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USER'S MANUAL

RENESAS

IE-78327-R

IN-CIRCUIT EMULATOR

HARD WARE
(rev.B)

Document No. EEU-1358B
(O. D. No. EEU-718B)
Date Published July 1991 P
Printed in Japan

USER'S MANUAL

NEC

IE-78327-R

IN-CIRCUIT EMULATOR

HARD WARE
(rev. B)

MS-DOS™ is a trademark of Microsoft Corporation.

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The IE-78327-R conforms to the standards of VCCI, which restricts radio interference in commercial and industrial areas.

Since using the IE-78327-R in residential districts or their neighboring districts may cause radio or TV interference, follow this manual.

MAJOR REVISIONS

Page	Description
All	The uPD78323, uPD78324, and uPD78P324 are added.

PREFACE

Users:

This manual is intended for users who use 78K/III series 8- and 16-bit single-chip microcomputers and debug their systems using the IE-78327-R. This manual is also intended for users who want to upgrade other in-circuit emulators to have functions equivalent to that of the IE-78327-R.

The IE-78327-R can emulate the uPD78328 and uPD78322 series microcomputers. Before using this manual, the user should be familiar with the functions and use of the target device and have knowledge of a debugger.

Organization:

The IE-78327-R Manual consists of the following two parts: Hardware (this manual) and Software.

Hardware	Software
Basic specifications	Function overview
Configuring the system	Description of commands
External interface functions	

Purpose:

- The IE-78327-R Manual: The hardware part explains the basic specification of the IE-78327-R and how to connect external devices to it.

- The IE-78327-R Manual: The software part explains how to start the IE-78327-R for debugging the target device to develop it and how to execute the commands.

Several cautions must be observed to use the IE-78327-R. Refer to the summary in Chapter 12 of the IE-78327-R: Software
For the most recent information about this product, please contact an NEC representative.

Guidance:

<Target devices>

This manual explains the following two sets of the target devices which can be emulated with the IE-78327-R:

[The uPD78328 series]
- uPD78327
- uPD78328
- uPD78P328

[The uPD78322 series]
- uPD78320
- uPD78322
- uPD78P322
- uPD78323 (Note)
- uPD78324 (Note)
- uPD78P324 (Note)

Note: Under development

Hardware

<To understand the basic specifications>

See Chapters 1 and 2.

<To change the target device>

See Chapter 3.

<To change the user clock>

See Chapter 4.

<To connect an external device to the IE-78327-R>

See Sections 1.3 and 1.4 and Chapters 5 through 7.

<To understand the differences between the target device and IE-78327-R target interface circuit>

See Chapter 8.

<To understand the details of the functions of an IE-78327-R serial or parallel interface>

See Chapters 9 and 10.

Software

<To obtain information on the overview of the IE-78327-R>

See Chapter 1.

<To understand the basic operating procedure and functions>

See Chapters 2 and 3.

<To understand the details of command input>

See Chapters 5 through 7.

<To understand the types, functions, and input formats of commands>

See Chapter 8.

<To understand the cautions on the use of the IE-78327-R>

See Chapter 12.

Terminology:

The following table shows the meaning of misunderstandable words in this manual.

Terminology	Meaning
Emulation device	Device that emulates a target device in the emulator, including an emulation CPU
Emulation CPU	CPU that executes the program coded by the user in the emulator
Target device	Device to be emulated such as a uPD78327 chip
Target program	Program to be debugged, that is, user-coded program
Target system	System to be debugged, that is, user-produced system, including a target program and user-produced hardware. In a narrow sense, refers only to hardware.

Notation:

Note: Explanation of the part indicated in the text

Caution: Information which the user should read with particular care

Remark: Supplementary information

CONTENTS

LIST OF PHOTOGRAPHS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1 OVERVIEW

The IE-78327-R is an in-circuit emulator which has been developed to efficiently debug the hardware and software of an application system using a uPD78328- or a uPD78322-series product.

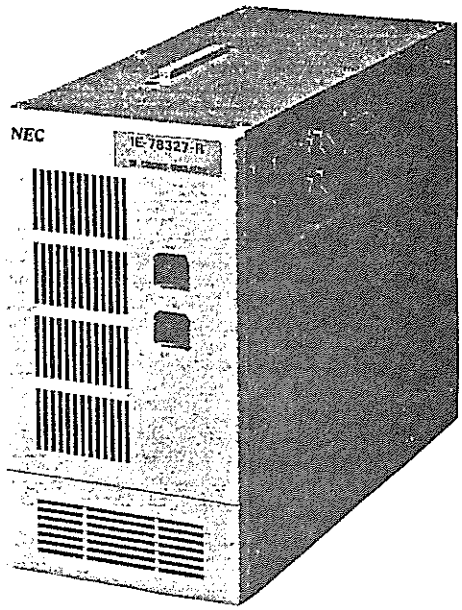
Organization of this chapter

1.1 Features

The IE-78327-R is superior because it:

- Enables emulation of uPD78328- and uPD78322-series products.
- Enables real-time execution and real-time trace.
- Has many break and trace functions.
- Can output the contents of the real-time tracer without stopping the emulation CPU.
- Can search data in the real-time tracer.
- Can count the elapsed execution time or the number of instructions executed.
- Can sample the data in the specified internal RAM within a stated time, and display it.
- Can display the executed areas in the program area.
- Can perform symbolic debugging.
- Can perform online assembling and disassembling.
- Can input 8-bit trace data using the external sense clips.
- Contains 64K bytes of emulation memory.
- Is available for any package using an optional emulation probe.
- Can be used as an emulator for other 78K series by replacing the emulation board with the optional one.
- Can download object and symbol files at high speed using a Centronics interface. (Ten times faster than downloading using the RS-232-C interface)

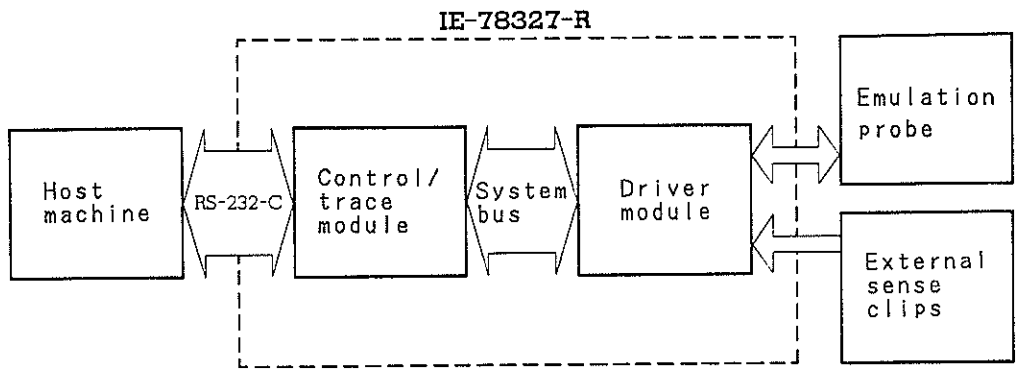
Photo 1-1 IE-78327-R



1.2 Hardware Configuration

Figure 1-1 shows the basic hardware configuration of the IE-78327-R.

Fig. 1-1 IE-78327-R Hardware Configuration

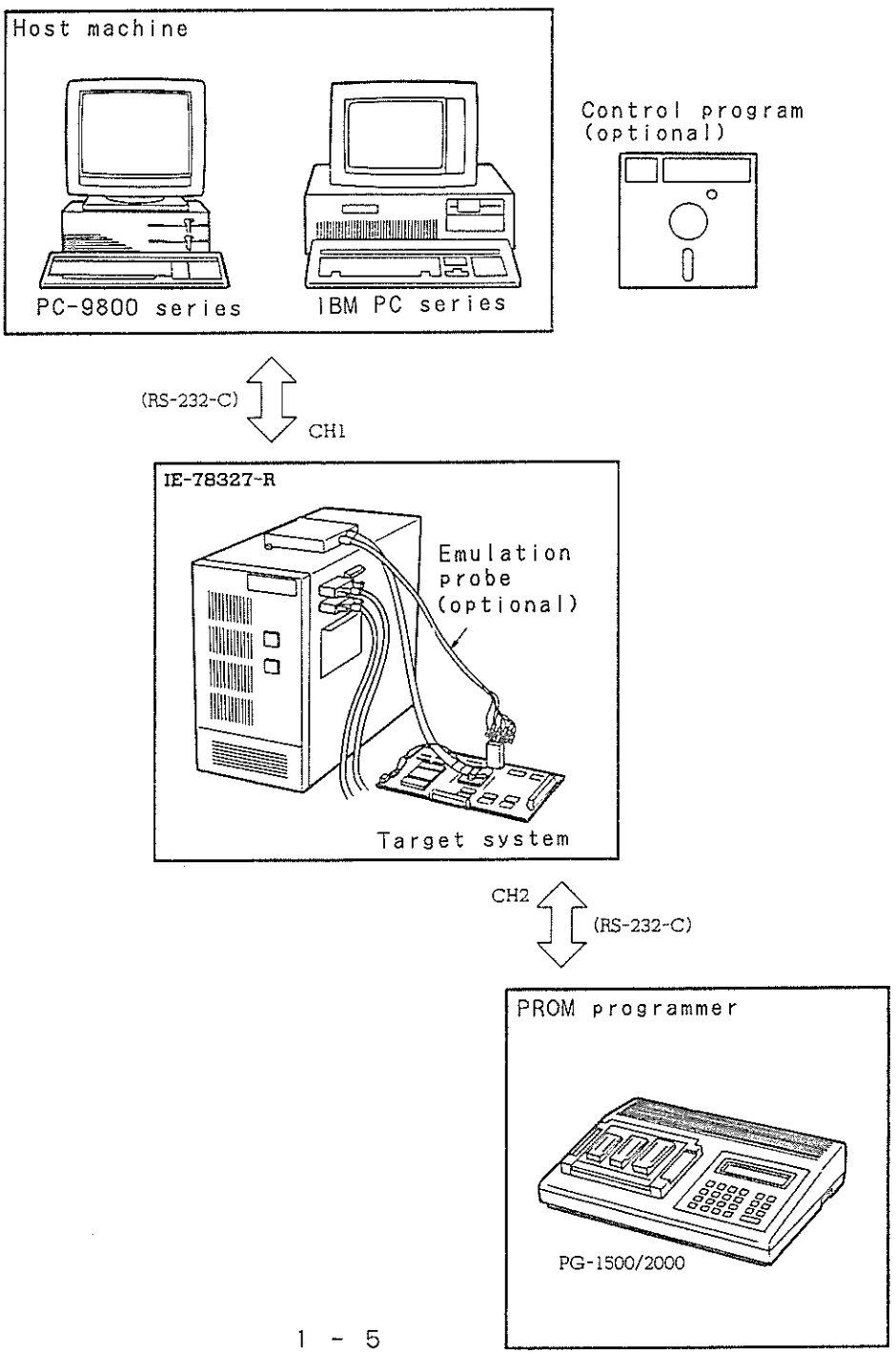


1.3 System Configuration and Upgrade

(1) System configuration of the IE-78327-R

The IE-78327-R operates in combination with a host machine (the PC-9800 series/IBM PC series) and a PROM programmer (the PG-1500/PG-2000).

Fig. 1-2 System Configuration



(2) System upgrade from another function to IE-78327-R

If either the 75X or 78K series in-circuit emulators are currently used, the system can be upgraded to the emulator that has functions equivalent to that of the IE-78327-R. To upgrade the system, replace the emulation and break boards with the boards for the IE-78327-R.

The in-circuit emulators in hand are divided into two types: in-circuit emulators using a new cabinet and those using an old cabinet. Only in-circuit emulators using a new cabinet can be upgraded.

The control program for the IE-78327-R in-circuit emulator is required for the system upgrade from another function to the IE-78327-R by changing the boards.

Table 1-1 lists the models that can be upgraded and the boards required for the system upgrade.

Table 1-1 System Upgrade from Another Function to IE-78327-R

In-circuit emulator in hand		Necessary optional boards	
		IE-78327-R-EM	IE-78330-R-BK
Old	IE-78112-R	x	x
	IE-78210-R(*1)		
	IE-78220-R(*1)		
	IE-78310-R(*1)		
	IE-78310A-R		
New	IE-75000-R	o	o
	IE-78000-R(*2)		
	IE-78130-R		
	IE-78140-R(*2)		
	IE-78230-R		
	IE-78240-R		
	IE-78320-R(*1)		
	IE-78330-R		—
	IE-78350-R(*2)		o
	IE-78600-R		

*1 Maintenance product. There is no stock to sell.

*2 Under development

Remarks 1. A new cabinet is used for the IE-78327-R.

2. o: Required

—: Unrequired

x: The system cannot be upgraded.

The use of the IE-78327-R is the same as that of the in-circuit emulator upgraded with optional boards such as IE-78327-R-EM.

To upgrade the system, take the following steps.

(a) Removing the boards

① Check whether the power to the emulator is off.

② Remove the six screws from the top of the main unit and open the cover.

③ Pick up the card pullers at both sides of the emulation and break (or event/trace) boards, and extract the emulation board from the slot.

(b) Replacing the boards

In place of the extracted boards, install the emulation board (IE-78327-R-EM) and the break board (IE-78330-R-BK) with the event/trace board into the main unit.

Then, the board configuration is equivalent to that of the IE-78327-R.

To set the user clock, take the same steps as those of the IE-78327-R.

1.4 Procedure for Setting Up the System

Set up the system as follows:

① Change the development mode. (When the target device is changed) — See Chapter 3.

The IE-78327-R is factory-set to the uPD78328-series development mode. Change the configuration of the emulation board a little to change the target device from a uPD78328-series product to a uPD78322-series product.

② Set the user clock. (When it needs to be set) — See Chapter 4.

Mount a crystal oscillator on the emulation board of the IE-78327-R to change the operation clock.

③ Connect the emulation probe to the IE-78327-R. — See Chapter 5.

Connect the connector board attached to the optional emulation probe to the emulation board of the IE-78327-R. Then, connect the emulation probe to the IE-78327-R.

④ Connect the cables supplied with the IE-78327-R. — See Chapter 2.

Connect the power cable and interface cable.

⑤ Connect the peripheral equipment to the IE-78327-R. — See Chapter 6.

Connect the following equipments.

- Host machine
- PROM programmer (if necessary)
- Printer (if necessary)

⑥ Connect the target system. — See Chapter 7.

Connect the target system to the emulation probe.

Remark: For steps ①, ②, and ③ above, the cover on the top of the IE-78327-R needs to be removed. So, it is recommended that these steps be performed at a time.

1.5 Development Modes and Target Devices

The IE-78327-R can emulate the uPD78328-series and the uPD78322-series products. The system is factory-set to the uPD78328-series development mode.

For emulation of a uPD78322-series product, it is necessary to change the configuration of the emulation board installed in the main unit a little. See Chapter 3 for the details.

The development modes of the IE-78327-R and the corresponding target devices are shown below.

[uPD78328-series development mode]	[uPD78322-series development mode]
. uPD78327	uPD78320
. uPD78328	uPD78322
. uPD78P328	uPD78P322
	uPD78323(Note)
	uPD78324(Note)
	uPD78P324(Note)

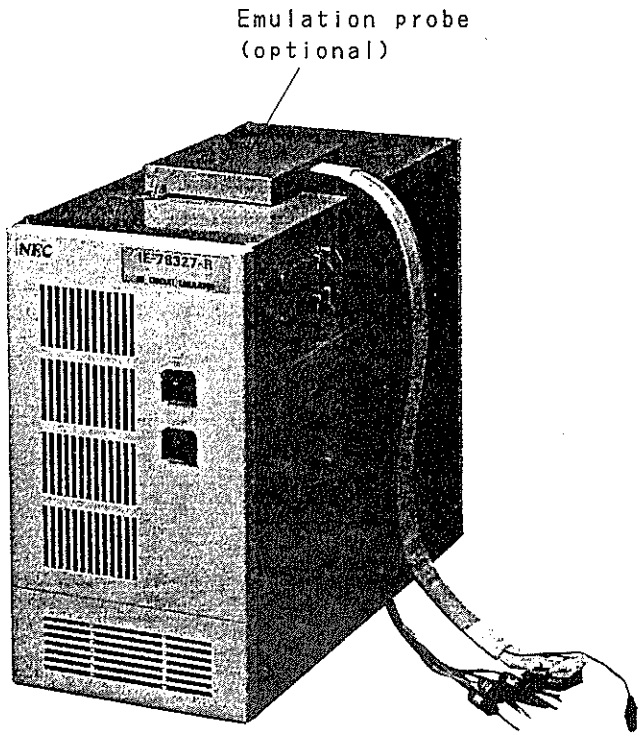
Note: Under development

1.6 Emulation Probes

The following optional emulation probes are available according to the target devices. Use an emulation probe suited to the package.

Order code
EP-78327CW-R (For 64-pin shrink DIP)
EP-78327GF-R (For 64-pin QFP)
EP-78327LP-R (For 68-pin PLCC)
EP-78320L-R (For 68-pin PLCC)
EP-78320GJ-R (For 74-pin QFP)

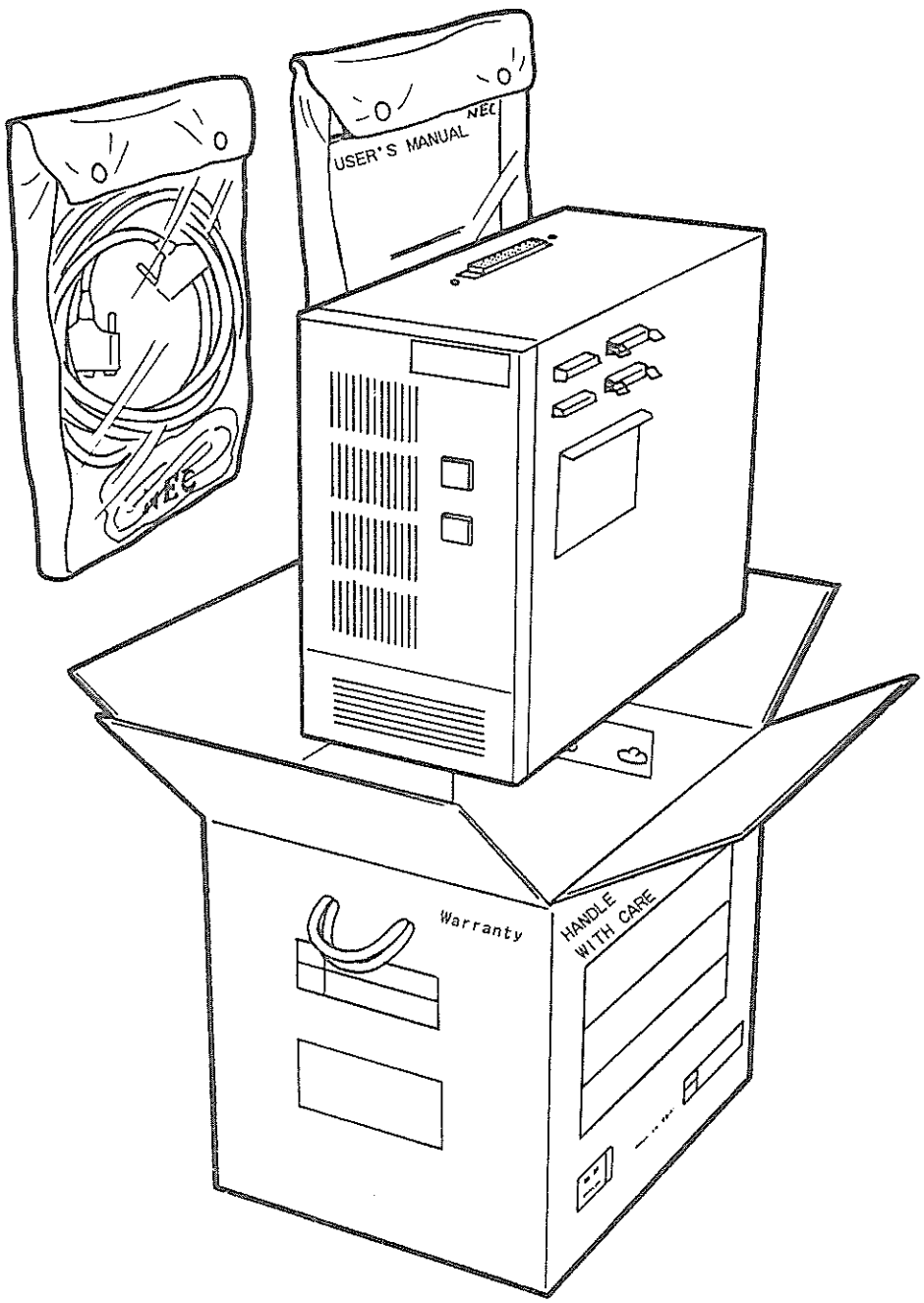
Photo 1-2 Emulation Probe



1.7 Checking the Contents of the Package

The IE-78327-R main unit and accessory bags are packed in a box. Three boards are installed in the main unit. In the accessory bags, this manual, bipolar ROM, cables, and other accessories are packed. Check the contents of the package according to this section. Contact an NEC salesperson or agency if anything is missing or broken.

Fig. 1-3 Checking the Contents of the Package



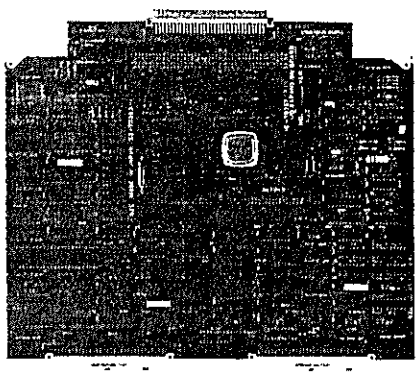
(1) Checking the boards

Three boards are installed in the IE-78327-R. Open the cover of the top of the main unit according to the procedures on the next page, and check them.

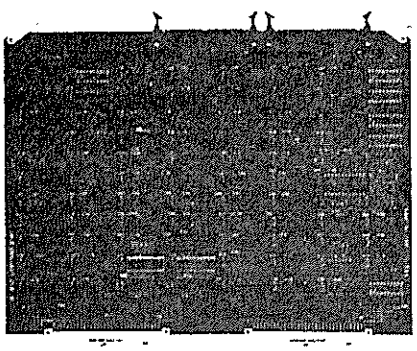
(a) Emulation board (IE-78327-R-EM): 1
(b) Break board (IE-78330-R-BK)(Note): 1
(c) Control/trace board (fixed in the IE-78327-R): 1

Photo 1-3 Boards

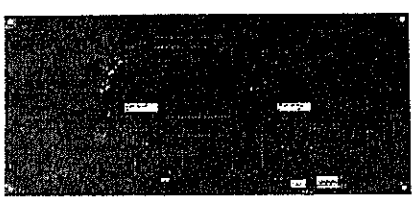
(a) Emulation board



(b) Break board



(c) Control/trace board

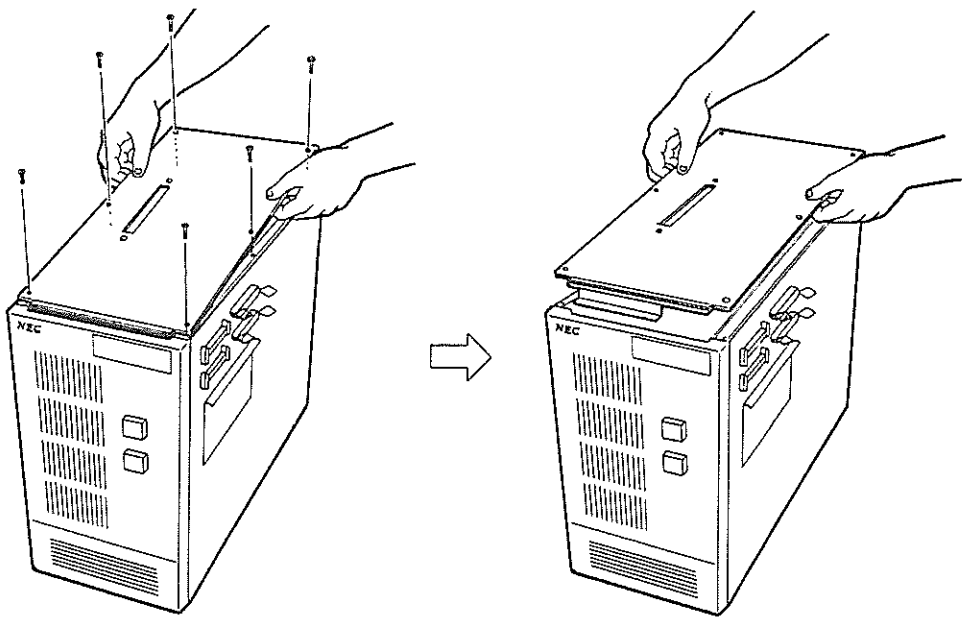


Note: The even trace board is attached to the break board with screws.

o Procedure

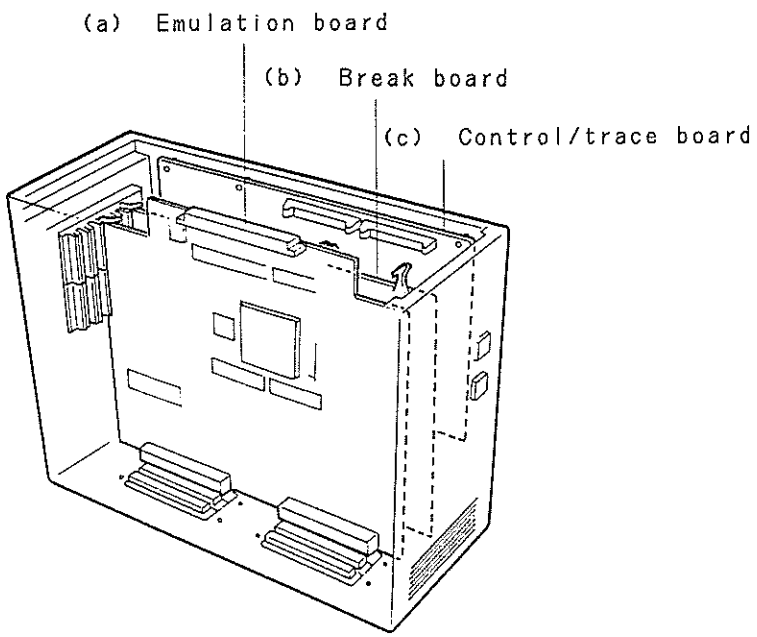
① Remove the six screws from the top of the main unit and open the cover.

Fig. 1-4 Top View of the Main Unit



② Confirm that the boards are installed as follows.

Fig. 1-5 Location of the Boards



(2) Checking the accessories

Two accessory bags are packed in the box. Confirm that the following accessories are packed. (See Photo 1-4.)

(a)	User's Manual: Hardware (this manual):	1
(b)	User's Manual: Software:	1
(c)	Bipolar ROM (228080 x 1)(Note 1):	1
(d)	100-VAC power cable with an AC adapter:	1
(e)	200-VAC power cable(Note 2):	1
(f)	RS-232-C interface cable:	1
(g)	Ground lead:	1
(h)	Spare fuse:	1
(i)	Accessory list:	1
(j)	Warranty:	1
(k)	Packing list:	1

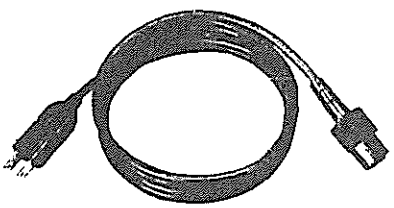
Notes 1. This bipolar ROM is used to change the development mode of the IE-78327-R from the uPD78328 series to the uPD78322 series.

2. The IE-78327-R operates on either 100 VAC or 200 VAC. Use the proper power cable according to the line voltage.

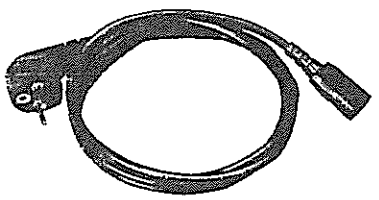
Photo 1-4 Accessories

(c) Bipolar ROM (Example)

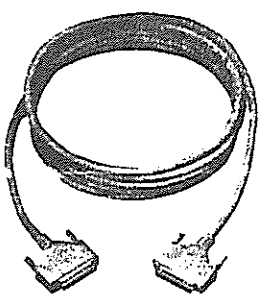
(d) 100-VAC power cable



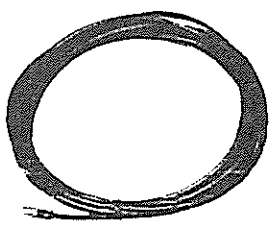
(e) 200-VAC power cable



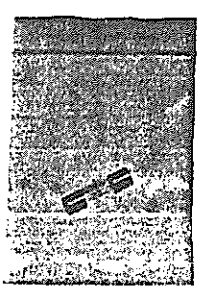
(f) RS-232-C interface cable



(g) Ground lead



(h) Spare fuse



CHAPTER 2 NOMENCLATURE AND FUNCTION OF EACH PART

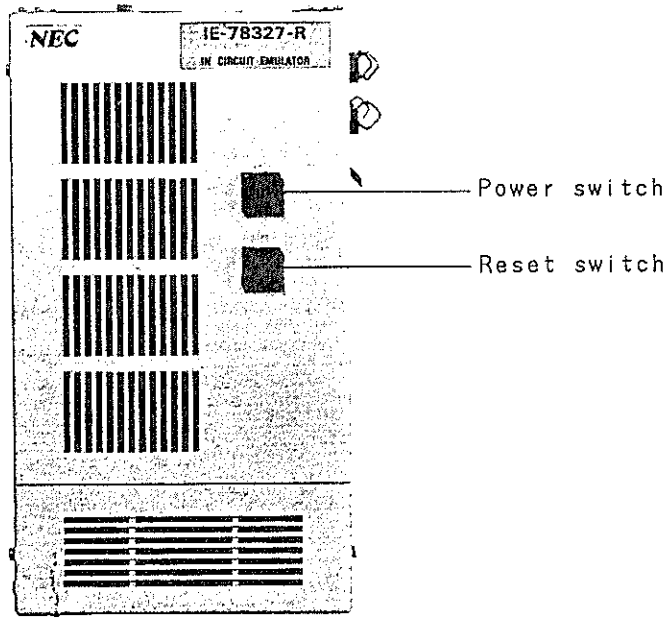
This chapter explains the nomenclature and function of each part of the IE-78327-R, how to set the switches, and how to connect the cables supplied with the IE-78327-R.

