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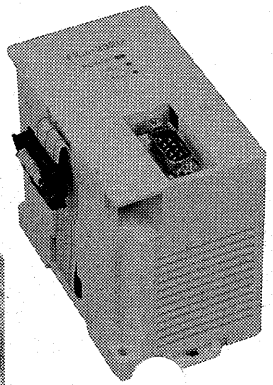
USER'S MANUAL

RS-232C INTERFACE BLOCK FX2N-232IF



FX2N

Foreword

- This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the FX2N-232IF RS-232C Interface Block. It should be read and understood before attempting to install or use the unit. Further information can be found in the FX PROGRAMMING MANUAL, FX2N series hardware manuals.
- If in doubt at any stage during the installation of the FX2N-232IF RS-232C Interface Block always consult a professional electrical engineer who is qualified and trained to the local and national standards.
  If in doubt about the operation or use of the FX2N-232IF RS-232C Interface Block please consult the nearest Mitsubishi Electric distributor.
- This manual is subject to change without notice.

FX2N-232IF RS-232C INTERFACE BLOCK

USER'S MANUAL

Manual number :JY992D66701
Manual revision :A
Date :October 1997

Guidelines for the safety of the user and protection of the FX2N-232IF RS-232C Interface Block

This manual provides information for the installation and use of the FX2N-232IF RS-232C Interface Block. 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 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 compliance product should be trained to use that product in a safe and coordinated manner in compliance to established safety practices. The operators should also be familiar with all documentation which is connected with the actual operation of the completed equipment.

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

Note's on the symbology used in this manual

At various times through out 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 the 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 **POSSIBLY** cause physical and property damage.

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

Software warnings

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

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

3) Indicates a point of interest or further explanation.

CONTENTS

1. INTRODUCTION

The RS-232C interface block FX2N -232IF (hereinafter referred to as "232IF") is connected to the FX2N programmable controller to realize full duplex serial data communication with another RS-232C interface such as a personal computer, bar code reader, printer, etc.

1.1 Outline of Product

Applicable PC
The 232IF can be connected as a special block of the FX2N programmable controller.

Control instructions
Send/receive data is received and sent and diversified control commands are manipulated using the FROM/TO instruction.

Number of I/O points
Connection method
The number of I/O points occupied is 8 in all (either input or output). However, the capacity of the 5 V power supplied from the PC 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.

Communication method
Full duplex start-stop synchronization and non-protocol procedure are used. The communication format can be specified using the buffer memories (BFMs).

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.

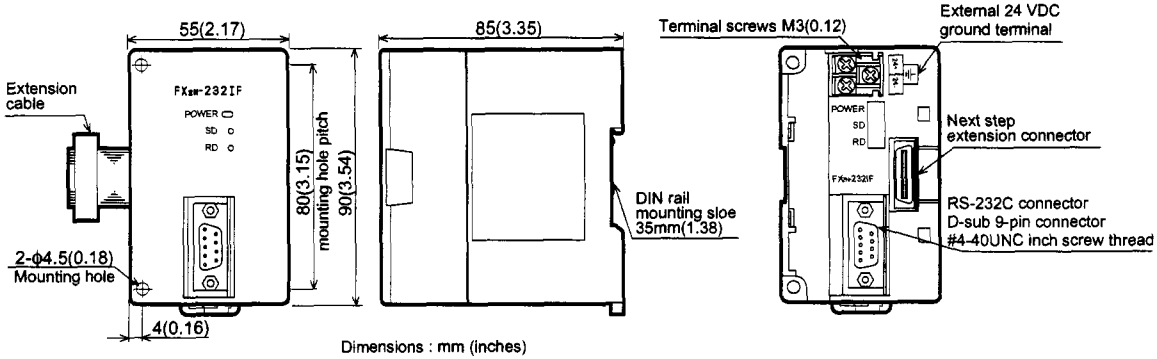
ASCII/HEX conversion function

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.

2. SPECIFICATIONS

2.1 Appearance and Name of Each Portion

Weight : Approx. 0.3 kg Accessory : Special block No. label



POWER LED : Lt when both the 5 VDC power supplied from the PC basic unit and the 24 VDC power supplied from the external terminal are supplied.

SD (TXD) LED : Lt while data is sent to the RS-232C equipment connected to the 232IF.

RD (RXD) LED : Lt while data is received from the RS-232C equipment connected to the 232IF.

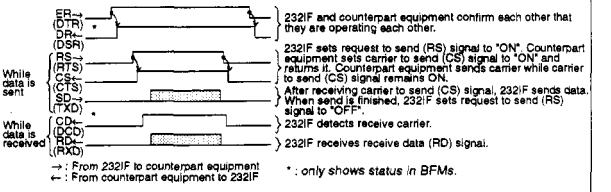
2.2 General Specifications and Performance Specifications

General specifications

Insulating withstand voltage: 500 VAC, 1 minute between the entire external terminal and the ground terminal

Other specifications are equivalent to those of the PC basic unit.

Performance specifications

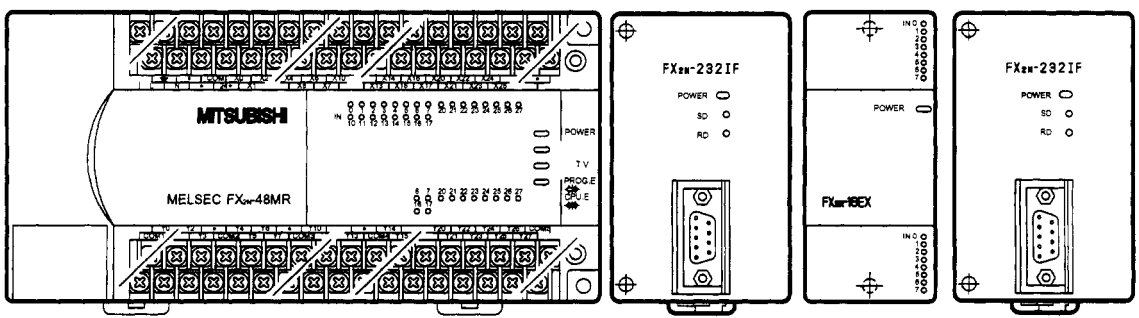
Driving power supply	24 VDC ±10%, 80 mA
Current consumption	5 VDC, 40 mA (supplied from PC via extension cable)
Transmission standard	In accordance with RS-232C, D-Sub 9-pin connector
Isolation method	Photocoupler isolation
Transmission distance	15 m or less
Arrangement of D-sub 9-pin connector Operation of each signal	1 : CD (DCD) Carrier detection 2 : RD (RXD) Receive data 3 : SD (TXD) Send data 4 : ER (DTR) Data terminal ready 5 : SG (signal ground) 6 : DR (DSR) Data set ready 7 : RS (RTS) Request to send 8 : CS (CTS) Carrier to send 9 : CI (RI) Calling indicator 
Indication (LED)	POWER, SD (TXD), RD (RXD)
Communication method	Full duplex start-stop synchronization, non-protocol procedure. Communication format is specified by buffer memories (BFMs).
Transmission speed	300, 600, 1200, 2400, 4800, 9600, 19200
Number of I/O points occupied	8 PC I/O points total (either input or output)
Applicable PC	FX2N programmable controller
Communication with PC	Communication is performed by FROM/TO instruction given by PC via buffer memories. Each of send/receive buffer accommodates 256 words.

