GE Fanuc Automation

Computer Numerical Control Products

Series 15i / 150i – Model A Remote Buffer

Descriptions Manual

B-63322EN-1/01 1999

Warnings and notices for this publication

GFLE-003

Warning

In this manual we have tried as much as possible to describe all the various matters. However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.

Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

Notice

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained herein does not purport to cover all details or variations in hardware or software, nor to provide every contingency in connection with installation, operation, or maintenance. Features may be described herein which are not present in all hardware and software systems. GE Fanuc Automation assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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Helpmate	Series Six
LogicMaster	Series Three
Modelmaster	VuMaster
PowerMotion	Workmaster
ProLoop	

PREFACE

Applicable product name

The models covered by this manual, and their abbreviations are:

Product name	Abbreviations	
FANUC Series 15*i*-MA	15*i*-MA	Series 15*i*
FANUC Series 150*i*-MA	150*i*-MA	Series 150*i*

Related manuals

The table below lists manuals related to MODEL A of Series 15*i*, and Series 150*i*. In the table, this manual is marked with an asterisk (*).

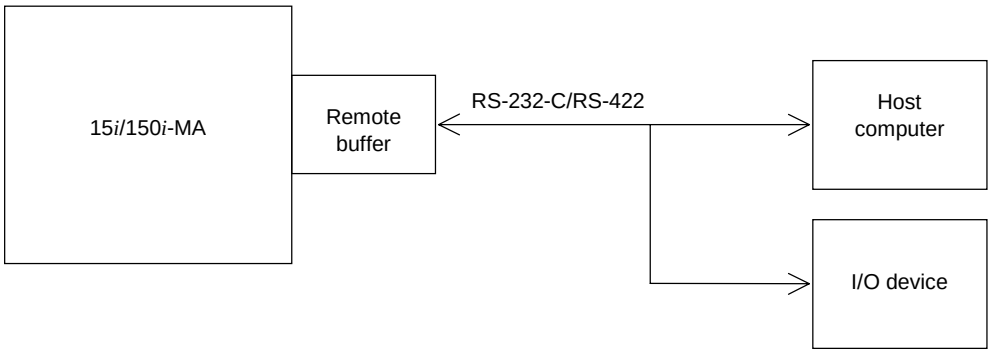
Table 1 (a) Related manuals

Manual name	Specification number	
DESCRIPTIONS	B-63322EN	
CONNECTION MANUAL (Hardware)	B-63323EN	
CONNECTION MANUAL (Function)	B-63323EN-1	
OPERATOR'S MANUAL (PROGRAMMING) for Machining Center	B-63324EN	
OPERATOR'S MANUAL (OPERATION) for Machining Center	B-63324EN-1	
MAINTENANCE MANUAL	B-63325EN	
PARAMETER MANUAL	B-63330EN	
DESCRIPTIONS (Supplement for Remote Buffer)	B-63322EN-1	*

CONTENTS

1 GENERAL

The remote buffer for FANUC Series 15*i*/150*i*-MODEL A is an option and is used to allow a large number of data to be continuously supplied to the CNC at high speed by connecting it to the host computer or I/O device through a serial interface.



The followings can be performed by the remote buffer.

1) It is used to perform DNC operation at high speed and with high reliability by performing on-line connection to the host computer.

2) It is used to download the NC program and parameters from the host computer. When protocol B or expansion protocol B is used, NC programs and parameters can also be uploaded to the host computer.

3) It is used to perform DNC operation and download various kinds of data by connecting to the I/O device. The following I/O devices can be connected.

   (1) FANUC PROGRAM FILE Mate
   (2) FANUC HANDY FILE

Hereafter, the destination where the remote buffer is connected to is called “Host computer” for ease of explanation.

2 INTERFACE BETWEEN REMOTE BUFFER AND HOST COMPUTER

2.1 ELECTRICAL INTERFACE

The following which interfaces are provided as standard specifications.

1) RS-232-C interface
2) RS-422 interface (Note 1)

	RS-232-C	RS-422
Interface	Serial voltage interface (start-stop system)	Balance transmission serial interface (start-stop system)
Baud rate	50 – 19200 baud rate (Note 2)	50 – 86400 baud rate (Note 1)
Cable length (MAX.)	100m (4800 baud or less) 50m (9600 baud) 15m (19200 baud) It differs depending on I/O devices.	Approximately 800m (9600 baud or less) 50m (19200 baud or more)

NOTE
1 When the baud rate exceeding 38400 BPS is used, the synchronization of reception clock is required. Prepare the TT (*TT) and RT (*RT) signals.
2 When the baud rate used is 19200 baud or more, use the RS-422 interface.

2.2 SOFTWARE INTERFACE

The following four protocols for communication between the remote buffer and host computer are provided. The protocol meeting the requirement of specifications of connection device can be selected by setting a parameter.

Protocol	Features of protocol	Interface used	Transfer rate (Max.)
Protocol A	It is the handshake system where transmit/receive is repeated between the both.	RS-232-C	19200 BPS
		RS-422	86400 BPS
Expansion protocol A	It is nearly the same as the protocol A. However, the NC program can be transferred at high-speed so that it can be applied to the high-speed DNC operation.	RS-422	86400 BPS
Protocol B	It is the system for controlling the communication between the both by the control code output from the remote buffer.	RS-232-C	19200 BPS
Expansion protocol B	The control system is the same as that of protocol B. However, it allows the transmission speed to be increased. In this case, it is required to receive the reception synchronization clock from the source.	RS-422	86400 BPS

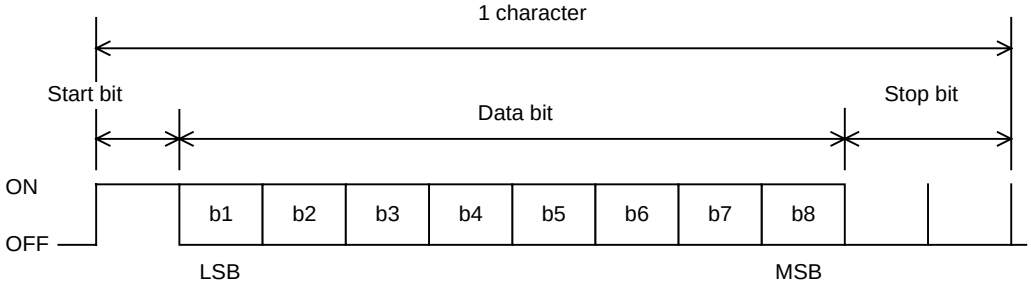
NOTE
The average data transfer speed becomes smaller than the maximum transfer speed.

3 ELECTRICAL INTERFACE

3.1 TRANSMISSION SYSTEM

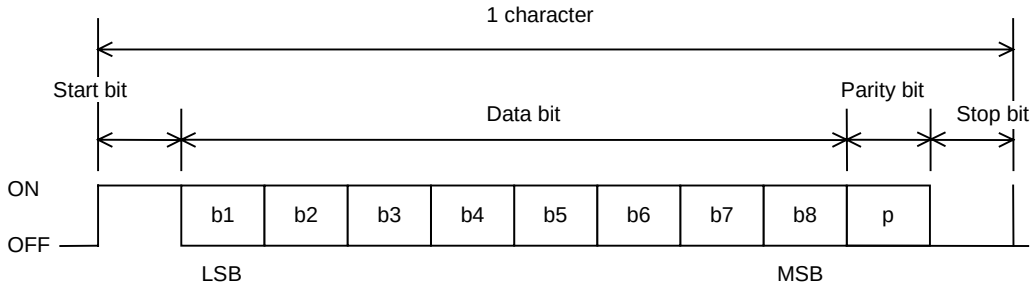
It is the start-stop system for adding the start bit before and stop bit after the information bits, respectively.
The format for adding one parity bit to each byte of data to be transmitted is also allowed.

1) Format with no parity bit



Data bit is sent starting from the LSB.

2) Format with parity bit

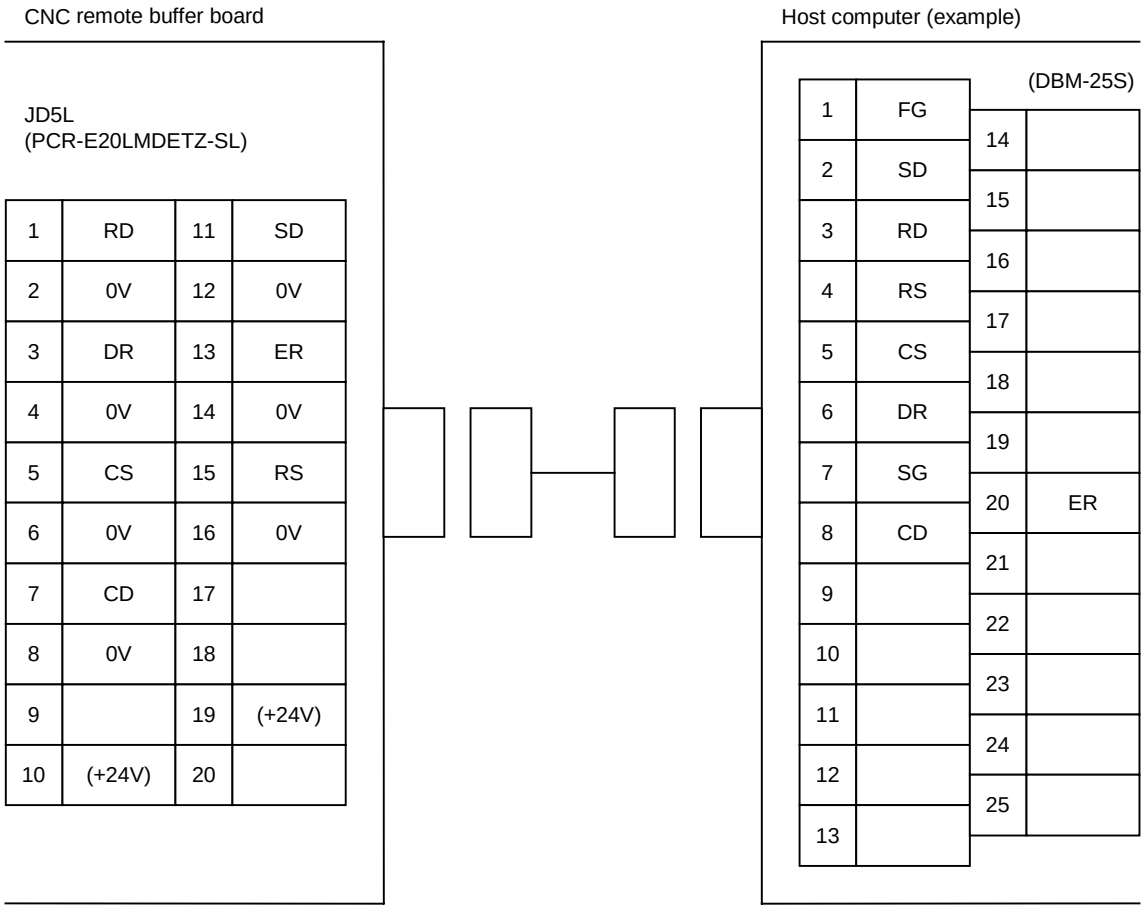


Data bit is sent starting from the LSB.
The format with parity bit becomes the even parity including a parity bit. The number of stop bits of parameter determines whether there is a parity bit or not.

Stop bit 1 → With parity bit
Stop bit 2 → With no parity bit

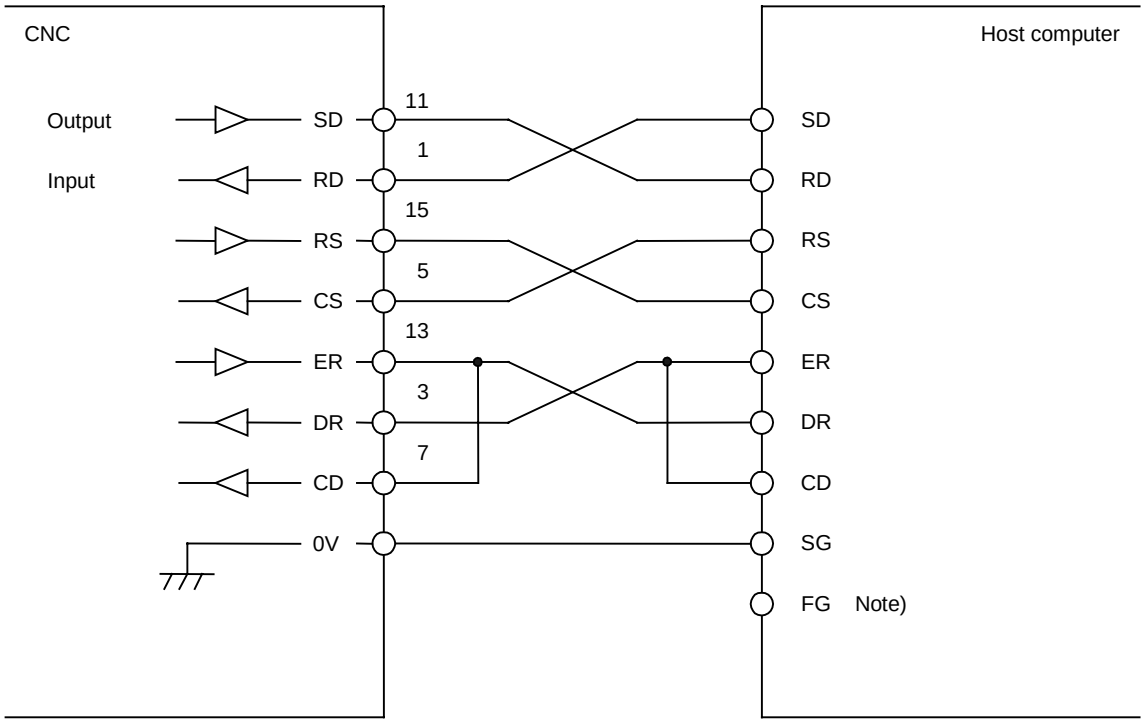
3.2 RS-232-C INTERFACE

1) Connection between devices



NOTE
(+24V) is used as the power to FANUC RS-232-C devices.

2) General diagram of signal connection



When no CS is used, short-circuit it with the RS. However, when the protocol A or expansion protocol A is used, perform connecting as shown in the figure above for use as busy control.
When DR is not used, short-circuit it with ER.
Always short-circuit CD to ER.

NOTE
Connect the FG pin to the FG pin of the relay connector or to the protective grounding pin inside the locker.

3) Signal description

Signal name	RS-232-C circuit number	Input/ output	Description	
SD	103	Output	Send data	See “3.1” for the bit configuration.
RD	104	Input	Receive data	
RS	105	Output	Request to send It is used to inform whether the remote buffer is ready to receive data or not. When the ER signal is on and this signal is on, the remote buffer is ready to receive data.	
CS	106	Input	Clear to send It is used to know the busy status at the host computer. When the DR signal is on and this signal is on, the host computer is regarded as being ready to receive data.	
DR	107	Input	Data set ready When this signal is on, it is considered that the preparation at the host computer has been completed. Generally, it is connected to the ER signal of the host computer. When this signal is off during data transmission, an alarm occurs. Always connect it to the ER signal of CNC side when this signal is not used.	
ER	108.2	Output	Data terminal ready When this signal is on, it is considered that the remote buffer is in ready condition. In general, it is connected to the ER signal at the host computer. If it is turned off during transmission of data, an alarm occurs. If this signal is not used, always connect this to the ER signal at the CNC side.	
CD	109	Input	Received line signal detector This signal is not used for connection to the host computer. Thus, connect it to the ER signal of remote buffer side.	
SG	102		Grounding for signal	
FG	101		Grounding for protection	

NOTE

Turn on or off signal according to the following:

	-3 V or less	+3 V or more
Function	OFF	ON
Signal Condition	Marking	Spacing

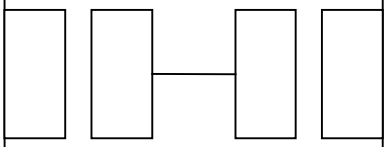
3.3 RS-422 INTERFACE

1) Connection between devices

CNC remote buffer board

JD6L
(PCR-E20LMDETZ-SL)

1	RD	11	SD
2	*RD	12	*SD
3	RT	13	TT
4	*RT	14	*TT
5	CS	15	RS
6	*CS	16	*RS
7	RR	17	TR
8	0V	18	*TR
9	*RR	19	(+24V)
10	(+24V)	20	

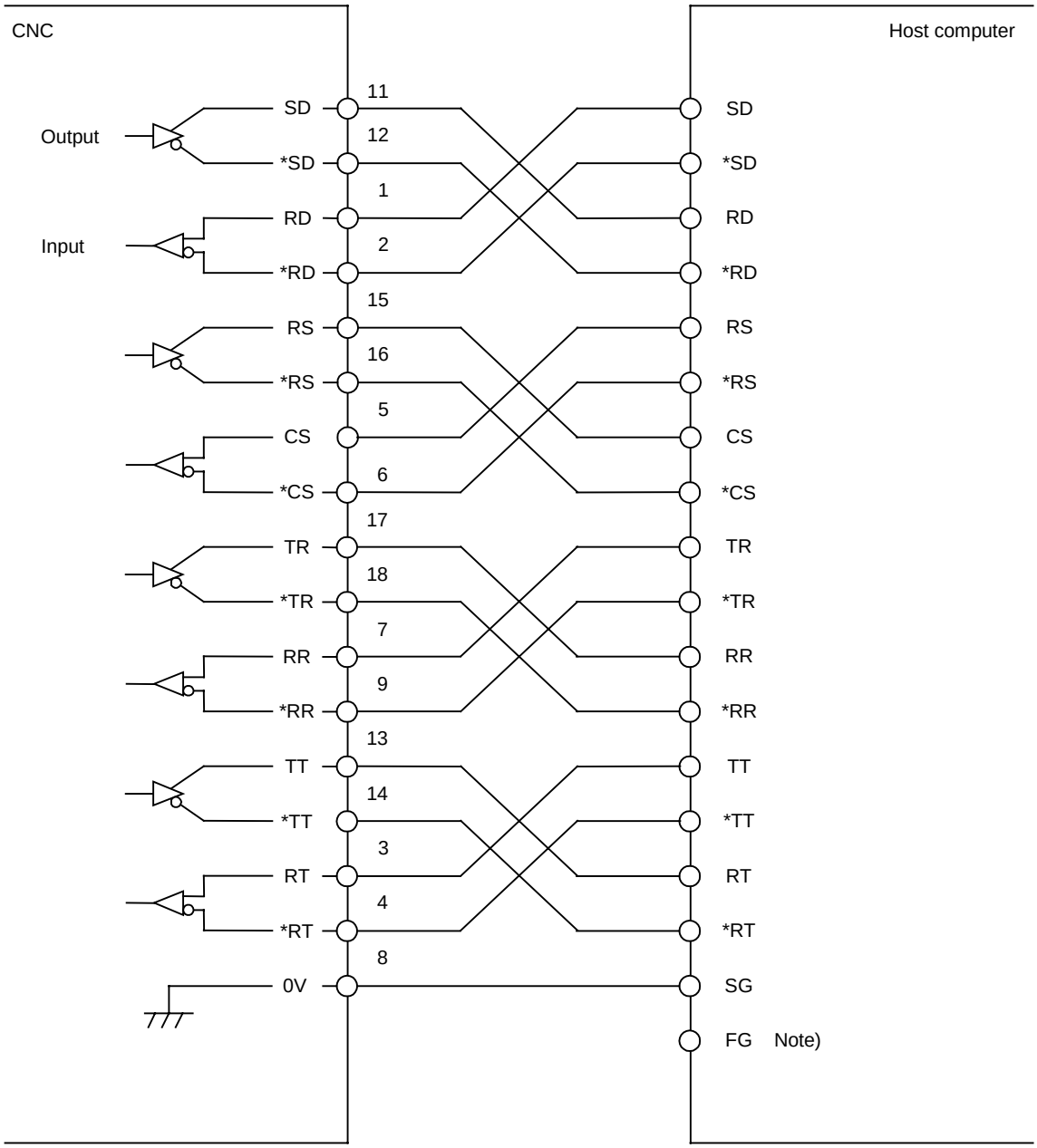


Host computer (example)

1	FG	20	
2		21	
3		22	*SD
4	SD	23	
5		24	*RD
6	RD	25	*RS
7	RS	26	*RT
8	RT	27	*CS
9	CS	28	
10		29	*RR
11	RR	30	*TR
12	TR	31	
13		32	
14		33	
15		34	
16		35	*TT
17	TT	36	
18		37	
19	SG		

NOTE
Do not connect anything to the (+24V) pin.

