

DX200 OPTIONS INSTRUCTIONS

FOR THE INTERRUPT JOB 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 manuals above correspond to specific usage.
Be sure to use the appropriate manual.

Part Number: 165259-1CD
Revision: 0



MANDATORY

- This manual explains the interrupt job function of the DX200 system and general operations. 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.

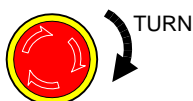
Figure 1: Emergency Stop Button



- 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 DX200 cabinet after use.

The programming pendant can be damaged if it is left in the P-point maximum envelope of the manipulator, 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

Interrupt Job Function

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.

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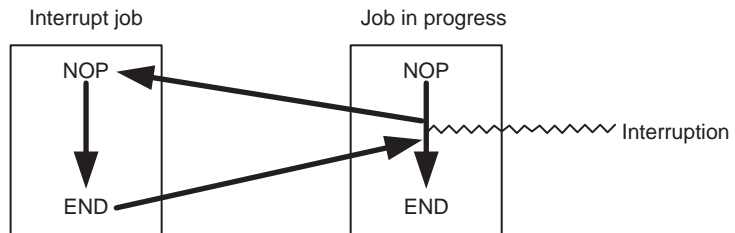
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1 What is the Interrupt Job Function?

The interrupt job function is a kind of call job. When a signal to interrupt the job is sent from a peripheral device or another system, this function momentarily suspends a job in progress, and executes the job corresponding to the signal.

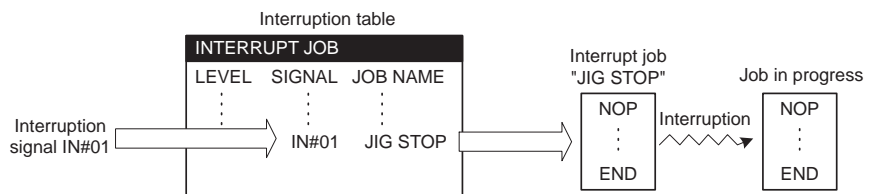
This function is useful when an error occurs in a peripheral device or in another system, or when the manipulator should be withdrawn in an emergency.



An interruption table defines the relation among the interruption levels (priority of an interruption signal), the interruption signals, and the interrupting jobs.

Sending a user input signal specified in the table calls, a job corresponding to that signal. When interrupt job is completed, the suspended job is restarted from the instruction line where the cursor was at the time of interruption.

NOTE If an interruption signal is received while the manipulator is in the “step” cycle, the manipulator stops at once, and then the next starting operation starts the interrupt job.



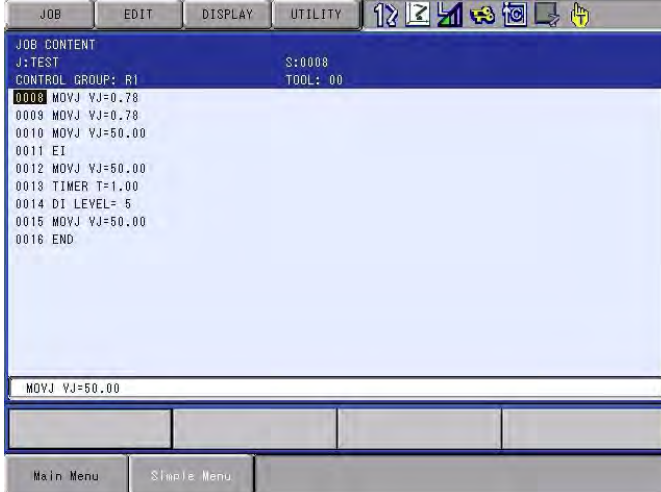
The smaller the interruption level number becomes, the higher the priority of the processing becomes.

Since the DX200 determines which interrupt job is to be executed according to this interruption table, make sure the settings for this table are correct. The system engineer sets up this interruption table.

An interrupt job can be executed when the start lamp is ON and between the execution of the EI (enable interruption) instruction and the DI (disable interruption) instruction.

A different interruption level can be specified for both EI and DI.

