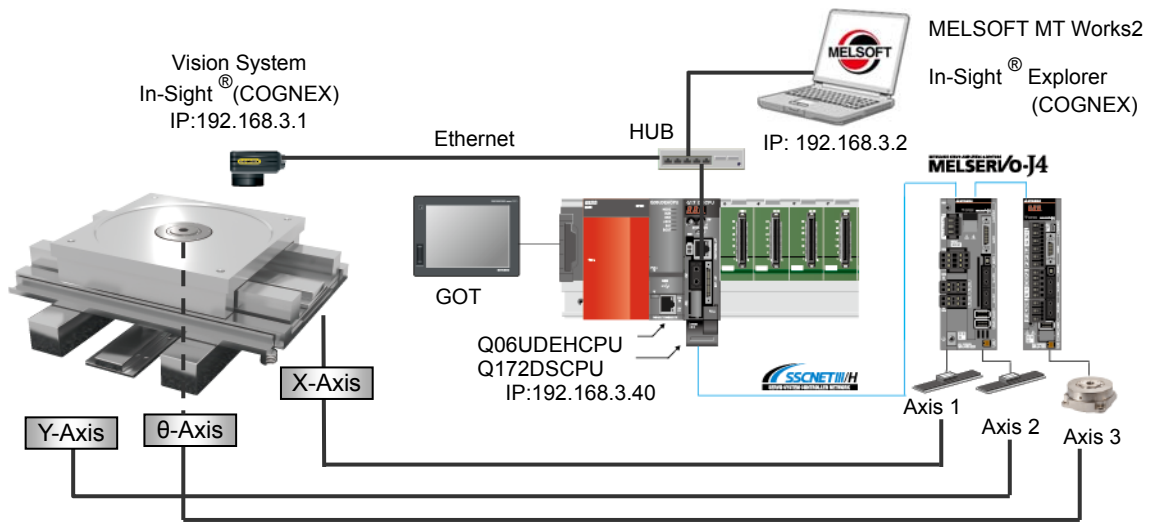


Motion Alignment (X-Y-θ)

[System Configuration]



[Mitsubishi solution]

Motion CPU: Q172DSCPU **Servo amplifier: MR-J4W2-B, MR-J4-B** **Linear servo motor: LM-H3**
PLC CPU: Q06UDEHCPU **GOT: GT165*-V** **Direct drive motor: TM-RFM**
Main base: Q35DB **Vision System: In-Sight® series**
Engineering environment: MELSOFT MT Works2 (Motion), MELSOFT GX Works2 (PLC), MELSOFT GT Works3 (GOT)
In-Sight® Explorer (Vision System (COGNEX))
Motion CPU operating system software: SW8DNC-SV22QL

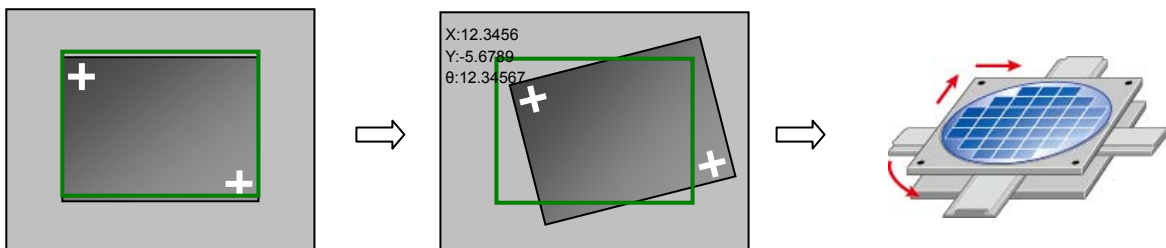
[Operation description]

The position of the work piece on the alignment table is corrected by detecting the deviation of the position using the Vision System.

[Control points]

- Point1: By connecting the Motion controller and the Vision System directly via Ethernet, the result of the image processing (deviation from normal position) can be obtained in high speed using dedicated SFC instructions.
- Point2: By using linear servo motors for the X- and Y-Axis, and a direct drive motor for the θ-Axis, the position command is directly translated and positioning with high response and a high degree of accuracy without the play and backlash of a gear can be performed.

[Control Overview]



The In-Sight® Explorer vision tool is used to register the image of the normal position of the work piece as a pattern.

The Vision System detects the deviation of the current image to the regular pattern and sends it to the device memory of the Motion controller.

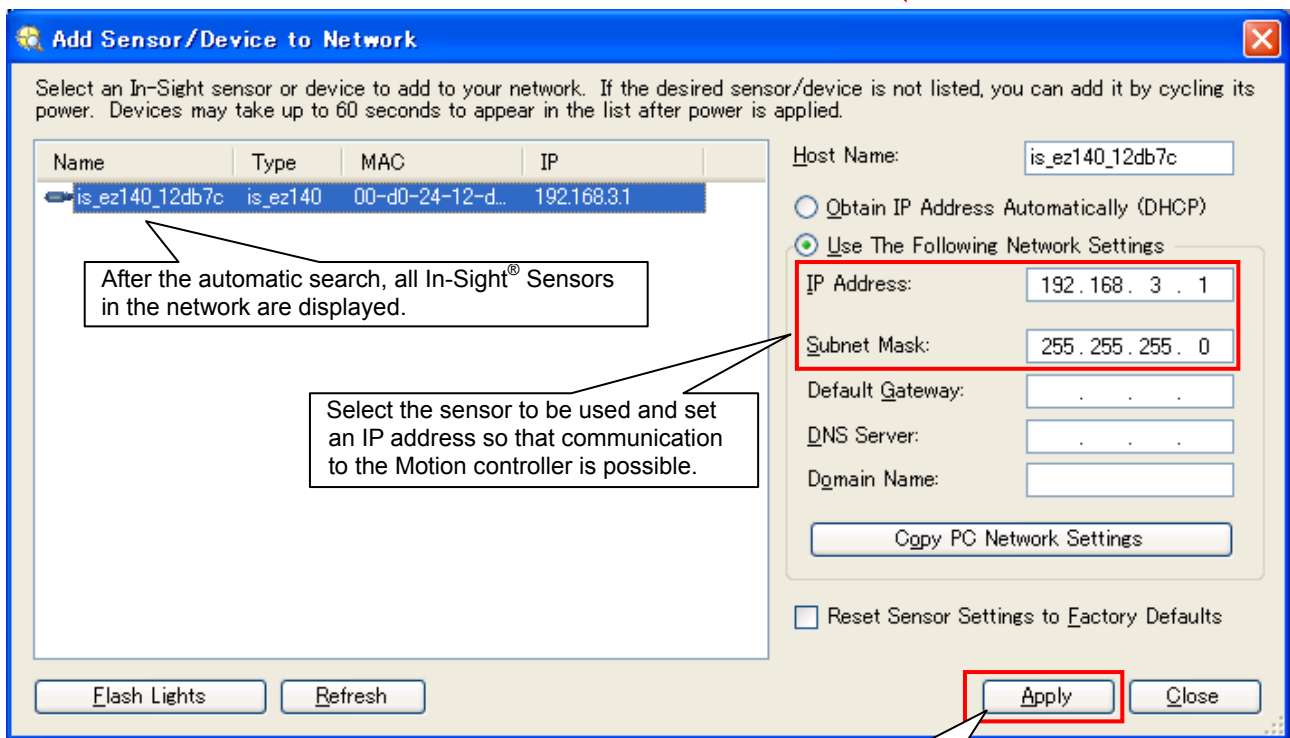
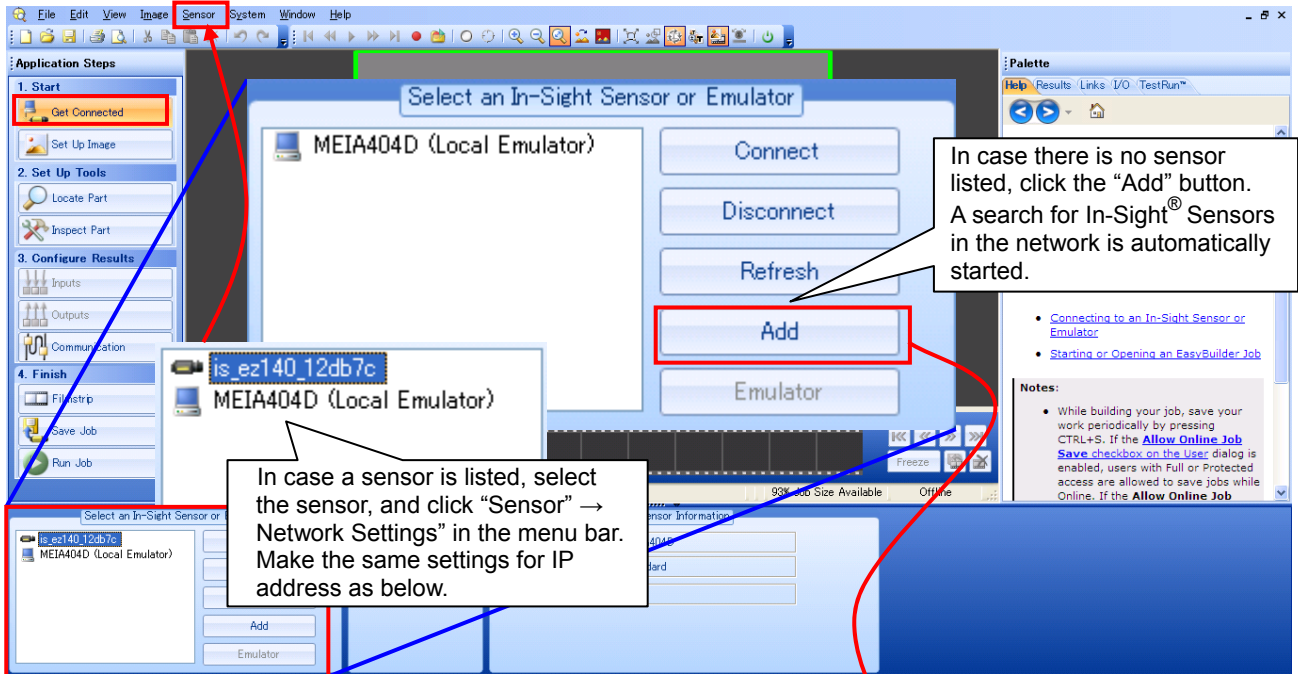
The deviation amount received from the Vision System is compensated by the Motion controller.

