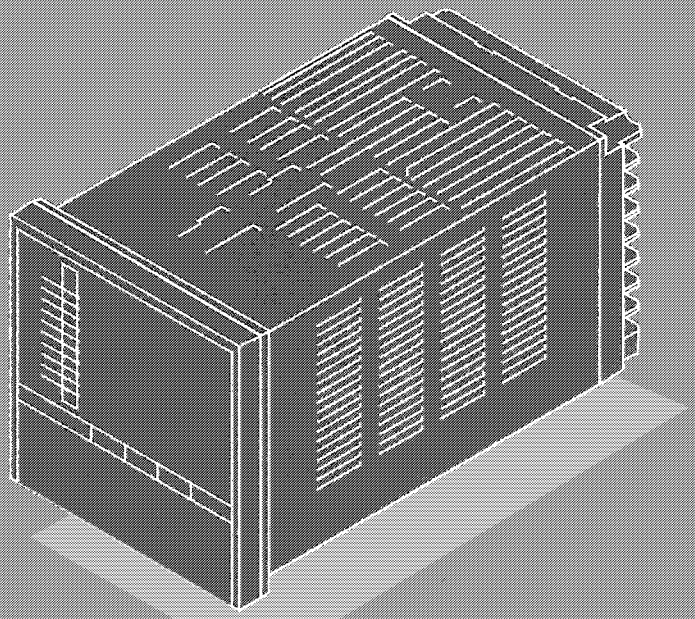
OMRON

ES100 Digital Controller

Communications Guide User's Manual



Cat. No. H072-E1-2

Introduction

This User's Manual describes how to use the communications functions of the ES100. Please read and understand this User's Manual before using the controller's communications functions. When you have finished with this manual, store it in a safe place.

■ About this Manual

The ES100 supports two communications features: serial communications (terminal communications) and BCD (binary coded decimal) communications.
Select the communications type according to the type of controller that you are using.
Accordingly, this manual is divided into two sections:

CHAPTER 1 SERIAL COMMUNICATIONS
CHAPTER 2 BCD COMMUNICATIONS

● When using serial communications:
•ES100□-□••□01□ (RS-232C interface)
•ES100□-□••□04□ (RS-422/485 interface)
➨ For details, see Chapter 1 Serial Communications

● When using BCD communications:
•ES100□-□••□E
➨ For details, see Chapter 2 BCD Communications

Caution

© OMRON, 1994
All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form, or by any means, mechanical, electronic, photocopying, recording, or otherwise, without the prior written permission of OMRON.

No patent liability is assumed with respect to the use of the information contained herein.
Moreover, because OMRON is constantly striving to improve its high-quality products, the information in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.

Contents

CHAPTER 1 SERIAL COMMUNICATIONS ---------- 1-1

1.1 Introduction ---------- 1-2
1.2 Preparations ---------- 1-4
1.3 Commands/Responses ---------- 1-7
1.4 Error Code Tables ---------- 1-25
1.5 Program Examples ---------- 1-28

CHAPTER 2 BCD COMMUNICATIONS ---------- 2-1

2.1 Introduction ---------- 2-2
2.2 Preparations ---------- 2-3
2.3 Timing of Operations ---------- 2-5
2.4 Assigning DSL Codes ---------- 2-8
2.5 Description of Data Items ---------- 2-11
2.6 Program Examples ---------- 2-14

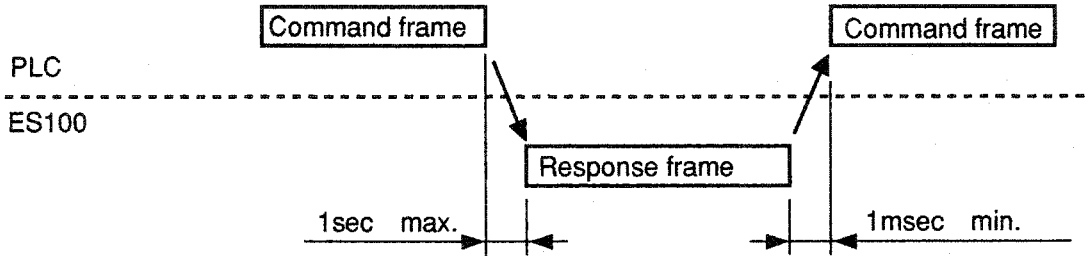
CHAPTER 1 SERIAL COMMUNICATIONS

1.1 Introduction ---------- 1-2
What is "serial communications?" 1-2
About the serial interface --------- 1-2
Data frame configuration --------- 1-3
1.2 Preparations ---------- 1-4
Switch settings ---------- 1-4
Wiring terminals ---------- 1-4
Cable connections ---------- 1-5
Multiple connections ---------- 1-6
Setting parameters ---------- 1-6
1.3 Commands/Responses ---------- 1-7
Command configuration ---------- 1-7
Command lists ---------- 1-8
Variable area ---------- 1-8
Parameters ---------- 1-13
Program data ---------- 1-18
Delete pattern ---------- 1-20
Pattern information ---------- 1-20
Operating instruction ---------- 1-21
Controller status ---------- 1-23
Echo back test ---------- 1-24
Command limitations ---------- 1-24
1.4 Error Code Tables ---------- 1-25
Communication errors ---------- 1-25
ES100 errors ---------- 1-25
1.5 Program Examples ---------- 1-28
How to use programs ---------- 1-28
Program list ---------- 1-29
Examples ---------- 1-31

1.1 Introduction

■What is "serial communications?"

"Serial communications" is a method of transmitting and receiving the various data set on the ES100 to the PLC (Programmable Logic Computer) via the RS-232C (or, RS-422/485) serial interface. Serial communications involves receiving a command frame from the PLC, and transmitting a response frame in response to the command frame.



The following functions can be executed by serial communications:

- Read/write of variable areas
- Read/write of parameter areas
- Read/write/delete of sequence setting value
- Read of pattern information
- Operating instructions
- Read of controller status
- Echo back test

Some information cannot be executed in write operations.

■About the serial interface

Communications conforming to the RS-232C, RS-422 or RS-485 interface are carried out depending on the type of ES100.
Communications is carried out.

- ES100□-□□01□□ (RS-232C interface)
- ES100□-□□04□□ (RS-422/485 interface)

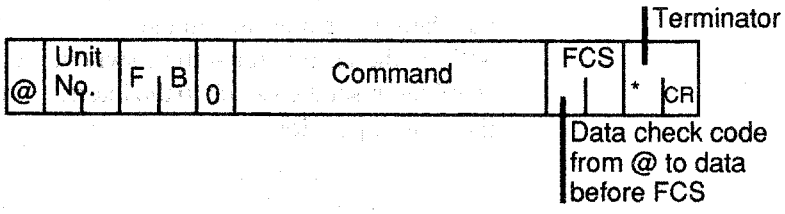
Selection of the RS-422 and RS-485 is set by switch settings on the ES100.

■ Data frame configuration

Data is handled in 1-byte units, and expressed by ASCII code.

● Command frame

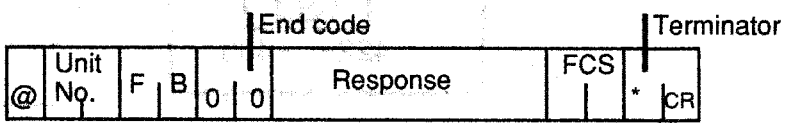
The command frame is transmitted to the ES100 from the PLC. The format of the frame is as follows.



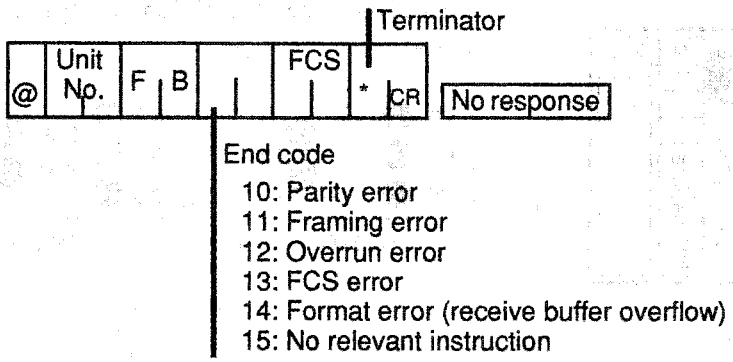
● Response frame

The response frame is transmitted to the PLC from the ES100. The format of the frame varies as follows depending on whether transmission ends normally or abnormally.

● Normal end



● Abnormal end

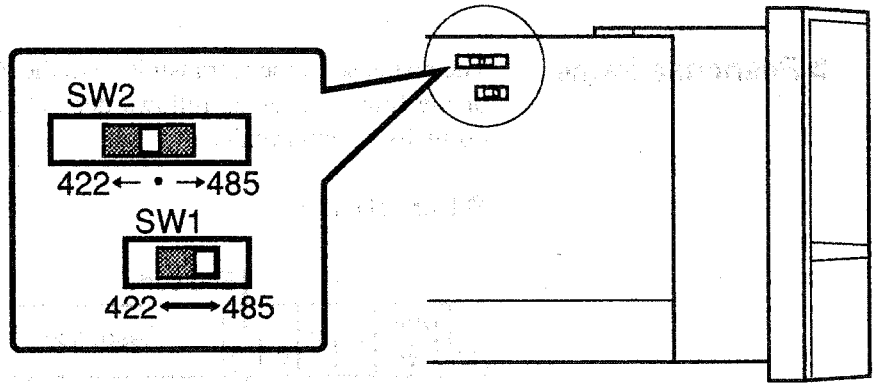


1.2 Preparations

■ Switch settings

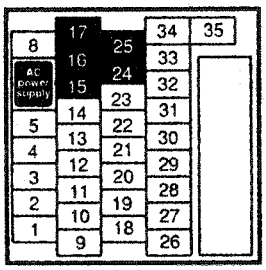
The ES100□-□□01□ (RS-232C interface) does not have any switches requiring setting.

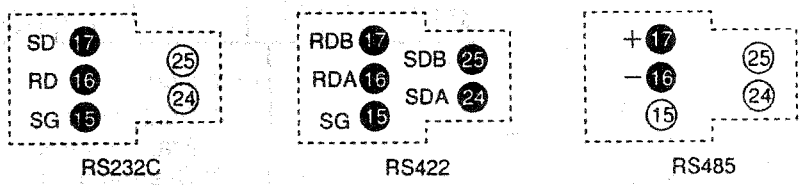
The ES100□-□□04□ (RS-422/485 interface) has an interface selection switch and terminator setting switch which must both be set. These switches are located on the printed circuit board at the left of the main unit.
SW1 is the RS-422/RS-485 interface selection switch. Set this switch matched to the interface in use.
SW2 is the terminator setting switch. When the ES100 is selected as the terminator, set the switch to the interface in use. Otherwise, set the switch to the central position.



■ Wiring terminals

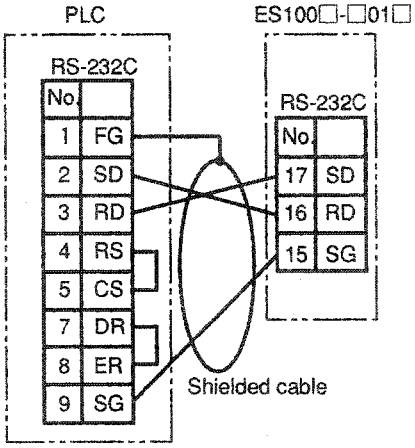
- Terminal No.15 to 17, 24 and 25 are serial communications terminals. The terminals on the ES100□-□□01□ are wired for the RS-232C interface, and the terminal on the ES100□-□□04□ are wired for the RS-422/485 interface. Before wiring terminals, check the type of controller in use.