NOTE



```
JOB CONTENT
J:TEST                               S:0008
CONTROL GROUP: R1                     TOOL: 00
0008 MOVJ VJ=0.78
0009 MOVJ VJ=0.78
0010 MOVJ VJ=50.00
0011 EI
0012 MOVJ VJ=50.00
0013 TIMER T=1.00
0014 DI LEVEL= 5
0015 MOVJ VJ=50.00
0016 END

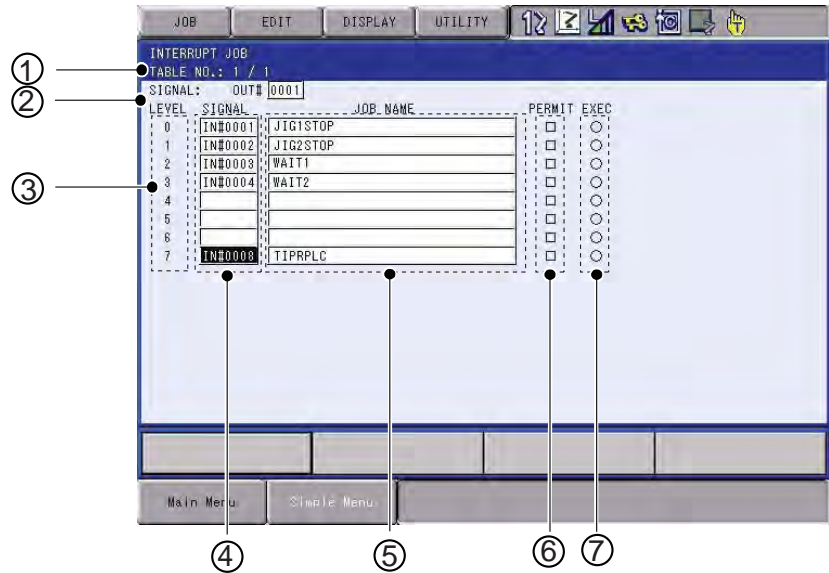
MOVJ VJ=50.00

Main Menu  Simple Menu
```

2 Setting of the Interrupt Job Function

2.1 Interruption Table Display

1. Select {JOB} under the main menu.
2. Select {INTERRUPT JOB} in the sub menu.



①TABLE NO. (Initial value: 1)

②OUTPUT SIGNAL (Initial value: no setting)

A user output signal that is turned ON during the execution of an interrupt job.

③LEVEL

The interruption level indicates the priority of the interruption signal.

The smaller the interruption level number becomes, the higher the priority of the processing becomes. Eight levels from 0 to 7 can be set.

④SIGNAL (Initial value: no setting)

A user input signal serves as an interruption signal.

⑤JOB NAME (Initial value: no setting)

A job name corresponding to an interruption signal

⑥PERMIT

Interruption enabled or disabled status (for diagnosis)

■(Enabled): Interruption enabled by the execution of the EI instruction

□(Disabled): Interruption disabled

⊙EXEC

- (ON): Interrupting job in progress
- (OFF): Interrupting job not in progress

“Exec” turns ON when an interruption signal is received and the interrupt job is called, and turns OFF when the job is completed.

“Exec” turns OFF in the following cases:

- An interrupt job is completed and the suspended job is restarted.
- Another job is called.
- CLEAR STACK instruction is executed.




{INTERRUPT JOB} appears when the security mode is the edit mode or management mode.

2.2 Setting of Interruption Table

In a system where an independent control is used simultaneously with the interrupt job function, an interrupt job can be set and executed for each task.

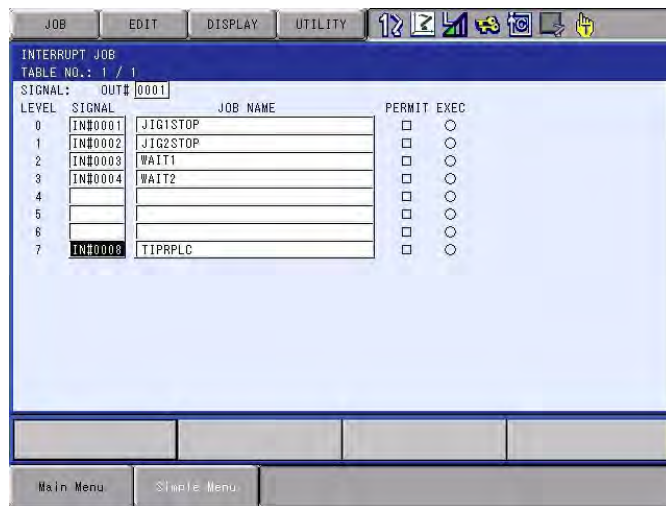
When using four tasks (16 tasks maximum) for the independent control:

Pressing the page key  changes the table No. in this order : "1" → "2" → "3" → "4" → "1."

Pressing [SHIFT] + the page key  changes the table No. in the reverse order : "4" → "3" → "2" → "1" → "4."

