

MITSUBISHI
PROGRAMMABLE CONTROLLERS
MELSEC-F

Changes for the Better

USER'S MANUAL

FX COMMUNICATION (RS-232C, RS-485, RS-422)

RS-232C

**FX-232ADP
FX0N-232ADP
FX2NC-232ADP
FX1N-232-BD
FX2N-232-BD
FX2N-232IF**

RS-485

**FX-485ADP
FX0N-485ADP
FX2NC-485ADP
FX1N-485-BD
FX2N-485-BD
FX-485PC-IF**

RS-422

**FX1N-422-BD
FX2N-422-BD**



Foreword

- This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the communication facilities of FX series. It should be read and understood before attempting to install or use the unit.
- Further information can be found in the respective manual of each programmable controller.
- If in doubt at any stage of the installation of the communication facilities of FX series always consult a professional electrical engineer who is qualified and trained to the local and national standards that applies to the installation site.
- If in doubt about the operation or use of the communication facilities of FX series please consult the nearest Mitsubishi Electric distributor.
- This manual is subject to change without notice.

FX COMMUNICATION (RS-232C, RS-485, RS-422)

USER'S MANUAL

Manual number : JY992D69901

Manual revision : E

Date : April 2003

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Guidelines for the Safety of the User and Protection of the programmable controllers

This manual provides information for the use of the FX series communication unit. The manual has been written to be used by trained and competent personnel. The definition of such a person or persons is as follows;

- a) Any engineer who is responsible for the planning, design and construction of automatic equipment using the product associated with this manual should be of a competent nature, trained and qualified to the local and national standards required to fulfill that role. These engineers should be fully aware of all aspects of safety with regards to automated equipment.
- b) Any commissioning or service engineer must be of a competent nature, trained and qualified to the local and national standards required to fulfill that job. These engineers should also be trained in the use and maintenance of the completed product. This includes being completely familiar with all associated documentation for the said product. All maintenance should be carried out in accordance with established safety practices.
- c) All operators of the completed equipment (see Note) should be trained to use this product in a safe manner in compliance to established safety practices. The operators should also be familiar with documentation which is associated with the operation of the completed equipment.

Note : Note: the term 'completed equipment' refers to a third party constructed device which contains or uses the product associated with this manual.

Notes on the Symbols Used in this Manual

At various times throughout this manual certain symbols will be used to highlight points of information which are intended to ensure the users personal safety and protect the integrity of equipment. Whenever any of the following symbols are encountered its associated note must be read and understood. Each of the symbols used will now be listed with a brief description of its meaning.

Hardware Warnings



- 1) Indicates that the identified danger **WILL** cause physical and property damage.



- 2) Indicates that the identified danger could **POSSIBLY** cause physical and property damage.



- 3) Indicates a point of further interest or further explanation.

Software Warnings



- 4) Indicates special care must be taken when using this element of software.



- 5) Indicates a special point which the user of the associate software element should be aware of.



- 6) Indicates a point of interest or further explanation.

- Under no circumstances will Mitsubishi Electric be liable responsible for any consequential damage that may arise as a result of the installation or use of this equipment.
- All examples and diagrams shown in this manual are intended only as an aid to understanding the text, not to guarantee operation. Mitsubishi Electric will accept no responsibility for actual use of the product based on these illustrative examples.
- Please contact a Mitsubishi Electric distributor for more information concerning applications in life critical situations or high reliability.

Further Information Manual List

Table 1: Further Information Manual List

Manual name	Manual No.	Description
FX _{1S} Hardware Manual	JY992D83901	This manual contains written hardware explanation of wiring, installation and specification, etc. regarding the FX _{1S} Series programmable controller.
FX ₀ / FX _{0N} Hardware Manual	JY992D47501	This manual contains written hardware explanation of wiring, installation and specification, etc. regarding the FX ₀ and FX _{0N} Series programmable controllers.
FX Hardware Manual	JY992D47401	This manual contains written hardware explanation of wiring, installation and specification, etc. regarding the FX Series programmable controller.
FX _{2C} Supplementary Manual	JY992D50201	This manual contains supplementary data regarding the FX Series programmable controller Hardware Manual
FX _{1N} Hardware Manual	JY992D88201	This manual contains written hardware explanation of wiring, installation and specification, etc. regarding the FX _{1N} Series programmable controller.
FX _{2N} Hardware Manual	JY992D66301	This manual contains written hardware explanation of wiring, installation and specification, etc. regarding the FX _{2N} Series programmable controller.
FX _{2NC} Hardware Manual	JY992D76401	This manual contains written hardware explanation of wiring, installation and specification, etc. regarding the FX _{2NC} Series programmable controller.
FX Programming Manual	JY992D48301	This manual contains written instructions regarding the FX ₀ , FX _{0S} , FX _{0N} , FX, FX _{2C} , FX _{2N} and FX _{2NC} Series programmable controllers.
FX Programming Manual II	JY992D88101	This manual contains written instructions regarding the FX _{1S} , FX _{1N} , FX _{2N} and FX _{2NC} Series programmable controllers.
FX / FX _{0N} -485ADP User's Guide	JY992D53201	This manual contains written hardware explanation of installation and specification regarding the FX-485ADP and FX _{0N} -485ADP.
FX _{2NC} -485ADP Installation Manual	JY997D01201	This manual contains written hardware explanation of installation and specification regarding the FX _{2NC} -485ADP.
FX-232ADP User's Guide	JY992D48801	This manual contains written hardware explanation of installation and specification regarding the FX-232ADP.
FX _{0N} -232ADP User's Guide	JY992D51301	This manual contains written hardware explanation of installation and specification regarding the FX _{0N} -232ADP.
FX _{2NC} -232ADP Installation Manual	JY997D01101	This manual contains written hardware explanation of installation and specification regarding the FX _{2NC} -232ADP.
FX _{2N} -232-BD User's Guide	JY992D66001	This manual contains written hardware explanation of installation and specification regarding the FX _{2N} -232-BD.

Table 1: Further Information Manual List

Manual name	Manual No.	Description
FX _{2N} -485-BD Hardware Manual	JY992D73401	This manual contains written hardware explanation of installation and specification regarding the FX _{2N} -485-BD.
FX _{2N} -422-BD User's Guide	JY992D66101	This manual contains written hardware explanation of installation and specification regarding the FX _{2N} -422-BD.
FX _{1N} -232-BD Hardware Manual	JY992D84501	This manual contains written hardware explanation of installation and specification regarding the FX _{1N} -232-BD.
FX _{1N} -485-BD Hardware Manual	JY992D84301	This manual contains written hardware explanation of installation and specification regarding the FX _{1N} -485-BD.
FX _{1N} -422-BD User's Guide	JY992D84101	This manual contains written hardware explanation of installation and specification regarding the FX _{1N} -422-BD.
FX-485-IF Hardware Manual	JY992D81801	This manual contains written hardware explanation of installation and specification regarding the FX-485-IF.

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1. Introduction

1.1 Abbreviations, Generic Names and Terms Used in This Manual

Abbreviation List

Abbreviation/generic name/term		Description
CPU	FX1S Series	Generic name of FX1S Series main units
	FX0N Series	Generic name of FX0N Series main units
	FX1N Series	Generic name of FX1N Series main units
	FX Series	Generic name of FX Series main units
	FX2 Series	Generic name of FX2 Series main units
	FX2N Series	Generic name of FX2N Series main units
	FX2C Series	Generic name of FX2C Series main units
	FX2NC Series	Generic name of FX2NC Series main units
	FXCPU	Generic name of FX0/FX0S/FX1S/FX0N/FX1N/FX1/FX/FX2/FX2N/FX2C/FX2NC Series main units
Others	FX/WIN	Abbreviation of programming software FX-PCS/WIN-E for FX Series PLC
	Windows95	Abbreviation of Microsoft Windows95
	Windows98	Abbreviation of Microsoft Windows98
	Windows NT4.0	Abbreviation of Microsoft Windows NT Workstation 4.0
	Windows 2000	Abbreviation of Microsoft Windows 2000 Professional
	Windows	Generic name of Windows95, Windows98, Windows NT4.0 and Windows2000
	Personal computer (PC)	Personal computer compatible with Windows to which GX Developer or FX-PCS/WIN-E is installed

This manual describes the following product in the new name.

Conventional name	New name	Remarks
GPPW	GX Developer	Abbreviation of software package SW□D5C-GPPW-E

1.2 Communication Types

The FX Series supports the following 5 types of communication.

1) N:N network

Data transfer with FX_{2N}, FX_{2NC}, FX_{1N}, FX_{1S}, FX_{0N} programmable controllers can be performed on a N:N basis. They can link data of a small-scale system if using this network. For the system configuration please refer to subsection 1.2.1, specifications refer to chapter 3, wiring refer to chapter 2, settings and the number of transferred data and example program refer to chapter 4, diagnostics refer to chapter 12.

2) Parallel link

Data transfer with FX_{2N}, FX_{2NC}, FX_{1N}, FX and FX_{2C} programmable controllers can be performed on a 1:1 basis for 100 auxiliary relays and 10 data registers. With the FX_{1S} and FX_{0N} data transfer is performed for 50 auxiliary relays and 10 data registers. For the system configuration please refer to subsection 1.2.2, specifications refer to chapter 3, wiring refer to chapter 2, setting and example program refer to chapter 5, diagnostics refer to chapter 12.

3) Computer link (Data transfer using dedicated protocol)

Data transfer with RS-485 (RS-422) units can be performed on a 1:n (16) basis using dedicated protocol. For the system configuration please refer to subsection 1.2.3, specifications refer to chapter 3, wiring refer to chapter 2, setting of communication format refer to chapter 6, dedicated protocol refer to chapter 7 & 8, diagnostics refer to chapter 12.

4) No protocol communication (Data transfer using RS instruction)

Data communication with a diversified RS-232C unit including personal computers, bar code readers and printers can be performed using no protocol communications. This communication uses RS instruction's or an FX_{2N}-232IF special function block. For the system configuration please refer to subsection 1.2.3, specifications refer to chapter 3, wiring refer to chapter 2, setting of communication format, RS instruction and example program refer to chapter 6 and 9, diagnostics refer to chapter 12. When using the RS instruction, for setting the communication format refer to chapter 6, for the RS instruction and example program please refer to chapter 9. Or when using an FX_{2N}-232IF, for setting and example program please refer to chapter 10.

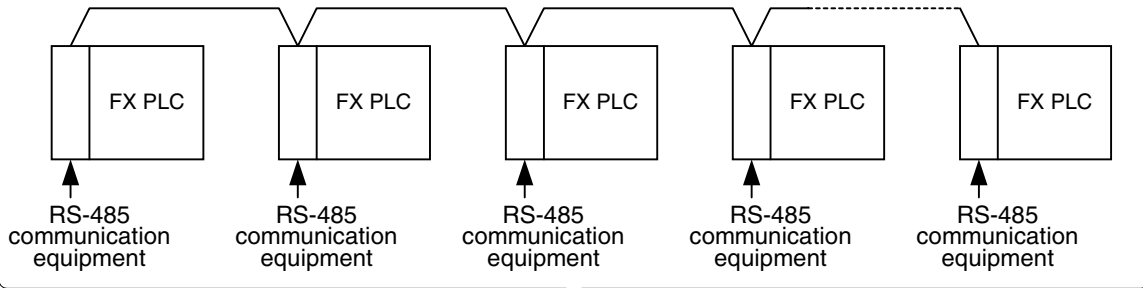
5) Optional programming port

The port can support programming protocol, if connected to an FX_{2N}-232-BD, FX_{0N}-232ADP, FX_{2NC}-232ADP, FX_{1N}-232-BD, FX_{2N}-422-BD and FX_{1N}-422-BD for the FX_{2N}, FX_{2NC}, FX_{1N}, FX_{1S} Series programmable controller. For notes on use, refer to chapter 11, diagnostics refer to chapter 12.

1.3 System Configuration

For programming protocol refer to chapter 11.

1.3.1 N:N Network



Up to eight FX series programmable controllers can be connected. The total extension distance is 500m(1640' 5") when only the FX0N-485ADP and FX2NC-485ADP are used in the configuration, and 50m(164' 0") when the FX1N-485-BD and FX2N-485-BD are used.

FX Series PLC	Interface
FX0N, FX2NC	FX0N-485ADP
	FX2NC-485ADP
FX1S, FX1N	FX1N-CNV-BD + FX0N-485ADP
	FX1N-CNV-BD + FX2NC-485ADP
	FX1N-485-BD
FX2N	FX2N-CNV-BD + FX0N-485ADP
	FX2N-CNV-BD + FX2NC-485ADP
	FX2N-485-BD

1.3.2 Parallel Link



1) FX2N, FX2NC (Shielded twisted-pair cable)

①, ②	Using interface	Extension distance
FX2N	FX2N-485-BD	Max. 50m (164' 0")
	FX2N-CNV-BD + FX0N-485ADP	Max. 500m (1640' 5") *1
	FX2N-CNV-BD + FX2NC-485ADP	
FX2NC	FX0N-485ADP	Max. 500m (1640' 5") *1
	FX2NC-485ADP	

Note:

*1 When including an FX2N-485-BD in the system configuration, this total extension distance has a max of 50m (164' 0").

2) FX_{1N} (Shielded twisted-pair cable)

①, ②	Using interface	Extension distance
FX _{1N}	FX _{1N} -485-BD	Max. 50m (164' 0")
	FX _{1N} -CNV-BD + FX _{0N} -485ADP	Max. 500m (1640' 5") * ²
	FX _{1N} -CNV-BD + FX _{2NC} -485ADP	

*² When including an FX_{1N}-485-BD in the system configuration, this, total extension distance has a max of 50m (164' 0").

3) FX_{1S} (Shielded twisted-pair cable)

①, ②	Using interface	Extension distance
FX _{1S}	FX _{1N} -485-BD	Max. 50m (164' 0")
	FX _{1N} -CNV-BD + FX _{0N} -485ADP	Max. 500m (1640' 5") * ³
	FX _{1N} -CNV-BD + FX _{2NC} -485ADP	

*³ When including an FX_{1N}-485-BD in the system configuration, this, total extension distance has a max of 50m (164' 0").

4) FX_{0N} (Shielded twisted-pair cable)

①, ②	Using interface	Extension distance
FX _{0N}	FX _{0N} -485ADP	Max. 500m (1640' 5")
	FX _{2NC} -485ADP	

5) FX, FX_{2C} (Shielded twisted-pair cable and glassfiber cable)

①, ②	Using interface	Extension distance
FX ₂ , FX _{2C}	FX ₂ -40AW (Shielded twisted-pair cable)	Max. 10m (32' 9")
	FX ₂ -40AP (Glassfiber cable)	Max. 50m (164' 0")



Note;

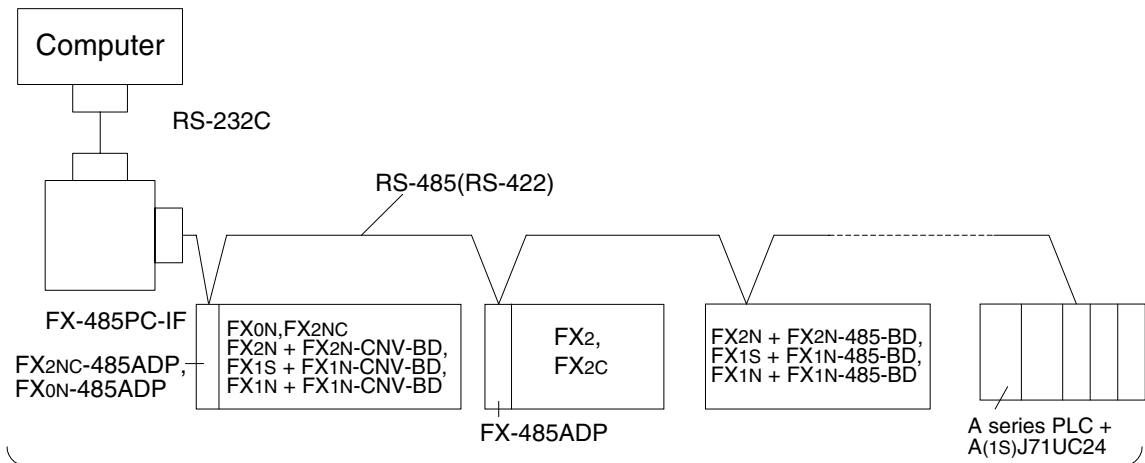
Parallel link is only possible between the same series of PLC's, or between other series in the same group. However, parallel link between each group cannot be achieved.

Group's are separated as follows.

Group No.	Series
Group 1	FX _{2N} , FX _{2NC}
Group 2	FX _{1N}
Group 3	FX _{1S}
Group 4	FX _{0N}
Group 5	FX, FX _{2C}

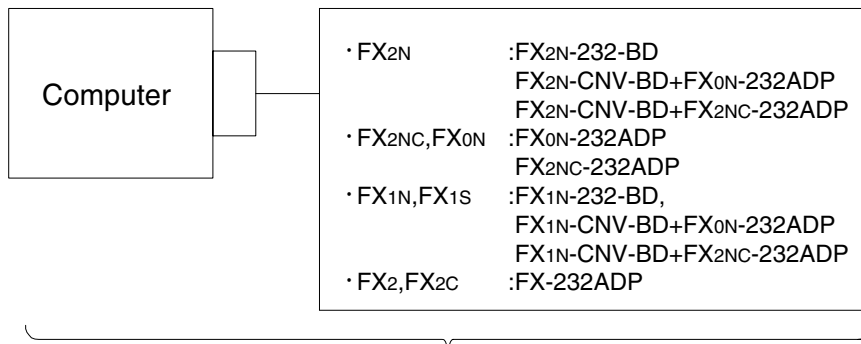
1.3.3 Computer Link

1) In the case of 1:N connection using RS-485 (RS-422)



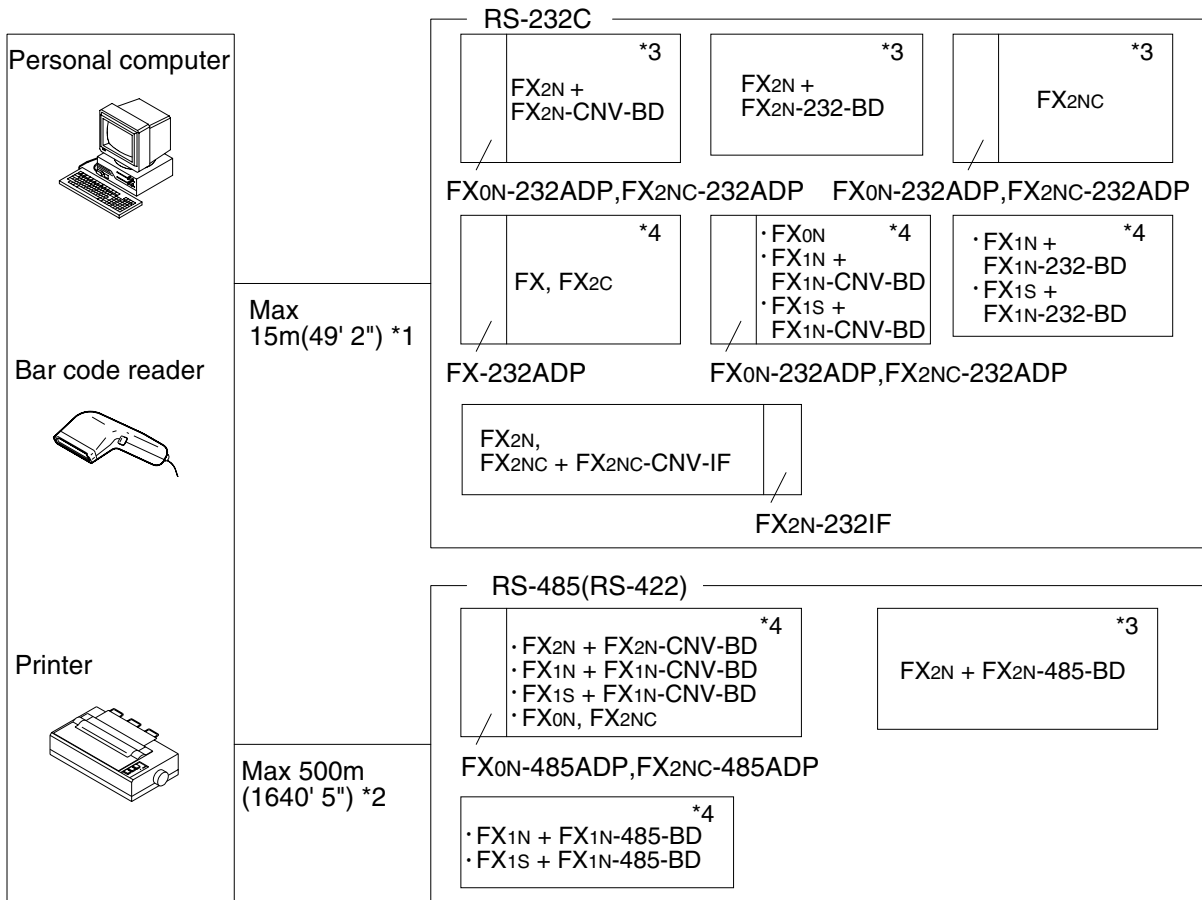
Up to sixteen FX series programmable controllers can be connected.
 The total extension distance is 500m(1640' 5") when only the FX0N-485ADP and FX2NC-485ADP are used in the configuration, and 50m(164' 0") when the FX1N-485-BD and FX2N-485-BD are used.

2) In the case of 1:1 connection using RS-232C



Total extension distance is 15m(49' 2").

1.3.4 No Protocol Communication



- *1 The RS-485/RS-232C signal convertor is necessary in the case of an RS-485 interface for a computer connection.
- *2 When using an FX1N-485-BD a FX2N-485-BD in a system the total extension distance has a max of 50m(164' 0").
But, RS-485/RS-232C signal convertor is necessary in the case of an RS-232C interface for a computer connection.
- *3 This system configuration can achieve full-duplex or half-duplex communication.
- *4 This system configuration can only achieve half-duplex communication.

1.4 Supported Functions and Applicable Versions

Items		FX2N, FX2NC	FX1N, FX1S	FX0N	FX, FX2C
N:N network		All versions	All versions	V2.00 or more	No support
Parallel link				All versions	All versions
Computer link				V1.20 or more	V3.30 or more
No protocol communication	Use RS instruction			All versions	V3.00 or more
	Use FX2N-232IF	Not supported.			

2. Specifications

2.1 Communication Specification

2

	N:N network	Parallel link	Computer link (dedicated protocol)	No protocol communication
Transmission standard	Conforming to RS-485	Conforming to RS-485 and RS-422	Conforming to RS-485 and RS-422 or RS-232C	
Transmission distance	Max. 500m		RS-485(RS-422): Max. 500m(1640' 5") RS-232C: Max. 15m (49' 2")	
Number of stations	Max. 8 stations	1:1	1:N (N is Max. 16 stations)	RS-232C:1:1 RS-485:1:N *1
Communication method	Half-duplex communication			FX, FX2C, FX0N, FX1N, FX1S: half-duplex communication FX2N, FX2NC*2: full-duplex communication
Data length	Fixed		7 bit / 8 bit	
Parity			None / Odd / Even	
Stop bit			1 bit / 2bit	
Baud rate (bps)	38,400	19,200	300/600/1,200/2,400/4,800/9,600/19,200	
Header character	Fixed			None / effective
Terminator character				
Control line	—			
Protocol	—		Format 1 / Format 4	None
Sum check	Fixed		None / effective	
Supported programmable controller	FX2N, FX2NC, FX1N, FX1S, FX0N	FX2N, FX2NC, FX1N, FX1S, FX0N, FX, FX2C		

*1 FX2N, FX2NC, FX1N, FX1S and FX0N PLCs are supported.

*2 When using an FX0N-485ADP or FX2NC-485ADP, this system is only half-duplex.

2.2 Communication Time

2.2.1 N:N network

		Communication device		
		Pattern 0 Bit device: 0 point Word device: 4 points	Pattern 1 Bit device: 32 points Word device: 4 points	Pattern 2 Bit device: 64 points Word device: 8 points
Total station number	2	18	22	34
	3	26	32	50
	4	33	42	66
	5	41	52	83
	6	49	62	99
	7	57	72	115
	8	65	82	131



Note;

If a N:N network is used, the scan time of each station programmable controller becomes about 10 percent longer regardless of the number of link stations or the communication device pattern used.

2.2.2 Parallel link

Normal Mode	70ms for reciprocation + Operation cycle of master station + Operation cycle of slave station (ms)
High speed mode	20ms for reciprocation + Operation cycle of master station + Operation cycle of slave station (ms)

2.2.3 Computer link

Calculations to determine the approximate time until communication is complete.

1) Programmable controller → Computer

$$\begin{aligned} \text{Communication time} &= \text{Total number of characters based on dedicated protocol}^{*1} \\ &\times \text{Time to send or receive one character (ms)}^{*2} \\ &+ \text{Programmable controller's maximum scan time (ms)} \times 3 \\ &+ \text{Message wait (ms)} \end{aligned}$$

2) Computer → Programmable controller

$$\begin{aligned} \text{Communication time} &= \text{Number of total characters based on dedicated protocol}^{*1} \\ &\times \text{Time to send or receive one character (ms)}^{*2} \\ &+ \text{Programmable controller's maximum scan time (ms)} \\ &+ \text{Message wait (ms)} \end{aligned}$$

Note:

*1 Please count the number of characters with reference section 7.4.1 and 7.4.2 and chapter 8.

*2 Please refer to the following expression for time calculation.

$$\begin{aligned} \text{Time to send or receive one character} &= 1/\text{baud rate} \times \text{number of bits in character} \\ &(\text{start bit}(1) + \text{Data length}(7 \text{ or } 8) + \text{Parity bit}(0 \text{ or } 1) + \text{Stop bit}(1 \text{ or } 2)) \end{aligned}$$

Example

When 1 character = 10 bits (Data length = 7, Parity bit = 1, stop bit = 1 start bit = 1), the time is as follows.

Baud rate (bps)	Time to send or receive one character (ms)
300	33.34
600	16.67
1200	8.34
2400	4.17
4800	2.08
9600	1.04
19200	0.52

Note;

Please refer to following table for the relation between reading word points and communication time.

“Message time = 0ms, Maximum scan time = 20ms, Dedicated protocol format = format 1, Command = WR, Baud rate = 9,600 or 19,200 bps”

Reading word points	Baud rate (bps)	
	9,600	19,200
10	0.3 s	0.2 s
32	0.4 s	0.3 s
64	0.5 s	0.4 s

MEMO

3. Wiring

Terminal layout when using a communication unit, please refer to the individual units manual.



Common

1) This system is designed to read and write data (forced on/off) while the programmable controller is running.

If abnormal data is written to the programmable controller, due to effects of noise, the programmable controller may malfunction and cause machine trouble or an accident. Therefore, observe the following cautions.

- Do not lay signal cables near high voltage power cables or put them in the same trunking duct.
Otherwise effects of noise or surge induction are likely to take place. Keep a safe distance of more than 100 mm (3.94") from these wires.
- Ground the shield wire or shield of a shielded cable at one point on the programmable controller. Do not, however, ground at the same point as high voltage lines.



2) Cut off phases of power source externally, before installation or wiring work in order to avoid electric shock or serious damage to the product.



3) Replace the provided terminal cover before supplying power and operating the unit after installation or wiring work in order to avoid electric shock.

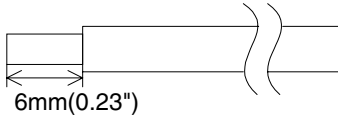
3.1 Caution on cable selection

3.1.1 FX_{1N}-485-BD, FX_{2N}-485-BD, FX_{2NC}-485ADP

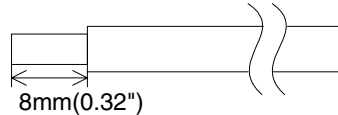


To connect the RS-485(RS-422) unit, use a shielded twist-pair cable. The cable model must be AWG 26 to 16, and the maximum tightening torque must be 0.6 N·m (6 kgf·cm). If a cable other than the AWG 26 to 16 is used, normal communication cannot be assured as the terminal may be imperfectly contacted. It is recommended to insert a cable integrated by a crimping tool into the terminal.

FX_{1N}-485-BD,FX_{2N}-485-BD



FX_{2NC}-485ADP



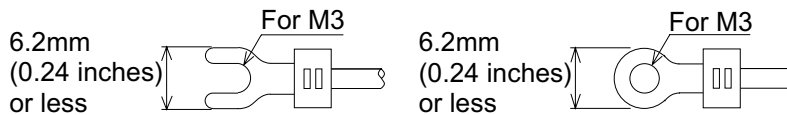
Number of cables connected to terminal and their specification

	FX _{1N} -485-BD, FX _{2N} -485-BD	FX _{2NC} -485ADP
When connecting 1 cable	AWG26-16	AWG26-16
When connecting 2 cables		AWG26-20
Tightening torque	0.6N·m	0.4 to 0.5N·m

3.1.2 FX_{0N}-485ADP



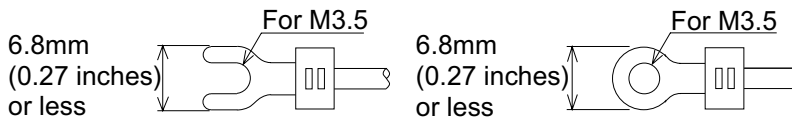
1) The terminal screws of the FX_(0N)-485ADP are M3 screws, therefore, crimp style terminal (see drawing) suitable for use with these screws should be fitted to the cable for wiring.



2) The terminal tightening torque is 0.5 to 0.8 N·m (5 to 8 kgf·cm), tighten securely to avoid malfunction.

3.1.3 FX₂-40AW

1) The terminal screws for the terminal block of the FX₂-40AW are M3.5 screws, therefore crimp style terminal (see drawing) suitable for use with these screws should be fitted to the cable for wiring.



2) The terminal tightening torque is 0.5 to 0.8 N·m (5 to 8 kgf·cm), tighten securely to avoid malfunction.

3.2 Using RS-232C Interface

Below is a typical wiring example. Please wire similar to the following pin name, when a pin number on the side of a counterpart machine differs.

3.2.1 Using RS Instruction or Computer Link

1) Terminal specification device

Programmable Controller Side					RS-232C Device Side					
Signal name	FX _{2N} -232-BD FX _{1N} -232-BD	FX _{2NC} - 232ADP	FX _{0N} - 232ADP	FX- 232ADP	Uses CS, RS		Signal name	Uses DR, ER		
					9-pin D-SUB	25-pin D-SUB		9-pin D-SUB	25-pin D-SUB	
FG	-			1	FG	-	1	FG	-	1
RD(RXD)	2			3	RD(RXD)	2	3	RD(RXD)	2	3
SD(TXD)	3			2	SD(TXD)	3	2	SD(TXD)	3	2
ER(DTR)	4			20	RS(RTS)	7	4	ER(DTR)	4	20
SG(GND)	5			7	SG(GND)	5	7	SG(GND)	5	7
DR(DSR)	6			6	CS(CTS)	8	5	DR(DSR)	6	6

Note;

When using ER and DR signals, please also check if RS and CS signals are needed according to the RS-232C device specifications.

2) Modem specification device

Programmable Controller Side					RS-232C Device Side					
Signal name	FX _{2N} -232-BD FX _{1N} -232-BD	FX _{2NC} - 232ADP	FX _{0N} - 232ADP	FX- 232ADP	Uses CS, RS		Signal name	Uses DR, ER		
					9-pin D-SUB	25-pin D-SUB		9-pin D-SUB	25-pin D-SUB	
FG	-			1	FG	-	1	FG	-	1
CD(DCD)	1			8	CD(DCD)	1	8	FG	1	8
RD(RXD)	2			3	RD(RXD)	2	3	RD(RXD)	2	3
SD(TXD)	3			2	SD(TXD)	3	2	SD(TXD)	3	2
ER(DTR)	4			20	RS(RTS)	7	4	ER(DTR)	4	20
SG(GND)	5			7	SG(GND)	5	7	SG(GND)	5	7
DR(DSR)	6			6	CS(CTS)	8	5	DR(DSR)	6	6

Note;

The FX_{0N}-232ADP and FX_{2NC}-232ADP does not monitor the CD pin (pin8).

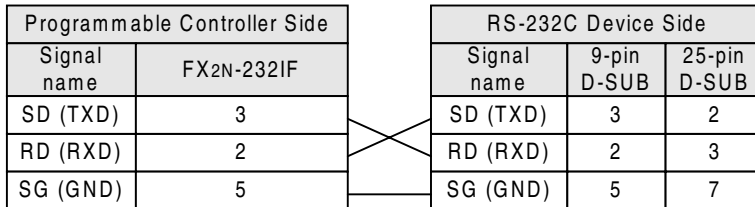
3) Computer link

Please refer to 2.2.1 1) for wiring.

3.2.2 Using FX_{2N}-232IF

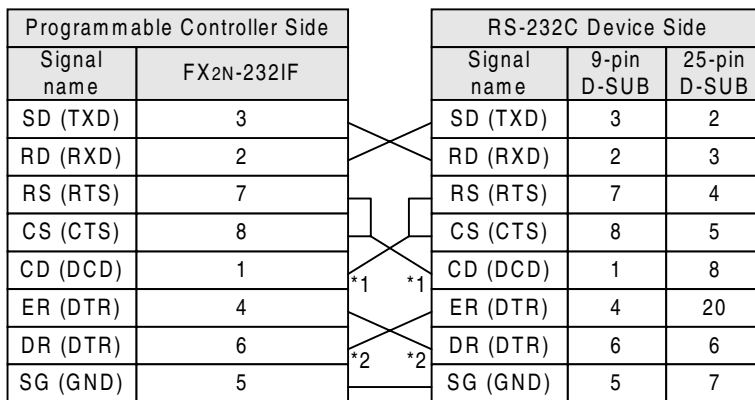
The signal wiring of the RS-232C equipment varies depending on the RS-232C connection specifications. Check the specifications of the RS-232C equipment used, then connect the signals correctly. Representative wiring examples are shown below.

- 1) Terminal specification device (No control line)
 Setting communication format (BFM #0); b9=0, b8=0



Communication is performed in accordance with the condition determined by the software in the FX_{2N}-232IF and the counterpart equipment.

- 2) Terminal specification device (Use control line)
 - a) Standard RS-232C mode (Use cross cable)
 Setting communication format (BFM #0); b9=0, b8=1



As the carrier to send (CS) signal pin of the FX_{2N}-232IF itself receives the request to send (RS) signal, signal transfer is performed as if the counterpart equipment is functioning.

Note:

- *1 When the CD signal is not monitored, the CD signal pin is not required to be connected. With regard to the CD signal, the FX_{2N}-232IF only indicates the status.
- *2 The FX_{2N}-232IF only indicates the status.

b) Interlink connection mode (Use interlink serial cross cable)
 Setting connection format (BFM #0); b9=1, b8=1

Programmable Controller Side		RS-232C Device Side		
Signal name	FX _{2N} -232IF	Signal name	9-pin D-SUB	25-pin D-SUB
SD (TXD)	3	SD (TXD)	3	2
RD (RXD)	2	RD (RXD)	2	3
RS (RTS)	7	RS (RTS)	7	4
CS (CTS)	8	CS (CTS)	8	5
ER (DTR)	4	ER (DTR)	4	20
DR (DTR)	6	DR (DTR)	6	6
SG (GND)	5	SG (GND)	5	7

In the interlink connection mode, data exceeding 512 bytes (upper limit of the receive buffer in the FX_{2N}-232IF) can be received.

Note:

*1 The FX_{2N}-232IF only indicates the status.

*2 In this mode, the request to send (RS) signal functions as the signal to enable receive in the FX_{2N}-232IF.

When receiving data exceeding 512 bytes, the FX_{2N}-232IF sets the request to send (RS) signal to "OFF" and requests the counterpart equipment to suspend the send operation. When the data saved in the receive buffers is read by the sequence program, the remaining data can be received.

3) Modem specification device

Standard RS-232C mode (Using straight cable)
 Setting communication format (BFM #0); b9=0, b8=1

Programmable Controller Side		RS-232C Device Side		
Signal name	FX _{2N} -232IF	Signal name	9-pin D-SUB	25-pin D-SUB
SD (TXD)	3	SD (TXD)	3	2
RD (RXD)	2	RD (RXD)	2	3
RS (RTS)	7	RS (RTS)	7	4
CS (CTS)	8	CS (CTS)	8	5
CD (DCD)	1	CD (DCD)	1	8
ER (DTR)	4	ER (DTR)	4	20
DR (DTR)	6	DR (DTR)	6	6
SG (GND)	5	SG (GND)	5	7
CI (RI)	9	CI (RI)	9	22

Note:

*1 The FX_{2N}-232IF indicates the status exclusively.

*2 When the CD signal is not monitored, the CD signal pin is not required to be connected. With regard to the CD signal, the FX_{2N}-232IF indicates the status exclusively.

*3 When the CI signal is not required, the CI signal pin is not required to be connected. With regard to the CI signal, the FX_{2N}-232IF indicates the status exclusively.

3.3 Using RS-485 Interface

3.3.1 Wiring Selection

The wiring of RS-485 can either be one-pair or two-pair. The wiring method is decided according to application usage. Please select the wiring method from the table below.

Usage		One-pair wiring	Two-pair wiring
No protocol (Use RS instruction) *1	Half-duplex communication	●*2	○
	Full-duplex communication *3	×	○
Dedicated protocol (Use computer link)*1	It is necessary to set the message wait time to 70 ms or less.	×	○
	It is not necessary to set the message wait time to 70 ms or less.	●*2	○
	Use the on-demand function	×	○
Parallel link *4		●	○
N:N network		○	×

●...Recommendation, ○...OK, ×...Cannot use

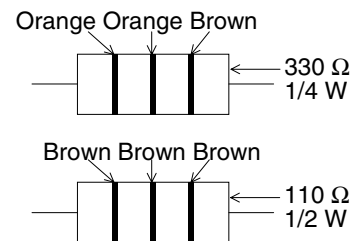
Note:

- *1 When this product is added to the system, please match the wiring to the existing method of the system.
- *2 When using an FX_{2N}-485-BD with this wiring method, remember to take account of/ignore the “echo” of the commands sent from the FX_{2N} programmable controller.
- *3 Please use the FX_{2N} programmable controller and FX_{2N}-485-BD together. Full-duplex combination cannot be achieved with other configurations.
- *4 For wiring parallel link, see section 2.4.

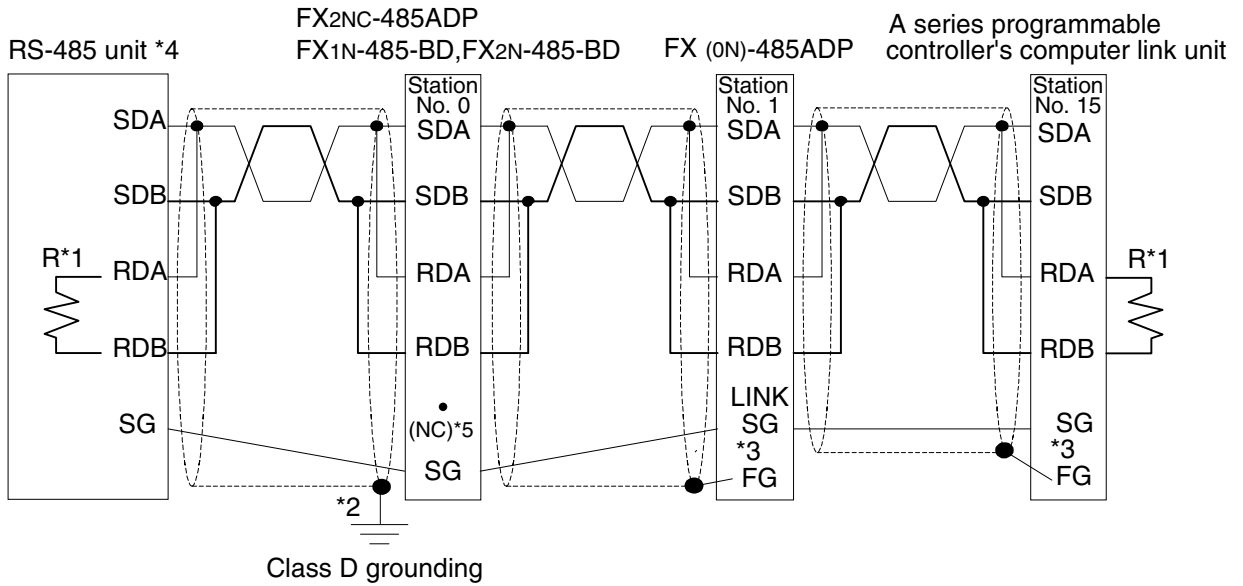
3.3.2 Terminal Resistor

A terminal resistor must be used at both ends of the communication line as described in section 2.3.3 and 2.3.4.


- 1) In the case of two-pair wiring, connect the terminal resistor (330Ω, 1/4W) between terminals SDA and SDB and between terminals RDA and RDB. Use the resistors offered as accessories with the product.
- 2) In the case of one-pair wiring, connect the terminal resistor (110Ω, 1/2W) between terminals RDA and RDB. Use the resistors offered as accessories with the product.