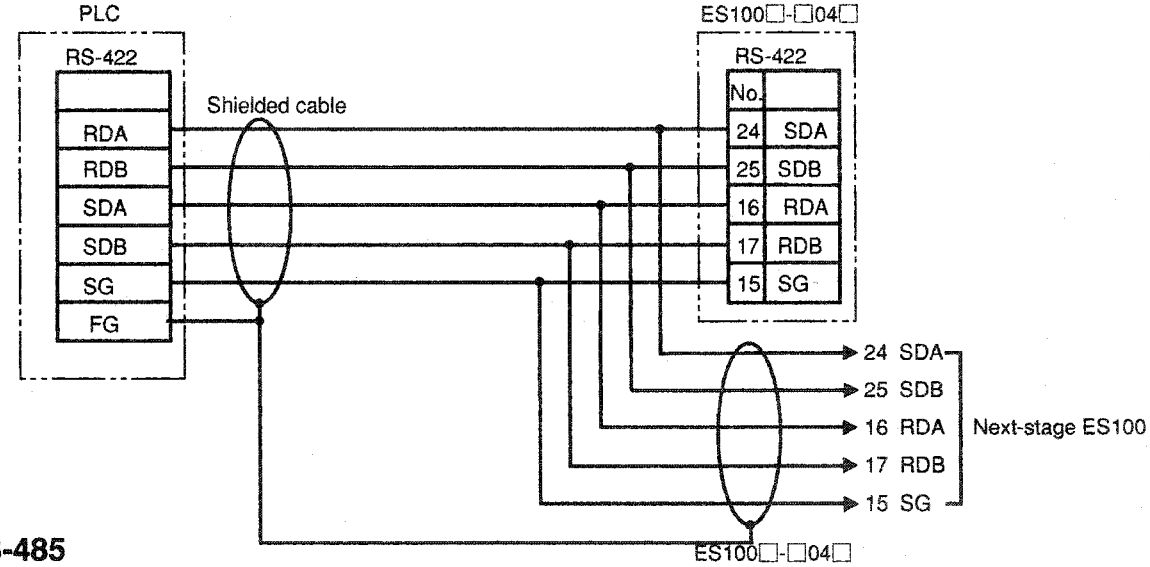


■ Cable connections

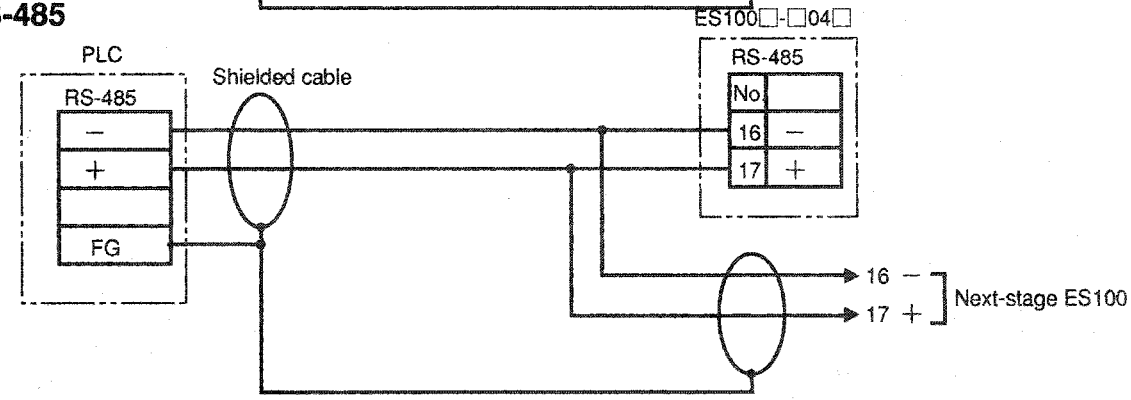
● RS-232C



● RS-422



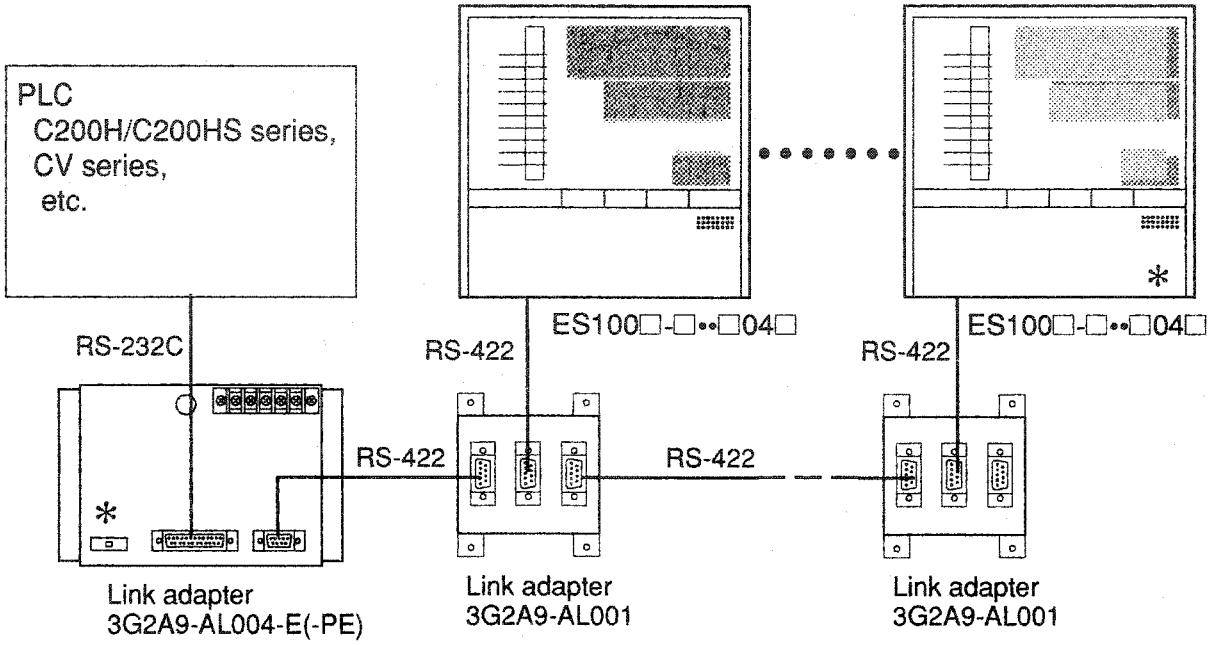
● RS-485



■ Multiple connections

The following shows an example of connecting two or more ES100 to the PLC.

- The RS-422 interface (ES100□-□••□04□) is used.
- Link adapters are used to facilitate wiring.
- A terminator must be set to the end station ES100 (marked by an "*") or end station link adapter. The terminator is set by switch settings.



■ Setting parameters

The PLC and ES100 using the same communications leads must use the same communications protocol. The following describes the communications parameter settings to be made on the ES100.

● Communications parameters

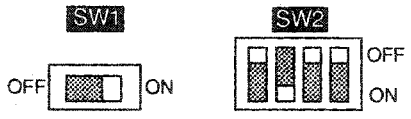
Parameter/Display Symbol		Description	Setting
Unit No.	C041	0 to 99	0 to 99
Baud rate	C042	1200/2400/4800/9600/19200	0/1/2/3/4
Bit length	C322	7bit/8bit	0/1
Parity	C323	None/even/odd	0/1/2
Stop bit	C324	1/1.5/2	0/1/2

Inverted settings indicate factory defaults.

● How to set DIP switches

● Switches

Set the DIP switches as follows. (enabled in setting level 2 technical mode)



● Unit No., baud rate

Set in the "Unit No." and "Baud rate" parameters in the specification setting mode (setting level 2).

● Bit length, parity, stop bit

Set in the "Bit length," "Parity" and "Stop bit" parameters in the technical mode (setting level 2).

1.3 Commands/Responses

■ Command configuration

The following shows the basic format of commands and responses.

MRC	SRC	Command/response information	Data

● MRC/SRC

MRC and SRC are command classification codes. The following table shows the relationship between these codes and commands.

MRC	SRC	Command Name
01	01	Read variable
	02	Write variable
02	01	Read parameter
	02	Write parameter
06	01	Read controller status
08	01	Echo back test
30	01	Read program data
	02	Write program data
	03	Delete pattern
	04	Read pattern information
	05	Operating instruction

● Command/response information

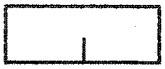
This information indicates whether to read or write commands or responses. The format of this information varies according to the classification code.

● Data

This is the target data to be read or written. Sometimes there is no data depending on the command transmitted. Data comes in the following two formats:

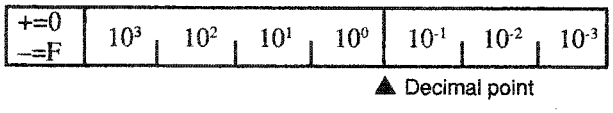
• Code data (2 bytes)

Setting range: 00 to FF



• Numeric data (8 bytes)

Setting range: -1999.000 to 9999.000



When batch transferring multiple sets of data, the data for the designated number of elements are arranged following each other. For example, with commands handling numeric data, the data section is 16 bytes when the number of designated elements is set to "2". The data section can handle up to 472 bytes.

■ Command lists

Command Type	Write	Read	Data Type	Remarks	See page #
Variable area *1	√	√	Code/numeric	Write impossible during auto-tuning	1-8
Parameter *1	√	√	Numeric	Write impossible during auto-tuning	1-13
Program data *1,3	√	√	Numeric	Write impossible during auto-tuning	1-18
Delete pattern *1,2				Impossible during running	1-20
Pattern information	–	√	Code		1-20
Operating instruction					1-21
Controller status					1-23
Echo back test					1-24

*1 Writing of data and delete pattern are enabled only in the remote setting mode.
*2 Delete pattern is not supported on ES100X.
*3 Writing that involves incrementing or decrementing the number of steps during program running is not supported.
*4 Some commands are not supported on some models of the ES100.

■ Variable area

Carries out reading and writing on the variable area of the ES100. Designate the start address and number of elements, and continuously read and write the multiple elements. Set the number of elements in Hex. The data section comprises both code data and numeric data. Continuously set the write data for the number of designated elements.

● Read format

Command

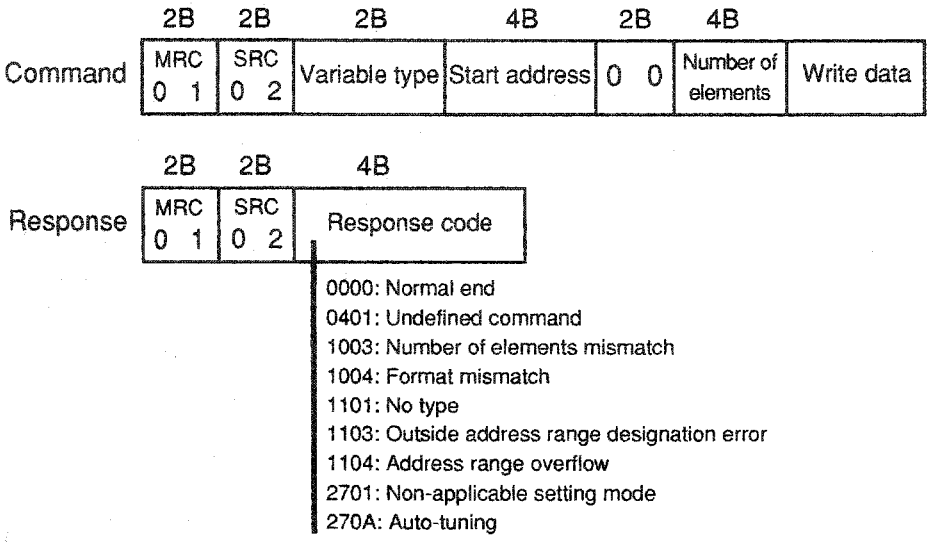
2B	2B	2B	4B	2B	4B
MRC 0 1	SRC 0 1	Variable type	Start address	0 0	Number of elements

Response

2B	2B	4B	
MRC 0 1	SRC 0 1	Response code	Read data

0000: Normal end
0401: Undefined command
1004: Format mismatch
1101: No type
1103: Outside address range designation error
1104: Address range overflow
110B: Response length overflow

● Write format



● Address table

Variable Type	Address	Element	Data Type	R/W
Digital data (40)	0001	Digital input 1	Code	Read only
	0002	Digital input 2		
	0003	Digital input 3		
	0004	Digital input 4		
	0005	Digital input 5		
	0006	Digital input 6		
	0007	Digital input 7		
	0008	Digital input 8		
	0015	Event 1		
	0016	Event 2		
	0017	Event 3		
	0018	Event 4		
	0019	Event 5		
	001A	Event 6		
	001B	Event 7		
	001C	Event 8		
	001D	Event 9		
	001E	Event 10		
	0029	Time signal 1		
	002A	Time signal 2		
	002B	Time signal 3		
	002C	Time signal 4		
	002D	Time signal 5		
	002E	Time signal 6		
	002F	Time signal 7		
	0030	Time signal 8		
	0031	Time signal 9		
	0032	Time signal 10		
	003D	ON/OFF timer 1		
	003E	ON/OFF timer 2		
	003F	ON/OFF timer 3		
	0040	ON/OFF timer 4		

Variable Type	Address	Element	Data Type	R/W
Digital data (40)	0047	Run/Reset (stop)	Code	Read only
	0048	Hold		
	0049	A.T. execution		
	004A	Manual/auto mode		
	004B	Local SP mode		
	004C	Remote SP mode		
	004D	Fixed SP mode		
	004E	Local setting mode		
	004F	Remote setting mode		
	0050	External setting mode		
	0054	Key protect cancel		
	0055	Direct/reverse inversion action		
	0056	Integral reset		
	0057	Feed-forward OFF		
	0058	MV tracking ON		
	0059	Cascade OFF		
	005A	Cascade open		
	005B	Wait		
	005C	Wait alarm		
	005D	Heater burnout alarm		
	005E	ON/OFF count alarm		
	008D	Digital output 1	Code	R/W
	008E	Digital output 2		
	008F	Digital output 3		
	0090	Digital output 4		
	0091	Digital output 5		
	0092	Digital output 6		
	0093	Digital output 7		
	0094	Digital output 8		
	0095	Digital output 9		
	0096	Digital output 10		
	00A1	Digital user buffer 1		
	00A2	Digital user buffer 2		
	00A3	Digital user buffer 3		
	00A4	Digital user buffer 4		
	00A5	Digital user buffer 5		
	00A6	Digital user buffer 6		
	00A7	Digital user buffer 7		
	00A8	Digital user buffer 8		
	00A9	Digital user buffer 9		
	00AA	Digital user buffer 10		
	00AB	Digital user buffer 11		
	00AC	Digital user buffer 12		
	00AD	Digital user buffer 13		
	00AE	Digital user buffer 14		
	00AF	Digital user buffer 15		
	00B0	Digital user buffer 16		

Variable Type	Address	Element	Data Type	R/W
Digital data (40)	00BF	Data for mixed operation 1	Code	R/W
	00C0	Data for mixed operation 2		
	00C1	Data for mixed operation 3		
	00C2	Data for mixed operation 4		
	00C3	Data for mixed operation 5		
	00C4	Data for mixed operation 6		
	00C5	Data for mixed operation 7		
	00C6	Data for mixed operation 8		
Error detection data (42)	0000	Error group 0	Code	Read only
	0001	Error group 1		
	0002	Error group 2		
	0003	Error group 3		
	0004	Error group 4		
	0005	Error group 5		
	0006	Error group 6		
	0007	Error group 7		
	0008	Error group 8		
	0009	Error group 9		
	000A	Error group 10		
	000B	Error group 11		
	000C	Error group 12		
	000D	Error group 13		
	000E	Error group 14		
	000F	Error group 15		
Heater burnout data (43)	0000	Heater burnout alarm	Code	Read only
ON/OFF count (C5)	0000	Counter 1	Numerical value	Read only
	0001	Counter 2		
	0002	Counter 3		
	0003	Counter 4		
	0004	Counter 5		
	0005	Counter 6		
	0006	Counter 7		
	0007	Counter 8		
	0008	Counter 9		
	0009	Counter 10		
	000A	Counter 11		
	000B	Counter 12		
ON/OFF timer count (C6)	0000	Timer 1	Numerical value	Read only
	0001	Timer 2		
	0002	Timer 3		
	0003	Timer 4		
Check data (C7)	0000	Control operation cycle	Numerical value	Read only
Power ON timer count (C8)	0000	Continuous power ON time	Numerical value	Read only

Variable Type	Address	Element	Data Type	R/W
Program data (C9)	0000	Pattern No.	Numerical value	Read only
	0001	Step (bank) No.		
	0002	PID set No.		
	0003	Elapsed step (bank) time		
	0004	Remaining step (bank) time		
	0005	Elapsed pattern time		
	0006	Pattern No. at run		
	0007	Pattern repeat execution count		
	0008	Total pattern time		
	0009	Elapsed step (bank) time ratio		
	000A	Elapsed pattern time ratio		
	000B	Elapsed wait time		
Analog data (CA)	0001	PV	Numerical value	R/W
	0002	Remote SP		
	0003	PV bias value		
	0004	Cascade SP		
	0005	Primary loop tracking value		
	0006	Secondary loop PV		
	0007	Feed-forward amount		
	0008	MV tracking value		
	0009	MV at stop		
	000B	Analog output 1		
	000C	Analog output 2		
	000D	Analog output 3		
	0015	Analog user buffer 1		
	0016	Analog user buffer 2		
	0017	Analog user buffer 3		
	0018	Analog user buffer 4		
	0019	Analog user buffer 5		
	001A	Analog user buffer 6		
	001B	Analog user buffer 7		
	001C	Analog user buffer 8		
	0029	Analog input 1	Numerical value	Read only
	002A	Analog input 2		
	0033	SP		
	0034	Local SP		
	0035	Fixed SP		
	0036	Deviation		
	0037	PID manipulated variable		
	0038	Secondary loop SP		
	0039	Secondary loop fixed SP		
	003A	Secondary loop deviation		
	003B	Manual MV		
	003C	Manipulated variable		
	003D	Valve opening position		
	003E	Valve opening for control		
	003F	Heater current		
Control monitor data (CB)	0000	SP	Numerical value	Read only
	0001	PV		
	0002	Manipulated variable		
	0003	Valve opening position		
	0004	Secondary loop SP		
	0005	Secondary loop PV		

■ Parameters

Carries out reading and writing on the parameter area of the ES100. Designate the start address and number of elements, and continuously read and write the multiple elements. Set the number of elements in Hex. The data section comprises numeric data. Continuously set the write data for the number of designated elements.

