ICOP-6021

Embedded 386SX CPU ISA Half Size SBC

User's Manual

(Version 1.1)

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T a b l e   o f   C o n t e n t s

C h a p t e r 0
Startup

0.1   Packing List

Product Name	Function	Package
ICOP-6021	Embedded 386SX ISA Half Size All-in-One SBC	● **ICOP-6021 Embedded 386SX CPU SBC** ● **FDD cable x 1** ● **HDD cable x 1** ● **Printer cable with bracket x 1** ● **AT KB / PS2 Mouse Y-cable x 1**

0.2 Specifications

Features	ICOP-6021
Chipset	DM&P(ALi) M6117D
Processor	386SX-40MHz
Multi I/O Chip	ALi 5113
BIOS	AMI BIOS
Watchdog Timer	From 30.5μs to 512 seconds
Bus Interface	ISA and PC/104 standard compliant
Memory	4MB onboard and one 72pin SIMM socket for extension
SSD	DiskOnChip/Flash x1 or Micro Disk Chip x 1
Digital I/O	16 bit
Enhanced IDE Port	1
Floppy Connector	1
Serial Port	RS232 X 2 (or RS232x1,RS485x1)
Parallel Port	1
Power Requirement	+5V@500mA, ±12V@20mA
Board Weight	175g
Board Size	185mm X 122 mm
Operating Tempture	-20 ~ +60°C

0.3 Component Location

ICOP-6021

Parallel Port

GPIO Cont.

EIDE Port

Keyb. Cont.

FDD Port

P8 Power Cont.

RS485.

SIMM2

MDC Socket

DOC Socket

PS/2 Keyb.