3. CONNECTION AND WIRING

3.1 Connection with the PC

Connecting the extension cable

The 232IF can be directly connected to the basic unit of the FX2N PC or connected on the right side of another extension block/unit. A number is assigned to each special unit/block counting from the one nearest the basic unit in the way of "No. 0, No. 1 . . . No. 7". Up to eight special units/blocks in all can be connected in principle. However, the capacity of the 5 VDC power supplied from the PC is limited. The current consumption of the 5 VDC power in the 232IF is 40 mA. Make sure that the total current consumption of the 5 VDC power supply including other special blocks is equivalent to or less than that available.



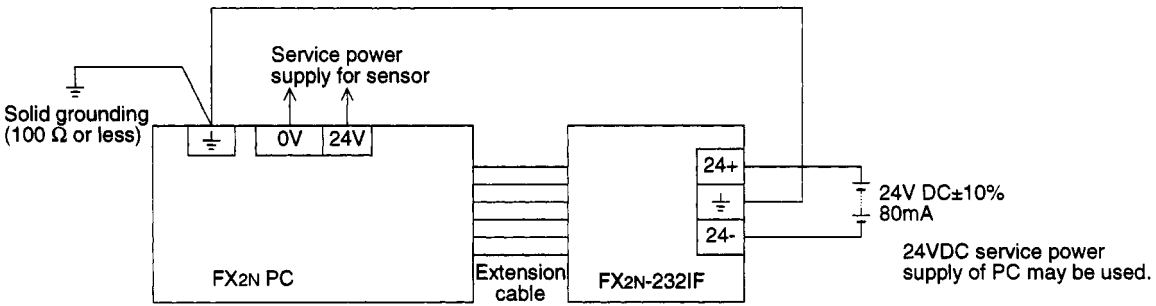
FX2N-48MR-ES/UL
X000-X027
Y000-Y027

FX2N-232IF
Special block
No.0

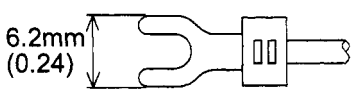
FX2N-16EX
-ES/UL
X030-X047

FX2N-232IF
Special block
No.1

3.2 Power Supply Wiring



Wiring

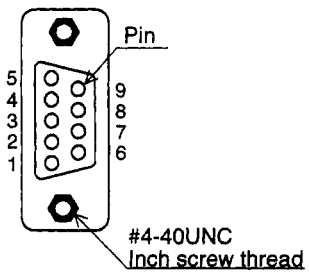


Handling of the crimp-style terminal

Use the crimp-style terminals of the dimensions shown on the figure on the left.
Make sure that the tightening torque of the terminal is 0.5 to 0.8 N (5 to 8 kgf•cm).
Tighten each terminal securely to avoid malfunction.

3.3 Wiring of RS-232C Equipment

Pin arrangement of communication connector

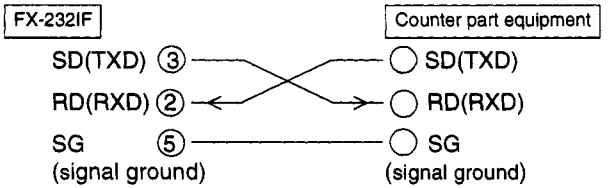


Pin No.	Signal name	Function	Signal direction 232IF:Counterpart equipment
1	CD (DCD)	Carrier detection	←
2	RD (RXD)	Receive data (LED indication provided)	←
3	SD (TXD)	Send data (LED indication provided)	→
4	ER (DTR)	Data terminal ready	→
5	SG	Signal ground	—
6	DR (DSR)	Data set ready	←
7	RS (RTS)	Request to send (or clear to receive)	→
8	CS (CTS)	Clear to send	←
9	CI (RI)	Calling indication (Ring indication)	←

Connection example

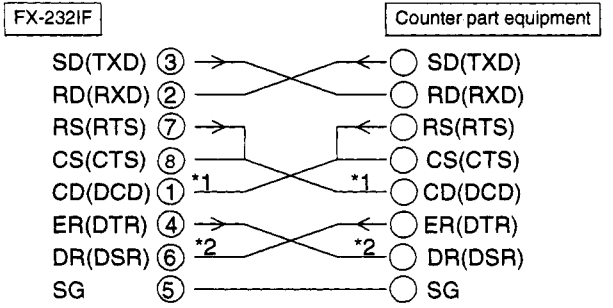
The signal wiring of the RS-232C equipment varies depending on the RS-232C specifications connected. Check the specifications of the RS-232C equipment used, then connect the signals correctly. Representative wiring examples are shown below.

Connection with counterpart equipment of terminal specifications (when control line is not used)
BFM #0 communication format: b9 = 0, b8 = 0, without control line



Communication is performed in accordance with the condition determined by the software in the 232IF and the counterpart equipment.

Connection with counterpart equipment of terminal specifications (when control line is used)
Cross cable used, BFM #0 communication format: b9 = 0, b8 = 1, standard RS-232C mode

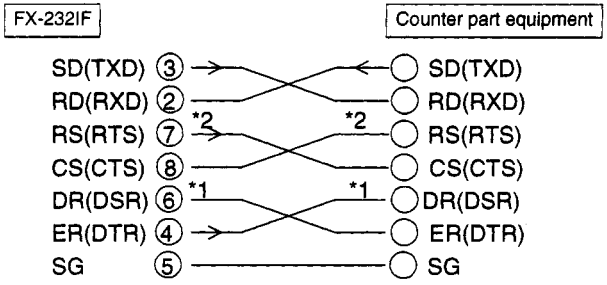


Because the carrier to send (CS) signal pin of the 232IF itself receives the request to send (RS) signal, signal transfer is performed as if the counterpart equipment is functioning.