● Read format

Command

2B	2B	4B	4B	4B
MRC 0 2	SRC 0 1	Parameter type	Start address	Number of elements

Response

2B	2B	4B	4B	4B	4B	
MRC 0 2	SRC 0 1	Response code	Parameter type	Start address	Number of elements	Read data

0000: Normal end
0401: Undefined command
1004: Format mismatch
1101: No type
1103: Outside address range designation error
1104: Address range overflow
110B: Response length overflow

● Write format

Command

2B	2B	4B	4B	4B	
MRC 0 2	SRC 0 2	Parameter type	Start address	Number of elements	Write data

Response

2B	2B	4B
MRC 0 2	SRC 0 2	Response code

0000: Normal end
0401: Undefined command
1003: Number of elements mismatch
1004: Format mismatch
1101: No type
1103: Outside address range designation error
1104: Address range overflow
1109: Correlation related error
110D: Setting range error
2701: Non-applicable setting mode
270A: Auto-tuning

● Address table

Parameter Type	Address	Element	Data Type	R/W
Technical parameter (level 1) (C002)	0000	Analog operation parameter 1	Numerical value	R/W
	0001	Analog operation parameter 2		
	0002	Analog operation parameter 3		
	0003	Analog operation parameter 4		
	0004	Analog operation parameter 5		
	0005	Analog operation parameter 6		
	0006	Analog operation parameter 7		
	0007	Analog operation parameter 8		
	0008	Analog operation parameter 9		
	0009	Analog operation parameter 10		
	000A	Analog operation parameter 11		
	000B	Analog operation parameter 12		
	000C	Analog operation parameter 13		
	000D	Analog operation parameter 14		
	000E	Analog operation parameter 15		
	000F	Analog operation parameter 16		
	0010	Analog operation parameter 17		
	0011	Analog operation parameter 18		
	0012	Analog operation parameter 19		
	0013	Analog operation parameter 20		
	0014	Analog operation parameter 21		
	0015	Analog operation parameter 22		
	0016	Analog operation parameter 23		
	0017	Analog operation parameter 24		
	0018	Analog operation parameter 25		
	0019	Analog operation parameter 26		
	001A	Analog operation parameter 27		
	001B	Analog operation parameter 28		
	001C	Analog operation parameter 29		
	001D	Analog operation parameter 30		
	001E	Analog operation parameter 31		
	001F	Analog operation parameter 32		
	0020	Straight-line approximation 1 input 1		
	0021	Straight-line approximation 1 input 2		
	0022	Straight-line approximation 1 output 1		
	0023	Straight-line approximation 1 output 2		
	0024	Straight-line approximation 2 input 1		
	0025	Straight-line approximation 2 input 2		
	0026	Straight-line approximation 2 output 1		
	0027	Straight-line approximation 2 output 2		
	0028	Straight-line approximation 3 input 1		
	0029	Straight-line approximation 3 input 2		
	002A	Straight-line approximation 3 output 1		
	002B	Straight-line approximation 3 output 2		
	002C	Straight-line approximation 4 input 1		
	002D	Straight-line approximation 4 input 2		
	002E	Straight-line approximation 4 output 1		
	002F	Straight-line approximation 4 output 2		

Parameter Type	Address	Element	Data Type	R/W
Technical parameter (level 1) (C002)	0030	Broken-line approximation 1 input 1	Numerical value	R/W
	0031	Broken-line approximation 1 input 2		
	0032	Broken-line approximation 1 input 3		
	0033	Broken-line approximation 1 input 4		
	0034	Broken-line approximation 1 input 5		
	0035	Broken-line approximation 1 input 6		
	0036	Broken-line approximation 1 input 7		
	0037	Broken-line approximation 1 input 8		
	0038	Broken-line approximation 1 input 9		
	0039	Broken-line approximation 1 input 10		
	003A	Broken-line approximation 1 output 1		
	003B	Broken-line approximation 1 output 2		
	003C	Broken-line approximation 1 output 3		
	003D	Broken-line approximation 1 output 4		
	003E	Broken-line approximation 1 output 5		
	003F	Broken-line approximation 1 output 6		
	0040	Broken-line approximation 1 output 7		
	0041	Broken-line approximation 1 output 8		
	0042	Broken-line approximation 1 output 9		
	0043	Broken-line approximation 1 output 10		
	0044	Broken-line approximation 2 input 1		
	0045	Broken-line approximation 2 input 2		
	0046	Broken-line approximation 2 input 3		
	0047	Broken-line approximation 2 input 4		
	0048	Broken-line approximation 2 input 5		
	0049	Broken-line approximation 2 input 6		
	004A	Broken-line approximation 2 input 7		
	004B	Broken-line approximation 2 input 8		
	004C	Broken-line approximation 2 input 9		
	004D	Broken-line approximation 2 input 10		
	004E	Broken-line approximation 2 output 1		
	004F	Broken-line approximation 2 output 2		
	0050	Broken-line approximation 2 output 3		
	0051	Broken-line approximation 2 output 4		
	0052	Broken-line approximation 2 output 5		
	0053	Broken-line approximation 2 output 6		
	0054	Broken-line approximation 2 output 7		
	0055	Broken-line approximation 2 output 8		
	0056	Broken-line approximation 2 output 9		
	0057	Broken-line approximation 2 output 10		

Parameter Type	Address	Element		Data Type	R/W
Adjustment parameter (C003)	0000	Fixed SP		Numerical value	R/W
	0001	Control output 1 pulse cycle			
	0002	Control output 2 pulse cycle			
	0003	Fuzzy strength			
	0004	Cooling coefficient			
	0005	Heater burnout alarm setting			
	0006	Position-proportional dead band			
	0007	ON/OFF control hysteresis			
	0008	ON/OFF count alarm setting			
	0009	ON/OFF control hysteresis			
	000A	Manual reset			
	000B	SP setting lower limit			
	000C	SP setting upper limit			
	000D	SP rise rate limit			
	000E	SP fall rate limit			
	000F	MV change rate limit			
	0010	Secondary loop fixed SP			
	0011	Secondary loop P			
	0012	Secondary loop I			
	0013	Secondary loop D			
	0014	Secondary loop manual reset			
PID control parameter (C004)	0000	P		Numerical value	R/W
	0001	I			
	0002	D			
	0003	MV lower limit	PID set 1		
	0004	MV upper limit			
	0005	PV bias value			
	0006	Automatic selection range upper limit			
	0007	P			
	0008	I			
	0009	D			
	000A	MV lower limit	PID set 2		
	000B	MV upper limit			
	000C	PV bias value			
	000D	Automatic selection range upper limit			
	000E	P			
	000F	I			
	0010	D			
	0011	MV lower limit	PID set 3		
	0012	MV upper limit			
	0013	PV bias value			
	0014	Automatic selection range upper limit			
	0015	P			
	0016	I			
	0017	D			
	0018	MV lower limit	PID set 4		
	0019	MV upper limit			
	001A	PV bias value			
	001B	Automatic selection range upper limit			

Parameter Type	Address	Element		Data Type	R/W
PID control parameter (C004)	001C	P	PID set 5	Numerical value	R/W
	001D	I			
	001E	D			
	001F	MV lower limit			
	0020	MV upper limit			
	0021	PV bias value			
	0022	Automatic selection range upper limit			
	0023	P	PID set 6		
	0024	I			
	0025	D			
	0026	MV lower limit			
	0027	MV upper limit			
	0028	PV bias value			
	0029	Automatic selection range upper limit			
	002A	P	PID set 7		
	002B	I			
	002C	D			
	002D	MV lower limit			
	002E	MV upper limit			
	002F	PV bias value			
	0030	Automatic selection range upper limit			
	0031	P	PID set 8		
	0032	I			
	0033	D			
	0034	MV lower limit			
	0035	MV upper limit			
	0036	PV bias value			
	0037	Automatic selection range upper limit			
Tuning parameter (C009)	0001	Hunting inhibit required level		Numerical value	R/W
	0002	Overshoot inhibit required level			
	0003	Response improvement required level			
Manual mode parameter (C00A)	0000	Manual MV		Numerical value	R/W

■ Program data

Carries out reading and writing on the program parameter area of the ES100. Designate the start address and number of elements of the target patterns and steps (banks), and continuously read and write the multiple elements. Set the number of elements in Hex.
The data section comprises numeric data. Continuously set the write data for the number of designated elements.

● Read format

Command

2B	2B	2B	2B	4B	4B
MRC 3 0	SRC 0 1	Pattern No.	Step No.	Start address	Number of elements

Response

2B	2B	4B	2B	2B	4B	4B	
MRC 3 0	SRC 0 1	Response code	Pattern No.	Step No.	Start address	Number of elements	Read data

0000: Normal end
0401: Undefined command
1004: Format mismatch
1103: Outside address range designation error
1104: Address range overflow
110B: Response length exceeded
270F: Pattern not set
2710: Pattern No. range error
2711: Step No. range error

● Write format

Command

2B	2B	2B	2B	4B	4B	
MRC 3 0	SRC 0 2	Pattern No.	Step No.	Start address	Number of elements	Write data

Response

2B	2B	4B
MRC 3 0	SRC 0 2	Response code

0000: Normal end
0401: Undefined command
1003: Number of elements mismatch
1004: Format mismatch
1103: Outside address range designation error
1104: Address range overflow
1109: Correlation related error
110D: Setting range error
2701: Non-applicable setting mode
2706: Running
270A: Auto-tuning
270F: Pattern not set
2710: Pattern No. range error
2711: Step No. range error
2713: Program capacity exceeded

● Address table (pattern parameters)

Step No.	Address	Element	Unit	Data Type	R/W
FF	0000	PV start	—	Numerical value	R/W
	0001	End condition	—		
	0002	End step No.	—		
	0003	Pattern repeat count	Times		
	0004	Pattern link destination No.	—		

● Address table (step parameters)

Step No.	Address	Element		Unit	Data Type	R/W
Programmable type : 00 to 63 Fixed type : 00 to 07	0000	Local SP		U	Numerical value	R/W
	0001	Step (bank) time		Hours: minutes or minutes: seconds		
	0002	PID set No.		—		
*1	0003	Wait code		—		
	0004	Event 1 setting		U or %		
	0005	Event 2 setting				
	0006	Event 3 setting				
	0007	Event 4 setting				
	0008	Event 5 setting				
	0009	Event 6 setting				
	000A	Event 7 setting				
	000B	Event 8 setting				
	000C	Event 9 setting				
	000D	Event 10 setting				
*1	000E	Time signal 1	ON time	Hours: minutes or minutes: seconds		
	000F		OFF time			
	0010	Time signal 2	ON time			
	0011		OFF time			
	0012	Time signal 3	ON time			
	0013		OFF time			
	0014	Time signal 4	ON time			
	0015		OFF time			
	0016	Time signal 5	ON time			
	0017		OFF time			
	0018	Time signal 6	ON time			
	0019		OFF time			
	001A	Time signal 7	ON time			
	001B		OFF time			
	001C	Time signal 8	ON time			
	001D		OFF time			
	001E	Time signal 9	ON time			
	001F		OFF time			
	0020	Time signal 10	ON time			
	0021		OFF time			

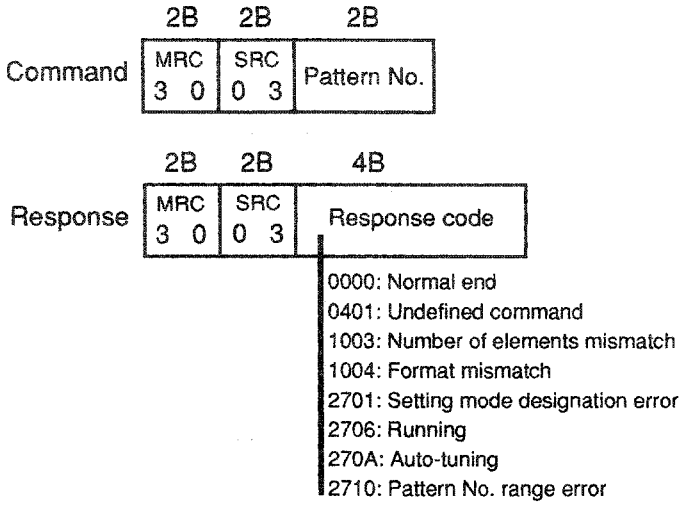
*1 About fixed type controllers (ES100X)

- Wait codes and time signal parameters are not used.
- Set the bank No. to the "Step No." parameter.
- Set the "pattern No." parameter to "01".
- "FFFFFFFF" is set when the address of unused parameters is read.

*2 Set the "pattern No." and "step No." parameters in Hex. For example, when designating pattern 14, Set "pattern No." to "0E".
However, note that read data is numeric data, and so is expressed in BCD codes. For example, is the "pattern link destination No." parameter is set to "70", the pattern is linked to pattern 70.

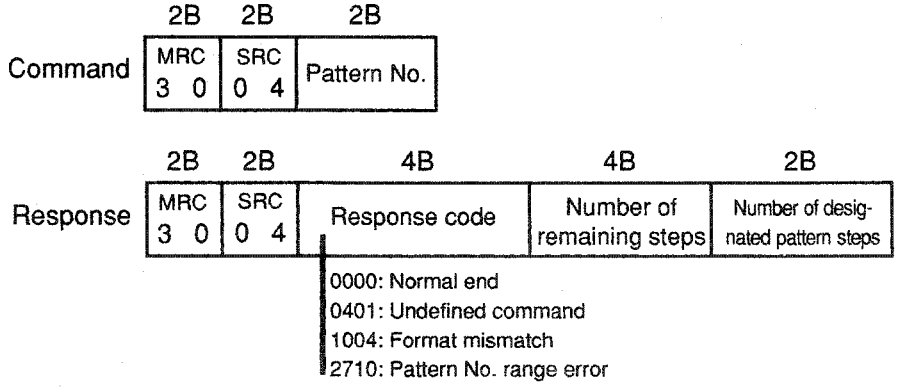
■ Delete pattern

Deletes designated program patterns.
When the pattern No. is set to "00", all patterns are deleted.
This command does not have a data section.



