

FS100 OPTIONS INSTRUCTIONS

FOR I/O OUTPUT TIMING CONTROL FUNCTION

-
- Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.
 - This instruction is applicable to both FS100 and FS100L controllers.
-

MOTOMAN INSTRUCTIONS

(FOR SMALL -SIZED MANIPULATORS)
 MOTOMAN-□□□ INSTRUCTIONS
 FS100 INSTRUCTIONS
 FS100 OPERATOR'S MANUAL
 FS100 MAINTENANCE MANUAL

(FOR LARGE AND MEDIUM-SIZED MANIPULATORS)
 MOTOMAN-□□□ INSTRUCTIONS
 FS100L INSTRUCTIONS
 FS100 OPERATOR'S MANUAL
 FS100L MAINTENANCE MANUAL

The FS100 OPERATOR'S MANUAL above is applicable for both FS100 and FS100L controllers.

Part Number: 170766-1CD
 Revision: 0

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MANDATORY

- This manual explains the I/O output timing control function of the FS100 system. Read this manual carefully and be sure to understand its contents before handling the FS100.
- General items related to safety are listed in Chapter 1: Safety of the FS100 Instructions. To ensure correct and safe operation, carefully read the FS100 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.



This instruction manual is applicable to both FS100 (a controller for small-sized manipulators) and FS100L (a controller for large and medium-sized manipulators).

The description of "FS100" refers to both "FS100" and "FS100L" in this manual unless otherwise specified.

Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the FS100.

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



WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.



CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.



MANDATORY

Always be sure to follow explicitly the items listed under this heading.



PROHIBITED

Must never be performed.

Even items described as "CAUTION" may result in a serious accident in some situations.

At any rate, be sure to follow these important items



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



WARNING

- Before operating the manipulator, check that servo power is turned off when the emergency stop button on the programming pendant is pressed.
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.

Fig. 1: Emergency Stop Button



- In the case of not using the programming pendant, be sure to supply the emergency stop button on the equipment. Then before operating the manipulator, check to be sure that the servo power is turned OFF by pressing the emergency stop button.
Connect the external emergency stop button to the 5-6 pin and 16-17 pin of the robot system signal connector (CN2).
- Upon shipment of the FS100, this signal is connected by a jumper cable in the dummy connector. To use the signal, make sure to prepare a new connector, and then input it.

If the signal is input with the jumper cable connected, it does not function, which may result in personal injury or equipment damage.

- 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.

Fig. 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.
 - Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

The emergency stop button is located on the programming pendant.



WARNING

- 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 FS100.
 - Moving the manipulator with the programming pendant.
 - Running the system in the check mode.
 - Performing automatic operations.

Injury may result if anyone enters the working envelope of the manipulator during operation. Always press an emergency stop button immediately if there are problems.



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 FS100 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 FS100 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 FS100 controller, manipulator cables, the FS100 programming pendant (optional), and the FS100 programming pendant dummy connector (optional).

In this manual, the equipment is designated as follows:

Equipment	Manual Designation
FS100 or FS100L controller	FS100
FS100 or FS100L programming pendant	Programming pendant
Cable between the manipulator and the controller	Manipulator Cable
FS100 or FS100L programming pendant dummy connector	Programming pendant dummy connector

Descriptions of the programming pendant keys, buttons, displays and keyboard of the PC 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 is an exception, and a picture is not shown.
	Axis Keys Numeric Keys	“Axis Keys” and “Numeric 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 key  +COORD key 
	Mode Key	Three kinds of modes that can be selected by the mode key are denoted as follows: REMOTE, PLAY, or TEACH
	Button	Three buttons on the upper side of the programming pendant are denoted as follows: HOLD button START button EMERGENCY STOP button
	Displays	The menu displayed in the programming pendant is denoted with { }. ex. {JOB}
PC Keyboard		The name of the key is denoted ex. Ctrl key on the keyboard

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 ® and ™ are omitted.

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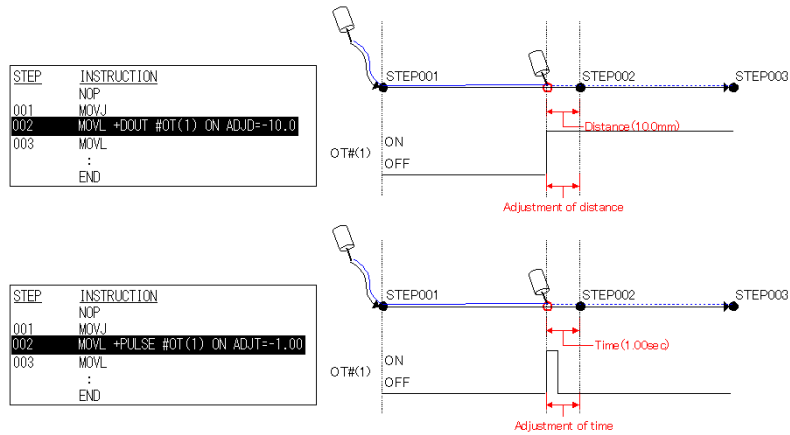
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1 About I/O Output Timing Control Function

I/O output timing control function is a function that can adjust the timing of general output signal by distance or time which based on the teaching position for the move instruction.

When the manipulator reaches to the specifying point which specified the time or distance while the manipulator is operating the move instruction, this function can output the general output signal. This function can adjust to deviation of work timing from the operation delay of the manipulator or devices which controlled by general output signal such as, valve and cylinder. Therefore, the manipulator can operate correctly, when it reaches to the expected position.

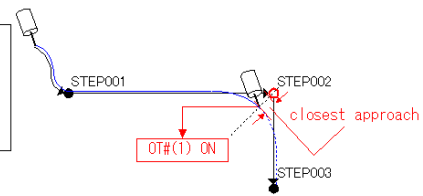
Fig. 1-1: I/O Output Timing Control Function



In case of the signal output is specified as distance, and the manipulator does not reach to the signal output position, such as the movement of the inward turning operation, the signal will be outputted when the manipulator comes to closest approach.

