DX200 OPTIONS
INSTRUCTIONS

FOR SEARCH 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: 165556-1CD
Revision: 0

YASKAWA
MOTOMAN ROBOTICS

MANUAL NO.
HW1481813◈0

MANDATORY

- This manual explains the search function of the DX200. 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.

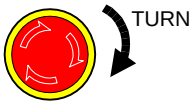
Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

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 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 cabinet of the DX200 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	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}

Description of the Operation Procedure

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

Registered Trademark

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

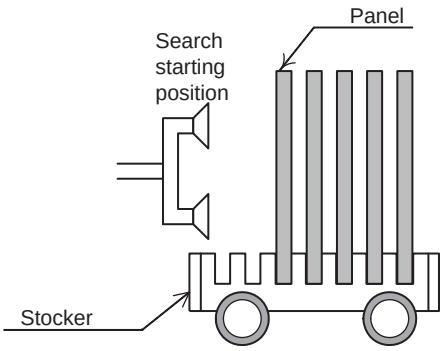
1 Search Function

The search function moves the manipulator to a specified position and stops it when a specified direct input signal comes ON.

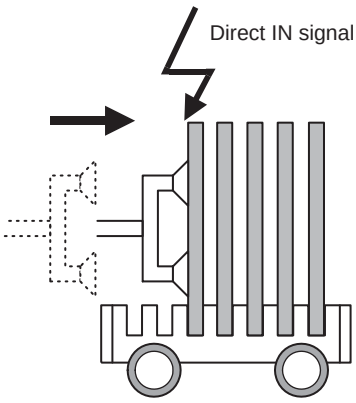
Position data at the point the manipulator stops can be taken-in. This information can be used with other instructions, for instance, to obtain the distance from a goal position and modify operation accordingly.

<Example> A manipulator performs a handling operation of panels

1. The manipulator moves to the search starting position.



2. The manipulator moves to the goal position in the search operation at low-speed. When the manipulator comes to the position to take the panel, a input signal (Direct-IN signal) from the sensor comes ON, then the manipulator stops. At this moment, the difference between the search starting position and the detected position is calculated.



3. On the base of the calculated difference, the program is modified to proceed the operation.

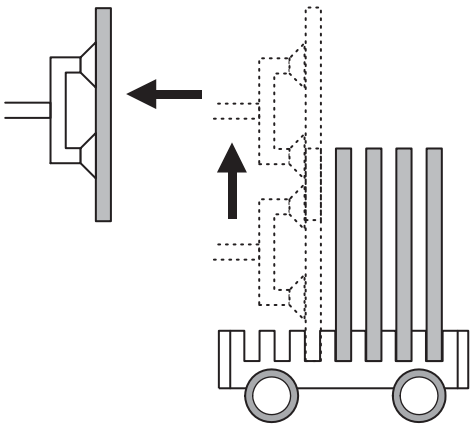


Table 1-1: JOB:WORK

Line NO.	Instruction	Content
000	NOP	
001	MOVJ VJ=20.00	
002	MOVL V=300.0 PL=0	
003	REFP 1	Set the target point of the search operation
004	CALL JOB:SRCH	Search operation
005	SFTON P002	parallel shift start
006	DOUT OT#(1)=ON	Execution of operation
007	MOVL V=100.0	
008	SFTOF	parallel shift end
009	MOVJ VJ=20.00	
010	END	

Table 1-2: JOB:SRCH

Line NO.	Instruction	Content
000	NOP	
001	GETS LPX000 $PX021	Load the target point of the search operation
002	MOVL LP000 V=100.0 SRCH RIN#(1)=ON DIS=0.1	Search operation
003	GETS LB000 $B002	Load the detection result
004	JUMP *NG IF LB000=0	Determination of the detection result
005	GETS LPX001 $PX002	Load the detected position
006	MSHIFT PX002 RF LPX000 LPX001	
007	SETE P002 (4) 0	Shift amount calculation
008	SETE P002 (5) 0	
009	SETE P002 (6) 0	
010	GETE LD000 P002 (1)	
011	GETE LD001 P002 (2)	
012	GETE LD002 P002 (3)	Shift length calculation
013	SET LR000 EXPRESS LD000 * LD000 + LD001 * LD001 + LD002 * LD002	
014	SQRT LR000 LR000	
015	JUMP *NG IF LR000>400000	Shift length check
016	JUMP *NG IF LR000<300000	
017	RET	Normal termination
018	*NG	
019	PAUSE	Abnormal termination
020	JUMP *NG	
021	END	

