DENSO

DENSO Robotics

THIRD PARTY PRODUCTS

PROVIDER MANUAL

Maker

Panasonic Industrial Devices SUNX Co., Ltd.

Products／Series

Panasonic PV260

Robot calibration instruction guide

Vision

Contents

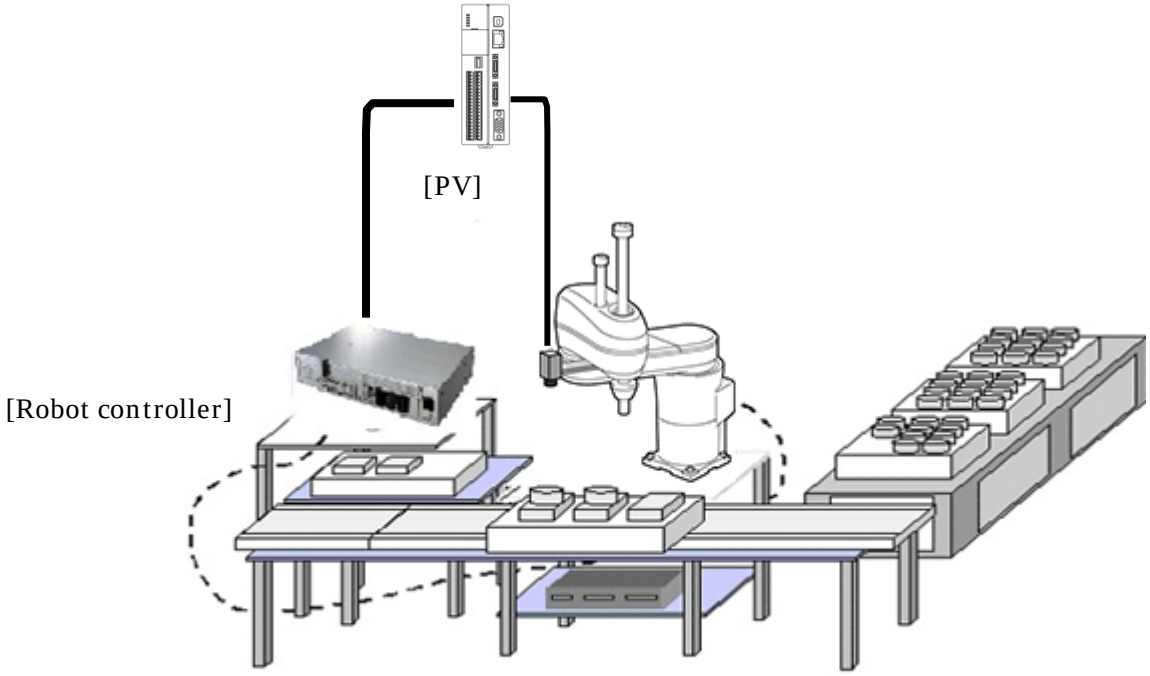
1. Introduction

This is an instruction guide for robot calibration with Panasonic vision system PV260.

For details about PV260 operation, please refer to the instruction manual of PV260.

1.1. System configuration

The following shows the system configuration at the robot calibration.



The following products and conditions are used in this manual as a sample.

- Robot model : SCARA robot (HM4060)
- Camera mount position : Second axis (1 camera)
- IP address of PV260 : 192.168.0.62
- Setting method for Calibration : Semi-Auto (1 point)

1.2. Calibration procedure

Calibration is performed in the following steps.

1. Preparation on PV260
   (1) Communication setting
   (2) Robot setting
   (3) Calibration setting
2. Calibration

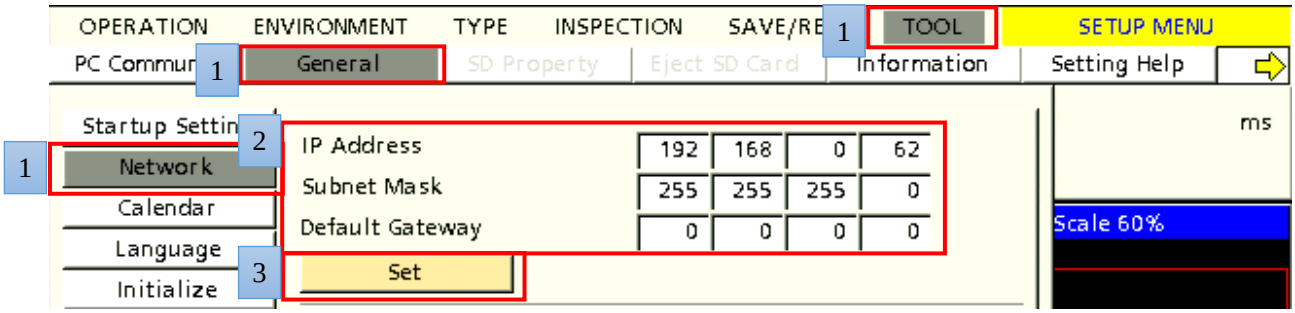
2. Communication setting

Configure the network setting of PV260 and confirm the communication with a robot.

2.1 Network setting of PV260

Configure TCP/IP for Ethernet as the following shows.

1. From [TOOL] tab, press [General], press [Network].
2. Enter [IP Address], [Subnet Mask], and [Default Gateway].
3. Press [Set].

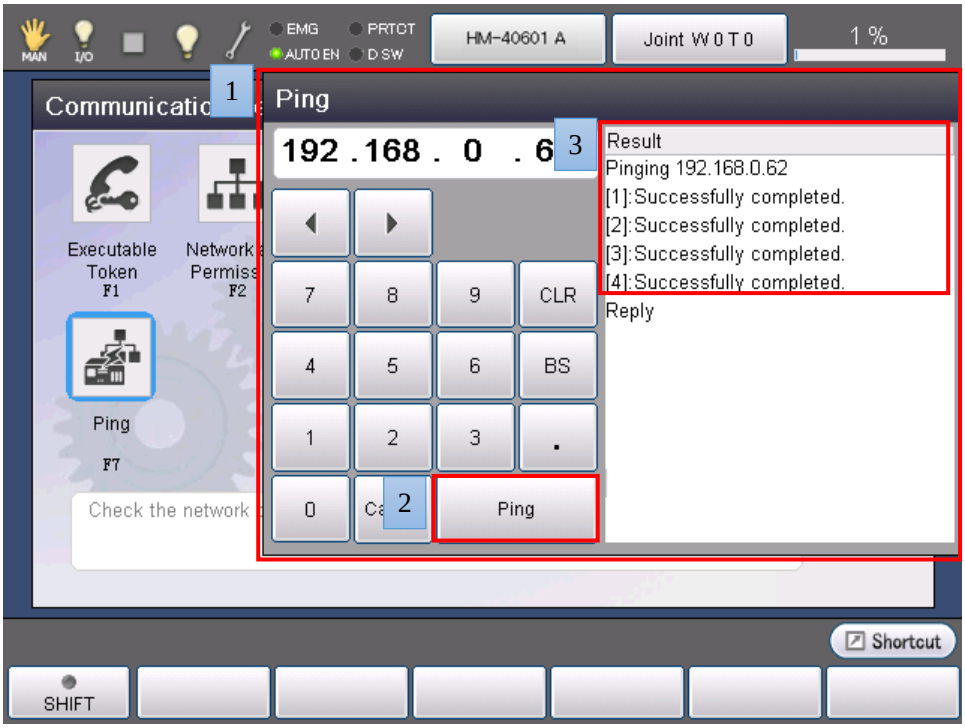


2.2 Confirm the Robot to PV260 communication

Confirm the communication between robot and PV260. Send ping to PV260 from the robot controller and check if PV260 receives the reply correctly.

To send ping, use a teach pendant. Perform the following steps.