*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 232IF only indicates the status.

*2 The 232IF only indicates the status.

Interlink serial cross cable used, BFM #0 communication format: b9 = 1, b8 = 1, RS-232C interlink connection mode

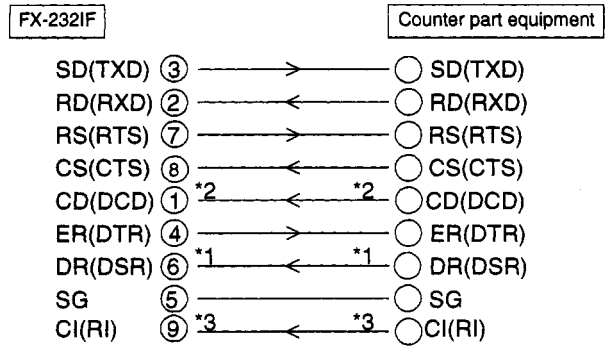


In the interlink connection mode, data exceeding 512 bytes (upper limit of the receive buffer in the 232IF) can be received.

*1 The 232IF only indicates the status.

*2 In this mode, the request to send (RS) signal functions as the signal to enable receive in the 232IF.
When receiving data exceeding 512 bytes (upper limit of the receive buffer in the 232IF), the 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.

Connection with counterpart equipment of modem specifications (Control line is essential.)
Straight cable used, BFM #0 communication format: b9 = 0, b8 = 1, standard RS-232C mode



*1 The 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 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 232IF indicates the status exclusively.

4. ALLOCATION OF BUFFER MEMORIES (BFMs)

4.1 BFM List

The RS-232C interface block FX2N-232IF (232IF) transmits data with the PC via the buffer memories BFMs (16-bit RAM memories) in the 232IF.

FNC78 (FROM) and FNC79 (TO) instructions are used to read and write the buffer memories.

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 (X 10 ms) "0" eliminates time-out time.	0	W
# 4 # 5	Send header, lower 2 bytes Send header, upper 2 bytes	4 bytes max., zero suppression	0 (no header) 0	W
# 6 # 7	Send terminator, lower 2 bytes Send terminator, upper 2 bytes	4 bytes max., zero suppression	0(no terminator) 0	W
# 8 # 9	Receive header, lower 2 bytes Receive header, upper 2 bytes	4 bytes max., zero suppression	0 (no header) 0	W
# 10 # 11	Receive terminator, lower 2 bytes Receive terminator, upper 2 bytes	4 bytes max., zero suppression	0(no terminator) 0	W
# 12	Receive suspension waiting time (in interlink connection)	0 to 32,327 (X 10 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

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

4.2 Details of Buffer Memories

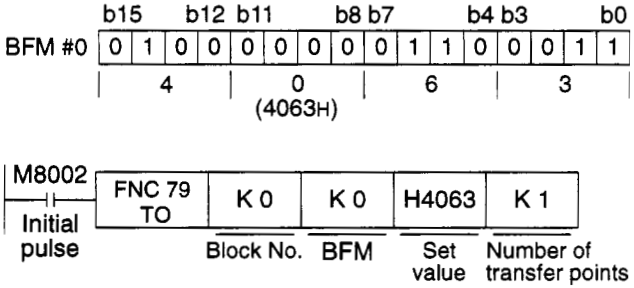
BFM #0: Communication format

Bit	Description	0	1	Initial value
b0	Data length	7 bit	8 bit	1 : 8 bit
b1 b2	Parity	(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)	(0011) : 300 (0100) : 600 (0101) : 1200 (0110) : 2400 (0111) : 4800 (1000) : 9600 (1001) : 19200		(1000) : 9600 bps
b8 b9	Control line	(00) : Not used (01) : Standard RS-232C (11) : RS-232C interlink connection mode		(00) : Not used
b10 b11	Addition of CR and LF	(00) : Not added (01) : CR only (11) : CR and LF		(00) : Not added
b12 b13	Availability of check sum and ASCII/HEX conversion	(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	Undefined (disabled)			0: Undefined

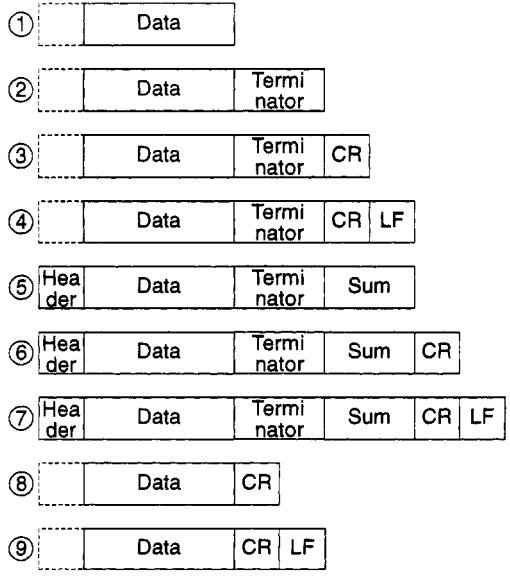
The communication format is determined on the rising edge of the send/receive enable command (BFM #1 b0). Accordingly, the setting of the communication format should be preliminary transferred using the TO instruction before BFM #1 b0 is turned on. Also, the send header and the send terminator are determined in 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 exclusively are changed it is not necessary to turn BFM #1 b0 off. The change becomes valid from the next send/receive operation.

Setting example of communication format (hexadecimal, constant specification)

Data length : 8 bits
Parity : Odd
Stop bit : 1 bit
Baud rate : 2,400 bps
Control line : Not used
CR, LF : Not added
Check sum and ASCII/HEX conversion : Not available
Buffer data length : 8 bits



Communication format list



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

- The header can be specified in the ⋯ portion in the communication format.
- In the communication format type ①, hexadecimal data (binary) and ASCII code can be send and received.
  In the communication format types ② to ⑨, the send/receive data should be any ASCII code except the header, the terminator, CR and LF.
  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.

● b0 to b7 (data length, parity, stop bit and baud rate):
b0 to b7 should be aligned with the communication specifications of the connected counterpart equipment.

● b9 and b8 (control line):
For examples of connecting the equipment corresponding to each setting, refer to Paragraph 3.3.