2) General diagram of signal connection



NOTE
Connect the FG pin to the FG pin of the relay connector or to the protective grounding pin inside the locker.

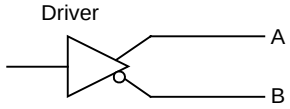
3) Signal description

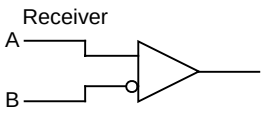
Signal name	RS-232-C circuit number	Input/ output	Description	
SD	103	Output	Transmission data	See “3.1” for the bit configuration.
RD	104	Input	Reception data	
RS	105	Output	Transmission request It is used to inform whether the remote buffer is ready to receive data or not. When the TR signal is on and this signal is on, the remote buffer is ready to receive data.	
CS	106	Input	Clear to send It is used to know the busy status at the host computer. When the RR signal is on and this signal is on, the host computer is regarded as being ready to receive data.	
TR (ER)	108.2	Output	Terminal Ready When this signal is on, it is considered that the operation of remote buffer has been completed. In general, it is connected to the ER signal at the host computer. If it is turned off during transmission of data, an alarm results. If this signal is not used, always connect this to the ER signal at the CNC side.	
RR (DR)	109	Input	Receiver Ready When this signal is on, it indicates that the host computer is ready to transmit data to the remote buffer. If this signal is not used, always connect it to the TR signal at the remote buffer side.	
TT	113	Output	Transmission timing Transmission clock transmission terminal at the remote buffer side. When 38400 baud or more is used, always connect it to the RT signal at the host computer side.	
RT	115	Input	Reception timing Reception clock input terminal at the remote buffer side. When 38400 baud or more is used, always connect it to the TT signal at the host computer side.	
SG	102		Grounding for signal	
FG	101		Grounding for protection	

NOTE

The signal turn on/off according to the following:

	A < B	A > B
Function	OFF	ON
Signal Condition	Marking	Spacing



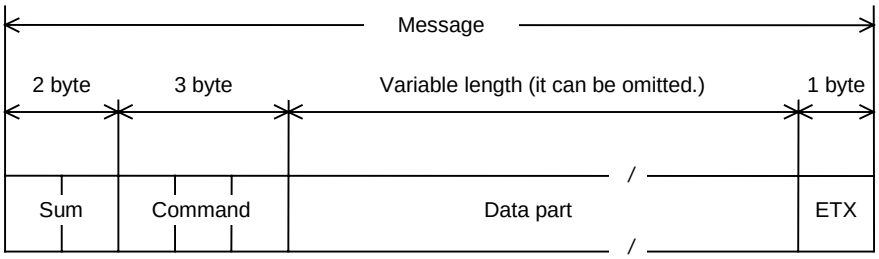


4 PROTOCOL A

It is used for the handshake system where the communication between the remote buffer and host computer repeats transmission/reception each other.

4.1 MESSAGE FORMAT

The information (character-string) exchanged between the remote buffer and host computer is called “message”. The general type of message is shown as below:



Field	Byte length	Abbreviation	Meaning	Remarks
Checksum	2	No	It is used to indicate the lower 8 bits of binary sum of all bytes from the command field to end code by two-digit hexadecimal number (0 – 9 and A – F).	Transmit the MSB before the LSB.
Command	3	No	It is used to display the type of message (functions) and to specify the operation and response of the partner.	
Data	0 – n	Yes	It is the data part corresponding to a command. Abbreviate it when a command without data part is used. Details are described later.	SAT, SET, DAT, RTY SDI, SDO
End code (ETX)	1	No	It indicates the end of message. Not transmit a code which is the same as an end code to data part.	

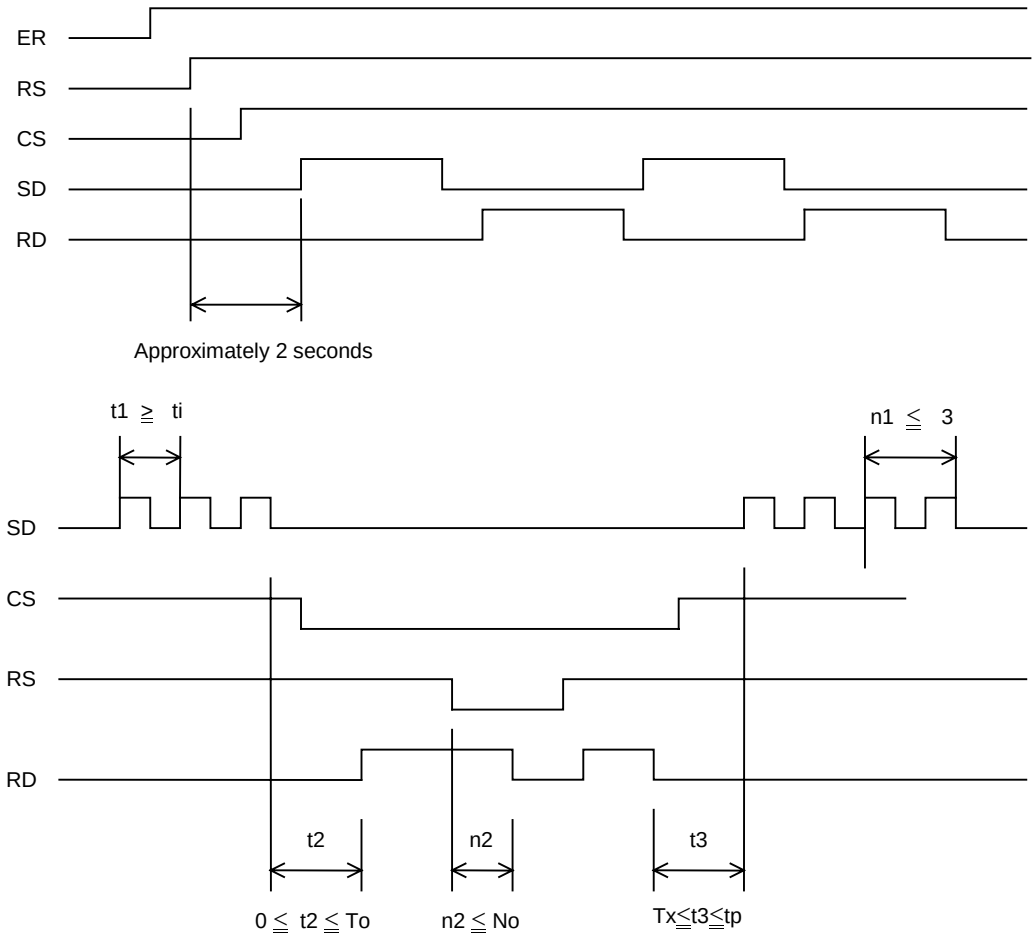
4.2 CODE SYSTEM

The communication codes between the remote buffer and host computer are described below:

Field	Command	Code	Related parameters
Checksum	---	ISO/ASCII	5000#2
Command name	---	ISO/ASCII	5000#2
Data part	DAT	ISO/ASCII/EIA/Bin	0000#2
	Commands other than DAT	ISO/ASCII	5000#2
End code	---	ISO/ASCII	5000#2
		CR/ETX	5000#3

4.3 COMMUNICATION SYSTEM

It is used to perform communication between the remote buffer and host computer. When the both are ready to operate after power on, the communication starts from the transmission of remote buffer and reception of host computer and then the transmission/reception is repeated.



(1) Approximately two seconds are required for the first request after both of remote buffer and host computer are ready. However, when the CS signal is off, the first transmission is performed after turning on the CS signal.

(2) The minimum time period between bytes is determined by the parameter Ti (msec) of SET command. There is no prescription of minimum time period between reception bytes.

(3) Switching from transmission to reception
Immediately the remote buffer side can be ready to receive signal. Start transmission within the parameter setting time (To sec) at the host computer side. When no response is obtained for the time period (To or more), an error occurs in the host computer. (Overtime)

(4) Switching from reception to transmission
The remote buffer waits for Tx msec (parameter setting time) and moves to the transmission process after completion of reception. When there is no transmission after waiting another parameter (Tp seconds), it is considered that an error occurred in the remote buffer.

(5) Overrun on reception
When the RS signal is turned off by the remote buffer on reception of signal, stop the transmission within the overrun parameter number bytes by the host computer.

(6) Overrun on transmission
When the CS is turned off on transmission of remote buffer, the transmission is suspended within 3 bytes including that which is currently being transmitted.

4.4 COMMAND

4.4.1 Command Table

Commands used in the protocol A are described below:

Origin station R: Remote buffer H: Hoast computer

Command	Origin station	Functions	Data part	Executed command at CNC side
SYN	R	Initialization command It is used to command the initialization of host.	Meaningless	SYN
	H	Response of SYN Response when the initialization does not end yet Initialization command It is command to initialize the remote buffer.	Meaningless	
RDY	R	Notice of initialization end The host should respond the RDY in the case of end of initialization or the SYN when the initialization has not ended.	Meaningless	RDY, SYN
	H	Notice of initialization end It is used to notice that the initialization of host has ended.	Meaningless	
RST	R	Notice of CNC reset Immediately after the CNC is reset, transmit this command when it is possible to transmit signal.	Meaningless	ARS
ARS	H	Response corresponding to the RST	Meaningless	
ALM	R	Notice of CNC alarm occurrence When an alarm occurs in CNC, transmit this command when it is possible to transmit immediately after that.	Meaningless	AAL
AAL	H	Response corresponding to the ALM	Meaningless	
SAT	R	Notice of remote buffer status It is used to notice the status of remote buffer by transmitting it when there is no data to be especially transmitted while the Tp sec has passed after receiving the command.	Status	SET..... Normal CLB RDI SDO SYN
SET	H	Response corresponding to the SAT It is used to modify the setting parameter of remote buffer by specifying the data part.	Modification parameter	
GTD	R	Transmit command of NC data Transmit this command when the space of remote buffer exceeds Nb bytes of parameter setting value in the remote operation status.	Meaningless	DAT ..... Normal EOB ..... End WAT ..... Busy RDI SDO
DAT	H	Response corresponding to the GTD Transmit this command with the NC data.	NC data	
WAT	H	Response corresponding tot he GTD Transmit this command if the NC data cannot be transmitted within To when the GTD has been received. The GTD is transmitted again by the remote buffer after a parameter setting time of Tw.	Meaningless	

Command	Origin station	Functions	Data part	Executed command at CNC side
EOD	H	Response corresponding to GTD Transmit this command when the GTD has been received while the transmission of NC data has been completed.	Meaningless	
CLB	H	Buffer clear It can be transmitted as the response of SAT when the buffer at the remote buffer side is to be cleared.	Meaningless	
RDI	H	DI reading request It is used to request transmission of image of specified 8-bit DI. The DI image at that time is responded by the SDI command in the remote buffer. This command can be transmitted as responses of SAT and GTD.	Meaningless	
SDI	R	Notice of DI It is used to transmit the signal status of DI as the response of RDI command. The host should transmit the response of command received immediately before transmitting the RDI after receiving this command.	DI image	Response corresponding to the GTD/SAT
SDO	H	DO output request It is used to command that the 8-bit image of data part should be output to the DO. It can be transmitted as responses of SAT, GTD, and SDI.	DO image	
RTY	R/H	Request of retransmission It is used to request the retransmission of the same message as before. Immediately transmit this command when a transmit error is detected during reception of messages.	Reason for retransmission	Command transmitted immediately before

4.4.2 Description of Data Part

Data part of message is of variable length. Up to 4096 and 72 bytes can be received/transmitted in the case of <DAT> and the others, respectively.

1) Data part of SAT

Byte position	Meaning and code	Default value (hexadecimal)
1	Switching of remote/tape operations According to parameter (Data No. 5000, #1) setting. (*C)	0
2	Status of remote buffer 0: Non-completion status of operation preparation 1: Reset status 2: Operation status 3: Alarm status 4: Open line	0
3	Causes of shift to alarm status 0: NC alarm 1: Checksum error (retry over) 6: Reception of unexpected response (command error) A: Overrun error (retry over)	0
4	Not used	---
5 - 8	Number of bytes currently stored in the buffer (Four-digit hexadecimal number)	0000
9 - 12	Current value of parameter Nb Empty area limit of buffer (Four-digit hexadecimal number)	07D0
13 - 16	Current value of parameter No Amount of maximum overrun on reception (Four-digit hexadecimal number)	0032
17 - 20	Current value of parameter No Number of times of retry on detecting a transmission error (Four-digit hexadecimal number)	000A
21 - 24	Current value of parameter Tp Polling time interval (second) (Four-digit hexadecimal number)	0005
25 - 28	Current value of parameter To Time-out time (second) (Four-digit hexadecimal number)	0014
29 - 32	Current value of parameter Ti Minimum time interval between bytes transmitted (Four-digit hexadecimal number)	000A
33 - 36	Current value of parameter Tx Minimum switching time from reception to transmission (Four-digit hexadecimal number)	0064
37 - 40	Current value of parameter Tw Waiting time on reception of (WAT) (Four-digit hexadecimal number)	0005

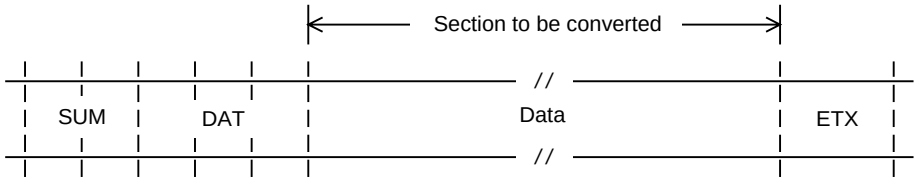
Byte position	Meaning and code	Default value (hexadecimal)
41 - 44	Unit for the boring time (four digits in hexadecimal) Setting parameter P_2 to 1 sets the unit for the boring time to 0.1 seconds. 15 0 0 0 0 0 0 0 0 0 0 0 0 0 0 P_2 0 0	0000
45 - 46	Note) Code to be converted (two-digit hexadecimal number)	00
47 - 78	Note) Code after conversion (two-digit hexadecimal number)	00
49 - 54	Reserve	---
55 - 56	Packet length parameter n of expansion protocol A (two-digit hexadecimal number) 00: Normal protocol A 01: Expansion protocol A NC data length = 256 bytes Packet length = 260 bytes 02: Expansion protocol A NC data length = 512 bytes Packet length = 516 bytes 04: Expansion protocol A NC data length = 1024 bytes Packet length = 1028 bytes	00
57 - 72	Not used	---

NOTE

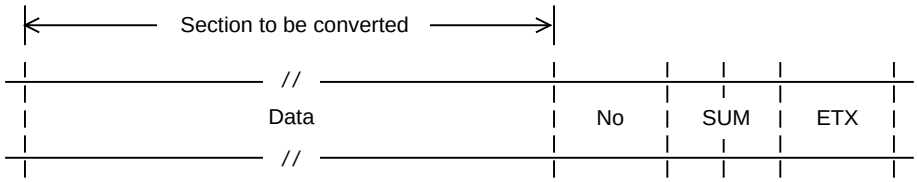
Bytes 45, 46, 47, and 48 of SAT

These bytes contain the parameters necessary for the remote buffer to convert the protocol A <DAT> command data and expansion protocol A data in the specified section. Specify the code to be converted in bytes 45 and 46. Specify the code to which conversion is to be performed in bytes 47 and 48. For details, refer to Section 4.4.2 (3).

a) Protocol A



b) Expansion protocol A



<Example of use>
The host computer handles an EOB code in an NC program as ";" and transmits it to the CNC as is. When '3' and 'B' (= 3BH) are specified in SET command bytes 45 and 46, and ' ' and 'A' (= 0AH) are specified in bytes 47 and 48, ";" is converted to "LF" which is then transmitted to the CNC.

2) Data part of SET

The format of data part of command <SET> is the same as that of data part of <SAT> except the following points.
Data part can be abbreviated when no parameter is modified.

Byte position	Meaning and code	Remarks
1	Switching request of remote/tape operations	
2	Status of host computer	Ignore
3 - 8	Not used	
9 - 48	Modified value of parameter	
49 - 54	Not used	
55 - 56	Parameter for expansion protocol	
57 - 72	Not used	

3) Data part of DAT

Up to 4096 bytes of NC data can be received at the data part of command <DAT>.
Transmit the NC data depending on the specifications of NC since no data process is performed in the remote buffer other than the conversion code set by the parameter.
Also, always add the EOR code to the end of NC program.

4) Data part of SDI

Byte position	Meaning
1 - 2	2-byte hexadecimal display of 8-bit contents of DI (PMC address: G152)
3 - 72	Not used (it can be omitted.)

1) Data part of SDO

Byte position	Meaning
1 - 2	2-byte hexadecimal display of 8-bit contents of DO (PMC address: F152)
3 - 72	Not used (it can be omitted.)