NOTE

STEP	INSTRUCTION
	NOP
001	MOVJ
002	MOVL +DOUT #OT(1) ON ADJ=D=0.0
003	MOVL
	:
	END



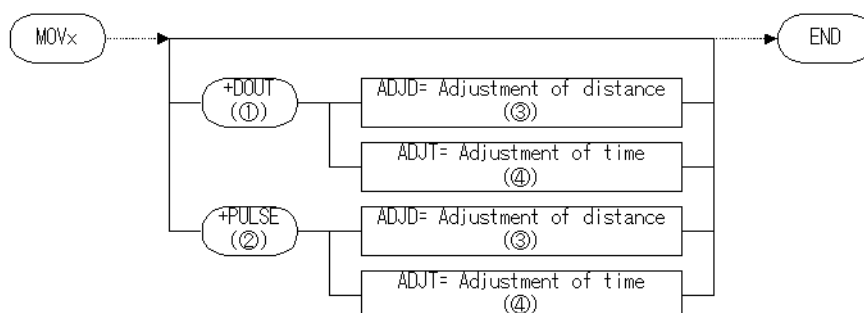
2 Setup of I/O Output Timing Control Function

2.1 Instruction of I/O Output Timing Control Function

2.1.1 Configuration of Synchronized Signal Output Instruction at Move Instruction

On the I/O output timing control function, as shown at *Table 2-1 "Configuration of Synchronized Output Signal"*. The synchronized signal output instruction (+DOUT/+PULSE) added to the move instruction will output the general output signal. The configuration of instruction is shown as follows.

Fig. 2-1: Configuration of Synchronized Output Signal



① **+DOUT**

Synchronized signal output instruction

② **+PULSE**

Synchronized pulse output instruction

③ **ADJD=**

Adjustment distance tag (setting data range: -3276.8 to 0.0 [mm])

④ **ADJT=**

Adjustment time tag (setting data range: -32.768 to 0.000 [mm])

NOTE

The synchronized signal output instruction (+DOUT/+PULSE) can be added four move instructions, as follows

• MOVJ/MOVL/MOVC/IMOV

NOTE

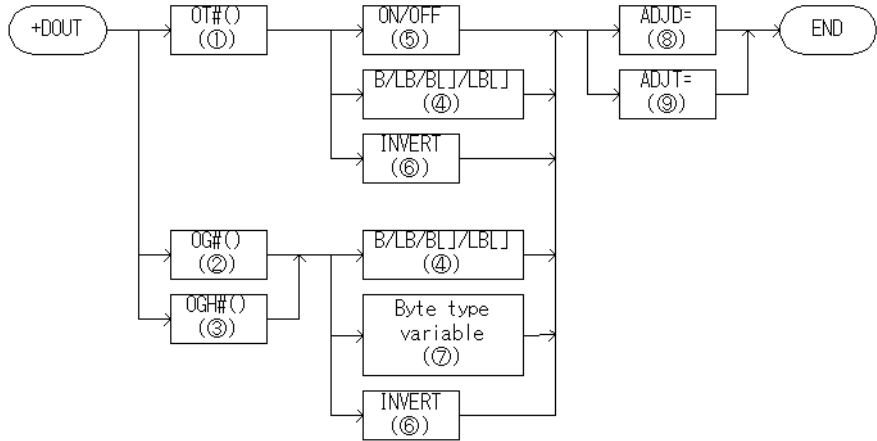
The I/O output timing control function can only adjust timing of the signal output to the previous direction (-direction) against the teaching position. For the backward direction (+direction) from the teaching position, operate the signal output to adjust to the previous direction against the teaching position of the next move instruction.

2.1.2 Configuration of +DOUT Instruction

+DOUT instruction which is added to the move instruction performs adjustment to the output timing of the general output signal.

The additional item of the +DOUT instruction is shown as follows.

Fig. 2-2: Configuration of +DOUT



Choose of the tags from the following table

No	Tag	Explanation	Note
1	OT# (Output No.)	Specifies the output number signal.	No:1 to 1024 Variable B/I/D/LB/LI/LD can be used.
2	OG# (Output group No.)	Specifies the output number group signal (1group 8 points).	No:1 to 128 Variable B/I/D/LB/LI/LD can be used.
3	OGH# (Output group No.)	Specifies the output number group signal (1group 4 points).	No:1 to 256 Variable B/I/D/LB/LI/LD can be used.

Output signal

Output signal OT#(x) is 1 point, OGH#(x) is 1 group 4 points, and OG#(x) is 1 group 8 points.



OT#(8)	OT#(7)	OT#(6)	OT#(5)	OT#(4)	OT#(3)	OT#(2)	OT#(1)
OGH#(2)				OGH#(1)			
OG#(1)							

No	Tag	Explanation	Note
4	B Variable number/ LB Variable number / B [Array number]/ LB [Array number]	The least significant bit of the specified byte type variable specifies ON/OFF of the output signal.	Least significant bit: 0: OFF 1: ON
5	ON/OFF	Specifies ON/OFF of the output signal.	
6	INVERT	Refers the current signal status to output OFF when the status is ON, and output ON when the status is OFF.	

I/O Output Timing Control 2 Setup of I/O Output Timing Control Function
 2.1 Instruction of I/O Output Timing Control Function

No	Tag	Explanation	Note
7	Byte type constant	When the constant byte type is expressed in bit form, the corresponding ON/OFF output signal is specified. Specifies ON/OFF of the output signal by bit value.	
8	ADJD	Based on the teaching position for the move instruction, specifies the distance of the previous direction (-direction) against the teaching position. In case of specified [ADJD=0.0], the signal will be outputted when the manipulator passed the teaching position or comes to the closest approach.	No: -3276.8 to 0.0 [mm] Variable B/I/D/LB/LI/LD can be used.



If specified adjustment distance from [ADJD=] is longer than the movement distance of the target step, the signal will be outputted at the moment of the cursor moves to the move instruction. Unable to adjust the signal output timing across the steps.

No	Tag	Explanation	Note
9	ADJT	Based on the teaching position for the move instruction, specifies the time of the previous direction (-direction) against the teaching position.	No: -32.768 to 0.000 [sec] Variable B/I/D/LB/LI/LD can be used.



