DENSO

Conveyer tracking board
For RC5 controller

Serial No.:
Password label for Extension board:

If the password label is put on above column, your extension board is necessary to enable the extension function. Refer to “Preface” on next page.

DENSO ROBOT

RC5 CONTROLLER

OPTIONS MANUAL (SUPPLEMENT)

Preface

Thank you for purchasing optional devices designed for DENSO robots.

This manual covers the specifications, installation, and use of the optional conveyer tracking board to be configured in the **-D/-E series robot system together with the RC5 controller.

Before use, read this manual carefully to safely get the maximum benefit from your robot and options in your assembling operations.

Optional board covered by this manual

The optional conveyer tracking board designed for robot systems configured with RC5 controller

To the customer who purchased an extension board as an additional component

If you purchase an extension board requiring the system to enable the extension function with a password, check the password label on the cover of this manual. The password is prepared in relation to the serial number assigned to your robot controller. By using the password, you need to make the system enable the extension function according to the procedure below.

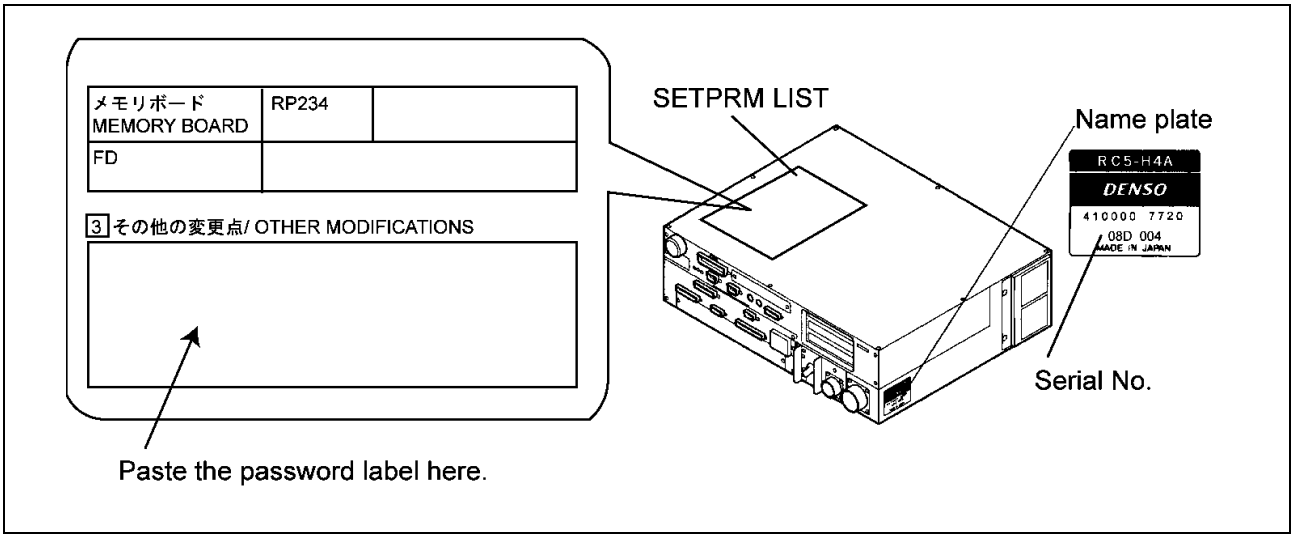
NOTE: If your extension board is installed to any robot controller other than the one whose serial number you informed us of at the time of purchase, the extension function cannot be enabled.

NOTE: If you purchase a robot controller with a built-in extension board, no enabling operation is required since the robot controller is set up with the extension function enabled.

(1) Check that the serial number printed on the password label on the cover of this manual is identical with that of your robot controller.

(2) Remove the password label from this manual and attach it to the OTHER MODIFICATIONS area of the SETPRM LIST on your robot controller.

(3) Enable the extension function of the extension board according to the instructions given on the following pages.

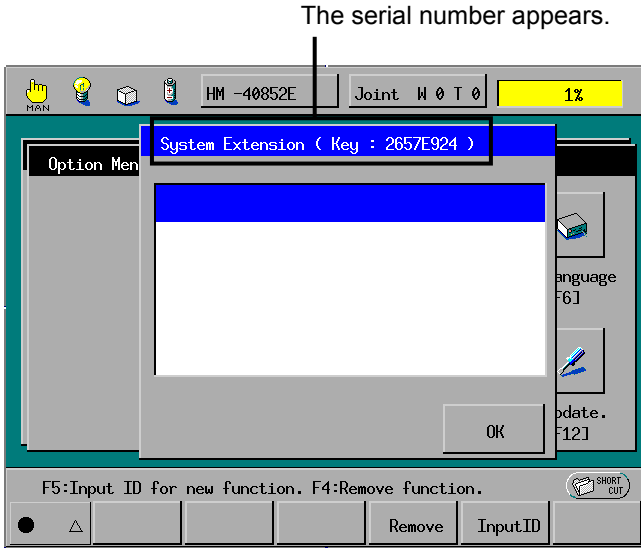


Enabling extension functions by the teach pendant

Access: [F6 Set]—[F7 Options.]—[F8 Extnsion]—[F5 Input ID]

Enables the extension function. Once enabled, the setting will be retained even if the controller power is turned off and on.

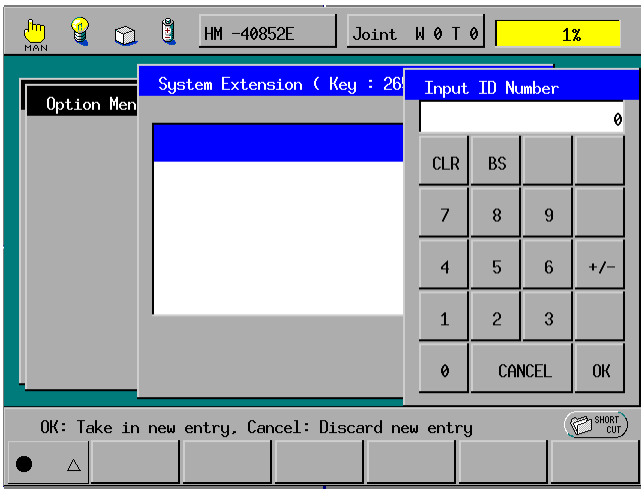
(1) Press [F8 Extnsion] in the Option Menu, and the System Extension window will appear as shown below.



(2) Press [F5 Input ID] on the System Extension window, and the numeric keypad will appear.

(3) Enter the password and press [OK].

The name of the newly added function will be displayed.



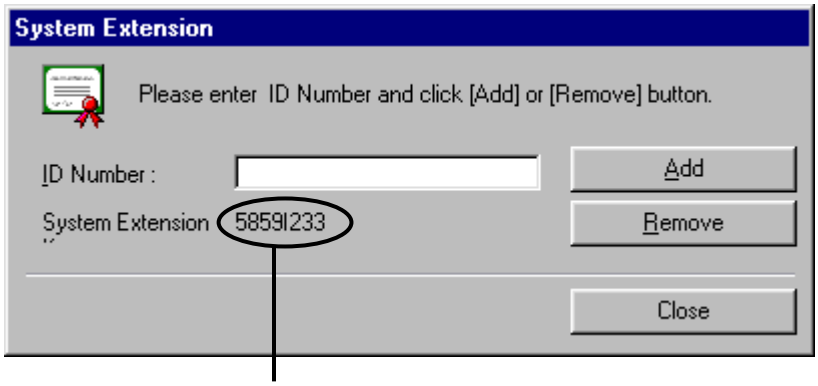
(4) Restart the controller to make the extension function go into effect.

Enabling extension functions in WINCAPSII

Enables the extension function. Once enabled, the setting will be retained even if the controller power is turned off and on.

(1) When WINCAPSII and the controller are in connection, choose the “System Extension” from Help Menu.

(2) The System Extension window appears. Enter the password and press [Add].



The serial number appears.

(3) Restart the controller to make the extension function go into effect.

Contents

Chapter 1 Hardware Setting for Conveyer Tracking

1.1 Optional Components

Table below shows the optional components of the conveyer tracking system.

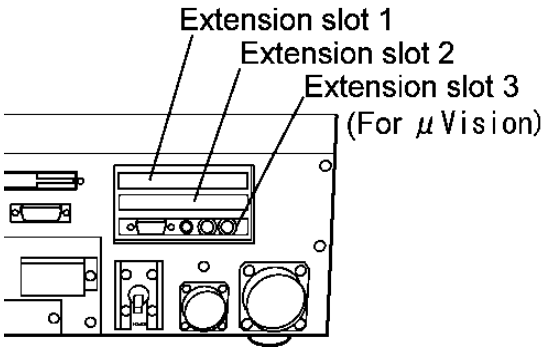
Optional Components

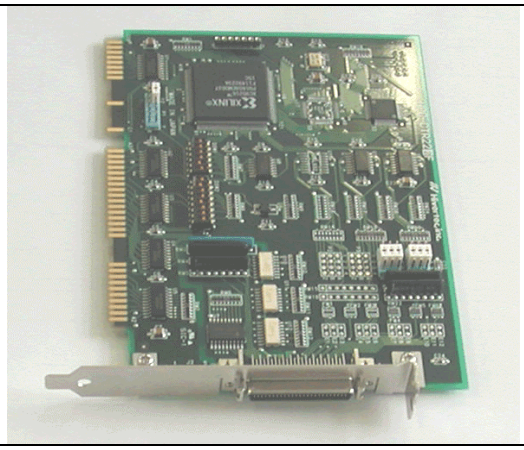
No.	Part name	Remarks	Part No.
1	Conveyer tracking board		410010-1660
2	Encoder	OMRON: E6B2-CWZ1X1000P/R	410010-1690
3	Encode cable	（3m）	410141-2440
4	Encode cable	（5m）	410141-2430
5	Encode cable	（15m）	410141-2420
6	5V power supply cable	（2m）Encoder to DC/DC converter	410141-2450
7	DC/DC converter	（24V-5V）OMRON: S82S-7305	410010-1680

1.2 Conveyer Tracking Board Specifications

1.2.1 Location of Conveyer Tracking Board

The conveyer tracking board may be inserted into extension slot 1, 2 or 3 of the robot controller. For mounting the board to the controller, refer to “OPTIONS MANUAL, Mounting Extension Boards”.



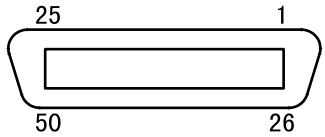


1.2.2 Specifications

Items	Specifications
Input count configuration	Line receiver input, Non isolation (Note)
Input signal	**A**、$\overline{A}$、**B**、$\overline{B}$、**Z**、$\overline{Z}$
Maximum response frequency	1.5MHz
No. of channels	2（32Bit）
Supply voltage	5VDC（±5%）

Note: The Input count configuration is non isolation. Encoder-power-supply-0V must be common to 0V of the controller.

1.2.3 Pin Assignment of Conveyer Tracking Board



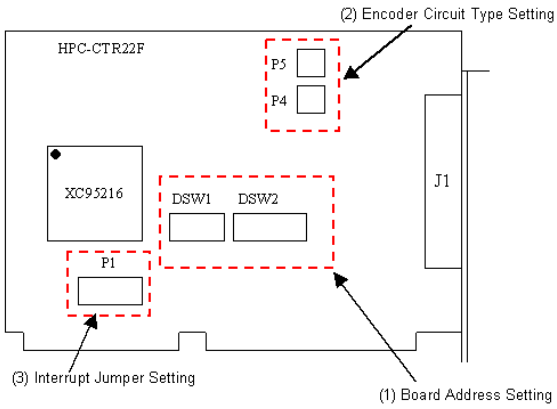
View from the cable side

Connector model: 10250-52A2JL (SUMITOMO 3M Limited)

Terminal number	Input signal	Terminal number	Input signal
1	**XA**	9	**YA**
2	**X$\overline{A}$**	10	**Y$\overline{A}$**
3	**XB**	11	**YB**
4	**X$\overline{B}$**	12	**Y$\overline{B}$**
5	**XZ**	13	**ZB**
6	**X$\overline{Z}$**	14	**Z$\overline{Z}$**
7	**GND**	15	**GND**

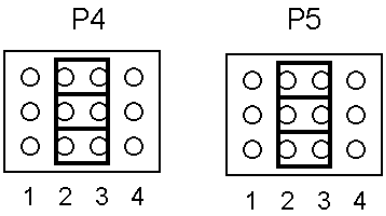
1.2.4 Conveyer Tracking Board Settings (Factory-default Settings)

The conveyer tracking board is shipped with the following factory-default settings. Check the settings before installing the board into the controller after purchase.
The settings are made for (1) Board address, (2) Encoder circuit type, and (3) Interrupt jumper.



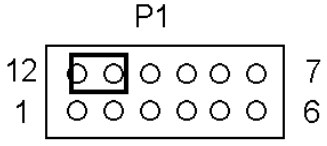
(2) Encoder circuit type setting

Set Jumper P4 and P5 as shown in Figure below.



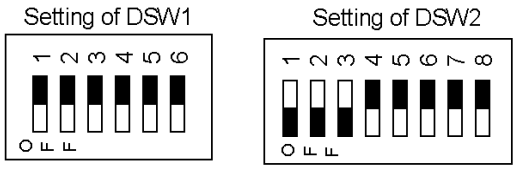
(3) Interrupt jumper setting
Set jumper P1 as shown in Figure below. Pin 11 and 12 are short-circuited.

Caution: Do not miss-connect to “Pin 1 to 6” side.



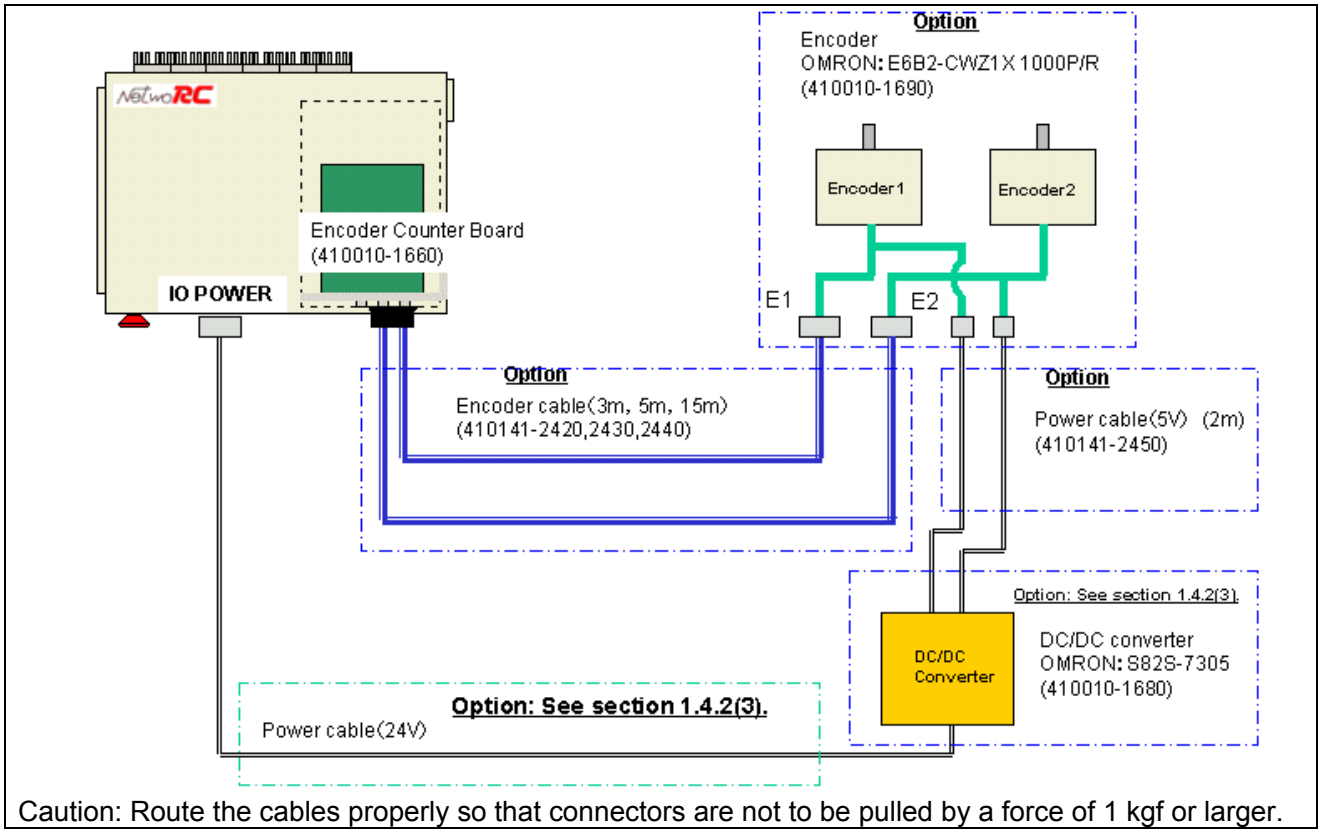
(1) Board address setting
Set DSW1 and DSW2 shown in Figure below.

DSW1: All switches are ON.
DSW2: Switches 1 to 3 are OFF, and switches 4 to 8 are ON.



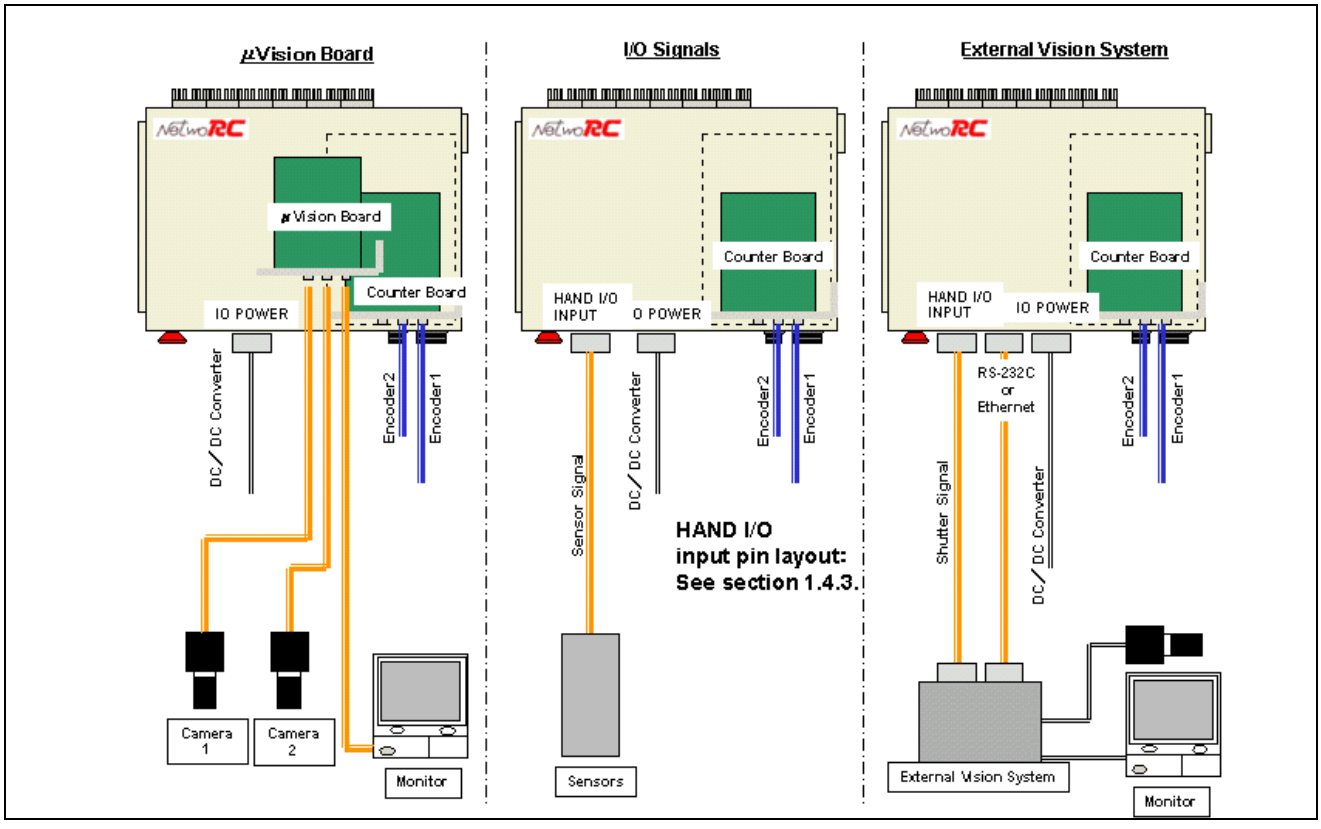
1.3 System Configuration of Conveyer Tracking

1.3.1 Encoder Configuration



Caution: Route the cables properly so that connectors are not to be pulled by a force of 1 kgf or larger.