- When not used (b9 = 0, b8 = 0) is specified, communication is performed using only the SD and RD signals without using the control line.
- When standard RS-232C mode (b9 = 0, b8 = 1) is specified, 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 (b9 = 1, b8 = 1) is specified, the request to send (RS) signal functions as the signal to enable receive in the 232IF. 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.
  At this time, when the data saved in the receive buffers is read to data registers in the PC using the sequence program, the remaining data can be received.
  Make sure to perform the RS-232C interlink connection when specifying this mode.

● b11 and b 10 (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.

● 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 the ASCII/HEX conversion are available. (b13 = 1, b12 = 1)

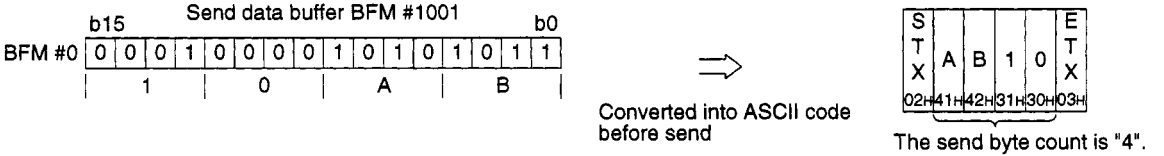
For the check sum addition format, refer to the communication format list shown above.

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.

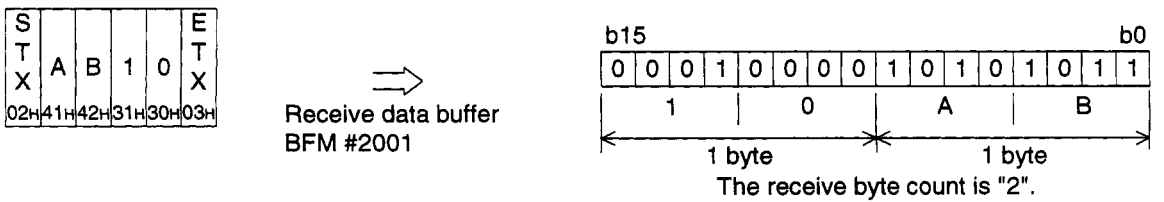
Send format when hexadecimal data is converted into ASCII code

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



Receive format when ASCII code is converted into hexadecimal data

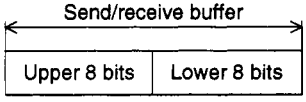
Example: When the receive data "10ABH", the header "STX" and the terminator "ETX" are received



● 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)

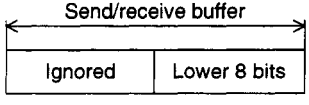


16-bit data is divided into upper 8 bits and lower 8 bits, then sent and received.

Example of send buffers

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

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



Upper 8 bits are ignored,and lower 8 bits only are sent and received as valid data.

Example of send buffers

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

BFM #1: Command

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.

● 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.

● 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)

● 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)
- BFM #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, b 8 = 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.

● b3 (error reset):

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

BFM #2: Receive upper limit byte count

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.

BFM #3: Receive time-out time

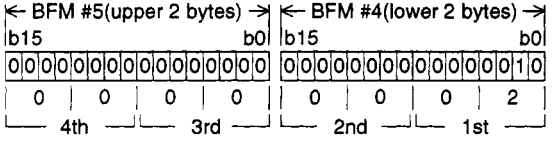
Setting range 1 to 32, 767 (x 10 ms)
"0" eliminates time-out time. The initial value is "0".

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.

BFMs #5 (upper) and #4 (lower): Send header
Setting range 4 bytes maximum, zero suppression
The initial value is "0" (not provided).

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.



Example:02H(STX)

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

BFMs #7 (upper) and #6 (lower): Send terminator
Setting range 4 bytes maximum, zero suppression
The initial value is "0" (not provided).

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.

BFMs #9 (upper) and #8 (lower): Receive header
Setting range 4 bytes maximum, zero suppression
The initial value is "0" (not provided).

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.

BFMs #11 (upper) and #10 (lower): Receive terminator
Setting range 4 bytes maximum, zero suppression
The initial value is "0" (not provided).

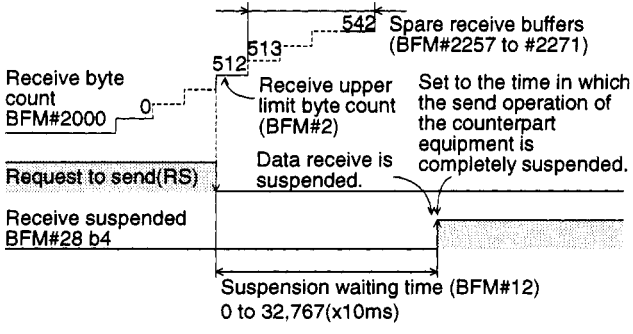
For the receive data of the 232IF, 4 terminators maximum can be specified. When the number of terminators is less than 4, the upper "0"s are ignored (zero suppression).
As the first terminator, specify an ASCII code from 01H to 1FH. (As the second to fourth terminators, any ASCII code can be specified.)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

BFM #12: Receive suspension waiting time
Setting range 0 to 32, 767 (x 10 ms)
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.



BFM #13: Number of remaining send data
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.

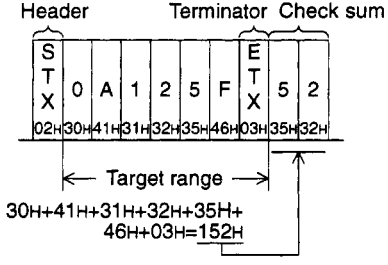
BFM #14: Number of receive buffers
Saved value 0 to 256^{+15} (for spare receive buffers)

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.

BFM #15: Send sum result
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.

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.

BFM #16: Receive sum result
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.

BFM #20: Time from CS ON to send start
Set value 0 to 32, 767 (x 10 ms)
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.

BFM #21: Time from completion of actual send to RS OFF (completion flag ON)
Set value 0 to 32, 767 (x 10 ms)
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.

BFM #28: Status

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 PC using the FROM instruction, then utilized.

● 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) is set to "ON".

● 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).

● 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.

● 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).

● 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 PC and the receive completion command executed (BFM #1 b2).

● 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.

● b7 (being received)

b7 is turned on after the head data is received until the receive completion status (BFM #28 b1) is set.

● b8 (RS), b9 (ER),b12 (DR), b13 (CD), b14 (CS), b15 (CI)

These bits indicate the ON/OFF status of the control signals.

BFM #29: Error code

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.

