

MELSOFT

Programmable Logic Controllers

Operating Manual (MELSAP-L)

GX Developer 7

● SAFETY INSTRUCTIONS ●

(Always read these instructions before using this equipment.)

Before using this product, please read this manual and the relevant manuals introduced in this manual carefully and pay full attention to safety to handle the product correctly.

The instructions given in this manual are concerned with this product. For the safety instructions of the programmable controller system, please read the CPU module user's manual.


In this manual, the safety instructions are ranked as "DANGER" and "CAUTION".



Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.



Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight personal injury or physical damage.

Note that the  CAUTION level may lead to a serious consequence according to the circumstances. Always follow the instructions of both levels because they are important to personal safety.

Please save this manual to make it accessible when required and always forward it to the end user.

[Design Instructions]

DANGER

- When data change, program change or status control is to be made from a personal computer to the running PLC, configure up an interlock circuit in the outside of the PLC system to ensure that the whole system will always operate safely.
Also, determine corrective actions to be taken for the system when a communication error occurs due to a cable connection fault or the like in online operation performed from the personal computer to the PLC CPU.

CAUTION

- Online operation performed with a personal computer connected to the running CPU module (especially program change, forced output or operating status change) should be started after carefully reading the manual and fully ensuring safety.
Not doing so can cause machine damage or accident due to miss operation.

REVISIONS

* The manual number is given on the bottom left of the back cover.

Print Date	* Manual Number	Revision
Jun.,2001	IB(NA)-0800192-A	First edition

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INTRODUCTION

Thank you for choosing the Mitsubishi MELSOFT Integrated Software.
Before using the equipment, please read this manual carefully to use the product to its optimum.
A copy of this manual should be forwarded to the end user.

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About Manuals

The following manuals are also related to this product.
In necessary, order them by quoting the details in the tables below.

Related Manuals

Manual Name	Manual Number (Model Code)
GX Developer Version 7 Operating Manual (Start-up) Describes the system configuration, installation method and starting method of GX Developer.	IB-0800189
GX Developer Version 7 Operating Manual Explains the functions of the programming, printout, monitoring and debugging methods and so on SW7D5C -GPPW-E.	IB-0800190
GX Developer Version 7 Operating Manual (SFC) Describes the method of creating SFC programs using the MELSAP-II format and the MELSAP3 format of the SW7D5C-GPPW-E, and also the method of printing them, monitoring them, and debugging them.	IB-0800191
QCPU (Q mode) Programming Manual (MELSAP-L) Describes the necessary programming method, specifications and functions for creating programs using the MELSAP-L format.	SH-080076 (13JF61)

Abbreviations and Generic Names Used in This Manual

This manual uses the abbreviations and terms listed in the following table to discuss the GPP Function Software Package and PLC module. In addition, the following table lists the names of modules whose names must be indicated explicitly.

Abbreviation/Generic term	Description/Target module
MELSAP-L	Abbreviation for an SFC function in the MELSAP-L format
MELSAP-II/3	Generic term for an SFC function in the MELSAP-II or MELSAP3 format
SFC program	Generic term for a program in the MELSAP-L, MELSAP-II or MELSAP3 format
QCPU (Q mode)	Generic term for Q02(H), Q06H and Q25H
QCPU (A mode)	Generic term for Q02(H)-A and Q06H-A Described as ACPU in the main text.
QnACPU	Generic term for PLC available with MELSEC-QnA
ACPU	Generic term for PLC available with MELSEC-A Including MOTION (SCPU) (However, GPPW does not support A1, A2, A3, AH3, A3M, A52G, A73, A0J2 and A3V.)
FXCPU	Generic term for PLC available with MELSEC-F
GX Developer	Generic product name for SWnD5C-GPPW, SWnD5C-GPPW-A, SWnD5C-GPPW-V and SWnD5C-GPPW-VA product types. (n means any of versions 0 to 6)
GPPQ	Abbreviation for an SW□IVD-GPPQ or SW□NX-GPPQ format software package
GPPA	Abbreviation for an SW□SRXV-GPPA, SW□NX-GPPA or SW□IVD-GPPA format software package
Software package for motion controller	Generic name for software packages for the motion controller which allow SFC programs to be edited

1. OVERVIEW

This manual describes the editing and monitoring operations of the MELSAP-L format SFC functions (hereafter abbreviated to MELSAP-L), which are included in the functions of GX Developer (unless otherwise specified, the product GX Developer herein is its English version 7.)

For a description of functions other than MELSAP-L, and also the specifications of SFC programs, please refer to the relevant manuals indicated in "Related Manuals". SFC means Sequential Function Chart.

MELSAP-L is a description format which is intended to promote efficiency of sequence program development and also to making program a part.

The machine control section can be created as a part by describing the flow of operation and the control of the machine separately, that is, by describing the operation sequence of the machine using MELSAP-L, and the control of the machine including the various interlocks using a sequence program (circuit/list).

The system is designed in such a way that output conditions, such as interlocks, cannot be described at the steps in MELSAP-L. This permits prompt rectification of trouble that occurs if an output fails to appear at a step despite the activation of the step.

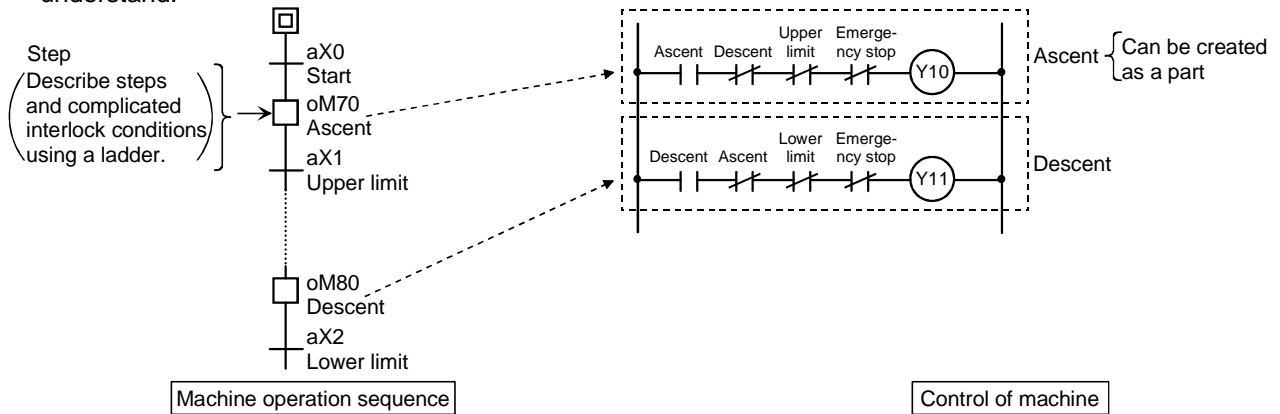
(1) Creation using MELSAP-L + sequence program

(a) MELSAP-L side

By creating an SFC program that is related to the interlock conditions, the flow of operation is easy to understand.

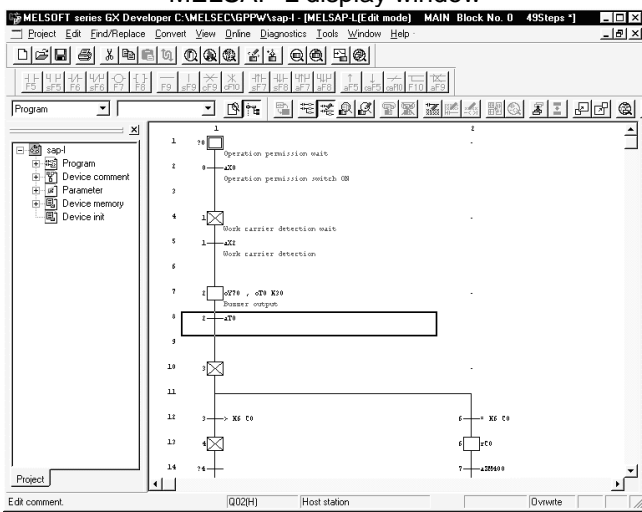
(b) Sequence program side

By creating conditions regardless of the flow of operation, it can be created as a part.



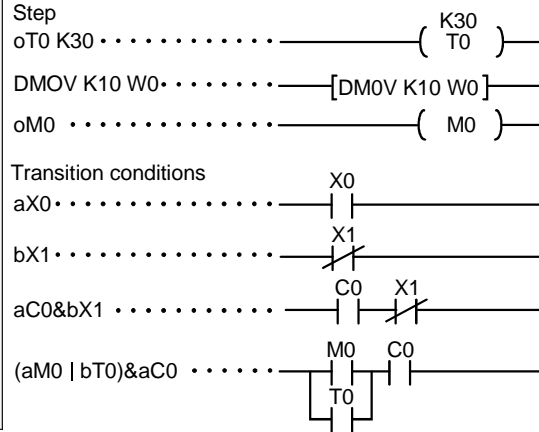
(2) Description format in MELSAP-L

MELSAP-L display window



The description format inside the steps and transition conditions of MELSAP-L are as follows.

<Example>



You cannot describe contact-equivalent instructions inside steps.

The PLC types that are compatible with MELSAP-L in the GX Developer are as follows.

- QCPU (Q02CPU, Q02HCPU, Q06HCPU, Q12HCPU, Q25HCPU)
You cannot select MELSAP-L when the project PLC type is ACP, QnACP, QCPU-A, FXCPU or a motion controller.
If the PLC type is changed to one other than QCPU, the MELSAP-II or MELSAP3 format is used.

1.1 Features

The features of MELSAP-L are described below.

- (1) The operation sequence and ON/OFF status of devices can be monitored on the same screen.
SFC diagram monitoring employs automatic scrolling, enabling the operation sequence and configuration at each step to be readily grasped.
In addition, programs (instructions) can be described directly on an SFC diagram, permitting the ON/OFF status of a contact and coil with two or more operation outputs and transition conditions to be monitored on the same screen.
- (2) Highly operable editing functions
Editing by means of programming, cut & copy & paste can be done using the function keys, tool buttons, menu bars, and so on.
SFC diagram editing can also be done for other projects, programs and blocks.
(Cut & copy & paste is intended for use between MELSAP-L programs.)
- (3) The display format can be changed over according to the particular situation.
The display format of a MELSAP-L format program can be changed over to the MELSAP3 format by the GX Developer display menu.
If you wish to display the transition conditions and operation outputs as a ladder, display them in the MELSAP3 format.

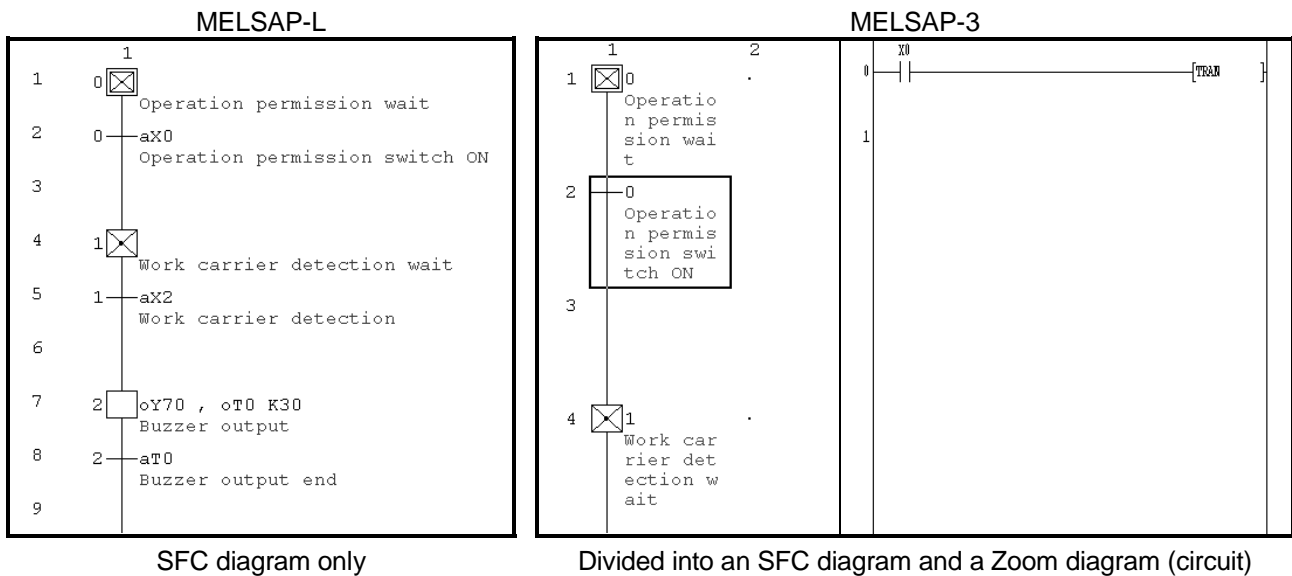
2. MELSAP-L FORMAT PROGRAMS

This section describes SFC programs in the MELSAP-L format.

2.1 MELSAP-L Format SFC Diagrams

In an SFC program created in the MELSAP-L format, each operation unit in a series of operations of the machine is expressed as one step, and instructions such as contacts and coils that perform actual control are set at each step.

In MELSAP3, the SFC diagram is divided into an SFC diagram that indicates the operation sequence, and a Zoom diagram that indicates detailed control for each transition condition. In MELSAP-L, on the other hand, control instructions are directly described and indicated on an SFC diagram.



MELSAP-L is a simple display format that does not display notes, device comments or contacts to the operation outputs (contact-equivalent instructions).

Device comments can be set in this format.

If you use the MELSAP-L format to display an SFC program that contains notes and contacts to the operation outputs (contact-equivalent instructions) that were edited in the MELSAP3 format, "???" will be displayed.

For details of the "???" indication, refer to section 2.4.

2

2.2 Operation Output Instructions

(1) MELSAP-L format instructions

In MELSAP-L, operation output instructions are described in the following format.

Instruction	Example of MELSAP-L format	Example of list format	Example of circuit symbol
Output(o)	oY70	OUT Y70	
High speed timer (h)	hT0 K100	OUTH T0 K100	
Set (s)	sM100	SET M100	
Reset (r)	rM200	RST M200	
Instructions other than the above (o, h, s, r) are the same as in the list format.	MOV K100 D0	MOV K100 D0	

To put a number of operation outputs in parallel inside the same step, partition each output with a comma (,).

MELSAP-L format	Circuit
oY70,sM100,MOV K100, D0	

(2) Instructions that cannot be described at operation outputs

The following instructions cannot be input to operation outputs in MELSAP-L.

- NOP
- MPS, MRD, MPP
- Contact instruction
- Comparison operation instruction (=, <, >, etc.)

For details, refer to the QCPU (Q mode) Programming Manual (MELSAP-L).

(3) Precautions to observe when describing operation outputs

- Do not make an operation output for each instruction that does not require execution conditions (DI, EI, etc.). Describe it at the end.

Example: oY70, MOV D0 D100, DI Correct
 DI, oY70, MOV D0 D100 Incorrect

- You can describe up to 24 instructions in one operation output.

2.3 Instructions for Transition Conditions

(1) MELSAP-L format instructions

In MELSAP-L, transition conditions are described in the following format.

Instruction	Example of MELSAP-L format	Example of list format	Example of circuit symbol
Open contacts (a)	aX0	LD X0	
Close contacts (b)	bX10	LDI X10	
Rise contacts (p)	pM100	LDP M100	
Fall contacts (f)	fM200	LDF M200	
Comparison operation instruction* (=, <, >, etc.)	= D0 K100	LD = D0 K100	

*: For details of comparison operation instructions, refer to the QCPU (Q mode) / QnACPU Programming Manual (Common Instructions).

To connect contact instructions in series (AND), separate each instruction using "&".

To connect contact instructions in parallel (OR), separate each instruction using "|".

MELSAP-L format	Circuit
aX0 & aX10	
aX0 aX10	

If "&" and "|" exist together, "&" will take priority.
 In order to increase the priority, use "()".

MELSAP-L format	Circuit
aX0 aM0 & aX1	
(aX0 aM0) & aX1	
aX0 & aX1 aM0 & aM1	
aX0 & (aX1 aM0) & aM1	

(2) Instructions that cannot be described at transition conditions

- All instructions with the exception of contact instructions and comparison operation instructions

2.4 Precautions to Observe When Creating Programs

The precautions to observe when creating SFC programs using MELSAP-L are set out below.

- (1) When a program was made using MELSAP-L
 - (a) PLC types other than QCPU (Q mode) are not compatible with the MELSAP-L format.
 - (b) You can select ladder, MELSAP3 or MELSAP-L for each program. However, you cannot specify MELSAP3 or MELSAP-L in units of SFC program blocks.
 - (c) If a number of SFC programs (MELSAP-L format and MELSAP3 format) exist in the PLC CPU, only one program can be executed. (This does not apply to control STC programs.)
If you wrote a number of SFC programs, set all but one of them in the standby program by means of a PLC parameter program setting.
 - (d) You cannot input a contact or contact-equivalent instruction to an operation output.
 - (e) The operation output/transition conditions per block can consist of up to 2k sequence steps.
Each operation output or transition condition can consist of up to 512 sequence steps.
When checking the number of sequence steps, display them in the MELSAP3 format.
 - (f) Each operation output/transition condition program can be displayed using up to 32 characters in the case of an SFC diagram.
If the number of characters exceeds 32, "..." is displayed at the 32nd character position.
If you place the mouse cursor in the program display column, up to 256 characters can be displayed.
If 256 characters are exceeded, "..." appears at and after the 253rd character position.
Note: Depending upon the resolution of the peripheral equipment (display), it may not always be possible to display up to 256 characters.
 - (g) You cannot make notes.
 - (h) You cannot display device comments on an SFC diagram.
Edit and display device comments in the device comment creation dialog box.
 - (i) If you change the PLC type to ACPUL or QCPUL (A mode), the MELSAP-II format will be activated.
 - (j) If you change the PLC type to QnACPU, the MELSAP3 format will be activated.
 - (k) If you attempt to make a project inquiry using a MELSAP-L format program as the inquiry source and a ladder program as the inquiry object, the inquiry will not take place.
You can make an inquiry by using a ladder program as the inquiry source and a MELSAP-L format program as the inquiry object.
You can make inquiries to both MELSAP-L and MELSAP3 format programs.

