YASKAWA

YRC1000 OPTIONS
INSTRUCTIONS

FOR 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
YRC1000 INSTRUCTIONS
YRC1000 OPERATOR'S MANUAL (GENERAL) (SUBJECT SPECIFIC)
YRC1000 MAINTENANCE MANUAL
YRC1000 ALARM CODES (MAJOR ALARMS) (MINOR ALARMS)

The YRC1000 operator's manual above corresponds to specific usage. Be sure to use the appropriate manual.
The YRC1000 operator's manual above consists of "GENERAL" and "SUBJECT SPECIFIC".
The YRC1000 alarm codes above consists of "MAJOR ALARMS" and "MINOR ALARMS".

Please have the following information available when contacting
Yaskawa Customer Support:
● System
● Primary Application
● Software Version *(Located on Programming Pendant by selecting:*
  {Main Menu} - {System Info} - {Version})
  Robot Serial Number *(Located on robot data plate)*
  Robot Sales Order Number *(Located on controller data plate)*

Part Number: 178676-1CD
Revision: 0

⚠ DANGER

- This manual explains the interrupt job function of the YRC1000 system. Read this manual carefully and be sure to understand its contents before handling the YRC1000. Any matter not described in this manual must be regarded as "prohibited" or "improper".

- General information related to safety are described in "Chapter 1. Safety" of the YRC1000 INSTRUCTIONS. To ensure correct and safe operation, carefully read "Chapter 1. Safety" of the YRC1000 INSTRUCTIONS.

⚠ CAUTION

- In some drawings in this manual, the protective covers or shields are removed to show details. Make sure to install all the covers and shields in place before operating this product.

- YASKAWA is not responsible for incidents arising from unauthorized modification of its products.   Unauthorized modification voids the product warranty.

NOTICE

- 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.

Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the YRC1000.

In this manual, the Notes for Safe Operation are classified as "DANGER", "WARNING", "CAUTION", or "NOTICE".

⚠ DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. Safety Signs identified by the signal word DANGER should be used sparingly and only for those situations presenting the most serious hazards.
⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury. Hazards identified by the signal word WARNING present a lesser degree of risk of injury or death than those identified by the signal word DANGER.
⚠ CAUTION	Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury. It may also be used without the safety alert symbol as an alternative to "NOTICE".
NOTICE	NOTICE is the preferred signal word to address practices not related to personal injury. The safety alert symbol should not be used with this signal word. As an alternative to "NOTICE", the word "CAUTION" without the safety alert symbol may be used to indicate a message not related to personal injury.

Even items described as "CAUTION" may result in a serious accident in some situations.
At any rate, be sure to follow these important items.

> NOTE: To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as "DANGER", "WARNING" and "CAUTION".

<div align="center">

⚠ DANGER

</div>

- Before operating the manipulator, make sure the servo power is turned OFF by performing the following operations. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.
  - Press the emergency stop buttons on the front door of the YRC1000, on the programming pendant, on the external control device, etc.
  - Disconnect the safety plug of the safety fence.
    (when in the play mode or in the remote mode).

If operation of the manipulator cannot be stopped in an emergency, personal injury and/or equipment damage may result.

Fig. : Emergency Stop Button

- Before releasing the emergency stop, make sure to remove the obstacle or error caused the emergency stop, if any, and then turn the servo power ON.

Failure to observe this instruction may cause unintended movement of the manipulator, which may result in personal injury.

Fig. : Release of Emergency Stop

TURN

- Observe the following precautions when performing a teaching operation within the manipulator's operating range:
  - Be sure to perform lockout by putting a lockout device on the safety fence when going into the area enclosed by the safety fence. In addition, the operator of the teaching operation must display the sign that the operation is being performed so that no other person closes the safety fence.
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Always keep in mind emergency response measures against the manipulator's unexpected movement toward a person.
  - Ensure a safe place to retreat in case of emergency.

Failure to observe this instruction may cause improper or unintended movement of the manipulator, which may result in personal injury.

