3. Tape Punch Interface

(1) An RS232C serial interface is provided to allow connection of a tape punch.

Connecting a peripheral device such as a tape reader or tape punch that also has an RS232C serial interface to this RS232C interface enables bulk transfer of NC part program data.

When the RS232C interface is used for connecting a tape punch, it is necessary to set the parameters so that communication is possible between the NC and the external device (tape punch).

(2) There are two methods for data transfer using RS232C - the normal BTR (behind tape reader) method and a method using DC code control - and the method for connection to the peripheral device differs according to which of these is used.

3-1. Operation Commands

(1) The table given below indicates which command can be used with which input/output devices.

Command \ Peripheral Device		Sector Device	Tape Reading Device	Tape Punching Device	Printing Device
F2 DIR		Input			Output
F3 PIP	F1 READ	Output	Input		
	F2 PUNCH	Input		Output	
	F3 VERIFY	Output Input	Input		
F5 FREE		Input			Output
F6 LIST		Input			Output

[Supplement] For the operation of the commands, refer to Section 5 "PROGRAM OPERATION".

(2) Peripheral Device Classification and Abbreviations

Sector devices

MD1: → User memory
FD0: → 3.5-inch floppy disk
FD1: → 3.5-inch floppy disk

Tape reading devices

TR: → Tape reader
CN0: → Tape reader connected at RS232C channel 0
CN1: → Tape reader connected at RS232C channel 1
CN2: → Tape reader connected at RS232C channel 2
CN3: → Tape reader connected at RS232C channel 3

Tape punching devices

CN0: → Tape punch connected at RS232C channel 0
CN1: → Tape punch connected at RS232C channel 1
CN2: → Tape punch connected at RS232C channel 2
CN3: → Tape punch connected at RS232C channel 3

Printing devices

CN: → Console
PN: → NC operation panel
CN0: → Printer connected at RS232C channel 0
CN1: → Printer connected at RS232C channel 1
CN2: → Printer connected at RS232C channel 2
CN3: → Printer connected at RS232C channel 3

(3) If no device name is specified, the following selections are made automatically.

For sector devices	MD1:	
For tape reading devices	TR:	(This selection can be changed by setting NC optional parameter (word) No. 57.)
For tape punching devices	CN0:	(This selection can be changed by setting NC optional parameter (word) No. 45.)
For printing devices	PN:	

The default device for a tape reading device or tape punching device can be changed by changing the parameter settings.

(4) If no output NC program name is specified, the same name as the input NC program name is automatically assigned.

(5) If no input NC program name is specified, the name "A.MIN" will be automatically assigned unless a program name is designated on the tape, in which case that name will be used.

3-2. Parameter Settings

Set the following parameters before connecting a peripheral device.

After setting the parameters, press function key [F7] (BACKUP) and on completion of the backup operation switch the power off and then back on again.

The old parameter settings will remain valid if the power is not switched off and back on.

(1) NC optional parameter (bit) No.1

Bit No. / Parameter No.	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
1	Special tape codes ignored	Special tape code alarm	Tape rewind	Tape read verify	Tape delimiter code: % (ER)	Tape TV check	Automatic tape code recognition	Tape coding system

(a) bit 0 Tape coding system

= 1 : Tape code set to ISO code (Initial value = 1)

= 0 : Tape code set to EIA code

(b) bit 1 Automatic tape code recognition

= 1 : Tape code automatically recognized (Initial value = 1)

= 0 : Tape code not automatically recognized

The codes used for tape punching and tape verification depend on the combination of the settings made for bit 0 and bit 1.

bit 1	bit 0	Contents
1	1	In "READ" and "VERIFY" operations, EIA and ISO tape codes are automatically recognized. In "PUNCH" operations, program data is punched in the ISO code.
1	0	In "VERIFY" operations, EIA and ISO codes are automatically recognized. In "PUNCH" operations, program data is punched in the EIA code.
0	1	In "VERIFY" operations, the control assumes that the coding system is ISO. (If the tape code is not ISO, an error occurs.) In "PUNCH" operations, program data is punched in the ISO code.
0	0	In "VERIFY" operations, the control assumes that the coding system is EIA. (If the tape code is not EIA, an error occurs.) In "PUNCH" operations, program data is punched in the EIA code.

(c) bit 2 Tape TV check

The tape TV check is a check on the number of characters of tape data in each block of the program.

It is checked that the number of codes from the code following one LF (EOB) to the next LF (EOB) is an even number.

bit 2	Contents
0	In "READ" operations, no TV check is performed. In "PUNCH" operations, the number of characters per block is not adjusted.
1	In "READ" operations, it is checked if the number of characters in each block is an even number; if it is an odd number, an alarm occurs. In "PUNCH" operations, a space is added if necessary to make the number of characters in one block an even number.

(Initial value = 0)

(d) bit 3 Tape delimiter code %/ER

Sets whether or not the %/ER code is used instead of tape feed to mark the end of program information on the tape.

bit 3	Contents
0	Tape feed is taken to indicate the end of program data.
1	The % (ER) code is taken to indicate the end of program data.

(Initial value = 0)

[Supplement] The data up until the second appearance of an CR, and LF or EOB on the tape is ignored.

(e) bit 4 Tape reading verification

Sets whether or not the program information is automatically verified when a tape is read.

bit 4	Contents
0	Verification is not performed on completion of a "READ" operation.
1	Verification is performed on completion of a "READ" operation.

(Initial value = 0)

[Supplement] File names are not verified.

(f) bit 5 Tape rewind

Sets whether or not the tape is rewound after reading (if verification is not performed).

bit 5	Contents
0	Operation stops after the tape has been read.
1	The tape is rewound after it has been read.

(Initial value = 0)

(g) bit 6 Special code alarm

Sets whether or not special codes ($20 to $5F, HT) trigger an alarm.

(h) bit 7 Special code store

Sets whether or not special codes are stored.

bit 7	bit 6	Contents
*	1	An alarm occurs when a special code is read.
1	0	Special codes are read but not stored.
0	0	Special codes are read normally.

(Initial values: bit 6 = 1, bit 7 = 0)

(2) NC optional parameters (bit) No. 8, 13, 14, 21, 22

Used to set the RS232C data handled by the channels used.

NC optional parameter (bit) No.	Channel	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	
No. 8	CN0 :	File name read/not read	DC code control TYPE 2	Standard DC code control	8-bit JIS/ 7-bit JIS	Even/ odd parity	Parity check performed/ not performed	Ready signal setting	1-bit/ 2-bit stop bit	
No. 13	CN1 :									
No. 14	CN2 :									
No. 21	CN3 :									
		0	0	0	0	0	0	1	0	Initial value

Explanation of settings for parameter (bit) Nos. 8, 13, 14, 21, 22

(a) bit 0 RS232C stop bit check

= 0 : 2 stop bits

= 1 : 1 stop bit

(b) bit 1 Determines whether or not the RS232C interface uses the "EXT-INT" signal as the ready signal.

= 0 : The "EXT-INT" signal is used as the ready signal.

= 1 : The "EXT-INT" signal is not used as the ready signal.

(c) bit 2 RS232C parity check (determines whether or not a parity bit is appended to 8-bit data)

= 0 : Parity check not performed

= 1 : Parity check performed

(d) bit 3 RS232C even/odd parity

= 0 : Odd parity

= 1 : Even parity

(e) bit 4 RS232C 8-bit/7-bit JIS

= 0 : 7-bit JIS

= 1 : 8-bit JIS

(f) bits 5, 6 Specify the DC code control conditions.

bit 6	bit 5	Contents
0	0	No DC code control
1	0	No DC code control
0	1	Standard DC code control
1	1	DC code control TYPE 2

(g) bit 7 Required file name output in DNC-A mode (special specification)

= 0 : Required file name not output
= 1 : Required file name output

(3) NC optional parameter (bit) No. 12

(a) bit 2 Specifies whether or not the file name is punched out.

bit 2	Contents
0	The file name is punched out.
1	The file name is not punched out.

(Initial value = 0)

(b) bit 3 Specifies the end of record code when punching in the ISO coding system.

bit 3	Contents
0	CR, LF is output.
1	Only LF is output.

(Initial value = 0)

(c) bit 4 Specifies the code used for tape feed during punching.

bit 4	Contents
0	The NULL code is output.
1	The SPACE code is output.

(Initial value = 0)

(d) bit 5 Specifies whether or not feed holes are punched during tape punching.

bit 5	Contents
0	Feed holes are punched.
1	Feed holes are not punched.

(Initial value = 0)

(4) NC optional parameters (bit) No. 27 to 31, 49 to 51

(a) These parameters are used to set special EIA codes.

Parameter No.	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	
No. 27	Sets the punch holes for the EIA code that represents "=".								
No. 28	Sets the punch holes for the EIA code that represents "*".								
No. 29	Sets the punch holes for the EIA code that represents "[".								
No. 30	Sets the punch holes for the EIA code that represents "]".								
No. 31	Sets the punch holes for the EIA code that represents "$".								
No. 49	Sets the punch holes for the EIA code that represents "#".								
No. 50	Specifies an irregular code.								
No. 51	Specifies the regular code (ISO) corresponding to the irregular code.								
	0	0	0	0	0	0	0	0	Initial value

(b) In both the EIA and ISO coding systems, it is possible to have one code treated as another in program reading and program punching.

(c) Set a code which is to be treated as another code (i.e. an irregular code) for optional parameter (bit) No. 50 and the regular code that corresponds to this irregular code for optional parameter (bit) No. 51.

