Motoman XRC Controller

ServoFloat Function Manual

for UP/SKX-Series Robots

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SECTION 1
INTRODUCTION

1.1 About this Document

This manual provides instructions for Servofloat Function and contains the following sections:

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 – SERVOFLOAT FUNCTION
Provides detailed instructions to utilize the Servofloat Function.

1.2 Reference to Other Documentation

For additional information refer to the following:

- Concurrent I/O Parameters Manual (P/N 142102-1)
- 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 Manipulator Manual (P/N 142104-1)
- Motoman SK16X, XRC Manipulator Manual (P/N 142105-1)
- Motoman SK45X, XRC Manipulator Manual (P/N 142106-1)
- Motoman UP130, XRC Manipulator Manual (P/N 142107-1)

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, SK16X, 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 to PART 1 of the MRC controller PLC can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1. 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 parts 1 and 2, 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 parts 1 and 2, 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 THE SERVOFLOAT FUNCTION

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

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

YASKAWA

MANUAL NO. RE-CKI-A430

MANDATORY

- This manual explains the servofloat function of the YASNAC XRC system and general operations. 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

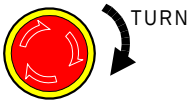
- Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the playback panel or programming pendant are pressed.
  When the servo power is turned off, the SERVO ON READY lamp on the playback panel and the SERVO ON LED on the programming pendant are turned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

- Using the servofloat function, instead of the standard position controls, the manipulator may not move to the taught position depending on the applied external force and gravity. To avoid any accident, pay full attention to the motion of the manipulator during operation.

- While operating the manipulator, never go under the manipulator arm.

  During execution of the servofloat function, the manipulator generates enough torque to resist gravity to maintain the position. However, the arms may drop due to a sudden variation in the load, which may cause an accident or damage to the devices.

- If the values for the maximum force and maximum torque are set too low, gravity may cause an arm to drop.

  The arm drop may cause an accident or damage to the devices.

- Prevent any sudden load variation by removing a workpiece, etc. during execution of servofloat function.

- Do not perform the manipulator at high-speeds.

  Since complete position control is not performed during execution of the servofloat function, the manipulator does not move exactly along the taught path. The higher the speed becomes, the greater the variation from the path alignment becomes. Set the operation speed of the manipulator within 10% to 20% of the upper limit of the maximum speed. For setting any higher speeds, increase the speed gradually from a low-speed, and confirm the path of the manipulator movement.

- Perform a running-in.

  When starting the manipulator after a long period of disuse, the friction resistance may not be stabilized for a short period of time. When using the servofloat function, operate all the axes by [MOVJ VJ=25.00] for 3 minutes after starting in order to stabilize the friction resistance.

CAUTION

- When a major alarm or emergency stop occurs during execution of the servofloat function, avoid applying any external force to the manipulator.

  When a major alarm or emergency stop occurs during execution of the servofloat function, the servo power supply turns OFF and the brake activates simultaneously. If any external force continues to be applied to the manipulator in this state, the manipulator may be broken.
  In the following cases, stop the device which creates external force on the manipulator.
  - When the manipulator signal output “operating” is turned OFF.
  - When the manipulator signal output “Servo ON” is turned OFF.
  - When the manipulator signal output “Alarm/error occurrence” is turned ON.

- Do not apply any external force to the manipulator when the servofloat function is not executed.

  If an external force continues to be applied to the manipulator when the servofloat function is not executed, the manipulator may be broken. Confirm that the message “Servo float activated” appears on the bottom of the programming pendant display and the specific output 5084 “SERVOFLOAT ON R1” is output before applying any external force.

- 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 manipulator product.
The manipulator usually consists of the controller, the playback panel, the programming pendant, and supply cables.
The MOTOMAN manipulator is the YASKAWA industrial manipulator 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.

1 Servofloat Function

The servofloat function of the XRC consists of the link servofloat function and the linear servofloat function. The link servofloat function controls the torque independently for each axis; and the linear servofloat function controls the torque on the Cartesian coordinates. Select these two functions by setting the servofloat instructions accordingly.

