TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1

INTRODUCTION AND INSTALLATION

1.1 GENERAL INFORMATION

The PED-4000 Analysis and Emulation System of IBM PC compatible hardware and software transforms the person computer into a high performance tool for analysis and emulation of the Small Computer System Interface (SCSI).

1.1.1 Overview Of The PED-4000 System

The basic PED-4000 System consists of a PED-4001 Data Acquisition and Emulation Module and State Analysis Program. The Data Acquisition and Emulation Module occupies a single, full length, expansion slot in the host computer and interfaces to the SCSI bus through a 50-pin header.

Optional programs; the PED-4002 Command Analysis Program, the PED-4010 Initiator Emulation Program, and the PED-4020 Target Emulation Program combine with the PED-4001 to form an integrated state analysis and emulation environment. A common syntax and vocabulary is shared between the acquisition control language of state and command analysis and the emulation control language of initiator and target emulation.

All programs use a uniform set of keyboard and display conventions, setup and operation menus, function key responses, and common service utilities such as Help messages, File Load, File Save, and Print.

Utilizing all of these features, the PED-4000 can greatly accelerate development, evaluation, test, and validation of SCSI circuits, controllers, peripherals, sub-systems, and systems.

1.1.2 Overview Of This Manual

This manual describes the installation, operation, and user/program interface procedures for using the PED-4001 Data Acquisition and Emulation Module with the State Analysis Program. Throughout this manual the term PED-4001 analyzer, or simply analyzer, will be used to refer to both the module and the State Analysis Program.

Section 1 of this manual presents an overview of the PED-4001 analyzer, identifies the hardware and software required to run the analyzer, and describes installation procedures.

Section 2 describes the user/program interface conventions. Keyboard operations such as function and action keys, deletion keys, cursor movements, and character entries are described in detail. Display conventions such as status windows, data windows, menu windows, and response requests are also described in this section.

Section 3 describes the logic architecture of the PED-4001 module and the format of state data records and data fields in acquisition memory.

Section 4 explains the structure and usefulness of the Help and File utility programs which are an integral part of the PED-4001 analyzer.

Section 5 explains the acquisition control language structure. The language syntax and descriptions of commands are included in this section.

Section 6 presents step-by-step procedures required for running the PED-4001 program. A total discussion of setup procedures, data definitions, state analysis capture, and state analysis display procedures is included in this final section.

Appendix A at the end of this manual contains quick reference summaries of setup procedures, command syntax, display format, and keyboard entries to allow rapid access to this information. Appendix B provides instructions on reconfiguring the State Analysis Program to your particular host environment.

1.2 HARDWARE AND SOFTWARE REQUIREMENTS

The following hardware and software is required to operate the PED-4001:

1. An IBM PC or compatible host computer with keyboard,
2. Minimum of 320 kByte RAM,
3. At least one 360 kByte floppy disk drive,
4. Color/graphics or monochrome host module,
5. A color or monochrome monitor,
6. PC/MS-DOS 2.0, or later Operating System,
7. The PED-4001 module and software.

When installed into the host computer, the PED-4001 will also support the following options:

1. Multi-function Module installed in the host (expanded RAM and clock),
2. A second floppy disk drive and a hard disk drive,
3. A printer port and printer, and
4. PED-4002, PED-4010, and PED-4020 Analysis and Emulation Programs.

1.3 INSTALLATION PROCEDURES

The first thing you should do upon receiving the PED-4001 is to check that you have everything you will need to install and operate the analyzer on your host computer. By now you should have established that the minimum hardware and software required are installed in the host system. Next, you should check that you have received all of the components of the PED-4001 packaged in the shipping/storage carton. In addition to this manual, the carton should contain the following:

1. A full-size printed circuit board (the PED-4001 Data Acquisition and Emulation Module),
2. A plastic printed circuit board guide,
3. A ribbon cable with a 15-pin connector on one end and a connector/bracket assembly on the other end. This assembly provides for external inputs and SYNC output signals to/from the PED-4001 System module.
4. A 5 foot cable with a 15-pin connector on one end and 8 micro-clips on the other end of color coded wires. These micro-clips allow for easy connection of external inputs and the SYNC output.
5. A 5 1/4" floppy disk (the PED-4001 State Analysis Program),
6. A manual entitled, "PED Data Acquisition and Emulation Module User's Manual",
7. A loose-leaf binder entitled PED-4000 SCSI Analysis & Emulation System User's Manual.

If any of the above listed elements of the analyzer are missing, contact Pacific Electro Data, Inc. for instructions. When satisfied that everything you need for the PED-4001 is available, continue with the installation procedure.

1.3.1 Checking The Module Address Configuration

The PED-4001 module provides for selection of an I/O address, hardware interrupt, and a DMA channel. These selections are made by shorting blocks on the component side of the module.

The module has been configured at the factory to operate with the supplied software. If there is a conflict with other resource of your PC, i.e., the PC already has an SDLC communications module, the PED-4001 module and program will have to be reconfigured to avoid any conflicts. If this is the case, you should refer to the PED-4001 Data Acquisition and Emulation Module User's Manual and appropriate host computer manual for instructions on how to reconfigure the system.

NOTE

> Throughout this manual, whenever hexadecimal values are used, the alphanumeric value is followed by an upper case h (H).

Holding the PED-4001 module with the component side and the bottom edge connector facing you, refer to Table 1-1 and Figure 1-1 and confirm that the shorting blocks agree with the factory set default addresses. For reference purposes only, the default values are as follows:

1. I/O Address - 380H to 38FH
2. Hardware Interrupt - 3
3. DMA Channel - 1.

When you are satisfied that the shorting blocks are configured as indicated in Table 1-1 the module is ready to be installed in the host computer.

Table 1-1. Factory Set Shorting Block Configuration

LOCATION	SHORTING BLOCK	ADDRESS	FUNCTION
E1	ACROSS A & B	380H	I/O ADDR
E2	ACROSS A & B	38FH	I/O ADDR
E6	INSTALLED	3	IRQ ADDR
E11	INSTALLED	1	DMA CHNL
E12	INSTALLED	1	DMA CHNL

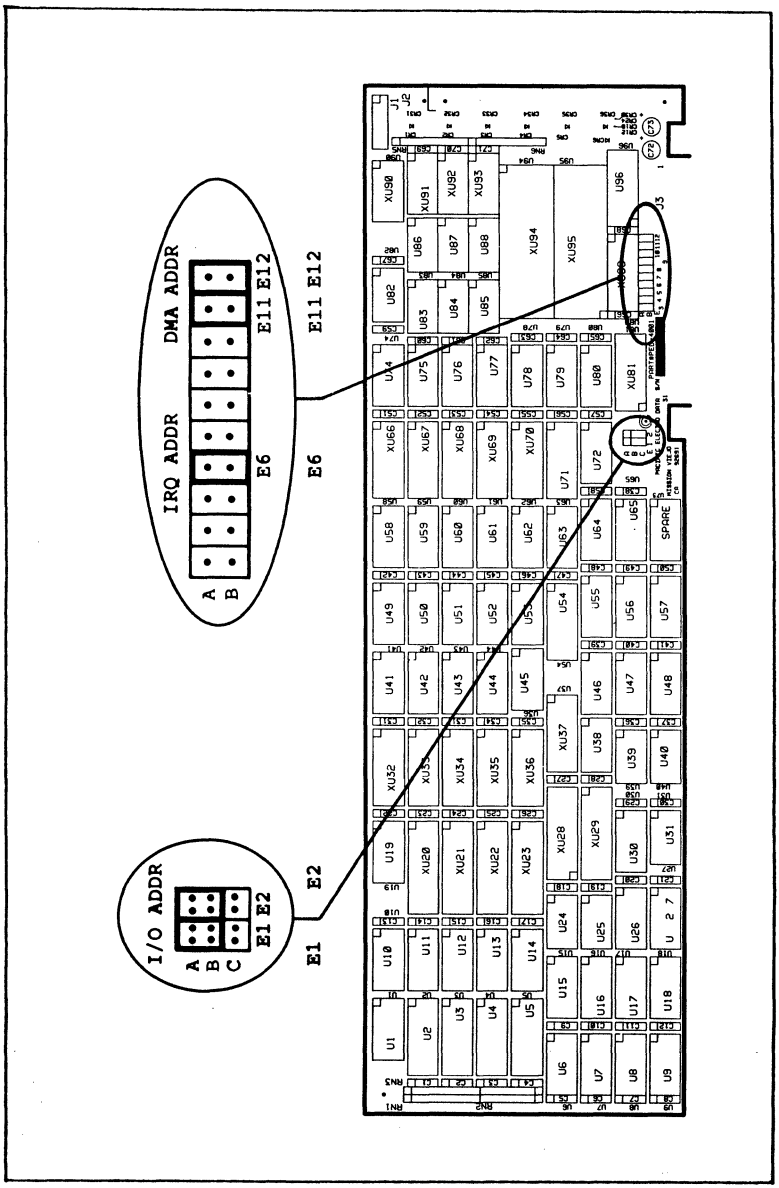

Figure 1-1. Shorting Blocks Locations On The Module

1.3.2 Installing The Module

The only tool required to install the module in the host computer is a screwdriver.

If you are not familiar with the procedures for removing the cover on the host computer to install option modules, refer to the host computer user's manual and follow those instructions.

CAUTION

ALWAYS BE SURE THAT THE AC POWER SWITCH ON THE HOST COMPUTER IS IN THE OFF POSITION AND THAT THE AC POWER CORD HAS BEEN REMOVED FROM THE COMPUTER, OR AC OUTLET, BEFORE INSTALLING OR REMOVING ANY MODULES.

The following instructions have been written for the IBM PC, however, the procedures for any compatible host computer should be very similar.

Step 1. Select any open full-length expansion slot receptacle on the PC system board and locate the metal bracket that covers the cut-out on the back panel of the PC chassis. Using the screwdriver remove and save the bracket-retaining screw and then the bracket.

Step 2. Install the plastic module guide supplied with the PED-4001 module on the inside of the PC front panel.

Step 3. Carefully line up the front bottom corner of the PED-4001 module in the plastic module guide channel. Hold the module level and slowly lower it into the PC chassis until the bottom edge connector of the module rests on the expansion slot receptacle on the PC system board.

Step 4. Exerting pressure evenly along the top edge of the module, press the module down until it seats in the expansion slot receptacle. If the module does not seat into the receptacle with a reasonable amount of pressure, check that the module bottom edge connector is lined up with the slot receptacle and that the module is oriented the same as all other modules in the PC chassis (i.e.; the ribbon cable connector is facing to the back of the PC).

