” is stored.																Scan Count
			Bit 15 ←→ Bit 0																
Total Judgement	504	0001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	OK
Judgement	505	E01E	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	0	JDC001, JDC002
Numerical calculation	506	00D7	“215” is stored.																CAC000
	507	F777	“-2185” is stored.																CAC002

Concept:

- The number of scans is stored in the start register (data output register).
  When specifying "32-bit" for "Bit Width", the number of scans is stored in the first two registers.
- Four pieces of judgement data are stored per word (16 bits). (Four bits are used for a piece of data.)
  Data is output up to Judgement specified with the largest number. For unset judgement data within the range, "E" is output such as JDC000.
  Also, when the number of output data is "3" which is not multiples of 4 like this example, "E" is stored in each part which cannot make a word.
- Only the data of Numeric Calculation that are set to output are output.
  (In the case where the data of CAC000 or CAC002 is out of the range between -32768 and +32767, “0” is stored in the registers No.506 and 507.)
- Numerical calculation results are rounded to whole numbers and output.
- Negative numbers are output in the complement number of 2.
- When specifying "32-bit" for “Output data”;
  - Four Judgement data are stored per word as the same as when you select "16-bit".
  - Each data of Scan Count and Numerical Calculation uses two words (32-bit). In the case, the data is output from of lower 16-bit to upper 16-bit, and data of lower word (16-bit) is stored in the register of smaller number.

4.4.4 Controlling PV240 through PLC Communication

For controlling PV240 through PLC Communication, PLC sends commands to PV240 and receives the responses.

For the details of the control and commands to be used, refer to PV200 User's Manual .PV240 uses the following signals for the timings that PV240 reads commands sent by PLC and PLC receives responses. Refer to the timing charts for the details of the timing of each signal.

Those signals can be read when PV240 is in RUN menu. PV200 cannot be controlled when it is in SETUP menu. (Refer to PV200 User's Manual)

Timing signal for PV240 to read the command sent by PLC

The timing varies according to the selected "Command Read Type".

Polling	Uses the command start bit of the control register. PLC turns on the command start bit after writing a command.
Parallel Input	PLC turns on the signal of "Read PLC Communication Command" assigned to ASSIGN or EXTRA after writing a command.

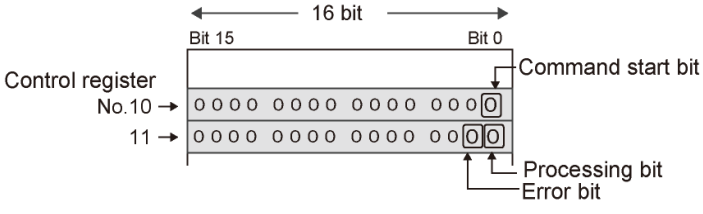
Timing signal for PLC to read the received response

PV240 sets the response completion (COR = the first word of command output register) to 1 after writing responses.

Also, PV240 sets the processing bit of the control register to zero after setting the response completion (COR) to one.

Control register

Example: Control Register = 10



Command start bit:

The zeroth register number specified in "Control Register".
It is used when setting "Command Read Type" to "Polling". It indicates that a command was sent to PV240 from PLC. PLC turns on (sets to 1) after setting the command. PV240 performs polling, and starts reading the command after confirming this bit is on. Also, PLC turns off this bit (sets to zero) when the processing bit is on.

Processing bit:

The zeroth bit of the next register number specified in "Control Register".
PV240 turns on this bit (sets to 1) during the command processing. After the processing, PV240 writes response to the command in the command output register and turns off this bit (sets to zero). Monitoring this bit shows the timing that the next trigger can be used.

Error bit:

The first bit of the next register number specified in "Control Register".
It indicates that an error occurred. When an error occurred, PV240 turns on this bit (sets to 1).
(1) When the response error to the control command occurred
(2) When the "Start Bit Off Timeout" error occurred when using polling

Transmitting bit :

The eighth bit of the next register number specified in "Control Register".
It indicates PV240 can communicate. In such state, PV240 turns on this bit (sets to 1).
It turns on when RUN menu is displayed after the startup of PV240. As PV240 cannot perform PLC communication once switching to SETUP menu, PV240 turns off this bit (sets to zero).

If PV200 is turned off or the communication cable is disconnected while this bit is on, it will retain on state.

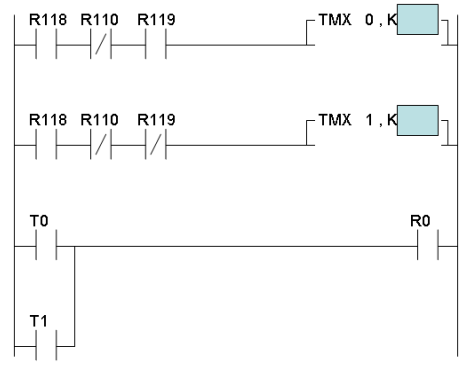
Watch Dog bit :

The ninth bit of the next register number specified in "Control Register"
When "Watch Dog Timer" is set to "Yes", PV240 switches this bit on (sets to 1) and off (sets to 0) periodically. The watch dog bit is overwritten with a period of the integral multiple of polling time and a longer period of the set watch dog time. However, when the transmitting bit is off, PV240 does not switch the watch dog bit on and off. Also, during some processings such as saving the image memory in a SD card (the processing bit turns on), the processing time of switching the watch dog bit on and off gets slow.

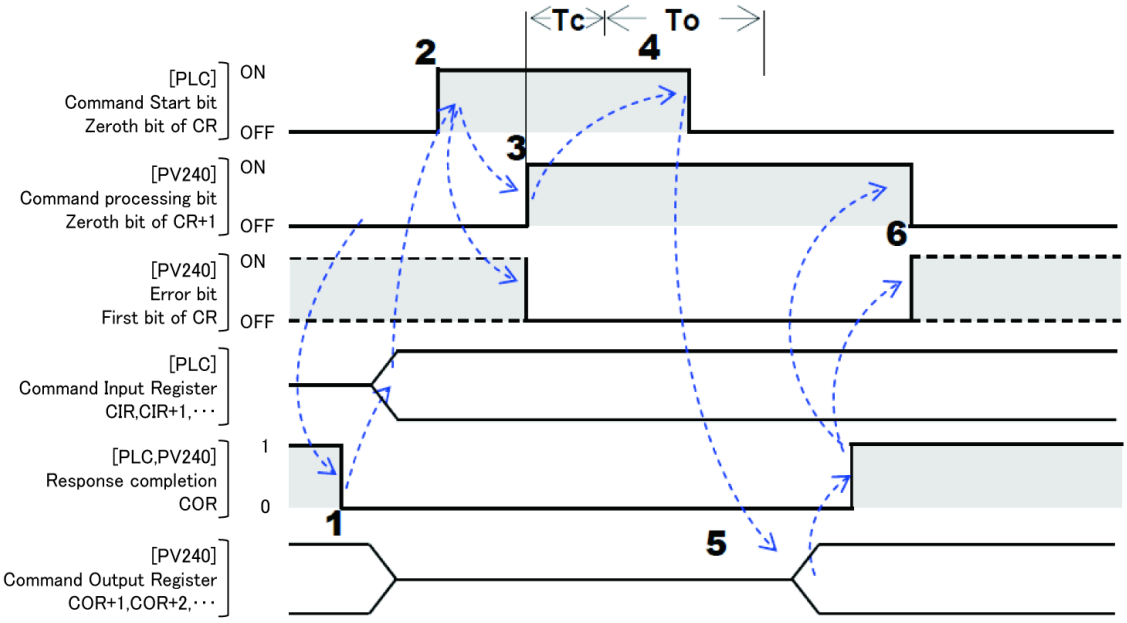
Therefore, for checking communication errors, set the check timer long enough in combination with the processing bit, transmitting bit and watch dog bit.

R110:	Processing bit
R118:	Transmitting bit
R119:	Watch Dog bit
T0:	Watch dog bit ON check timer
T1:	Watch dog bit OFF check timer
R0:	Communication error

Example of sequence for checking communication errors



PLC Communication: Control Command Timing Chart (Command Read Type: Polling)



Tc: Command processing time. It varies depending on the content. For example, the processing time of saving data in a SD card may be over several seconds.
To: Timeout period. An error occurs when the command start bit does not turn off within the time of Tc + To.
CR: PLC address specified in "Control Register".
CIR: PLC address specified in "Command Input Register".
COR: PLC address specified in "Command Output Register".

1. **PLC confirms that the command processing bit is off, and resets the response completion (COR) to zero to clear the previous result output. (Off-state) Then, PLC writes a command in the command input registers (CIR, CIR+1, ...) to give PV240.**

2. **PLC turns on the command start bit.**
   PV240 monitors the command start bit in the specified polling cycle, and starts reading the commands from the command input register (CIR) as the first register once it confirms that the start bit is on.

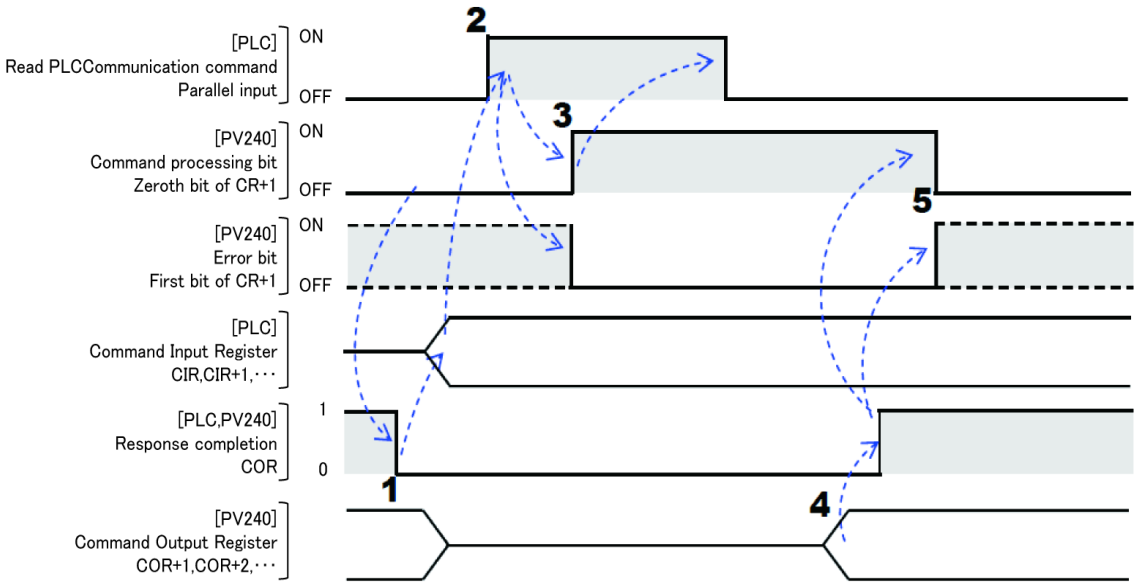
3. **PV200 turns on the command processing bit. Also, PV240 turns off the error bit regardless of the previous state.**

4. **PLC turns off the command start bit within the time of Tc + To after confirming the command processing bit is on.**
   During this process, PV240 confirms that the command start bit is off by polling.
   PV240 responds the error code (113) when the command start bit does not turn off within the time of Tc + To.

5. **PV240 write responses in the command output register, and then sets the response completion (COR) to 1. (On-state)**

6. **PV240 turns off or on the error bit according to the error occurrence, and then turns off the command processing bit.**

PLC Communication: Control Command Timing Chart (Command Read Type: Parallel Input)



CR: PLC address specified in "Control Register".
CIR: PLC address specified in "Command Input Register".
COR: PLC address specified in "Command Output Register".

1. **PLC confirms that the command processing bit is off, and resets the response completion (COR) to zero to clear the previous result output. (Off-state) Then, PLC writes a command in the command input registers (CIR, CIR+1, ...) to give PV240.**

2. **PLC turns on the "Read PLC Communication Command" assigned to the parallel I/O terminal of PV240.**
   PV240 starts reading the commands from the command input register (CIR) as the first register once it confirms this parallel signal is on.

   Assign "Read PLC Communication Command" to one of ASSIGN0-1 and EXTRA0-2 from "ENVIRONMENT" > "Input/Output" > "Parallel" in SETUP menu.

3. **PV240 turns on the command processing bit. Also, PV240 turns off the error bit regardless of the previous state.**
   PLC can turn off the "Read PLC Communication Command" signal after turning on the command processing bit.

4. **PV240 write responses in the command output register, and then sets the response completion (COR) to 1. (On-state)**

5. **PV240 turns off or on the error bit according to the error occurrence, and then turns off the command processing bit.**

4.4.5 List of PLC Communication Commands

The following commands are used for PLC communication.

List of Alignment Commands

	Refer to	Command	Description
Request Stage Current Position	130	**TAG**	Obtains the coordinate of the stage current position.
Request Stage Absolute Position Move	131	**TAR**	Specifies the movement amount of stage absolute position. It is specified with the absolute position (stage coordinate system) of XYTheta or UVW.
Execute Calibration	132	**CAE**	Starts a calibration sequence.
Execute Auto Alignment	134	**AAE**	Starts an auto alignment sequence. Target running offsets are specified.
Execute Auto Alignment (Simple Flow)	135	**AAS**	Starts an auto alignment sequence. Target running offsets are specified. Obtaining the stage current position (TAG) at the time of retry is omitted, and the execution time is shorter than AAE command.
Get Target Position	136	**TGG**	When "Target Position" is set to "Mark Detection", detected mark position is registered as target position. When "Target Position" is set to "Center of Display", center position of display is registered as target position.
Get Object Position	137	**OBG**	Detects object marks.
Reset, Cancel Alarm	138	**ARR**	Turns off the parallel I/O error flag. Clears an error message on the screen.
Execute Aligment for 1 camera	139	**ACL**	Executes an alignment sequence once at an obtained object position.
Get Deviation	140	**GDV**	Obtains the amount of deviation between the target and object positions.
Get Stage Adjustment Amount	141	**AZG**	Obtains the adjustment amount (absolute value) based on the current position (absolute value).
Set Target Position (Specify Camera Coordinate)	141	**TGS**	Specifies camera coordinates and registers the position.
Move Rotation Center	143	**SRP**	Moves the rotation center for alignment calibration.
Print Screen	144	**PS**	Obtains print screen images of screens.
Save Print Screen in Image Memory	145	**PSM**	Saves print screen images in the dedicated image memory.
Save Print Screen in SD	145	**SSM**	Saves print screen images saved in the dedicated image memory to an SD card, and clears data within the image memory.
Get Distance between Target/Object Marks	146	**GML**	Obtains two distances between target marks and the distance between object marks.
Change Camera Shutter Speed	146	**CSH**	Changes the shutter speed of a camera.
Change Threshold of Change Judgement	147	**SCT**	Changes the threshold of change judgement of X, Y and Theta.
Get Deviation/Stage Adjustment Amount	148	**AOG**	Obtains the current value, and returns the adjustment amount plus the amount of deviation after the detection of an object.
Set Object Position	149	**OBS**	Assigns the coordinate of an object position directly instead of the detected position by the checker when executing alignment.
Output Alignment Result Data	150	**RTD**	Saves the latest result of the execution of Alignment to an SD card.

Note

*1: Both reading and writing cannot be executed when the PV240 stops.

*2: This cannot be executed when you select “TOOL” > "General", "Setting Help", or "Update".

4.5 Descriptions of PLC Communication Commands

The "Command" in the tables means commands to be issued (sent) to PV200 from PLC. CIR is written at the beginning. The "Response" means the responses to PLC from PV240 to the sent commands. COR is written at the beginning.

The CIR and COR in the tables mean the following contents.

CIR: Address specified in "Command Input Register". A request to PV240 is written with this address at the beginning.

COR: Address specified in "Command Output Register". A response is written by PV240 with this address at the beginning.

The common error codes in PLC communication are as follows. For the details of the error codes peculiar to each command, refer to the description of each command.

Error code

100 An undefined command was sent.

111
- PLC response timeout
- Register number error
- Format error of a response from PLC

113 Command Start Bit Off Timeout

114 When "Parallel Input" has not been selected for "Command Read Type", the "Read PLC Communication Command" signal was input.

For Read and Write commands

200 Operation is stopped. (However, except Read of "Operation Status")

252
- The specified parameter does not exist. (e.g. The number of uncreated checker is specified as a parameter.)
- The specified parameter value is out of the settable range. (e.g. Maximum value of slice level is being set to over 256.)
- The specified values led to the status of “Maximum value < Minimum value” when entering them.
- When specifying the moving distance of the marker, a part of the circumscribing rectangle of the marker (the intersection point when Shape is Cross line) after move was out of the nine screens where checker area is settable.

Request Stage Current Position［TAG］

Requests the stage current position.

Command	
CIR	**4001 h**
CIR +1	**0100 h**
CIR +2	**0014 h**
CIR +3 , CIR +4	**Axis #1 absolute value**
CIR +5 , CIR +6	**Axis #2 absolute value**
CIR +7 , CIR +8	**Axis #3 absolute value**
CIR +9 , CIR +10	**Axis #4 absolute value**
CIR +11,CIR +12	**Axis #5 absolute value**

Response	
COR	**000A h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

	XYTheta Stage	Line Theta Stage	UVW Stage
Axis #1 absolute value	X-axis position		U-axis position
Axis #2 absolute value	Y-axis position		V-axis position
Axis #3 absolute value	Theta-axis position	Stroke position	W-axis position
Axis #4 absolute value	Not used (0 fixed)		
Axis #5 absolute value			

Parameter	
X-axis position	1 / 10000 mm
Y-axis position	1 / 10000 mm
Theta-axis position	1 / 100000 degree
Stroke position	1 / 10000 mm
U-axis position	1 / 10000 mm
V-axis position	1 / 10000 mm
W-axis position	1 / 10000 mm

Request Stage Absolute Position Move［TAR］

Specifies the movement amount of stage absolute position.
It is specified with the absolute position (stage coordinate system) of XYTheta or UVW.

Command	
CIR	**4001 h**
CIR +1	**0200 h**
CIR +2	**0000 h**

Response	
COR	**0014 h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0014 h**
COR +3 , COR +4	**Axis #1 absolute value**
COR +5 , COR +6	**Axis #2 absolute value**
COR +7 , COR +8	**Axis #3 absolute value**
COR +9 , COR +10	**Axis #4 absolute value**
COR +11,COR +12	**Axis #5 absolute value**

	XYTheta Stage	Line Theta Stage	UVW Stage
Axis #1 absolute value	X-axis position		U-axis position
Axis #2 absolute value	Y-axis position		V-axis position
Axis #3 absolute value	Theta-axis position	Stroke position	Theta-axis position
Axis #4 absolute value	Not used (0 fixed)		
Axis #5 absolute value			

Parameter	
X-axis position	1 / 10000 mm
Y-axis position	1 / 10000 mm
Theta-axis position	1 / 100000 degree
Stroke position	1 / 10000 mm
U-axis position	1 / 10000 mm
V-axis position	1 / 10000 mm
W-axis position	1 / 10000 mm

Execute Calibration [CAE]

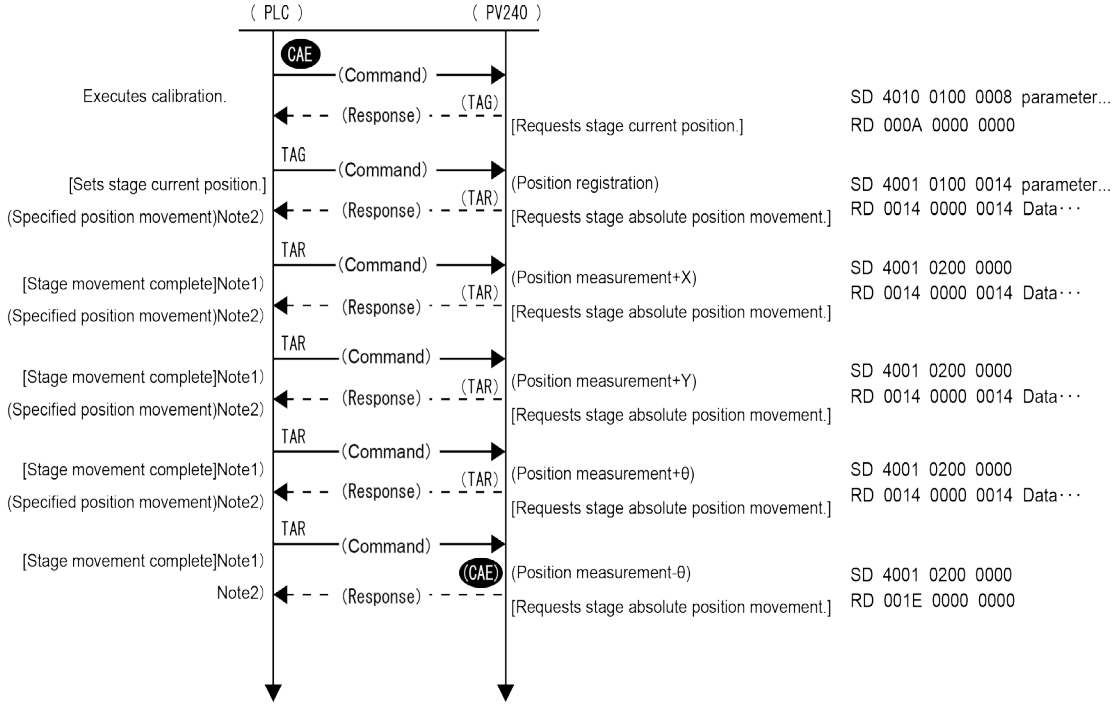
Starts a calibration sequence.

Command	
CIR	**4010 h**
CIR +1	**0100 h**
CIR +2	**0008 h**
CIR +3 , CIR +4	**Mark No.**
CIR +5 , CIR +6	**Reserved**

Response	
COR	**001E h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

Parameter	
Mark No.	0: Mark0 and Mark1 1: Mark0 2: Mark1
Reserved	0: Fixed

●Command Flow



Note1) Error processing is performed when movement cannot be completed.
Note2) Alignment checker execution error processing

Execute Calibration (with Rotation Point Adjustment) [CAE]

Starts a calibration sequence when Rotation Point Adjustment is performed.