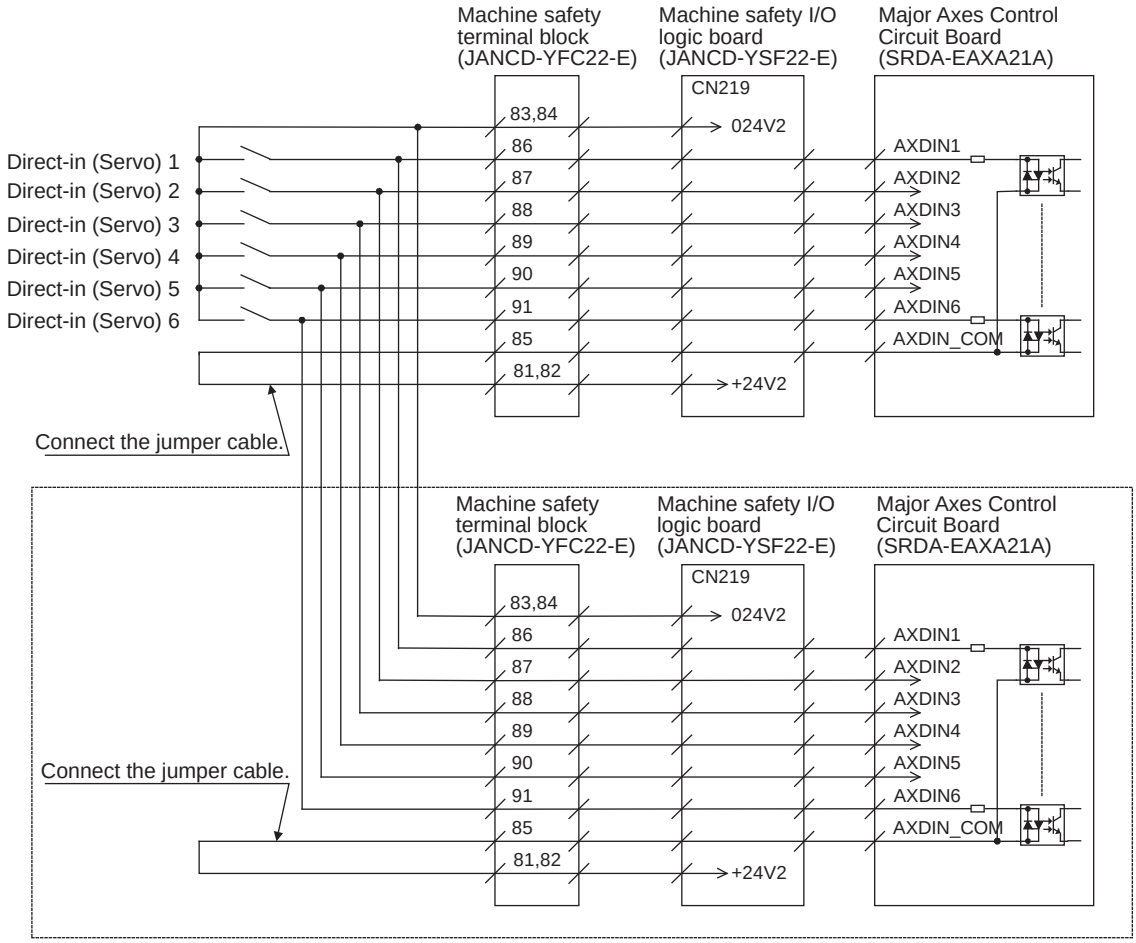
2 Wiring

Output signals of the sensor used in the system are connected to the DX200 input port for direct-input signals. The signals that are input from this port are called direct-in signals.

The output signals of the sensor used in the system can be connected via a sequencer to the direct-in signal input port, however, processing variations may result due to scanning timing of the sequencer.

It is therefore recommended to connect the output signal of the sensor directly to the DX200 input port.

2.1 Direct IN Connection



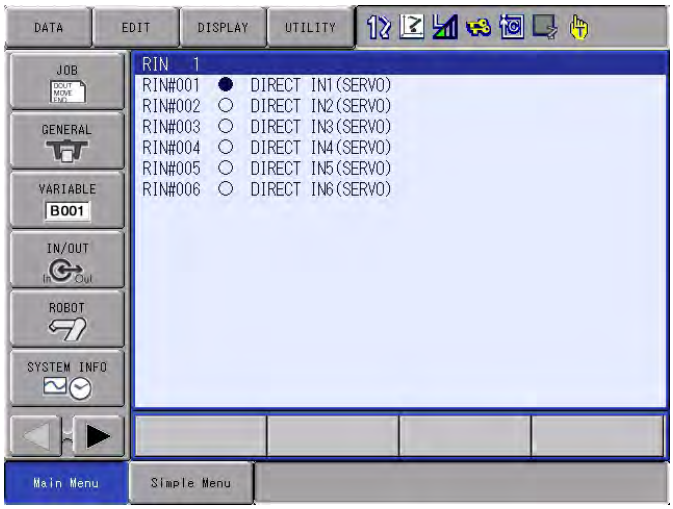
The ⬚ part of wiring is that if there is a slave for the coordinated control side major axes control circuit board (SRDA-EAXA21A).

