

RTE-V832-PC

USER'S MANUAL (Rev. 1.04)

Midas lab

REVISION HISTORY

Date	REV.	Chapter	Explanation of revision
September 10, 1998	1.02		First edition
February 2, 1999	1.03	11.1	Revised RFC set value
December 26, 2000	1.04	8.9	The interrupt input from the printer of PIC is changed into the rising edge from high level. The board of revision newer than Rev.2.1 corresponds.

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1. INTRODUCTION

The **RTE-V832-PC** is an evaluation board, conforming to the PCI bus interface, that is designed to evaluate the NEC V832 RISC processor. This board can be inserted into the PCI slot of a DOS/V-compatible machine.

The board features a V832 capable of operating at a maximum speed of 143 MHz, memory, serial and parallel interfaces, and inputs/outputs such as audio inputs/outputs. As the memories, a high-speed SRAM and high-capacity SDRAM are provided as standard. The SDRAM is controlled by using the internal memory controller of the V832.

These functions enable the RTE-V832-PC to be used for a wide variety of applications including processor performance evaluation and application program development at the initial stage, and to also be used as an engine for demonstration and simulation.

The GHS Multi or Midas PARTNER source-level debugger can be used as a development software tool with the RTE-V832-PC. The type of monitor to be stored in ROM depends on the debugger type.

In ROM, the monitor specified at the time of purchase is stored. Even when neither of the debuggers is purchased together with the RTE-V832-PC, they can be purchased at anytime subsequently.

1.1. NUMERIC NOTATION

This manual represents numbers according to the notation described in the following table. Hexadecimal and binary numbers are hyphenated at every four digits, if they are difficult to read because of many digits being in each number.

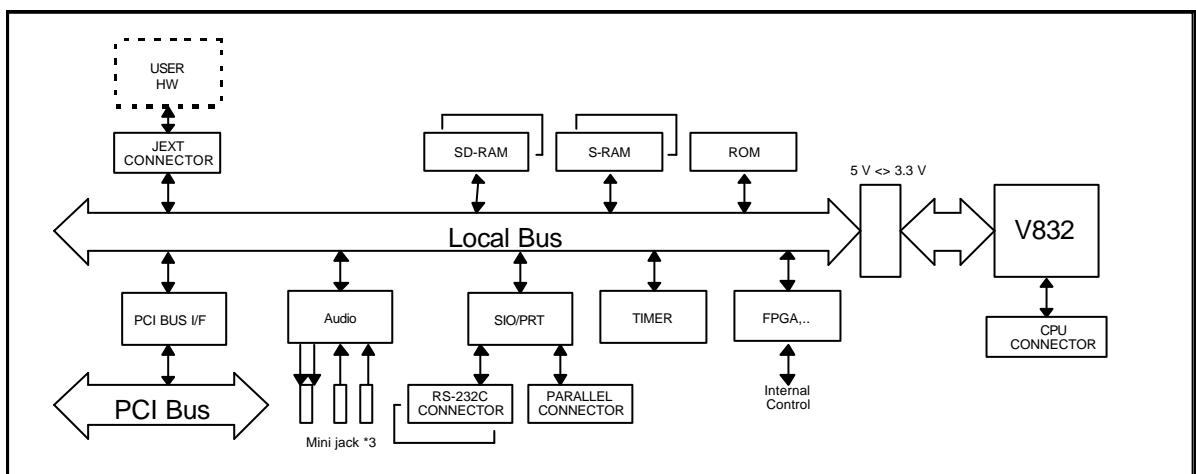
Number	Notation rule	Example
Decimal number	Only numerals are indicated.	"10" represents number 10 in decimal.
Hexa-decimal number	A number is suffixed with letter H.	"10H" represents number 16 in decimal.
Binary number	A number is suffixed with letter B.	"10B" represents number 2 in decimal.

Number Notation Rules

MULTI is a trademark of Green Hills Software, Inc. in the US.

2. FUNCTIONS

The overview of each function block of the RTE-V832-PC is shown below.



RTE-V832-PC Block Diagram

3. MAJOR FEATURES

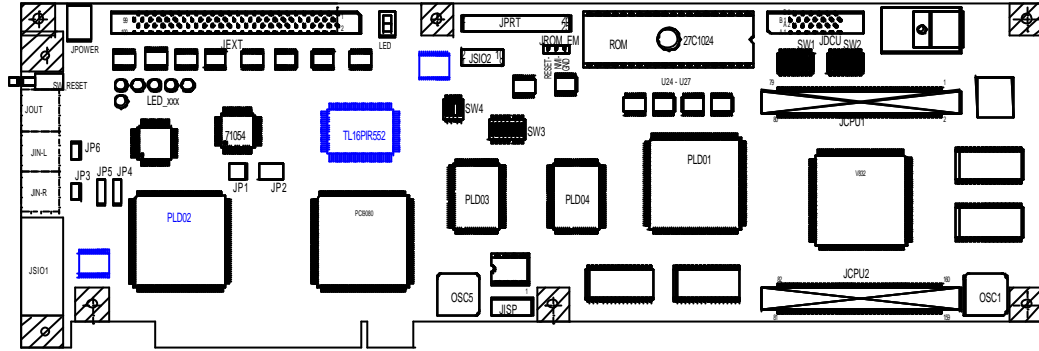
- Two types of monitor ROM are provided: one is used for the Green Hills Multi and the other for the Midas PARTNER.
- Real-time execution and evaluation at a high-level language level using Multi or PARTNER.
- A ROM emulator can be connected.
- 512K bytes of high-speed SRAM and 32M bytes of SDRAM are provided as standard.
- SRAM and DRAM can be evaluated in 16-bit bus mode.
- Two serial interfaces and one printer interface are provided.
- Two timer channels are provided. (One channel is used for the monitor.)
- Two audio input channels and two audio output channels are provided.

4. BASIC SPECIFICATIONS

Processor	V832
CPU clock	142.8 MHz
Bus clock	47.6 MHz
Power consumption	+5 V (2 A)
Memory	
EPROM	128 KB 64 K × 16 bits (40-pin DIP) × 1 (512K bytes max.)
SRAM	512 KB 128 K × 8 bits × 4
DRAM	32 MB 64 M-SDRAM × 4
I/O	
Serial (2 ch)	Equivalent to NS16550, 10-pin header, DB9 connector
Printer	IEEE1284-compatible, 26-pin header
Audio input/output (2 ch)	μ PD63310, Mini-jack (MIC × 2, LINEOUT × 1)
Timer	Equivalent to i8254, 500-ns resolution
I/O port	LED (7-segment) display/switch input
Others	
CPU connector	Connector with all function pins of the V832 connected
32-bit standard external extension bus	RTE-PC standard 32-bit interface (16M bytes, 32-bit bus, correspond to DMA)
Reset switch	Push type

5. BOARD CONFIGURATION

The physical layout of the major components on the RTE-V832-PC board is shown below. This chapter explains each component.



RTE-V832-PC Components Layout

5.1. RESET SWITCH (RESET)

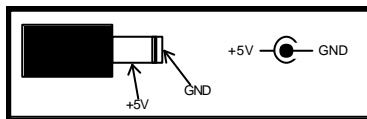
RESET is a reset switch for the entire board. Pressing this switch causes all the circuits including the CPU to be reset.

5.2. POWER JACK (JPOWER)

When this board is to be used as a standalone, that is, without being inserted in a PCI bus slot, the board should be supplied with power from an external power supply by connecting it to the JPOWER connector.

The external power should be one rated as listed below.

- Voltage: 5 V
- Current: Maximum of 2.0 A (excluding the current supplied to the JEXT connector)
- Mating connector: Type A (5.5 mm in diameter)
- Polarity:



[Caution] When attaching an external power supply to the board, be careful about its connector polarity. When inserting the board into the PCI bus slot, do not attach the JPOWER connector to an external power supply. It may result in a malfunction.

5.3. SWITCH 1 (SW1)

SW1 is a general-purpose input port switch. When the monitor is used, all SW1 switches except some are already set. When the port is read, a switch being set to OFF represents 1, while its being set to ON represents 0. Set this switch for assignment with the monitor by referring to the following sections and in accordance with your environment:

When using Multi, see Section 13.1.2.

When using PARTNER, see Section 14.1.1.

5.4. SWITCH 2 (SW2)

SW2 sets the H/W status of this board. All the bits of this switch can be read by software. When this switch is read from a port, OFF indicates 1 and ON indicates 0. For details, see Section 8.2.

No.	Function name	Description
1	BSIZE16	Specifies bus size of SRAM and SDRAM. <input type="checkbox"/> OFF: 32 bits (factory setting) <input type="checkbox"/> ON: 16 bits
2	BCLK_HI	Specifies frequency of bus clock. <input type="checkbox"/> OFF: Frequency exceeding 33 MHz (factory setting) <input type="checkbox"/> ON: Frequency less than 33 MHz
3	CMODE	Directly connected to CMODE pin of CPU. <input type="checkbox"/> OFF: Multiplied by 8 <input type="checkbox"/> ON: Multiplied by 6 (factory setting)
4	TEST	Must always be OFF.
5	ROM_TYPE0	Specifies the type of ROM to be used.
6	ROM_TYPE1	[ROM_TYPE1, ROM_TYPE0] <input type="checkbox"/> OFF, <input type="checkbox"/> OFF When monitor ROM is used (factory setting) [OFF, ON] When 27C4096 is used [ON, OFF] When 27C2048 is used [ON, ON] When 27C1024 is used
7	BNK_DIS	Specifies whether the upper and lower halves (banks) of ROM are separated <input type="checkbox"/> OFF: Upper and lower halves of ROM are separated (factory setting). <input type="checkbox"/> ON: Upper and lower halves of ROM are used as a contiguous area.
8	BNK_LOW	Selects either the upper or lower half when BNK_DIS = OFF <input type="checkbox"/> OFF: Selects upper half. <input type="checkbox"/> ON: Selects lower half (factory setting).

5.5. SWITCH 3 (SW3)

SW3 physically cuts the interrupts used in this board. All the bits of this switch are set to ON (connected status) at the factory. Set the corresponding bit of this switch only when it is used externally, and only when the internally used interrupt is unnecessary.

No.	INT name	Internally used interrupt source
1	INTP03	PIC-INT0 (Do not set this bit to OFF when the monitor is used.)
2	INTP02	PIC-INT1
3	INTP01	EXTbus-INT0
4	INTP00	Audio
5	INTP13	EXTbus-INT3
6	INTP12	EXTbus-INT2
7	INTP11	EXTbus-INT1
8	INTP10	Printer

5.6. SWITCH 4 (SW4)

SW4 physically cuts the DMA used by this board. All the bits of this switch are set to ON (connected status) at the factory. Set the corresponding bit of this switch only when it is used externally, and only when the internally used DMA is unnecessary.

No.	DMA name	Internally used interrupt source
1	DMARQ2-	EXTbus-DREQ0-
2	DMAAK2-	EXTbus-DACK0-
3	DMARQ3-	EXTbus-DREQ1-
4	DMAAK3-	EXTbus-DACK1-

[Caution] Set switch bits 1 and 2, and 3 and 4 to the same positions.

5.7. LED

The LEDs are used to indicate statuses, as listed below.

LED	Description
POWER	Lights when power is supplied to the RTE-V832-PC board.
PLY	Lights in green when voice is output. Lights in red if an error occurs during voice output.
REC	Lights in green when voice is recorded. Lights in red if an error occurs during voice recording.
PCI_PERR	Lights if a parity error occurs in the PCI bus.
PCI9_DEAD	Lights if the PCI controller is deadlocked.
TOVER	Lights when a time-out occurs.

LED Indication

[Caution] If PCI_PERR and PCI9_DEAD light, restart the system.

5.8. TEST PINS FOR ROM EMULATOR (JROM_EM)

Test pins (JROM_EMs) are used to connect a ROM emulator. They accept control signals from the ROM emulator. The following table lists the signal names and functions related to each test pin.