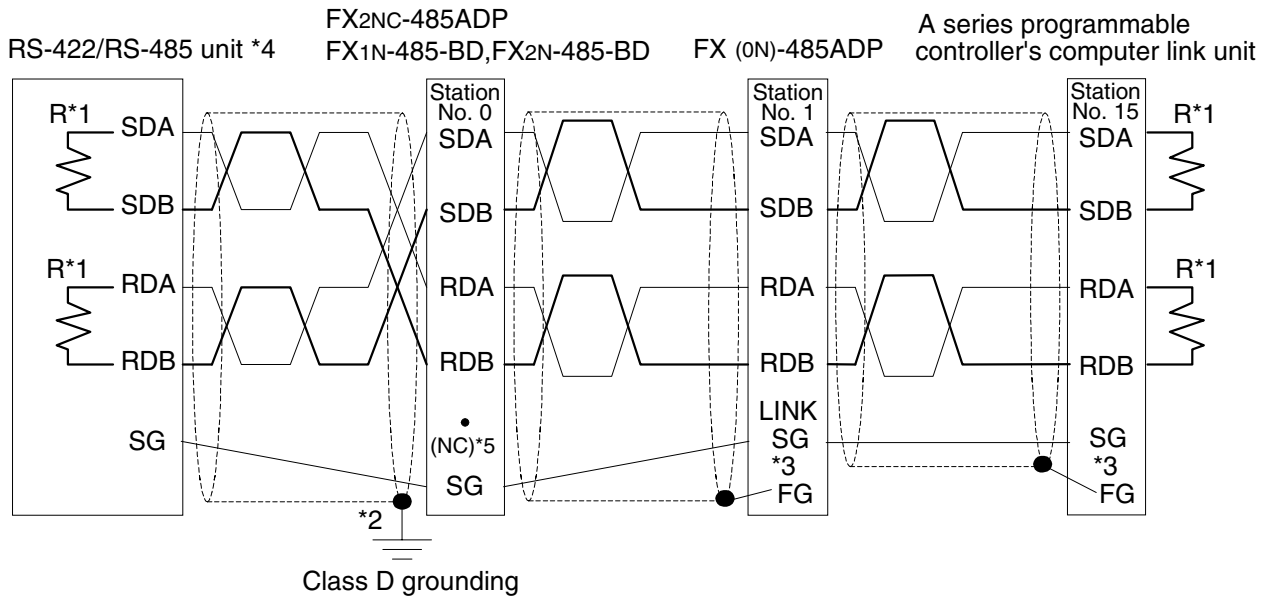
3.3.3 One-pair Wiring




Note:

- *1 R is a terminating resistor (110Ω)
- *2 Make sure to connect the shield of the appropriate cable with the FX2N-485-BD, FX1N-485-BD or FX2NC-485ADP to ground that has a resistance of 100Ω or less (Class D grounding).
- *3 Make sure to connect the terminal FG to the ground terminal  of a programmable controller grounded with resistance of 100Ω or less (Class D grounding). However, for a computer link unit of the A series programmable controller, see the manual of the computer link unit.
- *4 When using an RS-232C/485 converter, use the FX-485PC-IF. Have in mind that "echo" occurs on the RS-232C side if one-pair wiring is performed using the FX-485PC-IF.
- *5 In the case of FX2NC-485ADP

3.3.4 Two-pair Wiring



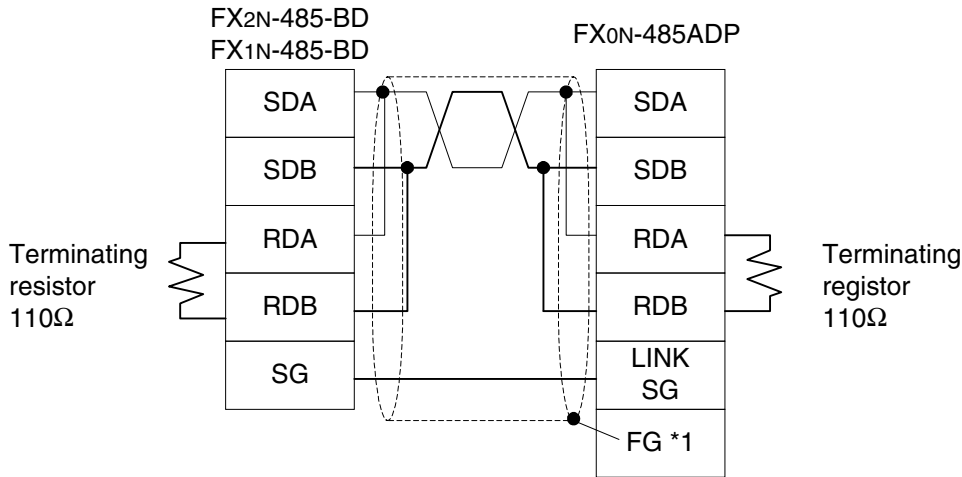
Note:

- *1 R is a terminating resistor (330Ω)
- *2 Make sure to connect the shield of the appropriate cable with the FX_{2N}-485-BD, FX_{1N}-485-BD or FX_{2NC}-485ADP to ground that has a resistance of 100Ω or less (Class D grounding).
- *3 Make sure to connect the terminal FG to the ground terminal  of a programmable controller grounded with resistance of 100Ω or less (Class D grounding). However, for a computer link unit of the A series programmable controller, see the manual of the computer link unit.
- *4 When using an RS-232C/485 converter, use the FX-485PC-IF.
- *5 In the case of FX_{2NC}-485ADP

3.4 Parallel Link

3.4.1 FX_{2N(1N)}-485-BD and FX_{0N}-485ADP

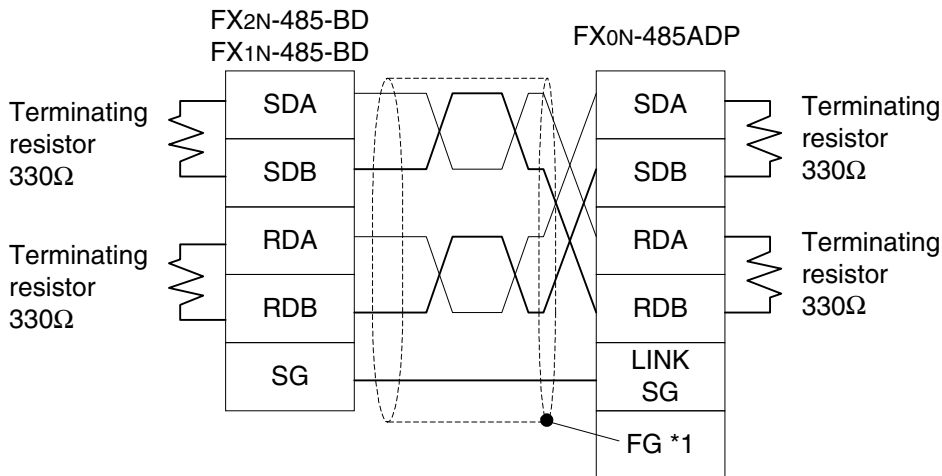
1) One-pair Wiring



Note:

*1 Connect the terminal FG to the ground terminal of a programmable controller grounded with a resistance of 100Ω or less (Class D grounding). If the programmable controller is not equipped with a ground terminal, connect the terminal FG directly to a ground with the resistance of 100Ω or less (Class D grounding).

2) Two-pair Wiring

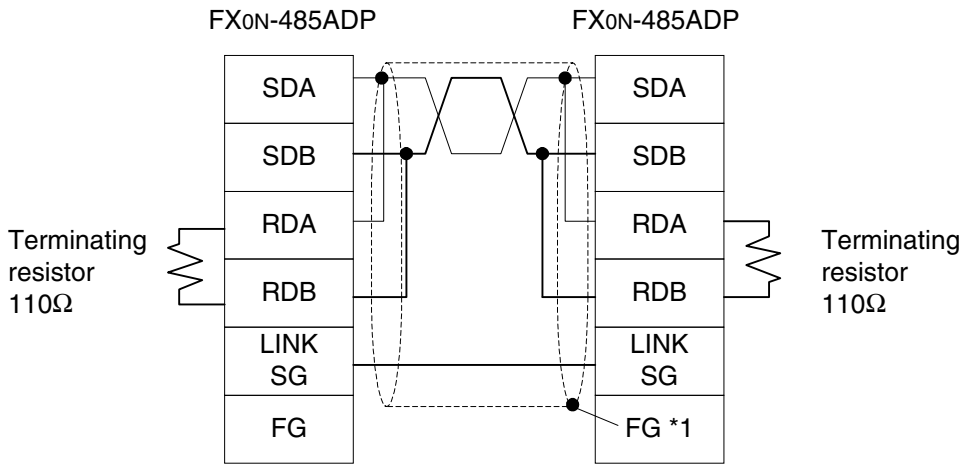


Note:

*1 Connect the terminal FG to the ground terminal of a programmable controller grounded with a resistance of 100Ω or less (Class D grounding). If the programmable controller is not equipped with a ground terminal, connect the terminal FG directly to a ground with the resistance of 100Ω or less (Class D grounding).

3.4.2 FX_{0N}-485ADP and FX_{0N}-485ADP

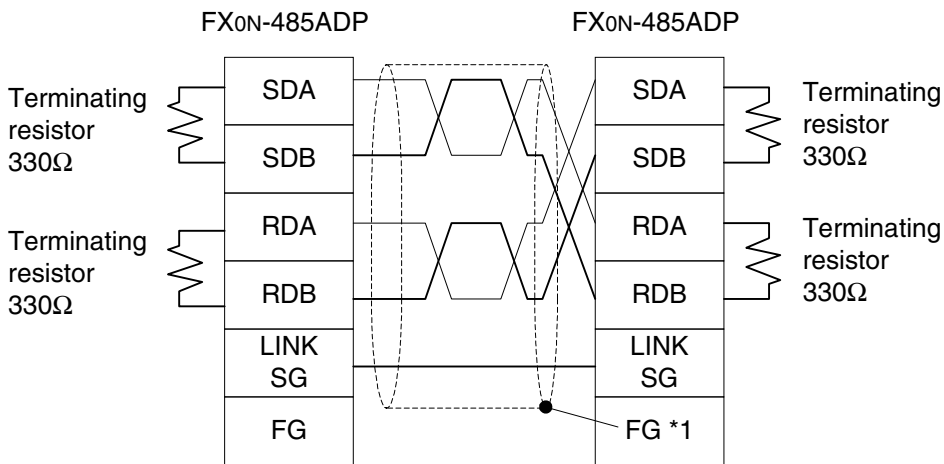
1) One-pair Wiring



Note:

*1 Connect the terminal FG to the ground terminal of a programmable controller grounded with a resistance of 100Ω or less (Class D grounding). If the programmable controller is not equipped with a ground terminal, connect the terminal FG directly to a ground with the resistance of 100Ω or less (Class D grounding).

2) Two-pair Wiring

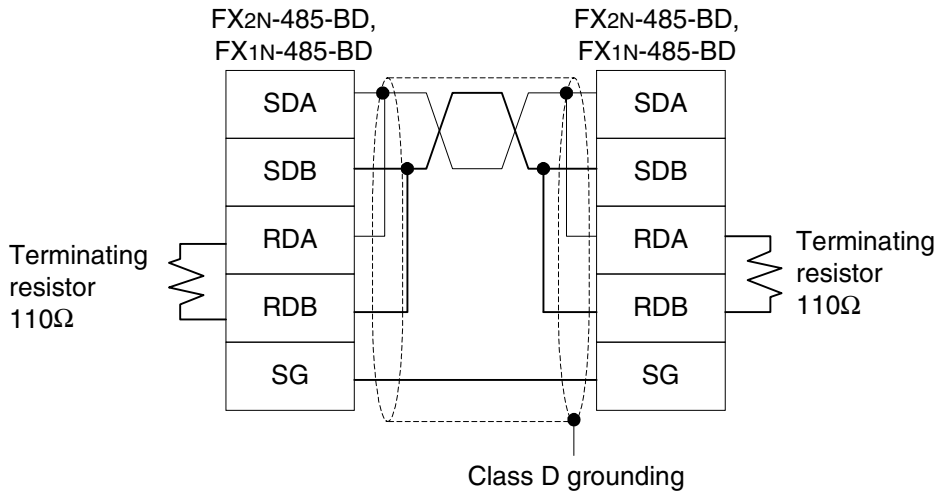


Note:

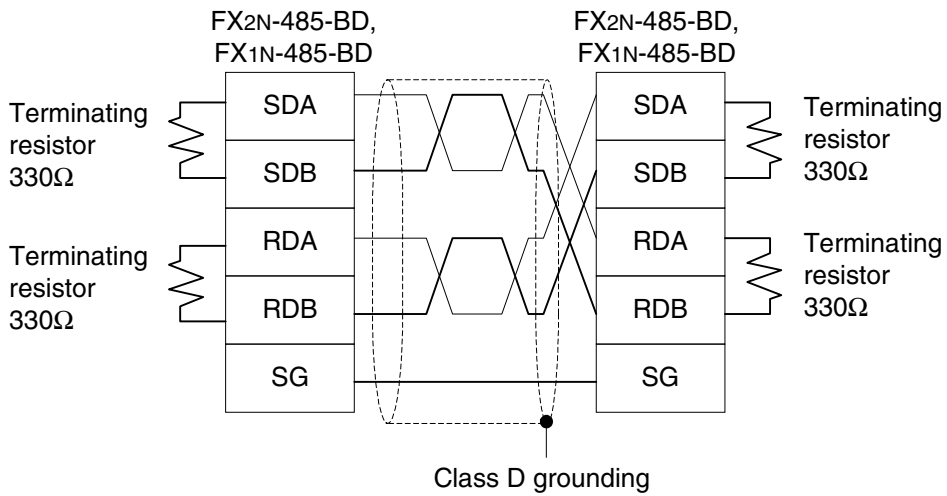
*1 Connect the terminal FG to the ground terminal of a programmable controller grounded with a resistance of 100Ω or less (Class D grounding). If the programmable controller is not equipped with a ground terminal, connect the terminal FG directly to a ground with the resistance of 100Ω or less (Class D grounding).

3.4.3 FX2N(1N)-485-BD and FX2N(1N)-485-BD

1) One-pair Wiring

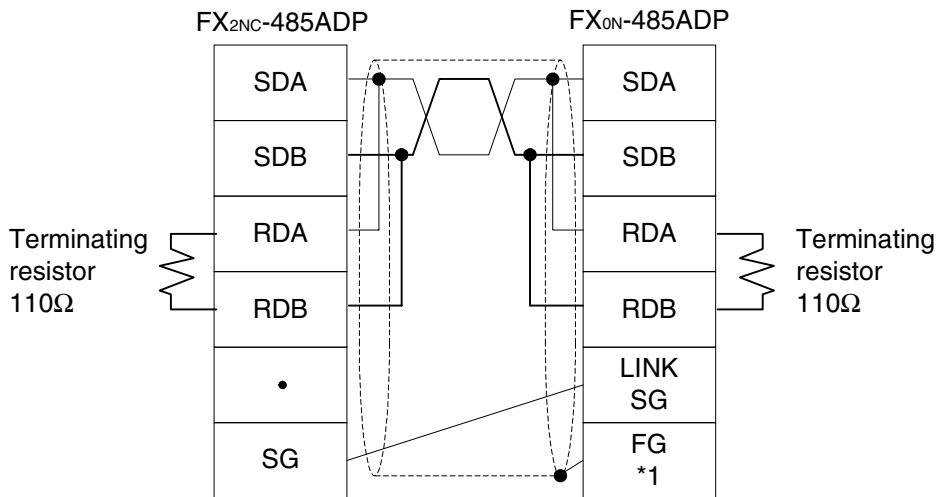


2) Two-pair Wiring



3.4.4 FX_{2NC}-485ADP and FX_{0N}-485ADP

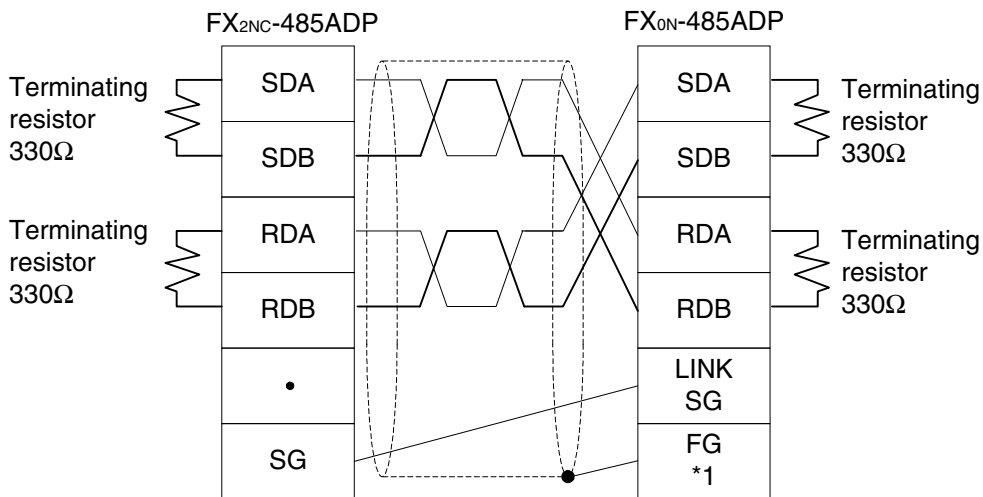
1) One-pair Wiring



Note:

*1 Connect the terminal FG to the ground terminal of a programmable controller grounded with a resistance of 100Ω or less (Class D grounding). If the programmable controller is not equipped with a ground terminal, connect the terminal FG directly to a ground with the resistance of 100Ω or less (Class D grounding).

2) Two-pair Wiring

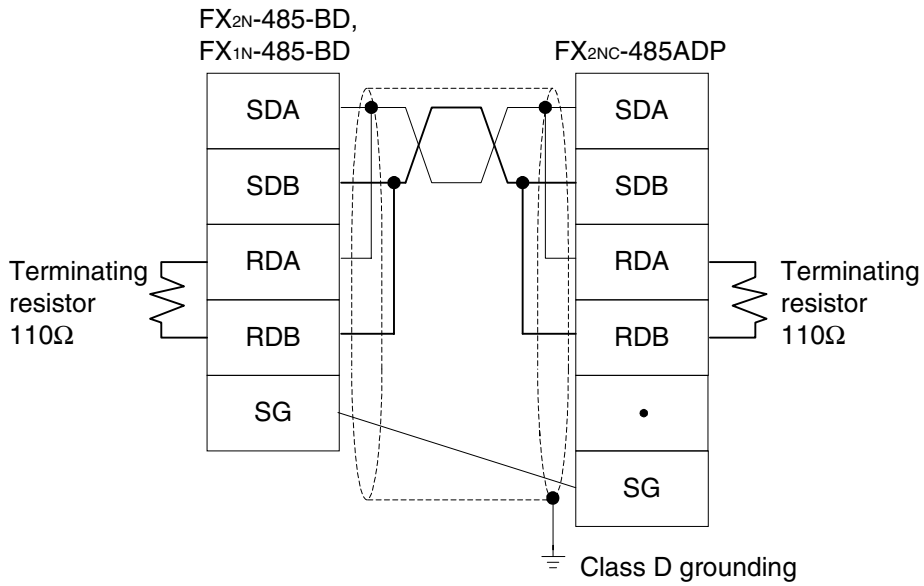


Note:

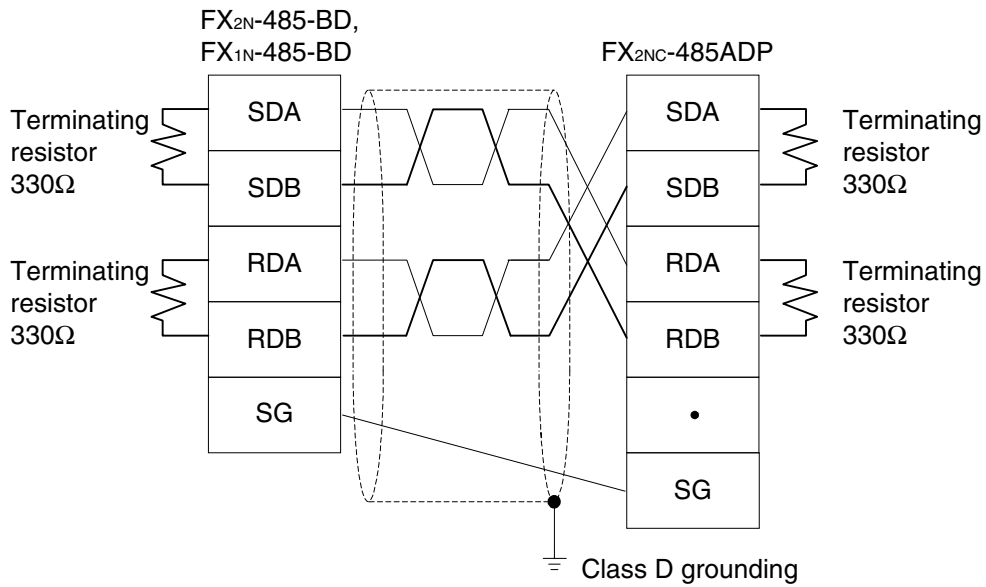
*1 Connect the terminal FG to the ground terminal of a programmable controller grounded with a resistance of 100Ω or less (Class D grounding). If the programmable controller is not equipped with a ground terminal, connect the terminal FG directly to a ground with the resistance of 100Ω or less (Class D grounding).

3.4.5 FX_{2N(1N)}-485-BD and FX_{2NC}-485ADP

1) One-pair Wiring

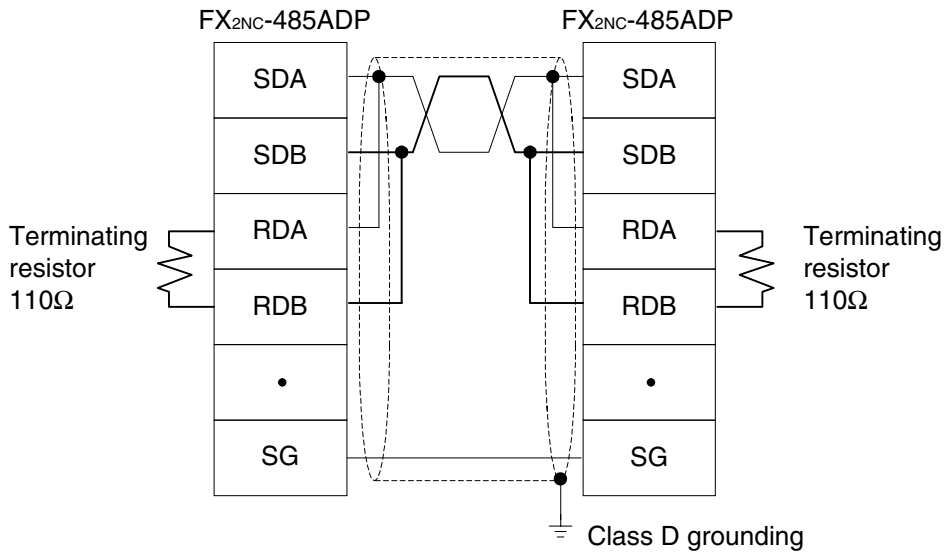


2) Two-pair Wiring

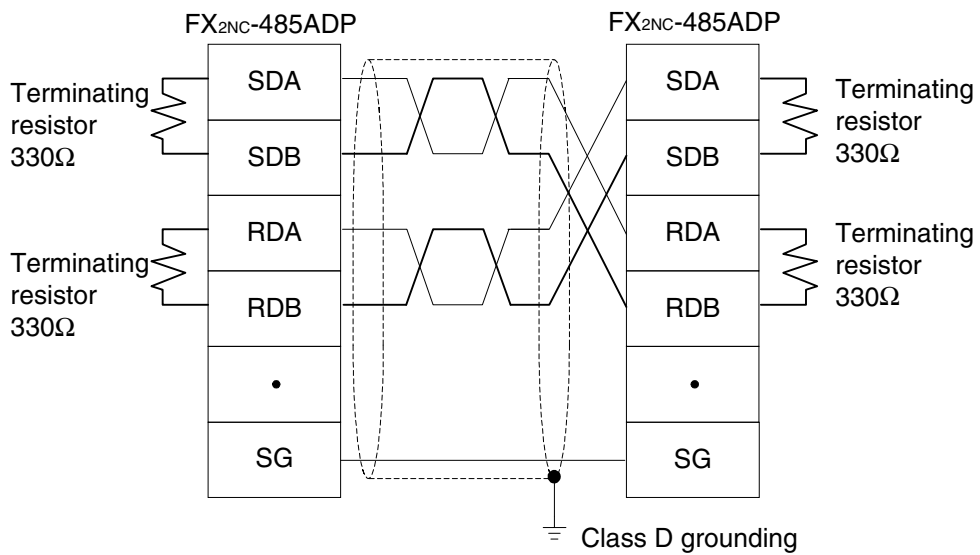


3.4.6 FX_{2NC}-485ADP and FX_{2NC}-485ADP

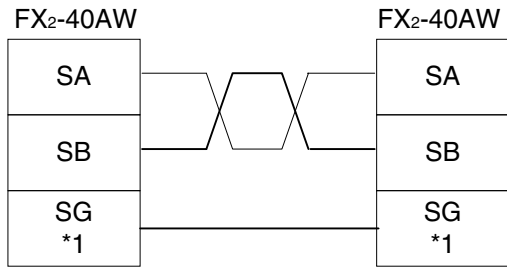
1) One-pair Wiring



2) Two-pair Wiring



3.4.7 FX2-40AW and FX2-40AW

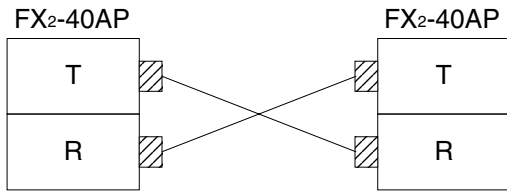


Note:

*1 Connect the terminal SG to the terminal SG of the basic unit.
Two SG terminals are connected to each other internally.

3

3.4.8 FX2-40AP and FX2-40AP



Note:

- "▨" indicates an optical connector. Keep optical connectors away from cabling carrying high loads. Output terminals (Y000 to Y003) located near optical connectors must have light loads connector.

MEMO

4.1.2 Data Registers

Attribute	Data Registers		Name	Description	Response type
	FX _{0N} , FX _{1S}	FX _{1N} , FX _{2N} , FX _{2NC}			
R	D8173		Station No.	Saves its own station No.	M, L
R	D8174		Total number of slave stations	Saves total number of slave stations	M, L
R	D8175		Refresh range	Saves refresh range	M, L
W	D8176		Station number setting	Sets its own station No.	M, L
W	D8177		Total slave station number setting	Sets total number of slave stations	M
W	D8178		Refresh range setting	Sets refresh range	M
W/R	D8179		Retry count setting	Sets retry count	M
W/R	D8180		Comms time-out setting	Sets comms time-out	M
R	D201	D8201	Current network scan time	Saves current network scan time	M, L
R	D202	D8202	Maximum network scan time	Saves maximum network scan time	M, L
R	D203	D8203	Number of communication error at master station	Number of communication error at master station *1	L
R	D204 to D210 *2	D8204 to D8210 *3	Number of communication error at slave station	Number of communication error at slave station *1	M, L
R	D211	D8211	Code of communication error at master station	Code of communication error at master station *1	L
R	D212 to D218 *2	D8212 to D8218 *3	Code of communication error at slave station	Code of communication error at slave station *1	M, L
—	D219 to D255	—	Not used	For internal processing	—

R : Read only W : Write only M : Master station L : Slave station

*1 The number of communication errors occurred in its own station cannot be counted in the CPU error status, the program error status or the stop status.

*2 Number (Same meaning but looks better.) in accordance with the slave station No.
Slave station No.1 is D204, D212, slave station No.2 is D205, D213,
... slave station No.7 is D210, D218.

*3 Number (Same meaning but looks better.) in accordance with the slave station No.
Slave station No.1 is D8204, D8212, slave station No.2 is D8205, D8213,
... slave station No.7 is D8210, D8218.

**Note;**

- Devices M503-M511 and D201-D255 in the FX_{0N} and FX_{1S} cannot be used in the program. These devices are used by the N:N network.

4.2 Setting

N:N settings become valid when the program is run or when the power of the programmable controller is turned ON.

4.2.1 Setting the Station No. (D8176)

Set a value 0 to 7 to the special data register D8176.

Set value	Description
0	Master station
1 to 7	Slave station No. Example: 1 is slave station No.1, 2 is slave station No.2

4.2.2 Setting the Total Number of Slave Stations (D8177)

Set a value 1 to 7 to the special data register D8177. (Default = 7)
This setting is not required for the slave station.

Set value	Description
1	1 slave station
2	2 slave stations
:	:
7	7 slave stations

4.2.3 Setting the Refresh Range (D8178)

Set a value 0 to 2 to the special data register D8178. (Default = 0)

This setting is not required for the slave station.

The devices used in each pattern are occupied by all the stations for the N:N network.

Communication device	Refresh range		
	Pattern 0 (FX _{0N} , FX _{1S} , FX _{1N} , FX _{2N} , FX _{2NC})	Pattern 1 (FX _{1N} , FX _{2N} , FX _{2NC})	Pattern 2 (FX _{1N} , FX _{2N} , FX _{2NC})
Bit device (M)	0 point	32 points	64 points
Word device (D)	4 points	4 points	8 points



Note;

- Please set the refresh range to pattern 0. When setting it other than pattern 0, all FX_{0N} and FX_{1S} series units in the system experience a communications error. In this case, please note that link time becomes as long as the FX_{0N} and FX_{1S} communication error is occurring.

1) In the case of pattern 0 (FX_{0N}, FX_{1S}, FX_{1N}, FX_{2N}, FX_{2NC})

Station No.	Device No.	
	Bit device (M)	Word device (D)
	0 point	4 points
No.0	—	D0 to D3
No.1	—	D10 to D13
No.2	—	D20 to D23
No.3	—	D30 to D33
No.4	—	D40 to D43
No.5	—	D50 to D53
No.6	—	D60 to D63
No.7	—	D70 to D73

2) In the case of pattern 1 (FX_{1N}, FX_{2N}, FX_{2NC})

Station No.	Device No.	
	Bit device (M)	Word device (D)
	32 points	4 points
No.0	M1000 to M1031	D0 to D3
No.1	M1064 to M1095	D10 to D13
No.2	M1128 to M1159	D20 to D23
No.3	M1192 to M1223	D30 to D33
No.4	M1256 to M1287	D40 to D43
No.5	M1320 to M1351	D50 to D53
No.6	M1384 to M1415	D60 to D63
No.7	M1448 to M1479	D70 to D73

3) In the case of pattern 2 (FX_{1N}, FX_{2N}, FX_{2NC})

Station No.	Device No.	
	Bit device (M)	Word device (D)
	64 points	8 points
No.0	M1000 to M1063	D0 to D7
No.1	M1064 to M1127	D10 to D17
No.2	M1128 to M1191	D20 to D27
No.3	M1192 to M1255	D30 to D37
No.4	M1256 to M1319	D40 to D47
No.5	M1320 to M1383	D50 to D57
No.6	M1384 to M1447	D60 to D67
No.7	M1448 to M1511	D70 to D77

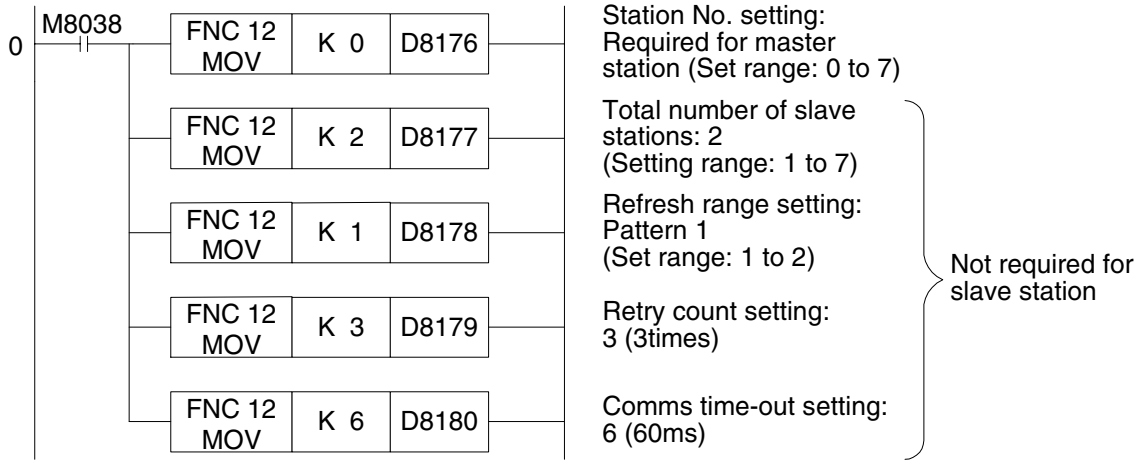
4.2.4 Setting Retry Count (D8179)

Set a value 0 to 10 to the special data register D8178. (Default = 3)
 This setting is not required for the slave station.
 If a master station tries to communicate with the slave station at this retry count (or over), communication error occur in the station.

4.2.5 Setting Comms Time-out (D8180)

Set value 5 to 255 to the special data register D8179. (Default = 5)
 This value multiplied by 10(ms) is duration of the comms time-out.
 Comms time-out is the communication dwell time between the master station and slave station.

4.2.6 Program Used for Setting



Make sure to write the program above step 0 as the N:N network parameter setting program. This program does not require to be executed, because it becomes effective automatically when it is programmed in this position.

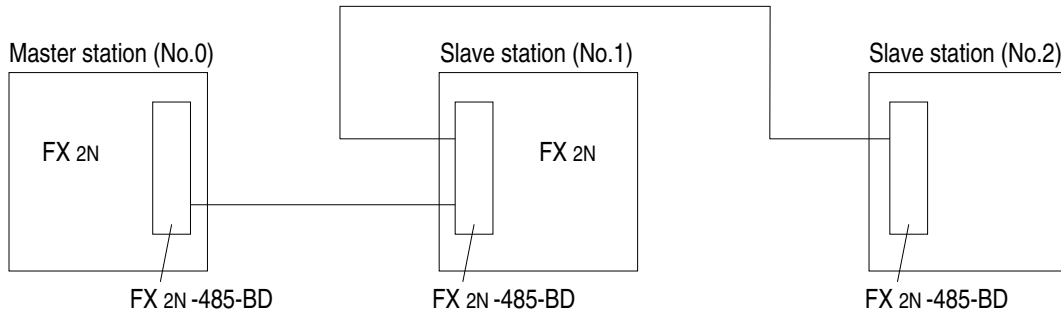


Note:

- Setting of the parameters for the N:N network is started at step 0 (LD M8038), and finished when any instruction or device other than the program above is processed.

4.3 Example Program

4.3.1 System Configuration



- Refresh range: 32 bit devices and 4 word devices (Pattern 1)
- Retry count: 3 times
- Comms time-out: 5 (50 ms)

4.3.2 Operations

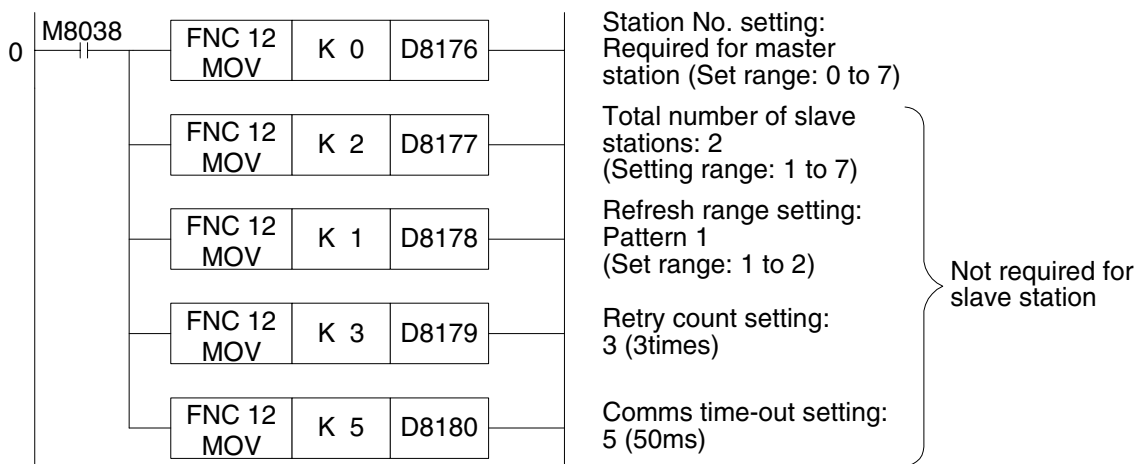
The following operations are performed in the system configuration above.

- 1) The input points X000 to X003 (M1000 to M1003) in the master station are output to the output points Y010 to Y013 in the stations Nos.1 and 2.
- 2) The input points X000 to X003 (M1064 to M1067) in the station No.1 are output to the output points Y014 to Y017 in the master station and the station No.2.
- 3) The input points X000 to X003 (M1128 to M1131) in the station No.2 are output to the output points Y020 to Y023 in the master station and the station No.1.
- 4) The data register D1 in the master station is specified as the set value of the counter C1 in the station No.1.
The contact (M1070) status of the counter C1 is reflected on the output point Y005 in the master station.
- 5) The data register D2 in the master station is specified as the set value of the counter C2 in the station No.2.
The contact (M1140) status of the counter C2 is reflected on the output point Y006 in the master station.
- 6) The value of the data register D10 in the station No.1 and the value of the data register D20 in the station No.2 are added in the master station, and saved to the data register D3.
- 7) The value of the data register D10 in the master station and the value of the data register D20 in the station No.2 are added in the station No.1, and saved to the data register D11.
- 8) The value of the data register D10 in the master station and the value of the data register D10 in the station No.1 are added in the station No.2, and saved to the data register D21.

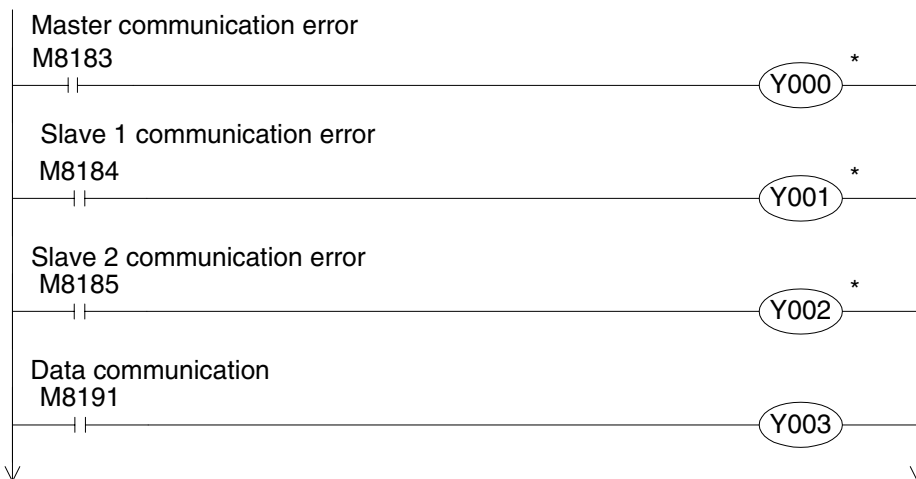
4.3.3 Example of Setting Program

For the setting program of the master station and the stations Nos.1 and 2, refer to the program below.

	Master station	Slave station No.1	Slave station No.2	Remarks
D8176	K0	K1	K2	Station No.
D8177	K2	—	—	Total slave station : 2 stations
D8178	K1	—	—	Refresh range : Pattern 1
D8179	K3	—	—	Retry count : 3 times (default)
D8180	K5	—	—	Comms time-out : 50 ms (default)



4.3.4 Example of Error Program

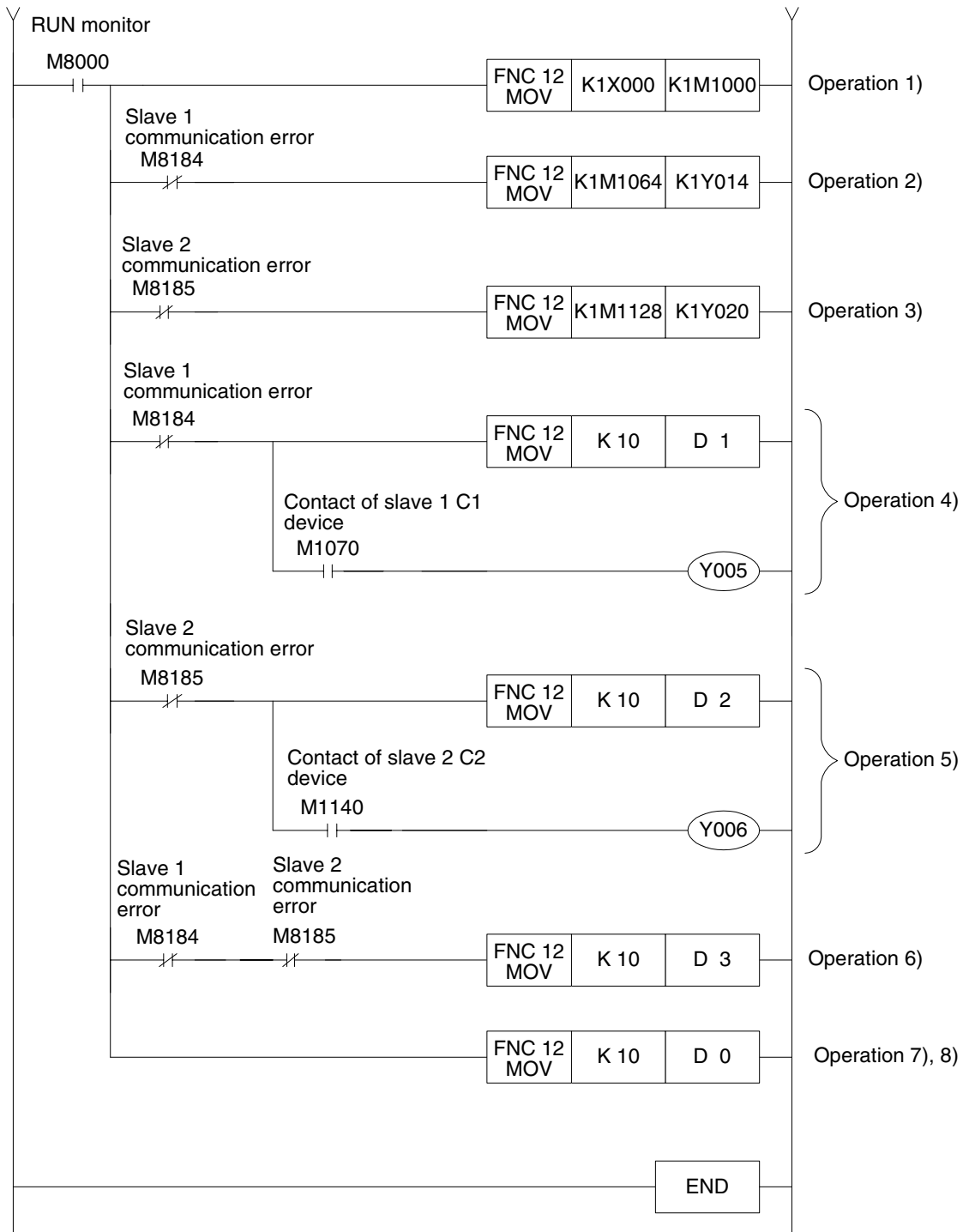


Continued to a), b) or c) in "4.3.5 Program".

