BUF(PC)E

Buf Extension Adapter Set
for ISA(AT) Bus

User's Guide

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INTRODUCTION

Thank you for purchasing the BUF(PC)E. The BUF(PC)E is an expansion bus adapter that expands expansion slots by connecting the CONTEC AT bus chassis (FA-PAC series) to the computer.

The BUF(PC)E is composed of:
• BUS-PC(PC)E: installed to the computer.
• BUS-PAC(PC)E: installed to the CONTEC AT bus chassis (FA-PAC series).
• Cable for connection between these two boards.

In addition to the above, the optional AT bus chassis (FA-PAC series) is required to use the products listed above.

Features

• By connecting the FA-PAC series to the computer with the BUF(PC)E, the expansion slot in the FA-PAC can be used as a regular expansion slot.
• By setting the switches on the BUS-PC(PC), you can set the following:
a) Set a window area for the memory board in the FA-PAC. When memory is accessed, the data bus gate is opened or closed.
b) Enable or disable interrupt signals (IRQ3-7, 9-12, 14, 15).
c) Place 0-7 memory waits or I/O wait.

Composition of This Manual

This manual consists of the following sections: Board Set-up, Specifications and Appendix.

"Board Set-up" contains the information to set-up the boards and install them into the computer.

"Specifications" contains the specifications of this product and conditions.

Limited Three Year Warranty

CONTEC Interface boards are warranted by CONTEC MICRO-ELECTRONICS, U.S.A., Inc. to be free from defects in material and workmanship for up to three year from the date of purchase by the original purchaser.

Replacement or repair will be free of charge only when this device is returned to CONTEC U.S.A., and freight prepaid with an original invoice.

This warranty is not applicable for scratches or normal wear, but only for the electronic circuitry and original boards. It is also not applicable if the device has been tampered with or damaged through abuse, mistreatment, neglect or unreasonable use, or if the original invoice is not included, in which case repairs will be considered beyond the warranty policy. If a replacement with a new device is needed, regular factory prices will be charged, and the product will be returned to you COD, and no other written warranty will apply.

The obligation of the warrantor is solely to repair or replace the product. In no event will the warrantor be liable for any incidental or consequential damages due to such defect or consequences that arise from inexperienced usage, misuse, or malfunction of this device.

How to Obtain Service

For replacement or repair, return the device freight prepaid, with a copy of the original invoice. Please obtain a Return Merchandise Authorization Number (RMA) from our Sales Administration before returning any product No. product will be accepted without an RMA number.

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2188 Bering Drive
San Jose, CA 95131

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           (408) 434-6767
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Cautions

Follow these precautions when handling the board.

• Protect from physical shock. Do not bend the board.

• Do not modify the board. CONTEC does not guarantee the operation of a modified board and is not liable for any damage caused by modification.

• Do not touch the metal terminals (edge connectors) as this may impair the connection. If you have touched a terminal, wipe it with alcohol.

• The board has jumpers and switches. Check the settings of these jumpers and switches before installing the board.

• Set the jumpers and switches properly. Improper setting may cause board malfunction.

• The board must be installed in the proper slot of the computer or in the CONTEC AT bus chassis (FA-PAC series).

• Do not insert or remove while the power of the computer is turned on. Turn off the power of the computer before installing or removing the board. To install or remove the board in the FA-PAC, turn off the power of the unit before installing or removing the board.

• The power consumption total of boards in the computer should not exceed the computer's rated power consumption. If power consumption exceeds the rated power consumption of the computer, use an FA-PAC.

• FA-PAC may limit the type of boards. The following boards cannot be used in the FA-PAC.
(1) A board that uses an external CPU or external DMA.
    (A board that uses the DMA of the computer can be used.)
(2) A board that expands the FA-PAC

• If the computer has specifications stating that a certain board cannot be used in the computer, then that board cannot be used in the FA-PAC.

• Do not exceed the rated external power voltage and drive current.