If specified adjustment time from [ADJT=] is longer than the movement time of the target step, the signal will be outputted at the moment of the cursor moves to the move instruction. Unable to adjust the signal output timing across the steps.

2.1.3 Registration of +DOUT Instruction

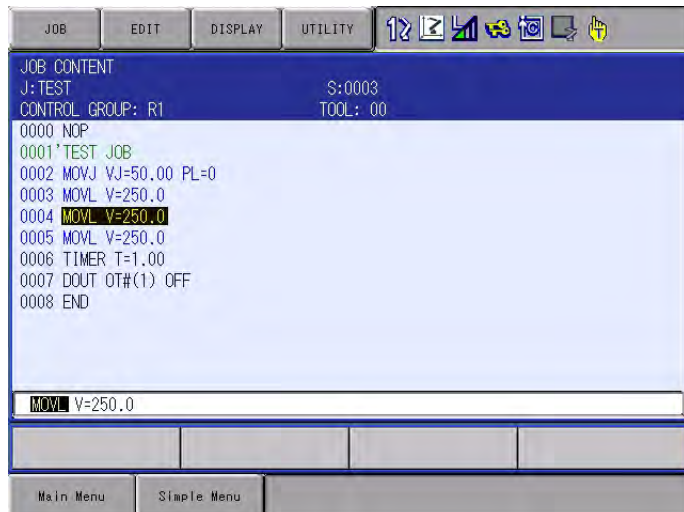
Perform the registration of instructions while the cursor is in the address area of the job content display on the teach mode.

1. Select {JOB} under the main menu.
2. Select {JOB CONTENT}.
3. Move the cursor to desired move instruction of the teaching position to register the +DOUT instruction.



4. Press [SELECT].

– Move instruction appears in the input buffer line.

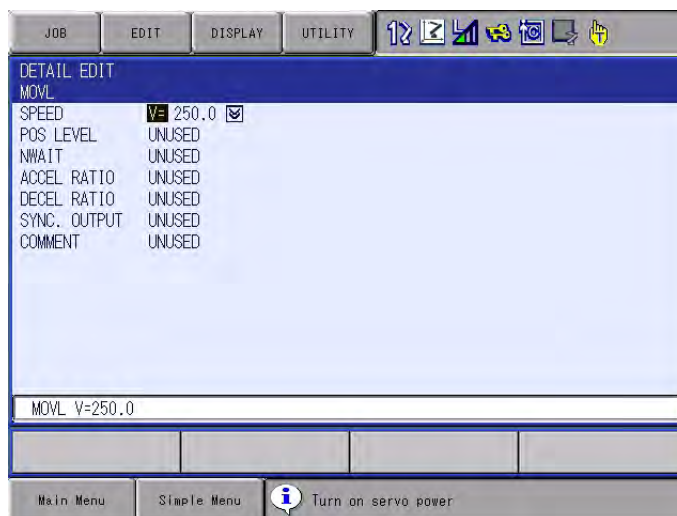


2 Setup of I/O Output Timing Control Function

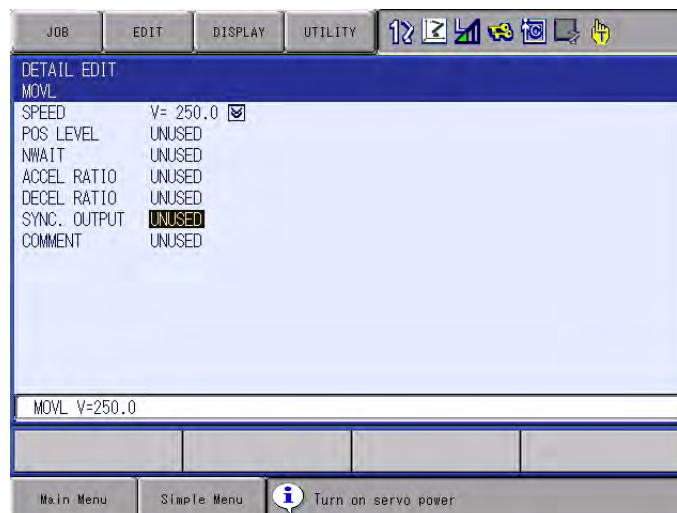
2.1 Instruction of I/O Output Timing Control Function

5. Changing additional item of the +DOUT instructions

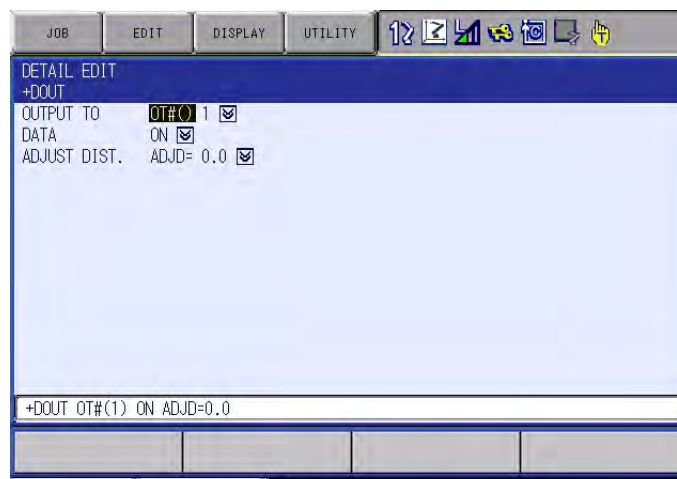
- Move the cursor to the input buffer line, and then press the [SELECT] key to appear the detail edit display of the move instruction.



- Move the cursor to the [UNUSED] of the [SYNC. OUTPUT], and press [SELECT] key.



