SOM-2367

Transmeta Crusoe TM5800
SOM-144 System On Module

Users Manual

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This manual is for the SOM-2367.

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Packing List

Before you begin installing your card, please make sure that the following materials have been shipped:

- 1 SOM-2367 System On Module CPU module
- CD-ROM or Disks for utility, drivers, and manual (in PDF format)

Additional Information and Assistance

1.Visit the Advantech web site at **www.advantech.com** where you can find the latest information about the product.
2.Contact your distributor, sales representative, or Advantech's customer service center for technical support if you need
additional assistance. Please have the following information ready before you call:
•Product name and serial number
•Description of your peripheral attachments
•Description of your software (operating system, version, application software, etc.)
•A complete description of the problem
•The exact wording of any error messages

Contents

Chapter 1 General Information 1
1.1 Introduction 2
1.2 Specifications 3
1.2.1 Mechanical and Envir onmental 4
1.3 Board layout: dimensions 5
Figure 1.1: Board layout: dimensions 5
Chapter 2 Installation 7
2.1 Jumpers and connectors 8
Table 2.1: Jumpers and connectors 8
2.2 Board layout: jumper/connector locations 9
Figure 2.1: Jumper/connector locations 9
Figure 2.2: Solder side connectors 10
2.3 Safety Precautions 11
2.4 Setting jumpers 12
2.4.1 Clear CMOS (J1) 13
2.5 144-pin SODIMM of SOM 144/PCI (PCI/IDE/ Serial port /USB/AC97/KB/Mouse) (CN2)13
2.6 Recommended front-end 80-pin connector (Ethernet/IrDA/Printer/FDD/ATX) (CN1)13
2.7 Card Installation 14
Figure 2.3: Installing the SOM-2367 14
2.8 Card removal 15
Figure 2.4: SOM-2367 Removal 15
Chapter 3 Award BIOS Setup 17
3.1 System test and initialization 18
3.1.1 System configuration verification 18
3.2 Award BIOS setup 19
3.2.1 ..... Entering setup19
Figure 3.1: BIOS setup program initial screen 19
3.2.2 Standard CMOS setup 20
Figure 3.2: CMOS setup screen 20
3.2.3 BIOS features setup 21
Figure 3.3: BIOS features setup 21
3.2.4 Chipset features setup 21
Figure 3.4: Chipset features setup 21
3.2.5 Power management setup 22
Figure 3.5: Power management setup 22
3.2.6 PnP/PCI configuration 22
Figure 3.6: PnP/PCI configuration 22
3.2.7 Integrated peripherals 23

Figure 3.7: ROM PCI/ISA BIOS 23
3.2.8 Load BIOS defaults 23
Figure 3.8: Load BIOS defaults screen 23
3.2.9 Change password 24
3.2.10 Auto detect hard disk 25
Figure 3.9: IDE HDD auto detection screen 25
3.2.11 Save & exit setup 25
3.2.12 Exit without saving 25
Chapter 4 Audio Setup 27
4.1 Introduction 28
4.2 DOS utilities 28
4.2.1 Via Sound Blaster Pro compatible set up program . 28
4.2.2 VIA Sound Blaster Installation 29
4.3 Driver installation 29
4.3.1 Before you begin 29
4.3.2 Windows 95/98 drivers 30
4.3.3 Windows NT drivers 37
Chapter 5 PCI Bus Ethernet Interface 41
5.1 Introduction 42
5.2 Installation of Ethernet driver 42
5.2.1 Installation for Windows 98/2000 43
5.2.2 Installation for Windows NT 45
5.3 Further information 47
Appendix A System Assignments 51
A.1 System I/O ports 52
Table A.1: System I/O ports 52
A.2 DMA channel assignments 53
Table A.2: DMA channel assignments 53
A.3 Interrupt assignments 54
Table A.3: IRQ 6 54
A.4 1st MB memory map 55
Table A.4: 1st MB memory map 55
Appendix B Programming the Watchdog Timer 57
B.1 Watchdog timer instructions 58

CHAPTER 1

General Information

This chapter gives background information on the SOM-2367.

Sections include:

- Card specifications
- Board layout

Chapter 1 Introduction

1.1 Introduction

Advantech's new SOM-144 Module, the SOM-2367, a Transmeta TM5800 system on module comes equipped with DDR SDRAM support, two USB interfaces, IrDA interfaces, AC 97 interfaces, a 10/100 base-T Ethernet interface (for SOM-2367). In addition, it is equipped with two RS-232 serial ports. One bi-directional printer port supports SPP, ECP and EPP modes. Three master PCI interfaces, an IDE HDD interface and a floppy disk controller provide functional expansion. With its industrial grade reliability, the SOM-2367 can operate continuously at temperatures up to 140° F (60° C). This compact unit offers all these functions within the space of a 2.5" hard disk drive (68 mm * 100 mm).

The numerous features provide an ideal price/performance solution for high-end commercial and industrial applications where stability and reliability are essential. The SOM-2367 Series complies with the "Green Function" standard and supports three types of power saving features: Normal, Doze and Sleep modes. The SOM-2367 also supports LongRun function. The system can automatically slow CPU frequency down to 300 MHz and CPU core voltage from 1.3 V to 0.9 V depending on the CPU loading application. The long run function can save over 50% in power consumption using only 3.2 W with TM5800-800 CPU and Max. 512 MB memory. The SOM-2367 is compact, highly integrated and easy to maintain, upgrade, and install. These features make it ideal for applications such as small industrial controllers, Panel PCs, security systems, Internet gateways, instruments, medical equipment, building automation and well as others:

1.2 Specifications

CPU: Embedded Transmeta Crusoe TM5800-800 1.3 V processor
Chipset: Transmeta Crusoe chip and VIA VT82C686 (super South Bridge)
BIOS: AWARD 256 KB FLASH memory
RAM memory: DDR SDRAM SO-DIMMx1(Max. 512 MB) on board.

PCI/IDE/ Serial port /USB/AC97/KB/Mouse (SODIMM socket):
I/O expansion: 3 master PCI bus (3.3 V PCI)
Enhanced IDE hard disk drive interface: Supports up to two EIDE devices. BIOS auto-detect., PIO Mode 3 or Mode 4 transfer, Ultra DMA33 mode-4) up to 33 MB/sec.
Serial ports: Support two serial ports,TTL signal
PS/2 Keyboard and PS/2 Mouse
Universal Serial Bus: Two USB ports, USB 1.1 compliant.
AC97 codec interface:
AC97 version 2.0, compliant interface.

Ethernet/IrDA/FDD/Printer/ATX Power (front-end connector):
Ethernet interface (SOM-2367 only):
Ethernet Chipset: RTL8139(Intel 82551ER optional)
Ethernet interface: PCI 10/100 Mbps Ethernet. IEEE 802.3 U protocol compatible I/O address switchless
Infrared: Supports IrDA version 1.0 SIR (115.2 kbps), IrDA version 1.1 MIR (1.152 Mbps) and FIR (4 Mbps) protocol, and SHART ASK-IR protocol (max baud rate 57.6kbps)

Supports ATX power supply

Floppy disk drive interface/Multi-mode parallel port:
FDD interface and parallel port share the same bus either FDD or Parallel port can be used at one time.
FDD interface supports one floppy disk drive
Parallel supports SPP, ECP and EPP.

