ICOP-6015
ICOP-6016

Embedded 386SX CPU Tiny Board Series

User's Manual

(Version 1.3)

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C h a p t e r 0
Startup

0.1   Packing List

PRODUCT NAME	FUNCTION	PACKAGE
ICOP-6015	Embedded 386SX Tiny Board with LAN	● ICOP-6015 Embedded 386SX CPU Tiny Board with LAN ● Utility and Drivers Diskette x 1 ● RS232 cable x 2 ● Printer cable with bracket x 1 ● AT KB / PS2 Mouse Y-cable x 1
ICOP-6016	Embedded 386SX Tiny Board with I/O	● ICOP-6016 Embedded 386SX CPU Tiny Board with I/O ● Utility and Drivers Diskette x 1 ● RS232 cable x 2 ● Printer cable with bracket x 1 ● AT KB / PS2 Mouse Y-cable x 1

0.2 Specifications

Feature	ICOP-6015	ICOP-6016
Chipset	DM&P(ALi) M6117D	
BIOS	AMI BIOS	
Watchdog Timer	From 30.5μs to 512 seconds	
Bus Interface	ISA bus signal interface	
Memory	4MB (up to 8MB)onboard	
I/O Chip	ALi 5113	
Keyboard Connector	1	
IDE port	1	
Serial Port	RS232 X 2,(or RS232X1,RS485X1)	
DiskOnChip / Flash Disk	1	
Digital I/O	16 Bit	
Parallel Port	1	
Network Chipset	Realtek 8019AS	X
Network Interface	RJ-45	X
Power Requirement	+5V @0.4A	
Board Weight	80g	
Board Size	100 X 66 mm	
Operating Temperature	-20 ~ +60°C	

0.3   Component Location

ICOP-6015(6)

COM2

Parallel Port

GND/+5V

COM1

GPIO Cont.

Ethernet RJ-45
(Only on ICOP-6015)