1.3.2 Sensor Configuration



1.4 Specifications of Components

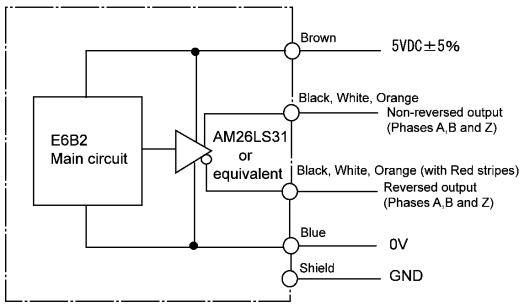
1.4.1 Encoder

(1) Specifications

Be sure to read the INSTRUCTION Sheet enclosed in the package.

Item	Specifications
Part No.	410010-1690
Model	E6B2-CWZ1X（OMRON）
Type	Incremental
Supply voltage	5VDC（±5%）
Current consumption	160 mA max.
Output circuit configuration	Line driver output
Output phase	**A**、$\overline{A}$、**B**、$\overline{B}$、**Z**、$\overline{Z}$
Maximum response frequency	100 kHz
Slewing speed	6000 r/min
Resolution	1000 pulses/revolution (Note 1)
Starting torque	980 μNm max.
Moment of inertia	1×10^{-6} kgm^2 max.
Shaft loading	Radial：30 N、 Axial：20 N
Dust & splash proof	IP50
Ambient temperature	-10℃ to +70℃
Ambient humidity	35% to 85%RH

OUTPUT CIRCUIT DIAGRAM



Terminal	Wire color
DC5V	Brown
0V	Blue
A	Black
B	White
Z	Orange
$\overline{A}$	Black/Red
$\overline{B}$	White/Red
$\overline{Z}$	Orange/Red

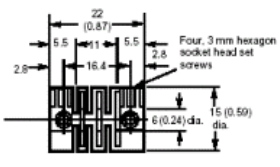
Note 1: The number of pulses is multiplied by 4, so the count value is 4000 pulses/revolution.

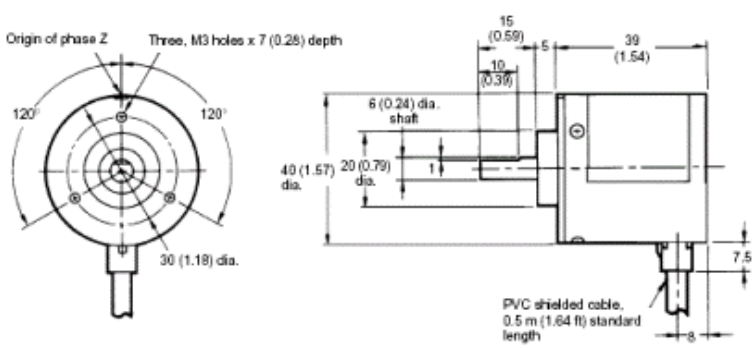
Note 2: Since this equipment is neither dust-proof nor drip-proof, protect it with a cover or something if used in an adverse environment.

Note 3: Protect the encoder connectors by putting covers on them after installation.

(2) Outline drawing

■ ACCESSORIES
Shaft Coupler E69-C06B (included)
for two 6 mm diameter shafts





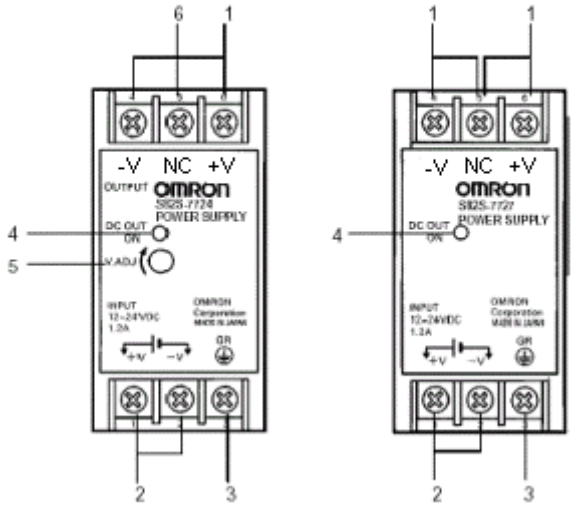
1.4.2 DC/DC Converter

Be sure to read the INSTRUCTION Sheet enclosed in the package.

(1) Specifications

Model	S82S-7305
	DIN Rail Mount
Input voltage	10.2 to 27.5VDC
Output voltage	5V
Poer ratings	3W
Output current	0.6A
Voltage adjustment range	±5%
Ambient temperature	0℃ to +50℃
Ambient humidity	25 to 85%RH

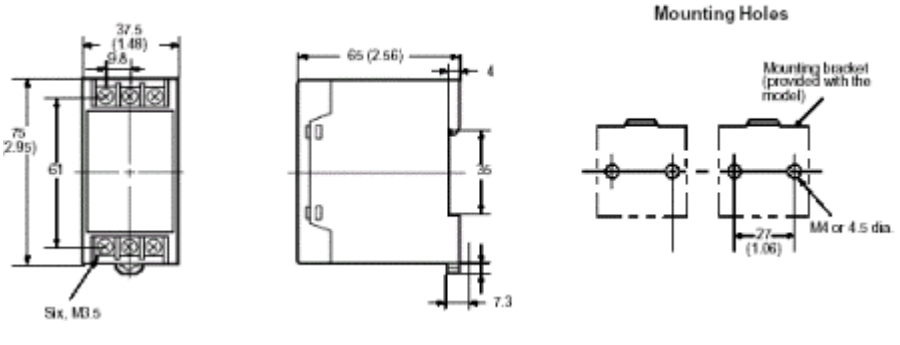
Front Panel and Its Functions



1. **DC Output Terminals:** Connect load wiring.
2. **Input Terminals:** Connect input wiring.
3. **Ground Terminals:** Connect ground wiring.
4. **Output LED Indicator:** Lights when DC current is being output.
5. **V. ADJ Adjuster:** Use to adjust the output voltage.
6. **NC Terminals:** Vacant terminals.

Note: Since this equipment is neither dust-proof nor drip-proof, protect it with a cover or something when used in an adverse environment.

(2) Outer dimensions



(3) Wiring for DC/DC Converter

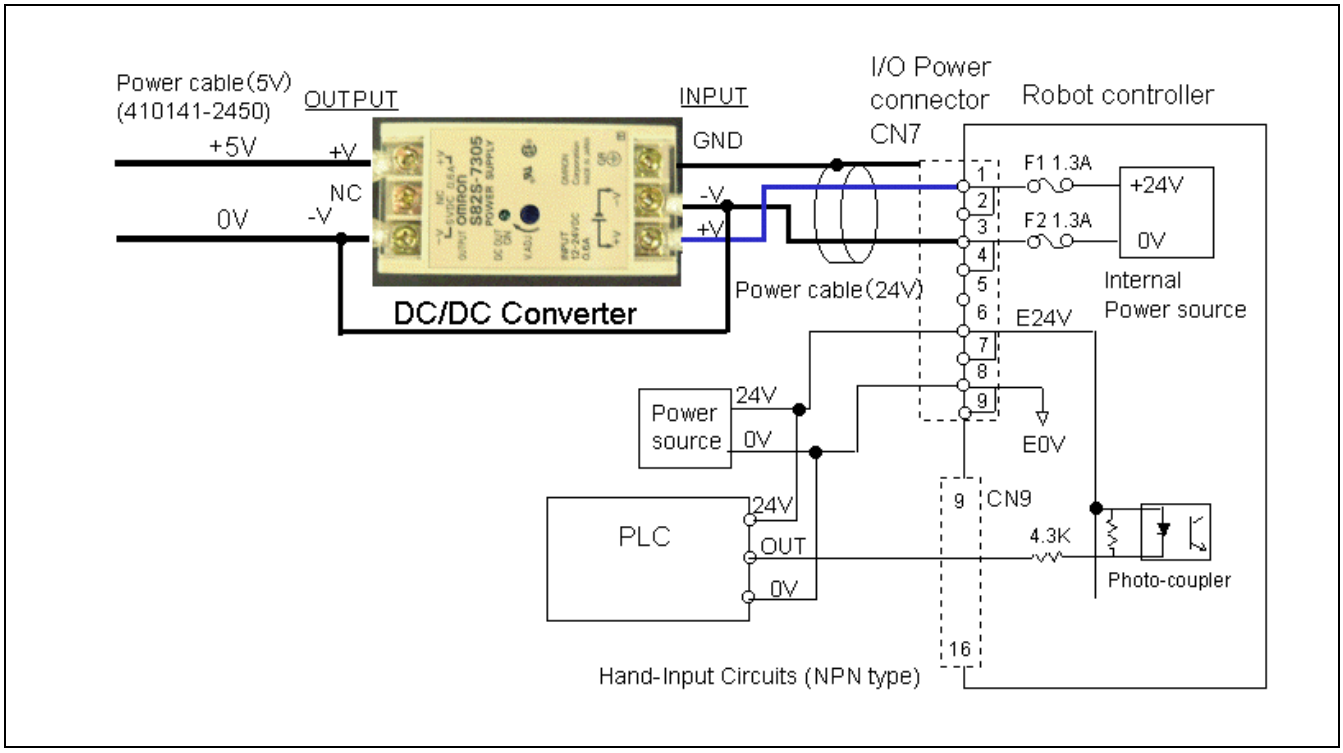
A wiring example when hand input (NPN type) is used is shown in the diagram below. Refer to “IRC5 INTERFACE MANUAL” for details.

Notes:

(1) Use a twisted pair shielded cable as the power cable (24 V).

(2) Connect the shield with CN7 shell and the GND terminal of the DC/DC converter.

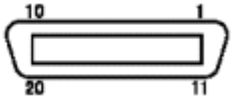
(3) The capacity of current for the internal power supply is 1.3 A. When using PLC or a proximity switch, use external power supplies.



1.4.3 Sensor Signal Input Pin Layout (NPN Type I/O)

Table below shows sensor signal input pin layout. Refer to “IRC5 INTERFACE MANUAL” for details.

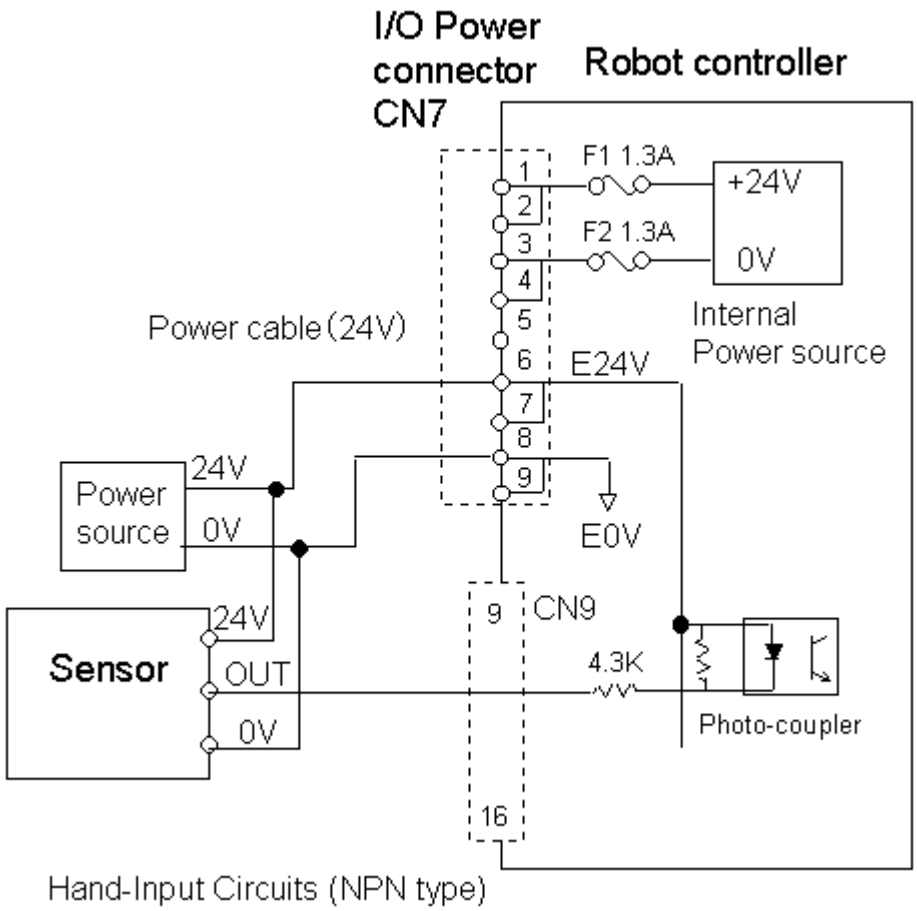
HAND I/O（CN9）



View from the cable aside

Terminal No.	Name	Port No.	I/O interrupt No.	Terminal No.	Name	Port No.	I/O interrupt No.
1	Hand output 1	64	-	**11**	**Hand input 3**	**50**	**3**
2	Hand output 2	65	-	**12**	**Hand input 4**	**51**	**4**
3	Hand output 3	66	-	**13**	**Hand input 5**	**52**	**5**
4	Hand output 4	67	-	**14**	**Hand input 6**	**53**	**6**
5	Hand output 5	68	-	**15**	**Hand input 7**	**54**	**7**
6	Hand output 6	69	-	**16**	**Hand input 8**	**55**	**8**
7	Hand output 7	70	-	17	Power E24V for Hand	-	-
8	Hand output 8	71	-	18	Power E0V for Hand	-	-
9	**Hand input 1**	**48**	**(1) Note**	19	Not connected	-	-
10	**Hand input 2**	**49**	**(2) Note**	20	Not connected	-	-

Note:I/O interrupt No. 1 and 2 (Hand input 1 and 2) are not yet usable. Do not use them.



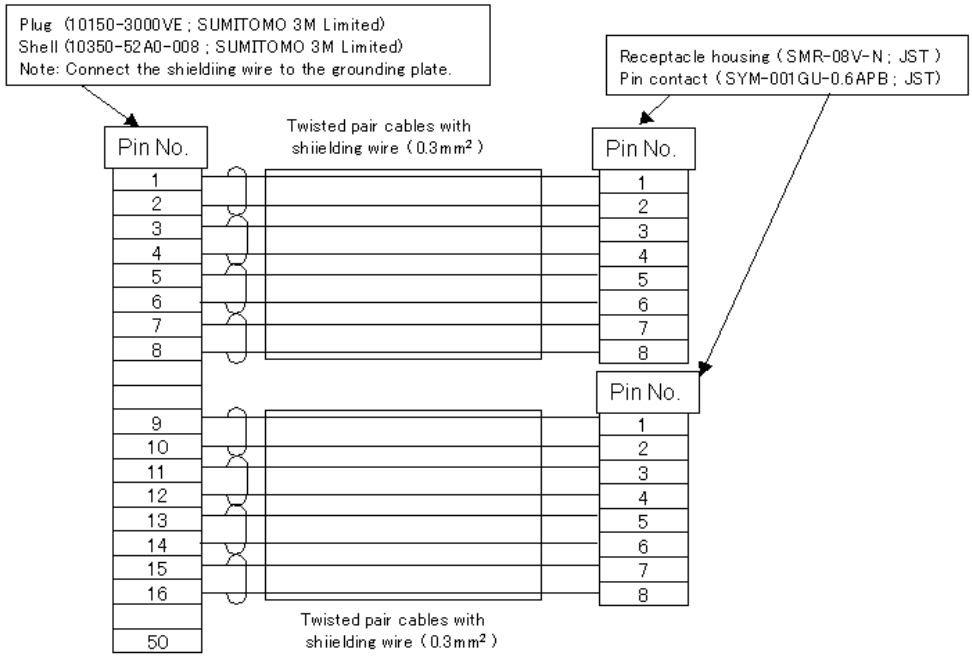
Hand-Input Circuits (NPN type)

1.4.4 Wiring Diagram of Optional Cables and Precautions in Wiring

(1) Encoder cable

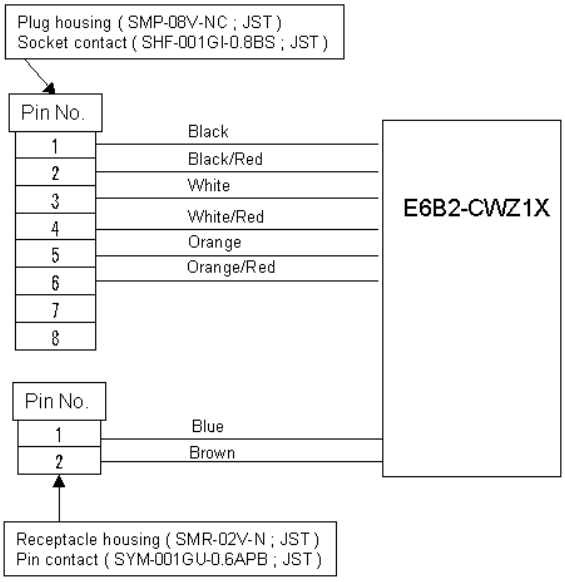
The following shows a wiring diagram of encoder cables.

Wiring Diagram of Encoder Cables



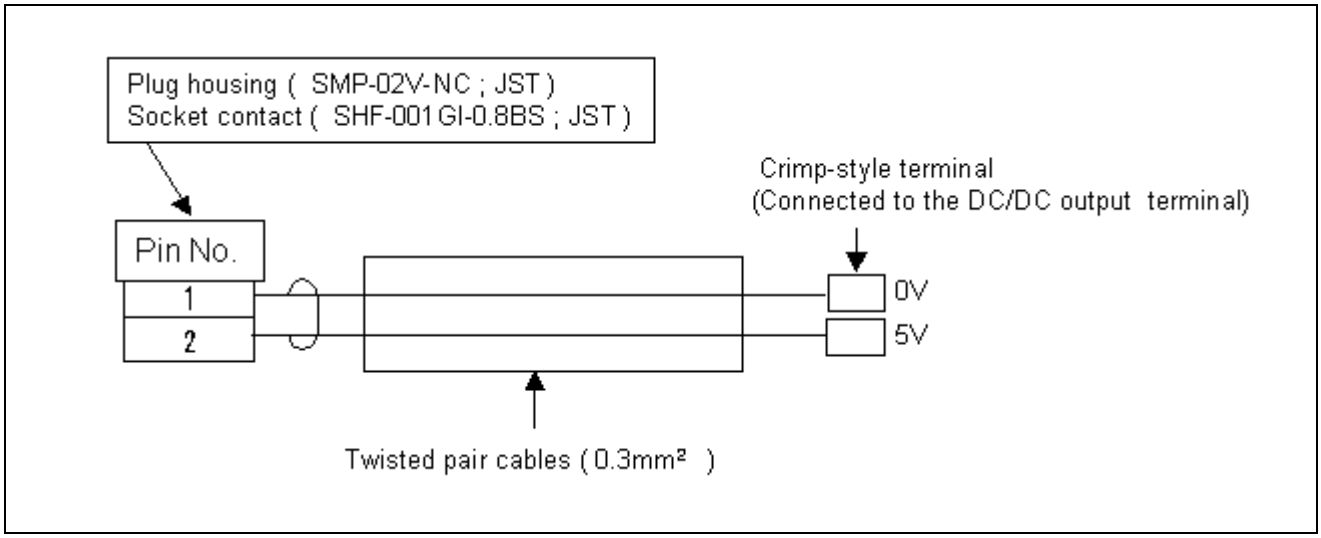
(2) Wire connections of encoder (E6B2-CWZ1X) cables

Connect the encoder cable wires to the following connector pins.