Organization of this chapter

2.1 Nomenclature and Function of Each Part in Main Unit

(1) Front

Photo 2-1 Front View of the IE-78327-R



[Power switch]

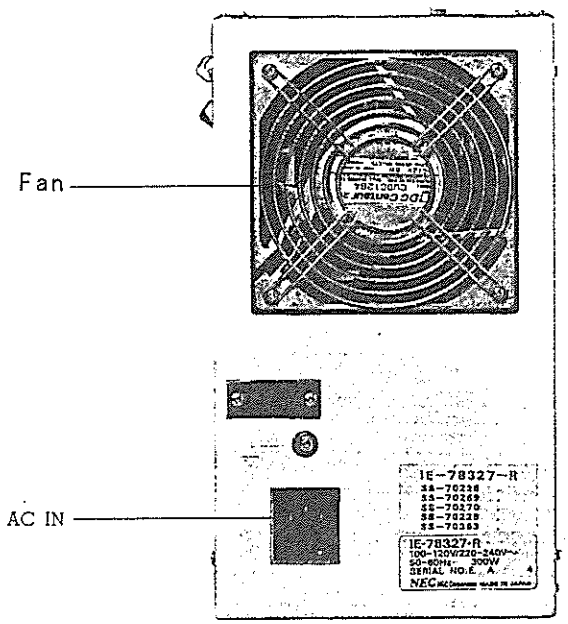
Turns the power on and off.

[Reset switch]

Resets the IE-78327-R.

(2) Rear

Photo 2-2 Rear View of the IE-78327-R



[Fan]

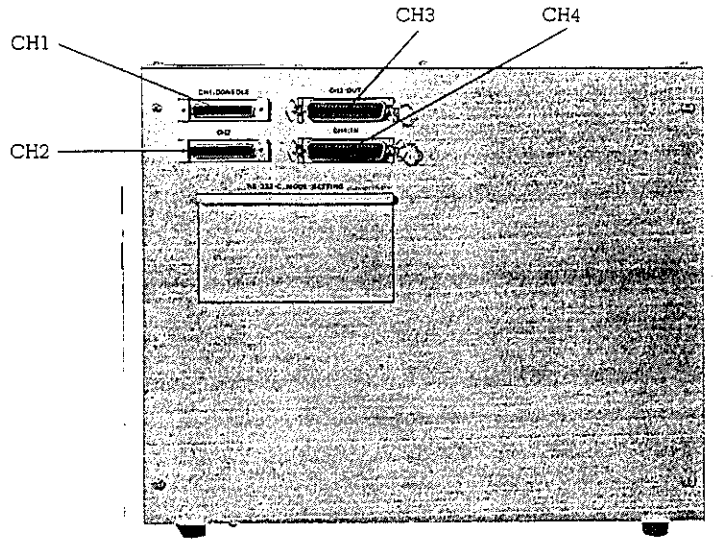
Cools the inside of the cabinet.

[AC IN]

Supplies power by connecting the power cable to it.

(3) Side

Photo 2-3 Right Side of the IE-78327-R (1)



[CH1 (I/O)]

Used for connecting the host machine using the RS-232-C interface cable.

[CH2 (I/O)]

Used for connecting a PG series PROM programmer using the RS-232-C interface cable.

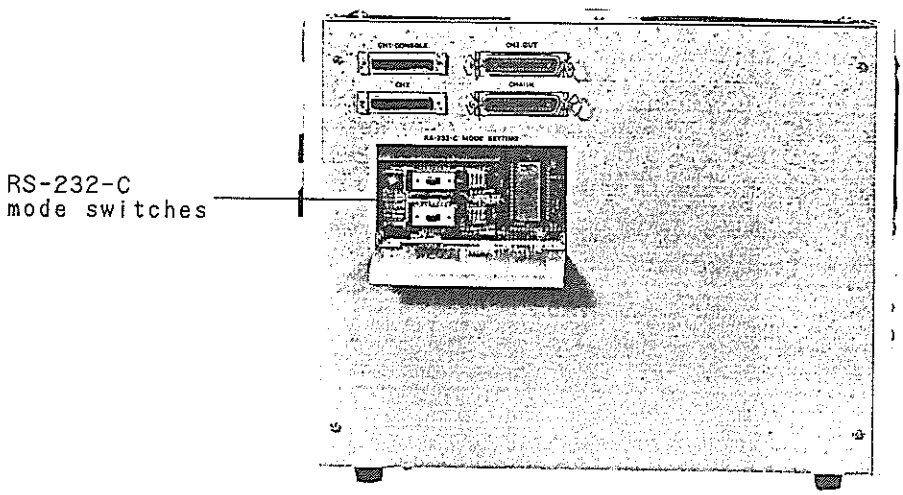
[CH3 (output only)]

Used for outputting data input in CH4 as is (through the output terminal).

[CH4 (input only)]

Used to execute high-speed download from the host machine using a parallel interface cable.

Photo 2-4 Right Side of the IE-78327-R (2)



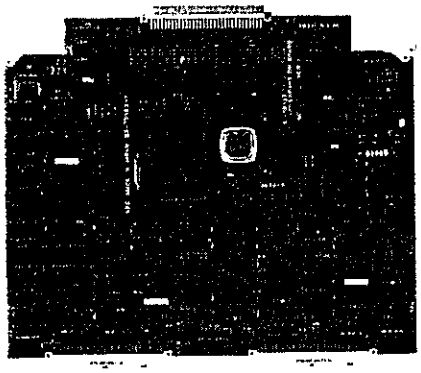
[RS-232-C mode switches]

Used for switching the modem/terminal mode, selecting RTS/FG, and setting the baud rate.

(4) Boards

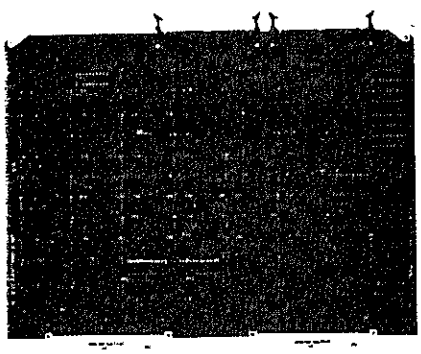
[Emulation board]

Emulates the target device.



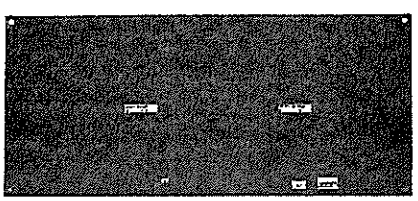
[Break board]

Controls the breaks, events, and tracing.



[Control/trace board]

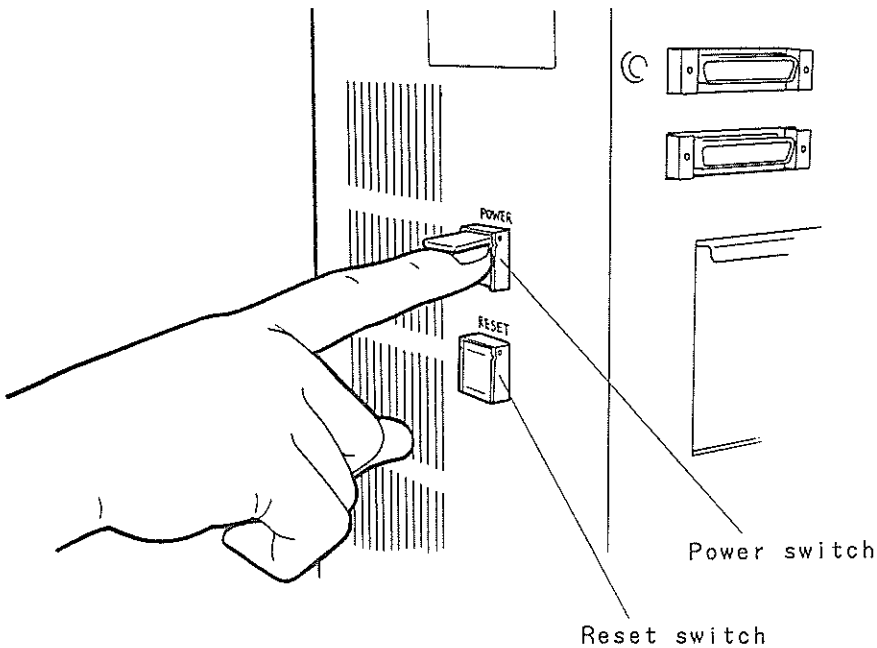
Controls the entire IE-78327-R.



2.2 Setting the Switches

(1) Power switch and reset switch

Fig. 2-1 Power Switch and Reset Switch



[Power switch]

. This is a pushbutton switch.

. Setting

Power-on: Press this switch once. The power-on LED goes on.

Power-off: Press this switch once. The LED goes off.

[Reset switch]

. This is a pushbutton switch.

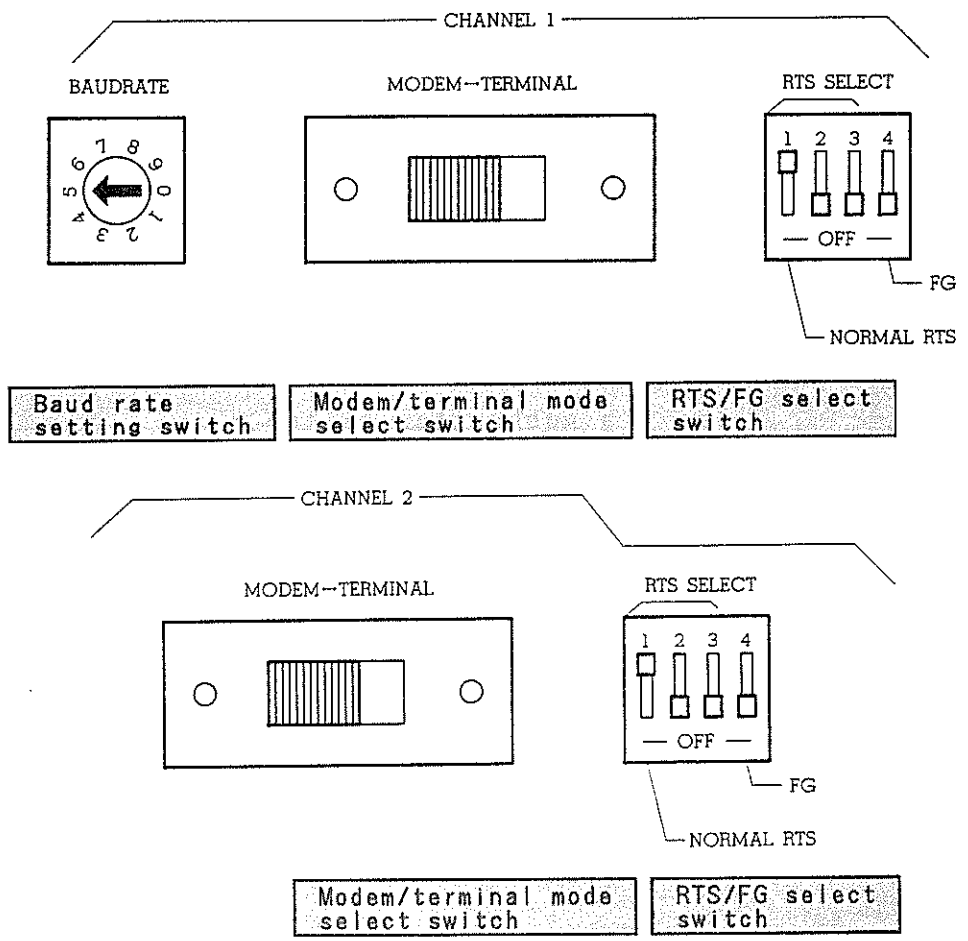
. Setting

Reset: Press this switch once to reset the IE-78327-R.

(2) RS-232-C mode switches

Open the RS-232-C mode switch cover on the right side of the main unit. (See Figure 2-2.) The setting modes depend on each of the peripheral equipment. For details, see Chapter 6.

Fig. 2-2 RS-232-C Mode Switches



[Modem/terminal mode select switch (for channels 1 and 2)]

. This is a slide switch.

. This switch is factory-set to the modem mode.

. Setting

  Modem mode: Slide the switch from right to left.
  Terminal mode: Slide the switch from left to right.

[RTS/FG select switch (for channels 1 and 2)]

. This is a DIP switch.

. This switch consists of switches 1 to 4.

. Slide the switches upward to set them to ON.
  Slide the switches downward to set them to OFF.

. The switches are factory-set as follows:
  1: ON
  2 and 3: OFF
  4: OFF

. Setting

  To select RTS: Set switches 1 to 3 as follows:
  1: ON
  2 and 3: OFF
  To put the FG in the open state: Set switch 4 to OFF.

[Baud rate setting switch (for channel 1)]

. This is a micro DIP switch.

. This switch has 10 positions (0 to 9).

. Turn the switch clockwise or counterclockwise to set the baud rate.

. This switch is factory-set to position 5 (9600 bps).

. Setting

  9600 bps: Set the switch to position 5.

Cautions 1. This switch is used to set the baud rate of channel 1. To set the baud rate of channel 2, use a software command. For details, see Sections 6.5 and 6.6 and refer to the description of the MOD command in User's Manual: Software.

2. Position 7, which corresponds to 0 bps, must not be used.

2.3 Connecting the Cables Supplied with the IE-78327-R

[Location]

Install the IE-78327-R in a place satisfying the following conditions:

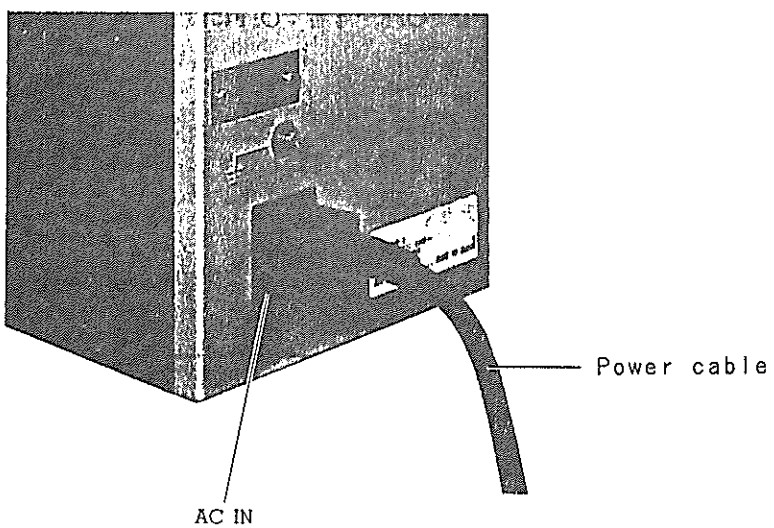
. A place which is free from dust

. Where no obstructions are placed near the air intake

(1) Power cable

Connect the power cable to the AC IN jack on the rear of the IE-78327-R main unit.

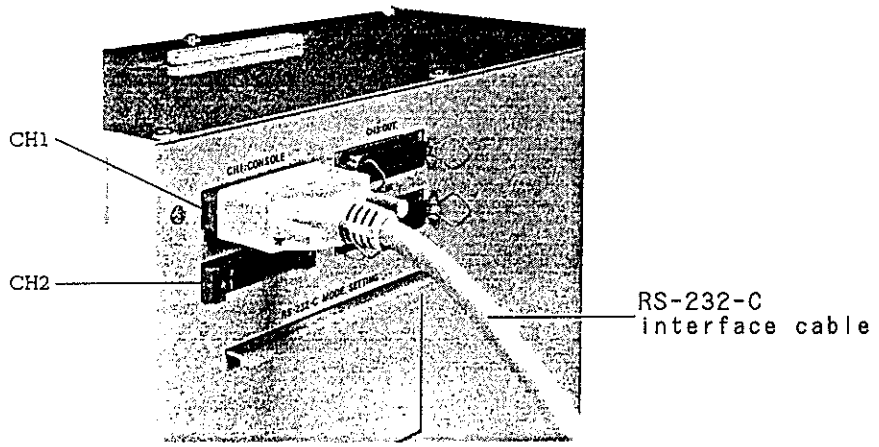
Photo 2-5 Connecting the Power Cable



(2) RS-232-C interface cable

Connect the RS-232-C interface cable to the CH1 or CH2 serial interface port on the right side of the IE-78327-R main unit.

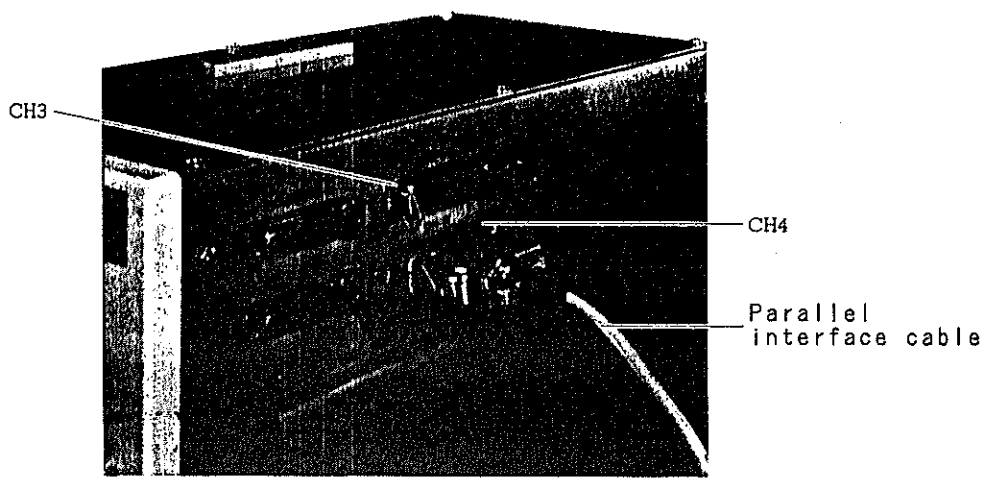
Photo 2-6 Connecting the RS-232-C Interface Cable



(3) Parallel interface cable

Connect a parallel interface cable to the CH3 or CH4 parallel interface port on the right side of the IE-78327-R main unit.

Photo 2-7 Connecting a Parallel Interface Cable



CHAPTER 3 CHANGING THE DEVELOPMENT MODE

The IE-78327-R is factory-set to the uPD78328-series development mode. It is also used to develop a uPD78322-series product by changing the configuration on the emulation board a little.

This chapter explains the procedure to change the development mode of the IE-78327-R taking an example of the change from the uPD78328-series development mode to the uPD78322-series development mode.

This procedure also applies to the case to change the development mode from the uPD78322-series development mode to the uPD78328-series development mode.

Organization of this chapter

3.1 Preparation for the Change (from the uPD78328 series to the uPD78322 series mode)

To change the development mode of the IE-78327-R, change the configuration of the emulation board (I/O expansion board and bipolar ROM) as follows.

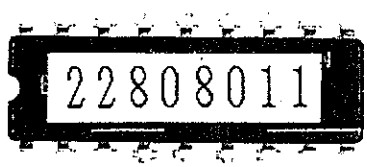
Table 3-1 Changing the Configuration

Section to be changed on the emulation board	Setting for uPD78328 series development (factory-set)	Setting for uPD78322 series development
I/O expansion board	Fixed	Removed
Bipolar ROM	228080 x 0	228080 x 1 (accessory)

[Required item]

- Bipolar ROM (accessory: 228080 x 1)
- Phillips type screwdriver

Photo 3-1 Bipolar ROM (Example)



3.2 Changing Procedures

[Outline of change]

- o Turn off the power.
- o Remove the I/O expansion board on the emulation board.
- o Exchange the bipolar ROM on the emulation board.

Remark: See Table 3-1 on the previous page for changing the IE-78327-R from the uPD78322-series development mode to the uPD78328-series development mode.

(1) Turning off the power

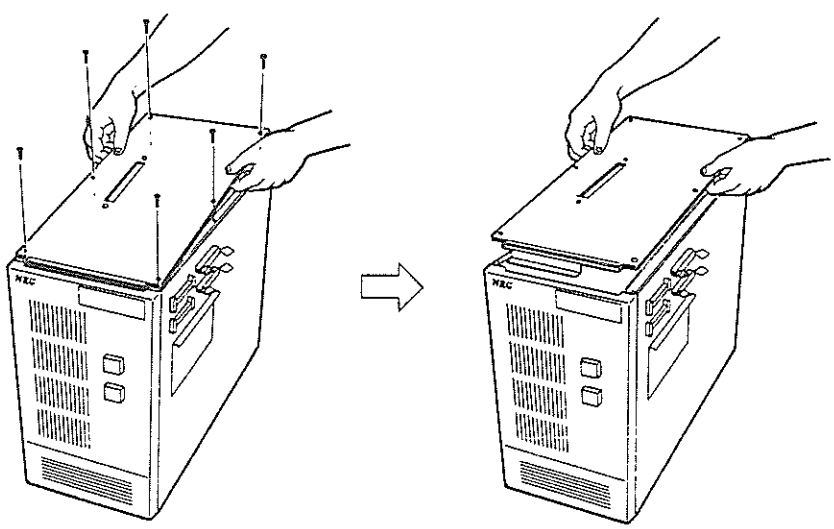
Check whether the power to the IE-78327-R is off. If the power is on, be sure to turn off the power.

(2) Removing the I/O expansion board on the emulation board

- o Procedure

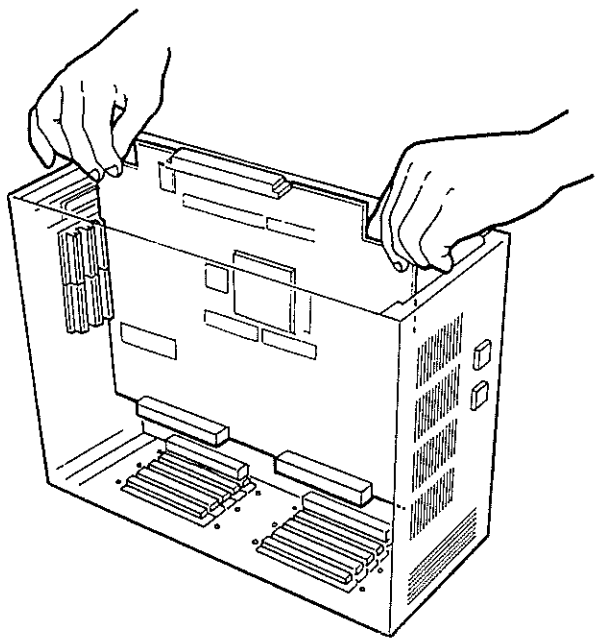
  ① Remove the six screws from the top of the main unit and open the cover.

Fig. 3-1 Top View of the Main Unit



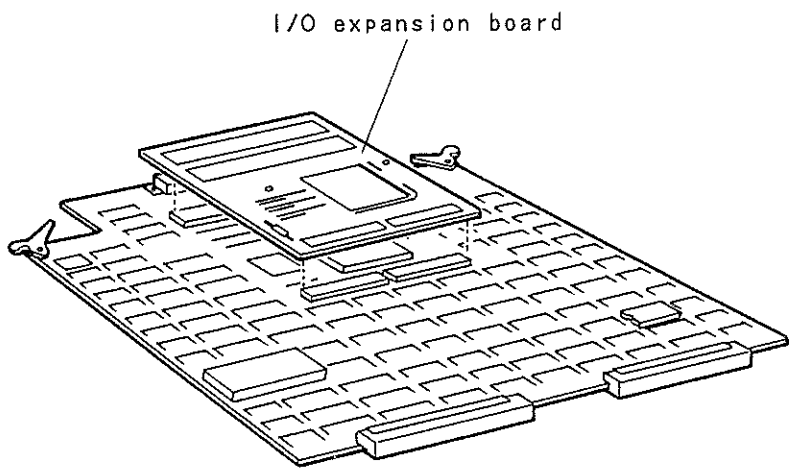
② Pick up the card pullers at both sides of the emulation board, and extract the emulation board.

Fig. 3-2 Emulation Board



③ Remove the I/O expansion board on the emulation board. Take care not to bend any pin of the connector.

Fig. 3-3 I/O Expansion Board



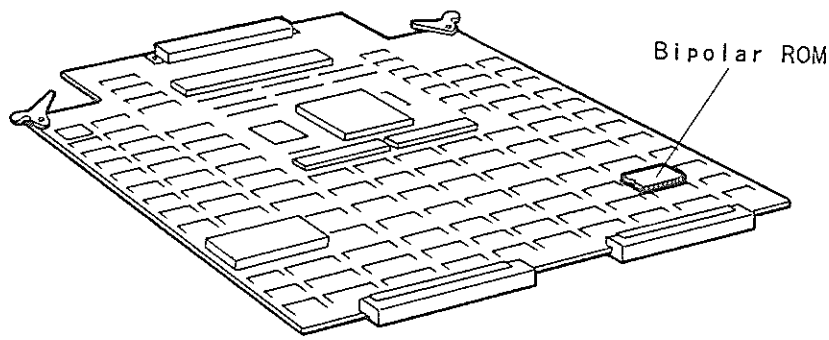
(3) Exchanging the bipolar ROM on the emulation board

o Procedure

① Dismount the bipolar ROM (accessory: 228080 x 0) installed on the socket IC80 on the emulation board.

② Mount the bipolar ROM for the uPD78322-series development (accessory: 228080 x 1) on the socket IC80.

Fig. 3-4 Location of the IC80



③ Replace the emulation board into the main unit.

④ Replace the cover and fasten it with the six screws.

CHAPTER 4 SETTING THE USER CLOCK

This chapter explains setting the user clock.

A clock signal cannot be generated from outside the IE-78327-R main unit, such as from the target system. Unless the clock setting is changed, when the IE-78327-R is started, the crystal oscillator on the emulation board of the IE-78327-R generates an external system clock signal of 16 MHz and supplies it to the emulation device.

Insert a crystal oscillator in the user clock setting socket on the emulation board and specify the user clock in the CLK command to supply the same external system clock signal as that used in the target system (user clock) to the IE-78327-R.

Organization of this chapter

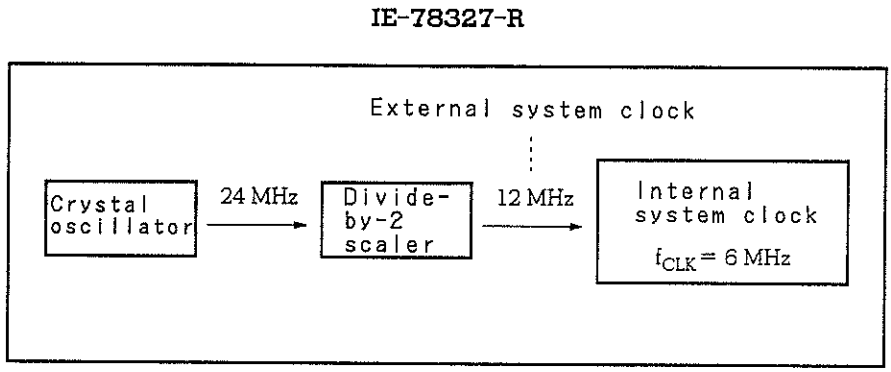
4.1 Conditions of a Crystal Oscillator for the User Clock

Use a crystal oscillator that satisfies the following conditions for the user clock.

[It generates a clock signal at twice the frequency of the external system clock (up to 16 MHz).]

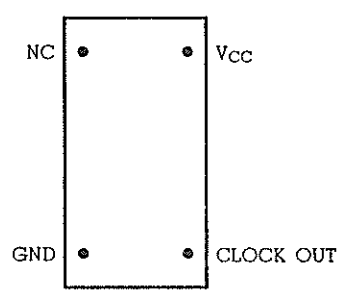
A crystal oscillator which generates a clock signal at twice the frequency of the external system clock is required to change the external system clock of the IE-78327-R. For example, when the 12-MHz external system clock is to be used for the IE-78327-R (when internal system clock f_{CLK} is to be set to 6 MHz), the crystal oscillator must generate the 24-MHz clock signal. This has twice the frequency of the external system clock. See Figure 4-1.

Fig. 4-1 Clock Signal Generated by the Crystal Oscillator (when f_{CLK} = 6 MHz)



[Its pins are arranged as follows.]

