

A Guide to RS-232C Communication

CONTENTS

SONY



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HIT BIT

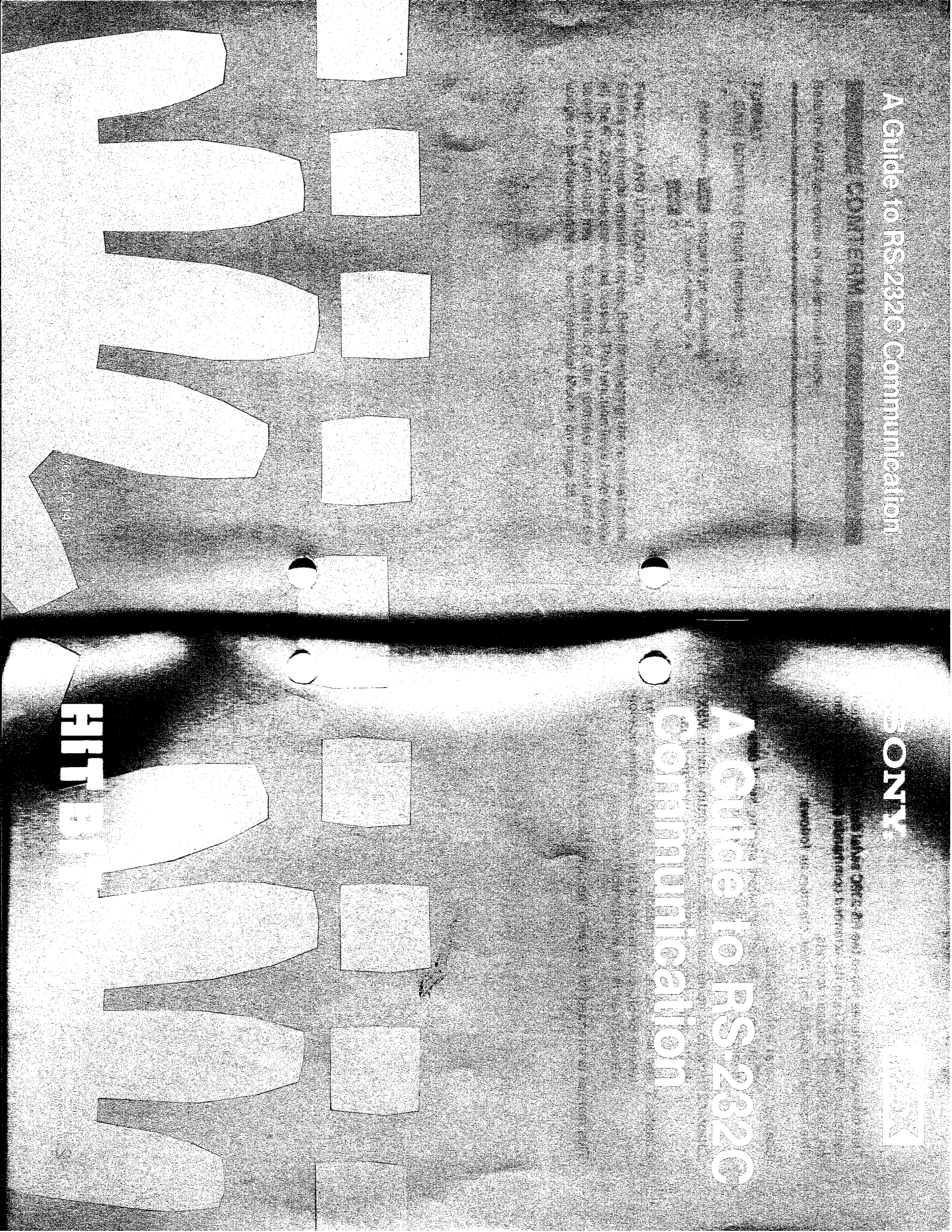


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This manual introduces you to the RS-232C serial data communication using the MSX-BASIC and its extended commands specially provided for the RS-232C communications.
This manual is divided into three chapters as follows:

Chapter 1 What is the RS-232C ?
What needs to be set up before starting serial data communication through the RS-232C interface?

Chapter 2 How to execute serial data communication using MSX-BASIC and extended BASIC commands and functions.

Chapter 3 The MSX-BASIC commands and functions, and the extended BASIC commands for the RS-232C communication are explained in the alphabetical order.

This manual is intended for use with the Sony MSX system only.

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Chapter 1
GENERAL
OVERVIEW
OF RS-232C

1-1 WHAT IS THE RS-232C?

The MSX computer has a variety of functions as a stand-alone personal computer. You can make your own programs using MSX-BASIC, for example, store them on an external memory device such as a floppydisk, and the program can later be loaded and executed, or modified, printed out, and so forth.

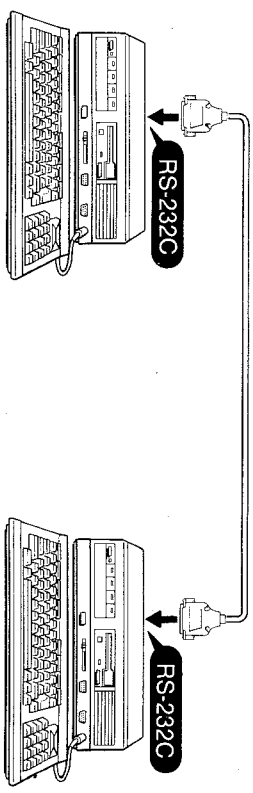
The RS-232C can further expand the functions of the stand-alone computer by providing you, the user of the MSX computer, with communication with other devices such as a computer. By setting up communications with other personal computers, you can exchange the programs or data with the other computer lovers who live far away from you. This is because the RS-232C conforms to the industry standard for serial data interface between a modem and a terminal equipment standardized by the EIA (Electronic Industries Association), and two computers with the RS-232C interfaces can be connected via the modems and the telephone line, for example. An increasing number of personal computers have the RS-232C standard interface, and between these computers communication can easily be performed.

Before performing communication through the RS-232C interface, you may have to work on system set-up, communication mode settings such as transmit/receive speed, data length, and signal control. All those jobs which are said to be a little troublesome, can easily be executed using MSX-BASIC commands and functions specially provided for RS-232C communication. The usage of MSX-BASIC commands and functions is thoroughly covered in this manual.

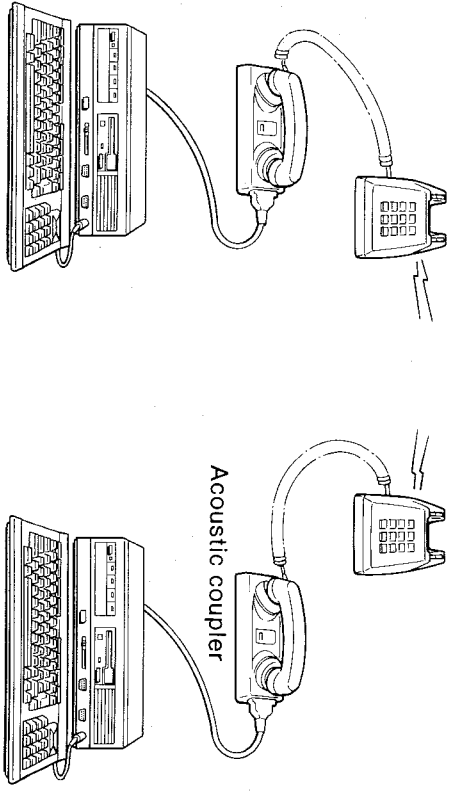
1-2 SYSTEM CONFIGURATION

To perform communication through the RS-232C interfaces, there are mainly three types of system configuration. The following illustrations show the examples when MSX computers have RS-232C interfaces on them.

Connecting two computers directly via the RS-232C interface cable
This system is used to exchange data files between the computers via the RS-232C interface, for example.

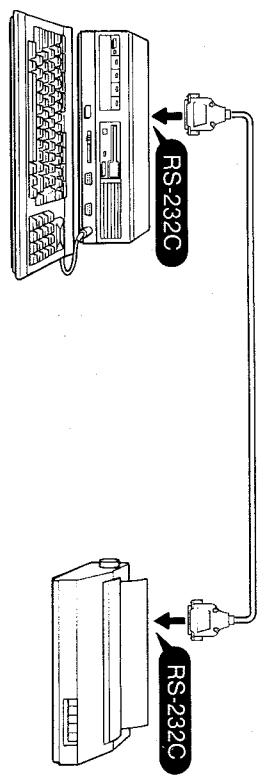


Connecting two computers via telephone line
This system enables communicating with the equipment far away.