Power management: Supports power saving modes including Normal/ Doze/Sleep modes. APM 1.1 compliant

Note: All interfaces are compliant with SOM-144 Specification and Design Guide Rev 1.0

1.2.1 Mechanical and Environmental

Dimensions (L x W): 68 mm x 100 mm (2.8" x 4.1")
Power supply voltage: +5 V (4.75 V ~ 5.25 V)
Power requirements: (SOM-2367 w/Max 512 MB memory, TM5800-800 CPU)
LongRun mode: +5 V @ 0.64 A
Typical mode: +5 V @ 0.85 A, Max: +5 V @ 1.6 A
Weight: 0.05 Kg

1.3 Board layout: dimensions

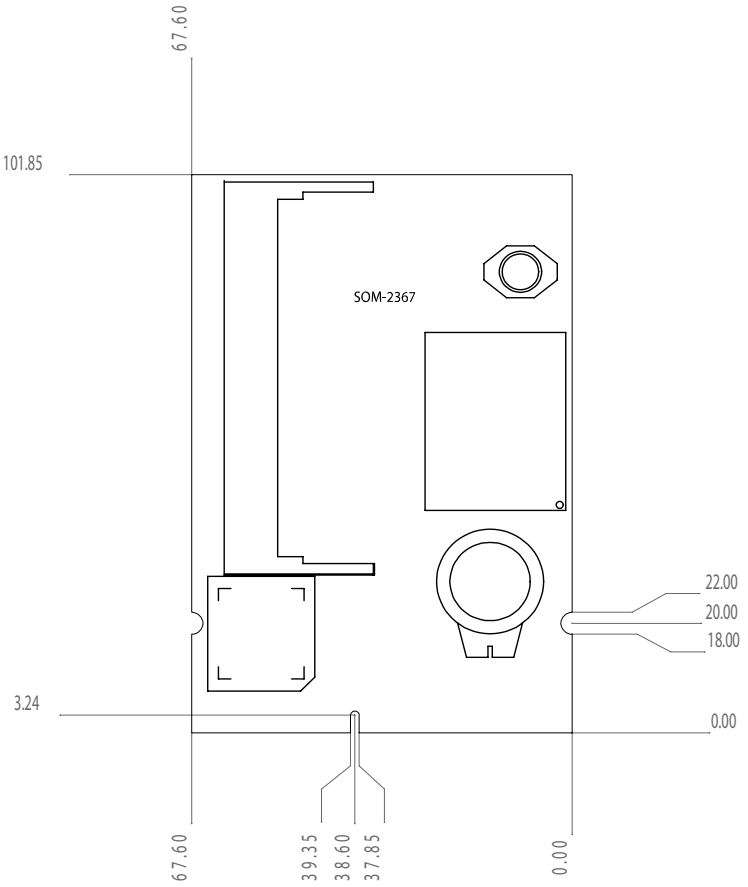


Figure 1.1: Board layout: dimensions

CHAPTER 2

Installation

This chapter explains the setup procedures of SOM-2367 hardware, including instructions on setting jumpers and connecting peripherals, switches and indicators. Be sure to read all safety precautions before you begin the installation procedure.

Chapter 2 Installation

2.1 Jumpers and connectors

On-board connectors link to external devices such as hard disk drives, keyboards, floppy drives, and so on. In addition, the board has jumpers for configuring your board for specific applications.

The table below lists the function of each of the board's jumpers and connectors. Later sections in this chapter give detailed information on each jumper setting, and instructions for connecting external devices to your card.

Table 2.1: Jumpers and connectors

Name	Function
CN1	Front-end connector (Ethernet/IrDA/FDD/LPT)
CN3	Power connector
CN2	SODIMM gold finger (PCI/IDE/Serial port/USB/AC97/KB/ Mouse)
J1	Clear CMOS

2.2 Board layout: jumper/connector locations

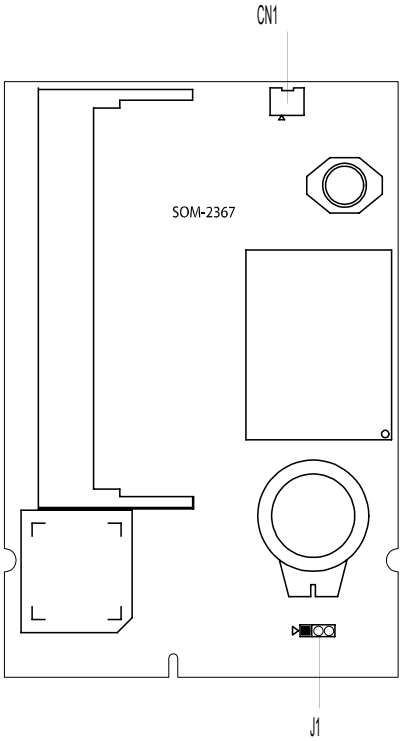


Figure 2.1: Jumper/connector locations

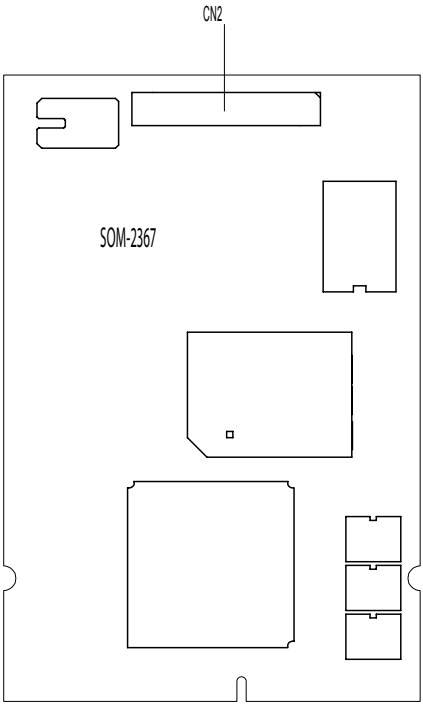


Figure 2.2: Solder side connectors

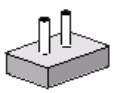
2.3 Safety Precautions

Warning! *Always completely disconnect the power cord from your chassis whenever you are working on it. Do not make connections while the power is on because sensitive electronic components can be damaged by the sudden rush of power. Only experienced electronics personnel should open the PC chassis.*

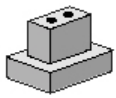
Caution! *Always ground yourself to remove any static charge before touching the CPU card. Modern electronic devices are very sensitive to static electric charges. Use a grounding wrist strap at all times. Place all electronic components on a static-dissipative surface or in a static-shielded bag when they are not in the chassis.*

2.4 Setting jumpers

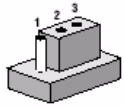
You may configure your card to match the needs of your application by setting jumpers. A jumper is a metal bridge used to close an electric circuit. It consists of two metal pins and a small metal clip (often protected by a plastic cover) that slides over the pins to connect them. To "close" a jumper, you connect the pins with the clip. To "open" a jumper, you remove the clip. Sometimes a jumper will have three pins, labeled 1, 2 and 3. In this case you would connect either pins 1 and 2, or 2 and 3.



open



closed



closed 2-3

The jumper settings are schematically depicted in this manual as follows.

open

closed

closed 2-3

A pair of needle-nose pliers may be helpful when working with jumpers.

If you have any doubts about the best hardware configuration for your application, contact your local distributor or sales representative before you make any changes.

Generally, you simply need a standard cable to make most connections.

2.4.1 Clear CMOS (J1)

This jumper is used to erase CMOS data and reset system BIOS information.

The procedure for clearing CMOS is:

1. Turn off the system.
2. Short pin 2 and pin 3.
3. Turn on the system. The BIOS is now reset to its default setting.

2.5 144-pin SODIMM of SOM 144/PCI (PCI/IDE/ Serial port /USB/AC97/KB/Mouse) (CN2)

The SOM-2367 is compliant with *SOM-144 Design Specification Rev. 1.0.* For the description of each signal, please refer this document. You may find it in the CD-ROM that comes with your SOM-2367 module.

2.6 Recommended front-end 80-pin connector (Ethernet/IrDA/Printer/FDD/ATX) (CN1)

The SOM-2367 is compliant with the SOM-144 Design Specification Rev. 1.0. For the description of each signal, please refer to this document. It is included on the CD-ROM that comes with your SOM-2367 module.

2.7 Card Installation

1. Plug SOM-144 module into the solution board's SODIMM socket.
2. Connect the front-end connector to the solution board
3. Must screw the SOM-144 module and the solution board together.