2.2.1 Setting of Signals

1. Move the cursor to the item to be selected, and press [SELECT].



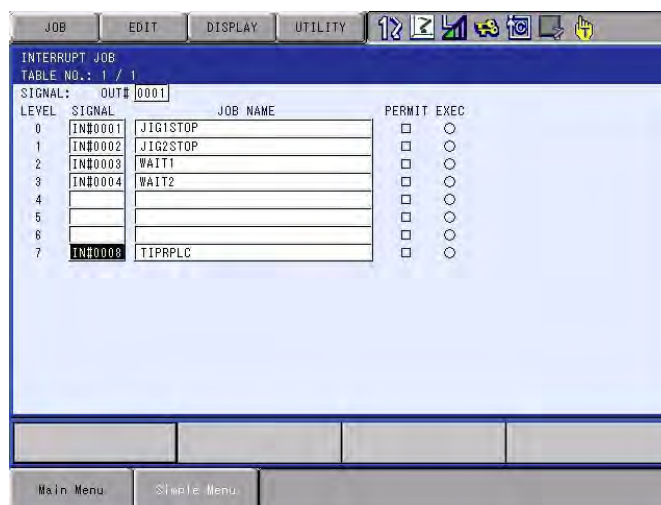
2. Enter a numerical value using the Numeric keys.



Entering "0" in SIGNAL clears the set signal No. and job name.

2.2.2 Setting of Job Names

1. Move the cursor to the item to be selected, and press [SELECT].



2. Select a job in the JOB LIST window.
3. Press [ENTER].

2.3 Setting of Interruption Levels

To specify the levels where interruptions can be enabled or disabled by the EI and DI instructions respectively, set the bits corresponding to the levels to "1."

	d7	d6	d5	d4	d3	d2	d1	d0
	LEVEL7	LEVEL6	LEVEL5	LEVEL4	LEVEL3	LEVEL2	LEVEL1	LEVEL0
The set values for the EI/DI instructions	128	64	32	16	8	4	2	1

For example, the set value of level 0 is "1" and the set value of level 2 is "4," with a total set value of "5." Therefore, to permit levels 0 and 2, set the EI instruction to "5."

EI
LEVEL=5

d7	d6	d5	d4	d3	d2	d1	d0
0	0	0	0	0	1	0	1

4 + 1 → 5

The status of other interruption levels remains unchanged.



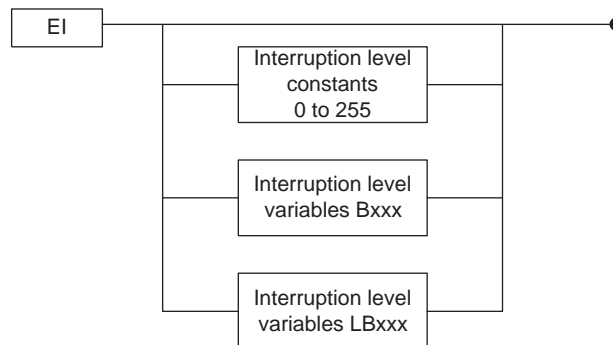
- If no interruption level is specified, all levels from 0 to 7 enable or disable interruption.
- If the interruption level is set to "0," it is treated like an NOP instruction where no operation is executed and proceeds to the next instruction.

3 Registration of Instructions

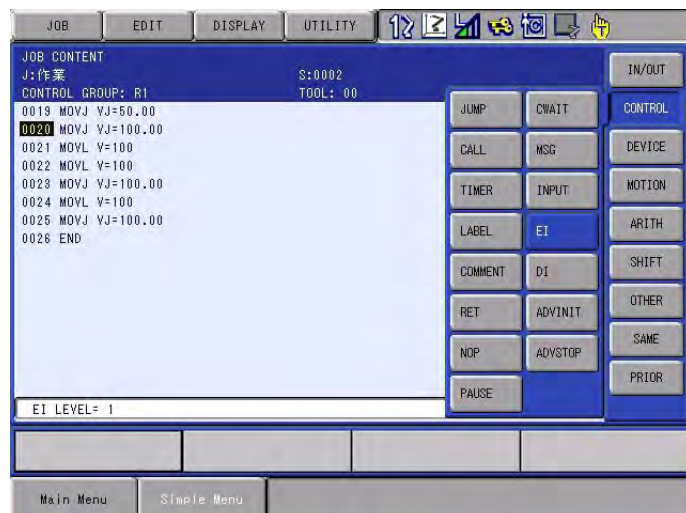
3.1 EI (Enable Interruption) Instruction

Executing an EI instruction activates the specified interruption levels set in the additional item.