■ Pattern information

Reads the number of remaining steps and the number of steps of the designated program pattern.
When the pattern No. is set to "00", the number of remaining steps and the number of steps for each of the patterns are read.
This command does not have a data section.



About the number of remaining steps Though up to 100 (0 to 99) steps can be used in each pattern on the ES100, the maximum number of steps that can be used in a program is 400. The "number of remaining steps" indicates the total number of steps available for use in the program. For example, if 40 steps each are used in two patterns, the number of steps used so far is 80, which means that the number of remaining steps is 320.

■ Operating instruction

Executes functions corresponding to the operation parameters of the ES100. This command does not have a data section.

Command

2B	2B	2B	4B
MRC 3 0	SRC 0 5	Operating instruction	Related information

Response

2B	2B	4B
MRC 3 0	SRC 0 5	Response code

- 0000: Normal end
- 0401: Undefined command
- 1004: Format mismatch
- 110C: Operating instruction parameter error
- 2701: Non-applicable setting mode
- 2703: Type/specification setting re-confirmation
- 2705: Motor calibration setting error
- 2706: Running
- 2707: Reset (Stop)
- 2709: Manual mode
- 270A: Auto-tuning
- 270B: Fine tuning not executed
- 270C: MV tracking ON
- 270D: Cascade OFF
- 270E: Cascade open
- 270F: Pattern not set
- 2710: Pattern No. range error
- 2711: Step No. range error
- 2712: Fine tuning
- 2714: PID set No. range error

● Operating instruction code list

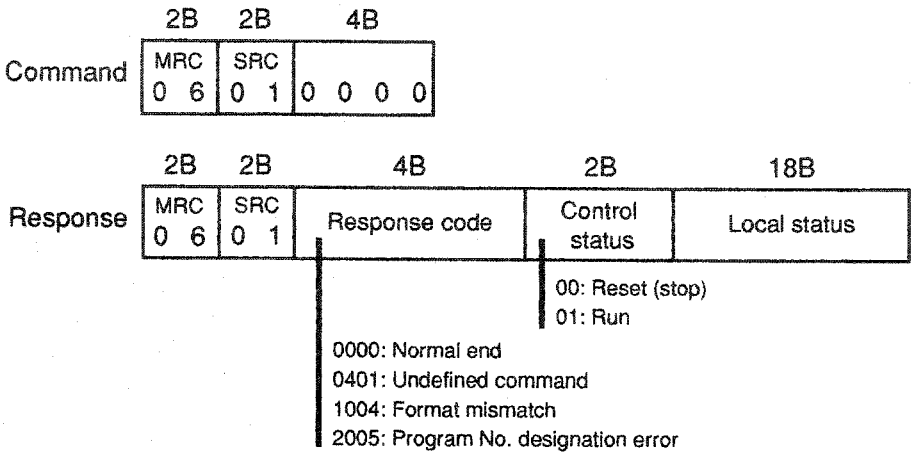
Code	Description	Related Information	Code	Description	Related Information
04	Remote setting mode		25	Pattern advance	
05	Local setting mode		26	Pattern restart	
06	External setting mode		28	Run/reset (step) inversion	
07	Run *1	Pattern No. /Bank No.	29	Hold/hold cancel inversion	
			2A	Auto/manual inversion	
08	Reset (stop)		2B	A.T. execution/A.T. cancel inversion	
09	Hold		:		
0A	Advance		2D	MV tracking ON/OFF inversion	
0B	Back		2E	Feed-forward ON/OFF inversion	
0C	Auto mode		2F	Cascade open/closed inversion	
0D	Manual mode		30	Cascade ON/OFF inversion	
0E	Local SP mode		31	Local/remote SP mode inversion	
0F	Remote SP mode		32	Local/fixed SP mode inversion	
10	Fixed SP mode		:		
11	A.T. execution	PID set No.	37	Pattern No. change	Pattern No.
12	A.T. cancel		38	Bank No. change	Bank No.
13	F.T. execution	PID set No.	:		
14	F.T cancel		3D	ON/OFF timer 1 reset	
15	Key protect enabled		3E	ON/OFF timer 2 reset	
16	Key protect disabled		3F	ON/OFF timer 3 reset	
17	Reset event standby sequence		40	ON/OFF timer 4 reset	
18	Direct/reverse inversion		:		
19	Direct/reverse inversion cancel		45	ON/OFF counter 1 reset	
1A	Integral reset		46	ON/OFF counter 2 reset	
1B	Integral reset cancel		47	ON/OFF counter 3 reset	
1C	MV tracking ON		48	ON/OFF counter 4 reset	
1D	MV tracking OFF		49	ON/OFF counter 5 reset	
1E	Feed-forward ON		4A	ON/OFF counter 6 reset	
1F	Feed-forward OFF		4B	ON/OFF counter 7 reset	
20	Cascade open		4C	ON/OFF counter 8 reset	
21	Cascade closed		4D	ON/OFF counter 9 reset	
22	Cascade ON		4E	ON/OFF counter 10 reset	
23	Cascade OFF		4F	ON/OFF counter 11 reset	
24	Hold cancel		50	ON/OFF counter 12 reset	

*1 About code "07" (Run) related information
With ES100P, this information is the pattern No. With ES100X, this information is the bank No.
Designate "0000" when there is not related information.

Designate "0000" when there is not related information.

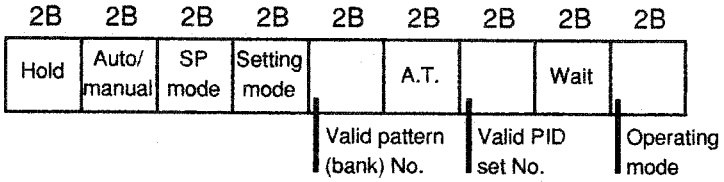
■ Controller status

Reads the control status of the ES100.
This command does not have a data section.



● Local status

2 bytes each are allocated to each item.



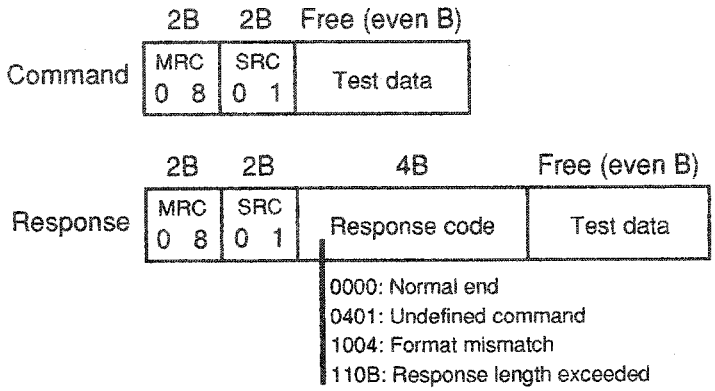
Local Status	Description
Hold	00: Not in hold 01: In hold
Auto/manual	00: Auto mode 01: Manual mode
SP mode	00: Local SP mode 01: Remote SP mode 02: Fixed SP mode
Setting mode	00: Local setting mode 01: Remote setting mode 02: External setting mode
Valid pattern (bank) No.	00 to 63 (Hex): Pattern (bank) No.
A.T.	00: Not auto-tuning 01: Auto-tuning
Valid PID set No.	01 to 08 : Corresponding to PID set No.
Wait	00: Not in wait operation 01: In wait operation 02: Wait alarm being output
Operating mode	00: Setting level 1 (*1) 01: Setting level 1 (*2) 02: Setting level 2 (*1) 03: Setting level 2 (*2)

*1 Technical mode display OFF

*2 Technical mode display ON

■ Echo back test

Tests the serial communications function between the ES100 and the PLC. Either type of data can be held in the data section. However, note that the data is set so that the number of data items is an even number of bytes.



■ Command limitations

Command		Remote Setting Mode			External and Local Setting Modes		
		Run		Reset (stop)	Run		Reset (stop)
		Auto-tuning			Auto-tuning		
Variable area	R	√	√	√	√	√	√
	W	—	√	√	—	—	—
Parameter*1	R	√	√	√	√	√	√
	W	—	√	√	—	—	—
Program data*2	R	√	√	√	√	√	√
	W	—	√	√	—	—	—
	Delete	—	—	√ *3	—	—	—
Pattern information read		√	√	√	√	√	√
Operating instruction		√	√	√	√	√	√
Controller status		√	√	√	√	√	√
Echo back test		√	√	√	√	√	√

*1 The data that can be read or written varies according to the controller type.
*2 Writing that involves incrementing or decrementing the number of steps during program running is not supported.
*3 This is supported only on programmable type controllers.
*4 All commands cannot be used when the ES100 is in the communications test mode or initialization mode.

1.4 Error Code Tables

■ Communication errors

Communication errors can be checked by the end code in the response frame.

End Code	Code Name	Description
00	Normal end	Communications ended normally without any error.
10	Parity error	A parity check error was detected in the receive data.
11	Framing error	The stop bit was "0".
12	Overrun error	An attempt was made to receive new data before the receive data register became free.
13	FCS error	The FCS (frame check sequence) did not match.
14	Format error	Either the received command length was an odd number, or the command length received 512 bytes.
16	No relevant instruction	An undefined header code was received.

■ ES100 errors

ES100 errors can be checked by the response code issued in response to each command.

End Code	Code Name	Description
0000	Normal end	The command block from the host computer was not in error.
0401	Undefined command	An undefined code was used for MRC and SRC.
1003	Number of elements mismatch	The designated number of elements and write data length did not match by a variable area, parameter, or program data write command.
1004	Format mismatch	The transmitted command data contained data other than "0" to "9" and "A" to "F".
1101	No type	An undefined variable type and parameter type was designated by a variable area or parameter R/W commands.
1103	Outside address range designation error	The read start address or write start address are outside of the address range of the designated type by a variable area, parameter or program data read/write command.
1104	Address range overflow	A number of elements and read set value outside of the address range of the designated type were set by a variable area, parameter and program data read/write command.
1109	Correlation related error	The values of the SP setting upper and lower limits and the MV limitter upper and lower limits were inverted by the parameter write command. Also, the local SP and fixed SP are outside of the SP setting upper and lower limit range.

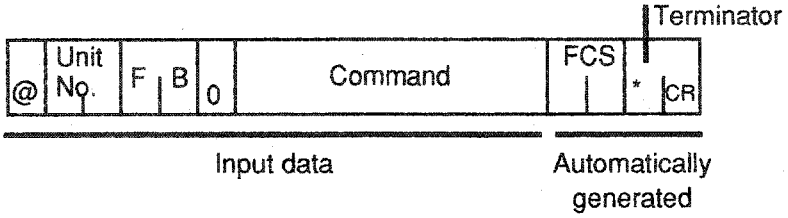
End Code	Code Name	Description
110B	Response length over	The designated number of elements or number of settings is too large by a variable area, parameter or program data read command.
110C	Operating instruction parameter error	Values outside of the designated range were set to the operating instruction code or related information by an operating instruction command, and to the parameters of the operating mode type by an operating mode change command.
110D	Range error	The values of the set data are outside of the setting range by a parameter or program data write command.
2005	Program No. designation error	Values outside of the designation range were set to the program No. by reading the controller status.
2701	Non-applicable setting mode	A command that cannot be accepted in the designated setting mode was transmitted.
2703	Type/specification setting re-check	(1) An attempt was made to execute auto-tuning by an operating instruction command during cascade control. (2) An attempt was made to execute the operating instruction by one of the following operating instruction commands when not in cascade control: • Cascade open • Cascade closed • Cascade ON • Cascade OFF (3) An attempt was made to change the pattern No. or execute fixed SP by an operating instruction command on a controller. (4) An attempt was made to change the bank No. by an operating instruction command on a programmer or when the bank selection method is set to time setting on a controller. (5) An attempt was made to execute one of the following operating instructions on a controller: • Hold • Advance • Back • Pattern advance • Pattern restart (6) An attempt was made to execute integral reset by an operating instruction command when executing floating control on a position-proportional type controller.
2705	Motor calibration setting error	An attempt was made to execute run by the operating instruction command when motor calibration was not executed or when the fully open and fully closed positions were inverted.
2706	Running	An attempt was made to execute pattern No. change during program running.
2707	Reset (stop) in progress	An attempt was made to invert hold, advance, back, pattern advance, pattern restart, auto-tuning or hold/hold cancel by an operating instruction command during resetting (program stop).
2709	Manual mode	An attempt was made to execute auto-tuning by the operating instruction command in the manual mode.

End Code	Code Name	Description
270A	Auto-tuning	(1) An attempt was made to execute one of the following operating instructions during auto-tuning: • Run, hold, advance, back, pattern advance, pattern restart • SP mode change, A.T. execution, F.T. execution, F.T. cancel • Integral reset, integral reset cancel • MV tracking ON/OFF • Feed-forward ON/OFF • Cascade open/closed • Cascade ON/OFF • Change bank No. (2) An attempt was made to execute variable area write, parameter write or program data write during auto-tuning.
270B	F.T. not executed	An attempt was made to cancel fine-tuning by an operating instruction command when fine-tuning was not being executed.
270C	MV tracking ON	An attempt was made to execute auto-tuning by an operating instruction command when MV tracking was ON.
270D	Cascade OFF	An attempt was made to execute cascade open by an operating instruction command when cascade was OFF.
270E	Cascade open	An attempt was made to execute cascade OFF by an operating instruction command when cascade was open.
270F	Pattern not set	(1) The pattern designated by program data read/write is not set. (2) Either all patterns are not set, or the pattern (including linked patterns) designated by this command is not set when an attempt was made to execute run by an operating instruction command. (3) All patterns are not set when an attempt was made to execute the local SP mode by an operating instruction command during running using a fixed SP.
2710	Pattern No. range error	The pattern No. designated by program data read/write/deletion, valid pattern information read, operating instructions, and operating instruction related information is not 1 to 99.
2711	Step No. range error	The step No. designated by the program data read/write command is not 1 to 99. Or, the designated bank No. is not 0 to 7.
2712	Fine tuning	(1) An attempt was made to cancel fine-tuning or execute auto-tuning by an operating instruction command while fine-tuning was executing. (2) An attempt was made to execute fine-tuning or auto-tuning by an operating instruction command while fine-tuning was canceled.
2713	Program capacity over	An attempt was made to set the maximum number of steps to a new step using the program data write command with the maximum number of steps already set.
2714	PID set No. range error	The PID set No. designated by related information is not 1 to 8 when auto-tuning or fine-tuning are executed by an operating instruction command.