Step 5. Install the bracket-retaining screw that was removed in Step 1 to secure the module bracket to the back of the PC chassis.

Step 6. Select an open expansion slot receptacle close to the PED-4001 module. Remove the rear bracket screw and bracket assembly from the back of the PC chassis. Install the ribbon cable connector/bracket assembly where the PC rear bracket assembly was removed using the same screw. When the connector/bracket assembly is mounted properly, the 15-pin connector on the back of the assembly should protrude out of the back of the PC chassis. Install the ribbon cable connector to the 14-pin header connector located in the upper edge of the module near the rear module mounting bracket with the red stripe of the ribbon cable pointing to the rear of the PC. The 5-foot cable with a 15-pin connector on one end and 8 micro clips on the other end can be plugged into the connector/bracket now or after the PC cover is replaced since the mating receptacle extends out the back of the PC chassis.

Step 7. Replace the PC chassis cover by sliding it from the front of the PC until it stops securely against the rear panel of the chassis. Replace any screws removed earlier when removing the cover.

Step 8. Make certain that the keyboard and monitor connectors are still plugged into the PC and then reconnect the AC power cord.

1.3.3 Initializing The Software

The PED-4001 State Analysis Program diskette has all the files necessary to operate the PED-4001 analyzer, but does not contain PC/MS-DOS. You will therefore want to copy all files from the supplied program diskette to a formatted system diskette and use that new system diskette to run the system. Or, if you plan to use a hard disk drive, you should copy all PED-4001 program files to the hard disk. The procedures for these copy operations are briefly described in the following paragraphs.

COPYING TO A SYSTEM DISKETTE

Install the PC/MS-DOS diskette in drive A and turn on the host computer. When the computer has booted remove the PC/MS-DOS diskette and put a formatted system diskette in drive A. If the new diskette has not been formatted, enter the following before removing the PC/MS-DOS diskette:

```
FORMAT /S [CR]
```

and follow the instructions given by the FORMAT DOS commands.

NOTE

> The symbol [CR] represents the Carriage Return key on the host computer keyboard.

When you have a formatted system diskette in drive A, put the PED-4001 State Analysis Program diskette in drive B and copy all files from drive B to drive A by doing the following:

```
COPY B:*.* A: [CR]
```

You now have a system diskette in drive A that has all of the PED-4001 software files on it. This should be your working diskette from now on. Store the original PED-4001 State Analysis Program diskette in a safe place.

COPYING TO A HARD DISK

Install the PC/MS-DOS diskette in drive A and turn on the host computer. When the computer has booted look at the monitor display and make certain that you are logged onto the hard disk drive (usually this will be drive C). If you are, you will see the following prompt on the monitor.

```
C>
```

If you don't have this prompt displayed on the monitor, type the following to log on to drive C.

```
C: [CR]
```

Then type the following to make the directory called PED:

```
MKDIR \PED [CR]
```

Now remove the PC/MS-DOS diskette from drive A and insert the PED-4001 State Analysis Program diskette in drive A and type the following to copy all files from disk A to the directory called \PED on drive C:

```
CHDIR \PED [CR]

COPY A:*.* [CR]
```

The hard disk drive now has all of the PED-4001 software files on it. You should now remove the PED-4001 State Analysis Program diskette from drive A and store it in a safe place.

1.4 SYSTEM START UP MESSAGE

Once the PC system diskette (or the hard disk) has been loaded with all of the PED-4001 files, logging onto the system is a simple task. To log on, boot the system diskette (or hard disk) from the start-up logged drive (usually drive A for the diskette or drive C for the hard disk) and type the following message.

```
PED4001 [CR]
```

You may find it convenient to create a AUTOEXEC.BAT file to automatically load the PED-4001 program at power-on or after a reset. If you are not certain how to do this, refer to the PC DOS Reference Manual for instructions.

1.5 PED-4001 STATE ANALYSIS PROGRAM FILES

The PED-4001 program diskette (which should now be copied onto your working diskette or hard disk) contains several files which are used by the PED4001 to perform state analysis. These files are listed below with brief descriptions of their functions.

PED4001.EXE - State Analysis Program Execution File.

XXX.HLP - HELP Message Files. These files are called by the program from the logged system drive.

XXX.DA - Saved DATA File.

XXX.DAF - Saved Formatted DATA File.

XXX.SU - Saved SETUP File.

DSETUP.SU - Default SETUP File. This file is called from the logged system drive when the program is loaded.

STATUS.REM - Text File that gives the status of execution files on the disk.

READ-ME.DOC - Text File that gives the latest revisions to the PED-4001 State Analysis Program User's Manual.

1.6 RECONFIGURING THE SOFTWARE

This program has been configured to operate with the PED-4001 Data Acquisition and Emulation Module in a "standard" PC system. If you reconfigure the PED-4001 module or have a "non-standard" PC system you must reconfigure the program by setting software switches at the time that the program is loaded. For information on how to perform these reconfigurations, refer to Appendix B of this manual.

SECTION 2

USER/PROGRAM INTERFACE

2.1 INTRODUCTION

The PED-4000 system programs provide a uniform set of keyboard and display conventions. These conventions are described in this section.

2.2 KEYBOARD ENTRIES

There are several keyboard entry conventions associated with the PED-4000 system software that merit discussion at this point. The keyboard entry conventions that need to be defined are: the function keys, action keys, cursor movement keys, deletion keys, and character entry keys.

2.2.1 Function Keys

Six of the ten function keys on the PC style keyboard (F5 through F10) are programmed to cause the following immediate operations to occur when they are pressed.

HELP (F5) - A Help message is displayed to aid you in the current operation of the State Analysis Program.

FILE (F6) - The File Utility is entered which allows you to load prestored Setup and Data files from a disk or, to save Setup and Data information to a disk, or a printer.

SETUP (F7) - The program enters the State Analysis Setup operation.

EXIT (F8) - The program exits the present operation and goes to the next higher menu. The exact action that will occur is a function of the present operation, but it is the normal means of leaving one operation and returning to a menu which allows selection of another operation.

GO (F9) - The program will enter the State Analysis Capture operation or, if already in the Capture operation, it will Arm the PED-4001 module.

STOP (F10) - The program will enter the State Analysis Display operation.

INDEX (SHIFT F9) - This two key combination manually Indexes the PED-4001 module. The SHIFT F9 key combination is only valid, however, if the module is Armed and is doing a Capture operation.

DISARM (SHIFT F10) - Returns the PED-4001 module to the Disarmed status. The SHIFT F10 key combination is only valid, however, if the module is Armed and is doing a Capture operation.

2.2.2 Action Keys

With the exception of the six Function Keys just described, there are only two other keys that will cause state analysis operations to proceed. These are the [ESC] key and the [CR] key. All entries (other than the Function Keys) must be concluded with a [ESC] or [CR] key.

The Escape [ESC] key causes the preceding keyboard entered string to be ignored and the present operation to be unaltered. If no string was entered before pressing the [ESC] key, the program will exit from the current operation.

The Carriage Return [CR] key causes the preceding keyboard entry to be executed.

2.2.3 Menu and Text Cursor Movement

Vertical cursor movement in a menu or text field is done by entering the label of the destination field followed by a [CR] or, by moving the cursor incrementally using the Up Arrow key for up motion and the Down Arrow key or Space Bar for down motion. If there is no active vertical menu or text field, the Space Bar will move the cursor to the right.

Horizontal cursor movement in a menu or text field is done by entering the label field followed by a [CR] or, by moving the cursor incrementally using the Left Arrow for left motion and the the Right Arrow for right motion.

2.2.4 Character Deletion Keys

During entry of labels or text (prior to pressing the [ESC] or [CR] keys) the Backspace key will move the cursor one character to the left and will delete this character at the new cursor position. If the cursor is already a the left most character of the label or text, the character at the present cursor position will be deleted and the cursor will not move. The Delete [DEL] key will delete the character at the current cursor position and the cursor position will be unchanged.

2.2.5 Character Entry Conventions

All Menu Label characters are numeric. All Table Label characters are alphanumeric. All Program Key Word characters are alphabetic and upper/lower case is ignored.

2.2.6 Cursor Movement During Display Operation

You control the display operation from the cursor movement pad and the keyboard. The cursor pad affects movements of the cursor as follows:

[up arrow] - one line up,
[down arrow] - one line down,
[page up] - nine lines up,
[page down] - nine lines down,
[home] - to first line on state data set,
[end] - to last line in state data set.

The space bar [SP] also moves the data cursor one line down.

The [left arrow] and [right arrow] move the menu cursor to allow selection of display operations. The menu cursor can also be moved by entering the menu item label number followed by a [CR].

2.3 MONITOR DISPLAY CONVENTIONS

There are several monitor display conventions associated with the PED-4000 system software that merit discussion at this point. The monitor display conventions that need to be defined are: the status and user information, data and menu information, and response requests.

2.3.1 Status and User Information

User Information is displayed in titled windows with double-bar borders. Reverse, dark, and bright video is used within the windows to enhance easy recognition. Information displayed within these windows includes PED-4000 system status and SCSI bus status.

2.3.2 Data and Menu Information

Setup, response data, and menu information is displayed in titled windows with single-bar borders. To enhance recognition, data cursors are bright video and menu cursors are reverse video.

2.3.3 Response Requests

User response is prompted by text outside of a window. In most situations, however, action selections can also be made from a menu within a window. All response entries must be followed by a [CR] to cause the selected action to occur.

2.4 PROGRAM STRUCTURE

The PED-4001 State Analysis Program is written in the "C" language with functions written in assembly language only when performance dictated the need to do so. The "C" language was selected with the intent of making the program as tailorable, portable, and maintainable as possible while achieving maximum performance.

Maximum use of MS-DOS and BIOS utilities also helps to achieve the high degree of tailorability, portability, and maintainability of the program.

SECTION 3

PED-4001 SYSTEM STRUCTURE

3.1 INTRODUCTION

This section presents a logic model of the PED-4001 Data Acquisition and Emulation Module as it is applied to state analysis. Also, a model of the PED-4001 State Analysis Program software process in formatting the captured state vectors into state records for display is presented.

Figure 3-1 shows a typical configuration of computer hosts and peripherals attached via the SCSI bus and how the PED-4000 system ties into the cluster.