The regular code must be set in the ISO coding system.

1) If an irregular code is encountered during reading it is read as the corresponding regular code.

2) If the regular code corresponding to an irregular code occurs during punching, the irregular code is punched.

(5) NC optional parameters (word) No. 1, No. 2

Parameter No.	Item	Contents	Factory Set Initial Value	Setting Range
1	Tape feed holes in punching	For punchout in the PIP holes in (transfer) mode, tape feed hole areas are punched out before and after program punch out. The number of feed holes is set by this parameter.	600	1 to 10000
2	Defaults of tape lengths in divided punching	A file of machining programs which is too long to be stored in a roll of paper tape is divided into smaller files to be punched out. The lengths of the divisions are set by this parameter. The divisions are closed at the breaks of each block, so that the actual tape length is slightly different from the setting. A divided punchout gives the beginning of each tape part a file name. Note that the setting does not include the lengths corresponding to the file name and feed hole.	180 m (590 ft)	1 to 300 m (3.3 to 984 ft)

(6) NC optional parameters (word) No. 6, 39, 40, 41, 42

Set the baud rates for channels CN0: to CN3:.

NC Optional Parameter (word) No.	Channel	Contents	Initial Value
No. 6	CN0 :	Any of the following baud rates can be set: 110, 150, 200, 300, 600, 1200, 2400, 4800, 9600, 19200,	600 baud
No. 39	CN1 :		
No. 40	CN2 :		
No. 41	CN3 :		

(7) NC optional parameters (word) No. 34, 35, 36, 37, 38

Set the ready completion waiting times for channels CN0: to CN3:.

NC Optional Parameter (word) No.	Channel	Setting Range (Unit: Seconds)	Contents	Initial Value
No. 34	CN0 :	1 to 9999	This is the waiting time between output of DC1 (tape reader start) or the cessation of data reception and reception of data; or the waiting time (when CTS and DSR are ON) until the RS232C ready completed status comes into effect. If there is no response within this time an alarm occurs.	10 seconds
No. 35	CN1 :			
No. 36	CN2 :			
No. 37	CN3 :			

(8) NC optional parameter (word) No. 45

Used to select the punch channel for data transfer.

Setting for No. 45	Peripheral Device		Initial Value
0	CN0 : (TT:)	[RS232C]	0 (This selects CN0:)
1	CN1 :	[RS232C]	
2	CN2 :	[RS232C]	
3	CN3 :	[RS232C]	

(9) NC optional parameter (word) No. 57

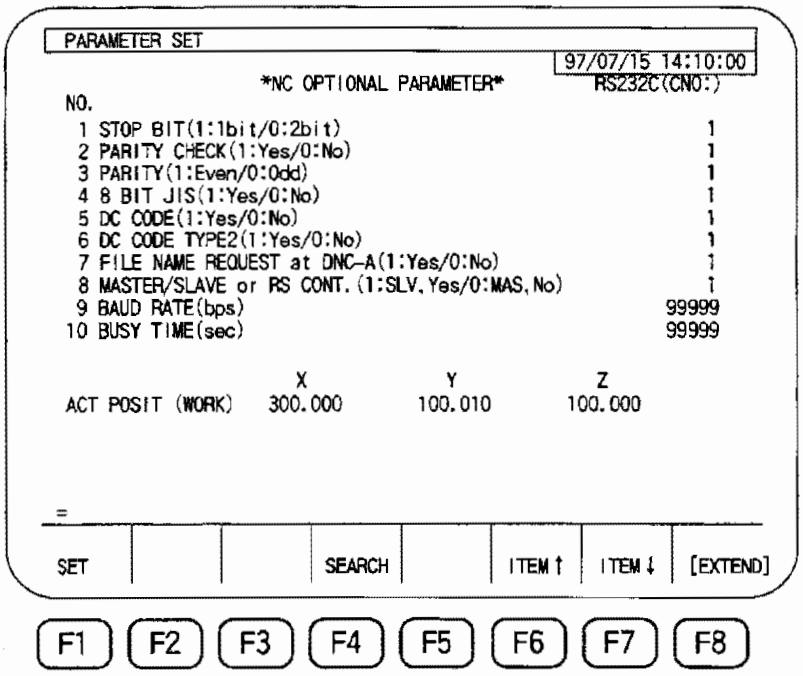
Used to select the read channel for data transfer.

Setting for No. 57	Peripheral Device		Initial Value
0	TR :	[Standard tape reader]	0 (This selects TR:)
1	CN0 :	[RS232C]	
2	CN1 :	[RS232C]	
3	CN2 :	[RS232C]	
4	CN3 :	[RS232C]	
5	CN4 :	[RS232C]	

(10) NC optional parameter RS232C (CN0:)

This screen displays the parameters to be used for the tape punch interface function, which are allocated to NC optional parameter (bit) and NC optional parameter (word). Note that they are only for CN0: device and it is necessary to set the parameters for the individual NC optional parameter (bit) and NC optional parameter (word) screens for other devices.

When the following parameters are set, the corresponding NC optional parameters are set accordingly. Conversely, if NC optional parameters are set, the corresponding parameters shown below are set accordingly.



(a) 1 STOP BIT (1:1bit/0:2bit) (NC optional parameter (bit) No. 8, bit 0)

RS232C stop bit check

= 0 : Stop bit 2

= 1 : Stop bit 1

(b) 2 PARITY CHECK (1:Yes/0:No) (NC optional parameter (bit) No. 8, bit 2)

RS232C parity check (sets whether or not a parity bit is added to 8-bit data)

= 0 : No parity

= 1 : Parity check

(c) 3 PARITY (1:Even/0:Odd) (NC optional parameter (bit) No. 8, bit 3)

RS232C odd parity scheme

= 0 : Odd parity

= 1 : Even parity

(d) 4 8 BIT JIS (1:Yes/0:No) (NC optional parameter (bit) No. 8, bit 4)

RS232C 8-bit JIS

= 0 : 7-bit JIS

= 1 : 8-bit JIS

(e) 5 DC CODE (1:Yes/0:No) (NC optional parameter (bit) No. 8, bit 5)

DC code control

= 0 : Controlled by DC code

= 1 : Not controlled by DC code

(f) 6 DC CODE TYPE2 (1:Yes/0:No) (NC optional parameter (bit) No. 8, bit 6)

DC code control type 2

= 0 : DC code control type 2 is not executed.

= 1 : DC code control type 2 is executed.

6 DC CODE TYPE2	5 DC CODE	Description
0	0	Controlled by DC code
1	0	Not controlled by DC code
0	1	Standard DC code control
1	1	DC code control type 2

(g) 7 FILE NAME REQUEST at DNC-A (1:Yes/0:No) (NC optional parameter (bit) No. 8, bit 6)

Request file name output at DNC-A (option)

= 0 : Request file name is not output

= 1 : Request file name is output

(h) 8 MASTER/SLAVE or RS CONT. (1:SLV, Yes/0:MAS, No)
(NC optional parameter (bit) No. 40, bit 0)

Master/slave station designation or RS control designation

= 0 : Master station or without RS control

= 1 : Slave station or with RS control

(i) 9 BAUD RATE (bps) (NC optional parameter (word) No. 6)

Selection of baud rate from 110, 150, 200, 300, 600, 1200, 2400, 4800, 9600, and 19200.

Initial value: 600

(j) 10 BUSY TIME (sec) (NC optional parameter (word) No. 34)

Sets the delay time until data receiving or RS232C getting ready (CTS and DSR ON) after sending DC1 (tape reader start) or interruption of data receive. If there is no response within the set length of time, an alarm occurs.

Setting range: 1 to 9999 sec.

Initial value: 0

3-3. Tape Format

3-3-1. Input Format

(1) ISO Coding System

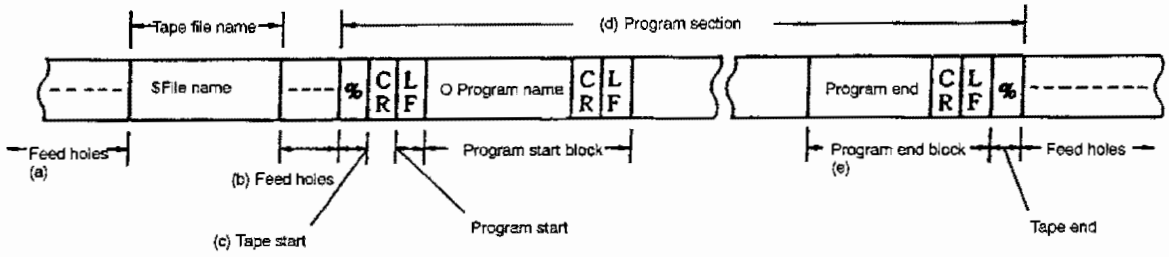


Fig. 3-3 Input Format (ISO Coding System)

(2) EIA Coding System

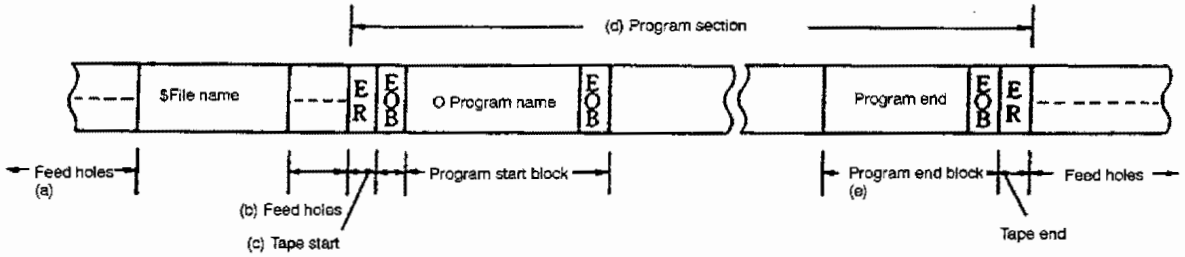


Fig. 3-4 Input Format (EIA Coding System)

(a) Feed holes (in ISO coding: NUL or SPACE, in EIA coding: BLANK or SPACE)

(b) Input the file name after the "$" symbol.