(3) Wiring diagram of 5V power supply cable

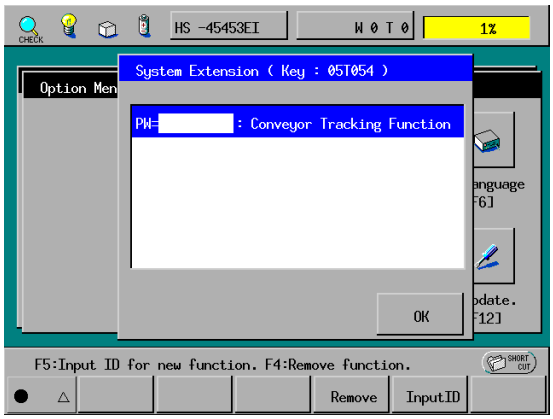
The following shows a wiring diagram of the 5V power supply cable.



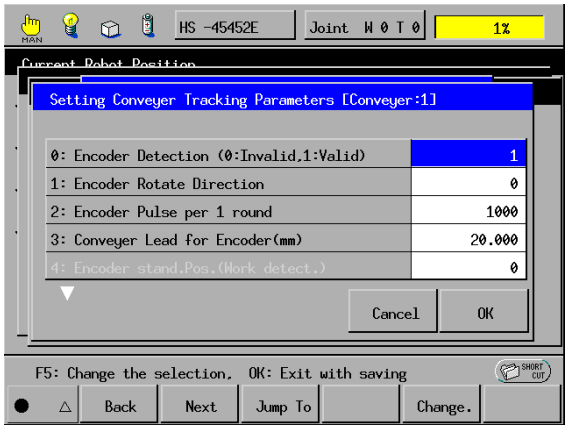
1.5 Hardware Operation Confirming Procedure

(1) Confirm that the Conveyer tracking function is effective using the teach pendant.

Access: [Top Screen]-[F6 Set]-[F7 Options.]-[F8 Extension]



(2) Set Conveyer tracking parameters.
Refer to “2.1 Setting Conveyer Tracking Parameters”.



(3) Confirm the encoder count value.
Refer to “2.1 Setting Conveyer Tracking Parameters”.

Operate the Conveyer and confirm “Encoder current position”.
Confirm that the value changes according to the conveyer operation.

(4) Confirm the encoder count value when a workpiece is detected.
Refer to “2.1 Setting Conveyer Tracking Parameters”.

Operate the conveyer and confirm “Encoder stand. Pos. (Work detect.)”.
Confirm that the value changes every time a workpiece is detected.

1.6 Camera Setting when μVISION is in Use

(1) Camera setting

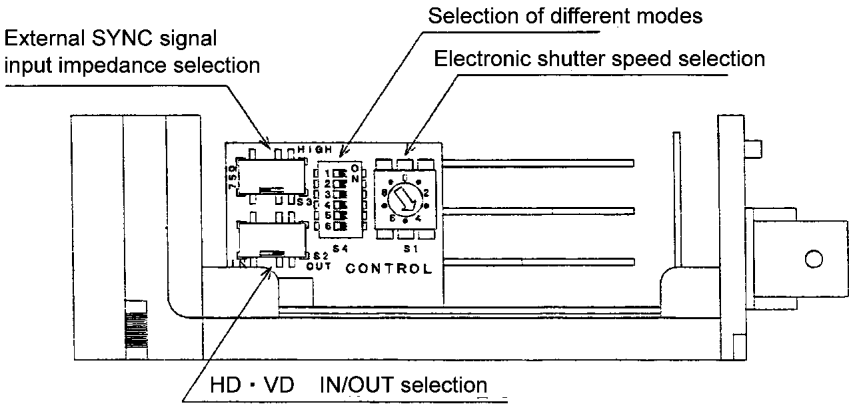
When using the conveyer tracking function with CS8320B, turn on the field shutter function and restart reset function. For the setting method in detail, refer to the manual attached to the camera.

Mode selection switch settings

Turn on the mode selection switches Nos. 2, 3, and 6, and turn off the other switches.

No.	Function name	Switch position	
		OFF	ON
1	Gamma correction	1.0	0.45
2	CCD accumulation mode	Frame accumulation	Field accumulation
3	Restart/Reset	OFF	ON
4	Special shutter	OFF	ON
5	Not used	—	—
6	VD out/FLD out	VD out	FLD out

Side view after opening the camera cover



(2) Note

To validate the above setting, you need to use the CAMIN instruction to set the Conveyer tracking use mode and use the CAMMODE instruction to set the reset function as the camera function and to set field take-in as the storage method. For details, refer to “Chapter 3” and “PROGRAMMER’S MANUAL”.

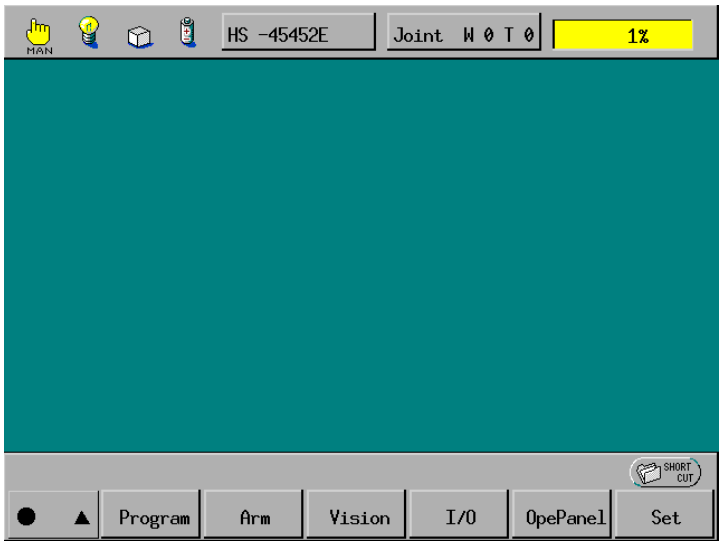
Chapter 2 Conveyer Tracking Adjustment

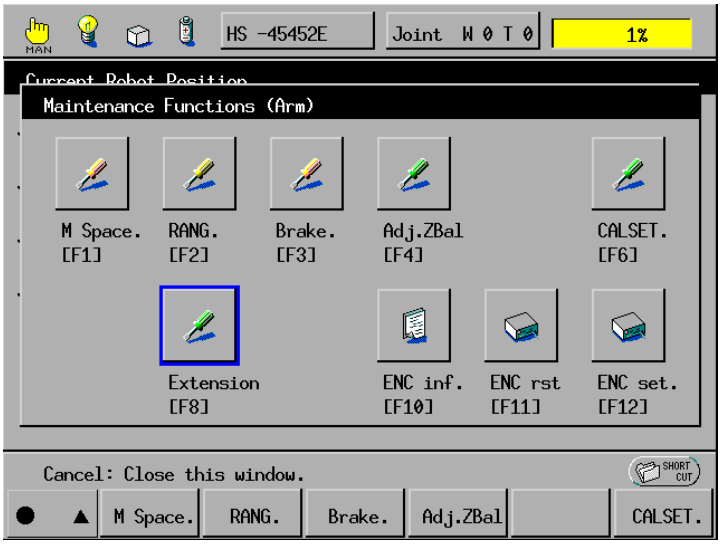
2.1 Setting Conveyer Tracking Parameters

To use the conveyer tracking function, you need to set conveyer tracking parameters with a teach pendant.

2.1.1 How to Set Conveyer Tracking Parameters

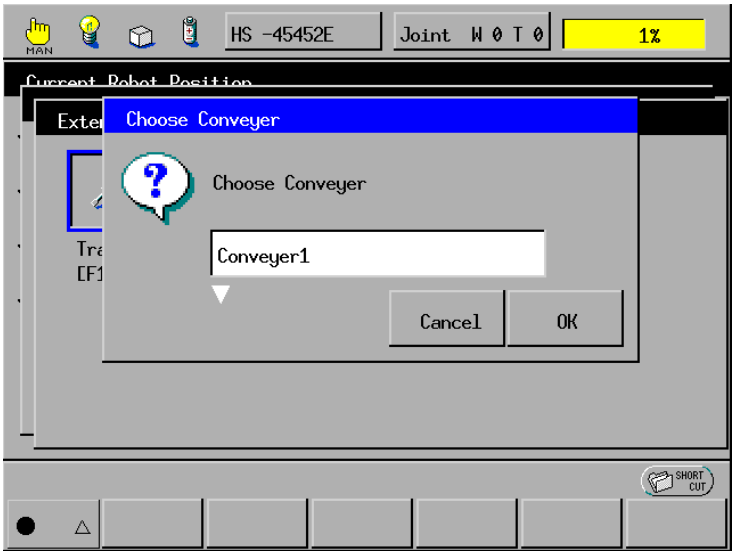
(1) From the basic screen, select function items, in this order: [F2 Arm] → Shift → [F12 Maint.].





(2) From the Maintenance screen, select [F8 Extension].

(3) Pressing [F1 Tracking] displays the parameter setting screen.
This screen is displayed only when the conveyer tracking function is enabled as an extension function.

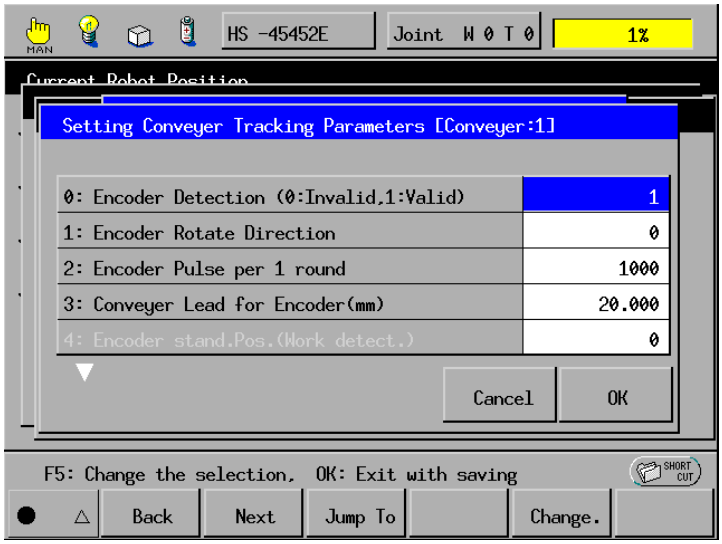


(4) Use the △key, ▽key, or the jog dial to select the conveyer number (Conveyer1, Conveyer2).

The conveyer number is the same as the encode number, which depends on the connector number (E1, E2) of the encoder cable. The encoder connected to E1 is referred to as encoder 1, and the encoder connected to E2 is called encoder 2. For details, refer to “1.3.1 Encoder Configuration” in “Hardware Setting for Conveyer Tracking”.

When using two conveyers, you need to set parameters for each of conveyers 1 and 2.

(5) Selecting the conveyer number and then pressing [OK] displays the parameter screen. Pressing [Cancel] returns to the preceding screen.



(6) Select a parameter you want, press [Change], and then enter a numeric value. Pressing [OK] now changes the parameter value to the new one.
For the content of parameters, see “Table: List of Conveyer Tracking Parameters”.

Note: There are two types of parameters: those immediately enabled after their values are changed and those enabled after the controller power is turned off and then on. When you change parameters of the latter type, turn the controller power off and then turn it on. For details, see “Table: List of Conveyer Tracking Parameters”.

Table List of Conveyer Tracking Parameters

Parameter name	Entry range	Factory default	Unit	Description	Remarks	Controller restart
Encoder Detection (0: Invalid, 1: Valid)	0 to 1	0		Set to “1” to use the function.		Needed
Encoder Rotate Direction	0 to 1	0		Set to “1” to invert the direction (+/-) of the encoder count.	Set the parameter so that the direction of the conveyer operation is “+”.	Needed
Encoder Pulse per 1 Round	0 to 100000	1000	[P/R]	Set the number of pulses per rotation of the encoder.	The number is multiplied by 4 at the counter board. The encoder count value is 4 times the number of pulses.	Needed
Conveyer Lead for Encoder	0 to 100000	20	[mm]	Set the conveyer operation amount per rotation of the encoder.		Needed
Encoder stand. Pos. (Work detect.)				The encoder count value when the latest workpiece is detected is displayed.	This parameter cannot be changed.	
Encoder stand. Pos. (motion start.)				The encoder count value when the workpiece subject to tracking is detected is displayed.	This parameter cannot be changed.	
Encoder current position				The current encoder count value is displayed.	This parameter cannot be changed.	
Conveyer CALSET (X,Y)	-360 to 360	0	[deg]	Set the direction of the conveyer operation (rotation angle with respect to the X-axis on the XY plane).	See “Conveyer Calibration”.	Not needed
Conveyer CALSET (Z)	-360 to 360	0	[deg]	Set the direction of the conveyer operation (rotation angle with respect to the XY plane).	See “Conveyer Calibration”.	Not needed
Encoder max. speed (rpm)	0 to 20000	6000	[rpm]	Set the upper speed limit for the encoder.		Not needed
Encoder min. speed (rpm)	0 to 20000	0	[rpm]	Set the lower speed limit for the encoder.		Not needed
Conveyer Track Upper Pos. (mm)	-2000 to 2000	200	[mm]	Set the range (+ side) of robot positions allowing tracking.	**(Note1)**	Not needed
Conveyer Track Lower Pos. (mm)	-2000 to 2000	-200	[mm]	Set the range (- side) of robot positions allowing tracking.	**(Note1)**	Not needed
Tracking start Pos.(+) (mm)	-2000 to 2000	200	[mm]	Set the workpiece position (+ side) allowing the start of tracking operation with the tracking operation wait command.	See the description of the operation wait command “WAITTRACKMOVE”.	Not needed
Tracking start Pos.(-) (mm)	-2000 to 2000	-200	[mm]	Set the workpiece position (- side) allowing the start of tracking operation with the tracking operation wait command.	See the description of the operation wait command “WAITTRACKMOVE”.	Not needed
Tracking accel rate	0 to 100	25	[%]	Set the acceleration at the start of tracking operation and the deceleration at the end of tracking operation.		Not needed
Tracking Position Adjustment value	0 to 50	7		Set the positional compensation amount for delay in tracking operation processing.	Increase the value if the tracking operation position lags in the direction of the conveyer’s upstream.	Not needed
I/O Interrupt Detection (0:Invalid, 1:Valid)	0 to 1	0		Set to “1” to detect the workpiece by hand I/O interrupt.	Set to “0” to detect the workpiece by μVision.	Needed
I/O Interrupt Number	3 to 8	0		Set the hand I/O Interrupt number to be used for workpiece detection.		Needed

Note1: When setting “Conveyer Track Upper Pos.” and “Conveyer Track Lower Pos.”, pay attention to their changing order. Following cases will occur error:

Entering value of “Conveyer Track Upper Pos.” ≦ Current value of “Conveyer Track Lower Pos.”

Entering value of “Conveyer Track Lower Pos.” ≧ Current value of “Conveyer Track Upper Pos.”

(Continued on following page)

Parameter name	Entry range	Factory default	Unit	Description	Remarks	Controller restart
Edge Trigger (0:Up, 1:Down)	0 to 1	0		When the parameter is set to “0”, an interrupt occurs at a rising edge (OFF→ON). When the parameter is set to “1”, an interrupt occurs at a falling edge (ON→OFF). Note: Parameter “1” is not yet usable. Use parameter “0”.		Needed
Workpiece detection position accuracy	0 to 100	5	mm	Set a range in which detected workpieces are recognized as the same after the same workpiece has been detected for multiple times as a result of repeated visual recognition process.	Set the parameter to a value smaller than the minimum distance between workpieces.	Not needed
Interrupt data setting	0 to 10	0		Set a condition for setting encoder data into the conveyer tracking data buffer at hand I/O interrupt.	Set this value to 1 if external visual equipment is used.	Not needed
Interrupt delay correction value	0 to 30	0	2ms	Set a wait length from when a hand I/O interrupt occurs to when an encoder value is obtained.	For adjustment method, refer to “3.4 Conveyer tracking accuracy checking procedures”.	Not needed

2.1.2 Detailed Explanation of Parameters

1. Encoder Detection

   To use the encoder, set this parameter to “1”. If it is set to “0”, the encoder value is not counted.

2. Encoder Rotate Direction

   Set this parameter so that the encoder count value increases (change in the direction of +) when the conveyer operates.

   The encoder count value is displayed in “Encoder current position”. Check the encoder count value before the conveyer operation, and close the parameter window. After the conveyer operation, open the parameter window again and check the encoder count value.

   If the encoder count value after the conveyer operation decreases, change “Encoder Rotate Direction” accordingly.

3. Encoder Pulse per 1 round

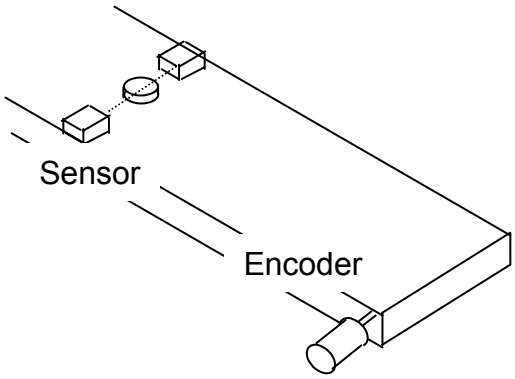
   Set the number of pulses per rotation of the encoder. When you use E6B2-CWZ1X, set this parameter to 1000. The encoder pulses undergo frequency division at the conveyer tracking board, where four times the number of pulses is counted. Therefore, the encoder count value per rotation of the encoder is four times the number of encoder pulses.

4. Conveyer Lead for Encoder

   Conveyer movement amount per rotation of the encoder. This parameter checks the setting value for correctness when conveyer calibration is being executed.

5. Encoder stand. Pos. (Work detect.)

   This parameter indicates the encoder count value when a workpiece is detected with a camera or sensor. The value changes each time a workpiece is detected.



6. Encoder stand. Pos. (motion start.)

   This parameter indicates the encoder count value when the workpiece subject to the current tracking is detected. The value changes each time the workpiece subject to tracking changes.

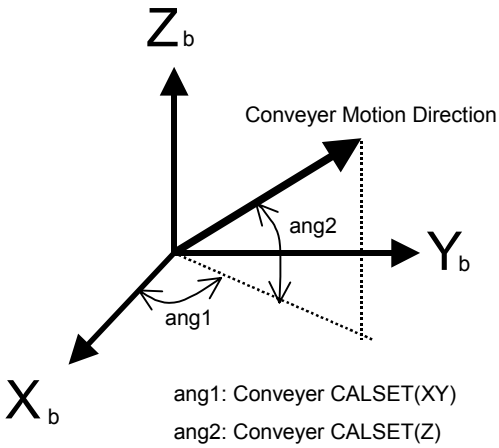
7. Encoder current position

   This parameter indicates the current encoder count value.

   Confirm that when the encoder makes one rotation, the encoder count value increases four times the encoder pulse value (Encoder Pulse per 1 round).

8. Conveyer CALSET(X,Y)
9. Conveyer CALSET(Z)

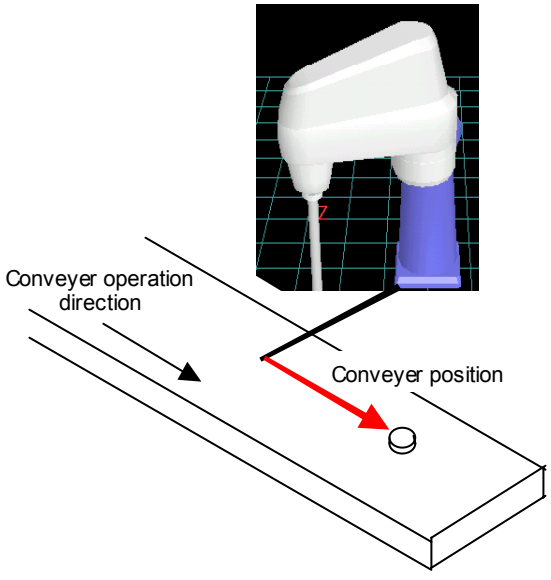
These parameters set conveyer operation directions with respect to the robot base coordinates. Each corresponds to the angle shown in the following figure.



