NOTICE

The drivers and utilities for Octagon products, previously provided on a CD, are now in a self-extracting zip file located at the Octagon Systems web site on the product-specific page. Download this file to a separate directory on your hard drive, then double click on it to extract the files. All references in this manual to files and directories on the CD now refer to files in the Utilities zip file.

O C T A G O N S Y S T E M S

Embedded PCs For Extreme Environments

2040 PC/104 CPU
User's Manual

5167 (1099)

OCTAGON SYSTEMS®

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Westminster, CO

IMPORTANT!

Please read the following section before installing your product:

Octagon's products are designed to be high in performance while consuming very little power. In order to maintain this advantage, CMOS circuitry is used.

CMOS chips have specific needs and some special requirements that the user must be aware of. Read the following to help avoid damage to your card from the use of CMOS chips.

Using CMOS circuitry in industrial control

Industrial computers originally used LSTTL circuits. Because many PC components are used in laptop computers, IC manufacturers are exclusively using CMOS technology. Both TTL and CMOS have failure mechanisms, but they are different. Described below are some of the failures which are common to all manufacturers of CMOS equipment. However, much of the information has been put in the context of the Micro PC.

Octagon has developed a reliable database of customer–induced, field failures. The average MTBF of Micro PC cards exceeds 11 years, yet there are failures. Most failures have been identified as customer–induced, but there is a small percentage that cannot be identified. As expected, virtually all the failures occur when bringing up the first system. On subsequent systems, the failure rate drops dramatically.

- Approximately 20% of the returned cards are problem–free. These cards, typically, have the wrong jumper settings or the customer has problems with the software. This causes frustration for the customer and incurs a testing charge from Octagon.
- Of the remaining 80% of the cards, 90% of these cards fail due to customer misuse and accident. Customers often cannot pinpoint the cause of the misuse.
- Therefore, 72% of the returned cards are damaged through some type of misuse. Of the remaining 8%, Octagon is unable to determine the cause of the failure and repairs these cards at no charge if they are under warranty.

The most common failures on CPU cards are over voltage of the power supply, static discharge, and damage to the serial and parallel ports. On expansion cards, the most common failures are static discharge, over voltage of inputs, over current of outputs, and misuse of the CMOS circuitry with regards to power supply sequencing. In the case of the video cards, the most common failure is to miswire the card to the flat panel display. Miswiring can damage both the card and an expensive display.

- **Multiple component failures:** The chance of a random component failure is very rare since the average MTBF of an Octagon card is greater than 11 years. In a 7 year study, Octagon has never found a single case where multiple IC failures were not caused by misuse or accident. It is very probable that multiple component failures indicate that they were user–induced.

- **Testing "dead" cards:** For a card that is "completely nonfunctional", there is a simple test to determine accidental over voltage, reverse voltage or other "forced" current situations. Unplug the card from the bus and remove all cables. Using an ordinary digital ohmmeter on the 2,000 ohm scale, measure the resistance between power and ground. Record this number. Reverse the ohmmeter leads and measure the resistance again. If the ratio of the resistances is 2:1 or greater, fault conditions most likely have occurred. A common cause is miswiring the power supply.

- **Improper power causes catastrophic failure:** If a card has had reverse polarity or high voltage applied, replacing a failed component is not an adequate fix. Other components probably have been partially damaged or a failure mechanism has been induced. Therefore, a failure will probably occur in the future. For such cards, Octagon highly recommends that these cards be replaced.

- **Other over–voltage symptoms:** In over–voltage situations, the programmable logic devices, EPROMs and CPU chips, usually fail in this order. The failed device may be hot to the touch. It is usually the case that only one IC will be overheated at a time.

- **Power sequencing:** The major failure of I/O chips is caused by the external application of input voltage while the Micro PC power is off. If you apply 5V to the input of a TTL chip with the power off, nothing will happen. Applying a 5V input to a CMOS card will cause the current to flow through the input and out the 5V power pin. This current attempts to power up the card. Most inputs are rated at 25 mA maximum. When this is exceeded, the chip may be damaged.

- **Failure on powerup:** Even when there is not enough current to destroy an input described above, the chip may be destroyed when the power to the card is applied. This is due to the fact that the input current biases the IC so that it acts as a forward biased diode on powerup. This type of failure is typical on serial interface chips.

- **Hot insertion:** Plugging cards into the card cage with the power on will usually not cause a problem. (**Octagon urges that you do not do this!**) However, the card may be damaged if the right sequence of pins contacts as the card is pushed into the socket. This usually damages bus driver chips and they may become hot when the power is applied. This is one of the most common failures of expansion cards.
- **Terminated backplanes:** Some customers try to use Micro PC cards in backplanes that have resistor/capacitor termination networks. CMOS cards cannot be used with termination networks. Generally, the cards will function erratically or the bus drivers may fail due to excessive output currents.
- **Excessive signal lead lengths:** Another source of failure that was identified years ago at Octagon was excessive lead lengths on digital inputs. Long leads act as an antenna to pick up noise. They can also act as unterminated transmission lines. When 5V is switched onto a line, it creates a transient waveform. Octagon has seen submicrosecond pulses of 8V or more. The solution is to place a capacitor, for example 0.1 µF, across the switch contact. This will also eliminate radio frequency and other high frequency pickup.

≡ Avoiding damage to the heatsink/CPU

WARNING!
When handling any Octagon CPU card, extreme care must be taken not to strike the heatsink (if installed) against another object, such as a table edge. Also, be careful not to drop the CPU card, since this may cause damage to the heatsink/CPU as well.

Note Any physical damage to the CPU control card is **not** covered under warranty.

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Abbreviations and terms used in this manual

Throughout this manual, the following symbols and terms are used:

Autoexecution	Automatic execution of a program on powerup or reset.
BIOS	Basic Input Output System.
Console port	Video card or COM1 where BIOS and DOS messages appear and keyboard input is available.
DRAM	Dynamic Random Access Memory devices.
Expansion card	The expansion cards add I/O functions to the PC/104 system, such as analog input/output, digital input/output, motion control, and display.
Flash	Electrically erasable PROM which allows at least 100,000 write cycles.
h	The suffix "h" denotes a hexadecimal number. A decimal number has no prefix or suffix. For example, 1000h and 4096 are equivalent.
KB	Kilobyte (1,024 8–bit bytes).
MB	Megabyte (1,048,576 8–bit bytes).
Memory device	The type of static RAM, DRAM, flash memory, or EPROM specified for either volatile or nonvolatile memory.
PC/104 expansion	An expansion bus used for holding 8– and 16–bit expansion cards.
PC SmartLINK	A serial communications software package designed by Octagon for use with the 2040 PC/104 CPU.
Solid–state disk (SSD)	A simulated disk which uses a high speed solid–state memory device. For example, flash memory, EEPROM, or static RAM.
SRAM	Static Random Access Memory.
TTL compatible	Transistor transistor logic compatible; 0–5V logic levels.
W[–]	Denotes a jumper block and the pins to connect.
XMODEM	A communications protocol which allows transfer of files between two computers.

Conventions used in this manual

≡ Notes and warnings

Note A note is supplementary or background information. At other times, it is a hint or reminder that makes a task easier or quicker.

> **WARNING!**
>
> A warning gives vital information. Failure to heed a warning may cause system failure, equipment damage, or bodily harm to the system operator.

≡ Command format and procedures

Commands must be entered in a specific format. To indicate the format, this manual uses the conventions below. The conventions cover the rules for issuing all commands, including the most complex ones. The command format looks like this:

command [**type_this** | **or_ this**] *input* {*optional_input*}

Follow these rules and conventions:

- Information which appears on your screen is shown in a different type face, for example:

  ```
  PhoenixBIOS(TM) A486 Version 1.03
  Copyright (C) 1985-1994 Phoenix Technologies, Ltd.
  All Rights Reserved
  Octagon Systems Corp.
  ```

- Commands that you must key in are shown in **Courier Bold**, for example:

  C:> **RESET**

- Italicized refers to information that is specific to your particular system or program, e.g.,

  Enter *filename* means enter the name of your file.

- Paired angle brackets are used to indicate a specific key on your keyboard, e.g., <ESC> means the escape key; <CTRL> means the control key; <F1> means the F1 function key.

- All addresses are given in hexadecimal, for example, 328h.

About this manual

The *2040 PC/104 CPU user's manual* provides information about installing and configuring the 2040 PC/104 CPU. This manual is divided into four sections:

- Section 1 — Installation

  Chapter 1: Overview
  Chapter 2: Quick start
  Chapter 3: SETUP programs
  Chapter 4: Save and run programs

- Section 2 — Hardware

  Chapter 5: Serial ports
  Chapter 6: LPT1 parallel port
  Chapter 7: Console devices
  Chapter 8: SSDs, DRAM, and battery backup
  Chapter 9: External drives
  Chapter 10: Interpreting "beep" codes
  Chapter 11: PC/104 expansion

- Section 3 — System management

  Chapter 12: Watchdog timer and hardware reset
  Chapter 13: Serial EEPROM
  Chapter 14: Troubleshooting

- Section 4 — Appendices

  Appendix A: Technical data
  Appendix B: Software utilities
  Appendix C: Accessories

Overview: Section 1 – Installation

Section 1 provides installation and programming instructions, startup options, and system configuration program examples. The following chapters are included:

Chapter 1: Overview
Chapter 2: Quick start
Chapter 3: SETUP programs
Chapter 4: Save and run programs

Chapter 1: Overview

≡ Description

The 2040 is a rugged and reliable PC/104 CPU with a low–power 386SX 40 MHz CPU. The 2040 PC/104 CPU integrates serial communications, a multifunctional parallel port, a solid–state disk, keyboard and speaker ports, and a PC/104 interface.

≡ 2040 PC/104 CPU major hardware features

CPU

The CPU is a low–power 386SX with a clock speed of 40 MHz.

Solid–state disks

SSD0

The 2040 PC/104 CPU has an on–board 512 KB flash which contains the BIOS and software extensions.

SSD1

A 32–pin DIP socket accepts an M–Systems DiskOnChip®. The socket exhibits high retention force and affords a gas tight contact.

SSD2

A 32–pin DIP socket accepts either a 128 KB or a 512 KB SRAM. SRAM is automatically backed up when an AT battery is connected. The socket exhibits high retention force and affords a gas tight contact.

RAM

The 2040 PC/104 CPU has 4 MB DRAM on board.

Serial ports protected against ESD

The 2040 PC/104 CPU has two serial ports for 8–wire RS–232C interfaces. COM1 can also be used as a console interface. These serial ports have the following common specifications:

- IEC1000, level 3, ESD protection specification
  - — Contact discharge ±6 kV
  - — Air–gap discharge ±8 kV
- Backdrive protection
- 16C550 compatible
- Up to 115.2K baud
- 16–byte FIFO buffers
- Enabled and disabled in SETUP

Multifunctional printer port

The 2040 PC/104 CPU incorporates the latest enhanced parallel port. It includes the following features:

- Unidirectional
- Bidirectional
- IEEE 1284, ECP and EPP modes
- 14 mA of drive current
- Backdrive protection
- Floppy drive mode

The following represent applications in the multifunctional parallel port:

- LPT1 for PC compatible printers
- 17 general purpose digital I/O lines
- Up to a 4 x 4 matrix keypad
- 4–line alphanumeric display
- MPB–16PC, 16–position opto–module rack

Watchdog timer added for safety

The watchdog timer resets the system or generates an NMI (nonmaskable interrupt) if the program stops unexpectedly. The watchdog is enabled, disabled and strobed under software control. The time–out period is 1.6 seconds typical, 1.00 seconds minimum to 2.25 seconds maximum. The watchdog timer can be strobed by the I17HNDLR.EXE utility (a TSR program) to extend the timeout up to a maximum of 60 hours.

Real time calendar/clock with battery–backup

The real time clock is fully AT compatible and uses the standard DOS calls. An optional off–card battery powers the real time clock when the 5 volt supply is removed.

Keypad and LCD display support for low cost operator interface

For embedded applications, the parallel printer port can interface with a 16–key matrix keypad and a 2– or 4–line LCD display. The 2040 PC/104 CPU is supplied with software that provides keypad scanning and display operation. Supplied display and keypad drivers in C and Basic support these devices.

Speaker, keyboard, and mouse

A speaker and keyboard can be connected to the utility port. If a mouse is needed, it can be connected to a COM port. The keyboard controller accepts an AT style keyboard. Alternately, COM1 can be used as a console port, and all keyboard and video information is redirected through COM1. Neither the keyboard nor the mouse are required for operation.

PC/104 16–bit interface

The PC/104 interface accepts an 8– or 16–bit PC/104 expansion board. PC/104 expansion boards are available from several manufacturers. As many as three PC/104 expansion boards may be stacked on the 2040 PC/104 CPU.

Hardware reset

A hardware reset ensures complete reset of the system and all attached peripherals. A hardware reset can be done by any of the following methods:

- An expired watchdog timer cycle
- Cycling power
- Momentarily pulling the master reset line to ground (pin 3, connector J5)

5 Volt operation lowers system cost

The 2040 PC/104 CPU operates from a single 5V ±5% supply.

- 5V ±5%, 800 mA maximum
- +12V, –12V, and –5V supplied to PC/104 connector; not required for 2040 PC/104 CPU operation

≡ 2040 PC/104 CPU major software features

Diagnostic software verifies system integrity automatically

The 2040 PC/104 CPU has built–in diagnostic software that can be used to verify on–card I/O and memory functions. On powerup, a series of tests is performed. If a problem occurs, the failed test can be identified by a series of beeps. The test is performed automatically every time the system is reset or powered up. Memory verification does not require software, test equipment, monitor, keyboard, disks, or test fixtures. See the *Interpreting "beep" codes* chapter for a complete listing of tests and failures and their descriptions.

SETUP information stored in EEPROM for high reliability

Loss of SETUP data is serious in industrial applications. Most PCs store SETUP information in battery–backed CMOS RAM. If the battery fails or is replaced during routine maintenance, this information is lost. Without a keyboard and monitor in embedded applications, time consuming re–initialization is required.

The 2040 PC/104 CPU stores the SETUP information in EEPROM. If a backup battery should fail, only the system date and time are lost.

Phoenix BIOS

The 2040 PC/104 CPU has a Phoenix AT BIOS with Octagon BIOS extensions.

Boot sequence

A 2040 PC/104 CPU can be configured to boot from an on–card, solid–state disk, an external floppy, or a hard disk.

Fast boot

You can speed up the BIOS portion of the boot process to approximately five seconds by disabling the "Power on memory test" in Setup. This deletes the memory test and rearranges some of the other test sequences, decreasing the boot time by about 65%.

≡ Specifications

Rugged environmental operation

- Operating temperature –40° to 70°C
- Nonoperating temperature –55° to 90°C, nonoperating
- Relative humidity 5% to 95% noncondensing
- Altitude –100m to 10,000m
- Shock 40g, 3 axis
- Vibration 6g, 3 axis

Size

3.8" x 3.6"

Chapter 2: Quick start

This chapter covers the basics of setting up a 2040 PC/104 CPU system and tells you:

- How to set the configuration jumpers on the 2040 PC/104 CPU
- How to install the 2040 PC/104 CPU
- How to connect a power supply
- How to install a bootable disk
- How to use a serial console

WARNING!

The 2040 PC/104 CPU contains static sensitive CMOS components. Do the following to avoid damaging your card and its components:

- Ground yourself before handling the 2040 PC/104 CPU card
- Disconnect power before removing or inserting a PC/104 expansion board
- When programming a memory device, place the device in the socket before applying power.

≡ Equipment required

There are several options for installing a bootable disk and loading your applications. This chapter provides procedures for installing an M–Systems DiskOnChip and using a floppy disk drive to transfer files to the DOC. The following equipment is required:

- +5V power supply
- VTC–9F, FCA–12, and null modem cables
- floppy disk drive
- M–Systems DiskOnChip, preformatted and loaded with an operating system

≡ Configuration jumpers

Before you continue with the installation of your 2040 PC/104 CPU, review the following table for a list of jumper configurations to ensure you have the correct configuration.

The 2040 PC/104 CPU component diagram is on the following page.