COM2 Port

COM1 Port
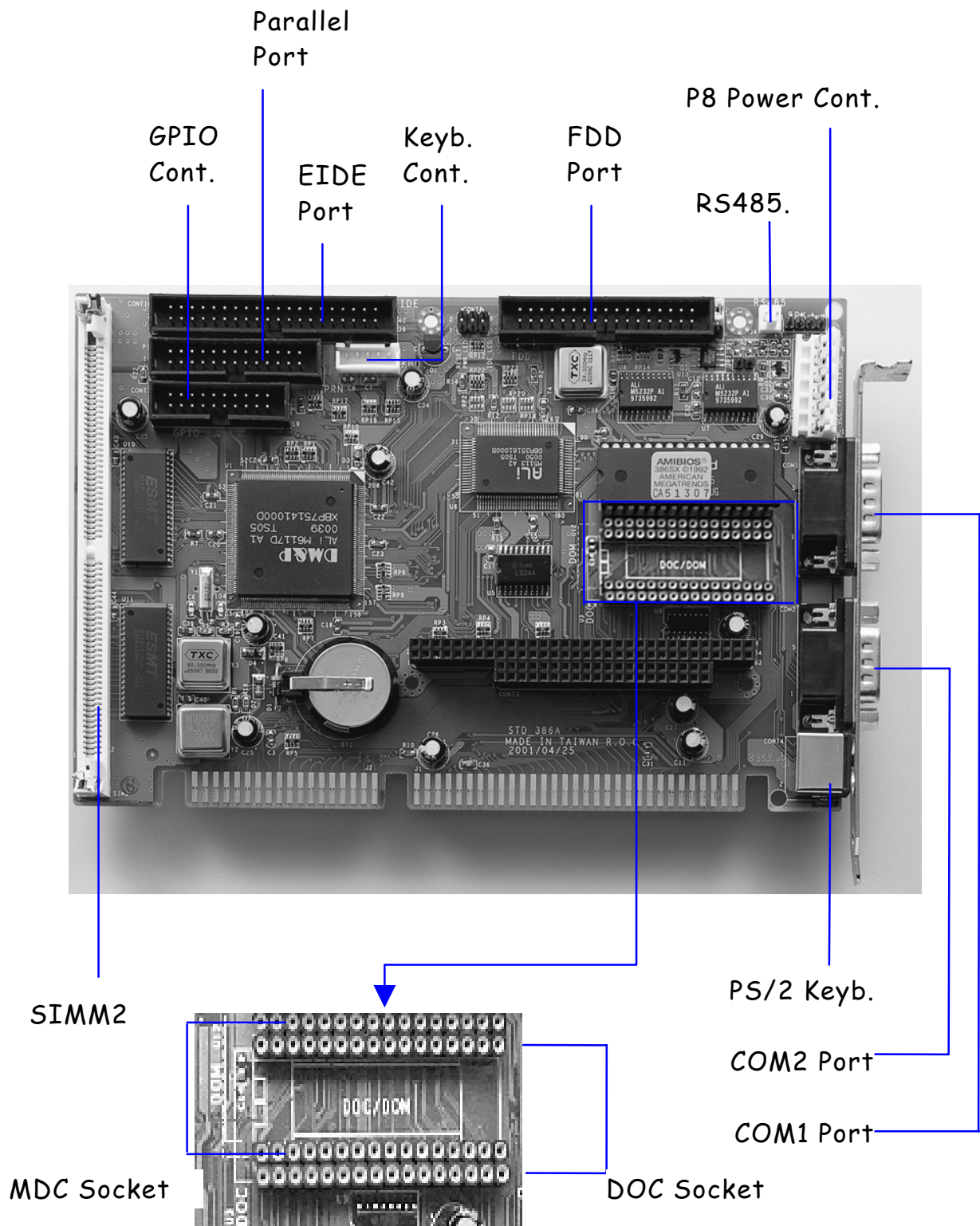
C h a p t e r 1
Introduction

1.1   Features

● Half-size (185x122 mm) Embedded CPU Single Board Computer

● ISA-bus interface with onboard PC/104 connector

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

● 4MB EDO RAM onboard and one 72pin SIMM socket for extension

● Enhanced IDE devices and FDD interface

● One Bi-directional Parallel Port

● DB-9 connector for RS232 x2, (or RS232 x1 and RS485 x1)

● Watchdog timer

● 16-bit GPIO connector on-board

● Dual Socket for DiskOnChip(or Flash Disk) or Micro Disk Chip

● Onboard Keyboard, Mouse connector

● Single voltage +5 V power connector

● Operating temperature from –20 °C +60 °C

● Flexible OEM/ODM design

1.2 Specifications

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

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

• **DRAM Memory:** 4MB EDO DRAM onboard and one 72pin SIMM socket for extension

• **Bus Interface:** ISA and PC/104

• **Data Bus:** 16-bit

• **Bus Speed:** PC/104 - 8 MHz

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

• **DMA Channels:** 7

• **Interrupt Levels:** 15

• **Enhanced IDE:** supports one port and up to two enhanced IDE (PIO mode 4) hard drives

• **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.

• **Keyboard and Mouse Connectors:** supports different tpye connectors of AT Keyboard and PS/2-mouse

High Speed Multi I/O

• **Chipset:** 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

• **Floppy Disk Drive Interface:** supports up to two floppy drives, 5¼" (360 KB or 1.2 MB) and 3½ " (720 KB, 1.44 MB)

• **Bi-directional Parallel Port:** supports SPP, EPP and ECP mode

Environmental and Power

• **Power Requirements:**

   +5 V@0.5A

• **Board Dimensions:** 185 (L) x 122 (W) mm.

• **Board Weight:** 175 g

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

1.3 DiskOnChip 2000 Flash Disk

Flash Disk DiskOnChip ® 2000

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

• **Capacity:** 1-144 MByte capacity

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

• **Memory Window:** 8 KByte

1.4 MicroDisk Chip

• **Capacity:** 4, 8, 16, 32, 48, 64, 96, 128 MB (unformatted)
• **IDE interface through 32 pin dip package.**
• **Host data transfer rate:** PIO4 data transfer (max. 16.6 MBps).

