FS100 OPTIONS INSTRUCTIONS

FOR CONVEYOR COORDINATED 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.

Part Number: 174512-1CD
Revision: 1
MANDATORY

- This manual explains the conveyor coordinated function of the FS100. Read this manual carefully and be sure to understand its contents before handling the FS100.
- General items related to safety are listed in Chapter 1: Safety of the FS100 Instructions. To ensure correct and safe operation, carefully read the FS100 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 “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.

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

Fig. : 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.

Fig. : 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.
  – Keep in mind the emergency response measures against the manipulator’s unexpected motion toward you.
  – Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.
WARNING

• Confirm that no person is present in the manipulator’s operating range and that you are in a safe location before:
  – Turning ON the power for the FS100.
  – Moving the manipulator with the programming pendant.
  – Running the system in the check mode.
  – Performing automatic operations.

Injury may result if anyone enters the manipulator’s operating range during operation. Always press an emergency stop button immediately if there are problems.

The emergency stop button is located on the programming pendant.

CAUTION

• Perform the following inspection procedures prior to teaching the manipulator. If problems are found, correct them immediately, and be sure that all other necessary tasks have been performed.
  – Check for problems in manipulator movement.
  – Check for damage to the insulation and sheathing of external wires.

• Return the programming pendant to a safe place after use.

If the programming pendant is inadvertently left on the manipulator, on a fixture, or on the floor, the manipulator or a tool may collide with the programming pendant during manipulator movement, which may result in personal injury or equipment damage.

• Read and understand the Explanation of Warning Labels in the FS100 Instructions before operating the manipulator.
Definition of Terms Used Often in This Manual

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>FS100L 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>

Descriptions of the programming pendant, 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</td>
</tr>
<tr>
<td></td>
<td>The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]</td>
</tr>
<tr>
<td></td>
<td>Symbol Keys</td>
</tr>
<tr>
<td></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></td>
<td>The Cursor is an exception, and a picture is not shown.</td>
</tr>
<tr>
<td></td>
<td>Axis Keys</td>
</tr>
<tr>
<td></td>
<td>“Axis Keys” and “Numeric Keys” are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td></td>
<td>Numeric Keys</td>
</tr>
<tr>
<td></td>
<td>Keys pressed simultaneously</td>
</tr>
<tr>
<td></td>
<td>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></td>
<td>Mode Key</td>
</tr>
<tr>
<td></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></td>
<td>Button</td>
</tr>
<tr>
<td></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></td>
<td>Displays</td>
</tr>
<tr>
<td></td>
<td>The menu displayed in the programming pendant is denoted with { }. ex. {JOB}</td>
</tr>
<tr>
<td></td>
<td>PC Keyboard</td>
</tr>
<tr>
<td></td>
<td>The name of the key is denoted ex. Ctrl key on the keyboard</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 brand names for each company or corporation. The indications of (R) and TM are omitted.

Safeguarding Tips

All operators, programmers, maintenance personnel, supervisors, and anyone working near the system 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 equipment, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this equipment.
- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.
- The system must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06-2012, section 4.2.5, Sources of Energy, 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).

Mechanical Safety Devices

The safe operation of this equipment 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 R15.06-2012 safety standards, and other local codes that may pertain to the installation and use of this equipment.

Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety equipment is provided as standard:

- Safety barriers
- Door interlocks
- Emergency stop palm buttons located on operator station

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.
Programming, Operation, and Maintenance Safety

All operators, programmers, maintenance personnel, supervisors, and anyone working near the system must become familiar with the operation of this equipment. 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 equipment should be permitted to program, or maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

- Inspect the equipment 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 all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.

- Check the E-Stop button on the operator station for proper operation before programming. The equipment must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.

- Back up all programs and jobs onto suitable media before 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.

- Any modifications to the controller unit can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to the controller unit. Making any changes without the written permission from Yaskawa will void the warranty.

- Some operations require a standard passwords and some require special passwords.

- The equipment allows modifications of the software for maximum performance. Care must be taken when making these modifications. All modifications made to the software will change the way the equipment operates and can cause severe personal injury or death, as well as damage parts of the system. Double check all modifications under every mode of operation to ensure that the changes have not created hazards or dangerous situations.

- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.