2.2 Confirmation of Direct IN Signal Status

Check the status of direct-input signal on the RIN INPUT window.

2.2.1 RIN INPUT Window

1. Select {IN/OUT} under the main menu
2. Select {RIN}
   – The RIN INPUT window appears.
   – "●" indicates the ON status of direct IN signal.
   – "○" indicates the OFF status of direct IN signal



3 Instructions

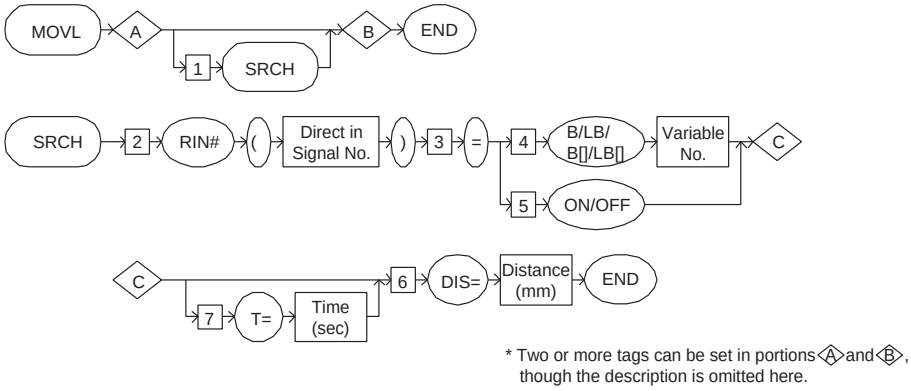
3.1 SRCH (Search Instruction)

3.1.1 Function

The SRCH is an instruction to execute the search function. It is set as an additional item to the move instruction.

- MOVL
- IMOV
- SMOVL

3.1.2 Construction



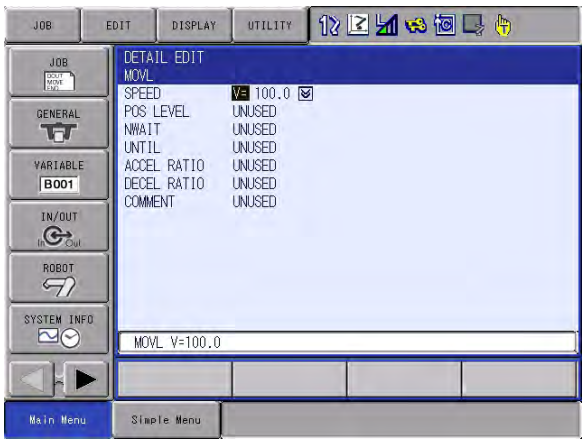
* Two or more tags can be set in portions A and B, though the description is omitted here.

3.1.3 Explanation

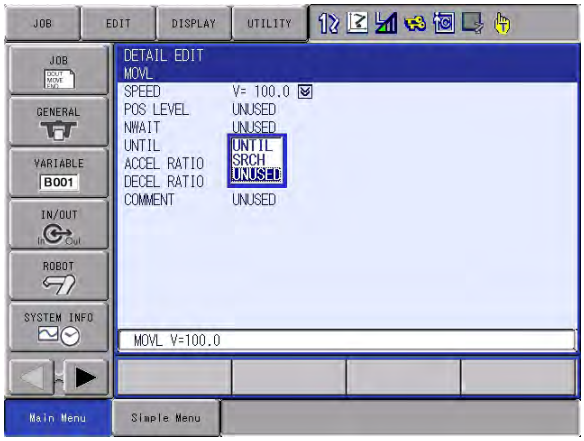
№	Tag	Explanation	Note
1	SRCH	Specifies the SRCH instruction. SRCH instruction is an instruction to execute search operation.	
2	RIN# (Input number)	Specify direct in signal number.	No.:1 - 6 B/I/D/B[ ]/I[ ]/D[ ]/LB/LI/LD/LB[ ]/LI[ ]/LD[ ] can be used.
3	=	It is equal.	
4	B Variable number/ LB Variable number/ B [Array number]/ LB [Array number]/	Specify byte type variables which are used as detection conditions.	Last significant bit: 0: OFF 1: ON
5	ON/OFF	Specify detection conditions by ON/OFF.	
6	Distance	Specify the distance to extend the target point.	Distance: 0.1 - 6553.5mm Variable B/I/D/B[ ]/I[ ]/D[ ]/LB/LI/LD/LB[Distance can be specified with variables B/I/D/B[]/D[]/LB/LI/LD/LB[]/LI[]/LD[] (unit: 0.1 mm).
7	Time	When using direct in signal search start delay time (in 0.01 s) and start point search unit, set 0.1 s or more. This is because there may be cases where the relay (200 V) is switched when starting search operation and direct in signal is constantly received.	unit: 0.01 - 655.35 s Time can be specified with variables I/LI/I[]/LI[] (unit: 0.01 s).

