DX200 OPTIONS
INSTRUCTIONS

FOR MULTI-LAYER WELDING FUNCTION

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

MOTOMAN INSTRUCTIONS

MOTOMAN--□□□ INSTRUCTIONS
DX200 INSTRUCTIONS
DX200 OPERATOR'S MANUAL
DX200 MAINTENANCE MANUAL

The DX200 Operator's manual above corresponds to specific usage.
Be sure to use the appropriate manual.

Part Number: 165302-1CD
Revision: 0

MOTOMAN ROBOTICS

MANUAL NO.
HW1482197◈0

MANDATORY

- This manual explains the Multi-layer Welding Function of the DX200 system. Read this manual carefully and be sure to understand its contents before handling the DX200.
- General items related to safety are listed in Chapter 1: Safety of the DX200 Instructions. To ensure correct and safe operation, carefully read the DX200 Instructions before reading this manual.

CAUTION

- Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.
- The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.
- YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.
- If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.
- YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.

Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the DX200.

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 pressing the emergency stop buttons on the front door of the DX200 and the programming pendant.
  When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

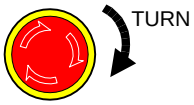
Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

Figure 1: 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.

Figure 2: Release of Emergency Stop



- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Keep in mind the emergency response measures against the manipulator's unexpected motion toward you.
  - Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

- Confirm that no person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  - Turning ON the power for the DX200.
  - Moving the manipulator with the programming pendant.
  - Running the system in the check mode.
  - Performing automatic operations.

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there is a problem. The emergency stop buttons are located on the right of the front door of the DX200 and the 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 DX200 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 Warning Labels in the DX200 Instructions before operating the manipulator:

Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.

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

In this manual, the equipment is designated as follows:

Equipment	**Manual Designation**
DX200 controller	DX200
DX200 programming pendant	Programming pendant
Cable between the manipulator and the controller	Manipulator cable

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

Equipment		Manual Designation
Programming Pendant	Character Keys /Symbol Keys	The keys which have characters or its symbol printed on them are denoted with [ ]. ex. [ENTER]
	Axis Keys /Numeric Keys	[Axis Key] and [Numeric Key] 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}

Description of the Operation Procedure

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

Registered Trademark

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

Table of Contents

1 Outline

1.1 Multi-layer Welding Function

The multi-layer welding function is used to weld a workpiece with multiple layers which, otherwise, cannot be satisfactorily welded with a single layer. The first layer is welded while the COMARC instruction executes the arc sensing for correcting the path. At the same time, the path is stored and jobs for the 2nd and following layers are created automatically based on the stored path by the memory and playback function.
(Memory and playback function)

The workpieces subjected to the multi-layer welding are generally thick and have problems such as “variations in welding accuracy”, “distortion during welding”, and “positioning errors due to setting error”. Therefore simply reproducing the taught path is not enough to attain high-quality welding. For the solution of these problems, the search function and the arc sensing function are used.

1.2 Features

The main features of multi-layer welding function are listed below.

Table 1-1: Main features of multi-layer welding function

Items	Contents	Features
Point variables	The taught position data on the 1st layer are registered in point variables. These point variables are used for the weldings on the 2nd and the following layers.	By using the point variables where the taught position data on the first layer are registered, the time required for the teaching for the second and the following layers can be reduced.
Memory and playback function	Stores the corrected path of the first layer by the arc sensor and reproduces the stored path on the second and the following layers.	Reproducing the corrected path on the first layer for the second and the following layers realizes the high-quality welding. For reproducing the corrected path for the second and the following layers, either the same direction as the welding on first layer or the reversed direction can be selected.
Search and shift function	Four shift patterns are available. At the execution of the instruction, the amount of the deviation from the taught position is automatically calculated and the following steps are shifted accordingly.	One instruction executes search and shift functions, which simplifies the operation. Specifying the shift type such as shift in parallel or shift in rotation makes the correction of the workpiece positioning error easy.
Overriding Welding Condition Function	During playback operation, the welding conditions can be adjusted and changed.	Overriding the welding conditions such as arc sensing, weaving amplitude, realizes easy adjustment of the welding conditions.
Shift function	After the search and shift operations, the taught position can be modified during the shift operation in teach mode.	Since it is not necessary to change the target position on the master workpiece, the modification of the taught position is easy.

2 Basic Operations

2.1 Robot Posture Control by Euler Angles

2.1.1 Outline

Different from the robot control in the ordinary coordinate systems, the robot optimum posture for welding is controlled by Euler angles. The robot posture control by Euler angles is shown in *Figure 2-1*.

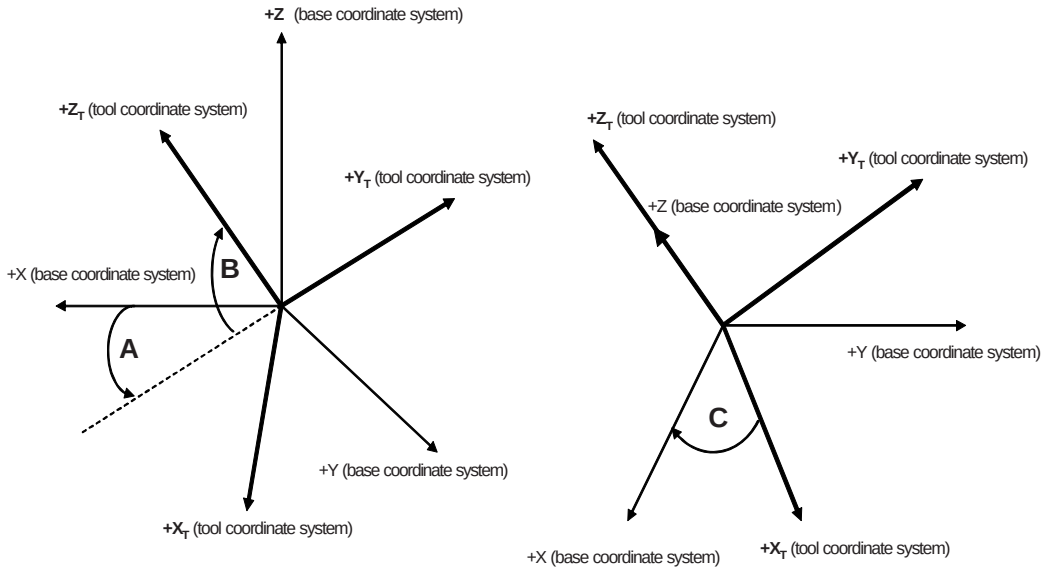
The Euler angles in the base coordinate system are as follows:

A: The angle between the X-axis and the Z-axis of the tool coordinate system projected on the X-Y plane of the base coordinate system ($-180° < A \leq 180°$)

B: The angle between the Z-axis of the tool coordinate system and the X-Y plane of the base coordinate system ($-90° < B \leq 90°$)

C: The angle to move X and W-axis of the tool coordinate system on X' and Y'-axis where X', Y' and Z' are the axes in such coordinate system as Z-axis of the base coordinate system is moved on Z-axis of the tool coordinate system by rotating the base coordinate system around Z-axis and then around Y-axis ($-180° < C \leq 180°$):

Fig. 2-1: Euler Angles

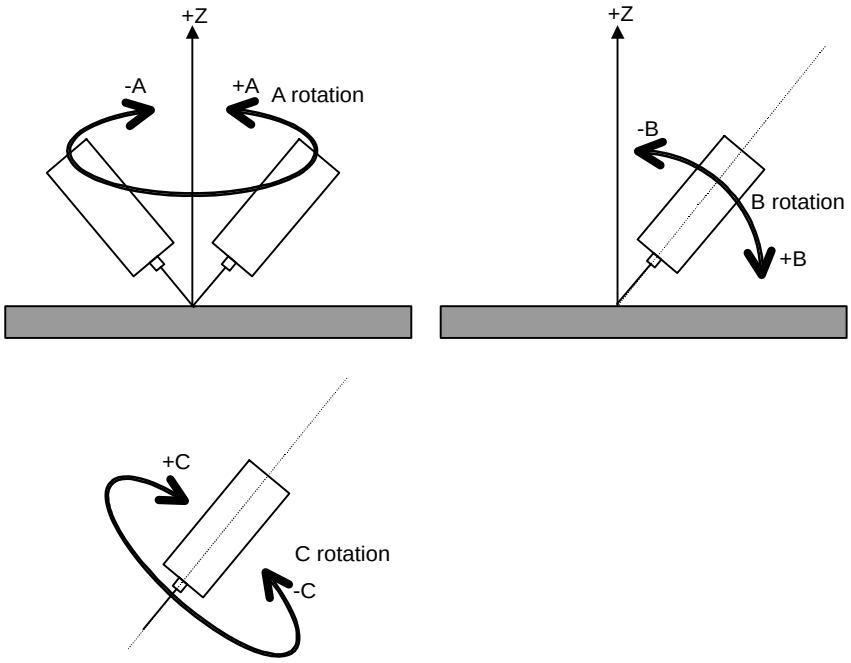


2.1.2 Operation

2.1.2.1 Cartesian coordinate system

When the Cartesian coordinate system is selected, pressing X, Y, or Z key moves the tool in parallel to the X, Y, or Z axis in the base coordinate system. Accordingly, pressing axis key changes the tool posture without changing the position of the tool center point as shown in *Figure 2-2*.