C h a p t e r 2
Installation

2.1 Jumper Settings

ICOP-6021
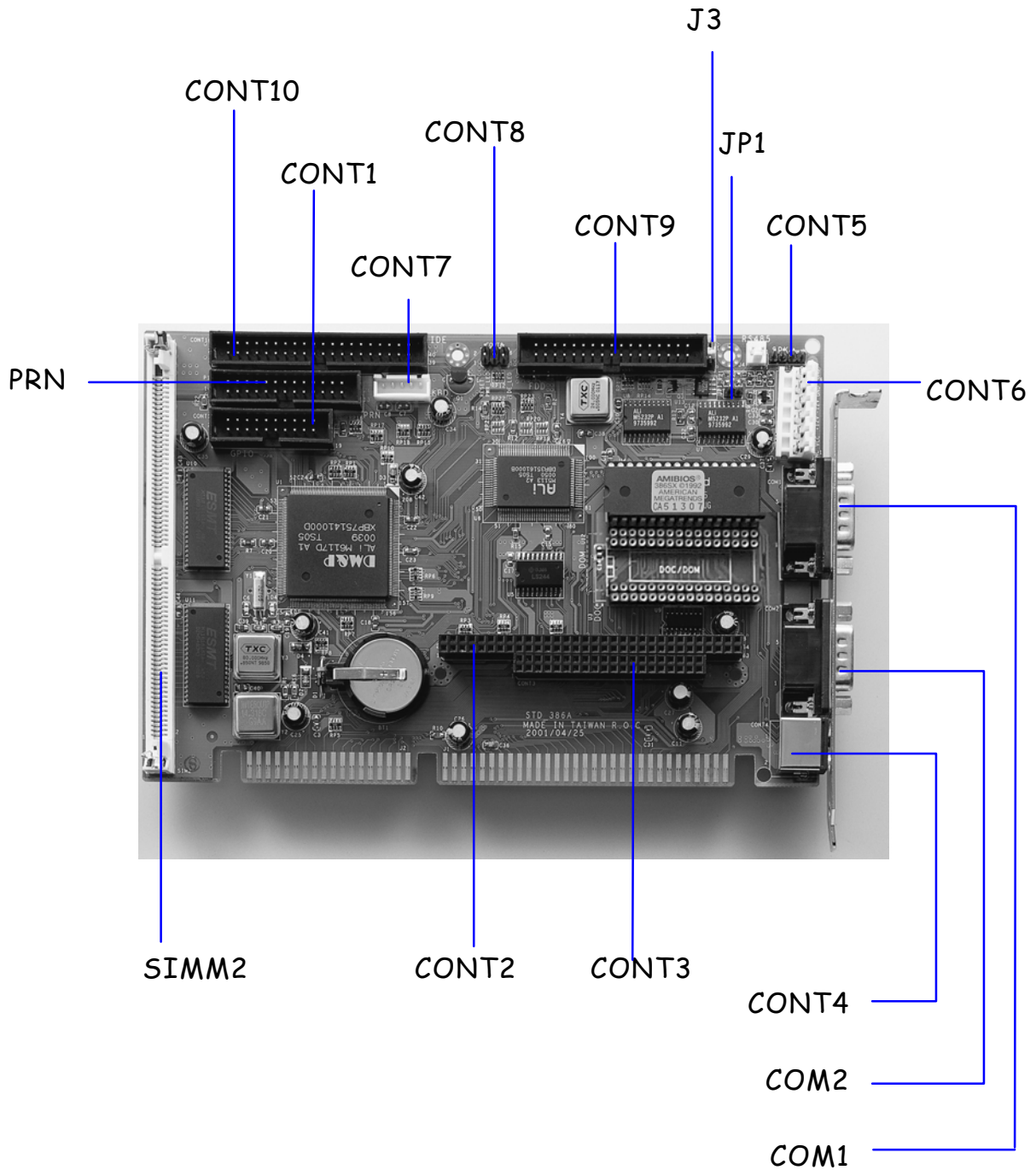
JP1   Terminator of RS485 (Only close when ICOP-6021 is the farest-end device of RS485 chain)

J3   RS-232/485 selection

1-2: RS-232 mode

2-3: RS-485 mode

2.2   Connectors

CONT1   Internal 20-pin box header for 16-bit GPIO (digital I/O)

CONT2   PC/104 bus 64-pin

CONT3   PC/104 bus 40-pin

CONT4   External PS/2 and AT keyboard connector

CONT5   Speaker connector

CONT6   Power connector

CONT7   Internal AT-keyboard connector

CONT8   1-2 Reset

 3-4 Power LED connector

 5-6 IDE LED connector

CONT9   FDD connector

CONT10 Internal 40-pin box header for IDE

COM1   External 9-pin male D-type connector for COM1

COM2   Internal 10-pin box header connector for COM2

SIM2   72-pin SIMM socket

2.3　DiskOnChip/Flash ROM Disk

2.3.1 Setup a DiskOnChip ® 2000 Flash Disk

Installation Instructions

1. Make sure the ICOP-602X(V) is powered OFF

2. Plug the DiskOnChip 2000 device(s) 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: (Software Setting only for ICOP-6020 & ICOP-6025)

> 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 – only for ICOP-6020)
> 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 ICOP-602X(V)'s Flash disk you will have to initialize it using a software utility called "PC104.EXE". This program can be found on the utility disk in the subdirectory "A:\FLASH"

- Connect a keyboard and floppy disk ICOP-602X(V) to the PC/104 bus and boot-up your system.