When conveyer calibration is executed, the computation value is applied.

10. Conveyer Track Upper Pos. (mm)
11. Conveyer Track Lower Pos. (mm)

These parameters set the tracking operation range with conveyer positions. As shown in the figure below, the conveyer position is expressed by the distance from the line, drawn from the robot home position perpendicularly to the direction of conveyer operation, to the point in question in the conveyers. The conveyer operation direction is regarded as the plus (+) side.



12. Tracking start Pos.(+) (mm)
13. Tracking start Pos.(-) (mm)

These parameters set the tracking operation start position with conveyer positions.

The tracking operation wait command (WAITTRACKMOVE) is placed in the wait status until the workpiece subject to tracking comes into the specified tracking operation start range.

14. Tracking accel rate

When the tracking operation starts, the robot is accelerated until its speed becomes the same as the conveyer speed. When the tracking operation terminates, the robot is decelerated from the conveyer speed. This parameter sets such acceleration/deceleration speed at the time of the tracking operation start/stop. The greater the setting value, the shorter the switching time at the start or stop of the tracking operation. Note, however, that too great a setting value may cause “commanded acceleration error.

15. Tracking Pos. Adjustment value

When chucking the workpiece on the conveyer, the chucking position may shift according to a rise in the conveyer speed. If that is the case, use this parameter to adjust the position. If the shift is in the direction of the upstream of the conveyer, increase the value. If the shift is in the direction of the downstream of the conveyer, decrease the value.

Note: If the chucking position shifts when the conveyer speed is low or when the conveyer stops, re-teaching is required.

16. I/O Detection

There are two methods of detecting workpieces: the method with μVision and the method with Hand I/O input interrupts. (Refer to “1.3.2 Sensor configuration”)

To detect workpieces with Hand I/O input interrupts, set this parameter to “1”. Also, confirm that “Encoder Detection” is set to 1.

17. I/O Port Number

This parameter sets interrupt numbers for Hand I/O input connection destination. The following table shows the correspondence between Hand I/O input interrupt numbers, terminal numbers, and port numbers:

Hand I/O (CN9)

Terminal No.	Name	Port No.	I/O interrupt No.
11	Hand input 3	50	**3**
12	Hand input 4	51	**4**
13	Hand input 5	52	**5**
14	Hand input 6	53	**6**
15	Hand input 7	54	**7**
16	Hand input 8	55	**8**

18. Edge Trigger

This parameter sets the interrupt occurrence timing for Hand I/O input.

When “0” is set, an interrupt is generated to detect a workpiece when the input signal specified in “I/O Port Number” changes from OFF to ON (rising edge).

When “1” is set, an interrupt is generated to detect a workpiece when the input signal specified in “I/O Port Number” changes from ON to OFF (falling edge).

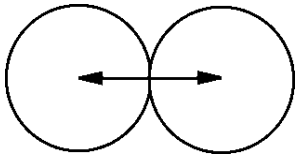
Note: Parameter “1” is not yet usable. Use parameter “0”.

19. Workpiece detection position accuracy

The same workpiece may be detected for multiple times on a conveyer as a result of repeated visual recognition process or others. In this case, detected workpieces are checked if they are the same based on the difference in the workpiece positions on the conveyer. This parameter sets a workpiece position error range in which workpieces are recognized as the same.

If the parameter is set to a value larger than the minimum distance between workpieces shown below, two different workpieces are falsely recognized as the same. And if the parameter is set to a value smaller than the minimum distance between workpieces, the same workpiece is falsely recognized as multiple, different workpieces.

Set the parameter using the following guideline.

Setting value = Minimum distance between workpieces × 0.5	 Minimum distance between workpieces

20. Interrupt data setting

This parameter sets a condition for setting encoder value into the conveyer tracking data buffer when a hand I/O interrupt occurs.

0: Upon execution of TrackDataSet command, all the encoder values obtained during hand I/O interrupts are set into the conveyer tracking data buffer.

1: Upon execution of TrackDataSet, the encoder values obtained during the latest hand I/O interrupt are set into the conveyer tracking data buffer.
If you use the shutter ON signal as the hand I/O interrupt signal by using external visual equipment, set this parameter to 1.

21. Interrupt delay correction value

This parameter sets a wait length from when a hand I/O interrupt occurs to when an encoder value is obtained.
The wait length is “Set value × 2 (ms)”.

For how to adjust setting values, refer to the procedures (3) in “3.4.2 When visual equipment is used” of “3.4 Conveyer tracking accuracy checking procedures”.

2.2 Conveyer Calibration

The setting of conveyer operation direction is indispensable to conveyer tracking. To set the conveyer operation direction, use the conveyer tracking parameters (Conveyer CALSET(X,Y), Conveyer CALSET(Z)). Conveyer calibration refers to the work of setting conveyer tracking parameters (Conveyer CALSET(X,Y), Conveyer CALSET(Z)).

2.2.1 How to Execute Conveyer Calibration

There are two methods as shown below:

(1) Calculate conveyer tracking parameters (Conveyer CALSET(X,Y), Conveyer CALSET(Z)) based on the layout drawing of the conveyer and then enter the calculated value.

(2) Use the library **CONVCAL** for automatic setting.
The method in (2) above uses actual equipment and its precision is higher than (1). The procedure of (2) is explained in the following section.

2.2.2 Conveyer Calibration Execution Procedure

(1) Setting conveyer tracking parameters

Check whether the following conveyer tracking parameters are set correctly:

a) Encoder Detection
Check that “1” (Valid) is set for this parameter.

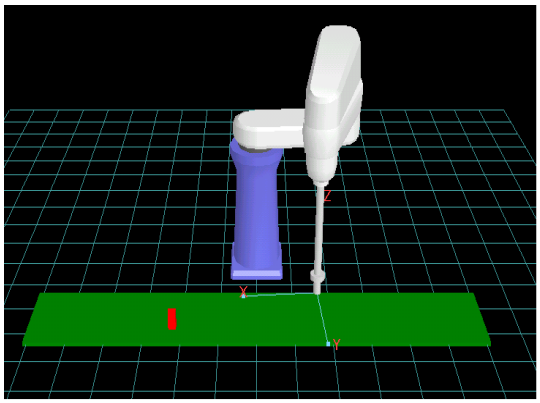
b) Encoder Rotate Direction
Check that when the conveyer operates, the encoder count value is incremented.

c) Encoder Pulse per Round

d) Conveyer Lead for Encoder
Check the conveyer operation amount per rotation of the encoder.

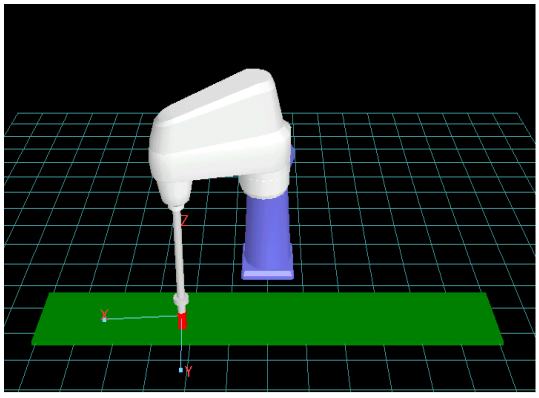
(2) Execution of the conveyer calibration library (**CONVCAL**)

(2-1) Outline of the conveyer calibration library (**CONVCAL**)

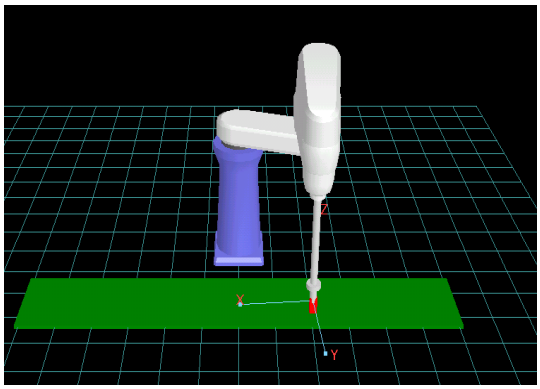


a) Set a reference point on the conveyer (placing a workpiece or a mark).

b) Move the conveyer so that the reference point falls within the robot operation range.



c) Move the robot to the reference point and read the position data by teaching.
(Measurement point 1)



d) Operate the conveyer and move the reference point.

e) Move the robot to the reference point again and read the position data by teaching.
(Measurement point 2)

f) The conveyer calibration data is computed based on the robot positions and encoder values for measurement points 1 and 2.

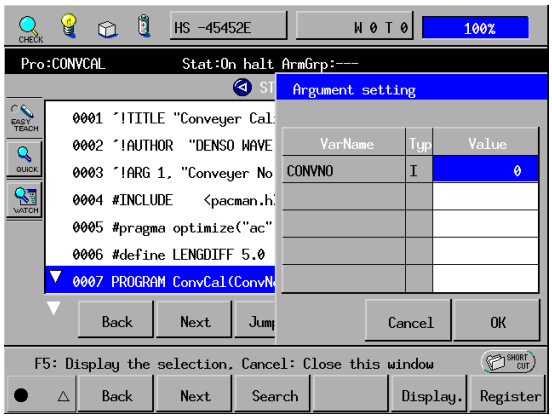
Note: Specify accurate positions for measurement points 1 and 2. If you give rough positions, the tracking operation precision will deteriorate.

(2-2) Execution procedure for the conveyer calibration library (**CONVCAL**)

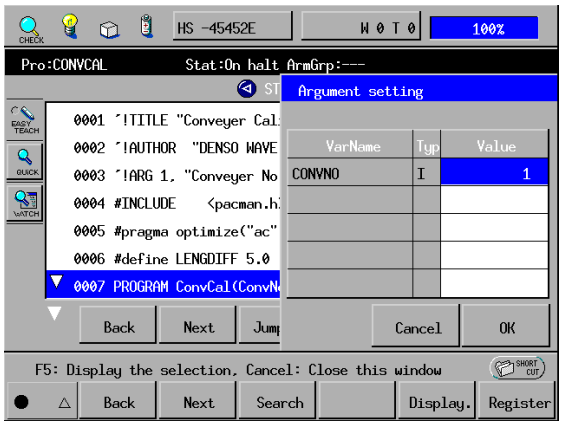
The execution procedure for the conveyer calibration library (**CONVCAL**) is explained below using the pendant screen.

a) Set a reference point on the conveyer and move the conveyer until the reference point comes within the robot operation range. Move the robot manually to the reference point. This position is measurement point 1.

b) Switch to the teach check mode and execute the program **CONVCAL**.
The library argument setting window is displayed.
CONVNO is the conveyer number. Enter the conveyer number for calibration.

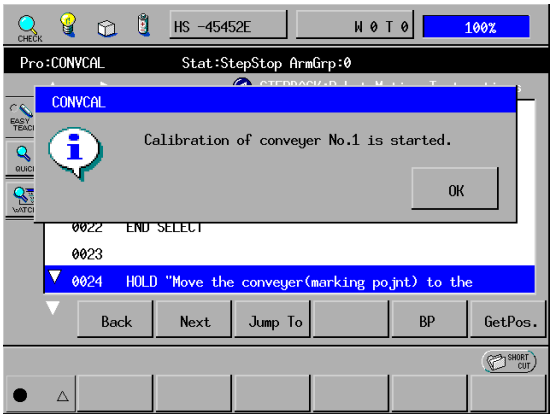


Press “Display”.
The parameter display screen is displayed.
Press “Change” and enter the conveyer number.
Pressing the Cancel key after entering a numeric value will return to the original screen.



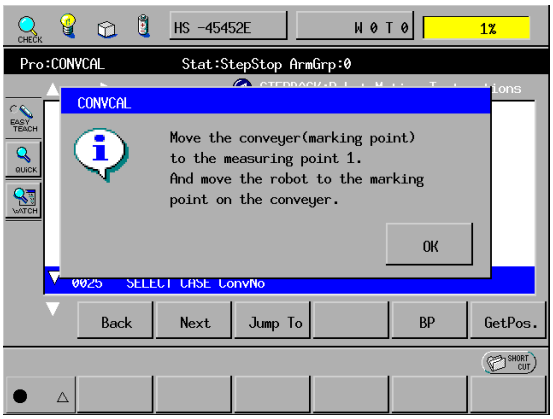
Check that the value of CONVNO is the same as the conveyer number for calibration.

c) Execute the program step by step. After several steps are executed, the following message is displayed:



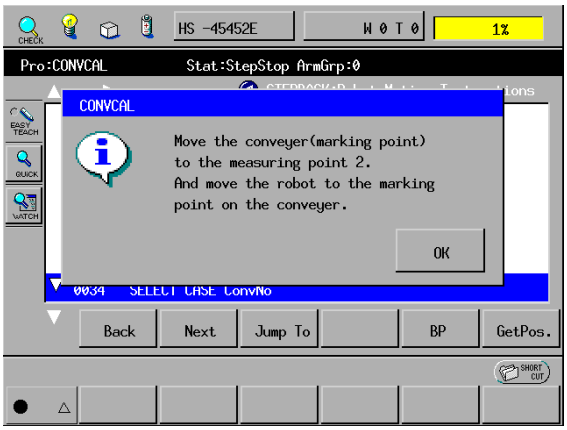
If the conveyer number is set incorrectly, an error is indicated and the program terminates.

d) Execute the library step by step until the following message is displayed:



Confirm that the robot has moved to measurement point 1 and then press OK. If the robot has not reached measurement point 1, switch to the manual mode and move the robot to that point.

e) Execute the library step by step until the following message is displayed:

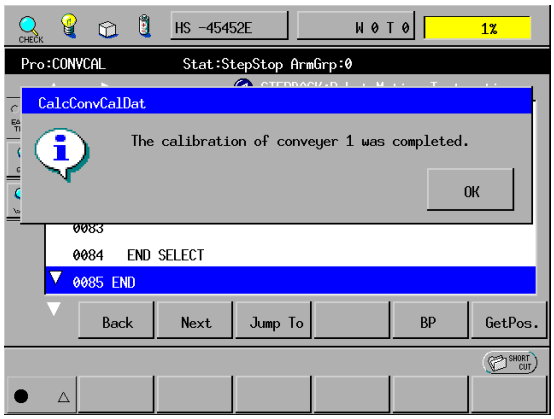


Press OK.

Operate the conveyer to move the reference point. Move it to a position away from measurement point 1 within the robot operation range, and then stop the conveyer.

Switch to the manual mode and move the robot to the reference point. This position is measurement point 2.

f) Switch to the teach check mode and execute the library step by step. When the following message is displayed, conveyer calibration is completed.



If the conveyer tracking parameters (Encoder Pulse per Round, Conveyer Lead for Encoder) are set incorrectly, an error is indicated. In that case, correct the conveyer tracking parameters and execute conveyer calibration once again.

2.3 Camera Calibration

2.3.1 General

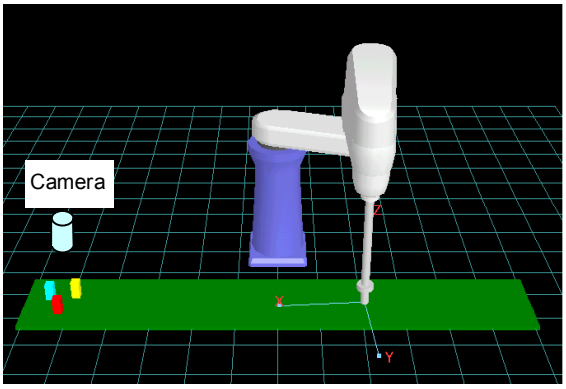
To recognize workpieces with μVision, camera calibration is required. Camera calibration is a task of computing relational formulas between robot coordinates and camera coordinates by using WINCAPS Ⅱ vision manager. (Refer to Section 9.4.5 “Camera CAL” in the WINCAPS Ⅱ Guide for details.)

In camera calibration, the robot is moved to the mark position recognized visually, and the relational formula between the robot coordinates and camera coordinates is computed. However, at the time of conveyer tracking, the visual recognition position may be distant from the robot work position and therefore it may be impossible to move the robot to the mark position recognized visually.
In that case, execute camera calibration in the following procedure using the library CALCCAMCALPOS:

(1) Prepare three calibration marks and make visual recognition.
(2) Operate the conveyer, and when three calibration marks come within the robot operation range, stop the conveyer.
(3) Move the robot to the three calibration mark positions and read the position data by teaching. Based on the conveyer movement amount, convert the teaching position data to the camera recognition position data. Using the conversion result, compute the relational formula between the robot coordinates and the camera coordinates.

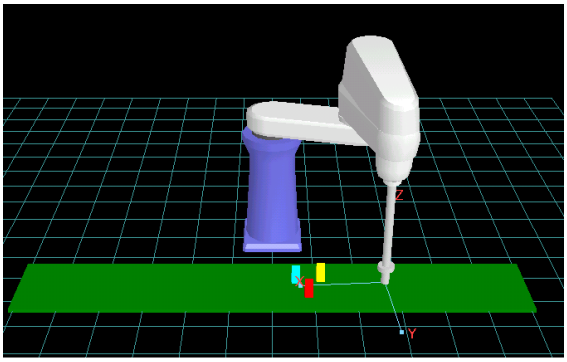
Note: Before executing camera calibration, complete conveyer calibration. If you execute camera calibration with conveyer calibration incomplete, correct results of camera calibration cannot be obtained.

Execution of camera calibration is outlined below.

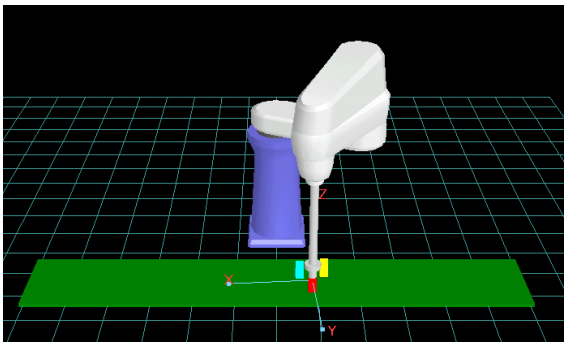


a) Prepare three calibration marks, and visually recognize the calibration marks with the conveyer placed in stop status.

b) Enter the vision coordinates using the camera calibration tool of the Wincaps Ⅱ vision manager.



c) Operate the conveyer, and when the three calibration marks come within the robot operation range, stop the conveyer.



d) Read the position data of three calibration marks by teaching them one by one.

e) Based on the conveyer movement amount, convert the teaching position data to the camera recognition position data. The conversion result is stored in variables.

f) Execute camera calibration using the camera calibration tool of the vision manager.

2.3.2 Execution Procedure for Camera Calibration Library (CALCCAMCALPOS)

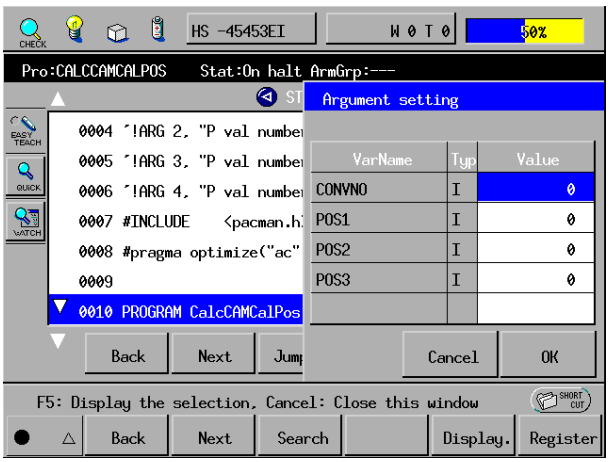
The execution procedure for the camera calibration library (CALCCAMCALPOS) is explained blow using the pendant screen.

a) Prepare three camera calibration marks, and visually recognize the camera calibration marks with the conveyer placed in stop status.