Fig. 4-2 Crystal Oscillator (Top View)



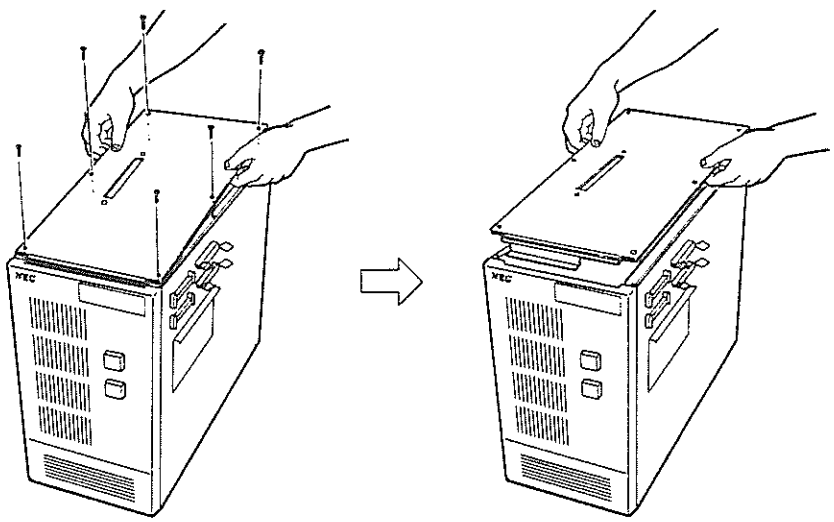
4.2 Mounting the Crystal Oscillator

o Procedure

① Turn off the power of the IE-78327-R.

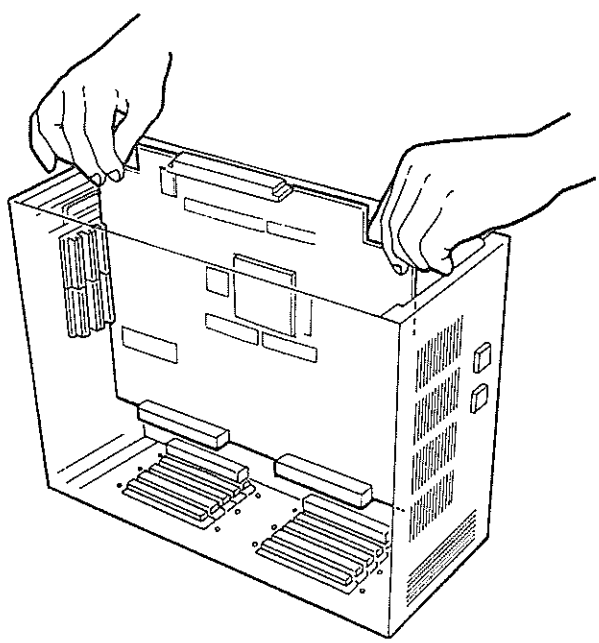
② Remove the six screws from the top of the IE-78327-R and open the cover.

Fig. 4-3 Top View of the Main Unit

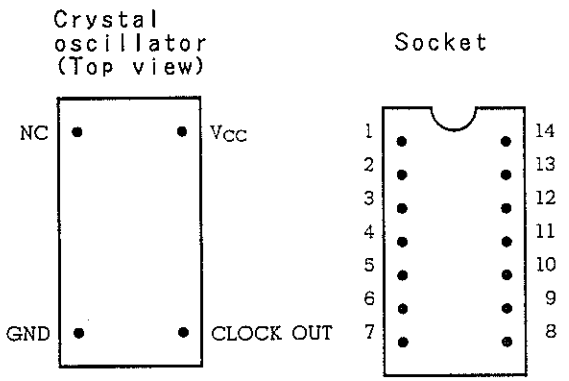


③ Extract the emulation board.

Fig. 4-4 Emulation Board

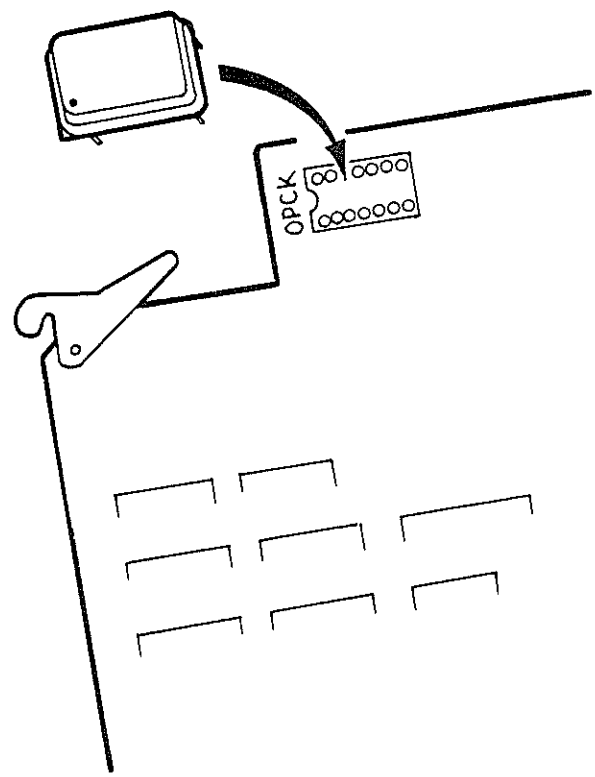


④ Insert the crystal oscillator in the part base socket (OPCK) on the emulation board. Insert the pins of the crystal oscillator into the socket pins as shown in the following figure.



Crystal oscillator pin	Socket pin No.
NC	1
GND	7
CLOCK OUT	8
V_{CC}	14

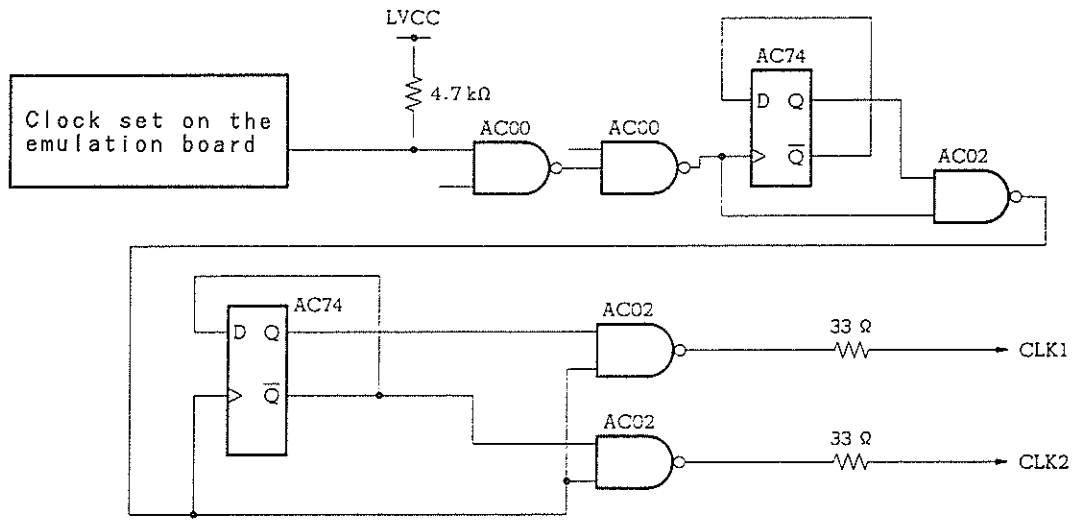
Fig. 4-5 Enlarged Emulation Board



⑤ Install the emulation board in the IE-78327-R.

⑥ Turn on the power of the IE-78327-R.

When CLK U is specified in the CLK command, the following circuit is made, and the crystal oscillator supplies the clock signal to the emulation device in the IE-78327-R.



CHAPTER 5 CONNECTING THE EMULATION PROBE

This chapter outlines connection of the emulation probe to the IE-78327-R. For details of the connection, refer to the user's manual for the emulation probe.

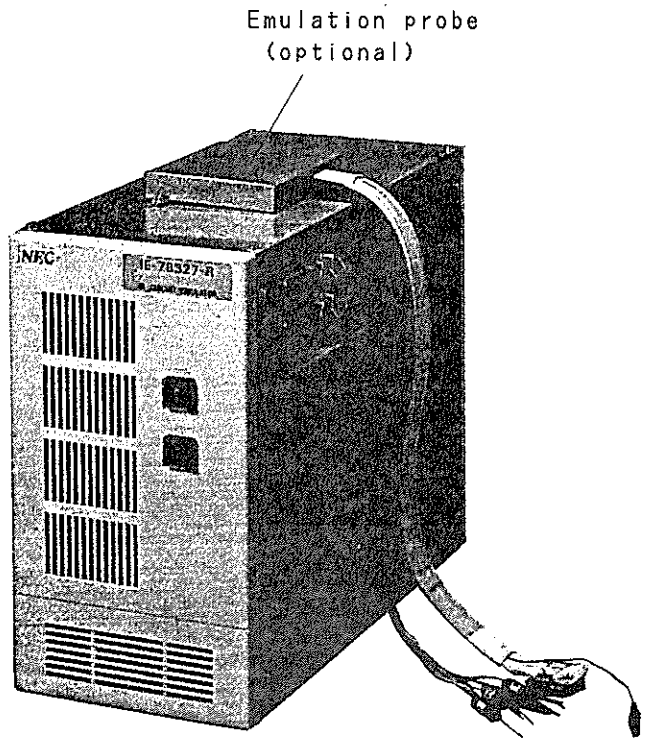
Organization of this chapter

5.1 Ordering Information on the Emulation Probe

The following optional emulation probes are available according to the target devices. Use an emulation probe suited to the package.

Order code
EP-78327CW-R (For 64-pin shrink DIP)
EP-78327GF-R (For 64-pin QFP)
EP-78327LP-R (For 68-pin PLCC)
EP-78320L-R (For 68-pin PLCC)
EP-78320GJ-R (For 74-pin QFP)

Photo 5-1 Emulation Probe



5.2 Outline of the Connection

[Before connection]

<To change the development mode (uPD78328-series mode ⟷ uPD78322-series mode)>

Change the configuration of the emulation board of the IE-78327-R a little. (See Chapter 3.)

<To set the user clock>

To supply the same clock signal as that used in the target system (user clock) to the IE-78327-R, mount a crystal oscillator on the emulation board. (See Chapter 4.)

[Outline of the connection]

- Mounting the connector board of the emulation probe to the emulation board of the IE-78327-R
- Connecting the DIN connector of the emulation probe to that on the top of the IE-78327-R

Cautions 1. For details on connecting the emulation probe, refer to the user's manual for the emulation probe. Wrong connection may damage the IE-78327-R.

2. If the connector board of the emulation probe is not electrically connected to the IE-78327-R, the IE-78327-R cannot perform emulation using the target system.

(1) Mounting the connector board of the emulation probe to the emulation board of the IE-78327-R

o Procedure

① Remove the six screws from the top of the IE-78327-R and open the cover.

② Pick up the card pullers at both sides of the emulation board, and extract the emulation board from the slots.

③ Mount the connector board of the emulation probe to connectors CN3 and CN4 on the emulation board.

④ Replace the emulation board in the IE-78327-R.

⑤ Replace the cover on the top of the IE-78327-R, and fasten it with the six screws.

(2) Connecting the DIN connector of the emulation probe to that on the top of the IE-78327-R

o Procedure

① Connect the DIN connector of the emulation probe to that on the top of the IE-78327-R.

② Fasten the emulation probe to the IE-78327-R with mounting screws.

CHAPTER 6 CONNECTING PERIPHERAL EQUIPMENT

The IE-78327-R can debug and program the target device after the peripheral equipment has been connected and the system has been configured. This chapter explains how to connect the peripheral equipment to the IE-78327-R and how to set each device. Read this chapter before connecting the peripheral equipment.

For the procedure for configuring the system, see Section 1.4. For details of activating the system, refer to Chapter 2 in User's Manual: Software.

Organization of this chapter

6.1 Peripheral Equipment

The following three types of peripheral equipment can be connected to the IE-78327-R:

- Host machine
- PROM programmer

(1) Host machine

[PC-9800 series]

For the PC-9800 series, the optional IE-78327-R control program can be run under MS-DOS™ to provide a consistent development environment for software development through total evaluation, including the hardware.

[IBM PC series]

For the IBM PC series, the optional IE-78327-R control program can be run under PC DOS™ to provide a consistent development environment for software development through total evaluation, including the hardware.

(2) PROM programmer

[PG-1500]

The PG-1500 is a PROM programmer for typical 256K- to 1M-bit PROMs. It can also program PROMs built in NEC single-chip microcomputers using the optional socket adapter.

The PG-1500 has key panel switches and a serial interface, so it can operate as a stand-alone PROM programmer. It can also operate as a remote PROM programmer through a console connected to the serial interface.

Use an RS-232-C interface cable available on the market to connect the PG-1500 to the IE-78327-R.

[PG-2000]

The PG-2000 is a PROM programmer for typical 16K- to 256K-bit PROMs. It has key panel switches and a serial interface, so it can operate as a stand-alone PROM programmer. It can also operate as a remote PROM programmer through a console connected to the serial interface.

Use the RS-232-C interface cable supplied with the PG-2000 to connect the PG-2000 to the IE-78327-R.

Remark: The PG-2000 is a PROM programmer for maintenance and cannot be purchased.

6.2 IE-78327-R Interfaces

The IE-78327-R is connected to peripheral equipment via serial interfaces (channels 1 and 2) and/or parallel interfaces (channels 3 and 4).

(1) Serial interfaces (channels 1 and 2)

Channels 1 and 2 are used according to the peripheral equipment to be connected as follows:

Serial interface	Peripheral equipment to be connected
Channel 1 (I/O)	PC-9800 series IBM PC series
Channel 2 (I/O)	PG-1500 PG-2000

Table 6-1 outlines the functions of channel 1. Table 6-2 outlines the functions of channel 2. For details, see Chapter 9.

Table 6-1 Function Outline of Channel 1

Item		Setting	Set by(*)
Mode selection		Terminal/modem mode	H
Baud rate (bps)		300, 600, 1200, 2400, 4800, 9600, 19200	H
Handshaking		Hardware (1 character) and software (flow control) handshaking	Fixed
Character specifications	Character length	8 bits The most significant bit (MSB) is set to 0 if output and is ignored if input.	Fixed
	Parity bit	None	Fixed
	Stop bit length	2 bits	Fixed

* H: Switches (Hardware) S: Software

Table 6-2 Function Outline of Channel 2

Item		Setting	Set by(*)
Mode selection		Terminal/modem mode	H
Baud rate (bps)		300, 600, 1200, 2400, 4800, 9600, 19200	S
Handshaking		Hardware (1 character) or software (flow control) handshaking	S
Character specifications	Character length	7 or 8 bits When the 8-bit length is specified, the most significant bit (MSB) must be 0 if output and is ignored if input.	S
	Parity bit	Even parity/odd parity/none	S
	Stop bit length	1 bit/2 bits	S

* H: Switches (Hardware) S: Software

(2) Parallel interfaces (channels 3 and 4)

Channel 3 is an output-only channel, and channel 4 is an input-only channel. For details of the functions of channels 3 and 4, see Chapter 10.

Parallel interface	Peripheral equipment to be connected
Channel 3 (output only)	Printer
Channel 4 (input only)	PC-9800 series IBM PC series

6.3 Connecting a PC-9800 Series Computer

[Outline of connection]

- o Turn off the power.
- o Set channel 1 of the IE-78327-R.
- o Connect the PC-9800 series computer to the IE-78327-R with the cable.
- o Turn on the power.

(1) Turning off the power

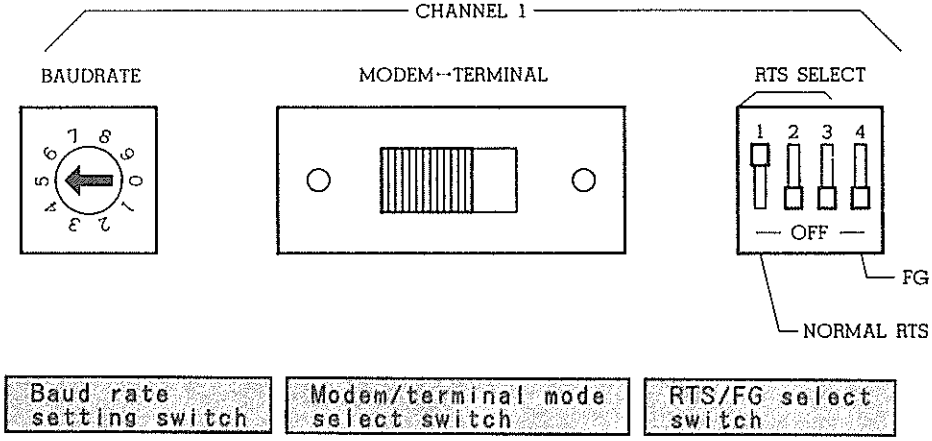
Check whether the power to the IE-78327-R and PC-9800 series computer is off. If the power is on, turn off the power first.

(2) Setting channel 1 of the IE-78327-R

Table 6-3 Setting Channel 1

Item	Setting
Mode selection	Modem mode
Baud rate	9600 bps
Frame ground	Switch 4: OFF
RTS selection	Switch 1: ON, Switches 2 and 3: OFF

Fig. 6-1 Setting Channel 1



o Procedure

① Open the RS-232-C mode switch cover on the right side of the IE-78327-R.

② Slide the modem/terminal mode select switch (CH1) from right to left to set channel 1 to the modem mode.

③ Turn the baud rate setting switch (CH1) clockwise or counterclockwise and set the switch to position 5 to set the baud rate to 9600 bps.

④ Slide switch 4 of the RTS/FG select switch (CH1) downward (OFF).

⑤ Set switches 1 to 3 of the RTS/FG select switch (CH1) as follows:

1: ON (upward)
2: OFF (downward)
3: OFF (downward)

(3) Connecting the PC-9800 series computer to the IE-78327-R with the cable

o Procedure

① Connect the standard RS-232-C channel on the rear of the main unit of the PC-9800 series computer to the CH1 serial interface port above the RS-232-C mode switches of the IE-78327-R with the cable supplied with the IE-78327-R.

② For a parallel interface, connect the printer connector on the rear of the main unit of the PC-9800 series computer to the CH4 parallel interface port of the IE-78327-R with the printer cable for the PC-9800 series.

Table 6-4 Cable Connection

IE-78327-R	Cable to be used	PC-9800 series
CH1	RS-232-C cable	Standard RS-232-C channel
CH4	Printer cable	Printer connector

(4) Turning on the power

Turn on the power in the following sequence. Turn off the power by reversing the power-on sequence. Turn on and off the power for ordinary operations using the same sequence.

o Procedure

[Power-on sequence]

① Turn on the power switch of the PC-9800 series computer.

② Turn on the power switch of the IE-78327-R.

[Power-off sequence]

① Turn off the power switch of the IE-78327-R.

② Turn off the power switch of the PC-9800 series computer.

6.4 Connecting an IBM PC Series Computer

[Outline of connection]

- o Turn off the power.
- o Set channel 1 of the IE-78327-R.
- o Set the asynchronous communication adapter of the IBM PC series computer.
- o Connect the IBM PC series computer to the IE-78327-R with the cable.
- o Turn on the power.

(1) Turning off the power

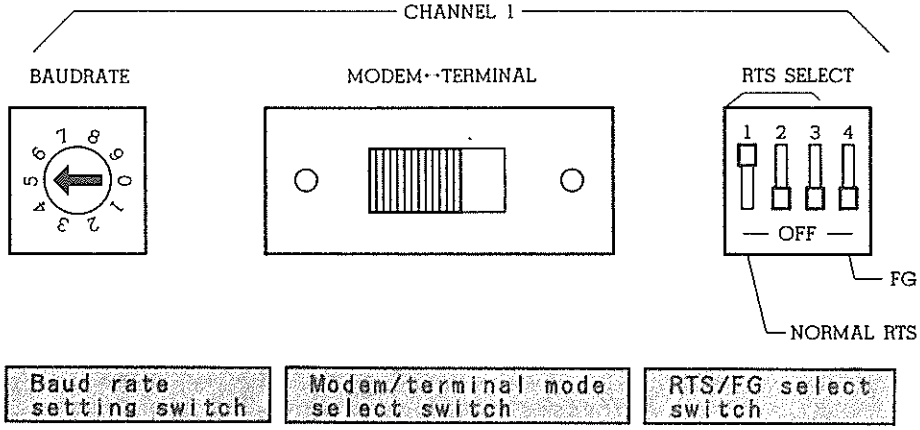
Check whether the power to the IE-78327-R and IBM PC series computer is off. If the power is on, turn off the power first.

(2) Setting channel 1 of the IE-78327-R

Table 6-5 Setting Channel 1

Item	Setting
Mode selection	Modem mode
Baud rate	9600 bps
Frame ground	Switch 4: OFF
RTS selection	Switch 1: ON, Switches 2 and 3: OFF

Fig. 6-2 Setting Channel 1



o Procedure

① Open the RS-232-C mode switch cover on the right side of the IE-78327-R.

② Slide the modem/terminal mode select switch (CH1) from right to left to set channel 1 to the modem mode.

③ Turn the baud rate setting switch (CH1) clockwise or counterclockwise and set the switch to position 5 to set the baud rate to 9600 bps.

④ Slide switch 4 of the RTS/FG select switch (CH1) downward (OFF).

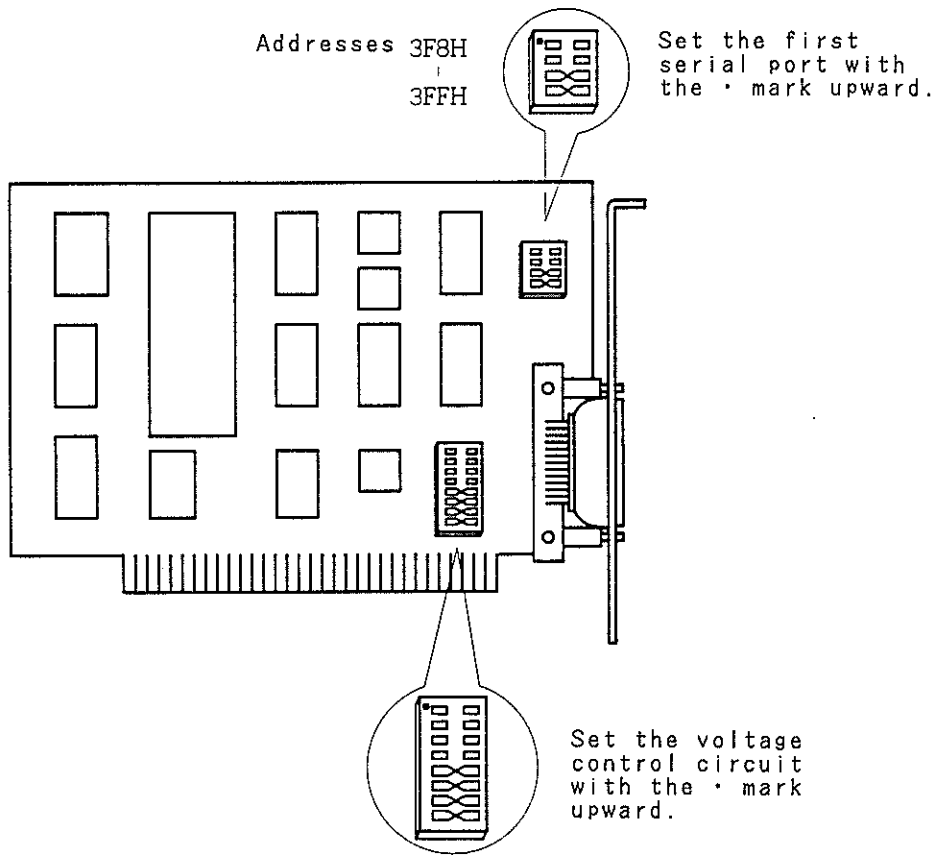
⑤ Set switches 1 to 3 of the RTS/FG select switch (CH1) as follows:

1: ON (upward)
2: OFF (downward)
3: OFF (downward)

(3) Setting the asynchronous communication adapter of the IBM PC series computer

Set the asynchronous communication adapter in the IBM PC series computer as shown in Figure 6-3. The IE-78327-R control program supports only the first serial port (No. 0).

Fig. 6-3 Setting the Asynchronous Communication Adapter

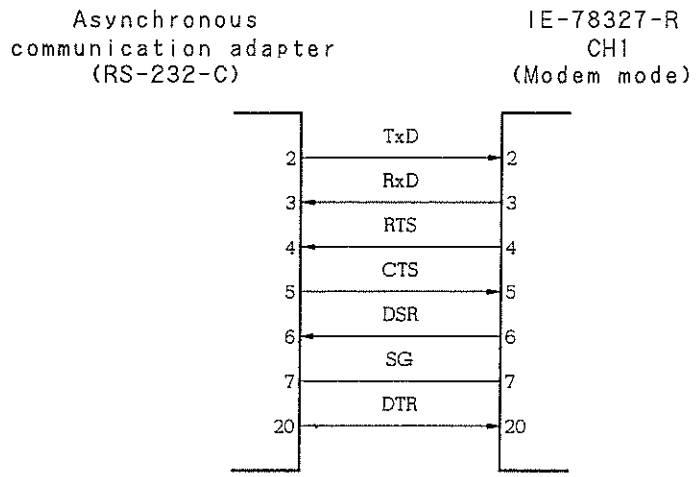


(4) Connecting the IBM PC series computer to the IE-78327-R with the cable

o Procedure

① Connect the RS-232-C channel of the asynchronous communication adapter, which is an IBM PC option, to the CH1 serial interface port of the IE-78327-R with an RS-232-C cable for the IBM PC series.

Fig. 6-4 Connecting the IBM PC Series Computer with an RS-232-C Cable



② For a parallel interface, connect the printer connector on the rear of the main unit of the IBM PC series computer to the CH4 parallel interface port of the IE-78327-R with a printer cable for the IBM PC series.

Table 6-6 Cable Connection

IE-78327-R	Cable to be used	IBM PC series
CH1	RS-232-C cable	RS-232-C channel of the asynchronous communication adapter
CH4	Printer cable	Printer connector

(5) Turning on the power

Turn on the power in the following sequence. Turn off the power by reversing the power-on sequence. Turn on and off the power for ordinary operations using the same sequence.

o Procedure

[Power-on sequence]

① Turn on the power switch of the IBM PC series computer.

② Turn on the power switch of the IE-78327-R.

[Power-off sequence]

① Turn off the power switch of the IE-78327-R.

② Turn off the power switch of the IBM PC series computer.

6.5 Connecting the PG-1500

[Outline of connection]

- o Turn off the power.
- o Set channel 2 of the IE-78327-R.
- o Connect the PG-1500 to the IE-78327-R with the cable.
- o Turn on the power to the PG-1500.
- o Set the function mode of the PG-1500.
- o Turn on the power to the IE-78327-R.

(1) Turning off the power

Check whether the power to the IE-78327-R and PG-1500 is off. If the power is on, turn off the power first.

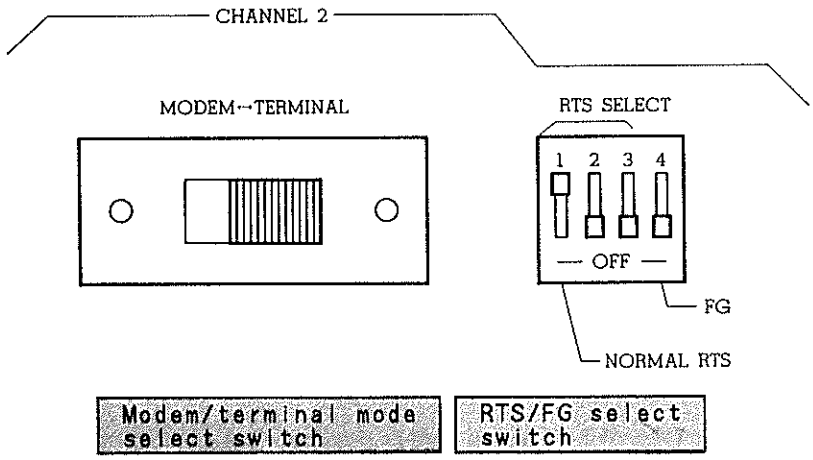
(2) Setting channel 2 of the IE-78327-R

Some settings of channel 2 of the IE-78327-R are set by RS-232-C mode switches on the main unit when the power is off. Some settings are set by executing the MOD command when the IE-78327-R is active. The following shows setting by the RS-232-C mode switches on the main unit.

Table 6-7 Setting Channel 2

Item	Setting
Mode selection	Terminal mode
Frame ground	Switch 4: OFF
RTS selection	Switch 1: ON, Switches 2 and 3: OFF

Fig. 6-5 Setting Channel 2



o Procedure

① Open the RS-232-C mode switch cover on the right side of the IE-78327-R main unit.

② Slide the modem/terminal mode select switch (CH2) from left to right to set channel 2 to the terminal mode.

③ Slide switch 4 of the RTS/FG select switch (CH2) downward (OFF).

④ Set switches 1 to 3 of the RTS/FG select switch (CH2) as follows:

1: ON (upward)
2: OFF (downward)
3: OFF (downward)

Remark: Setting channel 2 by the MOD command

Use the MOD command to set the handshaking, baud rate, and character specifications of channel 2. For details, refer to the description of the MOD command in User's Manual: Software.

Table 6-8 Setting Channel 2 by the MOD Command

Item		Setting	Set by
Handshaking		1 character	MOD command
Baud rate		9600 bps	
Character specifications	Character length	8 bits	
	Parity bit	None	
	Stop bit length	2 bits	

(3) Connecting the PG-1500 to the IE-78327-R with the cable

Connect the serial interface connector at the right on the PG-1500 rear panel to the CH2 serial interface port of the IE-78327-R. Use an RS-232-C interface cable available on the market for connection.

Table 6-9 Cable Connection

IE-78327-R	Cable to be used	PG-1500
CH2	RS-232-C interface cable available on the market	Serial interface connector

(4) Turning on the power to the PG-1500

Turn on the power switch on the right side of the PG-1500 main unit.

