
μ Analyst 2000
MODEL 2100

INTERACTIVE STATE ANALYZER

User's Manual



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READ THIS FIRST

In this manual you'll find the information you need to install and operate the Northwest Instrument Systems, Inc., Model 2100 Interactive State Analyzer, as part of the μAnalyst 2000™ instrumentation system.

The manual explains the features of the Interactive State Analyzer and describes all operating menus, displays, and hardware connections. It also shows how to use the Interactive State Analyzer in time-aligned acquisitions with the Model 2200 Interactive Timing Analyzer.

A special feature of the manual is the demonstration session in Section 7. This session gives you the opportunity to operate the Interactive State Analyzer's hardware and software, before getting into actual applications.

Take a few minutes to look over the following pages. They describe how the manual is organized and explain which product and software versions are covered.

USING THIS MANUAL

This manual has seven sections and several appendices.

Introduction	Section 1 provides an overview of the Interactive State Analyzer and its key features. It also lists the analyzer's components and specifications.
Installation	Section 2 shows how to install the Interactive State Analyzer in the μAnalyst 2000 Mainframe, and how to connect both products to your personal computer.
Getting Started	Section 3 shows how to use the μAnalyst software with floppy and fixed-disk computer systems. It also explains the μAnalyst's start-up procedures and defines any possible error conditions.
Modes of Operation	Section 4 discusses the Interactive State Analyzer's key features and their theory of operation.
Menus	Section 5 covers all operational and mechanical aspects of the Interactive State Analyzer menus.

State & Timing Together	Section 6 describes how to use the Interactive State Analyzer in time-aligned acquisition with the Model 2200 Interactive Timing Analyzer.
Demonstration	Section 7 provides hands-on exercises that use the Interactive State Analyzer to acquire data from a demo circuit board.
Appendices	Appendices at the back of the manual provide reference information, such as data file formats and clocking examples.

Each section in the manual is preceded by a tabbed page so that information can be referenced easily. Other reference aids include a table of contents and a full cross-reference index.

PRODUCTS COVERED BY THIS MANUAL

The information in this manual applies to the μAnalyst products listed below.

μAnalyst 2000 Mainframe

Model 2100(E) Interactive State Analyzer (ISA)

ISA Controller Board

ISA 16-Channel Memory Board (Option 001)

ISA 32-Channel Memory Board (Option 002)

If your μAnalyst 2000 Mainframe has a serial number lower than 2000B001350, refer to Figure 2-2 (Section 2, *Installation*) when connecting to the EXT or CL BNCs. Disregard the BNC labeling that appears on the 2000A mainframe chassis.

Procedures for installing the above products are provided in the *Installation* section of this manual.

SOFTWARE VERSIONS COVERED BY THIS MANUAL

The information in this manual applies to the μAnalyst Operating Software listed below.

SYSTEM DISK V1.00, DOS-Compatible

HELP DISK V1.00, DOS-Compatible

The SYSTEM DISK is available in two versions: 512K or 256K. The 512K version can be used with computers having 512K or greater memory, while the 256K version can be used with computers having 256K or greater memory. When you are using the 256K version, the size of the state analyzer's reference memory is limited to the amount of free space in RAM.

Only one SYSTEM DISK is needed to operate the μAnalyst. Use the disk that is appropriate for the memory capacity of your personal computer.

Procedures for loading the μAnalyst's software are provided in the *Getting Started* section of this manual.

RELATED PRODUCTS AND OPTIONS

The following products and options may be operated in conjunction with the Model 2100 Interactive State Analyzer.

Model 2200 Interactive Timing Analyzer

The Model 2200 is a 16-channel, 100 MHz timing analyzer. You can operate this product independently within the mainframe, or you can use it in time-aligned acquisition with the Interactive State Analyzer.

The Model 2200 comes equipped with a memory board, a trigger board, three data probes, and a user's manual.

Time Stamp Board (Option 003)

This board is available as an option to the Interactive State Analyzer. It provides 16 input channels, coupled with a 20 MHz asynchronous clock. You can measure the real-time execution of state events and view their time distributions in a histogram format.

The Time Stamp comes equipped with a memory board, a 16-channel data probe, and a manual supplement.

Mnemonic Disassemblers

A variety of mnemonic disassemblers are available for the Interactive State Analyzer, including:

Z80

8085

8086

8088

68000

68008

68010

Each disassembler comes equipped with mnemonics software, a single-plug probe connector, and a manual supplement.

New disassembler packages are currently under development. For more information, contact Northwest Instrument Systems, Inc.

PC COMPATIBILITY REQUIREMENTS

To operate the μAnalyst products and software covered in this manual, you must have a personal computer that meets the requirements listed below.

PC Compatibility Requirements

Type	IBM® PC™, PC AT™, PC XT™; or COMPAQ™, COMPAQ PLUS™
Drives	2 double-sided disk drives; or 1 fixed disk, plus 1 double-sided disk drive.
Memory	256K or 512K RAM.
*Monitor	IBM Monochrome Monitor, with Monochrome Display and Printer Interface; or IBM Composite Video Monochrome Monitor, with Color/Graphics Monitor Adapter.
Software	Disk Operating System (DOS) Version 2.00 or higher.

*The IBM Composite Video Monochrome Monitor must be used if you are operating the Model 2200 Interactive Timing Analyzer.

If desired, you may also use a printer in conjunction with the μAnalyst. Compatible printers include:

- Epson RX-80, MX-80, FX-80
- IBM PC Graphics Printer

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Using this section. This section introduces you to the μ Analyst 2000 and its Model 2100 Interactive State Analyzer (ISA). It describes the key product features, components, and specifications.

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DESCRIPTION

The Model 2100 Interactive State Analyzer (ISA) is a powerful tool for designing, debugging, and evaluating software-intensive systems. It installs in the μ Analyst 2000 Mainframe and operates under the control of your IBM-compatible personal computer.

The state analyzer's hardware consists of a controller board and expandable memory boards. These boards plug into the expansion slots located within the μ Analyst mainframe chassis. You can configure the state analyzer with 16 to 80 acquisition channels, using any combination of the following board types:

- Controller Board (one required)—provides synchronous clocking, triggering, and control logic.
- 16-Channel Memory Board (optional)—provides 16 acquisition channels with 4096 bits-per-channel memory.
- 32-Channel Memory Board (optional)—provides 32 acquisition channels with 4096 bits-per-channel memory.

A minimum state analyzer configuration consists of the controller board and at least one memory board.

Once installed in the mainframe, the state analyzer is controlled by menu-driven operating software. This software is contained on the μ Analyst's SYSTEM and HELP DISKS.

The various software menus are both easy to learn and use. They control all facets of the analyzer's operation, including clocking, triggering, storage qualification, and data display. They also control linked operations between the state analyzer and other μ Analyst products, such as the Model 2200 Interactive Timing Analyzer.

The rest of this section discusses the state analyzer's key features and system components. It also gives you a complete list of hardware specifications and software characteristics.

KEY FEATURES

Key features of the Interactive State Analyzer include:

- **Universal Clocking**—Five external sample clocks make the state analyzer compatible with virtually any type of microprocessor system. You can use one or all of these sample clocks to synthesize a master sampling clock. The clock lines are logically ORed, and they each provide a data sampling rate up to 10 MHz.
- **Single-Probe Demultiplexing**—Two hold clocks let you demultiplex data without double probing. You can use these clocks to latch and hold data until the master sampling clock is valid. The demultiplexing is all handled internally by the state analyzer.
- **15-Level Triggering and Storage Qualification**—You have up to 15 trigger/store states at your disposal when defining a trigger. Each state contains four word recognizers, which can be arranged in powerful IF-THEN-ELSE sequences that perform such actions as activating the trigger, branching to a different state, or qualifying data for storage.
- **Multiple-Preview Acquisition**—A special acquisition mode enables you to acquire a qualified event, as well as to capture the seven events directly preceding that event. This gives you all the benefits of storage qualification, plus the ability to trace information leading up to each qualified event.
- **Acquisition and Reference Memories**—The state analyzer's acquisition and reference memories can be displayed in hexadecimal, octal, binary, or ASCII radices. You can view these two memories side by side, and make continuous acquisitions until both memories are equal or not equal. The differences between the two memories are highlighted on the display screen.
- **Histogram Overview Displays**—The state analyzer's histogram display lets you view an overall picture of system activity. In this display, acquired events are binned into user-defined ranges, and you see a histogram readout of the percentage of activity falling within each range.

- **Time Stamp Measurements**—You can add a Time Stamp Board to the state analyzer at any time. This board provides a 20 MHz asynchronous clock that lets you measure the real-time execution of your software code. The time distribution of recorded events is shown in the state and histogram displays. (See *Related Products and Options* at the front of this manual.)
- **Mnemonic Disassemblers**—The state analyzer offers a wide variety of mnemonic disassemblers which can convert acquired microprocessor software back into an assembly source listing format. Each disassembler comes equipped with its own disassembly software and a single-plug probe connector. (See *Related Products and Options* at the front of this manual.)
- **Time-Aligned Displays with Timing Analyzer**—The state analyzer can share the μ Analyst mainframe with the Model 2200 Interactive Timing Analyzer (see Section 6 of this manual). A cross-aligned mode lets you operate the two analyzers in tandem, where state events arm timing acquisitions, or vice versa. The state and timing data is then time-correlated on the display screen.
- **I/O Utilities**—Mass storage is available through the state analyzer's interface to the personal computer. You can save menu setups and reference data on disk, then recall them at any time. You can also make permanent records of setups and data by using an IBM-compatible printer.

SYSTEM COMPONENTS

The following paragraphs briefly describe the components required for operating the Model 2100 Interactive State Analyzer. While reading these paragraphs, refer to Figure 1-1 for an overview of how these components fit together.

NOTE

Installation procedures for the various components are provided in Sections 2 and 3 of this manual.

State Analyzer Boards and Probes

The state analyzer boards plug into the expansion slots located within the μ Analyst 2000 Mainframe. Probes are connected to these boards through slot openings in the mainframe's back panel.

1. Introduction

MODEL 2100

The state analyzer boards and probes include:

- Controller Board, with one P2901 Clock Probe
- 16-Channel Memory Board, with one P2902 Data Probe
- 32-Channel Memory Board, with two P2902 Data Probes

A minimum state analyzer configuration requires the controller board and at least one memory board. A maximum configuration allows any number of memory boards up to 80 parallel channels.

μ Analyst 2000 Mainframe

The μ Analyst 2000 Mainframe houses the state analyzer boards, and provides the hardware interface to the personal computer. This interface consists of:

- μ Analyst Interface Board
- PC Interface Board
- 48-inch Interface Cable

NOTE

The mainframe can house other μ Analyst products simultaneously with the state analyzer. Refer to *Related Products and Options* at the front of this manual.

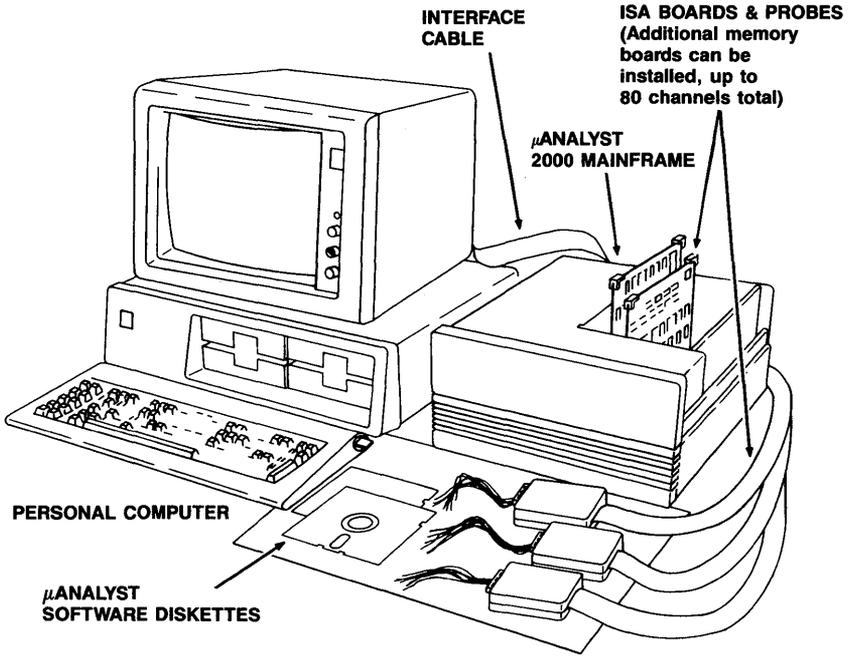
μ Analyst Software

The μ Analyst System Operating Software is provided as part of the state analyzer package. It contains the menus necessary for operating the analyzer by itself or in conjunction with other μ Analyst products.

PC Compatibility

An IBM or IBM-compatible personal computer, and DOS operating software, are essential to the state analyzer and all μ Analyst products. A list of compatible personal computers and their memory requirements are provided at the front of this manual under *PC Compatibility Requirements*.

00842-001



■ Figure 1-1. System Components.

SPECIFICATIONS

The specifications for the μ Analyst 2000 Mainframe operating the Model 2100 are listed in Tables 1-1 and 1-2. These are the performance standards or limits against which the instrument is tested.

■ Table 1-1: Hardware Specifications

μ ANALYST 2000 MAINFRAME

Power: 105-125 Vac; 50-60 Hz (or 210-250 Vac; 50-60 Hz with option V1).

Operating Environment, Temperature: 25° C \pm 10° C.

Dimensions: See Figure 1-2.

STATE ANALYZER BOARDS AND PROBES (Measured at 25° C)

The following specifications apply to the State Analyzer Controller Board and its P2901 Clock Probe; the 16-Channel Memory Board and its P2902 Data Probe; and the 32-Channel Memory Board and its two P2902 Data Probes.

Inputs

Clock Inputs

- Clock Channels: 5 ORed sample clocks and 2 hold clocks.
- Input Loading of P2901 Clock Probe: 1 TTL FAST load ($I_{in_{LOW}} = 600 \mu A$).
- Input Voltage Range: -0.5 V to 7.0 V.
- Dynamic Range: 0 V to 5.0 V.
- Threshold: 1.4 V, TTL.
- Maximum Synchronous Sample Rate: 10 MHz.
- Minimum Clock Pulse Width: 25 ns.

Data Inputs

- Data Channels: 16 to 80 input channels; 16 channels per P2902 Data Probe.
- Input Loading of P2902 Data Probe: 1 TTL LS load ($I_{in_{LOW}} = 100 \mu A$) maximum.
- Input Voltage Range: -0.5 V to 7.0 V.
- Dynamic Range: 0 V to 5.0 V.
- Threshold: 1.4 V, TTL.

Continued

Table 1-1 (cont.): Hardware Specifications

- Data Setup Time: 25 ns.
- Data Hold Time: 0 ns.
- Data Input Modes: Normal, Multiplexed.

External (EXT) BNC Input 1 TTL load ($I_{in_{LOW}} = 1.6 \text{ mA}$).

Outputs

Clock Probe Outputs

- Real-Time Programmable Output (from state-trigger machine): 2 lines; open collector; internally pulled up by 4.7 K Ω .
- Run/Stop Line: Open collector; internally pulled up by 4.7 K Ω .

Crosslink (CL) BNC Output

Crosslink Line: programmable output; 74128 (50 Ω line driver).

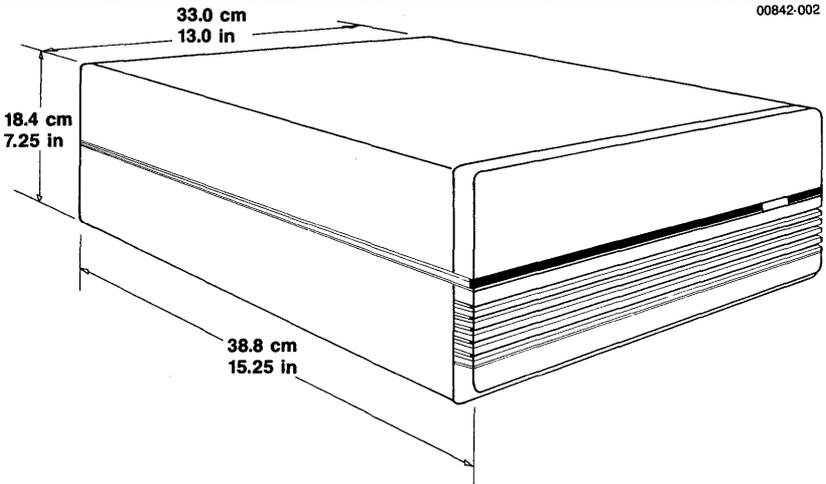


Figure 1-2. Dimensions of the μ Analyst 2000 Mainframe.

■ Table 1-2: Software Characteristics

Acquisition Memory

Configurable from 16 to 80 channels with 4096 bits-per-channel memory depth.

Reference Memory

Dynamically allocated at runtime using personal computer RAM.

Programmable State-Trigger Machine

- Number of Independent States: 15
- Word Recognizers per State: 4 total. 2 used for branching, triggering, and output control; 2 used for storage qualification (ANDed or ORed). Each word may be specified with a value or *not* value. Each bit within a word may be specified as 1, 0, or X (don't care).
- Programmable Outputs per State: 2 real-time output lines and 1 Crosslink line.
- Event Counters per State: 1, programmable from 1 to 4096.
- Event Counter Modes: after, before.
- Event Counter Inputs: sample clocks, store clocks, or word recognizer occurrences.

Menus

- Format Menu: channel group assignment; display order; group labels; radix and polarity selection; sample and hold clock and mux/no-mux setup; run/stop polarity.
- Trigger-Store Menu: state machine programming; trigger position (begin, center, end, and delay up to 4096); storage qualification programming; symbolic state definition, multiple-preview acquisition selection; starting state selection.
- Symbol Menu: word recognizer symbol name and value definition; mask definition.
- Display Menu: hexadecimal, octal, binary, and ASCII display formats; data display of acquisition, reference, or both; display of memory comparisons with data differences highlighted; single line or page scrolling; find word (scroll by value); compress mode.
- Histogram Menu: 16 user-selectable ranges; 1 qualifier event; activity percentages shown in histogram and numerical readout.
- I/O Menu: save and load setup and data to and from disk; path name setup; disk directory display; print data, symbols, or trigger information.

Continued

■ Table 1-2 (cont.): Software Characteristics

- Configuration Menu: μ Analyst mainframe hardware description; interface address selection; software option selections.
- Help Information: general help summary; individual help summary for menu fields.

Run (Go) Modes

Go once; Go forever; Go until acquisition = reference; Go until acquisition < > reference; Stop acquisition after memory overflow.

Using this section. This section shows you how to install the μ Analyst 2000 Mainframe and the Model 2100 Interactive State Analyzer. It also describes all exterior mainframe controls and indicators.

Detailed start-up procedures are provided in Section 3, *Getting Started*.

SECTION CONTENTS

Unpacking/Repacking Information	2-3
Installing the μAnalyst	2-3
Mainframe Power Requirements	2-5
Fuse Replacement	2-5
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UNPACKING/REPACKING INFORMATION

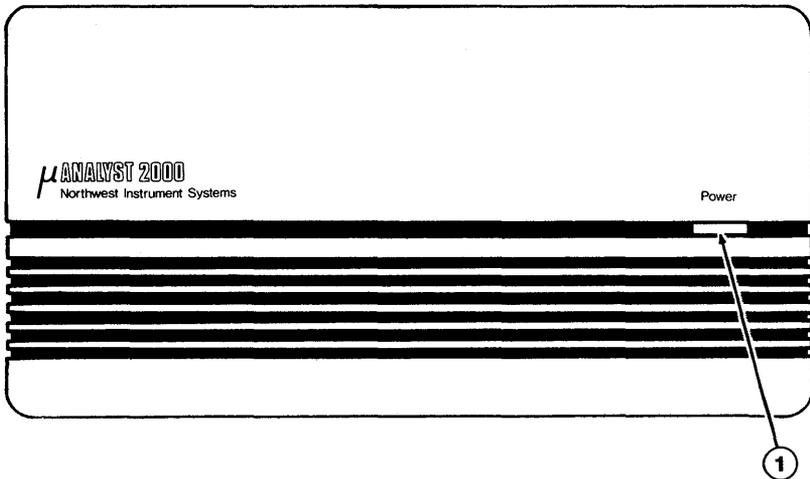
Before unpacking the μ Analyst 2000 Mainframe or the Interactive State Analyzer, carefully inspect their shipping cartons for damage. If the cartons show signs of damage, notify the carrier and contact Northwest Instrument Systems, Inc., immediately.

Keep the original shipping cartons and packing materials, and use them if you need to repackage and ship the products.

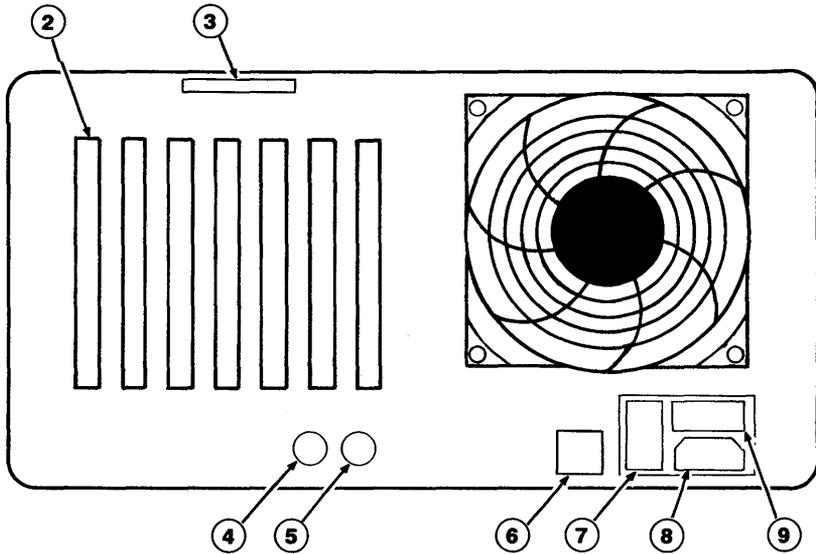
INSTALLING THE μ ANALYST

Figures 2-1 and 2-2 illustrate the controls and connectors on the μ Analyst mainframe. Refer to these figures while reading the following paragraphs.

00842-003



■ Figure 2-1. The front panel of the μ Analyst mainframe.



■ Figure 2-2. The back panel of the μ Analyst mainframe.

- ① **Power Indicator**—this light tells you that the mainframe is receiving power.
- ② **Slot Openings**—these openings let you access the boards installed in the mainframe's expansion slots (labeled 1—7). You use these openings to connect probes and cables.
- ③ **Serial Number**—this label tells you the serial number of your mainframe.
- ④ **External (EXT) Input**—this BNC connector receives an external input line through a 74128 ($\text{lin}_{\text{low}} = 1.6 \text{ mA}$). You can store the input from this line in acquisition memory, and you can use it for setting up word-recognizer/trigger conditions (see Section 5's *Format Menu* and *Symbol Menu* subsections).
- ⑤ **Crosslink (CL) Output**—this BNC connector outputs a TTL level signal through a 74128 (50 Ohm line driver). You can program the logic level of this output (high/low) with each trigger-state transition (see Section 5's *Trigger-Store Menu* subsection).

NOTE

The Crosslink output signal is also used internally by the Interactive State Analyzer in arming the Model 2200 Interactive Timing Analyzer (see Section 6, *State and Timing Together*).

- ⑥ **Line-Voltage Rating**—this label tells you the line voltage of the mainframe: either 105-125 Vac to meet United States requirements; or 210-250 Vac to meet European requirements.
- ⑦ **Fuse Holder**—this is the location of the mainframe's power fuse. Procedures for replacing the fuse are provided later in this section.
- ⑧ **Power Receptacle**—this is used for installing the mainframe's power cord.
- ⑨ **On/Off Switch**—this turns on the mainframe.

Mainframe Power Requirements

Your μ Analyst 2000 Mainframe operates off a 50-60 Hz single-phase power source. It is wired at the factory for either 105-125 Vac or 210-250 Vac (with Option V1). Before connecting the mainframe to a power source, verify that the line-voltage rating on the mainframe's back panel (see Figure 2-2, callout number 6) is correct for the nominal voltage you are using.

CAUTION

You could damage your mainframe if the input voltage applied does not fall within the line-voltage range specified on the mainframe's back panel.

Fuse Replacement

To replace the fuse in the μ Analyst 2000 Mainframe, proceed as follows:

1. Make sure the mainframe is turned off and disconnected from any power source.
2. Locate the fuse holder on the mainframe's back panel (see Figure 2-2, callout number 7).
3. Insert a small, flat-bladed screwdriver or similar tool under the tab at the lower-right corner of the fuse holder (see Figure 2-3).
4. Carefully lift the tab away from the back panel.
5. Lift up on the catch and remove the fuse-holder circuit board from the fuse-holder carrier (see Figure 2-4).

2 Installation

MODEL 2100

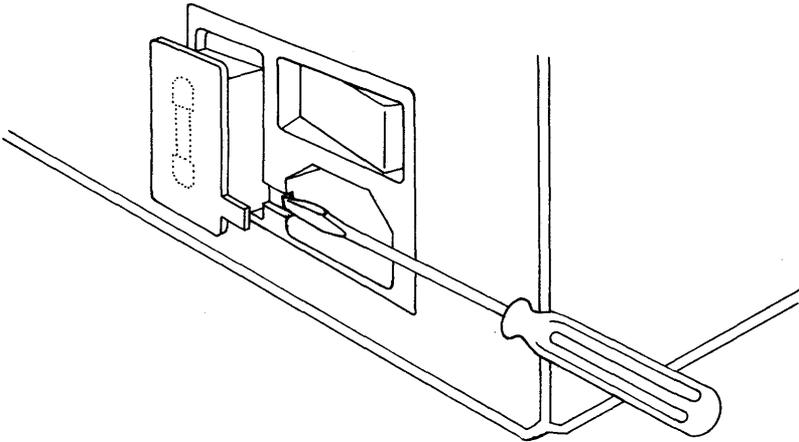
6. For a 105-125 Vac unit, install a 3 A fuse.
7. For a 210-250 Vac unit, install a 1.5 A fuse.

CAUTION

To avoid risk of fire, replace the fuse with one of an equivalent type and rating.

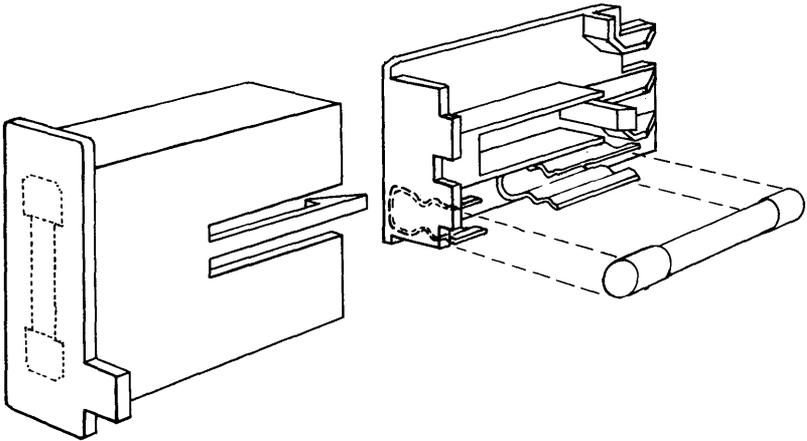
8. Snap the fuse-holder circuit board back into the fuse-holder carrier.
9. Push the fuse holder back into the receptacle until its surface is flush with the receptacle surface.

00842-005



■ Figure 2-3. Removing the fuse holder.