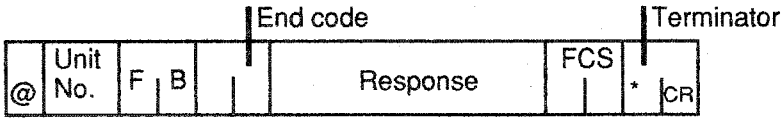
1.5 Program Examples

■ How to use programs

The program described in this section is intended to obtain the corresponding response frame data when part of the command frame data is input.
The input format is as follows. The FCS and terminator are automatically generated, and need not be input.



The output format is as follows. The content of the response frame is displayed as it is. When communications ends abnormally, there is no response section. If this happens, check the content of the error by the error code.



● Operation procedure

(1) Load the program.
(2) Input "RUN".
(2) When "SEND DATA:" is displayed, input the command data (@ to command section).
(3) The content of the response frame is displayed after "RESPONSE:"

● Precautions when using programs

- Set the communications protocol as follows:
  - Baud rate: 9600 bps
  - Bit length: 7 bits
  - Parity: Even
  - Stop bit: 2
- Make sure that the cable is connected correctly.

■ Program list

```
1   ' ***************************************************************************************
2   ' *  ES100LNK.BAS  3/15/94 - VERSION 1.20                                               *
3   ' *  PROVIDES FOR COMMUNICATION BETWEEN AN IBM COMPATIBLE PERSONAL COMPUTER *
4   ' *  AND SEVERAL (UP TO 32) ES100 PROCESS CONTROLLERS. COMMUNICATIONS                   *
5   ' * CAN BE ACHIEVED ONLY THROUGH THE REAR COMMUNICATIONS PORT IF MULTIPLE      *
6   ' * CONTROLLERS ARE CONNECTED THROUGH RS422.                                           *
7   ' ***************************************************************************************
100 ' ***************************************************************************************
101 ' * OPEN COM1 WITH DEFAULT ES100 COMMUNICATIONS PARAMETERS – CAN BE                     *
102 ' * BE ADJUSTED TO OTHER COMM PARAMETERS IF MATCHED IN ES100 SETUP (REAR          *
103 ' *  PORT ONLY)                                                                         *
104 ' ***************************************************************************************
110 OPEN "COM1: 9600, E, 8, 2, LF, RS, CS, DS" AS #1
120 ' ***************************************************************************************
121 ' * SET UP INITIAL VARIABLES AND PRINT UNIT NUMBER INSTRUCTIONS                         *
122 ' ***************************************************************************************
125 CLS
130 U$="00"
140 CLR$=SPACE$ (255)
150 LOCATE 24, 1
155 PRINT "PRESS U TO CHANGE UNIT NUMBER, PRESS ENTER TO REPEAT COMMAND"
157 ' ***************************************************************************************
158 ' *  BEGINNING OF MAIN LOOP                                                             *
159 ' ***************************************************************************************
160 LOCATE 1,1:PRINT CLR$: LOCATE 1,1
170 PRINT "  MRSRTY START #OF"
175 PRINT "  C C PE ADDR ITEM"
180 INPUT "  COMMAND"; CC$
181 IF CC$="U" THEN LOCATE 4,1: INPUT "UNIT ##";U$:GOTO 160
182 PRINT
183 ' ***************************************************************************************
184 ' * CLEAR PREVIOUS RESPONSE                                                             *
185 ' ***************************************************************************************
186 LOCATE 9,1:PRINT CLR$:LOCATE 11,1:PRINT CLR$
187 LOCATE 17,1:PRINT CLR$:LOCATE 19,1:PRINT CLR$
188 LOCATE 5,1
189 IF CC$="  " THEN 300: ' IF CR THEN SEND SAME COMMAND
190 ' ***************************************************************************************
191 ' *  ADD START OF TEXT CHARACTER (@) AND UNIT NUMBER U$ AND TYPE ID "FBO"                *
192 ' ***************************************************************************************
200 C$ = "@"+U$+"FBO"+CC$
210 REM CHECKSUM (FCS) CALCULATION
211 ' * CALCULATE FRAME CHECKSUM AND ADD FCS AND TERMINATOR (*) TO COMMAND              *
212 ' ***************************************************************************************
220 CKSM = 0
230 FOR N = 1 TO LEN (C$)
240 CKSM= CKSM XOR ASC(MID$(C$,N,1))
250 NEXT N
260 CKSM$ = HEX$ (CKSM)
270 IF LEN (CKSM$) = 2 GOTO 290
```

```
280 CKSM$ = "0" + CKSM$
290 C$ = C$ + CKSM$ + "*"
300 '*****************************************************************************************
301 '* SEND COMMAND AND RECEIVE RESPONSE FROM CONTROLLER                                    *
302 '* Z EQUALS NUMBER OF TRIES BEFORE DECLARING COMMUNICATION ERROR                        *
303 '*****************************************************************************************
310 PRINT
320 PRINT "COMMAND SENT TO CONTROLLER"
330 PRINT "  "+C$
340 PRINT #1, C$
350 Z=0
360 Z=Z+1:IF Z=1000 THEN PRINT "NO RESPONSE":GOTO 410
365 IF LOC(1)=0 THEN 360
370 LINE INPUT #1, R$
380 PRINT
390 PRINT "RESPONSE FROM CONTROLLER"
400 PRINT "  "+R$
402 PRINT
405 GOSUB 1000
410 GOTO 160
420 END
1000 ' *****************************************************************************************
1001 ' * DECODE RESPONSE FROM CONTROLLER                                                      *
1002 ' *****************************************************************************************
1010 UNIT$=MID$(R$,2,2)
1020 COMMAND$=MID$(R$,8,4)
1025 IF LEN(COMMANDS)<4 THEN COMMAND$="    ":'CHECKS FOR ILLEGAL COMMAND
1030 COMPCODE$=MID$(R$,6,2)
1035 LN=(LEN(R$)-14)
1036 IF LN<0 THEN 1060:' CHECKS FOR PRESENCE OF DATA IN CONTROLLER RESPONSE
1040 TEXT$=MID$(R$,12,LN)
1045 RESPCODE$=LEFT$(TEXT$,4)
1050 RESPONSE$=MID$(TEXT$,5,LN)
1060 CHECKSUM$=MID$(RIGHT$(R$,3),1,2)
1070 LOCATE 15,1
1100 PRINT "UNIT COM- END CHECK  RESP  DATA"
1105 PRINT " NO  MAND  CODE  SUM  CODE"
1110 PRINT " "+UNIT$+"  "+COMMAND$+"  "+COMPCODE$+"  "+CHECKSUM$+"  "+RESPCOD$+"  ";
1120 FOR X=1 TO LN STEP 8:'PRINTS DATA IN 8 CHAR BLOCKS FOR READABILITY
1130 PRINT MID$(RESPONSE$.X,8)+"  ":
1140 NEXT X
1199 RETURN
```

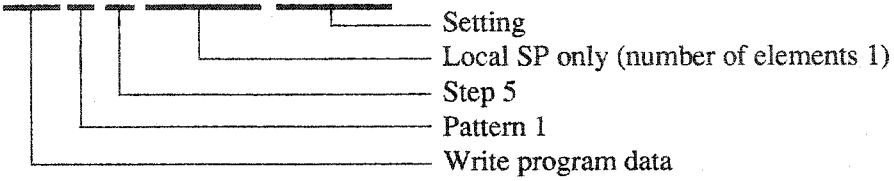
■ Examples

- Set the unit No. to "00".
- The following examples show a space inserted between blocks in order to make the examples easier to understand. However, when inputting the actual programs do not input spaces. Responses are displayed with no spaces between blocks.

● Set local SP of step 5 (pattern 1) to "300.0".

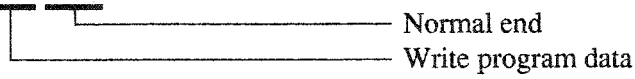
- Input data

@ 00 FB0 3002 01 05 0000 0001 00300000



- Response

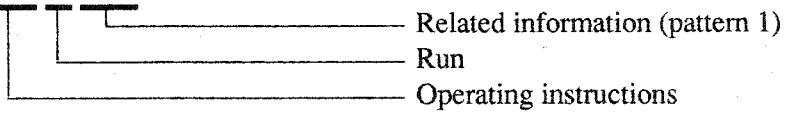
@ 00 FB00 3002 0000 35 *



●Start running by pattern 1.

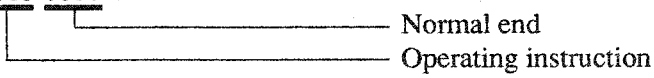
- Input data

@ 00 FB0 3005 07 0001



- Response

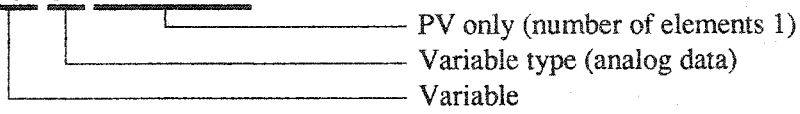
@ 00 FB00 3005 0000 42 *



● Read PV data.

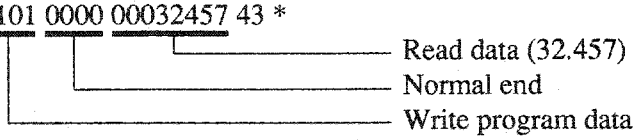
- Input data

@ 00 FB0 0101 CA 0001 00 0001



- Response

@ 00 FB00 0101 0000 00032457 43 *



CHAPTER 2
BCD
COMMUNICATIONS

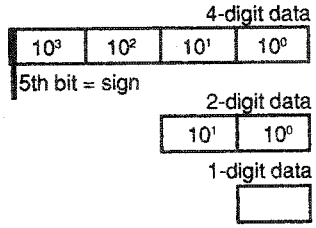
2.1 Introduction ---------- 2-2
What is "BCD communications?"- 2-2
PLC conditions ---------- 2-2
2.2 Preparations ---------- 2-3
Setting parameters ---------- 2-3
Wiring expanded
I/O connectors ---------- 2-3
Connecting to I/O terminal block 2-4
2.3 Timing of Operations ---------- 2-5
Write operation ---------- 2-5
Read operation ---------- 2-6
2.4 Assigning DSL Codes ---------- 2-8
2.5 Description of Data Items -------- 2-11
4-digit set data ---------- 2-11
3-digit set data ---------- 2-11
2-digit set data ---------- 2-11
1-digit set data ---------- 2-12
2.6 Program Examples ---------- 2-14
How to use programs ---------- 2-14
I/O and DM assignments --------- 2-15
Program list ---------- 2-17

2.1 Introduction

■What is "BCD communications?"

"BCD communications" is a method of transmitting single items of BCD (binary-coded decimal) data via the parallel port of the PLC (programmable logic controller).

Command types are designated by a Hexadecimal 2-digit code called the "DSL code."



Data is handled in 1-, 2- or 4-digit sets depending on the command type. For example, data such as event settings that is significant when expressed by four digits is handled as a 4-digit data set. On the other hand, data such as error codes that is significant when expressed by one digit is handled as independent data items of one digit each.
Though data is made up of five bits, the 5th bit is used as the sign when the 4th bit of 4-digit data is set.

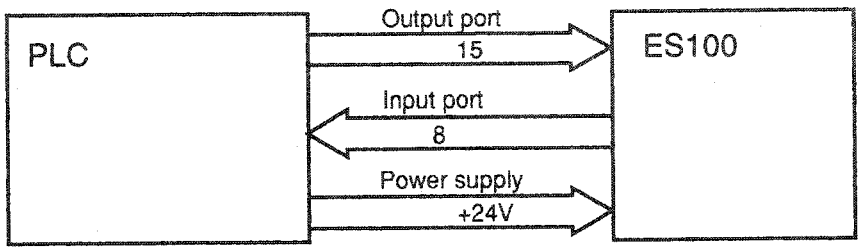
When writing data, the DSL code and write data are simultaneously output from the PLC, and the ES100 returns the read data and the response.
When communication ends normally, the content of the write data and read data match, and a "normal end" is indicated in the response code.

When reading data, the DSL code is output from the PLC, and the ES100 returns the read data and the response code.
When communication ends normally, the content of the write data and read data match, and the response code indicates a "normal end."

■PLC conditions

The PLC requires a program for acquiring memory area for commands and responses, and generating signals for satisfying operating timing conditions.

15 output ports and 8 input ports are required.



About controller type

The controller type for BCD communications is ES100□-□ □ □ □ □ E.
The expanded I/O connector is used for BCD communications. However, as the same terminals are used for digital I/O, switch to BCD communications in parameters.
For details on how to switch to BCD communications, see 2.2 Preparations.

2.2 Preparations

■ Setting parameters

Set the "BCD communications/digital I/O" parameter to "1" before connecting the cable between the ES100 and the PLC.
This parameter is set in the specification setting mode (setting level 2).
When this parameter is set, the No.1 display of the ES100 indicates "C040".

■ Wiring expanded I/O connectors

Signals are minus logic. When Low, signals are ON or logic state 1.

GNDI	1	2	GNDI
+24VI	3	4	+24VI
$\overline{\text{DSL1}}$	5	6	$\overline{\text{DSL2}}$
$\overline{\text{DSL3}}$	7	8	$\overline{\text{DSL4}}$
$\overline{\text{DSL5}}$	9	10	$\overline{\text{DSL6}}$
$\overline{\text{DSL7}}$	11	12	$\overline{\text{DSL8}}$
$\overline{\text{WD1}}$	13	14	$\overline{\text{WD2}}$
$\overline{\text{WD3}}$	15	16	$\overline{\text{WD4}}$
$\overline{\text{WD5}}$	17	18	$\overline{\text{STRB}}$
$\overline{\text{VAL}}$	19	20	
GNDO	21	22	GNDO
+24VO	23	24	+24VO
$\overline{\text{RD1}}$	25	26	$\overline{\text{RD2}}$
$\overline{\text{RD3}}$	27	28	$\overline{\text{RD4}}$
$\overline{\text{RD5}}$	29	30	$\overline{\text{RSP1}}$
$\overline{\text{RSP2}}$	31	32	$\overline{\text{RDY}}$
	33	34	

- Power supply
  +24VI, GNDI Power supply for input signals
  +240VO, GNDO Power supply for output signals.
  Connect +24VI with +24VO and GNDI with GNDO at the PLC.

- DSL code ($\overline{\text{DSL1}}$ to $\overline{\text{DSL8}}$)
  Hexadecimal 2-digit codes for designating the data type.

- Write data ($\overline{\text{WD1}}$ to $\overline{\text{WD5}}$)
  Data for writing in BCD single digits.
  $\overline{\text{WD5}}$ is valid only when data is set to the 4th digit.