1. From the main window, press [F6: Setting] - [F5: Communication and Token] - [F7: Ping].
2. Enter IP address of PV260, press [Ping].
3. When the screen displays both [Successfully completed] and [Reply], communication is opened.



3. Robot setting on PV260

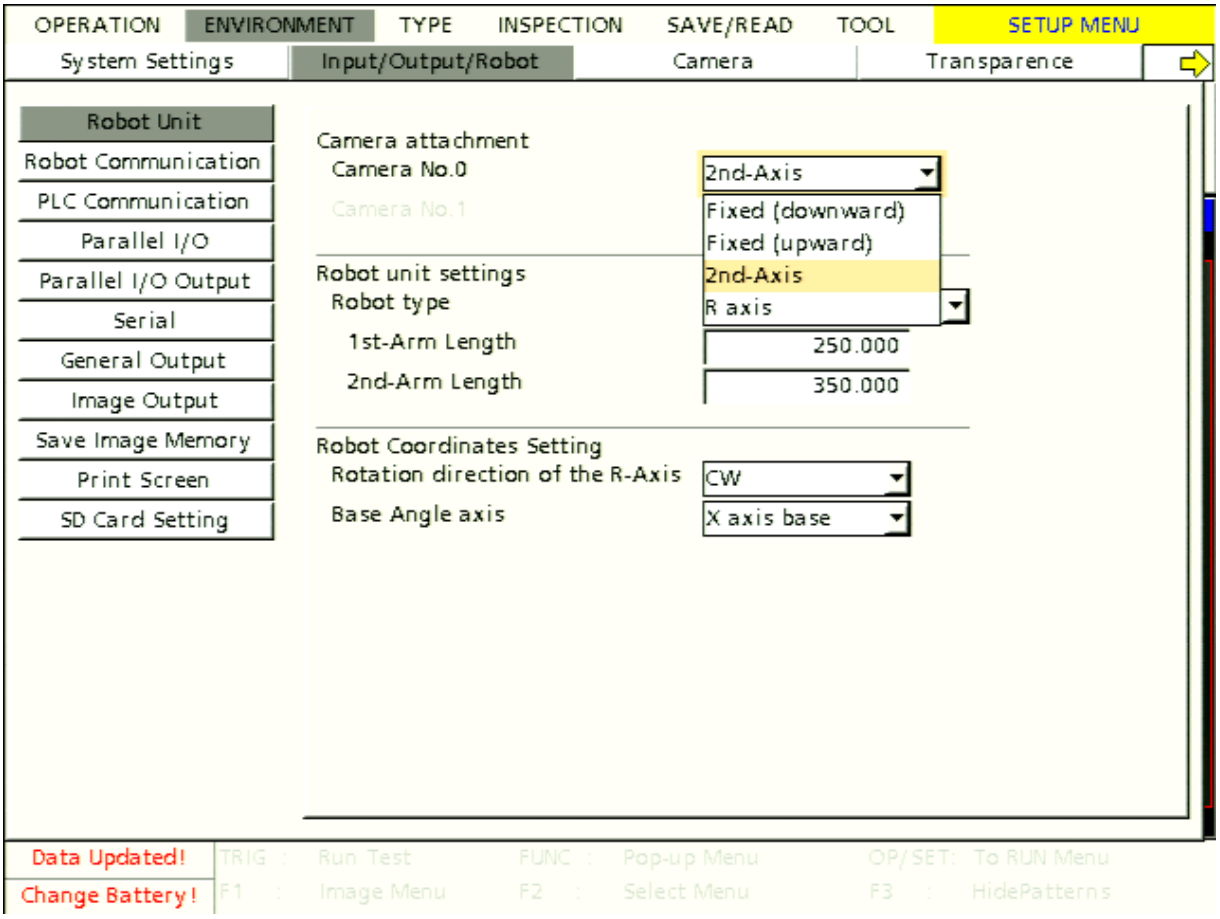
This chapter describes the robot setting on PV260 required for calibration.

3.1 Robot Unit setting

Set the robot unit used at the calibration. From [Environment], press [Input/Output/Robot], and press [Robot Unit].

Set the following items.

- Camera attachment
- Robot unit setting
- Robot coordinates setting

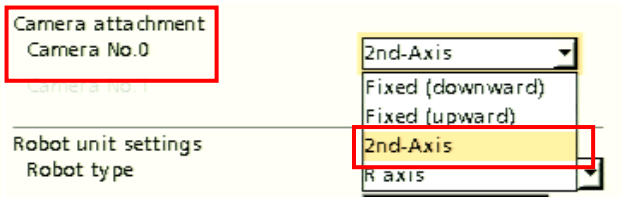


3.1.1 Camera Attachment

Specify how the camera is mounted in the robot.

In this sample, from [Camera No.0], select [2nd-Axis].

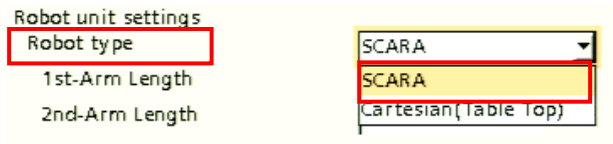
Note: Because only one camera is used in this instruction guide, leave the [Camera No.1] as-is.



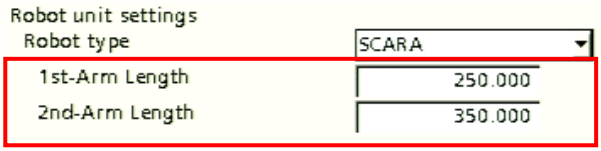
3.1.2 Robot unit setting

Set the calibration target robot information as follows.

1. On [Robot type], press [SCARA].



2. Enter values for [1st-Arm Length] and [2nd-Arm Length].



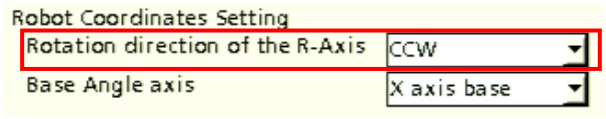
You can check the 1st- and 2nd-Arm Length of your robot from the content ”HM (Floor-mount, Standard type) (ID:4594)” of the DENSO ROBOT USER MANUALS.

Type	A	B	C	D	F
HM-4060*, HM-4A60*	600	250	350	213	286°
HM-4070*, HM-4A70*	700	350	350	199	294°
HM-4085*, HM-4A85*	850	350	500	281	294°
HM-40A0*, HM-4AA0*	1000	500	500	284	294°

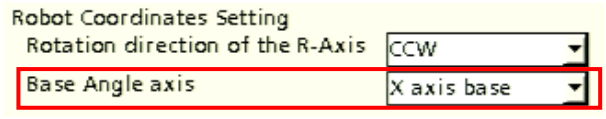
3.1.3 Robot coordinates setting

Set the calibration target robot coordinate system as follows.

