FS100 OPTIONS
INSTRUCTIONS
FOR CONVEYOR SYNCHRONIZED FUNCTION

SUPPLEMENTARY FOR CONTINUOUS OPERATION CONVEYOR SYNCHRONIZED FUNCTION

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

• This instruction is applicable to both FS100 and FS100L controllers.

MOTOMAN INSTRUCTIONS
(FOR SMALL -SIZED MANIPULATORS) (FOR LARGE AND MEDIUM-SIZED MANIPULATORS)
MOTOMAN-□□□ INSTRUCTIONS MOTOMAN-□□□ INSTRUCTIONS
FS100 INSTRUCTIONS FS100L INSTRUCTIONS
FS100 OPERATOR’S MANUAL FS100 OPERATOR’S MANUAL
FS100 MAINTENANCE MANUAL FS100L MAINTENANCE MANUAL

The FS100 OPERATOR’S MANUAL above is applicable to both FS100 and FS100L controllers.

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Revision: 1
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www.motoman.com
Continuous Operation
Conveyor w/ Sync

MANDATORY

• This manual explains the conveyor synchronized function of the FS100/ FS100L system. Read this manual carefully and be sure to understand its contents before handling the FS100/ FS100L.

• General items related to safety are listed in Chapter 1: Safety of the FS100/ FS100L Instructions. To ensure correct and safe operation, carefully read the FS100/ FS100L Instructions 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.

NOTE

This instruction manual is applicable to both FS100 (a controller for small-sized manipulators) and FS100L (a controller for large and medium-sized manipulators).

The description of “FS100” refers to both the “FS100” and “FS100L” in this manual unless otherwise specified.
We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-2012). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

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

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the equipment. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the equipment. NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE EQUIPMENT!

We recommend approved Yaskawa training courses for all personnel involved with the operation, programming, or repair of the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the FS100.

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

DANGER
Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.

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 “DANGER”, “WARNING” and “CAUTION”.

NOTE
Continuous Operation
Conveyor w/ Sync

Notes for Safe Operation

**WARNING**

- Before operating the manipulator, check that servo power is turned OFF when the emergency stop button on the programming pendant is pressed. When the servo power is turned OFF, the SERVO ON LED on the programing pendant is 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 button does not function.

*Figure 1: Emergency Stop Button*

- In the case of not using the programming pendant, be sure to supply the emergency stop button on the equipment. Then before operating the manipulator, check to be sure that the servo power is turned OFF by pressing the emergency stop button. Connect the external emergency stop button to the 5-6 pin and 16-17 pin of the robot system signal connector (CN2).

- Upon shipment of the FS100, this signal is connected by a jumper cable in the dummy connector. To use the signal, make sure to supply a new connector, and then input it.

If the signal is input with the jumper cable connected, it does not function, which may result in personal injury or equipment damage.

- 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.

*Figure 2: Release of Emergency Stop Button*

- Observe the following precautions when performing teaching operations within the manipulator’s operating range:
  - Be sure to use a lockout device to the safeguarding when going inside. Also, display the sign that the operation is being performed inside the safeguarding and make sure no one closes the safeguarding.
  - 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.
The MOTOMAN is the YASKAWA industrial robot product.

The MOTOMAN usually consists of the manipulator, the FS100 controller, manipulator cables, the FS100 programming pendant (optional), and the FS100 programming pendant dummy connector (optional).

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS100 controller</td>
<td>FS100</td>
</tr>
<tr>
<td>FS100 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator Cable</td>
</tr>
<tr>
<td>FS100 programming pendant dummy connector</td>
<td>Programming pendant dummy connector</td>
</tr>
</tbody>
</table>
### Description of the Operation Procedure

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

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant</td>
<td>Character Keys: The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]</td>
</tr>
<tr>
<td>Symbol Keys</td>
<td>The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture. ex. PAGE key</td>
</tr>
<tr>
<td>Axial Keys</td>
<td>Axes Keys and “Numeric Keys” are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td>Numeric Keys</td>
<td>Keys pressed simultaneously: When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them. ex. SHIFT key +COORD key</td>
</tr>
<tr>
<td>Mode Key</td>
<td>Three kinds of modes that can be selected by the mode key are denoted as follows: REMOTE, PLAY, or TEACH</td>
</tr>
<tr>
<td>Button</td>
<td>Three buttons on the upper side of the programming pendant are denoted as follows: HOLD button, START button, EMERGENCY STOP button</td>
</tr>
<tr>
<td>Displays</td>
<td>The menu displayed in the programming pendant is denoted with { }. ex. {JOB}</td>
</tr>
</tbody>
</table>

### 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, or that the item is directly selected by touching the screen.

### Registered Trademark

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or bland names for each company or corporation. The indications of (R) and TM are omitted.
Customer Support Information

If you need assistance with any aspect of your Continuous Operation Conveyor w/ Sync system, please contact Motoman Customer Support at the following 24-hour telephone number:

(937) 847-3200

For routine technical inquiries, you can also contact Motoman Customer Support at the following e-mail address:

technical.support@motoman.com

When using e-mail to contact Motoman Customer Support, please provide a detailed description of your issue, along with complete contact information. Please allow approximately 24 to 36 hours for a response to your inquiry.

Please use e-mail for routine inquiries only. If you have an urgent or emergency need for service, replacement parts, or information, you must contact Motoman Customer Support at the telephone number shown above.

Please have the following information ready before you call Customer Support:

- System
  Continuous Operation Conveyor w/ Sync

- Robots

- Primary Application

- Controller
  FS100/FS100L

- Software Version
  Access this information on the Programming Pendant’s LCD display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {SOFTWARE VERSION}

- Robot Serial Number
  Located on the robot data plate

- Robot Sales Order Number
  Located on the FS100/FS100L controller data plate
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# Continuous Operation
## Conveyor w/ Sync

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1 Continuous Operation Conveyor Synchronized Function

The “conveyor synchronized function” has been used in such applications as painting and sealing of large work pieces that are brought in mainly on a single conveyor.

On the other hand, for applications in which work pieces that are brought in intermittently on a conveyor are handled, and subsequently paid out on a different conveyor (while synchronized with the motion of the conveyor), it is necessary to frequently switch over between synchronization control of the carry-in side conveyor, and synchronization control of the discharge side conveyor.

In order to switch over conveyor synchronization control using the conventional conveyor synchronized function, it is necessary to end the conveyor synchronized status after the conveyor synchronization operation has been fully completed. This will enable the next conveyor synchronization operation to be executed. For this reason, each time synchronization control is switched over, the robot always stops momentarily.