Fig. 2-2: Jog Motion in Posture Control



A: Rotates around the Z-axis in the base coordinate system

B: Rotates the tool in horizontal and vertical motion to the X-Y plane

C: Rotates centering around the tool axis

2.1.2.2 Tool coordinate system

When the tool coordinate system is selected, pressing Z key moves the tool in parallel to the Z-axis of the base coordinate system.

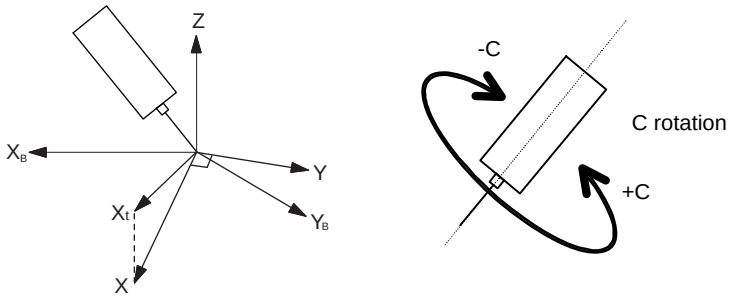
Pressing X key moves the tool to the direction that the X direction of the tool coordinate system is projected on the X-Y plane of the base coordinate system.

Pressing Y key moves the tool by 90 degrees from the X direction in counterclockwise on base coordinate XY plane.

Pressing each A and B rotation key moves the tool same as A and B rotation of cartesian coordinate system.

Pressing C rotation key rotates the tool in the reverse direction of the C rotation of the cartesian coordinate system.

Fig. 2-3: Jog Motion in Tool Coordinate System



2.2 Point Variables

2.2.1 Outline

The point variables store and manage the taught position data in the job. The point variables can be used to move the robot to the same position multiple times in one job.

Registering the taught position data to the point variables can reduce the time required for teaching within the job.

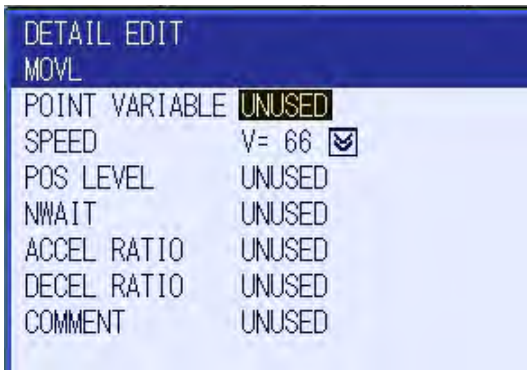
Difference between the point variables and the position variables (P***)

- The position variables can be read or written from/to all jobs, while the point variables can be used only in the job where these point variables are registered. Therefore, the identical numbers can be used for the point variables of other jobs.
- The taught position data and the shift amount can be stored in the position variable. In the point variables, only the taught position data can be stored.
- 128 position variables are available as standard (can be expanded to 5,000). A point variable is created when a move instruction is registered in the job, and the point variable number can be set arbitrarily in the range from 0 to 9999.
- By using the instructions SET and SETE, a position can be registered to a position variable, however, these instructions can not be used to register a position to a point variable.
- The position variables cannot be deleted (can be left without position data). The point variables are deleted when the job where these point variables are registered is deleted.

2.2.2 Registering Point Variables

■ **Replacing the taught position data of the move instruction with the point variable.**

1. Move the cursor to the instruction area, and press [SELECT] twice on the desired move instruction.
   – The detail edit display of the move instruction appears.



   • Select “UNUSED” of “POINT VARIABLE,” and select “T”.
   • Press [SELECT], and enter a point variable number.

2. Press [ENTER].
   – The entered point variable number (T0010) appears in the input buffer line.

3. Press [ENTER].

   – The entered contents are registered in the job. If another point variable with the same number has been already used in the same job, the already used point variable, even if no taught position data is specified in the point variable, is registered. Newly created and numbered point variable has no taught position data regardless of SERVO ON/OFF status.

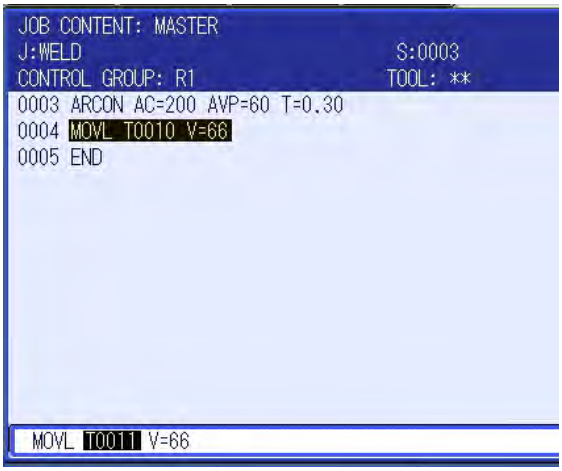
NOTE

- When a point variable with no taught position data specified is registered, "✶" is indicated for the TOOL number in the job content display.
- The job in which the point variable with no taught position data specified is registered cannot be loaded/saved by FC2 (same as for the position variables).

■ Changing the number of the point variable (Method 1)

1. -Move the cursor to the instruction area, and press [SELECT] on the desired move instruction.
   -Move the cursor to the point variable whose number to be changed, and press [SELECT].
   – A new number for the point variable can be typed.

2. Enter a point variable number and press [ENTER].
   – The entered point variable number (T0011) appears in the input buffer line.
   .



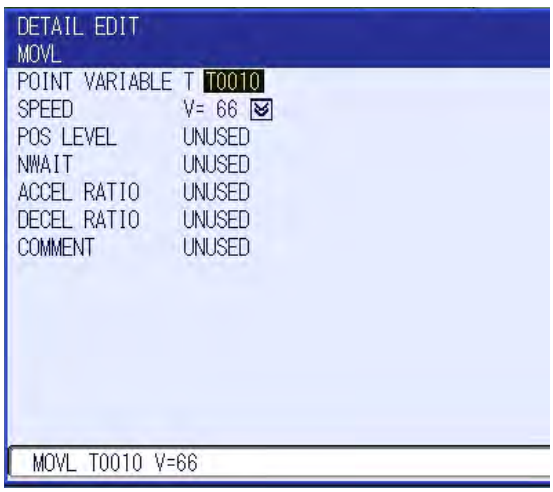
3. Press [ENTER].
   – The entered contents are registered in the job. If another point variable with the same number has been already used in the same job, the already used point variable, even if no taught position data is specified in the point variable, is registered. Newly created and numbered point variable has no taught position data regardless of SERVO ON/OFF status.

NOTE

- When a point variable with no taught position data specified is registered, "✶" is indicated for the TOOL number in the JOB CONTENT display.
- The job in which the point variable with no taught position data specified is registered can not be loaded/saved by FC2 (same as for the position variables).

■ **Changing the number of the point variable (Method 2)**

1. Move the cursor to the instruction area, and press [SELECT] twice on the desired move instruction.
   – The detail edit display of the move instruction appears.
   .



2. Enter a point variable number and press [ENTER].
   – The entered point variable number (T0011) appears in the input buffer line.

3. Press [ENTER].
   – The entered contents are registered in the job. If another point variable with the same number has been already used in the same job, the already used point variable, even if no taught position data is specified in the point variable, is registered. Newly created and numbered point variable has no taught position data regardless of SERVO ON/OFF status.
   .

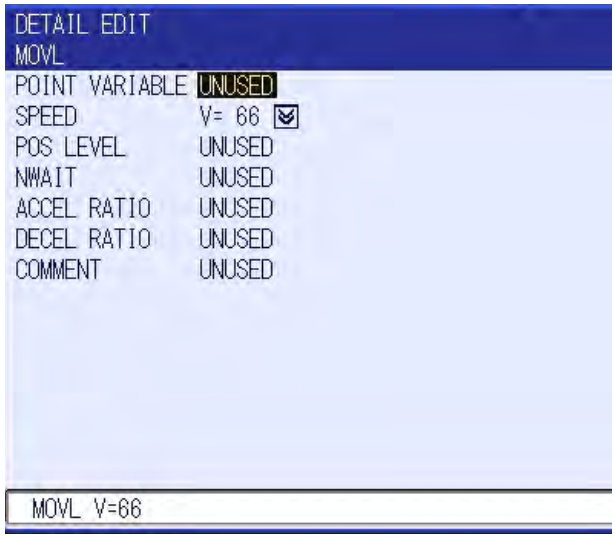
NOTE

- When a point variable with no taught position data specified is registered, "✶" is indicated for the TOOL number in the job content display.
- The job in which the point variable with no taught position data specified is registered can not be loaded/saved by FC2 (same as for the position variables).