Signal	Input/output	Function
RESET- (1)	Input	When a low level is supplied to this test pin, the CPU is reset. A reset request signal from the ROM emulator is connected to the test pin. The test pin is pulled up with 1 k Ω .
NMI- (2)	Input	When a low level is supplied to this test pin, an NMI signal is given to the CPU. This signal can be masked by software, so it is necessary to reset the mask. (See Section 8.9.) An NMI request signal from the ROM emulator is connected to the test pin. The test pin is pulled up with 1 k Ω .
GND (3)	---	This test pin is at a ground level. The ground level of the ROM emulator is connected to the test pin.

JROM_EM Pin Functions

5.9. CLOCK SOCKET (OSC1)

An oscillator for generating the clock signal to be supplied to the CPU is mounted in the OSC1 socket. With the V832, a PLL is used to generate a system clock. The frequency of the oscillator must be one-sixth or one-eighth the internal operating frequency of the V832.

Accepts DIP 8-pin (half-type) oscillators.

[Caution] When you have to cut an oscillator pin for convenience, be careful not to cut it too short, or otherwise the frame (housing) of the oscillator may touch a tine in the socket, resulting in a short-circuit occurring.

5.10. ROM SOCKETS

The RTE-V832-PC has ROM sockets to hold 40-pin ROM chips to provide standard 128K bytes (64K × 16 bits). When the ROM chips used here are to be replaced, their type should be 27C1024, 27C2048, or 27C4096, and the access time should be 120 ns or less. SW2 may need to be set according to the type and purpose of the ROM chips to be used. For details, see Section 5.4.

5.11. DMARQ0-, DMARQ1- SEPARATION JUMPER (JP1)

JP1 is a jumper that physically cuts off DMARQ0- and DMARQ1-, used for Audio data transfer, from the V832. Usually, jumper 1-2, and 3-4.

[Remark] If this jumper is opened, Audio data cannot be transferred by means of DMA.

5.12. TIMER CLOCK FREQUENCY SELECT JUMPER (JP2)

JP2 is used to select which of two clocks is to be supplied to the timers (CH#1, CH#2) that can be used by applications.

- 1-2: 2 MHz (factory-set)
- 3-4: 4 MHz
- 5-6: 8 MHz

5.13. AUDIO INPUT LEVEL SELECT JUMPERS (JP3, JP4, JP5, JP6)

These jumpers are used to select the input level of Audio. Set these jumpers as shown below, depending on whether MIC or LINE is used. MIC is the factory setting.

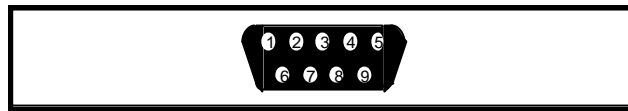
Input level	JP3	JP4	JP5	JP6
MIC	Short	1-2 short	1-2 short	Short
LINE	Open	2-3 short	2-3 short	Open

5.14. SERIAL CONNECTOR (JSIO1, JSIO2)

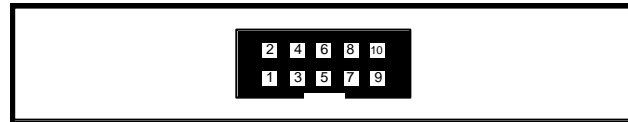
The JSIO1 and JSIO2 connectors are used for the RS-232C interface that is controlled by the serial controller (TL16PIR552PH). JSIO1 is a 9-pin D-SUB RS-232C connector like that commonly used on the PC/AT, while JSIO2 is a pin plug type connector with a pitch of 2.54 mm. All signals on both of these connectors are converted to the RS-232C level. The figures and table below indicate the pin and signal arrangements of these connectors.

For the signals to be connected to the host, the table indicates two modes of wiring on the host: one for a 9-pin D-SUB connector, and the other for a 25-pin D-SUB connector. (Regular cross-cable wiring is used for these connections.)

The pin arrangement of JSIO2 will be identical to that of JSIO1 when a push-fit connector is used with a ribbon cable.



JSIO1 Pin Arrangement (Male)



JSIO2 Pin Arrangement

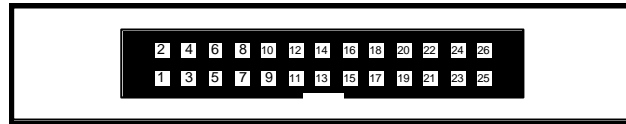
JSIO1 pin No.	JSIO2 pin No.	Signal name	Input/ output	Connector pin number on the host side	
				D-SUB9	D-SUB25
1	1	DCD	Input		
2	3	RxD(RD)	Input	3	2
3	5	TxD(SD)	Output	2	3
4	7	DTR(DR)	Output	1, 6	6, 8
5	9	GND		5	7
6	2	DSR(ER)	Input	4	20
7	4	RTS(RS)	Output	8	5
8	6	CTS(CS)	Input	7	4
9	8	RI	Input		
--	10	NC			

JSIO1 and JSIO2 Connector Signals

5.15. PARALLEL CONNECTOR (JPRT)

The JPRT connector is used for parallel communication controlled by the parallel (printer) controller (TL16PIR552PH). JPRT is a pin plug type connector with a 2.54 mm pitch. All signals on the connector are 5-V level signals. The figure and table below indicate the pin and signal arrangements of the connector.

The pin arrangement of JPRT will be identical to that of the 25-pin D-SUB connector, like that commonly used on the PC/AT, when a push-fit connector is used with a ribbon cable.



JPRT Pin Arrangement

JPRT pin No.	Signal name	JPRT pin No.	Signal name
1	STB-	2	AUTO_FD-
3	D0	4	ERROR-
5	D1	6	INIT-
7	D2	8	SELECT_IN-
9	D3	10	GND
11	D4	12	GND
13	D5	14	GND
15	D6	16	GND
17	D7	18	GND
19	ACK-	20	GND
21	BUSY	22	GND
23	PE	24	GND
25	SELECT	26	NC

JPRT Connector Signals

5.16. AUDIO MINI-JACKS (JIN-R, JIN-L, JLINEOUT)

Audio jacks are provided for two monaural microphone or line input channels and one stereo output channel. The input/output conditions of these jacks are indicated below.

JIN-R, JIN-L

Electrical input condition

When MIC input is specified: 140 mVp-p (Internal amplification: About 20 dB)

When LINE input is specified: 1.4 Vp-p

Physical shape of mating plug

Monaural mini-plug (♂3.5) × 2 channels

JLINEOUT

Electrical output condition

1.4 Vp-p

Physical shape of mating plug

Stereo mini-plug (♂3.5) × 1 channel

[Supplement] Selection between MIC and LINE is performed by setting JP3, JP4, JP5, and JP6.

5.17. DEBUGGING CONNECTOR (JDCU)

The JDCU connector is used to connect a debug tool based on the debug function built into the V832.

On-board connector: 8830E-026-170S manufactured by KEL

Pin No.	Signal name	Pin No.	Signal name
A1	TRCCLK	B1	GND
A2	TRCDATA0	B2	GND
A3	TRCDATA1	B3	GND
A4	TRCDATA2	B4	GND
A5	TRCDATA3	B5	GND
A6	NC.	B6	GND
A7	DDI	B7	GND
A8	DCK	B8	GND
A9	DMS	B9	GND
A10	DDO	B10	GND
A11	DRST-	B11	NC.
A12	NC.	B12	NC.
A13	NC.	B13	+3.3 V

JDCU Connector Signals

5.18. CPU CONNECTOR (JCPU-1, JCPU-2)

The CPU connector signals are connected directly to the V832. Many signals are used on the board. So, be careful when extracting signals from the JCPU. The 3.3-V signal level is used.

Pin No.	Signal name	Pin No.	Signal name
1	GND	2	CS1-
3	CS0-	4	WE-
5	RAS-	6	UUDQM
7	ULDQM	8	LUDQM
9	LLDQM	10	+3.3 V
11	GND	12	SDCLKOUT
13	CKE	14	CAS-
15	A1	16	A2
17	A3	18	A4
19	+2.5 V	20	GND
21	+3.3 V	22	GND
23	A5	24	A6
25	A7	26	A8
27	A9	28	A10
29	A11	30	+3.3 V
31	GND	32	A12
33	A13	34	A14
35	A15	36	A16
37	A17	38	A18
39	A19	40	+5 V
41	GND	42	A20
43	A21	44	A22
45	A23	46	CLKOUT
47	BCLK2 (buffered CLKOUT)	48	MWR0-
49	MWR1-	50	MWR2-
51	MWR3-	52	NC.
53	NC.	54	NC.
55	NC.	56	NC.
57	NC.	58	GND
59	+2.5 V	60	GND
61	NC.	62	BT16B (GND)
63	RESET-	64	NMI-
65	NC.	66	CMODE
67	P3	68	P4
69	P2	70	P1
71	P0	72	+5 V
73	GND	74	INTP0
75	INTP12	76	INTP11
77	INTP13	78	PB0
79	PB1	80	+2.5 V

JCPU-1 Connector Signals

Pin No.	Signal name	Pin No.	Signal name
81	GND	82	INTP00
83	INTP01	84	INTP02
85	INTP03	86	DMARQ3-
87	DMARQ2-	88	DMARQ1-
89	DMARQ0-	90	DMAAK3-
91	DMAAK2-	92	DMAAK1-
93	DMAAK0-	94	TC-/STOPAK-
95	CS7-	96	CS6-
97	CS5-	98	CS4-
99	CS3-	100	CS2-
101	+3.3 V	102	GND
103	HLDK-	104	HLDRQ-
105	R/W-	106	READY -
107	BCYST-	108	IORD-
109	IOWR-	110	UUBEN-
111	ULBEN-	112	LUBEN-
113	LLBEN-	114	MWR-
115	MRD-	116	+3.3 V
117	GND	118	D0
119	D1	120	+2.5 V
121	GND	122	D2
123	D3	124	D4
125	D5	126	D6
127	D7	128	+5 V
129	GND	130	D8
131	D9	132	D10
133	D11	134	D12
135	D13	136	D14
137	D15	138	+5 V
139	GND	140	D16
141	D17	142	D18
143	D19	144	D20
145	D21	146	D22
147	D23	148	+5 V
149	GND	150	+2.5 V
151	GND	152	D24
153	D25	154	D26
155	D27	156	D28
157	D29	158	D30
159	D31	160	+5 V

JCPU-2 Connector Signals

The connector used is the FX2-80P-1.27SV, manufactured by Hirose Electric Co., Ltd.

5.19. EXTENSION BUS CONNECTOR (JEXT)

The JEXT connector is provided to enable memory or I/O extension. This connector is internally connected to the local bus of the board. For details, see Chapter 10.

6. CONNECTION WITH THE HOST PC

6.1. STANDALONE USE OF THE BOARD (RS-232C CONNECTION)

Serially connect the host machine by means of the following procedure:

- <1> Get an RS-232C cable for connection with the host and an external power supply (+5 V, ?? A) on hand. For the power supply, watch for its voltage, capacity, and **connector polarity**. The RS-232C cable is of the type generally called a cross cable. Confirm the wiring before using this cable. See Sections 5.14. and 5.2. for RS-232C cable connection and the power supply, respectively.
- <2> Set and check the setting of DIPSW on the board. Specify a baud rate by using SW1 (see Sections 13.1.2 and 14.1.1).
- <3> Connect the JSIO1 connector and host machine with the RS-232C cable, and supply power to the JPOWER connector. Confirm that the POWER-LED on the board lights. **If the LED does not light, turn off the power immediately, and check the connection.**
- <4> Start the debugger on the host machine, and connect it via the RS-232C interface. If an error occurs, confirm the setting of the serial cable and switches (especially, the baud rate).

[Cautions]

1. When power is applied to the board while the board is not connected to the PCI bus, also connect the supplied PCI bus terminator board.
2. Place the board on an insulating material. If a conductive material touches the board while power is supplied to the board, the board may malfunction.

