

Motoman XRC Controller
TouchSense
Function Manual
for UP/SKX-Series Robots

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SECTION 1

INTRODUCTION

1.1 About this Document

This manual provides instructions for the Motoman TouchSense Function. The Yaskawa manual *Starting Point Detecting Function* has been used as the basis for this TouchSense manual but has been modified to reflect the Motoman TouchSense product where necessary. Please note that all references to Starting Point Detecting are the same as TouchSense. This manual 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 – TOUCHSENSE FUNCTION

Provides detailed instructions to utilize the TouchSense 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

STARTING POINT DETECTING FUNCTION
BASIC OPERATION

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.





MANDATORY

- This manual explains the starting point detecting 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.

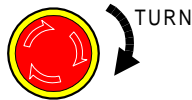
Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.



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 robot work envelope to teach a job.

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

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

Improper or unintended manipulator operation may result in injury.

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

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



WARNING

- Since detected voltage (200V), welding current, and welding voltage are applied to the starting point detecting unit, install the unit securely so that it does not fall.
- Failure to observe this warning may result in an electric shock or damage to the unit.
- Before connecting the inter-unit cables and the welding cables, be sure to turn OFF the power supply to the XRC and the welder.

Failure to observe this warning may result in an electric shock.

- Special attention should be paid during starting point detection, since 200 VDC is applied across the wire and the workpiece (welding jig).

Failure to observe this warning may result in an electric shock.

- Do not place any object directly on the cable of the starting point detecting unit.

Failure to observe this warning may result in an injury or damage caused by the disconnection of the cable.

- Attach the cable of the starting point detecting unit for the wire feeder with the wire stand, to protect it from robot movement. If interference between the cable and the peripheral devices can not be avoided, cover the cable with a rubber plate or spiral tube, etc.

Failure to observe this warning may result in an electric shock, an injury, or damage to the cable.

- Do not lay the cable of the starting point detecting unit directly on the floor, but install them in a pit or duct or attach the cable with a protective cover.

Failure to observe this warning may result in an injury or damage to the cable.

- Since a high current flows through the welding cable, separate it from the cables of the control circuit system. If the cables can not be separated, take preventative measures such as using metallic ducts or tubes on the cables of the control circuit system.



CAUTION

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

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

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

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

Definition of Terms Used Often in This Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product.


The manipulator usually consists of the controller, the playback panel, the programming pendant, and supply cables.

The MOTOMAN manipulator is the YASKAWA industrial robot product.

In this manual, the equipment is designated as follows.

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

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

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

Description of the Operation Procedure

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



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1 Outline of the Function

The starting point detecting function searches for the groove to be welded.

This function helps find the groove regardless of workpiece size dispersion or setting position.

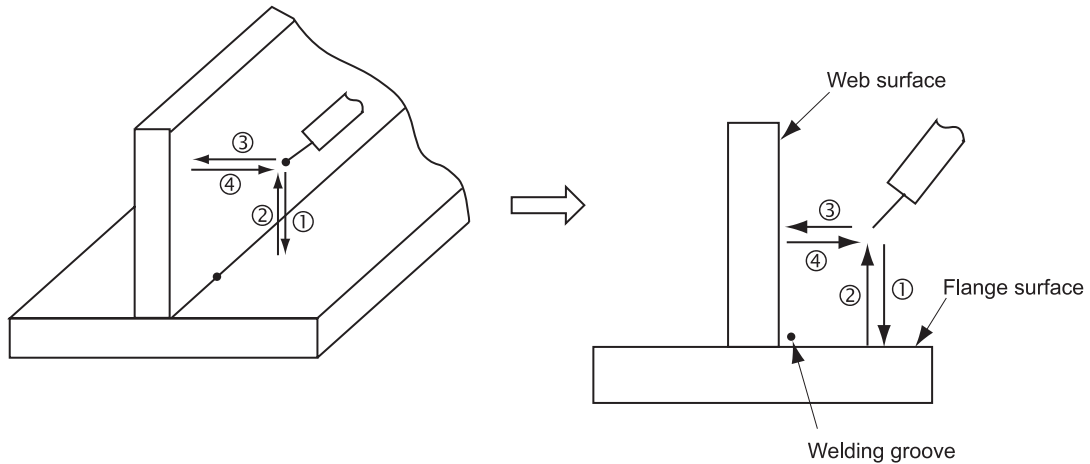


Fig. 1 Starting Point Detection

The manipulator moves to positions ① through ④ as in Fig. 1 to find the points where the wire touches the base metal. It then calculates the difference between the taught and actual positions of the flange and the web, and finds the welding groove.

Fig.2 shows how the flange and the web surface position errors h and l are used to change the taught position of the groove to the actual position S' .

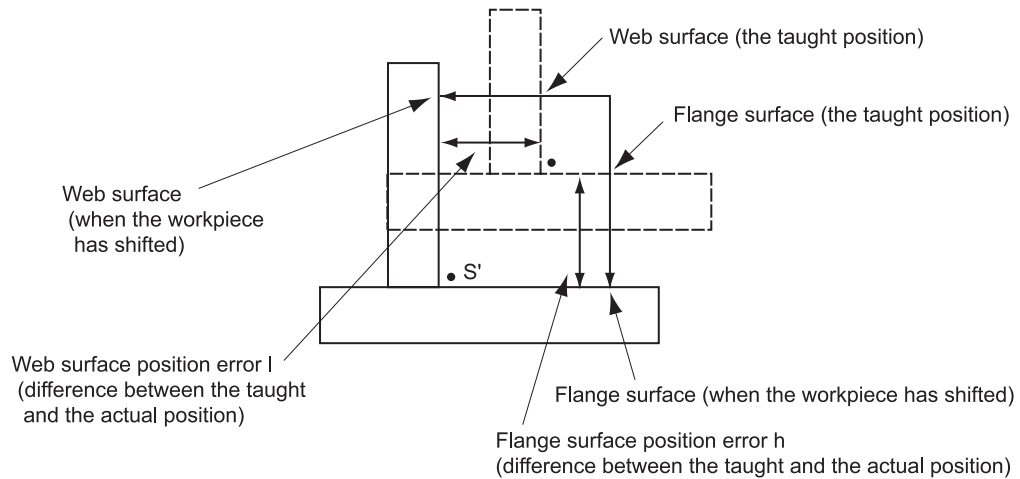


Fig. 2 Locating Welding Groove



2 Installation



WARNING

- Since detected voltage (200V), welding current, and welding voltage are applied to the starting point detecting unit, install the unit securely so that it does not fall.
- Failure to observe this warning may result in an electric shock or damage to the unit.
- Before connecting the inter-unit cables and the welding cables, be sure to turn OFF the power supply to the XRC and the welder.