3.1.4 Register SRCH Instruction

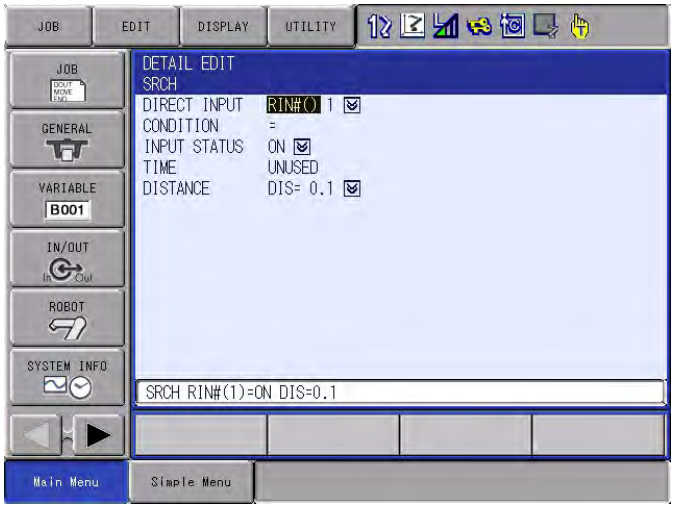
1. Move the cursor to the instruction area.
2. Move the cursor to the move instruction where SRCH instruction is to be registered.
3. Press [SELECT] twice.
   (1) Press [SELECT] once to display the contents registered in the job in the input buffer line.
   (2) Press [SELECT] once more, and the DETAIL EDIT window of the move instruction appears.



4. Select {UNTIL}.



5. Select {SRCH}.
6. Set each item on the DETAIL EDIT window of SRCH instruction.
   – The DETAIL EDIT window of SRCH instruction appears.



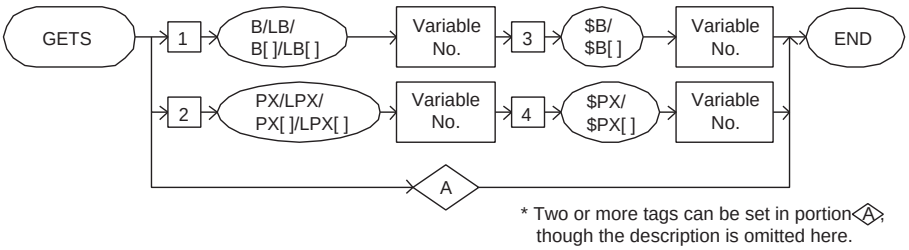
7. Press [ENTER].
   – Returns to the DETAIL EDIT window of the move instruction.
8. Press [ENTER] twice.
   (1) Press [ENTER] once to display the set contents in the input buffer line.
   (2) Press [ENTER] once more, and the set contents are registered in the job.

3.2 GETS Instruction

3.2.1 Function

Saves the system variable ($ variable) as a user variable.

3.2.2 Construction



* Two or more tags can be set in portion A, though the description is omitted here.

3.2.3 Explanation

.

№	Tag	Explanation	Note
1	B Variable number/ LB Variable number/ B [Array number]/ LB [Array number]	Specify byte type variable number to save system variable.	
2	PX Variable number/ LPX Variable number/ PX [Array number]/ LPX [Array number]	Specify expanded position type variable number to save system variable.	
3	$B Variable number/ $B [Array number]	Specify byte type system variable number to set.	
4	$PX Variable number/ $PX [Array number]	Specify expanded position type variable number to set.	

SUPPLE-MENT

System variable

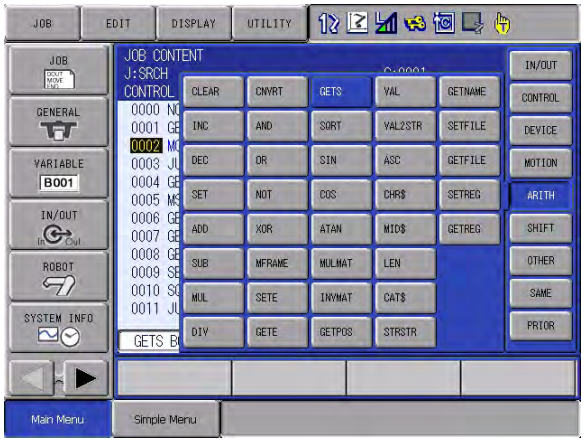
The GETS is the only instruction that refers to system variables written by the controller system.

The following system variables are available.