6.2. INSERTING INTO PCI SLOT (PCI BUS CONNECTION)

Insert the board into the PCI slot of the host PC by means of the following procedure:

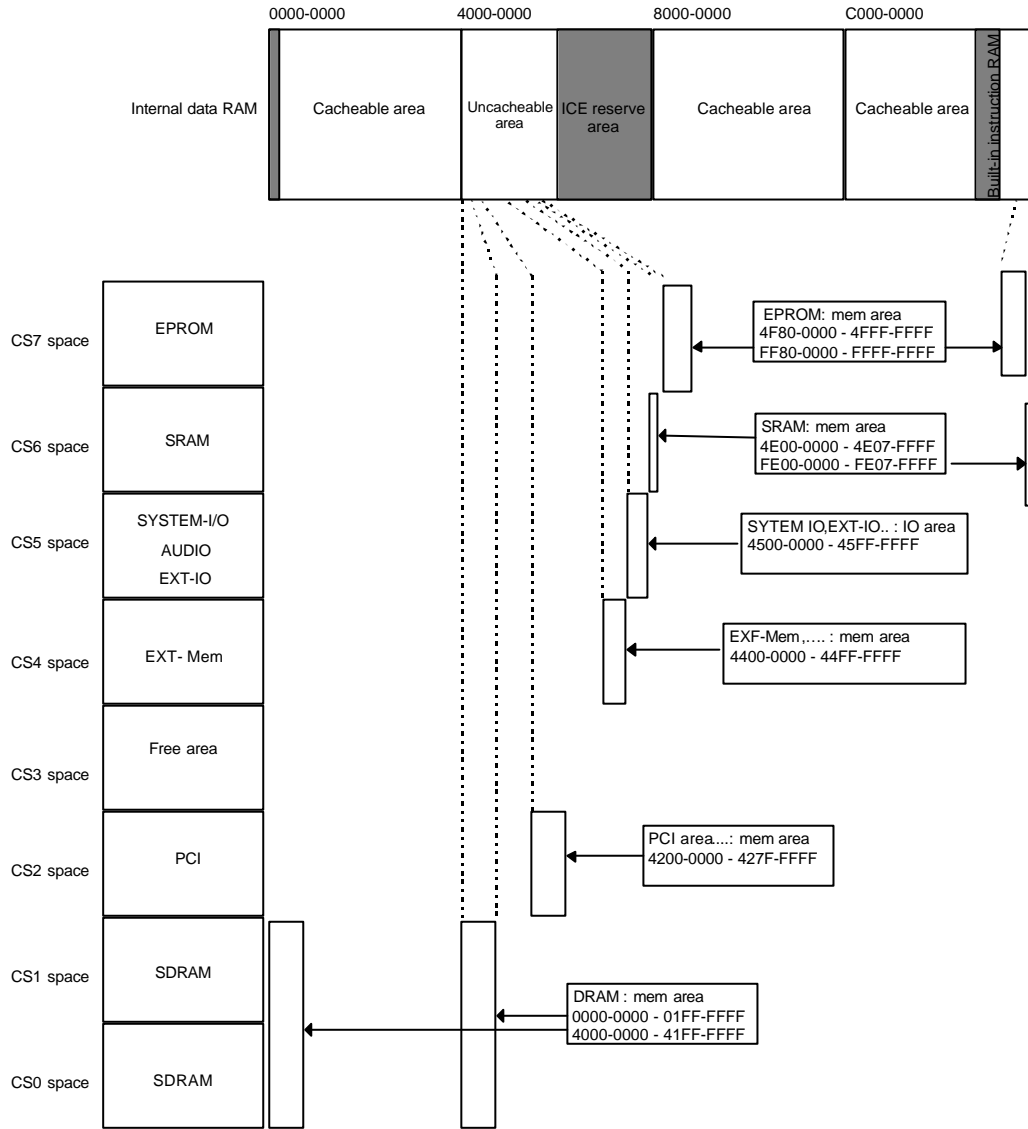
- <1> Set and check the DIPSW on the board.
- <2> Open the housing of the PC, and insert the board into the PCI slot. Confirm that the board is securely mounted, and fix the back panel with a screw.
- <3> Turn on the power to the PC, and check that the POWER-LED on the board lights. **If the LED does not light, turn off the PC power immediately, and check the connection.** Also confirm that the host machine operates normally.
- <4> Start the debugger on the host machine and connect it via the PCI bus. If an error occurs, check whether the board is correctly mounted, and whether the software has been correctly installed.

7. HARDWARE REFERENCES

This chapter describes the hardware of the RTE-V832-PC.

7.1. MEMORY AND I/O MAP

The figure below shows the memory and I/O mapping on the board.



Memory and I/O Mapping

CS0 space (x000-000 to x0FF-FFFF, x800-000 to x8FF-FFFF)

SDRAM of 16M bytes is mapped. Both the 16-bit and 32-bit data bus widths can be specified by using SW2-1. However, the memory capacity is limited to 8M bytes when the 16-bit width is selected. For interfacing with SDRAM, the DRAM controller built into the V832 is used.

CS1 space (x100-000 to x1FF-FFFF, x900-000 to x9FF-FFFF)

SDRAM of 16M bytes is mapped. Both the 16-bit and 32-bit data bus widths can be specified by using SW2-1. However, the memory capacity is limited to 8M bytes when the 16-bit width is selected. For interfacing with SDRAM, the DRAM controller built into the V832 is used.

CS2 space (x200-000 to x27F-FFFF, xA00-000 to xA7F-FFFF)

A controller is mapped as a bridge to PCI.

CS3 space (x300-000 to x3FF-FFFF, xB00-000 to xBFF-FFFF)

CS3 is not used.

CS4 space (x400-000 to x40F-FFFF, xC00-000 to xC0F-FFFF)

The 16M-byte memory area on the EXT bus is mapped.

CS5 space (x500-000 to x5FF-FFFF, xD00-000 to xDFF-FFFF)

The I/O devices of the board, such as the timer, Audio, and serial and parallel interfaces, and EXT bus IO area are mapped. Because full decoding is not performed, image spaces appear at various locations. So, never attempt to access other than the specified I/O addresses.

Wait control is exercised by external FPGA. For details of each I/O device, see Chapter 8.

CS6 space (x600-000 to x6FF-FFFF, xE00-000 to xEFF-FFFF)

A high-speed SRAM of 512K bytes (NEC's *m*PD431008LE-15: 128K × 8 bits, 15 ns) is mapped. Both the 16-bit and 32-bit data bus widths can be specified by using SW2-1. A memory capacity of 512K bytes is allocated even when the 16-bit width is selected. An SRAM image appears at 512K-byte intervals.

Wait control is exercised by the bus controller built into the CPU. Access is possible with no wait clock cycles when a 33-MHz or less external clock is used.

CS7 space (x700-000 to x7FF-FFFF, xF00-000 to xFFF-FFFF)

This is a space for boot ROM that is booted by the 16-bit bus (BT16B pin is fixed to 16 bits).

As an EPROM, a 27C1024, 27C2048, or 27C4096 (120 ns or less) (40-pin DIP type) can be used. The evaluation board is factory-fitted with a 27C1024 incorporating the monitor.

Wait control is exercised by the bus controller built into the CPU. The ROM area requires an access time of 120 ns or longer.

[Caution] When SDRAM and SRAM are used at the 16-bit width, set SW2-1: BSIZE32 to ON and then set the memory controller. Only either one of SDRAM and SRAM can be used at the 16-bit width.
--

8. I/O MAP

I/O devices such as Audio, UART/PRINTER, TIC, and PIO, and EXT-BUS are mapped to separate I/O spaces. These I/O spaces are mapped to the space of CS5. This section explains the mapping and I/O devices.

8.1. I/O LIST

The table below lists the I/O areas and functions.

Address	Function
4500-0000H	See the description of DIPSW2.
4500-1000H	See the description of DIPSW1.
4500-2000H	7-segment LED display data setting
4500-5000H	Command setting/reference (Time-Over-Enable)
4500-6000H	EXT-BUS-High Addr setting/reference (EXA23, EXA22)
4500-8000H to 4500-801FH	UART-CH#1 (TL16PIR552) setting/reference
4500-9000H to 4500-901FH	UART-CH#2 (TL16PIR552) setting/reference
4500-A000H to 4500-A01FH	PRINTER-PP (TL16PIR552) setting/reference
4500-B000H to 4500-B00FH	Timer controller (μ PD71054) setting/reference
4500-D000H to 4500-D01FH	Interrupt controller setting/reference
4500-E000H to 4500-E01FH	PRINTER-ECP (TL16PIR552) setting/reference
4540-0000H to 457F-FFFFH	EXT-BUS IO space (*1)
4580-0000H to 4580-001FH	Audio-Control register setting/reference
4580-1000H to 4580-100FH	μ PD63310 register setting/reference
4580-2000H	Audio-FIFO data register setting/reference

*1: EXT-BUS I/O space

As the EXT-BUS I/O space, a 16M-byte space is accessed by using the EXT-IO high-order address setting register (4500 through 6000H) to specify the high-order address. The relation between the address and the I/O space that can be accessed is shown below.

Set value of EXT-IO high-order address setting register [A23, A22]	I/O space of EXT-BUS that can be accessed by 4540-0000H through 457F-FFFFH
[0.0]	00-0000H to 3F-FFFFH
[0.1]	40-0000H to 7F-FFFFH
[1.0]	80-0000H to BF-FFFFH
[1.1]	C0-0000H to FF-FFFFH

8.2. DIPSW2 READ PORT (4500-0000H [READ ONLY])

This port is used to read the status of DIP-SW2. The data format of this port is shown in the table below.

Logical address	Data bus								Setting
	D7	D6	D5	D4	D3	D2	D1	D0	
4500-0000H input	SW2 -8	SW2 -7	SW2 -6	SW2 -5	SW2 -4	SW2 -3	SW2 -2	SW2 -1	0 = ON 1 = OFF
Hardware allocation	BNK_ MODE 1	BNK_ MODE 0	ROM_ TYPE 1	ROM_ TYPE 0	PT_ PRT EN	CPU_ CMODE	BCLK _Hi	BSIZE 32	

SW2-1 corresponds to bit 1 of SW2, and SW2-8 corresponds to bit 8 of SW2. When a bit of the corresponding switch is set to ON, 0 is read; when it is set to OFF, 1 is read. SW2 is mainly used to set the hardware environment. For how to set this switch, see Section 5.4.

8.3. DIPSW1 READ PORT (4500-1000H [READ ONLY])

This port is used to read the status of DIP-SW1. The table below indicates the data format.

Logical address	Data bus								Setting
	D7	D6	D5	D4	D3	D2	D1	D0	
4500-1000H input	SW1 -8	SW1 -7	SW1 -6	SW1 -5	SW1 -4	SW1 -3	SW1 -2	SW1 -1	0 = ON 1 = OFF

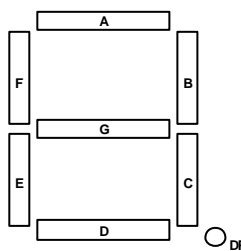
SW1-1 corresponds to switch 1 of SW1, while SW1-8 corresponds to switch 8 of SW1. When a bit is ON, 0 is read. When a bit is OFF, 1 is read. SW1 is used to set the operation of the monitor. For how to set this switch, see Sections 13.2.1 and 14.1.1.

8.4. 7-SEGMENT LED DISPLAY DATA OUTPUT PORT (4500-2000H [WRITE ONLY])

This port sets the data to be displayed on the 7-segment LED. The table below indicates the data format. When a bit is set to 0, the corresponding segment is turned on.

Logical address	Data bus								Setting
	D7	D6	D5	D4	D3	D2	D1	D0	
4500-2000H output	7SEG -DP	7SEG -G	7SEG -F	7SEG -E	7SEG -D	7SEG -C	7SEG -B	7SEG -A	0 = Turned on 1 = Turned off

The figure below illustrates the correspondence between the bits and the segments of the 7-segment LED.



8.5. COMMAND REGISTER (4500-5000H [READ/WRITE])

This register has the following functions:

Logical address	Register	Data bus							
		D7	D6	D5	D4	D3	D2	D1	D0
4500-5000H	CMD#1 (initial value)	X	X	X	X	X	X	X	TOVEN (0)

TOVEN: Controls the use of the time-over function. When the length of a bus cycle reaches 512 bus clocks, the time-over function returns READY-, and forcibly terminates the bus cycle.

TOVEN	Time-over function
0	Used (Reset value)
1	Not used

8.6. EXT-IO HIGH-ORDER ADDRESS SETTING REGISTER (4500-6000H [READ/WRITE])

This register specifies a high-order address (A23, A22) to access the I/O space of the external extension bus (EXT bus).