Failure to observe this warning may result in an electric shock.

- Special attention should be paid during starting point detection, since 200 VDC is applied across the wire and the workpiece (welding jig).

Failure to observe this warning may result in an electric shock.

Three types of starting point detecting unit are available : floor-mounted standard type, floor-mounted slim type, and side-by-side type.

The starting point detecting unit should be installed outside of the manipulator interference area.

For installation method, refer to the diagrams of each type.

2.1 Floor-mounted Standard Type

The floor-mounted standard type should be installed on the side of the welders. When installing a floor-mounted standard type on a welder or another device, attach the unit securely with a fixing jig to the 4-M6 tapped mounting holes on the side of unit to prevent the unit from falling.

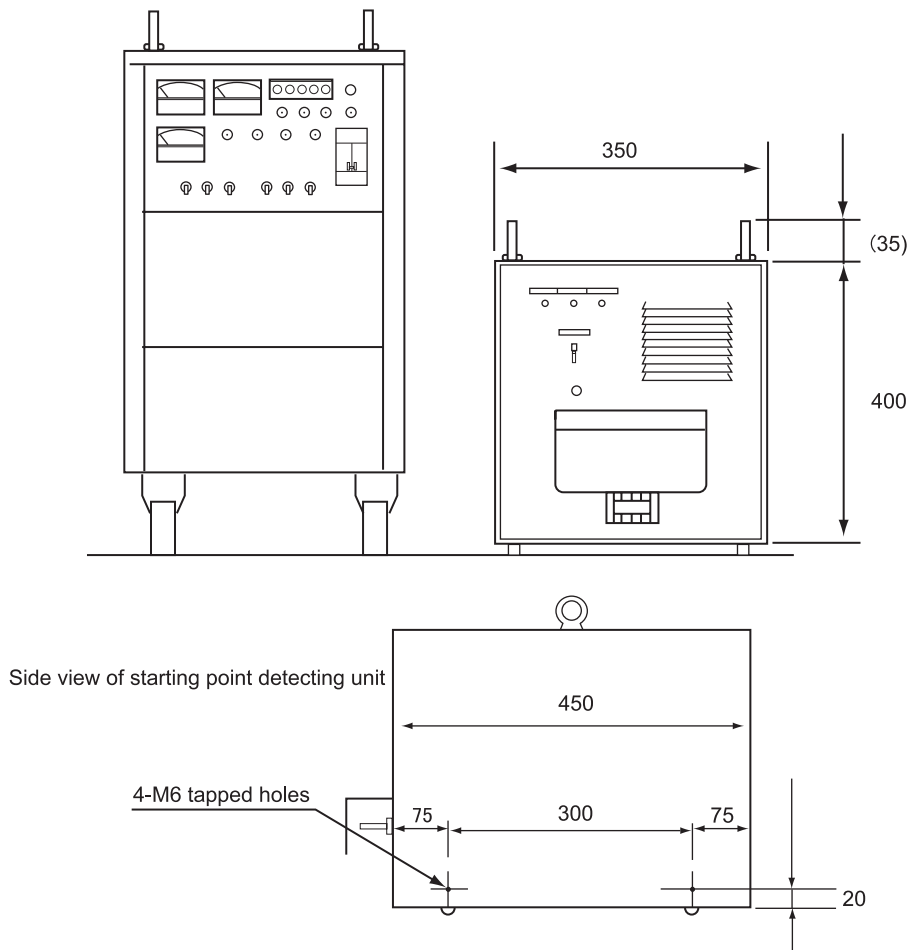


Fig. 3 Floor-mounted Standard Type Installation (Dimensions in mm)

2.2 Floor-mounted Slim Type

To prevent the unit from falling, weld the bracket at the bottom of the starting point detecting unit to the common base, or drill holes on the bracket to attach the unit with anchor bolts.

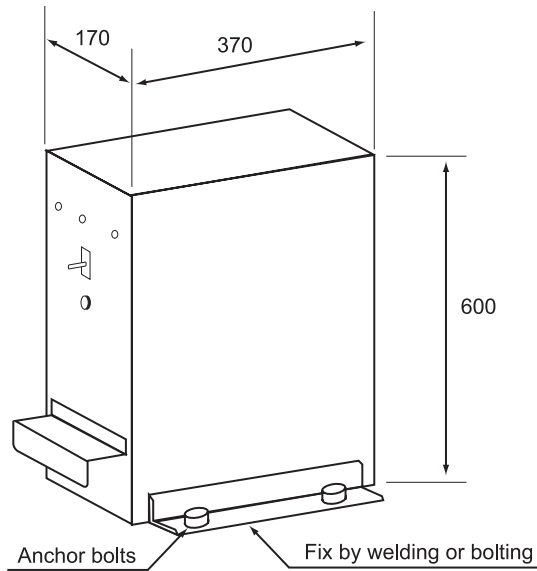


Fig. 4 Floor-mounted Slim Type Installation (Dimensions in mm)

2.3 Side-by-side Type

The starting point detecting unit should be attached to a welder with eyebolts on the top of the welder.