BOARD SET-UP

BUS-PC(PC)E

Component Location
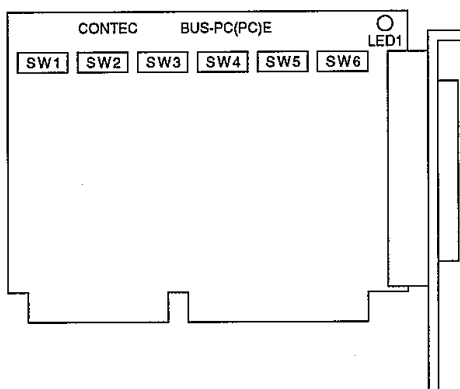
Figure 1. BUS-PC(PC)E Board

DIP switches
SW1 : Sets the upper limit of the memory address (unit: 010000H)
SW2 : Sets the lower limit of the memory address (unit: 010000H)
SW3 : Set the segment and access specification for the memory
      inserted in the FA-PAC.
SW4,5: Enables/disables an interrupt signal from the board in the
      FA-PAC.
SW6 : Sets the waits for memory access and I/O access.

LEDs
LED1 : Turns on when the power is turned on.

DIP Switches (SW1 - SW3)

These DIP switches set the window area of the memory board in the FA-PAC. (These DIP switches are not used for I/O access.)

Memory address - upper limit

Memory address - lower limit

*SW1 and SW2 must be set when SW3-4 is turned on.
*The SW3-1 setting only applies when SW3-4 is ON.
*Normally set SW3-1 OFF.

ON : Enables the addresses set by SW1 and SW2 to be accessed.
OFF: Disables access of these addresses.

ON : Enables the addresses 080000H-09FFFFH to be accessed.
OFF: Disables access of these addresses.

ON : Enables the addresses 0C0000H-0DFFFFH to be accessed.
OFF: Disables access of these addresses.

ON : When using 16-bit memory access expansion in the area set by SW1 and SW2.
OFF: When using standard 8-bit or 16-bit memory access in the area set by SW1 and SW2.

Figure 2. Setting SW1 - SW3

16-Bit Memory Access Expansion Function

When the 16-bit memory access expansion function is enabled (SW3-1: ON), the MEMCS16 (D01) signal processed by the BUF board is output at an earlier timing than usual. This provides more reliable 16-bit memory access. (See "ISA 16-Bit Memory Access".)

ISA 16-Bit Memory Access

The ISA 16-bit bus specification is such that, depending on the personal computer used and the mounted board, there may be insufficient time for the MEMCS16 (D01) signal (which requests 16-bit memory access). In this case, if an ISA bus unit is inserted, the system will not operate correctly due to signal delay.

Note!

> *When the 16-bit memory access expansion function is enabled (SW3-1: ON), boards with 8-bit and 16-bit memory access cannot be used together in the area set by SW1 and SW2.*

Window area

When you use a memory board in the FA-PAC, you have to allocate the accessible memory addresses as external memory to avoid competing with the computer's internal memory. Those memory addresses are called a window area.

SW1 - SW3 : Setting example

To set addresses 020000H - 09FFFFH as the window area, set the switches as follows:
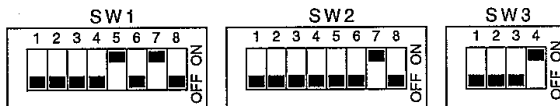
Figure 3. SW1 - SW3: Setting Example

Note!

> *These example switch settings may conflict with the computer's memory. Check the computer's documentation.*

DIP Switches (SW4 - SW6)
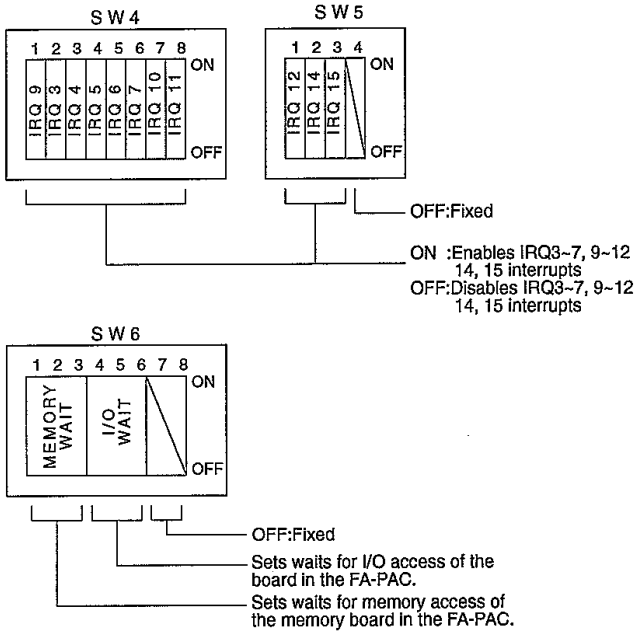
Figure 4. Setting SW4 - SW6