To specify the levels where interruptions can be enabled, set the bits corresponding to the levels to "1." The status of the other interruption levels remains unchanged.



1. Move the cursor to the address area.
 2. Press [INFORM LIST].
 3. Select {CONTROL}.
 4. Move the cursor to "EI."
- The EI instruction appears in the input buffer line with the previously registered additional items.



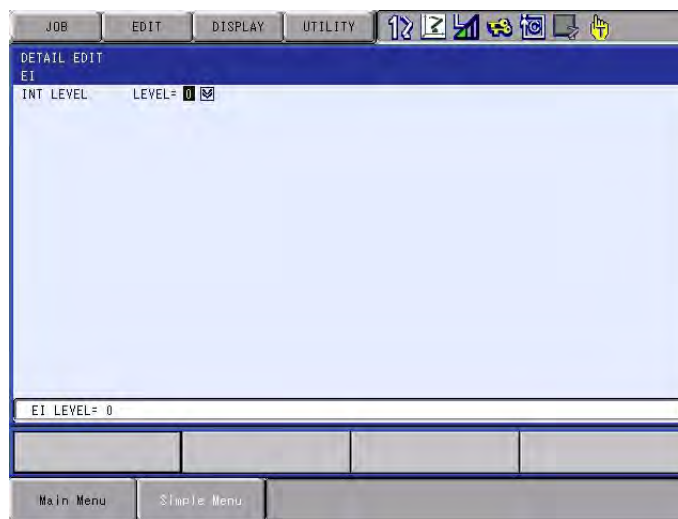
Interrupt Job Function

3 Registration of Instructions

3.1 EI (Enable Interruption) Instruction

5. Press [SELECT] twice to set an interruption level in the DETAIL EDIT window.

– Enter the interruption level using the Numeric keys.



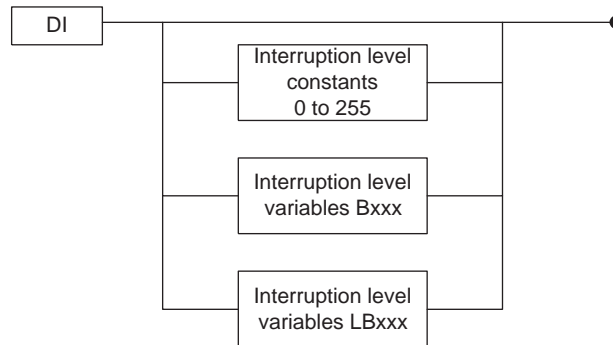
6. Press [ENTER] twice.

– Pressing [ENTER] once shows the set contents in the input buffer line. Pressing [ENTER] again registers the set contents in the job.

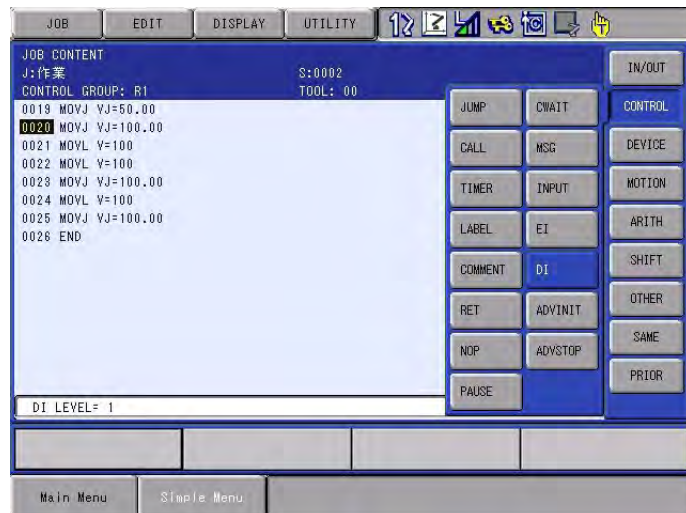
3.2 DI (Disable Interruption) Instruction

Executing a DI instruction activates the specified interruption levels set in the additional item.

To specify the levels where interruptions can be disabled, set the bits corresponding to the levels to "1." The status of the other interruption levels remains unchanged.



1. Move the cursor to the address area.
2. Press [INFORM LIST].
3. Select {CONTROL}.
4. Move the cursor to "DI".
 - The DI instruction appears in the input buffer line with the previously registered additional items.