The “continuous operation conveyor synchronized function” is an expanded version of the conveyor synchronized function. It enables the interpolation motion to continue during conveyor synchronization switchover between two different conveyors.

By using this method of control, conveyor synchronization can be realized without stopping the synchronization switchover operation, hence the cycle time can be reduced.
2 Instructions Related to Continuous Operation Conveyor Synchronization

The continuous operation conveyor synchronized function is an expanded version of the conventional “conveyor synchronous operation function”. Consequently, the basic part of this function is identical to the conventional conveyor synchronous operation function. For details, refer to the “FS100 Conveyor Synchronous Operation Function Instruction Manual”. Here, a description is given of the part concerning “continuous operation conveyor synchronization”.

2.1 SYSTART Instruction

The SYSTART instruction is a instruction which indicates the start of the conveyor synchronous operation section.

2.1.1 Syntax tree

2.1.2 Addition of [CONT] Tag

In order to execute continuous operation conveyor synchronization, the CONT tag must be added to the SYSTART instruction. By adding the CONT tag, switchover from the specified conveyor synchronization section to the next conveyor synchronization section can be performed without interruption.

2.1.3 Addition of [TRAP] Tag

During execution of the SYSTART instruction, if the conveyor position has already gone past STP, and in addition the allowable quantity (the maximum excess amount specified by “OL=”) has been exceeded, the SYSTART instruction will be terminated, and conveyor synchronization will not be executed. Consequently, normally after the SYSTART instruction has been executed, the $B variable ($B008) is read using the GETS instruction, and a check is carried out ‘to see if conveyor synchronization started normally’. If conveyor synchronization was not executed, the job execution destination is changed using a JUMP instruction.

: SYSTART CV#(1) STP=50.000 OL=10.0
GETS B000 $B008
JUMP *END IF $B008=0
SYMOVL CV#(1) CTP=60.000
SYMOVL CV#(1) CTP=70.000
*END
SYEND CV#(1)
:
2 Instructions Related to Continuous Operation Conveyor Synchronization

2.2 SYEND Instruction

However, in the case of such a job configuration, it is not known whether or not a JUMP instruction will be executed until the actual time of execution, so a prior read operation (an operation for reducing the instruction processing time by performing the necessary computation for execution of the instruction in advance) cannot be executed. Consequently, operation cannot take place continuously when a SYSTART instruction is executed. For this reason, a “TRAP” tag is added to the SYSTART instruction. When a TRAP tag is used, a prior read operation takes place based on the assumption that “conveyor synchronization is executed normally”. When a TRAP tag is used, if conveyor synchronization was not executed because the allowable quantity was exceeded, the program will jump to the label position specified by the TRAP tag.

2.2 SYEND Instruction

The SYEND instruction is a instruction which indicates the end of the conveyor synchronous operation section.

2.2.1 Syntax Tree

![Syntax Tree Diagram]

2.2.2 Addition of [CONT] Tag

Normally, when a SYEND instruction is executed, the conveyor origin registration status is canceled, and when the conveyor origin limit switch is subsequently turned ON, the conveyor origin is updated. However, if the conveyor synchronization is switched over frequently, and the conveyor waits for an input from the limit switch during each switchover, the processing time will become long. To overcome this, the program will be modified so that each time a conveyor SYSTART instruction is executed, the conveyor position is not reset but remains fixed, and conveyor synchronization control alone starts and ends. When a [CONT] tag is added to the SYEND instruction, the conveyor follow-up operation ends, but the conveyor origin registration status is not canceled, permitting ongoing monitoring of the conveyor position. Consequently, there is no need to input the conveyor origin limit each time the conveyor synchronization is to be switched over.
2 Instructions Related to Continuous Operation Conveyor Synchronization
2.3 SYMOVL Instruction

The SYMOVL instruction is a instruction which executes the conveyor synchronized operation.

In the continuous conveyor synchronization system, “TRAP” tags and “FPL=” tags can be used under the SYMOVL instruction.

2.3.1 Addition of [TRAP] Tag

When “TRAP” tags are added to the SYMOVL instruction and one of the limit overs mentioned below occur during the SYMVOL instruction, the manipulator stops the instruction and jumps to the label set to the [TRAP] tag without alarming.

- Object limit over for the [TRAP] tag execution
  - Alarm 4414: EXCESSIVE SEGMENT
  - Alarm 4416: PULSE LIMIT
  - Alarm 4418: CUBE LIMIT
  - Alarm 4420: SPECIAL SOFTLIMIT
  - Alarm 4422: MECHANICAL INTERFERENCE
  - Alarm 4426: SPECIAL MECHANICAL INTRF
  - Alarm 4732: OVER ACCELERATION
  - Alarm 4902: CUBE INTERFERENCE (TCP)

When specifying the [TRAP] tag to the SYMOVVL instruction, execute “SYEND” instruction at the destination of the jump operation and terminate the conveyor synchronizing status.

In case a limit over occurs while SYMOVVL instruction is executed, the instruction is discontinued and the manipulator moves to the label:"LMTOVER."
2.3.1.1 Registration of the Instruction

Register a [TRAP] tag when the cursor is in the address area of the JOB CONTENT window in the teach mode.

1. Select {JOB} under the main menu.
2. Select {JOB CONTENT}.
3. Move the cursor to the move instruction to which the [TRAP] tag is to be registered.
4. Press [SELECT].
   – The move instruction is displayed in the input buffer line.
5. Change the additional item of the [TRAP] tag.
   – Move the cursor to the move instruction of the input buffer line and press [SELECT] to display the DETAIL EDIT window of the move instruction.
   – Move the cursor to “UNUSED” of “JUMP TO(ERROR)” and press [SELECT].
   – The selection dialog appears. Select “TRAP”.

![DETAIL EDIT Window](image)
2 Instructions Related to Continuous Operation Conveyor Synchronization

2.3 SYMOVVL Instruction

- After the DETAIL EDIT window of the [TRAP] tag appears, specify the label of jump destination to “JUMP TO”.

<table>
<thead>
<tr>
<th>DETAIL EDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPEED: Y=1000.0</td>
</tr>
<tr>
<td>CONVEYOR FILE: CVH1</td>
</tr>
<tr>
<td>TEACHING POS: CTP=50,000</td>
</tr>
<tr>
<td>POS LEVEL: Unused</td>
</tr>
<tr>
<td>MAIT: Unused</td>
</tr>
<tr>
<td>UNTIL: Unused</td>
</tr>
<tr>
<td>ACCEL RATIO: Unused</td>
</tr>
<tr>
<td>DECEL RATIO: Unused</td>
</tr>
<tr>
<td>JUMP TO/ERROR: Unused</td>
</tr>
</tbody>
</table>

- Press [ENTER] to close the DETAIL EDIT window of the [TRAP] tag and display the DETAIL EDIT window of the move instruction.

