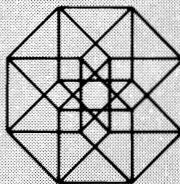


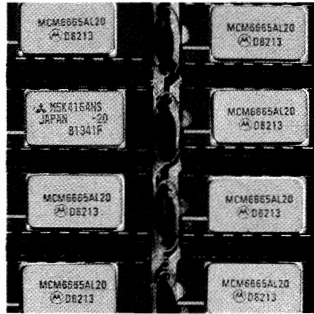
# Quadboard™ Operation Manual

These Reference Notes may be inserted in the  
"OPTIONS" Section of your IBM Personal  
Computer "Guide To Operations".

QUADRAM  
CORPORATION

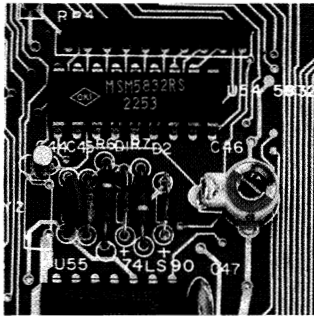


# Four functions on one board



## 256K MEMORY EXPANSION

Socketed and expandable in 64K increments to 256K, full parity generation and checking are standard. A Quadboard exclusive feature allows parity to be switch disabled to avoid lock-up upon error detection. The dip switches also allow selective addressing on any 64K block. Memory access and cycle time naturally meet all IBM specifications.



## CLOCK/CALENDAR.

Quadboard eliminates the hassle of manually inputting the date on system boot-up by providing the clock and all software routines necessary for inserting the appropriate programs on your diskettes. The internal computer clock is automatically set for compatibility with most software routines which utilize clock functions. On-board battery keeps the clock running when the computer is off.

Periodic updates or changes to this material will be made in new editions of this publication.

Requests for dealer information, comments or other inquiries may be addressed to: Quadram Corporation, 4357 Park Drive, Norcross, Georgia 30093. Quadram Corporation has no obligation to return or hold confidential any material or information you supply unless arrangements are made pursuant to Quadram's receipt of said information.

Material in this manual applies to Quadboards™ with part number 8914-3 and is intended to operate with the Quadmaster™ disk, version 1.6.

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## 1. INTRODUCTION

The Quadboard from Quadram Corporation is a multiple function expansion board for the IBM Personal Computer. It is designed to greatly increase the PC's capabilities while only using one expansion slot. The following functions are implemented on the Quadboard:

- 1) Random Access Memory (RAM) expansion from 64K to 256K bytes in 64K byte increments.
- 2) An EIA RS-232-C serial interface for asynchronous communications.
- 3) A Centronics compatible parallel printer interface.
- 4) A battery powered Clock/Calendar

Figure 1 is a block diagram of the Quadboard showing its major features and their approximate locations on the board. All necessary software utilities are included on a disk.

Additionally a program is provided on the QuadMaster disk (QuadRAM Drive) that allows a portion of the Quadboard's memory to be used as an extra disk drive. The QuadRAM Drive will emulate a single-sided or double-sided disk drive. QuadRAM Drive saves time by allowing high speed access of frequently used files that are normally stored on the disk.

The Quadboard is completely hardware and software compatible with the Personal Computer and was designed for performance and reliability. It has been constructed of high quality components and designed for minimum power consumption. Each board has been "burned-in" and thoroughly tested to insure many years of reliable service.

## 2. DESCRIPTION

This section provides a description of the Quadboard's features and the support software included on the disk. Operational details are given in the OPERATION section (section 4).

### 2.1. MEMORY

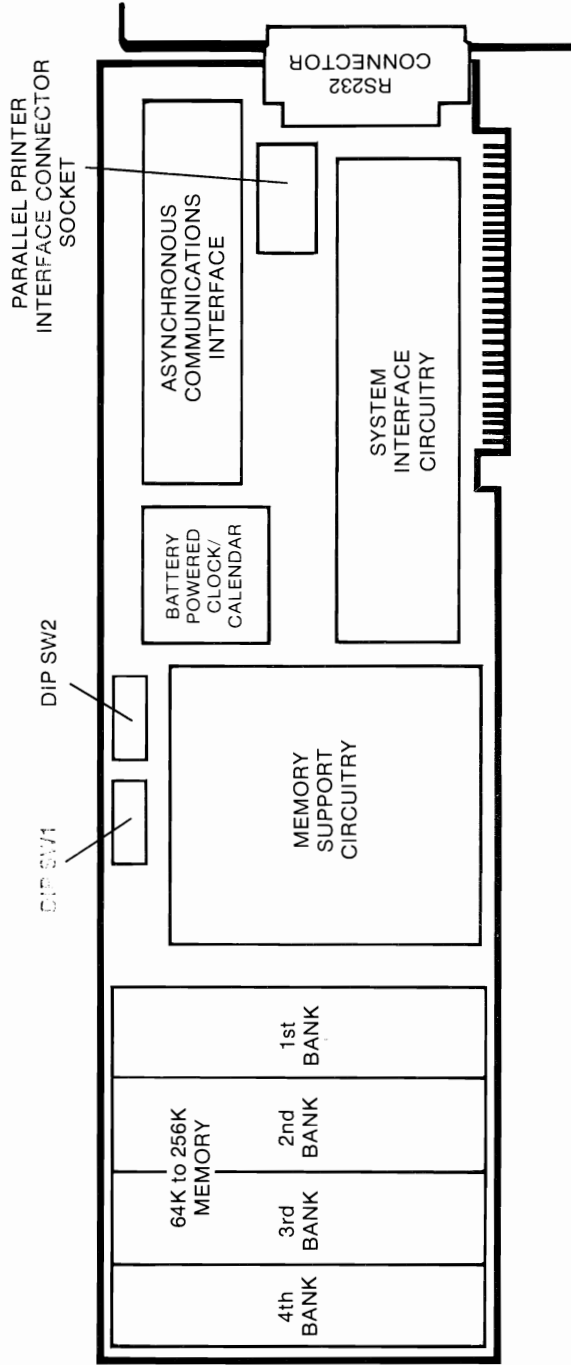
The memory section is made up of four rows of nine sockets. One, two, three or four rows will have IC's installed depending on whether the Quadboard is configured for 64K, 128K, 192K or 256K bytes of memory, respectively. Each row is a 64K bank of memory that includes eight data bits and one parity bit. When a parity error is detected a latch is set and an I/O Channel Check line is activated to indicate an error to the processor.

### 2.2. ASYNCHRONOUS COMMUNICATIONS INTERFACE

The Asynchronous Communications Interface (serial interface) is a standard EIA RS-232-C interface that is fully programmable and supports IBM asynchronous communications. The baud rate is programmable from 50 to 9600 baud. An INS 8250 Asynchronous Communications Element (ACE) or equivalent IC controls all serial operations.

Communications protocol is a function of system code and must be loaded before the adapter is operational. System software is required to handle all interface and control signal status. This software is automatically provided when using DOS or ADVANCED BASIC.