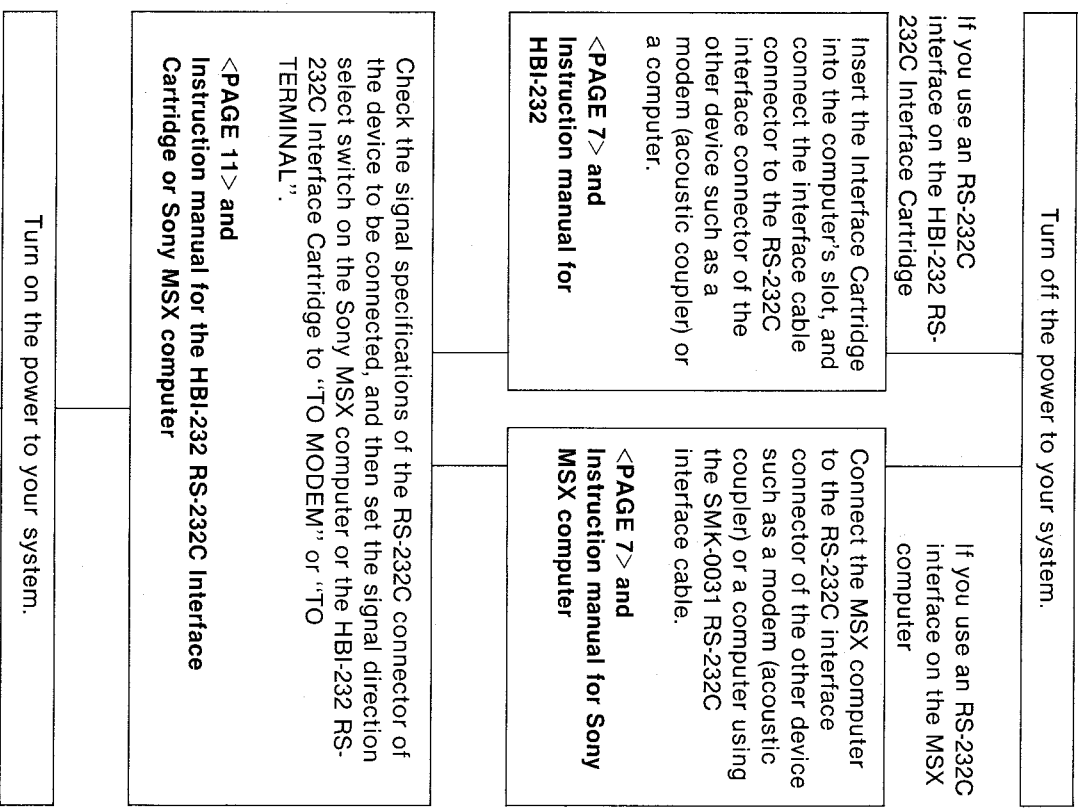


1-3 PREPARATION

Connecting to peripherals
 This system allows the MSX computer to utilize peripherals, such as a printer which is provided with an RS-232C interface.



The following flow chart indicates how to start RS-232C communication.
 For details of each procedure, refer to the page shown in <PAGE **>.



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1-3-1 SWITCHING THE SIGNAL FLOW

There are two types of RS-232C interface specifications: **MODEM** type and **TERMINAL** type. Since the RS-232C is a standard for serial data communication between a modem and a terminal equipment, **MODEM** type interface and **TERMINAL** type interface can be directly connected with a standard straight cable. However, if two **MODEM** type equipments or two **TERMINAL** type equipments are connected, a cross cable called a null modem cable is required. With the Sony MSX computer, switching between **MODEM/TERMINAL** can easily be performed using the signal direction select switch so that **MODEM** or **TERMINAL** equipment can be connected to the MSX computer without the null modem cable.

If the equipment to be connected is a **TERMINAL** type, set the switch to **TO TERMINAL** position, and if it is a **MODEM** type, set the switch to **TO MODEM** position. The function and flow direction of the signals when the MSX computer's switch is set to **TO MODEM** is as follows:

Pin No.	Signal name	Function when MSX computer's switch is set to TO MODEM	Signal flow TERM ↔ MODEM
1	FG	Protective ground	—
2	SD (TXD)	Transmit data	→
3	RD (RXD)	Receive data	←
4	RS (RTS)	Notifies the connected device that your MSX computer is ready to start transmitting data (Request to Send).	→
5	CS (CTS)	The connected device notifies your MSX computer that it is ready to receive data. (Clear to Send)	←
6	DR (DSR)	The connected device notifies your MSX computer that it is ready for both transmitting and receiving data. (Data Set Ready)	↔
7	SG	Signal ground	—

Set the RS-232C data format and communication mode so that communication mode matches to that of the connected device on the other side.
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Let's expand your computer world through the RS-232C port¹⁾!

For details of actual communication, see "2-1 Practicing RS-232C Serial Data Communication" on page 18 and BASIC command and function reference on page 32.

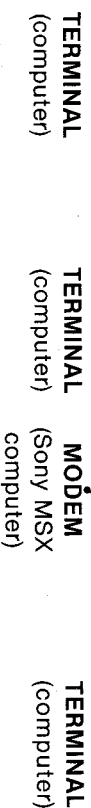
¹⁾The RS-232C port is the RS-232C interface on the MSX computer, or on the RS-232C Interface Cartridge.

8 CD (DCD)	The connected modem notifies your MSX computer that it has detected the carrier signal ¹⁾ . (Data Carrier Detect)	↑
9-19 NC	No connection	—
20 ER (DTR)	Notifies the connected device that your MSX computer is ready for both transmitting and receiving data. (Data Terminal Ready)	↓
22 CI (RI)	The connected modem notifies that it has detected the telephone ringing.	↑

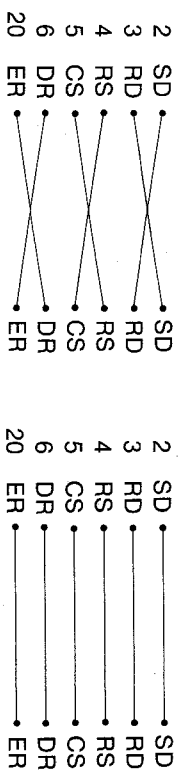
¹⁾Carrier detect signal is used to notify that the communication line is operative when the computers are connected to a telephone line through the modems (acoustic couplers) and a telephone line.

To connect two terminal equipments (computers)

Sony MSX computer is designated to a modem equipment by setting the switch to TO TERMINAL position.



A null modem cable required.



No null modem cable required.

1-3-2 SETTING THE RS-232C DATA FORMAT AND COMMUNICATION MODE

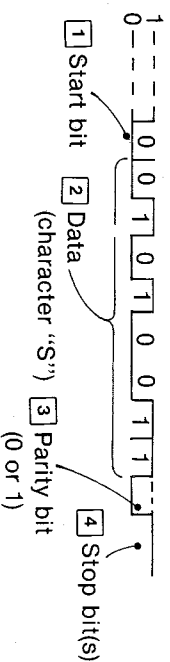
Before starting communication through the RS-232C interface, data format such as data length, parity, etc. and the transmit/receive speed have to be set. In addition, communication control modes specially provided for the MSX computer are available. All those data format and communication mode settings can be made using the MSX extended BASIC command "COMINI" (see page 55).

Data format and communication speed

Data format

In the MSX computer, data is handled in 8-bit (1 byte) unit. In addition, data transmit/receive is performed in **asynchronous mode** in which no sync character is used to transmit/receive data and specified data format assures of correct data communication. The same data format needs to be specified in both transmitter and receiver in the RS-232C serial data communication so that data can be exchanged without fail. The chart below shows the typical data format for transmitting ASCII character in asynchronous mode which is often employed in the MSX computer.

To transmit "S" (53H = 01010011b)



1 Start bit

This bit indicates that the character following this bit is the data character. This bit is defined to be 0.