- Confirm that no person is present in the manipulator's operating range and that the operator is in a safe location before:
  - Turning ON the YRC1000 power
  - Moving the manipulator by using the programming pendant
  - Running the system in the check mode
  - Performing automatic operations

Personal injury may result if a person enters the manipulator's operating range during operation. Immediately press an emergency stop button whenever there is a problem. The emergency stop buttons are located on the front panel of the YRC1000 and on the right of the programming pendant.

- Read and understand the Explanation of the Warning Labels before operating the manipulator.

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<table>
<tbody>
<tr><td colspan="2" align="center">⚠️ **WARNING**</td></tr>
</tbody>
</table>

⚠️ WARNING
• Perform the following inspection procedures prior to conducting manipulator teaching.   If there is any problem, immediately take necessary steps to solve it, such as maintenance and repair. – Check for a problem in manipulator movement. – Check for damage to insulation and sheathing of external wires. • Always return the programming pendant to the hook on the YRC1000 cabinet after use. If the programming pendant is left unattended on the manipulator, on a fixture, or on the floor, etc., the Enable Switch may be activated due to surface irregularities of where it is left, and the servo power may be turned ON. In addition, in case the operation of the manipulator starts, the manipulator or the tool may hit the programming pendant left unattended, which may result in personal injury and/or equipment damage.

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 manipulator cables.

In this manual, the equipment is designated as follows:

Equipment	Manual Designation
YRC1000 Controller	YRC1000
YRC1000 Programming Pendant	Programming Pendant
Cable between the manipulator and the controller	Manipulator Cable

Descriptions of the programming pendant keys, 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 [SELECT] 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.

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Contents

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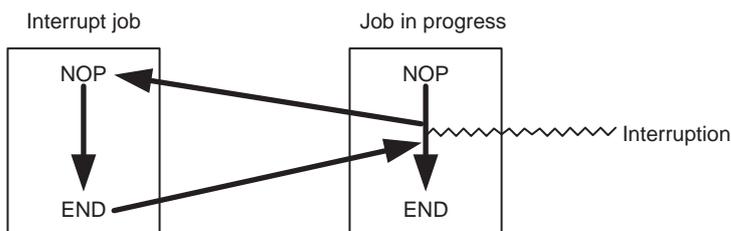
An interruption table defines the relation among the interruption levels (priority of an interruption signal), the interruption signals, and the interrupting jobs.

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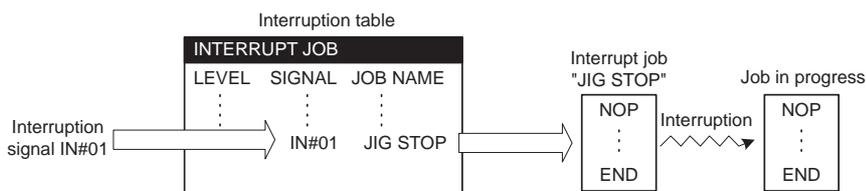
The smaller the interruption level number becomes, the higher the priority of the processing becomes.

Since the YRC1000 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.