1. On [Robot coordinates setting], from [Rotation direction of the R-Axis], press [CCW].



2. On [Robot coordinates setting], from [Base Angle Axis], press [X axis base].

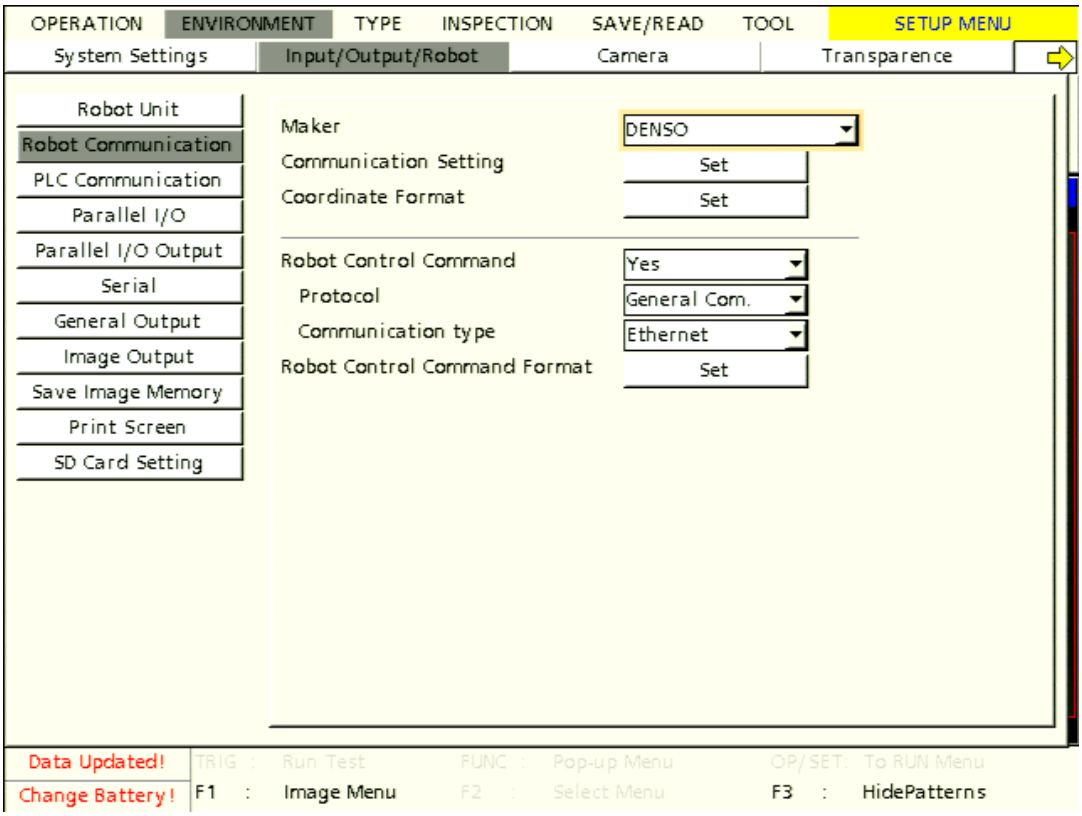


3.2 Robot Communication

Set the robot communication used in the calibration. From [Environment], press [Input/Output/Robot], and press [Robot Communication].

Set the following items

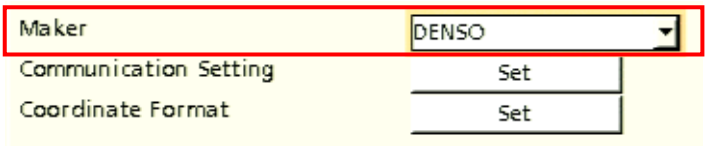
- Maker
- Coordinate Format



3.2.1 Maker

Specify the manufacturer of robot that connects with PV260.

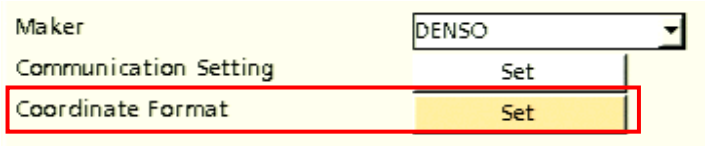
From [Maker], select [DENSO].



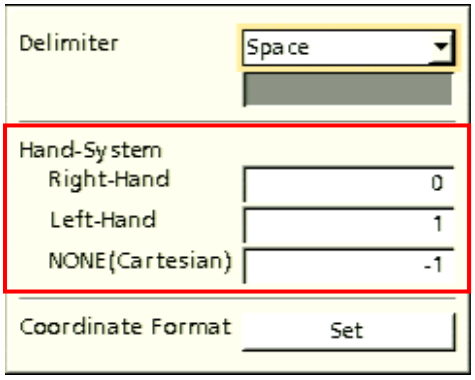
3.2.2 Coordinate Format

Specify the coordinate format of robot that connects with PV260 as follows.

1. On [Coordinate Format], press [Set].



2. On [Hand-System], enter values in [Right-Hand], [Left-Hand], and [NONE(Cartesian)].
   Enter “0” in [Right-Hand], “1” in [Left-Hand], and “-1” in [NONE (Cartesian)].



4. Calibration setting on PV260

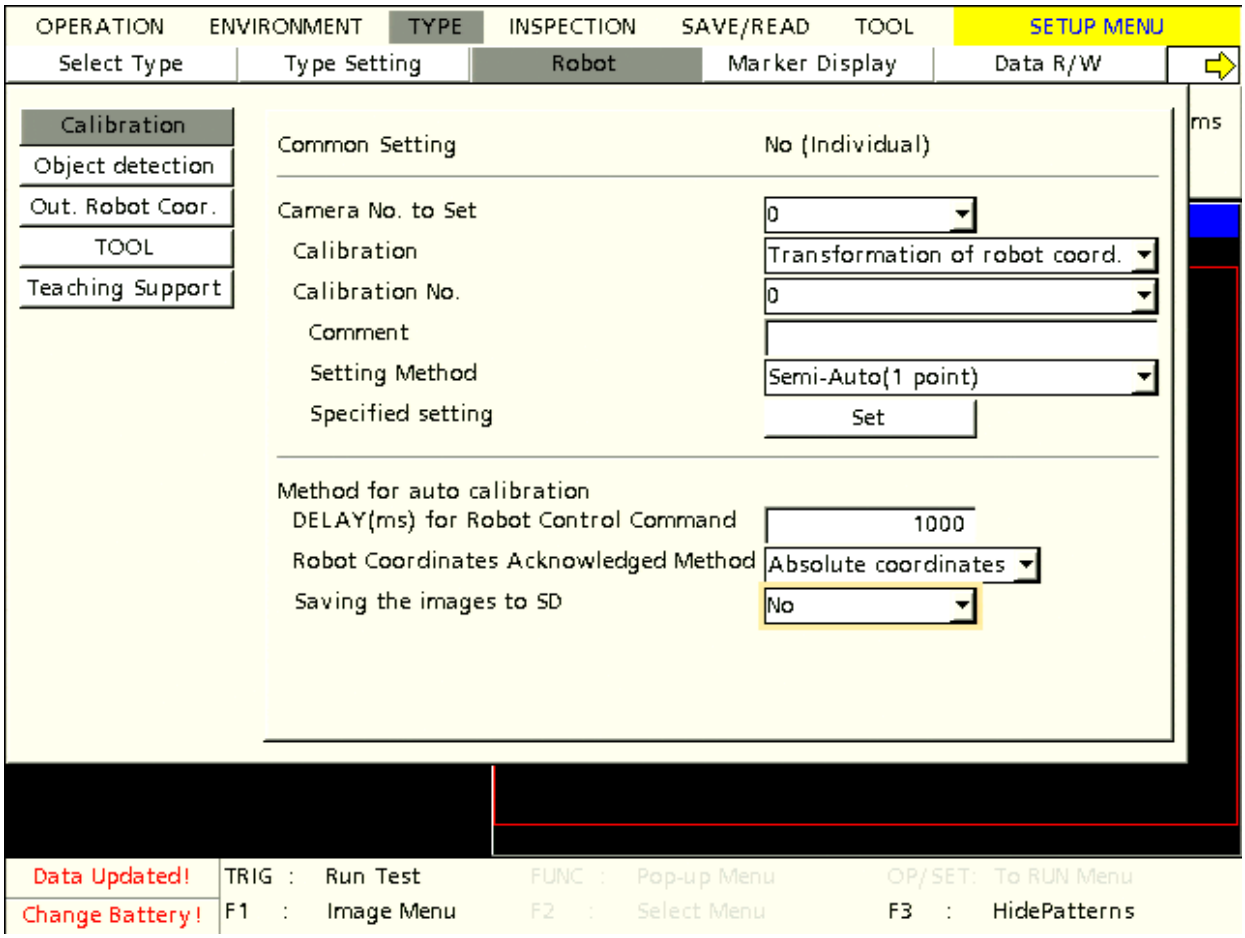
This chapter describes the calibration settings on PV260, such as camera number, calibration method.