1.1 Link Servofloat Function

The link servofloat function works in combination with the position control and the torque control, whereas an ordinary control is a position control that generates torque to keep the taught position regardless of the applied external force. “Torque control” keeps the taught position only by using the torque against the gravitational and frictional forces. Therefore, a manipulator moved by an external force will not return to its original position.

With the servofloat function, external force moves the manipulator since the torque control has priority over the position control.

For example, when removing a workpiece from the die-casting machine, a large external force is applied to the manipulator by the extruding cylinder when a workpiece is grasped and pulled out. The servofloat function is used to protect the manipulator from excessive external force, and the manipulator moves according to the force applied from the die-casting machine.

Note that the manipulator does not move exactly to the taught position or along the taught path, because complete position control is not performed during execution of the servofloat function.

1.2 Linear Servofloat Function

When a manipulator pushes a workpiece or visa-versa, a movement to one predetermined direction may be desirable. With the link servofloat function, a servofloat motion in one direction is not possible since torque control is performed independently for each axis.

This function can specify the control of force in one direction within a space.*1*

When unloading a die-casting machine, this function is useful for considerably long ejection distances or when polishing or grinding.

1 When external force is applied, the R, B, and T-axes move the same as in the link servo-float function.
Only the end of the U-axis moves in a linear motion.

1.3 Using the Link Servofloat Function and the Linear Servofloat Function

Use the link servofloat function when high-ferquency noise, motor vibration, or unsteady manipulator motion occur depending on the manipulator posture, speed, and movement direction.

NOTE

Tool load information setting
The servofloat function compensates for gravity in real-time in order to prevent the arms from dropping due to gravity even when the generated torque is limited. For this purpose, the tool load information used for gravity compensation must be set correctly. Otherwise, the servofloat function cannot be performed properly and the arms may drop down or rise up.
For the tool load infomation, refer to Section “3.11.3 Tool Load Information Setting” in order to correctly set the tool load information.

2 The Servofloat Function

Enable the servofloat function with the servofloat function start instruction FLOATON. It remains enabled until one of the following conditions is established.

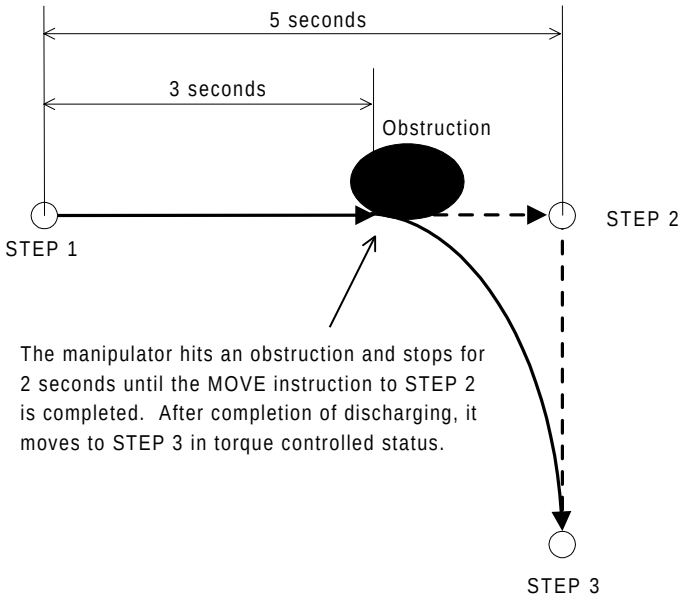
- Performing the a servofloat function end instruction FLOATOF
- Performing the FWD/BWD key operation, jogging, or a job startup after the cursor is moved
- Performing the FWD/BWD key operation, jogging, or a job startup after a job call, job selection, or job editing
- Turning the servo ON again after an emergency stop

When the function is enabled, the manipulator generates only the torque that is less that the value set to the servofloat condition file. The manipulator uses the torque to operate and keep the position. If a large external force is applied, the manipulator moves according to this force.