> **NOTE**
>
> 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.

```
  JOB        EDIT      DISPLAY    UTILITY

JOB CONTENT
J:TEST                          S:0010
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.
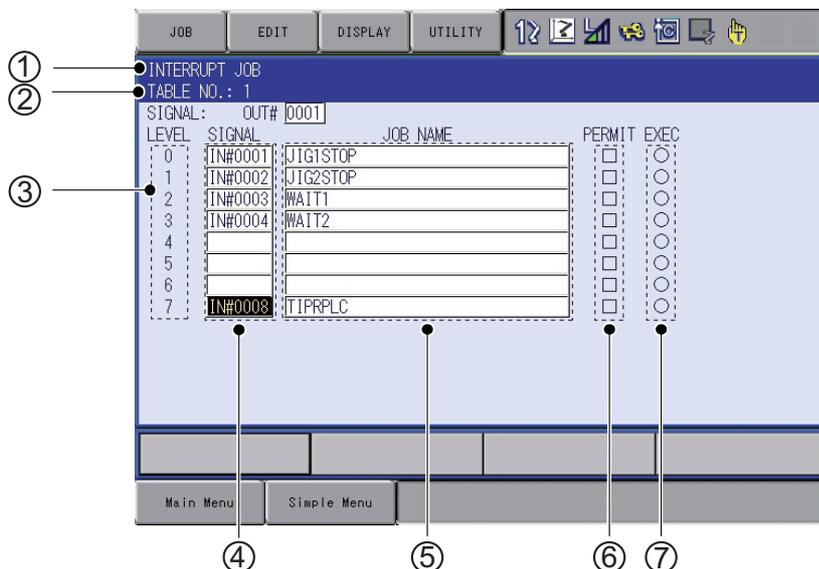
①**TABLE NO. (Initial value: 1)**

②**OUTPUT SIGNAL (Initial value: no setting)**
A user output signal that is turned ON during the execution of an interrupt job.

③**LEVEL**
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.

④**SIGNAL (Initial value: no setting)**
A user input signal serves as an interruption signal.

⑤**JOB NAME (Initial value: no setting)**
A job name corresponding to an interruption signal

⑥**PERMIT**
Interruption enabled or disabled status (for diagnosis)
■(Enabled): Interruption enabled by the execution of the EI instruction
□(Disabled): Interruption disabled

⑦EXEC

● (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.

> NOTE
