

EPSON

Epson RC+ 8.0 Option Conveyor Tracking

Original instructions

© Seiko Epson Corporation 2026

Rev.1
ENM269S9056F

Table of Contents

1. Introduction	6
1.1 Introduction	7
1.2 Trademarks	7
1.3 Notation	7
1.4 Terms of Use	7
1.5 Manufacturer	7
1.6 Contact Information	7
1.7 Before Use	8
2. Safety	9
2.1 Conventions	10
2.2 Definitions	10
2.2.1 Robot Power	10
2.2.2 Safeguard	11
2.2.3 Operation Mode	11
2.2.4 Start Mode	12
2.2.5 Changing Operation Mode	12
2.2.6 Emergency Stop	13
2.2.7 Teach Pendant	13
2.3 Installation and Design Precautions	13
2.4 Precautions regarding Robot Operation	13
2.5 Backup of Projects and Controller	14
3. Conveyor Tracking Function	15
3.1 What is Conveyor Tracking?	16
3.1.1 Overview	16
3.1.2 Conveyor Tracking Processes	17
3.1.3 System Structure	19
3.1.4 Key Terms	20
3.1.5 Conveyor Tracking Commands	21
3.2 Settings to be Configured Before Conveyor Tracking Operation	22
3.2.1 Tracking Area	22
3.2.2 Tracking Mode	22
3.2.3 Tracking Abort Line	22

4. Conveyor tracking settings	23
4.1 Hardware Configuration	24
4.1.1 Hardware Installation	24
4.1.1.1 Conveyor tracking option kit B	24
4.1.1.1.1 Conveyor Tracking Option Kit B Specifications	24
4.1.1.1.2 External Dimensions	24
4.1.1.1.3 Signal Connections	25
4.1.1.1.4 Connection method	28
4.1.1.1.5 Connection Drawing	28
4.1.1.1.6 Methods for Installation	29
4.1.1.2 PG (Pulse Generator) Board	32
4.1.1.2.1 PG Board Specifications	32
4.1.1.2.2 DIP switch settings	33
4.1.1.2.3 Jumper settings	33
4.1.1.2.4 Rotary switch settings	33
4.1.1.2.5 Signal Connections	34
4.1.1.2.6 Signal Assignments: PG board connector (DX10A-100S)	34
4.1.1.2.7 Signal Assignments: PG board connector terminal block 1	36
4.1.1.2.8 Signal Assignments: PG board connector terminal block 2	37
4.1.1.2.9 Encoder Input Circuit	38
4.1.2 Wiring Example of Vision Conveyor Tracking System	38
4.2 Software Configuration	40
4.2.1 Conveyor Encoder Configuration	40
4.2.1.1 How to set the user-defined output remote I/O	40
4.2.1.2 Verifying Encoder Operation	40
4.2.1.3 Verifying Hardware Conveyor Trigger / Vision Trigger	42
4.2.2 Creating Conveyors in a Project	43
4.2.3 Configuring Conveyors	44
4.2.4 Vision Conveyors	46
4.2.4.1 Vision conveyor camera and lighting	46
4.2.4.2 Vision calibration sequence	46
4.2.4.3 Vision Conveyor Calibration (Straight Conveyor)	49
4.2.4.4 Vision Conveyor Calibration (Circular Conveyor)	54
4.2.4.5 Vision conveyor operation check	60

4.2.5 Sensor Conveyors	63
4.2.5.1 Sensor Conveyor Calibration (Straight Conveyor)	63
4.2.5.2 Sensor Conveyor Calibration (Circular conveyor)	69
4.2.5.3 Sensor conveyor operation check	76
4.2.6 Calibration Results	78
4.2.7 Pickup Area	80
4.2.7.1 Changing the Upstream / Downstream limits positions	81
4.2.8 Adjusting the Z value	86
4.2.9 Queue Sorting	88
4.2.10 Double Registration Prevention	89
4.2.11 Tracking Abort Line	90
4.2.11.1 How to set a tracking abort line	91
4.2.11.2 How to set the Z rising height	92
4.2.11.3 How to check the tracking abort state	92
4.2.11.4 Program	94
5. Checking the conveyor tracking operation	97
5.1 Operational Checks	98
5.1.1 Verifying Encoder Operation	98
5.1.2 Verifying Trigger Operation	98
5.1.3 Verifying Conveyor Tracking Operation	98
5.2 Confirming Settings	98
5.2.1 Verifying Conveyor Calibration	98
5.2.2 How to Check the Tracking Abort State	98
6. Conveyor tracking sample program	99
6.1 Vision Conveyor Programming	100
6.2 Sensor Conveyor Programming	102
6.3 Tracking Mode	103
6.3.1 Quantity-priority mode	103
6.3.2 Accuracy-priority mode	103
6.3.3 Accuracy-priority Mode - Acquiring Tracking Delay	104
6.3.4 Variable speed conveyor mode	106
6.3.5 Setting the offset value, acceleration and deceleration for variable speed conveyor mode	106
6.4 Abort Tracking	110
6.5 Conveyor Tracking Programming with a 6-Axis Robot	110

6.6 Multi-conveyor Programming	111
6.7 Multi-robot Programming	114
7. Recommendations For Efficient Use	120
7.1 Tips for Accuracy Improvement of Conveyor Tracking	121
7.1.1 Overview	121
7.1.2 Tips for System Construction	121
7.1.3 Tips for Vision Calibration	123
7.1.4 Tips for Conveyor Calibration	124
7.1.5 Troubleshooting for Workpiece Detection	125
7.1.6 Offset	128
7.2 Dispense Application on Conveyors	130
7.2.1 Overview	130
7.2.2 Setting a Target Point	130
7.2.3 Adjusting an Amount of Dispensing	131
7.3 How to shorten the picking cycle time	132
7.4 Manipulator Posture	132

1. Introduction

1.1 Introduction

Thank you for purchasing this Epson robot system.

This manual provides the information necessary for correctly using the software.

Before using the system, please read this manual and related manuals to ensure correct use.

After reading this manual, store it in an easily accessible location for future reference.

Epson conducts rigorous testing and inspection to ensure that the performance of our robot systems meets our standards. Please note that if the Epson robot system is used outside the operating conditions described in the manual, the product will not perform up to its basic performance.

This manual describes potential hazards and problems that are foreseen. To use the Epson robot system safely and correctly, be sure to follow the safety information contained in this manual.

1.2 Trademarks

Microsoft, Windows, the Windows logo, Visual Basic, and Visual C++ are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

Intel Core is a trademark of Intel Corporation.

XVL is a registered trademark of Lattice Technology, Co., Ltd.

All other company names, brand names, and product names are registered trademarks or trademarks of their respective companies.

1.3 Notation

Microsoft® Windows® 10 operating system

Microsoft® Windows® 11 operating system

In this manual, the above operating systems are referred to as Windows 10 and Windows 11, respectively. Windows 10 and Windows 11 are sometimes collectively referred to as Windows.

1.4 Terms of Use

No part of this instruction manual may be reproduced or reprinted in any form without express written permission.

The information in this document is subject to change without notice.

Please contact us if you find any errors in this document or if you have any questions about the information in this document.

1.5 Manufacturer

SEIKO EPSON CORPORATION

1.6 Contact Information

Contact information details are listed in the "Supplier" section in the following manual.

Note that the contact information may vary depending on your region.

"Safety Manual - Contact Information"

The Safety Manual is also available at the following site.

URL: <https://download.epson.biz/robots/>



1.7 Before Use

Before using this manual, be sure that you understand the following information.

The Installation Folder for Epson RC+ 8.0

You can change the path for the installation folder for Epson RC+ 8.0 anywhere. This manual assumes that Epson RC+ 8.0 is installed in `C:\EpsonRC80`.

2. Safety

Please read "Safety Manual" before installing the robot system or before connecting cables and check the safety requirements.

For the safety of the Controller with Safety Board, refer to the safety manual for the product you use.

2.1 Conventions

The following symbols are used in this manual to indicate important safety information. Be sure to read the descriptions shown with each symbol.

WARNING

This symbol indicates an imminently hazardous situation which, if operation is not performed properly, will result in death or serious injury.

WARNING

This symbol indicates a potentially hazardous situation which, if operation is not performed properly, could result in an injury due to electric shock.

CAUTION

This symbol indicates a potentially hazardous situation which, if operation is not performed properly, may result in a minor or moderate injury or in property damage only.

2.2 Definitions

2.2.1 Robot Power

The status of robot power is explained below in terms of restriction to operation:

Operation-prohibited status:

Robot cannot be operated.

Restricted (low power) status:

Robot can operate at low speed and low torque.

Unrestricted (high power) status:

Robot can operate without restriction.

The robot will not operate regardless of the control actions taken by the operator when in the operation-prohibited state. During operation, when the safeguard circuit opens, the system will switch to operation-prohibited state.

The robot will operate at low speed and torque in the restricted state (low power). In the unrestricted state (high power), the robot will operate at the programmed speed and torque.

In the event that the robot should make an unexpected movement, the restricted state (low power) decreases operating speed allowing the operator to avoid danger. The torque is also decreased to minimize serious injury to the operator should one be struck by the robot. The maximum values of the decreased speed and torque are set according to the robot used and cannot be changed by the user.

As a safety precaution the initial power state of the robot will be set to either the restricted (low power) state or the operation-prohibited state. The system will not change to the unrestricted (high power) state if the appropriate procedures are not followed.

When the system is in restricted (low power) state or operation-prohibited state, a single failure will not cause a runaway action that surpasses the assigned speed or torque decrease. This is due to the multi-protect circuit and mutual monitoring circuit in the control system.

2.2.2 Safeguard

Safety barriers for safety must be installed around the Manipulator, and safeguards must be installed at the entrance and exit of the safety barriers.

The term "safeguard" mentioned in this manual is a safety device with an interlock that allows entry into the safety barriers. Safeguards include safety door switch, safety barriers, light curtains, safety gates, safety floor mats, and so on. The safeguard is an input that informs the Robot Controller that an operator may be inside the safeguard area.

For RC700-E, RC800 series:

You need to assign at least one Safeguard (SG) in Safety Function Manager. For more details, refer to the following manual.

"Safety I/O Connector" in "Robot Controller Manual"

For models other than RC700-E, RC800 series:

Connect the interlock switch to the safeguard input of the controller's EMERGENCY connector. For more details, refer to the following manual.

"EMERGENCY" in "Robot Controller Manual"

When the safeguard is opened, Protective Stop operates to change the safeguard state to open (displayed: SO).

Safeguard open

Operations are prohibited. Further robot operation is not possible until either the safeguard is closed and the latch is released, or TEACH or TEST mode is turned on and the enable circuit is activated.

Safeguard closed

The robot can operate automatically in an unrestricted (high power) state. To ensure safe operation, install a safety system using safety doors, light curtains, safety floor mats, etc.

WARNING

- If a third person accidentally releases the safeguard while an operator is working inside the Safety barriers, this may result in a hazardous situation. To protect the operator working inside the Safety barriers, implement measures to lock out or tag out the latch release switch.
- To protect operators working near the robot, be sure to connect a safeguard switch and make sure that it works properly.

2.2.3 Operation Mode

The operation mode is defined as the single control point for the controller, therefore you cannot use more than one operation mode at the same time.

There are four operation modes for the controller: AUTO, PROGRAM, TEACH, and TEST. AUTO operation modes allow you to execute programs in the controller when the safeguard is closed. PROGRAM operation mode allows you to execute and

debug programs when the safeguard is closed. TEACH operation mode allows you to jog and teach the robot at slow speed while inside the safeguarded area.

TEST operation mode allows you to execute a program at slow speed while the safeguard is opened.

KEY POINTS

Teaching operation described in this manual is the operation of AUTO operation mode or PROGRAM operation mode. This intended for jogging the robot or teaching operation outside the safeguard.

2.2.4 Start Mode

The Start mode specifies the operation mode for Epson RC+ 8.0 when it starts. You can set the Epson RC+ 8.0 to start in AUTO or PROGRAM mode.

For information on how to change the start mode, see below.

"Epson RC+ 8.0 User's Guide - Operation"

2.2.5 Changing Operation Mode

You can change from AUTO operation mode or PROGRAM operation mode to TEACH mode by setting the mode selector key switch on the Teach Pendant to the TEACH position as described below.

- TP1, TP2: Teach
- TP3, TP4: TEACH/T1, TEACH/T2

When the mode selector key switch is changed as described below to send a release latch input signal, the operation mode is returned to the previous operation mode.

- TP1, TP2: Auto
- TP3, TP4: AUTO

The AUTO operation mode can be changed to PROGRAM mode during the Epson RC+ 8.0 startup sequence. A password can be used to allow only certain personnel to change the startup operation mode.

When Epson RC+ 8.0 starts in AUTO operation mode, the AUTO operation mode cannot be changed to PROGRAM operation mode after the system has started. To change the operation mode, restart the system and log into PROGRAM mode, then set the start mode again and restart Epson RC+ 8.0.

For details on the Start Mode, see below.

"Epson RC+ 8.0 User's Guide - Operation - Starting Epson RC+ 8.0 - Start Mode"

To change to TEST operation mode:

- TP1: Switch the mode selector key switch on the Teach Pendant to Teach, and then select Function key F1: Test Mode.
- TP3, TP4: Switch the mode selector key switch on the Teach Pendant to TEACH/T1 or TEACH/T2, and then tap the [Test] tab.

For more details, refer to the following manual.

- "Functions Operation Mode (TEACH/AUTO/TEST) in Robot Controller Option Teach Pendant TP1 Manual"
- "Functions Operation Mode (TEACH/AUTO) in Robot Controller option Teach Pendant TP2 manual"

- "Functions Operation Mode (TEACH/AUTO/TEST) in Robot Controller option Teach Pendant TP3 manual"
- "Operation Mode (TEACH/AUTO/TEST) in Robot Controller option Teach Pendant TP4 manual"

KEY POINTS

- T2 mode cannot be used on RC700-A and RC700-D Controllers complying with the UL standards.
- T2 mode can be used on RC700-E and RC800 series.

2.2.6 Emergency Stop

The controller is equipped with an emergency stop input terminal. If the normally closed emergency stop circuit is broken, the power supplied to all motors will be shut off (and enter servo-free status) and the robot will be stopped by dynamic braking.

For more details on wiring, refer to the following manual:

"EMERGENCY" in "Robot Controller Manual"

2.2.7 Teach Pendant

Operators can use the teach pendant to operate the robot in the TEACH or TEST operation mode.

For operation instructions, refer to the following manuals.

- "Robot Controller option Teach Pendant TP1 manual"
- "Robot Controller option Teach Pendant TP2 manual"
- "Robot Controller option Teach Pendant TP3 manual"
- "Robot Controller option Teach Pendant TP4 manual"

2.3 Installation and Design Precautions

For installation and design precautions, refer to the following manuals.

- "Safety Manual"
- "Robot Controller Manual"
- "Manipulator Manual"

2.4 Precautions regarding Robot Operation

For precautions regarding robot operation, refer to the following manuals.

- "Safety Manual"
- "Robot Controller Manual"
- "Manipulator Manual"

2.5 Backup of Projects and Controller

After a project has been created or edited, or after system data including robot parameters has been edited, the project and controller files should be copied and stored in media other than the hard disk on the PC (e.g. USB memory key). Keep the backup media in a safe place in case of damaged data on the hard disk.

To backup, select [Controller Tools] from the Epson RC+ 8.0 [Tools] menu and execute [Controller Backup]. See details below.

"Epson RC+ 8.0 User's Guide - Epson RC+ 8.0 GUI - [Tools] menu - [Maintenance] (Tools Menu)"

Backup Controller is a function to backup both the project and the Controller.

To backup only the project data, select [Copy] from the [Project] menu. See details below.

"Epson RC+ 8.0 User's Guide - Epson RC+ 8.0 GUI - [Project] menu - [Copy Project] (Project Menu)"

CAUTION

If your system cannot be restored by Restore Controller, you must restore robot calibration parameters (Hofs, CalPIs) before operating the robot. If you fail to do so, the robot will move to incorrect positions.

3. Conveyor Tracking Function

3.1 What is Conveyor Tracking?

3.1.1 Overview

Conveyor Tracking is a process in which a robot picks up parts from a stationary or moving conveyor that are found by a vision system or sensor.

When a sensor or vision camera detects a workpiece on the conveyor, the Controller's I/O input latches the encoder's pulse value corresponding to the conveyor's rotational position at that moment. The workpiece position on the moving conveyor is then calculated and tracked based on the latched position and the pulse values generated by the subsequent rotation of the conveyor.

The Epson RC+ 8.0 Conveyor Tracking option supports both tracking and indexed conveyor systems.

Tracking conveyor system

Conveyor moves constantly. Vision system or sensor system finds the parts on it and robot picks them up as they move. During tracking, the robot can move along with the part as it picks up parts.

Indexed conveyor system

Conveyor moves a specified distance and then stops. The vision system finds the parts and robot picks up each part. After finding and picking up all parts, the conveyor moves again.

Up to 16 logical conveyors can be defined in each project. To define a logical conveyor, set a conveyor number, a robot number, encoder and select vision or sensor.

Multiple conveyors and multiple-robot conveyors are supported.

Applicable conveyor tracking models and connection methods are shown below.

Controller	Supported/Not Supported	Connection method	
		Conveyor tracking option kit B	Pulse Generator (PG) Board
RC90 series Manipulators	Supported	Not supported	Max 2 boards supported
RC700-A	Supported	Not supported	Max 4 boards supported
RC700-D, RC700-E	Supported	Not supported	Max 3 boards supported
T series Manipulator	Not supported	-	-
VT series Manipulator	Not supported	-	-
RC800 series (*1)	Supported	Supported	Max 3 boards supported

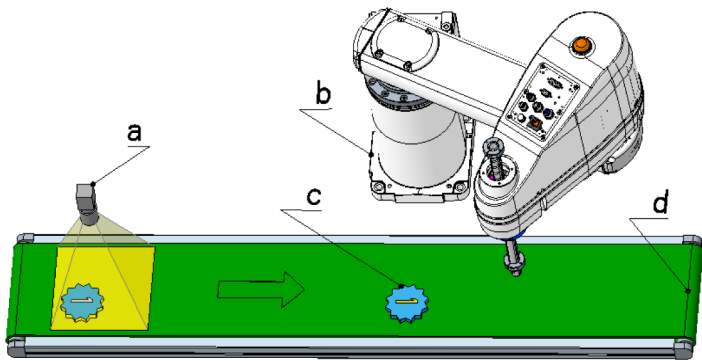
*1: Not supported by some of the RC800 series.

For details on multi robots, refer to the following manual.

"Robot Controller Manual"

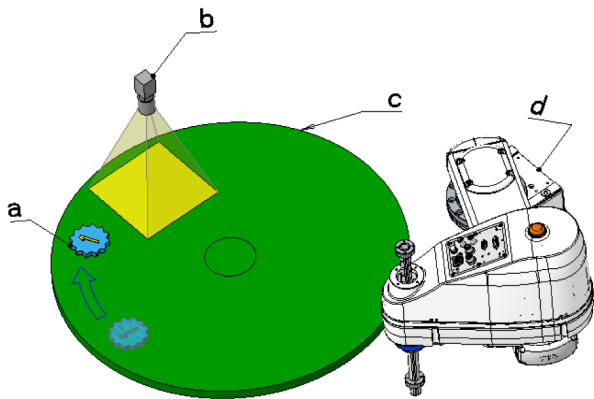
There are two types of conveyors that can be used with the Conveyor Tracking option: straight conveyors and circular conveyors, as shown in the figure below. These conveyors have different calibration and programming methods.

- Straight conveyor tracking system



Symbol	Description
a	Camera
b	Robot #
c	Workpiece
d	Straight conveyor

- Circular conveyor tracking system

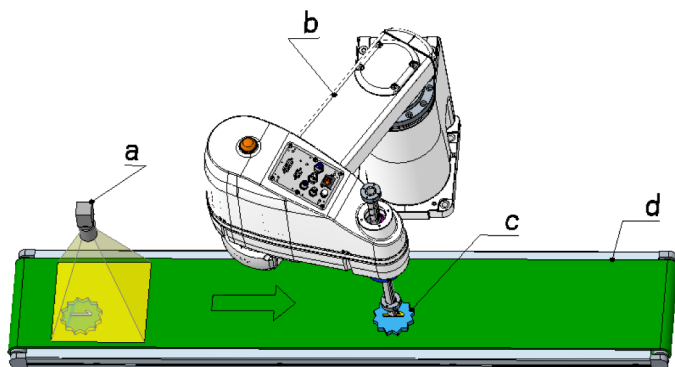


Symbol	Description
a	Workpiece
b	Camera
c	Circular conveyor
d	Robot #

3.1.2 Conveyor Tracking Processes

Tracking conveyor system

1. Vision system or sensor system finds the parts on a continuously moving conveyor.
2. Robot picks up the parts on the conveyor as they move.

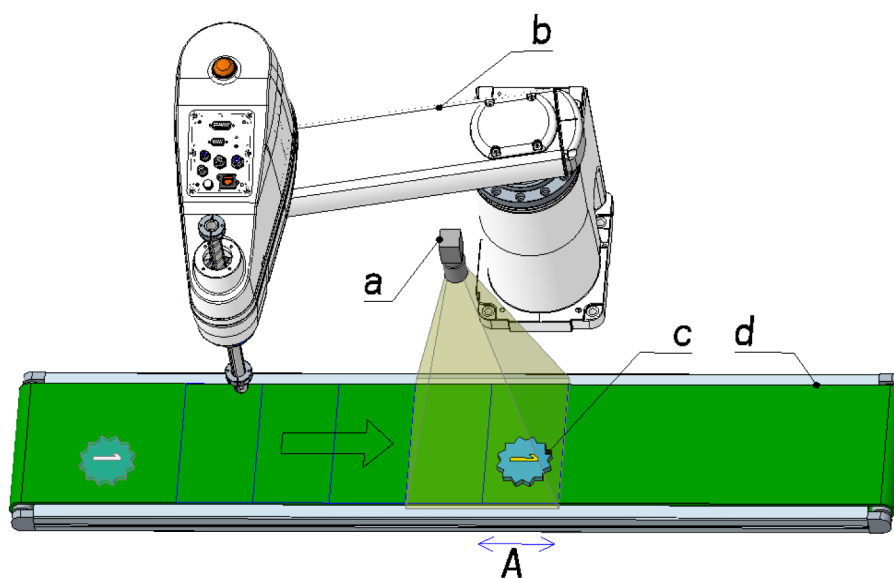


Configuration example of Tracking Conveyor System (Vision System)

Symbol	Description
a	Camera
b	Robot #
c	Workpiece
d	Straight conveyor

Indexed conveyor system

1. Conveyor moves a specified distance.
2. Vision system finds the parts on the conveyor when it stops.
3. Robot picks up the parts found by vision system.
4. After finding and picking up all parts, conveyor moves by the specified distance again.



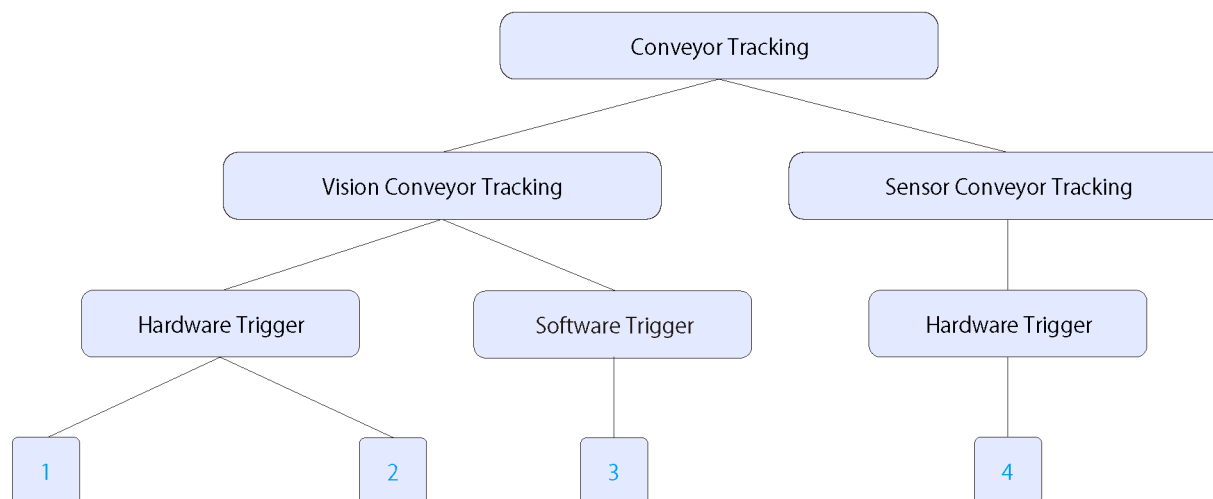
Configuration example of Indexed Conveyor System (Vision System)

Symbol	Description
a	Camera
b	Robot #
c	Workpiece

Symbol	Description
d	Straight conveyor
A	Index interval

3.1.3 System Structure

The conveyor system configurations and trigger methods are as shown below.



	PG Board Connection	Conveyor Tracking Option Kit B Connection	Trigger Method	Description
1			Hardware trigger	This method latches the camera image and encoder count using trigger signals from the robot controller I/O output. [Detection by vision only]
2			Hardware trigger	This method latches the camera image and encoder count using trigger signals from the photoelectric sensor output. [Detection by vision + sensor]

	PG Board Connection	Conveyor Tracking Option Kit B Connection	Trigger Method	Description
3			Software trigger	This method latches the camera image and encoder count using the command from the software (Epson RC+), without using trigger signal. A delay occurs compared to the hardware trigger due to the time it takes to process the command. [Detection by vision only]
4			Hardware trigger	This method latches the encoder count using the photoelectric sensor output. In the case of a sensor conveyor, the position is estimated based only on the workpiece identification output by a photoelectric sensor, without using a camera. (Because displacement cannot be detected in the width direction of the conveyor, a guide or other device is required to regulate any displacement in the width direction.) [Detection by sensor only]

There are hardware trigger and software trigger as trigger methods for latching the camera image and encoder count.

	Hardware trigger	Software trigger
Use cases	- When high-precision picking is required - When the conveyor speed is fast (Generally, a hardware trigger is recommended for conveyor tracking.)	- When using conveyor tracking on a trial basis - When the conveyor speed is slow
Overview	A configuration that latches via an external trigger signal from a photoelectric sensor, Controller I/O, etc. The system synchronizes based on the trigger signal latching the camera image with the encoder count.	This configuration does not use an external trigger. The configuration latches the encoder count at a software level via the "Cnv_Trigger" software command.
Characteristics	**Pros ** The timing can be adjusted with high precisions as a physical trigger signal is used to synchronize camera imaging and encoder counting, making it suitable for imaging moving workpieces. It is especially important to improve synchronization accuracy when the conveyor speed is high and displacement between the imaging and encoder latch timing can easily affect accuracy. **Cons ** The trigger cable must be wired to the camera, PG board or Conveyor Tracking Option Kit B.	**Pros ** Simple system configuration as no trigger signal wiring is required. **Cons ** As the camera capture commands and the encoder count commands are issued separately in the SPEL sequence code, the camera capture timing and encoder latch timing vary according to the communication speed and the amount of vision processing calculations. This timing variation adversely affects the conveyor tracking accuracy.

3.1.4 Key Terms

Here explains key terms used in this section.

Queue

Waiting queue of the FIFO (First-In, First-Out) type for each conveyor.

With the queue, you can register the point data of workpieces running on the conveyor and user data. When you add data, it will be registered to the end of the queue. When you delete data from the queue, the remaining data in the queue will be moved up automatically.

Queue depth

The number of data entries registered in a queue.

Maximum number of queue data is each conveyor 1000. The maximum total of queue data for all conveyors is 1000.

Queue user data

Optional real value that can be registered with the point data in a queue.

You can store additional information such as sorted data or part type determined by the image processing.

Downstream Conveyor

Use this when using multiple conveyors and you run them continuously.

By making an association (upstream/downstream) between conveyors, you can move a queue using the Cnv_QueMove command. "Multiple conveyors" is not necessarily more than one conveyor. You can use one long physical conveyor and set upstream side and downstream side as different logical conveyors. This enables the robots cooperative work, for instance, robot at the downstream side can pick up the workpieces that the robot at upstream fails to pick in time.

Upstream Limit

Dividing line in the upstream side of the Pickup Area.

Downstream Limit

Dividing line in the downstream side of the Pickup Area.

Pickup Area

The area between the upstream limit and downstream limit.

The robot picks parts which flow in the Pickup Area.

The robot starting pickup near the downstream limit continues its operation over the downstream limit. Make sure that the Pickup Area covers the whole robot motion range.

See details below.

Pickup Area

3.1.5 Conveyor Tracking Commands

All Conveyor Tracking commands begin with the same prefix: "Cnv_".

For details, refer to Help or the following manual:

"SPEL+ Language Reference"

KEY POINTS

- To track a part as the conveyor moves, you must use Cnv_QueGet in a motion command statement.

For example:

```
Jump Cnv_QueGet(1) 'this tracks the part
```

You cannot assign the result from Cnv_QueGet to a point and then track it by moving to the point.

```
P1 = Cnv_QueGet(1)
Jump P1 'this does not track the part!
```

When you assign the result from Cnv_QueGet to a point, the coordinate values correspond to the position of the part when the point assignment was executed.

- After pausing the manipulator, the operation command of conveyor tracking cannot be continued. The error 4403 will occur.

3.2 Settings to be Configured Before Conveyor Tracking Operation

3.2.1 Tracking Area

See below.

[Pickup Area](#)

3.2.2 Tracking Mode

See below.

[Tracking Mode](#)

3.2.3 Tracking Abort Line

See below.

[Tracking Abort Line](#)

4. Conveyor tracking settings

4.1 Hardware Configuration

4.1.1 Hardware Installation

To use conveyor tracking, you must install encoders for each physical conveyor on the system. Each encoder is wired to a box connector (CH1, CH2) on conveyor tracking option kit B or to a single channel on the pulse generator (PG) board. Conveyor tracking option kit B allows up to two encoders to be installed. The pulse generator (PG) board allows up to four encoders to be installed. A trigger input is also provided for each encoder to latch position, such as when used with a vision camera with a strobe.

4.1.1.1 Conveyor tracking option kit B

4.1.1.1.1 Conveyor Tracking Option Kit B Specifications

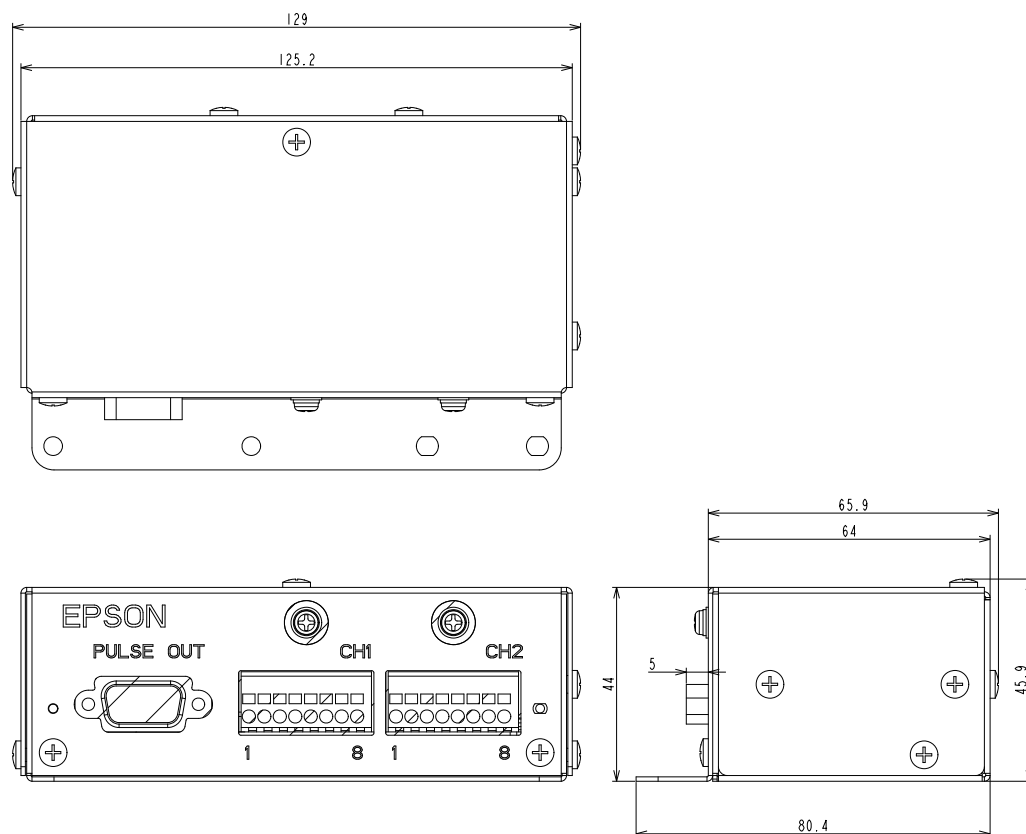
The following table shows the main specifications of conveyor tracking option kit B.

Name	Conveyor tracking option kit B
Compatible Controller	RC800 series (*1)
Encoder channels	2 channels
Encoder Type	ABZ phase differential input (RS-422 line receiver)
Input Pulse Rate	Max. 5 MPPS
Input Signal	Conveyor pulse latch input
connector	D-SUB 15 pins 3 rows (Controller side) Push-in (encoder side)
Cable Set	3m, 10m

*1: Not supported by some of the RC800 series.

4.1.1.1.2 External Dimensions

The figures below show the external dimensions of the pulse box for the conveyor tracking option kit B.



4.1.1.1.3 Signal Connections

Signal connections of Controller PULSE IN connector

The signal connections of the PULSE IN connector, which is the Controller's conveyor tracking I/F port, are shown in the table below.

Pin	Dir	Signal	Description
1	In	+A2	Phase +A signal for Counter 2 for CH2
2	In	+B2	Phase +B signal for Counter 2 for CH2
3	In	+A1	Phase +A signal for Counter 1 for CH1
4	In	+B1	Phase +B signal for Counter 1 for CH1
5	In	TRG1_IN	Trigger input for Counter 1
6	In	-A2	Phase -A signal for Counter 2 for CH2
7	In	-B2	Phase -B signal for Counter 2 for CH2
8	In	-A1	Phase -A signal for Counter 1 for CH1
9	In	-B1	Phase -B signal for Counter 1 for CH1
10	-	GND	Power supply ground
11	In	TRG2_IN	Trigger input for Counter 2
12	Com	TRG2_COMMON	Trigger common for Counter 2 for CH2
13	Com	TRG1_COMMON	Trigger common for Counter 1 for CH1

14	-	GND	Power supply ground
15	Out	+24V	24V power supply for encoder power generation

Carefully note the following when creating a cable for conveyor tracking applications.

CAUTION

24 VDC for operation of conveyor tracking option kit B is supplied through the PULSE IN connector. Use carefully as explained below.

- Do not connect anything other than a conveyor tracking cable to the PULSE IN connector. Otherwise, connected equipment and Controllers may get damaged.
- Do not use 24 VDC even if the customer prepares conveyor tracking cable. Our guarantee does not cover damage to connected equipment or Controllers used in this way.
- Commercially available D-SUB 15-pin cables cannot be used due to different pin assignments and wiring. When preparing cables yourself, follow the table, ensuring that the pin assignments and wiring are correct.

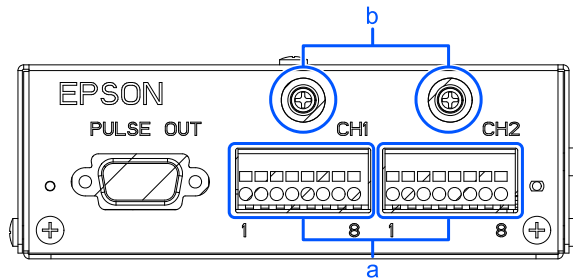
Signal connections of PULSE OUT connector with conveyor tracking option kit B

The signal connections of PULSE OUT connectors with conveyor tracking option kit B is shown in the table below.

Pin	Dir	Signal	Description
1	Out	+A2	Phase +A signal for Counter 2 for CH2
2	Out	+B2	Phase +B signal for Counter 2 for CH2
3	Out	+A1	Phase +A signal for Counter 1 for CH1
4	Out	+B1	Phase +B signal for Counter 1 for CH1
5	Out	TRG1_IN	Trigger input for Counter 1
6	Out	-A2	Phase -A signal for Counter 2 for CH2
7	Out	-B2	Phase -B signal for Counter 2 for CH2
8	Out	-A1	Phase -A signal for Counter 1 for CH1
9	Out	-B1	Phase -B signal for Counter 1 for CH1
10	-	GND	Power supply ground
11	Out	TRG2_IN	Trigger input for Counter 2
12	Com	TRG2_COMMON	Trigger common for Counter 2 for CH2
13	Com	TRG1_COMMON	Trigger common for Counter 1 for CH1
14	-	GND	Power supply ground
15	In	+24V	24V power supply for encoder power generation

CAUTION

Do not connect cables other than those supplied with conveyor tracking option kit B. Such cables may damage connected equipment and conveyor tracking pulse boxes.

Signal wiring for encoder connectors (CH1, CH2) with conveyor tracking option kit B

The signal connections of CH1 and CH2, the encoder connection terminals (a) for users, are shown in the table below. The pins are arranged in the order of 1→8 as printed on the main unit, and CH1 and CH2 have the same signal connections.