Command	
CIR	**4010 h**
CIR +1	**0100 h**
CIR +2	**0008 h**
CIR +3 , CIR +4	**Mark No.**
CIR +5 , CIR +6	**Reserved**

Response 1	
COR	**001E h**
COR +1	**Error Code**
COR +2	**0000 h**

Response 2	
COR	**001E h**
COR +1	**Error Code**
COR +2	**0004 h**
COR +3 , COR +4	**Final deviation**

Response 3	
COR	**001E h**
COR +1	**Error Code**
COR +2	**0008 h**
COR +3 , COR +4	**Final deviation**
COR +5 , COR +6	**Final deviation**

Parameter	
Mark No.	0: Mark0 and Mark1 1: Mark0 2: Mark1
Reserved	0: Fixed
Final deviation	1 / 10000 mm

Execute Auto Alignment[AAE]

Starts an alignment sequence.
This command is used when capturing two object marks simultaneously.

▶ Note

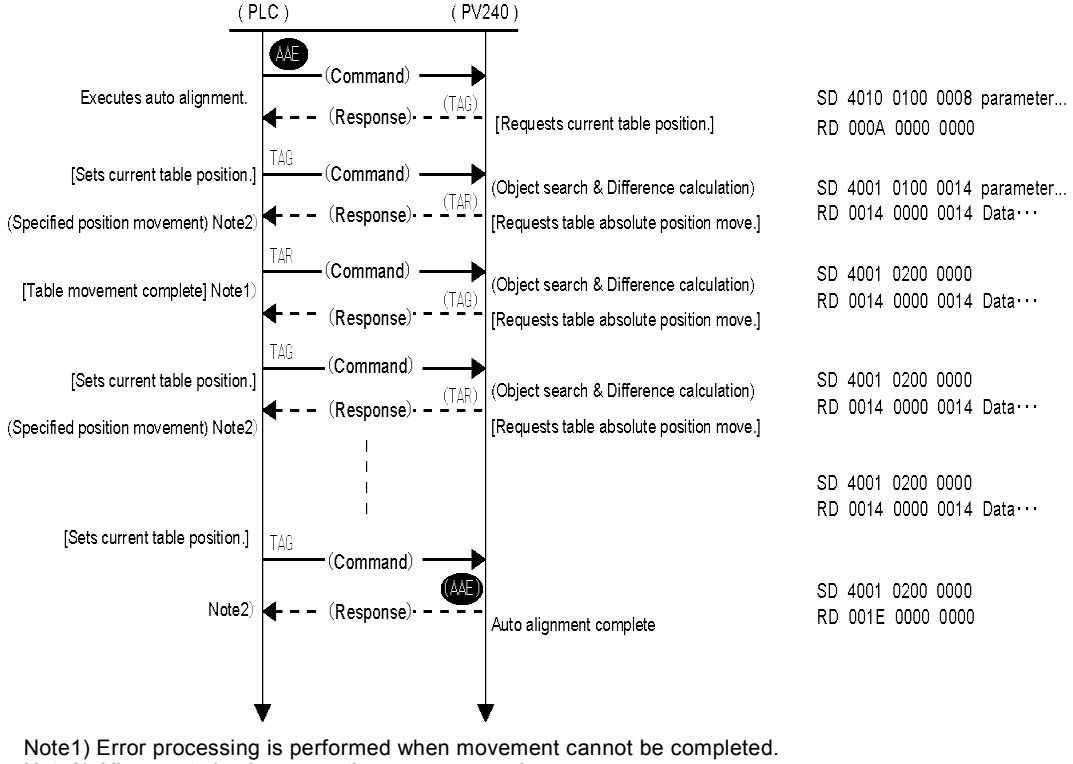
When the timing of capturing the object mark0 is different from that of capturing the mark1, use ACL command.

Command	
CIR	**4010 h**
CIR +1	**0200 h**
CIR +2	**0010 h**
CIR +3 , CIR +4	**Reserved**
CIR +5 , CIR +6	**X offset**
CIR +7 , CIR +8	**Y offset**
CIR +9 , CIR +10	**Theta offset**

Response	
COR	**0028 h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

Parameter	
Reserved	0: Fixed
X offset	1 / 10000 mm
Y offset	1 / 10000 mm
Theta offset	1/100,000 degree

●Command Flow



Note1) Error processing is performed when movement cannot be completed.
Note2) Alignment checker execution error processing

Execute Auto Alignment (Simple Flow)［AAS］

Starts an auto alignment sequence. Target running offsets are specified. Obtaining the stage current position (TAG) at the time of retry is omitted, and the execution time is shorter than AAE command. This command is used when capturing two object marks simultaneously.

▶ Note

When the timing of capturing the object mark0 is different from that of capturing the mark1, use ACL command.

Command	
CIR	**4010 h**
CIR +1	**0202 h**
CIR +2	**0010 h**
CIR +3, CIR +4	**Reserved**
CIR +5, CIR +6	**X offset**
CIR +7, CIR +8	**Y offset**
CIR +9, CIR +10	**Theta offset**

Response	
COR	**002A h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

Parameter	
Reserved	0: Fixed
X offset	1 / 10000 mm
Y offset	1 / 10000 mm
Theta offset	1 / 100000 degree

Get Target Position[TGG]

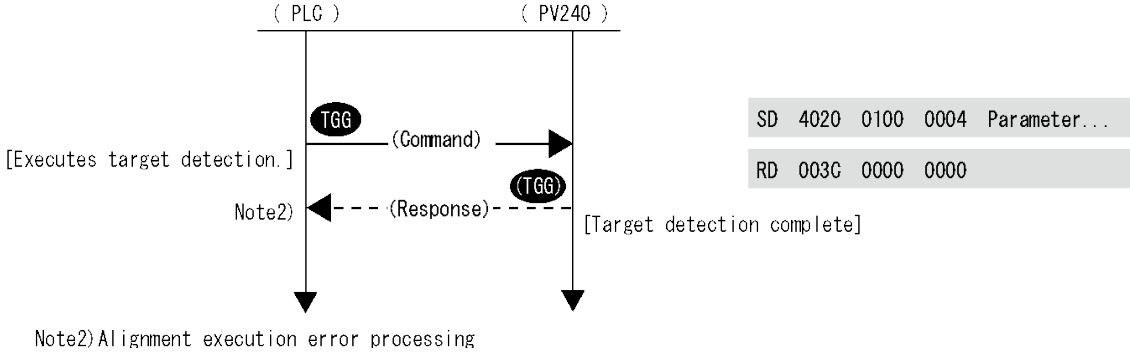
When "Target Position" is set to "Mark Detection", a detected mark position is registered as the target position.
When "Target Position" is set to "Center of Display", the center position of the display is registered as the target position.

Command	
CIR	**4020 h**
CIR +1	**0100 h**
CIR +2	**0004 h**
CIR +3 , CIR +4	**Mark No.**

Response	
COR	**003C h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

Parameter	
Mark No.	0: Mar0 and Mar1 1: Mark0 2: Mark1

●Command Flow



Get Object Position［OBG］

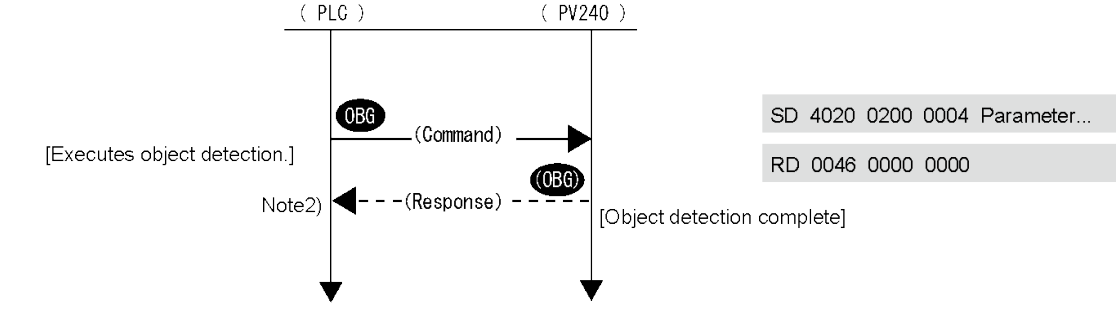
Detects object marks.

Command	
CIR	**4020 h**
CIR +1	**0200 h**
CIR +2	**0004 h**
CIR +3 , CIR +4	**Mark No.**

Response	
COR	**0046 h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

Parameter	
Mark No.	0: Mar0 and Mar1 1: Mark0 2: Mark1

●Command Flow



Note2)Alignment execution error processing

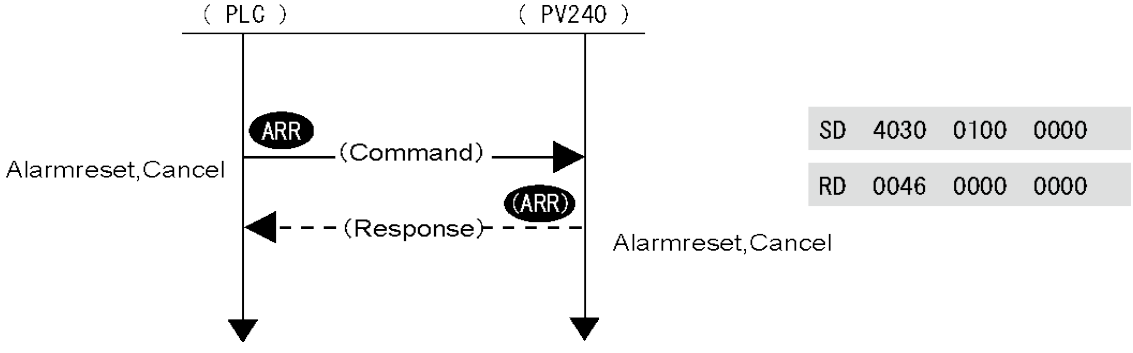
Reset, Cancel Alarm［ARR］

Turns off the parallel I/O error flag.
Clears an error message on the screen.

Command	
CIR	**4030 h**
CIR +1	**0100 h**
CIR +2	**0000 h**

Response	
COR	**0064 h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0**

●Command Flow



Execute Alignment for 1 Camera (with Target Offsets)[ACL]

Executes an alignment sequence once by this command after obtaining two object positions. Target offsets can be specified.
This command is used when the timing of capturing object marks is different between Mark0 and Mark1, in such a case that one object mark is captured after moving a camera after the other mark was captured. (It is not related to "TYPE" > "Type Setting" > Capture Delay".) Use AAE or AAS command for capturing two object marks simultaneously.

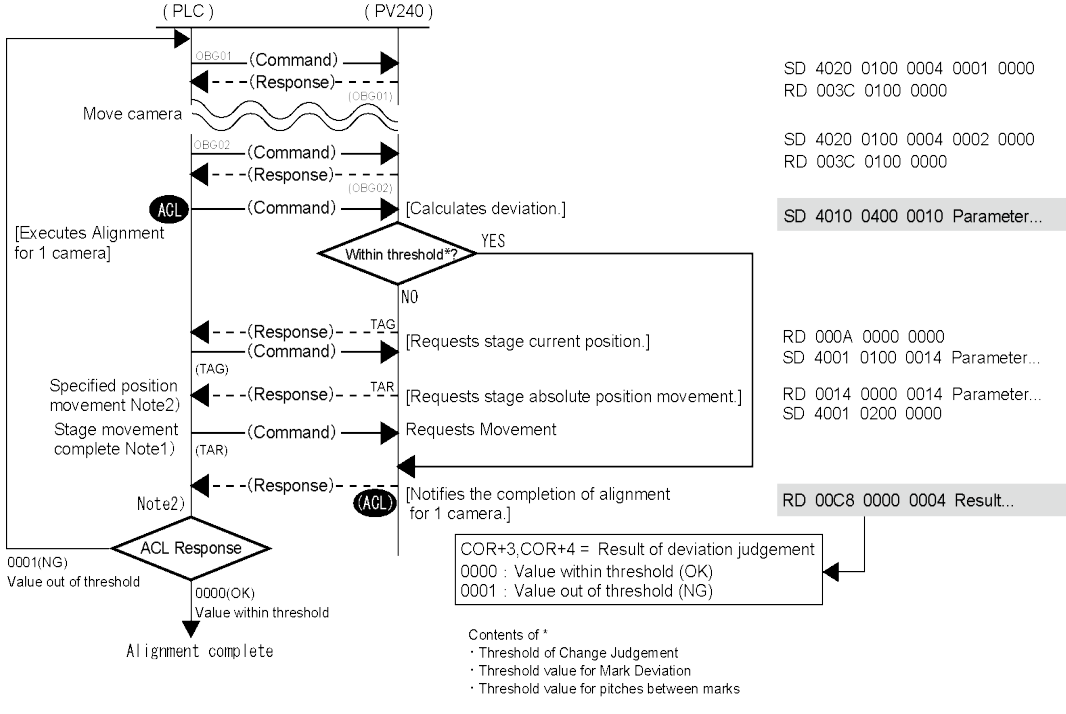
Command	
CIR	**4010 h**
CIR +1	**0400 h**
CIR +2	**0010 h**
CIR +3, CIR +4	**Reserved**
CIR +5, CIR +6	**X offset**
CIR +7, CIR +8	**Y offset**
CIR +9, CIR +10	**Theta offset**

Response	
COR	**00C8 h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0004 h**
COR +3, COR +4	**Result* = OK (0000), NG (0001)**

* A value returned to "Result" at the time of error occurrence is not determined. Sometimes, 0000 is returned.

Parameter	
Reserved	0: Fixed
X offset	1 / 10000 mm
Y offset	1 / 10000 mm
Theta offset	1 / 100000 degree

●Command Flow



Note1) Error processing is performed when movement cannot be completed.
Note2) Alignment checker execution error processing

Get Deviation (with Target Offsets)[GDV]

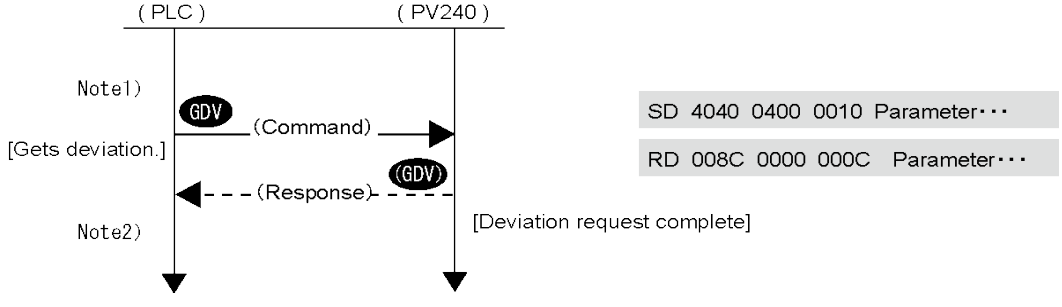
Gets the difference between the currently detected target position and object position. Target offsets can be specified.

Command	
CIR	**4040 h**
CIR +1	**0400 h**
CIR +2	**0010 h**
CIR +3, CIR +4	**Reserved (0 fixed)**
CIR +5, CIR +6	**X offset**
CIR +7, CIR +8	**Y offset**
CIR +9, CIR +10	**Theta offset**

Response	
COR	**008C h**
COR +1	**Normal end = 0 or Error code**
COR +2	**000C h**
COR +3, COR +4	**X amount of deviation**
COR +5, COR +6	**Y amount of deviation**
COR +7, COR +8	**Theta amount of deviation**

Parameter	
X-axis offset, X amount of deviation	1 / 10000 mm
Y-axis offset, Y amount of deviation	1 / 10000 mm
Theta-axis offset, Theta amount of deviation	1 / 100000 degree

●Command Flow



Note1) The latest object position has been detected.
Note2) Alignment checker execution error processing

Get Stage Adjustment Amount (Absolute Value) [AZG]

Obtains the adjustment amount (absolute value) based on the current position (absolute value).

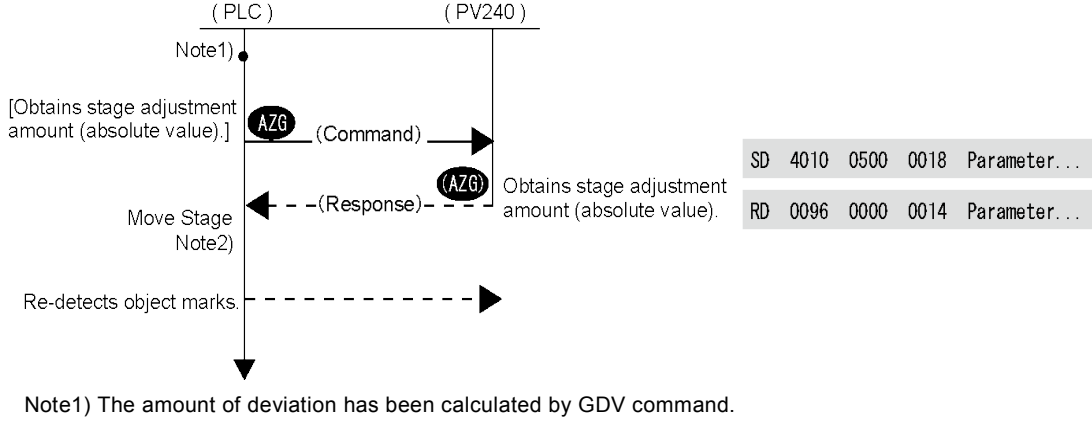
Command	
CIR	**4010 h**
CIR +1	**0500 h**
CIR +2	**0018 h**
CIR +3, CIR +4	**Axis #1 absolute value**
CIR +5, CIR +6	**Axis #2 absolute value**
CIR +7, CIR +8	**Axis #3 absolute value**
CIR +9, CIR +10	**Axis #4 absolute value**
CIR +11, CIR +12	**Axis #5 absolute value**
CIR +13, CIR +14	**Reserved (0 fixed)**

Response	
COR	**0096 h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0014 h**
COR +3, COR +4	**Axis #1 absolute value**
COR +5, COR +6	**Axis #2 absolute value**
COR +7, COR +8	**Axis #3 absolute value**
COR +9, COR +10	**Axis #4 absolute value**
COR +11, COR +12	**Axis #5 absolute value**

	XYTheta Stage	Line Theta Stage	UVW Stage
Axis #1 absolute value	X-axis position		U-axis position
Axis #2 absolute value	Y-axis position		V-axis position
Axis #3 absolute value	Theta-axis position	Stroke position	W-axis position
Axis #4 absolute value	Not used (0 fixed)		
Axis #5 absolute value			

Parameter	
X-axis position	1 / 10000 mm
Y-axis position	1 / 10000 mm
Theta-axis position	1 / 100000 degree
Stroke position	1 / 10000 mm
U-axis position	1 / 10000 mm
V-axis position	1 / 10000 mm
W-axis position	1 / 10000 mm

●Command Flow



Note1) The amount of deviation has been calculated by GDV command.
Note2) Alignment checker execution error processing

Set Target Position (Specify Camera Coordinate) [TGS]

Specifies camera coordinates and registers the target position.

Command	
CIR	**4020 h**
CIR +1	**0101 h**
CIR +2	**000C h**
CIR +3, CIR +4	**Mark No.**
CIR +5, CIR +6	**Camera X coordinate**
CIR +7, CIR +8	**Camera Y coordinate**

Response	
COR	**003E h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

Parameter	
Mark No.	1: Mark0 2: Mark1
Camera X coordinate	1 / 10000 pix
Camera Y coordinate	1 / 10000 pix

Move Rotation Center［SRP］

Moves the rotation center for alignment calibration.

Command	
CIR	**4040 h**
CIR +1	**0100 h**
CIR +2	**0010 h**
CIR +3, CIR +4	**Mark No.**
CIR +5, CIR +6	**Reserved**
CIR +7, CIR +8	**X-axis movement**
CIR +9, CIR +10	**Y-axis movement**

Response	
COR	**006E h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

Parameter	
Mark No.	1: Mark0 2: Mark1
Reserved	0 (Fixed)
X-axis movement	1 / 10000 mm
Y-axis movement	1 / 10000 mm

Print Screen［PS］

Obtains print screen images of screens.

Command	
CIR	**0600 h**
CIR +1	**0130 h**
CIR +2	**0**

Response	
COR	**Response completion = 1**
COR +1	**Normal end = 0 or Error code**
COR +2	**0**

Print Screen (Specify File Name)［PS NAME］

Obtains a print screen image of a specified file name.

Command	
CIR	**0600 h**
CIR +1	**0133 h**
CIR +2	**0006 h**
CIR +3	**File name**
CIR +4	
CIR +5	

Response	
COR	**Response completion = 1**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

●Example of file name: "ABC"

Register No.	Character	1 byte = 16 bits
Checker No.	BA	0x4241
X offset	0C	0x0043

Save Print Screen in Image Memory[PSM]

Saves print screen images in the dedicated image memory.

Command	
CIR	**0600 h**
CIR +1	**0134 h**
CIR +2	**0000 h**

Response	
COR	**Response completion = 1**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

●Error code

265

- Image data was discarded because the number of saved print screen images exceeds the limit (10 images).
- No SD memory card is attached or cannot be accessed.
- Capacity of the SD memory card is used up.
- The SD memory card is write-protected.
- "Write When Cover is Open" is se to "Disable", and the cover is open.
- Ethernet communication cannot be established (with connection problems such as cable unconnected or disconnection)
- Image Receiver is not activated or stops.

Save Print Screen in SD[SSM]

Saves print screen images to an SD card from the dedicated image memory, and deletes data in the image memory.

Command	
CIR	**0600 h**
CIR +1	**0123 h**
CIR +2	**0000 h**

Response	
COR	**Response completion = 1**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

●Error code

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- No SD memory card is attached or cannot be accessed.
- SD card memory is used up.
- The SD memory card is write-protected.
- No image is saved in the dedicated image memory.
- "Write When Cover is Open" is se to "Disable", and the cover is open.

Get Distance between Target/Object Marks［GML］

Obtains the distance between target marks and the distance between object marks.

Command	
CIR	**4040 h**
CIR +1	**0600 h**
CIR +2	**0000 h**

Response	
COR	**012C h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0008 h**
COR +3, COR +4	**Distance between target marks**
COR +5, COR +6	**Distance between object marks**

Parameter	
Distance between target marks	1 / 10000 mm
Distance between object marks	1 / 10000 mm

Change Camera Shutter Speed［CSH］

Command	
CIR	**4030 h**
CIR +1	**0300 h**
CIR +2	**0008 h**
CIR +3, CIR +4	**Camera No.**
CIR +5, CIR +6	**Shutter speed**

Response	
COR	**0041 h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

Parameter	
Camera No.	0: Camera 0 1: Camera 1
Shutter speed	[1/100 msec units] 0.10 msec to 500 msec: 0.3-Mega Compact Gray Camera (ANPVC5030) 0.03 to 1000 msec: Cameras other than the above

Set Threshold of Change Judgement[SCT]

Changes the thresholds for judging the amount of deviation of X, Y and Theta which are used as the judgement condition of Alignment checker.