6) Data part of RTY

Byte position	Meaning
1	Reason for requesting retransmission 1: Checksum error 3: Overrun error (Data received after RS has been turned off)
2 - 72	Not used (it can be omitted.)

7) Data part of other commands

Byte position	Meaning
1 - 72	Not used (it is generally omitted.)

4.5 PARAMETER TABLE

Parameters which can be set in the data part of SET command are shown as below:

Parameter	Meaning	Unit	Range	On turning on power
Nb	Number of bytes of minimum buffer empty area on transmission of GTD (Note 1)	Byte	1 - 4000	2000
No	Maximum amount of overrun on reception of data	Byte	2 - 2000	50
Ne	Number of retry times on detection of transmission error	Times	0 - 100	10
Tp	Polling time interval	Sec	1 - 99	5
To	Time-out time	Sec	1 - 999	20
Ti	Minimum time interval between transmission bytes	msec	0 - 10 (Note 2)	10
Tx	Minimum switching time from reception to transmission	msec	0 - 100	100
Tw	Wait time on reception of WAT	Sec	0 - Tp	5

NOTE
1 Setting value l+No≤Nb≤4000 (l : Data length for DAT command)
2 2 msec step

4.6 ERROR PROCESS

1) Open-line error

When the following error occurs, it may be an open line error. Restart the initialization of remote buffer for recovering the line. When the line is recovered, it waits for transmission of SYN and is SYN wait status.
The procedures are the same as those of initialization on power on other than continuation or SYN of host computer.

(1) Framing error
(2) Overrun error
(3) Parity error
(4) Data Set Ready off
(5) Buffer full (the transmission stop request is unacceptable.)
(6) Time out
(7) Number of retry times has been exceeded.

2) Reception error

Ignore the reception data and restart the reception of SAT command at the remote buffer side when the following errors occurs.

(1) Number of retry times exceeded
Number of RTY reception times + Number of retransmission by checksum error > Ne

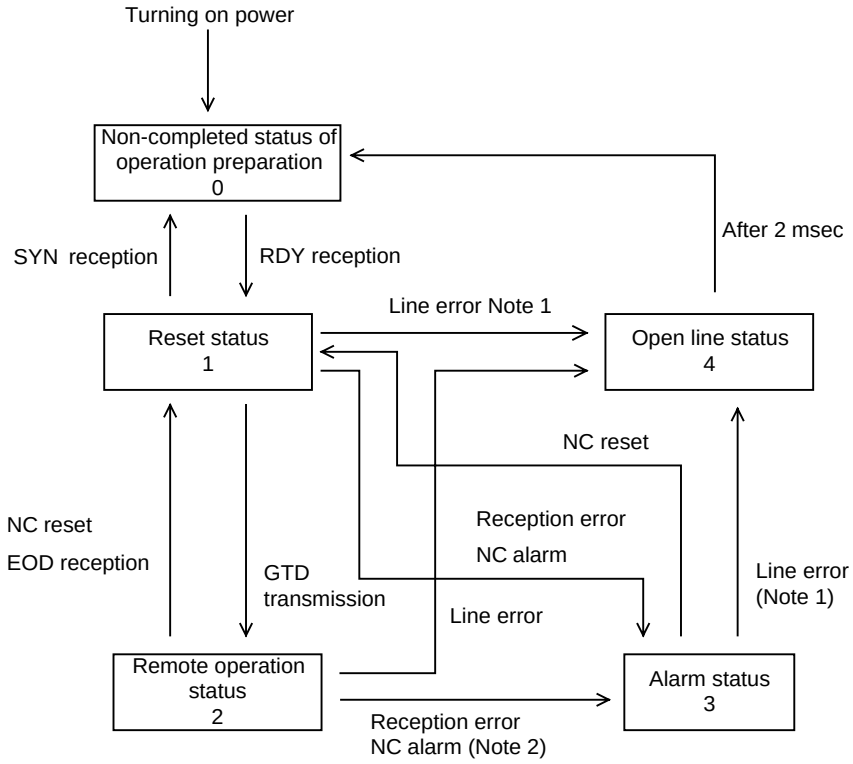
(2) Command error
Message format error
Reception of undefined command
Reception of unexpected command

(3) Overrun
This results if the transmission stop request is not accepted and the reception buffer is overflown.

3) Reception during transmission
Data received during transmission is ignored.

4.7 STATUS TRANSITION

The status transition diagram of remote buffer is shown as below:



NOTE

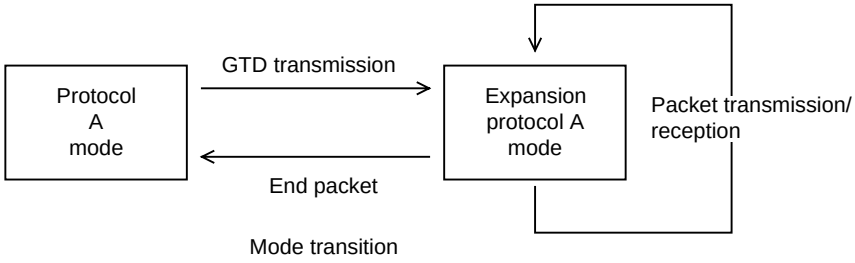
1 Causes of line error
   (1) DR off
   (2) Number of retry times over
   (3) Time out
   (4) Buffer full
2 Reception error
   (1) Undefined command
   (2) Unexpected command
   (3) Number of retry times over by sum error
   (4) Overrun

5 EXPANSION PROTOCOL A

It allows the NC data between the remote buffer and host computer to be efficiently transferred by adding the high-speed reception function to the protocol A.

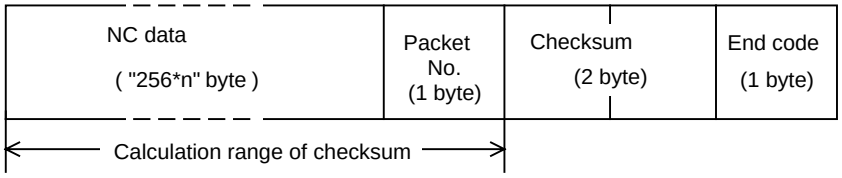
5.1 COMMUNICATION SYSTEM

The expansion protocol A is the same as the protocol A excluding the transmission of NC data.
The expansion protocol A mode is initiated after the <GTD> is output to the host computer by the remote buffer according to the data request from the CNC side.
The communication system is performed in the full duplex mode in the expansion protocol A. The NC data transmitted is packeted and is transmitted to the remote buffer by the host computer. Also, perform the reception process of monitor packet from the remote buffer.



5.2 DATA PACKET FORMAT

The NC data is transferred to the remote buffer using the following format by the host computer after receiving the <GTD>.
When the NC data transmitted becomes multiple packets, the packets can be transmitted in order without waiting the response from the remote buffer by the host computer.



1) NC data

The NC data is the fixed length of “256*n” bytes and the n is specified with the parameter (byte position 55 to 56) by the <SET> command.
The default value of n is 0. In the case of “n = 0”, the normal protocol A is used.

n = 0 : Normal protocol A
n = 1, 2, 4 : Expansion protocol A

NOTE
Note that n is set to 0 automatically even if n is set to the values other than listed above.

2) Packet No.

a) Effective packet : 30h – 39h (ASCII code)
Be sure to assign packet No. 30h to the first packet. If there is only one effective packet, assign FFh to the packet, since it is not only the first but also the last packet.
If there is more than one effective packet, packet No. 30h is transmitted to the host computer by the remote buffer, along with the monitor packet <NAK> of retransfer request.
Hereafter, the value incremented by 1 should be the packet No.
However, the value next to 39h becomes 30h.
If there is only one packet, the packet is both the first and the last; be sure to assign FFh.
Also, when the loss or improper order of packet No. is detected, the improper packet No. is transmitted to the host computer along with the monitor packet No. <NAK>.
When the checksum error is detected, the improper packet No. is transmitted to the host computer with the monitor packet <NAK> of retransfer request by the remote buffer.

b) End packet : FFh
The end packet is transmitted by setting the packet No. to FFh. The data part of end packet is considered to be the effective data. However, the end packet received after transmitting <CAN> ignores the data part.
This allows the expansion protocol A mode to be ended and the normal protocol A mode is initiated.
However, when the checksum error is detected at the end packet, the before packet No. +1 is transmitted as the end packet No. to the host computer with monitor packet <NAK> of retransmission request. (Note)
The host computer should shift to the protocol A when the command of protocol A is received after transmitting the end packet.

NOTE
If FFh is assigned to the first packet, packet No. 0 is transmitted to the host computer with <NAK>, since this packet is the last packet.

c) Invalid packet : Other than above
Transmit this invalid packet with the dummy data of "256*n" bytes when the time out may occur since time is required for editing of NC data transmitted by the host computer.
The remote buffer is processed as an invalid packet.

3) Checksum

The checksum is obtained by adding the NC data to the packet No. in units of byte and then expressing the 1 byte data produced by neglecting the overflow above 8 bits out of the total value above using ASCII 2-byte code.

4) End code

The end code should be the ASCII code CR (0Dh).

5.3 MONITOR PACKET FORMAT

The monitor packets transmitted from the remote buffer to the host computer are shown as below. All packets have the fixed length consisting of 5 bytes.

1) Stop request

CAN (18h)	Meaningless (20h)	Checksum (2 byte)	End code (0Dh)

The stop request is transmitted to the host computer by the remote buffer when resetting the NC and stopping data reception by an alarm.
Transmit the end packet (the NC is dummy) after transmitting the packet which is currently being transmitted and move to the normal protocol A mode when this packet is received by the host computer.
If the end packet was being transmitted when the CAN packet was received, the end packet need not be retransmitted in response to CAN.
Transmit the end packet even in the DC3 reception status.

2) Retransmission request

NAK (15h)	Packet No. (1 byte)	Checksum (2 byte)	End Code (0Dh)

When a check sum error is detected in the received packet, the retransmission request corresponding to the packet is transmitted by the remote buffer.
The host computer should perform retransmission from the corresponding packet immediately after ending the transmission of packet which is currently being transmitted when it receives this packet.

3) Interruption request

DC3 (93h)	Meaningless (20h)	Checksum (2 byte)	End code (0Dh)

The interruption request is transmitted to the host computer by the remote buffer when the reception buffer may become overflown.
The host computer should interrupt the transmission and wait until the next monitor packet is received after completing the transmission of packet which is currently being transmitted when it receives this packet.

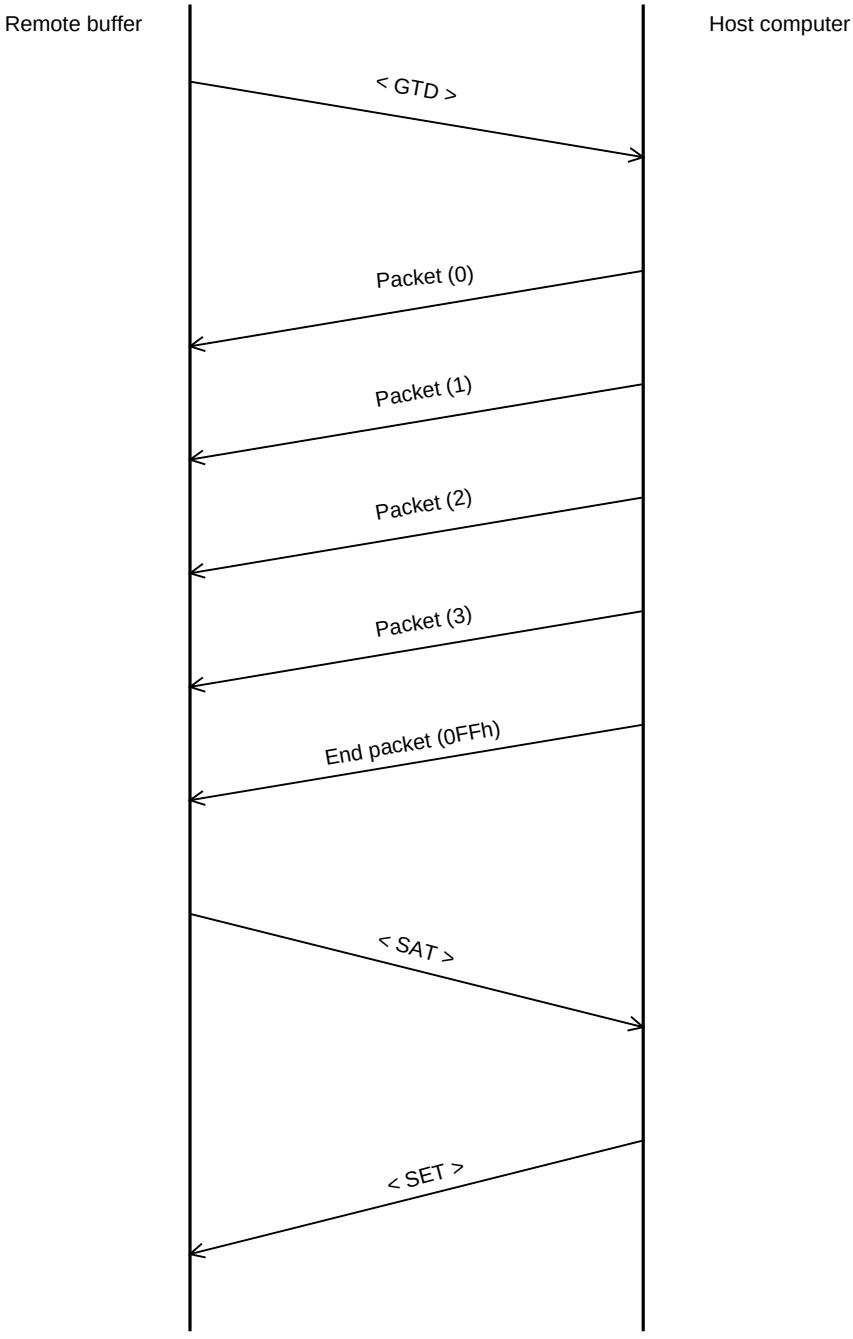
4) Restart request

DC1 (11h)	Meaningless (20h)	Checksum (2 byte)	End code (0Dh)

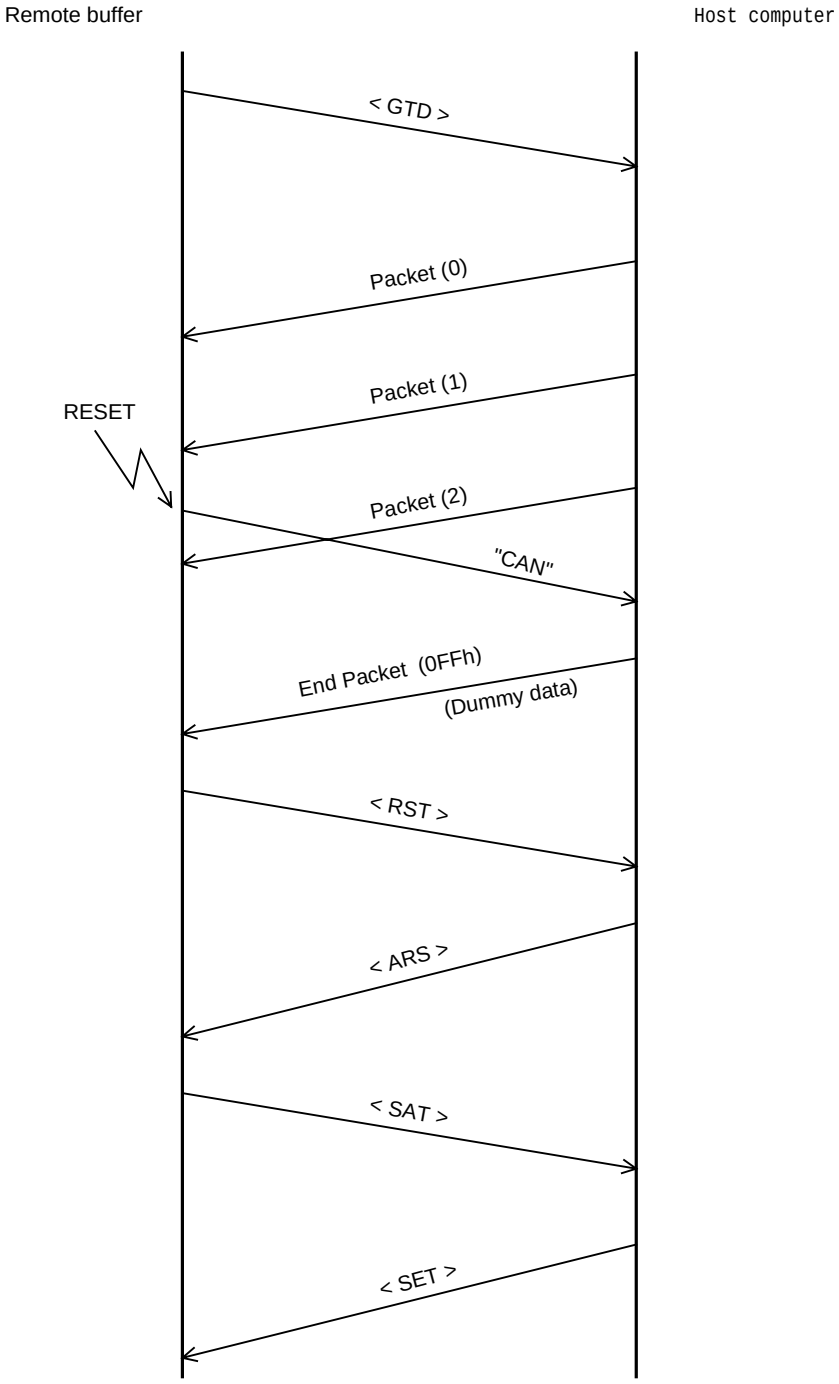
The restart request is transmitted to the host computer by the remote buffer when there is space in the reception buffer after requesting interruption.
The host computer should restart the transmission from the next packet following the interrupted one when this packet is received.