[In-Sight® Explorer job sample settings procedure]

The vision tool In-Sight® Explorer can connect to the Vision System, set up the communication settings and register the image pattern. (In this sample program, In-Sight® Explorer version 4.8.1 is used.)

(1) Network settings of the Vision System

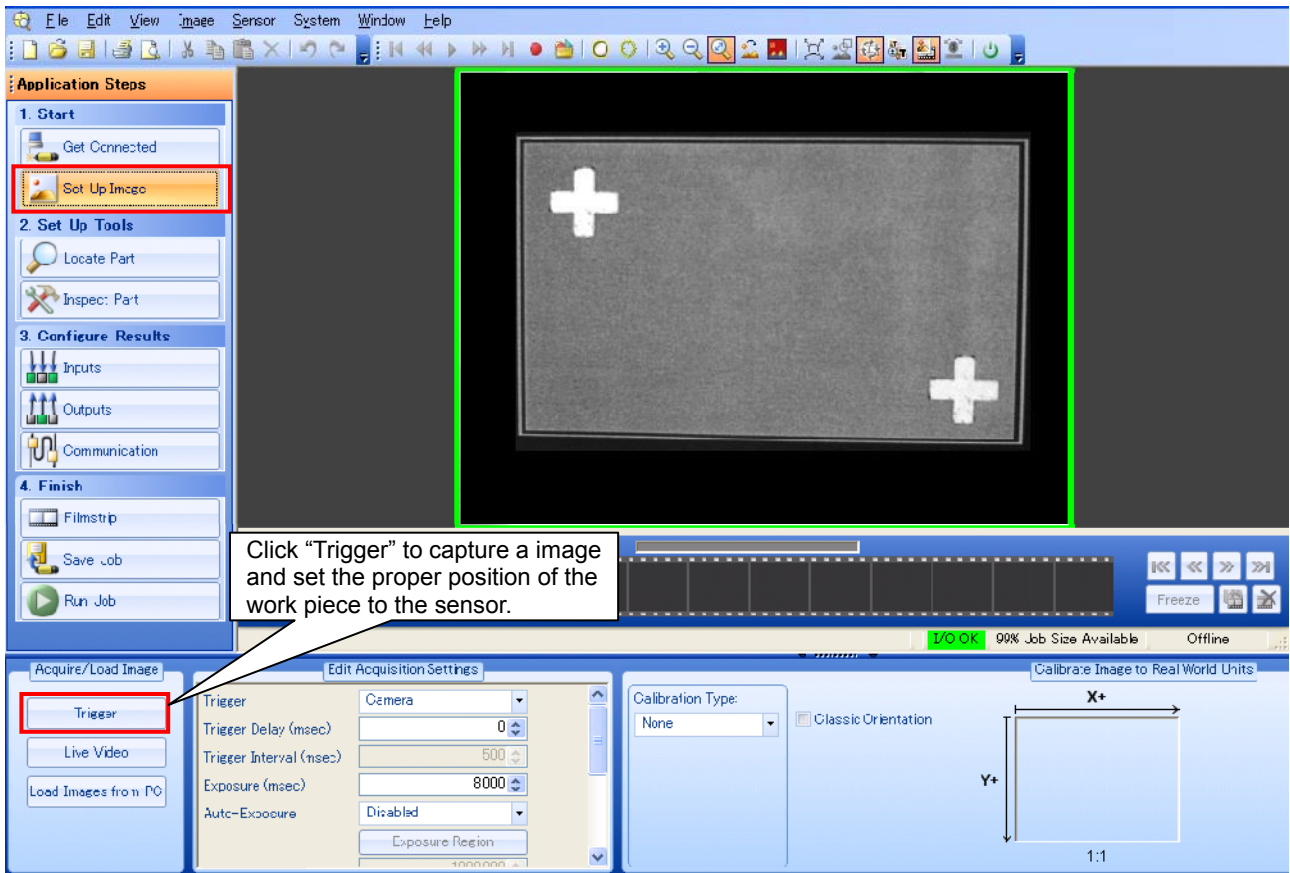
Start the In-Sight® Explorer and set the IP address of the Vision System under “Select an In-Sight Sensor or Emulator” on the “Get Connected” screen.



Apply the settings above to the sensor.

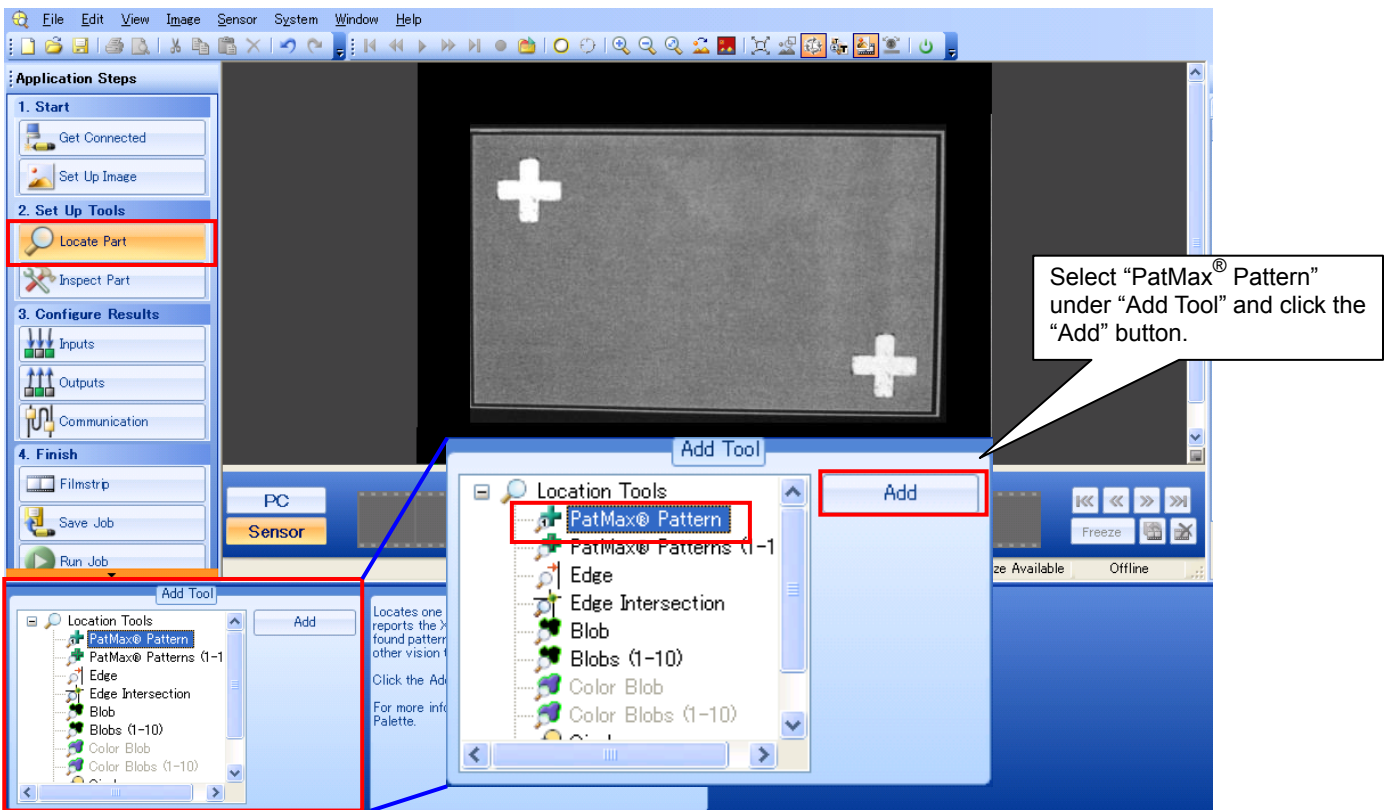
(2) Capture the image

Use the sensor to capture the normal position (alignment position) of the target work piece in the "Set Up Image" screen.