**FIGURE 1  
QUADBOARD BLOCK DIAGRAM**



The serial interface is implemented as Data Terminal Equipment (DTE) and uses a male 25 pin D-type connector. The connector is mounted at the rear of the board and has an IBM expansion slot panel mounted to it that replaces the installed blank panel.

### 2.3. PARALLEL PRINTER INTERFACE

The parallel printer interface is designed to connect to printers with Centronics compatible interfaces. It is exactly like IBM's Parallel Printer Adapter and supports the graphics functions on many printers with graphics features. Driver software may be required to support the graphics functions in some printers. A short cable with a 16 pin DIP header at one end and a female 25 pin D-type connector at the other end is provided for interfacing a printer to the Quadboard.

### 2.4. CLOCK/CALENDAR

The Clock/Calendar is a battery powered, crystal controlled date and time keeping circuit that is used to set the Personal Computer's own internal Clock/Calendar whenever DOS is booted from a disk. A NiCad battery provides power for the Clock/Calendar when the PC is turned off. The battery is recharged when the PC is turned on. An adjustment is provided for setting the accuracy of the Clock/Calendar. This is preset at the factory and normally will not require adjustment. Software for automatically setting the PC's internal Clock/Calendar when DOS is booted is provided on an accompanying disk. A program is also provided on the QuadMaster disk for setting the Quadboard's Clock/Calendar.

## 2.5. DIP SWITCHES

Two 8-position DIP switches are provided on the Quadboard to allow the user to program several memory, serial interface, parallel interface and clock options. These programmable features allow the user to:

- 1) Set the Quadboard's starting memory address on any 64K boundary.
- 2) Enable or disable each 64K block of memory.
- 3) Disable or enable parity checking of the Quadboard's memory.
- 4) Configure the serial port as "COM1:" or "COM2:".
- 5) Configure the parallel printer port as "LPT1:" or "LPT2:".
- 6) Disable or enable accessing of the Quadboard's Clock/Calendar.

## 2.6. SOFTWARE: QUADMASTER™

All necessary software utilities are included on the QuadMaster disk. These utilities include software to:

- 1) Load the PC's Clock/Calendar with the time and date stored in the Quadboard's Clock/Calendar.
- 2) Set the Quadboard's Clock/Calendar.
- 3) Set aside a portion of the Quadboard's memory for use as an extra disk drive (QuadRAM Drive).
- 4) Perform diagnostics on all parts of the Quadboard.

The utilities for loading the PC's Clock/Calendar when DOS boots up and installing the QuadRAM Drive in memory are provided in machine language form so that a particular language is not needed to run them. The diagnostics and clock setting software are written in BASIC.

## 3. INSTALLATION

The Quadboard may be plugged into any slot in the Personal Computer. Refer to the "Guide to Operations" manual for detailed instructions for opening the PC chassis and for installing option boards.

### WARNING

Be sure the Personal Computer is turned off before removing the cover. Never insert or remove an option board with the PC's power turned on. Damage to the option board or the PC could result.

Before installing the Quadboard in the Personal Computer certain programmable options need to be selected by setting appropriate DIP switches. These settings are explained in the following sections. Figure 2 shows the location and details of the Quadboard's two DIP switches. Two types of DIP switches are used on the Quadboard: one type has slide switches and the other type has rocker switches. A switch is set to the "ON" position by sliding it in the direction indicated by the arrow or rocking it towards the "ON" indication on the DIP switch; a switch is set to the "OFF" position by sliding or rocking it in the opposite direction. Figures 3A and 3B are quick reference guides explaining each switch's function. These are handy after the user has gone through the detailed installation instructions once or twice and understands each programmed function.

The Quadboard may be able to be used as shipped from the factory. When the Quadboard leaves the factory the DIP switches are set as follows:

### QUADBOARD FACTORY SETTINGS

Quadboard Memory Bank Enabling	..... set for installed memory
Quadboard Memory Starting Address	..... 64K
Quadboard Memory Parity	..... OFF
Serial Port Address	..... COM1:
Parallel Port Address	..... LPT2:
Clock/Calendar	..... ENABLED
Clock/Calendar Contents	..... current Eastern Standard time and date

### 3.1. MEMORY EXPANSION

Two DIP switches on the IBM system board and two on the Quadboard must be set before the additional memory can be used by the Personal Computer. Switches on the IBM System Board are used to indicate the amount of total accessible system memory. Switches on the Quadboard are used to set the starting address of the Quadboard's memory and to enable the installed memory. Reporting of Quadboard memory parity errors may also be disabled or enabled.

#### 3.1.1. IBM SYSTEM BOARD SWITCH SETTINGS

The IBM system board has two DIP switches that are used to indicate the total amount of memory installed in the Personal Computer. The total amount of installed memory includes the 64K installed on the system board plus all that is installed in memory expansion cards. The system board DIP switches are labelled "SW1" and "SW2" on the system board. These two switches should be set according to the following table.

**TABLE 1  
IBM SYSTEM BOARD SWITCH SETTINGS**

TOTAL SYSTEM MEMORY	SWITCH 1 POSITIONS		SWITCH 2 POSITIONS							
	3	4	1	2	3	4	5	6	7	8
96K	(ALWAYS OFF)	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
128K	(ALWAYS OFF)	ON	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF
160K	(ALWAYS OFF)	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
192K	(ALWAYS OFF)	ON	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF
224K	(ALWAYS OFF)	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
256K	(ALWAYS OFF)	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
288K	(ALWAYS OFF)	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
320K	(ALWAYS OFF)	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
352K	(ALWAYS OFF)	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
384K	(ALWAYS OFF)	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF
416K	(ALWAYS OFF)	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
448K	(ALWAYS OFF)	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF
480K	(ALWAYS OFF)	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
512K	(ALWAYS OFF)	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
544K	(ALWAYS OFF)	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

*see correction*

The table on page 10 of the Quadboard manual is incorrect (Table 1: IBM System Board Switch Settings). Use the following table to set the IBM System Board Switches for memory expansion.

TOTAL SYSTEM MEMORY	SWITCH 1 POSITIONS		SWITCH 2 POSITIONS							
	3	4	1	2	3	4	5	6	7	8
96K	(ALWAYS OFF)	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
128K	(ALWAYS OFF)	ON	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF
160K	(ALWAYS OFF)	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF
192K	(ALWAYS OFF)	ON	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF
224K	(ALWAYS OFF)	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF
256K	(ALWAYS OFF)	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
288K	(ALWAYS OFF)	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
320K	(ALWAYS OFF)	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
352K	(ALWAYS OFF)	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
384K	(ALWAYS OFF)	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
416K	(ALWAYS OFF)	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
448K	(ALWAYS OFF)	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
480K	(ALWAYS OFF)	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
512K	(ALWAYS OFF)	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
544K	(ALWAYS OFF)	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

NOTE: Refer to the IBM *Guide to Operations* manual for more information about system board switch settings.