(2) If you use the MELSAP-L format to display a program created in the MELSAP3 format

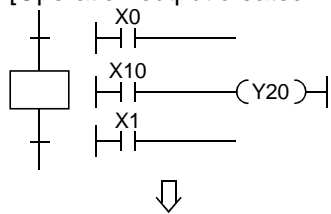
format
If you display the following operation outputs and transition conditions in the MELSAP-L format, "???" will appear.

- An operation output containing a NOP instruction
- An operation output containing a contact or contact-equivalent instruction
- An operation output containing a note

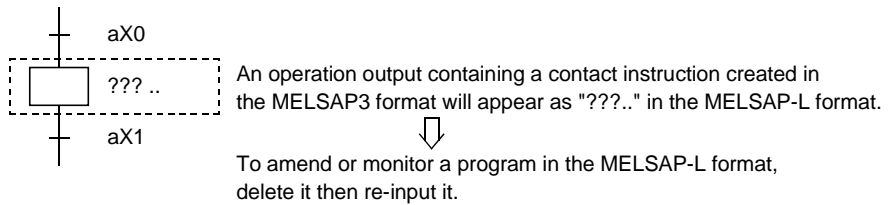
If "???" appears, change over to the MELSAP3 format, and check the circuit. In the case of a circuit that exists in the MELSAP3 format, you cannot use the MELSAP-L format to amend or monitor the program, however the CPU will perform processing normally.

If you wish to amend or monitor a program in the MELSAP-L format after checking it in the MELSAP3 format, delete the program displayed as "???" in the SFC symbol/program input window, then input it once again in the MELSAP-L format.

[Operation output created in the MELSAP3 format]

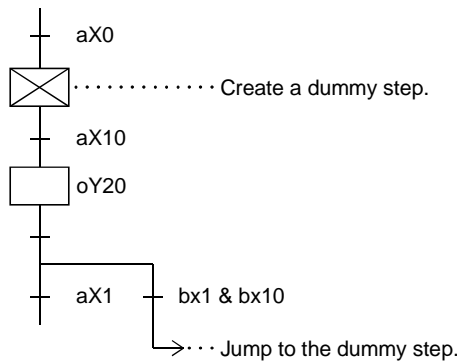


[Display in MELSAP-L format]



[Example of program in the MELSAP-L format]

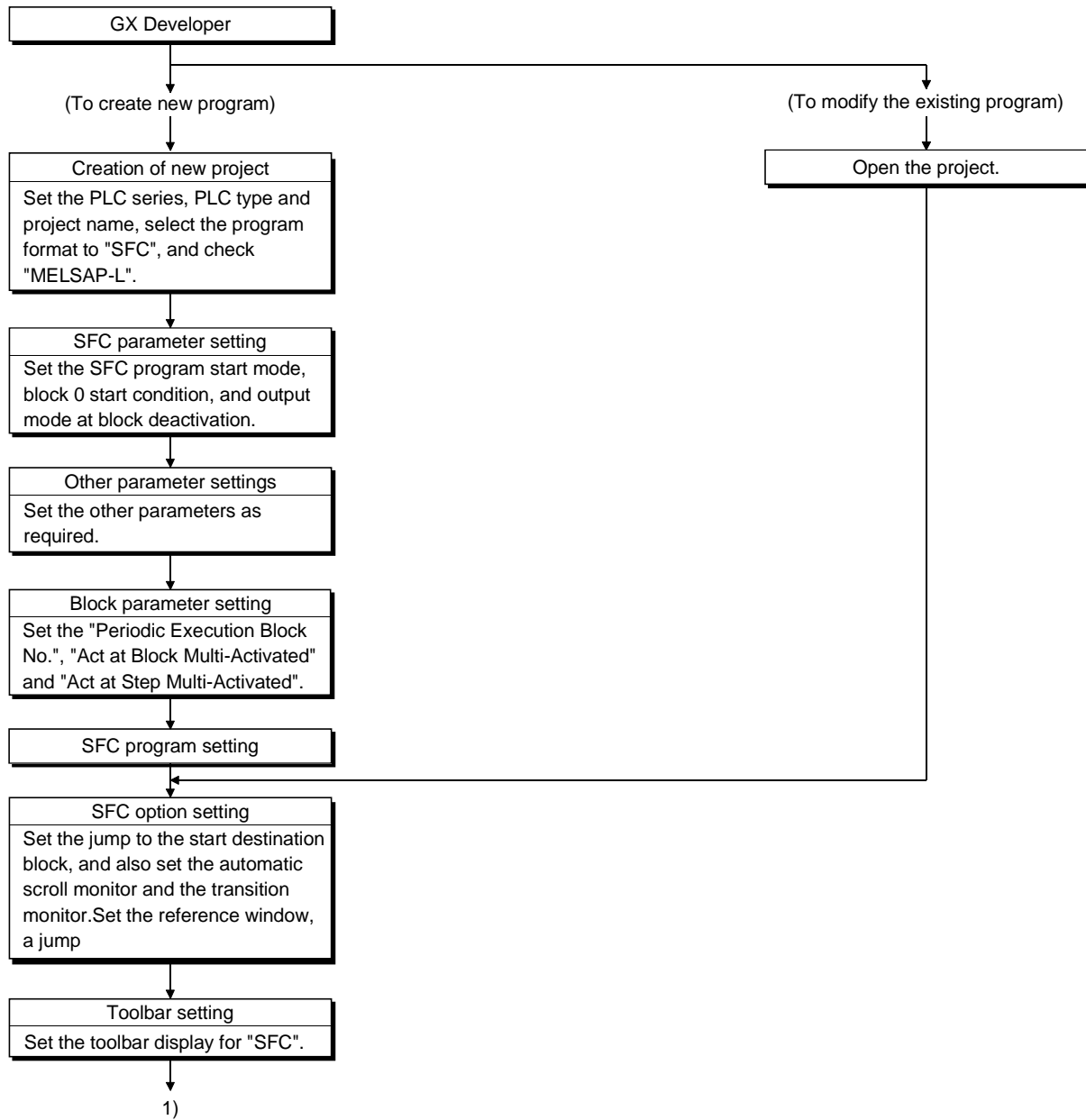
The diagram below shows an example of the case in which the same program as a MELSAP3 format program is created in the MELSAP-L format.



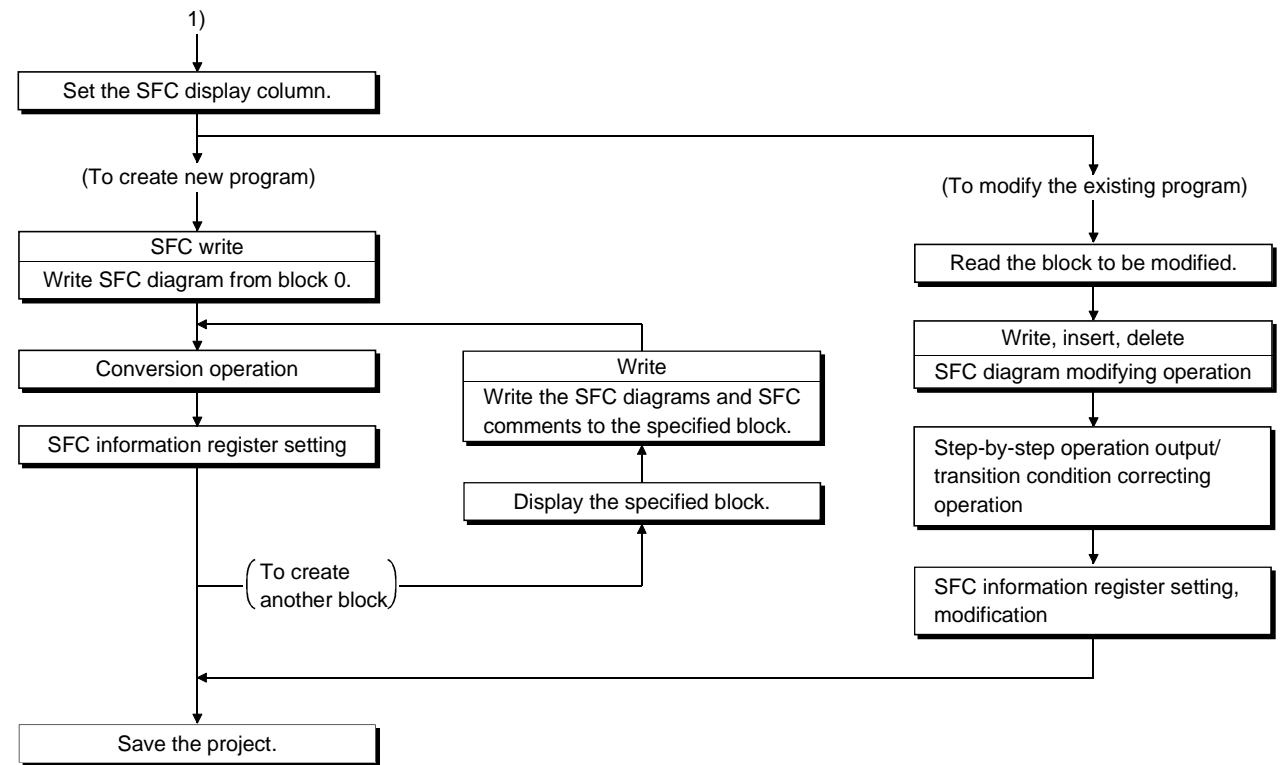
- (3) Compatibility with GX Developer prior to GX Developer (SW4D5C-GPPW-E or earlier)
- (a) If you read a MELSAP-L format program using the GX Developer (SW4D5C-GPPW-E), it will be displayed in the MELPAP3 format.
Once you overwrite and save the program with the GX Developer (SW4D5C-GPPW-E), it will be displayed in the MELSAP-L format, even if you subsequently read it with the GX Developer (SW5D5C-GPPW-E or later).
Once you change the PLC type into a type other than QCPU (Q mode) after reading it to the GX Developer (SW4D5C-GPPW-E), it will not be displayed in the MELSAP-L format, even if you subsequently read it with the GX Developer (SW5D5C-GPPW-E or later).
- (b) If you wish to use a MELSAP-L format program in the GX Developer (SW3D5C-GPPW-E or later), first change the PLC type to ACPU or QnACPU then read the program. (The program will be read in the MELSAP-II format or the MELSAP3 format.)

3. MELSAP-L PROGRAM EDITING METHOD

3.1 MELSAP-L Program Editing Outline Procedure



3



3

POINT
This outline procedure is given for your reference. You can perform the operations in any order without following the above procedure.

3.2 List of SFC Diagram Symbols

Shown below is a list of symbols used in SFC programs.

A block indicates a series of operations that start at the initial step and end at the end step.

The minimum unit of operation is divided into a step and a transition. The operation output or transition condition is displayed using a MELSAP-L format instruction (program).

(1) List of MELSAP-L format SFC diagram symbols

Class	Name	SFC Diagram Symbol	Quantity
Step	Initial step	0 □	Any one of these steps in a block * The initial step at top left (first row) of the SFC diagram is set to No.0
	Dummy initial step	0 ☒	
	Coil hold initial step	0 □ SC	
	Operation hold step (without transition check) initial step	0 □ SE	
	Operation hold step (with transition check) initial step	0 □ ST	
	Reset initial step	0 Sn □ R	
	Initial step	i □	
	Dummy initial step	i ☒	
	Coil hold initial step	i □ SC	
	Operation hold step (without transition check) initial step	i □ SE	
	Operation hold step (with transition check) initial step	i □ ST	
	Reset initial step	i Sn □ R	
	Step	i □	Including initial step, Max. 512 steps in one block i = Step number (1 to 511) n = Reset destination step number m = Start destination block number
	Dummy step	i ☒	
	Coil hold step	i □ SC	
	Operation hold step (without transition check)	i □ SE	
	Operation hold step (with transition check)	i □ ST	
	Reset step	i Sn □ R	
	Block start step (with end check)	Bm □	
	Block start step (without end check)	Bm □	

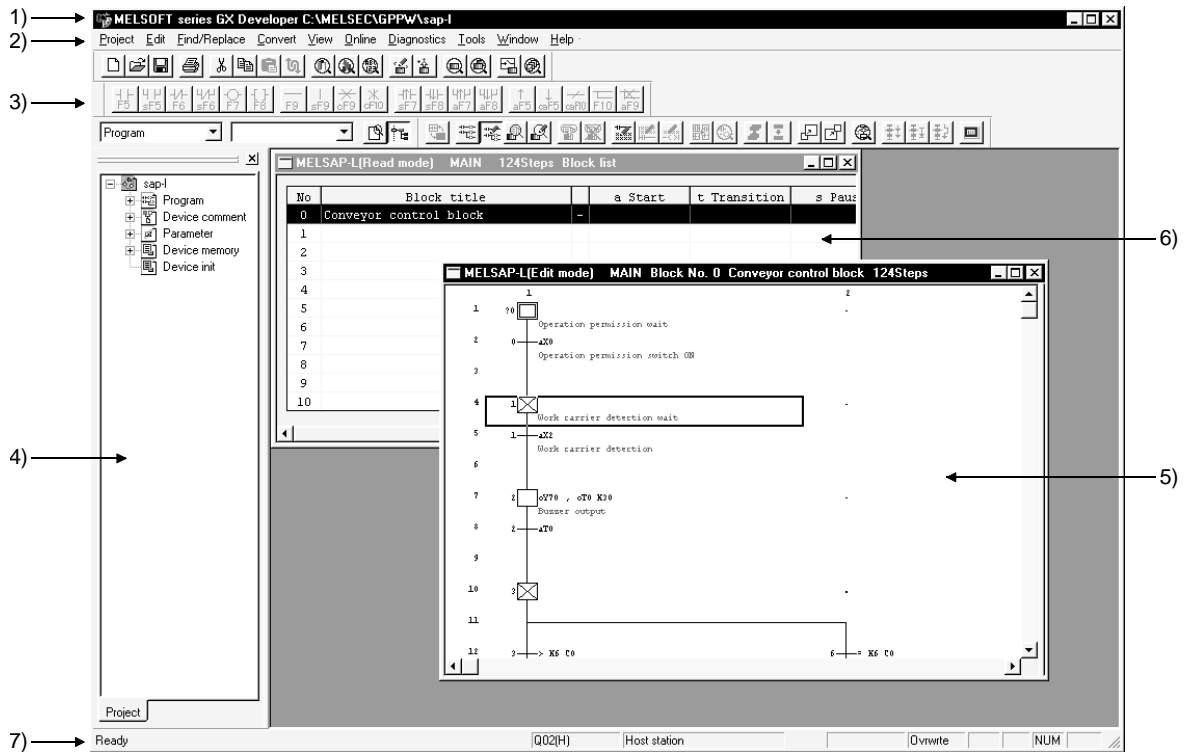
Class	Name	SFC Diagram Symbol	Quantity
Transition	Series transition	a +	a, b = Transition condition number
	Selective branch		
	Selective branch-parallel branch		
	Selective coupling		
	Selective coupling-parallel branch		
	Parallel branch		
	Parallel coupling		
	Parallel coupling-parallel branch		
	Parallel coupling-selective branch		
	Parallel coupling-selective coupling		
	Jump		a = Transition condition number j = Jump destination number
Block end	Block end		More than one block end may be provided in one block.

POINT

If "?" is attached to the left side of the step number or transition condition number, it means that the operation output/transition condition program is not set. When you set the program, "?" is no longer displayed.