- Read data ($\overline{\text{RD1}}$ to $\overline{\text{RD5}}$)
  Data for reading in BCD single digits.
  $\overline{\text{RD5}}$ is valid only when data is set to the 4th digit.

- Communication enable signal ($\overline{\text{VAL}}$)
  Communication is possible for the duration that this signal is ON.

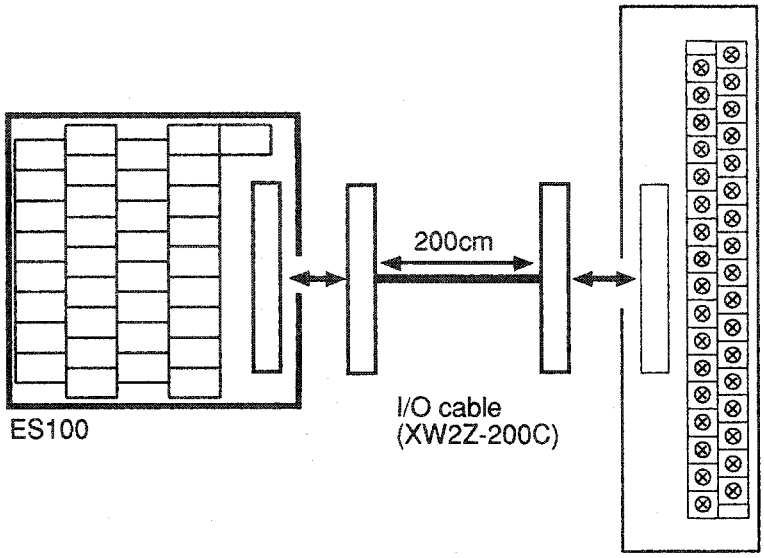
- Strobe signal ($\overline{\text{STRB}}$)
  Instructs start of command processing.

- Ready signal ($\overline{\text{RDY}}$)
  Indicates that commands can be received.

- Response signal ($\overline{\text{RSP1}}$, $\overline{\text{RSP2}}$)
  Expresses the content of the response in code.

■ Connecting to I/O terminal block

We recommend using the following terminal block and cable as the expanded I/O connector.



I/O terminal block (XW2B-34G5)

● Compatible connector

Use the OMRON XG4M-3430 (or equivalent product) as the connector at the cable side to be connected to the expanded I/O connector.

● Terminal block wiring diagram

I/O terminal block (XW2B-34G5)

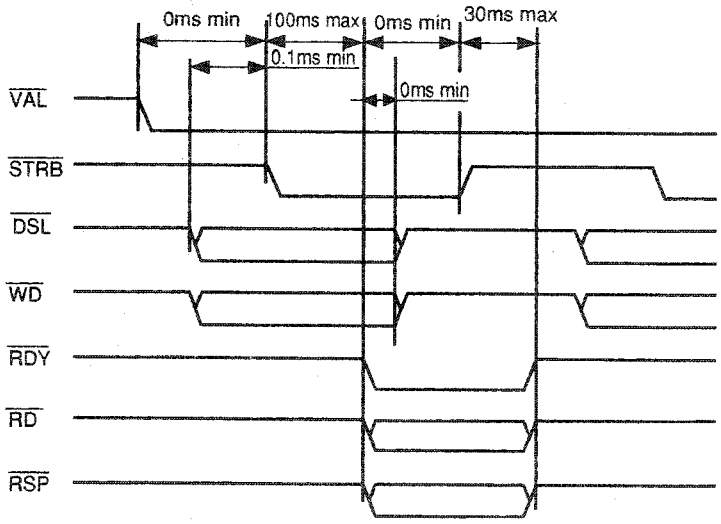
GNDI	+24VI	$\overline{\text{DSL1}}$	$\overline{\text{DSL3}}$	$\overline{\text{DSL5}}$	$\overline{\text{DSL7}}$	$\overline{\text{WD1}}$	$\overline{\text{WD3}}$	$\overline{\text{WD5}}$	$\overline{\text{VAL}}$	GNDO	+24VO	$\overline{\text{RD1}}$	$\overline{\text{RD3}}$	$\overline{\text{RD5}}$	$\overline{\text{RSP2}}$	
1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
GNDI	+24VI	$\overline{\text{DSL2}}$	$\overline{\text{DSL4}}$	$\overline{\text{DSL6}}$	$\overline{\text{DSL8}}$	$\overline{\text{WD2}}$	$\overline{\text{WD4}}$	$\overline{\text{STRB}}$		GNDO	+24VO	$\overline{\text{RD2}}$	$\overline{\text{RD4}}$	$\overline{\text{RSP1}}$	$\overline{\text{RDY}}$	

2.3 Timing of Operations

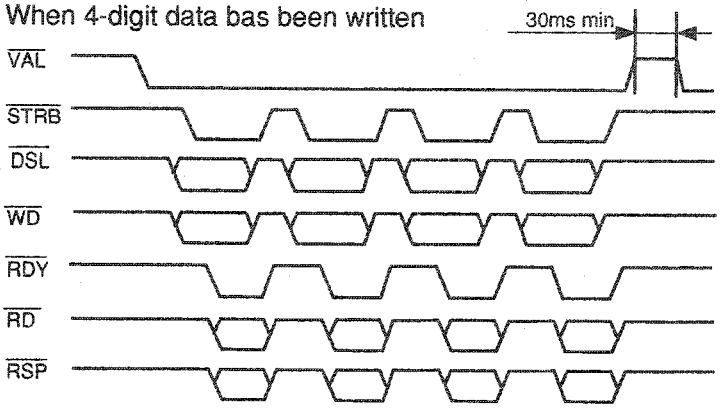
Follow the procedure below to set the signal timing.

■ Write operation

(1) Set the VAL signal ON.
(2) Output the DSL and write data.
(3) Set the STRB signal ON.
(4) When the RDY signal is confirmed ON, read the response and read data after a fixed time has elapsed.
(5) Set the STRB signal OFF.
(6) When the data type requires two digits or more, repeat steps (2) to (5) for subsequent digits.
(7) When the operation (called a "set") has ended for all digits, set the VAL signal OFF.



When 4-digit data bas been written

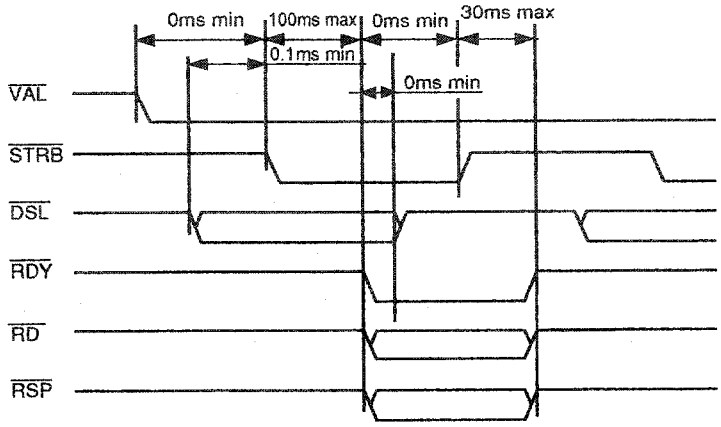


When continuously writing data, hold the VAL signal OFF period for 30 ms or more until writing of the subsequent set of data is started.

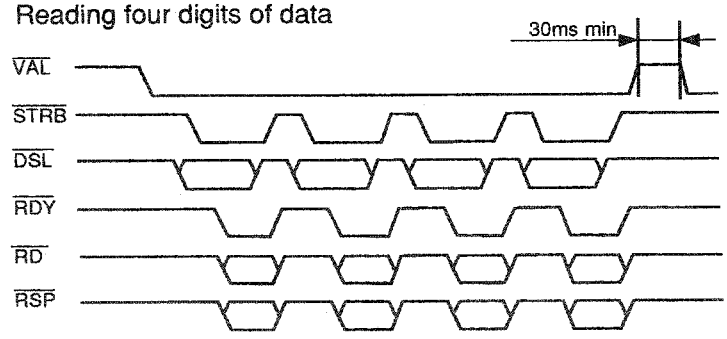
Check the communications status by response codes.
Check the content of the write data by comparing the read data. Content of the write data is normal if the write data matches the read data.

■ Read operation

(1) Set the VAL signal ON.
(2) Output the DSL.
(3) Set the STRB signal ON.
(4) When the RDY signal is confirmed ON, read the response and read data after a fixed time has elapsed.
(5) Set the STRB signal OFF.
(6) When the data type requires two digits or more, repeat steps (2) to (5) for subsequent digits.
(7) When the operation (called a "set") has ended for all digits, set the VAL signal OFF.



Reading four digits of data



When continuously reading data, hold the VAL signal OFF period for 30 ms or more until reading of the subsequent set of data is started.
Check the communications status by response codes.

The following shows the configuration of pulsed signals (signals made up of a combination of two or more signals).

● DSL code

DSL8 DSL5	DSL4 DSL1
Upper order digits 0~F	Lower order digits 0~F

The setting range is 00 to FF. However, do not set undefined codes in the DSL code assignment tables in 2.4. These codes result in an error.

● Write data

WD5	WD4	WD3	WD2	WD1
1=− 0=+	2^3	2^2	2^1	2^0

The 5th bit is valid only when the 4th digit is set.

● Read data

RD5	RD4	RD3	RD2	RD1
1=− 0=+	2^3	2^2	2^1	2^0

The 5th bit is valid only when the 4th digit is set.

● Response

RSP1	PSP2	Description
0	0	Communication acceptable state, communication normal end
1	0	Single set normal end
0	1	Error generated, underfined command
1	1	Single set abnormal end

- "Single set" refers to the number of digits (1, 2 or 4) designated by commands.
- The response is "10" or "11" at the final digit for data of two digits or more. Otherwise, the response is "00" or "01"

2.4 Assigning DSL Codes

DSL codes are expressed in Hexadecimal two digits. Codes 00 to 7F are for write, and codes 80 to FF are for read.

DSL	Command		Remark	DSL	Command		Remark
00	Undefined			80	Read PV	10^0	
01				81		10^1	
02				82		10^2	
03				83		10^3	
04	Undefined			84	Read analog input 2	10^0	For 2-input type
05				85		10^1	controllers only
06				86		10^2	
07				87		10^3	
08	Write local SP	10^0		88	Read local SP	10^0	
09		10^1		89		10^1	
0A		10^2		8A		10^2	
0B		10^3		8B		10^3	
0C	Write step time	10^0		8C	Read step time	10^0	
0D	(bank time)	10^1		8D	(bank time)	10^1	
0E		10^2		8E		10^2	
0F		10^3		8F		10^3	
10	Write P	10^0		90	Read P	10^0	
11		10^1		91		10^1	
12		10^2		92		10^2	
13		10^3		93		10^3	
14	Write I	10^0		94	Read I	10^0	
15		10^1		95		10^1	
16		10^2		96		10^2	
17		10^3		97		10^3	
18	Write D	10^0		98	Read D	10^0	
19		10^1		99		10^1	
1A		10^2		9A		10^2	
1B		10^3		9B		10^3	
1C	Write manual MV	10^0	Invalid with posi-	9C	Read manual MV	10^0	Invalid with posi-
1D		10^1	tion-proportional	9D		10^1	tion-proportional
1E		10^2	type	9E		10^2	type
1F		10^3		9F		10^3	
20	Write event 1 setting	10^0		A0	Read event 1 setting	10^0	
21		10^1		A1		10^1	
22		10^2		A2		10^2	
23		10^3		A3		10^3	
24	Write event 2 setting	10^0		A4	Read event 2 setting	10^0	
25		10^1		A5		10^1	
26		10^2		A6		10^2	
27		10^3		A7		10^3	
28	Write event 3 setting	10^0		A8	Read event 3 setting	10^0	
29		10^1		A9		10^1	
2A		10^2		AA		10^2	
2B		10^3		AB		10^3	
2C	Write event 4 setting	10^0		AC	Read event 4 setting	10^0	
2D		10^1		AD		10^1	
2E		10^2		AE		10^2	
2F		10^3		AF		10^3	

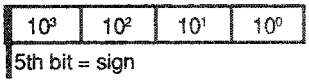
DSL	Command		Remark	DSL	Command		Remark
30	Write event 5 setting	10^0		B0	Read event 5 setting	10^0	
31		10^1		B1		10^1	
32		10^2		B2		10^2	
33		10^3		B3		10^3	
34	Write event 6 setting	10^0		B4	Read event 6 setting	10^0	
35		10^1		B5		10^1	
36		10^2		B6		10^2	
37		10^3		B7		10^3	
38	Write event 7 setting	10^0		B8	Read event 7 setting	10^0	
39		10^1		B9		10^1	
3A		10^2		BA		10^2	
3B		10^3		BB		10^3	
3C	Write event 8 setting	10^0		BC	Read event 8 setting	10^0	
3D		10^1		BD		10^1	
3E		10^2		BE		10^2	
3F		10^3		BF		10^3	
40	Write event 9 setting	10^0		C0	Read event 9 setting	10^0	
41		10^1		C1		10^1	
42		10^2		C2		10^2	
43		10^3		C3		10^3	
44	Write event 10 setting	10^0		C4	Read event 10 setting	10^0	
45		10^1		C5		10^1	
46		10^2		C6		10^2	
47		10^3		C7		10^3	
48	Write fixed SP	10^0		C8	Read fixed SP	10^0	
49		10^1		C9		10^1	
4A		10^2		CA		10^2	
4B		10^3		CB		10^3	
4C	Digital input A			CC	Digital output A		
4D	Digital input B			CD	Digital output B		
4E	Digital input C			CE	Digital output C		
4F	Undefined			CF	Undefined		
50	Pattern No. selection	10^0	ES100P only	D0	Valid pattern No.	10^0	ES100P only
51		10^1		D1		10^1	
52	Bank No. selection	10^0	ES100X only	D2	Valid step No.	10^0	
53		10^1		D3	(bank No.)	10^1	
54	Undefined			D4	Error code 1		
55				D5	Error code 2		
56				D6	Error code 3		
57				D7	Error code 4		
58	Undefined			D8	Status 1		
59				D9	Status 2		
5A				DA	Status 3		
5B				DB	Status 4		
5C	Undefined			DC	Controller type code A		
5D				DD	Controller type code B		
5E				DE	Controller type code C		
5F				DF	Controller type code D		

DSL	Command	Remark	DSL	Command		Remark
60	Undefined		E0	Analog user buffer 1	10^0	
61			E1		10^1	
62			E2		10^2	
63			E3		10^3	
64	Undefined		E4	Analog user buffer 2	10^0	
65			E5		10^1	
66			E6		10^2	
67			E7		10^3	
68	Undefined		E8	Analog user buffer 3	10^0	
69			E9		10^1	
6A			EA		10^2	
6B			EB		10^3	
6C	Undefined		EC	Analog user buffer 4	10^0	
6D			ED		10^1	
6E			EE		10^2	
6F			EF		10^3	
70	Undefined		F0	Undefined		
71			F1			
72			F2			
73			F3			
74	Undefined		F4	Undefined		
75			F5			
76			F6			
77			F7			
78	Undefined		F8	Undefined		
79			F9			
7A			FA			
7B			FB			
7C	Undefined		FC	Version No.	10^0	
7D			FD		10^1	
7E			FE		10^2	
7F			FF	Communication abort		

Commands are valid for ES100 control states when commands are being executed.
For example, when writing the local SP and event set value, the target step is the step (bank) being executed at that time. Also, the target P, I and D are the PID set being executed at that time.