### 3.1.2. QUADBOARD MEMORY SWITCH SETTINGS

The Quadboard also has two DIP switches that must be set before its memory can be utilized. These switches set the starting address of the Quadboard's memory and enable accessing of the installed memory. Memory parity may also be enabled or disabled. The switches are labeled "SW1" and "SW2" and are located along the top edge of the board (as it is installed in the PC). Figure 2 shows the actual location of the switches.

#### 3.1.2.1. QUADBOARD MEMORY BANK ENABLING/DISABLING

Positions 5,6,7 and 8 of DIP switch 1 are used to enable or disable each of the four memory banks. For the average user Table 2 will be sufficient for setting these switches. For more details on these switches refer to the OPERATION section of this manual.

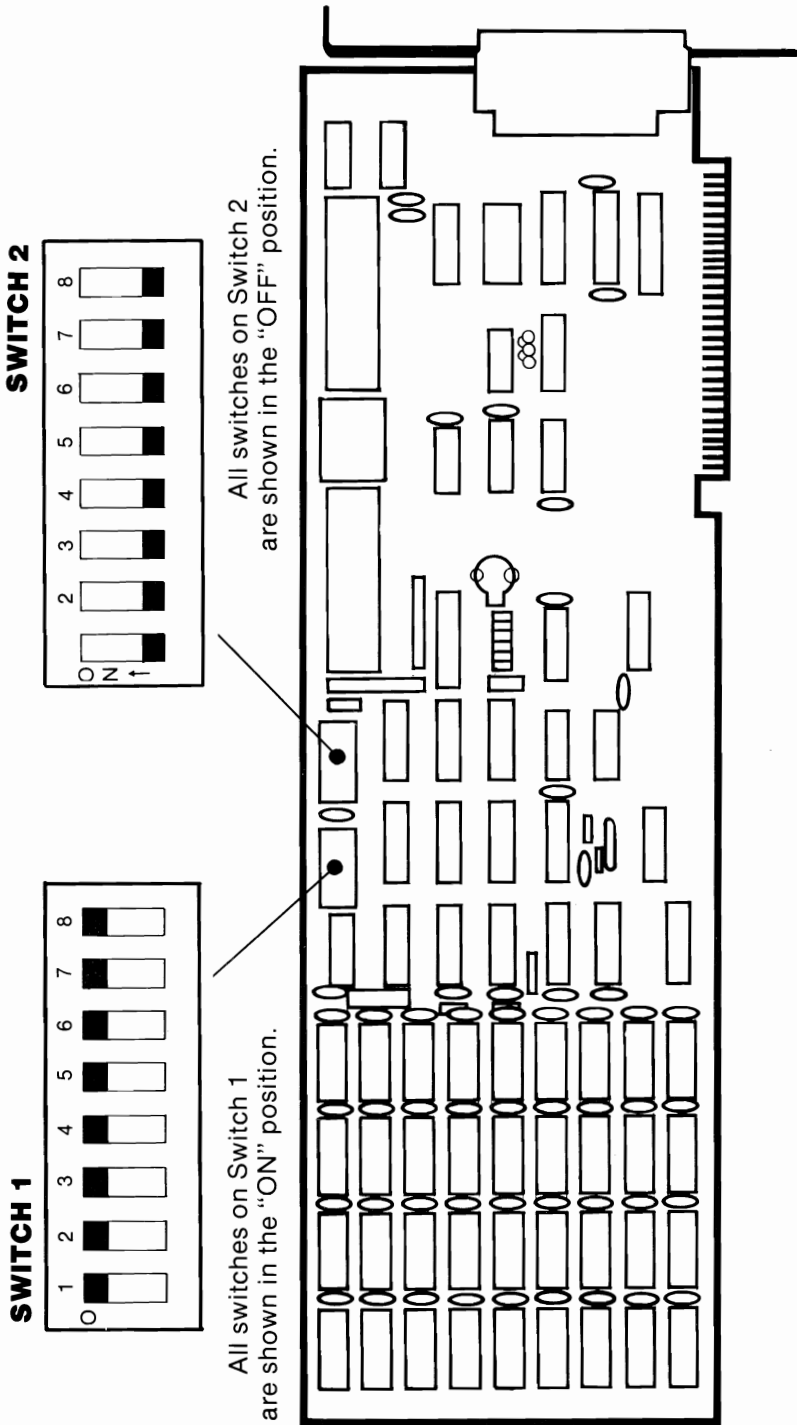
**TABLE 2  
QUADBOARD MEMORY BANK  
ENABLING**

TOTAL QUADBOARD MEMORY	QUADBOARD SWITCH 1 POSITIONS:			
	5	6	7	8
64K	OFF	OFF	OFF	ON
128K	OFF	OFF	ON	ON
192K	OFF	ON	ON	ON
256K	ON	ON	ON	ON

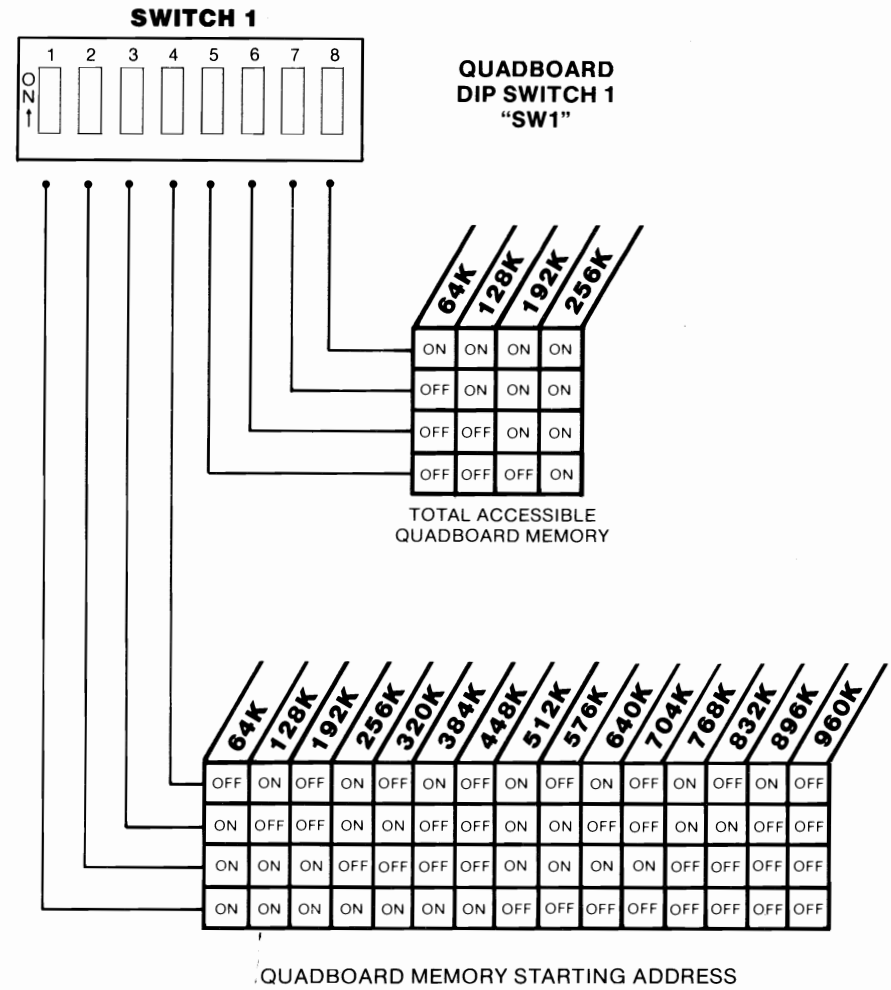
NOTE: When the PC is first turned on, a check of all the installed memory is performed. This check typically takes about 15 seconds when 64K of memory is installed on the PC's system board. With a 256K Quadboard installed, this memory check can take as long as 45 seconds to perform. Be prepared for a longer wait before the disk starts spinning when the PC is first turned on.