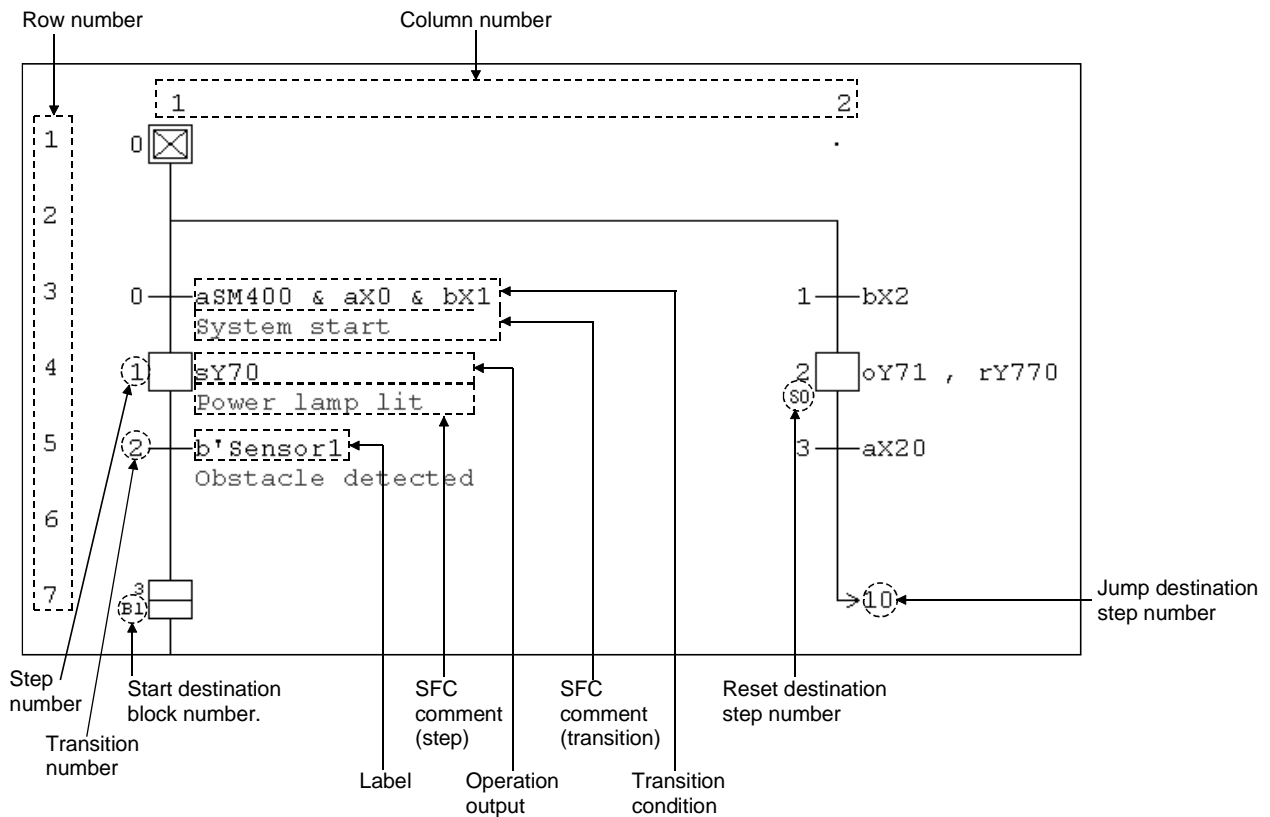
3.3 Basic SFC Diagram Editing Screen

(1) Overall configuration of screen



- 1) Title bar
- 2) Menu bar
- 3) Tool bar
- 4) Project data list
- 5) MELSAP-L editing screen
- 6) Block list screen
- 7) Status bar

(2) Configuration of MELSP-L editing screen



POINT

- Perform the following operation to show the SFC chart in the specified block.
 1. Move the cursor from [View] → [Display block list] → any display block position, and press the [Enter] key.
 2. Choose [View] → [Display block list] → any block position, and double-click that position.
 3. Choose [Find/Replace] → [Find step no./block no.] → any block No., and specify it.
 4. Press the space key on the block starting step in the SFC chart.
 5. Move the cursor from [Window] → data name, and press the [Enter] key.
 6. Move the cursor from [Window] → data name, and double-click it.

3.4 Creating/Modifying the SFC Diagram

3.4.1 Writing an SFC diagram

An SFC diagram may be created in any of the following four methods.

1. Starting from the tool button on the toolbar
2. Starting from the function key
3. Starting from the menu on the toolbar
4. Starting from pressing the **Enter** key on the SFC diagram.

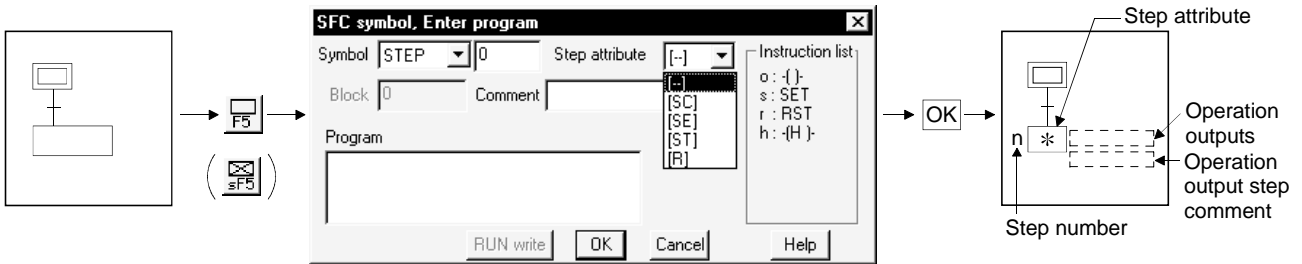
Performing any of the above operations shows the, Enter SFC symbol, enter program window.



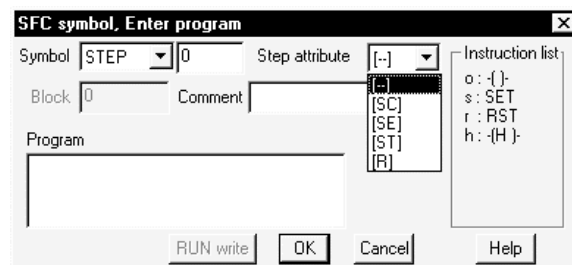
Enter data by the operations given on the pages that follow.

POINT																																																			
The symbols that can be created in the SFC diagram are determined by the cursor position (line).																																																			
The step created in the first line automatically becomes the initial step.																																																			
You can create various kinds of steps or jumps in the 1(+multiple of 3) th line.																																																			
You can create a series transition line, selective branch or a parallel coupling in the 2 (+multiple of 3) th line.																																																			
You can create a parallel branch or a selective coupling in the 3 (+multiple of 3) th line.																																																			
However, if you create a selective branch or a parallel coupling in the 2 (+multiple of 3) th line, a series transition will be created in the 3(+multiple of 3)th line.																																																			
You can create " " (vertical line) in any position other than the 1st line.																																																			
<table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="width: 10%;"></th> <th style="width: 20%;">1</th> <th style="width: 20%;">2</th> <th style="width: 20%;">3</th> <th style="width: 20%;">4</th> <th style="width: 20%;"></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">?0</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td rowspan="3" style="vertical-align: middle; padding-left: 10px;">← The 1st line automatically becomes the initial step.</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">?0</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;"> </td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td rowspan="3" style="vertical-align: middle; padding-left: 10px;">← ". " prevents a transition (excluding a jump) from being created.</td> </tr> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> </tr> <tr> <td style="text-align: center;">6</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> </tr> <tr> <td style="text-align: center;">7</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td style="text-align: center;">.</td> <td></td> </tr> <tr> <td style="text-align: center;">8</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		1	2	3	4		1	?0	.	.	.	← The 1st line automatically becomes the initial step.	2	?0	.	.	.	3		.	.	.	4	← ". " prevents a transition (excluding a jump) from being created.	5	6	7		8						
	1	2	3	4																																															
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5																																															
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- (1) Operation method created from the tool button
 - (a) Write (overwrite) operation example
 - 1) Step (/)

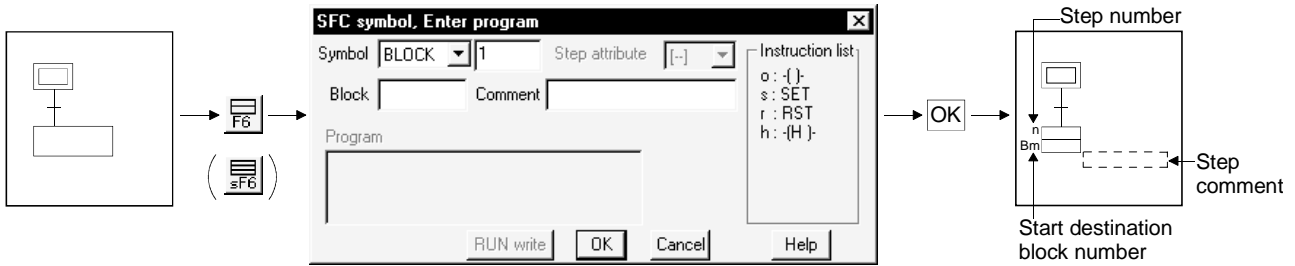


- **Diagram symbol**
 "STEP" (DUMMY) appears.
 You can change the diagram symbol by clicking
- **Step number**
 Numbers are automatically assigned in the input sequence (ascending order).
 If you wish to specify the step number, enter a number in the range 1 to 511.
 After creating an SFC diagram, you can re-assign numbers in sequence from top left to bottom right by sorting.
 When you input the operation output program to " " (dummy step), the display automatically switches to " " (step).
- **Step attribute**
 When you wish to add a step attribute, click , then select the attribute.
 If you select the reset step "[R]" using the step attribute, enter the reset destination step number



- **Comment**
 You can enter up to 32 characters as a step comment.
 When you click [View] → [Display comment of step and TR] from the menu bar, the comment appears in the SFC diagram.
- **Program**
 Input the operation output coil and instruction.
 You can input a number of coils and instructions by partitioning then with commas (.).
 For details of instructions, refer to section 2.2.
 For details of the input method, refer to section 3.5.
- **RUN write** button
 You can perform a "write during RUN" operation by clicking this button.
 For details of a "write during RUN" operation, refer to section 3.11.

2) Block start step (□ / ▢)

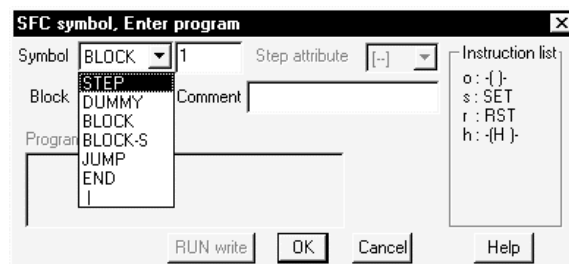


- Diagram symbol
"BLOCK (BLOCK-S) appears.
You can change the diagram symbol by clicking .
- Step number
Numbers are automatically assigned in the input sequence (in ascending order).
To specify a step number, enter a number in the range 1 to 511.
After creating an SFC diagram, you can assign numbers once again in sequence from top left to bottom right by sorting.
- Blocks
Enter the start destination block number
- Comment
You can enter up to 32 characters as step characters.
When you click [View] → [Display comment of step and TR] from the menu bar, the comment appears in the SFC diagram.

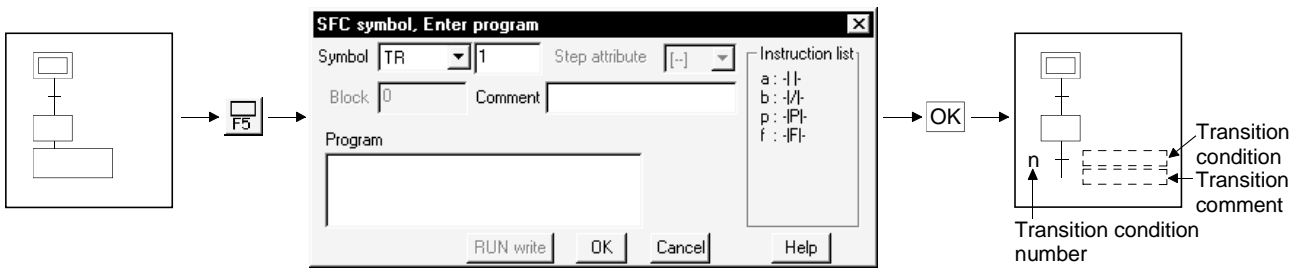
POINT

You can change the kind of step (diagram symbol) by either clicking of the diagram symbol in the SFC symbol/program input window, or by pressing a function key.

If you inadvertently click the wrong tool button, you can re-select the step without closing the SFC symbol/program input window.



3) Series transition (+)




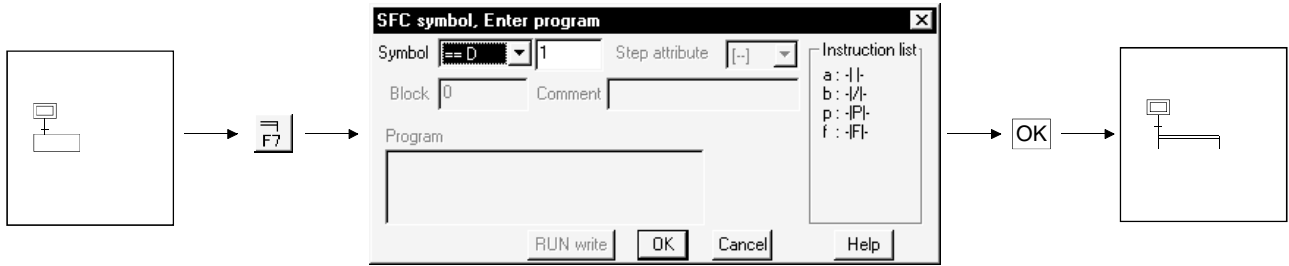
- Diagram symbol
"TR" is displayed.
You can change the diagram symbol by clicking .
- Transition condition number
Numbers are automatically assigned in the input sequence (in ascending order).
To specify a transition condition number, enter a number in the range 1 to 511.
After creating an SFC diagram, you can assign numbers once again in sequence from top left to bottom right by sorting.
- Comment
You can enter up to 32 characters as a transition comment.
When you click [View] → [Step/Display comment of step and TR] from the menu bar, the comment appears in the SFC diagram.
- Program
Enter the transition condition program (contact and comparison operation instructions).
You can input a number of contacts and instructions using "&" (AND) or "|" (OR).
For details of contacts and instructions, refer to section 2.3.
For details of the input method, refer to section 3.5.
- button
You can perform a "write during RUN" operation by clicking this button.
For details of a "write during RUN" operation, refer to section 3-11.


4) Selective branch ()




- Diagram symbol
"-- D" appears.
You can change the diagram symbol by clicking .
- Number of branches
Enter the number of branch lines.
You can create branch lines equal in number to the entered value, in a single operation.
The initial value is "1".

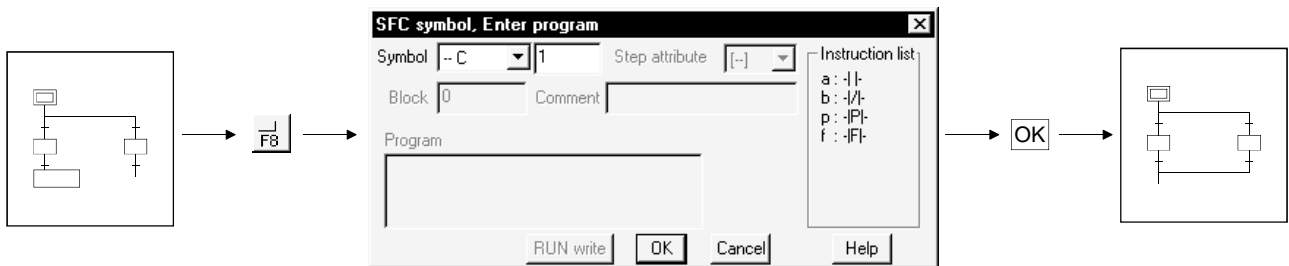
5) Parallel branch ()




- Diagram symbol
"==D" appears.
You can change the diagram symbol by clicking .

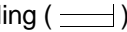
- Number of branches
Enter the number of branch lines.
You can create parallel branches equal in number to the entered value, in a single operation.
The initial value is "1".

6) Selective coupling()




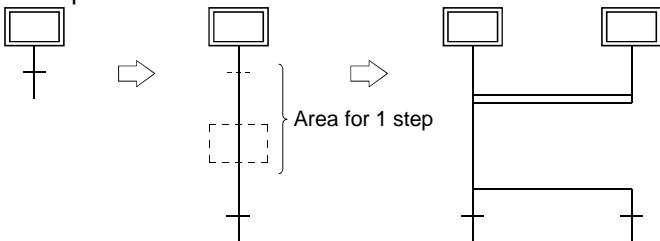
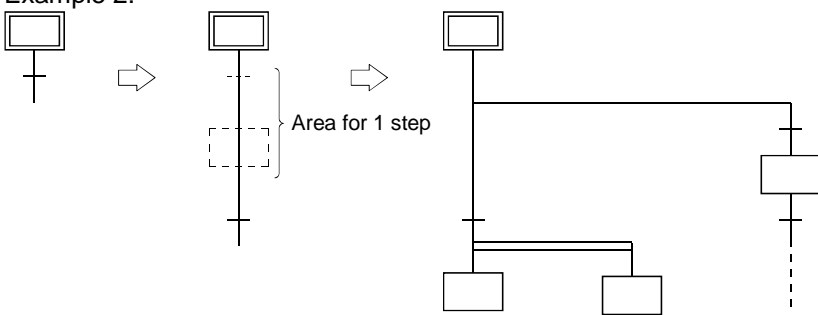
- Diagram symbol
"==C" appears.
You can change the diagram symbol by clicking .

- Number of couplings
Enter the number of coupling lines.
You can create couplings equal in number to the entered value, in a single operation.
The initial value is "1".

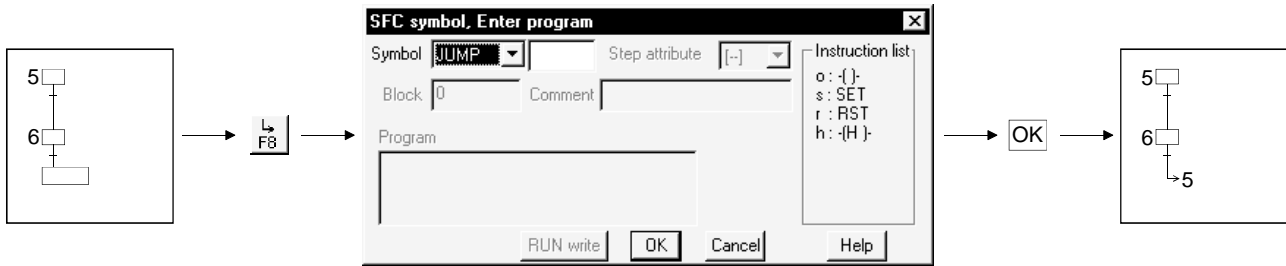
7) Parallel coupling ()



- Diagram symbol
"==C" appears.
You can change the diagram symbol by clicking .
- Number of branches
Enter the number of branch lines.
You can create parallel couplings equal in number to the entered value, in a single operation.
The initial value is "1".