2 Data length

For the RS-232C communication, data length of one character has to be defined according to the type of data to be transmitted/received. The data length is specified in bit units, and **8-bit data length is usually employed in the MSX computer.**

5 bits } Used for special purposes such as domestic or

6 bits } international telex for example.

7 bits: Used only for ASCII code

8 bits: Used to exchange a program in machine language, or codes of 80H to FFH.

3 Parity bit

The "parity bit" can be utilized for the RS-232C communication so that incorrect data transfer can be detected. This is the error checking method in which the total number of binary "1"s in a character data is always even or always odd.

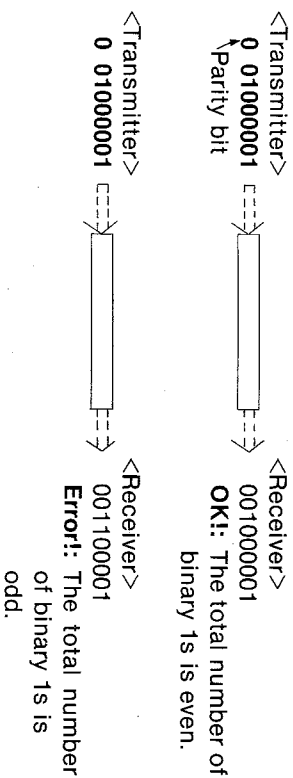
The value of the parity bit is automatically set to 1 or 0 so that the total number of binary "1"s in a character data and the parity bit is always even or always odd.

Example

Character data = "A" (41H)

Data length = 8 bits

Even parity



The type of the parity check can be selected out of the following 4 types. **No parity check type is usually employed in the MSX computer.**

Even parity:

Total number of binary "1"s is always set to even.

Odd parity:

Total number of binary "1"s is always set to odd.

No parity:

No parity check which is often employed in the RS-232C communication.

Ignore parity:

When transmitting, no parity bit will be sent to the connected device, and when receiving the received parity bit will be ignored. This mode is effective only when the data length is 5 to 7 bits.

4 Stop bit length

The stop bit(s) is added at the end of a data character, and it indicates the end of the data. For the RS-232C communication, stop bit length has to be defined. Either 1 bit, 1.5 bits, or 2 bits is selectable, and **1-bit stop bit length is usually employed in the MSX computer.**

Baud rate

Baud rate is the data flow speed to transmit or receive data including start bit and stop bit(s) specified by the number of bits per second. The same speed has to be specified in both the connected devices on a communication line. However, it is possible to set a different speed for transmitting and receiving data in one device. One of the following baud rates can be selected:

50, 75, 110, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, 19200 bps (bits/second)

When communicating via an acoustic coupler and a telephone line, it is recommended to specify 300 or 1200 bps.

Note: To perform communication using BASIC, it is recommended to set a speed at or lower than 1200 bps so that correct data transfer is assured.

To set communication control modes

The following communication control modes are useful to modify the data delimiter according to the connected device, prevent data overflow, and so forth.

Shift-in/shift-out control

When the connected device on the other side uses 7-bit JIS (Japan Industry Standard) character set, the SI code (0FH) and SO code (0EH) control is used. SI code notifies that data following the code is the Japanese Katakana characters, and SO code the alphanumeric characters. **Since the MSX computer usually employs 8-bit character data, it is not necessary to specify SISO control unless the connected device uses the 7-bit JIS character set.**

Automatic line feed insert/delete control

The MSX computer uses a set of carriage return code (0DH) and line feed code (0AH) as a data delimiter. However, to communicate with a computer which puts only a carriage return code as a data delimiter, the line feed code after the carriage return code has to be deleted when transmitting data, and has to be added when receiving data by activating this control mode.

To perform RS-232C serial data communication with another MSX computer, normally it is not necessary to specify this mode.

XON/XOFF control

In RS-232C communication, data to transmit or received data is once stored in a specified buffer area which is called a file. The XON/XOFF control mode prevents overflow of the buffer. In this method, the receiver will send an XOFF code (13H) to the transmitter when 113 characters of data is in the receive buffer (128 characters), and will send XON code (11H) when there are 2 characters remaining in the receive buffer.

The transmitter will suspend data transmission when it receives the XOFF code, and will resume data transmission when it receives XON code.

When the computer is connected to a device which is not programmed to use the overflow control such as a printer, do not activate this overflow control mode.

CS-RS handshake

In this method, computer first sends the RS (Request to Send) signal to the modem to notify that it is to start data transmission, and when the modem sends back the CS (Clear to Send) signal to the computer, the computer starts data transmission. Namely, data exchange is started after the connected modem notifies the computer that it is ready to receive data responding to the request of data transmission from the computer.

Normally, CS-RS handshake control is employed. If the CS-RS handshake is activated with the MSX computer, the computer will suspend data transmission by PRINT#, SAVE, until the CS signal is set to ON.

When the CS-RS handshake method is not adopted in the connected device, do not specify the CS-RS handshake method.

Time out

When CS-RS handshake is designated, data transmission is not resumed until the CS signal changes to ON. If a certain time is specified, time out error can be signaled. The time out error will be declared when the specified time has elapsed before the CS signal is set to ON, which prevents the computer from endlessly waiting for the CS signal set to ON. The time is specified in seconds in the range from 0 to 255.

Chapter 2

BASIC OPERATION

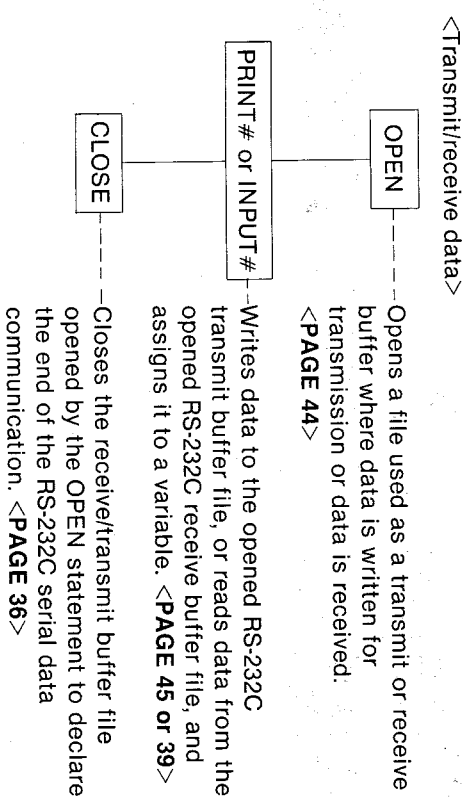
2-1 PRACTICING RS-232C SERIAL DATA COMMUNICATION

There are mainly two ways of using serial data communication for your MSX computer: data/program exchange with another computer or operating the MSX computer as a terminal of the other host computer. In the terminal mode, all your MSX computer can do is sending data from the keyboard, or receiving program from the host computer, for example.

2-1-1 DATA AND PROGRAM COMMUNICATION

Basic procedure for transmitting or receiving data

The following is the basic procedure for transmitting or receiving data after preparation is made. Setting a specified area in the memory is required for data exchange in the RS-232C communication. (Not necessary for transmitting/receiving program) The specified area is called a file. For details of the MSX-BASIC command names described below, see the explanation in Chapter 3.



Note

The signals status will be as follows:

RS signal: **ON** when the OPEN statement is executed.

OFF when the CLOSE statement is executed.

ER signal: **ON** when the computer is turned on.

CS signal: In case CS-RS handshake control is activated by the MSX-BASIC command COMINI, data transmission by the PRINT# will be suspended until the CS signal is set to ON.

Basic procedure for transmitting or receiving program

If the connected device is another MSX computer, the transmitted or received programs can be utilized in both MSX computers. However, when the connected device is an other type of computer, the exchanged programs cannot be utilized either in the connected computer or in your MSX computer. However, if the MSX-BASIC programs is transmitted as a data file from an other type of computer to your MSX computer, you can use the MSX-BASIC program (see the program example on page 23).

For details of the MSX-BASIC command names described below, see the explanation in Chapter 3.

The following are the MSX-BASIC commands to transmit or receive program via a specified RS-232C port (interface) after preparation is made.

<Transmit> **SAVE** ----- Sends a program in ASCII format through the specified RS-232C port.