> {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] changes the table No. in this order : "1" → "2" → "3" → "4" → "1."

Pressing [SHIFT] + [PAGE] 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.

NOTE	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.

> NOTE
> • 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.
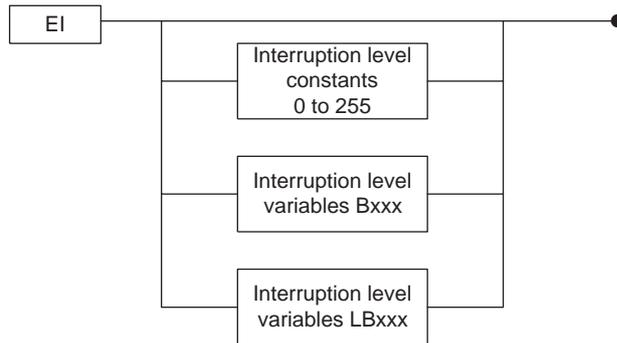
1. Move the cursor to the address area.

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.

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.
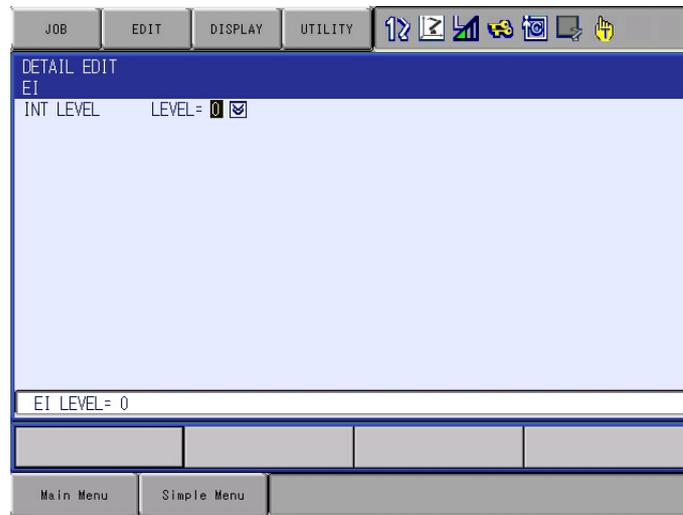

1. Move the cursor to the address area.

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.
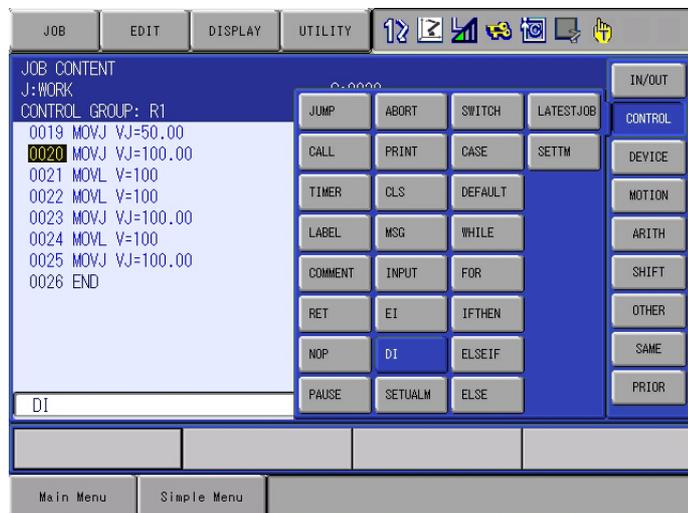
3   Registration of Instructions
3.2   DI (Disable Interruption) Instruction

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

    – Enter the interruption level using the Numeric keys.

JOB	EDIT	DISPLAY	UTILITY	

DETAIL EDIT
DI