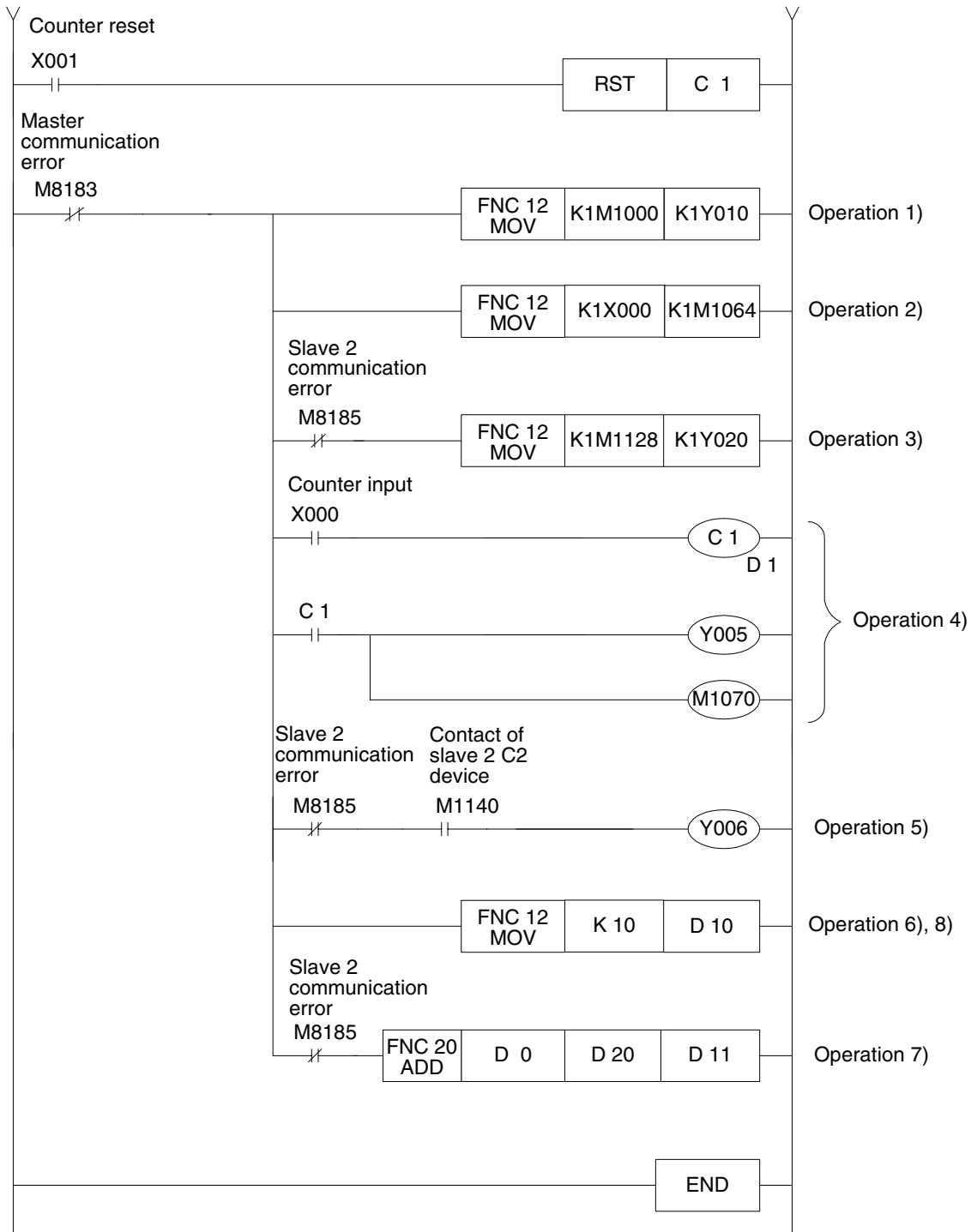
* A station cannot recognize its own error. An error program for each station is not necessary.

4.3.5 Example of Operation Program

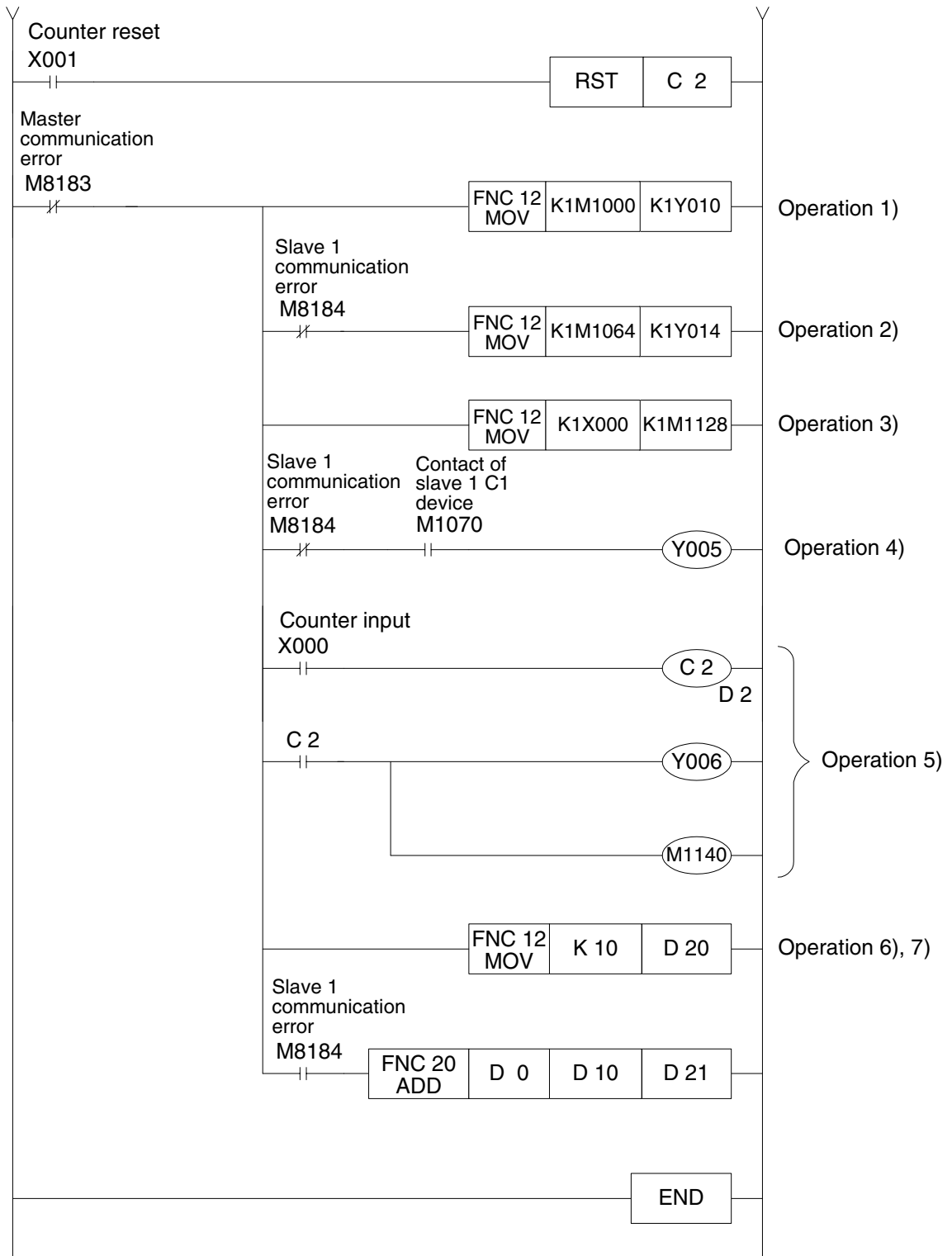
a) Program of master station



b) Program of slave station No.1



c) Program of slave station No.2



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5. Parallel link

Data transfer with FX_{2N}, FX_{2NC}, FX_{1N}, FX, FX_{2C} programmable controllers can be performed on a 1:1 basis for 100 auxiliary relays and 10 data registers. Data transfer with FX_{1S}, FX_{0N} programmable controller can be performed on a 1:1 basis for 50 auxiliary relays and 10 data registers.

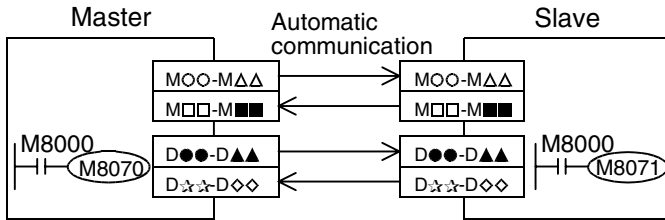
For system configuration, refer to subsection 1.2.2.

5.1 Related Flags and Data Registers

Device	Operation
M8070	Driven when the programmable controller is a master station in a parallel link.
M8071	Driven when the programmable controller is a slave station in a parallel link.
M8072	ON while the programmable controller is operating in a parallel link.
M8073	ON when M8070/M8071 are incorrectly set during parallel link operations.
M8162	High speed mode for parallel link, 2 data words read/write only.
M8070	Parallel link watchdog time (Default: 500 ms).

5.2 Mode and Link Device

5.2.1 Normal Mode (Special auxiliary relay M8162: OFF)



		FX _{2N} , FX _{2NC} , FX _{1N} , FX, FX _{2C}	FX _{1S} , FX _{0N}
Communication devices	Master → Slave	M800 to M899 (100 points), D490 to D499 (10 points)	M400 to M449 (50 points), D230 to D239 (10 points)
	Slave → Master	M900 to M999 (100 points), D500 to D509 (10 points)	M450 to M499 (50 points), D240 to D249 (10 points)
Communication time		70 (ms) + Scan time of master (ms) + Scan time of slave (ms)	



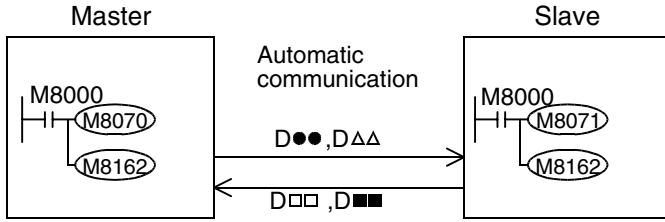
Note;

Parallel link is possible between PLC's in the same series, or in other series as long as they are in the group. However, parallel link between each different group cannot be achieved.

Groups are separated as follows.

Group No.	Series
Group 1	FX _{2N} , FX _{2NC}
Group 2	FX _{1N}
Group 3	FX _{1S}
Group 4	FX _{0N}
Group 5	FX, FX _{2C}

5.2.2 High Speed Mode (Special auxiliary relay M8162: ON)



		FX _{2N} , FX _{2NC} , FX _{1N} , FX, FX _{2C}	FX _{1S} , FX _{0N}
Communication devices	Master → Slave	D490, D491 (2 points)	D230, D231 (2 points)
	Slave → Master	D500, D501 (2 points)	D240, D241 (2 points)
Communication time		20 (ms) + Scan time of master (ms) + Scan time of slave (ms)	



Note;

Parallel link is possible between PLC's in the same series, or in other series as long as they are in the group. However, parallel link between each different group cannot be achieved.

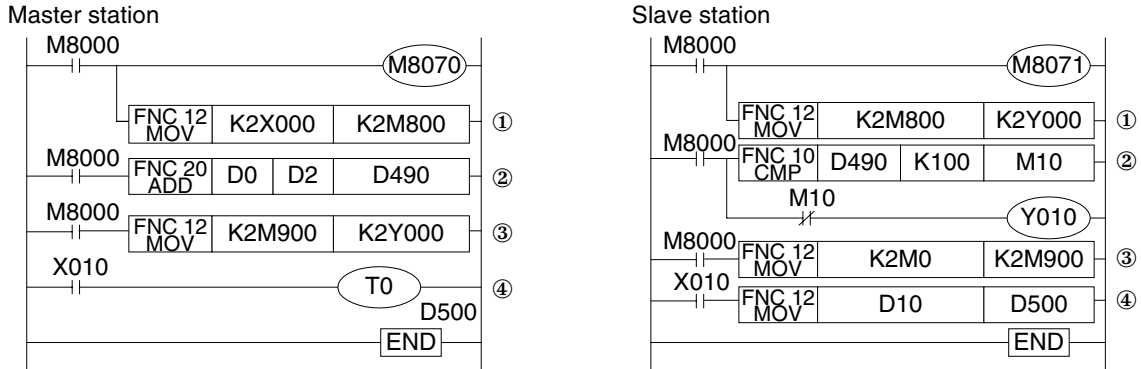
Groups are separated as follows.

Group No.	Series
Group 1	FX _{2N} , FX _{2NC}
Group 2	FX _{1N}
Group 3	FX _{1S}
Group 4	FX _{0N}
Group 5	FX, FX _{2C}

5.3 Example Program

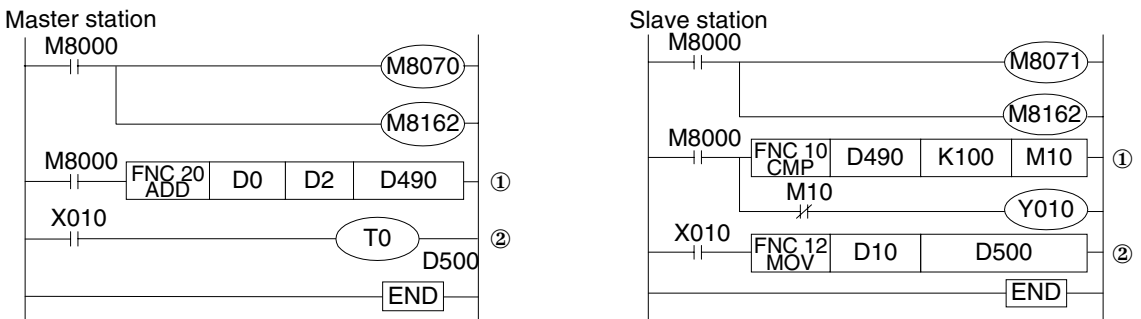
5.3.1 Normal Mode

The ON/OFF status of the inputs X000 to X007 in the master station is output to Y000 to Y007 in the slave station (①). When the calculation result (D0+D2) in the master station is 100 or less, Y010 in the slave station is turned on (②). The ON/OFF status of M0 to M7 in the slave station is output to Y000 to Y007 in the master station (③). The value of D10 in the slave station is set to the timer (T0) in the master station (④).



5.3.2 High Speed Mode

When the calculation result (D0+D2) in the master station is 100 or less, Y010 in the slave station is turned on (①). The value of D10 in the slave station is set to the timer (T0) in the master station (②).



Note;

In the normal mode, “FNC 81 PRUN” instruction can be used for ①. However, this instruction is only supported for FX1S, FX1N, FX, FX2C, FX2N, FX2NC programmable controller.

6. Communication format (D8120)

This chapter explains setting the communication between no protocol communication (RS instruction) and computer link. For the RS instruction, refer to Section 9. For computer link, refer to Sections 7 and 8.

6.1 What Is Communication Format?

The communication format decides the communication setting (data length, parity, and baud rate, etc.) between computer link and no protocol communication (RS instruction).

The communication format can be set using the special data register D8120* in a programmable controller. Set D8120 in accordance with external equipment used.

After modifying the setting of the D8120, make sure to turn off the power of the programmable controller, then turn it on again.

* In the FX_{2N}, FX_{2NC} series, this setting can be performed using parameters.

6.2 Related Flags and Data Registers

6.2.1 Special Auxiliary Relays

Special auxiliary relays	Description
M8121	Data transmission delayed (RS instruction)
M8122	Data transmission flag (RS instruction)
M8123	Finished receiving flag (RS instruction)
M8124	Carrier detection flag (RS instruction)
M8126	Global flag (computer link)
M8127	On-demand handshake flag (computer link)
M8128	On-demand error flag (computer link)
M8129	On-demand word/byte changeover (computer link)
	Time out evaluation flag (RS instruction)
M8161	8 bits/16 bits changeover flag (RS instruction)

() indicates the applicable application.

6.2.2 Special Data Registers

Special data registers	Description
D8120	Communication format (RS instruction, computer link)
D8121	Station No. setting (computer link)
D8122	Number of remaining data to be transmitted (RS instruction)
D8123	Number of receive data (RS instruction)
D8124	Data header <Initial value: STX> (RS instruction)
D8125	Data terminator <Initial value: ETX> (RS instruction)
D8127	On-demand head device register (computer link)
D8128	On-demand data length register (computer link)
D8129	Data network Time-out timer value (RS instruction, computer link)

() indicates the applicable application.

6.3 Communication Format (D8120)

Bit No.	Name	Description	
		0 (bit = OFF)	1 (bit = ON)
b0	Data length	7 bit	8 bit
b1 b2	Parity	(b2, b1) (0, 0) : None (0, 1) : Odd (1, 1) : Even	
b3	Stop bit	1 bit	2 bit
b4 b5 b6 b7	Baud rate(bps)	(b7, b6, b5, b4) (b7, b6, b5, b4) (0, 0, 1, 1) : 300 (0, 1, 1, 1) : 4,800 (0, 1, 0, 0) : 600 (1, 0, 0, 0) : 9,600 (0, 1, 0, 1) : 1,200 (1, 0, 0, 1) : 19,200 (0, 1, 1, 0) : 2,400	
b8*1	Header	None	Effective (D8124) Default : STX (02H)
b9*1	Terminator	None	Effective (D8125) Default : ETX (03H)
b10 b11 b12	Control line	No protocol	(b12, b11, b10) (0, 0, 0) : No use <RS-232C interface> (0, 0, 1) : Terminal mode <RS-232C interface> (0, 1, 0) : Interlink mode <RS-232C interface > (FX _{2N} V2.00 or more) (0, 1, 1) : Normal mode 1 <RS-232C interface>, <RS-485 (RS-422) interface>*3 (1, 0, 1) : Normal mode 2 <RS-232C interface> (FX, FX _{2C} only)
		Computer link	(b12, b11, b10) (0, 0, 0) : RS-485 (RS-422) interface (0, 1, 0) : RS-232C interface
b13*2	Sum check	Sum check code is not added	Sum check code is added automatically
b14*2	Protocol	No protocol	Dedicated protocol
b15*2	Transmission control protocol	Protocol format 1	Protocol format 4

*1 Make sure to set to "0" when computer link used.

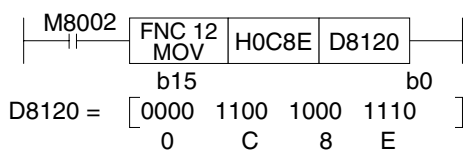
*2 Make sure to set to "0" when no protocol communication used.

*3 When using RS-485 (RS-422) interface, make setting control line the same as this. But control line of communication is the same as when not using control line operation.

This connection (RS-485) is supported in the FX_{0N}, FX_{1S}, FX_{1N}, FX_{2N}, FX_{2NC} series.

6.4 Example of setting program

When setting the contents shown on the left, perform programming as follows.



Data length	7 bits
Parity	Even
Stop bit	2 bits
Baud rate	9600 bps
Protocol	No protocol
Header	No used
Terminator	No used
Control line	Normal mode 1

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7. Computer Link

This chapter explains the details and methods of specifying dedicated protocol used for linking of the FX programmable controller and computer. The dedicated protocol is available in two types, format 1 and format 4 (the format names conform to the dedicated protocols used in the computer link unit of the A series programmable controller).

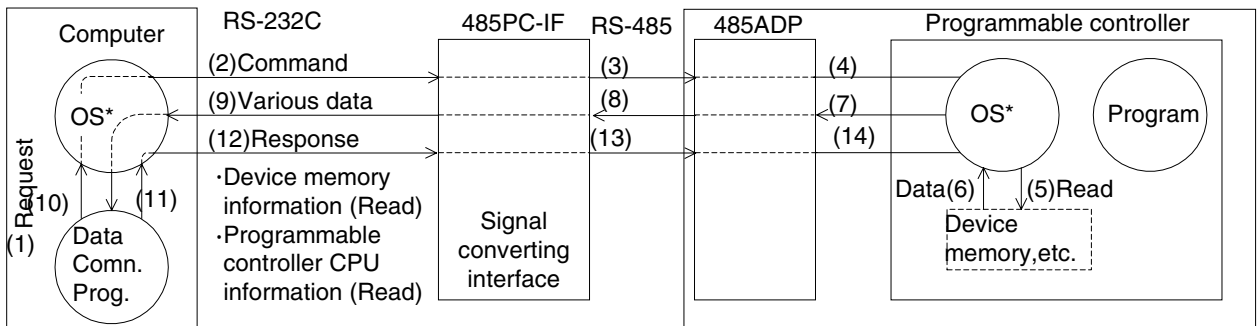
In this chapter FX_{2N}-232-BD, FX_{1N}-232-BD, FX_{0N}-232ADP and FX-232ADP refer to 232ADP, FX_{2N}-485-BD, FX_{1N}-485-BD, FX_{0N}-485ADP and FX-485ADP refer to 485ADP, FX-485PC-IF refer to 485PC-IF.

When interface of programmable controller using RS-232C, please after read 232ADP instead of 485ADP.

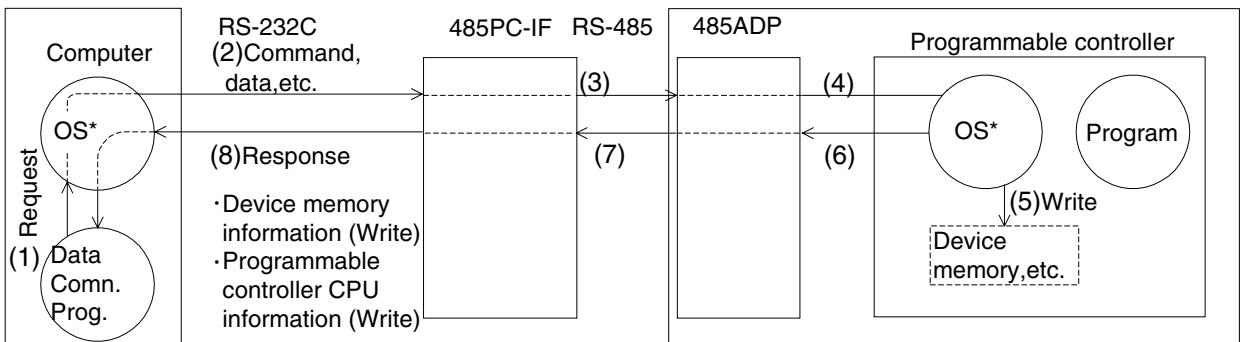
7.1 Data Flow by Link

Shown below are drawings of data flow for reading, writing, and status control of the programmable controller.

1) The computer reads data from programmable controller.

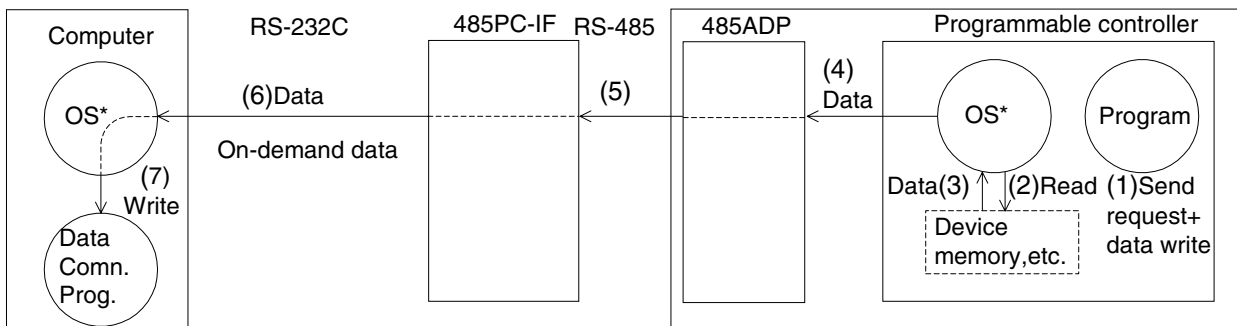


2) The computer sends data to programmable controller.



*OS (operating system) is the software for operating (or using) effectively the resources such as the CPU, memory, terminal, file and network.

3) Programmable controller sends data to the computer.



*OS (operating system) is the software for operating (or using) effectively the resources such as the CPU, memory, terminal, file and network.

7.2 Information Needed Before Programming

7.2.1 Programmable Controller Operation

The operation and the scan time of programmable controller using computer link is as follows. While the programmable controller is running, access requests to the programmable controller from the computer are processed on every END processing. The processing of Send or Receive data is performed using interrupts.

Therefore, during the processing of Send or Receive, the scan time is extended; typically by about 10%. The scan time can be monitored using the special data registers D8010 to D8012 of the programmable controller.

Note:

- These are in units of 0.1 ms

7.2.2 Computer Notes

- 1) Conditions under which the transmission sequence is initialized.
The transmission sequence of the programmable controller is initialized during the following conditions.
 - When the power is turned on
 - When data communication is completed normally
 - When control code EOT or CL is received
 - When a NAK control code is received
 - After the time-out check time has elapsed (see section 7.4.4)
- 2) Occurrence of a framing error at the computer side
When a commercial RS-485 interface is used at the computer, if nothing is transmitted from the programmable controller to the computer at the interface, a framing error may occur at the computer.
Accordingly, read and skip the data at the computer until any one of STX, ACK, and NAK is transmitted from the programmable controller.
- 3) NAK response from programmable controller
NAK response from the programmable controller to the computer is done when an error is detected.
- 4) Command transmission from computer
When sending a command from the computer to the programmable controller using dedicated protocol, only send the command after a gap of approximately two PLC scans from the time the data communications required by the previous command was elapsed.

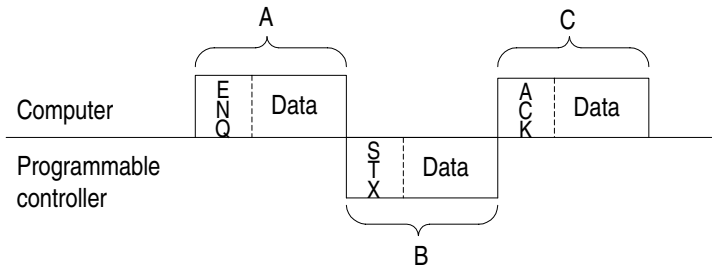


Caution:

When using RS-485 wiring (one pair, see section 2.3.3) remember to take account of/or ignore the “echo” of the commands sent from the computer.

7.3 How to Read a Control Protocol Diagram

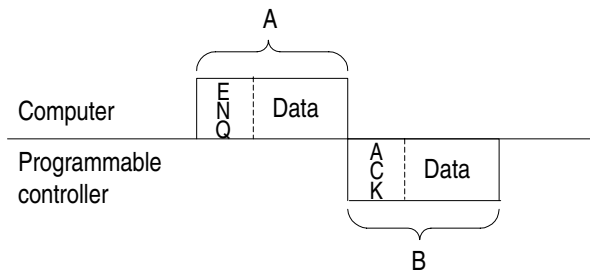
- 1) When the computer reads data from the programmable controller
(computer ← programmable controller)



- a) Areas A and C indicate transmission from the computer to the programmable controller.
- b) Area B denotes transmission from the programmable controller to the computer.
- c) The computer program is created so that the data is transmitted in the order read from left to right, and the protocol determines that the data is sent in the sequence A, B, C.

(Example: In area A, ENQ is transmitted followed by all other data, starting to the right, after the ENQ.)

- 2) When writing data from the computer into the programmable controller
(computer → programmable controller)



- a) Areas A indicates transmission from the computer to the programmable controller.
- b) Area B denotes transmission from the programmable controller to the computer.
- c) The computer program is created so that the data is transmitted in the order read from left to right, and the protocol determines that the data is sent in the sequence A, B.

(Example: In area A, ENQ is transmitted followed by all other data, starting to the right, after the ENQ.)

7.4 Basic Formats of Dedicated Protocol

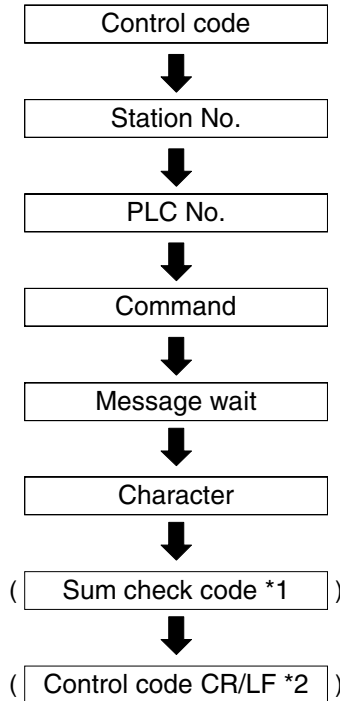
There are two formats for the dedicated protocol; which may be selected by setting special data register D8120(see chapter 6).

The difference between these two formats is whether CR + LF is added to each block or not.

The protocols are format 1 and format 4. (The format names conform to the computer link unit for the A series programmable controller.)



Basic format of transmitted data.



Note:

*1 Whether or not to add sum check code can be selected using the communication format special data register D8120.

*2 Whether or not to add terminating CR + LF codes is determined by the protocol selected.

7.4.1 Control Protocol Format 1

Description	Control protocol
<p>To read data from the PLC to the computer</p>	
<p>To write data from the computer to the PLC</p>	
<p>Remarks</p>	<ol style="list-style-type: none"> 1) Sum check code is used when the sum check flag is set "Yes" ("b13=1" in special data register D8120), and not used when set to "No" ("b13=0"). 2) When the sum check flag is set to "Yes", the sum check is made on the characters in the asterisked area. 3) In the diagram, the contents of character area A, character area B, and character area C depend on the individual system, but do not differ depending on the format of control protocol. For details of each character area, see the link contents.

7.4.2 Control Protocol Format 4

Description	Control protocol
<p>To read data from the PLC to the computer</p>	<p>Transmission sequence</p> <p>Computer Programmable controller</p> <p>ENQ</p> <p>Sum check code</p> <p>Character area A</p> <p>Message wait time</p> <p>Command</p> <p>PLC No.</p> <p>Station No.</p> <p>ENQ</p> <p>STX</p> <p>Sum check code</p> <p>Character area B</p> <p>Error code</p> <p>PLC No.</p> <p>Station No.</p> <p>NAK</p> <p>ACK</p> <p>Sum check code</p> <p>Error code</p> <p>PLC No.</p> <p>Station No.</p> <p>NAK</p>
<p>To write data from the computer to the PLC</p>	<p>Computer Programmable controller</p> <p>ENQ</p> <p>Sum check code</p> <p>Character area C</p> <p>Message wait time</p> <p>Command</p> <p>PLC No.</p> <p>Station No.</p> <p>ENQ</p> <p>ACK</p> <p>Sum check code</p> <p>Error code</p> <p>PLC No.</p> <p>Station No.</p> <p>NAK</p> <p>Sum check code</p> <p>Error code</p> <p>PLC No.</p> <p>Station No.</p> <p>NAK</p> <p>Transmission sequence</p>
<p>Remarks</p>	<ol style="list-style-type: none"> 1) Sum check code is used when the sum check flag is set "Yes" ("b13=1" in special data register D8120), and not used when set to "No" ("b13=0"). 2) When the sum check flag is set to "Yes", the sum check is made on the characters in the asterisked area. 3) In the diagram, the contents of character area A, character area B, and character area C depend on the individual system, but do not differ depending on the format of control protocol. For details of each character area, see the link contents.

7.4.3 Control Protocol Parts Explained

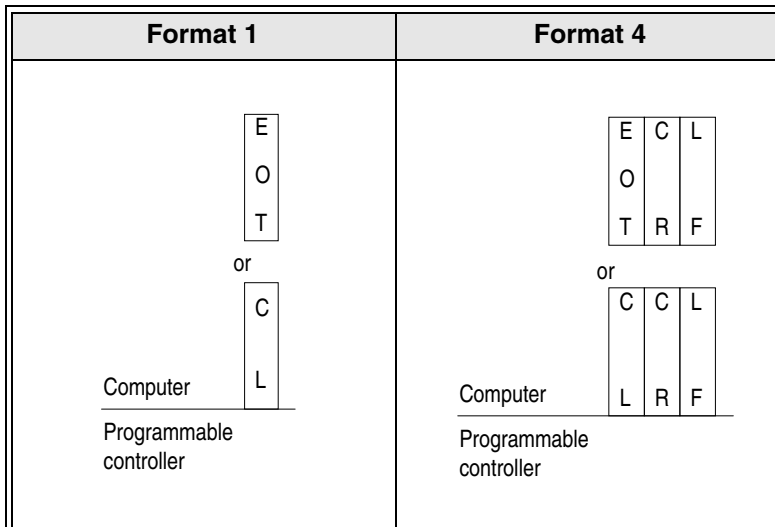
This is to explain the content of data set in each control procedure.

1) Control codes

The control codes are listed below.

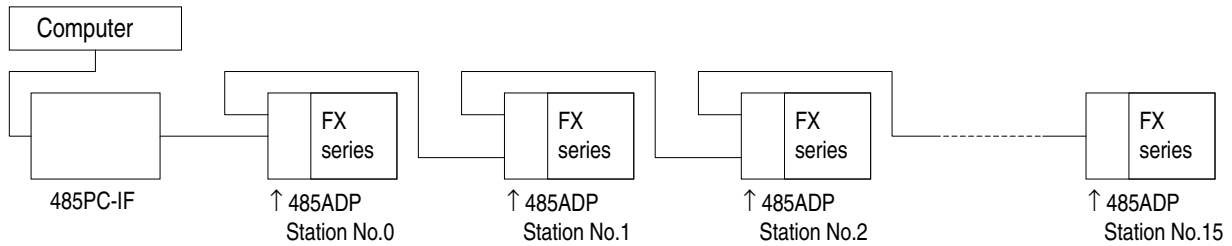
Signal	Code (Hexadecimal)	Description	Signal	Code (Hexadecimal)	Description
STX	02H	Start of Text	LF	0AH	Line Feed
ETX	03H	End of Text	CL	0CH	Clear
EOT	04H	End of Transmission	CR	0DH	Carriage Return
ENQ	05H	Enquiry	NAK	15H	Not Acknowledge
ACK	06H	Acknowledge			

- a) The programmable controller initializes the transmission sequence when receiving any one of ENQ, ACK, NAK, and starts.
- b) When EOT, or CL code is received as follows, the programmable controller initializes the transmission sequence. At this time, no response is made from the programmable controller.

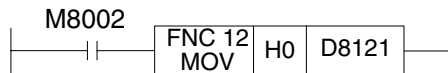


2) Station number

The station number is the number provided at the programmable controller in order to determine which programmable controller the computer accesses. In the FX series programmable controller, the station number is set by the special data register D8121(special D8121 hereinafter). The setting range is 00H to 0FH. In the case of FX_{0N} series turn on M8120 when using the special D8121. For the setting method of an A series programmable controller, see the A series manual.



The following instructions can be used to set the station number of station 0 in the above system.



Notes

- 1) When setting station numbers, don't set the same number at more than 1 station. Otherwise, transmission data may become confused and communication irregular.
- 2) Station numbers need not be set in numerical order, but are free to be set within the specified range(00H to 0FH). For example, setting in a random order or skipping numbers is acceptable.
- 3) PLC number
 The PLC number is the number identifying the programmable controller CPU on the A series MELSECNET(II) or MELSECNET/B.
 Accordingly, the PLC number for an FX series programmable controller is FF_H, and is represented as two ASCII characters; i.e. "FF". When using the on-demand function the PLC number is automatically converted to FF_H by the programmable controller.
 For the PLC number of programmable controller CPU on the MELSECNET(II), MELSECNET/B see the computer link manual for A series programmable controllers.
- 4) Command
 Used to specify the operation required, e.g. read, write, etc. Commands are defined using two ASCII characters.
 For a description of the available commands, see section 7.7.1.

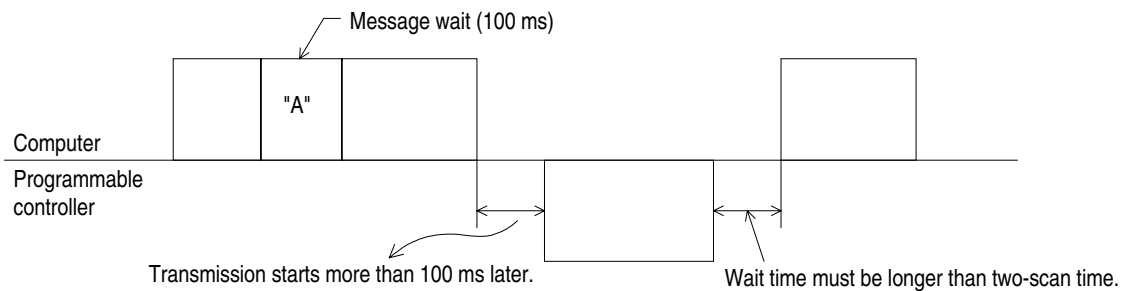
5) Message wait

This is a delay time required by some computers to switch between send and receive states. The message wait time determines the minimum delay before the programmable controller sends data after receiving a message from the computer. Set the wait time according to the computer specifications.

The message wait time may be set between 0 to 150 ms in 10 ms increments. The value is set using a single ASCII character ("0" to "F") representing 0H to FH (0 to 15).

When using the 485PC-IF in a 1:n system always set the message to be 70 ms or longer (7 or more). If scan time of programmable controller is 70 ms or more on the network, message wait time needs to be set at maximum scan time or more.

Example: Setting the message wait time



6) Sum check code

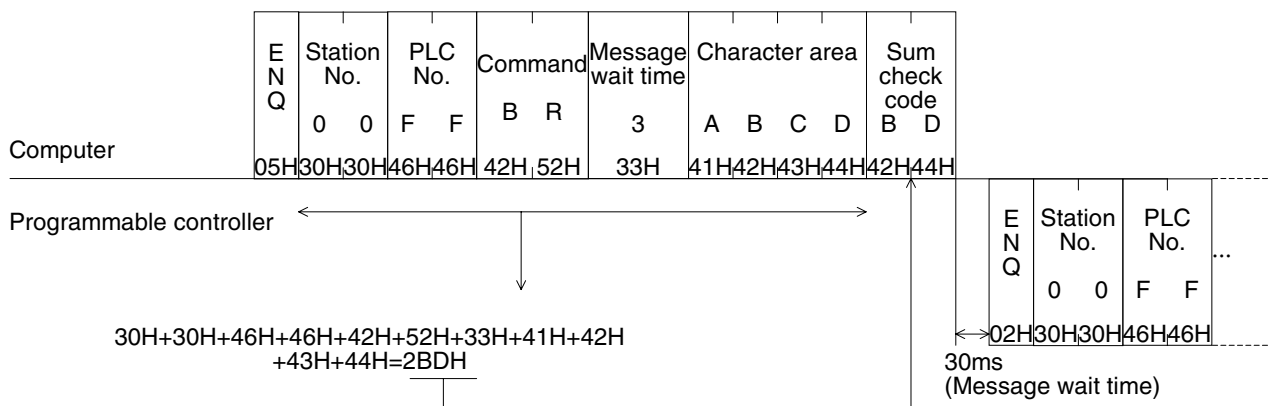
The sum check code is used to verify that the data in a message has not been corrupted. It is calculated by adding (summing) the hexadecimal values of the ASCII character codes in the sum check area of a message. The lower two digits (in hexadecimal) of the summed result (the sum check code) are then represented as two ASCII characters at the end of the message. (Note: The sum of the decimal ASCII character codes, converted to hexadecimal, will give the same result).

Special data register D8120 (communication format) b13, sets whether or not to add the sum check code to the message.

- When "b13=1", the sum check code is automatically added to messages when transmitting, and a new sum check value is calculated from the Receive data and compared with the received sum check value, thereby checking the Receive message.
- When "b13=0", the sum check code is not added, and the Receive data is not checked.

An example showing how to calculate the sum check code is given below.

Example: When transmitting station number 0, PLC number FF, command BR (device memory batch read), message wait time 30 ms, and data ABCD in format 1, the sum check code is calculated as follows.

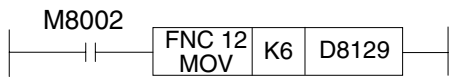


7.4.4 Time-out Check Time

The time out check time refers to the duration after termination of receive (final character received) of a failed transmission from the computer to the programmable controller, until the send sequence is initialized.

This check time is specified as follows depending on the model and version of the programmable controller.

To set the time-out check time as 60 ms:



Other function information:

- In the case of FX0N series, turn on M8120 when using the special D8129.

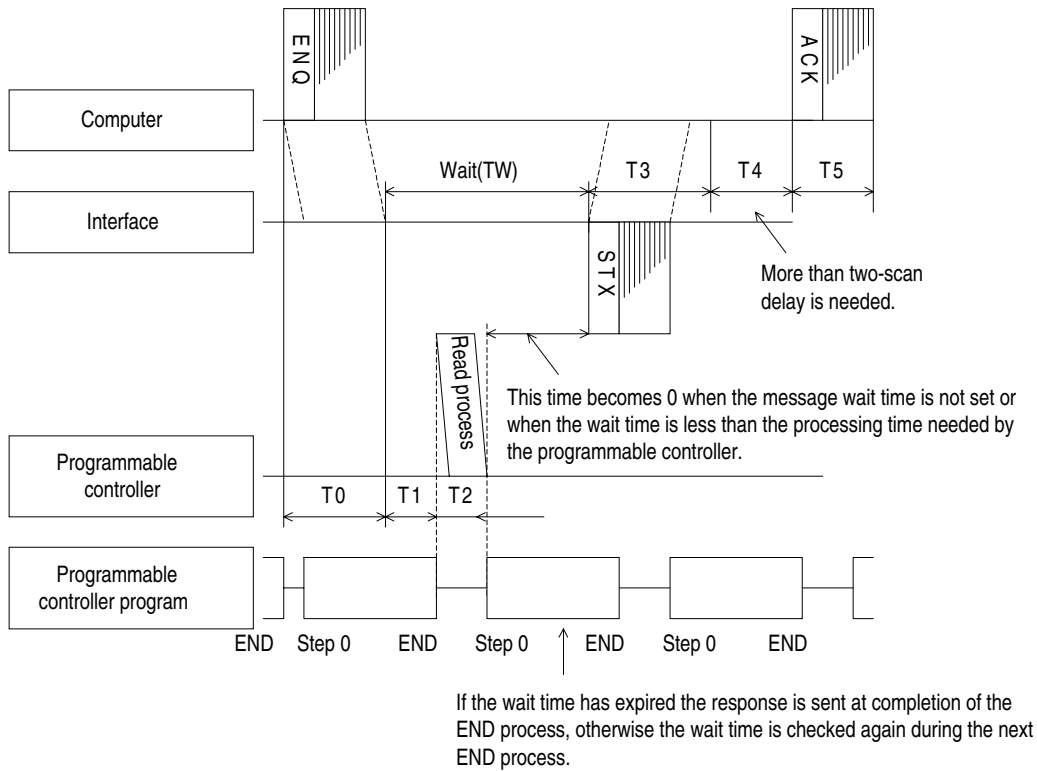
PC series	Setting range
FX0N, FX1S, FX1N	1 to 255 (10 to 2,550 ms) ; however, a setting of "0" gives 100 ms.
FX, FX2C, FX2N, FX2NC	1 to 3,276 (10 to 32,760 ms) ; however, setting of "0" gives 100 ms.

It must be noted that the time-out check time is not updated until the next character is received, and hence must be set to at least more than the time necessary to receive one character at the baud rate (transmission speed) in use. When 1 character = 12 bits, the minimum setting of time-out check time is as follows.