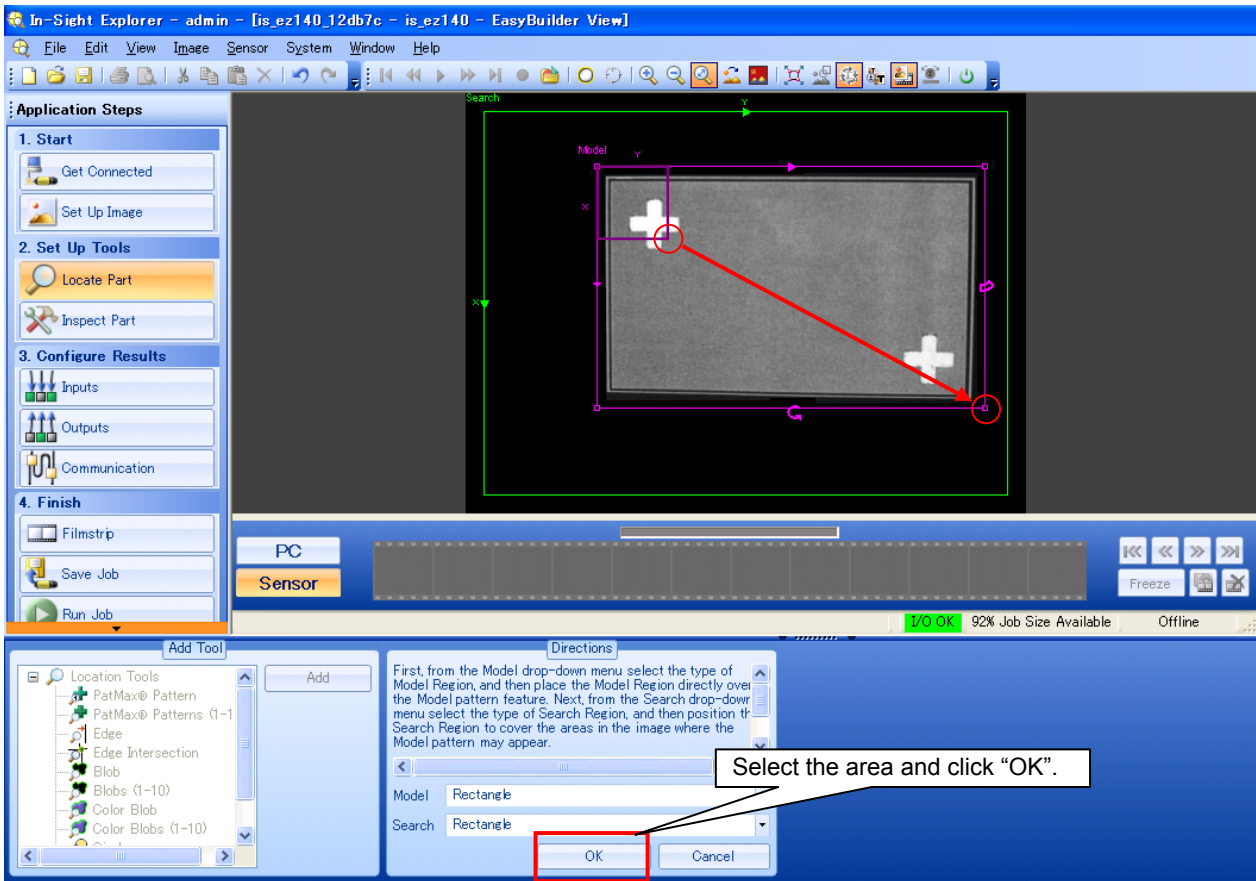


(3) Registration of the image pattern

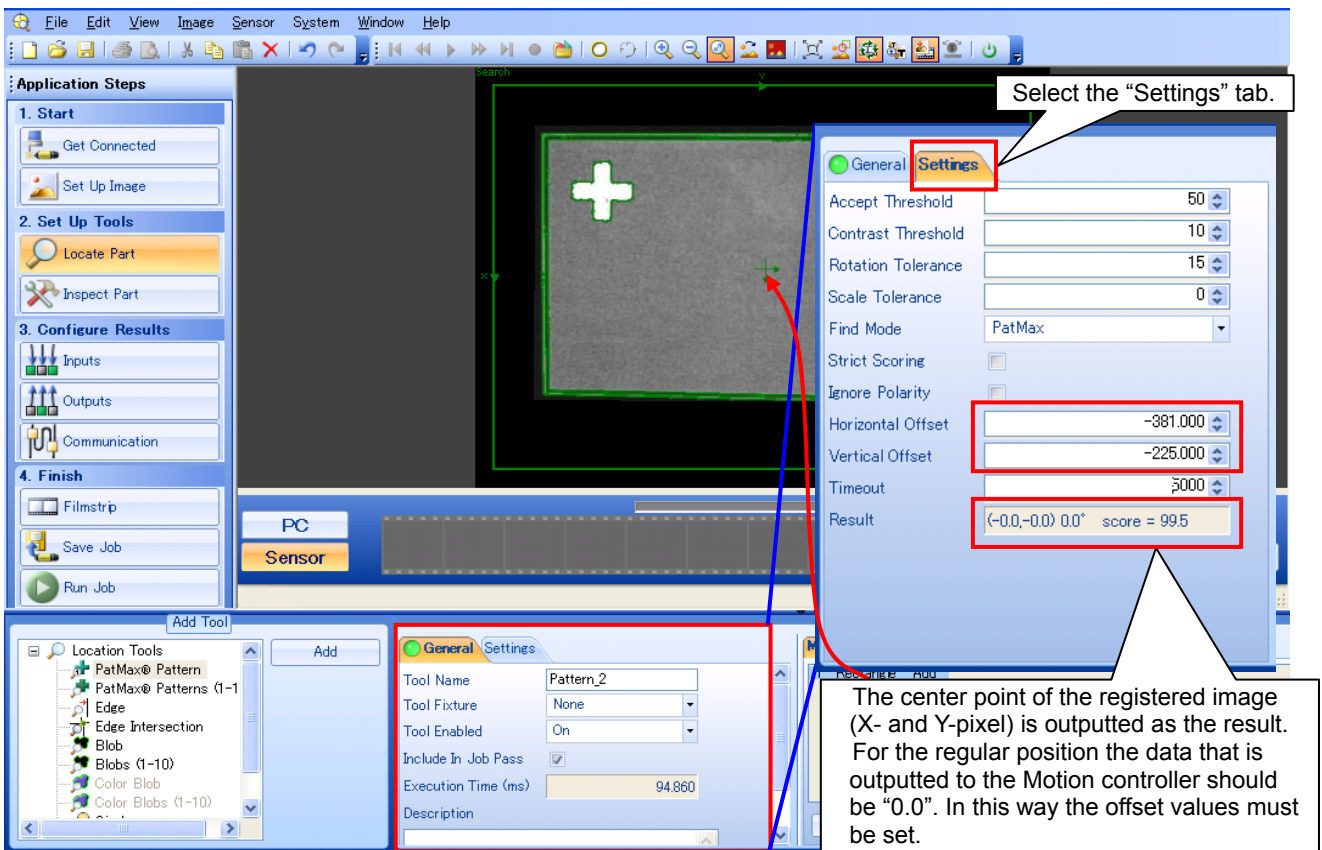
1) Select "PatMax® Pattern" as location tool in the "Locate Part" screen to register the image of the work piece.



2) Select the area for the position detection.