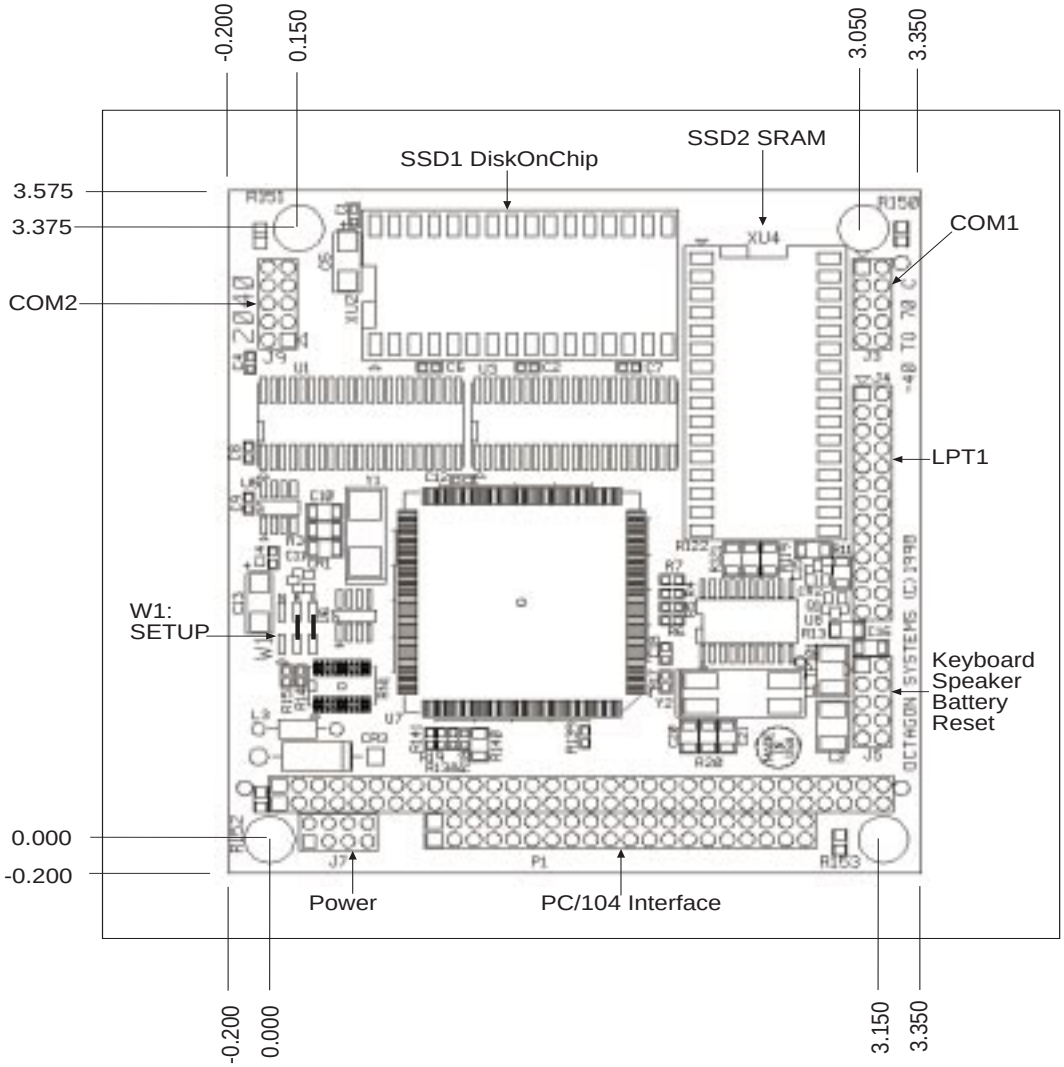
Table 2–1 SETUP: W1

Pins	Description
1–2	(N)MI: Watchdog time–out connected to NMI
3–4*	(R)eset: Watchdog time–out connected to reset
5–6*	(S)etup: Use SETUP information: On* = on–board EEPROM; Off = BIOS default

* = default

Note When the "N" jumper W1[1–2] is on instead of the default "R" jumper W1[3–4] , the system will not reset after SETUP is run. A power cycle reset is required.

Figure 2–1 Component locations and mounting dimensions



≡ Installing the 2040 PC/104 CPU board

The 2040 PC/104 CPU can be installed two ways – mounted on a flat surface, or connected to a PC/104 interface. The following equipment is included with the 2040:

- 4 threaded hex stainless steel standoffs (4–40 x 3/8")
- 4 screws (4–40 x 1/4")
- 4 KEP nuts (4–40)
- 4 internal star lock washers (4–40)

Mounting on a flat surface

To mount the 2040 PC/104 CPU on a flat surface, use the #4 standoffs, washers, and screws and place them in the four holes on the 2040 PC/104 CPU board. Refer to Figure 2–1 for the center–to–center mounting hole dimensions and for the location of the designated holes used for mounting the hardware. Fasten the board securely to the mounting surface.

WARNING!

Before the 2040 PC/104 CPU is powered on for bench testing, all four standoffs, screws and washers should be secured to the board. The standoff pieces will ensure full support of the 2040 PC/104 CPU board. These hardware pieces will reduce the circuit board flex when a PC/104 expansion board and/or the SSD are inserted. Flexing of the 2040 PC/104 CPU board should be avoided, since it can cause problems with the copper circuit traces, keyboard, monitor, and surface mounted components.

Connecting to a PC/104 interface

The 2040 PC/104 CPU can be connected to an existing PC/104 system. Use the #4 standoffs, washers, and screws and place them in the four holes on the 2040 PC/104 CPU board, with the male end of the standoff facing down. Align the PC/104 pins with the connectors below, and the standoffs with the mounting holes below, then firmly press the boards together. Secure the boards together with the KEP nuts.

≡ Power supply

The 2040 PC/104 CPU requires 5V ±5%, 800 mA maximum. It is designed to operate from a single +5 VDC supply, typically supplied at connector J7. In some configurations where the 2040 is connected to another PC/104 system, the power required by the 2040 can be drawn from the system through the PC/104 connector. If you are using the PC/104 interface, you may also require ±12 VDC. Make sure that you utilize both +5 VDC conductors and both ground conductors. Refer to Figure 2–2 and Table 2–2.

WARNING!

Accidently crossing the wires, i.e., plugging +5V wires into the ground connector or the ground wires into the +5V connector will damage the 2040 PC/104 CPU.

It is important that a quality power supply be used with the 2040 PC/104 CPU. For example, when a particular application calls for a custom power supply, there are several internal issues to consider such as current capacity, line and load regulation, maximum ripple, hold up time, efficiency, and current limiting. You should also consider the power devices and equipment such as the power cable conductor gauge, number and length of conductors, mating connectors, and the power supply to external PC/104 devices.

Octagon supplies are designed to ramp up fast (less than 50 ms), discharge fast on power down and to regulate properly under a no load condition.

Most desktop PC switching supplies are rated at 5V at 20A or more. Switching supplies usually requires a 20% load to operate properly, that is, 4A or more. Since a typical Micro PC system takes less than 2A, the desktop PC supply does not regulate properly. Output drift up to 6-7V and/or 7-8 voltage spikes have been reported. If the power supply comes up slowly (that is, longer than 50 ms), the sequencing of ICs on the board may be out of sync, thus, causing the system to lock up.

If large output capacitors are used, powering the system down and then up may lock up the Micro PC. If the power supply does not drain below 0.7V, the CMOS components on the Micro PC will act like diodes and forward bias.

If using a non-Octagon supply, select a supply that has a low or no minimum load requirement, comes up in less than 50 ms and discharges quickly on power down.

WARNING!

Make sure the power supply is OFF when connecting the power cable to the 2040 PC/104 CPU board. Damage to the 2040 PC/104 CPU may occur if the power is ON when connecting the power cable.

Figure 2–2 Power connector

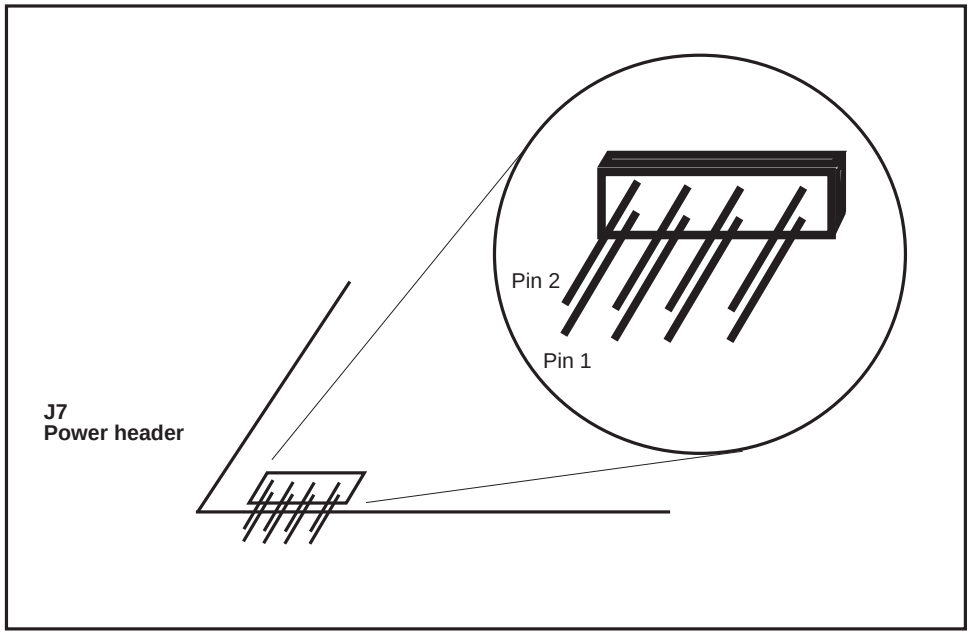


Table 2–2 Power pinout: J7

Pin	Function
1	Gnd
2	+5 VDC
3	NC
4	+12 VDC to PC/104
5	–5 VDC to PC/104
6	–12 VDC to PC/104
7	Gnd
8	+5 VDC

≡ Bootable disks

The 2040 PC/104 CPU has an on–board 512 KB flash which contains the BIOS and software extensions. It does not contain an operating system or a bootable disk.

The 2040 PC/104 CPU is fully compatible with several operating systems, including MS-DOS and ROM-DOS. You can download a trial version of ROM-DOS from www.datalight.com/rom-dos.htm.

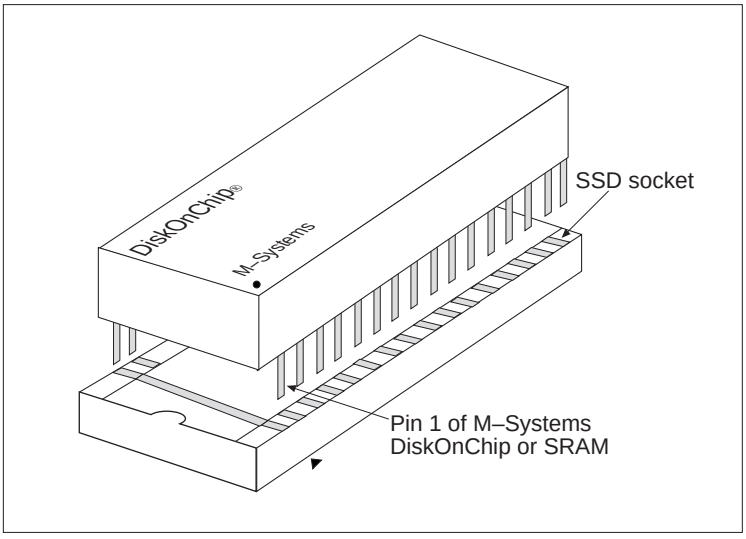
There are three choices for supplying a bootable disk: a floppy drive (through LPT1 or a PC/104 card), a PC/104 hard drive, or an M–Systems DiskOnChip (DOC). The example in this chapter shows how to use a DOC to boot your system and a floppy drive connected to LPT1 to install your applications.

The memory address for an M–Systems DiskOnChip is at E8000–EBFFFh. This memory address is not bank switchable and cannot be disabled.

When ordering an M–Systems DiskOnChip, you can specify that you want it preformatted and with an operating system already installed. This simplifies your startup procedures. Refer to your M–Systems utility disk for more information on using DiskOnChip.

Before installing the DOC, remove power from the 2040. Align pin 1 of the DiskOnChip with pin 1 of the SSD1 socket, then firmly press the chip into the socket. Refer to Figure 2–3 for correct SSD alignment.

Figure 2–3 M–Systems pin alignment with the 2040 SSD1 socket

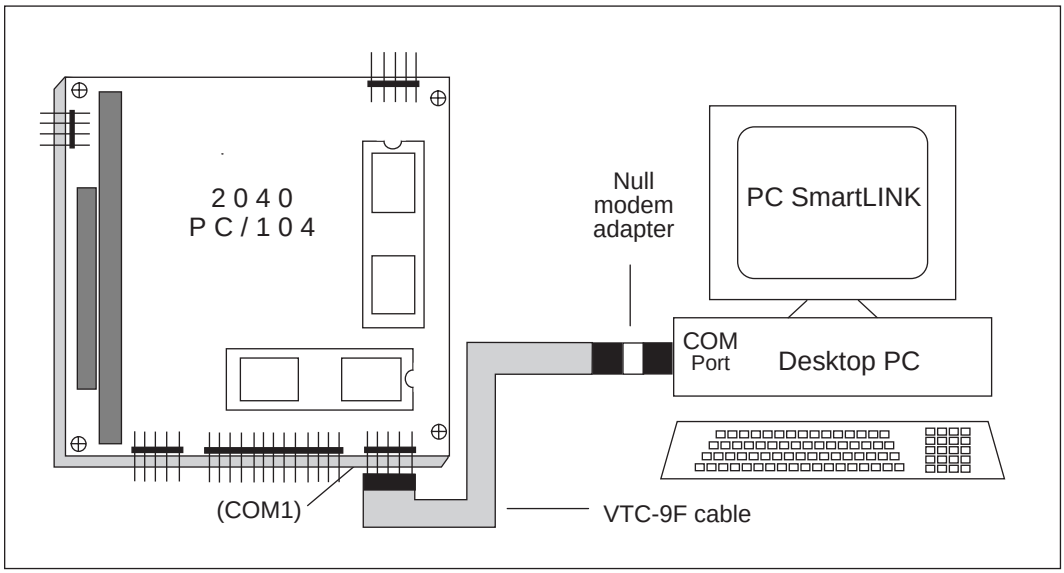


≡ Serial console

COM1 can serve as a console device, allowing you to use your desktop PC to communicate with the 2040. The default configuration stored in the BIOS SETUP is for COM1 to be a console device. Use the figure below to connect a desktop computer to the 2040 as a console device. This connection requires a VTC–9F cable and a null modem adapter. It also requires PC SmartLINK, available from Octagon, or an equivalent terminal emulator.

Note When interfacing the 2040 PC/104 CPU to your desktop PC, you must use a null modem adapter.

Figure 2–4 Serial console connections



Power up the 2040. You should see the BIOS sign–on messages for the 2040 on your monitor. If the boot process completes and the C:\> prompt appears, you have a bootable disk. Go to the *Floppy disk* section for information on transferring files.

If the message "press C to try again or S for setup" appears, the boot did not complete. The most likely reason is that the DOC does not have an operating system installed. Press S to enter Setup, then configure LPT1 as a floppy drive, number of floppy drives to 1, and floppy drive size to the size of the floppy you will be installing. Save the Setup changes, then power off the 2040. Ensure that the S jumper is on so that the next time the 2040 is powered, it will use the parameters from the Setup stored in EEPROM. Proceed to the next section, *Floppy drive.*

≡ Floppy drive

This section describes how to install a floppy drive. The floppy drive can be used as a boot device, or to transfer programs to a DOC.

Note If you have a DOC installed on the 2040 and have booted, you may have the utilities TRANSFER.EXE or REMDISK/REMSERVE (ROM DOS) or INTERLINK/INTERSVR (MS DOS) on the DOC. You can use these utilities to transfer files from your host computer to the 2040 over the serial console. Refer to the documentation included with your operating system for information on how to use these utilities.

Configuring setup

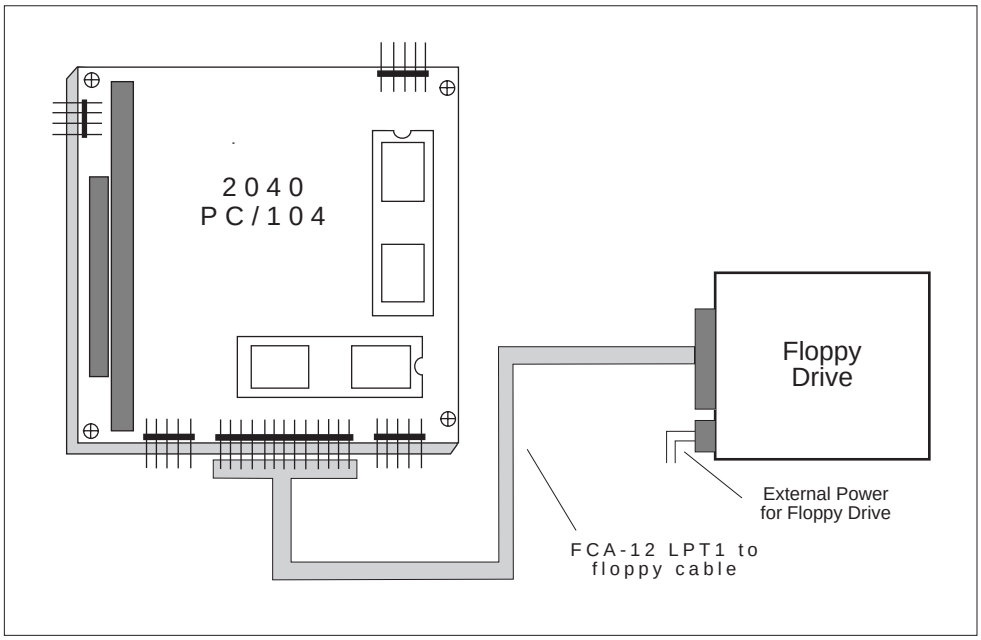
The default in the BIOS SETUP is for LPT1 in bidirectional mode. If you have previously run SETUP and changed the settings for LPT1 to floppy drive, and saved those settings, ensure that the SETUP jumper is on so that the BIOS uses the settings from the EEPROM.