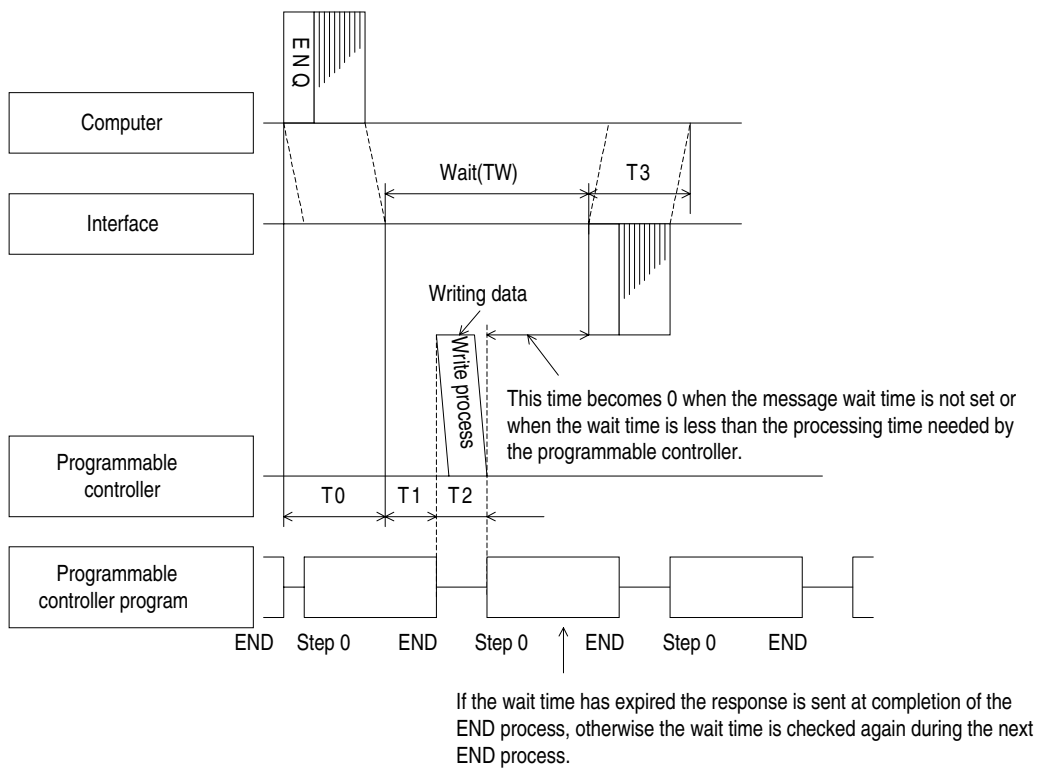
Baud rate (bps)	Time to receive one character (ms)	Time-out check time (set value)
300	40	50ms (5)
600	20	30ms (3)
1200	10	20ms (2)
2400	5	10ms (1)
4800	2.5	10ms (1)
9600	1.25	10ms (1)
19200	0.625	10ms (1)

7.5 Communication Timing Chart

7.5.1 Reading Data from Programmable controller



7.5.2 Writing Data to Programmable Controller



7.5.3 Communication Time

This is to explain the method of calculating the approximate time until all communication is over.

For the locations of T0 to T4, see the previous page.

- 1) When reading data from the programmable controller to the computer
 Communication time = T0 + (T1 + T2 or TW, whichever is longer) + T3 + T4 + T5

$$T0, T3, T5 = \frac{1 + 7(8) + 0(1) + 1(2)}{\text{baud rate}} \times \text{number of characters}$$

T1 =max. 1 scan time (during RUN, message processing is done at END processing, a maximum delay of 1 scan could occur depending on message timing; during STOP, T1 is 1 ms)
 T2 =END process time of programmable controller during data communication
 T4 =A delay of at least 2 scans is required. However, using one-pair wiring on the 1:N system configuration, this time need to set "Time-out timer value (D8129) + 1 scan time" or more.
 TW = set time when message wait is set.

- 2) When writing data from the computer to the programmable controller
 Communication time = T0 + (T1 + T2 or TW, whichever is longer) + T3

$$T0, T3 = \frac{1 + 7(8) + 0(1) + 1(2)}{\text{baud rate}} \times \text{number of characters}$$

T1 =max. 1 scan time (during RUN, message processing is done at END processing, a maximum delay of 1 scan could occur depending on message timing; during STOP, T1 is 1 ms)
 T2 =END process time of programmable controller during data communication
 TW = set time when message wait is set.

7.6 Character Area Data Transmission

The data shown in the following examples are samples of the data used in character area B when reading or character area C when writing data. (see section 7.4.1 and 7.4.2)

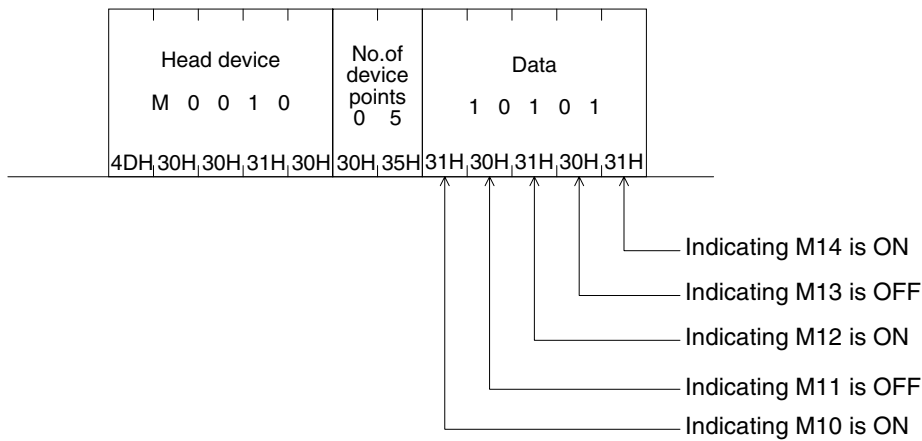
7.6.1 Bit Device Memory

Bit device memory is handled in 1 bit units (1 point) or in word unit (16 points).

1) Bit units (units of 1 point)

When handling bit device memory in bit units, the specified number of devices, in an increasing order from the specified head device, are represented sequentially from the left, as "1"(31H) when ON, and as "0"(30H) when OFF.

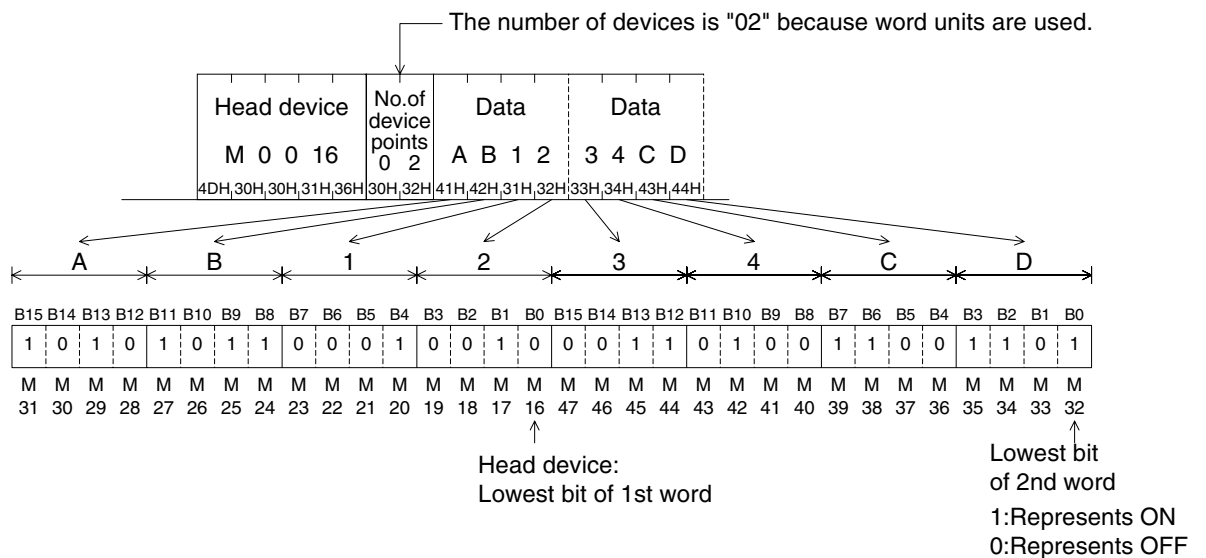
Example: When transmitting the on/off status of five points from M10



2) Word units (units of 16 points)

When handling bit device memory in word units, each word (16 bits, highest bit being first) is expressed as 4 hexadecimal digits (each of 4 bits) starting with the higher digit. Each digit being represented by the appropriate ASCII character.

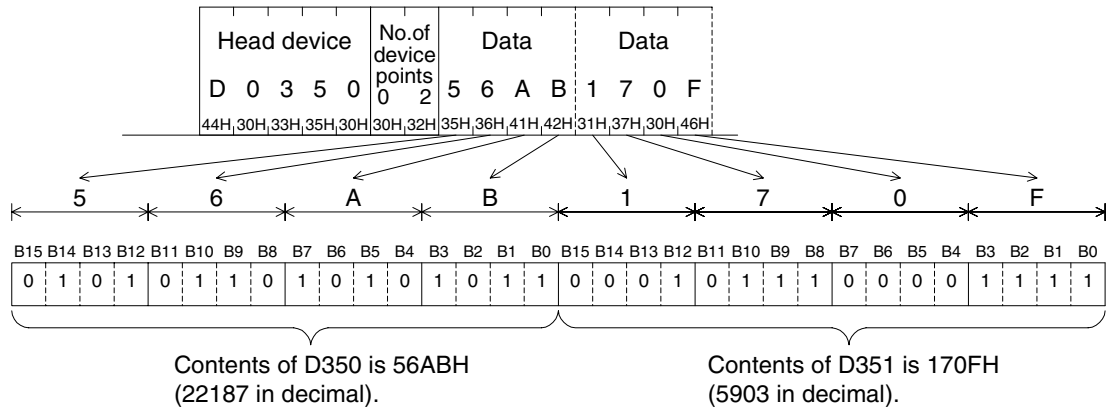
Example: When transmitting the on/off status of 32 points from M16



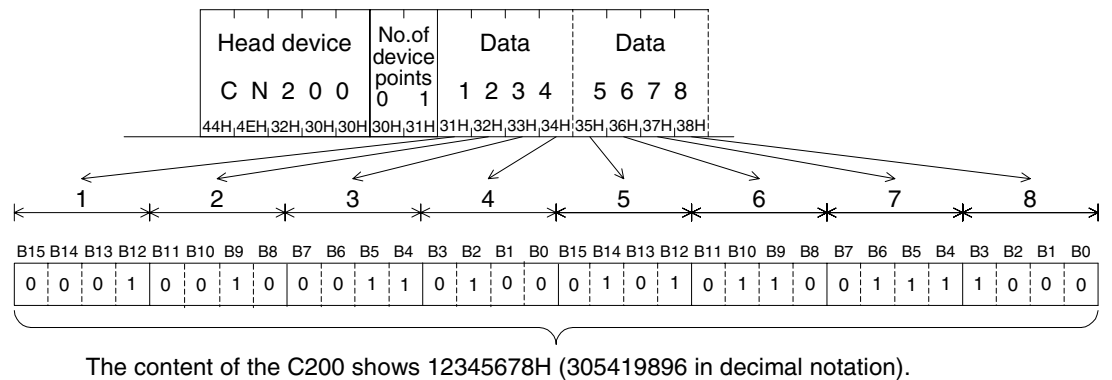
7.6.2 Word Device Memory

When handling word device memory, each word is expressed as 4 hexadecimal digits (each of 4 bits) starting with the higher digit. Each digit being represented by the appropriate ASCII character.

Example 1) When showing the contents of data registers D350, D351



Example 2) When showing the contents of C200* (32-bit counter)



* The device code of C200 is CN200.

7.7 Commands and Device Ranges

7.7.1 Commands

			Command		Description	Maximum No. of units per communication	
			Symbol	ASCII code		FX _{0N} , FX _{1S}	FX, FX _{2C} , FX _{1N} , FX _{2N} , FX _{2NC}
Device memory	Batch read	Bit unit	BR	42H, 52H	Reads a group of bit devices (X, Y, M, S, T, C), result is in units of 1 device.	54 points	256 points
		Word unit	WR	57H, 52H	Reads a group of bit devices (X, Y, M, S), result is in units of 16 devices.	13 words, 208 points	32 words, 512 points
					Reads a group of word devices (D, T, C), result is in units of 1 device.	13 points	64 points
	Batch write	Bit unit	BW	42H, 57H	Writes a group of bit devices (X, Y, M, S, T, C), data is in units of 1 device.	46 points	160 points
		Word unit	WW	57H, 57H	Writes a group of bit devices (X, Y, M, S), data is in units of 16 devices.	10 words, 160 points	10 words, 160 points
					Writes a group of word devices (D, T, C), data is in units of 1 device.	11 points	64 points
	Test (select write)	Bit unit	BT	42H, 54H	Set/reset individual bit devices (X, Y, M, S, T, C) selectively in units of 1 device.	10 points	20 points
		Word unit	WT	57H, 54H	Set/reset bit devices (X, Y, M, S) selectively in units of 16 devices.	6 words, 96 points	10 words, 160 points
					Write word devices (D, T, C*) selectively in units of 1 device.	6 points	10 points
	PC	Remote run	RR	52H, 52H	Remote run/stop request to programmable controller.	—	—
Remote stop		RS	52H, 53H				
PC type read		PC	50H, 43H	PC type name(code) is read.			
Global		GW	47H, 57H	Set/reset the global flag (M8126 for FX series) to all connected programmable controllers.	1 point	1 point	
On-demand		—		Send request from programmable controller. Possible, however, only in 1:1 system configuration.	Maximum 13 words	Maximum 64 words	
Loopback test		TT	54H, 54H	Characters received from the computer are directly sent back to the computer.	25 characters	254 characters	

* Computer except high speed (32-bit) counters C200 to C255.

7.7.2 Device specification ranges

The following is the device and device number range that can be used in the access of device memory.

Each device is composed of five characters.

Device (1 character, 2 characters with timer and counter) + device number (4 characters, 2 characters with timer and counter) = 5 characters.

1) Bit devices

Device	Device specification characters					Decimal/octal expression	Usable command	
	FX0N	FX1S	FX, FX2C	FX1N	FX2N, FX2NC		BR, BW, BT	WR, WW, WT
Inputs (X)	X0000~X0177	X0000~X0017	X0000~X0337	X0000~X0177	X0000~X0267	Octal	○	○
Outputs (Y)	Y0000~Y0177	Y0000~Y0015	Y0000~Y0337	Y0000~Y0177	Y0000~Y0267			
Auxiliary relays (M)	M0000~M0511		M0000~M1535		M0000~M3071	Decimal	○	×
States (S)	S0000~S0127		S0000~S0999					
Special auxiliary relays (M)	M8000~M8254		M8000~M8255					
Timer contacts (T)	TS000~TS063		TS000~TS255					
Counter contacts (C)	CS000~CS031 CS235~CS254		CS000~CS255					

In FX series, the timer coil (TC) and counter coil (CC) are not supported.

2) Word devices

Device	Device specification characters				Decimal/octal expression	Usable command		
	FX0N	FX1S	FX, FX2C	FX1N, FX2N, FX2NC		BR, BW, BT	WR, WW	WT
Timer current value (T)	TN000~TN063		TN000~TN255			Decimal	×	○
Counter current value(C)	CN000~CN031 CN235~CN254		CN000~CN255					
Data registers (D)	D0000~D0255		D0000~D0999	D0000~D7999				
File registers (D)	D1000~D2499		—	D1000~D2999				
RAM file registers (D)	—		D6000~D7999		—			
Special data registers(D)	D8000~D8255		D8000~D8255			○		

* Only CN000 to CN199 can be used.

(C200 to C255 of 32 bit counter or high speed counter cannot be used.)



Notes

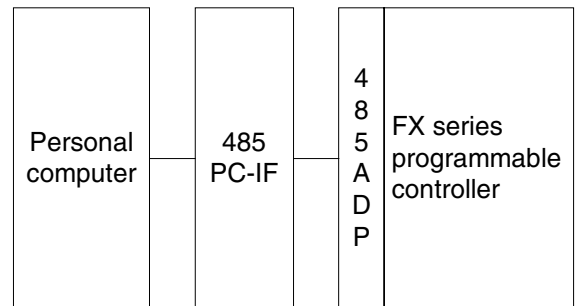
- 1) When using bit devices specified in word units (WR, WW, WT), the number of the head device must be a multiple of 8 (or if an octal device end in 0) e.g. X30, M24.
- 2) The special auxiliary relays (M8000 to M8255) and special data registers (D8000 to D8255) can be read only, write only, and received for system use.
If an attempt is made to write outside the write enable range, an error may occur in the programmable controller. Accordingly, for details of special auxiliary relays and special data registers, see the programmable controller manual.

7.8 Example Computer Program for Loopback Test

This is an example of a BASIC program for communication of the computer link using a computer, programmable controller 485PC-IF, and 485ADP. (not used outside Japan.)
 Please see loopback test command see section 8.11.

1) Setting of transmission specification

Item		Description
Communication method		Half-duplex communication method
Synchronizing method		Start-stop synchronization method
Baud rate		9600 bps
Data format	Start bit	1 bit
	Data length	7 bit
	Parity bit	None
	Stop bit	1 bit
Sum check		Sum check is used
Station No.		Station No.0
Exclusive protocol format		Format 1



According to the above transmission specification, the transmission specification and transmission procedure of the programmable controller are set as follows.

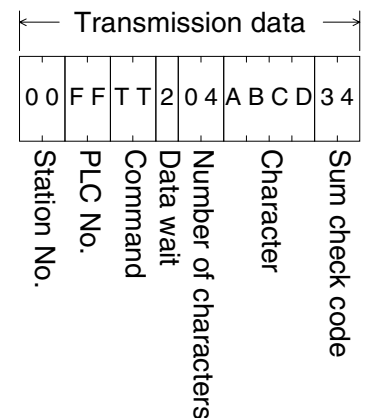
D8120 = H6080
 D8121 = H0000
 D8129 = K0

} For setting and details, see chapter 6, and section 7.4.

2) Program example

```

10 T0 = 3000      : ' Reception wait counter (adjusted depending on computer speed)
20 STCNT = 14    : ' Normal data length
30 NACNT = 7     : ' Data length of error code (NAK statement)
40 ERFLG = 0
50 ENQ$ = CHR$(5)
60 STX$ = CHR$(2)
70 ETX$ = CHR$(3)
80 NAK$ = CHR$(&H15)
90 *DATASEND      : ' Data transmission
100 CLOSE #1
110 OPEN"COM1": "AS#1"
120 SENDDATA$ = "00FFTT204ABCD34" : ' Transmission data
130 PRINT #1, ENQ$, SENDDATA$;
140 *REC0: ' Reception of first character
150 RVCNT = 1
160 GOSUB *RECWAIT
170 IF ERFLG = 99 THEN GOTO ERRORFIN1
180 BUF$ = RCV$
    
```



```

190 HED$ = LEFT$(BUF$.1)
200 IF HED$ = STX$ OR HED$ = NAK$ THEN GOTO *REC1 ELSE GOTO *REC0
210 *REC1                                : ' Reception of remaining data
220 IF HED$ = STX$ THEN RVCNT = STCNT-1
230 IF HED$ = NAK$ THEN RVCNT = NACNT-1
240 GOSUB *RECWAIT
250 IF ERFLG = 99 THEN GOTO *ERRORFIN1
260 BUF$ = BUF$ + RCV$
270 *PRINTRDATA                          : ' Display of received data
280 PRINT "Received data"
290 PRINT "HEX ASCII"
300 FOR I=1 TO LEN(BUF$)
310  PRT1$ = MID$(BUF$,I,1)
320  PRT1$ = HEX$(ASC(PRT1$))
330  IF PRT2$ = "2" THEN PRINT " "; "02"; "STX" :GOTO 370
340  IF PRT2$ = "3" THEN PRINT " "; "03"; "ETX" :GOTO 370
350  IF PRT2$ = "15" THEN PRINT " "; "15"; "NAK" :GOTO 370
360  PRINT " "; PRT2$; " "CHR$(&H22); PRT1$; CHR$(&H22)
370 NEXT I
380 IF HED$ = NAK$ THEN GOTO *ERRORFIN2
390 *DATACHECK                            : ' Check of received data
400 DDATA$ = STX$ + "00FF04ABCD" + ETX$ + "5D" : ' Normal data
410 FOR J=1 TO LEN(BUF$)
420  RDATA$ = MID$(BUF$,J,1)
430  ODATA$ = MID$(DDTA$,J,1)
440  IF RDATA$ <> ODATA$ THEN GOTO *ERRORFIN3
450 NEXT J
460 PRINT "Received data is normal"
470 PRINT "Loopback test complete ":GOTO *FIN
480 *ERRORFIN1
490 PRINT "Data is not received at all or data content is insufficient."
500 GOTO *FIN
510 *ERRORFIN2
520 ERRORCODE$ = MID$(BUF$,6,2)
530 PRINT "Error code" ;ERRORCODE$; "H is received."
540 GOTO *FIN
550 *ERRORFIN3
560 PRINT "Received data is abnormal.(";J;"-th character)"
570 *FIN
580 CLOSE #1
590 END
600 *RECWAIT                              : ' Wait for receive
610 FOR I=1 TO T0
620  RCV$ = ""
630  IF LOC(1) => RVCNT THEN GOTO *BUFIN
640 NEXT
650 IF RCV$ = "" THEN ERFLG=99
660 RETURN
670 *BUFIN                                : ' Reading of received data
680 RCV$ = INPUT$(RVCNT,#1)
690 RETURN

```

3) Operation

- a) Start the computer program.
- b) Send four characters "ABCD" from the computer to the FX programmable controller.
- c) The FX programmable controller returns the four characters "ABCD" back to the computer.
- d) The computer compares the data received from the programmable controller and the original sent data, and displays a result message.

4) List of result messages

Message	Remedy
Received data is normal.	Data sending and receiving is normal.
Data is not received at all or data content is insufficient.	Check again the writing, station No., transmission specification, and transmission protocol.
Error code 00H is received.	Refer to error code list in chapter 12.
Received character is abnormal. (0-th character)	Check for faulty writing, observing writing cautions.

8. Commands

This chapter describes the structure and gives examples for each command of the dedicated protocol.

See also Chapter 7 “Communication using Dedicated Protocols”.

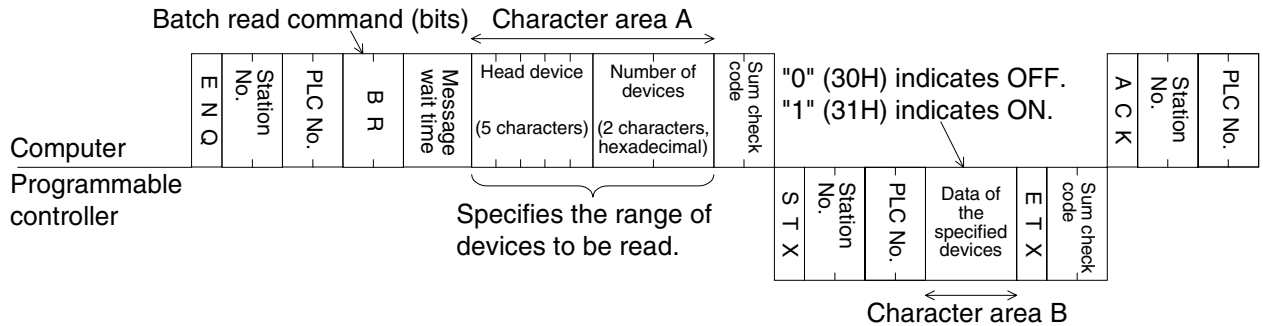
The reference pages for command are given below.

Command	Description	Section
BR	Bit devices read in units of 1 point.	8.1
WR	Bit devices read in units of 16 points, or word devices read in units of 1 point.	8.2
BW	Bit devices written in units of 1 point.	8.3
WW	Bit devices written in units of 16 points, or word devices written in units of 1 point.	8.4
BT	Bit devices specified in units of 1 point, and set/reset (forced on/off).	8.5
WT	Bit devices specified in units of 16 points, and set/reset (forced on/off), or word devices specified in units of 1 point, and data written.	8.6
RR	Programmable controller is started (RUN) by remote control.	8.7
RS	Programmable controller is stopped (STOP) by remote control.	8.7
PC	Programmable controller type name code is read.	8.8
GW	Global signal is turned on/off on all linked programmable controllers.	8.9
—	On-demand function (Send request is issued from the Programmable controller. There is no command).	8.10
TT	Characters received from the computer are directly returned to the computer.	8.11

8.1 Batch Read of Bit Device (BR command)

1) Command specification

Protocol format 1 is shown.



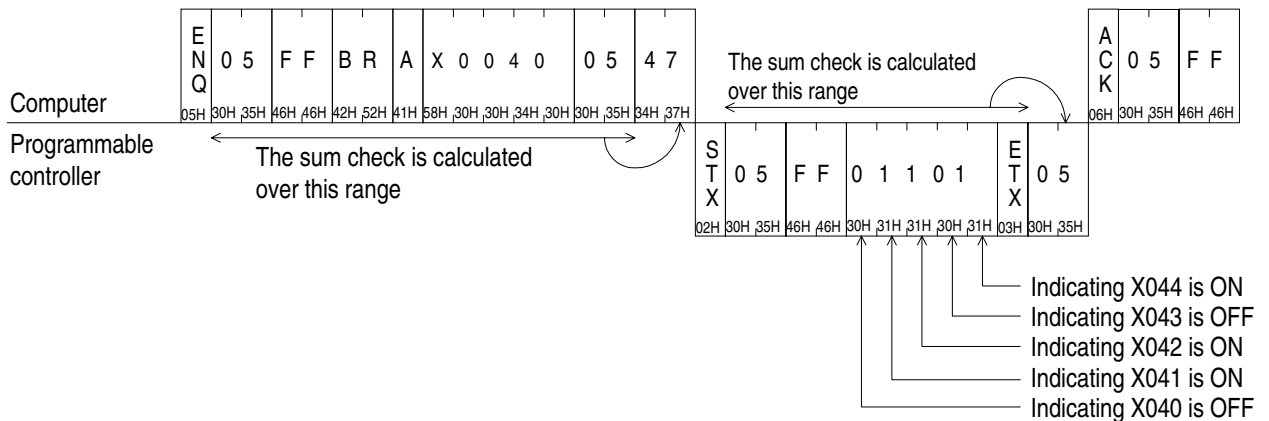
Notes

- Specify the range and number of devices so as to satisfy the following conditions.
 - 1 ≤ number of devices ≤ 256(54 for FX0N)(256 points are specified by 00H)
 - Head device No. + number of devices - 1 ≤ max. device No.
- The station number, PC (PLC) number, number of devices, and sum check code are expressed in hexadecimal.

2) Command example

To read five points of data from X040 to X044 at station No.5 (with message wait time set to 100 ms).

(Assuming that X040 and X043 are OFF and X41, X42 and X44 are ON)



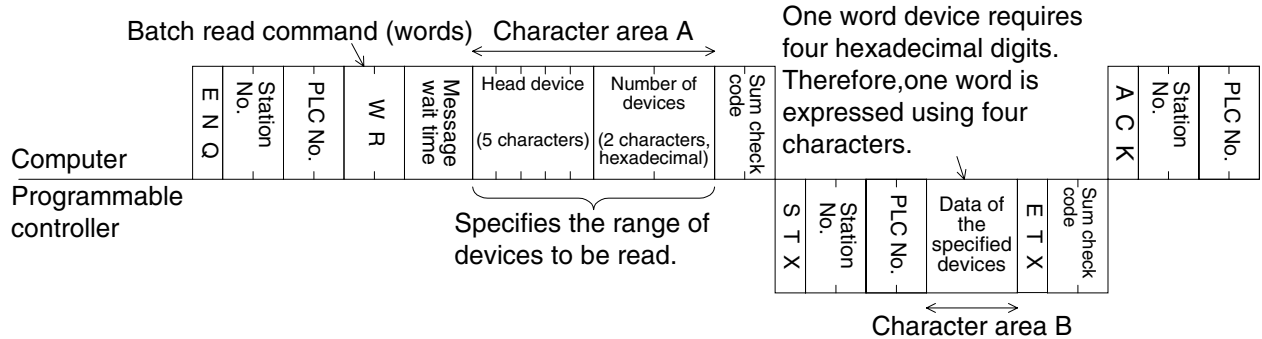
Notes

- Message wait time can be specified from 0 to 150 ms in 10 ms increments, expressed by 0H to FH (in hexadecimal).
Therefore, 100 ms is expressed as "A".

8.2 Batch Read of Word Device (WR command)

1) Command specification

Protocol format 1 is shown.



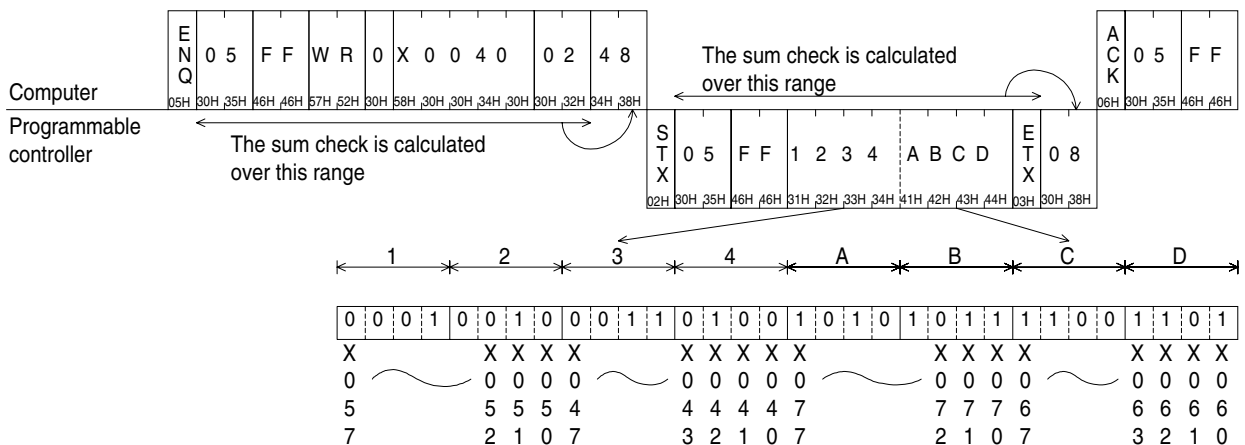
Notes

- Specify the range and number of devices (16 bit words) so as to satisfy the following conditions.
 - $1 \leq \text{number of devices} \leq 64$ (32 words in the case of bit devices) (13 words for FX0N)
 - Head device No. + number of devices (number of devices \times 16 in the case of bit devices) - 1 \leq max. device No.
 - When reading 32-bit devices (C200 to C255), the returned data is a double word. Hence, the maximum number of devices is 32.
- The station number, PC (PLC) number, number of devices, and sum check code are expressed in hexadecimal.

2) Command examples

a) Example 1

To read 32 points of data from X040 to X077 at station No.5 (with message wait time set to 100 ms).

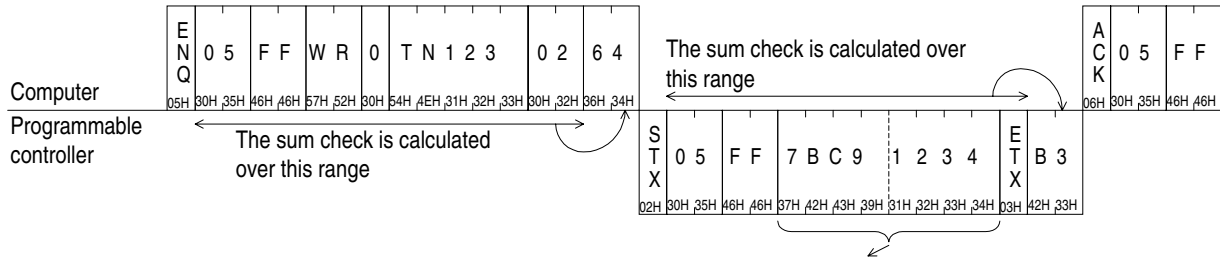


Notes

- Command WR uses word units. When reading 32 points, the number of devices is specified by "02" (16 points (bits) per one word unit).

b) Example 2

To read the present value of two points, T123 and T124, at station No.5.

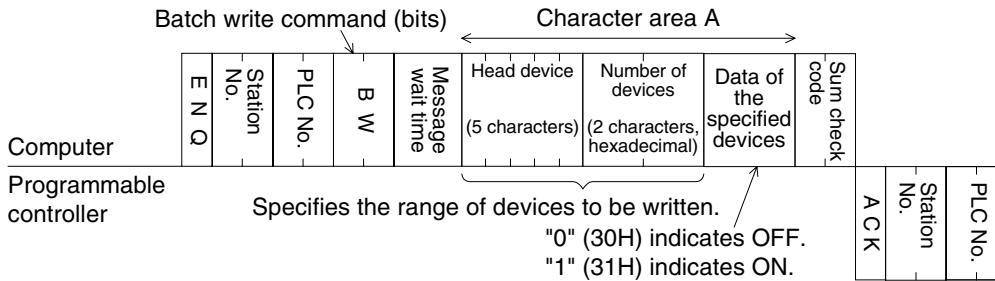


Present value of T123: 7BC9H(hexadecimal): indicates 31689 in decimal.
 Present value of T124: 1234H(hexadecimal): indicates 4660 in decimal.

8.3 Batch Write of Bit Device (BW command)

1) Command specification

Protocol format 1 is shown

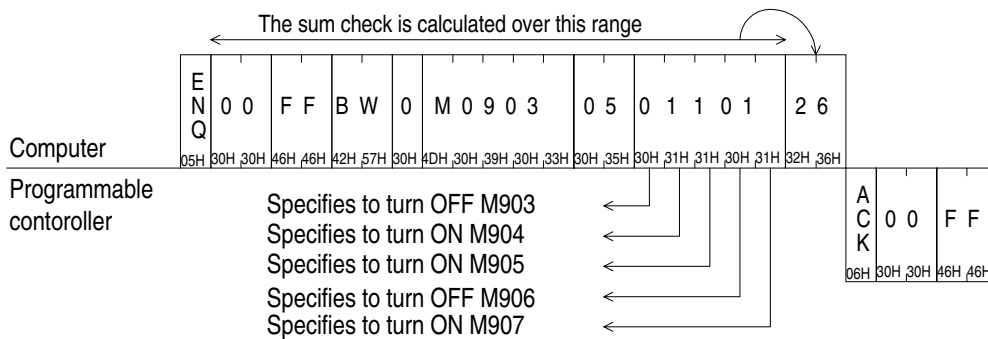


Notes

- Specify the range and number of devices so as to satisfy the following conditions.
 - $1 \leq \text{number of devices} \leq 160$
 - $\text{Head device No.} + \text{number of devices} - 1 \leq \text{max. device No.}$
- The station number, PC (PLC) number, number of devices, and sum check code are expressed in hexadecimal.

2) Command example

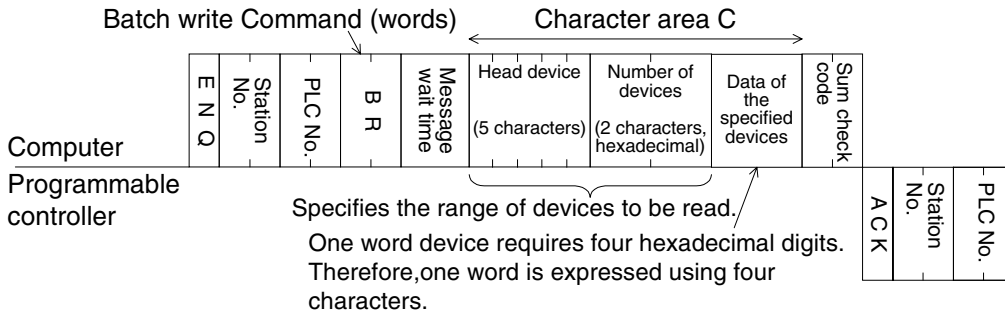
To write data into five points from M903 to M907 at station No.0 (with message wait time set to 0 ms).



8.4 Batch Write of Word Device (WW command)

1) Command specification

Protocol format 1 is shown



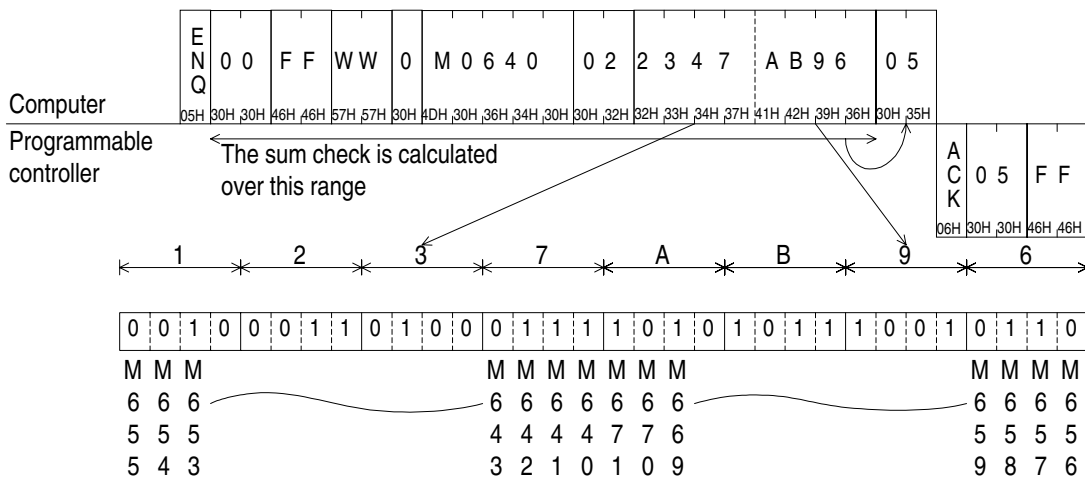
Notes

- Specify the range and number of devices (16 bit words) so as to satisfy the following conditions.
 - 1 ≤ number of devices ≤ 64 (10 words in the case of bit devices)
 - Head device No. + number of devices (number of devices × 16 in the case of bit device) - 1 ≤ max. device No.
- The station number, PC (PLC) number, number of devices, and sum check code are expressed in hexadecimal.

2) Specification examples

a) Example 1

To write to 32 points from M640 to M671 at station No.0 (with message wait time set to 0 ms).

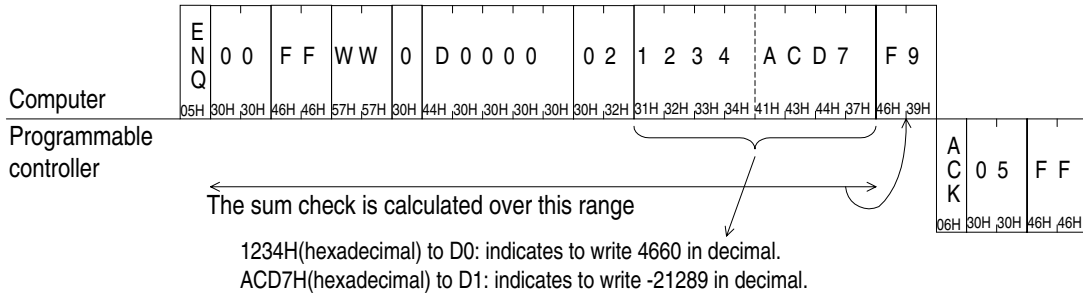


Notes

- Command WW uses word units. When writing 32 points, the number of devices is specified by "02" (16 points (bits) per one word unit).

b) Example 2

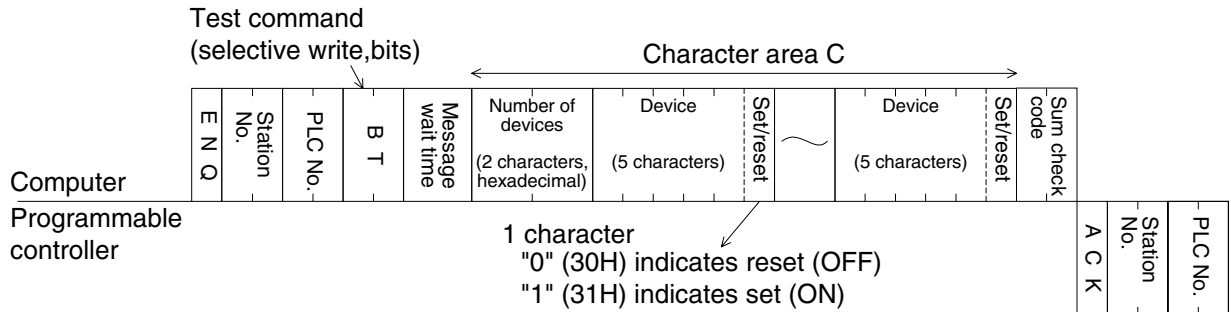
To write to data to two points, D0 and D1, at station No.0 (with message wait time set to 0 ms).



8.5 Test of Bit Device (BT command)

1) Command specification

Protocol format 1 is shown

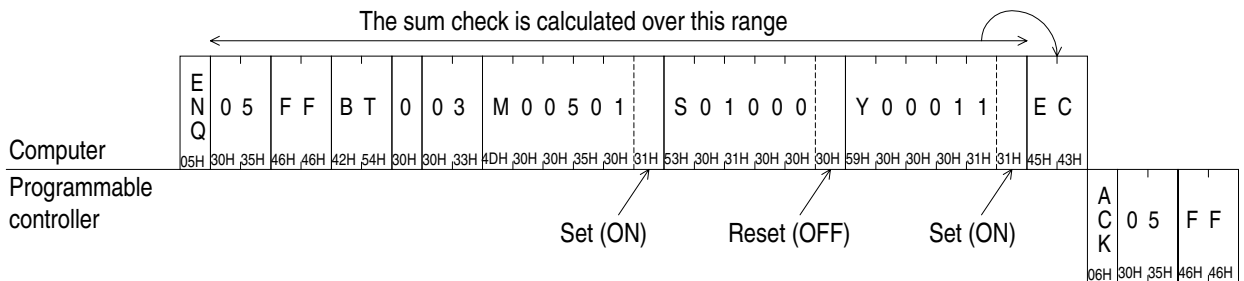


Notes

- Specify the range and number of devices so as to satisfy the following condition.
 - $1 \leq \text{number of devices} \leq 20$ (10 for FX0N)
- The station number, PC (PLC) number, number of devices, and sum check code are expressed in hexadecimal.

2) Specification example

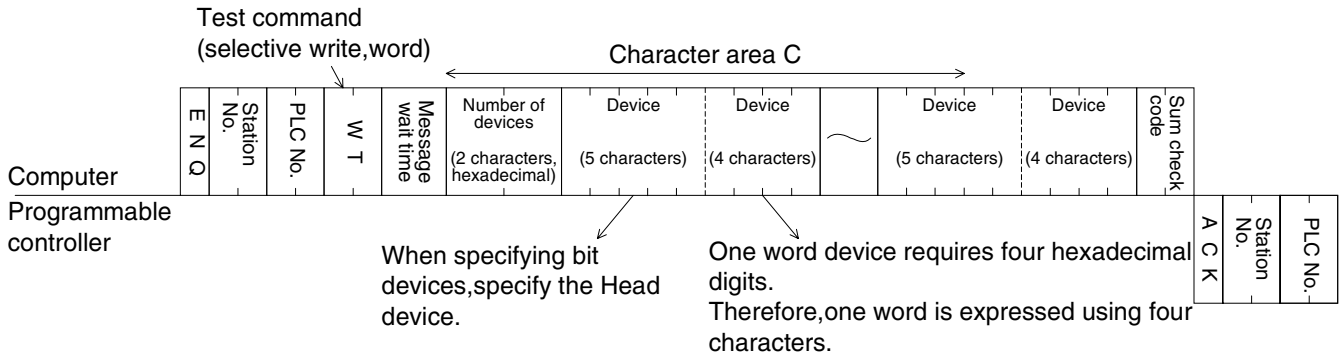
To set ON M50, OFF S100, and ON Y001 at station No.5 (with message wait time set to 0 ms).



8.6 Test of Word Device (WT command)

1) Command specification

Protocol format 1 is shown.