- Use proper replacement parts.

- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.
**Maintenance Safety**

Turn the power OFF and disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

Perform only the maintenance described in this manual. Maintenance other than specified in this manual should be performed only by Yaskawa-trained, qualified personnel.

**Summary of Warning Information**

This manual is provided to help users establish safe conditions for operating the equipment. Specific considerations and precautions are also described in the manual, but appear in the form of Dangers, Warnings, Cautions, and Notes.

It is important that users operate the equipment in accordance with this instruction manual and any additional information which may be provided by Yaskawa. Address any questions regarding the safe and proper operation of the equipment to Yaskawa Customer Support.
Customer Support Information

If you need assistance with any aspect of your FS100 system, please contact Yaskawa Customer Support at the following 24-hour telephone number:

(937) 847-3200

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

techsupport@motoman.com

When using e-mail to contact Yaskawa 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 Yaskawa Customer Support at the telephone number shown above.

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

• System
  FS100

• Primary Application

• Controller
  FS100/FS100L

• Software Version
  Access this information on the Programming Pendant’s LCD display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {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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1 Conveyor Coordinated Function

1.1 Conveyor Coordinated Function

The conveyor coordinated function enables the manipulator to follow the conveyor controlled as a station axis of the FS100.

Controlling the manipulator and a conveyor axis by the FS100 makes it possible for the manipulator to follow the conveyor more accurately than in the conventional conveyor synchronized function, even though the conveyor repeats the acceleration-deceleration operation.

1.2 Configuration of Conveyor Coordinated Function

The conveyor coordinated function is what the conventional conveyor synchronized function is expanded. It became possible to use a station axis of the FS100 as a conveyor axis. (Hereinafter, a station axis used as a conveyor is described as a “conveyor coordinated axis”.)

In the same way as the usual station axis, a conveyor coordinated axis is moved by the move instruction of the job.

Set the conveyor condition file to register the conveyor coordinated axis as the conveyor before use.

To make the manipulator follow the conveyor coordinated axis, use the same instructions for conveyor synchronized operation (SYSTART/SYMOVL/SYEND, etc.) as used in the conventional conveyor synchronized control. The same jobs used in the conventional conveyor synchronized control can be also used in this function.

Also, the conveyor coordinated axis can be used together with an external conveyor synchronized by the conventional synchronized function. At this time, the counter module: CNTR-01R is necessary to read the encoder. In a system synchronizing only a conveyor coordinated axis, CNTR-01R is not necessary.
1 Conveyor Coordinated Function

1.2 Configuration of Conveyor Coordinated Function

When using both the external conveyor and the conveyor coordinated axis, CNTR-01R is necessary.

*Fig. 1-1: External Conveyor and Conveyor Coordinated Axis*

When using only the conveyor coordinated axis, CNTR-01R is not necessary.

*Fig. 1-2: Conveyor Coordinated Axis Only*
The conveyor coordinated function is what the conveyor synchronized function is expanded. This manual explains only the contents specific to the conveyor coordinated function. For the conventional conveyor synchronized function, refer to the following manuals.

**NOTE**

FS100 OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION (161365-1CD)

FS100 OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION SUPPLEMENTARY FOR CONVEYOR SYNCHRONIZED FUNCTION WITH SHIFT FUNCTIONS (161595-1CD)

FS100 OPTIONS INSTRUCTIONS FOR CONVEYOR SYNCHRONIZED FUNCTION SYPPLEMENTARY FOR CONTINUOUS OPERATION CONVEYOR SYNCHRONIZED FUNCTION (164097-1CD)
2 Setting

2.1 Setting the Mechanical Specification for the Conveyor Coordinated Axis

To coordinate the manipulator and the conveyor coordinated axis accurately, the conveyor coordinated axis is registered as a specific station type.

Set the mechanical specifications of the conveyor coordinated axis as follows.

2.1.1 Confirmation of the “Mechanical Specifications” of the Station Axis

Select [SYSTEM] and [SETTING] to display CONTROL GROUP window in the maintenance mode.

Select “DETAIL” at “CV-MPP0003-A0*” of S1 or S2.

Press [Enter] to display CONNECT and AXES CONFIG windows.
2 Setting
2.1 Setting the Mechanical Specification for the Conveyor Coordinated Axis

MECHANICAL SPEC window appears. Confirm the following values are set.