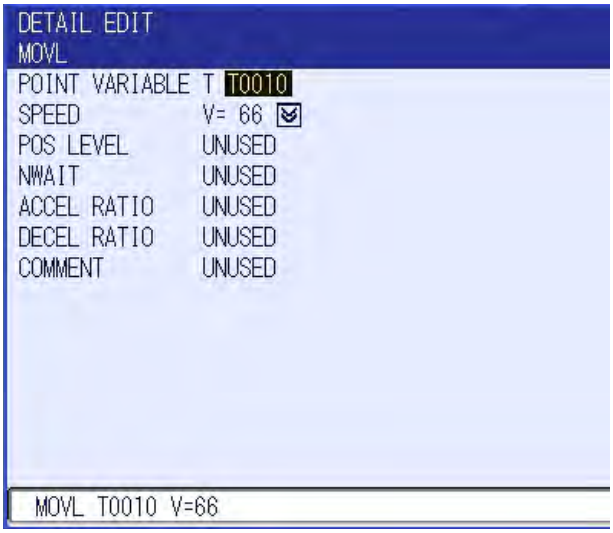
2.2.2.1 Registering a move instruction together with a point variable

1. Press [MOTION TYPE] to select the desired move instruction.
   – Each time [MOTION TYPE] is pressed, the move instruction is switched in the following order: “MOVJ”→ “MOVL”→ “MOVC”→ “MOVS”→ “MOVJ.

2. Press [SELECT] to display the detail edit display.
   – The detail edit display of the selected move instruction appears. Select “UNUSED” of “POINT VARIABLE,” and select “T”.



3. Enter a point variable number and press [ENTER].
   – The entered point variable number appears in the input buffer line.



4. Press [ENTER].
   – The entered contents are registered in the job. If another point variable with the same number has been already used in the same job, the already used point variable, even if no taught position data is specified in the point variable, is registered. Newly created and numbered point variable has no taught position data regardless of SERVO ON/OFF status.
   .

NOTE

- When a point variable with no taught position data specified is registered, "✶" is indicated for the TOOL number in the job content display.
- The job in which the point variable with no taught position data specified is registered can not be loaded/saved by FC2 (same as for the position variables).

2.2.3 Deleting a Point Variable

■ **Deleting the move instruction**

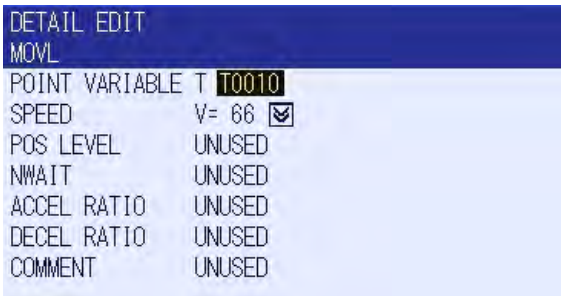
1. Move the cursor to the line number of the move instruction to be deleted.
2. Press [DELETE] and [ENTER].

NOTE

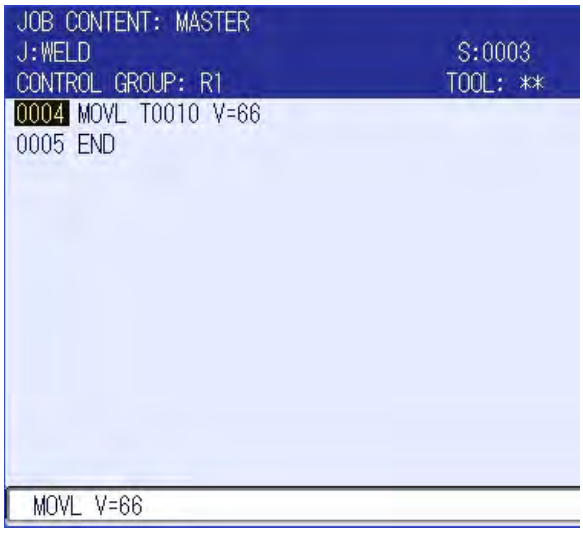
- When the deleted point variable is not used for other move instructions in the same job, it becomes in unused status, but retains the taught position data. However, the point variables in unused status will be deleted when another job is selected.
- Even if the manipulator's currnt position and the taught position (point variables) are different, a move instruction can be deleted.
- A move instruction with the point variable that has no taught position data specified can be also deleted.

■ **Deleting the point variable designation**

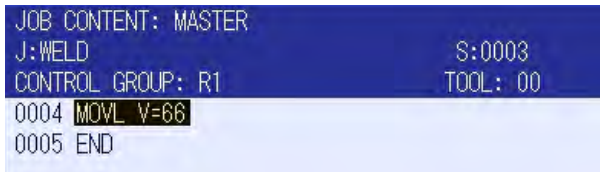
1. Move the cursor to the instruction area, and press [SELECT] twice on the desired move instruction.
   – The detail edit display of the move instruction appears.



2. Select the point variable (T0010), then select “UNUSED” and press [ENTER].
   – The modified contents appears in the input buffer line.



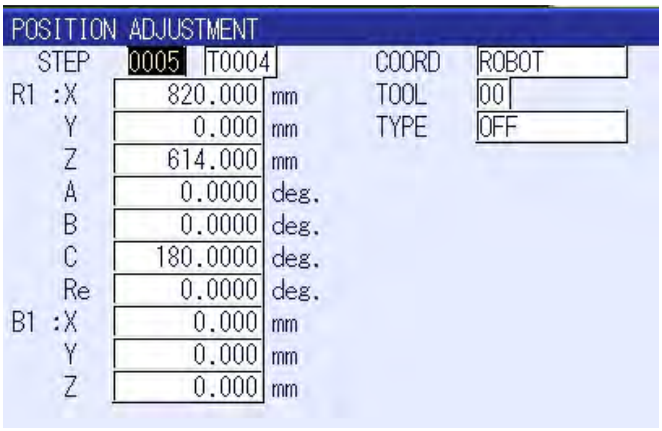
3. Press [ENTER].
   – The entered modification is registered in the job. The taught position data of the deleted point variable is reregistered.



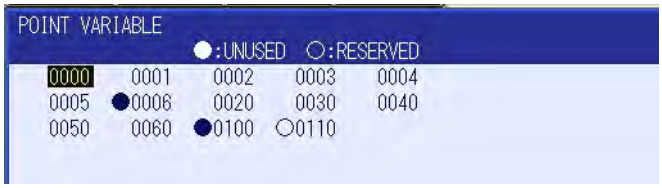
2.2.4 Editing the Point Variable (Taught Position Data)

■ **The taught position data can be edited by entering a numerical value. (Teaching point adjustment function)**

1. In JOB CONTENT display, select {POSITION ADJUSTMENT} from the pull-down menu of {UTILITY}.
   – The position adjustment display appears.



Selecting the point variable displays the list of point variables. Select a point variable whose position data is to be corrected.



2. Select the element to be changed in the position adjustment display.
   – Enter a value by using [Numeric Keys] .
   Enter a numerical value, and press [ENTER] and select "COMPLETE".

SUPPLE-MENT

For the details of changing the taught position data, refer to DX200 OPTIONS INSTRUCTIONS FOR TEACHING POINT ADJUSTMENT FUNCTION WITH PROGRAMMING PENDANT (Part Number: 165466-1CD).

2.3 Memory and Playback Function

2.3.1 Outline

The memory and playback function is used to correct the robot motion path for the correction amount measured by COMARC sensor and saved every sampling time set in the parameter. At the welding of the first layer, the result (correction amount) of the sensing by COMARC function is saved, and the saved correction amount is used at the welding of the second and following layers for correcting the robot motion path.

For the welding of the second and following layers, the corrected path can be reproduced in the reverse direction of the welding of the first layer.

NOTE

- COMARC function
  The COMARC function is necessary to use the memory and playback function.
  And, an expansion storage is needed to use the memory and playback function.

2.3.2 Instructions for Memory and Playback Function

The instructions used for the memory and playback function are listed below.

Table 2-1: Instructions for Memory and Playback Function

Sensor Instructions				
MEMON	Function	Starts the memory and playback function.		
	Instruction item	Data 1	REC	Saves the path correction amount measured by COMARC.
			PLY	Executes the correction for the saved correction amounts in the forward direction.
			BACKPLY	Executes the correction for the saved correction amounts in the reversed direction.
		Data 2	MPF# (File number)	1 - 50
MEMOF	Function	Cancels the memory and playback function.		
	Instruction items	None		
Arithmetic Instructions				
CLEAR	Function	Deletes a memory replay file.		
	Instruction items	MPF		Deletes all the memory and playback files.

2.3.3 Application Example

Create a welding job with two layers and three paths.

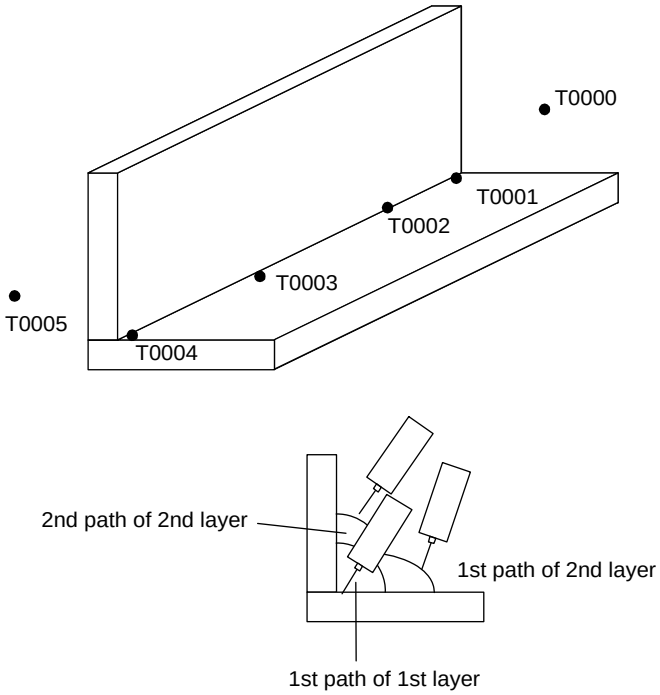
Execute the sensing by COMARC function during the welding on the first layer, and weld the first path of the second layer in the reverse direction of the welding on the first layer, then weld the second path of the second layer in the same direction of the welding on the first layer.

