

PM-1041 Ver 1.x

486 DX66 with

SVGA CPU Board

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Introduction

Welcome to the PM-1041 486 DX66 with SVGA CPU Board. The PM-1041 board is an all-in-one CPU board, which comes equipped with PC/104 solution for limited-space application. It offers all the functions that a full-fledged computer needs.

In addition, the PM-1041 provides SVGA display controller on board, which can supply CRT resolutions up to 1024x768@64K colors.

This board has a built-in DiskOnChip™(DOC) Flash Disk Socket for embedded applications. The DOC Flash Disk is 100% software compatible with hard disk. Users can use any DOS command without any extra software utility. The DOC is currently available from 2MB to 144MB.

1.1 Specifications

CPU	Embedded SGS Thomson DX-66 STPC Client
System bus connector	PC104 connector
System memory	One 144-pin SODIMM socket supports 8,16 or 32MB EDO/FPR DRAM
Enhanced IDE Interface	Supports up to two EIDE devices with BIOS auto-detect function
Floppy disk drive interface	Supports up to two floppy disk drives
Serial ports	Two RS-232 ports with 16C550 UART (or compatible) with 16-byte FIFO buffer. Support up to 115.2Kbps. Ports can be individually configured to COM1, COM2 or disabled.
Bi-directional parallel Port	Configurable to LPT1, LPT2, LPT3 or disabled. Supports EPP/ECP/SPP.
IrDA port	Supports Serial Infrared (SIR) and Amplitude Shift Keyed IR (ASKIR) interface
Watch-dog timer	Can be set by 1~255 seconds intervals. Reset or NMI is generated when CPU does not periodically trigger the timer.
VGA display	Completes backward compatibility to VGA and SVGA , supports CRT resolutions up to 1024 x 768 @ 64K colors , 512KB – 4MB share memory , set in BIOS
Flash disk socket	The DiskOnChip™ compatible 32pin dip socket is provided for Flash Disk (DiskOnChip™) applications which will let users to use the Flash Disk with DOS command without any extra software utility.
Keyboard / Mouse connector	Supports standard PC/AT keyboard and PS/2 mouse
Power consumption	+5V @1.4A
Operating temperature	0° ~ 55°C (CPU needs Cooler)

1.2 What You Have

In addition to this *User's Manual*, the PM-1041 package includes the following items:

- PM-1041 486DX66 with SVGA CPU board
- RS-232 cable x 2
- Printer cable x 1
- FDD cable x 1
- HDD cable x 1
- One 6-pin header converts to two 6-pin DIN cable for keyboard and mouse connection x 1
- VGA cable x 1

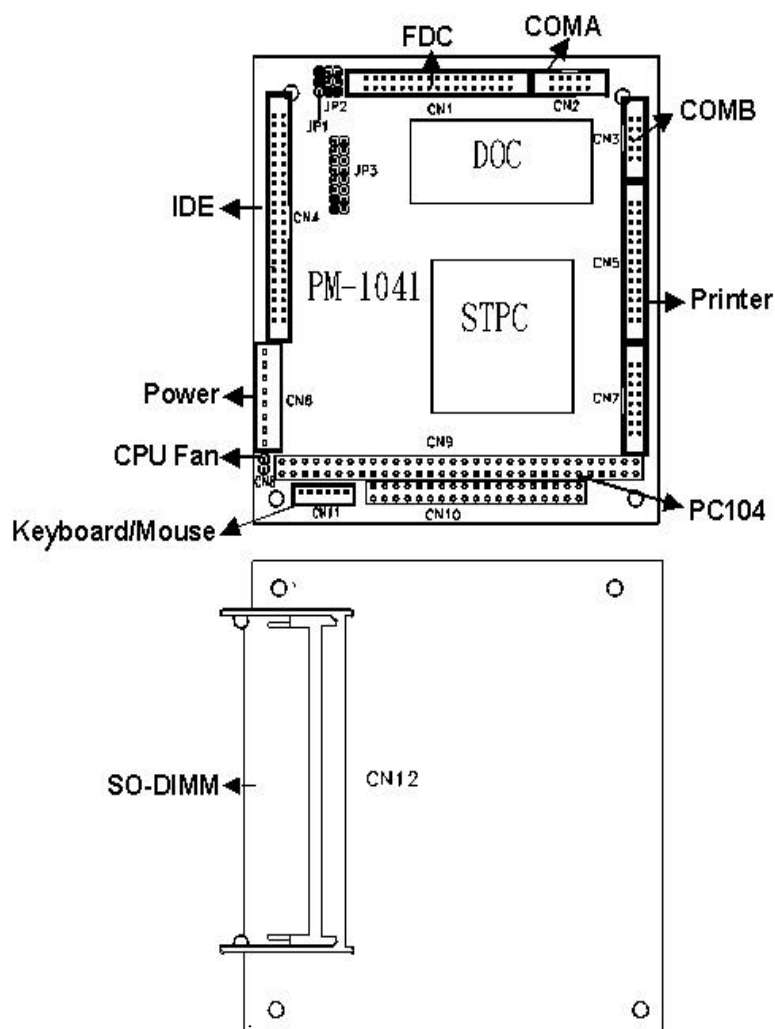
If any of these items are missing or damaged, contact the dealer from whom you purchased this product. Keep the shipping materials and carton in case you want to ship or store the product in the future.