BFM #30: Model code
The model code of the 232IF is "K7030".

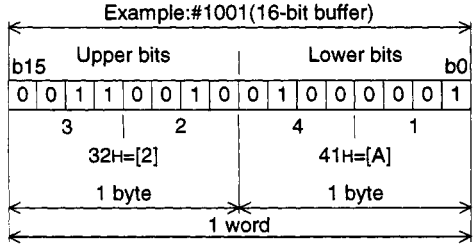
The model code is a fixed code assigned to each special extension equipment handled by the FROM/TO instruction. The PC can distinguish the equipment type by reading this code.

BFM #1000: Send byte count
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.

BFMs #1001 to #1256: Send buffers
Each of them is a 16-bit buffer to save the send data, and accommodates 512 bytes/256 words.

Send/receive buffer structure



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

BFM #2000: Receive byte count

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

BFMs #2001 to #2256: Receive buffers

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).

BFMs #2257 to #2271: Spare receive buffers for interlink connection mode

Each of them is a spare buffer for the interlink connection in the case where the data exceeding 512 bytes is received, and is used to receive the 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).

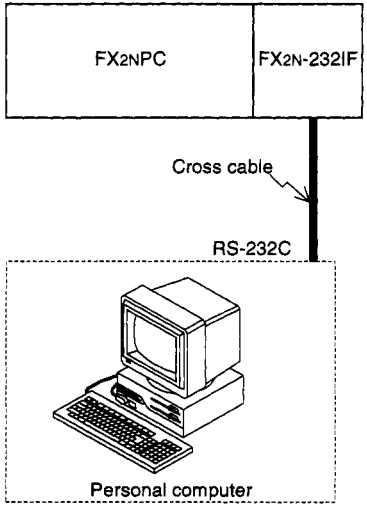
MEMO

5. TRANSMISSION PROGRAM

5.1 Example of sending/receiving the data of 16-bit buffer length

This paragraph describes an example in which data of 16-bit buffer length 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 PC is sent to the counterpart equipment, and the data received from the counterpart equipment is saved to the data registers D301 to D304 in the PC.

System configuration

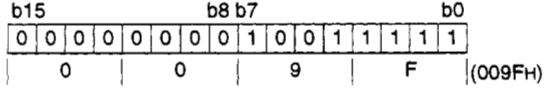


Setting example of buffer memories (The items not described here are set to the initial value respectively.)

BFM #0: Communication format

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



BFM #1: Command
M0 → b0: Send/receive enable (ER ON)
M1 → b1: Send command
M2 → b2: Receive completion reset command
M3 → b3: Error reset

BFM #2: Receive upper limit byte count
8 bytes

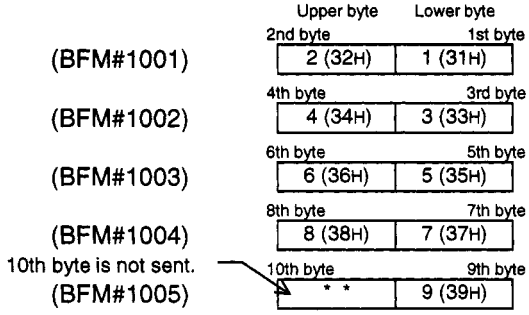
BFMs #4 to #11: Header and terminator
BFMs #4 and #8 (send/receive header): 02H (STX)
BFMs #6 and #10 (send/receive terminator): 03H (ETX)

BFM #28: Status
b0 → M10: Send completion
b1 → M11: Receive completion
b2 → M12: Receive time-out
b3 → M13: Error occurrence
b4 → M14: Receive suspended
b5 → M15: Undefined
b6 → M16: Being sent
b7 → M17: Being received
b8 → M18: RS(RTS)
b9 → M19: ER(DTR)
b10 → M20: Undefined
b11 → M21: Undefined
b12 → M22: DR(DSR)
b13 → M23: CD(DCD)
b14 → M24: CS(CTS)
b15 → M25: CI(RI)

BFM #1000: Send byte count
9 bytes

BFMs #1001 ~: Send buffers

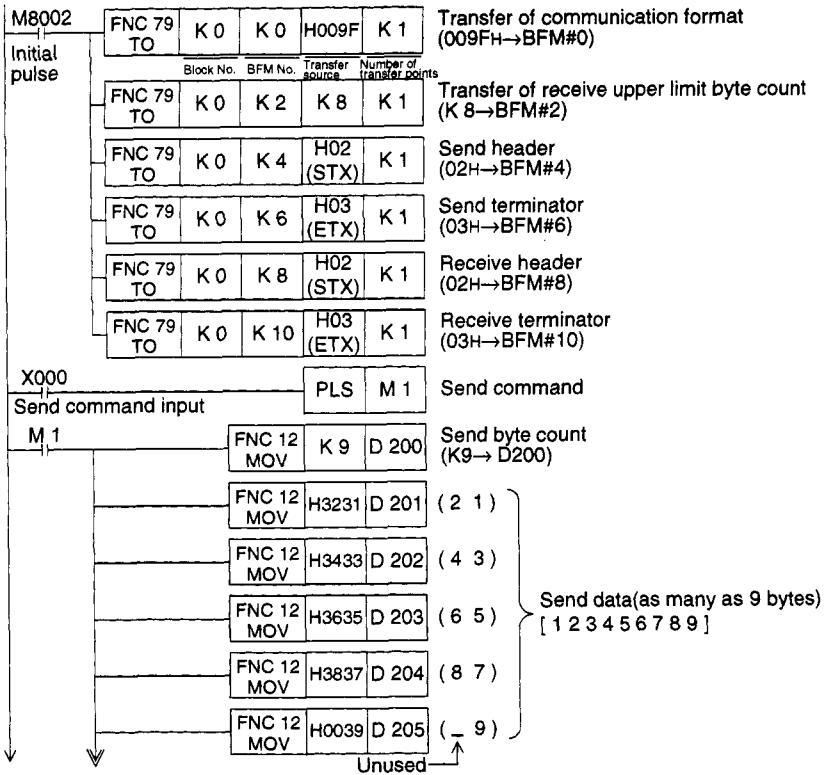
Nine-byte send data "123456789" is prepared in ASCII code in accordance with the send byte count specified above.