You can enter SETUP by pressing the "backspace" key followed by the "S" key during BIOS POST sequence (this occurs between the memory test and boot). Configure LPT1 as a floppy drive, number of floppy drives to 1, and floppy drive size to the size of the floppy you will be installing. Save the Setup changes, then power off the 2040. Ensure that the SETUP jumper is on so that the BIOS uses the settings from the EEPROM during the next boot.

Installing a floppy disk drive

1. Disconnect power to the 2040 PC/104 CPU.
2. Insert one end of an Octagon FCA–12 cable into the rear of the floppy drive. Make sure pin 1 on the cable is connected to pin 1 on the drive.
3. Insert the other end of the cable into J4 on the 2040 PC/104 CPU.
4. Connect power to the floppy drive.
5. Power up the system. If you have a bootable disk in SSD1, the system should boot up. If you do not have a bootable disk in SSD1, you will need to insert a boot disk into the floppy disk drive. Refer to the next section for information on creating a boot disk.

Figure 2–5 LPT1 and a Floppy Drive



Creating a boot disk

You can create a floppy boot disk on any PC that has DOS installed. This floppy can then be inserted in the floppy disk drive connected to the 2040 and used to boot the system.

To create a boot disk, insert a blank, formatted floppy into the floppy drive of your PC. If you are running Windows on your PC, exit Windows and open up the DOS shell. Type the command **SYS A:**, then press Enter.

The SYS command copies three files to the floppy disk. Two of the files are hidden (not shown by the DIR command), and the third file is COMMAND.COM. These three files are sufficient to boot the system.

Insert the boot disk in the 2040 floppy drive, then power on the system. The console monitor should return the A:\ prompt. Type **C:** to change to the C drive (if you have installed a DiskOnChip). Type **DIR** then press Enter.

If the C: or DIR commands return the message "No drive found" or "Abort Retry Fail", the DiskOnChip is probably not formatted. Refer to your M–Systems documentation for information on how to format the DOC.

If the DIR command returns a list of files from the DOC, and the list does not contain the file COMMAND.COM, then the DOC most likely does not contain an operating system. Return to the A: drive, type the command **SYS C:**, then press Enter. This should copy the boot files to the DOC. Remove the floppy disk from the floppy disk drive and cycle power to the 2040. The 2040 should boot from the DOC.

≡ Copying files

Once you have a bootable disk in SSD1, or a bootable PC/104 hard drive, you can use the floppy disk drive to transfer files to the bootable disk. Use the COPY command to copy files (such as, **COPY MYPRGRM.COM C:**). Once the files are copied, you can remove the floppy disk drive.

When DOS starts up, it processes the files CONFIG.SYS and AUTOEXEC.BAT. If you add the command line for your application to the AUTOEXEC.BAT file, your application will automatically start when the system boots. Refer to your operating system documentation for information on modifying these two files.

Chapter 3: SETUP program

The SETUP program defines the 2040 PC/104 CPU system parameters. This program is shipped with default configuration parameters stored in the serial EEPROM. Changes are made by running the SETUP program. The SETUP program is stored on the 2040 utility disk.

SETUP can be entered in one of two ways:

- Run SETUP.COM. To run SETUP.COM, this program must be resident on either the floppy disk drive and/or hard drive, or on a flash device such as the M–Systems DiskOnChip. SETUP.COM is on the 2040 utility disk.
- Press the "backspace" key followed by the "S" key during BIOS POST sequence (this occurs between the memory test and boot).

The system will display the 2040 setup parameters and available options. Select the option by pressing the space bar until the correct information appears, then press <ENTER>. Press <ESC> twice if you want to exit setup without saving your responses.

By removing the SETUP jumper from the "S" position at W1[5–6], you force the setup to revert to the defaults stored in BIOS. The default settings allow you to restart the system in a known configuration.

Table 3-1 SETUP Jumpers: W1

Pins	Description
1–2	(N)MI: Watchdog time–out connected to NMI
3–4*	(R)eset: Watchdog time–out connected to reset
5–6*	(S)etup: Use SETUP information: On* = on–board EEPROM; Off = BIOS default

* = default

Note Options having an * are default settings.

- Serial Console on COM1:
  Enabled*
  Disabled

Note When this option is disabled, it may be overridden by connecting the COM1 RTS line to the COM1 RI line.

- COM1 Console Baud Rate:
  1200
  2400
  4800
  9600*
  14400
  19200
  28800
  38400
  57600
  115200

- Power on memory test:
  Enabled*
  Disabled

  Disabling this option speeds up the BIOS boot process to about five seconds (Octagon's "fast boot" feature). It disables the memory test and rearranges the sequence of other power-on tests. Note that this feature only speeds up the Octagon BIOS portion of the boot process. It does not affect the time required to load various operating systems. You may also press the space bar to cancel the memory test while in progress.

- Boot Sequence:
  C: Only*
  A: Then C:

Note The M–Systems DiskOnChip software typically overrides the "C: Only" option.

- Serial Port A:
  Enabled*
  Disabled

- Serial Port B:
  Enabled*
  Disabled

- Parallel (LPT) Port:
  Enabled*
  Disabled

- Parallel Port Mode:
  Bidirectional mode*
  EPP mode
  ECP mode
  Floppy disk mode
  Standard (Unidirectional) mode

Note Standard mode is provided for compatibility only. We recommend the use of bidirectional mode. EPP and ECP modes are provided for equipment that has the capability to operate in these modes for enhanced performance.

- Parallel Port Address:
  378h*
  278h
  3BCh

- Parallel Port Interrupt:
  IRQ5
  IRQ7*
- Number of floppy drives:
  0*, 1, 2
- Floppy drive 1 size:
  5.25", 360KB
  5.25", 1.2 MB
  3.5", 720KB
  3.5", 1.44 MB*
- Floppy drive 2 size:
  5.25", 360KB
  5.25", 1.2 MB
  3.5", 720KB
  3.5", 1.44 MB*
- Swap drives A and B:
  Yes, No*
- Number of hard drives:
  0*, 1, 2
- Auto drive configuration:
  Enabled*
  Disabled
- Drive 0 parameters:
  Cylinders (xxx):
  Heads (x):
  Sectors (xx):
- Drive 1 parameters:
  Cylinders (xxx):
  Heads (x):
  Sectors (xx):
- Setup entry via hotkey:
  Enabled*
  Disabled
- Shadow video BIOS:
  Enabled
  Disabled*
- Shadow C8000H - CFFFFH
  Disabled*
  Enabled
- Shadow D0000H - D7FFFH
  Disabled*
  Enabled
- Shadow D8000H - DFFFFH
  Disabled*
  Enabled

```
Press ENTER to SAVE the changes or
Press ESC to EXIT without saving the changes.
Saving options.
Options saved.
```

Depending on the options you have selected, the system may display the following message:

```
You must reset for these options to take effect.
```

If you entered SETUP with the hotkeys (i.e., "backspace" and "S" keys), the system will reboot automatically. However, if the watchdog jumper is set to NMI, then the I/O parity check error appears and the board will halt. A power cycle reset is then required.

Running SETUP over the console port

1. To run SETUP make sure you have established a communications link between a keyboard and monitor (via a PC/104 video card) with the 2040 PC/104 CPU *or* a serial communications link between the 2040 PC/104 CPU and your PC. See the *Console devices* chapter for more information on these two communication links. Ensure the SETUP.EXE file has been copied from the 2040 utility disk to the boot drive, or that a floppy drive is connected to the system.
2. Enter:

   ```
   C:\> SETUP
   ```

Note If you are not booting from the SSD1 drive, the drive designator may differ.

Note You may also enter **SETUP** after the memory test and before the system has booted by pressing the "backspace" key followed by the "S" key.

3. The system will display the 2040 PC/104 CPU setup parameters and available options. Select the option by pressing the space bar until the correct information appears, then press <ENTER>. Press <ESC> twice if you want to exit SETUP without saving your responses.

SETUP example

The following example configures a system with no memory test, 9600 baud, printer at 378h, and booting from C:

```
                OCTAGON SYSTEMS CORPORATION
             2040 PC/104 CPU SETUP UTILITY Vx.x
          (c) Phoenix Technologies, Ltd. 1985, 1995
 ____________________________________________________
 (Press SPACE to CHANGE, ENTER to ACCEPT, ESC to EXIT)


Serial Console on COM1:          Enabled
COM1 Console Baud Rate:          9600
Power on memory test:            DISABLED
Boot Sequence:                   C: ONLY
Serial Port A:                   ENABLED
Serial Port B:                   ENABLED
Parallel (LPT) Port:             ENABLED
    Parallel Port Mode:          Bidirectional Printer
                                 Port
    Parallel Port Address:       378h
    Parallel Port Interrupt:     IRQ7
Number of floppy drives:         1
Floppy drive 1 size:             3.5", 1.44 MB
Swap drives A and B:             No
Number of hard drives:           0
SETUP Entry via Hotkey:          ENABLED
Shadow Video BIOS area:          DISABLED
Shadow C8000h–CFFFFh:            DISABLED
Shadow D0000h–D7FFFh:            DISABLED
Shadow D8000h–DFFFFh:            DISABLED

Press ENTER to SAVE the changes
Press R to RESTART with original values or
Press ESC to EXIT without saving the changes:

Options Saved.

You must reset for these options to take effect.
2040 C:\>
```

Note Executing SETUP /D will change all setup parameters to default values.

Chapter 4: Save and run programs

≡ Save and run your programs on the 2040 PC/104 CPU

Once you have written, tested and debugged your application, you can then save it in SSD1 if you have a DOC, or to a PC/104 hard disk. When you reboot the 2040 PC/104 CPU, your program can automatically load into DOS memory and execute. This assumes SSD1 contains a bootable DOS.

This chapter describes the following:

- Saving an application program
- Autoexecuting the program from the 2040 PC/104 CPU
- Overriding autoexecution of your program

The information in this chapter assumes you are using ROM–DOS or MS–DOS in your application. Some Microsoft programs make undocumented DOS calls. With ROM–DOS, an error returns when an undocumented DOS call is made, causing your program to operate erratically.

Adding your application

To add your application to your SSD or hard disk, do the following:

1. Depending on the operating system you have installed, you may have the utilities TRANSFER.EXE or REMDISK/REMSERVE (ROM–DOS) or INTERLINK/INTERSVR (MS–DOS) on the DOC. You can use these utilities to transfer files from your host computer to the 2040 over a serial console. Refer to the documentation included with your operating system for information on how to use these utilities.

   From a floppy drive on the 2040 PC/104 CPU, issue the COPY command.

2. Add or remove any device drivers for your application. You may want to do the same for the CONFIG.SYS file on your bootable drive.

3. To autoexecute your application, add your application name to the AUTOEXEC.BAT file.

Overriding the autoexecution of your application

You may stop the autoexecution of your application by doing one of the following options:

Option 1

1. Press F5 or F8 on a local keyboard (connected to the 2040). For more information, see your ROM–DOS or MS–DOS manual.

Option 2

1. Press Ctrl-C when the system is first starting. This halts all batch files.
2. Change AUTOEXEC.BAT and/or CONFIG.SYS to **not** call out your program.

Option 3

1. Install a floppy.
2. Change SETUP option "Boot Sequence" to "A: THEN C:"
3. Change SETUP to enable the floppy.
4. Boot from floppy.
5. Change AUTOEXEC.BAT on C:.

Overview: Section 2 – Hardware

Section 2 discusses usage, functions, and system configurations of the 2040's major hardware features. The following chapters are included:

Chapter 5: Serial ports
Chapter 6: LPT1 parallel port
Chapter 7: Console devices
Chapter 8: SSDs, DRAM, and battery backup
Chapter 9: External drives
Chapter 10: Interpreting "beep" codes
Chapter 11: PC/104 expansion

Chapter 5: Serial ports

≡ Description

The 2040 PC/104 CPU has two serial ports, COM1 and COM2. These serial ports interface to a printer, terminal, or other serial device. Both ports support 5–, 6–, 7–, or 8–bit word lengths, 1, 1.5, or 2 stop bits, and baud rates up to 115.2K. COM1 can be used as a serial console or an 8–wire RS–232; COM2 is a dedicated 8–wire RS–232.

The serial ports have the following specifications:

- 16C550 compatible
- 16–byte FIFO buffers
- IEC 1000, level 3, ESD protection
  - — Contact discharge ±6 kV
  - — Air–gap discharge ±8 kV
- Backdrive protection
- Up to 115.2K baud operation

The following sections describe these ports in more detail.

≡ Serial port configurations

COM1

COM1 is a full 8–wire RS–232. The I/O address for COM1 is 3F8h. IRQ4 is dedicated to COM1. If COM1 is not used under interrupt control, IRQ4 may be used by other resources. If COM1 is the console, COM1 uses IRQ4. COM1 can be used for console I/O or RS–232 I/O. COM1 uses the J3, 10–pin header.

When a video card is **not** connected to the PC/104, COM1 can be used as the console port. All video and keyboard information is redirected through the console port.

COM1 can be enabled as a serial console by two methods. SETUP allows you to select COM1 as a serial console. This is the default configuration stored in the BIOS. Also, when COM1 RTS is connected to COM1 RI the serial console on COM1 is enabled. This hardware configuration overrides the COM1 setting in SETUP. Figure 5–1 shows a custom null modem cable that performs this configuration.

Table 5–1 shows the pinout for COM1 and COM2.

COM2

COM2 is a dedicated full 8–wire RS–232 configuration. The I/O address for COM2 is 2F8h. IRQ3 is dedicated to COM2. If COM2 is not used under interrupt control, IRQ3 may be used by other resources. COM2 uses the J9, 10–pin header.

Table 5–1 shows the pinout for COM1 and COM2.

Note See the *Accessories* appendix for mating information on COM1 and COM2.

Table 5–1 COM1 and COM2 pinouts (J3 and J9 connectors)

Pin	Signal	Pin	Signal
1	DCD	2	DSR
3	RxD	4	RTS
5	TxD	6	CTS
7	DTR	8	RI
9	Gnd	10	Gnd

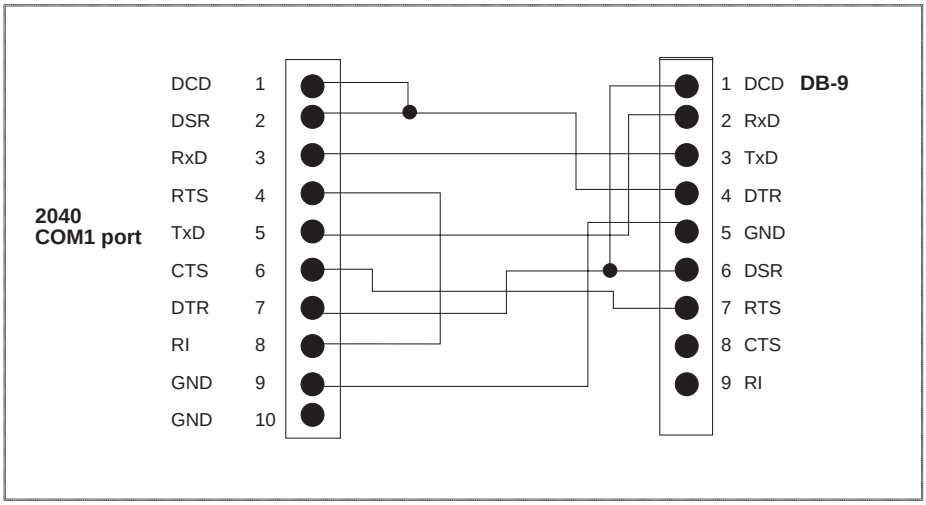
≡ Function and use of serial ports

COM1 as the serial console device

Instead of using a PC/104 video card to connect a monitor, you can use COM1 as a console device. COM1 can be enabled as a serial console by two methods. SETUP allows you to select COM1 as a serial console. This is the default configuration stored in BIOS. Also, when COM1 RTS is connected to COM1 RI the serial console on COM1 is enabled. This hardware configuration overrides the COM1 setting in SETUP. Figure 5–1 shows a custom null modem cable that performs this configuration.