2.1 Moving with the Move Instruction

If an external force prevents manipulator operation, the manipulator does not reach the taught position when the servofloat function is enabled. Even though the manipulator does not actually reach the taught position, the instruction that would be activated at that position are nonetheless enabled, so the move instruction terminated.
Therefore, when the manipulator cannot reach the taught position because of an external force, the manipulator performs the next instruction.

The following figure shows an example where the operation time is 5 seconds from STEP 1 to STEP 2. If the manipulator hits an obstruction 3 seconds after STEP 1 and stops there, it remains stopped at the position for the remaining 2 seconds, and then moves to STEP 3 without moving to STEP 2 when moving with the torque control.

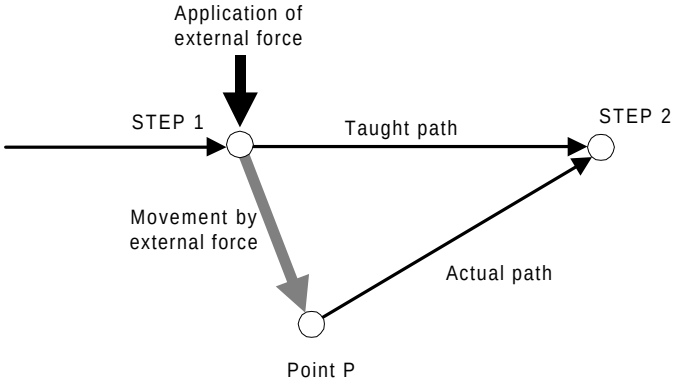



```
STEP 1   MOVL  V=100.0
         FLOATON  FL#(1)
STEP 2   MOVL  V=100.0
STEP 3   MOVL  V=100.0
         FLOATOF
```

2.2 Moving with the TIMER and WAIT Instructions

When the servofloat function is enabled, torque control can be performed even during the TIMER and WAIT instructions. These instructions end when time is up or when a condition described in page 2-1 is established.

For example, in the following figure, the manipulator reaches STEP 1, and the FLOATON instruction enables the servofloat function. Then the manipulator waits for the input of IN#1 by the WAIT instruction. In this state, if an external force is applied to the manipulator, the manipulator moves to the point P and stops. If the FLOATOF instruction is performed at this point, the servofloat function is disabled and the manipulator moves from point P to STEP 2.




```
STEP 1   MOVL  V=100.0
         FLOATON  FL#(1)
         WAIT  IN#(1)=ON
         FLOATOF
STEP 2   MOVL  V=100.0
```

2.3 Operation Check

When the servofloat function is enabled, the soft limit, cube interference, and the S-axis interference are checked at the actual position of the manipulator even though external force moved the manipulator.

2.4 When an Alarm Occurs

If an alarm occurs when the servofloat function is enabled, the servofloat function may remain effective depending on the type of alarm. To disable the servofloat during an alarm, enter “external emergency stop” or “servo OFF signal” during the “alarm occurrence” signal output. This turns OFF the servo power supply and applies the brakes.

2.5 Display during Servofloat Operation

When the servofloat function is enabled, the message “Servo float activated” appears at the bottom of the programming pendant display, and the specific output 5084 “SERVOFLOAT ON R1” is output.

2.6 Turning Servo ON Again During Servofloat Operation

When the servo power has been turned OFF due to an emergency stop during servofloat operation and turns ON again, press the [SERVO ON READY] on the playback panel until this servo recognizes that the power supply is turned ON. If the button is not pressed for a long enough time, the message “depress servo power ON” appears and the servo power cannot be turned ON.

3 Servofloat Condition Files

CAUTION

- If the values for the maximum force and maximum torque are set too low, gravity may cause an arm to drop.

  The arm drop may cause an accident or damage to the devices.

There are two kinds of servofloat condition files: the link servofloat condition file specified for the link servofloat function, and the linear servofloat condition file specified for the linear servofloat function.