Setting memory waits

When the memory board in the FA-PAC is accessed, waits set by SW6-1, 2, 3 are placed.

Table 1. Setting Memory Waits

SW6			MEMORY
1	2	3	WAITS
OFF	OFF	OFF	0
OFF	OFF	ON	1
OFF	ON	OFF	2
OFF	ON	ON	3
ON	OFF	OFF	4
ON	OFF	ON	5
ON	ON	OFF	6
ON	ON	ON	7

*: Default

Setting I/O waits

When the board in the FA-PAC is accessed, waits set by SW6-4, 5, 6 are placed.

Table 2. Setting I/O Waits

SW6			I/O
4	5	6	WAITS
OFF	OFF	OFF	0
OFF	OFF	ON	1
OFF	ON	OFF	2
OFF	ON	ON	3
ON	OFF	OFF	4
ON	OFF	ON	5
ON	ON	OFF	6
ON	ON	ON	7

*: Default

Note!

Even if you set a 0 wait for an I/O wait, the waits which were set in the interface board in the FA-PAC are placed. Set SW6-1, 2, 3 as 2 waits, and set SW6-4, 5, 6 as 2 waits.

BUS-PAC(PC)E
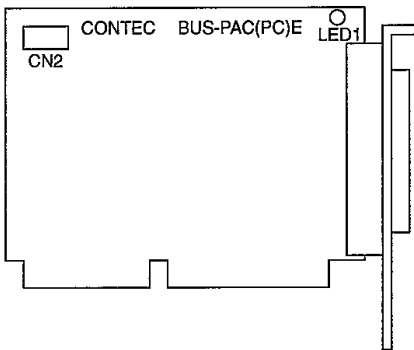
Figure 5. BUS-PAC(PC)E Board

Connector description

CN2 : External LED power feed pin
Power feed pin for the ISA bus unit power supply LED
(display)

LEDs

LED1 : Turns on when the power is turned on.

Connector (CN2)

CN2 is the external LED power feed pin (the power feed pin for the ISA bus unit power supply LED (display)). Some models of the ISA bus unit series require a power feed for a power supply LED. Connect as shown below when a power feed is required.

Pin No.	Signal name
1	GND
2	N.C.
3	+5V
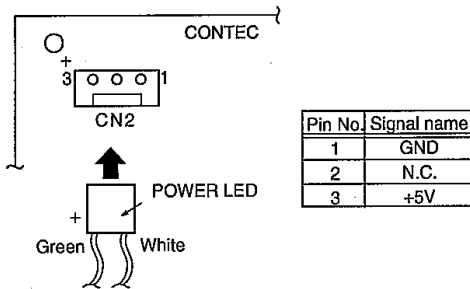
The ISA bus unit power supply LED

Figure 6. External LED power feed pin
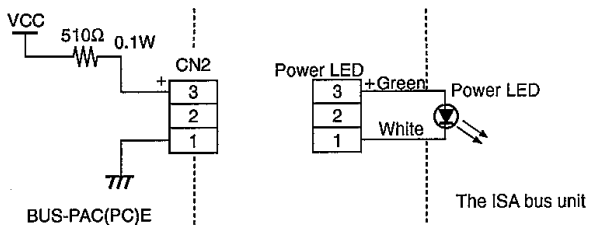
Figure 7. External LED power feed circuit

Installing Boards

Install the BUS-PC(PC)E board in the computer's expansion slot.
Install the BUS-PAC(PC)E in the slot of the I/O expansion unit.
Connect the board and computer using the cable provided.