MOTION RANGE (+) 360.000 deg
MOTION RANGE (-) -360.000 deg
REDUCTION RATIO (NUMER) 1.000
REDUCTION RATIO (DENOM) 9999.000
2. Setting
2.1 Setting the Mechanical Specification for the Conveyor Coordinated Axis

2.1.2 Setting Conveyor Coordinate Mechanical Specification

The following settings are necessary to move the conveyor.

Perform the setting in the following procedure.

<Setup procedure>

1. Select {SYSTEM}, {SETTING} and then “CONVEYOR COORDINATE MECHA SPEC” in the maintenance mode.

2. Set the gear ratio, rotation ratio and load inertia ratio and “enable” the function. Then press [ENTER] to complete the setting.

Set the following values for the gear ratio, rotation ratio and load inertia ratio.

GEAR RATIO Reduction ratio of the speed reducer etc. (If there is a sprocket, set the rotation ratio between the sprocket and the motor.)

ROTATION RATIO Rotation ratio between the conveyor and the motor (How many times the motor rotates per one whole rotation of the conveyor operated as the conveyor coordinated axis.)

INERTIA Perform the setting in the same way as the usual external axis.

Calculation example of rotation ratio
Rotation ratio = sprocket tooth number ÷ chain number of the whole conveyor x gear ratio
* When one chain moves per two sprocket teeth, calculate the sprocket tooth number by “the actual sprocket tooth number / 2”.

2 Setting
2.1 Setting the Mechanical Specification for the Conveyor Coordinated Axis

The setting in the maintenance mode is completed.

**<Rotation Ratio>**

After the normal setup and on-line (normal) startup, if the conveyor coordinated axis rotates one time from where the pulse is “0” in the jog operation, the axis comes where the pulse is “0”. In case of a half rotation, the axis comes where the pulse is “4096 x rotation ratio / 2”. (In the example, 4096 x 98437 / 1000 / 2 = 201599 pulse) When the values are different from the above, confirm the rotation ratio because it may be wrong.

**<Gear Ratio and Load Inertia Ratio>**

When the gear ratio and load inertia ratio are wrong, the conveyor coordinated axis may move vibrationally. In this case, confirm the values of the gear ratio and load inertia ratio.

The setting in the maintenance mode is completed.
2 Setting
2.2 Setting for the Conveyor Synchronization Operation

2.2 Setting for the Conveyor Synchronization Operation

2.2.1 Conveyor Condition File

By setting the conveyor condition file, the conveyor coordinated axis can be recognized as the synchronizing target conveyor.

When using the usual conveyor, “CN1” or “CN2” is set for “PORT NO.”. In the case of registering the conveyor coordinated axis, register “S1” or “S2” there.

For other settings than “PORT NO.”, set values in the same way as the conventional conveyor synchronized control.

![Conveyor Condition File Example](image)

(Example)

As shown in the following figure, when using CV#1 as the conveyor coordinated axis and CV#2 as the external conveyor, set S1 for the PORT NO. in the conveyor condition file of CV#1. (For the PORT NO. of CV#2, set CN1 etc.)

*Fig. 2-1: Setting the Port No.*
2.2 Setting for the Conveyor Synchronization Operation

2.2.2 Conveyor Home Position Signal (LS Signal)

Conveyor home position signal (LS signal) for the conveyor specified as the conveyor coordinated axis can be turned ON by inputing the specific input.

Create the job and ladder so that the specific input is turned ON at the timing when the conveyor coordinated axis moves to the home position. (Refer to Chapter 4 “Job Example”.)

<table>
<thead>
<tr>
<th>40660</th>
<th>40661</th>
<th>40662</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyor Home position signal S1</td>
<td>Conveyor Home position signal S2</td>
<td>Conveyor Home position signal S3</td>
</tr>
</tbody>
</table>

Also, conveyor home position signal for the external conveyor can be turned ON by the specific input. (Instead of using the specific input, the external LS signal can be also used as usual.)