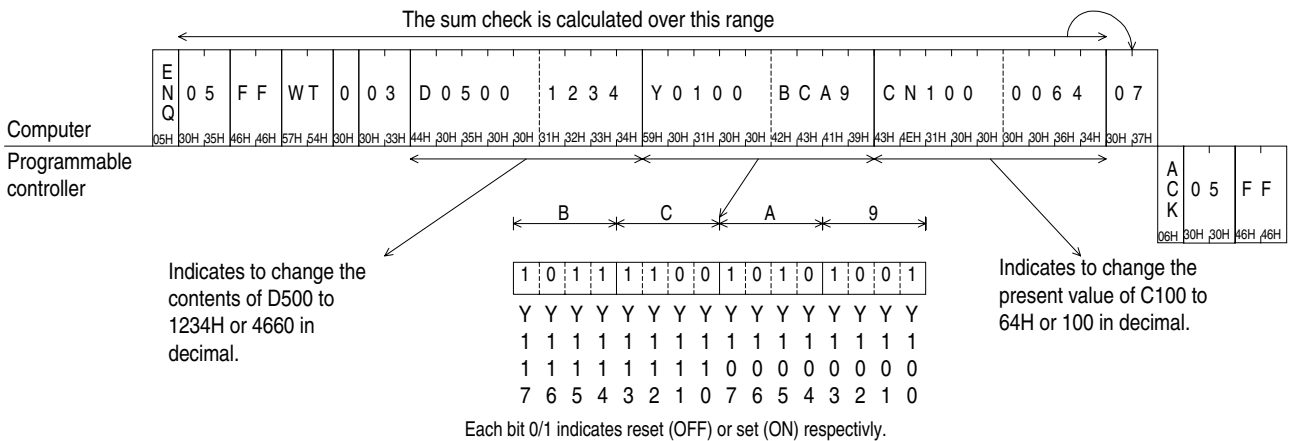


Notes

- Specify the range and number of devices (16 bit words) so as to satisfy the following conditions.
 - 1 ≤ number of devices ≤ 10 (6 for FX0N) (one unit is 16 points for bit devices)
- The station number, PC (PLC) number, number of devices, and sum check code are expressed in hexadecimal.
- C200 to C255 (CN200 to CN255) which are 32-bit devices cannot be handled in this command.

2) Specification example

To changing the present value of D500 to 1234H, bits Y100 to Y117 to BCA9H, and the present value of C100 to 100 at station No.5 (with message wait time set to 0 ms).

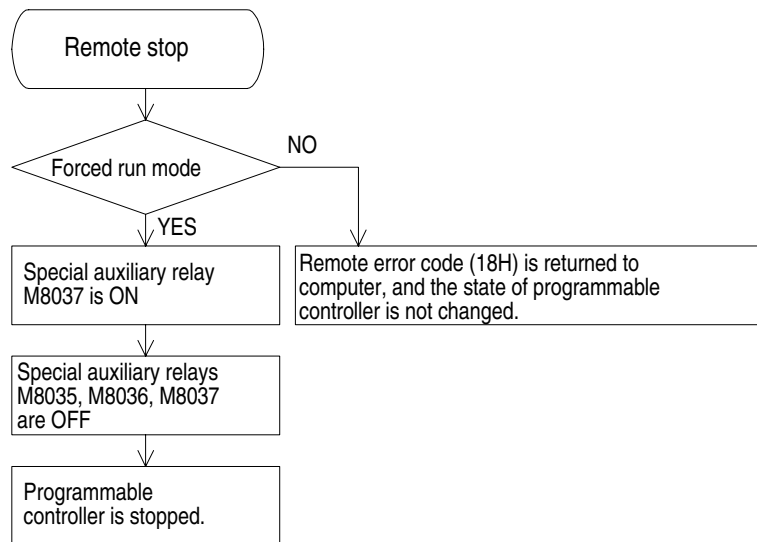


8.7 Remote RUN/STOP (RR, RS commands)

8.7.1 Operation of Remote RUN/STOP

When remote RUN/STOP is requested from the computer, the programmable controller forced run mode, and the special auxiliary relays M8035, M8036, M8037 are controlled as follows.

- Remote RUN**
 When remote RUN (RR command) is requested, M8035 and M8036 are set ON at the programmable controller, and forced RUN mode becomes active; the programmable controller switching to RUN.
 However, when remote run is executed while the programmable controller is running (forced or otherwise), the state is not changed, and the remote error code (18H) is returned to the computer.
- Remote STOP**
 When remote STOP (RS command) is requested, M8037 is set ON at the programmable controller. This in turn resets M8035, M8036 and M8037 to OFF and forced RUN mode is disabled; the programmable controller switching to STOP.
 However, when remote STOP is executes while the programmable controller is not in forced RUN mode, the state is not changed, and the remote error code (18H) is returned to the computer.



8.7.2 Conditions for Valid Execution of Remote RUN/STOP

The RUN terminal of the programmable controller is OFF, any built-in RUN/STOP switch is at STOP.

- Remote RUN**
 The programmable controller should be stopped.
- Remote STOP**
 The programmable controller should be in forced run mode.



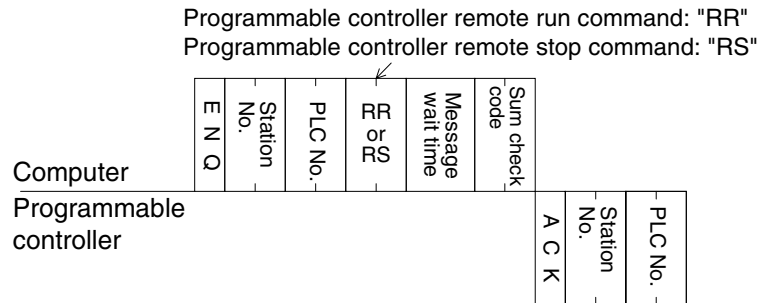
Notes

- Forced RUN mode is not restored after a power failure. When the programmable controller is in forced RUN mode, if the power source is turned off and on, the special auxiliary relays M8035, M8036, M8037 are all reset to OFF, and the programmable controller remains in STOP.

8.7.3 Control Specification and Examples of Remote RUN/STOP

1) Control specification

Protocol format 1 is shown.



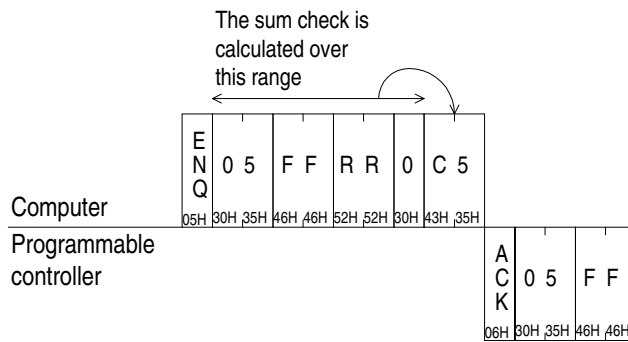
Notes

- The station number, PC (PLC) number, number of devices, and sum check code are expressed in hexadecimal.

2) Operation examples

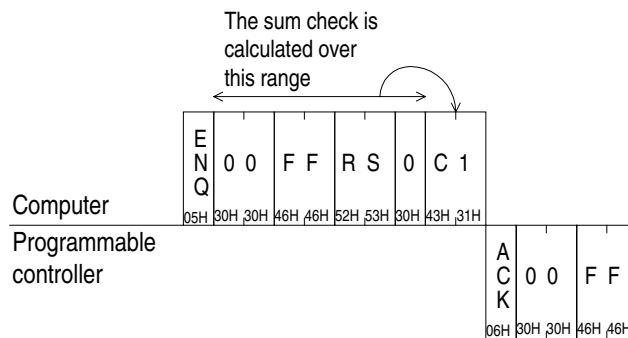
a) Example 1

To execute remote RUN at station No.5 (with a message wait time set to 0 ms).



b) Example 2

To execute remote STOP at station No.0 (with message wait time set to 0 ms).



8.8 Reading The Programmable Controller Type (PC command)

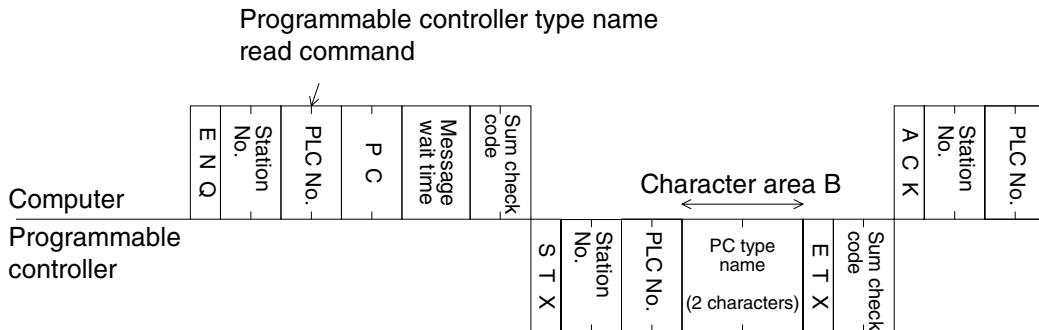
8.8.1 Type Codes

Programmable controller type	Type code (hex.)	Programmable controller type	Type code (hex.)
FX ₁ S	F2H	A2USCPU	82H
FX ₀ N	8EH	A2CPU-A1, A2USCPU-S1	83H
FX, FX ₂ C	8DH	A3CPU, A3NCPU	A3H
FX ₁ N	9EH	A3ACPU	94H
FX ₂ N, FX ₂ NC	9DH	A3HCPU, A3MCPU	A4H
A0J2HCPU	98H	A3UCPU	84H
A1CPU, A1NCPU	A1H	A4UCPU	85H
A1SCPU, A1SJCPU	98H	A52GCPU	9AH
A2CPU(-S1), A2NCPU(-S1), A2SCPU	A2H	A73CPU	A3H
A2ACPU	92H	A7LMS-F	A3H
A2ACPU-S1	93H	AJ72P25/R25	ABH
A2CCPU	9AH	AJ72LP25/BR15	8BH

8.8.2 Control Specification and Example

1) Control specification

Protocol format 1 is shown.

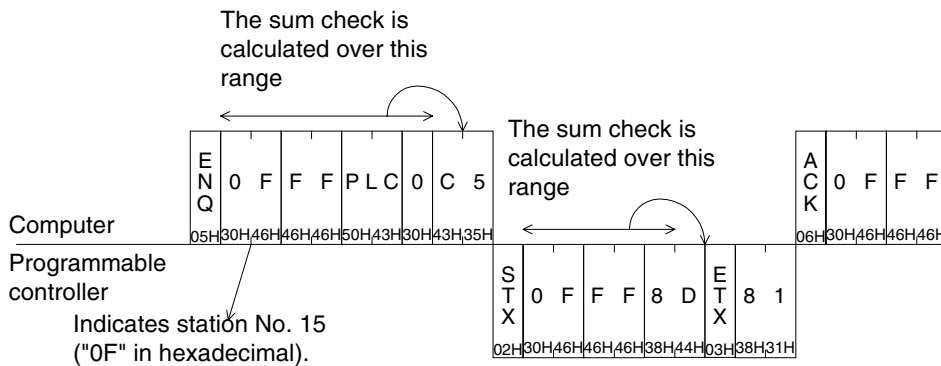


Notes

- The station number, PC (PLC) number, number of devices, and sum check code are expressed in hexadecimal.

2) Specification example

To read the type name from station No.15 (with message wait time set to 0 ms)



Indicates the type name of the Programmable controller is FX, FX2C series.

8.9 Global Function (GW command)

This function is to turn on and off the global operation flag at all stations in the multidrop link. For an FX series programmable controller this is special auxiliary M8126, and for an A series programmable controller, it is Xn2 of the computer link unit. This function can be used for initialization, resetting or simultaneous start/stop of all programmable controller stations.

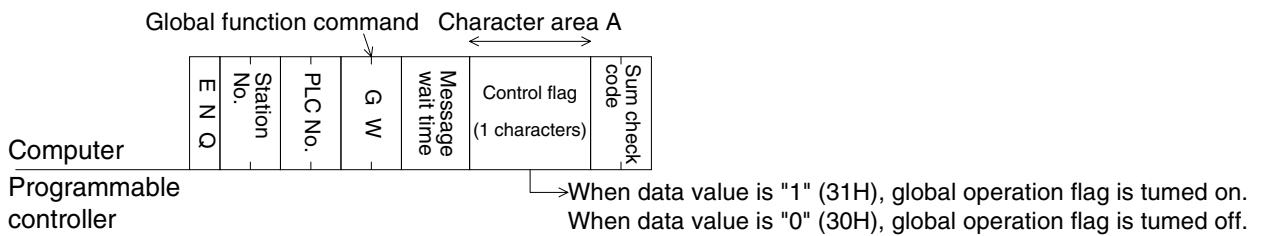
8.9.1 Control Specification and Example of Global Function

The global function is to turn on or off the special auxiliary relay M8126 (global operation flag) at all stations in the multidrop link.

- The station number specified in the control protocol must indicate all stations, and is hence specified as FFH ("FF"). If other than FFH is specified as the station number, the special auxiliary relay M8126 of the specified station is turned on/off.
- No reply is given by the programmable controller to this command.
- If the programmable controller power is turned off, the communication format changed, or the programmable controller is stopped, the special auxiliary relay M8126 of that station is turned off, and the global function operation is cleared.

1) Control specification

Protocol format 1 is shown.

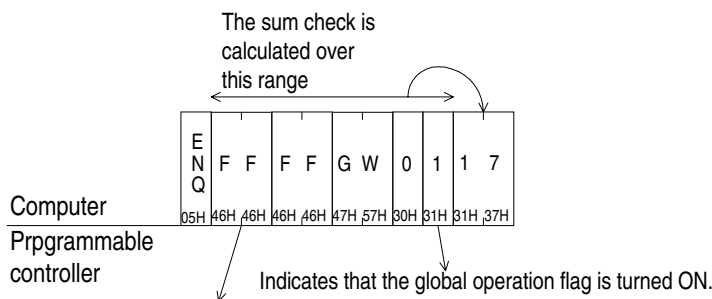


Notes

- The station number, PC (PLC) number, number of devices, and sum check code are expressed in hexadecimal.

2) Specification example

To turn on the global operation flag at all programmable controller stations in the computer link; auxiliary relay M8126 in an FX series PLC station, and Xn2 in an A series programmable controller station.

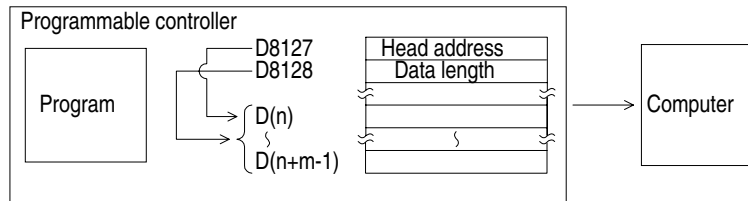


"FF" is specified to indicate all stations.

For a specific station, specify the station number between "00" to "0F" ("00" to "1F" for A series).

8.10 On-demand Function

Data transmission between the computer and programmable controller is usually initiated by the computer only. The on-demand function is used if there is a need to transmit data from the programmable controller to the computer. The range of data registers containing the data to be sent is specified in special data registers.



Notes

- This function can only be used when the configuration of the computer and programmable controller is 1:1.

8.10.1 Special Devices Used in On-demand Function

The special data registers and auxiliary relays used in the on-demand function are explained in the following table.

Device	Name	Description
M8127	On-demand handshake signal	On during execution of on-demand ON: on-demand data being transmitted OFF: on-demand data transmission complete
M8128	On-demand error flag	On if there is error in specified value for data transmission in on-demand ON: error OFF: no error
M8129	Flag for specifying word or byte data format	Word/byte data format for on-demand data. ON: byte units (8-bits per data register) OFF: word units (16-bits per data register)
D8127	On-demand head device number register	The head device number of the data area in which the data to be transmitted is stored. Set by programmable controller's program.
D8128	On-demand data length register	The data length to be transmitted by on-demand. Set by programmable controller's program.

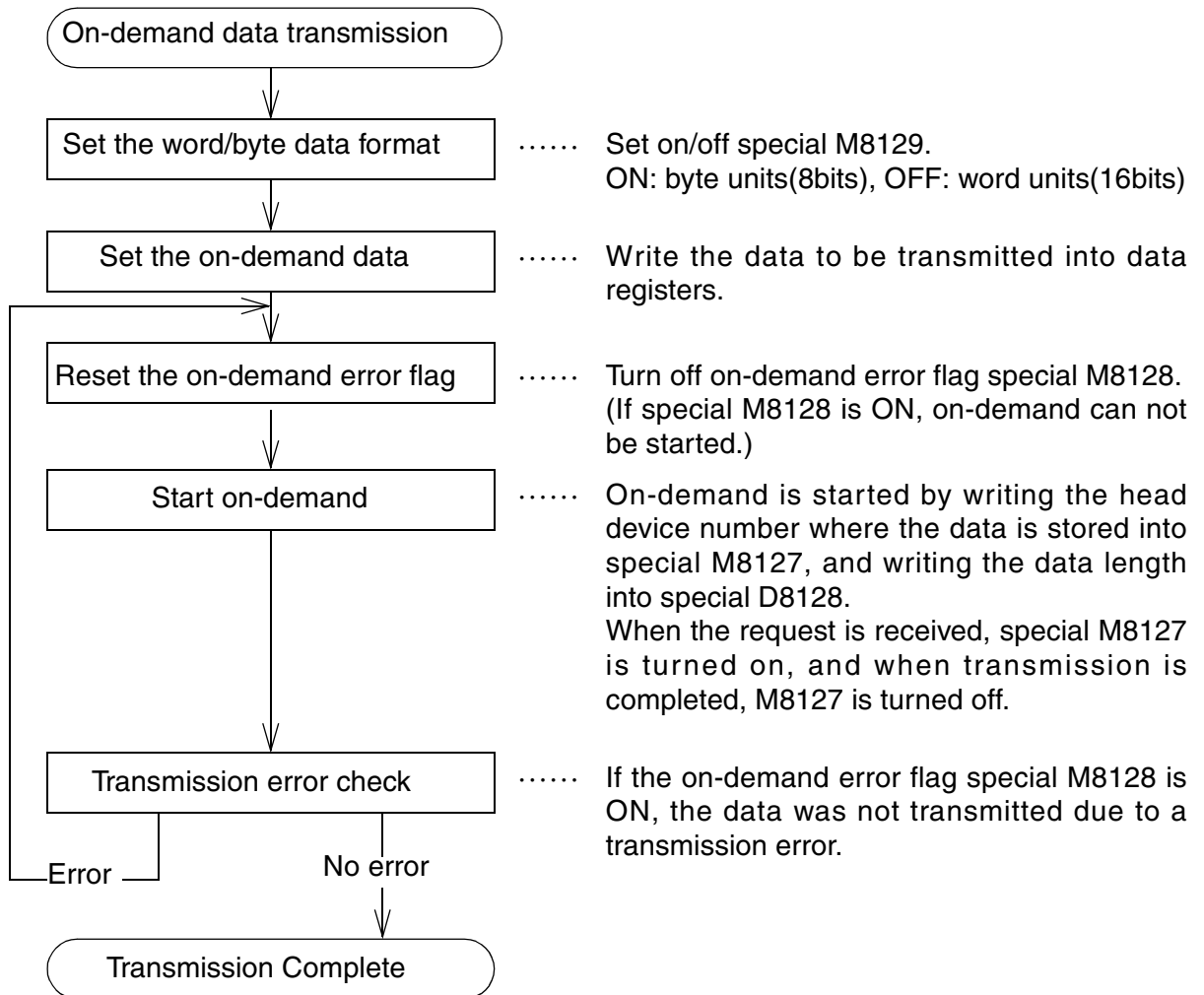


Notes

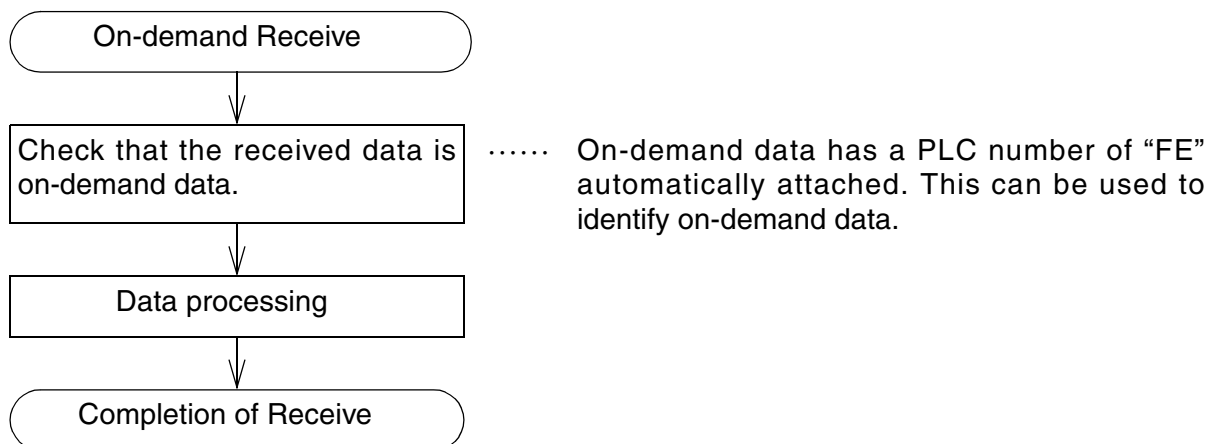
- The on-demand handshake signal is turned on when data transmission to the computer is started from the programmable controller, and is turned off when transmission of the specified data is complete.
This is used as an interlock so that multiple on-demand requests can not be issued simultaneously.

8.10.2 On-demand Control Protocol

1) Control protocol programmable controller

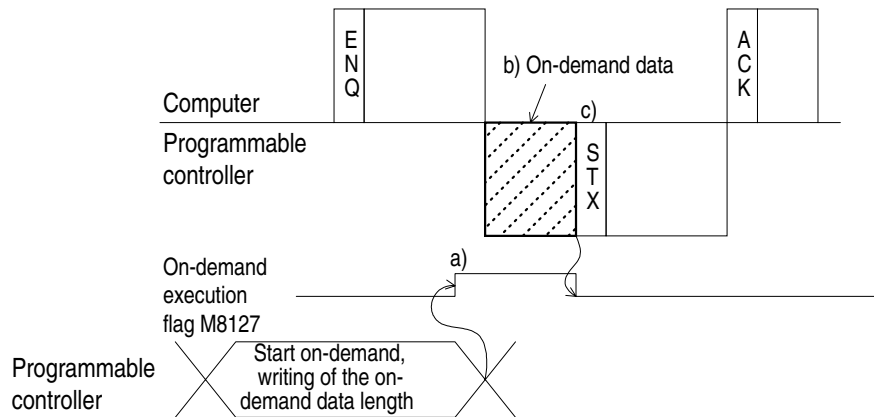


2) Control protocol at computer



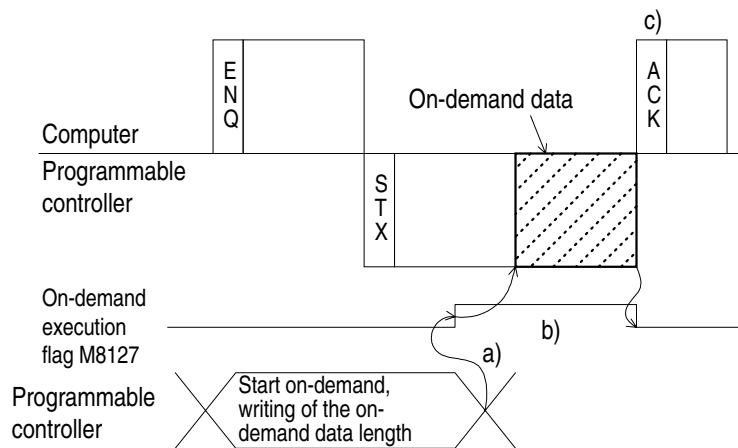
3) On-demand request time chart.

- When the computer is transmitting data



- a) When on-demand is requested, the on-demand execution signal (special M8127) is immediately turned on.
- b) Transmission of on-demand data is forced to wait until completion of reception of command data (ENQ-) from the computer.
- c) Transmission of response data (STX-) to command data (ENQ-) is forced to wait until completion of transmission of on-demand data.

- When the computer is receiving data

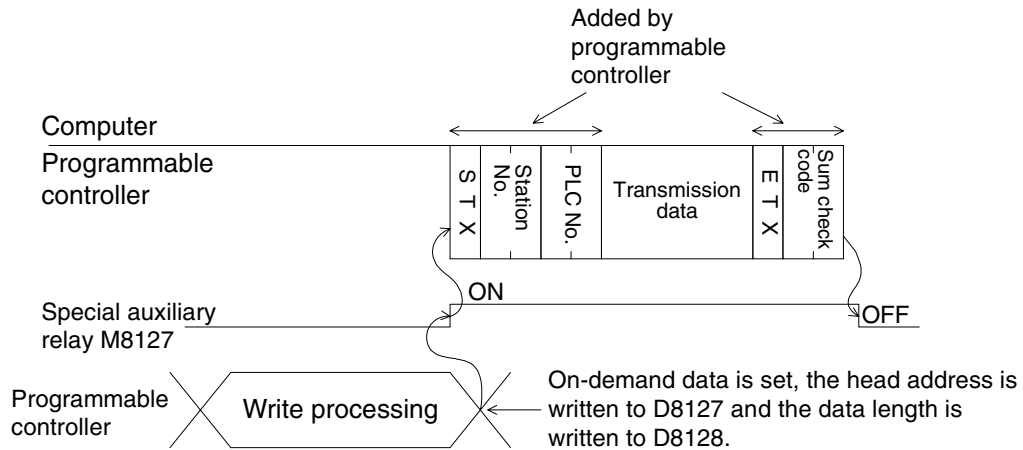


- a) When on-demand is requested, the on-demand execution signal (special M8127) is immediately turned on.
- b) Transmission of on-demand data is forced to wait until completion of transmission of response data (STX-) to the command data (ENQ-) from the computer.
- c) Transmission of response data (ACK-) from the computer to the transmission of response data (STX-) from the programmable controller should be done after completion of reception of on-demand data.

8.10.3 Specification and Example of On-demand

1) Command specification

Protocol format 1 is shown.



Notes

- Specify the data length so as to satisfy the following condition.
Data length ≤ 40H (64 points)(13 points for FX0N)
- The PLC number, “FE” is added by the programmable controller.
- The station number, PLC number, number of devices, and sum check code are expressed in hexadecimal.

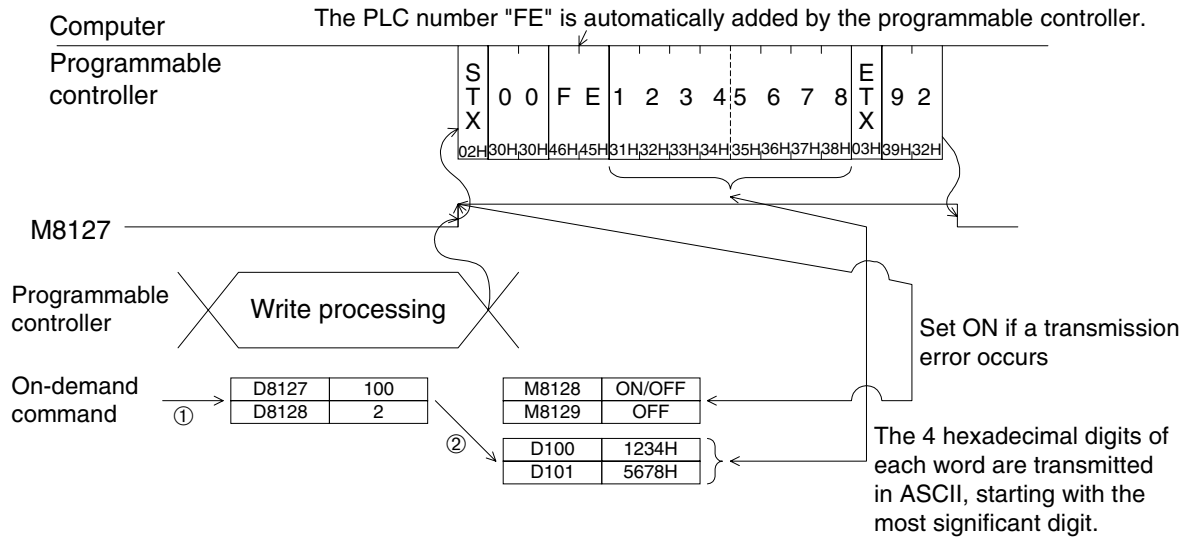


Important

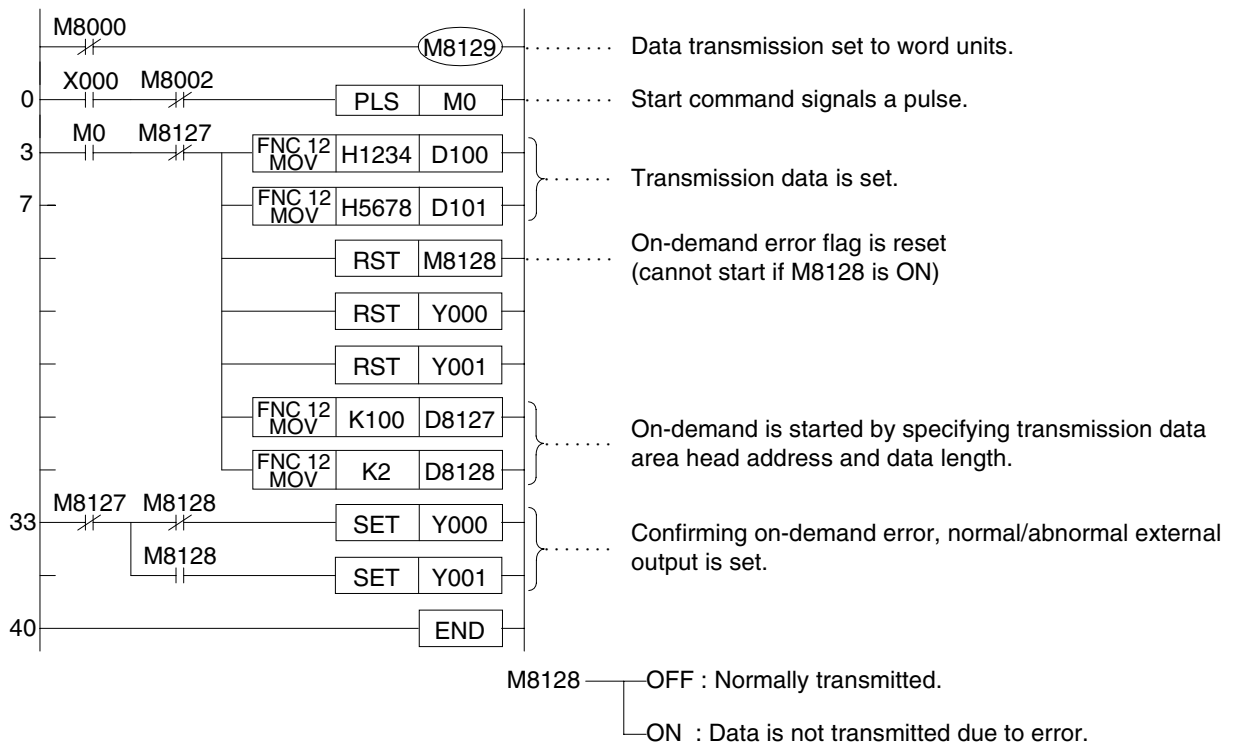
- Don't use the on-demand function unless the system configuration is 1:1.
- If the on-demand function is used in a multidrop system in which the computer and the programmable controller are connected in 1:n configuration, normal communication data in control protocol formats 1 to 4, and on-demand data become confused, and normal data transmission is not possible.

2) Specification Example 1

To transmit the data stored in data registers D100 and D101 from the programmable controller (when the station number is 0, and data is specified in word units)

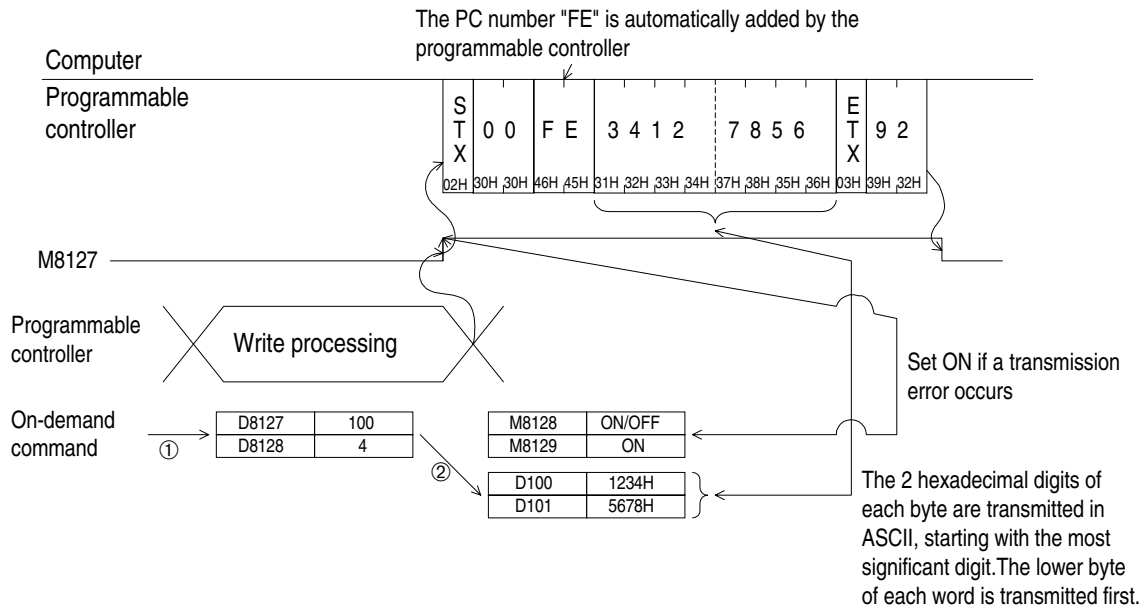


Program example

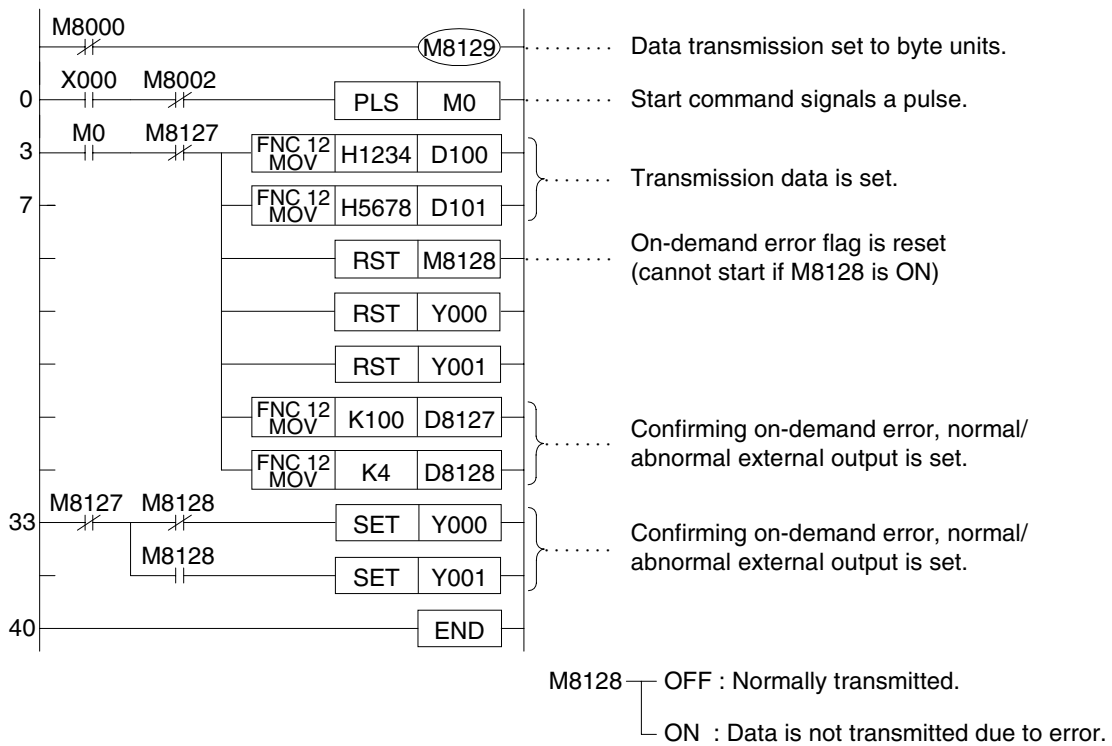


3) Specification Example 2

To transmit the data stored in data registers D100 and D101 from the programmable controller (when the station number is 0, and data is specified in byte units)



Program example

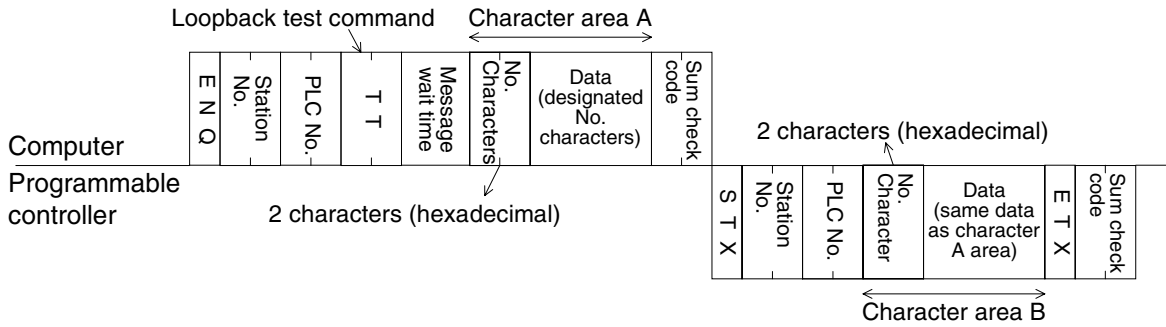


8.11 Loopback Test

The loopback test is the function for testing if communication between the computer and programmable controller is operating as normal or not.

1) Command Specification

Protocol format 1 is shown.

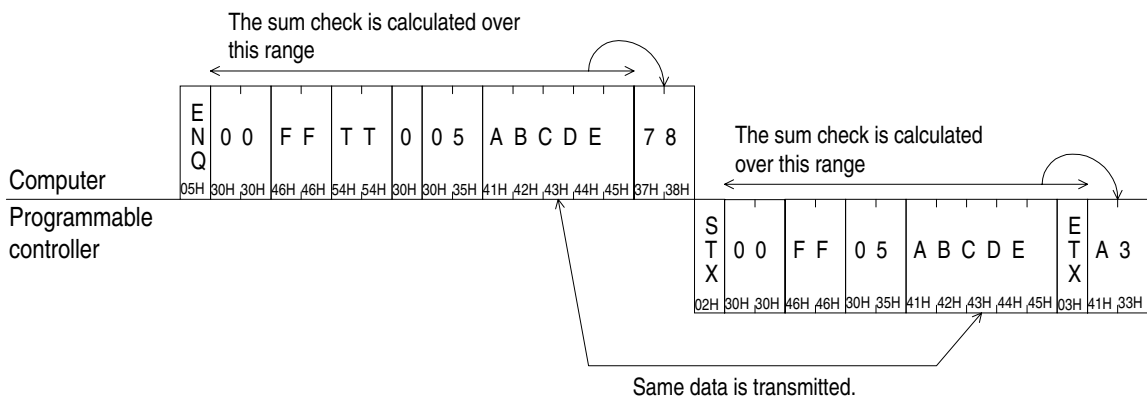


Notes

- Specify the number of characters so as to satisfy the following condition.
 - $1 \leq \text{No.characters} \leq 254$ (25 for FX0N)
- The station number, PC (PLC) number, number of devices, and sum check code are expressed in hexadecimal.

2) Specification example

To test the Loopback with data "ABCDE" at station No.0 (with message wait time set to 0 ms)



MEMO

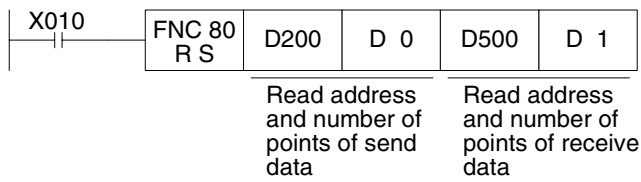
9. RS instruction

This section refers to the RS instruction. For target devices, refer to the application instruction manual of each programmable controller.

9.1 Function and Operation

9.1.1 Send and Receive Program

An RS instruction sends and receives serial data via the RS-232C port (optional equipment).



- The data transmission format can be set using the special data register D8120. Even if the setting of D8120 is modified while an RS instruction is driven, such modification are not accepted.
- In a system in which a send operation is not performed, set the number of send points to “K0”.
In a system in which a receive operation is not performed, set the number of receive points to “K0”.

Supporting RS Instruction and Programming Protocol

When using the RS instruction in conjunction with a FX_{2N}-232-BD or FX_{0N}-232ADP, FX_{2NC}-232ADP, the user can switch between no protocol communication and the programming tool (Programming Protocol) under the following conditions:

Accordingly, when data is received from the counterpart equipment while an RS instruction remains OFF, “NAK” will be sent back to the counterpart equipment.

Programmable Controller and Version

	Supporting Version
FX _{2N}	V2.01 or more
FX _{2NC}	All products (V2.01 or more)

Operating Conditions and Format Set Content

The programmable controller can change from using no protocol communication to programming protocol (and back) by manipulating the RS instruction and Register D8120 and shown below.

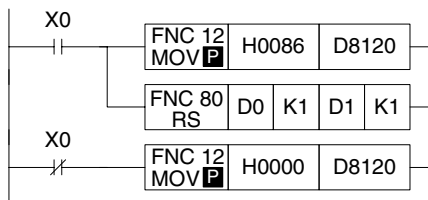
- 1) With the RS instruction ON, move the data options shown below into the Register D8120 to use no protocol communication.

Table: Set communication format (D8120)

Item	Content			
	H0086	H0186	H0286	H0386
Data length	7 Bit			
Parity bit	Even number (EVEN)			
Stop bit	1 Bit			
Baud rate (bps)	9600 bps			
Header	Off	On	Off	On
Terminator	Off		On	

- 2) To use programming protocol, turn the RS instruction OFF and move the data H0000 into the communication format Register D8120. When the programmable controller is taken out of RUN mode (by FX-PCS/WIN-E Software or the front panel switch), complete editing and program downloads can be accomplished. On line changes can be performed with the programmable controller in Run Mode.