<Receive> **LOAD** ----- Loads a program in ASCII format from the specified RS-232C port

Notes

The signals status will be as follows:

RS signal: **ON** before and while receiving a program.

OFF after receiving a program.

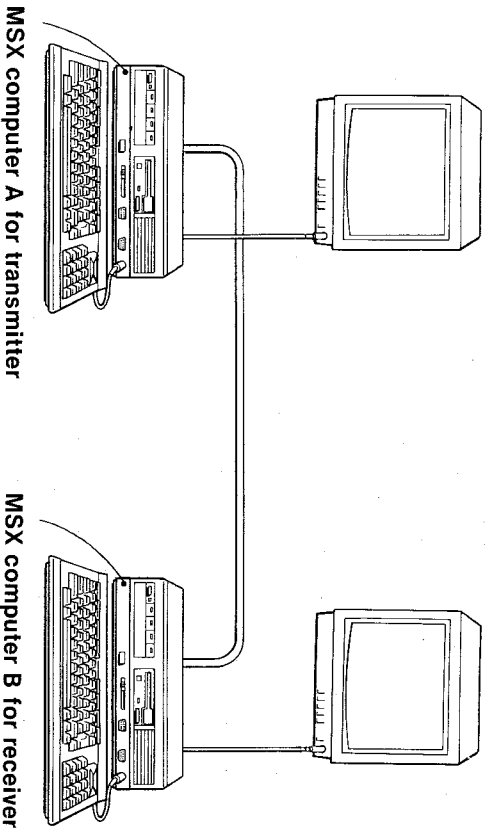
ER signal: **ON** when the computer is turned on.

CS signal: In case CS-RS handshake control is activated by the MSX-BASIC command COMINI, program transmission by the SAVE will be suspended until the CS signal is set to ON.

Examples for transmitting and receiving data

The following example is the case in which numeric data input from the keyboard of the MSX computer A is transmitted to the MSX computer B where the input numeric data is processed and then displayed on the monitor screen.

The calculation $A + B + C =$ will be performed on the MSX computer B according to the numeric data input from the MSX computer A. The result of the calculation will be displayed on the monitor screen connected to the MSX computer B.



<<Program for MSX computer A as a transmitter>>

```

10 DIM A(2)
20 CALL COMINI ("0:8N3XNNNN",300,300,5)
30 OPEN "COMO:" FOR OUTPUT AS #1
40 PRINT: PRINT "Input data to send"
50 INPUT "A=";A(0)
60 INPUT "B=";A(1)
70 INPUT "C=";A(2)
80 PRINT #1,"start"
90 S$=""
100 FOR I=0 TO 2
110 IF I<>2 THEN S$=S$+STR$(A(I))+"," ELSE S$=S$+STR$(A(I))-8
120 NEXT I
130 PRINT #1,S$
140 PRINT #1,"End"
150 GOTO 40

```

The each step above means:

- 1 Declares the name of numeric type array variables from A(0) to A(2) where the value of A, B, and C will be assigned.
- 2 Initializes the RS-232C port numbered 0 (see page 34) so that the data format and communication modes settings will be performed as follows:

```

RS-232C port number: 0 (0)
Data length: 8 bits (8)
Parity check: No parity check (N)
Stop bit: 2 bits (3)
XON/XOFF control: Enables control (X)
CS-RS handshaking: No handshaking (N)
Automatic line feed insert/delete: No insert/delete (NN)
Shift-in/shift-out control: No control (N)
Transmit/receive speed: 300 bps (.300,300)
Time out: 5 seconds (.5)

```

- 3 Opens the file for the RS-232C transmit buffer with the file number 1.
- 4 Displays the message "Input data to send" on the monitor screen.
- 5 Prompts you to input the value of the variables A(0), A(1), and A(2) from the keyboard, one by one according to the displays "A=", "B=", and "C=" on the monitor screen.
- 6 Sends the message "Start" to the connected MSX computer B.
- 7 Assigns a null string to the string type variable S\$ so that value set in S\$ will be cleared.
- 8 Converts numeric type data assigned to the variables A(0), A(1), A(2) to the string type variable S\$.
- 9 Writes data assigned to the S\$ to the transmit buffer file 1 so that the data will be sent to the MSX computer B.
- 10 Sends the message "End" to the connected MSX computer B.

«Program for MSX computer B as a receiver»

```

10 CALL COMINI("O:8N3XNNNN",300,300,5) _____1
20 OPEN "COMO:" FOR INPUT AS #1 _____2
30 PRINT: PRINT "###" Now waiting data "###" _____3
40 LINE INPUT #1,G$ _____4
50 IF G$="Start" THEN 60 ELSE 30 _____4
60 INPUT #1,A,B,C _____4
70 PRINT "A=";A _____5
80 PRINT "B=";B _____5
90 PRINT "C=";C _____5
100 D=A+B+C _____6
110 PRINT "A+B+C=";D _____6
120 LINE INPUT #1,G$ _____7
130 IF G$="End" THEN 30 ELSE 120 _____7
140 END

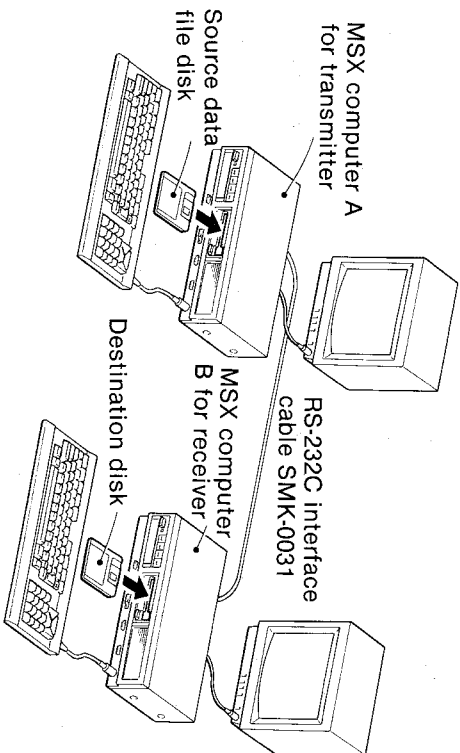
```

The each step above means:

- 1 Initializes the RS-232C port numbered 0 so that the data format and communication modes settings will be performed the same as the MSX computer A, the transmitter.
- 2 Opens the file for the RS-232C receive buffer with the file number 1.
- 3 Displays the message "###" Now waiting data "###" on the monitor screen.
- 4 Starts reading data from the receive buffer file, and assigns it to numeric type variables A, B, and C if the message "Start" is sent from the transmitter.
- 5 Displays the numeric data assigned to the variables A, B and C on the monitor screen.
- 6 Calculates "A + B + C" and displays the answer "D" by numeric constants.
- 7 If the "End" message is sent from the transmitter, waits for another data input from the transmitter's keyboard.

Examples for transmitting and receiving a data file

The following example is the case in which data is exchanged between the two MSX computers. The data file of a MSX-BASIC program stored in a floppydisk of computer A is transmitted to and received by the MSX computer B, and the data file is stored on a destination floppydisk of the MSX computer B. Any desired file on the source floppydisk can be specified for transmission by inputting its file name from the keyboard.



