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IND-386SXE SBC User's Manual

For MCSI PART NO. 71300901 IND-386SXE
All-In-One Single Board Computers
For Industrial/Embedded Systems Applications

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PREFACE

This manual provides information about the MCSI IND-386SXE All-In-One Single Board Computer. This information is intended for users who must implement IBM PC/AT compatible computer solutions to a wide variety of applications which cannot be satisfied using conventional desktop computers. This manual assumes that the reader has a good understanding of MS-DOS and the standard IBM PC/AT compatible architecture. For more information on the IBM PC compatible hardware and software architecture, refer to any of the many books available on the subject. A few suggestions are listed below:

- *Advanced MS-DOS Programming*, Microsoft Press
- *Programmers Guide to the IBM PC,* Microsoft Press
- *Programming the 80386,* Sybex
- *Undocumented DOS,* Addison Wesley

INVENTORY CHECKLIST

The complete IND-386SXE All-In-One Single Board Computer package consists of the following:

IND-386SXE All-In-One Single Board Computer
This Manual
PROMDISK Software Utilities Diskette

If any of the above is missing or appears to be damaged, inform MCSI immediately.

Please look for a file called README on the distribution disk for this product. It contains "last minute" changes and updates to this hard copy manual. This file will also document new utility programs.

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SECTION 1 - INTRODUCTION

The IND-386SXE All-In-One Single Board Computer (SBC) is a high performance system board that provides the primary elements for building an IBM PC/AT compatible computer for a wide variety of embedded systems applications. The IND-386SXE SBC contains all the basic elements found in a standard IBM PC/AT compatible desktop computer system.

The IND-386SXE SBC is fully compatible with the IBM PC/AT (ISA Bus) which means virtually all the software written for the IBM PC/AT will run on the IND-386SXE SBC.

1.1 FEATURES

Comment: Page: 1

A complete list of features is listed below:

- IBM PC/AT Compatible Plug-in Computer
- IND-386SXE Includes AMD 80C386SX (or equivalent)
- Optional 80C387SX Numeric Co-Processor
- Chips & Technology Chip Set
- Chips and Technology BIOS
- 25MHz Turbo Operation
- Passive Backplane Architecture
- 512K-Byte DRAM System Memory
- 4M-byte PROMDISK Disk Emulator for Diskless Applications
- AT Compatible Keyboard Port
- Two RS-232 Serial Ports, COM1 & COM2
- Optional RS-232 Serial Port for COM3
- Parallel Printer Port, LPT1
- Clock/Calendar with Battery Backup
- Low Power CMOS Design
- IBM PC/XT Size Plug-in Multilayer Board for Low EMI and High Reliability
- WatchDog Timer and Power Monitor
- Dual Floppy Disk Port (standard & high density)
- IDE Hard Disk Port
- On-board Mini Speaker
- External Speaker Port
- Optional External Reset

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SECTION 2 - SYSTEM DESCRIPTION

The following sections describe the major system features of the IND-386SXE All-In-One Single Board Computer.

2.1 PROCESSOR

The IND-386SXE SBC uses an AMD or Intel 80C386SX microprocessor. It is fully object code compatible with the 8086/8088, 80286, and 80386 family of products. Some of the distinctive features include:

- 16-bit External Data Bus
- 32-bit Internal Architecture
- 16M-byte Directly Addressable Memory Space
- Internal 14 Word by 16-bit Register Set
- Operand Addressing Modes
- Bit, Byte, Word, and String Operations
- 8 & 16-bit Signed/Unsigned Arithmetic
- Integrated Memory Manager

2.2 CO-PROCESSOR

The IND-386SXE SBC has a 68-pin PLCC socket which is designed to accept an optional Intel 80C387SX (or equivalent) or Cyrix 87SLC numeric data co-processor.

The 80C387SX is a high performance numeric data co-processor which provides up to 100 times the performance of the CPU alone. Over seventy numeric processing instructions are added to the instruction set, and eight 80-bit registers are added to the register set. The 80C387SX is compatible with the IEEE Floating Point Standard 754-1985.

2.3 SYSTEM MEMORY (DRAM)

The IND-386SXE SBC can support up to 512K-bytes of dynamic random access memory (DRAM) organized as one bank of 256KMx16. The memory is configured using four 256Kx4 DRAMs with a maximum access time of 70ns.

2.4 DMA CONTROLLER

The IND-386SXE SBC memory refresh and DMA functions are included in the System Controller chip which includes the equivalence of two 82C37 DMA controllers. The two DMA controllers are cascaded to provide four DMA channels for transfers to 8-bit peripherals (DMA1) and three channels for transfers to 16-bit peripherals (DMA2). DMA2 Channel 0 provides the cascade interconnection for the two DMA devices thereby maintaining IBM PC/AT compatibility. DMA Channel 3 is inoperative and should not be used. The DMA channel assignments are listed below:

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DMA Channel 0: Not Used (8-bit)
DMA Channel 1: Not Used (8-bit)
DMA Channel 2: Floppy Disk (8-bit)
DMA Channel 3: Inoperative DO NOT USE
DMA Channel 5: Not Used (16-bit)
DMA Channel 6: Not Used (16-bit)
DMA Channel 7: Not Used (16-bit)

The DMA request (DRQx) and acknowledge (DACKx/) lines are available on the P1/P2 98-pin edge connector.

2.5 INTERRUPT CONTROLLER

The IND-386SXE SBC has the equivalence of two 82C59A interrupt controllers included in the System Controller chip. The controllers accept requests from peripherals, resolve priorities on pending interrupts and interrupts in service, interrupt the CPU, and provide the vector address of the interrupt service routine. The two interrupt controllers are cascaded in a fashion compatible with the IBM PC/AT. The interrupt priority and assignments are shown below in descending order of priority:

Highest	IOCHCK/	Parity Check (Non-maskable)
	IRQ0	System Timer (Not Available)
	IRQ1	Keyboard (Not Available)
	IRQ8	Real Time Clock (Not Available)
	IRQ9	S/W Redirect to INT 0AH (IRQ2)
	IRQ10	Not Used
	IRQ11	Not Used
	IRQ12	Not Used
	IRQ13	Co-processor (Not Available)
	IRQ14	Not Used
	IRQ15	Not Used
	IRQ3	Serial Port 2
	IRQ4	Serial Port 1
	IRQ5	Parallel Port 2 (Not Used)
	IRQ6	Floppy Disk Controller
Lowest	IRQ7	Parallel Port 1

The interrupt request lines IRQx and IOCHCK/ are available on the 98-pin edge connector except as noted above.