POINTS
<ul style="list-style-type: none"> • Input method used when a branch and a coupling are used together in a single transition condition <p>1) For Q/QnACPU</p> <p>When a branch and a coupling are used together in a single transition condition, reserve an area for one step using " " (vertical line) and then enter the branch and coupling symbols.</p> <p>Example 1:</p>  <p>Example 2:</p>  <ul style="list-style-type: none"> • For branch/coupling line entry, entering the number of branches/couplings as "-n" creates them from right to left.

8) Jump transition (\hookrightarrow)

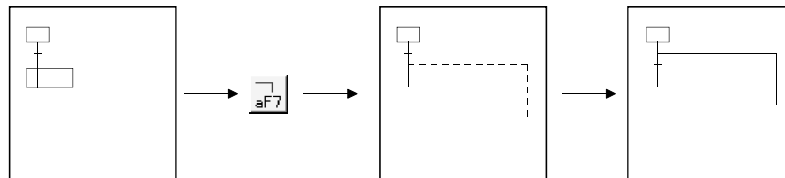


- Diagram symbol
You can change the diagram symbol by clicking .
- Jump destination step number
Enter the step number of the jump destination.
When you click the **OK** button, the display of the step () specified at the jump destination changes to ().

9) End step (\perp)



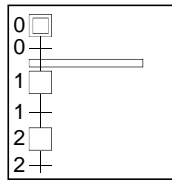
10) Rule write



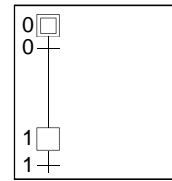
- To write a rule, click / / / and drag from the first position to the last position of the rule entry.

POINT	If you write a rule over the existing step/transition, the step/transition symbol and operation output/transition condition sequence program are not erased.
--------------	--

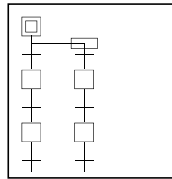
11) Row insert



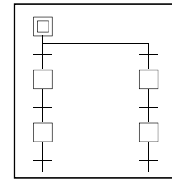
[Edit] → [Insert line]
([Shift] + [Insert])



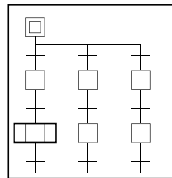
12) Column insert



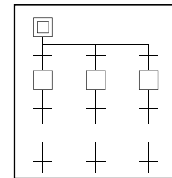
[Edit] → [Insert row]
([Ctrl] + [Insert])



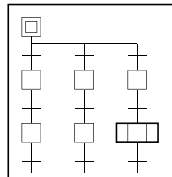
13) Row delete



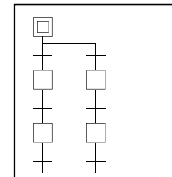
[Edit] → [Delete line]
([Shift] + [Delete])



14) Column delete



[Edit] → [Delete row]
([Ctrl] + [Delete])



(b) Write (insert) operation example

When an SFC diagram is created by a write (insert) operation, insertion results are as described below on an SFC diagram symbol basis.

Note that step/transition condition number changing, simultaneous SFC comment creation and so on can be performed as in the write (overwrite) operation.


1) Step (□)




- Point the cursor to a desired position and click the SFC symbol (step) to insert a step in the cursor position.
If you do not change the step number when inserting by overwriting on "I" (vertical line), the lowest vacant number will be assigned.
- When the insert position is within a branch ladder, "I" (vertical line) is automatically inserted into another branch.


2) Series transition (- +)

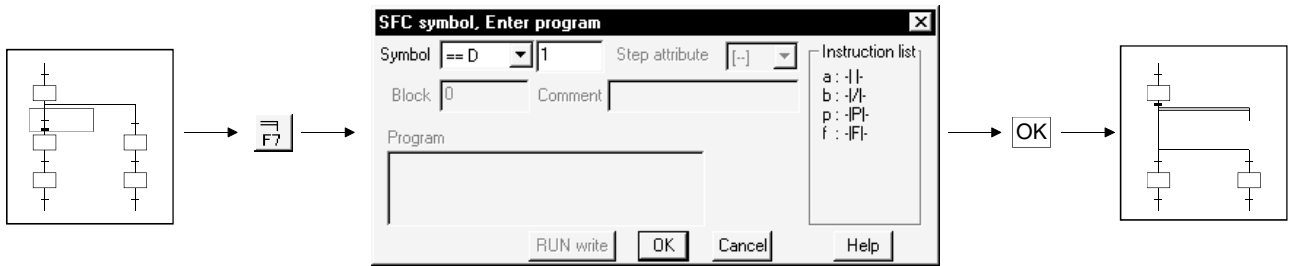



- Point the cursor to a desired position and click  to insert a transition in the cursor position.
If you do not change the transition condition number when inserting by overwriting on "I" (vertical line), the lowest vacant number will be assigned.
- When the insert position is within a branch ladder, "I" (vertical line) is automatically inserted into another branch.

3) Selective branch ()



4) Parallel branch ()

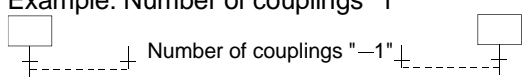


5) Selective coupling ()



6) Parallel coupling ()



POINTS
<ul style="list-style-type: none"> • Entering "-n" as the number of branches/couplings enters them from right to left. Example: Number of couplings "1"  • Inserting a branch/coupling may generate an SFC diagram that cannot be converted. In this case, correct the SFC diagram with the edit function (cut and paste) and then perform a conversion operation.

(2) Operation starting from the function key

(a) The SFC symbols are assigned to the following function keys.

[Step]

SFC symbol						
Function key	F5	F6	Shift + F6	F8	F7	Shift + F5

[Transition or branch/coupling]

SFC symbol						
Function key	F5	F6	F7	F8	F9	Shift + F9

[Rule entry]

SFC symbol					
Function key	Alt + F5	Alt + F7	Alt + F8	Alt + F9	Alt + F10

(b) Operation procedure

• Step/transition/branch/coupling entry

1) Press the function key.



2) Since the window as was shown when the tool button was clicked appears, refer to the tool button operation procedure and enter the required items.

3) Press the **Enter** key.

• Rule entry

1) Press the function key.



2) Using the arrow keys, move the cursor to the first position of a branch/coupling.

3) Hold down the **Shift** key and move the cursor with the arrow keys.

4) Move the cursor to the last position of the branch/coupling and release your hand from the key.

(3) Operation starting from the menu on the toolbar

(a) Step/transition/branch/coupling entry

1) Click [Edit] on the toolbar.



2) Move the cursor to [SFC symbol] in the edit menu.



3) Click the SFC symbol to be entered.



4) Since the window as was shown when the tool button was clicked appears, refer to the tool button operation procedure and enter the required items.

5) Press the key.

(b) Rule entry

1) Click [Edit] on the toolbar.



2) Move the cursor to [Edit the line] in the edit menu.



3) Click the branch/coupling line to be entered.



4) Drag from the first position to the last position of the entry.

(4) Operation starting from the key1) Press the key.

2) Since the window as was shown when the tool button was clicked appears, refer to the tool button operation procedure and enter the required items.

3) Press the key.

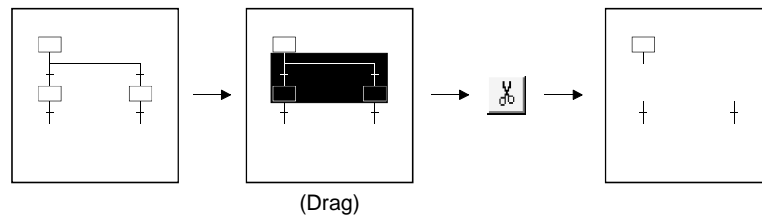
POINT
Operation starting from the <input type="text" value="Enter"/> key is a method useful for entry of steps (<input type="checkbox"/>) and transitions (<input type="checkbox"/>) consecutively in the column direction.

3.4.2 Deleting the SFC diagram

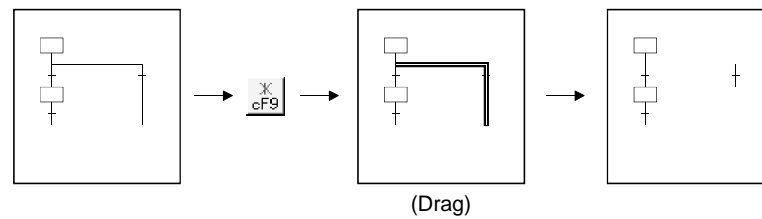
This section explains how to delete the existing SFC diagram symbols.

(1) Operation using the tool button to delete

(a) Specifying the area and making deletion



(b) Deleting the branch/coupling/vertical line only



(2) Operation using the function key to delete

- Hold down the **[Shift]** key and choose the deletion area with the arrow keys.
- ↓
- Press the **[Delete]** key.






(3) Operation to delete from the menu on the toolbar

- With the mouse, drag over the area to be deleted.
- ↓
- Click **[Cut]** in the edit menu.

POINT
Performing the [Undo] operation after making a deletion returns to the status immediately prior to the deletion.
• Tool button : Click
• Function key : [Ctrl] + [Z]
• Menu : Click [Undo] in the edit menu.

3.4.3 Changing the step attribute

This section describes how to change the step attribute in the existing SFC diagram. The step attribute can be changed by any of the following tool button clicking, menu operation and key pressing.

Tool Button	Key Pressing	Menu	Description
	Ctrl + 1	1) Editing ↓	• Makes the preset step attribute invalid.
	Ctrl + 2	2) Step attribute setting ↓	• Changes the preset step attribute to SC .
	Ctrl + 3	3) Choose a new attribute.	• Changes the preset step attribute to SE .
	Ctrl + 4		• Changes the preset step attribute to ST .
	Ctrl + 5		• Changes the preset step attribute to R and sets the reset destination step No. • When it has already been set to R , changes the reset destination step No.

POINT


If the step attribute has been changed, the existing operation output sequence program remains unchanged.

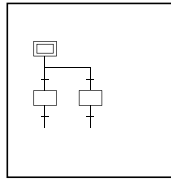
3.4.4 Cutting/Copying and pasting the SFC diagram

This section provides the operation to cut/copy and paste the SFC diagram.

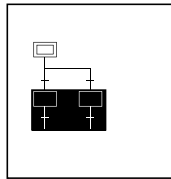
(1) Specifying the area, cutting or copying the SFC diagram, and pasting it



[Operation procedure]

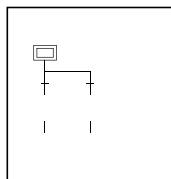
1. Choose [Edit]→[Write mode] or  (F2).
2. Click the first position of the SFC diagram to be cut, and move the cursor.



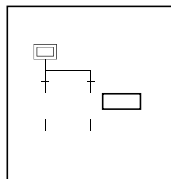
3. Drag over the area to be cut or copied.
The specified area is highlighted.




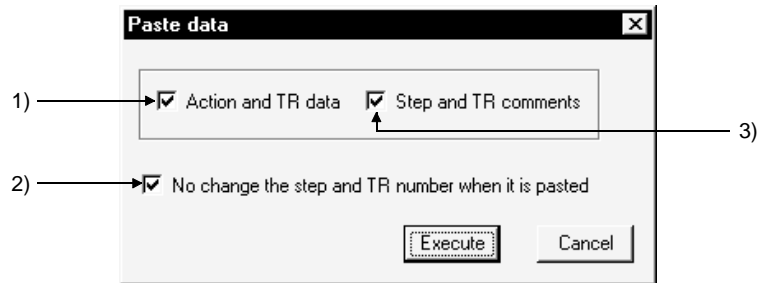
4. When cutting, choose [Edit] → [Cut] or  (Ctrl+X), or when copying, choose [Edit] → [Copy] or  (Ctrl+C) to cut the ladder in the specified area.



5. Click the position where the cut (copied) SFC diagram will be applied, and move the cursor.



6. When you choose [Edit] → [Paste] or  (Ctrl + V), the Paste data window appears. Make pasting choices.

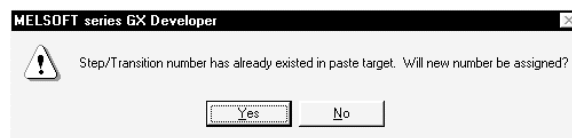


- 1) Selection of whether or not the operation output/transition condition sequence program is also pasted simultaneously.
- 2) Selection of whether or not the original step/transition condition number is changed.
- 3) Selection of whether or not the step/transition comment is also pasted simultaneously.

POINT

"Not changing" the original step/transition condition number is useful for a moving operation.

7. When you selected "not to" change the original step/transition condition number but the pasting destination already has the same step/transition condition number, the following window appears.



Choosing **Yes** executes pasting after the system has assigned a new number by reassigning lower to higher free numbers to the step/transition condition numbers of the pasting destination SFC diagram.

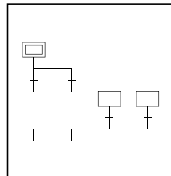
Choosing **No** suspends pasting.

8. When the first position of the cut or copied SFC diagram is a step and its pasting position is a transition position, or vice versa, the following window appears.



When this window has appeared, click the button, move the pasting position one row higher or lower, then perform a pasting operation again.

9. After the pasting operation is over, make conversion.
Note that a conversion error occurs if a branch/coupling is incorrect after pasting. Therefore, make conversion after performing the SFC diagram editing operation.




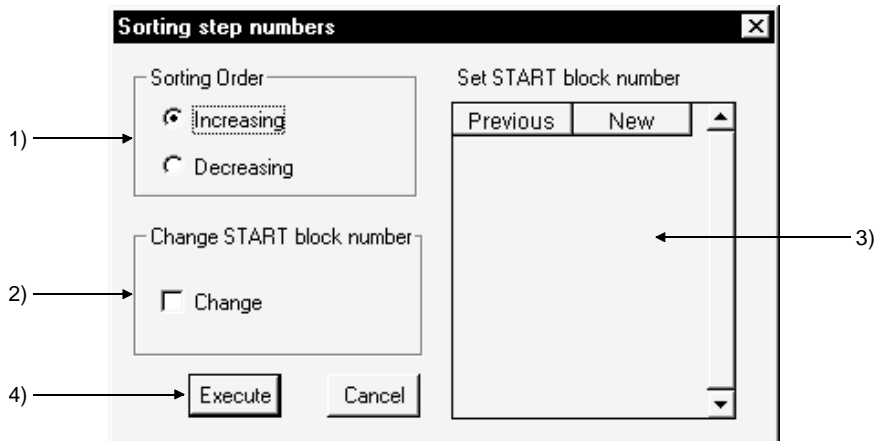
POINTS

- Cutting/copying and pasting between different blocks in the same program can be executed by displaying the corresponding blocks by performing [Window] → [Tile vertically] or [Tile horizontally] operation.
- Cutting/copying and pasting between different projects can be executed after opening the corresponding projects by performing [Project] → [Start new GX Developer session] operation.
- Copying of an operation output/transition condition sequence program should be done within approx. 2k steps.

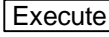
3.4.5 Sorting the SFC diagram

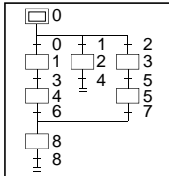
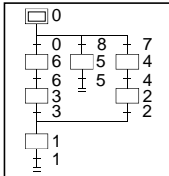

This operation reassigns the step/transition numbers of the created SFC diagram.

- [Operation procedure]
- [Tools] → [Sort] or 
- [Setting screen]



[Setting items]

- 1) Sorting Order
Specify whether the step/transition numbers are in an ascending or descending order.
- 2) Change START block number
Specify whether the start destination block number is to be changed or not.
- 3) Set START block number
When you have selected "Change", enter a new block number.
- 4)  button
Executes sorting as set on the above screen.

POINTS	
<ul style="list-style-type: none"> • The result of executing sorting by specifying an ascending or descending order is as follows. <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>(When ascending order is specified)</p>  </div> <div style="text-align: center;"> <p>(When descending order is specified)</p>  </div> </div> 	
<ul style="list-style-type: none"> * Immediately after sorting, a "Undo" operation can be performed only once. *  is step "0" if you specify either the ascending or descending order. 	
<ul style="list-style-type: none"> • The SFC devices (e.g. BLm\Sn, BLn\TRn) used with the operation outputs/transition conditions are not the objects of sorting. Sort them by performing a device number changing operation or the like. 	

3.4.6 Redisplaying the SFC diagram

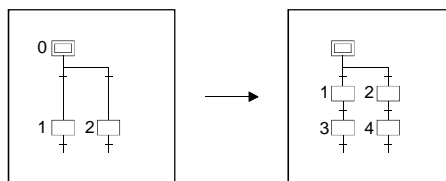
[Setting purpose]

This operation is performed to return the unconverted SFC diagram being edited to the status immediately prior to editing, or to top-shift or left-shift the freed row or column of the "I" (vertical line)/branch/coupling line.