Command	
CIR	**4050 h**
CIR +1	**0100 h**
CIR +2	**0010 h**
CIR +3, CIR +4	**Reserved**
CIR +5, CIR +6	**Threshold of change judgement X**
CIR +7, CIR +8	**Threshold of change judgement Y**
CIR +9, CIR +10	**Threshold of change judgement Theta**

Response	
COR	**0190 h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

Parameter	
Reserved	0 (Fixed)
Threshold of change judgement X	1 / 10000 mm
Threshold of change judgement Y	1 / 10000 mm
Threshold of change judgement Theta	1 / 100000 degree

Get Deviation/Stage Adjustment Amount［AOG］

Obtains the current value from PLC, and returns the adjustment amount plus the amount of deviation after the detection of an object.

Command	
CIR	**4010 h**
CIR +1	**0520 h**
CIR +2	**001C h**
CIR +3, CIR +4	**Reserved**
CIR +5, CIR +6	**Stage current value (Axis #1 absolute value)**
CIR +7, CIR +8	**Stage current value (Axis #2 absolute value)**
CIR +9, CIR +10	**Stage current value (Axis #3 absolute value)**
CIR +11, CIR +12	**Offset X**
CIR +13, CIR +14	**Offset Y**
CIR +15, CIR +16	**Offset Theta**

Response	
COR	**00AA h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0018 h**
COR +3, COR +4	**Amount of deviation X**
COR +5, COR +6	**Amount of deviation Y**
COR +7, COR +8	**Amount of deviation Theta**
COR +9, COR +10	**Stage adjustment value (Axis #1 absolute value)**
COR +11, COR +12	**Stage adjustment value (Axis #2 absolute value)**
COR +13, COR +14	**Stage adjustment value (Axis #3 absolute value)**

	XYTheta Stage	Line Theta Stage	UVW Stage
Axis #1 absolute value	X-axis position		U-axis position
Axis #2 absolute value	Y-axis position		V-axis position
Axis #3 absolute value	Theta-axis position	Stroke position	W-axis position

Parameter	
Reserved	0 (Fixed)
X-axis position, Offset X	1 / 10000 mm
Y-axis position, Offset Y	1 / 10000 mm
Theta-axis position, Offset Theta	1 / 100000 degree
Stroke position	1 / 10000 mm
U-axis position	1 / 10000 mm
V-axis position	1 / 10000 mm
W-axis position	1 / 10000 mm

Set Object Position［OBS］

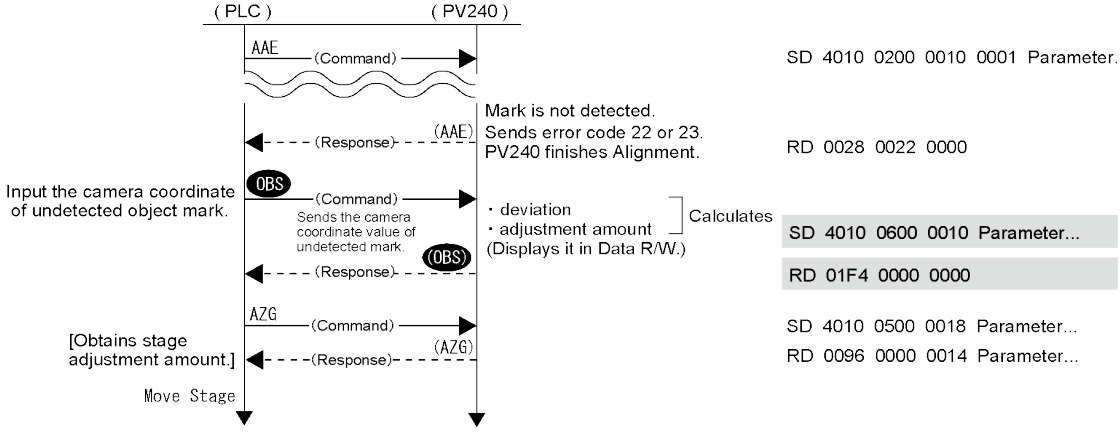
Assigns the coordinate of an object position directly instead of the detected position by the checker, and executes alignment once.

Command	
CIR	**4010 h**
CIR +1	**0600 h**
CIR +2	**0010 h**
CIR +3, CIR +4	**Mark No.**
CIR +5, CIR +6	**Object* X coordinate value**
CIR +7, CIR +8	**Object* Y coordinate value**
CIR +9, CIR +10	**Object* X coordinate value**
CIR +11, CIR +12	**Object* Y coordinate value**

Response	
COR	**01F4 h**
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

Parameter	
Mark No.	00: Both, 01: Mark0, 02: Mark1
Object X coordinate (CIR +5,CIR+6)	1/10000 in pixels
Object Y coordinate (CIR +7,CIR+8)	1/10000 in pixels
Object X coordinate (CIR +9,CIR+10)	1/10000 in pixels
Object Y coordinate (CIR +11,CIR+12)	1/10000 in pixels

*) For specifying Mark No.00 for parameter CIR+3 and CIR+4, input the X coordinate of Mark0 in CIR+5 and CIR+6, the Y coordinate of Mark0 in CIR+7 and CIR+8, the X coordinate of Mark1 in CIR+9 and CIR+10, and the Y coordinate of Mark1 in CIR+11 and CIR+12.
For specifying Mark No.1 for parameter CIR+3 and CIR+4, input the X coordinate of Mark0 in CIR+5 and CIR+6, the Y coordinate of Mark0 in CIR+7 and CIR+8, and 0 in CIR+9, CIR+10, CIR+11 and CIR+12.
For specifying Mark No.02 for parameter CIR+3 and CIR+4, input the X coordinate of Mark1 in CIR+5 and CIR+6, the Y coordinate of Mark1 in CIR+7 and CIR+8, and 0 in CIR+9, CIR+10, CIR+11 and CIR+12.



Output Alignment Result Data[RTD]

Saves the latest result of the execution of Alignment to an SD card.
For using this function, set "Output" for SD Card to "No" in "ENVIRONMENT" > "Input/Output" > "General Output".
This function is used to output the latest alignment result held by PV240 to an SD card when the following RTD command is received regardless of the settings of "Alignment result output" and "Output Conditions" in "ENVIRONMENT" > "Input/Output" > "Alignment result output".

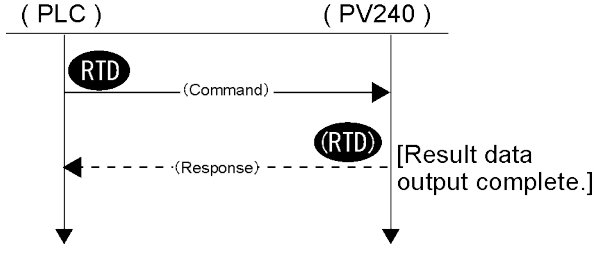
Output Destination: ¥ Panasonic-ID SUNX Vision ¥PV240¥Result
File Name:YYYYMMDD_ALN_RSLT.txt
YYMMDD: Alignment execution time (When a date is changed, results are output to another file.)

Output content
• Execution date • Judgement • Inspection Time (Outputs "----------".) • No. of retries • Amount of deviation X • Amount of deviation Y • Amount of deviation Theta • Mark the amount of deviation M0 X, Mark the amount of deviation M0 Y • Mark the amount of deviation M1 X, Mark the amount of deviation M1 Y All the above results are output. ▶ Note For details of the output format of results, refer to page 25 ”Result Data Output Format”.

Command	
CIR	**4030 h**
CIR +1	**0400 h**
CIR +2	**0000 h**

Response	
COR	0001 h
COR +1	**Normal end = 0 or Error code**
COR +2	**0000 h**

●Command Flow



SD	4030	0400	0000
RD	0001	0000	0000

Note) Error (Error signal=ON. Error number is displayed in the information display area at the same time.)

4.6 List of Error Codes

The following is the list of error codes.

Error code	Error
E000	Normal end
E001	Communication error
E002	Checksum error
E003	Command parameter error
E011	Specified mark unregistered
E014	Calibration/Alignment calculation failed
E015	Calibration data unregistered
E017	Target position unregistered
E020	Number of alignment retries exceeded
E021	Target position outside screen error
E022	Mark0 undetected
E023	Mark1 undetected
E025	Mark pitch incorrect
E034	Movement threshold error (X)
E035	Movement threshold error (Y)
E036	Movement threshold error (Theta)
E037	Movement threshold error (X, Y)
E038	Movement threshold error (X, Theta)
E039	Movement threshold error (Y, Theta)
E040	Movement threshold error (X, Y, Theta)
E060	Alignment checker unregistered
E061	Calibration checker unregistered
E062	Target checker unregistered
E063	Object checker unregistered
E064	Sequence error
E066	Alignment command issued in STOP
E067	Calibration data incomplete

4.7 Command Communication Log

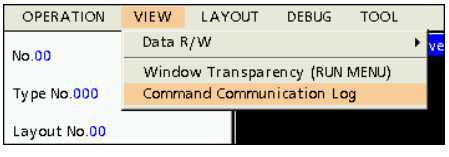
This is a function to display the communication logs (history) of the general-purpose communication and PLC communication, or to save the logs in SD cards.The following communication data can be displayed and saved.

Control commands :	Commands from external devices + Responses from PV240 Requests from PV240 to external devices + Responses from external devices
Result output:	Outputs from PV240 + Responses from external devices (Data set to "Output" from "ENVIRONMENT" > "Input/Output" > "General Output")

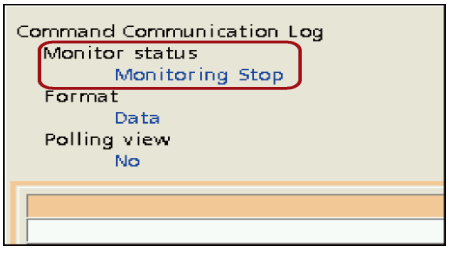
As PV240 can accept a start signal and control command sent with the keypad or an external device showing the window of a command communication log, the communication log can be confirmed during an ongoing inspection.
For details, refer to PV200 User's Manual.

4.7.1 Confirming Communication Logs on Monitor

1. Select "View" > "Command Communication Log" from the menu bar in RUN menu.



2. The "Command Communication Log" window is displayed.

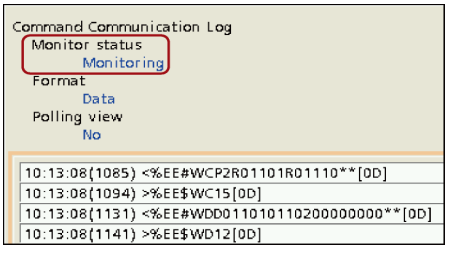


3. Press the F1 key when "Monitoring Stop" is displayed as the monitor status. "Monitoring" is displayed.

(When the monitor status has been already "Monitoring", there is no need to press this button. Logs are already displayed in the communication log list.)

▶ Note

The F1 key switches whether to keep monitoring the monitor display or pause when the command communication log window is displayed.



4. When PV240 communicates with external devices (general-purpose communication , PLC communication), the communication data is displayed on the monitor.

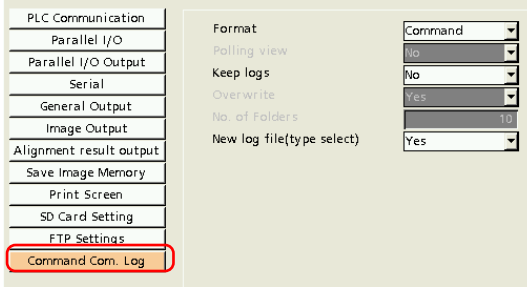
3. To close the "Command Communication Log" window, press the CANCEL key while the cursor is in the "Command Communication Log".

4.7.2 Saving Communication Log and Setting Display Contents

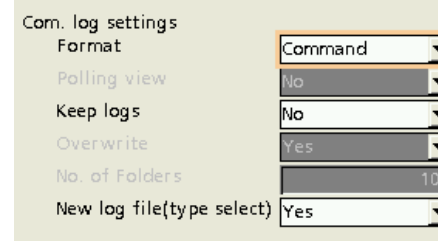
Command communication logs are displayed in RUN Menu, and can be saved in SD memory cards.

For setting the display contents and the saving method of communication logs, use the "Command Com. Log" menu in "ENVIRONMENT" > "Input/Output", or the menu displayed by selecting "Settings" in the pop-up menu displayed with the FUNC key on the "Command Com. Log" window in RUN menu.

"ENVIRONMENT" > "Input/Output" > "Command Com. Log" menu

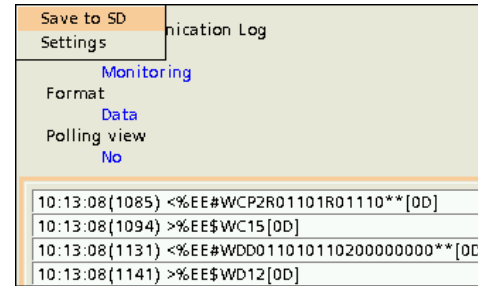


"RUN Menu" > "Command Com. Log" pop-up menu



Format	Select Command (Default) or Data.
Polling view	No (Default) / Yes Select whether or not polling data is displayed/saved as logs.
Keep logs	No (Default) / Yes Select whether or not logs are always saved to SD cards.
Overwrite	No (Default) / Yes Set whether to overwrite an existing file or not when the number of log folders reaches the specified number or when it exceeds the capacity of the SD card.
No. of Folders	1 to 1000 (Default: 10) Set the maximum number of folders to store communication log files generated by [Keep logs].
New log file (type select)	No (Default) / Yes Select whether or not logs are automatically saved in a new file when a type is switched by an external device. When selecting "No", logs are added to the file to which data is being written. (This function is not available when a type is switched with the keypad.)

There are two methods to save logs, one is to always save logs and the other is to manually save the data displayed in the log list. For always saving logs, make the above setting. For saving logs manually, press the FUNC key while the "Command Com. Log" window is displayed and select "Save to SD".



Chapter 5

Alignment Function Setting

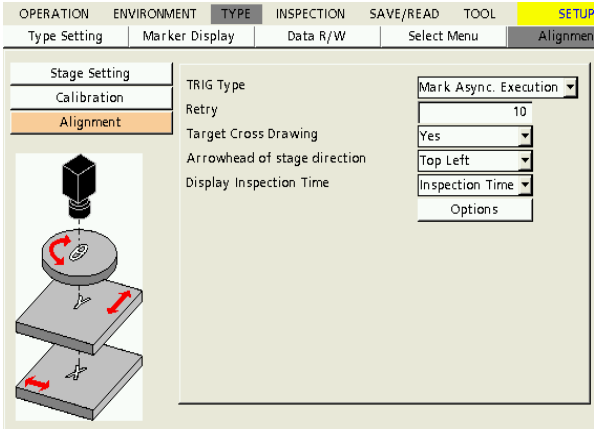
5.1 Setting Alignment Function

Make the settings related to the alignment function in preparation for inspections. After completing the settings in this chapter, make necessary settings for executing Alignment inspection.
For information on each item, refer the following chapters.

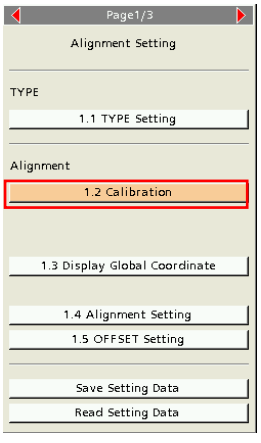
- Calibration setting: Chapter 6
- Target setting: Chapter 7
- Object setting: Chapter 8
- Judgement condition setting: Chapter 9

5.2 TYPE > Alignment > Alignment

This setting is made from "TYPE" > "Alignment" > "Alignment" in Normal Menu. In Engineering Menu, it is made from "1.2 Calibration" and "1.4 Alignment Setting" on the top page.



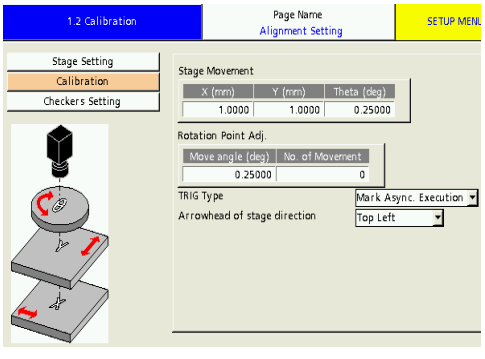
In Normal Menu

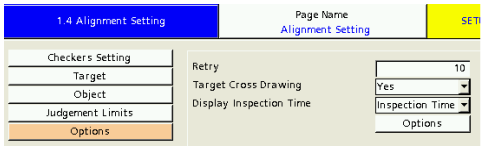


In Engineering Menu

Note

The following items are divided into two items in Engineering Menu.
- "TRIG Type" and "Arrowhead of stage direction": "1.2 Calibration" > "Calibration"
- "Retry" and "Target Cross Drawing": "1.4 Alignment Setting" > "Options"





TRIG Type

Select an operation method when pressing the TRIG key in a situation related to Alignment*.

(When the TRIG key is pressed in a situation other than that related to Alignment, a test is executed like the standard PV200.)

Mask Sync. Execution (Default)	Pressing the TRIG key once in a situation related to Alignment* captures and detects two marks, and performs alignment calculation (calculates the deviation and stage adjustment amounts, etc.).

Mark Async. Execution	Pressing the TRIG key in a situation related to Alignment* displays the menu** for selecting "Mark0 Detection", "Mark1 Detection" and "Alignment Execution" like the right figure, and executes a selected item. Mark0 Detection Mark1 Detection Alignment Execution Also, the manual calibration setting is made for each mark. (Refer to page 168.) (**: Selectable items vary by situations that the TRIG key is pressed.)

* Menus in "INSPECTION" > "Alignment" > "Checkers Setting" > "Target Checker" / "Object Checker" / "Target" / "Object" / "Judgement Limits", and RUN menu.

Retry

Specify how many times alignment operation is retried until OK judgement is obtained (within thresholds) at the time of alignment execution.
(However, when an error occurs during the execution, it will be terminated.) For information on the termination of alignment operation due to errors, refer to page 198.)

Target Cross Drawing

Select whether to display a target position using a cross or not.

Yes (default)	: Displays the target position of Mark0 using a pink cross. Displays the target position of Mark1 using a blue cross.
No	: Not display.

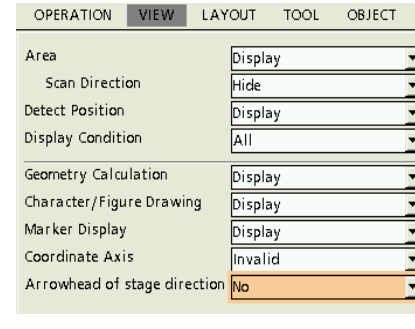
Arrowhead of Stage Direction

Select whether to display an arrow indicating the rotation direction of stage and the direction of the XY axes of global coordinate in RUN menu or not.

No (Default)	: Not display.
Top Left Bottom Left Top Right Bottom Right	: Displays an arrow. Select a position where it is displayed on the screen window. On the screen window that displays a camera image after the calibration registration with an arrow indicating the rotation direction of stage in the information display area, the arrow indicating the positive direction of XY axes is displayed.

Note

- It is also possible to select whether to display or hide the arrowhead of stage direction in RUN menu. Press the F1 key in RUN menu, and set it in "Screen0 (Screen1)" > "Display Patterns" > "Arrowhead of stage direction".



Display Alignment Time

Select whether to display the execution time of alignment in the information display area in RUN menu or not. (The execution time of alignment: The time from the start to the finish of alignment.)

Inspection Time (Default):	Displays "Inspection Time" in the information display area in RUN menu.
Alignment Time:	Displays the execution time of alignment in the information display area in RUN menu. At this time, the execution time of inspection is not displayed.

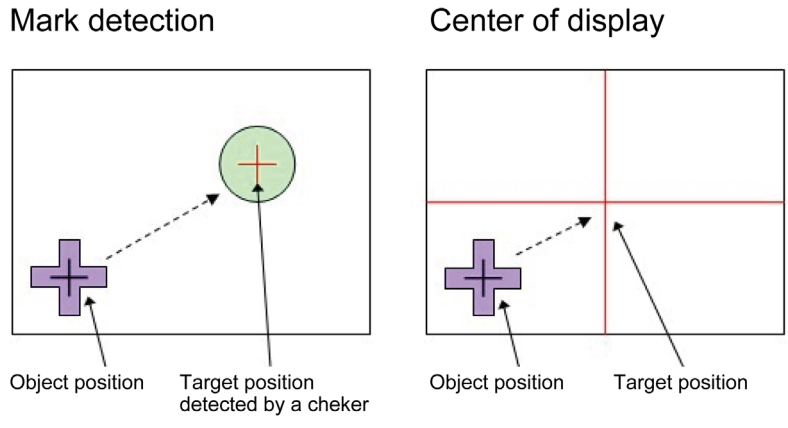
Options

Set as necessary.

Target Position

Select Mark Detection or Center of Display for the target position.
There are two methods, which aligns the object position with a target position using a checker and aligns the object position with the center of the screen.
(Target position: The target position to move the mark. Object position: The position of an object to be moved.)

Mark Detection (Default)	: Detects the target position using a checker. The position detected by a checker specified in "INSPECTION" > "Alignment" > "Target" > "Target Checker" is used as the target position. The following checkers are selectable for detecting the target position. Smart Matching / Corner Detection / Feature Extraction / Contour Matching / Smart Edge (Circle) / Arbitrary Point
Center of Display	: The center of the display is used as the target position. (When running a test in SETUP menu, "----" is displayed in the judgement field in "INSPECTION" > "Alignment" > "Target" > "Target Checker.)



Display Data R/W

Select whether to fix Data R/W for the R/W display for alignment or set and display Data R/W arbitrarily.

Fixed	: Data R/W is fixed as the R/W display for alignment. It cannot be edited (such as registering or deleting data). It becomes editable by changing the setting to "Free".
Free (Default)	: Data R/W can be edited freely.

Display Total Judgement

Select whether to display the results of alignment (whether Delta X, Delta Y and Delta Theta are within thresholds) in the screen as "Total Judgement" or not.