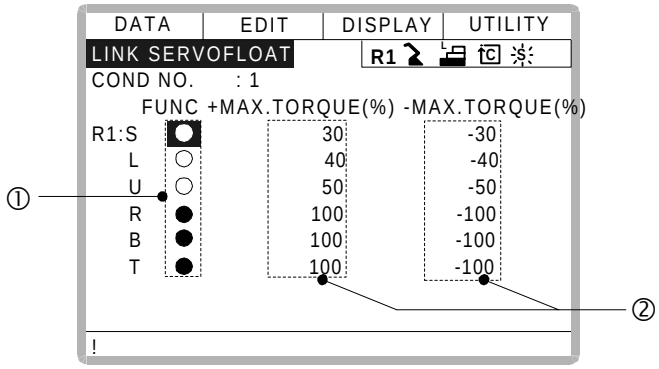
3.1 Link Servofloat Condition File

Operation

Select {ROBOT} from the top menu ➡ Select {LINK SERVOFLOAT}*1 ➡ Select an item to be set, and set the value*2

Explanation

1 The link servofloat display appears.



①FUNC

Enables/Disables the link servofloat function for each axis.

"●" indicates that the function is enabled; "○" indicates that the function is disabled.

Pressing [SELECT] switches between "●" and "○".

②(+) MAX. TORQUE / (-) MAX. TORQUE

Limits the amount of torque generated for keeping control of the position of each axis.

Set the value for each axis using the ratios (%) of the positive and negative sides of the motor to the motor rated torque. The smaller the value is set, the more easily the manipulator can be moved by an external force.

2 The display enters the number input status. Enter a value for "MAX. TORQUE" by pressing the number keys. Then, press [ENTER].

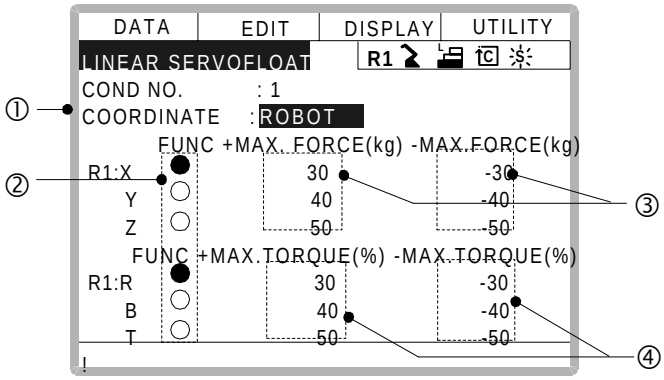
3.2 Linear Servofloat Condition File

Operation

Select {ROBOT} from the top menu ➡ Select {LNR. SERVOFLOAT}*1 ➡ Select an item to be set, and set the value*2

Explanation

1 The linear servofloat display appears.



①COORDINATE

Sets a coordinate system for the linear servofloat function.

Select the ROBOT coordinates, BASE coordinates, USER coordinates or TOOL coordinates.

Pressing [SELECT] displays the selection dialog box. Select a coordinate system to be set.

②FUNC

Enables/Disables the linear servofloat function for each axis.

"●" indicates that the function is enabled; "○" indicates that the function is disabled.

Pressing [SELECT] switches between "●" and "○".

③(+) MAX. FORCE / (-) MAX. FORCE

Limits the amount of force generated for keeping control of the position of each axis.

When the linear servofloat is enabled, a force bigger than this set value is not generated. The smaller the value is set, the more easily a set coordinate axis can be moved by an external force. However, if the set value is less than the manipulator friction, the manipulator may not move.

④(+) MAX. TORQUE / (-) MAX. TORQUE

Limits the amount of torque generated for keeping control of the position of R-, B-, and T-axes.

Set the value for each axis using the ratios (%) of the positive and negative sides of the motor to the motor rated torque. The smaller the value is set, the more easily an axis can be moved by an external force.

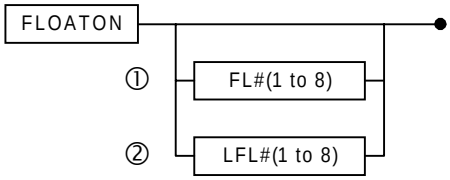
2 The display enters the number input status. Enter a value for "MAX. TORQUE" by

pressing the number keys. Then, press [ENTER].