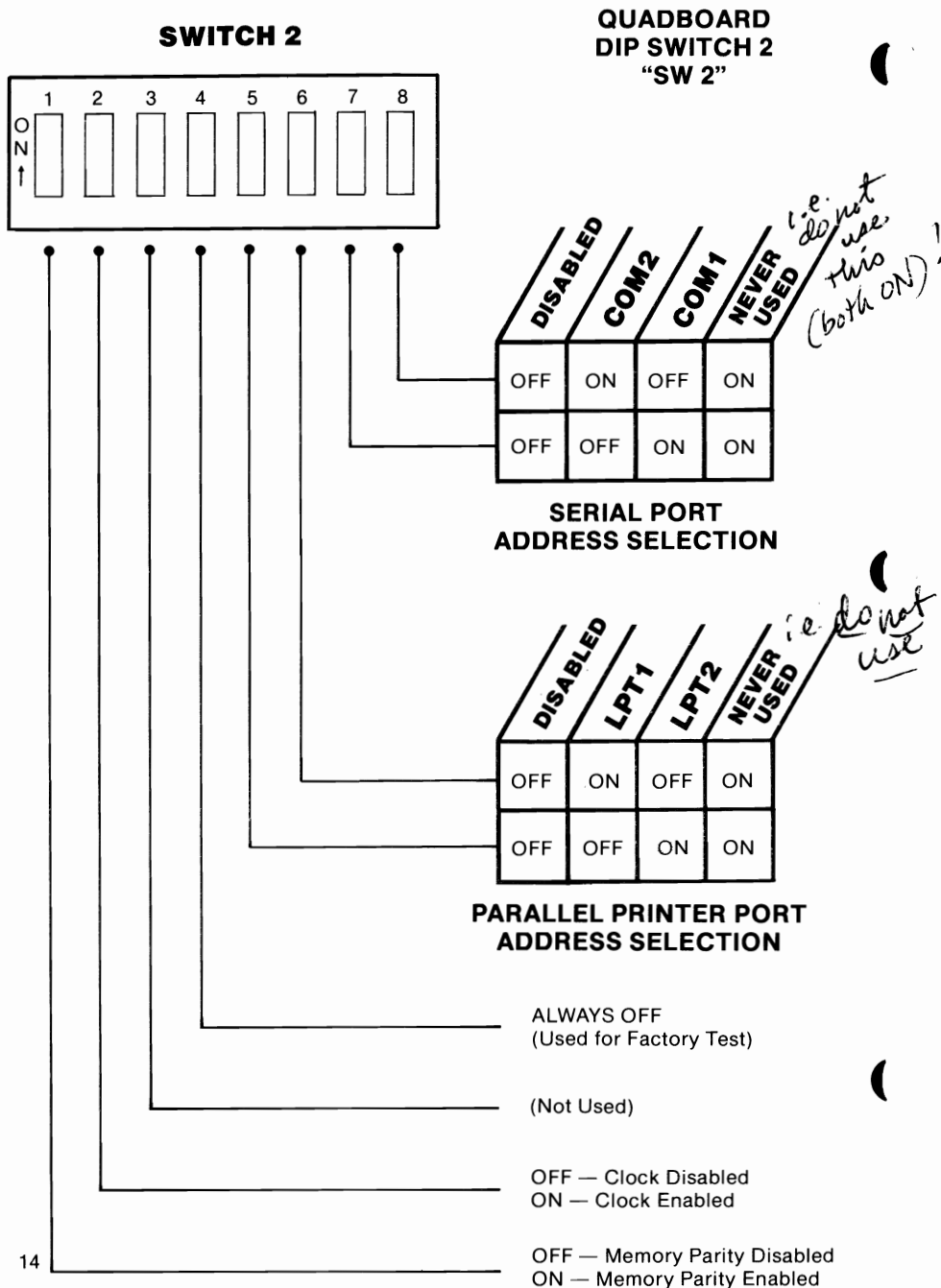
**FIGURE 2  
QUADBOARD DIP SWITCH DETAILS**



**FIGURE 3A  
QUADBOARD MEMORY STARTING ADDRESS  
QUICK REFERENCE**



**FIGURE 3B  
QUADBOARD DIP SWITCH 2 —  
QUICK REFERENCE**



**3.1.2.2. QUADBOARD MEMORY STARTING ADDRESS**

The starting address of the Quadboard's memory is switch selectable in increments of 64K bytes. Before any memory expansion board can be used in the PC, the system board must have 64K bytes of memory installed. If your PC does not contain 64K it must first be upgraded to 64K. Your dealer can do the upgrade or you can do it yourself. Consult the "Options" section of your IBM "Guide to Operations" manual for system board memory expansion instructions. If additional memory expansion boards are used the Quadboard's starting address will begin where the other expansion board's memory ends. Table 3 lists the switch headings for each memory setting.

**TABLE 3  
QUADBOARD MEMORY STARTING ADDRESS**

STARTING ADDRESS	QUADBOARD SWITCH 1 POSITIONS:			
	1	2	3	4
64K	ON	ON	ON	OFF
128K	ON	ON	OFF	ON
192K	ON	ON	OFF	OFF
256K	ON	OFF	ON	ON
320K	ON	OFF	ON	OFF
384K	ON	OFF	OFF	ON
448K	ON	OFF	OFF	OFF
512K	OFF	ON	ON	ON
576K	OFF	ON	ON	OFF
640K	OFF	ON	OFF	ON
704K	OFF	ON	OFF	OFF
768K	OFF	OFF	ON	ON
832K	OFF	OFF	ON	OFF
896K	OFF	OFF	OFF	ON
960K	OFF	OFF	OFF	OFF

NOTE: All four switches should never be in the "ON" position.