(5) Setting the function mode of the PG-1500

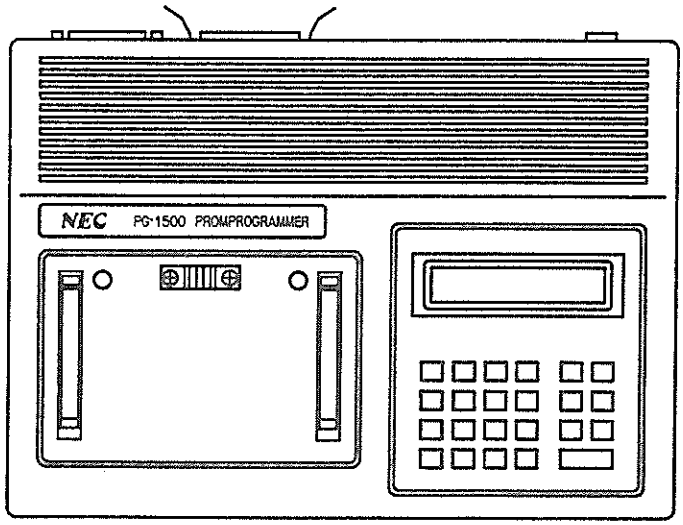
Set the PG-1500 with the key switches on the front panel. For details, refer to PG-1500 User's Manual.

Table 6-10 Setting the PG-1500

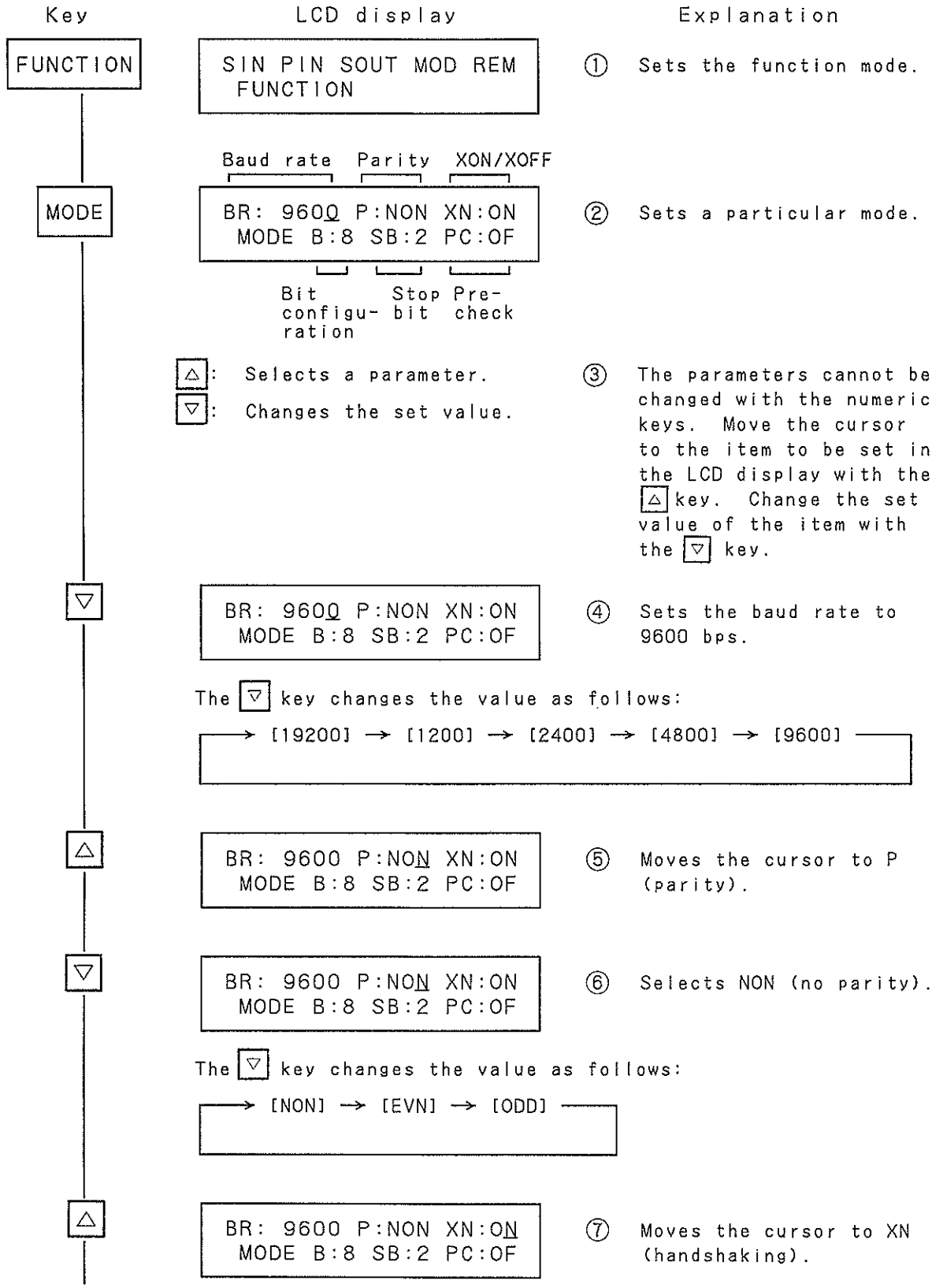
Item	Setting	LCD display
Baud rate	9600 bps	BR:9600
Parity bit	None	P:NON
Handshaking	1 character	XN:OF
Character length	8 bits	B:8
Stop bit length	2 bits	SB:2
Precheck(*)	None	PC:OF

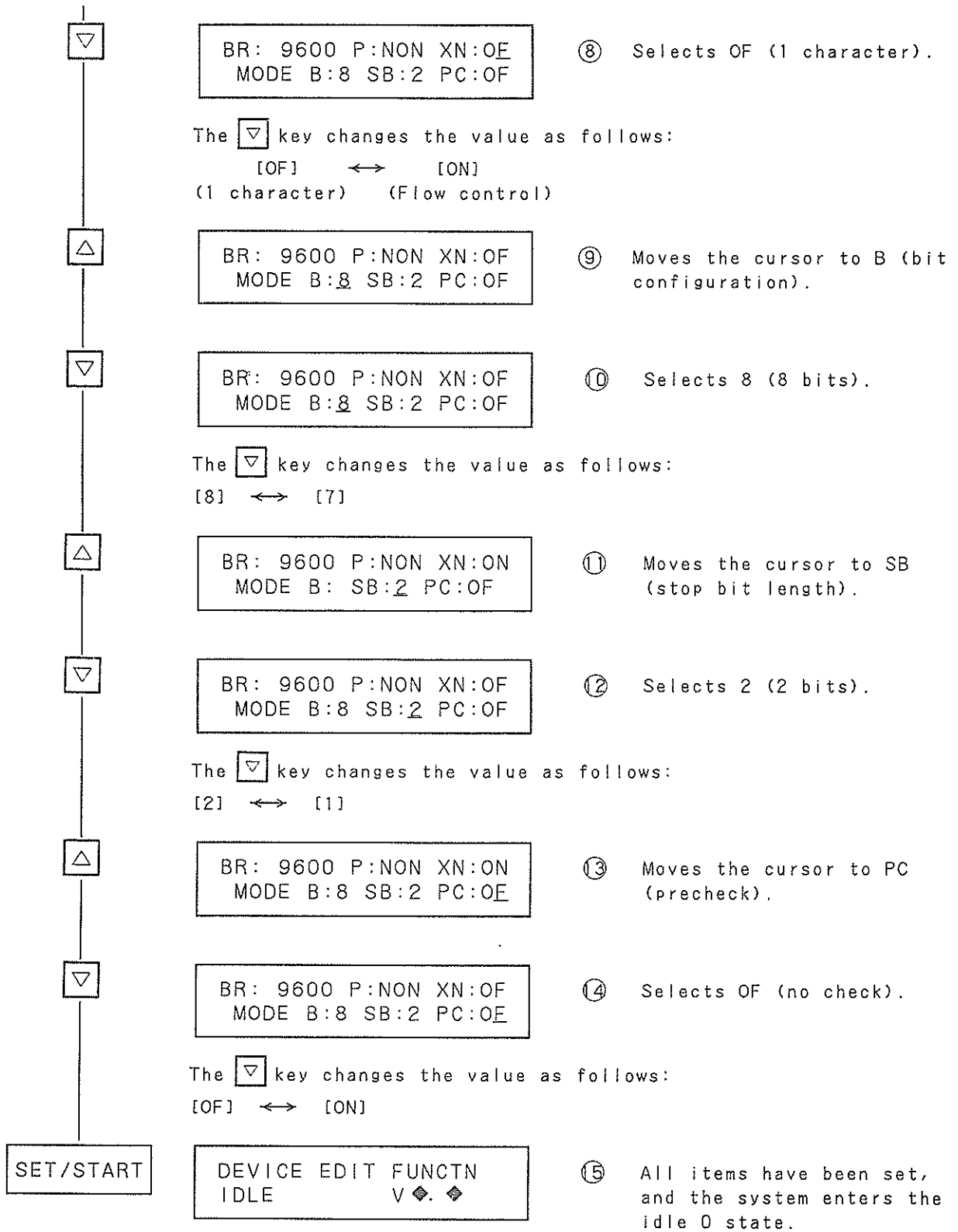
* Function which prechecks if the device is correctly installed. Available only for the 27xx system.

Fig. 6-6 PG-1500 Front Panel



o Procedure


Key
LCD display
Explanation
FUNCTION
SIN PIN SOUT MOD REM
FUNCTION
① Sets the function mode.
Baud rate
Parity
XON/XOFF
MODE
BR: 9600 P:NON XN:ON
MODE B:8 SB:2 PC:OF
② Sets a particular mode.
Bit configu-ration
Stop bit
Pre-check
△: Selects a parameter.
▽: Changes the set value.
③ The parameters cannot be changed with the numeric keys. Move the cursor to the item to be set in the LCD display with the △ key. Change the set value of the item with the ▽ key.
▽
BR: 9600 P:NON XN:ON
MODE B:8 SB:2 PC:OF
④ Sets the baud rate to 9600 bps.
The ▽ key changes the value as follows:
→ [19200] → [1200] → [2400] → [4800] → [9600]
△
BR: 9600 P:NON XN:ON
MODE B:8 SB:2 PC:OF
⑤ Moves the cursor to P (parity).
▽
BR: 9600 P:NON XN:ON
MODE B:8 SB:2 PC:OF
⑥ Selects NON (no parity).
The ▽ key changes the value as follows:
→ [NON] → [EVN] → [ODD]
△
BR: 9600 P:NON XN:ON
MODE B:8 SB:2 PC:OF
⑦ Moves the cursor to XN (handshaking).



Caution: The set values are not changed unless the SET/START key is pressed. Press the SET/START key to write the set values in NV-RAM in the PG-1500.

(6) Turning on the power to the IE-78327-R

Turn on the power switch on the front of the IE-78327-R main unit.

Remark: Ordinary power-on and power-off sequence

o Procedure

[Power-on sequence]

① Turn on the power switch of the PG-1500.

② Press the RESET key then the SERIAL(B) key on the PG-1500 front panel.

③ Turn on the power switch of the IE-78327-R.

[Power-off sequence]

① Turn off the power switch of the PG-1500.

② Turn off the power switch of the IE-78327-R.

6.6 Connecting the PG-2000

[Outline of connection]

- o Turn off the power.
- o Set channel 2 of the IE-78327-R.
- o Set the serial interface mode of the PG-2000.
- o Connect the PG-2000 to the IE-78327-R with the cable.
- o Turn on the power.

(1) Turning off the power

Check whether the power to the IE-78327-R and PG-2000 is off. If the power is on, turn off the power first.

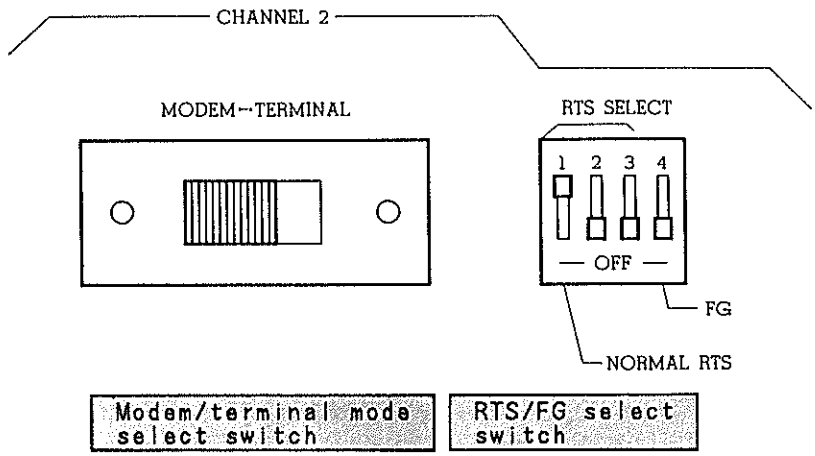
(2) Setting channel 2 of the IE-78327-R

Some settings of channel 2 of the IE-78327-R are set by RS-232-C mode switches on the main unit when the power is off. Some settings are set by executing the MOD command when the IE-78320-R is active. The following shows setting by the RS-232-C mode switches on the main unit.

Table 6-11 Setting Channel 2

Item	Setting
Mode selection	Modem mode
Frame ground	Switch 4: OFF
RTS selection	Switch 1: ON, Switches 2 and 3: OFF

Fig. 6-7 Setting Channel 2



o Procedure

① Open the RS-232-C mode switch cover on the right side of the IE-78327-R main unit.

② Slide the modem/terminal mode select switch (CH2) from right to left to set channel 2 to the modem mode.

③ Slide switch 4 of the RTS/FG select switch (CH2) downward (OFF).

④ Set switches 1 to 3 of the RTS/FG select switch (CH2) as follows:

1: ON (upward)
2: OFF (downward)
3: OFF (downward)

Remark: Setting channel 2 by the MOD command

Use the MOD command to set the handshaking, baud rate, and character specifications of channel 2. For details, refer to the description of the MOD command in User's Manual: Software.

Table 6-12 Setting Channel 2 by the MOD Command

Item		Setting	Set by
Handshaking		1 character	MOD command
Baud rate		9600 bps	
Character specifications	Character length	8 bits	
	Parity bit	None	
	Stop bit length	2 bits	

(3) Setting the serial interface mode of the PG-2000

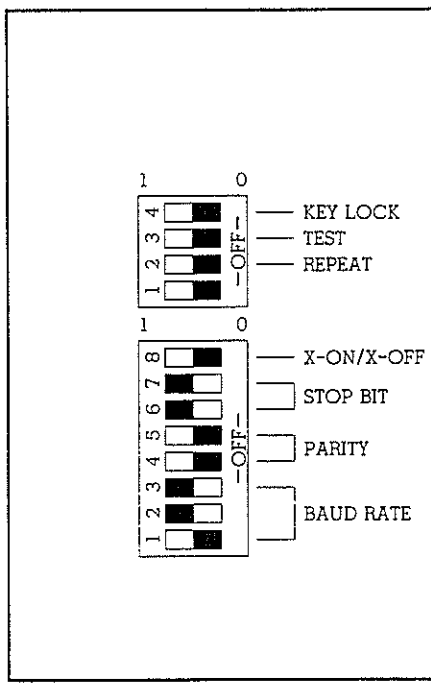
Set the PG-2000 with the 8-bit DIP switch on the bottom of the PG-2000 main unit. For details, refer to PG-2000 Instruction Manual.

Table 6-13 Setting the PG-2000

Item	Setting	Switches
Baud rate	9600 bps	1: OFF 2: ON 3: ON
Parity bit	None	4: OFF 5: ON/OFF (*)
Stop bit length	2	6: ON 7: ON
Handshaking	1 character	8: OFF

* Either ON/OFF may be set.

Fig. 6-8 Switches on the Bottom of the PG-2000



6 7	STOP BIT
0 0	—
1 0	1BIT
0 1	1.5BIT
1 1	2BIT
4 5	PARITY BIT
0 ×	OFF
1 0	ODD
1 1	EVEN
1 2 3	BAUD RATE
0 0 0	110
1 0 0	300
0 1 0	600
1 1 0	1200
0 0 1	2400
1 0 1	4800
0 1 1	9600

Caution: The 4-bit DIP switch is used for factory inspection. All switches must be set in the OFF position.

o Procedure

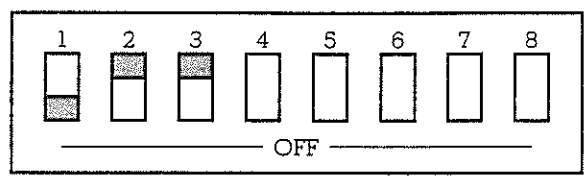
① Set the baud rate with switches 1 to 3 to 9600 bps. This is the same baud rate as for the IE-78327-R.

Fig. 6-9 Setting the Baud Rate of the PG-2000

1: OFF (downward)

2: ON (upward)

3: ON (upward)

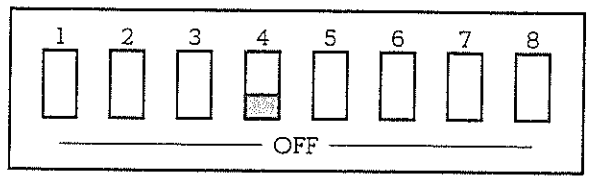


② Set the parity bit with switches 4 and 5 to no parity. This is the same as the set value for the IE-78327-R.

Fig. 6-10 Setting the Parity Bit of the PG-2000

4: OFF (downward)

5: ON/OFF (either)

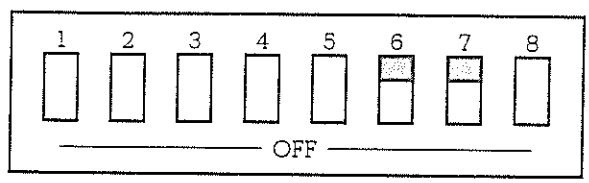


③ Set the stop bit length with switches 6 and 7 to 2 bits. This is the same length as for the IE-78327-R.

Fig. 6-11 Setting the Stop Bit Length of the PG-2000

6: ON (upward)

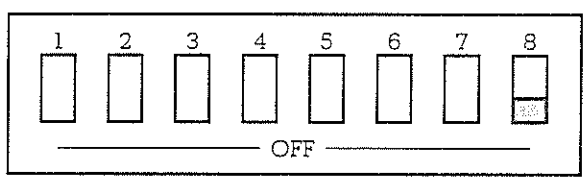
7: ON (upward)



④ Set the handshaking with switch 8 as follows:

Fig. 6-12 Setting the Handshaking of the PG-2000

8: OFF (downward)



(4) Connecting the PG-2000 to the IE-78327-R with the cable

Connect the serial interface connector at the left on the PG-2000 rear panel to the CH2 serial interface port of the IE-78327-R. Use the RS-232-C interface cable supplied with the PG-2000 for connection.

Caution: Be sure to use the cable supplied with the PG-2000.

Table 6-14 Cable Connection

IE-78327-R	Cable to be used	PG-2000
CH2	RS-232-C interface cable	Serial interface connector

(5) Turning on the power

Turn on and off the power in the following sequence. Turn on and off the power for ordinary operations in the same sequence.

o Procedure

[Power-on sequence]

① Turn on the power switch of the PG-2000.

② Press the REM key then the START key on the PG-2000 front panel.

③ Turn on the power switch of the IE-78327-R.

[Power-off sequence]

① Turn off the power switch of the PG-2000.

② Turn off the power switch of the IE-78327-R.

CHAPTER 7 CONNECTING THE TARGET SYSTEM

This chapter explains how to connect the target system to the emulation probe connected to the IE-78327-R. It also explains the handling of latch-up. Be sure to read this chapter before connecting the target system.

Organization of this chapter

7.1 Connecting the Target System

[Before connection]

<When the user clock has not been set>

See Chapter 4 and set the clock (only it needs to be set).

<When the connector board has not been connected>

See Chapter 5 and connect the connector board of the emulation probe (option) to the I/O emulation board.

[Outline of connection]

o Connect the target system to the emulation probe.

o Connect the target system to the external sense clips.

(1) Connecting the target system to the emulation probe

The following outlines how to connect the target system to the emulation probe. For the details of connection, refer to the user's manual of the emulation probe.

o Procedure

① Connect the ground clip of the emulation probe to GND (signal ground) in the CPU socket of the target system. If the ground clip is not connected, the IE-78327-R may be destroyed by static electricity.

② Insert the tip of the emulation probe main unit into the CPU socket of the target system with the first-pin mark of the emulation probe aligned with the first pin of the CPU socket. Do not break or bend the pins of the emulation probe.

The following diagrams show the connection of the target system to the emulation probe.

Fig. 7-1 Connecting the Target System to the EP-78327CW-R

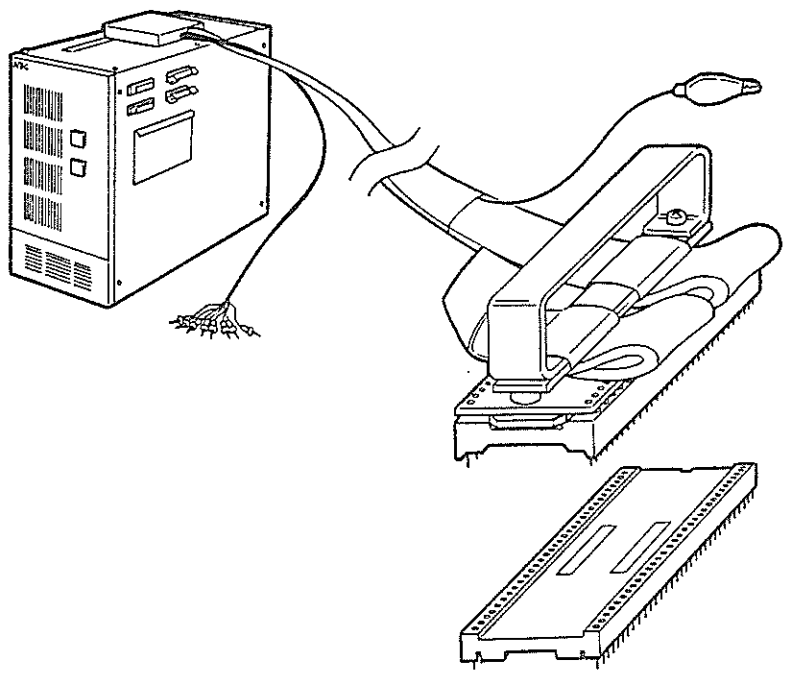


Fig. 7-2 Connecting the Target System to the EP-78327GF-R

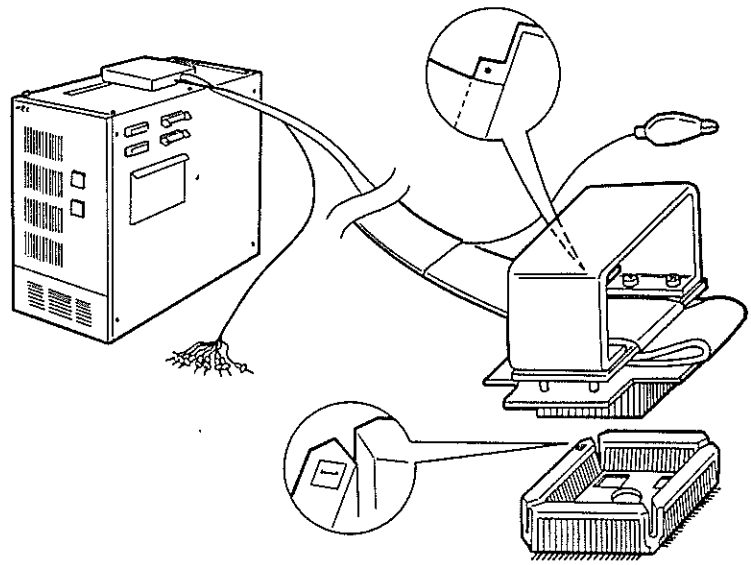


Fig. 7-3 Connecting the Target System to the EP-78327LP-R or the EP-78320L-R

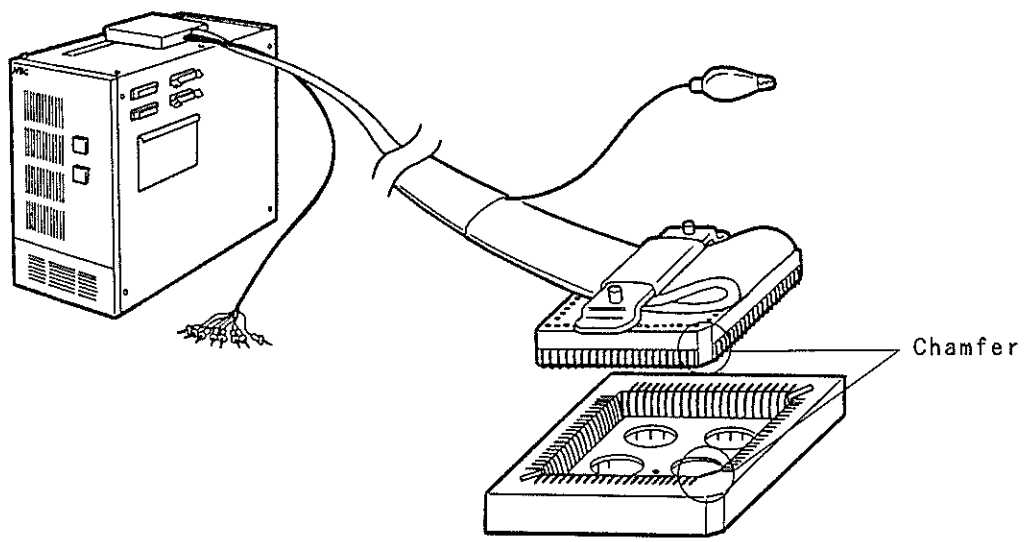
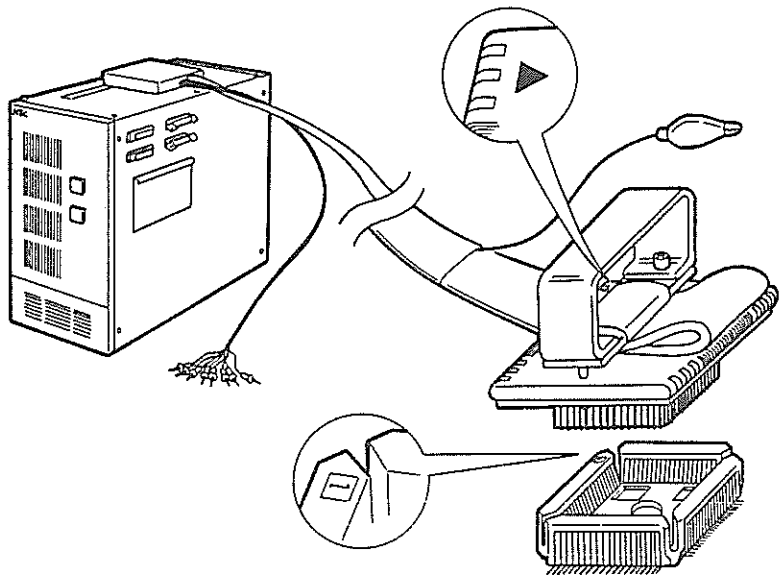


Fig. 7-4 Connecting the Target System to the EP-78320GJ-R



(2) Connecting the target system to the external sense clips

The IE-78327-R can trace the bus cycle of the target device in real time. It can also trace any eight signal lines in real time using the external sense function. Eight external sense clips are provided for the eight signal lines.

Cautions 1. Connect the external sense clips only to the signal lines compatible with the TTL. If a sense clip is connected to another signal line, the IE-78327-R cannot correctly detect the high or low level of the signal. This may destroy the sensor of the IE-78327-R main unit, depending on the voltage level.

2. The eight external sense clips are generally input signal lines. The signal line of external sense clip 1, however, can be used as an external trigger output signal line for an event according to the specification in the OUT command. (For details, see the description of the OUT command.) Do not connect the signal line of external clip 1 to be used as an output signal line to any line to output signals from the target system.

3. Use an IC clip for connecting the external sense clips.

o Procedure

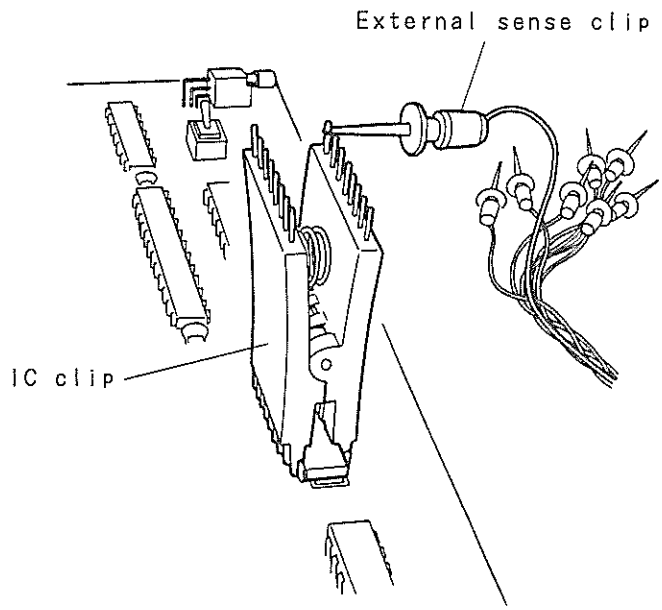
① Turn off the power to the IE-78327-R.

② Turn off the power to the target system.

③ Set an IC clip at the IC to be traced in the target system.

④ Connect the external sense clips to the IC clip.