If no file name is specified, the same file name as that specified for the output NC program name will be automatically selected. If no output NC program name is specified, the name set will be "A.MIN".

(c) Feed holes

(d) Start and end the program section with the % (ER) code.

(e) Always include M02 or M30, or END, or RTS in the program end block.

[Supplement] Codes that cannot be set in the EIA coding system can be replaced by codes that can be set so that they can be read. For details, see Section 6, 3-3-3, "EIA Special Codes".

3-3-2. Output Format

(1) ISO Code

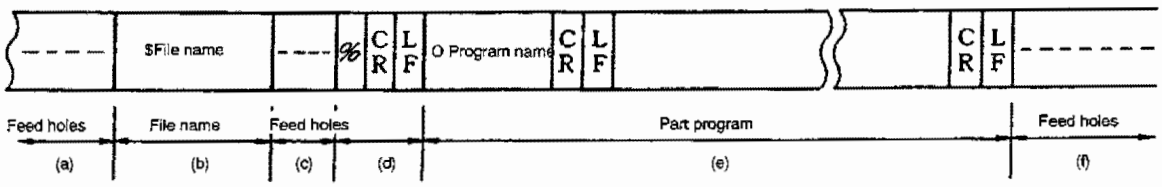


Fig. 3-5 Output Format (ISO Code)

(2) EIA Code

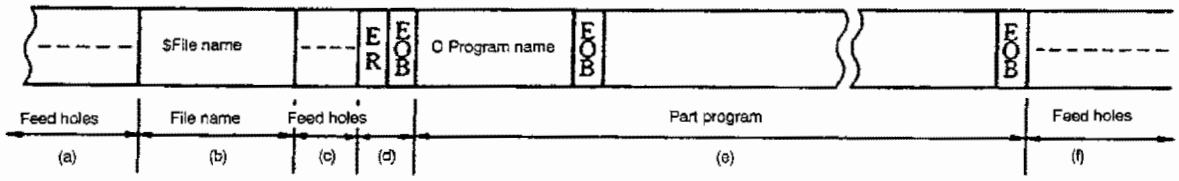


Fig. 3-6 Output Format (EIA Code) (1)

(a) 600 tape feed holes are punched in the tape leader section.

The number of feed holes to be punched out can range, as needed, from 1 to 10000 with a parameter.

For details, consult III, "PARAMETERS".

(b) The file name is punched out following the "$" code. (Program data is punched out in the ISO coding system.)

(c) 50 tape feed holes are punched out.

The number of the tape feed holes cannot be changed.

(d) Either of the following is punched out.

%, CR, and LF

ER and EOB

(e) The part program data is punched out following the program name (number).

(f) The same number of tape feed holes as in a) are punched out in the tape trailing section.

[Supplement] 1. When the program data is punched out in the EIA code, the presence of a code not available in the EIA coding system causes an error. Tape punching-out halts and an error message is given on the display screen.

When the tape delimiting code is the "%" (ER) code, i.e., when bit 3 of parameter No. 1 of NC optional parameter (bit) is 1, the "%" code or "ER" is punched out before feed holes.

2. The part program is split and punched out, if it si too long to be contained in one paper tape roll. Paper tape length may be changed from 1 to 300 meters (3 to 984 feed) using the NC optional parameter (word) No. 2.

As the format, the file name is also punched out, for the second tape and so on. Since the tape ends with "CR" or "LF", actual tape length is somewhat difference from the tape length set using the parameter.

When designating paper tape punch out operation on more than one paper taper roll, specify option D in the following format:

P ␣ <file-name>, <device-name>:;D

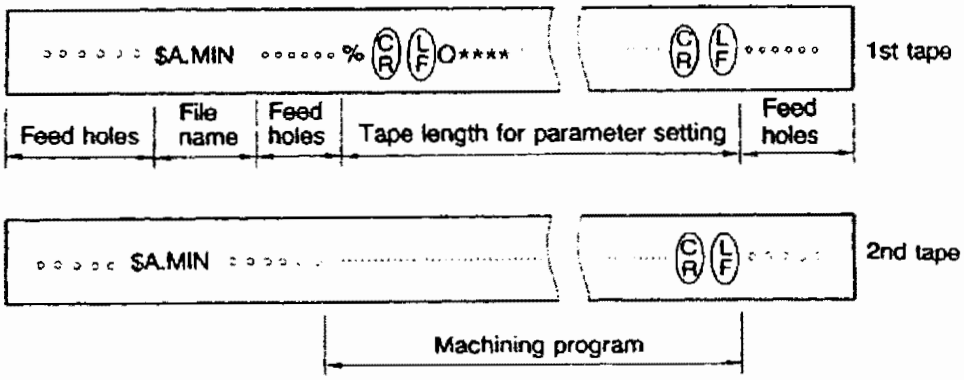


Fig. 3-7 Output Format (EIA Code) (2)

3-3-3. EIA Special Codes

(1) There are some characters, such as "=" and "*", that are not represented by codes in the EIA coding system. To make it possible to use these characters when creating an EIA program tape, other characters are sometimes temporarily substituted for them.

(2) When a program tape created in this way is read into the NC, the substituted characters must be converted back to "=" and "*" by using editing functions.

(3) This troublesome procedure is made easier by setting EIA special codes for the characters for which substitution is necessary in advance; the control then automatically substitutes the appropriate characters when a program is input from or output to tape.

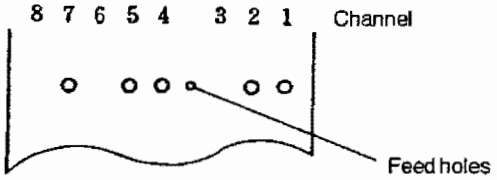
(a) Setting the EIA special codes

1) Special codes can be set for the following 6 characters:

=, *, [,], $, #

2) Special codes are set as bit patterns in NC optional parameters (bit) No. 27 through 31 and No. 49.

Example: Suppose the puncher key "[ ]" is determined for punching the "=" code, and that the arrangement of punched holes by this key operation is as below.



Set this arrangement of punched holes by a "1" and a "0", where "1" indicating a punched hole and "0" a position not punched. Setting will be as below:

0 1 0 1 1 0 1 1

Set this at the No. 27 of NC optional parameter (bit). Repeating the same operations, set all the codes used on the NC.

[Supplement]

1. When inputting a program in the EIA coding system, if the special code "$" is input at the head of the program, the character string immediately following the "$" is read as the file name (in EIA codes) for the program.

2. When outputting a program using the EIA coding system, if the "$" special code is set the file name will be punched out in EIA codes. If the "$" special code is not set, the file name will be punched out in ISO codes.

3. There is no check to determine whether or not the bit patterns assigned to special codes already represent characters in the EIA coding system.

   Example: If the special code for the character "=" is set as 01100001 (the EIA code for "A") and "A=B" is output for punching, what will actually be punched is "AAB". When the tape is read, the data will be interpreted as "==B".

4. Special codes are only converted when commands are executed in the PIP mode.

   They are not converted in the DNC mode.

3-4. Specifications

3-4-1. RS232C Interface

(1) Communication Method

Start-stop synchronization

This is a method in which a pre-determined signal is sent at the beginning and end of a character.

The data for each character comprises the following bits (see Fig. 6-8): (A) start bit (1 bit), (B) information bits (8 bits), (C) parity bit (1 bit), (D) stop bit (2 bits).