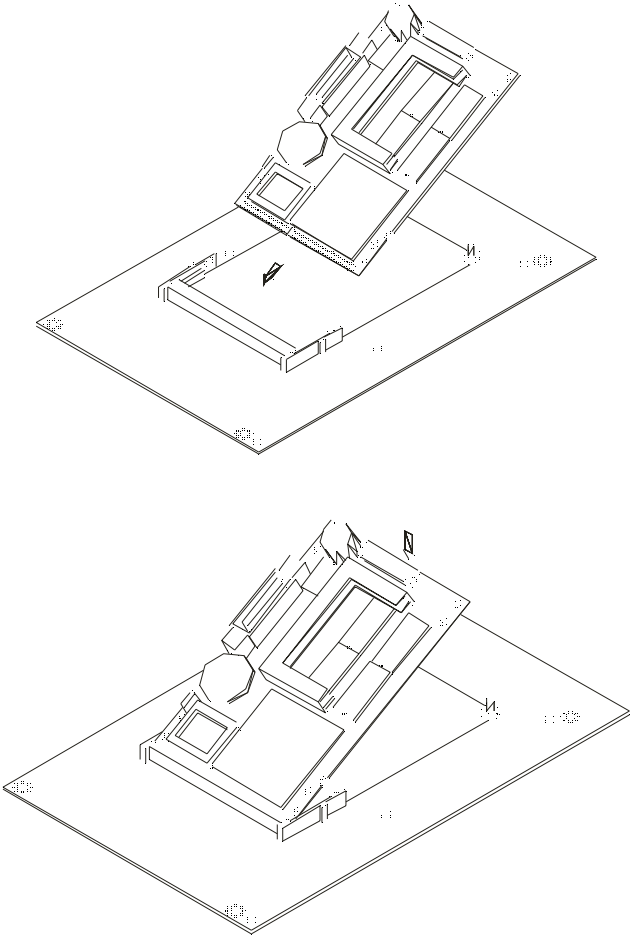


Figure 2.3: Installing the SOM-2367

2.8 Card removal

1. Unscrew two screws.
2. Bend out the positioning holders of SODIMM socket and release the SOM 144 module.
3. Unplug SOM-144 module from the socket.

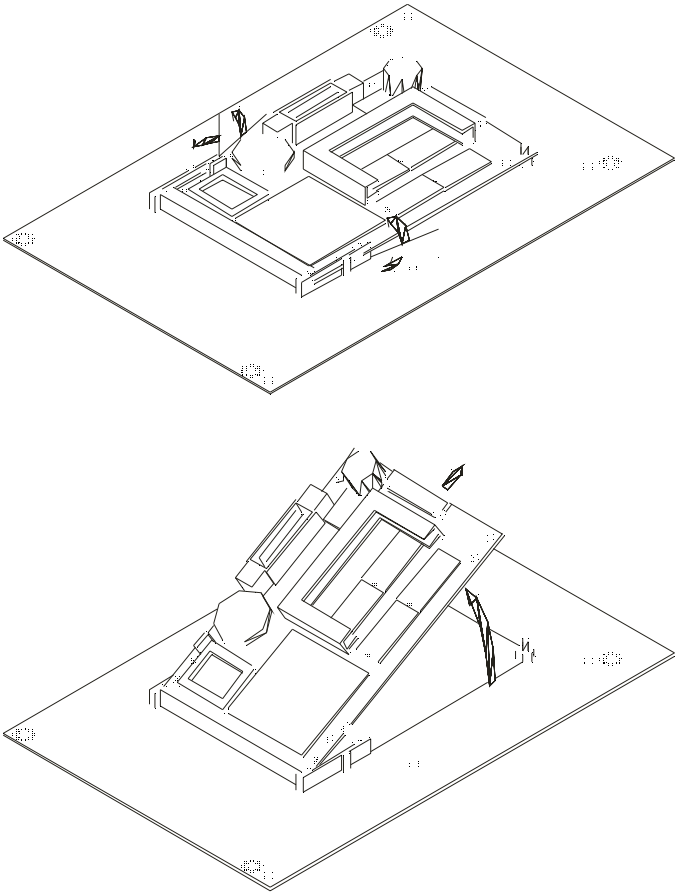


Figure 2.4: SOM-2367 Removal

CHAPTER 3

Award BIOS Setup

This chapter describes how to set BIOS configuration data.

Chapter 3 Award Bios Setup

3.1 System test and initialization

These routines test and initialize board hardware. If the routines encounter an error during the tests, you will either hear a few short beeps or see an error message on the screen. There are two kinds of errors: fatal and non-fatal. The system can usually continue the boot up sequence with non-fatal errors. Non-fatal error messages usually appear on the screen along with the following instructions:

press <F1> to RESUME

Write down the message and press the F1 key to continue the bootup sequence.

3.1.1 System configuration verification

These routines check the current system configuration against the values stored in the board's CMOS memory. If they do not match, the program outputs an error message. You will then need to run the BIOS setup program to set the configuration information in memory.

There are three situations in which you will need to change the CMOS settings:

1. You are starting your system for the first time
2. You have changed the hardware attached to your system
3. The CMOS memory has lost power and the configuration information has been erased.

The SOM-2367 Series' CMOS memory has an integral lithium battery backup. The battery backup should last ten years in normal service, but when it finally runs down, you will need to replace the complete unit.

Warning! *Always completely disconnect the power cord from your chassis whenever you are working on it. Do not make connections while the power is on because sensitive electronic components can be damaged by the sudden rush of power. Only experienced electronics personnel should open the PC chassis.*

3.2 Award BIOS setup

Award's BIOS ROM has a built-in Setup program that allows users to modify the basic system configuration. This type of information is stored in battery-backed CMOS RAM so that it retains the Setup information when the power is turned off.

3.2.1 Entering setup

Power on the computer and press <Del> immediately. This will allow you to enter Setup.

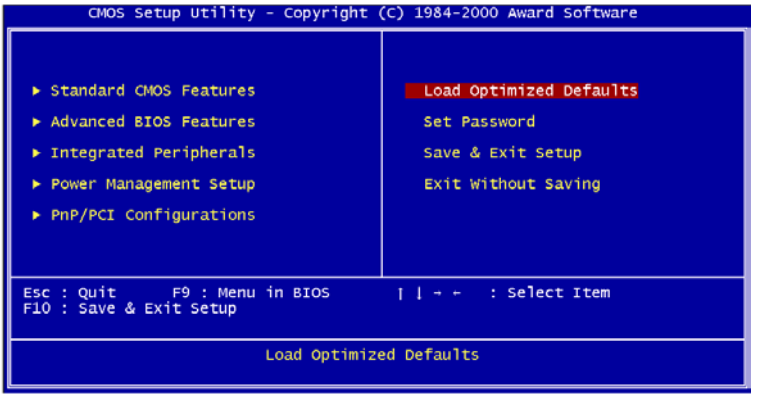


Figure 3.1: BIOS setup program initial screen

3.2.2 Standard CMOS setup

When you choose the Standard CMOS Setup option from the Initial Setup Screen menu, the screen shown below is displayed. This standard Setup Menu allows users to configure system components such as date, time, hard disk drive, floppy drive and display. Once a field is highlighted, on-line help information is displayed in the left bottom of the Menu screen.