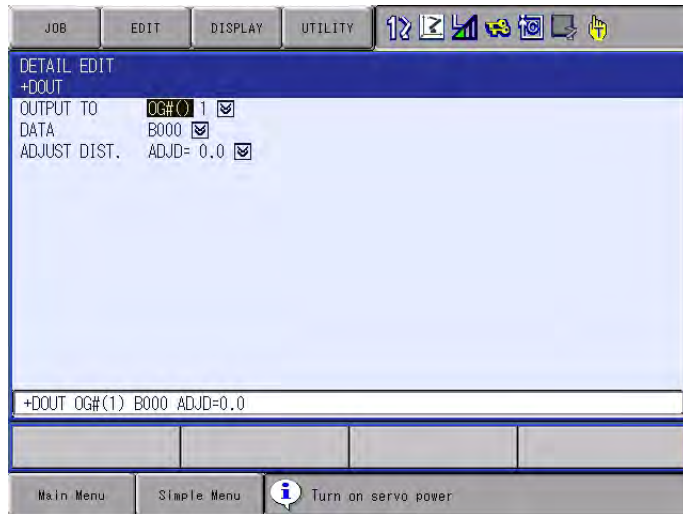
- When the selection dialog appears, select the [+DOUT] to display the detail edit display of the [+DOUT].



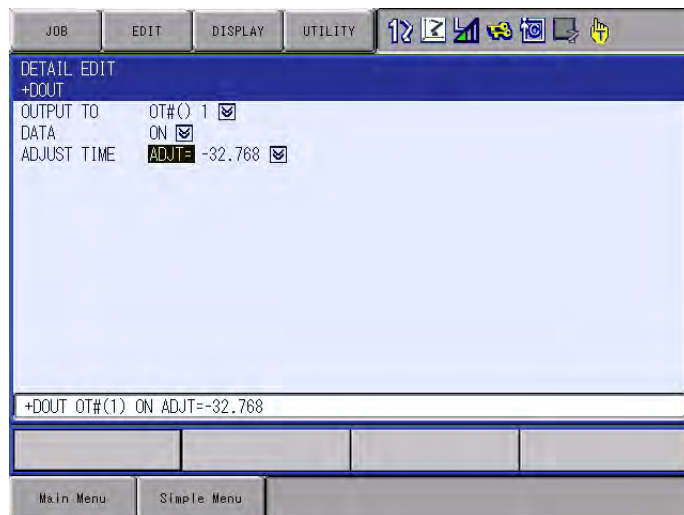
2 Setup of I/O Output Timing Control Function

2.1 Instruction of I/O Output Timing Control Function

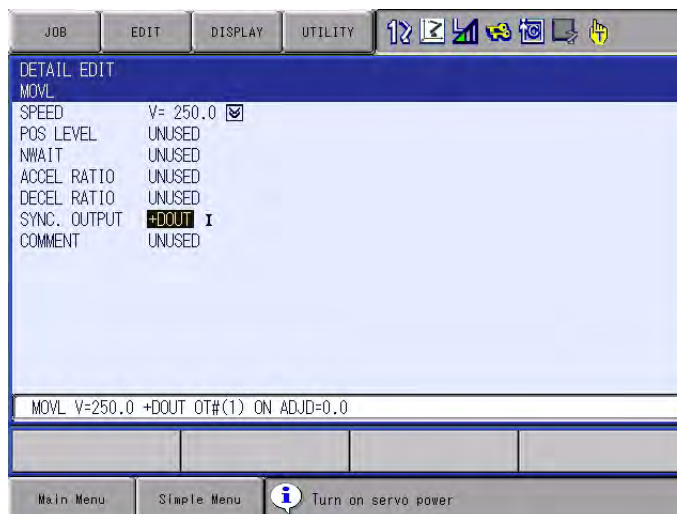
- To change from [OUTPUT TO] to [OG#()] or [OGH#()], move the cursor to [OT#()] of [OUTPUT TO], and press [SELECT] key. The selection dialog will appear, then select [OG#()] or [OGH#()].



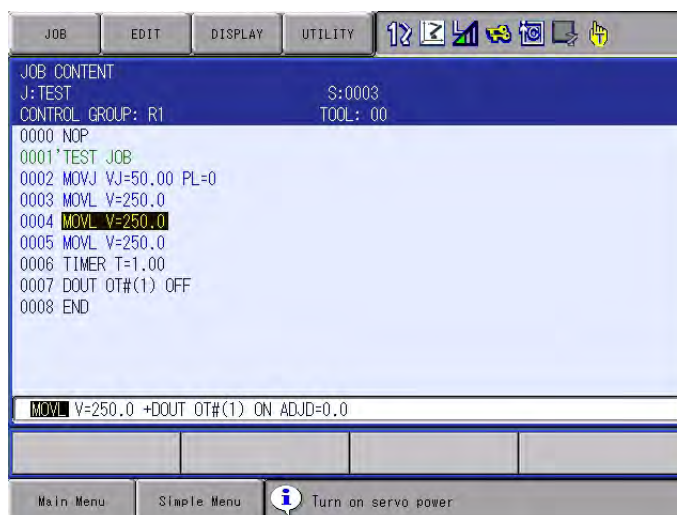
- To add [ADJUST TIME], move the cursor to [ADJ=], and press [SELECT] key. The selection dialog will appear, then select [ADJT=].



- After adding or changing of additional items, and press [ENTER] key. The detail edit display of [+DOUT] will disappear, and the detail edit display of the move instruction will appear again.

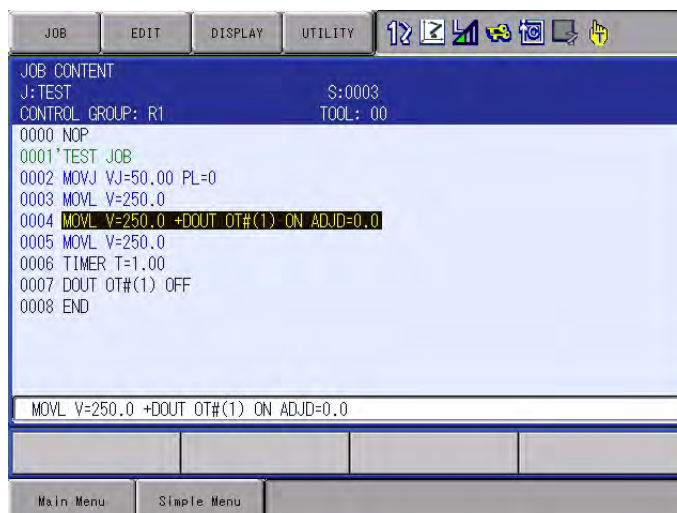


- Press [ENTER] key, and the detail edit display of the move instruction will disappear. The job content display will appear.