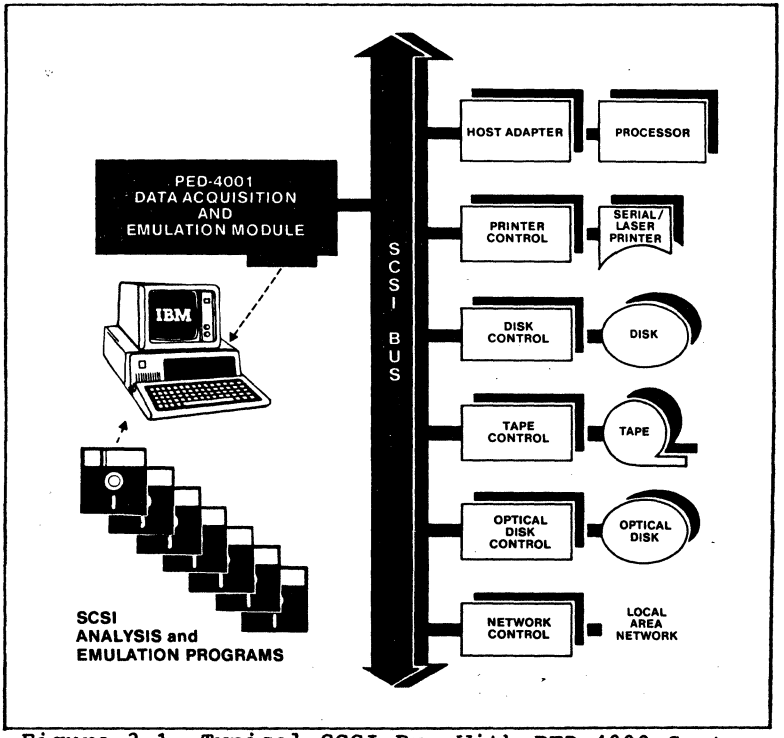

Figure 3-1. Typical SCSI Bus With PED-4000 System

3.2 STATE ANALYZER HARDWARE LOGIC MODEL

Figure 3-2 is a logic diagram of the PED-4001 Data Acquisition and Emulation Module. This logic has a 2048 word memory that captures the SCSI bus state vectors under control of the programmed acquisition sequence controller. These state vector captures are in response to activity on the SCSI bus and the 5 external input signals connected to the PED-4001 module.

3.2.1 Acquisition Memory

The data word stored in the acquisition memory is made up of the 18 SCSI signals, the 5 external input signals to the module, and the contents of the elapsed-time counter. The elapsed-time counter is incremented once every 100 nsec. by the 10 MHz clock. The counter is cleared following every write to the acquisition memory so that the time elapsed between each write to the memory is stored as part of the captured state. The data word that is stored in the acquisition is referred to as the state vector.

To conserve space in the acquisition memory, state vectors are written into the memory only after a qualified state change has occurred. This technique is referred to as Transition Time State Recording which is different than conventional timing analysis where the state vectors are stored on every clock period to preserve timing information. Conventional state analysis does not preserve timing information. In the PED-4001 module,the determination of what are qualified state changes is made by the edge compare logic.

3.2.2 Edge Compare Logic

The edge compare logic (shown in simplified form in Figure 3-3) compares the present state of each of the 18 SCSI bus signals with the contents of the corresponding bits of the last-state register. The last-state register is loaded with the states of the SCSI bus signals on each write to the acquisition memory and contains the previous state of these SCSI signals. If the present state of an SCSI signal is '1' and QUAL1 is 'TRUE', then CHANGE is 'TRUE'. In like manner, if the last

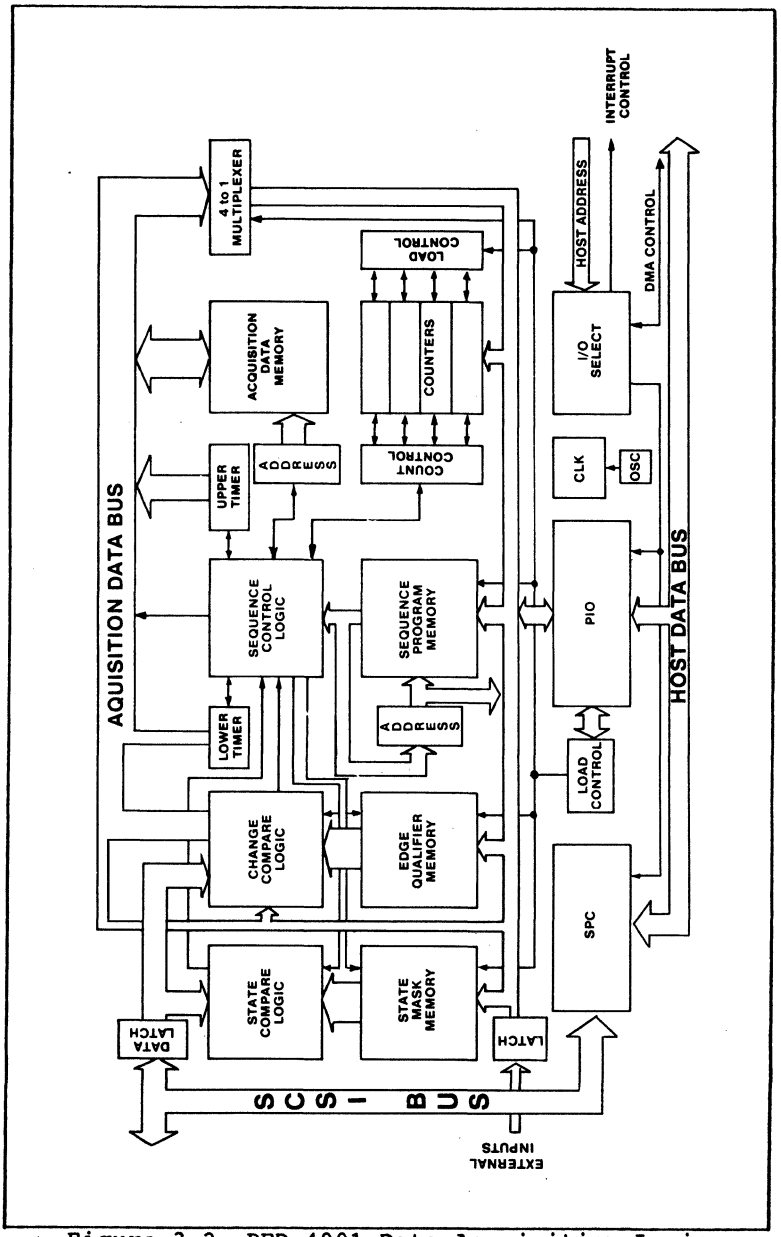

Figure 3-2. PED-4001 Data Acquisition Logic

state were a '1' and QUAL0 is 'TRUE', then CHANGE again is ' TRUE'. Therefore, if both QUAL1 and QUAL0 are 'TRUE', then either transition of the SCSI signal will cause the CHANGE signal to be 'TRUE'. But, if both QUAL1 and QUAL0 are 'FALSE', then CHANGE will remain 'FALSE'. If CHANGE signal from any one, or more, of the SCSI signals is '1' and the control signal SAVEN is 'TRUE', then a write to acquisition memory will be made.

Sixteen edge qualifier words are stored in the edge qualifier RAM. Each edge qualifier word contains 36 bits which are the QUAL1 and QUAL0 bits for each of the 18 SCSI bus signals. The active edge qualifier word is selected when the SAVE command is executed by the acquisition sequence controller. What is contained in the edge qualifier RAM is determined by you during the test setup phase. If you choose to save the state vector on the rising edge of the SCSI signal (a '0' to '1' transition), then QUAL1 for that edge qualifier word is set 'TRUE'. If you choose to save the state vector on the falling edge of the SCSI signal (a'1' to '0' transition), then QUAL0 for that edge qualifier word is set 'TRUE'. Both QUAL1 and QUAL0 are set 'TRUE', if you have selected both rising and falling transitions of the SCSI signal. If you select not to save either edge transition of a particular SCSI signal, both QUAL1 and QUAL0 for that signal are set 'FALSE'.

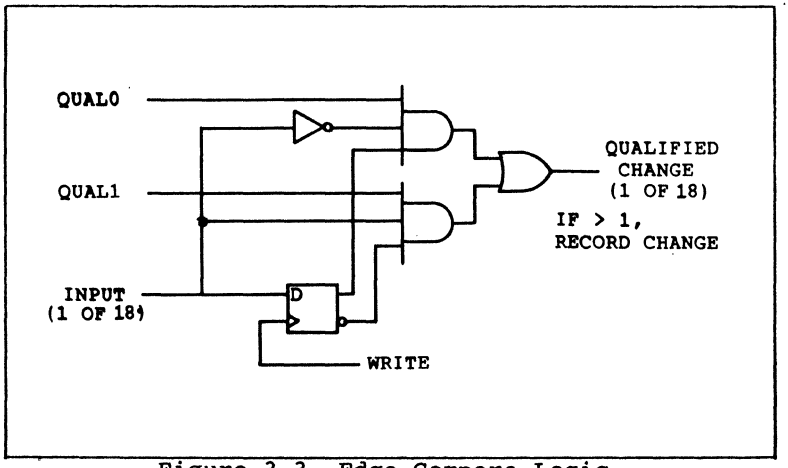

Figure 3-3. Edge Compare Logic

3.2.3 State Compare Logic

It is the state compare logic that gives the PED-4001 module the true power of state analysis. With this logic, the module has the ability to take a specific action as the result of a particular state or sequence of states having occurred, or not occurred, on the SCSI bus. Figure 3-4 is a representative logic diagram of the state compare logic.

If the present state of a signal is '1' and MASK1 is 'TRUE', or if the present state of a signal is '0' and MASK0 is 'TRUE', then MATCH is 'TRUE'. If both MASK1 and MASK0 are true, then MATCH is always 'TRUE. Logic state comparison is done on a bit-by-bit basis of the 18 SCSI signals and the 5 external input signals to the PED-4001 module. Also, the parity of the 9 bit SCSI data bus is compared with PODD and PEVEN masks. During this comparison, a match of the full 24 bit signal state word occurs only if all 24 MATCH signals are simultaneously 'TRUE'.