Installing the BUS-PC(PC)E Board

Note!
- *Refer to the computer manual for board installation.*
- *Turn off the power and unplug the power cable from the computer.*

(1) Remove the screws from the rear of the computer. When removing screws, use a screwdriver that matches the screw heads.

Cover mounting screws
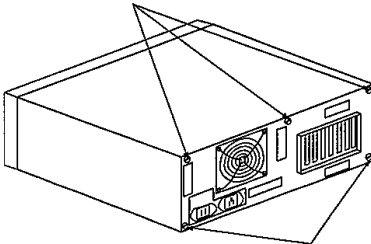
Cover mounting screws

Rear panel of IBM-PC/XT/AT

(2) Hold the left and right sides of the front cover and remove it from the computer's chassis by sliding it to the front.
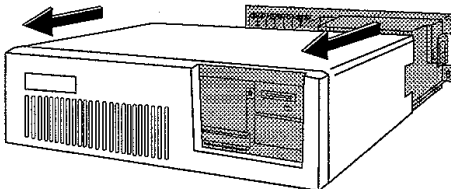
(3) Remove the screw retaining the cover of the slot where the board is to be mounted, and remove the cover from the rear panel.
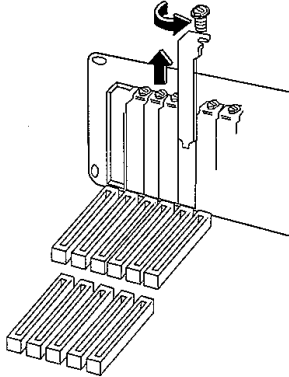
(4) Insert the board into the slot with the parts side on the right.
(5) After the board is inserted fully, secure the rear panel with the screws.

Top view
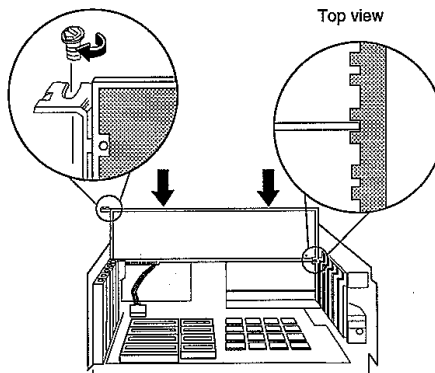
(6) Attach the cover in its the original position.

Installing the BUS-PAC(PC)E Board

Refer to the FA-PAC user's guide and install the board.

Connecting BUS-PC(PC)E to BUS-PAC(PC)E

After installation, connect the BUS-PC(PC)E board to the BUS-PAC(PC)E board with the cable provided. The connection cable is a 96-pin shielded cable. The cable has identical connectors at each end.
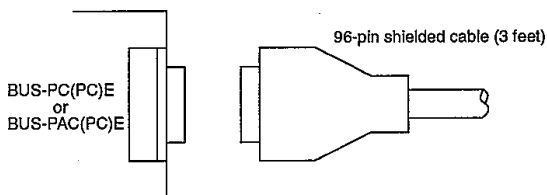
Figure 8. Connection Diagram

Cautions

- Ground the computer and the FA-PAC (frame ground) with the appropriate ground wire.
- Please install the BUS-PC(PC)E board in the computer. You cannot install the BUS-PC(PC)E board in the FA-PAC.

BUS-PC(PC)E

Computer

FA-PAC

BUS-PAC(PC)E

FA-PAC

FA-PAC

BUS-PAC(PC)E

BUS-PAC(PC)E   BUS-PC(PC)E

*You cannot install the BUS-PC(PC)E in the FA-PAC.
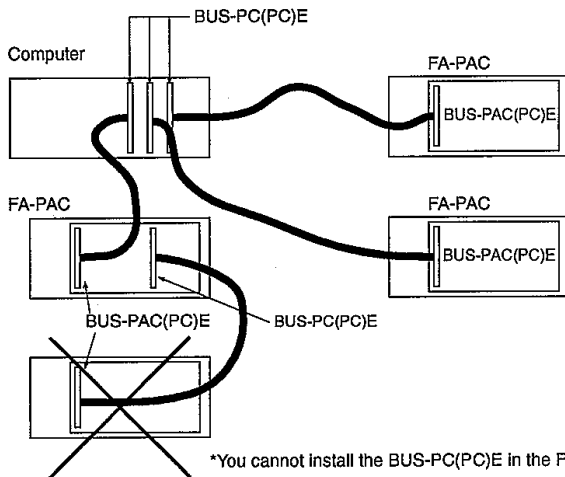
Figure 9. Installing 3 FA-PAC