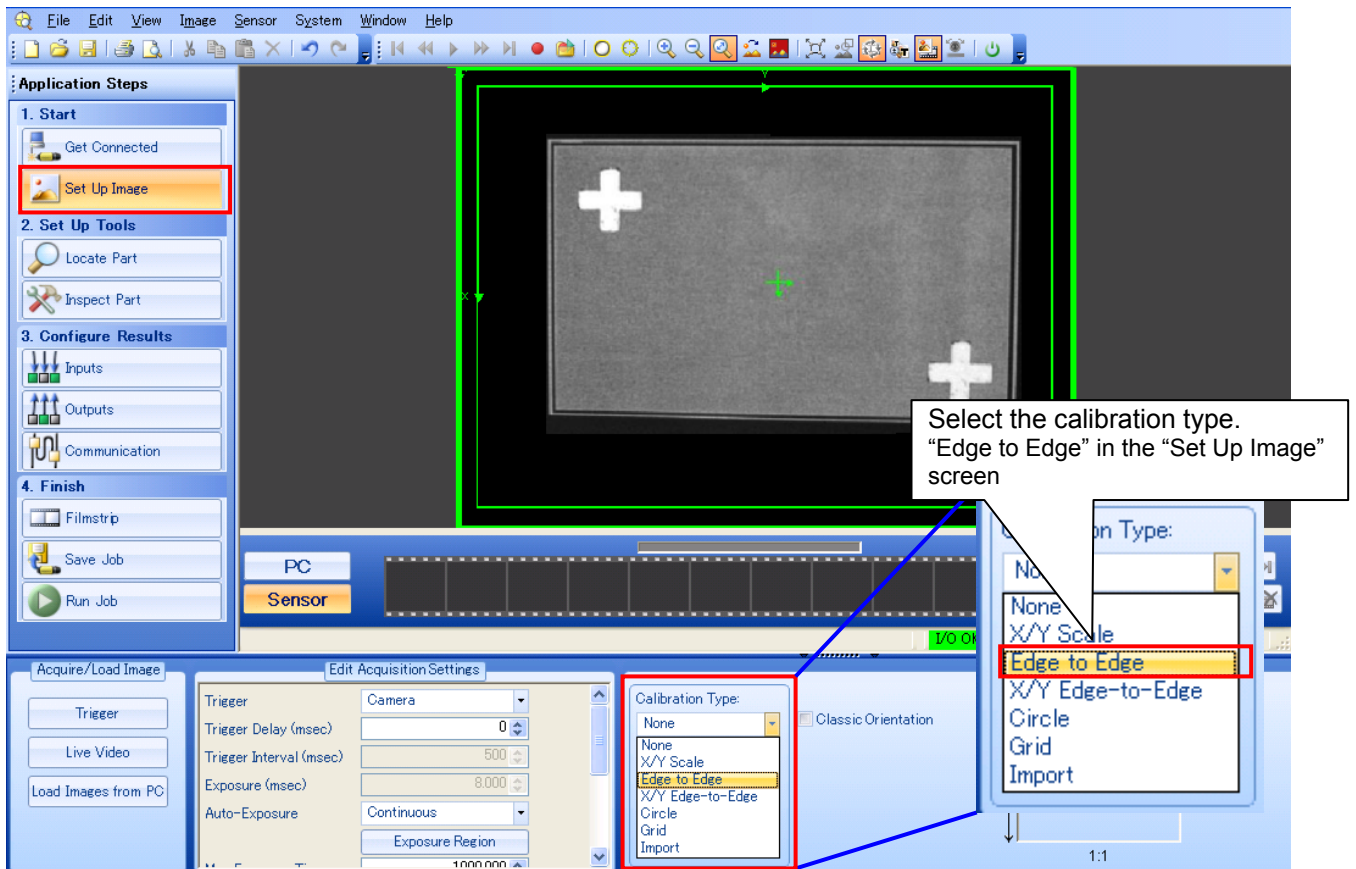
3) Set the offset values so that the image processing result (X- and Y- coordinates) for the regular position becomes "0.0".



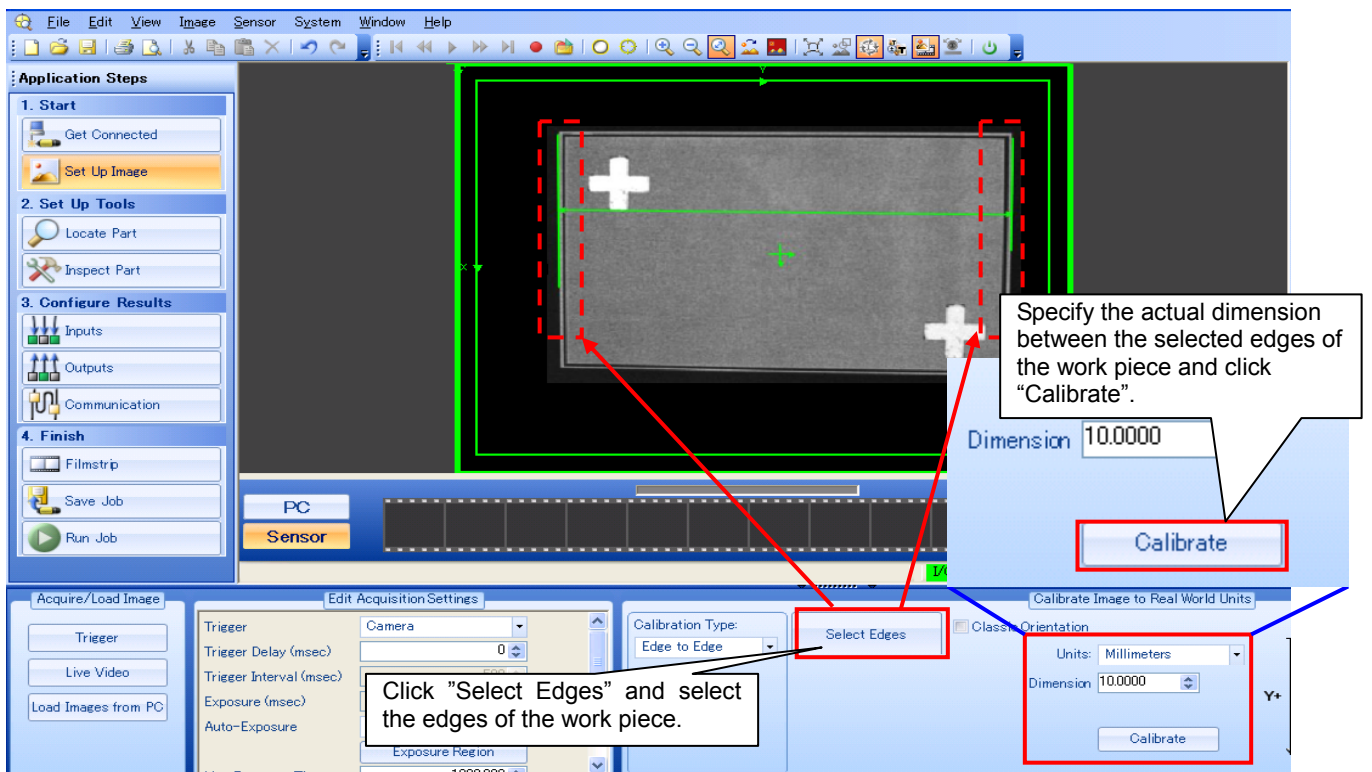
(3) Calibration settings

Return to the "Set Up Image" screen and make the calibration settings so that the image processing result in pixels can be converted to a real world unit such as "mm".

1) Select the calibration type.