INT LEVEL   LEVEL= 0

DI LEVEL= 0

Main Menu	Simple Menu	
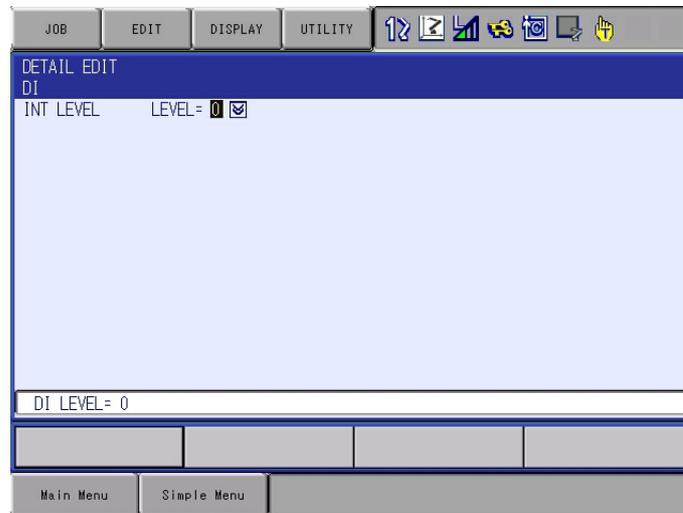
6. Enter the interruption level using the Numeric keys.

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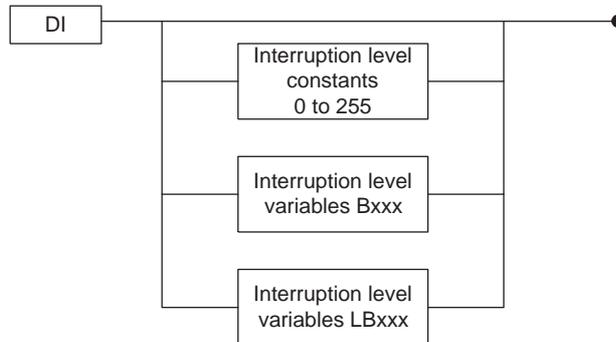   line. Pressing [ENTER] again registers the set contents in the job.

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.

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.

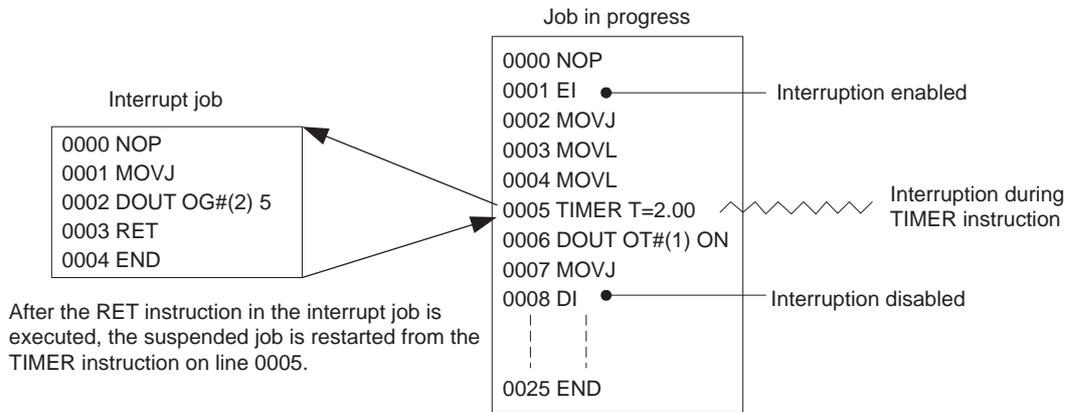## 4.8   If an interrupt job cannot be executed

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"

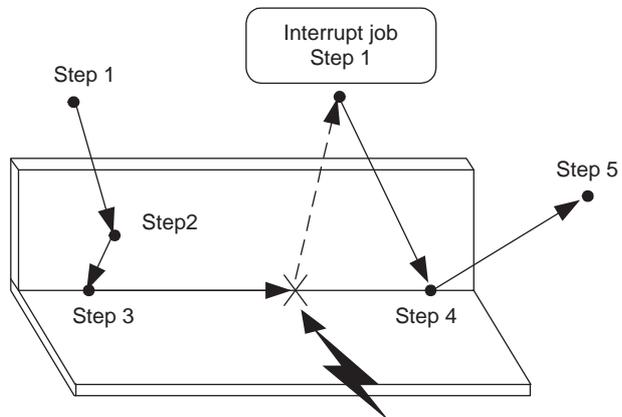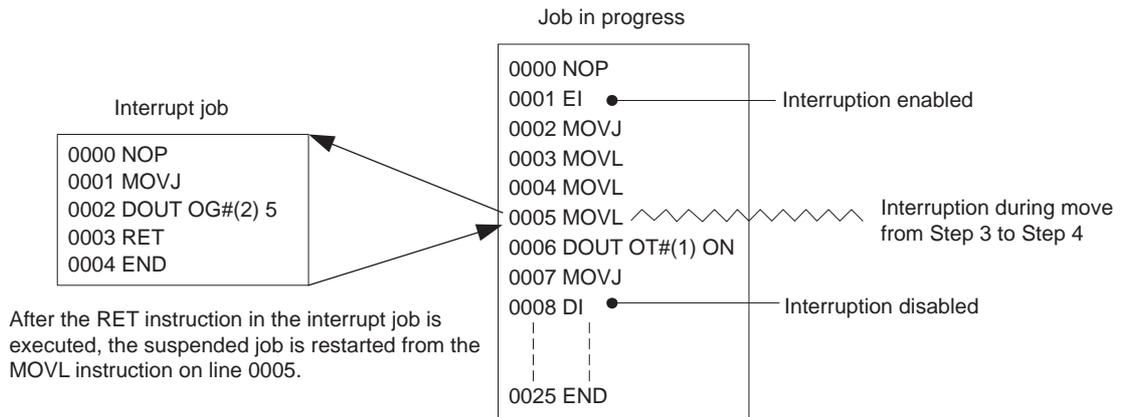- During return operation of a restart function for arcing application

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

5   Application Examples
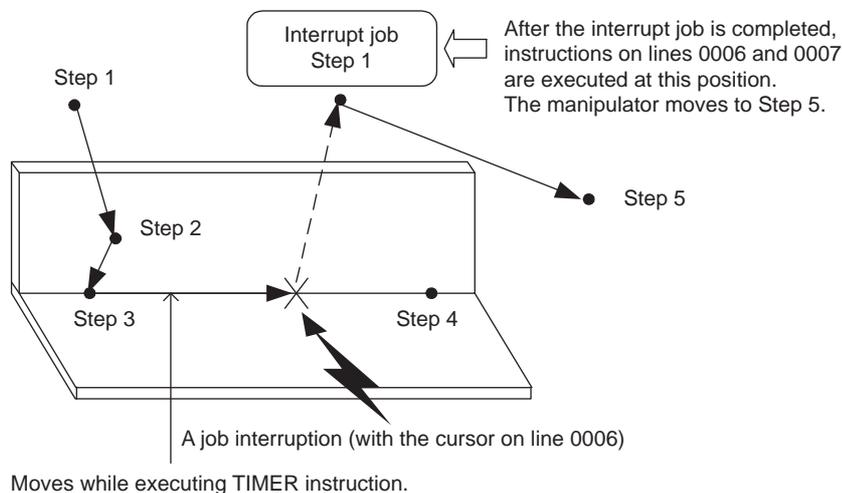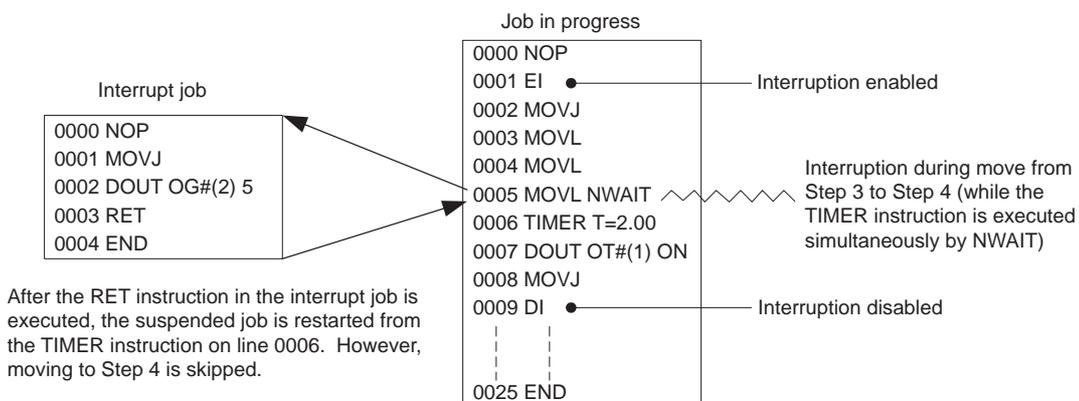
5.1   Interruption During Timer Instruction

Job in progress