- Press [ENTER] to close the DETAIL EDIT window of the move instruction and display the JOB CONTENT window.

6. Press [ENTER].

- The instruction displayed in the input buffer line is registered.
2.3.2 Addition of [FPL=] Tag

When the [FPL=] tag is added to the SYMOVL instruction, feedback positioning level function operates during execution of the SYMOVL instruction.

2.3.2.1 Feedback Positioning Level Function

The feedback positioning level function monitors that the actual manipulator control point (feedback position) passes the point specified from the teaching position in real time. At the passing timing, the function starts the continuous operation (outputting the operation command of the next move instruction).

This function enables to start the continuous operation at the specified position independently from the operation speed.
2.3.2.2 Details of the Instruction

The feedback positioning level function starts to output the next step operation command at the timing when the manipulator control point passes the continuous operation start point specified by the “HIGH POS LEVEL tag” (FPL=) which is added to the move instruction.

(A) HIGH POS LEVEL tag (FPL=)

Specifies the continuous operation start point at intervals of 0.1[mm] from the teaching position.
(Setting range: 0.0 to 6553.5 [mm])

If FPL= 0.0 is specified, the continuous operation starts at the timing when the actual manipulator control point reaches the teaching position as shown in (a) of Fig. 2-1.

<Job example 1>:
SYMOVL (teaching position A) V=1500.0 CV#(1)
SYMOVL (teaching position B) V=1500.0 CV#(1) FPL=0.0
SYMOVL (teaching position C) V=1500.0 CV#(1)

If a bigger value than FPL= 0.0 is specified, the continuous operation starts before the actual manipulator control point reaches the teaching position. The cycle time becomes shorter as shown in (b) of Fig. 2-1.

<Job example 2>:
SYMOVL (teaching position A) V=1500.0 CV#(1)
SYMOVL (teaching position B) V=1500.0 CV#(1) FPL=10.0
SYMOVL (teaching position C) V=1500.0 CV#(1)
The "HIGH POS LEVEL tag" (FPL=) can be added only to MOVL instruction and SYMOVL instruction among move instructions.

(a): When FPL=0.0 (Job example 1)  (b): When FPL=10.0 (Job example 2)
2.3.2.3 Registration of the Instruction

Register a [FPL=] tag when the cursor is in the address area of the JOB CONTENT window in the teach mode.

1. Select {JOB} under the main menu.
2. Select {JOB CONTENT}.
3. Move the cursor to the move instruction to which the [FPL=] tag is to be registered.
4. Press [SELECT].
   – The move instruction is displayed in the input buffer line.
5. Change the additional item of the [FPL=] tag.
   – Move the cursor to the move instruction of the input buffer line and press [SELECT] to display the DETAIL EDIT window of the move instruction.
   – Move the cursor to “UNUSED” of “POS LEVEL” and press [SELECT].
   – The selection dialog appears. Select “FPL=“.
   – Press [ENTER] to close the DETAIL EDIT window of the move instruction and display the JOB CONTENT window.
6. Press [ENTER];
   – The instruction displayed in the input buffer line is registered.
2.3.4 Notes

The feedback positioning level function monitors the feedback position after the operation command (current value) reaches the teaching position. When a big value is input to the “HIGH POS LEVEL tag” (FPL=), the continuous operation does not start at the input FPL position but starts after the manipulator operation command reaches the teaching position.

Job example
NOP
SYMOVL FPL=100.0
SYMOVL
END

NOTE

The feedback positioning level function enables to adjust the continuous operation start position independently from the operation speed. However, the operation path may be changed when the operation speed is changed.
2.4 GETS Instruction

In order to make an STP specification using a SYSTART instruction, or set the value of a CTP specification of an SYMOVL instruction to a value that corresponds to the position of the work piece or the tray with respect to the conveyor, it is necessary to acquire the conveyor position as the “instant at which the work piece is detected using a vision camera” or the “instant at which the tray is detected by the sensor”, for example. When a GETS instruction is used, the present position of the conveyor can be acquired as a double accuracy type variable (D variable).

$D004 : \text{Present position of conveyor CV# (1)}

$D005 : \text{Present position of conveyor CV# (2)}

$D006 : \text{Present position of conveyor CV# (3)}

$D007 : \text{Present position of conveyor CV# (4)}

$D008 : \text{Present position of conveyor CV# (5)}

$D009 : \text{Present position of conveyor CV# (6)}

* Unit : 0.001 mm

Method of use

GETS D0010 $D004 \cdots \text{The present position of the CV#(1) conveyor is stored in D0010.}
2.5 SY_PICK/SY_PLACE Instruction

### 2.5.1 Function

SY_PICK/SY_PLACE instruction realizes workpiece picking/placing operations while the arm is synchronizing with the conveyor.

By making the workpiece picking/placing operations with a single instruction, which used to be made by the combination of instructions such as SYSTART and SYMOVL instructions, the workpiece picking/placing jobs synchronizing with the conveyor can be made with less difficulties.

After specifying conditions shown below to the tag, a series of operation is enabled.

- Position variables (P variable) to which the position of a workpiece is registered
- Operation speed
- Conveyor number
- Shift value to the via position (approach position) before the position where the manipulator picks/releases a workpiece
- Shift value to specify the raised position of the manipulator’s arm after the arm picks/releases a workpiece
- Conveyor start position for the conveyor synchronized operation
- Conveyor position to correspond to the workpiece for the conveyor synchronized operation
- The hand number
- Waiting time for the manipulator to pick/release a workpiece
- B variable to store the operation result, etc.

SY_PICK/SY_PLACE instructions are available only in the system where the “Continuous operation conveyor synchronized function” is valid.
2.5.1.1 SYPICK Instruction

SYPICK instruction enables the manipulator to pick up a workpiece which is at a specified position on the conveyor.

This instruction executes the following operations continuously while the conveyor synchronized function is valid.

7. Move the manipulator's arm to the approach point (overhead position of the workpiece)
8. Move it to the workpiece position
9. Turn ON the specified hand signal
10. Instruct the arm to follow the workpiece on the conveyor only during the specified time
11. Move the arm to the raised position (overhead position of the workpiece)
2.5.1.2 SYPLACE Instruction

SYPLACE instruction enables the manipulator to place a workpiece to a specified position on the conveyor.

This instruction moves the manipulator almost the same operation as SYPLACE instruction except turning OFF the hand signal at the specified workpiece position on the conveyor.

This instruction executes the following operations continuously while the conveyor synchronized function is valid.