2

Jumper Setting

This chapter describes how to install the PM-1041. At first, the layout of PM-1041 is shown, and the unpacking information that you should be careful is described. The jumpers setting instructions of CMOS and DiskOnChip Flash Disk are also included.

2.1 PM-1041's Layout



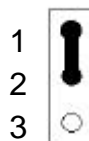
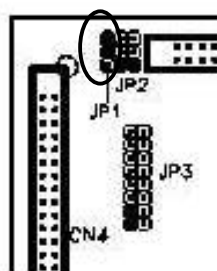
2.2 Unpacking Precautions

Some components on PM-1041 SBC are very sensitive to static electric charges and can be damaged by a sudden rush of power. To protect it from unintended damage, be sure to follow these precautions:

- ✓ Ground yourself to remove any static charge before touching your PM-1041 SBC. You can do it by using a grounded wrist strap at all times or by frequently touching any conducting materials that is connected to the ground.
- ✓ Handle your PM-1041 SBC by its edges. Don't touch IC chips, leads or circuitry if not necessary.
- ✓ Do not plug any connector or jumper while the power is on.

2.3 Clear CMOS Setup (JP1)

If you want to clear the CMOS Setup (for example: if you forgot the password, you should clear the setup and then set the password again.), you should close the JP1 about 3 seconds, then open again. Now, the password has been cleared from your CMOS.



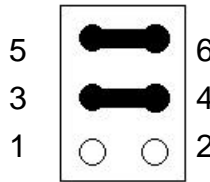
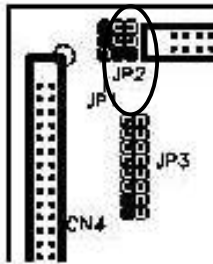
JP1 : Clear CMOS Setup

- **JP1 : Clear CMOS Setup (Reserve Function)**

JP1	DESCRIPTION
1-2	NORMAL
2-3	CLR CMOS

2.4 DiskOnChip™ Flash Disk (JP2)

The DiskOnChip™ Flash Disk Chip (DOC) is produced by M Systems. Because the DOC is 100% software compatible to hard disk and DOS, users don't need any extra software utility. It is just 'plug and play', easy and reliable. Right now the DOC is available from 2MB to 144MB. The DiskOnChip will only share 8KB memory address.



JP2 : DiskOnChip Flash Disk Setup

- **JP2 : DiskOnChip Memory Address Setting**

Address	JP2		
	1-2	3-4	5-6
C8000 – C9FFF	OPEN	CLOSE	CLOSE
D0000 – D1FFF	CLOSE	OPEN	CLOSE
D8000 – D9FFF	OPEN	OPEN	CLOSE

3

Connection

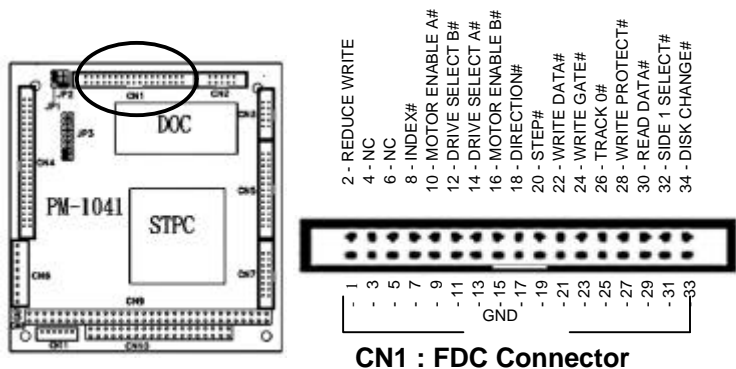
This chapter describes how to connect peripherals, switches and indicators to the PM-1041 board.

Table of Connectors

LABEL	FUNCTION
CN1	Floppy Disk Drive Connector
CN2	COMA Connector
CN3	COMB Connector
CN4	IDE Disk Drive Connector
CN5	Parallel Port
CN6	External Power Connector
CN7	VGA Connector
CN8	CPU Fan Connector
CN9	PC/104-64 CON A
CN10	PC/104-40 CON B
CN11	PS/2 Mouse and Keyboard Connector
CN12	SO-DIMM Socket Connector

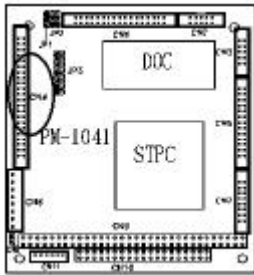
3.1 Floppy Disk Drive Connector (CN1)

The PM-1041 board comes equipped with a 34-pin daisy-chain drive connector cable which can support up to two floppy drives. The detailed pin assignment of the connector is specified as below:

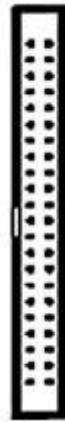


3.2 IDE Disk Drive Connector (CN4)

You can attach four IDE (Integrated Device Electronics) hard disk drives to the PM-1041 IDE controller. The IDE supports the Ultra DMA/33 interface.