```
0000 NOP
0001 EI          •        ———— Interruption enabled
0002 MOVJ
0003 MOVL
0004 MOVL
0005 TIMER T=2.00  ∿∿∿∿∿   ———— Interruption during
0006 DOUT OT#(1) ON                TIMER instruction
0007 MOVJ
0008 DI          •        ———— Interruption disabled
  ┆     ┆
0025 END
```

Interrupt job

```
0000 NOP
0001 MOVJ
0002 DOUT OG#(2) 5
0003 RET
0004 END
```

After the RET instruction in the interrupt job is executed, the suspended job is restarted from the TIMER instruction on line 0005.

5.2   Interruption During Move Instruction

Job in progress

```
0000 NOP
0001 EI          •        ———— Interruption enabled
0002 MOVJ
0003 MOVL
0004 MOVL
0005 MOVL  ∿∿∿∿∿∿∿∿∿∿     ———— Interruption during move
0006 DOUT OT#(1) ON                from Step 3 to Step 4
0007 MOVJ
0008 DI          •        ———— Interruption disabled
  ┆     ┆
0025 END
```

Interrupt job

```
0000 NOP
0001 MOVJ
0002 DOUT OG#(2) 5
0003 RET
0004 END
```

After the RET instruction in the interrupt job is executed, the suspended job is restarted from the MOVL instruction on line 0005.

Interrupt job
Step 1

Step 1

Step 5

Step2

Step 3

Step 4

A job interruption (with the cursor on line 0005)

5.3   Interruption During Move Instruction with NWAIT

Job in progress

```
0000 NOP
0001 EI          ●————————— Interruption enabled
0002 MOVJ
0003 MOVL
0004 MOVL                    Interruption during move from
0005 MOVL NWAIT  〜〜〜〜〜〜   Step 3 to Step 4 (while the
0006 TIMER T=2.00            TIMER instruction is executed
0007 DOUT OT#(1) ON          simultaneously by NWAIT)
0008 MOVJ
0009 DI          ●————————— Interruption disabled
  ¦     ¦
0025 END
```

Interrupt job