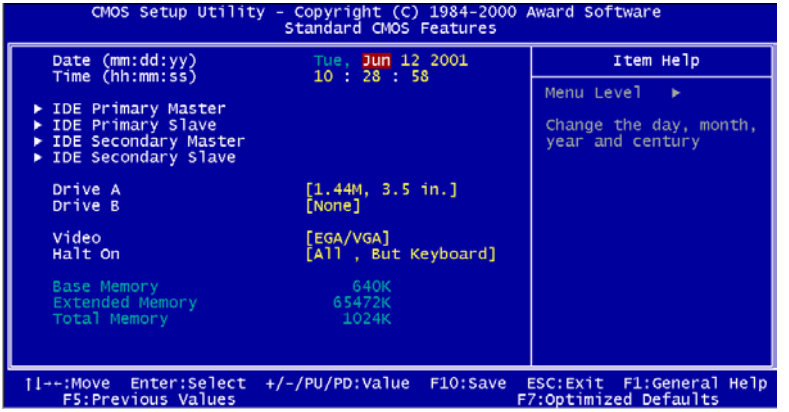


Figure 3.2: CMOS setup screen

3.2.3 BIOS features setup

By choosing the BIOS FEATURES Setup option from the Initial Setup Screen menu, the screen below is displayed. This sample screen contains the manufacturer's default values for the SOM-2367 Series.

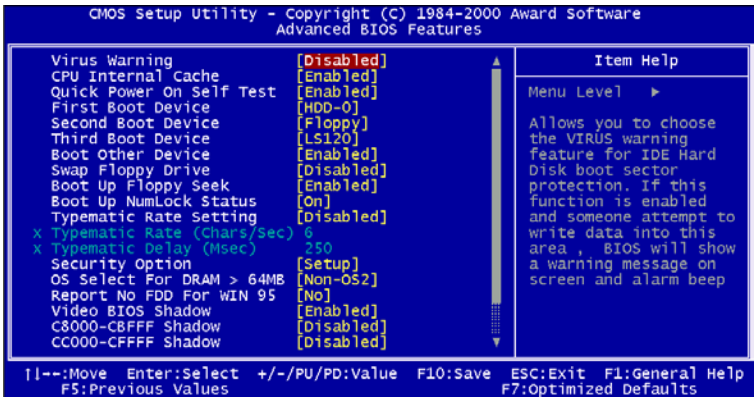


Figure 3.3: BIOS features setup

3.2.4 Chipset features setup

By choosing the CHIPSET FEATURES Setup option from the Initial Setup Screen menu, the screen below is displayed. This sample screen contains the manufacturer's default values for the SOM-2367 Series.

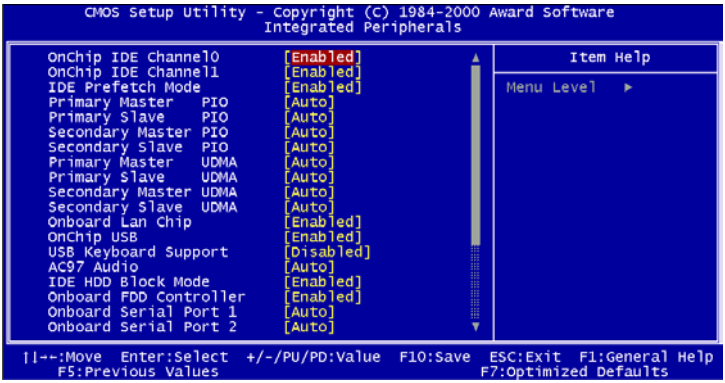


Figure 3.4: Chipset features setup

3.2.5 Power management setup

By choosing the POWER MANAGEMENT Setup option from the Initial Setup Screen menu, the screen below is displayed. This sample screen contains the manufacturer's default values for the SOM-2367 Series.

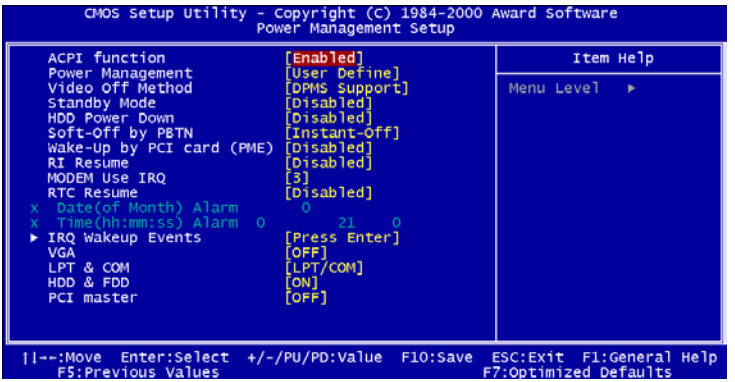


Figure 3.5: Power management setup

3.2.6 PnP/PCI configuration

By choosing the PnP/PCI CONFIGURATION option from the Initial Setup Screen menu, the screen below is displayed. This sample screen contains the manufacturer's default values for the SOM-2367 Series.

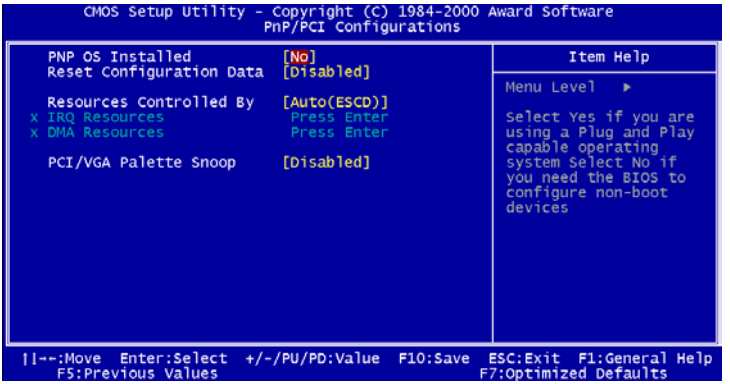


Figure 3.6: PnP/PCI configuration

3.2.7 Integrated peripherals

By choosing the INTEGRATED PERIPHERALS option from the Initial Setup Screen menu, the screen below is displayed. This sample screen contains the manufacturer's default values for the SOM-2367

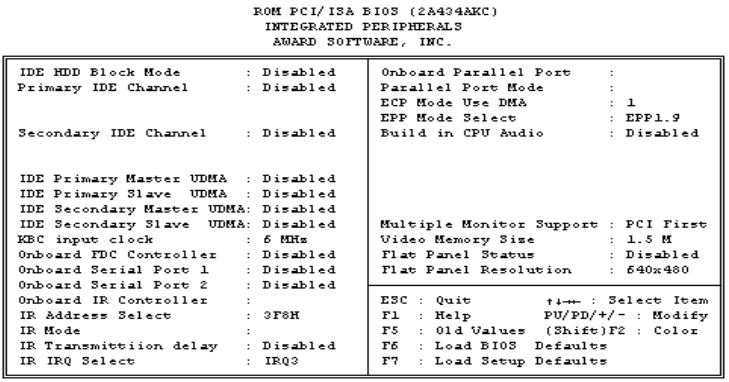


Figure 3.7: ROM PCI/ISA BIOS

3.2.8 Load BIOS defaults

LOAD BIOS DEFAULTS loads the default system values directly from ROM. If the stored record created by the Setup program becomes corrupted (and therefore unusable), these defaults will load automatically when you turn the SOM-2367 Series on.

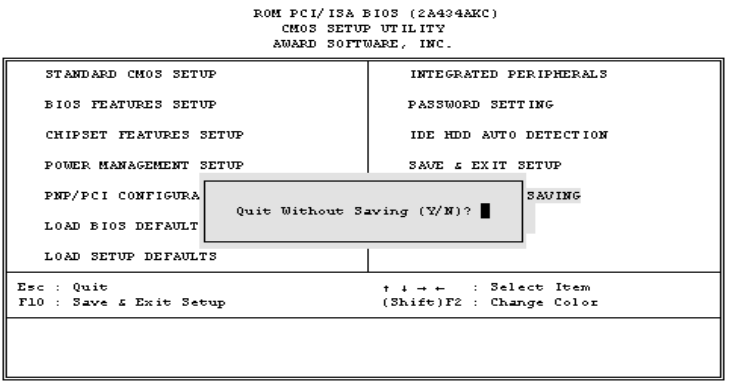


Figure 3.8: Load BIOS defaults screen

3.2.9 Change password

To change the password, choose the PASSWORD SETTING option form the Setup main menu and press <Enter>.