2.5 Description of Data Items

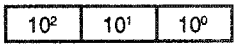
■4-digit set data



Data is handled in 4-digit sets when the following commands are executed. Output four digits continuously when writing data. Read all four digits when reading data.
The 5th bit is valid only when the 4th digit is set. The 5th bit shows the sign. "1" indicates a minus sign. "0" indicates a plus sign.

- PV
- Analog input 2
- Local SP
- Step (bank) time
- P, I, D
- Manual MV
- Events 1 to 10 settings
- Fixed SP
- Analog user buffers 1 to 4

■3-digit set data



Data is handled in 3-digit sets when the following command is executed. Output three digits continuously when writing data. Read all three digits when reading data.

- Version No.

■2-digit set data

Data is handled in 2-digit sets when the following command are executed. Output two digits continuously when writing data. Read all two digits when reading data.

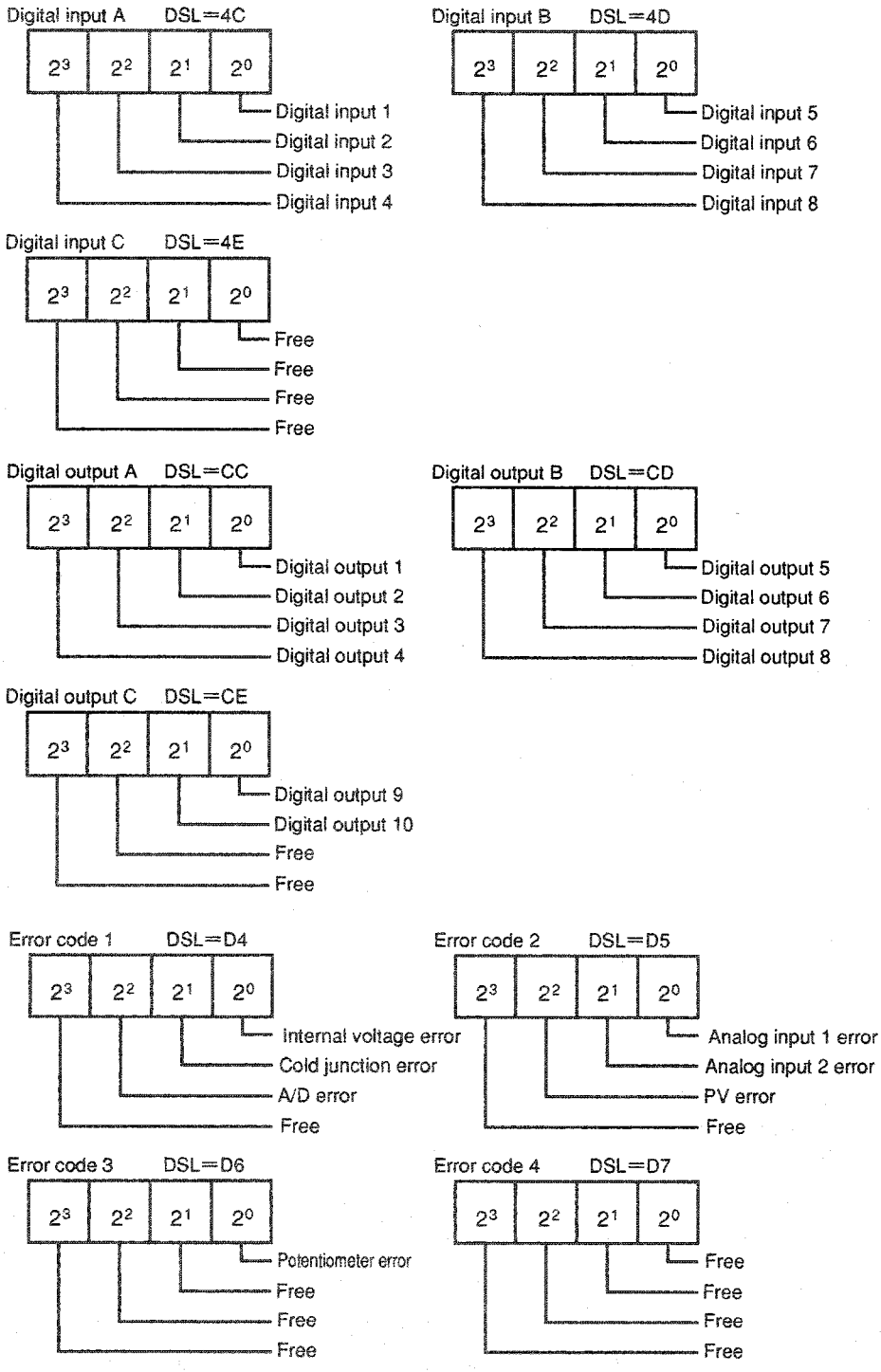
- Pattern No. selection
- Bank No. selection
- Valid pattern No.
- Valid step (bank) No.

■ 1-digit set data

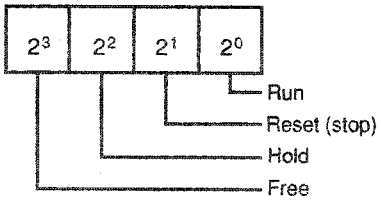
Data is handled in 1-digit set when the following commands are executed.

- Digital inputs A to C
- Digital outputs A to C
- Error codes 1 to 4
- Statuses 1 to 4
- Controller type codes A to D

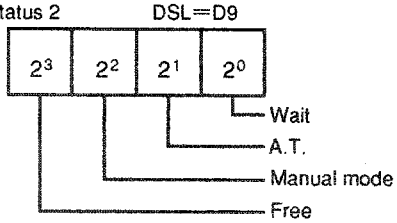
● Details of data



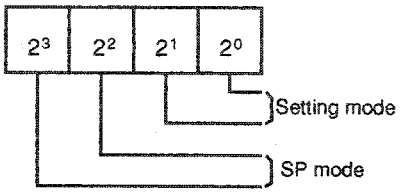
Status 1 DSL=D8



Status 2 DSL=D9



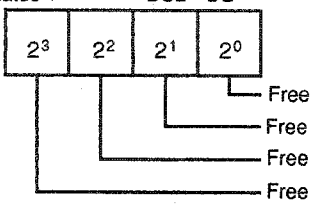
Status 3 DSL=DA



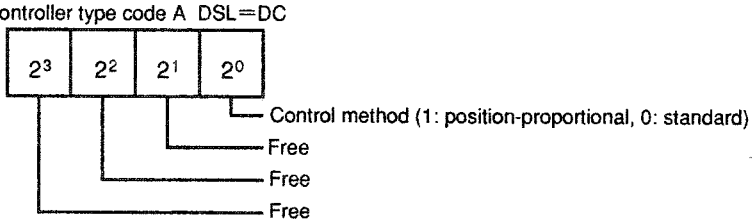
2^1	2^0	Setting mode
0	0	Local
0	1	Remote
1	0	External

2^3	2^2	SP mode
0	0	Local
0	1	Remote
1	0	Fixed

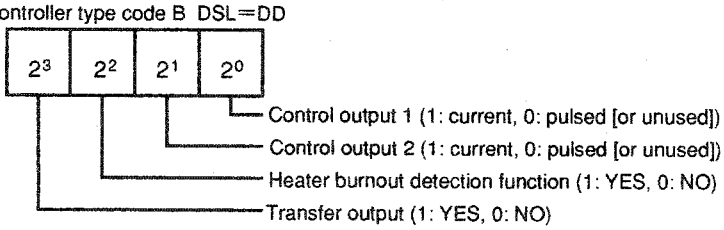
Status 4 DSL=DB



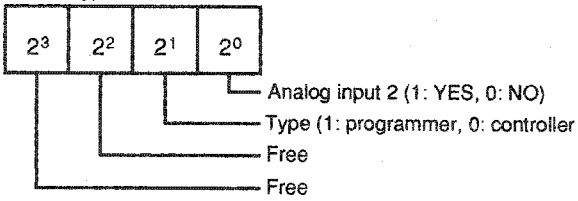
Controller type code A DSL=DC



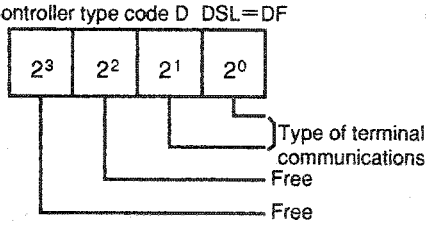
Controller type code B DSL=DD



Controller type code C DSL=DE



Controller type code D DSL=DF



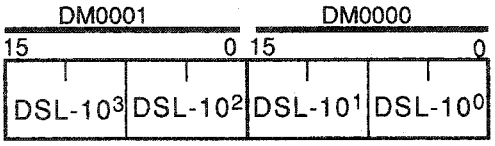
2^1	2^0	Type of terminal communications
0	0	None
0	1	RS-232C
1	0	RS-422/485

2.6 Program Examples

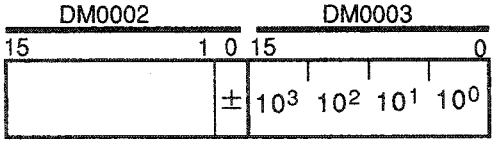
The following describes a program example where OMRON SYSMAC C1000H is used as the PLC.
The cycle time (in this example, 1.5 ms) is used for signal timing. So, pay attention to the signal timing when using other controller types.
When using this program when setting up an actual program, make sure that you have fully understood the content of the program, and pay attention to the ladder order.
In this example, the write data and response codes are not checked. In an actual program, check the write data and response codes to make sure that data is being transferred reliably.

■ How to use programs

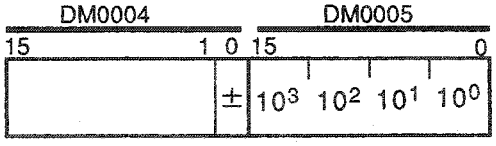
(1) Set the DSL codes of the commands to be executed to DM0000 and DM0001 for the necessary number of digits.



(2) With commands containing write data instructions, set the write data up to the 4th digit to DM0003, and the sign to DM0002.



(3) Input the "start input" signal.
(4) The read data up the 4th digit is set to DM0005, and the sign is set to DM0004.



■ I/O and DM assignments

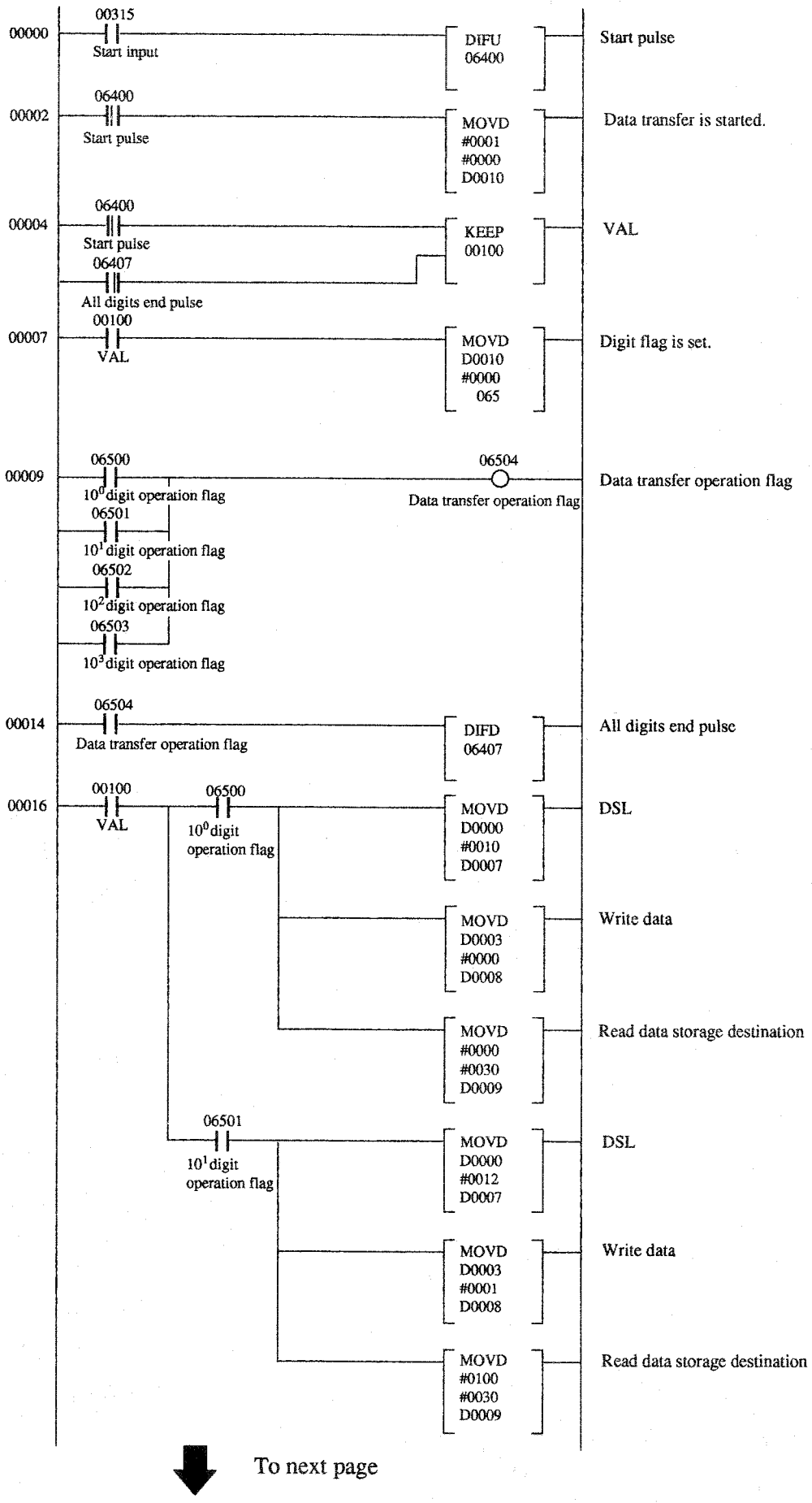
I/O

Address	Description	Address	Description
00000	DSL1	00100	VAL
01	DSL2	01	STRB
02	DSL3	02	
03	DSL4	03	
04	DSL5	04	
05	DSL6	05	
06	DSL7	06	
07	DSL8	07	
08	WD1	08	
09	WD2	09	
10	WD3	10	
11	WD4	11	
12	WD5	12	
13		13	
14		14	
15		15	
00200	RD1	00300	RDY
01	RD2	01	
02	RD3	02	
03	RD4	03	
04	RD5	04	
05		05	
06		06	
07		07	
08	RSP1	08	
09	RSP2	09	
10		10	
11		11	
12		12	
13		13	
14		14	
15		15	Start input
06400	Start pulse	06500	10^0 digit operation flag
01	DSL data write pulse	01	10^1 digit operation flag
02	STRB start pulse	02	10^2 digit operation flag
03	RDY rise pulse	03	10^3 digit operation flag
04	RDY rise pulse (with 1 cycle delay)	04	Data transfer operation flag
05	Data read pulse	05	
06	Digit end pulse	06	
07	All digits end pulse	07	
08		08	
09		09	
10		10	
11		11	
12		12	
13		13	
14		14	
15		15	