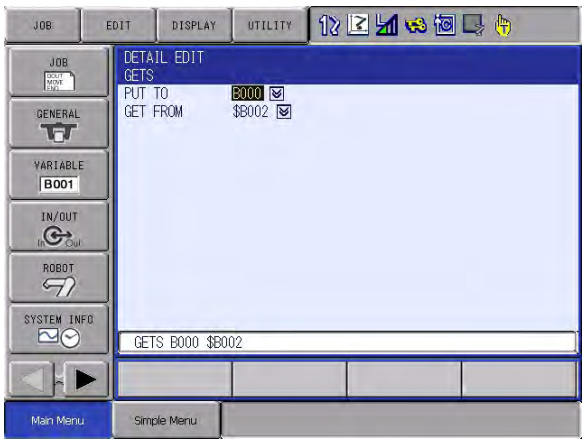
System Variable	Type	No.	Explanation
$B type variable	Byte type	$B002	Specifies detected/not detected of the SRCH instruction 0: Not detected, 1: Detected
$PX type variable	Expanded position type	$PX002	Position detected by the optional SRCH instruction (pulse type)
		$PX003	Position detected by the optional SRCH instruction (XYZ type)
		$PX011 - 018	Teaching position by REFP 1 - 8 instruction (pulse type)
		$PX021 - 028	Teaching position by SREFP 1 - 8 instruction (pulse type)

3.2.4 Register GETS Instruction

1. Move the cursor to the address area.
2. Move the cursor to the line where GETS instruction is to be registered.
3. Press [INFORM LIST].
   (1) The instruction list dialog box appears.
   (2) The cursor moves to the instruction list dialog box while the cursor in the address area changes to an under bar.
4. Select {GETS}.
   – At this stage, the instruction on the cursor position is displayed with the previously registered additional items in the input buffer line.



5. Press [SELECT] twice.



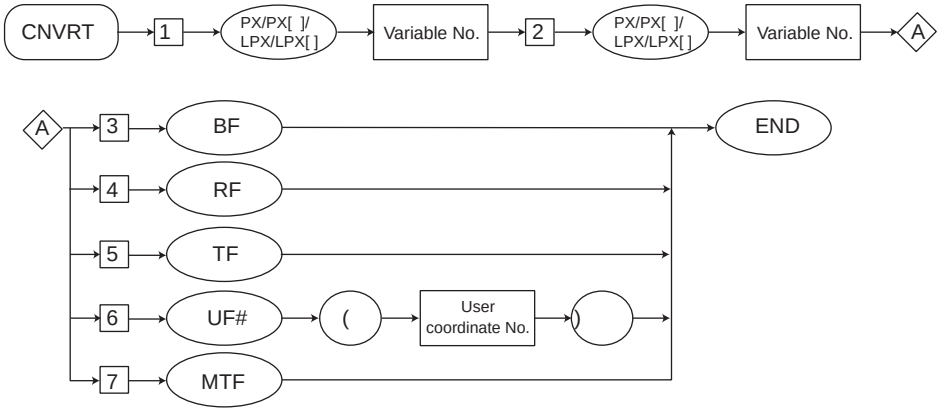
6. The DETAIL EDIT window of GETS instruction appears.
7. Press [ENTER] twice.
   (1) Press [ENTER] once to display the set contents in the input buffer line.
   (2) Press [ENTER] once more, and the set contents are registered in the job.

3.3 CNVRT (Position Type Variable Conversion Instruction)

3.3.1 Function

The CNVRT is an instruction to convert a pulse data position type variable into XYZ type position type variable of the specified coordinate system.

3.3.2 Construction



3.3.3 Explanation

№	Tag	Explanation	Note
1	PX Variable number/ LPX Variable number/ PX [Array number]/ LPX [Array number]	Specifies the number of the expanded position type variable where the converted data is stored.	
2	PX Variable number/ LPX Variable number/ PX [Array number]/ LPX [Array number]	Specifies the number of the expanded position type variable to be converted.	
3	BF	Specifies the conversion in the base coordinate system.	
4	RF	Specifies the conversion in the robot coordinate system.	
5	TF	Specifies the conversion in the tool coordinate system.	
6	UF# (User coordinate number)	Specifies the conversion in the user coordinate system.	No.: 1 - 63 Variable B/I/D/LB/LI/LD can be used.
7	MTF	Specifies the conversion on the master tool coordinate system. On the master tool coordinate system, the data is converted to a position relative to the master manipulator.	Available only with the optional independent coordinate function.

SUPPLE-MENT

Expanded position type variables

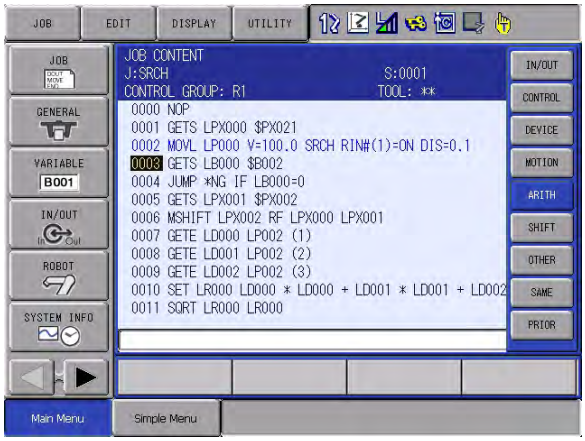
The expanded position type variable is a position type variable that depends on the control group in the job.