4 Instructions for the Servofloat Function

4.1 FLOATON Instruction

FLOATON is an instruction to enable and start the link servofloat function or the linear servofloat function.
Additional items for the FLOATON instruction are as follows:



①FL# ( ) (Setting range: 1 to 8)
Sets the link servofloat condition file number.

②LFL# ( ) (Setting range: 1 to 8)
Sets the linear servofloat condition file number.

4.2 FLOATOF Instruction

FLOATOF is an instruction to disable and end the link servofloat function or the linear servofloat function. The servofloat function can be also disabled by performing servo OFF.

4.3 SPDL Tag

The SPDL tag is a stop confirmation tag with which a motion is completed when the number of speed feedback pulses of all the axes becomes less than a constant value.
Use an SPDL tag to confirm the end of a motion caused by an external force. Add it to the move instruction immediately before the FLOATOF instruction.
If the move instruction is completed with a SPDL tag added, the next instruction will not be performed as long as the manipulator is being moved by an external force.

Only “0” can be set for the SPDL tag.
An example of an SPDL tag added to a move instruction is shown as follows:

```
MOVJ  VJ=50.00  SPDL=0
```

5 Registration of Instruction

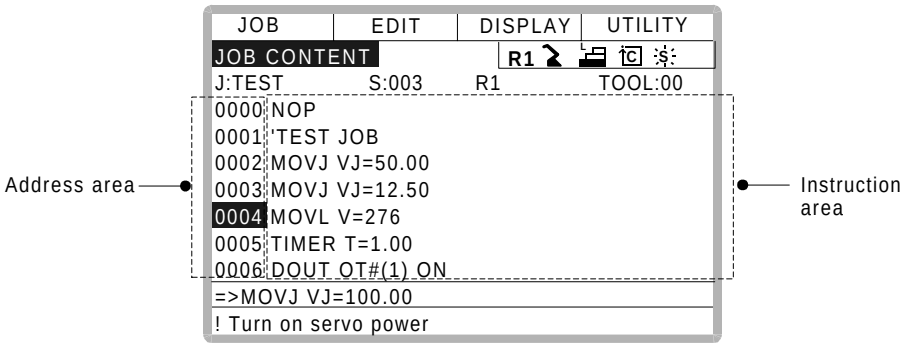
When in the job content display in teach mode, register an instruction with the cursor in the address area.

Operation

Select {JOB} from the top menu ➡ Select {JOB CONTENT}*1 ➡ Move the cursor to the address area

Explanation

1 The job content display appears.



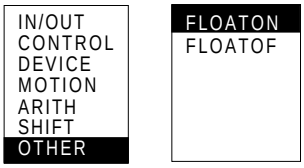
5.1 FLOATON Instruction

Operation

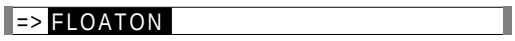
Move the cursor to the line where “FLOATON” is to be registered ➡ Press [INFORM LIST]*1 ➡ Select “FLOATON”*2 ➡ Change any additional items and numerical values*3 ➡ Press [INSERT] and [ENTER]*4

Explanation

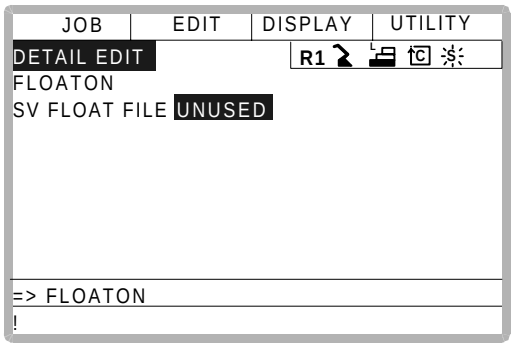
1 The instruction dialog box appears.