1. Move the manipulator’s arm to the approach point (overhead position of the workpiece)
2. Move it to the workpiece position.
3. Turn OFF the specified hand signal.
4. Instruct the arm to follow the workpiece on the conveyor only during the specified time by the timer
5. Move the arm to the raised position (overhead position of the workpiece)
2.5.2 Details of SY PICK/SY PLACE Instructions

The difference between SY PICK and SY PLACE instructions is whether the instruction turns ON or OFF the control signal of the specified number of the hand. And the meanings of the tag at each instruction is almost the same.

**Description of each tag**

1. **Position Variable (manipulator)**
   Specify the workpiece position (positions to be picked placed) with the position variable. (mandatory)

2. **Speed (V=)**
   Specify the operation speed. (mandatory)
   When only this basic operation speed is specified and speeds for other operations are not specified, they conform to this speed.

3. **Control Point Speed (P) (VP=)**
   Specify the operation speed from the approach point to the workpiece position. If this setting is omitted, the arm will move with the same speed as Speed (V=) during this operation.
   Set a value when different speed from Speed (V=) is required.

4. **Control Point Speed (B) (VB=)**
   Specify the operation speed from the workpiece position to the raised position. If this setting is omitted, the arm will move with the same speed as Speed (V=) during this operation.
   Set a value when different speed from Speed (V=) is required.

5. **Conveyor Condition File (CV#( ))**
   Specify the conveyor number with which the manipulator synchronizes its motion. (mandatory)
2.5 SYPICK/SYPLACE Instruction

- **Shift Value (A) (SFTA):**
  Specify the shift values from the workpiece to the approach point or to the raised point by the position variables (P variable or LP variable). (mandatory)
  The shift value can be specified only by using the base coordinate system.

  - **NOTE:**
    The shift value should be specified by using the "base coordinate system". Please be careful with the direction of the shift value.

- **Shift Value (B) (SFTB):**
  Specify the shift values from the workpiece to the raised point by the position variables (P variable or LP variable). (mandatory)
  If this setting is omitted, this value conforms to the Shift value (A).
  The shift value can be specified only by using the base coordinate system.

- **Synchronizing Operation Start Position (STP=)**
  Specify the conveyor position to start the synchronized operation with the manipulator. When the conveyor exceeds this position, the synchronized operation starts.
  It is same as STP in SYSTART instruction. (mandatory)

- **Allowable Limit (OL=)**
  Specify the maximum tolerable exceeding limit position on the conveyor after the conveyor exceeds the start position (STP=) at the time instruction is executed. (mandatory)
  If "0" is set, (OL=) will not be checked.
  It is same as OL in SYSTART instruction. In case the conveyor position has exceeded STP+OL position at the time instruction is executed, the instruction is terminated and "1" is set to the result flag.

- **Teaching Position (CTP=)**
  Specify the conveyor position over the workpiece position.
  It is same as CTP in SYMOVL instruction. (mandatory)

- **Hand Number Specification (HAND#*)**
  Specify the number of hand whose signal is to be switched when the arm reaches to the workpiece position.
  The signal is switched to "ON" under SYPICK instruction and switched to "OFF" under SYPLACE instruction. More than two hand numbers from HAND #1 to #4 can be specified at a time.

- **“PICK” Keep Time (T=)**
  Set the timer for the arm to hold to pick/place the workpiece when it reaches to the workpiece position. (mandatory)
  The arm keeps holding at the workpiece position for the specified time while following the conveyor movement.

- **Inner Path Determination LV (A) (PLA=)**
  Specify the inner path from the start position to workpiece position by way of the approach point. The determination level ranges from 1 to 8.
  It is same as position level (PL=) in MOV□ instruction.

- **Inner Path Determination LV (B) (PLB=)**
  Specify the inner path from start position to workpiece position by way of the raised point.
  This instruction is valid only in the status when the next instruction such as SYPICK is ready to be executed.
2. Instructions Related to Continuous Operation Conveyor
   Synchronization
   2.5 SY PICK/SYPLACE Instruction

- **Result Flag**
  Specify the byte variable (B variable or LB variable) to which the execution result is stored. (mandatory)
  SY PICK instruction execution result can be stored in the B variable. The stored result to the B variable can be used to determine the succeeding actions to the respective results below.

1. The arm failed to pick/place the workpiece because the conveyor exceeded the specified position.
2. The arm was able to pick the workpiece (the hand signal was turned ON) but failed to move to the raised point.
3. All the operation was done normally.
2.5.3 Notes

- Both SY PICK and SY PLACE instructions cannot be used with SFTON instruction. The shift value is canceled when those instructions are executed.

- Under the [FWD] operation, whole series of the instruction is executed continuously. Therefore, the manipulator cannot stop at the approach point. Also, the [BWD] operation is invalid. (In case [BWD] is pressed, the arm moves to the workpiece position.)

- Under SY PICK or SY PLACE instruction:
  - In case the conveyor position is already exceeded STP+ PL position when the instruction is executed, the instruction is terminated without executing synchronized operation with the conveyor
  - The instruction is terminated and synchronized operation with the conveyor is cutoff in case the manipulator exceeded its range of motion during the movement to/from the approach point, work position or raised point.

The manipulator may stop by the alarm if it exceeded the range while it keeps holding status (for picking/placing the workpiece) for the specified time set by the timer.

To improve the cycle time for workpiece pick/place operations, please do not omit setting STP and OL so that all the operation is completely done.

2.5.4 Registration of Instruction

Details of SY PICK/SY PLACE instruction can be registered with the list of (DEVICE) instruction.

1. Move the cursor to the line just before the column to which the instruction is registered.
2. Press [INFORM LIST].
3. Select (DEVICE).
Instructions Related to Continuous Operation Conveyor Synchronization

2.5 SYPICK/SYPLACE Instruction

4. Select either “SYPICK” or “SYPLACE”.

   – “SYPICK” or “SYPLACE” instruction appears in the input buffer line.

5. When adding/modifying the additional item, press [SELECT] and move the cursor to the input buffer line. Then, move the cursor to the instruction and press [SELECT]. The DETAIL EDIT window appears.

   – Press [ENTER] when adding/modifying operation of the additional item is done.

   – The DETAIL EDIT window closes and JOB window appears.