On the [TYPE] tab, press [Robot], press [Calibration].

Set the following items.

- Camera No. to Set
- Calibration
- Calibration No.
- Setting Method
- Specified setting

  For details about Specified setting, see 5. Specified setting (Semi-Auto (1 point)).

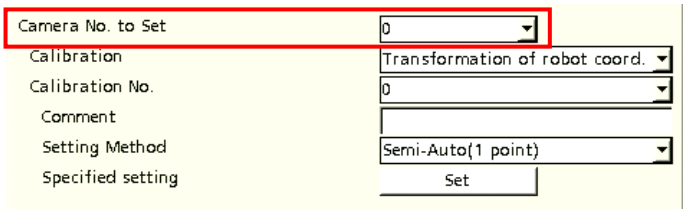


4.1 Camera No. to Set

Select a camera number to perform calibration.

From [Camera No. to Set], select a desired camera number.

In this sample, “Camera number 0” is selected.

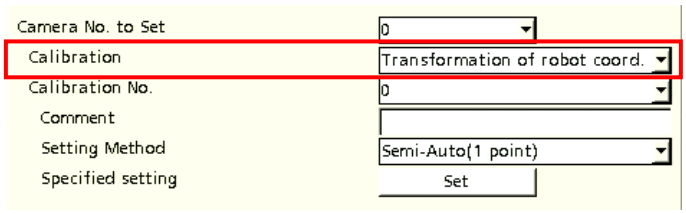


4.2 Calibration

Select a calibration method from No, X/Y, and Transformation of robot coordinate.

From [Calibration], select a desired calibration method.

In this sample, “Transformation of robot coordinate” is selected.

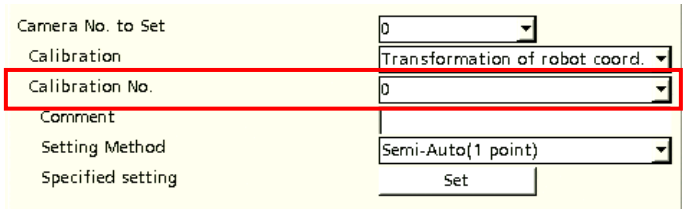


4.3 Calibration No.

Select a calibration number..

From [Calibration No.], select a desired calibration number.

In this sample, “Calibration number 0” is selected.

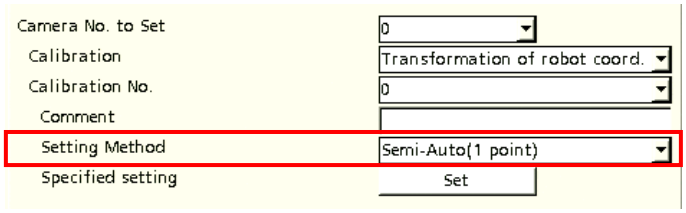


4.4 Setting Method

Select a calibration setting method.

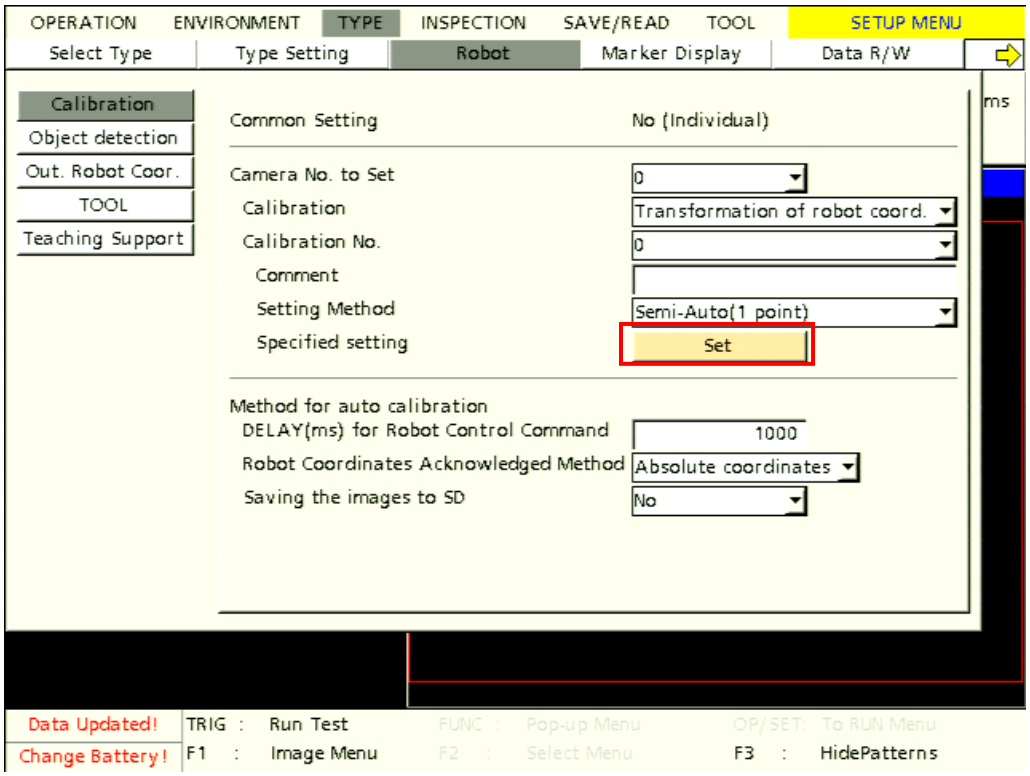
From [Setting Method], select a desired method from Manual (3 point), Semi-Auto (1 point), and Auto (1 point).

In this sample, Semi-Auto (1 point) is selected.

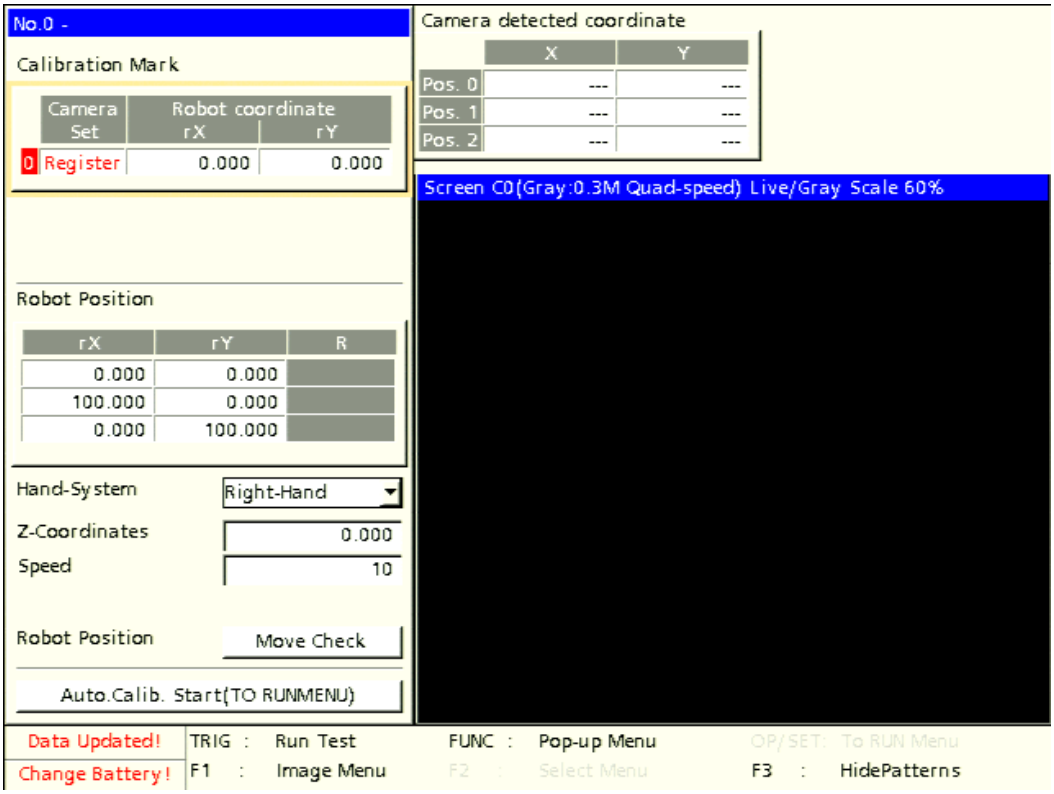


5. Specified setting (Semi-Auto (1 point))

This chapter describes the detailed calibration settings of Setting Method (see 4.4 Setting Method). Note that the following settings are available only when Semi-Auto (1 point) is selected in Setting Method.
On the [TYPE] tab, press [Robot], press [Calibration], from [Specified setting], press the [Set] button.