Table 2-2: Application Example

Job	
NOP	
MOVJ VJ=100	Stand-by point
MOVJ VJ=60	Moves the robot to the approach position.
MOVL T0000 V=200	Welding start position T0000
ARCON AC=330 AV=30 V=40	
COMARCON AMP=1.0 FREQ=3.5••	Starts the arc sensor.
MEMON REC MPF#(1)	Starts the saving operation for the memory and playback function.
MOVL T0001	
MOVL T0002	
MOVL T0003	
MOVL T0004	
MEMOF	Stops the memory and playback function.
COMARCOF	Stops the arc sensor.
ARCOF AC=200 AV=25 T=0.1	End of welding on 1st layer
GETS PX000 $PX040	Gets the correction amount measured by COMARC function.
SFTON P000 BF	Shifts for the correction amount.
'2Layer 1Path	(Welding on 1st path of 2nd layer)
MOVL T0005	Moves the robot to the approach position for 2nd layer.
SFTON P001 TF	Shifts the welding start position for 1st path of 2nd layer.
MOVL T0004 V=200	
ARCON AC=250 AV=28 V=40	
MEMON BACKPLY MPF#(1)	Starts the reproduction of the welding on the 1st layer in the reverse direction.
MOVL T0003	
MOVL T0002	

Job	
MOVL T0001	
MOVL T0000	
MEMOF	
ARCOF AC=180 AV=20 T=0.1	
SFTOF	Cancels the shift function.
'2Layer 2path	(Welding on 2nd path of 2nd layer)
MOVL V=200	Move the robot to the approach position for 2nd layer.
SFTON P002 TF	Shifts the welding start position for 2nd path of 2nd layer.
MOVL T0000 V=200	
ARCON AC=200 AV=25 T=0.1	
MEMON PLY MPF#(1)	Starts the reproduction of the welding on the 1st layer in the forward direction.
MOVL T0001	
MOVL T0002	
MOVL T0003	
MOVL T0004	
MEMOF	Cancels the memory replay function.
ARCOF AC=180 AV=20 T=0.1	
MOVL T0005	
MOVJ VJ=100	

Fig. 2-4: Application Example



2.4 Multi-layer Welding Tool Shift Function

2.4.1 Outline

For multi-layer welding, teaching the welding path on the 1st layer and shifting the taught positions to weld on the second and following layers can largely reduce the time required for teaching.

2.4.2 Tool Shift Coordinate System

The coordinates for the multi-layer welding tool shift function are determined by the positional relation between the robot coordinate and the tool coordinate.

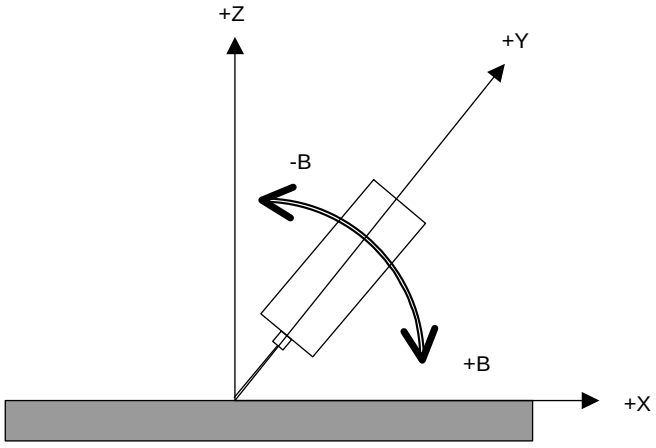
Multi-layer welding tool shift coordinate X: Z-axis of the tool coordinate projected on X-Y plane of the robot coordinate system

Multi-layer welding tool shift coordinate Y: Direction to Z-axis of the tool coordinate

Multi-layer welding tool shift coordinate Z: Direction to Z-axis of the robot coordinate

Multi-layer welding tool shift coordinate B: The posture angle from X-axis of the multi-layer welding tool shift coordinate in the direction to Z-axis

Fig. 2-5: Tool Shift Coordinate System



SUPPLE-MENT

<Posture angle setting>
With the multi-layer tool shift function, the multi-layer tool shift coordinates A and C can not be set.

2.4.3 Registering

Specify the tag TF in SFTON (shift ON) instruction, and the taught positions for the move instructions after the SFTON instruction will be shifted for the shift amount set in the position variable (P***) in the multi-layer tool shift coordinate system.

Instruction : SFTON

Format : SFTON P000 TF

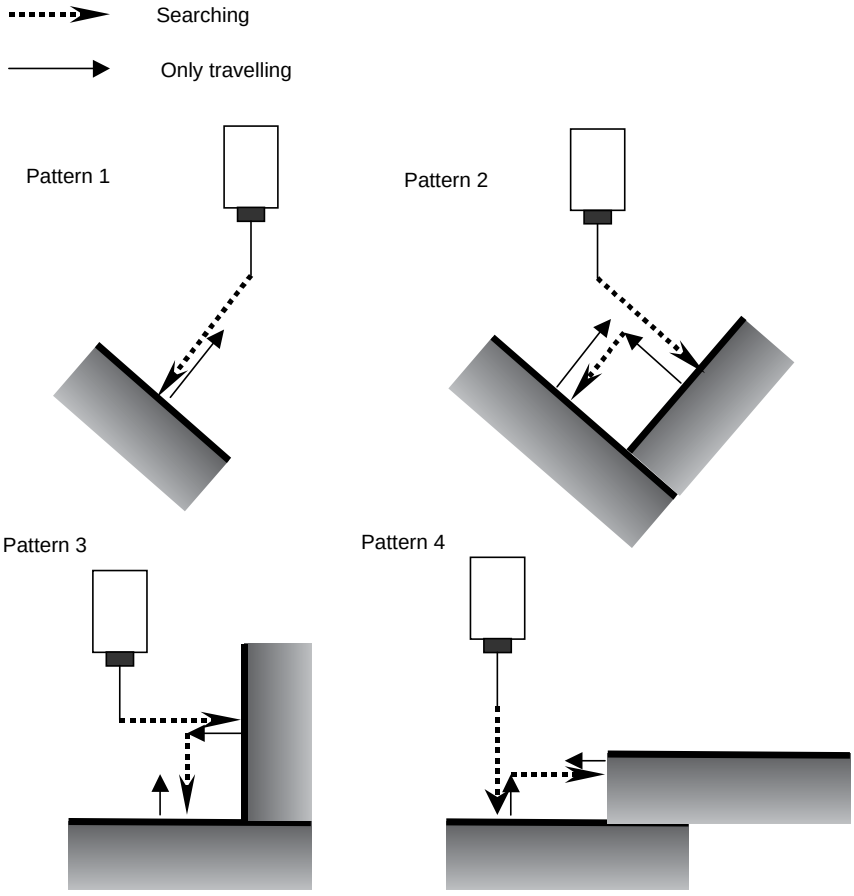
2.5 Search and Shift Function

2.5.1 Outline

The search and shift function detects the workpiece position error by using the search sensor and correct the taught position.

SRSFT instruction starts searching the tool end from the point the tool ends is not in contact with the workpiece and stops searching when the tool end contacts the workpiece. There are four motion patterns. Each motion pattern is shown below.

Fig. 2-6: Motion Pattern of Serch and Shift Instruction

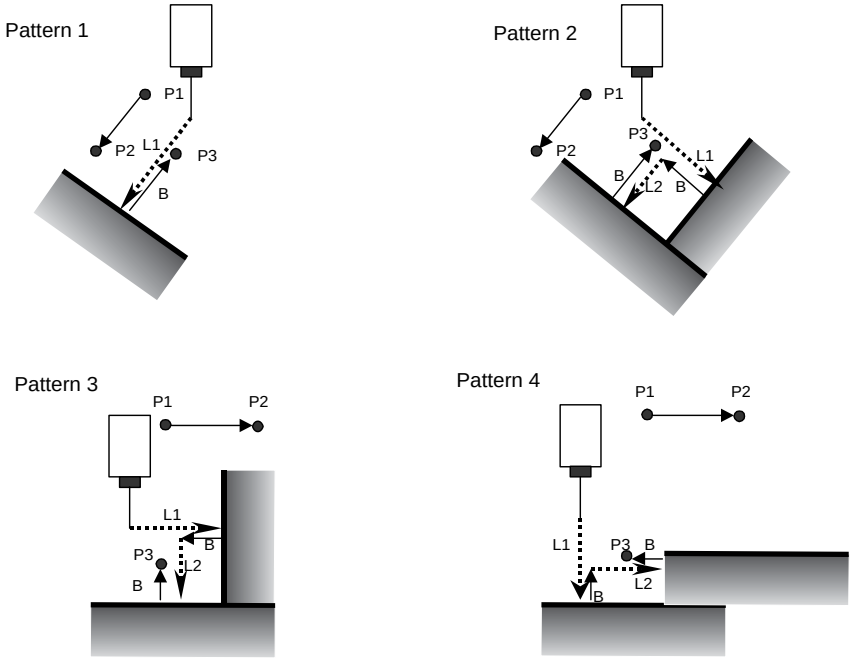


2.5.2 Items to be Set for SRSFT Instruction

Set the following items for SRSFT instruction.