Sixteen state mask words are stored in the state mask RAM. Each state mask word is 48 bits long with a MASK1 and MASK0 bit for each of the 23 input signals, plus a bit each for PODD and PEVEN. A particular state mask is selected by the flow control commands executed by the acquisition sequence controller. The contents of the state mask RAM is determined by you during the analysis setup phase. When defining a state mask, if you wish to specify that a signal must be a '1', then MASK1 is set to 'TRUE' and MASK0 to 'FALSE'. Or, if you wish to specify that a signal must be a '0', then MASK1 is set to 'FALSE' and MASK0 to 'TRUE'. If you don't care about the signal state, (indicated by the symbol '*' during setup), both MASK1 and MASK0 are set to 'TRUE'.

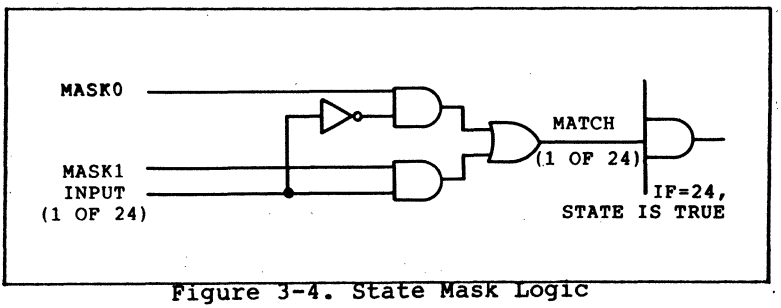

Figure 3-4. State Mask Logic

3.2.4 Counter Logic

Another important resource available in the data acquisition logic for controlling the acquisition sequence is the set of four 16-bit counters. Three of these counters are used in FOR....NEXT loops in the acquisition sequence program. The fourth counter is dedicated as the INDEX counter. The logic associated with the FOR/NEXT counters is shown in Figure 3-5.

Each counter is in fact a latch/counter combination. The initial count value is set into the latch during the state analysis setup phase. The FOR command in the acquisition sequence program causes the counter to be initialized with the contents of the latch. The NEXT command in the acquisition sequence program tests the counter for a zero count. If the count is not zero, the counter is decremented and the program continues execution at the first command beyond the FOR command, causing the loop to be repeated. If the count is zero, program execution continues with the first command beyond the NEXT command, thus breaking the loop sequence.

The INDEX counter is initialized from the latch with execution of the INDEX command or by a 'MANUAL INDEX' ([SHIFT] [F9]) keyboard entry. Each time a state vector is written to the acquisition memory, the INDEX counter is incremented. The data capture process is automatically halted if the INDEX counter reaches a count of 2048, which is the size of the acquisition memory. The initial INDEX count is specified by you when the latch is set during the setup phase. The INDEX counter determines the state vector capture window and the pre- or post-indexing inside that window.

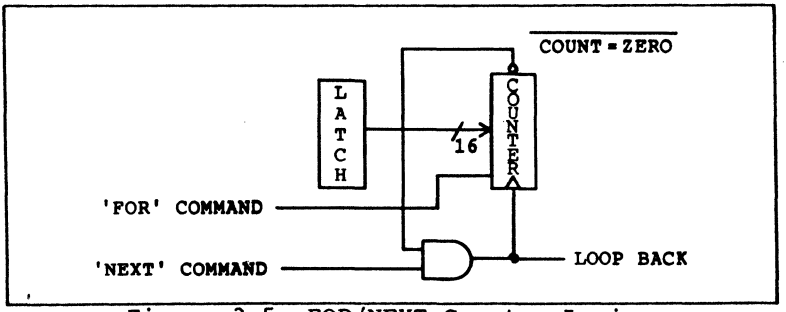

Figure 3-5. FOR/NEXT Counter Logic

3.2.5 Acquisition Sequence Control Logic

The acquisition sequence control logic and the acquisition sequence program RAM are the last two major components of the state analysis portion of the module. They also are what could be referred to as the "glue" which binds the other components of the module into a powerful state analysis tool. These two components of the module control the capture of state vectors in acquisition memory in response to SCSI bus and external input signal activity as specified by the acquisition sequence program and the contents of the edge qualifier RAM, the state mask RAM, and the counter latches.

The contents of the acquisition sequence program RAM is a machine code version compiled from the acquisition program source code which is entered during the state analysis setup phase. Acquisition sequence controller commands are listed at this time for reference purposes only. Some of the controller commands have been explained earlier in this section. Refer to Section 5 Acquisition Control Language for a detailed explanation of the structure and function of each of these commands.

Operation Group	Flow Control Group
HALT	DO..UNTIL(state mask)
INDEX	DO..WHILE(state mask)
SAVE(edge qualifier)	FOR(counter)..NEXT(counter)
SKIP	IF(state mask)..ELSE..ENDIF
SYNC	

3.2.6 Logic Description Conclusion

A word of caution is in order in closing this discussion of the module logic. These descriptions present a valid logic model of the module and its interface with the state analysis program. However, they do not present a fully accurate description of the actual hardware and software implementation in the system. Some liberties were taken in these descriptions with the intent of simplifying the principles presented. A faithful description of the actual implementation of this logic is presented in the PED-4001 Data Acquisition and Emulation Module User's Manual.

3.3 STATE ANALYSIS DATA DISPLAY FORMATTING

Each state data vector saved in acquisition memory during state analysis capture is formatted into a state data record that contains 10 different data fields. Each state data record corresponds to a single line of a formatted data display. Formatting is done upon entering the display operation after all data has been captured, but before it is displayed. Some of these fields were created during the formatting process by applying the rules of SCSI protocol to the captured state data. There is no guarantee that the displayed data in these fields is absolutely accurate for two reasons.

1. The captured data may be insufficient to accurately interpret what really occurred at the time that it was captured.
2. The devices on the bus may not be operating according to the rules of the SCSI protocol.

The data displayed in the first four fields (Time, External Signals, SCSI Control, and SCSI Data) should, however, be reliable because they are direct copies of the captured state vector.

3.3.1 Time Field

The total elapsed time (labeled TOTAL TIME), or delta time (labeled DELTA TIME), in minutes, seconds, and milliseconds (to the nearest 100 nanosecond), is displayed as the first field in the state data record. In displays of elapsed time, the INDEX line, or Line '0', is the zero time reference for the display. Pre-INDEX events are given as negative time in reference to the INDEX line. If the data was not INDEXed, the first state data line (Line '0') is always taken as the zero time reference.

3.3.2 External Signal Field

The binary state of the 5 external input signals is displayed in the EXTRN field of the state data line. The sources of these five signals are:

1. The 5 address bits of the acquisition program memory,
2. The TAG character from the command-level or emulation program running foreground during the state analysis capture, or
3. The binary state of the 5 external input lines to the module.

3.3.3 SCSI Bus Control Field

The binary states of the 9 SCSI control signals (RST, BSY, SEL, ATN, MSG, C/D, I/O, REQ, and ACK) are displayed as the third field of the state data line.

3.3.4 SCSI Bus Data Field

The binary states of the 8 data and 1 parity bits are included in the fourth field of the state data line. In addition, the data is displayed in one of several optional display formats (Hexadecimal, Octal, ASCII, or extended ASCII). See Section 6 "Data Display Window".

3.3.5 SCSI Bus Phase Field

The SCSI control and data fields are decoded according to the rules of SCSI protocol to determine the bus phase.

Two phases are non-standard in the SCSI protocol. These two non-standard phases are;

1. BUS CLEAR - which indicates that all signals of the interface are unasserted,

2. INTERPHASE - which indicates that the state data captured is insufficient to decode the actual phase according to the SCSI rules of protocol.

There are a total of 12 phases that are displayed in this field. In the list that follows, the two non-standard phases are identified with a * symbol.

Control Phase	Information Phase
BUS FREE	DATA OUT
BUS CLEAR (*)	DATA IN
ARBITRATION	COMMAND
SELECTION	STATUS
RESELECTION	MESSAGE OUT
INTERPHASE (*)	MESSAGE IN

3.3.6 SCSI Bus Condition Field

The SCSI control and data fields are decoded according to the rules of the SCSI protocol to determine the condition.

Those decoding rules are summarized in the following listing. In the listing, the character * indicates a 'don't care' condition.

Control	Data	Condition
RBSAMCIRA SSETS//EC TYLNGDOQK	P76543210	
1********	*********	RESET
011******	EVEN PARITY	ERROR
010***11*	EVEN PARITY	ERROR
010***0*1	EVEN PARITY	ERROR
0**1*****	*********	ATTENTION
0**0*****	ODD PARITY	NORMAL

3.3.7 Initiator and Target Bus Device ID's Field

The captured data bus state during the arbitration and selection phases are decoded according to the rules of the SCSI protocol to identify the target and initiator. In single host, non-arbitrating systems, only the target ID is expected. It is your responsibility to know the ID of the unidentified initiator.

3.3.8 Number of Requests Field

This field of a displayed line provides the total number of '0-to-1' transitions of the REQ signal that were saved in the captured state data since the last captured phase change occurred.

3.3.9 Number of Acknowledges Field

The ninth field of a displayed line gives the total number of '0-to-1' transitions of the ACK signal that were saved in the captured state data since the last captured phase change occurred.

3.3.10 State Data Line Number Field

This is the last field of a displayed line. It contains the number of the currently displayed line of the formatted state data. The first line is always indicated as Line '0'.

SECTION 4

STATE ANALYSIS UTILITIES

4.1 INTRODUCTION

Two utility programs are provided to aid you when using the PED-4001 for state analysis. The two utilities provided are the Help Utility and the File Utility.

4.2 HELP UTILITY

The Help Utility displays several messages, keyed to the present operation, when the HELP key [F1] is depressed and the system is not BUSY. Also, if the HELP item on the state analysis top menu is selected, an indexed listing of, and access to, all Help messages is provided. The intent of the Help Utility, and its messages, is to give you immediate access to "How to..." information that may be needed when operating the system.

4.3 FILE UTILITY

The File Utility allows you to save and access state analysis setup and captured data to disk or to print data for a hardcopy record. The four File Utility operations available to you are as follows.

1. LOAD
2. SAVE
3. PRINT
4. EXIT

4.3.1 File Load

Selecting the File Load Utility will cause the display of all files of the type selected. The type selected is implied by the present operation (Setup or Display), or is made by you in response to the prompt:

SELECT TYPE OF LOAD [1. SETUP 2. DATA]

You then enter the name of the desired file from the displayed list. The file will then be loaded into the system and normal operation will continue. If a new setup is entered, the acquisition program is automatically re-compiled after loading the new file.

Data files are either unformatted binary files (.DA extension) or formatted, extended ASCII files (.DAF extension). Both an unformatted and a formatted version of the same named file may be on the disk. If that is the case, the formatted file is always the file that is loaded.