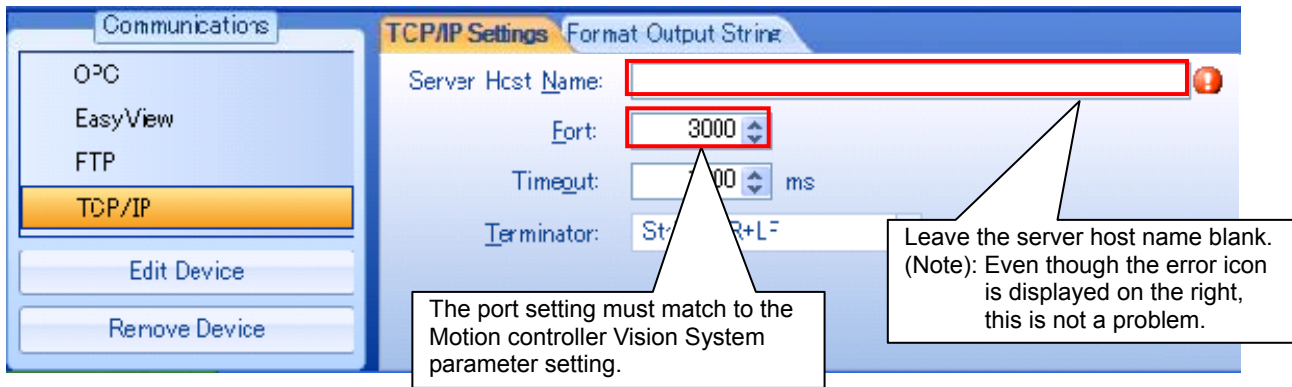
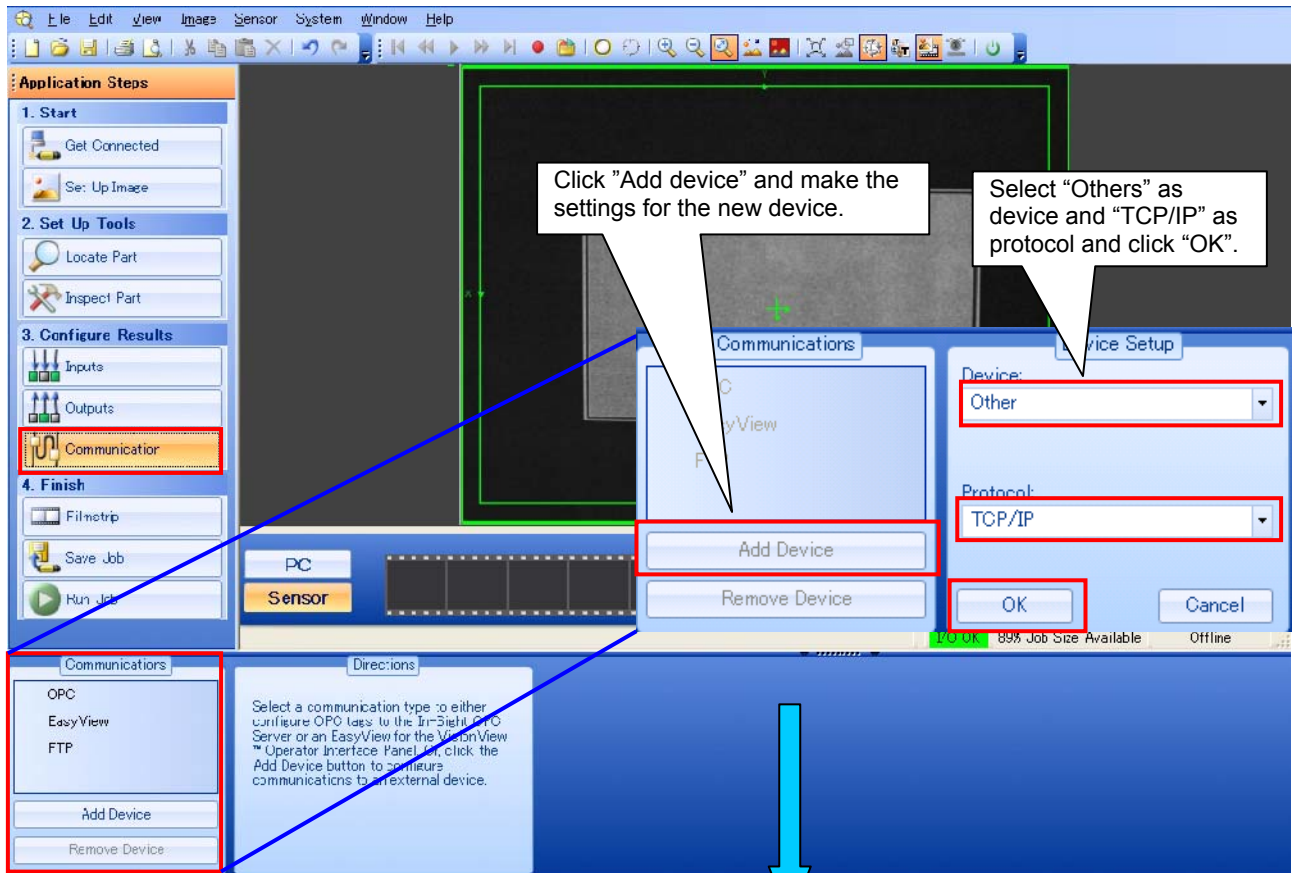
2) Define the actual dimensions of the work piece by its edges.



(4) Communication Settings

In the "Communication" screen the settings are made so that the image processing result (deviation amount) can be transmitted to the storage devices for image data of the Motion controller.

1) Add the settings to communicate with the Motion controller.



1) Select the data (deviation amount of X, Y and θ) of the image processing result to be sent to the Motion controller.

Communications

TCP/IP Settings **Format Output String**

Format String...

Formatted String:
-0.0006,-0.0004,0.0000

Select the "Format Output String" tab, and click on "Format String".

Select "Standard" and choose any of the characters in the dropdown.

is_ez140_12db7c - FormatString

Leading Text:

Trailing Text:

Terminators: None

Use Delimiter

Standard: Comma

Other:

| Label | Name | Data Type |
|-------|-------------------------|----------------|
| Label | Pattern_2.Fixture.X | Floating Point |
| Label | Pattern_2.Fixture.Y | Floating Point |
| Label | Pattern_2.Fixture.Angle | Floating Point |

Click "Add" and select the data to be sent from the displayed list of items.

Label:

Include Label

Fixed Width

Data Type: Floating Point

Decimal Places: 4

Field Width: 8

Pad:

Output String:
-0.0006,-0.0004,0.0000

Select floating point as "Data Type" and choose the "Decimal Places" to match the setting in the Motion controller.
Set X and Y to $\times 10^{-4}$ [mm]
Set θ to $\times 10^{-5}$ [degree]

Move Up

Move Down


| Name | Data Type |
|-------------------------------|----------------|
| Job | |
| Pattern_1 | |
| Pattern_2 | |
| Pattern_2.Accept_Threshold | Integer |
| Pattern_2.Contrast_Threshold | Integer |
| Pattern_2.Description | String |
| Pattern_2.Error_Count | Integer |
| Pattern_2.Execution_Time | Integer |
| Pattern_2.External_Retrain | Floating Point |
| Pattern_2.Fail | Integer |
| Pattern_2.Fail_Count | Integer |
| Pattern_2.Find_Mode | Integer |
| Pattern_2.Fixture.Angle | Floating Point |
| Pattern_2.Fixture.Score | Floating Point |
| Pattern_2.Fixture.X | Floating Point |
| Pattern_2.Fixture.Y | Floating Point |
| Pattern_2.Horizontal_Offset | Floating Point |
| Pattern_2.Ignore_Polarity | Integer |
| Pattern_2.Include_In_Job_Pass | Integer |
| Pattern_2.Pass | Integer |
| Pattern_2.Pass_Count | Integer |
| Pattern_2.Patterns | String |
| Pattern_2.Result | String |
| Pattern_2.Rotation_Tolerance | Integer |
| Pattern_2.Scale_Tolerance | Integer |
| Pattern_2.Status | Integer |
| Pattern_2.Strict_Scoring | Integer |
| Pattern_2.Timeout | Integer |
| Pattern_2.Tool_Enabled | Integer |
| Pattern_2.Tool_Enabled_Status | Integer |
| Pattern_2.Vertical_Offset | Floating Point |