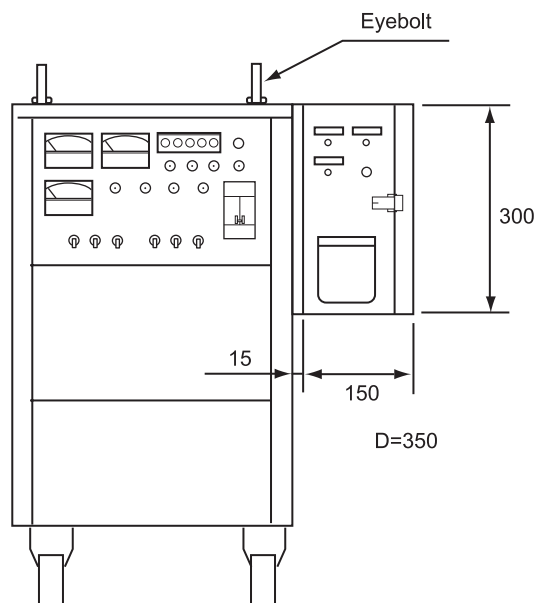


Fig. 5 Side-by-side Type Installation (Dimensions in mm)

3 Wiring



WARNING

- Do not place any object directly on the cable of the starting point detecting unit.

Failure to observe this warning may result in an injury or damage caused by the disconnection of the cable.

- Attach the cable of the starting point detecting unit for the wire feeder with the wire stand, to protect it from robot movement. If interference between the cable and the peripheral devices can not be avoided, cover the cable with a rubber plate or spiral tube, etc.

Failure to observe this warning may result in an electric shock, an injury, or damage to the cable.

- Do not lay the cable of the starting point detecting unit directly on the floor, but install them in a pit or duct or attach the cable with a protective cover.

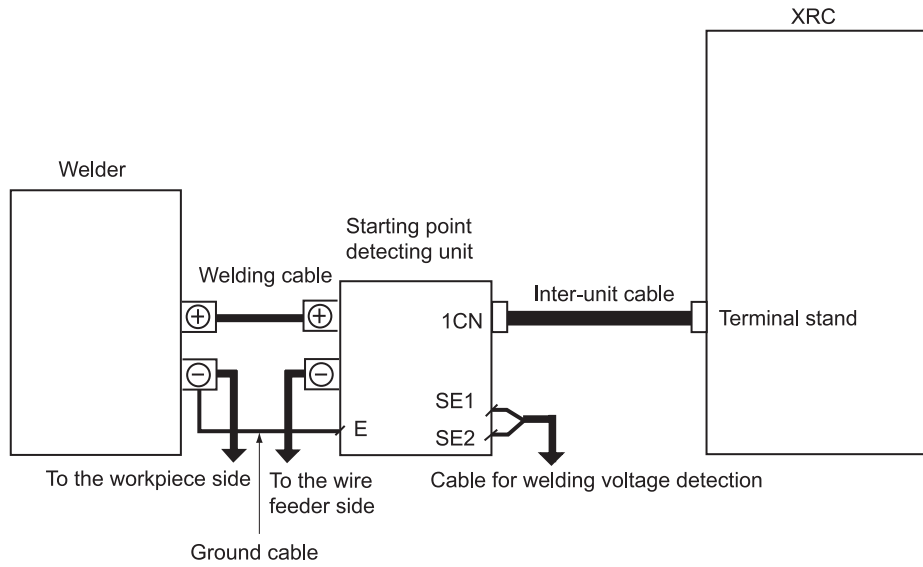
Failure to observe this warning may result in an injury or damage to the cable.

- Since a high current flows through the welding cable, separate it from the cables of the control circuit system. If the cables can not be separated, take preventative measures such as using metallic ducts or tubes on the cables of the control circuit system.

Wire the unit in the following manner, referring to Fig. 6.

1. Connect the 1CN on the starting point detecting unit to the XRC terminal stand.
2. Connect the + terminal of the starting point detecting unit to the + terminal of the welder.
3. Connect the - terminal of the starting point detecting unit to the torch power supply section on the wire feeder side.
4. For the floor-mounted standard type and the floor-mounted slim type, connect the front terminal stand of the starting point detecting unit to the welding voltage detecting terminal on the wire supply unit side.
For the side-by-side type, connect the front terminal stand of the starting point detecting unit to the terminal stand inside the welder.

- Floor mounted type (standard and slim types)



- Side-by-side type

DAIHEN : CPVY-350

NASTOA : Inverter Ace 350Y

MATSUSHITA : YD-350RFG10, YD-200RFG10

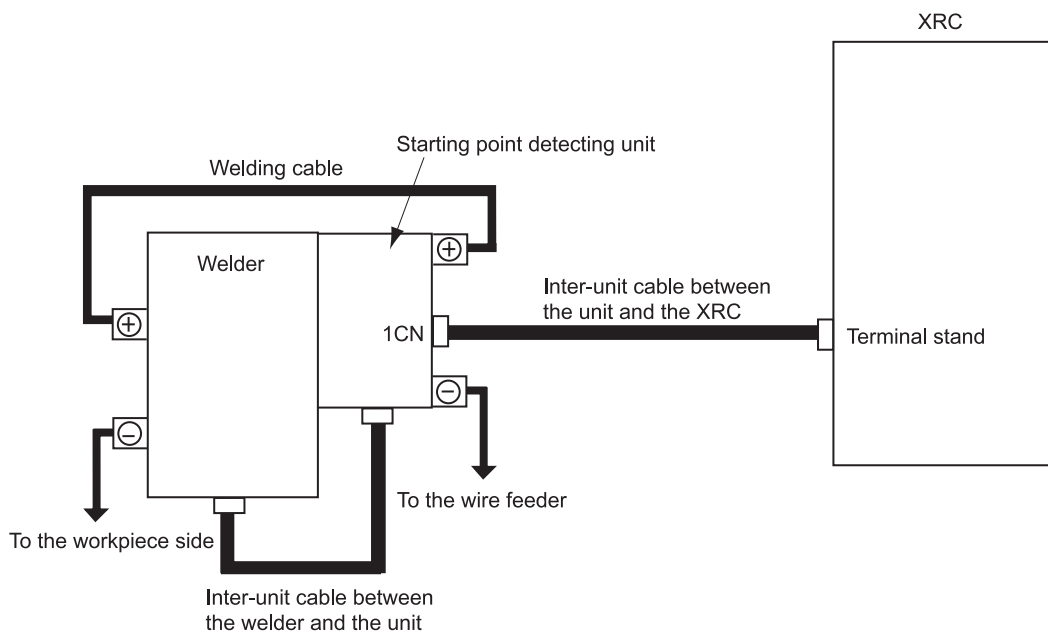


Fig 6 Diagram of Starting Point Detecting Unit

4 Teaching

This chapter describes the teaching methods of the single starting point detecting function and the coordinated starting point detecting function.