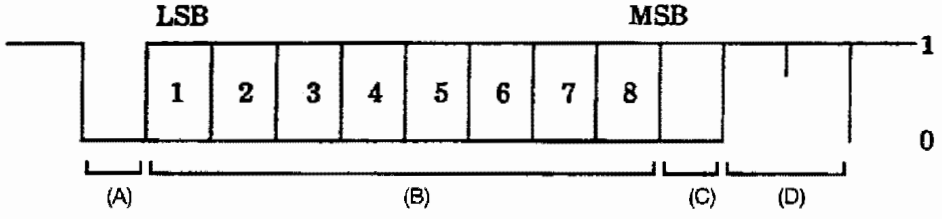


Fig. 3-8 Bit Configuration

(2) Baud Rate (BPS - baud)

110, 150, 200, 300, 600, 1200, 2400, 4800, 9600, 19200

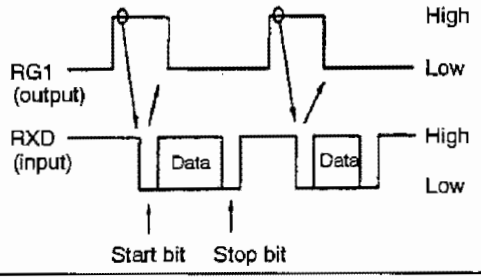
(3) Data Configuration

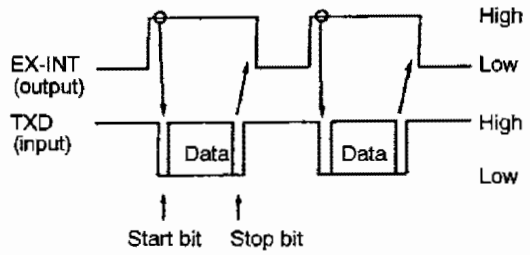
Start bit : 1 bit
Data bits : 8 bits
Parity bit : 1 bit or absent (selected by parameter setting)
Stop bits : 1 bit or 2 bits (selected by parameter setting)

(4) Parity Check (character parity)

Odd/even parity or no parity check (selected by parameter setting)

(5) Signal Descriptions

Signal Name	Direction	Details
FG	—	Protective grounding
TXD	Output	Send data Data line from the NC to peripheral devices.
RXD	Input	Send data Data line from peripheral device to the NC.
RTS	Output	Request to send Comes ON when data transmission or reception starts. Thereafter, it is normally ON.
CTS	Input	Clear to send When this signal is OFF, data is not output from the NC. Used for BUSY/READY control. If this signal is not used, connect the RTS signal at the NC.
DSR	Input	Data set ready Indicates that the peripheral device is in the communication enabled status. If this signal goes OFF during data communication, an error will occur at the NC. This signal cannot be used to execute BUSY/READY control. If this signal is not used, connect it to DTR at the NC side.
SG	—	Connection for signals
RG1	Output	Data request (register 1) This signal is used to execute receive BUSY control at the NC side. It comes ON when the NC is in the reception enabled status and data transfer from a peripheral device is requested. It goes OFF on reception of a start bit from the peripheral device (it goes OFF once per character). 
RG2	Output	Register 2 Presently not used.

Signal Name	Direction	Details
SG SG SG	— — —	Grounding for signal Grounding for signal Grounding for signal
DTR	Output	Data terminal ready This signal comes ON when the NC is ready for operation. If data is transferred to the NC while this signal is OFF, it will not be read by the NC.
EX-INT	Input	External interrupt This signal is used for BUSY/READY control at the peripheral device side. When this signal is used, the following applies for transfer of each character: (1) When the signal is OFF, the NC cannot start data transfer. (2) When data transfer starts, this signal temporarily goes OFF; when it comes ON again the next data is transferred. (It goes through the sequence ON, OFF, and ON for each character).  The EXT-INT signal cannot be used for a peripheral device which has a buffer, meaning that the ready signal does not switch ON/OFF for every character. For this type of device, use the CTS signal.

3-5. Connection to Peripheral Devices

If an RS232C interface is used, a special-purpose cable must be used to connect the signals that are required by an external device since the signals used for the connection vary according to the external device.

A typical example is shown below.

3-5-1. BTR System (No DC Codes)

Example 1:

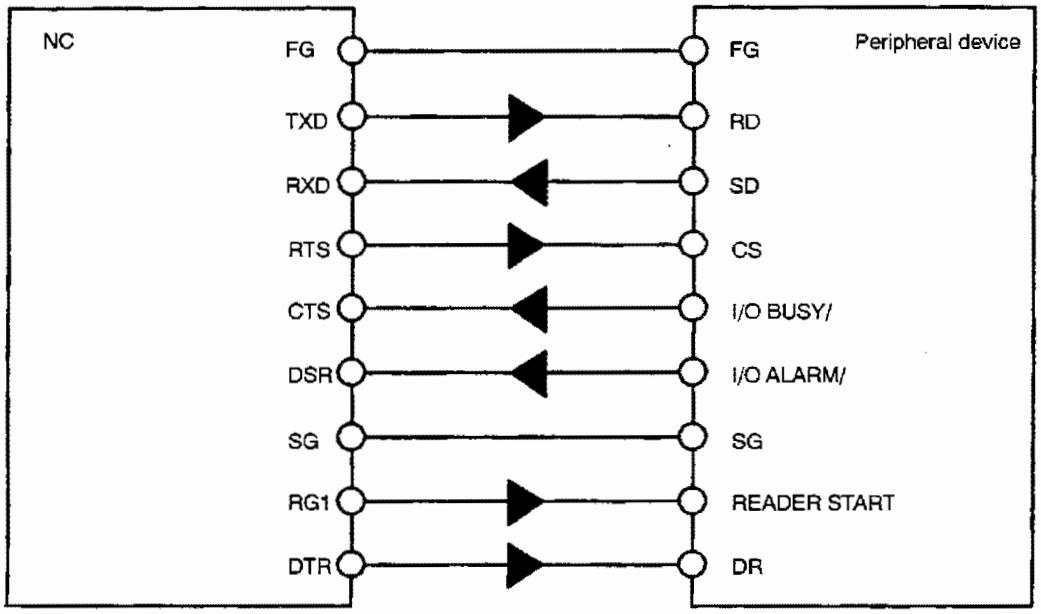


Fig. 3-9 Connection for BTR System (No DC Codes) (1)

[Supplement] Since no EXT-INT signal is used in this example, bit 1 of NC optional parameter (bit) No. 8 (No. 13, 14, 21, 22) (Ready signals of CN0: to CN4:) should be set to "1" in advance.

(1) Timing Chart for READ

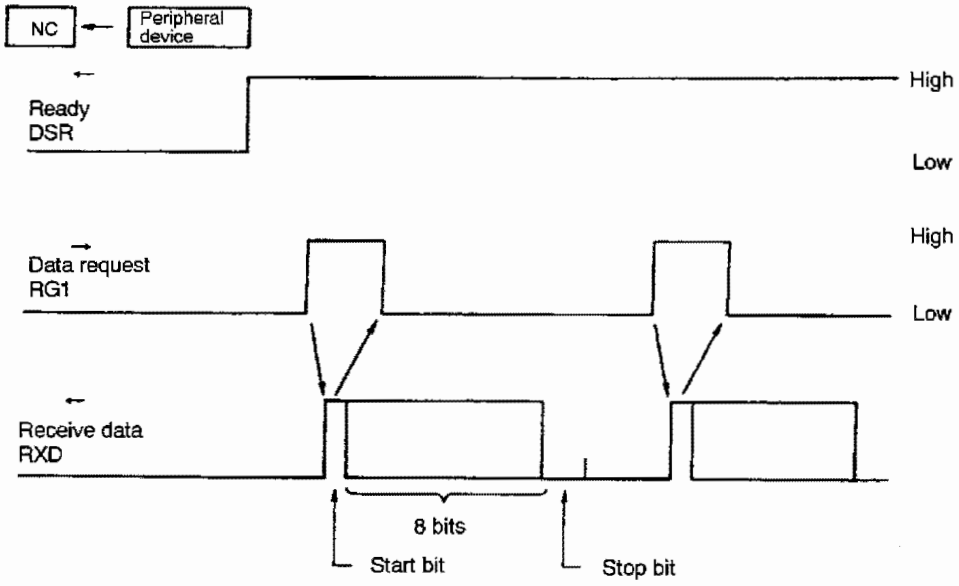


Fig. 3-10 Timing Chart for READ [BTR System (No DC Codes)]

(a) Data request signal RG1 is output from the NC.

(b) On receiving this signal, the peripheral device transfers serial data.

(c) The data request signal is forcibly set to the "Low" status in the interface circuit by the start bit in the received data.

(2) Timing Chart for PUNCH and LIST

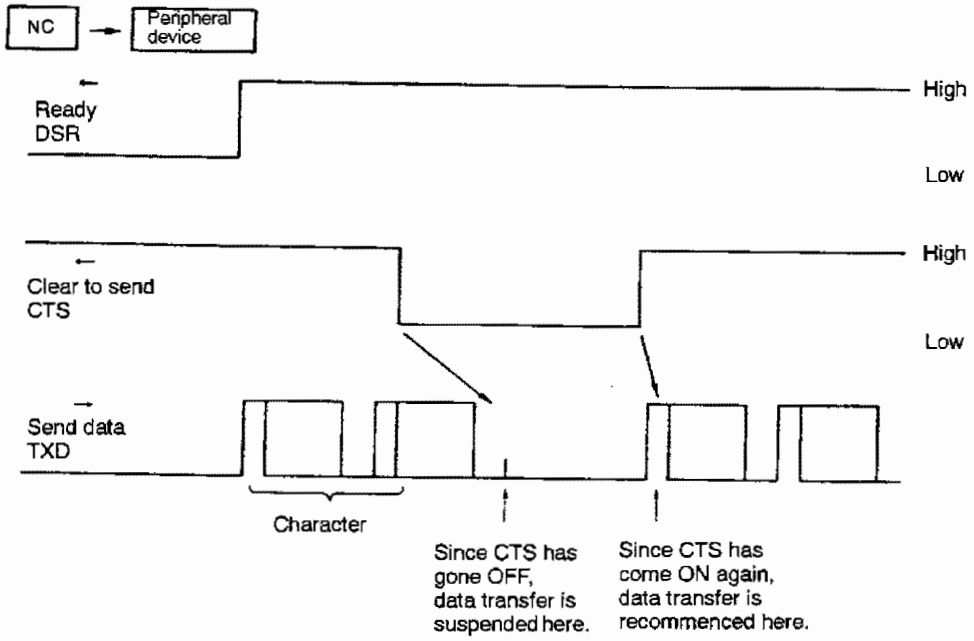


Fig. 3-11 Timing Chart for PUNCH and LIST [BTR System (No DC Codes)]

(a) While CTS is OFF, no data is sent from the NC.