Fig. 7-5 Connecting the External Sense Clips



7.2 Power-on/Power-off Sequence

Turn on and off the power in the following sequence after connecting the target system. For details of the activation and termination of the IE-78327-R, refer to User's Manual: Software.

Caution: Turn on and off the power in the correct sequence, otherwise the IE-78327-R may operate abnormally or may be destroyed.

o Procedure

[Power-on sequence]

① Turn on the power to the IE-78327-R.

② The following message appears.

```
Power on target system (Y/N)
```

③ Turn on the power to the target system.

④ Enter Y.

[Power-off sequence]

① Enter RES-H or press the reset switch on the IE-78327-R.

② The following message appears.

```
Power on target system (Y/N)
```

③ Turn off the power to the target system.

④ Turn off the power to the IE-78327-R.

7.3 Handling Latch-up

If latch-up occurs in the emulation device, serial interface chip, or neighboring CMOS IC in the IE-78327-R, turn off the power immediately.

o The IE-78327-R detects latch-up, and the power to the following devices is automatically turned off.

  . Emulation device
  . Serial interface chip
  . Neighboring CMOSs
  . Other CMOSs

o The latch-up warning circuit in the IE-78327-R operates, and the following message appears on the display of the host machine.

```
Emulation CPU latchup !
```

. Turn off the power to the target system.

. Turn off the power to the IE-78327-R.

CHAPTER 8 TARGET INTERFACE CIRCUIT

The target interface circuit allows the IE-78327-R to behave like the target device and consists of the emulation device and the gates such as CMOS and TTL.

If debugging is performed after the target system is connected to the IE-78327-R, the target interface circuit of the IE-78327-R is used to emulate the target device as if it operates in the target system.

The target device (uPD78328 or uPD78322 series) consists of a CMOS LSI. The emulation device in the target interface circuit also consists of a CMOS LSI. The AC and DC characteristics of the emulation device is therefore almost the same as those of the target device.

If the signals of the emulation device are input and output through gates in the target interface circuit, however, the emulation device differs in AC and DC characteristics from the target device.

For AC characteristics, in particular, the gate delay time in which each gate differs is taken whenever a signal passes through a gate.

Take the above precaution when designing the target system.

This chapter describes the target interface circuit for the uPD78328 series development mode and uPD78322 series development mode.

Organization of this chapter

8.1 In the uPD78328 Series Development Mode

The following three target interface circuits are described below.

- Circuit that inputs signals from and output them to the emulation device directly or through registors.
- Circuit that inputs signals from and output them to the emulation device through gates
- Circuit that inputs signals to the control/trace module

(1) Circuit that inputs signals from and outputs them to the emulation device directly or through resistors

This circuit serves as the interface of the following signals.

- Signals related to Port 0
- Signals related to Port 2
- Signals related to Port 3
- Signals related to Port 4
- Signals related to Port 5
- Signals related to Port 7
- Signals related to Port 8
- Signals related to Port 9
- A/D converter related signals
- ASTB signal

Fig. 8-1 Diagram of a Circuit Equivalent to the Port-Pin Emulation Circuit (In the uPD78328 Series Development Mode)

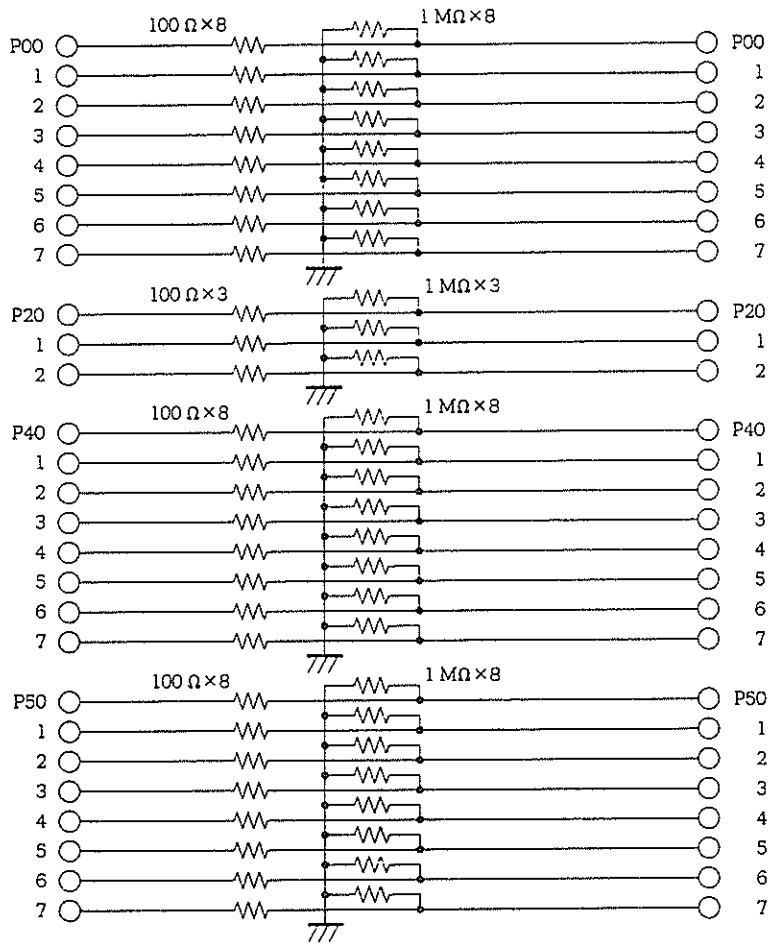
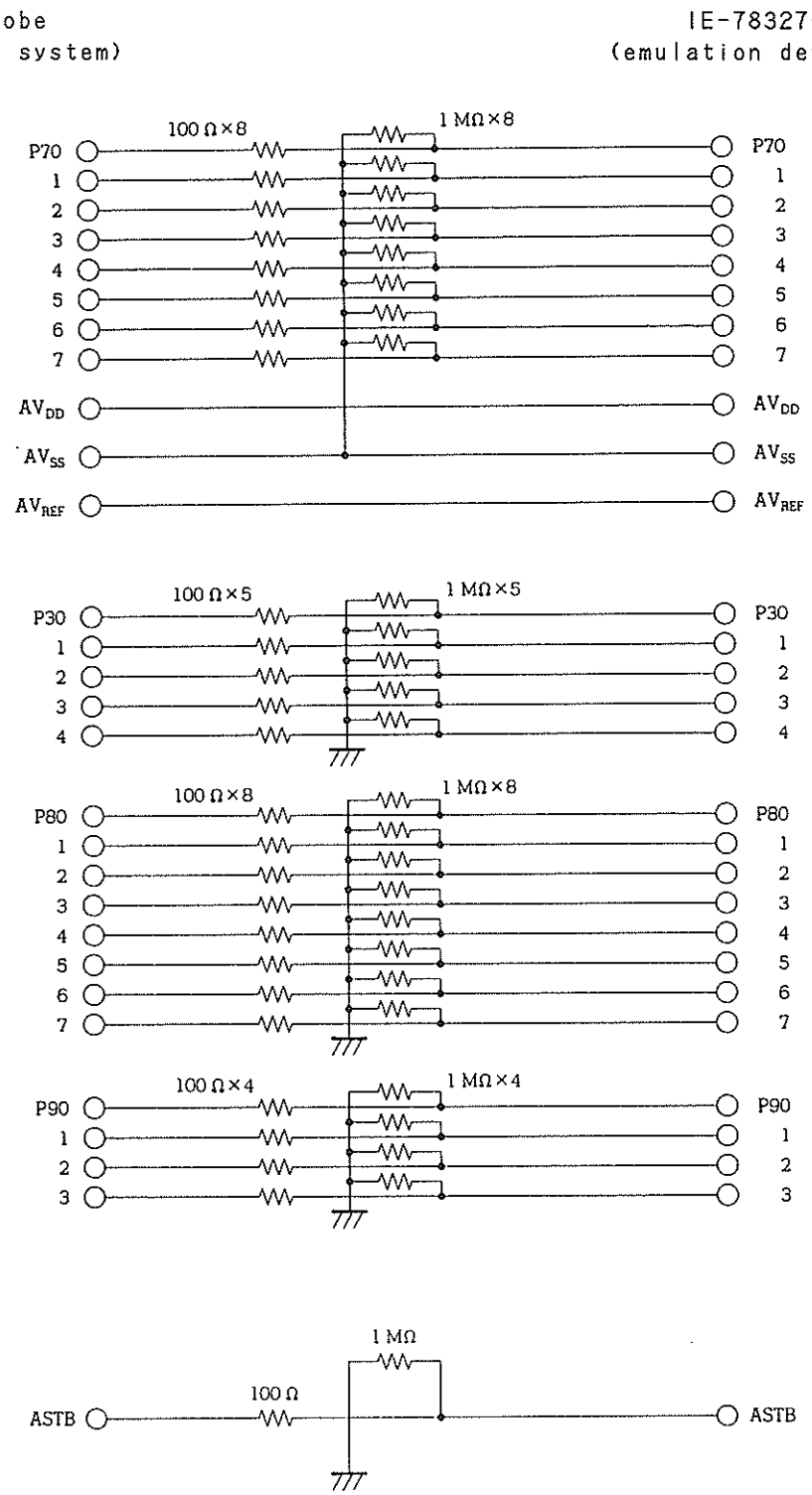


Fig. 8-2 Diagram of a Circuit Equivalent to the Port-Pin and ASTB Pin Emulation Circuit (In the uPD78328 Series Development Mode)

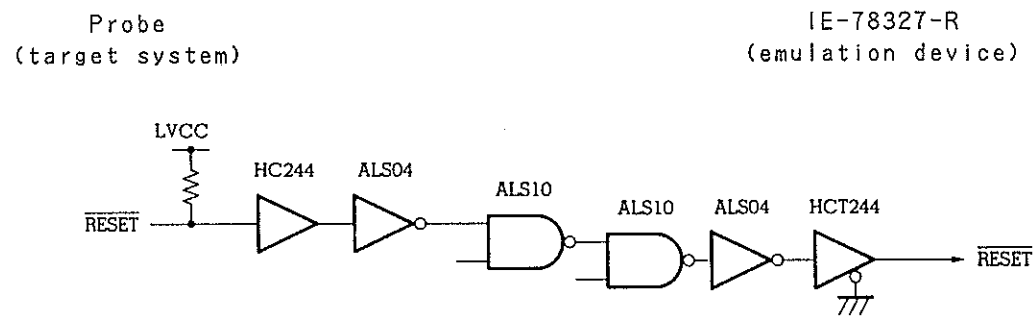


(2) Circuit that inputs signals from and outputs them to the emulation device through gates

This circuit serves as the interface of the following signal:

$\overline{\text{RESET}}$ signal

Fig. 8-3 Diagram of a Circuit Equivalent to the $\overline{\text{RESET}}$-Signal Emulation Circuit (In the uPD78328 Series Development Mode)



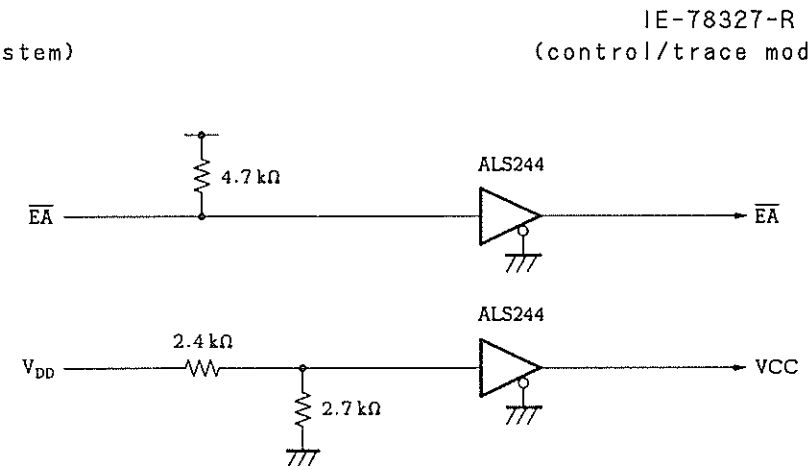
(3) Circuit that inputs signals to the control/trace module

This circuit serves as the interface of the following signals:

- VCC signal (level check signal)(Note)
- $\overline{EA}$ signal

Note: The VCC signal detects the state of supplying power to the target system (voltage V_{DD}), but does not supply power to the emulation device. The power is supplied from the power supply of the IE-78327-R to the emulation device.

Fig. 8-4 Diagram of a Circuit Equivalent to the $\overline{EA}$-Signal and VCC-Signal Emulation Circuit (In the uPD78328 Series Development Mode)



8.2 In the uPD78322 Series Development Mode

The following three types of the target interface circuit are described below.

- Circuit that inputs signals from and output them to the emulation device through resistors.
- Circuit that inputs signals from and output them to the emulation device through gates
- Circuit that inputs signals to the control/trace module

(1) Circuit that inputs signals from and outputs them to the emulation device through resistors

This circuit serves as the interface of the following signals.

- Signals related to Port 0
- Signals related to Port 2
- Signals related to Port 3
- Signals related to Port 4
- Signals related to Port 5
- Signals related to Port 7
- Signals related to Port 8
- Signals related to Port 9
- A/D converter related signals
- ASTB signal

Fig. 8-5 Diagram of a Circuit Equivalent to the Port-Pin Emulation Circuit (In the uPD78322 Series Development Mode)

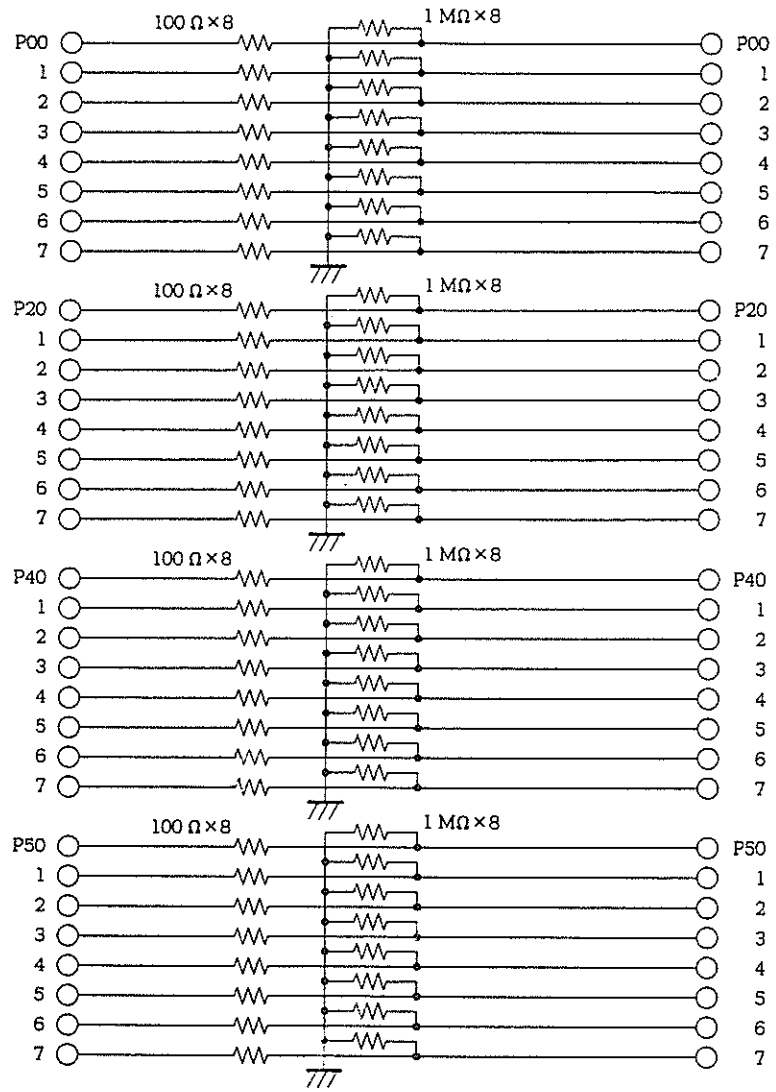
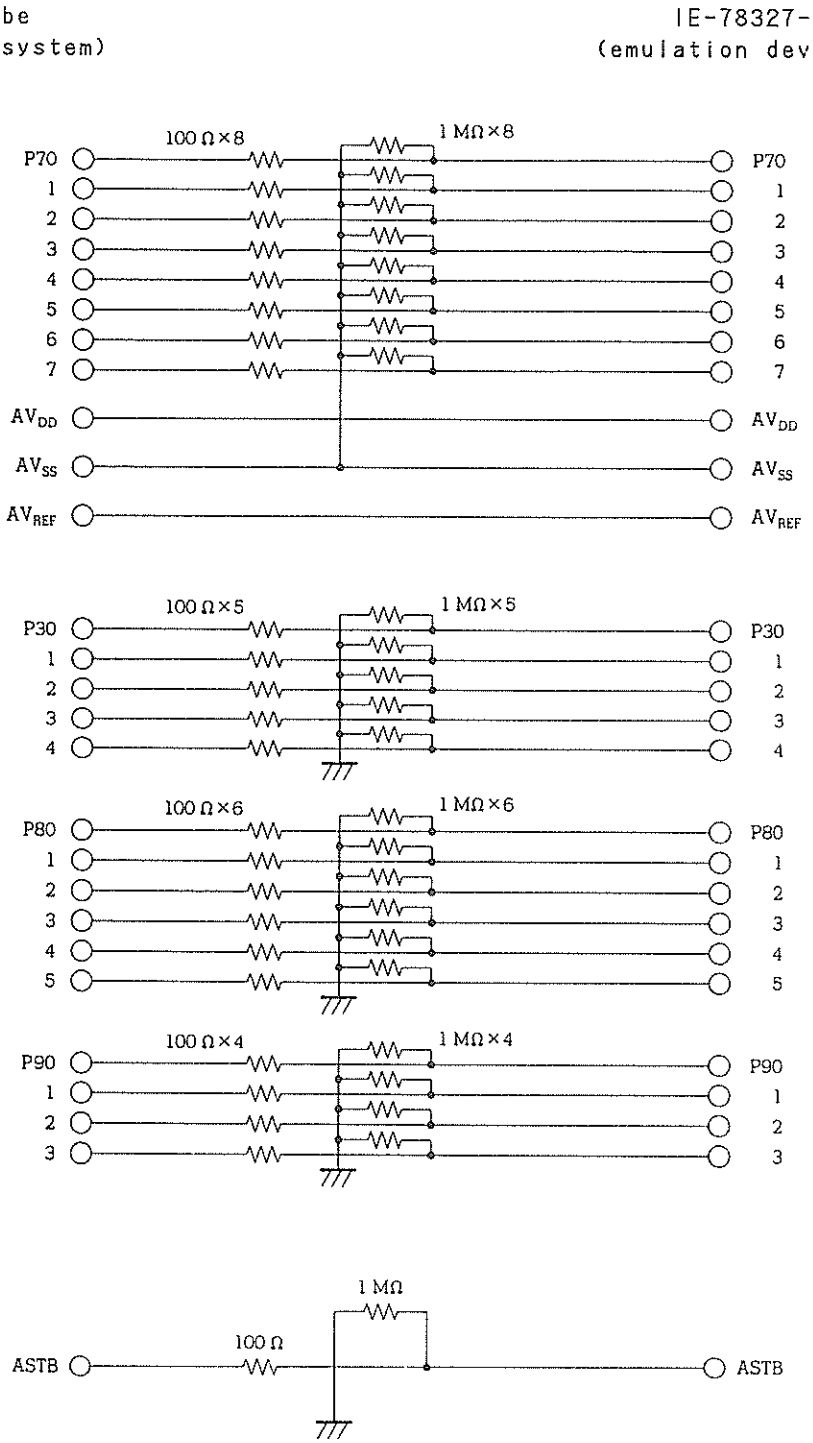


Fig. 8-6 Diagram of a Circuit Equivalent to the Port-Pin and ASTB Pin Emulation Circuit (In the uPD78322 Series Development Mode)

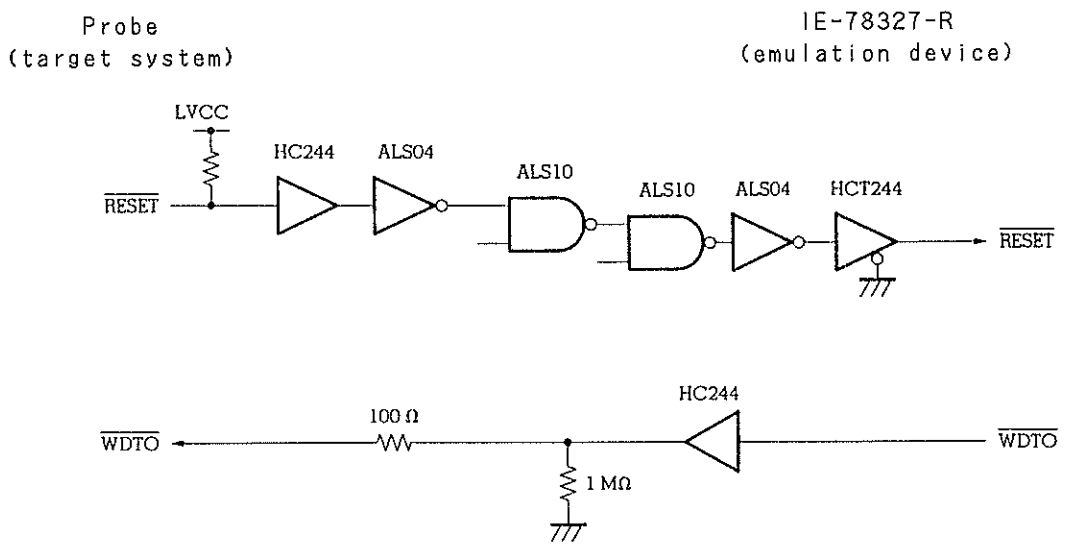


(2) Circuit that inputs signals from and outputs them to the emulation device through gates

This circuit serves as the interface of the following signals:

- $\overline{\text{RESET}}$ signal
- $\overline{\text{WDTO}}$ signal

Fig. 8-7 Diagram of a Circuit Equivalent to the $\overline{\text{RESET}}$-Signal and $\overline{\text{WDTO}}$-Signal Emulation Circuit (In the uPD78322 Series Development Mode)



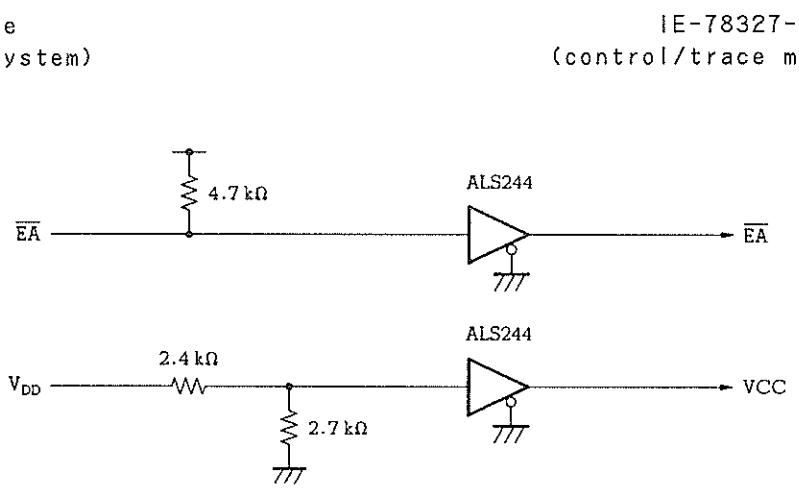
(3) Circuit that inputs signals to the control/trace module

This circuit serves as the interface of the following signals:

- VCC signal (level check signal)(Note)
- $\overline{EA}$ signal

Note: The VCC signal detects the state of supplying power to the target system (voltage V_{DD}), but does not supply power to the emulation device. The power is supplied from the power supply of the IE-78327-R to the emulation device.

Fig. 8-8 Diagram of a Circuit Equivalent to the $\overline{EA}$-Signal and VCC-Signal Emulation Circuit (In the uPD78322 Series Development Mode)



CHAPTER 9 FUNCTIONS OF CHANNELS 1 AND 2

This chapter details the functions of channels 1 and 2 of the IE-78327-R.

Channels 1 and 2 are serial interfaces provided for the host machine and the PROM programmer respectively.

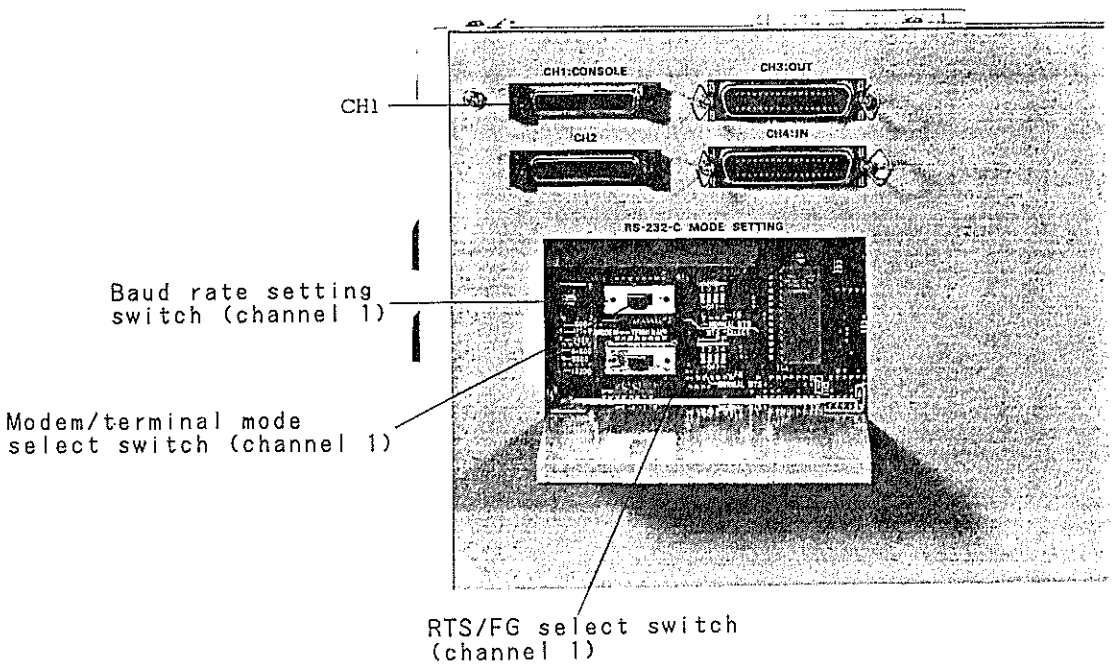
Without reading this chapter, the user can operate the IE-78327-R correctly by connecting the serial interface port (CH1) with the host machine, or, if necessary, by connecting the serial interface port (CH2) with the PROM programmer according to Chapter 6.

Organization of this chapter

9.1 Channel 1 Functions

Channel 1 is a serial interface for the host machine. It is based on RS-232-C. The RS-232-C mode switches on the right side of the IE-78327-R main unit contain channel 1 mode setting switches (CHANNEL 1). A serial interface port (CH1) is provided above the switches.

Photo 9-1 Channel 1



Channel 1 has the functions (1) to (5) below to control the RS-232-C interface. With these functions, channel 1 transfers control data between the IE-78327-R and the host machine, and loads files such as object files.

(1) to (3) below can be set with the CHANNEL 1 switches. However, the setting values of (4) and (5) are fixed, and cannot be modified.

(1) Mode switching

Setting item	Setting	Switch
Mode switching	Modem mode and terminal mode	Modem/terminal mode select switch

(2) RTS and FG setting

Setting item	Setting	Switch
RTS, FG	1: On, 2 to 4: Off	RTS/FG select switch

(3) Baud rate selection

Setting item	Setting	Switch
Baud rate	9600 bps	Baud rate setting switch

(4) Handshaking

Setting item	Setting	Switch
Handshaking	Hardware handshaking used together with software handshaking	Fixed

(5) Character specification

Setting item	Setting	Switch
Character length	8 bits (with the most significant bit set always to 0 for output and ignored for input)	Fixed
Parity bit	None	
Stop bit length	2 bits	

(1) Mode switching

The modem/terminal mode select switch is used for mode switching between the terminal mode and modem mode. The terminal mode is set by sliding the switch from left to right. The modem mode is set by sliding the switch from right to left. The modem mode must be set for connection with the host machine.