6. Press [ENTER] key.

- The instruction in the input buffer line will be registered.

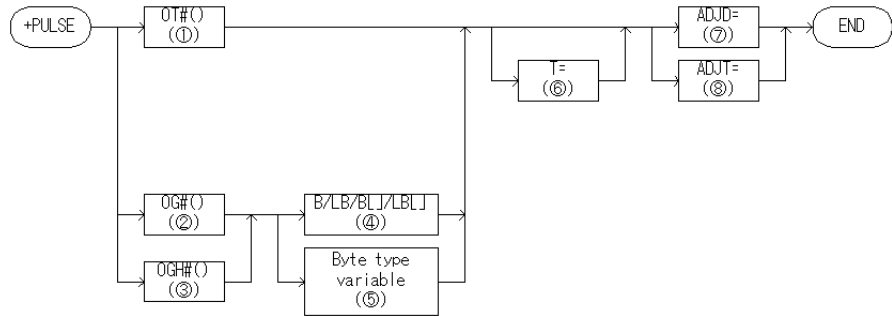


2.1.4 Configuration of +PULSE Instruction

+PULSE instruction which is added to the move instruction performs adjustment to the pulse output timing of the general output signal.

The additional item of the +PULSE instruction is shown as follows.

Fig. 2-3: The Configuration of +PULSE Instruction



Choose one of the tags from the following table

No	Tag	Explanation	Note
1	OT# (Output No.)	Specifies the number of the signal to which the pulse signal is output.	No.: 1 to 1024 Variable B/I/D/LB/LI/LD can be used.
2	OG# (Output group No.)	Specifies the group number of the signal (1 group 8 points) to which the pulse signal is output.	No.: 1 to 128 Variable B/I/D/LB/LI/LD can be used.
3	OGH# (Output group No.)	Specifies the group number of the signal (1 group 4 points) to which the pulse signal is output.	No.: 1 to 256 Variable B/I/D/LB/LI/LD can be used.

Output signal

Output signal OT#(x) is 1 point, OGH#(x) is 1 group 4 points, and OG#(x) is 1 group 8 points.



OT#(8)	OT#(7)	OT#(6)	OT#(5)	OT#(4)	OT#(3)	OT#(2)	OT#(1)
OGH#(2)				OGH#(1)			
OG#(1)							

No.	Tag	Explanation	Note
4	B Variable number/ LB Variable number/ B [Array Number] / LB [Array Number]	Specifies the number of the corresponding pulse output signal when the contents of the specified byte type variable is expressed in bits.	Bit: 0: OFF 1: ON
5	Byte type constant	Specifies the number of the corresponding pulse output signal when the specified byte type constant is expressed in bits.	
6	T=Time	Specifies the time during which the pulse signal is output. The pulse signal is output during the specified time T.	Units: seconds Variable I/LI/I[]/LI[] can be used. (Units: 0.001 seconds) When the time is not specified, the pulse signal is output during 0.30 seconds.
7	ADJD	Based on the teaching position for the move instruction, specifies the distance of the previous direction (-direction) against the teaching position. In case of specified "ADJD=0.0", the signal will be outputted when the manipulator passed the teaching position or comes to the closest approach.	No: -3276.8 to 0.0 [mm] Variable B/I/D/LB/LI/LD can be used.



If specified adjustment distance from [ADJD=] is longer than the movement distance of target step, the signal will be outputted at the moment of the cursor moves to the move instruction. Unable to adjust the timing of signal output across the step.

No.	Tag	Explanation	Note
8	ADJT	Based on the teaching position for the move instruction, specifies the time of the previous direction (-direction) against the teaching position.	No: -32.768 to 0.000 [sec] Variable B/I/D/LB/LI/LD can be used.



If specified adjustment time from [ADJT=] is longer than the movement time of target step, the signal will be outputted at the moment of the cursor moves to the move instruction. Unable to adjust the timing of signal output across the step.

2.1.5 Registration of +PULSE Instruction

Perform the registration of instructions while the cursor is in the address area of the job content display on the teach mode.

1. Select {JOB} under the main menu.
2. Select {JOB CONTENT}.
3. Move the cursor to desired move instruction of the teaching position to register the +PULSE instruction.



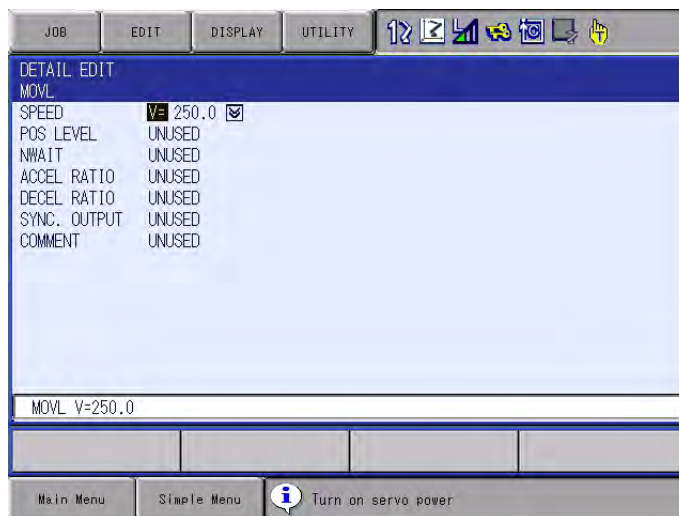
4. Press [SELECT].

– Move instruction appears in the input buffer line.