Keyb. Cont.
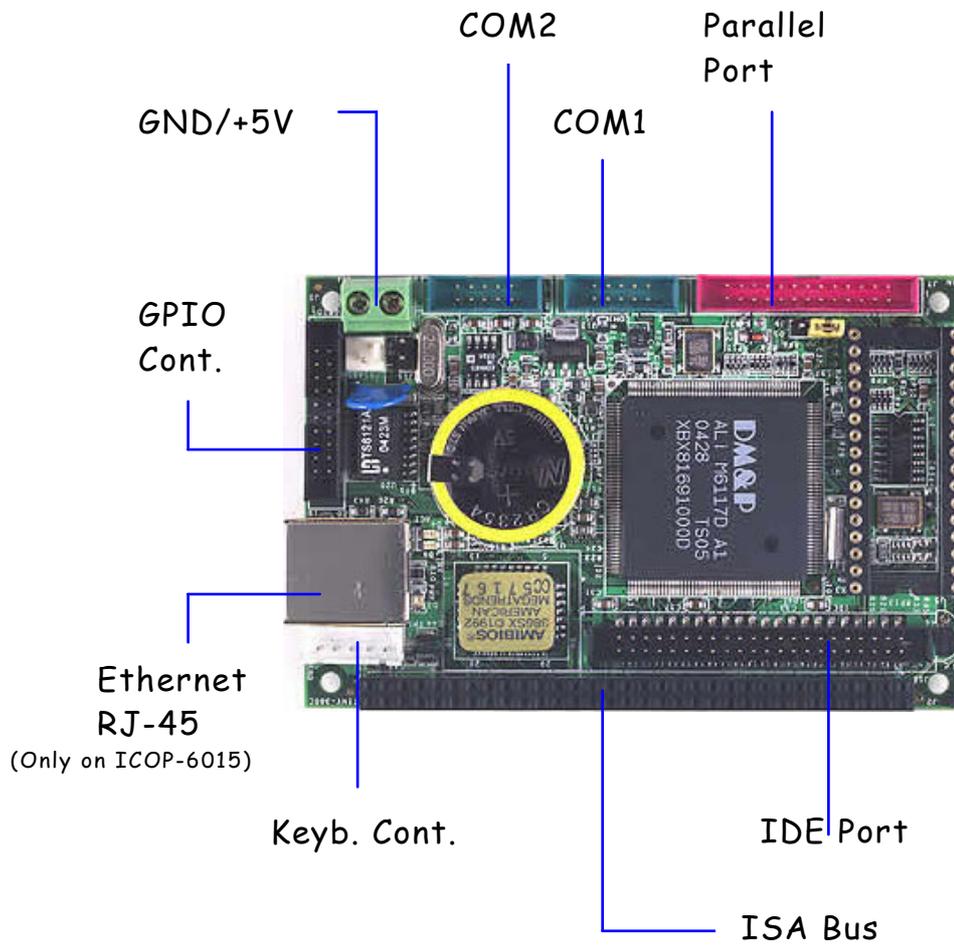
IDE Port

ISA Bus

C h a p t e r 1
Introduction

1.1   Features

- Tiny-size (100x66 mm) Embedded CPU Modules

- 8-bit ISA-bus signal interface

- DM&P (ALi) M6117D Embedded CPU, 100% compatible with 386SX-40 CPU

- 4MB (up to 8MB) EDO RAM onboard

- One Enhanced IDE Port

- One Bi-directional Parallel Port

- RS-232/485 interface

- Watchdog timer

- 16-bit GPIO connector onboard

- Socket for Flash or DiskOnChip

- Onboard AT-keyboard header

- Onboard Ethernet, compatible with NE2000 (Note 1)

- Single voltage +5 V power connector

- Operating temperature from –20 $\sim$ +60℃

- Flexble OEM/ODM design

Note 1: only for ICOP-6015 series

1.2 Specifications

• **Embedded CPU :** DM&P(Ali) M6117D is an implementation of an INTEL compatible 386SX-40 CPU, Realtime clock, a watchdog timer and ALi's M1217B chipset

• **BIOS:** Y2K compliant AMI system BIOS

• **DRAM Memory:** 4MB (up to 8MB) EDO DRAM onboard

• **Bus Interface:** ISA bus signal interface

• **Data Bus:** 16-bit

• **Bus Speeds:** PC/104 - 8 MHz

(above values are defaults, bus speeds are programmable up to 16 MHz)

• **DMA Channels:** 7

• **Interrupt Levels:** 15

• **Watchdog Timer:** generates either a RESET, NMI or an IRQ when your application loses control over the system. Optionally the watchdog can trigger a user specified interrupt. The watchdog is configurable from 30.5μs to 512 seconds (in 30.5μs segments)

• **Real-time Clock:** included in M6117D with onboard lithium battery backup for 10 years of data retention. CMOS data backup of BIOS setup and BIOS default.

High Speed Multi I/O

• **Chipse :** ALi 5113 or SMS CFDC37C669

• **Serial ports:** Supports high speed RS-232 port, high speed RS-232/485 port (jumper selectable). Both with 16C550 UART and 16 byte FIFO. BIOS enabled/ disabled

• **Bi-directional Parallel Port:** supports SPP, EPP and ECP mode. BIOS enabled/disabled

Environmental and Power

• **Power Requirements:**

single voltage +5 V

• **Board Dimensions:** 100 (L) x 66 (W) mm.