Yes	: Displays the results of alignment as total judgement. At this time, even if the "Total Judge." in "INSPECTION" > "Judgement" > "Condition" has been set, its result is not displayed as total judgement.
No (Default)	: Displays the result specified in "Total Judge." under "INSPECTION" > "Judgement" > "Condition" as total judgement. When a type is selected, JDC000=ALN000_JUDGE (judgement result of Alignment checker No.000) is automatically set in "INSPECTION" > "Judgement", and JDC000 is set in Total Judgement.

Checksum

Select whether to add a checksum or not for improving the reliability of communication data when executing an alignment command using general purpose communication.

Checksum

Unlike the normal BCC, the sum of all the ASCII character codes of a command and command parameter is calculated, and the lower one-byte value is expressed as hexadecimal two-digit values using ASCII characters.

Example) In the case of Reset Alarm command

&	**A**	**R**	**R**	**¥**
	41H	**52H**	**52H**	

▼The lower two bytes of addition result▼

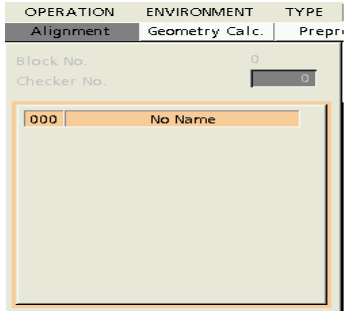
E5H

Command composition including checksum

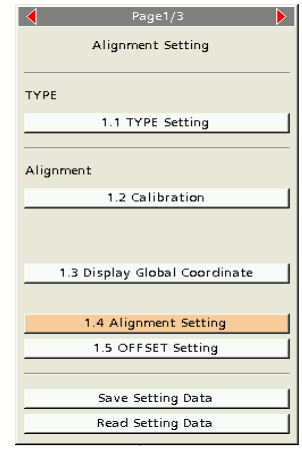
&	**A**	**R**	**R**	**¥**	**E**	**5**
					Checksum	

5.3 INSPECTION > Alignment

Specify the items in "INSPECTION" for the settings and judgement conditions of mark detection and base positions required for Alignment.

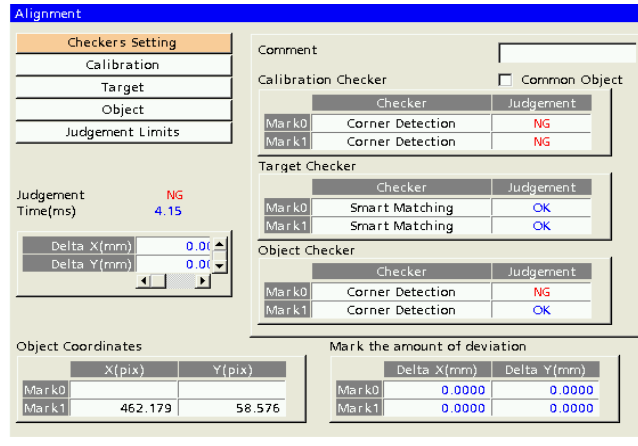


In Normal Menu



In Engineering Menu

* The screen below is the Alignment menu window in Normal Menu.



Checkers Setting :	A list of "Checkers" in "Calibration", "Target" and "Object". Each checker can be directly specified here, however, as for Calibration and Target, position registration is necessary after the checker setting.
Calibration :	Set for converting the camera coordinate system to stage coordinate system. The coordinate position of a mark captured with a camera is automatically converted to the system coordinate system by performing Calibration. (*: Acquires the angle of a camera, camera view range, and the relation between the camera and a stage automatically, and creates a new coordinate.)
Target :	Set target positions (target) for alignment.
Object :	Set for detecting marks to be used for alignment.
Judgement Limits :	Set the allowable range for the deviation between a target position and an object position at the time of the execution of alignment.

About the tables

a: Displays the deviation between the target and object positions at the time of the execution of alignment. (Refer to page 199.)

b: Displays the object coordinate at the time of the execution of alignment.

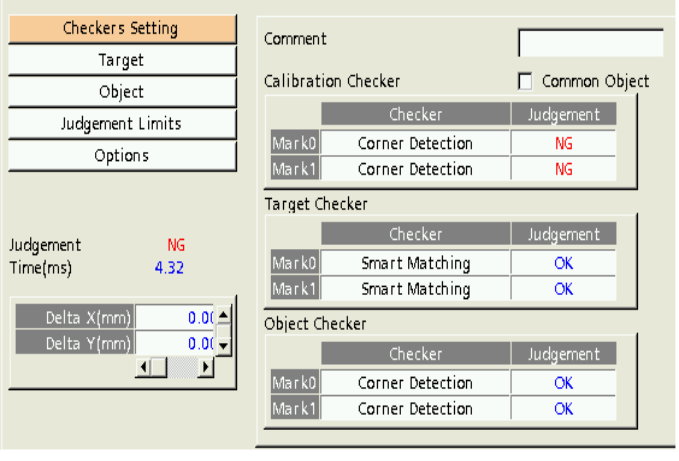
c: Displays the deviation between the target and object positions for each mark at the time of the execution of alignment.

5.3.1 Setting Checkers (Bulk Checker Setting)

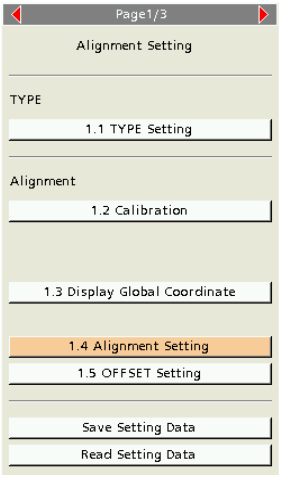
In "Checkers Setting", the settings for the mark detection performed in Alignment are made. Make the settings for checkers for Calibration, Target and Object. The checkers listed in this menu can be also set individually in "INSPECTION" > "Alignment" > "Calibration", "Target" or "Object". (For details of the setting procedures, refer to 6.3.1 (page 166), 7.1.1 (page 182) and 8.1.1 (page 192).) Each checker specified in "Calibration", "Target" or "Object" under "Checkers Setting" can be copied and pasted.

When Calibration Checker or Target Checker has been set in "Checkers Setting", each position should be registered after the setting. It is set in "INSPECTION" > "Alignment" > "Calibration" or "Target" in Normal Menu. In Engineering Menu, it is set in "1.4 Alignment Setting" on page 1.

Normal Menu



Engineering Menu



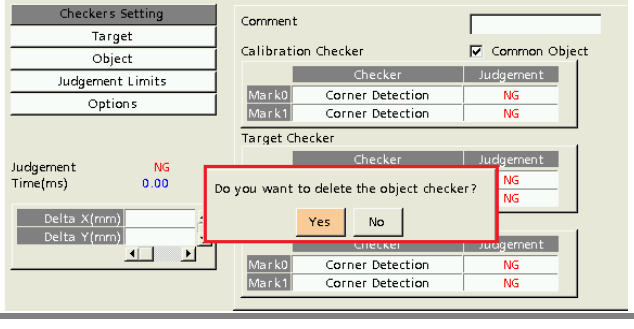
5.3.2 Checkers Setting > Comment

A name for Alignment checker "No.000" can be specified.

5.3.3 Checkers Setting > Common Object

This item is set to use specified Calibration checkers by Object checkers in common. If checked, the checkers specified in "Calibration" are also used as the checkers for detecting objects. However, Object checkers cannot be used as Calibration checkers.

▶Caution
Note that if "Common Object" is checked after the setting of Object Checker, the message "Do you want to delete the object checker?" will appear and the Object Checker will be deleted.



Chapter 6

Calibration Setting

6.1 Setting Calibration

About Calibration

Performs an operation to convert the coordinate system of a camera to the coordinate system of the stage by capturing a mark on the stage within the view range of the camera and moving the stage in the X, Y and Theta directions. The coordinate position of the mark captured with the camera is automatically converted to the system coordinate system (global coordinate system) by performing Calibration.

For executing Calibration, the communication between a communication device and the stage should be established in advance. (Refer to Manual Setting on page 168 or Setting with General Commands or PLC Communication on pages 82, 84, 132 and 133.)

Operation of Calibration

1. **Moves the stage from the base position in the X direction and detects the mark position.**
2. **Moves the stage from the base position in the Y direction and detects the mark position.**
3. **Moves the stage from the base position in the +Theta direction and detects the mark position.**
4. **Moves the stage from the base position in the -Theta direction and detects the mark position.**

Executing the procedures 1 to 4 shows the relation between the positions of the base mark and the center of the stage.
The movement amounts in X, Y and Theta directions described in the above steps 1 to 4 are specified in "TYPE" > "Alignment" > "Calibration" > "Stage Movement". For details, refer to 6.2.1.

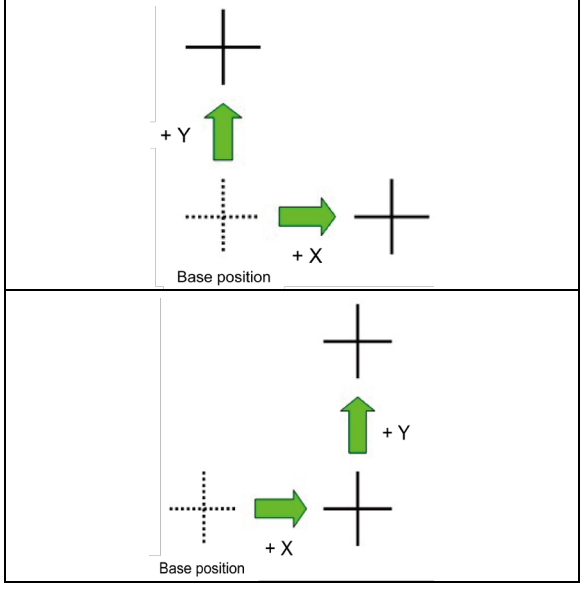
▶ Caution

- For executing the above steps 1 to 4, change the position and angle of the stage to the base position.
- Calibration should be performed when installing a camera for the first time or reinstalling the camera or stage for maintenance.

▶ Note

If marks are not detected from the stage base position with the +X, +Y or +/-Theta for detecting the mark positions in the above steps 1 to 4, correct calibration data cannot be created.

Stage movement when executing Calibration



⇒ **OK**

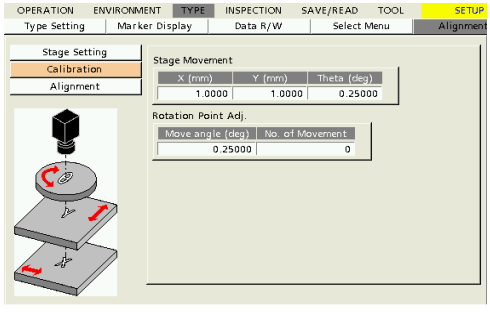
Correct calibration data is created.

⇒ **NG**

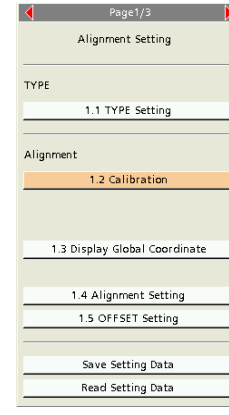
Wrong calibration data is created.

6.2 TYPE > Alignment > Calibration

"TYPE" > "Alignment" > "Calibration"



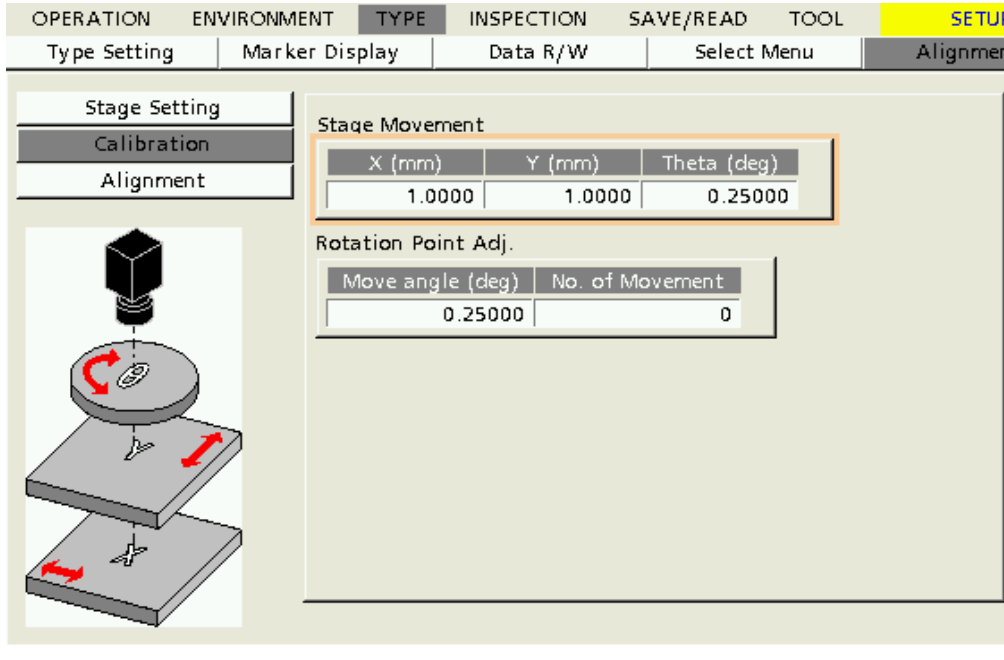
In Normal Menu



In Engineering Menu

6.2.1 Stage Movement

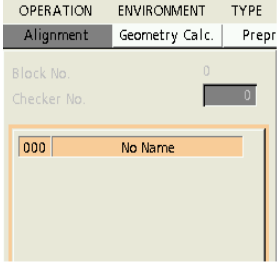
Specify each moving distance of the X, Y, Theta axes for moving the stage when performing calibration. Set the values within the range that the detection mark does not go out of the screen. Especially for theta, moving the table widely as much as possible improves the accuracy of the rotation center.



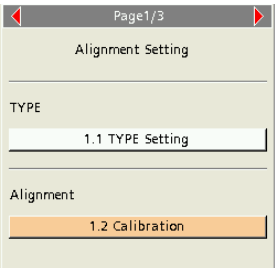
6.3 INSPECTION > Alignment > Calibration

In the case of Engineering Menu, set "Checker" under "1.2 Calibration" on page 1.

[Normal Menu]



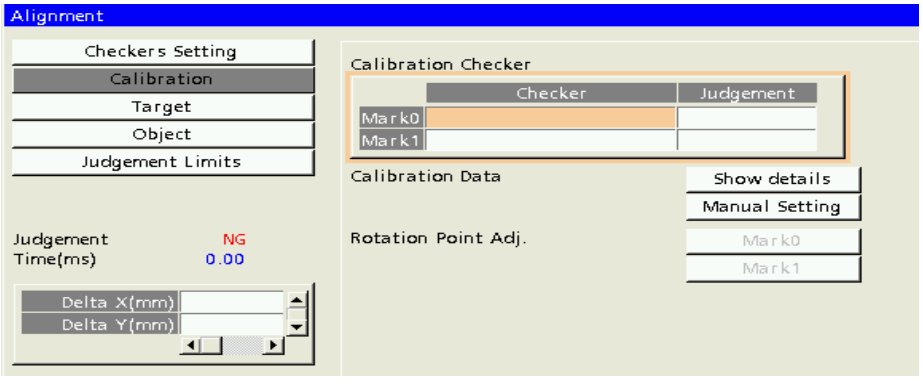
[Engineering Menu]

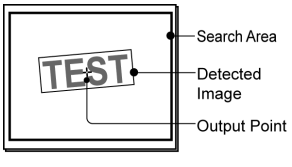
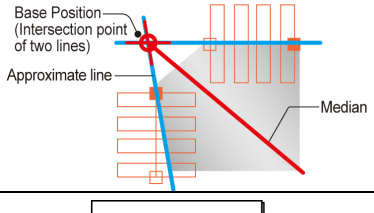
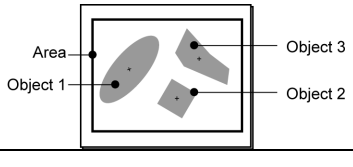


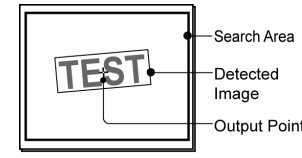
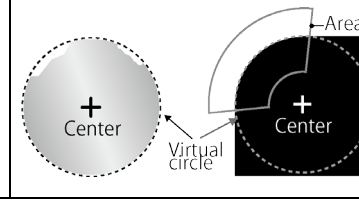
6.3.1 Checker

Register checkers which obtain coordinate values for executing calibration for each mark.

* For details of how to set and operate checkers, refer to PV200 User's Manual (4th Edition or later).



Checker		Detected image
Smart Matching	This is a function that searches and detects a similar part to the registered image pattern. Template: 	
Corner Detection	The horizontal base checker and vertical base checker are both set, the intersection point of two approximate lines will be considered as the base position.	
Feature Extraction	Feature Extraction binarizes an image captured by a camera, detects a specified size of clusters of white or black pixels (hereinafter called “object”), and then judges as OK or NG depending on the measured number.	

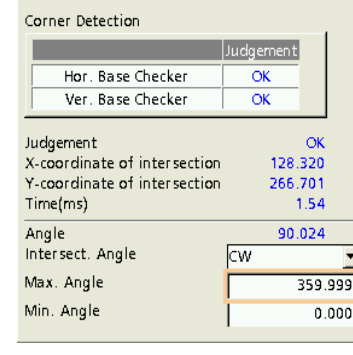
Contour Matching	Contour Matching searches and detects a similar part of an inspection image to the registered contour information on the part of an image the brightness of which varies. Template: 	
Smart Edge (Circle))	Smart Edge (Circle) is a function to output the center point, radius or diameter of a round object by detecting edges of the object with a number of cells. The central coordinate or radius of a circle can be also detected when a whole object cannot be captured or for the angle of a chamfered object.	

For changing the type of a used checker after selecting the checker, press the FUNC key once and "Delete" the checker before setting a new checker.

When using "Corner Detection" (Calibration/Target/Object)

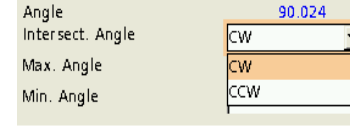
In "Corner Detection" which is a checker type for Calibration, Target and Object, each line is detected with Horizontal Base Checker and Vertical Base Checker, and the intersecting point and angle of two lines are calculated simultaneously.

When the intersecting point is detected and the angle is within the range of "Max. Angle" to "Min. Angle", it is judged as OK and the position of the intersecting point is used for alignment.



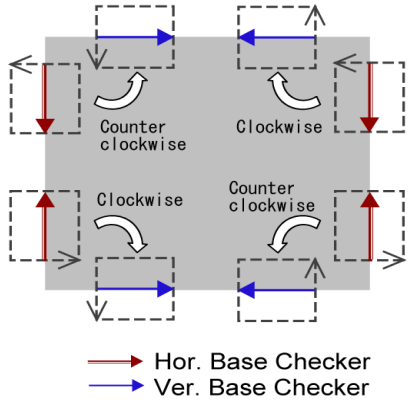
Setting of [Intersecting angle]

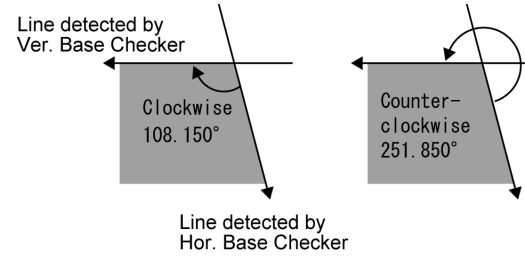
Select CW (Default) or CCW.
The calculated angle is an intersecting angle of the line detected with Horizontal Base Checker and the line detected with Vertical Base Checker.



Note

The directions of the lines detected with each base checker depend on the positions of the start and end points in each checker area.



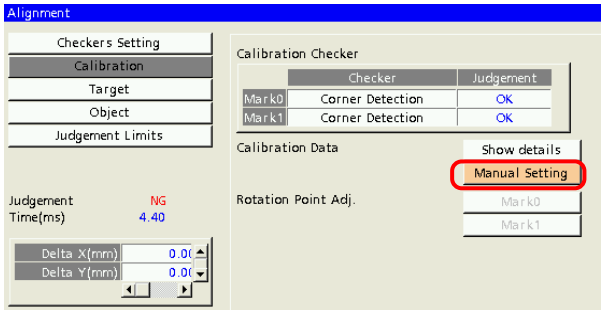


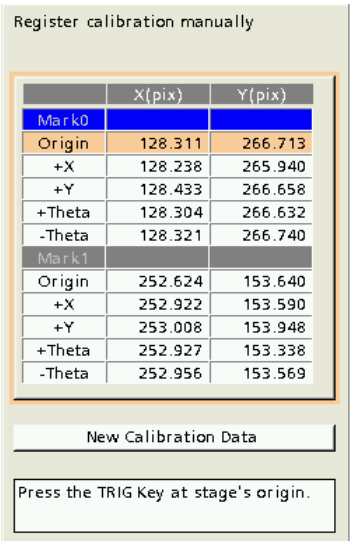
Setting of "Max. Angle" and "Min. Angle"

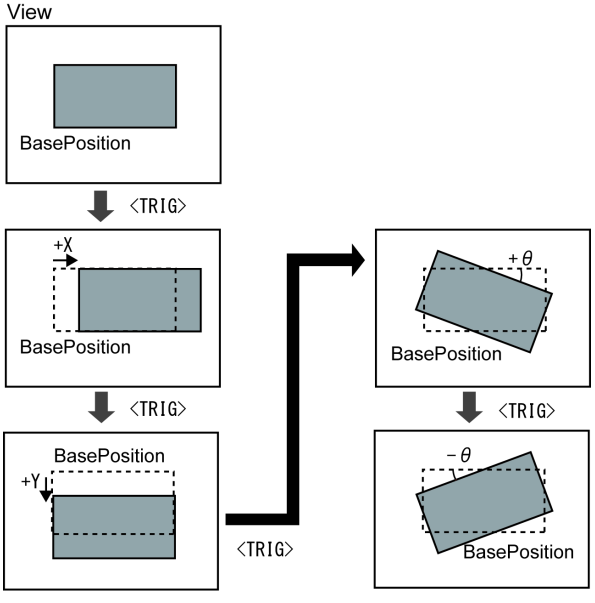
Set them in the range of 0.000 degrees to 359.999 degrees.
If the detected intersecting angle is out of this range, the result is judged as NG in SETUP menu, and errors 22 and 23 are displayed during alignment.