Logical address	Register	Data bus							
		D7	D6	D5	D4	D3	D2	D1	D0
4500-6000H	CMD#1 (initial value)	X	X	X	X	X	X	EA23 (0)	EA22 (0)

8.7. UART/PRINTER (TL16PIR552) (4500-8000H TO 4500-A03EH)

The Texas Instruments TL16PIR552 (dual UART with 1,284 parallel port) LSI is used as UART/PRINTER. TL16PIR552 has two UART channels and one bidirectional printer port channel conforming to IEEE1284. It also has a 16-character FIFO buffer in the transmission/reception block of the UART, and a function for automatically controlling RTS/CTS flow. Therefore, an overrun error can be suppressed by the minimum interrupt.

Each register of the TL16PIR552 is assigned as listed below. For an explanation of the function of each register, refer to the manual provided with the TL16PIR552. (The manual for TL16PIR552 is available from the TI&ME corner of the Texas Instruments home page (<http://www.ti.com/>).)

Address	Function	Read	Write
4500-8000H	UART-CH#0	RBR/DLL	THR/DLL
4500-8004H		IER/DLM	IER/DLM
4500-8008H		IIR	FCR
4500-800CH		LCR	LCR
4500-8010H		MCR	MCR
4500-8014H		LSR	LSR
4500-8018H		MSR	MSR
4500-801CH		SCR	SCR
4500-9000H		UART-CH#1	RBR/DLL
4500-9004H	IER/DLM		IER/DLM
4500-9008H	IIR		FCR
4500-900CH	LCR		LCR
4500-9010H	MCR		MCR
4500-9014H	LSR		LSR
4500-9018H	MSR		MSR
4500-901CH	SCR		SCR
4500-A000H	PRINTER (PPCS-)		DATA
4500-A004H		DSR	-----
4500-A008H		DCR	DCR
4500-A00CH		EPPADDR	EPPADDR
4500-A010H to 4500-A01CH		EPPDATA	EPPDATA
4500-E000H	PRINTER (ECPCS-)	PPDATAFIFO/ TESTFIFO/CNFGA	PPDATAFIFO/ TESTFIFO
4500-E004H		CNFGB	-----
4500-E008H		ECR	ECR

TL16PIR552 Register Arrangement

The XIN input of the TL16PIR552 is connected to the 22.1184-MHz clock.

Each interrupt of UART-CH#0, UART-CH#1, and PRINTER can be connected to the interrupts of the CPU via PIC. The interrupt from PRINTER can be directly connected to INTP10 of the V832 via SW3-8.

Interrupt source	Connected CPU interrupt	Interrupt edge
PRINTER	INTP10	Rising edge

UART-CH#0 is connected to the JSIO1 connector on the rear panel of the board, UART-CH#1 is connected to the JSIO2 connector, and PRINTER is connected to JPRT. UART-CH#0 is used when the debugger is used in serial communication mode. At this time, INTP3 or NMI is used as the interrupt via PIC.

TL16PIR552 is reset when the system is reset.

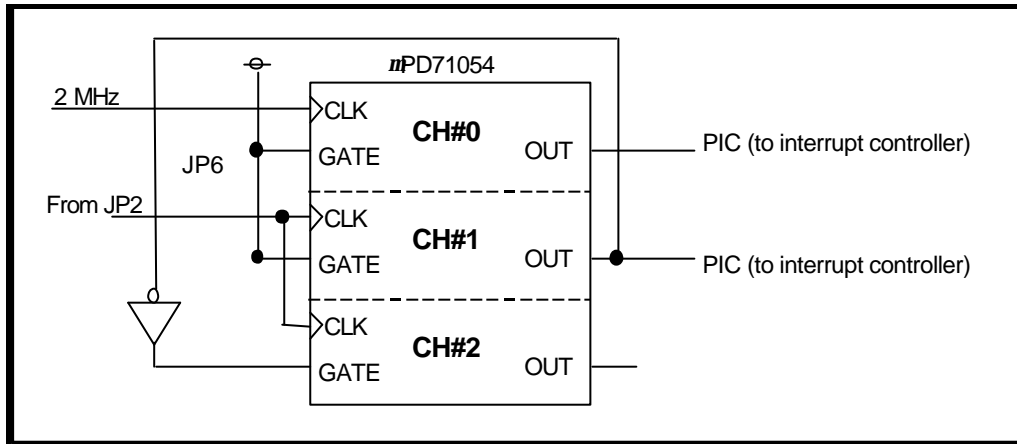
8.8. TIC (mPD71054) (4500-B000H TO 4500-B00CH)

The NEC mPD71054 is installed as a TIC. The mPD71054 is compatible with the Intel i8254. It has three timers/counters. These timers/counters are used to generate monitor timer interrupts. Each register of the TIC is assigned as listed below.

Address	Read	Write
4500-B000H	COUNTER#0	COUNTER#0
4500-B004H	COUNTER#1	COUNTER#1
4500-B008H	COUNTER#2	COUNTER#2
4500-B00CH	-----	Control Word

TIC Register Arrangement

The channels of the TIC are connected as shown in the figure below. Channel 0 is used as the interval timer for the monitor program. Channels 1 and 2 can be used by a user program as necessary. Channel 2 is connected to channel 1 by means of a cascade connection.



Examples of modes

- CH#0: Mode 2 (rate generator)
- CH#1: Mode 2 (rate generator)
- CH#2: Mode 0 (down counter)

8.9. INTERRUPT CONTROLLER (PIC) (4500-D000H TO 4500-D018H)

The PIC mainly exercises interrupt-related control. The table below indicates the assignment of registers.

With the RTE-V832-PC, INT0 of the PIC is connected to NMI or INTP03 of the V832 according to the specification of NMI/INT3-. INT1 is connected to INTP02.

Logical address	Register	Data bus							
		D7	D6	D5	D4	D3	D2	D1	D0
4500-D000H	PIC INT0M	0	IM06	IM05	IM04	IM03	IM02	IM01	IM00
4500-D008H	PIC INT1M	0	IM16	IM15	IM14	IM13	IM12	IM11	IM10
4500-D010H	PIC INTR	IR7	IR6	IR5	IR4	IR3	IR2	IR1	IR0
4500-D018H	PIC INTEN	0	0	0	NMI/ INT3-	0	0	0	NMIEN

The INT0M and INT1M registers mask interrupts applied to INT0 and INT1, respectively. When the IM0x or IM1x bit is set to 1, the interrupt is enabled. When multiple bits are selected, each OR value activates an interrupt.

[Caution] Always write 0 into bit 7 of INT0M and INT1M.

The INTR register is an interrupt status register, for which 1 is read whenever there is an interrupt request. This does not depend on the state of masking. To clear an edge interrupt request, the corresponding bit of this register must be set to 1.

The table below indicates the interrupt source assigned to each bit of IM0[0..7], IM1[0..7], and IR[0..7].

IM0, IM1, IR	Interrupt source	Request level
0	Timer 0 (mode 2)	Edge (rising)
1	Serial 0	Level (high)
2	Host (PCI communication)	Level (low)
3	Time-over	Edge (rising)
4	Timer 1 (mode 2)	Edge (rising)
5	Serial 1	Level (high)
6	Parallel (printer)	Edge (rising)
7	Reserved	Edge (falling)

The INTEN register enables or disables all interrupts.

NMIEN: Disables a non-maskable interrupt (NMI) by hardware. At this time, the NMI pin is high. The NMI request from the JROM_EM1 connector is input to the CPU, regardless of this bit.

NMIEN	NMI
0	Sets a mask. (Reset value)
1	Does not set a mask.

NMI/INTP3-: Specifies whether an INT0 interrupt is to be applied to NMI or INTP03.

NMI/INTP3-	INT0
0	INTP03 (Reset value)
1	NMI

[Caution] INT0 (NMI/INTP03) is used with the monitor. So, never modify the related registers. INT1 is released, and can be used freely.

8.10. AUDIO CONTROLLER (AUDCNT) (4580-0000H TO 4580-0010H, 4580-2000H)

AUDCNT controls digital data input to and output from the audio chip (*m*PD63310).

Logical address	Register	Data bus							
4580-0000H	CONTROL	D15	D14	D13	D12	D11	D10	D9	D8
		RST	0	0	0	0	RM1	RM0	REC
		D7	D6	D5	D4	D3	D2	D1	D0
4580-0008H	STATUS	0	0	0	0	0	PM1	PM0	PLY
		D15	D14	D13	D12	D11	D10	D9	D8
		0	FF1	0	EF1	0	ROV	RUD	REX
4580-0010H	MCLKDIV	D7	D6	D5	D4	D3	D2	D1	D0
		0	0	0	0	0	POV	PUD	PEX
		0	0	0	DIV4	DIV3	DIV2	DIV1	DIV0
4580-2000H	AUDIO DATA	D15 to D0							
		First time: L channel, 16 bits, Second time: R channel, 16 bits							

The CONTROL register controls voice recording/replay. (Read/write)

RST	Audio reset
0	Reset clear (Reset value)
1	Reset

PLY	Replay operation
0	Stop (Reset value)
1	Start

PM0	Underflow interrupt upon replay
0	Disable (Reset value)
1	Enable

PM1	Overflow interrupt upon replay
0	Disable (Reset value)
1	Enable

REC	Recording operation
0	Stop (Reset value)
1	Start

RM0	Underflow interrupt upon recording
0	Disable (Reset value)
1	Enable

RM1	Overflow interrupt upon recording
0	Disable (Reset value)
1	Enable

The STATUS register is a read-only register for indicating various statuses.

PEX	Replay status
0	Stopped
1	Being conducted

POV	Overflow upon replay
0	No overflow detected
1	Overflow detected

PUD	Underflow upon replay
0	No underflow detected
1	Underflow detected

FF0	EF0	Data buffer status for replay
0	1	Empty
1	0	Full (buffer write disabled)

REX	Recording status
0	Stopped
1	Being conducted

ROV	Overflow upon recording
0	No overflow detected
1	Overflow detected

RUD	Underflow upon recording
0	No underflow detected
1	Underflow detected

FF1	EF1	Data buffer status for recording
0	1	Empty (buffer read disabled)
1	0	Full

The MCLKDIV register is used to determine the MCLK frequency.

DIV4	DIV3	DIV2	DIV1	DIV0	MCLK 49.152/(DIV + 2)	Sampling frequency (MCLK/256)	Bytes/sec fs * 4
0	0	0	0	0	24.576 MHz		
0	0	0	0	1	16.384 MHz		
0	0	0	1	0	12.288 MHz	48.0 KHz	192.0 KB
0	0	0	1	1	9.830 MHz	38.4 KHz	153.6 KB
0	0	1	0	0	8.192 MHz	32.0 KHz	128.0 KB
0	0	1	0	1	7.022 MHz	27.5 KHz	109.7 KB
0	0	1	1	0	6.144 MHz	24.0 KHz	96.0 KB
0	0	1	1	1	5.461 MHz	21.3 KHz	85.3 KB
0	1	0	0	0	4.915 MHz	19.2 KHz	76.8 KB
0	1	0	0	1	4.468 MHz	17.5 KHz	69.8 KB
0	1	0	1	0	4.096 MHz	16.0 KHz	64.0 KB
0	1	0	1	1	3.780 MHz	14.8 KHz	59.1 KB
0	1	1	0	0	3.511 MHz	13.7 KHz	54.9 KB
0	1	1	0	1	3.277 MHz	12.8 KHz	51.2 KB
0	1	1	1	0	3.072 MHz	12.0 KHz	48.0 KB
0	1	1	1	1	2.891 MHz	11.3 KHz	45.2 KB
1	0	0	0	0	2.731 MHz	10.7 KHz	42.7 KB
1	0	0	0	1	2.587 MHz	10.1 KHz	40.4 KB
1	0	0	1	0	2.458 MHz	9.6 KHz	38.4 KB
1	0	0	1	1	2.341 MHz	9.1 KHz	36.6 KB
1	0	1	0	0	2.234 MHz	8.7 KHz	34.9 KB
1	0	1	0	1	2.137 MHz	8.3 KHz	33.4 KB
1	0	1	1	0	2.048 MHz	8.0 KHz	32.0 KB
1	0	1	1	1	1.966 MHz	7.7 KHz	30.7 KB
1	1	0	0	0	1.890 MHz	7.4 KHz	29.5 KB
1	1	0	0	1	1.820 MHz	7.1 KHz	28.4 KB
1	1	0	1	0	1.755 MHz	6.9 KHz	27.4 KB
1	1	0	1	1	1.695 MHz	6.6 KHz	26.5 KB
1	1	1	0	0	1.638 MHz	6.4 KHz	25.6 KB
1	1	1	0	1	1.586 MHz	6.2 KHz	24.8 KB
1	1	1	1	0	1.536 MHz	6.0 KHz	24.0 KB
1	1	1	1	1	1.489 MHz	5.8 KHz	23.3 KB

8.11. mPD63310 REGISTER (4580-1000H TO 4580-100FH)

The mPD63310 register is assigned as indicated below. For details, refer to the data sheet provided with the mPD63310.