• **Board Weight:** 80 g

• **Extended Operating Temperature:** -20~+60 °C

1.3　DiskOnChip 2000 Flash Disk

Flash Disk DiskOnChip ® 2000

• **Package:** Single Chip FlashDisk in 32-pin DIP JEDEC

• **Capacity:** 1-144 MByte capacity

• **Data Reliability:** ECC/EDC error correction

• **Memory Window:** 8 Kbyte

1.4 Network Interface

• **Chipset:** Realtek 8019AS single chip

• **Type:** 10BASE-T

• **Connectors:** onboard RJ-45 connectors

• **Monitoring LEDs:** network ready indicator, network activity indicator

• **Compatibility:** NE2000

C h a p t e r   2
Installation

2.1   Jumper Settings

ICOP-6015(6)
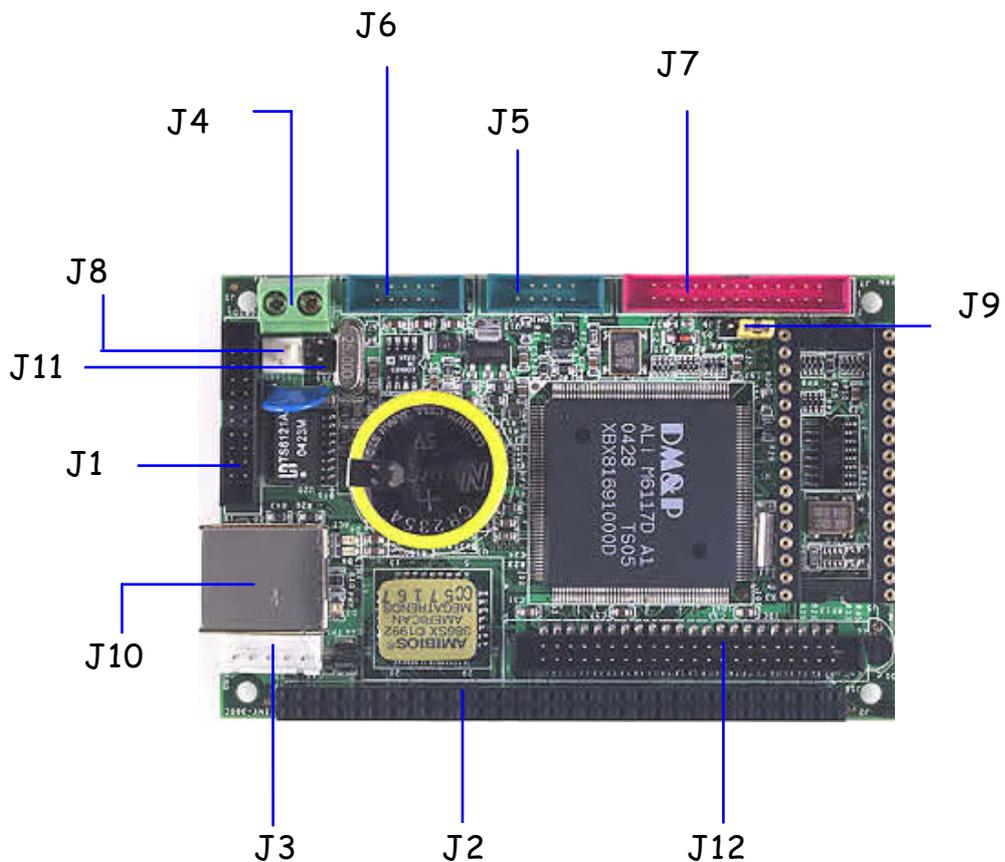
J9: RS-232/485 selection for COM2

      1-2: RS-232 mode (**J6** active)

      2-3: RS-485 mode (**J8** active)

2.2   Connectors

J1   20-pin header for 16-bit GPIO

J2   64-pin ISA bus

J3   5-pin keyboard connector

J4   +5V Power connector

J5   10-pin box header connector for COM1 RS-232

J6   10-pin box header connector for COM2 RS-232

J7   Printer Port

J8   2-pin COM2 RS-485 connector

J10   LAN RJ45 connector (**ICOP-6015** only)