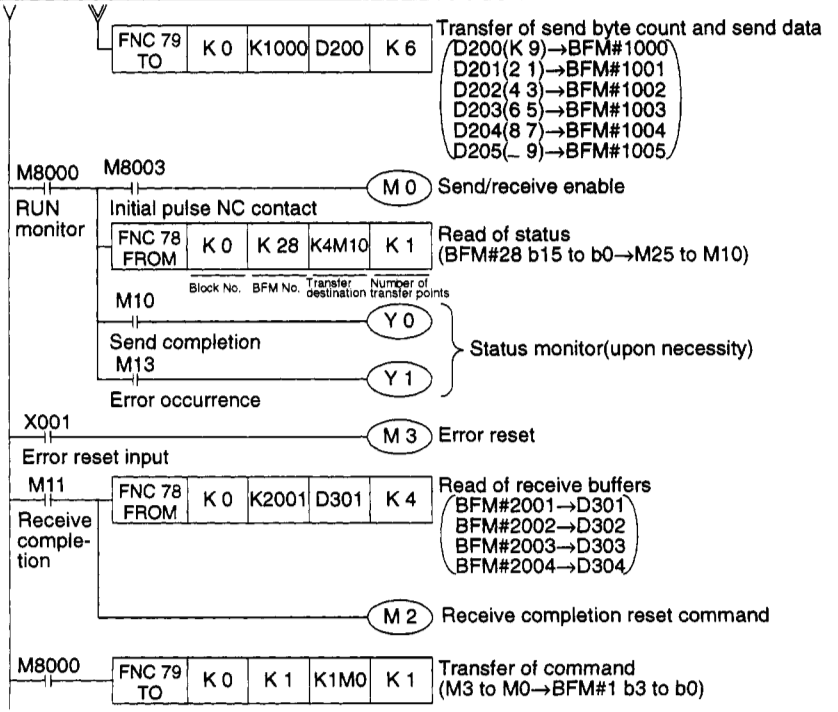


BFMs #2001 ~: Receive buffers

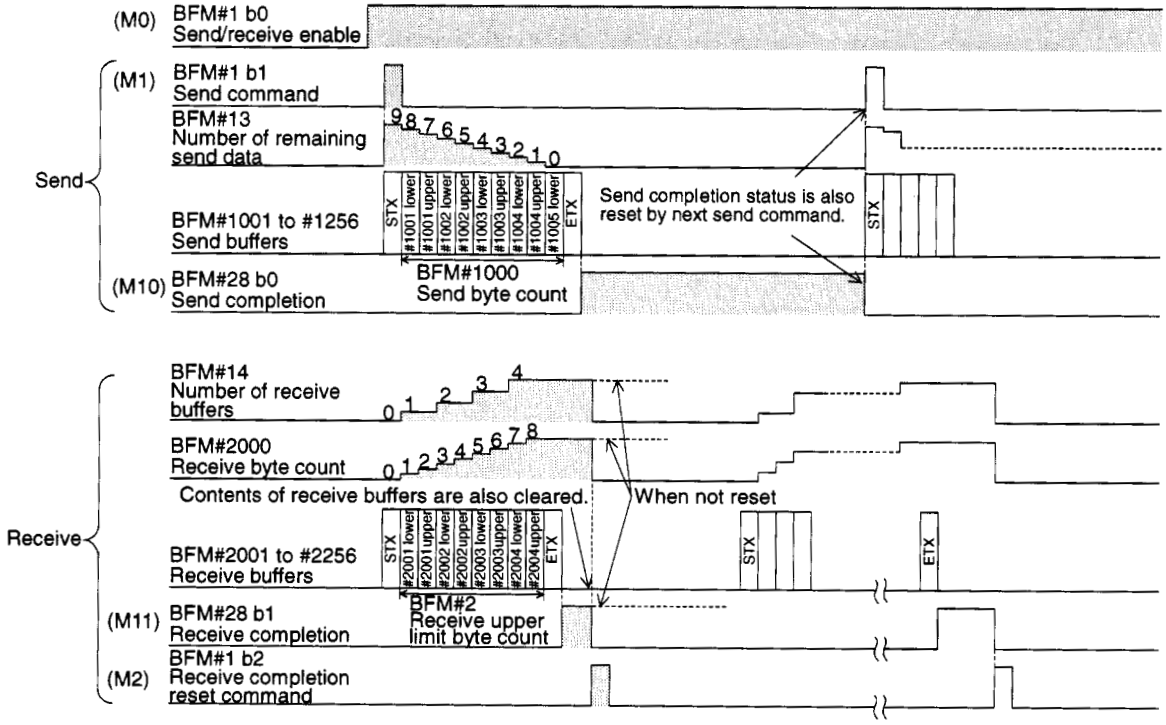
Eight-byte receive data specified in accordance with the receive upper limit byte count (BFM #2) is read to the data registers D301 to D304 in the PC.

Example of sequence program




FNC 79 TO K 0 K1000 D200 K 6
Transfer of send byte count and send data
D200(K 9)→BFM#1000
D201(2 1)→BFM#1001
D202(4 3)→BFM#1002
D203(6 5)→BFM#1003
D204(8 7)→BFM#1004
D205(_ 9)→BFM#1005
M8000
RUN monitor
M8003
Initial pulse NC contact
M 0
Send/receive enable
FNC 78 FROM K 0 K 28 K4M10 K 1
Block No. BFM No. Transfer destination Number of transfer points
Read of status
(BFM#28 b15 to b0→M25 to M10)
M10
Send completion
Y 0
M13
Error occurrence
Y 1
Status monitor(upon necessity)
X001
Error reset input
M 3
Error reset
M11
Receive comple-tion
FNC 78 FROM K 0 K2001 D301 K 4
Read of receive buffers
BFM#2001→D301
BFM#2002→D302
BFM#2003→D303
BFM#2004→D304
M 2
Receive completion reset command
M8000
FNC 79 TO K 0 K 1 K1M0 K 1
Transfer of command
(M3 to M0→BFM#1 b3 to b0)

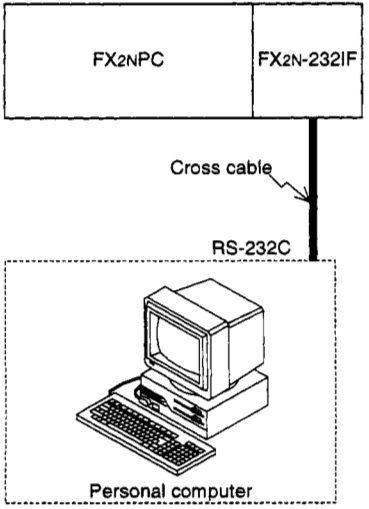
Operation chart



5.2 Example of sending/receiving the data of 8-bit buffer length

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

System configuration

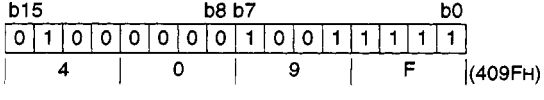


Setting example of buffer memories (The items not described here are set to the initial value respectively.)