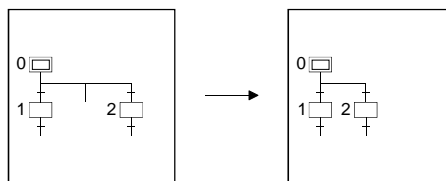
[Operation procedure]

[View] → [Review SFC]

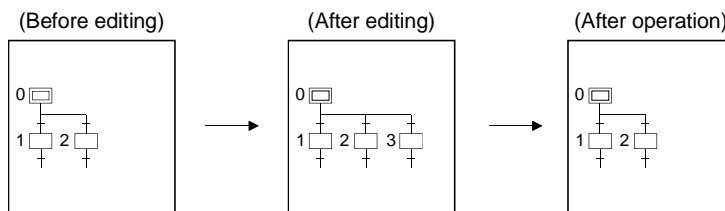
1) Top-shift redisplaying example



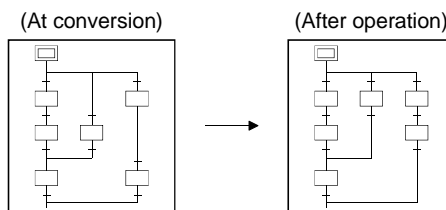
2) Left-shift redisplaying example



3) Unconverted SFC diagram redisplaying example



4) After-conversion SFC diagram optimizing display



3.5 Creating Operation Outputs and Transition Conditions

Input the operation output and transition condition program from the SFC symbol/program input window when creating an SFC diagram.

After creating the SFC diagram, you can re-display the SFC symbol/program input window by double-clicking the pertinent step/transition, and change the program.

For details of the method of describing operation output/transition instructions, refer to sub-sections 2.2 and 2.3.

For details of instructions that can be used, refer to the QCPU (Q mode) programming manual (MELSAP-L).

(1) Entering operation outputs

When entering an o, h, s or r instruction at the operation output, do not enter a space between the instruction and the device name.

Example: oY1
o_X1

In the case of a timer or counter, enter a space between the device name and the set value.

Example: oTO_K30
oTOK30

In the case of another instruction, enter spaces between the instruction, device name, set value, and so on, as in the list format.

Example: MOV_K100_D0
MOVK100D0

There is no need to make any distinction between upper case and lower case letters when entering an instruction.

By pressing the button, o, h, s and r will become lower case letters, and other letters will be set to upper case letters, automatically.

Example: If you enter "AX1" or "ax1" as an instruction,

↓
"aX1" will appear after you click the OK button.

(2) Transition conditions

If you enter the a, b, p or f instruction in a transition condition, do not enter a space between the instruction and the device name.

Example: aX1 Correct
a_X1 Incorrect

In the case of a comparison operation instruction, enter spaces between the instruction, device name, set value, and so on, as in the list format.

Example: =_K1000_D10 Correct
=K1000D10 Incorrect

"()", which indicates the priority sequence of "&" and "|", is optimized (necessary part only) after being entered.

Example: When entering: (aX0 & bX1) |(aX3 & bX4)

After entering: aX0 & bX1 |aX3 & bX4

Because "&" takes priority over "|", "(" is unnecessary.

3.6 Comment Creation Method

In MELSAP-L, the comments that can be created are broadly divided into the following two kinds.

- SFC comments
- Device comments

The term "SFC comment" is a generic term that refers to a "step comment" that is added to each step of an SFC diagram, and a "transition comment" that is added to each transition line.

The term "device comment" is a comment that is added to each device as in the case of a circuit.

The method of creating SFC comments and device comments is described below.

3.6.1 Method of creating an SFC comment


You can create an SFC comment from the SFC symbol/Enter program window when creating an SFC diagram.

The method of creating and modifying comment data alone after creating an SFC diagram is set out below.

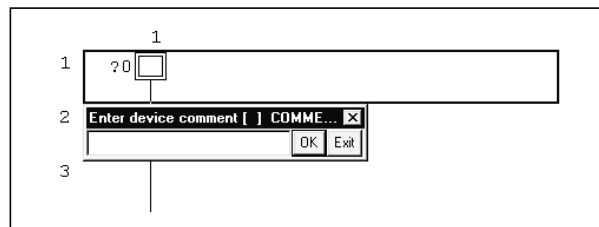
(1) Using the SFC diagram editing screen

[Operation procedure]

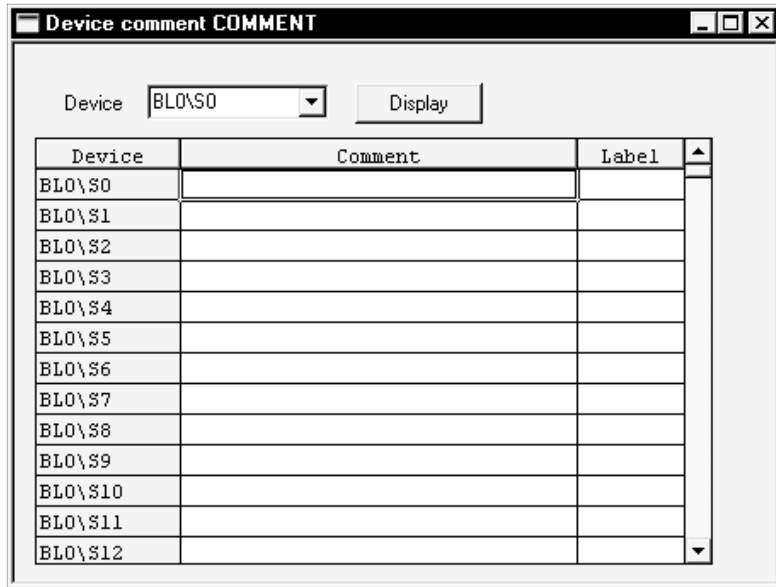
[Edit] → [Documentation] → [Comment] → Double-click at the editing position.

 → Double click at the editing position.

[Setting screen]



- (2) Using the device comment editing screen
 - [Operation procedure]
 - Project data list device comment → COMMENT0
 - [Setting screen]



- 1) Device name
 - Specifies the device for creating a comment.
 - When creating an SFC comment, specify the device name as follows.
 - Step comment: BLm\Sn
 - Transition comment: BLm\TRn
 - (m= Block number, n= Step/transition condition number)

POINT
<ul style="list-style-type: none"> • If you enter "BLm" (m= Block number) as the device name, you can create or modify the block title. For details of block titles, refer to section 3.7.

3.6.2 Method of creating a device comment

There are two methods of creating a device comment, a method of creating it from the comment input window after creating an SFC diagram, and a method of creating it from the comment editing screen.

Note, however, that a device comment does not appear on the SFC diagram editing screen.

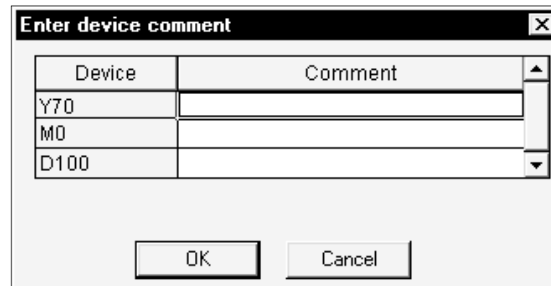
You can display the label to be added to the device on the SFC diagram editing screen.

(1) Using the SFC diagram editing screen

[Operation procedure]

[Tool] → [Option] → Program common tab → Check [Continues during command write] device comment input box → Double-click the editing position on the SFC diagram → Set SFC symbol/program input window to [OK].

[Setting screen]



1) Device

The device name used for the operation output/transition condition at the editing position is displayed.

(2) Using the device comment editing screen

When creating a device comment from the device comment editing screen, use the same operation procedure as that for the circuit.

For details of operation, refer to the GX Developer operating manual.



POINT
<ul style="list-style-type: none"> You cannot create a label for each device, from an SFC diagram. Create the device name from the device comment editing screen of (2). You cannot display a created device comment on an SFC diagram. When you click [View] → [Display label of step and TR] menu, the displayed program device name changes over to the label. (Refer to sub-section 3.13.3.)

3.7 Setting the Block Information

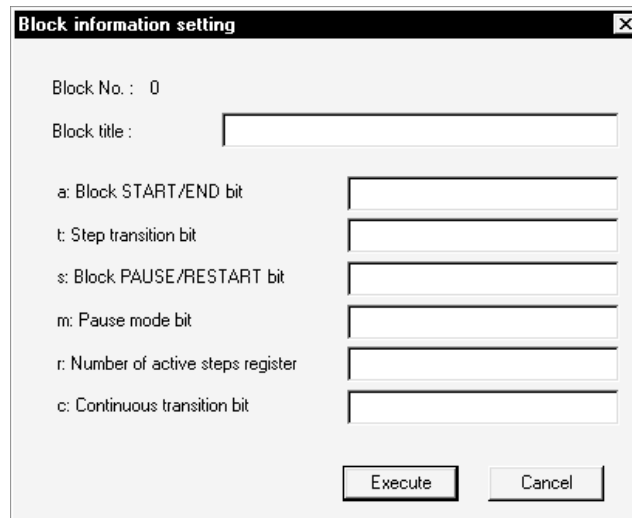
[Setting purpose]

This operation is performed to set the block information of the corresponding block at the time of a conversion operation after creation of an SFC diagram.

[Operation procedure]

- SFC diagram creation →  (F4)
- [Edit] → [Block information] or 

[Setting screen]



Enter a device into each item.

No device may be entered into an unnecessary item.

POINT

- For details of the function and contents of each item, refer to the QCPU (Q mode) program manual (MELSAP-L).
- You can create a program title by entering the device name as "BLm" on the device comment editing screen. (Refer to section 3.6.1)

3.8 Displaying the Block List

You can display a list of blocks of the SFC program being edited.
 You can perform editing such as cut & paste in monitor or block units.

[Operation procedure]
 [View] → [Display block list]
 [Block list screen]

No	Block title	a Active	c Transition	c Clear	s Stop	r Register
0	Start of blocks 1, 2	- M0	M1	M2	M3	D0
1	Machining process handling bl	- M10	M11	M12	M13	D10
2	Finishing start block	- M20	M21	M22	M23	D20
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

- 1) One screen displays 32 blocks.
 Using the scroll bar, [Page Up] / [Page Down] or ↑ / ↓ key, you can change the displayed blocks.
- 2) Indicates whether the corresponding blocks have been converted or not.
 - : Already converted
 * : Not yet converted

POINTS
In the SFC block list, you can perform the following.
1) Block information setting/correction
2) Batch copy between blocks
3) Jump to SFC diagram display in the specified block
4) SFC monitoring in the block list
5) (Batch) Conversion of unconverted blocks

3.9 SFC-Related Parameter Settings

Among the parameter settings made for operating the QCPU(Q mode), this section explains the setting of parameters related to SFC programs.

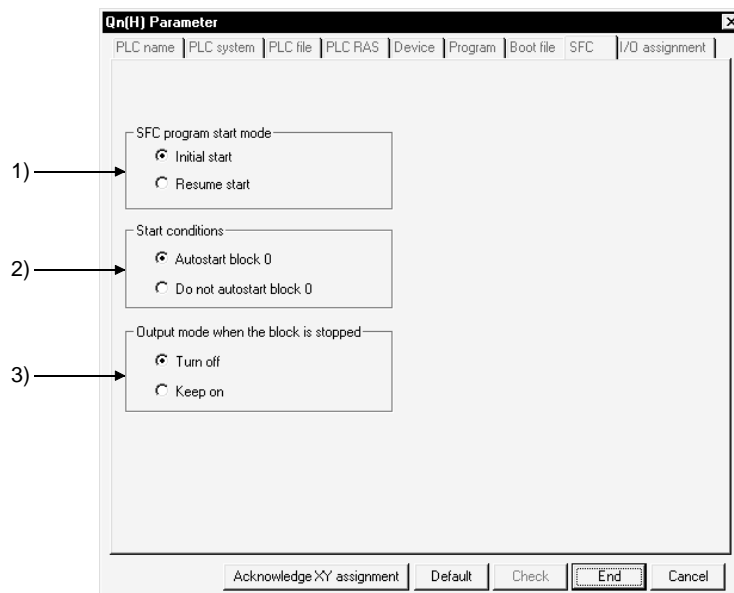
3.9.1 SFC setting in PLC parameters

This section gives the operation performed to set the SFC-related parameters using the PLC parameters.

[Operation procedure]

PLC parameters in project data list → SFC setting

[Setting screen]



[Item explanation]

1) SFC program start mode

Set an initial start or resume start to start the SFC program.

2) Start conditions

Set autostart block 0/do not autostart block 0 at the initial start of the SFC program.

3) Output mode when the block is stopped

Set whether a stop is made by turning off the coil outputs which were turned on by the OUT instruction or by keeping them on (latched) when a stop request is sent to any block.

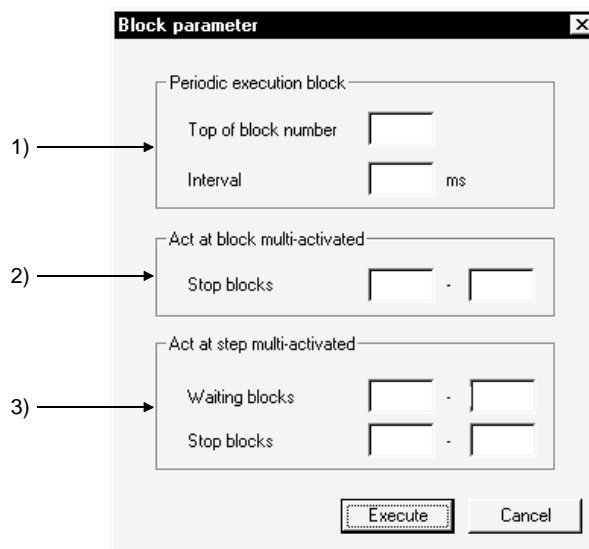
3.9.2 Setting the block parameters

This section provides how to set the block parameters.

[Operation procedure]

[Tools] → [Set SFC information] → [Block parameter]

[Setting screen]



[Item explanation]

1) Periodic execution block

All blocks from the set block number onward are periodic execution blocks. Do not set periodic execution blocks when processing all blocks with each scan.

Enter the execution interval within the range 1 to 65535 (ms) in 1ms increments.

2) Act at block multi-activated

Set the operation mode at block multi-activated.

For blocks in the specified range, the operation mode at block multi-activated is set to "Stop".

For blocks outside the specified range, the operation mode at block multi-activated is set to "standby".

Do not set this item if all blocks are to be set in "standby".

3) Act at step multi-activated

Set the operation mode at step multi-activated within the range of block units.

Regarding blocks specified as "waiting blocks", the operation mode at step multi-activated is set to "transition".

Regarding blocks specified as "stop blocks", the operation mode at step multi-activated is set to "stop".

Do not set this item if all blocks are to be set in "standby" mode.

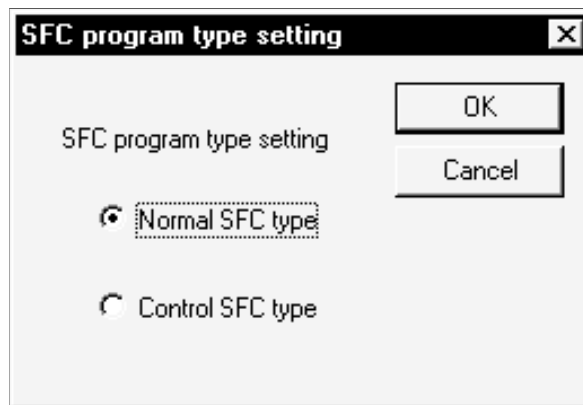
3.9.3 SFC program setting

Set whether the SFC program file being edited is to be a "Normal SFC Program" or a "Control SFC program".

[Operation procedure]

[Tools] → [Set SFC information] → [SFC type]



[Setting screen]



[Item explanation]

Selects whether to make the SFC program a normal SFC type or a control SFC type.

When Control SFC type is selected, an SFC program can be created for block 0 only.

Note that if a block start step ( , ) is designated in block 0, an error occurs when the program is executed and CPU operation stops.

3.10 Conversion Operation

With MELSAP-L, if only the operation outputs/transition conditions are edited, a conversion operation is unnecessary.

Item	Conversion Definition
Conversion (all programs being edited)	<ul style="list-style-type: none"> All programs being edited are batch-converted.
Block conversion(F4)	<ul style="list-style-type: none"> Only one SFC diagram block being edited is converted.
Block conversion (All blocks being edited)	<ul style="list-style-type: none"> All SFC diagram blocks being edited are batch-converted.
Block conversion error	<ul style="list-style-type: none"> The block No's in SFC diagram conversion error and the number of errors are displayed A detailed error is displayed per block specified.

3.11 Instructions for Online SFC Program Writing

This section provides instructions for writing the operation outputs/transition conditions of an SFC program to the CPU during RUN.

- If you create operation outputs/transition conditions alone in the overwrite mode after converting an SFC diagram, the **RUN write** button in the SFC symbol/program input window will be active.



- When you click the **RUN write** button, a "write during RUN" operation takes place. You cannot simultaneously write operation outputs/transit conditions for more than one point while a "write during RUN" operation is taking place. Perform a "write during RUN" operation for each operation output/transition condition.
- If you select "Write during RUN (while PLC is running)" or "Write if PLC STOP" when making a "write during RUN" setting by selecting [Tool] → [Option] → <<Program common>>, you can also write data to the CPU by pressing the **OK** button in the SFC symbol/program input window.
- The "write during RUN" method used is the normal "write during RUN" method.
- To execute "Write during RUN", display the SFC diagram/program input window, then press **Shift** + **F4**. (The same result can be achieved by pressing the **F4** button followed by the **OK** button.)
- You cannot execute "Write during RUN" using an SFC diagram. After creating or modifying an SFC diagram, stop the CPU then select the [Online] → [Write to PLC] menus and write data to PLC.
- You cannot execute "Write during RUN" in the insertion mode.