00842-006



■ Figure 2-4. Detaching the fuse-holder circuit board.

Power Cords

If your μ Analyst 2000 Mainframe has a line-voltage rating of 105-125 Vac, it is shipped with a standard grounded 3-pin North American power plug. The plug's protective-ground contact connects to the accessible metal parts of the mainframe through the power cord protective grounding conductor. For protection against electrical shock, insert this plug into a power source that has a securely attached protective-ground contact.

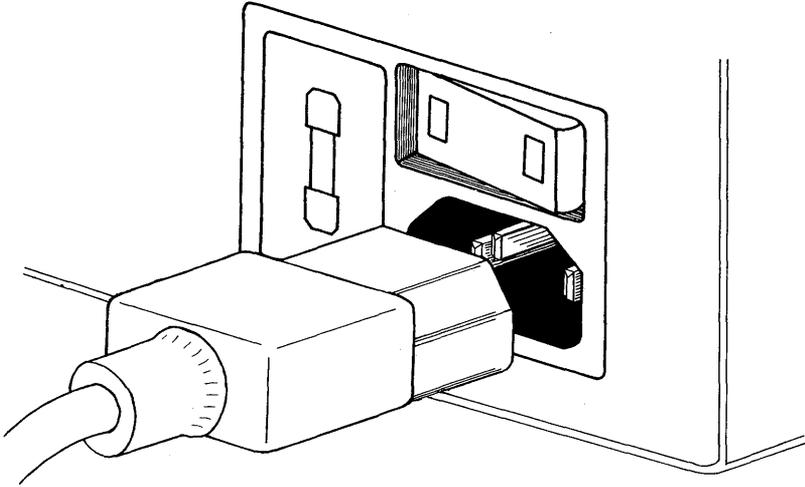
CAUTION

Hazardous voltages may be present on the exposed metal surfaces of the mainframe if the protective-ground connection of the power source socket is not securely grounded.

If your mainframe has a line-voltage rating of 210-250 Vac, it is shipped with an unterminated power cord. Wire this power cord to a grounded plug appropriate for the power available at your site. Wire the plug as follows:

- Green/yellow—safety (earth) ground
- Brown—live (hot)
- Blue—neutral

Figure 2-5 illustrates how to connect the power cord to the mainframe.



00842-007

■ **Figure 2-5. Connecting the power cord.**

CONNECTING THE PC INTERFACE

The μ Analyst 2000 Mainframe is shipped with interface hardware that allows you to connect the mainframe to a personal computer. This interface hardware includes:

- μ Analyst Interface Board
- PC Interface Board
- 48-inch Interface Cable

The following paragraphs explain how to connect the various pieces of the interface hardware. For these procedures, you also need access to your personal computer manual.

Installing the μ Analyst Interface Board

The μ Analyst interface board is installed in the μ Analyst mainframe at the factory and resides in the mainframe's expansion slot 1. You do not need to perform any preliminary installation of this board.

If you ever want to remove and re-install the μ Analyst interface board, simply follow the procedures contained later in this section under *Installing the State Analyzer Boards*. The only rule regarding the installation of the interface board is that it must reside in slot 1.

Installing the PC Interface Board

If you purchased your personal computer from Northwest Instrument Systems, Inc., the PC interface board is installed at the factory. It resides in the computer's option slot area and is indicated by a label reading μ ANALYST-PC INTERFACE CARD.

If you are not using a personal computer purchased from Northwest Instrument Systems, Inc., you must install the PC interface board as described below.

NOTE

These procedures are based on an IBM Personal Computer. If you are using an alternate, compatible computer, consult that computer's manual for instructions on how to install option boards.

1. Turn off your personal computer and disconnect it from any power source. Also turn off any external power switches to printers, etc.

CAUTION

You can damage your personal computer or PC interface board if you install the board while the computer is receiving power.

2. Gain access to the computer's internal expansion slots. When doing this, follow the procedures, and adhere to any cautions and warnings, specified in your computer manual.
3. Choose the expansion slot you want to use for the PC interface board; any unused slot is appropriate. Then, using a screwdriver, remove the screw that holds the expansion slot cover in place. Lift the slot cover up and out.
4. Locate the address switches on the PC interface board. These switches determine the computer memory range that will be used by the μ Analyst interface.

The switches are factory-set for the address range DE000—DEFFF, hexadecimal (see Figure 2-6). You can reset these switches for any 4K bytes of contiguous memory addresses, as long as the memory addresses are not used by another part of your computer.

The polarity of the switches is inverted so that ON=0 and OFF=1. The switches set the most significant 8 bits of the address range only; the lower 12 bits of the range are always 000—FFF, hexadecimal.

NOTE

If you're using an IBM PC AT, these switches must be set to the default address range of DE000—DEFFF to avoid collision with the computer system's ROM.

5. Insert the PC interface board into the computer's expansion slot, as shown in Figure 2-7.
6. Replace the cover of the computer.

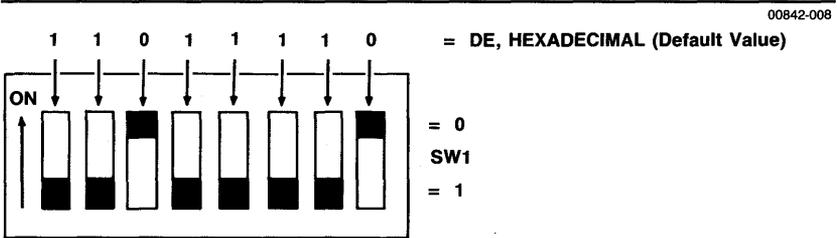
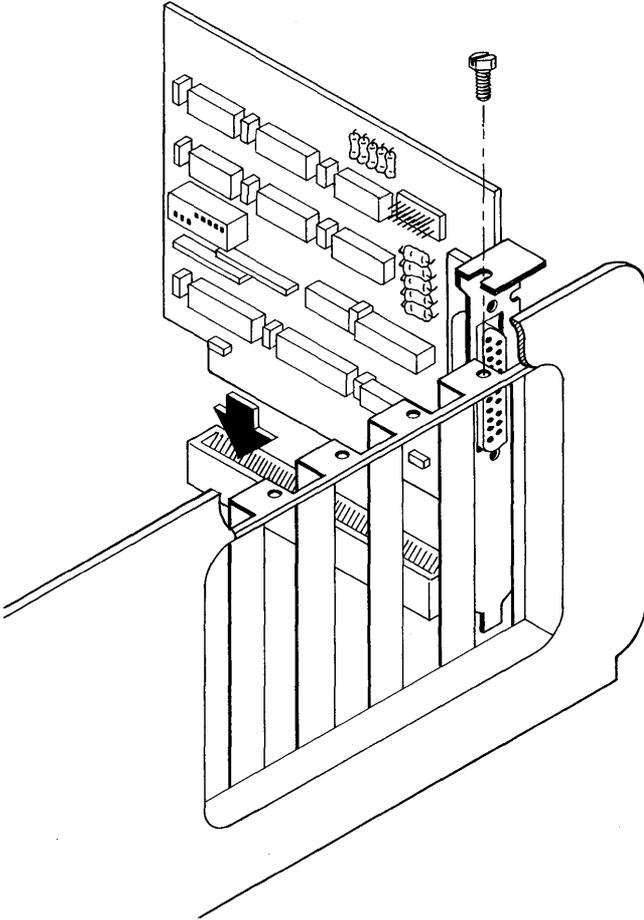


Figure 2-6. Address switches on the PC interface board. These switches are factory-set to the address range DE000—DEFFF, hexadecimal. The polarity of the switches is inverted so that ON=0 and OFF=1.

00842-009



■ Figure 2-7. Installing the PC interface board.

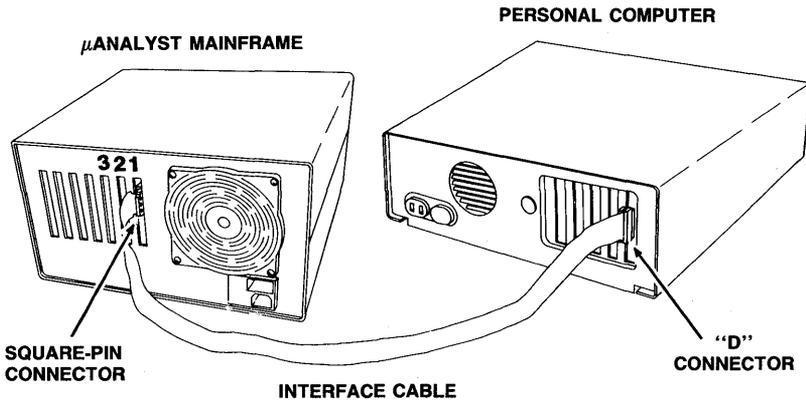
Connecting the Interface Cable

Once the μ Analyst and PC interface boards are installed, you connect them using the interface cable. Figure 2-8 illustrates how you make this connection. The D-connector end of the cable is attached to the PC interface board, while the square-pin end of the cable is attached to the μ Analyst interface board.

NOTE

The square-pin end of the cable is keyed to the μ Analyst's board connector so that it cannot be installed incorrectly. Never force the cable connection.

00842-0010



■ Figure 2-8. Connecting the interface cable.

INSTALLING THE STATE ANALYZER BOARDS

If you order the Interactive State Analyzer separately from the μ Analyst mainframe, you will need to install the analyzer boards yourself. The mainframe's card cage is operator accessible, and it contains no hazardous voltages (it is low voltage/low power).

WARNING!

When installing the analyzer's boards, you should gain access to the mainframe's card cage only. Other compartments within the mainframe contain hazardous voltages.

Before attempting to install any boards into the mainframe, turn off the mainframe and disconnect it from any power source. While the voltages within the mainframe's card cage are not hazardous, they may damage board circuitry.

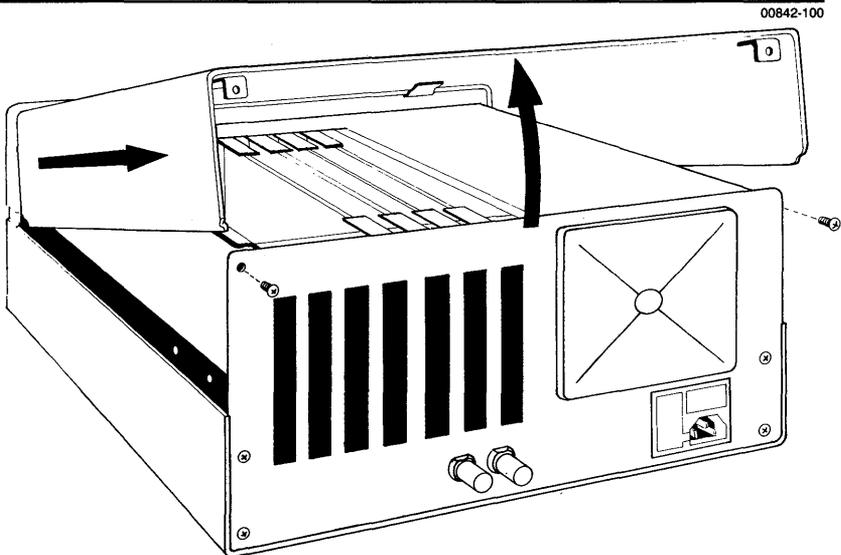
CAUTION

Damage to board circuitry may occur if you install a board while the mainframe is receiving power.

Removing the Mainframe's Cover

To install the analyzer boards, you must first remove the mainframe's top cover. Figure 2-9 illustrates how this is accomplished. Refer to the figure while reading the following steps.

1. Remove the two screws at the upper left and right corners of the mainframe back panel.
2. Lift up the back end of the top cover slightly, then guide the sides of the top cover out of the grooves in the mainframe's side panel.
3. Slide the top cover back a few inches so that its front edge disengages from the mainframe.
4. Lift the top cover until it is clear of the mainframe, and set it aside.



■ Figure 2-9. Removing the mainframe's cover.

Installing and Removing Boards

Figure 2-10 illustrates how the mainframe looks when the top cover is removed. Seven expansion slots, labeled 1—7, are contained in the card cage. Each slot consists of two parallel connectors located at the bottom of the mainframe on the backplane circuit board. You can read the individual slot numbers in the open area of this backplane circuit board, or you can read them on the mainframe's back panel.

Slot 1 is dedicated to the μ Analyst interface board. Slots 2—7 are available for housing the state analyzer and other μ Analyst products.

There are only two rules regarding the placement of the analyzer's boards: 1) the controller board and all memory boards must be installed in contiguous slots; and 2) the controller board must be installed in the lowest numbered of these contiguous slots.

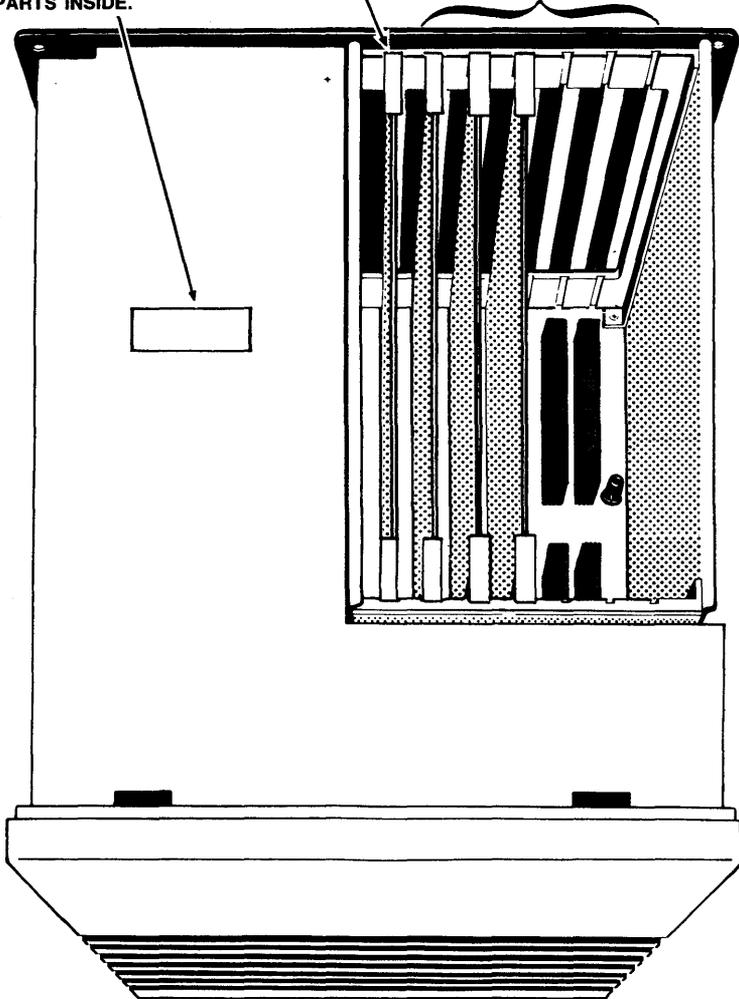
NOTE

The recommended placement of the state analyzer boards is the controller board in slot 2, and one to five memory boards in slots 3 to 7. This placement matches factory configurations.

**LABEL: WARNING!
NO USER SERVICEABLE
PARTS INSIDE.**

**μSLOT 1
(Reserved for
interface board)**

**μSLOTS 2-7
(Available for
ISA boards)**



■ **Figure 2-10. The mainframe's card cage.**

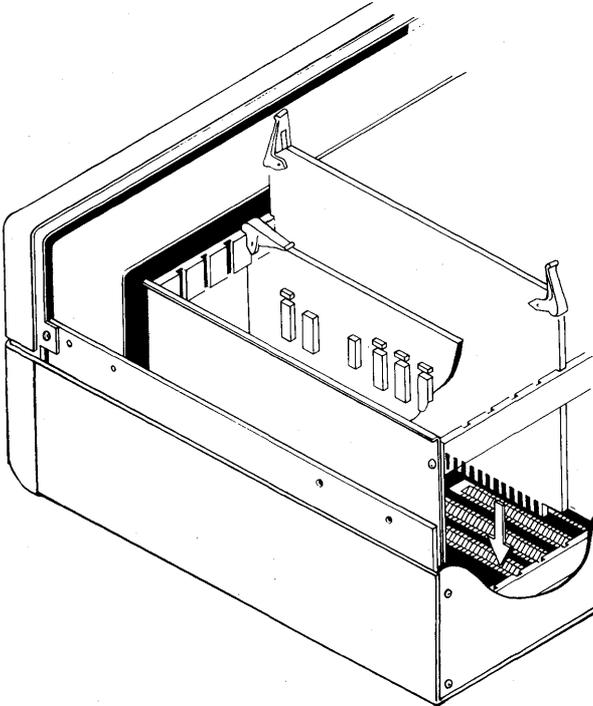
2 Installation

MODEL 2100

To install a board (refer to Figure 2-11):

1. Position the board over the chosen slot, with the board's probe connector(s) facing toward the back of the mainframe.
2. Align the board with the two card guides at the top of the slot, then gently lower the board until it engages with the two card guides at the bottom of the slot.
3. Slide the board down through the card guides until it is resting on top of the slot connectors.
4. Gently but firmly push down on the plastic ejector levers at the upper corners of the board until the board is solidly seated in the slot connectors.

00842-012



■ Figure 2-11. Installing a circuit board into the μ Analyst mainframe.

To remove a circuit board:

1. Lift both plastic ejector levers on the board until the board pops free of the edge connectors.
2. Slide the board up and out of the mainframe.

Replacing the Mainframe's Cover

To replace the mainframe's top cover, simply reverse the procedures shown in Figure 2-9 as follows:

1. With the clips toward the front of the chassis and the threaded tabs toward the back, lower the top cover into the grooves along both sides the mainframe at a slight angle, back higher than front.
2. Gently push the cover forward to engage the clips at the front of the mainframe. There should be a slight gap between the front of the top cover and the step at the rear of the upper surface of the front panel.
3. Lower the top cover and engage the sides into the grooves of the side rails, all along their length. The cover should sit just above the top of the back panel, with the two threaded tabs aligned with the two holes in the back panel.
4. Replace the screws in the upper left and right corners of the mainframe's back panel.

CONNECTING THE PROBES

The state analyzer comes equipped with one P2901 Clock Probe and with one to five P2902 Data Probes. The exact number of P2902 Data Probes depends on the number and type of memory boards included in the analyzer package.

The P2901 Clock Probe is used with the controller board. It provides 11 user-accessible channels, arranged as five sample clocks, two hold clocks, two real-time programmable outputs (RPOs), one run/stop indicator output, and one ground line.

The P2902 Data Probes are used with the memory boards. One probe is required for 16-channel memory boards, and two probes are required for 32-channel memory boards. Each probe provides 16 channels of data input and one ground line.

Tables 2-1 and 2-2 describe the signal characteristics of the P2901 and P2902 probes.

Table 2-1: P2901 Clock Probe Lines

Lines*	Description	Characteristics
S1-S5	Five external sample clocks that are logically ORed to form the master clock.	25 ns min pulse width. 10 MHz max clock rate.
H1, H2	Two hold clocks that can latch and hold data until the master clock is valid.	25 ns min pulse width. 10 MHz max clock rate.
RP01 RP02	Real-Time Programmable Output lines that can be set high/low with every trigger state.	Open collector, Pulled up by 4.7 K Ω . 8 mA I _{OL} .
Run/Stop	Output line that can be programmed to change levels (high/low) when the analyzer starts and stops acquisition.	Open collector, Pulled up by 4.7 K Ω 8 mA I _{OL} .
GND	Ground line.	Tied to chassis ground.

* The sample clocks, hold clocks, and run/stop line are programmed in the Format Menu; the RPOs are programmed in the Trigger-Store Menu. See Section 5, *Menus*.

Table 2-2: P2902 Data Probe Lines

Lines*	Description	Characteristics
D0-D15	Data input channels.	Setup time: 25 ns. Hold time: 0 ns.
GND	Ground line.	Tied to chassis ground.

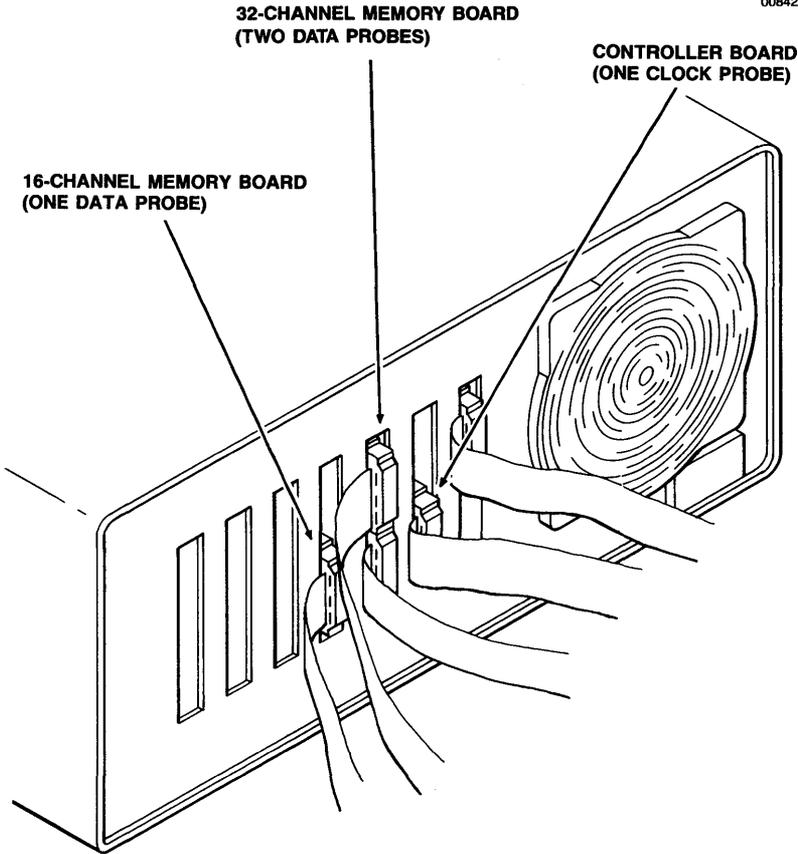
* The data channels are organized for display in the Format Menu. See Section 5, *Menus*.

Connecting Probes to Boards

The P2901 and P2902 probes are connected to their respective boards through the slot openings in the mainframe's back panel. These openings let you access the probe connectors located on the back edge of the boards.

Figure 2-12 illustrates how you connect the probes to the boards. When making these connections, be sure that the raised tab on the probe is keyed to the board's probe connector. Never force a probe connection.

00842-0013



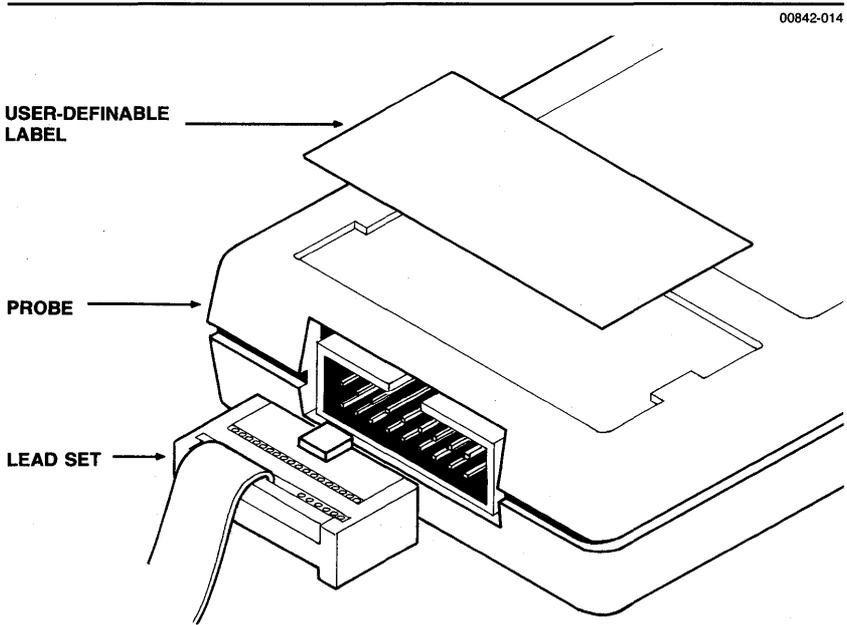
■ **Figure 2-12. Connecting the probes to the boards.**

Installing Lead Sets

The standard accessories for the P2901 Clock Probe include: an 11-channel, square-pin flying lead set; 11 grabber clips; and five user-configurable probe labels with a plastic overlay.

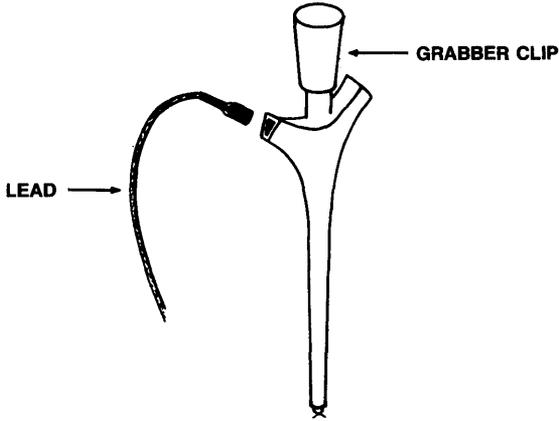
The standard accessories for the P2902 Data Probe include: a 17-channel, square-pin flying lead set; 17 grabber clips; and five user-configurable probe labels with a plastic overlay.

Figures 2-13 and 2-14 illustrate how these accessories are assembled. When connecting a lead set to the probe, make sure that the raised tab on the lead set is keyed appropriately. Never force the connection.



■ Figure 2-13. Installing a lead set on a probe.

00842-015



■ Figure 2-14. Installing a grabber clip.

Customizing Probe Interfaces.

The pinouts from the P2901 and P2902 probes are defined below. You will find these pinouts useful if you want to design a mating probe connector (i.e., test port) as a standard part of the state analyzer system.

NOTE

The following pinouts assume that you are looking directly into the front of the probe, and that the label side of the probe is facing up.

P2901 Clock Probe

H1	S4	S2	GND	RPO2	n/a	n/a	n/a	
15	13	11	9	7	5	3	1	pins
16	14	12	10	8	6	4	2	pins
H2	S5	S3	S1	Run/ Stop	RPO1	n/a	n/a	

P2902 Data Probe

Ch14	Ch12	Ch10	Ch8	Ch6	Ch4	Ch2	Ch0	GND	GND	
19	17	15	13	11	9	7	5	3	1	pins
20	18	16	14	12	10	8	6	4	2	pins
Ch15	Ch13	Ch11	Ch9	Ch7	Ch5	Ch3	Ch1	GND	GND	

Using this section. This section shows you how to load the μ Analyst software and start the system. It also provides instructions on how to run the μ Analyst software from a fixed disk.

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THE μ ANALYST SOFTWARE

The μ Analyst's software package contains three diskettes:

- **SYSTEM DISK for 512K**—runs on computers that have a memory capacity of 512K or greater.
- **SYSTEM DISK for 256K**—runs on computers that have a memory capacity of 256K or greater.
- **HELP DISK**—runs on computers that have a memory capacity of 256K or greater.

Each SYSTEM DISK contains the entire μ Analyst menu operating software. Only one is required per system. Use the SYSTEM DISK that fits the memory capacity of your personal computer.

NOTE

The SYSTEM DISK for 256K memory has certain limitations. For details, refer to the front of this manual, under the page titled *Software Versions Covered in this Manual*.