CH1

Pin	Dir	Signal	Description
1	In	+B1	Phase+ B signal for Counter 1
2	In	-B1	Phase -B signal for Counter 1
3	In	+A1	Phase+ A signal for Counter 1
4	In	-A1	Phase -A signal for Counter 1
5	In	TRG1_IN	Trigger input for Counter 1
6	Com	TRG1_COMMON	Trigger common for Counter 1
7	GND	GND	Power supply ground for +5 V power supply for encoder
8	Out	+5V	+5 V power supply for encoder

CH2

Pin	Dir	Signal	Description
1	In	+B2	Phase+ B signal for Counter 2
2	In	-B2	Phase- B signal for Counter 2
3	In	+A2	Phase+ A signal for Counter 2
4	In	-A2	Phase- A signal for Counter 2
5	In	TRG2_IN	Trigger input for Counter 2
6	Com	TRG1_COMMON	Trigger common for Counter 2
7	GND	GND	Power supply ground for +5 V power supply for encoder
8	Out	+5V	+5 V power supply for encoder

- Our conveyor system does not require Z-phase wiring. Insulate to prevent contact with panel, etc.
- Pins 1 to 4: Connect to encoder output +A, -A, +B, and -B.
- Pins 5 to 6: When latching conveyor pulse by external signal, connect to latch signal. Exactly when the signal is turned OFF to ON, the encoder pulse is latched.
- Pins 7 to 8: 5 V power supply and GND for encoders. Connect GND to 7 and power supply terminal to 8.
- Wiring shield screw: Secure the wiring shield with the shield fastening screw (b) on top of the connector.

4.1.1.1.4 Connection method

Conveyor tracking option kit B can be connected for 2 CHs. Push in to connect. Connect with the power off.

The wire to be connected should be processed into AWG24 to 16 or a ferrule terminal.

For details on connectors and wire connections, see the [SPT 1.5/ 8-H-3.5] specifications.

The counter trigger terminal is bipolar.

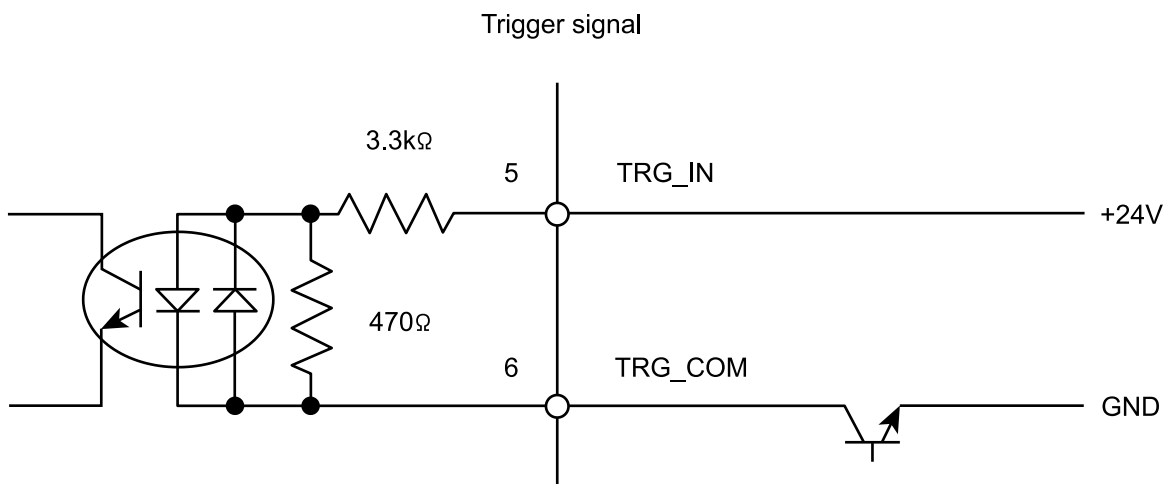
⚠ WARNING

Keep cables connected at all times and provide protection with guarding covers. Do not place heavy objects on cables, bend excessively, pull forcibly, or pinch. This may cause cable damage, wire breakage, or poor contact, resulting in improper system operation or electric shock.

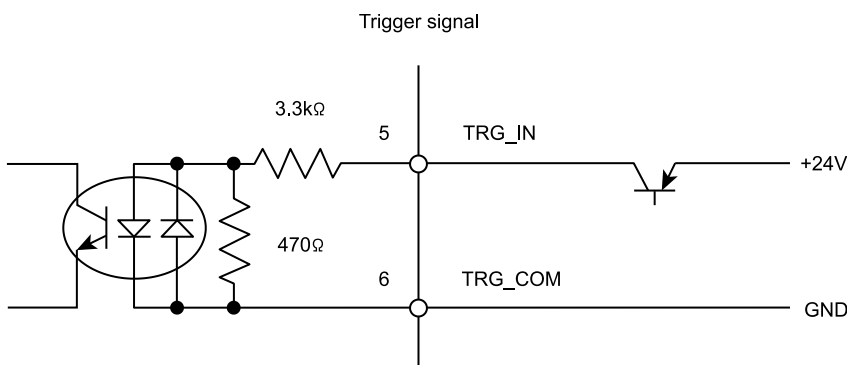
4.1.1.1.5 Connection Drawing

- Input voltage range: +24 V±10%
- Input current: 5 mA Typ, when +24 V input

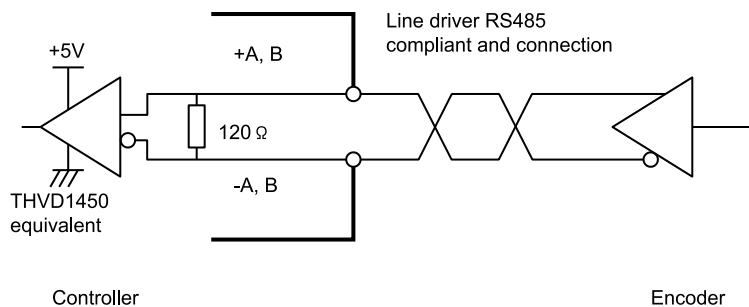
Input Circuit Drawing and Wiring Example 1



Input Circuit Drawing and Wiring Example 2

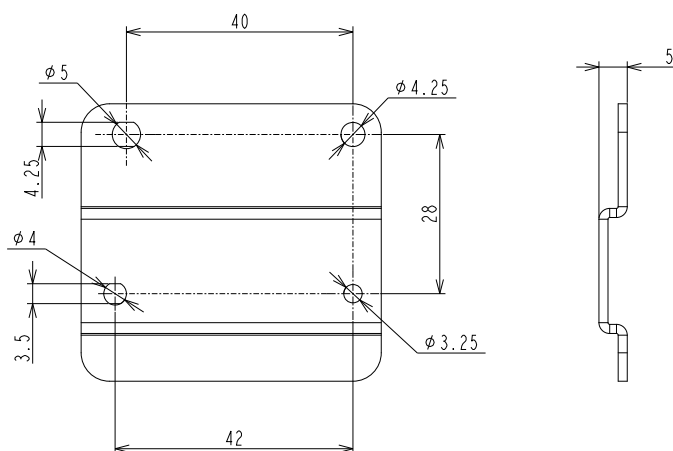


Input Circuit Drawing and Wiring Example 3



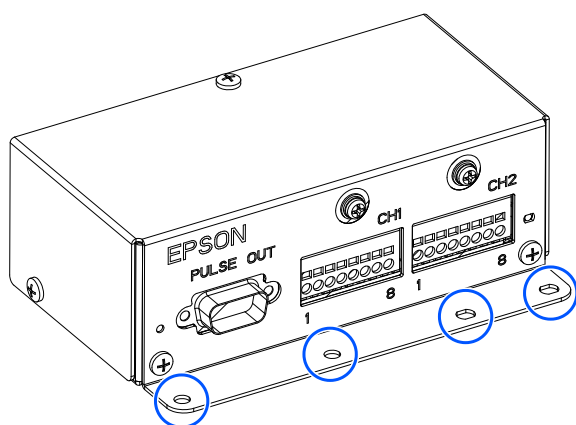
4.1.1.1.6 Methods for Installation

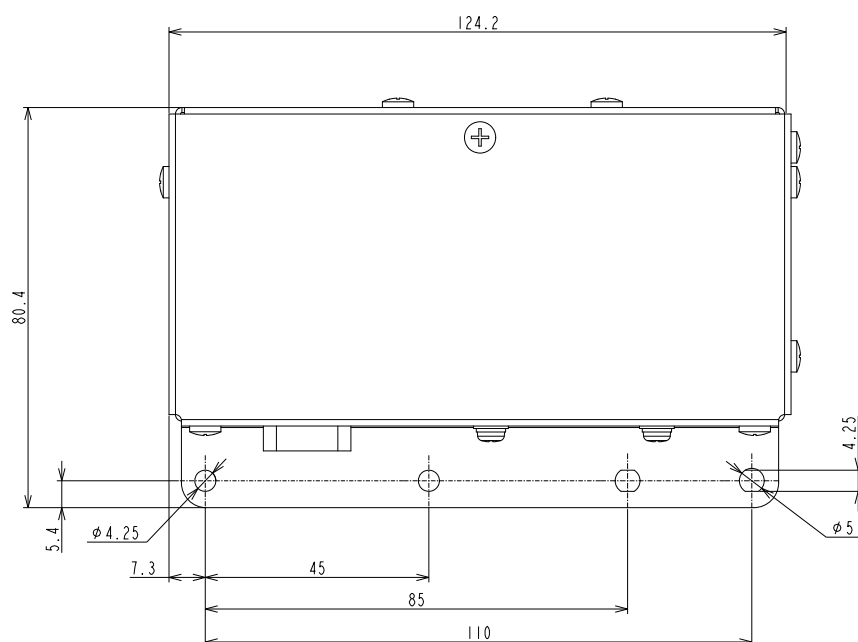
By using the included mounting panel or commercially-available DIN rail mount brackets, the conveyor tracking option kit B can be installed in four different ways.



■ Placed on the floor

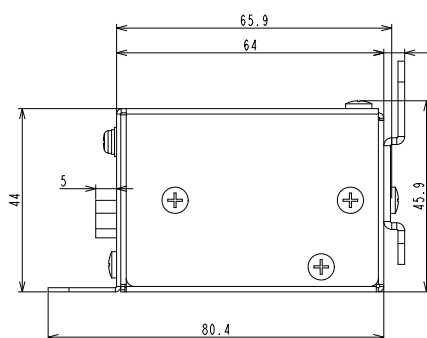
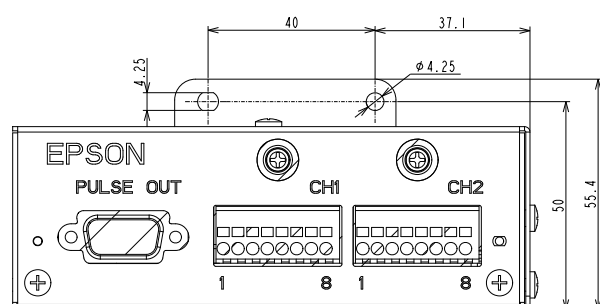
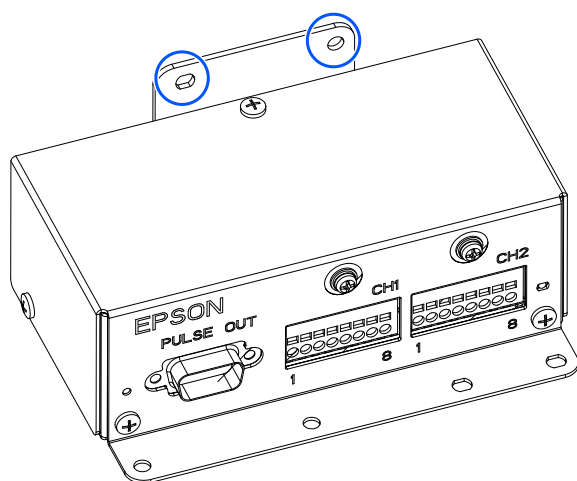
Do not install the included panel, and use the securing holes on the bottom of the unit to secure the kit with screws.





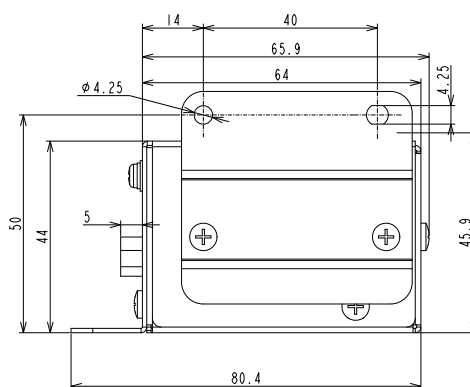
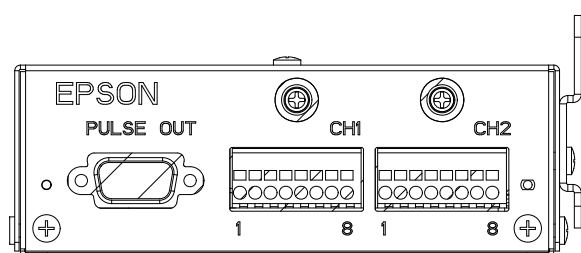
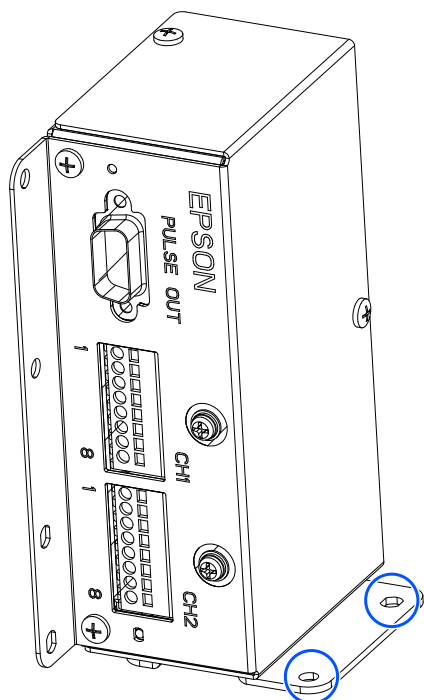
■ Wall-mounted

Install the included panel on the rear of the unit and use the securing holes on the included panel to secure the kit with screws.



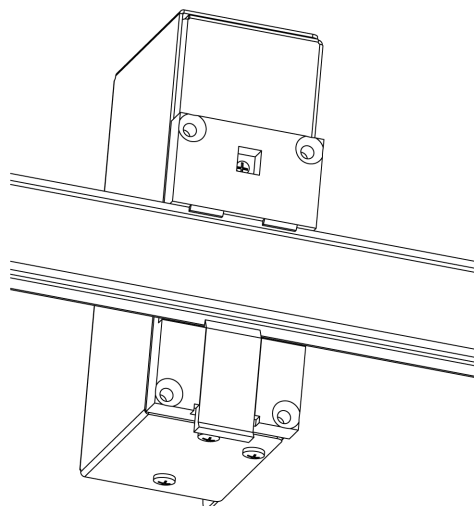
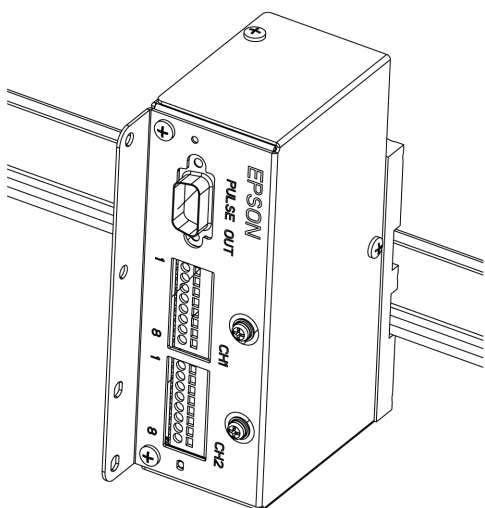
■ Placed vertically

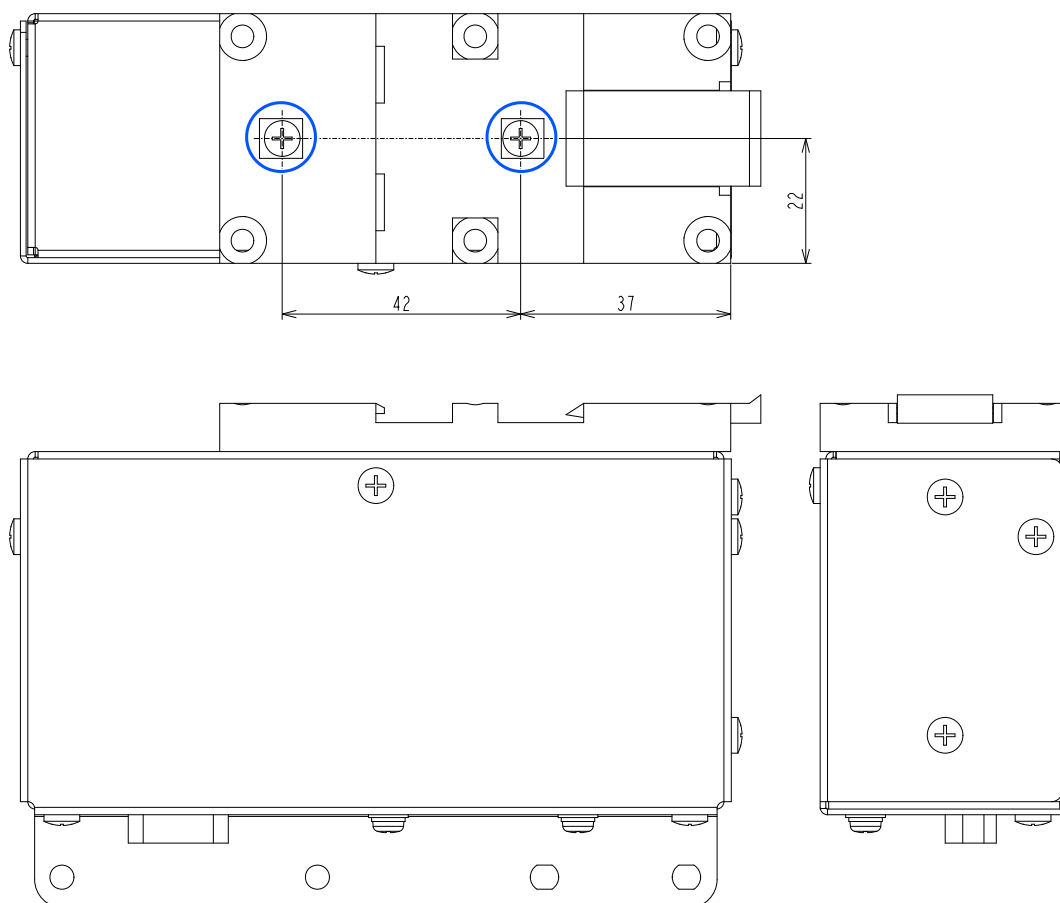
Install the included panel on the side of the unit, turn the unit 90 degrees, and use the securing holes on the included panel to secure the kit with screws.



■ DIN rail mounting

Mount a DIN rail mounting bracket on the commercial DIN rail mounting bracket securing holes on the rear of the unit, and then secure the kit to the DIN rail. We do not sell DIN rails or DIN rail mounting brackets. Please use commercially available products.





DIN rail securing bracket that has been confirmed for installation: TAKACHI DRA-1

4.1.1.2 PG (Pulse Generator) Board

4.1.1.2.1 PG Board Specifications

The table below shows the specification for the PG board.

Board Name	H756
Compatible Controller	RC800 Series(*1)/RC700 Series/RC90 Series
Encoder channels	4 channels / board
Encoder Type	ABZ phase differential input (RS-422 line receiver)
Input Pulse Rate	Max. 5 MPPS
Input Signal	Conveyor pulse latch input
Board Address	Set the DIP switch according the board number. (See DIP Switch Settings later in this chapter).
connector	DX10A - 100S (Hirose Electric Co. ,Ltd.)
External power supply	24V $\pm$ 2V 200mA or under

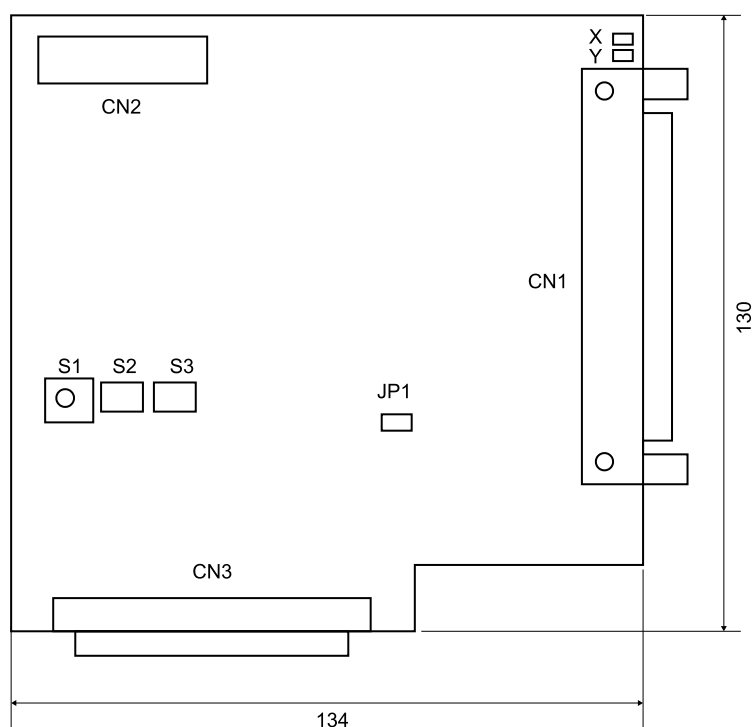
*1: Not supported by some of the RC800 series.

The following rotary encoder models have been tested:

- OMRON E6B2-CWZ1X

■ TAMAGAWA TS5312N512-2000C/T

The figure below shows the layout of the PG board.



4.1.1.2.2 DIP switch settings

The PG Board address is set by DIP switch (S2, S3). Set this according to the board number, as shown in the following table.

Board #	Address	S2				S3			
		1 (A15)	2 (A14)	3 (A13)	4 (A12)	1 (A11)	2 (A10)	3 (A9)	4 (A8)
1	1100h	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON
2	1200h	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF
3	1300h	OFF	OFF	OFF	ON	OFF	OFF	ON	ON
4	1400h	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF

If you purchased the PG board separately, place the attached Board No. Label sticker on the board panel prior to installation of the board in the Control Unit and keep a written record of the address setting and the board number.

If you have purchased the PG Board with the Control Unit, the board address has been set properly before shipment and further settings should not be necessary.

4.1.1.2.3 Jumper settings

The jumpers are reserved and should not be changed.

4.1.1.2.4 Rotary switch settings

The rotary switch S1 is reserved and should not be changed.

S1 : Position of 1

4.1.1.2.5 Signal Connections

The table below lists the connectors on the PG board and the compatible connectors for wiring:

Receptacle on the Board		DXA10A-100S (manufacturer: Hirose Electric Co., Ltd.)
Wiring Plug Connectors	Individually pressed-in type	DX30-100P (for AWG#30), DX30A-100P (for AWG#28)
	Pressed-in-as-a-whole type	DX31-100P (for AWG#30), DX31A-100P (for AWG#28)
	Soldered type	DX40-100P
Connector for Wiring to the Cover		DX-100-CV1

4.1.1.2.6 Signal Assignments: PG board connector (DX10A-100S)

The signals on the PG board connector are assigned as shown in the table below.

Pin	Dir	Signal	Description	Pin	Dir	Signal	Description
1	-	-	Not used	51	-	-	Not used
2	-	-	Not used	52	-	-	Not used
3	-	-	Not used	53	-	-	Not used
4	-	-	Not used	54	-	-	Not used
5	-	-	Not used	55	-	-	Not used
6	-	-	Not used	56	-	-	Not used
7	-	-	Not used	57	-	-	Not used
8	-	-	Not used	58	-	-	Not used
9	-	-	Not used	59	-	-	Not used
10	In	TRG1	Trigger input for Counter 1	60	-	-	Not used
11	In	TRG2	Trigger input for Counter 2	61	-	-	Not used
12	In	TRG3	Trigger input for Counter 3	62	-	-	Not used
13	In	TRG4	Trigger input for Counter 4	63	-	-	Not used
14	In	EXTV	External power supply for Input circuit	64	In	EXTVGND	External power supply GND for Input circuit
15	In	EXTV	External power supply for Input circuit	65	In	EXTVGND	External power supply GND for Input circuit
16	-	-	Not used	66	-	-	Not used
17	-	-	Not used	67	-	-	Not used
18	-	-	Not used	68	-	-	Not used
19	-	-	Not used	69	-	-	Not used
20	-	-	Not used	70	-	-	Not used

Pin	Dir	Signal	Description	Pin	Dir	Signal	Description
21	-	-	Not used	71	-	-	Not used
22	-	-	Not used	72	-	-	Not used
23	-	-	Not used	73	-	-	Not used
24	-	-	Not used	74	-	-	Not used
25	In	+A1	Phase +A signal for Counter 1	75	In	+A3	Phase +A signal for Counter 3
26	In	-A1	Phase -A signal for Counter 1	76	In	-A3	Phase -A signal for Counter 3
27	In	+B1	Phase +B signal for Counter 1	77	In	+B3	Phase +B signal for Counter 3
28	In	-B1	Phase -B signal for Counter 1	78	In	-B3	Phase -B signal for Counter 3
29	In	+Z1	Phase +Z signal for Counter 1	79	In	+Z3	Phase +Z signal for Counter 3
30	In	-Z1	Phase -Z signal for Counter 1	80	In	-Z3	Phase -Z signal for Counter 3
31	-	-	Not used	81	-	-	Not used
32	-	-	Not used	82	-	-	Not used
33	-	-	Not used	83	-	-	Not used
34	-	-	Not used	84	-	-	Not used
35	-	-	Not used	85	-	-	Not used
36	-	-	Not used	86	-	-	Not used
37	-	-	Not used	87	-	-	Not used
38	-	-	Not used	88	-	-	Not used
39	-	-	Not used	89	-	-	Not used
40	-	-	Not used	90	-	-	Not used
41	In	+A2	Phase +A signal for Counter 2	91	In	+A4	Phase +A signal for Counter 4
42	In	-A2	Phase -A signal for Counter 2	92	In	-A4	Phase -A signal for Counter 4
43	In	+B2	Phase +B signal for Counter 2	93	In	+B4	Phase +B signal for Counter 4
44	In	-B2	Phase -B signal for Counter 2	94	In	-B4	Phase -B signal for Counter 4
45	In	+Z2	Phase +Z signal for Counter 2	95	In	+Z4	Phase +Z signal for Counter 4
46	In	-Z2	Phase -Z signal for Counter 2	96	In	-Z4	Phase -Z signal for Counter 4

Pin	Dir	Signal	Description	Pin	Dir	Signal	Description
47	-	-	Not used	97	-	-	Not used
48	-	-	Not used	98	-	-	Not used
49	-	-	Not used	99	-	-	Not used
50	-	GND	GND	100	-	GND	GND

Pin # 25 to 30, 41 to 46, 75 to 80, 91 to 96

Connect the pin numbers shown above with encoder output (+A, -A, +B, -B, +Z, -Z).

Pins # 10 to 13

When the conveyor pulse is latched by external signal, connect the pin numbers shown above with latch signal.

Exactly when the signal is turned OFF to ON, the encoder pulse is latched.

Pins # 14, 15, 64 and 65

When using the pin # 10 to 13, connect external power with the pin numbers shown above.

When not using the pin # 10 to 13, it is not necessary to connect external power with the pin numbers shown above.

4.1.1.2.7 Signal Assignments: PG board connector terminal block 1

The signals on PG board connector terminal block 1 are assigned as shown in the table below. The pin numbers in parentheses are the pins on the PG board connector.

Pin	Signal	Description	Pin	Signal	Description
1 (16)	-	Not used	26 (32)	-	Not used
2 (17)	-	Not used	27 (33)	-	Not used
3 (18)	-	Not used	28 (34)	-	Not used
4 (19)	-	Not used	29 (35)	-	Not used
5 (20)	-	Not used	30 (36)	-	Not used
6 (21)	-	Not used	31 (37)	-	Not used
7 (22)	-	Not used	32 (38)	-	Not used
8 (23)	-	Not used	33 (39)	-	Not used
9 (24)	-	Not used	34 (40)	-	Not used
10 (25)	+A1	Phase +A signal for Counter 1	35 (41)	+A2	Phase +A signal for Counter 2
11 (26)	-A1	Phase -A signal for Counter 1	36 (42)	-A2	Phase -A signal for Counter 2
12 (27)	+B1	Phase +B signal for Counter 1	37 (43)	+B2	Phase +B signal for Counter 2
13 (28)	-B1	Phase -B signal for Counter 1	38 (44)	-B2	Phase -B signal for Counter 2
14 (29)	+Z1	Phase +Z signal for Counter 1	39 (45)	+Z2	Phase +Z signal for Counter 2
15 (30)	-Z1	Phase -Z signal for Counter 1	40 (46)	-Z2	Phase -Z signal for Counter 2

Pin	Signal	Description	Pin	Signal	Description
16 (31)	-	Not used	41(47)	-	Not used
17 (48)	-	Not used	42 (49)	-	Not used
18 (9)	-	Not used	43 (50)	GND	GND
19 (60)	-	Not used	44 (61)	-	Not used
20 (10)	TRG1	Trigger input for Counter 1	45 (11)	TRG2	Trigger input for Counter 2
21 (1)	-	Not used	46 (5)	-	Not used
22 (2)	-	Not used	47 (6)	-	Not used
23 (3)	-	Not used	48 (7)	-	Not used
24 (4)	-	Not used	49 (8)	-	Not used
25 (14)	EXTV	External power supply	50 (64)	EXTVGND	External power supply ground

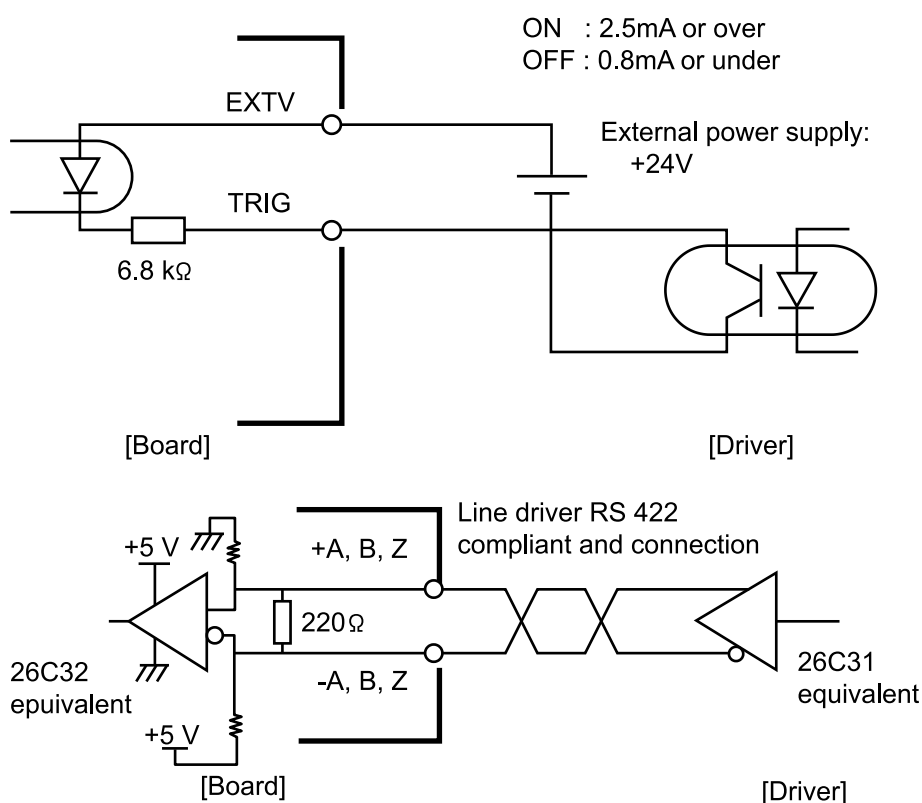
4.1.1.2.8 Signal Assignments: PG board connector terminal block 2

The signals on PG board connector terminal block 2 are assigned as shown in the table below. The pin numbers in parentheses are the pins on the PG board connector.

Pin	Signal	Description	Pin	Signal	Description
1 (66)	-	Not used	26 (82)	-	Not used
2 (67)	-	Not used	27 (83)	-	Not used
3 (68)	-	Not used	28 (84)	-	Not used
4 (69)	-	Not used	29 (85)	-	Not used
5 (70)	-	Not used	30 (86)	-	Not used
6 (71)	-	Not used	31 (87)	-	Not used
7 (72)	-	Not used	32 (88)	-	Not used
8 (73)	-	Not used	33 (89)	-	Not used
9 (74)	-	Not used	34 (90)	-	Not used
10 (75)	+A3	Phase +A signal for Counter 3	35 (91)	+A4	Phase +A signal for Counter 4
11 (76)	-A3	Phase -A signal for Counter 3	36 (92)	-A4	Phase -A signal for Counter 4
12 (77)	+B3	Phase +B signal for Counter 3	37 (93)	+B4	Phase +B signal for Counter 4
13 (78)	-B3	Phase -B signal for Counter 3	38 (94)	-B4	Phase -B signal for Counter 4
14 (79)	+Z3	Phase +Z signal for Counter 3	39 (95)	+Z4	Phase +Z signal for Counter 4
15 (80)	-Z3	Phase -Z signal for Counter 3	40 (96)	-Z4	Phase -Z signal for Counter 4
16 (81)	-	Not used	41 (97)	-	Not used
17 (98)	-	Not used	42 (99)	-	Not used
18 (59)	-	Not used	43 (100)	GND	GND

Pin	Signal	Description	Pin	Signal	Description
19 (62)	-	Not used	44 (63)	-	Not used
20 (12)	TRG3	Trigger input for Counter 3	45 (13)	TRG4	Trigger input for Counter 4
21 (51)	-	Not used	46 (55)	-	Not used
22 (52)	-	Not used	47 (56)	-	Not used
23 (53)	-	Not used	48 (57)	-	Not used
24 (54)	-	Not used	49 (58)	-	Not used
25 (15)	EXTV	External power supply	50 (65)	EXTVGND	External power supply ground

4.1.1.2.9 Encoder Input Circuit



4.1.2 Wiring Example of Vision Conveyor Tracking System

Example of Hardware Trigger (Asynchronous Reset Mode)

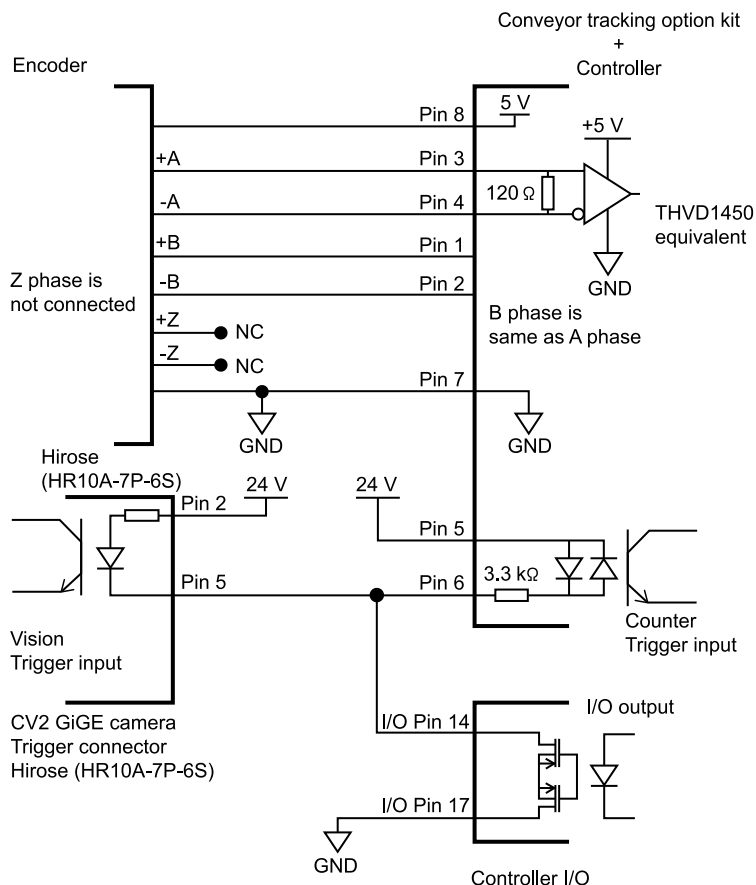
Wire the trigger terminal of the camera and the encoder latch terminal of the PG board to the I/O output of the controller. The PG board detects the trigger when the I/O output turns from OFF to ON. Set the camera so that it also detects the trigger when the I/O output turns from OFF to ON.

For software trigger, it is not necessary to connect the trigger terminal of the camera to the encoder latch terminal of the PG board.