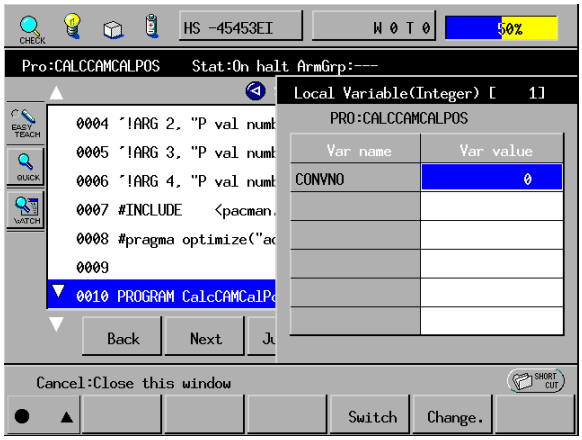
b) Enter camera coordinates using the camera calibration tool of the Wincaps Ⅱ vision manager.

In camera calibration, find the robot coordinates and camera coordinates for each of the three marks and compute the relational formula between the robot coordinates and the camera coordinates. The three marks are called mark 1, mark 2, and mark 3 in the following explanations:

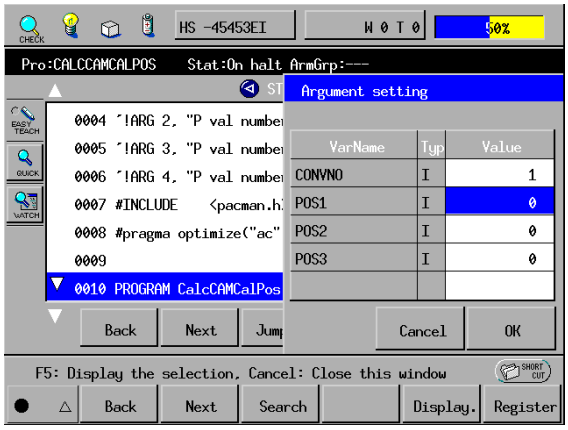
c) Switch to the teach check mode and execute the library CALCCAMCALPOS. The library argument setting window is displayed.



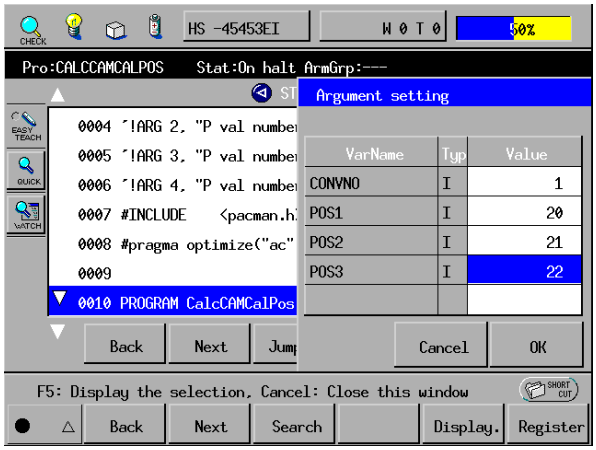
CONVNO is the conveyer number. Enter the conveyer number for calibration.
POS1 is a P-type variable number to store the robot coordinates for mark 1. Likewise, POS2 and POS3 are P-type variable numbers to store the robot coordinates for mark 2 and mark 3, respectively. Set the numbers so that they are stored in separate P-type variables.
Move the cursor to CNVNO and press “Display” to display the parameter display screen.



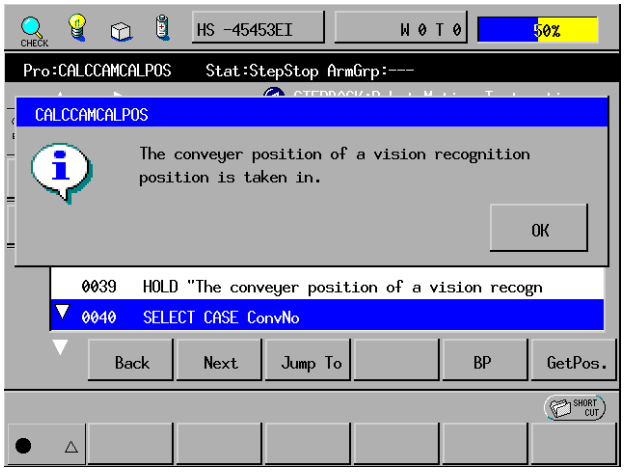
Press “Change” and enter the conveyer number.
Pressing the Cancel key after entering the numeric value returns to the original screen.



Likewise, enter numeric values sequentially by moving the cursor to POS1 to POS3.
Enter all numeric values for CNVNO and POS1 to POS3.
(The diagram below is an example of storing conveyer number 1, and mark 1 in P20, mark 2 in P21 and mark 3 in P22.)

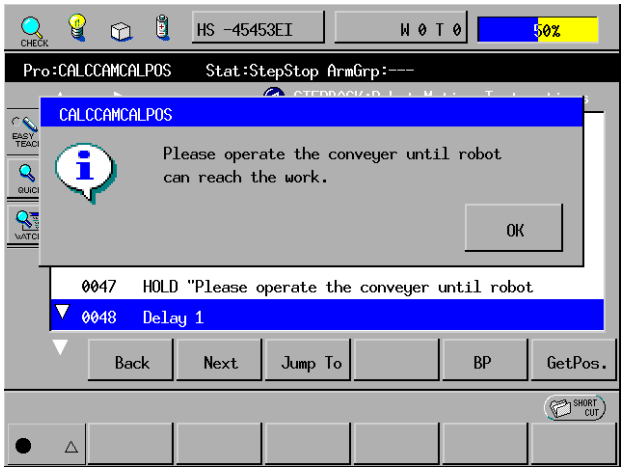


d) Execute the library step by step. When several steps are executed, the following message is displayed:



Confirm that the conveyer is placed in the stop status at the camera calibration mark recognition position, and then press OK. Execute the library step by step continuously.

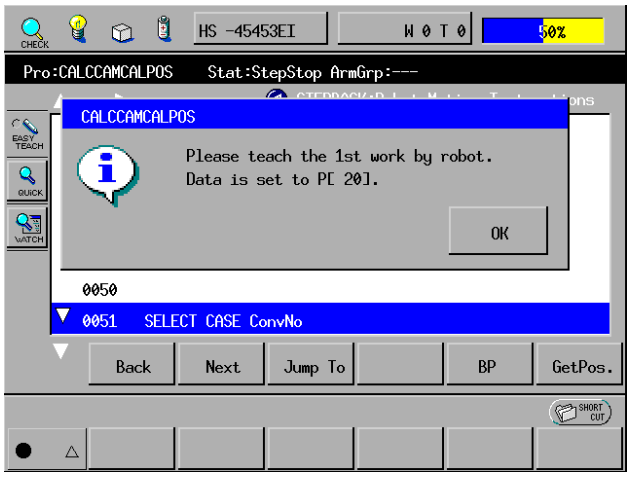
e) Execute the library step by step until the following message is displayed:



Press OK.

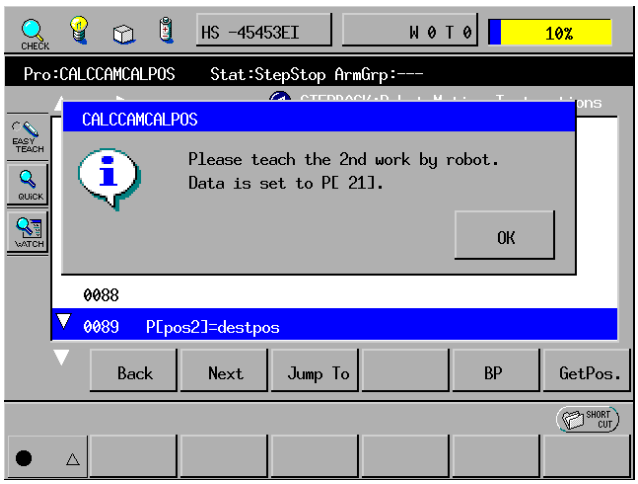
Operate the conveyer, and when the three calibration marks come into the robot operation range, stop the conveyer.

f) Execute the library step by step until the following message is displayed:



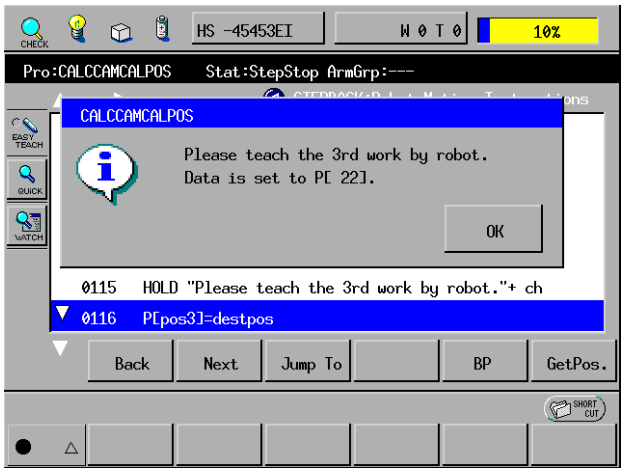
Press OK.
Switch to the manual mode and move the robot to the position of mark 1.
When the movement is completed, switch to the teach check mode again and execute the program step by step.

g) Execute the library step by step until the following message is displayed:



Press OK.
In the same way as for mark 1, switch to the manual mode and move the robot to the position of mark 2.
When the movement is completed, switch to the teach check mode again and execute the program step by step.

h) Execute the library step by step until the following message is displayed:



Press OK.
In the same way as for marks 1 and 2, switch to the manual mode and move the robot to the position of mark 3.
When the movement is completed, switch to the teach check mode again and execute the program step by step.

i) Execute the library to END. The robot coordinates for the calibration marks are computed and the results are stored in the specified P-type variables.
j) Import the stored robot coordinates with the WINCAPS Ⅱ vision manager, and execute the camera calibration. This concludes the calibration.

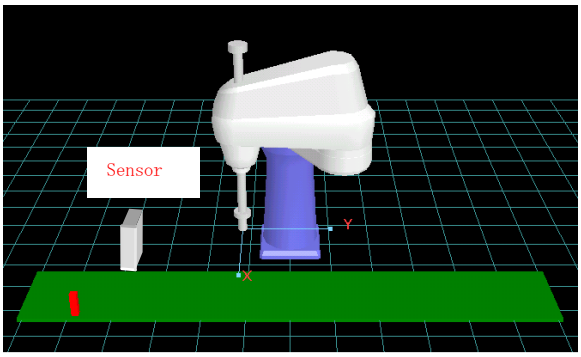
2.4 Teaching of Workpiece Position when Hand I/O Input Interrupt is in Use

2.4.1 General

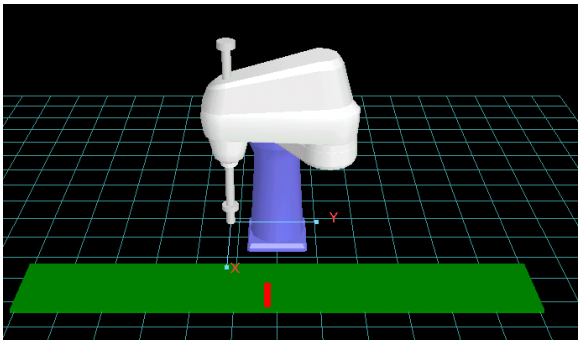
To detect workpieces using Hand I/O input interrupts, it is necessary to teach the workpiece position when it is detected. However, at the time of conveyer tracking, the workpiece detection position may be distant from the robot work position and therefore it may be impossible to move the robot to the workpiece detection position.
In that case, teach the workpiece detection position in the following procedure using the library CalcIOTeachPos:

Note: Before teaching the workpiece position for Hand I/O input interrupts, set conveyer tracking parameters and then execute conveyer calibration.

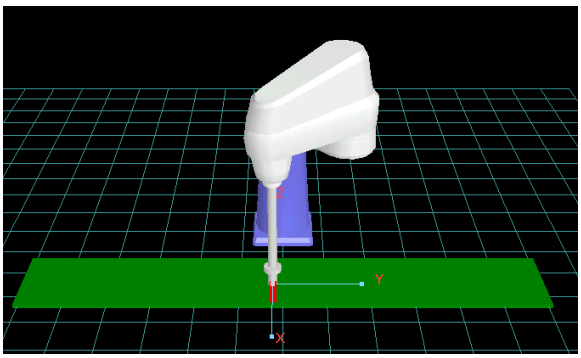
Execution of workpiece position teaching is outlined below.



a) Prepare one workpiece for teaching.
b) Switch to the auto mode
c) Operate the conveyer and detect the workpiece with the sensor.



d) Operate the conveyer, and when the robot operation range is reached, stop the conveyer.

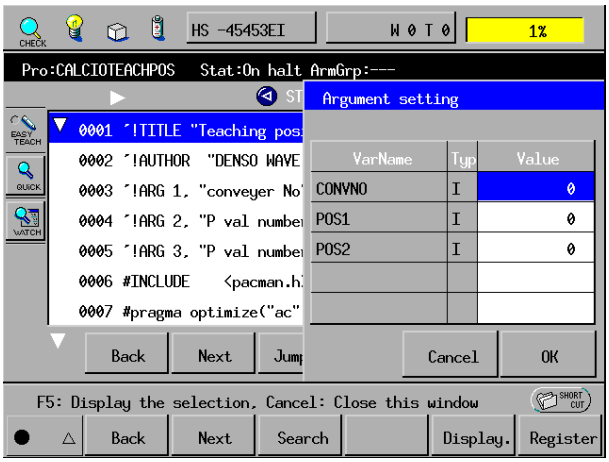


e) Switch to the manual mode and teach the workpiece chucking position.

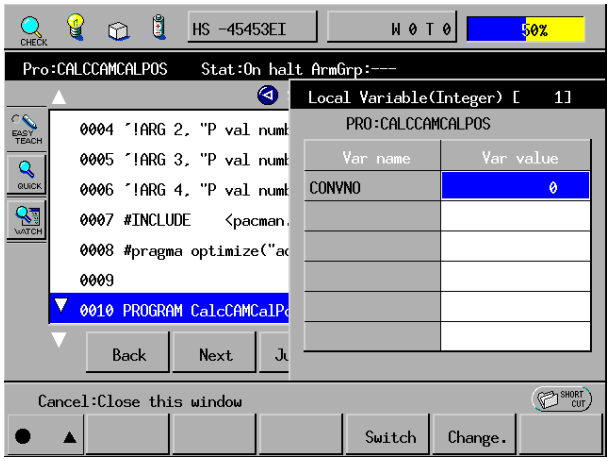
2.4.2 Execution Procedure for the Workpiece Position Teaching Library (CALCIOTEACHPOS)

The execution procedure for the workpiece position teaching library (CALCIOTEACHPOS) is explained below using the pendant screen.

a) Switch to the auto mode and place a workpiece on the conveyer and operate the conveyer. After detecting the workpiece with the sensor, when the workpiece comes within the robot operation range, stop the conveyer.
b) Switch to the manual mode and manually operate the robot to the workpiece holding position.
c) Switch to the teach check mode and execute the library CALCIOTEACHPOS.

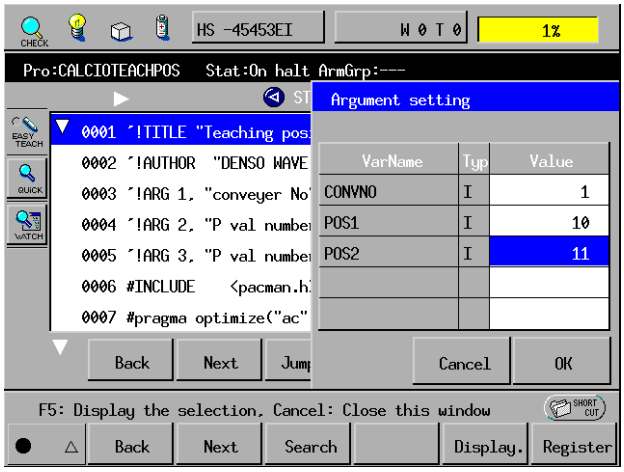


The library argument setting window is displayed. CONVNO is the conveyer number. Enter the conveyer number for calibration.
POS1 is a P-type variable number to store the workpiece position obtained by teaching.
POS2 is a P-type variable number to store the workpiece position when the workpiece is detected by the sensor (Hand I/O input interrupt). Set numbers for POS1 and POS2 in such a way that they are stored in separate P-type variables.
Move the cursor to CNVNO and press “Display” to display the parameter display screen.

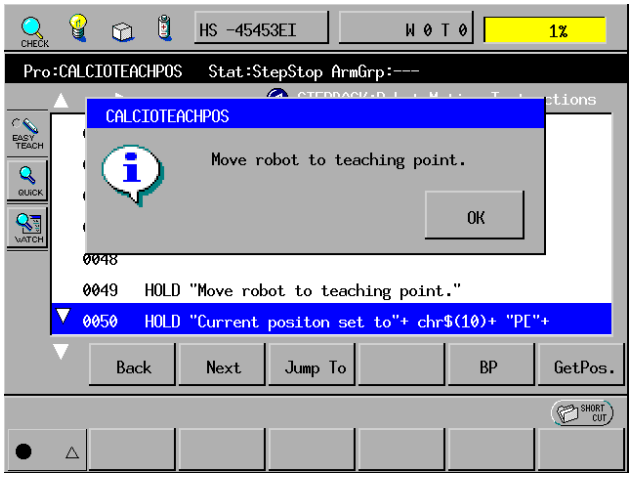


Press “Change” and enter the conveyer number.
Pressing the Cancel key after entering the numeric value returns to the original screen.

Next move the cursor to POS and press “Display”, and set the storage number by pressing “Change”. Change the setting for POS2 too.
Enter all numeric values for CNVNO, POS1 and POS2.
(The diagram on the left is an example of storing conveyer number 1 and workpiece teaching position in P10, and the workpiece position when it is detected in P11.)

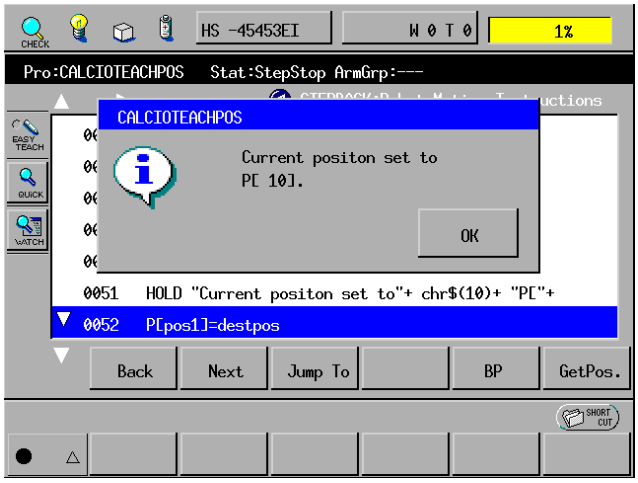


d) Execute the library step by step. When several steps are executed, the following message is displayed:

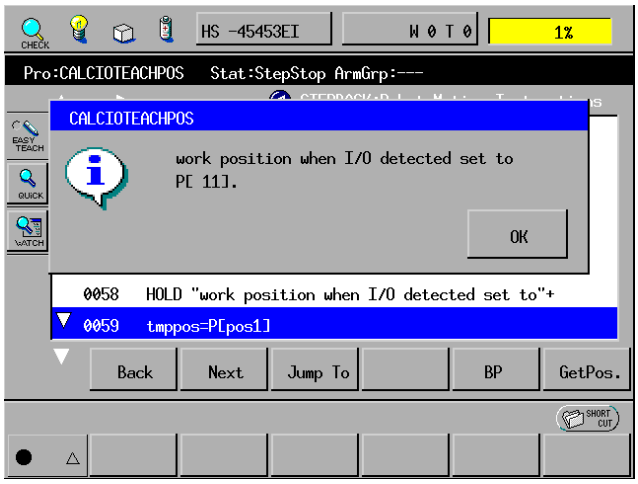


Press OK.
If the robot is not at the workpiece teaching position when the message is displayed, operate the robot manually.
After confirming that the robot is at the workpiece teaching position, execute the library step by step.

e) When the library is executed several steps, the following message is displayed:
The workpiece position is taken into the specified P-type variable.
Press OK, and execute the library step by step.



f) When several steps are executed, the following message is displayed:

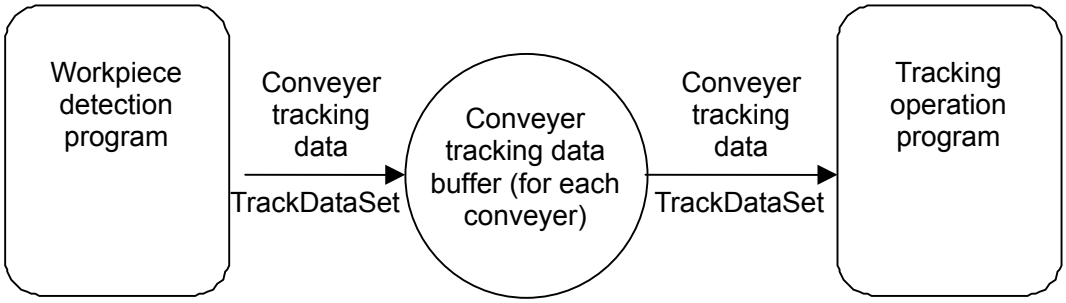


The workpiece position when it is detected is taken into the specified P-type variable
Press OK and continue to execute the library step by step.

g) Execute the library step by step up to the end of the program. When the program is terminated, the setting of teaching positions is completed.