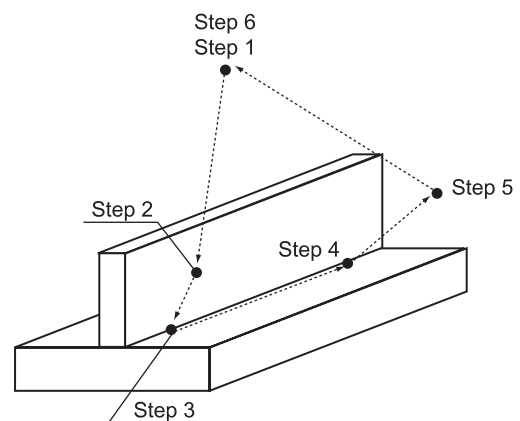
4.1 Single System

The single manipulator starting point detecting function detects the starting point with a single manipulator that includes the base axis. Detect the single manipulator starting point in the following manner.

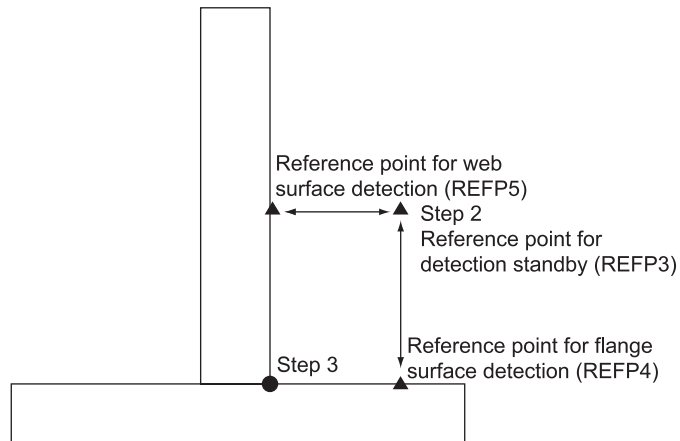
First, make a program for welding and a program for detecting the starting point.

1. Make a work job for welding.

```
WK01
NOP
MOVJ JV =50.00
MOVJ VJ =50.00
MOVL V =200
ARCON
MOVL V =60
ARCOF
MOVJ VJ =50.00
MOVJ VJ =50.00
END
```



2. Teach the following three reference points for defining the detection path near the groove. Add the reference points between the teaching steps 2 and 3.
- Reference point for detection standby (REFP3)
 - Reference point for flange surface detection (REFP4)
 - Reference point for web surface detection (REFP5)

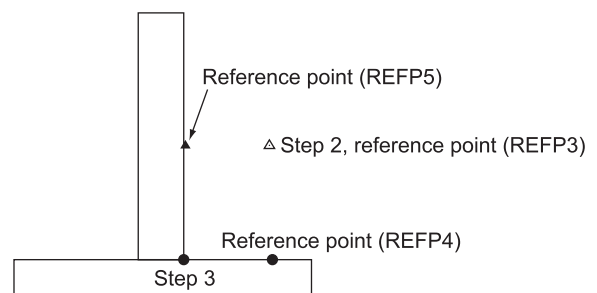
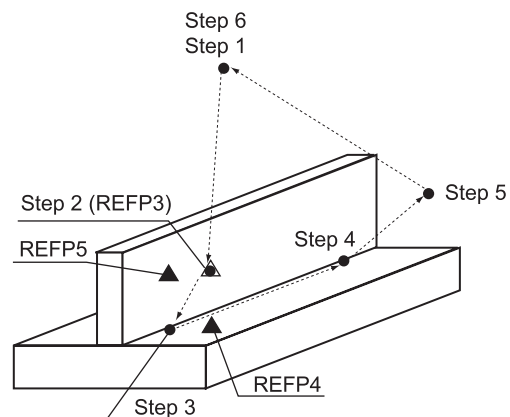


Reference Point Locations

```

WK01
NOP
MOVJ VJ =50.00
MOVJ VJ =50.00
REFP3
REFP4
REFP5
MOVL V =200
ARCON
MOVL V =60
ARCOF
MOVJ VJ =50.00
MOVJ VJ =50.00
END

```



Point Teaching for Defining Detection Path

3. Add the CALL instruction for the single starting point detecting job, TCH_JOB, in the work job WK01. In this example, the single starting point detecting job is named TCH_JOB.