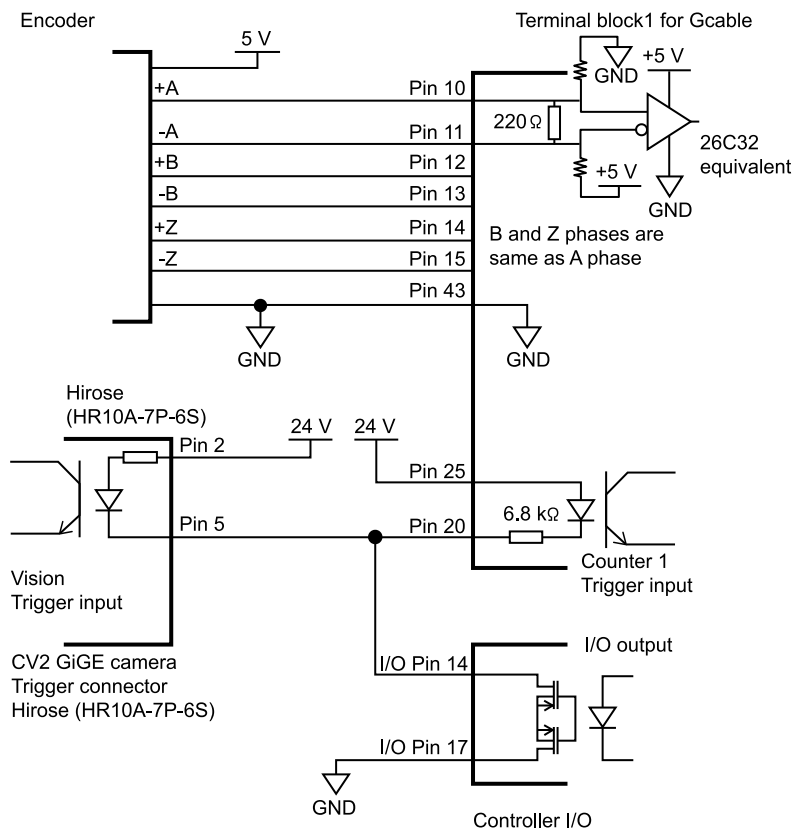
Wiring example of the hardware conveyor trigger

(CV2, Controller I/O output pin10 and Counter 1 are used)

- When using conveyor tracking option kit B



- When using PG board



4.2 Software Configuration

4.2.1 Conveyor Encoder Configuration

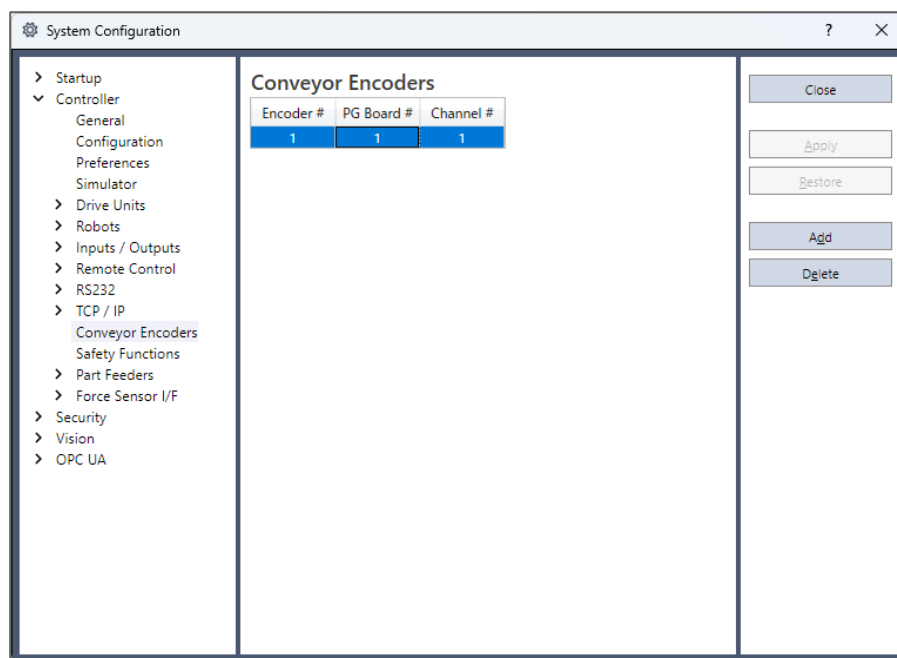
4.2.1.1 How to set the user-defined output remote I/O

Before you can create any conveyors in a project, you must add conveyor encoders to the system. Each physical conveyor must have an encoder.

Before setting up, wire the encoder to the PULSE IN connector on the control unit. If using a Controller without a PULSE IN connector, install one PG board for every four encoders and wire the encoders to the board(s).

If the encoder is wired using a PG board, set up the conveyor encoder. If the encoder is wired to the PULSE IN connector, no setup is required.

To define system encoders in Epson RC+, select [Setup]-[System Configuration] and select the [Conveyor Encoders].



Click the [Add] button to add an encoder. Encoders are added in the order of Axis number.

You can delete the last encoder in the list. Select it, then click the [Delete] button.

4.2.1.2 Verifying Encoder Operation

After wiring the encoders, add them to Epson RC+ as described in the previous section. Next, confirm the operation by following the steps below.

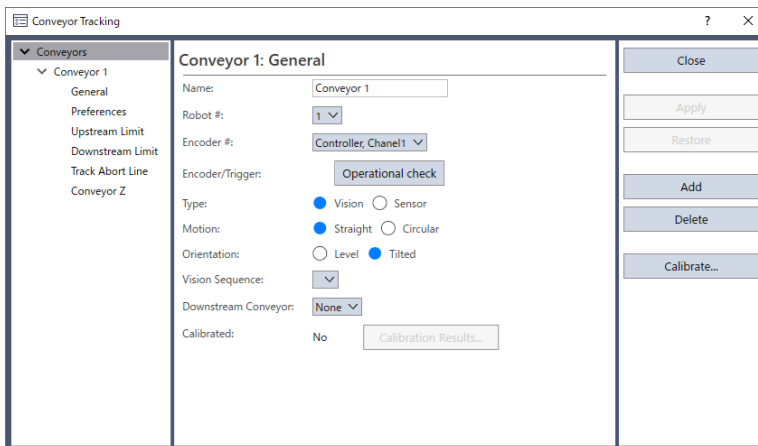
1. Start Epson RC+.
2. Create a new project called "TestCnv".
3. Set up the conveyor, using the information below for reference.

Creating Conveyors in a Project

- Encoder: Controller, Counter 1
- Type: Sensor

Select the encoder according to the actual wiring.

Make sure to perform the calibration, otherwise the conveyor tracking system cannot work properly. When you only check the encoder operation, it is not necessary to calibrate the conveyors.



- The pulse value can be read from the specified encoder by using the [Operational check] button and the Cnv_Pulse function in the program or command window.

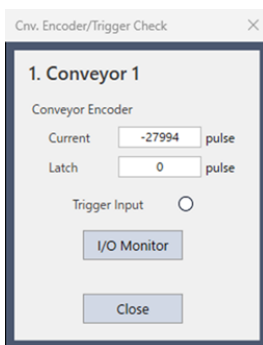
Using the check operation window

The conveyor tracking operation check window is only available with Epson RC+ Standard Edition and above.

The following screen appears when you click the [Operational check] button.

Operate the conveyor and check that the current value of the conveyor encoder changes.

After confirming, click the [Close] button.



Using the command window

Execute the following output statements in the command window to read the pulses from the encoder.

Next, operate the conveyor and execute the same command again to verify that the encoder pulse value has changed.

```
>Print Cnv_Pulse(1)
```

KEY POINTS

The above is an example of a command when the conveyor tracking number is 1.

Using a program

Run the program below and operate the conveyor. When the conveyor starts moving, the value of Cnv_Pulse will be changed.

If you are unable to acquire or update the encoder pulse value, check the encoder wiring.

```
Function main
Do
    Print Cnv_Pulse(1)
    Wait .5
Loop
End
```

KEY POINTS

If the setting screen was closed before performing calibration, run [Project] - [Rebuild].

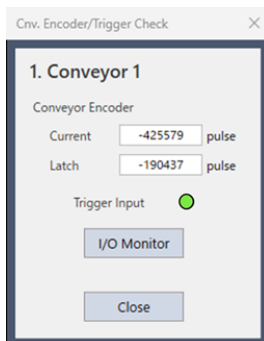
4.2.1.3 Verifying Hardware Conveyor Trigger / Vision Trigger

Verifying the Hardware Conveyor Trigger

■ Using the check operation window

The conveyor tracking operation check window is only available with Epson RC+ Standard Edition and above.

1. Click the [Operational check] button.
2. Operate the conveyor and check that the current value of the conveyor encoder changes.
3. While the conveyor is moving, turn on the I/O output number to which you wired the trigger to latch the encoder pulse.
4. Confirm that the [Trigger Input] lamp is lit and the conveyor encoder latch value changes.



- If the [Trigger Input] lamp does not light up and the latch value does not change, check the wiring of the hardware trigger.

■ Using the command window

1. Move the conveyor and stop it.
2. Check the encoder pulse. Enter the following to the command window.

```
> Print CnvPulse (Conveyor number)
```

3. Turn ON the I/O output number which the trigger is wired to. Latch the encoder pulse.
4. Check the latch pulse. Enter the following to the command window.

```
> Print Cnv_LPulse (Conveyor number)
```

- If the same value as obtained in the Step 2 is latched, the verification is completed.

- If not, check the hardware conveyor trigger wiring.

Verifying the Vision Trigger

1. Set the RuntimeAcquire property of the vision sequence to “Strobed” and the TriggerMode property to “Leading”.
2. Execute the vision sequence and put it into the trigger waiting state.
3. Turn ON the I/O output number which the trigger is wired to and release the shutter.
 - If the captured image is displayed on the VisionGuide window, the verification is completed.
 - If not, check the vision trigger wiring.

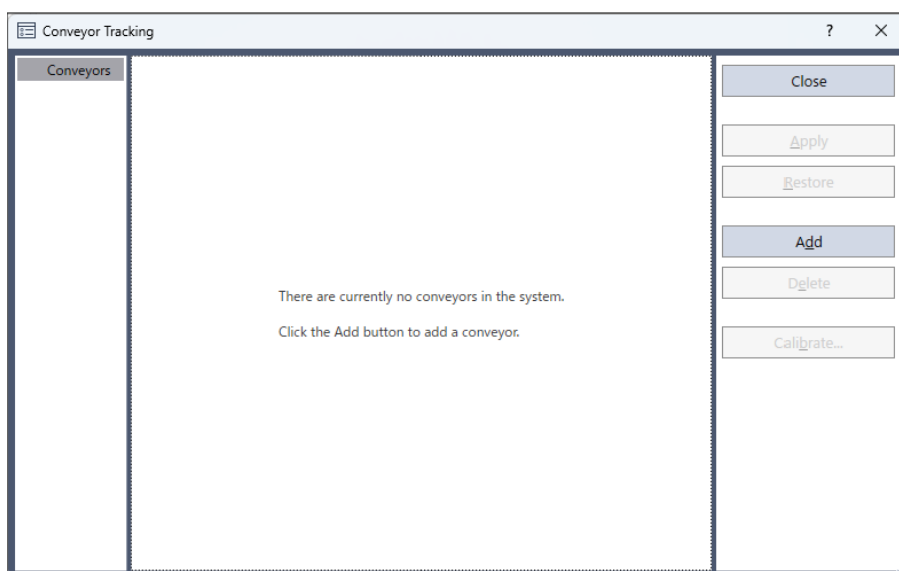
4.2.2 Creating Conveyors in a Project

Conveyors are configured for each Epson RC+ project. Up to 16 conveyors can be created per project. A conveyor is a logical entity that combines a robot with one or more conveyors.

There are two types of conveyors: vision and sensor. If you will be using a vision camera to find the parts on the conveyor, you must first create a vision sequence to find the parts. This vision sequence is required when you define the conveyor.

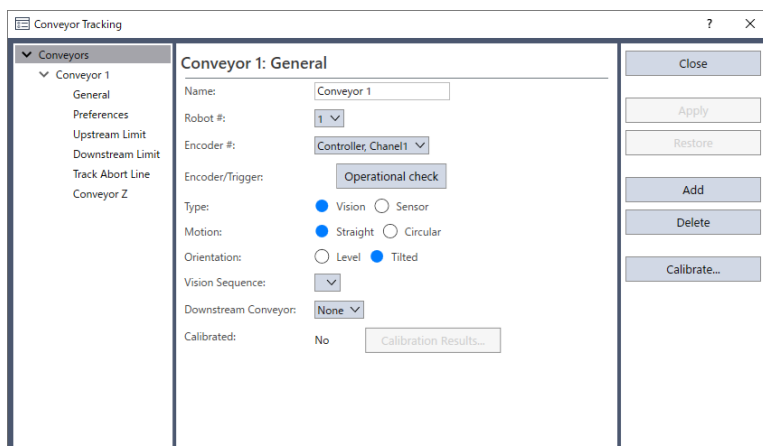
To add a conveyor to a project

1. Select [Tools]-[Conveyor Tracking] to open the [Conveyor Tracking] configuration dialog.



2. To add a conveyor, click the [Add] button.

The dialog shown below appears.



3. Enter a name for the conveyor, then specify the Robot #, Encoder #, Type, Motion, and Orientation.

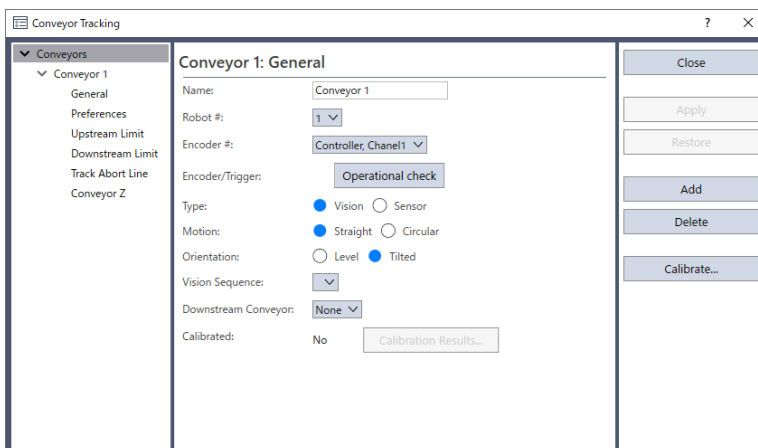
KEY POINTS

- A default conveyor name is created automatically when a new conveyor is added. You can change the name as desired.
- When you use a straight conveyor, select "Line" for [Motion].
- When you use a circular conveyor, select "Circular" for [Motion].

4.2.3 Configuring Conveyors

After a conveyor has been created, you can set its parameters.

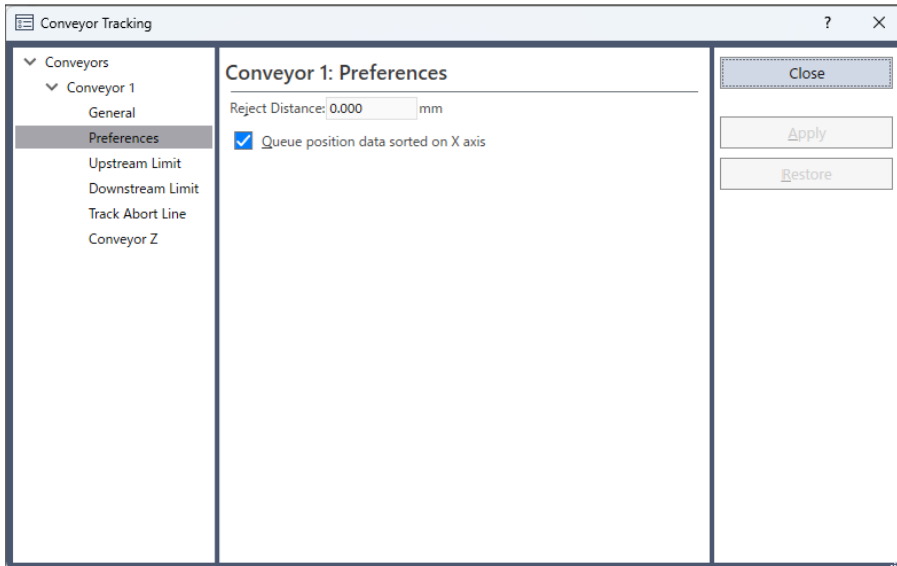
1. Select [Tools]-[Conveyor Tracking].
2. Select the conveyor you want to edit.
3. There are three setup pages shown in the tree under each conveyor: [General], [Preferences], [Upstream Limit], [Downstream Limit], and [Conveyor Z].
 - To change the [Upstream Limit] and [Downstream Limit], refer to 16.16 Pickup Area Changing the Upstream / Downstream limits positions.
 - To change the settings of Reject Distance and queue position data sort, click on [Preferences].
 - To change other parameters, click on [General].
4. Click on [General] or [Preferences]. The dialog shown below appears. Edit any of the configuration options.



The screenshot shows the 'Conveyor Tracking' dialog box with the 'General' tab selected for 'Conveyor 1'. The left sidebar lists the available tabs: General, Preferences, Upstream Limit, Downstream Limit, Track Abort Line, and Conveyor Z. The main area contains the following configuration options:

- Name:** Conveyor 1
- Robot #:** 1
- Encoder #:** Controller, Chane1
- Encoder/Trigger:** Operational check
- Type:** Vision (selected), Sensor
- Motion:** Straight (selected), Circular
- Orientation:** Level, Tilted (selected)
- Vision Sequence:** (dropdown menu)
- Downstream Conveyor:** None
- Calibrated:** No, with a 'Calibration Results...' button

On the right side of the dialog, there are buttons for 'Close', 'Apply', 'Restore', 'Add', 'Delete', and 'Calibrate...'.



5. Click [Apply] to save changes.

KEY POINTS

If you changed Robot #, Encoder #, Orientation, Type, or Vision Sequence, you need to calibrate the conveyor again.

The following table explains the parameters you can edit in the [General] and [Preferences] pages.

Name	You can name conveyors. There is a restriction on the number of characters to be input. Up to 16 bytes
Robot #	You can select a robot that is configured.
Encoder #	You can select an encoder that is configured. Select by encoder number.
Type	You can select vision type and sensor type. ■ Vision: Detects workpieces using a camera. ■ Sensor: Detects workpieces using a sensor.
Motion	You can select the conveyor motion; Straight conveyor or Circular conveyor.
Orientation	When you selected Straight conveyor, you can specify if the conveyor is level or tilted. Tilted is set by default. Normally you don't have to change it. ■ Tilted: Conveyor slope is detected during the calibration. No special usage conditions apply. ■ Level: Conveyor slope is not detected during the calibration. You need to observe the following: ■ The conveyor must be level with the robot X and Y planes.
Vision Sequence	Select a vision sequence for the calibration. This is only necessary when using the vision type.
Downstream Conveyor	When two or more conveyors have been set, you can select a conveyor number for the downstream conveyor.

Calibrate...	Click this button to execute the calibration. The calibration procedure is different for each type and conveyor orientation.
Adjusting the Z value	After the calibration is completed, you can calibrate the Z coordinate value of the conveyor again.
Reject Distance	You can set distance to prevent the duplicate registration of workpieces on conveyors. ▪ The distance also can be set from the SPEL program using the Cnv_QueReject command. ▪ If the distance is different from the one set by Cnv_QueReject command, the Cnv_QueReject command setting has precedence.
Queue position data sorted on X axis	You can select whether to sort the queue or not.

KEY POINTS

After the calibration, change the parameters for Robot #, Encoder #, Type, Motion, Orientation, Vision Sequence, Adjust Z, and Upstream/Downstream limit.

4.2.4 Vision Conveyors

A vision conveyor uses a camera to locate parts that will be retrieved by one or more robots. In this section, instructions are provided for vision conveyor calibration.

The straight conveyor and the circular conveyor have different calibration methods.

4.2.4.1 Vision conveyor camera and lighting

It is important to choose the correct camera and lighting for the vision conveyors used in your application.

For applications with a slow moving conveyor and non-critical pick up constraints, you may be able to use a Vision Guide camera and simple lighting with no strobe.

For applications with fast moving parts, you will need to use a camera that is capable of asynchronous reset along with a strobe lamp.

4.2.4.2 Vision calibration sequence

Before you can calibrate a vision conveyor, you must first create a calibration sequence.

KEY POINTS

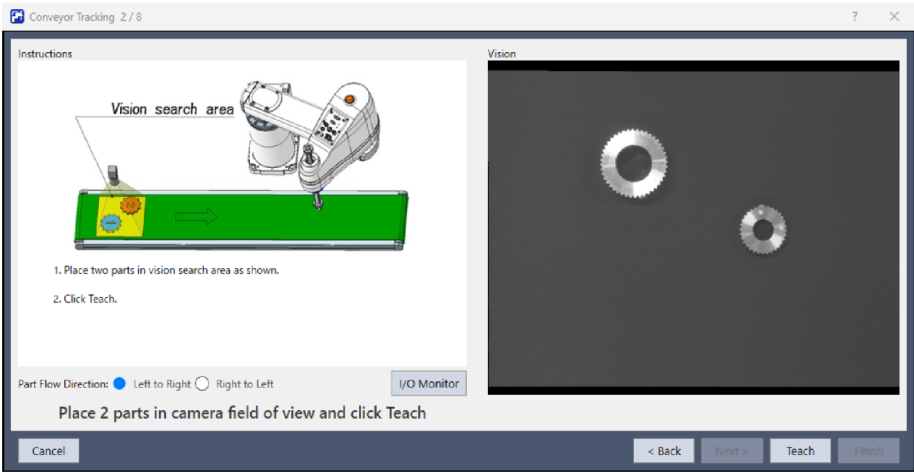
To accurately locate the feature points of the workpiece, see the following.

- [Tips for Vision Calibration](#)
- [Tips for Conveyor Calibration](#)

This sequence is used by the system during the calibration process and must be linked to a camera calibration. The conveyor system commands use camera coordinates in millimeters. Although you can use any type of Vision Guide camera calibration, you only need to use a Standalone calibration.

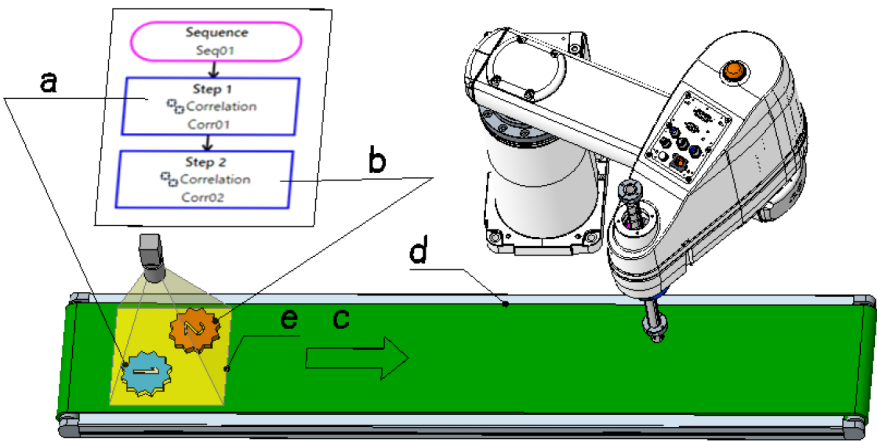
The calibration sequence needs a sequence that uses one object for each workpiece.

Place two workpieces on the conveyor as shown below.



It is recommended to place the two parts diagonally in the field of view. Also, the first object of a sequence must be taught with the robot as Part 1. The second object of a sequence must be taught with the robot as Part 2.

To make it as easy as possible for operators to calibrate the conveyor, the parts that will be found in the vision sequence should be located such that part 2 is after part 1 in the direction of part flow. In the figure below, object 1 in the vision sequence is Corr01, which locates Part 1. Object 2 is Corr02, which locates Part 2.



Symbol	Description
a	Work 1
b	Work 2
c	Direction of the conveyor motion
d	Conveyor
e	Vision search area.

 **KEY POINTS**

When calibrating the vision conveyor tracking, pay attention to the followings to calibrate properly.

- Link Workpiece 1 with Vision Sequence 1, and Workpiece 2 with Vision Sequence 2 in the settings.

■ As the workpiece placement in Vision Guide changes according to the camera orientation, check which is Workpiece 1 in Vision Guide beforehand.

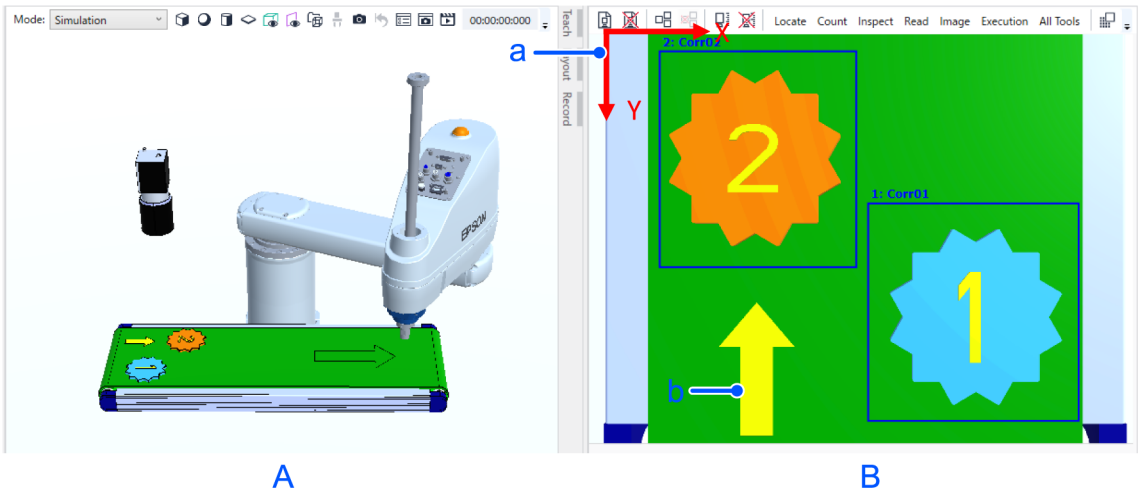
The figure below shows an example of how the position of the workpiece displayed in Vision Guide changes depending on the camera orientation.

For details about the Vision Guide coordinate system, see below.

"Vision Guide 8.0 Software - Vision Guide Overview - Coordinate System"

Camera installation example 1

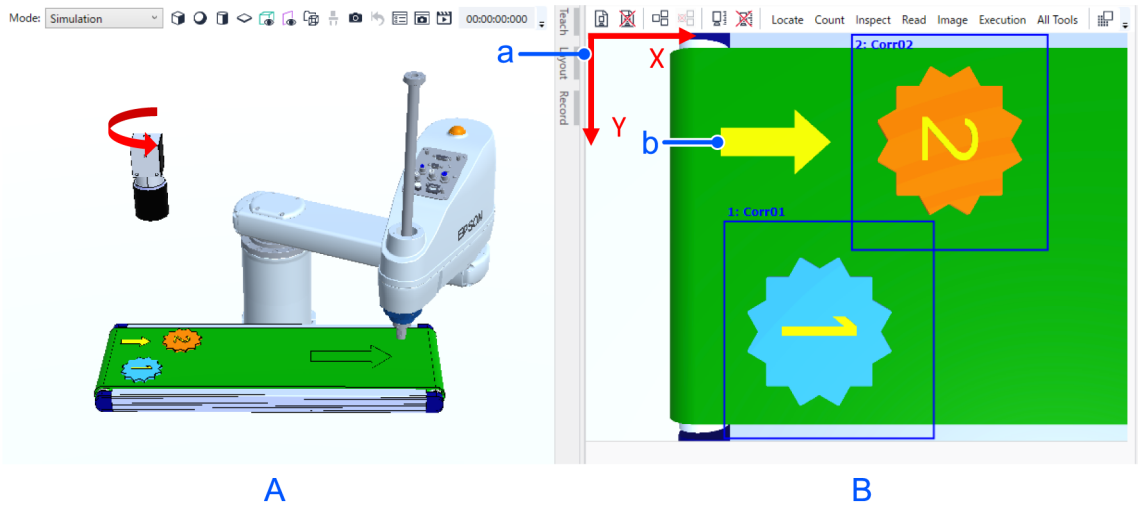
Workpieces 1 and 2 are displayed vertically on the Vision screen.



Symbol	Description
A	Camera Installation diagram
B	Vision screen
a	Image coordinate system in Vision
b	Direction of the conveyor motion

Camera installation example 2

When the camera is rotated 90° from the state in camera installation example 1. Workpieces 1 and 2 are displayed horizontally on the Vision screen.



Symbol	Description
A	Camera Installation diagram
B	Vision screen
a	Image coordinate system in Vision
b	Direction of the conveyor motion

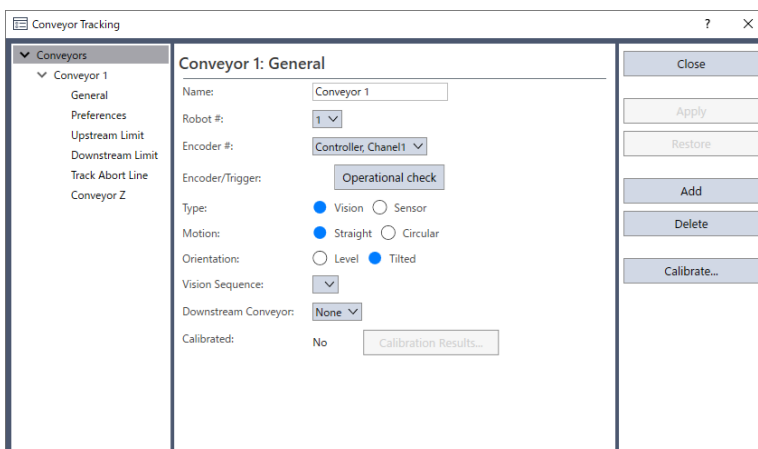
4.2.4.3 Vision Conveyor Calibration (Straight Conveyor)

Follow these steps to calibrate a straight vision conveyor:

KEY POINTS

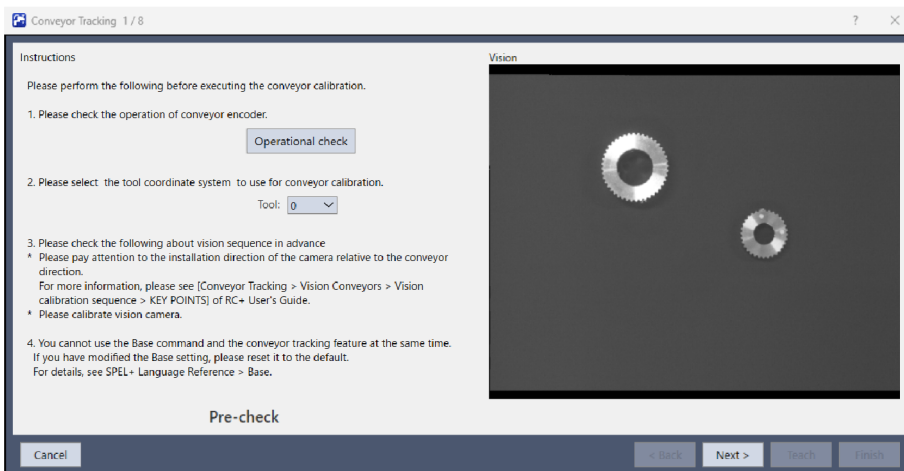
- When teaching part positions with the robot during calibration, it is important to position X, Y, and Z of each point accurately. The conveyor is calibrated in X, Y, Z, U, V, and W. To accurately perform teaching, see the following.
Tips for Conveyor Calibration
- In step 15 (Set the upstream limit) and 17 (Set the downstream limit), set as wide distance as possible between the upstream limit and downstream limit. This allows for more accurate calibration. After the calibration, adjust the Pickup Area by resetting the upstream / downstream limits.
- For the level orientation, it determines the conveyor height with the position of robot end effector taught in the step 12. It cannot be used for the tilted conveyor for it does not detect the conveyor slope. Steps 19 to 20 are not displayed.
- For the tilted orientation, it calibrates the conveyor slope with the position of robot end effector taught in the steps 12, 14, 16, 18, and 20.

1. Select [Tools]-[Conveyor Tracking].
2. Select the conveyor you want to calibrate.
3. Select [Vision] for the [Type].



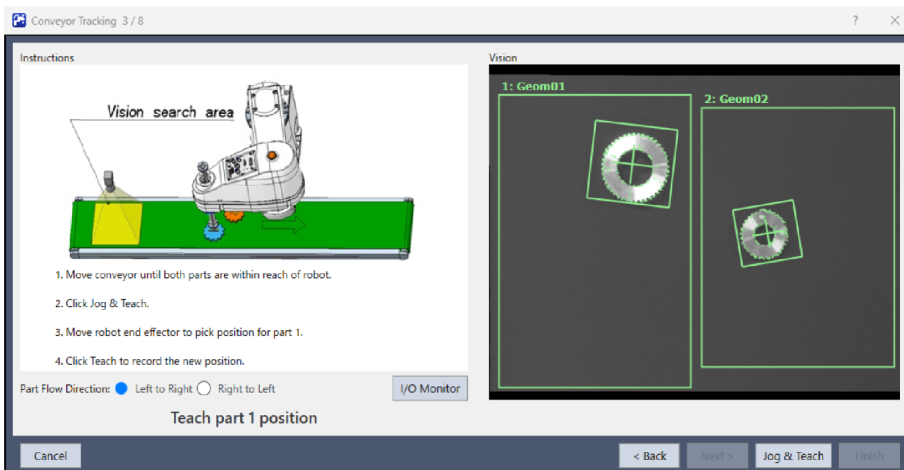
4. Set the [Vision Sequence].
5. Click the [Apply] button.

6. Click the [Calibrate] button. The [Conveyor Tracking Calibration] wizard is displayed. Follow the instructions displayed on the screen to confirm the settings of the conveyor encoder, the tool coordinate system, and the vision sequence.



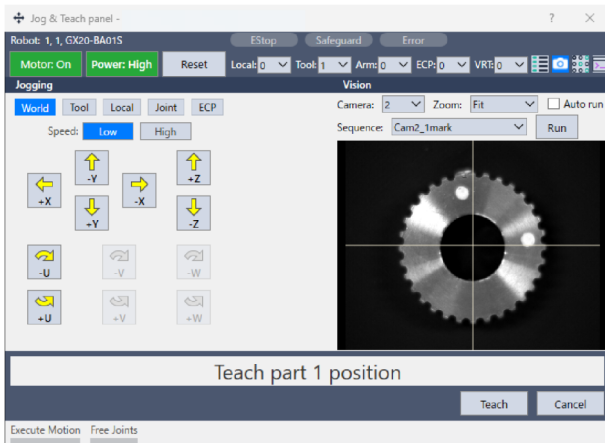
7. Select the [Part Flow Direction] to best match the conveyor you are calibrating. The instruction pictures will change according to the setting. [Part Flow Direction] is only used to aid in the instructions. It has no effect on the calibration.
8. Place two parts on the conveyor as shown in the figure in the wizard.
9. Check the live video in [Vision]. The camera orientation may not be the same as the picture.
10. Arrange the parts to be inside the range correctly and click the [Teach] button.
11. Move the conveyor until both parts are within reach of the robot. Do not move the parts, only the conveyor. Proper calibration cannot be performed unless the encoder pulse count value changes according to the workpiece position.

Click the [Jog & Teach] button.

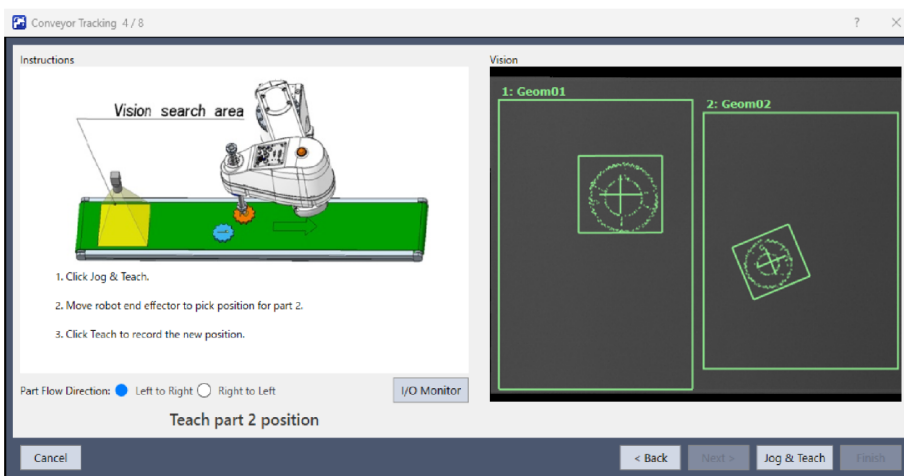


12. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position for Part 1.

Click the [Teach] button.

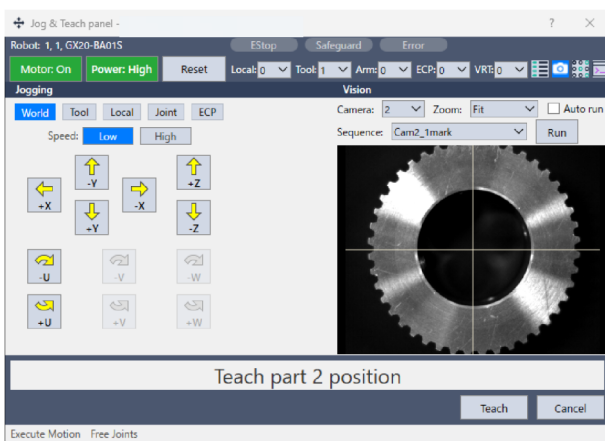


13. Click the [Jog & Teach] button.



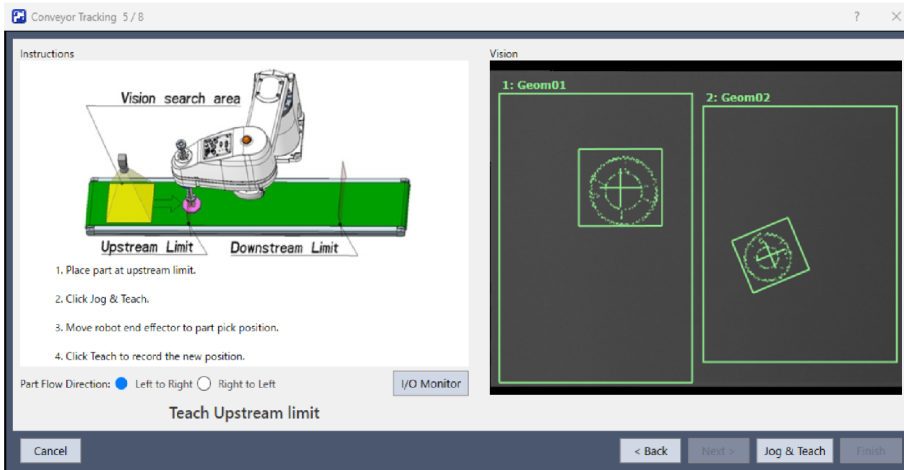
14. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position for Part 2.