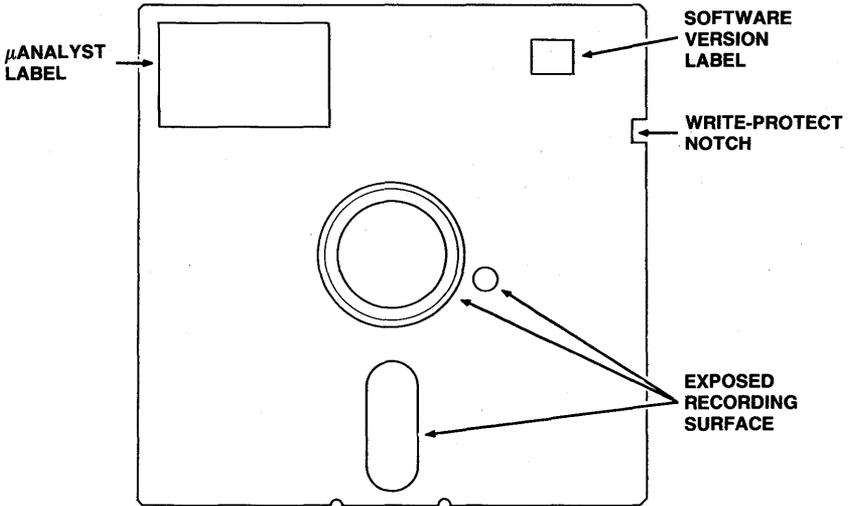
The HELP DISK can be used with either 512K or 256K of computer memory. This diskette is not required for operating the μ Analyst, but it is recommended. It provides a Help Information System that is comprehensive and extremely useful. In addition, it provides demonstration and training programs that will assist you in learning the state analyzer's features and operations (see Section 7 of this manual).

The rest of this section shows you how to load and operate the SYSTEM and HELP DISKS.

USING DISKETTES

Diskettes require special care in handling and storage. When using diskettes, you should always observe the following rules:

- Hold diskettes by their upper left or right corners. Never touch their exposed recording surfaces (see Figure 3-1).
- Never fold or bend diskettes.
- When diskettes are not in use, store them in their accompanying paper envelopes.
- Store diskettes in a dry area with temperatures between 10°-52° C (50°-125° F).
- Never expose diskettes to magnetic fields, such as those surrounding permanent magnets or electronic motors.



■ Figure 3-1. A μ Analyst diskette.

COPYING DISKETTES FOR BACKUP

When you first unpack the μ Analyst diskettes, place adhesive tabs over their write-protect notches. Then use the diskettes to make back-up copies.

The procedures for making back-up copies are listed below. These procedures assume that you know how to use the DISKCOPY command. If not, refer to your DOS reference manual.

To make back-up copies:

1. Install a bootable DOS diskette (version 2.00 or higher) into drive A of the personal computer, then turn the computer on.
2. Now, use the DISKCOPY command to copy the files from the μ Analyst's SYSTEM DISK (source diskette) to a new, blank diskette (target diskette).
3. Finally, use the DISKCOPY command to copy the files from the μ Analyst's HELP DISK (source diskette) to the another new, blank diskette (target diskette).

NOTE

The DISKCOPY command automatically formats the target diskettes when it copies the files.

Continue using the above procedures to make as many back-up copies as you want. When you're finished, put the write-protected diskettes in a safe place, and use the back-up copies for operating the μ Analyst.

USING A FIXED DISK

As an alternative to using diskettes, you can install the μ Analyst software in a fixed disk. This fixed disk must contain the DOS operating system (version 2.00 or higher), and it must have at least 500K bytes of free disk space.

NOTE

For a complete list of compatible fixed-disk computer systems, refer to the page titled *PC Compatibility Requirements* at the front of this manual.

You install the μ Analyst software in a fixed disk by executing the FINSTALL batch file as described below. This batch file is contained in the μ Analyst's SYSTEM DISK. When it is executed, the batch file creates a subdirectory titled ANALYST at the root level on the fixed disk. It then copies all of the μ Analyst system and help files into this subdirectory.

To use the FINSTALL batch file:

1. Power up your fixed-disk computer, and if necessary, load the DOS operating system.
2. Insert the μ Analyst's SYSTEM DISK into drive A (the floppy disk drive of the fixed-disk computer).
3. Enter drive A.
4. Type the batch file command:

FINSTALL C: (where C is the fixed-disk drive of your computer.)

Then press the return key.

5. Follow the on-screen instructions provided by the batch file. A message on the screen will tell you when the copying procedure is complete.

STARTING THE μ ANALYST

NOTE

The following procedures assume that you have installed the μ Analyst hardware and have connected the mainframe to the personal computer as specified in Section 2 of this manual. If not, do so at this time.

There are two methods of starting the μ Analyst: one for diskettes and one for fixed disks. These two methods are described in the following paragraphs.

Starting the μ Analyst Using Diskettes:

1. Insert a bootable DOS diskette (version 2.00 or higher) into drive A of the personal computer.
2. Turn on both the personal computer and the μ Analyst mainframe.
3. Remove the DOS diskette from drive A and replace it with the μ Analyst's HELP DISK.
4. Now, insert the μ Analyst's SYSTEM DISK into drive B of the personal computer.
5. Enter drive B. Then type the word ANALYZE and press the return key.

The start-up procedure is now complete.

Starting the μ Analyst Using a Fixed Disk:

NOTE

The following procedures assume you have transferred the μ Analyst software onto a fixed-disk computer as described earlier under *Using a Fixed Disk*.

- ① Turn on both the fixed-disk computer and the μ Analyst.
- ② Enter drive C (the fixed-disk drive).
- ③ Enter the ANALYST subdirectory by typing the Change Directory command as follows:

CD ANALYST

Then press the return key.

- ④ Finally, type the word ANALYZE and press the return key.
The start-up procedure is now complete.

A Successful Start-Up Display

The Configuration Menu is the first menu displayed by the μ Analyst. This menu tells you the status of the μ Analyst hardware and software, and it directs you to the various levels of operation.

Figure 3-2 illustrates a successful start-up display of the Configuration Menu. The right side of menu tells you the status of the μ Analyst. It specifies the software version in use, and it lists all product boards and their mainframe slot locations.

The left side of the menu provides a list of the μ Analyst's operating options. Through these options, you access the various menus and control all system-level functions. (*Note: We will describe these options in detail in Section 5 of this manual.*)

00842-017

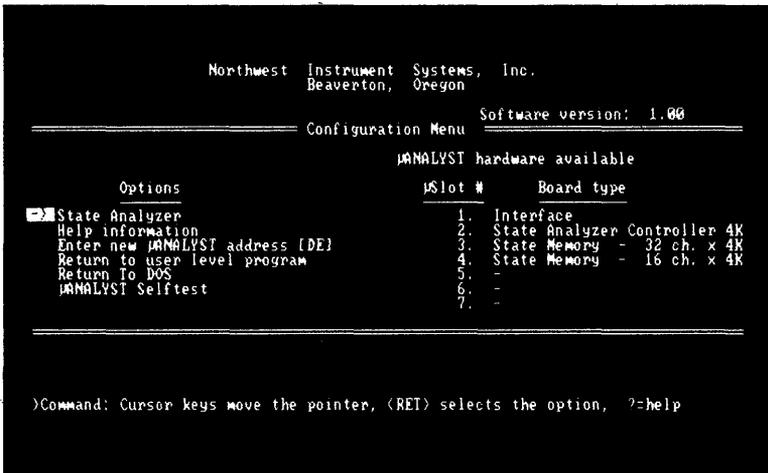


Figure 3-2. A successful start-up display.

Start-Up Error Conditions

When the μ Analyst software is first loaded, it tests the PC interface address and checks the μ Analyst mainframe for installed circuit boards. The following paragraphs list and define the possible start-up error conditions.

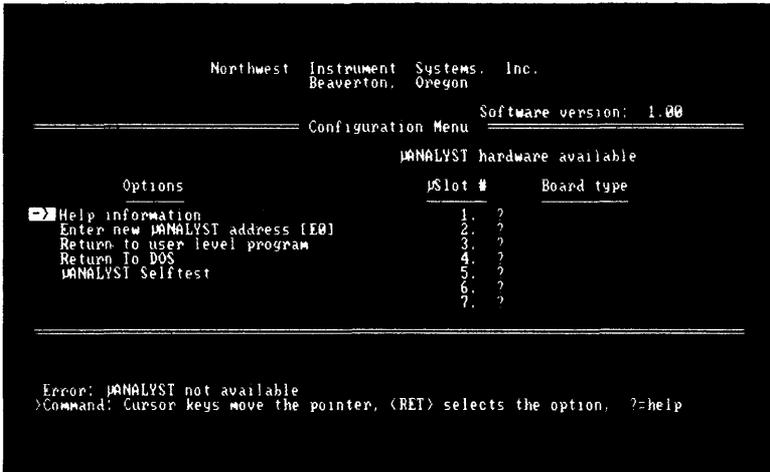
Error Condition: The Configuration Menu does not appear on start-up.

This error indicates a problem with your personal computer or with the μ Analyst SYSTEM DISK. First, check your personal computer to see if it is working properly. Then, check the label on your μ Analyst SYSTEM DISK to make sure it fits the memory capacity of your computer.

If the above two procedures do not locate the problem, make a new back-up copy from your original μ Analyst SYSTEM DISK and try reloading the software. If the new back-up copy fails, contact Northwest Instrument Systems, Inc.

Error Condition: The Configuration Menu displays a question mark (?) next to each of the slot locations (see Figure 3-3).

00842-018



■ Figure 3-3. Start-up error condition.

If your display looks like Figure 3-3, one of five things is probably wrong:

1. The interface cable between the μ Analyst and the personal computer is not securely connected.
2. The power to the μ Analyst mainframe is not on.
3. The μ Analyst or PC interface boards are poorly seated in their slot connectors.

4. The address switches on the PC interface board have been set to an address range that is being used by another PC-based product.
5. The address switches on the PC interface board have been changed from their original default setting of DE hexadecimal.

If the error is caused by one of the first three problems, take appropriate action.

If the error is caused by the fourth problem, you will have to change the address range for either the μ Analyst or the conflicting product. Procedures for changing the μ Analyst's address range and its switch settings are provided in Section 2 of this manual, under the subsection titled *Installing the PC Interface Board*.

00842-019

```
Northwest Instrument Systems, Inc.
Beaverton, Oregon

Software version: 1.00
===== Configuration Menu =====
                                 $\mu$ ANALYST hardware available
Options                           $\mu$ Slot #      Board type
-----
State Analyzer                   1.         Interface
Help information                 2.         State Analyzer Controller 4K
-> Enter new  $\mu$ ANALYST address [D1] 3.         State Memory - 32 ch. x 4K
Return to user level program     4.         State Memory - 16 ch. x 4K
Return To DOS                    5.         -
 $\mu$ ANALYST Selftest              6.         -
                                7.         -
                                8.         -
                                9.         -
                               10.         -
=====
Message: Enter the 8 MS bits (in HEX) for  $\mu$ ANALYST interface address, ?=help
)Edit: Enter 0 thru F ?=help
```

■ Figure 3-4. Entering a new μ Analyst address.

If the error is caused by the fifth problem, you can rectify the condition by entering a new address range into the Configuration Menu. To do this, move the blinking screen pointer to the Configuration Menu's Enter New μ Analyst Address option selection as shown in Figure 3-4. Press the return key. Now, using hexadecimal notation, enter the new address range into the reverse video field. Again, press the return key.

3 Getting Started

MODEL 2100

The Configuration Menu will check the newly entered address location, and if it finds the μ Analyst software, it will immediately replace the question marks with the appropriate hardware list.

NOTE

If the SYSTEM DISK is not write-protected, the Configuration Menu will remember the newly entered μ Analyst address and will automatically search that location whenever the μ Analyst is restarted.

If none of the above procedures corrects the error condition, contact Northwest Instrument Systems, Inc.

Error: The Configuration Menu displays a question mark (?) next to a specific slot location.

A question mark next a slot indicates that the board installed in that slot is either poorly seated or faulty. If the problem still exists after you have reseated the board, contact Northwest Instrument Systems, Inc.

Using this section. This section gives you an overview of the Interactive State Analyzer and its operating features. As you use the analyzer, keep in mind the main points of this section. The text here will help you program the analyzer with more understanding, and you will find that desired results are easier to define and achieve.

Throughout this section, reference is made to the various state analyzer menus. The menus are described in detail in Section 5 of this manual.

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DATA ACQUISITION MODES

The Interactive State Analyzer has two data acquisition modes: the standard mode, where data is sampled and stored according to the storage qualification established in the Trigger-Store Menu; and the Multiple-Preview Acquisition (MPA) mode, where a sequence of unqualified data occurring before each qualified event is also stored.

Standard Data Acquisition Mode

In the standard data acquisition mode, data is sampled at each sample clock cycle and compared to a set of word recognizer values specified in the Trigger-Store Menu. Qualified data (data words matching the events programmed in the storage qualification IF <event> THEN STORE line of each state) is stored when the comparison is valid. The trigger event is always stored, too.

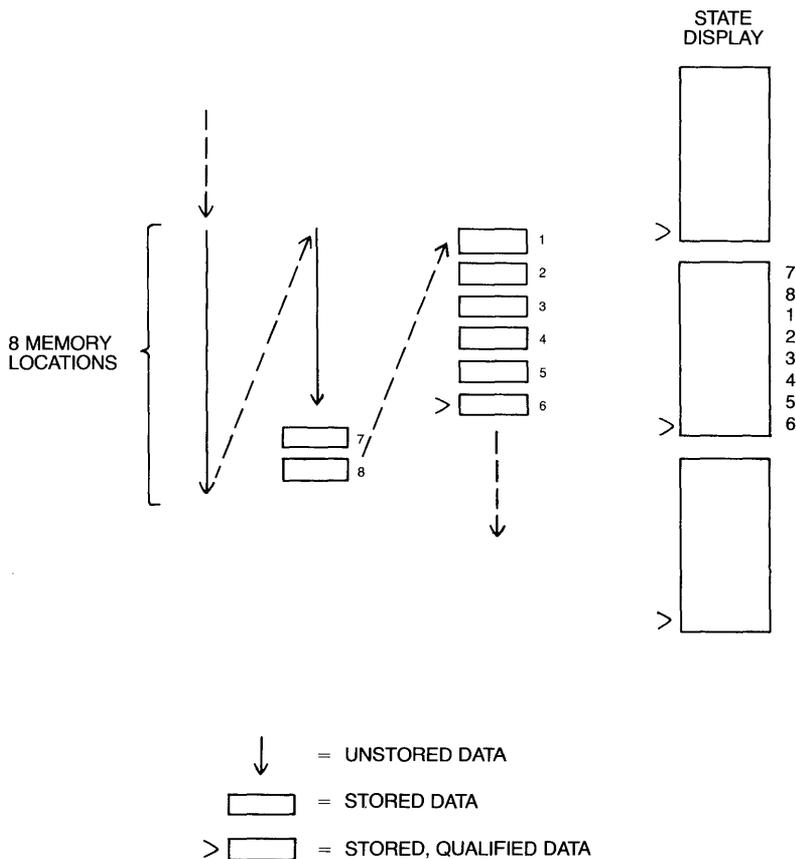
As an option (in the Trigger-Store Environment Submenu), you can also program the analyzer to store each event that causes a state transition. Since state names are stored along with the event that caused the state transition, program flows are easily traced. The demonstration example in Section 7 uses this capability to follow the operation of the demo circuit board.

Multiple-Preview Acquisition Mode

Qualified data storage is a powerful feature that allows you to define what kind of data to store, and ignore the rest. Multiple-Preview Acquisition (MPA) extends this concept, enabling you to solve more complex problems.

For example, suppose you know that a certain event is associated with a failure. You could try to find the cause of the failure by triggering on the failure-related event and looking at the data preceding it. But if the failure is intermittent, you would be forced to start the logic analyzer repeatedly until the cause was captured. MPA helps solve this kind of problem.

In MPA mode, the state analyzer's hardware is reconfigured so that data is stored continually while the machine waits for a qualified acquisition. When qualified data is detected, up to seven of the previous unqualified events are retained in memory, while the storage process begins again, until the system triggers. This process is illustrated in the example shown in Figure 4-1.



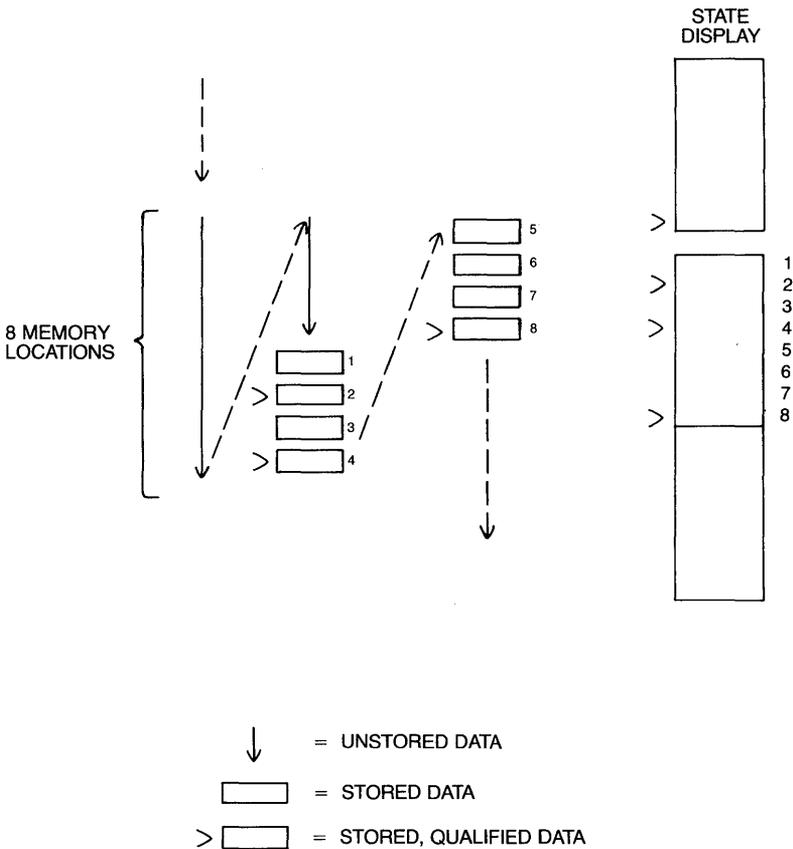
■ **Figure 4-1. MPA data acquisition.**

As shown in the example, unqualified data storage first fills location 1, then location 2, and so forth with each sample clock. If no qualified data is detected before location 8 has been written, new unqualified data overwrites location 1, then 2, and so on. In this particular example, a qualified event is finally detected and stored in location 6. Locations 7-8 and 1-5 now contain unqualified data stored on the seven sample clock cycles immediately preceding the qualified event.

On the state display, you will generally see data displayed as multiple groups of eight words. The qualified words (those matching the IF <event> THEN STORE line in the Trigger-Store Menu) are marked with a right arrow symbol (>).

In Figure 4-2 you can see that several qualified events occurred within eight sample clocks of one another. In this case, storage continues in the same group of eight locations, and then immediately continues in the next group of eight. In this example, the event in location 8 happened to be qualified.

00842-021



■ Figure 4-2. Qualified events, all within eight sample clocks.

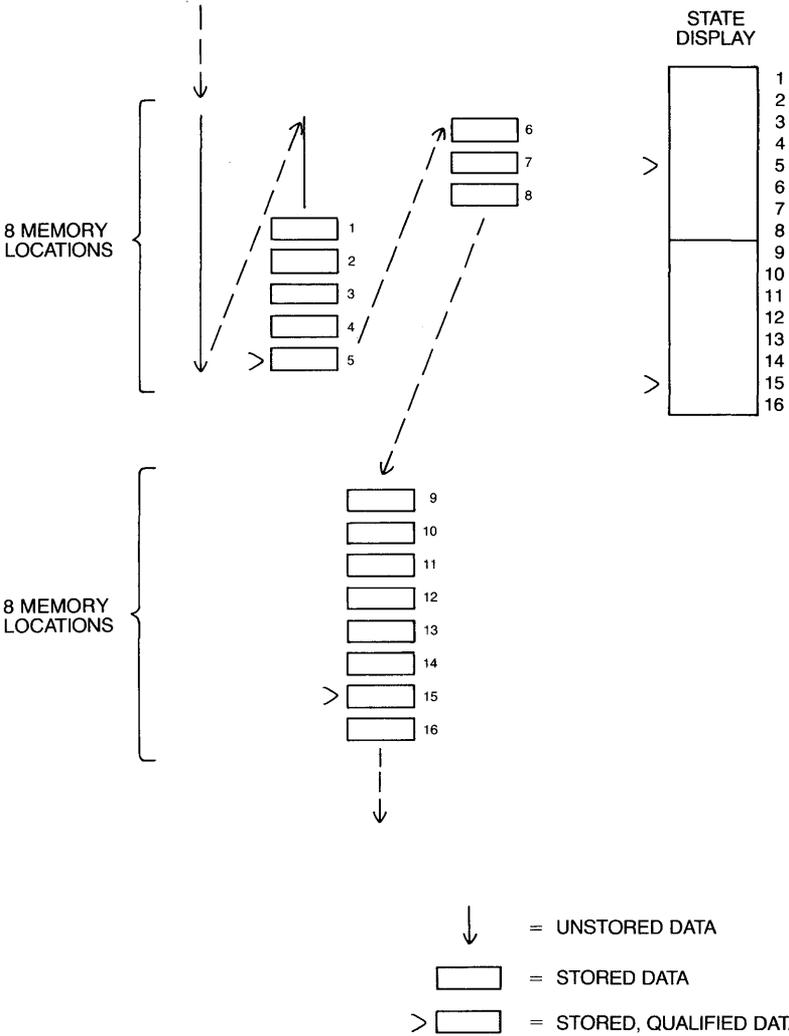
4 Modes of Operation

MODEL 2100

If the event in location 8 had not been qualified, the acquisition could have continued in much the same way as the acquisition represented in Figure 4-3. As in the example in Figure 4-2, several qualified acquisitions are made within eight sample clocks. When all eight locations in the current group are filled, new unqualified samples are stored in the next group.

If a qualified acquisition occurs before all the locations in this group of eight have had data stored in them once, this is treated as a special case in the state display. Note, in the state display to the right of Figure 4-3, that there are no blank lines between the two groups of eight unqualified events. Data not separated by blank lines is acquired on successive sample clocks, while a blank line between two lines of data indicates that an indeterminate number of sample clocks occurred between these two events.

00842-022



■ Figure 4-3. Unqualified events, within eight sample clocks.

As an example of how useful MPA mode can be, suppose you are debugging a program module you've just written. One bug seems to be associated with a global variable accessed by other modules you did not write. You could use the standard data acquisition mode to monitor the reading and writing of this variable by qualifying storage on the variable address, but this would not enable you to store the code that caused the variable to change. With the MPA mode, using the same storage qualification and triggering, the state analyzer will capture the executing code causing each of up to 512 accesses to this variable. Now you can search out the bug by looking back through the data acquired before the trigger.

 **NOTE**

For a more detailed example of how to use the MPA mode, refer to Section 7 of this manual.

CLOCKING OPTIONS

The Interactive State Analyzer features a sophisticated clocking scheme. The P2901 Clock Probe provides seven input signals for use in establishing the synchronous sample and hold clocks. It also provides three output signals, the Run/Stop line and the Real-Time Programmable Outputs, which can be used for interacting with the system under test.

The following paragraphs describe how these input and output signals are used. The sample clocks, hold clocks, and Run/Stop signal are all programmed in the Format Menu. The Real-Time Programmable Outputs are programmed in the Trigger-Store Menu.

 **NOTE**

Detailed procedures for using the state analyzer clocking options to acquire data from various microprocessors are provided in Appendix C of this manual.

Sample Clocking

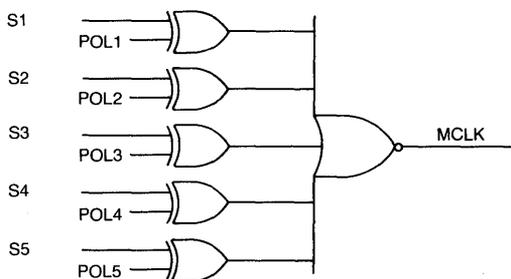
The sample clocks determine the time at which the state memory boards sample synchronous data. There are five sample clocks, which are ORed together to create the master clock. They are labeled S1 through S5 on the clock probe.

As you can see from the example in Figure 4-4, when the sample clocks do not overlap in time, they produce a master clock consisting of pulses contributed by each of the sample clock pulses.

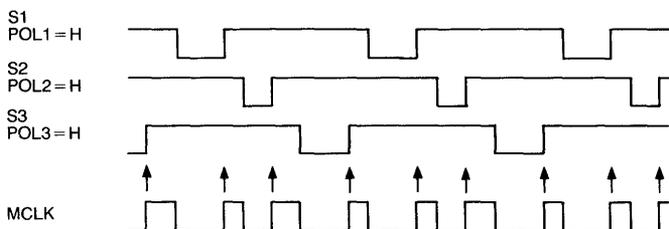
When the sample clocks do overlap, the master clock, which is the sum of all the sample clocks, merges the pulses to create a longer pulse.

You select the polarity of each sample clock in the Format Menu. The slope referred to on the menu is the slope of the trailing edge of the sample clock—the edge on which data is sampled.

00842-023

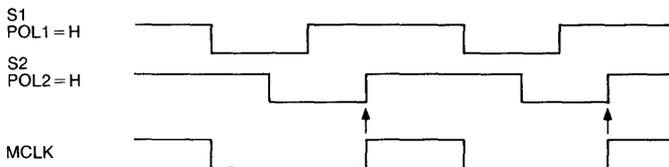


A



B

↑: ACTIVE EDGE



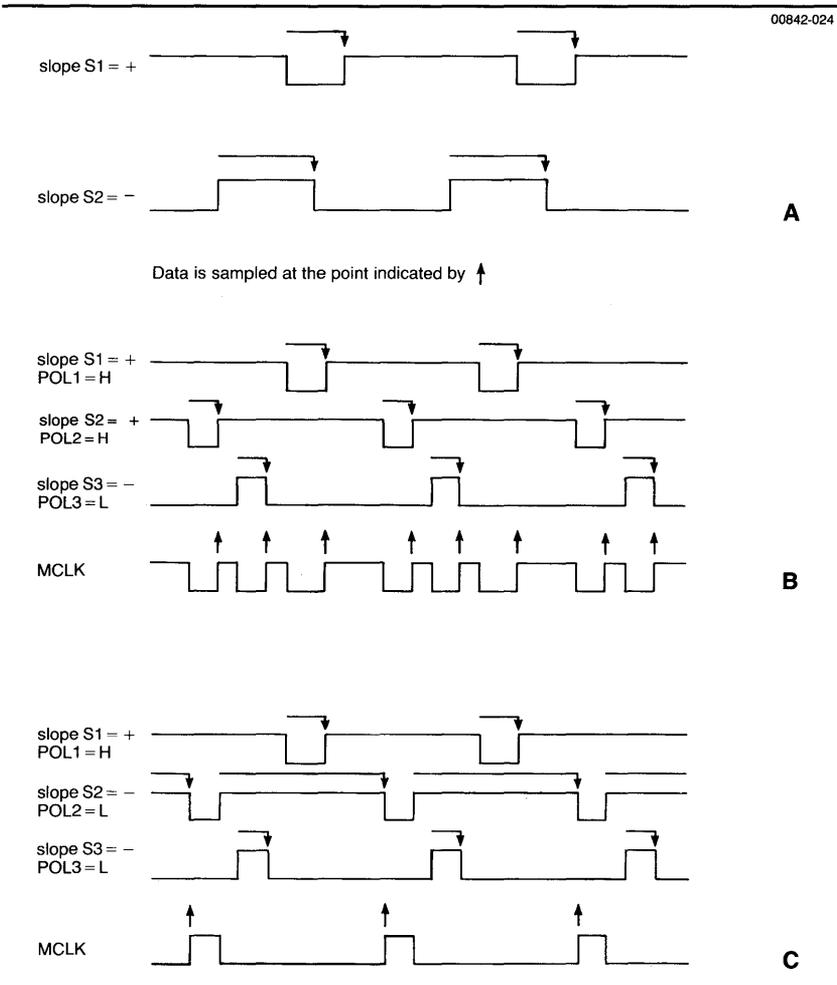
C

■ Figure 4-4. Using the five sample clocks to form the master clock.