«Program for MSX computer A as a transmitter»

```

10 MAXFILES=2 _____1
20 INPUT "Input data file name to send: ";F$ _____2
30 PRINT "###Now sending data ###" _____3
40 CALL COMINI("0:8N3XNNNN",300,300,5) _____4
50 OPEN "COMO:" FOR OUTPUT AS #1 _____5
60 OPEN F$ FOR INPUT AS #2 _____6
70 BUF$="Start":PRINT #1,BUF$ _____7
80 IF EOF(2) THEN GOTO 120 _____8
90 LINE INPUT #2,BUF$ _____8
100 PRINT #1,BUF$ _____8
110 GOTO 80 _____8
120 BUF$="End":PRINT #1,BUF$ _____9
130 CLOSE _____9
140 END _____9

```

The each step above means:

- 1 Declares the number of files that can be simultaneously opened in this program is 2.
- 2 Prompts the user to input the name of the file to be transmitted from the keyboard. The input file name will be assigned to the variable F\$.
- 3 Displays the message "### Now sending data ###" on the monitor screen.
- 4 Initializes the RS-232C port numbered 0 so that the data format and communication modes settings will be performed as follows:

- RS-232C port number: 0 (0)
- Data length: 8 bits (8)
- Parity check: No parity check (N)
- Stop bit: 2 bits (3)
- XON/XOFF control: Enables control (X)
- CS-RS handshaking: No handshaking (N)
- Automatic line feed insert/delete: No insert/delete (NN)
- Shift-in/shift-out control: No control (N)
- Transmit/receive speed: 300 bps (.300,300)
- Time out: 5 seconds (.5)

- 5 Opens the RS-232C file for the transmit buffer as the file number 1.
- 6 Opens the data file "F\$" stored on the floppydisk of the MSX computer A as the file number 2.
 - The mode "INPUT" is specified so that the contents of the file number 2 can be read and assigned to a string type variable.
- 7 Sends the message "Start" to the connected MSX computer B.
- 8 Checks if the EOF (end-of-file) code has been read from the file number 2. If EOF code has not been received, reads a character string one by one from the file number 2 on the floppydisk, and then assigns it to a string type variable BUF\$. Writes data assigned to the BUF\$ to the transmit buffer file 1 so that the data will be sent to the MSX computer B.
- 9 If the EOF (end-of-file) code has been received in the file numbered 2, the message "End" will be sent to the MSX computer B, and all opened files will be closed, and this program will end.

«Program for MSX computer B as a receiver»

```

10 MAXFILES=2
20 CLEAR 2000
30 DIM BUF$(500)
40 INPUT "Input file name to save: ",F$
50 CALL COMINI("0:8N3XNNNN",300,300,5)
60 OPEN "COMO:" FOR INPUT AS #1
70 OPEN F$ FOR OUTPUT AS #2
80 LINE INPUT #1,S$
90 IF S$="Start" THEN GOTO 100 ELSE 80
100 N=1
110 LINE INPUT #1,S$
120 IF S$<>"End" THEN BUF$(N)=S$ ELSE 160
130 PRINT BUF$(N)
140 N=N+1
150 GOTO 110
160 PRINT"###Now saving data ###"
170 N=N-1
180 FOR I=1 TO N
190 PRINT #2, BUF$(I)
200 NEXT
210 CLOSE
220 END

```

The each step of the above program means:

- 1 Declares the number of files simultaneously opened in this program is 2.
- 2 Sets the size of the character string area to 2000 bytes in memory.
- 3 Declares an area of 501 string type variables from BUF\$(0) to BUF\$(500).
- 4 Prompts the user to input the name of the file to save the received data from the keyboard.
- 5 Initializes the RS-232C port numbered 0 so that the same data format and communication modes settings as the MSX computer A are performed on the MSX computer B.
- 6 Opens the receive buffer file with the file number 1.
- 7 Opens the data file "F\$" on a floppydisk of the MSX computer B with the file number 2 so that received data file will be written into the file.
 - The mode "OUTPUT" is specified so that the received data will be written into the file numbered 2.
- 8 Waits for the message "Start" to be sent from the transmitter.
- 9 Upon receipt of the message "Start", starts receiving character strings one by one until the message "End" will be sent from the transmitter. While receiving character strings one by one, the character string last received is displayed on the screen.

- 10 Upon receipt of the message "End", the message "### Now saving data ###" will be displayed on the screen, and starts writing the received data in the receive buffer to the file numbered 2 on the floppydisk.
- 11 Closes all opened files when all data in the receive buffer is stored on the floppydisk, and the program will end.

Examples for transmitting and receiving a program

The following example is the case in which MSX computer A will transmit a program in an ASCII format, and the MSX computer B will receive the program also in an ASCII format until EOF (end-of-file) code is received. The RS-232C communication port number 0 is utilized in both transmitter and receiver.

```

MSX computer A      CALL COMINI("0:8N3XNNNN",1200,1200,5)
(transmitter)      SAVE "COMO:"

MSX computer B      CALL COMINI("0:8N3XNNNN",1200,1200,5)
(receiver)          LOAD "COMO:"

```

2-2 TERMINAL OPERATION

In this mode, your MSX computer is often connected to the host computer through a modem equipment (acoustic coupler), for example, and is used as a terminal of the host computer. If set to the terminal mode, the program of your MSX computer is no longer operative, and all your MSX computer can do is to just display the data transmitted from the host computer, and to input the data from the keyboard to transmit to the host computer. However, various extra functions are also available using the keyboard as shown below.

Basic procedure to set up a terminal

The following is the MSX-BASIC command for setting your MSX computer to a terminal of a host computer after preparation is made. For details of the MSX-BASIC command described below, see the explanation in Chapter 3.

COMTERM.....Sets your MSX computer to work as a terminal.

To reset the terminal, or to exit from the terminal mode, press the **CTRL** key and **STOP** key simultaneously.

Note

The RS signal is held ON while your MSX computer is working as a terminal.

Extra terminal functions using the keyboard

The data received from the host computer, or input from the keyboard and transmitted to the host computer, is also displayed on the screen, printed out, and so forth. In addition, the break sequence¹⁾ can be transmitted using the keys on the keyboard of your MSX computer. Press the following set of keys to activate the extra terminal function mode.

SHIFT + **F1**

Displays the received control codes (00H to 1FH) by “^” and the character assigned to the control code plus 40H.

ex.) The return code (0DDH) will be displayed as follows:

^ M
4DH

To exit from this function mode, press the **SHIFT** and **F1** keys simultaneously again.

¹⁾ Break sequence: The break sequence are used to set the SD signal to spacing state 0.

SHIFT + **F2**
Displays the data input from the keyboard on the screen. To exit from this function mode, press the **SHIFT** and **F2** keys simultaneously again.

SHIFT + **F3**
Displays and prints out the data input from the keyboard at the same time. To exit from this function mode, press the **SHIFT** and **F3** keys simultaneously again.

STOP

Press and hold this key to transmit break sequence to the host computer.

Note

The **SHIFT** key is identical with the **↓** key on the MSX computers such as HB-10P.

Chapter 3
MSX-BASIC
FOR RS-232C
COMMUNICATIONS

3-1 COMMANDS AND FUNCTIONS OF THE MSX-BASIC FOR RS-232C COMMUNICATION

The MSX-BASIC commands and functions are specially provided for the RS-232C communication. Using those commands and functions, various communication modes, interrupt control, receive/transmit control, all of which are indispensable for the RS-232C communication, can easily be set. The following MSX-BASIC commands and functions are divided into two categories:

MSX-BASIC commands and functions used for RS-232C communication

Extended MSX-BASIC commands for RS-232C communication
 Executed with the "CALL" statement

The commands and functions in each category are explained in alphabetical sequence.

3-1-1 INTRODUCTORY REMARKS

LOAD (load) Command, function name

Loads a BASIC program from the RS-232C port. Function

FORMAT
 LOAD "COM [port number]:"[R]

Format

Port number **Cond.** Integer type constants, $0 \leq \text{port number} \leq 4$

Omit 0 Input condition

When input is omitted

R **Omit** Loads a BASIC program only.

FUNCTION AND UTILIZATION

Supplementary command and function explanations, and execution examples in which commands and functions are utilized.

Execution example
 LOAD "COM0:",R

- In regard to a function, **FUNCTION** is written in front of the function name as follows:
 Function EOF (end of file)
- An input item inside [] in the Format section can be omitted.
- The "..." indicates that the input item can be repeatedly specified within the input range per line as follows:
 INPUT #file number, variable [variable].....

3-1-2 LIST OF COMMANDS AND FUNCTIONS FOR RS-232C

<MSX-BASIC commands and functions for RS-232C>

Command	Name of command or function	Function	Page
OPEN	OPEN	Opens an RS-232C file ¹⁾ .	44
CLOSE	CLOSE	Closes the file opened by an OPEN statement.	36
PRINT #	PRINT #	Writes data to a transmit buffer file.	45
PRINT #USING	PRINT #USING	Writes data to a transmit buffer file in a specified format.	46
INPUT #	INPUT #	Reads data from a receive buffer file, and assigns it to a variable.	39
LINE INPUT #	LINE INPUT #	Reads a string from a receive buffer file, and assigned it to a variable.	40
SAVE	SAVE	Sends a BASIC program to the RS-232C port ²⁾ .	51
LOAD	LOAD	Loads a BASIC program from the RS-232C port.	41

¹⁾The file is the specified buffer area which is used as a **receiver/transmit buffer** for the RS-232C communication.