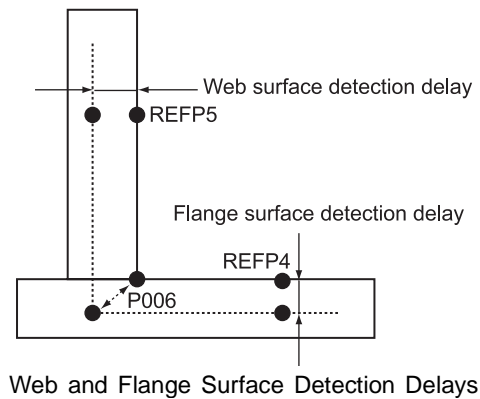
```
WK01
NOP
MOVJ VJ =50.00
MOVJ VJ =50.00
REFP3
REFP4
REFP5
CALL JOB:TCH_JOB
MOVL V =200
ARCON
MOVL V =60
ARCOF
MOVJ VJ =50.00
MOVJ VJ =50.00
END
```

Addition of the CALL Instruction for the Starting Point Detecting Job

4. Program to the work job, the detected starting point shift amount and an instruction to shift the welding path. The starting point shift amount is set at the position variable "P006" after carrying out the job, "TCH_JOB".

```
WK01
NOP
MOVJ VJ =50.00
MOVJ VJ =50.00
REFP3
REFP4
REFP5
CALL JOB:TCH_JOB
SFTON P006
MOVL V =200
ARCON
MOVL V =60
ARCOF
SFTOF
MOVJ VJ =50.00
MOVJ VJ =50.00
END
```

5. Measure the shift amount compensating for detection delay that is included in the starting point shift amount "P006", in advance. Also, when an offset from the groove position is required for welding, measure the offset separately.



Measurement of Shift Amount Compensating for Detection Delay

- 1) Detect the starting point when the positions are taught and the workpiece is not offset.
- 2) Calculate the differences between the detected web surface position and the taught web surface position, and between the detected flange surface position and the taught flange surface position. Register the differences at the position variable P006.
- 3) Copy the set value at the position variable P006 to P010. This offset amount of P010 is the amount of the detection delay offset.

To subtract the detection delay offset amount P010 from the offset amount P006 obtained by starting point detection, add a subtraction instruction as follows.

```

WK01
NOP
MOVJ VJ =50.00
MOVJ VJ =50.00
REFP3
REFP4
REFP5
CALL JOB:TCH_JOB
SUB P006 P010
SFTON P006
MOVL V =200
ARCON
MOVL V =60
ARCOF
SFTOF
MOVJ VJ =50.00
MOVJ VJ =50.00
    
```

Addition of Subtraction Instruction

The work job added with the starting point detecting function has been completed.

4.2 Coordinated System

The coordinated starting point detecting function detects the starting point in a coordinated operation using two manipulators or a manipulator and station.

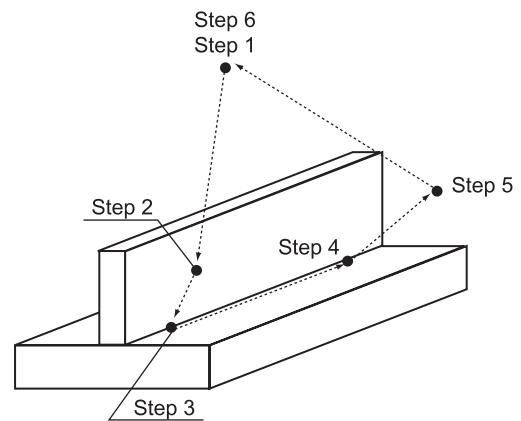
When a welding job carries out a coordinated operation, the coordinated starting point detection must be carried out instead of the single starting point detection.

Detect the coordinated starting point in the following manner.

1. Make a work job for welding.

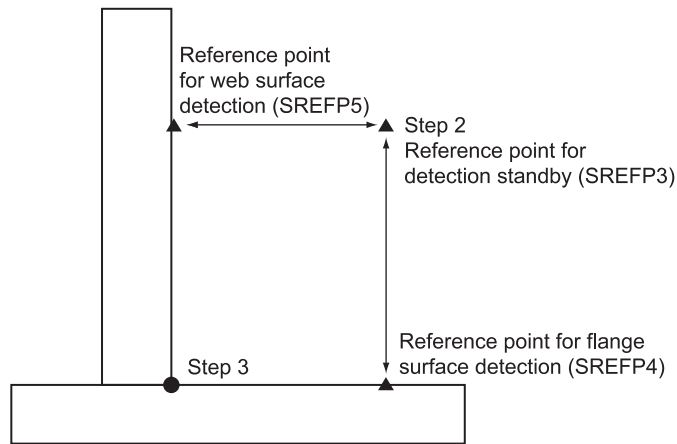
```

WK01
NOP
MOVJ VJ =50.00
+MOVJ
MOVJ VJ =50.00
+MOVJ
SMOVL V =200
+MOVL
ARCON
SMOVL V =60
+MOVL
ARCOF
MOVJ VJ =50.00
+MOVJ
MOVJ VJ =50.00
+MOVJ
END
  
```



2. Teach the following three reference points for defining the detection path near the groove. Add the reference points between the teaching steps 2 and 3.

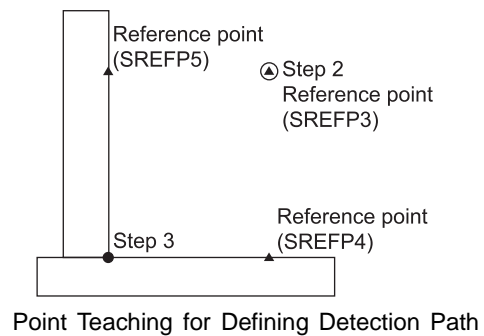
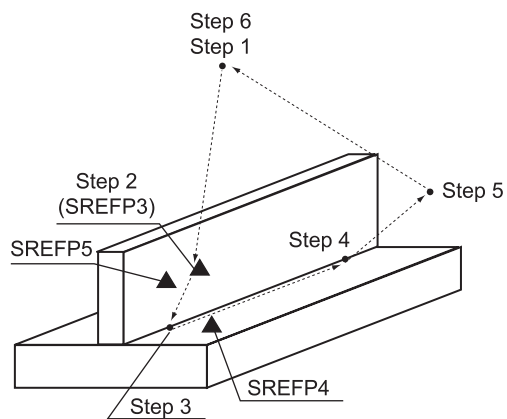
- Reference point for detection standby (SREFP3)
- Reference point for flange surface detection (SREFP4)
- Reference point for web surface detection (SREFP5)