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2.6 TIMERS

The IND-386SXE SBC has the equivalence of an 82C54 Programmable Timer included in the System Controller chip. The 82C54 is a three channel Programmable Counter/Timer chip. The three timers are driven by a 1.19MHz clock source derived from the on-board 14.3818MHz crystal oscillator. The three timers are used as follows:

TIMER Channel 0: System Timer
TIMER Channel 1: Timer for DRAM refresh
TIMER Channel 2: Tone Generation for Audio

2.7 CLOCK/CALENDAR AND CMOS RAM

The IND-386SXE SBC has the equivalence of an MC146818 real time clock/calendar with 128 bytes of CMOS RAM included in the System Controller chip. An on-board lithium battery is used to provide power to the system chip when the system power is off.

The 128 byte CMOS RAM consists of 14 bytes used by the clock/calendar, and 114 bytes used by the system BIOS.

Should your CMOS become corrupted, i.e. loss of battery power or accidentally clobbered, strange errors may occur while attempting to run your programs. Refer to Section 3.0 for instructions on how to clear the CMOS and reset the initial SETUP values.

2.8 BATTERY

The IND-386SXE SBC contains an on-board Lithium battery used for powering the System Controller chip during standby operation in the absence of the normal +5 volt supply.

During normal operation, the battery should last greater than five years before needing replacement. A replacement battery may be ordered directly from MCSI.

Care must be taken when handling, shipping, and storing the IND-386SXE board. The following precautions should be adhered to in order to prevent accidentally damaging the battery:

DO store the board in a non-conductive, static free container, or INSIDE the original Anti-Static Bag. This bag has been specially designed to prevent battery discharge.

DO NOT allow the board to come in contact with the outside of the bag; the outer surface of the bag is conductive.

DO NOT place the board on a metal bench or other conductive surfaces at any time.

DO NOT connect any equipment, circuits, etc., to the on-board battery as serious damage may result. Any additional current drain will dramatically reduce its life.

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2.9 KEYBOARD

The IND-386SXE SBC contains an IBM PC/AT compatible keyboard controller for interfacing to a generic IBM PC/AT compatible keyboard. The keyboard controller assembles the serial data from the keyboard into bytes and interrupts the CPU via IRQ1 after each byte is ready to be read. The IRQ1 service routine reads port 60H to get the keyboard scan code and acknowledges by sending a positive pulse to port 61H to clear the interrupt for the next byte. Refer to Appendix D for the keyboard connector location and pin assignments.

2.10 SPEAKER PORT

The IND-386SXE SBC contains an on-board sub-miniature audio speaker to provide audio interface to the user. Because of the small size of the speaker, the sound output is much reduced over that of the larger speaker found in most desktop computers. A connector is provided to connect an external speaker if the sound output is not sufficient.

Refer to Appendix D for the speaker port connector location and pin assignments.

2.11 RESET SWITCH

The IND-386SXE SBC includes an on-board power detector and power on reset circuit to reset the computer after power is applied, and to hold the computer reset during low power, brown-out conditions. In addition, there are provisions for connecting an external, normally open, push button reset switch. In addition, the reset switch input signal is also connected to the I/O Bus connector pin B16 for use by other controllers.

Refer to Appendix D for the reset switch connector location and pin assignments.

2.12 PRINTER PORT

The IND-386SXE SBC contains the equivalence of an IBM PC/AT Parallel Printer Port. The Parallel Printer Port can be configured as a standard IBM PC/AT compatible printer port, an 8-bit bi-directional port, or disabled completely. The interface consists of twelve buffered outputs which are latched and can be written and read under program control. An additional five inputs are provided for reading printer status. Refer to the IBM PC/AT Hardware Reference Manual for detailed programming and applications information.

The address, configuration, and enabling/disabling of the port are configured using the BIOS's INTERNAL SETUP program. Refer to Section 3.0 for more information. Refer to Appendix D for the connector location and pin assignments.

Note: The default interrupt for the printer port is IRQ7.

2.13 STANDARD SERIAL PORTS

The IND-386SXE SBC has the equivalence of two NC16C450 UARTs. The two UARTs can be configured as standard IBM PC/AT RS-232C compatible serial ports or individually disabled.

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The port addresses, and enabling/disabling of the serial ports are configured using the BIOS's INTERNAL SETUP program. Refer to Section 3.0 for more information. Refer to Appendix D for the connector location and pin assignments.

Note: Interrupts for Serial Ports 1 & 2 default to IRQ4 & IRQ3, respectively.

2.14 Optional Serial Port

The IND-386SXE SBC has an optional NC16C450 UART. The UARTs is configured as a standard IBM PC/AT RS-232C compatible COM3 serial port or disabled.

The optional serial port can be enabled or disabled, and the interrupt selected as IRQ5, IRQ6, or IRQ7 with mini-jumper E6. Refer to Appendix D for the connector location and pin assignments.

2.15 Floppy Disk Port

The IND-386SXE SBC contains an IBM PC/AT compatible dual floppy disk port with the equivalence of an NEC PD72056B Floppy Disk Controller, an on-chip digital data separator, and an IBM PC/AT compatible floppy disk adapter bus interface circuit. An on-board digital data separator provides optimum performance with the following disk drive types:

5.25"	360K Double-Sided
3.5"	720K High Capacity
5.25"	1.2M High Capacity
3.5"	1.44M High Density

The port address, and enabling/disabling of the floppy port is configured using the BIOS's INTERNAL SETUP program. Refer to Section 3.0 for more information. Refer to Appendix D for the connector location and pin assignments.

Note: The default interrupt for the floppy port is IRQ6. IRQ6 can be discounted entirely from the floppy disk port by removing E6(9-10) mini-jumper.

2.16 IDE Hard Disk Port

The IND-386SXE SBC contains an Integrated Drive Electronics (IDE) Port which directly interfaces to hard disk drives with embedded controllers.

The enabling/disabling of the IDE port is configured using the BIOS's INTERNAL SETUP program. Refer to Section 3.0 for more information. Refer to Appendix D for the connector location and pin assignments.

2.17 WatchDog Timer

The IND-386SXE SBC includes a DALLAS DS1232 WatchDog Timer chip. The WatchDog Timer ensures that if an application program gets "lost or bombs", the WatchDog Timer will reset the system.

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The WatchDog Timer is enabled by executing a write command to memory address 0F000:FF55H. Once enabled, the WatchDog Timer must be re-enabled within approximately one second, otherwise the WatchDog Timer will force a hardware reset to occur. Normally, the enabling of the WatchDog Timer would occur in a critical application program once every main loop or during the idle loop.

The WatchDog Timer is disabled during power up and hardware reset. Once the WatchDog Timer is enabled, it cannot be disabled by any means other than a hardware reset.