2 The “FLOATON” instruction appears in the input buffer line.



3 < To register without change>
To register the instruction displayed in the input buffer line without any changes, go to ***4***.
< To edit the additional items>
To add an additional item, with the cursor on the instruction in the input buffer line, press [SELECT] to call the detail edit display.



With the cursor on “UNUSED” for the “SV FLOAT FILE”, press [SELECT]. The selection dialog box appears with the choices “FL# ( )” or “LFL# ( )”. Select one.

After adding an additional item, press [ENTER]. The detail edit display closes, and the job content display reappears.

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

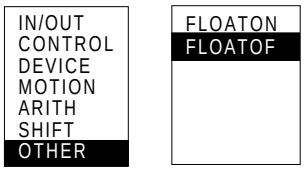
5.2 FLOATOF Instruction

Operation

Move the cursor to the line where “FLOATOF” is to be registered ➡ Press [INFORM LIST]*1 ➡ Select “FLOATOF”*2 ➡ Press [INSERT] and [ENTER]*3

Explanation

1 The instruction list dialog box appears.



2 The “FLOATOF” instruction appears in the input buffer line.

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

5.3 Addition of SPDL Tag to a Move Instruction

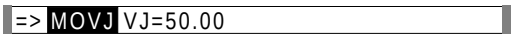
When in the job content display in teach mode, add an SPDL tag to a move instruction, with the cursor in the instruction area.

Operation

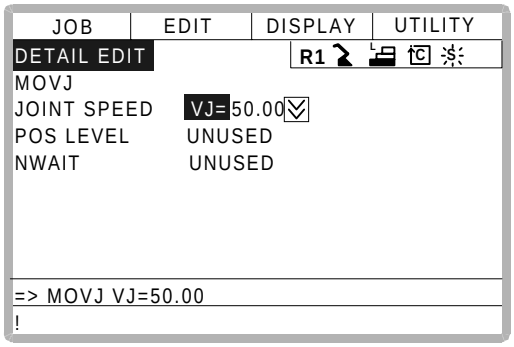
Select the line of the move instruction where the SPDL tag is to be added*1 ➡ Press [SELECT]*2 ➡ Press [INSERT] and [ENTER]*3

Explanation

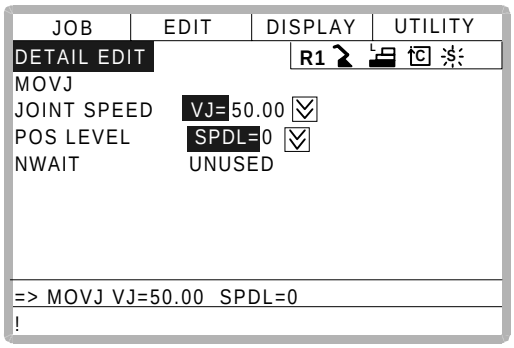
1 The move instruction appears in the input buffer line.



2 The detail edit display appears.



With the cursor on “UNUSED” for the “POS LEVEL”, press [SELECT]. The selection dialog box appears with the choice, “SPDL=”.



After adding “SPDL=” to the move instruction, press [ENTER]. The detail edit display closes, and the job content display reappears.

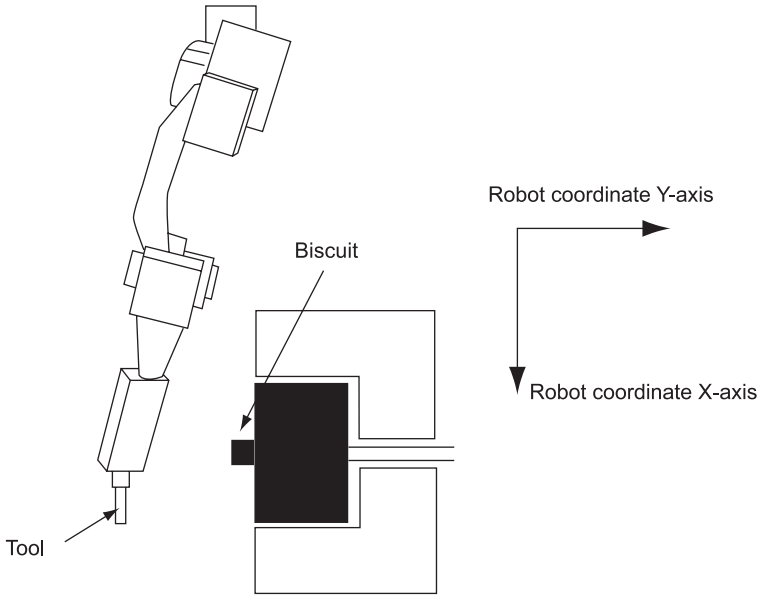
3 The instruction displayed in the input buffer line is registered.