²⁾The RS-232C port number is specified to the RS-232C interface as follows.

- 0: ● RS-232C interface on the MSX computer
 ● RS-232C interface on the RS-232C interface cartridge which is first inserted into the computer's slot when the MSX computer has no resident RS-232C interface.
 1-4: Port number increases one by one as an RS-232C interface is added to the MSX computer using the RS-232C interface cartridge, for example.

Command	Name of command or function	Function	Page
RUN	RUN	Loads a program from the RS-232C port and executes the program.	50
MERGE	MERGE	Loads a program in ASCII format from the RS-232C port, and merges it into the program currently in memory.	43
EOF	EOF	When the last data of a file has been read, -1 is given, otherwise 0 is given.	37
INPUT\$	INPUT\$	Inputs a specified number of characters from the receive buffer file.	38
LOC	LOC	Returns the number of characters in the receive buffer file.	42
LOF	LOF	Returns the free space remaining in the receive buffer file.	42

<MSX-BASIC extended commands for RS-232C>

Name of the commands	Function	Page
COMINI	Initializes the communication mode.	55
COMTERM	Sets the MSX computer in the terminal mode.	62
COMDTR	Sets the ER (DTR) signal to ON/OFF.	54
COMBREAK	Sends the break sequence.	53
COMSTAT	Reads the RS-232C port status.	60
COM GOSUB	Declares a subroutine to which program branches when an interrupt occurs from the RS-232C port.	52
COMON	Enables the interrupt from the RS-232C port.	58
COMOFF	Disables the interrupt from the RS-232C port.	58
COMSTOP	Suspends the interrupt from the RS-232C port.	59

The above extended commands are executed with the CALL (-) statement.

3-1-3 MSX-BASIC COMMANDS AND FUNCTIONS

MSX-BASIC commands and functions used for RS-232C communication.

CLOSE (close)

Closes a file opened by an OPEN statement.

FORMAT

CLOSE [#] [file number] [,file number].....

File number **Cond**

Integer constants,
 $1 \leq$ file number \leq the number specified by
MAXFILES = statement

Omit

Closes all the files.

FUNCTION AND UTILIZATION

The file number has to be the one assigned to the file opened with the OPEN statement. The file number of the file closed can be used again when opening a new file. If the file closed is a transmit buffer file, an EOF code (1AH) will be sent to the connected device.

- The opened files will also be closed by the RUN, END, CLEAR, or NEW commands.

Execution example

CLOSE #1,2,3

The files numbered 1, 2, and 3 are all closed.

Function **EOF** (end of file)

When the last data of a file has been read, -1 is given, otherwise 0 is given.

FORMAT

EOF (file number)

File number **Cond**

Integer constants, variables, array variables, their
expressions,
 $1 \leq$ file number \leq the number specified by
MAXFILES = statement

Given value: Integer type (-1 or 0)

FUNCTION AND UTILIZATION

The file is the one opened as a receive buffer by the OPEN statement. This function checks if the EOF code (1AH) which indicates the end of data is received in the receive buffer file or not. If -1 is given, EOF code is received, otherwise 0 is given.

Execution example

IF EOF(1) THEN CLOSE #1

When the last data is read while data is being read from the receive buffer whose file number is 1, the file is closed by the above statement.

Function **INPUT\$(input dollar)**

Inputs a specified number of characters from a receive buffer file.

FORMAT

INPUT\$(X, [#] file number)

- X **Cond:** Numeric type constants, variables, array variables, their expression,
 $1 \leq X < 256$
- File number **Cond:** Integer constants,
 $1 \leq$ file number \leq the number specified by
MAXFILE = statement

FUNCTION AND UTILIZATION

Reads number of characters (string type data) specified by X from the RS-232C receive buffer file. The file number should be the one assigned to the file opened by the OPEN statement as a receive buffer.

Execution example

```
10 OPEN "COM0:" FOR INPUT AS #1
20 X$=INPUT$(50,#1)
30 CLOSE
```

Opens an RS-232C receive buffer file with the file number 1, inputs 50 characters from the file, and then closes the file.

Range of "X"

During initial status, if X is outside the range from 1 to 200, an error occurs. When the size of the character area is set to more than 255 by a CLEAR statement, a value from 1 to 255 can be selected.

INPUT#(input number)

Reads data from a receive buffer file, and assigns it to a variable.

FORMAT

INPUT# file number, variable [variable],.....

- File number **Cond:** Integer constants,
 $1 \leq$ file number \leq the number specified by
MAXFILES = statement
- Variable **Cond:** Numeric type or string type, their array variables

FUNCTION AND UTILIZATION

Reads data from the receive buffer file. The file number has to be the one assigned to the file opened by the OPEN statement as a receive buffer. If the data is numeric type, spaces, return codes, and line feed codes before the data are ignored. If the data is string type, the data from the first character to the character before a space, comma, return code, or line feed code is read as one data. If the characters are inside " ", only these characters are read as data.

To specify the variables, be sure to assign the type of variables appropriate for the data to be read as follows:

```
ex.) "ABCDEFGG"-----A$(string type variable)
1,2,3,4,5-----A%(numeric type variable)
```

Execution example

```
10 OPEN "COM0:" FOR INPUT AS #1
20 IF EOF(1) THEN GOTO 50
30 INPUT #1,A$:PRINT A$
40 GOTO 20
50 CLOSE #1
```

Opens a receive buffer file numbered 1, reads string type data from the file, and assigns the data to the variable A\$ while displaying it on the screen. If the EOF code is received (the last data has been read), the file is closed.

LINE INPUT # (line input number)

Reads a string from a receive buffer file, and assign it to a variable.

FORMAT

LINE INPUT # file number, variable

File number **Cond.** Integer constants,

$1 \leq$ file number \leq the number specified by
MAXFILES = statement

Variable **Cond.** String type variables, array variables

FUNCTION AND UTILIZATION

Reads string type data from the RS-232C receive buffer file. However, a space, comma, and line feed codes are not considered as punctuation for the data string, which differs from the INPUT# statement. The character string including those items is assigned to a variable as character string data. Only the return code is considered to be punctuation for data. Up to 254 characters can be read from the file.

Execution example

```
10 OPEN "COM0:" FOR INPUT AS #1
20 IF EOF(1) THEN GOTO 60
30 LINE INPUT #1, A$
40 PRINT A$
50 GOTO 20
60 CLOSE #1:END
```

Opens an RS-232C receive buffer file with the file number 1, reads string data from the file, and assigns the data to the string type variable A\$. The contents of the data is displayed on the screen. If end of data character is received, the file numbered 1 is closed.

LOAD (load)

Loads a BASIC program from the RS-232C port.

FORMAT

LOAD "COM [port number] :"[R]

Port number **Cond.** Integer type constants,

$0 \leq$ port number ≤ 4

R **Omit** 0 Loading the program only

FUNCTION AND UTILIZATION

A LOAD statement closes all opened files and deletes the current program from memory, then loads a BASIC program in the ASCII format into memory from the specified port. If the "R" option is specified, however, all data files remain open and the program that is loaded is automatically executed. Upon receipt of the EOF code (1AH), the program loading will end.

Execution example

```
LOAD "COM0:",R
```

Function **LOC (location)**

Returns the number of characters in the receive buffer file.

FORMAT

LOC (file number)

File number **Cond.** Numeric constants, variables, array variables, their expressions,
 $1 \leq$ file number \leq the number specified in
MAXFILES = statement

FUNCTION AND UTILIZATION

The file number should be the one assigned to the file opened by the OPEN statement as a receive buffer.
The size of the RS-232C receive buffer is 128 characters max.

Function **LOF (length of file)**

Returns the free space remaining in the receive buffer file.

FORMAT

LOF (file number)

File number **Cond.** Numeric constants, variables, array variables, their expressions,
 $1 \leq$ file number \leq the number specified by the
MAXFILES = statement
Integer type

FUNCTION AND UTILIZATION

Returns the size of the free space remaining in the receive buffer by the number of characters. The file number should be the one assigned to the file opened by the OPEN statement as a receive buffer.