5.4 COMMUNICATION EXAMPLE

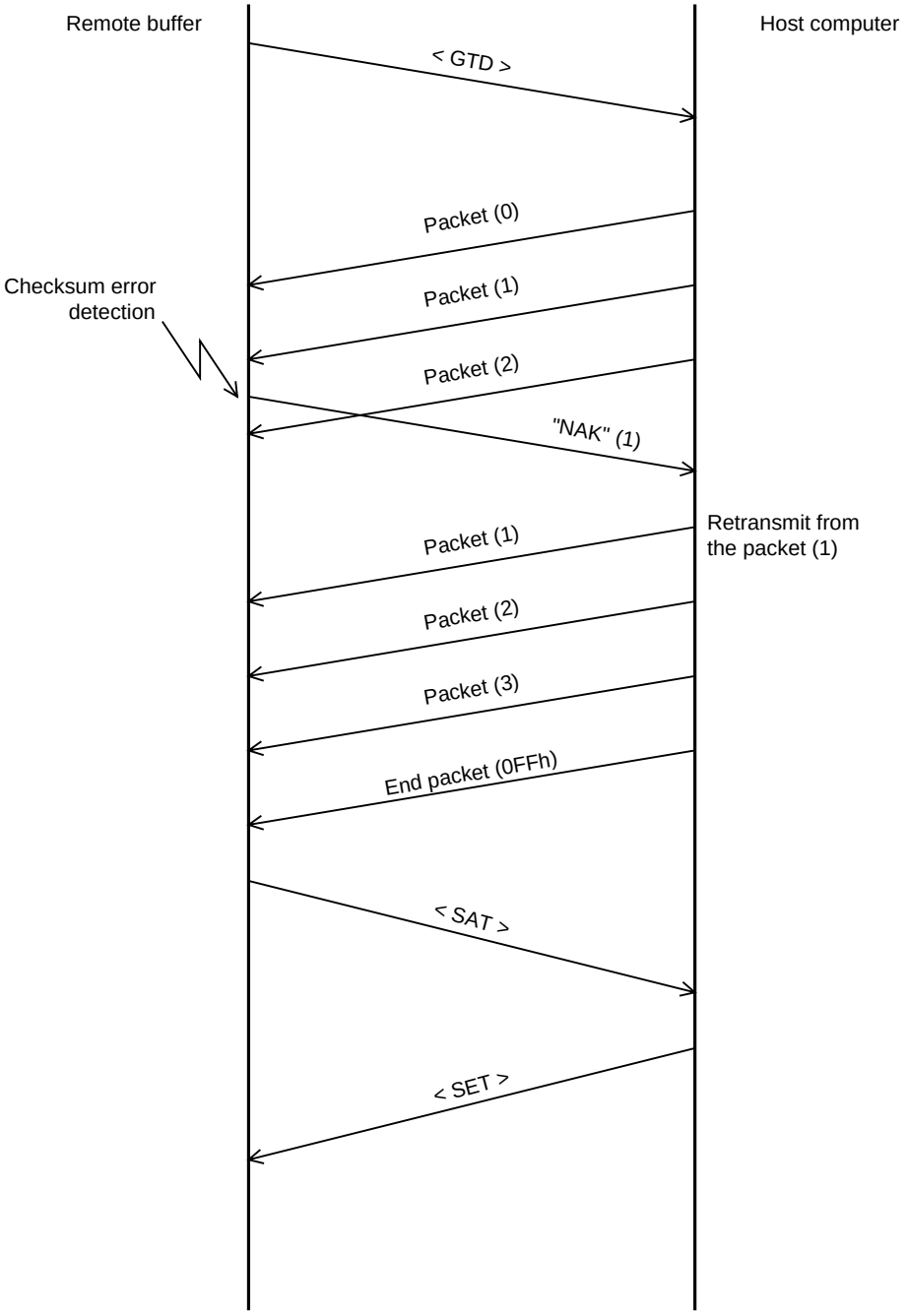
1) Normal



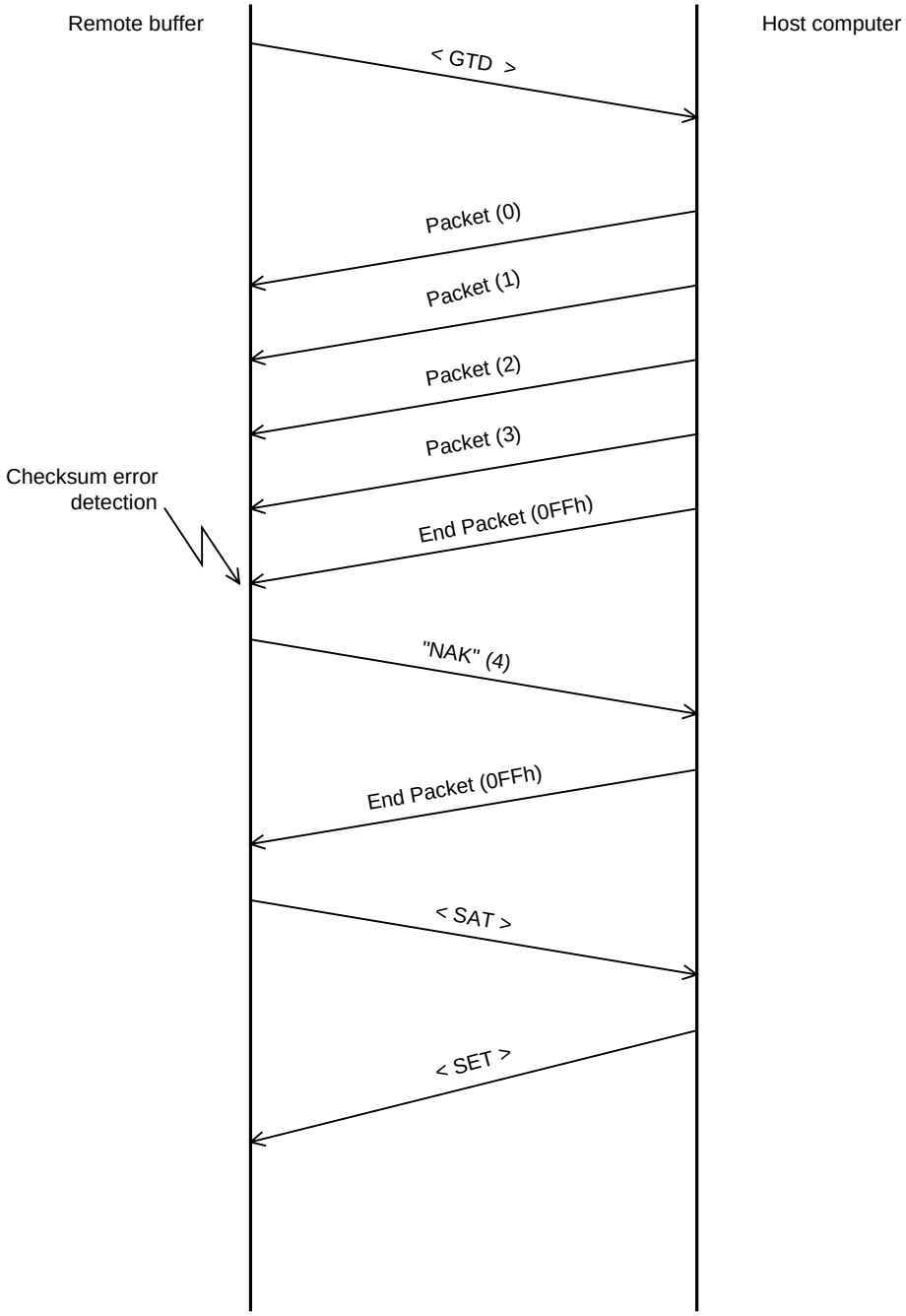
2) Stop request



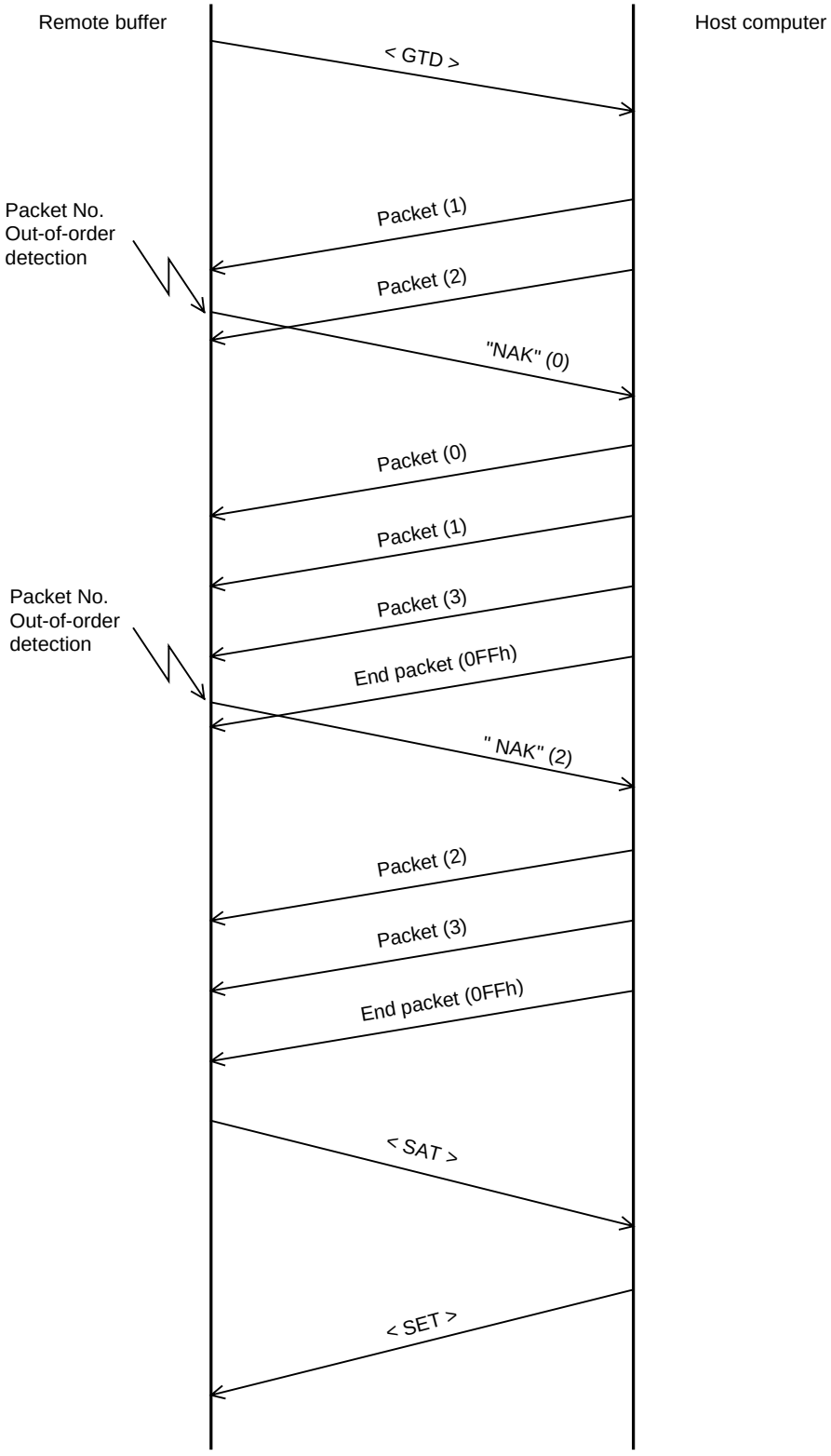
3) Retransmission (i)



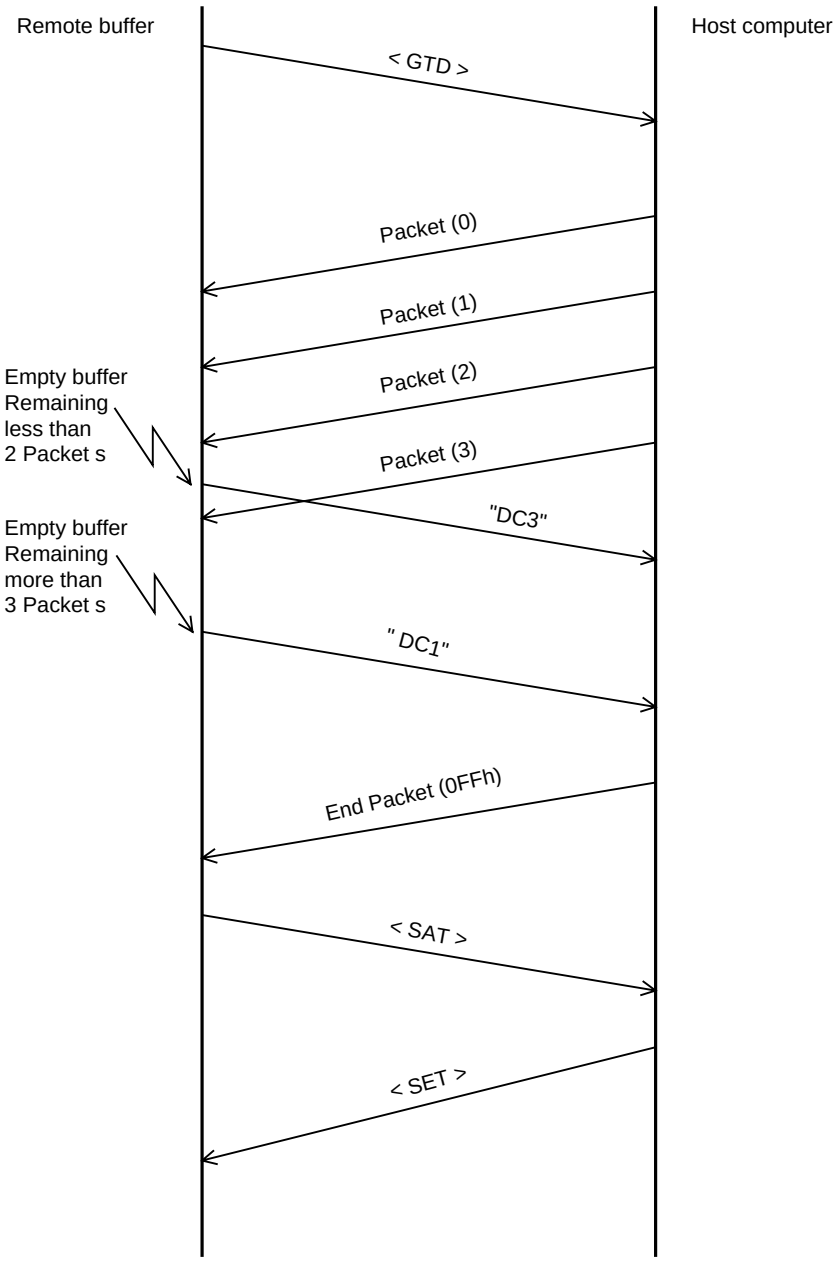
3) Retransmission (ii)



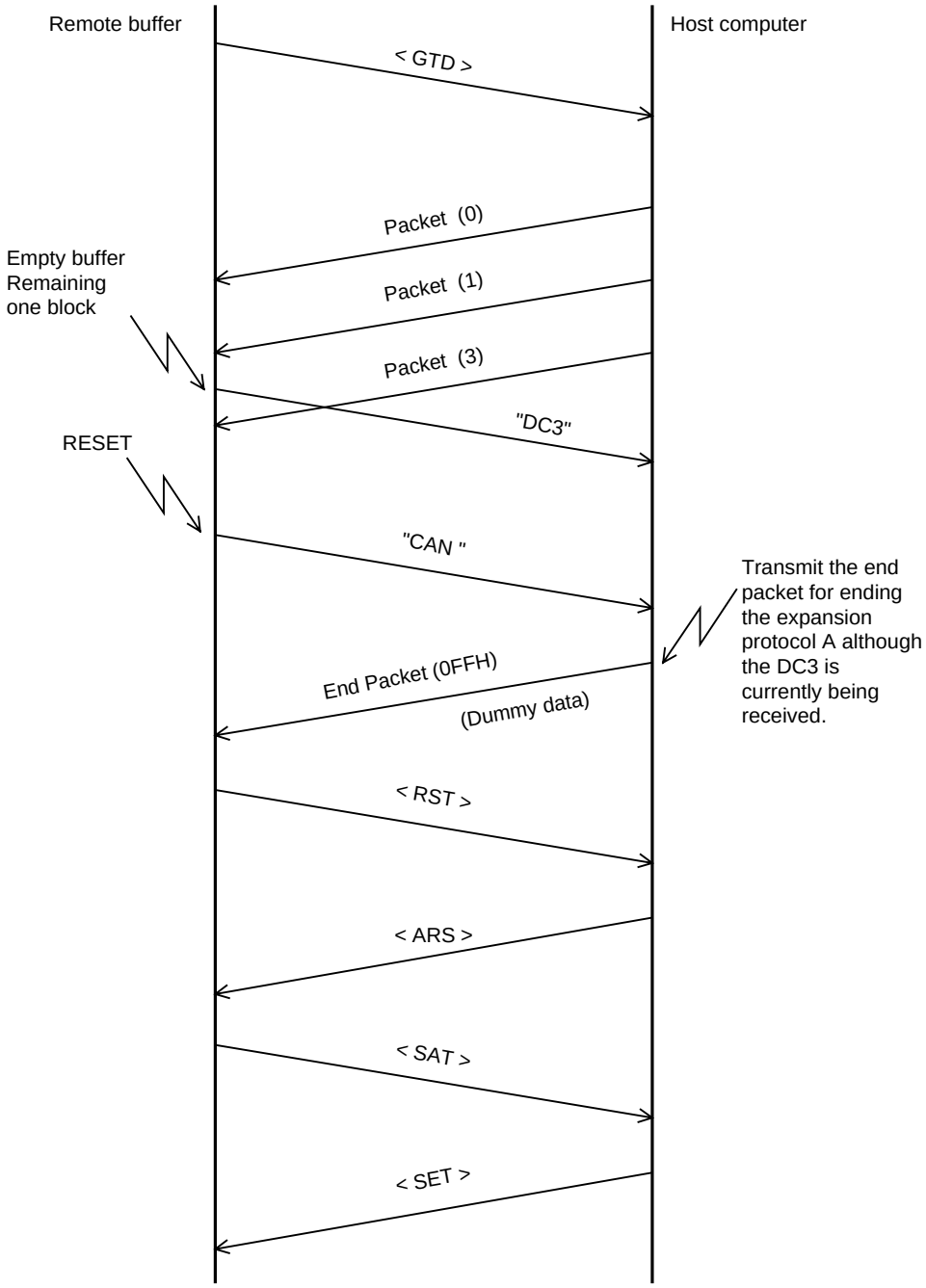
3) Retransmission (iii)