Note When interfacing the 2040 PC/104 CPU to your desktop PC, you must use a null modem cable. Commercial null modem adapters do not connect RI to RTS; they can be used if COM1 is enabled as a serial console in SETUP. The custom null modem below configures COM1 as a serial console regardless of the settings in SETUP. You also need PC SmartLINK, available from Octagon, or an equivalent terminal emulator.

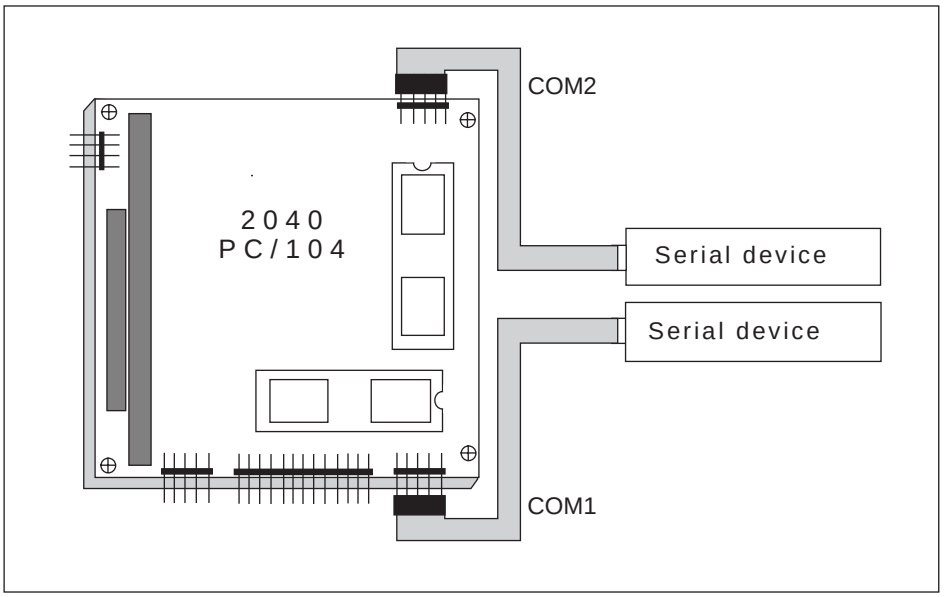
Figure 5–1 Custom null modem adapter with RTS and RI connected



COM1 and COM2 as RS–232 I/O

COM1 and COM2 can be used as RS–232 serial ports. COM1 and COM2 support 8–wire RS–232 configurations. Use a VTC–9F or VTC–9M cable to interface from the 2040 PC/104 CPU to the serial device.

Figure 5-2 2040 PC/104 CPU serial devices



Chapter 6: LPT1 parallel port

≡ LPT1 parallel port

The LPT1 port has a 26–pin connector. It supports the unidirectional standard mode, bidirectional mode, enhanced parallel port (EPP) mode, and extended capabilities port (ECP) mode. The default I/O address is 378h (IRQ7). You can also select I/O address 278h or 3BCh, or IRQ5, in the SETUP menu.

The LPT1 port supports a number of devices including a PC compatible printer, a floppy drive, a multiline display, a matrix keypad or an opto rack with opto–isolated digital I/O modules.

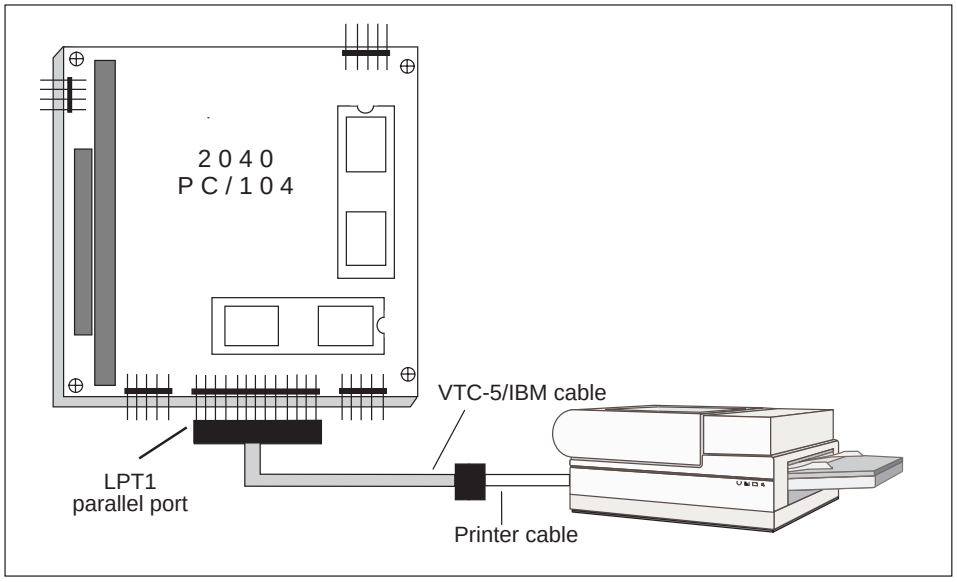
≡ Printer

Note See the *Accessories* appendix for mating information on the LPT1 printer port connector.

To install a printer:

1. Make sure that the LPT1 port is in standard or bidirectional mode.
2. Connect an Octagon VTC–5/IBM cable from the LPT1 port to the 25–pin connector on your printer cable. You can also connect a PCA–36 cable directly from LPT1 to a Centronics interface on a printer.
3. Connect the cable to your printer.

Figure 6–1 LPT1 as a printer port



≡ Floppy drive

The LPT1 parallel port can be used as a floppy disk drive port. Refer to the *External Drives* chapter for connection information.

≡ Display

The LPT1 port supports either a 4 x 20 or a 4 x 40 liquid crystal display (LCD). To interface the displays to the 2040 PC/104 CPU, use the Octagon 2010 interface board. A CMA–26 cable is required to connect the interface board to the 2040 PC/104 CPU. The program DISPLAY.EXE (found on the 2040 PC/104 CPU utility disk) provides an easy method to use the display. Refer to the file DISPLAY.DOC on the 2040 PC/104 CPU utility disk for information on initializing and using the display. Also, refer to the *2010 product sheet* for more information on the interface board.

To install a display:

1. Connect a CMA–26 cable from the LPT1 port on the 2040 PC/104 CPU (J4) to J1 on the 2010. See Figure 6–2 (next page).
2. Connect the display cable to either the 14–pin or 16–pin header on the 2010. The size of the display will determine which header to use.
3. Refer to the file DISPLAY.DOC for more information on initializing and using the display.

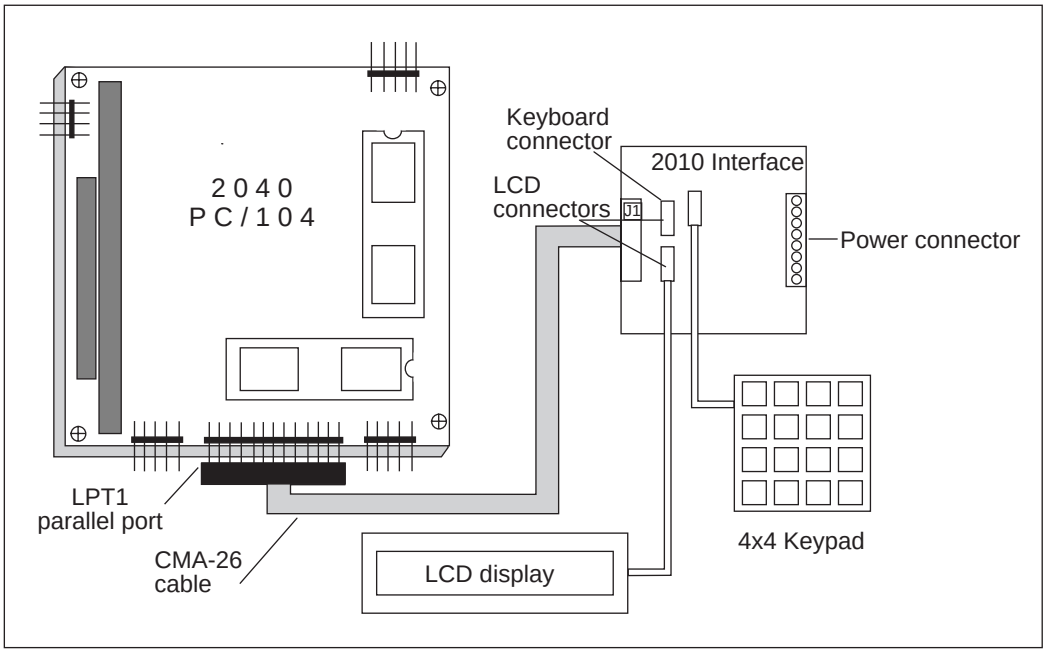
≡ Keypad

LPT1 also supports 4 x 4 matrix keypads. To interface the keypad to the 2040 PC/104 CPU, use the Octagon 2010 interface board. A CMA–26 cable is required to connect the interface board to the 2040 PC/104 CPU. The program DISPLAY.EXE (found on the 2040 PC/104 CPU utility disk) provides an easy method to use the keypad. Refer to the file DISPLAY.DOC on the 2040 PC/104 CPU utility disk for information on initializing and using the keypad. Also, refer to the *2010 product sheet* for information on the interface board.

To install a keypad:

1. Connect a CMA–26 cable from the LPT1 port on the 2040 PC/104 CPU (J4) to J1 on the 2010. See Figure 6–2.
2. Connect the keypad cable to the 10–pin header on the 2010.
3. Refer to the DISPLAY.DOC file for more information on reading the keypad.

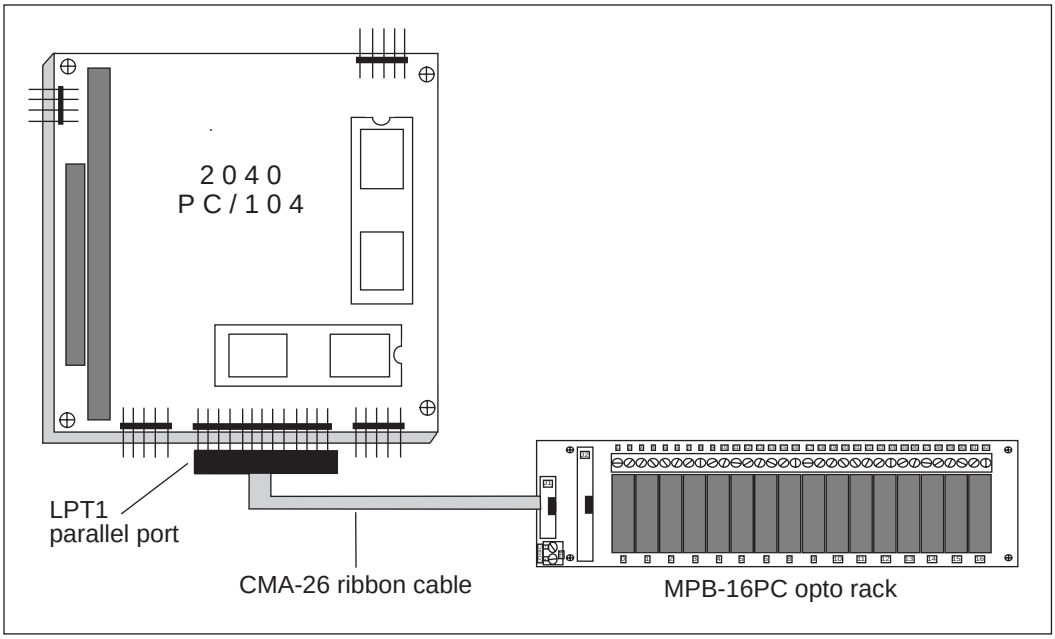
Figure 6–2 LPT1 as a display or keypad port



≡ Opto rack

The Octagon MPB–16PC opto rack interfaces directly to the parallel printer port and can control high voltage/high current G4 opto–isolated modules. Of the sixteen positions available, eight can be either input or output, four are dedicated as inputs and the other four are dedicated as outputs. Refer to the *MPB–16PC opto module rack product sheet* for more information.

Figure 6–3 LPT1 and an opto rack



Chapter 7: Console devices

≡ Description

The 2040 PC/104 CPU has three console options. You can use a PC/104 video card with a monitor and a keyboard as your console. You can also use COM1 as the console, or you can run the system without a console device.

≡ Selecting console devices

The following represent the 2040 PC/104 CPU's three options for console devices:

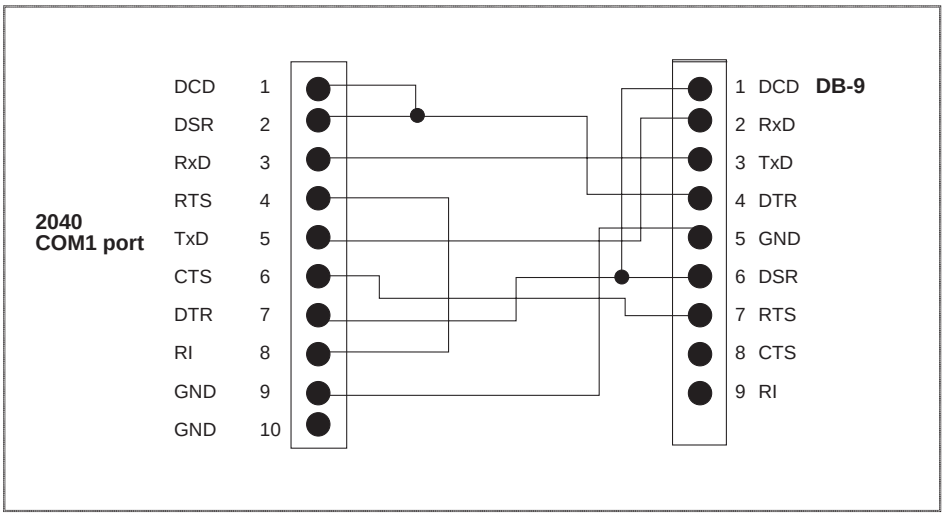
- A standard PC/104 video card, such as an Octagon 2430 SVGA card, and a keyboard.
- Serial console from COM1. A serial cable/null modem adapter plugged into a host PC running SmartLINK provides both input and output. The local keyboard also allows input.
- No console device means no video output, either from a PC/104 card or the serial console. The local keyboard allows input.

COM1 as serial console device

Instead of using a PC/104 video card to connect a monitor, you can use COM1 as a console device. COM1 can be enabled as a serial console by two methods. SETUP allows you to select COM1 as a serial console. This is the default configuration stored in BIOS. Also, when COM1 RTS is connected to COM1 RI the serial console on COM1 is enabled. This hardware configuration overrides the COM1 setting in SETUP. Figure 7–1 shows a custom null modem cable that performs this configuration.

Note When interfacing the 2040 PC/104 CPU to your desktop PC, you must use a null modem cable. Commercial null modem adapters do not connect RI to RTS; they can be used if COM1 is enabled as a serial console in SETUP. The custom null modem below configures COM1 as a serial console regardless of the settings in SETUP. You also need PC SmartLINK, available from Octagon, or an equivalent terminal emulator.

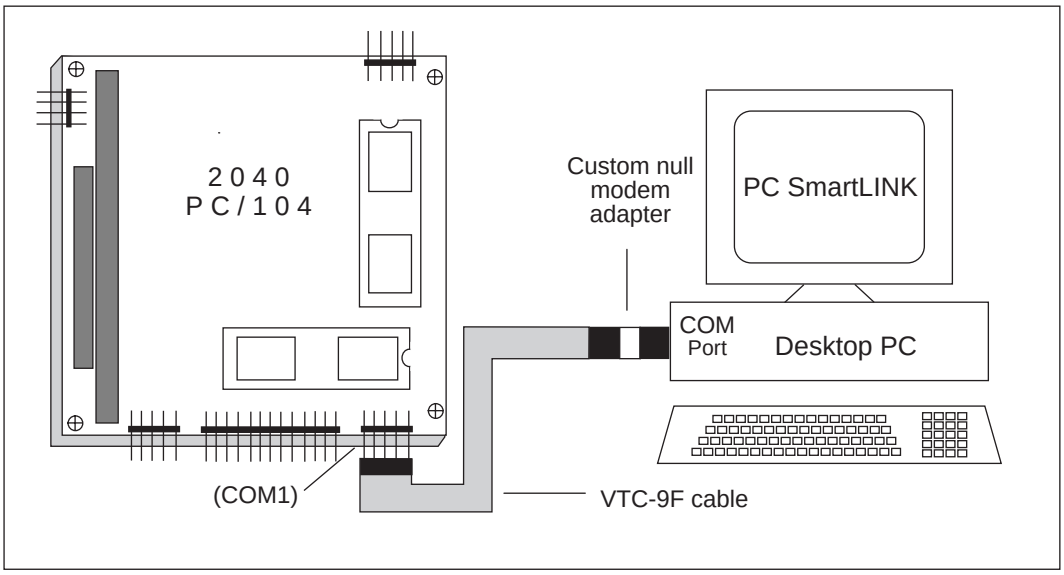
Figure 7–1 Custom null modem adapter with RTS and RI connected



You can use a commercial null modem adapter instead of the custom null modem adapter shown above if the SETUP option "Serial Console on COM1" is enabled (default configuration). If this option is disabled in SETUP, you can get the serial console back by any of the following:

1. Using the custom null modem adapter shown above.
2. Removing the "S" jumper W1[5-6] and rebooting. This causes the 2040 to use the default SETUP settings from the BIOS.
3. Installing a PC/104 video card/keyboard to run SETUP and enable the serial console.

