XRC and XRC 2001 Controller

Conveyor Tracking with Shift Functions Manual

for UP/SKX-Series Robots

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SECTION 1
INTRODUCTION

1.1 About this Document

This manual provides information on how to use Conveyor Tracking with Shift Functions on the XRC controller.

This manual is organized as follows:

SECTION 1 – INTRODUCTION

General information about this manual, a list of reference documents, and customer service information.

SECTION 2 – SAFETY

Provides information for the safe use and operation of Motoman products.

SECTION 3– CONVEYOR TRACKING WITH SHIFT FUNCTIONS MANUAL

Provides detailed instructions for setting up Conveyor Tracking with Shift Functions on the XRC controller, alarms, and message transmission protocols.

1.2 Reference to Other Documentation

For additional information refer to the following:

- Concurrent I/O Parameters Manual for XRC 2001 (P/N 147626-1)
- Operator's Manual for General Purpose (P/N 142099-1)
- Operator's Manual for Handling (P/N 142100-1)
- Operator's Manual for Spot Welding (P/N 142101-1)
- Operator's Manual for Arc Welding (P/N 142098-1)
- Motoman UP6, XRC 2001 Manipulator Manual (P/N 145960-1)
- Motoman UP20, XRC 2001 Manipulator Manual (P/N 145965-1)
- Motoman UP50, XRC 2001 Manipulator Manual (P/N 145964-1)
- Motoman UP130/165, XRC 2001 Manipulator Manual (P/N 145967-1)

1.3 Customer Service Information

If you are in need of technical assistance, contact the Motoman service staff at (937) 847-3200. Please have the following information ready before you call:

- Robot Type (UP6, UP130, UP165, etc.)
- Application Type (welding, handling, etc.)
- Robot Serial Number (located on the back side of the robot arm)
- Robot Sales Order Number (located on back side of XRC controller)

NOTES

SECTION 2
SAFETY

2.1 Introduction

It is the purchaser's responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06. The address is as follows:

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: (734) 994-6088
FAX: (734) 994-3338

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. **The robot must not be operated by personnel who have not been trained!**

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.

This safety section addresses the following:

- Standard Conventions (Section 2.2)
- General Safeguarding Tips (Section 2.3)
- Mechanical Safety Devices (Section 2.4)
- Installation Safety (Section 2.5)
- Programming Safety (Section 2.6)
- Operation Safety (Section 2.7)
- Maintenance Safety (Section 2.8)

2.2 Standard Conventions

This manual includes information essential to the safety of personnel and equipment. As you read through this manual, be alert to the four signal words:

- DANGER
- WARNING
- CAUTION
- NOTE

Pay particular attention to the information provided under these headings which are defined below (in descending order of severity).

DANGER!

Information appearing under the DANGER caption concerns the protection of personnel from the immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.

WARNING!

Information appearing under the WARNING caption concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.

CAUTION!

Information appearing under the CAUTION caption concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

NOTE: Information appearing in a NOTE caption provides additional information which is helpful in understanding the item being explained.

2.3 General Safeguarding Tips

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06, section 6.13.4 and 6.13.5, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

2.4 Mechanical Safety Devices

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06 safety standards, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety measures are available:

- Safety fences and barriers
- Light curtains
- Door interlocks
- Safety mats
- Floor markings
- Warning lights

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.

2.5 Installation Safety

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

- Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06 safety standards are permitted to install the equipment.
- Identify the work envelope of each robot with floor markings, signs, and barriers.
- Position all controllers outside the robot work envelope.
- Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
- Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
- Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

2.6 Programming Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Programming tips are as follows:

- Any modifications of the controller PLC can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to the PLC. Making any changes without the written permission of Motoman will **VOID YOUR WARRANTY!**
- Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. **YOUR WARRANTY WILL BE VOID** if you use these special passwords.
- Back up all programs and jobs onto a floppy disk whenever program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
- The concurrent I/O (Input and Output) function allows the customer to modify the internal ladder inputs and outputs for maximum robot performance. Great care must be taken when making these modifications. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations that may damage the robot or other parts of the system.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.

- Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place.
- Check the E-STOP button on the teach pendant for proper operation before programming.
- Carry the teach pendant with you when you enter the workcell.
- Be sure that only the person holding the teach pendant enters the workcell.
- Test any new or modified program at low speed for at least one full cycle.

2.7 Operation Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Operation tips are as follows:

- Be sure that only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories are permitted to operate this robot system.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Inspect the robot and work envelope to ensure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Ensure that all safeguards are in place.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. This includes controller parameters, ladder, and I/O (Input and Output) modifications. Check and test all changes at slow speed.

2.8 Maintenance Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Maintenance tips are as follows:

- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Back up all your programs and jobs onto a floppy disk whenever program changes are made. A backup must always be made before any servicing or changes are made to options, accessories, or equipment to avoid loss of information, programs, or jobs.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- Be sure all safeguards are in place.
- Use proper replacement parts.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. This includes controller parameters, ladder, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).

YASNAC XRC OPTIONS
INSTRUCTIONS

FOR CONVEYOR SYNCHRONIZED FUNCTION WITH SHIFT FUNCTIONS

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MOTOMAN INSTRUCTIONS

MOTOMAN SETUP MANUAL
MOTOMAN-□□□ INSTRUCTIONS
YASNAC XRC INSTRUCTIONS
YASNAC XRC OPERATOR'S MANUAL
YASNAC XRC OPERATOR'S MANUAL for BEGINNERS
YASNAC XRC OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION

The YASNAC XRC operator's manuals above correspond to specific usage.
Be sure to use the appropriate manual.

YASKAWA MANUAL NO. HW0480784 ②

MANDATORY

- This manual explains the synchronized-to-conveyor control with shift functions of the YASNAC XRC system for teaching, playback, editing of jobs and files, and management of each operation. Read this manual carefully and be sure to understand its contents before handling the YASNAC XRC.

- General items related to safety are listed in Section 1: Safety of the Setup Manual. To ensure correct and safe operation, carefully read the Setup Manual before reading this manual.

CAUTION

- Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.

- The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.

- YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.

- If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.

- YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.

Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the YASNAC XRC.

In this manual, the Notes for Safe Operation are classified as “WARNING,” “CAUTION,” “MANDATORY,” or “PROHIBITED.”

 WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.
 CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.
 MANDATORY	Always be sure to follow explicitly the items listed under this heading.
 PROHIBITED	Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “CAUTION” and “WARNING.”

WARNING

- Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the playback panel or programming pendant are pressed.
  When the servo power is turned off, the SERVO ON READY lamp on the playback panel and the SERVO ON LED on the programming pendant are turned off.

  Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

  Emergency Stop Button 

- Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

  Injury may result from unintentional or unexpected manipulator motion.

  Release of Emergency Stop 

- Always set the Teach Lock before entering the robot work envelope to teach a job.

  Operator injury can occur if the Teach Lock is not set and the manipulator is started from the playback panel.

- Observe the following precautions when performing teaching operations within the working envelope of the manipulator :
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Ensure that you have a safe place to retreat in case of emergency.

  Improper or unintended manipulator operation may result in injury.

- Confirm that no persons are present in the manipulator's work envelope and that you are in a safe location before:
  - Turning on the YASNAC XRC power
  - Moving the manipulator with the programming pendant
  - Running check operations
  - Performing automatic operations

  Injury may result if anyone enters the working envelope of the manipulator during operation. Always press an emergency stop button immediately if there are problems.The emergency stop button is located on the right side of both the YASNAC XRC playback panel and programming pendant.

CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.
  -Check for problems in manipulator movement.
  -Check for damage to insulation and sheathing of external wires.

- Always return the programming pendant to the hook on the XRC cabinet after use.

  The programming pendant can be damaged if it is left in the manipulator's work area, on the floor, or near fixtures.

- Read and understand the Explanation of the Alarm Display in the setup manual before operating the manipulator.

Definition of Terms Used Often in This Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product.
The manipulator usually consists of the controller, the playback panel, the programming pendant, and supply cables.
The MOTOMAN manipulator is the YASKAWA industrial robot product.
In this manual, the equipment is designated as follows.

Equipment	Manual Designation
YASNAC XRC Controller	XRC
YASNAC XRC Playback Panel	Playback Panel
YASNAC XRC Programming Pendant	Programming Pendant

Descriptions of the programming pendant and playback panel keys, buttons, and displays are shown as follows:

Equipment		Manual Designation
Programming Pendant	Character Keys	The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]
	Symbol Keys	The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture. ex. page key  The cursor key is an exception, and a picture is not shown.
	Axis Keys Number Keys	“Axis Keys” and “Number Keys” are generic names for the keys for axis operation and number input.
	Keys pressed simultaneously	When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them, ex. [SHIFT]+[COORD]
	Displays	The menu displayed in the programming pendant is denoted with { }. ex. {JOB}
Playback Panel	Buttons	Playback panel buttons are enclosed in brackets. ex. [TEACH] on the playback panel

Description of the Operation Procedure

In the explanation of the operation procedure, the expression “Select • • •” means that the cursor is moved to the object item and the SELECT key is pressed.

4 Playback

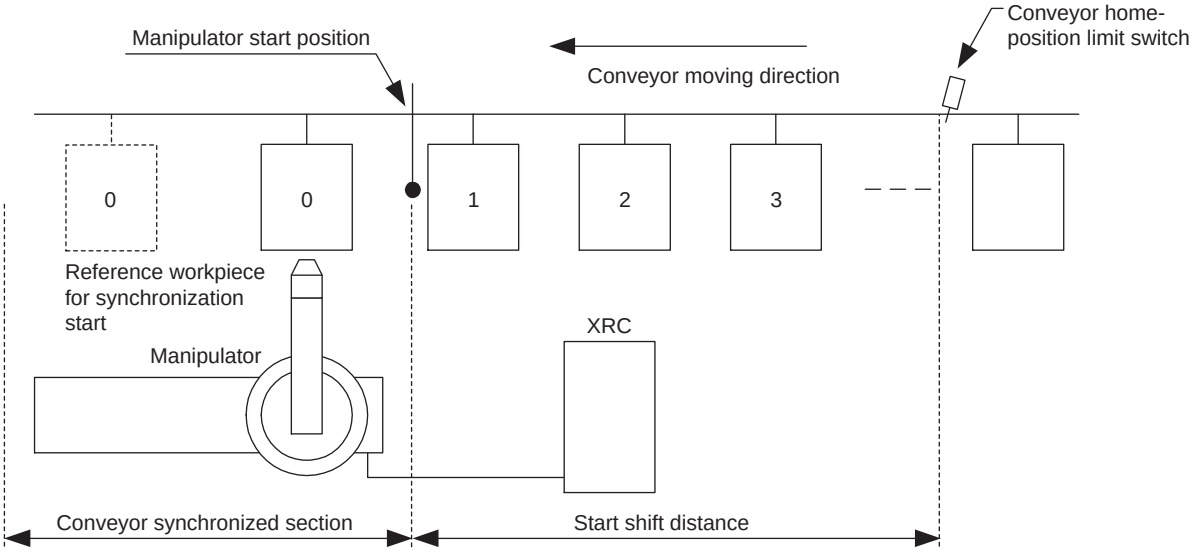
1 Conveyor Synchronized Function with Shift Functions

1.1 Conveyor Synchronized Function with Shift Functions

In the conveyor synchronized function of the position tracking type, the taught motion path of the manipulator is corrected according to the conveyor travel amount so that the manipulator performs follow-up motion in the conveyor moving direction at a constant relative speed to the workpiece.
There are two conveyor synchronized function types:
Manipulator follow-up control: The manipulator's basic axis moves in synchronization with the conveyor movement.
Travel-axis follow-up control: A travel axis (external axis) moves in synchronization with the conveyor movement.
When the conveyor synchronized function is used with "shift functions," it is useful for a situation where the conveyor home-position limit switch, the workpiece identification detecting limit switch (WORK ID detecting limit switch), and the workpiece detecting limit switch (WORK IN/NOT detecting limit switch) cannot be installed near the manipulator. Using the conveyor synchronized function with shift functions, the information of all the workpieces that pass all the limit switches to reach the synchronization start position of the manipulator can be managed. And then, when a workpiece reaches the manipulator start position, the corresponding job is started so that the manipulator can start the job in synchronization with the conveyor.
In such operation flow, the section from each limit switch to the manipulator start position is defined as "shift section," and the section from the manipulator start position to the synchronization start position of the manipulator is defined as "synchronized section."

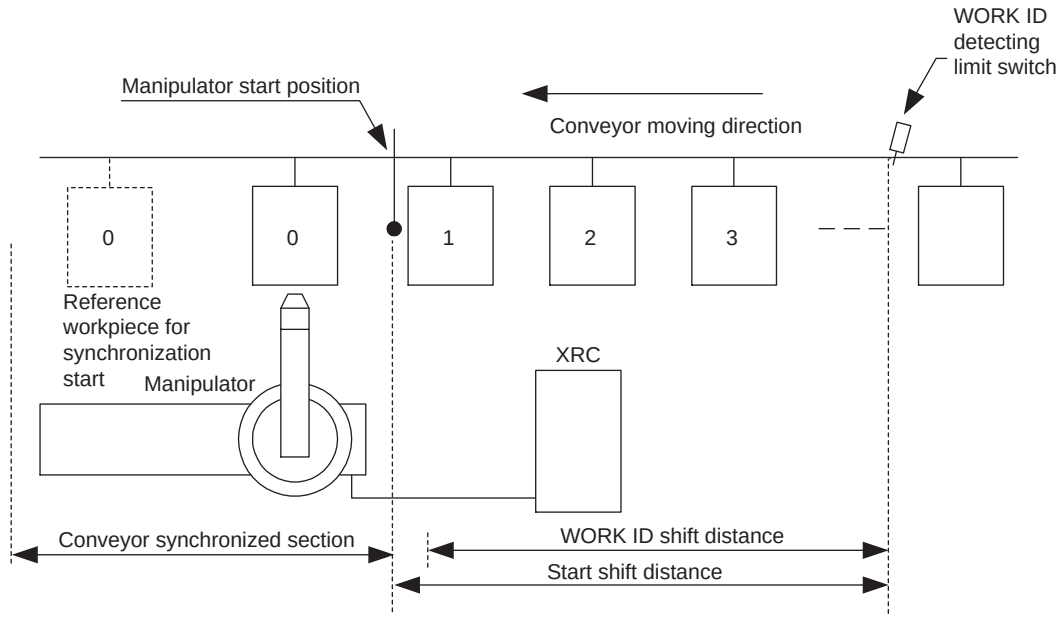
1.2 Start Shift Function

When the conveyor home-position limit switch is not installed near the manipulator, the second workpiece may pass the conveyor home-position limit switch before the first workpice, which passed the conveyor home-position limit switch, enters the conveyor synchronized section.
The XRC manages the position information of all the workpieces that passed the conveyor home-position limit switch, and starts the job programmed for each workpiece when the corresponding workpiece reaches the manipulator start position so that the manipulator executes the job in the follow-up motion to the conveyor.
For the above control, the start shift function manages up to 99 workpiece position data from the conveyor home-position limit switch to the reference workpiece for synchronization start.



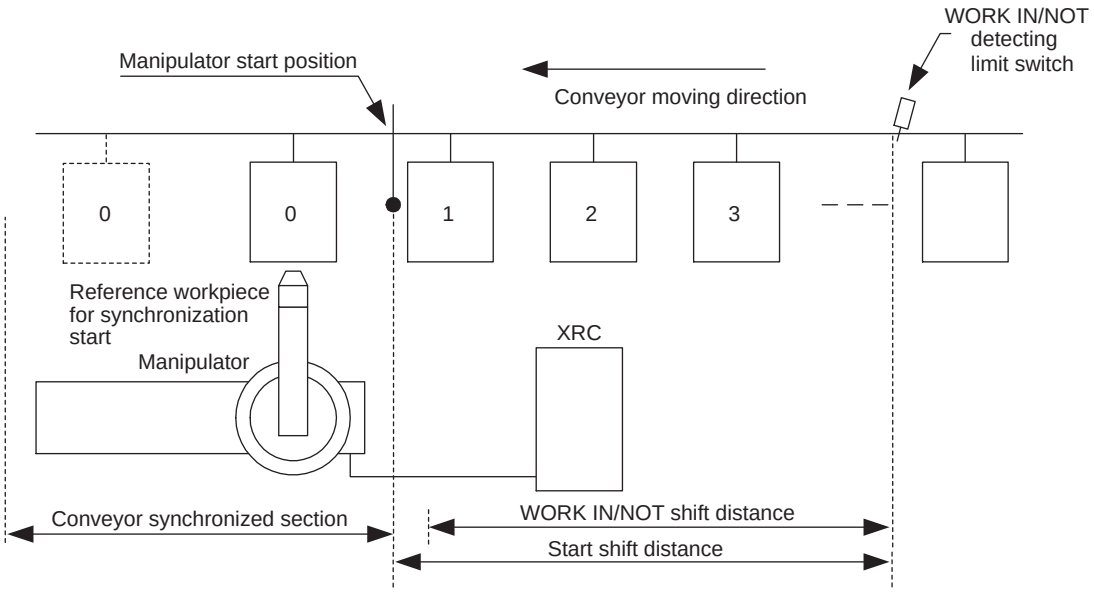
1.3 WORK ID Shift Function

When the workpieces are conveyed sequentially and the WORK ID detecting limit switch is turned on, the XRC reads the WORK ID of each workpiece by the predefined general-purpose input signal.
When the WORK ID detecting limit switch is not installed near the manipulator, the second workpiece may pass the WORK ID detecting limit switch before the first workpice, which passed the WORK ID detecting limit switch, enters the conveyor synchronized section.
The XRC manages the WOKD ID information of all the workpieces that passed the WORK ID detecting limit switch, and starts the job programmed for each workpiece when the corresponding workpiece reaches the manipulator start position so that the manipulator executes the job in the follow-up motion to the conveyor.
For the above control, the WORK ID shift function manages the WORK ID information up to 99 workpieces in the section from the WORK ID detecting limit switch to the reference workpiece for synchronization start.



1.4 WORK IN/NOT Shift Function

In the system that workpieces are conveyed in skits, the WORK IN/NOT detecting limit switch is activated when a skit passes, and the XRC reads whether a workpiece is in or not from the predefined general-purpose input signal.
When the WORK IN/NOT detecting limit switch is not installed near the manipulator, the second workpiece may pass the WORK IN/NOT detecting limit switch before the first workpiece, which passed the WORK ID detecting limit switch, enters the conveyor synchronized section. The XRC manages the WORK IN/NOT information obtained through the WORK IN/NOT detecting limit switch. When the XRC receives the information that a workpiece is in the skit, the XRC starts the job for the workpiece to move the manipulator in synchronization with the conveyor.
For the above control, the WORK IN/NOT shift function manages up to 99 skit data in the section from the WORK IN/NOT detecting limit switch to the reference workpiece for synchronization start.



1.5 Precautions on Using Conveyor Synchronized Function with Shift Functions

With the conveyor synchronized function with shift functions, the shift data such as Start Shift, WORK ID, and WORK IN/NOT in the synchronized section and shift section are automatically saved when the playback operation is completed normally or when the conveyor stops. However, manually save the data before turning OFF the power supply of the XRC to assure the data saving.

The actual conveyor status and the conveyor data in the XRC may differ in the following cases, which may cause a malfunction. Make sure that the actual conveyor status and the XRC data are same. If not, clear the conveyor data in the XRC.