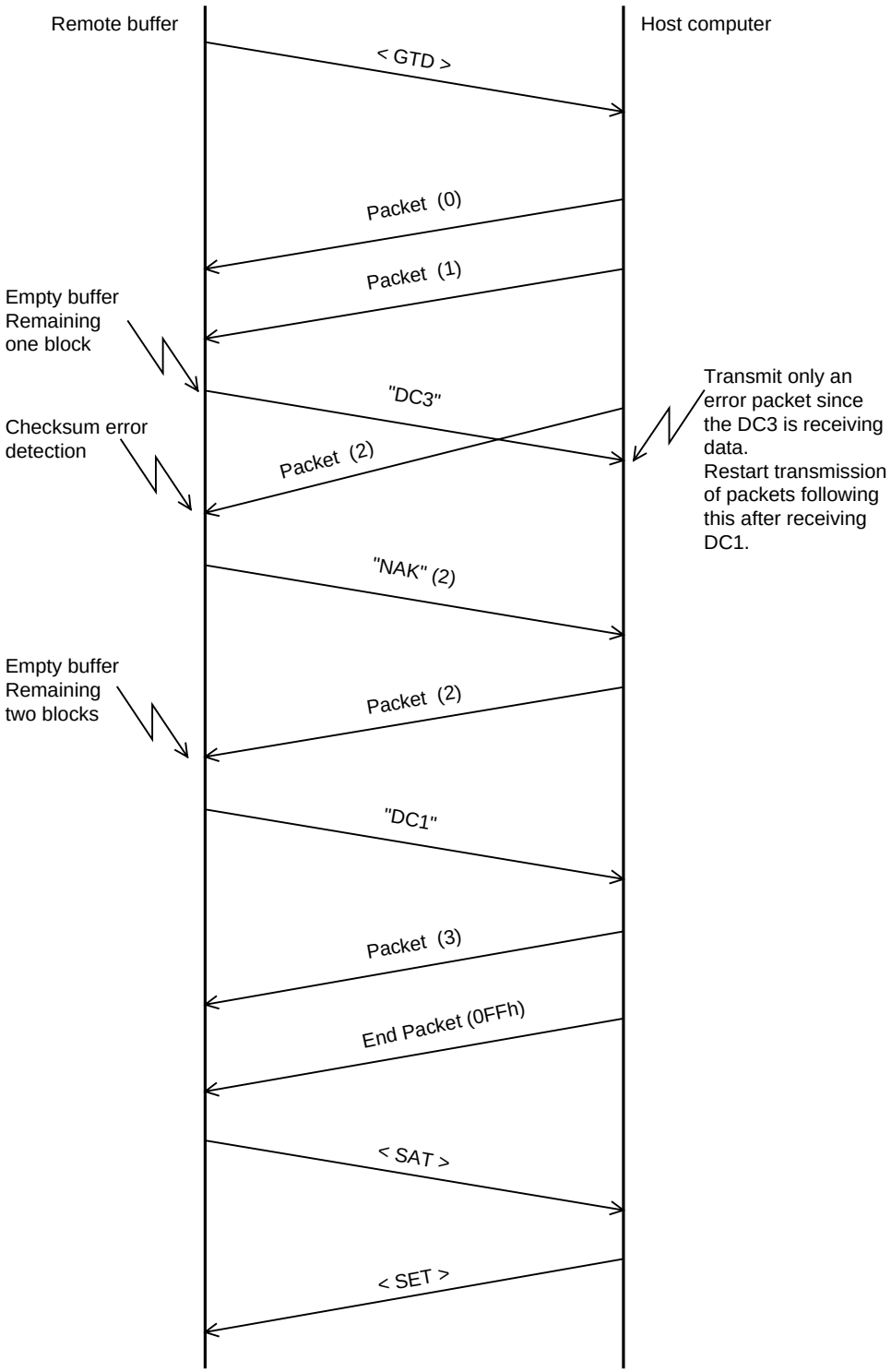
4) Interruption → Restart



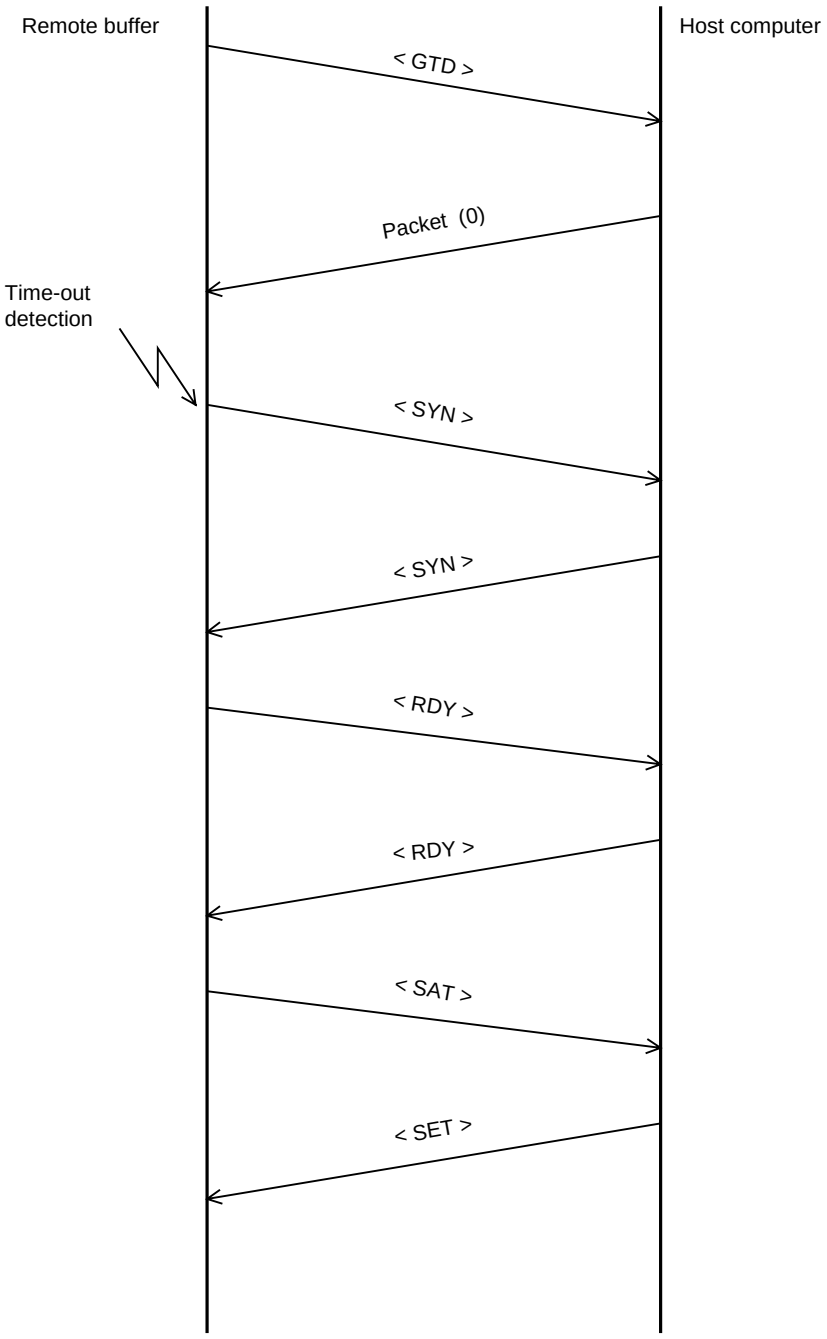
5) Interruption → Start



6) Interruption → Retransmission



7) Time-out detection



NOTE

The time-out monitoring period lasts until the next one packet is received immediately after output of <GTD>. After that, it is the time between reception of one packet and that of another.

6 PROTOCOL B

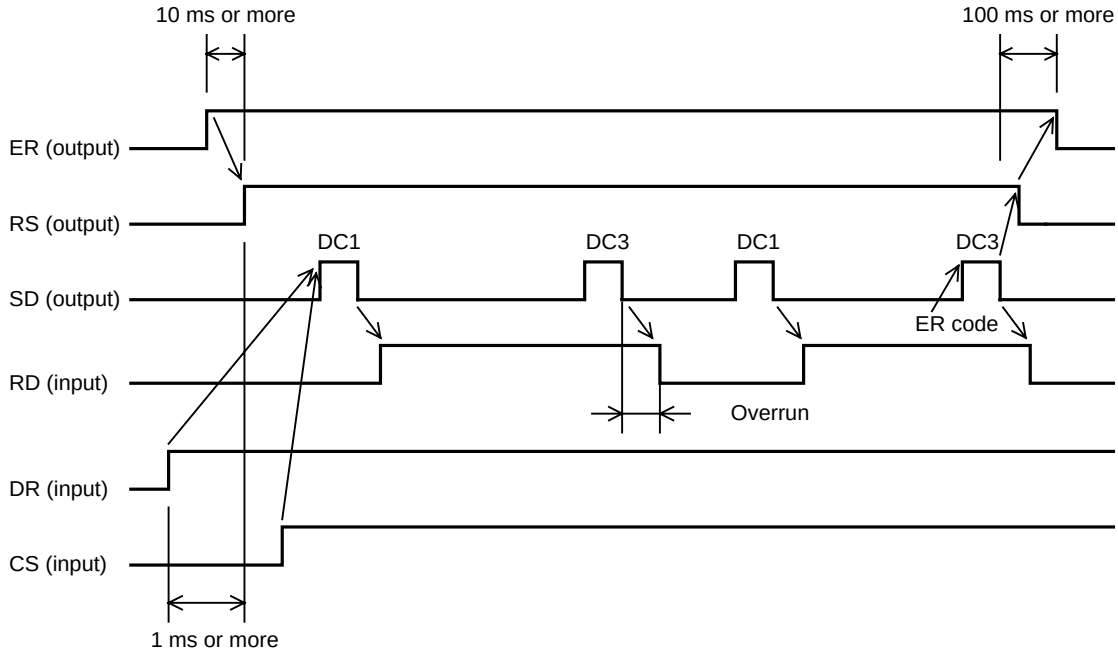
The protocol B is used to control the communication between the remote buffer and host computer by the control code.

6.1 COMMUNICATION SYSTEM

The communication system can be in either of two settings, one in which the CNC reset/alarm state is posted to the host and the other in which it is not posted. When ETX (bit 3 of parameter No. 5000) is 1, the system is in the setting in which the state is posted.

6.1.1 When the CNC Alarm/Reset is not Posted to the Host

1) When the remote buffer receives data
The remote buffer requests the host computer to send data.

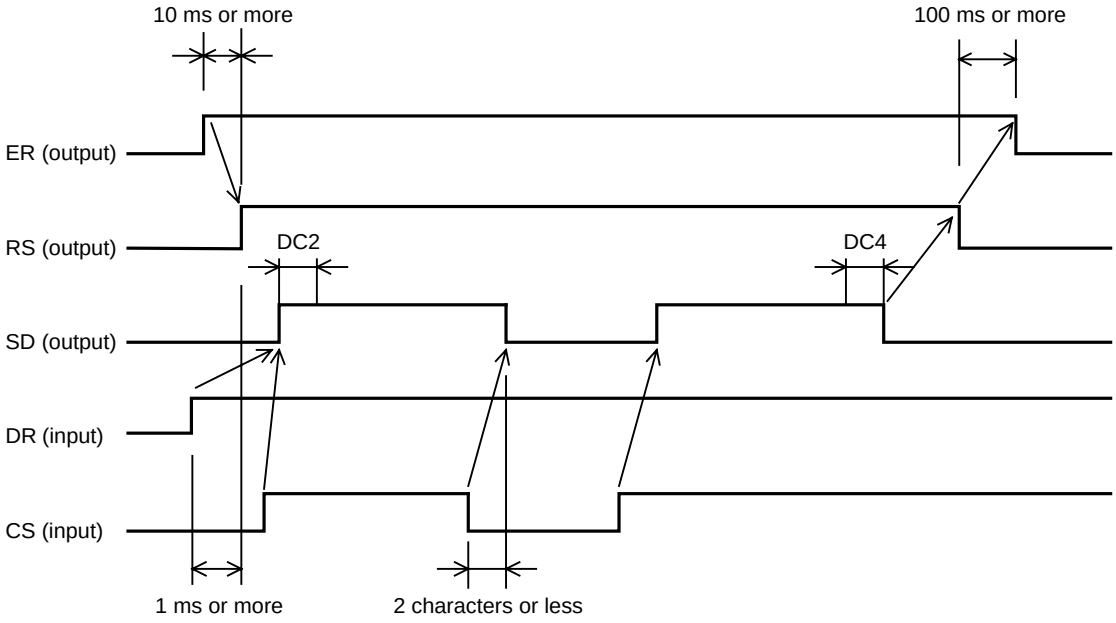


(1) The remote buffer transmits the DC1 code.
(2) The host computer starts to transmit the DC3 code to the remote buffer by the DC1 code.
(3) When the empty area of remote buffer area becomes the value specified, the DC3 code is transmitted.
(4) The host computer should stop transmission to the remote buffer by the DC3 code. The overrun value is specified later.
(5) The remote buffer transmits the DC1 code when the remainder of buffer data becomes less than the level specified and requests the host computer to start transmitting data.
(6) The host computer should start transmitting data again by the DC1 code. The transmission data is a continuation of previous data.

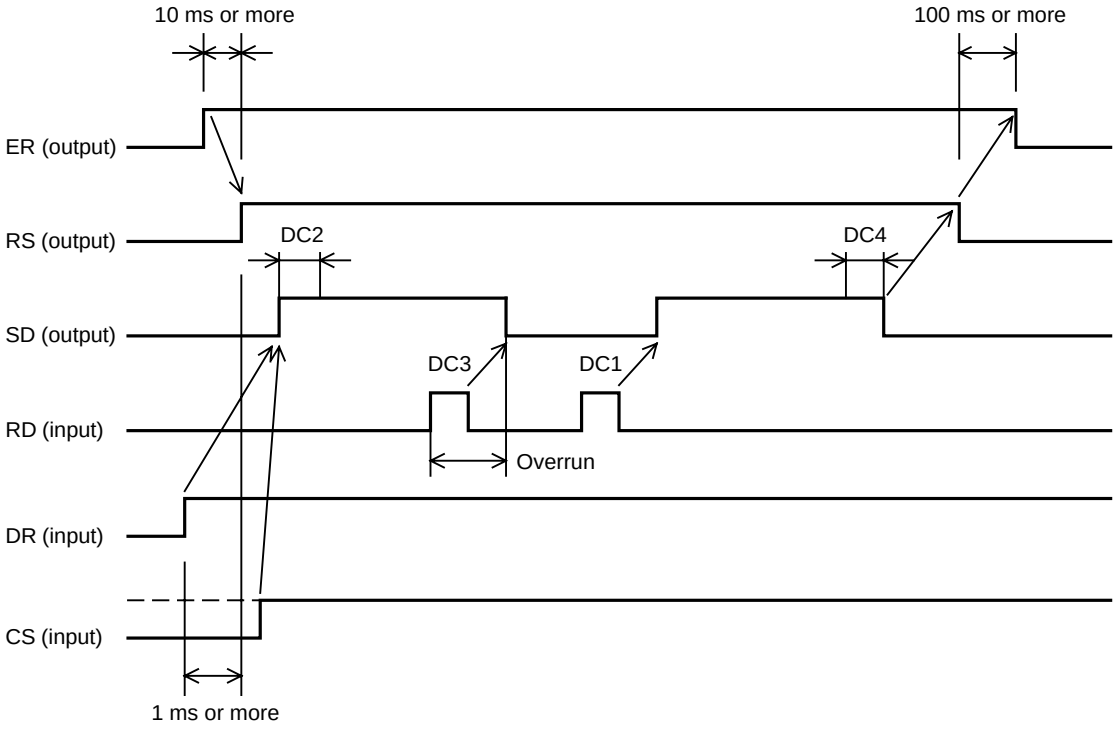
(7) The remote buffer transmits the DC3 code when the data read is completed. The end of data read is indicated by the detection of ER or NC reset.
(8) The host computer stops transmission of data.

2) When the remote buffer sends data (punch-out)

(Fig. A)



(Fig. B)

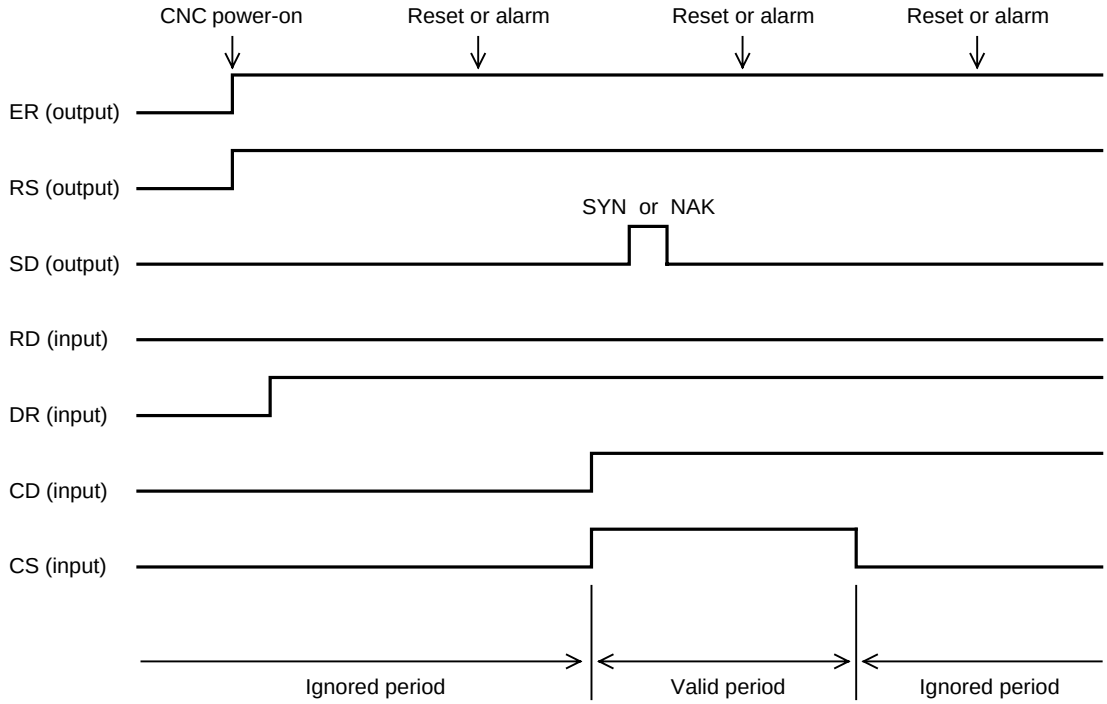


(1) The remote buffer transmits the DC2 code.
(2) The remote buffer then transmits punch-out information.
(3) If the processing speed of the host computer is not high enough to handle arriving data, perform one of the following:
    (a) Turn the CS signal of the remote buffer off. The remote buffer stops data transmission within two characters including the character being sent. (See Fig. A.)
    (b) Send a DC3 code to the remote buffer. The remote buffer stops data transmission within the overrun, which will be explained later, from the point when DC3 is sent. To make the remote buffer resume data transmission, send a DC2 code to the remote buffer. (See Fig. B.)
(4) When the host computer completes data processing, turn the CS signal of the remove buffer on. Then, the remote buffer sends the data following the previous data.
(5) When data transmission is completed, the remote buffer sends the DC4 code.