6 Application Example of the Servofloat Function

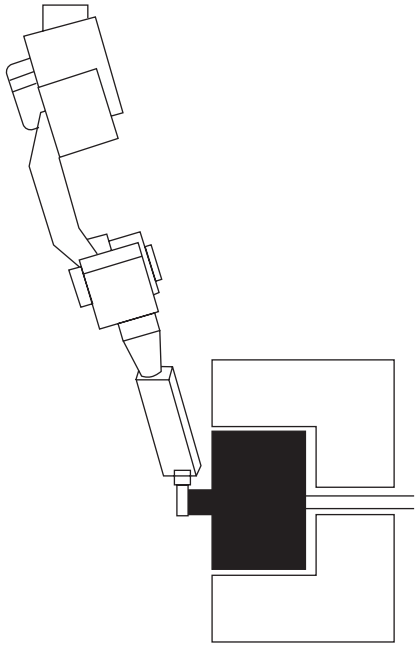
When removing a workpiece from a die-casting machine, a large external force is applied to the manipulator during extraction after grasping it. In such a case, the following example is applicable using the servofloat function.

6.1 Movement Example

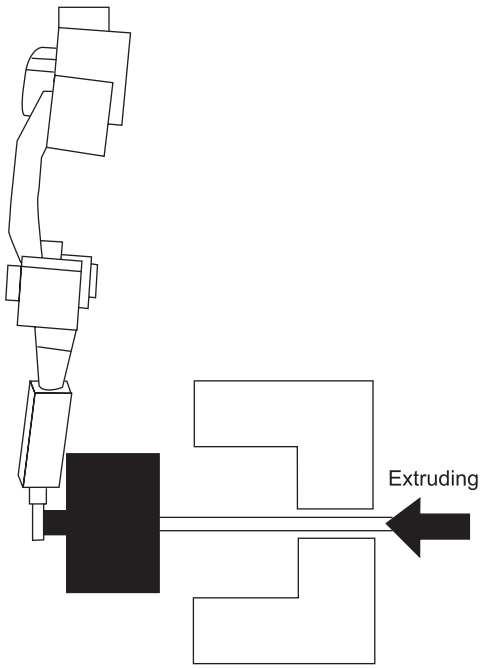
1. Moves to the waiting point.



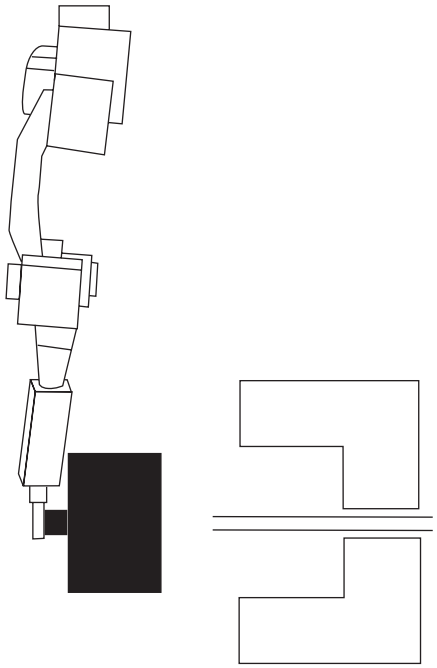
2. Moves to the grasping starting point and performs the TIMER instruction, and then starts the servofloat function.
3. When function enabled, the manipulator grasps a “biscuit”.