OK Cancel

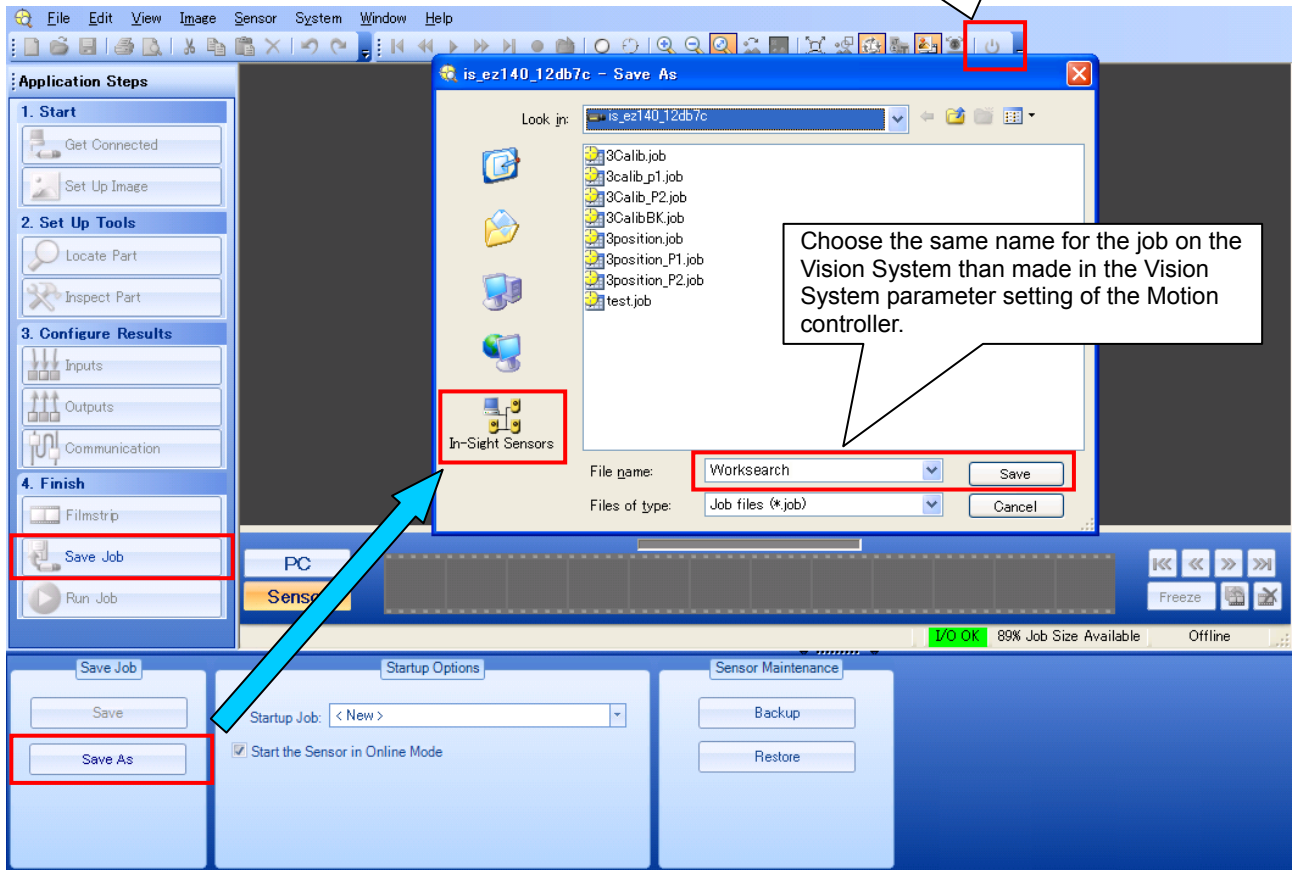
(5) Save the job → Online

Use the “Save Job” screen to write the settings made before to the Vision System. When saving is completed, change the status to online.

When the saving of the job is completed, change the status to Online by clicking the icon.



This enables the communication between Motion controller and Vision System.



[Sample Settings of the Vision System Parameter in MT Developer2]

Setting the parameters for the communication between Motion controller and Vision System and for the execution of vision dedicated instructions.

(1) Ethernet communication settings

Make settings such as IP address and port number of the Vision System.

Ethernet Communication
 Set the parameters related to the vision system Ethernet communication.

| | | |
|--------------------------|---|--|
| Item | | |
| Vision System No. | 1 | Set the IP address of the Vision System |
| IP Address | 192.168.3.1 | |
| Port No. | Set the port number used for communication | |
| For Telnet Communication | 23 | D2000: Status of the Vision System |
| For TCP/IP Communication | 3000 | D2001: Error code of vision dedicated instructions (Stored in consecutive devices) |
| User Name | admin | |
| Password | | |
| Status Storage Device | D2000L | |
| Error Flag | M0 | |

Choose a User Name, which was registered either with "Full" or "Protected" access in the Vision System access settings. In the sample project, the default settings of the sensor with the user "admin" for full access are used.
 User name: admin
 Password: not required

In-Sight® Explorer [User Access Settings] screen

| Name | Access | View | FTP-R | FTP-W | Online/Offline | Online Job Sa |
|----------|-----------|--------|-------|-------|----------------|---------------|
| admin | Full | Normal | Yes | Yes | Enabled | Disabled |
| monitor | Locked | Custom | No | No | Disabled | Disabled |
| operator | Protected | Custom | Yes | No | Enabled | Disabled |

(2) Operation of the vision program

Make the settings to execute a vision program (job) which is registered on the Vision System from the Motion controller.

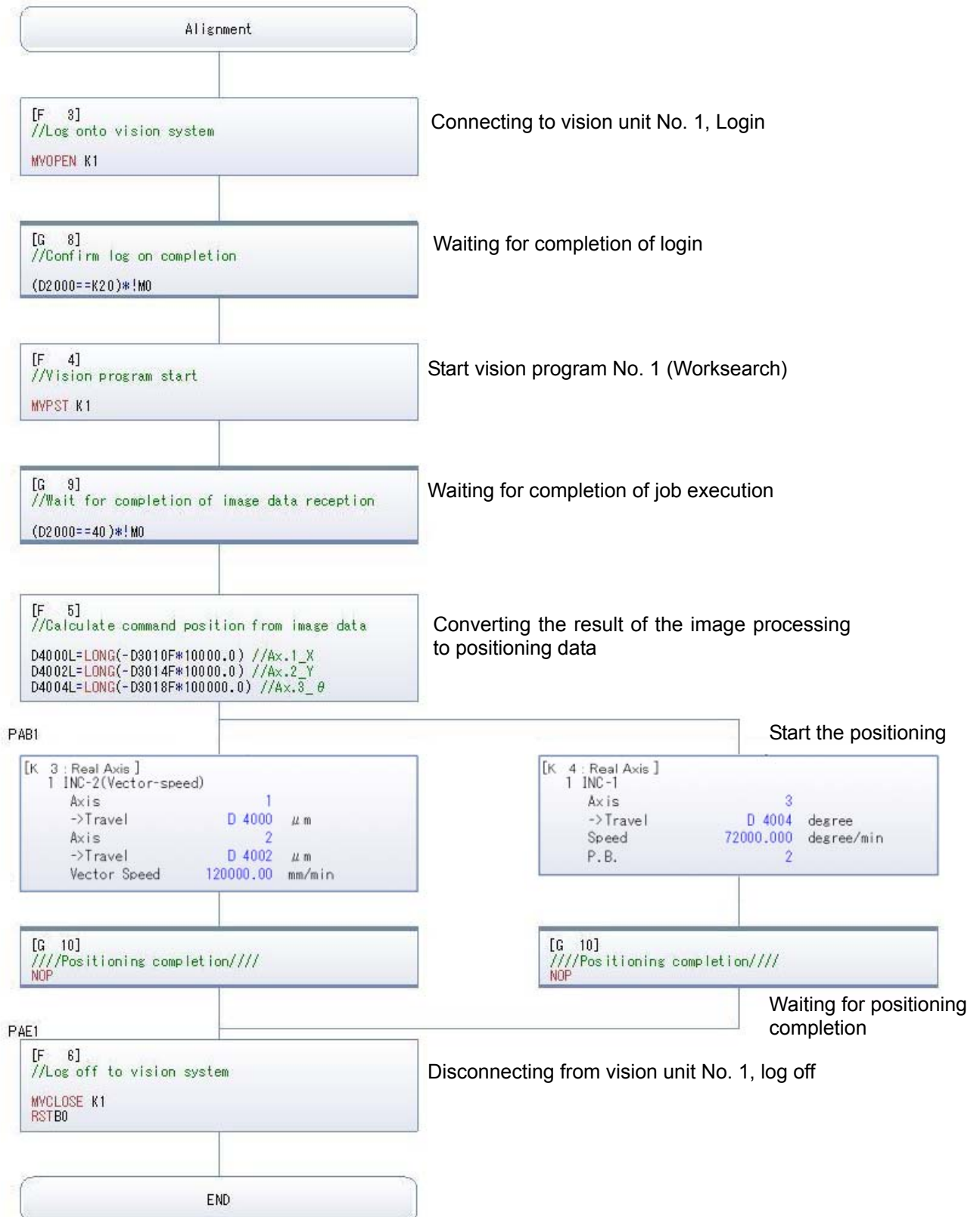
Convert

| Item | | | |
|-------------------------------------|--|---|---|
| [-] Vision Program Operation | The job (vision program) set in the vision system is assigned as a prog | | |
| Program No. | 1 | 2 | 3 |
| Vision System No. | 1 | | |
| Vision Program Name | Worksearch | | |
| Status Storage Device | D3000 | | |
| Read Value Cell | | | |
| Read Value Storage Device | | | |
| Image Data Storage Device | D3010F | | |

Set the job name of the Vision System

Devices for storing the result of the image processing
D3010F: Deviation in X direction
D3014F: Deviation in Y direction
D3018F: θ deviation

[SFC sample program: Alignment Process]



[GOT Sample Screen]

[GOT: Home Screen]



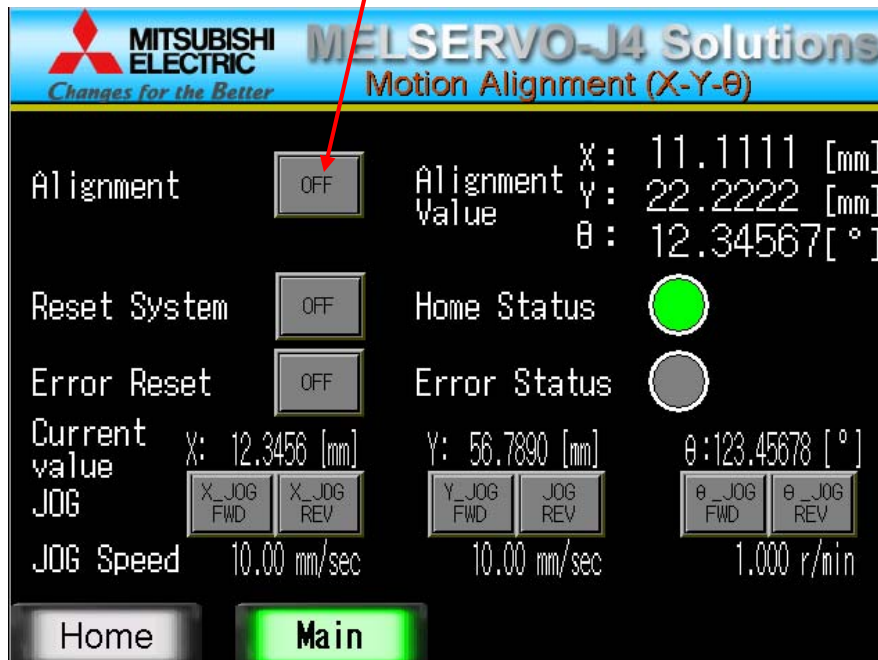
Language Selection

Screen Selection

Start alignment operation

When turned ON, the Vision System captures the image of the work piece and the compensation of the deviation is executed.