Click the [Teach] button.



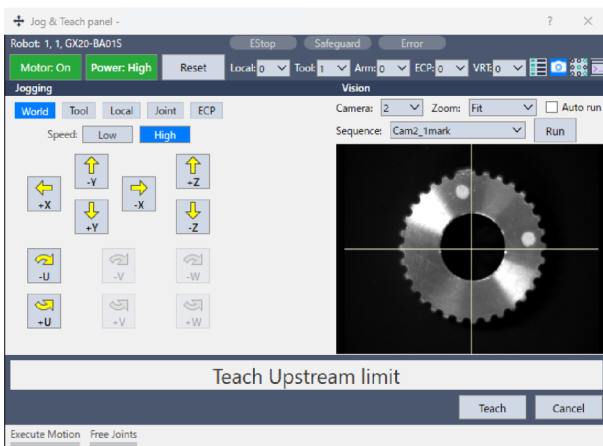
15. Now move or place the part at the upstream limit. The [Vision] image has not been updated from step 13. You can execute one work like [Instructions].

Click the [Jog & Teach] button.



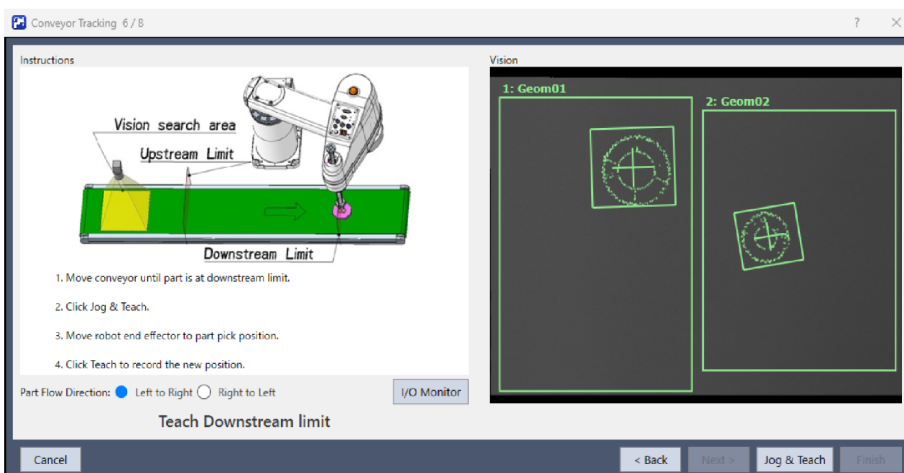
16. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector above the part.

Click the [Teach] button.



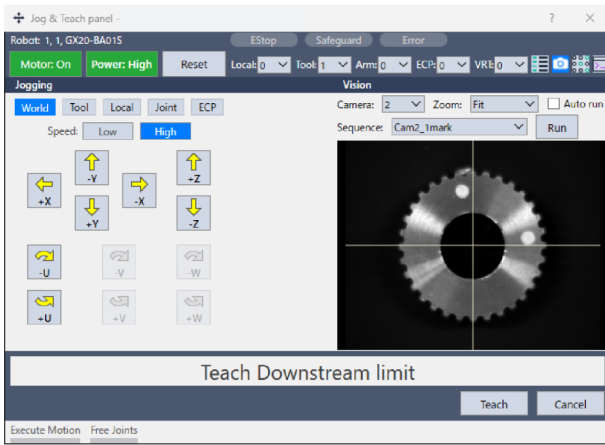
17. Move the conveyor so the part is at the downstream limit. Do not move the parts, only the conveyor. Proper calibration cannot be performed unless the encoder pulse count value changes according to the workpiece position.

Click the [Jog & Teach] button.



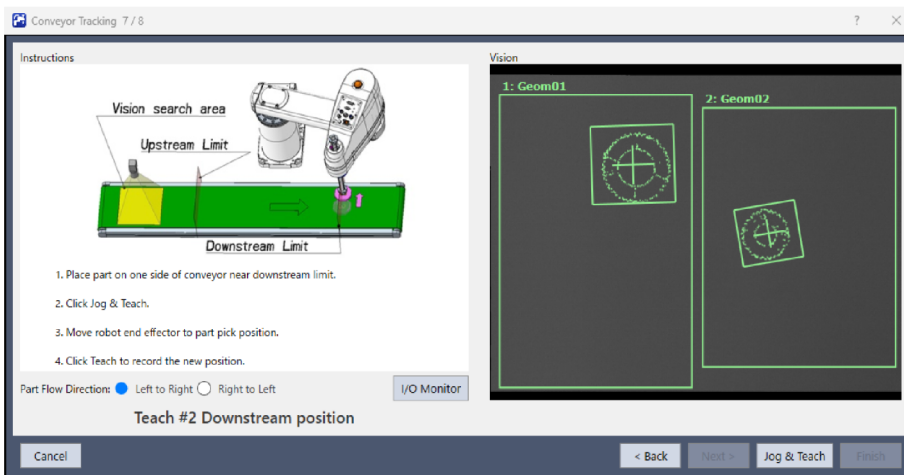
18. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector above the part.

Click the [Teach] button.



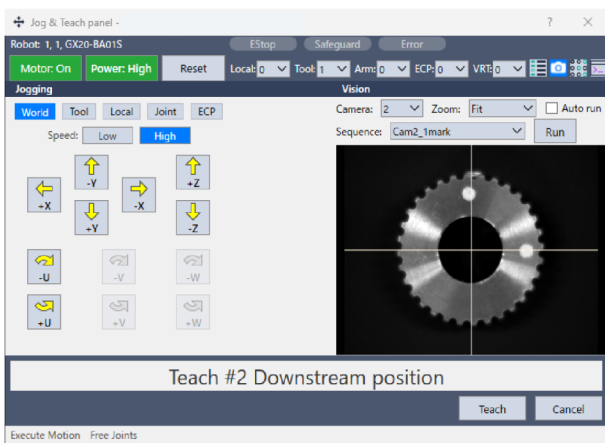
19. Place the workpiece at the end of the conveyor near the downstream limit. This point is used to determine the tilt of the conveyor from side to side.

Click the [Jog & Teach] button.



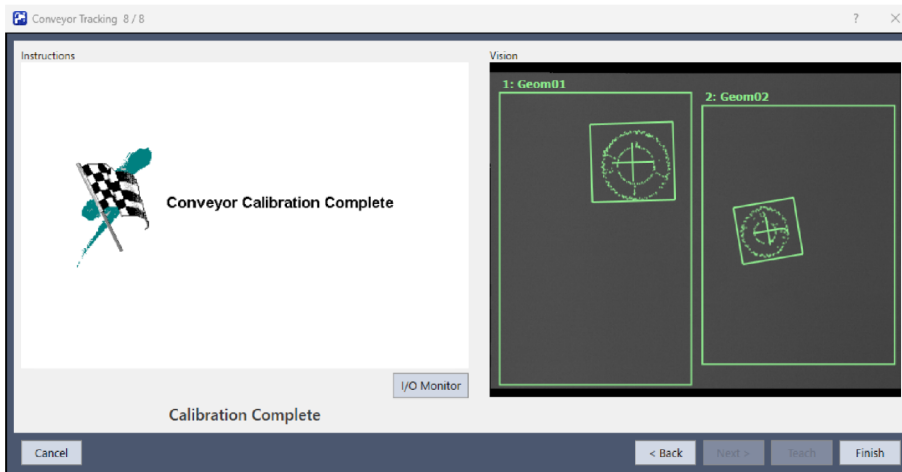
20. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position.

Click the [Teach] button.



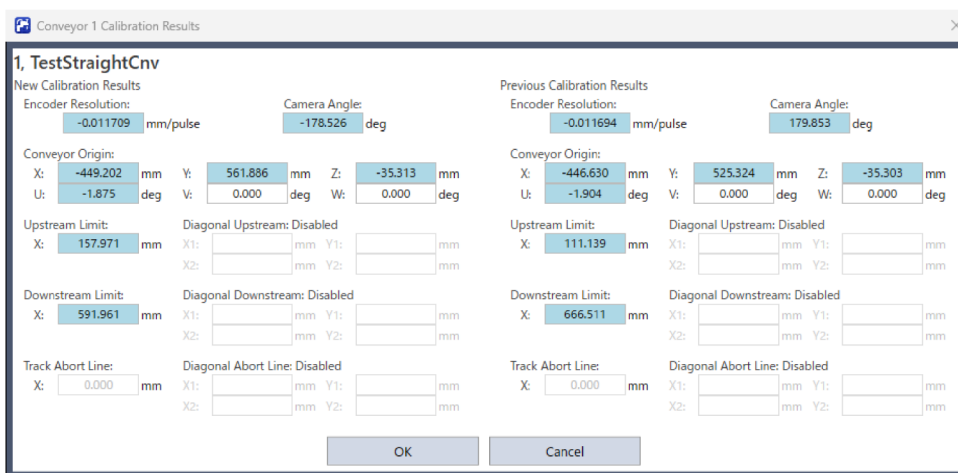
21. The calibration complete picture will be displayed.

Click the [Finish] button.



22. The Calibration Results screen is displayed.

- Click the [OK] button to complete the calibration.
- Click the [Cancel] button to return to the Calibration Complete screen in step 21.



4.2.4.4 Vision Conveyor Calibration (Circular Conveyor)

Follow these steps to calibrate a circular vision conveyor:

KEY POINTS

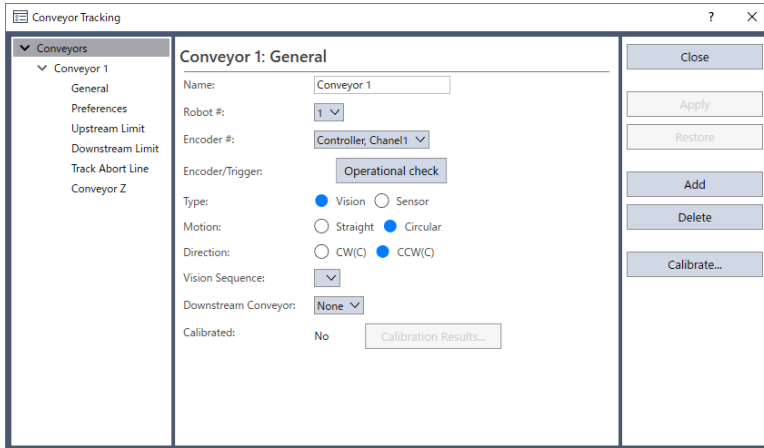
- When teaching part positions with the robot during calibration, it is important to position X, Y, and Z of each point accurately. The conveyor is calibrated in X, Y, Z, U, V, and W. To accurately perform teaching, see the following.
Tips for Conveyor Calibration
- In steps 13, 17, and 19, move the robot directly above workpiece 1 and teach the position. To perform an accurate calibration, set as wide a distance as possible between the points to be taught in steps 13, 17, and 19.

- Select [Tools]-[Conveyor Tracking].
- Select the conveyor you want to calibrate.
- Select [Vision] for the [Type].
- Select [Circular] for the [Motion].

5. Select the conveyor rotating direction for the [Direction].

KEY POINTS

Be careful not to calibrate with a wrong direction, otherwise, the robot will not track the parts.



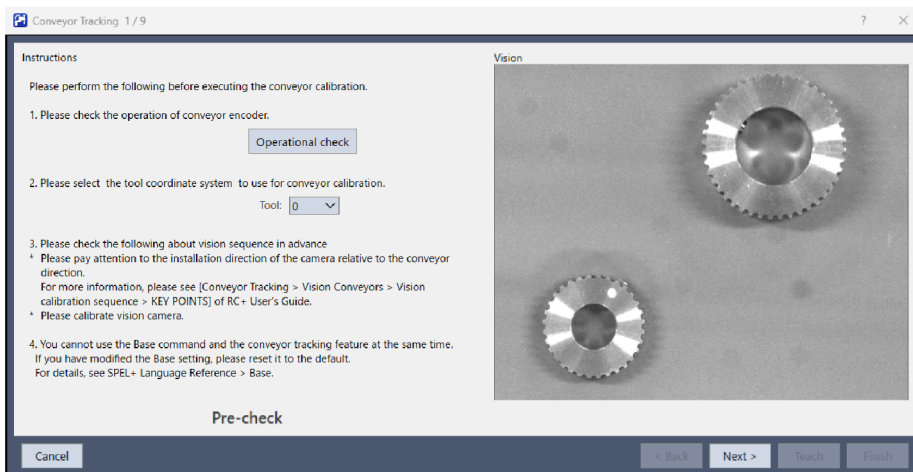
6. Set the [Vision Sequence].

7. Click the [Apply] button.

8. Click the [Calibrate] button.

The [Conveyor Tracking Calibration] wizard is displayed.

Follow the instructions displayed on the screen to confirm the settings of the conveyor encoder, the tool coordinate system, and the vision sequence.

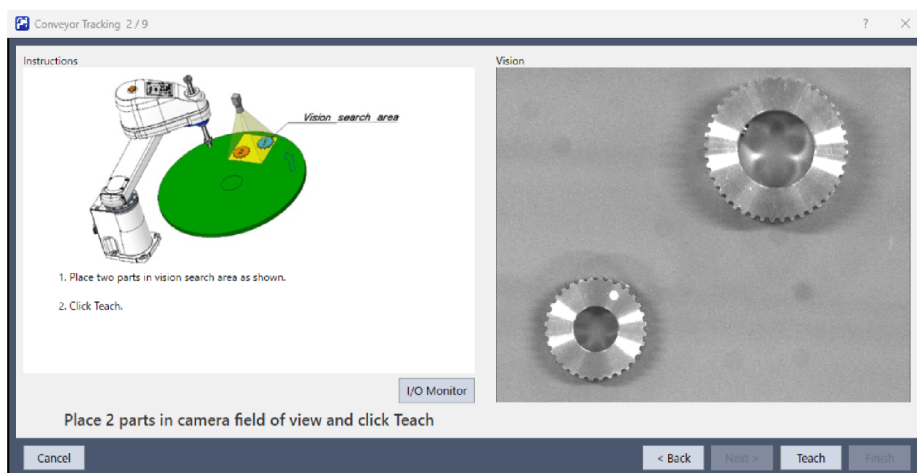


9. Check if the conveyor direction shown in the wizard is the same as the conveyor you want to use.

10. Place two parts on the conveyor as shown in the figure in the wizard.

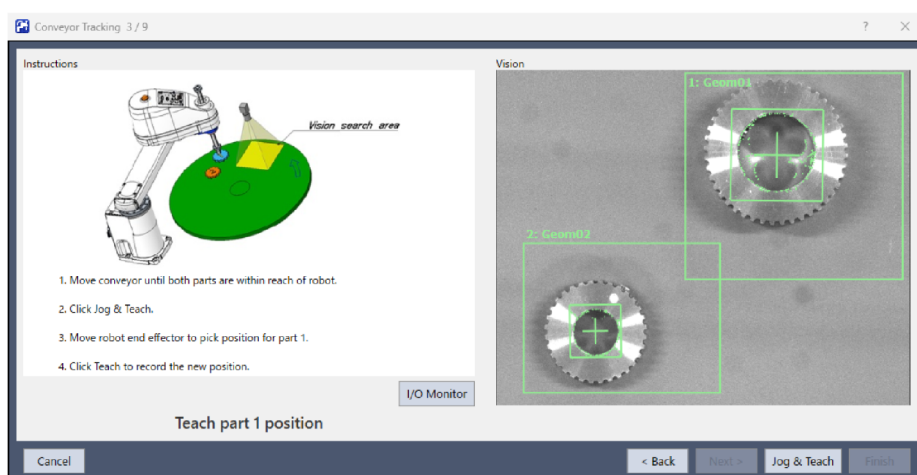
11. Select the [Vision] tab to see live video. The camera orientation may not be the same as the picture.

12. Arrange the parts to be inside the range correctly and click the [Teach] button.



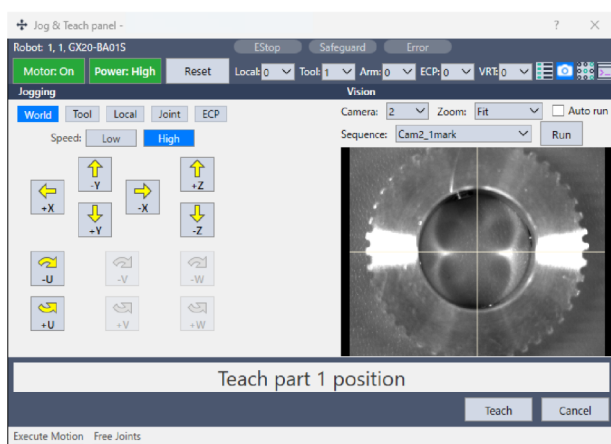
13. Move the conveyor until both parts are within reach of the robot. Do not move the parts, only the conveyor. Proper calibration cannot be performed unless the encoder pulse count value changes according to the workpiece position.

Click the [Jog & Teach] button.

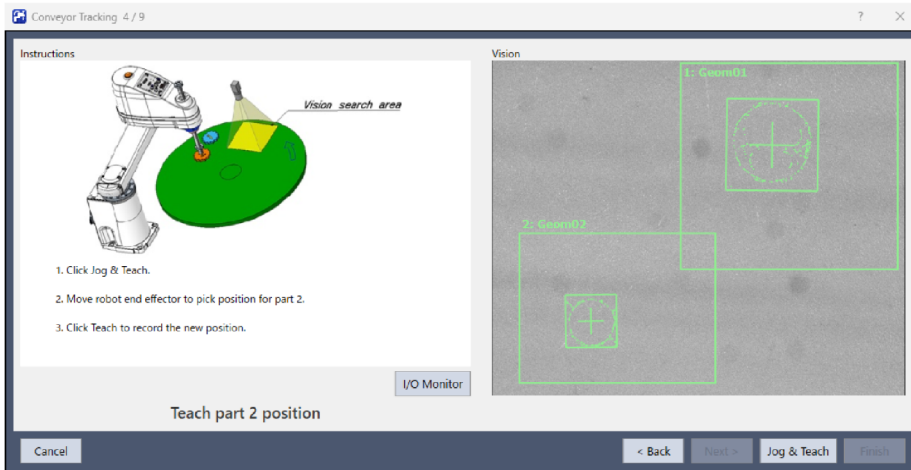


14. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position for Part 1.

Click the [Teach] button.

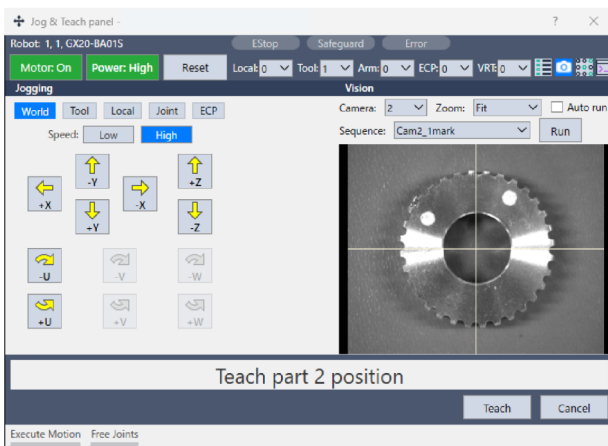


15. Click the [Jog & Teach] button.



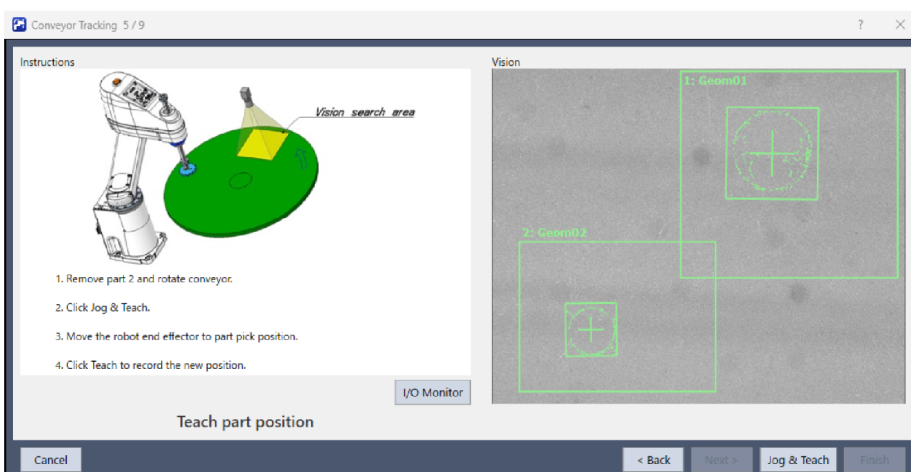
16. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position for Part 2.

Click the [Teach] button.



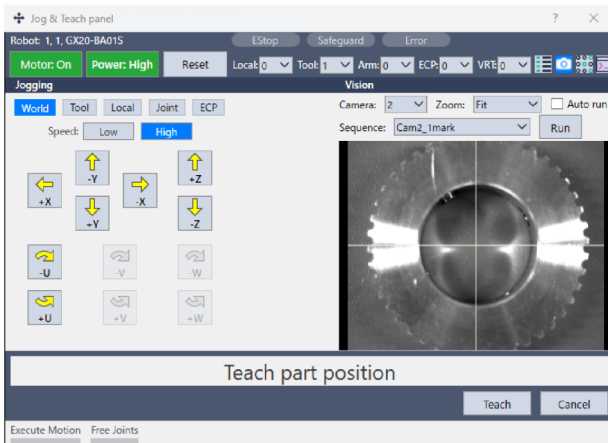
17. Remove Part 2. Move the conveyor to move Part 1.

Click the [Jog & Teach] button.



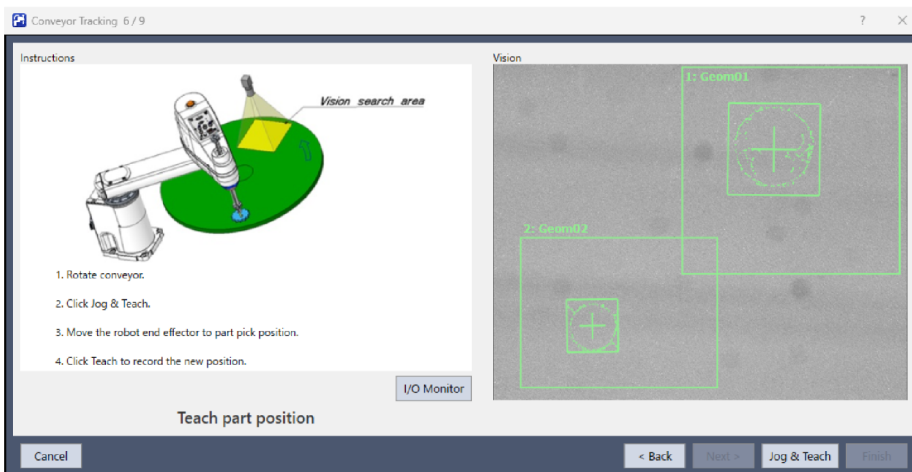
18. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position.

Click the [Teach] button.



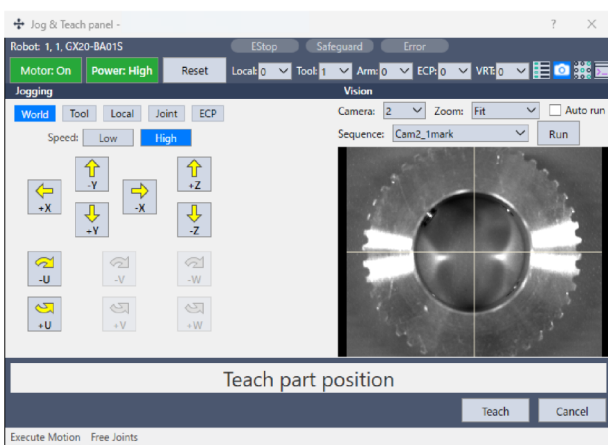
19. Move the conveyor by hand to move Part 1. Proper calibration cannot be performed unless the encoder pulse count value changes according to the workpiece position.

Click the [Jog & Teach] button.



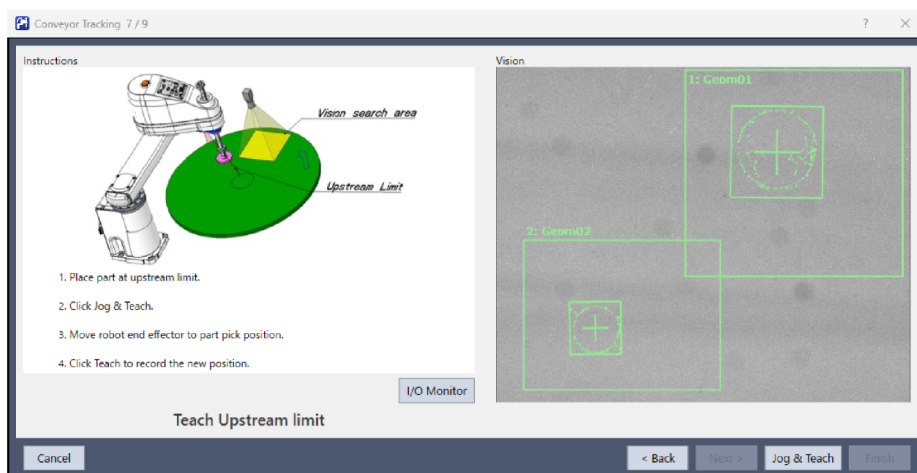
20. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position.

Click the [Teach] button.



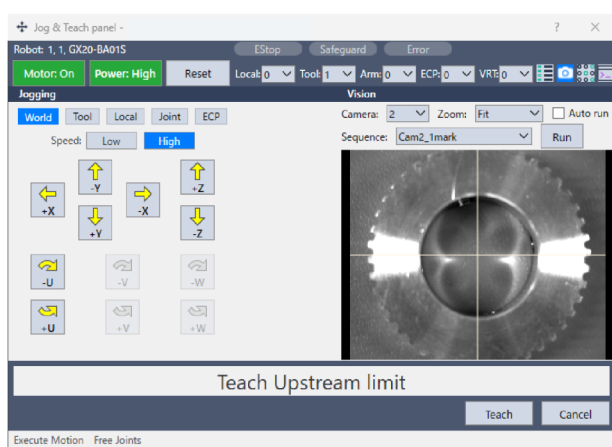
21. Place a part on the upstream limit.

Click the [Jog & Teach] button.



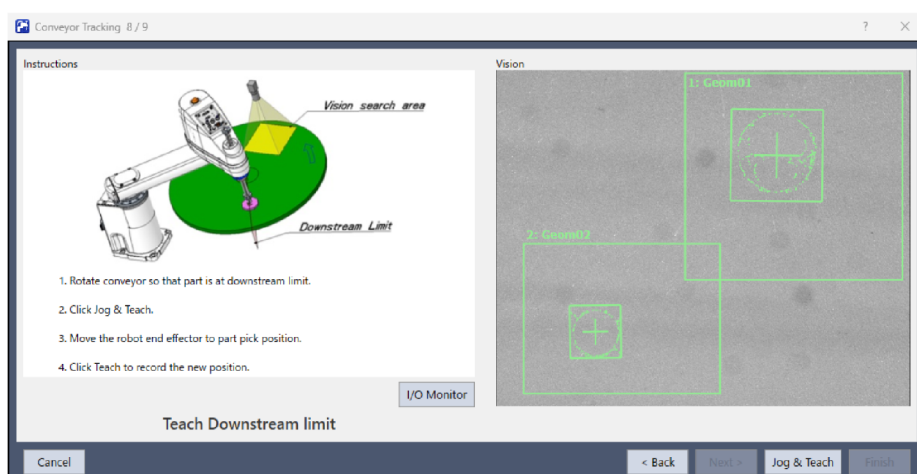
22. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector above the part.

Click the [Teach] button.



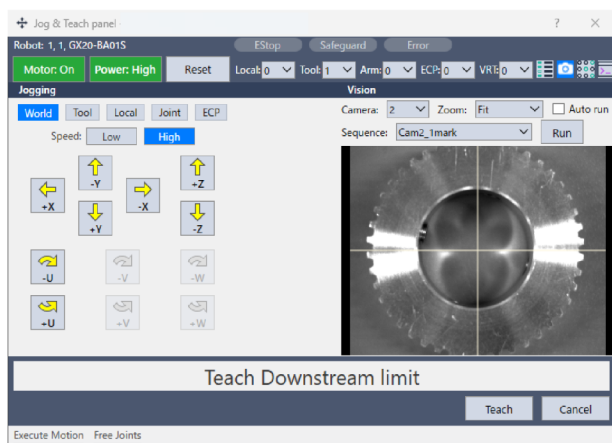
23. Move the conveyor so the part is at the downstream limit.

Click the [Jog & Teach] button.



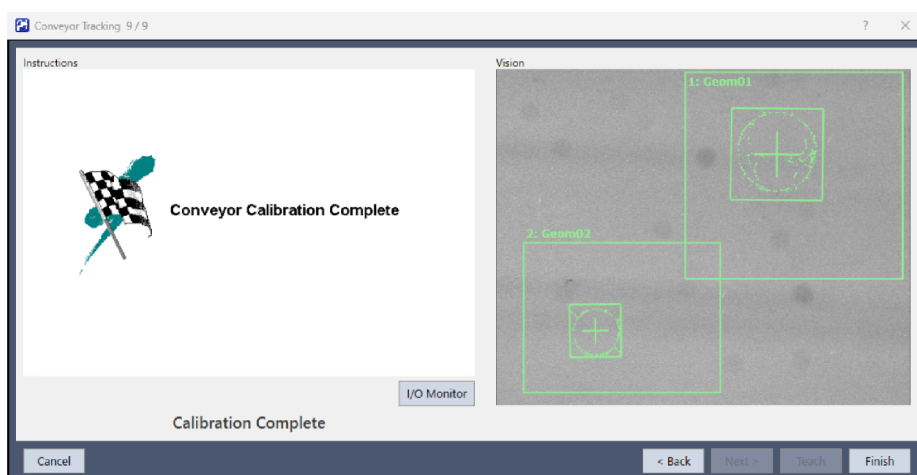
24. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector above the part.

Click the [Teach] button.



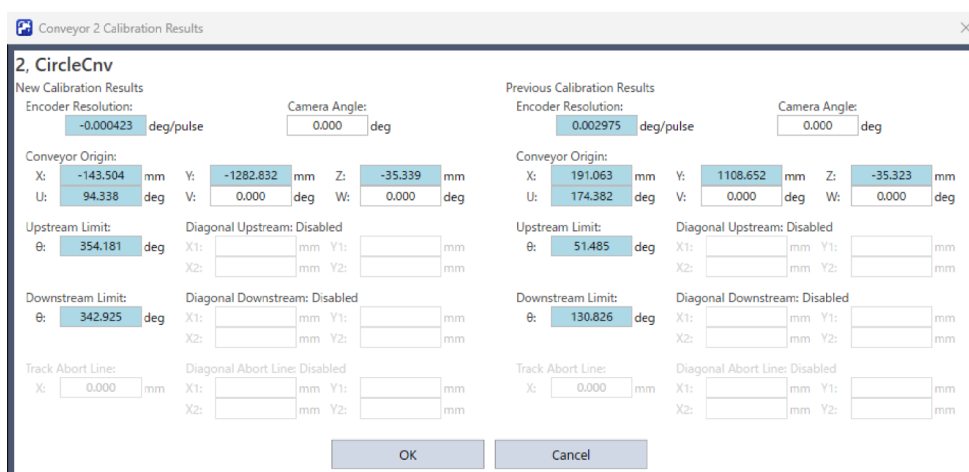
25. The calibration complete picture will be displayed.

Click the [Finish] button.



26. The Calibration Results screen is displayed.

- Click the [OK] button to complete the calibration.
- Click the [Cancel] button to return to the Calibration Complete screen in step 25.



4.2.4.5 Vision conveyor operation check

After the calibration, we recommend that you check if the sensor conveyor works properly. Select a suitable method since the verification procedures vary depending on the system.

This section uses the program and the command window described in.

Vision Conveyor Programming

Method 1: When the conveyor can be stopped arbitrary and the conveyor speed can be 30 mm/sec or less

1. Clear the all queue data registered to each conveyor.

```
>Cnv_QueueRemove 1,All
```

2. Place the part in the vision search area.
3. Execute the program “ScanConveyorStrobed” to register a queue.
4. Halt the program “ScanConveyorStrobed” and move the conveyor until the part enters the Pickup Area.
5. Pick up the part.

When using the 6-axis robot, set U, V, and W values as shown below. When using the SCARA robot, setting of U, V, and W are not necessary.

```
>Go Cnv_QueueGet(1,0):U(90):V(0):W(180)
```

6. Check if the robot end effector is above the center of a part.
7. Move the conveyor at 50mm/sec or less and check if the robot follows the part. At this point, the end effector will be off the center of part but this is not a problem.
8. Stop the tracking motion of the robot.

```
>Cnv_AbortTrack
```

In case the following symptoms occur with the above method, the Vision Guide or conveyor calibration was not executed properly. Perform the calibration again.

- In step (6), the robot end effector is more than 1 mm away from the center of the part.
- The robot cannot follow the part when the conveyor is moved in step (7).

Method 2: When the conveyor can be stopped arbitrary and the conveyor speed can be 100 mm/sec or less

1. Clear the all queue data registered to each conveyor.

```
>Cnv_QueueRemove 1,All
```

2. Place the part in the vision search area.
3. Execute the program “ScanConveyorStrobed” to register a queue.
4. Halt the program “ScanConveyorStrobed” and move the conveyor until the part enters the Pickup Area.
5. Pick up the part.

When using the 6-axis robot, set U, V, and W values as shown below. When using the SCARA robot, setting of U, V, and W are not necessary.

```
>Go Cnv_QueueGet(1,0):U(90):V(0):W(180)
```

6. Check if the robot end effector is above the center of a part.

7. Change the mode to “High Power”.

```
>Power High
```

8. Move the conveyor and check if the robot follows the part. At this point, the end effector will be off the center of part but this is not a problem.
9. Stop the tracking motion of the robot.

```
>Cnv_AbortTrack
```

In case the following symptoms occur with the above method, the Vision Guide or conveyor calibration was not executed properly. Perform the calibration again.

- In step (6), the robot end effector is more than 2 mm away from the center of the part.
- The robot cannot follow the part when the conveyor is moved in step (8).

Method 3: When the conveyor can be stopped arbitrary

1. Clear the all queue data registered to each conveyor.

```
>Cnv_QueueRemove 1,All
```

2. Place the part in the vision search area.
3. Execute the program “ScanConveyorStrobed” to register a queue.
4. Halt the program “ScanConveyorStrobed” and move the conveyor until the part enters the Pickup Area.
5. Pick up the part.

When using the 6-axis robot, set U, V, and W values as shown below. When using the SCARA robot, setting of U, V, and W are not necessary.

```
>Go Cnv_QueueGet (1,0):U(90):V(0):W(180)
```

6. Check if the robot end effector is above the center of a part.
7. Stop the tracking motion of the robot.

```
>Cnv_AbortTrack
```

8. Use the program “Main” to check if the robot follows the part.

At this point, change the wait time after tracking to 0.2 to 0.5 in the sample program.

In case the following symptoms occur with the above method, the Vision Guide or conveyor calibration was not executed properly. Perform the calibration again.

- In step (6), the robot end effector is more than 1 mm away from the center of the part.
- The robot moves to different position from the parts in step (8).

Method 4: When the conveyor cannot be stopped and the speed cannot be changed arbitrary

1. Move the conveyor.
2. Change the sample program as follows.
 - Change the wait time after tracking to 0.2 to 0.5

- Set the tracking mode to "0"
3. Execute the sample program "Main".
 4. Place the part after the conveyor speed becomes constant.
 5. Check if the robot follows the part.
 6. Change the sample program as follows.
 - Set the tracking mode to "1"
 7. Execute the sample program "Main".
 8. Place the part after the conveyor speed becomes constant.
 9. Check if the robot follows the part.

In case the following symptoms occur with the above method, the Vision Guide or conveyor calibration was not executed properly. Perform the calibration again.

- When comparing step (5) and (9), a distance between the robot and the part is smaller in step (5).
- The robot moves to different position from the parts in step (5).

4.2.5 Sensor Conveyors

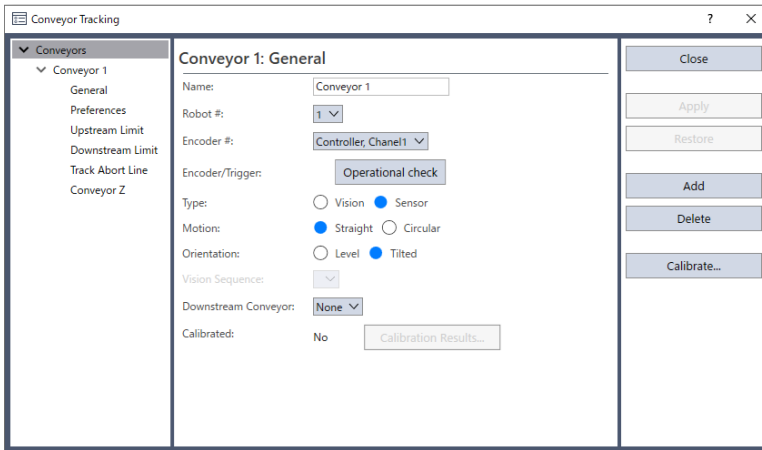
4.2.5.1 Sensor Conveyor Calibration (Straight Conveyor)

Follow these steps to calibrate a straight sensor conveyor:

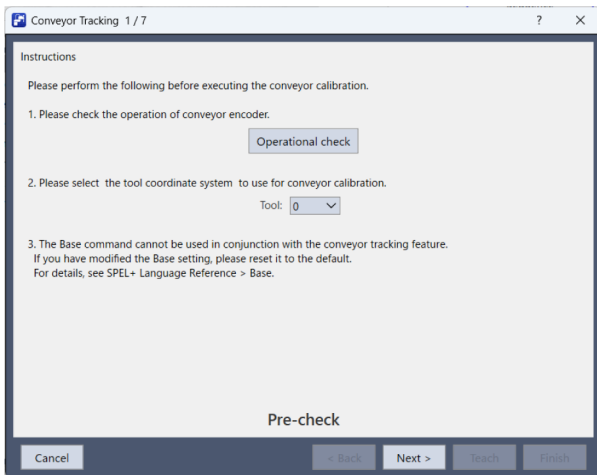
KEY POINTS

- When teaching part positions with the robot during calibration, it is important to position X, Y, and Z of each point accurately. The conveyor is calibrated in X, Y, Z, U, V, and W.
To accurately perform teaching, see the following.
Tips for Conveyor Calibration
- In step 9 (Set the upstream limit) and 11 (Set the downstream limit), set as wide distance as possible between the upstream limit and downstream limit. This allows for more accurate calibration. After the calibration, adjust the Pickup Area by resetting the upstream / downstream limits.
- For the level orientation, the conveyor height is determined by the position of the robot end effector taught in step 8. It cannot be used for the tilted conveyor for it does not detect the conveyor slope. Steps 19 to 20 are not displayed.
- For the tilted orientation, it calibrates the conveyor slope with the position of robot end effector taught in the steps 8, 10, 12, and 14.