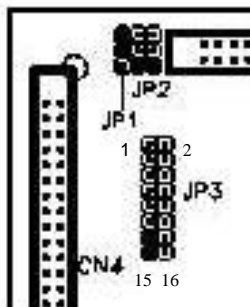
RESET# - 1	2 - GND
DATA 7 - 3	4 - DATA8
DATA 6 - 5	6 - DATA9
DATA 5 - 7	8 - DATA10
DATA 4 - 9	10 - DATA11
DATA 3 - 11	12 - DATA12
DATA 2 - 13	14 - DATA13
DATA 1 - 15	16 - DATA14
DATA 0 - 17	18 - DATA15
GND - 19	20 - NC
IDE DRQ - 21	22 - GND
IOW# - 23	24 - GND
IOR# - 25	26 - GND
IDE CHRDY - 27	28 - GND
IDE DACK - 29	30 - GND - DEFAULT
INTERRUPT - 31	32 - NC
SA1 - 33	34 - NC
SA0 - 35	36 - SA2
HDC CS0# - 37	38 - HDE CS1#
HDD ACTIVE# - 39	40 - GND
VCC - 41	42 - NC
GND - 43	44 - NC



CN4 : HDD Connector

3.3 Switches, Indicators and IrDA infrared port (JP3)

The connection of JP3 is illustrated as the following table for reference.



• JP3: General connectors

	PIN NO.	DESCRIPTION	PIN NO.	DESCRIPTION	
BATTERY	1	BATTERY	2	VCC	IR CONNECTOR
CON	3	VCC	4	NC	
RESET	5	GND	6	IR-RX	
	7	RESET SW	8	GND	
HDDLED	9	VCC	10	IR-TX	
	11	IDE LED	12	NC	KEYLOCK CON
WATCH	13	Watch dog active	14	KEYLOCK	
DOG	15	Reset in	16	GND	

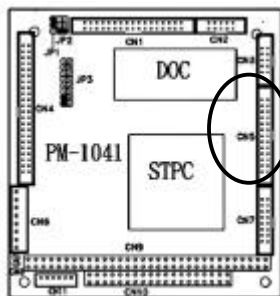
Note : JP3 Pin 13&15 Watch-Dog Setting

JP1	Watch-Dog Setting
Shut	Enabled
Open	Disabled

For detailed information on Watch-Dog Timer, please refer to Appendix A.

3.4 Parallel Port (CN5)

This port is usually connected to a printer. The PM-1041 includes an on-board parallel port accessed through a 26-pin mini-pitched flat-cable connector CN5.



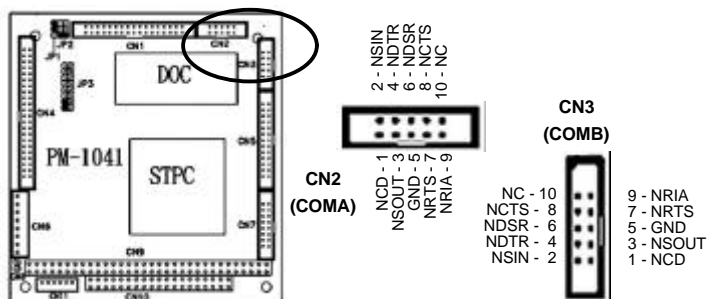
NC - 26	25 - GND
GND - 24	23 - GND
GND - 22	21 - GND
GND - 20	19 - GND
GND - 18	17 - PRINTERSELECT LN#
INITIALIZE - 16	15 - ERROR#
AUTO FORM FEED# - 14	13 - PRINTER SELECT
PAPER EMPTY - 12	11 - BUSY
ACKNOWLEDGE - 10	9 - DATA 7
DATA 6 - 8	7 - DATA 5
DATA 4 - 6	5 - DATA 3
DATA 2 - 4	3 - DATA 1
DATA 0 - 2	1 - STROBE#



CN5 : Parallel Port Connector

3.5 Serial Port (CN2, CN3)

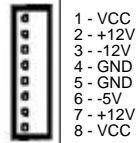
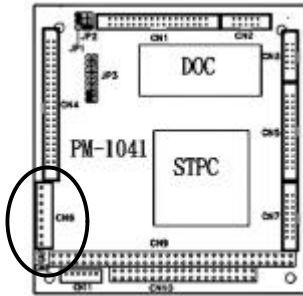
The PM-1041 offers two high speed NS16C550 compatible UARTs with Read/Receive 16 byte FIFO serial ports.



CN2&3 : COMA and COMB Connectors

3.6 External Power Connector (CN6)

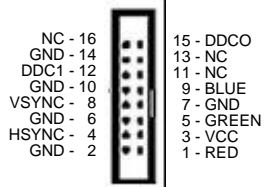
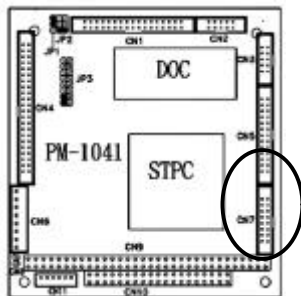
The PM-1041 has an on-board external power connector CN6. The PM-1041 is only powered by Vcc(+5) which should come from external power connector CN6's pin1 and pin8, and power GND from pin4 and pin5. The extra power supply like $\pm 12\text{VDC}$ and -5VDC provided by CN6 will be passed to CN9 and CN10 and only for PC104 slot use.