BFM #0: Communication format

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	(1): 8 bits
b15	Undefined	—

◀ Specification item for 8-bit length



BFM #1: Command
M0 → b0: Send/receive enable (ER ON)
M1 → b1: Send command
M2 → b2: Receive completion reset command
M3 → b3: Error reset

BFM #2: Receive upper limit byte count
8 bytes

BFMs #4 to #11: Header and terminator
BFMs #4 and #8 (send/receive header): 02H (STX)
BFMs #6 and #10 (send/receive terminator): 03H (ETX)

BFM #28: Status

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)

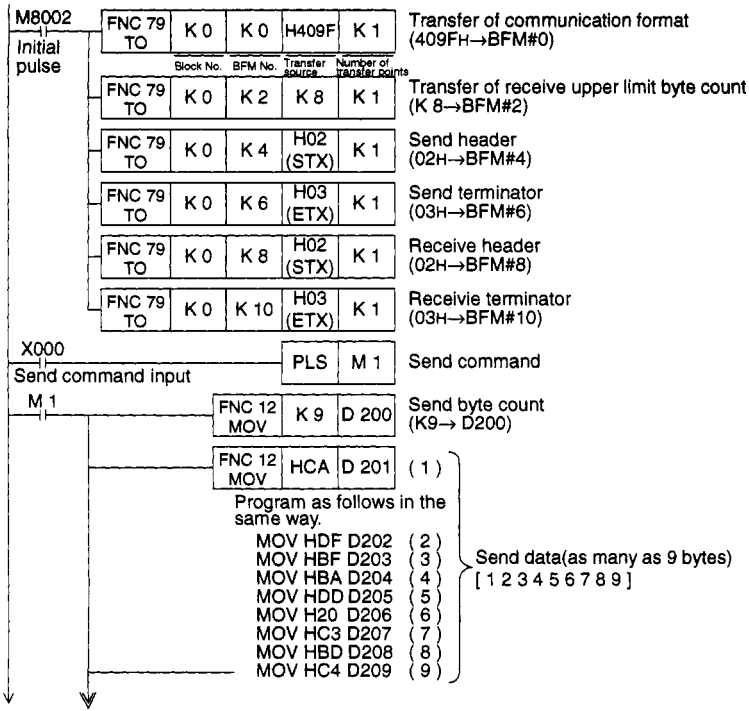
BFM #1000: Send byte count
9 bytes

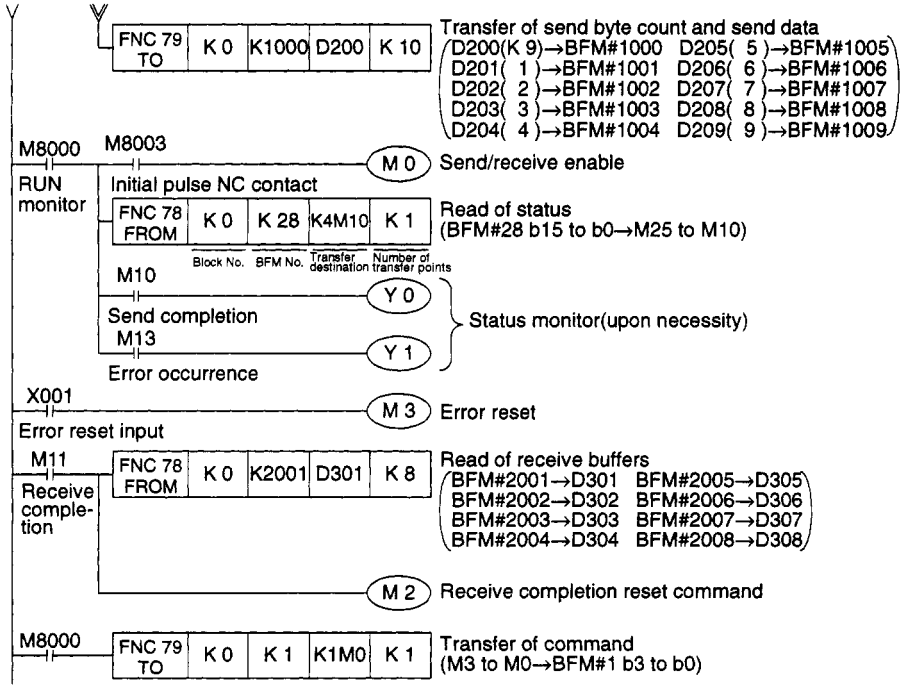
BFMs #1001 ~: Send buffers
Nine-byte send data "123456789" is prepared in the ASCII code in accordance with the send byte count specified above.

	Upper byte	Lower byte	
(BFM#1001)	Ignored	1 (30H)	1 byte
(BFM#1002)	Ignored	2 (31H)	2 byte
(BFM#1003)	Ignored	3 (32H)	3 byte
(BFM#1004)	Ignored	4 (33H)	4 byte
(BFM#1005)	Ignored	5 (34H)	5 byte
(BFM#1006)	Ignored	6 (35H)	6 byte
(BFM#1007)	Ignored	7 (36H)	7 byte
(BFM#1008)	Ignored	8 (37H)	8 byte
(BFM#1009)	Ignored	9 (38H)	9 byte