6.1.2 When the CNC Alarm/Reset is Posted to the Host

When the remote buffer becomes ready after the power is turned on, the remote buffer turns the ER signal on, and keeps the ER signal on until the power is turned off. When an alarm occurs in the NC, the NAK code is sent to the host computer, and when the NC is reset, the SYN code is sent to the host computer. This is not performed, however, if the host computer is not ready for reception (each of the DR, CD, and CS signals is on).

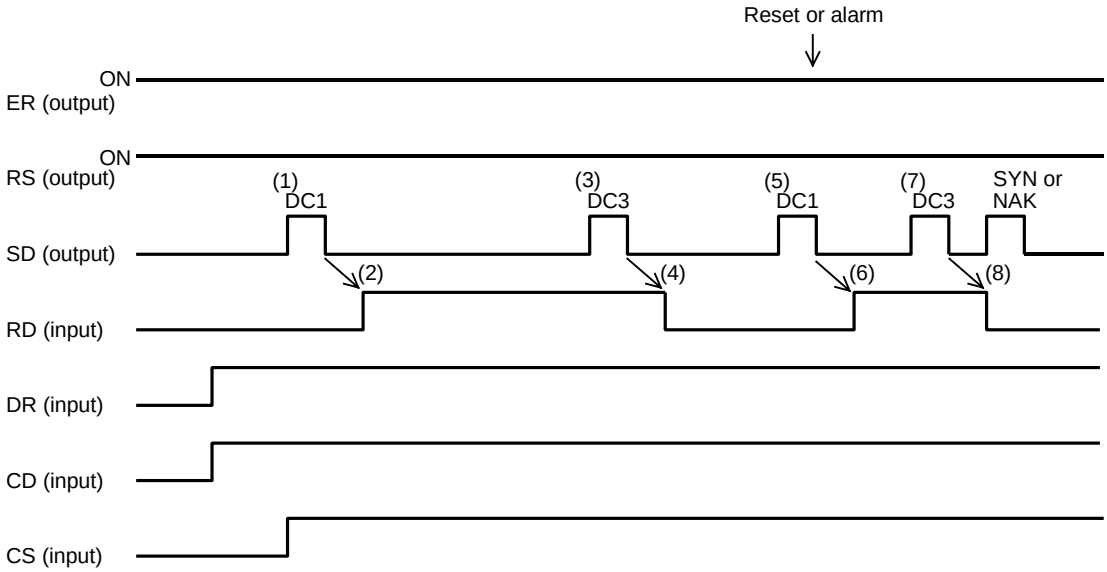
1) When the remote buffer is neither receiving nor transmitting data



The “SYN” or “NAK” code is output upon reset of the CNC or the detection of a CNC alarm, but only during the valid period shown in the above figure.

2) When the remote buffer is receiving or transmitting data

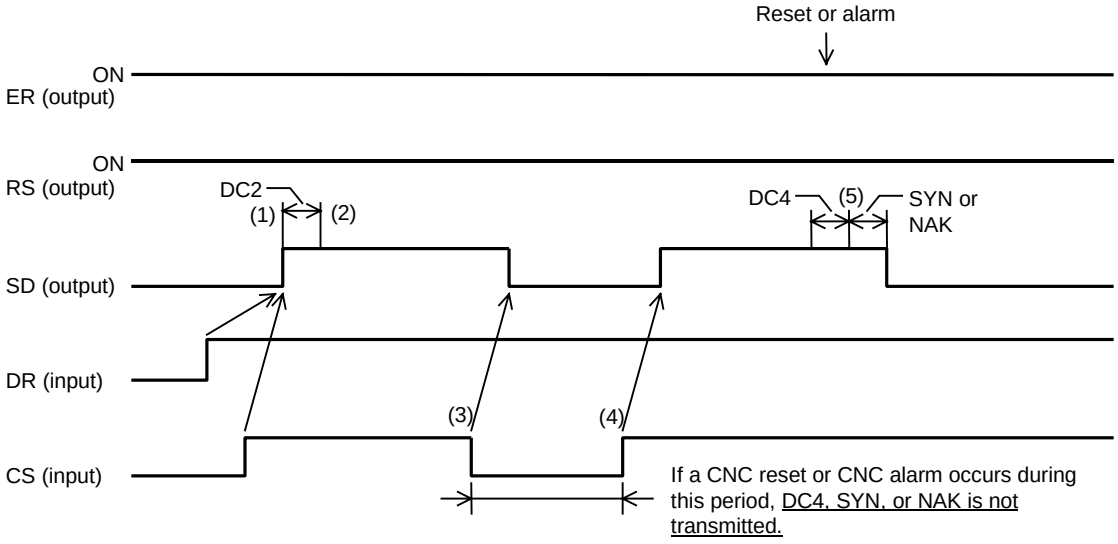
<When the remote buffer is receiving data>



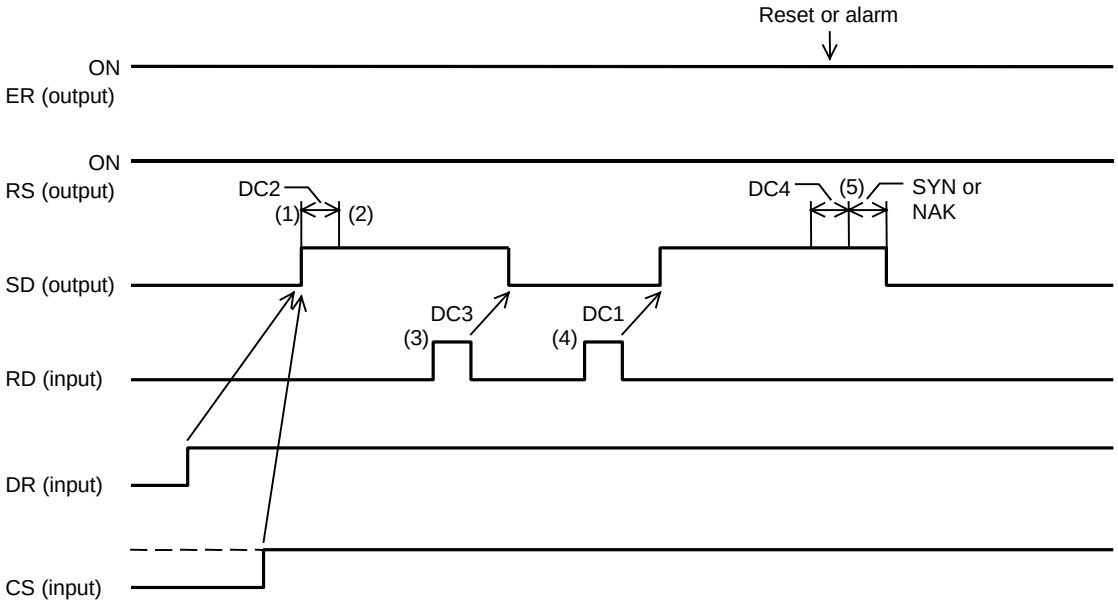
(1) The remote buffer transmits the DC1 code.
(2) Upon receiving the DC1 code, the host computer shall start transmitting data to the remote buffer.
(3) Once the amount of free space in the remote buffer falls below the specified value, the remote buffer transmits the DC3 code.
(4) Upon receiving the DC3 code, the host computer shall stop transmitting data to the remote buffer.
(5) Once the amount of data in the remote buffer falls below the specified value, the remote buffer transmits the DC1 code to request that the host computer restart data transmission.
(6) Upon receiving the DC1 code, the host computer shall restart data transmission, picking up from the data immediately after that transmitted last.
(7) When the CNC has been reset or an alarm has been issued in the CNC, the remote buffer transmits, to the host computer, the DC3 code, followed by the SYN code (for reset) or NAK code (for an alarm). Thus, data reading is terminated.
(8) The host computer shall stop data transmission.

<When the remote buffer is transmitting data (punch-out)>

(Fig. A)



(Fig. B)



(1) The remote buffer transmits the DC2 code.
(2) The remote buffer starts transmitting punch-out data.
(3) If data processing in the host computer cannot keep pace with the rate of data transmission from the remote buffer:
   (a) Turning off the CS signal for the remote buffer causes the remote buffer to stop data transmission after transmitting a maximum of most two characters, including the character currently being transmitted. (See Fig. A.)
   (b) Transmitting a DC3 code to the remote buffer causes the remote buffer to stop data transmission, such that the amount of data transmitted after transmission of the DC3 code does not exceed the overrun. (See Fig. B.)

NOTE
If the RBETX bit of parameter No. 5000 is set to 1, method (a) cannot be used because, while the CS signal is off, a SYN/NAK or DC4 code is not transmitted even if CNC reset or a CNC alarm occurs. In such a cause, use method (b).

(4) For method (a) in step (3)
Once data processing by the host computer terminates, turning on the CS signal for the remote buffer causes the remote buffer to restart data transmission, picking up from the data immediately after that transmitted last.
For method (b) in step (3)
Transmitting a DC1 code to the remote buffer causes the remote buffer to restart data transmission.
(5) When the CNC has been reset or an alarm has been issued in the CNC, the remote buffer transmits, to the host computer, a DC4 code, followed by a SYN code (for reset) or NAK code (for an alarm).

6.2 CONTROL CODE

The control code is as shown below regardless of the ISO, EIA, and Binary data:

Control code	Function	Code (hexadecimal)	
		Bit 2 of parameter No. 5000 = 0	Bit 2 of parameter No. 5000 = 1
DC1	Starts host transmission.	11H	11H
DC3	Stops host transmission.	93H	13H
DC2	Starts punch-out.	12H	12H
DC4	Stops punch-out.	14H	14H
NAK	Posts an NC alarm.	95H	15H
SYN	Posts NC reset.	96H	16H

6.3 BUFFER CONTROL

The buffer control method of remote buffer is described in the following:

Protocol	Interface	MAX baud rate	DC3 transmission conditions	DC1 transmission conditions	Allowable overrun value
Protocol B	RS-232-C	19200	Remaining characters <= 512 characters	Vacant space >= 4096 characters	Less than 512 characters
Expansion protocol B	RS-422	86400	Remaining characters <= 2560 characters	Vacant space >= 4096 characters	Less than 2560 characters

6.4 ALARM AND RESET OF CNC

Once an alarm has been issued in the CNC, or upon the CNC being reset, the remote buffer transmits the DC3 code, then:

(1) When the CNC reset/alarm state is not to be posted to the host (parameter No. 5003 bit 3 = 0)
Turns off the ER signal, then performs close processing.

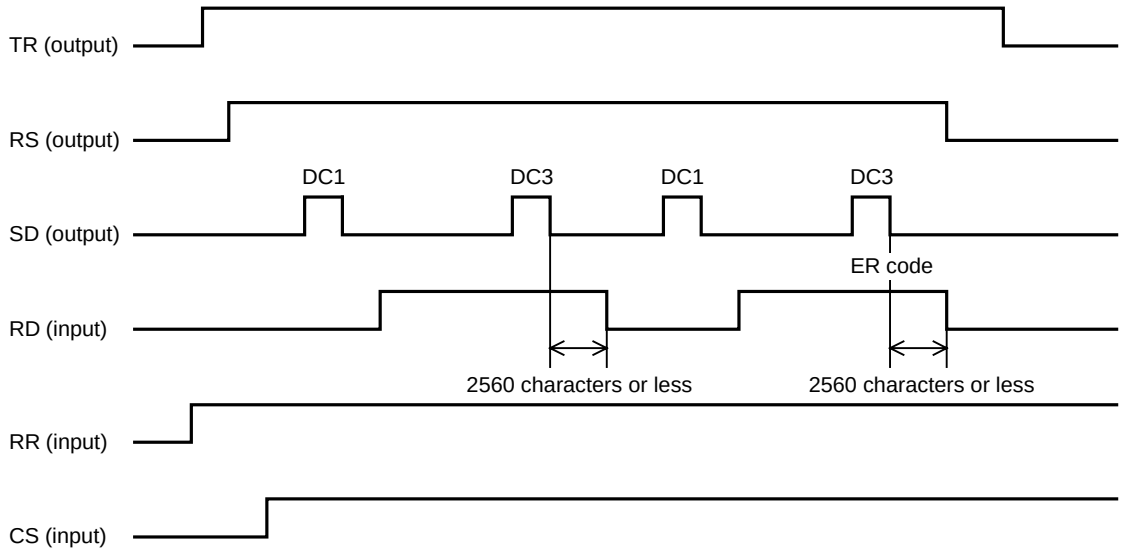
(2) When the CNC reset/alarm state is to be posted to the host (parameter No. 5003 bit 3 = 1)
Transmits the "SYN" or "NAK" code to the host, then performs close processing.

NOTE
1 When the parameter is set to post the CNC reset/alarm to the host, the CNC terminates communication upon the occurrence of an alarm in the CNC during communication in either of the following cases:
(1) For foreground operation: The reset key or the STOP key (soft key) is pressed.
(2) For background operation: The STOP key (soft key) is pressed. (A reset does not cause communication to terminate.)
2 When the remote buffer transmits data (for punch-out), pressing the STOP soft key of the CNC cannot stop the data transmission until all the buffered data between the CNC and remote buffer has been transmitted to the host computer.
To stop data transmission immediately, press the RESET key.

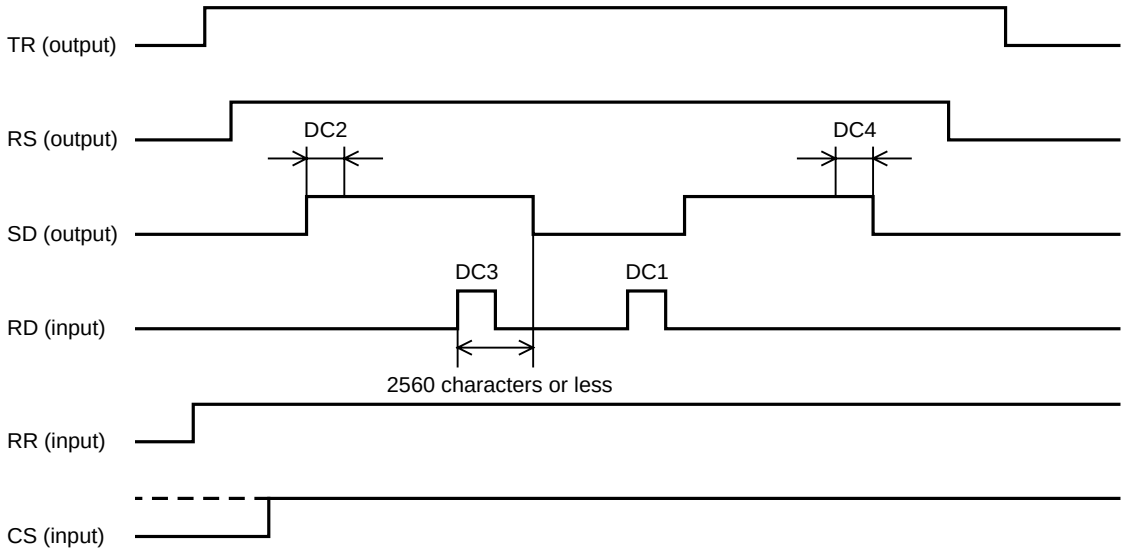
7 EXPANSION PROTOCOL B (RS-422)

The expansion protocol B is a protocol used to enable high-speed transmission with a simple protocol. The communication system is the same as that of protocol B.
However, the overrun value after transmission of DC3 is limited to 1280 characters or less to enable high-speed transmission.

* When the remote buffer receives data



* When the remote buffer transmits data

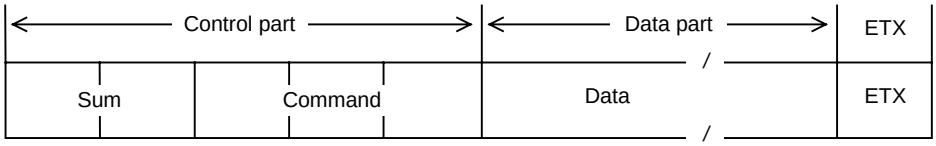


8 DATA INTERFACE

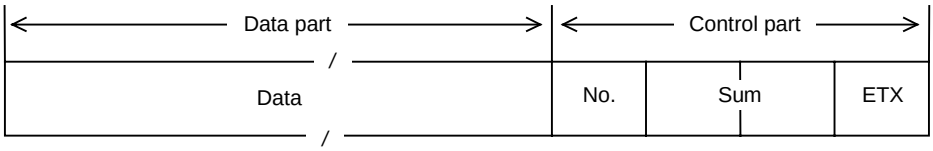
8.1 DATA PART

Data received from the host computer is largely classified into two parts, namely the control part and data part.
With the protocol B/expansion protocol B, all data received from the host computer become the data part.
See the following figure for the data part of protocol A/expansion protocol A.

1) Protocol A
Packet configuration of <DAT>

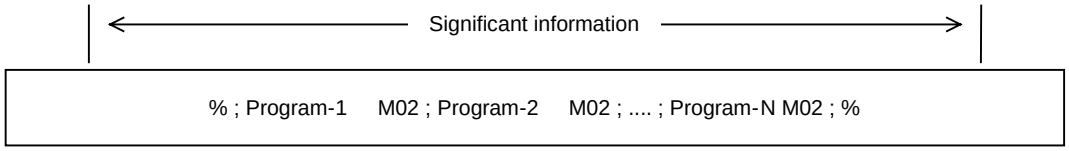


2) Expansion protocol A
Configuration of response packet for <GTD>



8.2 INTERFACE OF DATA PART

The interface of data part is in conformity the provisions of data which can be handled through the serial port by the CNC.
The end of data part is judged by the detection of EOR code. Also, all data after EOR code is ignored.
In general, the data part configuration is as shown below. However, in the case of DNC operation, the data already received will be lost by the CNC reset.