3.12 Search and Replacement

The method of searching for and replacing devices and instructions in MELSAP-L is described below.

POINT			
<ul style="list-style-type: none"> • If you use the MELSAP-L format to display an SFC program created in the MELSAP3 format, instructions that cannot be input using MELSAP-L will be displayed as "???.", however they can be found. If you wish to replace instructions that are displayed as "???.", replace them all together using "all replace". If you replace one instruction at a time, a replacement error will occur. • If you display a program containing a note (created in the MELSAP3 format) in the MELSAP-L format, "???.", will appear, preventing you from carrying out a search or replacement operation. • For a search/replacement made in an SFC program, the object area changes with the "searching direction" specified. 			
	a) Downward from top	b) Downward from cursor position	c) Upward from cursor position
Block 0	↓ 1)		
Block 1 • Cursor position	↓ 2)	↓ 1)	↑ 1)
Block 2	↓ 3)	↓ 2)	↑ 2)
Block n	↓ n)	↓ n)	↑ n)
<p>* When a search/replacement is to be performed in an SFC program after a search has been made in another program, all blocks will be searched. When making searches/replacements in an SFC program within the "specified range (step range)", specify the step numbers (e.g. <input type="checkbox"/> <input type="checkbox"/>) of the SFC diagram.</p>			

3.12.1 Searching for a device

This operation searches for the specified device to find the output/transition condition of the name block under which it is used.

Move the cursor to the step/transition of the SFC diagram used by the device.


The operation method is the same as that used for the circuit mode.

For details of the operation method, refer to the GX Developer operating manual.

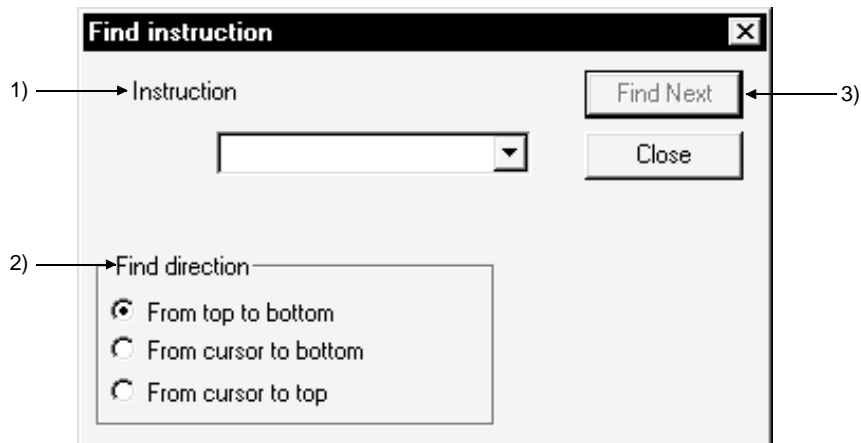
3.12.2 Searching for an instruction

This operation searches for the specified instruction to find the operation output/transition condition under which the corresponding block is used. Move the cursor to the step/transition of the SFC diagram in which the instruction is used.

[Operation procedure]

[Find/Replace] → [Instruction] or 

[Setting screen]



[Setting screen]

1) Instruction

Specifies the name of the instruction to be found.

A search can be performed using a normal instruction name and the following MELSAP-L format instruction names.

a (open contacts).....LD, AND, OR

b (close contacts)LDI, ANI, ORI

p (rise contacts)LDP, ANDP, ORP

f (fall contacts)LDF, ANDF, ORF

o (output).....OUT, OUTH, SET, RST

h (high speed timer)OUTH

s (set)SET

r (reset)RST

2) Find direction

Sets the search direction.

For details of the search direction for each setting, refer to section 3.12.

3) **Find Next** button

Clicking this button causes a search for the next object instruction to take place.

POINT
A pulse type instruction (+P, MOVP, etc.) is the object of a search, even if "P" has been removed from the instruction name. Example: Search specification "MOV" → Search object "MOV", "MOVP"

3.12.3 Searching for a character string

This operation searches for the specified character string to see if it is used as an SFC comment (step comment, transition comment). (Device comments are not included.) Move the cursor to the step/transition of the SFC diagram in which the character string is used.

The operation method is the same as in the ladder mode.

For details of the operation method, refer to the GX Developer operating manual.

3.12.4 Searching for the Step No./Block No.

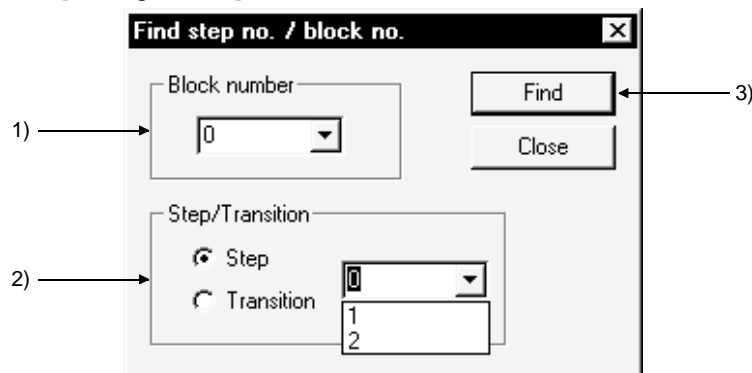
[Setting purpose]

This operation is performed to show the specified block on the screen by specifying the block No. and step No./transition No. when the cursor is in the SFC diagram.

[Operation procedure]

[Find/Replace] → [Find step no./block no.]

[Setting screen]



[Item explanation]

- 1) Block number
Enter the block No. to be searched for.
- 2) Step/Transition
Specify the cursor position after a search is over.
- 3) **Find** button
Click this button to show the SFC diagram in the specified block.

POINTS
<ul style="list-style-type: none"> • When the cursor is in the SFC diagram, pressing any "number" key shows the following window. <div style="text-align: center;"> </div> <p>Clicking the OK button or pressing the Enter key allows the cursor to move to the specified step in the SFC diagram currently displayed. Also, turning on the block no. radio button enables a block search.</p>

3.12.5 Replacing the devices

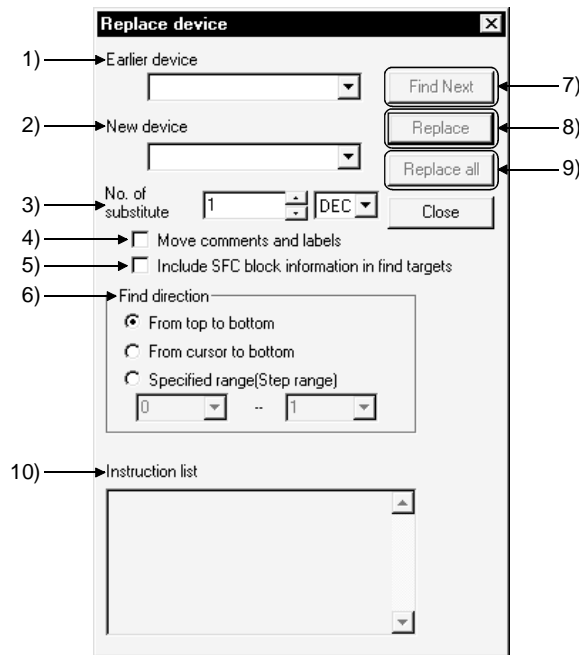
[Setting Purpose]

This operation is performed to replace character string constants used in operation outputs/transition conditions and SFC block information.

[Operation procedure]

[Find /Replace] → [Replace device]

[Setting screen]



[Item explanation]

1) Earlier device

Specify the device and character string constant to be replaced.

2) New device

Specify the new device and character string.

3) No. of substitutions

Set the number of substitution points from the devices set using the old device setting.

You can specify the number of substitution points in either decimal or hexadecimal notation.

4) Move comments and labels.

Set whether or not to simultaneously move comments and labels added to devices.

5) Include SFC block information in find targets

Set whether or not to include devices set in the block information of each block.

- 6) Find direction
Set the search direction.
For details of the search direction under to each setting, refer to sub-section 3.12.
- 7) **Find Next** button
Searches for the next target device without replacing the device at the location of the cursor.
- 8) **Replace** button
Replaces the device at the location of the cursor, then replaces the next target device.
- 9) **Replace all** button
Replaces all of the devices in the search area.
- 10) Instruction list
Displays programs that include the devices to be replaced, when "Find Next" or "Replace" is executed.
The devices to be replaced are highlighted.

POINT								
<ul style="list-style-type: none"> • You cannot replace a bit device with a word device, or vice-versa. It is possible to make an expansion specification, but digits, indices and indirect modification cannot be done. Examples of expansion specification, and word/bit device replacement targets <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">X0 → J1\GO Replacement possible</td> <td style="width: 50%;">X0 → D0 Replacement not possible</td> </tr> <tr> <td>D0.1 → U10\GO... Replacement possible</td> <td>X0 → K4X0 Replacement not possible</td> </tr> <tr> <td>D0 → D0.5..... Replacement possible</td> <td>D0 → D0.5 Replacement not possible</td> </tr> <tr> <td>X0 → D1.1 Replacement possible</td> <td></td> </tr> </table> <ul style="list-style-type: none"> • When replacing other program devices, refer to section 3.12. • If a range specification exists, only range specification of the currently open program will be effective. Other programs will be replaced from the first one. • If, after replacing a device that is used in the SFC block information, you cannot use the device, an error will be displayed and replacement will be interrupted. 	X0 → J1\GO Replacement possible	X0 → D0 Replacement not possible	D0.1 → U10\GO... Replacement possible	X0 → K4X0 Replacement not possible	D0 → D0.5..... Replacement possible	D0 → D0.5 Replacement not possible	X0 → D1.1 Replacement possible	
X0 → J1\GO Replacement possible	X0 → D0 Replacement not possible							
D0.1 → U10\GO... Replacement possible	X0 → K4X0 Replacement not possible							
D0 → D0.5..... Replacement possible	D0 → D0.5 Replacement not possible							
X0 → D1.1 Replacement possible								

3.12.6 Replacing the instructions

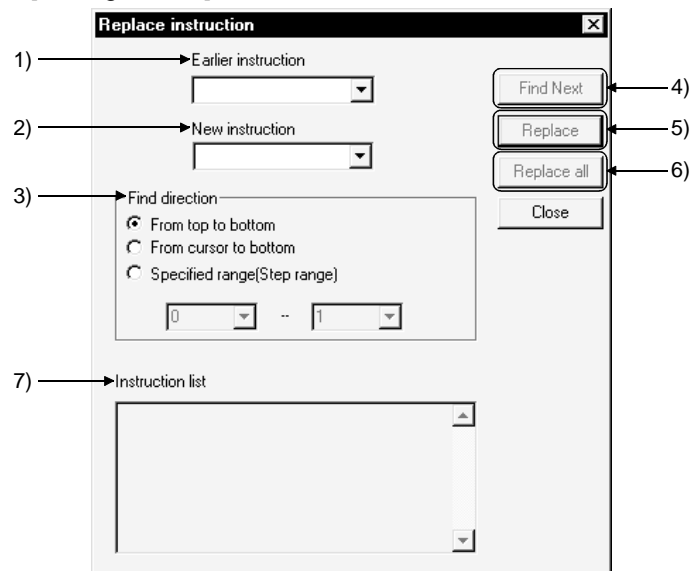
[Setting purpose]

This operation is performed to replace the instructions used in the operation output/transition condition of each block.

[Operation procedure]

[Find/Replace] → [Replace instruction]

[Setting screen]



[Item explanation]

1) Earlier instruction

Specify the instruction to be replaced.

You can also specify the instruction by using a MELSAP-L format instruction name.

For details of MELSAP-L format instruction names, refer to section 3.12.2.

2) New Instruction

Specify the new instruction.

You can also specify the instruction by using an instruction name in the MELSAP-L format.

3) Find direction

Set the search direction.

For details of the search direction under each setting, refer to sub-section 3.12.

4) **Find Next** button

Searches for the next target instruction without replacing the instruction at the location of the cursor.

5) **Replace** button

Replaces the instruction at the location of the cursor, then searches for the next target instruction.

6) **Replace all** button

Replaces all of the target instructions in the search area.

7) Instruction list

Display programs that include the instructions to be replaced, when "Find next" or "Replace" is executed.

The instructions to be replaced are highlighted.

POINT
<ul style="list-style-type: none">• You can also specify an instruction + device when inputting an instruction.• You cannot execute when the instruction format resulting from replacement is logically invalid.• When you wish to replace instructions in another program, refer to sub-section 3.12.• If a constant had been set in a device when you replaced an instruction that handles 16 bits (words) with an instruction that handles 32 bits (double words) by means of an instruction replacement, the constant will be transformed as follows.<ul style="list-style-type: none">Negative constant of K (Example: K-1) → sign-expanded (K-1)In the case of H, a constant whose sign bit is ON (Example: HFFFF) → Constant for which sign expansion does not take place (H0000FFFF) <p>Example: MOV K- 1 D0 (MOV is replaced by DMOV) DMOV K- 1 D0 MOV K- 200 D0 (MOV is replaced by DMOV) DMOV K- 200 D0 MOV HFFFF D0 (MOV is replaced by DMOV) DMOV H0000FFFF D0</p> <p>Alternatively, when replacing an instruction that handles 32 bits with one that handles 16 bits, the upper 16 bits are discarded.</p> <p>Example: DMOV K- 1 D0 (DMOV is replaced by MOV) MOV K- 1 D0 DMOV K150000 D0 (DMOV is replaced by MOV) MOV K18928 D0 DMOV HFFFFFFFF D0 (DMOV is replaced by MOV) MOV HFFFF D0</p>

3.12.7 Replacing the open/close contacts

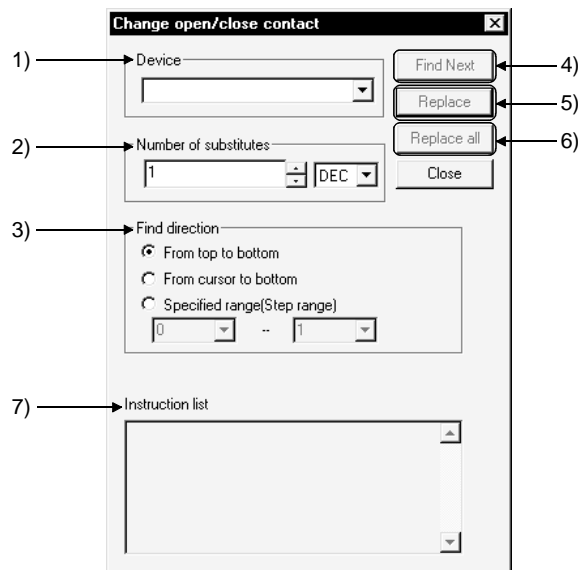
[Setting purpose]

This operation replaces the open contacts of a device used under the transition condition of each block with close contacts, and the close contacts with open contacts.

[Operation procedure]

[Find/Replace] → [Change over open/close contact]

[Setting screen]



[Item explanation]

1) Device

Specify the device whose open/close contacts you wish to change over.

2) Number of substitutes

Set the number of point at which open/close contacts are to be changed over continuously, from the specified device.

3) Find direction

Set the search direction.

For details of the search direction under each setting, refer to sub-section 3.12.

4) **Find Next** button

Searches for the next target point without replacing the open/close contacts at the location of the cursor.

5) **Replace** button

Replaces the open/close contacts at the location of the cursor and then searches for the next target point.

6) **Replace all** button

Replaces all of the target contacts in the search range.

7) Instruction list

Displays programs that include the contacts to be replaced, when "Find Next" or "Replace" is executed.

The contacts to be replaced are highlighted.

POINT	
	<ul style="list-style-type: none">• You can make an extension specification for a device specification and also specify a bit No. modification, but you cannot specify an index modification. Device specification example X0, J1•B6, D0.5, U10•G0.3 : Can be specified. X0Z3 : Cannot be specified. (An index modification cannot be specified.)• You can change the open/close contacts of the following instructions. Open contacts: LD, AND, OR, LDP, ANDP, ORP, EGP Close contacts: LDI, ANI, ORI, LDF, ANDF, ORF, EGF• If you wish to change the open/close contacts of another program, refer to sub-section 3.12.

3.12.8 Replacing a character string

This operation replaces the character string of an SFC comment.

The operation method is the same as in the ladder mode.

For details of the operation method, refer to the GX Developer operating manual.

3.12.9 Replacing the Step No.

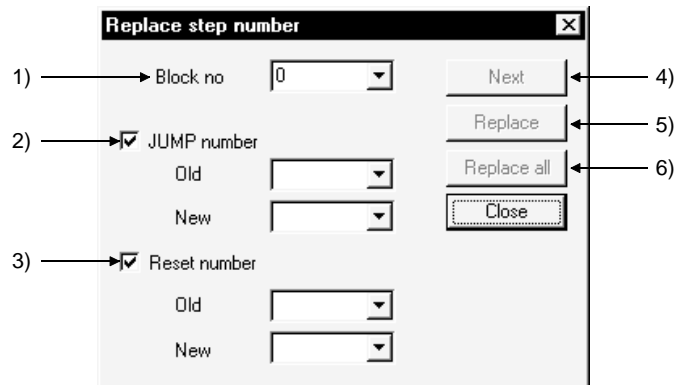
[Setting purpose]

This operation is performed to replace the jump destination step number and the reset destination step number of each block.

[Operation procedure]

[Find/Replace] → [Replace step no.]