1. If the CMOS is bad or this option has never been used, a default password is stored in the ROM. The screen will display the following messages:

   Enter Password:

   Press <Enter>.

2. If the CMOS is good or this option has been used to change the default password, the user is asked for the password stored in the CMOS. The screen will display the following message:

   Confirm Password:

   Enter the current password and press <Enter>.

3. After pressing <Enter> (ROM password) or the current password (user-defined), you can change the password stored in the CMOS. The password can be at most eight (8) characters long.

Remember - to enable this feature, you must first select either Setup or System in the BIOS FEATURES SETUP.

3.2.10 Auto detect hard disk

The IDE HDD auto detection utility can automatically detect the IDE hard disk installed in your system. You can use it to self-detect and/or correct the hard disk type configuration.

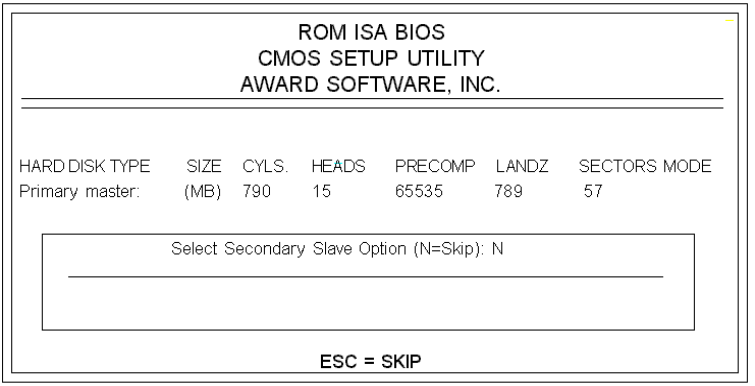


Figure 3.9: IDE HDD auto detection screen

3.2.11 Save & exit setup

If you select this option and press <Enter>, the values entered in the setup utilities will be recorded in the chipset's CMOS memory. The microprocessor will check this every time you turn your system on and compare this to what it finds as it checks the system. This record is required for the system to operate.

3.2.12 Exit without saving

Selecting this option and pressing <Enter> lets you exit the Setup program without recording any new values or changing old ones.

CHAPTER 4

Audio Setup

The SOM-2367 is equipped with an audio interface that records and playback CD-quality audio. This chapter provides instructions for installing the software drivers on the included audio driver diskettes.

Chapter 4 Audio Setup

4.1 Introduction

The SOM-2367's on-board audio interface provides high-quality stereo sound and FM music synthesis (ESFM) by using the VIA VT82C686 audio controller from VIA. The audio interface can record, compress, and play back voice, sound, and music with built-in mixer control.

The SOM-2367 on board audio interface also supports the Plug and Play (PnP) standard and provides PnP configuration for the audio, FM, and MPU-104 logical devices. It is compatible with Sound Blaster™; Sound Blaster Pro™ version 3.01, voice and music functions. The ESFM synthesizer is register compatible with the OPL3 and has extended capabilities.

4.2 DOS utilities

4.2.1 Via Sound Blaster Pro compatible set up program

Please "Enabled" the Sound Blaster setting on the BIOS first before you want to play the Sound Blaster compatible DOS games. You could follow the selecting to enable the setting on the BIOS:

INTEGRATED PERIPHERALS -> Onboard Legacy Audio

-> Sound Blaster (Disable -> Enabled)

Chipset Feature Setup->On Chip Sound (Disable-> Enabled)

The Sound Blaster Pro compatible sound chip is integrated into the VIA PCI audio device in order to have Sound Blaster compatible DOS games running on the system.

If you want to play those Sound Blaster compatible DOS games under the real mode MS-DOS or the "Restart in MS-DOS" from Win9x.

Then you should run this setup program to enable the OPL3 MIDI music. Otherwise, the music will not be heard but the sound still could be heard. If you want to play the legacy games on the Windows DOS Box then you need then you don't need to install this program.

4.2.2 VIA Sound Blaster Installation

You can enable the Sound Blaster Pro compatible function by using this function.

Step 1. Enable the Sound Blaster first on the BIOS setting of the "Onboard Legacy Audio" and "On-Chip Sound".

Step 2. Run the "Install.exe".
A> INSTALL

Step 3. The program will copy the relative files into the directory which you assign. Next, the program will insert the following new line into the AUTOEXEC.BAT and copy the original AUTOEXEC.BAT to AUTOEXEC.VIA.
C: \VIAUDIO\VIAUDIO.COM

Step 4. Reboot the system when the installation is complete.

Step 5. Uninstall by deleting the line from the AUTOEXEC.BAT>.

4.3 Driver installation

4.3.1 Before you begin

To facilitate the installation of the audio drivers, you should read the instructions in this chapter carefully before you attempt installation. The audio drivers for the SOM-2367 board are located on the audio driver CD. You must install the drivers by using the supplied SETUP program.

.

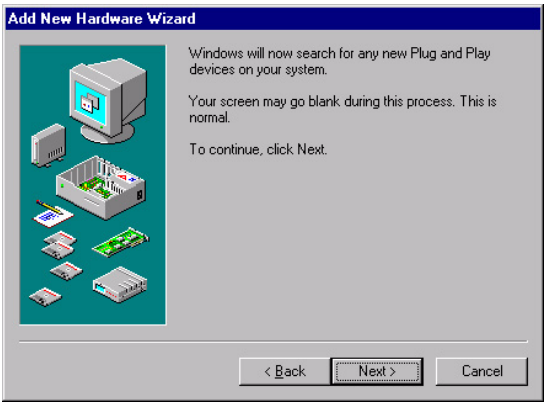
Note: *The files on the software installation diskette are compressed. Do not attempt to install the drivers by copying the files manually. You must use the supplied SETUP program to install the drivers.*

4.3.2 Windows 95/98 drivers

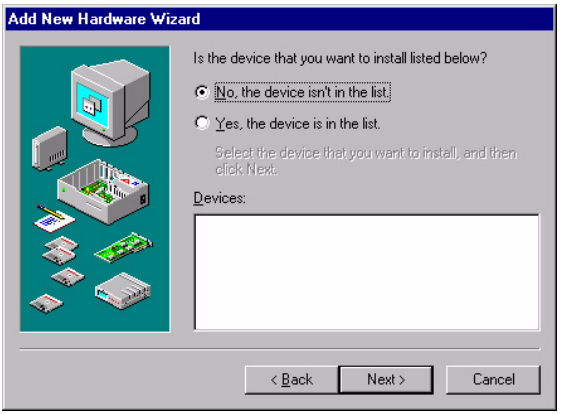
Step 1. Click "Start" and select "Settings". Click "Control Panel" and double-click "Add New Hardware".

Step 2. In the Add New Hardware Wizard window, click "Next".

Step 3. In the following Add New Hardware Wizard window, click "Next" for Windows to search for Plug and Play devices.

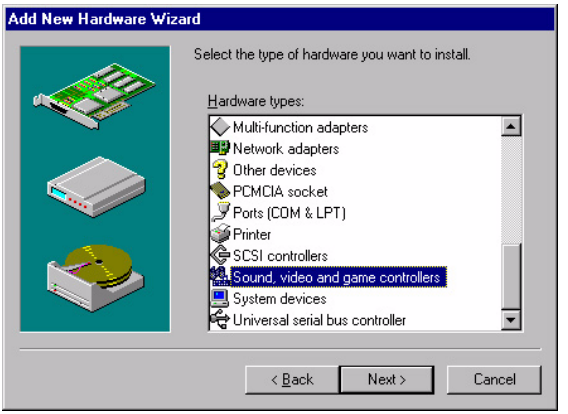


Step 4. In the following Add New Hardware Wizard window, select "No, the device isn't ."and click "Next".