Address	Function	D5	D4	D3	D2	D1	D0
4580-1000H	Address register	Register number					
4580-1008H	Data register	Gain control data					

9. INTERRUPTS AND DMA

This chapter describes the interrupts and DMA for the RTE-V832-PC.

9.1. INTERRUPT

External interrupt	Interrupt signal	Remark
NMI-	NMI	INT0 (dedicated to MONITOR) interrupt signal of PIC
INTP00	INT_AUDIO	Interrupt can be generated when an error occurs.
INTP01	EXTBUS-INT0	Interrupt request from INT0 of EXT-BUS
INTP02	PIC-INT1	Interrupt request from INT1 (USER-released) of PIC
INTP03	PIC-INT0	Interrupt request (dedicated to MONITOR) from INT0 of PIC
INTP10	INT_PRN	Interrupt request from printer IF
INTP11	EXT-BUS INT1	Interrupt request from INT1 of EXT-BUS
INTP12	EXT-BUS INT2	Interrupt request from INT2 of EXT-BUS
INTP13	EXT-BUS INT3	Interrupt request from INT3 of EXT-BUS

- Remarks**
1. All the interrupts, except NMI, are positive logical request signals.
 2. All the signals can be physically separated by using SW3 (they are connected in the factory setting).
 3. All the interrupts from EXT-BUS are inverted and connected to the V832.
 4. Two interrupts (INT0, INT1) can be generated by selecting interrupt requests from the interrupt sources listed below with the interrupt controller (see Section 8.9). INT0 is used for the system (used with the monitor), while INT1 is used for a user application.

Interrupt sources selectable by PIC
Timer 0 (mode 2)
Serial CH#0
Host (PCI communication)
Time-over
Timer 1 (mode 2)
Serial CH#1
Parallel (printer)

9.2. USING NMI

This section describes the method of using NMI for transporting the monitor, for example, to the board. NMI is edge-detected. NMI can be masked by hardware because the interrupt source is a level output. For an explanation of masking, see the description of the INTEN register in Section 8.9. The following procedure applies when an NMI occurs.

- <1> Set the NMIEN of the PIC to 0 to mask the NMI by hardware.
- <2> Check the INTR of the PIC.
- <3> Perform NMI processing for the interrupt source, and clear the request.
- <4> Reset the NMIEN of the PIC to 1 to reset the mask.
- <5> Return from NMI processing.

[Caution] When data is written to a register related to INT0 of NMI, INTP03, and PIC, the monitor may hang up.

9.3. DMA REQUEST

DMARQ-/AK-	DMARQ signal	Remark
CH0	Replay request	A DMA request for data to be written to the audio data buffer during replay. A timeout results in an underrun error.
CH1	Recording request	A DMA request for data to be read from the audio data buffer during recording. A timeout results in an overflow error.
CH2	DMARQ0- request from EXT-BUS	
CH3	DMARQ1- request from EXT-BUS	

Remarks 1. Set DMARQ-/AK-[3..0] to negative logic.

2. CH0 and CH1, JP1, and CH2 and CH3 can be physically separated by using SW4 (they are connected in the factory setting).

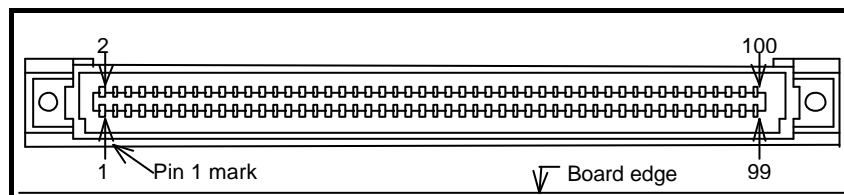
10. EXT-BUS

The JEXT connector is a connector for the EXT-BUS provided to extend the memory or I/O. The local bus of this board is connected to the JEXT connector.

10.1. PIN ARRANGEMENT

Number	Signal name	Number	Signal name	Number	Signal name	Number	Signal name
1	GND	2	+5 V	3	D0	4	D1
5	D2	6	D3	7	GND	8	D4
9	D5	10	D6	11	D7	12	GND
13	D8	14	D9	15	D10	16	D11
17	GND	18	D12	19	D13	20	D14
21	D15	22	GND	23	D16	24	D17
25	D18	26	D19	27	GND	28	D20
29	D21	30	D22	31	D23	32	GND
33	D24	34	D25	35	D26	36	D27
37	GND	38	D28	39	D29	40	D30
41	D31	42	GND	43	+5 V	44	GND
45	Reserve	46	Reserve	47	(A1)	48	A2
49	A3	50	A4	51	GND	52	A5
53	A6	54	A7	55	A8	56	A9
57	A10	58	GND	59	A11	60	A12
61	A13	62	A14	63	A15	64	A16
65	GND	66	A17	67	A18	68	A19
69	A20	70	A21	71	A22	72	A23
73	GND	74	+5 V	75	MRD-	76	Reserve
77	MWR0-	78	MWR1-	79	NWR2-	80	MWR3-
81	IORD-	82	IOWR-	83	GND	84	READY
85	GND	86	INT0-	87	INT1-	88	INT2-
89	INT3-	90	DMARQ0-	91	DMARQ1-	92	DMAAK0-
93	DMAAK1-	94	RESET-	95	32/16BIT-	96	N/C
97	+5 V	98	GND	99	CLK	100	GND

JEXT Connector Pin Arrangement



JEXT Pin Arrangement

10.2. SIGNALS

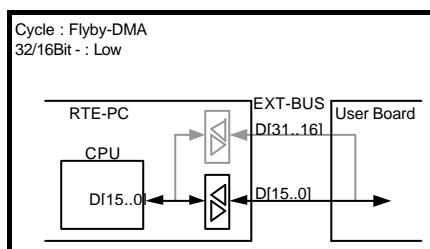
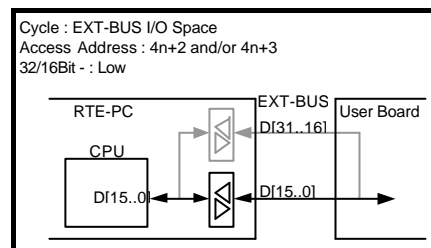
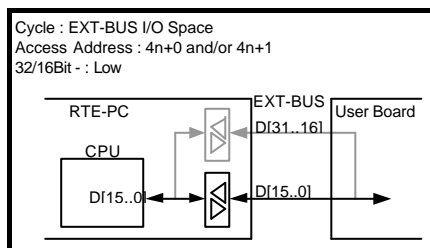
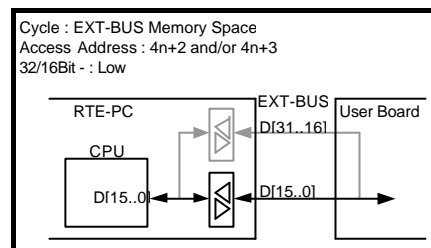
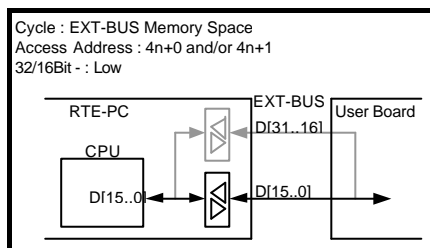
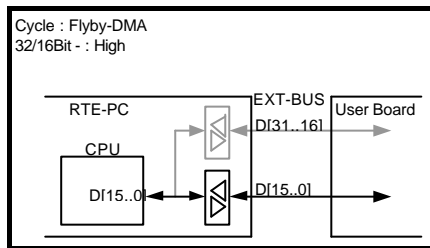
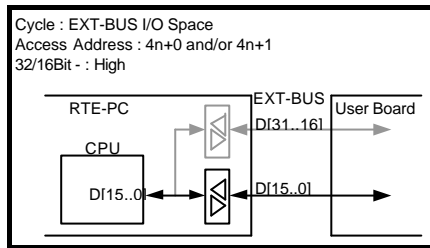
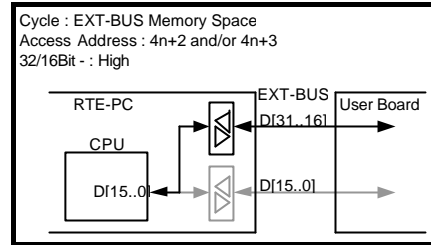
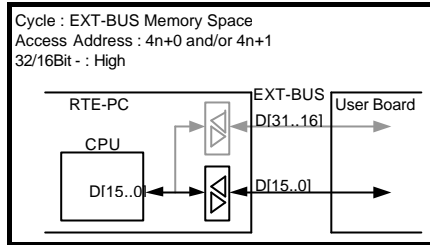
Signal name	Input/output	Function
D[0..31]	Input/output	Data bus signal, connected to the CPU data bus signal via a buffer. It is pulled up with a 10-k Ω resistor on the board.
A[1..23]	Output	Address bus signal, connected to the CPU address signal via a buffer
MRD-	Output	Memory read cycle timing signal, which becomes active only when the EXT-BUS space is accessed.
MWR-[0..3]	Output	Memory write cycle timing signal. MWR0- corresponds to D[0..7], MWR1-, to D[8..15], MWR2-, to D[16..23], and MWR3-, to D[24..31]. This signal becomes active only when the EXT-BUS space is accessed.
IORD-	Output	Timing signal of the I/O read cycle. Asserted active when the EXT-BUS space is accessed or in the flyby DMA cycle (reference).
IOWR-	Output	Timing signal of the I/O write cycle. Asserted active when the EXT-BUS space is accessed or in the flyby DMA cycle (reference).
READY	Input	Signal for notifying the CPU of the end of a cycle. It is valid for the EXT-BUS space. To have the CPU reliably recognize READY, it is necessary to keep READY active until MRD-, MWR-[0..3], IORD-, or IOWR- becomes inactive. It is pulled up with a 10-k Ω resistor on the board.
INT-[0..3]	Input	Active-low interrupt request signal. Connected to the INTP01, INTP11, INTP12, and INTP13 pins of the CPU, respectively, via SW3 after being buffered by the inverter. It is pulled up by a 10 k Ω resistor on the board (see Chapter 9).
DMARQ-[0..1]	Input	Active-low DMA request signals. Connected to the DMARQ2- and DMARQ3- pins of the CPU via SW4 after being buffered. Pulled up by a 10 k Ω resistor on the board (see Chapter 9).
DMAAK-[0..1]	Output	Active-low DMA acknowledge signals. DMAAK0- and DMAAK1- of the CPU are buffered and connected via SW4 (see Chapter 9).
RESET-	Output	Active-low system reset signal
32/16BIT-	Input	When this signal goes low, only D[15..0] are used if the CPU is in the 16-bit data bus mode. If the CPU is in the 32-bit data bus mode, D[15..0] or D[31..16] are used as an address bus (16-bit bus mode). When this signal goes high, D[31..0] of the data bus are used (32-bit bus mode). This signal must not be changed dynamically. It is pulled up by a 10 k Ω resistor on the board.
CLK	Output	Clock signal, connected to the CLKOUT pin of the V832 after a buffer.
Reserve	--	Reserved signal. Connect nothing to this pin when the board uses EXT-BUS.