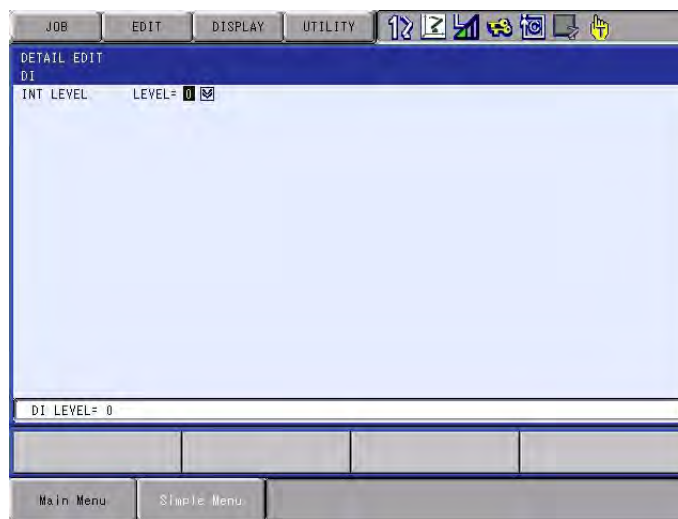


Interrupt Job Function

3 Registration of Instructions

3.2 DI (Disable Interruption) Instruction

5. Press [SELECT] twice to set an interruption level in the DETAIL EDIT window.
 - Enter the interruption level using the Numeric keys.



6. Enter the interruption level using the Numeric keys.
 - Pressing [ENTER] once shows the set contents in the input buffer line. Pressing [ENTER] again registers the set contents in the job.

4 Execution of an Interrupt Job

4.1 Interruption Signal Detection

An interruption signal is detected at the rising edge of the signal.

If more than one interruption signal is detected at the same time, the job for the level with higher priority is executed.

4.2 Timing for Interrupt Job Execution

The timing of executing an interrupt job depends on what instruction is being executed when the interruption signal is received, and can be divided into the following two types.

- Suspends the instruction being executed to do an interrupt job
The following instructions are suspended while executing an interrupt job.

Move Instructions	MOVJ MOVL MOVC IMOV
I/O Instruction	WAIT
Control Instruction	TIMER

- Executes an interrupt job after the completion of the instruction being executed.
Any instructions other than those listed above are completed before starting an interrupt job.

4.3 Deceleration Before Interrupt Job Execution

If the manipulator is moving at a high speed and the interrupt job is executed immediately after the interruption signal is received, an excessive shock to the manipulator may result.

To avoid this risk, the manipulator automatically decelerates upon receipt of the interruption signal, and then the interrupt job is executed.

4.4 Interruption Signal Entered During Another Interrupt Job

All interruptions are automatically disabled during the execution of an interrupt job. Therefore, if another interruption signal with a higher priority is received, its corresponding job is not executed.

The new signal is ignored. When an interrupt job is completed, even if any interruption signal is ON, the corresponding interrupt job is not executed until the rising edge of the interruption signal is detected.

Interrupt Job Function	4 Execution of an Interrupt Job 4.5 Output Signal of "Interrupt Job in Execution"
------------------------	--

4.5 Output Signal of "Interrupt Job in Execution"

During execution of an interrupt job, the output signal turns ON to indicate that the interrupt job is being executed. This output signal turns ON when an interruption signal is received and the interrupt job is called, and turns OFF when the interrupt job completes.

The output signal "Interrupt Job in Execution" turns OFF in the following cases:

- The execution of an interrupt job completes and the suspended job is restarted.
- Another job is called.
- The CLEAR STACK instruction is executed.

4.6 Automatic Interruption Disabled Status

Only execution of the EI instruction enables interruptions. Even after the main power supply turns OFF, the interruption enabled/disabled status is kept.

However, when a job is called, all interruption levels are automatically disabled for security.

4.7 Job Call Stack

Job calls made by interruptions are processed like other job calls. The same job call stack is used for both kinds of job calls.

Therefore, adding an interrupt job to a job call stack filled to level 8 causes the stack to overflow.