SPECIFICATIONS

Specifications

Table 3. BUS-PC(PC)E

Item	Specifications
Power consumption	DC 5V 300mA (from computer)
Environment	0~50°C 30~90% (No condensation)
Dimensions	160X122X22(mm)

Table 4. BUS-PAC(PC)E

Item	Specifications
Power consumption	DC 5V 500mA (from computer)
Environment	0~50°C 30~90% (No condensation)
Dimensions	160X122X22(mm)

Table 5. System Specifications

Item	Specifications
Accessible I/O area	0000~FFFFH (No limitation)
Accessible	080000H~09FFFFH (Set by DIP switch)
memory area	0C0000H~0DFFFFH (Set by DIP switch)
	000000H~FEFFFFH (Set by DIP switch)
Available interrupt level	IRQ3~7, 9~12, 14, 15
Cable	96-pin shielded cable
At bus clock	Supported up to 8MHz

Note!

1. The driver ICs for address wire, control wire and data wire are 74ALS573 and 74LS541.
The fan-out is 20mA. When you are installing an interface board, collect all fan-outs with bus driver receiver ICs, such as 74LS244 and 74LS245.

2. AT bus clock
If you are using a 16-bit bus interface board in the FA-PAC, set the AT bus clock of the computer to 8MHz or lower. Operation higher than 8MHz is not guaranteed.
For further details on AT bus clocks, see the computer's documentation.
An AT bus clock is an I/O channel connector clock, not a CPU clock.

3. FA-PAC may limit the type of boards. The following boards
cannot be used in the FA-PAC.
• A board that uses an external CPU or external DMA.
(A board that uses the DMA of the computer can be used.)
• A board that expands the FA-PAC.

System Block Diagram

Computer   FA-PAC Series
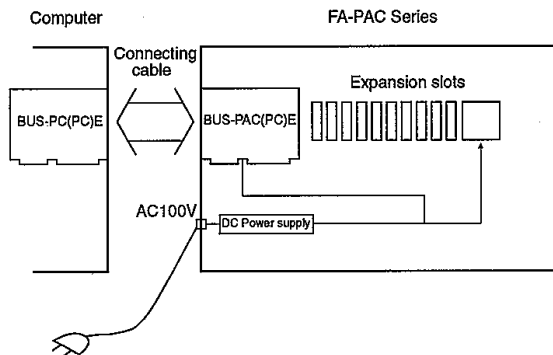
Figure 10. System Block Diagram

Expansion Bus Signals

The expansion slot signals in the FA-PAC connected to this expansion bus adapter are limited.

For further details on each signal line, see the computer's documentation.

Table 6. Limitations of Expansion Slot Signals

Pin No.	Signal name	I/O	Note	Pin No.	Signal name	I/O	Note
A01	IOCHCK*	I		B01	GND		
A02	SD7	I/O		B02	RESETDRV	O	
A03	SD6	I/O		B03	+5V		Note2
A04	SD5	I/O		B04	IRQ9	I	
A05	SD4	I/O		B05	-5V		Note2
A06	SD3	I/O		B06	DREQ2	I	
A07	SD2	I/O		B07	-12V		Note2
A08	SD1	I/O		B08	OWS*		Note1
A09	SD0	I/O		B09	+12V		Note2
A10	IOCHRDY	I		B10	GND		
A11	AEN	O		B11	SMEMW*	O	
A12	SA19	O		B12	SMEMR*	O	
A13	SA18	O		B13	IOW*	O	
A14	SA17	O		B14	IOR*	O	
A15	SA16	O		B15	DACK3*	O	
A16	SA15	O		B16	DREQ3	I	
A17	SA14	O		B17	DACK1*	O	
A18	SA13	O		B18	DREQ1	I	
A19	SA12	O		B19	REFRESH*	O	
A20	SA11	O		B20	CLK	O	
A21	SA10	O		B21	IRQ7	I	
A22	SA09	O		B22	IRQ6	I	
A23	SA08	O		B23	IRQ5	I	
A24	SA07	O		B24	IRQ4	I	
A25	SA06	O		B25	IRQ3	I	
A26	SA05	O		B26	DACK2*	O	
A27	SA04	O		B27	TC	O	
A28	SA03	O		B28	BALE	O	
A29	SA02	O		B29	+5V		Note2
A30	SA01	O		B30	OSC	O	
A31	SA00	O		B31	GND		