Figure 7–2 The 2040 PC/104 CPU and a serial console



Keyboard, speaker, and mouse

You can add a keyboard and a local speaker with any of the console options listed above in the *Selecting console devices* section. Interface the keyboard and speaker via the 10–pin connector at J5. You may use any external speaker from 8–50 ohms. Table 7–1 shows the pinout for connector J5.

If your application requires a mouse, you can connect a serial mouse to COM1 or COM2, and load a mouse driver. The 2040 PC/104 CPU does not require a keyboard, speaker, or mouse for operation.

Table 7–1 Speaker, battery, keyboard, and reset: J5

Pin	Signal	Function
1	+Speaker	+5V in series with 33 Ω
2	GND	3.6V external battery, negative
3	Reset SW	External reset
4	KBD SW	Inhibit switch to disable keyboard
5	KBD Data	Keyboard data
6	KBD CLK	Keyboard clock
7	Ground	Signal and power ground
8	KBD PWR	+5V for keyboard
9	BATV+	3.6V external battery, positive
10	PWR good	Power good input

≡ Transferring files between the 2040 PC/104 CPU and your PC

Once you have established communications between your PC and the 2040 PC/104 CPU, you can serially download files to any read/write drive used by the 2040 PC/104 CPU. You can also upload files from the 2040 PC/104 CPU to your desktop PC for editing and debugging.

There are two methods to download files through the serial port to the 2040 PC/104 CPU. Depending on the operating system you have installed, you may have the utilities TRANSFER.EXE or REMDISK/REMSERVE (ROM–DOS) or INTERLINK/INTERSVR (MS–DOS) on the DOC. You can use these utilities to transfer files from your host computer to the 2040 over a serial console. Refer to the documentation included with your operating system for additional information on how to use these utilities.

ROM–DOS operating system

The TRANSFER utility is used to download files, one at a time, to the 2040 PC/104 CPU using the XMODEM protocol. TRANSFER.EXE is used to send or receive files via the serial port (e.g., COM1). TRANSFER.EXE uses the XMODEM protocol, as does PC SmartLINK. (See the note below on XMODEM).

Note XMODEM only transfers files in which the file size is exactly on a 128–byte boundary. If the file size does not fall exactly on the boundary, XMODEM automatically rounds the file size up to the next 128–byte boundary with padding characters. For example, a file with a size of 10,000 bytes, will be rounded up to 10,112 bytes, transferred, and written with the new file size. In most cases, this is not a concern, but in some instances the XMODEM padding causes problems. The padding problems become apparent when an application program is expecting a specific file size or is expecting characters other than the padding characters to be at the end of the file.

REMDISK/REMSERV utilities allow access to all of the files on a remote disk drive. Once these programs are executed, single or multiple files can then be transferred to and from the 2040 PC/104 CPU using DOS COPY or XCOPY commands.

MS–DOS operating system

For information on using INTERLINK/INTERSVR utilities, refer to the documentation included with your operating system.

≡ Transferring files to the 2040 PC/104 CPU

The following steps detail the procedures for transferring files from your PC to a virtual drive on the 2040 PC/104 CPU. This procedure assumes you are using ROM–DOS, and have the TRANSFER utility available. In order to transfer files from your PC to the 2040 PC/104 CPU, you must execute the TRANSFER program from both the 2040 PC/104 CPU and your PC.

1. Connect a 9-pin serial cable with a null modem adapter between COM1 of your PC to COM1 of the 2040 PC/104 CPU, using a VTC–9F cable.

2. Execute the TRANSFER program from the 2040 PC/104 CPU to receive a file from your PC.

   TRANSFER /COM1 /R /V <drive>*filename.ext*

   <drive> is the drive on the 2040 PC/104 CPU where the file will be transferred.

   /R specifies to receive a file (default).

   filename.ext is the name of the file on the 2040 PC/104 CPU which you are receiving from your PC.

   COM1 specifies the serial port on the 2040 PC/104 CPU.

   /V enables "R" characters upon receiving a block and "T" upon transferring a block. Do not use /V when using a serial console.

3. Execute the TRANSFER program from your PC to send a file to the 2040 PC/104 CPU. /S specifies send to file.

   TRANSFER /COM1 /S /V <drive><path>*filename.ext*

   filename.ext is the name of the file on the PC which you are sending to the 2040 PC/104 CPU.

Note An alternate method of transferring a file is to press <ALT><D>, when you use PC SmartLINK.

Note Transfer will time-out if the program has not been started after approximately 40 seconds. It displays the following message:

```
Failed to receive <drive>filename.ext
Deleting  <drive>filename.ext
```

Also, you may speed up the transfer using the /Bnnnn switch to increase the baud rate. Example: /B57600. When you use a serial console, do not use the /B option on the 2040 PC/104 CPU. Instead, change the serial console baud rate in SETUP.

≡ Transferring files from the 2040 PC/104 CPU

This procedure assumes you are using ROM–DOS, and have the TRANSFER utility available. In order to transfer files from your PC to the 2040 PC/104 CPU, you must execute the TRANSFER program from both the 2040 PC/104 CPU and your PC.

1. Connect a 9-pin serial cable with a null modem adapter between COM1 of your PC to COM1 of the 2040 PC/104 CPU, using a VTC–9F cable.

2. Execute the TRANSFER program from the 2040 PC/104 CPU to send a file to your PC.

   TRANSFER /COM1 /S /V *filename.ext*

   filename.ext is the name of the file on the 2040 PC/104 CPU which you are sending to your PC.

   /V enables "R" characters on receiving a block and "T" on transferring a block.

   /COM1 /S /V: Send in verbose mode

3. Execute the TRANSFER program from your PC to receive a file from the 2040 PC/104 CPU.

   TRANSFER /COM1 /R /V *filename.ext*

   filename.ext is the name of the file on the PC which you are receiving from the 2040 PC/104 CPU.

   /COM1 /R /V: Receive in verbose mode

Note Transfer will time-out if the program has not been started after approximately 40 seconds. It displays the following message:

```
Failed to receive <drive>filename.ext
Deleting  <drive>filename.ext
```

Also, you may speed up the transfer using the /Bnnnn switch to increase the baud rate. Example: /B57600. When you use a serial console, do not use the /B option on the 2040 PC/104 CPU. Instead, change the serial console baud rate in SETUP.

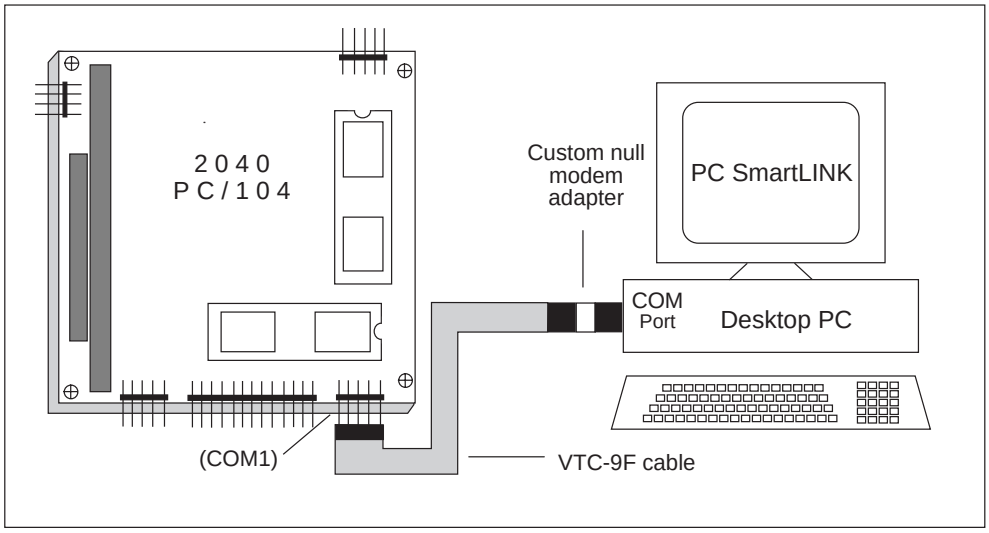
Downloading files to the 2040 PC/104 CPU using PC SmartLINK

This procedure assumes you are using ROM–DOS, and have the TRANSFER utility available. The following information shows how to download files between the 2040 PC/104 CPU and your PC using Octagon's PC SmartLINK. For other communication programs, refer to those program instructions for performing Xmodem file transfer to a target system. The hardware and software requirements are:

- Desktop PC, running PC SmartLINK, connected by a VTC–9F cable and a null modem adapter to COM1 of the 2040 PC/104 CPU.
- 2040 PC/104 CPU with ROM–DOS operating system.

1. Connect the equipment according to the following diagram:

Figure 7–3 Downloading files using PC SmartLINK and TRANSFER.EXE



2. Start PC SmartLINK and power on the 2040 PC/104 CPU.

Note PC SmartLINK is a DOS application. File transfer problems will occur when running in Windows. If you are using Windows on your PC, restart the PC in DOS mode before running SmartLINK.

3. Execute the TRANSFER.EXE program from the 2040 PC/104 CPU by entering:

   `C:\> TRANSFER filename.ext`

   filename.ext is the name of the file on your PC which you are sending to 2040 PC/104 CPU.

   The following message is displayed from the 2040 PC/104 CPU:

   `Receiving filename.ext . . .`

4. Execute the following steps using PC SmartLINK:
   - Press <ALT><D> to enter the download screen.
   - Type in the name of the file to transfer, e.g.:
     C:\MPC\DEMO*filename.ext*
   - To begin the transfer:
     — either press **ENTER** (default download START);
     — tab to **START**;
     — click on the **START** button in the download screen.
   - When the file transfer is completed, press <ESC> twice to return to the main PC SmartLINK screen.

Note TRANSFER.EXE will time-out if the program has not been started after approximately 40 seconds. If the time-out occurs, the following message from the 2040 PC/104 CPU is displayed:

```
Failed to receive filename.ext!
Deleting filename.ext
```

6. When the file transfer is complete, type the following DOS command to view the drive directory and confirm that your file has been transferred to the 2040 PC/104 CPU:

```
C:\> DIR
```

The system will display the contents of drive contents:

```
Volume in drive is <label>
Directory of <drive>:\

filename ext   27264 06-07-96   2:57p

     1 file(s) 27264 bytes
```

Chapter 8: SSDs, DRAM, and battery backup

≡ Description

The 2040 PC/104 CPU contains one solid–state disk, a socket for a second solid–state disk, and a socket for SRAM modules.

≡ Booting

The 2040 PC/104 CPU can boot from an external drive such as a floppy connected to LPT1 or a PC/104 hard drive, or from an M–Systems DiskOnChip (DOC) in SSD1. For an external drive, the boot sequence is specified in SETUP. For an M–Systems DOC, the BIOS in SSD0 automatically looks for BIOS extensions in the DOC during the boot process.

≡ SSD0

SSD0 contains an on–board 512 KB flash. 128 KB contains the BIOS drive and power management. 384 KB is unused, but is not accessable.

≡ SSD1 socket/M–Systems DiskOnChip

SSD1 is a 32–pin DIP socket for an M–Systems DiskOnChip (DOC). If a DOC is installed in SSD1 it can be programmed as a boot drive. The socket exhibits high retention force and affords a gas tight contact.

The memory address for a DOC is at E8000–EBFFFh. This memory address is not bank switchable and cannot be disabled.

Before installing M–Systems DOC, align pin 1 of the DOC with pin 1 of the SSD1 socket. Refer to Figure 8–1 for the location of the SSD1 socket, and refer to Figure 8–2 for correct SSD alignment.

Figure 8–1 SSD socket locations

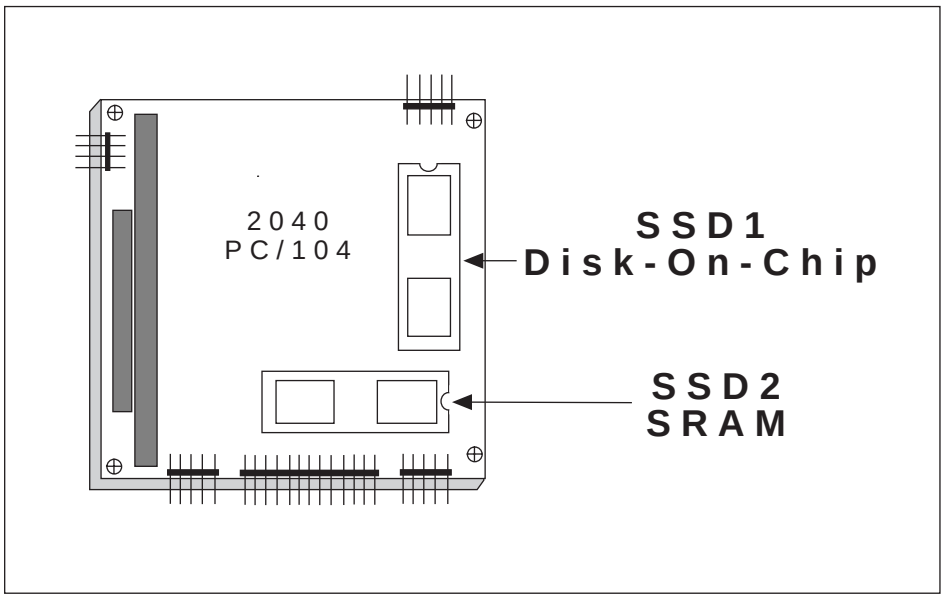
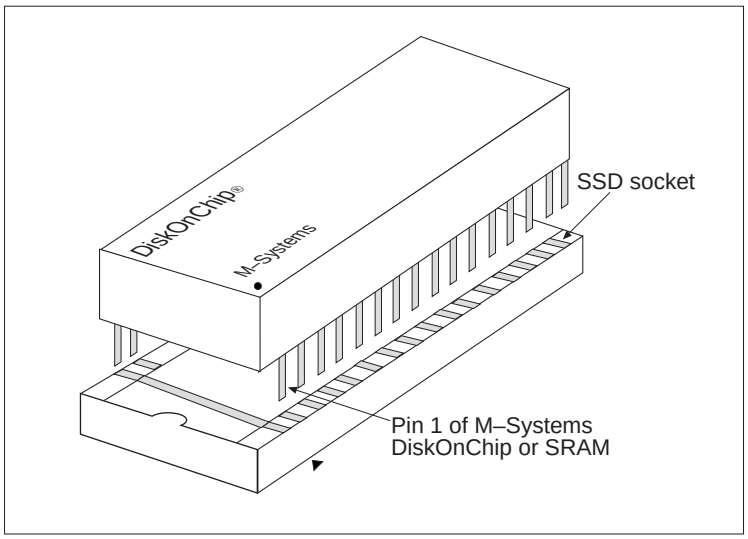


Figure 8–2 M–Systems pin alignment with the 2040 SSD1 socket



WARNING!

Incorrect installation of an SSD1 device will destroy the chip. To install a device in SSD1, be sure to match the notch in the device with the notch in the SSD1 marked silkscreen on the 2040.

≡ SSD2

SSD2 is a 32–pin DIP socket for a 128 KB or 512 KB SRAM module. The SRAM is automatically backed up by a user–supplied battery installed at J5. Table 8–1 shows the pinout for connector J5. The socket exhibits high retention force and affords a gas tight contact.

Table 8–1 Connector J5 pinout

Pin	Signal	Function
1	+Speaker	+5V in series with 33 Ω
2	GND	3.6V external battery, negative
3	Reset SW	External reset
4	KBD SW	Inhibit switch to disable keyboard
5	KBD Data	Keyboard data
6	KBD CLK	Keyboard clock
7	Ground	Signal and power ground
8	KBD PWR	+5V for keyboard
9	BATV+	3.6V external battery, positive
10	PWR good	Power good input

Note SRAM contents are sometimes affected by system noise. Therefore, the use of SRAM is not recommended in electrically noisy environments, especially when systems are critical. Also note that SRAM devices require a battery to back up the SRAM files (see "Battery backup for SSD2 SRAM and real time calendar clock" in this chapter.