A sample assembly language program to enable the WatchDog Timer is shown below:

```
ENABLE_WDT:
      push  ds          ;save regs
      push  ax
      mov   ax,0F000H   ;WatchDog Timer address
      mov   ds,ax
      mov   ds[0FF55H],al ;enable WDTimer
      pop   ax          ;restore regs
      pop   ds
      ret
```


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SECTION 3 - SETUP

The IND-386SXE uses a Chips and Technologies BIOS. The BIOS includes an internal Setup Utility for configuring the system. The system configuration settings are stored in the on-board CMOS memory which is backed up by a Lithium battery.

3.1 USING THE INTERNAL SETUP UTILITY

The Setup Utility on the IND-386SXE can be invoked by running the ASETUP.EXE program from the DOS prompt. This will cause the Setup Utility to display the STANDARD SETUP MENU. The **PgUp** and **PgDn** keys are used to scroll through the three setup menus. Using the ↑↓ cursor keys, move the highlighted bar to the option you wish to modify and then press **Enter** to select it. The **Esc** and **F10** keys are used to save the changes before exiting the Setup Utility. The **Esc** key may be used to exit the Setup Utility without saving the changes. The **+** and **-** keys are used to scroll through the selections for a given setting. The **+** key is also used to increase the setting and the **-** key to decrease the setting.

After making the desired selections from the various setup menus, you can save your selections by pressing the **F10** key or by selecting the appropriate selection from the STANDARD SETUP MENU.

The 82C711 CONFIGURATION MENU is used to configure the parallel, serial, floppy, and IDE ports. To configure the 82C711, the MANUAL OVERRIDE function should be set to "Enabled" and the desired configuration for the ports specified by the configuration menu selections. If the MANUAL OVERRIDE function is set to "Disabled", the BIOS will dynamically configure the ports based on the I/O devices present in the system.

3.2 CLEARING THE CMOS MEMORY

Should your CMOS become corrupted, i.e. loss of battery power or accidentally clobbered, strange errors may occur while attempting to run your programs. A jumper at E5 has been provided to force the BIOS to use its internal default SETUP values. This is accomplished by first removing power from the IND-386SXE and momentarily interrupting the battery power to the system controller chip. To interrupt the battery power, remove the shunt from pins 1 & 2 and momentarily connect it to pins 2 & 3 (the "Clear CMOS" position). After waiting a few seconds, return the shunt back to its original position.

WARNING: DO NOT apply power to the IND-386SXE with the shunt in the clear CMOS position ---- serious damage will result.

Refer to Appendix B for the location of the CMOS shorting jumper.

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SECTION 4 - PROMDISK DISK EMULATOR

The IND-**386SXE** SBC includes an on-board 4M byte PROMDISK Disk Emulator for applications requiring diskless operation. The PROMDISK memory is made up of eight 32-pin JEDEC standard byte-wide memory sockets which may be configured to accept EPROMs, FLASH EPROMs, NVRAMs, and SRAMs. The eight sockets are arranged in three groups consisting of sockets U8-U11, and U34-U37. Each group of sockets can be configured separately allowing up to two drives to be implemented with different type chips, or a single drive with the same type chips. The grouping of the sockets was chosen to provide the most flexibility with the minimum number of configuration jumpers and switches.

4.1 PROMDISK DRIVE CONFIGURATION

During the power on diagnostics, the PROMDISK control program determines the drive configuration by looking for the PROMDISK signature at sockets U8, U34, and U37. Drives configured from different type chips must start on the group boundaries, i.e. U8, U34, and U37. Likewise, Read/Write drives using SRAMs or NVRAMs must also start on group boundaries because PROMDISK sizes and determines the chip type dynamically. The allowable PROMDISK drive configurations are shown below:

PROMDISK Disk Drive Configuration

U8	U9	U10	U11	U34	U35	U36	U37
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	A
-	-	-	-	-	-	-	B
A	A	A	A	-	-	-	-
B	B	B	B	-	-	-	-
-	-	-	-	A	A	A	A
-	-	-	-	B	B	B	B
A	A	A	A	A	A	A	A
B	B	B	B	B	B	B	B
A	A	A	A	A	A	A	B
B	B	B	B	B	B	B	A
A	A	A	A	B	B	B	B
B	B	B	B	A	A	A	A

Note: A & B in the above table are used for illustration and could be any drive letter, i.e. B & C, C & D, etc.

4.2 PROMDISK MEMORY SETUP

The PROMDISK memory can be configured to accept EPROMs, FLASH EPROMs, NVRAMs, and SRAMs. For proper operation the devices should have a maximum access time of 150 nanoseconds or less.

The memory sockets can be configured to emulate up to two fixed or floppy disk drives simultaneously. The type of chips, i.e. EPROM or SRAM used for each drive is selected by the PROMDISK Configuration Switch SW1 positions 1, 3, and 5. The ON position denotes EPROM, and

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OFF denotes SRAM. Sockets U8-U11 are controlled by SW1 position 1, sockets U34-U36 by SW1 position 3, and socket U37 by SW1 position 5. PROMDISK Configuration Switch SW1 positions 2, 4, & 6 select FLASH or standard EPROM for the individual drives. The ON position selects FLASH EPROM, and OFF selects standard EPROM. Configuration jumpers E1, E2, & E4, pins 1 & 2 select the programming voltage for FLASH EPROMs. Sockets U8-U11 are controlled by E1, sockets U34-U36 by E2, and socket U37 by E4. Install the shunt jumper between pins 2 & 3 for when using SRAMs, and remove the jumper entirely for all other device types. Refer to Appendix E for the PROMDISK configuration switch and jumpers.

4.3 PROMDISK DISABLE FEATURE

The PROMDISK control firmware can be disabled by setting the PROMDISK Configuration Switch SW1 position 7 to the ON position. This will cause the PROMDISK firmware to be bypassed during the power-up process. In addition, this switch is also accessible at the Miscellaneous I/O Connector J4 pin 6. Switching J4 pin 6 to ground (J4 pin 8) has the same effect. It should be noted, however, that when SW1 position 7 is ON, J4 pin 6 will have no effect. Refer to Appendix E for the PROMDISK configuration switch.

4.4 PROMDISK HARDWARE REASSIGN

The PROMDISK driver includes a hardware reassign feature which allows the installed PROMDISK drives to be reassigned to the next higher drive, ie. drive A to B, drive B to C, etc. This feature allows the user to selectively boot off a physical drive, if installed, without having to remove or reprogram the PROMDISK chips. The Hardware Reassign feature is enabled by setting the PROMDISK Configuration Switch SW1 position 8 to the ON position. In addition, this switch is accessible at the Miscellaneous I/O Connector J4 pin 7. Switching J4 pin 7 to ground (J4 pin 8) has the same effect. It should be noted, however, that when SW1 position 8 is ON, J4 pin 7 will have no effect. Refer to Appendix E for the PROMDISK configuration switch.