Item	Contents
PATTERN	
SHIFT	0 (no shift), 1 (shift in parallel), 2 (shift in rotation)
VELOCITY	Search speed (in units of cm/min)
DIR_START (P1)	Position P1 in the figure below
DIR_END (P2)	Position P2 in the figure below
OFFSET 1 (L1)	The distance L1 in the figure below (in units of mm)
OFFSET 2 (L2)	The distance L2 in the figure below (in units of mm)
RETRACT AMOUNT	The distance B in the figure below (in units of mm)
MAX. SEARCH DISTANCE	An alarm occurs if the search is not ended within the set travel distance.
END_POINT (P3)	The search end position at teaching (position P3 in the figure below)

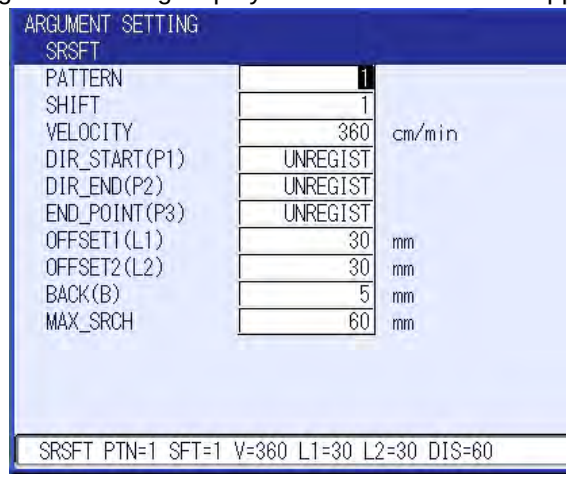
Fig. 2-7: Each Position Data of SRSFT Instruction



2.5.3 Registering SRSFT Instruction

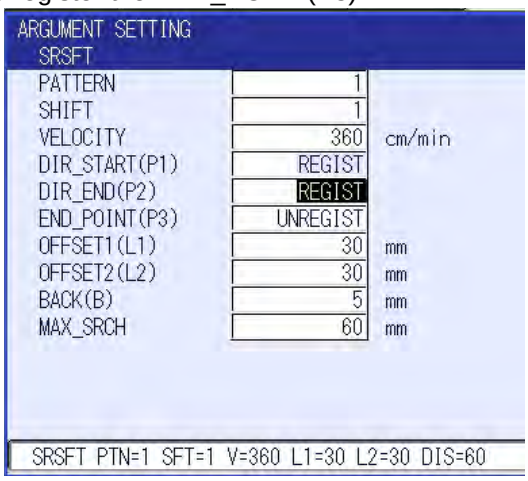
1. Move the cursor to the address area.
2. Press [INFORM LIST].
3. Select “MACRO”.
   – The macro instruction list appears.

4. Select “SRSFT”.
   – The argument setting display for SRSFT instruction appears.



5. Move the manipulator to the travel start point (P1), and press [MODIFY] with the cursor on “UNREGIST” of P1, then press [ENTER] to register the position of P1.
6. Move the manipulator to the travel end point (P2), and press [MODIFY] with the cursor on “UNREGIST” of P2, then press [ENTER] to register the position of P2.

7. At the same manipulator position of the travel end point (P2), move the cursor and press [MODIFY] on “UNREGIST” of P3, then press [ENTER] to register the END_POINT(P3).



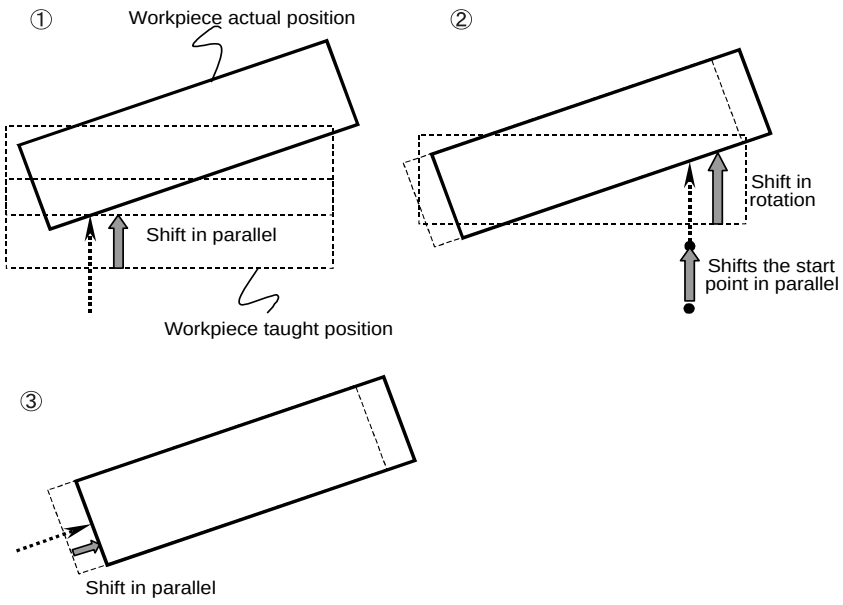
8. With the argument setting display, press [INTERLOCK] + [TEST START] to execute the SRSFT instruction. (The manipulator starts searching and stops.)
9. Register the manipulator stop position to END_POINT (P3) in the argument setting display.
10. Press [ENTER] twice to complete the registeration and return to the job content display.

2.5.4 Application Example of SRSFT Instruction

Table 2-3: Application Example of SRSFT Instruction

Job	
SFTOF3D	Cancels the 3-dimension shift.
MOVJ VJ=60	
SRSFT PTN=3 SFT=1 V=360••	Searches for 1st point (Shift in parallel). ①
MOVJ VJ=60	
SRSFT PTN=3 SFT=2 V=360••	Searches for 2nd point (Shift in rotation). ②
MOVJ VJ=60	
SRSFT PTN=1 SFT=1 V=360••	Searches for 3rd point (Shift in parallel). ③
MOVJ VJ=60	
MOVL V=200	Moves to the welding start point.
:	
:	

Fig. 2-8: Shift Direction by the SRSFT Instruction

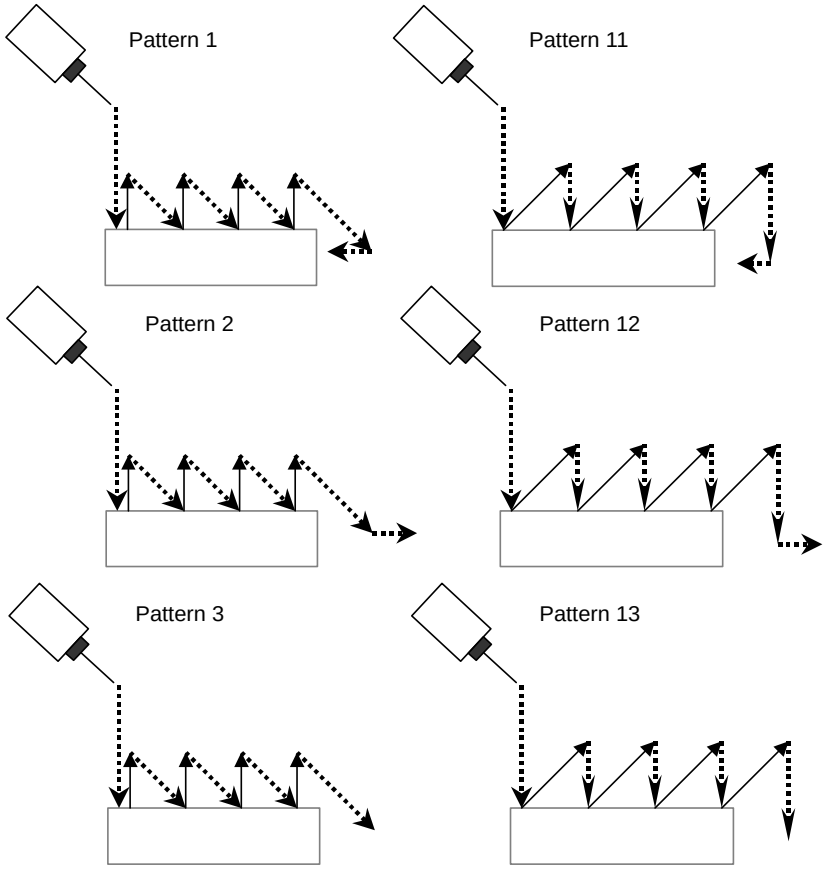


2.6 Search Function for Sticking

2.6.1 Outline

The search function for sticking detects the edge face of the workpiece. There are 6 searching patterns.