- The conveyor moves while the power is not supplied to the XRC or during the XRC start-up sequence.
- A momentary power failure occurs during operation in play mode.
- The power to the XRC is turned OFF without saving the latest conveyor data.
- The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”

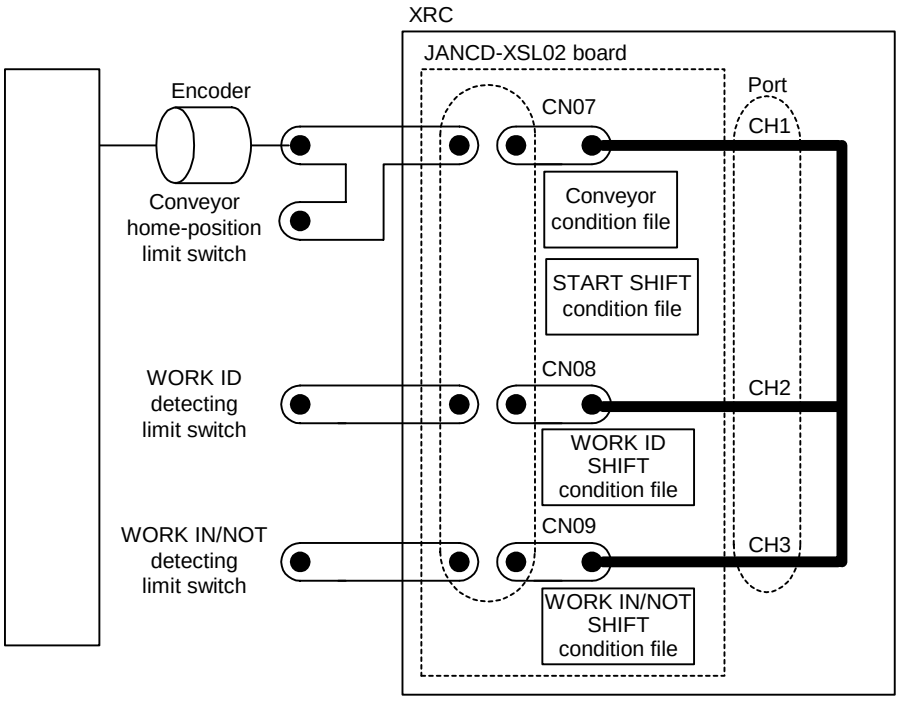
When all the shift functions such as Start Shift function, WORK ID Shift function, and WORK IN/NOT Shift function are disabled (set to “NOT USED”), the XRC operates in the same way as the operation with the basic conveyor synchronized function without shift functions. Refer to “YASNAC XRC OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION” for the basic conveyor synchronized function.

1.5 Precautions on Using Conveyor Synchronized Function with Shift Functions

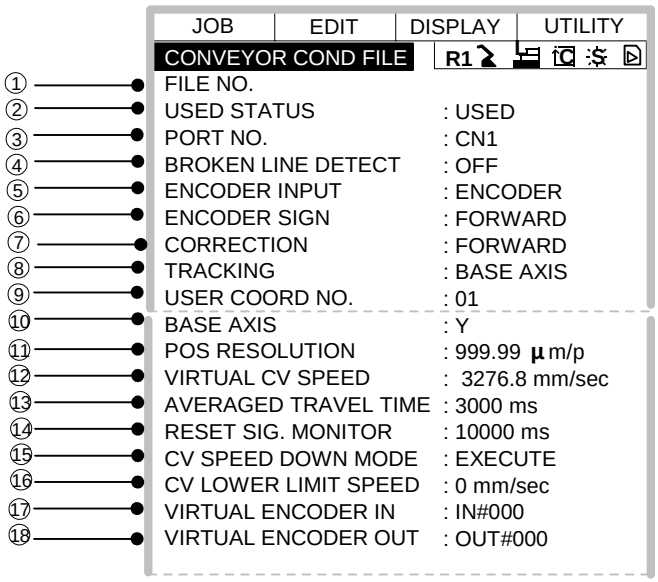
2 Conveyor Condition File

2.1 Conveyor Condition File

To execute the conveyor synchronized function with shift functions properly, the conveyor data must be set to the XRC. The data are set in the conveyor condition file, start shift condition file, WORK ID condition file, and WORK IN/NOT condition file.
The conveyor condition file sets the characteristics of the conveyor and the input method of the encoder, etc. Also, the conveyor supplemental condition file such as the Start Shift condition file, the WORK ID Shift condition file, and the WORK IN/NOT Shift condition file sets shift functions.



Although, in the above connection example, the conveyor encoder and conveyor home-position limit switch are connected to CN07, the WORK ID detecting limit switch to CN08, and the WORK IN/NOT detecting limit switch to CN09, each limit switch can be connected to any connector from CN07 to 09 on the conveyor synchronization board JANCD-XSL02. Also, more than two different limit switches can be connected to one connector.
Which limit switch is to be connected to which connector can be specified in the conveyor supplemental condition file explained later. Refer to “2.6 Start Shift Condition File,” “2.8 WORK ID SHIFT Condition File,” and “2.10 WORK IN/NOT SHIFT Condition File” for details.
Refer to “2. Hardware Specifications” of “YASNAC XRC OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION” for the connecting method of encoder and each limit switch.



①FILE NO.

The conveyor condition file number is shown below.

Board for synchronization (JANCD-XSL02)	File Number
With one board	1 to 3
With two boards	1 to 6

②USED STATUS (USED/NOT USED)

Specify whether to use or not to use the conveyor condition file.

③PORT NO. (CN1/CN2/CN3)

Select the port number where the encoder in use is connected.

Use this port number for the start shift home-position limit switch of the conveyor synchronized function with shift functions.

④BROKEN LINE DETECT (ON/OFF)

Specify whether the disconnection detection is to be enabled or not.

⑤ENCODER INPUT (ENCODER/VIRTUAL ENCODER)

Specify whether the actual encoder input or a virtual pulse encoder is used for the conveyor synchronized control.

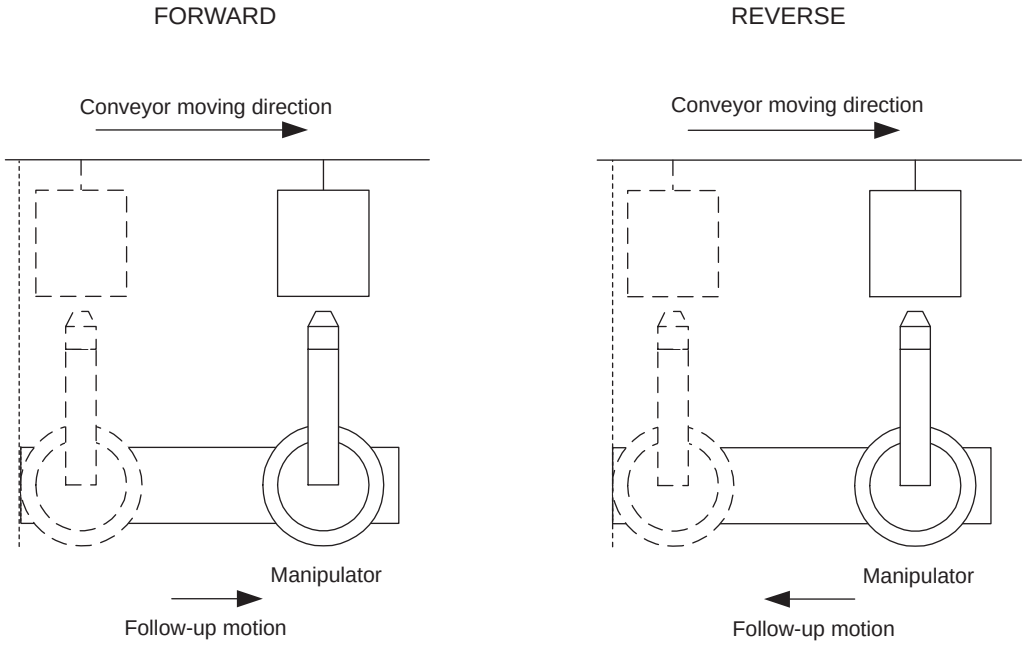
If the virtual pulse encoder is selected, the manipulator can execute the synchronized motion to the conveyor even if the encoder is not connected or the conveyor is not running, which can be used for confirming the manipulator motion at the test run.

⑥ENCODER SIGN (FORWARD/REVERSE)

Specify whether the sign of the position pulse input from the encoder should be inverted or not. When “REVERSE” is selected, the sign of the conveyor position and the data on the conveyor speed display is inverted so that the manipulator executes the follow-up motion in the reverse direction.

⑦CORRECTION (FORWARD/REVERSE)

Specify if the direction of the follow-up motion should be reversed or not. If “REVERSE” is selected, the sign of the correction position on the conveyor speed display is reversed and the manipulator executes the follow-up motion in the reversed direction.



⑧TRACKING (ROBOT AXIS/BASE AXIS)

Specify whether the manipulator is synchronized with the robot axis or the base axis (travel axis). If “BASE AXIS” is selected for the system without base axis, no synchronized motion can be performed.

⑨USER COORD NO. (1 to 24)

When “ROBOT AXIS” is selected in (8), specify the user coordinate number in whose X-axis direction the manipulator moves in synchronization with the conveyor movement.

⑩BASE AXIS (X/Y/Z)

When “BASE AXIS” is selected in (8), specify X-, Y-, or Z-axis to move in synchronization with the conveyor movement.

⑪POS RESOLUTION (0 to 999.99 µm/pulse)

This data convert one pulse from the encoder to the conveyor travel amount (µm).
For the details of setting method, refer to “4.3 Setting of Conveyor Positional Resulution” of “YASNAC XRC OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION.”

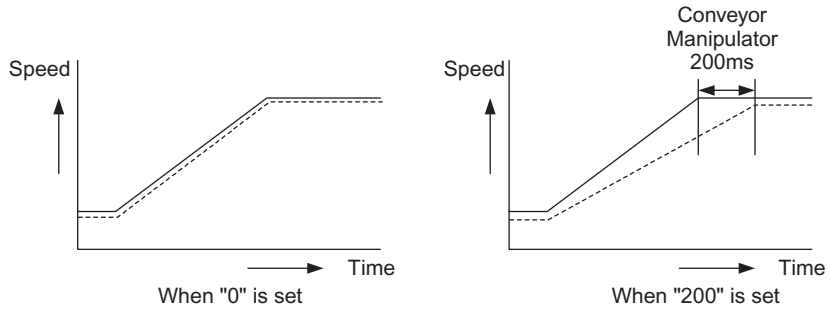
⑫VIRTUAL CV SPEED (-3276.8 to +3276.7 µm/s)

When “VIRTUAL ENCODER” is selected in (5), set the virtual encoder speed.

⑬AVERAGED TRAVEL TIME (0 to 3000 ms)

Set a time to average the travel amount so that the manipulator moves smoothly at the sudden change of the conveyor speed.

When using the conveyor with large pulsation, set the value between 300 and 500. If this setting is not used, set to “0.”



⑭RESET SIG. MONITOR (0 to 65535 ms)

If no encoder reset signal for a specified conveyor has been input when the SYSTART instruction is carried out, set the amount of time to wait for the conveyor home-position input signal.

If the actual waiting time is greater than the setting, the SYSTART instruction is aborted and the next instruction is carried out. Prepare the job so that the manipulator takes retreat motion by internal status. When “0” is set, the system waits for the conveyor home-position input signal without being interrupted by the time limit for encoder reset signal monitoring.

⑮CV SPEED DOWN MODE (EXECUTE/ALARM/PAUSE JOB/JOB INTERRUPTION AFTER OPERATION)

Specify the action of the manipulator when the conveyor speed is lowered below the conveyor speed lower limit set in (16).

- EXECUTE
  Regardless of the conveyor speed, the manipulator executes the job. When the conveyor stops, the manipulator continues the synchronized motion with the conveyor moving at the speed “0.”
- ALARM
  When the conveyor average speed becomes below the set value in (16) for 0.1 second or more, an alarm occurs and the manipulator stops.
- PAUSE JOB
  When the conveyor average speed becomes below the set value in (16) for 0.1 second or more, the job execution is interrupted (only the move instructions are suppressed) and the manipulator performs only the follow-up motion. When the conveyor speed recovers to the set value in (16) or higher, the job execution is re-started.
- JOB INTERRUPTION AFTER OPERATION
  When the conveyor average speed becomes below the set value in (16) for 0.1 second, the manipulator executes the job up to the spray off instruction and executes only the follow-up motion to the conveyor moving direction. When the conveyor speed recovers to the set value in (16) or higher, the manipulator re-executes the job.
  If move instruction (SYMOV*) is not registered between SPYOF instruction and the next SPYON instruction , work does not interrupt.In this mode,please register move instruction (SYMOV*) between the SPYOF instruction and the next SPYON instruction .

⑯CV LOWER LIMIT SPEED (0 to 65535 mm/s)
When a mode other than “EXECUTE” is selected in (16), set the conveyor speed lower limit by which the manipulator takes the respective action.

⑰VIRTUAL ENCODER IN (IN#000 to IN#192)
Set the general-purpose input signal number to be set for the virtual encoder . When this signal is input, the encoder input enters the virtual encoder mode.
000: Virtual encoder not used
001 to 192: The general-purpose input signal of the set number activates the virtual encoder mode.

⑱VIRTUAL ENCODER OUT (OUT#000 to OUT#192)
When “VIRTUAL ENCODER” is selected in (5), set the general-purpose output signal number to be set for the virtual encoder output.
000: Virtual encoder not used
001 to 192: The general-purpose output signal of the set number is output from the virtual encoder

2.2 Editing Conveyor Condition File

2.2.1 Display the Conveyor Condition File

Operation

Select {ROBOT} under the top menu ➡ Select {CV CONDITION} ➡ Display a desired conveyor condition file*1*

Explanation

1 Press the page key to display the next file number.

Press [SHIFT] + the page key to display the previous file number.

2.2.2 Edit the Conveyor Condition File

■ Selecting “USED STATUS”

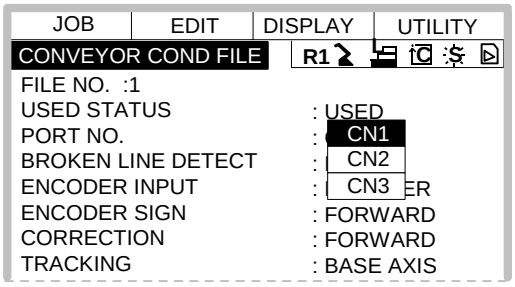
Operation

Select “USED STATUS” ➡ ”USED” or “NOT USED” is selected alternately

■ Selecting “PORT NO.”

Operation

Select “PORT NO.” ➡ The selection dialog appears ➡ Select a desired port number



■ Selecting “BROKEN LINE DETECT”

Operation

Select “BROKEN LINE DETECT” ➡ ”OFF” or “ON” is selected alternately

■ Selecting “ENCODER INPUT”

Operation

Select “ENCODER INPUT” ➡ ”ENCODER” or “VIRTUAL ENCDR” is selected alternately

■ Selecting “ENCODER SIGN”

Operation

Select “ENCODER SIGN” ➡ ”FORWARD” or “REVERSE” is selected alternately

■ Selecting “CORRECTION”

Operation

Select “CORRECTION” ➡ ”FORWARD” or “REVERSE” is selected alternately

■ Selecting “TRACKING”

Operation

Select “TRACKING” ➡ ”ROBOT AXIS” or “BASE AXIS” is selected alternately

■ Specifying “USER COORD NO.”

Operation

Select “USER COORD NO.” ➡ Enter a value by pressing the number keys

■ Selecting “BASE AXIS”

Operation

Select “BASE AXIS” ➡ The selection dialog box appears ➡ Select a desired axis

■ Specifying “RESOLUTION”

Operation

Select “RESOLUTION” ➡ Enter a value by pressing the number keys

■ Specifying “VIRTUAL CONVEYOR SPEED”

Operation

Select “VIRTUAL CONVEYOR SPEED” ➡ Enter a value by pressing the number keys

■ Specifying “AVERAGED TRAVEL TIME”

Operation

Select “AVERAGED TRAVEL TIME” ➡ Enter a value by pressing the number keys

■ Specifying “RESET SIGNAL MONITORING TIME”

Operation

Select “RESET SIGNAL MONITORING TIME” ➡ Enter a value by pressing the number keys

■ Selecting “CONVEYOR SPEED DOWN MODE”

Operation

Select “CONVEYOR SPEED DOWN MODE” ➡ Selection dialog box appears ➡ Select a desired mode

■ Specifying “CONVEYOR LOWER LIMIT SPD”

Operation

Select “CONVEYOR LOWER LIMIT SPD” ➡ Enter a value by pressing the number keys

■ Specifying “VIRTUAL ENCODER INPUT”

Operation

Select “VIRTUAL ENCODER INPUT” ➡ Enter a value by pressing the number keys

■ Specifying “VIRTUAL ENCODER OUTPUT”

Operation

Select “VIRTUAL ENCODER OUTPUT” ➡ Enter a value by pressing the number keys

NOTE Editing the conveyor condition file clears both the shift data and the synchronization data. Observe the above precaution when the conveyor condition file is modified.

2.3 Setting Conveyor Resolution

The encoder mounted on the conveyor sends the pulse amount to the XRC as the conveyor current position data. In order that the manipulator recognizes this pulse amount as the conveyor travel amount for its follow-up motion, this pulse amount must be converted into a distance.
The conveyor travel amount (μm) per 1 pulse to be used for this conversion is called “RESOLUTION.”
The resolution is set in units of micrometer. For example, when the conveyor resolution is 30 μm/pulse, set “RESOLUTION” to “30.00.”
The setting range is from 0 to 999.99 μm/pulse. Since the XRC internally quadruples every encoder pulse number, the conveyor’s maximum positional resolution is 3999.96 μm/pulse.
As the resolution error is stored as much as the conveyor travel pulse amount, the setting must be correct. For example, when the resolution is set 0.01 μm/pulse bigger, the follow-up error of 0.1 mm at the point that the conveyor moves for 1000 pulses.
The conveyor resolution is mentioned in the specification of each conveyor. However, this value cannot be used because of the following reason.

NOTE As the feedback pulse becomes four times the amount of the pulse from the conveyor encoder, the conveyor resolution of the conveyor condition file is 1/4 of the conveyor resolution mentioned in your conveyor specifications.

For more detailed informaiton on the setting method, refer to “4.3 Setting Conveyor Positional Resulution” of “YASNAC XRC OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION.”

2.4 Detection Function for BROKEN LINE DETECT Status (Conveyor Pulse)

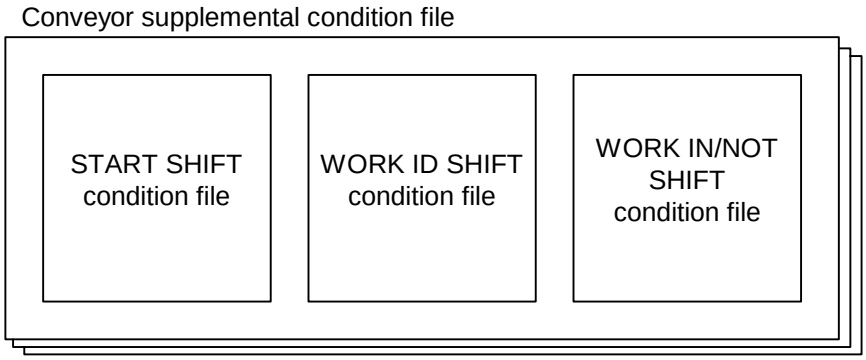
When “BROKEN LINE DETECT” in the CONVEYOR COND FILE display is set ON (enabled), an alarm occurs if the broken line detection status signal for conveyor pulse is detected. The following specific outputs are used to output the disconnection detection.
For the production line, whether the alarm occurrence stops the entire line or not can be specified by the concurrent I/O ladder program or by the setting on the host controller, referring to the information of these outputs.

5317	5316	5315	5314	5313	5312	5311	5310
		BROKEN LINE DETECT (CONVEYOR COND FILE 6)	BROKEN LINE DETECT (CONVEYOR COND FILE 5)	BROKEN LINE DETECT (CONVEYOR COND FILE 4)	BROKEN LINE DETECT (CONVEYOR COND FILE 3)	BROKEN LINE DETECT (CONVEYOR COND FILE 2)	BROKEN LINE DETECT (CONVEYOR COND FILE 1)

The time to output the broken line detection status signal can be set.
Set the time to output the signal sent from the board for synchronization to the main CPU in the sensor parameter SE017 (setting for output time of broken line detection signal). This prevents the main CPU from failing to get the information of the disconnection status when the output time is too short. Set 50 ms or more considering the time lag between the signal writing of the board for synchronization and the signal reading of the main CPU.