Note: A non-bootable drive cannot be reassigned to a bootable drive.

4.5 PROMDISK CUSTOM FEATURES

The PROMDISK control firmware can be customized to contain custom drive configurations and/or small setup or user defined control programs which can be executed as part of the start-up procedure just prior to the boot process. The custom features are selected by the PROMDISK Configuration Switch SW1 positions 9 and 10. Contact the factory for more information concerning these custom features. Refer to Appendix E for the PROMDISK configuration switch.

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SECTION 5 - USING THE PROMDISK SOFTWARE

The IND-**386SXE** PROMDISK can be configured to emulate up to two drives simultaneously, each of which can be operated as a Read-Only or Read/Write floppy or fixed disk drive. The paragraphs that follow describe how to use PROMDISK in the floppy and fixed disk emulator modes. The operating modes of the two drives can be mixed for added flexibility. The fixed disk drive emulator assumes that fixed disk drives start with drive "C", and that drives "A & B" are always floppy drives. Remember that the PROMDISK hardware portion of the board must be properly configured prior to changing the types of memory used for each drive.

5.1 USING SRAMS WITH PROMDISK

This section describes how to use the PROMDISK Disk Emulator with SRAMs or NVRAMs. The paragraphs that follow assume that the PROMDISK drives have been configured, and the SRAMs are installed on the board in accordance with Sections 4 and 6 of this manual. The board must then be installed in the target system with a floppy or fixed disk, and your current version of DOS loaded before continuing on.

5.1.1 Formatting SRAMs in the Floppy Disk Mode

When PROMDISK is configured to emulate a Read/Write floppy disk drive using SRAMs or NVRAMs, it is necessary to format the PROMDISK using the PROMDISK Format Utility INDFORM.COM. Once formatted, the PROMDISK drive can be treated just like a physical floppy disk drive and can be randomly accessed at memory bus speed, thereby increasing system throughput orders of magnitude over that of a typical floppy disk system. The standard PROMDISK firmware does not allow SRAMs to be configured as a bootable floppy drive, i.e. drive A. If this limitation presents a problem, a special version of the PROMDISK firmware can be requested from the factory. If you wish to configure the SRAMs as a bootable drive, you must configure the SRAMs as a PROMDISK fixed disk drive C (refer to Section 5.1.2). To format the PROMDISK SRAMs in the floppy disk mode you first boot the target system with your operating system. Once the system is booted, you format the PROMDISK floppy disk drive by typing:

```
INDFORM {pddrive} {startChip} {numChips} [response]
```

Where:

`pddrive` is the PROMDISK drive to format
`startChip` is the starting chip number, i.e. 1, 5, or 8.
`numChips` is the number of chips in the set, i.e. 1-8.
`response` is the optional "no operator response feature" for unattended operation.

Example 1: To format PROMDISK drive B as a *floppy disk drive* starting at chip number one and containing four SRAMs, type:

```
INDFORM B 1 4
```

Example 2: To format PROMDISK drive B as a *floppy disk drive* starting at chip number five and containing four SRAMs, with no operator response required, type:

```
INDFORM B 5 4 N
```


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NOTES:

1. **The standard DOS format program, FORMAT.EXE, cannot be used to format a PROMDISK floppy disk drive.**
2. **Be sure to include the device driver DRIVER.SYS in your CONFIG.SYS file when emulating PROMDISK floppy drives C through Z. Refer to Section 5.3 for more details.**

If the selected PROMDISK drive was never formatted or the data has been corrupted, the PROMDISK Format Utility will prompt you to reboot the system so that the PROMDISK control program can initialize and configure the drive. After the system is rebooted, you must run INDFORM again to format the drive.

5.1.2 Formatting SRAMs in the Fixed Disk Mode

When PROMDISK is configured to emulate a Read/Write fixed disk drive using SRAMs or NVRAMs, it is necessary to first create a valid DOS partition that can be recognized by both the system BIOS and your operating systems Format Program. Once a valid DOS partition has been created, you simply use the Format Program supplied with your operating system to format the PROMDISK SRAMs.

To initialize the PROMDISK SRAMs with a valid DOS partition you first boot the target system using a floppy disk containing your operating system. Once the system is booted, you initialize the PROMDISK fixed disk drive using the PROMDISK Fixed Disk Initialization Program INDFDISK.COM.

Example 1: To initialize PROMDISK drive C starting at chip number one and containing four chips, type:

```
INDFDISK C 1 4
```

Example 2: To initialize PROMDISK drive D starting at chip number eight and containing one chip, type:

```
INDFDISK D 8 1
```

After the SRAMs have been initialized, the program will instruct you to reboot the system. After rebooting the system, the PROMDISK SRAMs must be formatted using the Format Program supplied with your operating system. You must remember to copy the system files if you plan to make the PROMDISK a bootable drive.

Example 1: To format PROMDISK drive C as a bootable drive under MS-DOS 5.0, type:

```
FORMAT C:/u/s
```

Example 2: To format PROMDISK drive D as a non-bootable drive under MS-DOS 5.0, type:

```
FORMAT D: /u
```

After the PROMDISK drive is formatted, you may reboot your system and use the PROMDISK drive just like a physical fixed disk drive.

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5.1.3 Software Write Protect for SRAM Drives

The IND-**386SXE** PROMDISK includes a software write protect feature. If you wish to incorporate the write protect capability on your R/W drives, use the PDPRO.COM Utility Program. To write protect PROMDISK drive B, type:

Example 1: To write protect *(disable)* PROMDISK drive B, type:

```
PDPRO B:/p
```

Example 2: To unprotect *(enable)* PROMDISK drive B, type:

```
PDPRO B:/u
```

Note: The protect bit is reset to the unprotected state when the system is rebooted.

5.2 USING EPROMS WITH PROMDISK

This section describes how to use the IND-**386SXE** PROMDISK with standard (ultraviolet light erasable) EPROMs and FLASH EPROMs. Standard EPROMs must be programmed using an external EPROM programmer from binary image files created with the PROMDISK PDCREATE.EXE Software Utility, whereas FLASH EPROMs can be programmed on-board. The paragraphs that follow assume that the PROMDISK drives have been configured, and if using FLASH EPROMs they are already installed on the board. The board must then be installed in the target system with a floppy or fixed disk, and your current version of DOS loaded before continuing on.

5.2.1 Creating a PROMDISK List File or Work Disk

The PROMDISK PDCREATE.EXE Programming Utility provides two methods of programming FLASH EPROMs or creating binary image files. The first method uses a *list file* to specify the source and structure of the PROMDISK. This method has no limit on the size of the PROMDISK it can create and assumes the files are DOS compatible. The second method involves creating a *work disk* containing the files you wish to emulate on the PROMDISK. This method limits the size of the PROMDISK to the size of your *work disk,* and also requires the *work disk* to be reformatted each time changes are made to it. The only advantage of the *work disk* method is that it uses BIOS calls to read the disk sector by sector and therefore is able to create a PROMDISK containing a non-DOS type operating system. The *work disk* method **cannot** be used to create a PROMDISK fixed disk drive. Therefore, you must first decide whether to use a PROMDISK *list file* or *work disk* to specify your PROMDISK files.