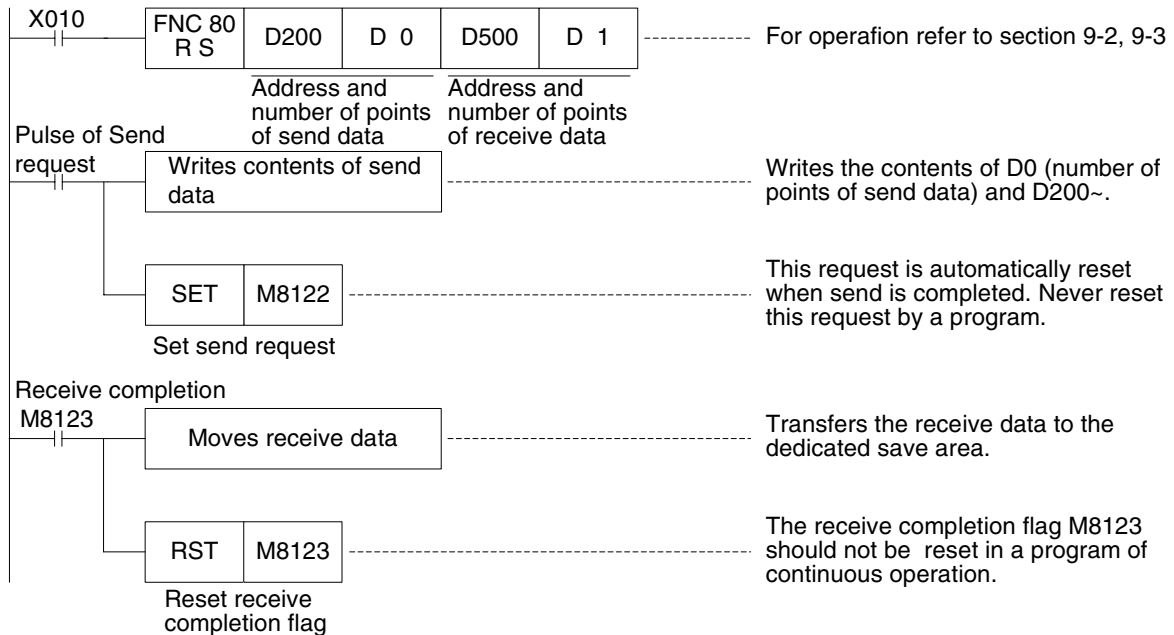
Example of changing the communication format (D8120) between H0086 and H0000. The programmable controller is first set for no protocol communication using the RS instruction.



9.1.2 Operation of RS Instruction

An RS instruction specifies the head address and the number of points of the send data sent from a programmable controller as well as the head address for receive data save destination and the maximum acceptable number of points of receive data.

The data send/receive sequence using an RS instruction is described below.



Note:

Though an RS instruction can be used in a program as many times as you want, make sure that only one RS instruction is driven at any one time (Two or more RS instructions cannot be turned on at one time.). For changeover, assure the OFF time is equivalent to or longer than one cycle time.

In the FX0N, FX1S, FX1N, FX and FX2C, assure the OFF time is equivalent to or longer than two scan times between completion of send and the start of receive or between completion of receive and the start of send. In the FX2N and FX2NC whose version is earlier than V 2.00, assure the OFF time is equivalent to or longer than 100 μs between completion of send and start of receive or between completion of receive and start of send. (Refer to Paragraph 9.2.1.)

This OFF time is not required in the FX2N, FX2NC whose version is V 2.00 or higher because full duplex communication is enabled.



While an RS instruction is driven, modification to D8120 is not accepted. Turn OFF the RS instruction, then modify the setting.

9.1.3 Related Flags and Data Registers

1) Send request <M8122>

When M8122 is set by a pulse instruction in the receive wait status or the receive completion status, data from D200 to D0 is sent. When send is completed, M8122 is automatically reset. When the RS instruction drive input X010 is turned on, the programmable controller is set to the receive wait status.



Note:

In the FX, FX_{2C}, FX_{0N}, FX_{1S}, FX_{1N} and earlier versions than V 2.00 of the FX_{2NC} and FX_{2N}, pay attention to the following points.

While the programmable controller is receiving data, send is only performed after receive is completed. During this time, the send wait flag M8121 is actuated.

After the head data is received and before the receive completion flag M8123 is turned on, it is regarded that a receive is being performed. If the send request is given while the head data is received, data may be confused.

2) Receive completion <M8123>

- When the receive completion flag M8123 is turned ON, transfer the receive data to another save destination, then reset M8123.
- When M8123 is reset, the programmable controller is set to the receive wait status again. To reset M8123, use a sequence as described on the previous page. When the RS instruction drive input X010 is turned on, the programmable controller is set to the receive wait status.
- When an RS instruction is executed while D1 is "0", M8123 (execution completion flag) is not actuated and the programmable controller is not set to the receive wait status. If the programmable controller is set from this status to the receive wait status, set D1 to a value equivalent to or greater than "1", then turn off M8123 (from the ON status).

3) Carrier detection <M8124>

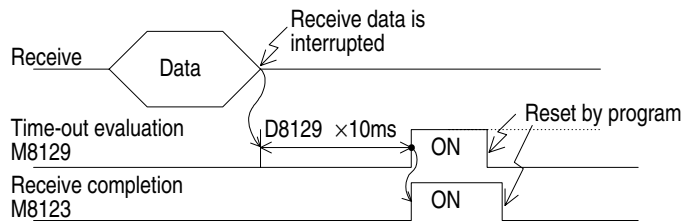
When the CD (DCD) signal (channel receive carrier detection) is received (from the modem to the programmable controller) when the line of the modem is established, M8124 is turned on. While M8124 is turned off, the dial No. can be sent. While M8124 is turned on, data can be sent and received.

4) Time-out evaluation <M8129> (Valid in the FX_{2N}, FX_{2NC} programmable controller earlier than V2.00)

If receive is not restarted within the time specified by D8129 after the receive data is interrupted on the midway, it is regarded as time-out, M8129 is turned on, and receive is completed (Refer to the figure below.).

M8129 is not automatically turned OFF. Reset it using a sequence program.

When this function is used, data can be received without using a terminator even in equipment in which the number of send data may be changed.

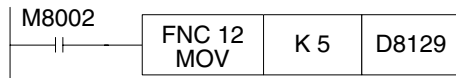


5) Time-out evaluation time <D8129> (Valid in V 2.00 or later of the FX_{2N}, FX_{2NC} programmable controller)

Set the time used for time-out evaluation described above. The value set here multiplied by “10 ms” is regarded as the evaluation time.

When D8129 is set to “0”, the evaluation time equates to “100 ms”.

Example: When the time-out evaluation time is set to “50 ms”



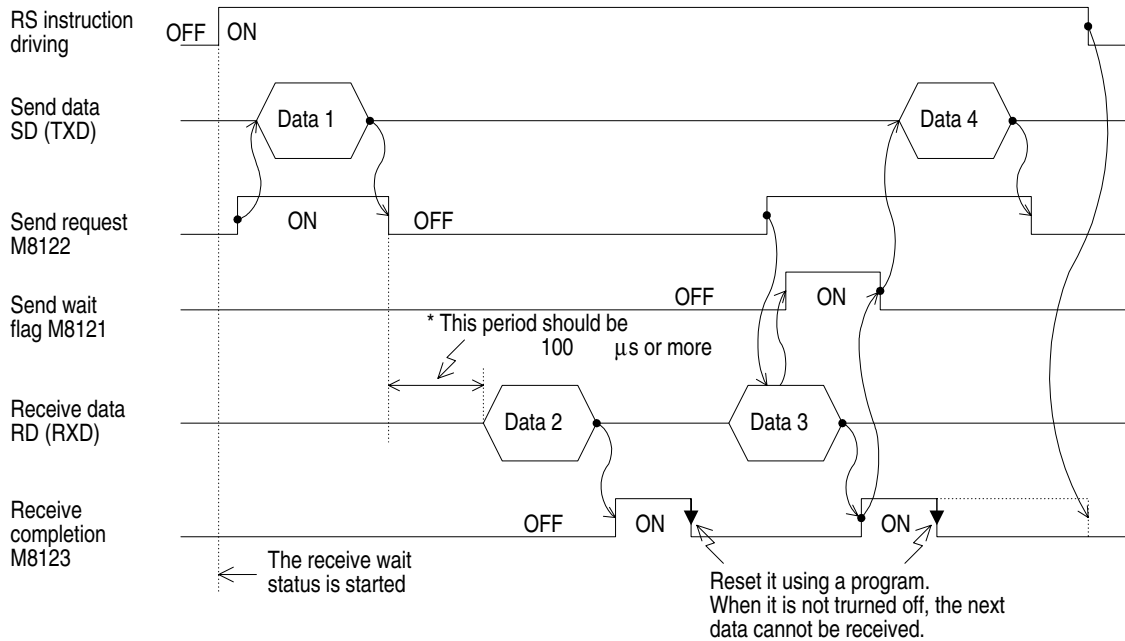
9.2 Hardware Hand Shake Operation

9.2.1 FX, FX2C, FX0N, FX1S, FX1N and FX2N (earlier than V 2.00)

In the FX, FX2C, FX0N, FX1S, FX1N and FX2N (earlier than V 2.00), half duplex communication is performed.

Accordingly, when the send flag is turned ON while data is received, the send wait flag M8121 is turned on. When the receive completion flag is changed from OFF to ON, send is started.

- 1) Do not use hardware hand shakeD8120 ((b12, b11, b10) = (0, 0, 0))



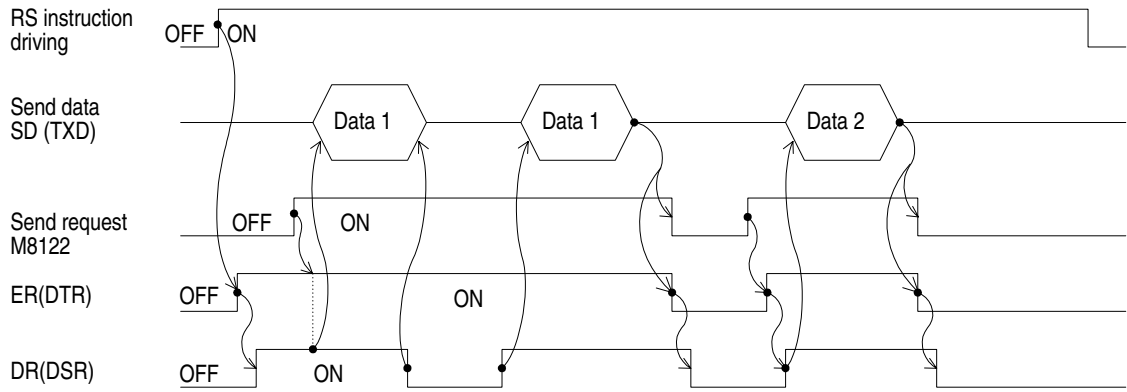
Note:

* In FX1S, FX1N, FX0N, FX and FX2C series, the period should be longer 2 scan times or more.

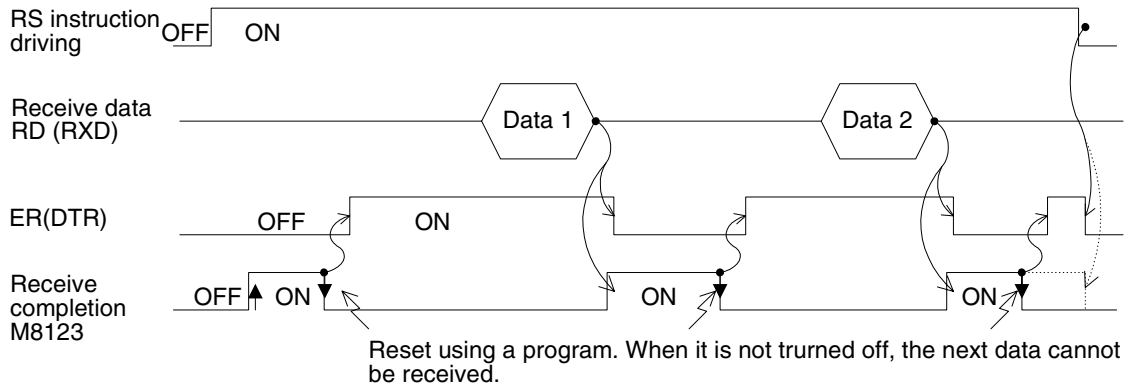
2) Use terminal mode of control line

This mode is available for send only or receive only.

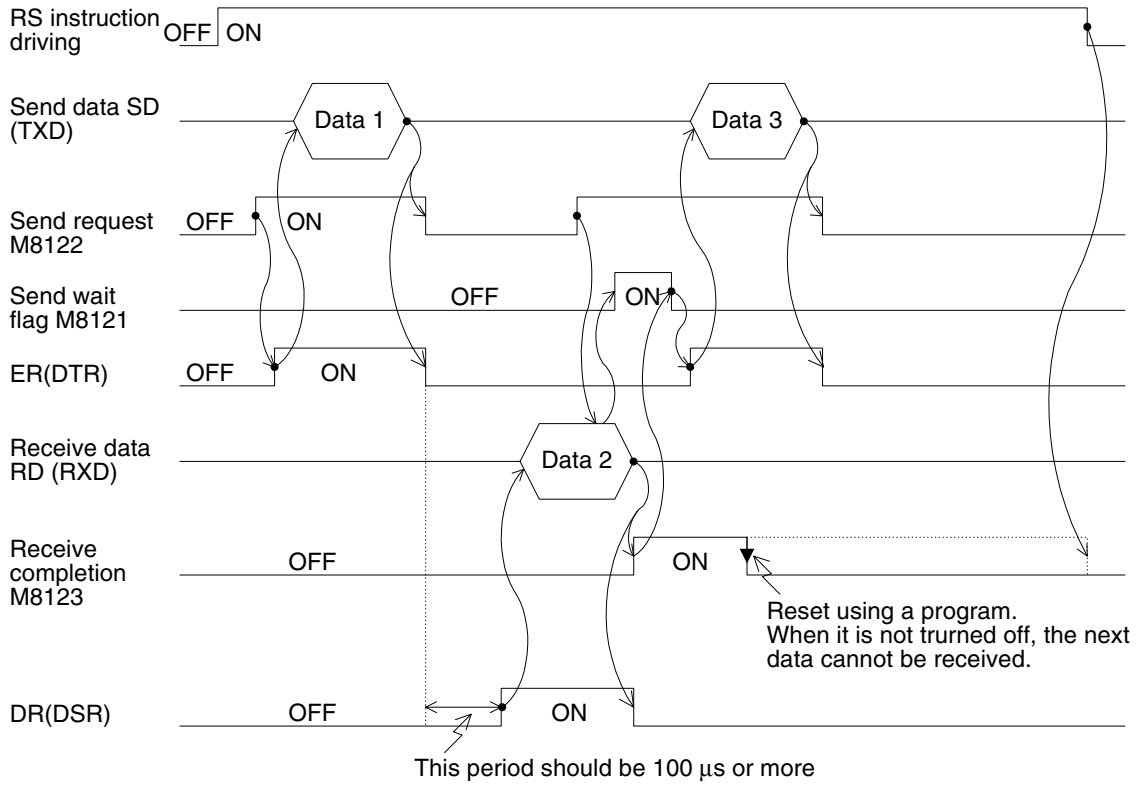
a) Send only



b) Receive only



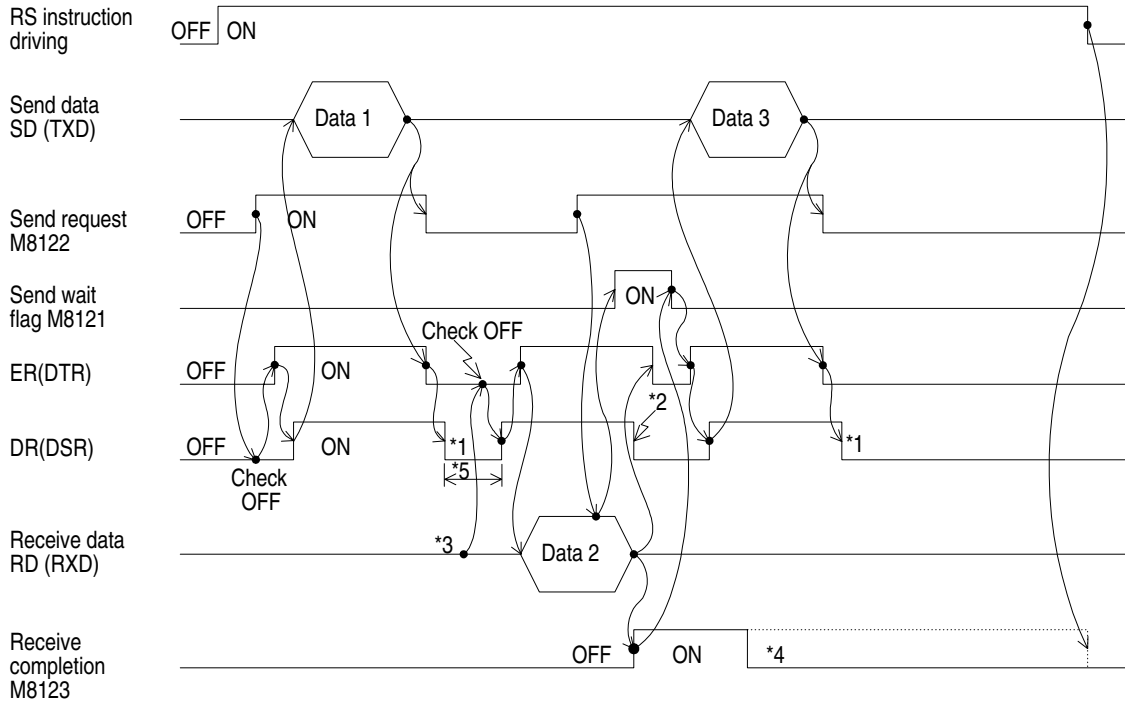
3) Use normal mode 1 of control line



Note:

* When using FX1S, FX1N, FX0N, FX, or FX2C, this period should be longer than 2 scan times or more.

4) Use normal mode 2 of control line (FX, FX2c only)



- *1 Please turn OFF ER (DTR) of DR (DSR) later.
- *2 When the data is sent, please turn OFF DR (DSR). When it is turned ON, the next data cannot be communicated.
- *3 When sending data to the programmable controller, please check to turn OFF the ER (DTR) signal.
- *4 Reset using a program. When it is turned ON, the next data cannot be received.
- *5 This period should be longer than 2 scan times or more.

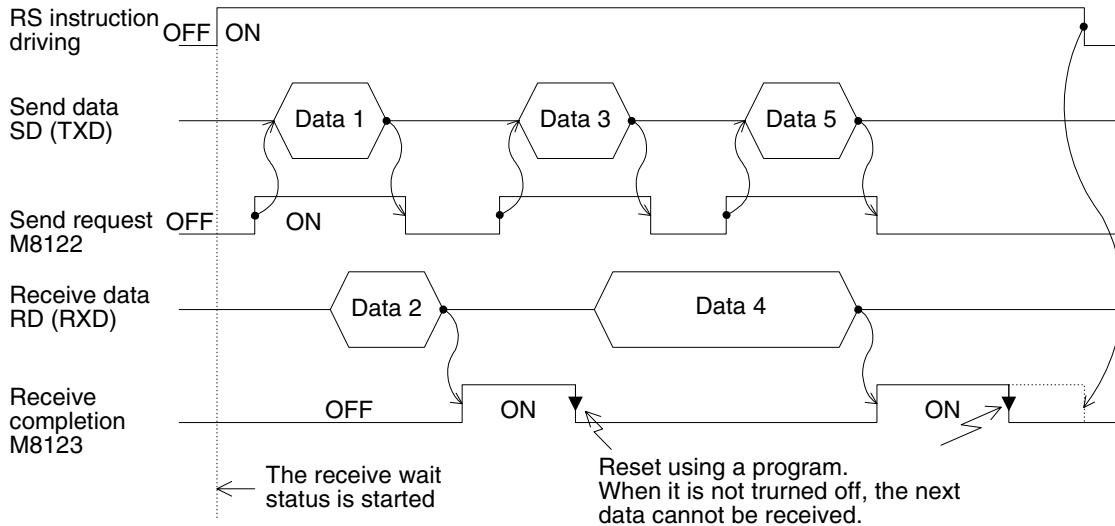
9.2.2 FX_{2N}, FX_{2NC} (V 2.00 or later)

In the FX_{2N} V 2.00 or later, full duplex communication is performed. When performing half duplex communication, pay rigid attention so that the send flag is not turned on while data is received. If it is turned on, send is started. As the result, the counterpart equipment may not be able to receive data or the send/receive data may be damaged.

In full duplex communication, the send wait flag M8121 is not turned on.

In version V 2.00 or later, the programming protocol (Section 12) is supported while an RS instruction remains OFF.

1) Do not use hardware hand shake

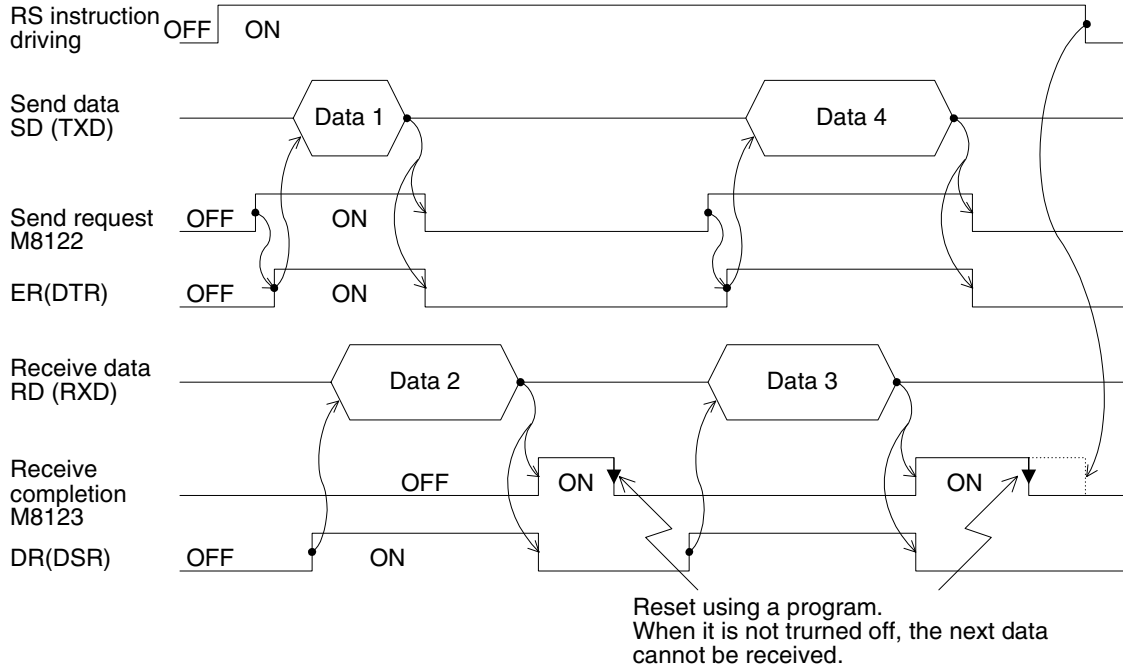


2) Use terminal mode of control line

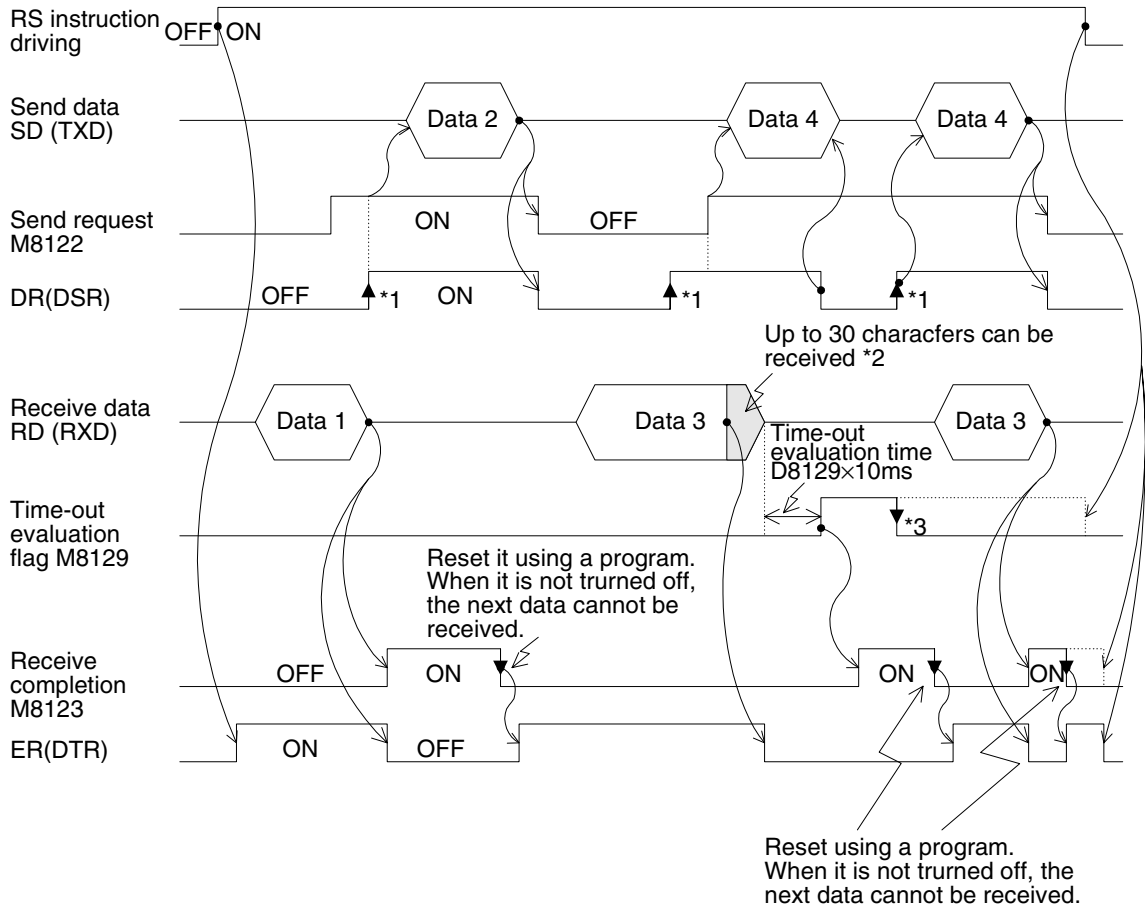
This mode is available for send only or receive only.

The control line and the transmission sequence are equivalent to those in the FX_{2N} series whose version is earlier than V 2.00. Refer to paragraph 9.2.1.

3) Use normal mode 1 of control line



4) Use interlink mode of control line



- *1 While the counterpart equipment is ready to receive, turn ON the DR (DSR) signal. While both the DR (DSR) signal and the send request are turned on, the FX_{2N} sends the data.
- *2 In the interlink mode, the programmable controller turns OFF the ER (DTR) signal before the 30th character receive buffer limit, and requests the counterpart equipment to stop send. After this send request, up to 30 characters can be received. The 31st and later characters cannot be received. Stop send temporarily, then send the remaining data after the ER (DTR) signal is turned ON again. When send is stopped, receive is completed after the time-out evaluation time is expired. When send is not stopped, receive is completed after the final character of the send data is received or the 30th character is received. Therefore, receive points need to set 30th or more.
- *3 Reset using a sequence program. If it is turned ON, the next data cannot be received.

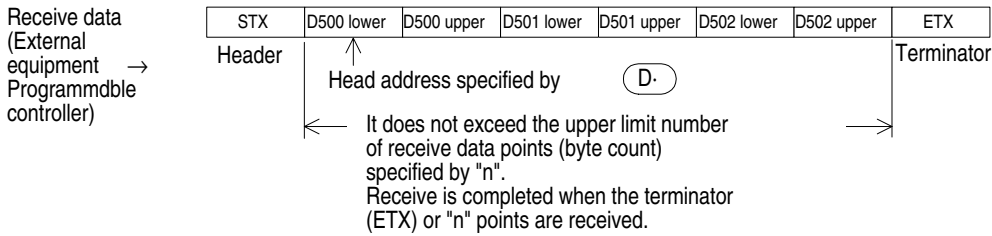
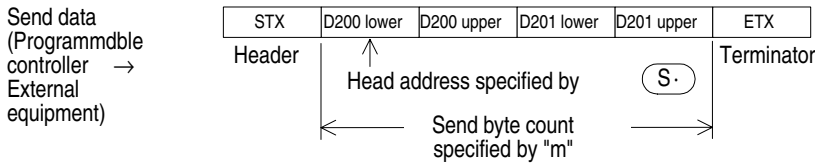
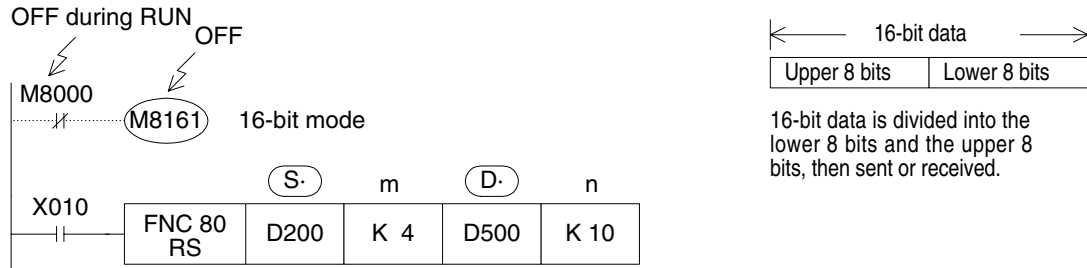


In the interlink mode, make sure to set the number of receive points to 30 characters or more.

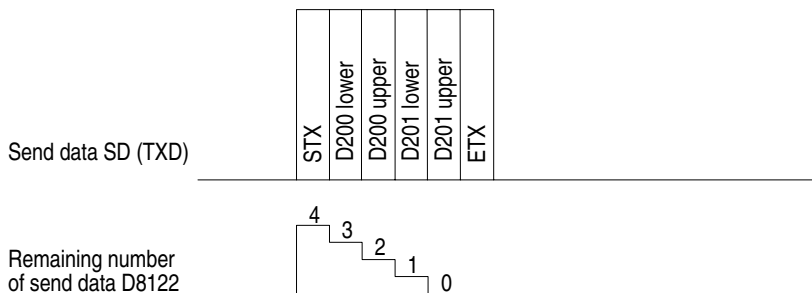
9.3 Number of Communication Data

9.3.1 Deal with 16 bits Data

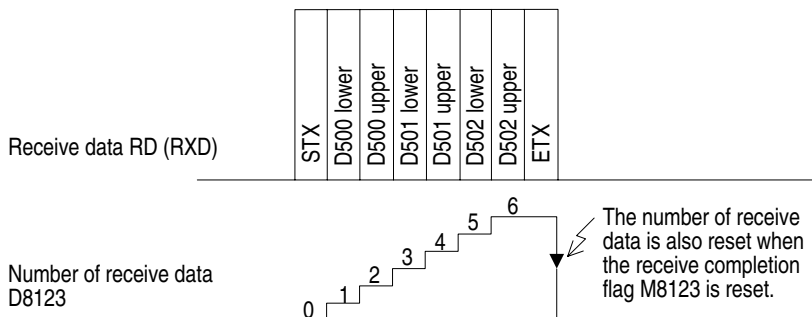
When M8161 is set to OFF (M8161 is shared by an ASCII instruction, a HEX instruction and a CCD instruction.)



1) Send data and remaining number of send data

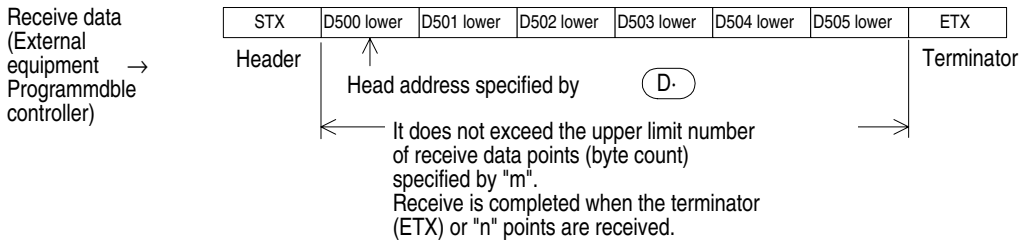
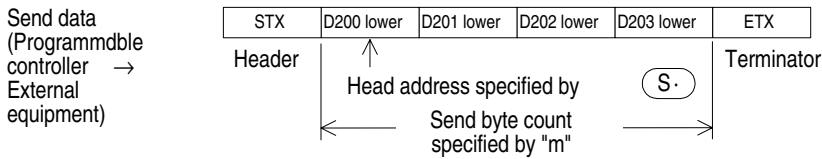
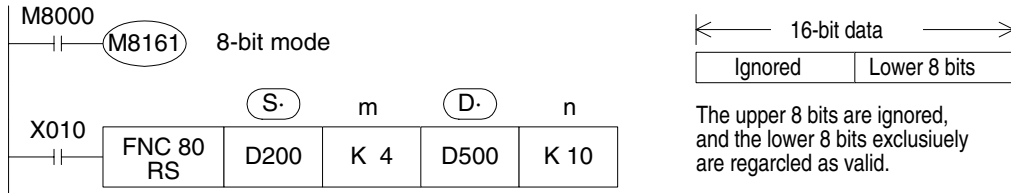


2) Receive data and number of receive data

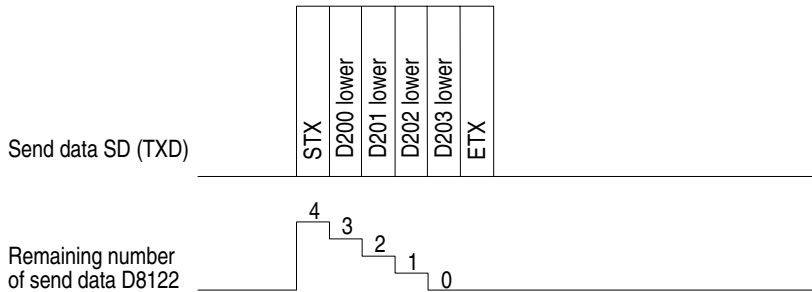


9.3.2 Deal with 8 bits Data

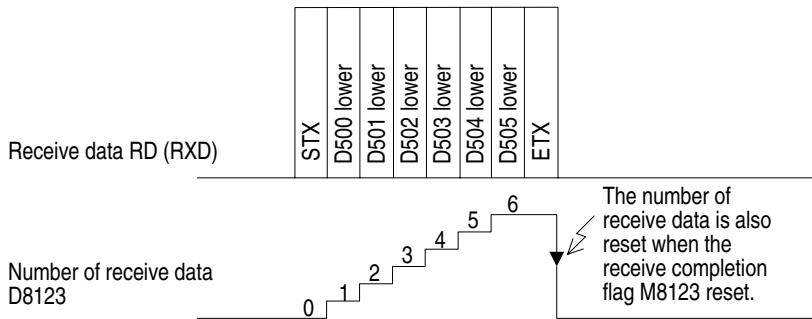
When M8161 is set to ON (M8161 is shared by an ASCII instruction, a HEX instruction and a CCD instruction.)



1) Send data and remaining number of send data



2) Receive data and number of receive data

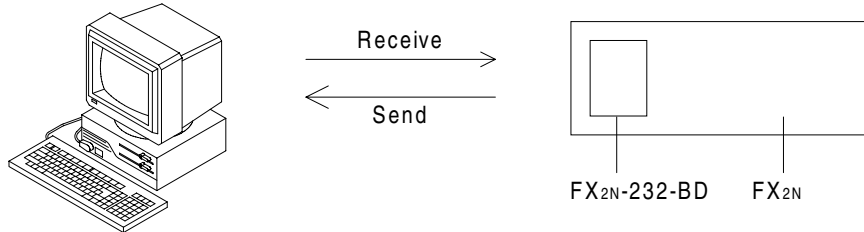


9.4 Example Program

9.4.1 Personal Computer

When a programmable controller is connected to a personal computer, and data send/receive is performed by the programmable controller

1) System configuration



Use a communication cable suitable to the arrangement of connector pins of the personal computer used. (For the representative wiring, refer to chapter 2.)

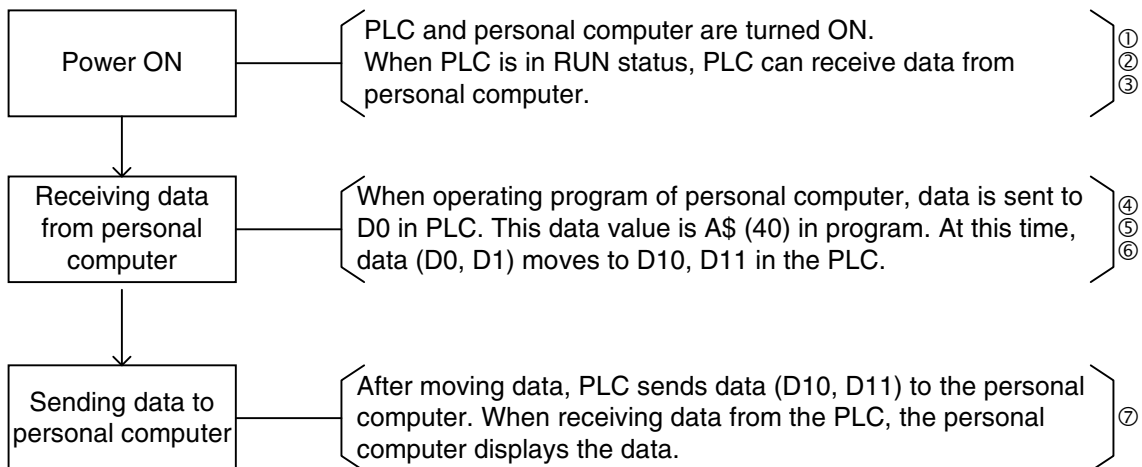
2) Communication format

If the communication format of the commercial communication software used cannot realize the following setting, set the programmable controller in accordance with the commercial communication software.

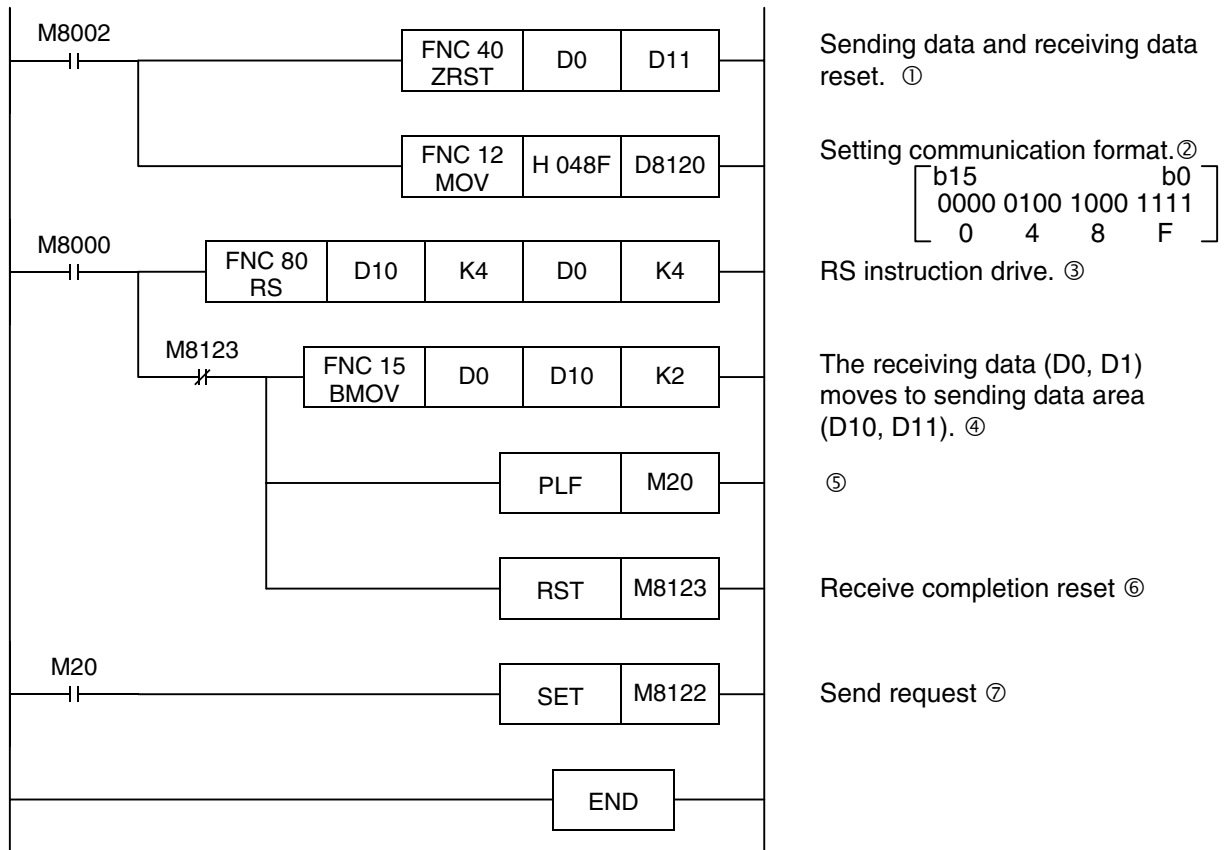
(The communication format in this example is set as follows.)

Data length	8 bit
Parity	Even
Stop bit	2 bit
Baud rate	9,600 bps
Header	None
Terminator	None
Control line	Normal mode 1
Protocol	No protocol

3) Operation



4) Example program of programmable controller



5) Example program of computer

This is an example of a BASIC program for communication of RS instruction communication (no protocol communication). This BASIC program is written by not know overseas.

```

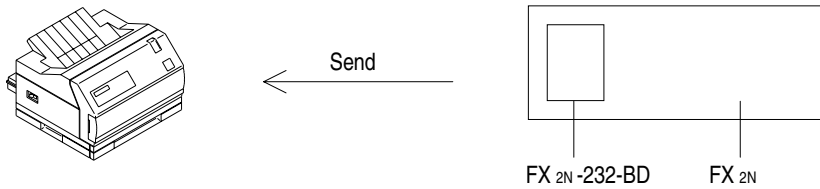
10 CLOSE #1:A$="40"           Text of ASCII stored.
20 OPEN "COM1:" AS #1        COM1 port is opened.
30 PRINT #1,A$              Data is sent to PLC.
40 CLOSE #1:FOR I=J TO 2000:NEXT *1
50 OPEN "COM1:" AS #1
60 FOR I=1 TO 100 *1
70 IF LOC(1)>=4 GOTO 100     Length of received data is checked.
80 NEXT
90 CLOSE #1:PRINT "TIME OUT ERROR":END
100 B$=INPUT$(LOC(1),#1)
110 PRINT B$                Received data is displayed.
120 END
    
```

*1 This counter is used for waiting time of receiving data from PLC. Please change setting value of counter for personal computer CPU speed.

9.4.2 Printer

Connecting FX_{2N}-232-BD and printer, and printing out the data send from the programmable controller.