4.8 If an interrupt job cannot be executed

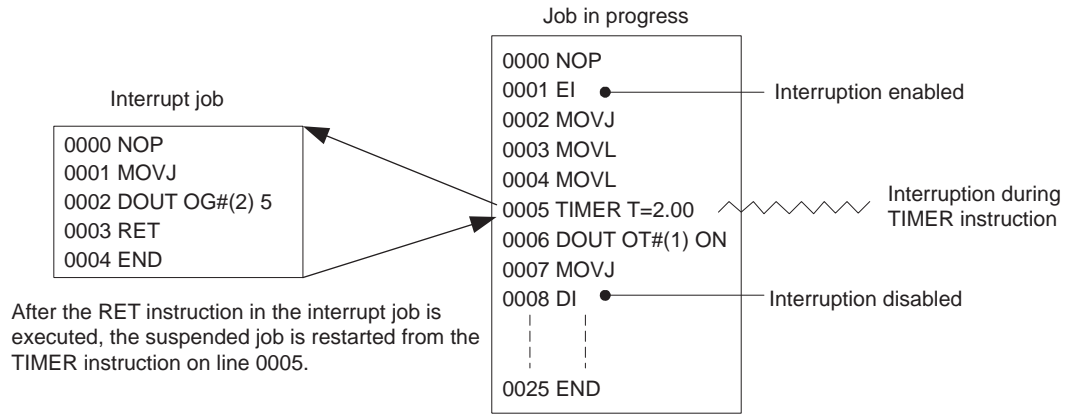
An interrupt job cannot be executed in any of the following cases:

- During 1 step-back operation caused by the dedicated input #40090-#40097 " 1 step-back operation command"
- During return operation of a restart function for arcing application

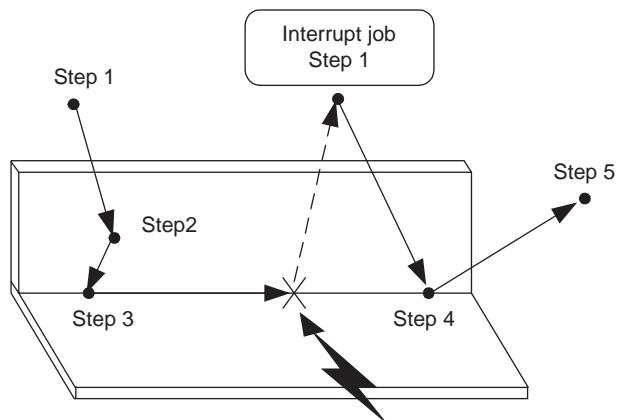
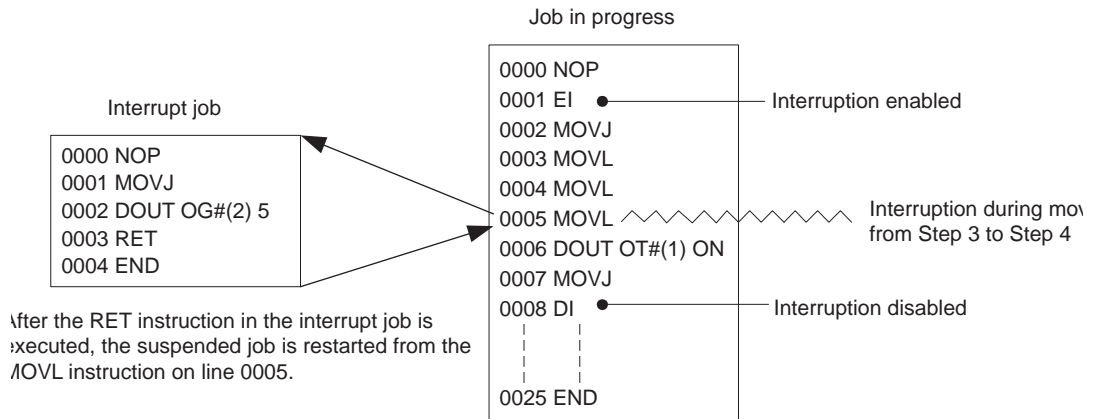
If an interrupt job is attempted, "AL4525: Specified job not executable" is displayed.