If you choose the PROMDISK *list file* method, you must first create an ASCII file containing a list of files you wish to include in your PROMDISK disk emulator using a text editor of your choice. This file will be referred to as the PROMDISK *list file* and must end with the extension *.LST*. This file is used by the PROMDISK Programming Utility PDCREATE.EXE to specify the files, their location, and for creating PROMDISK subdirectories. The first line of the *list file* must contain the PROMDISK keyword [BOOT SOURCE], followed by the location of the boot sector for the operating system you plan to use. If you wish to create a bootable PROMDISK drive, the next line of the list must contain the PROMDISK keyword [SYSTEM], then followed by the list of system files. The remainder of the

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list specifies the PROMDISK directories, subdirectories, and their associated files. The format of the *list file* is shown below:

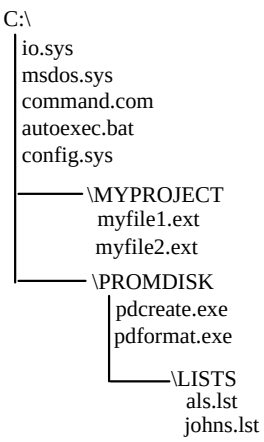
Format for List File	***Remarks***
[BOOT SOURCE]	PROMDISK Boot Source Keyword
drive:	Location of Boot Sector and System Files
[SYSTEM]	PROMDISK System Keyword
[filename.SYS]	Hidden System File(s)
[filename.COM]	System Command File
[VOLUME]	PROMDISK Volume Keyword
volumeName	Volume Name (11 characters max)
[\]	PROMDISK Root Directory
[drive][path]MYFILE1.EXT	Location of File(s) in Root Directory
[\subdirectoryName]	PROMDISK Subdirectory
[drive][path]MYFILE2.EXT	Location of File(s) in Subdirectory

Example 1: A typical *list file* for a bootable fixed disk is shown below:

PROMDISK List File

```
[BOOT SOURCE]
b:
[SYSTEM]
io.sys
msdos.sys
command.com
[\]
autoexec.bat
config.sys
[\myproject]
c:\myproject\myfile1.ext
d:\myfile2.ext
[\promdisk]
c:\pdiii\pdcreate.exe
c:\pdiii\pdformat.exe
[\promdisk\lists]
d:\data\als.lst
d:\data\johns.lst
```

PROMDISK Directory Structure



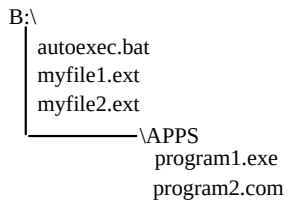
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Example 2: A typical *list file* for a non-bootable floppy disk is shown below:

PROMDISK List File

```
[BOOT SOURCE]
c:
[\]
autoexec.bat
c:\project\myfile1.ext
d:\myfile2.ext
[\apps]
c:\doug\program1.exe
c:\daenah\program2.com
```

PROMDISK Directory Structure



If you do not have access to a text editor, you can use the standard DOS copy command to create the PROMDISK *list file*. To create a PROMDISK *list file* named MYLIST.LST using the list of files from example two above, at the DOS prompt you would type:

```
copy con mylist.lst
[boot source]
c:
[\]
autoexec.bat
c:\myproject\myfile1.ext
d:\myfile2.ext
[\apps]
c:\doug\program1.exe
c:\daenah\program2.com
^Z                                  (control Z)
```

Once you have created your PROMDISK *list file,* you can proceed to Section 5.2.2 to determine the size and number of memory chips that will be required to emulate your specified drive.

If you choose to use the *work disk* method to specify your PROMDISK drive, you must first format a floppy diskette using the version of DOS that your files require for operation. Be sure that the format utility you use completely erases the diskette. If you are using DOS 5.0 FORMAT.EXE, be sure to use the /U option. Also, if you are making a bootable PROMDISK drive A, be sure to transfer the system files using the FORMAT /S option. You then copy the files you wish to emulate onto the newly formatted work diskette. You can then proceed to Section 5.2.2 to determine the size and number of memory chips that will be required to emulate your specified drive.

Note: The work disk method cannot be used to create a PROMDISK fixed disk drive.

5.2.2 Sizing the PROMDISK

Use the *size* option of the PROMDISK utility PDCREATE.EXE to determine the size and number of chips required for emulation.

Example 1: To determine the number of chips required to emulate the files specified by your PROMDISK *list file* named MYFILES.LST located on your drive B, type:

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```
PDCREATE B:MYFILES SIZE
```

Note: DO NOT add an extension to the list file filename. PDCREATE assumes the extension .LST.

Example 2: To determine the number of chips required to emulate the files specified by your PROMDISK w*ork disk* located on your drive B, type:

```
PDCREATE B SIZE
```

Note: DO NOT add a colon after the drive letter when sizing a work disk.

The PROMDISK sizer will report the type, size, and number of chips required for drive emulation.

5.2.3 Programming FLASH EPROMs

Use the PROMDISK Programming Utility PDCREATE.EXE to program the FLASH EPROMs. Using the size information from Section 5.2.2 above, program the FLASH EPROMs by typing:

```
PDCREATE source numChips kSize destfile pddrive [option]
```

Where:
`source` is the location and name of the *list file* (with no extension) or the location of the *work disk.*
`numChips` is the number of chips from Section 5.2.2.
`kSize` is size of the chip(s) in K-bytes, i.e. 128, 256, or 512.
`destFile` enter FLASH for FLASH EPROMs, or output filename without extension to create the binary images.
`pddrive` PROMDISK drive to program, i.e. A, B, C, etc.
`options:`
`/dN` = Use DOS to read floppy (0 = no, <1>= yes)
`/fN =` Starting chip <1>, 5, or 8
`/hN =` Fixed disk partition (0 = no, <1>= yes)
`/pN =` Pause before reading disk (0 = no, <1> = yes)
`/sN =` Presize before writing (0 = no, <1>= yes)
`/vN =` Verbose setting (0, <1>, or 2)
<> denotes the default value

Note: DO NOT add an extension to the destFile filename when making binary images; PDCREATE adds the extension .PD1, .PD2, etc.

The PDCREATE program will check to see if the FLASH EPROMs are erased, erase them if necessary, and program them accordingly. After the chips are programmed, PDCREATE will prompt you to reboot the computer to initialize the PROMDISK drive.

Example 1: To build a 1M-byte PROMDISK drive C using four INTEL FLASH 256Kx8 chips starting at chip one from your *list file* named MYFILES.LST located in drive A, type:

```
PDCREATE A:MYFILES 4 256 FLASH C /f1
```


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Example 2: To build a 128K PROMDISK drive B using one INTEL FLASH 128Kx8 chip starting at chip eight from your *work disk* located in drive A, type:

```
PDCREATE A 1 128 FLASH B /f8
```

5.2.4 Programming Standard EPROMs

Standard EPROMs must be programmed from an external EPROM programmer using the binary image file(s) created with the PROMDISK PDCREATE.EXE Programming Utility before installing them on the PROMDISK board. The procedure for creating binary image file(s) is the same as the procedure for programming FLASH EPROMs (Section 5.2.3 above) except that an output filename is specified instead of the word "FLASH". After programming the EPROMs with an external EPROM programmer, they must be installed on the board in accordance with Sections 4 and 6 of this manual before installing the board in your target system.

Example 1: To create the binary image file(s) named MYIMAGE.PDx for a 512K PROMDISK drive B using 4 128Kx8 EPROMs from your PROMDISK *list file* named MYFILES.LST located in drive A, type:

```
PDCREATE A:MYFILES 4 128 MYIMAGE B
```

Example 2: To create the binary image file for a 256K PROMDISK drive B using one 256Kx8 EPROM from your PROMDISK *work disk* located in drive A, type:

```
PDCREATE A 1 256 MYIMAGE B
```

The build program will create the binary images for the files specified in your file list and write the images to the selected filename. The selected filename extension .PDx will be incremented for each chip in the set.

5.2.5 Programming the EPROM Drive A

When PROMDISK is configured as drive A, your system will automatically try to boot from PROMDISK. If your PROMDISK drive A is corrupted or the EPROMs have been erased, your system will hang-up since there is no valid boot sector. If this occurs, simply reassign the PROMDISK drives using SW1-8. Refer to Section 4.5 for more information on the PROMDISK reassign feature.

5.3 EMULATING FLOPPY DRIVES C THROUGH Z

When emulating floppy disk drives C through Z in systems that do not allow floppy disks to be configured for these drives or in systems with hard disks, you must specify the DOS device driver DRIVER.SYS in your CONFIG.SYS file. The CONFIG.SYS and DRIVER.SYS files must be contained in the root directory of your boot drive.

Example: To configure your system with a physical disk for drive A and PROMDISK floppy drive C, you must first set the system CMOS for a physical floppy disk installed for drive A and *NONE* installed for drives B through D. Next, you make a CONFIG.SYS file containing the following:

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```
DEVICE = DRIVER.SYS  /d:2
```

5.4 DYNAMIC DRIVE ASSIGNMENT

The IND-**386SXE** PROMDISK supports dynamic drive assignments for its two drives. This feature is extremely useful during the development stages when the IND-**386SXE** board is installed in a development system with a different drive configuration than the final target system. The PDASSIGN.COM software utility allows the user to reassign or even hide the PROMDISK drives. The format for PDASSIGN is shown below:

```
PDASSIGN {oldDrive}={newDrive}
```

Where:
`{oldDrive}` is the PROMDISK drive you wish to reassign.
`{newDrive}` is the letter A through Z for the new PROMDISK drive. Entering a dash (-) will hide the drive until the system is rebooted.

Notes:
1.0 PROMDISK fixed disk drives cannot be reassigned.
2.0 The PROMDISK drives are reset to their original assignments when the system is rebooted.
3.0 If you experience problems accessing a real floppy disk drive after using PDASSIGN, make sure your source diskette is the same media type, i.e. if you need to access a 1.44M floppy diskette, you should build your PROMDISK with PDCREATE using the same size drive.

Example 1: To reassign PROMDISK drive A to B, type:

```
PDASSIGN A=B
```

Example 2: To reassign PROMDISK drive B to A, type:

```
PDASSIGN B=A
```

Example 3: To hide PROMDISK drive A, type:

```
PDASSIGN A=-
```

The following is a typical application example:

The PROMDISK is configured as drives A and B. Drive A contains DOS, and drive B the application program. To protect (hide) the application program on drive B, you would execute PDASSIGN B=- from within the application program or from the DOS prompt. This would cause the PROMDISK drive B to be inaccessible, and the physical drive B, if installed, to be accessible.

5.5 PROMDISK CUSTOM FEATURES

The PROMDISK control firmware can be customized to include custom drive configurations and/or small setup or user defined control programs which can be executed as part of the start-up procedure

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just prior to the boot process. Contact the factory for more information concerning these custom features.

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SECTION 6 - INSTALLATION

This section describes the procedures for installing the IND-**386SXE** All-In-One Single Board Computer into your system. The following is a list of typical peripherals required to build a minimum system:

- Passive Backplane and Power Supply
- IBM PC/AT Type Keyboard
- Display Adapter Card
- Display Monitor
- Floppy or Hard Disk with MS-DOS

6.1 INSTALLING THE CO-PROCESSOR

When installing or removing the Math Co-processor, be sure to first touch a grounded surface to discharge any static electricity from your body. Use the following procedure to install the Co-processor:

1. Match pin one (white dot) on the Co-processor chip with pin one of the PLCC socket. Note pin 1 is marked on the board. In addition, the PLCC socket may have an arrow marked on the base of the socket denoting the side containing pin one.

2. To complete the installation, gently press the Co-processor chip into place.

3. Double check the insertion and orientation of the chip before applying power. Improper installation will result in permanent damage to the chip.

A special tool is required to remove the chip from the PLCC socket. Contact the factory or your local chip distributor more details.

6.2 INSTALLING THE PROMDISK MEMORY

The IND-**386SXE**'s PROMDISK supports the popular JEDEC standard byte-wide memory devices. For proper operation the devices should have a *maximum access time of less than 150 nanoseconds*. The memory chips are installed left to right, top to bottom, starting at the leftmost socket. Be sure that the PROMDISK configuration jumpers and switches are properly set in accordance with Section 4 of this manual, and that you first touch a grounded surface to discharge any static electricity from your body. Use the following procedure to install the PROMDISK memory chips:

1. Line pin one of the memory chip indicated usually with a notch or white dot with pin one (upper leftmost pin) of the socket.

2. Carefully push the chip into the socket until the bottom of the chip comes in contact with the bottom of the socket.
3. Check to make sure that all the pins of the chip are installed and that there are no pins bent under the chip.

4. Repeat Steps 1-3 for the remaining chips.

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To remove a memory chip, wedge a very small screwdriver between the chip and the socket, and gently pry the chip out of the socket. Care must be taken not to insert the screwdriver under the socket otherwise serious damage to the socket may result.