CN6: External Power Connector

3.7 VGA Connector (CN7)

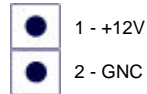
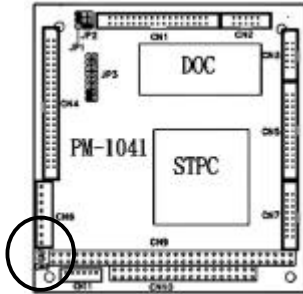
PM-1041's built-in 16-pin VGA connector can directly connect to your CRT monitor via the attached VGA cable.



CN7: 16-PIN Female Connector

3.8 CPU Fan Connector (CN8)

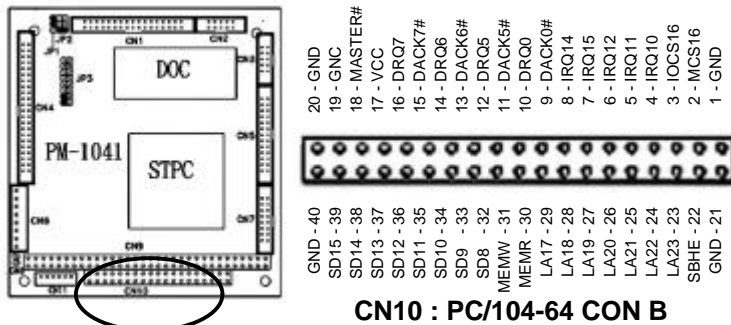
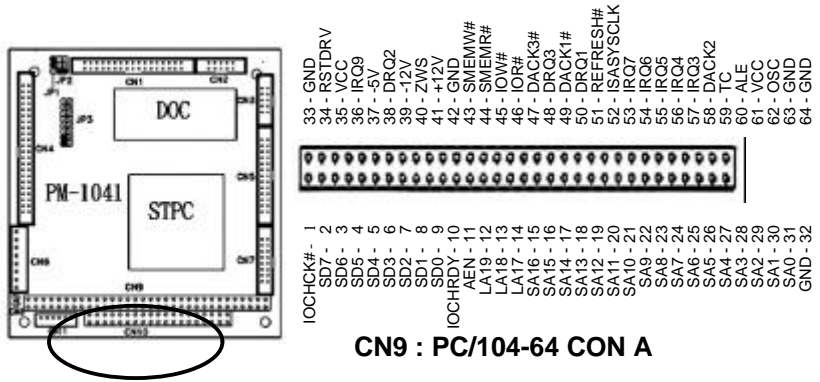
The PM-1041 provides an optional CPU cooling fan connector which only presents when +12V power is supplied to CN6. Please note that the PM-1041's STPC chip has already installed a heat sink. However, while running under environment temperature above 60°C, users still have to add an additional CPU cooling fan.



CN8: CPU Fan Connector

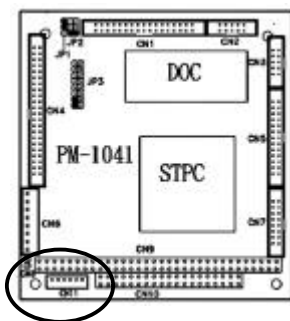
3.9 PC/104 Connection Bus (CN9, CN10)

The PM-1041's PC/104 expansion bus lets you attach any kind of PC/104 modules. There are two PC/104 connectors on this board: PC/104-64 and PC/104-40.



3.10 PS/2 Mouse and Keyboard Connector (CN11)

The attached 6-pin header converting to two 6-pin DIN cables for keyboard and mouse connection allows users to connect both PS/2 mouse and keyboard. Please note that only by connecting with the attached cable, the keyboard and mouse will work appropriately.