[Setting screen]



[Item explanation]

1) Block no.

Enter the first block No. to be replaced.

2) JUMP number

Set this number when replacing the jump destination step number of a jump transition.

When replacing a step number, enter the replacement source and the step number after replacement.

3) Reset number (Only for QCPU(Q mode))

Set this number when replacing the reset destination step number of a reset step.

When replacing a step number, enter the replacement source and the step number after replacement.

4) **Next** button

Searches for the next target instruction without replacing the step on the cursor.

5) **Replace** button

Replaces the step on the cursor and searches for the next target instruction.

6) **Replace all** button

Replaces all target steps in the search range.

POINT

After replacement, always perform a conversion operation because the step number is in an unconverted status. An error check is also made at the time of conversion.

3.12.10 Listing contacts/coils used

This operation lists where the specified devices are used in the operation outputs/transition conditions and block information.

The symbols displayed represent the following.

"Step"

- S:n = Used as the operation output of step n.
- TR:n = Used as transition condition n.

"Sequence step"

- a = Used as the block start end bit of the applicable block.
- t = Used as the step transition bit of the applicable block.
- c = Used as the continuous transition bit of the applicable block.
- s = Used as the block pause/restart bit of the applicable block.
- m = Used as the pause mode bit of the applicable block.
- r = Used as the number of active step registers of the applicable block.

The operation method is the same as in the ladder mode.

For details of the operation method, refer to the GX Developer Operating Manual.

3.12.11 Searching for the device use status

This operation lists how the devices are used device-by-device (e.g. X, Y, M, D).

A device search also covers devices used in the block information, and if they are used in the block information alone, they are shown as being used as contacts.

The operation method is the same as in the ladder mode.

For details of the operation method, refer to the GX Developer Operating Manual.

3.12.12 Changing the T/C set values

This operation changes the set values of the timers/counters used in the operation outputs inside the block being displayed. (The T/C set values in different blocks cannot be changed at the same time.)

The operation method is the same as in the ladder mode.

For details of the operation method, refer to the GX Developer Operating Manual.

3.13 Providing Displays

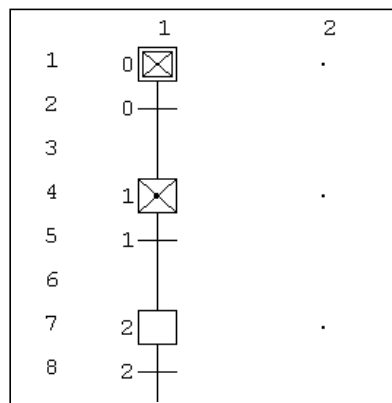
3.13.1 Displaying programs

[Setting purpose]

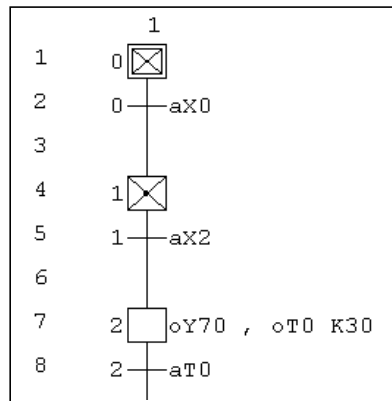
This operation displays the operation output/transition condition program in the created SFC diagram.

[Operation procedure]

1. Select [View] → [Display program] (**Ctrl** + **Alt** + **F8**).



2. The operation output/transition condition program appears on the screen.



3. If you select [View] → [Displayprogram] (**Ctrl** + **Alt** + **F8**) when the program is displayed, the program will disappear from the screen. Under the initial settings, the program is displayed.

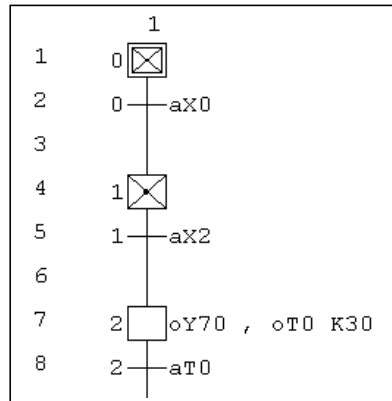
3.13.2 Displaying the step/transition comments

[Setting purpose]

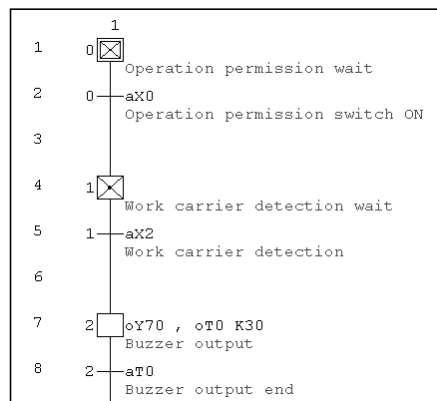
This operation displays created SFC comments.

[Operation procedure]

1. Choose [View] → [Display comment of step and TR] (**Ctrl** + **F5**).



2. The SFC comments appear on the screen.



3. When the SFC comments are being shown, choosing [View] → [Display comment of step and TR] (**Ctrl** + **F5**) hides the SFC comments.

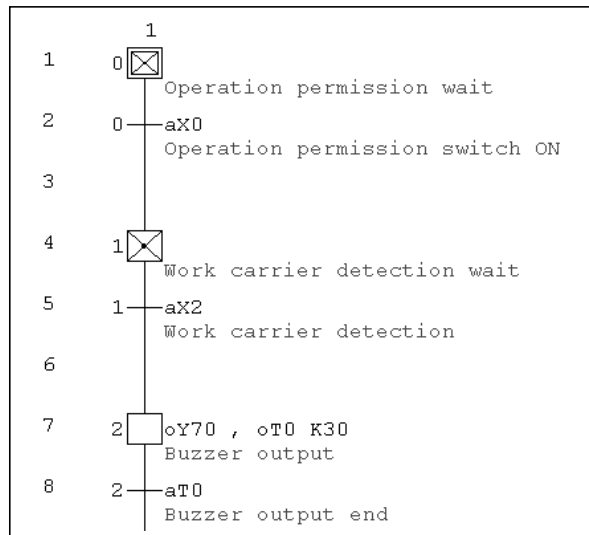
3.13.3 Displaying a label in the SFC diagram

[Setting purpose]

This operation replaces a device name in the program with a created label and then displays it.

[Operation procedure]

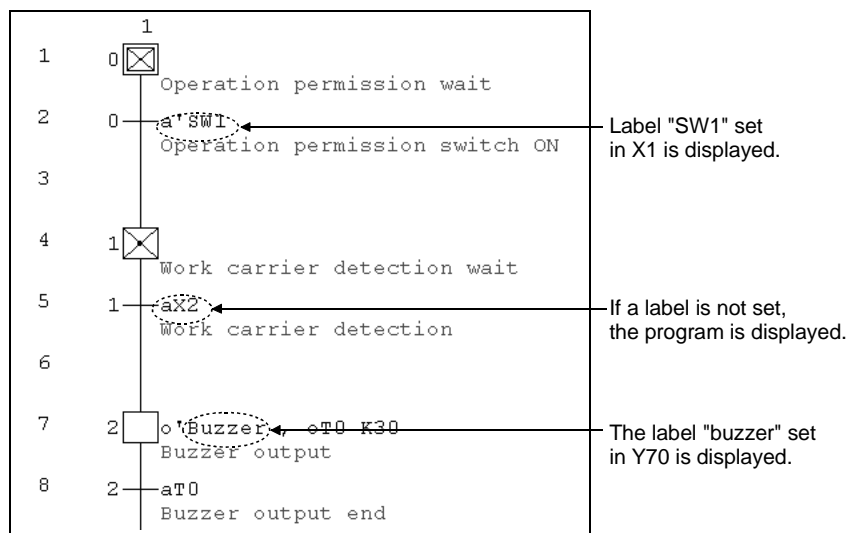
1. Choose [View] → [Display label of step and TR] (**Alt** + **Ctrl** + **F6**).



2. The label replaces the device name on the display screen.

The label is displayed in the form "instruction label".

If a label is not set in a device, the program remains displayed.



3. When the label are being shown, choosing [View] → [Display label of step and TR] (**Alt** + **Ctrl** + **F6**) hides the label.

POINT
<ul style="list-style-type: none">• Use the device comment edit screen to create a label. For details of the device comment edit screen, refer to the GX Developer operating manual.

3.13.4 Displaying a program in the MELSAP3 format

By selecting [View] → [MELSAP3 format], you can use the MELSAP3 format to display a program created in the MELSAP-L format.

No restrictions occur when you change to a MELSAP3 format display.

For details of performing operations in the MELSAP3 format, refer to the GX Developer operating manual (SFC).

The following restrictions occur if you use the MELSAP-L format to display an SFC program created or modified in the MELSAP3 format.

- If an operation output contains a note, contact or comparison operation instruction, "???" will appear when you display the program in the MELSAP-L format.
You cannot modify an operation output that was displayed as "???". (Refer to section 2.4.)

3.14 Setting the SFC Diagram Display

3.14.1 Setting the SFC diagram display

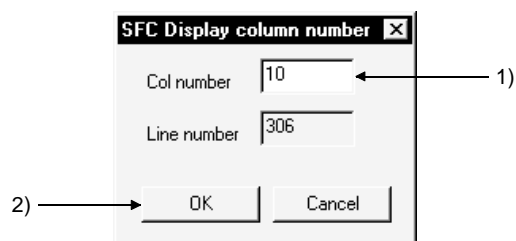
[Setting purpose]

This operation is performed to set the number of branches that can be edited/displayed when the SFC diagram is edited/read.

[Operation procedure]

[View] → [Raw of SFC]

[Setting screen]



[Item explanation]

1) Col number

Enter the number of columns (number of branches).

The number that may be input is any of 1 to 32.

Entering the number of columns automatically shows the number of rows that may be entered.

2) button

Click this button when the setting is complete.

3.14.2 Setting the SFC setting options

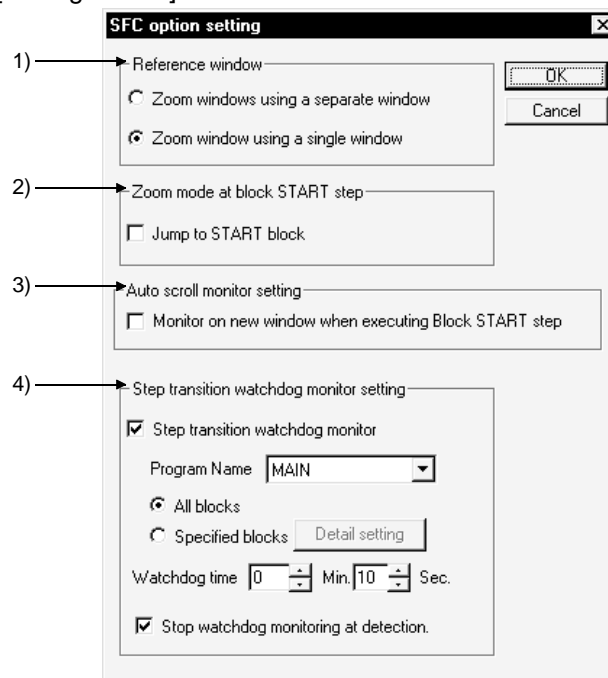
[Setting purpose]

This operation is used to set details when editing or monitoring an SFC program.

[Operation procedure]

[Tool] → [Set SFC information] → [Option]

[Setting screen]



[Item explanation]

1) Reference window

This window is used to display or not display several operation output/transition condition sequence program windows alongside each other in the MELSAP-II/3 format.

This setting cannot be made in the MELSAP-L format.

2) Zoom mode at block START step

Sets whether or not a jump will be made to the start destination block when the cursor moves to the block start step.

3) Auto scroll monitor setting

Sets whether or not the start destination block window will be opened and monitored when the active step moves to the block start step during monitoring of automatic scrolling.

If GX Developer is minimized, you cannot open the start destination block window.

If the block started while GX Developer was minimized, the block that was monitored prior to minimization will be monitored after minimization is canceled.

4) Step transition watchdog monitor setting

Sets whether or not steps that do not move within the specified monitoring period will be monitored.

To carry out transition monitoring, set the name of the program to be monitored, specify the block, and set the monitoring period.

If you set "Stop watchdog monitoring at detection", transition monitoring will stop when a non-transition step is detected.

4. MONITORING AND TEST FUNCTIONS

MELSAP-L has the following monitoring and test functions.

[Monitoring]

- SFC diagram monitor
- All-block batch monitor
- Block list monitor
- Device batch monitor
- Device registration monitor
- Buffer memory batch monitor
- Program list monitor
- Interrupt program list monitor

[Test]

- Device test

An explanation of monitoring and testing in MELSAP-L is set out below. For details of operating the device batch monitor, device registration monitor, buffer memory batch monitor, program list monitor, and interrupt program list monitor functions, refer to the GX Developer operating manual.

4.1 SFC Diagram Monitor


This operation is used to monitor the operation and control status of the PLC CPU with SFC diagrams and to conduct test operations.

[Operation procedure]


- When monitoring

[Online] → [Monitor] → [Monitor mode] or  ([F3])

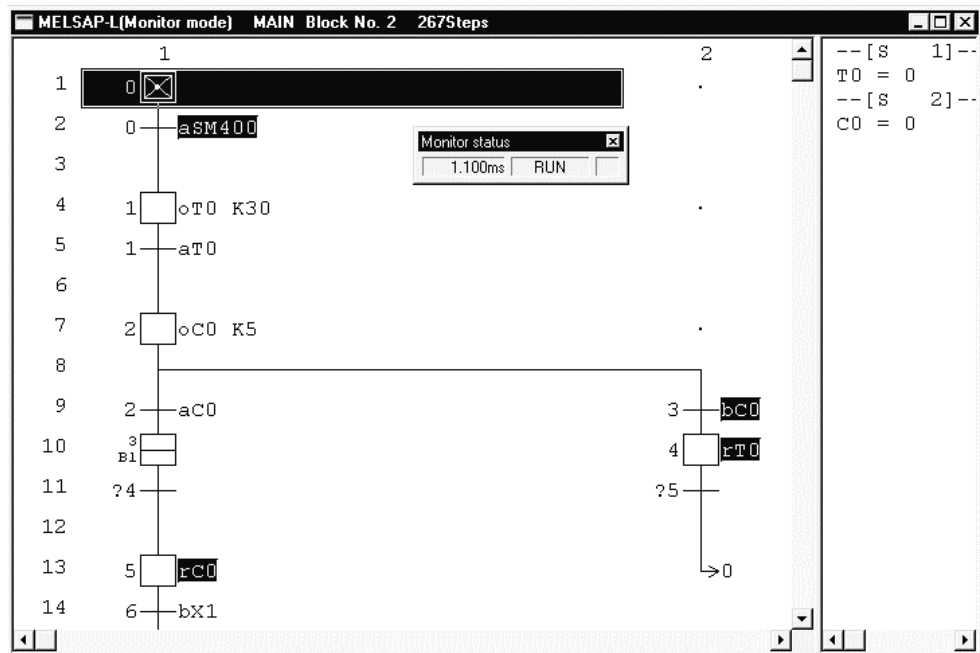
- When stopping monitoring

[Online] → [Monitor] → [Stop monitor] or  ([Alt] + [F3])

- When resuming monitoring

[Online] → [Monitor] → [Start monitor] or  ([F3])

[Screen]



4

1) When monitoring, screen is automatically divided into two display areas. (Left and right on the screen)

The SFC diagram monitor area that indicates the active steps is displayed on the left side of the screen.

The current value monitor area for word devices is displayed on the right side of the screen.

The dividing line between the left and right parts of the screen can be moved.

2) During SFC diagram monitoring, steps are shown as follows.

 (blue) : Active step

SC (yellow) : Step specified as a hold step and being in a hold status

 : Inactive step

3) During monitoring, the bit device output status of the operation output is highlighted as shown below.

Bit device output status	Example of a display during monitoring
Coil output	oY70 , sM0
When bit device to be reset is OFF	rM0
Continuity status of the timer, high speed timer and counter	oT0 K30 , hT10 K100 , oC1 K5
When the timer, high speed timer and counter are in the time-up or count-up status	oT0 K30 , hT10 K100 , oC1 K5
When the bit device in the application instruction is ON (Excluding the digital specification bit device)	BCD C4 K4Y20

4) For the transition condition, when the contacts go into a continuity status, the corresponding display is highlighted.

Example:

When open contact X1 is ON : **aX1**
 When close contact X2 is OFF : **bX2**
 When comparison operation instruction D0 = D100 : **≡ D0 D100**

However, the character string data comparison instruction (\$ =, \$>, etc.) is not highlighted.

5) The current value monitor area displays the current value of the word device on the SFC diagram monitor screen.

It displays the step number/transition condition number of the word device whose current value is being monitored.

Step No. : ---[S n]---

Transition No. : ---[TR n]---

You cannot register a device in the device registration monitor from the current value monitor by drag-and-drop.

6) You can change the block to be monitored, by means of the following operation.

- Select block start step and input space key.
- When the setting "Jump to start block" was made by the option setting "Zoom mode at block start step", click the button in the dialog box that appears when you select the block start step. (Refer to section 3.14.2.)
- Display the block list, then double-click the block number (Refer to section 3.8.)
- Specify the block to be monitored by step number/block number detection. (Refer to section 3.12.4.)