MERGE (merge)

Loads a program in ASCII format from the RS-232C port, and merges it into the program currently in memory.

FORMAT

MERGE "COM [port number];"

Port number **Cond.** Integer type constants,
 $0 \leq$ port number ≤ 4
Omit 0
Integer type

FUNCTION AND UTILIZATION

If some of the line numbers of the program in memory match line numbers of the program incoming from the RS-232C port, the lines of the program from the RS-232C port replaces the matching lines of the program currently in memory.
After the MERGE command executed, the merged program will reside in memory, and control will return to BASIC at the command level.

Execution example

MERGE "COM0:"

Loads lines of the program from the RS-232C port numbered 0, and merges them with the program in memory.

OPEN (open)

Opens an RS-232C file.

PRINT # (print number)

Writes data to an RS-232C transmit buffer file.

FORMAT

OPEN "COM [port number];" [FOR model] AS [#] file number

Port number **Cond.** Integer type constants,
0 ≤ port number ≤ 4

Omit 0

Mode **Cond.** OUTPUT, INPUT
Omit OUTPUT/INPUT

File number **Cond.** Integer constants,

1 ≤ file number ≤ the number specified by
MAXFILES = statement

FUNCTION AND UTILIZATION

Allocates an I/O buffer which will be used as a transmit or receive buffer for RS-232C communication. The buffer allocated is called a file. The transmit buffer file will be opened if OUTPUT is specified as the mode, and the receive buffer file will be opened if INPUT as the mode. If "mode" is not specified, and no EOF (end-of-file) code handling is done, the RS-232C port can be accessed for both transmitting and receiving data.

An OPEN statement must be executed before the following statements using the RS-232C files:

PRINT#, PRINT# USING, INPUT#, LINE INPUT#, INPUT\$

Execution example

```
OPEN "COM0:" FOR OUTPUT AS #1
```

Opens RS-232C transmit buffer with the file number 1.

FORMAT

PRINT # file number, expression [separator] [expression]....

File number **Cond.** Integer constants, 1 ≤ file number ≤ the number specified by MAXFILES = statement

Expression **Cond.** String type and numeric type constants, variables,

array variables, their expressions

Separator **Cond.** Comma (,) or semicolon (;)

FUNCTION AND UTILIZATION

The file is the one opened by the OPEN statement as a transmit buffer. Numeric type constants, numeric type and string type variables are written as they are, and string type constants are written inside quotation marks (" ").

Separator function

When data is punctuated with a comma (,), spaces are inserted between the data by a 14-digit tab function, and when it is punctuated with a semicolon (;), it is followed by the next data. If a separator is not written at the end, return code and line feed code will be output.

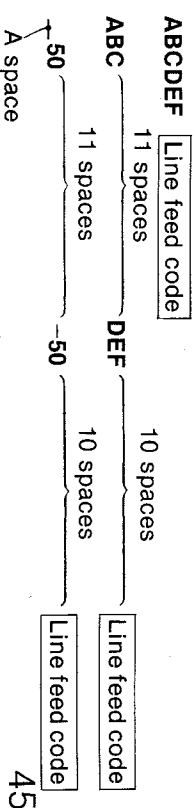
Numeric data and signs

In regard to signs that indicate positive or negative, "+" is omitted while "-" sign is transmitted.

Execution example

```
10 OPEN "COM0:" FOR OUTPUT AS #1
20 A$="-"ABC":B$="DEF"
30 PRINT #1,A$,B$
40 PRINT #1,A$,B$
50 PRINT +50,-50
60 CLOSE #1
```

Using the above program, data will be transmitted in the following format:



PRINT # USING (print number using)

Writes data to a transmit buffer file in a specified format.

FORMAT

PRINT # file number USING format symbol; expression
[expression],....

File number **Cond** Integer constants,

$1 \leq$ file number \leq the number specified by
MAXFILES = statement

Expression **Cond** String type and numeric type constants, variables,
array variables, their expressions

FUNCTION AND UTILIZATION

Writes data specified by the expression in a specified format to a transmit buffer file, and then the data will be transmitted from the port. The file should be the one opened by the OPEN statement as a transmit buffer file. The value of an expression is displayed in a format specified by a format symbol as follows:

Symbol	Expression format and Execution example
"i"	Outputs the first 1 character. PRINT #1 USING "i"; "United", "Nation"
"\n\n"	Data to be transmitted → UN
"\n\n\n"	Outputs n + 2 characters. When data is smaller than n + 2 characters, inserts spaces for the residual characters.
n spaces	PRINT #1 USING "\n\n\n"; "ABCDEF", "GHI", "JKLM" Data to be transmitted → ABCDGH IJKLM

"&"

Outputs all character string.

```
10 OPEN "COM0:" FOR OUTPUT AS #1
20 A$="North":B$="South"
30 PRINT #1 USING "&Pole",A$,B$
40 CLOSE #1
```

Data to be transmitted → North Pole South Pole

"#"

Writes # by the number of numeral digits to be transmitted.
Decimal point is ". "

```
PRINT #1 USING "POINT:###.#";:123.4
```

Data to be transmitted → POINT:123.4

- When the number of integer digits is less than the specified # number, transmitted data is preceded by spaces, and if it is more, "%" is added before the data.

```
10 OPEN "COM0:" FOR OUTPUT AS #1
20 PRINT #1 USING "###";:12
30 PRINT #1 USING "####";12345
40 CLOSE #1
```

Data to be transmitted → 12

space %12345

- When the number of digits in a fraction of numeric data is smaller than the specified # number, "0" is added, and when it is larger, it is rounded to the nearest whole number.

```
10 OPEN "COM0:" FOR OUTPUT AS #1
20 PRINT #1 USING "##.##";:25.3
30 PRINT #1 USING "###.##";:25.345
40 CLOSE #1
```

Data to be transmitted → 25.30

25.35

The "+" sign of numeric data is ignored and the "u" sign is counted as one digit.

	<pre> 10 OPEN "COM0:" FOR OUTPUT AS #1 20 PRINT #1 USING "###";+123 30 PRINT #1 USING "###";-123 40 CLOSE #1 </pre> <p>Data to be transmitted → 123 %-123</p>
--	---

"+"	<p>"+" is added if it is a positive numeral, and "-" is added if it is a negative numeral before or after the numeric data.</p> <pre> 10 OPEN "COM0:" FOR OUTPUT AS #1 20 PRINT #1 USING "+###";123,-123 30 PRINT #1 USING "###";123,-123 </pre> <p>Data to be transmitted → +123 -123 123+ 123-</p>
-----	--

"_"	<p>"_" is added after negative numeric data.</p> <pre> PRINT #1 USING "###-";123,-123 </pre> <p>Data to be transmitted → 123 123-</p>
-----	---

"*"	<p>The space before numeric data is filled with "*" . One "*" in the format expresses one digit.</p> <pre> 10 OPEN "COM0:" FOR OUTPUT AS #1 20 PRINT #1 USING "#####";123 30 PRINT #1 USING "#####";-234 40 CLOSE #1 </pre> <p>Data to be transmitted → *****123 *****-234</p>
-----	--

"E"	<p>Adds "E" before numeric data. One "E" in the format is counted as one digit.</p> <pre> 10 OPEN "COM0:" FOR OUTPUT AS #1 20 PRINT #1 USING "E###";1234 30 PRINT #1 USING "+E###";-1234 40 CLOSE #1 </pre> <p>Data to be transmitted → E1234 -E1234</p>
-----	--

"**E"	<p>Adds "E" just before the numeric data, and the space before that is filled with "**".</p> <pre> PRINT #1 USING "**E###.###";12.34 </pre> <p>Data to be transmitted → **E12.34</p>
","	<p>When this is specified somewhere before the decimal point, data is transmitted by the insertion of commas between each 3 digits to the left of the decimal point.</p> <pre> PRINT #1 USING "#,###.###";12345.67 </pre> <p>Data to be transmitted → 12,345.67</p>
"^ ^ ^ ^"	<p>Transmit numeric data by floating point type format. "^{^ ^ ^ ^}" corresponds to the digits for the exponent part.</p> <pre> PRINT #1 USING "###.###^ ^ ^ ^";234.56 </pre> <p>Data to be transmitted → 2.35E+02</p>

RUN (run)

Loads a program from the RS-232C port, and executes the program.