JEXT Connector Signals

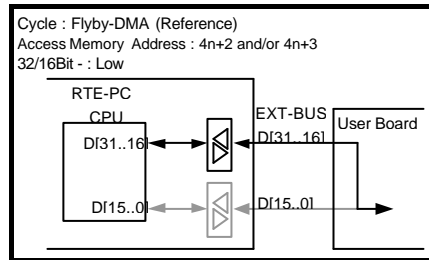
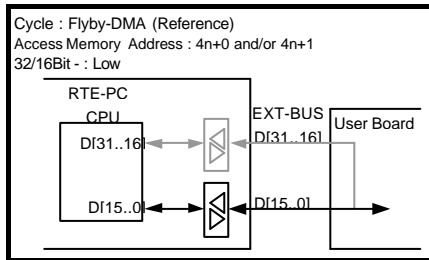
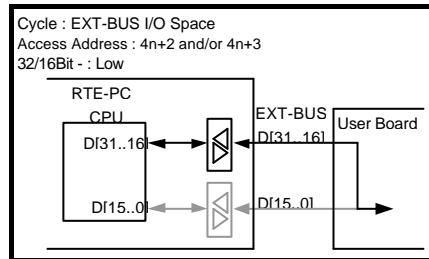
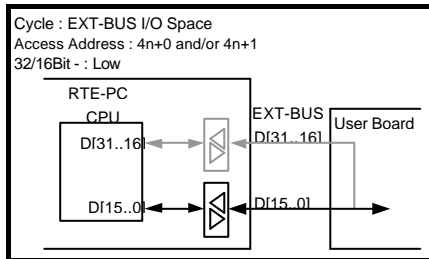
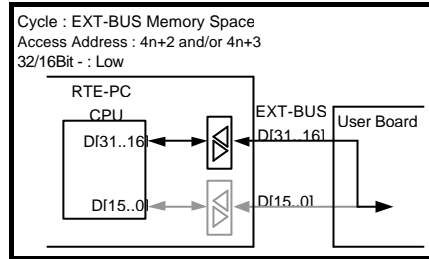
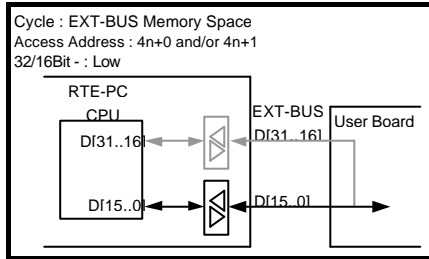
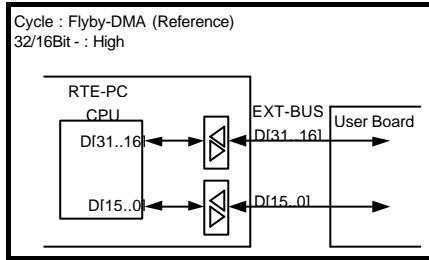
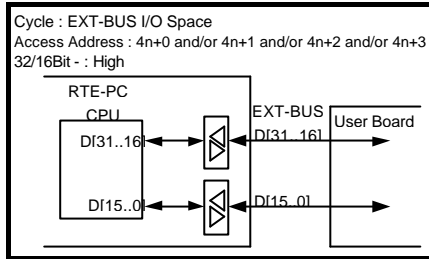
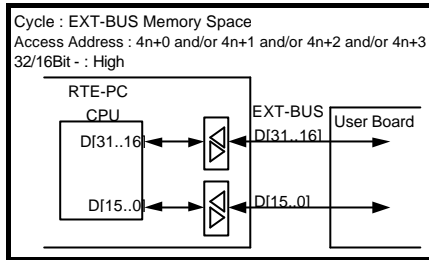
- Cautions**
1. The 32/16BIT- signal will not be supported by all the products of the RTE-PC series in the future. If it is planned to use the board connected to EXT-BUS with a new member of the RTE-PC series, design the board so that it operates in 32-bit bus mode.
When 32/16BIT- is low, MWR2- and MWR3- are not asserted. Instead, MWR0- and MWR1- are asserted.
When 32/16BIT- is low, jumper D[15..0] and D[31..16] on the board connected to EXT-BUS (see Section 10.3).
 2. A1 is valid when the 32/16BIT- signal is low. Therefore, A1 will not be output by future RTE-PC series that do not support the 32/16BIT- signal.
 3. The maximum access bus width in one cycle of the EXT-BUS depends on the bus width of the data bus of the CPU. This does not pose a problem to the V832 because it has a 32-bit data bus. If a 16-bit CPU is used, however, the data size that can be accessed at any one time is limited to a maximum of 16 bits. This must be taken into consideration when designing a general-purpose board that is to be used with this bus.
 4. The DMA function will not be supported by all members of the RTE-PC series in the future.

10.3. CONNECTION OF DATA BUS

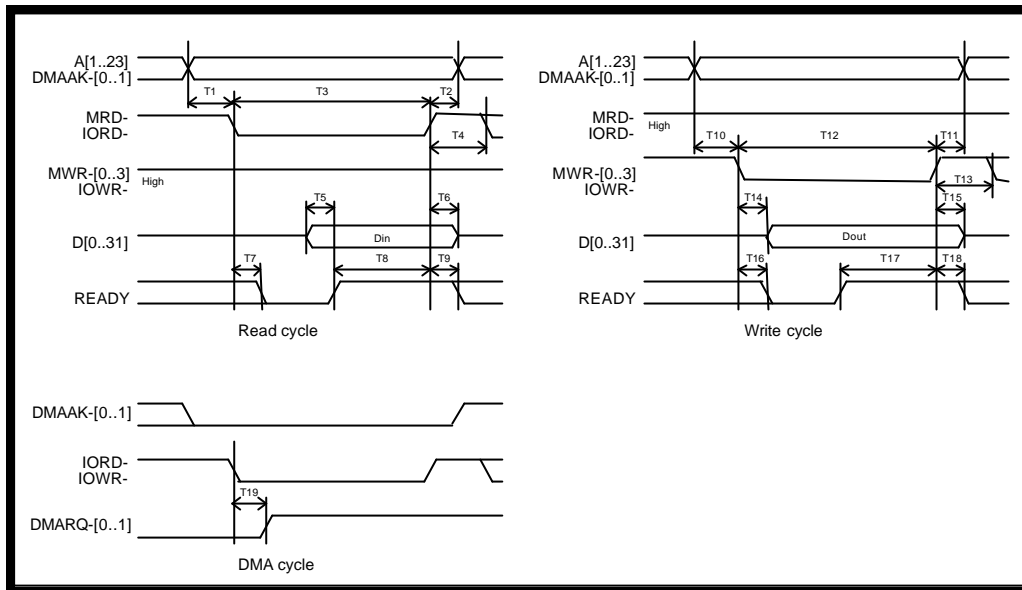
10.3.1. 16-Bit Data Bus CPU (Reference)



10.3.2. 32-Bit Data Bus CPU (with V832)



10.4. TIMING



EXT-BUS Cycle

Symbol	Description	Min. (ns)	Max. (ns)
T1	ADDR, DMAAK- → MRD-, IORD- setup time	10	
T2	MRD-, IORD- → ADDR, DMAAK- hold time	10	
T3	MRD-, IORD- cycle time	50	
T4	MRD-, IORD- cycle interval	20	
T5	RD DATA → RD READY setup time	0	
T6	MRD-, IORD- → RD DATA hold time	0	
T7	MRD-, IORD- → RD READY delay time		20
T8	RD READY → MRD-, IORD- delay time	15	
T9	MRD-, IORD- → RD READY hold time	0	
T10	ADDR, DMAAK- → MWR-, IOWR- setup time	10	
T11	MWR-, IOWR- → ADDR, DMAAK- hold time	10	
T12	MWR-, IOWR- cycle time	50	
T13	MWR-, IOWR- cycle interval	20	
T14	MWR-, IOWR- → WR DATA delay time		20
T15	MWR-, IOWR- → WR DATA hold time	10	
T16	MWR-, IOWR- → WR READY delay time		20
T17	WR READY → MWR-, IOWR- delay time	0	
T18	MWR-, IOWR-, → WR READY hold time	0	
T19	IORD-, IOWR- → DMARQ- inactive delay time		xx

EXT-BUS AC Specifications

10.5. APPLICABLE CONNECTORS

The connectors used for EXT-BUS and the connectors that can be connected to those connectors are listed below. If EXT-BUS is connected to multiple boards, use a cable to make a daisy-chain connection.

EXT-BUS connector	: KEL 8830E-100-170S
Applicable connector (for board)	: KEL 8802-100-170S
Applicable connector (for cable)	: KEL 8825E-100-175
Right angle for cable (for board)	: KEL 8830E-100-170L KEL 8831E-100-170L

10.6. NOTES ON USE

The following points must be noted when designing the board that is to be connected to EXT-BUS.

1. When two or more boards are connected to EXT-BUS, Hi-Z control must be performed so that the READY signal is driven only when a board is selected.
2. T7 and T16 must be satisfied to insert a wait state into the cycles of EXT-BUS. To do so, control with the normal not ready technique (that retains the not ready status normally and returns ready when an access takes place and the slave device is ready) is recommended.
3. When executing a DMA cycle in single transfer mode, T19 in the timing chart must be satisfied if the next DMA cycle is not to be generated. However, T19 differs among the products because it is heavily dependent upon the specifications of the DMA controller.
4. Because there is not an enough space to access the 16M-byte I/O space of EXT-BUS with RTE-V832-PC, the high-order two bits (A23 and A22) are accessed by the outputs from the EXT-IO high-order address setting register #1 port. For details of this port, see Section 8.6.

11. SOFTWARE

This chapter describes the initialization of the hardware of the RTE-V832-PC board, and explains how to use peripheral devices.

11.1. INITIALIZATION

The boot routine initializes the bus controller built into the V832 for external memory or I/O access as follows.

Bus clock: 33 MHz Max.

Register	Internal I/O address	Set value	Size	Remarks
BCTC	C000-0010H	22H	byte	
DBC	C000-0012H	00H (43H)	byte	() indicates the set value when SW2-1 (BSIZE32) is ON(0).
PWC0	C000-0014H	7000H	half-word	
PWC1	C000-0016H	4000H	half-word	
PIC0	C000-0100H	0000H	half-word	
PIC1	C000-0102H	0000H	half-word	
SDC	C000-0020H	9401H	half-word	
RFC	C000-0022H	0102H 8102H	half-word	First time: 33MHz >> 11.5 μ s Second time: Refresh Enable
PAC	C000_00F4	FFH	byte	Port A: select DMACont sig.
PBC	C000_00FA	FFH	byte	Port B: select INTPxx

Bus clock: 33 MHz Min.

Register	Internal I/O address	Set value	Size	Remarks
BCTC	C000-0010H	22H	byte	
DBC	C000-0012H	00H (43H)	byte	() indicates the set value when SW2-1 (BSIZE32-) is ON(0).
PWC0	C000-0014H	7200H	half-word	
PWC1	C000-0016H	7111H	half-word	
PIC0	C000-0100H	0000H	half-word	
PIC1	C000-0102H	0000H	half-word	
SDC	C000-0110H	941AH	half-word	
RFC	C000-0022H	0104H 8104H	half-word	First time: 47.6MHz >> 13.4 μ s Second time: Refresh Enable
PAC	C000_00F4	FFH	byte	Port A: select DMACont sig.
PBC	C000_00FA	FFH	byte	Port B: select INTPxx

For detailed information about the registers, refer to the manual provided with the V832 CPU.