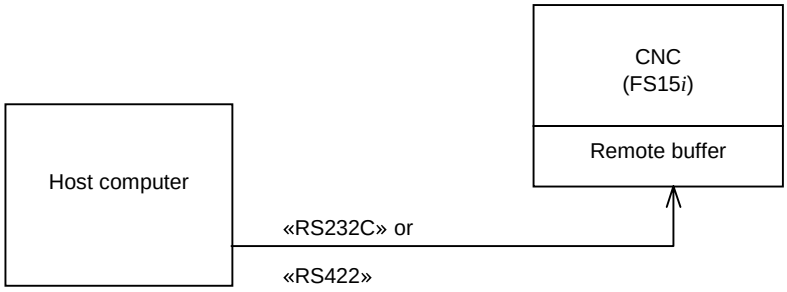


9 BINARY INPUT OPERATION FUNCTION

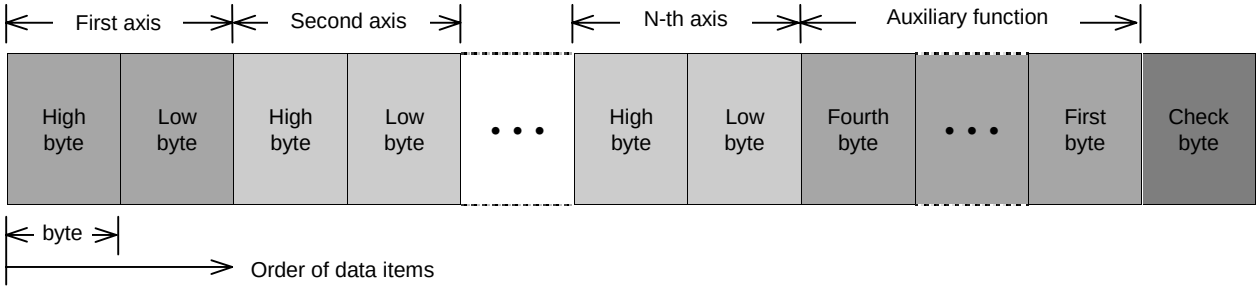
9.1 FUNCTION EXPLANATION

Once a single "G05;" block is specified in normal NC command format, operation can be performed by specifying desired move data and auxiliary functions in the following format.
By specifying zero for all of the travel distances along all axes and the auxiliary function, the system subsequently accepts commands in normal NC command format again..

- Binary input operation on: G05;
- Binary input operation off: Zero specified for all of the travel distances along all axes and the auxiliary function



- Data format for binary input operation



(1) In this format, the travel distance per unit time along each axis (two bytes) is arranged for all axes, starting with the first axis, followed by an auxiliary function (four bytes. See (6).) and by the check byte (one byte).
(2) The unit time in msec can be specified with bits 0, 1, and 2 of parameter No. 7618.
(3) All data must be in binary representation.

(4) The travel distance along each axis must be specified in the following units. (Negative travel distances must be in two's-complement form.)

	IS_A	IS_B	IS_C	IS_D	IS_E	Unit
Millimeter machine	0.01	0.001	0.0001	0.00001	0.000001	mm
Inch machine	0.001	0.0001	0.00001	0.000001	0.0000001	inch
Rotation axis	0.01	0.001	0.0001	0.00001	0.000001	deg

(5) The following data formats can be selected for the travel distance, using RDS (bit 2 of parameter No. 7609). (Specify the travel distance per unit time using the bits marked with the asterisk (*).)

• Special format (bit 2 of parameter No. 7609 = 0)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
*	*	*	*	*	*	*	0	*	*	*	*	*	*	*	0

• General format (bit 2 of parameter No. 7609 = 1)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

(Example) If the travel distance per unit time is 700 microns (Millimeter machine, unit: IS_B.)

• Special format (bit 2 of parameter No. 7609 = 0)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	0	0	1	1	1	1	0	0	0

• General format (bit 2 of parameter No. 7609 = 1)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0	1	0	1	1	1	1	0	0

NOTE
For the protocol A, the data format for the travel distance must always be the special one.

(6) Whether to use auxiliary functions can be specified with RAX (bit 3 of parameter No. 7609).

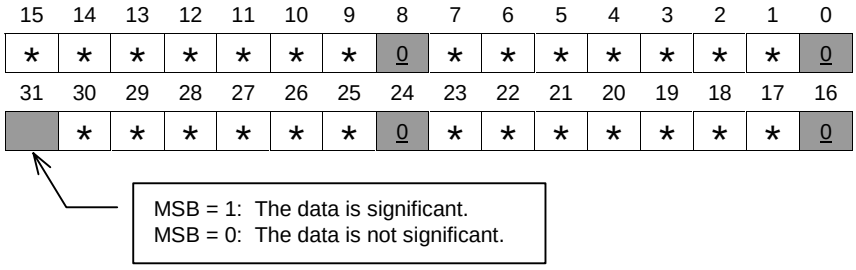
• Bit 3 of parameter No. 7609 = 0 …
Does not use auxiliary functions.
(The data length is [2 * N + 1] bytes.)

- Bit 3 of parameter No. 7609 = 1 ...
  Uses auxiliary functions.
  (The data length is [2 * N + 5] bytes.)

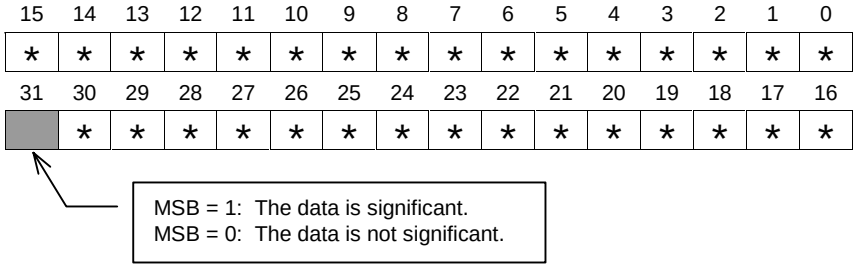
(7) When the parameter is set to use auxiliary functions, specify the auxiliary functions to be used, using parameter No. 2034, as follows:
- "0"... Second auxiliary functions
- "1"... Miscellaneous functions
- "2"... S functions
- "3"... T functions

(8) The following data formats can be selected for the auxiliary function, using RDS (bit 2 of parameter No. 7609). (Specify data using the bits marked with the asterisk (*) and specify whether the data is significant using the MSB.)

- Special format (bit 2 of parameter No. 7609 = 0)



- General format (bit 2 of parameter No. 7609 = 1)



When the MSB is 1, the data specified with the bits marked with the asterisk (*) is sent to the auxiliary function, described above.
After the time set for parameter No. 2010 has elapsed, a strobe signal is sent for the time set for parameter No. 2012. The system does not, however, wait for FIN.

(9) The check byte must be the result of adding together all the other [2 * N + (0 or 4)] bytes in byte-by-byte basis, with any overflows of 8 bits or more removed.

9.2 TRANSFER RATE

After every unit time set for the appropriate parameter, the CNC extracts data of 2 * N + n bytes (where N is the number of axes, n is equal to 1 when auxiliary functions are not used and 5 when they are used.) from the remote buffer. To achieve smooth machining without any interruption of pulse distribution during machining, the baud rate of transfer between the host computer and the remote buffer must be at least

(2 * N + n) * 11/T * 1000 (bps) (where T is the unit time.).

For example, when three axes are used, auxiliary functions are not used, and the unit time is 2 msec,
the baud rate must be at least

(2 × 3 + 1) bytes × 11 bits/byte/2 msec × 1000 = 38500 bps.

9.3 NOTES

NOTE

1 In binary input operation mode, any modal commands (such as G00, G02, G03, and G90) before the G05 block are disabled, and are executed as linear interpolation G01 based on the command data format (equivalent to linear incremental commands). Upon leaving binary input operation mode, the system accepts modal commands as usual again.

2 An alarm is issued if G05; is specified in the following modes: Cutter compensation, three-dimensional cutter compensation, interrupt macro, canned cycle, three-dimensional coordinate conversion, coordinate conversion, programmable mirror image, scaling, polar coordinate interpolation, polar coordinate command, normal direction control, hypothetical axis interpolation, cylindrical interpolation, constant surface speed control, spindle speed fluctuation detection

3 In binary input operation mode, single blocks are disabled. By setting G5S (bit 3 of parameter No. 2007) to 1, they are enabled.

4 Feed hold and interlocking are enabled.

5 Turning mirror images on and off is enabled even in binary input operation.

6 Program restarts and block restarts cannot be used.

7 Registration in memory is not possible.

8 In binary input operation mode, acceleration/deceleration after interpolation is subject to the acceleration/ deceleration in cutting feed mode (G01).

9 The action to be taken when manual intervention is performed in binary input operation mode does not follow ABS (bit 3 of parameter No. 2409), but the action in the manual/absolute off state (the travel due to the intervention is not regained at a restart) is always assumed. In a mode other than binary input operation mode, ABS (bit 3 of parameter No. 2409) is effective.

10 If binary input operation is performed when acceleration/ deceleration before look-ahead interpolation or fine HPCC is enabled, acceleration/deceleration before look-ahead interpolation or fine HPCC remains enabled. In operation with the unit time shorter than 8 msec, acceleration/deceleration before look-ahead interpolation or fine HPCC must be enabled. Only when the unit time is 1 msec (2 msec for a system with 11 or more controlled axes), acceleration/deceleration before look-ahead interpolation or fine HPCC can be disabled in binary input operation mode by setting G5H (bit 3 of parameter No. 7713) to 1. Even in this case, however, acceleration/deceleration before look-ahead interpolation or fine HPCC must be enabled.

11 In binary input operation mode, it is not possible to perform intervention through MDI operation.

10 PARAMETER

The following describes the parameters related to the remote buffer.

	#7	#6	#5	#4	#3	#2	#1	#0
0000			XXX	EIA	NCR	ISP	CTV	TVC

[Input section] Setting input
[Data type] Bit type

#0 TVC Specifies whether TV check is performed.
0: Do not perform.
1: Perform.

#1 CTV Specifies whether characters are counted for TV check during control out.
0: Count.
1: Do not count.

#2 ISP Specifies whether ISO codes contain a parity bit.
0: Contain parity bit.
1: Do not contain parity bit.
A parity bit is located at channel 8 in a punched tape in the ISO code.

#3 NCR Specifies how to punch an EOB (end-of-block) code when using ISO codes.
0: Punch LF CR CR.
1: Punch LF.

#4 EIA Specifies the code system to use for punch codes.
0: ISO code
1: EIA code

#5 XXX This parameter bit must always be set to 0.

10.1 INPUT DEVICE NUMBER

0020	Interface number of input device for foreground

[Input type] Setting input
[Data type] Integer
[Valid data range] 0 to 16
Set the interface No. of an input device for the foreground.
For the remote buffer, set a value of 10.

0021	Interface number of output device for foreground

[Input type] Setting input
[Data type] Integer
[Valid data range] 0 to 16
Set the interface No. of an output device for the foreground.
For the remote buffer, set a value of 10.

0022	Interface number of input device for background

[Input type] Setting input
[Data type] Integer
[Valid data range] 0 to 16
Set the interface No. of an input device for the foreground.
For the remote buffer, set a value of 10.

0023	Interface number of output device for background

[Input type] Setting input
[Data type] Integer
[Valid data range] 0 to 16
Set the interface No. of an output device for the foreground.
For the remote buffer, set a value of 10.

10.2 EXCLUSIVE PARAMETER FOR REMOTE BUFFER

	#7	#6	#5	#4	#3	#2	#1	#0
5000			0	CDC	ETX	TCC	ECH	422

[Input type] Parameter input
[Data type] Bit

NOTE
When this parameter is specified, the power must be turned off and then on again for the parameter settings to take effect.

#0 422 : Interface between the host and remote buffer
0 : RS-232-C
1 : RS-422
The system determines whether the remote buffer board is provided with an RS-232-C or RS-422 interface, and automatically sets the appropriate value.

#1 ECH : The response of the SAT at the switching between remote operation and DNC operation is (for the protocol A only):
0 : Always transmit 0 to SAT data part (Byte position 1)
1 : Echo back SET data part (Byte position 1) to SAT data part (Byte position 1)

#2 TCC : Communication code
Communication code for protocol A
0 : ASCII
1 : ISO

Communication code for protocol B/expansion protocol B (DC1, DC2, DC3, DC4, SYN, NAK)
0 : ISO
1 : ASCII

#3 ETX : For protocol A, the message end code is:
0 : CR code of ASCII/ISO
1 : ETX code of ASCII/ISO
(ASCII or ISO is selected by using the parameter TCC.)

For protocol B or expansion protocol B, the remote buffer:
0 : Does not post notification of CNC reset or an alarm to the host computer.
1 : Transmits the SYN code for CNC reset, or the NAK code for a CNC alarm.

When this parameter is set to 1, the settings of the following parameters also became effective when the power is turned off, then back on:
No. 5070, 5072, 5073, 5082, 5083

#4 CDC : CD (Signal quality detection) for RS-232-C interface
0 : is checked
1 : is not checked

5070	Minimum baud rate for receiving reception clock from the other device (Remote buffer RS-422 only)

[Input type] Setting input
[Data type] Integer
[Valid data range] 0 to 13

Boundary value at which the clock received by the CNC is to be synchronized with the host clock.

1:	50	9:	2400	
2:	100	10:	4800	
3:	110	11:	9600	
4:	150	12:	19200	
5:	200	13:	38400	[bps]
6:	300			
7:	600			
8:	1200			

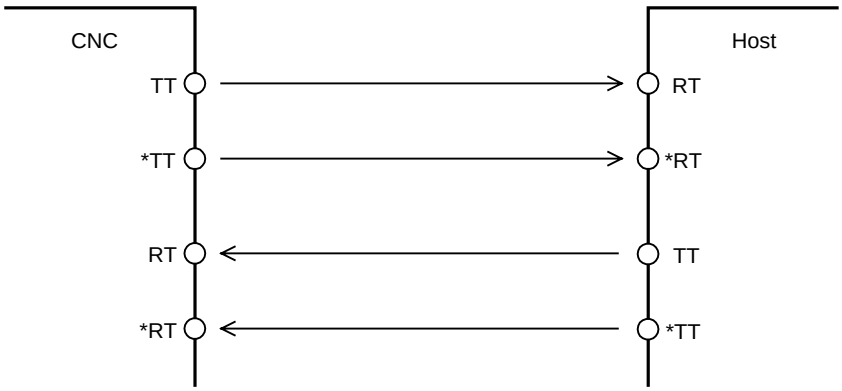
When using PROGRAM FILE Matc, set 13.

NOTE
1 At 38400 bps or higher, the received clock must always be synchronized. If the transfer rate exceeds this parameter, the clock received by the CNC is synchronized with the clock on the host.
(They are synchronized when the setting of parameter No. 5073 is equal to or more than the setting of parameter No. 5070.)
2 Using the RS-422 interface enables asynchronous communication to be performed at high speed because the transmission clock obtained from the transmitting station is used as the reception clock by the receiving station. This technique is called clock synchronous communication.

To perform clock synchronous communication, the following conditions must be satisfied:

(1) The value of parameter No. 5073 is equal or greater than the value of parameter No. 5070. The CNC assumes the use of clock synchronous communication when this condition is satisfied.

(2) The TT signal from the CNC is connected to the RT signal for the host, and the TT signal from the host is connected to the RT signal for the CNC, in both cases via cables.
(3) A synchronizing clock, the same as the baud rate clock, is output from the TT pins. JIS refers to this signal as the transmission signal element timing.



In clock synchronous communication, the transmission clock is determined from the baud rate. The transmission clock output by the transmitting station is used as the reception clock. To perform clock synchronous communication, set the following from the host computer:

(1) The host shall output the transmission signal element timing as the TT signal (ST1 signal, as defined by JIS).
(2) The TT signal clock cycle shall be the same as the baud rate clock cycle (clock rate: 1).

5071	RS-422 I/O specifications number (Remoto buffer)

[Input type] Setting input
[Data type] Integer
[Valid data range] 0 to 8

Set the specification number of the host (reader/punch device) of the remote buffer.
The specification numbers and their corresponding reader/punch device specifications are as follows.

Specification No.	Reader/punch device specification
1	Uses the control codes (DC1-DC4). Outputs feed by punching. Tape reader.
2	Does not use the control codes (DC1-DC4). Outputs feed by punching.
3	Uses the control codes (DC1-DC4). Does not outputs feed by punching.
4	Does not use the control codes (DC1-DC4). Does not outputs feed by punching.
8	PROGRAM FILE Mate Handy File (remote mode)

5072	RS-422 Number of stop bits (Remote buffer)

[Input type] Setting input
[Data type] Integer
[Valid data range] 1 to 2
Set the number of stop bits of the RS-422 device of the remote buffer.

NOTE
When this stop bit is set to 1, the parity bit is also provided.

5073	RS-422 baud rate (Remote buffer)

[Input type] Setting input
[Data type] Integer
[Valid data range] 2 to 15
Set the baud rate of the RS-422 device of the remote buffer.
The settings and their corresponding baud rates are as follows.

Setting value	baud rate
-	-
2	100
3	110
4	150
5	200
6	300
7	600
8	1200

Setting value	baud rate
9	2400
10	4800
11	9600
12	19200
13	38400
14	76800
15	86400

5074	RS-422 Selection of protocol (Remote buffer)

NOTE
When this parameter is specified, the power must be turned off and then on again for the parameter settings to take effect.

[Input type] Setting input
[Data type] Integer
[Valid data range] 1 to 3

1 : Protovol B
2 : Expansion protocol B
3 : Protocol A/expansion protocol A by the parameter <SET>.

NOTE
In the case when the protocol A/expansion protocol A were selected, if the following parameters are modified, they become valid after the power is turned off and then on.
No. 5070, 5072, 5073

5081	RS-232-C Specification of I/O device (Remote buffer)

[Input type] Setting input
[Data type] Integer
[Valid data range] 0 to 8
Set the specification number of the RS-232-C I/O device of the remote buffer.
The specification numbers and their corresponding reader/punch device specifications are as follows.

Specification No.	Reader/punch device specification
1	Uses the control codes (DC1-DC4). Outputs feed by punching. Tape reader.
2	Does not use the control codes (DC1-DC4). Outputs feed by punching.
3	Uses the control codes (DC1-DC4). Does not outputs feed by punching.
4	Does not use the control codes (DC1-DC4). Does not outputs feed by punching.
7	FANUC CASSETTE (Bubble cassette)
8	FLOPPY CASSETTE, PROGRAM FILE Mate Handy File (remote mode)

5082	RS-232-C Number of stop bits (Remote buffer)

[Input type] Setting input
[Data type] Integer
[Valid data range] 1 to 2
Set the number of stop bits of the RS-232-C device of the remote buffer.

NOTE
When this stop bit is set to 1, the parity bit is also provided.

5083	RS-232-C BAUD rate (Remote buffer)

[Input type] Setting input
[Data type] Integer
[Valid data range] 1 to 12

Set the baud rate of the RS-232-C device of the remote buffer.

Setting value	baud rate
1	50
2	100
3	110
4	150
5	200
6	300

Setting value	baud rate
7	600
8	1200
9	2400
10	4800
11	9600
12	19200

5084	RS-232-C Selection of protocol (Remote buffer)

NOTE
When this parameter is specified, the power must be turned off and then on again for the parameter settings to take effect.