```
0000 NOP
0001 MOVJ
0002 DOUT OG#(2) 5
0003 RET
0004 END
```

After the RET instruction in the interrupt job is executed, the suspended job is restarted from the TIMER instruction on line 0006. However, moving to Step 4 is skipped.

Interrupt job
Step 1

After the interrupt job is completed, instructions on lines 0006 and 0007 are executed at this position. The manipulator moves to Step 5.

Step 1

Step 5

Step 2

Step 3   Step 4

A job interruption (with the cursor on line 0006)

Moves while executing TIMER instruction.

5.4   Interruption During Circular Interpolation Move Instruction (MOVC)

Job in progress

Interrupt job

```
0000 NOP
0001 MOVJ
0002 DOUT OG#(2) 5
0003 RET
0004 END
```

```
0000 NOP
0001 EI          ●————————  Interruption enabled
0002 MOVJ
0003 MOVL
0004 MOVC
0005 MOVC  ∿∿∿∿∿∿∿∿∿∿  Interruption during move
0006 MOVC                    from Step 3 to Step 4
0007 MOVL
0008 DOUT OT#(1) ON
0009 MOVJ
0010 DI          ●————————  Interruption disabled
         ┊  ┊
0025 END
```

After the RET instruction in the interrupt job is executed, the manipulator moves to Step 4 with linear interpolation. The suspended job is restarted from MOVC instruction on line 0005.

Interrupt job
Step 1

Step 1

Step 6

Moves with linear interpolation.

Step 2

Step 3   Step 4   Step 5

A job interruption (with the cursor on line 0005)

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

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NOTE
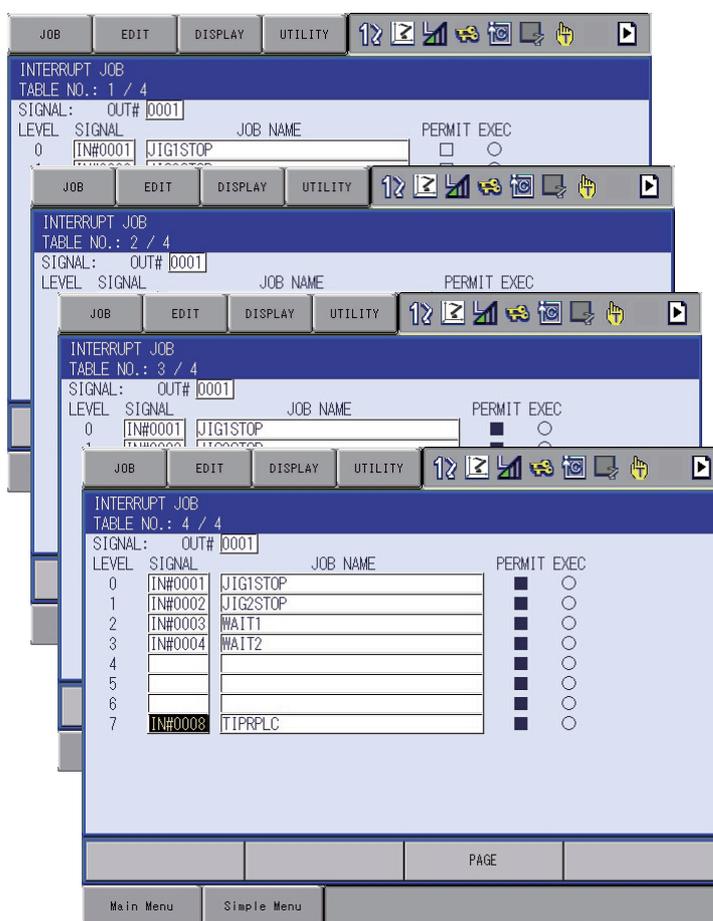
• EI and DI instructions are valid only in each individual task. For example, an EI instruction in subtask 1 does not affect any interruption tables in the master task or in subtask 2.

• 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	

YRC1000 OPTIONS
INSTRUCTIONS

FOR INTERRUPT JOB FUNCTION

Specifications are subject to change without notice
for ongoing product modifications and improvements.

YASKAWA

YASKAWA ELECTRIC CORPORATION