4.3.2 File Save

Selecting the File Save Utility will cause the display of all files on disk of the type selected. The type selected is implied by the present operation (Setup or Display), or is made by you in response to the prompt:

SELECT TYPE OF LOAD [1. SETUP 2. DATA]

You may then enter any valid name you wish to assign to the file to be saved and that file will be saved on disk and then normal operation will be resumed. As is true with any disk write operation, if you select as a name for a disk file a name that already exists on the disk, the new file will replace the current file on the disk. Data files are normally saved as unformatted binary files of 8196 bytes in length.

Files to be used in the COMPARE operation must be formatted, extended ASCII files. To save a formatted file, type the two keys [/] and [F] after the selected file name and prior to the [CR]. Formatted files are considerably larger than the unformatted files. As an example, a file of 1000 formatted lines is 85,000 characters in length.

4.3.3 File Print

Selecting the File Print Utility will cause the listing, to the printer port, of the system setup or display data. Prior to printing the selected information you are given the opportunity to assign the listing a title of up to 40 characters. The type of information selected is implied by the present operation (Setup or Display), or is made by you in response to the prompt:

SELECT TYPE OF PRINT [1. SETUP 2. DATA]

If display data is to be printed, you may select the starting line and the last line of formatted display data to be printed by line numbers. If no line numbers are specified, all lines of the display data will be printed.

SECTION 5

ACQUISITION PROGRAM CONTROL LANGUAGE

5.1 INTRODUCTION

This section describes the control language syntax and the structure of command words associated with the Acquisition Control Program.

5.2 LANGUAGE SYNTAX

The language syntax is a set of rules that must be followed by you whenever entering or editing an acquisition program through the host keyboard.

5.2.1 Delimiter Characters

Only three delimiter characters are recognized by the acquisition program compiler. They are: space [SP], semicolon [;], and carriage return [CR]. All commands must be separated by one or more delimiter characters. No delimiter is allowed between the command and the leading parenthesis of its associated label. All characters between a semicolon and a carriage return are ignored.

5.2.2 Labels

A label may consist of any combination of 1 to 8 printing characters, except delimiters. Labels are always enclosed in parenthesis. The same identical label must occur in the setup table appropriate for the command associated with that label. (See paragraph 5.3 for descriptions of command words.) Spaces within the parenthesis following a label are ignored.

5.2.3 Command Key Words

Command key words must appear exactly as defined in paragraph 5.3 'Description of Commands' except for character case. Either upper or lower case can be used. The leading parenthesis of labeled commands must immediately follow the last character of the command.

5.2.4 Comments

The program may be annotated with comments starting with a semi-colon [;] and ending with a carriage return [CR].

5.3 DESCRIPTION OF COMMANDS

The following paragraphs describe the structure of command words as they apply to the Acquisition Control Program.

5.3.1 Syntax

Each of the commands below has its syntax defined according to the following conventions:

1. Words in capital letters are key words and must be entered as shown described in the following paragraphs except for character case.

2. Labels shown in bold lower case inside parenthesis (xxxx) must be included and the same identical label must occur in the setup table appropriate for the associated command key word.

3. Characters in square brackets ([ ]) are optional parameters.

4. Labels in carrots (< >) refer to the contents of the setup table entry identified by the label.

5. All punctuation, except square brackets, must be included as shown.

5.3.2 Operation Group

Commands in the Operation Group cause the following specific operations described to occur.

HALTS

HALT - Stops the capture sequence, causing the analyzer to automatically enter the DISPLAY operation.

INDEX - Captures the present state data vector to acquisition memory and initializes the index counter to <INDEX> count.

when the count is 0 to 2047. when the com
the analyzer stops capturing data.
note: this command can be issued multiple times to r
the county

SAVES
SAVE(edge-qualifier) - Causes the subsequent capture of state data vectors entered by transitions qualified by <edge-qualifier> and writes them into the acquisition memory. The label edge-qualifier must exist in the table of EDGE QUALIFIERS.

SKIP - Stops all sequential capture of the state data vectors.

SYNCS
SYNC - Issues 100 nanosecond positive going pulse to the SYNC SIGNAL output.

5.3.3 Program Flow Control Group

The following commands alter program flow as described below.

UNTILS
DO [expression] UNTIL(state-mask) - Repeatedly executes [expression] until state matching <state-mask> is detected. The label state-mask must be present in the table of STATE MASKS.

WHILES
DO [expression] WHILE(state-mask) - Repeatedly executes [expression] while state matching <state-mask> is detected. The label state-mask must be present in the table of STATE MASKS.

FORS NEXTS
FOR(counter) [expression] NEXT(counter) - Repeats execution of [expression] <counter> times. The label counter must exist in the table of COUNTERS.

IFS ELSES
IF(state-mask) [expression 1] [ELSE expression 2] ENDIF - If the present state matches <state-mask> then execute [expression 1], [otherwise, execute expression 2], and continue execution at the first statement past ENDIF. The label state-mask must exist in the table of STATE MASKS.

5.3.4 Trace 'S' Suffix

The plural form of the command key words, as listed below, will cause the present state record to be saved at each execution of that plural form of the command if the acquisition program TRACE is ON or set to ALL. The command key words that allow a plural suffix are: ELSES, FORS, HALTS, IFS, NEXTS SAVES, SYNCS, UNTILS, and WHILES.

SECTION 6

PED-4001 SYSTEM OPERATION

6.1 INTRODUCTION

This section starts with instructions on connecting the PED-4001 analyzer to the SCSI system and follows with instructions on how to load the State Analysis Program into the host computer. The remainder of the section takes you through each of the operations of that program (i.e.: SETUP, CAPTURE, and DISPLAY).

6.2 CONNECTING TO THE SCSI SYSTEM

Connecting the PED-4001 to the SCSI system to be analyzed involves the following procedures:

1. Connecting the SCSI bus cable connector to the SCSI connector header mounted on the PED-4001 module bracket,

2. Connecting desired signals to the analyzer external inputs using the cable provided with the analyzer, and

3. Connecting the analyzer SYNC output to a compatible input of a device to be synchronized with the execution of the acquisition program.

NOTE

When connecting up the system, it is recommended that the main system power be OFF. It is also recommended that the PED-4001 host PC power be applied before applying power to the SCSI system device.

6.2.1 Connecting The SCSI Bus Cable

SCSI bus devices are daisy chained together with a common cable with both ends of the cable terminated. All signals are common between all SCSI devices. The SCSI cable is a 50-conductor flat-ribbon cable with 50-pin IDC style connectors attached along the length of the cable. The PED-4001 module is

connected to the bus by mating one of these ribbon cable connectors (other than either end of the cable) to the 50-pin header on the PED-4001 module bracket. Be sure to observe and maintain correct connector and cable orientation. The colored dot on the bracket near the upper left side of the header identifies pin 1 of the PED-4001 header connector.

CAUTION

Be certain to observe the following precautions when connecting the SCSI system to the PED-4001 host PC.

1. Observe connector orientation. A failure to do so may damage the PED-4001 and/or other attached devices.

2. Connect the PED-4001 SCSI header to standard, single-ended SCSI devices and cables only. A failure to do so may damage the PED-4001 and/or other attached devices.

A typical configuration where the PED-4001 is connected to system with one SCSI host device and one SCSI peripheral device is shown in Figure 6-1.

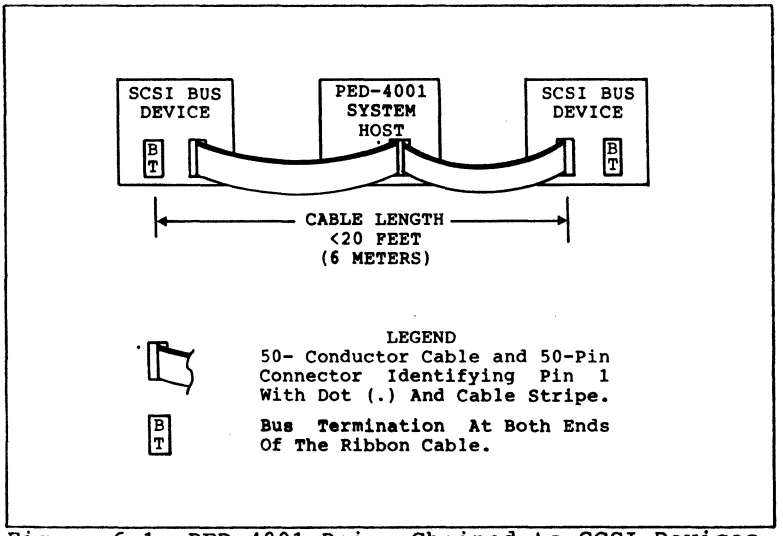

Figure 6-1. PED-4001 Daisy Chained to SCSI Devices.

The assignment of the SCSI signals of the PED-4001 to the 50-pin header is given in Table 6-1. The slash (/) preceding the signal term denotes a negative TRUE (0 volt) logic signal.

Table 6-1. PED-4001 SCSI Header Pin Assignments

TERM	PIN	TERM	PIN
--	1	/DB0	2
GND	3	/DB1	4
GND	5	/DB2	6
GND	7	/DB3	8
GND	9	/DB4	10
GND	11	/DB5	12
GND	13	/DB6	14
GND	15	/DB7	16
GND	17	/DBP	18
GND	19	--	20
GND	21	--	22
GND	23	--	24
--	25	--	26
GND	27	--	28
GND	29	--	30
GND	31	/ATN	32
GND	33	--	34
GND	35	/BSY	36
GND	37	/ACK	38
GND	39	/RST	40
GND	41	/MSG	42
GND	43	/SEL	44
GND	45	/C/D	46
GND	47	/REQ	48
GND	49	/I/O	50

6.2.2 Connecting External Input And SYNC Outputs

The PED-4001 will accept, for analysis and display, five TTL level signals as external inputs and also provides a TTL level signal as a SYNC output. Access to these signals is via the DA15 connector at the back of the PED-4001 host PC and the cable/probe assembly supplied with the PED-4001. Table 6-2 identifies the DA15 connector pin term and number, the cable wire color, and the microclip color for each of the five inputs and the SYNC output. The two black microclips are

connected to the PED-4001 System signal common. It is intended that the brown-wire/black-microclip signal common be used in conjunction with the orange-wire/red-microclip SYNC output, and that the black-wire/black-microclip signal common be used in conjunction with the five external input signals.