Continued to next page

Specifications

Table 6. Limitations of Expansion Slot Signals, *Continued*

Pin No.	Signal name	I/O	Note	Pin No.	Signal name	I/O	Note
C01	SBHE*	O		D01	MEMCS16*	I	
C02	LA23	O		D02	IOCS16*	I	
C03	LA22	O		D03	IRQ10	I	
C04	LA21	O		D04	IRQ11	I	
C05	LA20	O		D05	IRQ12	I	
C06	LA19	O		D06	IRQ15	I	
C07	LA18	O		D07	IRQ14	I	
C08	LA17	O		D08	DACK0*	O	
C09	MEMR*	O		D09	DREQ0	I	
C10	MEMW*	O		D10	DACK5*	O	
C11	SD8	I/O		D11	DREQ5	I	
C12	SD9	I/O		D12	DACK6*	O	
C13	SD10	I/O		D13	DREQ6	I	
C14	SD11	I/O		D14	DACK7*	O	
C15	SD12	I/O		D15	DREQ7	I	
C16	SD13	I/O		D16	+5V		Note2
C17	SD14	I/O		D17	MASTER*		Note1
C18	SD15	I/O		D18	GND		

A signal with an asterisk (*) means "active low".

Note 1: This signal is not connected (Open) and independent of the computer.

Note 2: This signal is independent of the computer and dependent on the power supply specifications of the FA-PAC used.

Error Recovery

The FA-PAC must be set correctly for proper use. If the FA-PAC does not function properly, first check the setting and make sure it is being used properly. If the following situation occurs, it can normally be corrected using a simple recovery procedure.
• You cannot turn on the power.
• Your computer does not start.

You Cannot Turn On The Power

(1) Check the power cable. Is it connected properly?
(2) Is the power switch of the computer and/or FA-PAC turned on?
(3) Check the operation procedure.
(4) Does the computer turns on without the expansion boards in the FA-PAC? If the computer power is turned on without the expansion boards in it, the total power consumption of the installed boards may exceed the limit. Check the total power consumption.

The Computer Does Not Start

(1) Is the board properly installed?
(2) If you are using an interrupt, the interrupt may not be available in the computer.
(3) If multiple boards have been installed in the computer, the interrupt level and I/O address may overlap.

APPENDIX

A. PC/AT Series Interrupts

Some boards are capable of utilizing interrupts from personal computers.

For use with PC/AT and compatible machines, this product provides signals with interrupt levels IRQ3 to 7, 9 to 12, 14 and 15. Concerning the interrupt levels of the expansion bus, the board can use an unused interrupt level in a specific configuration where independent levels are assigned to different peripheral devices.