<table>
<thead>
<tr>
<th>40670</th>
<th>40671</th>
<th>40672</th>
<th>40673</th>
<th>40674</th>
<th>40675</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyor Home position signal CN1</td>
<td>Conveyor Home position signal CN2</td>
<td>Conveyor Home position signal CN3</td>
<td>Conveyor Home position signal CN4</td>
<td>Conveyor Home position signal CN5</td>
<td>Conveyor Home position signal CN6</td>
</tr>
</tbody>
</table>
3 Conveyor Coordinated Axis Operation

The conveyor coordinated axis can be operated by the jog operation or the move instruction (MOVJ) in the same way as the usual station axis.

The position pulse of the conveyor coordinated axis is automatically changed to a value between -180 degrees and +180 degrees when one rotation of the conveyor is regarded as 360 degrees. Even though the axis moves in one direction continuously, the value does not exceed the range between -180 degrees and +180 degrees. Therefore, the conveyor coordinated axis can move continuously without exceeding the pulse limit even though the axis moves in one direction continuously.

When using MOVJ instruction, the axis automatically moves in the nearer direction, in the direction where the moving amount is 180 degrees or less. Therefore, when using the move instruction of the job (MOVJ) to make the conveyor coordinated axis move continuously, divide one conveyor rotation into at least three to teach.

(Example) When executing such jobs as follows, the axis moves continuously in the + direction.

```
NOP
*0
MOVJ EX000 // 0 deg
MOVJ EX001 // 120deg
MOVJ EX002 // -120deg
JUMP *0
END
```

*Fig. 3-1: Continuous Motion of the Conveyor Coordinated Axis*
4 Job Example

4.1 System Configuration

Assume the following system configuration here.

The conveyor coordinated axis (CV#1) controlled by the FS100 is the bucket conveyor.

The workpiece throwing device puts workpieces in the buckets from the upper stream of the bucket conveyor. After putting the workpieces in the bucket, the workpiece throwing device sends the “bucket sending request” signal to the FS100.

When the FS100 receives the “bucket sending request” signal from the workpiece throwing device, the FS100 moves the bucket conveyor for one bucket amount and sends the “bucket sending completion” signal to the workpiece throwing device.

When the workpiece throwing device receives the bucket sending completion signal, the device turns OFF the bucket sending request and puts workpieces in the empty buckets. This procedure is repeated.

The manipulator picks up the workpieces from the buckets when the buckets including workpieces come in the range of motion, and then put the workpieces on the external conveyor (CV#2).

Fig. 4-1: System Configuration of the Conveyor Coordinated Axis
4.2 Conveyor Coordinated Axis Job

Following is how to create the conveyor coordinated axis job that turns ON the conveyor home position signal when receiving the “bucket sending request” signal, and moves the conveyor for one bucket amount and outputs the “bucket sending completion” signal.

*This is a job configuration example when the setting is as follows.

- Conveyor home position signal (S1): OUT#(2)
- “Bucket sending request” signal: IN#(2)
- “Bucket sending completion” signal: OUT#(3)
- By inputing the conveyor home position signal every time one bucket is moved, each bucket position on the conveyor is stored in the conveyor start shift que.

```
STR #10010  //OT#(1)
OUT #40660  //Conveyor home position signal
```

- “Bucket sending request” signal: IN#(2)
- “Bucket sending completion” signal: OUT#(3)
The following job example is to teach the conveyor to input the home position signal every time it moves 10 degrees in the condition that the conveyor installed 36 buckets moves 10 degrees for one bucket.

```plaintext
JOB: CV
/JOB
//NAME: CV
//GROUP: ST1
NOP +0 ' 0deg
WAIT INH(2)=ON
PULSE OT#(1) T=0.005
MOVJ EX000 // 0 deg
DOUT OT#(3) ON
WAIT INH(2)=OFF
DOUT OT#(3) OFF : 10deg
WAIT INH(2)=ON
PULSE OT#(1) T=0.005
MOVJ EX001 // 10 deg.
DOUT OT#(3) ON
WAIT INH(2)=OFF
DOUT OT#(3) OFF : 20deg
WAIT INH(2)=ON
PULSE OT#(1) T=0.005
MOVJ EX002 // 20 deg.
DOUT OT#(3) ON
WAIT INH(2)=OFF
DOUT OT#(3) OFF
: : : -170deg
WAIT INH(2)=ON
PULSE OT#(1) T=0.005
MOVJ EX019 // -170 deg.
DOUT OT#(3) ON
WAIT INH(2)=OFF
DOUT OT#(3) OFF
: : : -160deg
WAIT INH(2)=ON
PULSE OT#(1) T=0.005
MOVJ EX020 // -160 deg.
DOUT OT#(3) ON
WAIT INH(2)=OFF
DOUT OT#(3) OFF
: : : -10deg
WAIT INH(2)=ON
PULSE OT#(1) T=0.005
MOVJ EX035 // -10 deg.
DOUT OT#(3) ON
WAIT INH(2)=OFF
DOUT OT#(3) OFF
JUMP +0
END
```