Fig. 2-9: Search Pettern of Search Function for Sticking



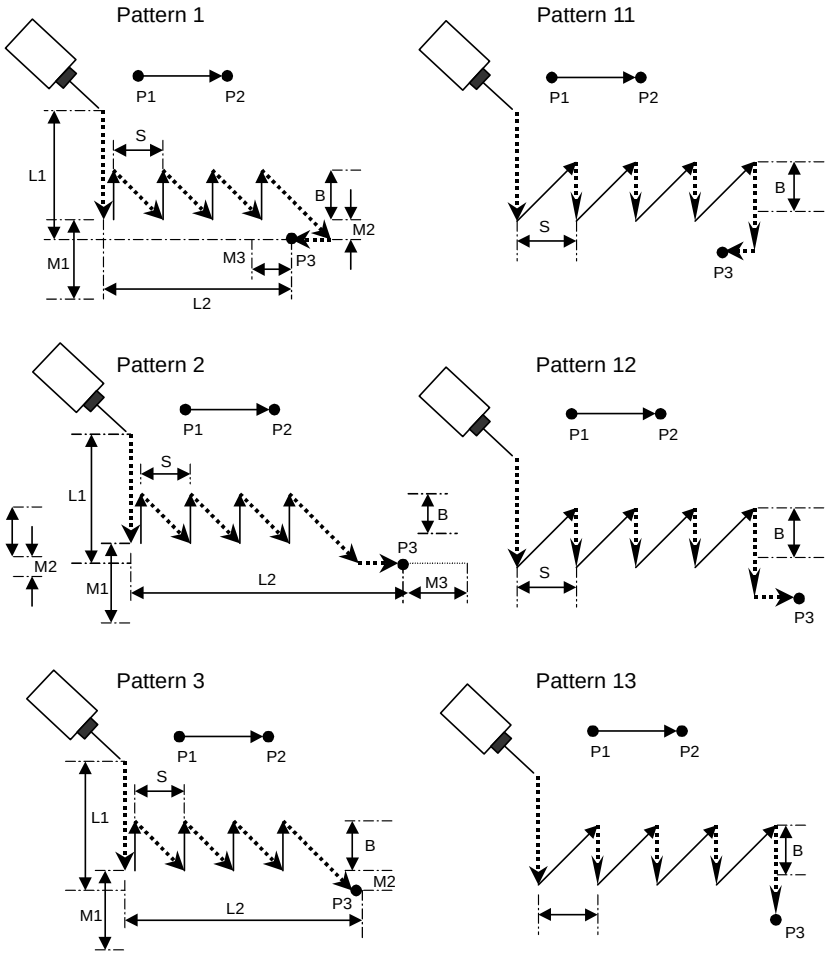
2.6.2 Items to be Set for SRSTCK Instruction

Set the following items for SRSTCK instruction.

Table 2-4: Setting Items of SRSTCK instruction

Item	Contents
PATTERN	Search pattern (See the patterns below)
SHIFT	Shift type 0 (no shift), 1 (shift in parallel), 2 (shift in rotation)
VELOCITY	Search speed in units of cm/min
DIR_START (P1)	Position P1 in the figure below
DIR_END (P3)	Position P2 in the figure below
OFFSET 1 (L1)	The distance L1 in the figure below (in units of mm)
OFFSET 2 (L2)	The distance L2 in the figure below (in units of mm)
RETRACT AMOUNT (B)	The retract distance after the search
INITIAL MAX. SEARCH DISTANCE (M1)	The distance M1 in the figure below (in units of mm)
STICK FEED (S)	The feed pitch S in the figure below (in units of mm)
MAX SEARCH DISTANCE	The maximum distance for searching (in units of mm)
EDGE DETECTING DISTANCE (M2)	If nothing is detected within this distance, the end of this distance is considered as the edge (in units of mm).
EDGE SEARCH SPEED	Final searching speed in units of cm/min
EDGE SEARCH OFFSET (M3)	The distance M3 in the figure below (in units of mm)
END_POINT (P3)	Search end position

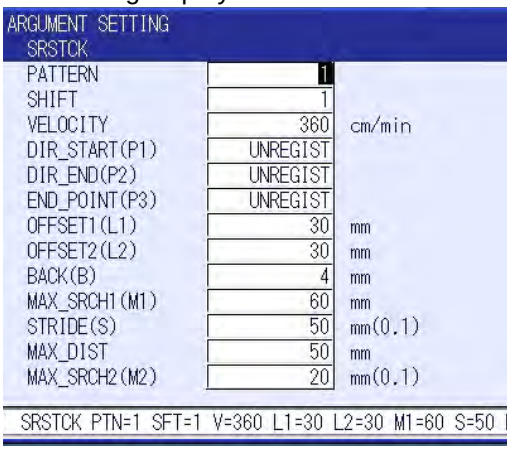
Fig. 2-10: Position Data of Each Search Pettern of SRSTCK instruction



2.6.3 Registering

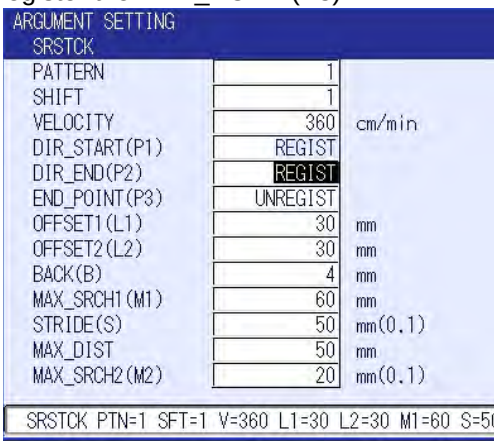
1. Move the cursor to the address area.
2. Press [INFORM LIST].
3. Select “MACRO”.
   – The macro instruction list appears.

4. Select “SRSTCK”.
   – The argument setting display for SRSTCK instruction appears.



5. Move the manipulator to the travel start point (P1), and press [MODIFY] with the cursor on “UNREGIST” of P1, then press [ENTER] to register the position of P1.
6. Move the manipulator to the travel end point (P2), and press [MODIFY] with the cursor on “UNREGIST” of P2, then press [ENTER] to register the position of P2.

7. At the same manipulator position of the travel end point (P2), move the cursor and press [MODIFY] on “UNREGIST” of P3, then press [ENTER] to register the END_POINT(P3).



8. With the argument setting display, press [INTERLOCK] + [TEST START] to execute the SRSTCK instruction. (The manipulator starts searching and stops.)
9. Register the manipulator stop position to END_POINT (P3) in the argument setting display.
10. Press [ENTER] twice to complete the registeration and return to the job content display.

2.7 Shift Function

2.7.1 Outline

The shift function shifts the positions in the section between SFTON instruction and SFTOF instruction.

In SFTON instruction, specify a coordinate system for the shift amount. The coordinate systems that can be specified are BF, RF, TF, UF, BP (travelling axis), and EX (station axis). When two SFTON instructions with different coordinate systems specified are executed consecutively, the positions are shifted for the specified two shift amounts.

Example:

```
:
SFTON  P000  BF    (100.000 mm to X direction is specified in P000)
SFTON  P001  RF    (100.000 mm to Y direction is specified in P001)
MOVL  V=100        (Shifts the position for 100.000 mm to X direction in
                    the base coordinate system, and for 100.000 mm to
                    Y direction in the robot coordinate system.)
:
```

When two SFTON instructions with the same coordinate system specified are executed, the last STFON instruction is valid.

Example:

```
:
SFTON  P000  BF    (100.000 mm to X direction is specified in P000.)
SFTON  P001  BF    (100.000 mm to Y direction is specified in P001.)
MOVL  V=100        (Shifts the positions for 100.000 mm to Y direction in
                    the base coordinate system.)
:
```

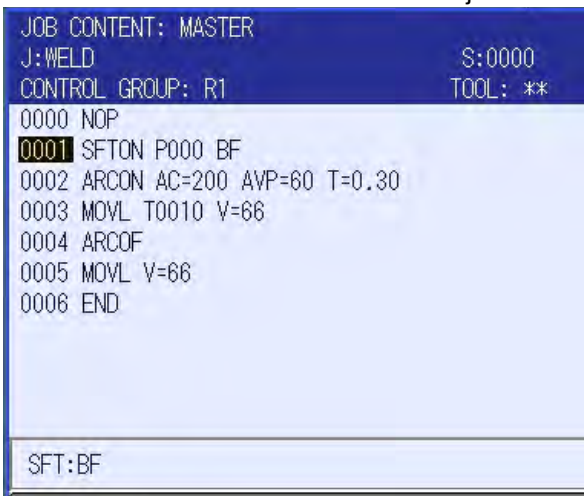
In SFTOF instruction, the coordinate system for canceling shift function can be specified. When the coordinate system is not specified, all the coordinate systems for shift function are cancelled.

2.7.2 Continuity of Shift Function

The shift function can be cancelled by executing SFTOF instruction or selecting another job.