4 Modes of Operation

MODEL 2100

The polarity of the slope on the sample clocks affects the ORing of the clocks. Figure 4-5 shows how a simple change of polarity changes the master sample clock considerably. One way to look at this is in terms of clock periods. By defining the trailing edge of the clock, you are also defining the period from the leading to the trailing edge to be used in ORing the clocks together.

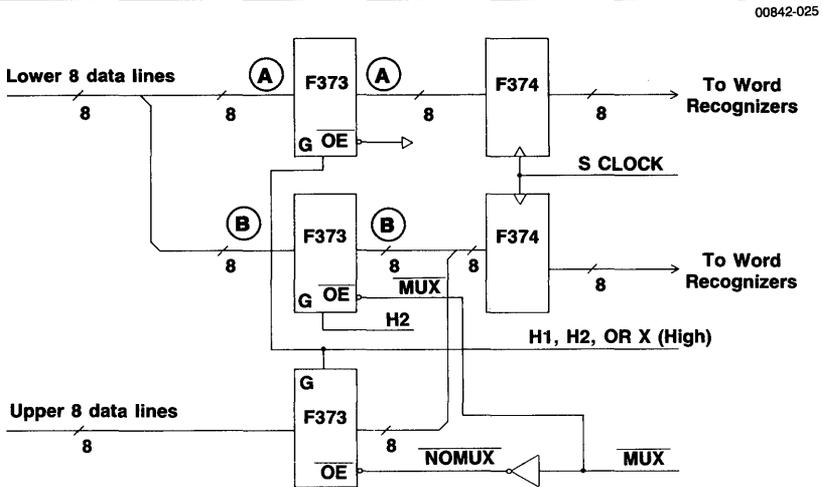


■ Figure 4-5. The effects of sample clock polarity.

Hold Clocks and Demultiplexing

For microprocessors or systems that multiplex data and addresses onto the same bus, the Interactive State Analyzer provides a convenient way to demultiplex the signals. Through the Format Menu, you can select multiplexed or non-multiplexed acquisition for each data probe.

Figure 4-6 illustrates how the data channels from a probe are routed to the word recognizers. Typically, all 16 channels are routed via Path A. In the multiplex mode, however, the probe's upper 8 channels (D8-D15) are ignored and only its lower 8 channels (D0-D7) are acquired. These lower 8 channels are sampled subject to different hold clocks on Path B.



■ Figure 4-6. Multiplexed/non-multiplexed input circuitry on the state memory boards.

4 Modes of Operation

MODEL 2100

The two hold clocks available for demultiplexing are labeled H1 and H2 on the clock probe. Figure 4-7 illustrates sample and hold clocking and demultiplexing.

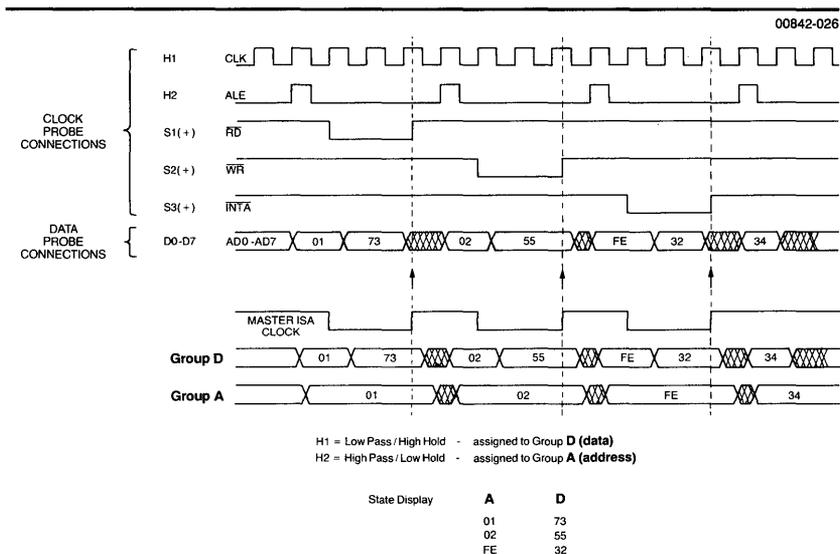
In this example, sample clocks S1, S2, and S3 are connected to the \overline{RD} , \overline{WR} , and \overline{INTA} strobes of the microprocessor. Their polarities are all set to positive (in the Format Menu), because their trailing edges are positive-going. S1 and S5 are not connected, and so are set to off.

The least significant 8 bits of the data probe (bits D0-D7) have been connected to the AD0-AD7 lines on the microprocessor, which carry multiplexed address and data information.

The hold clocks enable the state analyzer to demultiplex this bus and acquire both address and data simultaneously. Inside the analyzer, the probe lines D0—D7 are split into two paths, one for addresses and one for data. Each path is sampled by a hold clock, and the resulting address and data are held until the master clock occurs. When the master sample occurs, the address and data are both stored in memory.

In Figure 4-7, H2 (hold clock 2) is connected to the microprocessor's ALE (Address Latch Enable). H2 has been programmed in the Format Menu to be high pass, low hold. This means that the address and data lines will pass transparently through the H2 presample latch while ALE is high, and will be latched, or held, when ALE goes low. The data gathered by the presample latch is represented in Figure 4-7 by Group A. As you can see from the diagram, the microprocessor's valid address (the lower 8 bits) has been latched and held so it can be clocked into the analyzer by the master clock.

Notice, in Figure 4-7, that the data portion of the address and data (73, 44, 32) has shifted slightly to the right in Group D. This happens because H1 (hold clock 1) is connected to the microprocessor's CLK signal. H1 has been programmed to be low pass, high hold. The microprocessor data is held in the H1 presample latch for nearly half a microprocessor clock period after it has changed on the address/data lines. H1 will generate data hold times only if the microprocessor system allows the data to go invalid before the end of its data strobes (\overline{RD} , \overline{WR} , and \overline{INTA} , for example).



■ **Figure 4-7. Using sample and hold clocks with a multiplexed microprocessor.**

Run/Stop Line

The Run/Stop line is an output generated by the state analyzer to indicate the run/stop status of the analyzer hardware. Its output polarity can be programmed in the Format Menu as either high for run and low for stop, or vice versa.

Real-Time Programmable Outputs

The Real-Time Programmable Outputs, labeled RPO1 and RPO2 on the clock probe, are user-programmable outputs. They can be programmed to change value with the transitions from state to state while the analyzer is running. The RPOs are programmed in the Trigger-Store Menu, where you define what logic levels the RPOs should output at each state transition.

TRIGGERING OPTIONS

The flexibility of the Interactive State Analyzer, which provides you with the tools for homing in on the sources of problems, is based on its programmable state machine. Here are its key features:

- Fifteen independent states controlling triggering and state sequencing, storage qualification, and three programmable external outputs (the RPOs) and the Crosslink line (the CL).
- Two word recognizers per state to control triggering, state sequencing, and the programmable outputs.
- Two word recognizers per state for data storage qualification.

You can program the fifteen states to detect sequences of events, including branching sequences. Six variations of IF-THEN-ELSE programming logic are available, as shown in Figure 4-8.

-
- A. IF <event> OCCURS (1-4096) TIMES THEN (GOTO <state> or TRIGGER).
 - B. IF <event> OCCURS (1-4096) TIMES THEN (GOTO <state> or TRIGGER).
ELSEIF <event> OCCURS ANYTIME THEN (GOTO <state> or TRIGGER).
 - C. IF <event> OCCURS AFTER (1-4096) (SAMPLE or STORE) CLOCKS THEN
(GOTO <state> or TRIGGER).
 - D. IF <event> OCCURS AFTER (1-4096) (SAMPLE or STORE) CLOCKS THEN
(GOTO <state> or TRIGGER).
ELSEIF <event> OCCURS ANYTIME THEN (GOTO <state> or TRIGGER).
 - E. IF <event> OCCURS BEFORE (1-4096) (SAMPLE or STORE) CLOCKS THEN
(GOTO <state> or TRIGGER).
ELSE (GOTO <state> or TRIGGER).
 - F. IF <event> OCCURS BEFORE (1-4096) (SAMPLE or STORE) CLOCKS THEN
(GOTO <state> or TRIGGER).
ELSEIF <event> OCCURS ANYTIME THEN (GOTO <state> or TRIGGER).

■ **Figure 4-8. IF-THEN-ELSE Triggering Options.**

The simplest trigger mode is mode A:

IF <event> OCCURS (1-4096) TIMES THEN (GOTO <state> or TRIGGER).

In this mode, events are counted until the total matches the preset value, and then the action is taken. Like all versions of the state program, until the IF or ELSEIF condition occurs, data is stored according to the storage definition specified below the two IF-THEN-ELSE definitions in each state. When the definition is satisfied, control is transferred to another specified state or the system is triggered (which means that acquisition ends, subject to the trigger position programmed at the top of the Trigger-Store Menu). During this transition the Real-Time Programmable Outputs (RPOs) and the Crosslink (CL) are set to the new values defined in the state you are leaving.

Trigger mode A is useful for identifying particular events or setting up looping conditions. For example, you could define the state as follows:

IF RESET OCCURS 0001 TIMES THEN TRIGGER.

Data will be qualified and stored continuously until the RESET is detected, and then acquisition will stop. Qualified data leading up to the RESET will be stored and displayed, so you can see what caused this condition.

An additional ORed event added in mode B expands this flexibility. The first event takes precedence over the second if the two occur at the same sample.

Building on the preceding example, a more elaborate definition is:

**IF RESET OCCURS 0001 TIMES THEN TRIGGER
ELSEIF PROC1 OCCURS ANYTIME THEN GOTO <2> ,**

where PROC1 stands for procedure 1 (so named in the Symbol Menu).

Now we can look for occurrences of RESET that come before PROC1. If the GOTO <2> were changed to TRIGGER, we would be looking only for RESET or PROC1 to occur before triggering.

Another valuable capability offered in mode C is counting clocks. You count sample clocks (the five system clocks ORed together to generate the master clock, according to specifications in the Format Menu) or store clocks (the sample clocks that correspond to storing qualified data).

4 Modes of Operation

MODEL 2100

The addition of ELSEIF to mode C gives you mode D. Here's a trick for setting up three ORed events:

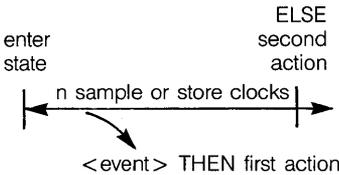
```
IF ANY VALUE OCCURS AFTER 0001 STORE CLOCKS  
THEN GOTO <2>  
ELSEIF <event 3> THEN GOTO <2>  
IF <event 1> OR <event 2> THEN STORE
```

Event 1 and event 2 cause their respective data to be stored. When one store clock occurs, the top IF line is true. The ELSEIF line is the third ORed event. The disadvantage of this technique is that, for this state, only event 1 or event 2 data is stored. This mode is useful for the ORed recognition of three events which move to another state with less restrictive data qualification.

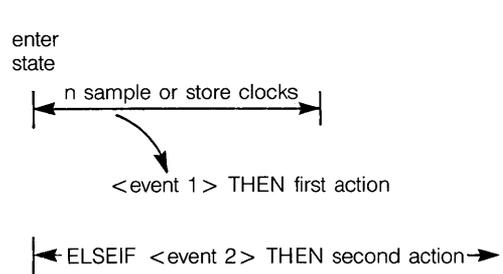
Modes E and F, using the BEFORE parameter, open a window of a specified number of sample or store clocks. If the event occurs when the window is open, the first action will be taken. In mode E, if the event fails to occur before the count is completed, the second action is taken automatically. In mode F, the second action is an ORed condition that can occur at any time before or after the count is completed.

The following diagram illustrates the differences between modes E and F.

Mode E



Mode F



Let's see how you can define a state or sequence of states that tests indefinitely until a condition is met and the proper data stored. Consider this state definition:

```
IF IOERR OCCURS BEFORE 0020 STORE CLOCKS THEN  
TRIGGER  
ELSEIF TRAP1 OCCURS ANYTIME THEN GOTO <next> ,
```

where IOERR is an I/O error and TRAP1 is a procedure designed to catch the error.

This allows you to narrow in on a very specific problem. You'll find out what causes the I/O error to occur within 20 qualified data events of entering the state. The ELSEIF condition provides a way to restart acquisition when the error has been handled properly.

Several additional examples of state machine programming are described in detail in the demonstration exercises in Section 7.

STORAGE QUALIFIER OPTIONS

Figure 4-9 illustrates the storage qualifier options available in the state machine.

-
- A. ALWAYS—> STORE
 - B. IF/name OCCURS THEN—> STORE
 - C. IF/name OR/name OCCUR THEN—> STORE
 - D. IF/name AND/name OCCUR THEN—> STORE
 - E. NEVER—> STORE

■ Figure 4-9. Storage qualifier options.

Two word recognizers are available for data storage qualification in each state. The five modes listed in Figure 4-9 show the combinations available.

The simplest is mode A: always store all sampled data.

Mode E sets the state to never store data, just as mode A sets the state to always store. Mode E is useful in conjunction with the acquisition mode to store all state transitions (as specified in the Trigger-Store Environment Submenu). Then the only storage is the movement between states, that is, the causes of state transitions.

Mode B uses one event to qualify storage. The event can be as loosely defined as a control line, such as store all I/O accesses or all READ accesses, or it can be as tightly specified as a single data value stored into a variable. Similarly, the NOT selection for the event can also be loosely defined, for example, as store all bus cycles except I/O cycles, or tightly defined, for example, as store when the variable is written to a value that is not a given value.

4 Modes of Operation

MODEL 2100

Mode C, the ORing of two events for storage, is useful for more complex storage qualification. In MPA mode, you can see code and stack information leading up to two separate procedures defined by the two events. The ORed combination of two events can also be used to obtain a range of addresses outside the strict binary range with just one event.

For example, suppose you want to trace code accessing a data array that starts at hexadecimal address 1240 and ends at 1284. The address range can be split out as follows:

1240-127F, or 1280-1284

Event 1 is programmed to the value 1240 with a mask FFC0. Event 2 is 1280 with a mask FFFC.

With MPA mode on, this storage qualification will display code that accesses any element of the array. This ORing technique does not support full-range recognition, but it does permit an approximate area of values that can cover the range required, although it may overlap additional values.

Mode D, the ANDing of two events, may seem not to be useful, because all channels are ANDed together to form one count. But it is useful when one event recognizes one portion of the channels and the other is set to a not value of another portion.

For example, to store all writes to address B7F2 with a data value not equal to 20, you would program event 1 for address=B7F2 and event 2 for data=20. The following store line would provide this setup:

```
IF <event 1> and / <event 2> THEN —> STORE
```

RUN (GO) MODES

Several run modes are provided by the Interactive State Analyzer. These modes are selected in the Display Environment Sub-menu, and they are started by pressing G for Go from the command line. Each run mode is introduced below:

- **GO ONCE**—The analyzer gathers data until a trigger is found. The acquisition continues until memory is filled with the specified amount of post-trigger data. The amount of pre- and post-trigger is specified in the Trigger Position field in the Trigger-Store Menu.
- **GO FOREVER**—The analyzer takes successive acquisitions. This mode is often used while viewing either the Display or Histogram Menu. The analyzer updates the display or histogram automatically with each new acquisition.

- GO TIL ACQ = REF—After each acquisition, the analyzer compares acquisition data to the contents of reference memory. The acquisitions continue until the two memories match. (The comparison parameters are set up in the Display Environment Submenu.)
- GO TIL ACQ < > REF—After each acquisition, the analyzer compares acquisition data to the contents of reference memory. The acquisitions continue until a difference between the memories is found.

Both GO TIL ACQ = REF and GO TIL ACQ < > REF can be used to help isolate intermittent problems.

In addition to the above modes, the state analyzer provides a special feature that lets you acquire data until a memory overflow is detected. This feature is useful when you cannot establish an appropriate trigger. Once started, the analyzer periodically checks acquisition memory and stops acquisition the first time it detects a memory overflow condition.

STATE DISPLAY & ANALYSIS

Once data is acquired, you can use the Display Menu to view the data in a columnar, radix format. You can also make acquisition and reference memory comparisons.

State Display

The organization of the Display Menu is set up through the Format Menu. You can organize incoming channels into logical groups, with each group containing from one to 32 channels. You can also name the groups and specify their display radices as hexadecimal, octal, binary, or ASCII.

The Display Menu shows the data in columns that reflect the selected channel groups and their radices. Special command-line functions are provided that allow you to scroll the display window to the portion of memory you are interested in. You can page backwards and forwards through memory, or you can jump to any specific memory location.

Reference Memory Comparisons

At any time, you can transfer acquisition data to the reference memory, then compare new acquisitions with old. The boundaries of this data transfer and comparison are set up through the Display Environment Submenu.

Display modes are available that let you view acquisition and reference memories separately, or in comparison. When viewed in comparison, the two memories are displayed side by side and any differences between them are highlighted.

HISTOGRAM OVERVIEW DISPLAYS

A special feature of the state analyzer is its Histogram Menu.

In this menu, you can perform range-activity measurements of acquired data.

The Histogram Menu works in the following way. You define up to 16 address or data ranges for a specific channel group. The state analyzer then calculates and graphically displays the percentage of acquired data that falls into each range.

Additional functions are provided that allow you make continuous acquisitions while in this menu. This way, you can dynamically monitor the system under test and observe any shifts in activity levels.

STATE AND TIMING TOGETHER MODES

If you have both the Interactive State Analyzer and the Model 2200 Interactive Timing Analyzer installed in your μ Analyst, you can use them together in time-aligned acquisition modes. The μ Analyst provides a full range of cross-arming and cross-triggering capabilities.

Refer to Section 6, *State and Timing Together*, for a detailed discussion of how to use these two analyzers together.

Using this section. This section details all facets of the menu structures used in the Interactive State Analyzer. It covers the uses, mechanics, and applications of each menu, both in total and in their component parts.

It is recommended that first-time users read the entire section, then later use it as a reference guide.

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MENU STYLE

In Northwest Instrument Systems' products the word *menu* takes on extended meaning. The following paragraphs introduce you to our way of implementing menus.

What are Menus?

Traditionally, *menu* has referred to a simple, one-dimensional list of function or command options. This is also true for the Interactive State Analyzer, but menu also refers to a more visual, two-dimensional method of displaying selectable or programmable items. Fields within a menu may have multiple choices associated with them.

The command line is a list of directives or operations that appears at the bottom of the screen. Typically, these commands move the system from one menu to another, or initiate specific actions within the system or the menu currently displayed.

When you are in the edit mode, the edit prompt line appears in place of the command line. This line indicates the acceptable edit choices for a specific field. The following subsections will have more details about the command and edit modes.

Command and Edit Modes

In the following pages and in using the state analyzer itself, you will notice several command options. One important item to remember is that there are two distinct menu modes:

- **Edit**—to set up or change a programmable field within a menu, you must be in the edit mode.
- **Command**—to run the analyzer as programmed, you must be in the command mode. Other functions of this mode include viewing collected data, using various tools to analyze the data, storing the collected data, and so on.

Visual and Audio Cues

The state analyzer keeps you informed of what it is doing through several reserved lines at the bottom of the screen.

At the bottom of the screen is the command line. This line shows what commands are currently available. Mnemonic key assignments are used wherever possible in this line. For example, you would press E to enter the edit mode, G to go, M to list the menus available, and so on. Keep an eye on this line; the scope of available commands can change from mode to mode and menu to menu.

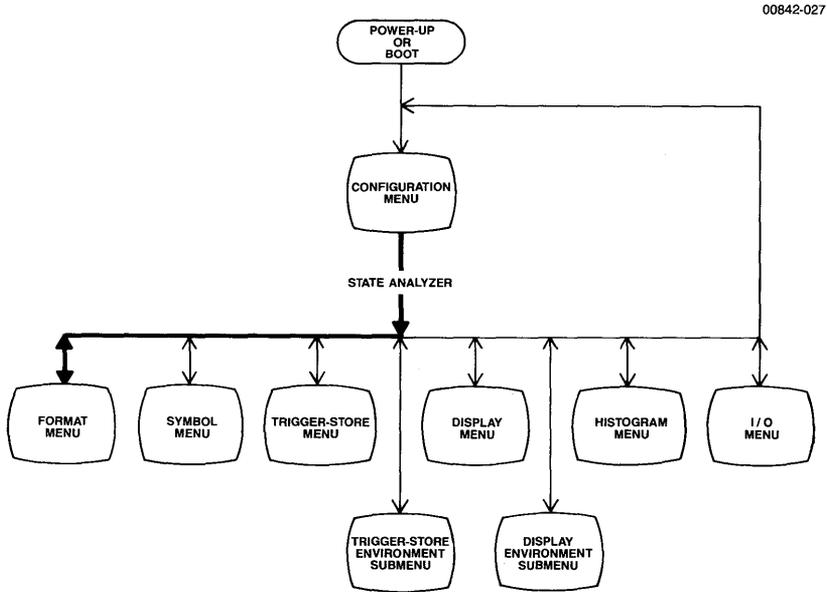
The next line up from the bottom displays errors, warnings, and other messages. Appearance of text on this line is accompanied by some audible signal. A short clicking sound indicates that additional information has been displayed. A beep indicates a warning, a potential error condition, or an error condition. When you hear a click or beep, refer to this line.

Menu Flow and Hierarchy

Figure 5-1 shows the basic structure of the state analyzer menus.

Note that once you are in the Format Menu you can freely jump from menu to menu. (The bold line to the Format Menu indicates the first-time path taken from the Configuration Menu.)

You enter a menu by pressing M for Menus from the command, then by pressing the first letter of the menu name. For example, T for Trigger-Store. You enter an environment submenu by pressing V for enVironment from the command line, then by pressing the first letter of the submenu name.



■ Figure 5-1. Menu Flowchart.

Programming Fields Within Menus

As you will see later on, there are a lot of things that you can program in any menu to make the analyzer perform as needed. Some basic conventions have been followed throughout the state analyzer system.

1. To change a programmable field, you must be in the edit mode. You can only enter the edit mode when the Edit command appears on the command line at the bottom of the screen.
2. Pressing the escape key exits the edit mode and returns you to the command mode.
3. Once you are in the edit mode, fields that appear in reverse video are programmable. The field that can be modified will blink.
4. Many of the fields are programmed by making selections from a predetermined list of options. When prompted by the edit prompt line "SPACE scrolls through choices," all you need to do is press the space bar to view and select the options.

When the desired option appears, you can move to another field by using the cursor keys, the return key, or the tab key. Or, you can leave the edit mode by pressing escape.

5. In command or edit mode, your options are listed on the bottom line of the screen. When in doubt about what do next, consult this line. <SP> at the end of the line means that the list of command choices is too long to fit on one line. Press the space bar to see the remaining choices.

Conventions of Use

In edit mode, there are several ways to move to the desired field:

Four Cursor
(arrow) Keys

These keys move the screen cursor to the nearest programmable field in the direction selected.

If the field is a text field, the left and right cursor keys move the screen cursor through each individual character position. At either end of a text field, an additional left or right cursor key press moves the screen cursor to the nearest field.

The up and down cursor keys move the screen cursor to nearest field above or below the current field.

- Return or Tab Key Either key moves the screen cursor to the start of the next field. If the screen cursor is in the last field in the menu, either key will move the cursor to the first field in the menu.
- Control-Return or Shift-Tab Key Either key moves the screen cursor to the start of the previous field.
- Escape Key This key exits the edit mode and returns you to the command mode. If you have made an input error prior to pressing the escape key, the system will not exit the edit mode. Instead, it will advise you of the problem and prompt for re-entry of the information. Press the escape key again when the error condition has been corrected.

Command Line Summary

In the command line, some groups of commands are subordinate to others and will only appear after the command has been selected. (For example, the list of menu choices are subordinate to the Menu command.)

The commands described in the following paragraphs are the ones you will see and use most frequently. Additional commands that are specific to a menu are covered in the appropriate portions of this section, and are not described here.

- Edit** Press E to enter the edit mode. Edit mode must be entered before any programmable fields on the current screen can be accessed and altered.
- Once you are in edit mode, the edit prompt line appears. This prompt line tells you what edit options are available for a particular field.
- Some edit commands are specific to a particular menu or field within a menu. These edit commands are covered in the appropriate portions of this section.
- Press the escape key to exit the edit mode and return to the command mode.
- enVir** Press V to call up the Environment Submenu selections. The command line will list the submenu choices available. Refer to the appropriate portions of this section for details on each submenu listed.

Go Press G to start the instruments in the μ Analyst. The go mode for the analyzer is determined by the Display Environment Submenu. Refer to that submenu later in this section for a complete listing.

Menu Press M to call up the menu selections. The command line will list the menu choices available. Refer to the appropriate portions of this section for details on each menu listed.

 **NOTE**

The User Menu and User Program Menu selections are not covered in this manual. These menus are only available if you have designed custom software for the Interactive State Analyzer.

Display Press D to enter the state analyzer's Display Menu. For details of this menu, refer to the appropriate portion of this section.

User__display Press U to enter a display you have programmed to work with the Interactive State Analyzer. (This type of custom programming is not covered in this manual.)

?=help Press the ? (question mark) key to call up the μ Analyst's Help Information System. Once you are in the Help system, use the command line choices to move through the help text.

 **NOTE**

The Help Information System is only available if you installed the μ Analyst's HELP DISK (refer to Section 3 of this manual).

<SP> Press the space bar to scroll through the command line choices. This option appears only if the list of choices is too long to fit on the screen.

5 Configuration Menu

MODEL 2100

OVERVIEW

The Configuration Menu is the first menu displayed by the μ Analyst. It tells you the status of the μ Analyst hardware and software, plus it gives you access to the μ Analyst's various operating options.

The operating options available in the Configuration Menu are dependent on the type of hardware you have installed in the μ Analyst mainframe. This section describes the options available for operating the Interactive State Analyzer only. Section 6 of this manual describes the options available for operating the state analyzer in conjunction with the Model 2200 Interactive Timing Analyzer.

OPTION SELECTIONS

Figure 5-2 shows the Configuration Menu and its operating options. Use the numbered callouts in this figure as a reference while reading the following paragraphs. To select an option, simply move the screen pointer to that option, then press the return key.

00842-028

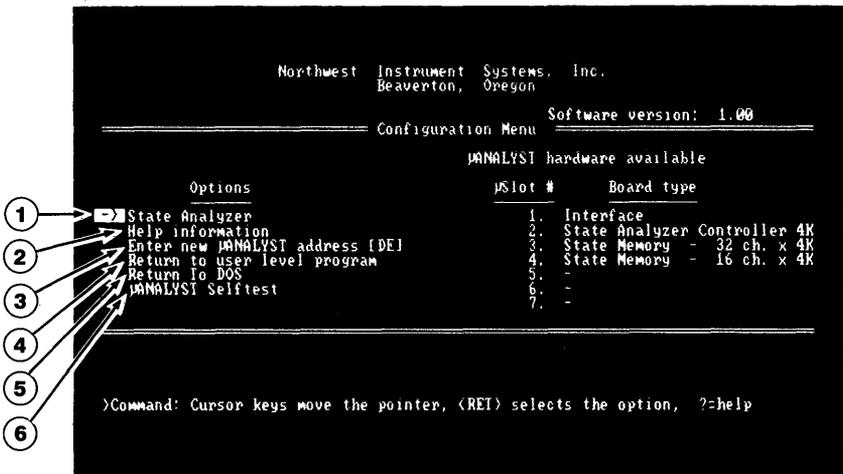


Figure 5-2. The Configuration Menu and its selectable options.