- Wait for “Sending request” to be ON
- Turn On “Home position signal”
- Move the conveyor for one bucket amount
- Turn On “Sending completion”
- Wait for “Sending request” to be OFF
- Turn OFF “Sending completion”
4.3 Manipulator Job

The manipulator job executes the picking operation between CV#(1) and CV#(2).

The same job for the picking operation in the usual “continuous operation conveyor synchronized function” can be used.

(Whether the conveyor is the usual conveyor or the conveyor coordinated axis, the manipulator job is the same.)

```assembly
/JOB
/NAME R1-MOTION
:
:
/GROUP1 RB1
/LVARS 10, 0, 3, 0, 0, 1, 0, 0
NOP
*TOP
MOVL C00000 V=500.0 // Operation home position
,
*PICK-CV
SYSTART CV#(1) STP=240.000 CONT OL=35.0 TRAP *TRAP1
SYNOVL C00001 V=3350.0 CV#(1) CTP=240.000
DOUT OTH(10) ON // Hand
SYNOVL C00002 V=3350.0 CV#(1) CTP=240.000
TIMER T=0.050
SYNOVL C00003 V=3350.0 CV#(1) CTP=240.000
SYEND CV#(1) CONT
CYQUE CV#(1)
,
*PLACE-CV
SYSTART CV#(2) STP=100.000 CONT OL=50.0 TRAP *TRAP2
SYNOVL C00004 V=3350.0 CV#(2) CTP=120.000
SYNOVL C00005 V=3350.0 CV#(2) CTP=120.000
DOUT OTH(10) OFF // Hand
TIMER T=0.030
SYNOVL C00006 V=3350.0 CV#(2) CTP=120.000
SYEND CV#(2) CONT
CYQUE CV#(2)
JUMP *PICK-CV
,
*TRAP1
CYQUE CV#(1)
GETS LPX000 $PX000
MOVL LP000 V=100.0
JUMP *PICK-CV
,
*TRAP2
CYQUE CV#(2)
GETS LPX000 $PX000
MOVL LP000 V=100.0
JUMP *PLACE-CV

END
```
4.4 Master Job

The aforementioned “conveyor coordinated axis job” and “manipulator job” should be operated independently.

Start respective jobs from the master job by the independent control function.

```
/JOB
//NAME MASTER
NOP
PSTART JOB:CV SUB1
PSTART JOB:ROBOT SUB2
END
```

In the actual system, the home positioning of the manipulator and conveyor should be taken into consideration when the system starts.
5 Supplementary Contents

5.1 Adjusting the Conveyor Coordinated Axis Accuracy

When setting the “delay time correction” to adjust the accuracy of the relative relationship between the conveyor coordinated axis and the manipulator, perform the following procedure.

*This setting is for the case in which the extremely severe accuracy is required. In most cases, the “conveyor coordinated function” can produce enough accuracy. Therefore set “0” in the normal use. Setting the value may lead to less accuracy because of the excess correction.

1. Select the teach mode and the maintenance mode or higher for the security mode, and then select {Manipulator} and {Conveyor coordinated set}.

2. When the conveyor synchronized operation starts and the manipulator moves slower than the conveyor coordinated axis, set a bigger value than the present value for CV AXIS LATE TIME (example: change to 42 from 40) to adjust the accuracy.

On the contrary, when the manipulator moves faster than the conveyor coordinated axis, set a smaller value than the present value for CV AXIS LATE TIME.

*Be sure to set a even number.
FS100 OPTIONS
INSTRUCTIONS
FOR CONVEYOR COORDINATED FUNCTION

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