2.5 Conveyor Supplemental Condition File

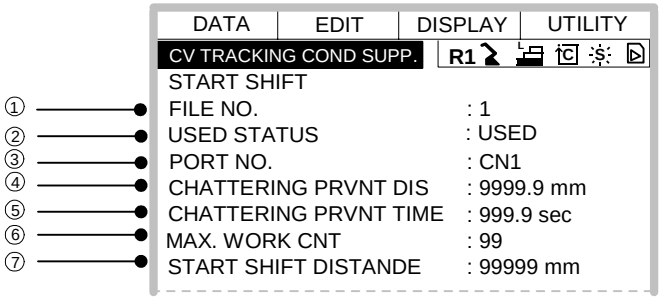
To use the conveyor synchronized function with shift functions, the conveyor supplemental condition file “CV TRACKING COND SUPP.” must be set in addition to the conveyor condition file.
The CV TRACKING COND SUPP. file consists of three files: START SHIFT SET, WORK ID. SHIFT SET, and WORK IN/NOT SHIFT SET. Set the files of the functions required for your system configuration.



The maximum number of the conveyor supplemental condition files depends on the number of mounted conveyor synchronization boards (JANCD-XSL02).

Number of Conveyor Synchronization Boards (JANCD-XSL02)	File Number
1	1 to 3
2	1 to 6

2.6 Start Shift Condition File



①FILE NO.

Displays the conveyor condition file number.

②USED STATUS (USED/NOT USED)

Specify whether the start shift condition file is used or not.

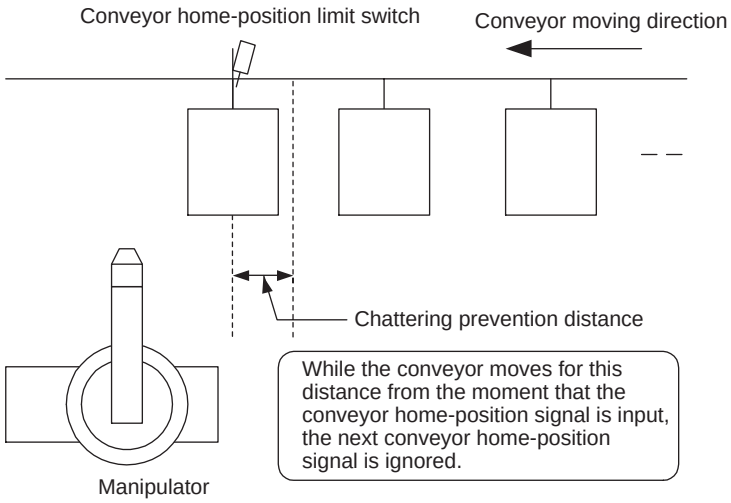
③PORT NO.

Displays the port number where the encoder specified in the conveyor condition file is connected.

④CHATTERING PRVNT DIS (0 to 9999.9 mm)

While the conveyor moves for the chattering prevention distance from the moment that the conveyor home-position signal is input, the next conveyor home-position signal input is ignored.

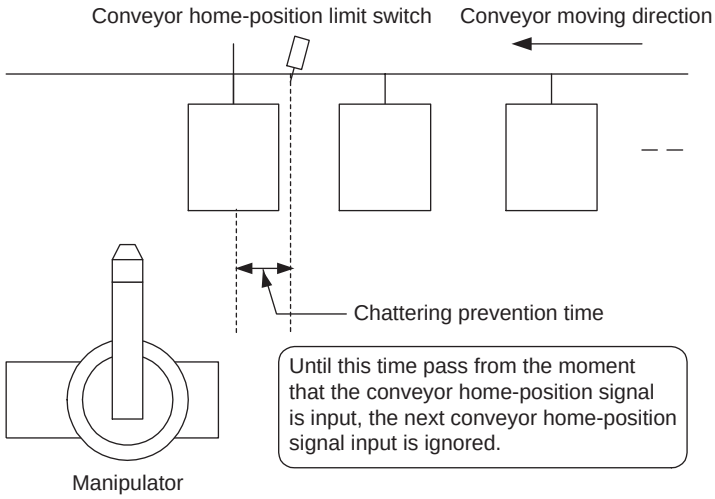
Set “0” to disable monitoring for the chattering prevention distance and to count the number of workpieces with every input.



⑤CHATTERING PRVNT TIME (0 to 999.9 seconds)

Until the chattering prevention time pass from the moment that the conveyor home-position input signal is input, the next conveyor home-position signal input is ignored.

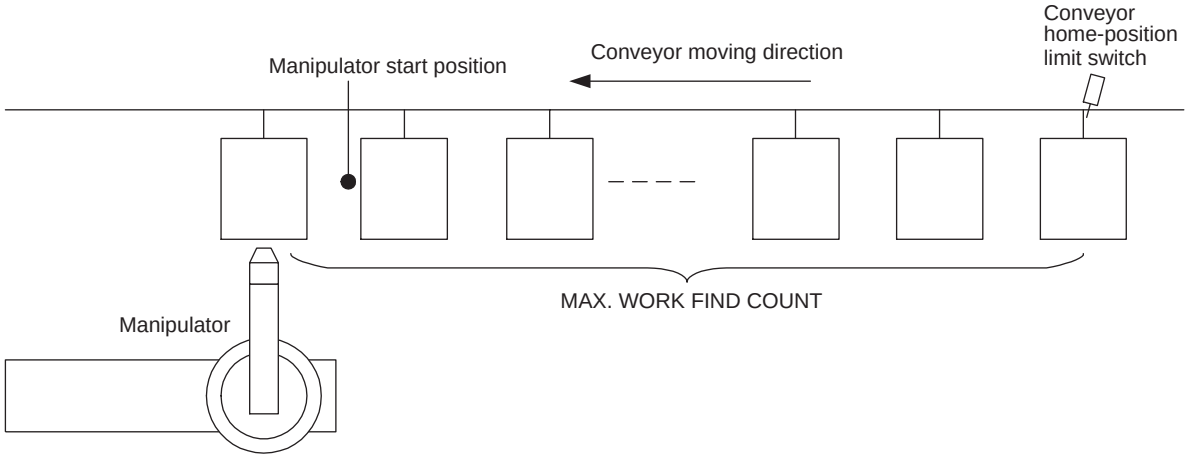
Set “0” to disable monitoring for the chattering prevention time and to count the number of workpieces with every input.



If both the distance and the time for the chattering prevention are set, the larger one is applied.

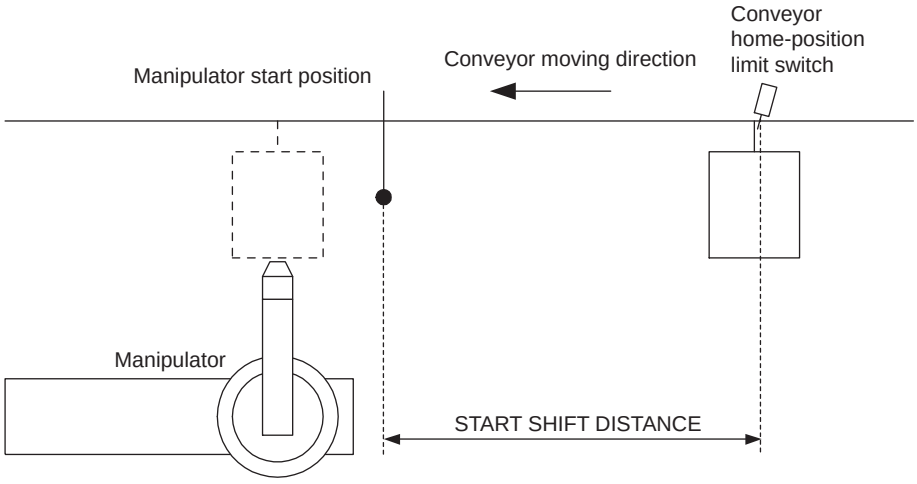
⑥MAX. WORK CNT (0 to 99 workpieces)

Set the maximum number of workpieces that move between the converyor home-position limit switch to the reference workpiece for synchronization start.



⑦START SHIFT DISTANCE (0 to 99999mm)

When the conveyor home-position limit switch cannot installed within the manipulator working envelope, the home-position limit switch ON signal is shifted in synchronization with the conveyor movement to the manipulator working envelope. Set the distance from the conveyor home-position limit switch to the shift end position. When 0 is set, the SYSTART instruction is executed when the conveyor home-position limit switch ON signal is input.



2.7 Editing the Start Shift Condition File

2.7.1 Display of the Start Shift Condition File

Operation

Select {ROBOT} under the top menu ➡ Select {CV CONDITION SUPPLE} ➡ Select {DISPLAY} ➡ Select “START SHIFT”*1*

Explanation

1 Press the page key to select the next file number.

Press [SHIFT] + the page key to select the previous file number.

2.7.2 Editing the Start Shift Condition File

■ Selecting “USED STATUS”

Operation

Select “USED STATUS” ➡ ”USED” or “NOT USED” is selected alternately

■ Selecting “PORT NO.”

Operation

Select “PORT NO.” ➡ The selection dialog appears ➡ Select a desired port number

■ Specifying “CHATTERING PREVENTION DISTANCE”

Operation

Select “CHATTERING PREVENTION DISTANCE” ➡ Enter a value by pressing the number keys

■ Specifying “CHATTERING PREVENTION TIME”

Operation

Select “CHATTERING PREVENTION TIME” ➡ Enter a value by pressing the number keys

■ Specifying “MAX. WORK FIND COUNT”

Operation

Select “MAX. WORK FIND COUNT” ➡ Enter a value by pressing the number keys

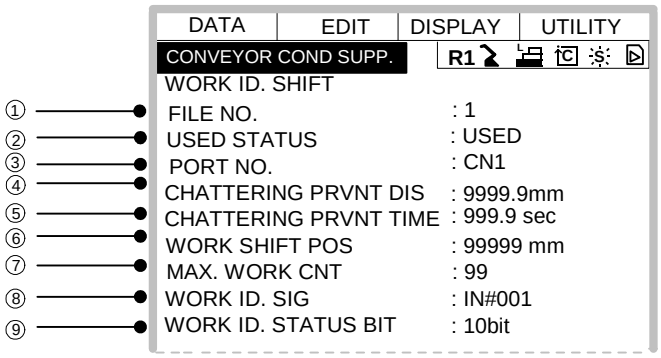
■ Specifying “START SHIFT DISTANCE”

Operation

Select “START SHIFT DISTANCE” ➡ Enter a value by pressing the number keys

NOTE Editing the start shift condition file clears both the shift data and the synchronization data. Observe the above precaution when the start shift condition file is modified.

2.8 WORK ID SHIFT Condition File



①FILE NO.

Displays the WORK ID SHIFT condition file.

②USED STATUS (USED/NOT USED)

Specify whether the WORK ID SHIFT condition file is used or not.

③PORT NO. (CN1/CN2/CN3)

Displays the port number where the WORK ID detecting limit switch is connected.

④CHATTERING PRVNT DIS (0 to 9999.9 mm)

Set a distance to prevent the repeated inputs of the WORK ID detecting limit switch signal due to the limit switch chattering. While the conveyor moves for the set distance from the moment the WORK ID detecting limit switch signal is input, another WORK ID detecting limit switch signal is ignored.

Set “0” to disable monitoring for the chattering prevention distance and to count the number of workpieces with every input.

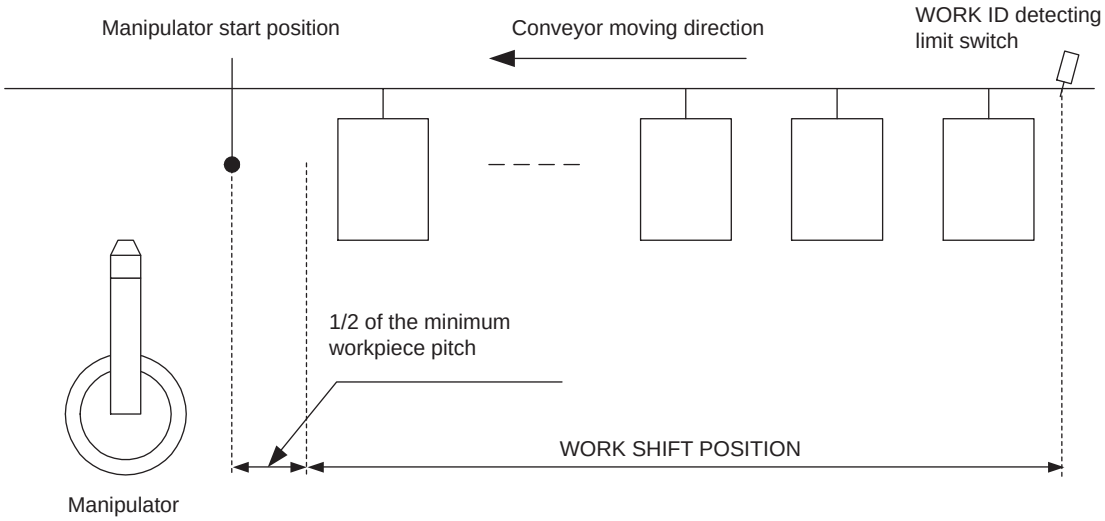
⑤CHATTERING PRVNT TIME (0 to 999.9 sec)

Set a time to prevent the repeated inputs of the WORK ID detecting limit switch signal due to the limit switch chattering. Until the set time passes from the moment the WORK ID detecting limit switch signal is input, another WORKD ID detecting limit switch signal is ignored.

Set “0” to disable monitoring for the chattering prevention time and to count the number of workpieces with every input. If both the distance and the time for the chattering prevention are set, the larger one is applied.

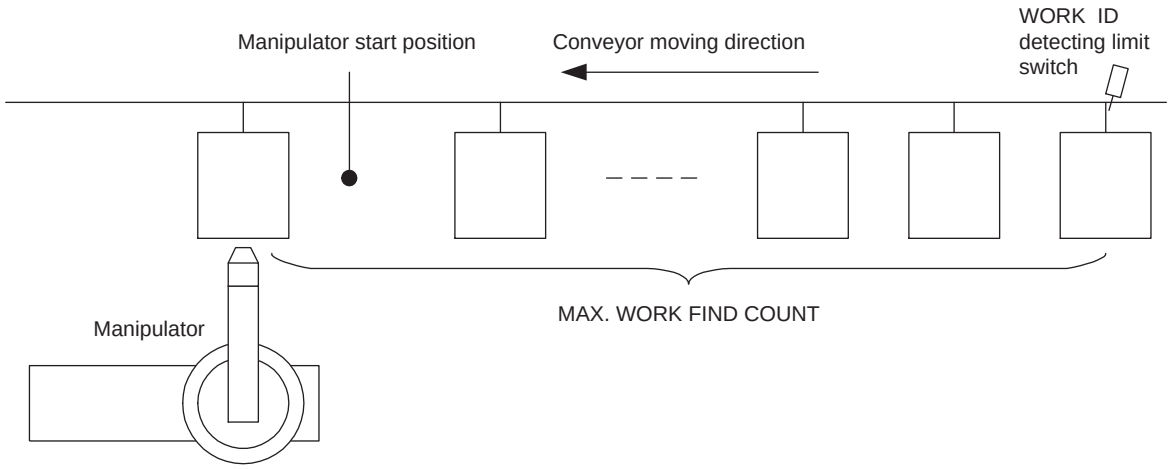
⑥WORK SHIFT POS (0 to 99999 mm)

Set the distance from the WORK ID detecting limit switch to the shift end position. Normally, set the value of the distance from the WORK ID detecting limit switch to the manipulator start potision subtracted by 1/2 of the minimum workpiece pitch.



⑦MAX. WORK CNT (1 to 99 workpieces)

Set the maximum number of workpieces that are set between the WORK ID detecting limit switch to the reference workpiece for synchronization start.



⑧WORK ID SIG (0 to 192)

Set the head general-purpose input number that specifies the WORK ID number.

⑨WORK ID STATUS BIT (1 to 10)

Set the number of valid bits of the WORK ID number.

Maximum 10 bits can be set to specify up to the WORK ID number 1024.

2.9 Editing the WORK ID SHIFT Condition File

2.9.1 Display the WORK ID SHIFT Condition File

Operation

Select {ROBOT} under the top menu ➡ Select {CONVEYOR COND SUPP.} ➡ Select {DISPLAY} ➡ Select “WORK ID SHIFT”*1

Explanation

*1 Press the page key  to select the next file number.

Press [SHIFT] + the page key  to select the previous file number.

2.9.2 Edit the WORK ID SHIFT Condition File

■ Selecting “USED STATUS”

Operation

Select “USED STATUS” ➡ “USED” or ”NOT USED” is selected alternately

■ Selecting “PORT NO.”

Operation

Select “PORT NO.” ➡ The selection dialog appears ➡ Select a desired port number

■ Specifying “CHATTERING PREVENTION DISTANCE”

Operation

Select “CHATTERING PREVENTION DISTANCE” ➡ Enter a value by pressing the number keys

■ Specifying “CHATTERING PREVENTION TIME”

Operation

Select “CHATTERING PREVENTION TIME” ➡ Enter a value by pressing the number keys

■ Specifying “WORK SHIFT POSITION”

Operation

Select “MAX. WORK SHIFT POSITION” ➡ Enter a value by pressing the number keys

■ Specifying “MAX. WORK FIND COUNT”

Operation

Select “MAX. WORK FIND COUNT” ➡ Enter a value by pressing the number keys

■ Specifying “WORK ID SIGNAL”

Operation

Select “WORK ID SIGNAL” ➡ Enter a value by pressing the number keys

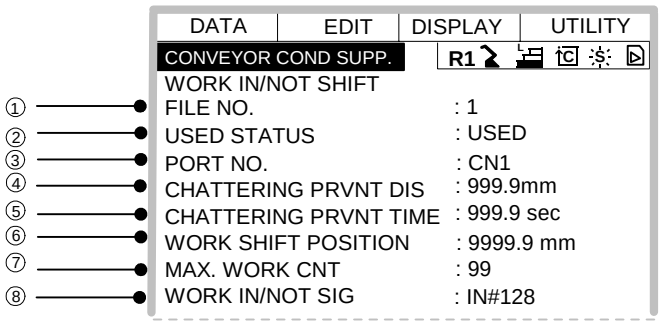
■ Specifying “WORK ID STATUS BIT”

Operation

Select “WORK ID STATUS BIT” ➡ Enter a value by pressing the number keys

NOTE Editing the WORK ID SHIFT condition file clears both the shift data and the synchronization data.
Observe the above precaution when modifying the WORK ID SHIFT condition file.

2.10 WORK IN/NOT SHIFT Condition File



①FILE NO.
Displays the WORK IN/NOT SHIFT condition file number.

②USED STATUS (NOT USED/USED)
Specify whether the WORK IN/NOT SHIFT condition file is used or not.

③PORT NO. (CN1/CN2/CN3)

Displays the port number where the WORK IN/NOT detecting limit switch is connected.

④CHATTERING PRVNT DIS (0 to 9999.9 mm)

Set a distance to prevent the repeated inputs of the WORK IN/NOT detecting limit switch signal due to the limit switch chattering. Until the conveyor moves for the set distance from the moment the WORK IN/NOT detecting limit switch signal is input, another WORK IN/NOT detecting limit switch signal is ignored.

Set “0” to disable monitoring for the chattering prevention distance and to count the number of workpieces with every input.

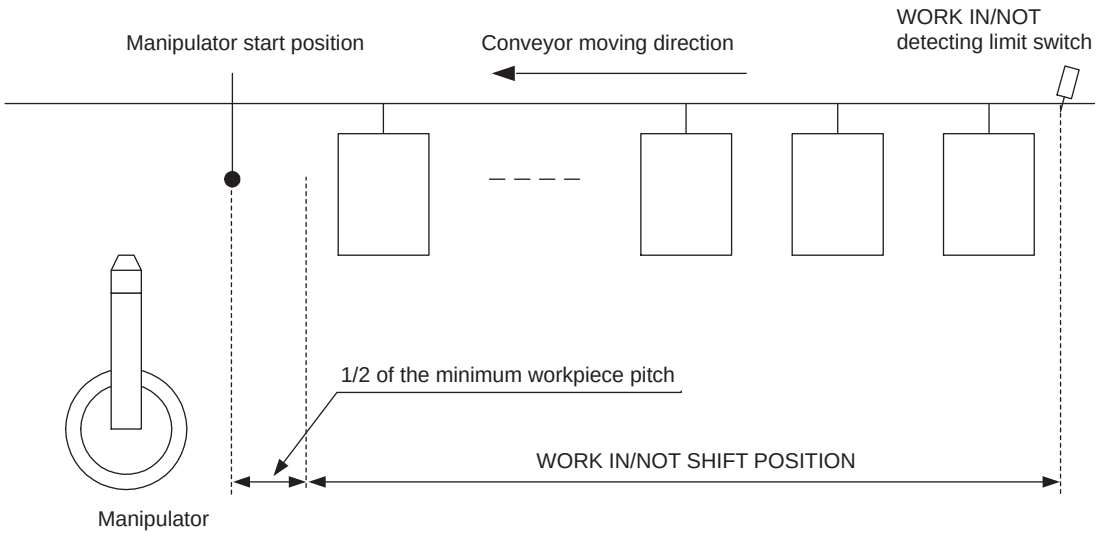
⑤CHATTERING PRVNT TIME (0 to 999.9 seconds)

Set a time to prevent the repeated inputs of the WORK IN/NOT detecting limit switch signal due to the limit switch chattering. Until the set time passes from the moment the WORK IN/NOT detecting limit switch signal is input, another WORKD ID detecting limit switch signal is ignored.