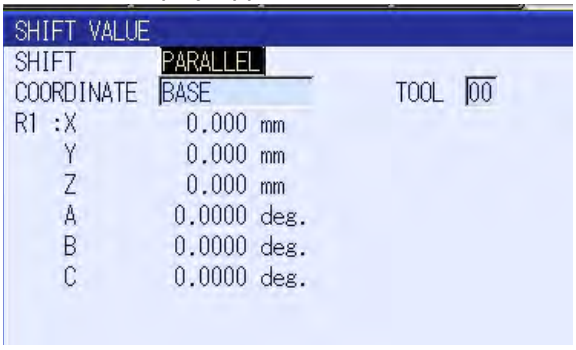
While editing the job such as changing or deleting the taught position data in SFTON status, the taught position data without the shift amount are registered. Accordingly, the taught position data can be corrected during the welding of the 2nd and following layers.

During the shift operation, “SFT” and the coordinate system that is specified in SFTON instruction are indicated on the job content display.

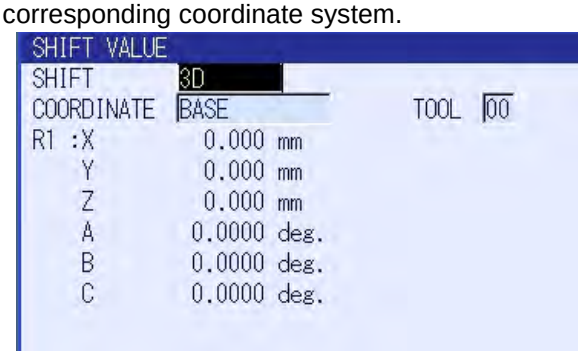


2.7.3 Shift Amount Display

1. Select {ROBOT} from the top menu, and select {SHIFT} from the sub menu.
   – The shift amount display appears.



2. Select a shift type.
   – Selecting a shift type, “PARALLEL” or “3D,” and a coordinate, “BASE,” “ROBOT,” “TOOL,” and “USER,” displays the shift amounts in the corresponding coordinate system.



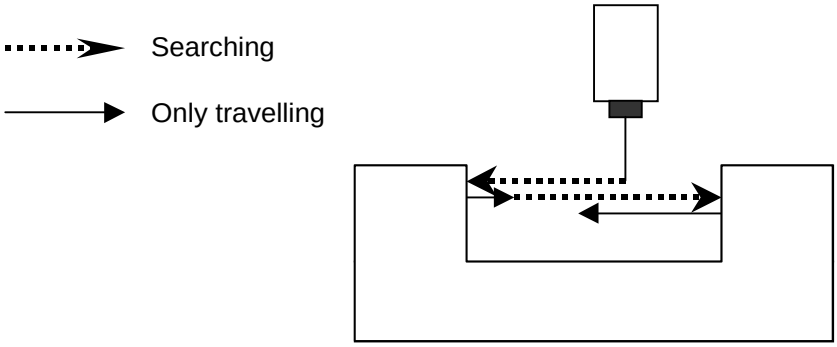
2.8 Beveling Width Measuring Function

2.8.1 Outline

The beveling width measuring function measures the beveling width by using the search function. The measured width is stored in the specified variable number by using SRGAP instruction. According to the measured beveling width, the welding conditions will be changed.

The tool stop position after the search is the center of the beveling.

Fig. 2-11: Serch Pettern of Beveling Width Measuring Function



2.8.2 Items to be Set for SRGAP instruction

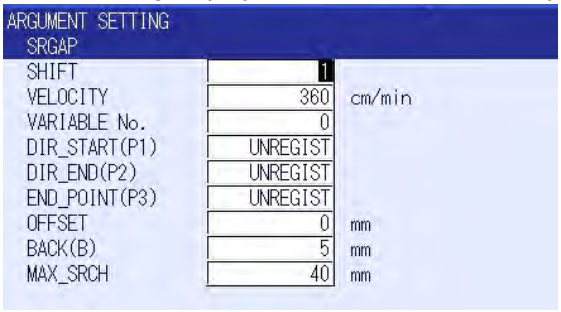
Table 2-5: Setting Items of Beveling Width Measuring Function

Item	Contents
SHIFT	Shift type: 0: No shift, 1: Shift in parallel, 2: Shift in rotation
VELOCITY	Search speed (in units of cm/min)
VARIABLE_No.	Variable number to store the measured beveling width
DIR_START (P1)	Travel start point P1
DIR_START (P2)	Travel end point P2
END_POINT (P3)	Search end point P3
OFFSET 1 (L1)	Offset amount of the start position (in units of mm)

2.8.3 Registering

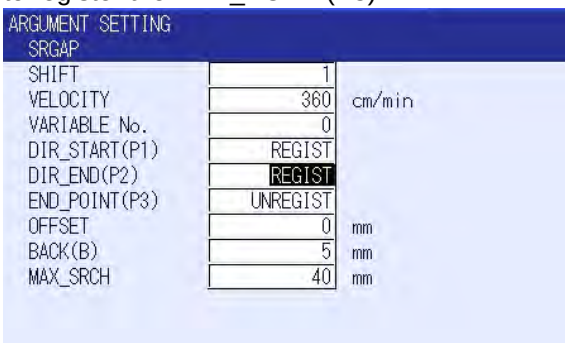
1. Move the cursor to the address area.
2. Press [INFORM LIST].
3. Select “MACRO”.
   – The macro instruction list appears..

4. Select “SRGAP”.
   – The argument setting display for SRGAP instruction appears..



5. Move the manipulator to the travel start point (P1), and press [MODIFY] with the cursor on “UNREGIST” of P1, then press [ENTER] to register the position of P1.
6. Move the manipulator to the travel end point (P2), and press [MODIFY] with the cursor on “UNREGIST” of P2, then press [ENTER] to register the position of P2.

7. At the same manipulator position of the travel end point (P2), move the cursor and press [MODIFY] on “UNREGIST” of P3, then press [ENTER] to register the END_POINT(P3).



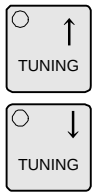
8. With the argument setting display, press [INTERLOCK] + [TEST START] to execute the SRGAP instruction. (The manipulator starts searching and stops.)
9. Register the manipulator stop position to END_POINT (P3) in the argument setting display.
10. Press [ENTER] twice to complete the registeration and return to the job content display.

2.9 Overriding Welding Condition Function

2.9.1 Outline

- During welding, each welding condition such as welding current, welding voltage, speed, weaving single amplitude, and sensing condition can be adjusted individually by using the specific keys shown below on the programming pendant.
- The adjusted welding conditions can be automatically set for the tag and condition file attached to the instruction to set the welding condition such as ARCON and ARCSET. However, when variables are used for the welding condition or the condition file, this function is invalid.
- For overriding the welding conditions, the following keys are used.

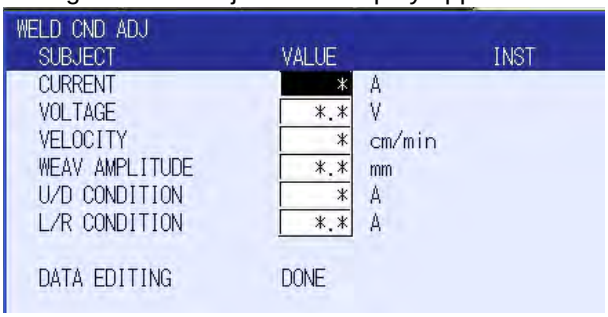
Fig. 2-12: Keys for Adjusting Welding Condition



- The units for adjusting the welding conditions by pressing the above keys can be set by the parameters listed in 2.10.5.

2.9.2 Operation

1. Select “WELD CND ADJ” from “UTILITY” in the job playback display.
   – The welding condition adjustment display appears..



2. Move the cursor to the condition to be adjusted and adjust the condition by using the specific keys.
   – The welding is executed under the adjusted welding condition.
3. Press [ENTER].
   – The adjusted welding condition is overwritten in the condition file of the job.
4. Press [CANCEL].
   – The job content display appears.

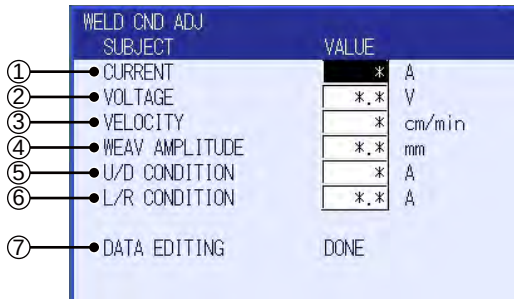
NOTE

Only the welding condition data that have been set are displayed.

For example, when the weaving operation is not set, "***" is displayed for "WEAV AMPLITUDE."
And, when COMARC function is not used, "U/D CONDITION" and "L/R CONDITION" are not displayed.

When the instruction such as ARCOF are executed, the adjustment is disabled and "***" is displayed for each welding condition.

2.9.3 Welding Condition Adjustment Display



①CURRENT

Move the cursor to the data and press the TUNING key to adjust the welding current value.
The welding current is specified by the following instructions:

- The instruction item (AC=) to ARCON instruction
- The current value set in the welding start condition file (ASF# (*) specified by ARCON instruction
  (When an enhanced type file is used, the data will not be overwritten.)
- The instruction item (AC=) to ARCSET instruction
- The instruction item (AC=) to ARCCUR instruction
- The set value by AWELD instruction

When ARCOF instruction is executed, the welding current adjustment is disabled.
When COMARC function is used, ⑤ "U/D CONDITION" will be changed in proportion to the welding current adjustment.
On the contrary, adjusting U/D CONDITION will not change the welding current value.