1. Select [Tools]-[Conveyor Tracking].
2. Select the conveyor you want to calibrate.

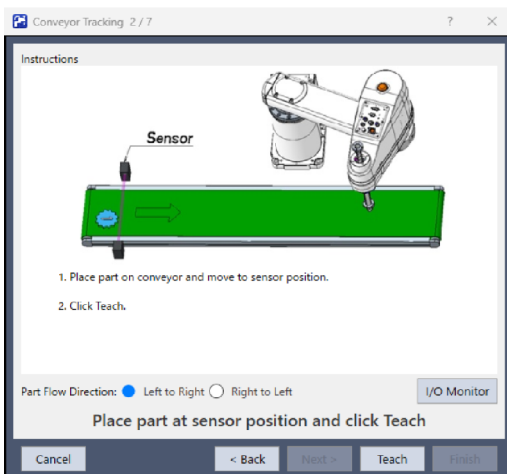


3. Click the [Calibrate] button. The [Conveyor Tracking Calibration] wizard is displayed.
4. Follow the instructions displayed on the screen. Confirm the conveyor encoder, the tool coordinate system, and the base coordinate system.



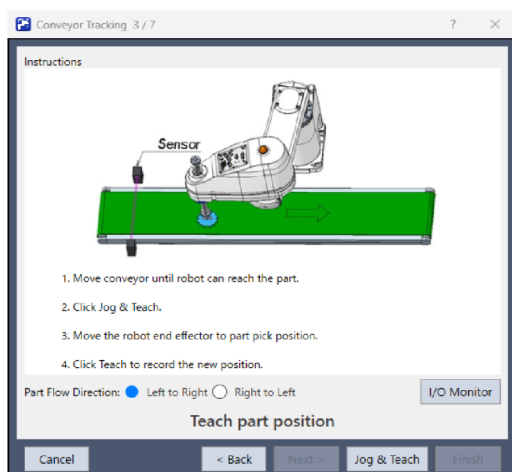
5. Select the [Part Flow Direction] to best match the conveyor you are calibrating. The instruction pictures will change according to the setting. [Part Flow Direction] is only used to aid in the instructions. It has no effect on the calibration.
6. Place a part on the conveyor and move the conveyor toward the sensor until the sensor just turns on.

Click the [Teach] button.



7. Move the conveyor until the part is within reach of the robot. Do not move the parts, only the conveyor.

Click the [Jog & Teach] button.

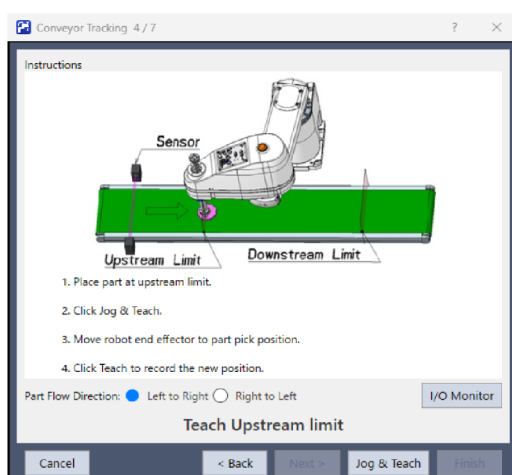


8. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position.

Click the [Teach] button.



9. Now move or place the part at the upstream limit. Click the [Jog & Teach] button.



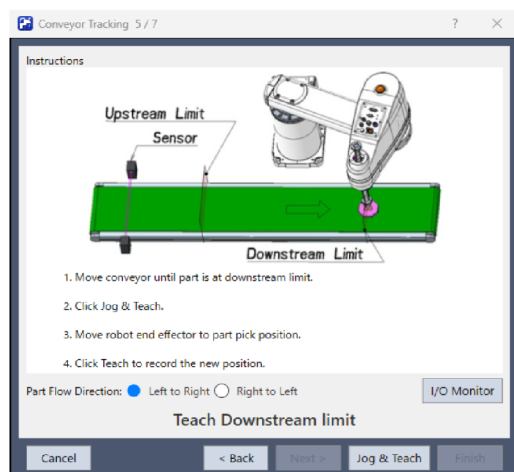
10. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position.

Click the [Teach] button.



11. Move the conveyor so the part is at the downstream limit. Do not move the parts, only the conveyor.

Click the [Jog & Teach] button.



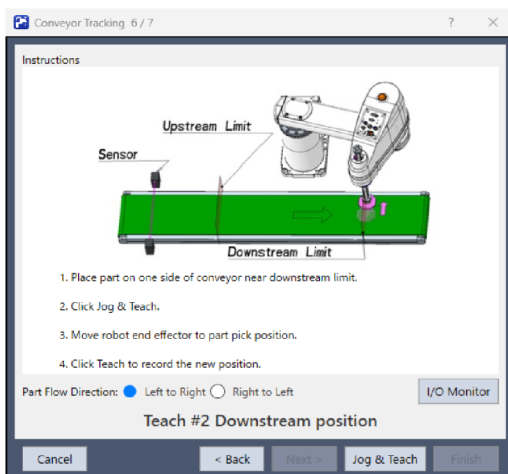
12. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position.

Click the [Teach] button.



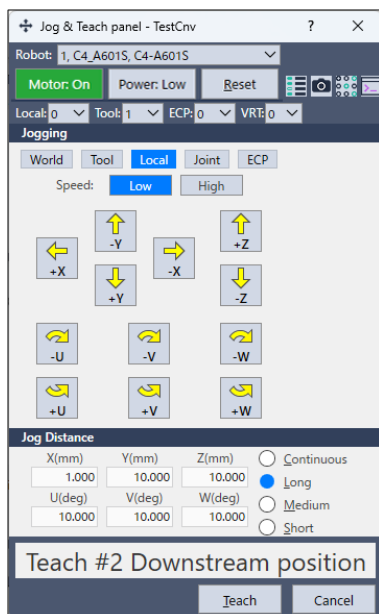
13. Place the workpiece at the end of the conveyor near the downstream limit. This point is used to determine the tilt of the conveyor from side to side.

Click the [Jog & Teach] button.

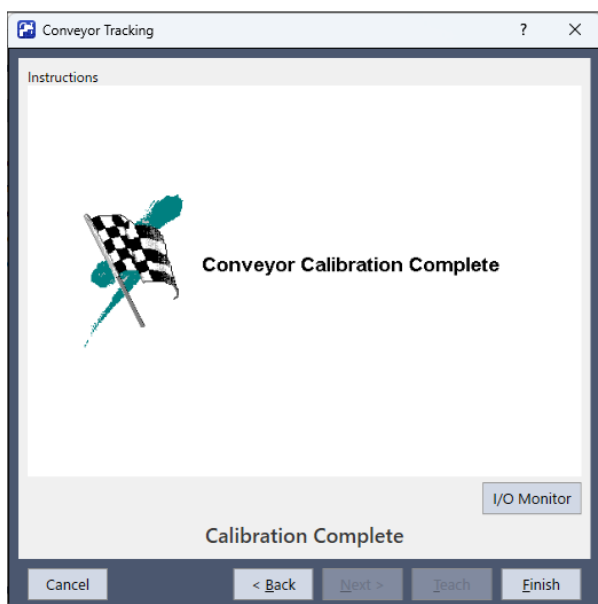


14. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position.

Click the [Teach] button.



15. The calibration complete picture will be displayed. Click the [Finish] button.



16. The Calibration Results screen is displayed.

- Click the [OK] button to complete the calibration.
- Click the [Cancel] button to return to the Calibration Complete screen in step 15.

Conveyor 1 Calibration Results											
1, Conveyor 1											
New Calibration Results						Previous Calibration Results					
Encoder Resolution:			Camera Angle:			Encoder Resolution:			Camera Angle:		
0.000000 mm/pulse			0.000 deg			0.000000 mm/pulse			0.000 deg		
Conveyor Origin:						Conveyor Origin:					
X:	-0.020 mm	Y:	508.010 mm	Z:	569.951 mm	X:	-0.020 mm	Y:	508.010 mm	Z:	569.951 mm
U:	0.000 deg	V:	-90.000 deg	W:	90.000 deg	U:	0.000 deg	V:	0.000 deg	W:	0.000 deg
Upstream Limit:						Upstream Limit:					
X: -0.000 mm			Diagonal Upstream: Disabled			X: -0.000 mm			Diagonal Upstream: Disabled		
X1:	0.000 mm	Y1:	0.000 mm	X2:	0.000 mm	X1:	0.000 mm	Y1:	0.000 mm	X2:	0.000 mm
Downstream Limit:						Downstream Limit:					
X: 0.000 mm			Diagonal Downstream: Disabled			X: -0.000 mm			Diagonal Downstream: Disabled		
X1:	0.000 mm	Y1:	0.000 mm	X2:	0.000 mm	X1:	0.000 mm	Y1:	0.000 mm	X2:	0.000 mm
Track Abort Line:						Track Abort Line:					
X: 0.000 mm			Diagonal Abort Line: Disabled			X: 0.000 mm			Diagonal Abort Line: Disabled		
X1:	0.000 mm	Y1:	0.000 mm	X2:	0.000 mm	X1:	0.000 mm	Y1:	0.000 mm	X2:	0.000 mm
OK						Cancel					

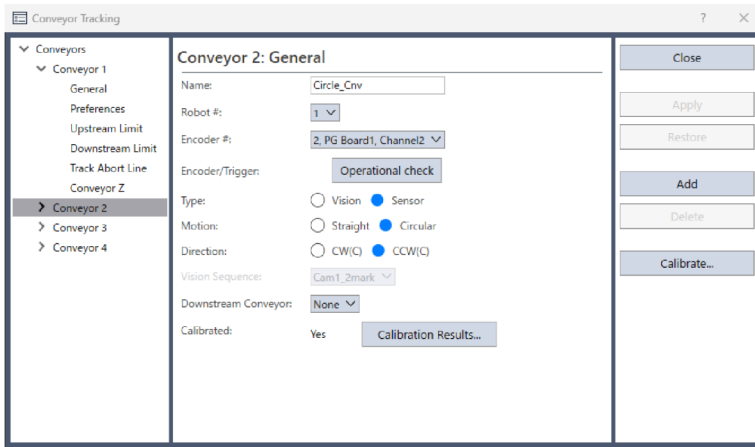
4.2.5.2 Sensor Conveyor Calibration (Circular conveyor)

Follow these steps to calibrate a circular sensor conveyor:

KEY POINTS

- When teaching part positions with the robot during calibration, it is important to position X, Y, and Z of each point accurately. The conveyor is calibrated in X, Y, Z, U, V, and W. To accurately perform teaching, see the following.
Tips for Conveyor Calibration
- In steps 10, 12, and 14, move the robot directly above the workpiece and teach the position. To perform an accurate calibration, set as wide a distance as possible between the points to be taught in steps 10, 12, and 14.

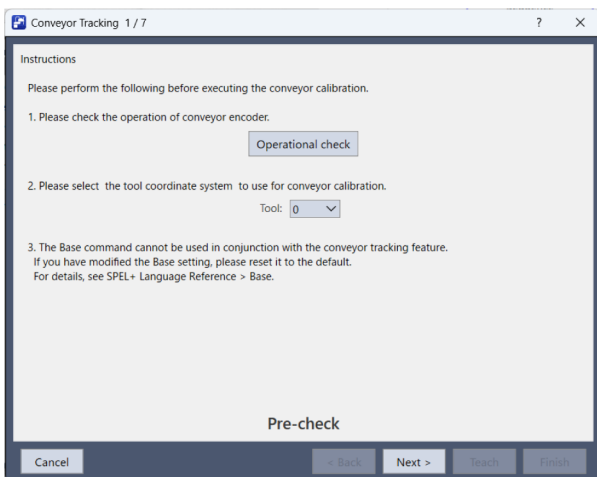
- Select [Tools]-[Conveyor Tracking].
- Select the conveyor you want to calibrate.
- Select [Sensor] for the [Type].
- Select [Circular] for the [Motion].
- Select the conveyor rotating direction for the [Direction]. Be careful not to calibrate with a wrong direction, otherwise, the robot will not track the parts.



6. Click the [Apply] button.

7. Click the [Calibrate] button.

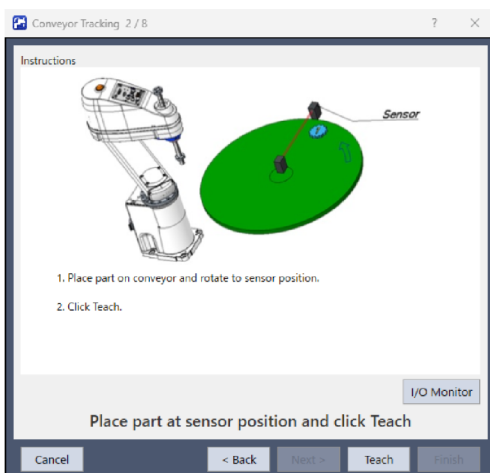
The [Conveyor Tracking Calibration] wizard is displayed. Follow the instructions on the screen to confirm the conveyor encoder, the tool coordinate system, and the base coordinate system.



8. Check if the conveyor direction shown in the wizard is the same as the conveyor you want to use.

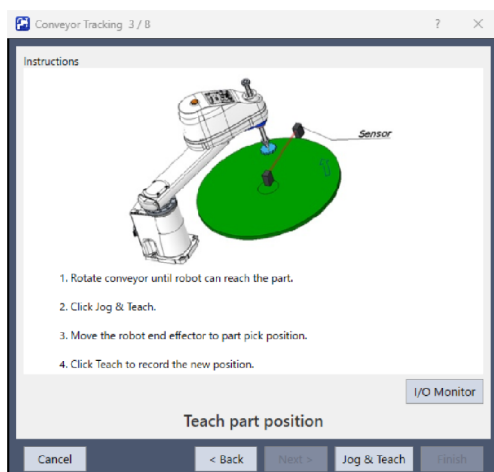
9. Place a part on the conveyor and move the conveyor toward the sensor until the sensor just turns on.

Click the [Teach] button.



10. Move the conveyor by hand to move Part.

Click the [Jog & Teach] button.



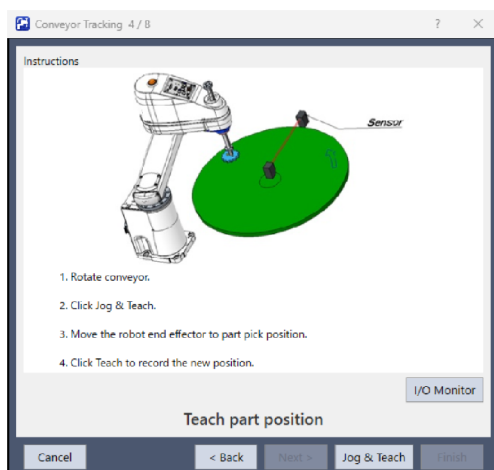
11. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position.

Click the [Teach] button.



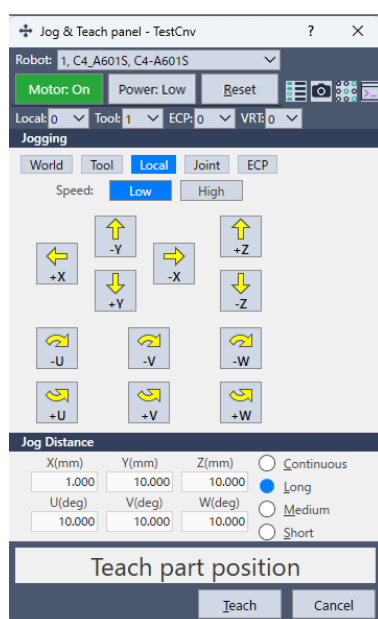
12. Move the conveyor to move Part.

Click the [Jog & Teach] button.



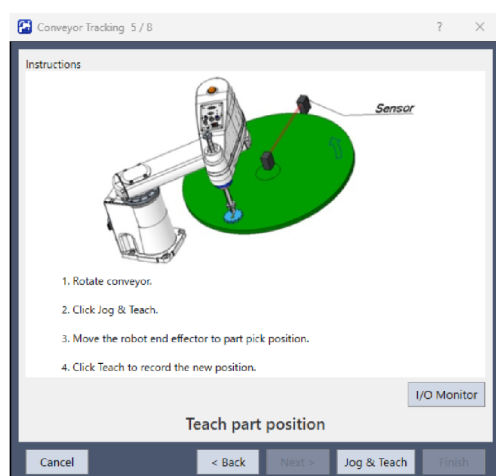
13. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position.

Click the [Teach] button.



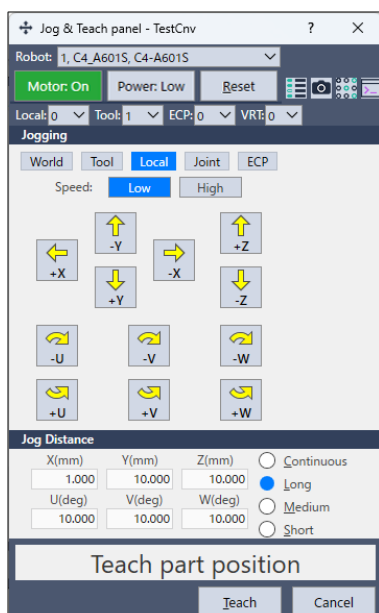
14. Move the conveyor to move Part.

Click the [Jog & Teach] button.



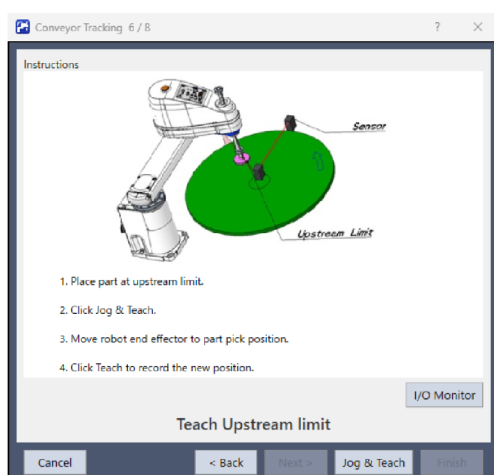
15. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position.

Click the [Teach] button.



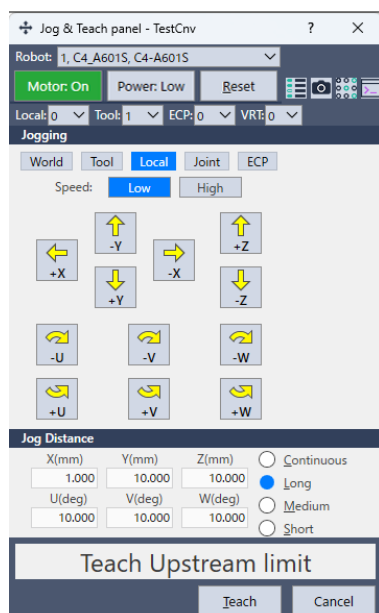
16. Place a part on the upstream limit.

Click the [Jog & Teach] button.



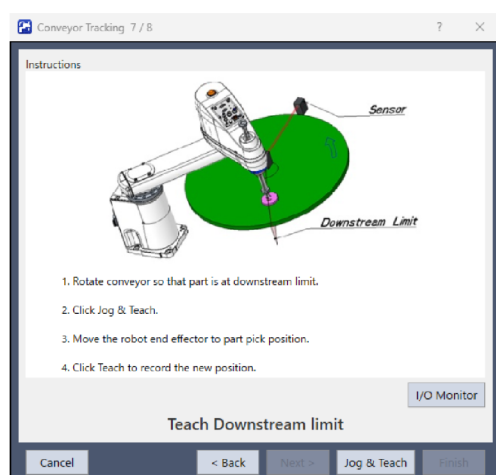
17. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector above the part.

Click the [Teach] button.



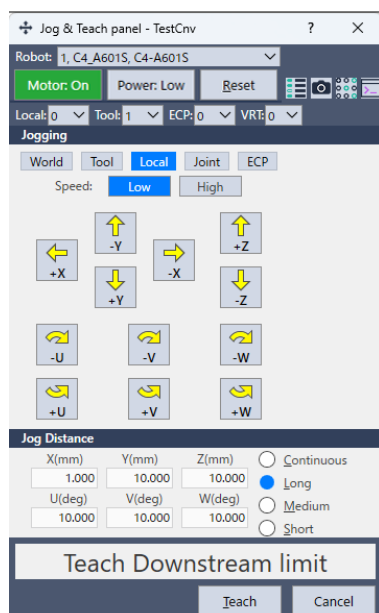
18. Move the conveyor so the part is at the downstream limit.

Click the [Jog & Teach] button.



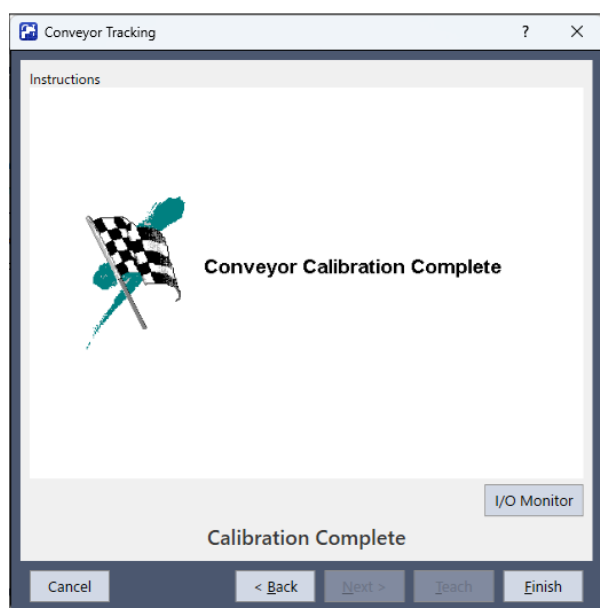
19. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector above the part.

Click the [Teach] button.



20. The calibration complete picture will be displayed.

Click the [Finish] button.



21. The Calibration Results screen is displayed.

- Click the [OK] button to complete the calibration.
- Click the [Cancel] button to return to the Calibration Complete screen in step 20.

4.2.5.3 Sensor conveyor operation check

After the calibration, we recommend that you check if the sensor conveyor works properly. Select a suitable method since the verification procedures vary depending on the system.

This checking method uses the program and command window described below.

Sensor Conveyor Programming

Method 1: When the conveyor can be stopped arbitrary and the conveyor speed can be 30 mm/sec or less

1. Clear the all queue data registered to each conveyor.

```
>Cnv_QueueRemove 1,All
```

2. Detect the part using the sensor.
3. Execute the program “ScanConveyor” to register a queue.
4. Halt the program “ScanConveyor” and move the conveyor until the part enters the Pickup Area.
5. Pick up the part.

When using the 6-axis robot, set U, V, and W values as shown below. When using the SCARA robot, setting of U, V, and W are not necessary.

```
>Go Cnv_QueueGet (1,0):U(90):V(0):W(180)
```

6. Check if the robot end effector is above the center of a part.
7. Move the conveyor at 50mm/sec or less and check if the robot follows the part. At this point, the end effector will be off the center of part but this is not a problem.
8. Stop the tracking motion of the robot.

```
>Cnv_AbortTrack
```

In case the following symptoms occur with the above method, the conveyor calibration was not executed properly. Perform the calibration again.

- In step (6), the robot end effector is more than 1 mm away from the center of the part.
- The robot cannot follow the part when the conveyor is moved in step (7).

Method 2: When the conveyor can be stopped arbitrary and the conveyor speed can be 100 mm/sec or less

1. Clear the all queue data registered to each conveyor.

```
>Cnv_QueueRemove 1,All
```

2. Detect the part using the sensor.
3. Execute the program “ScanConveyor” to register a queue.
4. Halt the program “ScanConveyor” and move the conveyor until the part enters the Pickup Area.
5. Pick up the part.

When using the 6-axis robot, set U, V, and W values as shown below. When using the SCARA robot, setting of U, V, and W are not necessary.

```
>Go Cnv_QueueGet(1,0):U(90):V(0):W(180)
```

6. Check if the robot end effector is above the center of a part.
7. Change the mode to “High Power”.

```
>Power High
```

8. Move the conveyor and check if the robot follows the part. At this point, the end effector will be off the center of part but this is not a problem.
9. Stop the tracking motion of the robot.

```
>Cnv_AbortTrack
```

In case the following symptoms occur with the above method, the conveyor calibration was not executed properly. Perform the calibration again.

- In step (6), the robot end effector is more than 2 mm away from the center of the part.
- The robot cannot follow the part when the conveyor is moved in step (8).

Method 3: When the conveyor can be stopped arbitrary

1. Clear the all queue data registered to each conveyor.

```
>Cnv_QueueRemove 1,All
```

2. Detect the part using the sensor.
3. Execute the program “ScanConveyor” to register a queue.
4. Halt the program “ScanConveyor” and move the conveyor until the part enters the Pickup Area.
5. Pick up the part.

When using the 6-axis robot, set U, V, and W values as shown below. When using the SCARA robot, setting of U, V, and W are not necessary.

```
>Go Cnv_QueueGet(1,0):U(90):V(0):W(180)
```

6. Check if the robot end effector is above the center of a part.

7. Stop the tracking motion of the robot.

```
>Cnv_AbortTrack
```

8. Use the program “Main” to check if the robot follows the part.

At this point, change the wait time after tracking to 0.2 to 0.5 in the sample program.

In case the following symptoms occur with the above method, the conveyor calibration was not executed properly. Perform the calibration again.

- In step (6), the robot end effector is more than 1 mm away from the center of the part.
- The robot moves to different position from the parts in step (8).

Method 4: When the conveyor cannot be stopped and the speed cannot be changed arbitrary

1. Move the conveyor.
2. Change the sample program as follows.
 - Change the wait time after tracking to 0.2 to 0.5
 - Set the tracking mode to "0"
3. Execute the sample program “Main”.
4. Place the part after the conveyor speed becomes constant.
5. Check if the robot follows the part.
6. Change the sample program as follows.
 - Set the tracking mode to "1"
7. Execute the sample program “Main”.
8. Place the part after the conveyor speed becomes constant.
9. Check if the robot follows the part.

In case the following symptoms occur with the above method, the conveyor calibration was not executed properly. Perform the calibration again.

- When comparing step (5) and (9), a distance between the robot and the part is smaller in step (5).
- The robot moves to different position from the parts in step (5).

4.2.6 Calibration Results

Calibration results will appear once conveyor calibration is complete, or when navigating from [Tools]-[Conveyor Tracking] and clicking the [Calibration Results...] button.

- Left: Latest calibration results
- Right: Previous results

Items where values differ between the latest results and the previous results are highlighted in yellow.

The latest calibration results are used for conveyor tracking. Previous results have no effect on performance.

KEY POINTS

- The [Calibration Results...] button will be unavailable under the following circumstances:

- When conveyor calibration has not been performed
- When changing the Robot #, Encoder #, Orientation, Type, and Vision Sequence
- Diagonal upstream limit, diagonal downstream limit, tracking abort line, and diagonal tracking abort line values only appear when settings have been configured as described in the procedure below.

Configuring Conveyors

- The [Restore Previous Results] button will not appear when calibration results are shown after conveyor calibration is complete.
- Values cannot be overwritten on the calibration results screen.

1, Conveyor 1

Current Calibration Results

Encoder Resolution: 0.000000 mm/pulse Camera Angle: 0.000 deg

Conveyor Origin:

X: -0.020 mm Y: 508.010 mm Z: 569.951 mm

U: 0.000 deg V: -90.000 deg W: 90.000 deg

Upstream Limit: Diagonal Upstream: Disabled

X: -0.000 mm X1: 0.000 mm Y1: 0.000 mm

X2: 0.000 mm Y2: 0.000 mm

Downstream Limit: Diagonal Downstream: Disabled

X: 0.000 mm X1: 0.000 mm Y1: 0.000 mm

X2: 0.000 mm Y2: 0.000 mm

Track Abort Line: Diagonal Abort Line: Disabled

X: 0.000 mm X1: 0.000 mm Y1: 0.000 mm

X2: 0.000 mm Y2: 0.000 mm

Restore Previous Results OK Cancel

Previous Calibration Results

Encoder Resolution: 0.000000 mm/pulse Camera Angle: 0.000 deg

Conveyor Origin:

X: -0.020 mm Y: 508.010 mm Z: 569.951 mm

U: 0.000 deg V: 0.000 deg W: 0.000 deg

Upstream Limit: Diagonal Upstream: Disabled

X: -0.000 mm X1: 0.000 mm Y1: 0.000 mm

X2: 0.000 mm Y2: 0.000 mm

Downstream Limit: Diagonal Downstream: Disabled

X: -0.000 mm X1: 0.000 mm Y1: 0.000 mm

X2: 0.000 mm Y2: 0.000 mm

Track Abort Line: Diagonal Abort Line: Disabled

X: 0.000 mm X1: 0.000 mm Y1: 0.000 mm

X2: 0.000 mm Y2: 0.000 mm

Performing conveyor tracking using previous results:

Click the [Restore Previous Results] button to overwrite the calibration results with the previous results as shown on the screen below. Only one set of previous results can be stored. Restoring previous results will wipe the previous results stored.

Click the [OK] button on this screen to restore results. Click the [Cancel] button to return the screen to the way it was before restoring. Note that you cannot undo restored calibration results once confirmed.

Conveyor 1 Calibration Results

1, Conveyor 1

Current Calibration Results

Encoder Resolution:0.000000mm/pulse

Camera Angle:0.000deg

Conveyor Origin:

X:-0.020mm

Y:508.010mm

Z:569.951mm

U:0.000deg

V:0.000deg

W:0.000deg

Upstream Limit:

X:-0.000mm

X1:0.000mm

Y1:0.000mm

X2:0.000mm

Y2:0.000mm

Diagonal Upstream: Disabled

Downstream Limit:

X:-0.000mm

X1:0.000mm

Y1:0.000mm

X2:0.000mm

Y2:0.000mm

Diagonal Downstream: Disabled

Track Abort Line:

X:0.000mm

X1:0.000mm

Y1:0.000mm

X2:0.000mm

Y2:0.000mm

Diagonal Abort Line: Disabled

Restore Previous Results

OK

Cancel

Previous Calibration Results

Encoder Resolution:0.000000mm/pulse

Camera Angle:0.000deg

Conveyor Origin:

X:-0.020mm

Y:508.010mm

Z:569.951mm

U:0.000deg

V:0.000deg

W:0.000deg

Upstream Limit:

X:-0.000mm

X1:0.000mm

Y1:0.000mm

X2:0.000mm

Y2:0.000mm

Diagonal Upstream: Disabled

Downstream Limit:

X:-0.000mm

X1:0.000mm

Y1:0.000mm

X2:0.000mm

Y2:0.000mm

Diagonal Downstream: Disabled

Track Abort Line:

X:0.000mm

X1:0.000mm

Y1:0.000mm

X2:0.000mm

Y2:0.000mm

Diagonal Abort Line: Disabled

4.2.7 Pickup Area

The Pickup Area is the range where the robot can pick up parts.

In the figure below, the robot can pick up the parts in gray.

The diagram shows a conveyor belt with a 'Vision' area on the left. A 'Pickup Area' is defined between an 'Upstream limit' and a 'Downstream limit'. Several 'Parts' are shown on the conveyor. Arrows indicate the 'Parts Flow' from left to right. The 'Pickup Area' is the region where the robot can pick up parts, which are shown in gray.

If the Pickup Area is not appropriate, the robot cannot pick up parts. Follow the steps and cautions below to carefully set the Pickup Area.

To define the Pickup Area:

1. After calibration, the Pickup Area will be defined as shown in the following figure. Note that the positions of upstream limit and downstream limit depend on the positions you teach during the calibration.

The diagram shows a conveyor belt with a 'Vision search area' on the left. A 'Pickup Area' is defined between an 'Upstream limit' and a 'Downstream limit'. A 'Robot motion range' is shown as a semi-circle above the 'Pickup Area'. A robot arm is shown picking up a part from the conveyor. The 'Part Flow' is indicated by an arrow pointing right.

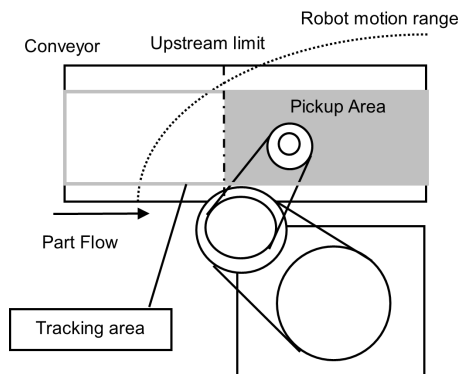
2. Decide the upstream limit position.

80

The robot starts pickup from the line defined by the upstream limit. The Pickup Area from the upstream limit must be within the robot motion range. (See the figure below.)

KEY POINTS

The robot does not start pickup until parts cross the upstream limit. If you set the upstream limit in uppermost position, you can reduce the robot standby time.

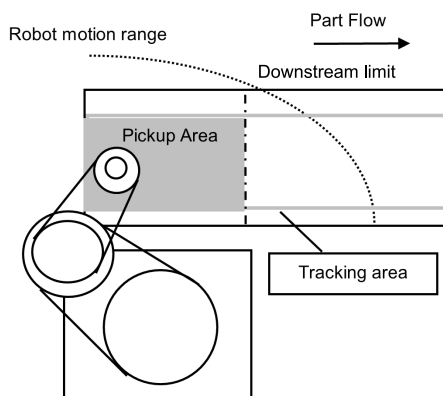


3. Decide the downstream limit position.

Once the robot starts pickup, it continues its operation even over the downstream limit to complete the whole operation. Therefore, set the downstream limit in uppermost possible position so that the robot can operate within its motion range until it completes the operation. (See the figure below.)

KEY POINTS

The downstream limit position depends on the conveyor speed and robot position when it starts pickup. If the robot goes over the motion range during the operation, move the downstream limit to upper side.



4.2.7.1 Changing the Upstream / Downstream limits positions

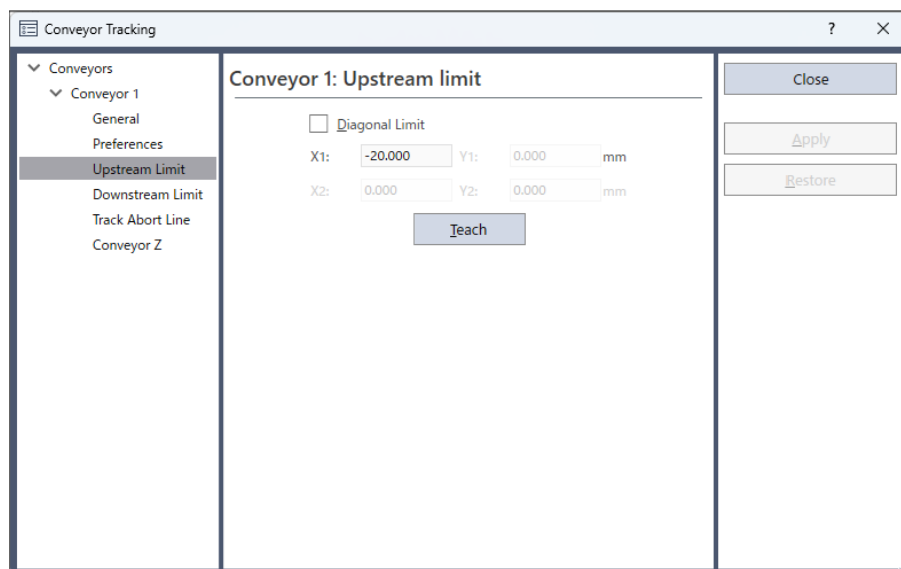
To change the upstream limit and downstream limit positions, follow the steps below.

To change the Upstream Limit:

- Select [Tools]-[Conveyor Tracking].
- Select the conveyor you want to edit.

- Click [Upstream Limit].
- The dialog shown below appears.

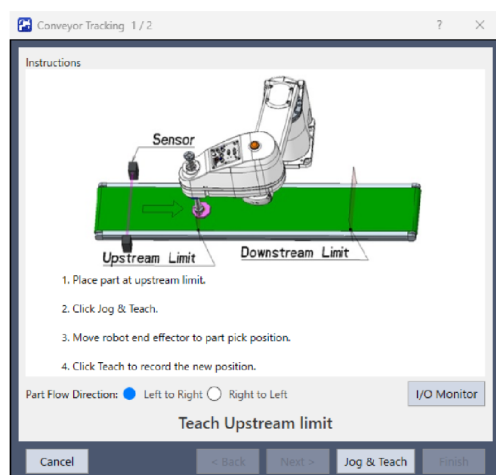
To define the X1 value, enter a value directly or use Jog & Teach. Entering values directly is for fine adjustment.