DM

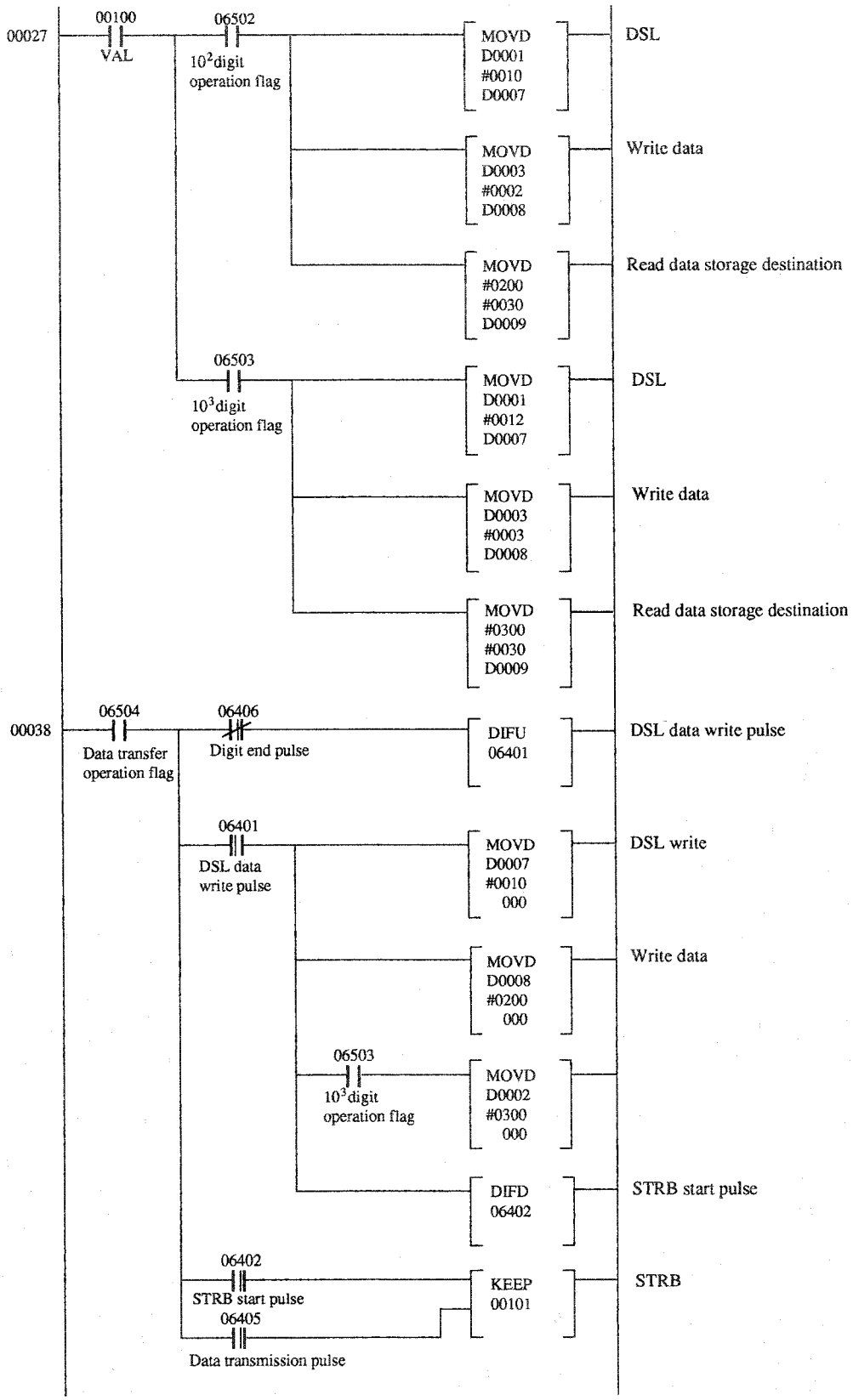
Address	Description	Address	Description
0000	DSL 10^1 digit, 10^0 digit	0016	
0001	DSL 10^3 digit, 10^2 digit	0017	
0002	Write data sign	0018	
0003	Write data	0019	
0004	Read data sign	0020	
0005	Read data	0021	
0006	DSL write digit destination	0022	
0007	Data for DSL write	0023	
0008	Data for write data	0024	
0009	Data read digit designation	0025	
0010	Data transfer digit designation	0026	
0011		0027	
0012		0028	
0013		0029	
0014		0030	
0015		0031	

■ Program list



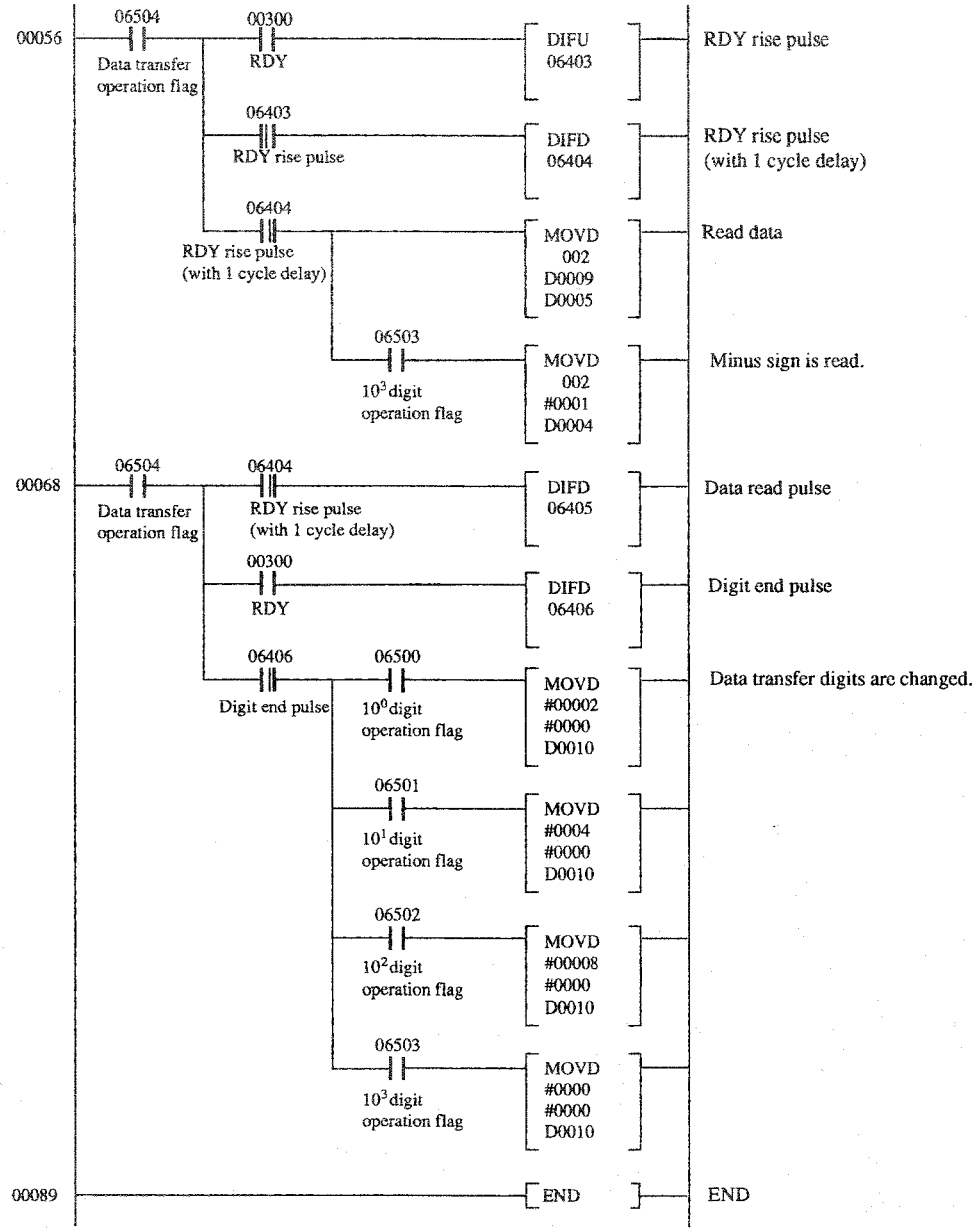
To next page

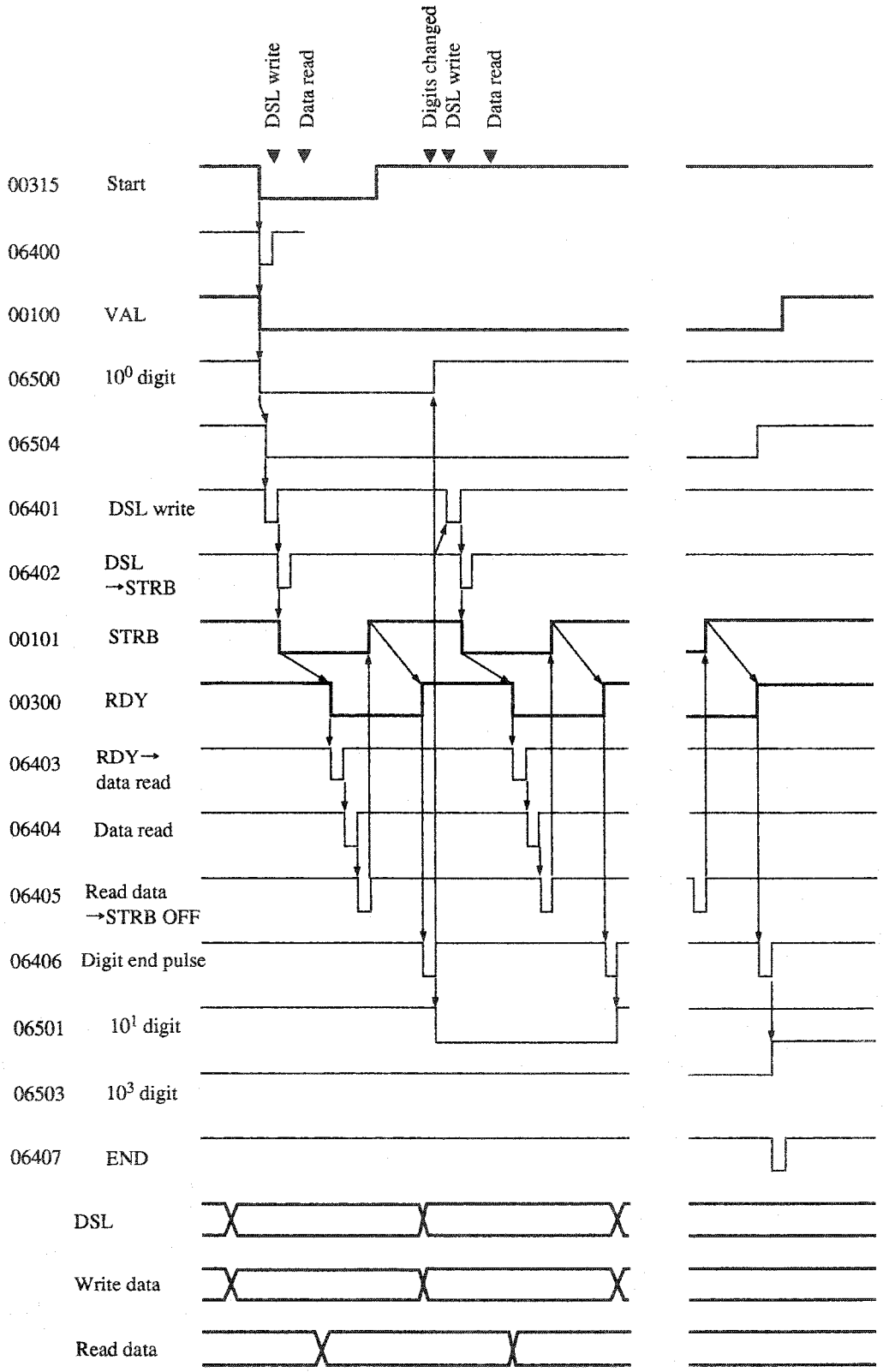
From previous page



To next page

From previous page




DSL write
Data read
Digits changed
DSL write
Data read
00315 Start
06400
00100 VAL
06500 10^0 digit
06504
06401 DSL write
06402 DSL →STRB
00101 STRB
00300 RDY
06403 RDY→ data read
06404 Data read
06405 Read data →STRB OFF
06406 Digit end pulse
06501 10^1 digit
06503 10^3 digit
06407 END
DSL
Write data
Read data

OMRON

OMRON Corporation
Systems Components Division H.Q.
28F Crystal Tower Bldg.
1-2-27, Shiromi, Chuo-ku,
Osaka 540 Japan
Phone: 06-949-6012 Fax: 06-949-6021

Regional Headquarters

OMRON EUROPE B.V.
Wegalaan 67-69, NL-2132 JD Hoofddorp
The Netherlands
Tel: (31)2356-81-300/Fax: (31)2356-81-388

OMRON ELECTRONICS, INC.
1 East Commerce Drive, Schaumburg, IL 60173
U.S.A.
Tel: (847)843-7900/Fax: (847)843-8568

OMRON ASIAPACIFIC PTE LTD.
510 Thomson Road #13-03
SLF Bldg.
1129 Singapore
Tel: (65)353-2611/Fax: (65)353-5391

Authorized Distributor:

Cat. No. H072-E1-2

Note: Specifications subject to change without notice.

Printed in Japan
0596-1M (0794) ⓑ