5 Application Examples

5.1 Interruption During Timer Instruction

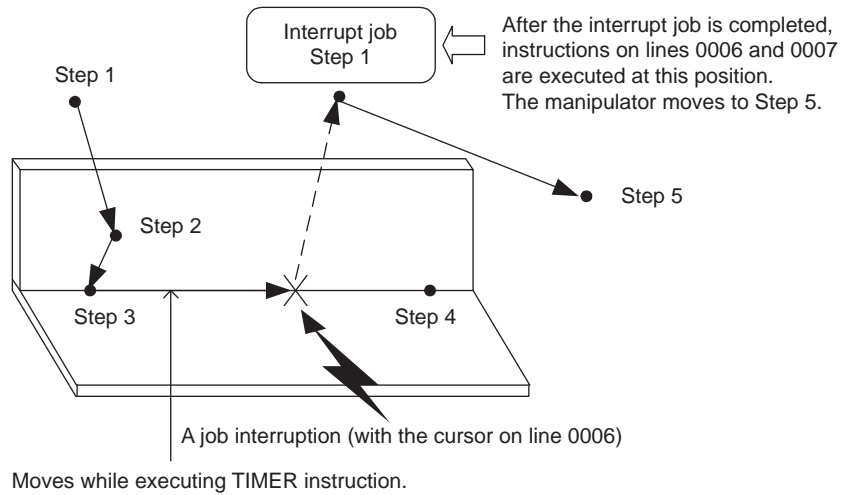
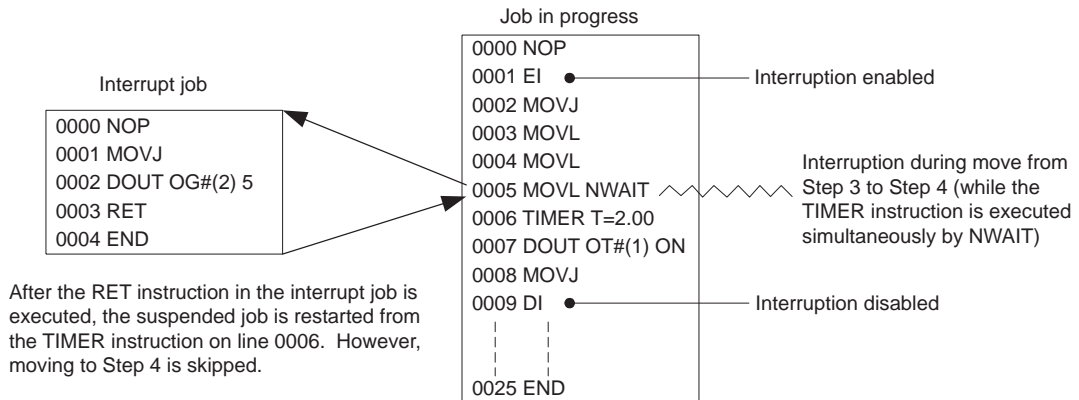


5.2 Interruption During Move Instruction

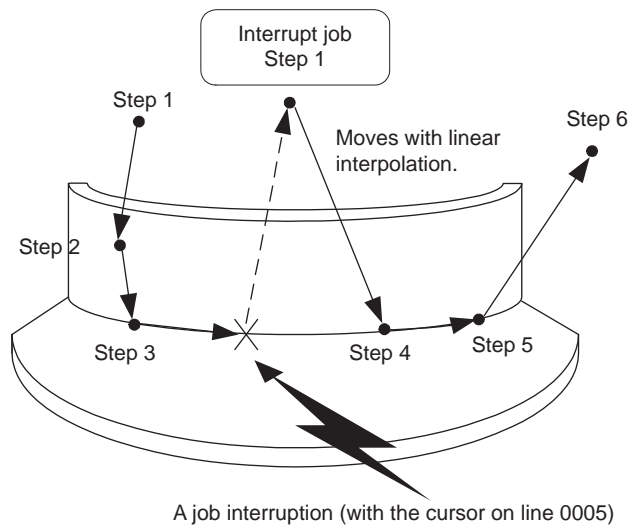
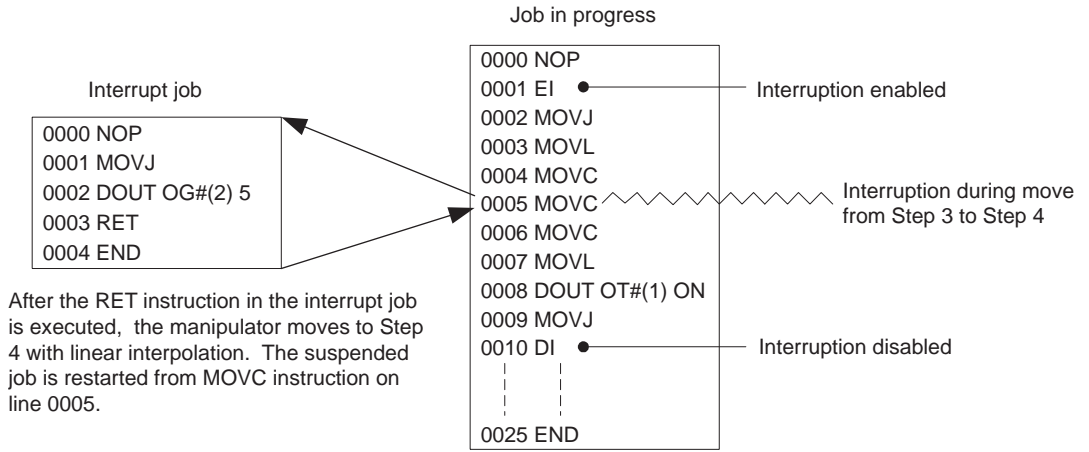