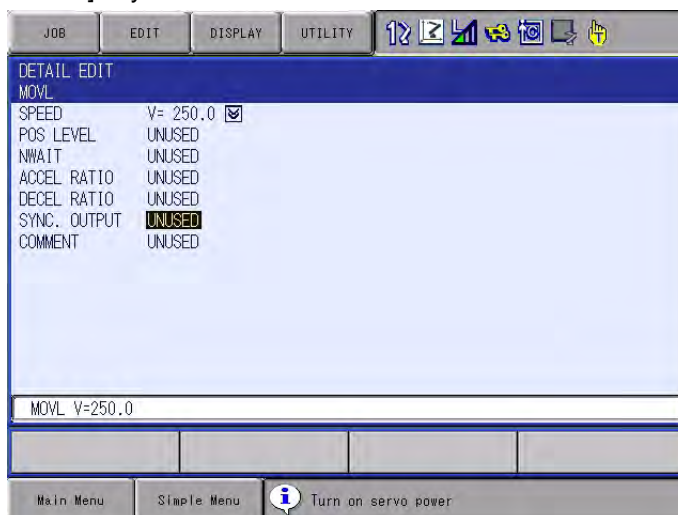


5. Changing additional item of the +PULSE instructions

- Move the cursor to the input buffer line, and then press the [SELECT] key to appear the detail edit display of the move instruction.



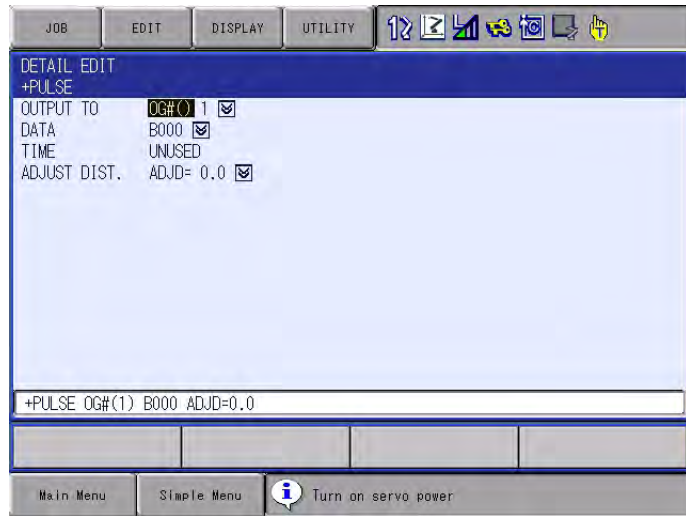
- Move the cursor to the [UNUSED] of [SYNC OUTPUT], and press [SELECT] key.



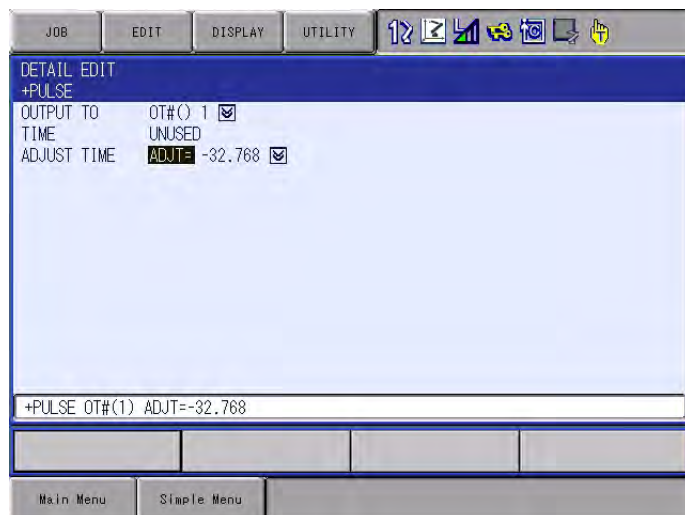
- When the selection dialog appears, select the [+PULSE] to display the detail edit display of the [+PULSE].



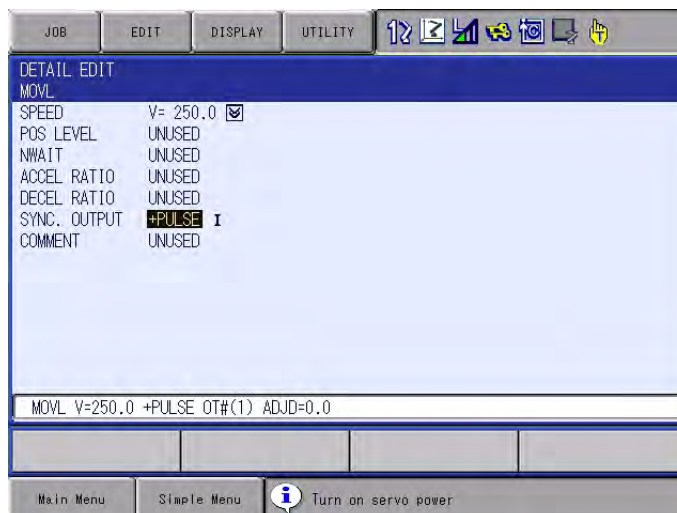
- To change from [OUTPUT TO] to [OG#()] or [OGH#()], move the cursor to [OT#()] of [OUTPUT TO], and press [SELECT] key. The selection dialog will appear, then select [OG#()] or [OGH#()].



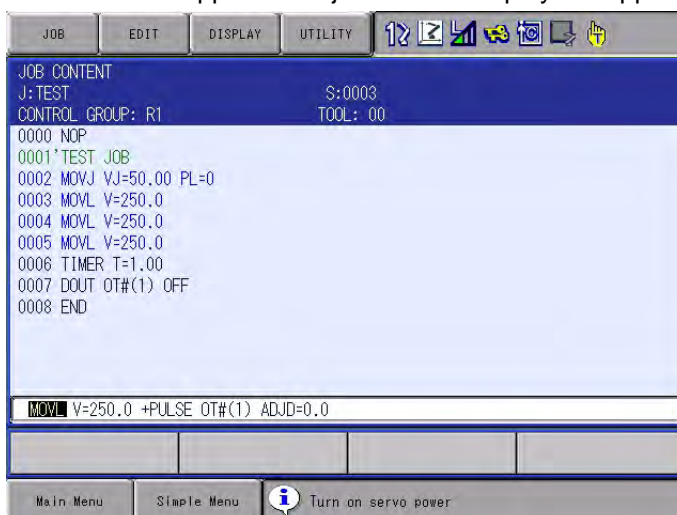
- To add [ADJUST TIME], move the cursor to [ADJ=], and press [SELECT] key. The selection dialog will appear, then select [ADJT=].