6.3 COMPLETING THE INSTALLATION

To complete the installation, the following steps should be followed:

1. Set the configuration jumpers in accordance with Appendix E.
2. Install the IND-**386SXE** SBC into one of the 98-pin I/O slots in a passive backplane.
3. Install a Display Adapter Card into one of the slots in the backplane.
4. Connect the applicable I/O cables and peripherals, i.e. floppy disk, IDE hard disk, monitor, power supply, etc.
5. Connect an IBM PC compatible keyboard.
6. Turn power on to the display monitor.
7. Turn power on to the backplane power supply.
8. After the DOS prompt, run the ASETUP.EXE program to invoke the Setup Utility.
9. Reconfigure the IND-**386SXE** SBC using SETUP.
10. Boot the system.

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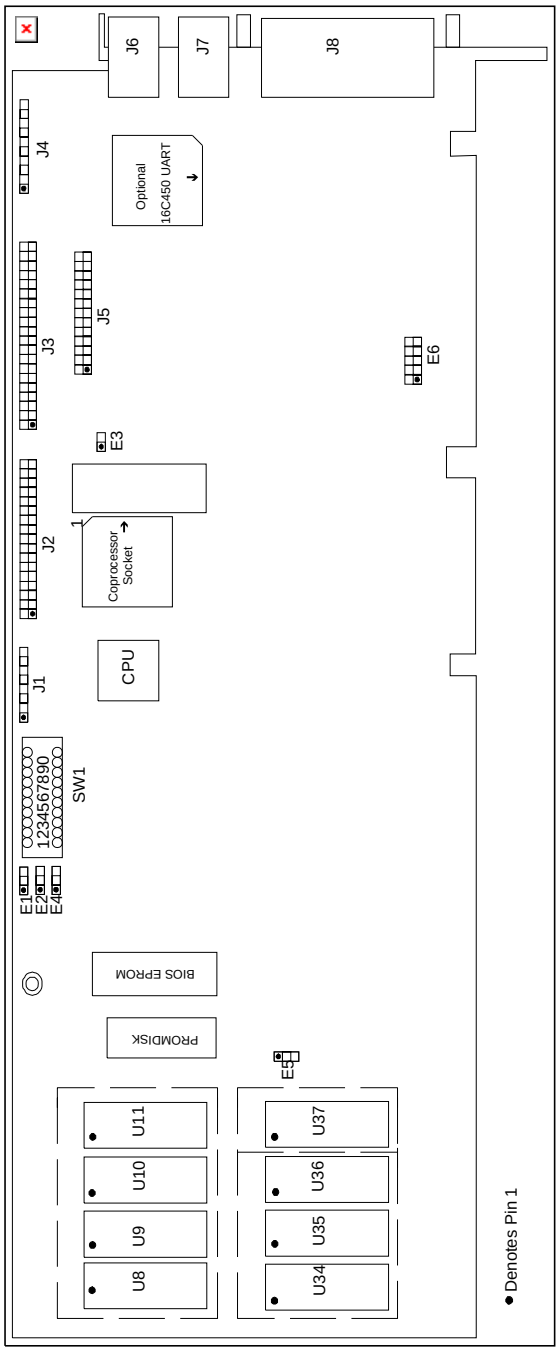
APPENDIX A - SPECIFICATIONS

This appendix lists the specifications for the IND-**386SXE** All-In-One Single Board Computer.

CPU:	IND-386SXE includes AMD or Intel 80C386SX (25MHz)
Co-processor:	80C387SX (optional)
Memory:	512K DRAM System Memory (not expandable)
Disk Emulator:	4M PROMDISK Disk Emulator, 8-32pin sockets, supports EPROMs, FLASH EPROMs, NVRAMs, & SRAMs.
BIOS:	C&T with Internal SETUP
Clock/Cal:	PC/AT Compatible with battery back-up
I/O Bus:	IBM PC/AT Compatible 98-pin Edge Connector
DMA:	7 Channels (DMA Channel 1 inoperative)
Timers:	3 Programmable
Interrupts:	16
Reset:	Controlled by on-board power detector with provisions for external reset switch
I/O Ports:	I/O Controller 82C721 2 - RS-232 Serial Ports (COM Ports 1 & 2 at rear connectors J8 & J7) 1 - Optional RS-232 Serial Port (COM3 at rear connector J6) 1 - Parallel Printer Port (at header J5) 1 - IBM PC/AT Compatible Keyboard Port (at header J1) 1 - On-board Speaker with Speaker Port (J4) 1 - Dual 3.5"/5.25" Floppy Disk Port (J2) 1 - IDE Hard Disk Port (J3) 1 - WatchDog Timer
Speed:	25MHz
Battery:	Lithium for Clock/Calendar (five years operation under typical conditions)
Benchmark:	LANDMARK v2.0 = 19 MHz
Size:	Full Size XT board 13.3"L X 4.2"H
Power:	+5VDC @ 1.4A, ±12VDC @ 0.020A

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APPENDIX B - BOARD OUTLINE



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APPENDIX C - MEMORY AND I/O MAPS

The following is the memory map for the IND-386SXE SBC. The addresses are fully PC/AT compatible, unless otherwise specified.

IND-386SXE SBC Memory Map

Address	Used For	Size
00000H - 003FFH	Interrupt Vectors	1.0K
00400H - 005FFH	BIOS Values	0.5K
00600H - 7FFFFH	User RAM (DOS)	510.5K
80000H - 9FFFFH	User RAM (DOS)*	128.0K
A0000H - AFFFFH	Reserved for EGA*	64.0K
B0000H - B7FFFH	Video RAM (MDA)*	32.0K
B8000H - BFFFFH	Video RAM (CGA)*	32.0K
C0000H - C3FFFH	Video BIOS*	16.0K
C4000H - C7FFFH	EMS Window	16.0K
C8000H - DFFFFH	ROM Scan Devices*	96.0K
E0000H - E3FFFH	PROMDISK Window	16.0K
E4000H - E4FFFH	PROMDISK Driver	4.0K
E5000H - EFFFFH	Custom Firmware	44.0K
F0000H - FFFFFH	BIOS	64.0K
100000H - FFFFFFH	User Memory	15.0M

External to the IND-386SXE

The following is the I/O map for the IND-386SXE SBC. I/O addresses are fully PC/AT compatible, unless otherwise specified.