Chapter 3 Conveyer Tracking Program

3.1 General



The conveyer tracking program consists of two programs, the workpiece detection program and tracking operation program, and the conveyer tracking data buffer for storing detected workpiece data. The conveyer tracking data buffer is provided on each conveyer (conveyer 1, conveyer 2).
Tracking data for the conveyer specified by the workpiece detection program is stored in the buffer.
The tracking operation program obtains the tracking data of the specified conveyer and executes tracking operation. Execute the workpiece detection program and the tracking operation program under a multi-task environment.

Cautions at executing the conveyer tracking motion

(1) The conveyer tracking program must be executed in the auto mode. In the teach check mode, conveyer tracking motion is forbidden .
(2) Conveyer tracking motion is stopped when the conveyer tracking program is completed or the mode switch is setted in the manual mode or GIVEARM command is executed.
(3) During tracking operation, do not use the following operation commands:
   a) Encoder value checking operation (@E is assigned to a point from which operation command pass starts)
      An error 6651 “Check command time over” happens if the encoder value checking operation is used.
   b) Operation command changing an operation pattern of a robot
      A robot operation pattern cannot be changed during the tracking operation even at PTP operation. If you execute a command to change the pattern, errors 6844 “Robot posture mismatch (track)” or 667A “Destination position out of motion space 2” happen.
(4) The following functions cannot be used during the tracking operation.
      Current limiting、OffSrvLock、OffPWM
      An error 6847 “Time out of waiting tracking motion” occurs if those functions are used.
(5) If tracking operation stops (stop by motor-OFF, halt, emergent stop and stop by error), the operation returns to the normal mode from the tracking mode and an error 6841 “Interrupted track motion” occurs.
      Note: If tracking operation stops by step stop, the tracking mode continues.
   To start tracking operation again, execute the tracking-enabling command again.

3.2 Program Examples

3.2.1 Workpiece Detection Program

(1) When using μVISION

```
PROGRAM Vision
    DEFPOS VisResult,PosResult
    PosResult=(0,0,240,0,0)

  TrackDataInitialize 1            'Initializing conveyer 1 data buffer
  TAKEVIS
    VISSCREEN 0,0,0
    VISCLS
    VISBRIGHT 221
    VISPLNOUT 0,1
    VISWORKPLN 0
    VISDEFCHAR 2,2,3
    WINDMAKE R,0,510,479,0,2

DO                          'Camera recognition results are always monitored.
      CAMMODE 1,1,1'Set to field take-in, reset function
      CAMIN 1,0,0,1   'Photographing for conveyer 1 ('camera No. 1), conveyer tracking set to
                      Enabled
      VISPLNOUT 0
      BLOB 0,0,0,1,125,255,1,2000,0
      Label%=0
      IF VISSTATUS(0)=0 THEN          'Recognition terminated normally
        IF VISSTATUS(1)<>0 THEN
          Label%=VISSTATUS(1)
          SHMODEL 0,0,0,3,80,0,Label%,0,0
          IF VISSTATUS(0)=0 THEN
            cnt%=VISGETNUM(0,0)     'The number of recognized workpieces obtained
            FOR cnt1%=1 TO cnt%
              'Camera coordinates converted to robot coordinates
               LETX VisResult=VISGETNUM(cnt1%-1,1)
               LETY VisResult=VISGETNUM(cnt1%-1,2)
               CALL viTran6(0, POSX(VisResult),POSY(VisResult),PosResult)
              'Data on recognized workpieces is saved to the conveyer tracking data buffer
               TrackDataSet 1,cnt%,PosResult
            NEXT
          ENDIF
        ENDIF
      ENDIF
  LOOP UNTIL IO[220]=ON     'Repeated until the workpiece recognition processing termination
                            signal is ON
END
```

(2) When using a Hand I/O input interrupt

```
PROGRAM IODetect
 TrackDataInitialize 1          'Initializing conveyer 1 data buffer
 DO                             'Workpiece recognition results are always monitored
    'The detected workpiece data is saved to the conveyer tracking data buffer
    'The number of detected workpieces is determined within TrackDataSet
    TrackDataSet 1,1,P1         'P indicates the position where the workpiece is detected
                                (computation result of CaIcIOteachPos)
    Delay 200                   'Waiting for 0.2(s)m
 LOOP UNTIL IO[220]=ON          'Repeated until the workpiece recognition processing termination
                                signal (such as 220) is ON
END
```

(3) When using an external visual equipment

For the Interrupt data setting of conveyer tracking parameters, set the value to 1 when using an external visual equipment. The sample program using RS-232C is shown as follows.

```
PROGRAM ExtVision

DEFINT ErrNo = 0
DEFSNG VisData(4),Masterang
DEFPOS VisResult
PosResult=(0,0,240,0,0)
TrackDataInitialize 0
TAKEVIS
FLUSH #1                                'Initializing serial communication buffer

DO
  LINEINPUT #1,S[1]                     'Receiving visual data via RS-232C
  cnt% = VAL(LEFT$(S1,1))               'Obtaining the number of recognized workpieces
    IF cnt% <> 0 THEN                   'When the number of recognized workpieces is except 0
     TmpBuff$ = MID$(S1,3,LEN(S1)-2)
     TmpBuff$ = TmpBuff$ + ",E"
     FOR cnt1%=1 TO cnt%
        FOR cnt2%=1 TO 3
           ii% = STRPOS(TmpBuff$,",")       'Comma "," searching
             IF ii% = 0 THEN                'When data is abnormal
              ErrNo = 2                     'Setting data error flag
              EXIT FOR
           END IF
           VisData(cnt2%) = VAL(LEFT$(TmpBuff$,ii%-1))      'Sampling data
           IF VisData(cnt2%) >= 999.0 THEN                  'When data is abnormal'
              ErrNo = 3                                     'Setting data error flag
              EXIT FOR
           END IF
           TmpBuff$ = MID$(TmpBuff$,ii%+1,LEN(TmpBuff$)-ii%)
        NEXT cnt2%
        LETX VisResult = VisData(1)                         'Assigns X element
        LETY VisResult = VisData(2)                         'Assigns Y element
        CALL viTran6_s(POSX(VisResult),POSY(VisResult),PosResult)  'Converts to robot coordinate
        TrackDataSet 1,cnt%,PosResult                       'The recognized workpiece data is
                                                             saved in the conveyer tracking buffer
```

```
        NEXT cnt1%
      END IF
   LOOP UNTIL IO[220]=ON          'Repeats until the end signal of recognizing workpiece outputs ON
GIVEVIS

END
```

3.2.2 Tracking Operation Program

```
   PROGRAM Main
     DEFPOS PassPos

     RUN IODetect        'Executing the workpiece detection program under a multi-mask environment
     TAKEARM
     MOVE P,P10,S=20                    'P10 Home Position
     DO
          IF TrackDataNum(1)>0 THEN          'If the conveyer tracking data buffer has data,
            'data is obtained from the conveyer tracking data buffer
            TrackDataGet 1,0,rest%,P11
            IF rest%>=0 THEN          'When workpiece data is obtained normally
               LETZ P11=F11           'Set a position in the direction of Z.
               LETT P11=0             'Set a posture at the tracking operation. (Note 1)
               LETF P11=1             'Set a robot figure at the tracking operation.

               VEL!=CurTrackSpd(1)

               CALL SetTrackStartArea(1,VEL!*F13,1000)   'The tracking start range is changed
                                                          according to the conveyer speed
               WAITTRACKMOVE 1,P11,30   'Waiting until the workpiece subject to tracking reaches the
                                         tracking start range
              PassPos=CurTrackPos( 1,P11,1)  'Obtaining the operation terminating position in the case
                                              of PTP operation for the workpiece subject to tracking
               LETZ PassPos=F11+70
               MOVE P,@P PassPos,S=100
               CALL SetTrackMove(1)          'Conveyer 1 tracking is effective
               APPROACH P,P11,@P 70,S=100
               MOVE P,P11,S=100

               DELAY 100                    'Chucking a workpiece
               DEPART P,@P 30,S=100
               CALL ResetTrackMove          'Canceling conveyer 1 tracking

               APPROACH P,P21,30,S=100
               MOVE P,@E P21,S=100          'Position where the workpiece is ejected
               DEPART P,@P 70,S=100
            ENDIF
     ENDIF
    LOOP UNTIL IO[128]=ON   'Repeated while the tracking operation signal (such as 128) is ON
END
```

Note 1: (1) If the robot is a six-axis type, set a posture at the tracking operation as follows.

```
LETTR P11=RVEC(P20)          'P20: The position and figure on the robot working
```

(2) When using a Hand I/O input interrupt, this command is not necssarry.

3.3 Program Confirmation Procedure

(1) Check the encoder count value.

Operate the conveyer and check the conveyer tracking parameter “Encoder current position”. Confirm that the value changes according to the conveyer operation.

(2) Check the encoder count value when a workpiece is detected.

Switch to the auto mode. Then, operate the conveyer and check “Encoder stand. Pos. (Work detect.). Confirm that the value changes every time a workpiece is detected.

(3) Check the workpiece detection program.

(3-1) Execute the workpiece detection program and let workpieces flow on the conveyer. Count the number of workpieces visually at this time.

(3-2) Stop the conveyer.

(3-3) Execute the following program and check the number of data items within the conveyer tracking data buffer:

```
PROGRAM CHKBUFNUM
 I50=TrackDataNum(1)      ‘For conveyer 1, I50: Assign an unused I-type variable.
 END
```

The number of data items within the conveyer tracking data buffer is set in “I50”. Check the value in “I50” and confirm that it matches the number of detected workpieces that was confirmed visually.

(4) Set operation inhibiting areas.

The conveyer tracking operation may sometimes travel to an unexpected position because of a programming mistake. Use the area function to set operation inhibited area.

(5) Check the conveyer tracking operation.

Move the robot near the center of the conveyer and execute the following program. Confirm that the robot follows the conveyer.

When conveyer tracking speed and conveyer speed deviate from each other.

Check the encoder lead amount of conveyer tracking parameter.

When conveyer tracking direction and conveyer moving direction deviate from each other.

Execute conveyer calibration again.

```
PROGRAM CHKCONVEYERTRACK
TakeArm
CALL SetTrackMove(1)
DELAY 1000          ‘Following conveyer 1 for 1(s)
CALL ResetTrackMove
END
```

If the robot gets out of the operation range while following the conveyer, an error occurs.

If the robot moves to a position outside the tracking range that was set in the conveyer tracking parameters “Conveyer Track Upper Pos. (mm)” and “Conveyer Track Lower Pos. (mm)”, an error occurs.

(6) Check the tracking operation using the workpiece to be detected.

Check the tracking operation using one detected workpiece.

Start with low conveyer speed and robot speed and increase each speed gradually.

Use the following program to confirm tracking of the workpiece to be detected.

```
PROGRAM CHKWORKTRACK
    DEFPOS PassPos
    RUN IODetect          'Executing the workpiece detection program under a multi-mask
environment
    TAKEARM
    MOVE P,P10,S=20                'P10 Home Position

    DO
        IF TrackDataNum(1)>0 THEN        'If the conveyer tracking data buffer has data,
          'data is obtained from the conveyer tracking data buffer
          TrackDataGet 1,0,rest%,P11
          IF rest%>=0 THEN          'When workpiece data is obtained normally
             LETZ P11=F11           'Set a position in the direction of Z (50 mm above the conveyer).
             LETT P11=0             'Set a posture at the tracking operation. (Note 1)
             LETF P11=1             'Set a robot figure at the tracking operation.
           'The tracking starts when the workpiece reaches the conveyer position 0
            CALL SetTrackStartArea(1,0,1000)
            WAITTRACKMOVE 1,P11,30
           PassPos=CurTrackPos( 1,P11,1)  'Obtaining the operation terminating position in the case
                                           of PTP operation for the workpiece subject to tracking
           LETZ PassPos=F11
           MOVE P,PassPos

           CALL SetTrackMove(1)         'Conveyer 1 tracking is effective
           MOVE P,P11
           DELAY 1000                   'Following the workpiece for 1(s)
           CALL ResetTrackMove          'Canceling conveyer 1 tracking

           MOVE P, P21                  'Position where the workpiece is ejected
        ENDIF
    ENDIF
  LOOP
END
```

Note 1: (1) If the robot is a six-axis type, set a posture at the tracking operation as follows.

LETTR P11=RVEC(P20) 'P20: The position and figure on the robot working

(2) When using a Hand I/O input interrupt, this command is not necssarry.

(7) Execute the tracking operation program.

Start with low conveyer speed and robot speed, and increase each speed gradually.

Start with one workpiece and increase the number of workpieces gradually.

Reduce the workpiece interval gradually.

3.4 Conveyer Tracking Accuracy Checking Procedures

3.4.1 Encoder Installation Check

Check encoder and conveyer rotation for any slip or looseness between them. Correct any slip or looseness if found.

3.4.2 When Visual Equipment is Used (μVISION Board, External Visual Equipment)

(1) Calibration and teaching operation checking procedure

(1-1) Place a workpiece on a conveyer at a position within a visual recognition area, and execute the visual recognition checking program (CheckVision). For the visual recognition checking program (CheckVision), refer to the program example 1.

(1-2) Move the conveyer until the workpiece enters into both the robot movable area and the tracking operation area, and stop the conveyer.

(1-3) Set the robot operation speed to low (SP10 or less) and execute the tracking checking program (CheckTracking). Set the timer (I30 in the program) to a value 200 (0.2(s)) or more after the chuck position moving command is executed. For the tracking checking program (CheckTracking), refer to the program example 2.

(1-4) If the workpiece chucking position is correct, go to the procedure (2); if any deviation is found in the chucking position, go to the procedure (1-5).

(1-5) Check if the conveyer calibration result is correct by referring to “(5) Check the conveyer tracking operation” in “3.3 Program confirmation procedures”. If any deviation is found in the conveyer calibration, execute the conveyer calibration again by referring to “2.2 Conveyer Calibration”.

(1-6) Check if the visual recognition checking program (CheckVision) is correct. As shown in the program example 1, assign the visual recognition checking result to the P-type variable and check the value of the P-type variable (P22).

(1-7) Check if the tracking operation program (CheckTracking) is correct. As shown in the program example 2, assign the tracking operation position to the P-type variable (P11) and check the value of the P-type variable.

(1-8) If no problem was found in the procedures (1-6) and (1-7), execute the camera calibration again by referring to the “2.3 Camera Calibration”. After the calibration, start the procedures again from (1-1).

(1-9) If the deviation in the workpiece chucking position cannot be corrected, correct the position to the conveyer operation direction as shown in the position correcting program (PosAdjust) in the program example 4.

(2) Robot speed-increase checking operation

(2-1) Execute the procedures (1-1)-(1-3) while increasing the robot speed gradually.

(2-2) If the workpiece chucking position deviates from normal position as the speed increases, increase the timer value (I30 in CheckTracking) after the chuck position moving command is executed.

(3) Workpiece recognition process check

(3-1) Set the conveyer tracking parameter “Workpiece detection position accuracy” to 2 mm (the same value as operation accuracy).

(3-2) Place a workpiece on a conveyer at a position within a visual recognition area, and execute the workpiece detection program (Vision). For the workpiece detection program (Vision), refer to “3.2.1 Workpiece detection program”.

(3-3) Move the conveyer until the workpiece moves out of the visual recognition area.

(3-4) Terminate the workpiece detection program (Vision), and execute a program (CHKBUFNUM) for checking the number of data in the conveyer tracking data buffer. Verify the number of data (I50) is 1. For the data count program (CHKBUFNUM), refer to “(3) Check the workpiece detection program” of “3.3 Program Confirmation Procedure”.

(3-5) Repeat the procedures (3-2)-(3-4) several times. If the number of data is 1 for all the checks, go to the procedure (3-12); if not, go to (3-6).

(3-6) Place a workpiece on a conveyer at a position within a visual recognition area, and execute the workpiece detection program (Vision) without moving the conveyer.

(3-7) After a while, the workpiece detection program (Vision) terminates. Verify that the number of data (I50 in CHKBUFNUM) is 1 by executing the program (CHKBUFNUM) for checking the number of data in the conveyer tracking data buffer.

(3-8) Verify the number of data is 1 by repeating the procedures (3-6)-(3-7) several times. If the number of data is 1, go to (3-9); otherwise, the image processing program has a problem. Check the image processing program.

(3-9) When the μVision board is used, check the camera settings to see if the field shutter function and the restart/reset function are turned on. Check that both the 1st and 2nd parameters of CAMMODE command are 1 and that the 4th parameter of CAMIN command is 1. Refer to “1.6 Camera Setting when μVISON is in Use”.

(3-10) For external visual equipment, check that the hand I/O interrupt signal is the shutter-on signal (image-capturing start signal). If any delay is found between the shutter-on signal and image-pickup, set the conveyer tracking parameter “Interrupt delay correction value” to the delay time.

(3-11) Execute the procedures (3-2)-(3-5) again.

(3-12) Restore the conveyer tracking parameter “Workpiece detection position accuracy” to an original value.

(4) Conveyer speed-increase checking operation

(4-1) Set the timer (I30), in the tracking operation program (Main), to a value adjusted in (2) after the chuck position moving command is executed. For the tracking operation program (Main), refer to “3.2.2 Tracking operation program”. (The example of workpiece detection program is named as IODetect (RUN IODetect). Change the name to “Vision (RUN Vision)).

(4-2) Set both the robot speed and conveyer speed to low, and execute the tracking operation program (Main).

(4-3) Placing a workpiece on a conveyer, move the conveyer to check the tracking operation and the workpiece chucking position. If something is wrong with the tracking operation, check if the tracking operation program is correct.

(4-4) Execute the procedure (4-3), while keeping the conveyer speed at low and increasing robot speed. If the workpiece chucking position deviates depending on the robot speed, adjust the timer (I30 in Main) after the chuck position moving command is executed.

(4-5) Increasing the conveyer speed gradually, check the workpiece chucking position. If the workpiece chucking position deviates from normal position as the conveyer speed increases, adjust the conveyer tracking parameter “Tracking position adjustment value”.
However, a limitation to the chuck position accuracy is (conveyer speed (mm/s) $\times$ 0.008) (mm) + a value equivalent to the camera pixels.