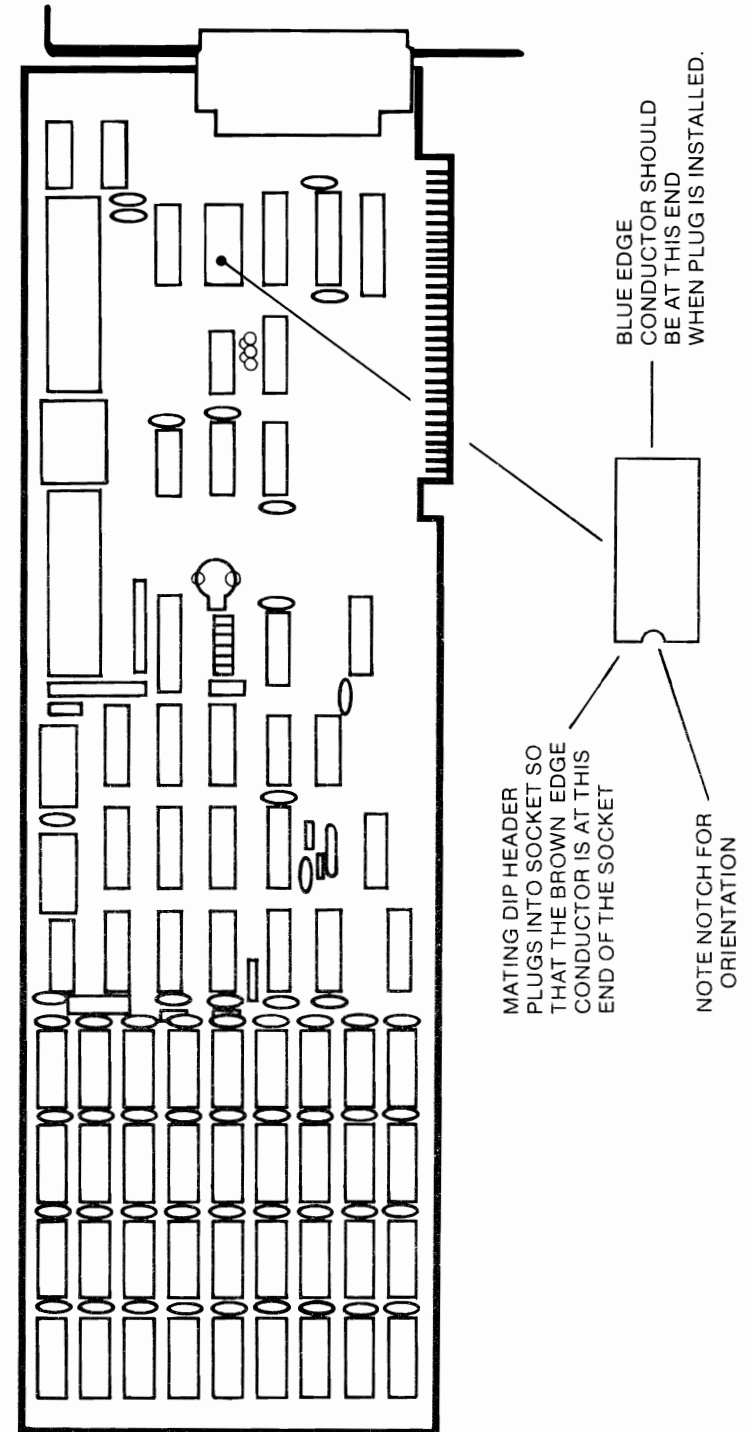
### 3.1.2.3 QUADBOARD MEMORY PARITY ENABLING/DISABLING

DIP switch 2, position 1 is used for enabling or disabling the reporting of memory Quadboard parity errors to the system board. Selecting the "OFF" position keeps memory parity errors from being recognized by the system board; the "ON" position allows them to be recognized. The normal position for most users will be the "OFF" position.

### 3.2. ASYNCHRONOUS COMMUNICATIONS (SERIAL) INTERFACE

The only set-up required for the serial port is selection of its address. It can be addressed as device "COM1:" or "COM2:". The Quadboard's serial port is virtually identical to IBM's serial port design. Table 4 lists the switch positions for programming the serial port.

FIGURE 4  
PARALLEL PRINTER PORT  
DIP HEADER INSTALLATION



**TABLE 4  
SERIAL PORT ADDRESS SELECTION**

DIP SWITCH 2 POSITION:		SERIAL PORT CONFIGURATION
7	8	
OFF	OFF	SERIAL PORT DISABLED
OFF	ON	"COM2:"
ON	OFF	"COM1:"
ON	ON	BOTH SWITCHES SHOULD NEVER BE ON AT THE SAME TIME

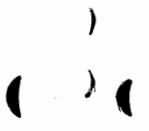
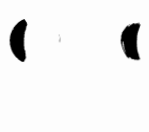
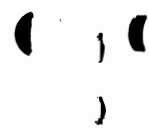
### 3.3. PARALLEL PRINTER INTERFACE

Installation instructions for the Parallel Printer Interface include connector location/cable routing and parallel port address selection.

#### 3.3.1. PARALLEL PRINTER PORT — CONNECTOR LOCATION/ CABLE ROUTING

Included with the Quadboard is a 16 conductor cable with a 16 pin DIP header on one end and a female, 25 pin D-type connector on the other end. Quadram offers an optional printer cable to connect between the 25 pin D-type connector and the printer's 36 pin input connector. The 16 pin DIP header plugs into a mating 16 pin socket on the Quadboard. Figure 4 shows details of the 16 pin DIP header installation. The DIP Header should be plugged into the socket with the blue conductor of the flat ribbon cable closest to the rear of the board (panel end) and the brown conductor toward the front of the board. The D-type connector can be mounted in one of two places.

Some IBM Personal Computers have a D-type cutout in the rear panel. A plastic cap is usually installed in this hole. If your PC has this cutout, the D-type connector can be mounted here. Route the cable from



the Quadboard, between the Disk Controller card and its bracket, to the D-type cutout. Remove the plastic cap and mount the D-type connector here with the stand-off screws provided. Skip to section 3.3.2. for port addressing selection.

For those PC's that do not have the D-type cutout in the rear panel Quadram provides an extra panel with a D-type cutout. This panel can replace any blank panel in the PC. The D-type connector should then be mounted in this panel with the stand-off screws provided.

#### 3.3.2. PARALLEL PRINTER INTERFACE ADDRESS SELECTION

Three switches are used to program the parallel port's address. It can be addressed as device "LPT1:" or "LPT2:". Positions 4, 5 and 6 of DIP switch 2 are used for address selection. Position 4 is used for factory tests and must be set to the "OFF" position for proper operation. The switch settings are summarized in Table 5.

**TABLE 5  
PARALLEL PRINTER PORT ADDRESS SELECTION**

DIP SWITCH 2 POSITIONS:			PARALLEL PORT ADDRESS
4	5	6	
OFF	OFF	OFF	PARALLEL PORT DISABLED
OFF	OFF	ON	"LPT1:"
OFF	ON	OFF	"LPT2:"
OFF	ON	ON	BOTH SWITCHES SHOULD NEVER BE ON AT THE SAME TIME

NOTE: Running IBM's Diagnostic test on the Quadboard's parallel port will yield a 901 Error Code. This is normal and does not indicate a problem.