J11   For external speaker

J12   44-pin header for IDE port

2.3   DiskOnChip/Flash Disk

2.3.1 Setup a DiskOnChip ® 2000 Flash Disk

Installation Instructions

1. Make sure the ICOP-601X is powered OFF

2. Plug the DiskOnChip 2000 device(s) or Flash Disk into its socket. Verify the direction is correct (pin 1 of the DiskOnChip 2000 is aligned with pin 1 of the socket)

3. Set address for both DiskOnChip and Flash Disk devices as below instructions:

> Step1: Enter to AMI BIOS Setup Utility while system power on
> Step2: Enter to "Advanced Chipset Setup"
> Step3: Select "GPCS Function" to "Enable"

(For DiskOnChip)
> Step4: Setect "GPCS0 Command" to "MEMR/W 8bit"
> Step5: Select "GPCS0 Start Address" to "0C8000 HEX"
> Step6: Select "GPCS0 Size" to "8 KBYTE" (goto Step 10)

(For Flash Disk)
> Step4: Setect "GPCS0 Command" to "MEMR/W 8bit"
> Step5: Select "GPCS0 Start Address" to "0E0000 HEX"
> Step6: Select "GPCS0 Size" to "64 KBYTE"
> Step7: Select "GPCS1 Command" to "IOW 8bit"
> Step8: Select "GPCS1 Start Address" to "000100 HEX"
> Step9: Select "GPCS1 Size" to "2 BYTE"
>
> Step10: Save changed and exit.

4. Power up the system

5. During power up you may observe the messages displayed by the DiskOnChip 2000 when its drivers are automatically loaded into system's memory

6. At this stage the DiskOnChip 2000 can be accessed as any disk in the system

7. If the DiskOnChip 2000 is the only disk in the system, it will appear as the first disk (drive C: in DOS)

8. If there are more disks besides the DiskOnChip 2000, the DiskOnChip 2000 will appear by default as the last drive, unless it was programmed as

first drive. (please refer to the DiskOnChip 2000 utilities user manual)

9. If you want the DiskOnChip 2000 to be bootable: a - copy the operating system files into the DiskOnChip by using the standard DOS command (for example: sys d:) b - The DiskOnChip should be the only disk in the systems or should be configured as the first disk in the system (c:) using the DUPDATE utility

For more information on DiskOnChip2000 technology, visit M-Systems Web site **http://** www.m-sys.com where you can find Utilities Manual, Data Sheets and Application Notes. In addition, you can find the lasted DiskOnChip 2000 S/W Utilities.

2.3.2 Setting up a Flash Disk

Before you can use the Flash disk, you will have to initialize it by using a software utility called "PC104.EXE". This program can be found in the subdirectory "Driver and Utility" of ICOP CD-Rom.

- run PC104.EXE (this is a DOS command line utility)

ICOP-601X FLASH disk initialize program V1.0

FLASH manufacturer : (1)ATMEL (2)SST

Input manufacturer number (1,2) : **1**

Input quantity of FLASH (1,2) : **2**

Simulation disk:

(1)DISK-A (2)DISK-B (3)DISK-C (4)DISK-D

Input manufacturer number (1,2,3,4) : **1**

FLASH-DISK initialize finish.

(Text in bold should be entered by user)

- After running the PC104.EXE configuration program reboot the system, while holding down the left "Ctrl" key. This will bring you to the "Flash Disk Utility"

- "CHANGE CURRENT DISK NUMBER" lets you select the drive you want to assign to the disk, either A, B, C or D

- "CHANGE FLASH DISK SIZE" lets you select the amount of Flash chips that are onboard.

- make selections and reboot the system after closing the program

Your disk can now be formatted and setup with normal DOS commands such as

FORMAT, FDISK, COPY, SYS etc.

Note : when assigning the solid state disk as either C or D, you first have to run FDISK before formatting the drive !

2.4   Watchdog Timer

The watchdog timer uses a 32.768 KHz frequency source with a 24-bit counter. Its time range stretches from 30.5 ms to 512 sec. with a resolution of 30.5 ms. When the watchdog times out a System RESET, NMI or IRQ can be invoked. Watchdog timer control and the 24-bit counter itself occupy 6 consecutive 8-bit address locations.