CAUTION

1. Excessive voltage applied to the input microclips may damage the PED-4001. The maximum ratings for the input signals with respect to signal common are as follows:

   Maximum Positive 7 volts *

   Maximum Negative -0.3 volts *.

   * Note that these voltages are dc + ac peak.

2. Never apply external voltage to the SYNC output signal.

3. The black ground microclips should only be connected to the signal common of the equipment under analysis.

Table 6-2. Input/SYNC Output Connector Pin List

TERM	PIN	WIRE	MICROCLIP
--	1	--	--
GND	2	BLK	BLK
GND	3	--	--
GND	4	--	--
GND	5	--	--
GND	6	--	--
GND	7	--	--
GND	8	BRN	BLK
EXT4	9	WHT	WHT
EXT3	10	BLU	BLU
EXT2	11	GRN	GRN
EXT1	12	YEL	YEL
EXT0	13	RED	RED
--	14	--	--
SYNC	15	ORG	RED

WARNING

1. The ground wire of the 3-prong ac power plug places the chassis and housing of the PED-4001 host PC at earth ground. Use only a 3-wire ac power outlet and do not attempt to defeat the ground wire connection or 'float' the PED-4001 host PC. Floating the host PC or in any way defeating the earth ground may pose a great safety hazard to the user and equipment.

2. When handling a microclip, touch only the insulated portion of the clip. Never touch the exposed tip portion of the clip.

6.2.3 Starting State Analysis

If you have not done so already, turn on the PED-4001 host PC and get the system prompt (i.e., >A:). With the configured diskette in the logged drive (i.e., drive A,) enter, from the keyboard, the following prompt:

PED4001 [CR]

This will load the PED-4001 State Analysis Program. After the program has been loaded, the main state analysis menu (shown below) lets you select the option of entering one of these three operations, or to select the HELP utility, the FILE utility, or EXIT to the disk operating system program. To select a main menu option, place the reverse video cursor over the desired option number and press the carriage return [CR] key.

STATE ANALYSIS

1. SETUP
2. CAPTURE
3. DISPLAY
4. HELP
5. FILE
6. EXIT

NOTE

During program load, the module is initialized with default SETUP parameters. This allows you to go directly to the CAPTURE operation by placing the cursor on 2, using the space [SP] bar and then pressing [CR]. If however you wish to observe, or change, the SETUP parameters you can select SETUP by moving the cursor to 1, and then press [CR]. Table 6-3 identifies the default SETUP parameters.

6.3 STATE ANALYSIS SETUP

The conditions for which SCSI bus state activity is captured are defined by the default parameters established during a program load. The parameters can be redefined by entering the SETUP operation from the main menu, or by pressing the [F7] function key. The SETUP operation actually sets up and initializes the Data Acquisition and Emulation Module for the state analysis task to be performed.

The parameters controlled by the SETUP operation are shown by the State Analysis Setup Menu that follows and Table 6-1 identifies the default conditions for each. The parameter to be viewed, or changed, is selected by placing the reverse video cursor at the number desired (using the [SP] bar) and then pressing the [CR] key.

Table 6-3. SETUP Parameter Default Conditions

PARAMETER	DEFAULT CONDITION
Edge Qualifier	The edge qualifier used in default is labeled CALL.
State Mask	The state mask used in default is labeled '*'.
Counters	The INDEX counter is set to a default value of 5. The other three counters are not used in default.
Acquisition Program	SAVE(CALL) INDEX WHILE(*).
Trace	Trace OFF.
Display Format	Defaults are: TOTAL TIME, HEX display of date bits, BLOCK of 2048 words.

6.3.1 Edge Qualifiers Table

This table contains 16 edge qualifier entries. Each edge qualifier entry consists of a label field, a SCSI bus control field, and a SCSI bus data data field. You may select and edit the contents of the three fields in response to displayed prompts.

The label may be any combination of from 1 to 8 printing characters, excluding spaces. Each label in the table must be unique. The two SCSI bus fields are 9 characters in length. Each character position of each field corresponds to a bit on the SCSI bus.

The SCSI has no bus clock signal. The state analysis system lets you define any combination of the 18 SCSI signal edges as clocks for saving state data. Sixteen such combinations can be defined in the Edge Qualifiers Table for later use in the acquisition program. The program uses the table entry label to identify the Edge Qualifiers Table entry.

The Edge Qualifiers Table entry to be changed is selected by entering its label by name or by pointing to the label with the cursor and then pressing [CR]. The field of the table entry is then selected by moving the blinking cursor to the desired field of the selected table entry and then pressing [CR]. The individual signals of the data or control fields are then selected and changed from the keyboard. Qualified edges of either rising (FALSE-to-TRUE), falling (TRUE-to-FALSE), both rising and falling, or neither transitions are defined for each bit. The [1] key is used to indicate a rising edge of a signal, the [0] key is used to indicate a falling edge of a signal, the [2] key indicates both edges of a signal, and the [*] key is used to indicate neither edge of a signal. An event is qualified for capture if one or more of the qualified edges are detected in any state change.

You may also change the label field to any unique string of up to 8 characters. However, no spaces are allowed within the label string.

To leave the change or select levels, use the [ESC] or EXIT ([F8]) keys.

6.3.2 State Masks Table

This table contains 16 state mask entries. Each state mask entry consists of a label, a data parity field, an external input field, a SCSI bus control field, and a SCSI bus data field. You can select and edit the 5 fields by responding to displayed prompts.

The label may be any combination of up to 8 printing characters, excluding any spaces. Each label in the State Masks Table must be unique.

The parity field is one bit long. The mask state is entered from the keyboard as odd, even, or no parity with the [1], [0], or [*], keys respectively.

The external input field is 5 characters long and the two SCSI bus fields are 9 characters each. Each character position for each of the three fields corresponds to a bit in the external input, the SCSI bus data, and the SCSI bus control fields. In each of these fields, mask states are defined as TRUE, FALSE, or 'don't care' by keyboard entries of [1], [0], or [*], respectively.

The State Masks Table is used in the control of data capture during state analysis by the acquisition program. During the Capture operation, a state match is detected only if all bits of the input state match the '1' and '0' patterns of the selected entry from the State Masks Table. In this matching process,'don't care' [*] bits are ignored. In the acquisition program, the selected state mask is identified by the State Masks Table entry label.

After indicating that a change is to be made to the State Masks Table (by placing the cursor at the YES prompt on the screen and pressing [CR]), the desired state mask is selected by entering the label name or by pointing to the label with the reverse video cursor and pressing [CR]. The individual signal bits within the external input, control, or data fields are then changed by keyboard entries [1], [0], or [*] as desired.

The label can also be changed to any unique string of up to 8 characters with no imbedded spaces.

To leave the change or select levels, use the [ESC] or EXIT ([F8]) keys.

6.3.3 Counters Table

The Counters Table contains labels and count values of the 4 hardware counters on the PED-4001 module. The label identifies the hardware counter. The content of the count field defines the initial value of the counter. You may select and edit the label and count field in response to displayed prompts.

The first counter is dedicated to the index operation and permanently carries the label INDEX. The INDEX counter is activated by the INDEX command in an acquisition program. This counter is used to specify the 'zero time' reference in the 2048 word acquisition data memory window. The range of valid INDEX count values is from 1 to 2047.

The other 3 counters are used in FOR...NEXT loops in the acquisition program. The labels for these counters may be any combination of up to 8 printing characters with no imbedded spaces. The range of valid FOR...NEXT count is from 1 to 32768.

No of times = 2048 - Index + 1.

(time# starts from 0)

After indicating that a change to the Counter Table is to be made, the desired counter is selected by entering its label name or by pointing to the label with the reverse video cursor and pressing [CR]. The label or count field is then selected by moving the blinking cursor to the desired field and then pressing [CR] again. The label or counter field value is then entered from the keyboard and is followed by another [CR].

To leave the change or select levels, use the [ESC] or EXIT ([F8]) keys.

6.3.4 Acquisition Program

The Acquisition Program controls the sequence of SCSI state data capture actions by the PED-4001. The acquisition Program source code, written in a 'pigeon' BASIC syntax, is entered by using a built-in line editor and is compiled by you in response to displayed prompts. The program source code may contain up to 32 lines of 64 characters each. The compiled program may be up to 30 bytes long, and compiled commands are 1 or 2 bytes long.

When entering source code with the line editor, four operations are available from the editor menu. These operations are:

1. LOCATE - Moves the cursor to the program line number specified by you.

2. INSERT - Inserts a blank line immediately above the present cursor position.

3. DELETE - Deletes the line at the present cursor position.

4. EDIT - Brings the line at the present cursor position down for editing.

During line edit operations, the first keyboard entered character is placed at the present cursor position with additional characters entered at the new cursor position as it moves one character to the right for each entered character. The maximum line length allowed is 64 characters. During edit operations, characters can be deleted with either the [DEL] key or the backspace key. The backspace key removes the character immediately to the left of the current cursor position and the [DEL] key removes the character at the cursor position. In both delete cases, characters to the right of the cursor move one character to the left to fill in the deleted character position.

The program source code is automatically compiled as you exit from the acquisition program line editor. Exit the line editor by pressing the EXIT key ([F8]) or the [ESC] key and compile the program by pressing the [CR] key.

Successful compilation is indicated by the prompt 'COMPILE COMPLETE' being displayed. Each line of the display of the compiled program contains the source code command in upper case to the right of the colon (:). The column of numbers just to the left of the colon gives the line number of the source program. The middle two columns of hexadecimal numbers gives the machine code of the command, and the left most column of hexadecimal numbers gives the memory address of the coded command. Multiple commands can be entered on the same line, however if this is done, the machine code of only the last command on the line is displayed.

If an error is detected during the compile operation, an error message and a prompt that takes you back to the line editor will be given. Most error messages are self explanatory. A syntax error will take you back to the line containing the error. Other errors, such as missing parenthesis or missing terminating key words (UNTIL, WHILE, NEXT, etc.) will take you back to line 00 of the program.

6.3.5 Program Trace

To aid in the acquisition program test and debug procedures, a program trace capability has been provided. One of three options may be picked

during State Analysis Setup. These are: trace no commands, trace only commands ending in the suffix 's', or trace all commands. The trace suffix 's' form of the command key words is explained in Section 5. This trace capability is invoked during State Analysis Setup by the TRACE option. The trace can be set to OFF, to ON, and to ALL. Trace OFF is the normal operating configuration. If the trace is turned ON, two changes occur to the normal data capture process. First, the address of the acquisition program memory address register, rather than the 5 external inputs are saved in the 5-bit external field. Secondly, each time a command with a key word ending in the letter 's' is executed, the present state vector is written to the acquisition memory. When the trace is set to the ALL option it functions like the trace ON option except that the state data vector is written to the acquisition memory on the execution of every command. Except for these mentioned changes, the capture operation is normal.