<Example>

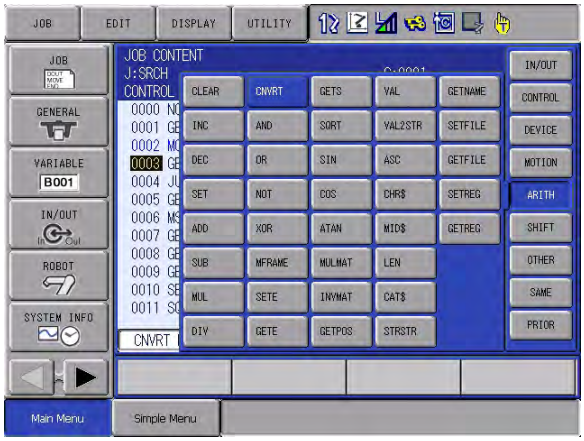
- When the control group is R1:
  PX000 indicates P000.
- When the control group is R1 + B1:
  PX000 indicates P000 and BP000.
- When the control group is R1 + B1 + ST1:
  PX000 indicates P000 + BP000 + EX000.
- When the control group is R1 + R2 + B1 + B2 + ST1 in the coordinated job (master R1 + B1):
  PX000 indicates the following:
  P000: R2 (slave)
  P001: R1 (master)
  BP000: B2 (slave)
  BP001: B1 (master)
  EX000: ST1

3.3.4 CNVRT Instruction

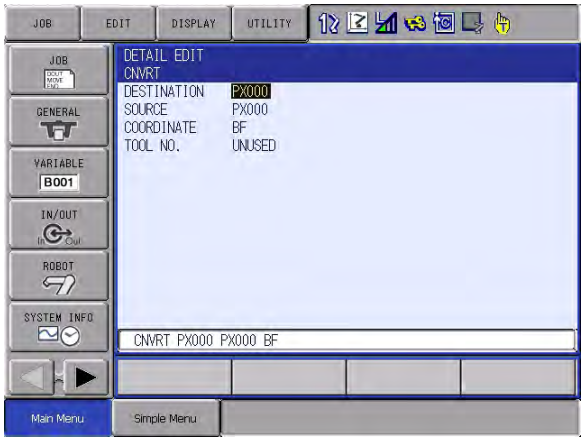
1. Move the cursor to the address area.
2. Move the cursor to the line where CNVRT instruction is to be registered.
3. Press [INFORM LIST].
   (1) The instruction list dialog box appears.
   (2) The cursor moves to the instruction list dialog box while the cursor in the address area changes to an under bar.



4. Select {CNVRT}.
   – At this stage, the instruction on the cursor position is displayed with the previously registered additional items in the input buffer line.



5. Press [ENTER] twice.
   – The DETAIL EDIT window of CNVRT instruction appears.



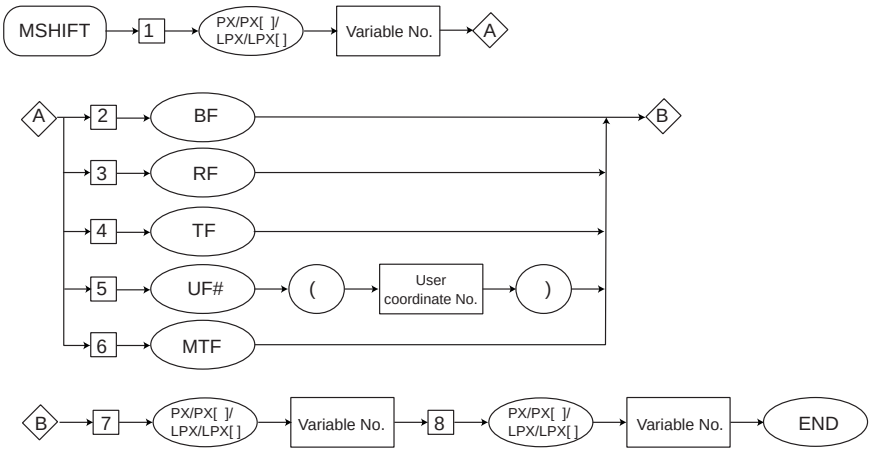
6. Set variables on the DETAIL EDIT window of CNVRT instruction
7. Press [ENTER] twice.
   (1) Press [ENTER] once to display the set contents in the input buffer line.
   (2) Press [ENTER] once more, and the set contents are registered in the job.

3.4 MSHIFT Instruction

3.4.1 Function

Calculate shift amount in the specified coordinate system from the reference position and the target position.

3.4.2 Construction



3.4.3 Explanation

1. PX Variable number/LPX Variable number/PX [array number]/LPX [array number]

   – Add the following tag.