11.2. LIBRARIES

Libraries are required for programming using the C compiler for I/O accesses and other purposes. However, the methods of writing these libraries and passing their parameters described below are specific to the MULTI. So, modifications may be required, for example, when another compiler is used.

```
/* I/O library */

/* GHS V800 compiler parameter passing */
/* arg0 : r6, arg1 : r7, arg2 : r8, return : r10 */

inb(int addr) /* Byte (8 bits) input */
{
    __asm(" in.b 0[r6], r10");
}

inh(int addr) /* Half-word (16 bits) input */
{
    __asm(" in.h 0[r6], r10");
}

inw(int addr) /* Word (32 bits) input */
{
    __asm(" in.w 0[r6], r10");
}

outb(int addr, int data) /* Byte (8 bits) output */
{
    __asm(" out.b r7, 0[r6]");
}

outh(int addr, int data) /* Half-word (16 bits) output */
{
    __asm(" out.h r7, 0[r6]");
}

outw(int addr, int data) /* Word (32 bits) output */
{
    __asm(" out.w r7, 0[r6]");
}
```

11.3. USING TIMERS

A sample time measurement is indicated below which uses timer 1 and timer 2 cascaded with each other by an external timer (8254) on the board. Timer 1 is initialized as an interval counter (mode 2), and timer 2 is initialized as a down counter (mode 0). By determining the counter values before and after a routine whose execution time is to be measured, the execution time can be calculated. Note that both timers function as down counters. Note also that command recovery (dummy read from the ROM area) is required for successive accesses to the external timer.

```

/* Sample execution time measurement using timers */

#define TIMERCLK    2000000                                /* 2MHz */
#define INTERVAL   (TIMERCLK * 10 / 1000)                /* 10 ms (1/100) */
#define IOWAIT()   (*(char *)0x4PFF0000)                 /* For I/O command recovery */

InitTimer()                                               /* Timer initialization */
{
    outb(0x4500B00C, 0x74);                               IOWAIT();        /* Timer 1 set to mode 2 */
    outb(0x4500B004, INTERVAL);                           IOWAIT();        /* Lower digit count of timer 1 */
    outb(0x4500B004, INTERVAL / 256);                     IOWAIT();        /* Higher digit count of timer 1 */
    outb(0x4500B00C, 0xB0);                               IOWAIT();        /* Timer 2 set to mode 0 */
    outb(0x4500B008, 0xFF);                               IOWAIT();        /* Lower digit count of timer 2 */
    outb(0x4500B008, 0xFF);                               IOWAIT();        /* Higher digit count of timer 2 */
    return 0;
}

LatchTimer()                                              /* Count Latch */
{
    int count1, count2, counts;

    outb(0x4500B00C, 0xDC);                               IOWAIT();        /* Timer 1/2 multiple latch */
    count1 = inb(0x4500B004);                             IOWAIT();
    count1 += inb(0x4500B004) * 256;                       IOWAIT();        /* Count of timer 1 */
    count2 = inb(0x4500B008);                             IOWAIT();
    count2 += inb(0x4500B008) * 256;                       IOWAIT();        /* Count of timer 2 */
    counts = INTERVAL * (0xFFFF - count2)
            + (INTERVAL - count1);
    return counts;
}

double total_time;

main()
{
    int start_count, stop_count;

    InitTimer();
    start_count = LatchTimer();                             /* Start count value */
    func();
    stop_count = LatchTimer();                             /* Stop count value */
    total_time = (double)(stop_count - start_count)
                / (double)TIMERCLK;                       /* Seconds */

    return 0;
}
#include <time.h>
func()             /* Time measurement routine */
{
    ...
}

```

11.4. AUDIO I/O

A sample program using the audio input/output interface mounted on the board is indicated below. For data input/output, the DMA built into the V832 is used.

```

/* Audio input/output sample */

#define DMA0          0xC0000030      /* Built-in DMA ch0 (replay) */
#define DMA1          0xC0000040      /* Built-in DMA ch1 (recording) */
#define AUDIO_DATA    0x45802000     /* Audio data (FIFO) */

static Set63310Reg(int reg, int data)/* Set nPD63310 register */
{
    outb(0x45801000, reg);           /* Write address register */
    outb(0x45801008, data);         /* Write data register
    return 0;
}

static Get63310Reg(int reg)          /* Acquire nPD63310 register */
{
    outb(0x45801000, reg);           /* Write address register */
    return inb(0x45801008) & 0x3F;   /* Read data register (6 bits) */
}

AudioInit()                          /* Audio initialization */
{
    outh(0x45800000, 0x8000);         /* Reset audio */
    outh(0x45800010, 8);              /* fs = 12 kHz */
    inh(0x45800010);                 /* Dummy read */
    outh(0x45800000, 0);              /* Reset clear */
    Set63310Reg( 0, 0);               /* IN1L 0db */
    Set63310Reg( 1, 0);               /* IN1R 0db */
    Set63310Reg(17, 0);              /* OUTDACL 0db*/
    Set63310Reg(18, 0);              /* OUTDACR 0db */
    return 0;
}

AudioTerm();                          /* Audio termination processing */
{
    Set63310Reg( 0, 0x20);            /* IN1L mute */
    Set63310Reg( 1, 0x20);            /* IN1R mute */
    Set63310Reg(17, 0x20);            /* INDACL mute */
    Set63310Reg(18, 0x20);            /* INDACR mute */
    outh(0x45800000, 0);              /* Stop command */
    return 0;
}

AudioPlay(int addr, int size)         /* Use replay processing DMA0 */
{
    outh(DMA0 + 0, addr >> 16);      /* DMA-DSA0H */
    outh(DMA0 + 2, addr);              /* DMA-DSA0L */
    outh(DMA0 + 4, AUDIO_DATA >> 16); /* DMA-DDA0H */
    outh(DMA0 + 6, AUDIO_DATA);        /* DMA-DDA0L */
    size = (size / 2 - 1) * 2;         /* DMA transfer count */
    outh(DMA0 + 8, size >> 16);        /* DMA-DBC0H */
    outh(DMA0 + 10, size);             /* DMA-DBC0L */
    outh(DMA0 + 12, (0<<12)           /* DMA-DCHC0
                    | (1<<10)         /*
                    | (0<<8)          /*
                    | (2<<6)          /*
                    | (0<<5)          /*
                    | (0<<4)          /*
                    | (1<<3)          /*
                    | (1<<1)          /*
                    | 1);             /*
    outh(0x45800000, 0x0001);         /* Start replay */
    while ((inh(DMA0 + 12) & 1) != 0) /* Wait for DMA termination */
        ;
    while ((inh(0x45800008) & 0x10) == 0) /* Wait for FIFO empty */
        ;
    outh(0x45800000, 0);              /* Replay termination */
}

```



```

    return 0;
}

AudioRecord(int addr, int size) /* Use record processing DMA1 */
{
    outh(DMA1 + 0, AUDIO_DATA >> 16); /* DMA-DSA1H */
    outh(DMA1 + 2, AUDIO_DATA); /* DMA-DSA1L */
    outh(DMA1 + 4, addr >> 16); /* DMA-DDA1H */
    outh(DMA1 + 6, addr); /* DMA-DDA1L */
    size = (size / 2 - 1) * 2; /* DMA transfer count */
    outh(DMA1 + 8, size >> 16); /* DMA-DBC1H */
    outh(DMA1 + 10, size); /* DMA-DBC1L */
    outh(DMA1 + 12, (0<<12) /* DMA-DCHC1 TYP (DMARQ) */
                | (2<<10) /* TBT I/O->MEM */
                | (2<<8) /* SAD fix */
                | (0<<6) /* DAD inc */
                | (0<<5) /* DAL Low */
                | (0<<4) /* DRL Low */
                | (1<<3) /* TM demand */
                | (1<<1) /* DS half-word */
                | 1); /* Enable */

    outh(0x45800000, 0x100); /* Start recording */
    while ((inh(DMA1 + 12) & 1) != 0)
        ; /* Wait for DMA termination */
    outh(0x45800000, 0); /* Recording termination */
    return 0;
}

#define COUNT 0x10000 /* L/R data sample count */

int buffer[COUNT]; /* L/R data buffer */

main()
{
    inb(0xC000006E);
    outb(0xC000006E, 1); /* DMA-DC MEM=1 */
    AudioInit(); /* Initialization */
    AudioRecord((int)buffer, sizeof(buffer)); /* Recording */
    AudioPlay ((int)buffer, sizeof(buffer)); /* Replay */
    AudioTerm(); /* Termination */
    return 0;
}

```

Audio data consists of 16-bit data for each of Lch (left) and Rch (right). Data is to be input and output, in order, from L1 to R1 to L2 to R2 and so forth for both recording and replay.

[Caution] When recording/playing back, set the status in which Multi timer is not used (set both SW1-3 and SW1-4 to ON). If a timer interrupt occurs, a voice overrun/underrun error may occur.

12. DEVELOPMENT OF APPLICATIONS USING MASKABLE INTERRUPTS

This chapter describes the methods of developing an application on the RTE-V832-PC by using a maskable interrupt, and related restrictions.

12.1. INTERRUPT VECTOR

The V832 interrupt vector area of addresses FFFF-FE00H to FFFF-FFFFH is fixed in the ROM, and cannot be rewritten. So, for the NEC monitor, an alternate vector area is allocated in the SRAM; in a vector at addresses FFFF-FE00H to FFFF-FFFFH, an instruction for causing a branch to the alternate vector area is placed. If, for example, an interrupt with exception code FE00H is generated, the CPU interrupt function causes a branch to address FFFF-FE00H, where an instruction for causing a branch to the corresponding alternate vector area is placed. This means that, by rewriting the alternate vector area in the same way as with the original vector area, a branch to the user program interrupt handling routine can be caused when an interrupt is generated.

The difference from an ordinary V832 program is that a vector area is fixed in ROM, and no rewriting by a program is required. However, a program running on the monitor must rewrite the alternate vector area to enable an interrupt.

With the monitor of the RTE-V832-PC, an alternate vector area is allocated at FE07-0000H to FE07-01FFH in SRAM. So, for an interrupt with exception code FE00H, an instruction for causing a branch to the interrupt handling routine is to be written at address FE07-0000H; for an interrupt with exception code FE10H, an instruction for causing a branch to the interrupt handling routine is to be written at address FE07-0010H, and so forth. Moreover, the V832 CPU contains cache memory, so that the cache must be cleared after the vector is rewritten. Otherwise, an instruction may be executed before rewriting.

A sample program for alternate vector rewriting is given below (when the relative address from the interrupt handling routine to an alternate vector area is within 26 bits).

```

#define VECT_CPU  0xfffffe00                /* Start of CPU interrupt vector */
#define VECT_RAM  0xfe070000                /* Start of alternate interrupt vector */
#define VECT(n)   ((VECT_CPU - n) + VECT_RAM) /* Find interrupt vector address */

main()
{
    extern void __interrupt IntEntry();      /* Interrupt handling routine */
    int addr, ofs, inst;

    /* Allocation of alternate vector address for 0xfffffe30 of CPU vector,
       and creation of JR dest26 instruction for branching to interrupt handling routine */
    addr = VECT(0xfffffe30);
    ofs = (int)IntEntry - addr;
    inst = 0xa8000000 | (ofs & 0x3fffffe);   /* 32-bit instruction JR dest26 */

    /* Vector replacement */
    di();                                    /* Interrupt disable __asm("di"); */
    *((unsigned short*)(addr + 0)) = (inst >> 16) & 0xffff; /* Higher 16-bit code */
    *((unsigned short*)(addr + 2)) = (inst & 0xffff);        /* Lower 16-bit code */
    outw(0xFFFFFFFF4, 3);                    /* Clear cache */

    /* Interrupt device initialization, etc. */
    .....
    ei();                                    /* Interrupt enable __asm("ei"); */
    .....
}

```

12.2. INTERNAL INSTRUCTION RAM

With the V832, a maskable interrupt vector can be placed in the internal RAM (IHA bit of the HCCW system register). When this function is used, the vector setting requirement does not differ between an ordinary V832 program and a program using the monitor on the RTE-V832-PC.

For an explanation of the method of vector usage with the internal instruction RAM and that of modifying the contents of the internal instruction RAM, refer to the manual provided with the CPU.

When a program is placed in the internal instruction RAM for purposes including interrupt handling, the user is required to pay careful attention to the compiled object codes. For the switch-case statement of C, in particular, a jump table is created in the instruction code, and a code for causing a branch by referencing the table may be generated. Such a reference to the table is made with the LD instruction. However, the internal instruction RAM cannot be referenced by the LD instruction, so that the program may perform an unpredictable operation.

12.3. GENERAL RESTRICTIONS/NOTES

This section describes restrictions and notes relating to the debugging of an application using a maskable interrupt.