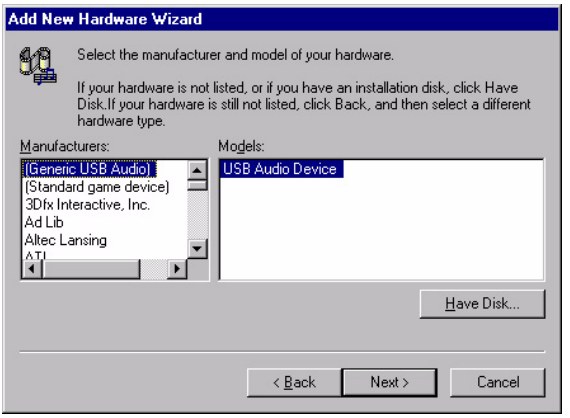


Step 5. In the following Add New Hardware Wizard window, select "No, I want to select..." and click "Next".

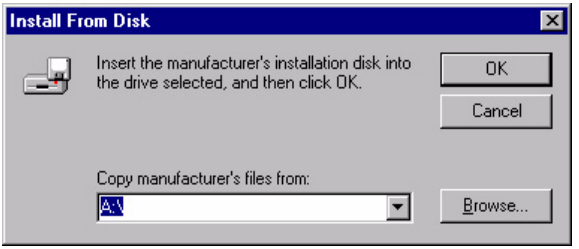
Step 6. In the following Add New Hardware Wizard window, select "Sound, video and game controllers" and click "Next".



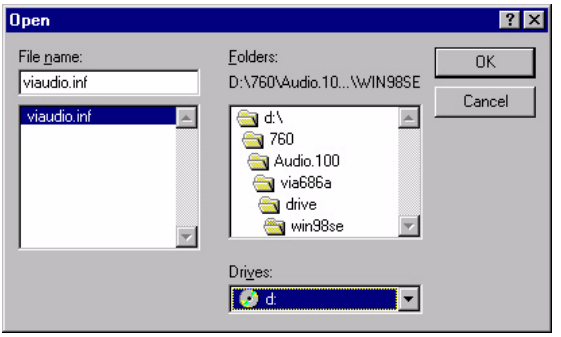
Step 7. In the following Add New Hardware Wizard window, click "Have Disk...".



Step 8. In the Install From Disk window, click "Browse".



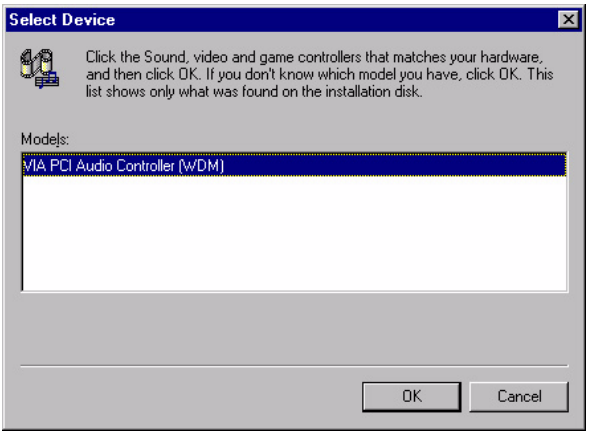
Step 9. In the Open window, select "D:\SOM144\2367\Audio\Win98se\".



Step 10. In the Install From Disk window, click" OK".

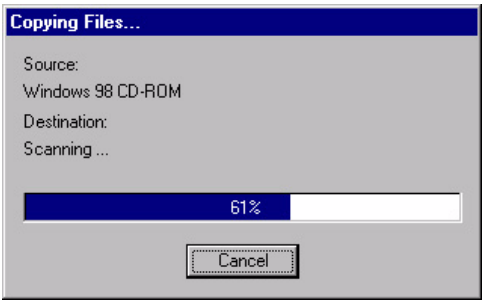
Note: For Windows 95, the path is: "D:\\SOM-144\2367\Audio\Win9x\"

Step 11. In the Select Device window, select "VIA PCI Audio Controller (WDM)" and click "OK".



Step 12. In the Add New Hardware Wizard window, click "Next".

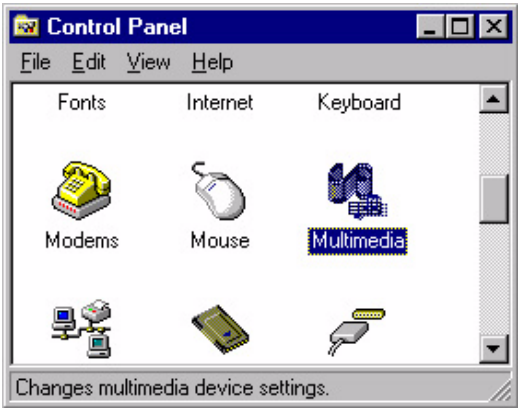
Step 13. A Copying Files... window will appear.



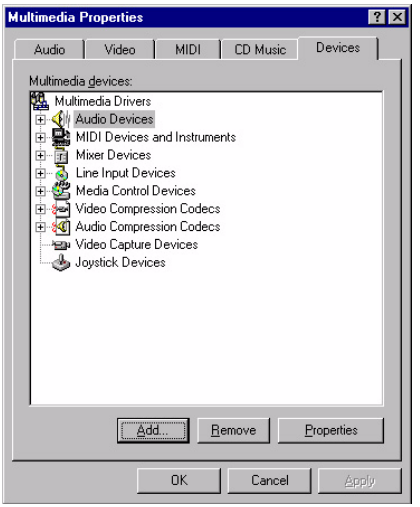
Step 14. In the Add New Hardware Wizard window, click "Finish". Then reboot the system.

4.3.3 Windows NT drivers

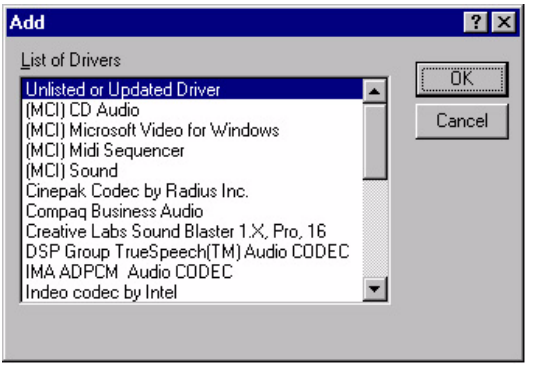
Step 1. Click "Start" and select "Settings". Click "Control Panel" and double-click "Multimedia".



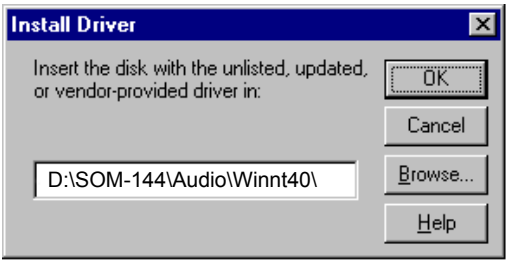
Step 2. In the Multimedia Properties window, select the "Devices" tab. Then select the "Audio Devices" item, and click "Add...".



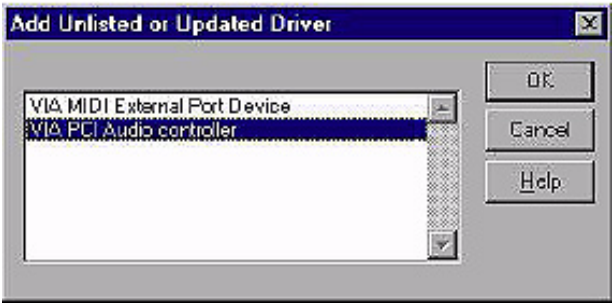
Step 3. In the Add window, select the "Unlisted ..." item and click "OK".



Step 4. When the Install Driver window appears, insert the utility disc into the CD-ROM drive. Type: D:\SOM144\Audio\Winnt40\ Then click "OK".