Set “0” to disable monitoring for the chattering prevention time and to count the number of workpieces with every input. If both the distance and the time for the chattering prevention are set, the larger one is applied.

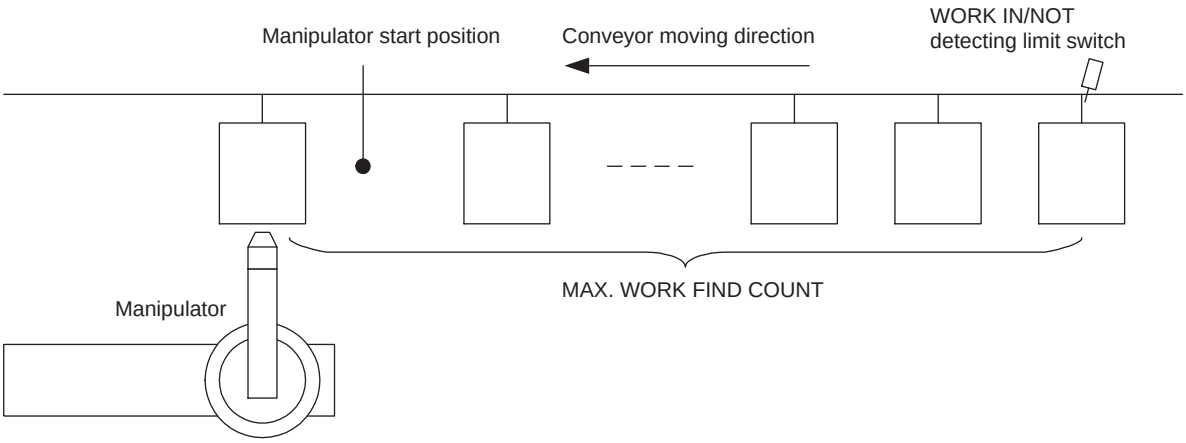
⑥WORK SHIFT POSITION

Set the distance from the WORK IN/NOT detecting limit switch to the shift end position. Normally, set the distance from the WORK IN/NOT detecting limit switch to the manipulator start position subtracted by 1/2 of the minimum workpiece pitch.



⑦MAX. WORK CNT (1 to 99)

Set the maximum number of workpieces that are set between the WORK IN/NOT detecting limit switch to the reference worpiece for synchronization start.



⑧WORK IN/NOT SIG (0 to 192)

Set the general-purpose output signal number that specifies the presence/absence of work-piece.

2.11 Editing the WORK IN/NOT SHIFT Condition File

2.11.1 Display the WORK IN/NOT SHIFT Condition File

Operation

Select {ROBOT} under the top menu ➡ Select {CONVEYOR COND SUPP.} ➡ Select {DISPLAY} ➡ Select “WORK IN/NOT SHIFT”*1

Explanation

1 Press the page key to select the next file number.

Press [SHIFT] + the page key to select the previous file number.

2.11.2 Edit the WORK IN/NOT SHIFT Condition File

■ Selecting “USED STATUS”

Operation

Select “USED STATUS” ➡ “USED” or ”NOT USED” is selected alternately

■ Selecting “PORT NO.”

Operation

Select “PORT NO.” ➡ The selection dialog appears ➡ Select a desired port number

■ Specifying “CHATTERING PREVENTION DISTANCE”

Operation

Select “CHATTERING PREVENTION DISTANCE” ➡ Enter a value by pressing the number keys

■ Specifying “CHATTERING PREVENTION TIME”

Operation

Select “CHATTERING PREVENTION TIME” ➡ Enter a value by pressing the number keys

■ Specifying “MAX. WORK IN/NOT SHIFT POSITION”

Operation

Select “MAX. WORK IN/NOT POSITION” ➡ Enter a value by pressing the number keys

■ Specifying “MAX. WORK FIND COUNT”

Operation

Select “MAX. WORK FIND COUNT” ➡ Enter a value by pressing the number keys

■ Specifying “WORK IN/NOT SIGNAL”

Operation

Select “WORK IN/NOT SIGNAL” ➡ Enter a number by pressing the number keys

NOTE Editing the WORK IN/NOT SHIFT condition file clears both the shift data and the synchronization data.
Observe the above precaution when modifying the WORK IN/NOT SHIFT condition file.

2.11 Editing the WORK IN/NOT SHIFT Condition File

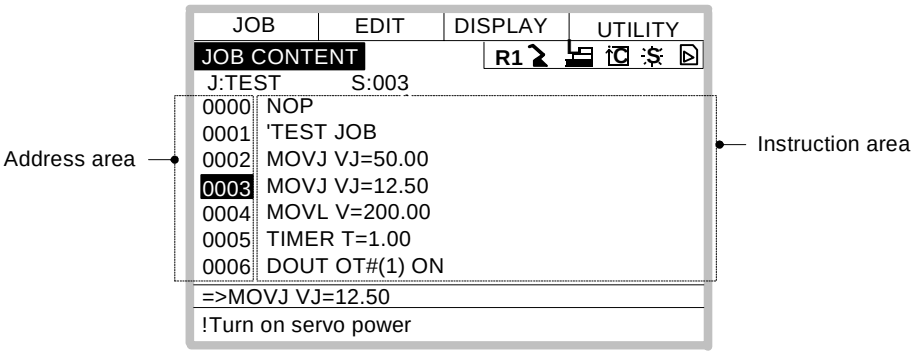
3 Teaching

3.1 Registering Instructions

The instructions can be registered when the cursor is in the address area on the job content display in teach mode.

Operation

Select {JOB} under the top menu ➡ Select {JOB CONTENT} ➡ Move the cursor to the address area



3.1.1 SYSTART Instruction

■ Function

The SYSTART instruction starts the conveyor synchronized control. The manipulator starts follow-up motion by a move instruction after the SYSTART instruction, or TIMER or WAIT instruction.
When this instruction is executed, the manipulator stops and waits until the conveyor current position value exceeds the synchronization start position value. When the conveyor current position value exceeds the synchronization start position value, the manipulator starts the follow-up motion.
When the conveyor current position value exceeds the synchronization start position value within the tolerance (OL) at the moment the SYSTART instruction is executed, the manipulator starts the follow-up motion from the point the SYSTART instruction is executed.
When the conveyor current position value exceeds the synchronization start position value beyond the tolerance (OL) at the moment the SYSTART instruction is executed, the system variable $B008 is reset to “0,” and the manipulator executes the proceeding instruction without the synchronized motion. At the normal completion, “1” is set to the system variable $B008.

NOTE The system variable $B008 cannot be read directly. Copy the system variable to B□□□ by using a GETS instruction and read the value.
<Example> GETS B000 $B008
JUMP *NG IF B000<1

When the SYSTART instruction has been executed and then another SYSTART instruction is executed in the middle of the job, the manipulator completes the execution of the previous move instruction, and tracks the conveyor in the stand-by posture until the conveyor reaches the synchronization start position for the next SYSTART instruction. Then, when the conveyor reaches the synchronization start position, the manipulator executes the next instruction.

When the SYEND instruction with a tag CONT (continuity attribute) is executed in the middle of the job of a SYSTART instruction and then another SYSTART instruction is executed, the manipulator completes the execution of the previous move instruction and stops without changing its posture until the conveyor reaches the synchronization start position for the next SYSTART instruction. When the conveyor reaches the synchronization start position, the manipulator starts the follow-up motion to the conveyor.

■ Format

SYSTART CV#(1) STP=50.000 OL=10.0
① ② ③

①Conveyor condition file No. (CONVEYOR FILE)
Set the conveyor condition data file No. to be used.
②Synchronization start position (SYNC START POS)
Set the conveyor position where the synchronized operation starts.
③Tolerance (OVER LIMIT)
The maximum excess to execute the synchronized operation when the conveyor current position value exceeds the synchronization start position value at the execution of SYSTART instruction. When omitted or 0 is set, tolerance check is not executed.

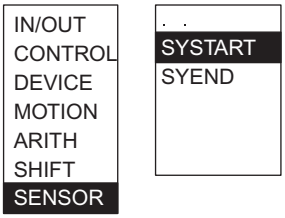
■ Registering the SYSTART Instruction

Operation

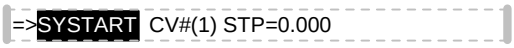
Move the cursor to the line just above the place where a SYSTART instruction is to be registered ➡ Press [INFORM LIST]*1 ➡ Select “SYSTART”*2 ➡ Change the additional items*3 ➡ Press [INSERT] and [ENTER]

Explanation

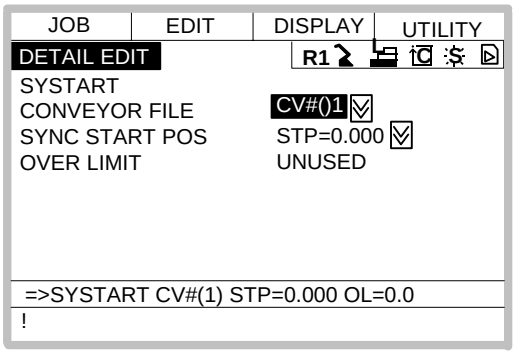
1 The instruction list dialog appears.



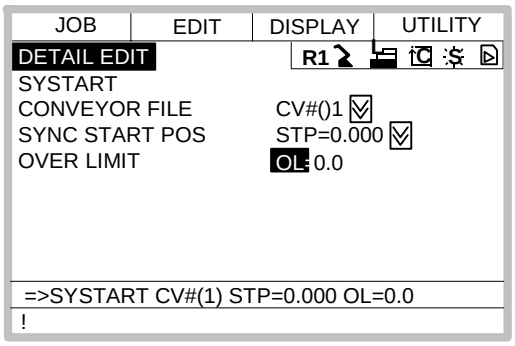
2 The SYSTART instruction is displayed in the input buffer line.



3 <Register without editing the additional items>
Perform the operation *4.
<Edit the additional items>
- To change the conveyor condition file number or/and the synchronization start position
  Move the cursor to CONVEYOR FILE or SYNC START POS, and press [SELECT].
  Enter a desired number or value by using the number keys, then press [ENTER].
- To add, change, or delete an additional item
  Move the cursor to the instruction in the input buffer line, and press [SELECT]. The detail edit display appears.



To add a tolerance, select “UNUSED” in OVER LIMIT. And then the selection dialog appears. Select “OL=.”



After having added or changed the additional items, press [ENTER]. The detail edit display is closed and the job content display appears.

4 The instruction displayed in the input buffer line is registered.

3.1.2 SYEND Instruction

■ Funtcion

The SYEND instruction ends the conveyor synchronized control. The synchronized operationends at the step where this instruction is registered.
Executing a SYEND clears the conveyor home-position data. When the conveyor home-position limit switch is on after the conveyor home-position data is cleared, the conveyor home-position data will be updated.
Register SYEND instruction at the synchronization end step and the head of the job that executes the manipulator synchronized motion.

■ Format

SYEND CV#(1) CONT
① ②

①Conveyor condition file number
Set the conveyor condition file number to be used.

②Continuity attribute
Without ON signal from the conveyor home-position limit switch, the XRC executes the SYSTART instruction and the manipulator starts the follow-up motion when the converyor current position reaches and passes the synchronization start position. (Refer to “3.1.1 SYSTART Instruction.”) The manipulator stops while it waits for the start of the follow-up motion.

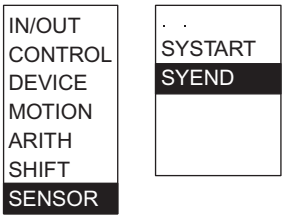
■ Registering the SYEND Instruction

Operation

Move the cursor to the line just above the place where a SYEND instruction is to be registered ➡ Press [INFORM LIST]*1 ➡ Select “SYEND”*2 ➡ Change the additional items ➡ Press [INSERT] and [ENTER]*3

Explanation

1 The instruction list dialog appears.



2 The SYEND instruction is displayed in the input buffer line.

3 The instruction displayed in the input buffer line is registered.

NOTE The conveyor synchronized motion can be suspended in the middle of a job. To suspend the conveyor synchronized motion, insert the SYEND instruction added with a tag CONT (continuity attribute). The manipulator completes the execution of the previous move instruction of the SYEND instruction with a tag CONT, and stops to wait until the conveyor current position value reaches the value set for STP of the next SYSTART instruction. To wait until the conveyor current position value reaches the value set in STP for the SYSTART instruction moving the manipulator with the follow-up control to the conveyor, keep the SYSTART instruction executed without using the SYEND instruction.

3.1.3 SYMOV□ Instruction

■ Function

These move instructions executes the conveyor synchronized motion. Except that the conveyor positions at the time of teaching are registered as CTP (conveyor position at teaching), these instructions are same as ordinary move instructions. Joint motion, linear interpolation, and circular interpolation can be performed in the same way as the ordinary move instructions.

SYMOVJ	Conveyor synchronized joint motion
SYMOVL	Conveyor synchronized linear interpolation
SYMOVC	Conveyor synchronized circular interpolation

When these instructions are used, the teaching method is different from that with the ordinary move instructions. Refer to “3.1.5 Interpolation Mode for Conveyor Synchronized Motion.”

■ Format

SYMOVJ VJ=50.00 CV#(1) CTP=100.000
SYMOVL V=200.00 CV#(1) CTP=100.000
SYMOVC V=200.00 CV#(1) CTP=100.000
① ② ③

①Play speed
Set the manipulator motion speed in playback mode.
②Conveyor condition file number
Set the conveyor condition file number to be used.
③Conveyor position at teaching
Set the conveyor position at teaching.

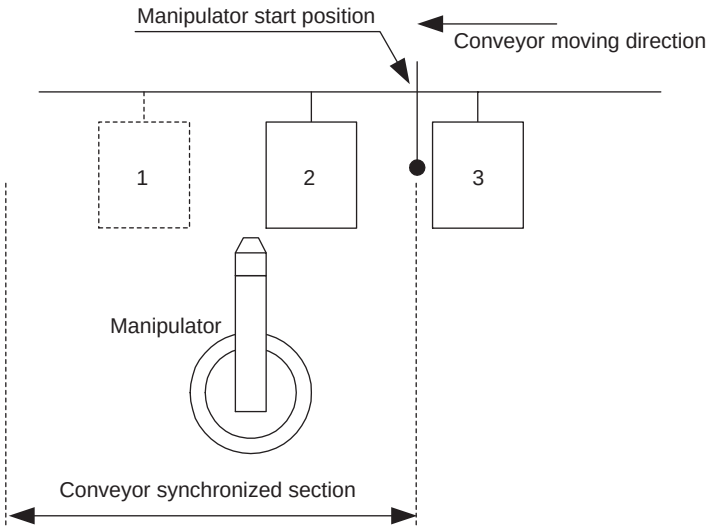
■ Precautions on Executing the SYMOVJ Instruction

When the SYMOVJ instruction is executed under the condition where “ROBOT AXIS” is set for “TRACKING” in the CONVEYOR COND FILE display for the system with large pulsation conveyor, the manipulator’s motion may become unstable. This is because the XRC calculates in real time the manipulator’s motion speed according to the conveyor pulsation.
To stabilize the manipulator’s motion in such a case, set the average speed of the conveyor in units of μm/s to the parameter S3C469 (conveyor model speed for starting SYMOVJ).
The SYMOVJ instruction calculates the orbit based on the conveyor speed when beginning to operate.The robot operation changes according to the conveyor speed changes to maintain a relative position of robot and conveyer (work) positions.The robot operation stops, too, when the conveyor stops.When the conveyor speed goes up again, the robot operation is restarted.
During the synchronized operation with the conveyor, three axes of the manipulator wrist may move faster than the set play-speed regardless of the conveyor moving direction. Therefore, set approximately 70% maximum of the actual play-speed for the SYMOVJ instruction. However, even if the play speed for the SYMOVJ instruction is set lower than 70%, the wrist may not be able to move depending on the conveyor speed or the manipulator’s wrist posture. In such a case, reset the play speed lower.

3.1.4 CVQUE Instruction

■ Function

The CVQUE instruction switches the conveyor position data, which is used for the conveyor synchronized motion, to the position data of the next workpiece. If the next workpiece information is not set in the shift table, the CVQUE instruction is ignored.



If the CVQUE instruction is executed after the end of conveyor synchronized motion for the workpiece 1, the conveyor position data switches to the position data for the workpiece 2.

■ Format

CVQUE CV#(1)
①

①Conveyor condition file number
Set the conveyor condition file number to be used.

NOTE When the CVQUE instruction is executed, the first information of the WORK ID shift data and WORK IN/NOT shift data are set to the system variables and deleted from each shift data. Pay attention to the execution timing of CVQUE instruction when preparing a job.

3.1.5 Interpolation Mode for Conveyor Synchronized Motion

The interpolation mode for conveyor synchronized move instruction at teaching differs from that for the standard move instruction. Switch the interpolation mode in the manner described below.
Once the conveyor positions at teaching are registered, they must be properly set up in relation to the conveyor home-position (the position where the conveyor home-position limit switch turns on.)

■ Switching the Interpolation Mode

Press [SHIFT] + [MOTION TYPE]. The interpolation mode displayed in the input buffer line switches between the standard interpolation and the interpolation for synchronized motion.

Then, each time [MOTION TYPE] is pressed, the interpolation mode changes as SYMOVJ → SYMOVL→SYMOVC.

3.2 Manipulator Motion Speed

Generally, teaching in the direction opposite to the conveyor moving direction gives such a result as a manipulator can move more easily and slowly in playback operation.
In conveyor synchronized operation, the manipulator motion speed is the teaching speed added to the conveyor speed.
Refer to “5.2 Motion Speed” of “YASNAC XRC OPTIONS INSTRUCTION FOR CONVEYOR SYNCHRONIZED FUNCTION” for more information on the relation between the manipulator motion speed and the conveyor moving direction.

3.3 Wrist Posture in Conveyor Synchronized Section

In the conveyor synchronized section, the manipulator wrist maintains its taught posture while the manipulator moves in synchronization with the conveyor movement. Teach a posture so that the wrist can be moved in the conveyor moving direction.
For further information on the wirst posture, refer to “5.3 Wrist Posture in Synchronization” of “YASNAC XRC OPTIONS INSTRUCTION FOR CONVEYOR SHNCHRONIZED FUNCTION.”

3.4 Changing Circular Steps

Continuous circular steps should be taught on the same conveyor position.
When continuous circular steps are taught on different conveyor positions, a motion path is different from the taught path in the synchronized motion.