4. After having grasped a workpiece, the “start extraction instruction” signal is output, and the manipulator performs an extracting motion.
5. The “start extraction instruction” signal starts the extraction operation of the die-casting machine. Thereby, the manipulator performs an extracting motion.
6. The die-casting machine outputs the “end extraction instruction” signal when the manipulator reaches the completion position. The manipulator ends the servofloat function.



7. The manipulator returns to its normal motion and performs an extraction motion with the workpiece. Then, it returns to the home position.



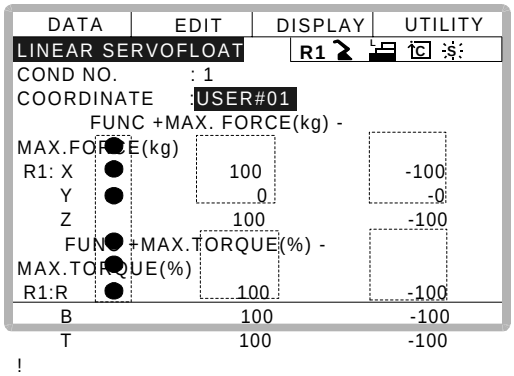
6.2 Job Example

No.*1	Explanation	Instruction
1	Moves to the waiting point.	MOVJ VJ=50.0
2	Moves to the workpiece grasping point.	MOVL V=300.0
	Stops and waits for 0.5 seconds.	TIMER T=0.50
	Starts the linear servofloat function.	FLOATON LFL#(1)
3	Turns ON the “grasping instruction” signal. (general output No. 10)	DOUT OT#(10)=1
	Waits for the “grasping answer” signal. (general input No. 10)	WAIT IN#(10)=1
4	Turns ON the “start extraction instruction” signal. (general output No. 11).	DOUT OT#(11)=1
5	Performs the extraction motion. Ends the motion when the “end extraction instruction” signal (general input No. 11) is input during the motion.	MOVL V=50.0 UNTIL IN#(11)
	Stops and waits for 0.5 seconds.	TIMER T=0.50
6	Completes the servofloat function.	FLOATOF
7	Starts the extracting.	MOVL V=300.0
	Returns to the waiting point.	MOVJ VJ=50.0

1 The numbers represent the procedure numbers in “6.1 Movement Example”.

6.3 A Setting Example in the Linear Servofloat Condition File

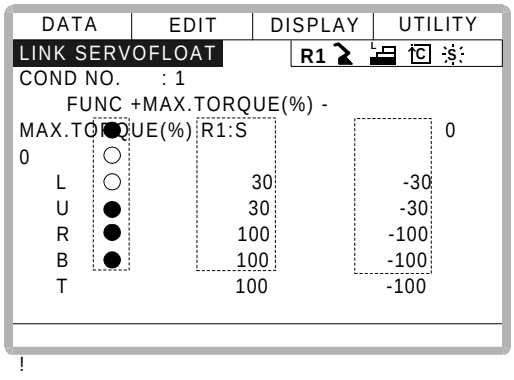
For the example described in “6.1 Movement Example”, set the servofloat condition file as follows.
In the example, the extracting direction corresponds to that of the Y-axis of the robot coordinates. If the direction does not correspond to the robot coordinates, define the extracting direction with the user coordinates and set “COORDINATE” to “USER#01”.



6.4 A Setting Example for the Link Servofloat Condition File

For the example described in “6.1 Movement Example”, specify the link servofloat condition file by specifying LF# as the FLOATON instruction file. In this case, a setting example is as follows.

Since the S-axis moves according to the force applied by the extruding cylinder of the die-casting machine, set the “MAX. TORQUEs” of the S-axis to “0”. Set the “MAX. TORQUEs” of the L- and U-axes to “30” to prevent the arms from dropping or rising up due to the load variation. To orientate the tool posture, set the “MAX. TORQUEs” of the R-, B-, and T-axes to “100”.
Using the above settings as a guide, adjust the ratio of each set value according to the circumstances.



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INSTRUCTIONS

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