Once the [Set] button is pressed, the [Specified setting] window appears.



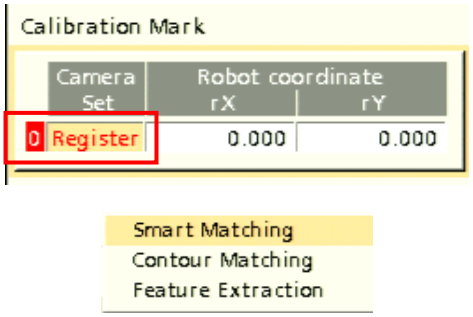
Set the following items.

- Calibration Mark
- Robot Position
- Hand-System

5.1 Calibration Mark

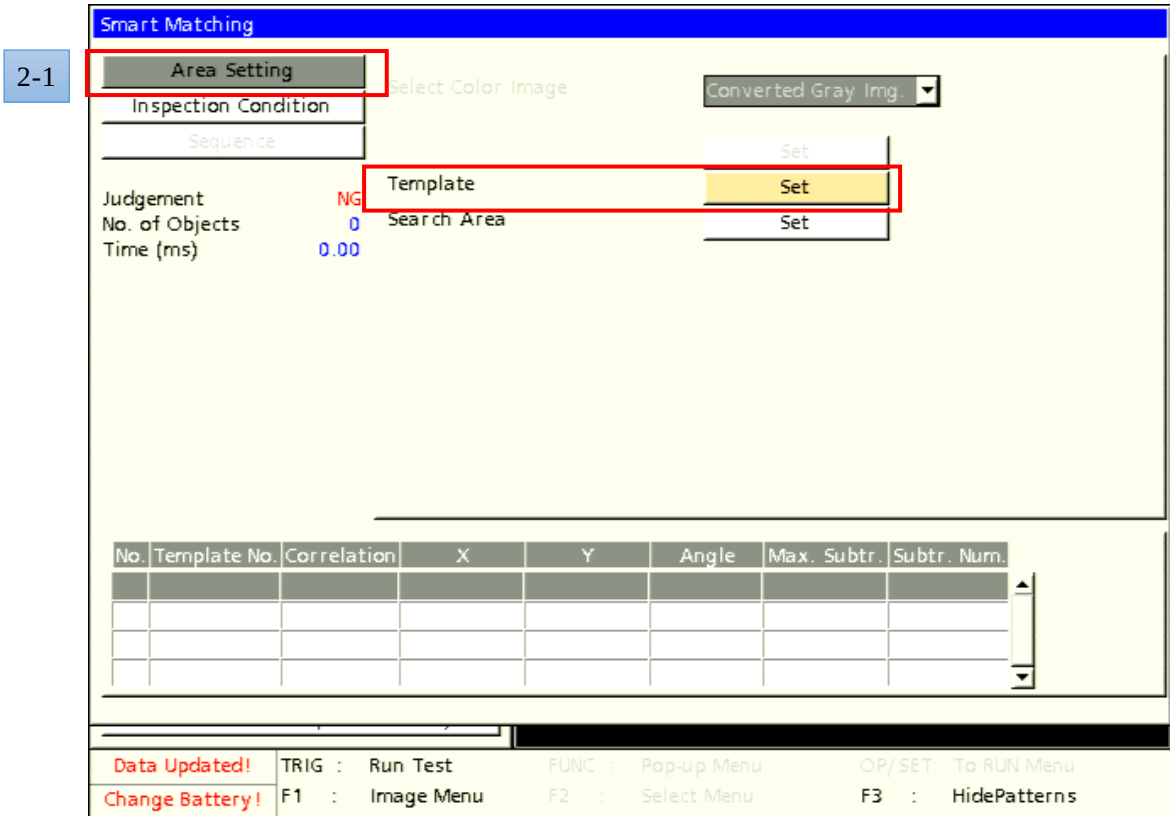
Set a calibration mark as follows.

1. From [Calibration Mark], on [Camera Set], press [Register]. Select a desired Base Checker. In this sample, select [Smart Matching] as a Base Checker.