### 3.4. CLOCK/CALENDAR

The Clock/Calendar can be enabled or disabled by setting position 2 of DIP switch 2 to the "ON" or "OFF" position. This feature is intended for those users who may have two Clock/Calendars in their system because they have two Quadboard's installed or a Clock/Calendar and Quadboard installed. One of the Clock/Calendars must be disabled to prevent bus conflicts when the Clock/Calendar is addressed. Setting the switch to the "ON" position enables the Clock/Calendar; setting it to the "OFF" position disables the Clock/Calendar.

Software for setting the Quadboard's Clock/Calendar and loading the PC's Clock/Calendar from the Quadboard's Clock/Calendar when DOS is booted up is included on the accompanying QuadMaster disk.

#### 3.4.1. SETTING THE PC'S INTERNAL CLOCK/CALENDAR

Two versions of the program for loading the PC's internal Clock/Calendar from the Quadboard's Clock/Calendar are included; one is written in BASIC (PWRUPCLK.BAS) and the other is in machine language form (PWRUPCLK.COM). Either of these files can be installed in the AUTOEXEC.BAT file to have the PC's internal Clock/Calendar when DOS boots up.

Installing the BASIC version in the AUTOEXEC.BAT file requires that the line, "BASIC PWRUPCLK" be added; installing the machine language version requires the line "PWRUPCLK" be added. This should be added on any disk that you wish the PC's Clock/Calendar to be automatically loaded when DOS is booted.

#### 3.4.2. SETTING THE QUADBOARD'S CLOCK/CALENDAR

A BASIC language program is provided to allow the user to set the Quadboard's Clock/Calendar. Since the Quadboard's Clock/Calendar is battery powered it will continue to keep time when the PC is turned off and will rarely need setting. However, if it should need to be set, the BASIC program, "SETCLK.BAS" can be used to set the Quadboard's time and date. The program prompts the user for the new date and/or time. It also shows the format for entry of each item. A typical time and date setting session is shown below.

From DOS, type:

```
BASIC SETCLK ↵ (ENTER)
```

Or, if already in BASIC, type:

```
RUN "SETCLK" ↵ (ENTER)
```

CRT will display the current date and time:

```
DATE XX-XX-XXXX, TIME XX:XX:XX
```

You will now be asked if you want to change the date:

```
CHANGE DATE (Y/N)?
```

To change date, type:

```
Y ↵ (ENTER)
```

*continued on next page*

CRT will display:

ENTER NEW DATE (MM-DD-YY):

Enter the desired new date. For example, March 28, 1982 would be entered as:

3-28-82 ↵ (ENTER)

You will now be asked if you want to change the time:

CHANGE TIME (Y/N)?

To change the time, type:

Y ↵ (ENTER)

CRT will display:

ENTER NEW TIME (HH:MM):

Enter the desired new time (24 hour format).  
For example:

3:45 ↵ (ENTER) FOR 3:45 A.M.  
OR 15:45 ↵ (ENTER) FOR 3:45 P.M.

Note that the new time is entered only to the full minute and the PC's Clock/Calendar is NOT yet updated. If you have entered a new date and/or time the CRT will now display:

PRESS ENTER TO SET NEW DATE/TIME:

At this point the clock can be synchronized with an external source simply by pressing ENTER at the appropriate time. When you press ENTER both the Quadboard's Clock/Calendar and the PC's internal Clock/Calendar will be updated with the entered time and date.

The CRT will display the new time and date:

DATE XX-XX-XXXX, TIME XX:XX:XX

### 3.5. SOFTWARE INSTALLATION: QUADMASTER™

The QuadMaster disk accompanying the Quadboard should be copied and stored in a safe place for back-up. It is also a good idea to Write-Protect the original disk to insure that none of the files are ever accidentally written over. Software installation requires that two files be copied to your DOS disks. These two files contain programs to:

- 1) Load the PC's internal Clock/Calendar with the date and time from the Quadboard's Clock/Calendar.
- 2) Use part of the Quadboard's memory as an additional disk drive (QuadRAM Drive).

These two programs can be automatically executed whenever DOS is booted up by installing them in the AUTOEXEC.BAT file. Refer to the DOS manual's discussion of the AUTOEXEC.BAT file for more details about batch processing.

The two files QD.EXE and PWRUPCLK.COM should be copied to any DOS disk that you will be using. Optionally, the BASIC version, PWRUPCLK.BAS, can be used instead of the PWRUPCLK.COM routine. The QD.EXE file contains the program for using part of the Quadboard's memory as a disk drive (QuadRAM Drive); the PWRUPCLK.COM file contains the program that loads the PC's internal Clock/Calendar with the correct time and date when DOS is booted up. The operation and use of these programs is explained in the OPERATIONS section of this manual.

#### 3.5.1. QUADRAM DRIVE INSTALLATION

Once the QuadRAM Drive program (QD.EXE file) has been copied to the DOS disk it can be run at any time by typing "QD n" where n is a number between 0 and 10 specifying the number of 32K blocks of memory to

Reboots  
the system

set aside for use by the QuadRAM Drive. The QuadRAM Drive requires an IBM Personal Computer running PC-DOS (or MS-DOS) with 64K of memory installed on the system board, a disk drive and a Quadboard. The QuadRAM Drive is intended for use only with a Quadboard and may not work with other memory boards.

When you run the QuadRAM Drive program (by typing "QD n") the specified number of 32K blocks of memory are reserved for use as an additional disk drive. The drive letter (B:, C: or D:) assigned to the QuadRAM Drive depends on how many physical drives are installed in the system. Table 6 shows how drive letters are assigned to the QuadRAM Drive.

**TABLE 6  
QUADRAM  
DRIVE LETTER ASSIGNMENTS**

NUMBER OF PHYSICAL DRIVES IN SYSTEM	DRIVE LETTER ASSIGNED TO QUADRAM DRIVE
1	B:
2	C:
3	D:
4	D:

The program merely adds one more disk drive to the system, except when there are already four physical drives installed in the system. When there are four drives installed, the D: physical drive is disabled and the QuadRAM Drive becomes the D: drive. The system can be restored to its normal configuration by typing "QD 0". This assigns zero 32K blocks of RAM for use as the QuadRAM Drive. The system then has all of memory free again.

The QuadRAM Drive program insures there is always at least 64K of memory free. Thus, the user must have at least 96K of memory in order to specify the minimum of one 32K block for the QuadRAM Drive. Table 7 lists the maximum number of 32K blocks that can be specified for various system memory sizes.

**TABLE 7  
QUADRAM DRIVE  
BLOCK/MEMORY ALLOTMENTS**

TOTAL SYSTEM MEMORY	MAXIMUM NUMBER OF 32K BLOCKS FOR QUADRAM DRIVE
Less than 96K	0 (can't use QuadRAM Drive)
96K	1 (32K)
128K	2 (64K)
160K	3 (96K)
192K	4 (128K)
224K	5 (160K)
256K	6 (192K)
288K	7 (224K)
320K	8 (256K)
352K	9 (288K)
384K or more	10 (320K)

When running under DOS 1.0 the maximum disk storage is 160K bytes (DOS 1.0 only supports single-sided drives). Therefore the maximum amount of memory that should be allotted to the QuadRAM Drive is 160K bytes (five 32K blocks). DOS 1.1 supports double-sided disk drives and the maximum number of ten 32K blocks (320K bytes) can be specified, if there is sufficient memory installed to support it.