- 1) If an interrupt is generated before alternate vector setting, or if an interrupt is generated with other than a valid alternate vector set, a break occurs at the point where the interrupt is generated. This is because the initial value of the alternate vector is an instruction for causing a branch to the break handling routine of the monitor ROM.
- 2) If the relative address from an alternate vector area to the interrupt handling routine exceeds 26 bits, the contents of at least one register must be destroyed, or a branch relay point must be created, to cause a branch to the interrupt handling routine.
- 3) An alternate vector area is protected as a ROM monitor management area, so that the area cannot be rewritten by downloading a program. The user may consider the use of the following method; that is, a vector area is defined as an independent section in the source program, and such an area is assigned as an alternate vector area by a link-time parameter. This method cannot be used, however, because downloading will invariably fail.
- 4) Immediately after rewriting an alternate vector area, always flush the cache memory in the CPU. Otherwise, a vector existing before alternate vector rewriting may be used.
- 5) All peripherals, including interrupt-related peripherals, can be initialized only with the reset switch on the board. This means that if, after a program is executed, another program is loaded, the peripherals will still be in the statuses set by the previous program. So, use the procedure below when, after executing a program that uses a peripheral, another program is to be loaded and executed.
 - (1) For resetting, press the reset switch of the RTE-V832-PC.
 - (2) Load and execute another program.
- 6) Before setting the EI (interrupt enable) state, set the DI (interrupt disable) state at the start of program execution, then set the peripherals and vectors.

12.4. RESTRICTIONS ON BREAK POINTS IN THE INTERRUPT HANDLING

The following restrictions are imposed on breaks in the interrupt handling routine:

- 1) During a break, all maskable interrupts are rejected.
- 2) The single step function sets a temporary breakpoint in the next instruction. So, when a user program placed in the EI (interrupt enable) state is subject to single stepping, an interrupt is accepted even during single stepping.
- 3) After a break in the interrupt handling routine, exiting from the interrupt handling routine by single stepping is impossible. (Specifically, single stepping based on the last ")" of the interrupt handling routine is disabled.) Similarly, IRET instruction single stepping is impossible.
- 4) The Return function of the debugger does not support return from an interrupt handling routine to the original routine.

13. APPENDIX A MULTI MONITOR

This chapter describes how to make the settings required to establish a connection between the Multi monitor stored in ROM and the Multi debugger on the host. It also provides notes on the use of the Multi monitor.

13.1. BOARD SETTING

13.1.1. RTE for Win 32 Installation

When the board is used with the Multi debugger, communication software called RTE for Win32 must be installed in the PC. Refer to the RTE for Win32 Installation Manual (supplied with this product) for installation and test methods.

13.1.2. SW1 Setting

SW1 is a switch for general-purpose input ports. For the Multi monitor in the factory-installed ROM, SW1 is used as shown below.

SW1	1	2	Baud rate
Setting	ON	ON	Not used
	OFF	ON	38400 baud
	ON	OFF	19200 baud
	OFF	OFF	9600 baud (Factory-set)

Baud Rate Setting

SW1	3	4	Profiler period
Setting	ON	ON	Timer is not used.
	OFF	ON	200 Hz 5 ms
	ON	OFF	100 Hz 10 ms
	OFF	OFF	60 Hz 16.67 ms (Factory-set)

Profiler Period Setting

SW1	5	Debug mode
Setting	ON	7-segment LED used by the monitor
	OFF	Normal use state (Factory-set)

Debug Mode Setting

SW1	6	Break interrupt
Setting	ON	INTP3 used (Factory-set)
	OFF	NMI used

Break Interrupt Setting

SW1-7 and SW1-8 are not used with the Multi monitor.

13.1.3. Connection of Board

Connect the board to the PC by using either the serial or PCI bus, by referring to Chapter 6.

13.2. MULTI MONITOR

13.2.1. Monitor Work RAM

The monitor uses the first 64K bytes area in the SRAM as work RAM. In other words, user programs are not allowed to use logical addresses FE07-0000H to FE07-FFFFH.

13.2.2. Interrupt

When using an interrupt with a user program, see Chapter 12.

13.2.3. Interrupt for Forced Break

NMI or INTP03 can be selected as an interrupt to be used by the monitor for a communication, forced break (the Halt button for the Multi debugger), or a timer (such as profiler). INTP03 is to be selected when a program using the DMA is used (for audio input/output, for example). In other cases, the use of NMI is recommended. The differences between the two interrupts are listed below.

When NMI is used

A break can occur at any time during user program execution. If, however, a break occurs during DMA operation, the DMA is also terminated. (The DMA does not restart even upon reexecution.)

When INTP03 is used

No break will occur if the user program uses an interrupt with a higher priority than INTP03, or if interrupts are disabled. DMA operation is continued even during a break.

13.2.4. _INIT_SP Setting

_INIT_SP (stack pointer initial value) is set to FE06-FFF0H (highest SRAM address) by the monitor. (_INIT_SP can be changed in the Multi debugger environment.)

13.2.5. Remote Connection

Either serial or PCI bus connection can be selected to connect the monitor with the Multi debugger. To switch from serial connection to PCI bus connection or vice versa, it is necessary to reset the monitor (by pressing the reset switch on the rear panel) and run the Check RTE32.exe utility of RTE for Win32.

13.2.6. Monitor Execution Area

The 128K-byte ROM contains two codes; the lower 64K-byte area contains the code to be executed in the cacheable area, while the higher 64K-byte area contains the code to be executed in the uncacheable area.

To enable a program to be downloaded at higher speed, select the cacheable area.

Note that monitor intervention (including profile timer operation) temporarily flushes the cache used during user program execution, so that data obtained from profile measurements may have a larger error. To prevent this from occurring, select the uncacheable area.

The use of the cacheable area is factory-set (with SW2-8 on).

13.2.7. Special Instruction

The monitor uses the following instruction for single step, breakpoint, and system call functions.

BRKPNT instruction (0x6cxx)

Do not use a code that may be interpreted as a break instruction in the user program.

13.3. RTE COMMANDS

When the monitor and server are connected, the TARGET window is opened. The RTE commands can be issued in this window. The following table lists the RTE commands.

Command	Description
HELP, ?	Displays help messages.
INIT	Initializes.
VER	Displays the version number.
INB, INH, or INW	I/O read
OUTB, OUTH, OUTW	I/O write
DCTR, ICTR, PLLCR, CMCR	Changes or displays the internal registers.
SFR	Displays or sets the internal I/O.

RTE Commands

Some commands require parameters. All numeric parameters such as addresses and data are assumed to be hexadecimal numbers. The following numeric representations are invalid:

0x1234 1234H \$1234

13.3.1. HELP(?)

<Format> HELP [command-name]

Displays a list of RTE commands and their formats. A question mark (?) can also be used in place of the character string HELP. If no command name is specified in the parameter part, the HELP command lists all usable commands.

<Example> HELP SFR

Displays help messages for the SFR command.

13.3.2. INIT

<Format> INIT

Initializes the RTE environment. Usually, this command should not be used.

13.3.3. VER

<Format> VER

Displays the version number of the current RTE environment.

13.3.4. INB, INH, INW

<Format> INB [address]

INH [address]

INW [address]

Reads from an I/O register. The INB, INH, and INW commands access in byte, halfword, and word units, respectively. If an address is omitted, the previous address is assumed.

<Example> INB 1000

Reads a byte from an I/O register at 1000H.

13.3.5. OUTB, OUTH, OUTW

<Format> OUTB [[address] data]
 OUTH [[address] data]
 OUTW [[address] data]

Writes to an I/O register. The OUTB, OUTH, and OUTW commands access in byte, halfword, and word units, respectively. If an address or data is omitted, the previous address or data is assumed.

<Example> OUTH 2000 55AA

Writes the halfword 55AAH to the I/O register at 2000H.

13.3.6. DCTR Command

<Format> DCTR [ALL]

Displays the contents of DCTR registers. There are 256 DCTR registers. Among these 256 registers, the contents of the registers whose valid bit is on are displayed except when ALL is specified. If ALL is specified, the contents of all DCTR registers are displayed. The DCTR registers are mapped on the I/O space f2000000h-f2000fffh.

13.3.7. ICTR Command

<Format> ICTR [ALL]

Displays the contents of ICTR registers. There are 128 ICTR registers. Among these 128 registers, the contents of the registers whose valid bit is on are displayed except when ALL is specified. If ALL is specified, the contents of all ICTR registers are displayed. The ICTR registers are mapped on the I/O space fa000000h-fa000fffh.

13.3.8. PLLCR Command

<Format> PLLCR

Displays the value of the PLLCR register.

13.3.9. CMCR Command

<Format> CMCR [=] VALUE

Specifies a value in the cache memory control register (CMCR).

13.3.10. SFR Command

<Format> SFR [register-name [=data]]

When a register name is specified with data omitted, the data read from the register is displayed. When a register name is specified, and data is specified after =, the data is written to the register. The size of data is automatically determined according to the valid size of the specified register. For details of the internal I/O registers, refer to the manual provided with the V832 CPU.

<Example 1> SFR

A list of registers is displayed.

<Example 2> SFR IMR

The contents of the IMR register are displayed.

<Example 3> SFR IMR=55AA

Data 55AAH is written into the IMR register.

14. APPENDIX B PARTNER MONITOR

This chapter describes how to make the settings required to establish a connection between the PARTNER monitor stored in ROM and the PARTNER on the host. It also provides notes on the use of the PARTNER monitor.

14.1. BOARD SETTING

14.1.1. SW1 Setting

SW1 is a switch for general-purpose input ports. For the PARTNER monitor in the factory-installed ROM, SW1 is used as shown below.

SW1	1	2	Baud rate
Setting	ON	ON	115200 baud
	OFF	ON	38400 baud
	ON	OFF	19200 baud
	OFF	OFF	9600 baud (Factory-set)

Baud Rate Setting

SW1	3	4	Timer
Setting	ON	ON	Always use this switch in this status. (Factory-set)

SW1	5	Debug mode
Setting	ON	7-segment LED used by the monitor
	OFF	Normal use state (Factory-set)

Debug Mode Setting

SW1	6	Break interrupt
Setting	ON	INTP3 used (Factory-set)
	OFF	NMI used

Break Interrupt Setting

SW1-7 and SW1-8 are not used.

14.2. PARTNER MONITOR

14.2.1. Monitor Work RAM

The monitor uses the first 64K bytes area in the SRAM as work RAM. In other words, user programs are not allowed to use logical addresses FE07-0000H to FE07-FFFFH.

14.2.2. Interrupt

When using an interrupt with a user program, see Chapter 12.

14.2.3. Interrupt for Forced Break

NMI or INTP03 can be selected as an interrupt to be used by the monitor for communications and a forced break (the ESC button). INTP03 is to be selected when a program using the DMA is used (for audio input/output, for example). In other cases, the use of NMI is recommended. The differences between the two interrupts are listed below.

When NMI is used

A break can occur at any time during user program execution. If, however, a break occurs during DMA operation, the DMA is also terminated. (The DMA does not restart even upon reexecution.)

When INTP03 is used

No break will occur if the user program uses an interrupt with a higher priority than INTP03, or if interrupts are disabled. DMA operation is continued even during a break.

14.2.4. SP Setting

The stack pointer initial value is set to FE06-FFF0H (highest SRAM address) by the monitor. The monitor uses a 32-byte stack area set by the user program.

14.2.5. Remote Connection

Serial connection or PCI bus connection can be selected for connection of the debugger. To change the connection from one to another, reset the monitor (press the reset switch on the rear panel), and start RPTSETUP.exe to change the communication path.

14.2.6. Monitor Execution Area

The 128K-byte ROM contains two codes; the lower 64K-byte area contains the code to be executed in the cacheable area, while the higher 64K-byte area contains the code to be executed in the uncacheable area.

If the monitor is executed in the cacheable area, the monitor execution speed is faster. So, the program is downloaded at a higher speed. Normally, use the cacheable area (the area is factory-set). The use of the cacheable area is factory-set (with SW2-8 on).

14.2.7. Special Instruction

The monitor uses the following instruction for the single step, breakpoint, and system call functions.

BRKPNT instruction (0x6cxx)

Do not use a code that may be interpreted as a break instruction in the user program.

- Memo -

RTE-V832-PC User's Manual

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