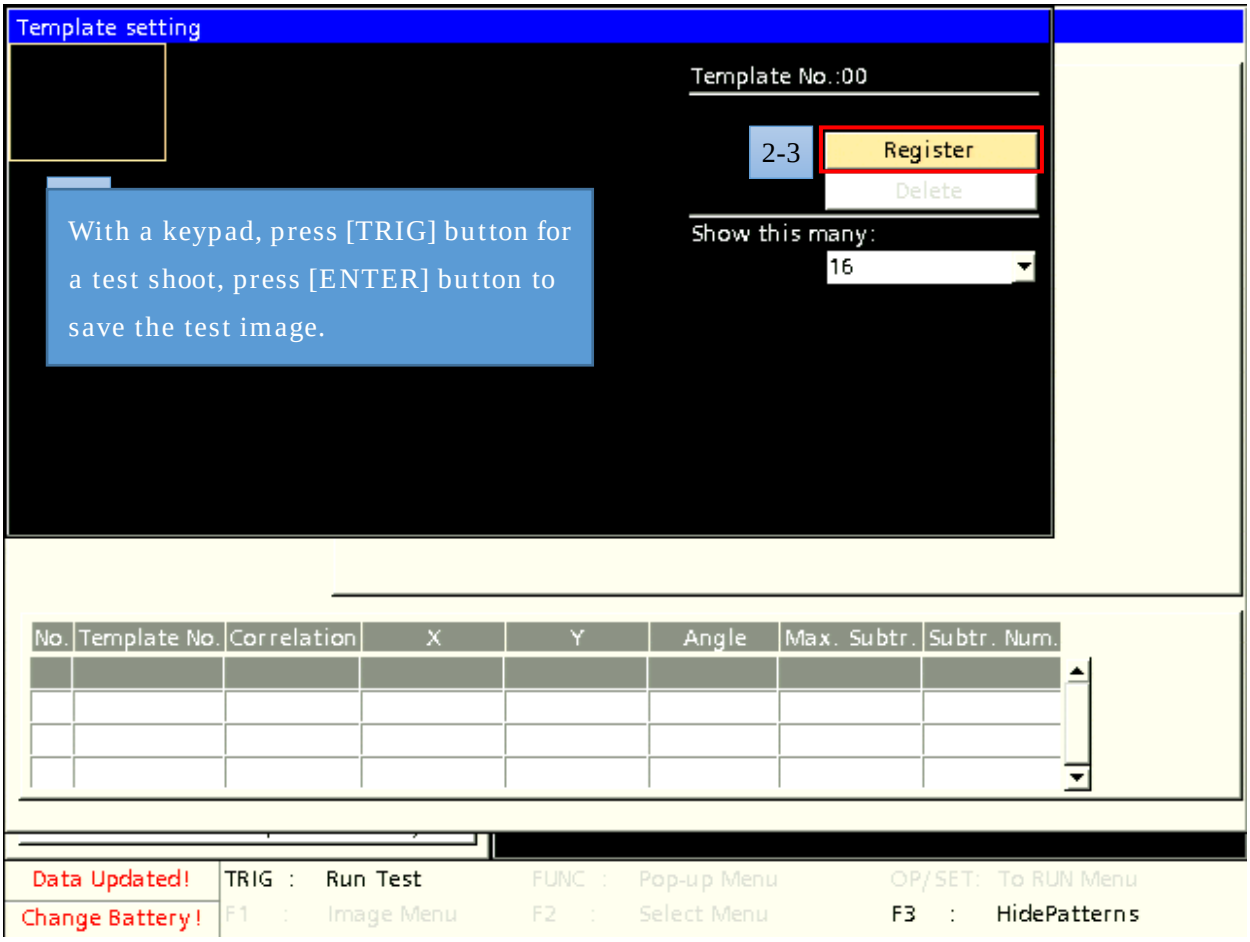


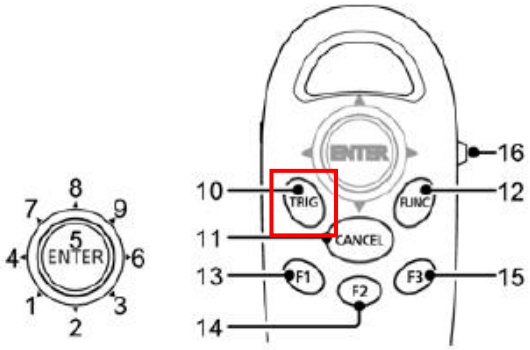
2. Register a template for Smart Matching as follows.

   2-1 From the [Smart Matching] window, press [Area Setting]. From [Template], press the [Set] button. The [Template setting] window appears.



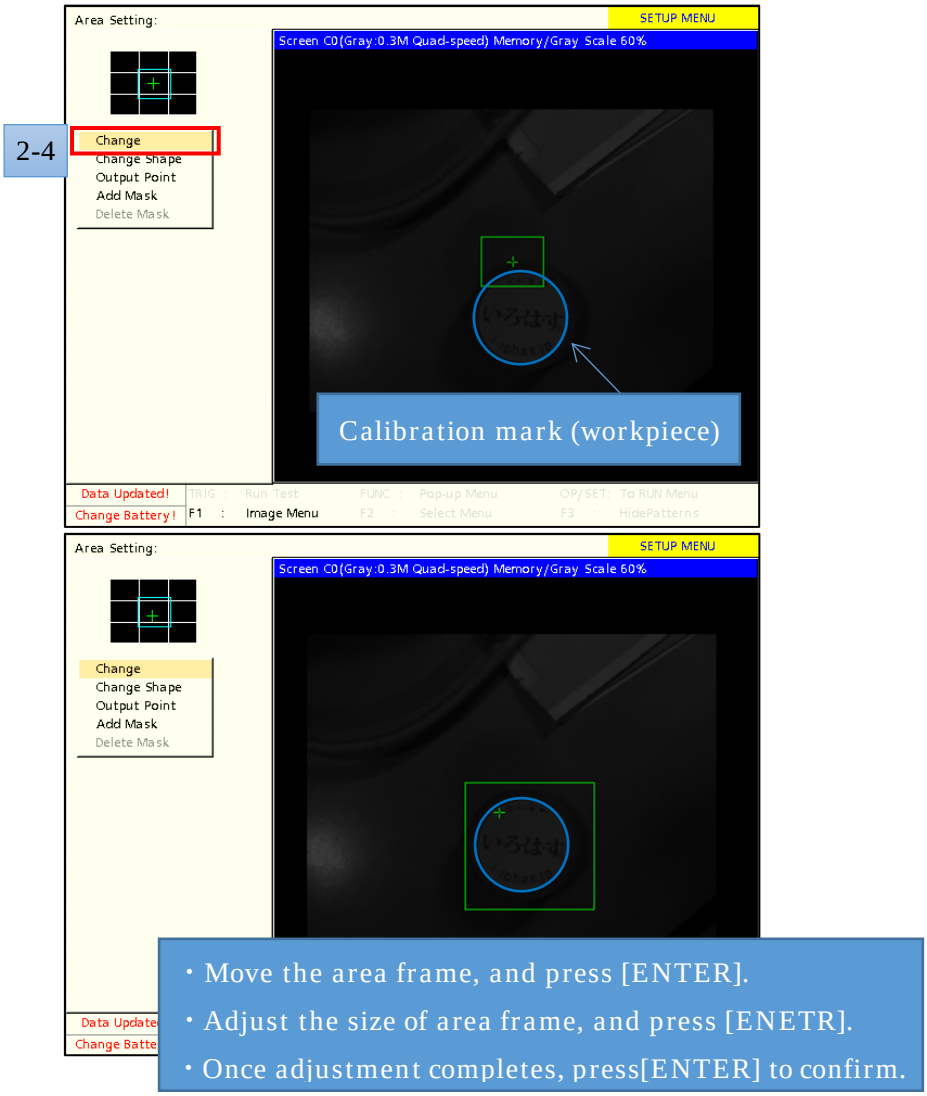
2-2 Anywhere on the [Template setting] window, press [TRIG] button of the keypad for test shoot. Press the [ENTER] button of the keypad in order to save the test image.





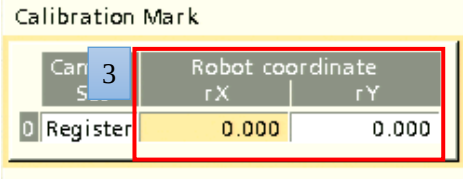
2-3 On the [Template setting] window, press [Register]. The [Area Setting] window appears.

2-4 On the [Area Setting] window, adjust an area frame (rectangle) so that it encloses a calibration mark (circle). Press [Change] to move the area frame. Adjust the frame position and then press [ENTER] to confirm. Once the frame position is confirmed, you are allowed to adjust the frame size. Adjust the frame size, and press [ENTER] to confirm.



2-5 Press [CANCEL] until the [Specified setting] window appears.

3. On [Robot coordinate], enter the robot coordinates that are used at the calibration ([rX], [rY]). With a teach pendant, move the robot tool end position to the calibration mark. Check the X /Y coordinates on the teach pendant, and then enter the values in [Robot coordinate rX / rY] with a keypad.



5.2 Robot Position

Set the robot positions for calibration.

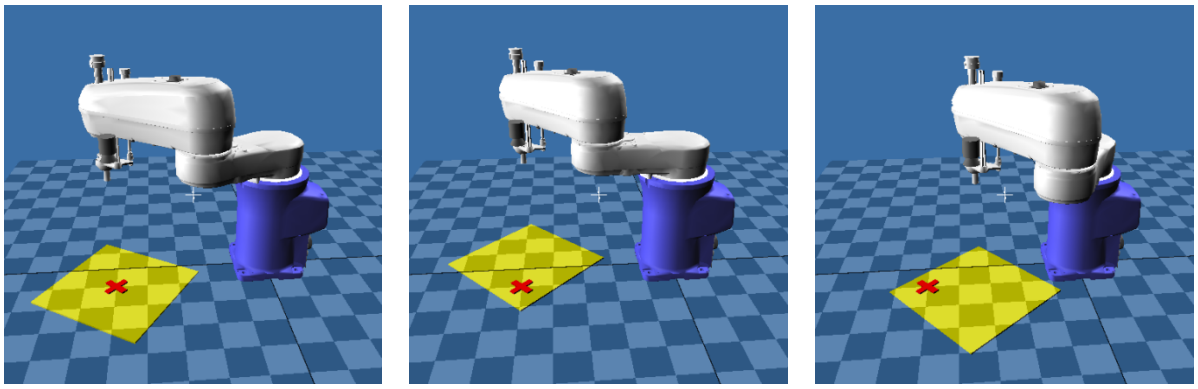
In this sample, robot coordinates ([rX], [rY]) for three points are determined. The robot moves to the three points at the calibration.