6.3.2 Manual Setting (Calibration Data)

Calibration data can be created manually after registering Calibration checkers.
(When the communication among PV240, a communication device and the stage is established, the calibration using PLC communication or general commands can be executed in RUN menu.)







Execute the following procedure for Mark0 and Mark1.

1. **Move the stage to the base position (origin position), and detect the mark position at the base position by pressing the TRIG key.**

2. **Move the stage in the +X direction <u>from the base position</u>, and detect the mark position at the +X position by pressing the TRIG key.**

3. **Move the stage in the -Y direction <u>from the base position</u>, and detect the mark position at the +Y position by pressing the TRIG key.**

4. **Move the stage in the +Theta direction <u>from the base position</u>, and detect the mark position at the +Theta position by pressing the TRIG key.**

5. **Move the stage in the -Theta direction <u>from the base position</u>, and detect the mark position at the -Theta position by pressing the TRIG key.**

After the above procedure, create data with the "New Calibration Data" button.
In the above procedure, pressing the TRIG key in each step and detecting a mark proceeds the operation to the next step automatically, however, if no mark is detected, the cursor does not go to the next step.

▶Caution

- Note that the stage is always moved from the base position in the above steps 1 to 4.

- When setting "TYPE" > "Alignment" > "Alignment" > "TRIG Type" >"Mark Sync. Execution", both Mark0 and Mark1 are detected simultaneously and Calibration is executed. When "Mark Async. Execution" is selected, Calibration is executed for each mark separately.

Note

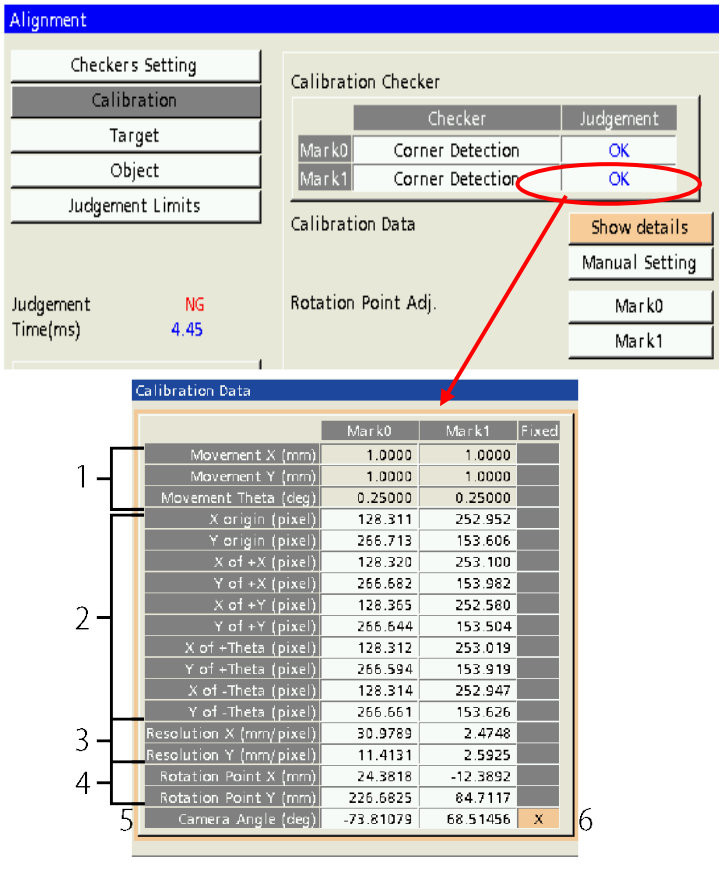
If marks are not detected from the stage base position with the +X, +Y or +/-Theta for detecting the mark positions, correct calibration data cannot be created.

6.3.3 Manual Setting (Calibration Data)

Calibration data calculated by PV240 can be confirmed. In the menu under "Show details", global coordinates can be confirmed from the pop-up menu displayed with the FUNC key. (Refer to page 171.)

Note

Data is displayed under "Show details" after the execution of Calibration. 0 is displayed before Calibration.



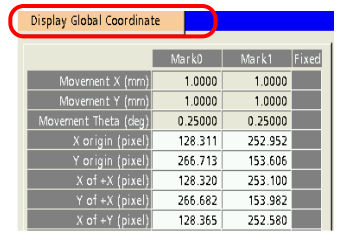
	Contents	Details
1	**Movement X, Y, Theta**	Movement amount of the stage when creating calibration data. Displays the set values in "TYPE" > "Alignment" > "Calibration" > "Stage Movement" at the time of the creation.
2	**Calibration mark positions when setting Calibration**	Displays the detected positions of the calibration mark when the stage is moved in each direction for setting Calibration. (Origin position, +X coordinate, +Y coordinate, +/-Theta coordinate)
3	**Resolution X, Y**	Displays the resolutions calculated by the creation of calibration data.
4	**Rotation Point**	Displays the rotation center of the stage calculated by the creation of calibration data and Rotation Point Adjustment.
5	**Camera Angle**	Displays the angle of a camera to the global coordinate calculated by the creation of calibration data.
6	**Camera Angle Fixed**	This item is used to prevent "Camera Angle" from being updated when creating calibration data. "X" is set. (Set this item for preventing a different camera angle from being created every time calibration is executed.)

6.3.4 Display Global Coordinate (Show Details)

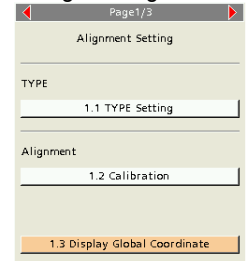
Global coordinates created by the calibration setting can be confirmed. Global Coordinate is coordinates which show mark positions of camera coordinates (in pixels) in mm as the rotation center (0, 0) of the stage, and it is created by the execution of calibration. If the position or direction of a displayed camera image is different from the appearance of workpiece by sight when displaying the global coordinate, it should be adjusted. Refer to the next page on the handling method.

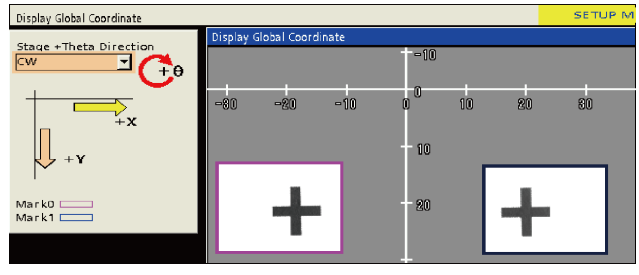
For displaying the global coordinate, select "Display Global Coordinate" with the FUNC key under "INSPECTION" > "Alignment" > "Calibration" > "Show details". In Engineering Menu, select "Display Global Coordinate" on page 1.

Display of the pop-up menu by "Calibration" > "Show details"



Engineering Menu

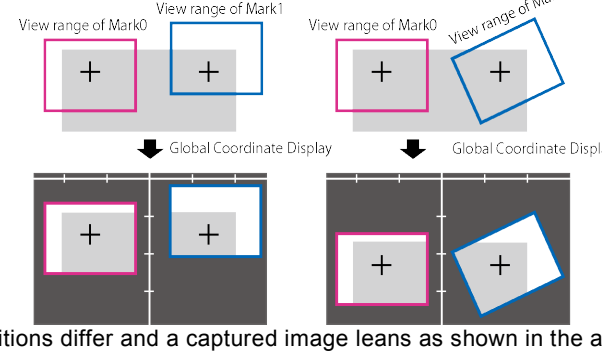




The global coordinate display shows the positional relation of cameras and the stage showing two marks on the global coordinate.
X axis is in the horizontal direction and Y axis is in the vertical direction. Camera images in each view range are the images at the time of executing a test or inspection before "Display Global Coordinate".
The origin (0, 0) of the global coordinate display is a rotation center of the stage, and the scales displayed on the coordinate axes are in millimeters.
The camera view range capturing Mark0 is surrounded with a pink square, and that capturing Mark1 is surrounded with a blue square. When no calibration registration is performed before Display Global Coordinate, the coordinate axes and camera images are not displayed.

The following figures show examples of detecting different marks by two cameras.

The installation positions of cameras differ between the marks.



The camera setting angle leans.

When the camera positions differ and a captured image leans as shown in the above figures, the images

are displayed in the same positional relation as those watched by eyes on the global coordinate display by executing Calibration.

Confirmation Items for Global Coordinate Display

Confirm the following points about whether calibration data is created correctly.

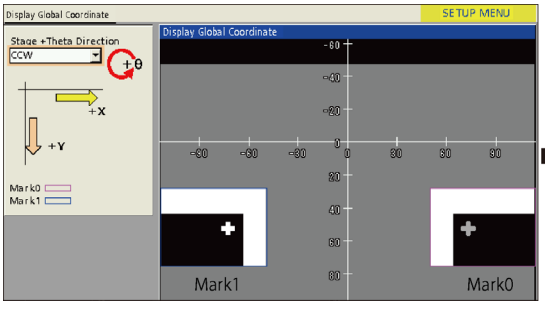
- Confirm the actual locations of cameras and stage.
- Confirm the stage operation direction and rotation direction.
  Confirm whether the rotation center position of stage (or whether it is almost correct before performing Rotation Point Adjustment) and the directions of X and Y axes match the stage.
- Confirm captured images (inspection objects).

When it is determined that displayed global coordinates are inappropriate while confirming the above confirmation, adjust them. Examples are as follows.

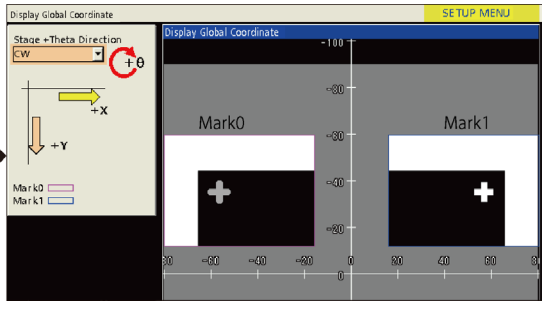
Example of how to handle when the camera position on Global Coordinate Display differs from the object

Case 1	The view range showing two marks are inverted by 180 degrees.
Conceivable cause	At the time of executing Calibration, detected data cannot be obtained properly due to any error by checkers when rotating the stage by +/-Theta.
Solution	Change the setting of "Stage + Theta Direction" to the other. (Change in "Display Global Coordinate" > "Stage + Theta Direction" or "TYPE" > "Alignment" > "Stage Setting" > "Stage + Theta Direction".)

Failed

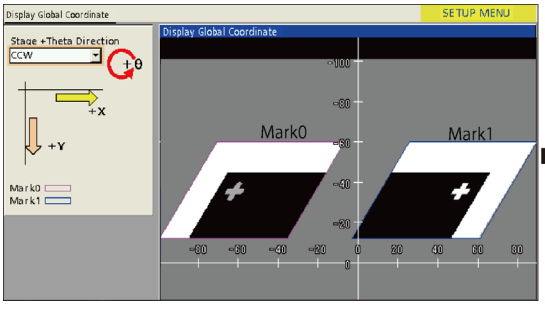


Succeeded by changing "Stage + Theta Direction"

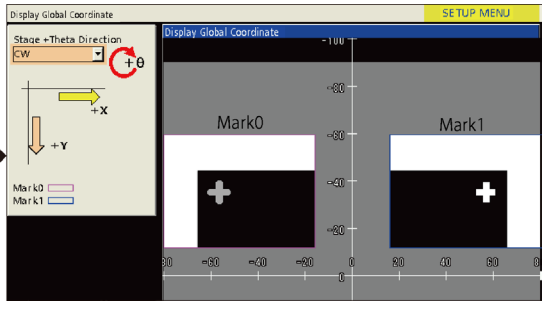


Case 2	Slanted camera images are displayed
Conceivable cause	The operation of the stage of a communication device controlling the stage is not correct.
Solution	Check the operation of the stage or the communication device controlling the stage and adjust.

Failed (Images are slanted.)

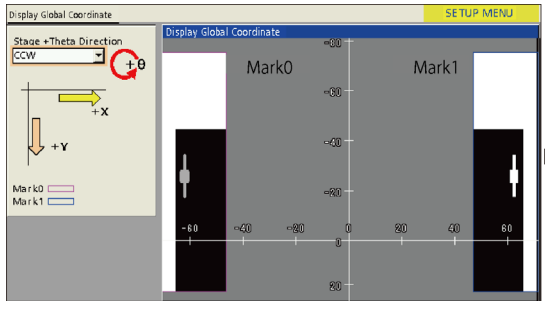


Succeeded

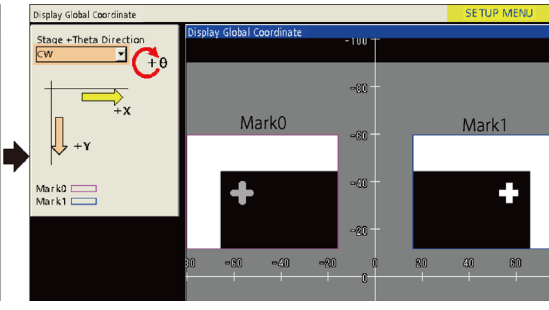


Case 3	The aspect ratio of camera images is wrong. (The aspect ratio of 0.3-Mega Camera and 2-Mega Camera is 3:4 (vertical : horizontal), and that of 4-Mega camera is 1:1.)
Conceivable cause	Malfunction of the stage or a device controlling the stage occurs or detection by a checker is not correct. (An error by checkers or a detected position exceeds the edge of the image.)
Solution	Check the operation of the stage or the communication device controlling the stage and adjust. Confirm whether the detection by checkers is correct.

Failed (Displayed images are vertically long.)



Succeeded



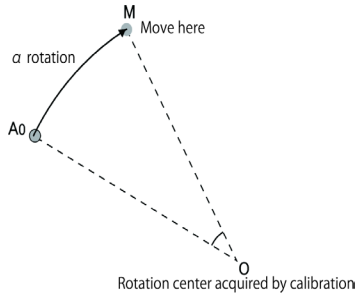
6.3.5 Rotation Point Adjustment (Calibration Data)

The calibration setting in Chapter 6.3.2 performs image capturing and detection in the +X, +Y, +Theta and -Theta directions once for each direction and acquires the rotation center of the stage. However, as there is the possibility of occurrence of a detection error with this value alone, it is necessary to acquire the rotation center of the stage more accurately. "Rotation Point Adjustment" should be executed for each mark.
Two methods are available for Rotation Point Adjustment; by performing the adjustment manually or using the communication with an external device. In the case of the manual adjustment, follow the guide in "Mark0" and "Mark1" under "INSPECTION" > "Alignment" > "Calibration". In the case of the automatic adjustment, make a program with an external device such as a PLC in advance and performs it in RUN menu. At this time, "No. of Movement" should be set under "TYPE" > "Alingment" > "Calibration" > "Rotation Point Adj." > "No. of Movement".

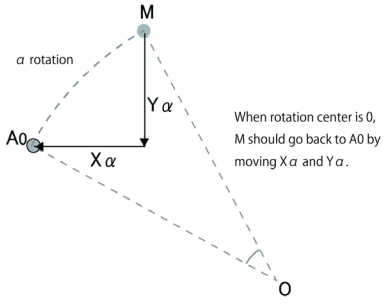
Concept

With the presence of the deviation in the rotation center of the stage acquired by executing Calibration, an error such as the following occurs. So, the stage rotation center should be determined after verifying the deviation.

1

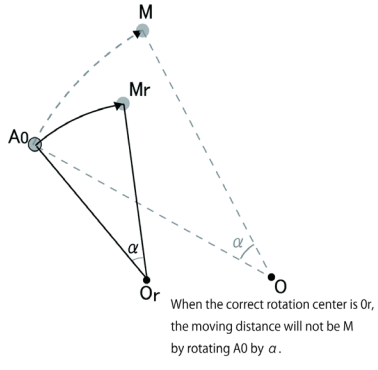


2

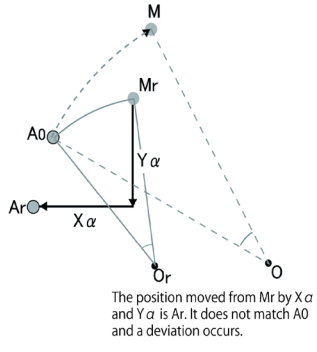


When the stage rotation center acquired by "Calibration" is accurate, it is possible to calculate the X and Y coordinates and the movement amount at the time of rotating the mark on the rotation center by the angle α. Therefore, A0 will return to its original position by Stage +αTheta and moving it for the movement amount Xα and Yα.

3

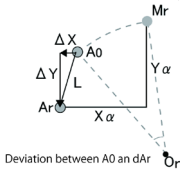


4



However, when a deviation occurs in the acquired rotation center, it does not return to the original A0 position and it moves to a wrong position like Ar. When moving the stage actually and the points do not match, the acquired rotation center is deviated.

5

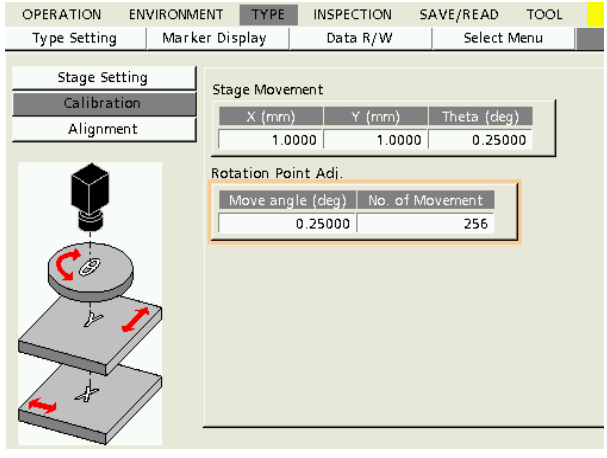


At this time, as the difference between A0 and Ar, the amount of deviation delta X and delta Y are obtained, the image checker can calculate the center of the stage. For obtaining a more accurate rotation center, Rotation Point Adjustment is performed.
The flow of the operation is as follows; After the above fig. 2, if a deviation occurs like fig. 4, calculate the deviation (fig. 5). Calculate the center coordinate which assumed to be correct, and verify whether the new coordinate is less deviated (by the image checker). Move the stage again to check whether a deviation occurs or not like fig. 2 or fig. 4, and repeat the procedure. Finally, determine the coordinate less deviated as the rotation center.

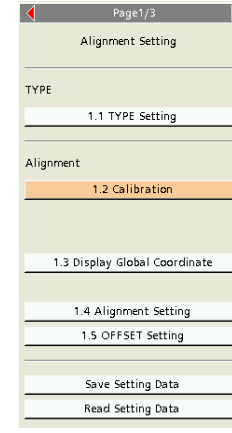
TYPE > Alignment > Calibration > Rotation Point Adjustment

Set "Move Angle" and "No. of Movement" in "Calibration". In the case of Engineering Menu, set "Calibration" under "1.2 Calibration".

"Normal Menu" > "Rotation Point Adjustment"



"Engineering Menu"



Move Angle

It is used for the rotation point adjustment with the calibration command (PLC, general purpose communication) and on the rotation point adjustment window.
Setting range: -180.00000 degrees to 180.00000 degrees, Default: 0.25000 degrees, 5 digits after the decimal point

No. of Movement

0 to 99 (Default: 0)

Specify the number of times of moving the stage for performing Rotation Point Adjustment.

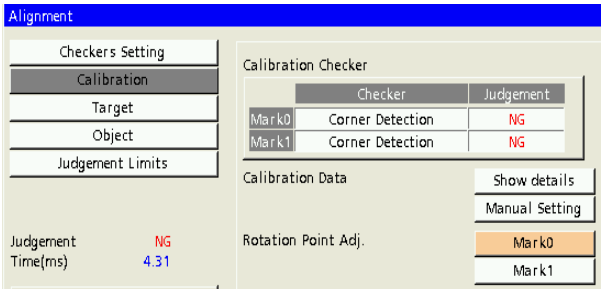
Set this value to 2 or larger in the case of performing Rotation Point Adjustment using PLC communication or general purpose communication. (This item is not necessary for executing it manually in SETUP menu.) When this item is set, Rotation Point Adjustment is automatically executed after calibration registration. The number of times of moving the stage by "No. of Movement" and the number of times of executing Rotation Point Adjustment are as follows.

- 0: Rotation Point Adjustment is not executed.
- 2 to99: Rotation Point Adjustment is executed for "(Number of Movement)-1" while the stage moves for "Number of Movement".
  (No. of Movement: When specifying 2, Rotation Point Adjustment is executed once while the stage moves for two times.)

Rotation Point Adjustment (Manual Setting)

This is a method for executing Rotation Point Adjustment for the stage according to the instruction of the menu in SETUP menu. (For executing Rotation Point Adjustment by the command control from an external device, refer to page 84 or 133.) It is executed after the calibration registration (after the manual setting). It is executed for both Mark0 and Mark1.

The setting is made from "INSPECTION" > "Alignment" > "Calibration" > "Rotation Point Adjustment" > "Mark0 and "Mark1". In Engineering Menu, set "Rotation Point Adjustment" > "Mark0" and "Mark1" under "Checker" of "1.2 Calibration" on page 1.



Flow of Rotation Point Adjustment

1	**Measurement of deviation** 1. Capture an image the base position of the stage, and measure the detected position. 2. Capture the image moving the stage, and measure the deviation. →The Image Checker calculates the amount of deviation of Mark0.

⬇

2	**Confirmation of the amount of deviation.** Calculate the amount of deviation of the mark, and obtain a new rotation center of the stage. The position of the obtained rotation center is still provisional.

⬇

3	**Adjustment** Verify whether the provisional center is more appropriate than the first rotation center or not. For the verification, move the stage and execute the operation once again.