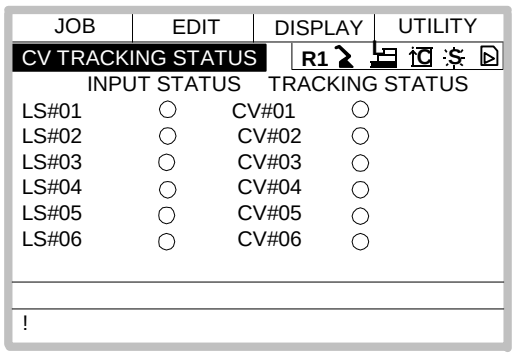
3.5 Teaching

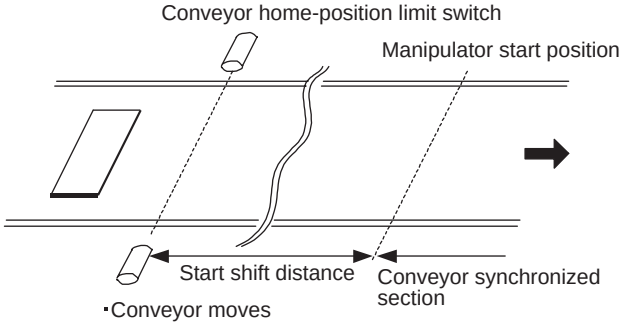
The conveyor positions at teaching are registered in a job. The conveyor position is defined as follows:

- When the start shift function is not used, the distance from the conveyor home-position (the position where the conveyor home-position limit switch turns on) to the synchronization start position.
- When the start shift function is used, the distance from the manipulator start position to the synchronization start position.

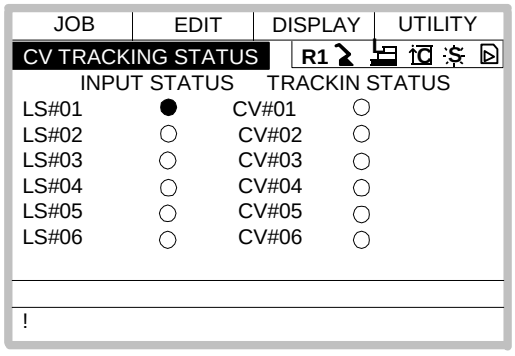
When performing a teaching to a workpiece, move the conveyor to turn on the conveyor home-position limit switch by the workpiece, then move to a teaching position. The position where the conveyor home-position limit switch is turned on is automatically registered as the conveyor home-position.

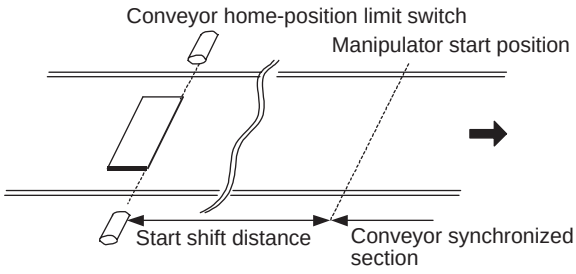
①





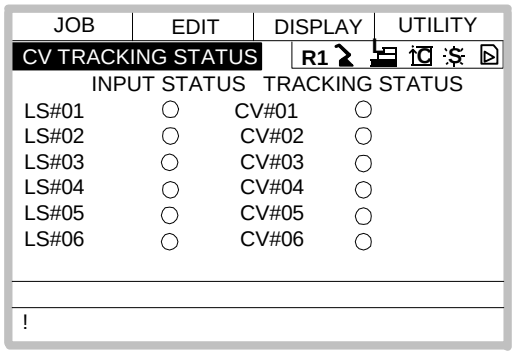
②

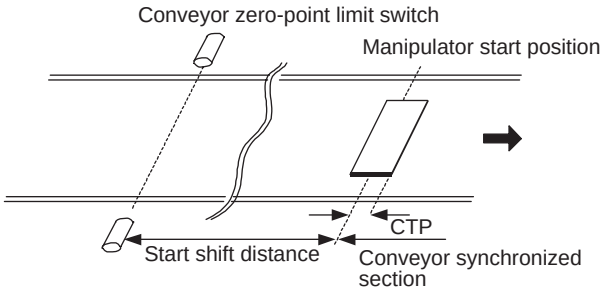




・The conveyor home-position limit switch turns on.
・The distance to the manipulator start position is displayed on the conveyor monitor (shift).

③





・When the conveyor moves to the manipulator start position, the conveyor position is reset to 0 mm.
・Confirm the position by FWD key operation, and add or modify the step.

Add or Modify

SYMOVL V=1000.0 CV#(1) CTP=100.000

The displays described on the previous page are in case two conveyor synchronization boards are inserted.

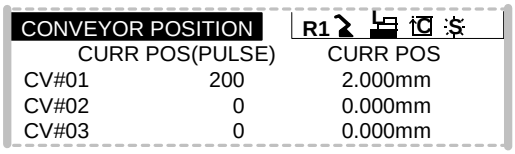
NOTE Perform teaching after having confirmed that the conveyor is completely stopped. Teaching while the conveyor moves may cause an error or segment over alarm.

Operation

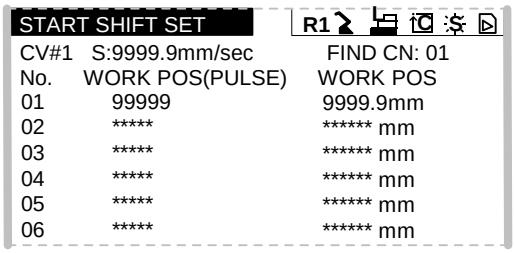
Select {ROBOT} under the top menu ➡ Select {CV MONITOR}*1 ➡ Move the conveyor*2 ➡ Press [SHIFT] + [MOTION TYPE]*3 ➡ Select a interpolation type*4 ➡ Press an axis key*5 ➡ Press [ENTER]*6

Explanation

1 The conveyor position display appears.

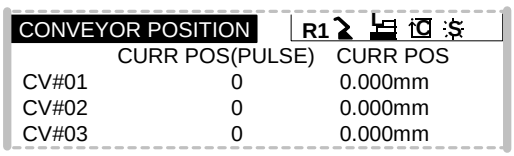


In the start shift section, the workpiece position cannot be confirmed in the conveyor monitor, but can be confirmed in the conveyor monitor (shift).
To display the conveyor monitor (shift), select {ROBOT} under the top menu, and select {CONVEYOR MONITOR (SHIFT)}.



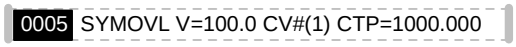
While the conveyor is moving, if there is a workpiece in the start shift section, the workpiece position measured from the manipulator start position is displayed in the column No. 1.

2 Move the conveyor. Then, stop the workpiece at the teaching position after the conveyor home-position limit switch is turned on. At the moment the conveyor home-position limit switch is turned on, make sure that “0” is displayed in “CURR POS (PULSE)” on the conveyor position display and the counter is reset.



When using the start shift function: Start the conveyor. Make sure that the workpiece passes the manipulator start position when the conveyor moves for the preset start shift distance or more after the conveyor home-position limit switch is turned on.

3 The conveyor interpolation mode enters.
4 Select the interpolation method to be used by pressing [MOTION TYPE].
5 Move the manipulator to the desired position by using axis operation keys.
6 The step is registered.
When teaching the position 1000 mm from the conveyor home-position (or the manipulator start position) in linear interpolation using No.1 conveyor characteristic file, the following step is registered.



Proceed the rest of the teaching in the same manner as the normal teaching.
To use a move instruction for synchronizing to the conveyor after having changed to the standard interpolation mode, the operation to select the interpolation mode for conveyor synchronized move instruction is necessary.

NOTE

As long as the conveyor synchronized operation is not being performed, a conveyor home-position input signal is accepted and the conveyor home-position is updated. Therefore, even though teaching is made on the same conveyor position, if the conveyor home-position limit switch turns on inadvertently , the conveyor position data will be changed. If there is a risk that the conveyor home-position limit switch is turned on inadvertently, perform a FWD key operation for that step after programming a move instruction for conveyor synchronized motion such as SYMOVL and SYMOVC. This starts the conveyor synchronized operation so that the conveyor home-position will not be changed even if the conveyor home-position limit switch turns on. In this case, execute a SYEND instruction at the end of teaching to cancel the synchronization.

3.6 Teaching After Interruption of Synchronized Motion in Playback Operation

After the synchronized motion is interrupted by a hold operation or switching to teach mode during playback operation, another conveyor home-position cannot be registered since no conveyor home-position input signal is accepted. At this moment, the tracking status in the conveyor tracking display is “ON” (marked with ●).
In this case, another conveyor home-position can be registered by either of the following operations.

(1) Add a step or change the step after interruption of synchronized motion
(2) Perform another teaching (for other workpiece)

For the details of the above operations, refer to “5.6 Teaching After Interruption of Playback in Synchronized Operation” of “YASNAC XRC OPTIONS INSTRUCTION FOR CONVEYOR SYNCHRONIZED FUNCTION.”

3.7 Notes on Operation

The conveyor synchronized move instructions are special insturctions to register the conveyor positions together with the manipulator positions. Therefore, the conveyor synchronized move instructions are different from standard move instructions such as MOVJ, and these instructions have the following restrictions on operations.

3.7.1 Confirming Reach to Step

When the manipulator reaches the target step in FWD/BWD operation or test run (step motion mode), the operation is stopped and the cursor stops blinking. In this way, it can be easily confirmed that the manipulator reaches the target step.

NOTE When the manipulator reaches the target step, the cursor stops blinking. However, when the following operations are performed, the cursor restarts blinking. In this case, move the cursor to the target step and perform FWD operation again.

- Emergency stop
- The cursor movement in editing job
- File and job editing operation
- Jog operation

3.7.2 Changing Tool

The first FWD operation of the SYMOV□ after changing a tool should be performed on the conveyor position at changing a tool.
Performing the FWD operation after changing a tool and moving the conveyor causes a segment over alarm.

3.7.3 Deleting Taught Positions

Before deleting a move instruction, the manupulator must be placed at the step position to be deleted. However, this condition cannot be satisfied with conveyor synchronized motion move instructions. This is because a taught position for a conveyor synchronized motion move instruction is interpreted to different step positions on the conveyor position, as explained before. Therefore, ordinary deleting operation is not possible.
To delete a conveyor synchronized move instruction, press [MODIFY] to change the step position. Then, after the cursor blinks, press [DELETE].

3.7.4 Manipulator Stand-by Position for the SYSTART Instruction

The manipulator's stand-by position for the SYSTART instruction should be same as the manipulator's position for a move instruction for the conveyor synchronized motion (SYMOV□) after the SYSTART instruction. If these two positions are different, the manipulator may not be on the taught position to start moving because the XRC executes the move instruction for the conveyor synchronized motion immediately after the synchronization starts.

3.8 Job Examples

3.8.1 Job Example for the Conveyor Synchronized Function without Shift Functions

An example of the job without using the start shift is given below. Use this example as the basic programming for application to various system.

	Instruction	Description
0000	NOP	
0001	SYEND CV#(1)	Resets the registered status of the conveyor's home position. The conveyor home-position limit switch becomes valid.
0002	MOVJ V=50.00	Starts the job and moves the manipulator to the stand-by position.
0003	SYSTART CV#(1) STP=100.000	Conveyor synchronization start instruction When the conveyor reaches the specified position, the conveyor synchronized control starts.
0004	GETS B000 $B008	The system variable to indicate whether the synchronization has started normally or not The contents of $B008 is copied to B000: Synchronization started normally if B000=1, and an error occurred if B000=0
0005	JUMP *END IF B000=0	If B000=0 (the synchronization did not start normally), jumps to the label [*END].
0006	SYMOVL CV#(1) CTP=50.000	Move instruction for the conveyor synchronized motion
0007	:	The manipulator moves in synchronization with the conveyor.
0008	SYMOVL CV#(1) CTP=50.000	
0009	*END	Jumps here if the conveyor synchronization did not start normally.
0010	SYEND CV#(1)	Ends the synchronization.
0011	CVQUE CV#(1)	Switches the reference workpiece for synchronization.
0012	MOVJ V=50.00	Returns the manipulator to the stand-by position and ends the job.
0013	END	

Set “NOT USED” for START SHIFT, WORK ID. SHIFT, and WORK IN/NOT SHIFT of the CONVEYOR COND SUPP. file.

NOTE
- Do not insert the instructions “MOVJ,” “MOVL,” “MOVC,” “MOVS,” or “IMOV” during the conveyor synchronization (from the SYSTART instruction to the SYEND instruction). The manipulator may not be able to move depending on the manipulator’s posture in synchronization with the conveyor immediately before the execution of these instructions (move instruction status for the conveyor synchronization).
- After the SYEND instruction, insert the CVQUE instruction before the next SYSTART instruction whether the Start Shift function is used or not.

3.8.2 Job Example when Using the Start Shift Function

An example of the job using the start shift function is given below.

■ Master Job

	Instruction	Description
0000	NOP	
0001	SYEND CV#(1)	Resets the registered status of the conveyor’s home position. The conveyor home-position limit switch becomes valid.
0002	*TOP	
0003	MOVJ V=50.00	Moves the manipulator to the stand-by position.
0004	SYSTART CV#(1) STP=100.00 OL=10.0	Conveyor synchronization start instruction When the conveyor reaches the specified position, the conveyor synchronized control starts.
0005	GETS B000 $B008	The system variable to indicate whether the synchronization has started normally or not The contents of $B008 is copied to B000: Synchronization started normally if B000=1, and an error occurred if B000=0
0006	JUMP *END IF B000=0	If B000=0 (the synchronization did not start normally), jumps to the label [*END].
0007	CALL JET#(1) ENTRY=18	Starts the work job registered in the job registration table 1.
0008	*END	Jumps here if the conveyor synchronization did not start normally.
0009	SYEND CV#(1)	Ends the synchronization.
0010	CVQUE CV#(1)	Switches the reference workpiece for synchronization.
0011	JUMP *TOP	
0012	END	

Set “USED” for START SHIFT, and set “NOT USED” for WORK ID. SHIFT and WORK IN/NOT SHIFT of the CONVEYOR COND file.

With the standard concurrent ladder program for painting application, the specific input signal 4176 “Single Work Control (Tracking Area)” is ON when the system is not running.

NOTE
- After the SYEND instruction, insert the CVQUE instruction before the next SYSTART instruction whether the Start Shift function is used or not.
- Be sure to program the SYEND instruction at the beginning of the master job to reset the registered status of the conveyor’s home position.

■ Work Job

	Instruction	Description
0000	NOP	
0001	SYSTART CV#(1) STP=200.00	Waits for the synchronization start of the module 1. The manipulator moves following up the conveyor until the conveyor reaches the specified position.
0002	SYMOVL CV#(1) CTP=200.00	Move instruction for the conveyor synchronized motion
	:	
0003	SYMOVL CV#(1) CTP=200.00	Move instruction for the conveyor synchronized motion
0004	SYEND CV#(1) CONT	Ends synchronization of module 1. Holds the conveyor synchronization.
0005	SYSTART CV#(1) STP=1000.00	Waits for the synchronization start of module 2. The manipulator stops and waits until the conveyor reaches the specified position.
0006	SYMOVL CV#(1) CTP=1000.00	Move instruction for the conveyor synchronized motion
	:	
0007	SYMOVL CV#(1) CTP=1000.00	Move instruction for the conveyor synchronized motion
0008	SYSTART CV#(1) STP=2000.00	Waits for the synchronization start of module 2. The manipulator stops and waits until the conveyor reaches the specified position.
0009	SYMOVL CV#(1) CTP=2000.00	Move instruction for the conveyor synchronized motion
	:	
0010	SYMOVL CV#(1) CTP=2000.00	Move instruction for the conveyor synchronized motion
0011	END	

NOTE
- Do not insert the instructions “MOVJ,” “MOVL,” “MOVC,” “MOVS,” or “IMOV” during the conveyor synchronization (from the SYSTART instruction to the SYEND instruction). The manipulator may not be able to move depending on the manipulator’s posture in synchronization with the conveyor immediately before the execution of these instructions (move instruction status for the conveyor synchronization).
- Teach the target position of the manipulator for the move instruction, which is executed after the conveyor synchronized motion starts, as close as possible to the manipulator’s stand-by position before the conveyor synchronization starts. If these two positions are too far, the manipulator may not be able to move.

3.8.3 Job Example Using the Start Shift, WORK ID Shift, and WORK IN/NOT Shift Functions

An example of the job using all the shift functions (Start Shift, WORK ID Shift, and WORK IN/NOT Shift) is given as follows.

■ Master Job

	Instruction	Description
0000	NOP	
0001	SYEND CV#(1)	Resets the registered status of the conveyor’s home position. The conveyor home-position limit switch become valid.
0002	*TOP	
0003	MOVJ V=50.00	Moves the manipulator to the stand-by position.
0004	GETS I000 $I000	Gets the WORK IN/NOT shift completion status, and stores to I000.
0005	GETS I006 $I006	Gets the WORK ID shift completion status, and stores to I006.
0006	JUMP *TOP IF I000=0	If the WORK IN/NOT shift is not completed, jumps to [*TOP].
0007	JUMP *TOP IF I006=0	If the WORK ID shift is not completed, jumps to [*TOP].
0008	CVQUE CV#(1)	Switches the reference workpiece for synchronization.
0009	GETS I012 $I012	Gets the WORK IN/NOT information, and stores to I012.
0010	GETS I018 $I018	Gets the WORK ID information, and stores to I018.
0011	JUMP *TOP IF I012=0	If no workpiece exists, the manipulator does not execute the job.
0012	SYSTART CV#(1) STP=100.00 OL=100.0	Start instruction for the conveyor synchronization. Starts the conveyor synchronized control when the conveyor reaches the specified position.

	Instruction	Description
0013	GETS B000 $B008	The system variable to indicate whether the synchronization has started normally or not The contents of $B008 is copied to B000: Synchronization started normally if B000=1, and an error occurred if B000=0
0014	JUMP *END IF B000=0	If B000=0 (the synchronization did not start normally), jumps to the label [*END].
0015	CALL JET#(1) ENTRY=I018	Reads the WORK ID information stored in I018, and starts the I018 registered job in the job registration table.
0016	*END	
0017	SYEND CV#(1)	Ends the synchronization.
0018	JUMP *TOP	
0019	END	

Set “USED“ for the START SHIFT, WORK ID. SHIFT, and WORK IN/NOT SHIFT of the CONVEYOR COND SUPP. file.
With the standard concurrent ladder program for painting application, the specific input signal 4176 “Single Work Control (Tracking Area)” is ON while the system is not running. Therefore, when preparing a job without loops in the master job or for the case of alarm occurrence, modify the concurrent ladder program according to the production line.

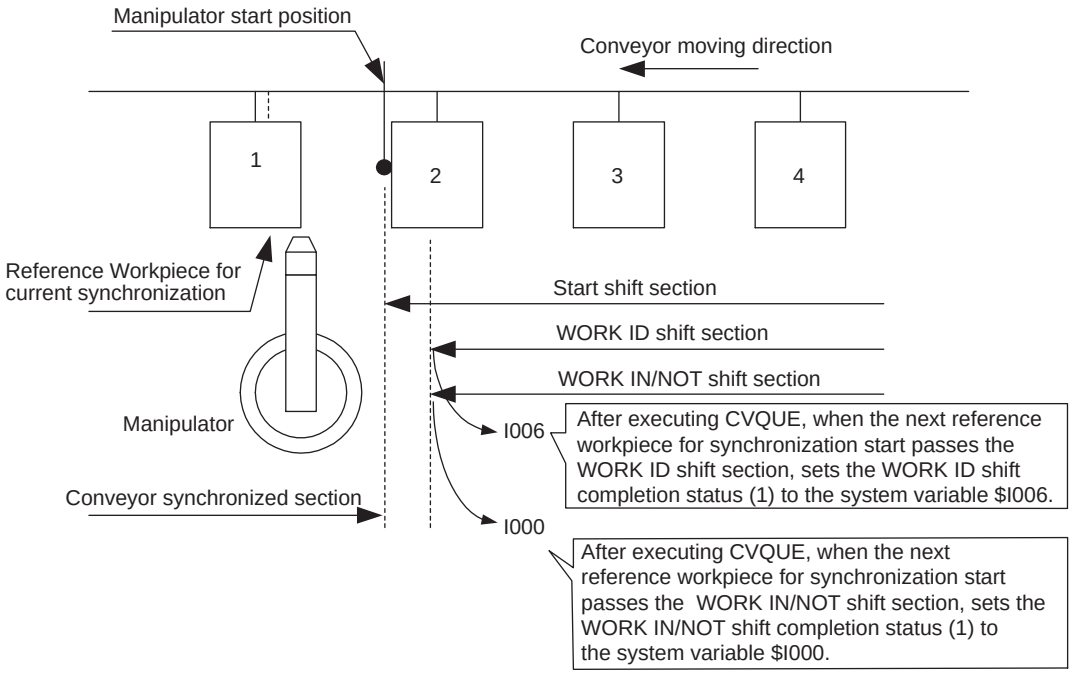
The system variables are defined as follows:

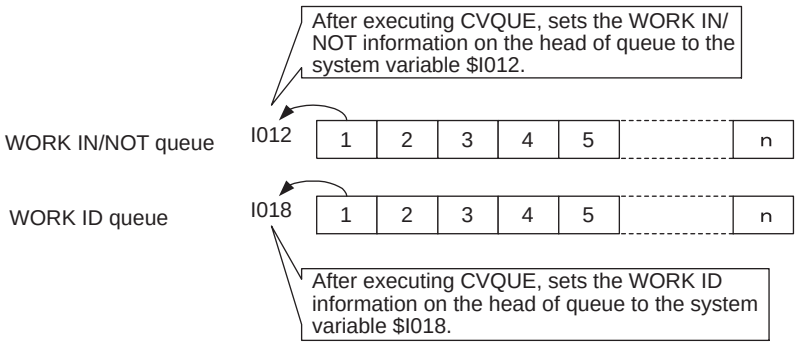
$I000 to $I005: Stores the WORK IN/NOT shift completion status.
$I000: Corresponds to the WORK IN/NOT characteristic file 1.
to to
$I005: Corresponds to the WORK IN/NOT characteristic file 6.