When you directly specify the value, enter the value in the box and click .

- When you use Jog & Teach, click the [Teach] button.
- The dialog shown below appears.

Follow the instructions given during calibration.



To change the downstream limit, click [Downstream Limit] and edit the value in the same way as the upstream limit.

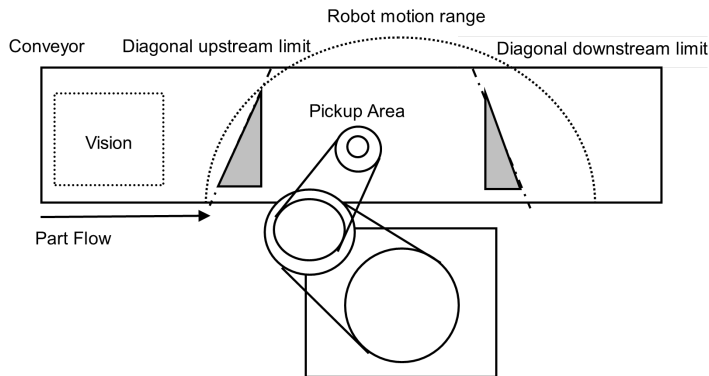
KEY POINTS

Upstream and downstream positions can be changed from the SPEL program by using Cnv_Upstream and Cnv_Downstream commands. (When diagonal upstream and downstream limits are used, they cannot be changed from the SPEL program.)

Diagonal Upstream / Downstream Limits

After the calibration, you can set the dividing lines for the Pickup Area (upstream limit / downstream limit) directed diagonally to the part flow.

When you change the dividing lines to diagonal positions, the Pickup Area also changes as shown below. The area indicated in gray is widened by changing the dividing lines to diagonal positions. In addition, diagonal dividing lines are called the diagonal upstream / downstream limits.



The following are the advantages you can get by widening the Pickup Area.

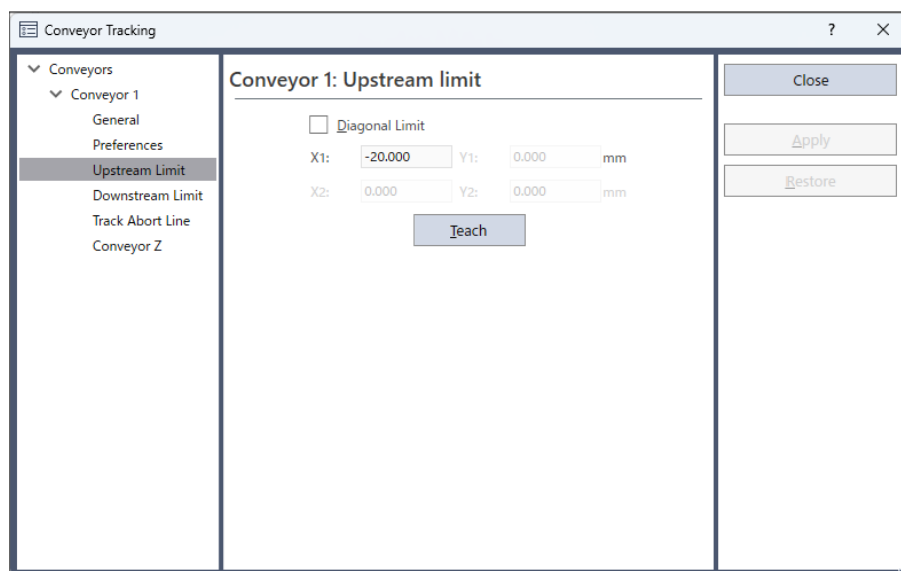
- Reduce robot standby time by widening the upper side Pickup Area.
- Less possibility of missing parts which flow longer after the downstream limit by widening the Pickup Area.

KEY POINTS

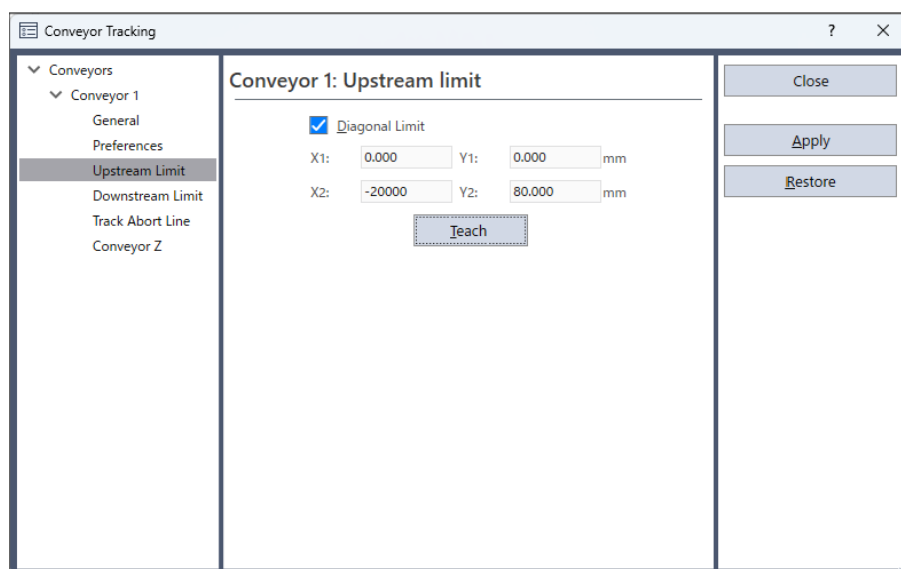
If there are too many parts on the conveyor for the robot to pick up, it only makes the robot move for longer distance and longer time and the number of parts the robot can pick up may decrease, even in a widened Pickup Area. The robot capacity refers to how fast or how many parts robot can pick up. The robot capacity depends on the pickup area width, robot standby position, and conveyor speed.

To set the diagonal upstream limit:

1. Select [Tools]-[Conveyor Tracking].
2. Select the conveyor you want to edit.
3. Click [Upstream Limit].
4. The dialog shown below appears.



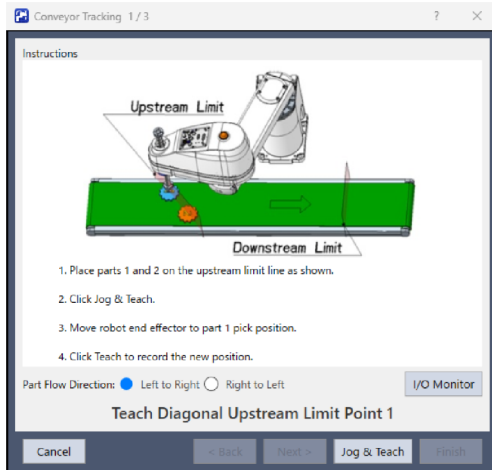
Check the [Diagonal Limit] check box in [Upstream Limit] and click the [Apply] button. The dialog shown below appears.



To define the values for X1, Y1, X2, Y2, enter the values directly or use Jog & Teach. Entering values directly is for fine adjustment.

5. When you directly specify the values, enter the values in the boxes and click the [Apply] button.
6. When you use Jog & Teach, click the [Teach] button.

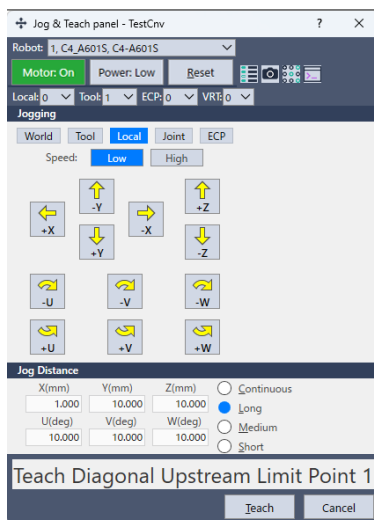
The window shown below appears.



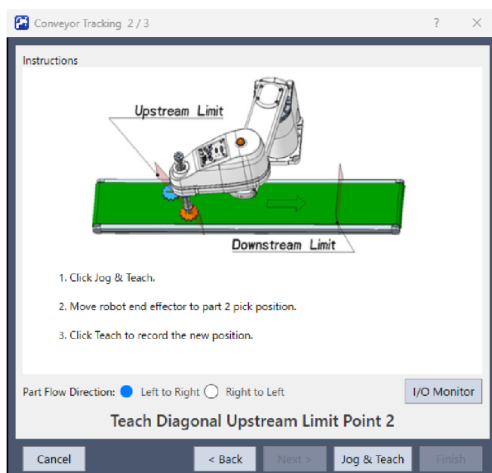
7. Place two parts on the conveyor.

Click the [Jog & Teach] button.

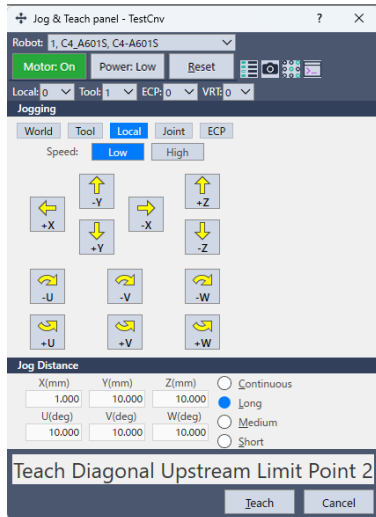
8. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position. Click the [Teach] button.



9. The window shown below appears. Click [Jog & Teach].

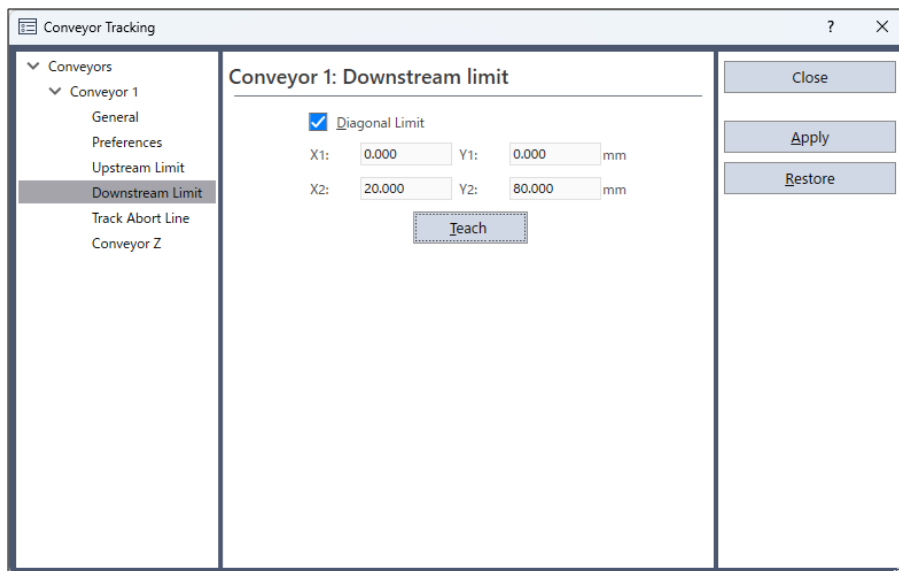


10. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position. Click the [Teach] button.



To set the diagonal downstream limit, click [Downstream Limit] to display the downstream limit setting page and check the [Diagonal Limit] checkbox, then click the [Apply] button.

The dialog shown below appears. Click the [Teach] button and follow the directions in the wizard.



Note that the “Error 4415” occurs when the diagonal upstream / downstream limits are defined as in the following cases.

- They are perpendicular to the part flow direction.
- They are parallel to the part flow direction.
- The diagonal upstream limit and downstream limit cross on the conveyor.

4.2.8 Adjusting the Z value

You can adjust the conveyor Z value after the calibration is completed.

Adjusting the Z value is a function to change the work pickup height that has been determined during calibration.

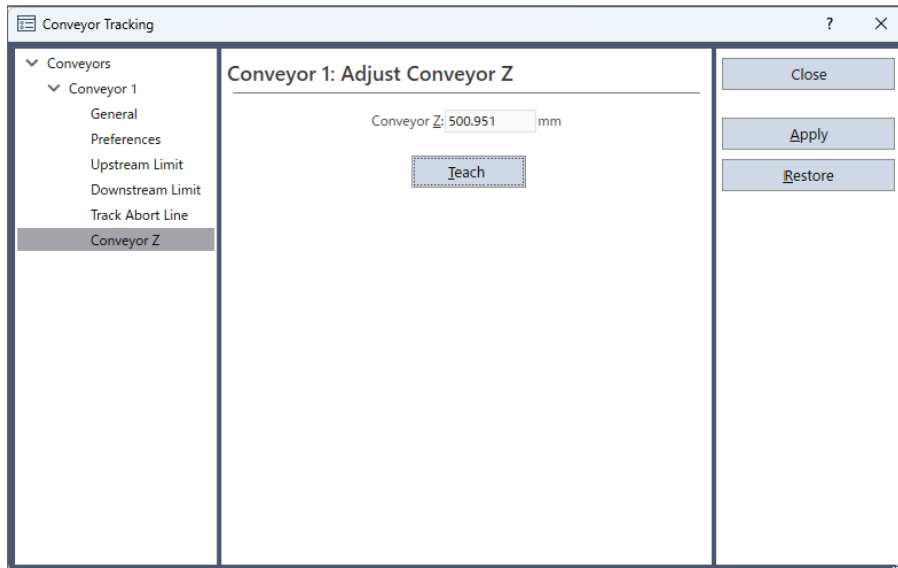
In the following cases, adjust the Z value:

- To use a part that is different from the one defined during calibration.
- The tool has been changed on the robot after calibration.

To adjust the Z value:

1. Select [Tools]-[Conveyor Tracking].
2. Select the conveyor you want to edit.
3. Click on [Conveyor Z].
4. The dialog shown below appears.

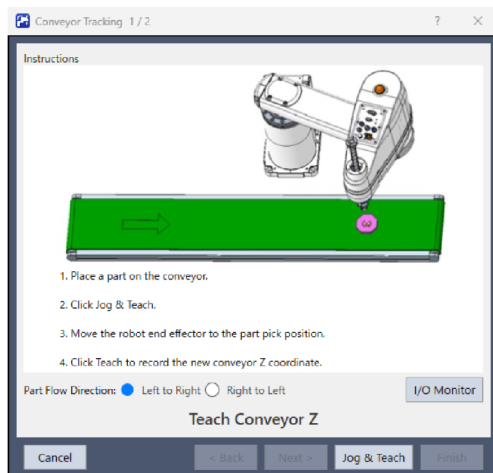
Click on [Teach].



5. The window shown below appears.

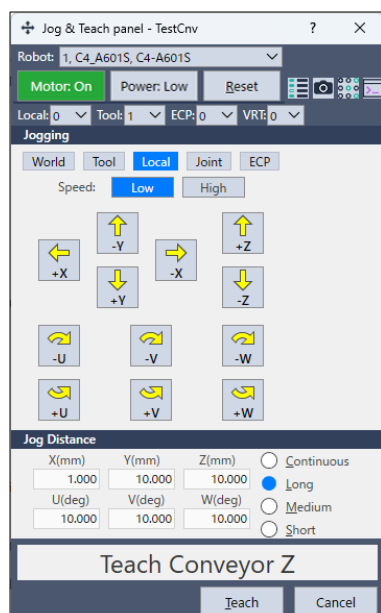
Place a part in the robot motion range.

Click [Jog & Teach].



6. The [Jog & Teach panel] will appear. Click the jog buttons to move the robot end effector to the pick position.

Click the [Teach] button.

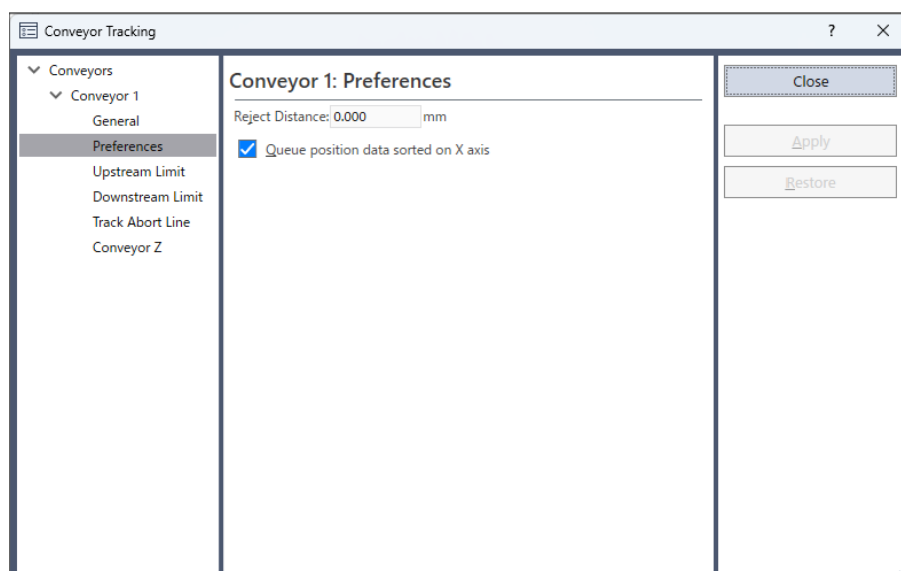


4.2.9 Queue Sorting

When you set the queue sorting, it registers the queue data in the order of position along the X axis in the conveyor local coordinate system. Set 0 or nothing for the index number of Cnv_QueGet command, the robot picks up parts from the downstream side.

To set the queue sorting

1. Select [Tools]-[Conveyor Tracking].
2. Click the conveyor you want to configure and select [Preferences].



3. Set the [Queue position data sorted on X axis] checkbox.
4. Click the [Apply] button.

KEY POINTS

- When you set a diagonal upstream limit, register the queue data in the order of entering the Pickup Area.

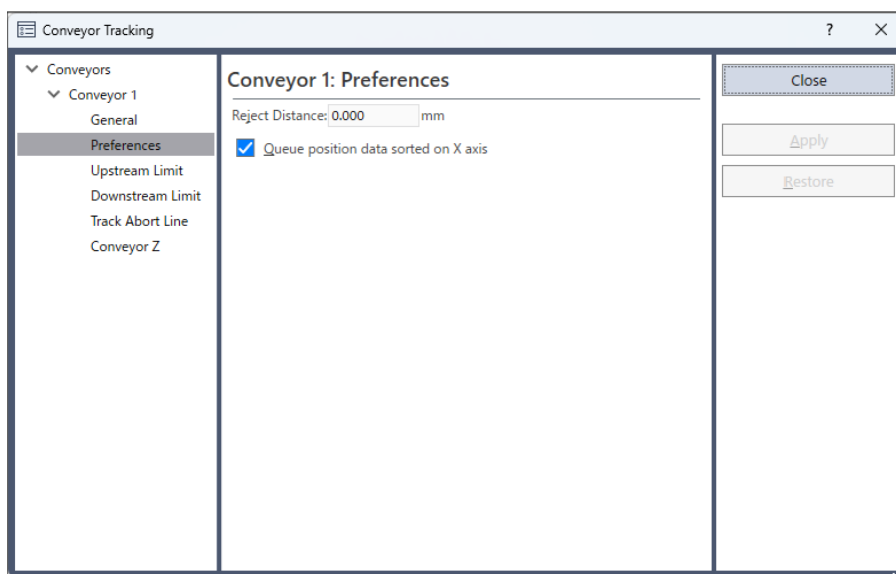
- Also, when you set a diagonal upstream limit, note that the queue sorting cannot be canceled.
- The queue sorting function is applied to both upstream and downstream conveyors.

4.2.10 Double Registration Prevention

Cnv_QueueReject avoids registering the same part doubly. If Cnv_QueueReject value is not changed from the default (0 mm), the robot may perform the pickup motion at the position where the part is not placed, since the same part is registered to the queue several times.

Cnv_QueueReject can be set by using the command or by following the steps below.

1. Select [Tools]-[Conveyor Tracking].
2. Click the conveyor you want to configure and select [Preferences].

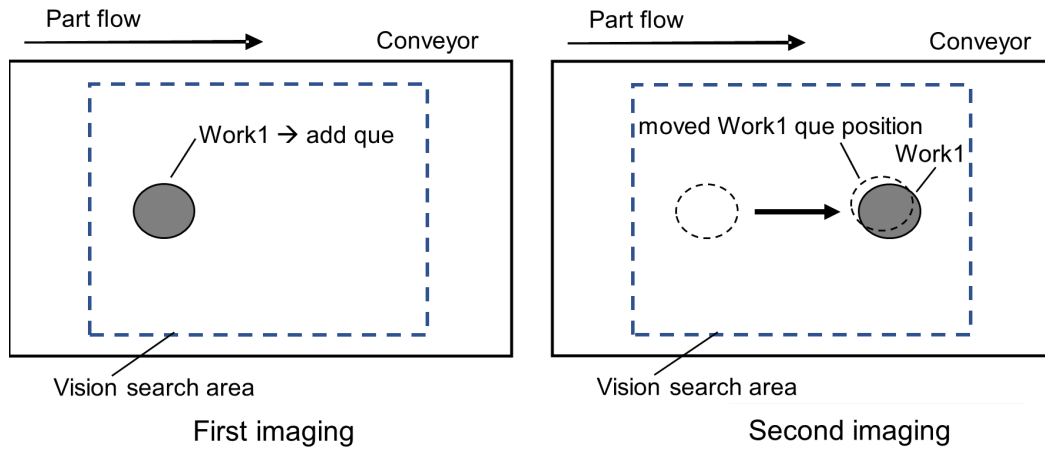


3. Set the value to [Reject Distance].
4. Click the [Apply] button.

KEY POINTS

If “Cnv_QueueReject” is used in the program, the value set for “Cnv_QueueReject” will be used instead of the value set in the above step.

When the same workpiece is imaged multiple times as shown in the figure below, the moved Work1 queue position which from the initially registered Work1 will not exactly match the coordinates of the newly registered Work1 queue due to the influence of the camera and conveyor etc. To prevent the same workpiece from being registered in the queue more than once, it is recommended to enter a value similar to the workpiece size as the double registration prevention distance.



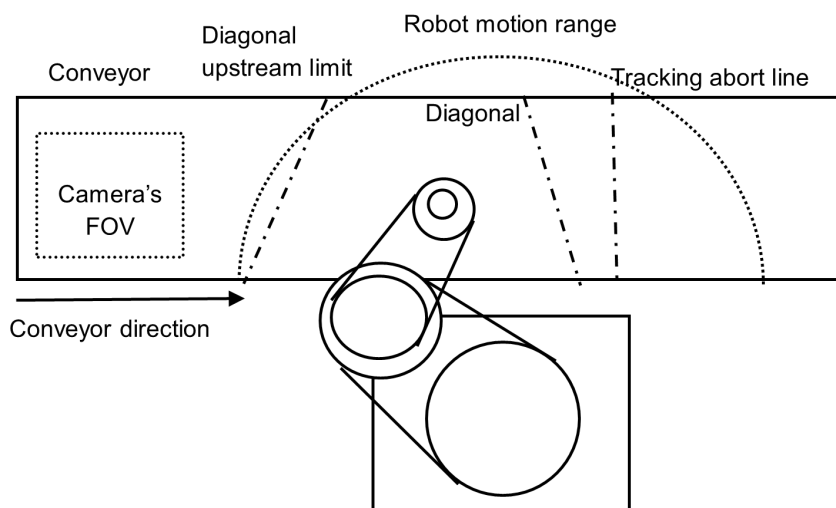
4.2.11 Tracking Abort Line

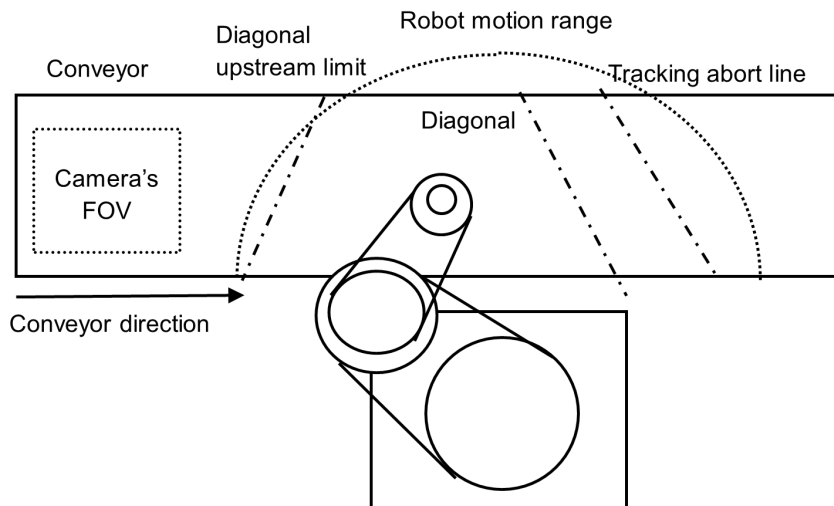
The tracking abort lines cancel or abort the robot's tracking motion in following cases:

- When it is predicted before the robot starts tracking that it catches up the workpiece beyond the abort tracking line.
- When the workpiece passes the tracking abort line while the robot performs the tracking motion. At this time, there is a function to detect whether the Z axis is descending for picking and to ascend in the height direction for safety. This height can be set arbitrarily.

KEY POINTS

- When you set the tracking abort line, the out of motion range error will not occur during conveyor tracking.
- If errors such as the out of motion range error occurs even though the tracking abort line is set, it is possible that the robot motion range has been reached during deceleration. Set the line more upstream than the current position.
- The circular conveyor does not support the setting of the tracking abort line.

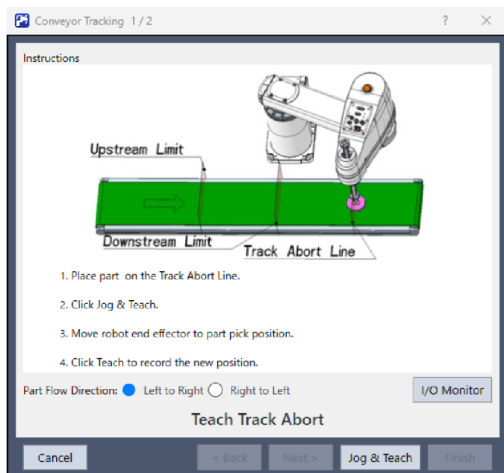




4.2.11.1 How to set a tracking abort line

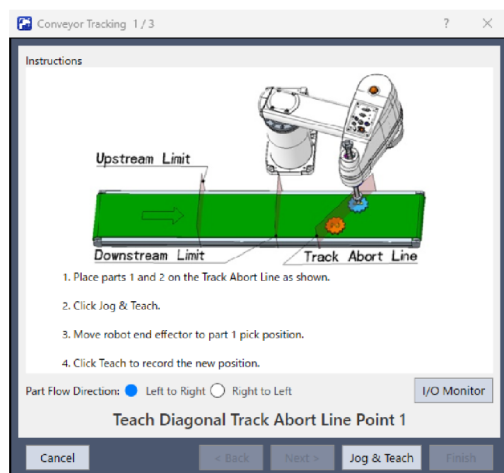
Set a tracking abort line in the following way.

1. Select [Tools]-[Conveyor Tracking].
2. Select the conveyor to configure.
3. Select [Track Abort Line].
4. Check the [Enable tracking abort line] checkbox.
 - i. Click [Teach]. The GUI will be displayed.



- ii. If you want to enable the diagonal tracking abort line, check the [Diagonal Track Abort Line] checkbox.

Click [Teach]. The GUI will be displayed.

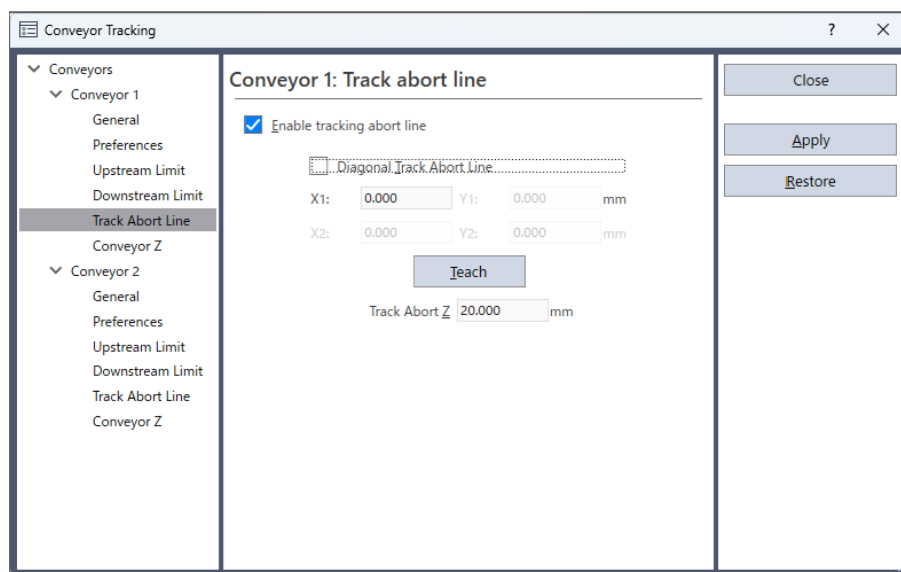


2. Follow the steps in the window and finish the setting.

4.2.11.2 How to set the Z rising height

The default rising height during tracking abort is 10 mm. You can change the height in the following way.

1. Select [Tools]-[Conveyor Tracking].
2. Select the conveyor to configure.
3. Select [Track Abort Line].
4. Set the rising height and click the [Apply] button.



KEY POINTS

If the out of motion range error occurs while the hand rises, decrease the rising height.

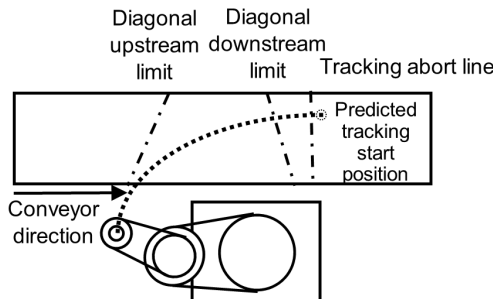
4.2.11.3 How to check the tracking abort state

You can check the tracking state in relation to the tracking abort line using the Cnv_Flag function.

A Cnv_Flag return value of “0” indicates normal operation, while “other than 0” indicates that tracking has been canceled or aborted. If the return value is other than "0", perform the following adjustments.

When 1:

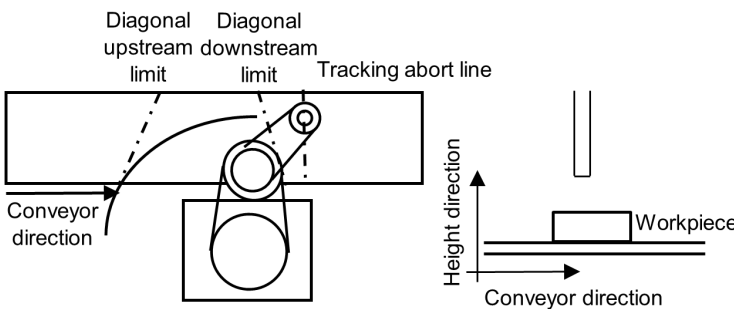
Tracking has been canceled as the workpiece is expected to exceed the tracking abort line before tracking commences.



Motion start may be delayed due to the downstream limit position setting. Set a downstream limit that is further toward the upstream side than the current position.

When 2:

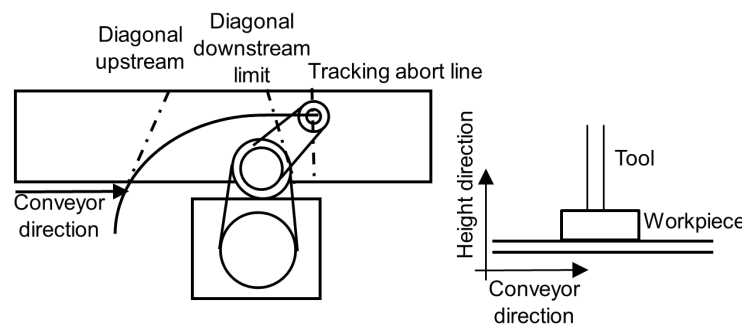
Tracking has been aborted as the tracking abort line was crossed during tracking (before pickup).



Motion start and completion could be delayed due to an improper downstream limit position and robot standby position. Set a downstream limit that is further toward the upstream side than the current position. Alternatively, bring the robot standby position closer to the downstream limit.

When 3:

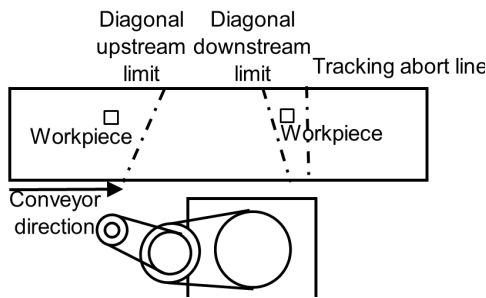
Tracking has been aborted as the tracking abort line was crossed during tracking (during pickup).



Motion start and completion could be delayed due to an improper downstream limit position and robot standby position, or an improper pickup time. Set a downstream limit that is further toward the upstream side than the current position. Alternatively, bring the robot standby position closer to the downstream limit. Try reducing the workpiece pickup time.

When 4:

Tracking has been canceled as the workpiece was outside the Pickup Area during motion command execution.



Refer to the sample program to put the robot on standby until the workpiece exceeds the upstream limit.

If this still occurs even when performing the above, the number of workpieces in the work flow may exceed the robot's processing capacity, causing the workpieces to exceed the downstream limit. Try performing the following adjustments.

- Reduce the number of workpieces
- Increase acceleration using Cnv_Accel
- Setup a downstream conveyor

KEY POINTS

If tracking motion is canceled or aborted, the program will continue to execute the subsequent instruction without stopping.

4.2.11.4 Program

If the tracking abort line is configured, the error 4406 does not occur. When you set the tracking abort line, use Cnv_Flag as in the following program. Do not use this program when the abort line is not used.

KEY POINTS

- Use the program 2 after the downstream limit is configured in the program 1 and Cnv_Flag do not return 2 and 3.
- When using the program 1, the robot can operate without an error even though the downstream setting is not adequate since the robot aborts the tracking motion. However, abort of tracking increases the cycle time. It is recommended to adjust the downstream line if you are using the program 1.

Program 1

```
Function RB1
'Moves to the waiting position P0
Jump P0
Do
  'Waits until the workpiece passes the upstream limit
  Wait Cnv_QueLen(1, CNV_QUELEN_PICKUPAREA) > 0
  Jump Cnv_QueGet(1)          'Executes the command to operate conveyor
tracking

  'When the state is normal, operates the picking
  If Cnv_Flag(1) = 0 Then
    On Vacuum1                'Vacuum ON
    Wait 0.1
```

```

    'If the workpiece crosses the tracking abort line during picking, causing
    tracking to stop,
    release the pickup-failed workpiece.
    If Cnv_Flag(1) = 3 Then
        Jump P2                'Moves to the position to release the pickup-
failed workpiece
        Off Vacuum1            'Releases the workpiece
        Wait 0.1
        Jump P0                'Moves to the waiting position P0

    'The picked workpiece is moved to the placing position P1
    Else
        Cnv_QueRemove 1, 0      'Deletes the picked queue
        Jump P1                'Moves to the position to release the workpiece
        Off Vacuum1            'Releases the workpiece
        Wait 0.1
    EndIf

    'If the operation is canceled because it is expected to cross the tracking abort
    line, the queue is deleted.
    ElseIf Cnv_Flag(1) = 1 Then
        Cnv_QueRemove 1, 0      'Deletes the queue data

    'If the operation is canceled because the workpiece at the time of executing '
    the operation command is outside the Pickup Area, the queue is deleted.

    ElseIf Cnv_Flag(1) = 4 Then
        Cnv_QueRemove 1, 0      'Deletes the queue data

    'If the tracking motion is aborted since the workpiece passed the tracking
    abort line,
    'the queue is deleted.
    ElseIf Cnv_Flag(1) = 2 Then
        Cnv_QueRemove 1, 0      'Deletes the queue data
        Jump P0                'Moves to the waiting position P0
    EndIf
    Loop
Fend

```

Program 2

```

Function RB1

    'Moves to the waiting position P0
    Jump P0
    Do
        'Waits until the workpiece passes the upstream limit
        Wait Cnv_QueLen(1, CNV_QUELEN_PICKUPAREA) > 0
        Jump Cnv_QueGet(1)      'Starts tracking

    'When the state is normal, operates the picking
    If Cnv_Flag(1) = 0 Then
        On Vacuum1              'Vacuum ON
        Wait 0.1
        Cnv_QueRemove 1, 0      'Deletes the picked queue
        Jump P1                'Moves to the position to release the workpiece
        Off Vacuum1            'Releases the workpiece
        Wait 0.1

    'If the operation is canceled because it is expected to cross the tracking abort
    line, the queue is deleted.
    ElseIf Cnv_Flag(1) = 1 Then
        Cnv_QueRemove 1, 0      'Deletes the queue data

```

```
'If the operation is canceled because the workpiece at the time of executing  
'the operation command is outside the Pickup Area, the queue is deleted.  
ElseIf Cnv_Flag(1) = 4 Then  
    Cnv_QueueRemove 1, 0      'Deletes the queue data  
EndIf  
Loop  
Fend
```

5. Checking the conveyor tracking operation

5.1 Operational Checks

5.1.1 Verifying Encoder Operation

See below.

[Verifying Encoder Operation](#)

5.1.2 Verifying Trigger Operation

See below.

[Verifying Hardware Conveyor Trigger / Vision Trigger](#)

5.1.3 Verifying Conveyor Tracking Operation

See below.

- [Vision conveyor operation check](#)
- [Sensor conveyor operation check](#)

5.2 Confirming Settings

5.2.1 Verifying Conveyor Calibration

See below.