① State Analyzer

Select this option to enter the menus that control the Interactive State Analyzer. If the system has just been started up, the μ Analyst will enter the state analyzer's Format Menu; otherwise, it will enter the last state analyzer menu used.

You'll find detailed information about how to use the state analyzer menus later in this section.

② Help Information

Select this option to enter the μ Analyst's Help Information System. The μ Analyst will display general information about the state analyzer, its menu conventions, and its keyboard mechanics.

In addition to this option, you can use the ?=Help command to obtain specific information about each option selection. Simply move the screen pointer to the option under question, then press the ? (question mark) key.

③ Enter New μ Analyst Address

Select this option only if you need to enter a new memory range for the PC interface board (see Section 2's *Installing the PC Interface Board* subsection).

NOTE

This option is only available on system start-up. It will not be available once any of the state analyzer menus have been viewed or used.

The default setting for this option is DE hexadecimal, which matches the default setting of the PC interface board. If you have changed the setting on the interface board, enter the corresponding 2-digit code, in hexadecimal notation, into this option's field.

If the μ Analyst SYSTEM DISK is not write-protected, the μ Analyst stores the new address value. This way, whenever you restart the system, the new address is automatically entered.

④ Return to User Level Program

If custom software is installed, you can use this option to return to your program.

5 Return to DOS

Select this option to return to the DOS operating software. The μ Analyst will prompt you with a message reading:

“Have you saved your SETUP and DATA? Do you really want to return to DOS (y/N/?)”

This message is a reminder that once you leave the Configuration Menu to return to DOS, all menu setups and memories are lost.

If you have already saved your setups via the state analyzer's I/O Menu, or if you don't want to save your setups, press Y for Yes. The μ Analyst will exit to DOS.

If you want to save your menu setups and have not yet done so, press N for No. Then enter the state analyzer's I/O Menu and save your setups. When you're finished, return to the Configuration Menu and exit to DOS.

NOTE

Procedures for using the I/O Menu are provided later in this section.

6 μ Analyst Selftest

Select this option if you want to run the μ Analyst's internal diagnostics. These diagnostics perform a first-fault, static test of the μ Analyst boards. They take several minutes to execute.

While the diagnostics are being executed, the μ Analyst updates the display screen to tell you which board is being tested and the results. If no faults are found in the board being tested, the μ Analyst will tell you that the board has passed the selftest. If a fault is found, the μ Analyst will display a coded message similar to that shown in Figure 5-3.

If a board fails the selftest, contact Northwest Instrument Systems, Inc.

```
Northwest Instrument Systems, Inc.
Beaverton, Oregon

Software version: 1.00
===== Configuration Menu =====

ANALYST hardware available

Options                                Slot #    Board type
State Analyzer                          1. Interface
Help information                         2. State Analyzer Controller 4K
Enter new ANALYST address [DEL]         3. State Memory - 32 ch. x 4K
Return to user level program            4. State Memory - 16 ch. x 4K
Return To DOS                            5. -
-> ANALYST Selftest                       6. -
                                           7. -

Warning: ISA 32 channel memory board malfunction: U14,U15 failed zeros test
)Command: Cursor keys move the pointer, (RET) selects the option, ?=help
```

■ Figure 5-3. An example of a selftest error.

OVERVIEW

The Format Menu allows you to set up acquisition parameters for the system under test and to format acquired data.

In this menu, you define the state analyzer's flexible clocking scheme. Five sample clocks are ORed to make up the master clock. Two hold clocks allow you to delay, or stretch, data until a valid sample clock samples the data. A combination of sample and hold clocking and the multiplexed data acquisition mode enable you to capture data from multiplexed systems.

For the clock probe, you can set the polarity of the run/stop line. For the data probes, you can specify multiplexed or non-multiplexed data acquisition.

To make the Symbol and Display Menus easier to interpret, you can assign labels to channel groups, specify their appropriate radix and polarity, and predetermine their display order. This subsection explains how you use the Format Menu to perform all of these activities.

MENU FIELD SELECTIONS

Figure 5-4 illustrates a typical Format Menu display. You enter this menu by pressing M for Menu, then F for Format from the command line.

Use the numbered callouts in Figure 5-4 as a reference while reading the following field descriptions. To make any changes to a field, you must be in edit mode (press E for Edit), and you must have the screen cursor positioned in the field.

If the HELP DISK is installed, you can use the ?-Help function to obtain information about a specific field. To do this, enter the edit mode, then move the screen cursor to the desired field and press the ? (question mark) key.

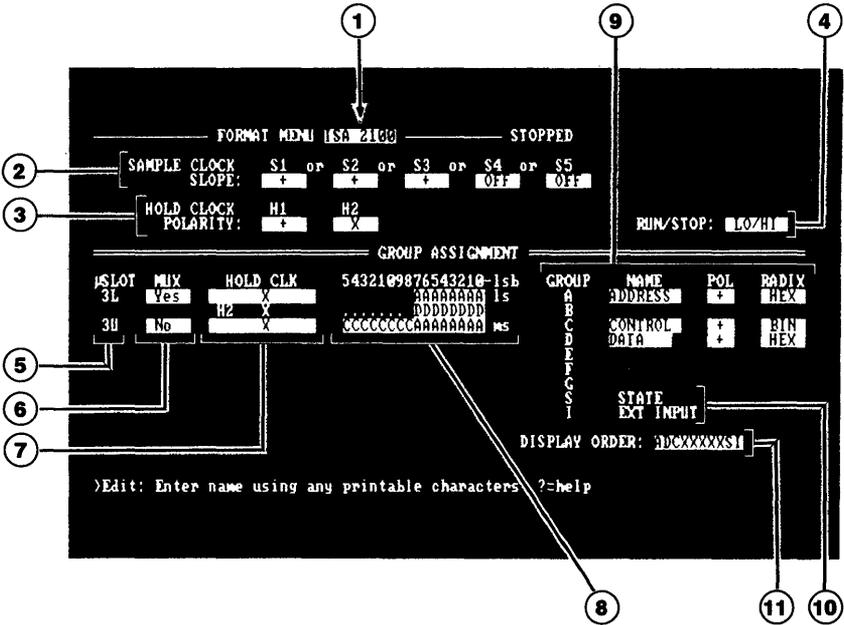


Figure 5-4. The Format Menu and its field selections.

1 Name

This field lets you name your menu setups. The name you enter here will appear at the top of all other state analyzer menus, and it will be automatically stored with any menu setups or memories in the I/O Menu.

The default name in this field is ISA 2100. You can change this to any other name using up to eight characters. A useful name might be the name of the microprocessor or test procedure you are working with, such as 8086__SYS or MEMCHECK.

2 Sample Clock Slope

These fields are used to establish the synchronous, master sampling clock. The five sample lines, labeled S1—S5, are provided via the clock probe attached to the state analyzer’s controller board. Each line provides a maximum sampling rate of 10 MHz.

You can use one or all of these sample lines to define the master clock. The lines work together in an ORed condition.

5 Format Menu

MODEL 2100

Using the space bar, you can set the polarity of any sample line to:

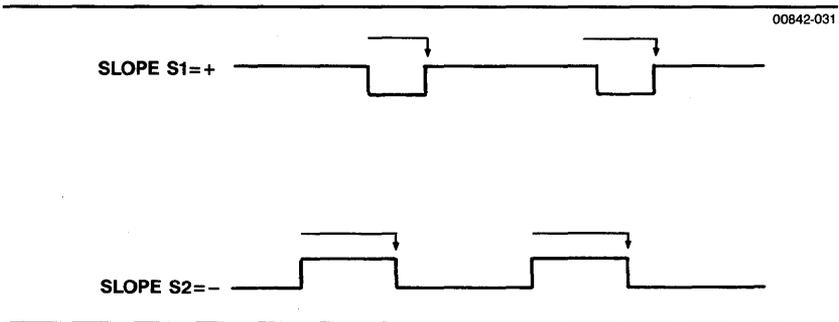
- + (positive polarity)—data is sampled on the signal's rising edge.
- - (negative polarity)—data is sampled on the signal's falling edge.
- OFF—the sample line is not used.

NOTE

If you turn a sample line off, make sure that the line is physically disconnected from any signal source. Otherwise, it may cause interference with the other sample lines.

Positive vs Negative Clock Polarity. Figure 5-5 illustrates the difference between positive and negative clock polarity.

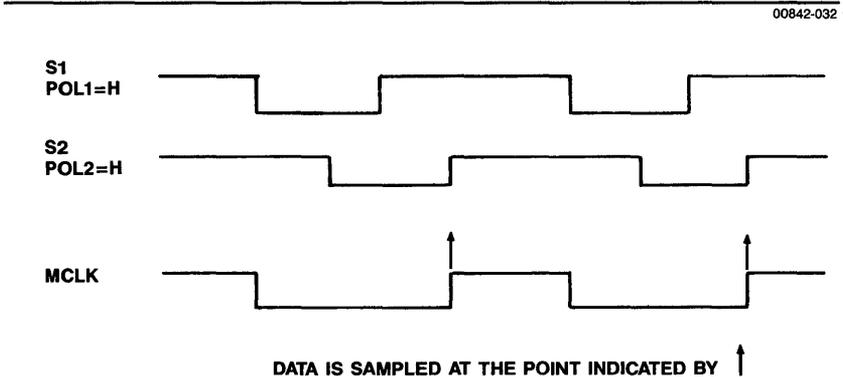
When positive polarity is selected for a clock, the data is sampled on the clock's rising edge, and the pulse width for the clock is defined from falling edge to rising edge. When negative polarity is selected for a clock, the data is sampled on the clock's falling edge, and the pulse width for the clock is defined from rising edge to falling edge.



■ **Figure 5-5. Sample clock polarity.**

Overlapping Clocks. The five sample clocks are ORed to produce the master clock. When the sample clocks do not overlap in time, they produce a master clock consisting of pulses contributed by each of the sample clock pulses. When the sample clocks do overlap, the master clock combines the pulses to create a longer pulse.

An example of overlapping sample clocks is provided in Figure 5-6. Data sampling occurs on the rising edge of the master clock (MCLK).



■ **Figure 5-6. Overlapping sample clocks.**

③ Hold Clock Polarity

These fields are used to set the polarity of the two external hold clocks. The hold clocks, labeled H1 and H2, are provided by the clock probe. Using the space bar, you can set the polarity of either hold clock to:

- + (positive polarity)
- - (negative polarity)
- X (off)

Depending on how the hold clocks are being used, the selected polarity may refer to level or edge clocking. (For details, see *Hold Clock* field, callout number 7.)

④ Run/Stop

This field lets you program the polarity of the Run/Stop line. The line is an open collector output from the clock probe, and it is used to indicate to external hardware when the analyzer is running (acquiring data) and when it is stopped.

Using the space bar, you can set the polarity of the Run/Stop line to:

- HI/LO—the line is high when the analyzer is running and low when it is stopped.
- LO/Hi—the line is low when the analyzer is running and high when it is stopped.

⑤ μ Slot (Probe Identifiers)

This menu column is not a programmable field. Rather, it serves as a probe identifier for the MUX, Hold Clock, and Channel/Group Assignment fields (see callout numbers 6, 7, and 8).

In this column, each probe is identified by its slot number. An *L* indicates the lower probe on a 32-Channel Memory Board, while a *U* indicates the upper probe. A 16-Channel Memory Board has only one probe, so there is not an *L* or *U* designation.

⑥ MUX (Multiplex)

These fields allow you to establish multiplexed or non-multiplexed acquisition for each data probe.

Using the space bar, you can set each probe to:

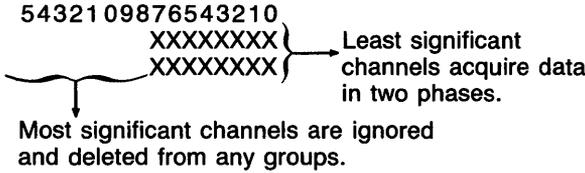
- YES—the probe acquires multiplexed data.
- NO —the probe does not acquire multiplexed data.

When you first attempt to set a probe's MUX field to YES, the μ Analyst will prompt you with the following message:

“Change channel assignments to keep groups contiguous? (y/N/?)”

This message is a reminder that when a probe is set to multiplexed acquisition, its eight most significant channels are ignored and removed from any channel groups. The multiplexed data is acquired in two phases on the eight least significant channels.

Verify that you want to select multiplexed acquisition by pressing Y for yes. The probe channels will be automatically rearranged as shown below.



NOTE
 Multiplexed Clocking and channel-to-group assignments are discussed under the next two menu fields, *Hold Clock* and *Channel/Group Assignments*, callout numbers 7 and 8.

7 Hold Clock

These fields are used to assign the hold clocks, H1 or H2, to specific data probes.

The characteristics of the two hold clocks are determined by the polarities set up in the Hold Clock Polarity fields (see callout number 3). Table 5-1 describes the various hold-clock selections, and explains when they are available for use.

When acquiring non-multiplexed data, you can program the probe's Hold Clock field to any of the available selections listed in Table 5-1.

When acquiring multiplexed data, you can program the Hold Clock field for the first data byte to any available selection, but you cannot program the Hold Clock field for the second data byte. As shown below, the second data byte's Hold Clock field is always set to H2 (either HI = PASS or LO = PASS, depending the H2 polarity).

	HOLD CLK	5432109876543210
Byte 1 (programmable)	X	XXXXXXXX
Byte 2 (non-programmable)	H2	XXXXXXXX

A detailed example of how to use the hold clocks is provided in Section 7 of this manual.

■ **Table 5-1: Hold Clock Selections**

Field Selection	Description
X	This selection is always available. It turns the hold clock field off. The probe will acquire data using the master sampling clock only.
H1 X (H2 X)	This selection is available when the H1(H2) hold clock is turned off (X) in the Hold Clock Polarity field. It has no affect on acquisition. The probe will acquire data using the master sampling clock.
H1 \wedge EDGE (H2 \wedge EDGE)	<p>This selection is available only if the H1(H2) hold clock is set to a positive (+) polarity, and if you are using a 32-channel memory board. (16-channel memory boards only allow level clocking).</p> <p>With this selection, the probe will latch data on the rising edge of the hold clock, then hold it until a master sampling clock occurs.</p>
H1 \vee EDGE (H2 \vee EDGE)	<p>This selection is available only if the H1(H2) hold clock is set a negative (-) polarity, and if you are using a 32-channel memory board. (16-channel memory boards only allow level clocking).</p> <p>With this selection, the probe will latch data on the falling edge of the hold clock, then hold it until a master sampling clock occurs.</p>
H1 HI=PASS (H2 HI=PASS)	<p>This selection is available when the H1(H2) hold clock is set to a positive (+) polarity.</p> <p>With this selection, the probe will pass data to its latches while the hold clock's level is high, then hold that data while the hold clock's level is low. The data will then be clocked into memory when a master sampling clock occurs.</p>
H1 LO=PASS (H2 LO=PASS)	<p>This selection is available when the H1(H2) hold clock is set to a negative (-) polarity. With this selection, the probe will pass data to its latches while the hold clock's level is low, then hold that data while the hold clock's level is high. The data will then be clocked into memory when a master sampling clock occurs.</p>

8 Channel/Group Assignments

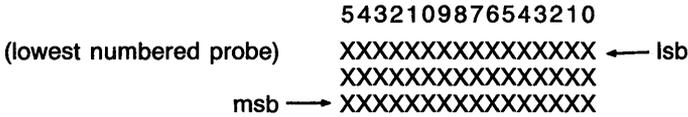
These fields let you organize data channels into meaningful display groups. Seven groups, labeled A—G, are available for use. Each group can contain up to 32 channels.

To assign a channel to a group, simply enter the group letter into the channel's field. To set a channel to don't care, enter an X.

All channels within a given group must be contiguous; that is, they must be linked from least significant bit (lsb) to most significant bit (msb). The following paragraphs explain how to determine the bit significance for both non-multiplexed and multiplexed channels.

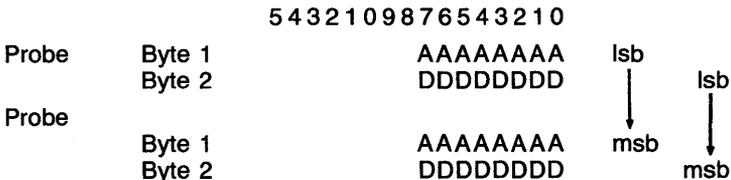
Bit Significance of Non-Multiplexed Channels. With non-multiplexed channels, the least significant bit (lsb) is the lowest numbered channel of the lowest numbered probe. The most significant bit (msb) is the highest numbered channel of the highest numbered probe.

For example, if your display shows three probes, the bit significance of their channel fields would read as:



Bit Significance of Multiplexed Channels. The bit significance of the multiplexed channels is linked by first and second byte acquisitions. The first bytes (the top channel fields) of all multiplexed probes are linked together, and so are the second bytes (the second channel fields).

For example, suppose you were using two probes to demultiplex a 16-bit address/data bus. The channels of the two probes would be linked as shown below:



9 Group Name, Polarity, and Radix

These fields are used to assign names, logic polarities, and radices to your channel groups.

Enter a group name using up to eight characters. Useful names might be ADDRESS, DATA, STATUS, CONTROL, etc.

Select a group's polarity using the space bar. Choices include: positive (+) or negative (-). If positive polarity is selected, the Display Menu will show data above the probe threshold as high (1) and data below the probe threshold as low (0). If negative polarity is selected, the Display Menu will show data above the probe threshold as low (0), and data below the probe threshold as high (1).

NOTE

The Trigger-Store Menu automatically adjusts its word recognizers to match the selected polarity.

Select a group's radix by using the space bar. Choices include: HEX (hexadecimal), OCT (octal), BIN (binary), or ASC (ASCII). If ASCII is selected, only the seven least significant bits of the group determine the ASCII character (see Appendix A at the back of this manual).

10 STATE and EXT INPUT Groups

These groups are not programmable. They are reserved for status information that is always acquired and available for display. The STATE group is reserved for trigger-store state information, while the EXT INPUT group is reserved for data received via the External Input connector.

11 Display Order

This field is used to specify the display order of the channel groups. You can assign any order to the groups using the characters A—F, S, and I. The selected group order is then reflected in the Symbol and Display Menus.

You can also inhibit the display of any group by entering an X for don't care. The inhibited group does not appear on the state display, but it is still available for defining word recognizers in the Symbol Menu.

OVERVIEW

The Symbol Menu enables you to program values associated with the names you've assigned to channel groups in the Format Menu. Once the values are assigned, the symbols can be used in the Trigger-Store Menu and the Display Environment Submenu as identifiers for word recognizers and find words. This means you can refer to user-created events by name throughout the menu setups, making them easier to read and understand.

When working in the Symbol Menu, you may enter the symbol name, enter the value you wish to assign to the name, insert a line to add a new symbol to an already filled-in table, or delete a line that is in error or is no longer needed.

A symbol table is created in one of two ways. You can create symbols in the Trigger-Store Menu, and then go back and enter their values into the Symbol Menu. (This is the more usual approach, because it's easier.) Or you can first create symbols and values in the Symbol Menu, and then enter the symbols by name in the Trigger-Store Menu as part of the triggering and qualification conditions. You can also buffer data from the Display Menu and use it to assign a value to a symbol.

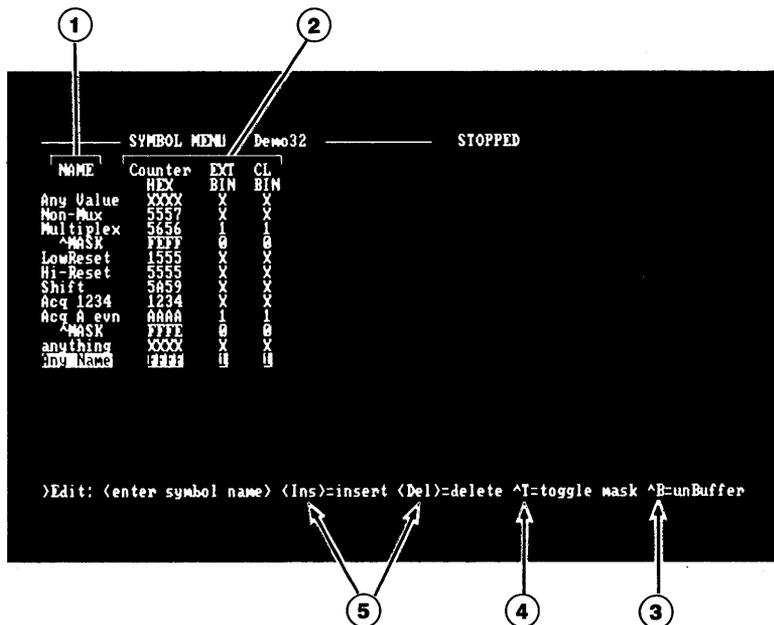
This subsection shows you how to use the Symbol Menu to enter new symbols or modify existing symbols.

MENU FIELD SELECTIONS

Figure 5-7 illustrates a typical Symbol Menu display. To enter this menu, press M for Menu, then S for Symbol from the command line.

Use the numbered callouts in Figure 5-7 as a reference while reading the following field descriptions. To program a menu field, you must be in the edit mode (press E for Edit), and you must have the screen cursor positioned in the field.

If the μ Analyst's HELP DISK is installed, you can use the ?=Help function to obtain information about a specific field. To do this, enter the edit mode, then move the screen cursor to the desired field and press the ? (question mark) key.



■ Figure 5-7. The Symbol Menu and selectable fields.

1 Name

This field is used for entering, deleting, or modifying symbol names.

A minimum symbol table consists of two symbol names: Any Value and Any Name. These two names are automatically entered into the symbol table at system start-up.

The Any Value name is a permanent symbol that cannot be modified or deleted. It will always reside at the top of the symbol table. Its value is made up of all don't care (X) entries and it can be used to match any event in a trigger-store state. The second default symbol, Any Name, can be modified but not deleted.

To insert a new symbol name, move the screen cursor to an existing symbol name (e.g., Any Name). Then, press the insert key. A new, blank Name field will appear at the cursor location. Enter any desired name up to nine characters.

To modify an existing symbol name, simply enter a new name over the old one.

To delete a symbol name, move the screen cursor to the Name field of the symbol you want to delete. Then, press the delete key. Both the symbol name and its value will be deleted from the table.

NOTE

If you try to delete a symbol name that is currently being used by a menu, the μ Analyst will ask you to confirm the operation by pressing Y for Yes. Menus that use symbols include the Trigger-Store and Histogram Menus, and the Display Environment Submenu.

2 Data Values

These fields are used for assigning data values to the symbol names.

NOTE

An alternate procedure for entering symbol values is discussed under callout number 4, *unBuffer*.

The column headings above the data value fields correspond to the channel groups and radices assigned in the Format Menu. When entering values, you must use the appropriate radix notation, as defined below:

- HEX—Enter 0 through F, or enter X for don't care.
- OCT—Enter 0 through 7, or enter X for don't care.
- BIN—Enter 0 or 1, or enter X for don't care.
- ASC—Enter an ASCII character or control character (see Appendix A at the back of this manual).

A special condition may arise when you are entering a value. The first digit entry may have fewer legal values than what is usually available under the radix. This occurs when the number of channels assigned to the group is fewer than what is expected by the radix.

For example, a group may have six channels and a hexadecimal radix. This would mean that the first character in the group can only have a value of 0 through 3, or X.

If such a condition should arise, the message line at the bottom of the screen will prompt you accordingly.

③ unBuffer

As an alternative to typing in data values, you can use this command to transfer a data value directly from a line in the state display.

To use this command, you must first go to the Display Menu and enter one of the display lines into the buffer (see the *Display Menu* later in this section).

Once you have buffered a line, return to the Symbol Menu. Position the screen cursor in the Name field of the symbol you want to receive the buffered value. Then, press Control-B (^ B) for unBuffer.

The buffer can only hold one line, so if you wish to make several entries this way, you must return to the Display Menu after one unbuffering operation, place another value in the buffer, go back to the Symbol Menu, and enter the next buffered value.

④ Toggle Mask

The Control-T (^ T) Toggle Mask command lets you set individual masked bits without changing their radix to binary. The command toggles between masked and non-masked values. With masked values, the symbol value and mask are split into two lines, and with non-masked values they are merged.

Each symbol may be thought of as containing two words. The first word is the value of the symbol, and the second word, or mask word, represents which channels are considered as part of the value (cares) and which are not (don't cares). Care bits are represented by 1 and don't care bits by 0.

It is usually convenient to define a symbol as having a specific value in a manageable radix. For example, suppose you were looking for modifications made to hexadecimal addresses in the range D8 to DF. It's much easier to deal with D8 than with its binary representation 11011000. In binary radix, you could define a word to cover the hexadecimal range D8 to DF as 11011XXX. Then in hexadecimal you could define the symbol for the address D8 and assign a mask value F8. The lower three bits are treated as don't cares, but the readability and sense of address D8 are preserved.

For non-masked symbols, enter X into a character position to define the don't care. Depending on the radix of the character position, the don't care may apply to one or more bits. For example, an X entered into a hexadecimal character sets all four bits of the character to don't care.

When merging the symbol value and symbol mask, you may generate a question mark (?) character as part of the value (see Figure 5-8). The question mark indicates that some bits within the boundary of that character (determined by the radix) are set to don't cares.