FORMAT

RUN "COM [port number];" [,R]

Port number **Cond:** Integer type constants,
 $0 \leq \text{port number} \leq 4$
Omit 0
Omit All data files are closed.

R

FUNCTION AND UTILIZATION

Loads a program in ASCII format from the RS-232C port, and upon receipt of the EOF code (1AH), stops loading the program and executes it.

The RUN command closes all opened files and deletes the current contents of memory before loading the designated program. When the "R" option is specified, however, all data files remain opened.

Execution example

RUN "COM0:" ,R

Loads a program from the RS-232C port numbered 0, and executes the loaded program. The all data files remain opened, and no memory contents will be erased by this command.

SAVE (save)

Sends a BASIC program to the RS-232C port.

FORMAT

SAVE "COM [port number];"

Port number **Cond:** Integers type constants,
 $0 \leq \text{port number} \leq 4$
Omit 0

FUNCTION AND UTILIZATION

Sends an MSX-BASIC program to the specified RS-232C port, and the program will be transmitted in ASCII format from the port.

When the transmission of data is completed, the EOF code (1AH) will be sent at the end of the data.

Execution example

SAVE "COM0:"

COM GOSUB

Declares a subroutine to which program branches when an interrupt occurs from the RS-232C port.

FORMAT

CALL COM ([Port number:], GOSUB start line number)

Port number

Cond: Integer type constants,
 $0 \leq \text{port number} \leq 4$

Omit: 0

Start line number

Cond: Integer constants,
 $0 \leq \text{number} \leq 65529$

FUNCTION AND UTILIZATION

Sets the starting line number of a subroutine to trap when the first character is received after CALL COMMON (see page 58) is executed. If another interrupt occurs while the subroutine, the interrupt will be suspended because CALL COMSTOP is automatically executed.

Append the RETURN statement at the end of the interrupt service routine so that program execution will return to a location next to the CALL COM GOSUB after completing the subroutine. The RETURN statement automatically executes CALL COMMON to enable interrupt from the RS-232C port unless CALL COMOFF has been explicitly executed inside the subroutine.

Note: Interrupt does not take place when MSX-BASIC is not executing a program. When an error trap (resulting from an ON ERROR statement) takes place, it automatically disables all event trappings (including ERROR, STRIG, STOP, SPRITE, INTERVAL and KEY).

Execution example

```
CALL COM (, GOSUB 1000)
```

Specifies the line 1000 as the start line of the subroutine which is executed when a character is input from the RS-232C port number 0.

COMBREAK (communication break)

Sends break sequence.

FORMAT

CALL COMBREAK (["port number:"]; expression)

Port number

Cond: Integer type constants,
 $0 \leq \text{port number} \leq 4$

Expression **Cond:** Numeric type constants, variables, array variables,
 their expression,
 $3 \leq \text{expression} \leq 32767$

FUNCTION AND UTILIZATION

Sends break sequence to the specified RS-232C port by the number of characters specified by the "expression". All transmit data will be 0 by sending the break sequence, which indicate that transmission is suspended.

Execution example

```
CALL COMBREAK (, 20)
```

The 20 break characters will be sent to the RS-232C port number 0.

COMDTR

Sets the ER (DTR) signal to ON/OFF.

FORMAT

CALL COMDTR (["port number:"], expression)

Port number **Cond.** Integer type constants,
Omit $0 \leq \text{port number} \leq 4$

Expression **Cond.** Numeric type constants, variables, array variables,
their expression

FUNCTION AND UTILIZATION

Turns off the ER (DTR) signal when the value of "expression" is 0, otherwise turns on the ER signal. At the computer's power-on, the ER signal is ON.

Execution example

CALL COMDTR (, 0)

The ER (DTR) signal from the RS-232C port 0 will be turned off.

COMINI (communication initialize)

Initializes the communication mode.

FORMAT

CALL COMINI (["data string expression"] [receive baud rate] [transmit baud rate] [time out])

Data string **Cond.** String type constants, variables, array
variables, and their expression
Omit "0:8N1XHNNN"

Receive baud rate **Cond.** Numeric type constants, variables, array
variables, and their expression, $50 \leq \text{Receive}$
baud rate ≤ 1200
Omit 1200

Transmit baud rate **Cond.** Numeric type constants, variables, array
variables, and their expression, $50 \leq \text{Transmit}$
baud rate ≤ 1200
Omit the same baud rate as the receive baud rate

Time out **Cond.** Numeric type constants, variables, array
variables, and their expression
 $0 \leq \text{time out} \leq 255$
Omit 0

COMON

Enables the interrupt from the RS-232C port.

FORMAT

CALL COMON (["port number:"])

Port number **Cond.** Integer type constants,
 $0 \leq \text{port number} \leq 4$

Omit 0

FUNCTION AND UTILIZATION

Enables interrupt caused by incoming characters from the specified RS-232C port. If the starting line number of the subroutine is specified with the CALL COM GOSUB statement, the subroutine will be executed.

COMOFF

Disables the interrupt from the RS-232C port.

FORMAT

CALL COMOFF (["port number:"])

Port number **Cond.** Integer type constants,
 $0 \leq \text{port number} \leq 4$

Omit

FUNCTION AND UTILIZATION

Disables interrupt caused by incoming character from the specified RS-232C port. After this statement is executed, the interrupt will not take place even if there is an interrupt request from the RS-232C port.

COMSTOP

Suspends the interrupt from the RS-232C port.

FORMAT

CALL COMSTOP (["port number:"])

port number **Cond.** Integer type constants,
 $0 \leq \text{port number} \leq 4$

Omit 0

FUNCTION AND UTILIZATION

Suspends the interrupt request by incoming characters from the RS-232C port until the CALL COMON statement is executed.

COMSTAT (communication status)

Reads the RS-232C port status.

FORMAT

CALL COMSTAT (["port number:"]; variable)

Port number **Cond.** Integer type constants, 0 ≤ port number ≤ 4
OnOff 0

Variable **Cond.** Numeric type variables, array variables

FUNCTION AND UTILIZATION

Reads the status of the specified RS-232C port. The status is returned in numeric data, and it is assigned to the variable. The bit assignments of the numeric data, if its binary expression is given, are as follows:

MSB bit 15 **Receive buffer overflow error** (Data is transmitted when the buffer is full.)

0: No error
1: Error occurred

bit 14 **Time out error** (The specified time has elapsed since the CS signal had been OFF.)

0: No error
1: Error occurred

bit 13 **Framing error** (The binary "0" bit has been received instead of the stop bit.)

0: No error
1: Error occurred

bit 12 **Overrun error** (Next data is received before reading the last data from the receive buffer file.)

0: No error
1: Error occurred

bit 11 **Parity error** (see page 14)

0: No error
1: Error occurred

bit 10 **Control break key** (**CTRL** + **STOP** keys) was pressed

0: Not pressed
1: Pressed

60

bit 9 Reserved: 0
bit 8 Reserved: 0

bit 7 **CS (CTS) signal status**
0: OFF
1: ON

bit 6 **Timercounter set for the time out error detection**
0: Not set
1: Set

bit 5 Reserved: 0
bit 4 Reserved: 0

bit 3 **DR (DSR) signal status**
0: OFF
1: ON

bit 2 **Break sequence detected since COMSTAT is executed.**
0: Not detected
1: Detected

bit 1 Reserved: 0

bit 0 **CD signal status**
0: OFF
1: ON

Execution example

```
CALL COMSTAT("0:",A):PRINT BIN$(A)
```

The numeric data of the RS-232C port 0 status is assigned to the numeric type variable "A", and a binary expression of A is given as string type data.

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COMTERM

Sets the MSX computer in the terminal mode.

FORMAT

CALL COMTERM [{"port number:"}]

Port number **Cond** Integer type constants,
 $0 \leq \text{port number} \leq 4$

Omit 0

FUNCTION AND UTILIZATION

Enters a terminal emulator mode. Before entering the terminal mode, all the RS-232C files should be closed. The function keys have special use in the terminal mode. For details of the terminal mode and the usage of the function keys, read "Terminal Mode" on page 28.