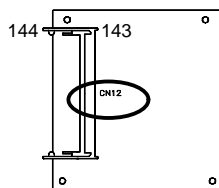


- 1 - KEYBOARD DATA
- 2 - MOUSE DATA
- 3 - GND
- 4 - VCC
- 5 - DEYBOARD CLOCK
- 6 - MOUSE CLOCK



CN11 : PS/2 Mouse and Keyboard Connector

3.11 SO-DIMM Socket Connector (CN12)



CN12 : SO-DIMM Socket Connector

1	GND	30	MA3	59	NC	88	MD50	117	CAS3
2	GND	31	MA1	60	NC	89	MD19	118	CAS7
3	MD0	32	MA4	61	NC	90	MD51	119	GND
4	MD32	33	MA2	62	NC	91	GND	120	GND
5	MD1	34	MA5	63	+3.3V	92	GND	121	MD24
6	MD33	35	GND	64	+3.3V	93	MD20	122	MD56
7	MD2	36	GND	65	NC	94	MD52	123	MD25
8	MD34	37	MD8	66	NC	95	MD21	124	MD57
9	MD3	38	MD40	67	MWE	96	MD53	125	MD26
10	MD35	39	MD9	68	NC	97	MD22	126	MD58
11	+3.3V	40	MD41	69	RAS0	98	MD54	127	MD27
12	+3.3V	41	MD10	70	NC	99	MD23	128	MD59
13	MD4	42	MD42	71	NC	100	MD55	129	+3.3V
14	MD36	43	MD11	72	NC	101	+3.3V	130	+3.3V
15	MD5	44	MD43	73	GND	102	+3.3V	131	MD28
16	MD37	45	+3.3V	74	NC	103	MA6	132	MD60
17	MD6	46	+3.3V	75	GND	104	MA7	133	MD29
18	MD38	47	MD12	76	GND	105	MA8	134	MD61
19	MD7	48	MD44	77	NC	106	MA11	135	MD30
20	MD39	49	MD13	78	NC	107	GND	136	MD62
21	GND	50	MD45	79	NC	108	GND	137	MD31
22	GND	51	MD14	80	NC	109	MA9	138	MD63
23	CAS0	52	MD46	81	GND	110	NC	139	GND
24	CAS4	53	MD15	82	GND	111	MA10	140	GND
25	CAS1	54	MD47	83	MD16	112	NC	141	NC
26	CAS5	55	GND	84	MD48	113	+3.3V	142	NC
27	+3.3V	56	GND	85	MD17	114	+3.3V	143	+3.3V
28	+3.3V	57	NC	86	MD49	115	CAS2	144	+3.3V
29	MA0	58	NC	87	MD18	116	CAS6		

4

AMI BIOS Setup

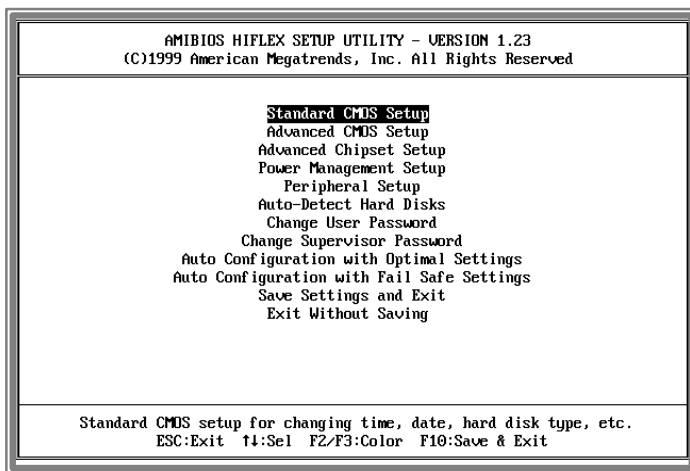
The PM-1041 uses the AMI PCI/ISA BIOS for system configuration. The AMI BIOS setup program is designed to provide maximum flexibility in configuring the system by offering various options which may be selected for end-user requirements. This chapter is written to assist you in the proper usage of these features.

4.1 Getting Started

When powering on the system, the BIOS will enter the Power-On-Self-Test (POST) routines. These routines will be executed for system test, initialization and system configuration verification. After the POST routines are completed, the following message will appear:

" Hit DEL if you want to run SETUP"

To access AMI PCI/ISA BIOS Setup program, press key. The following screen will be displayed at this time.



When choose **Auto Configuration with Fail Safe Settings**, it will load the minimized settings for Troubleshooting. The performance should be very poor when use this setting.

When choose **Auto Configuration with Optimal Settings**, it will load optimized defaults for regular use. Choosing this setting will modify all applicable settings.

4.2 Standard CMOS Setup

The Standard CMOS Setup is used for basic hardware system configuration. The main function is for Date/Time setting and Floppy/Hard Disk Drive setting. Please refer to the following screen for this setup.

AMIBIOS SETUP - STANDARD CMOS SETUP									
(C)1999 American Megatrends, Inc. All Rights Reserved									
Date (mm/dd/yyyy): Tue Dec 07, 1999					Base Memory: 0 KB				
Time (hh/mm/ss) : 17:13:55					Extd Memory: 0 MB				
Floppy Drive A: 1.44 MB 3½									
Floppy Drive B: Not Installed									
					LBA	Blk	P10	32Bit	
Type					Size	Cyln	Head	WPcom	Sec
Pri Master : Auto					Mode	Mode	Mode	Mode	Mode
Pri Slave : Auto									Off
Sec Master : Not Installed									Off
Sec Slave : Not Installed									
Boot Sector Virus Protection					Disabled				
Month: Jan - Dec					ESC:Exit F1:Sel				
Day: 01 - 31					PgUp/PgDn:Modify				
Year: 1901 - 2099					F1:Help F2/F3:Color				