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```

SYMBOL MENU      Demo32      STOPPED

NAME Counter EXT CL
          HEX  BIN  BIN
Any Value XXXX X X
Non-Mux  5557 X X
Multiplex 5656 1 1
^MASK    FFFF 0 0
LowReset  1555 X X
Hi-Reset  5555 X X
Shift     5A59 X X
Acq 1234  1234 X X
Acq A evn AAAA 1 1
^MASK    FFFE 0 0
anything XXXX X X
demomask 0000 0 0
^MASK    F87F 1 1
Any Name  FFFF 1 1

)Edit: <enter symbol name> <Ins>=insert <Del>=delete ^T=toggle mask ^B=unBuffer

```

```

SYMBOL MENU      Demo32      STOPPED

NAME Counter EXT CL
          HEX  BIN  BIN
Any Value XXXX X X
Non-Mux  5557 X X
Multiplex 5656 1 1
^MASK    FFFF 0 0
LowReset  1555 X X
Hi-Reset  5555 X X
Shift     5A59 X X
Acq 1234  1234 X X
Acq A evn AAAA 1 1
^MASK    FFFE 0 0
anything XXXX X X
demomask 0000 0 0
^MASK    F87F 1 1
Any Name  FFFF 1 1

)Edit: <enter symbol name> <Ins>=insert <Del>=delete ^T=toggle mask ^B=unBuffer

```

■ Figure 5-8. The Toggle-Mask Option.

⑤ Insert and Delete

These two commands are useful when you are entering symbol names. By pressing the insert key, you can insert a new, blank Name field at the screen cursor location. Conversely, by pressing the delete key, you can delete the symbol Name field and its value.

For more information about inserting and deleting symbols, refer back to callout number 1, *Name*.

OVERVIEW

The Trigger-Store Menu is used to determine which data is stored in memory, and when. You can set up as many as 15 trigger states, with four states displayed on the screen at one time. These states can be used independently, or they can be combined in any sequential or branching order.

Within each state, you can specify one or two word recognizers for defining IF-THEN-ELSE triggering conditions, and you can specify one or two word recognizers for defining storage qualification. You can also assert the Real-Time Programmable Outputs (RPOs) and Crosslink (CL) output for interaction with the system under test.

In the rest of this subsection, you'll find detailed information on how to use the Trigger-Store Menu to set up the various triggering and storage qualifier conditions.

NOTE

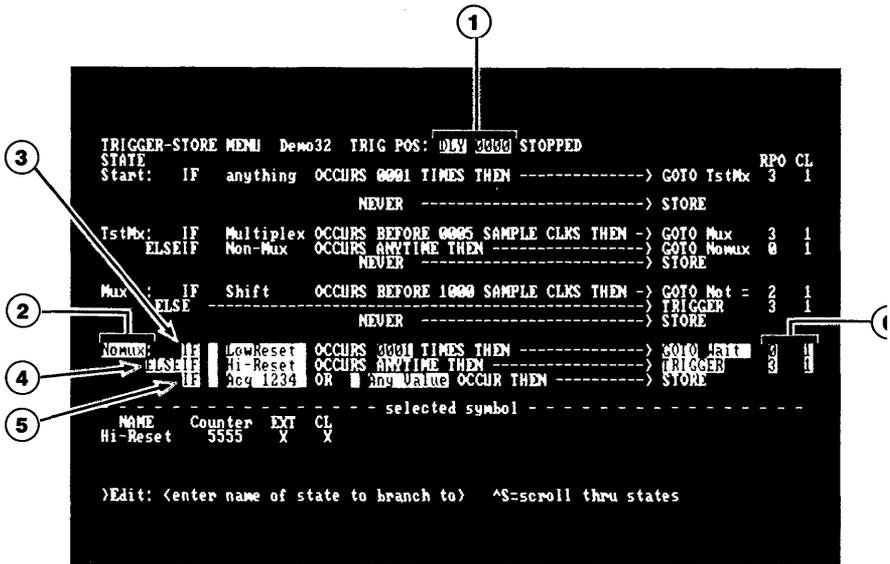
In portions of this subsection, reference is made to parameters established within the Trigger-Store Environment Submenu. We will discuss these parameters and show how they are used in the next subsection.

MENU FIELD SELECTIONS

Figure 5-9 illustrates a typical Trigger-Store Menu display. You enter this menu by pressing M for Menu, then T for Trigger-Store from the command line.

Use the numbered callouts in Figure 5-9 as a reference while reading the following field descriptions. To change a menu field, you must be in the edit mode (press E for Edit), and you must have the screen cursor positioned in the field.

If the μ Analyst's HELP DISK is installed, you can use the ?=Help function to obtain information about a specific field. To do this, enter the edit mode, then position the screen cursor in the desired field and press the ? (question mark) key.



■ Figure 5-9. The Trigger-Store Menu and its selectable fields.

① Trigger Position

This field is used to position the trigger in acquisition memory. Using the space bar, you can select:

- BEGIN—the trigger is delayed by 4082 words.
- CENTER—the trigger is delayed by 2047 words.
- END—the trigger is delayed by 13 words.
- DELAY <0—4096 >—the trigger is delayed by the specified number of words.

The total acquisition memory depth is 4096 words. Data acquired before the trigger is called pre-trigger data, and data acquired after the trigger is called post-trigger data.

The amount of pre-trigger data acquired in memory depends on how quickly the trigger occurs. The state analyzer looks for a trigger immediately; it does not wait until memory is full.

NOTE

When the state analyzer is operating in the MultiplePreview Acquisition (MPA) mode, the only trigger position available is DELAY <0—4096>. (Refer to the *Trigger Environment Submenu* contained later in this section.)

2 State

This field is used to name, insert, or delete trigger states. Altogether, there are 15 trigger states available for use. Each state provides two word recognizers for establishing trigger conditions, and two word recognizers for establishing storage qualification.

To insert a state, move the screen cursor to a current State field, then press the insert key. The current State field will move down one position on the screen, and a new, blank State field will appear at the cursor location.

NOTE

You can also create a new state by entering the name of the state into one of the GOTO fields (see callout number 3).

To name a state, enter up to five characters. To rename an existing state, simply enter the new name over of the old one. The μ Analyst will ask you to confirm the renaming by pressing Y for Yes or N for No.

NOTE

When you rename a state, all references to that state (as in GOTO trigger actions) will be automatically updated.

To delete a state, move the screen cursor to the State field you want deleted. Then, press the delete key. The μ Analyst will delete the state and its word recognizers.

NOTE

When you delete a state, all references to that state (as in GOTO trigger actions) will default to the next sequential state. If there are no next states, the references will default to their own state.

3 1st Word Recognizer

The 1st Word Recognizer can be used by itself, or it can be combined with the 2nd Word Recognizer to form IF-THEN-ELSE triggering conditions. The possible options for the 1st Word Recognizer are listed below.

- A. IF (/) <symbol> OCCURS (1-4096) TIMES THEN—> (GOTO <state> or TRIGGER)
- B. IF (/) <symbol> OCCURS AFTER (1-4096) (SAMPLE or STORE) CLOCKS THEN —> (GOTO <state> or TRIGGER)

C. IF (/) <symbol> OCCURS BEFORE (1-4096) (SAMPLE or STORE) CLOCKS THEN → (GOTO <state> or TRIGGER)

As you can see, each word-recognizer option has several programmable fields. The following paragraphs describe how you make entries into these fields.

Logical True or Not True (/) Field. Use this field to specify whether the symbol used in the word recognizer is set to its logical true or not true value. Your choices include:

- A blank field—the symbol is set to its true value and recognition will occur when the symbol value appears at the probe tips.
- / (not)—the symbol is set to its not true value and recognition will occur when any value other than the symbol value appears at the probe tips.

Symbols. Use this field to enter the symbol you want to use for word recognition. The value of the symbol is defined in the Symbol Menu.

To use a symbol that has already been defined in the Symbol Menu, simply enter the symbol's name. If you can't remember all of the available symbols and their names, you can use the Control-S (^ S) key to scroll through the symbols. Each symbol and its value will appear at the bottom of the screen under the heading "selected symbol."

You can also enter a symbol that has not been defined in the Symbol Menu. To do this, simply enter any name using up to eight characters. The μ Analyst will then ask if you want to add the name to the Symbol Menu. Press Y for yes.

When you are finished with the Trigger-Store Menu, you will need to return to the Symbol Menu and enter the values for any new symbol names you have created.

Occurrence Counter (1—4096). Use this field to set up the word-recognizer counter. Depending on the word-recognition option you've selected, the field may serve as an occurrence counter or a time window. Valid entries into the field include 1—4096, inclusive.

The counter can be set to count SAMPLE or STORE clocks. Sample clocks are defined by the master sample clock. Store clocks, on the other hand, are not physical clocks. Rather, they are defined by the words you have asked the analyzer to store (see *Storage Qualifiers*, callout number 4).

GOTO <state> or TRIGGER. Use this field to set up the word-recognizer action.

When you set a word recognizer to GOTO, you must also enter the name of a state. The name can belong to an existing state, or it can be a new one. If you enter a new name, the μ Analyst will ask if you want to insert a new state. Press Y for yes. Then go to the newly entered state and define it.

NOTE

If you have already defined 15 states, the μ Analyst will not allow you to insert a new state from the GOTO field. Instead, a message will appear reading "no new states are available; must use an existing state name."

④ 2nd Word Recognizer

The 2nd Word Recognizer can be used in conjunction with the 1st Word Recognizer. It allows you to set up the IF-THEN-ELSE triggering conditions outlined below.

- A. IF (/) <symbol> OCCURS (1-4096) TIMES THEN → (GOTO <state> or TRIGGER)
ELSEIF (/) <symbol> OCCURS ANYTIME THEN → (GOTO <state> or TRIGGER)
- B. IF (/) <symbol> OCCURS AFTER (1-4096) (SAMPLE or STORE) CLOCKS THEN → (GOTO <state> or TRIGGER)
ELSEIF (/) <symbol> OCCURS ANYTIME THEN → (GOTO <state> or TRIGGER)
- C. IF (/) <symbol> OCCURS BEFORE (1-4096) (SAMPLE or STORE) CLOCKS THEN → (GOTO <state> or TRIGGER)
ELSEIF (/) <symbol> OCCURS ANYTIME THEN → (GOTO <state> or TRIGGER)
- D. IF (/) <symbol> OCCURS BEFORE (1-4096) (SAMPLE or STORE) CLOCKS THEN → (GOTO <state> or TRIGGER)
ELSE _____>(GOTO <state> or TRIGGER)

As you can see, the various word-recognizer options have several programmable fields, including: Logical True and Not True (/), Symbols, and GOTO or TRIGGER actions. You program these fields as specified under *1st Word Recognizer*, callout number 3.

⑤ Storage Qualifiers

The third line of each state is used for establishing storage qualifier conditions. These storage qualifier conditions determine which data, if any, the analyzer will store while it is executing the state. The possible options for the storage qualifiers are listed below.

- A. ALWAYS _____ > STORE
- B. IF (/) <symbol> OCCURS THEN _____ > STORE
- C. IF (/) <symbol> OR (/) <symbol> OCCUR THEN —> STORE
- D. IF (/) <symbol> AND (/) <symbol> OCCUR THEN -> STORE
- E. NEVER _____ > STORE

Options A and B have no additional programmable fields. Options B, C, and D have programmable Logical True and Not True (/) fields and Symbol fields. You program these fields as specified under *1st Word Recognizer*, callout number 3.

⑥ RPO and CL Outputs

These fields let you assert the Real-Time Programmable Outputs (RPOs) and Crosslink (CL) signals.

Real-Time Programmable Outputs (RPOs). The RPOs are two output lines provided via the state analyzer's clock probe. The lines are labeled RPO1 and RPO2.

Using the space bar, you can set the RPOs to two bits encoded as 0, 1, 2, or 3. The encoding works as shown in Table 5-2. A zero (0) corresponds to a low-level (open collector, actively pulled down) output and a one (1) corresponds to a high-level (open collector, resistively pulled up) output.

■ **Table 5-2: RPO Output Values**

Field Selection	RPO2	RPO1
0	0	0
1	0	1
2	1	0
3	1	1

The RPO values are output to the clock probe when a transition from the current state to the next state occurs. Thus, while data is being acquired in a particular state, the RPO lines are set according to the value in the previous state.

NOTE

The starting values of the RPOs are programmed via the Trigger-Store Environment Submenu.

Crosslink (CL). The Crosslink signal is output through the CL BNC connector located on the back of the μ Analyst mainframe. It is also output internally on the μ Analyst's interconnect bus, and it can be used for crosslink triggering between the state analyzer and other μ Analyst products, such as the Interactive Timing Analyzer.

Using the space bar, you can program the Crosslink to output a 0 (active low) or a 1 (open collector high). The Crosslink value is output when a transition from the current state to the next state occurs.

SPECIAL COMMAND-LINE FUNCTIONS

As shown in Figure 5-10, the Trigger-Store Menu provides an additional command-line function that is not available in other menus.

This command, labeled Scrollstates, lets you scroll backward or forward through the defined trigger-store states. To use this command, press S. The display will scroll in the direction indicated by the pointer (< or >) at the front of the command line. To change the direction of the pointer to <, press the < (less than) or - (minus) key. To change the direction of the pointer to >, press the > (greater than) or + (plus) key.

You can also scroll through the trigger-store states by pressing the up and down cursor keys.

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TRIGGER-STORE MENU Demo32 TRIG POS: 044 0000 STOPPED
STATE
Start: IF anything OCCURS 0001 TIMES THEN -----> GOTO TstMx RPO CL
NEVER -----> STORE
TstMx: IF Multiplex OCCURS BEFORE 0005 SAMPLE CLKS THEN -> GOTO Mux 3 1
ELSEIF Non-Mux OCCURS ANYTIME THEN -----> GOTO Nomux 0 1
NEVER -----> STORE
Mux : IF Shift OCCURS BEFORE 1000 SAMPLE CLKS THEN -> GOTO Mot = 2 1
ELSE -----> TRIGGER 3 1
NEVER -----> STORE
Nomux: IF Hi-Reset OCCURS 0001 TIMES THEN -----> GOTO Mot 0 1
ELSEIF Hi-Reset OCCURS ANYTIME THEN -----> TRIGGER 3 1
IF Acc 1234 OR any value OCCUR THEN -----> STORE
----- selected symbol -----
NAME Counter EXT CL
Hi-Reset 5555 X X

)Command: Display Edit Go Menus Scrollstates enVir ?=help (SP)
    
```

■ Figure 5-10. The Trigger-Store Menu's Scrollstates command.

OVERVIEW

The Trigger-Store Environment Submenu allows you to define several supporting trigger parameters. While these parameters are readily accessible, they have been placed in a submenu so that their meanings are not obscured, and so that the main Trigger-Store Menu is not cluttered.

In this submenu, you can set up Multiple-Preview Acquisition to enhance the trigger's storage qualifier functions. You can specify whether the analyzer automatically stores all state transitions (i.e., the events which cause the analyzer to move from one state to another). Plus, you can establish starting values for the trigger states and the Real-Time Programmable Outputs (RPOs).

In the rest of this subsection, you'll find detailed information about how to use this submenu and its features.

SUBMENU FIELD SELECTIONS

The Trigger-Store Environment Submenu is called to the screen by pressing V for enVironment, then T for Trigger-Store. It can be called from any state analyzer menu. When it is called, the submenu temporarily covers the lower half of the screen.

Figure 5-11 illustrates how the submenu appears when it is called from the Trigger-Store Menu. The submenu is automatically in edit mode; it has no command line. You exit the submenu by pressing the escape key.

Use the numbered callouts in Figure 5-11 as a reference while reading the following field descriptions.

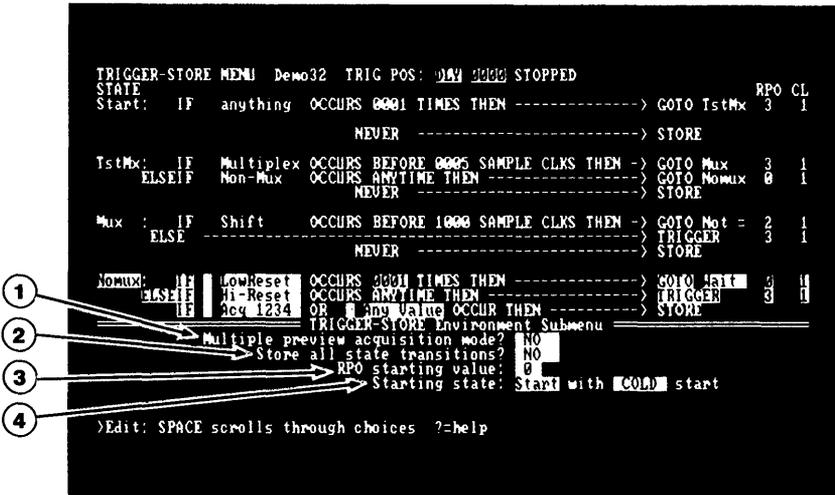


Figure 5-11. Trigger-Store Environment Submenu.

1 Multiple-Preview Acquisition

This field is used to establish Multiple-Preview Acquisition. Using the space bar, you can select:

- NO—Multiple-Preview Acquisition is turned off.
- YES—Multiple-Preview Acquisition is turned on.

When Multiple-Preview Acquisition is turned off, the state analyzer acquires data as specified in the Trigger-Store Menu. It stores events only if they match the specified storage qualifiers and trigger conditions.

When Multiple-Preview Acquisition is turned on, the state analyzer still acquires data as specified in the Trigger-Store Menu, but it also acquires up to seven unqualified events immediately preceding each qualified event. This way, you see a small window of data leading up to the events you are interested in.

NOTE

A detailed application example of how to use Multiple-Preview Acquisition is provided in Section 7 of this manual.

② Store All State Transitions

This field lets you specify whether or not the state analyzer acquires all events that cause state transitions (as defined by the Trigger-Store Menu).

Using the space bar, you can select:

- NO—the state analyzer does not automatically acquire events that cause trigger state transitions. It only acquires the events if they match the specified storage qualifier conditions.
- YES—the state analyzer does automatically acquire all events that cause trigger state transitions, regardless of whether or not the events match the specified storage qualifier conditions.

The usefulness of always storing state transitions becomes apparent when you set up NEVER STORE storage qualifiers in the Trigger-Store Menu.

For example, suppose you want to monitor several subroutine accesses, but do not want to store all of the subroutine activity. You could set up a state sequence that follows the paths of the subroutines and select NEVER STORE storage qualification. Storing all state transitions would then allow you to verify that the subroutine accesses occurred correctly, without scrolling through a lot of memory data.

③ RPO Starting Value

This field is used to specify the starting values of the Real-Time Programmable Output (RPO) signals.

Because the RPOs change at state transitions, you must define their initial value—the value the RPOs are set to when the state analyzer is started. Then, when the state analyzer leaves the first state, the RPO values change to the value defined in the first state.

In default, the RPOs start with a value of 0. Using the space bar, you can change this starting value to any value listed in Table 5-3.

■ Table 5-3: RPO Starting Values

Field Selection	RPO2	RPO1
0	0	0
1	0	1
2	1	0
3	1	1

④ Starting State

When you name the starting state in this field, the state analyzer starts operating from any of the 15 defined trigger states. For example, you could define several short trigger sequences to perform individual tests and have all the sequences resident in the state machine simultaneously. You would indicate which test to perform by selecting the state name of the beginning desired state as the start state.

At the end of an acquisition cycle, one data acquisition remains in the analyzer's pipeline. With a WARM start this data will be treated as the first value of the next acquisition, and with a COLD start it will be ignored.

All selections are made by using the space bar.

OVERVIEW

The Display Menu lets you view acquired data according to the format set the Format Menu. It also enables you to compare reference memory with acquisition memory and view any differences in highlighted video.

The menu provides three basic state displays, including:

- Acquisition Memory Display
- Reference Memory Display
- Acquisition and Reference Memory Comparisons

The rest of this subsection discusses these displays and their associated programmable fields. It also discusses the special command-line functions that allow you to manipulate the memories and their displays.

NOTE

Certain menu parameters, such as comparison limits, are set up via the Display Environment Submenu. This submenu will be discussed in the next subsection.

ACQUISITION MEMORY DISPLAY

Figure 5-12 illustrates a typical state display of acquisition memory. You enter this display by pressing D for Display from the command line.

The state display is formatted according to the specifications you have entered in the Format Menu. The column headings reflect the channel group names and their display order. The data is presented in the chosen radix and polarity.

There are only two programmable fields in the Display Menu: one programs the starting memory location for the top of the data list, and the other lets you specify whether to display data from acquisition memory, reference memory, or both.

Use the numbered callouts in Figure 5-12 while reading the following field descriptions. To change a field value, you must be in the edit mode (press E for Edit), and you must have the screen cursor positioned in the field.

If the HELP DISK is installed, you can use the ?=Help function to obtain information about a particular field. To do this, enter the edit mode, then move the screen cursor to the desired field and press the ? (question mark) key.



■ **Figure 5-12. Acquisition Memory Display.**

① LOC (Location)

This field lets you specify the starting memory location for the top of the data list. The trigger position has a number value of 0. Words acquired before the trigger (pre-trigger data) have negative number values, and words acquired after the trigger (post-trigger data) have positive number values.

You can update the display to any portion of memory, by entering the following values into the LOC field:

- -9999 to +9999—the display updates to the location number specified, or to the location nearest that number. For example, if you specify -9999 and the lowest pre-trigger data location is -23, the display will update to location -23.
- B—the display updates to the Beginning location in memory.
- E—the display updates to the Ending location in memory.
- T—the display updates to the Trigger's location in memory.

Once you have entered the location value, press the return key to complete the entry.

 **NOTE**

This is only one method for moving through the data display. Other methods are described later in this subsection, under *Special Command-Line Functions*.

② Memory Selection

This field lets you select the memory display. Using the space bar, you can select:

- ACQ—the display shows the current acquisition memory.
- REF—the display shows the current reference memory.
- <—ACQ REF—>—the display shows an acquisition and reference memory comparison.

Figure 5-12 illustrates an ACQ memory display. A REF memory display and an <—ACQ REF—> memory comparison are illustrated in Figures 5-13 and 5-14, respectively.

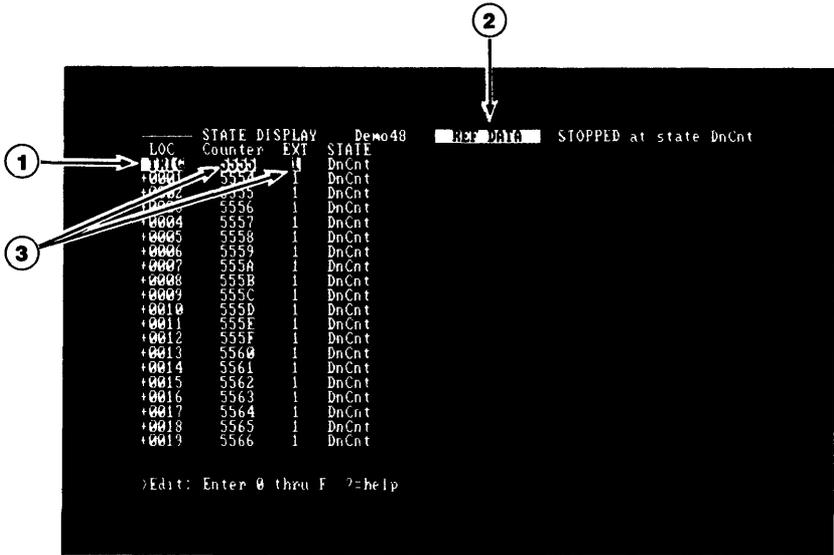
REFERENCE MEMORY DISPLAY

Figure 5-13 illustrates a typical display of reference memory. To enter this display, select the REF value in the Memory Selection field.

 **NOTE**

To achieve a display similar to that shown in Figure 5-13, you must first enter data into reference memory. To do this, use the Ref<—acq command (see *Special Command-Line Functions* later in this subsection).

The numbered callouts in Figure 5-13 illustrate the programmable fields within the reference memory display. Only the field numbered 3 is discussed here, since it is the only field different than those provided in the acquisition memory display. For information on how to manipulate fields numbered 1 and 2, refer back to the *Acquisition Memory Display* portion of this subsection.



■ Figure 5-13. Reference Memory Display.

③ Editing Reference Data

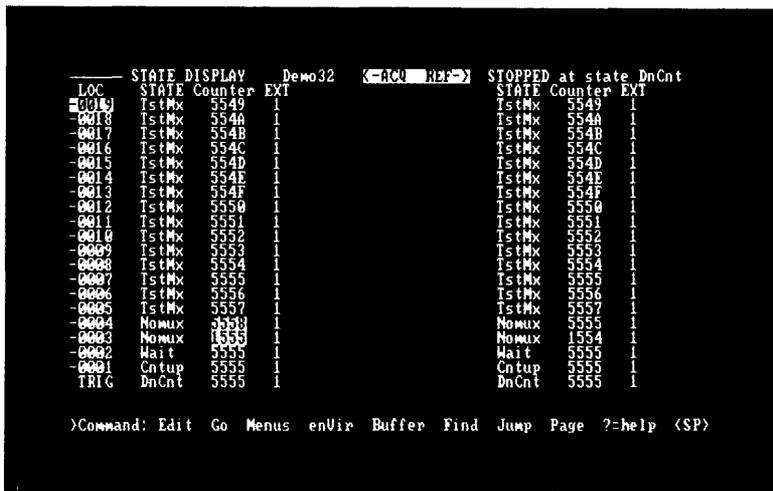
These fields let you modify the content of reference memory. You can change any data value as long as you use the appropriate radix notation. The only exceptions are:

1. You cannot edit any values in the STATE group.
2. You cannot edit values with an ASCII radix.

To scroll the reference data window, use the LOC field or use any of the command-line functions listed later in this subsection.

MEMORY COMPARISONS

Figure 5-14 illustrates a typical comparison display of the acquisition and reference memories. The two memories are presented side by side, with acquisition memory on the left side of the display and reference memory on the right.



■ Figure 5-14. Acquisition and Reference Memory Comparison.

Comparison of Multiple-Preview Acquisitions. If either set of data was acquired in the Multiple-Preview Acquisition mode, there may be some blank lines in the data (see Figure 5-15). A blank line indicates a gap in the sampled data; two samples separated by a blank line were not acquired on successive sample clocks.

When you're comparing acquisition and reference data, the blank lines may not occur in the same places in both sets of data. In this case a blank line will appear in the data that contains a gap, and a set of vertical bars will appear in the data that is continuous.

```

----- STATE DISPLAY Demo32 <ACQ> <HE> STOPPED at state DnCnt
LOC STATE Counter EXT STATE Counter EXT
-0020 Wait 1555 1 > Start 5555 1
-0022 Wait 1555 1 IstMx 5555 1
-0021 Wait 1555 1 IstMx 5556 1
-0020 Wait 1555 1 IstMx 5557 1
-0019 Wait 1555 1 > NoMx 5558 1
-0018 Wait 1555 1 > NoMx 5559 1
-0017 Wait 1555 1 Cntup 5555 1
-0016 > Wait 5555 1 Cntup 5556 1

-0015 Cntup 554E 1 Cntup 554E 1
-0014 Cntup 554F 1 Cntup 554F 1
-0013 Cntup 5550 1 Cntup 5550 1
-0012 Cntup 5551 1 Cntup 5551 1
-0011 Cntup 5552 1 Cntup 5552 1
-0010 Cntup 5553 1 Cntup 5553 1
-0009 Cntup 5554 1 Cntup 5554 1
-0008 > Cntup 5555 1 Cntup 5555 1

-0007 DnCnt 555C 1 DnCnt 555C 1

)Command: Edit Go Menus enVir Buffer Find Jump Page ?=help <SP>

```

■ Figure 5-15. Comparison of Multiple-Preview Acquisition data.

SPECIAL COMMAND-LINE FUNCTIONS

In addition to the standard commands, the Display Menu provides several specialized commands that allow you manipulate the display of data.

These commands do not all fit on the command line. To view all of the commands, press the space bar.

The following paragraphs describe the special commands in the order they appear on the command line. The bold, capitalized letter in a command indicates that you must press that letter to execute the command. Brackets < > around a command indicate that you must press the corresponding key to execute the command.

< or >

The pointer at the front of the command line controls the direction of paging and data find functions.

A < pointer specifies that paging and find functions will move backward through memory (toward pre-trigger data). To set the pointer in this direction, press the < (less than) or - (minus) key.

A > pointer specifies that paging and find functions will move forward through memory (toward post-trigger data). To set the pointer in this direction, press the > (greater than) or + (plus) key.

Buffer This command lets you store a data line in a special buffer for later unbuffering in the Symbol Menu. The data line stored is indicated at the top of the display by the reverse-video LOC field.

Find This command allows you to search acquisition or reference memory for a specific data pattern. The pointer at the front of the command line controls the direction of the search.

When the acquisition and reference memories are both displayed, the Find command searches acquisition memory for the pattern.

 **NOTE**

The data pattern being searched is specified in the Display Environment Submenu.

Next_diff This command searches acquisition and reference memory for the next difference between the two. The pointer at the front of the command line controls the direction of the search.

Total_diff This command prints a line on the bottom of the display that lists the total number of differences between acquisition and reference memory. The line also lists the location of the first difference in memory, and the location of the last difference.

Page This command allows you to move through the state data one page at a time. The pointer at the front of the command line determines the direction of the paging.

Ref<—acq This command transfers acquisition memory to reference memory. The previous contents of reference memory are lost.