[Calibration Results](#)

5.2.2 How to Check the Tracking Abort State

See below.

[How to check the tracking abort state](#)

6. Conveyor tracking sample program

6.1 Vision Conveyor Programming

Typically, two tasks are used to operate a vision conveyor.

One task finds parts with the vision system and adds them to the conveyor queue.

The other task checks for parts in the Pickup Area of the conveyor queue. When parts are in the Pickup Area, the robot picks up the parts. Next, the robot places the parts picked up to the specified position.

The following example is a sample program that uses Xqt to execute two tasks from the "main" function.

- First task: "ScanConveyorStrobed" function
- Second task: "PickParts" function

A corresponding program is shown below.

Wiring Example of Vision Conveyor Tracking System

This sample program is a hardware trigger structure that uses controller I/O to trigger the camera and latch the encoder.

The following program is a sample with Conveyor #1.

This sample program automatically recovers when the robot tracks the workpiece that is out of the Pickup Area.

```
Function main
  Motor On
  Power High

  Speed 30
  Accel 30, 30

  Xqt ScanConveyorStrobed 'Task that registers queues
  Xqt PickParts           'Task that tracks parts (queue)
Fend

Function ScanConveyorStrobed
  Integer i, numFound, state, trigger
  Real x, y, u
  Boolean found
  trigger = 4 'Allocates pin14 (output No. 4) of Controller I/O
(check wiring example)
  Off trigger 'Turns OFF the camera trigger and encoder latch I/O
  ' For a virtual camera, keep the OFF state for approximately 0.5 seconds or
  longer.
  ' Wait 0.5
  Do
    VRun FindParts 'Searches for parts on the conveyor
    On trigger     'Turns ON the camera trigger and encoder latch I/O
    Do
      VGet FindParts.AcquireState, state
      Loop Until state = 3
      VGet FindParts.Parts.NumberFound, numFound
      'Registers the part that has been shot as a queue
      For i = 1 To numFound
        VGet FindParts.Parts.CameraXYU(i), found, x, y, u
        Cnv_QueAdd 1, Cnv_Point(1, x, y)
      Next i
      Off trigger 'Turns OFF the camera trigger and encoder latch I/O
      Wait 0.1
    Loop
  Fend
```



```

Function PickParts
  OnErr GoTo ErrHandler
  Integer ErrNum
  Cnv_Mode 1,1           'Selects the tracking mode
  WaitParts:
  Do
    'Waits until a part (queue) enters the Pickup Area
    Wait Cnv_QueLen(1, CNV_QUELEN_PICKUPAREA) > 0
    'Starts tracking the part
    'When using the SCARA robot
    Jump Cnv_QueGet(1)
    Wait 0.1              'The robot moves at the same speed as the conveyor for
the Wait time specified to this part
    Jump P1               'Moves the picked part to a specified place
    Cnv_QueRemove 1, 0    'Clears the picked part (queue)
  Loop
  'Clears the parts (queue) in the downstream side from the Pickup Area
  'Automatically recovers from the error "The specified queue data is outside
the set area"
  ErrHandler:
    ErrNum = Err
    If ErrNum = 4406 Then
      Cnv_QueRemove 1, 0
      EResume WaitParts
  'Displays an error other than "The specified queue data is outside the set area"
  Else
    Print "Error!"
    Print "No.", Err, ":", ErrMsg$(Err, 1)
    Print "Line :", Erl(0)
    'User error occurred
    Error 8000
  EndIf
Fend

```

KEY POINTS

When you use software trigger, use the "ScanConveyorStrobed" function shown below.

When you use a software trigger, set the RuntimeAcquire property of the FindParts sequence to "Stationary".

```

Function ScanConveyorNonStrobed
  Integer i, numFound
  Real x, y, u
  Boolean found
  Do
    'Searches for parts on the conveyor
    VRun FindParts
    Cnv_Trigger 1          'Latches the encoder with software trigger
    VGet FindParts.Parts.NumberFound, numFound
    'Registers the part as a queue
    For i = 1 To numFound
      VGet FindParts.Parts.CameraXYU(i), found, x, y, u
      Cnv_QueAdd 1, Cnv_Point(1, x, y)
    Next i
    Wait 0.1
  Loop
Fend

```

KEY POINTS

For a virtual camera, when in the trigger wait state, if the camera trigger I/O is turned ON immediately after being turned OFF, the trigger may not be detected and the vision sequence may not complete. In such cases, after turning the camera trigger I/O OFF, use a Wait command or similar method to keep the OFF state for a certain period of time. Approximately 0.5 seconds or longer is recommended for the first time, and approximately 0.1 seconds or longer is recommended from the second time onward.

6.2 Sensor Conveyor Programming

Typically, two tasks are used to operate a sensor conveyor. One task waits for a part to trip the sensor and add it to the conveyor queue. The other task checks for parts in the Pickup Area of the conveyor queue. When parts are in the Pickup Area, the robot picks up the parts. Next, the robot places the parts picked up to the specified position.

This sample program automatically recovers when the robot tracks the parts that is out of the Pickup Area.

```
Function main
  Motor On
  Power High

  Speed 30
  Accel 30, 30

  Xqt ScanConveyor          'Task that registers queues
  Xqt PickParts             'Task that tracks parts (queue)
Fend

Function ScanConveyor
  Double lpulse1            'Previous latch pulse
  lpulse1 = Cnv_LPulse(1)   'Registers the latch pulse as lpulse1
  Do
    'Registers a part as a queue only when it passes the sensor
    If lpulse1 <> Cnv_LPulse(1) Then
      Cnv_QueueAdd 1, Cnv_Point(1, 0, 0)
      lpulse1 = Cnv_LPulse(1) 'Updates lpulse1
    EndIf
  Loop
Fend

Function PickParts
  OnErr GoTo ErrHandler
  Integer ErrNum
  Cnv_Mode 1,1              'Selects the tracking mode
  WaitParts:
  Do
    'Waits until a part (queue) enters the Pickup Area
    Wait Cnv_QueueLen(1, CNV_QUELEN_PICKUPAREA) > 0
    'Starts tracking the part
    'When using the SCARA robot
    Jump Cnv_QueueGet(1)
    Wait 0.1                  'The robot moves at the same speed as the
conveyor for the Wait time specified to this part
    Jump P1                  'Moves the picked part to a specified place
    Cnv_QueueRemove 1, 0     'Clears the picked part (queue)
  Loop
  'Clears the parts (queue) in the downstream side from the Pickup Area
  'Automatically recovers from the error '"The specified queue data is outside
the set area"
  ErrHandler:
EndFunction
```

```

ErrNum = Err
If ErrNum = 4406 Then
    Cnv_QueueRemove 1, 0
    EResume WaitParts
'Displays an error other than "The specified queue data is outside the set area"
Else
    Print "Error!"
    Print "No.", Err, ":", ErrMsg$(Err, 1)
    Print "Line :", Erl(0)
    'User error occurred
    Error 8000
EndIf
Fend

```

6.3 Tracking Mode

There are three tracking modes: quantity-priority mode accuracy-priority mode, and variable speed conveyor mode. The mode can be selected by the Cnv_Mode command.

Tracking mode selection is only available for linear conveyors. For circular conveyors, quantity-priority mode is only available.

6.3.1 Quantity-priority mode

Quantity-priority mode prioritizes reducing time to catch up with the workpiece (queue) over the picking accuracy. This mode is suitable for the conveyor tracking system in which space between the workpieces is narrow.

KEY POINTS

When the quantity-priority mode is selected, tracking delay (situation in which the Manipulator does picking motion at the posterior part of the workpiece to the direction of the conveyor motion) may occur. When you correct the tracking delay, write the program to add the offset as follows.

```
Go Cnv_QueueGet (Conveyor number, [Index]) + X (**)
```

X indicates the direction of the conveyor motion. ** indicates correction amount [mm]. For the details of offset, refer to the following manual:

"SPEL"+ Language Reference - Go"

6.3.2 Accuracy-priority mode

Accuracy-priority mode is the mode to correct the tracking delay. Accuracy-priority mode improves the picking accuracy while it takes more time to catch up with the workpiece. This mode is suitable for the conveyor tracking system for small workpieces.

When using the accuracy-priority mode, it is recommended to perform the tracking delay acquisition operation in advance. For details, see the following points.

[Accuracy-priority Mode - Acquiring Tracking Delay](#)

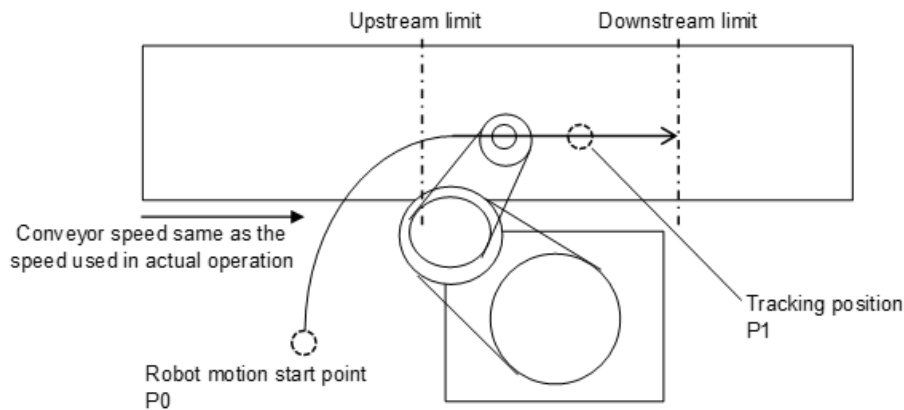
6.3.3 Accuracy-priority Mode - Acquiring Tracking Delay

When using the conveyor tracking accuracy priority mode, you can acquire and compensate for robot tracking delays to accurately track a workpiece.

The following tracking delay acquisition operation should be performed in advance to acquire tracking delays. Failing to set the offset value in advance may adversely affect accuracy and elapsed time.

Acquiring the tracking delay

When acquiring the tracking delay, the robot moves from the motion start point to the downstream limit as shown in the diagram below. This acquires the offset amount [mm] in the direction the conveyor is traveling.



This motion can be executed by running the following sample program.

Configure the following settings beforehand.

- Perform conveyor calibration
- Set Accel, Speed, Tool, and other parameters to the same settings as that used for actual operation
- Teach the robot the start position for the conveyor tracking motion as P0
- Teach the robot the following two points required to perform the motion
 - Point 1: The robot motion start point
 - Point 2: The point tracked on the conveyor
- Move the conveyor at the same speed as that used for actual operation

KEY POINTS

- The tracking delay is acquired based on the conveyor width-direction and height coordinates at the tracking position taught to the robot. Configure settings to closely match actual operation.
- The offset value changes based on the conveyor speed, robot acceleration, speed, and orientation. Therefore, the tracking delay should be reacquired when any of these settings are changed.
- Notes about this program
 - As this program runs on a virtual queue, no actual workpiece is required.
 - As a software trigger is used, make sure there is no hardware trigger input.

Function Cnv_Adjust_measure

```
'Move to robot motion start point
Motor On
```

```

Go P0

Power High
Speed 100
Accel 100, 100
Cnv_Accel 1, 2000

'Check conveyor operation
If Cnv_Speed(1) < 0.1 Then
    Print "Conveyor not operational"
    Exit Function
EndIf

'Register virtual workpiece to queue
Cnv_QueueRemove 1, All          'Clear queue
Cnv_Trigger 1                   'Latch conveyor pulse
Cnv_QueueAdd 1, XY(0, CY(P1@Cnv(1)), CZ(P1@Cnv(1)), CU(P1@Cnv(1)), 0, 0) /CNV(1)
'Register virtual workpiece to queue based on P1

Wait Cnv_QueueLen(1, CNV_QUELEN_PICKUPAREA) > 0
' Wait until queue enters the Pickup Area
Cnv_Adjust 1, On                'Turn offset acquisition flag On

'Perform motion
Go CnvQueueGet(1,0)             'For SCARA robots
'Go Cnv_QueueGet(1,0):U(90):V(0):W(180) ' For 6-axis robots

Do
Wait 0.02
Loop Until (CX(RealPos@CNV(1)) >= Cnv_Downstream(1))
' Wait until downstream limit is reached

Go Here                        'Stop robot
Cnv_QueueRemove 1, All         'Reset queue
Cnv_Adjust 1, Off              'Turn offset acquisition flag Off
Motor Off

'Output results of offset value acquired
If Cnv_AdjustGet(1, 0) = 1 Then
    'Acquired, results displayed
    Print "Offset amount =", Cnv_AdjustGet(1, 1)
Else
    Print "Unable to correctly acquire offset value"
    Print "Operation results(0:Not performed/2:Failed to acquire)=",
Cnv_AdjustGet(1, 0)
EndIf
Fend

```

KEY POINTS

- The offset value is reset when turning the controller off. Use Cnv_AdjustSet to set the offset value acquired within the program in use. To store the offset value acquired, add the following program to save the file to the Project folder.

```

Integer fileNum; String filename$
fileNum = FreeFile
filename$ = "File name"
AOpen filename$ As #fileNum
Print #fileNum,Cnv_AdjustGet(1,1)
Close #fileNum

```

- If the Cnv_AdjustGet(1,0) operation results are not "1" (offset value acquired), the robot may not have been able to reach the workpiece within the Pickup Area, and offset value acquisition may have exceeded 100 seconds. Check the Accel and Speed settings, upstream and downstream limit settings, the motion start point, and the conveyor speed.

6.3.4 Variable speed conveyor mode

The variable speed conveyor mode compensates for the delay in robot tracking in response to changes in conveyor speed.

It is suitable for conveyor systems where the conveyor may stop and continue is in progress while contact is made with the workpiece. For example, screw tightening applications are conceivable.

When stopping and continuing the conveyor in variable speed conveyor mode, set the limit of acceleration and deceleration after conveyor tracked and it is recommended that the operation used to determine the offset value be performed in advance. For details, see the next section, "Setting the offset value for variable speed conveyor mode".

KEY POINTS

If any of the following processes are performed when the conveyor is being stopped or while it is stopped, conveyor tracking will be terminated and cannot be continued.

- Open the safety door connected to the controller.
- Press the Emergency Stop button connected to the controller.
- Press the Pause button or execute the Pause command.

6.3.5 Setting the offset value, acceleration and deceleration for variable speed conveyor mode

The robot's tracking delay relative to conveyor speed changes depends on the conveyor speed, conveyor acceleration/deceleration, robot model used, Inertia setting, Weight setting, and other factors.

Therefore, it is necessary to set the offset value according to the operating environment, and the limit of acceleration and deceleration after conveyor tracked. In order to improve the robot's tracking delay, it is necessary to adjust the offset value and set the optimum value.

The amount of robot tracking delay is acquired with the Cnv_PosErr function, the offset value is set with Cnv_PosErrOffset, and the limit of acceleration and deceleration after conveyor tracked is set with Cnv_AccelLim.

KEY POINTS

When adjusting the offset value, set Cnv_Fine to "0". If the value is not "0", the amount of tracking delay cannot be acquired correctly with the Cnv_PosErr function.

In the quantity-priority mode and accuracy-priority mode, it is not possible to acquire and set offset values.

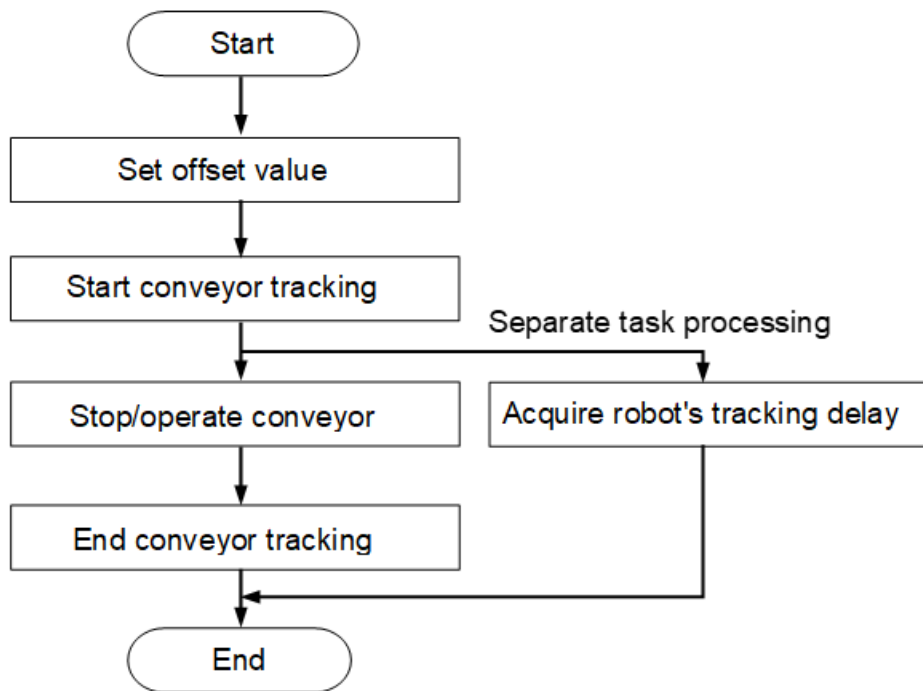
When acquiring the offset value, check the accuracy-priority mode - Acquiring tracking delay" setting. For a working program, use the sample program described below.

Set the limit to a value greater than the conveyor acceleration and deceleration when stopping or operating the conveyor. A rough guideline for the set value is about twice the conveyor acceleration and deceleration.

If the limit is too high, robot motion gets oscillatory due to variation of the conveyor speed or noise. If it is lowered too much, the robot will not stop tracking the conveyor even it stops, and it may move out of the operating area of the robot. In that case, set a tracking abort line or program to stop tracking at the downstream limit.

After setting the limit of acceleration and deceleration, follow the procedure below to set the offset value and acquire the robot's tracking delay.

In order to find the optimal offset value, change the offset value and perform multiple times.



```

Integer fileNum                                'Declare a file number
Function Cnv_PosErr_measure
  Motor On
  Go P0                                          'Move to robot motion start point
  Power High
  Speed 100
  Accel 100, 100
  Cnv_Accel 1, 2000
  Cnv_Fine 1,0                                'Fine setting
  Cnv_Mode 1,2                                'Variable speed conveyor mode
  Cnv_PosErrOffset 1,10                        'Set offset value
  ' Check conveyor operation
  If Cnv_Speed(1) < 0.1 Then
    Print "Conveyor not operational"
    Exit Function
  EndIf

  ' Register virtual workpiece to queue
  Cnv_QueRemove 1, All                          'Clear queue
  Cnv_Trigger 1                                'Latch conveyor pulse
  Cnv_QueAdd 1, XY(0, CY(P1@Cnv(1)), CZ(P1@Cnv(1)), CU(P1@Cnv(1)), 0, 0) /CNV(1)
  'Register virtual workpiece to queue based on P1

  Wait Cnv_QueLen(1, CNV_QUELEN_PICKUPAREA) > 0
  ' Wait until queue enters the Pickup Area
  Xqt CnvPosErrTest                            'Start acquiring offset values in
separate task
  
```

```

'Perform motion
Go Cnv_QueueGet(1,0)          'For SCARA robots
'Go Cnv_QueueGet(1,0):U(90):V(0):W(180) 'For 6-axis robots

Do
  Wait 0.02
Loop Until (CX(RealPos@CNV(1)) >= Cnv_Downstream(1))
' Wait until downstream limit is reached
Go Here                        'Stop robot
Cnv_QueueRemove 1, All        'Reset queue
Wait 0.5
Quit CnvPosErrTest            'End offset value acquisition
Motor Off

Fend

Function CnvPosErrTest
  fileNum = FreeFile          'Acquire a file number
  WOpen "poserr.csv" As fileNum 'csv filename
  Print #fileNum, "Time[sec],Cnv_PosErr[mm],Cnv_Speed[mm/s]"
  TmrReset 0
  Do
    Print #fileNum, Tmr(0), ",", Cnv_PosErr(1), ",",
    Cnv_Speed(1)
    Wait 0.01
  Loop
Fend

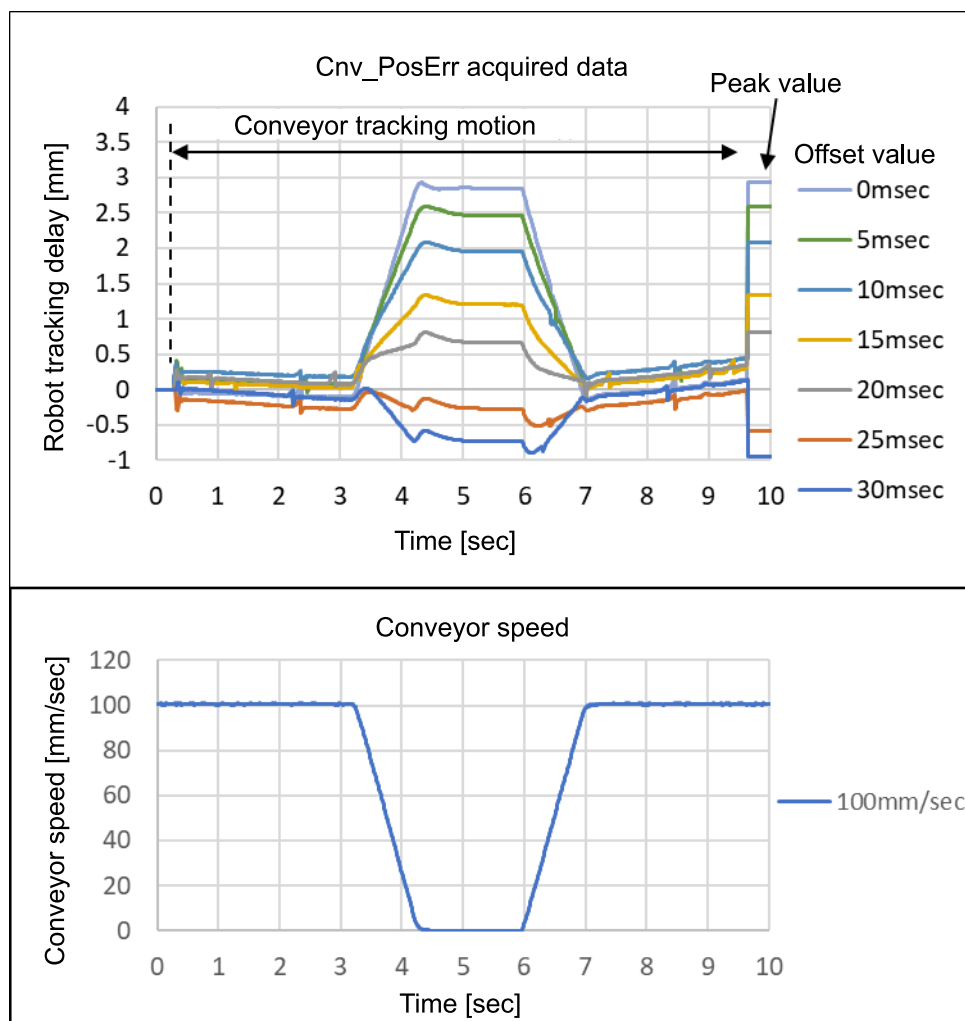
```

A "poserr.csv" file will be created in the project folder of Epson RC+ 8.0. Open the file in a spreadsheet or other software and create a line graph or scatter plot.

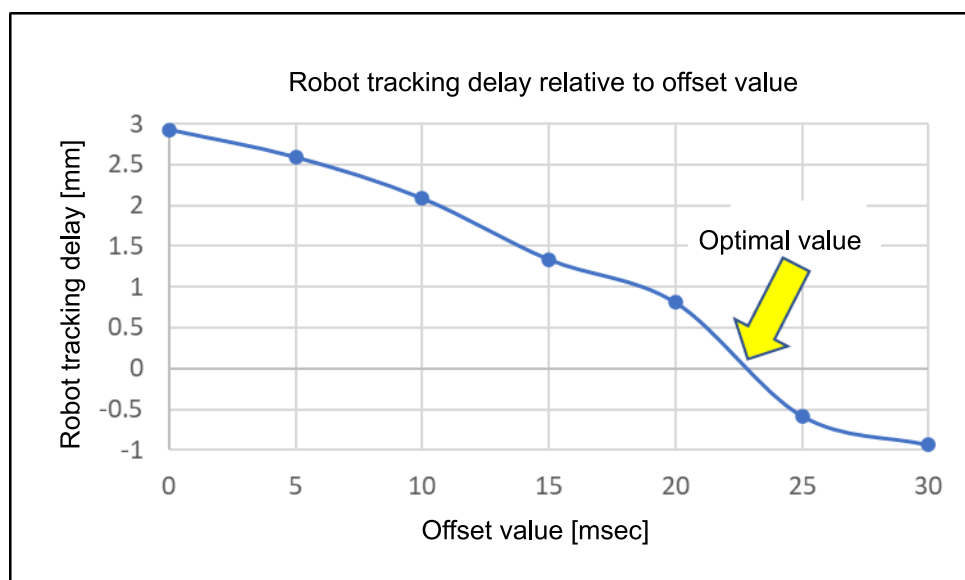
If data is acquired multiple times with different offset values, a graph like that shown below can be produced.

After a conveyor tracking operation, the return value of the Cnv_PosErr function will be the Cnv_PosErr peak value acquired during said operation. It is useful to use these peak values when creating graphs.

A positive tracking delay means that the robot is advancing too far downstream from the workpiece.



Plotting the robot's tracking delay against the offset value allows the optimal offset value to be set.



From the results shown above, add the following offset value setting to the conveyor tracking program:

```
Cnv_PosErrOffset 1, 22.7 'Offset value
```

CAUTION

- The offset values described in this procedure are for reference. Depending on the operating environment and the offset value that is set, the operation may not be successful or may cause vibration.
- If the robot performs an action different from the setting, immediately press the emergency stop button.

6.4 Abort Tracking

There are some situations when you want to abort tracking a part that moves out of the Pickup Area while the robot is tracking the part. In this case, use the Cnv_AbortTrack command in a separate task that monitors the conveyor queue.

```
Function MonitorDownstream
  Robot 1
  Do
    If Cnv_QueLen(1, CNV_QUELEN_DOWNSTREAM) > 0 Then
      Cnv_AbortTrack 0
    EndIf
    Wait .1
  Loop
Fend
```

KEY POINTS

- If you want to automatically interrupt tracking, please use the tracking abort line. See details below.
 - [Tracking Abort Line](#)
- For details on programs when using the tracking abort line, see below.
 - [How to check the tracking abort state](#)
 - [Program](#)

6.5 Conveyor Tracking Programming with a 6-Axis Robot

When you use a 6-axis robot in a conveyor tracking system, you need to set the values of U, V, and W.

For this, use the Cnv_QueGet command.

The following shows the case where the robot end effector moves toward a part during the pickup.

```
Go Cnv_QueGet(Conveyor number, [Index]):U(90):V(0):W(180)
```

An example of using Jump3 is shown below.

```
Jump3 P1, Cnv_QueGet(1):Z(**):U(90):V(0):W(180),
Cnv_QueGet(1):U(90):V(0):W(180)
```

KEY POINTS

When setting the Z(**) height, be aware of the following:

- Home position of Z in the tracking coordinate is the calibration position.
- To raise the Z height in the tracking coordinate, offset in a positive (+) direction.
- To lower the Z height in the tracking coordinate, offset in a minus (-) direction.
- Robot coordinate P1 can be converted to the conveyor coordinate and displayed.

```
> print P1@cnv1
```

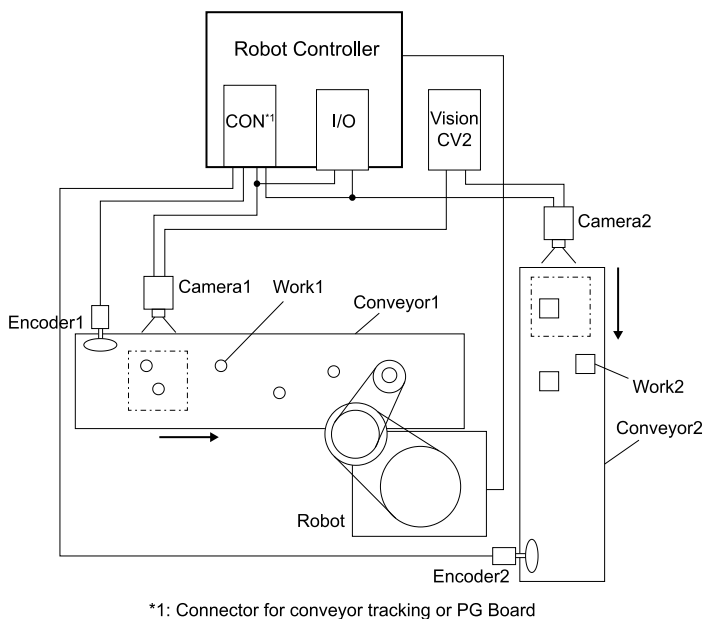
6.6 Multi-conveyor Programming

Epson RC+ supports multiple logical conveyors and robots. You can use multiple robots with one conveyor.

This section describes a conveyor system that uses one robot with two or more conveyors.

Conveyor tracking for several conveyors

This section describes a conveyor system where one robot picks up "Part 1" from Conveyor 1 and puts the picked parts above "Parts 2" on Conveyor 2 as shown in the figure below. In this conveyor system, each conveyor needs one encoder and camera (sensor).



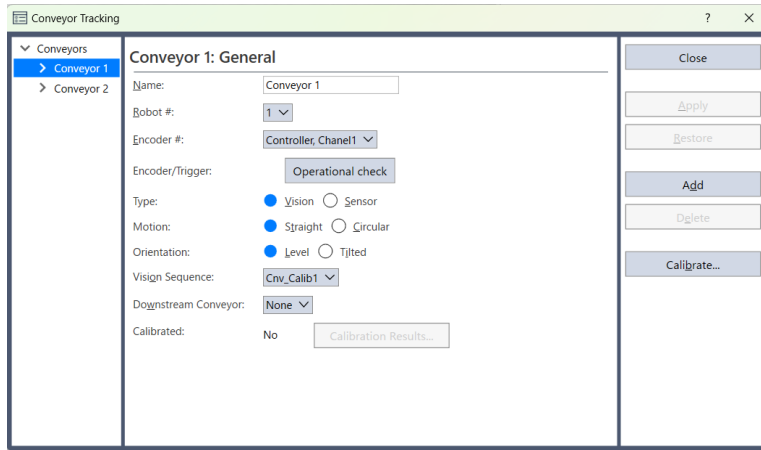
How to use several conveyors

Usage is described below.

1. See and create conveyors 1 and 2. (Set the robot in the upstream side to the Conveyor 1.)

Creating Conveyors in a Project

2. For the [Encoder] and [Vision Sequence], set the different number and sequence for each conveyor 1 and 2.



3. Calibrate Conveyor 1.

4. Check the operation while referring to either of the following:

- **Vision Conveyors**
- **Sensor Conveyors** - "Check the motion"

5. Calibrate Conveyor 2.

6. Check the operation of Conveyor 2.

A sample program is shown below.

This sample program automatically recovers when the robot tracks the workpiece that is out of the Pickup Area.

```
Function main
  Motor On
  Power High

  Speed 30
  Accel 30, 30

  Xqt ScanConveyorStrobed 'Task that registers queues
  Xqt PickParts           'Task that tracks parts (queue)
Fend
Function ScanConveyorStrobed
  Integer i, j, numFound, state, trigger1, trigger2
  Real x, y, u
  Boolean found

  trigger1 = 10 'Allocates pin10 of controller I/O to conveyor 1
  trigger2 = 11 'Allocates pin11 of controller I/O to conveyor 2
  Off trigger1; Off trigger2
  'Turns OFF the camera trigger and encoder latch
  ' For a virtual camera, keep the OFF state for approximately 0.5 seconds or
  longer.
  ' Wait 0.5
  Do
    VRun FindParts1      'Searches for parts on the conveyor
    On trigger1          'Turns ON the camera trigger and encoder latch I/O
    Do
      VGet FindParts1.AcquireState, state
    Loop Until state = 3
    VGet FindParts1.Parts.NumberFound, numFound
    'Registers the part that has been shot as a queue
    For i = 1 To numFound
      VGet FindParts1.Parts.CameraXYU(i), found, x, y, u
      Cnv_QueAdd 1, Cnv_Point(1, x, y)
```

```

Next i
Off trigger1          'Turns OFF the camera trigger and encoder latch I/O
Wait 0.1

'Registers the parts (queue) of the Conveyor 2
'Searches for parts on the conveyor
VRun FindParts2
On trigger2          'Turns ON the camera trigger and encoder latch I/O
Do
  VGet FindParts2.AcquireState, state
Loop Until state = 3
VGet FindParts2.Parts.NumberFound, numFound
'Registers the part that has been shot as a queue
For j = 1 to numFound
  VGet FindParts2.Parts.CameraXYU(j), found, x, y, u
  Cnv_QueAdd 2, Cnv_Point(2, x, y)
Next j
Off trigger2          'Turns OFF the camera trigger and encoder latch I/O
Wait 0.1
Loop
Fend
Function PickParts
  OnErr GoTo ErrHandler
  Integer ErrNum

  MemOff 1; MemOff 2    'Turns OFF the memory I/O

  Jump P1

  Do
    'Tracking of the Conveyor 1
    WaitPickup1:
    'Turns ON the memory I/O when the Conveyor 1 tracking phase starts
    MemOn 1              'Turns ON the memory I/O 1
    'Clears the parts (queue) in the downstream side from the downstream limit
    Do While Cnv_QueLen(1, CNV_QUELEN_DOWNSTREAM) > 0
      Cnv_QueRemove 1, 0
    Loop
    'Waits until a part (queue) enters the Pickup Area
    Wait Cnv_QueLen(1, CNV_QUELEN_PICKUPAREA) > 0

    'Starts tracking the part
    'When using the 6-axis robot
    Jump3 Cnv_QueGet(1):Z(0):U(90):V(0):W(180)
    'When using the SCARA robot
    Jump Cnv_QueGet(1)
    Wait 0.1 'The robot moves at the same speed as the conveyor for the Wait time
    specified to this part
    'Clears the picked part (queue)
    Cnv_QueRemove 1, All
    MemOff 1              'Turns OFF the memory I/O 1

    'Tracking of the Conveyor 2
    WaitPickup2:
    MemOn 2              'Turns ON the memory I/O 2
    'Waits until a part (queue) enters the Pickup Area
    Wait Cnv_QueLen(2, CNV_QUELEN_PICKUPAREA) > 0

    'Starts tracking the part
    'When using the 6-axis robot
    Jump3 Cnv_QueGet(2):Z(0):U(90):V(0):W(180)
    'When using the SCARA robot
    Jump Cnv_QueGet(2)
    Wait 0.1 'The robot moves at the same speed as
the conveyor for the Wait time specified to this part
    Wait 0.1 'The robot moves at the same speed as the conveyor for the Wait time

```

```

specified to this part
  'Clears the picked part (queue)
  Cnv_QueRemove 2, All
  MemOff 2           'Turns OFF the memory I/O 2

  Jump P1
Loop
  'Clears the parts (queue) in the downstream side from the Pickup Area
  'Automatically recovers from the error '"The specified queue data is outside
the set area"
ErrorHandler:
ErrNum = Err
If ErrNum = 4406 Then
  If MemSw(1) = On Then
    Cnv_QueRemove 1
    EResume WaitPickup1
  EndIf
  If MemSw(2) = On Then
    Cnv_QueRemove 2
    EResume WaitPickup2
  EndIf
  'Error other than "The specified queue data is outside the set area"
  'Is displayed
Else
  Print "Error!"
  Print "No.", Err, ":", ErrMsg$(Err, 1)
  Print "Line :", Erl(0)
  'User error occurred
  Error 8000
EndIf
Fend

```

KEY POINTS

For a virtual camera, when in the trigger wait state, if the camera trigger I/O is turned ON immediately after being turned OFF, the trigger may not be detected and the vision sequence may not complete. In such cases, after turning the camera trigger I/O OFF, use a Wait command or similar method to keep the OFF state for a certain period of time. Approximately 0.5 seconds or longer is recommended for the first time, and approximately 0.1 seconds or longer is recommended from the second time onward.

6.7 Multi-robot Programming

Epson RC+ supports multiple logical conveyors and robots. You can use multiple robots with one conveyor, or multiple robots with multiple conveyors.

This section describes a conveyor system that uses two or more robots with one conveyor and a conveyor system that uses one robot with two or more conveyors.

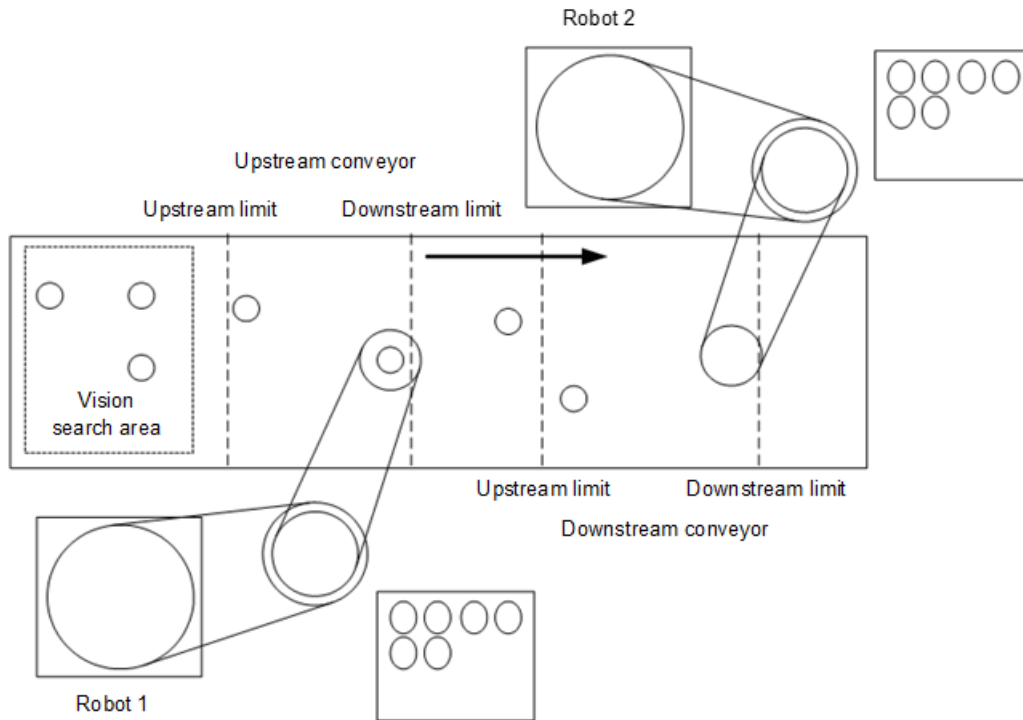
For details on multi robots, refer to the following manual.