(b) If CTS goes OFF during data transfer, data transfer is suspended within two characters from that point.

(c) When CTS comes ON again, data transfer is recommenced.

Example 2:

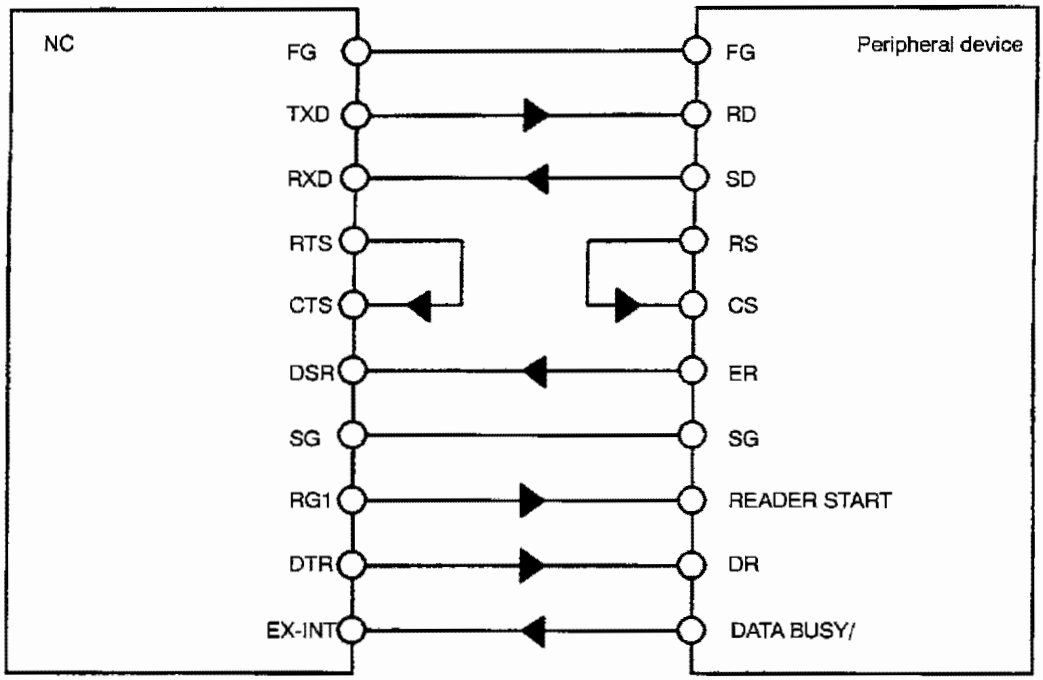


Fig. 3-12 Connection for BTR System (No DC Codes) (2)

[Supplement] Since an EXT-INT signal is used in this example, bit 1 of NC optional parameter (bit) No. 8 (No. 13, 14, 21, 22) (Ready signals of CN0: to CN4:) should be set to "0" in advance.

(3) The timing chart for READ is the same as that shown in Example 1.

(4) Timing Chart for PUNCH

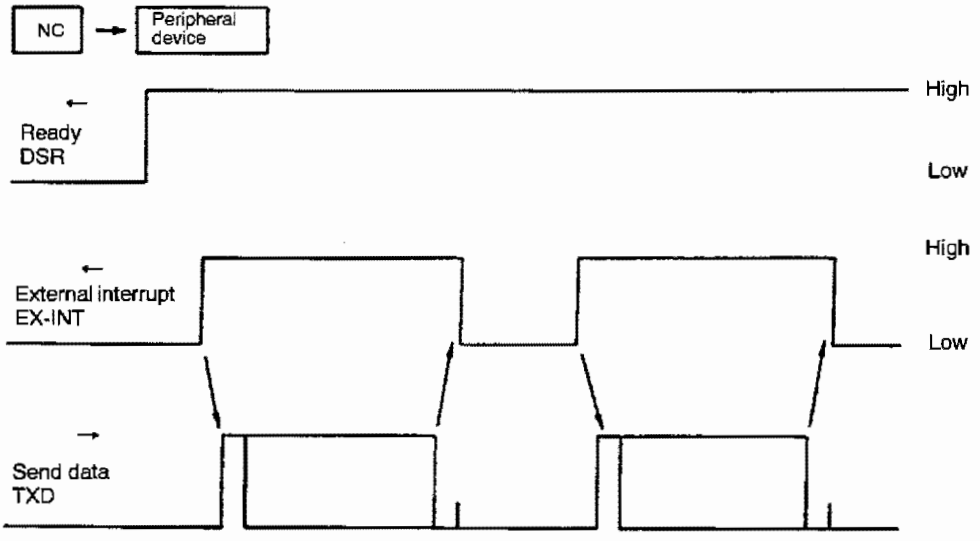


Fig. 3-13 Timing Chart for PUNCH [BTR System (No DC Codes)]

(a) When the external interrupt signal EXT-INT comes ON, data is sent from the NC.

(b) On reading the stop bit, the peripheral device forcibly sets the external interrupt signal to "Low". It is essential that the external interrupt signal be set to "Low" temporarily.

(c) On completion of processing, the peripheral device switches the EXT-INT signal ON again.

3-5-2. DC Code Control

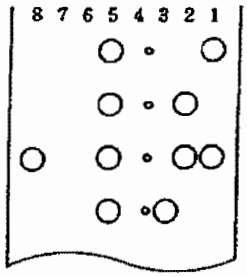
When DC code control is effective, the NC outputs DC control codes to control data transfer.

The user can select whether or not DC code control is performed by parameter setting.

The available DC control codes are DC1 through DC4, as shown below.

"DC" is the abbreviation for "device control", and these device control characters serve to start peripheral devices.

DC1 : Tape reader start →
DC2 : Tape punch start →
DC3 : Tape reader stop →
DC4 : Tape punch stop →



[Supplement]

1. Since DC control codes are automatically generated from the NC, the user does not have to write them into programs.
2. The control codes used are the ones shown above, regardless of whether the ISO or EIA coding system is used.
3. The NC unit cannot be controlled by control codes sent from the peripheral device.

Example 1:

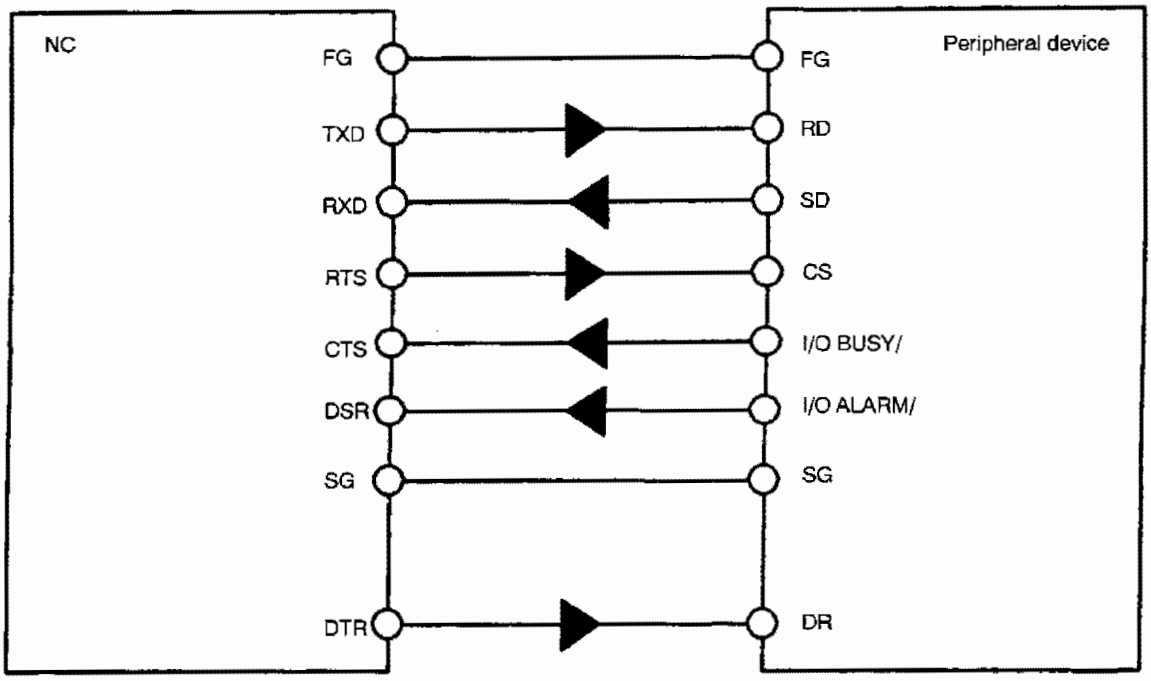


Fig. 3-14 Connection for DC Code Control

[Supplement] 4. Since no EXT-INT signal is used in this example, bit 1 of NC optional parameter (bit) No. 8 (No. 13, 14, 21, 22) (Ready signals of CN0: to CN4:) should be set to "1" in advance.