Fig. 9-1 Modem/Terminal Mode Select Switch (Channel 1)

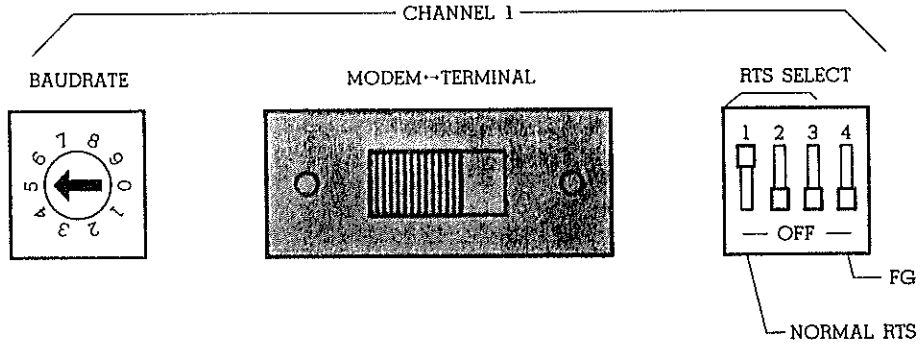
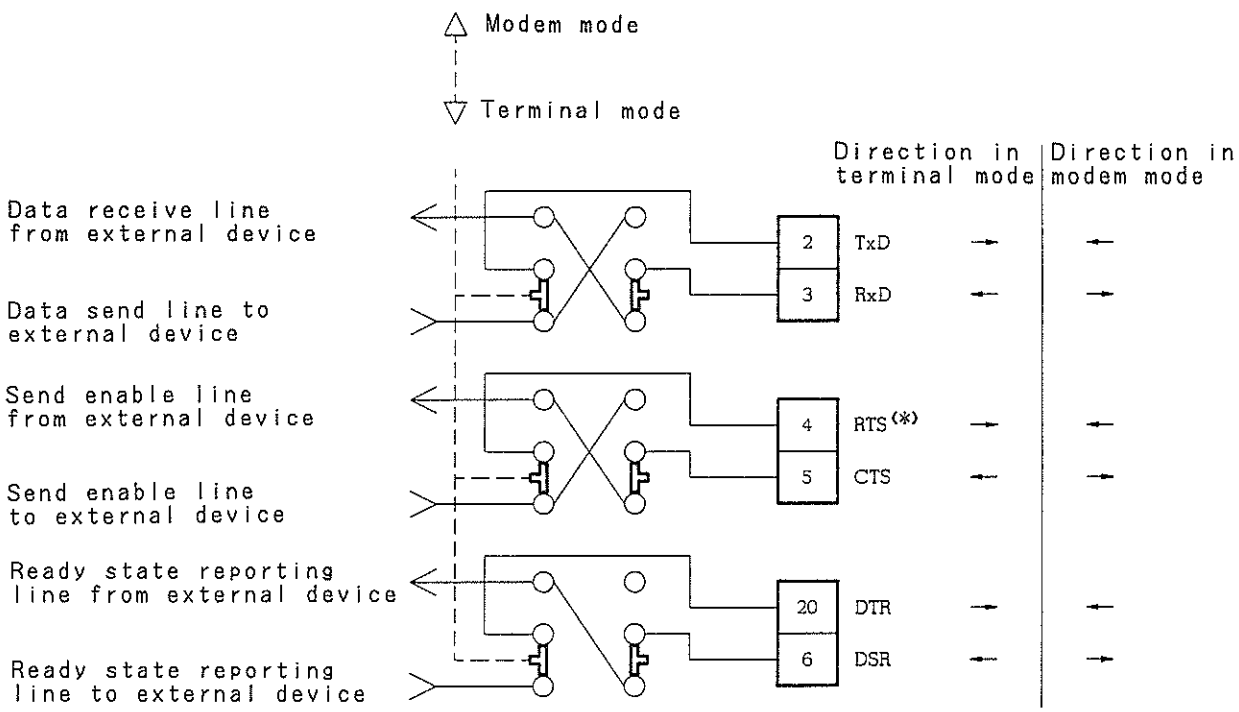


Fig. 9-2 Circuit Diagram of Modem/Terminal Mode Select Switch (Channel 1)



* See Section 9.1.(2).

(2) RTS and FG setting

The RTS/FG select switch is used for RTS and FG setting. The switch is on when it is set to the upper position. The switch is off when it is set to the lower position. (See Table 9-1, Figure 9-3, and Figure 9-4.)

[RTS setting]

Switches 1 to 3 of the RTS/FG select switch are used for RTS setting. Setting these switches determines which pin (pin 4, 11, or 21) of the RS-232-C interface cable is to be connected to the RTS signal line. RTS is usually connected to pin 4 of the RS-232-C interface. RTS must always be connected to RTS N (Switch 1: ON, Switch 2: OFF, and Switch 3: OFF) except in special cases.

[FG setting]

Switch 4 of the RTS/FG select switch is used for FG setting. It determine whether FG (Frame Ground) and SG (Signal Ground) are to be connected or open. Usually, FG and SG must be set open (Switch 4: OFF).

Table 9-1 RTS and FG Setting (Channel 1)

RTS name	RTS and FG setting				Device connected
	1	2	3	4	
RTS N	ON	OFF	OFF	OFF	Host machine, PROM programmer
RTS P	OFF	ON	OFF	OFF	Not to be set
RTS D	OFF	OFF	ON	OFF	

Fig. 9-3 RTS/FG Select Switch (Channel 1)

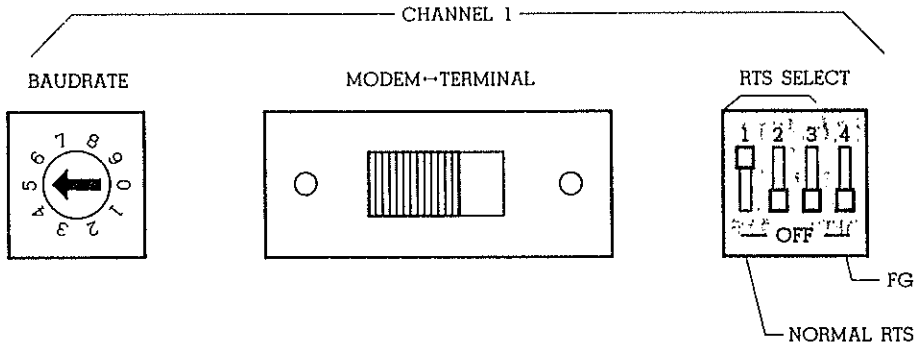
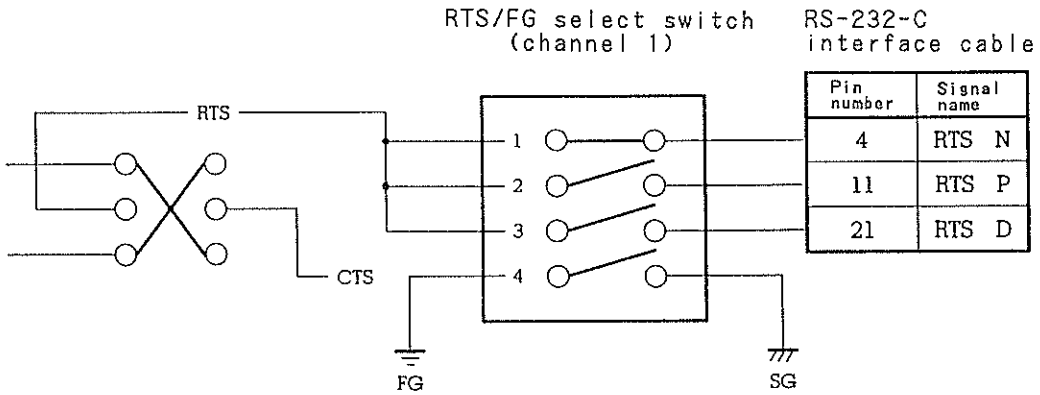


Fig. 9-4 Circuit Diagram of RTS/FG Select Switch (Channel 1)



(3) Baud rate selection

The baud rate of the host machine needs to be set to match that of the IE-78327-R. A baud rate is selected using the micro DIP switch for baud rate setting (for channel 1).

Fig. 9-5 Baud Rate Setting Switch (Channel 1)

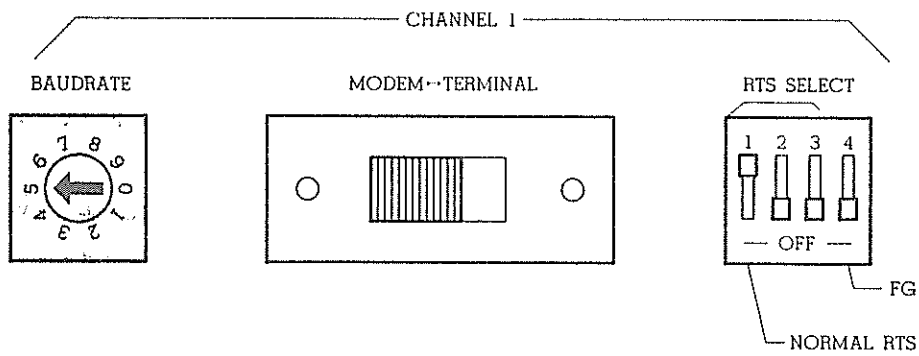


Table 9-2 Baud Rate Setting

Switch	Baud rate (bps)	Switch	Baud rate (bps)
0	300	5	9600
1	600	6	19200
2	1200	7(*)	0
3	2400	8	300
4	4800	9	600

* Do not select this position. Pulses required for data transfer are not generated when this position is selected.

(4) Handshaking

Hardware handshaking is performed by connecting the RTS, CTS, DSR, and DTR handshake signals. When these signals are not connected, software handshaking is performed. With channel 1, hardware handshaking and software handshaking are usually performed at the same time to transfer data.

In hardware handshaking, data is transferred one byte at a time using the handshake signals. This mode is called single-character handshaking. Software handshaking does not allow byte-by-byte handshaking, but allows block-by-block handshaking. This is called flow control.

With the IE-78327-R, an automatic hardware adjustment is made by using each handshake signal to prevent data overlapping in handshaking. When the buffer is full, for example, the CTS signal is controlled to stop data transfer completely. So no data is lost as long as the handshake signals are connected. When handshake signals are not connected, only software handshaking is performed, and data can be lost.

Hardware handshaking and software handshaking are explained below by using modem mode operation as an example.

[Hardware handshaking (in the modem mode)]

With the IE-78327-R, the uPD71051 is used for the RS-232-C interface. The signal output on the RxRDY pin of the uPD71051 is inverted for output onto the CTS line. When the receive buffer receives data from the RS-232-C interface, 1 appears on the RxRDY pin, and when the CPU in the IE-78327-R receives data from the buffer, 0 appears on the RxRDY pin (single-character handshaking). Thus CTS is controlled to prevent the terminal from sending the next data before the receive buffer becomes available.

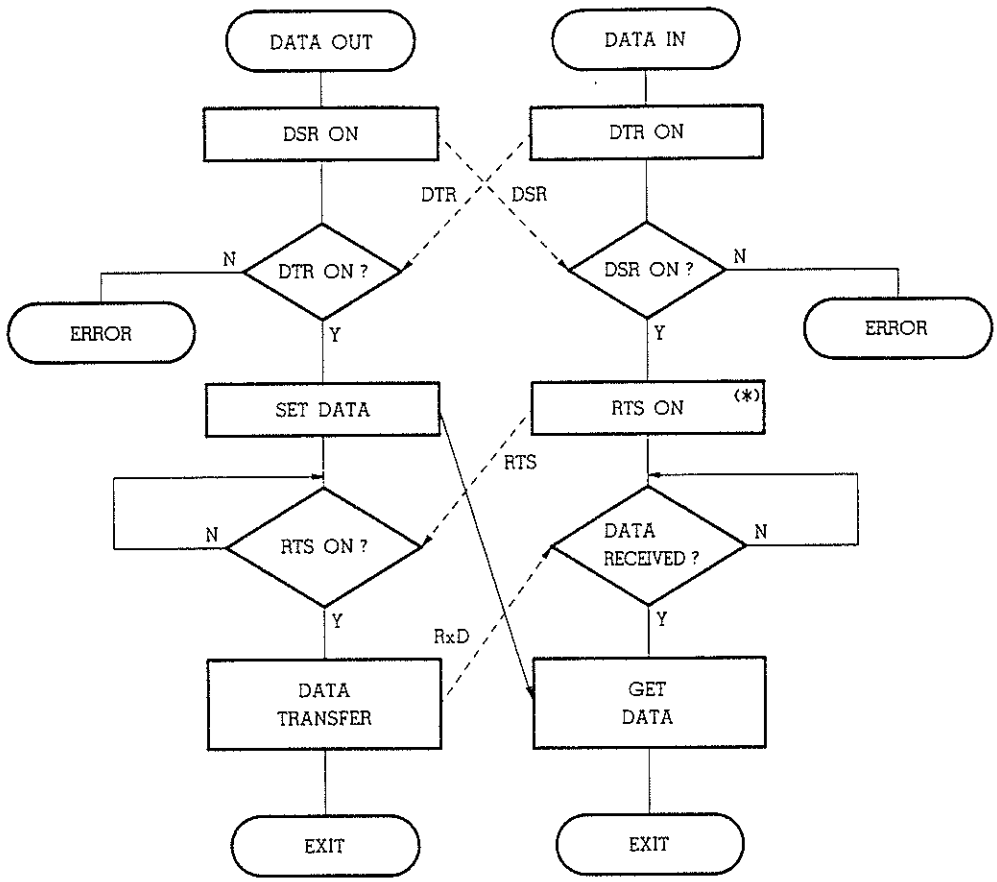
. Data transmission

  When both RTS and DTR are active, the terminal is assumed to be ready to receive data, and data is sent onto the RxD line.

. Data reception

  DSR must always be active. When the IE-78327-R is not ready to receive data, CTS is to be inactive. When the IE-78327-R is ready to receive data, CTS is to be made active. Then data is received from the TxD line.

Fig. 9-6 Data Transfer from Modem to Terminal
(Hardware Handshaking)



Remark: <----- : Handshake line, ←——— : Flow of data

* RTS is set on as a pulse signal.

① DSR is set on when power is turned on.

② The DTR pin is checked. When DTR is off, an error results. When DTR is on, processing proceeds to the next step.

③ Transfer data is set.

④ Data transfer is not started until RTS is set on. Transfer is started when RTS is set on.

⑤ Data is transferred.

① DTR is set on when power is turned on.

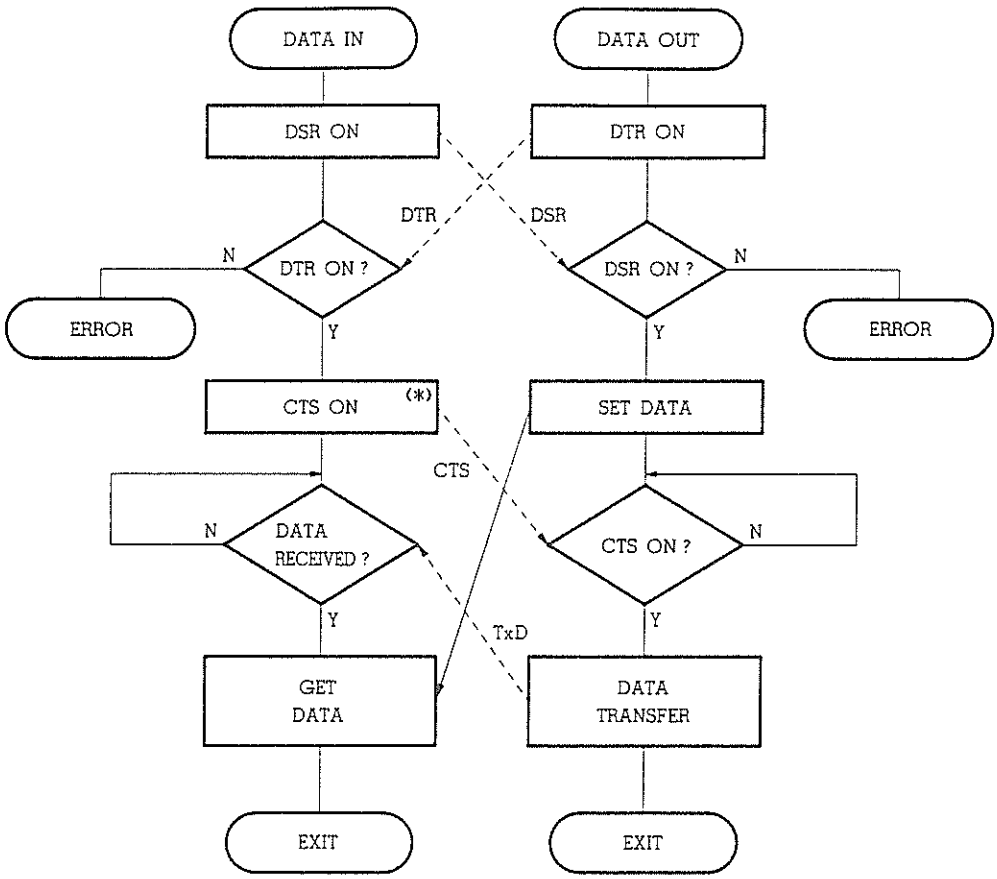
② The DSR pin is checked. When DSR is off, an error results. When DSR is on, processing proceeds to the next step.

③ RTS is set on to allow an external device to transfer data.

④ Polling is performed to check whether data reception is completed.

⑤ Data is taken in.

Fig. 9-7 Data Transfer from Terminal to Modem
(Hardware Handshaking)



Remark: <----- : Handshake line, <——— : Flow of data

* CTS is set on as a pulse signal.

① DSR is set on when power is turned on.

② The DTR pin is checked. When DTR is off, an error results. When DTR is on, processing proceeds to the next step.

③ CTS is set on to allow an external device to transfer data.

④ Polling is performed to check whether data recepsion is completed.

⑤ Data is taken in.

① DTR is set on when power is turned on.

② The DSR pin is checked. When DSR is off, an error results. When DSR is on, processing proceeds to the next step.

③ Transfer data is set.

④ Data transfer is not started until CTS is set on. Transfer is started when CTS is set on.

⑤ Data is transferred.

[Software handshaking (in the modem mode)]

Software handshaking does not allow byte-by-byte handshaking, but allows block-by-block handshaking (flow control).

. Data transmission

Basically, the IE-78327-R always assumes that the terminal can receive data, and send data onto the RxD line. However, when Ctrl-S is sent from the terminal on the TxD line, data transfer is suspended. With channel 1 of the IE-78327-R, four to five characters are sent after Ctrl-S is received, then data transfer is stopped.

When Ctrl-Q is sent from the terminal on the TxD line during transfer suspension, data transfer is resumed.

. Data reception

Basically, the IE-78327-R always receives data. Data is received using interrupts. Received data is loaded into a 128-byte buffer. When the buffer is loaded with data up to 50 percent of the buffer capacity, Ctrl-S is sent onto the RxD line to request the terminal to suspend data transmission. When data is transmitted after the request is issued, the data is received and loaded into the buffer. Then the CPU of the IE-78327-R takes in the data held in the buffer. When the data in the buffer is reduced to 35 percent of the buffer capacity, Ctrl-Q is sent onto the RxD line to request the terminal to resume data transfer.

So if a terminal that sends at least 64 bytes after receiving Ctrl-S is connected to channel 1, data can be lost.

(5) Character specification

The character specification for data transmission is described below.

[Character length]

A fixed character length of eight bits is used. When the IE-78327-R sends data, the most significant bit (MSB) is always 0. When the IE-78327-R receives data, the most significant bit is ignored: it is always assumed to be 0.

[Parity bit]

No parity bit is used.

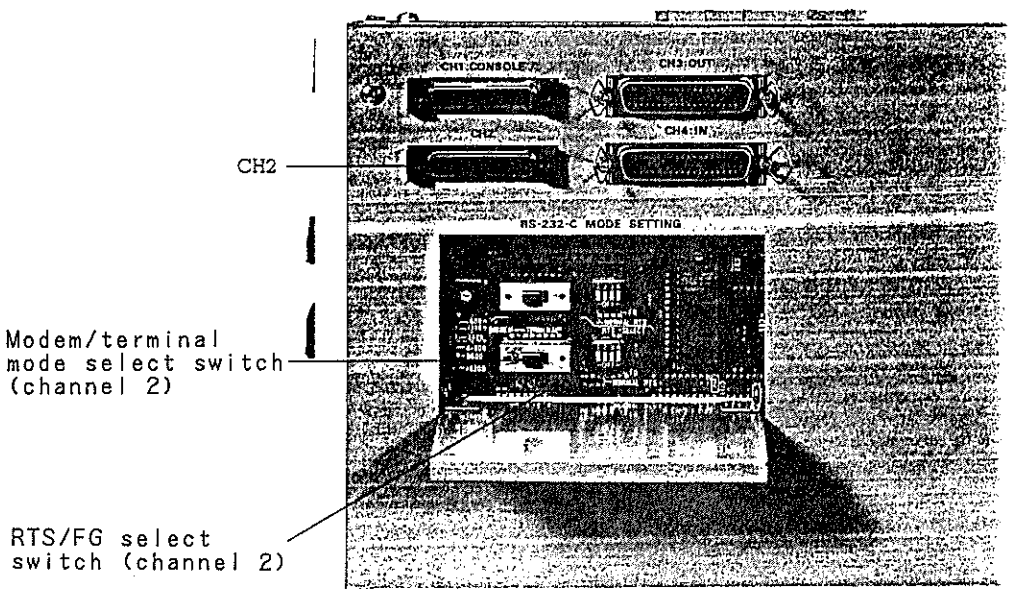
[Stop bit length]

A fixed stop bit length of two bits is used.

9.2 Channel 2 Functions

Channel 2 is a serial interface for a PROM programmer. It is based on RS-232-C. The RS-232-C mode switches on the right side of the IE-78327-R main unit contain channel 2 mode setting switches (CHANNEL 2). A serial interface port (CH2) is provided above the switches.

Photo 9-2 Channel 2



Channel 2 has the functions (1) to (5) below to control the RS-232-C interface. With these functions, channel 2 transfers control data between the IE-78327-R and a PROM programmer, and loads files.

All items below except (1) for mode switching (between terminal and modem) and (2) for RTS and FG setting can be set with the MOD command. When the operands of the MOD command are omitted, operation can be set interactively. The initial state is set to a baud rate of 9600 baud, single-character handshaking, a character length of eight bits, without parity, and a stop bit length of two bits.

(1) Mode switching

Setting item	Setting	Switch
Mode switching	Modem mode or terminal mode	Modem/terminal mode select switch

(2) RTS and FG setting

Setting item	Setting	Switch
RTS, FG	1: On, 2 to 4: Off	RTS/FG select switch

(3) Baud rate selection

Setting item	Setting	Switch
Baud rate	9600 bps	MOD command

(4) Handshaking

Setting item	Setting	Switch
Handshaking	Hardware handshaking or software handshaking	MOD command

(5) Character specification

Setting item	Setting	Switch
Character length	7 or 8 bits (with the most significant bit set always to 0 for output and ignored for input)	MOD command
Parity bit	Even parity/odd parity/without parity	
Stop bit length	1 bit or 2 bits	

Remark: MOD command

The MOD command can be set as a single command line at the time of command input or can be set interactively, omitting operands in the command line. By keying MOD ↵ , the user can set the MOD command interactively.

[Input format]

MOD[MODE={CHAR / FLOW}][BAUD={19200 / 9600 / 4800 / 2400 / 1200 / 600 / 300}][LONG={7 / 8}][PAR={NON / EVEN / ODD}][STOP={1 / 2}]

[Operands]

MODE: Handshaking mode
BAUD: Baud rate
LONG: Character length
PAR: Parity bit
STOP: Stop bit

[System operation mode]

trc:0>	x	emu:0>	o	brk:0>	o

[Example of command setting on a single line]

```
brk:0>MOD MODE=CHAR BAUD=4800 LONG=8 PAR=NON STOP=2↵
brk:0>
```

← Set on one line

[Example of interactive setting]

```
brk:0>MOD↵                  ← Interactive setting
 Mode CHAR=FLOW↵            ← Change to flow control
 Baud 4800=9600↵            ← Change baud rate to 9600 baud
 Long    8=↵                ← Character length not changed
 Par   NON=EVEN↵            ← Change parity to even
 Stop    2=1↵               ← Change stop bit to 1
brk:0>■
```

(1) Mode switching

The modem/terminal mode select switch provided as one of the RS-232-C mode switches on the right side of the main unit is used for mode switching between the terminal mode and modem mode (Figure 9-8). The modem mode is set by sliding the switch from right to left. The terminal mode is set by sliding the switch from left to right.

Fig. 9-8 Modem/Terminal Mode Select Switch (Channel 2)

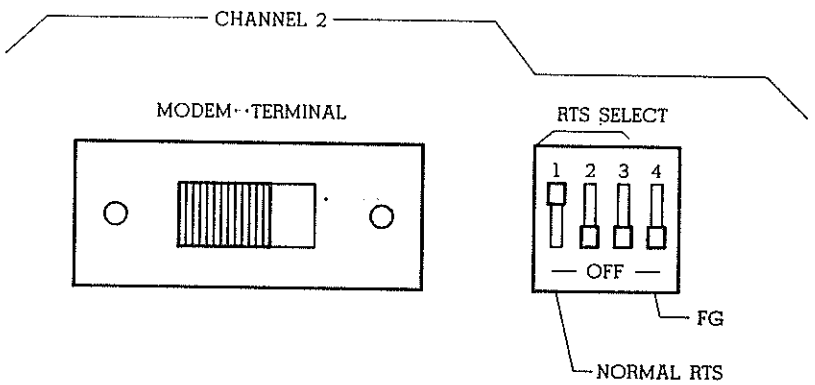
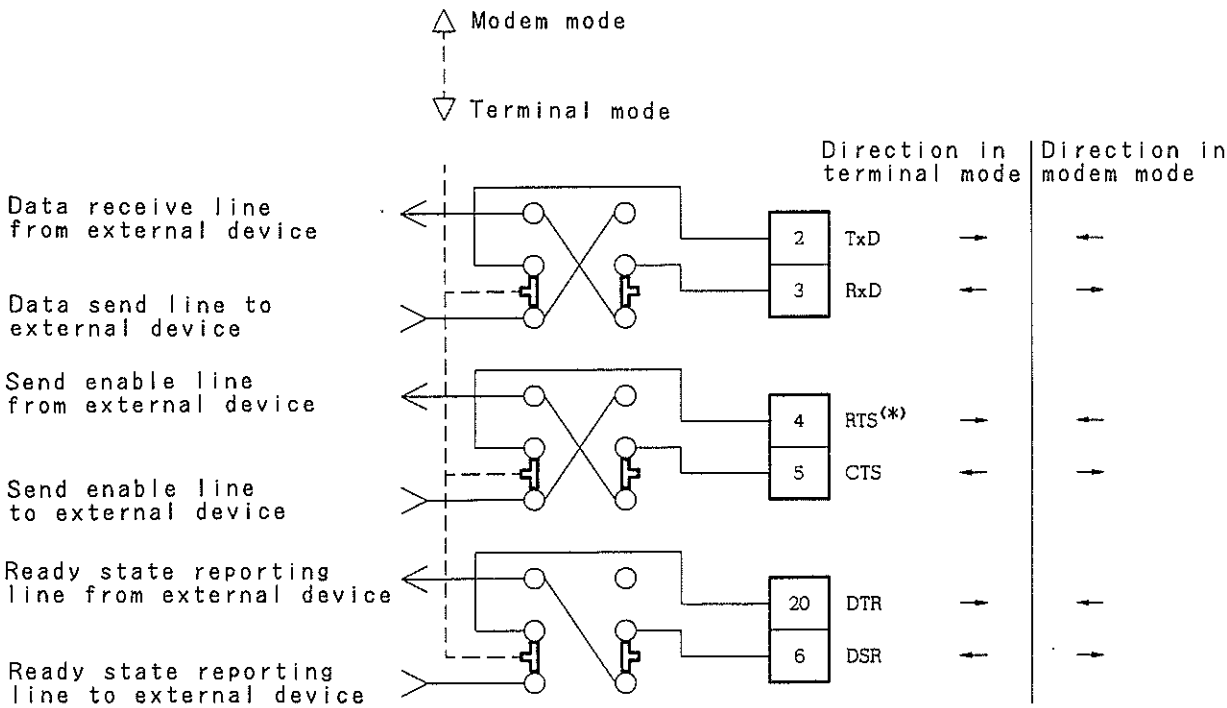


Fig. 9-9 Circuit Diagram of Modem/Terminal Mode Select Switch (Channel 2)



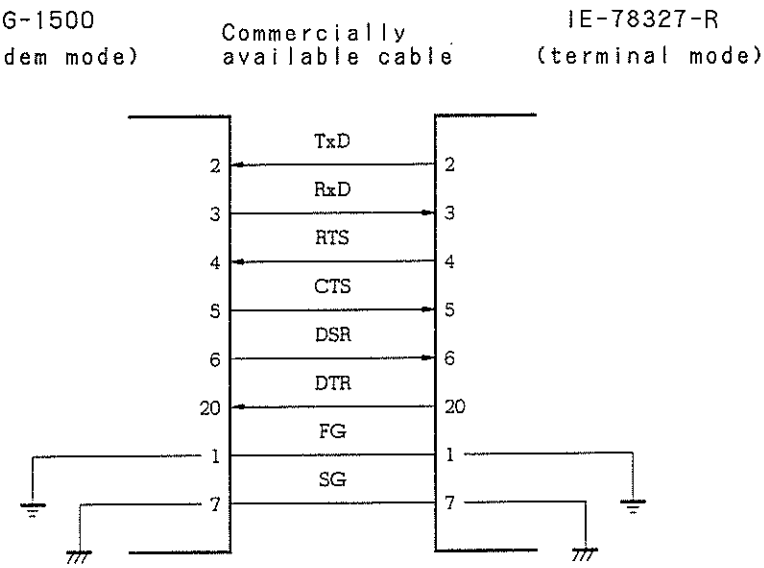
* See Section 9.2.(2).

An example of mode setting is explained below. In the example, a PROM programmer (PG-1500/2000) is connected.

[PG-1500]

The PG-1500 is a device that has the modem mode interface. To connect the PG-1500, a commercially available cable consisting of pairs of signal lines should be used. The IE-78327-R must be set to the terminal mode by sliding the switch from left to right.