[Input type] Setting input
[Data type] Integer
[Valid data range] 1 to 3

1 : Protocol B
2 : Expansion protocol B
3 : Protocol A/expansion protocol A by the parameter <SET>.

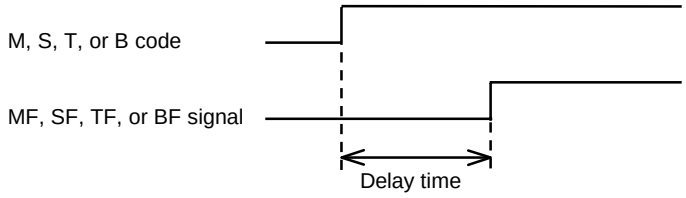
NOTE
In the case when the protocol A/expansion protocol A were selected, if the following parameters are modified, they become valid after the power is turned off and then on.
No. 5070, 5072, 5073

10.3 PARAMETERS RELATED TO BINARY INPUT OPERATION

2010	Delay time of strobe signals MF, SF, TF, and BF

[Input section] Parameter input
[Data type] Integer type
[Unit of data] msec
[Valid data range] 0 to 32767

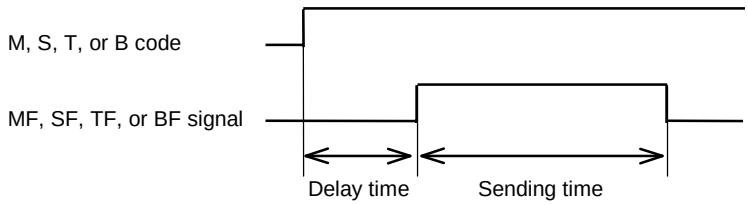
Set the time from the point an M, S, T, or B code is sent until the strobe signal MF, SF, TF, or BF signal is sent.



2012	Output time of strobe signals MF, SF, TF, and BF

[Input section] Parameter input
[Data type] Integer type
[Unit of data] msec
[Valid data range] 0 to 32767

Set the time from the point the strobe signal MF, SF, TF, or BF is sent until it is turned off.



2034	Type of auxiliary function used in binary input operation mode (remote buffer)

[Input section] Parameter input
[Data type] Integer type
[Valid data range] 0 to 3

Set the type of auxiliary function used in binary input operation mode.

0: Second auxiliary function
1: Miscellaneous function
2: S function
3. T function

	#7	#6	#5	#4	#3	#2	#1	#0
7609					RAX	RDS		

[Input section] Parameter input
[Data type] Bit type

#2 RDS The data format for the travel distance along an axis in remote buffer binary input operation mode is:
0: Special format
1: General format

#3 RAX In remote buffer binary input operation mode, auxiliary functions are:
0: Not used.
1: Used.

	#7	#6	#5	#4	#3	#2	#1	#0
2007					G5S			

[Input section] Parameter input
[Data type] Bit type

#3 G5S In binary input operation mode, the single-block stop is:
0: Disabled.
1: Enabled.

	#7	#6	#5	#4	#3	#2	#1	#0
7618						TM2	TM1	TM0

[Input section] Parameter input
[Data type] Bit type

NOTE
When this parameter is specified, the power must be turned off and then on again for the parameter settings to take effect.

#0 TM0
#1 TM1 Travel distance per unit time along each axis
#2 TM2 In the format for remote buffer binary input operation data, the travel distances per unit time along the individual axes are arranged sequentially. Set the unit time in msec.

TM2	TM1	TM0	Unit time
1	0	0	1 msec
0	0	1	2 msec
0	1	0	4 msec
0	0	0	8 msec
0	1	1	16 msec

7635	Number of axes in a single block that can accept commands (remote buffer)

[Input section] Parameter input
[Data type] Integer type
[Valid data range] 0 to number of controlled axes

Set the number of axes in a single block that can accept commands when using binary input operation mode. Do not change this parameter during operation.

NOTE
The axes that can accept commands from the remote buffer are the first n axes in the controlled axis list, where n is the number of axes specified for this parameter.
For example, when this parameter is 3, the fourth and any subsequent axes in the controlled axis list cannot accept commands.

	#7	#6	#5	#4	#3	#2	#1	#0
7713					G5H			

[Input section] Parameter input
[Data type] Bit type

#3 G5H In binary input operation mode, acceleration/deceleration before look-ahead interpolation or fine HPCC is:
0: Enabled.
1: Disabled.

Only when the unit time is 1 msec (2 msec for a system with 11 or more controlled axes), acceleration/deceleration before look-ahead interpolation or fine HPCC can be disabled in binary input operation mode by using this parameter.
Note that to do this, acceleration/deceleration before look-ahead interpolation or fine HPCC must be enabled.
In operation with the unit time shorter than 8 msec, acceleration/deceleration before look-ahead interpolation or fine HPCC must be enabled.

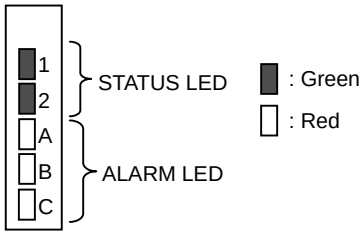
11 ALARM

Error code	Message	Description
PS0010	IMPROPER G-CODE	An unavailable G code is specified.
PS0011	IMPROPER NC-ADDRESS	An address that cannot be specified in an NC statement is specified. Or, parameter No. 1020 is not specified.
PS0012	INVALID BREAK POINT OF WORDS	Data that is not in the word format of address + numeric value is found in an NC statement. This alarm is also issued if data that is not a reserved word is specified or the syntax is not followed correctly in a custom macro.
SR0807	PARAMETER SETTING ERROR	An input/output interface not attached with an option is specified. The parameter setting for the baud rate for communication with an external input/output device, the number of stop bits, or the protocol selection contains an error.
SR0855	DATA SET READY DOWN (RMT-BUF)	The data set ready signal for reader/punch interface 10 turns off. Or, the CD signal (for the RS-232-C interface only) turns off.
SR0856	BUFFER OVERFLOW (RMT-BUF)	When the NC received data via reader/punch interface 10, the stop code (DC3) was sent, but data exceeding a constant amount (512 characters for the protocol B and 2560 characters for the extended protocol B) was received.
SR0890	CHECK SUM ERROR (G05)	A check sum error occurred. (Remote buffer binary input operation)
SR0891	ILLEGAL COMMAND G05	G05 was issued when it could not be issued.
SR 941	COMMUNICATION ERROR (RMT-BUF)	The remote buffer side detected an illegal command (CNC abnormality).
SR 944	COMMUNICATION ERROR (RMT-BUF)	Time-out resulted in protocol A (abnormality in host).
SR 945	COMMUNICATION ERROR (RMT-BUF)	The number of retry times has been exceeded in protocol A (abnormality in host).
SR 946	COMMUNICATION ERROR (RMT-BUF)	Framing error and overrun error resulted.
SR 947	COMMUNICATION ERROR (RMT-BUF)	Invalid response command has been received in protocol A (abnormality in host).
SR 948	COMMUNICATION ERROR (RMT-BUF)	Protocol A detected an error code (abnormality in HOST). Three possible causes are: 1. An END code is detected in a command name. 2. The command is undefined. 3. A command other than the expected one is received.

12 MAINTENANCE

12.1 LED INDICATIONS

The arrangement of the LEDs on the R.B. board is as shown in the figure on the right.
The upper two LEDs (green) indicate the current state of the software.
The lower three LEDs (red) indicate the state of the hardware.
The meanings of the LEDs are explained below.



12.1.1 Normal State

When the LEDs are either on or off (not flashing) and no error messages are displayed on the screen, the LEDs indicate the current state of the remote buffer board, and the remote buffer board is in the normal state.

Table 12.1.1 LED (green) indications and their meanings (STATUS LED)

No.	LED indication	Meaning	Code	Remarks
1	■ 1 ■ 2	The power has just been turned on, and the remote buffer CPU has not been activated.	3	
2	□ 1 □ 2	The board is in the power-on process, waiting for all the modules to be initialized.	0	
3	■ 1 □ 2	The board is idle, waiting for requests (commands) from the CNCs.	1	
4	□ 1 ■ 2	The board has received a request (command) from a CNC, and is handling it.	2	
5	■ 1 ■ 2	The board has received a stop request due to a reset/alarm/program end, and is waiting for the CNC to shut down.	3	

■ : On □ : Off

12.1.2 System Errors

When the LEDs are in any of the statuses shown below, there is a system error. For recovery, the board must be turned off then on again. The hardware may have to be replaced in some causes.

Table 12.1.2 (a) LED (green) indications and their meanings (STATUS LED)

No.	LED indication	Meaning	Code	Message
1	■ 1 ■ 2	An error occurred during a DRAM module test. ("RMT-BUF DRAM TEST:ERROR" is displayed on the screen, and the system fails to start.)		Displayed.
2	▩ 1 □ 2	The results of the parity check could not be accepted upon loading into the code area. (A system alarm error message is displayed, and the system fails to start.) (See Table 12.1.2 (c), "System alarm error messages.")	1	Displayed.
3	□ 1 ▩ 2	NMI occurred in a module other than the remote buffer.	2	Not displayed.
4	▩ 1⇔ □ 1 □ 2⇔ ▩ 2 LEDs 1 and 2 flash alternately.	Together with this LED indication, a system alarm error message is displayed. (See Table 12.1.2 (c), "System alarm error messages.") a) Hardware failure b) Illegal interrupt (generation of an invalid interrupt) c) F-BUS error d) DRAM parity error e) ARES bus error f) LFP bus error g) F-BUS write bus error h) Non-F-BUS write bus error	 4 5 6 7 8 9 A B	Displayed.

■ : On ▩ : Flashing □ : Off

When the LEDs are in any of the statuses shown above, perform an address search for 4n80E014 on the memory display screen, make a note of the contents of the nine words prior to 4n80E024, and report them.
In the above explanation, n is the logical slot number of the remote buffer (609I series).
(See "Determining the Logical Slot Number of the Remote Buffer Board," described below.)

NOTE
The DRAM area of the remote buffer is 4n8000000H to 4n9FFFFFH. If an attempt is made to display an address outside this range, a system error occurs.

Table 12.1.2 (b) LED (red) indications and their meanings (ALARM LED)

No.	LED (red) indication	Meaning
A	■ 1 □ 2 □ 3	This board is reset. It is not activated by the main CPU.
B	□ 1 ■ 2 □ 3	L-BUS bus error An error occurred inside this printed circuit board. The printed circuit board must be replaced.
C	□ 1 □ 2 ■ 3	DRAM parity error An error occurred in the DRAM module mounted in this printed circuit board. Replace the DRAM module.

■ : On □ : Off

Table 12.1.2 (c) System error messages

Code	Message	Description
1	DRAM CHECK SUM ERROR	The results of the parity check could not be accepted upon loading into the code area.
4	HARD ERROR	The printed circuit board must be replaced.
5	UNDEF IRT 00nn(aaaaaaaa) ERR-CODE:cccc	An illegal interrupt was generated. 00nn: Type of the generated interrupt cccc: Error code
6	F-BUS ERROR(aaaaaaaa)	When the R.B. board is the F-BUS bus master, a cycle results in a bus error.
7	DRAM PARITY 000n(aaaaaaaa)	A parity error occurred in DRAM. 000n: Byte train in which the error occurred
8	BUS ERROR(ARES) (aaaaaaaa)	When the ARES is the L-BUS bus master, a cycle results in a bus error.
9	BUS ERROR(LFP) (aaaaaaaa)	When the LFP is the L-BUS bus master, a cycle results in a bus error.
A	WRITE BUS ERROR(F-BUS) (aaaaaaaa)	When F-BUS is the L-BUS bus master, a write cycle results in a bus error.
B	WRITE BUS ERROR(aaaaaaaa)	When a device other than the F-BUS is the L-BUS bus master, a write cycle results in a bus error.

* aaaaaaaa is the execution address (next instruction) at the time the error occurs.

12.2 MATERIAL FOR REMOTE BUFFER TROUBLESHOOTING

NOTE
For an explanation of the logical slot number of the R.B. (remote buffer) board, see "Determining the Logical Slot Number of the Remote Buffer Board," below.

No.	External phenomenon	Investigation method
1	Operation does not start even after a cycle start. It is assumed that the following parameters are set correctly: • Baud rate RS422: parameter 5073 RS232C: parameter 5083 • Number of stop bits RS422: parameter 5072 RS232C: parameter 5082 • Protocol type RS422: parameter 5074 RS232C: parameter 5084 • External synchronization baud rate RS422: parameter 5070 • I/O device specification number RS422: parameter 5071 RS232C: parameter 5081	Follow the procedure described below: 1 Check if the LED indication is No. 4, described under "Normal state" in Section 1.1. If it is not, see the "Explanation of LED Indications." 2 Perform address searches for the following addresses on the memory display screen to check the contents of the buffer (with "long" specified for the read/write pointers and "byte" specified for the buffer). n: logical slot number of the R.B. board (Note 1) 4n810500(long) : read pointer 4n810504(long) : write pointer 4n810508(Byte) : 4n812507(Byte) } : buffer (8Kbyte) • If the read pointer is equal to the write pointer, the buffer is empty and the cause of the error is in the remote buffer or in the host. • If the read pointer is not equal to the write pointer, the cause of the error is in the NC. 3 Perform address searches for the following addresses on the memory display screen to check the latest send data (256 bytes) in the remote buffer (with "long" specified for the write pointer and "byte" specified for the send buffer). 4n823100(long) : write pointer 4n823104(Byte) : 4n823203(Byte) } : send buffer (256byte) The address equal to 4n823104 + (write pointer - 1) contains the latest send data. Note) The DRAM area of the remote buffer is 4n8000000H to 4n9FFFFFH. If an attempt is made to display an address outside this range, a system error occurs.
2	Operation stopped prior to its completion.	Follow the same procedure as that described above. The causes are the same as those described above.

No.	External phenomenon	Investigation method
3	(1) SR807 PARAMETER SETTING ERROR	(1) A required parameter is out of range. 1 Baud rate: parameter 5073 = 1 to 15, 5083=1 to 12 2 Number of stop bits: parameter 5072 or 5082 = 1 or 2 3 Protocol type: parameter 5074 or 5084 = 1 to 3
	(2) SR855 DATA SET READY DOWN(RMT-BUF)	The DR signal is OFF or the CD signal (which can be detected when the setting is RS232C and bit 4 of parameter No. 5000 is 0). 1 A connector or signal line is not connected. Check the signal line connections, referring to the connection diagrams shown in Sections 3.2 and 3.3. 2 The I/O device is not turned on. 3 An I/O device detected an error.
	(3) SR856 BUFFER OVWERFLOW(RTM-BUF)	The remote buffer is full. 1 An interruption (DC3/RS signal OFF) request cannot be accepted. (Error on the host)
	(4) SR941 COMMUNICATION ERROR(RMT-BUF)	Software error on the NC 1 An illegal command code request was made from the NC.
	(5) SR946 COMMUNICATION ERROR(RMTR-BUF)	Framing error, overrun error 1 The baud rate is not appropriate. 2 The number of stop bits is not set correctly. 3 Reception overrun

12.3 DETERMINING THE LOGICAL SLOT NUMBER OF THE REMOTE BUFFER BOARD

12.3.1 Determining the Logical Slot Number on the Screen Displayed at the Time a System Alarm Occurs

Display hardware information 1 (display of F-BUS slot information), shown below, using the PAGE page keys.

```
FANUC Series 15I F001A

SYS_ALM 300 SYSTEM ALARM (F-BUS SLOT (1))
OTHER-CPU
ERROR OCCURRED AT 1999/03/12 12:34:56

HARDWARE INFORMATION 1
. F-BUS SLOT CONFIGURATION

..□SLOT..MODULE NAME.. M ID...SLOT IO DATA..
. +---------+-----------------------------+----------+---------------------------------------+
..00:00. MOTHER BOARD  .   1234. 0000 0000 0000 0000 0000
..02:09. REMOTE BUFFER       10E1. 0000 0000 0000 0000 0000




.....PAGE UP OR DOWN (PAGE.6/ 8)
```

On the screen, the second half of the number identified by the SLOT column and the row containing REMOTE BUFFER (shown in the MODULE NAME column) is the logical slot number. In the example, the logical slot number of the remote buffer is 09.

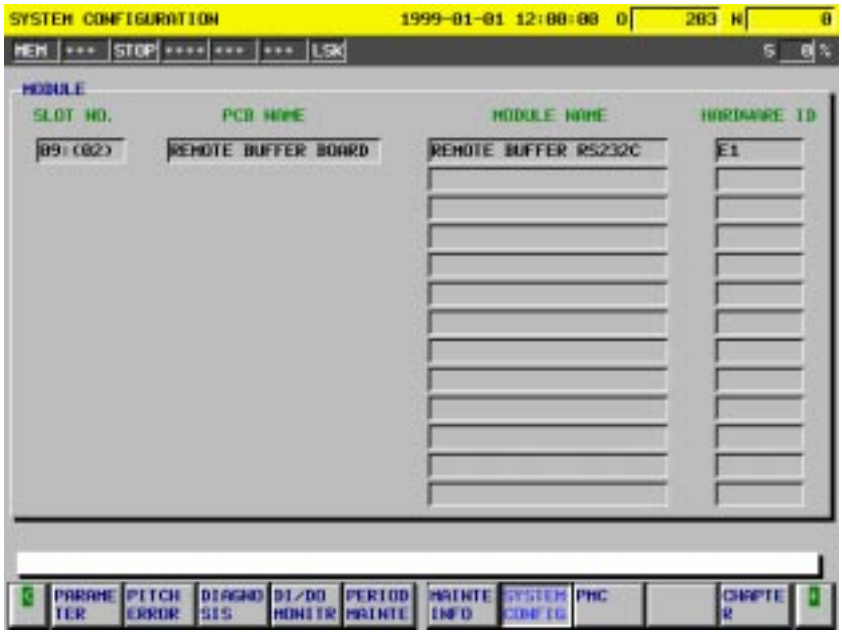
12.3.2 Determining the Logical Slot Number on the System Configuration Screen

Once the system has started normally, the logical slot number of the remote buffer printed circuit board can be determined by displaying the module configuration screen from the system configuration screen by means of the procedure described below.

(1) Press key SYSTEM.

(2) Press soft key [SYSTEMCONFIG].

(3) Select the remote buffer module configuration screen, shown below, using the PAGE page keys.



- Slot number: Number of the logical slot in which the remote buffer printed circuit board is installed.
  The number enclosed in parentheses ( ) is the physical slot number.

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Revision Record

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