When functioning properly the system resets the watchdog timer periodically to prohibit that it times out. If the watchdog timer times out, it will RESET the system, or generate and NMI or IRQ, depending on its configuration.

Watchdog or System Timer

Another great application is to generate a periodic IRQ signal. Under DOS environment, the 8254, system timer 0, will generate IRQ0 every 54.9 ms. The watchdog is like system timer 0. It can be programmed to periodically generate a configurable IRQ. It may be clear that the selected IRQ, will be no longer available to the system.

Configuring the Watchdog Timer in the BIOS

The M6117D watchdog configuration register can be controlled by software or can be setup in the BIOS. To do so go to BIOS Setup's "Advanched Chipset Setup"

> Watchdog Function = Enable/Disable

> Watchdog Signal = RESET, NMI or IRQ 3/4/5/6/7/9/10/11/12/14/15

> Watchdog Timer = 1/2/4/8/16/32/64/128/256/512 Seconds

The BIOS setup only offers a limited amount of time-out values. More a hiher resolution of timeout values refer to the next paragraph "Configuring the Watchdog Timer by Software" Note that in case of using the BIOS setup, the watchdog starts counting the moment it passes the BIOS setup. This means that if you set the time-out period to 1 second, the system will keep rebooting before being able to load operating system or software !

After you have finnished configuring you watchdog timer read "Timeout Status & Reset - INDEX 3CH" on page 12 and look at the example on page 15 to find out how to priodically reseting the timeout status to prevent the watchdog timer from invoking a RESET, NMI or IRQ.

Configuring the Watchdog Timer by Software

Chipset configuration registers

The M6117D configuration register INDEX 37H, 38H, 39H, 3AH, 3BH, 3Ch are used to control the watchdog functions and/or display its current status.

Enable/Disable watchdog - INDEX 37H

Bit	Value	Action
7	reserved	Do not modify the value of these bits!
6	0	Disable watchdog timer
	1	Enable watchdog timer
5-0	Other function	Do not modify the value of these bits!

Watchdog time out action - INDEX 38H

Bit	Value	Action
7-4	0000	No output signal
	0001	IRQ3
	0010	IRQ4
	0011	IRQ5
	0100	IRQ6
	0101	IRQ7
	0110	IRQ9
	0111	IRQ10
	1000	IRQ11
	1001	IRQ12
	1010	IRQ14
	1011	IRQ15
	1100	NMI
	1101	System RESET
	1110	No output signal
	1111	No output signal
3-0	Other function	Do not modify the value of these bits!

Watchdog timer - INDEX 39H, 3AH, 3BH

Index	3Bh	3Ah	39h
Bits	D7……D0	D7……D0	D7……D0
counter	[VSB……………	…………………	…………LSB]

For example

Index	3Bh	3Ah	39h	Time out
	00h	00h	01h	30.5µs
	00h	00h	02h	61µs
	00h	01h	00h	7.8 ms
	00h	02h	00h	15.6 ms
	01h	00h	00h	2 s
	02h	00h	00h	4 s
	FFh	FFh	FFh	512 s

Timeout Status & Reset - INDEX 3CH

Bit	Value	Action
7	0	Timeout has not occurred
	1	Timeout has occured
6	1	Reset timer
	0	Has no meaning
5-0		Other function, do not modify these bits

Programming the watchdog

To perform any operation on the M6117D configuration registers you always

have to unlock first and lock the registers afterwards

Unlock configuration register	Lock configuration register

```
mov al, 013h                    mov al, 013h

out 22h, al                     out 22h, al
```

```
nop                          nop

nop                          nop

mov al, 0c5h                 mov al, 000h

out 23h, al                  out 23h, al

nop                          nop

nop                          nop
```