Fig. 9-10 PG-1500 Connection (when Commercially Available Cable Consisting of Pairs of Signal Lines is Used)

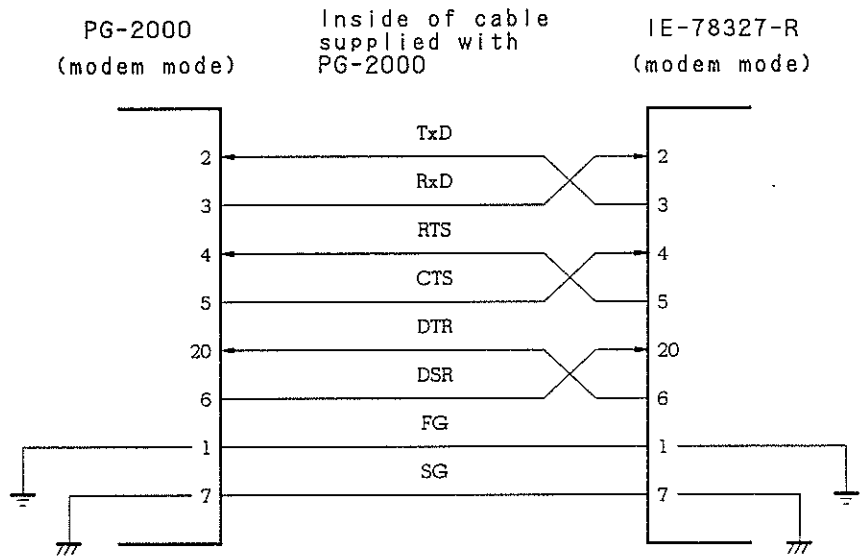


[PG-2000]

The PG-2000 is a device that has the modem mode interface. To connect the PG-2000, the cable supplied with the PG-2000 must always be used. The IE-78320-R must be set to the modem mode by sliding the switch to from right to left.

Caution: When the IE-78327-R is connected with the PG-2000, it is a connection between devices that are set to the modem mode. This is made possible by connection changes internal to the supplied cable. To connect the IE-78327-R with the PG-2000, the cable supplied with the PG-2000 must always be used. No other cables must be used.

Fig. 9-11 PG-2000 Connection (when Cable Supplied with PG-2000 is Used)



(2) RTS and FG setting

The RTS/FG select switch is used for RTS and FG setting. The switch is on when it is set to the upper position. The switch is off when it is set to the lower position. (See Table 9-3, Figure 9-12 and Figure 9-13.)

[RTS setting]

Switches 1 to 3 of the RTS/FG select switch are used for RTS setting. Setting these switches determines which pin (pin 4, 11, or 21) of the RS-232-C interface cable is to be connected to the RTS signal line. RTS is usually connected to pin 4 of the RS-232-C interface. RTS must always be connected to RTS N (Switch 1: ON, Switch 2: OFF, and Switch 3: OFF) except in special cases.

[FG setting]

Switch 4 of the RTS/FG select switch is used for FG setting. It determine whether FG (Frame Ground) and SG (Signal Ground) are to be connected or open. Usually, FG and SG must be set open (Switch 4: OFF).

Table 9-3 RTS and FG Setting (Channel 2)

RTS name	RTS and FG setting				Device connected
	1	2	3	4	
RTS N	ON	OFF	OFF	OFF	PROM programmer
RTS P	OFF	ON	OFF	OFF	Not to be set
RTS D	OFF	OFF	ON	OFF	

Fig. 9-12 RTS/FG Select Switch (Channel 2)

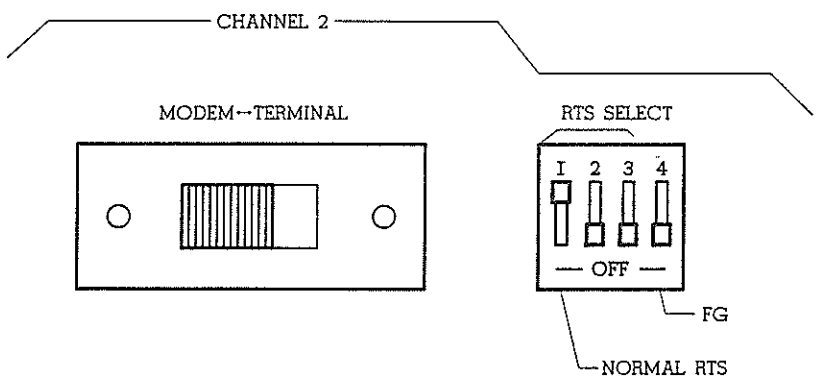
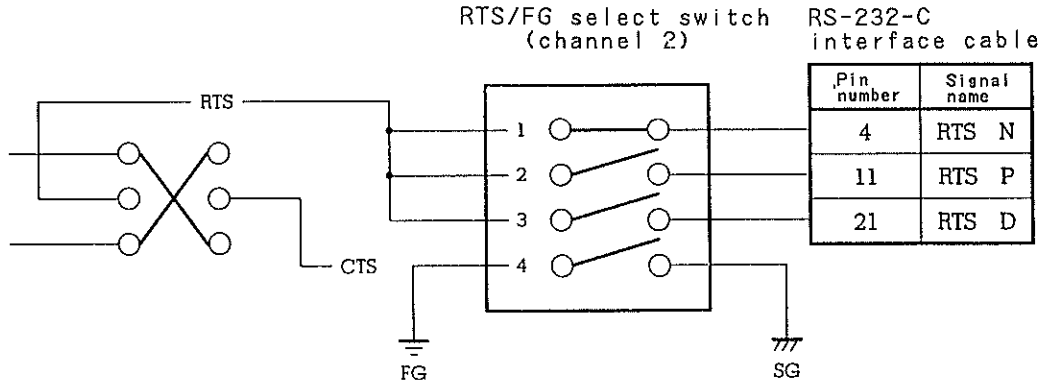


Fig. 9-13 Circuit Diagram of RTS/FG Select Switch (Channel 2)



(3) Baud rate selection

The baud rate of a PROM programmer needs to be set to match that of the IE-78327-R. A baud rate is selected using the MOD command. This command is entered from the host machine connected to channel 1 of the IE-78327-R.

(4) Handshaking

Hardware handshaking is performed by connecting the RTS, CTS, DSR, and DTR handshake signals. When these signals are not connected, software handshaking is performed. With channel 2, either hardware handshaking or software handshaking is usually performed to transfer data. The MOD command is used for handshake setting.

In hardware handshaking, data is transferred one byte at a time using the handshake signals (single-character handshaking). Software handshaking does not allow byte-by-byte handshaking, but allows block-by-block handshaking. This is called flow control.

Note that when the hardware handshake mode (single-character handshaking: CHAR) is selected, the handshake signals must be connected. Since no buffer is used, normal handshaking is not performed when hardware handshaking is selected without connecting the handshake signals.

When the software handshake mode (flow control: FLOW) is selected, a 96-byte buffer for storing serial data is available. However, some data can be lost, depending on the situation.

Hardware handshaking and software handshaking are explained below by using modem mode operation as an example.

[Hardware handshaking (in the modem mode)]

With the IE-78327-R, the uPD71051 is used for the RS-232-C interface. The signal output on the RxRDY pin of the uPD71051 is inverted for output onto the CTS line. When the receive buffer receives data from the RS-232-C interface, 1 appears on the RxRDY pin, and when the CPU in the IE-78327-R receives data from the buffer, 0 appears on the RxRDY pin (single-character handshaking).

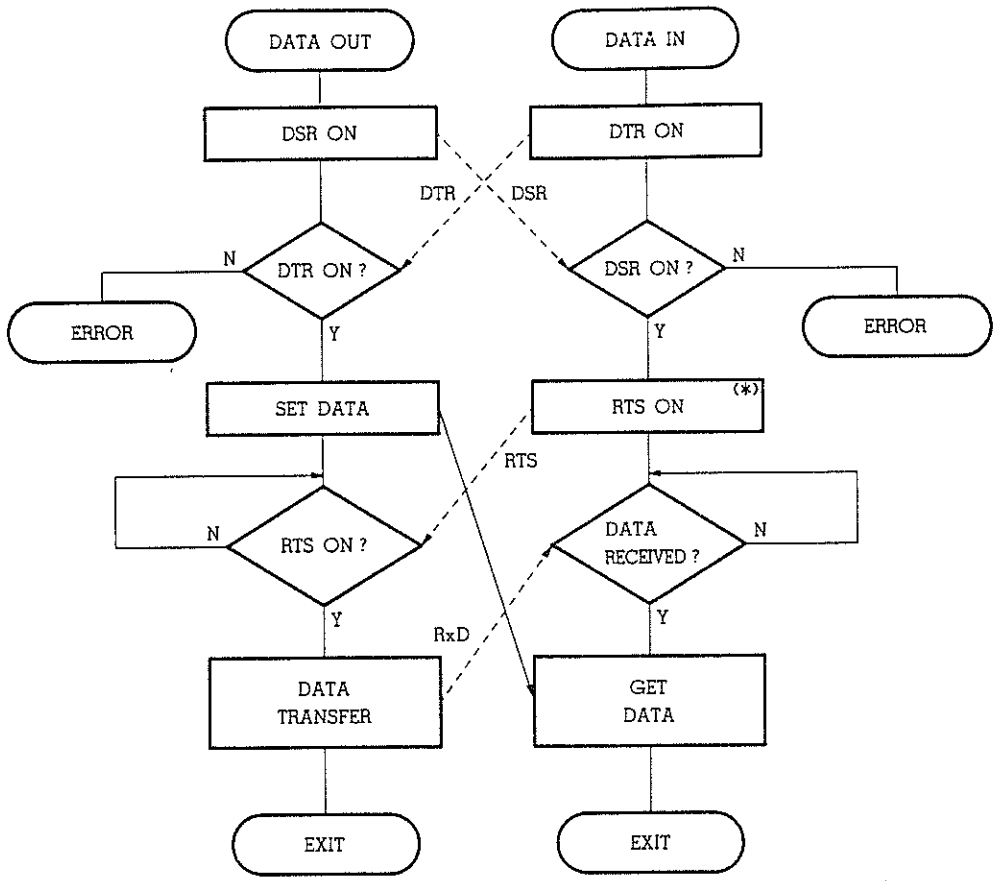
. Data transmission

  When both RTS and DTR are active, the terminal is assumed to be ready to receive data, and data is sent onto the RxD line.

. Data reception

  DSR must always be active. When the IE-78320-R is not ready to receive data, CTS is to be inactive. When the IE-78327-R is ready to receive data, CTS is to be made active. Then data is received from the TxD line.

Fig. 9-14 Data Transfer from Modem to Terminal
(Hardware Handshaking)



Remark: <----- : Handshake line, <——— : Flow of data

* RTS is set on as a pulse signal.

① DSR is set on when power is turned on.

② The DTR pin is checked. When DTR is off, an error results. When DTR is on, processing proceeds to the next step.

③ Transfer data is set.

④ Data transfer is not started until RTS is set on. Transfer is started when RTS is set on.

⑤ Data is transferred.

① DTR is set on when power is turned on.

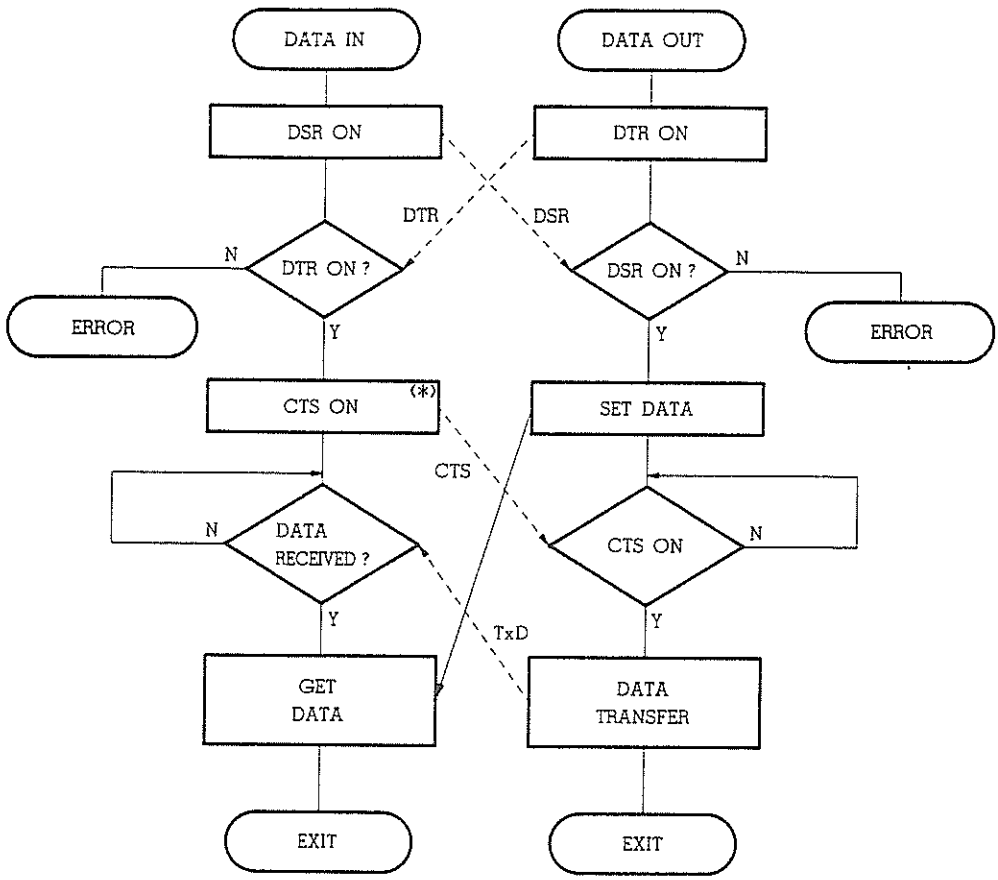
② The DSR pin is checked. When DSR is off, an error results. When DSR is on, processing proceeds to the next step.

③ RTS is set on to allow an external device to transfer data.

④ Polling is performed to check whether data reception is completed.

⑤ Data is taken in.

Fig. 9-15 Data Transfer from Terminal to Modem
(Hardware Handshaking)



Remark: <----- : Handshake line, <——— : Flow of data

* CTS is set on as a pulse signal.

① DSR is set on when power is turned on.

② The DTR pin is checked. When DTR is off, an error results. When DTR is on, processing proceeds to the next step.

③ CTS is set on to allow an external device to transfer data.

④ Polling is performed to check whether data recepsion is completed.

⑤ Data is taken in.

① DTR is set on when power is turned on.

② The DSR pin is checked. When DSR is off, an error results. When DSR is on, processing proceeds to the next step.

③ Transfer data is set.

④ Data transfer is not started until CTS is set on. Transfer is started when CTS is set on.

⑤ Data is transferred.

[Software handshaking (in the modem mode)]

Software handshaking does not allow byte-by-byte handshaking, but allows block-by-block handshaking (flow control).

. Data transmission

Basically, the IE-78327-R always assumes that the terminal can receive data, and send data onto the RxD line. However, when Ctrl-S is sent from the terminal on the TxD line, data transfer is suspended. With channel 2 of the IE-78327-R, four to five characters are sent after Ctrl-S is received, then data transfer is stopped.

When Ctrl-Q is sent from the terminal on the TxD line during transfer suspension, data transfer is resumed.

Data reception

Basically, the IE-78327-R always receives data. Data is received using interrupts. Received data is loaded into a 96-byte buffer. When the buffer is loaded with data up to 50 percent of the buffer capacity, Ctrl-S is sent onto the RxD line to request the terminal to suspend data transmission. When data is transmitted after the request is issued, the data is received and loaded into the buffer. Then the CPU of the IE-78327-R takes in the data held in the buffer. When the data in the buffer is reduced to 35 percent of the buffer capacity, Ctrl-Q is sent onto the RxD line to request the terminal to resume data transfer.

So if a terminal that sends at least 48 bytes after receiving Ctrl-S is connected to channel 2, data can be lost.

(5) Character specification

The character specification for data transmission is described below.

[Character length]

A character length of seven bits or eight bits must be selected using the MOD command. When the 8-bit length is selected, the most significant bit (MSB) of data output from the IE-78327-R is always 0. The most significant bit of data received by the IE-78327-R is ignored: it is always assumed to be 0.

[Parity bit]

The MOD command is used to select even parity, odd parity, or without parity.

[Stop bit length]

The MOD command is used to select a stop bit length of one bit or two bits.

CHAPTER 10 FUNCTIONS OF CHANNELS 3 AND 4

This chapter details channels 3 and 4 of the IE-78327-R.

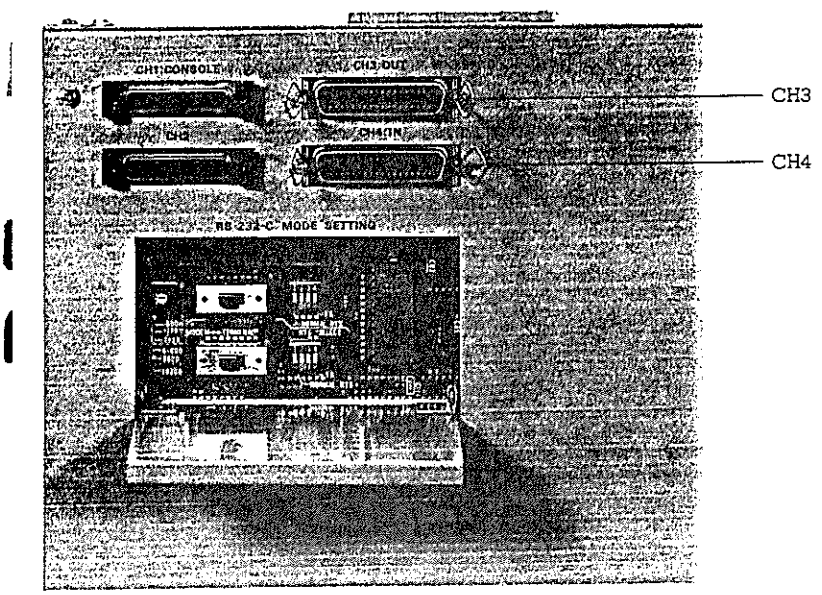
Organization of this chapter

10.1 Functions of Channels 3 and 4

Channels 3 and 4 are 8-bit parallel interfaces. Parallel interface ports (CH3 and CH4) are provided above the RS-232-C mode switches on the side of the IE-78327-R main unit. The TTL level is used for all input data and interface control signals. In addition, the interface circuitry conforms to Centronics.

Channel 3, when connected to a printer, can output data from channel 4 to the printer in through output mode. Channel 4 is used for connection to a host machine, and can download files such as object files at high speed.

Photo 10-1 Parallel Interface Ports (CH3 and CH4)



(1) High-speed download

With the IE-78327-R, two download methods are used. When channel 4 is used, high-speed download is possible.

Load mode	Description	Selection method
High-speed download	Parallel interface output of host machine is downloaded to parallel interface input (channel 4) of IE-78327-R.	① Select high-speed download mode at activation. ② Execute LOD command.
Normal download	RS-232-C interface output of host machine is downloaded to RS-232-C interface input (channel 1) of IE-78327-R.	Execute LOD command. (Do not select high-speed download mode at activation.)

[Executing high-speed download]

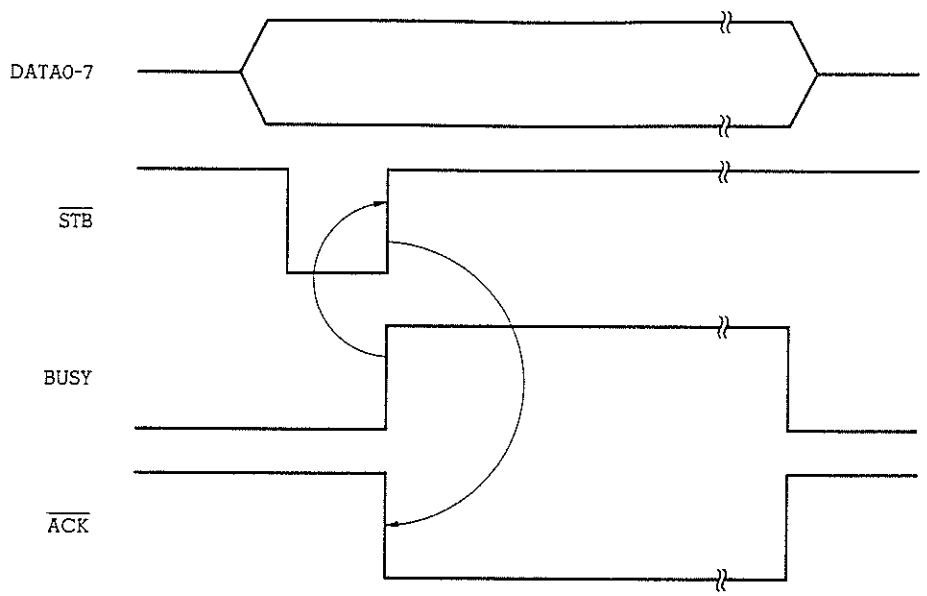
① The following message appears at IE-78327-R activation:

```
Do you use high speed down load mode? (Y/N)=
```

② Type in Y ↵ to select the high-speed download mode. Then the following files can be downloaded from the host machine at high speed through the parallel interface:

- Object file
- Symbol file
- Debugging environment file

Fig. 10-1 Timing of High-Speed Download Mode



(2) Through output

For through output from channel 4 to channel 3, download operation must be performed by means other than the load command. For example, when the PRINT command of MS-DOS is used for list output, the printer connected with channel 3 can be used for output without reconnecting the printer to the PC-9800.

When the parallel interface is already used (for example, for list output) by a command at the time of load command execution, the following message appears, and download operation is performed through serial interface channel 1:

```
Select Serial Interface
```

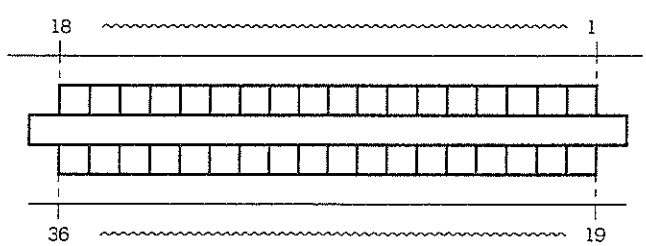
10.2 Signal Lines and Circuit Diagram of Parallel Interface

The input signals, port pin pin allocation, and circuit diagram of the parallel interface are described below.

Table 10-1 Parallel Interface Signals

Pin number	Signal name	Direction		Function
		CH3	CH4	
1	$\overline{STB}$	Output	Input	Strobe pulse signal for reading data
2	DATA0	Output	Input	Parallel data 0
3	DATA1	Output	Input	Parallel data 1
4	DATA2	Output	Input	Parallel data 2
5	DATA3	Output	Input	Parallel data 3
6	DATA4	Output	Input	Parallel data 4
7	DATA5	Output	Input	Parallel data 5
8	DATA6	Output	Input	Parallel data 6
9	DATA7	Output	Input	Parallel data 7
10	$\overline{ACK}$	Input	Output	Output upon completion of data input
11	BUSY	Input	Output	Signal for reporting that data cannot be received
19-30 33	GND	—	—	Signal ground
12	PE	—	Input	Not used (+5 V, pulled up with 3.3 kΩ registor)
32	$\overline{ERROR}$	—	Input	Not used (+5 V, pulled up with 3.3 kΩ registor)

Fig. 10-2 Pin Allocation of Parallel Interface Port (CH3 and CH4)



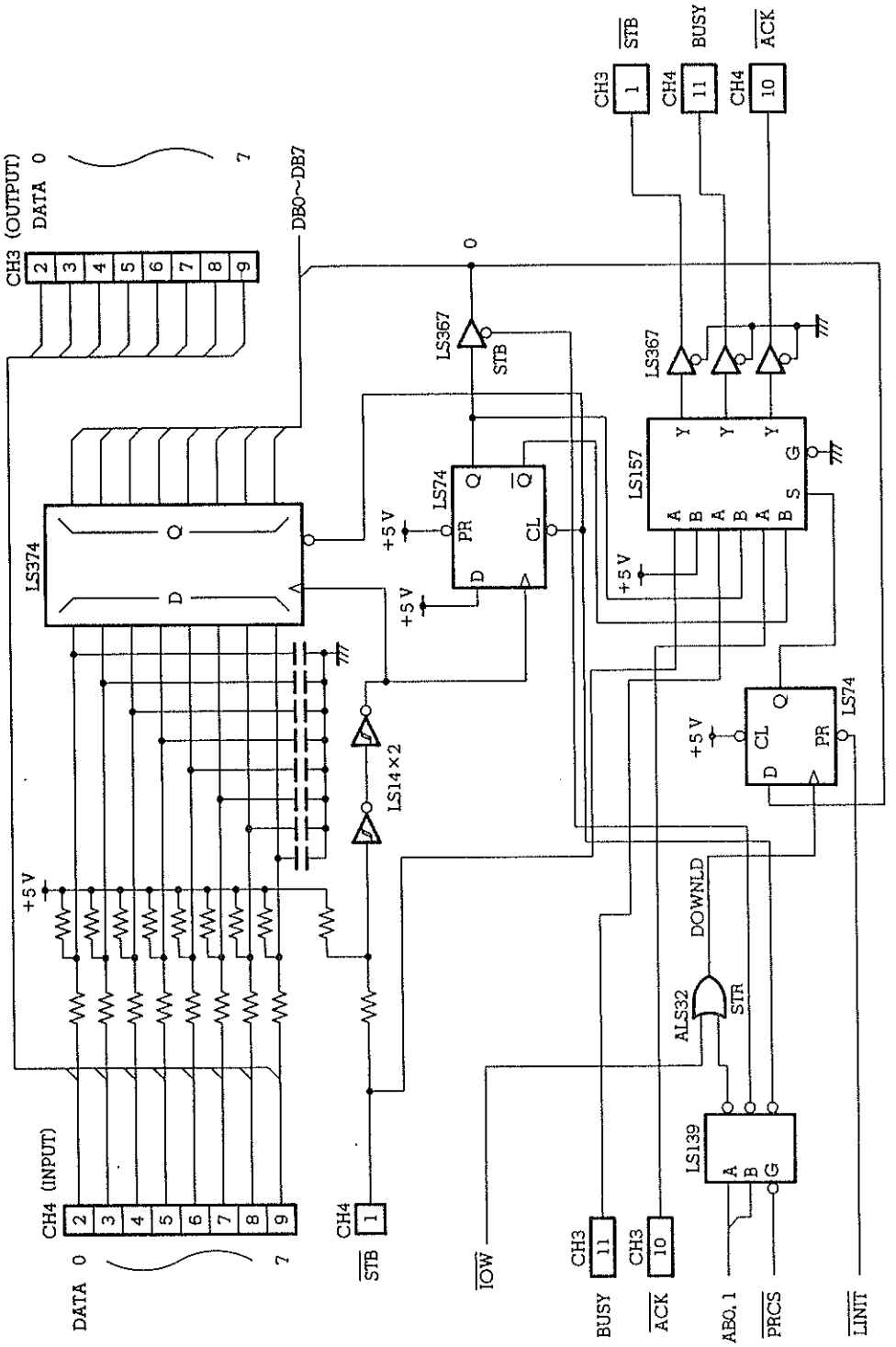


Fig. 10-3 Circuit Diagram of Parallel Interface

APPENDIX A SPECIFICATIONS

This appendix describes the IE-78327-R specifications. The specifications are divided into two categories: product specifications (including outside dimensions and electric specifications) and debugger specifications.

[Product specifications]

Outside dimensions	Depth:	370 mm
	Width:	160 mm
	Height:	283 mm
Weight		8.5 kg
Current		100 VAC
		50/60 Hz
		3 A
Operating temperature		10°C to 40°C
Storage temperature		-15°C to +45°C
Ambient humidity		10% to 80% RH

[Basic debugger specifications]

o Applicable device

uPD78328 series: uPD78327, uPD78328, and uPD78P328
uPD78322 series: uPD78320, uPD78322, uPD78323(Note), uPD78324(Note), uPD78P322, and uPD78P324(Note)

Note: Under development

o Frequency of internal system clock

Up to 8 MHz (Default: 8 MHz)

o Clock supply

Crystal resonator in IE-78327-R only (Clock cannot be supplied from target system.)

o Memory

. Alternate memory capacity

Internal ROM and expansion memory:	56K bytes
Internal RAM:	1280 bytes

. Mapping unit

Internal ROM and expansion memory:	In units of 8K bytes
Internal RAM:	In units of 128 bytes

o Event detection

. Bus detection: 4 points (address/data/status/external sense signal; when address is selected, one of four different detection conditions can be specified for one point.)

. Program execution detection:
4 points (address signal; address can not be masked.)

. External signal level detection:
External sense signal 4 bits

. Event trigger signal external output: 1 bit

o Event integration

. Sequential enable: Detects events sequentially.

. Trigger condition setting:
Sets conditions to stop or break the analyzer.

. Trace qualify condition setting:
Performs qualified tracing.

. Check point condition setting:
Traces the data of the specified internal RAM, registers, and SFRs.

. Pass count: Counts the event conditions specified in trigger conditions.