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

```
ICOP-602X(V) 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 EPROM 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
```

```asm
        mov ax, 0403bh ; Set the expected counter
                       ; value
        call writechip ; to [400000h]
        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, 01000000 ; 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 23h,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.
```

```
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
```

Appindex

Pin Assignments

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

Floppy Disk Connector

Pin	Description	Pin	Description
1	GND	2	Drive Enable Select
3	GND	4	N/C
5	GND	6	N/C
7	GND	8	Index #
9	GND	10	Drive select 0
11	GND	12	Drive select 1
13	GND	14	Drive select 2
15	GND	16	Motor enable
17	GND	18	Direction #
19	GND	20	STEP #
21	GND	22	Write data #
23	GND	24	Write gate #
25	GND	26	Track 0 #
27	GND	28	Write protect #
29	GND	30	Read data #
31	GND	32	Side 1 select #
33	GND	34	Disk change #

Parallel Port Interface

Pin	Description	Pin	Description
1	Strobe	2	Data 0
3	Data 1	4	Data 2
5	Data 3	6	Data 4
7	Data 5	8	Data 6
9	Data 7	10	Acknowledge #
11	Busy	12	Paper Empty #
13	Printer Select	14	Auto Form Feed #
15	Error #	16	Initialize #
17	Printer Select In #	18	GND
19	GND	20	GND
21	GND	22	GND
23	GND	24	GND
25	GND	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
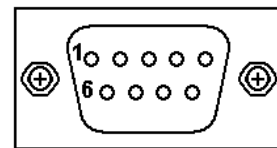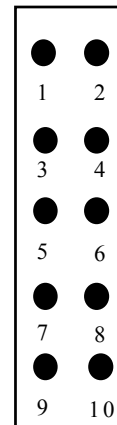
Keyboard and PS/2 Mouse Connector

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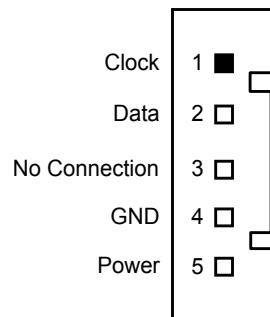
Note for Keyboard:

Pin1: KBCLK
Pin2: KBDATA

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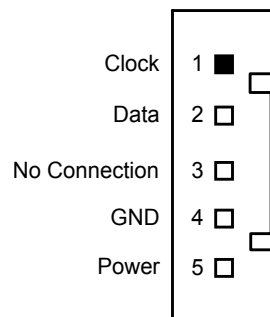
Note for Mouse:

Pin1: MCLK
Pin2: MDATA

PC/104 Connectors

64-Pin Long Connector

PIN No.	PIN Name	PIN No.	PIN Name
1	IOCHCHK *	2	0V
3	SD7	4	RESETDRV
5	SD6	6	+5V
7	SD5	8	IRQ9
9	SD4	10	-5V
11	SD3	12	DRQ2
13	SD2	14	-12V
15	SD1	16	ENDXFR *
17	SD0	18	+12V
19	IOCHRDY	20	(KEY)
21	AEN	22	SMEMW *
23	SA19	24	SMEMR *
25	SA18	26	IOW *
27	SA17	28	IOR *
29	SA16	30	DACK3 *
31	SA15	32	DRQ3
33	SA14	34	DACK1 *
35	SA13	36	DRQ1
37	SA12	38	REFRESH *
39	SA11	40	SYSCLK
41	SA10	42	IRQ7
43	SA9	44	IRQ6
45	SA8	46	IRQ5
47	SA7	48	IRQ4
49	SA6	50	IRQ3
51	SA5	52	DACK2 *
53	SA4	54	TC
55	SA3	56	SALE
57	SA2	58	+5V
59	SA1	60	OSC
61	SA0	62	0V
63	0V	64	0V

40-Pin Short Connector

PIN No.	PIN Name	PIN No.	PIN Name
1	0V	2	0V
3	MEMCS16 *	4	SBHE *
5	IOCS16 *	6	LA23
7	IRQ10	8	LA22
9	IRQ11	10	LA21
11	IRQ12	12	LA20
13	IRQ15	14	LA19
15	IRQ14	16	LA18
17	DACK0 *	18	LA17
19	DRQ0	20	MEMR *
21	DACK5 *	22	MEMW *
23	DRQ5	24	SD8
25	DACK6 *	26	SD9
27	DRQ6	28	SD10
29	DACK7 *	30	SD11
31	DRQ7	32	SD12
33	+5V	34	SD13
35	MASTER *	36	SD14
37	0V	38	SD15
39	0V	40	(KEY)

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

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.