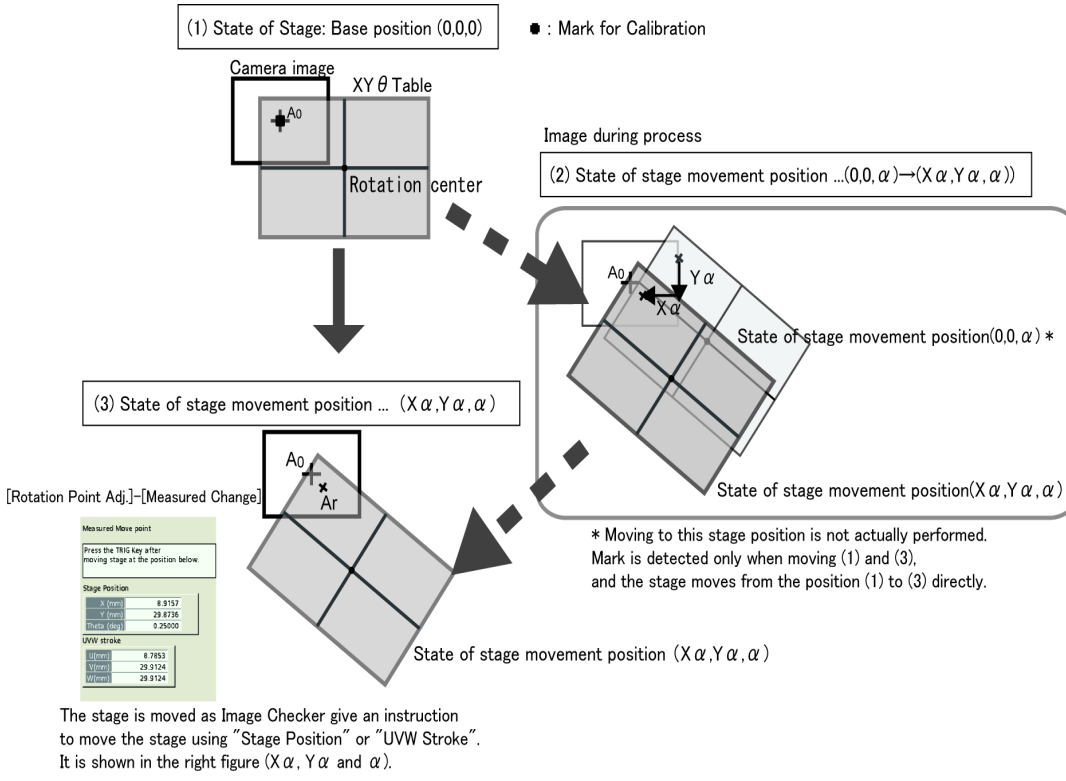
⬇ ⬆ The amount of deviation is too large.

4	**Confirmation of the adjustment result.** Confirm the amount of deviation and determine whether its value is within the allowable range or not.

⬇ When it is within the range

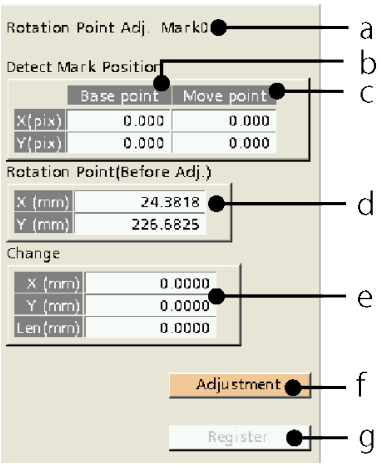
5	**Registration** Replace the first rotation center with the new one.

Image of Stage Movement



A correct rotation center is acquired from the deviation between A0 and Ar in the above step ③.

About Setting Menu



a: Target mark number which is currently set

b: Base point

Displays the detected mark position at the base point.

c: Move point

Displays the detected mark position at a position to where the stage moves.

d: Rotation point

Displays the rotation of the calibration data calculated by measurement.

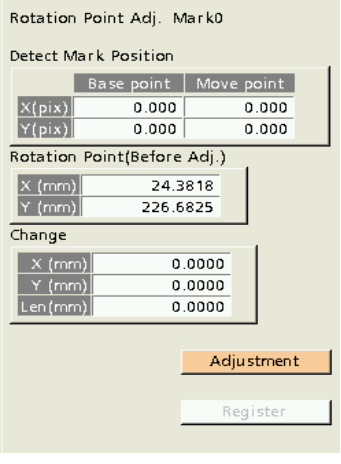
e: Measured Change button

Press this button for calculating or adjusting the deviation of the rotation center of calibration data.

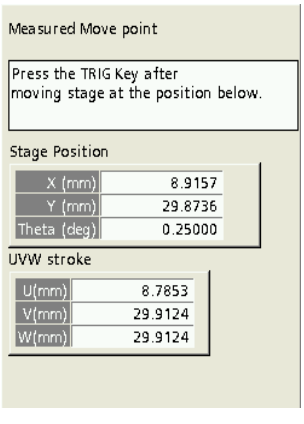
f: Register button

Press this button for registering the rotation center in calibration data and exiting the Rotation Point Adjustment window.

1. **Select "Measured Change".**



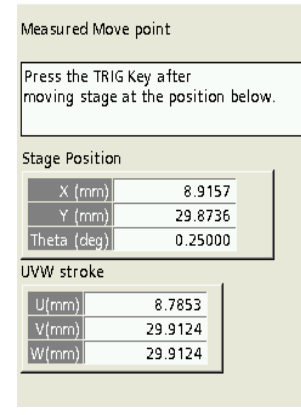
2. **Move the stage to the origin position and press the TRIG key.**



▶ Note

Match the stage with the base position. Otherwise the actual rotation center position is different.

3. Confirm the values of "Stage Position" or "UVW Stroke".
The stage moves by the displayed X, Y and Theta or U, V and W.

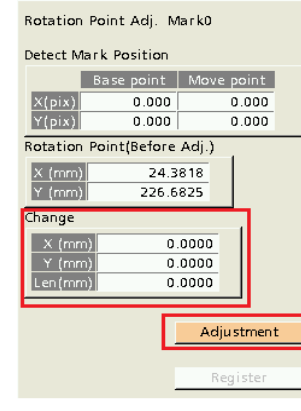


▶ Note

- These lists show the values for the both XYTheta stage and UVW stage. Confirm the stage being used and move the stage.
- The value displayed in the column for Theta is the theta of the base point measurement plus the value of "Move Angle (°)" in "TYPE" > "Alignment" > "Rotation Point Adjustment".

4. Press the TRIG key.

5. The window returns to the Rotation Point Adjustment menu automatically.
Values are displayed in "Detect Mark Position", "Rotation Point (Before Adj.)" and "Change".



▶ Note

A new rotation center is obtained with the condition of Step 3, however, it is not clear whether the rotation center should be replaced with this result or not at this time. For verifying it, follow the next step "Adjustment".

6. Select "Adjustment".

7. Move the stage by the values displayed in "Stage Position" or "UVW Stroke" in the same way as the above Steps 2 and 3, and press the TRIG key.

8. The window returns to the Rotation Point Adjustment menu automatically.
Confirm the value of "Change" and press "Register" when this value is within the allowable range. Repeat the "Adjustment" operation until the value is within the allowable range.

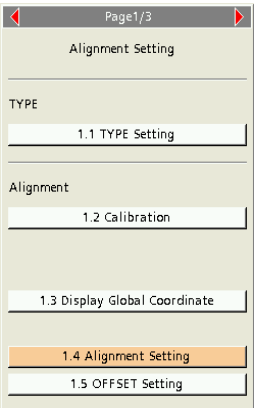
Chapter 7

Target Setting

7.1 Setting Target

This item is to set a target position for positioning using Alignment.

Set a method for detecting mark positions (Checker), and set coordinate values that are the target (movement destination) for Alignment. This setting is made from "INSPECTION" > "Alignment" > "Target" in Normal Menu. In Engineering Menu, it is made from "Target" under "1.4 Alignment Setting" on Page 1.

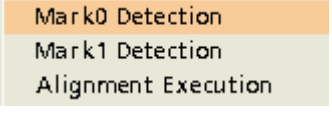


How to Set Target

1. Set target checkers. (Chapter 7.1.1)
2. Set Offset as necessary. (Chapters 7.1.2, 7.1.3)
3. Register target positions. (The registration is required for executing Alignment.)
4. Confirm the registered target positions.

Note

When selecting "Mark Async. Execution" in "TYPE" > "Alignment" > "Alignment" > "TRIG Type" (page 156), clicking the TRIG key on the target window displays the right menu. Select whether to select Mark0 or Mark1.

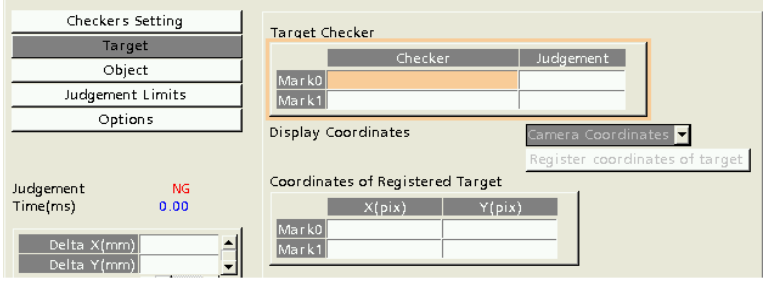


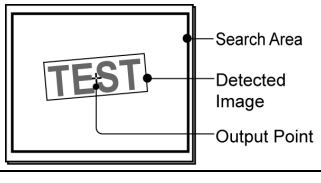
7.1.1 Target Checker

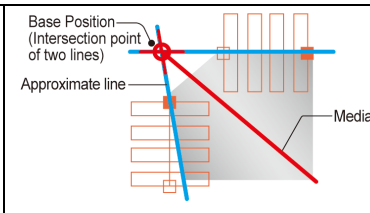
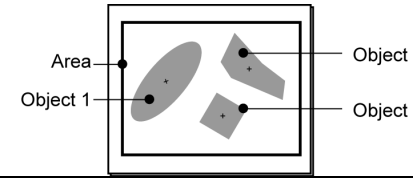
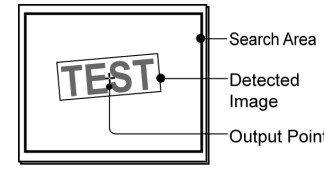
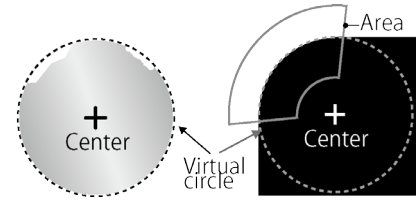
Set a method for detecting mark positions for each mark.

Note

- For changing a set checker to another checker, press the FUNC key to delete the set checker and select a new checker.
- For details of how to set and operate checkers, refer to PV200 User's Manual (4th Edition or later).

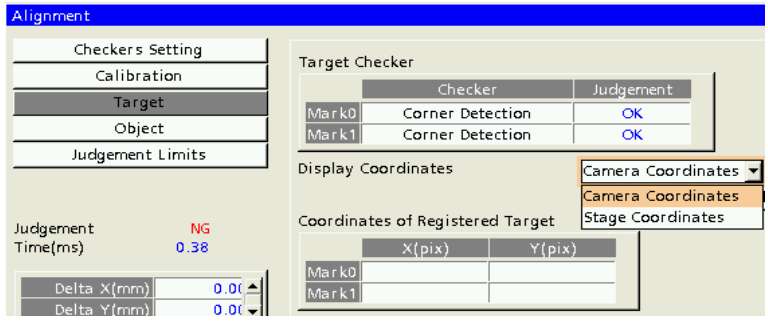


Checker		Checker
Smart Matching	Smart Matching	

Corner Detection	The horizontal base checker and vertical base checker are both set, the intersection point of two approximate lines will be considered as the base position.	
Feature Extraction	Feature Extraction binarizes an image captured by a camera, detects a specified size of clusters of white or black pixels (hereinafter called “object”), and then judges as OK or NG depending on the measured number.	
Contour Matching	Contour Matching searches and detects a similar part of an inspection image to the registered contour information on the part of an image the brightness of which varies. Template: 	
Smart Edge (Circle))	Smart Edge (Circle) is a function to output the center point, radius or diameter of a round object by detecting edges of the object with a number of cells. The central coordinate or radius of a circle can be also detected when a whole object cannot be captured or for the angle of a chamfered object.	
Desired Position	Sets the output point at a desired position by moving the cursor.	

7.1.2 Display Coordinates

Select a method for displaying coordinate values on the menu. "Display Coordinate" can be selected when calibration data has been registered. Changing this setting changes the unit display of "Coordinates of Registered Target". ("X(pix) and Y(pix)" are displayed in the following figure as "Camera Coordinates" is selected.) This item is common to "Display Coordinates" in "Object".

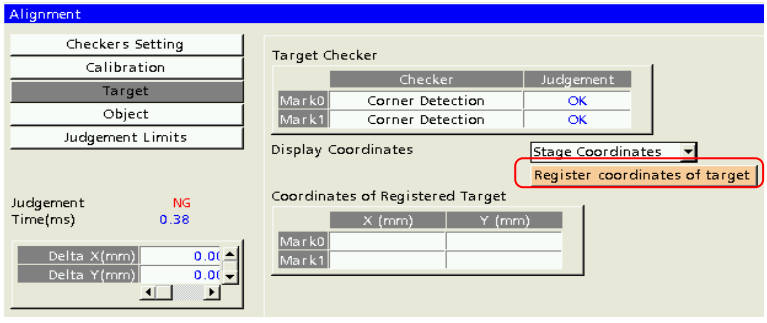


Display Coordinates

Camera Coordinates (Default)	The displayed values are in "pixels".
Stage Coordinates	The displayed values are in "mm". It requires that calibration data has been created.

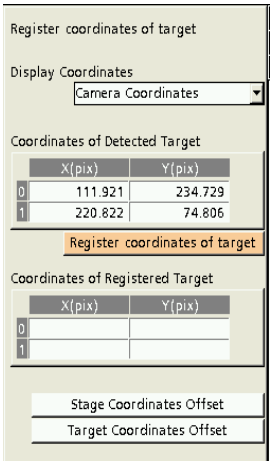
7.1.3 Register Coordinates of Target

Register target positions required for executing Alignment.



1. **Select "Register coordinates of target".**

2. **The menu window appears as the right figure.**



Coordinates of Detected Target
Displays the detected positions of target marks at the time of executing the previous test.
When "Stage Coordinates Offset" or "Target Coordinates Offset" is set, values added with these values are displayed.

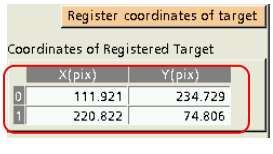
Register coordinates of target
The "Coordinates of Registered Target" are registered as the target positions.

Coordinates of registered target
The coordinates registered by "Register coordinates of target" are displayed.
Cross marks are displayed as the center of the registered positions on the screen window.
Mark0: Pink cross
Mark1: Blue cross

Stage Coordinates Offset
The registered target coordinates added with the offset specified here are used as the target coordinates. They are applied to the both target marks 0 and 1. The rotation center of offset Theta is "Change Base" ("Alignment" > "Judgement Limits" > "Change Base").

Target Coordinates Offset
The detected coordinates of the target registered in Target Checker added with offsets for each mark are the target coordinates for executing Alignment. (Refer to page 186 for details.)

3. **Register target positions by pressing the ENTER key on "Register coordinates of target" as necessary after setting "Stage Coordinates Offset" or "Target Coordinates Offset".**



Once registered, the target coordinates are displayed in "Coordinates of Registered Target".

▶ Note

If registering the target position failed, check whether or not calibration data has been registered and the target marks have been detected.

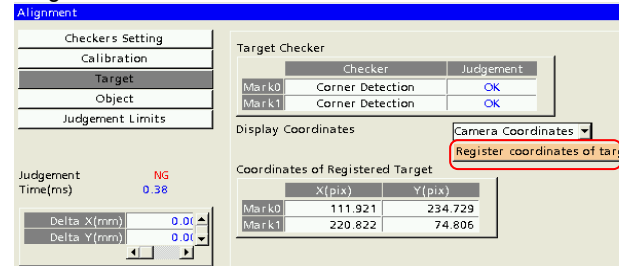
7.1.4 Stage Coordinates Offset

The registered target coordinates added with the offset specified here are used as the target coordinates for executing Alignment. These values are applied to the both target marks. Offsets are set for X, Y and Theta.

The rotation center of the offset Theta is the position selected in "Change Base" (In Normal Menu, "INSPECTION" > "Alignment" > "Judgement Limits". In Engineering Menu, "1.4 Alignment Setting" > Judgement Limits" on Page 1).

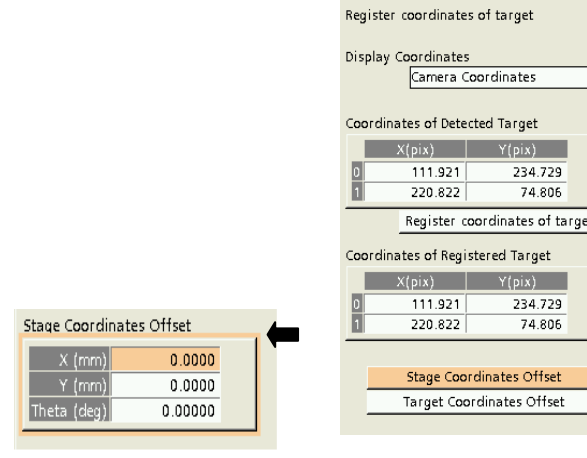
Offsets are specified in "Register coordinates of target".

1. After setting target checkers, select "Register coordinates of target".



2. The menu window appears as the right figure.

3. Select "Stage Coordinates Offset".

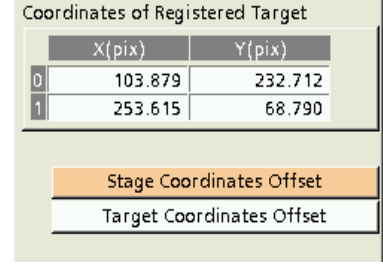


4. Set stage coordinates offsets. The positions that the values specified here are added to the detected positions of Mark0 and Mark1 are used as the target positions.
X (mm), Y (mm), Theta (°)

Set offsets so that each mark is within each view range when these values are added to the detected positions of the marks.

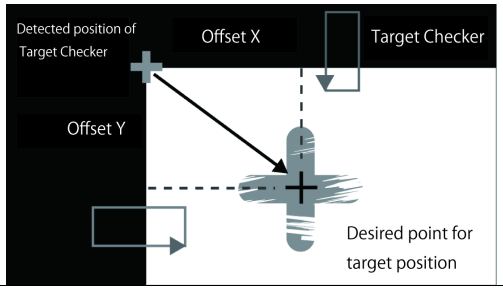
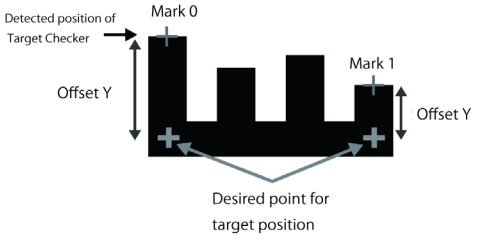
5. After the setting, press the CANCEL key to return to the previous menu.

6. The values of "Coordinates of Detected Target" and "Coordinates of Registered Target" in the "Register coordinates of target" menu are updated.



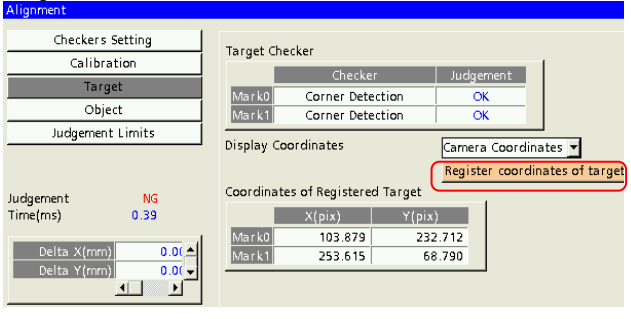
7.1.5 Offset Setting for Target

Set offsets to use the position moved by a certain movement amount from the detected position of the mark specified in "Target Checker" as the target position.

Example 1) When detecting a position you want to register is difficult	Example 2) When there is no point to be a mark at the position you want to register
	
If the condition of a captured image is bad as shown in the above figure, you can detect another position (the left end of the white area in the above figure) by Target Checker although you want to use the gray cross mark as the target position, and can set the position moved by the amount of offsets from the detected position as the target position.	If you want to use positions without characteristic points as the target positions, detect characteristic points as the target marks, set values for offset coordinates after checking the distances between the detected positions of the marks and the desired target positions on a drawing, etc.

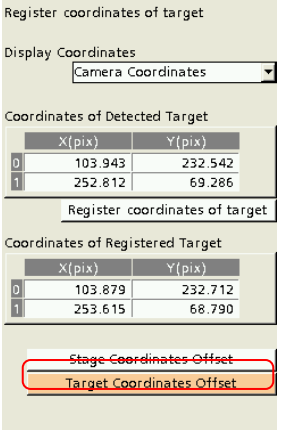
Offsets are specified in "Register coordinates of target".

1. After setting target checkers, select "Register coordinates of target".



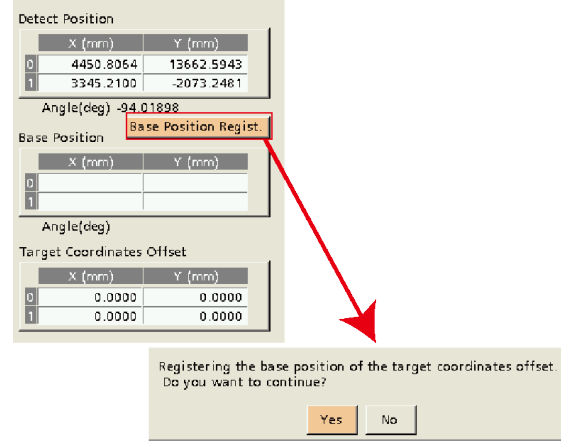
2. The menu window appears as the right figure.

3. Select "Target Coordinates Offset".



4. The "Target Coordinates Offset" menu appears.

The detected position of a target mark at the time of executing the previous test is displayed in "Detect Position". Press the TRIG key to execute a test.

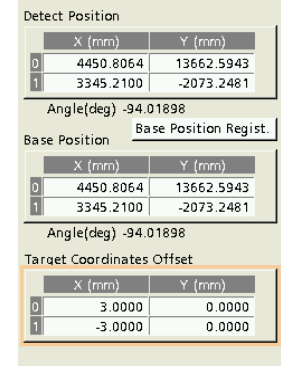


5. Confirm that two target marks are detected.

6. Press the ENTER key on the "Base Position Regist." button and register the current position as the base position as necessary. ("Target Coordinates Offset" is not required to be set at this time.) Once registered, the detected positions of each mark at the time of executing a test are displayed in "Base Position".

▶ Note

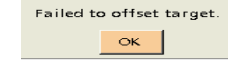
- PV240 recognizes the positional relation between the target marks on the global coordinates by registering target positions, and can get the target positions including offsets. (For details of Base Position Registration, refer to page 188.)
- For clearing the registered base position of target offsets, press the FUNC key and select "Delete the base position".