SSD2 socket

SSD2 resides in memory window EC000–EFFFFh. The SSD2 can contain either 128KB or 512KB of SRAM. The upper address lines are set via I/O port 1EC.

Accessing SRAM on the 2040

The System Control Register accesses the SRAM on the 2040. The System Control Register is accessed (read/write) at address 1ECH and is reset on power up. When you access the SRAM memory, you must first select the specific bank within the SRAM. After you select the bank number through the System Control Register, the bank of SRAM is available at addresses EC000H–EFFFFH.

Bits 5 and 6 are read only bits and should not be changed. Bit 7 is the watchdog control bit and should not be changed unless a change in the watchdog state is desired. Based on the state of SSD A14 – SSD A18, the lower bits select a binary addressable bank of memory in the SRAM. Refer to Table 8–2 and also to the TESTSRAM.CPP program on the 2040 utility disk in the examples directory.

The following is an example in C++, which accesses bank 2 of a 512k SRAM using C++:

```
SystemControlRegister = (inportb(0x1EC) & 0xE0);
// Read bits 5, 6 and 7 of the control register.
Bank2 = 0x02;  // 0x02 = 00010 for bank 2
outportb(SystemControlRegister | Bank2);
// Set bank 2 without changing bits 5, 6 & 7.
```

If you were using a 128K SRAM device the only difference would be Bank2 = 0x0A. This would set Bit 3 as is required for 128K SRAM devices. Refer to the TESTSRAM.CPP example on the 2040 utility disk.

Table 8–2 System control register

Register 0x1EC	WD Enable**	EEPROM Data	Usesetup Jumper	A18	A17	A16	A15	A14
Memory Select	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3***	**Bit 2**	**Bit 1**	**Bit 0**
Bank 0	x	x	x	0	0	0	0	0
Bank 1	x	x	x	0	0	0	0	1
Bank 2	x	x	x	0	0	0	1	0
Bank 3	x	x	x	0	0	0	1	1
Bank 4	x	x	x	0	0	1	0	0
Bank 5	x	x	x	0	0	1	0	1
Bank 6	x	x	x	0	0	1	1	0
Bank 7	x	x	x	0	0	1	1	1
Bank 8	x	x	x	0	1	0	0	0
Bank 9	x	x	x	0	1	0	0	1
Bank 10	x	x	x	0	1	0	1	0
Bank 11	x	x	x	0	1	0	1	1
Bank 12	x	x	x	0	1	1	0	0
Bank 13	x	x	x	0	1	1	0	1
Bank 14	x	x	x	0	1	1	1	0
Bank 15	x	x	x	1	1	1	1	1
Bank 16	x	x	1	1	0	0	0	0
Bank 17	x	x	1	1	0	0	0	1
Bank 18	x	x	1	1	0	0	1	0
Bank 19	x	x	1	1	0	0	1	1
Bank 20	x	x	1	1	0	1	0	0
Bank 21	x	x	1	1	0	1	0	1
Bank 22	x	x	1	1	0	1	1	0
Bank 23	x	x	1	1	0	1	1	1
Bank 24	x	x	1	1	1	0	0	0
Bank 25	x	x	1	1	1	0	0	1
Bank 26	x	x	1	1	1	0	1	0
Bank 27	x	x	1	1	1	0	1	1
Bank 28	x	x	1	1	1	1	0	0
Bank 29	x	x	1	1	1	1	0	1
Bank 30	x	x	1	1	1	1	1	0
Bank 31	x	x	1	1	1	1	1	1

* A17 must be set to 1 when accessing 128K SRAM devices.
** WD Enable, Bit 7 = 0; WD Disable, Bit 7 = 1.

≡ DRAM

The 2040 PC/104 CPU is shipped with 4 MB of DRAM on–card.

≡ Battery backup for SSD2 SRAM and real time calendar clock

If SRAM is used in SSD2 you need an AT battery for battery backup of the SRAM files. An AT battery also backs up the CMOS real time clock. The 2040 PC/104 CPU does not have a battery installed when it is shipped. To install a battery:

1. Power off the 2040 PC/104 CPU.
2. Install the 3.6V AT clock battery at the J5 connector. Refer to the component diagram in the *Quick start* chapter for the location of J5.

Table 8–3 Speaker, battery, keyboard, and reset: J5

Pin	Signal	Function
1	+Speaker	+5V in series with 33 Ω
2	GND	3.6V external battery, negative
3	Reset SW	External reset
4	KBD SW	Inhibit switch to disable keyboard
5	KBD Data	Keyboard data
6	KBD CLK	Keyboard clock
7	Ground	Signal and power ground
8	KBD PWR	+5V for keyboard
9	BATV+	3.6V external battery, positive
10	PWR good	Power good input

Chapter 9: External drives

≡ Description

The LPT1 parallel port can be used as a floppy disk drive port. The 2040 PC/104 CPU is compatible with all common floppy disk drives used on desktop PCs. It can also be used with a PC/104 floppy controller. The floppy drives use DMA channel 2.

The 2040 PC/104 CPU can also interface with any standard IDE or EIDE hard drives that have a PC/104 interface.

≡ Floppy disk controller

The 2040 PC/104 CPU uses an Octagon FCA–12 cable to connect directly to one or two 3.5 in. or 5.25 in. floppy drives via the LPT1 connector at J4.

Note See the *Accessories* appendix for mating information on the floppy disk connector.

Note If you wish to add a second floppy drive to your system, you must use a floppy drive cable which has two connectors.

Power requirements

You must supply power to the floppy drive(s) through an external source. Refer to your floppy drive manual for specific instructions.

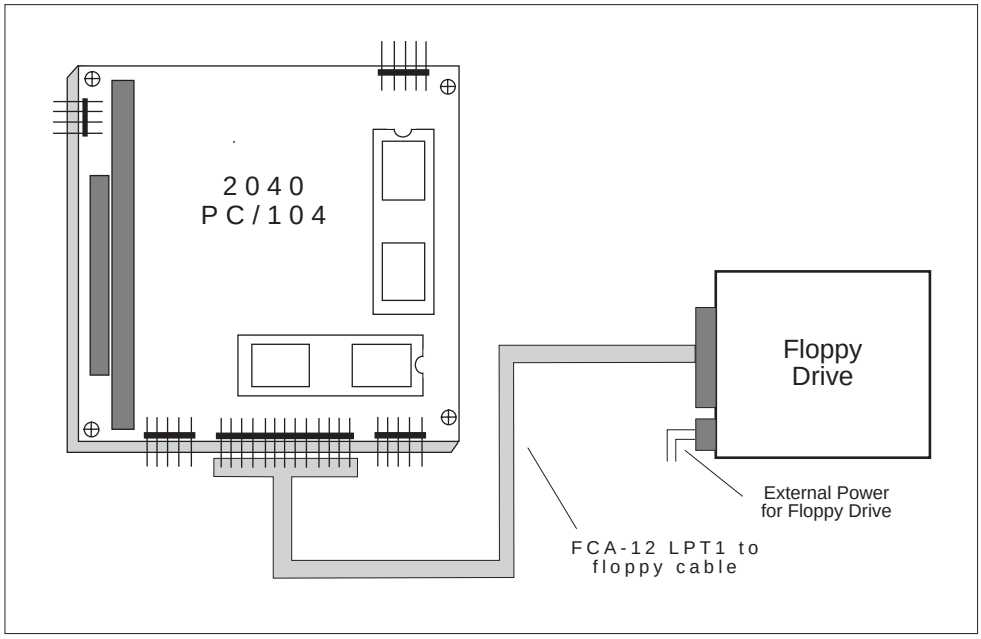
Installing a floppy disk drive

You can connect a floppy disk drive to LPT1, or use a PC/104 floppy disk controller card. This procedure shows how to connect a floppy disk drive to LPT1.

1. Disconnect power to the 2040 PC/104 CPU.
2. Insert one end of an Octagon FCA–12 cable into the rear of the floppy drive. Make sure pin 1 on the cable is connected to pin 1 on the drive.
3. Insert the other end of the cable into J4 on the 2040 PC/104 CPU.
4. Connect power to the floppy drive.
5. Run SETUP in the \UTILS subdirectory to set up the floppy drive. You can execute this program either by pressing <BACKSPACE><S> during system bootup or by executing the file SETUP.EXE. The system steps you through the configuration. Also, refer to the *SETUP programs* chapter for more information on the AT BIOS SETUP program. Reboot the system after running BIOS SETUP.

Note Ensure that the Setup jumper (W1[5–6]) is installed so that the system will use the Setup settings in EEPROM when the system is rebooted.

Figure 9–1 LPT1 and a Floppy Drive



≡ Hard disk controller

The 2040 PC/104 CPU will drive two PC/104 hard drives that have 16–bit IDE interfaces.

To install a hard drive:

1. Disconnect power to the 2040 PC/104 CPU.
2. Connect the PC/104 hard drive to the PC/104 connector on the 2040. Refer to the instructions included with the hard drive.
4. Execute the SETUP program to configure your system for a hard drive. You can execute this program either by pressing <BACK–SPACE><S> during system bootup or by executing the file SETUP.COM. This file is found on the 2040 PC/104 utility disk. The system steps you through the configuration. Also, refer to the *SETUP programs* chapter for more information on the BIOS SETUP program. Reboot the system after running BIOS SETUP.

Note Ensure that the Setup jumper (W1[5–6]) is installed so that the system will use the Setup settings in EEPROM when the system is rebooted.

5. Run FDISK on the hard drive. This partitions the hard drive, and assigns a drive letter. By default, it will assign the drive letter which is subsequent to your currently installed drives. When FDISK is finished, reboot the system.

Note Some hard drives are shipped from the factory pre–fdisked, and some are pre–formatted. Refer to the documentation included with your hard drive.

6. Format the hard drive using the DOS FORMAT command. When the drive is formatted, reboot the system.
7. If you want to boot the system from the hard drive, run the SYS command. The system copies COMMAND.COM as well as hidden files to the hard drive.
8. Reboot the system.

Chapter 10: Interpreting "beep" codes

≡ Description

The 2040 PC/104 CPU BIOS generates system status codes during POST. If a speaker is installed at J5, the beep codes are audible. The following table interprets these beep codes.

Table 10–1 Phoenix BIOS beep codes

Diagnostic port output	Beep codes	Description of test or failure
01h		80286 register test in-progress
02h	1-1-3	CMOS write/read test in-progress
03h	1-1-4	BIOS ROM checksum in-progress
04h	1-2-1	Programmable interval timer test in-progress or failure
05h	1-2-2	DMA initialization in-progress or failure
06h	1-2-3	DMA page register write/read test in-progress or failure
08h	1-3-1	RAM refresh verification in-progress or failure
09h		1st 64K RAM test in-progress
0Ah	1-3-3	1st 64K RAM chip or data line failure multi-bit
0Bh	1-3-4	1st 64K RAM odd/even logic failure
0Ch	1-4-1	1st 64K RAM address line failure
0Dh	1-4-2	1st 64K RAM parity test in-progress or failure
10h	2-1-1	1st 64K RAM chip or data line failure-bit 0
11h	2-1-2	1st 64K RAM chip or data line failure-bit 1
12h	2-1-3	1st 64K RAM chip or data line failure-bit 2
13h	2-1-4	1st 64K RAM chip or data line failure-bit 3
14h	2-2-1	1st 64K RAM chip or data line failure-bit 4
15h	2-2-2	1st 64K RAM chip or data line failure-bit 5
16h	2-2-3	1st 64K RAM chip or data line failure-bit 6
17h	2-2-4	1st 64K RAM chip or data line failure-bit 7
18h	2-3-1	1st 64K RAM chip or data line failure-bit 8
19h	2-3-2	1st 64K RAM chip or data line failure-bit 9
1Ah	2-3-3	1st 64K RAM chip or data line failure-bit A
1Bh	2-3-4	1st 64K RAM chip or data line failure-bit B
1Ch	2-4-1	1st 64K RAM chip or data line failure-bit C
1Dh	2-4-2	1st 64K RAM chip or data line failure-bit D
1Eh	2-4-3	1st 64K RAM chip or data line failure-bit E
1Fh	2-4-4	1st 64K RAM chip or data line failure-bit F
20h	3-1-1	Slave DMA register test in-progress or failure
21h	3-1-2	Master DMA register test in-progress or failure
22h	3-1-3	Master interrupt mask reg. test in-progress or failure
23h	3-1-4	Slave interrupt mask reg. test in-progress or failure
25h	N/A	Interrupt vector loading in-progress
27h	3-2-4	Keyboard controller test in-progress or failure

Table 10–1 Phoenix BIOS beep codes (cont'd)

Diagnostic port output	Beep codes	Description of test or failure
28h	N/A	CMOS power-fail and checksum checks in-progress
29h	N/A	CMOS config info. validation in-progress
2Bh	3-3-4	Screen memory test in-progress or failure
2Ch	3-4-1	Screen initialization in-progress or failure
2Dh	3-4-2	Screen retrace tests in-progress or failure
2Eh	N/A	Search for video ROM in-progress
30h	N/A	Screen believed operable:
30h	N/A	Screen believed running w/video ROM
31h	N/A	Monochromatic screen believed operable
32h	N/A	40-column color screen believed operable
33h	N/A	80-column color screen believed operable
34h	4-2-1	Timer tick interrupt test in-progress or failure
35h	4-2-2	Shutdown test in-progress or failure
36h	4-2-3	Gate A20 failure
37h	4-2-4	Unexpected interrupt in protected mode
38h	4-3-1	RAM test in-progress or failure above address 0FFFFh
3Ah	4-3-3	Interval timer channel 2 test in-progress or failure
3Bh	4-3-4	Time-of-day clock test in-progress or failure
3Ch	4-4-1	Serial port test in-progress or failure
3Dh	4-4-2	Parallel port test in-progress or failure
3Eh	4-4-3	Math coprocessor test in-progress or failure
50h	N/A	Beginning of CSET_INIT
51h	N/A	Loading the RCM table
52h	N/A	Loading the FCM table, doing DMC
53h	N/A	Entering CSET_BFR_VIDROM (before video ROM)
54h	N/A	Entering CSET_BFR_SIZMEM (before memory sizing)
55h	N/A	Entering CSET_AFT_MTEST (before memory test)
56h	N/A	Entering CSET_AFT_CMCFG (before CMOS configuration check)
57h	N/A	Entering CSET_BFR_OPROM (before option ROM scan)

Table 10–2 Additional error codes for Phoenix BIOS

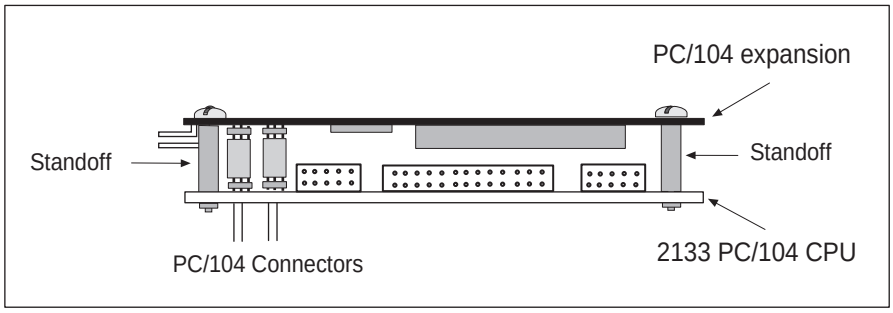
Diagnostic port output	Beep codes	Description of test or failure
C0h	N/A	Entry to power management initialization
C1h	N/A	Return from power management initialization
C2h	N/A	Entry to cache initialization
C3h	N/A	Return from cache initialization
D7h	N/A	Using defaults from ROM
D9h	N/A	Using EEPROM values
DFh	N/A	Exit CMOS initialization
E0h	N/A	Reset
E1h	N/A	BIOS determined it is an actual reset
E7h	N/A	Going to CMOS initialization
E8h	N/A	Returned from CMOS initialization
E9h	N/A	Entry to chipset initialization
EAh	N/A	Exit from chipset initialization
F0h	N/A	Loading chipset from EEPROM or defaults
F1h	N/A	Completed chipset load
F3h	N/A	Loading mvb specific values
F4h	N/A	Completed mvb load
F9h	N/A	Starting memory autosizing
FAh	N/A	Completed memory autosizing

Chapter 11: PC/104 expansion

≡ Description

The 2040 PC/104 CPU can interface to up to three additional PC/104 modules including A/D converters, digital I/O, serial ports, etc. The 2133 supports 8– and 16–bit cards and provides ±12V from the power supply at J7**.** These modules can be stacked on top of the 2040 to form a highly integrated control system.

Figure 11–1 Typical PC/104 module stack



WARNING!