Reference Point Locations

```

WK01
NOP
MOVJ VJ =50.00
+MOVJ
MOVJ VJ =50.00
+MOVJ
SREFP3
SREFP4
SREFP5
SMOVL V =200
+MOVL
ARCON
SMOVL V =60
+MOVL
ARCOF
MOVJ VJ =50.00
+MOVJ
MOVJ VJ =50.00
+MOVJ
END
    
```



Point Teaching for Defining Detection Path

3. Add the CALL instruction for the coordinated starting point detecting job, TCH_JOB, in the work job WK01. In this example, the coordinated starting point detecting job is named TCH_JOB.

```
WK01
NOP
MOVJ VJ =50.00
+MOVJ
MOVJ VJ =50.00
+MOVJ
SREFP3
SREFP4
SREFP5
CALL JOB:TCH_JOB
SMOVL V =200
+MOVL
ARCON
SMOVL V =60
+MOVL
ARCOF
MOVJ VJ =50.00
+MOVJ
MOVJ VJ =50.00
+MOVJ
END
```

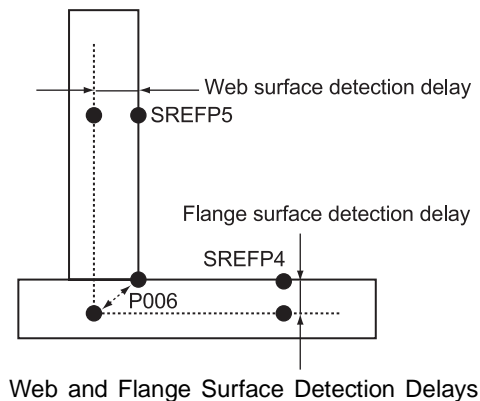
Addition of the CALL Instruction for the Starting Point Detecting Job

4. Program to the work job, the detected starting point shift amount and an instruction to shift the welding path. The starting point shift amount is set at the position variable "P006" after carrying out the job, "TCH_JOB".

```

WK01
NOP
MOVJ VJ =50.00
+MOVJ
MOVJ VJ =50.00
+MOVJ
SREFP3
SREFP4
SREFP5
CALL JOB:TCH_JOB
SSFTON P006
SMOVL V =200
+MOVL
ARCON
SMOVL V =60
+MOVL
ARCOF
SSFTOF
MOVJ VJ =50.00
+MOVJ
MOVJ VJ =50.00
+MOVJ
END
    
```

5. Measure the shift amount compensating for detection delay that is included in the starting point shift amount "P006", in advance. Also, when an offset from the groove position is required for welding, measure the offset separately.



Measurement of Shift Amount Compensating for Detection Delay

- 1) Detect the starting point when the positions are taught and the workpiece is not offset.
- 2) Calculate the differences between the detected web surface position and the taught web surface position, and between the detected flange surface position and the taught flange surface position. Register the differences at the position variable P006.
- 3) Copy the set value at the position variable P006 to P010. This offset amount of P010 is the amount of the detection delay offset.

To subtract the detection delay offset amount P010 from the offset amount P006 obtained by starting point detection, add a subtraction instruction as follows.

<p> WK01 NOP MOVJ VJ =50.00 +MOVJ MOVJ VJ =50.00 +MOVJ SREFP3 SREFP4 SREFP5 CALL JOB:TCH_JOB <u>SUB P006 P010</u> SSFTON P006 SMOVL V =200 +MOVL ARCON SMOVL V =60 +MOVL ARCOF SSFTOF MOVJ VJ =50.00 +MOVJ MOVJ VJ =50.00 +MOVJ END </p>
--

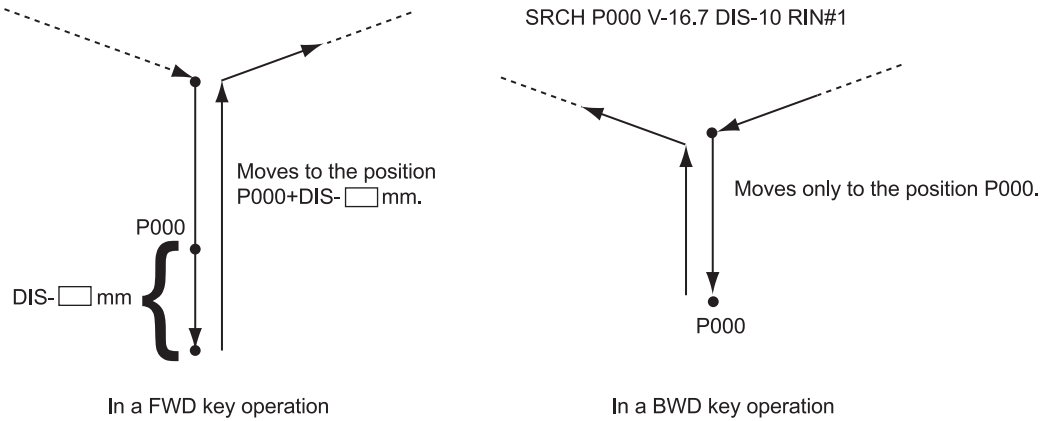
Addition of Subtraction Instruction

The work job added with the starting point detecting function has been completed.

NOTE

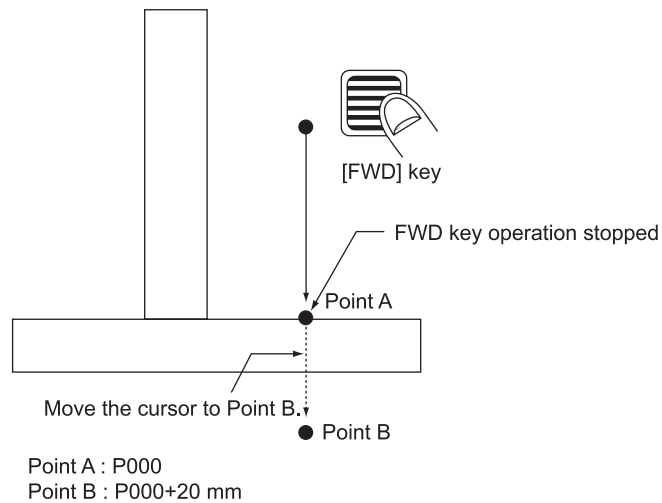
- The moving amount of the SRCH in a FWD key operation is different from the amount in a BWD key operation.