$I006 to $I011: Stores the WORK ID shift completion status.
$I006: Corresponds to the WORK ID characteristic file 1.
to to
$I011: Corresponds to the WORK ID characteristic file 6.

$I012 to $I017: Stores the first WORK IN/NOT information
$I012: Corresponds to the WORK IN/NOT characteristic file 1.
to to
$I017: Corresponds to the WORK IN/NOT characteristic file 6.

$I018 to $I023: Stores the first WORK ID information
$I018: Correcponds to the conveyor WORK ID characteristic file 1.
to to
$I023: Corresponds to the conveyor WORK ID characteristic file 6.





When the first workpiece for the WORK IN/NOT shift completes the shift section, (1) is set to the system variable $I000. When the first workpiece for the WORK ID shift completes the shift section, (1) is set to the system variable $I006.
In the job, these system variables are read out, and the CVQUE instruction is executed when both the WORK IN/NOT shift and the WORK ID shift completes the respective shift sections. Executing the CVQUE instruction sets the head information of WORK IN/NOT shift data and WORK ID shift data to the system variables $I012 and $I018 respectively and switches the reference workpiece for syncrhonization start to the next reference workpiece.

When the conveyor synchronized function with shift functions is valid, insert the CVQUE instruction after the SYEND instruction and before the next SYSTART instruction, whether the Start Shift function is used or not.

Be sure to program the SYEND instruction at the beginning of the master job to reset the registered status of the conveyor’s home position.

3.9 Manual Setting Function for Conveyor Position

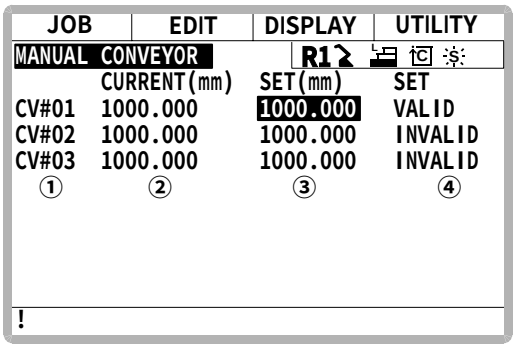
With the manual setting function for conveyor position, the conveyor position can be set from the programming pendant without moving the conveyor to modify the taught job.
Using this function, instead of moving the conveyor to move the workpiece to the teaching position, by removing a fastening device such as a dog and moving the workpiece to the desired position on the conveyor, the conveyor position can be input to modify the taught job.
When the taught job is modified by using the manual setting function for conveyor position, the newly-set value of the conveyor position is registered to the value of CTP when the registration of the move instruction for the synchronized motion (SYMOV□) is modified.

Operation

Select {ROBOT} under the top menu ➡ Select {MANUAL CONVEYOR}*1*

Explanation

1 The MANUAL CONVEYOR display appears.



①CV#
Displays CV#1 to 3 when one conveyor board is mounted, and CV#1 to 6 when two conveyor boards are mounted.

②CURRENT (mm)
Displays the conveyor's current position (in actual amount of pulses). When the manual setting function for the conveyor position is used, the position data set is displayed.

③SET (mm) (0 to 21000 mm)
Sets the conveyor position. A value out of the setting range cannot be entered.

④SET
Enables or Disables the manual setting mode for the conveyor position.

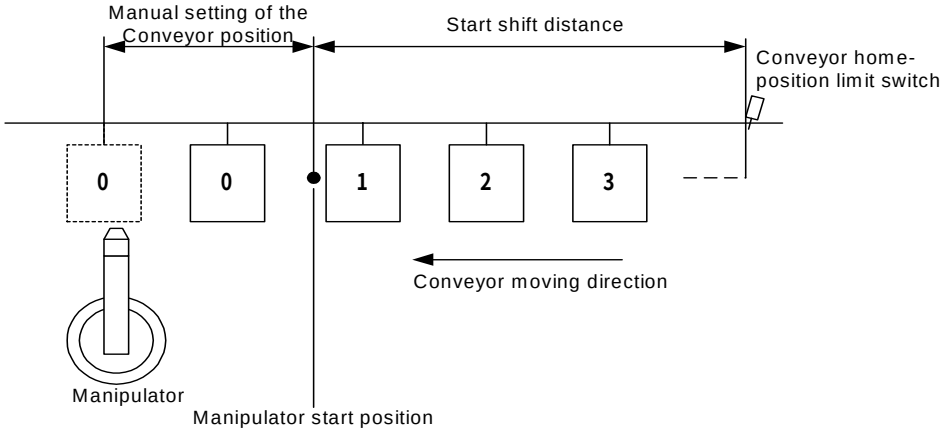
3.9.1 Precautions

■ When the Power is Turned ON

When the power is turned ON, all the manual setting functions for conveyor position are disabled regardless of the play or teach mode, and the actual conveyor positions are displayed in {CURRENT (mm)}.
When the MANUAL CONVEYOR display is called up after the power is turned ON, "***" appears in the column of {SET (mm)}. The set conveyor positions are retained until the power is turned OFF.

■ Definition of Conveyor Position

When the shift functions are used, the set conveyor position is defined as the distance from the manipulator start position as shown in the figure below. When the shift functions are not used, it is defined as the distance from the conveyor home-position limit switch.
When the conveyor moves in the manual setting mode for conveyor position, the pulse value of the actual conveyor is read out, and the actual conveyor status on the conveyor shift table and the synchronization table are updated.



NOTE
- When the teach mode is switched to the play mode while the manual setting function for conveyor position is enabled, the manual setting function for conveyor position is automatically disabled.
- The MANUAL CONVEYOR display can be viewed only in the teach mode.
- The manual setting function for conveyor position is valid only when the turntable synchronization function is disabled.

3.9.2 Manual Setting Procedure for the Conveyor Position

■ Setting the Conveyor Position

Operation

Move the cursor to the desired value in the column of the {SET (mm)} ➡ Enter a value using the number keys

■ Validating or Invalidating the Manual Setting

Operation

Move the cursor to the desired value in the column of the {SET} ➡ Press [SELECT] *1

Explanation

1 "VALID" or "INVALID" alternately appears.

3.10 Test Run without Moving the Conveyor

CAUTION

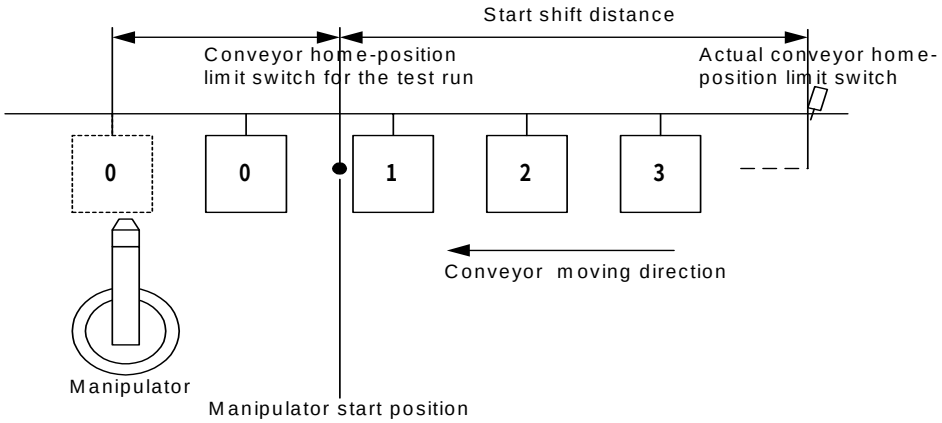
- During the test run using a virtual encoder, the manipulator moves in the pseudo conveyor synchronization. Therefore, the manipulator motion may be different from the taught motion. Make sure that no one is in the manipulator working envelope before starting the test run.
  Injury may result from unintentional or in unexpected manipulator motion.

A test run can be done to confirm the manupulator's motions without moving the conveyor in the teach mode. This is useful to confirm a continuous path and execution of each instruction. For a job without the conveyor synchronization instruction, the test run can be carried out without any special settings. For a job with the conveyor synchronization instruction, however, the following operations are required to carry out this test run.

1. Set "ENCODER INPUT" of the conveyor condition file to "VIRTUAL ENCODER."
   Or, specify the virtual encoder by the general-purpose input signal.
   (Refer to "2.2 Editing Conveyor Condition File" for the setting method.)
2. Turn ON the conveyor home-position limit switch of the actual conveyor.
3. Select a job for which the test run is to be carried out and open its JOB CONTENT display. Press [INTERLOCK] and [TEST START] at the same time. The virtual encoder starts counting the pseudo pulses and the manipulator starts moving.

The test run starts by pressing [INTERLOCK] and [TEST START] at the same time. To assure the safe operation, the manipulator moves only while these keys are pressed.

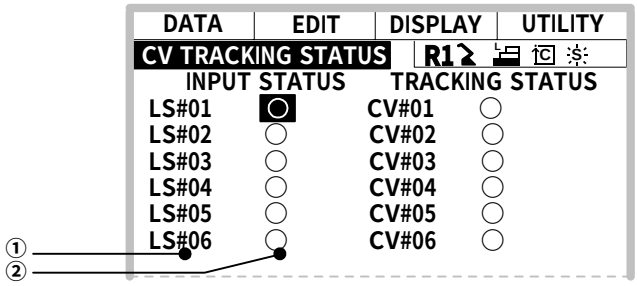
For a job where a start shift distance (WORK SHIFT POS) is set, the distance can be temporally changed to "0." In this way, only the manipulator's motion can be confirmed by the test run without waiting the manipulator to move for the start shift distance.
Set "1" for the sensor parameter SE016 "Ignorance of shift distance in virtual conveyor mode" so that the start shift distance is changed to "0" in the virtual encoder mode.



3.11 Manual Setting Function for Pseudo ON of the Conveyor Home-position Limit Switch

When the conveyor home-position limit switch cannot be turned ON, it can be pseudonymously turned ON in the following manner.

1. Open the CV TRACKING STATUS display.



①LS#

Indicates the conveyor home-position input signal number.

②STATUS

Displays the conveyor home-position input signal status, or inputs the conveyor home-position input signal.

2. Move the cursor to the limit switch number connected to the conveyor home-position input signal that is set in PORT NO. in the conveyor condition file.
3. By pressing [INTERLOCK] and [SELECT] at the same time, select “ON” status to pseudonymously turn the conveyor home-position input signal ON.

The manual setting function for pseudo ON of the conveyor home-position limit switch is valid only in the teach mode. This function is disabled in the play mode.

4 Playback

4.1 Conveyor Speed Down

When the conveyor slows down while the manipulator moves in synchronization with the conveyor, the manipulator will react according to the mode setting in the conveyor condition file:

```
CONVEYOR SPEED DOWN MODE: EXECUTE
CONVEYOR LOWER LIMIT SPD  : 0 mm/sec
```

Conveyor Condition File Display

- EXECUTE
  Regardless of the conveyor speed, the manipulator continues moving. When the conveyor stops, the manipulator motion is synchronized with the conveyor speed “0.”
- ALARM
  When the conveyor average speed remains below the set value in “CONVEYOR LOWER LIMIT SPD” for 0.1 second, an alarm occurs and the manipulator stops.
- PAUSE JOB
  When the conveyor speed remains below the set value in “CONVEYOR LOWER LIMIT SPD” for 0.1 second, the job execution is interrupted (only the execution of move instructions in the job are suppressed) and the manipulator continues only follow-up motion in the conveyor moving direction. When the conveyor speed recovers to the set value in “CONVEYOR LOWER LIMIT SPD” or higher, the job execution restarts.
- PAUSE JOB AFTER APRAY OFF
  When the conveyor average speed remains below the set value in “CONVEYOR LOWER LIMIT SPD” for 0.1 second, the manipulator executes the job up to the spray off instruction, and then executes only the follow-up motion in the conveyor moving direction. When the conveyor speed recovers to the “CONVEYOR LOWER LIMIT SPD” or higher, the job execution restarts.

For the details of the above four modes, refer to “2.1 Conveyor Condition File.”

NOTE The specific output 5027 turns ON when the conveyor slows down.

4.2 Accuracy

In the operation by the conveyor synchronized control, the manipulator motion path taught on the conveyor in stop status is reproduced on the conveyor in run status.
Therefore, the accuracy of the operation is determined by the amount of difference between the taught motion path and the synchronized motion path. Since the object is moving, it is impossible to appreciate the accuracy in the same way as the repetitive positioning accuracy for still-object.
The amount of difference between the taught motion path and the synchronized motion path is resulted from the following factors. Even if the following factors are adjusted not to cause the difference, the amount of difference can be about ten times of the amount of difference resulted from the repetitive positioning for still-object.

- Linearity of the conveyor in the synchronization section
- Conveyor movements that are not indicated in the pulse data from the conveyor encoder (such as swings with hanger conveyor)
- Difference between the manipulator actual dimensions and the dimensions registered in the XRC
- Conversion resolution error that occurs when converting the pulse data from the conveyor encoder to the conveyor travel amount in mm
- Manipulator mechanical accuracy such as arm bending
- Follow-up delay due to the conveyor speed fluctuation
- Manipulator system lag time
- Difference between the conveyor moving direction and the travel-axis moving direction when the synchronization is performed by the travel-axis

4.3 Conveyor Resolution Error

The synchronization error resulted from the conveyor resolution setting error increases as the conveyor position value increases. The farther the conveyor moves, the bigger the synchronization error becomes. The minimum value for conveyor positional resolution setting is 0.01 μm. Therefore, a maximum error of 0.005 μm per pulse may occur.
Entering a correct resolution is especially required when using the conveyor synchronized function with shift functions because of its large follow-up distance.
For example, when the conveyor resolution is 10 μm per pulse and the synchronization distance is 2 m, 200,000 pulses are output when the conveyor moves for 2 m. Since the maximum error per pulse is 0.005 μm, the following synchronization error may occur:
200,000 pulses × 0.005 μm = 1 mm

4.4 Restarting Synchronization After Manipulator Stops

When a manipulator stops during the synchronized operation in the following cases, the manipulator restarts the synchronized motion when the operation is restarted.

- At occurrence of minor failure alarm (excluding occurrence of alarm related to the conveyor synchronized control)
- At emergency stop or external emergency stop
- By hold or external hold
- By switching the mode (mode switching between play and teach mode)
- By switching the operation cycle (switching among Auto/1 cycle/Step)

4.5 Continuance of Conveyor Synchronized Status

The conveyor synchronized status started by SYSTART instruction remains until SYEND instruction is executed or the control power supply is turned off. Even if a manipulator stops in the cases explained in the previous section, the conveyor synchronized status remains. Note that a manipulator performs the synchronized motion by SYMOV□ instruction even if the cursor is moved in teach mode, the master job is called, or a job selection is made.

4.6 Continuance of Parallel Shift Status

The parallel shift status in the conveyor synchronized status continues even after a manipulator stops in the cases explained in the previous section. However, the parallel shift status is cleared in the following cases. Be careful when using the parallel shift function in combination with the conveyor synchronized control.

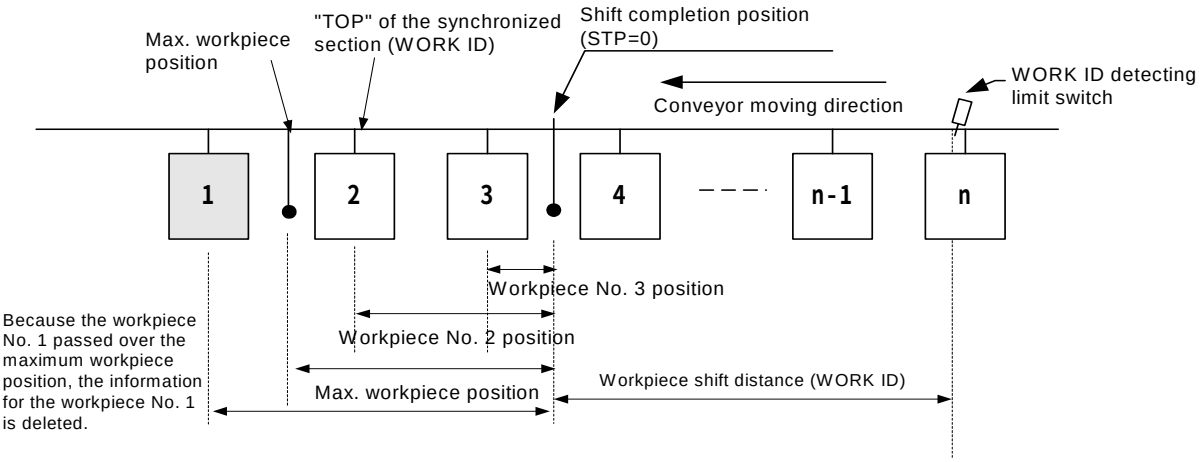
- Execution of SFTOF instruction
- The cursor is moved in teach mode.
- The master job is called.
- Job selection
- The main power supply is shut down.

4.7 Conveyor Synchronized Motion During Execution of TIMER and WAIT

While a manipulator is in waiting status by execution of TIMER, WAIT, etc. the manipulator continues the conveyor synchronized motion.

4.8 Detection of the Position beyond the Specified Maximum-workpiece-position

When a workpiece passes over the specified point (MAX. WORK POSITION) on the conveyor of the synchronized section without execution of the CVQUE instruction or the switching of workpieces, the position information, WORK ID information, and WORK IN/NOT information of the workpiece are automatically deleted from the job queue data.



Set the maximum workpiece position in the sensor parameter SxE13.

4.9 Information Management in Conveyor Synchronized Section

When the manipulator is stopped by an alarm during the conveyor synchronized operation and the conveyor continues moving, the memory of the detected workpieces in the synchronized section overflows. To avoid such overflow, the managed information of the detected workpieces in the conveyor synchronized section can be limited to the latest workpiece information only.
The workpiece information in the synchronized section is overwritten every input so that only the latest workpiece information is managed.
To use this overwriting mode for the workpiece information in the synchronized section, turn ON the specific input 4176. When the specific input 4176 is OFF, the XRC manages the workpiece information normally.

5 Conveyor Monitoring Displays for the Shift Functions

To monitor the conveyor synchronized status when using the shift functions, use the following display.

- CV (SYNCHRONIZATION) display

To monitor each shift status, use the following three displays.

- CV START SHIFT STATUS display
- CV WORK ID SHIFT STATUS display
- CV WORK IN/NOT SHIFT STATUS display

■ Open the CV (SYNCHRONIZATION) Display

Open the CV (SYNCHRONIZATION) display in the following manner.

Operation

Select {ROBOT} under the top menu ➡ Select {CV (SYNCHRONIZATION)} ➡ The conveyor synchronization section monitor display appears ➡ Open the desired display*1*

Explanation

1 Pressing the page key  switches the display.

Pressing [SHIFT] + the page key  returns to the previous display.

■ Open the Display to Monitor the Shift Status

Open a display to monitor the shift status in the following manner.