№	Tag	Explanation	Note
1	PX Variable number/ LPX Variable number/ PX [Array number]/ LPX [Array number]	Specifies the number of the expanded position variable to store the calculated shift.	<Data 1>

2. BF/RF/TF/UF# (User coordinate number)/MTF

№	Tag	Explanation	Note
2	BF	Specifies the conversion in the base coordinate system.	
3	RF	Specifies the conversion in the robot coordinate system.	
4	TF	Specifies the conversion in the tool coordinate system.	
5	UF# (User coordinate number)	Specifies the conversion in the user coordinate system.	No.: 1 - 63 Variable B/I/D/LB/LI/LD can be used.
6	MTF	Specifies the conversion on the master tool coordinate system. On the master tool coordinate system, the data is converted to a position relative to the master manipulator.	Available only with the optional independent/coordinated function.

3. PX Variable/ LPX Variable/PX [array number]/ LPX [array number]

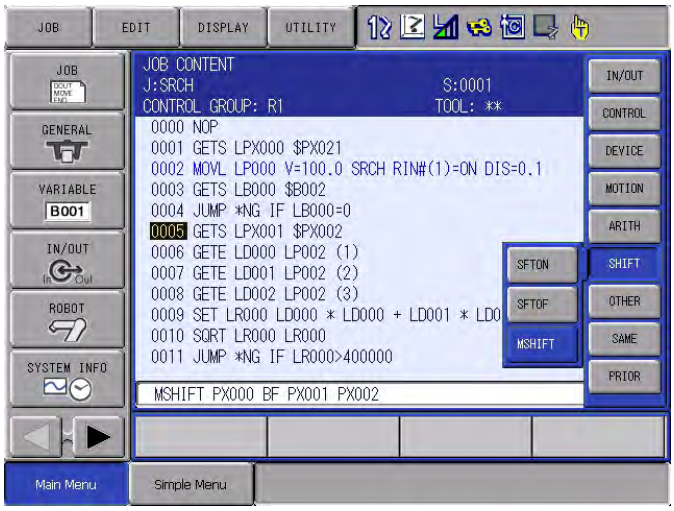
№	Tag	Explanation	Note
7	PX Variable number/ LPX Variable number/ PX [Array number]/ LPX [Array number]	Specifies the number of the expanded position variable to store the calculated shift.	<Data 2>

4. PX Variable number/ LPX Variable number/PX [array number]/ LPX [array number]

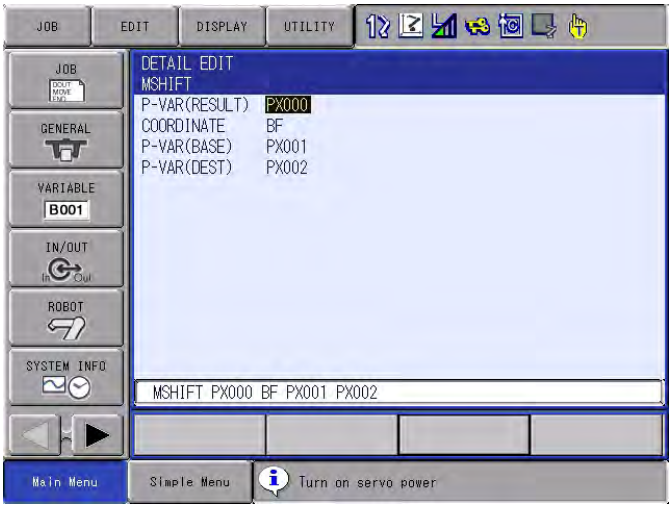
№	Tag	Explanation	Note
8	PX Variable number/ LPX Variable number/ PX [Array number]/ LPX [Array number]	Specifies the expanded position type variable number of the target position to calculate the amount of the shift.	<Data 3>

3.4.4 Register MSHIFT Instruction

1. Move the cursor to the address area.
2. Move the cursor to the line where MSHIFT instruction is to be registered.
3. Press [INFORM LIST].
   (1) The instruction list dialog box appears.
   (2) The cursor moves to the instruction list dialog box while the cursor in the address area changes to an under bar.
4. Select {MSHIFT}.
   – At this stage, the instruction on the cursor position is displayed with the previously registered additional items in the input buffer line.



5. Press [ENTER] twice.
   – The DETAIL EDIT window of MSHIFT instruction windows appears.



6. Set variables on the DETAIL EDIT window of MSHIFT instruction.
7. Press [ENTER] twice.
   (1) Press [ENTER] once to display the set contents in the input buffer line.
   (2) Press [ENTER] once more, and the set contents are registered in the job.