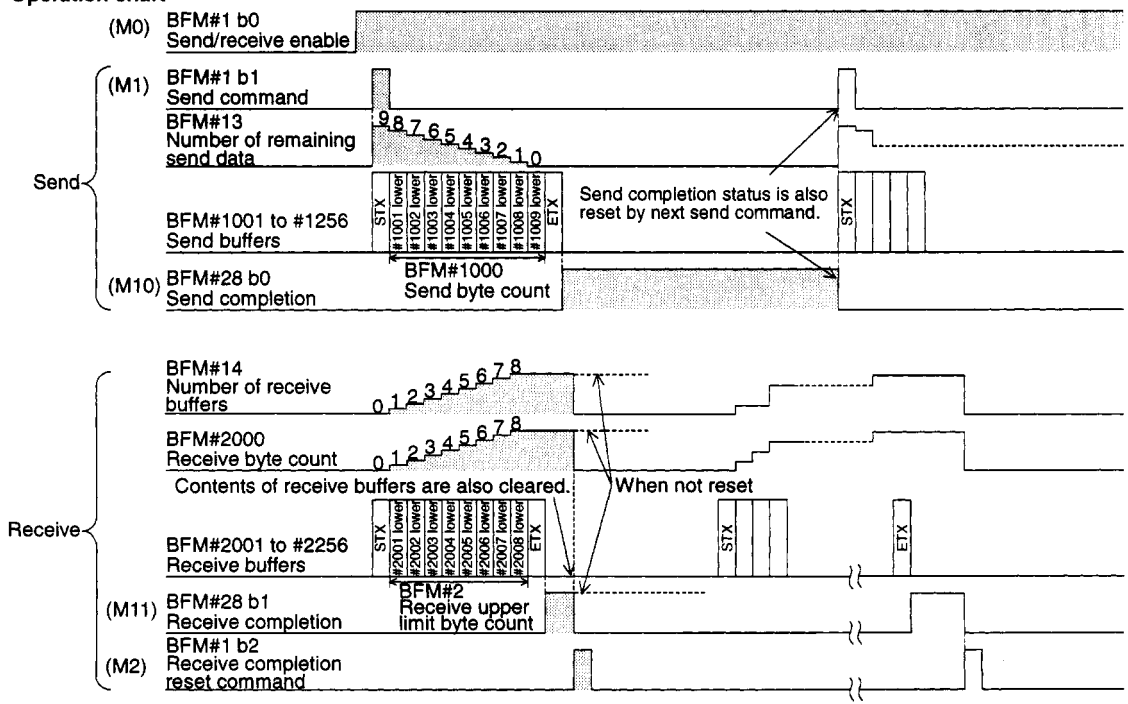
BFMs #2001 ~: Receive buffers
Eight-byte receive data specified in accordance with the receive upper limit byte count (BFM #2) is read to the data registers D301 to D308 in the PC.

Example of sequence program




FNC 79 TO | K 0 | K1000 | D200 | K 10
Transfer of send byte count and send data
(D200(K 9)→BFM#1000 D205(5)→BFM#1005
D201(1)→BFM#1001 D206(6)→BFM#1006
D202(2)→BFM#1002 D207(7)→BFM#1007
D203(3)→BFM#1003 D208(8)→BFM#1008
D204(4)→BFM#1004 D209(9)→BFM#1009)
M8000
RUN monitor
M8003
Initial pulse NC contact
M 0
Send/receive enable
FNC 78 FROM | K 0 | K 28 | K4M10 | K 1
Block No. | BFM No. | Transfer destination | Number of transfer points
Read of status
(BFM#28 b15 to b0→M25 to M10)
M10
Send completion
Y 0
M13
Error occurrence
Y 1
Status monitor(upon necessity)
X001
Error reset input
M 3
Error reset
M11
Receive comple-tion
FNC 78 FROM | K 0 | K2001 | D301 | K 8
Read of receive buffers
(BFM#2001→D301 BFM#2005→D305
BFM#2002→D302 BFM#2006→D306
BFM#2003→D303 BFM#2007→D307
BFM#2004→D304 BFM#2008→D308)
M 2
Receive completion reset command
M8000
FNC 79 TO | K 0 | K 1 | K1M0 | K 1
Transfer of command
(M3 to M0→BFM#1 b3 to b0)

Operation chart



6. APPENDIX

ASCII code table

HEX	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

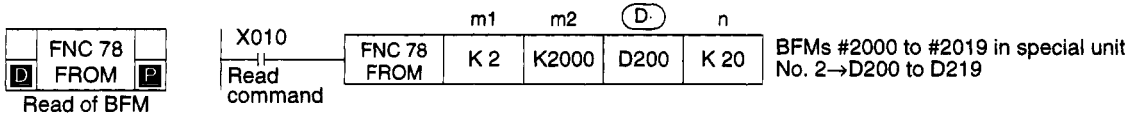
ASCII code table

Decimal	ASCII (hexadecimal)
0	30
1	31
2	32
3	33
4	34
5	35
6	36
7	37
8	38
9	39

Code	ASCII (hexadecimal)
STX	02
ETX	03

Alphabet	ASCII (hexadecimal)	Alphabet	ASCII (hexadecimal)
A	41	N	4E
B	42	O	4F
C	43	P	50
D	44	Q	51
E	45	R	52
F	46	S	53
G	47	T	54
H	48	U	55
I	49	V	56
J	4A	W	57
K	4B	X	58
L	4C	Y	59
M	4D	Z	5A

Outline of FROM/TO command

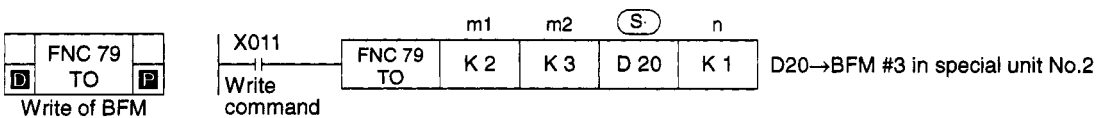


m1 : Special unit/block No. (K0 to K7 from the one nearest the basic unit)

m2 : Head specification No. in BFM (m2 = K0 to K32, 766)

(D·) : Head element No. in transfer destination. Either one can be selected among T, C, D, KnM, KnY, KnS, V and Z. The element No. can be modified using the index.

n : Number of transfer points (n = K1 to K32, 767)
In the FX2N PC whose version is 2.00 or more, when the FROM/TO instruction is executed while the M8164 is turned on, the contents of the D8164 are treated as the number of transfer points (n).



m1, m2, n : Same as above

(S·) : Head element No. in transfer destination. Either one can be selected among T, C, D, KnX, KnM, KnY, KnS, V, Z, K and H.
The element No. can be modified using the index.

- When X010 and X011 are turned off, transfer is not executed and the data in the transfer destination is not changed.
- When a large quantity of data is read/written using the FROM/TO instruction, the watch dog timer (D8000) in the PC should be rewritten to a large value.

MEMO

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.

Owing to the very great variety in possible application of this equipment, you must satisfy yourself as to its suitability for your specific application.

USER'S MANUAL

RS-232C INTERFACE BLOCK FX2N-232IF

MITSUBISHI ELECTRIC CORPORATION

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JY992D66701A
(MEE 9710)

Effective OCT. 1997
Specifications are subject to change without notice.