The easiest way to make use of the QuadRAM Drive is to have it automatically load and run whenever DOS is booted up. This is easily accomplished by including the line "QD n/A" in the AUTOEXEC.BAT file (n is the number of 32K blocks to reserve for the QuadRAM Drive). Be sure this is the first line of the AUTOEXEC.BAT file. The "/A" option causes the QuadRAM Drive program to check for a QuadRAM Drive already installed. If there is not one already installed the QuadRAM Drive is installed and DOS is booted up again. If there is a QuadRAM Drive installed the program returns to DOS.

*if in autoexec  
hangs up the drive!  
otherwise  
resets the system*



## 4. OPERATION

Details of the operation of the Quadboard's hardware and accompanying software are discussed in the following sections. This information is provided for more advanced users or those who have special system requirements. However the instructions in the installation section should be sufficient for most users.

### 4.1. MEMORY

The following three sections describe in detail the operation of the three programmable Quadboard memory features: the amount of accessible Quadboard memory; the starting address of the Quadboard's memory, and the disabling/enabling of memory parity.

NOTE: When the PC is first turned on, a check of all the installed memory is performed. This check typically takes about 15 seconds when 64K of memory is installed on the PC's system board. With a 256K Quadboard installed, this memory check can take as long as 45 seconds to perform. Be prepared for a longer wait before the disk starts spinning when the PC is first turned on.

### 4.1.1. ACCESSIBLE QUADBOARD MEMORY

Instructions were given in the INSTALLATION section ("QUADBOARD ACCESSIBLE MEMORY: section 3.1.2.1.) for setting DIP switch 1, positions 5-8 to enable accessing of 64K, 128K, 192K and 256K bytes of memory. Table 2 of that section applies to those Quadboards that have memory installed in consecutive blocks. Each of the switch positions actually enables or disables accessing of a 64K memory bank. Setting position 8 to the "ON" position enables the first 64K bank installed in sockets U28-U36; setting position 5 to the "ON" position enables the fourth 64K block of memory installed in sockets U1-U9. Disabling access to any of the four 64K memory blocks is accomplished by setting the appropriate DIP switch to the "OFF" position. Table 8 relates DIP switch positions and memory bank selection.

**TABLE 8  
MEMORY BANK ACCESSING**

DIP SWITCH 1 POSITION	MEMORY BANK ACCESS	QUADBOARD SOCKET DESIGNATOR
5	FIRST 64K	U28-U36
6	SECOND 64K	U19-U27
7	THIRD 64K	U10-U18
8	FOURTH 64K	U1-U9

These switches can be used to create 64K "holes" in the Quadboard's memory in case another memory board is installed in the PC whose address conflicts with one or more of the Quadboard's memory banks. The advantage of enabling or disabling memory banks with switches is that memory IC's do not have to be installed or removed as the memory requirements change. However, be aware that other switch settings (on the PC's system board or on the Quadboard) may have to be changed when the accessible memory configuration changes.



### 4.1.2. QUADBOARD MEMORY STARTING ADDRESS

There are no special instructions or additional information for setting the Quadboard's memory starting address. All relevant information is contained in section 3.1.2.2.

### 4.1.3. QUADBOARD MEMORY PARITY

The switch for enabling and disabling the reporting of memory parity errors simply connects/disconnects the Quadboard's memory parity line from the "I/O CH CK" line on the system board. When the Quadboard's memory parity line is disconnected (disabled), a pull-up resistor connected to the "I/O CH CK" line (located on the system board) causes memory parity to always look good when a Quadboard memory location is accessed. Disabling memory parity can sometimes be used to advantage when running programs that abort or stop running when a memory error is detected. Sometimes it is better for a program to produce a few erroneous results rather than no results at all.

## 4.2. ASYNCHRONOUS COMMUNICATIONS INTERFACE OPERATION

As mentioned earlier, the serial port is virtually identical to IBM's design for their Asynchronous Communications Interface. However, there is one small difference and that is the 20 milliamp current loop interface option is not implemented on the Quadboard. Refer to the appropriate IBM manual for a description of the serial port's capabilities (i.e., baud rate, number of data bits, parity sense, etc.). BASIC and DOS 1.1 provide simple commands to set the serial

port's programmable features. Additionally, a programmer can program the serial interface IC (an INS 8250 or equivalent) to meet any special needs. Table 9 lists the pins used on the serial interface connector. All listed signals are connected to the serial interface IC and may be read or controlled through this IC.

**TABLE 9  
SERIAL PORT CONNECTOR SIGNALS**

PIN NUMBER	RS-232 SIGNAL
1	PROTECTIVE GROUND
2	TRANSMITTED DATA (TXD)
3	RECEIVED DATA (RXD)
4	REQUEST TO DATA (RTS)
5	CLEAR TO SEND (CTS)
6	DATA SET READY (DSR)
7	SIGNAL GROUND
8	CARRIER DETECT (CD)
20	DATA TERMINAL READY (DTR)
22	RING INDICATE (RI)

The serial interface is implemented as a terminal device (Data Terminal Equipment, DTE).

If you have trouble getting the Quadboard's RS-232 interface to work when connected to another RS-232 device, the following notes may help to get it working.

- 1) If CTS (pin 5) is not used, wire it to RTS (pin 4).
- 2) If DSR (pin 6) is not used, wire it to DTR (pin 20).

- 3) Some RS-232 devices may already have a signal on pin 22 that may conflict with the RI output signal of the Quadboard. If this is true for your system, pin 22 will have to be disconnected between the Quadboard and the RS-232 device.
- 4) A loopback plug can be built for testing the Quadboard's serial interface. Connect the following pairs of pins together:

pin 2 to pin 3  
pin 4 to pin 5  
pin 6 to pin 20

- 5) Be sure that positions 7 and 8 of DIP switch 2 on the Quadboard are not both in the "ON" position.

The serial port's interrupt output is connected to the system board's IRQ 4 line. When changing the serial port's address from "COM1:" to "COM2:" it is necessary to disconnect the serial port's interrupt output from IRQ 4 and connect it to IRQ 3. To change from IRQ 4 to IRQ 3 perform the following steps:

- 1) Cut the trace from finger B24 of the edge connector (non-component side) to the feed-through hole.
- 2) Solder a piece of bus wire jumper between the two feed-thru holes where "W1" is silkscreened on the Quadboard near the edge connector fingers (on the component side). This "W1" is different from the one located between U62 and U63.