6.3.6 Display Format Selection

There are certain options for the display of time information, encoded SCSI data information, and the block size for formatting data. These selections are made during State Analysis Setup by selecting the DISPLAY FORMAT menu.

Time information can be selected to display as DELTA TIME between consecutive events or as the elapsed TOTAL TIME, either with respect to the first line of the display or with respect to the INDEX line. The default setting at a program load is for TOTAL TIME with respect to the INDEX line.

In addition to their binary states, the nine SCSI data bits are encoded and displayed in one of the following: hexadecimal (HEX), octal (OCT), ASCII (ASC), or in the extended character set of the PC (ECS). The default setting at a program load is for hexadecimal (HEX) encoding and display.

The time the processor takes to format the captured data is a direct function of the number of words being formatted and can take up to 3 minutes to format 1000 words on the PC. To minimize this delay in formatting time, you can specify a maximum format block (BLOCK) size and thereby split the formatting of large sets of captured data into

smaller segments The block size can be specified from 16 to 2048 in increments of 16. The default setting at a program load is a block size of 2048 words (i.e., all of the acquisition memory).

6.4 STATE ANALYSIS CAPTURE

The actual capture of SCSI state activity is under control of the CAPTURE menu. Control is turned over from the state analysis system host processor to the Data Acquisition and Emulation Module to perform the capture operation. Throughout the entire capture operation the PED-4000 SYSTEM STATUS window (located at the bottom of the display screen) indicates STATE ANALYSIS CAPTURE is in progress. Also during a capture operation, a second window located at the top of the display screen (called SCSI BUS STATUS) continuously indicates the present SCSI bus phase.

The analyzer must be armed to start the actual data capture operation under control of the acquisition program. This is accomplished by pressing the 'GO' ([F9]) key, or by selecting ARM from the menu and then pressing [CR]. When armed, the PED-4000 SYSTEM STATUS window will indicate both ARMED and BUSY. The analyzer can be disarmed at any time during a capture by pressing 'DISARM', (the [SHIFT] key and the [F10] key together), or by selecting DISARM from the menu and then pressing [CR] and selecting YES on the 'ARE YOU SURE' menu inquiry.

Normally, the analyzer will be indexed during the acquisition process by the INDEX command in the acquisition program. You can also manually index the analyzer by pressing 'INDEX', (the [SHIFT] and [F9] keys at the same time), or by selecting INDEX from the menu and then pressing [CR] and selecting YES on the 'ARE YOU SURE' menu inquiry.

The capture operation will automatically be stopped and the DISPLAY operation entered as the result of a full data window, or by the HALT command of an acquisition program. Capture operations can also be stopped manually by pressing the 'STOP' ([F10]) key, or by menu selection of DISPLAY and a [CR].

6.4.1 Disarmed and Un-indexed Capture Status

When disarmed and un-indexed, the state analysis system is considered to be in the Idle State. When idle, the analyzer is not under control of the acquisition program and is not saving state data in acquisition memory. It is however, monitoring the SCSI bus and will show the present bus phase on the the SCSI BUS STATUS window in real-time.

6.4.2 Armed and Un-indexed Capture Status

When armed and un-indexed, the analyzer is under control of the acquisition program and is saving state data in acquisition memory according to the rules of that program. State data in acquisition memory is not protected and the oldest data will be over written by new data after 2048 words are saved.

6.4.3 Armed and Indexed Capture Status

After the armed analyzer is indexed, the number of words as specified by the INDEX counter prior to the INDEX command being evoked are protected from being over written in the acquisition memory. This is because, the analyzer automatically disarms itself after writing 2048 minus <INDEX> words to the acquisition memory following the last INDEX occurrence. The analyzer may be re-indexed at any time prior to it being automatically disarmed, thereby extending the data capture operation by over writing the previously protected state data.

6.4.4 Disarmed and Indexed Capture Status

The analyzer may display a disarmed and indexed status for a brief period while captured state vectors are being read from the acquisition memory immediately prior to entering a DISPLAY operation.

6.4.5 Display Activity

If the analyzer is attached to an active SCSI bus, and there is bus activity, phase changes on the bus should be observed in the SCSI BUS STATUS window throughout the CAPTURE operation. To actually start the capture of state data, the system is armed by pressing the 'GO' ([F9]) key. The PED-4000 SYSTEM STATUS window will indicate CAPTURE, ARMED, BUSY.

The analyzer is now being controlled by the acquisition program and what happens next is determined by that program and the SCSI bus activity. Typically, you can expect the INDEXED indicator to be displayed followed by the automatic exit from CAPTURE to DISPLAY in the PED-4000 SYSTEM STATUS window. If this does not occur, the analyzer can be stopped by pressing the 'STOP' ([F10]) key. This will invoke the DISPLAY operation.

6.5 STATE ANALYSIS DISPLAY

The state analysis display operation involves the formatting, displaying, and post-capture processing of captured data.

6.5.1 State Analysis Display Formatting

The first task of the state analysis display operation for the host computer is that of formatting the data captured by the Data Acquisition and Emulation Module during state analysis capture. The System Status is BUSY during the formatting task. A window entitled CAPTURE STATUS shows the number of data words captured during the capture operation. A second window entitled FORMAT STATUS shows the number of lines formatted. Later in the operation, a third window entitled TIME MARK STATUS shows the number of lines that are time marked. The time required for formatting is a direct function of the format block size. The data display is automatically brought up to the host CRT display at the completion of the formatting task.

6.5.2 State Analysis Data Display Window

Nine formatted state data lines are displayed in the Data window at one time. Each state data line contains ten fields of information. These fields are explained in the following paragraphs:

> Event Time - The first field in the state record is the time of the state occurrence, in minutes, seconds, and milliseconds (to the nearest 100 nanoseconds). Time is displayed either as the delta time elapsed from the previous state change (DELTA TIME) or as the total time elapsed (TOTAL TIME). TOTAL TIME is displayed with respect to either the first state data record (LINE 0) or the INDEX. In other words, either LINE0 or INDEX is 'time zero'.

EXTRN - The binary state of the five external signals is displayed in the EXTRN field of the record. The source of these five signals are:

a. The lower five address bits of the acquisition program memory, if the program TRACE is set to ON or to ALL,

b. The TAG character from the command level program running foreground during the state analysis capture, or

c. The binary state of the five external inputs to the PED-4001 module. This is default.

SCSI Control - The binary state of the nine SCSI control signals (RST, BSY, SEL, ATN, MSG, C/D, I/O, REQ, and ACK) are displayed as the third field of the state data line.

DATA - The binary state of the eight data and one parity bits are displayed, together with an encoded display of the data, as the fourth field of the state data line. The eight bits of data, and the parity bit, are encoded and displayed in either hexadecimal (HEX) or octal (OCT). As an option, the eight data bits are displayed as a single PC extended ASCII character. Another option displays seven data bits as the 96 printing ASCII characters or the 32 control and NULL codes.

BUS PHASE - The SCSI control and data fields are decoded according to the rules of SCSI protocol to determine the bus phase. Two phases are non-standard in the SCSI protocol. These are: (1) BUS CLEAR indicates that all signals of the interface are unasserted, and (2) INTERPHASE indicates that the state data captured is insufficient to decode the actual phase according to the SCSI rules of protocol.

CONTROL PHASES:	INFORMATION PHASES:
BUS FREE	DATA OUT
BUS CLEAR	DATA IN
ARBITRATION	COMMAND
SELECTION	STATUS
RESELECTION	MESSAGE OUT
INTERPHASE	MESSAGE IN

CNDNT - The SCSI control and data fields are decoded according to the rules of SCSI protocol to determine the bus condition. Those decoding rules are summarized below. In the sample that follows, the asterisk (*) indicates a 'don't care' condition.

CONTROL RBSAMCIRA SSETS//EC TYLNGDOQK	DATA P76543210	CONDITION
1********	*********	RESET
011******	EVEN PARITY	ERROR
010***11*	EVEN PARITY	ERROR
010***0*1	EVEN PARITY	ERROR
0**1*****	*********	ATTENTION
0**0*****	ODD PARITY	NORMAL

BUS ID; I, T - The captured data bus state during the arbitration and selection phases are decoded according to the rules of SCSI protocol to identify the target and initiator. In single host, non-arbitrating systems, only the target ID is to be expected. You should already know the ID of the initiator.

NUM REQ's - The eighth field of the display line provides the total number of '0-to-1' transitions of the REQ signal saved in the captured state data since the last captured phase change.

NUM ACK's - The ninth field of the display line gives the total number of '0-to-1' transitions of the ACK signal saved in the captured state data since the last captured phase change.

LINE NUM - The last field contains the line number of the formatted state data, the first line being listed as line '0'.

6.5.3 SCSI Bus Status Window

The SCSI BUS STATUS window (located at the top of the display) gives the phase, condition, and bus device ID's for the data line at the data cursor (bright video) in the display data window. In addition, the status window gives the ID's of devices last pending for the bus and the type of data transfer occurring (asynch. or synch.).

6.5.4 Display Line Window

The last window presented in the state analysis display is the DISPLAY LINE window. This display provides the line number of the INDEX, the MARK, the PRESENT line of the cursor, and the LAST line of the formatted data set.

6.5.5 Display Operation Control

The display operations do the following:

1. LOCATE - Move the data cursor to the line number entered.

2. MARK - Recalculate the time field of all records using the line at the present data cursor as the 'zero-time' reference.

3. FIND - Search for the first occurrence of a line matching the current line template.

4. COMPARE - Using the current line template as a qualifier, compare the contents of the captured data memory with the contents of the formatted data file, tagging matches or mismatches in the process.

5. MORE - Format for display an additional block of state data.

APPENDIX A

REFERENCE MATERIAL

A.1 SETUP SUMMARY

FACTORY SET DEFAULT ADDRESSES

1. I/O Address - 380H to 38FH
2. Hardware Interrupt - 3
3. DMA Channel - 1.

FACTORY SET SHORTING BLOCK CONFIGURATION

LOCATION	SHORTING BLOCK	ADDRESS	FUNCTION
E1	ACROSS A & B	380H	I/O ADDR
E2	ACROSS A & B	38FH	I/O ADDR
E6	INSTALLED	3	IRQ ADDR
E11	INSTALLED	1	DMA CHNL
E12	INSTALLED	1	DMA CHNL

COPYING TO A SYSTEM DISKETTE

Install the PC/MS-DOS diskette in drive A and turn on the host computer to 'Boot' the system. When the computer has booted enter the following command string: FORMAT /S [CR]. Then remove the PC/MS-DOS diskette, put a blank diskette in drive A and follow the format instructions.