Read the value of a configuration register

For example, read INDEX 3Ch :

Unlock configuration register

```
mov al, 03ch

out 22h, al

nop

nop

in al, 23h

nop

nop

push ax
```

Lock configuration register

```
pop ax ;AL - result
```

Write data to configuration register

For example, write 0FFh to INDEX 3Bh :

Unlock configuration register

```
mov al, 03bh

out 22h, al

nop

nop

mov al, 0ffh

out 23h, al
```

```
        nop

        nop
```

Lock configuration register

Watchdog Program Example

We use the following sequence to initialize the watchdog timer:

(1) Unlock configuration register.

(2) Disable watchdog timer by setting INDEX 37H Bit 6 to '0'.

(3) Set the expected counter value to INDEX 3BH, 3AH, 39H.

(4) Select timeout action from INDEX 38H Bit 7-4.

(5) Enable watchdog timer by setting INDEX 37H Bit 6 to '1'.

(6) Lock configuration register.

Example: Set timeout to 128 sec to generate a system RESET.

```
; Please use MASM to compiler the following program

; Execute under DOS environment

dosseg

. model small

. stack 100h

.code

main proc

        mov ax, 0c513h ; Unlock config. register

        call writechip

        mov ax, 03737h ; Disable watchdog timer

        call readchip

        and al, 10111111b

        xchg ah, al

        call writechip

        mov ax, 0403bh ; Set the expected counter
                       ; value

        call writechip ; to [400000h]
```

```asm
        mov ax, 0003ah ; 30.5*sec*400000h= 128 sec

        call writechip

        mov ax, 00039h

        call writechip

        mov ax, 03838h ; Select "system reset" as

                       ; timeout action

        call readchip

        and al, 00001111b

        or al, 11010000b

        xchg ah, al

        call writechip

        mov ax, 03737h ; Enable watchdog timer

        call readchip

        or al, 01000000b

        xchg ah, al

        call writechip

        mov ax, 00013h ; Lock config. register

        call writechip

        mov ax, 04c00h

        int 21h

        main endp

readchip proc

        out 22h, al

        nop

        nop

        in al, 23h

        nop

        nop
```

```
        ret

readchip endp

writechip proc

        out 22h, al

        nop

        nop

        xchg ah, al

        out 23h, al

        nop

        nop

        xchg ah, al

        ret

writechip endp

end main
```

Reset watchdog timer

Resets the watchdog timer periodically to prevent timeout.

```
        mov ax, 0c513h ; Unlock configuration

                       ; register

        call writechip

        mov ax, 03C3Ch ; Reset watchdog timer

                       ; counter

        call readchip

        or al, 00100000 ; The counter is reset at

        xchg ah, al ; out 23h, al

        call writechip

        mov ax, 00013h ; Lock configuration

                       ; register

        call writechip
```

(the above code uses readchip and writechip procedures)

2.5   General Purpose I/O

M6117D supports 16 independent GPOs and GPIs. This group of GPOs does not need external 74LS373 to latch as generate purpose output. Also this group of GPIs do not share signals with the ISA data bus, so no external 74LS245 is required either.

At boot time the state of the GPIO ports can be set in the BIOS.

Go to BIOS Setup's "***Advanched Chipset Setup***"