6. Press [INSERT] and [ENTER].

   – The instruction indicated in the input buffer line is registered.
2.5.5 Example

*PICK
CALL JOB: PICKPOSCALC
SYPICK P100 V=2000.0 VB=1500.0 CV#(1) SFTA:P200 STP=D000 OL=100.0
     CTP=D000 HAND#1 T=0.020 PLA=8 FLAG:LB000
JUMP *PLACE IF LB000=3
MOVL P099 V=500.0
JUMP *PICK IF LB000=1
*PLACE
CALL JOB: PLACEPOSCALC
SYPLACE P101 V=1800.0 VP=1500.0 VB=1900.0 CV#(1) SFTA:P201 STP=D000 OL=100.0
     CTP=D000 HAND#1 T=0.020 PLA=4 FLAG:LB001
JUMP *PICK IF LB001=3
MOVL P099 V=500.0
JUMP *PLACE IF LB001=1
     :
2.5.6 Hand Control Signal Setting Window

2.5.6.1 User I/O Number Allocation to Hand Number

When using SY PICK/SY PLACE instruction, on the Hand Control Signal setting window, advanced allocation of user output signal which turns ON or OFF the hand, such as absorption pad, to any of #1 to #4 hand is necessary.

1. Select {GENERAL} on the main menu.
2. Select {HAND CONTROL SIGNAL}.
   - HAND CONTROL SIGNAL window appears.
3. Move the cursor to “OT OUTPUT” at the desired hand number, then press [SELECT].
   Input values to specify the user output signal for controlling the hand.
2.5.6.2 Precedence/Following Output of Hand Control Signal

Fine adjustment of the output timing for each output signal is possible by setting the desired time to “ON POS” or “OFF POS” on the hand control signal setting window.

Based on the arm reaching time to the workpiece, the timing to alternate the hand signal can be fine adjusted; just before or after the reaching time.

If a positive value is set, the signal alternates just after the reaching time, and it alternates just before the time if a negative value is set.

1. Select {GENERAL} on the main menu.

2. Select {HAND CONTROL SIGNAL}.

   – HAND CONTROL SIGNAL setting window appears.
3. Move the cursor to “ON TIME” or “OFF TIME” and press [SELECT]. Then, input a value.
3 Application Example

The continuous operation conveyor synchronized function is a helpful function which is used in a system that necessitates frequent switchover of synchronization control for a different conveyor. Concretely, this function can be used with the following picking system, for example.

3.1 System Configuration

- The workpiece supplied randomly from the “carry-in side conveyor” (CV#1) are lined up by the guide, then the limit switch for workpiece detection detects the front-edge of the workpiece.
- Buckets for receiving the workpieces are set at a regular intervals on the “carry-out side conveyor” (CV#2). And the limit switch for bucket detection detects the front-edge of the bucket.
- Each limit switch is connected to the FS100 to output its data.
- Also, each conveyor is connected to the FS100 to output its data.

3.2 Overall Processing Flow

- The workpiece that are supplied to CV#1 are picked in turn. However, if the workpiece has passed the specified area, it is not picked and flows to the down stream.
- When the workpiece is picked from CV#1, it is carried to the first bucket within the specified area on CV#2. If no workpiece is picked, the bucket flows to the down stream without a workpiece in it.

Repeat the above operation.
3.3 Example of a Job

- Every time the limit switch is turned ON, both CV#1 and CV#2 import their data to the conveyor cue using the start shift function of the conveyor synchronized function with shift function.

- Picking operation is enabled by repeating “PICK” and “PLACE” operations in turn as explained below.

[Picking operation]

1. Execute SYSTART instruction to CV#1.

2-A. In case the workpiece is already passed the specified area (STP+OL of =SYSTART) on the conveyor.
   Execute CVQUE instruction to switch the conveyor cue to the next cue, then execute SYSTART again.

2-B. In case the workpiece is within the specified area on the conveyor
   Execute “PICK” operation of the workpiece while synchronizing with CV#1.

3. Execute CVQUE instruction

4. Execute SYEND instruction

5. Shift to “PLACE” operation.

[Placing operation]

1. Execute SYSTART instruction to CV#2.

2-A. In case the workpiece is already passed the specified area (STP+OL of =SYSTART) on the conveyor.
   Execute CVQUE to switch the conveyor cue to the next cue, then execute SYSTART again.

2-B. In case the workpiece is within the specified area on the conveyor
   Execute “PLACE” operation of the workpieces while synchronizing with CV#2.

3. Execute CVQUE instruction

4. Execute SYEND instruction

5. Shift back to “PICK” operation.
3.3 Example of a Job

Initialization
(SYEND, etc.)

[PICK operation]

START

SYSSTART

Within OL area?

SYMCOVL
DOUT Absorb signal ON
SYMCOVL
TIMER
SYMCOVL

CYCLE
SYEND

[PLACE operation]

PLACE-START

SYSSTART

Within OL area?

SYMCOVL
SYMCOVL
DOUT Absorb signal OFF
SYMCOVL
TIMER
SYMCOVL

CYCLE
SYEND

PLACE-NEXT

DQUEUE
GETS
MOVL
Continuous Operation
Conveyor w/ Sync

3 Application Example
3.3 Example of a Job

Followings are the jobs that enable the previously mentioned operations.

```
0000  NOP
0001  " === Initialize
0002  SYEND CVR(1)
0003  SYEND CVR(2)
0004  SET LB 0 0 0
0005  'D
0006  INC LB 0 0 0
0007  CVQOE CVR(1)
0008  CVQOE CVR(2)
0009  JUMP 'D IF LB 0 0 0 < 88
0010  DOUT OT(1) OFF
0011  MOV/L C00000 V=1500.0
0012  WAIT INR(1)=ON
0013  '
0014  ' === PICK
0015  'PICK-ST
0016  SYSTART CVR(1) STP=200.000 CONT
  OL=150.0 TRAP *PICK-NXT
0017  SYMOV C00001 V=3000.0 CVR(1) CTP=300.000
0018  DOUT OT(1) ON
0019  SYMOV C00002 V=3000.0 CVR(1) CTP=300.000
0020  TIMR T=0.020
0021  SYMOV C00003 V=3000.0 CVR(1) CTP=300.000
0022  SYEND CVR(1) CONT
0023  CVQOE CVR(1)
0024  JUMP *PLACE-ST
0025  'PLACE-ST
0026  ' *PICK-NXT
0027  CVQOE CVR(1)
0028  GETS LPX(0000) SPX(0000)
0029  MOV/PL 00000 V=100.0
0030  JUMP *PICK-ST
0031  '
0032  ' === PLACE
0033  ' "PLACE-ST
0034  " SYSTART CVR(2) STP=400.000 CONT
  OL=200.0 TRAP *PLC-NXT
0035  SYMOV C00004 V=3000.0 CVR(2) CTP=500.000
0036  SYMOV C00005 V=3000.0 CVR(2) CTP=500.000
0037  DOUT OT(1) OFF
0038  TIMR T=0.020
0039  SYMOV C00006 V=3000.0 CVR(2) CTP=500.000
0040  SYEND CVR(2) CONT
0041  CVQOE CVR(2)
0042  JUMP *PICK-ST
0043  '
0044  "PLC-NXT
0045  "CVQOE CVR(2)
0046  GETS LPX(0000) SPX(0000)
0047  MOV/PL 00000 V=100.0
0048  JUMP *PLACE-ST
0049  END
```