A job interruption (with the cursor on line 0005)

5.3 Interruption During Move Instruction with NWAIT



5.4 Interruption During Circular Interpolation Move Instruction (MOVC)



6 System with Independent Control

In a system where an independent control is used simultaneously with the interrupt job function, an interrupt job can be set and executed for each task.

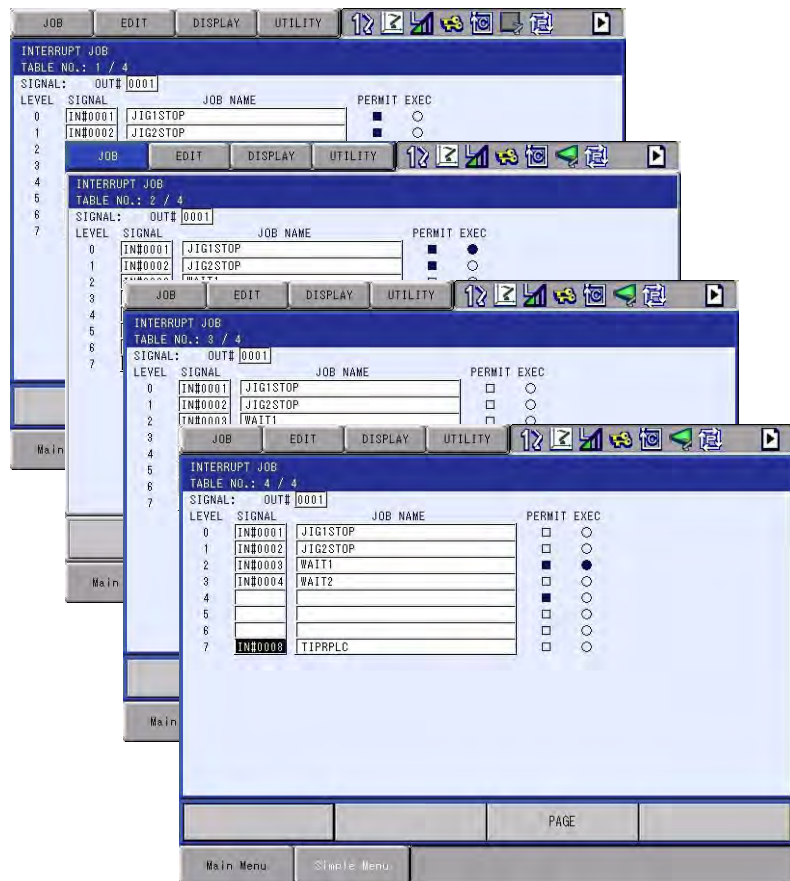
When using four tasks (sixteen tasks maximum) for the independent control, the table No. indicates the type of task being displayed as follows:

Master task ···· Table No. 1

Subtask 1 ···· Table No. 2

Subtask 2 ···· Table No. 3

Subtask 3 ···· Table No. 4



- EI and DI instructions are valid only in each individual task. For example, an EI instruction in subtask 1 does not affect any interruption tables in the master task or in subtask 2.
- The following instructions are used for independent control.

PSTART
PWAIT
TSYNC



During execution of an independent control instruction above, the interrupt job function can not be used. Program a DI and an EI instruction before and after the independent control instruction to disable interruptions.

<Job Example>

When a PSEND instruction is used

NOP
....
DI
PSTART JOB:R1 SUB1
EI
....
END

7 Instruction List

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

EI	Function	Enables a specified interruption level.	
	Additional Items	<Interruption level> B <Variable No.> LB <Variable No.>	0 to 255 for constants. When omitted, all levels are enabled.
	Example	EI LEVEL=1 EI LEVEL=B001 EI	
DI	Function	Disables a specified interruption level.	
	Additional Items	<Interruption level> B <Variable No.> LB <Variable No.>	0 to 255 for constants When omitted, all levels are disabled.
	Example	DI LEVEL=5 DI LEVEL=B001 DI	

DX200 OPTIONS INSTRUCTIONS

FOR THE INTERRUPT JOB FUNCTION

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