With a teach pendant, move the robot until the calibration mark appears on the camera's field of view. Once the mark appears, check the X/Y coordinates on the teach pendant screen, and then enter these values into the robot coordinate ([rX], [rY]). Do this step for different three field.

Note that the robot coordinates ([rX], [rY]) shall meet the following conditions.

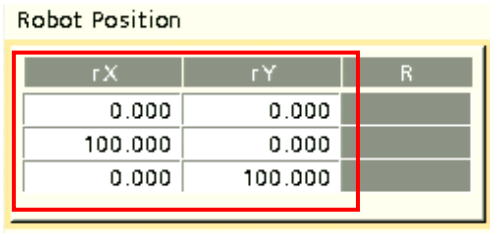
- These three points can create a plane (All three points shall not aligned on a linear line.)
- The position of calibration marks on the three fields shall be different (see the figure below).

[Example of robot position on Semi-Auto (1 point)]



:Field of view :Calibration mark

[[rX], [rY] input window]

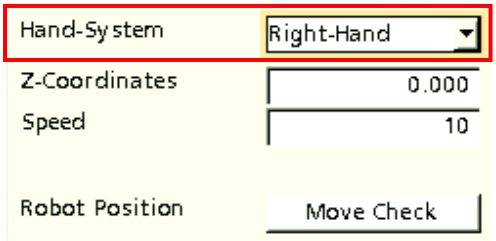


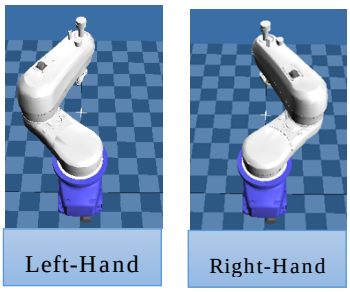
5.3 Hand-System

From [Hand-System], select a shoulder figure of the robot at the calibration.

Select [Right-Hand] for RIGHTY.

Select [Left-Hand] for LEFTY.





[Hand-System (Left-Hand, Right-Hand)]

6. Calibration

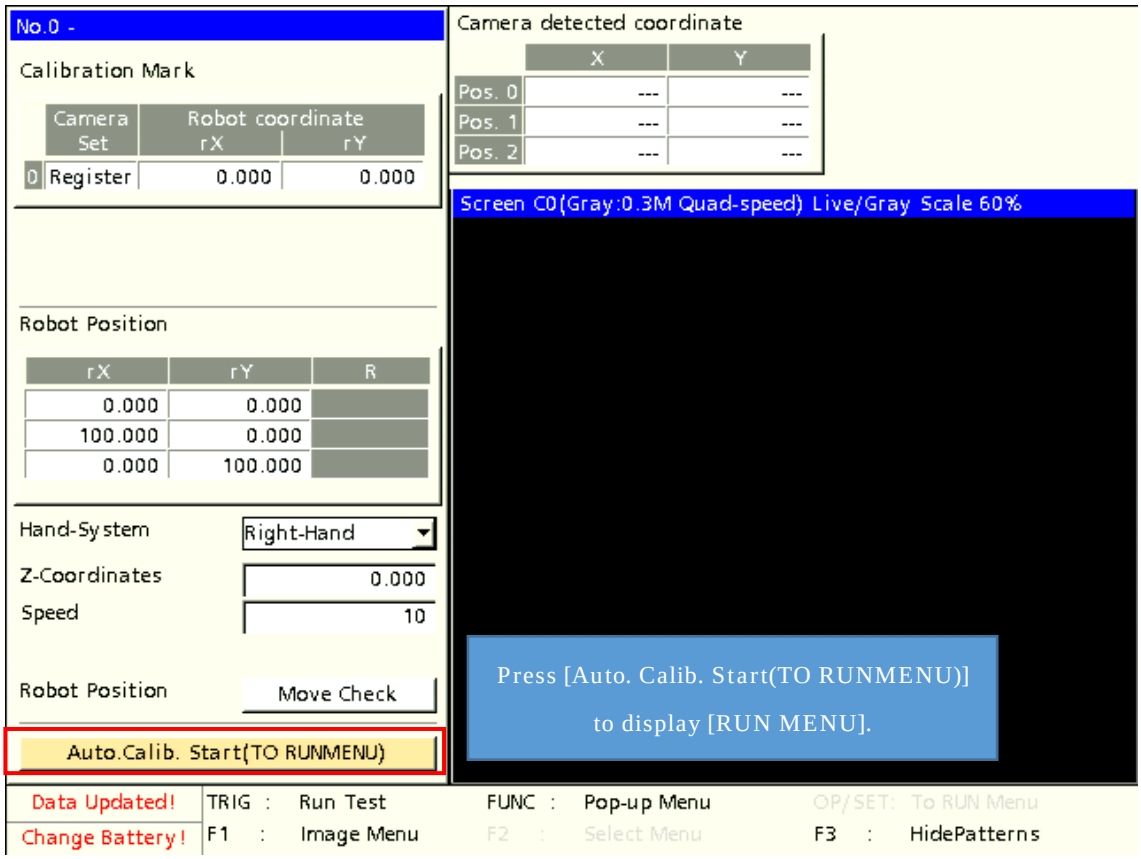
For calibration, run the calibration program from the robot.

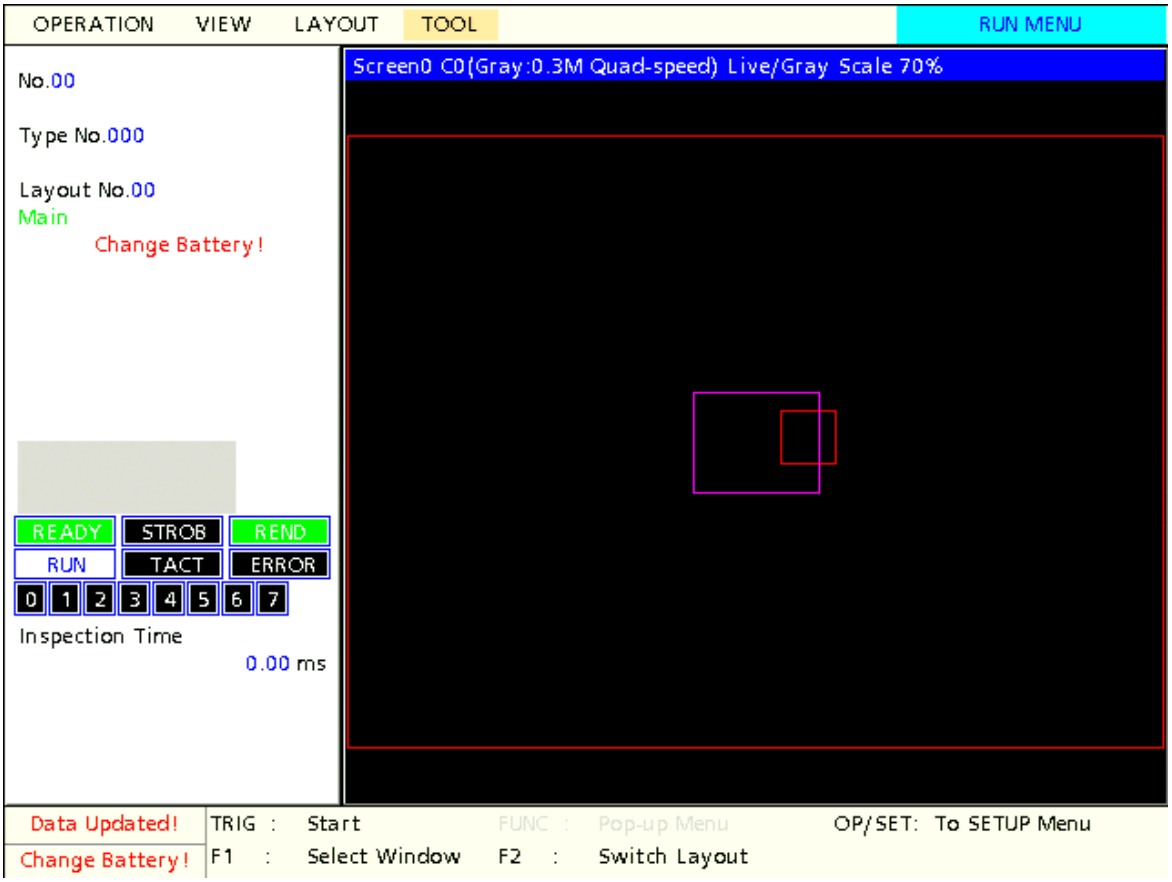
The following shows the calibration procedure.