When installing any PC/104 module, avoid excessively flexing the board. Mate pins correctly and use the required mounting hardware.

Note See the *Accessories* appendix for mating information on the PC/104 connector.

Overview: Section 3 – System management

Section 3 provides information on managing the 2040 in the areas of internal control and troubleshooting. The following chapters are included:

Chapter 12: Watchdog timer and hardware reset

Chapter 13: Serial EEPROM

Chapter 14: Troubleshooting

Chapter 12: Watchdog timer and hardware reset

≡ Description

The watchdog timer is a fail–safe against program crashes or processor lockups. It times out every 1.6 seconds (1.6 sec. typical, 1.00 sec. min., 2.25 sec. max.) unless reset by the software, or extended by the INT17 functions setWDTimer or incWDTimer. The watchdog timer is software controlled. It can be controlled through the enhanced INT 17h handler (I17HNDLER.EXE).

≡ Watchdog function definitions using Borland C code

This section provides definitions for the following functions: Enable watchdog, Strobe watchdog, and Disable watchdog.

Enable watchdog

To "enable" the watchdog timer, clear bit 7 of port IEC in the following Borland C code:

```
int portIEC;
portIEC = inportb(0xIEC)
outportb(0xIEC,port20c & 0x7F); // Enable watchdog
```

Strobe watchdog

The watchdog must be strobed before the timeout period expires. To "strobe" the watchdog timer use the following Borland C code:

```
inportb(0xIEC)
```

Disable watchdog

To "disable" the watchdog use the following Borland C code:

```
int portIEC;
portIEC = inportb(0xIEC)
outportb(0x20C,port20C & 0x80)
```

≡ Watchdog function definitions using enhanced INT 17h handler

This section provides definitions for the watchdog functions using the Int17 handler (I17HNDLR.EXE). I17HNDLR.EXE is a TSR program. Once executed it is active, but it must be executed each time the system is rebooted. If the Int17 functions will be used by your application, copy the utility to your hard drive and add it to your AUTOEXEC.BAT.

Enable watchdog

Function: fdh

Subfunction: 01h

Purpose: To enable the watchdog.

Calling registers:
AH fdh
AL 01h
DX ffffh

Return registers: None

Comments: This function enables the watchdog. Once the watchdog is enabled, it has to be strobed at a period of not less than 1.6 seconds or until the watchdog is disabled. Otherwise, a system reset will occur.

Programming example:

```
/* Inline assembly code for Borland C++ 3.1 */
asm {
mov  ax,0fd01h
mov  dx,0ffffh
int  17h
}
```

Strobe watchdog

Function: fdh

Subfunction: 02h

Purpose: To strobe the watchdog.

Calling registers:
AH fdh
AL 02h
DX ffffh

Return registers: None

Comments: This function strobes the watchdog. Once the

watchdog is enabled, it has to be strobed at a period of not less than 1.6 seconds or until the watchdog is disabled. Otherwise, a system reset will occur.

Programming example:

```
/* Inline assembly code for Borland C++ 3.1 */
asm {
mov ax,0fd02h
mov dx,0ffffh
int 17h
    }
```

The watchdog timer can also be strobed by reading address 1ECh. This may be faster than strobing the watchdog timer with an interrupts function call, for example:

```
A=INP(0x1EC)
```

Disable watchdog

Function: fdh

Subfunction: 03h

Purpose: To disable the watchdog.

Calling registers:

AH	fdh
AL	03h
DX	ffffh

Return registers: None

Comments: This function disables the watchdog. Once the watchdog is enabled, it has to be strobed at a period of not less than 1.6 seconds or until the watchdog is disabled. Otherwise, a system reset will occur.

Programming example:

```
    /* Inline assembly code for Borland C++ 3.1 */
    asm {
         mov   ax,0fd03h
         mov   dx,0ffffh
         int   17h

         }
```

Set WDTimer

Function: fdh

Subfunction: 04h

Purpose: To set the watchdog timer timeout period.

Calling registers:
AH fdh
AL 04h
BX count in ticks
DX ffffh

Return registers: BX remaining count

Comments: This function sets the counter for the software/watchdog timer. The software/watchdog strobe interrupt handler is installed in the user timer tick interrupt (INT 1C) chain. At each tick (approximately 54 ms or 18.2 times per second) the handler wakes up and checks the counter. If the counter is not zero, it decrements the counter.

Every eight ticks of the counter (or a little less than 1/2 second), the handler strobes the watchdog. Once the counter is down to 0, no further strobing occurs, until a new count is set. If the counter is set to 182, the handler will then strobe the watch dog automatically every 8 ticks for about 10 seconds (18.2 * 10) when the counter has decremented to 0. If no other strobing is done, the watchdog will reset in about 1 second after that.

A typical application would enable the watchdog and then do manual strobing with SetWDTimer. Before calling functions such as the flash write procedure (which may take longer than 1.2 seconds), the subroutine would increase the counter for that subroutine using IncrementWDTimer.

Notes: 1. The application is responsible for enabling the watchdog before using these functions.

2. The application may continue to strobe the watchdog manually. While the counter is not zero, strobing will occur from both places.

3. Setting the counter to 0 disables the automatic strobing.

4. If interrupts such as IRQ0 are disabled for a period longer than 1/2 second, the handler might not strobe the watchdog before the system resets.

5. If the period of IRQ0 is changed, this may change the INT 1C frequency, thereby changing the watchdog strobe frequency.

Programming example:

```
/* Inline assembly code for Borland C++ 3.1 */
asm {
      mov   ax,0fd04h
      mov   dx,0ffffh
      mov   bx,182            ; 10 seconds = 18.2*10
      int   17h               ; set counter to 10 seconds
      }
```

Additional example

```
asm {
      mov   ax, 0fd04h
      mov   dx,0ffffh
      mov   bx,0              ; 0 disables counter
      int   17h               ; disable counter
  }
```

IncrementWDTimer

Function: fdh

Subfunction: 05h

Purpose: To increment the watchdog timer timeout period.

Calling registers:
AH fdh
AL 05h
BX increment count in ticks
DX ffffh

Return registers: BX remaining count

Comments: See SetWDTimer comments

Programming example:

```
/* Inline assembly code for Borland C++ 3.1 */
asm {
      mov   ax,0fd05h
      mov   dx,0ffffh
      mov   bx,91             ; 5 seconds = 18.2*5
      int   17h               ; increment counter by 5s
      }
```

≡ Hardware reset

The 2040 PC/104 CPU does not have a reset button. However, pin 3 on connector J5 can be connected to a switch which momentarily pulls the pin to ground, causing a hardware reset. Also, the RESET command accomplishes the same thing as a reset button. This provides a more complete reset than the <CTRL><ALT><DEL> method.

WARNING!

When using COM1 as the console, the <CTRL><ALT> <DEL> commands on the host system keyboard only reset the host system. Use the RESET command to issue a hardware reset on the 2040.

Chapter 13: Serial EEPROM

≡ Description

Up to 768 words of user-definable data can be saved in the serial EEPROM. The serial EEPROM does not require battery backup to maintain the data when the system power is off. The serial EEPROM is easily accessible via software interrupts by most programming languages.

The serial EEPROM definitions include the following functions: Read a single word from serial EEPROM, Write a single word to serial EEPROM, Read multiple words from serial EEPROM, Write multiple words to serial EEPROM, and Return serial EEPROM size.

These functions require the INT17 handler (I17HNDLR.EXE). I17HNDLR.EXE is a TSR program. Once executed it is active, but it must be executed each time the system is rebooted. If the INT17 functions will be used by your application, copy the utility to your hard drive and add it to your AUTOEXEC.BAT.

≡ Serial EEPROM

Read a single word from the serial EEPROM

Function: fch

Subfunction: 00h

Purpose: To read a single word from the on-board serial EEPROM.

Calling registers:
AH fch
AL 00h
BX Word address (zero based)
DX ffffh (relative to user area)

Return registers:
Carry flag cleared if successful
AX Word read
Carry flag set if error
AL Error code

Error code	Meaning
ffh	Unknown error
01h	Function not implemented
02h	Defective serial EEPROM
03h	Illegal access

Comments: This function reads a word from the user area of the serial EEPROM.

Programming example:

```
/* Read word 2 */
unsigned int seeData;
/* Inline assembly code for Borland C++ 3.1 */
asm {
mov  ax,0fc00h
mov  bx,02h     /* Read word 2 */
mov  dx,0ffffh
int  17h
mov  seeData,ax /* store data in c environment */
    }
```

Write a single word to the serial EEPROM

Function: fch

Subfunction: 01h

Purpose: To write a single word to the on-board serial EEPROM.

Calling registers:

AH	fch
AL	01h
BX	Word address (zero based)
CX	Data word to write
DX	ffffh (relative to user area)

Return registers:

Carry flag cleared if successful
Carry flag set if error
AL Error code

Error code	Meaning
ffh	Unknown error
01h	Function not implemented
02h	Defective serial EEPROM
03h	Illegal access

Comments: This function writes a word to the user area of the serial EEPROM.

Programming example:

```
/* Write 0x1234 to word 3*/
unsigned int seeData = 0x1234;
/* Inline assembly code for Borland C++ 3.1 */
asm {
     mov  ax,0fc01h
     mov  bx,03h     /* Write word 3 */
     mov  cx,seeData /* Get write data from
                        c environment */
     mov  dx,0ffffh
     int  17h
    }
```

Read multiple words from the serial EEPROM

Function: fch

Subfunction: 02h

Purpose: To read multiple words from the on-board serial EEPROM.

Calling registers:

AH	fch
AL	02h
BX	Word address (zero based)
CX	Word count
DX	ffffh (relative to user area)
ES:DI	Destination pointer

Return registers:

Carry flag cleared if successful

AX	Word read

Carry flag set if error

AL	Error code

Error Code	Meaning
ffh	Unknown error
01h	Function not implemented
02h	Defective serial EEPROM
03h	Illegal access

Comments: This function reads multiple words from the user area of the serial EEPROM.

Programming example:

```
/* Read 10 words starting at word 5 */
unsigned int far *seeDataPtr = new unsigned int[10];
/* Allocate storage*/
/* Inline assembly code for Borland C++ 3.1 */
asm {
    mov   ax,0fc02h
    mov   bx,05h     /* Read starts at word 5 */
    mov   cx,10      /* Read 10 words */
    mov   dx,0ffffh
    les   di,seeDataPtr
    int   17h
    }
```

Write multiple words to the serial EEPROM

Function: fch

Subfunction: 03h

Purpose: To write multiple words to the on-board serial EEPROM.

Calling registers:

AH	fch
AL	03h
BX	Word address (zero based)

CX Word count
DX ffffh (user area relative address)
DS:SI Source pointer

Return registers: Carry flag cleared if successful
Carry flag set if error
AL Error code

Error Code	Meaning
ffh	Unknown error
01h	Function not implemented
02h	Defective serial EEPROM
03h	Illegal access

Comments: This function writes multiple words to the user area of the serial EEPROM.

Programming example:

```
/* Write 8 words starting at word 6*/
unsigned int far *seeDataPtr = new unsigned int[8];
/* Allocate storage*/
    unsigned int far* tmpPtr = seeDataPtr;
    for(int i=0;i<8;i++)
    *seeDataPtr = i;/* initialize data */
/* Inline assembly code for Borland C++ 3.1 */
    asm {
    push ds
    mov  ax,0fc03h
    mov  bx,06h     /* Write starts at word 6 */
    mov  cx,8       /* Write 8 words */
    mov  dx,0ffffh
    lds  si,seeDataPtr
    int  17h
    pop  ds
         }
```

Return serial EEPROM size

Function: fch

Subfunction: 04h

Purpose: To obtain the size of the on-board serial EEPROM.

Calling registers: AH fch
AL 04h
DX ffffh

Return registers: Carry flag cleared if successful
AX Size of the serial EEPROM (in words)
BX Size available to user (in words)
Carry flag set if error
AL Error code

Error code	Meaning
ffh	Unknown error
01h	Function not implemented
02h	Defective serial EEPROM
03h	Illegal access

Comments: This function returns the size (in words) of the serial EEPROM. Since the user cannot access all of the serial EEPROM, this function determines how much space is available to the user. This avoids the user from accessing unavailable addresses.

Programming example:

```
unsigned int seeUserSize;
/* Inline assembly code for Borland C++ 3.1 */
asm {
     mov   ax,0fc04h
     mov   dx,0ffffh
     int   17h
     mov   seeUserSize,bx
     }
```

Check CMOS battery

Function: fbh

Subfunction: 08h

Purpose: To check CMOS battery condition.

Calling registers:
AH fbh
AL 08h
DX ffffh

Return registers:
Carry flag cleared if successful
ZF set = battery okay, ZF clear = battery bad
AL copy of CMOS register 0Eh at powerup time
Carry flag set if error
AL Error code

Error Code	Meaning
ffh	Unknown error
01h	Function not implemented
02h	Defective serial EEPROM
03h	Illegal access

Comments: This function reports the condition of the CMOS battery. This is useful to determine if extended CMOS data (contents) should be relied upon or refreshed from EEPROM.

Programming example:

```
/* Reports the condition of the CMOS battery */
   unsigned int cmosflag;
/* Inline assembly code for Borland C++ 3.1 */
   asm {
         mov  ax,0fb08h
         mov  dx,0ffffh
         int  17h
         mov  cmosflag,al
       }
printf("The CMOS byte 0E at powerup time  = %02x\n",
cmosflag)
```

Chapter 14: Troubleshooting

If your system is not working properly, check the following items:

No screen activity – checking console serial communications

If you do not get the sign-on message after bootup:

1. Make sure all PC/104 expansion cards are removed from the 2040 PC/104 CPU. This ensures that other cards are not interacting with the 2040 PC/104 CPU.
2. The VTC-9F serial cable turns the 2040 PC/104 CPU serial port into a 9-pin AT serial port. Make sure a null modem adapter is installed on the other end, and that the assembly is inserted into the proper serial port on the PC. Make sure the VTC-9F serial cable is connected to J3 of the 2040 PC/104 CPU. Ensure that the SETUP jumper (W1 [5:6]) is removed, so that the 2040 is using the BIOS default settings. (The SETUP default settings specify COM1 as a serial console).
3. Make sure your power module provides +5V (+/-0.25V) and at least 1.5A of current.
4. After verifying the above conditions, you can monitor voltage levels by connecting an oscilloscope between the TxD* line on J3 (pin 5) and ground. After powerup, you should see a burst of activity on the oscilloscope screen. The voltage level should switch between +/-8V. This test verifies that the CPU is active and that the transmit from COM1 is functional.

Garbled serial console screen activity

If you do get activity on your console screen but the message is garbled, check the following:

1. Remove SETUP W1[5:6] to force 9600, N, 8, 1 for COM1.
2. If you are using PC SmartLINK, make sure you have configured the software for 9600 baud and have selected the correct serial port for communicating with your PC. Refer to the PC SmartLINK manual for information on selecting the baud rate.
3. If you are using communications software other than PC SmartLINK, Octagon cannot guarantee the operation. Make sure that the software parameters are set to match those of the 2040 PC/104 CPU: 9600 baud, 8 bits, 1 stop bit, no parity.

System generates a BIOS message but locks up when booting from SSD1

If the message "press C to try again or S for setup" appears, the boot did not complete. The most likely reason is that the DOC does not have an operating system installed.

Press S to enter Setup, then configure LPT1 as a floppy drive, number of floppy drives to 1, and floppy drive size to the size of the floppy you will be installing. Save the Setup changes, then power off the 2040. Ensure that the S jumper is on so that the next time the 2040 is powered, it will use the parameters from the Setup stored in EE-PROM. Install a floppy disk drive on LPT1, insert a boot disk in the floppy disk drive, then reboot.

Refer to you DOC manual for information on how to load an operating system on the DOC.

System will not recognize hard drive

1. Run SETUP. Change Primary Master Fixed Disk to User and specify Heads, Sectors, and Cylinders.
2. Check hard drive Master/Slave jumpers.

System locks up after powerdown/powerup

If the power supply does not drain below 0.7V, the CMOS components on the card will act like diodes and forward bias. This is typically caused by using power supplies that have large output capacitors. Either use a different power supply that discharges faster, leave the power off until the supply has adequate time to discharge or place a 100 ohm, large wattage resistor across the output capacitor.

≡ Technical assistance

Carefully recheck your system before calling Technical Support. Run as many tests as possible; the more information you can provide, the easier it will be for the Technical Support staff to help you solve the problem. For additional technical assistance, try the following:

Technical Support telephone:	303-426-4521
E-mail Technical Support:	Support@octagonsystems.com
Applications Notes (via web):	http://www.octagonsystems.com
FAQ (via web):	http://www.octagonsystems.com

Overview: Section 4 – Appendices

Section 4 contains a series of appendices which provides additional information about the 2040.