②VOLTAGE

Move the cursor to the data and press the TUNING key to adjust the welding voltage value.

The welding voltage is specified by the following instructions:

- The instruction items (AV=, and AVP=) to ARCON instruction
- The voltage value set in the welding start condition file (ASF# (*)) specified by ARCON instruction
  (when an enhanced type file is used, the data will not be overwritten.)
- The instruction items (AV=, and AVP=) to ARCSET instruction
- The instruction items (AV=, and AVP=) to ARCVOL instruction
- The set value by VWELD instruction

When ARCOF instruction is executed, the welding voltage adjustment is disabled.

③VELOCITY

Move the cursor to the data and press the TUNING key to adjust the robot motion speed.

The speed is specified by the following instructions:

- The instruction item (V=) to ARCON instruction
- The speed set in the welding start condition file (ASF# (*)) specified by ARCON instruction
- The instruction item (V=) to ARCSET instruction
- The instruction item (V=) to MOVL (SMOVL), MOVC (SMOVC), or MOVS (SMOVS) instruction

When ARCOF instruction is executed, the robot motion speed adjustment is disabled.

④WEAV AMPLITUDE

Move the cursor to the data and press the specific keys to adjust the weaving single altitude.

The weaving single altitude is specified by the following instructions:

- The weaving amplitude set in the weaving condition file (WEV# (*)) specified by WVON instruction
- The weaving amplitude set in the weaving condition file (WEV# (*)) specified by COMARCON (SCOMARCON) instruction
- The instruction item (AMP=) to COMARCON (SCOMARCON) instruction
- The instruction item (AMP=) to COMARCSET (SCOMARCST) instruction

When COMARCOF (SCOMARCOF) or WVOF instruction is executed, the weaving amplitude adjustment is disabled.

⑤U/D CONDITION

Move the cursor to the data and press the specific keys to adjust the sensing condition (upward/downward).
The upward/downward sensing condition is specified by the following instructions:

- The instruction item (U/D=) to COMARCON (SCOMARCON) instruction
- The instruction item (U/D=) to COMARCSET(SCOMARCST) instruction

When COMARCOF (SCOMARCOF) is executed, the upward/downward sensing adjustment is disabled.

⑥L/R CONDITION

Move the cursor to the data and press the specific keys to adjust the sensing condition (left/right).
The left/right side sensing condition is specified by the following instructions:

- The instruction item (L/R=) to COMARCON (SCOMARCON) instruction
- The instruction item (L/R=) to COMARCSET (SCOMARCST) instruction

When COMARCOF (SCOMARCOF) is executed, the left/right side sensing adjustment is disabled.

⑦DATA EDITING

Indicates whether the edition of a instruction or condition file is completed or not.
When the conditions set in the instruction or condition file agree with those set in the welding condition adjustment display, “DONE” is displayed. When not agree, “UNDONE” is displayed.
During adjustment of the welding conditions by pressing the specific key, “UNDONE” is displayed, and when [ENTER] is pressed and the adjusted conditions are registered, “DONE” is displayed.

The welding current and voltage set in the enhanced type welding condition file can be adjusted by the overriding welding condition function, but the data in the welding condition file will not be overwritten: the data in the welding condition file will not be replaced by the adjusted data.

2.9.4 Data Editing

As for move instructions, the instruction to be changed is edited automatically when the instruction ended execution.

However, when press “SELECT” and change the DATA EDITING to “DONE”, all the move instructions are subject to be edited automatically unless the velocity is adjusted (press the specific key) or ARCOF is executed.

Other instructions are edited automatically when the instruction to be edited is changed.

For example, ARCON is edited when ARCSET or ARCOF is being executed. Even when stopped manipulator while welding, jobs or condition files are edited automatically.

2.9.5 Parameters for the Units to Adjust Conditions

When using the specific keys to adjust a condition, the units for each condition can be set by the following parameters.

Set the multiplication of the minimum unit of each condition.

Table 2-6: Parameters for the Units to Adjust Conditions

Parameter	Meanings	Initial Value
S3C1200	The units for adjusting the welding current value (When the specific key is pressed once) Min. units for the current value: 1 A, Min. units for the command value: 0.01 V	1
S3C1201	The units for adjusting the welding current value (When the specific key is pressed consecutively) Min. units for the current value: 1 A, Min. units for the command value: 0.01 V	1
S3C1202	The units for adjusting the welding voltage value (When the specific key is pressed once) Min. units for the voltage value: 0.1 V or 1 %, Min. units for command value: 0.01 V	1
S3C1203	The units for adjusting the welding voltage value (When the specific key is pressed consecutively) Min. units for the voltage value: 0.1 V or 1 %, Min. units for the command value: 0.01 V	1
S3C1204	The units for adjusting the speed (When the specific key is pressed once) Min. units: 1 cm/min	1
S3C1205	The units for adjusting the speed (When the specific key is pressed consecutively) Min. units: 1 cm/min	1
S3C1206	The units for adjusting the weaving single amplitude (When the specific key is pressed once) Min. units: 0.1 mm	1
S3C1207	The units for adjusting the weaving single amplitude (When the specific key is pressed consecutively) Min. units: 0.1 mm	1
S1E51	The units for adjusting the sensing U/D condition (When the specific key is pressed once) Min. units: 1 A	1
S1E52	The units for adjusting the sensing U/D condition (When the specific key is pressed consecutively) Min. units: 1A	1
S1E53	The units for adjusting the sensing L/R condition (When the specific key is pressed once) Min. units: 0.1 A	1
S1E54	The units for adjusting the sensing L/R condition (When the specific key is pressed consecutively) Min. units: 0.1 A	1

2.10 Confirm the Welding Operation in Teach Mode

2.10.1 Outline

ARCON/ARCOF instructions can be executed by TEST RUN in the teach mode. By this operation, it is possible to confirm the welding conditions.

2.10.2 Operation

1. Set the security to the “MANAGEMENT MODE” and press [WORK] to turn ON the LED.
   – Pressing [WORK] turns ON the LED and makes a beep. By pressing [WORK] again, the LED is unlit and the beep stops.
2. Execute the test run (execute the welding).
3. Press [WORK] to turn OFF the LED.

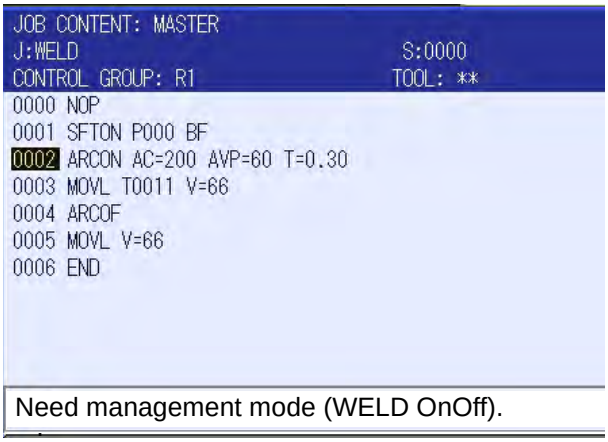
NOTE If the check run is enabled, turning ON the WORK LED does not execute the welding. Also when the security is not in “MANAGEMENT MODE”, welding is not executed.

2.10.3 Display

When the security mode is in “MANEGEMENT MODE”, “TEST START with arc welding.” is indicated on the job content display.

When the security mode is not in “MANEGEMENT MODE”, “Need management mode (WELD OnOff).” is indicated.

Indication of “TEST START with arc welding.”



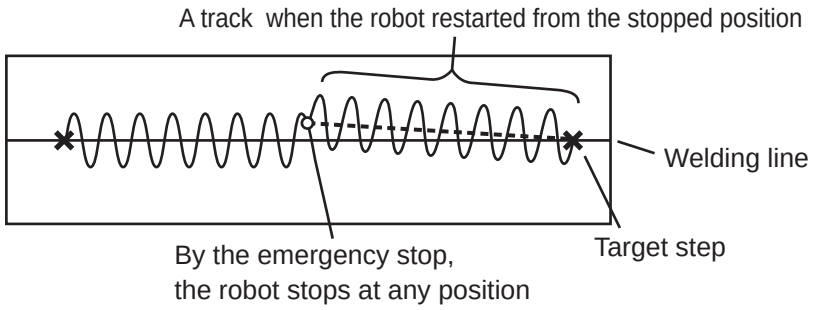
Indication of “management mode (WELD OnOff).”

2.11 How to Restart After an Emergency Stop in the Middle of Weaving

By the emergency stop in the middle of weaving, the robot stops weaving operation in any position. If simply re-start, the robot runs through the next step from any position and the welding may be come off the welding line.

Before restart welding, switch to the teaching mode and move the robot (the front-edge of the wire) on the welding line by the job operation.

Fig. 2-13: A track when the robot restarted from the stopped position



DX200 OPTIONS INSTRUCTIONS

FOR MULTI-LAYER WELDING FUNCTION

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