[GOT: Main Screen]



Measured Values

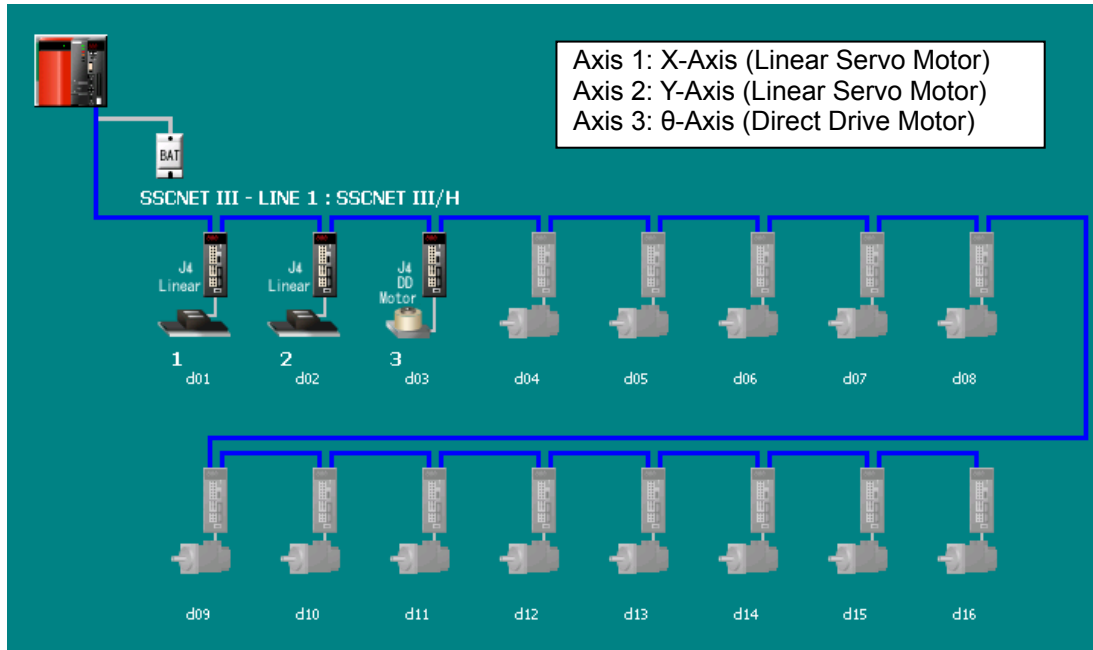
Display of the deviation amount when capturing the image of the work piece

JOG operation switch

Perform JOG operation in forward or reverse direction for each axis

(Note): Sample screen as default are set for English environment. When using Japanese environment, it's possible to switch to Japanese for GOT monitoring data in GT Designer 3 Language change the preview column from [2] to [1].

[System Setting]



[Servo Data Setting]

| Item | Axis1 | Axis2 | Axis3 |
|--|-----------------------------|-----------------------------|-----------------------------|
| Fixed Parameter | | | |
| Set the fixed parameters for each axis and their data is fixed... | | | |
| Unit Setting | 0:mm | 0:mm | 2:degree |
| Number of Pulses/Rev. | 10[PLS] | 10[PLS] | 1048576[PLS] |
| Travel Value/Rev. | 0.5[μm] | 0.5[μm] | 360.00000[degree] |
| Backlash Compensation | 0.0[μm] | 0.0[μm] | 0.00000[degree] |
| Upper Stroke Limit | 0.0[μm] | 0.0[μm] | 0.00000[degree] |
| Lower Stroke Limit | 0.0[μm] | 0.0[μm] | 0.00000[degree] |
| Command In-position | 10.0[μm] | 10.0[μm] | 0.00100[degree] |
| Sp. Ctrl. 10x Mult. for Deg. | - | - | 0:Invalid |
| Home Position Return Data | | | |
| Set the data to execute the home position return. | | | |
| OPR Direction | 0:Reverse Direction | 0:Reverse Direction | 0:Reverse Direction |
| OPR Method | 2: | | |
| Home Position Address | 0: | | |
| OPR Speed | - | - | - |
| Creep Speed | - | - | - |
| Travel After Dog | - | - | - |
| Parameter Block Setting | - | - | - |
| OPR Retry Function | - | - | - |
| Dwell Time at OPR Retry | - | - | - |
| Home Position Shift Amount | - | - | - |
| Speed Set at Home Pos. Shift | - | - | - |
| Torque Limit Value at Creep Speed | - | - | - |
| Operation for OPR Incompletion | 1:Not Execute Servo Program | 1:Not Execute Servo Program | 1:Not Execute Servo Program |
| OPR Request Setting in Pulse Conversion Unit | - | - | - |
| Standby Time after Clear Signal Output in Pulse C... | - | - | - |
| JOG Operation Data | | | |
| Set the data to execute the JOG operation. | | | |
| JOG Speed Limit Value | 120000.00[mm/min] | 120000.00[mm/min] | 72000.000[degree/min] |

[Devices used in this program]

| Device No. | Content | Device No. | Content |
|------------|---|------------|--|
| B0 | Automatic operation start (GOT) | M0 | Vision instruction error detection |
| B1 | Home position return (GOT) | D2000 | Vision system status |
| B2 | Error reset (GOT) | D2001 | Vision instruction error code |
| B5 | Home position return complete lamp (GOT) | D3000 | Vision system job load status |
| B6 | Error lamp (GOT) | D3010 | Image processing result, X-Axis deviation (64bit floating point) |
| B11 | X-Axis JOG forward (GOT) | ~ D3013 | |
| B12 | X-Axis JOG backward (GOT) | D3014 | Image processing result, Y-Axis deviation (64bit floating point) |
| B13 | Y-Axis JOG forward (GOT) | ~ D3017 | |
| B14 | Y-Axis JOG backward (GOT) | D3018 | Image processing result, θ -Axis deviation (64bit floating point) |
| B15 | θ -Axis JOG forward (GOT) | ~ D3021 | |
| B16 | θ -Axis JOG reverse (GOT) | D4000 | X-Axis alignment movement amount |
| W0 | X-Axis JOG speed setting (GOT): x 0.01[mm/sec] | D4001 | Y-Axis alignment movement amount |
| W1 | | D4002 | |
| W2 | Y-Axis JOG speed setting (GOT): x 0.01[mm/sec] | D4003 | θ -Axis alignment movement amount |
| W3 | | D4004 | |
| W4 | θ -Axis JOG speed setting (GOT): x 0.01[mm/sec] | D4005 | |
| W5 | | | |

[Content of Motion SFC sample programs]

Program configuration

| No. | Program Name | Automatic Start | Execution Task | Operation Summary |
|-----|----------------|-----------------|----------------|----------------------|
| 0 | Main | Yes | Normal | Main process |
| 1 | Motion control | Yes | Normal | Motion control |
| 2 | Home Position | No | Normal | Home position return |
| 3 | Alignment | No | Normal | Alignment process |