3.4.3 When Position is Recognized by a Sensor (Hand I/O Interrupt)

(1) Calibration and teaching operation checking procedures

(1-0) Execute the tracking data initialize program (DataInitialize).

(1-1) Place a workpiece upstream from a sensor on a conveyer. Change the operation mode to automatic and start the conveyer at low speed. Detect the workpiece position using a sensor while the conveyer is at operation.

(1-2) Move the conveyer until the workpiece enters into both the robot movable area and the tracking operation area, and stop the conveyer.

(1-3) Execute the hand I/O interrupt checking program (CheckIODetect). For the hand I/O interrupt checking program (CheckIODetect), refer to the program example 3.

(1-4) Setting the robot operation speed to low (SP10 or less), execute the tracking checking program (CheckTracking). Set the timer (I30 in CheckTracking) to a value 200 (0.2(s)) or more after the chuck position moving command is executed. For the tracking checking program (CheckTracking), refer to the program example 2.

(1-5) If the workpiece chucking position is correct, go to the procedures (2); if any deviation is found in the chucking position, go to the procedure (1-6).

(1-6) Check if the conveyer calibration is correct by referring to “(5) Check the conveyer tracking operation” in “3.3 Program confirmation procedures”. If any deviation is found in the conveyer calibration, execute the conveyer calibration again.

(1-7) Check the hand I/O interrupt checking program (CheckIODetect) for any abnormality. As shown in the program example 3, assign the workpiece detection position result to the P-type variable, and check the value of the P-type variable.

(1-8) Check the tracking operation program (CheckTracking) for any abnormality. As shown in the program example 2, assign the tracking operation position to the P-type variable, and check the value of the P-type variable.

(1-9) Perform again the workpiece position teaching when the hand I/O interrupt is executed. Refer to “2.4 Teaching of Workpiece Position when Hand I/O Input Interrupt is in Use”. Start the procedures from (1-1) again.

(1-10) If the deviation in the workpiece chucking position cannot be corrected, correct the position to the conveyer operation direction as shown in the position correcting program (PosAdjust) as shown in the program example 3.

(2) Robot speed-increase checking operation

(2-1) Execute the procedures (1-1)-(1-4) while increasing the robot speed gradually.

(2-2) If the workpiece chucking position deviates from normal position as the speed increases, increase the timer value (I30 in CheckTracking) after the chuck position moving command is executed.

(3) Workpiece recognition process check

(3-1) Set the conveyer tracking parameter “Workpiece detection position accuracy” to 2 mm (the same value as operation accuracy).

(3-2) Place a workpiece upstream from a sensor on a conveyer. Execute the workpiece detection program (IODetect) and detect the workpiece using the sensor. For the workpiece detection program (IODetect), refer to “(2) When using a Hand I/O input interrupt” in “3.2.1 Workpiece detection program”.

(3-3) Verify that the number of data is 1 by executing a program (CHKBUFNUM) for checking the number of data in the conveyer tracking data buffer. For the data count program (CHKBUFNUM), refer to “(3) Check the workpiece detection program” of “3.3 Program Confirmation Procedure”.

(3-4) Execute the procedures (3-2) and (3-3) several times while increasing the conveyer speed gradually. There is no problem if the number of data is 1. Restore the conveyer tracking parameter “Workpiece detection position accuracy” to an original value and go to the procedures (4); if not, go to the procedure (3-5).

(3-5) Check if the sensor signal has been turned on more than once for the same workpiece. If so, adjust the layout of the sensor or others. If chattering is found to happen in the sensor signal, set the conveyer tracking parameter “Workpiece detection position accuracy” to the following value or lower to neglect the chattering zone.

“Workpiece detection position accuracy” > Conveyer moving distance in the chattering zone

(3-6) If the number of detected data increases as the conveyer speed increases, check the conveyer tracking parameter “Interrupt timing”. Whenever the “Interrupt timing” is changed, teach again the workpiece position when an I/O interrupt occurs. Refer to “2.4 Teaching of Workpiece Position when Hand I/O Input Interrupt is in Use”.

(3-7) Execute the procedures (3-2)-(3-4) again.

(4) Conveyer speed-increase checking operation

(4-1) Set the timer (I30), in the tracking operation program (Main), to a value adjusted in (2) after the chuck position moving command is executed. For the tracking operation program (Main), refer to “3.2.2 Tracking operation program”.

(4-2) Set both robot speed and conveyer speed to low, and execute the tracking operation program (Main).

(4-3) Placing a workpiece on a conveyer, move the conveyer to check the tracking operation and the workpiece chucking position. If something is wrong with the tracking operation, check if the tracking operation program is correct.

(4-4) Execute the procedure (4-3) keeping the conveyer speed at low while increasing robot speed. If the workpiece chucking position deviates depending on the robot speed, adjust the timer (I30 in Main) after the chuck position moving command is executed.

(4-5) Increasing the conveyer speed gradually, check the workpiece chucking position. If the workpiece chucking position deviates from normal position as the conveyer speed increases, adjust the conveyer tracking parameter “Tracking position adjustment value”. However, a limitation to the chuck position accuracy is (conveyer speed (mm/s) $\times$ 0.008) (mm).

3.5 Tact time Decreasing Operation

(1) Adjust the conveyer tracking parameter “Tracking acceleration rate”. Refer to “(14) Tracking acceleration rate” in “2.1.2 Detailed explanation of parameters”.

(2) A wait is produced when the conveyer tracking mode switching operation (CALL SetTrackMove or CALL ResetTrackMove) is executed. Decrease the wait using the pass operation or NEXT operation.

(3) As shown in the program example 5 (PassMove), if you operate the conveyer based on a prediction using CurTrackPos command, the operation command (APPROACH P,P11,@P 70 in PassMove) becomes a moving command for very small distance and the pass operation becomes an ending operation. Use the position corrected to the conveyer predicted operation position as a point to be gone through.

(4) To decrease a tact time by decreasing the timer (I30 in Main) after the chuck position moving command is executed, adjust the conveyer tracking parameter “Tracking position adjustment value”. The maximum value of the conveyer tracking parameter “Tracking position adjustment value” is 50. If the chuck position deviates upper stream even when the parameter is set to the maximum value, shift the position obtained with TrackDataSet toward conveyer operation direction as shown in the program example 4 (PosAdjust).

3.6 Program Examples

(1) Program example 1 Visual recognition checking program

```
PROGRAM CheckVision
DEFPOS VisResult,PosResult
PosResult=(0,0,240,0,0)
TrackDataInitialize 1              'Initialize conveyer 1 data buffer
TAKEVIS
VISSCREEN 0,0,0
VISCLS
VISBRIGHT 221
VISPLNOUT 0,1
VISWORKPLN 0
VISDEFCHAR 2,2,3
CAMMODE 1,1,1                      'Resetting function, set for importing fields
WINDMAKE R,0,510,479,0,2
CAMIN 1,0,0,1                      'Shoot with conveyer 1 (No.1) camera; Enable conveyer tracking.
VISPLNOUT 0
BLOB 0,0,0,1,125,254,1,2000,0
Label%=0
IF VISSTATUS(0)=0 THEN             'Visual recognition terminates normally.
    IF VISSTATUS(1)<>0 THEN
        Label%=VISSTATUS(1)
        SHMODEL 0,0,0,3,80,0,Label%,0,0
        cnt%=VISGETNUM(0,0)        'Obtain the number of workpieces recognized.
        FOR cnt1%=1 TO cnt%
            'Convert Camera coordinates to Robot coordinates.
            LETX VisResult=VISGETNUM(cnt1%-1,1)
            LETY VisResult=VISGETNUM(cnt1%-1,2)
            CALL viTran6(0, POSX(VisResult),POSY(VisResult),PosResult)
            'Store recognized workpiece data into conveyer tracking data buffer.
            TrackDataSet 1,cnt%,PosResult
        NEXT
    ENDIF
ENDIF
END
```

(2) Program example 2　Visual recognition checking program

```
PROGRAM CheckTracking
DEFPOS PassPos
TAKEARM
MOVE P,P10,S=20                    'P10 Home Position

IF TrackDataNum(1)>0 THEN          'If data exists in conveyer tracking data buffer,
  TrackDataGet 1,0,rest%,P11       'obtain data from conveyer tracking data buffer.
  IF rest%>=0 THEN                 'When workpiece data is obtained normally.
    LETZ P11=F11                   'Set a position in the direction of Z.
    LETT P11=0                     'Set a posture at the tracking operation. (Note 1)
    LETF P11=1                     'Set a robot figure at the tracking operation.
    WAITTRACKMOVE 1,P11,30         'Wait until target workpiece enters into tracking start area.
    PassPos=CurTrackPos( 1,P11,1)  'Obtain operation termination position when PTP motion
                                   is carried out to a tracking-target workpiece position.
     LETZ PassPos=F11+70
     MOVE P,@P PassPos
     CALL SetTrackMove(1)          'Conveyer 1 tracking is enabled.
     APPROACH P,P11,@P 70
     MOVE P,P11
     DELAY I30
     CALL  HandChuck               'Workpiece chuck
     DEPART P,@P 30
     CALL ResetTrackMove           'Conveyer 1 tracking is released.
     APPROACH P,P21,30
     MOVE P,@E P21                 'P21: Workpiece output position
   ENDIF
 ENDIF
END
```

Note 1: (1) If the robot is a six-axis type, set a posture at the tracking operation as follows.

```
LETTR P11=RVEC(P20)          'P20: The position and figure on the robot working
```

(2) When using a Hand I/O input interrupt, this command is not necssarry.

(3) Program example 3　Hand I/O interrupt checking program

```
PROGRAM CheckIODetect
TrackDataSet 1,1,P100              'P100 is a workpiece detecting position (Calculation result
                                   of CalcIOteachPos)
END


PROGRAM DataInitalize
TrackDataInitialize 1              'Initialize conveyer 1 data buffer.
END
```

(4) Program example 4　Position correction program

```
PROGRAM PosAdjust
DEFVEC CnvVec
 IF TrackDataNum(1)>0 THEN              'If data exists in conveyer tracking data buffer,
      'obtain data from conveyer tracking buffer.
      TrackDataGet 1,0,rest%,P11
      IF rest%>=0 THEN                  'When workpiece data is obtained normally
          VEL!=CurTrackSpd(1)           'Obtain conveyer speed (mm/s).
          CALL  CalcConvVec(1,CnvVec)   'Calculate conveyer 1 vector in operation direction.
          'F99: Correction coefficient for conveyer speed
          LETX P11=POSX(P11)+POSX(CnvVec)*VEL!*F99
          LETY P11=POSY(P11)+POSY(CnvVec)*VEL!*F99
          LETZ P11=F11                  'Set a position in the direction of Z.
          LETT P11=0                    'Set a posture at the tracking operation. (Note 1)
          LETF P11=1                    'Set a robot figure at the tracking operation.
       ENDIF
    ENDIF
END
```

(5) Program example 5　Pass operation program

```
 PROGRAM PassMove
DEFPOS PassPos

IF TrackDataNum(1)>0 THEN           'If data exists in conveyer tracking data buffer,
   TrackDataGet 1,0,rest%,P11       'obtain data from conveyer tracking buffer.
    IF rest%>=0 THEN                'When workpiece data is obtained normally
        LETZ P11=F11                'Set a position in the direction of Z.
        LETT P11=0                  'Set a posture at the tracking operation. (Note 1)
        LETF P11=1                  'Set a robot figure at the tracking operation.
        WAITTRACKMOVE 1,P11,30      'Wait until target workpiece enters into tracking start area.
        PassPos=CurTrackPos( 1,P11,1)   'Obtain operation termination position when PTP
                                        motion is carried out to a tracking-target workpiece
                                        position.
         LETZ PassPos=F11+70
         MOVE P,@P PassPos
         CALL SetTrackMove(1)       'Conveyer 1 tracking is enabled.
         APPROACH P,P11,@P 70
         MOVE P,P11
         DELAY I30
         CALL  HandChuck            'Workpiece chuck
         DEPART P,@P 30
         CALL ResetTrackMove        'Conveyer 1 tracking is released.
         APPROACH P,P21,30
         MOVE P,@E P21              'P21: Workpiece output position
       ENDIF
  ENDIF
END
```

Note 1: (1) If the robot is a six-axis type, set a posture at the tracking operation as follows.

```
LETTR P11=RVEC(P20)          'P20: The position and figure on the robot working
```

(2) When using a Hand I/O input interrupt, this command is not necssarry.

TRACKDATAINITIALIZE (statement)

Function

Initializes data within the conveyer tracking data buffer

Format

TRACKDATAINITIALIZE <**Initialization mode**>

Explanation

This command initializes data within the conveyer tracking data buffer. Specify the initialization content with <**initialization mode**>.
Initialization mode value
0: Initializes conveyer-1 and conveyer-2 data.
1: Initializes only conveyer-1 data.
2: Initializes only conveyer-2 data.

Related item

TRACKDATASET

Example

```
PROGRAM PRO1
TRACKDATAINITIALIZE 0 ‘Initializing conveyer-1 and conveyer-2 data
END
```

Notes

Execution of TRACKDATAINITIALIZE erases the data saved with TRACKDATASET.

TRACKDATASET (statement)

Function

Saves data in the conveyer tracking buffer.

Format

TRACKDATASET <**conveyer_number**>, <**number_of_recognized_workpieces**>, <**recognized_workpiece_position**>

Explanation

This command saves P-type data given in <**recognized_workpiece_position**> into the tracking buffer for the conveyer specified in <**conveyer_number**>. It sets the number of workpieces recognized simultaneously in <**number_of_recognized_workpieces**>. For instance, if three workpieces have been recognized by a camera, it sets 3 in <**number_of_recognized_workpieces**>.

Related item

TRACKDATAGET, TRACKDATAINITIALIZE

Example

```
PROGRAM PRO1
:
:'If three workpieces (pos1, pos2, pos3) are recognized simultaneously by a camera on conveyer 1
TRACKDATASET   1,3,pos1     'The first recognized workpiece position is saved in the buffer
TRACKDATASET   1,3,pos2     'The second recognized workpiece position is saved in the buffer
TRACKDATASET   1,3,pos3     'The third recognized workpiece position is saved in the buffer
END
```

Notes:

Be sure to execute this command as many times as the number set for the number of workpieces to be recognized.
Otherwise, the tracking operation position may be abnormal.
Data in <**recognized_ workpiece_position**> is compared with the previously recognized workpiece position. If the system determines that the workpiece is at the same position, the data in <**recognized_workpiece_position**> is not saved but discarded.

Data saved with TRACKDATASET can be obtained from the buffer using TRACKDATAGET. The maximum number of data items that can be retained (the number of data items that have not been obtained with TRACKDATAGET) is 100.
When the power for the controller is turned off, data is erased.
Retained data can be erased with TRACKDATAINITIALIZE.

TRACKDATAGET (statement)

Function

Obtains data from the conveyer tracking buffer

Format

TRACKDATAGET <**conveyer_number**>, <**data_number**>,
<**number_of_remaining_data_items**>, <**recognized_workpiece_position**>

Explanation

This command obtains the workpiece position having the number specified in <**data_number**> from the tracking buffer of the conveyer specified in <**conveyer_number**> and then sets the position in <**recognized_workpiece_position**>. The number of data items remaining in the tracking buffer is set in <**number_of_remaining_data_items**>. If there is no data and an attempt to obtain data fails, the value of <**number_of_remaining_data_items**> is “-1”. <**data_number**> indicates the sequence number saved with TRACKDATASET. If “0” is specified, the data item that is the oldest of all retained data items (data items that have not been obtained with TRACKDATAGET) is applicable.

Related item

TRACKDATASET, TRACKDATAINITIALIZE

Example

```
PROGRAM PRO1
DEFINT REST
DEFPOS POS1
TAKEARM
MOVE P,P1
TRACKDATAGET 1,0,REST,POS1          'Obtaining the 0th workpiece recognition
                                    position on conveyer 1
IF(REST>=0) THEN                'If there is obtained data
   CALL SETTRACKMOVE(1)         'Starting conveyer 1 tracking
   MOVE P.,POS1                 'Tracking operation at the workpiece (POS1) position on
                                the conveyer
   CALL RESETTRACKMOVE          'Terminating the conveyer 1 tracking operation
ENDIF
END
```

Notes

If no data is set by TRACKDATASET, data cannot be obtained.
If the value of “number_of_remaining_data_items” is 0, data cannot be obtained.
Data obtained by TRACKDATAGET is erased from the buffer.

TRACKDATAINFO (statement)

Function

Obtains information within the conveyer tracking buffer

Format

TRACKDATAINFO <**conveyer_number**>, <**data_number**>,
<**encoder_value_at_recognition**>, <**availability**>,
<**workpiece_position_at_recognition**>

Explanation

This command obtains data specified in <**data_number**> from the tracking buffer of the conveyer specified in <**conveyer_number**>. The workpiece position is set in <**workpiece_position_at_recognition**>, and the encoder count value at workpiece recognition is set in <**encoder_value_at_recognition**>. If there is no data corresponding to the specified number, the value of <**availability**> is “-1”. <**data_number**> indicates the sequence number saved with TRACKDATASET. If “0” is specified, the data item that is the oldest of all retained data items (data items that have not been obtained with TRACKDATAGET) is applicable.

Related item

CALCWORKPOS,TRACKDATANUM

Example

```
PROGRAM PRO1
DEFINT LI1,ENC
DEFPOS POS1
TRACKDATAINFO 2,0,ENC,LI1,POS1      'The 0th data on conveyer 2 is obtained
                                    The availability is obtained in LI1
END
```

Notes

If there is no data corresponding to the specified number, the value of “availability” is “-1”.
When data acquisition is completed, the value of “availability” is “0”.
TRACKDATAINFO is only used to obtain information and the information is not erased from the buffer.

TRACKDATANUM (statement)

Function

Obtains the number of data items retained with TRACKDATASET

Format

<number_of_saved_data_items>=TRACKDATANUM(<**conveyer_number**>)

Explanation

This command obtains the number of data items retained in the tracking buffer of the conveyer specified in <**conveyer_number**>.

Example

```
PROGRAM PRO1
DEFINT   LI1
LI1=TRACKDATANUM (1)        'The number of data items retained for conveyer 1 is set
                            in LI1
END
```

CURTRACKPOS (statement)

Function

Obtains the position of the workpiece subject to tracking as a P type

Format

<**tracking-target_workpiece_position**>=CURTRACKPOS(<**conveyer_number**>, <**P_TYPE_POSITION_DATA**>, <**mode**>)

Explanation

This command sets the position of the workpiece subject to tracking in the conveyer specified in <**conveyer_number**> in <**P_TYPE_POSITION_DATA**>. The workpiece subject to tracking is the one for which data is obtained with TRACKDATAGET before this command is executed. Information about the position of the workpiece subject to tracking shown below can be obtained from <**mode**>.

0: Obtains the current position of the target workpiece.
1: Obtains the position of the workpiece at the termination of the operation when the robot is moved to the target workpiece position by PTP operation.
2: Obtains the position of the workpiece at the termination of the operation when the robot is moved to the target workpiece position by CP operation.

Related item

TRACKDATAGET, TRACKDATASET

Example

```
PROGRAM PRO1
DEFINT REST
DEFPOS POS1,POS2
TAKEARM

MOVE P,P1
TRACKDATAGET 1,0,REST,POS1          'Obtaining the 0th workpiece data from
                                    conveyer 1
POS2= CURTRACKPOS(1,POS1,1)         'Setting the workpiece position at termination of
                                    PTP operation in POS2
MOVE P POS2                         'Operation to POS2
CALL SETTRACKMOVE(1)                'Starting conveyer 1 tracking operation
MOVE P.,POS1                        'Tracking operation for the workpiece in POS1
CALL RESETTRACKMOVE                 'Terminating conveyer 1 tracking operation
END
```

Notes

If a tracking-target workpiece position is out of the robot movable area when specifying the mode, “Destination position out of motion space ” error occurs.

CURTRACKSPD (statement)

Function

Obtains the speed of the conveyer specified in <**conveyer_number**>.