1. Set PV260 to RUN menu.
2. Turn ON the robot motor.
3. Perform calibration.
4. Check the calibration result.

6.1 PV260 settings

On the [TYPE] tab, press [Robot], press [Calibration], from [Specific setting], press [Set] button. On the [Specific setting] window, press [Auto Calib.Start (TO RUNMENU)] to display [RUN MENU].





6.2 Robot setting

Set the robot to the Auto mode and turn ON the motor.

6.3 Perform Calibration

Run the calibration program. Once the program starts, the robot start moving according to the program. (For about program details, see 7.1 Calibration program for Semi-Auto (1 point).)

Before starting the program, check the following points.

- For the first time of calibration, run the robot with low speed because the robot starts moving as the program starts.
- Step-start causes a time-out error. Also, if the robot speed is too slow, a time-out error occurs.

6.4 Calibration result confirmation

Check the calibration result by running Pick and Place program.

(For about program details, see 7.2 Pick and Place program for Calibration check.)

Before starting the program, check the following points.

- When the robot is on the initial position (POS_HOME), a workpiece shall be displayed on the camera's field of view.

7. Reference (sample program)

7.1 Calibration program for Semi-Auto (1 point)

This program executes the robot motion and Semi-Auto (1 point) calibration based on the information specified by PV260.

```
'!TITLE “Sample_Calibration.pcs”
‘This script executes the robot motion and robot calibration automatically
‘based on the information specified by PV260

#include "Variant.h"

'Items specified by user
#define ADDRESS "192.168.0.62"            'IP address of PV260
#define CAL_NO 0                          'Calibration No.

Sub Main
    takearm

    Dim objPV as Object
    Dim vntVal as Variant
    Dim li as long
    Dim lpBase as Position
    Dim lpMove(3) as Position

    lpBase = CurPos

    'Specify options for robot calibration and establish connection.
    set objPV = cao.AddController("pv", "CaoProv.Panasonic.PV", "", " PV260=1,Conn=eth:" & ADDRESS)

    'Start of the calibration auto-setting
    call objPV.Execute("CalibrationStart", CAL_NO)

    'Get three points
    for li = 0 to 2
        'From PV260, receive robot coordinates where robot visits at the calibration.
        vntVal = objPV.Execute("GetMovePoint")

        'Copy the base position
        lpMove(li) = lpBase

        'Set the coordinate data
        if (vartype(vntVal) And VT_ARRAY) then
            LETX lpMove(li) = vntVal(0)
            LETY lpMove(li) = vntVal(1)
            LETRZ lpMove(li) = vntVal(2)
            LETF lpMove(li) = vntVal(3)
            Move P, @E lpMove(li)
            delay 500
        end if

        'Notify the robot motion completion to PV260
        ‘PV260 shoots test image and performs Base Checker
        call objPV.Execute("MoveEnd")
        delay 1000
    next

    'Notify the calibration auto-setting completion and receive the reply.
```

```
    call objPV.Execute("CalibrationEnd")

    givearm
End Sub
```

7.2 Pick and Place program for Calibration check

This is a program for the Pick and Place operation after the calibration.

Perform teaching for P[321] (place position) beforehand.

```
'!TITLE "Pick and Place template"
'
'Approach length 30mm
'Depart length   30mm
'Picking position        P[311]
'Place position  P[321]

#Include "Variant.h"

'Items specified by user
#Define ADDRESS "192.168.0.62"    'IP address of PV260
#define CAL_NO 0                  'Calibration No.

#Define LEN_APPLOACH 30           'Approach length
#Define LEN_DEPART 30             'Depart length

#Define POS_HOME 310              'Initial position
#Define POS_PICK 311              'Picking position (Workpiece detection position)
#Define POS_PLACE 321             'Place position

#Define CHACKED 0                 'Hold
#Define UNCHACKED 1               'Release


Sub Main
        TakeArm

        Dim objPV As Object
        Dim vntRet As Variant
        Dim vntPos As Variant
        Dim li As Long

        ' Write Chuck or Unchuck motion here, if necessary.
        Chuck UNCHUCKED

        'Move to the initial position.
        Move P, @E P[POS_HOME]

        Set objPV = Cao.AddController( "pv", "CaoProv.Panasonic.PV", "", "PV260=1,Conn=eth:" &
ADDRESS )

        'Inform robot coordinates (“%P=”command)
        Call objPV.SetPoint( VarChangeType( CurPos, VT_R4 + VT_ARRAY ) )

        'Workpiece detected
        vntRet = objPV.Calibrate( CAL_NO )

        'Repeat the processing up to the number of workpieces detected
        If UBound( vntRet ) >= 0 Then
```

```
                For li = 0 To UBound( vntRet )

                        'Set the initial position
                        P[POS_PICK + li] = P[POS_HOME]

                        vntPos = vntRet( li )

                        'Set the coordinate data
                        if (vartype(vntPos) And VT_ARRAY) then
                                LetX P[POS_PICK + li] = vntPos( 0 )
                                LetY P[POS_PICK + li] = vntPos( 1 )
                                LetRz P[POS_PICK + li] = vntPos( 2 )
                                LetF P[POS_PICK + li] = vntPos( 3 )
                        end if

                        'Robot motion processing
                        Call MoveRobot( li )
                Next
        End If

        'Move to the start position
        Move P, @E P[POS_HOME]

        GiveArm
End Sub


'Pick and Place
Sub MoveRobot( ByVal lCnt As Long )
        TakeArm Keep = 0

        '------- Robot motion at the picking position -------------------------
        'Approach motion: Approach to above the picking position
        Approach P, P[POS_PICK + lCnt], @0 LEN_APPLOACH

        'Descending: Go down to the picking position
        Move L, @0 P[POS_PICK + lCnt]

        'Write Chuck or Unchuck motion here, if necessary.
        Delay 300
        Chack CHACKED
        Delay 300

        'Ascending
        Depart L, @0 LEN_DEPART

        '------- Robot motion at the place position -------------------------
        'Approach motion: Approach to above the place position
        Approach P, P[POS_PLACE], @0 LEN_APPLOACH

        'Descending: Go down to the place position
        Move L, @0 P[POS_PLACE]

        ' Write Chuck or Unchuck motion here, if necessary.
        Delay 300
        Chack UNCHACKED
        Delay 300
```

```
        'Ascending
        Depart L, @0 LEN_DEPART
End Sub


'Write Chuck or Unchuck motion here, if necessary.
'Chuck motion: Turning ON/OFF of IO
Sub Chack( ByVal bVal As Long )
        If bVal = CHACKED Then
                IO64 = Off
                IO65 = On
        Else
                IO64 = On
                IO65 = Off
        End If
End Sub
```

Revision History

DENSO Robot
Provider
User's Manual

Panasonic Industrial Devices SUNX Vision Sensor Robot calibration instruction guide

Version	Supported RC8	Content
Ver.1.0.0	Ver.1.13.0	First version

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