- After adding or changing of additional items, and press [ENTER] key. The detail edit display of [+PULSE] will disappear, and the detail edit display of the move instruction will appear again.

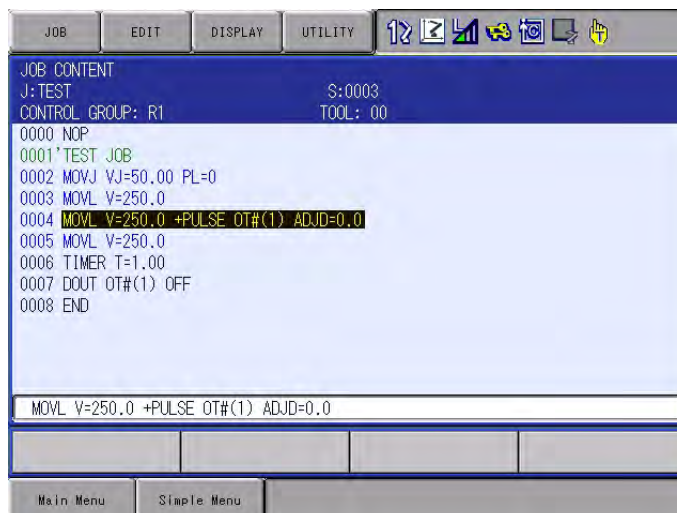


- Press [ENTER] key, and the detail edit display of the move instruction will disappear. The job content display will appear.



6. Press [ENTER] key.

- The instruction in the input buffer line will be registered.



2.2 Device Response Delay Time Compensate Parameter

The response time of devices such as valve and cylinder which are controlled from the synchronized signal output instruction (+DOUT/+PULSE) is known from catalog.

In these cases, the synchronized signal output instruction (+DOUT/+PULSE) will be able to output the signal in advance by setting the response time from these devices on to the parameter. It is unnecessary to consider delayed time from the devices during the adjustment operation of the adjustment distance or adjustment time. Therefore, it will reduce the adjustment man-hours.

JOB KIND	No	Semantics	Unit	Initial value
S4C	321	Compensating time of device response delay	0.01sec	0

2.3 Signal Output Control Parameter During the FWD Operation

At the teaching mode, when the move instruction with synchronized signal output instruction (+DOUT/+PULSE) in the FWD operation will be executed, it is able to specify the general output signal as [output] or [no output]. The parameter shown as follows. The initial value is set on as [0: output]. To output signal during the FWD operation, change the setting to [1: output].

JOB KIND	No	Semantics	Unit	Initial value
S4C	247	+DOUT/+PULSE during the FWD operation Execute specification 0: No output 1: Output	-	0

2.4 Notes

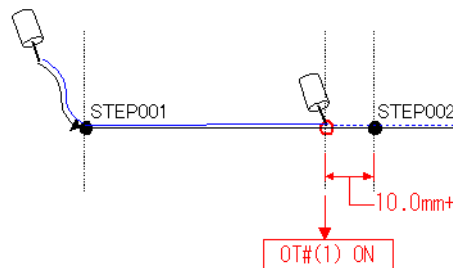
- The synchronized signal output instruction (+DOUT/+PULSE) is added to the move instruction of the first line. Thus, the control group which is monitored at the setting position as [adjustment distance] or [adjustment time] will be a specified robot in the first line.
- When the synchronized signal output instruction will be added to the joint move instruction, adjustment distance at specified at ADJD will be the straight line between the previous step teaching position and the current step teaching position added with synchronized signal output instruction.
- When the move instruction with the synchronized signal output instruction will operate by the BACK operation, the signal would not be outputted.
- The signal may be outputted in the different position from the specified distance when the synchronized signal output instruction (+DOUT/+PULSE) is used at the distance (ADJD) in the operation locus which the controlled point of the manipulator will be operated reciprocating/helical motion in the short pitch.

2.5 The Examples of the I/O Output Timing Control Function

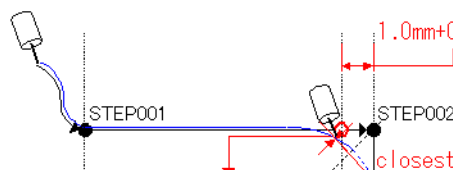
■ Specifying distance

In the case of setting [5] in the parameter [S4C321: device response delay time]

STEP	INSTRUCTION
	NOP
001	MOVJ
002	MOVL +DOUT #OT(1) ON ADJD=-10.0
003	MOVL
	:
	END



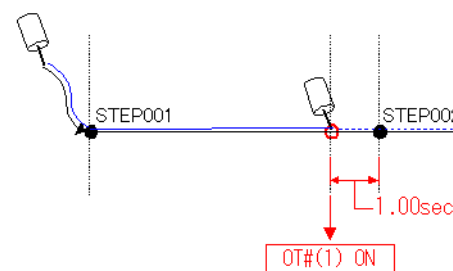
STEP	INSTRUCTION
	NOP
001	MOVJ
002	MOVL +DOUT #OT(1) ON ADJD=-1.0
003	MOVL



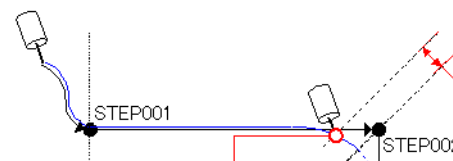
■ Specifying time

In the case of setting [5] in the parameter [S4C321: device response delay time]

STEP	INSTRUCTION
	NOP
001	MOVJ
002	MOVL +DOUT #OT(1) ON ADJT=-1.00
003	MOVL
	:
	END



STEP	INSTRUCTION
	NOP
001	MOVJ
002	MOVL +DOUT #OT(1) ON ADJT=-1.00
003	MOVL



2.6 Determination Angle Parameter for Preventing Incorrect I/O Output Timing Detection

If specify a signal output position by “distance” in the I/O output timing control function, the manipulator motion path is monitored every control cycle, and the signal is output when the manipulator arrives or most approaches to the specified output position.