Step 5. In the Add Unlisted or Updated Driver window, select the "VIA PCI Audio controller" item. Then click "OK".



Step 6. In the System Setting Change window, click "Restart Now".

CHAPTER 5

PCI Bus Ethernet Interface

This chapter provides information on Ethernet configuration.

- Introduction
- Installation of Ethernet driver for Win dows 98/NT/2000
- Further information

Chapter 5 PCI Bus Ethernet

5.1 Introduction

The SOM-2367 is equipped with a high performance 32-bit Ethernet chipset which is fully compliant with IEEE 802.3 100 Mbps CSMA/CD standards. It is supported by major network operating systems. It is also both 100Base-T and 10Base-T compatible.

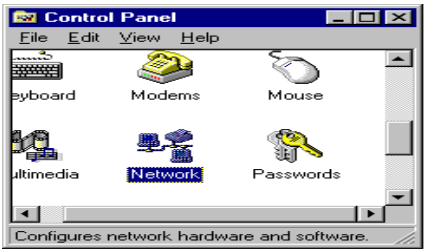
5.2 Installation of Ethernet driver

Before installing the Ethernet driver, note the procedures below. You must know which operating system you are using in your SOM-2367 Series, and then refer to the corresponding installation flow chart. Then just follow the steps described in the flow chart. You will quickly and successfully complete the installation, even if you are not familiar with instructions for MS-DOS or Windows.

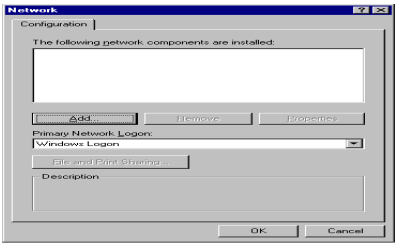
Note: *The windows illustrations in this chapter are examples only. You must follow the flow chart instructions and pay attention to the instructions which then appear on your screen.*

5.2.1 Installation for Windows 98/2000

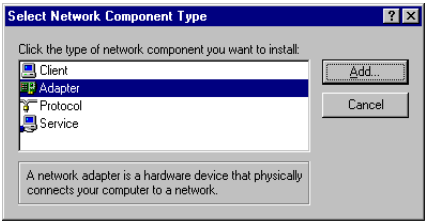
1. a. Select "Start", "Settings", "Control Panel".
   b. Double click "Network".



2. a. Click "Add" and prepare to install network functions.

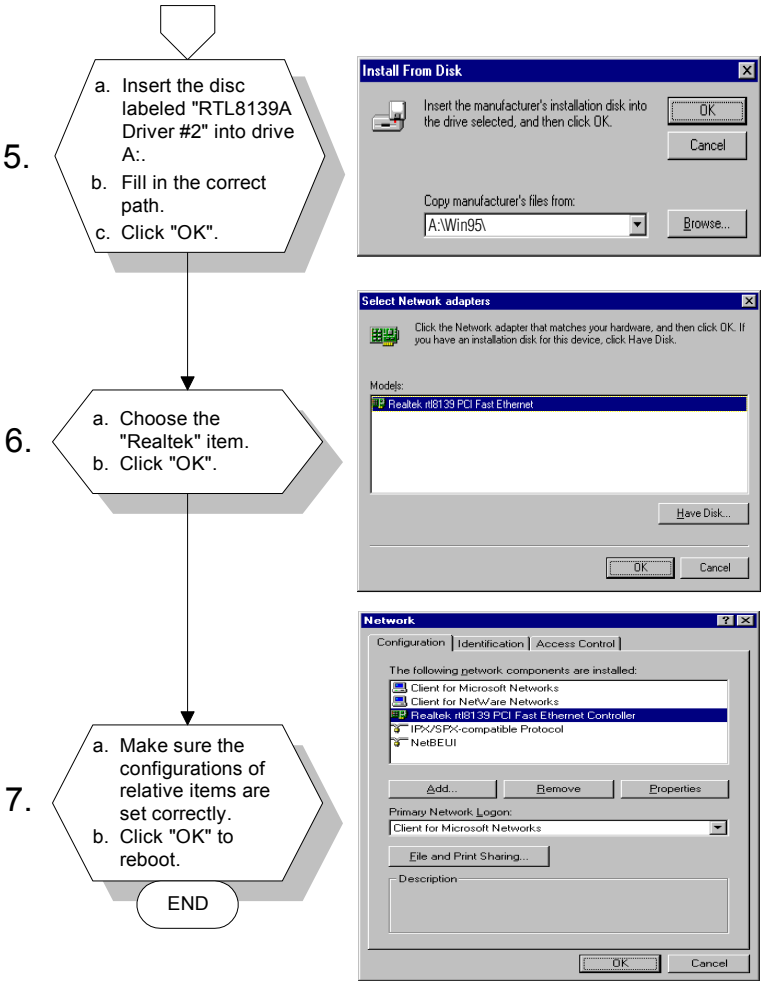


3. a. Select the "Adapter" item to add the Ethernet card.



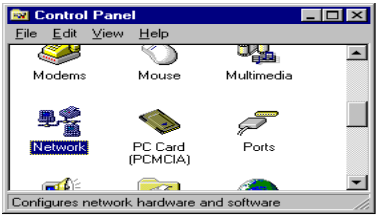
4. a. Click "Have Disk" to install the driver.

Note: *The correct path for Windows 98 is: D:\LAN\8139C\Win98"*

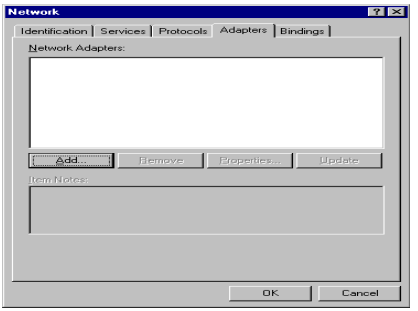


5.2.2 Installation for Windows NT

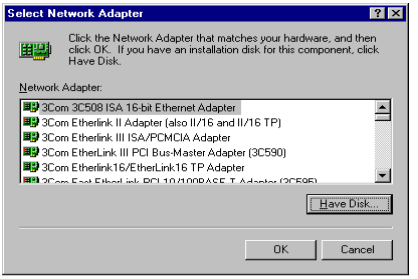
1. a. Select "Start", "Settings", "Control Panel".
   b. Double click "Network".



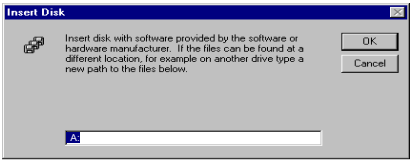
2. a. Choose the "Adapters" label.
   b. Click the "Add" button.