When you have a formatted system diskette in drive A, put the PED-4001 State Analysis Program diskette in drive B and copy all files from drive B to drive A by doing the following:

COPY B:*.* A: [CR]

You now have a formatted system diskette in drive A that has all of the PED-4001 program files on it.

COPYING TO A HARD DISK

Install the PC/MS-DOS diskette in drive A and turn on the host computer to 'Boot' the system. When the prompt C> appears, type the following to make a directory called PED:

```
MKDIR \PED [CR]
```

Now remove the PC/MS-DOS diskette from drive A and insert the PED-4001 State Analysis Program diskette in drive A and type:

```
CHDIR \PED [CR]
COPY A:*.* [CR]
```

The hard disk drive now has all of the PED-4001 System program files on it in the directory \PED.

SYSTEM START UP MESSAGE

To log on, boot the system diskette (or hard disk) from the start-up logged drive and type the message PED4001 [CR].

PED-4001 SYSTEM DIRECTORY

The PED4001 Directory contains the following files:

PED4001.EXE	-	State Analysis Program Execution File.
XXX.HLP	-	HELP Message Files. These files are called by the program from the logged system drive.
XXX.DA	-	Saved DATA File.
XXX.DAF	-	Saved Formatted DATA File.
XXX.SU	-	Saved SETUP File.
DSETUP.SU	-	Default SETUP File. This file is called from the logged system drive when the program is loaded.
STATUS.REM	-	Text File that gives the status of execution files on the disk.
READ-ME.DOC	-	Text File that gives the latest revisions of the PED-4001 State Analysis Program User's Manual.

A.2 COMMAND SUMMARY

COMMAND WORDS SYNTAX

1. Words in capital letters are key words and must be entered as shown described in the following paragraphs except for character case.
2. Labels shown in bold lower case inside parenthesis (**xxxx**) must be included and the same identical label must occur in the setup table appropriate for the associated command key word.
3. Characters in square brackets ([ ]) are optional parameters.
4. Labels in carrots (< >) refer to the contents of the setup table entry identified by the label.
5. All punctuation, except square brackets, must be included as shown.

OPERATION GROUP COMMAND WORDS

HALT - Stops the capture sequence, causing the analyzer to automatically enter DISPLAY operation.

INDEX - Captures the present state data vector to acquisition memory and initializes the index counter to <INDEX> count.

SAVE(**edge-qualifier**) - Causes the subsequent capture of state data vectors entered by transitions qualified by <**edge-qualifier**> and writes them into the acquisition memory. The label **edge-qualifier** must exist in the table of EDGE QUALIFIERS.

SKIP - Stops all sequential capture of the state data vectors.

SYNC - Issues 100 nanosecond positive going pulse to the SYNC SIGNAL output.

PROGRAM FLOW CONTROL GROUP COMMAND WORDS

DO [expression] UNTIL(**state-mask**) - Repeatedly executes [expression] until state matching <**state-mask**> is detected. The label **state-mask** must be present in the table of STATE MASKS.

DO [expression] WHILE(state-mask) - Repeatedly executes [expression] while state matching <state-mask> is detected. The label state-mask must be present in the table of STATE MASKS.

FOR(counter) [expression] NEXT(counter) - Repeats execution of [expression] <counter> times. The label counter must exist in the table of COUNTERS.

IF(state-mask) [expression 1] [ELSE expression 2] ENDIF - If the present state matches <state-mask> then execute [expression 1], [otherwise, execute expression 2], and continue execution at the first statement past ENDIF. The label state-mask must exist in the table of STATE MASKS.

DISPLAY OPERATION CONTROL COMMAND WORDS

1. LOCATE - Move the data cursor to the line number entered.

2. MARK - Recalculate the time field of all records using the line at the present data cursor as the 'zero-time' reference.

3. FIND - Search for the first occurrence of a line matching the current line template.

4. COMPARE - Using the current line template as a qualifier, compare the contents of the captured data memory with the contents of the formatted data file, tagging matches or mismatches in the process.

5. MORE - Format for display an additional block of state data.

LINE EDITOR COMMAND WORDS

1. LOCATE - Moves the cursor to the program line number specified by you.

2. INSERT - Inserts a blank line immediately above the present cursor position.

3. DELETE - Deletes the line at the present cursor position.

4. EDIT - Brings the line at the present cursor position down for editing.

A.3 DISPLAY FORMAT SUMMARY

STATUS AND USER INFORMATION

User Information is displayed in titled windows with double-bar borders. Reverse, dark, and bright video is used within the windows to enhance recognition. Information displayed within these windows includes PED-4000 System status and SCSI bus status.

DATA AND MENU INFORMATION

Setup, response data, and menu information is displayed in titled windows with single-bar borders. To enhance recognition, data cursors are bright video and menu cursors are reverse video.

RESPONSE REQUESTS

User response is prompted by text outside of a window. In most situations, however, action selections can also be made from a menu within a window. All response entries must be followed by a [CR] to cause the selected action to occur.

STATE ANALYSIS MENU

1. SETUP
2. CAPTURE
3. DISPLAY
4. HELP
5. FILE
6. EXIT

STATE ANALYSIS SETUP MENU

1. EDGE QUALIFIERS
2. STATE MASKS
3. COUNTERS
4. ACQUISITION PROGRAM
5. TRACE
6. DISPLAY FORMAT
7. EXIT

DISPLAY FORMAT MENUS

Select display foe change [1.TIME 2.DATA 3. EXIT]

Display time as [1. CLOCK 2. DELTA 3. EXIT]

CLOCK time wrt [1. INDEX 2. LINE0 3. EXIT]

Display data as [1.HEX 2.OCT. 3. ASC 4.ECS 5.EXIT]

FILES UTILITY MENU

1. LOAD
2. SAVE
3. PRINT
4. EXIT

A.4 KEYBOARD ENTRY SUMMARY

FUNCTION KEYS

HELP (F5) - A Help Menu is displayed to aid you in the operation current operation of the State Analysis Program.

FILE (6) - The File Utility is entered which allows you to load pre-stored Setup and Data files from a disk or, to save Setup and Data information to a disk, or a printer.

SETUP (7) - The program enters the State Analysis Setup operation.

EXIT (F8) - The program exits the present operation and goes to the next higher menu. The exact action that will occur is a function of the present operation, but it is the normal means of leaving one operation and returning to a menu which allows selection of another operation.

GO (F9) - The program will enter the State Analysis Capture operation or, if already in the Capture operation, it will Arm the PED-4001 module.

STOP (F10) - The program will enter the State Analysis Display operation.

INDEX (SHIFT F9) - This two key combination manually Indexes the PED-4001 module. The SHIFT F9 key combination is only valid, however, if the PED-4001 module is Armed and is doing a Capture operation.

DISARM (SHIFT F10) - Returns the PED-4001 module to the Disarmed status. The SHIFT F10 key combination is only valid, however, if the PED-4001 module is Armed and is doing a Capture operation.

ACTION KEYS

The Escape [ESC] key causes the preceding keyboard entered string to be ignored and the present operation to be unaltered. If no string was entered before pressing the [ESC] key, the program will exit from the current operation.

The Carriage Return [CR] key causes the preceding keyboard entry to be executed.

MENU AND TEXT CURSOR MOVEMENTS

Vertical cursor movement is done by entering the label of the destination field followed by a [CR] or, by moving the cursor incrementally using the Up Arrow key or the Down Arrow key. The Space Bar moves the cursor down. If there is no active vertical menu or text field, the Space Bar will move the cursor to the right.

Horizontal cursor movement is done by entering the label field followed by a [CR] or, by moving the cursor incrementally using the Left Arrow for left motion and the the Right Arrow for right motion.

CHARACTER DELETION KEYS

The Backspace key will move the cursor one character to the left and will delete this character. If the cursor is already at the left most character, the character at the present cursor position will be deleted and the cursor will not move. The Delete [DEL] key will delete the character at the current cursor position and the cursor position will be unchanged.

CURSOR MOVEMENT DURING DISPLAY OPERATIONS

[up arrow] - one line up,
[down arrow] - one line down,
[page up] - nine lines up,
[page down] - nine lines down,
[home] - to first line of state data set,
[end] - to last line in state data set,
[SP] (space bar) - one line down,
[left arrow] - one menu label left,
[right arrow] - one menu label right.

CHARACTER ENTRY CONVENTIONS

Menu Label Numbers - numeric,
Data Table Label Characters - alphanumeric,
Program Key Words - alphabetic (case ignored).

APPENDIX B

ACQUISITION PROGRAM CONFIGURATION

B.1 CONFIGURING THE PROGRAM

The program furnished with this analyzer is configured to operate with the Data Acquisition and Emulation Module in a "standard" PC system and is tied to the module factory default settings. If you reconfigure the module, or have a "non-standard" PC system, you can reconfigure the program to operate with your system. This reconfiguration from the default settings is done by setting software switches at the time the program is loaded. A switch setting follows on the same line as the program name. For example: "PED4001 ca vc" will select ASCII printer character set and a color board/monitor combination.

bnnn - Module base address, where 'nnn' is the desired address in hexadecimal. Default is 380H.

ca - Printer character set, where 'a' is an identifier for the selected character set. An identifier of 'a' selects the standard ASCII 96 character set and 'e' selects the extended ASCII character set. The factory default is the Extended ASCII Character Set (ECS).

dpathname - Path for data and setup files, where 'pathname' is any valid drive and directory name.

in - Interrupt number, where 'n' is the interrupt number assigned to the module. Valid numbers are 2, 3, 4, and 7. The factory default is 3.

lnn - Printer page length for creating page breaks, where 'nn' is the page size in number-of-lines. Valid sizes are '00' and '24' through '99'. A size of '00' inhibits page breaks. The factory default size is '66'.

mn - Direct memory access channel to be used by the program, where 'n' is '1' through '3'. The factory default value is '1'.

va - Video card and monitor type, where 'a' is the identifier letter as follows:

- m - monochrome board and monitor,
- c - color board and monitor,
- b - color board with monochrome monitor. This is the factory default identifier.