4 Alarm List

Alarm No.	Message	Cause	Remedy
4474	WRONG CONTROL GROUP AXIS	The CALL/JUMP/PSTART destination job could not be executed. An attempt was made to call or jump to a job whose control group cannot be controlled. (Subcode: The related control-group)	(1) Confirm the settings below. • Make the setting in advance so that the control group of the CALL/ JUMP destination job is included in that of the CALL/JUMP source job. • Don't start a job containing a running control group with a "PSTART" instruction.
4499	UNDEFINED POSITION VARIABLE	The position type variable is not registered. An attempt was made to use the position type variable that was not set. (Subcode: The variable number)	(1) Confirm the settings below. Set the position type variable.
4507	REFP POS ERROR (SEARCH MOTION)	Incorrect teaching point for search detection The search start point and the motion target point are the same, or the distance between the two points is too short.	(1) Confirm the settings below. • Perform the teaching again so that the search start point and the motion target point are not the same. • Increase the distance between the search start point and the motion target point.

5 Instruction List

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

SRCH	Function	Executes a search function.		
	Additional Item	RIN#(<direct IN No.>) = <status>		Direct IN No. : 1 - 6 Status : ON, OFF, B <variable No.>
		T = <time✍s>		Direct IN signal input check start delay time
		DIS = <distance✍mm>		A length of passing over the target point specified by the position type variable
	Example	MOVL P000 V=138 SRCH RIN#(1)=ON T=1.00 DIS=10.0		
GETS	Function	Saves the system variable as a user variable.		
	Additional Item	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
	Example	GETS B000 $B000 GETS I001 $I[1] GETS PX003 $PX001		
CNVRT	Function	Converts a pulse data position type data of Data 2 into a Cartesian data position type variable using a specified coordinate system, then saves in Data 1. Format : CNVRT <Data 1><Data 2> coordinate system		
	Additional Item	Data 1	PX <variable No.>	
		Data 2	PX <variable No.>	
		BF, RF, TF, UF# (<user coordinate system No.>), MTF		BF:Base coordinate system RF : Robot coordinate system TF : Tool coordinate system UF : User coordinate system MTF : Master tool coordinate system
	Example	CNVRT PX000 PX001 BF CNVRT LPX000 LPX001 TF		
SEFTOF	Function	Stop shift operation.		
	Additional Item	No		
	Example	SFTOF		

MSHIFT	Function	Calculate shift amount in the specified coordinate system from data 2 and data 3 and store the calculated value in data 1. Format : MSHIFT <Data 1><Coordinates><Data 2><Data 3>		
	Additional Item	Data 1	PX <variable No.>	
		Coordinate	BF, RF, TF, UF# (<user coordinate system No.>), MTF	BF:Base coordinate system RF : Robot coordinate system TF : Tool coordinate system UF : User coordinate system MTF : Master tool coordinate system
		Data 2	PX <variable No.>	
		Data 3	PX <variable No.>	
	Example	MSHIFT PX100 RF PX001 PX002		

DX200 OPTIONS INSTRUCTIONS

FOR SEARCH FUNCTION

HEAD OFFICE
2-1 Kurosakishiroishi, Yahatanishi-ku, Kitakyushu 806-0004, Japan
Phone +81-93-645-7745 Fax +81-93-645-7746

YASKAWA America Inc. M Robotics Division
100 Automation Way, Miamisburg, OH 45342, U.S.A.
Phone +1-937-847-6200 Fax +1-937-847-6277

YASKAWA Nordic AB
Box 504 Verkstadsgatan 2, PO Box 504 SE-385 25 Torsås, Sweden
Phone +46-480-417-800 Fax +46-486-414-10

YASKAWA Europe GmbH Robotics Div.
Yaskawastrasse 1, 85391 Allershausen, Germany
Phone +49-8166-90-0 Fax +49-8166-90-103

YASKAWA Electric Korea Co., Ltd
9F, KYOBO Securities Bldg., 26-4, Yeoido-Dong Yeoungeungpo-ku, Seoul, Korea
Phone +82-2-784-7844 Fax +82-2-784-8495

YASKAWA Electric (Singapore) PTE Ltd.
151 Lorong Chuan, #04-02A, New Tech Park, Singapore 556741
Phone +65-6282-3003 Fax +65-6289-3003

YASKAWA Electric (Thailand) Co., Ltd.
252/246, 4th Floor. Muang Thai-Phatra Office Tower II Rachadaphisek Road,
Huaykwang Bangkok, 10320, Thailand
Phone +66-2-693-2200 Fax +66-2-693-4200

YASKAWA Shougang Robot Co. Ltd.
1015. Boxuenan Rd. Maluzhen, Jiading District, Shanghai, China
Phone +86-21-5950-3521 Fax +86-20-3878-0651

YASKAWA ELECTRIC CHINA Co., Ltd.
12F Carlton Building, No. 21-42 Huanghe Road, Shanghai 200003, China
Phone +86-21-5385-2200 Fax +86-21-5385-3299

YASKAWA Robotics India Ltd.
#426, Udyog Vihar, Phase- IV, Gurgaon, Haryana, India
Phone +91-124-475-8500 Fax +91-124-475-8542

YASKAWA
MOTOMAN ROBOTICS

MANUAL NO.
HW1481813 ◈0