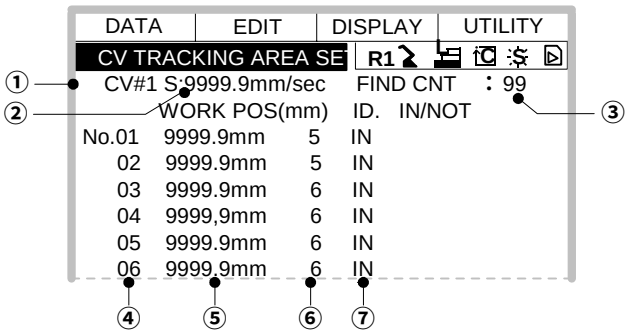
Operation

Select {ROBOT} under the top menu ➡ Select {CV (SHIFT)} ➡ The CV START SHIFT STATUS display appears ➡ Open a desired display*1*

Explanation

1 Press the area key, move the cursor to {DISPLAY} and press [SELECT]. Then, select the CV START SHIFT STATUS display, the CV WORK ID SHIFT STATUS display, or the CV WORK IN/NOT SHIFT STATUS display.

5.1 CV (SYNCHRONIZATION) MONITOR Display



①CV#

Displays the conveyor characteristic file number.

②S (mm/s)

Displays the conveyor average speed per 0.1 second.

③FIND CNT

Displays the number of workpieces that have passed the manipulator start position and are in the synchronizing section.

④No.

Displays the workpiece number that is detected.

⑤WORK POS (mm)

Displays the distance between the position of the detected workpiece in synchronization and the manipulator start position in mm.

When the painting operation for the first workpiece in synchronization is completed and the CVQUE instruction is executed, the workpiece for synchronization is switched to the next workpiece.

⑥ID.

Displays the WORK ID information of the detected workpiece in synchronization.

When the CVQUE instruction is executed after the job for the first workpiece in the synchronized section has been completed, the reference workpiece for synchronization is changed to the next workpiece.

⑦IN/NOT

Displays the WORK IN/NOT information of the detected workpiece in synchronization.

When the CVQUE instruction is executed after the job for the first workpiece in the synchronization section has been completed, the reference workpiece for synchronization is changed to the next workpiece.

5.1.1 Switching the Reference Workpiece for Synchronization

To switch the reference workpiece for synchronization from the currently objective workpiece to the next workpiece at teaching, follow the operation procedure below.

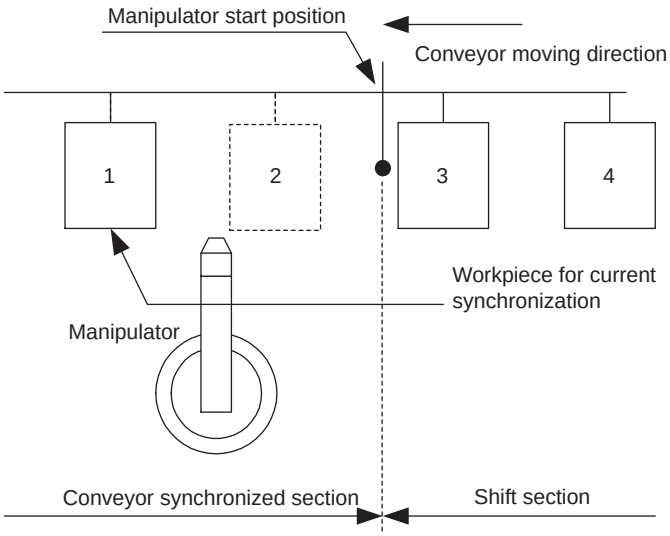
Operation

Press the area key ➡ Select {DATA} ➡ Select “SYNCHRONIZATION SWITCH”*1

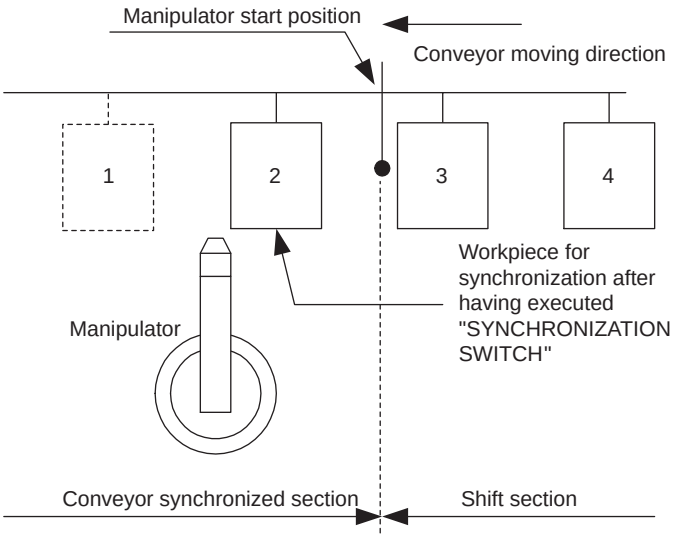
Explanation

1 Press the area key, move the cursor to [DISPLAY] and press [SELECT] to open the desired display.

The synchronization before switching the reference workpiece for synchronization is shown in the figure below. The workpiece for the current synchronization is the first workpiece on the conveyor synchronized section display.



Execute “SYNCHRONIZATION SWITCH” switches the objective workpiece to the next workpiece as shown in the figure below.



NOTE
- The information of the workpiece for current synchronization is deleted by the execution of “SYNCHRONIZATION SWITCH” and UNDO operation is not possible.
- “SYNCHRONIZATION SWITCH” is valid only when two or more workpieces are in the conveyor synchronized section. Do not execute “SYNCHRONIZATION SWITCH” operation when only one workpiece is in the conveyor synchronized section. Doing so causes an alarm because no workpiece exists to be switched.

5.1.2 Saving the Data of Conveyor Synchronized Section

The data of conveyor synchronized section are automatically saved at the following timings.

(1) At normal completion of playback operation
(2) In teach mode (always saved)

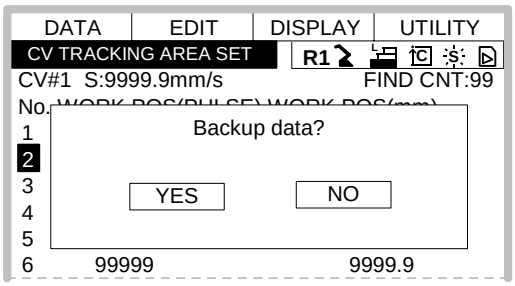
To save the data manually, follow the operation below.

Operation

Press the area key ➡ Select {DATA} ➡ Select “SAVE DATA”*1 ➡ Move the cursor to “YES” and press [ENTER]

Explanation

1 The following display appears.



NOTE

- The above saving operation saves only the data appeared on the display. The other shift data such as start shift data, WORK ID shift data, and WORK IN/NOT shift data can be saved on START SHIFT STATUS display, WORK ID SHIFT STATUS display, and WORK IN/NOT SHIFT display respectively. Save the necessary data according to the system configuration. Be sure to save the data before turning off the XRC power supply.
- When a momentary power failure occurs during playback operation, the data is not automatically saved. Therefore, the saved data and the actual value may differ when the power supply is turned ON again. In such a case, clear the data of both the shift data and the synchronization data.

5.1.3 Deleting a Data of Conveyor Synchronized Section

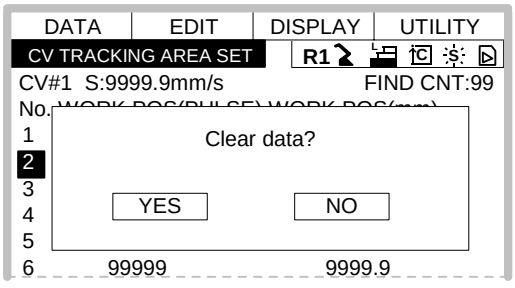
Delete a data of conveyor synchronized section in the following manner.

Operation

Press the area key ➡ Select {DATA} ➡ Select “CLEAR DATA”***1*** ➡ Move the cursor to “YES” and press [ENTER]

Explanation

1 The following display appears.



NOTE

- While power is supplied to the XRC, the XRC manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the XRC conveyor data in the following cases:
  - The conveyor moves while power is not supplied to the XRC or during the XRC start sequence.
  - A momentary power failure occurs during operation in play mode.
  - The power to the XRC is turned off without saving the latest conveyor data.
  - The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”
- “CLEAR DATA” operation deletes the data on the currently active display.
  Delete a start shift data on the start shift data display, a WORK ID shift data on the WORK ID shift display, and a WORK IN/NOT shift data on the WORK IN/NOT shift display respectively. Delete unnecessary shift data according to the system configuration.

5.1.4 Deleting the Shift Data and the Data of Conveyor Synchronized Section

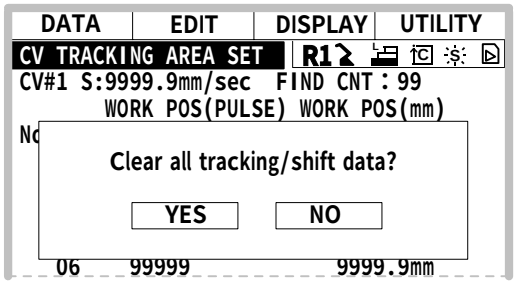
Delete the shift data and the data of conveyor synchronized section at a time in the following manner.

Operation

Press the area key ➡ Select {DATA} ➡ Select “ALL CLEAR”*1 ➡ Move the cursor to “YES” and press [ENTER]

Explanation

1 The following display appears.

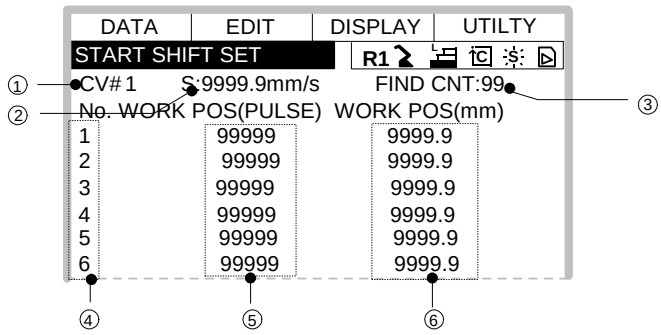


NOTE

While power is supplied to the XRC, the XRC manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the XRC conveyor data in the following cases:

- The conveyor moves while power is not supplied to the XRC or during the XRC start sequence.
- A momentary power failure occurs during operation in play mode.
- The power to the XRC is turned off without saving the latest conveyor data.
- The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”

5.2 CV START SHIFT STATUS Display



①CV#

Displays the conveyor start shift characteristic file number.

②S (mm/s)

Displays the conveyor average speed per 0.1 second.

③FIND CNT

Displays the number of workpieces that are detected by the start shift function and in the start shift section.

④No.

Displays the detected start shift workpiece number.

⑤WORK POS (PULSE)

Displays the distance between the detected workpiece position and the manipulator start position in pulses.

⑥WORK POS (mm)

Displays the distance between the detected workpiece position and the manipulator start position in mm.

When the first workpiece in the shift section reaches the manipulator start position, the information of this workpiece is deleted and the information of the next workpiece is displayed on the top.

5.2.1 Saving the Conveyor Start Shift Data

The conveyor start shift data are automatically saved at the following timings:

(1) At normal completion of playback operation
(2) At completion of test operation in teach mode
(3) At conveyor stop

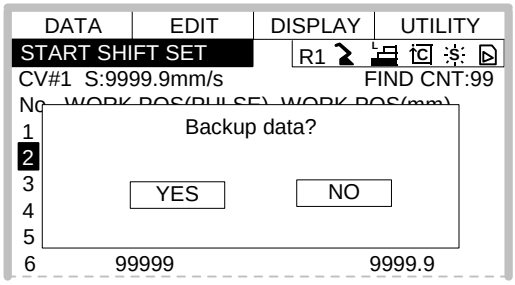
To save the data manually, follow the operation below.

Operation

Press the area key ➡ Select {DATA} ➡ Select “SAVE DATA”*1 ➡ Move the cursor to “YES” and press [ENTER]

Explanation

1 The following display appears.



NOTE

- “SAVE DATA” operation saves the shift data on the currently active display. Save a start shift data on the start shift data display, a WORK ID shift data on the WORK ID shift display, and a WORK IN/NOT shift data on the WORK IN/NOT shift display respectively. Save necessary shift data according to the system configuration. Be sure to save the shift data before turning off the power to the XRC.
- When a momentary power failure occurs during playback operation, the data is not automatically saved. Therefore, the saved data and the actual value may differ when the power supply is turned ON again. In such a case, clear the data of both the shift data and the synchronization data.

5.2.2 Deleting a Conveyor Start Shift Data

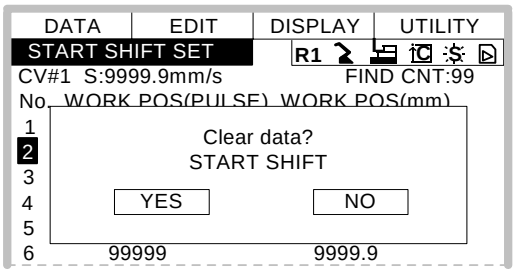
Delete a conveyor start shift data in the following manner.

Operation

Press the area key ➡ Select {DATA} ➡ Select “CLEAR DATA”*1 ➡ Move the cursor to “YES” and press [ENTER]

Explanation

1 The following display appears.



NOTE

- While power is supplied to the XRC, the XRC manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the XRC conveyor data in the following cases:
  - The conveyor moves while power is not supplied to the XRC or during the XRC start sequence.
  - A momentary power failure occurs during operation in play mode.
  - The power to the XRC is turned off without saving the latest conveyor data.
  - The virtual conveyor mode is set with the setting “Ignorance of shift distance in vertual mode.”
- “CLEAR DATA” operation deletes the shift data on the currently active display. Delete a start shift data on the start shift data display, a WORK ID shift data on the WORK ID shift display, and a WORK IN/NOT shift data on the WORK IN/NOT shift display respectively. Delete unnecessary shift data according to the system configuration.

5.2.3 Deleting the Shift Data and the Data of Conveyor Synchronized Section

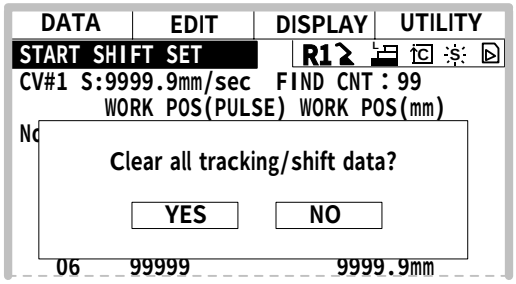
Delete the shift data and the data of conveyor synchronized section at a time in the following manner.

Operation

Press the area key ➡ Select {DATA} ➡ Select “ALL CLEAR” *1 ➡ Move the cursor to “YES” and press [ENTER]

Explanation

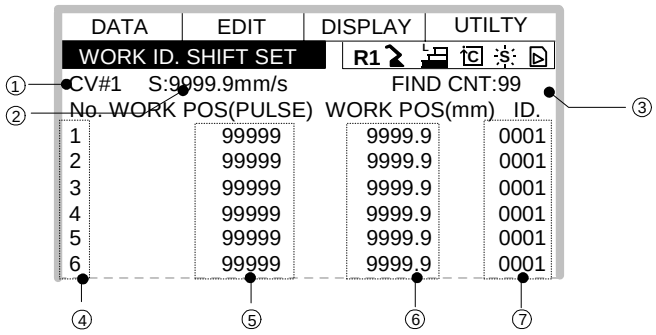
1 The following display appears.



NOTE While power is supplied to the XRC, the XRC manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the XRC conveyor data in the following cases:

- The conveyor moves while power is not supplied to the XRC or during the XRC start sequence.
- A momentary power failure occurs during operation in play mode.
- The power to the XRC is turned off without saving the latest conveyor data.
- The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”

5.3 CV WORK ID SHIFT STATUS Display



①CV#

Displays the conveyor WORK ID shift characteristic file number.

②S (mm/s)

Displays the conveyor average speed per 0.1 second.

③FIND CNT

Displays the number of workpieces that are detected by the WORK ID shift function and in the WORK ID shift section.

④No.

Displays the detected WORK ID shift workpiece number.

⑤WORK POS (PULSE)

Displays the distance between the detected workpiece position and the manipulator start position in pulses.

⑥WORK POS (mm)

Displays the distance between the detected workpiece position and the manipulator start position in mm.

When the first workpiece in the shift section reaches the manipulator start position, the WORK ID information of this workpiece is deleted and the WORK ID information of the next workpiece is displayed on the top.

⑦ID

Displays the WORK ID number that is read by the WORK ID detecting limit switch.

5.3.1 Saving the Conveyor WORK ID Shift Data

The conveyor WORK ID shift data are automatically saved at the following timings.

(1) At normal completion of playback operation
(2) At completion of test operation in teach mode

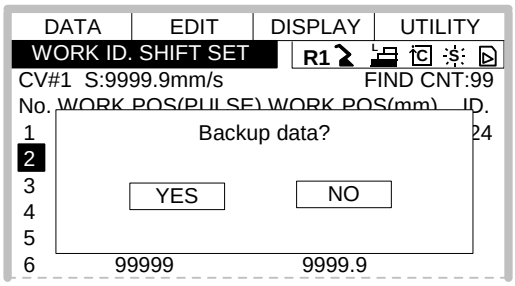
To save the data manually, follow the operation below.

Operation

Press the area key ➡ Select {DATA} ➡ Select “SAVE DATA”*1 ➡ Move the cursor to “YES” and press [ENTER]

Explanation

1 The following display appears.



NOTE

- “SAVE DATA” operation saves the shift data on the currently active display. Save a start shift data on the start shift data display, a WORK ID shift data on the WORK ID shift display, and a WORK IN/NOT shift data on the WORK IN/NOT shift display respectively. Save necessary shift data according to the system configuration. Be sure to save the shift data before turning off the power to the XRC.
- When a momentary power failure occurs during playback operation, the data is not automatically saved. Therefore, the saved data and the actual value may differ when the power supply is turned ON again. In such a case, clear the data of both the shift data and the synchronization data.

5.3.2 Deleting a Conveyor WORK ID Shift Data

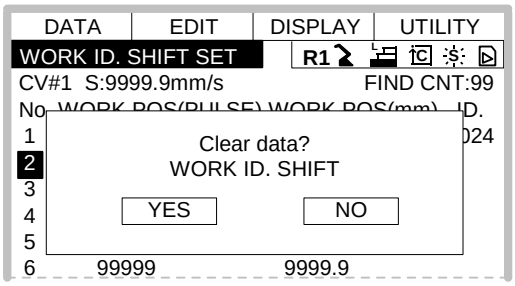
Delete a conveyor WORK ID shift data in the following manner.

Operation

Press the area key ➡ Select {DATA} ➡ Select “CLEAR DATA”*1 ➡ Move the cursor to “YES” and press [ENTER]

Explanation

1 The following display appears.



NOTE

- While power is supplied to the XRC, the XRC manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the XRC conveyor data in the following cases:
  - The conveyor moves while power is not supplied to the XRC or during the XRC start sequence.
  - A momentary power failure occurs during operation in play mode.
  - The power to the XRC is turned off without saving the latest conveyor data.
  - The vertual conveyor mode is set with the setting “Ignorance of shift distance in vertual mode.”
- “CLEAR DATA” operation deletes the shift data on the currently active display. Delete a start shift data on the start shift data display, a WORK ID shift data on the WORK ID shift display, and a WORK IN/NOT shift data on the WORK IN/NOT shift display respectively. Delete unnecessary shift data according to the system configuration.

5.3.3 Deleting the Shift Data and the Data of Conveyor Synchronized Section

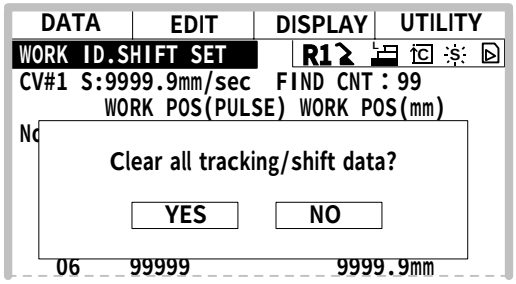
Delete the shift data and the data of conveyor synchronized section at a time in the following manner.