 **NOTE**

The boundaries of this memory transfer are set up in the Display Environment Submenu.

- Jump** This command lets you jump to specific locations within memory. These locations include:
- Begin** —jump to the beginning of memory.
 - End** —jump to the end of the memory.
 - Trigger** —jump to the trigger's position in memory.
- <Home> This key moves the display to the beginning of memory.
- <End> This key moves the display to the end of memory.
- <PgUp> This key moves the display one page backward in memory (toward pre-trigger data).
- <PgDn> This key moves the display one page forward in memory (toward post-trigger data).

OVERVIEW

Through the Display Environment Submenu, you may specify control parameters that will determine how data is acquired and displayed. These include:

- Setting acquisition (Go) modes.
- Setting the display mode to standard or compressed.
- Setting up comparisons between acquisition and reference memory, with options for range, offset, and mask.
- Setting up the find function, and requesting either that all states be included in the find pattern search or that the find pattern occur in a specified state.

The rest of this subsection shows you how to set up and use the above parameters, and explains the affects of these parameters on the state display.

SUBMENU FIELD SELECTIONS

The Display Environment Submenu is called to the screen by pressing V for enVironment, then D for Display from the command line. It can be called from any state analyzer menu. When it is called, the submenu temporarily covers the bottom half of the screen.

Figure 5-16 illustrates how the submenu appears when it is called from the Display Menu. The submenu is automatically in edit mode; it does not have a command line. You exit the submenu by pressing the escape key.

Use the numbered callouts in Figure 5-16 as a reference while reading the following field descriptions.



Figure 5-16. The Display Environment Submenu.

1 Acquisition Mode

This field establishes the state analyzer's acquisition (Go) mode. Using the space bar, you can select:

- GO ONCE— the analyzer acquires data until the trigger condition and delay count, if any, have been met.
- GO FOREVER— the analyzer makes repetitive acquisitions, using the starting state specified in the Trigger-Store Environment Submenu.
- GO TIL ACQ = REF—the analyzer makes repetitive acquisitions until the acquisition and reference memories are equal.
- GO TIL ACQ < > REF—the analyzer makes repetitive acquisitions until the acquisition and reference memories are unequal.

When the state analyzer is running in the above modes, you can stop acquisition in one of two ways. Press H (Halt) to stop the analyzer immediately; or press S (Stop) to stop the analyzer after the next trigger condition has been satisfied.

② Stop ACQ After Memory Overflow

This field is useful when you cannot specify an accurate or appropriate trigger condition. It allows you to stop acquisition when the analyzer detects a memory overflow condition.

Using the space bar, you can select:

- NO—the analyzer does not check for a memory overflow condition. Acquisition stops when a trigger has been generated and the post-trigger delay has been satisfied.
- YES—the analyzer periodically checks for a memory overflow condition. If an overflow has occurred, the analyzer will then stop acquisition, regardless of whether or not a trigger has been generated.

NOTE

A YES value in this field does not prevent data from being overwritten in the state analyzer's memory; it just stops acquisition the first time the analyzer detects that overwriting has occurred.

③ Display Mode

This field is used to compress the state display. Using the space bar, you can select:

- STANDARD—data is displayed in the standard format.
- COMPRESSED—data is displayed in the compressed format.

The compressed format packs more data onto the display by shortening group names, removing spaces, and creating additional columns of data display. In a system with a large number of channels or several groups with binary radix, it may not be possible to display more than one column of data in compressed format.

Figure 5-17 illustrates an example of the compressed display format.

```

STATE DISPLAY Demo32 ACQ DATA STOPPED at state DnCnt
LOC STATE Count EX LOC STATE Count EX LOC STATE Count EX
-0039 TstMx 5521 1 -0039 TstMx 5535 1 -0019 TstMx 5549 1
-0038 TstMx 5522 1 -0038 TstMx 5536 1 -0018 TstMx 5548 1
-0037 TstMx 5523 1 -0037 TstMx 5537 1 -0017 TstMx 5547 1
-0036 TstMx 5524 1 -0036 TstMx 5538 1 -0016 TstMx 5546 1
-0035 TstMx 5525 1 -0035 TstMx 5539 1 -0015 TstMx 5545 1
-0034 TstMx 5526 1 -0034 TstMx 553A 1 -0014 TstMx 554E 1
-0033 TstMx 5527 1 -0033 TstMx 553B 1 -0013 TstMx 554F 1
-0032 TstMx 5528 1 -0032 TstMx 553C 1 -0012 TstMx 5550 1
-0031 TstMx 5529 1 -0031 TstMx 553D 1 -0011 TstMx 5551 1
-0030 TstMx 552A 1 -0030 TstMx 553E 1 -0010 TstMx 5552 1
-0029 TstMx 552B 1 -0029 TstMx 553F 1 -0009 TstMx 5553 1
-0028 TstMx 552C 1 -0028 TstMx 5540 1 -0008 TstMx 5554 1
-0027 TstMx 552D 1 -0027 TstMx 5541 1 -0007 TstMx 5555 1
-0026 TstMx 552E 1 -0026 TstMx 5542 1 -0006 TstMx 5556 1
-0025 TstMx 552F 1 -0025 TstMx 5543 1 -0005 TstMx 5557 1
-0024 TstMx 5530 1 -0024 TstMx 5544 1 -0004 NowMx 5558 1
-0023 TstMx 5531 1 -0023 TstMx 5545 1 -0003 NowMx 1555 1
-0022 TstMx 5532 1 -0022 TstMx 5546 1 -0002 Wait 5555 1
-0021 TstMx 5533 1 -0021 TstMx 5547 1 -0001 Cntup 5555 1
-0020 TstMx 5534 1 -0020 TstMx 5548 1 TRIG DnCnt 5555 1

>Command: Edit Go Menus enVir Buffer Find Jump Page ?=help <SP>

```

■ Figure 5-17. The compressed display format.

④ Compare ACQ to REF

These fields control the acquisition and reference memory comparisons. They specify display highlighting, comparison limits, comparison offset, and masking.

Highlighting. You can turn display highlighting on and off using the space bar. Your choices include:

- NO—the highlighting is turned off.
- YES—the highlighting is turned on.

When you select YES, any differences between acquisition and reference data that are not masked by the compare mask symbol will be highlighted in the Display Menu.

From/To. The from and to parameters determine the range of data locations for all comparisons between acquisition and reference memories. These boundaries are also used for the transfer of acquisition data to reference memory.

The boundaries for the comparison can range from -9999 to +9999.

NOTE

If you are using the μ Analyst's 256K SYSTEM DISK, the size of reference memory may be limited. For details, refer to the front of this manual and the page titled *Software Versions Covered By This Manual*.

Offset. The offset parameter allows you to skew the reference data in relation to acquisition data. An offset of one or more will move the data in reference memory down (or forward) on the Display Menu. The offset parameter will be ignored during a transfer of acquisition to reference memory.

^ Mask. The ^ Mask parameter is the name of a symbol defined in the Symbol Menu. The mask part of the symbol specified will be used as a mask during compare operations. These operations include highlighting, GO TIL ACQ = REF or GO TIL ACQ < > REF acquisition modes, and Next_Diff and Total_Diff commands.

A zero bit in the ^ Mask field means don't compare for that channel.

Symbols are entered into the ^ Mask field by typing the selected symbol's name. If you cannot remember all of the symbol names within the Symbol Menu, you can use the Control-S (^ S) key to scroll through the symbol names. Each symbol name and its value appears on the bottom of the screen under the heading "selected symbol."

Operational Notes. For all the compare functions, the STATE group is ignored. When acquisition and reference data do not overlap, they are considered equal. For example, if the amount of reference data differs from the amount of acquired data, all data in unmatched line numbers will be considered equal (subject, however, to the offset parameter).

5 Find Pattern

This field establishes the find pattern used by the Display Menu's Find command.

The find pattern may consist of from one to four words, with each word specified by its name in the Symbol Menu. Note that the mask part of each symbol may be used to ignore part of the symbol during a find operation. A zero bit in the symbol's mask is a don't compare for that channel.

Use the insert key to insert a word in the search pattern. Use the delete key to delete a word in the search pattern.

Each word in the search pattern has a corresponding state field. This field lets you specify which trigger-store state the word must be in to match the find pattern. For example, suppose you set up the following conditions:

Find pattern Multiplex in state Mux

In this case, the Display Menu will compare the Multiplex pattern to all state samples that were acquired in the state Mux. Any other state samples will be ignored.

You can select between the various trigger-store states by using the space bar. If you leave the state field set to all blanks, the find word will be compared to all trigger-store states.

If the find pattern consists of more than one word, each word in the pattern may be separated by from 1 to 4096 locations. A value of 1 means that the words must be found in consecutive locations (i.e., there can be no other samples between them).

For example, suppose you set up the following conditions:

Find pattern	Multiplex	in state	Mux	
followed by	Non-Mux	in state	Nomux	within 01 locations
followed by	LowReset	in state	(blank)	within 50 locations

When you execute the Find command, the Display Menu will first look for the word Multiplex in state Mux. If this word is found, the menu will then look at the next immediate memory location to see if it contains the word Non-Mux in state Nomux.

If the next immediate location does not contain Non-Mux, the menu will again look for Multiplex followed by Non-Mux, and so on. If the next immediate location does contain Non-Mux, the menu will look for LowReset in the next 50 locations.

If LowReset is found, the menu will update the display to that location. If LowReset is not found, the menu will again search for Multiplex, followed by Non-Mux, and so on.

The Display Menu will continue to search for the pattern throughout the entire state memory. If the pattern cannot be found, a message will appear on the display.

OVERVIEW

The Histogram Menu is used to perform range-activity analysis on acquired state data. This can include address activity or specific data activity, optionally qualified by some value you select.

With this menu, you can define up to 16 ranges for a particular channel group. The system then calculates and displays the percentage of activity occurring within each range. You can view the range activity levels in a proportional bar graph, or you can view an occurrence count of the events falling into each range.

A defined range is called a bin, and the process of determining what data or address falls into a bin is called binning.

The rest of this subsection illustrates how you use the features of the Histogram Menu.

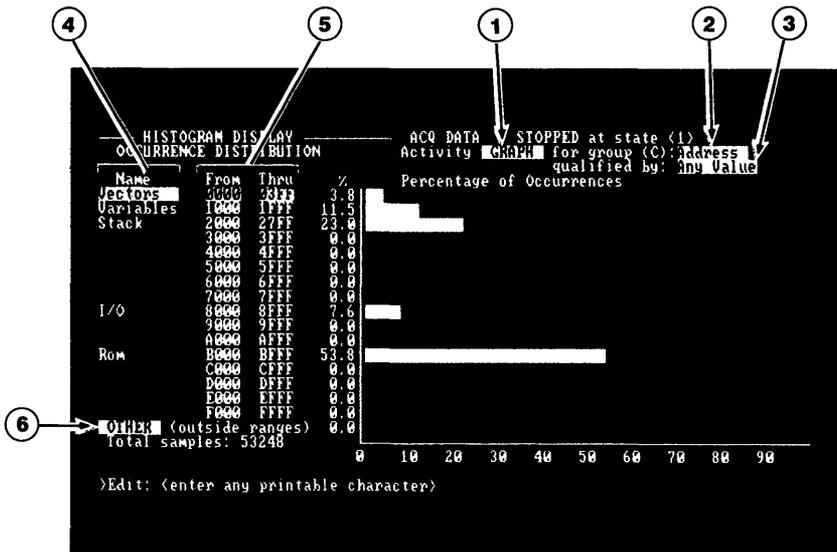
MENU FIELD SELECTIONS

Figure 5-18 illustrates a typical Histogram Menu display. To enter this menu, press M for Menu, then H for Histogram from the command line.

Use the numbered callouts in Figure 5-18 as a reference while reading the following field descriptions. To change a menu field, you must be in the edit mode (press E for Edit), and you must have the screen cursor positioned in the field.

If the μ Analyst HELP DISK is installed, you can use the ?=Help function to obtain information about a particular field. To do this, enter the edit mode, then move the screen cursor to the desired field and press the ? (question mark) key.

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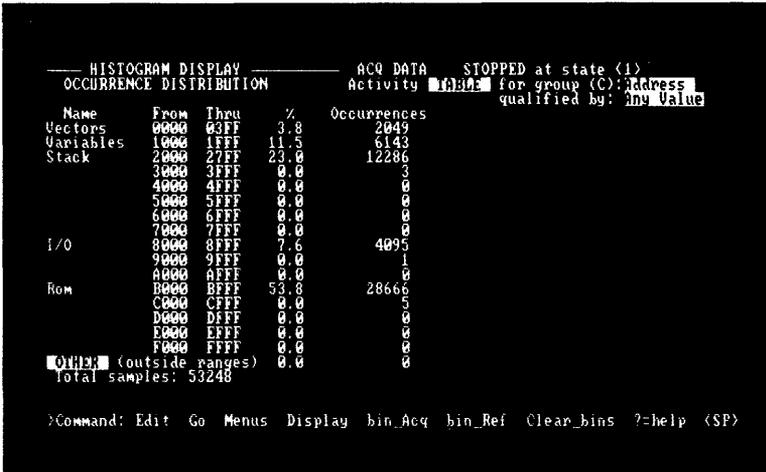
■ Figure 5-18. The Histogram Menu and its fields.

① Activity

This field determines the menu's display format. Using the space bar, you can select:

- GRAPH—the activity levels within the ranges are displayed as a proportional bar graph.
- TABLE—the activity levels within the ranges are displayed as a total occurrence count.

Figure 5-18 illustrates how the activity levels appear when a graph display is selected. Figure 5-19 illustrates how these same activity levels appear when a table display is selected.



■ Figure 5-19. Histogram Menu with a table display.

② For Group

This field selects the channel group that is to be analyzed. Only the data acquired from one channel group can be binned at any one time. The organization of channel groups is determined in the Format Menu.

Note that as you scroll through the groups, the names originally assigned in the Format Menu appear in the reverse video field. You cannot change groups names here, but you may go back to the Format Menu and do so. If no group name was assigned in the Format Menu, the default group name (A, B, C, etc.) appears in the field. The single letter reference always appears parenthetically just before the reverse video field.

Also note that the numerical range of the group, as determined by its assigned channels, is reflected in the From and Thru fields (see menu callout number 5).

③ Qualified By

This field lets you select a qualifier from the current list of symbols in the Symbol Menu. All values will be binned if the selected qualifier symbol is set to all don't cares (i.e., the Any Value symbol). Alternately, you can selectively use don't cares to range the data or look for a specific type of data.

For example, you might bin address information qualified by memory reads. The qualifier symbol would select the control line pattern that indicates a memory read, and the group containing the address bus information would be binned.

For more information on setting symbol values, refer to the Symbol Menu.

④ Name

These fields are used for naming the ranges. You can enter any name up to 10 characters. The names are for your reference only and do not affect the binning process. The up and down cursor keys select which line to edit.

⑤ From—Thru

These fields establish the inclusive beginning and ending limits for the ranges. Ranges may overlap, but the data will fall into the first bin that satisfies the range specification. Data will not be duplicated in any subsequent bins, even though another bin may satisfy the range requirements. The up and down cursor keys select which line to edit.

NOTE

To specify a range of one value, enter the same value into the From and Thru fields.

⑥ Other (Outside Ranges)

This field is used to include or exclude data that does not fall within any of the specified ranges. Using the space bar, you can select:

- OTHER—bin the data falling outside the ranges in this group.
- A blank field—ignore the data falling outside the ranges.

When OTHER is selected and its contents are greater than zero, percentages of the other ranges may change.

OPERATIONAL NOTES

Trigger-Store Setups for Range-Activity Measurements.

When you are acquiring data for a range-activity measurement, try to capture as broad a sampling as possible. The more code sampled during a given acquisition, the better the statistical distribution.

One way to optimize the state analyzer's sampling capability is to set up a storage qualification loop that captures a selection of the executing code rather than every cycle.

For example, you could set up the following storage loop in the Trigger-Store Menu:

```
<1> IF <Any Value> OCCURS AFTER 0050 SAMPLE CLOCKS THEN
      -> GOTO <2>
      NEVER_____> STORE
<2> IF <Any Value> OCCURS 0001 TIMES THEN_____> GOTO <1>
      ALWAYS_____> STORE
```

This storage loop stores one out of every 51 cycles. The state analyzer is able to monitor a much broader range of code before binning the data into the histogram ranges.

Notice that the above storage loop does not establish a trigger condition. To stop acquisition in this case, use the Stop ACQ After Memory Overflow option in the Display Environment Submenu.

Printing the Histogram Display. The bins must be cleared before binning a new group. You will be prompted if you attempt to change bin groups without first clearing the bins. If you do not wish to clear the bins, press N for No when the prompt appears. If you wish to clear the bins, enter Y for Yes.

Before clearing the bins, you may wish to first print the display using the PrtSc (PrintScreen) key. Bin names and range values can be saved on disk as part of a setup file in the I/O menu, but the binned data cannot be saved.

SPECIAL COMMAND-LINE FUNCTIONS

In addition to the standard command functions, the Histogram Menu provides specialized commands that allow you to control the binning process.

These commands do not all fit on the command line. To view the entire list of commands use the space bar.

The following paragraphs describe the commands in the order they appear on the command line. The bold, capitalized letter in each command indicates the letter key you must press to activate the command.

- Go** This command starts the acquisition and automatically bins acquisition memory for the range and group specified. This can be most useful when one of the continuous Go modes is used (as specified in the Display Environment Submenu). Repeated acquisitions are made, thus increasing the number of observations.
- Go with automatic binning only occurs when G is pressed while the Histogram Menu is on the screen.
- bin_**A**cq This command bins the data from acquisition memory. If data was previously binned and the bins were not cleared, the results of the new binning are added to the old bin data.
- bin_**R**ef This command bins the data from reference memory. If data was previously binned and the bins were not cleared, the results of the new binning are added to the old bin data.
- C**lear_bins This command clears the bins.

OVERVIEW

The I/O Menu lets you save menu setups and data. You can load the setups and data onto disk for mass storage, or you can output them to an IBM-compatible printer.

Setups and data stored on disk can be recalled and loaded into the state analyzer at any time. Setup files contain information from the Format, Symbol, Trigger-Store, and Histogram Menus, and from the Trigger-Store and Display Environment Submenus. Data files contain the data contents from reference memory.

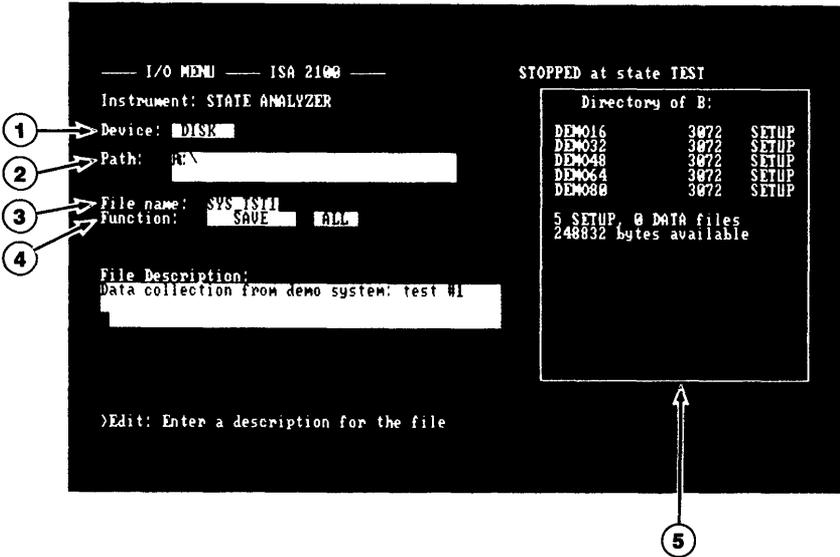
Using the menu's printer function, you can also make hard copies of the Symbol, Trigger-Store, and Display Menus. You can send these menus to a printer or save them on disk for later output to a printer. The rest of this subsection shows how to use the I/O Menu and its disk-storage and printer capabilities.

MENU FIELD SELECTIONS FOR DISK

Figure 5-20 illustrates the I/O Menu when DISK is the selected device. You enter the menu by pressing M for Menu, then I for I/O from the command line. You select the DISK device by using the space bar in the Device field (see menu callout number 1).

Use the numbered callouts in Figure 5-20 as a reference while reading the following field descriptions. To program a menu field, you must be in the edit mode (press E for Edit), and you must have the screen cursor positioned in the field.

If the HELP DISK is installed, you can use the ?=Help function to obtain information about any particular field. To do this, enter the edit mode, then move the screen cursor to the desired field and press the ? (question mark) key.



■ Figure 5-20. The I/O Menu with DISK as the selected device.

1 Device

This field establishes which I/O device the state analyzer will use: DISK or PRINTER. You make the selection by using the space bar.

NOTE

For information on how to use the PRINTER device, see Figure 5-21 later in this subsection.

2 Path

This field lets you specify the drive-directory path that leads to the file you want to use during the I/O function.

Initially, the Path field is set to the default drive and its root directory. You can set the field to an alternate path using up to 64 characters.

NOTE

Only one path name can be specified at any one time. The state analyzer will not search more than one path.

The delimiters of the path name are as follows:

<d>:\directory1\directory2\...

where <d>: is a drive location. If you do not want to change drives, leave out the <d>: designation and just enter the directories. The state analyzer will search for the directories in the current drive.

When a new drive or directory is entered into the Path field, the menu's directory window is automatically updated to show the state analyzer files located at that directory level (see callout number 5). The window will not show any DOS system files or user programs.

③ File Name

This field specifies which file will be used during the I/O function. For SAVE functions, enter a new file name. For LOAD or DELETE functions, enter the name of a file that already exists in the current directory.

A file name can be up to eight characters in length. Certain characters cannot be used in the name, such as dashes, commas, dollar signs, and others. The message line at the bottom of the menu will advise you when an illegal character has been entered.

④ Function

This field specifies the I/O function to be performed on the selected file. Using the space bar, you can specify one of the functions listed below:

- SAVE—saves the file on disk.
- LOAD—loads the file into the state analyzer.
- DELETE—deletes the file from disk.

The following paragraphs describe each of these functions. You execute a given function by pressing X for eXecute from the command line. (Refer to *Special Command-Line Functions* later in this subsection.)

SAVE Function. This function lets you save a new file on disk. The new file is identified by three elements: a file name, a file type, and a description.

NOTE

The disk used for storing the new file must be formatted for DOS (version 2.00 or higher). For procedures on how to format a diskette for DOS, refer to your DOS manual.

The file name is entered in the File Name field as described under callout number 3. If the entered name is the name of an already existing file, the existing file will be overwritten with the new file. In this case, the μ Analyst will ask you to confirm the action by pressing Y for Yes.

The file type is specified in the field which appears next to the SAVE field. Using the space bar, you can select:

- SETUP—which saves menu setup information.
- DATA—which saves the data from reference memory. (Data from acquisition memory cannot be transferred directly onto disk. To save acquisition memory, you must first transfer it to reference memory.)

NOTE

The byte structure used for DATA files is provided in Appendix B at the back of this manual.

- ALL—which saves both the menu setups and the data from reference memory. This selection creates two files with the same name, one for setup and one for data.

The file description is entered into the field that appears below the Function field. You can enter up to 135 characters. The description is saved with the file, and it will reappear on the screen whenever the file is loaded into the state analyzer.

LOAD Function. This function is the reverse of SAVE. It lets you load a file into the state analyzer. The file is identified by its name and type.

When you load a file, the current analyzer setup and/or reference memory will be overwritten by the file. The μ Analyst will ask you to confirm the action by pressing Y for Yes.

DELETE Function. This function is used to delete a file. The file is identified by its name and type.

When deleting a file, the μ Analyst will first display a description of the file, then it will ask you to confirm the action by pressing Y for Yes.

⑤ **Directory Window**

The directory window lists the state analyzer files that are located at the current drive-directory level.

The files are identified by their name, their byte size, and their type (either SETUP or DATA). The ALL file types are not listed, since they are made up of SETUP and DATA files.

The bottom two lines of the directory window tell you the total number of files contained in the directory and indicate how many bytes are still available for use.

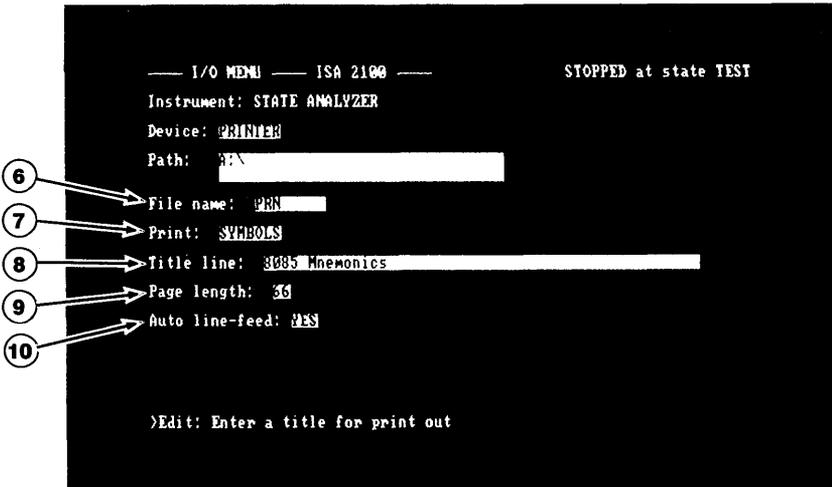
If the directory contains more files than can fit in the window, you can scroll through the files by pressing P for Page_directory from the command line. (Refer to *Special Command-Line Functions* contained later in this subsection).

MENU FIELD SELECTIONS FOR PRINTER

Figure 5-21 illustrates the I/O Menu when PRINTER is the selected device. You select the PRINTER device by using the space bar in the Device field.

Use the numbered callouts in Figure 5-21 as a reference while reading the following field descriptions. The numbered callouts for this figure do not start at 1, but rather they progress from the last number used under the DISK field selections. This is to avoid confusion between the two displays.

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■ Figure 5-21. The I/O Menu with PRINTER as the selected device.

⑥ File Name

This field specifies the type of print operation. You can send a file to a printer, or you can save an ASCII file on disk for later output to a printer.

To send a file to a printer, enter one of the following reserved DOS device names:

LPT1 or PRN—First Parallel Printer
LPT2—Second Parallel Printer
LPT3—Third Parallel Printer
COM1—Serial Port 1
COM2—Serial Port 2

📌 NOTE

For a complete list of printers that can be used with the μ Analyst, refer to the page titled *PC Compatibility Requirements* at the front of this manual.

To save a file on disk, enter any name up to eight characters. The new file will be stored at the drive-directory location specified in the Path field.

When you save a file on disk, the new file is only suitable for later outputting to a compatible printer. The ASCII format used in the file is not suitable for loading into the state analyzer. To create a file that can be loaded into the state analyzer, you must use the DISK device as shown in Figure 5-20.

⑦ Print

This field selects the source of the data to be printed. Using the space bar, you can select:

- SYMBOLS—prints the contents of the Symbol Menu.
- STATES—prints the contents of the Trigger-Store Menu.
- DATA—prints data based on the last-used Display Menu settings, e.g., ACQ, REF, <—ACQ REF—>, standard or compressed.

When you select DATA, you will be prompted to specify the range of data you wish to print: from what point in memory to what point in memory. The message line at bottom of the display will tell you the beginning and ending sequences in memory. Instead of entering numerical ranges, you may also enter B for Beginning, E for End, or T for Trigger.

8 Title Line

This field allows you to enter a 50-character page header. The header then appears at the top of each printed page. Each printed page is also automatically numbered.

9 Page Length

This field defines the length of the printed page, including title block.