To reset the conveyor home position, execute SYEND at the beginning without fail. (Do not tag CONT)

Clear all the conveyor cue

Off the absorb signal (OT#(1)) of the hand
Move to the operation start position
Wait the operation start position signal (OT#(10)) to be turned ON

```
```
Continuous Operation
Conveyor w/ Sync

3 Application Example
3.3 Example of a Job

Followings are the jobs if previously mentioned operations are realized with SYPICK/SYPLACE operations.

```
0000 NOP
0001 '=== Intialize
0002 SYEND CV(1)
0003 SYEND CV(2)
0004 SET LB000=0
0005 ')
0006 INC LB000
0007 CVQUE CV(1)
0008 CVQUE CV(2)
0009 JUMP 'IF LB000=0
0010 DOUT CT(1) OFF
0011 MOV, C00000 V=1500.0
0012 WAIT NK(1)=ON
0013 ')
0014 '=== PICK
0015 'PICK-ST
0016 SYPICK, P0100 V=3000.0 CV(1) SFTA=P0201 STP=400.000
0017 CVQUE CV(1)
0018 JUMP 'PICK-NXT IF LB001=1
0019 JUMP 'PLACE-ST
0020 ')
0021 'PICK-NXT
0022 GETS LPX00000 SPX0000
0023 MOV, LP09000 V=100.0
0024 JUMP 'PLACE-ST
0025 ')
0026 '=== PLACE
0027 'PLACE-ST
0028 SYPLACE, P0101 V=3000.0 CV(2) SFTA=P0201 STP=400.000
0029 CVQUE CV(2)
0030 JUMP 'PLACE-NXT IF LB002=1
0031 JUMP 'PLACE-ST
0032 ')
0033 'PLACE-NXT
0034 GETS LPX00000 SPX0000
0035 MOV, LP09000 V=100.0
0036 JUMP 'PLACE-ST
0037 END
```

To reset the conveyor home position, execute SYEND at the beginning of the operation without fail.
(Do not tag CONT)

Clear all the conveyor cue.

Move to the operation start point after the job is started up

PICK operation start
Execute SYPICK instruction

Shift the conveyor information to the next workpiece
If the result flag is 1
⇒ The workpiece position on the conveyor has passed OL
⇒ JUMP to "PICK-NXT" (to A)
PICK operation is finished, and JUMP to the beginning of PLACE operation

Destination of JUMP instruction when the workpieces is passed OL when SYSTART (A)
Import the present position to LP variable
Execute MOV instruction to the present position
Return to the beginning of PICK operation

PLACE operation start
Execute SYPLACE instruction

Shift the conveyor information to the next workpiece
If the result flag =1
⇒ The workpiece position on the conveyor has passed OL
⇒ JUMP to "PLACE-NXT" (to B)
PLACE operation is finished, and JUMP to the beginning of PICK operation

Destination of JUMP instruction when the workpieces is passed OL when SYSTART (B)
Import the present position to LP variable
Execute MOV instruction to the present position
Return to the beginning of PLACE operation

(Shift value of the desired position, approach point and raised point should be registered to the P variable in advance.)

PO100: Desired position for PICK
PO101: Desired position for PLACE
PO200: Shift value for PICK
PO201: Shift value for PLACE
Addition of the TRAP tag to the SYMOVL instruction

When TRAP tags are added to the SYMOVL instruction and a manipulator is about to exceed the limit during the instruction, the manipulator can be jumped to the specified label without alarming.

With this tag operation, a job in which a manipulator discontinues an operation and re-start a new operation can be constructed when the manipulator exceeds the range of motion while following a conveyor.

When reaching the destination of the jump, do not fail to execute "SYEND" instruction to terminate the conveyor synchronizing operation.

Following is an example of the job.

Bold-faced characters are added to the basic job which is mentioned earlier.

By setting a value to a local variable (LB001 or LB002) during the operation, the system judges which SYMOVLs are executed, and then switches the operations.

0000  NOP
0001  ' ==== Initialize
0002  SYEND CV#(1)
0003  SYEND CV#(2)
0004  SET LB000 0
0005  *0
0006  INC LB000
0007  CVQUE CV#(1)
0008  CVQUE CV#(2)
0009  JUMP *0 IF LB000<99
0010  DOUT OT#(absorb) OFF
0011  MOVL C00000 V=1500.0
0012  WAIT IN#(start operation)=ON
0013  '
0014  ' ==== PICK
0015  *PICK-ST
0016  SET LB001 0
0017  SYSTART CV#(1) STP=200.000 CONT OL=150.0 TRAP *PICK-NXT
0018  SYMOVL C00001 V=3000.0 CV#(1) CTP=200.000 TRAP *LMTOV1
0019  DOUT OT#(absorb) ON
0020  SYMOVL C00002 V=3000.0 CV#(1) CTP=200.000 TRAP *LMTOV1
0021  SET LB001 1
0022  TIMER T=0.020
0023  SYMOVL C00003 V=3000.0 CV#(1) CTP=200.000 TRAP *LMTOV1
0024  SYEND CV#(1) CONT
0025  CVQUE CV#(1)
0026  JUMP *PLACE-ST
0027  '
Continuous Operation  \[\text{3 Application Example}\]
Conveyor w/ Sync  \[\text{3.3 Example of a Job}\]

```
0028  `PICK-NXT
0029  CVQUE CV#(1)
0030  GETS LPX0000 SPX0001
0031  MOVL LP0000 V=100.0
0032  JUMP `PICK-ST
0033  `JMPQV1
0034  SYEND CV#(1)
0035  CVQUE CV#(1)
0036  GETS LPX0000 SPX0001
0037  SETE LP0000 (3) 1300000
0038  MOVL LP0000 V=1000.0
0039  JUMP `PLACE-ST IF LB001=1
0040  JUMP `PICK-ST
0041  JUMP `PLACE-ST
0042  ` == PLACE
0043  `PLACE-ST
0044  SET LB002 0
0045  SYSTART CV#(2) STP=300.000 CONT
OL=200.0 TRAP `PLC-NXT
0046  SYMOVL C00004 V=3000.000 CV#(2)
CTP=500.000 TRAP `LMTOV2
0047  SYMOVL C00005 V=3000.000 CV#(2)
CTP=500.000 TRAP `LMTOV2
0048  DOUT OT#(absorb) OFF
0049  SET LB002 1
0050  TIMER T=0.020
0051  SYMOVL C00006 V=3000.000 CV#(2)
CTP=500.000 TRAP `LMTOV2
0052  SYEND CV#(2) CONT
0053  CVQUE CV#(2)
0054  JUMP `PICK-ST
0055  `PLC-NXT
0056  CVQUE CV#(2)
0057  GETS LPX0000 SPX0001
0058  MOVLP LP0000 V=100.0
0059  JUMP `PLACE-ST
0060  `LMTOV2
0061  SYEND CV#(2)
0062  CVQUE CV#(2)
0063  GETS LPX0000 SPX0001
0064  SETE LP0000 (3) 1300000
0065  MOVL LP0000 V=1000.0
```