GPIO Sample Program

```
; Please use TASM to compiler the following program.
; Execute under DOS environment.
;
.286
.model small
.code
mov al,13h        ; Unlock 6117D configuration register.
out 22h,al        ;
mov al,0c5h       ;
out 23h,al        ;
mov al,4eh        ; Enable GPIO[7-0] is output pin.
out 22h,al                   ;
mov al,0ffh       ; If AL fill "FF", then
                  ; GPIO[7-0] set as output pin.
out 23,al         ; User can be set logic "1"
                  ; of OUT direction.
mov al,4fh        ; Enable GPIO[15-8] is input pin
out 22h,al        ;
mov al,00         ; If AL fill "00", then
                  ; GPIO[15-8] set as input pin.
```

```asm
out 23h,al          ; User can be set logic "0"

                    ; of IN direction.

mov al,47h          ; Output data port.

out 22h,al          ;

mov al,55h          ; Example data out value is 55h,

                    ; to output pin

out 23h,al          ; GPIO[7-0]. So user can

                    ; repeat this loop.

mov al,46h          ; If GPIO[7-0] is set input direction, then data

out 22h,al          ; input port is 46.

in al,23h           ; Example data input value

                    ; from data input GPIO[7-0]

mov al,4ch          ; Input data port

out 22h,al          ;

in al,23h           ; Read data from GPIO[15-8]

                    ; into AL register.

mov al,4dh          ; If GPIO[15-8] is set output

                    ; direction, then data

out 22h,al          ; output port is 4dh.

mov al,55h          ; output data value is 55h.

out 23h,al          ; Example data output value

                    ; to data input GPIO[15-8]

....... continue program

end
```

C h a p t e r 3
Network Interface

3.1 Introduction

The Realtek RTL-8019AS 10Mbps Ethernet controller board supports both 10BASE-T and Coax 10Base-2 'BNC' connectors, and allows direct connec-tion to your 10Mbps Ethernet based Local Area Network for full interaction with local servers, wide area networks such as the Internet.

I/O and IRQ settings can be done by software with the supplied utility software, or it can be set for Plug and Play compatibility. The controller supports : Full-Duplex Ethernet function to double channel bandwidth, auto media detection.

3.2 Software Support

On-board EEPROM (93C46) programming

Setup/Diagnostic program for DOS

Help utility for easy installation

RPL boot ROM for Novell Netware, Microsoft NT

NDIS2 (DOS,OS/2,Lantastic,WFW3.1¡K¡K)

NDIS3,NDIS4,NDIS5 for WIN95,98,NT3.51,4.0,5.0,WFW3.11

Netware 16-bit ODI driver for DOS,OS/2 and 32-bit ODI driver for Netware 3.x,4.x,5.0 Server

Packet driver for UNIX Client

SCO Unix driver

Linux driver

All operating systems that support standard NE2000

Appendix

## A. Pin assignment

IDE Interface Connector

Pin	Description	Pin	Description
1	Reset	2	GND
3	Data 7	4	Data 8
5	Data 6	6	Data 9
7	Data 5	8	Data 10
9	Data 4	10	Data 11
11	Data 3	12	Data 12
13	Data 2	14	Data 13
15	Data 1	16	Data 14
17	Data 0	18	Data 16
19	GND	20	N/C
21	N/C	22	GND
23	IOW #	24	GND
25	IOR #	26	GND
27	N/C	28	BALE-Default
29	N/C	30	GND-Default
31	Interrupt	32	IOCS16-Default
33	SA1	34	N/C
35	SA0	36	SA2
37	HDC CS0	38	HDC CSI #
39	HDD Active	40	GND
41	Vcc	42	Vcc
43	GND	44	N/C

Parallel Port Interface

PIN	DESCRIPTION	PIN	DESCRIPTION
1	Strobe	2	Auto Form Feed #
3	Data 0	4	Error #
5	Data 1	6	Initialize #
7	Data 2	8	Printer Select In #
9	Data 3	10	GND
11	Dat4 4	12	GND
13	Data 5	14	GND
15	Data 6	16	GND
17	Data 7	18	GND
19	Acknowledge #	20	GND
21	Busy	22	GND
23	Paper Empty #	24	GND
25	Printer Select	26	NC