Appendix A: Technical data

Appendix B: Software utilities

Appendix C: Accessories

Appendix A: Technical data

≡ Technical specifications

CPU

40 MHz 386SX

BIOS

AT compatible with industrial extensions. The BIOS has a "fast boot" feature which when selected allows the BIOS to boot in approximately five seconds.

DRAM

4 MB installed on–board

Floppy drive

Floppy drive support via the LPT1 port or off–card floppy controller

Hard drive

Hard drive support via PC/104 hard drive

SSD0

On–board 512 KB flash

SSD1

Supports an M–Systems DiskOnChip

SSD2

Supports a 128K or 512K SRAM

ROM–DOS

None supplied

Serial I/O

COM1 and COM2 are 16550 compatible, with 16–byte FIFO

Parallel port

LPT1 is PC compatible with multifunctional capability
Supports bi–directional, unidirectional, ECP, and EPP modes

Battery backup

AT style battery (not included)

Power requirements

5V ±0.25V, 800 mA maximum

Voltage supervisor

Reset threshold: +5V supply > 4.65V typical

Environmental specifications

–40° to 70° C operating
–55° to 90° C nonoperating
RH 5% to 95%, noncondensing
40G shock, 6G vibration

Size

3.8" x 3.6"

Watchdog timer

Default time-out is typically 1.6 seconds (1.0 seconds minimum) software enabled and strobed. Disabled on powerup and reset.

Bus mastering

Bus mastering is supported

Table A–1 2040 PC/104 CPU memory map

Hex range	Function
00000h—9FFFFh	System memory (640KB base RAM).
A0000h—BFFFFh	Off–card memory (Normally reserved for video memory).
C0000h—C7FFFh	Off–card memory. Reserved for video BIOS. Shadow enable/disable* option in SETUP.
C8000h—CFFFFh	Off–card memory. Shadow enable/disable* option in SETUP.
D0000h—DFFFFh	Off–card memory. Shadow enable/disable* option in SETUP.
E0000h—E7FFFh	Off–card memory.
E8000h—EBFFFh	SSD1/DiskOnChip. Shadow always disabled.
EC000h–EFFFFh	SSD2/SRAM. 16KB SSD2 memory paging window. Shadow always disabled.
F0000h—FFFFFh	64KB BIOS area. Shadow always enabled.
100000h—3FFFFFFh	63MB addressable extended memory

* = default

Table A–2 2040 PC/104 CPU I/O map

Hex range	Function
000h–0FFh	System I/O functions
100h–1EBh	Off–card I/O space
1ECh	System control register 0 (Refer to tables 1 and 13)
1EDh	System control register 1 EEPROM clock
1EEh	System control register 2 EEPROM chip select
1EFh	System control register 3 EEPROM data in
1F0h–277h	Off–card I/O space
278h–27Bh	Optional bi–directional parallel port address*
27Ch–2F7h	Off–card I/O space
2F8h–2FFh	COM2
300h–377h	Off–card I/O space
378h–37Bh	Bi–directional parallel port (LPT1)
37Ch–3BBh	Off–card I/O space
3BCh–3BFh	Optional bi–directional parallel port address*
3C0h–3F7h	Off–card I/O space
3F8h–3FFh	COM1

* These areas can be optionally assigned to the on–board, bi–directional parallel port in SETUP.

Table A–3 DMA map

Channel	Function
Channel 0	Reserved for bus memory refresh
Channel 1	Reserved for ECP parallel port
Channel 2	Reserved for floppy drive
Channel 3	Available
Channel 4	Slave
Channel 5	Available
Channel 6	Available (16 bit)
Channel 7	Available (16 bit)

Table A–4 Interrupt map

Interrupt	Function
IRQ0	System timer*
IRQ1	Keyboard*
IRQ2	Cascade*
IRQ3	COM2
IRQ4	COM1
IRQ5	Parallel port secondary IRQ
IRQ6	Free (normally reserved for the floppy drive)
IRQ7	Parallel port primary IRQ
IRQ8	RTC alarm
IRQ9	Free
IRQ10	Free
IRQ11	Free
IRQ12	Free (Normally reserved for the mouse port)
IRQ13	Floating point unit*
IRQ14	Free (Normally rerserved for hard disk drive)
IRQ15	Free

* = default

Table A–5 Available LPT1 port addresses

LPT1 port addresses
278h
378h*
3BCh

* = default

≡ Connector pinouts

Table A–6 PC/104 signal assignments

Pin	Row A	Row B	Row C	Row D
0	—	—	Gnd	Gnd
1	IOCHK*	Gnd	SBHE*	MEMCS16*
2	SD7	RESETDRV	LA23	IOCS16*
3	SD6	+5V	LA22	IRQ10
4	SD5	IRQ9	LA21	IRQ11
5	SD4	–5V	LA20	IRQ12
6	SD3	DRQ2	LA19	IRQ15
7	SD2	–12V	LA18	IRQ14
8	SD1	0 WS**	LA17	DACK0*
9	SD0	+12VDC	MEMR*	DRQ0
10	IOCHRDY	Key	MEMW*	DACK5*
11	AEN	SMEMW*	SD8	DRQ5
12	SA19	SMEMR*	SD9	DACK6*
13	SA18	IOW*	SD10	DRQ6
14	SA17	IOR*	SD11	DACK7*
15	SA16	DACK3*	SD12	DRQ7
16	SA15	DRQ3	SD13	+5V
17	SA14	DACK1*	SD14	Master*
18	SA13	DRQ1	SD15	Gnd
19	SA12	Refresh*	Key	Gnd
20	SA11	SYSCLK	—	—
21	SA10	IRQ7	—	—
22	SA9	IRQ6	—	—
23	SA8	IRQ5	—	—
24	SA7	IRQ4	—	—
25	SA6	IRQ3	—	—
26	SA5	DACK2*	—	—
27	SA4	TC	—	—
28	SA3	Bale	—	—
29	SA2	+5V	—	—
30	SA1	14 MHz	—	—
31	SA0	Gnd	—	—
32	Gnd	Gnd	—	—

* = active low; ** = wait state

Table A–7 Speaker, battery, keyboard, and reset: J5

Pin	Signal	Function
1	+Speaker	+5V in series with 33 Ω
2	GND	3.6V external battery, negative
3	Reset SW	External reset
4	KBD SW	Inhibit switch to disable keyboard
5	KBD Data	Keyboard data
6	KBD CLK	Keyboard clock
7	Ground	Signal and power ground
8	KBD PWR	+5V for keyboard
9	BATV+	3.6V external battery, positive
10	PWR good	Power good input

Table A–8 Power: J7

Pin	Function
1	Gnd
2	+5 VDC
3	NC
4	+12 VDC to PC/104
5	–5 VDC to PC/104
6	–12 VDC to PC/104
7	Gnd
8	+5 VDC

Table A–9 LPT1 printer connector: J4

Pin	DB-25 pin	Function	Pin	DB-25 pin	Function
1	1	STB*	14	20	Gnd
2	14	AFD*	15	8	DATA6
3	2	DATA0	16	21	Gnd
4	15	ERR*	17	9	DATA7
5	3	DATA1	18	22	Gnd
6	16	INIT*	19	10	ACK*
7	4	DATA2	20	23	Gnd
8	17	SLIN*	21	11	BUSY
9	5	DATA3	22	24	Gnd
10	18	Gnd	23	12	PE
11	6	DATA4	24	25	Gnd
12	19	Gnd	25	13	SLCT
13	7	DATA5	26	NC	+5V Safe

* = active low

Appendix B: Software utilities

≡ Introduction

The 2040 PC/104 CPU Software Utility Disk comes with the utilities listed below. This appendix describes the utilities and their use.

Support commands:

- COM1CON.EXE
- I17HNDLR.EXE
- LPT1CON.COM
- PGMBIOS.EXE
- RESET.COM
- SETUP.COM
- SCONSOLE.COM

Display commands:

In addition to the system support utilities, there are utilities to handle displays and keypads. These are located in the Display directory. Refer to Display.txt for information on these utilities.

- DISPLAY.EXE
- KPTEST.EXE
- DSPTEST.EXE
- DSQBTEST.EXE
- KPQBTEST.EXE
- KPOFF.COM
- KPON.COM

≡ COM1CON.EXE

Purpose

This support command enables COM1 as the console device when the system uses a video card.

Syntax

COM1CON.EXE

Parameter

/**U***x* specifies to revert to the video card.

Remarks

The memory for COM1CON is not released using the /U parameter. Only the interrupt vectors are restored to the previous state.

≡ I17HNDLR.EXE

Purpose

This support command allows the system to use the INT 17 functions.

Syntax

I17HNDLR

Remarks

The I17HNDLR allows the system to use the INT 17 functions. I17HNDLR is a TSR program. If you are using it, add the command to your AUTOEXEC.BAT file.

LPT1CON.COM

Purpose

This support command redirects the video to the LPT1 port.

Syntax

LPT1CON

Remarks

If you have a 2010 interface board and an LCD display connected to the LPT1 port, executing the DISPLAY.EXE and LPT1CON.COM programs allow you to use the display as the system console. You must reset your system to change the video to the original parameters.

≡ PGMBIOS.EXE

Purpose

This support command programs a new system BIOS into the 2040 PC/104 CPU.

Syntax

PGMBIOS [*filename*] [**/Y**] [**/C**] [**/?**]

Parameters

- *filename* specifies the BIOS .DAT file to program into flash.
- **/Y** specifies to perform the programming without first prompting "Are you sure?".
- **/C** specifies PGMBIOS is to allow programming even when the checksum is bad.
- **/?** requests a help menu.

Example

To program the BIOSFILE.BIN files into the SSD0 BIOS area, enter:

```
PGMBIOS BIOSFILE.BIN /Y
```

≡ RESET.COM

Purpose

This support command enables the watchdog timer and allows time–out to expire, thus restarting the system.

Syntax

RESET

Remarks

The RESET command also restarts all the expansion I/O cards on the bus. This differs from a <CTRL><ALT><DEL> reboot of the system which only restarts the system but not the expansion cards.

≡ SETUP.COM

Purpose

This support command configures various system parameters, including serial ports, a parallel port, and a floppy and hard drive.

Syntax

SETUP [**/D**]

Parameter

- **/D** returns all setup values to default values.

Remarks

From the directory where this utility file is located, enter:

SETUP

After the copyright message displays, the main menu appears:

```
                OCTAGON SYSTEMS CORPORATION
                  2040 SETUP UTILITY Vx.x
              (c) Phoenix Technologies, Ltd. 1985, 1995
_____________________________________________________________
(Press SPACE to CHANGE, ENTER to ACCEPT, ESC to EXIT)

Serial Console on COM1:          Enabled
COM1 Console Baud Rate:          9600
Power on memory test:            DISABLED
Boot  Sequence:                  C: ONLY
Serial Port A:                   ENABLED
Serial Port B:                   ENABLED
Parallel (LPT) Port:             ENABLED
    Parallel Port Mode:          Bidirectional  Printer
                                 Port
    Parallel Port Address:       378h
    Parallel Port Interrupt:     IRQ7
Number of floppy drives:         1
Floppy drive 1 size:             3.5", 1.44 MB
Swap drives A and B:             No
Number of hard drives:           0
SETUP Entry via Hotkey:          ENABLED
Shadow Video BIOS area:          DISABLED
Shadow  C8000h–CFFFFh:           DISABLED
Shadow  D0000h–D7FFFh:           DISABLED
Shadow  D8000h–DFFFFh:           DISABLED

Press ENTER to SAVE the changes
Press R to RESTART with original values or
Press ESC to EXIT without saving the changes:


Options Saved.

You must reset for these options to take effect.
2040 C:\>
```

Note Executing SETUP /D will change all setup parameters to default values.

See also

See the *SETUP programs* chapter for more information. You may also enter SETUP at post time by entering the "backspace" and "s" keys.

≡ SCONSOLE.EXE

Purpose

This support command checks whether the system is running on a serial console.

Syntax

SCONSOLE

Remarks

This command is useful in batch programs to detect if the serial console is in use. It returns an error level of 0 if the serial console is enabled, allowing a DOS batch file to "react" to the serial console being enabled.

Appendix C: Accessories

Table C–1 Cables and terminal board

Product	Description	Octagon part number
VTC-9F	Serial cable - Female	2746
VTC-9M	Serial cable - Male	2472
Null modem adapter	9-pin to 9-pin	2470
FCA-12	LPT1 to floppy cable	4809
VTC-5/IBM	LPT1 to DB25 printer cable	1237
PCA-36	LPT1 to Centronics printer cable	4808
CMA-26-12	12" cable for LPT1 port	2776
CMA-26-24	24" cable for LPT1 port	1257
STB-26	Terminal board, 26-position	2905

Table C–2 LCD displays and keypads

Product	Description	Octagon part number
LCD–4 x 20	LCD display w/cable, 40 character	2783
LCD–4 x 40	LCD display w/cable, 80 character	2784
2010	LCD display/keypad interface	3909
KP-1	Keypad w/cable, 16-key, low cost	1218
KP-2-16	Keypad w/cable, 16-key, relegendable	1736
KP-3	Keypad w/cable, 16-key, NEMA 2 rated	1737

Table C–3 Opto rack and modules

Product	Description	Octagon part number
MPB-16PC	PC opto rack, 16-position	3389
G4-IAC5	AC input, 90-140 VAC	2395
G4-IAC5A	AC input, 180-280 VAC	2396
G4-IDC5	DC input, 15-32 VDC	2397
G4-IDC5B	DC input, 4-16 VDC	2511
G4-IDC5D	DC input, 2.5-28 VDC	2529
G4-OAC5	AC output, 12-140 VAC	2398
G4-OAC5A	AC output, 12-280 VAC	2399
G4-ODC5	DC output, 5-60 VDC	2400
G4-ODC5A	DC output, 5-200 VDC	2503
G4-ODC5R	DC output, dry contact output	3013

Table C–4 Miscellaneous part numbers

Product	Description	Octagon part number
AT battery	Calendar/clock battery backup	3186
PC SmartLINK IV	Terminal emulation software	3447
CAMBASIC	Multitasking, industrial control programming language	4059

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Warranty

Octagon Systems Corporation (Octagon), warrants that its standard hardware products will be free from defects in materials and workmanship under normal use and service for the current established warranty period. Octagon's obligation under this warranty shall not arise until Buyer returns the defective product, freight prepaid to Octagon's facility or another specified location. Octagon's only responsibility under this warranty is, at its option, to replace or repair, free of charge, any defective component part of such products.

Limitations on warranty

The warranty set forth above does not extend to and shall not apply to:

1. Products, including software, which have been repaired or altered by other than Octagon personnel, unless Buyer has properly altered or repaired the products in accordance with procedures previously approved in writing by Octagon.
2. Products which have been subject to power supply reversal, misuse, neglect, accident, or improper installation.
3. The design, capability, capacity, or suitability for use of the Software. Software is licensed on an "AS IS" basis without warranty.

The warranty and remedies set forth above are in lieu of all other warranties expressed or implied, oral or written, either in fact or by operation of law, statutory or otherwise, including warranties of merchantability and fitness for a particular purpose, which Octagon specifically disclaims. Octagon neither assumes nor authorizes any other liability in connection with the sale, installation or use of its products. Octagon shall have no liability for incidental or consequential damages of any kind arising out of the sale, delay in delivery, installation, or use of its products.

Service policy

1. If a product should fail during the warranty period, it will be repaired free of charge. For out of warranty repairs, the customer will be invoiced for repair charges at current standard labor and materials rates.
2. Customers that return products for repairs, within the warranty period, and the product is found to be free of defect, may be liable for the minimum current repair charge.

Returning a product for repair

Upon determining that repair services are required, the customer must:

1. Obtain an RMA (Return Material Authorization) number from the Customer Service Department, 303-430–1500.
2. If the request is for an out of warranty repair, a purchase order number or other acceptable information must be supplied by the customer.
3. Include a list of problems encountered along with your name, address, telephone, and RMA number.
4. Carefully package the product in an antistatic bag. (Failure to package in antistatic material will VOID all warranties.) Then package in a safe container for shipping.
5. Write RMA number on the outside of the box.
6. For products under warranty, the customer pays for shipping to Octagon. Octagon pays for shipping back to customer.
7. Other conditions and limitations may apply to international shipments.

Note PRODUCTS RETURNED TO OCTAGON FREIGHT COLLECT OR WITHOUT AN RMA NUMBER CANNOT BE ACCEPTED AND WILL BE RETURNED FREIGHT COLLECT.

Returns

There will be a 15% restocking charge on returned product that is unopened and unused, if Octagon accepts such a return. Returns will not be accepted 30 days after purchase. Opened and/or used products, non-standard products, software and printed materials are not returnable without prior written agreement.

Governing law

This agreement is made in, governed by and shall be construed in accordance with the laws of the State of Colorado.

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