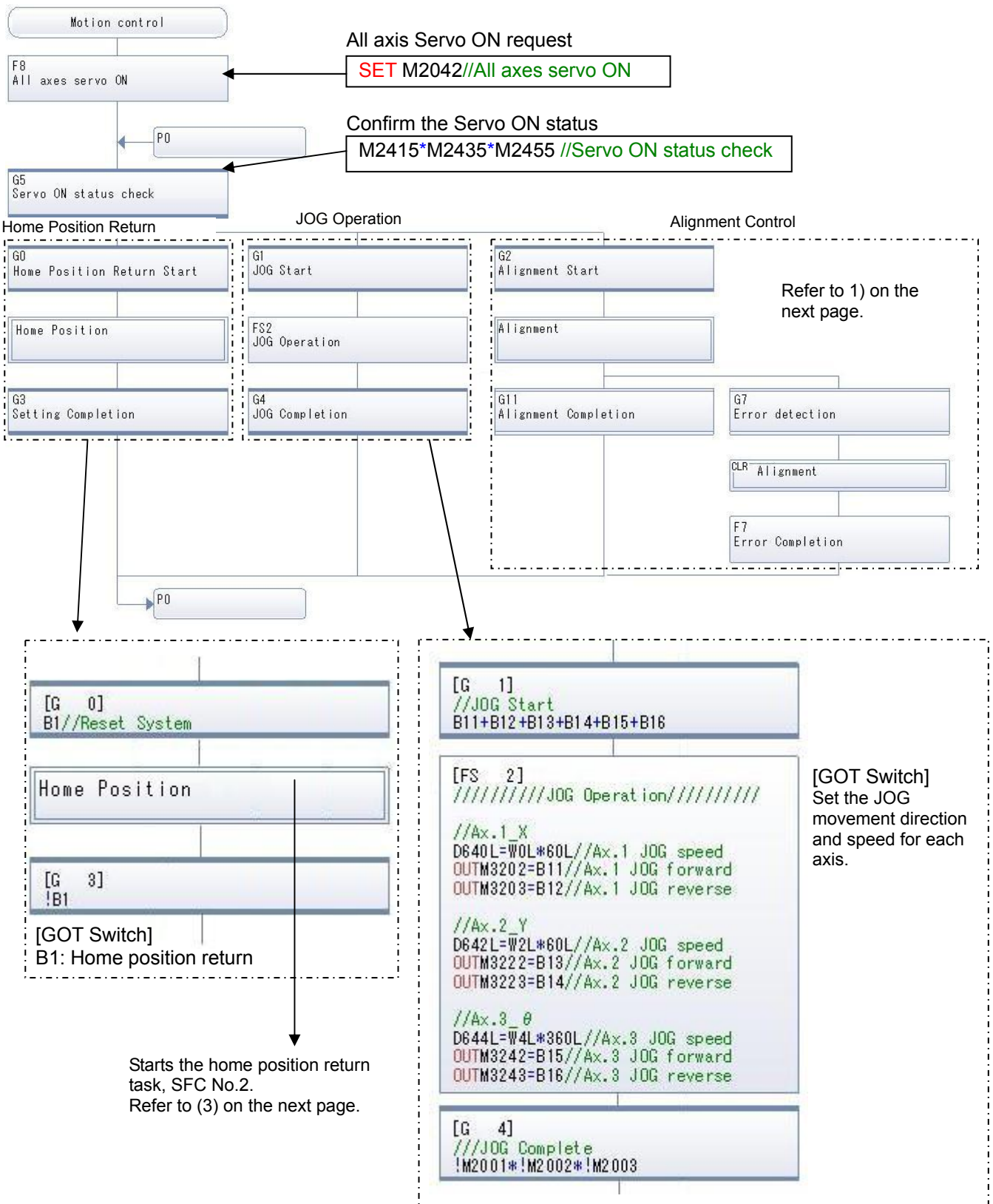
(1) No.0 Main: Main Process Normal Task [Automatic Start]

Sets initial data (JOG speed) and continuously executes the process for displaying on GOT screen and error reset.

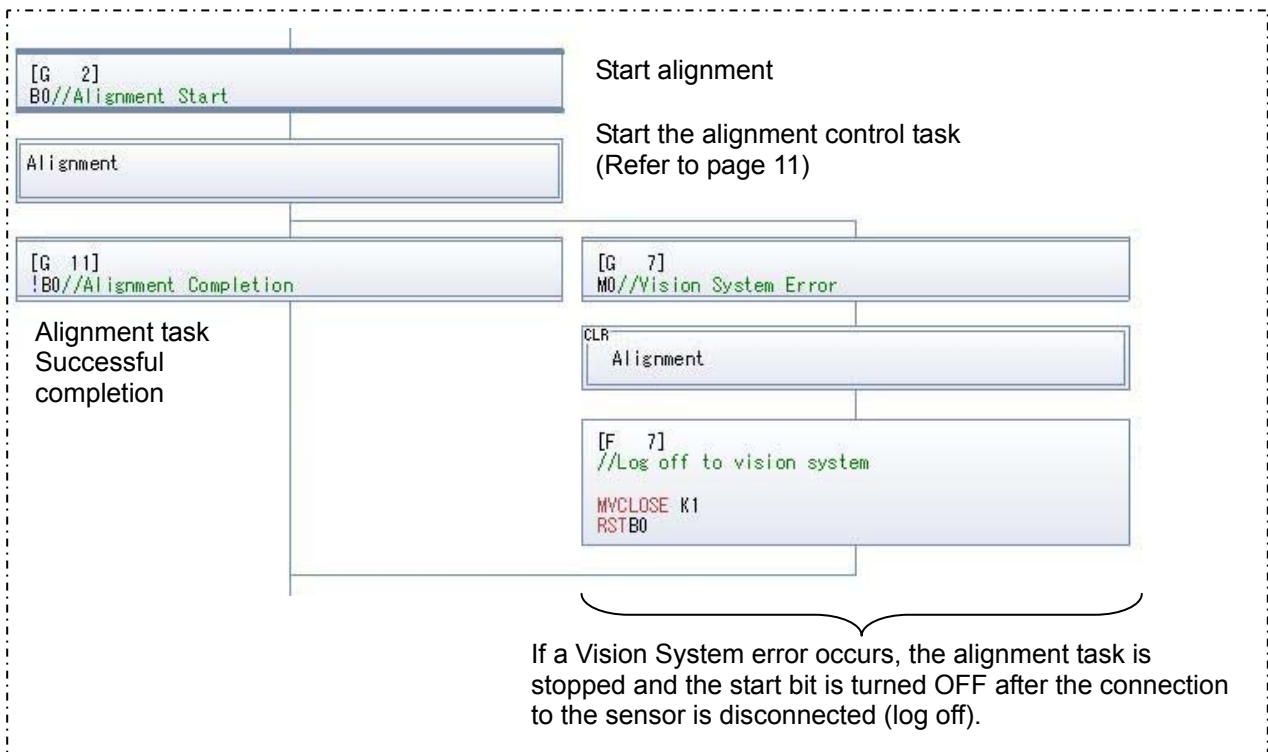


(2) No.1 Motion control: Motion Control Normal Task [Automatic Start]

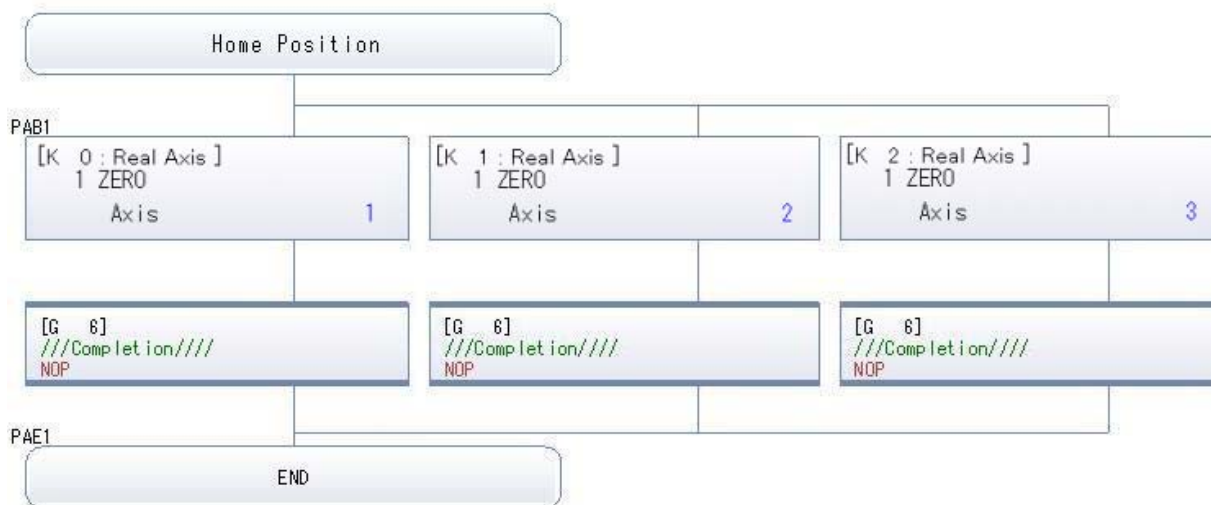
Via the switches on the GOT screen either "Home Position Return", "JOG Operation" or "Alignment Control" can be started.



1) Alignment control



(3) No.2 Home Position: Home position return Normal Task Executes the home position return servo program for each axis.



⚠ Cautions

- When diverting the sample program to the actual system, be sure to verify that there are no problems with control in the system.
- Add interlock conditions in the target system where considered necessary.