7. Set target coordinates offsets. Set them to make the detected positions of target marks be within the screen when the target coordinates offsets are added.

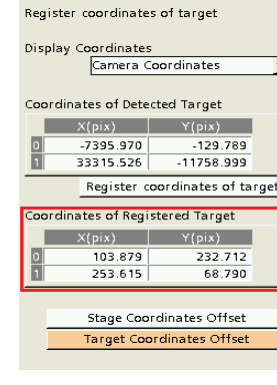
▶ Note

If the target position lies off the screen as a result of adding the target coordinates offsets, the right message appears. In that case, set appropriate values.



8. When setting "Target Coordinates Offset" and registering target positions, the table of "Coordinates of Registered Target" shows the registered values to which the offsets are added. At this time, cross marks whose center is located at these positions are displayed on the screen window.

Mark0: Pink cross
Mark1: Blue cross



About Base Position Registration of Offset

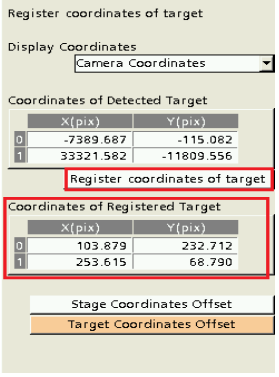
There are the following differences depending on whether "Base Position Regist." is made or not.

When setting offsets is required, set values for "Offset Coordinates". As for the directions of the offset coordinates X and Y, PV240 provides axes to be the base in two ways at this time.

(1) Set offsets on the global coordinates considering the positional relation of two marks.

(2) Set the direction from Mark0 to Mark1 as the direction of 0 degree for offset X, and set the direction that is vertical to it as that for offset Y.

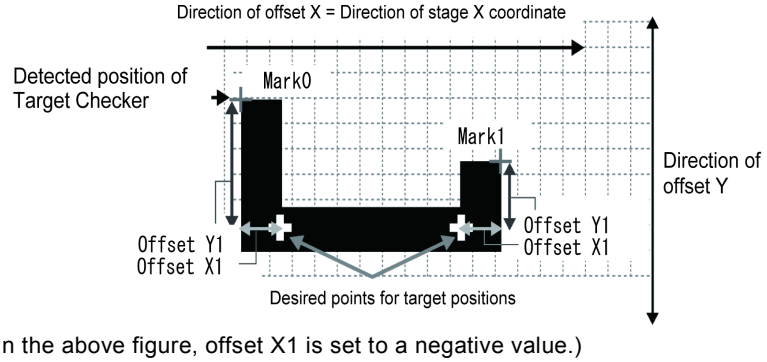
These differences depend on whether the base position of offset is registered or not. The method (1) is recommended because offset values are set in XY directions on the global coordinates and offset values can be set without paying particular attention to the mounting positions of cameras.



Difference in object positions depending on whether Base Position is registered or not

(1) When the base position of offsets is registered: Set offsets on the global coordinates considering the positional relation of two marks.

The positional relation of Mark0 and Mark1 on the global coordinates (such as Mark0 is right or left, above or below) is obtained by registering the base position. The target positions are the positions distant from the detected coordinates of each mark by offsets on the global coordinates.



(In the above figure, offset X1 is set to a negative value.)

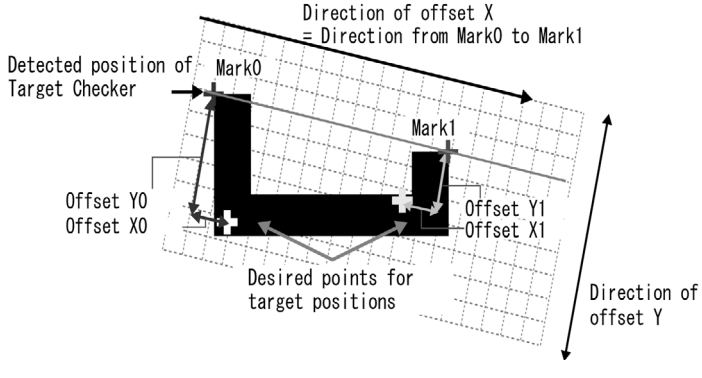
Required settings
・Base position registration
・Offset coordinate setting

(2) When the base position of offsets is not registered: Set the direction from Mark0 to Mark1 as the direction of 0 degree for offset X, and set the direction that is vertical to it as that for offset Y.

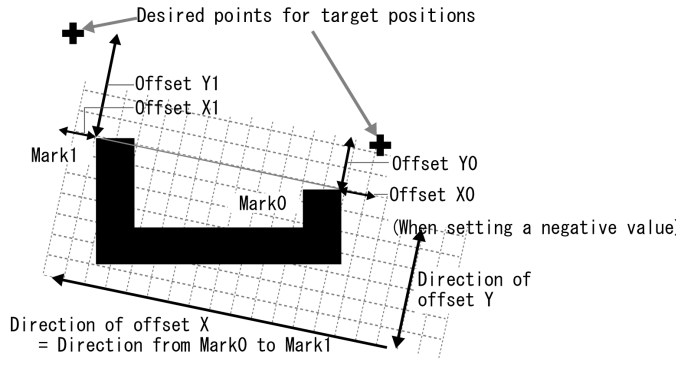
In this case, "Base Position Regist." is not made. If values are displayed in the table of "Base Position", press the FUNC key on the "Base Position Regist." button and delete the base position.

The target positions are the positions distant from the detected coordinates of each mark by offsets in the directions of axes made.

Example 1

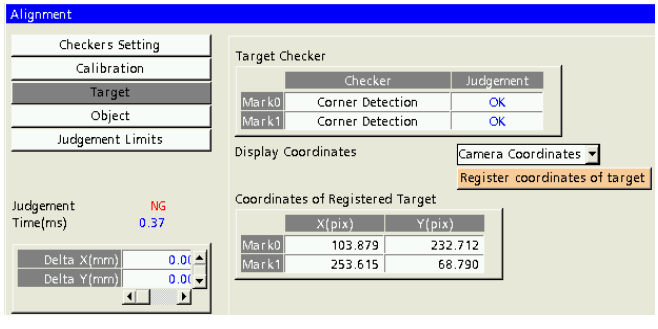


Required settings
・Offset coordinate setting (without "Base Position Regist.")

	When the same values are set as offset coordinates for (1) and (2), the target positions differ. It is necessary to set values for offsets X and Y considering the angle between the marks.	
	Example 2)  	In the right figure, Mark0 is set on the right and Mark1 is on the left. In this case, the offset X is directed to the left and the offset Y is directed to the opposite direction to the above figure. When a base position is not registered, offset values should be set considering the positional relation of Mark0 and Mark1.

7.1.6 Coordinates of Registered Target

The coordinate values to be the target (movement destination) are displayed.



Chapter 8

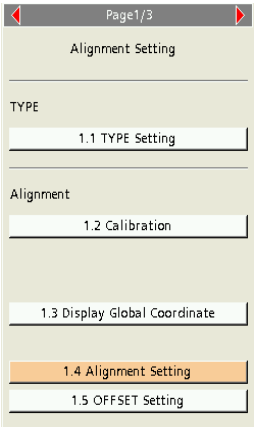
Object Setting

8.1 Setting Object

This item is to set an object for positioning using Alignment.

Set a method for detecting mark positions (Checker), and detect object coordinate values at the time of executing Alignment. Calculation and output needed for Alignment is performed comparing the detected object coordinate values and the registered target coordinate values.

This setting is made from "INSPECTION" > "Alignment" > "Object" in Normal Menu. In Engineering Menu, it is made from "Object" under "1.4 Alignment Setting" on Page 1.

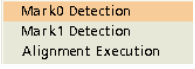


How to Set Object

1. Set object checkers.
(Checkers set for Calibration can be used for Object checkers in common. Check "Common Object" in this case.)
2. Set offsets as necessary.
3. Confirm the registered target positions.

Note

When selecting "Mark Async. Execution" in "TYPE" > "Alignment" > "Alignment" > "TRIG Type" (page 156), clicking the TRIG key on the object window displays the right menu.



"Mark0"/"Mark1": Detects the selected object mark.

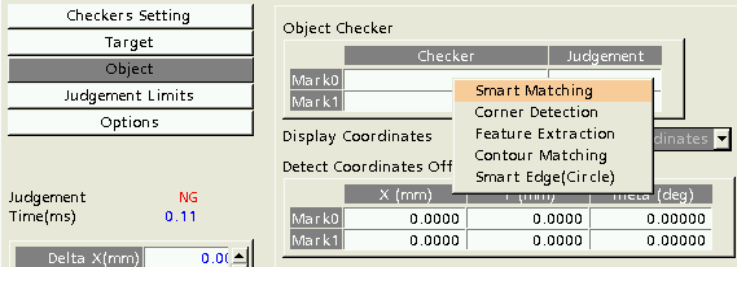
"Alignment Execution": Executes Alignment based on the positions of two object marks acquired beforehand.

8.1.1 Object Checker

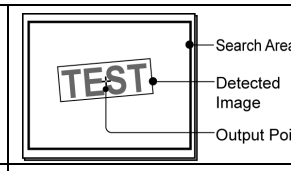
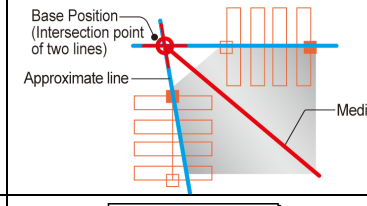
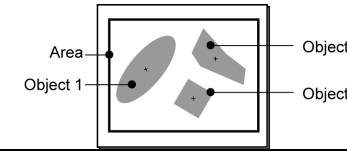
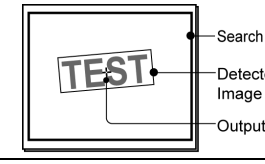
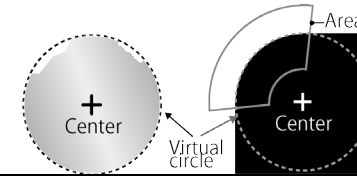
Set a checker to detect the mark position for each mark.

Note

- For details of how to set and operate checkers, refer to PV200 User's Manual (4th Edition or later).
- Checkers used as Calibration Checker can be used as Object Checker. In that case, check "Common Object" in "INSPECTION" > "Alignment" > "Checkers Setting". In the case of Engineering Menu, check "Common Object" in "Checkers Setting" of "1.4 Alignment Setting" on page 1. (For details of "Common Object", refer to page 162 (5.3.3 Checkers Setting > Common Object).)
- When "Common Object" is checked in "Checkers Setting", the settings in "Object" > "Object Checker" cannot be configured. In this case, adjust the settings in "Checkers Setting" > "Calibration Checker".



Checker	Detected image

Smart Matching	This is a function that searches and detects a similar part to the registered image pattern. Template: 	
Corner Detection	The horizontal base checker and vertical base checker are both set, the intersection point of two approximate lines will be considered as the base position.	
Feature Extraction	Feature Extraction binarizes an image captured by a camera, detects a specified size of clusters of white or black pixels (hereinafter called “object”), and then judges as OK or NG depending on the measured number.	
Contour Matching	Contour Matching searches and detects a similar part of an inspection image to the registered contour information on the part of an image the brightness of which varies. Template: 	
Smart Edge (Circle))	Smart Edge (Circle) is a function to output the center point, radius or diameter of a round object by detecting edges of the object with a number of cells. The central coordinate or radius of a circle can be also detected when a whole object cannot be captured or for the angle of a chamfered object.	

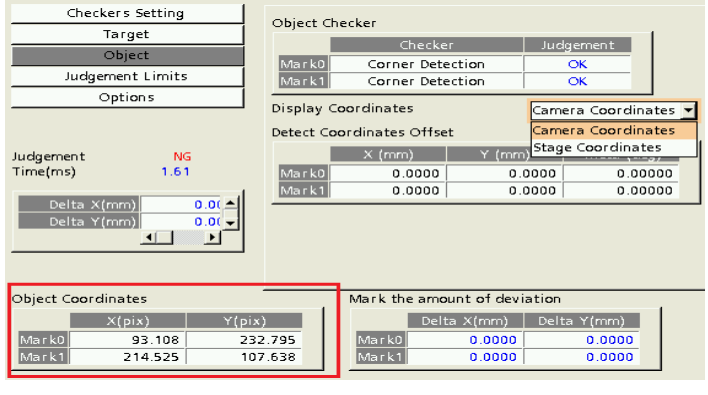
8.1.2 Display Coordinates

Select how to display coordinate values in "Object Coordinates". This item can be selected after setting "Calibration".

Changing this setting changes the unit display of "Object Coordinates". (This setting is not related to the values of coordinate axes to be displayed by "Display Patterns" > "Coordinate Axis" in the image menu displayed by pressing the FUNC key.)

▶ Note

"Display Coordinates" is a common item with "Display Coordinates" in "Target".



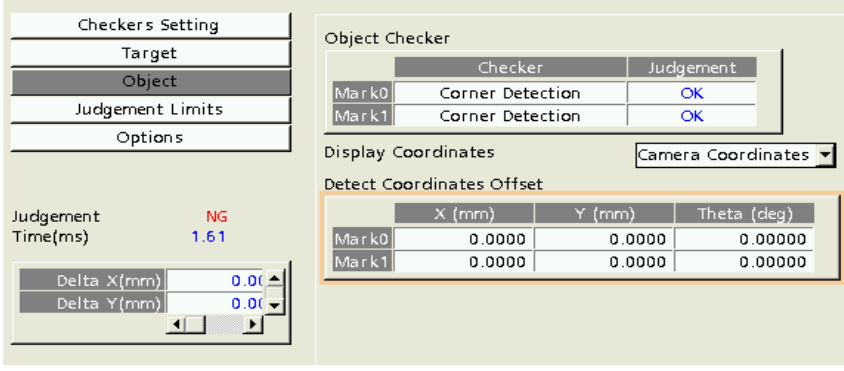
Display Coordinates

Camera Coordinates (Default)	The displayed values are in "pixels".
Stage Coordinates	The displayed values are in "mm". It requires that calibration data has been created.

8.1.3 Detect Coordinates Offset

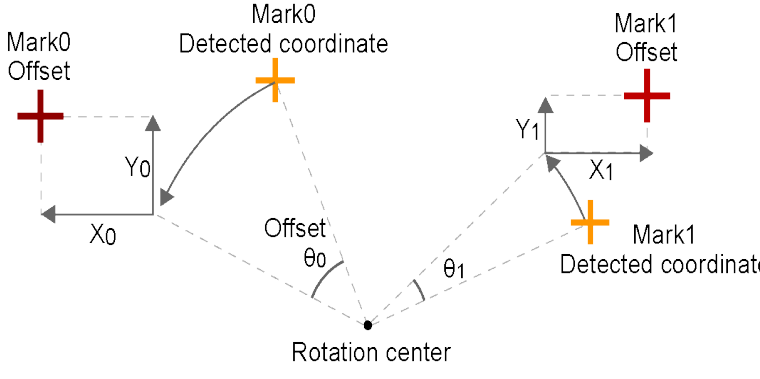
This setting is used to set a position which is the detected position by Object Checker plus offsets as object coordinates.

The rotation center of the detect coordinates offset Theta is the rotation center of the stage.



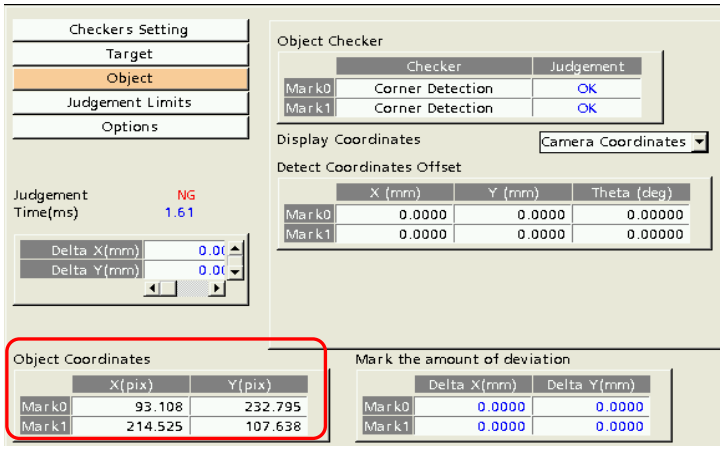
Object Coordinates by Setting Detect Coordinates Offset

By setting offsets, the position shifted from a detected mark position by the offsets is output as object coordinates. The positions of orange cross marks are detected as Mark0 and Mark1 in the following figure. By setting offsets, the positions of red cross marks will be the object coordinates.



8.1.4 Object Coordinates

Display the coordinate values of a detected object. (The unit display of coordinate values (pixel or mm) is set in 8.1.2 Display Coordinates.)

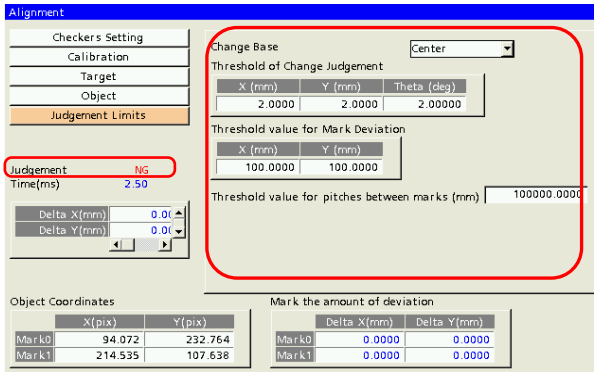


Chapter 9

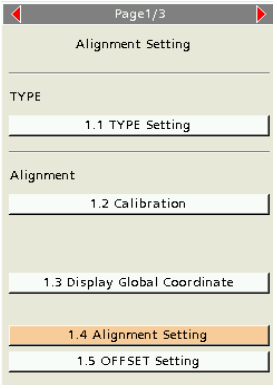
Judgement Condition Setting

9.1 Setting Judgement Limits

The amount of deviation (deviation of a specified position), the amount of deviation of each mark and the pitch between marks are used for the judgement reference for executing Alignment and judging an alignment result whether it is OK or NG. This setting is made from "INSPECTION" > "Alignment" > "Judgement Limits" in Normal Menu. In Engineering Menu, it is made from "Judgement Limits" under "1.4 Alignment Setting" on Page 1.



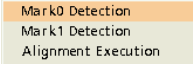
Normal Menu



Engineering Menu

Note

When selecting "Mark Async. Execution" in "TYPE" > "Alignment" > "Alignment" > "TRIG Type" (page 156), clicking the TRIG key on the target window displays the right menu. Select whether to select Mark0 or Mark1.



Termination of Alignment

Alignment is finished as follows.

Alignment succeeded.

At this time, the alignment result is judged as OK.
When the position specified in "Change Base" meets "Threshold value for Change Judgement" during the execution of "Retry", and each object coordinate and target coordinate is within the range of "Threshold value for Mark Deviation".

Alignment failed.

At this time the alignment result is judged as NG, and PV240 returns an error to a controller such as PLC. (For details of error contents, refer to Chapter 4.)
(1) Alignment failed.
When the position specified in "Change Base" does not meet "Threshold value for Change Judgement" even after "Retry", or each object coordinate is positioned apart from each target coordinate by "Threshold value for Mark Deviation" or more even if the position specified in "Change Base" meets the threshold value.
(2) Alignment was cancelled. (Alignment is not executed until the retry count and terminated.)
i. Target/Object marks are not detected.
ii. A stage movement amount exceeds "Stage MAX Distance" ("TYPE" > "Alignment" > "Stage Setting").
iii. The distance between target coordinates and the distance between object coordinates exceed "Threshold value for Mark Deviation" during the execution of Alignment.
iv. Others, e.g. Target/Object Checker is unset. (For details, refer to Chapter 4.6.)

In "Judgement Limits", items for judging alignment results when it is performed in the state that Alignment is executable (the state that marks can be detected and the stage can be moved) are specified.

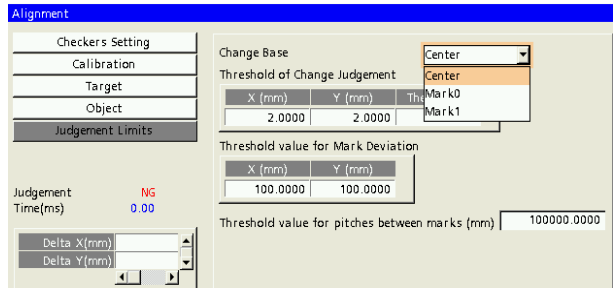
9.1.1 Change Base and Threshold Value for Change Judgement

Set the allowable range for the deviation between a target position and an object position at the time of the execution of alignment.

Determine the base position of the amount of deviation in "Change Base", and set thresholds in "Threshold value for Change Judgement" to judge as OK or NG for the amount of deviation of "Change Base".

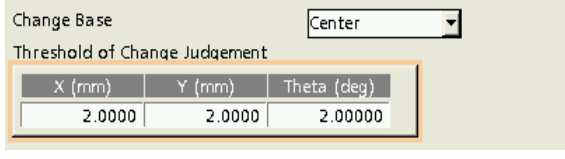
Change Base

Select the base position for determining the deviation between a target position and an object position at the time of the execution of alignment. Select Center (Default), Mark0 or Mark1.



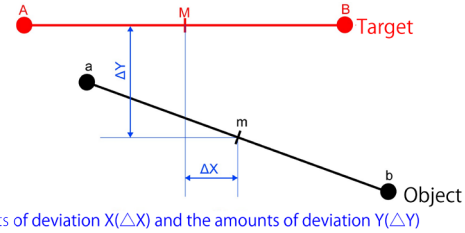
Threshold of Change Judgement

Set the allowable range for the deviation between the bases specified in "Change Base" for Target and Object when executing Alignment. Set the range for the amounts of deviation X, Y and Theta.