(1) Timing Chart for READ

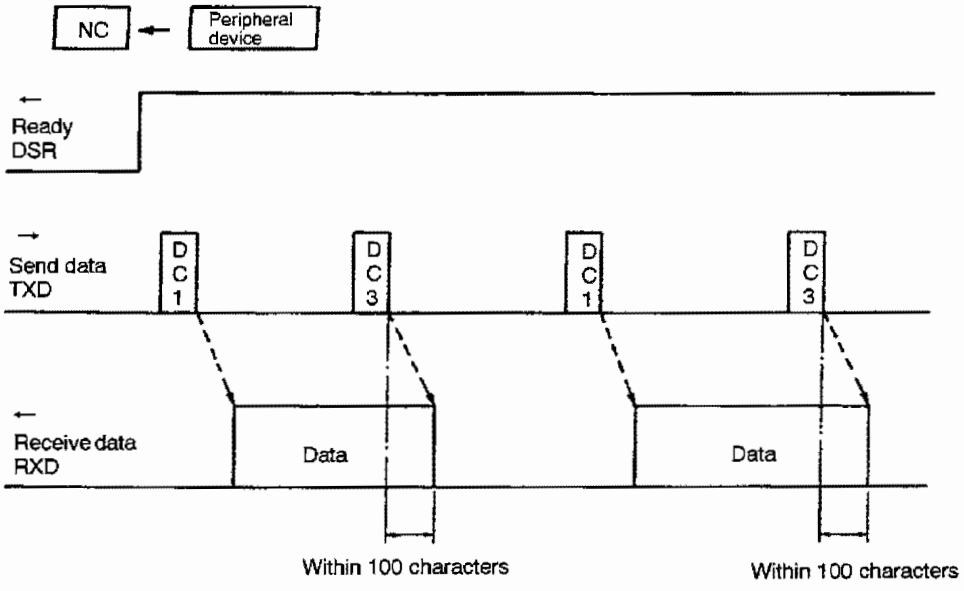


Fig. 3-15 Timing chart for READ (DC Code Control)

(a) The NC sends the DC1 code.

(b) On receiving the DC1 code, the peripheral device starts transferring data to the NC.

(c) After reading the program name, the NC sends the DC3 code.

(d) On receiving the DC3 code, the peripheral device suspends transfer of data to the NC. Data transfer stops within 100 characters after transmission of the DC3 code.

(e) When processing at the NC is completed, the NC sends the DC1 code again.

(f) On receiving the DC1 code, the peripheral device starts transferring the data immediately following the data sent in the last transfer operation.

(g) The NC sends a DC3 code and a DC1 code during reading of each 256-character section of the NC program (equivalent to a tape length of 0.65 m).

(h) The peripheral device sends the end of record code and data transfer is terminated.

(i) On completion of data reading, the NC sends the DC3 code.

(2) Timing Chart for PUNCH

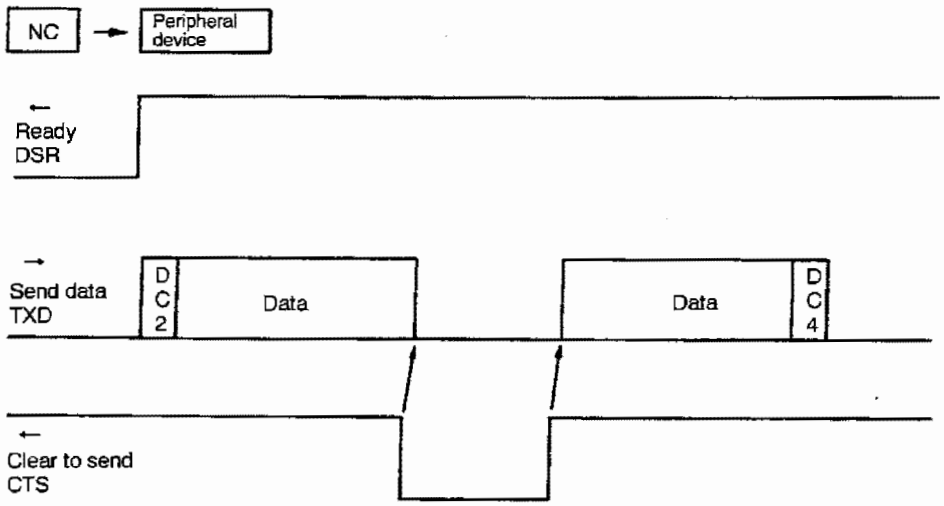


Fig. 3-16 Timing Chart for PUNCH (DC Code Control)

(a) The NC sends the DC2 code.

(b) If the CTS signal is ON, the data to be transferred is sent immediately following the DC2 code.

(c) When the CTS signal goes OFF, data transfer is suspended.

When the CTS signal comes ON again, the NC starts transferring the data following the previous transfer data.

(d) When data transfer is completed, the NC sends the DC4 code.

3-5-3. DC Code Control TYPE2

In the standard DC code control described in 3-5-2, DC codes can only be output from the NC. In TYPE2 control however, DC codes can also be output from the peripheral device.

When this type of control is used, the NC uses the four control codes DC1, DC2, DC3 and DC4, and the host computer side uses two: DC1 and DC3.

DC Code	NC	Host Computer
DC1	Enables data reading: (1) Starts data reading. (2) Cancels temporary stops.	Enables data reading: (1) Responds to DC2. (2) Cancels temporary stops.
DC2	Sent to the peripheral device at the beginning of a data transfer operation as a data reading request.	
DC3	Requests temporary stoppage of data transfer from the peripheral device.	Requests temporary stoppage of data transfer from the NC.
DC4	Terminates data transfer.	

To make TYPE2 control effective, set "1" for both the standard DC code control bit and the DC code control TYPE2 bit in the NC optional parameter (bit) for the relevant channel.

Example 1:

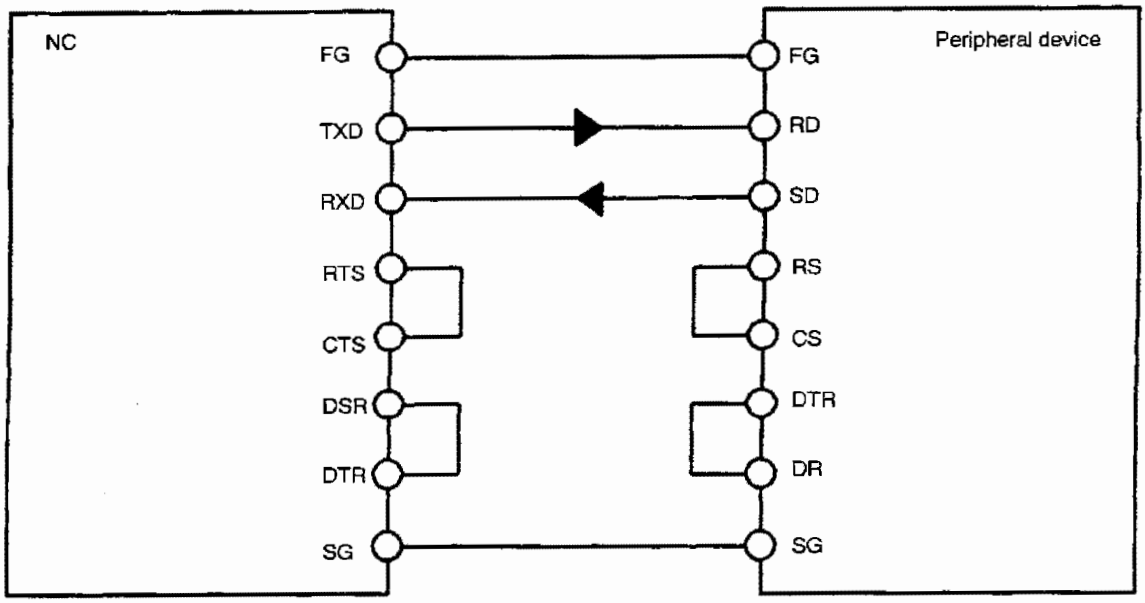


Fig. 3-17 Connection for DC Code Control TYPE2

(1) Timing Chart for READ

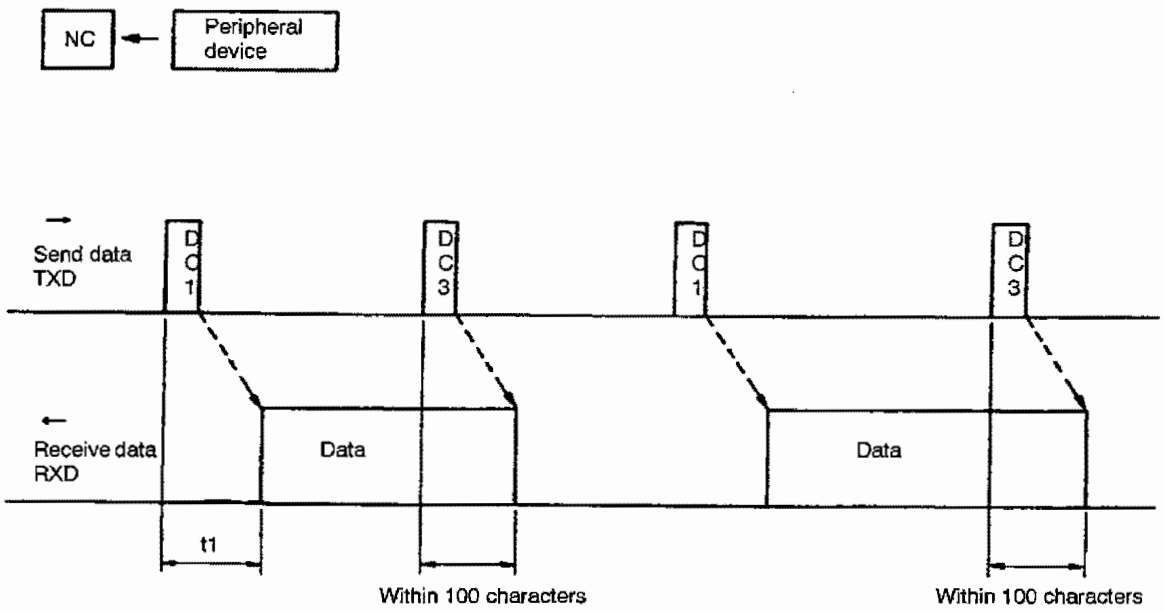


Fig. 3-18 Timing Chart for READ (DC Code Control TYPE2)

(a) The NC sends the DC1 code.