[Destination of the jump when a limit over occurs during the SYMOVL instruction]
Terminate the conveyor synchronized operation
Switch the conveyor information to the next work
Write the present position to the LP variable and re-write the Z-direction value, and regard this as an approach potation.
Execute the move to the approach position.

If “1” is set to LB001, jump to the head of PLACE operation because the manipulator has gripped a workpieces.
(If “0” is set to LB001, returns to the head of PICK operation.)

[PLACE operation start]
Set “0” to variable: LB002

When a limit over occurs during the SYMOVL instruction, the manipulator jumps to label: `LMTOV2.

When the hand finishes descending, set “1” to variable: LB002.

[Destination of the jump when a limit over occurs during the SYMOVL instruction]
### Application Example

#### 3.3 Example of a Job

<table>
<thead>
<tr>
<th>Line</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0069</td>
<td>JUMP *PICK-ST IF LB002=1</td>
<td>If &quot;1&quot; is set to LB002, jump to the head of PLACE operation because the manipulator has gripped a workpiece.</td>
</tr>
<tr>
<td>0070</td>
<td>JUMP *PLACE-ST</td>
<td>(If &quot;0&quot; is set to LB002, returns to the head of PICK operation.)</td>
</tr>
</tbody>
</table>

0071  
0072  END
3.4 Notes on Job Creation

In the system where the conveyor synchronized function with shift function is available, execute “SYEND” instruction right after the FX100 is turned ON or it won’t receive any data output from the limit switch.

Set “SYEND” instruction to be executed to the top of the master job, etc. (Do NOT tag “CONT” at this time.)

- When SYSTART instruction, to which CONT is tagged, has executed JUMP to the TRAP label, execute CVQUE instruction first, then execute MOV* instruction before executing the next SYSTART instruction. (Refer to section 3.3 “Example of a Job” on page 3-2.)

   : *PICK-ST
   SYSTART CV#(1) CONT TRAP *PICK-NXT
   :
   *PICK-NXT
   CVQUE CV#(1)
   GETS LPX000 $PX000
   MOVLP000
   JUMP *PICK-ST
   :

Execution of MOV* instruction before executing the next SYSTART instruction is necessary to reset the start point of conveyor synchronized operation.

If failure to execute this, the manipulator may operate in a very high-speed, for only a moment, trying to catch up the process for the distance that the conveyor has shifted by JUMP instruction or the alarm “EXCESSIVE SEGMENT (HIGH SPEED)” occurs when the next SYMOV* instruction is started.

- By combining the speed reducing area of the previous step and the speed increasing area of the following step, the manipulator can continuously operate between move instructions.

  However, it will not operate continuously under the following conditions.
  - When TIMER instruction exists between move instructions.
  - When JUMP instruction to TRAP label is executed by SYSTART instruction.
  - MOV* instruction is executed between SYMOV* instructions.
3.5 Notes on Teaching

○ Teaching positions before and after the SYSTART instruction.

The moving distance of the SYMOVIL instruction executed first time after the SYSTART instruction varies depending on the position of the conveyor when the SYSTART instruction is executed.

If the conveyor position when the SYSTART instruction is executed is:

- closer to the starting point ((B) in the figure below) than the CTP position of the SYMOVIL instruction, the motion speed becomes relatively slow because the moving distance is short.
- further from the starting point ((A) in the figure below) than the CTP position of the SYMOVIL instruction, the operation speed becomes relatively fast because the moving distance is long.

The motion of the manipulator is defined regardless of the practical moving distance but the moving time specified by the teaching position. Therefore, the speed of the manipulator becomes:

(A) relatively fast when it moves toward further point than the teaching position.
(B) relatively slow when it moves toward closer point than the teaching position.
When the manipulator’s moving distance between the starting point and the conveyor position is longer than the distance between the starting point and the teaching position, its operation speed becomes relatively fast and it may cause “EXCESSIVE SEGMENT” or “OVER ACCELERATION (only for MPP3)” alarm.

To avoid those alarms to occur, to the moving distance of the SYMOVL instruction executed first time after the SYSTART instruction, teach to set the distance between the starting point and the teaching position to be the maximum insofar as possible.

Following is an example of an ordinal picking system on the double conveyor.

Refer this as a guide when teaching the manipulator.

PA1  Workpiece picking position at the conveyor synchronized operation starting point on the picking side conveyor. (=STP position of the SYSTART instruction)

PA2  Workpiece picking start limit position at the conveyor synchronized operation starting point on the picking side conveyor. (=STP position of the SYSTART instruction + OL)

PB1  Workpiece placing position at the conveyor synchronized operation starting point on the placing side conveyor. (=STP position of the SYSTART instruction)

PB2  Workpiece placing start limit position at the conveyor synchronized operation starting point on the placing side conveyor. (=STP position of the SYSTART instruction + OL)

Combinations of teaching positions are as follows:
“PA1 to PB1”, “PA1 to PB2”, “PA2 to PB1”, “PA2 to PB2”

From the above mentioned combinations of positions, choose one with the longest distance when teaching.
For the shortest cycle time, set OL distance and distances of PICK area and PLACE area to be the shortest. (Refer to “Figure (a) below.)

When the OL distance and distances of PICK area and PLACE area are long, distance between the teaching positions become also relatively long and thus the cycle time becomes long. (Refer to “Figure (b) below.)

[Example]

Following example has the longest distance between “PA1 and PB2”.

In this example, to the “CTP” of the PICK side SYMOVL instruction, teach “STP” position of the SYSTART instruction.