"Robot Controller Manual"

Multi-robot conveyor

The multi-robot system uses two or more robots with one conveyor as shown below. In this system, the second robot (downstream) picks up the parts that the first robot (upstream) failed to pick up.

Although the system uses several robots, it uses only one camera (sensor), encoder, and conveyor.



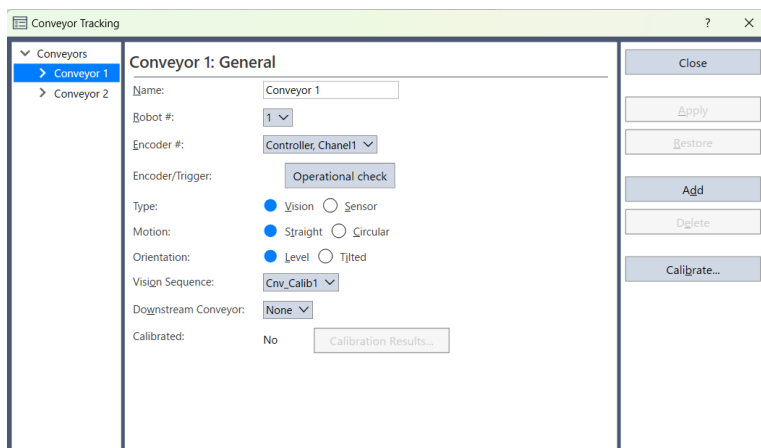
How to use multi-robot conveyor

To use the multi-robot conveyors, set the upstream and downstream conveyors. Instructions for using multi-robot conveyors are described below.

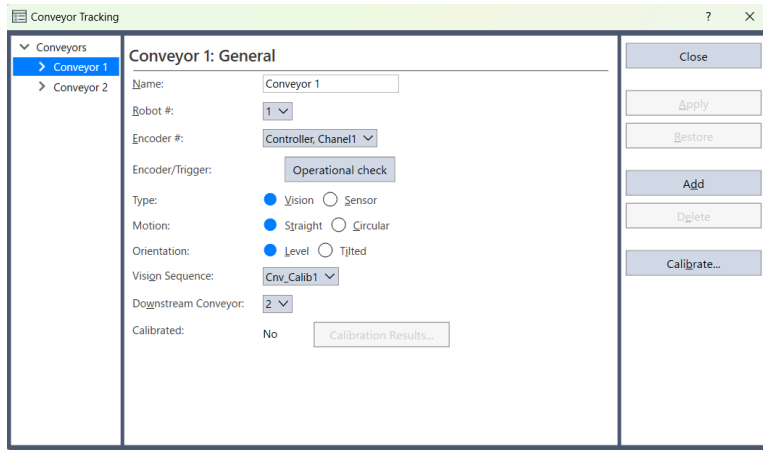
1. See and create conveyors 1 and 2. (Set the upstream-side robot to Conveyor 1.)

Creating Conveyors in a Project

2. For [Encoder] and [Vision Sequence], set the same number and sequence for both conveyors 1 and 2.



3. Calibrate Conveyor 1.
4. Check the operation while referring to either of the following:
 - **Vision Conveyors**
 - **Sensor Conveyors** - "Check the motion"
5. Set [Downstream Conveyor] to "2".



6. Calibrate Conveyor 2.

7. Check the operation of Conveyor 2.

- i. Clear the all queue data registered to each conveyor.

```
>Cnv_QueueRemove 1,All
>Cnv_QueueRemove 2,All
```

- ii. Place the part in the vision search area.

- iii. Execute the program “ScanConveyorStrobed” to register a queue.

- iv. Suspend (HALT) the program "ScanConveyorStrobed" and move the conveyor until the part enters the Pickup Area of the conveyor 1.

- v. Stop the program “ScanConveyorStrobed” and move the conveyor until the part enters the Pickup Area of the conveyor 2.

- vi. Execute the command below to move the queue from conveyor 1 to conveyor 2.

```
>Cnv_QueueMove 1,0
```

- vii. Pick up the part.

```
>Jump Cnv_QueueGet(2)
```

- viii. Check if the robot 2 end effector is above the center of a part. If the robot 2 end effector is not above the center of the part, perform the calibration again.

- ix. Move the conveyor and check if the robot follows the part. At this point, the end effector may have deviated from the center of the part. This is a result of not being able to accurately track sudden changes in conveyor speed. However, as tracking will correct over time, there does not present an issue.

- x. Stop the tracking motion.

```
>Cnv_AbortTrack
```

8. A sample program is shown below.

```
Function main
Xqt ScanConveyorStrobed 'Task that registers queues
Xqt PickParts1 'Task for the upstream robot to track the parts (queue)
Xqt PickParts2 'Task for the downstream robot to track the parts (queue)
```



```
Fend
```

```
Function ScanConveyorStrobed
```

```
Integer i, numFound, state, trigger
```

```
Real x, y, u
```

```
Boolean found
```

```
trigger = 10 'Allocates pin10 of controller I/O
```

```
Off trigger 'Turns OFF the camera trigger and encoder latch I/O
```

```
' For a virtual camera, keep the OFF state for approximately 0.5 seconds or longer.
```

```
' Wait 0.5
```

```
Do
```

```
    'Searches for parts on the conveyor
```

```
    VRun FindParts
```

```
    On trigger 'Turns ON the camera trigger and encoder latch I/O
```

```
    Do
```

```
        VGet FindParts.AcquireState, state
```

```
    Loop Until state = 3
```

```
    VGet FindParts.Parts.NumberFound, numFound
```

```
    'Registers the found part to the queue of conveyor 1
```

```
    For i = 1 To numFound
```

```
        VGet FindParts.Parts.CameraXYU(i), found, x, y, u
```

```
        Cnv_QueAdd 1, Cnv_Point(1, x, y)
```

```
    Next i
```

```
    Off trigger 'Turns OFF the camera trigger and encoder latch I/O
```

```
    Wait 0.1
```

```
    Loop
```

```
Fend
```

```
Function PickParts1
```

```
OnErr GoTo ErrHandler
```

```
Integer ErrNum
```

```
Robot 1
```

```
Motor On
```

```
Power High
```

```
Speed 30
```

```
Accel 30, 30
```

```
Jump P1
```

```
WaitParts:
```

```
Do
```

```
    'Waits until a part (queue) enters the Pickup Area
```

```
    Wait Cnv_QueLen(1, CNV_QUELEN_PICKUPAREA) > 0
```

```
    'Starts tracking the part
```

```
    'When using the 6-axis robot
```

```
        Jump3 Cnv_QueGet(1):Z(0):U(90):V(0):W(180)
```

```
    'When using the SCARA robot
```

```
    Jump Cnv_QueGet(1)
```

```
    Wait 1 'The robot moves at the same speed as the conveyor for the Wait time specified to this part
```

```
    Jump P1 'Moves the picked part to a specified place
```

```
    'Clears the picked part (queue)
```

```
    Cnv_QueMove 1, 0
```

```
Loop
```

```
'Moves the parts (queue) in the downstream side than the Pickup Area of conveyor1 'to the conveyor 2
```

```
ErrHandler:
```

```
ErrNum = Err
```

```
If ErrNum = 4406 Then
```

```
    Cnv_QueRemove 1, 0
```

```

    EResume WaitParts
    'When an error except the conveyor tracking motion range error occurs,
    'Error is displayed
Else
    Print "Error!"
    Print "No.", Err, ":", ErrMsg$(Err, 1)
    Print "Line :", Erl(0)
    'User error occurred
    Error 8000
EndIf
Fend

Function PickParts2
    OnErr GoTo ErrHandler
    Integer ErrNum

    Robot 2
    Motor On
    Power High
    LoadPoints "robot2.pts"
    Speed 30
    Accel 30, 30

    Go P1

    WaitParts:
    Do
        'Waits until a part (queue) enters the Pickup Area
        Wait Cnv_QueueLen(2, CNV_QUELEN_PICKUPAREA) > 0
        'Starts tracking the part
        'When using the 6-axis robot
        Jump3 Cnv_QueueGet(2):Z(0):U(90):V(0):W(180)
        'When using the SCARA robot
        Jump Cnv_QueueGet(2)
        Wait 1 'The robot moves at the same speed as the conveyor for the Wait time
specified to this part
        Jump P2 'Moves the picked part to a specified place
        'Clears the picked part (queue)
        Cnv_QueueRemove 2, 0
    Loop

    'Clears the picked part (queue)

    'Clear the parts (queue) in the downstream side than the Pickup Area of
conveyor 2
    'Automatically recovers from the error '"The specified queue data is outside
the set area"
    ErrHandler:
    ErrNum = Err
    If ErrNum = 4406 Then
        Cnv_QueueRemove 2, 0
        EResume WaitParts
        'Error other than "The specified queue data is outside the set area"
        'is displayed
    Else
        Print "Error!"
        Print "No.", Err, ":", ErrMsg$(Err, 1)
        Print "Line :", Erl(0)
        'User error occurred
        Error 8000
    EndIf
Fend

```

 KEY POINTS

For a virtual camera, when in the trigger wait state, if the camera trigger I/O is turned ON immediately after being turned OFF, the trigger may not be detected and the vision sequence may not complete. In such cases, after turning the camera trigger I/O OFF, use a Wait command or similar method to keep the OFF state for a certain period of time. Approximately 0.5 seconds or longer is recommended for the first time, and approximately 0.1 seconds or longer is recommended from the second time onward.

7. Recommendations For Efficient Use

7.1 Tips for Accuracy Improvement of Conveyor Tracking

7.1.1 Overview

This section provides the tips for improving the robot's performance to handle the workpieces in the Conveyor Tracking, which uses the vision system to detect the workpieces.

Process of Accuracy Improvement

Prepare the conveyor tracking in the following steps.

1. System construction
2. Vision calibration
3. Conveyor calibration
4. Check of the workpiece detection accuracy and the detection rate
5. Check of the workpiece handling accuracy

In order to improve the handling accuracy, proper preparations and adjustments in each step are necessary. The following sections describe tips for accuracy improvement for each step.

Subsequent descriptions use the SCARA robot. Please note that the tips are common in SCARA and 6-Axis robots.

7.1.2 Tips for System Construction

Tool Settings

In order to realize precise pickups, the end effector of the robot needs to pick up the workpieces correctly with a tool such as a vacuum pad attached.

To pick up the workpiece accurately by the tool, it is necessary to configure the tool in [Tools] page.

Eccentricity of the tool causes a constant pickup position gap. Make sure to configure the tool settings.

Also, adjustment by the tool settings is not effective for the improper tool such as a randomly-distorted vacuum pad due to the degenerated rubber. Make sure to use the proper tool.



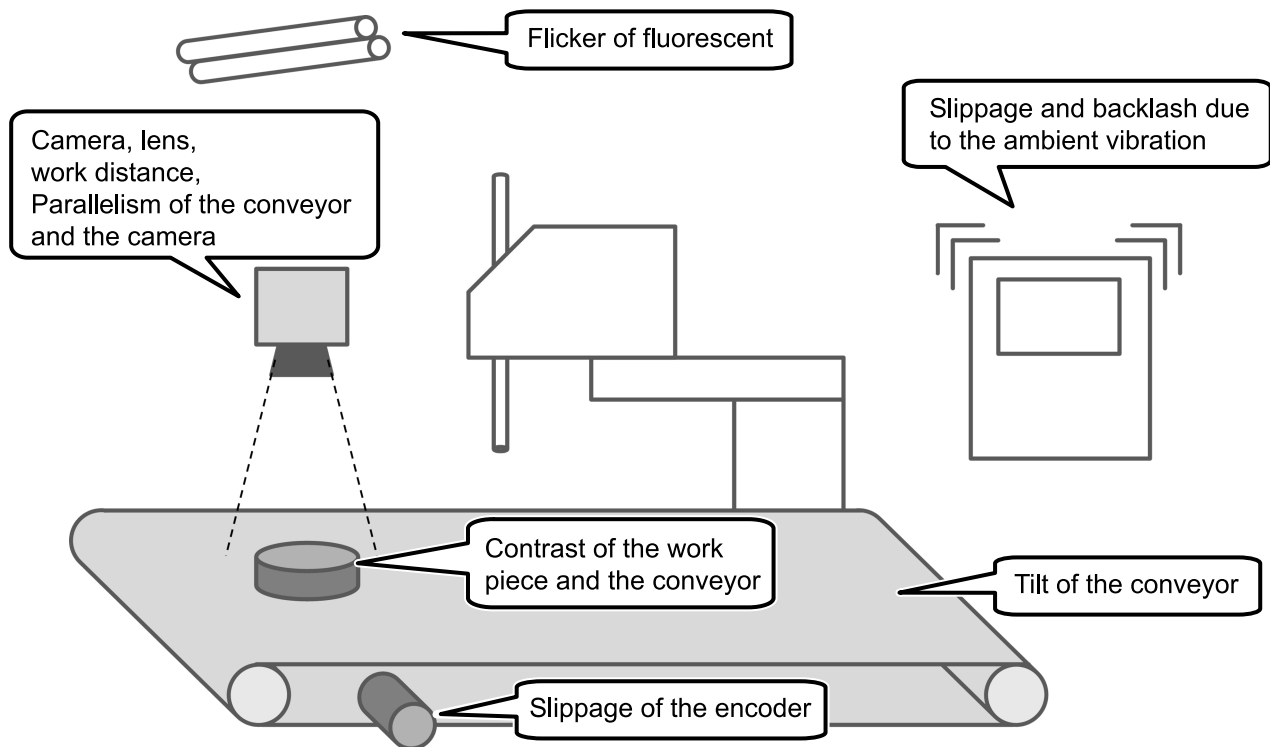
KEY POINTS

- For more details on tool settings, see below.
"Epson RC+ 8.0 User's Guide - Epson RC+ 8.0 GUI - [Tools] menu - [Robot Manager] (Tools Menu) - [Tool] - [Robot Manager] - [Tools] panel"
- For details on tool number selection, see below.
"Epson RC+ 8.0 User's Guide - Epson RC+ 8.0 GUI - [Tools] menu - [Robot Manager] (Tools Menu) - [Tool] - [Robot Manager] - [Jog & Teach] panel"
- After adjusting the tool, make sure to check the operation and ensure that the calibration result is accurate.

Installation and Environment

In order to realize precise pickups, the camera and the conveyor should be installed in the proper environment and calibrated properly.

Install the system with attention to the following points.



Important Points for Installation of the Conveyor System

- Use a proper camera and lens. Configure a work distance (distance from the lens to the object) properly. Also, ensure parallelism of the camera and the conveyor in order not to cause distortion of the field of view (FOV).
- Ensure horizontality of the horizontal conveyor to match the positions of the robot coordinate system and the conveyor coordinate system.

For the tilted conveyors, calibrate the tilt properly.

- If the encoder slips, pulse of the conveyor movement cannot be counted correctly.
- If the contrast of the workpiece and the conveyor is low, edges of the workpiece are difficult to be detected.
- Ambient vibration and source of the impact may cause slippage and backlash of the camera, the conveyor, and the workpieces. It may result in decrease in accuracy.
- General fluorescent lights have periodic flickers and may affect the work detection. Consider using fluorescent lights specialized for image processing or the LED lighting system.

KEY POINTS

Select and install the appropriate cameras and lenses to realize work detection which satisfies required pickup accuracy. Required work detection accuracy should be threefold of the required pickup accuracy. For details on modification of the FOV for accuracy improvement, see below.

Tips for Vision Calibration - "Field of View of Cameras"

7.1.3 Tips for Vision Calibration

Field of View of Cameras

A large field of view increases mm/pixel (length of 1 pixel) value and decreases detection accuracy of the workpieces.

If the following values from the calibration result do not satisfy the required accuracy,

- XmmPerPixel (X mm of one pixel)
- YmmPerPixel (Y mm of one pixel)

consider the following methods.

- Reinstall the camera and the workpiece to shorten the work distance (distance from the lens to the object)
- Use a high resolution camera
- Use a high resolution lens (e.g. our mega pixel lens) or a long-focal-length lens.



KEY POINTS

For details on the vision calibration, refer to the following manual.

"Vision Calibration" in "Vision Guide 8.0 Software"

Deviation and Tilt of the Field of View

If Error (deviation) or Tilt values displayed in the calibration result were more than "1", it can be considered that calibration was not done properly.

For more details, refer to the following manual.

"Vision Guide Software-[Calibration Complete Dialog Box"

Previous values		New values	
X mm per pixel:		X mm per pixel:	0.1545
Y mm per pixel:		Y mm per pixel:	0.1551
Max X error:		Max Y error:	0.0686
Max Y error:		Avg Y error:	0.0660
Avg X error:		Avg X error:	0.0000
Avg Y error:		Y tilt:	-0.35
X tilt:		X tilt:	0.92
Y tilt:		FOV:	98.91 mm X 74.47 mm
FOV:			

OK Cancel

Dialog displaying the calibration results

Reference Point Detection

For the vision calibration, use a proper combination of the reference point and the vision object; for instance, use a perfect circle as a reference point and detect it by the Blob object. In addition, it is necessary to perform a calibration with the “aperture” and “focus” of the camera adjusted to the workpiece.

- Adjust the camera aperture not too bright and not too dark in order to detect edges and marks of the workpiece.
- Adjust the focus to see the workpiece sharply. Blurs may affect the detection rate and accuracy.

KEY POINTS

- If the workpiece is thick and the top face does not come into the focus when the focus is placed on the conveyor, adjust the focus to the top face and set the reference point at the same height to calibrate.
- For details on reference points, refer to the following manual:
"Vision Guide 8.0 Software- Reference Points and Camera Points"
- For details on vision objects, refer to the following manual:
"Vision Guide 8.0 Software- Vision Objects"

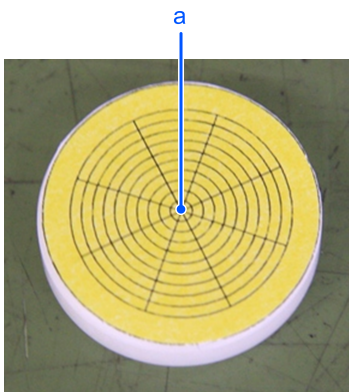
7.1.4 Tips for Conveyor Calibration

Workpiece and Tool

In order to realize precise pickups, it is necessary to perform a correct teaching in the conveyor calibration. To move the center of the end effector to the feature point (e.g. the center point) of the workpiece detected by the camera, it is recommended, for example, to use a workpiece and a tool as described below.

workpiece : Teaching point (a) is easy to be found

Tool : Tip point (b) is easy to be found (Make sure to configure the tool settings.)



Example of the workpiece and the tool used in the conveyor calibration

KEY POINTS

Perform a model teaching by overlaying the model origin of the Corr or Geom object on the teaching point, and adjust the positions of the camera coordinate system and the conveyor coordinate system correctly. If the teaching point is the center of balance of the workpiece (a perfect circle or a square), the center can be detected as the model origin by the Blob object.

Z Value Adjustment

The workpiece and the tool used in the conveyor calibration can have a different height from those used in actual workpiece handling. By adjusting the Z value after replacing the tool and the workpiece, errors related to the Z offset can be solved.

In the following cases, Z value adjustment is effective.

- Tool cannot reach and pick up the workpiece. (Z offset is too large)
- Robot collides with the workpiece and damages it. (Z offset is too small)

Like the above cases, redoing of the whole conveyor calibration process may not be required. If there is a problem in the pickup height, adjust the Z value as a first step.

KEY POINTS

For details on the Z value adjustment, see below.

[Adjusting the Z value](#)

7.1.5 Troubleshooting for Workpiece Detection

Teaching of Pickup Position

In order to realize precise pickups, the pickup position of the workpiece should be detected properly as a model origin. To compensate the constant pickup position gap in workpiece handling due to the gap between the pickup position and the model origin, following methods are effective.

- Perform a model teaching by overlaying the model origin of the Corr or Geom object on the teaching point and set the CameraX and CameraY as the pickup position.
- To set the center of balance as a pickup position, detect it as a model origin by the Blob object and set the CameraX and CameraY as the pickup position.

* CameraX: X coordinate of the detected workpiece position in the camera coordinate system

* CameraY: Y coordinate of the detected workpiece position in the camera coordinate system

KEY POINTS

For details on vision objects, refer to the following manual:

"Vision Guide 8.0 - Software- Vision Objects"

If the workpiece Cannot Be Detected in the Search Area

If the workpiece which is in the search area cannot be detected and an image processing error occurs, it can be improved by adjusting the vision properties. See the following points.

- Adjust the camera's exposure time

Long exposure time affects the work detection since it may blur the image of the moving workpiece. Use the ExposureTime property to shorten the exposure time.

- Adjust the shape score value

If the work detection rate is unstable, it may be improved by adjusting the Accept property of the vision object.

KEY POINTS

For details on the vision properties, refer to the following manual.

"Vision Guide 8.0 Properties and Results Reference"

If Work Detection Does Not Satisfy the Required Accuracy

If the work detection does not satisfy the required accuracy, it can be improved by adjusting the vision properties. See the following points.

- Adjust the camera's exposure time

Long exposure time affects the work detection since it may blur the image of the moving workpiece. Use the ExposureTime property to shorten the exposure time.

- Adjust the camera's field of view

Wide field of view increases the length of 1 pixel and decreases the detection accuracy. Check the XmmPerPixel and YmmPerPixel values.

KEY POINTS

Example: If approximately 0.5 mm of the image blur at the 100 mm/sec of the conveyor speed is acceptable, set the exposure time to 5 msec.

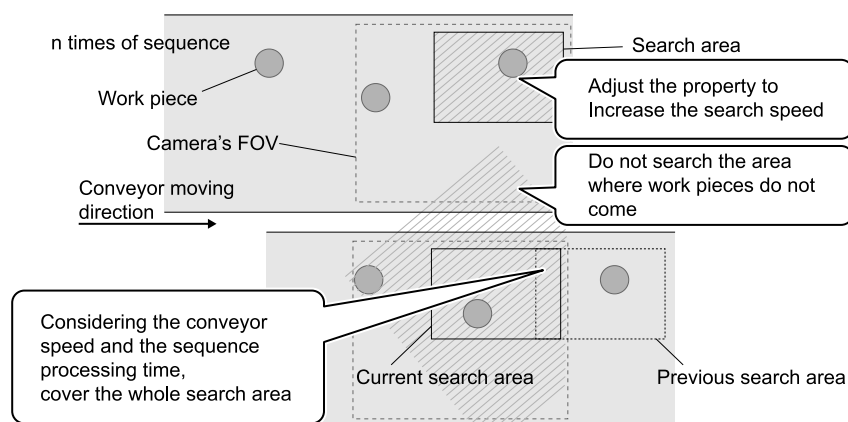
KEY POINTS

For details on the vision properties, refer to the following manual.

"Vision Guide 8.0 Properties and Results Reference"

Tips for the case if the image processing cannot be done in time

If the image processing cannot be done in time, it can be improved by adjusting the search area and the vision properties. See the following points.



Tips for the case if the image processing cannot be done in time

- Adjust the search window of the object

A large search window increases time to execute the vision objects. Adjust the search window as small as possible by eliminating the area where workpieces do not come in.

- Adjust the number of the objects to be detected

When you want to detect only one workpiece at a time, setting the NumberToFind property to “1” may reduce the execution time.

- Adjust the range of the expected scale

If there is no great variability in size of the workpieces, set the ScaleEnable property to “False”. If there is a small variability, narrow the ranges of the ScaleFactorMax and the ScaleFactorMin properties as much as possible.

- Adjust the range of the angled detection

If there is no great variability in angle among the workpieces, set the AngleEnable property to “False”. If there is a small variability, narrow the range of the AngleRange property as much as possible.

- Adjust the timeout period

A process is aborted when the image processing time is considered to exceed the timeout period. If image processing times vary, both the detection rate and the execution time may be improved by shortening the Timeout property.

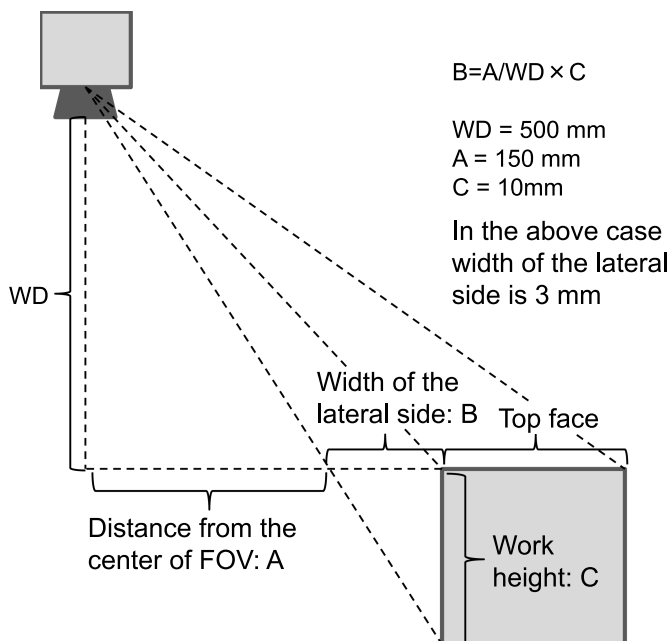
KEY POINTS

For details on the vision properties, refer to the following manual.

"Vision Guide 8.0 Properties and Results Reference"

When Using A Thick Workpiece

If the workpiece is thick, the camera's FOV includes the lateral side of the workpiece as shown in the figure below. If the top face and the lateral side of the workpiece have similar color, those two faces may be detected as a single top face of the workpiece. Pay attention to this influence especially when using the thick workpieces.



Influence of detecting the lateral side of the workpiece

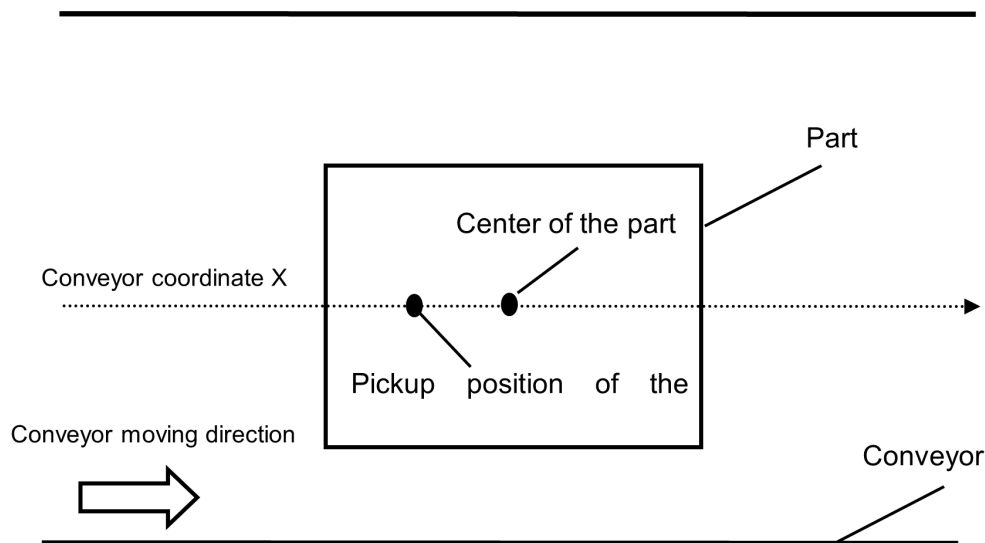
KEY POINTS

This influence can be decreased by increasing the work distance or replacing the lens with a one with a long focal distance and a narrow angle of view.

7.1.6 Offset

Pickup of moving parts

With conveyor tracking, the pickup position of the robot may deviate from the center of the part as shown below. This gap occurs as a result of accuracy errors of the vision system calibration, tool calibration, and tracking.



Followings are countermeasures for the problem.

1. Feed the part with an angle near 0°degree. Then, pick up the part.
2. Measure the gap between the center of the part and the robot's pickup position.
3. Repeat the steps 1 and 2 for five times and calculate the average.
4. Set the offset value in the program when tracking.

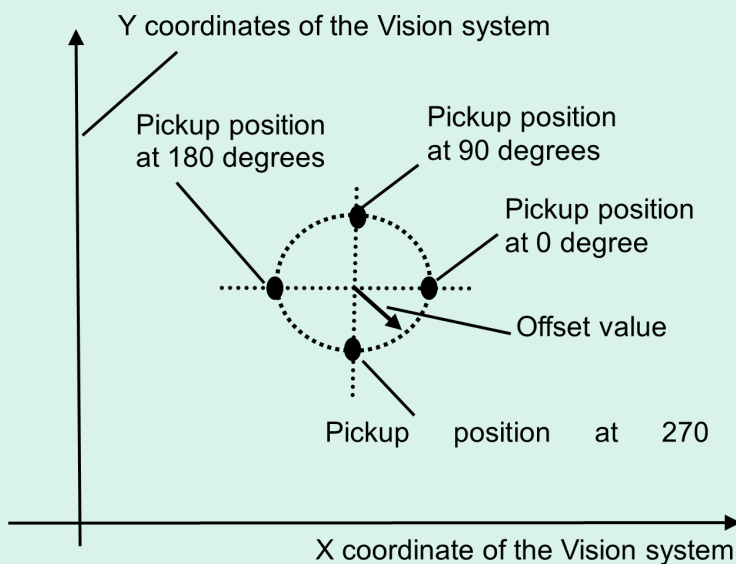
```
> Jump Cnv_QueueGet(1) +X(**)
```

5. Feed the part with an angle near 90°degree. Then, pick up the part.
6. If the gap is large, fine-tune the value set in the step (4).
7. Feed the part with an angle near 0°degree. Then, pick up the part.
8. If the gap is large, fine-tune the value set in the step (6).
9. Repeating steps 6 to 8 may improve picking accuracy.

KEY POINTS

If the gap between the center of the part and the pickup position can be measured by using the vision system, compensate the "Offset" as follows:

1. Feed the part with an angle near 0 degree. Then, pick up the part.
2. Take the image of the picked part by the camera and record X and Y coordinates.
3. Repeat the steps 1 and 2 for five times and calculate the average.
4. Feed the part with an angle near 90°degree. Then, pick up the part.
5. Take the image of the picked part by the camera and record X and Y coordinates.
6. Repeat the steps 4 and 5 for five times and calculate the average.
7. Feed the part with an angle near 180°degree. Then, pick up the part.
8. Take the image of the picked part by the camera and record X and Y coordinates.
9. Repeat the steps 7 and 8 for five times and calculate the average.
10. Feed the part with an angle near 270 degree. Then, pick up the part.
11. Take the image of the picked part by the camera and record X and Y coordinates.
12. Repeat the steps 10 and 11 for five times and calculate the average.
13. Plot the values in the steps 3, 6, 9, and 12 as shown in the figure below, and calculate the offset value.



14. Set the offset value in the program when tracking.

```
> Jump Cnv_QueueGet(1) +X(offset)
```

KEY POINTS

Depending on the offset value, the upstream limit may be exceeded and error 4406 may occur.

```
Wait Cnv_QueueLen(1, CNV_QUELEN_PICKUPAREA) > 0
Jump Cnv_QueueGet(1) +X(offset)
```

The error can be avoided by doing either of the following:

- Set the wait time before Jump command.
- Set the "offset" when registering the queue and not to register when executing the Jump command.

```
Cnv_QueueAdd 1, Cnv_Point(1, x + x(offset), y)
```

7.2 Dispense Application on Conveyors

7.2.1 Overview

Conveyor Tracking corresponds CP motion commands and Path motion and can be used in dispense application.

The following motion commands correspond:

- Move : Linear motion
- Arc : XY plane circular interpolation
- Arc3 : 3D circular interpolation
- CVMove : Free curve interpolation

CP motion and Path motion can be executed while following a workpiece. Dispensing speed of CP motion and Path motion are set in AccelS and Speeds.

```
'Setting of dispensing speed
SpeedS 50          'Dispensing speed 50mm/s
AccelS 1000 1000
```



KEY POINTS

- When executing a dispensing at a constant speed, add a pre-motion to reach the dispensing speed. When you use an optional analog I/O board, it can adjust the amount of dispensing according to the speed.
- When using the Arc and Arc3 commands for conveyor tracking, use the Arc syntax (1) and Arc3 syntax (1), which specify the midPoint, as described in the SPEL+ Language Reference.
- Arc syntax (2) to (4) and Arc3 syntax (2), which do not specify the midPoint, are not available for conveyor tracking.

7.2.2 Setting a Target Point

When executing CP motion and Path motion in Conveyor Tracking, specify a target point by using conveyor queue data detected in Vision system or points.

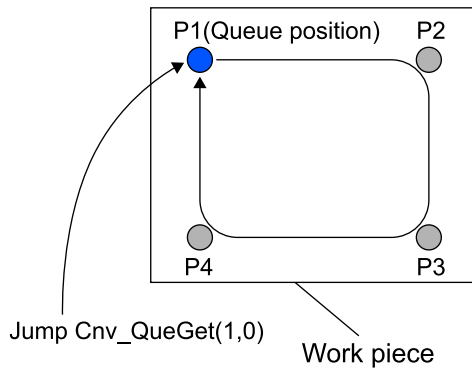
To use points:

Teach points in the dispensing path using a workpiece placed on the conveyor. Do not move the conveyor during teaching.

Specify the coordinate differences between points for CP motion and Path motion. If the angle of the workpiece is different from that of the teaching, calculate the angle difference and specify the coordinates.

The following is a sample program that uses CP motion and Path motion on a square shape.

Teach in the order of P1, P2, P3, P4, P1.



Converts point coordinates to conveyor coordinates (using conveyor 1)

```
P101 = P1 @CNV1; P102 = P2 @CNV1
P103 = P3 @CNV1; P104 = P4 @CNV1

Jump Cnv_QueueGet(1,0)      'Follows the queue position
Move Cnv_QueueGet(1,0)+X(CX(P102)-CX(P101))+Y(CY(P102)-CY(P101)) CP
Move Cnv_QueueGet(1,0)+X(CX(P103)-CX(P101))+Y(CY(P103)-CY(P101)) CP
Move Cnv_QueueGet(1,0)+X(CX(P104)-CX(P101))+Y(CY(P104)-CY(P101)) CP
Move Cnv_QueueGet(1,0)
```

To use CVMove command:

```
Converts point coordinates to conveyor coordinates (using conveyor 1)
P101 = P1 @CNV1; P102 = P2 @CNV1
P103 = P3 @CNV1; P104 = P4 @CNV1
Curve "MyFile", 0, 2, 4, P(101:104) 'Creates a Curve file

Jump Cnv_QueueGet(1,0)      'Follows the queue position
CVMove "MyFile"
```

To use conveyor queue data detected in Vision system:

Register the position of points P1 to P4 in the diagram of "To use points:" to Vision system as conveyor queue data. Converting coordinates as in "To use points:" or calculating the coordinate differences between points and the angle of a workpiece are not required.

To use CVMove command, create Curve in the same way as "To use points:"

```
Jump Cnv_QueueGet(1,0)      'Follows the queue position
Move Cnv_QueueGet(1,1) CP
Move Cnv_QueueGet(1,2) CP
Move Cnv_QueueGet(1,3) CP
Move Cnv_QueueGet(1,0)
```

7.2.3 Adjusting an Amount of Dispensing

Use the optional analog I/O board to output analog voltages according to the speed of the robot during Conveyor Tracking.

When you use a dispenser with a function to output the dispensing amount, the dispensing amount can be adjusted according to the speed of the robot.

For connection and use of the analog I/O board, refer to the following manuals:

- "Robot Controller RC800-A Manual - Analog I/O Board"
- "Robot Controller RC700 Series Manual - Analog I/O Board"
- "Robot Controller RC700-D Manual - Analog I/O Board"

- "Robot Controller RC700-E Manual - Analog I/O Board"
- "Robot Controller RC90 Series Manual - Analog I/O Board"

The SPEL+ command of the analog I/O board used for Conveyor Tracking is AIO_Set.

For more details, refer to the following manual.

"SPEL+ Language Reference"

KEY POINTS

AIO_Set cannot be used for circular conveyors.

7.3 How to shorten the picking cycle time

As examples, the following methods can be used to shorten the picking cycle time:

- -Use the Arch command
- -Use the Cnv_Accel command

KEY POINTS

The followings are the points to consider when using the Cnv_Accel command.

- Maximum Cnv_Accel value is 5000 mm/s².
- If the Cnv_Accel setting value is 0 or exceeds 5001, the default value (2000 mm/s²) will be set.
- If the acceleration error occurs, greater Cnv_Accel value cannot be specified. Decrease the Cnv_Accel value or decrease Accel or AccelS.

7.4 Manipulator Posture

Manipulator posture during the tracking motion is always the default posture regardless of the posture at the conveyor tracking calibration. To specify the posture for the tracking, write a program as shown in the following example.

Example: tracks the workpiece with Lefty arm position

```
jump Cnv_QueueGet(Conveyor number, [Index])/L
```

KEY POINTS

During tracking motion, singularity avoiding function cannot be used. Therefore, set the positions of the Manipulator and the conveyor so that the Manipulator does not pass through the singularity.