1) System configuration



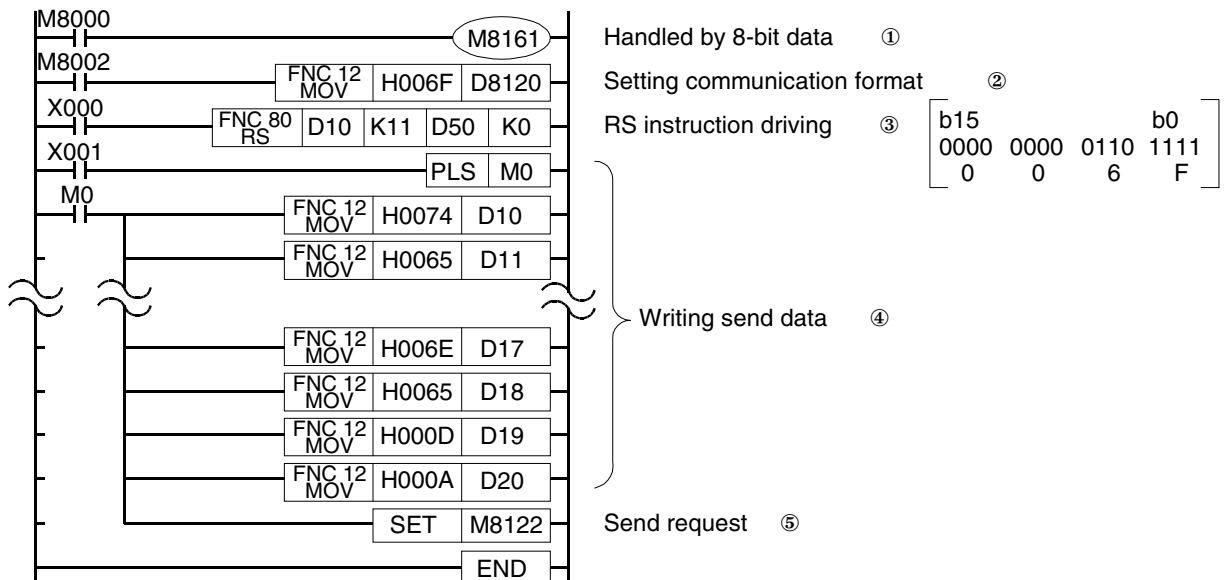
Use a communication cable suitable to the arrangement of connector pins of the printer used. (For the representative wiring, refer to chapter 2.)

2) Communication format

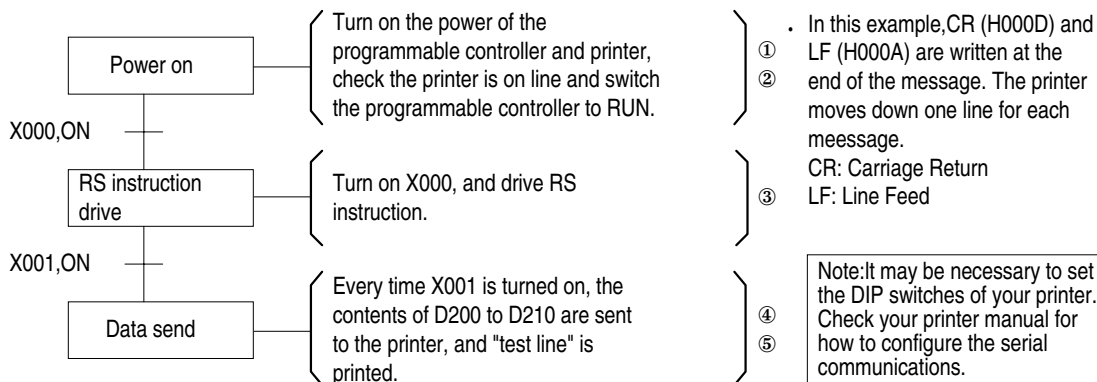
Let the communication format of the programmable controller be in accordance with that of the printer used. (The communication format in this example is set as follows.)

Data length	8 bit
Parity	Even
Stop bit	2 bit
Baud rate	2,400 bps
Header	None
Terminator	None
Control line	No use
Protocol	No protocol

3) Example program



4) Operation



10. FX_{2N}-232IF

10.1 Introduction

The RS-232C interface block FX_{2N}-232IF (hereinafter referred to as “232IF”) is connectable with to the FX_{2N}, FX_{2NC} programmable controller to realize full duplex serial data communication with another RS-232C interface such as a personal computer, bar code reader, printer, etc.

10.1.1 Outline of Product

- 1) Applicable programmable controller
The 232IF can be connected as a special block of the FX_{2N}, FX_{2NC} programmable controller.
- 2) Control instructions
Send/receive data is received and sent and diversified control commands are manipulated using the FROM/TO instruction.
- 3) Number of I/O points and connection method
The 232IF occupies 8 I/O points that can be allocated as either inputs or outputs. However the capacity of the 5 V power supplied from the programmable controller is limited.
The current consumption of the 5 V power of the 232IF is 40 mA. Make sure that the total current consumption of the 5 V power including other special blocks is equivalent to or less than that available.
- 4) Communication method
Full duplex start-stop synchronization and no protocol procedure are used. The communication format can be specified using buffer memories (BFMs).
- 5) Send/receive buffer
The send/receive buffer can accommodate 512 bytes/256 words.
When the RS-232C interlink connection mode is used, data exceeding 512 bytes/256 words can also be received.
- 6) ASCII/HEX conversion function
The function to convert and send a hexadecimal numeric (0 to F) saved in the send data buffer as well as the function to convert a received ASCII code into a hexadecimal numeric (0 to F) and save it to the receive buffer are provided.

10.2 Allocation of Buffer Memories (BFM's)

The RS-232C interface block FX_{2N}-232IF(232IF) transmits data with the programmable controller via buffer memories BFM's (16-bit RAM memories) in the 232IF. FNC78 (FROM) and FNC79 (TO) instructions are used to read and write the buffer memories.

10.2.1 BFM List

BFM No.	Name	Setting range	Initial value	R:For read W:For write
#0	Communication format	—	0087H	W
#1	Command	—	0	W
#2	Receive upper limit byte count	1 to 512 (when data length is 16 bits) 1 to 256 (when data length is 8 bits) "0" is treated as "512" or "256".	0	W
#3	Receive time-out time	1 to 32,767 (X10 ms) "0" eliminates time-out time.	0	W
#4	Send header, lower 2 bytes	4 bytes max., zero suppression	0 (no header)	W
#5	Send header, upper 2 bytes		0	
#6	Send terminator, lower 2 bytes	4 bytes max., zero suppression	0 (no terminator)	W
#7	Send terminator, upper 2 bytes		0	
#8	Receive header, lower 2 bytes	4 bytes max., zero suppression	0 (no header)	W
#9	Receive header, upper 2 bytes		0	
#10	Receive terminator, lower 2 bytes	4 bytes max., zero suppression	0 (no terminator)	W
#11	Receive terminator, upper 2 bytes		0	
#12	Receive suspension waiting time (in interlink connection)	0 to 32,327 (X10 ms)	0	W
#13	Number of remaining send data	0 to 512 (when data length is 16 bits) 0 to 256 (when data length is 8 bits)	0	R
#14	Number of receive buffers	0 to 256 + 15 *1	0	R
#15	Send sum result	—	0	R
#16	Receive sum result	—	0	R

Note : "W : For write" can be used for read also. Undefined BFM Nos. are not allowed to be used in program.

*1 : Spare buffers used in the interlink connection mode.

BFM No.	Name	Setting range	Initial value	R:For read W:For write
#20	Time from CS ON to send start	0 to 32,327 (X 10 ms)	0	W
#21	Time from completion of actual send to RS OFF (completion flag ON)	0 to 32,327 (X 10 ms)	0	W
#28	Status	—	0	R
#29	Error code	—	0	R
#30	Model code	—	K7030	R
#1000	Send byte count	0 to 512 (when data length is 16 bits) 0 to 256 (when data length is 8 bits)	0	W
#1001 to #1256	Send buffers	—	0	W
#2000	Receive byte count	0 to 512 + 30 *1 0 to 256 + 15 *1	0	R
#2000 to #2256	Receive buffers	—	0	R
#2257 to #2271	Spare receive buffers for interlink connection mode	—	0	R

Note : "W : For write" can be used for read also. Undefined BFM Nos. are not allowed to be used in the program.

*1 : Spare buffers used in the interlink connection mode.

10.2.2 Communication Format <BFM#0>

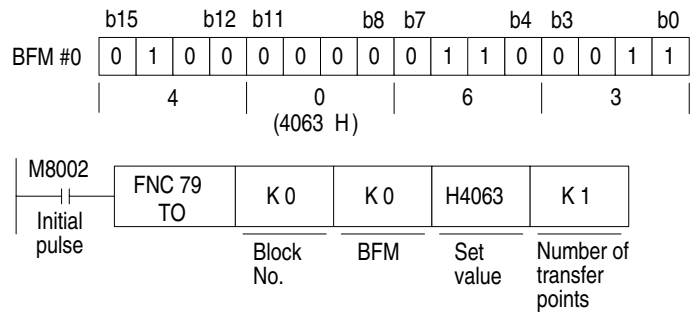
Bit	Description	0	1	Initial value
b0	Data length	7 bit	8 bit	1 : 8 bit
b1 b2	Parity	b1 (00) : None (01) : Odd (11) : Even		(11) : Even
b3	Stop bit	1 bit	2 bit	0 : 1 bit
b4 b5 b6 b7	Baud rate (bps)	b4 (0011) : 300 (0100) : 600 (0101) : 1200 (0110) : 2400 (0111) : 4800 (1000) : 9600 (1001) : 19200		(1000) : 9600 bps
b8 b9	Control line	b8 (00) : Unused (01) : Standard RS-232C (11) : RS-232C interlink connection mode		(00) : Unused
b10 b11	Addition of CR and LF	b10 (00) : Not added (01) : CR only (11) : CR and LF		(00) : Not added
b12 b13	Availability of check sum and ASCII/HEX conversion	b12 (00) : Not available (01) : ASCII/HEX conversion available (10) : Check sum available (11) : Check sum available, ASCII/HEX conversion available		(00) : Not available
b14	Send/receive buffer data length	16 bit	8 bit	0 : 16 bit
b15	Unused	—		0 : Unused

The communication format is determined on the rising edge of the send/receive enable command (BFM #1 b0).

Accordingly, the communication format setting should be preliminary transferred using the TO instruction before BFM #1 b0 is turned ON. Also, the send header and terminator are determined by the rising edge of the send command (BFM #1 b1). The receive header and the receive terminator are determined on the rising edge of BFM #1 b0 or on the rising edge of the receive completion reset command (BFM #1 b2). Accordingly, when only the header and the terminator are exclusively changed it is not necessary to turn BFM #1 b0 OFF. The change becomes valid from the next send/receive operation.

Note : Setting example (hexadecimal, constant specification)

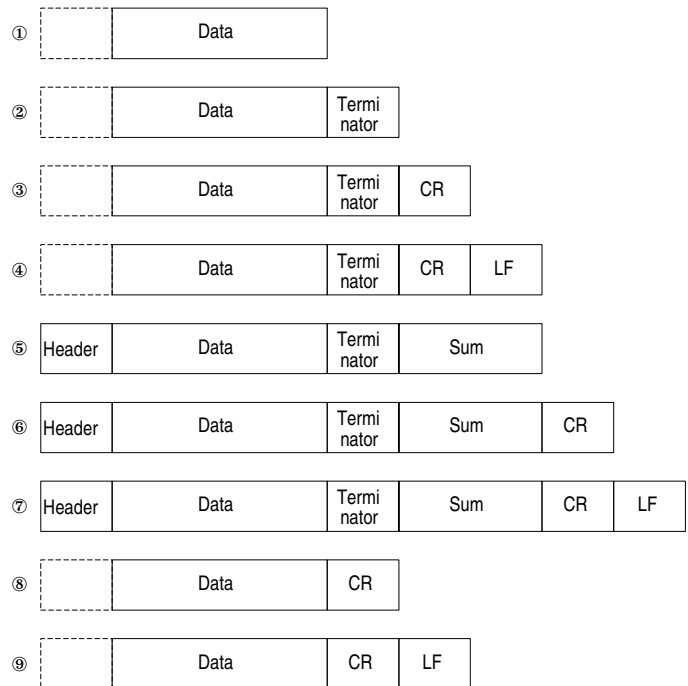
Data length	8 bits
Parity	Odd
Stop bit	1 bit
Baud rate	2400 bps
Control line	No used
CR, LF	No added
Sum check	No added
ASCII/HEX conversion	No used
Buffer data length	8 bits



1) Communication format

Select the communication format used to send/receive data via the 232IF among the 9 types shown on the left.

- The header can be specified in the [] portion of the communication format.
- In the communication format type ①, hexadecimal data (binary) and ASCII code can be sent and received. In the communication format types ② to ⑨, the send/receive data should be any ASCII code except the header, terminator and CR. Communication can be performed using the ASCII/HEX conversion function by specifying the BFM #0 b13 and the BFM #0 b12.
- The ASCII codes available for the initial terminator are 01H to 1FH.
- In the RS-232C interlink connection mode, the communication formats ② to ⑦ are available.



2) b0 to b7 (data length, parity, stop bit and baud rate)

b0 to b7 should be aligned with the communication specification of the connected counterpart equipment.

3) b9 and b8 (control line)

For examples of connecting the equipment corresponding to each setting, refer to section 2.2.2. For operation of control line, refer to section 10.3.

- When bits b9=0 and b8=0 communication is performed using only the SD and RD signals without using the control line.
- When standard RS-232C mode is specified (b9=0, b8=1), a cross cable is required to connect the equipment of terminal specifications and a straight through cable is required to connect the equipment of modem specifications.
- When RS-232C interlink connection mode is specified (b9=1, b8=1), the request to send (RS) signal functions as the signal to enable receive in the 232IF. When receiving data exceeds the receive upper limit byte count (BFM #2), the 232IF sets the request to send (RS) signal to OFF and requests the counterpart equipment to suspend the send operation.

At this time, when the data saved in the receive buffers is read to data registers in the programmable controller using the sequence program, the remaining data can be received. Make sure to perform the RS-232C interlink connection when specifying this mode.

4) b11 and b10 (addition of CR and LF)

Set these bits as follows.

- Not added. (b11=0, b10=0)
- CR only is added. (b11=0, b10=1)
- CR and LF are added. (b11=1, b10=1)

For the CR/LF addition format, refer to the communication format list shown above.

5) b13 and b12 (Availability of check sum and ASCII/HEX conversion)

Set these bits as follows.

- Neither the check sum nor the ASCII/HEX conversion is available. (b13=0, b12=0)
- The ASCII/HEX conversion only is available. (b13=0, b12=1)
- The check sum only is available. (b13=1, b12=0)
- Both the check sum and ASCII/HEX conversion are available. (b13=1, b12=1)

For the check sum addition format, refer to the communication format list shown above.

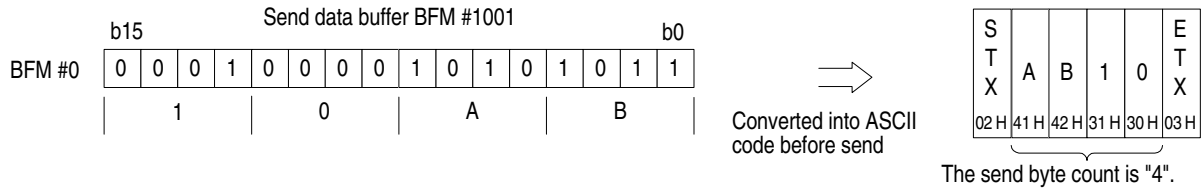
Note : ASCII/HEX conversion

When execution of the ASCII/HEX conversion is specified, the hexadecimal numeric data (0 to F) inside the send buffers (BFMs #1001 to #1256) is converted into the ASCII code, then sent. The received ASCII code is converted into hexadecimal numeric data (0 to F), then saved to the receive buffers (BFMs #2001 to #2256).

At this time, the send/receive byte count indicates the number of hexadecimal data.

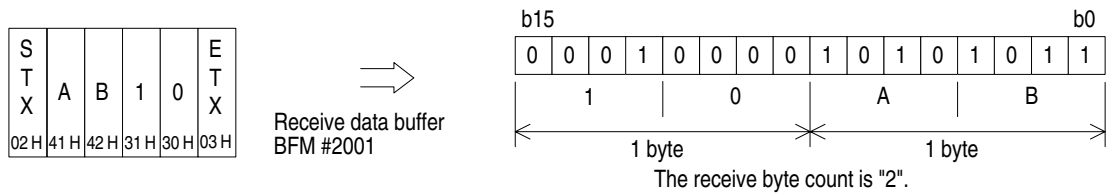
a) Send format when hexadecimal data is converted into ASCII code

Example : When the send data "10ABH", the header "STX" and the terminator "ETX" are sent



b) Receive format when ASCII code is converted into hexadecimal data

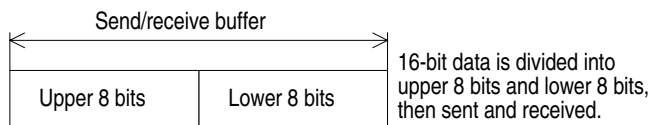
Example : When the receive data "10ABH", the header "STX" and the terminator "ETX" are received



6) b14 (send/receive buffer data length)

The data is treated as follows in accordance with the buffer data length.

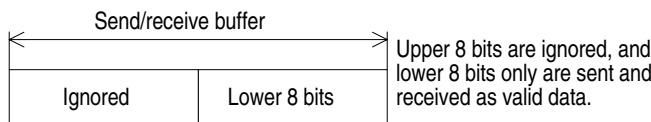
- In the case of 16 bits (b14=0)



Example of send buffers

S	BFM	BFM	BFM	BFM	E
T	#1001	#1001	#1002	#1002	T
X	lower	upper	lower	upper	X

- In the case of 8 bits (b14=1)



Example of send buffers

S	BFM	BFM	BFM	BFM	E
T	#1001	#1002	#1003	#1004	T
X	lower	lower	lower	lower	X

10.2.3 Command (BFM #1)

Bit	Description
b0	Send/receive enable (ER ON)
b1	Send command
b2	Receive completion reset command
b3	Error reset

BFM #1 gives the command for send/receive and the status information reset command to the 232IF.

1) b0 (send/receive enable)

While b0 is turned on, the 232IF can send and receive data.

The contents of the following setting items are determined on the rising edge of b0. Make sure to set the contents using the TO instruction before setting b0 to "ON".

- BFM #0 (communication format)
- BFMs #9 and #8 (receive header)
- BFMs #11 and #10 (receive terminator)

On the rising edge of b0, the error occurrence (BFM #28 b3) and the error code (BFM #29) are cleared.

2) b1 (send command)

On the rising edge of b1, the contents of the send buffers (BFMs # 1001 to #1256) are sent to the counterpart equipment up to the send byte count (BFM #1000).

When send is completed, the send completion status (BFM #28 b0) is set. BFM #28 b0 is automatically reset when the next send command (b1) is given.

When b1 is given, the contents of the following setting items are determined.

- BFMs #5 and #4 (send header)
- BFMs #7 and #6 (send terminator)

3) b2 (receive completion reset command)

When b2 is set to "ON", the following items are cleared.

- BFM #28 b1 (receive completion)
- BFM #2000 (receive byte count)
- BFMs #2001 to #2256 (receive buffers)

When receive is completed, b2 should be set to "ON" to clear the receive completion status (BFM #28 b1). If BFM #28 b1 is not reset, the next data cannot be received.

When b2 is set to "ON", the contents of the following setting items are determined.

- BFMs #9 and #8 (receive header)
- BFMs #11 and #10 (receive terminator)

In the RS-232C interlink connection mode (BFM #0 b9=1, b8=1), b2 functions as the receive continuation command to receive data exceeding the receive upper limit byte count (BFM #2), and clears the following items.

- BFM #28 b4 (receive suspended)
- BFM #2000 (receive byte count)
- BFMs #2001 to #2256 (receive buffers)
- BFMs #2257 to #2271 (spare receive buffers)

When b2 is set to "ON", the request to send (RS) signal is automatically set to "ON" also.

4) b3 (error reset)

When b3 is set to "ON", the error occurrence status (BFM #28 b3) and error code (BFM #29) are cleared.

10.2.4 Receive Upper Limit Byte Count <BFM #2>

Setting range: 1 to 512 (when buffer data length is 16 bits)
 1 to 256 (when buffer data length is 8 bits)
 "0" is regarded as "512" or "256". The initial value is "0".

BFM #2 specifies the maximum byte count received by the 232IF.
 When data is received up to the receive upper limit byte count, the receive completion status (BFM #28 b1) is set.
 When the receive terminator (BFMs #11 and #10) or the receive time-out time (BFM #3) is set and the set condition is satisfied, it is regarded that receive is completed even if the data received is within the receive upper limit byte count.

10.2.5 Receive Time-out Time <BFM #3>

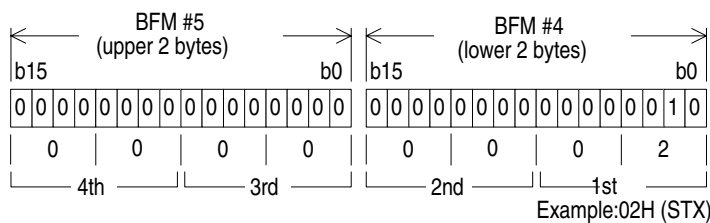
Setting range: 1 to 32,767 (x 10ms)
 "0" eliminates time-out time. The initial value is "0".

BFM #3 specifies the receive data waiting time limit.
 When the next data is not received within the receive time-out time starting from the receive edge of each data, the receive time-out flag (BFM #28 b2) is set to "ON", it is regarded that receive is completed, and the receive completion status (BFM #28 b1) is set.

10.2.6 Send Header <BFM #5 (upper), BFM #4 (lower)>

Setting range: 4 bytes maximum, zero suppression
 The initial value is "0" (No used).

For the send data of the 232IF, 4 headers maximum can be specified. When the number of headers is less than 4, the upper "0"s are ignored (zero suppression) and not transferred.



- The transmission order is fourth header, third header, second header, first header when 4 headers are specified.

10.2.7 Send Terminator <BFM #7 (upper), BFM #6 (lower)>

Setting range: 4 bytes maximum, zero suppression
 The initial value is "0" (No used).

For the send data of the 232IF, 4 terminators maximum can be specified. When the number of terminators is less than 4, the upper "0"s are ignored (zero suppression) and not transferred.
 As the first terminator, specify an ASCII code from 01H to 1FH. (As the second to fourth terminators, any ASCII code can be specified.)
 The register structure and the transmission order are equivalent to those of the send header described above.

10.2.8 Receive Header <BFM #9 (upper), BFM #8 (lower)>

Setting range: 4 bytes maximum, zero suppression
 The initial value is "0" (No used).

For the receive data of the 232IF, 4 headers maximum can be specified. When the number of headers is less than 4, the upper "0"s are ignored (zero suppression). The register structure and the transmission order are equivalent to those of the send header described above.

10.2.9 Receive Terminator <BFM #11 (upper), BFM #10 (lower)>

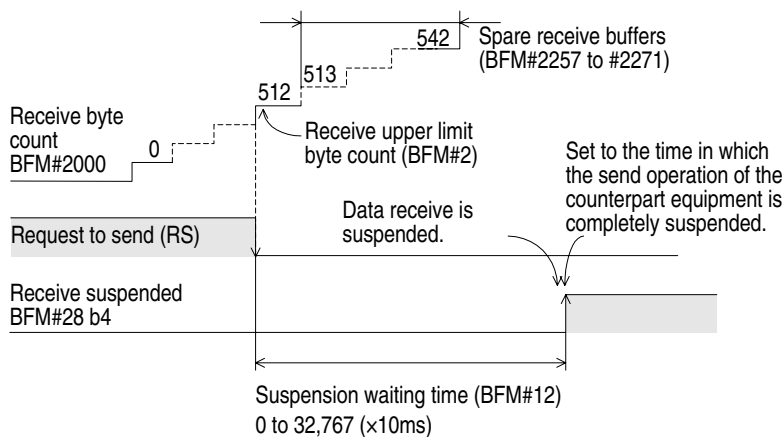
Setting range: 4 bytes maximum, zero suppression
 The initial value is "0" (No used).

For the receive data of the 232IF, 4 terminators maximum can be specified. When the number of terminators is less than 4, the upper "0"s are ignored (zero suppression). As the first terminator, specify an ASCII code from 01_H to 1F_H. (As the second to fourth terminators, any ASCII code can be specified.) The register structure and the transmission order are equivalent to those of the send header described above.

10.2.10 Receive Suspension Waiting Time <BFM #12>

Setting range: 0 to 32,767 (x 10ms)
 The initial value is 0 ms.

In the RS-232C interlink connection mode (BFM #0, b9=1, b8=1), when receiving data exceeding the receive upper limit byte count (BFM #2), the 232IF sets the request to send (RS) signal to "OFF" and requests the counterpart equipment to suspend the send operation. BFM #12 specifies the time after the request to send (RS) signal is turned off until the receive suspended status (BFM #28 b4) is turned on. The value set to the BFM #12 should be equivalent to or more than the time after the 232IF sets the request to send (RS) signal to "OFF" until the send operation of the counterpart equipment is completely suspended. If the time times out and the receive suspended status (BFM #28 b4) is set to "ON" before the send operation of the counterpart equipment is not suspended, the remaining data cannot be received.



10.2.11 Number of Remaining Send Data <BFM #13>

Saved value: 0 to 512 (when buffer data length is 16 bits)
 0 to 256 (when buffer data length is 8 bits)

The send byte count (BFM #1000) reduced by the number of data actually sent is during transmission.

10.2.12 Number of Receive Buffers <BFM #14>

Saved value: 0 to 256+15 (for spare receive buffers)

The number of buffers which have actually received data is saved in turn with regard to the receive buffers BFM #2001 to #2256 and the spare receive buffers BFM #2257 to #2271 for interlink connection mode.

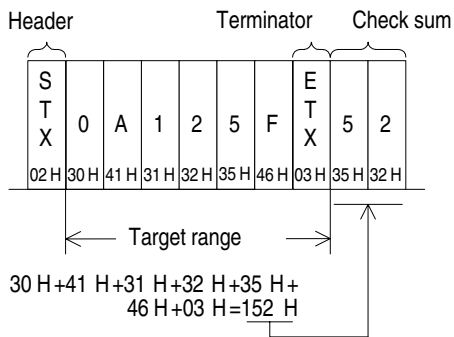
10.2.13 Send Sum Result <BFM #15>

Initial value: 0

The check sum value added to the send data is saved.
 The sum check target range and the calculation method are shown below.

Note; Sum check target range and calculation method

Example:



The total value including the terminator and excluding the header (1st byte of the header only) is calculated. Then, the lower 1 byte is converted into the ASCII code, and sent or received. The data converted into the ASCII code is placed in the order of upper digit and lower digit.

10

10.2.14 Receive Sum Result <BFM #16>

Initial value: 0

The sum check value of the receive data is saved.
 When the check sum added to the receive data is different from the receive sum result, "receive sum check error" occurs.
 The sum check target range and the calculation method are equivalent to those for the send sum result described above.

10.2.15 Time from CS ON to Send Start <BFM #20>

Set value: 0 to 32,767 (x 10ms)
The initial value is 0 ms.

The time after the clear to send (CS) signal is turned on until the 232IF starts the send operation can be set.

When "control line not used" is specified, the time after the send command is given until the send operation is started is specified.

Set BFM #20 when it is required by a modem, etc.

10.2.16 Time from Completion of Actual Send to RS OFF (completion flag ON) <BFM #21>

Set value: 0 to 32,767 (x 10ms)
The initial value is 0 ms.

The time after the 232IF sends the data until the RS signal is turned off and the send completion flag (BFM #28 b0) is turned on can be specified.

Set BFM #21 when it is required by a modem, etc.

10.2.17 Status <BFM #28>

Bit	Description
b0	Send completion
b1	Receive completion
b2	Receive time-out
b3	Error occurrence
b4	Receive suspended
b5	Undefined
b6	Being sent
b7	Being received

Bit	Description
b8	RS (RTS)
b9	ER (DTR)
b10	Undefined
b11	Undefined
b12	DR (DSR)
b13	CD (DCD)
b14	DS (CTS)
b15	CI (RI)

The 232IF status and the send/receive result are saved as status information. This information can be read from the programmable controller using the FROM instruction.

1) b0 (send completion)

When send of data up to the send byte count (BFM #1000) is completed, the send completion status (b0) is set. The send completion status (b0) is automatically reset when the next send command (BFM #1 b1) set to "ON".

2) b1 (receive completion)

When receive of data up to the receive upper limit byte count (BFM #2) is completed, the receive completion status (b1) is set. If the receive terminator (BFMs #11 and #10) or the receive time-out time (BFM #3) is set, it is regarded that receive is completed when the set condition is satisfied, then the receive completion status (b1) is set in the same way.

This status is required to be reset using the sequence program. If it is not reset, the next data cannot be received. This status can be reset using the receive completion reset command (BFM #1 b2).

3) b2 (receive time-out)

When the receive time-out time (BFM #3) is reached while data is received, the receive time-out status (b2) is set. At the same time, the receive completion status (b1) is also set.

This status is automatically reset when the receive completion reset command (BFM #1 b2) is executed.

4) b3 (error occurrence)

When an error occurs while data is sent or received, b3 is set to "ON" and the error is saved to the error code (BFM #29).

5) b4 (receive suspended)

When data exceeding the receive upper limit byte count (BFM #2) is received in the RS-232C interlink connection mode (BFM #0 b9=1, b8=1), the 232IF sets the request to send (RS) signal to "OFF", requests the counterpart equipment to suspend the send operation, then sets b4 after the receive suspension waiting time (BFM #12) has expired.

To receive the excess data in the interlink connection, the rising edge of the b4 is required to be monitored using the sequence program. The data as much as the receive byte count (BFM #2000) in the receive buffers (BFMs #2001 to #2271) or the data as much as the number of receive buffers (BFM #14) should be read to data registers in the programmable controller and the receive completion command executed (BFM #1 b2).

6) b6 (being sent)

b6 is turned on after the send command (BFM #1 b1) is given until the send completion status (BFM #28 b0) is set.

- 7) b7 (being received)
b7 is turned on after the head data is received until the receive completion status (BFM #28 b1) is set.
- 8) b8 (RS), b9 (ER), b12 (DR), b13 (CD), b14 (CS), b15 (CI)
These bits indicate the ON/OFF status of the control signals.

10.2.18 Error Code <BFM #29>

For error code, refer to chapter 12.

10.2.19 Model Code <BFM #30>

The model code of the 232IF is “K7030”.
The model code is a fixed code assigned to each special extension equipment handled by the FROM/TO instruction. The programmable controller can distinguish the equipment type by reading this code.

10.2.20 Send Byte Count <BFM #1000>

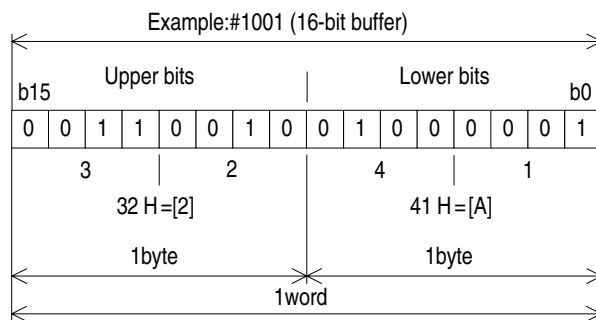
Setting range: 0 to 512 (when buffer data length is 16 bits)
0 to 256 (when buffer data length is 8 bits)

The BFM #1000 specifies how many bytes out of 512 bytes/256 words in the 16-bit send buffers (BFMs #1001 to #1256) are to be sent.

10.2.21 Send Buffers <BFMs #1001 to #1256>

Each of them is a 16-bit buffer to save the send data, and accommodates 512 bytes/256 words.

Note; Send/receive buffer structure



A numeric in the send/receive buffer is treated as hexadecimal (HEX).

10.2.22 Receive Byte Count <BFM #2000>

Saved value: 0 to 512^{+30*1} (when buffer data length is 16 bits)
0 to 256^{+15*1} (when buffer data length is 8 bits)

The byte count received from the counterpart equipment is saved.
This value is cleared by the receive completion reset command (BFM #1 b2).
*1 Spare buffers in the interlink connection mode

10.2.23 Receive Buffers <BFM #2001 to #2256>

Each of them is a 16-bit buffer to save the data received from the counterpart equipment, and accommodates 512 bytes/256 words. The buffer structure is equivalent to that of the send buffers.
The receive contents are cleared by the receive completion reset command (BFM #1 b2).

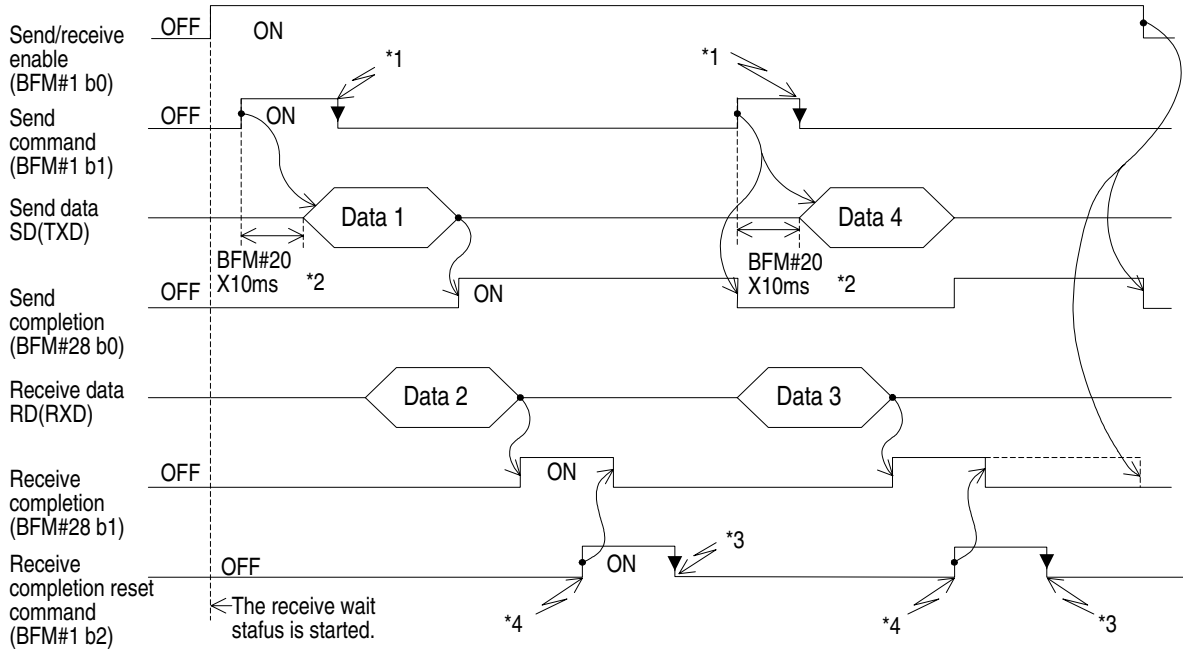
10.2.24 Spare Receive Buffers for Interlink Connection Mode <BFM #2257 to #2271>

Each of them is a spare buffer for the interlink connection in the case where the data exceeding 512 bytes is received, and also used to receive data after the request to send (RS) signal is turned off until the send operation of the counterpart equipment is suspended.
The receive contents are cleared by the receive completion reset command (BFM #1 b2).

10.3 Hardware Hand Shake Operation

10.3.1 No Hardware Hand Shake

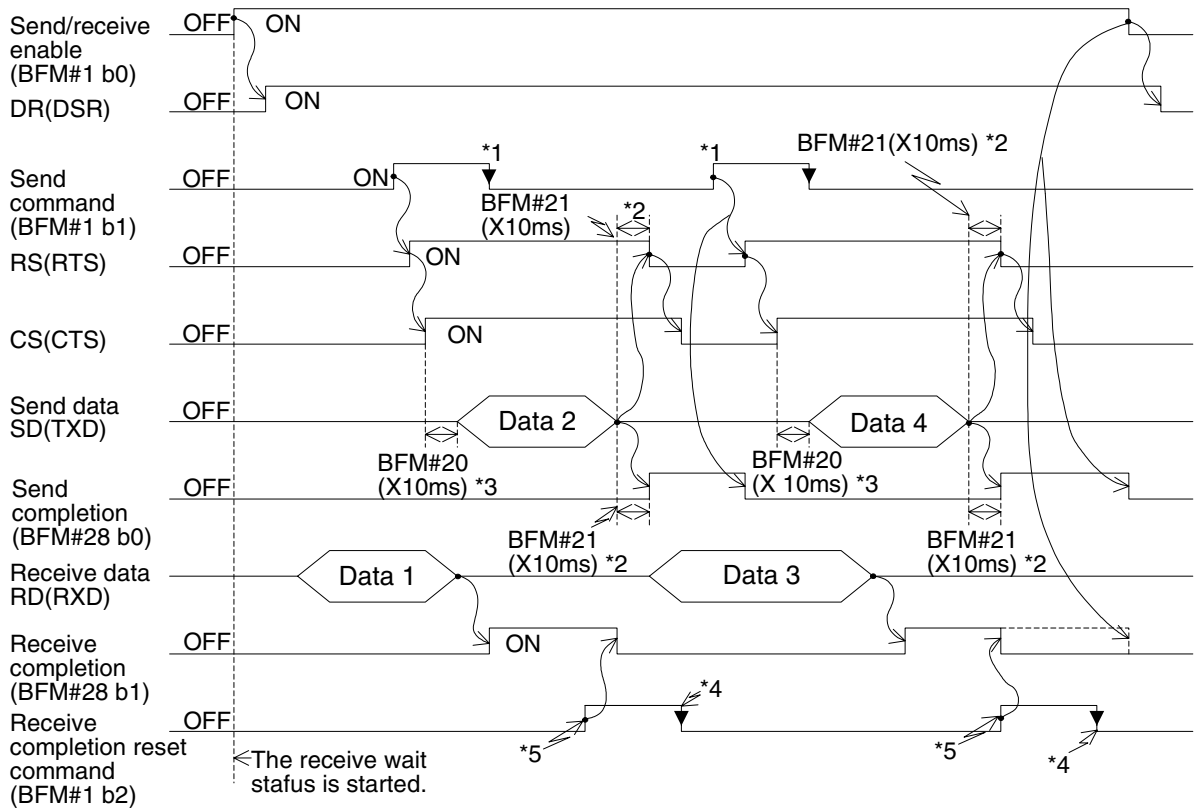
Setting BFM#0 (b9, b8)=(0, 0)



- *1 Turn off using a program. When it is turned ON, the next data cannot be sent.
- *2 Time set by BFM#20 (x10ms).
- *3 Turn it off using a program. When it is turned ON, the next data cannot be sent.
- *4 After receive is completed and the data is read, turn off the receive completion flag (BFM #28 b1) using a receive completion reset command (BFM #1 b2).

10.3.2 Standard RS-232C Mode

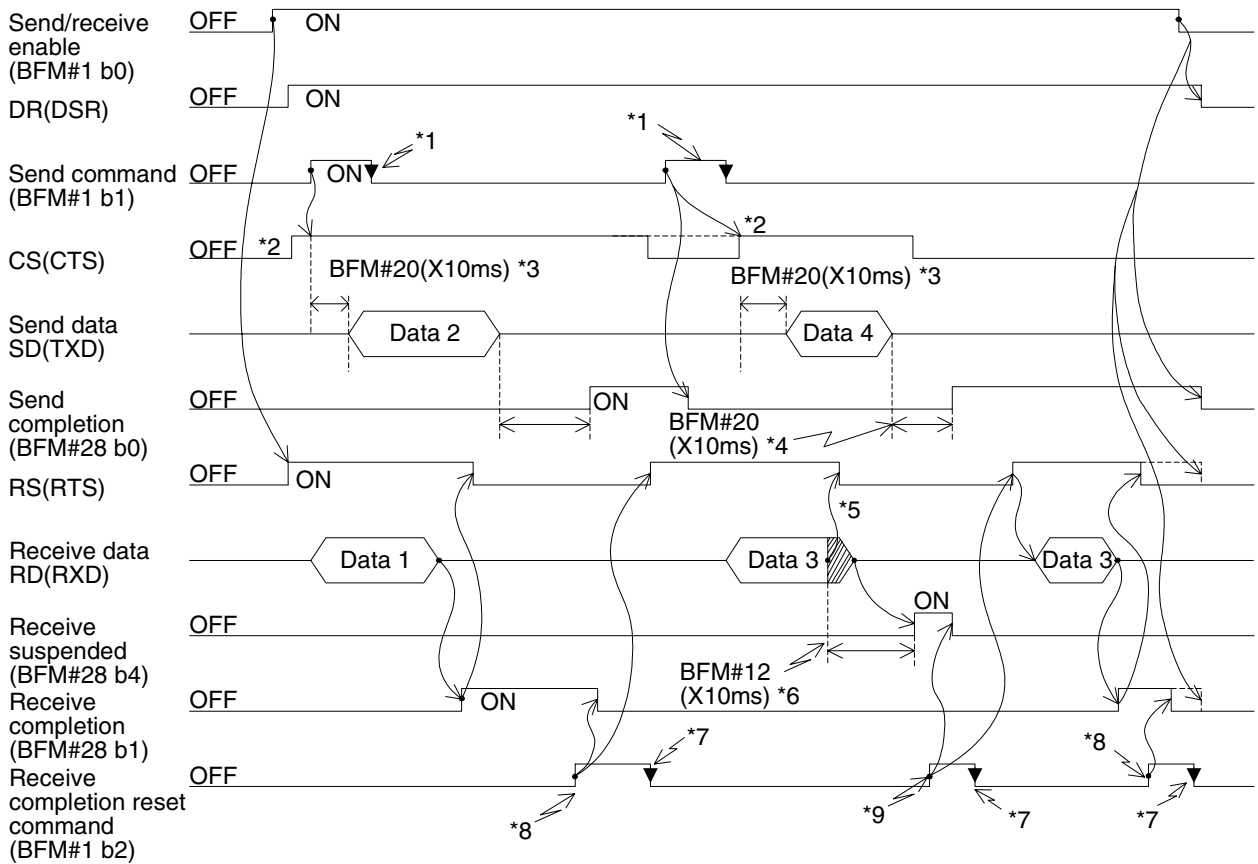
Setting BFM #0 (b9, b8) = (0, 1)



- *1 Turn off using a program. When it is turned ON, the next data cannot be sent
- *2 Time set by BFM #21 (x10ms)
- *3 Time set by BFM #22 (x10ms)
- *4 Turn off using a program. When it is turned ON, the next data cannot be received.
- *5 After receive is completed and the data is read, turn off the receive completion flag (BFM #28 b1) using a completion reset command (BFM #1 b2)

10.3.3 Interlink Mode

Setting BFM #0 (b9, b8) = (1, 1)



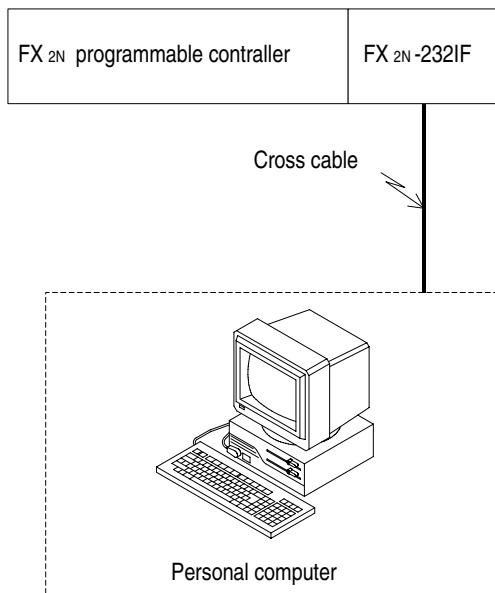
- *1 Turn off using a program. When it is turned ON, the next data cannot be sent.
- *2 Make sure that the CS (CTS) in the FX2N-232IF is turned on while the counterpart equipment is ready for receive.
- *3 Time set by BFM #20 (x10ms)
- *4 Time set by BFM #21 (x10ms)
- *5 The RS (RTS) is turned off when the upper limit of receive byte count specified by the BFM #2 is exceeded.
When the send/receive buffer data length is 16 bits (BFM #0 b14=0), interrupt send from the counterpart equipment within 30 bytes. When the send/receive buffer data a length is 8bits (BFM #0 b14=1), interrupt send from the counterpart equipment within 15 bits.
If send is not interrupted, all the send data cannot be received.
- *6 Time set by BFM #12 (x10ms)
- *7 Turn off using a program. When it is turned ON, the next data cannot be received.
- *8 After receive is completed and the data is read, turn off the receive completion flag (BFM #28 b1) using a receive completion reset command (BFM #1 b2).
- *9 Read the data as much as the receive byte count (BFM #14) in the receive buffer (BFM #2001 to BFM #2271) to the data registers in the programmable controller, then turn it ON.