(b) On receiving the DC1 code, the peripheral device starts transferring data to the NC.

(c) After reading the program name, the NC unit sends the DC3 code.

(d) On receiving the DC3 code, the peripheral device suspends transfer of data to the NC. Data transfer stops within 100 characters after transmission of the DC3 code.

(e) When processing at the NC is completed, the NC sends the DC1 code again.

(f) On receiving the DC1 code, the peripheral device starts transferring the data immediately following the data sent in the last transfer operation.

(g) The NC sends a DC3 code and a DC1 code during reading of each 256-character section of the NC program (equivalent to a tape length of 0.65 m).

(h) The peripheral device sends the end of record code and data transfer is terminated.

(i) On completion of data reading, the NC sends the DC3 code.

(2) Timing Chart for PUNCH

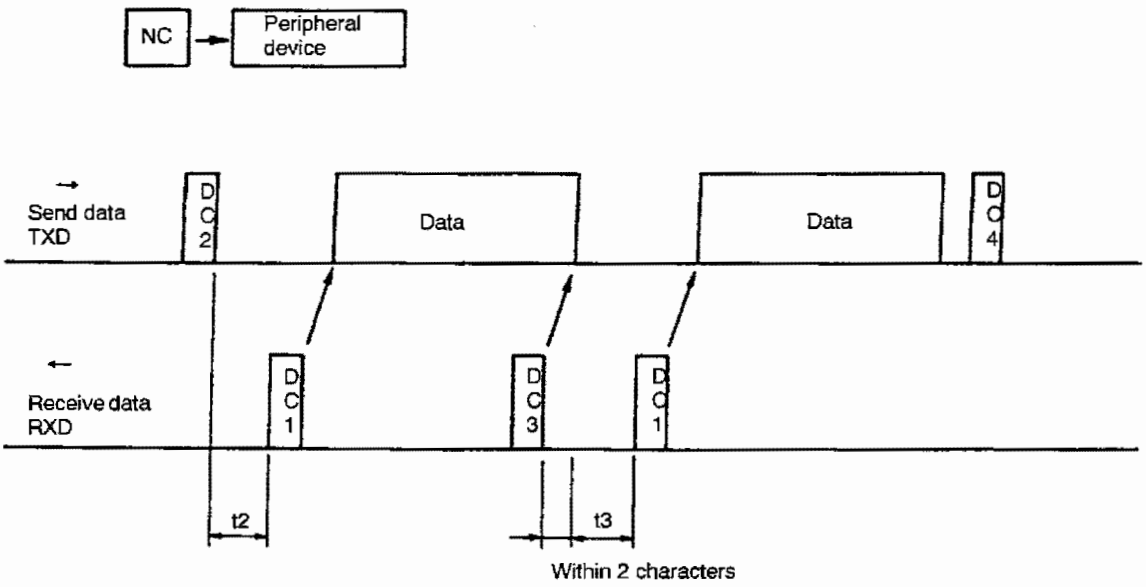


Fig. 3-19 Timing Chart for PUNCH (DC Code Control TYPE2)

(a) The NC sends the DC2 code.

(b) On receiving the DC2 code, the peripheral device sends the DC1 code to the NC.

(c) On reading the DC1 code, the NC starts transferring data to the peripheral device.

(d) If reception processing for the data transfer cannot keep pace with data reception, the peripheral device sends the DC3 code.

(e) The NC stops data transfer within 2 characters after receiving the DC3 code.

(f) After completing the processing backlog, the peripheral device sends the DC1 code again.

(g) On receiving the DC1 code, the NC starts transferring the data immediately following the data sent in the last transfer operation.

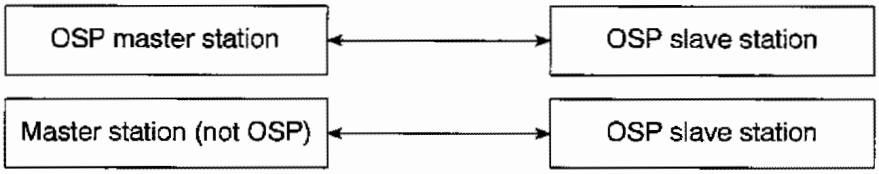
(h) The NC sends the end of record code at the beginning of the transfer data and the DC4 code when data transfer is completed.

[Supplement] If the times t1, t2 and t3 overrun the set values for the ready completion waiting times for the RS-232C channels set in the NC optional parameters (word), an RS232C device reading error occurs.

3-5-4. Slave Station Function

If an attempt is made to transfer data between two OSPs, it is normally impossible because both of the OSPs function as master stations. The slave station function allows communication between two OSPs by making one of them a slave station.

In the slave station mode, an OSP operates in the same way as a tape reader/punch.



Example 1: Example connection to a peripheral device when using the slave station function

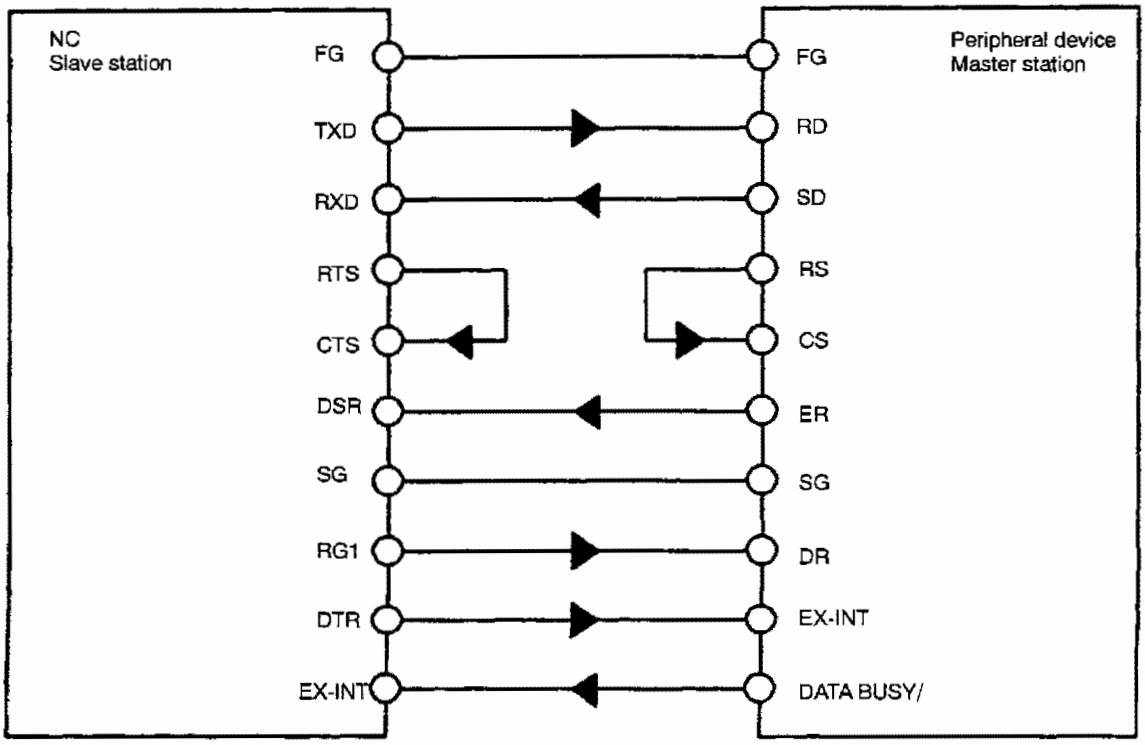


Fig. 3-20 Example Connection (1)

[Supplement] Since an EXT-INT signal is used in this example, bit 1 of NC optional parameter (bit) No. 8 (No. 13, 14, 21, 22) (Ready signals of CN0: to CN4:) should be set to "0" in advance.

(a) The timing chart for READ is the same as the one shown in 3-5-1 (Example 1).

(b) The timing chart for PUNCH is the same as the one shown in 3-5-1 (Example 2).

(c) When reading, the tape feed data following the program section is ignored.

(d) When punching, the tape feed data following the program section is not punched out.

(e) Notwithstanding c) above, if the end of record code is NULL, one character of NULL data is punched out.