• `MOVL P000 V = 10.0 SRCH RIN#1 = ON T = 0.1 DIS = 10.0`



- During a FWD key operation, the SRCH instruction is not output to the starting point detecting unit. Therefore, the manipulator moves as specified by the position variable set for the SRCH instruction and the distance (DIS), but detection is not done.

Holding down the [FWD] key moves the manipulator from point A to point B continuously. Release the [FWD] key, move the cursor to the next step, and then press the [FWD] key again.



- Since the starting point detecting function finds a workpiece position by touching with a wire, irregular wire length negatively affects the detection accuracy. Before detection, check to make sure that the wires are the same length.

5 Instructions

This chapter describes the instructions used in the starting point detecting function.

5.1 Format

5.1.1 SRCH (Search Instruction)

SRCH is an instruction to carry out the search function. It is an additional item to the move instruction.

Format : MOVL <Position type variable> <V = Speed> SRCH RIN# (Direct IN No.) = <Status>
<T = Time> DIS = <Distance>

- Position type variable : Manipulator (P) position type variable
- Speed : Control point speed (Set a moderate speed so that the welding wire is not bent.)
- Direct IN No. : 1 to 3
- Status : Status of direct IN No.
ON/OFF or B type variable
- Distance : Specifies the shift amount from the target point specified by the position type variable.
In units of 0.1 mm (0 to 6553.4 mm)
- Time : The delay time of starting the direct IN input check (in units of 0.01 sec.)
While the starting point detecting unit relay is switched from 0 V to 200V, a direct IN signal may be input continuously. Therefore, T must be set to 0.1 sec. or longer.
- Result When a direct IN signal is input, "1" is set to \$B002. When the direct IN signal is not input, "0" is set to \$B002.

5.1.2 GETS (Read-in System Variable Instruction)

GETS is an instruction to save a system variable (\$ variable) as a user variable. The XRC can not use system variables directly for operating instructions. Use GETS to fetch a value as a user variable.

Format : GETS <User variable> <System variable>

For GETS, remember the following points.

- The user and the system variables must be of the same type.

<Example>

GETS B000 \$B000

- Position variables can be specified only by PX variables.
- PX variables are position type variables that are defined in a job. In a job for a single manipulator, PX000 equals P000.

For details of \$PX variables, refer to “Section 5.2 System Variables”.

5.1.3 CNVRT (Position Variable Conversion Instruction)

CNVRT is an instruction to convert a pulse-type position variable into a Cartesian data position type variable, using a specified coordinate system.

Format : CNVRT PX variable PX variable <Coordinate system>
 (B) (A)

- PX variable (A) : Pulse data only
- PX variable (B) : Cartesian data (Converted Cartesian data is stored.)
- Coordinate system

Base coordinate :	BF
Manipulator coordinate :	RF
Tool coordinate :	TF
User coordinate :	UF
Master tool coordinate :	MTF

When the master tool coordinate is selected, the pulse data is converted into Cartesian data on the coordinates relative to the master manipulator (only when a coordinated system is selected).

5.2 System Variables

In this section, the system variable function and the PX variables are explained.

5.2.1 System Variable Function

GETS is the only instruction that refers to system variables written by the controller system.

System Variable	Type	Explanation
\$B-type	B	\$B002 : Specifies whether the SRCH instruction was detected/not detected. 0 : Not detected, 1 : Detected
\$I-type	I	Not used
\$D-type	D	Not used
\$R-type	R	Not used
\$PX-type	PX	\$PX000 : Current pulse \$PX002 : Detecting position pulse \$PX011 : REFP1 pulse \$PX012 : REFP2 pulse \$PX013 : REFP3 pulse \$PX014 : REFP4 pulse \$PX015 : REFP5 pulse \$PX016 : REFP6 pulse \$PX017 : REFP7 pulse \$PX018 : REFP8 pulse \$PX021 : SREFP1 pulse \$PX022 : SREFP2 pulse \$PX023 : SREFP3 pulse \$PX024 : SREFP4 pulse \$PX025 : SREFP5 pulse \$PX026 : SREFP6 pulse \$PX027 : SREFP7 pulse \$PX028 : SREFP8 pulse

5.2.2 PX Variables

The PX variable is a group of position variables that are defined by the control group specified in the job header.

- When the control group is R1, PX000 indicates P000.
- When the control group is R1+B1, PX000 indicates P000 and BP000.
- When the control group is R1+B1+ST1, PX000 indicates P000, BP000 and EX000.
- When the control group is R1+R2+B1+B2+ST1, and the job is a cooperated job and the master coordinates are R1+B1, PX000 indicates the following coordinates.

P000 R2 (slave)

P001 R1 (master)

BP000 B2 (slave)

BP001 B1 (master)

EX000 ST1

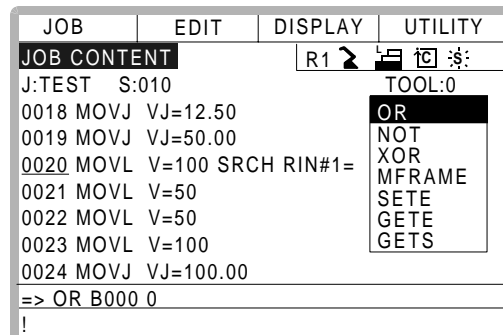
6.2 GETS Instruction

Operation

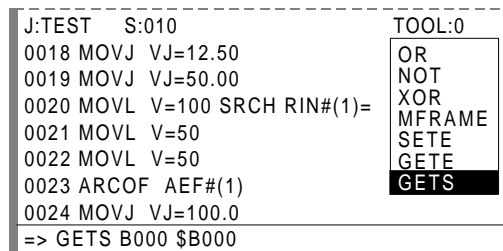
Move the cursor to the address area ➔ Move the cursor to the line where GETS instruction is to be registered ➔ Press [INFORM LIST]*1 ➔ Select "GETS"*2 ➔ Press [ENTER] twice*3 ➔ Enter variables in the detail edit display of GETS instruction ➔ Press [ENTER] twice*4