Format

<conveyer_speed>=CURTRACKSPD(<**conveyer_number**>)

Explanation

This command obtains the speed of the conveyer specified in <**conveyer_number**> in units of [mm/sec].

Related item

Example

```
PROGRAM PRO1
DEFSNG   LF1
LF1=CURTRACKSPD(1)  'Obtaining the speed of conveyer 1 in LF1
END
```

WAITTRACKMOVE (statement)

Function

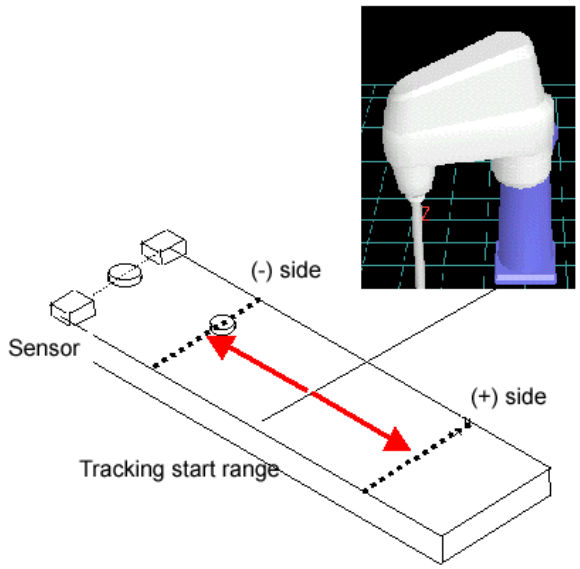
Waits for the position of the workpiece subject to tracking to enter the tracking start range

Format

WAITTRACKMOVE <**conveyer_number**>,<**recognized_workpiece_position**>, <**timeout**>

Explanation

This command waits for the workpiece specified in <**recognized_workpiece_position**> on the conveyer specified in <**conveyer_number**> to enter the tracking start range. <**timeout**> indicates the maximum wait time in seconds. If the workpiece does not fall into the tracking start range within the specified time-out period, a timeout error occurs.



Related item

TRACKDATAGET

Example

```
PROGRAM PRO1
DEFINT REST
DEFPOS POS1
TAKEARM
MOVE P,P1
TRACKDATAGET 1,0,REST,POS1          'Obtaining the 0th workpiece position
                                    from the conveyer 1 buffer
WAITTRACKMOVE 1,POS1,60             'Waiting for the workpiece to enter the tracking
                                    range for a maximum of 60 seconds
CALL SETTRACKMOVE(1)                'Starting conveyer 1 tracking
MOVE P.,POS1          'Tracking operation to the work (POS1) position on theconveyer
CALL RESETTRACKMOVE                 'Terminating tracking operation to conveyer 1
END
```

Notes

The tracking start range is a conveyer tracking parameter. Set this parameter either with a pendant or the tracking start range setting library.

While executing WAITTRACKMOVE, never allow WAITTRACKMOVE to be executed in other programs.

When a target workpiece is downstream from the tracking start area, an error 684B “Out of track start area” occurs.

The suspended stop by Halt is calculated as wait time.

CALCWORKPOS (statement)

Function

Obtains the current position of the specified workpiece.

Format

<**current_workpiece_position**>=CALCWORKPOS (<**conveyer_number**>, <**workpiece_position_at_recognition**>, <**encode_value_at_recognition**>)

Explanation

This command calculates the current position of the workpiece on the conveyer specified in <**conveyer_number**>. Information (<**workpiece_position_at_recognition**> and <**encode_value_at_recognition**>) of the workpiece subject to tracking is obtained with TRACKDATAINFO.

Related item

TRACKDATAINFO

Example

```
PROGRAM PRO1
DEFINT LP1,LI1,ENC,PNUM
DEFPOS POS1,POS2

PNUM=TRACKDATANUM(2)                ‘Obtaining the number of retained data items in
                                    conveyer 2
FOR LP1=0 TO PNUM-1                 ‘Referencing data items as many as PNUM
TRACKDATAINFO (2,LP1,ENC,LI1,POS1)  ‘Obtaining conveyer 2 data sequentially starting
                                    with the 0th
IF(LI1=0) THEN
        POS2=CALCWORKPOS(2,POS1,ENC)    ‘Setting the current position of the
                                        workpiece obtained with
                                        TRACKDATAINFO in POS2
                    :
                    :
                ENDIF
                NEXT LP1
END
```

CURTRACKPOSEX (statement)

Function

Obtains a tracking-target workpiece position in the P-type form.

Format

<**tracking-target_workpiece_position**>=CURTRACKPOSEX (<**conveyer_number**>, <**P-TYPE_POSITION_DATA**>, <**mode**>, <**error_information**>)

Explanation

Sets a tracking-target workpiece position on a conveyer, specified by <**conveyer_number**>, into a <**P-TYPE_POSITION_DATA**>. The tracking-target workpiece has been obtained with TRACKDATAGET before execution of this command. The following tracking-target workpiece position information can be obtained according to <**mode**>.

0: Obtains a current position of a target workpiece.

1: Obtains a target workpiece position at operation termination when the robot has been moved to the target workpiece position using the PTP operation.

2: Obtains a target workpiece position at operation termination when the robot has been moved to the target workpiece position using the CP operation.

<**error_information**> becomes 0 after a tracking-target workpiece position has been calculated, and becomes 1 when a tracking-target workpiece position is out of the robot movable area.

Related item

CURTRACKPOS

Example

```
PROGRAM PRO1
DEFINT REST,ERINF
DEFPOS POS1,POS2
TAKEARM

MOVE P,P1
TRACKDATAGET 1,0,REST,POS1              'Obtain the zeroth workpiece data from conveyer 1 data.
POS2= CURTRACKPOSEX(1,POS1,1,ERINF)     'Assign to POS2 a workpiece position after PTP operation has been terminated.
IF ERINF=0 THEN
        MOVE P POS2                     'Move to POS2.
        CALL SETTRACKMOVE(1)            'Start conveyer 1 tracking.
        MOVE P.,POS1                    'Track a workpiece at POS1.
        CALL RESETTRACKMOVE             'Terminate conveyer 1 tracking.
ENDIF
END
```

WAITTRACKMOVEEX (statement)

Function

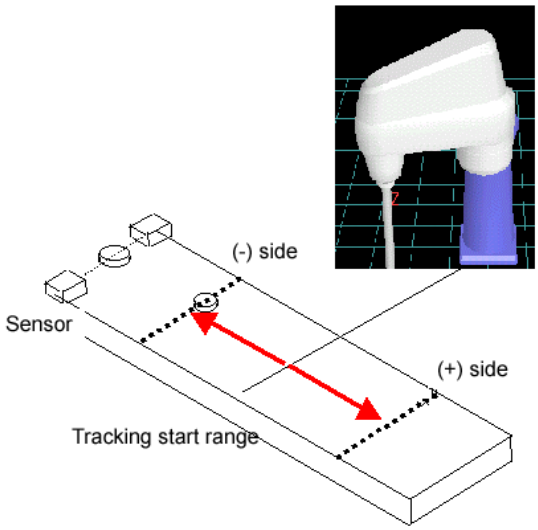
Waits for tracking-target workpiece to enter into a tracking start area.

Format

<**error_information**>=WAITTRACKMOVEEX(<**conveyer_number**>, <**recognized_workpiece_position**>, <**timeout_duration**>)

Explanation

Waits for a workpiece specified by <**recognized_workpiece position**> to enter into a tracking start area on a conveyer specified by <**conveyer_number**>. <**timeout_duration**> is a maximum wait duration in seconds. A timeout error occurs if a workpiece does not enter into a tracking start area. The value of <**error_information**> is “0” while a target workpiece is out of a tracking start area, “1” after a timeout, and “2” when the workpiece is downstream from the tracking start area.



Related item

WAITTRACKMOVE

Example

```
PROGRAM PRO1
DEFINT REST、ERINF
DEFPOS POS1
TAKEARM
MOVE P,P1
TRACKDATAGET 1,0,REST,POS1              'Obtain the zeroth workpiece position from
                                        conveyer1 buffer.
ERINF=WAITTRACKMOVEEX(1,POS1,60)        'Wait for up to 60 seconds until a workpiece
                                        enters into a tracking area.
IF ERINF=0 THEN
        CALL SETTRACKMOVE(1)            'Start conveyer 1 tracking.
        MOVE P.,POS1        'Perform tracking to a workpiece position POS1 on a conveyer.
        CALL RESETTRACKMOVE             'Terminate tracking of conveyer 1.
ENDIF
END
```

Notes

Tracking start area is a conveyer tracking parameter. Set this value using either the pendant or the tracking start area setting library.
Do not execute WAITTRACKMOVE while it is used in another program.
The suspended stop by Halt is calculated as wait time.

CAMIN (statement)

Function

Stores an image from the camera in the image memory (process screen).

Format

CAMIN <Camera number>[, <Storage memory number> [, <Table number> [, <Mode>]]]

Explanation

<Camera number> Designates the camera number (1 or 2).

<Storage memory number> Designates the number of the storage memory (process screen) (0 to 3). If this is ignored, 0 is set as the default.

<Table number> Designates the number of the look-up table to store from 0 to 15. If this is ignored, 0 is set as the default.

<Mode> Sets the conveyer tracking available. (0 or 1)
When not using the conveyer tracking, designates 0.
When using the conveyer tracking, designates 1.
0: Usually
1: Conveyer tracking

Note (1): If a camera is not connected, or if input is not available due to malfunction, an error will occur.
Note (2): If the table number is other than 0 when the image is stored, the table is changed. When this happens, the screen may appear disordered; however, this is not a failure.
Note (3): After execution, the number of the table automatically returns to 0.
Note (4): To execute this instruction, a µVision board (option) is required.

Related Terms

CAMMODE, CAMLEVEL, VISDEFTABLE

Example

```
CAMIN 1,0,0          'Converts an image from camera number 1, with table number
                     '0 (with the same brightness as of the camera image) and stores
                     'it in storage memory 0.
DELAY 2000           'Stops for 2 seconds.
CAMIN 1              'The same result can be obtained as CAMIN 1,0,0.
DELAY 2000           'Stops for 2 seconds.
I1 = 1               '
I2 = 0               '
I3 = 3               '
CAMIN I1,I2,I3       'Converts an image from camera number 1, with the table 3
                     '(reverse) and stores it in storage memory 0.
VISPLNOUT 0          'Outputs an image in storage memory number 0 to the monitor
                     'as a still-image.
```

3.8 List of Libraries Related to the Conveyer Tracking Function

SETTRACKMOVE (library)

Function

Starts the tracking operation for the specified conveyer

Format

SETTRACKMOVE(<**conveyer_number**>)

Explanation

This command starts the tracking operation for the conveyer specified in <**conveyer_number**>.

Related item

RESETTRACKMOVE

Example

```
PROGRAM PRO1
DEFINT REST
DEFPOS POS1
TAKEARM
MOVE P,P1
TRACKDATAGET 1,1,REST,POS1          'Obtaining the 1st workpiece position from
                                    conveyer 1 data
WAITTRACKMOVE 1,POS1,60             'Waiting for the workpiece to enter the tracking
                                    range for 60 seconds
CALL SETTRACKMOVE(1)                'Starting tracking for conveyer 1
MOVE P.,POS1                  'Tracking operation for POS1
CALL RESETTRACKMOVE                 'Terminating the tracking operation for conveyer 1
END
```

Notes

When you execute SETTRACKMOVE in the auto mode, the system enters the tracking operation mode.

When you execute SETTRACKMOVE in the teach check mode, an error 6002 “Wrong operation mode” occurs. In the teach check mode, the tracking operation mode is forbidden.

During the tracking operation mode, the robot follows in the direction of the conveyer operation even if no operational instruction is executed.

To return from the tracking operation mode to the normal operation mode, execute RESETTRACKMOVE.

When the conveyer tracking program is completed or the mode switch is setted in the manual mode or GIVEARM command is executed, the operation mode returns from the tracking operation mode to the normal operation mode and an error 6841 “Interrupted track motion” occurs.

RESETTRACKMOVE (library)

Function

Switches from the tracking operation mode to the normal operation mode

Format

RESETTRACKMOVE

Explanation

This command stops the tracking operation and switches to the normal operation mode.

Related item

SETTRACKMOVE

Example

```
PROGRAM PRO1
DEFINT REST
DEFPOS POS1
TAKEARM
MOVE P,P1
TRACKDATAGET 1,1,REST,POS1          'Obtaining the 1st workpiece position from
                                    conveyer 1 data
WAITTRACKMOVE 1,POS1,60             'Waiting for the workpiece to enter the tracking
                                    range for 60 seconds
CALL SETTRACKMOVE(1)                'Starting tracking for conveyer 1
MOVE P.,POS1                'Tracking operation for POS 1
CALL RESETTRACKMOVE                 'Terminating the tracking operation for conveyer 1
END
```

Notes

During the tracking operation mode, the robot follows in the direction of the conveyer operation. When you execute RESETTRACKMOVE, the robot decelerates its speed and then stops, returning to the normal operation mode.

CONVCAL (library)

Function

Executes conveyer calibration

Format

CONVCAL(<**conveyer_number**>)

Explanation

This command executes calibration for the conveyer specified in <**conveyer_number**>.

Related item

Notes

For the use method, see “2.2 Conveyer Calibration”.

CALCCAMCALPOS (library)

Function

Computes the robot coordinate value to be specified in ¥ when camera calibration of WINCAPS2 visual manager is executed.

Format

CALCCAMCALPOS(<**conveyer_number**>, <**P_type_variable_storage_number_1**>, < **P_type_variable_storage_number_2**>, < **P_type_variable_storage_number_3**>)

Explanation

This command stores the three workpiece positions to be used for camera calibration on the conveyer specified in <**conveyer_number**> in the P-type variables specified in <**P_type_variable_storage_number_1**> to <**P_type_variable_storage_number_3**>.

Notes

For the use method, see “2.3 Camera Calibration”.

CALCIOTEACHPOS (library)

Function

Computes the workpiece position when Hand I/O interrupt is used

Format

CALCIOTEACHPOS (<**conveyer_number**>,<**P_type_variable_storage_number_1**>, < **P_type_variable_storage_number_2**>)

Explanation

This command computes the workpiece position at Hand I/O interrupt based on the teaching position and conveyer movement amount.

Notes

For the use method, see “2.4 Instruction of Workpiece Position when Hand I/O input Interrupt is in Use”.

SetTrackStartArea (library)

Function

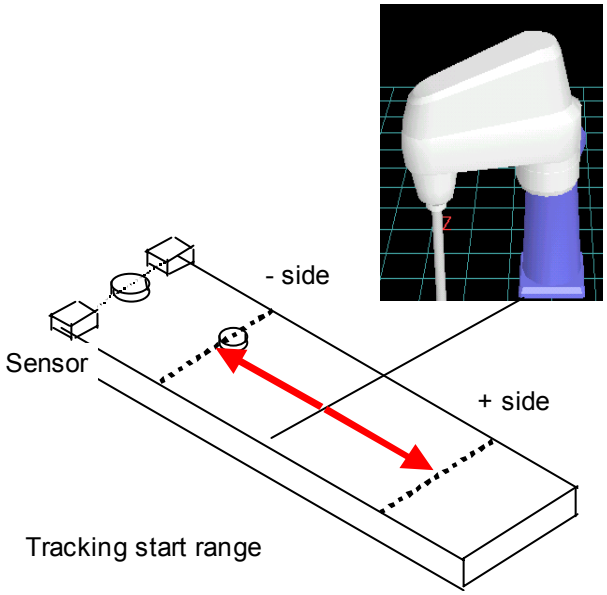
Sets the tracking start range at the time of WAITTRACKMOVE

Format

SetTrackStartArea
(<**conveyer_number**>,<**conveyer_upstream_(-)side_tracking_start_position**>,
<conveyer_downstream_(+)side_tracking_start_position>)

Explanation

This command sets the tracking start range at the time of WAITTRACKMOVE for the conveyer specified in <**conveyer_number**>.
<**conveyer_upstream_(-)side_tracking_start_position** > and
<conveyer_downstream_(+)side_tracking_start_position> are specified with conveyer positions.



Related item

WAITTRACKMOVE

Example

```
CALL SetTrackStartArea (1,-100,1000)    'Specifying that the tracking start range for
                                         conveyer 1 is between -100 mm and +1000
                                         mm
TRACKDATAGET 1,0,REST,POS1              'Obtaining the 0th workpiece position from the
                                         conveyer 1 buffer
WAITTRACKMOVE 1,POS1,60                 'Waiting for the workpiece to enter the tracking
                                         range for up to 60 seconds
```

CalcConvPos (library)

Function

Converts the work position of robot coordinate system to the conveyer position.

Format

CalcConvPos（<**conveyer_number**>、<**work_position**>、<**conveyer_position**>）

Explanation

Converts the work position specified in <**work_position**> of robot coordinate system to the conveyer position specified in <**conveyer_number**>.

Related item

CurTrackPos

Example

```
 DEFPOS Pos1, WPos
DEFSNG CnvPos
WPos=CurTrackPos（1, Pos1, 1）          ‘Caluculates the work position when
                                          conveyer 1 finishes PTP motion.
CALL  CalcConvPos(1, WPos, CnvPos)     ‘Caluculates the conveyer position of
                                          conveyer 1.
```

SetConvLowVelErr (library)

Function

Sets the low speed error detecting function.

Format

SetConvLowVelErr(（<**conveyer_number**>）

Explanation

Enables the low speed error detecting function of the conveyer specified in <**conveyer_number**>.
Entering 0 for <**conveyer_number**> disables the low speed error detecting function.
The low speed error detecting function detects when the conveyer speed value becomes lower than the setting value in conveyer tracking parameter.

Example

```
CALL   SetConvLowVelErr(1,)   ‘Enables the low speed error detecting function of
                                 conveyer 1.
```

CalcConvVec (library)

Function

Calculates conveyer vector.

Format

CalcConvVec (<**conveyer_number**>, <**conveyer_vector**>)

Explanation

Calculates conveyer vector of a conveyer specified by <**conveyer_number**>.

Related item

CalcConvPos

Example

```
DEFVEC CnvVec
CALL   CalcConvPos(1,ConvVec)    'Calculate a conveyer vector of conveyer 1.
```

SortTrackData (library)

Function

Calculates the number of a data item, in a conveyer tracking buffer, that is the most downstream on a conveyer.

Format

SortTrackData (<**conveyer_number**>, <**conveyer_buffer_data_count**>, <**conveyer_vector**>, <**the_number_of_the_most_downstream_data_item**>)

Explanation

Calculates the number of the most downstream data item selected from the data specified by <Conveyer buffer data count> in a conveyer tracking data buffer of a conveyer specified by <Conveyer number>, and assigns the number of the data to <The most downstream data number>.
Obtain <Conveyer buffer data count> using TrackDataNum.
Calculate <Conveyer vector> using CalcConvVec.

Related item

TrackDataGet, TrackDataNum, CalcConvVec

Example

```
DEFPOS TrackPos
DEFVEC CnvVec
DEFINT datnum, resnum
CALL   CalcConvPos(1,ConvVec)              'Calculation of the conveyer vector of conveyer 1
CALL SortTrackData(1,TrackDataNum(1),ConvVec, datnum)
TrackDataGet 1,datnum,resnum,TrackPos
```

SortTrackAllData (library)

Function

Calculates the number of a data item, from all data in a conveyer tracking buffer, that is the most downstream on a conveyer.

Format

SortTrackAllData (<**conveyer_number**>,
<**the_number_of_the_most_downstream_data_item**>)

Explanation

Calculates the number of the most downstream data item selected from all data in a conveyer tracking data buffer of a conveyer specified by <Conveyer number>, and assigns the number of the data to <The most downstream data number>.

Related item

SortTrackData

Example

```
DEFPOS TrackPos
DEFINT datnum, resnum
CALL SortTrackAllData(1, datnum)
TrackDataGet 1,datnum,resnum,TrackPos
```

RC5 CONTROLLER
CONVEYER TRACKING BOARD

OPTIONS MANUAL (SUPPLEMENT)

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The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

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