Interrupt levels and Interrupt Vectors

Interrupt levels

PC/AT and compatible machines have a master-slave configuration in which two interrupt controllers (8259) are used. As shown in Figure 5., IRQ2 to 7 of the expansion bus are assigned to the master side while IRQ9 to 12, 14 and 15 are assigned to the slave side.

```
               8259 (Master side)
CPU —— INT    IR  0 —— IRQ0 Timer
              IR  1 —— IRQ1 Keyboard
              IR  2 —— IRQ2
              IR  3 —— Expansion bus IRQ3 <Serial port2>
              IR  4 —— Expansion bus IRQ4 <Serial port1>
              IR  5 —— Expansion bus IRQ5 <Parallel port2>
              IR  6 —— Expansion bus IRQ6 <Floppy disk>
              IR  7 —— Expansion bus IRQ7 <Parallel port1>

               8259 (Slave side)
        INT   IR  0 —— IRQ8 Real-time clock
              IR  1 —— Expansion bus IRQ9  <Software interrupt>
              IR  2 —— Expansion bus IRQ10 <Reserved>
              IR  3 —— Expansion bus IRQ11 <Reserved>
              IR  4 —— Expansion bus IRQ12 <Mouse>
              IR  5 —— IRQ13 Numeric data processor
              IR  6 —— Expansion bus IRQ14 <Hard disk>
              IR  7 —— Expansion bus IRQ15 <Reserved>
```
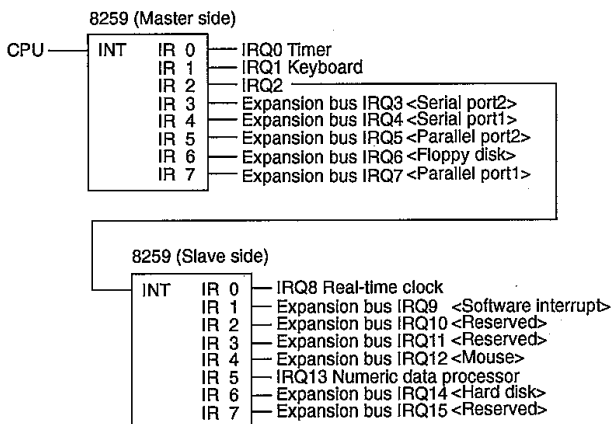
Figure 11. Interrupt Controller

Interrupt vectors

The interrupt vector table designates the relationship between the interrupt levels and the interrupt processing routines which correspond to them. The interrupt vector table has a size of 1K bytes starting with the least significant address (address zero) and the start addresses of the different interrupt processing routines are stored at intervals of 4 bytes.

The following table shows the interrupt vector table addresses corresponding to the interrupt controller and the vector numbers assigned to them.

Table 7. Interrupt Vector Table Addresses and Vector Number Assignment

	Address	Vector No.	Device	
Master side	0020H~0023H	08H	Timer	(IRQ0)
	0024H~0027H	09H	Keyboard	(IRQ1)
	0028H~002BH	0AH		(IRQ2)
	002CH~002FH	0BH	Serial port 2	(IRQ3)
	0030H~0033H	0CH	Serial port 1	(IRQ4)
	0034H~0037H	0DH	Parallel port 2	(IRQ5)
	0038H~003BH	0EH	Floppy disk	(IRQ6)
	003CH~003FH	0FH	Parallel port 1	(IRQ7)
Slave side	01C0H~01C3H	70H	Real-time clock	(IRQ8)
	01C4H~01C7H	71H	Software interrupt	(IRQ9)
	01C8H~01CBH	72H	Reserved	(IRQ10)
	01CCH~01CFH	73H	Reserved	(IRQ11)
	01D0H~01D3H	74H	Mouse	(IRQ12)
	01D4H~01D7H	75H	Numeric data processor	(IRQ13)
	01D8H~01DBH	76H	Hard disk	(IRQ14)
	01DCH~01DFH	77H	Reserved	(IRQ15)

B. I/O Port Address Map of PC/AT

Many expansion boards are controlled using several consecutive I/O addresses. However, with the PC/AC and compatible machines, some I/O addresses have already been assigned for use in controlling facilities in the main unit.