10.4 Example Program

10.4.1 Example of 16 Bits Data Communication

This system configuration describes an example in which 16-bit buffer length data is sent and received between the equipment of the terminal specifications. In this example, the ASCII code saved in the data registers D201 to D205 in the programmable controller sent to the counterpart equipment, and the data received from the counterpart equipment is saved to the data registers D301 to D304 in the programmable controller.

1) System configuration



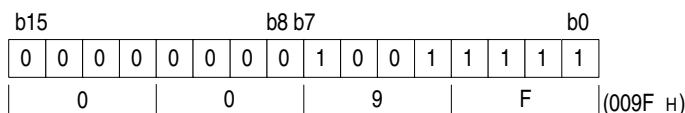
2) Example setting buffer memories

The items not described here are set to the default respectively.

a) Communication format <BFM #0>

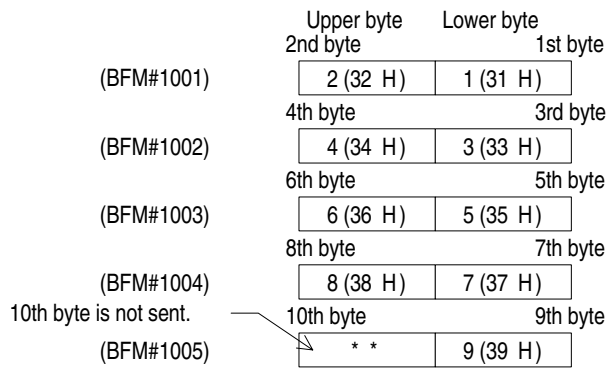
Bit	Description	Setting
b0	Data length	(1): 8 bits
b1 b2	Parity	(1, 1): Even
b3	Stop bit	(1): 2 bits
b4 b5 b6 b7	Baud rate	(1001): 19200 bps
b8 b9	Control line	(0, 0): Not used
b10 b11	Addition of CR and LF	(0, 0): Not added
b12 b13	Availability of check sum and ASCII/HEX conversion	(0, 0): Not available
b14	Send/receive buffer data length	(0): 16 bits
b15	Undefined	—

← Specification item for 16-bit length



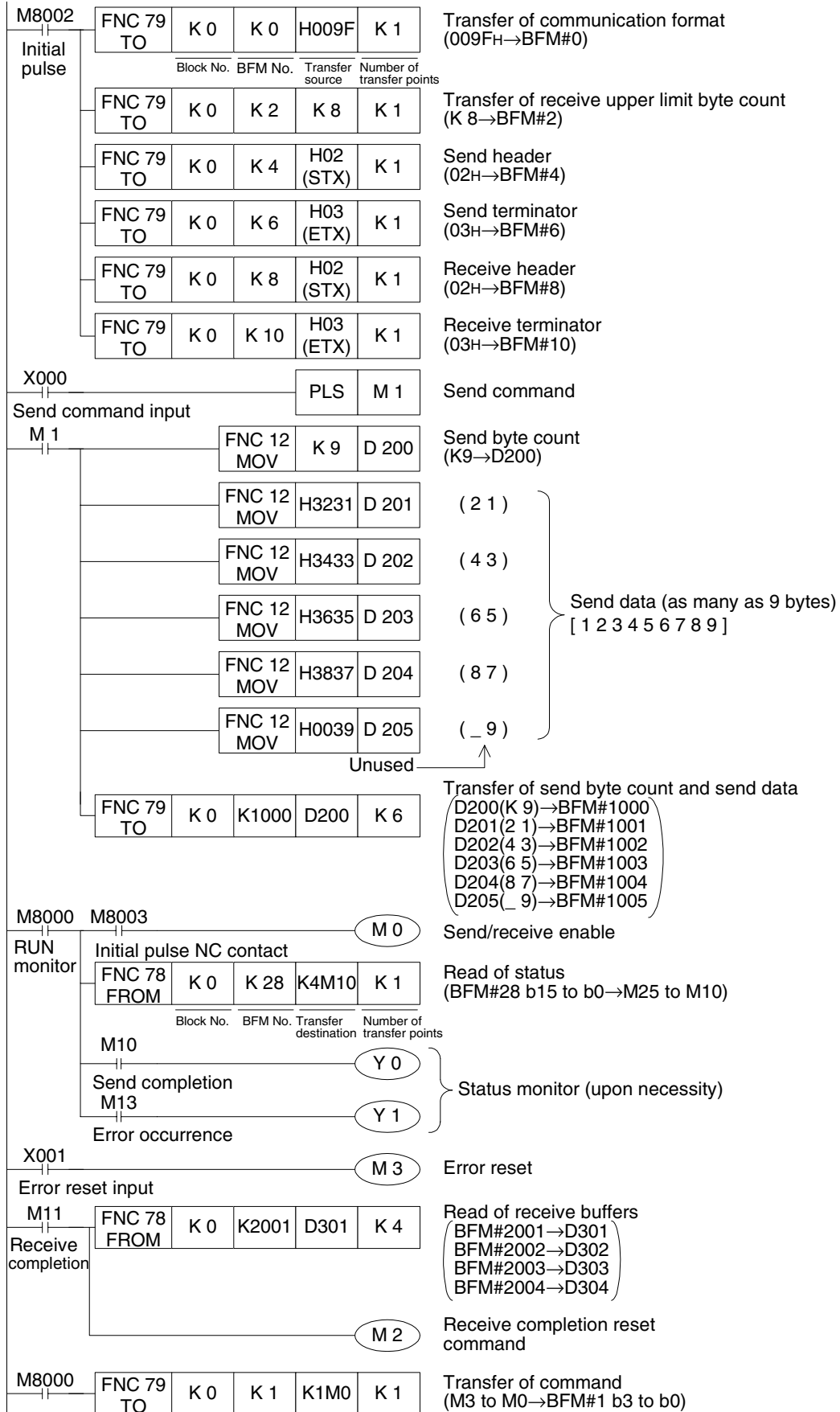
- b) Command <BFM #1>
 - M0→b0:Send/receive enable (ER ON)
 - M1→b1:Send command
 - M2→b2:Receive completion reset command
 - M3→b3:Error reset
- c) Receive upper limit byte count <BFM #2>
 - 8bytes
- d) Header and terminator <BFMs #4 to #11>
 - BFMs #4 and #8 (send/receive header): 02H (STX)
 - BFMs #6 and #10 (send/receive terminator):03H (ETX)
- e) Status <BFM #28>

b0→M10:Send completion	b8→M18:RS(RTS)
b1→M11:Receive completion	b9→M19:ER(DTR)
b2→M12:Receive time-out	b10→M20:Undefined
b3→M13:Error occurrence	b11→M21:Undefined
b4→M14:Receive suspended	b12→M22:DR(DSR)
b5→M15:Undefined	b13→M23:CD(DCD)
b6→M16:Being sent	b14→M24:CS(CTS)
b7→M17:Being received	b15→M25:CI(RI)
- f) Send byte count <BFM #1000>
 - 9 bytes
- g) Send buffers <BFMs #1001~>
 - 9-byte send data “123456789” is prepared in ASCII code in accordance with the send byte count specified above.

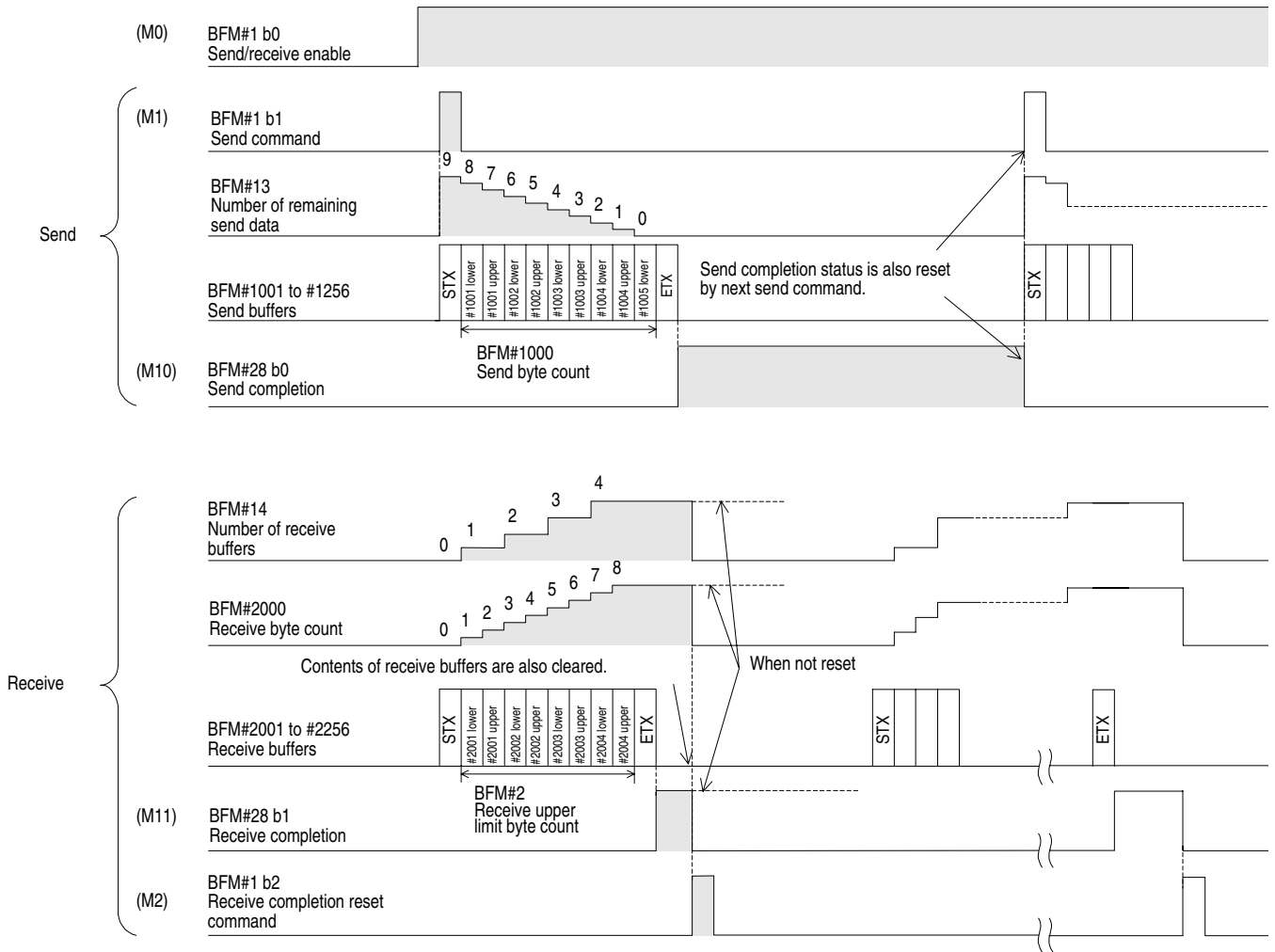


- h) Receive buffers <BFMs #2001~>
 - 8-byte receive data specified in accordance with the receive upper limit byte count (BFM #2) is read to the data registers D301 to D304 in the programmable controller.

3) Example program



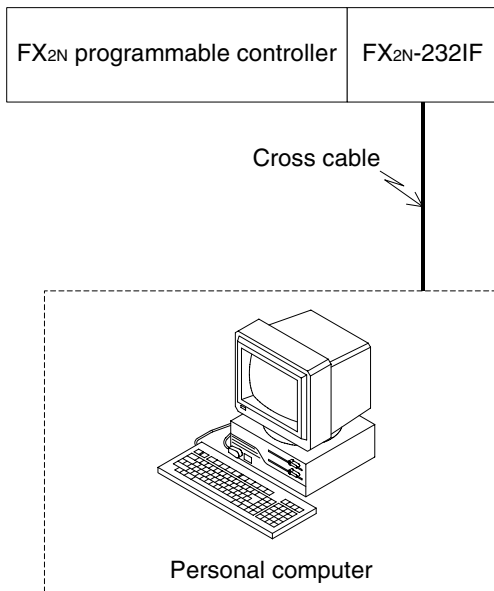
4) Operation chart



10.4.2 Example of 8 Bits Data Communication

This system configuration describes an example in which 8-bit buffer length data is sent and received between the equipment of the terminal specifications. In this example, the ASCII code saved in data registers D201 to D209 in the programmable controller is sent to the counterpart equipment, and the data received from the counterpart equipment is saved in data registers D301 to D308 in the programmable controller.

1) System configuration



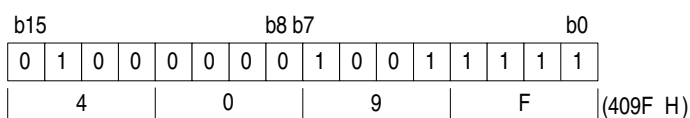
2) Example setting buffer memories

This items not described here are set to the default respectively.

a) Communication format <BFM #0>

Bit	Description	Setting
b0	Data length	(1): 8 bits
b1 b2	Parity	(1, 1): Even
b3	Stop bit	(1): 2 bits
b4 b5 b6 b7	Baud rate	(1001): 19200 bps
b8 b9	Control line	(0, 0): Not used
b10 b11	Addition of CR and LF	(0, 0): Not added
b12 b13	Availability of check sum and ASCII/HEX conversion	(0, 0): Not available
b14	Send/receive buffer data length	(0): 8 bits
b15	Undefined	—

← Specification item for 8-bit length



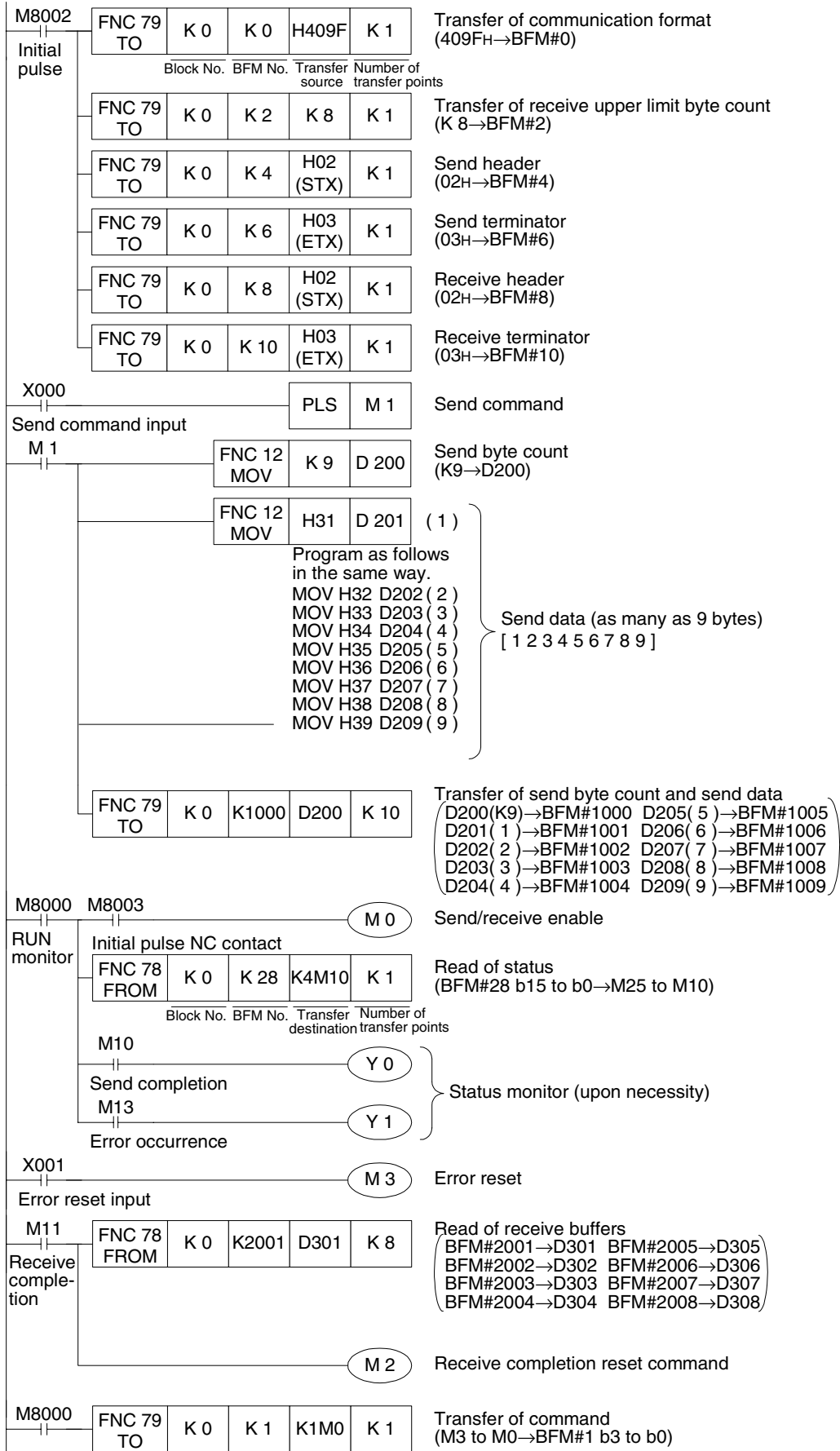
- b) Command <BFM #1>
 - M0→b0:Send/receive enable (ER ON)
 - M1→b1:Send command
 - M2→b2:Receive completion reset command
 - M3→b3:Error reset
- c) Receive upper limit byte count <BFM #2>
 - 8 bytes
- d) Header and terminator <BFMs #4 to #11>
 - BFMs #4 and #8 (send/receive header): 02H (STX)
 - BFMs #6 and #10 (send/receive terminator): 03H (ETX)
- e) Status <BFM #28>

b0→M10:Send completion	b8→M18:RS(RTS)
b1→M11:Receive completion	b9→M19:ER(DTR)
b2→M12:Receive time-out	b10→M20:Undefined
b3→M13:Error occurrence	b11→M21:Undefined
b4→M14:Receive suspended	b12→M22:DR(DSR)
b5→M15:Undefined	b13→M23:CD(DCD)
b6→M16:Being sent	b14→M24:CS(CTS)
b7→M17:Being received	b15→M25:CI(RI)
- f) Send byte count <BFM #1000>
 - 9bytes
- g) Send buffers <BFMs #1001~>
 - 9-byte send data “123456789” is prepared in the ASCII code in accordance with the send byte count specified above.

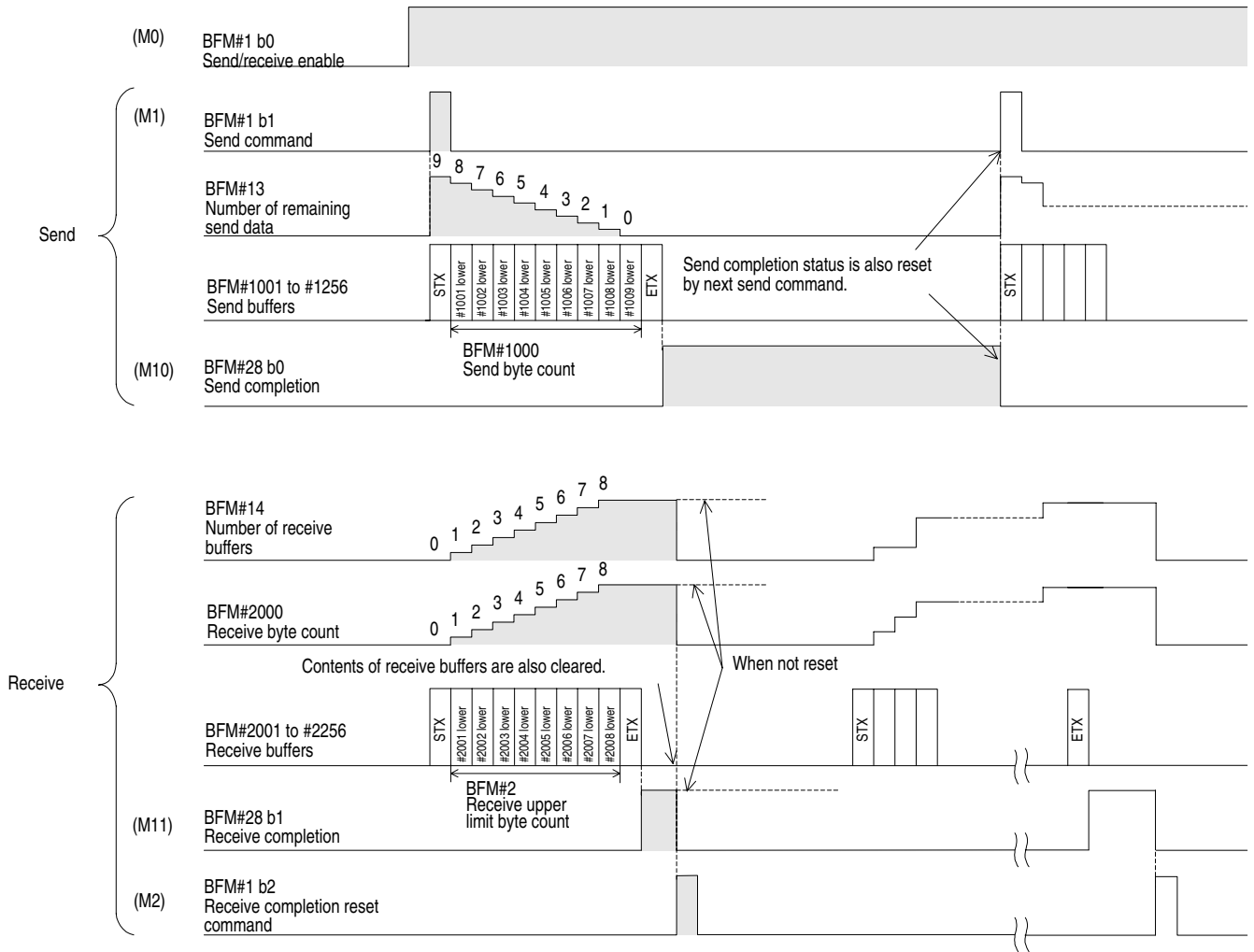
	Upper byte	Lower byte	
(BFM#1001)	Ignored	1 (31 H)	1 byte
(BFM#1002)	Ignored	2 (32 H)	2 byte
(BFM#1003)	Ignored	3 (33 H)	3 byte
(BFM#1004)	Ignored	4 (34 H)	4 byte
(BFM#1005)	Ignored	5 (35 H)	5 byte
(BFM#1006)	Ignored	6 (36 H)	6 byte
(BFM#1007)	Ignored	7 (37 H)	7 byte
(BFM#1008)	Ignored	8 (38 H)	8 byte
(BFM#1009)	Ignored	9 (39 H)	9 byte

- h) Receive buffers
 - 8-byte receive data specified in accordance with the receive upper limit byte count (BFM #2) is read to the data registers D301 to D308 in the programmable controller.

3) Example program



4) Operation chart



11. Optional Programming Port

This section describes connection to peripheral equipment (programming tool, data access unit and electronic operation terminal) using the FX_{2N}-232-BD, FX_{1N}-232-BD, FX_{0N}-232ADP, FX_{2NC}-232ADP, FX_{1N}-422-BD, or FX_{2N}-422-BD as well as cautions on communication. For the operating procedure of each peripheral equipment and installation of each interface, refer to the corresponding manual.

11.1 FX_{2N}-422-BD, FX_{1N}-422-BD

When an FX_{2N}-422-BD is installed on the FX_{2N} Series, or when an FX_{1N}-422-BD is installed on FX_{1N} or FX_{1S} Series, the following peripheral equipment (programming tool, data access unit and electronic operation terminal) can be connected.

However, the FX_{2N}-422-BD consumes 5V DC, 60 mA from the FX_{2N} programmable controller, and the FX_{1N}-422-BD consumes 5V DC, 60 mA from the FX_{1S} or FX_{1N} programmable controller. Make sure that the current consumption of 5V DC for special extensions and peripheral equipment does not exceed the capacity of the 5V DC power of the FX_{2N}, FX_{1N} or FX_{1S}.

Product	Connecting cable	Required 5V DC
FX-20P-E	FX-20P-CAB0 or FX-20P-CAB + FX-20P-CADP	180mA
FX-10P-E		120mA
Personal computer (For programming tool)	F ₂ -232CAB-1 + FX-232AW(C) + (FX-422CAB0 or FX-422CAB + FX-20P-CADP) *1	220mA
FX-10DM	FX-20P-CAB0 or FX-20P-CAB + FX-20P-CADP	220mA
FX-10DU-E	FX-20P-CAB0 or FX-20P-CAB + FX-20P-CADP	220mA
FX-20DU-E	FX-20DU-CAB0 or FX-20DU-CAB + FX-20P-CADP	180mA
FX-25DU-E, FX-30DU-E, FX-40DU-ES, FX-40DU-TK-ES, FX-50DU-TK(S)-E	FX-50DU-CAB0 (-1M, -10M, -20M, -30M, L) or FX-40DU-CAB (-10M, -20M, -30M) + FX-20P-CADP	0mA
F940GOT-SWD (LWD)-E, F930GOT-SBD	FX-50DU-CAB0 (-1M, -10M, -20M, -30M, L)	0mA
F940GOT-SBD (LBD)-H	F9GT-HCAB2-150 + F9GT-HCAB-3M (-10M) or FX-50DU-CAB0 (-1M) + F9GT-HCNB + F9GT-HCAB-3M (-10M)	0mA
GOT-A900 (Connecting direct CPU port type)	F9GT-CAB0 (-150, -10M)	0mA

*1: When using other products or cables please check the product manual for required 5V DC supply.



Note;

These products cannot be connected via FX-2PIF to port of FX_{1N}-422-BD or FX_{2N}-422-BD. If connecting, power supply circuit in PLC will go down.

11.2 FX_{2N}-232-BD FX_{1N}-232-BD FX_{0N}-232ADP and FX_{2NC}-232ADP

When an FX_{2N}-232-BD an FX_{0N}-232ADP or an FX_{2NC}-232ADP is installed on the FX_{2N}, FX_{2NC} Series, or when an FX_{1N}-232-BD is installed on FX_{1N} or FX_{1S} Series, a personal computer in which the following software is supported can be connected to each port.

However, the FX_{2N}-232-BD consumes 5V DC, 20 mA from the FX_{2N} programmable controller, the FX_{1N}-232-BD consumes 5V DC, 20 mA from the FX_{1N}, FX_{1S} programmable controller and the FX_{0N}-232ADP, FX_{2NC}-232ADP consumes 5V DC, 200mA from connected programmable controller.

Make sure that the current consumption of 5V DC for special extensions does not exceed the capacity of the 5V DC power of the FX_{2N}, FX_{2NC}, FX_{1S} or FX_{1N}.

- Programming software FX-PCS/AT-EE
- Programming software FX-PCS/WIN-E

11.2.1 Connection cables

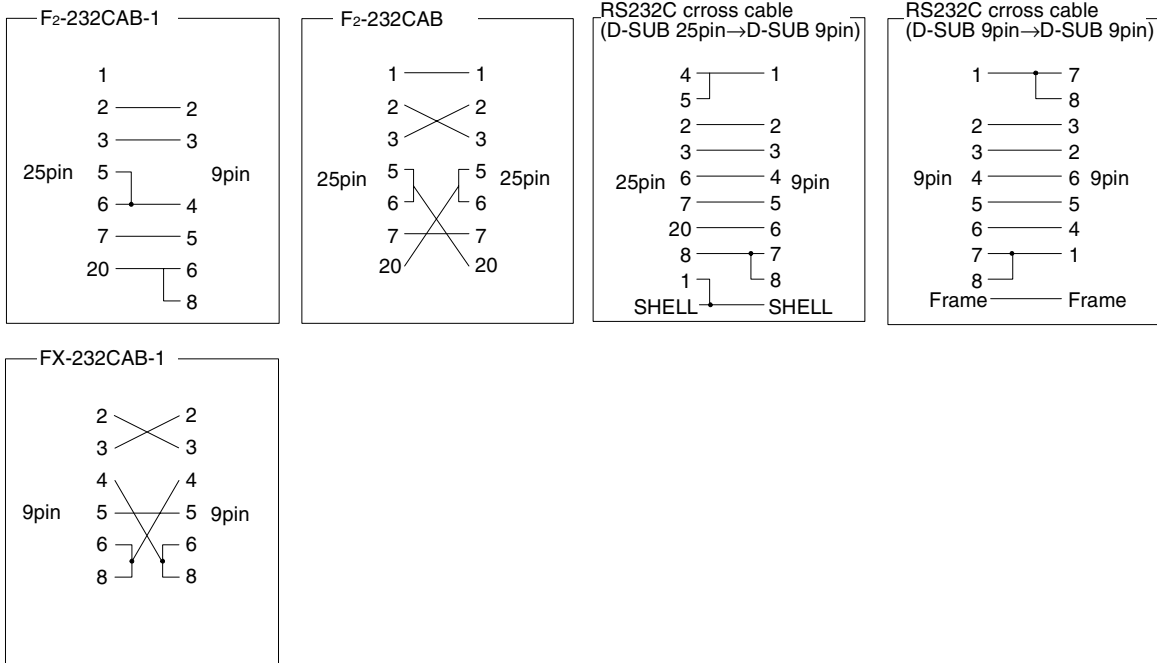
1) FX_{2N}-232-BD, FX_{1N}-232-BD, FX_{2NC}-232ADP

RS-232C connector of personal computer	FX _{2N} -232-BD, FX _{1N} -232-BD, FX _{2NC} -232ADP side	Personal computer side
D-SUB 9 pin	F2-232CAB-1	Gender changer
	FX-232CAB-1	
	RS-232C cross cable (D-SUB 9 pin to D-SUB 9 pin) see the reference bellow	
D-SUB 25 pin	RS-232C cross cable (D-SUB 25 pin to D-SUB 9 pin) see the reference bellow	
	F2-232CAB-1	

2) FX_{0N}-232ADP

RS-232C connector of personal computer	Cable
D-SUB 25 pin	F2-232CAB
D-SUB 9 pin	F2-232CAB-1

Note: Reference



11.3 Cautions on Use

11.3.1 Cautions on Setting

Never set communication to the FX1S, FX1N, FX2N and FX2NC series using a peripheral equipment or program. If it is set in such a way, communication with peripheral equipment is disabled.

11.3.2 Cautions on use



Connect a programming tool (FX-10P, FX-20P, A7HGP/PHP, etc.) to either a connector built in a programmable controller or connector in optional unit (FX2N: FX2N-422-BD, FX2N-232-BD, FX2N-CNV-BD + FX0N-232ADP, FX2N-CNV-BD + FX2NC-232ADP, FX2NC: FX0N-232ADP, FX2NC-232ADP, FX1N, FX1S: FX1N-422-BD, FX1N-232-BD, FX1N-CNV-BD + FX0N-232ADP, FX1N-CNV-BD + FX2NC-232ADP).

If the programming tool is connected to the both connectors, the following phenomena may occur.

- 1) A program in the programmable controller may be different from a program in the programming tool. If the program is modified or the set value of a timer, counter, etc. is modified in this status, a part of the program may be damaged and the programmable controller may malfunction.
- 2) If the sampling trace function provided in the programmable controller is used in the both ports, correct sampling trace results cannot be obtained.

Memo

12. Diagnostics

12.1 Common Items

- 1) Check the connection with the communication unit of the programmable controller and the optional equipment. When the connection is unstable, communication cannot be corrected. For the installation and connection method, refer to the manual of the communication unit of the optional equipment.
- 2) Check whether the VRRD or VRSC instruction is the program.
If it is used, delete it, turn off the power of the programmable controller, then turn it on again.
- 3) Each setting of communication format (D8120), parameter of programmable controller by FX-PCS/WIN-E, N:N network (D8173 to D8180) and parallel link (M8070, M8071) is suitable for the usage or it checks. The communication is not correctly done if setting is not suitable for the usage.
When each setting is changed, please turn off the power supply of the programmable controller, and turn it on again.
- 4) When using FX_{0N}-485ADP and FX-485ADP, the power supply must be supplied correctly.

12.2 N:N Network

12.2.1 Error Code

When occurring the communication error, auxiliary relays (FX_{2N}, FX_{2NC}, FX_{1N}, FX_{1S}: M8183 to M8191, FX_{0N}: M504 to M511) for error flag is turned ON in the station. And the error code is stored into the data registers (FX_{2N}, FX_{2NC}, FX_{1N}, FX_{1S}: D8211 to D8218, FX_{0N}: D211 to D218). This error code is following the table.

Error code	Meaning	Error station	Check station	Description	Checking points
01H	Comms time-out error	L	M	After master station send request to slave station, no answer passing comms time-out.	Check wiring, power of programmable controller, RUN/STOP state (RUN is OK)
02H	Station No. error	L	M	Station No. is not agreement between the master station and the slave station.	Check wiring
03H	Comms counter error	L	M	Communication counter is not agreement between the master station and the slave station.	Check wiring
04H	Comms format error	L	M, L	Communication format is not right from slave station.	Check wiring, power of programmable controller, RUN/STOP state (RUN is OK), station No. setting
11H	Comms time-out error	M	L	After slave station send answer to master station, master station do not send request to next slave station.	Check wiring, power of programmable controller, RUN/STOP state (RUN is OK)
14H	Comms format error	M	L	Communication format is not right from master station.	Check wiring, power of programmable controller, RUN/STOP state (RUN is OK), station No. setting
21H	No slave error	L	L *1	The station No. is not in this network.	Check station No. setting.
22H	Station No. error	L	L *1	Station No. is not agreement between the master station and the slave station.	Check wiring
23H	Comms counter error	L	L *1	Communication counter is not agreement between the master station and the slave station.	Check wiring
31H	Not receive comms parameter error	L	L *2	When slave station receive request from master station before communication parameter.	Check wiring, power of programmable controller, RUN/STOP state (RUN is OK)

M : Master station L : Slave station
 *1 Another slave station *2 Self station

12.2.2 Diagnostics

- 1) Check the status of the RD LED and the SD LED provided on each 485BD.
 - If both of them are lighted and extinguished, nothing is wrong.
 - If the RD LED is lighted/extinguished but the SD LED is not lighted/extinguished (not lighted at all), check the setting of the station No., the transmission rate (baud rate) and the total number of slave stations.
 - If the RD LED is not lighted/extinguished, check the wiring.
- 2) Make sure that the communication error (FX_{2N}: M8183 to M8190, FX_{0N}: M504 to M511) in each slave station is not turned on and that the data communication flag (FX_{2N}: M8191, FX_{0N}: M503) is not turned off. When one of the communication error flag is turned on or if the data communication flag is turned off, check the error code of data registers (FX_{2N}: D8211 to D8218, FX_{0N}: D211 to D218).

Please see the following section 12.2.1.

12.3 Parallel Link

12.3.1 Diagnostics

- 1) Check the status of the RD(RXD) LED and the SD(TXD) LED provided on each communication unit.
 - If the RD(RXD) and the SD(TXD) LED are lighted and extinguished, nothing is wrong.
 - If the RD(RXD) LED is lighted/extinguished but the SD(TXD) LED is not lighted/extinguished (not lighted at all), check the setting of the master station and the slave stations.
 - If the RD(RXD) LED is not lighted/extinguished, check the wiring.
- 2) Make sure that the master station and the slave stations are set correctly. If the setting is incorrect, correct it.
- 3) Make sure that the devices for the master station and the slave stations are handled correctly. If they are handled incorrectly, correct the program so that they are handled correctly.

12.4 Computer Link

12.4.1 NAK Error Code

The error code is sent following a NAK response to indicate the type of error that occurred. It is transmitted as two ASCII characters representing the hexadecimal codes ranging from 00H to FFH.

If two or more errors occur simultaneously, the error code with the lowest number is transmitted.

Error code (hexadecimal)	Error description
00H, 01H	—
02H	Sum error
03H	Protocol error (the communication protocol does not conform to the format selected with D8120)
04H, 05H	—
06H	Character area error (the character area is incorrectly defined, or the specified command is not available)
07H	Character error (the data to be written to a device consists of ASCII codes other than hexadecimal codes)
08H, 09H	—
0AH	PLC number error (the PLC number is not set to "FF" or not available from this station)
0BH to 0FH	—
10H	PLC number error (the PLC number is not set to "FF" or not available from this station)
11H to 17H	—
18H	Remote error (remote run/stop is disabled)

12.4.2 Programmable Controller Error Code

With the FX series programmable controllers, the following errors are not transmitted using a NAK, but instead are shown at the programmable controller by switching on special auxiliary relay M8063, and storing the error code in special data register D8063.

Error code (in D8063)	Error description
6301	Parity, overrun, framing error
6305	Command failure receiving a command other than GW (global) when the station number is "FF"
6306	Monitor timer over (message to be received is insufficient)

Because these errors are not transmitted it must be programmed at the computer so as to recognize an error by using a watchdog timer or other monitor timer.

12.4.3 Diagnostics

- 1) Check the status of the RD(RXD) LED and the SD(TXD) LED provided on each communication unit.
 - If both of them are lighted and extinguished, nothing is wrong.
 - If the RD(RXD) LED is lighted/extinguished but the SD(TXD) LED is not lighted/extinguished (not lighted at all), check the setting of the station No. and the transmission rate (baud rate).
 - If the RD(RXD) LED is not lighted/extinguished, check the wiring and confirm the connection with the programmable controller.
- 2) Make sure that the communication procedure is performed correctly. If it is not performed correctly, correct the setting in the computer.
- 3) Check the NAK error code and programmable controller error code.
Please see the following section 12.4.1 and section 12.4.2.

12.5 RS Instruction

12.5.1 Diagnostics

- 1) Check the status of the RD (RXD) LED and the SD (TXD) LED provided on the optional equipment.
 - If the RD (RXD) LED is not lighted while data is received or the SD (TXD) LED is not lighted while data is sent, check the installation and the wiring.
 - When the RD (RXD) LED is lighted while data is received or the SD (TXD) LED is lighted while data is sent, the installation and the wiring are correct.
- 2) Check the timing of data send/receive. For example, make sure that the counterpart equipment is ready for receive before starting to send data to it.
- 3) When the terminator is not used, check whether the send data capacity is equivalent to the acceptable data capacity. If the send data capacity may be changed, use the terminator.
- 4) Make sure that the external equipment is operating correctly.
- 5) Check whether the type of send data and the type of receive data are equivalent. If they are different, make them equivalent.
- 6) When two or more RS instructions are used in the program, make sure that only one RS instruction is actuated in one operation cycle.
Never turn off the RS instruction while data is received or sent.
- 7) In the FX_{2N} Series (V 2.00 or later), an RS instruction is not executed if the counterpart equipment receives "NAK".
Arrange the system so that the RS instruction is executed even if the counterpart equipment receives "NAK".

12.6 FX₂N-232IF

12.6.1 Error code

When an error occurs while data is sent or received, BFM #28 b3 is set to ON and the error code is saved in BFM #29.

Code	Description	Causes and countermeasures
0	No error	—
1	Receive parity error, overrun error, framing error	Communication format such as baud rate is not matched. Control timing is not matched.
2	Undefined	—
3	Defective receive character	Receive data is not ASCII code.
4	Receive sum check error	Receive sum is not equal calculated sum result (BFM #16).
5	Receive buffer overflow (only in interlink connection mode)	Receive byte count exceeds 512+30 bytes. Decrease receive upper byte count (BFM #2), and increase spare receive buffer area.
6	Baud rate setting error	Non-existing baud rate is specified.
7	Receive CR error	CR is not placed in correct position.
8	Receive LF error	LF is not placed in correct position.
9	Send/receive initial terminator setting error	Initial terminator is other than 01H to 1FH.
10	Receive terminator error	Receive terminator is not placed in correct position or not matched.
11	Undefined	—
12	Transmission sequence error	Transmission sequence is not matched.

12.6.2 Diagnostics

- 1) Check the status of the POWER LED provided in the FX₂N-232IF.
 - When it is Lit, the power source is correctly supplied.
 - If it is extinguished, supply from the power source correctly.
- 2) Check the status of the SD LED and the RD LED provided in the FX₂N-232IF.
 - If the RD LED is not Lit while data is received or the SD LED is not Lit while data is sent, check the installation and the wiring.
 - When the RD LED is Lit while data is received or the SD LED is Lit while data is sent, the installation and the wiring are correct.
- 3) Make sure that the communication setting (BFM #0) of the FX₂N-232IF is equivalent to that of the external equipment. If they are not equivalent each other, make them equivalent.
- 4) Make sure the timing of data send/receive. For example, make sure that the counterpart equipment is ready for receive before starting to send data to it.
- 5) When the terminator is not used, check whether the send data capacity is equivalent to the acceptable data capacity. If the send data capacity may be changed, use the terminator.
- 6) Make sure that the external equipment is correctly operating.
- 7) Check whether the type of send data and the type of receive data are equivalent. If they are different, make them equivalent.

12.7 Using Optional Programming Port

12.7.1 FX1S, FX1N and FX2N(C) earlier V2.00

- 1) Make sure that the communication format is set to the initial status (D8120 = K0).
Using a peripheral equipment, check the communication setting by parameters. If a non-procedure protocol (RS instruction) or dedicated protocol is selected in the setting, clear the setting using the peripheral equipment.
- 2) When an RS instruction is used in the program, delete the RS instruction, turn off the power of the programmable controller, then turn it on again.

12.7.2 FX2N, FX2NC whose version is V 2.00 or later

If an RS instruction is used in the program, make sure that it is not executed. If it is executed, the RS instruction has the priority.

Appendix A: ASCII code Lists

Table B-2: ASCII code Lists

Hex code	0	1	2	3	4	5	6	7
0		DLE	SP	0	@	P	`	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	\$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l	|
D	CR	GS	-	=	M	]	m	}
E	SO	RS	.	>	N	^	n	~
F	SI	US	/	?	O	_	o	DEL

MEMO

USER'S MANUAL

FX COMMUNICATION (RS-232C, RS-485, RS-422)



HEAD OFFICE: MITSUBISHI DENKI BLDG MARUNOUCHI TOKYO 100-8310
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