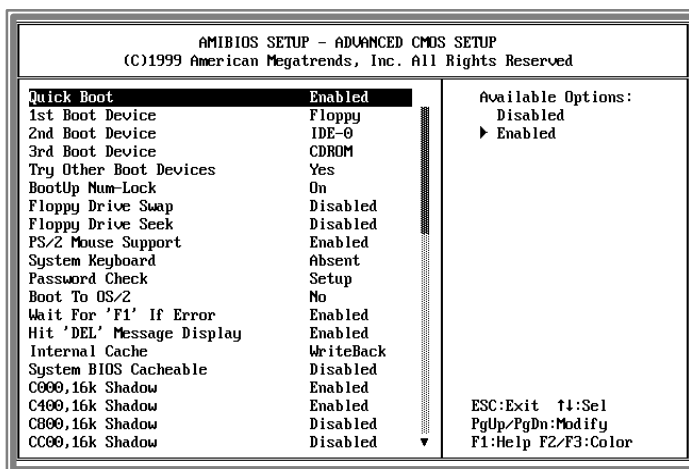
For IDE hard disk drive setup, please check the following setup procedure:

1. Use the Auto setting for detection during boot up.
2. Use the IDE HDD AUTO DETECTION in the main menu to automatically enter the drive specifications.
3. Manually enter the specifications by yourself from the "User" option.

4.3 Advanced CMOS Setup

The Advanced CMOS Setup is designed for user's tuning best performance of the PM-1041 board. As for normal operation, users don't have to change any default setting. The default setting is pre-set for most reliable operation.

Users can set "System Keyboard" to "Absent " for the applications which don't need keyboard.



You can change the value of each option by using <PgUp> and <PgDn> key. The available values are shown on the right screen.

- **Quick Boot > Enabled:** this will enable the BIOS to boot quickly when you turn on your computer. The BIOS will only check the first 1MB of the system memory.
- **Quick Boot > Disabled:** the BIOS will test all system memory when it boots up. It will spend about 40 seconds until it receives a Ready signal from the HDD. It will also wait for you to press the key or not.
- **1st, 2nd, 3rd Boot Device >** to define the device type for booting after the routines check up completes. If the 1st Boot Device fails, the BIOS will attempt to boot from the 2nd or the 3rd device.

- **Try Other Boot Devices** > the BIOS will try to boot from any other available device in the system if the 1st, 2nd and 3rd device fails to boot.
- **BootUp Num-Lock** > to turn on/off the Num-Lock option on a enhanced keyboard when you boot. If you turn it off, the arrow keys on the numeric keypad can be used just as the other set of arrow keys on the keyboard and vice versa.
- **PS/2 Mouse Support** > to testify whether or not a PS/2 mouse is supported.
- **System Keyboard** > to testify whether or not a keyboard is attached to the computer.
- **Password Check** > to define if a password is necessary or not for access to the system.
- **Boot to OS/2** > if you run the OS/2 operating system, this option must be set to yes.
- **System BIOS Cacheable** > to define whether or not the memory segment F000H can be read from or written to cache memory. Setting it Enabled will give faster execution in your system.
- **XXXX, 16k Shadow** > ROM Shadow is a technique in which BIOS code is copied from slower ROM to faster RAM. If you enable it then the BIOS will be executed from the RAM. Each option allows 16KB segment to be shadowed to the RAM.

4.4 Advanced Chipset Setup

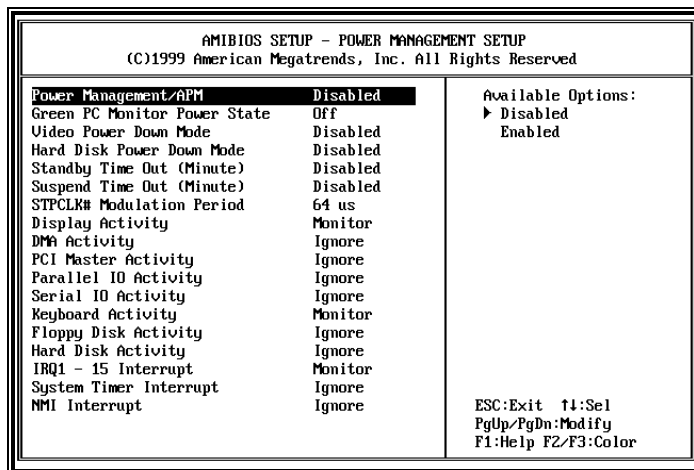
These setup functions mainly work for Chipset. These options are used to change the Chipset's registers. Please carefully change any default setting, otherwise the system may become unstable.

AMIBIOS SETUP - ADVANCED CHIPSET SETUP		
(C)1999 American Megatrends, Inc. All Rights Reserved		
DRAM Timing Type	E.D.O	Available Options: F.P.M ▶ E.D.O ESC:Exit F4:Sel PgUp/PgDn:Modify F1:Help F2/F3:Color
DRAM Main RAS	Active	
DRAM RAS Precharge Cycles	4	
DRAM RAS to CAS Delay Cycles	4	
DRAM CAS Low Pulse Width Cycles	4	
IPC Wait State Cycles	4	
ISA Clock Frequency	14MHz/2	
ISA Insert Wait State	Enabled	
ISA to Host Read Buffer	Enabled	
ISA to Host Write Posting	Enabled	
DMA Clock Frequency	ISACLK/2	
DMA MEMR IOW Synchronous	Disabled	
DMA 16 Bit Wait State Cycles	4	
DMA 8 Bit Wait State Cycles	4	
Memory Hole at 15M-16M	Disabled	
C0000-C7FFF cacheable	Disabled	
VGA Frame Buffer Size (KB)	4096	
VGA Clock Frequency (Mhz)	45	
IDE Controller	Enabled	