Example 2: Example connection to a peripheral device when using the slave station function and DC code control

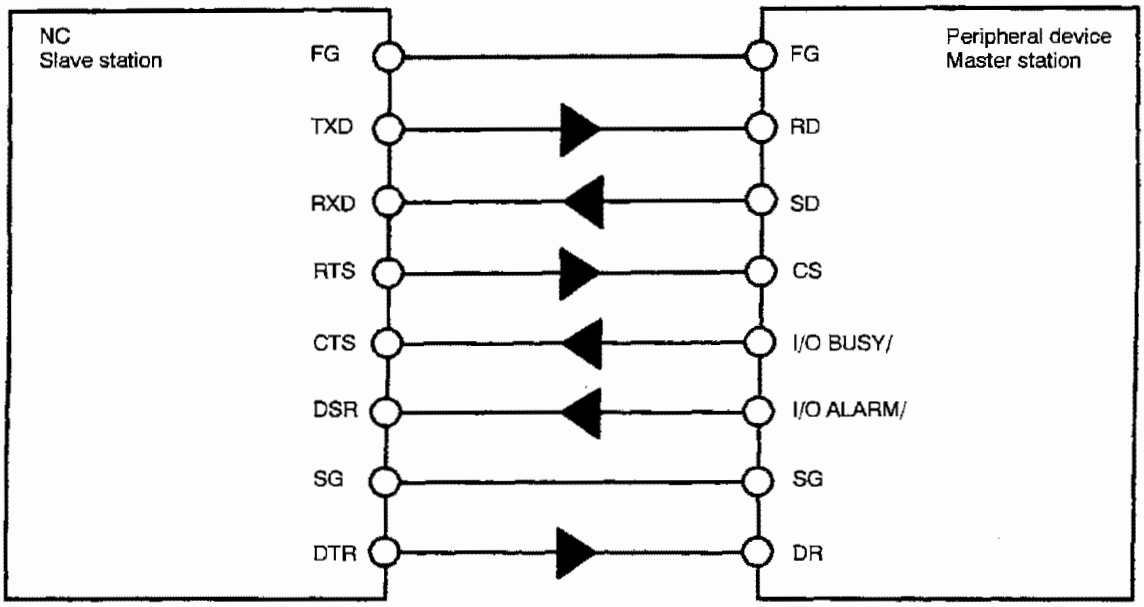


Fig. 3-21 Example Connection (2)

[Supplement] Since no EXT-INT signal is used in this example, bit 1 of NC optional parameter (bit) No. 8 (No. 13, 14, 21, 22) (Ready signals of CN0: to CN4:) should be set to "1" in advance.

(1) Timing Chart for READ

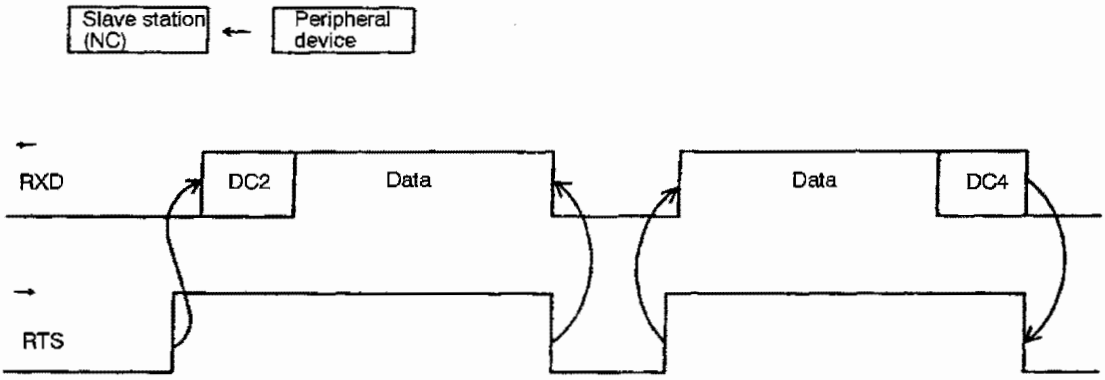


Fig. 3-22 Timing Chart for READ (Slave Station Function)

(a) When reading operation is executed at the NC, the RTS signal is switched ON.

(b) The peripheral device outputs the DC2 code.

(c) On reading the DC2 code, the NC starts data input processing.

(d) When the NC needs to stop reading temporarily to execute processing, it switches the RTS signal OFF. When this signal goes OFF, the peripheral device suspends data transfer to the NC.

(e) On completing the backlog of processing, the NC unit switches the RTS signal back ON.

When the RTS signal comes ON, the peripheral device recommences data transfer to the NC.

(f) The peripheral device outputs the DC4 code to terminate data transfer.

(g) On reading the DC4 code, the NC switches the RTS signal OFF, terminating data reading.

(2) Timing Chart for PUNCH

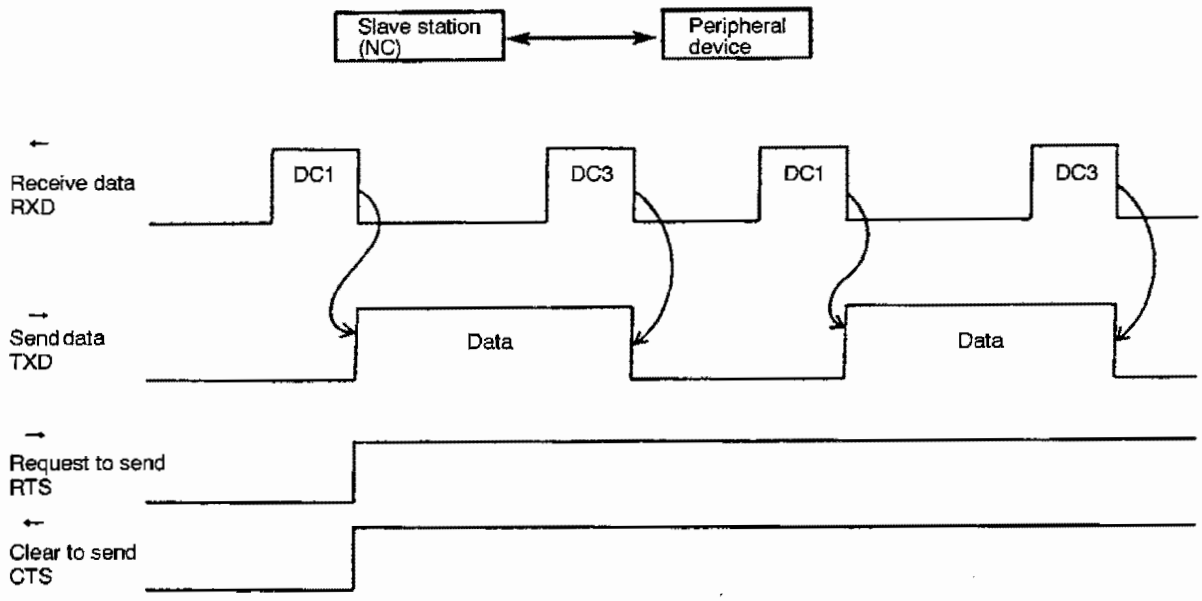


Fig. 3-23 Timing Chart for PUNCH (Slave Station Function)

(a) On reading the DC1 code sent from the peripheral device, the NC executes punch processing of the data.

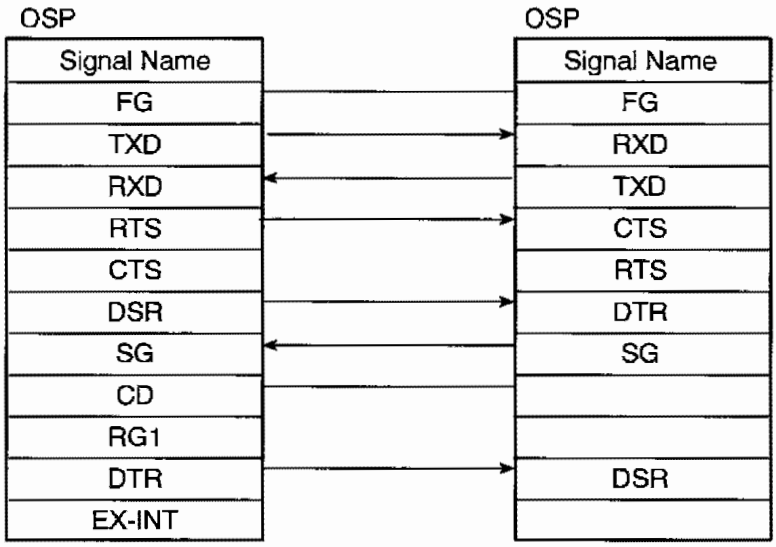
(b) On reading the DC3 code sent from the peripheral device, the NC suspends punch processing.

(c) On reading a DC1 code sent from the peripheral device again, the NC recommences punch processing.

(d) When all the data has been punched, the NC terminates punch processing on reception of the DC3 code from the peripheral device.

Example 3: Example connection between OSPs using the slave station function

Communication between two OSPs is executed by making one the master station and the other the slave station.



NC Parameters OSP

Optional parameter (bit) No. 8	Bit	7	6	5	4	3	2	1	0
	Data	0	0	1	*	0	0	1	0
	Condition Set	File name read	DC code control TYPE 2	Standard DC code control	8-bit JIS	Even parity	Parity check performed	No ready signal setting	1-bit stop bit

NC optional parameter (word) No. 6	Baud Rate
	2400

* indicates either "0" or "1" can be set.

(1) For the parameters indicated above, set the same values for the two OSPs.

(2) Set the channel used for the peripheral device by setting NC optional parameter (word) No. 45 (designation of punch device) and NC optional parameter (word) No. 57 (designation of read device) in advance.

(3) Bits 0 to 4 of NC optional parameter (bit) No. 40 are used to select master or slave status for each channel: set one of the two OSPs as the master station (set "0") and the other as the slave station (set "1").

(4) On completion of the steps above, communication between the two OSPs will be possible.