IND-386SXE SBC I/O Map

Address	Function
000H - 01FH	DMA Controller #1
020H - 021H	Interrupt Controller #1
022H - 023H	Configuration Address Register
040H - 05FH	System Timers
060H - 063H	Keyboard, Status, & System Control
070H - 07FH	Clock/Calendar & CMOS Ram Access
080H - 083H	DMA Page Register
0A0H - 0BFH	Interrupt Controller #2
0C0H - 0DFH	DMA Controller #2
1F0H - 1F8H	IDE Hard Disk
238H - 23FH	Serial Port COM2 (Optional)
278H - 27FH	Parallel Printer Port LPT1 (Optional)
2F8H - 2FFH	Serial Port COM2 (Default)
338H - 33FH	Serial Port COM1 (Optional)
378H - 37FH	Parallel Printer Port LPT1 (Default)
3BCH - 3BFH	Parallel Printer Port LPT1 (Optional)
3E8H - 3EFH	Serial Port COM3 (When installed)
3F0H - 3F7H	Floppy Disk Controller
3F8H - 3FFH	Serial Port COM1 (Default)

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APPENDIX D - CONNECTORS

J1 Keyboard Header

Pin	Signal
1	KBCLK
2	KBDATA
3	N/C
4	GND
5	+5VDC
6	Keyway
7	KBDINH/
8	Ground

J2 Floppy Disk Port Connector

Pin	Signal Name
2	RPMLC
4	Not Used
6	Not Used
8	INDEX/
10	MOTOR0/
12	DRIVE SELECT1/
14	DRIVE SELECT0/
16	MOTOR1/
18	DIRECTION
20	STEP/
22	WRITE DATA/
24	WRITE GATE/
26	TRACK0/
28	WRITE PROTECT/
30	READ DATA/
32	HEAD SELECT/
34	DISK CHANGE/

All odd numbered pins are GND

J3 IDE Hard Disk Port Connector

Pin	Signal	Pin	Signal
1	IDERST/	2	GND
3	IDED7	4	IDED8
5	IDED6	6	IDED9
7	IDED5	8	IDED10
9	IDED4	10	IDED11
11	IDED3	12	IDED12
13	IDED2	14	IDED13
15	IDED1	16	IDED14
17	IDED0	18	IDED15
19	GND	20	Not Used
21	Not Used	22	GND
23	IDEIOW/	24	GND
25	IDEIOR/	26	GND
27	Not Used	28	IDEALE
29	Not Used	30	GND
31	IRQ14	32	IOCS16/
33	IDESA1	34	Not Used
35	IDESA0	36	IDESA2
37	HDCS0/	38	HDCS1/
39	IDEACT/	40	GND

J4 Miscellaneous I/O Header

Pin	Signal Name	Description

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1	RESETSW/	Connect to ground to reset
2	GND	Ground
3	KEYWAY	No pin installed
4	IDELED/	IDE Hard Disk Indicator LED Cathode (-)
5	+5VDC	IDE Hard Disk Indicator LED Anode (+)
6	PDINHIBIT/	PROMDISK inhibit. Connect this pin to ground to inhibit the PROMDISK feature. (See Section 4.4)
7	REASSIGN/	PROMDISK reassign. Connect this pin to ground to reassign the PROMDISK drive letter. (See ection 4.5)
8	GND	Ground
9	SPEAKER (-)	Connect to Speaker (-)
10	SPEAKER (+)	Connect to Speaker (+)

J5 Printer Interface Connector

Pin	Signal	Pin	Signal
1	STROBE/	2	AUTOFD/
3	PDAT0	4	ERROR/
5	PDAT1	6	INIT/
7	PDAT2	8	SLCTIN/
9	PDAT3	10	GND
11	PDAT4	12	GND
13	PDAT5	14	GND
15	PDAT6	16	GND
17	PDAT7	18	GND
19	ACK/	20	GND
21	BUSY	22	GND
23	PE	24	GND
25	SLCT	26	GND

J6 Serial Port #3 Connector

Pin	Signal Name
1	GND
2	RECEIVE DATA #3
3	TRANSMIT DATA #3
4	CLEAR TO SEND #3
5	REQUEST TO SEND #3
6	+12V

J7 Serial Port #2 Connector

Pin	Signal Name
1	GND
2	RECEIVE DATA #2
3	TRANSMIT DATA #2
4	CLEAR TO SEND #2
5	REQUEST TO SEND #2
6	+12V

J8 Serial Port #1 Connector

Pin	Signal Name
2	Transmit Data #1
3	Receive Data #1

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4	Request to Send #1
5	Clear to Send #1
6	Data Set Ready #1
7	Ground
8	Carrier Detect #1
20	Data Terminal Ready #1
22	Ring Indicator #1

Note: All other pins not used

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APPENDIX E - CONFIGURATION JUMPERS & SWITCHES

This section provides a summary of the configuration jumpers and switches. The tables below and the Board Outline in Appendix B serve as quick references for determining the jumper and switch settings, and a means of finding detailed information elsewhere in the manual. The standard board has been configured at the factory for 27C010 EPROMs for sockets U8-U11, and 128K NVRAMs for sockets U34-U37.

PROMDISK Memory Configuration Switch SW1 and Configuration Jumpers E1, E2, & E4 (Section 4.2)

Chip P/N (Generic)	Type	Size	Switch 1, 3, or 5	Switch 2, 4, or 6	E1, E2, or E4
27C010	EPROM	128Kx8	On	Off	OFF
27C020	EPROM	256Kx8	On	Off	OFF
27C040	EPROM	512Kx8	On	Off	OFF
DS1245	NVRAM	128Kx8	Off	Off	2-3
HM628128L	SRAM	128Kx8	Off	Off	2-3
Various	SRAM	512Kx8	Off	Off	2-3
28F010	FLASH	128Kx8	On	On	1-2
28F020	FLASH	256Kx8	On	On	1-2

Notes: 1.0 Chips within a drive group cannot be mixed.

PROMDISK Disable Switch SW1

Function	SW1-7	Section
Disabled	On	4.3
Enabled	Off (Default)	4.3

PROMDISK Reassign Switch SW1

Function	SW1-8	Section
Enabled	On	4.4
Disabled	Off (Default)	4.4

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PROMDISK Custom Feature Switch SW1

Function	SW1-9	SW1-10	Section
Normal	Off	Off (Default)	4.5
Reserved	On	Off	
Reserved	Off	On	
Reserved	On	On	

E5 Clear CMOS Memory Jumper

1-2	Normal Operation (Default)	Section 3.3
2-3	Clear CMOS Data	Section 3.3

E6 Serial Port #3 Configuration Jumper

Function	1-2	3-4	5-6	7-8	9-10	Section 2.14
COM3 Disabled	XX	XX	XX	Off	XX	Section 2.14
IRQ5	On	Off	Off	ON	XX	Section 2.14
IRQ6	Off	On	Off	On	Off	Section 2.14
IRQ7	Off	OFF	On	On	XX	Section 2.14
Enable FDC IRQ6	XX	XX	XX	XX	On	Section 2.15

E3 Not Used

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