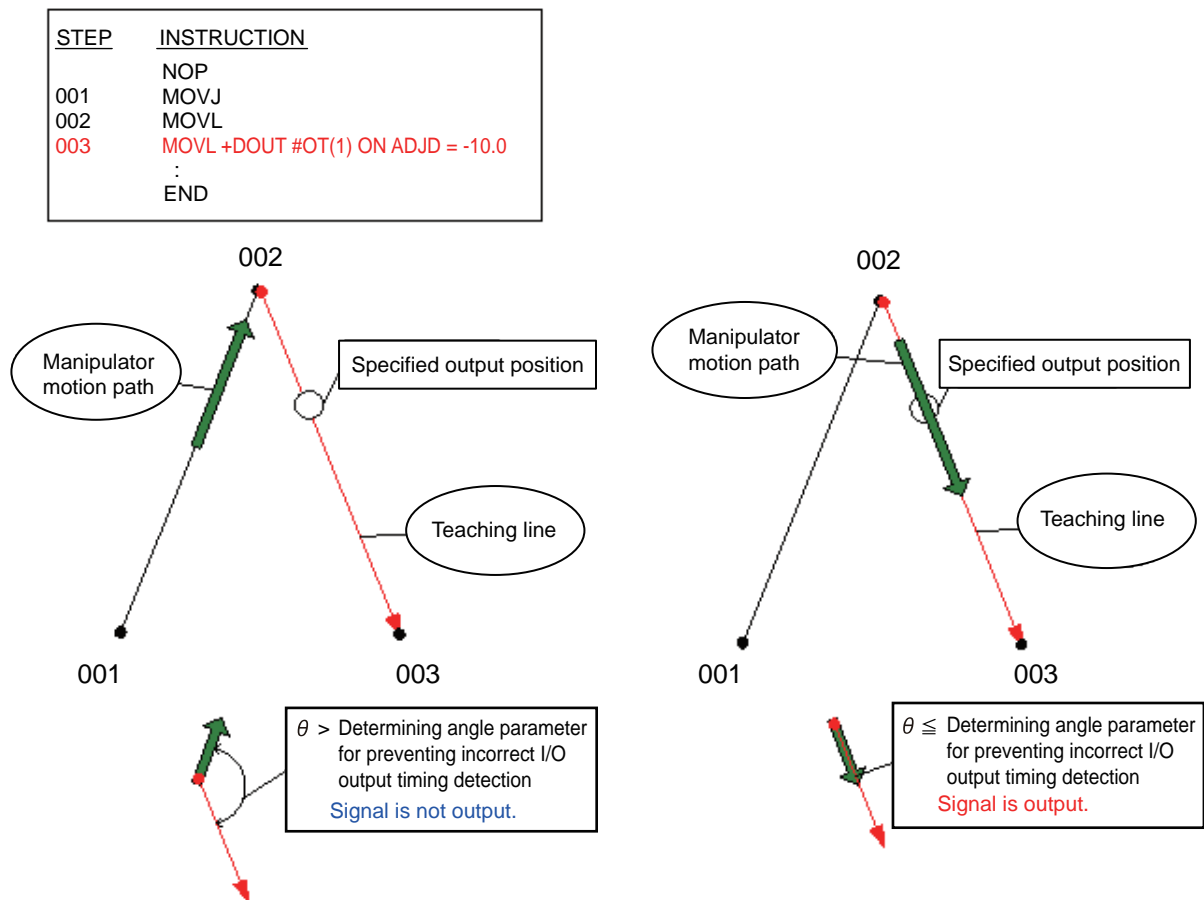
Followings are the conditions to determine that the manipulator has most approached to the specified output position.

Condition 1: The direction of the manipulator motion path is shifted from approaching direction to the direction away from the specified output position.

Condition 2: The degree that the teaching line (red arrow) which is between the previous step teaching position and the current step teaching position added with “synchronized signal output instruction” makes with the manipulator motion path (green arrow) is less than the “determination angle parameter for preventing incorrect I/O output timing detection”.

The “I/O output timing determination angle parameter for erroneous detection prevention”, mentioned in the condition 2, is the determination angle which prevents that the signal is output at an incorrect position.

Fig. 2-4: Determination Angle Parameter for Preventing Incorrect I/O Output Timing Detection



I/O Output Timing Control	2 Setup of I/O Output Timing Control Function 2.6 Determination Angle Parameter for Preventing Incorrect I/O Output Timing Detection
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The “determination angle parameter for preventing incorrect I/O output timing detection”, mentioned in the condition 2, can be specified by the parameter below.

Table 2-1: Determination Angle Parameter for Preventing Incorrect I/O Output Timing Detection

Type	Number	Meaning	Unit	Initial value
S3C	1305	Determination angle parameter for preventing incorrect I/O output timing detection (0 to 180.000 [deg])	0.001 deg	180000 (0: 90.000 [deg])

The initial value of the parameter is “180000: 180.000 [deg]”. Therefore, the manipulator’s closest approach to the specified output position has to be determined only by the condition 1, so as mentioned in *Section 2.4 “Notes”*,

if the manipulator motion path is like the manipulator moves with a reciprocal and/or spiral motion at a high pace, the signal may be output at a wrong position, not at the specified position.

Change the “determination angle parameter for preventing incorrect I/O output timing detection” in accordance with a usage state of the I/O timing control function.



If set a small value (less than 90.000 [deg]) to the determination angle parameter for preventing incorrect I/O output timing detection (S3C [1305]), the system cannot recognize that the manipulator has approached most to the specified output position and cannot output the signal properly.

Revision History

Date	CEN / ECN	Revision No.	Reason For Revision	Initials
8/21/2014	55467	0	Original Release	JFC

FS100 OPTIONS INSTRUCTIONS

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for ongoing product modifications and improvements.