- **Memory Hole at 15M-16M** > to specify the location of a memory hole in the CMOS RAM. This setting reserves 15MB to 16 MB memory address space for ISA expansion cards that specifically require this setting. Memory from 15MB and up will be unavailable to the system because expansion cards can only access memory up to 16MB.
- **VGA Frame Buffer Size (KB)** > to specify VGA share memory size

4.5 Power Management Setup

Power Management Setup helps users handle the PM-1041 boards "green" function. The features could shut down the video display and hard disk to save energy for example. The power management setup screen is as following:

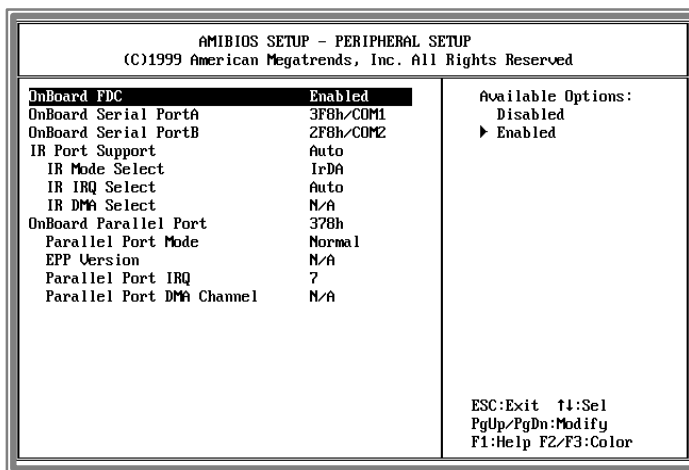


- **Power Management/APM** > to enable or disable the Advanced Power Management feature.
- **Green PC Monitor Power State** > to specify the power state of the monitor after the specified period of display-idle has ended.
- **Video Power Down Mode** > to specify the power state of the VESA VGA video subsystem after the specified period of display-idle has ended.
- **Hard Disk Power Down Mode** > to specify the power state of the hard disk after the specified period of hard drive-idle has ended.

- **Standby Time Out (Minute)** > to specify the length of the system-idle period while the system is in full power on state. After this period of time has ended, the system will go into Standby state.
- **Suspend Time Out (Minute)** > to specify the length of the system-idle period while the system is in Standby state. After this period of time has ended, the system will go into Suspend state.
- **Display Activity** > to specify if BIOS has to monitor display activity or not.

4.6 Peripheral Setup

This setup works mostly on (is almost working for) Multi-I/O Chip (W83977F). The options are used to change the Chipsets registers. Please carefully change any default setting to meet your application needs perfectly. The only special concern is Onboard Serial Port B. If you are using the IrDA port, you have to set this port accordingly.



When you enter the Peripheral Setup, the following items are available for setting:

- **On-board FDC >** The floppy disk drive controller can be Enabled or Disabled by this item. When you do not need floppy disk, the FDD controller can be disabled. If you set it Auto, the BIOS will try to enable any floppy drive controller on the ISA Bus.
- **Serial Port A >** The options are Disable, 3F8, 2F8, 3E8, 2E8 and Auto. You can set the I/O address of the serial port A (COMA) or disable it.
- **Serial Port B >** The options are Disable, 3F8, 2F8, 3E8, 2E8 and Auto. You can set the I/O address of the serial port B (COMB) or disable it.

- **OnBoard Parallel Port >** The options are Auto, Disable, 3BC, 378 or 278. You can set the I/O address of the parallel port or disable it.
- **IR Port Support >** to specify the IO Port address of the IR Port
- **Parallel Port Mode >** PM-1041 provides EPP Mode. EPP passes the parallel port to be used with devices which stick to the EPP specification. The existing parallel port signals will be used by EPP to provide asymmetric bi-directional data transfer driven by the host devices.
- **Parallel Port IRQ >** to define the Interrupt Request (IRQ) which is used by the parallel port.
- **Parallel Port DMA Channel >** to set the DMA Channel used by the parallel port.

E² Key™ Function

The PM-1041 provides an outstanding E²KEY™ function for system integrator. Based on the E²KEY™ you are free to store the ID Code, Pass Word, or Critical Data in the 1Kbit EEPROM. Because the EEPROM is nonvolatile memory, you don't have to worry about the loss of the very important data.

Basically the E²KEY™ is based on a 1Kbit EEPROM which is configured to 64 words (from 0 to 63). You could access (read or write) each word at any time.

When you start to use the E²KEY™ you should have the utility in the package. The software utility will include four files as follows:

README.DOC
E2KEY.OBJ
EKEYDEMO.C
EKEYDEMO.EXE.

The E2KEY.OBJ provides two library functions for users to integrate their applications with E²KEY™ function. These library functions (**read_e2key** and **write_e2key**) are written and compiled by C Language. Please check the following statement, then you will understand how to implement it easily.