**CAUTION:** Be careful to avoid getting solder on other traces and card edge fingers.

### 4.3. PARALLEL PRINTER INTERFACE OPERATION

The parallel printer interface is a standard Centronics type interface. The design is virtually identical to IBM's design except for three seldom used signals that are not brought out: AUTO FD XT, ERROR and SLCT IN. Table 10 lists the signals that are supported in the parallel printer interface.

**TABLE 10  
PARALLEL PRINTER  
INTERFACE SIGNALS  
(25 PIN D-TYPE CONNECTOR)**

PIN NUMBER	SIGNAL
1	<u>STROBE</u>
2	DATA 1 (LSB)
3	DATA 2
4	DATA 3
5	DATA 4
6	DATA 5
7	DATA 6
8	DATA 7
9	DATA 8 (MSB)
10	<u>ACK</u>
11	BUSY
12	* PE
13	SELECT
14	NOT USED
15	NOT USED
16	** INIT
17-23	NOT USED
24	GROUND
25	GROUND

\* A jumper (labeled W2) is provided on the Quadboard to allow the PAPER END (PE) input to be permanently disabled by grounding the PE input. This feature is included for those printers that do not have a PAPER END (or sometimes referred to as PAPER EMPTY) output signal. To ground the PE input install a piece of bus wire between the two W2 feed-throughs. W2 is located between U64 and the J1 DIP socket.

\*\* Jumper W1 (located between U62 and U63) is configured when it comes from the factory for pin 16 of the 25 pin D-type connector to carry the INIT signal to the printer. The trace on the printed circuit board can be cut and a piece of bus wire connected across the other side of W1 to allow pin 16 of the 25 pin connector to carry the AUTO FD XT signal.

As mentioned in the installation instructions, the parallel printer interface can be configured as LPT1: or LPT2:. Either configuration uses IRQ 7 as the interrupt to the system board.

#### **4.4. CLOCK/CALENDAR OPERATION**

The Clock/Calendar's battery is warranted to last five years; a typical lifetime is closer to ten years. The IBM PC can remain turned off for periods of up to six months and the Clock/Calendar circuitry, powered by the battery, will continue to keep accurate time. The battery is recharged when the PC is turned on. An adjustment is included for changing the Clock's time base to make it run faster or slower.

The Quadboard's Clock/Calendar is used to load the PC's internal Clock/Calendar when DOS is booted up. Software provided on the included QuadMaster disk is used to read the Quadboard's Clock/Calendar circuitry; format the date and time into DOS format; and store them in the appropriate memory locations for use by the PC's internal Clock/Calendar.

To change the date or time, the SETCLK.BAS program, which changes the Quadboard's Clock/Calendar card as well as the internal Clock/Calendar, must be used. The DOS DATE and TIME commands will not change the Quadboard's Clock/Calendar; they will only change the PC's internal Clock/Calendar. Likewise, using the DATE\$ and TIME\$ commands in BASIC only changes the PC's internal Clock/Calendar and not the Quadboard's Clock/Calendar. However, accessing DATE\$ and TIME\$ will display the correct time and date since the PC's Clock/Calendar is synchronized to the Quadboard's Clock/Calendar when DOS is booted up (assuming the PWRUPCLK program is executed from the AUTOEXEC.BAT file).

#### **4.5. QUADRAM DRIVE**

As discussed in the INSTALLATION section, the QuadRAM Drive is installed in memory by typing "QD" followed by a space and the number of 32K blocks to use for the QuadRAM Drive. If you allocate exactly five blocks (160K bytes) or ten blocks (320K bytes) the QuadRAM Drive is functionally identical to a single-sided or double-sided disk drive, respectively. If you specify less than five blocks the DOS sees the QuadRAM Drive as a single-sided disk with BAD SECTORS. Specifying more than five blocks but less than ten blocks causes the DOS to see the QuadRAM Drive as a double-sided disk drive with BAD SEC-

TORS. For example, typing "QD 4" causes the DOS to see a single-sided disk drive with 128K bytes of good storage and 32K bytes of BAD SECTORS. Running the CHKDSK program will allow you to see this.

When the QuadRAM Drive program is first executed, the copyright notice is displayed and the number of blocks specified is checked (to be between 0 and 10). It also checks to see if the "/A" option has been specified (see the "QUADRAM DRIVE INSTALLATION" section for more on the "/A" option). If there are no arguments or the program cannot interpret what has been entered, the message "Missing or bad parameter" is displayed. If there is less than 96K of memory available in the system, the message "Not enough memory for QuadRAM Drive" is printed on the screen. If there is at least 96K of memory, but not enough to allocate the number of blocks specified, a message stating "Not enough memory for specified disk size" is used.

If the command is entered correctly the QuadRAM Drive program allocates memory for use as a disk drive and updates the equipment flags to indicate to both the BIOS and DOS that there is another drive present. The last thing the QuadRAM Drive program does is re-boot the system to force both BIOS and DOS to recognize the change in memory size and the number of disk drives. For the advanced user, the QuadRAM Drive uses the highest memory area for the drive by changing the memory size in the BIOS data area and re-booting DOS. It is important to know that the AUTOEXEC.BAT file is executed normally when the system is booted.

After the QuadRAM Drive has been installed all calls to the BIOS disk routines are intercepted by the QuadRAM Drive program. If the function involves an actual physical disk drive, it is passed on to the ROM BIOS. If the function involves the QuadRAM Drive, the QuadRAM Drive program performs the appropriate action and returns to the calling program.

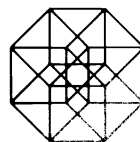
The easiest way to use the QuadRAM Drive is to have it automatically installed upon boot-up. By putting the command "QD n/A" (where "n" is the number of 32K blocks to allowcate to the QuadRAM Drive) in your AUTOEXEC.BAT file, you can have the QuadRAM Drive always available. (For details on the AUTOEXEC file, see your IBM DOS manual.) To create an AUTOEXEC file to install the QuadRAM Drive and to set the IBM's internal clock from the QuadBoard, type the following (that which is underlined):

```
A>copy con: autoexec. bat
qd n/A ↵ (ENTER)      (Replace "n" with the
                        number of 32K blocks
                        to allocate to the
                        QuadRAM Drive)

pwrupclk
        ↵ (ENTER)      (Press the F6 key fol-
                        lowed by ENTER)

1 file(s) copied
```

Now, if you have the files "QD.EXE" and "PWRUPCLK.COM" (both of these are on the QuadMaster distribution disk) on the same disk with the AUTOEXEC.BAT file, every time you boot up your system, the QuadRAM Drive will be automatically installed. If you want to enter other commands in the AUTOEXEC.BAT file be sure the "qd n/A" line is the first command in the file. Now, when you boot up the system (by turning the power to the system on or by pressing the keys "Ctrl", "Alt", and "Del" at the same time) you should see the message "Installing QuadRAM Drive . . ." After that, the screen should be cleared and the time displayed. When the "/A" switch is specified, the QuadRAM Drive program checks to see if there is already a QuadRAM Drive installed. If there is, the program returns to DOS. If the QuadRAM Drive is not already installed, the program installs it and then boots the system again.



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