Table 8. I/O Address Map of PC/AT

I/O address	Description of the register
X000H~X00FH	DMA controller
X020H~X021H	Master interrupt controller
X040H~X043H	Programmable interval timer
X060~X064H	Keyboard/mouse controller, etc.
X070~X071H	Real-time clock
X080~X08FH	DMA page register, etc.
X0A0H~X0A1H	Slave interrupt controller
X0C0H~X0DFH	DMA controller
X0F0H~X0FFH	Co-processor
X170H~X178H	Second hard disk controller
X1F0H~X1F8H	Hard disk controller
X200H~X207H	Game controller register
X238~X23BH	Bus mouse
X278H~X27FH	Parallel port 2
X2B0H~X2DFH	EGA
X2E8H~X2EFH	Serial port 4
X2F0H~X2F7H	Global real addresses for interrupt sharing
X2F8H~X2FFH	Serial port 2
X300H~X31FH	Prototype card
X370H~X377H	Second floppy disk controller
X378H~X37FH	Parallel port 1
X380H~X38FH	Second sync data link controller
X3A0H~X3AFH	Sync data link controller
X3B0H~X3BFH	MDA
X3C0H~X3CFH	EGA
X3D0H~X3DFH	CGA
X3E8H~X3EFH	Serial port 3
X3F0H~X3F7H	Floppy disk controller
X3F8H~X3FFH	Serial port 1

Note!

Since I/O addresses are decoded as 10 bits by PC/AT computers, the Xs in the above I/O addresses show undefined digits.

I/O Addresses that can be used with Expansion Boards

The expansion boards cannot be set to the I/O addresses listed above and these addresses should be avoided. In addition, it is probable that I/O addresses below X100H are used by the system. Therefore, the I/O addresses which can be used with the expansion boards are as listed below.

X108H to X16FH, X180H to X1EFH, X20EH to X21EH, X220H to X277H, X280H to X2AFH, X320H to X35FH.

Appendix

C. DMA Channel

IBM PC/AT computers and compatibles have 7 DMA channels
(DMA0 ~ 7). Use DMA channels 0 ~ 3 to send data (8 bits at a
time); the data unit is a maximum of 64 Kbytes. Use DMA channels
5 ~ 7 to send data (16 bits at a time); the data units a maximum of
128 Kbytes.

Table 9. DMA channel

DMAC #	Channel	Device
1	0	RESERVED
	1	RESERVED
	2	FDD
	3	(HARD DISK)
2	4	DMAC #1
	5	RESERVED
	6	RESERVED
	7	RESERVED

Note!
- *You cannot send data through DMA if an EMM driver is used with
  MS-DOS Ver. 3.xx.*
- *You cannot send more than 64 Kbytes of data (DMA 5 ~ 7 :
  128Kbytes).*

D. Difference from BUF(PC)H

This appendix describes the difference between BUF(PC)E and BUF(PC)H.
BUF(PC)E is an improved version of BUF(PC)H. You can use BUF(PC)E as BUF(PC)H, but there are some differences in specifications and hardware.

Table 10. Specifications difference

Item	BUF(PC)H	BUF(PC)E
Power consumption	BUS-PC(PC)H : DC 5V 700mA BUS-PAC(PC)H : DC 5V 800mA	BUS-PC(PC)E : DC 5V 300mA BUS-PAC(PC)E : DC 5V 500mA

Table 11. Difference in dip switches and jumpers

	BUF(PC)H (BUS-PC(PC)H)		BUF(PC)E (BUS-PC(PC)E)	
	SW1	SW2	SW1	SW2
Memory area	1bit : 0 D 0 0 0 0 H ~ 0 D F F F F H - Access enable/disable 2bit : 0 C 0 0 0 0 H ~ 0 C F F F F H - Access enable/disable SW3 (1 2 3 4)		SW3 (1 2 3 4) 2bit : 0 C 0 0 0 0 H ~ 0 D F F F F H - Access enable/disable	
	In BUF(PC)E, an access enable/disable can be set with 1bit.			
	—		SW3 (1 2 3 4) The 16-bit memory access expansion function is added.	
Interrupt	—		SW4 SW5 Interrput enable/disable is available.	
Number of waits	JP1 Memory wait	JP2 I/O wait	SW6 (1 2 3 4 5 6 7 8) MEMORY WAIT / I/O WAIT I/O wait Memory wait	
	3 setting with jumper pins.		8 setting with dip switches.	

Note!

The buffer cable pin assignments of BUF(PC)H and BUF(PC)E are incompatible. Thus, BUS-PC(PC)H cannot be connected to BUS-PAC(PC)E, and BUS-PC(PC)E cannot be connected to BUS-PAC(PC)H.

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