POINT

- When you set the auto scroll monitor function, the active steps are displayed continuously.
To perform automatic scroll monitoring, click or select [Online] → [Monitor] → [Auto scroll monitor].
- Automatic scroll monitoring of multiple steps active in series due to operation hold steps, for example, shows the active step closest to the initial step.
- When performing automatic scroll monitoring, you can automatically set the start destination block by means of the "Auto scroll monitor setting".
If GX Developer is minimized, the start destination block window will not open.
If the block started while GX Developer was minimized, the block that was monitored prior to minimization will be monitored after minimization is canceled. (Refer to section 3.14.2.)
- During monitoring, you cannot edit SFC diagrams.
- During editing, you cannot monitor SFC diagrams.
- If you open the write or monitoring screen during automatic scrolling, automatic scroll monitoring stops. When you resume monitoring, automatic scroll monitoring also resumes.

4.2 Transition Watchdog Monitor

The following is an explanation of the transition watchdog monitor function that monitors steps from which the program does not proceed to the next step after the lapse of the specified period.

[Operation procedure]

[Tool] → [Set SFC information] → [Option] → [Step transition watchdog monitor setting] → Carry out monitoring (refer to section 4.1).

[Screen]



- When the step transition watchdog is set, and the system detects a step from which a transition does not occur despite the lapse of the specified period, the above dialog box appears.
However, the display on the above dialog box is sometimes delayed beyond the specified period depending upon the capacity of the SFC program and the environment under which the computer operates.
- When you click **JUMP**, the step concerned in the SFC diagram appears.
- For details of the step transition watchdog monitor setting operation, refer to section 3.14.2.
- If you check "Stop watchdog monitoring at detection" when setting the step transition watchdog monitor, the monitor will stop each time a non-transition step is detected, however normal monitoring will continue.

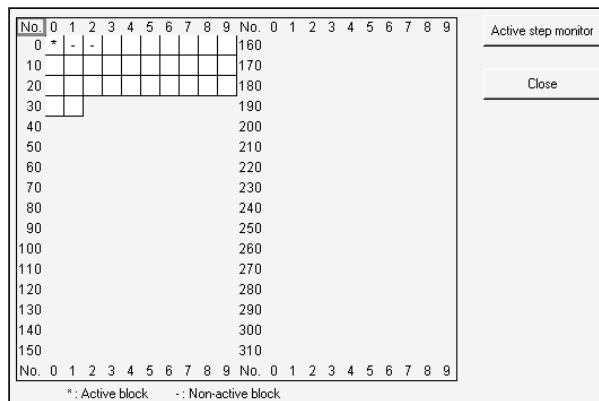
4.3 All Block Batch Monitor and Active Step Monitor

This operation is used to monitor the active/inactive states of all blocks in a list form and to monitor the step active/inactive states of the specified block from the block list in a list form.

[Operation procedure]

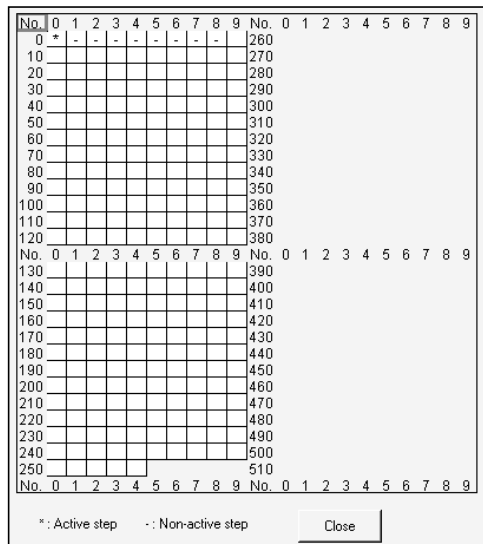
[Online] → [Monitor] → [All block batch monitor]

[Screen]



- * indication: The corresponding block is active.
- indication: The corresponding block is inactive.

To monitor the specified block for step active/inactive states, click the field of the block to be monitored, and click the **Active step monitor** button.




- * indication: The corresponding step is active.
- indication: The corresponding step is inactive.

After resetting the PLC CPU, if you carry out monitoring without having put the system in a RUN condition even once, the monitoring result will be blank. If you stop the PLC CPU and perform monitoring, the status at the time the sequencer was stopped will be displayed as the result of monitoring.

4.4 Block List Monitor

This operation is used to show and monitor a block list.

[Operation procedure]

[View] → [Display block list] →  ([F3])

[Screen]

No	Block title	a Active	t Transition	c Clear	s Stop	r Register
0	Start of blocks 1, 2	- M100	M101	M102	M103	D100
1	Machining process handling b1	- M110	M111	M112	M113	D110
2	Finishing start block	- M120	M121	M122	M123	D120
3						
4						
5						
6						
7						
8						


- The block No. fields of active blocks are highlighted.
When block information has been set, the status of the corresponding block can be confirmed in the block information.
- To switch the specified block to SFC diagram monitor during monitoring, double-clicking in the field of the corresponding block switches to the SFC diagram display of the specified block.

POINT	
Active registers cannot be monitored.	

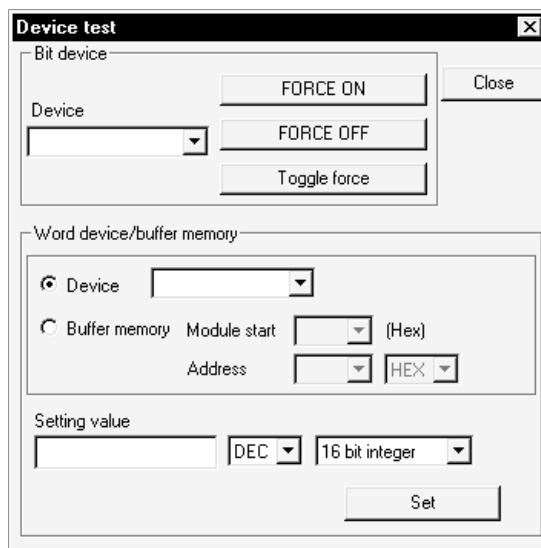
4.5 Device Test

An explanation of the device testing operation in MELSAP-L is set out below.

[Operation procedure]

[Online] → [Debug] → [Device test] or 

[Screen]



- To forcibly turn the bit device ON or OFF, input the device, and click **FORCE ON** / **FORCE OFF** / **Toggle force**.
- To change a word device or the current value of the buffer memory, specify the device or buffer memory, then enter the value to be set and click **Set**.
- You can start a device test either by using **Shift** + double-clicking (**Enter**) the operation output or transition condition of the SFC diagram monitor, or by using the right click menu.
- The current value display of a double word instruction (DMOV, DFRO, etc.) is displayed as a double word.
Check the value of a double word using the device batch monitor or the device registration monitor.

5. PRINTING SFC DIAGRAMS

5.1 SFC Diagram Print Setting

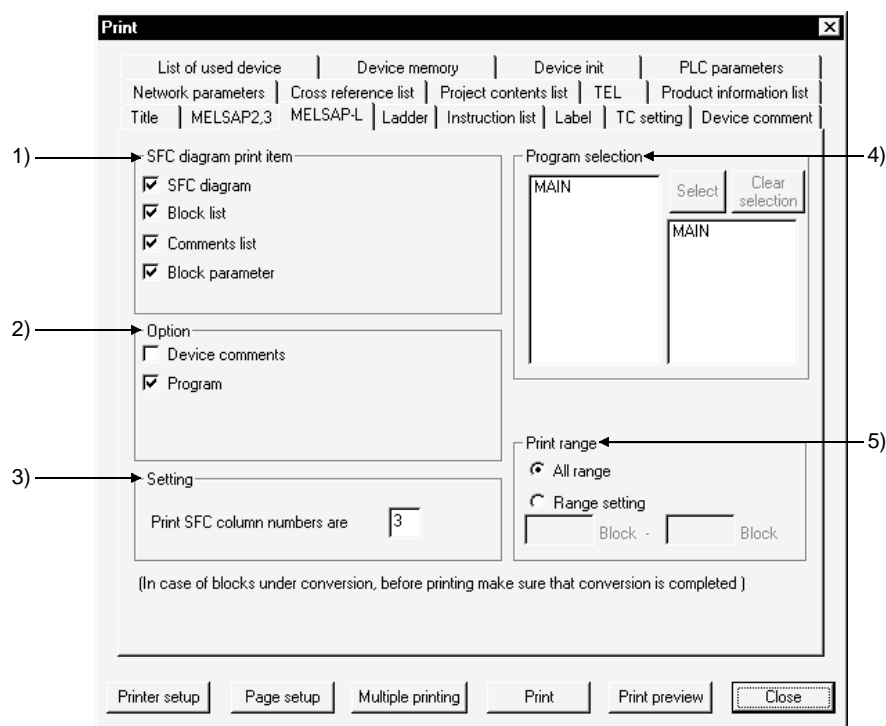
[Setting purpose]

This operation is used to set the object of printing such as a block list, comment list, and so on.

[Operation procedure]

Select [Project] → [Print] → <<MELSAP-L>>

[Screen]



[Item explanation]

1) SFC diagram print item

The items checked in the corresponding check boxes is printed.

2) Option

The items checked in the corresponding check boxes is added.

Some additional information items cannot be selected according to the print items.

3) Setting

Set the number of print columns on a single page.

The diagram is printed with automatic magnification/reduction specified according to the set number of columns.

4) Select program

Choose the program name to be printed.

5) Print range

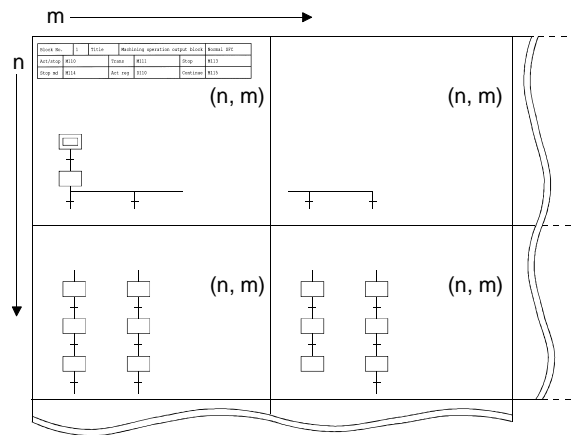
Set all area (all blocks) or the specified blocks.

5.2 SFC Diagram Printing Examples

This sub-section shows printing examples of an SFC diagram, block list, comment list and block parameters.

(1) SFC diagram printing example

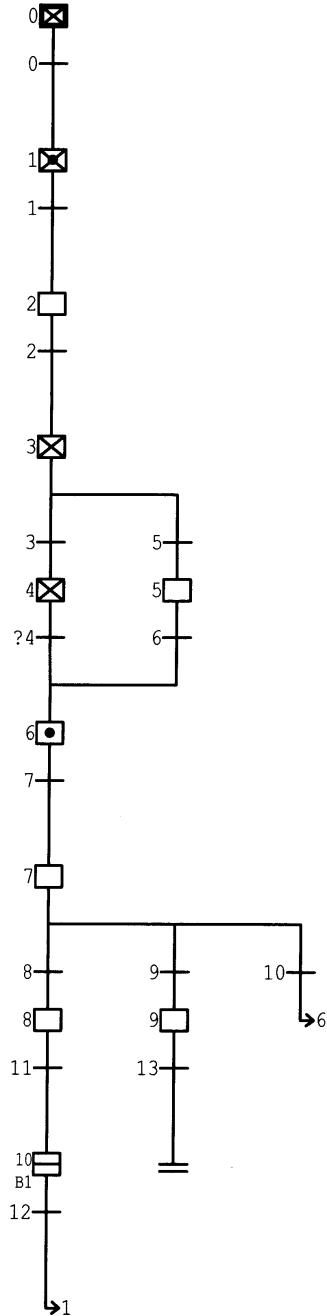
When you print an SFC diagram, the printout is divided into a number of pages depending upon the number of branches and couplings, and the number of steps. A number that indicates the position is printed at top right of each page.



• When there is no added information

Block No.	0	Title	Conveyor control block		Normal SFC
Start	M100	Trans	M101	Pause	M102
Pause md	M103	Active	D100	Continue	M104

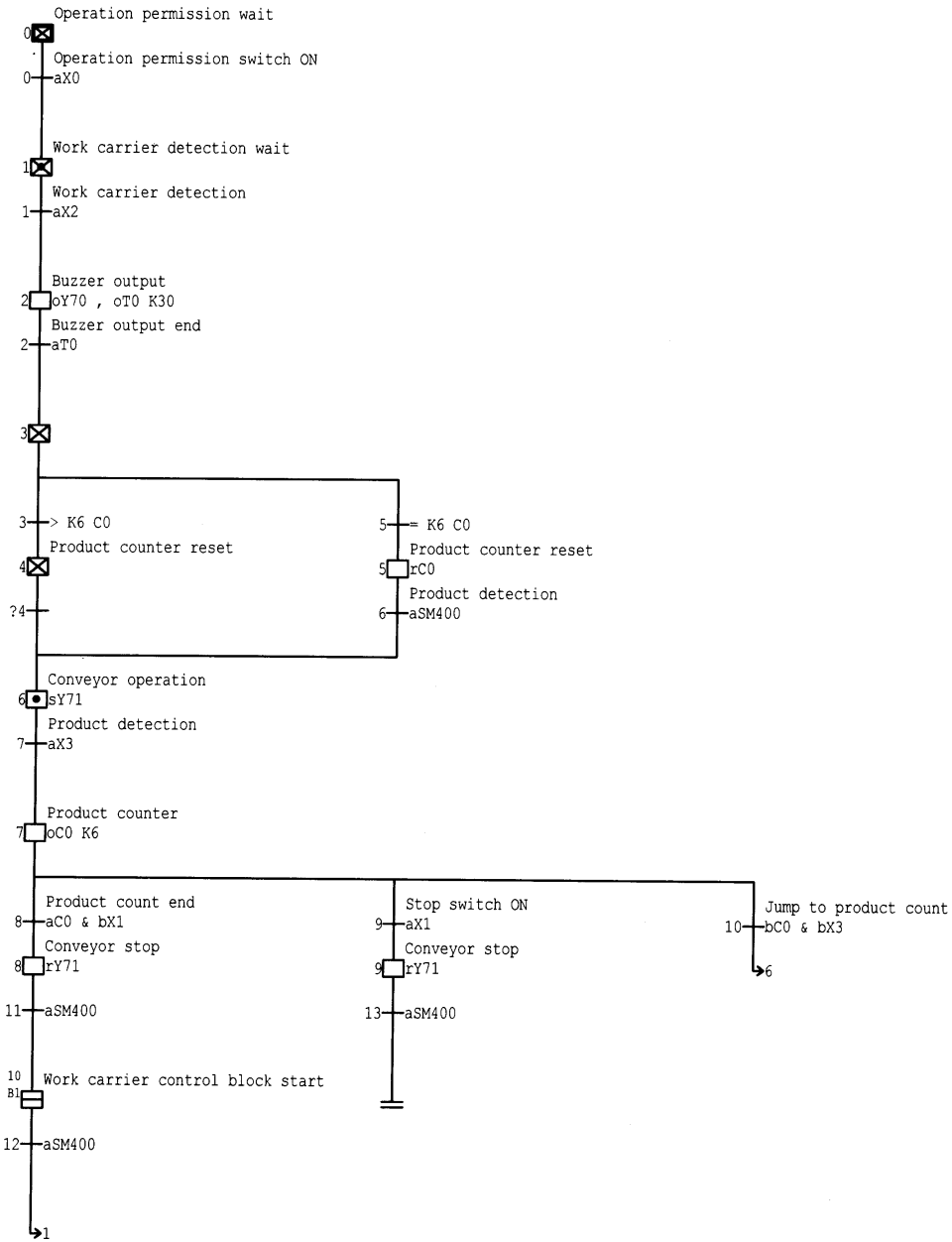
(1, 1)



- When there is added information (programs, device comments)

Block No.	0	Title	Conveyor control block			Normal SFC
Start	M100	Trans	M101	Pause	M102	
Pause md	M103	Active	D100	Continue	M104	

(1, 1)



(2) Block list printing example

Block list		
No.	Title/Information register	Block activation
0	Conveyor control block Start : M100 Transition : M101 Pause : M102 Pause Mode : M103 Active : D100 Continuous : M104	BL1
1	Work carrier control block Start : M200 Transition : M201 Pause : M202 Pause Mode : M203 Active : D200 Continuous : M204	

(3) Comment list printing example

The printed comment list is divided into step comments and transition comments.

- Step comments

Block No.	0	Title	Conveyor control block			Normal SFC
Start	M100	Trans	M101	Pause	M102	
Pause md	M103	Active	D100	Continue	M104	

Trancond	Comment	Dev Lbl
t0	Operation permission switch ON	
t1	Work carrier detection	
t2	Buzzer output end	
t3		
t4		
t5		
t6	Product detection	
t7	Product detection	
t8	Product count end	
t9	Stop switch ON	
t10	Jump to product count	
t11		
t12		
t13		

• Transition comments

Block No.	0	Title		Normal SFC
Start		Trans		Pause
Pause md		Active		Continue

Trancond	Comment	Dev Lbl
----------	---------	---------

TR0 Operation oermission switch ON
 TR1 Work carrier detection
 TR2 Buzzer output end
 TR3
 TR4
 TR5
 TR6 Product detection
 TR7 Product detection
 TR8 Product count end
 TR9 Stop switch ON
 TR10 Junp to product count
 TR11
 TR12
 TR13

(4) Block parameter printing example

Block parameter	[MAIN]
-----------------	--------

Periodic exec Blk	[] After
Execution interval	[]ms
Action at BL multi-act	Stop []-[]
Action at step Multi-activated	Waiting []-[]
	Stop []-[]

MEMO

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