And to the “CTP” of the PLACE side SYMOVL instruction, teach “STP + OL” position of the SYSTART instruction.
Continuous Operation
Conveyor w/ Sync

3  Application Example
3.5  Notes on Teaching

Undesirable example

PICK side teaching position
(CTP=250)

Conveyor flowing direction

Place side teaching position
(CTP=150)

CTP = STP

CTP = STP + OL

STP = 250
OL = 400

STP = 150
OL = 450

STP = 150
OL = 450
When above mentioned teaching is done, the manipulator may move longer distance than the distance between teaching positions as shown in the figure below.

As mentioned above, the manipulator will have to move longer distance than between the teaching positions during the fixed moving time with the increased speed. This can cause "EXCESSIVE SEGMENT" or "OVER ACCELERATION (only for MPP3)" alarm because the operation speed of the manipulator becomes relatively fast. To avoid the alarm to occur, change the teaching to set the distance between the starting positions to be the maximum insofar as possible.
For the shorter cycle time with shorter moving distance, set shorter synchronized operation start allowable range (= specification of OL for SYSTART instruction) so that the distance between the teaching points becomes shorter.

In this case, some workpieces can be left due to the shorter allowable range (OL).
Continuous Operation
Conveyor w/ Sync

3 Application Example
3.5 Notes on Teaching

When employing MPP3 to this system.
(1) **Recommended range of motion**

When using MPP3, please keep the recommended range of motion for MPP3.

Should operate MPP3 out of this range and in high-speed, the MPP3 may operate vibrational and increase the likelihood of arm fall-off.
(2) Tool mass information setting to the tool file

Like other manipulator, set the tool mass and load mass position information to the tool file correctly. When setting, be sure to include the mass of air tubes, etc. which are connected to the hand.

In case lighter mass than actual mass is set, the speed of the manipulator may unnecessarily increased, their arms may fall off, or “ARM FALL OFF” alarm may occur. However, on the other hand, if heavier mass than actual mass is set, an alarm “OVER ACCELERATION” may occur.

• When setting the tool mass and load mass position information, it will be regarded as “undefined” unless all the following conditions are satisfied.
  • Other than “0” is set to the tool mass (W)
  • “0” is not set to either of the load mass (Xg, Tg or Zg)

When above mentioned conditions are not satisfied, it is regarded that the maximum load is satisfactory set.

(Example)

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>0.000kg</td>
<td>2.000kg</td>
<td>2.000kg</td>
</tr>
<tr>
<td>Xg</td>
<td>0.000mm</td>
<td>0.000mm</td>
<td>0.000mm</td>
</tr>
<tr>
<td>Yg</td>
<td>0.000mm</td>
<td>0.000mm</td>
<td>0.000mm</td>
</tr>
<tr>
<td>Zg</td>
<td>50.000mm</td>
<td>0.000mm</td>
<td>50.000mm</td>
</tr>
<tr>
<td></td>
<td>undefined</td>
<td>undefined</td>
<td>defined</td>
</tr>
</tbody>
</table>
(3) Alarm 4732: OVER ACCELERATION

The MOTOMAN-MPP3 has the mechanism that its adjustable joint mounted on both ends of the L-arm will fall off when excessive force is applied to the tool part to minimized damages to the manipulator itself and peripheral devices when interfere with the tool or the peripheral devices. This fall off also may occur when the manipulator is operated in the excessive speed or acceleration.

In case the MPP3 is about to fall off its arms due to the excessive speed or acceleration, the fall off can be avoided by alarming the following alarm.

**Alarm 4732: OVER ACCELERATION**

When the TRAP tag is added to the conveyor synchronized interpolation instruction “SYMOVL” and excessive speed or acceleration is detected, the SYMOVL instruction is discontinued and the job jumps to the specified label by the tag without alarming. This will avoid the system to discontinue by the alarm and can continue its operation.

Check the following items when Alarm 4732: OVER ACCELERATION occurred.

i) Check that the mass and load mass position information of the tool file are appropriately set.

The system is monitoring the acceleration according to the mass and load mass position information of the tool file.
If this information is not appropriately set, the system regards that the maximum load is set and starts monitoring.
As the tool mass is increased, the allowable accelerating speed decreases, and the alarm 4732: OVER ACCELERATION can easily occur.
Also, in case lighter mass than the actual mass is set to the tool file, the arm may fall off because the alarm does not occur even if the manipulator is operated at faster acceleration than the allowable value.

ii) If a position level (PL=*) is set to the previous step to the step where the alarm 4732: OVER ACCELERATION occurred, cancel the setting.

When the PL specification is added, fast acceleration may occur due to the sudden change of the motion direction.
(Please be careful to the motion path because it will change when the PL specification is canceled.)
3.5 Notes on Teaching

iii) Do not move the manipulator longer than the distance between the teaching positions.

Review the setting of the teaching position and CPT of SYMOVL instruction or STP and OL of the SYSTART instruction so that the manipulator’s actual moving distance right before and after the SYSTART instruction would not exceed the distance between the teaching positions.

For the details, refer to "Teaching positions before and after the SYSTART instruction." on page 3-10.

iv) In case an alarm 4732: OVER ACCELERATION occurred at a sharp angle formed by the steps, change the teaching positions to broaden the angle.

When the angle formed by the steps is sharp, the alarm 4732: OVER ACCELERATION is easy to occur.
3.6 Notes on Operation

○ Resuming the synchronized operation after the manipulator is stopped.

In case the manipulator stopped during the conveyor synchronized operation, it will resume the operation by the restarting operation. This restart is executed after the following stops.

- Stop by the MINOR ALARM
- Stop by the EMERGENCY STOP or EXTERNAL EMERGENCYSTOP
- Stop by the MODE SWITCH (switch between the play mode and the teach mode)
- Stop by the motion cycle switching

The conveyor synchronizing status started by the SYSTART instruction does not stop till execution of SYEND instruction or turning OFF of the FS100 power supply even if above mentioned stops occurred.

Therefore, during the conveyor synchronized operation, the conveyor kept on flowing even if the manipulator stops. And when the manipulator is re-started, it will try moving toward the workpieces on the distant conveyor.

Followings are the notes on operations.

- If the manipulator stopped and resuming of the synchronized operation is required, stop the motion of conveyor at the same time or before the manipulator stops its motion. And resume the conveyor motion at the same time or after the manipulator resumes its motion.
- If above mentioned procedures cannot be executed, execute SYEND instruction to terminate the conveyor synchronized operation, and then, execute the operation by the SYSTART instruction again. (for example, start the job from the head of the master job, etc.)
FS100 OPTIONS
INSTRUCTIONS
FOR CONVEYOR SYNCHRONIZED FUNCTION

SUPPLEMENTARY FOR CONTINUOUS OPERATION CONVEYOR SYNCHRONIZED FUNCTION

Specifications are subject to change without notice for ongoing product modifications and improvements.