Serial Port Interface

10- PIN	D-TYPE	DESCRIPTION
1	1	Data Carrier Detect (DCD)/5V/12V
2	2	Receive Data (RXD)
3	3	Transmit Data (TXD)
4	4	Data Terminal Ready (DTR)
5	5	Ground (GND)
6	6	Data Set Ready (DSR)
7	7	Request to Send (RTS)
8	8	Clear to Send (CTS)
9	9	Ring Indicator (RI)/5V/12V
10	X	NC
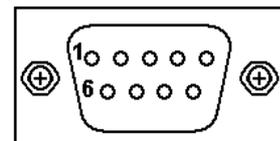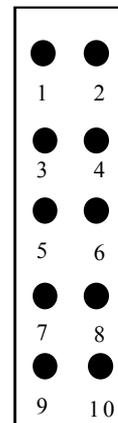
Keyboard and PS/2 Mouse Connector

Clock	1 ■	
Data	2 □	
No Connection	3 □	
GND	4 □	
Power	5 □	
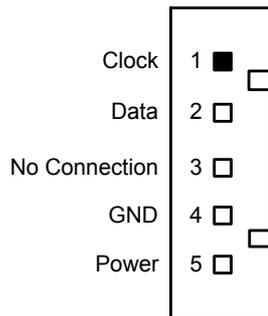
Note for Keyboard:

Pin1: KBCLK
Pin2: KBDATA

Clock	1 ■	
Data	2 □	
No Connection	3 □	
GND	4 □	
Power	5 □	
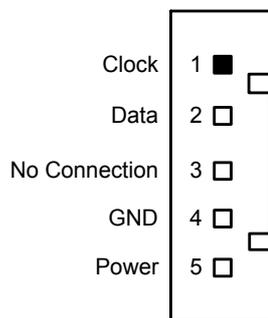
Note for Mouse:

Pin1: MCLK
Pin2: MDATA

16-bit General Purpose I/O

PIN	DESCRIPTION	PIN	DESCRIPTION
1	GND	2	Vcc
3	GP0	4	GP8
5	GP1	6	GP9
7	GP2	8	GP10
9	GP3	10	GP11
11	GP4	12	GP12
13	GP5	14	GP13
15	GP6	16	GP14
17	GP7	18	GP15
19	Vcc	20	GND

ISA Bus Connector

J2 (Only ICOP-6015/16)

PIN No.	PIN Name	PIN No.	PIN Name
1	GND	2	SBHE
3	RSTDRV	4	SD7
5	Vcc	6	SD6
7	SD8	8	SD5
9	SD9	10	SD4
11	SD10	12	SD3
13	SD11	14	SD2
15	SD12	16	SD1
17	SD13	18	SD0
19	GND	20	IOCHRDY
21	SMEMW	22	AEN
23	SMEMR	24	SA19
25	IOW	26	SA18
27	IOR	28	SA17
29	SD14	30	SA16
31	SD15	32	SA15
33	MEMCS16	34	SA14
35	IOCS16	36	SA13
37	REFRESH	38	SA12
39	SYSCLK	40	SA11
41	IRQ7	42	SA10
43	IRQ6	44	SA9
45	IRQ5	46	SA8
47	IRQ4	48	SA7
49	IRQ3	50	SA6
51	IRQ10	52	SA5
53	IRQ11	54	SA4
55	ALE	56	SA3
57	Vcc	58	SA2
59	OSC	60	SA1
61	GND	62	SA0
63	IRQ12	64	IRQ14

Warranty

This product is warranted to be in good working order for a period of one year from the date of purchase. Should this product fail to be in good working orderat any time during this period, we will, at our option, replace or repair it at noadditional charge except as set forth in the following terms. This warranty doesnot apply to products damaged by misuse, modifications, accident or disaster. Vendor assumes no liability for any damages, lost profits, lost savings or anyother incidental or consequential damage resulting from the use, misuse of, orinability to use this product. Vendor will not be liable for any claim made by anyother related party. Return authorization must be obtained from the vendor before returned merchan-dise will be accepted. Authorization can be obtained by calling or faxing the vendor and requesting a Return Merchandise Authorization (RMA) number. Returned goods should always be accompanied by a clear problem description.