Explanation

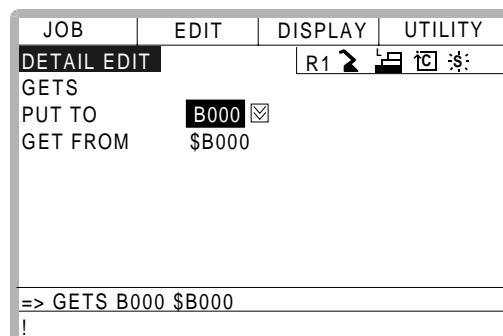
- *1 The instruction list dialog appears. The cursor moves to the instruction list dialog, while the cursor in the address area changes to an underbar.



- *2 The instruction where the cursor is positioned is displayed in the input buffer line with the previously registered additional items.



- *3 The detail edit display of the GETS instruction appears.



- *4 Pressing [ENTER] once displays the set contents in the input buffer line. Pressing [ENTER] again registers the set contents in the job.

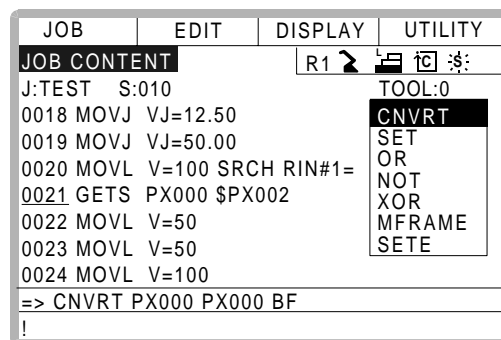
6.3 CNVRT Instruction

Operation

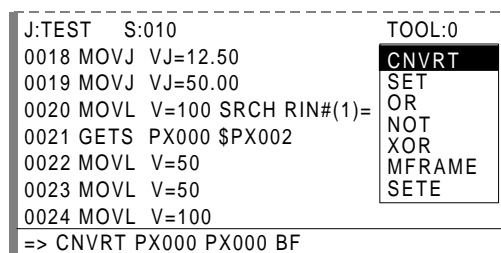
Move the cursor to the address area ➡ Move the cursor to the line where CNVRT instruction is to be registered ➡ Press [INFORM LIST]*1 ➡ Select "CNVRT"*2 ➡ Press [ENTER] twice*3 ➡ Enter variables in the detail edit display of CNVRT instruction ➡ Press [ENTER] twice*4

Explanation

- *1 The instruction list dialog appears. The cursor moves to the instruction list dialog, while the cursor in the address area changes to an underbar.



- *2 The instruction where the cursor is positioned is displayed in the input buffer line with the previously registered additional items.



6.3 CNVRT Instruction

- *3** The detail edit display of the CNVRT instruction appears.

JOB	EDIT	DISPLAY	UTILITY
DETAIL EDIT		R1	↩ ⏪ ⏩ ⏹
CNVRT			
DESTINATION	PX000		
SOURCE	PX000		
COORDINATE	BF		
=> CNVRT PX000 PX000 BF			
!			

- *4** Pressing [ENTER] once displays the set contents in the input buffer line. Pressing [ENTER] again registers the set contents in the job.

7 Alarm Message List

Alarm Number	Message	Cause	Remedy
4474	WRONG CONTROL GROUP AXIS	An instruction such as CALL or JUMP was used for a job other than in the currently used job control group.	Use the same control group for the call destination job, as the control group for the call source job.
4499	UNDEFINED POSITION VARIABLE	Undefined position data was used.	Define the position data.
4507	REFP POS ERROR (SEARCH MOTION)	The distance between the search starting point and the target point was too short to determine the search direction.	Reset the alarm and increase the distance between the search starting point and the target point.



8 Instruction List

< > indicates numerical or alphabetical data. If multiple items are shown in one section, select one of the items.

SRCH (Search)	Function	Executes the SRCH function	
	Format	RIN# (<Direct IN No.>) = <Status>	Direct IN No.: 1 to 3 Status : ON, OFF, B <Variable No.>
		T = <Time in sec.>	The delay time of starting the direct IN signal input check
		DIS = <Distance in mm>	Shift amount from the target point specified by the position variable
Example	MOVL P000 V=138 SRCH RIN#(1)=ON T=1.00 DIS=10.0		
GETS (Get S)	Function	Save the system variable as a user variable	
	Format	B <Variable No.> , I <Variable No.>, D <Variable No.>, R <Variable No.>, PX <Variable No.>	User variable
		\$B <Variable No.>, \$I <Variable No.>, \$D <Variable No.>, \$R <Variable No.>, \$PX <Variable No.>	System variable
Examples	GETS B000 \$B000 GETS I001 \$I[1] GETS PX003 \$PX001		

CNVRT (Convert)	Function	Converts the position variable of Data 2 to a Cartesian data position variable using a specified coordinate system, and stores in Data 1. Format: CNVRT <Data 1> <Data 2> Coordinate system specification		
	Format	Data 1	PX <Variable No.>	
		Data 2	PX <Variable No.>	
		BF, RF, TF, UF# (<User coordinate No.>), MTF		BF : Base coordinate RF : Manipulator coordinate TF : Tool coordinate UF : User coordinate MTF : Master tool coordinate
Examples	CNVRT PX000 PX001 BF CNVRT LPX000 LPX001 TF			

YASNAC XRC OPTIONS INSTRUCTIONS

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YASKAWA ELECTRIC CORPORATION

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