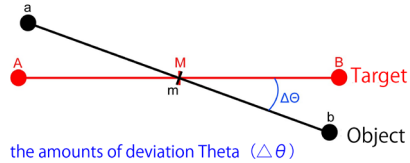


Default
X: 2.0000 mm
Y: 2.0000 mm
Theta: 2.00000 degrees

Change Base (Center) and Threshold Value for Change Judgement



the amounts of deviation X(△X) and the amounts of deviation Y(△Y)



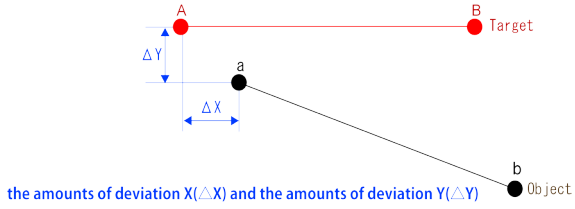
the amounts of deviation Theta（△θ）

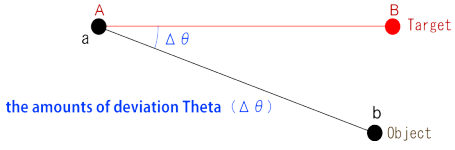
■When the middle point between target marks is “M” and the middle point between object marks is “m”, the distance until these points match by moving them in parallel in their X and Y directions is Delta X and Delta Y.

■The angle that the object line ab becomes parallel to the target line AB by rotating on the middle point "m" is Delta Theta.

■Judgment is executed for these deviations (Delta X, Delta Y, Delta Theta) with "Threshold value for Change Judgement".

Change Base (Mark0) and Threshold Value for Change Judgement



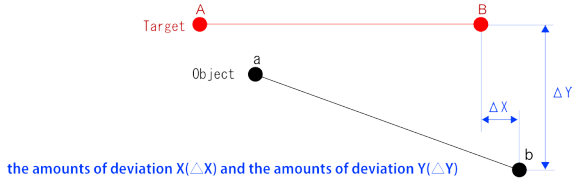


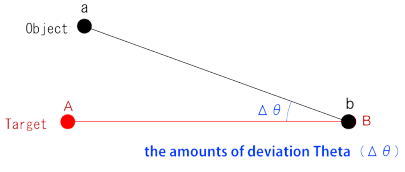
■When the target mark0 is "A", target mark1 is "B", object mark0 is "a" and object mark1 is "b", the distance until these marks match by moving them in parallel in their X and Y directions is Delta X and Delta Y.

■The angle that the object line ab becomes parallel to the target line AB by rotating on the object mark0 "a" is Delta Theta.

■Judgment is executed for these deviations (Delta X, Delta Y, Delta Theta) with "Threshold value for Change Judgement".

Change Base (Mark1) and Threshold Value for Change Judgement





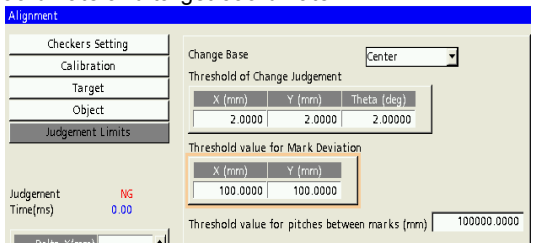
■When the target mark0 is "A", target mark1 is "B", object mark0 is "a" and object mark1 is "b", the distance until these marks match by moving them in parallel in their X and Y directions is Delta X and Delta Y.

■The angle that the object line ab becomes parallel to the target line AB by rotating on the object mark1 "b" is Delta Theta.

■Judgment is executed for these deviations (Delta X, Delta Y, Delta Theta) with "Threshold value for Change Judgement".

9.1.2 Threshold Value for Mark Deviation

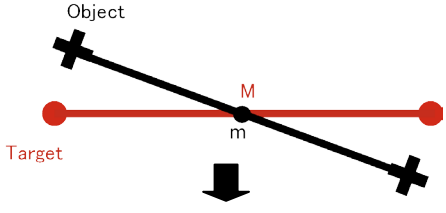
When the base positions of the object and target specified in "Change Base" meet "Threshold of Change Judgement", set "Threshold value for Mark Deviation" for determining the deviation between each object coordinate and target coordinate.



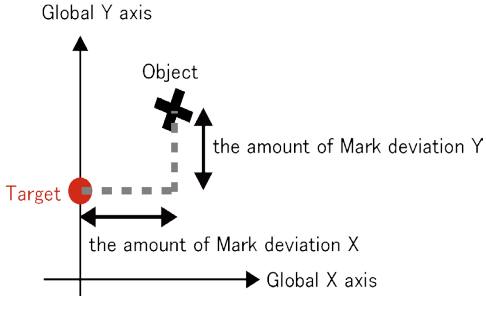
Default
X: 100.0000 mm
Y: 100.0000 mm

Concept

Change Base: An example using "Center" is explained below.



In the left figure, "Threshold of Change Judgement" is met. However, alignment should not be finished at this point since the target marks and object marks are separated from each other.



"Threshold value for Mark Deviation" is set here considering the deviation between the target and object marks.

As Alignment will be finished when the mark deviation amounts X and Y for the target and object on the global coordinates are within the range of "Threshold value for Mark Deviation", adjust the stage to make them be within the range.

Setting "Threshold value for Mark Deviation" enables more accurate alignment.

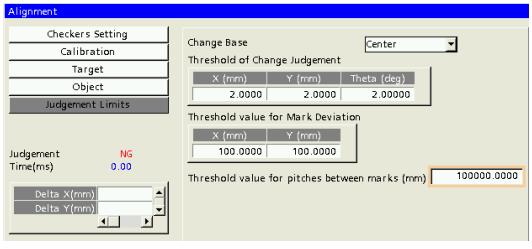
Note

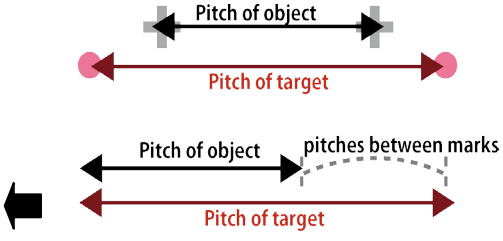
Judgement with "Threshold value for Mark Deviation" is performed for Mark0 and Mark1 regardless of the setting for "Change Base".

9.1.3 Threshold Value for Pitches Between Marks (mm)

If the difference between the distance between object marks and the distance between target marks which is calculated by PV240 is large when executing Alignment, and if the difference is larger than the threshold values specified here, an error is output and the alignment operation can be cancelled.

Default: 100000.0000 mm





Chapter 10

Judgement, Numeric Calculation, Geometry Calculation, Data R/W, Draw Character/Figure

10.1 Judgement Output

The execution results of Alignment can be registered for judgement formulas.

Registrable Data for Judgement Formulas

Item		Condition judged as OK
Checker-Alignment (ALN) No.000	Judgement (JUDGE)	The judgement result whether the deviation between a registered target coordinate and a detected object coordinate is within a specified threshold value for change judgement is returned.

Note

When a type is selected, JDC000=ALN000_JUDGE is automatically set in "INSPECTION" > "Judgement", and JDC000 is set in Total Judgement.

10.2 Numeric Calculation

Numeric results by executing Alignment can be registered for numeric calculations.

Registrable Inspection Data for Numeric Calculation

Note

When items in "Result" of numerical calculation and data R/W have been selected and "Statistics" has been selected, the compiled statistics data vary according to items.

Statistics type	Numeric Statistics	All Statistics	OK Statistics	NG Statistics
1	Judgment Statistics If the judgement of checker is OK, calculates “All Statistics” and “OK Statistics”. If the judgement is NG, calculates “All Statistics” and “NG Statistics”. When referring the statistics of judgments(JR/JD) during in RUN mode, the latest result is referred.	Scan Count (Judgment Count)	OK count	NG count
2	Statistics of checker results If the judgement of checker is OK, calculates “All Statistics” and “OK Statistics”. If the judgement is NG, calculates “All Statistics” and “NG Statistics”.	Minimum	OK Judge. Min.	NG Judge. Min.
		Maximum	OK Judge. Max.	NG Judge. Max.
		Average	OK average	NG average
		Range	OK Range	NG range
		Variance	OK Variance	NG Variance

Checker

Note that the unit of outputting alignment results and magnification are different from those of other checkers.

Item	Result No.	Result Type	Statistics Type	Details
Alignment (ALN) No.000 Common Result: 1/2 page	---	Judgement (JUDGE)	1	Output data OK=1, NG=0
		Inspection Time (TIME)	2	
Alignment		Change Delta X (DX) *1)	2	
		Change Delta Y (DY) *1)	2	
		Change Delta Theta (DT) *2)	2	
		Target mark pitch (TAR_P) *1)	2	
		Object mark pitch (OBJ_P) *1)	2	
		No. of Movement (MVCNT)	No	Output result only
Target: 2/2 page		Registration mark0 X (TAR0_X) *1)	2	
		Registration mark0 Y (TAR0_Y) *1)	2	
		Registration mark1 X (TAR1_X) *1)	2	
		Registration mark1 Y (TAR1_Y) *1)	2	
Object		Mark0 X (OBJ0_X) *1)	2	
		Mark0 Y (OBJ0_Y) *1)	2	
		Mark1 X (OBJ1_X) *1)	2	
		Mark1 Y (OBJ1_Y) *1)	2	
Mark the amount of deviation		Mark0 DeltaX (MX_CAM0) *1)	2	
		Mark0 DeltaY (MY_CAM0) *1)	2	
		Mark1 DeltaX (MX_CAM1) *1)	2	

Mark1 DeltaY (MY_CAM1) *1)	2

*1) Result is output in μm.
*2) Result multiplied by 100 is output.

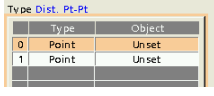
10.3 Geometry Calculation

Results of alignment can be referred in Geometry Calculation.
Geometry Calculation is set from "INSPECTION" > "Geometry Calc." in Normal Menu.

Referable geometry calculations: Those referring positions of points
(Distance between two points, Distance between point and line, Point of approximate lines, approximate circle, approximate ellipse)

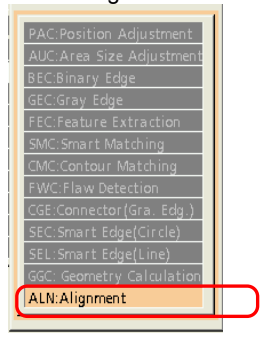
Setting example (Use for the points of the distance between two points)

References in Geometry Calculation

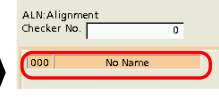


Only points in the results of Alignment can be referred.

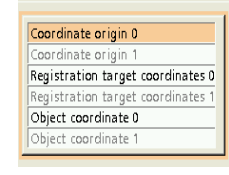
Select Alignment.



Select a checker number.



Select reference data.



The above six items can be referred.

List of Settable Items for Each Object

	Point	All Points	Line	Circle
ALN: Alignment	Yes Coordinate origin 0 Coordinate origin 1 Registration target coordinates 0 Registration target coordinates 1 Object coordinate 0 Object coordinate 1	No	No	No

Note

The checker with a camera number different from that selected for the setting geometry calculation cannot be specified or referred.

An operation error occurs if a test is executed at this time. ("E0071 No ref. checker result." is displayed.)

10.4 Data R/W

Alignment data can be referred in Data R/W.
The setting is made from "TYPE" > "Data R/W" > "Data R/W 0" and "Data R/W 1".
For details of the setting method, refer to "4.19 Displaying Data on the Screen and Updating Settings (Data R/W)" of PV200 User's Manual.

10.4.1 Settings Unique to PV240 (Presets)

Data R/W of PV240 provides "Presets" in which frequently used items at the time of Alignment are set, and the following contents are automatically stored when creating a type. Different preset items are prepared for Data R/W 0 and Data R/W 1 respectively. Edit and use them as necessary.

Preset items for Data R/W0

	Delta X	Delta Y	Delta Theta
Threshold	2.0000	2.0000	2.00000
Present Value	0.0000	0.0000	0.00000
Previous Valu	0.0000	0.0000	0.00000
Result	NG	No. of Executi	0

Displays deviations.

Preset items for Data R/W1

	Mark0		Mark1	
	X	Y	X	Y
Resolution	30.9789	11.4131	2.4748	2.5925
Rotation Poin	24.3818	226.6825	-12.3892	84.7117
Camera Angle	-73.81079		68.51456	

Displays calibration data.

Settings of Presets

Data R/W 0

	Text (Delta X)	Text (Delta Y)	Text (Delta Theta)
Text (Threshold)	Checker (Alignment No.000 Threshold X)	Checker (Alignment No.000 Threshold Y)	Checker (Alignment No.000 Threshold Theta)
Text (Present Value)	Checker (Alignment No.000 Change Delta X (present)	Checker (Alignment No.000 Change Delta Y (present)	Checker (Alignment No.000 Change Delta Theta (present)
Text (Previous Value)	Checker (Alignment No.000 Change Delta X (previous)	Checker (Alignment No.000 Change Delta Y (previous)	Checker (Alignment No.000 Change Delta Theta (previous)
Text (Result)	Checker (Alignment No.000 Judgement)	Text (No. of Execution)	Checker (Alignment No.000 No. of Movement)

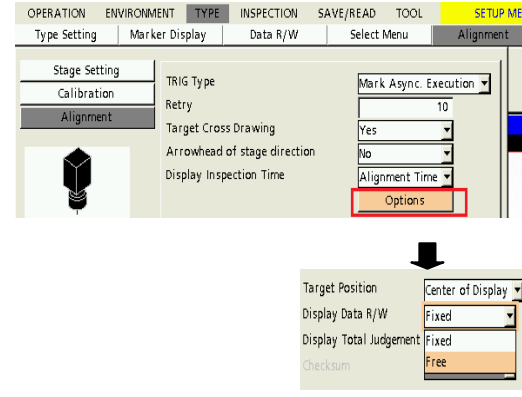
Data R/W 1

	Text (Mark0)		Text (Mark1)	
	Text (X)	Text (Y)	Text (X)	Text (Y)
Text (Resolution)	Checker (Alignment No.000 Calibration 0 Resolution X (mm/pixel))	Checker (Alignment No.000 Calibration 0 Resolution Y (mm/pixel))	Checker (Alignment No.000 Calibration 1 Resolution X (mm/pixel))	Checker (Alignment No.000 Calibration 1 Resolution Y (mm/pixel))
Text (Rotation Point)	Checker (Alignment No.000 Calibration 0 Rotation Point X (mm))	Checker (Alignment No.000 Calibration 0 Rotation Point Y (mm))	Checker (Alignment No.000 Calibration 1 Rotation Point X (mm))	Checker (Alignment No.000 Calibration 1 Rotation Point Y (mm))
Text (Camera Angle)	Checker (Alignment No.000 Calibration 0 Camera Angle (°))		Checker (Alignment No.000 Calibration 1 Camera Angle (°))	

How to Set Presets in Data R/W

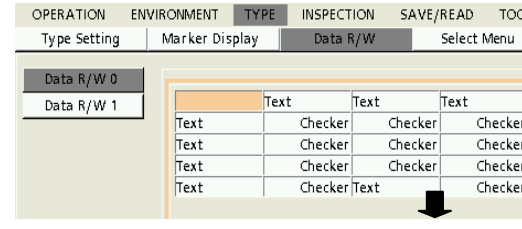
1. Set "Display Data R/W" to "Free" in "TYPE" > "Alignment" > "Alignment" > "Options".

(If it is set to "Fixed", Data R/W cannot be edited.)



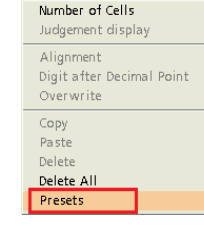
2. Select "TYPE" > "Data R/W".

3. Select "Data R/W 0" or "Data R/W 1".

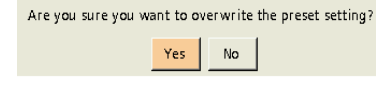


4. Press the FUNC key while the cursor is on the table.

5. Select "Presets".



6. Select "Yes" in the right dialog box.



7. Preset items are stored in "Data R/W".

▶ Note

- It is possible to add other items or edit the settings after storing the preset data.
- For displaying the Data R/W window in RUN menu, select "Data R/W 0" or "Data R/W 1" in "View" > "Data R/W".
- Inappropriate characters may be displayed depending on language specifications when switching language. So, read the preset data again after switching language. Accordingly, character strings are displayed in the selected language.

10.4.2 Referring Alignment Data

"Yes" in the "Change" column indicates the value of the cell is modifiable from Data R/W sheet.
For details of "Statistics Type", refer to page 205.

Alignment	(ALN)		Change	Statistics type
Parameter	Calibration	Checker 0 *1)	No	No
		Checker 1 *1)	No	No
	Target	Checker 0 *1)	No	No
		Checker 1 *1)	No	No
		Stage Coordinates Offset (X)	Yes	No
		Stage Coordinates Offset (Y)	Yes	No
		Stage Coordinates Offset (Theta)	Yes	No
		Target Coordinates Offset 0 (X)	Yes	No
		Target Coordinates Offset 0 (Y)	Yes	No
		Target Coordinates Offset 1 (X)	Yes	No
		Target Coordinates Offset 1 (Y)	Yes	No
	Object	Checker 0 *1)	No	No
		Checker 1 *1)	No	No
		Detect Coordinates Offset 0X	Yes	No
		Detect Coordinates Offset 0Y	Yes	No
		Detect Coordinates Offset 0Theta	Yes	No
		Detect Coordinates Offset 1X	Yes	No
		Detect Coordinates Offset 1Y	Yes	No
		Detect Coordinates Offset 1Theta	Yes	No
	Judgement Limits	Threshold of Change Judgement (X)	Yes	No
		Threshold of Change Judgement (Y)	Yes	No
		Threshold of Change Judgement (Theta)	Yes	No
		Threshold value for pitches between marks	Yes	No
		Threshold value for Mark Deviation (X)	Yes	No
		Threshold value for Mark Deviation (Y)	Yes	No
Result	Common Result	Judgement	No	No
		Execution Time	No	No
	Alignment	Change Delta X (present)	No	No
		Change Delta Y (present)	No	No
		Change Delta Theta (present)	No	No
		Change Delta X (previous)	No	No
		Change Delta Y (previous)	No	No
		Change Delta Theta (previous)	No	No
		Change Delta X (before last)	No	No
		Change Delta Y (before last)	No	No
		Change Delta Theta (before last)	No	No
		Target mark pitch	No	No
		Object mark pitch	No	No
		No. of Movement	No	No
	Calibration Mark0	Resolution X (mm/pixel)	No	No
		Resolution Y (mm/pixel)	No	No
		Rotation Point X (mm)	No	No
		Rotation Point Y (mm)	No	No
		Camera Angle (°)	No	No
	Calibration Mark1	Resolution X (mm/pixel)	No	No
		Resolution Y (mm/pixel)	No	No
		Rotation Point X (mm)	No	No
		Rotation Point Y (mm)	No	No
		Camera Angle (°)	No	No
	Target	Registration mark0 X *2)	No	No
		Registration mark0 Y *2)	No	No
		Registration mark1 X *2)	No	No

Alignment	（ALN）		Change	Statistics type
		Registration mark1 Y *2)	No	No
	Object	Mark0 X	No	No
		Mark0 Y	No	No
		Mark1 X	No	No
		Mark1 Y	No	No
	Mark the amount of deviation	Mark0 DeltaX	No	No
		Mark0 DeltaY	No	No
		Mark1 DeltaX	No	No
		Mark1 DeltaY	No	No
	Stage Adjustment Amount	Adjustment Amount Delta X *3)	No	No
		Adjustment Amount Delta Y *3)	No	No
		Adjustment Amount Delta Theta *3)	No	No

*1) When setting "Checker" (Calibration Checker, Target Checker, Object Checker) for the parameter of Alignment, characters indicating checkers used for each mark are displayed. (Smart Matching: SMC, Corner Detection: CNR, Feature Extraction: FEC, Contour Matching: CMC, Smart Edge (Circle): SEC, Arbitrary Point: FRE)
*2) The registered target coordinates are displayed.
*3) Use this value for moving the stage by Manual Alignment.

10.5 Character/Figure Drawing

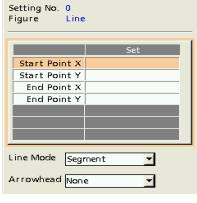
Detected positions and results of Alignment can be used for drawing positions of figures or displayed character strings in Draw Character/Figure.
Character/Figure Drawing is set from "INSPECTION" > "Draw Char/Fig." in Normal Menu.
For details of the setting method, refer to "4.14 Character/Figure Drawing" of PV200 User's Manual.

Using alignment data (detected positions) in Character/Figure Drawing

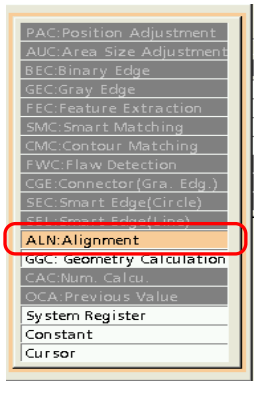
	Figure	Reference destination
Usable for drawing positions	Line Cross Rectangle Slanted rectangle Ellipse Character	Start point and End point Intersection point Start point and End point Center of rectangle Center of ellipse Displayed position
Usable for displayed characters	Character	Character string

Setting example1 (Use alignment data for point positions)

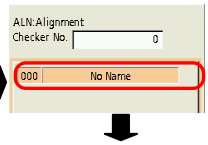
Start point of a line

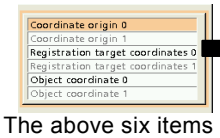


Select Alignment.



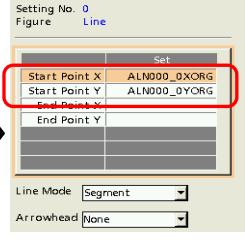
Select checker No. and reference data.





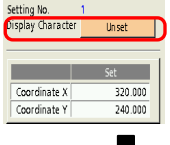
The above six items can be referred.

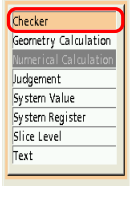
Specify a position of Alignment for start point.



Setting example 2 (Use alignment data for Display Character)

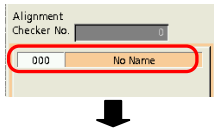
Character Display Character

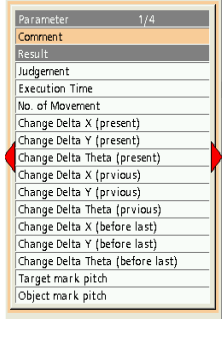




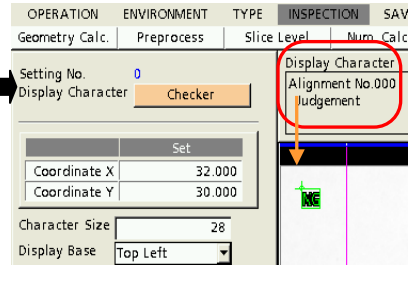
Select Alignment.

Select checker No. and reference data.





Specify a position of Alignment for start point.



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