Editor Note: What do these "/" marks in pairs stand for?

unsigned int read_e2key(unsigned int address)

/ This function will return the E²KEY™s data at address. The address range is from 0 to 63. Return data is one word, 16 bits */*

void write_e2key(unsigned int address,unsigned data)

/ This function will write the given data to E²KEY™ at address. The address range is from 0 to 63. The data value is from 0 to 0xffff. */*

To easy start to use the function, please refer to the included EKEYDEMO.C code at first.

Please note the E²KEY™ function is based on the working of parallel port. Therefore you should enable the ROCKY-P288EV's parallel port, otherwise it will not be working.

Appendix A. Watch-Dog Timer

The Watch-Dog Timer is provided to ensure that stand-alone systems can always recover from catastrophic conditions that cause the CPU to crash. This condition may have occurred by external EMI or a software bug. When the CPU stops working correctly, hardware on the board will perform hardware reset (cold boot) to bring the system back to a known state.

The Watch-Dog Timer is controlled by three I/O ports.

443	Write	Set Watch-Dog Time period
443 (hex)	Read	Enable the refresh the Watch-Dog Timer.
843 (hex)	Read	Disable the Watch-Dog Timer.

To enable the Watch-Dog Timer, users have to define the Timer before enable the Watch-dog Timer function. The output data is a value of time interval and the range of the value is from 01(hex) to FF(hex) and time interval 1 sec to 255 sec.

Data	Time Interval
01	1 sec
02	2 sec
03	3 sec
04	4 sec
.	.
.	.
.	.
FF	255 sec

This will enable and activate the countdown timer which will eventually time out and reset the CPU to ensure that this reset condition does not occur, the Watch-Dog Timer must be periodically refreshed by reading the same I/O ports 843H and 443H. This must be done within the time out period that is selected by software, please refer to the example program.

A tolerance of at least 30% must be maintained to avoid unknown routines within the operating system (DOS), such as disk I/O that can be very time consuming. Therefore if the time out period has been set to 10 seconds, the I/O port 443H must be read within 7 seconds.

Note: when exiting a program, it is necessary to disable the Watch-Dog Timer, otherwise the system will reset.

Example program:

```
TIMER_PORT = 443H
TIMER_START = 443H
TIMER_STOP = 843H
;
; INITIAL TIME PERIOD COUNTER
;
    MOV DX, TIMER_PORT
    OUT AL, 8 ; 8 SECONDS
;
; ADD YOUR APPLICATION HERE
;
    MOV DX, TIMER_START
    IN AL, DX. ; START COUNTER
;
; ADD YOUR APPLICATION HERE
;
W_LOOP:
    MOV DX, TIMER_STOP
    IN AL, DX
    MOV DX, TIMER_START
    IN AL, DX. ; RESTART COUNTER
;
; ADD YOUR APPLICATION HERE
;
    CMP EXIT_AP, 0
    JNE W_LOOP
    MOV DX, TIMER_STOP
    IN AL, DX
;
; EXIT AP
;
```

Appendix B. I/O Information

IO Address Map

I/O Address Range	Description
000-01F	DMA Controller #1
020-021	Interrupt Controller #1, Master
040-05F	8254 timer
060-06F	8042 (Keyboard Controller)
070-07F	Real time Clock, NMI (non-maskable interrupt) Mask
080-09F	DMA Page Register
0A0-0BF	Interrupt Controller #2
0C0-0DF	DMA Controller #2
0F0	Clear Math Coprocessor Busy
0F1	Reset Math Coprocessor
0F2	Core logic programming configuration
0F8-0FF	Math Coprocessor
1F0-1F8	Fixed Disk
200-207	Game I/O
278-27F	Parallel Printer Port 2 (LPT3)
2E8-2EF	Serial Port 4
2F8-2FF	Serial Port 2
300-31F	Prototype Card
360-36F	Reserved
378-37F	Parallel Printer Port 1 (LPT2)
3B0-3BF	Monochrome Display and Printer Adapter (LPT1)
3C0-3CF	Reserved
3D0-3DF	Color/Graphics Monitor Adapter
3E8-3EF	Serial Port 3
3F0-3F7	Diskette Controller
3F8-3FF	Serial Port 1
443	Watch-dog timer enable
843 or 043	Watch-dog timer disable

1st MB Memory Address Map

Memory address	Description
00000-9FFFF	System memory
A0000-BFFFF	VGA buffer
C0000-C7FFF	VGA BIOS
*D6000-DDFFF	DOC 2000
F0000-FFFFF	System BIOS
1000000-	Extend BIOS

IRQ Mapping Chart

IRQ0	System Timer	IRQ8	RTC Clock
IRQ1	Keyboard	IRQ9	Unused
IRQ2	Cascade to IRQ Controller	IRQ10	Unused
IRQ3	COM2	IRQ11	Unused
IRQ4	COM1	IRQ12	PS/2 mouse
IRQ5	Unused	IRQ13	FPU
IRQ6	FDC	IRQ14	Primary IDE
IRQ7	Printer	IRQ15	Secondary IDE

DMA Channel Assignments

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