Operation

Press the area key ➡ Select {DATA} ➡ Select “ALL CLEAR”*1 ➡ Move the cursor to “YES” and press [ENTER]

Explanation

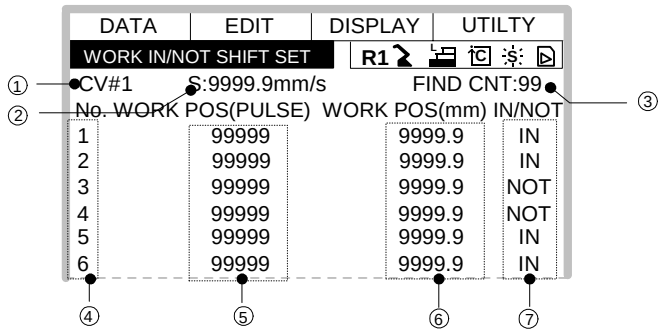
1 The following display appears.



NOTE

- While power is supplied to the XRC, the XRC manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the XRC conveyor data in the following cases:
  - The conveyor moves while power is not supplied to the XRC or during the XRC start sequence.
  - A momentary power failure occurs during operation in play mode.
  - The power to the XRC is turned off without saving the latest conveyor data.
  - The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”

5.4 CV WORK IN/NOT SHIFT STATUS Display



①CV#

Displays the conveyor WORK IN/NOT shift characteristic file number.

②S (mm/s)

Displays the conveyor average speed per 0.1 second.

③FIND CNT

Displays the number of workpieces that are detected by the WORK IN/NOT shift function and in the WORK IN/NOT shift section.

④No.

Displays the detected WORK IN/NOT shift workpiece number.

⑤WORK POS (PULSE)

Displays the distance between the detected workpiece position and the manipulator start position in pulses.

⑥WORK POS (mm)

Displays the distance between the detected workpiece position and the manipulator start position in mm.

When the first workpiece in the shift section reaches the manipulator start position, the WORK IN/NOT information of this workpiece is deleted and the WORK IN/NOT information of the next workpiece is displayed on the top.

⑦IN/NOT

Displays the WORK IN/NOT information that is read by the WORK IN/NOT detecting limit switch.

5.4.1 Saving the Conveyor WORK IN/NOT Shift Data

The conveyor WORK IN/NOT shift data are automatically saved at the following timings.

(1) At normal completion of playback operation
(2) At completion of test operation in teach mode

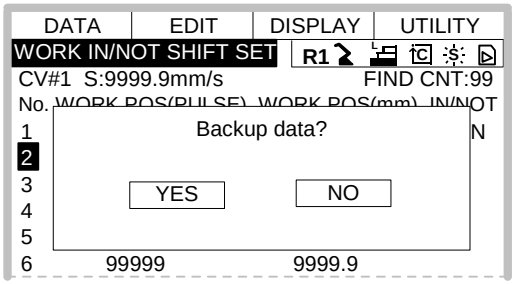
To save the data manually, follow the operation below.

Operation

Press the area key ➡ Select {DATA} ➡ Select “SAVE DATA”*1 ➡ Move the cursor to “YES” and press [ENTER]

Explanation

1 The following display appears.



NOTE

- “SAVE DATA” operation saves the shift data on the currently active display. Save a start shift data on the start shift data display, a WORK ID shift data on the WORK ID shift display, and a WORK IN/NOT shift data on the WORK IN/NOT shift display respectively. Save necessary shift data according to the system configuration. Be sure to save the shift data before turning off the power to the XRC.
- When a momentary power failure occurs during playback operation, the data is not automatically saved. Therefore, the saved data and the actual value may differ when the power supply is turned ON again. In such a case, clear the data of both the shift data and the synchronization data.

5.4.2 Deleting a Conveyor WORK IN/NOT Shift Data

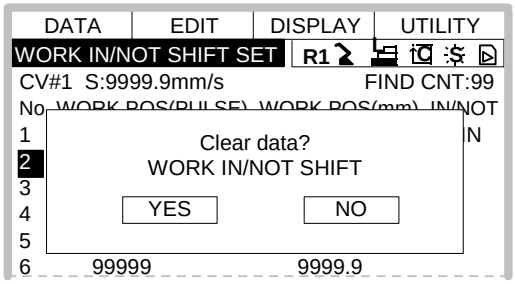
Delete a conveyor WORK IN/NOT shift data in the following manner.

Operation

Press the area key ➡ Select {DATA} ➡ Select “CLEAR DATA”*1 ➡ Move the cursor to “YES” and press [ENTER]

Explanation

1 The following display appears.



NOTE

- While power is supplied to the XRC, the XRC manages and updates automatically all the conveyor data regardless of the operation mode. Accordingly, deleting data while the conveyor is moving does not cause a problem. However, it may cause a malfunction due to inconsistency between the actual conveyor status and the XRC conveyor data in the following cases:
  - The conveyor moves while power is not supplied to the XRC or during the XRC start sequence.
  - A momentary power failure occurs during operation in play mode.
  - The power to the XRC is turned off without saving the latest conveyor data.
  - The vertual conveyor mode is set with the setting “Ignorance of shift distance in vertual mode.”
- “CLEAR DATA” operation deletes the shift data on the currently active display. Delete a start shift data on the start shift data display, a WORK ID shift data on the WORK ID shift display, and a WORK IN/NOT shift data on the WORK IN/NOT shift display respectively. Delete unnecessary shift data according to the system configuration.

5.5 Deleting All the Shift Data and Synchronization Data

5.5.1 Deleting All the Shift Data

Delete all the Start Shift, WORK ID Shift, and WORK IN/NOT Shift data by the following specific input signal.

Specific Input Signal	Signal Condition	Description
4174		At the rising edge of the signal, all shift data are cleared.

NOTE
Malfunction may occur due to inconsistency between the actual conveyor status and the XRC conveyor shift data in the following cases:
- The conveyor moves while power is not supplied to the XRC or during the XRC start sequence.
- A momentary power failure occurs during operation in play mode.
- The power to the XRC is turned off without saving the latest conveyor shift data.
- The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”

5.5.2 Deleting All the Synchronization Data

Delete all the synchronization data by the following specific input signal.

Specific Input Signal	Signal Condition	Description
4175		At the rising edge of the signal, all the synchronization data are cleared.

NOTE
Malfunction may occur due to inconsistency between the actual conveyor status and the XRC conveyor synchronization data in the following cases:
- The conveyor moves while power is not supplied to the XRC or during the XRC start sequence.
- A momentary power failure occurs during operation in play mode.
- The power to the XRC is turned off without saving the latest conveyor synchronization data.
- The virtual conveyor mode is set with the setting “Ignorance of shift distance in virtual mode.”

6 Instruction List

The instructions used for the conveyor synchronized control with shift functions are listed below. The numerical data to be set is explained in < >.

SYSTART	Function	Starts the conveyor synchronized operation.	
	Additional items	CV# (<Conveyor condition file No.>)	1 to 6
		STP=<Synchronization start position in mm>	
		OL=<Tolerance in mm>	When omitted or 0 is set, the tolerance check is not executed.
	Example	SYSTART CV#(1) STP=100.00	
SYMOVJ	Function	Moves the manipulator in joint interpolation in synchronization with the conveyor.	
	Additional items	CV# (<Conveyor condition file No.>)	1 to 6
		CTP= <Conveyor position at teaching in mm>	
		VJ= <Play speed in percentage>	
	Example	SYMOVJ VJ=50.00 CV#(1) CTP=100.00	
SYMOVL	Function	Moves the manipulator in linear interpolation in synchronization with the conveyor.	
	Additional items	CV# (<Conveyor condition file No.>)	1 to 6
		CTP=<Conveyor position at teaching in mm>	
		V= <Play speed>	
	Example	SYMOVL V=200.0 CV#(1) CTP=100.00	
SYMOVC	Function	Moves the manipulator in circular interpolation in synchronization with the conveyor.	
	Additional items	CV# (<Conveyor condition file No.>)	1 to 6
		CTP=<Conveyor position at teaching in mm>	
		V= <Play speed>	
	Example	SYMOVL V=200.0 CV#(1) CTP=100.00	

SYEND	Function	Ends the conveyor synchronized operation.	
	Additional items	CV# (<Conveyor condition file No.>)	1 to 6
		CONT	CONT (continuity attribute) may be omitted.
	Example	SYEND CV#(1)	
CVQUE	Function	Switches the workpiece for synchronization to the next workpiece.	
	Additional Items	None	
	Example	CVQUE	

7 Alarm List

Alarm No.	Message	Causes	Corrective Actions
1003	ROM ERROR (XCP02)		Replace the XCP02 board (ROM).
1109	SYSTEM ERROR (CONVEYOR) [Decimal Data: 0 to 255]	Internal error.	Replace the XSL02 board.
1400	CONVEYOR ENCONDER ERROR [Error occurred conveyor No.: 1, 2, 3]	Conveyor encoder error at the error occurred conveyor No.	Replace the encoder cable or the encoder.
1401	CANNOT CHANGE CONVEYOR MODE	The encoder selection “ENCODER/ VIRTUAL ENCDR” has been switched by the general purpose input signal during the conveyor synchronized operation.	Switch the encoder by the general purpose input signal while the manipulator is not in the conveyor synchronized operation.
4021	MEMORY ERROR (CONVEYOR CONDITION FILE) [Decimal Data: 0 to 255]	The conveyor condition file data in the memory has been destroyed.	Initialize the conveyor condition file in customer maintenance mode.
4530	CONVEYOR SYNCHRONIZATION ERROR [Decimal Data; 0 to 255]	1: The base axis specification in the conveyor condition file is set to other than 0, 1, and 2. 2: The robot axis specified for tracking does not exist. 3: The base axis specified for tracking does not exist in the job. The error data other than 1, 2, and 3 is an internal error.	Turn the power OFF then back ON. If the alarm occurs again, contact your YASKAWA representative.
4531	UNDEFINED CONVEYOR CONDITION FILE [Decimal Data: 0 to 255]	The conveyor condition file specified for the job is not set to “USED.”	Set the conveyor condition file to “USED.”
4532	CONVEYOR SPEED DOWN [Decimal Data: 0 to 255]	When the mode for conveyor speed down mode in the conveyor condition file is set to “ALARM,” the conveyor speed is lowered to less than its lower limit specified in the conveyor condition file.	Increase the conveyor speed so that it becomes higher than the conveyor speed lower limit specified in the conveyor condition file.

Alarm No.	Message	Causes	Corrective Actions
4533	ARITHMETIC ERROR [Decimal Data, 0 to 255]	Internal error.	Turn the power OFF then back ON. If the alarm occurs again, contact your YASKAWA representative.
4637	NO MORE WORKPIECE IN SYN SECTION	The CVQUE instruction is executed, but there is no more workpiece in the synchronization section.	Check the workpieces in the synchronization section and the data for the synchronization section.
4638	NO MORE WORKPIECE ID DATA IN SYN SECTION	The CVQUE instruction is executed, but there is no more workpiece in the synchronization section.	Check the workpieces in the synchronization section and the data for the synchronization section.
5020	SENSOR PARAMETER ERROR [Decimal Data: 0 to 255]	On the XSL02 board, when parameters were calculated using data in the conveyor condition file, an operation error occurred.	Check whether the data are properly set in the conveyor condition file. Confirm that “0” is not set for the user coordinate number.
5022	CONVEYOR POSITION LIMIT OVER [Alarm occurred conveyor condition file No.: 1, 2, or 3]	The corrected conveyor position value exceeds ±21 m.	Review the synchronization section. After this alarm occurs, the conveyor position is not updated. Therefore, the synchronized operation is not performed after the alarm is reset, and the manipulator continues operation at the position where the alarm occurred.
5023	CONVERYOR COUNTER LIMIT OVER [Alarm occurred conveyor condition file No: 1, 2, or 3]	The conveyor position counter pulse overflow	Review the conveyor resolution or the synchronization section. After this alarm occurs, the conveyor position is not updated. Therefore, the synchronized operation is not performed after the alarm is reset, and the manipulator continues operation at the position where the alarm occurred.

Alarm No.	Message	Causes	Corrective Actions
5070	WORK IN/NOT SHIFT DATA OVERFLOW	The WORK IN/NOT shift data overflow	Check the shift data and the actual workpiece status. If any inconsistency is found, delete the shift data and prepare newly the shift data.
5071	WORK ID SHIFT DATA OVERFLOW	WORK ID shift data overflow	Check the shift data and the actual workpiece status. If any inconsistency is found, delete the shift data and prepare newly the shift data.
5072	START SHIFT DATA OVERFLOW	Start shift data overflow	Check the shift data and the actual workpiece status. If any inconsistency is found, delete the shift data and prepare newly the shift data.
5073	SHIFT DATA OVERFLOW IN SYNCHRONIZATION SECTION	Shift section data overflow	Check the tracking area data in the synchronized section and the actual workpiece status. If any inconsistency is found, delete the shift data in the synchronized section and prepare newly the shift data.
5075	FAIL TO STOP CONVEYOR ENCODER	The encoder was not in stop status when the control power supply was turned on.	Delete the shift data and prepare newly the shift data.
5076	TRACKING AREA IN/NOT DATA POSITION LIMIT	The WORK IN/NOT data of the first workpiece in the synchronized section exceeds the preset value.	Delete the WORK IN/NOT data in the synchronized section.
5077	TRACKING AREA ID. DATA POSITION LIMIT	The WORK ID data of the first workpiece in the synchronized section exceeds the preset value.	Delete the WORK ID data in the synchronized section.
1402	WORK IN/NOT SHIFT DATA COUNT LIMIT OVER	The current position pulse operation error in the WORK IN/NOT shift data	Check the WORK IN/NOT shift data and the actual workpiece status.

Alarm No.	Message	Causes	Corrective Actions
1403	WORK IN/NOT SHIFT DATA POSITION LIMIT OVER	The current travel distance operation error in the WORK IN/NOT shift data	Check the WORK IN/NOT shift data and the actual workpiece status.
1404	WORK ID SHIFT DATA COUNT LIMIT OVER	The current position pulse operation error in the WORK ID shift data	Check the WORK ID shift data and the actual workpiece status.
1405	WORK ID SHIFT DATA POSITION LIMIT OVER	The current travel distance operation error in the WORK ID shift data	Check the WORK ID shift data and the actual workpiece status.
1406	START SHIFT DATA COUNT LIMIT OVER	The current position pulse operation error in the start shift data	Check the start shift data and the actual workpiece status.
1407	START SHIFT DATA POS LIMIT OVER	The current travel distance operation error in the start shift data	Check the start shift data and the actual workpiece status.

8 Specific I/O Signals

8.1 Specific Input Signals “4×××”

■ 4174: Delete All Shift Data

All the shift data are deleted by turning ON this signal.

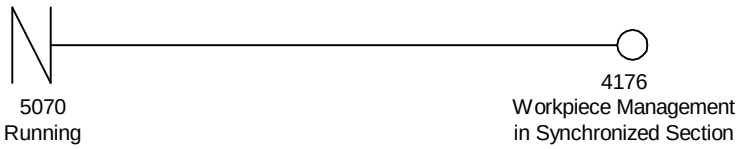
■ 4175: Delete All Synchronization Data

All the synchronization data are deleted by turning ON this signal.

■ 4176: Single Work Control (Tracking Area)

While this signal is ON, the XRC manages only the latest information of the workpiece in the conveyor synchronized section. When another workpiece passes the manipulator start position, the XRC overwrites the currently-stored workpiece information with the newly-entered workpiece information.

With the standard concurrent ladder program for painting application, the specific input signal 4176 “Information Management in Synchronized Section” is ON while the system is not running. See the following concurrent ladder program.



8.2 Specific Output Signals “5×××”

■ 5026: SYMOVJ in Execution

Indicates that the move instruction “SYMOVJ” for the conveyor synchronized motion is being executed.

■ 5027: Conveyor Speed Down

Indicates that the conveyor speed falls below the lower limit of the speed that is set in the Conveyor Condition File.

■ 5310 to 5315: Disconnection Detected

Indicates the detected disconnection of the conveyor pulse signals.
Each specific output signal corresponds to the following Conveyor Condition Files.

Conveyor Condition File No. 1: 5310
Conveyor Condition File No. 2: 5311
Conveyor Condition File No. 3: 5312
Conveyor Condition File No. 4: 5313
Conveyor Condition File No. 5: 5314
Conveyor Condition File No. 6: 5315

9 Conveyor Parameters

■ S3C469: Conveyor Model Speed for SYMOVJ

Specifies the conveyor speed at the execution of the SYMOVJ instruction when “ROBOT AXIS” is selected for “TRACKING” in the Conveyor Condition File. If “0” is set, the XRC refers to the actual conveyor speed immediately before the execution of SYMOVJ.
Set the conveyor speed to the conveyor model speed for SYMOVJ for the system where the conveyor speed varies largely.

- Units: μm/s

NOTE

- Regardless whether “ENCODER” or “VIRTUAL ENCODER” is selected for “ENCODER INPUT” in the Conveyor Condition File, the manipulator moves according to the conveyor model speed of the SYMOVJ instruction when the SYMOVJ instruction is executed. Therefore, when executing a job including the SYMOVJ instruction using a virtual encoder, set the same value as the virtual encoder speed or “0” to the parameter S3C469.

■ S3C470: Lower Limit of the Conveyor Speed for SYMOVJ

Sets the lower limit of the conveyor speed at the execution of the SYMOVJ instruction when “ROBOT AXIS” is selected for “TRACKING” in the Conveyor Condition File.
The specific output 5027 turns ON when the conveyor speed falls below the set speed.

- Units: μm/s

■ S4C105: Restoration of Conveyor Workpiece Data at Power ON

Specifies whether or not the conveyor workpiece data is to be restored when the power is turned ON.

0: All the conveyor workpiece data are cleared when the power is turned ON.
1: The conveyor workpiece data that were stored when the power was turned OFF are restored the next time the power is turned ON.

■ S4C131: Switch the conveyor speed unit of conveyor monitor

This parameter switch the conveyor speed unit of the conveyor monitor.

0: The conveyor speed is displayed by (mm/sec).
1: The conveyor speed is displayed by (m/min).

■ S4C132:The conveyor speed update timing of conveyor monitor

This parameter change the conveyor speed update timing of the conveyor monitor.

0 :Display conveyor speed is updated at real time.
Excluding 0 ：The conveyor speed update timing is value * 100msec.

10 Sensor Parameters (SxE)

Use the sensor parameters with their initial value settings.

No.	Contents	Initial Value
0	Application designation	16
1	Time to recognize the input of start signal*1	5
2	Reference time to recognize the occurrence of speed down	100
3	Time for averaging the speed variation amount	60
4	Time to recognize the falling edge of start signal	5
13	Maximum workpiece position (0 to 2000m)*2 0 corresponds to 21 m	0
14	Data overflow alarm specification Specifies the action to be taken when a workpiece is carried for the distance set in SxE13. 0: Alarm occurrence 1: No alarm occurrence	0
16	Ignorance of shift distance in virtual conveyor mode Specifies whether the start shift distance is to be “0” or not in the virtual conveyor mode. 0: Validates the start shift distance 1: Invalidates the start shift distance (set to 0)	0
17	Output time of detection signal for disconnection Sets the time during which the conveyor synchronization board sends the signal to the main CPU when a disconnection of the conveyor pulse signal is detected. Units: ms	0

1 The time to recognize the input of start signal (S1E) indicates the time from the moment that the conveyor home-position limit switch turns on until the XRC confirms the conveyor home-position limit switch ON input signal. The setting range is from 1 to 1000. Use the parameter S1E with its initial setting. However, if the conveyor home-position limit switch malfunction occurs frequently, change the setting to a bigger value as required.

2 The maximum workpiece position indicates the distance between the workpiece position and the manipulator start position. When a workpiece is carried for this distance from the manipulator start position, the XRC automatically deletes the workpiece information from the job queue or issues the alarm. Whether to automatically delete the information or issue the alarm can be selected by the setting of the sensor parameter

No.14 “Data overflow alarm specification.”
While the conveyor synchronization is not executed, however, the workpiece information is automatically deleted from the job queue regardless of the setting of the sensor parameter No.14.

YASNAC XRC OPTIONS
INSTRUCTIONS

FOR CONVEYOR SYNCHRONIZED FUNCTION WITH SHIFT FUNCTIONS

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