. Delay count: Specifies the delay amount between a met event condition and the corresponding trigger.

o Event count

Counts elapsed execution time and number of instructions (display only, not traceable)

o Sampler function

Samples the specified internal RAM data within a stated time, and displays it. Up to three words can be set.

o Coverage function

Displays the executed areas in the program area (including invalid fetches).

o Cause of break

. Event detection break

. Manual break

. Command break

. Fail-safe breaks: Non-map access break
Write-protect break
SFR illegal access break
Turbo access break

o Real-time trace

. Cause of trace Total trace
Sectional trace
Qualified trace

. Trace capacity 8K bytes x 88 bits

. Trace contents Main bus(Note 1): 16-bit address
16-bit data
6-bit status

CPU internal bus(Note 2): 9-bit address
16-bit data
7-bit status

Others: External sense signal 8 bits to be selected
8-bit time tag
Other 8 bits

Notes 1. The main bus is used to fetch program for or access data in the internal ROM or the expansion memory.
2. The CPU internal bus is used to access data in the internal RAM or the SFRs in the target CPU.

o Command functions

- Online assembling, disassembling
- Memory/register/SFR manipulation
- Event/trace condition setting
- Mapping
- Reset
- Emulation start/stop
- Symbolic debugging
- Object/symbol/debugging environment load and save
- Console redirection, help command, PROM programming control, history
- Line edit

o Target interface Emulation probe (optional)

o External interface

. RS-232-C	CH1:	For host machine connection
	CH2:	For PROM programmer connection
. Centronics interface	CH3:	For parallel output and printer connection
	CH4:	For parallel input and high-speed download

o Host machine PC-9800 series
IBM PC series

o Control program For MS-DOS (optional)
For PC DOS (optional)

o Language processing program Relocatable assembler
C compiler

o Others

. Support of stand-by functions

. Built-in latch-up protection circuit

. Trace display and event detection setting modification during emulation CPU operation

APPENDIX B BLOCK DIAGRAMS

This appendix provides the block diagrams of the control/trace module and driver module, which represent key functions of the IE-78327-R.

(1) Control/trace module block

<Driver control>

This is an interface with the driver module.

<Trace RAM>

A 14K-byte trace RAM is contained, and the RAM can hold the latest trace data (for 2047 steps) up to an event detection point.

<Memory bank selector>

The memory bank selector enables selection from ROM, DRAM, and trace RAM by means of bank switching.

<Serial interface>

Two RS-232-C interface channels are used.

<Parallel interface>

Two Centronics interface channels are used: one is used for high-speed download and the other for through output.

<I/O selector>

The I/O selector enables selection from the serial interface, parallel interface, and driver control by means of bank switching.

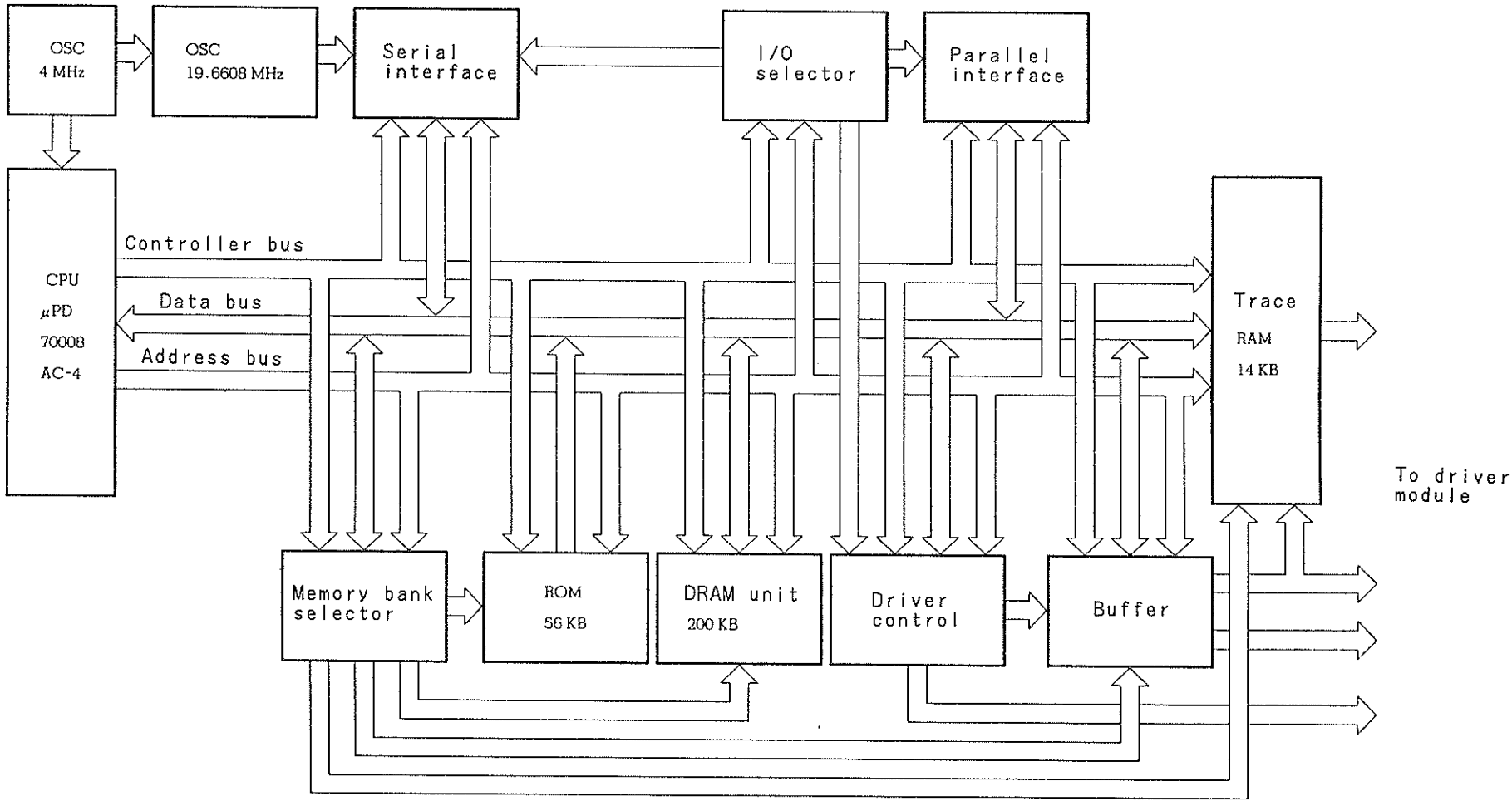
<DRAM unit>

A 192K-byte work area is available for symbols, and an 8K-byte work area is available for programs in a 200K-byte memory.

<ROM>

A 56K-byte ROM is available which contains a program for activating the IE-78327-R.

Fig. B-1 Block Diagram of Control/Trace Module



(2) Driver module block

<Event control>

This controls a wide variety of event detection functions available with the IE-78327-R.

<Break control>

This controls a wide variety of break functions available with the IE-78327-R. Many different break conditions can be set by a combination of event conditions.

<Trace control>

This controls trace conditions. The IE-78327-R has a trace function with a capacity of 2K bytes by 56 bits for storing CPU execution status. Many different trace conditions can be set by a combination of event conditions.

<Latch-up>

When a latch-up occurs with an emulation device or peripheral CMOS-TTL, this section removes power from the emulation device, CMOS around the emulation device, and TTL preceding the CMOS.

<Alternate memory>

This dual-port type memory is used for the supervisor CPU and emulation device to communicate with each other.

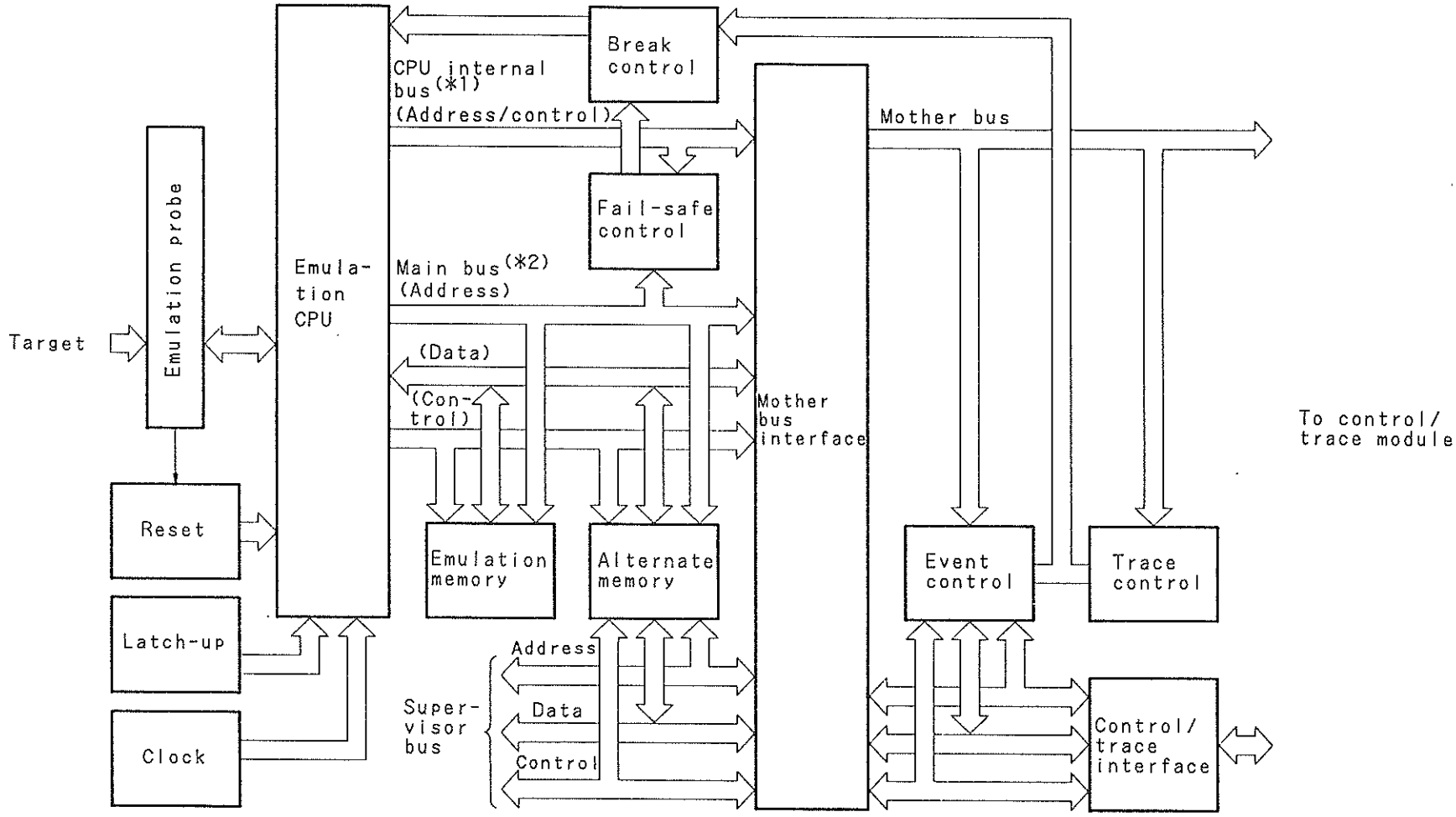
<Emulation memory>

This memory is a 56K-byte alternate memory that can be accessed by the uPD78328 and uPD78322 series. Even when a target system is not completed yet, software can be debugged by using this memory. By using the mapping function, memory from 0 to 56K bytes can be allocated in units of 8K bytes to expansion RAM and expansion ROM.

<Fail-safe control>

This circuit protects memory and an SFR read-only area.

Fig. B-2 Block Diagram of Driver Module



*1 CPU internal bus: Bus for accessing data in the CPU internal RAM and SFR

*2 Main bus: Bus for fetching programs from and accessing data in the internal ROM or expansion memory

APPENDIX C SETTING OF JUMPERS ON CONTROL/TRACE BOARD

This appendix explains the factory-set control/trace board jumper setting. Usually, the user need not modify the setting.

(1) Jumper setting

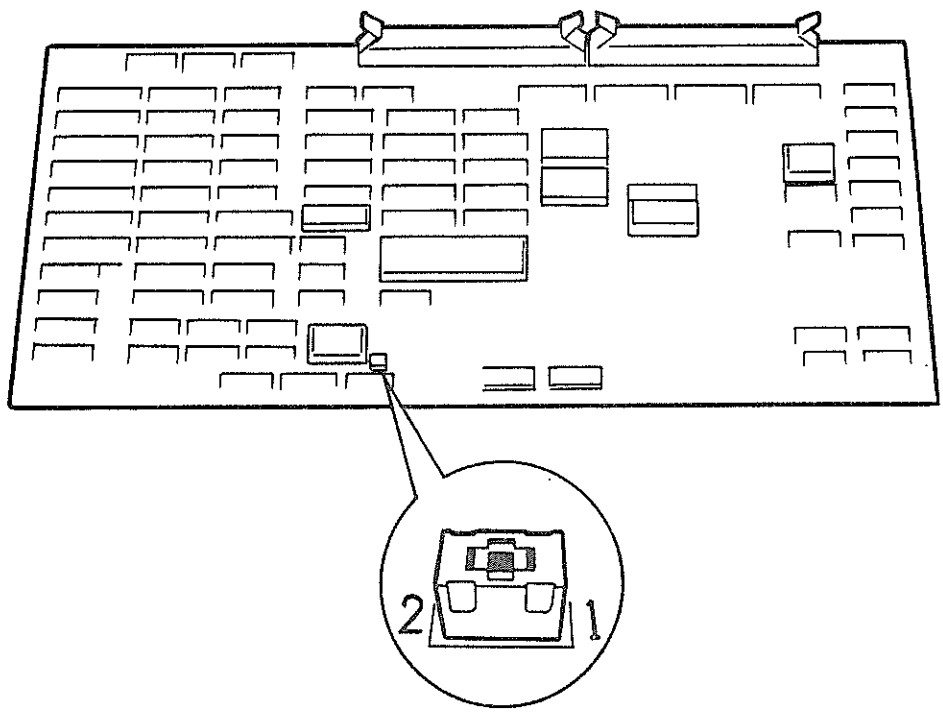
The jumper of the control/trace board is factory-set as described below.

Table C-1 Jumper Setting (Factory-Set)

Jumper No.	Setting
JP1	1-2 connected

Caution: If the jumper is set differently from the factory setting, abnormal operation results. Usual operation requires no change to the setting. So the factory-set jumper must not be changed.

Fig. C-1 Jumper Location on Control/Trace Board



(2) Installing and removing the control/trace board

The control/trace board can be installed and removed by using the procedure described below.

Procedure:

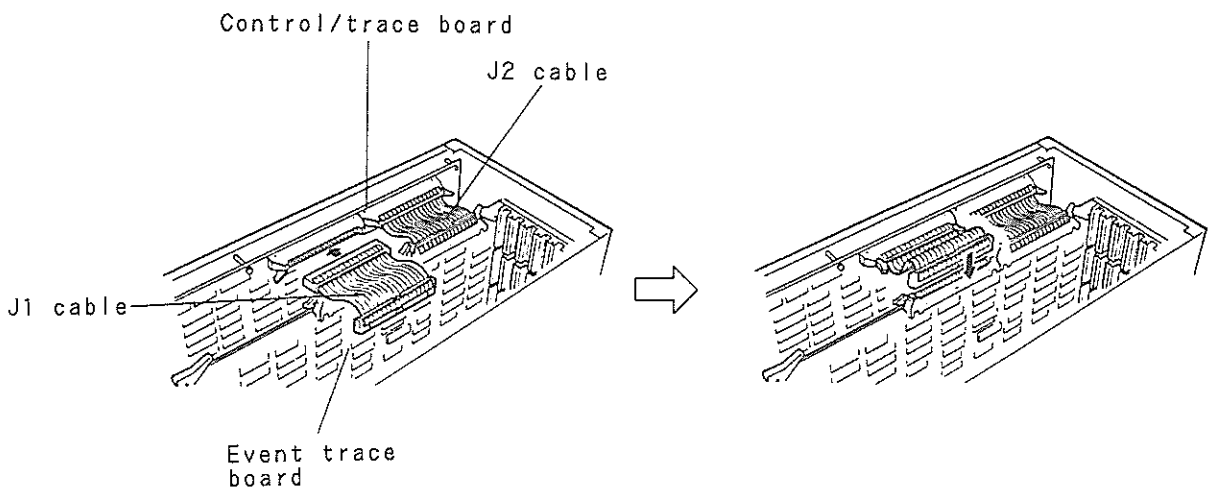
① Remove the six screws from the top of the IE-78327-R main unit to open the cover.

② Disconnect the cables (J1 and J2 cables) connecting the event trace board with the control/trace board.

③ Pick up the card pullers located on the both ends of the board and pull out the entire board from the slot.

④ To reconnect the J1 and J2 cables, make connections as shown in Figure C-2.

Fig. C-2 J1 and J2 Cable Connection



APPENDIX D COMMANDS

This appendix lists the commands used in the IE-78327-R in alphabetical order.

Command type		Command body	Sub-command	Operand	Default	Operation status		
						trc:	emu:	brk:
Line assemble		ASM	None	[word] word Assemble start address	0H	x	x	o
Condition setting for detection of each event	Condition setting for bus event detection	BRA	1 2 3 4	[A=mask16][V=mask8][C=status(*)][E=mask4] mask16 16-bit detection address range (up to 2 points) mask8 8-bit detection data mask4 4-bit external data status Detection status	A=0XXXXH V=0XXH C=NC E=0XXXXY	x	o	o
	Condition setting for external data detection	BRD	None	[mask4] mask4 Signal levels of external sense clip No. 1 to 4	0XXXXY	x	o	o
	Condition setting for program execution	BRS	1 2 3 4	[A=word] word Detection address	A=0H	x	o	o

(to be continued)

* Select one of the following items for status:

OP
RW
R
W
RWP
RP
WP
RWM
RM
WM
NC

(Cont'd)

Command type	Command body	Sub-command	Operand	Default	Operation status		
					trc:	emu:	brk:
Trigger condition setting	BRM	None	[[BRA1] [BRA2] [BRA3] [BRA4] [BRD] [BRS1] [BRS2] [BRS3] [BRS4] | OFF] BR? Each trigger condition OFF Releases each trigger condition.	BRA1	x	o	o
Check-point condition setting	CHK	None	{ [BRA1] [BRA2] [BRA3] [BRA4] [BRD] [BRS1] [BRS2] [BRS3] [BRS4] [REG | sfr | partition] | OFF } BR? Each check condition OFF Releases setting. REG Specifies register. sfr Specifies sfr names (up to 5 names). partition Valid internal RAM range	OFF	x	o	o
Clock selection	CLK	None	[I | U] I Clock within emulator U User-set clock	I	x	x	o
Display of elapsed execution time and number of executed instructions	CNT	None	None	None	x	o	o
Command file creation	COM	None	[file | LST | CON:] file File name LST: Printer CON: Console	CON:	o	o	o

(to be continued)

(Cont'd)

Command type		Command body	Subcommand	Operand	Default	Operation status		
						trc:	emu:	brk:
Display of CO coverage measurement results	Measurement result display	CVD	D(*)	[partition] partition Display range	None	x	x	o
	Measurement result initialization	CVD	K	[partition] partition Initialization range	None	x	x	o
Manipulation of CO coverage measurement range	Measurement range addition	CVM	A	[partition] partition Coverage range	None	x	x	o
	Measurement range display	CVM	D(*)	[partition] partition Display range	None	x	x	o
	Release of measurement range specification	CVM	K	[partition] partition Initialization range	None	x	x	o
Disassemble		DAS	None	{word / partition} word Disassemble start address / partition Disassemble address range	OH	x	x	o

(to be continued)

* This subcommand is assumed to be specified and is executed when only the command body is entered.

(Cont'd)

Command type	Command body	Sub-command	Operand	Default	Operation status		
					trc:	emu:	brk:
Directory display	DIR	None	[file] file File name	Current directory of current drive	o	o	o
Setting of trigger point location	DLY	None	[F / M / L] F Sets trigger point location at start of trace memory. M Sets trigger point location in middle of trace memory. L Sets trigger point location at end of trace memory.	L	x	o	o
Subprocess execution	DOS	None	None Executable only with MOS-DOS or PC DOS based machine. User can return to control program by entering EXIT<cr>.	None	o	o	o
Disable condition setting	DSB	None	[[BRA1] [BRA2] [BRA3] [BRA4] [BRD] [BRS1] [BRS2] [BRS3] [BRS4] / OFF] BR? Each disable condition OFF Releases each disable condition.	OFF	x	o	o
Enable condition setting	ENB	[1 / 2 / 3]	[[BRA1] [BRA2] [BRA3] [BRA4] [BRD] [BRS1] [BRS2] [BRS3] [BRS4] / ON] BR? Each enable condition ON Releases each enable condition.	ON	x	o	o
Display of event detector setting status	EVN	None	None	None	o	o	o

(to be continued)

(Cont'd)

Command type	Command body	Sub-command	Operand	Default	Operation status		
					trc:	emu:	brk:
Control program termination	EXT	None	None	None	x	x	o
Command history display	HIS	None	None	None	o	o	o
Command help display	HLP	None	[command] command Command body	None	o	o	o
Loading of object, symbol, and debugging environment	LOD	None	file[module name¥(*)][D][C][S][$V] file File name module name¥ Name of module D Specifies debugging environment. C Specifies object. S Specifies symbol. $V Specifies verification.	None	x	x	o
Result output to file	LST	None	[file / LST: / CON:] file File name LST: Printer CON: Console	CON:	o	o	o

(to be continued)

* When an IBM PC series machine is used as the host machine, \ is used in place of ¥.

(Cont'd)

Command type		Command body	Subcommand	Operand	Default	Operation status trc:	emu:	brk:
Mapping		MAP	I	[partition (*1): 0K / 8K / 16K / 24K / 32K / 40K / 48K / 56K] I ROM internal to emulation partition Mapping range	None	x	x	o
			[T / W / R / U / K]	[partition] (*1) T Emulation turbo access manager W Emulation RAM R Emulation ROM U User memory K Releases mapping (non-mapping) partition Mapping range	None	x	x	o
Mathematical operation		MAT	None	expression expression Expression	None	o	o	o
Memory manipulation	Memory contents change	MEM	C	[word] word Change start address	0H	x	o	o
	Memory contents display	MEM	D (*2)	[word / partition] word Display start address partition Display address range	0H	x	o	o
	Memory check	MEM	E	[partition] partition Check address range	None	x	x	o

(to be continued)

*1 Settable in units of 8K.

*2 This subcommand is assumed to be specified and is executed when only the command body is entered.

Command type		Command body	Sub-command	Operand	Default	Operation status		
						trc:	emu:	brk:
Memory manipulation	Memory contents initialization	MEM	F	partition data-string partition: Initialization address range data-string: Initialization data string	None	x	x	o
	Memory contents retrieval	MEM	G	partition data-string partition: Retrieval address range data-string: Retrieval data string	None	x	x	o
	Memory contents copy	MEM	M	partition word word: Copy destination start address partition: Copy source address range	None	x	x	o
	Memory contents comparison	MEM	V	partition word word: Comparison destination start address partition: Comparison source address range	None	x	x	o
	Memory contents exchange	MEM	X	partition word word: Exchange destination start address partition: Exchange source address range	None	x	x	o
Channel 2 mode setting		MOD	None	[MODE= CHAR / FLOW] [BAUD= 19200 / 9600 / 4800 / 2400 / 1200 / 600 / 300] [LONG= 7 / 8] [PAR= NON / EVEN / ODD] [STOP= 1 / 2] Handshaking mode; Baud rate; Character length; Parity bit; Stop bit	MODE= CHAR BAUD= 9600 LONG=8 PAR=NON STOP=2	x	o	o

(to be continued)

(Cont'd)

Command type	Command body	Sub-command	Operand	Default	Operation status		
					trc:	emu:	brk:
Data transfer between alternative memory and user memory	MOV		partition word[$V] U From alternative memory to user memory I From user memory to alternative memory word Transfer destination start address partition Transfer source address range $V Specifies verification.	None	x	x	o
Trigger signal external output specification	OUT	None	[OFF / ON] OFF Sets external sense clip No.1 as trace signal input. ON Sets external sense clip No.1 as trigger signal output.	OFF	x	o	o
Pass condition setting	PAS	None	pass8 pass8 Pass count	1T	x	o	o
PROM programmer control, control character change and cancellation	PGM	C	C Specifies control character change/cancellation.	None	x	x	o
Sampling address setting	PSA	None	[word][word][word] word Sample address	None	x	o	o

(to be continued)

Command type	Command body	Subcommand	Operand	Default	Operation status trc:	emu:	brk:
Sample data display	PSD	None	[ALL / F / L / T / point] [$Y / $B / $W] ALL — Displays all sample data. point — Number of sample pointer shifts F — Sets sample pointer at start of sample memory. L — Sets sample pointer at end of sample memory. T — Sets sample pointer at event detection point. $Y — Specifies bit display. $B — Specifies byte display. $W — Specifies word display.	None	x	o	o
Sample timing setting	PST	None	[number: .4 / .6 / .8] number — Sample timing .4 — 0.4 us .6 — 0.6 us .8 — 0.8 us	.4	x	o	o
Register manipulation — Register change	REG	C	[PSW flag name / register name] PSW flag name — Name of PSW flag register name — Name of register	R0	x	o	o
Register manipulation — Register display	REG	D(*)	[ALL / PSW flag name / register name] ALL — Specifies all registers of all register banks. register name — Name of register PSW flag name — Name of PSW flag	All registers of current bank	x	o	o
Resetting of IE-78327-R and emulation CPU	RES	None	[H] H — Resets IE-78327-R.	None	o	o	o

(to be continued)

* This subcommand is assumed to be specified and is executed when only the command body is entered.

(Cont'd)

Command type		Command body	Sub-command	Operand	Default	Operation status trc:	emu:	brk:
Execution	Real-time execution without breaks	RUN	N	[word] word Execution start address	0H	x	x	o
	Real-time execution under break conditions	RUN	B	[word] word Execution start address	0H	x	x	o
	Step-by-step execution	RUN	T	[word][,{(*1) / step16}][REG][TRD] word Execution start address step16 Number of 16-bit steps REG Specifies register display. TRD Specifies trace display. PRC Specifies procedure execution. *1 See below.	0H 1T	x	x	o
	Procedure execution	RUN	T	[word][,{(*1) / step16}][REG][TRD]PRC				

(to be continued)

*1 This is to be replaced with the following table:

register name { = | > | < | => | >= | =< | <= | >< | <> } { mask8 (*2) / mask16 }

PSW
flag name = bit

mask8 8-bit mask data
mask16 16-bit mask data
bit 1-bit numeric

*2 Only =, ><, or <> can be used with a mask representation.

(Cont'd)

Command type		Command body	Subcommand	Operand	Default	Operation status trc:	emu:	brk:
Saving of object and debugging environment		SAV	None	file[partition(*1)][C][D][$V] file: File name C: Specifies object. D: Specifies debugging environment. partition: Save address range $V: Specifies verification.	None	x	x	o
SFR manipulation	SFR change	SFR	C	[sfr name] sfr name: Name of sfr	PO	x	o	o
SFR manipulation	SFR display	SFR	D(*2)	[sfr name] sfr name: Name of sfr	None	x	o	o
Termination of execution		STP	None	[T] T: Terminates analyzer only.	None	o	(*3) o	x
Command input from file		STR	None	file[parameter] file: File name parameter: Actual parameter	None	o	o	o

(to be continued)

*1 Up to five save address ranges can be specified in partition.

*2 This subcommand is assumed to be specified and is executed when only the command body is entered.

*3 T specification is not allowed.

(Cont'd)

Command type		Command body	Sub-command	Operand	Default	Operation status		
						trc:	emu:	brk:
IE symbol manipulation	IESYMBOL registration	SYM	A	symbol word symbol Symbolic name word Symbol value	None	x	o	o
	IESYMBOL change	SYM	C	symbol word symbol Symbolic name word Symbol value	None	x	o	o
	IESYMBOL deletion	SYM	E	symbol symbol Symbolic name	All IE-SYMBOLs registered	x	o	o
	IESYMBOL load	SYM	L	None	None	x	o	o
	IESYMBOL save	SYM	S	None	None	x	o	o
Symbol manipulation	Deletion of all symbols	SYM	K	None	All symbols registered	x	o	o
	Display of all symbols	SYM	D(*1)	[module name¥(*2)] module name¥ Name of module	All symbols registered	x	o	o
	Current module specification	SYM	M	None	None	x	o	o

(to be continued)

*1 This subcommand is assumed to be specified and is executed when only the command body is entered.

*2 When an IBM PC series machine is used as the host machine, \ is used in place of ¥.

Command type	Command body	Sub-command	Operand	Default	Operation status		
					trc:	emu:	brk:
Trace data display	TRD	F I	[ALL] [$F / $J / $Q / $C] F Frame display I Instruction display ALL Specifies display of all trace data and all data that match retrieval condition. $F Specifies display of five lines before and after frame that matches retrieval condition. $J Specifies display of frames related to program branch processing. $Q Specifies display of frames that match retrieval condition. $C Specifies display of checkpoint frames.	None	x	o	o
Setting of trace data retrieval condition	TRF	None	[A= word / partition] [V=mask8] [C=status(*)] [E=mask8] word Retrieval address partition Retrieval address range status Retrieval status mask8 8-bit mask data	A=0XXXXH V=0XXH C=NC E=0XXH	x	o	o

(to be continued)

* Select one of the following items for status:

BROP
OP
RWI
RI
WI
RW
R
W
RWP
RP
WP
RWM
RM
WM
NC

(Cont'd)

Command type	Command body	Sub-command	Operand	Default	Operation status		
					trc:	emu:	brk:
Analyzer reactivation	TRG	None	None	None	x	o	x
Trace mode setting	TRM	None	[ALL / TRX / SEC] ALL All traces TRX Qualified trace SEC Sectional trace	ALL	x	o	o
Trace data selection	TRS	None	[E / T] E → EXIT External data T → TIME Time tag	EXT	x	o	o
Condition setting for qualified trace	TRX	None	[[BRA1] [BRA2] [BRA3] [BRA4] / OFF] BR? Qualify condition OFF Qualify release	OFF	x	o	o
Comparison of object file with memory contents	VRY	None	file file File name	None	x	x	o
Memory word length setting	WRD	None	[B / W] B Byte specification W Word specification	B	x	o	o

NEC