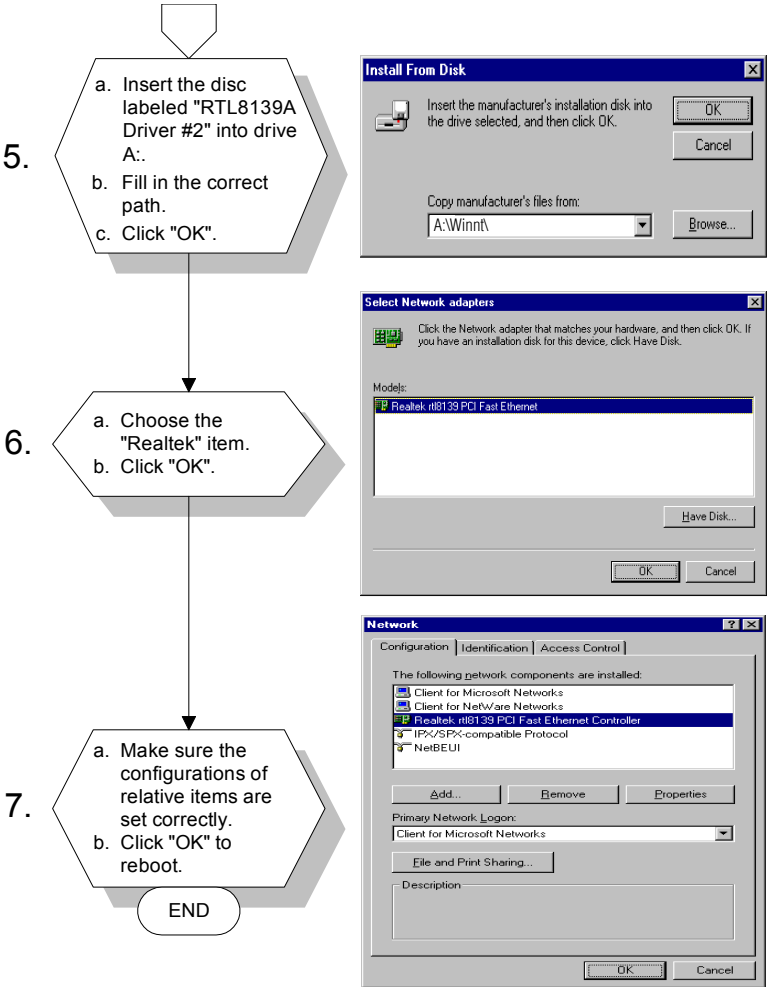


3. a. Press "Have Disk".



4. a. Type "A:".
   b. Press "OK".




5.
a. Insert the disc labeled "RTL8139A Driver #2" into drive A:.
b. Fill in the correct path.
c. Click "OK".
Install From Disk
Insert the manufacturer's installation disk into the drive selected, and then click OK.
OK
Cancel
Copy manufacturer's files from:
A:\Winnt\
Browse...
6.
a. Choose the "Realtek" item.
b. Click "OK".
Select Network adapters
Click the Network adapter that matches your hardware, and then click OK. If you have an installation disk for this device, click Have Disk.
Models:
Realtek rtl8139 PCI Fast Ethernet
Have Disk...
OK
Cancel
7.
a. Make sure the configurations of relative items are set correctly.
b. Click "OK" to reboot.
END
Network
Configuration
Identification
Access Control
The following network components are installed:
Client for Microsoft Networks
Client for NetWare Networks
Realtek rtl8139 PCI Fast Ethernet Controller
IPX/SPX-compatible Protocol
NetBEUI
Add...
Remove
Properties
Primary Network Logon:
Client for Microsoft Networks
File and Print Sharing...
Description
OK
Cancel

5.3 Further information

Intel website: www.intel.com

Advantech websites:www.advantech.com

www.advantech.com.tw

Appendix A

System Assignments

This chapter gives background information on the SOM-2367.

Sections include:

- System I/O ports
- DMA channel assignments
- Interrupt assignments
- 1st MB memory map

Appendix A System assignments

A.1 System I/O ports

Table A.1: System I/O ports

Addr. range (Hex)	Device
000-01F	DMA controller
020-021	Interrupt controller 1, master
022-023	Chipset address
040-05F	8254 timer
060-06F	8042 (keyboard controller)
070-07F	Real-time clock, non-maskable interrupt (NMI) mask
080-09F	DMA page register
0A0-0BF	Interrupt controller 2
0C0-0DF	DMA controller
0F0	Clear math co-processor
0F1	Reset math co-processor
0F8-0FF	Math co-processor
170- 178	2nd fixed disk for CompactFlash
1F0-1F8	1st fixed disk
200-207	Game I/O
278-27F	Reserved
2F8-2FF	Serial port 2
300-31F	Ethernet**
360-36F	Reserved
378-37F	Parallel printer port 1 (LPT2)
380-38F	SDLC, bisynchronous 2
3A0-3AF	Bisynchronous 1
3B0-3BF	Monochrome display and printer adapter (LPT1)
3C0-3CF	Reserved
3D0-3DF	Color/graphics monitor adapter
3F0-3F7	Diskette controller
3F8-3FF	Serial port 1
443	Watchdog timer

* PNP audio I/O map range from 220 ~ 250H (16 bytes)

MPU-401 select from 300 ~ 330H (2 bytes)

** default setting

A.2 DMA channel assignments

Table A.2: DMA channel assignments

Channel	Function
0	Available
1	Audio*
2	Floppy disk (8-bit transfer)
3	Parallel**
4	Cascade for DMA controller 1
5	Audio*
6	Available
7	Available

* Audio DMA default setting: DMA 1.5

Audio High DMA select: DMA 1.3

Audio Low DMA select: DMA 5.6.7

** Parallel port DMA default setting: DMA 3

Parallel port DMA select: DMA 1.3

A.3 Interrupt assignments

Table A.3: IRQ 6

Interrupt#	Interrupt source
NMI	Parity error detected
IRQ 0	Interval timer
IRQ 1	Keyboard
IRQ 2	Interrupt from controller 2 (cascade)
IRQ 8	Real-time clock
IRQ 9	Reserve
IRQ 10	Available
IRQ 11	Reserved for watchdog timer
IRQ 12	PS/2 mouse
IRQ 13	INT from co-processor
IRQ 14	Preliminary IDE
IRQ 15	Secondary IDE for CompactFlash
IRQ 3	Serial communication port 2
IRQ 4	Serial communication port 1
IRQ 5	Audio*
IRQ 6	Diskette controller (FDC)
IRQ 7	Parallel port 1 (print port)

*Audio default setting: IRQ5 USB and Ethernet IRQ is automatically set by the system

A.4 1st MB memory map

Table A.4: 1st MB memory map

Addr. range (Hex)	Device
F000h - FFFFh	System ROM
D800h - EFFFh	Unused
D000 - D400H	Available
C800h - D7FFh	Ethernet ROM*
C000h - C7FFh	VGA BIOS
B800h - BFFFh	CGA/EGA/VGA text
B000h - B7FFh	Reserved for graphic mode usage
A000h - AFFFh	EGA/VGA graphics
0000h - 9FFFh	Base memory

*default setting (if using Intel 82551ER ethernet chip)

Appendix B

Programming the Watchdog Timer

The SOM-2367 is equipped with a watchdog timer that resets the CPU or generates an interrupt if processing comes to a standstill for whatever reason. This feature ensures system reliability in industrial standalone or unmanned environments.

Appendix B Programming the Watchdog Timer

B.1 Watchdog timer instructions

Jumper J1 controls the watchdog settings. The default configuration of the timer is enabled via a system reset.

To enable the watchdog timer, you must write a program which writes 1 to I/O port address 443 (hex) at regular intervals. The first time your program reads the port, it enables the watchdog timer. After that, your program must write 1 to the port at time interval of less than 1.6 seconds, otherwise the watchdog timer will activate and reset the CPU or generate an interrupt on IRQ11. When you want to disable the watchdog timer, your program should write 0 to I/O port 443.

If CPU processing comes to a standstill because of EMI or a software bug, your program's signals to I/O port 443 to the timer will be interrupted. The timer will then automatically reset the CPU or invoke an IRQ, and data processing will continue normally.

You must write your program so that it writes 1 to I/O port 443 at an interval shorter than the timer's preset interval. The timer's intervals have a tolerance of ± 30%, so you should program an instruction that will refresh the timer about every second.

The following program shows how you might program the watchdog timer in BASIC:

```
10          REM Watchdog timer example program
20          X=Out &H443, 1 REM Enable and refresh the watchdog
30          GOSUB 1000 REM Task #1, takes 1 second to complete
40          X=Out &H443, 1 REM Refresh the watchdog
50          GOSUB 2000 REM Task #2, takes 1 second to complete
60          X=Out &H443, 0 REM Disable the watchdog
70          END
1000        REM Subroutine #1, takes 1 second to complete
      .
      .
      .
1070        RETURN
2000        REM Subroutine #2, takes 1 second to complete
      .
      .
2090        RETURN
```