Acceptable values are from 20 to 99 vertical lines. Select the value that fits the physical size of the paper you are using, as well as the lines-per-inch (lpi) setting of your printer.

10 Auto Line-Feed

An auto line-feed can be generated after every carriage return. Using the space bar, you can select: YES, generate line-feeds after every carriage return; or NO, do not generate line-feeds.

SPECIAL COMMAND-LINE FUNCTIONS

The following paragraphs describe the command-line functions specific to the I/O Menu. The bold, capitalized letter in a command indicates that you must press that letter to execute the command.

- P**age_directory This command only appears on the command line when the menu is set to the DISK device. The command lets you page forward through the files listed in the directory window. When the last file is reached, the paging starts over from the beginning of the directory.
- P**age_printer This command only appears on the command line when the menu is set to the PRINTER device. The command lets you send a form feed character (0C, hexadecimal) to the printer.
- e**Xecute This command appears when the menu is set to either the DISK or the PRINTER device. The command executes the I/O function designated on the screen.

Using this section. This section shows you how to use the Model 2100 Interactive State Analyzer in time-aligned acquisition with the Model 2200 Interactive Timing Analyzer.

During this section, it is assumed that you are already familiar with the operating menus of both analyzers. If not, refer to Section 5 of this manual for information on state analyzer menus, and refer to the *Interactive Timing Analyzer Users Manual* for information on timing analyzer menus.

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OVERVIEW

You can use the Interactive State Analyzer in conjunction with the Interactive Timing Analyzer if you have both products installed in the μ Analyst 2000 Mainframe. Many combinations of aligned and non-aligned acquisition modes are available for operating the two analyzers together.

Aligned acquisition means that common time reference information is stored with the state and timing data as it is placed in acquisition memory. This allows the synchronous data from the state analyzer to be correlated with the asynchronous data from the timing analyzer, and vice versa.

The correlated state and timing data is shown in a split-screen display. You can view of the same point in time from the different perspectives of the state and timing analyzers. Dual scrolling allows you to move between the analyzer memories simultaneously. When you scroll the state or timing window, the other window keeps in step.

The time correlation between state and timing data is handled internally by the μ Analyst. Post-acquisition software matches the state clocks to the timing acquisition data and uses the Crosslink (CL) signal as a common reference point.

Non-aligned acquisition means that the Crosslink (CL) signal is used in a more general way. Because the acquisitions are not time-aligned for display, more programming flexibility is allowed than in one of the aligned modes.

The options for operating the state and timing analyzers together allow for the state analyzer to arm the timing analyzer, and vice versa.

It is important to note the difference between triggering and arming. Triggering occurs when an incoming sample satisfies the programmed trigger condition. Arming an analyzer does not mean that the analyzer has been triggered, it only means that the analyzer has been enabled to look for its trigger. When the analyzer is not armed, the trigger condition may occur, but the analyzer will ignore it.

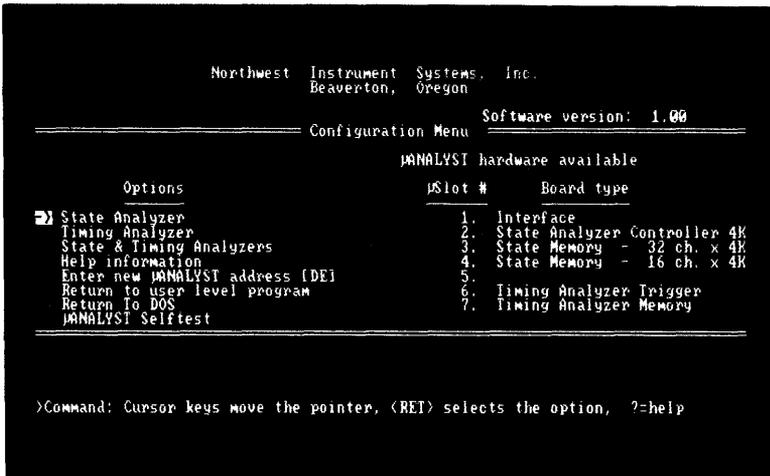
The Crosslink (CL) is an internal bus line that is used to communicate the arm/not-armed condition. The CL can be used in either direction—state arms timing or timing arms state. (The signal on the CL line also appears as an output at the CL BNC connector located on the mainframe's back panel).

ALIGNED/NON-ALIGNED MODES

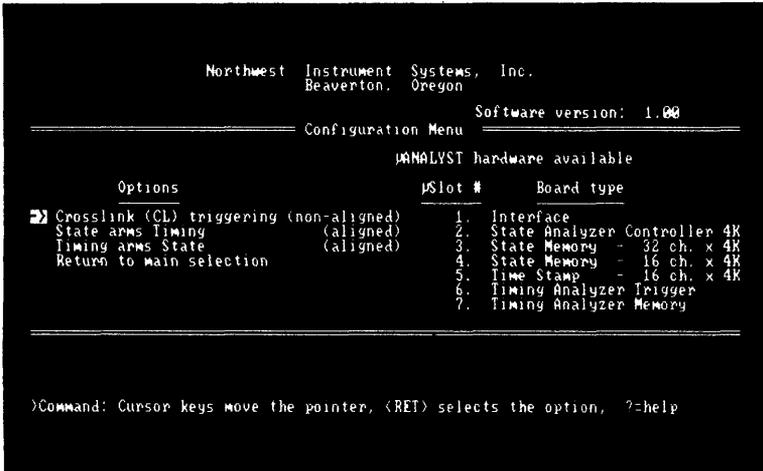
You select the aligned/non-aligned acquisition modes in the Configuration Menu. As shown in Figure 6-1, a special operating option, titled State & Timing Analyzers, is provided when both analyzers are installed in the μ Analyst mainframe.

To select the State & Timing Analyzers option, move the screen pointer to that option's location, then press the return key. The Configuration Menu will immediately display the aligned/non-aligned acquisition modes, as shown in Figure 6-2.

00842-048



■ Figure 6-1. The Configuration Menu when the state and timing analyzers are both installed in the μ Analyst mainframe.



■ Figure 6-2. Aligned/non-aligned acquisition modes.

The following paragraphs describe the various aligned/non-aligned acquisition modes. Note that the mode descriptions appear in a different order than the modes appear on the screen. This is because the two aligned modes (State Arms Timing and Timing Arms State) contain background information that will be needed for the non-aligned mode (Crosslink Triggering).

State Arms Timing (Aligned)

In this mode, the state analyzer looks for an occurrence or sequence of occurrences before arming the timing analyzer. The Crosslink (CL) line is used to provide the arming signal. The word recognizers and triggering sequences in the state analyzer must be programmed so that CL will go low (0) when you want the timing analyzer to be armed.

Once arming occurs, the timing analyzer will be able to look for its own trigger pattern. If the timing analyzer's trigger pattern has been set to all don't cares (Xs), it will trigger immediately.

There are some programming requirements in the State Arms Timing mode that must be followed. The requirements are listed below.

State Analyzer Programming Requirements, Aligned Mode, State Arms Timing (for information about the specific menus mentioned, see Section 5 of this manual):

1. Once the state analyzer asserts $CL=0$ in a trigger-store state, all of the following states must also assert $CL=0$. This way, CL remains asserted throughout the duration of the timing analyzer's acquisition.
2. All acquisition clocks must be stored, therefore:
 - a. The Multiple-Preview Acquisition (MPA) mode is not available in the Trigger-Store Environment Submenu.
 - b. The Store All State Transitions field must be set to YES in the Trigger-Store Environment Submenu.
 - c. The storage qualifiers must all be set to ALWAYS STORE in the Trigger-Store Menu.
3. Only 14 programmable states are allowed in the Trigger-Store Menu. The fifteenth state is allocated for internal use.

Timing Analyzer Programming Requirements, Aligned Mode, State Arms Timing (for information about the specific menus mentioned, refer to the *Interactive Timing Analyzer Users Manual*):

1. The Multi-Triggers mode is not available in the Format Menu.
2. The timebase selection in the Format Menu is limited to 10 or 20 ns. This guarantees storage of the state analyzer's master clock pulse.

If the programming requirements for the state and timing analyzers have not been met, you will be prompted when attempting to leave the edit mode. You can let the system correct the programming automatically, or you can enter the menus and correct the programming manually, using the displayed error message as a guide.

Time-Aligned Display Requirements. In addition to the programming requirements listed earlier, there are certain conditions that must be met before data can be correlated for display:

1. The state and timing memories must both contain the sample event that caused the $CL=0$ assertion.
2. The data in the state and timing memories must overlap at some point in time (i.e., their time domains must intersect).

Position the state and timing triggers carefully to ensure that the above two conditions are met. Only the state and timing data that overlaps is correlated for display.

Timing Arms State (Aligned)

In this mode, an arming signal is generated when the timing analyzer's trigger condition is met. The Crosslink (CL) line is asserted low (0) and held until both the state and timing acquisitions are complete.

On the state analyzer side of this mode, the CL is monitored by a preprogrammed state. This state is internally programmed to look for CL going low. (This internally programmed state will not be seen in the state analyzer's Trigger-Store Menu.)

Once the CL is asserted, the state analyzer goes to the start state you programmed in the Trigger-Store Environment Submenu. If this start state is programmed to trigger on all don't cares, the state analyzer will trigger immediately. Otherwise, it will execute the state sequences as programmed.

As with the State Arms Timing mode, there are some programming requirements in the Timing Arms State mode that must be followed. These requirements are listed below.

State Analyzer Programming Requirements, Aligned Mode, Timing Arms State (for information about the specific menus mentioned, see Section 5 of this manual):

1. All the states defined in the Trigger-Store Menu must be set to CL=1. In order for the Timing Arms State mode to work properly, only the timing analyzer can be allowed to assert CL=0.
2. All acquisition clocks must be stored, therefore:
 - a. The Multiple-Preview Acquisition (MPA) mode is not available in the Trigger-Store Environment Submenu.
 - b. The Store All State Transitions field must be set to YES in the Trigger-Store Environment Submenu.
 - c. The storage qualifiers must all be set to ALWAYS STORE in the Trigger-Store Menu.
3. Only 14 programmable states are allowed in the Trigger-Store Menu. The fifteenth state is used internally to look for the arming signal from the timing analyzer.

Timing Analyzer Programming Requirements, Aligned Mode, Timing Arms State (for information about the specific menus mentioned, refer to the *Interactive Timing Analyzer Users Manual*):

1. The Multi-Triggers Mode is not available in the Format Menu.
2. The timebase selection in the Format Menu is limited to 10 or 20 ns. This guarantees storage of the state analyzer's master clock pulse.

If the programming requirements for the state and timing analyzers have not been met, you will be prompted when attempting to leave the edit mode. You can let the system correct the programming automatically, or you can go back and change it manually, using the displayed error message as a guide.

Time-Aligned Display Requirements. In addition to the programming requirements listed earlier, there are certain conditions that must be met before data can be correlated for display:

1. The state and timing memories must both contain the sample event that caused the CL=0 assertion.
2. The data in the state and timing memories must overlap at some point in time (i.e., their time domains must intersect).

Position the state and timing triggers carefully to ensure that the above two conditions are met. Only the state and timing data that overlaps is correlated for display.

Crosslink Triggering (Non-Aligned)

In the non-aligned mode, the state and timing analyzers can arm each other, but their respective data is not time-aligned for the display. This allows greater flexibility in the available cross-arming and triggering setups. You can use any of the triggering modes, including Multiple-Preview Acquisition in the state analyzer, and Multi-Triggers in the timing analyzer. In addition, you can use any of the timing analyzer's timebase selections.

Note that, as with any trigger mode, it is possible to program arming/triggering sequences in which the state or timing triggers may never occur. Think carefully about your trigger and crosslink programming in both analyzers.

In the non-aligned mode, the state and timing analyzers can both sense and/or assert the Crosslink (CL) line. In the state analyzer, the CL is sensed within each defined symbol in the Symbol Menu, and the CL is asserted within each defined state in the Trigger-Store Menu.

In the timing analyzer, two extra CL programming fields appear in the Format Menu. As shown in Figure 6-3, one field appears above the trigger pattern and the other appears below the trigger pattern.

The field which appears above the pattern is used for sensing the CL signal asserted by the state analyzer. Using this field, you can specify that the timing analyzer look for its trigger once the state analyzer has asserted CL, or you can specify that timing analyzer looks for its trigger while the state analyzer is asserting CL (thus, creating a trigger window).

The field which appears below the pattern is used for asserting CL from the timing analyzer.

00842-050

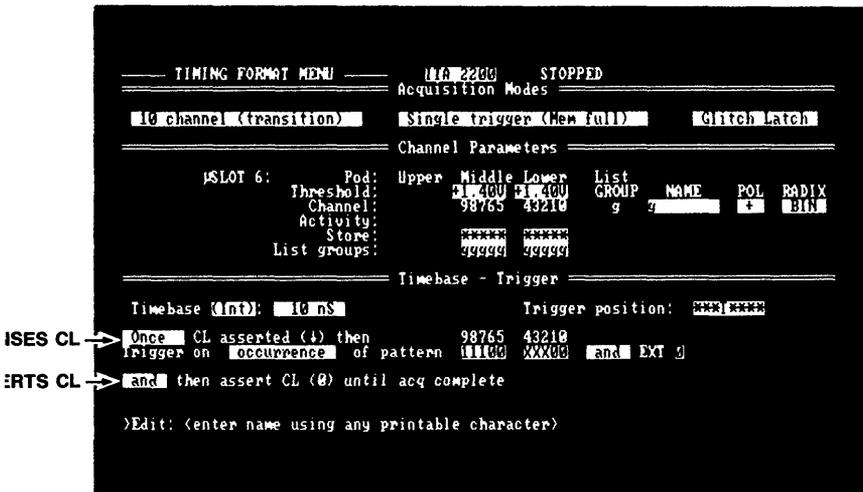


Figure 6-3. The Timing Analyzer's Format Menu when the nonaligned mode is selected.

As a simple example of the flexibility of the non-aligned mode, the timing analyzer could (1), be armed by the state analyzer; (2), once armed, it could trigger on its own programmed trigger pattern; and then (3), upon triggering, it could assert the CL to arm or trigger the state analyzer.

USING STATE & TIMING TOGETHER

You enter the aligned/non-aligned menus differently than you enter the individual state and timing menu systems. The following paragraphs describe how you enter the modes, then the menus.

Entering the Aligned/Non-Aligned Modes

The aligned/non-aligned modes can be entered at any time. To do so, first enter the Configuration Menu (press M for Menus and C for Configuration) and select the State & Timing Analyzers option. The Configuration Menu will then list the aligned/non-aligned mode choices.

Select your mode choice by pressing the return key. If your choice is one of the aligned modes and if the current state sequence or programming does not meet the aligned mode requirements discussed earlier, you will be prompted with the following message:

“Make all corrections to parameter violations (Y/N)?”

If you press Y for Yes, the μ Analyst will make all the necessary programming corrections. If you press N for No, you will need to select another choice.

Once you have made a mode choice, press the return key again. The μ Analyst will enter the state and timing menus.

Operating the State & Timing Menus

When using the state and timing analyzers together, or when observing their correlated acquisitions, you may need to jump back and forth between the state and timing analyzer menu systems and command lines.

To do this, press M for Menus from the command line. The current set of analyzer menus available (state or timing) is indicated on the command line, in brackets, in bold video. Press function key F1 to select STATE menus or press function key F2 to select TIMING menus. The menu list will then change accordingly.

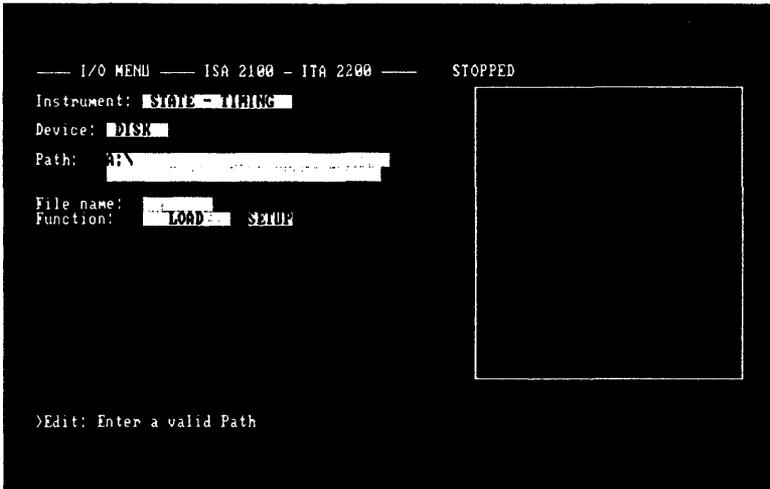
If at some point you need to identify which set of menus you are using, simply press M for Menus. You'll see which menus are currently active. Once familiar with both analyzers, you will notice that the state and timing menus are quite different and easy to distinguish.

Saving Files in the I/O Menu

If you are operating the state and timing analyzers in the non-aligned mode, the I/O Menu provides an additional field, labeled Instrument. As shown in Figure 6-4, this field lets you specify which instrument is used during the I/O operation. You can select STATE, TIMING, or STATE & TIMING.

If you are operating the state and timing analyzers in an aligned mode, the Instrument field is not programmable. It is automatically set to STATE & TIMING, so that the I/O operation is performed on both analyzers.

00842-051



■ Figure 6-4. The I/O Menu, when the state and timing non-aligned mode is selected.

SPLIT-SCREEN DISPLAY

A split-screen display mode is available if either of the aligned modes has been selected. As shown in Figure 6-5, this mode allows the simultaneous display of both timing and state data.

NOTE

It is assumed that the acquired state and timing data falls within the same time domain, or that at the least the domains intersect.

In the split-screen display, both sets of data are shown in their normal display mode. That is, timing data is shown in a waveform display, and state data is shown in a columnar radix display.

The split-screen shows up to 20 data lines, divided into two windows. You can specify the relative size of the windows in the timing analyzer's Environment Submenu. As shown in Figure 6-6, the submenu provides a field labeled State Split-Screen Size. This field determines how many lines of the display are dedicated to the state analyzer. You can enter any value into the field between 1 and 10, inclusive.

00842-052

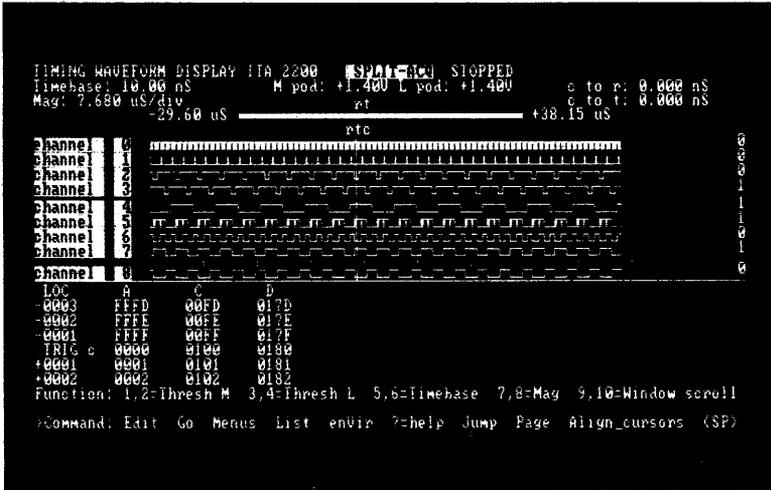
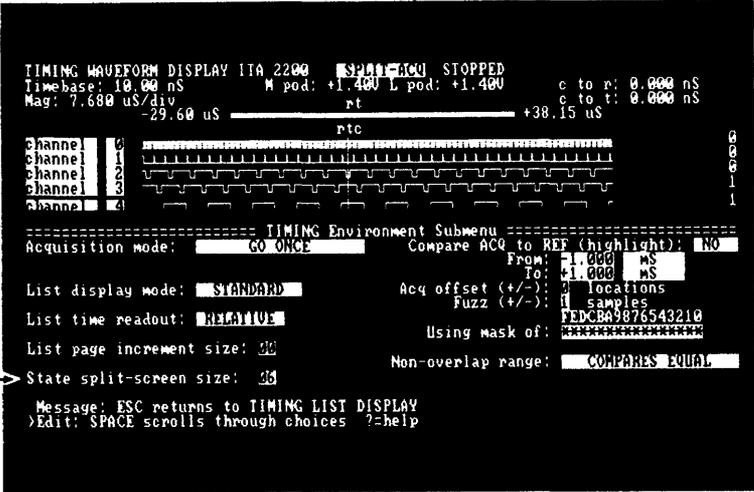


Figure 6-5. Split-screen display.



■ Figure 6-6. Selecting the size of the split-screen display in the timing analyzer's Environment Submenu.

All the display controls that are normally available for state and timing displays, are available for the split-screen display. The scrolling of the two display windows works in a master-slave fashion. For example, if you use the up and down cursor keys to scroll the state data, the timing waveforms are automatically scrolled left-to-right to the next corresponding state clock region.

If you use the left or right cursor keys to scroll the timing waveforms, the waveform display becomes the master. Calculations are made by the software to determine if the waveform scrolling has moved into a new state clock region. If so, the state display is scrolled accordingly. Should the scrolling action of one display force the other past its data, a message will advise you that the system has been scrolled beyond time-aligned data.

The split-screen mode becomes the default display mode when an aligned mode is selected. To change to another display mode, go to the waveform portion of the display, enter the edit mode, and select another choice in the Memory Selection field.

TYPICAL STATE & TIMING APPLICATIONS

Figures 6-7 and 6-8 illustrate some of the more common ways in which the two analyzers can be combined to arm/trigger one another.

00842-054

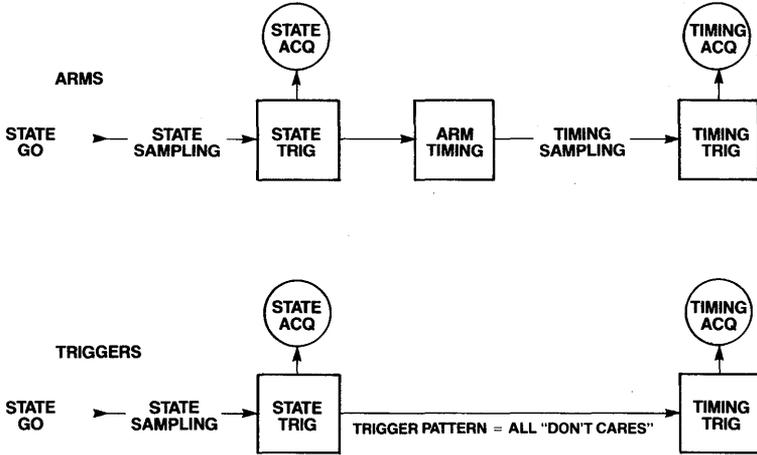


Figure 6-7. State Arms/Triggers Timing.

00842-101

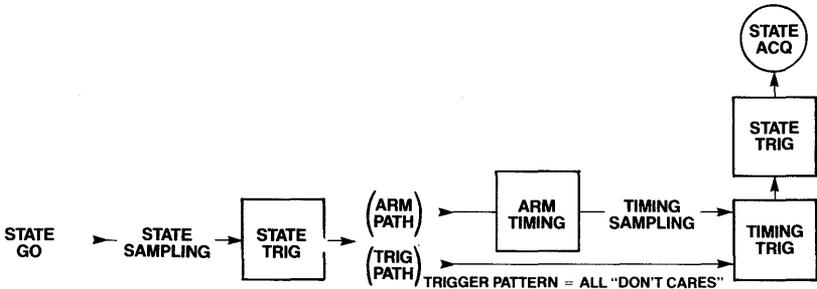


Figure 6-8. State Arms/Triggers Timing, Timing Triggers State.

Using this section. This section gives you an opportunity to operate the Interactive State Analyzer before getting into actual applications. The demonstration example is built around the demo circuit board, which you received as part of your state analyzer package.

Before attempting the demonstration example, it is recommended that you first read Sections 2, 3 and 4 of this manual. These sections show you how to install the μ Analyst hardware and software, and they provide important background information on the state analyzer features.

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SYSTEM SETUP

The μ Analyst products and accessories you'll need to set up the demo system are listed below:

- μ Analyst 2000 Mainframe, with the personal computer interface boards and cable.
- State Analyzer Controller Board and one P2901 Clock Probe
- State Memory Board (either 16- or 32-channel) and one P2902 Data Probe.
- μ Analyst software (SYSTEM DISK and HELP DISK).
- Demo Circuit Board

In addition to the above μ Analyst accessories, you'll also need a personal computer that meets the PC Compatibility Requirements listed at the front of this manual.

Installing the μ Analyst and the Personal Computer. If you haven't already done so, install the PC interface board into your personal computer. Also install the μ Analyst interface board and cable, the controller board, and the memory boards as described in Section 2 of this manual.

Connecting the Probes. Now, connect the clock and data probes as follows:

1. Attach the P2901 Clock Probe to the state analyzer controller board.
2. Attach the P2902 Data Probe to the state memory board that is farthest from the controller board. If this farthest board is a 32-channel memory board, attach the probe to the board's upper probe connector.

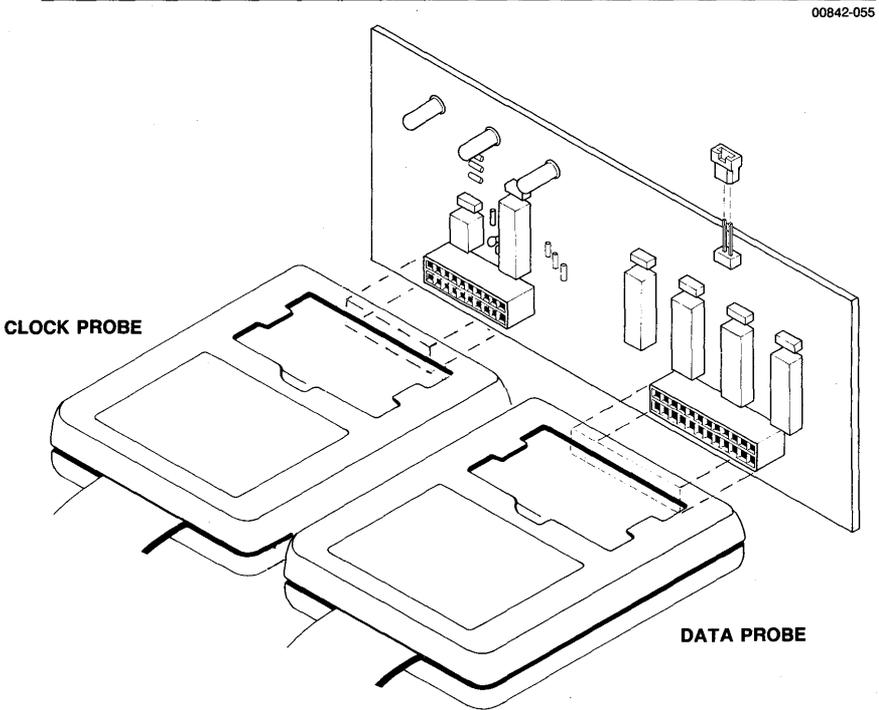
NOTE

It is important that you connect the probes exactly as described above. Otherwise, the demonstration example will not work properly.

Installing the Demo Board. To connect the demo circuit board to the μ Analyst, follow these steps, referring to Figure 7-1:

1. Connect the P2901 Clock Probe (from the Controller Board) to Clock Probe connector on the demo board.
2. Connect the P2902 Data Probe (from the Memory Board) to the Data Probe connector on the demo board.

When connecting a probe to the demo board, it is easiest if you hold the demo board vertically so that the two block connectors are at the bottom and horizontal. Center the probe's shrouded pin header over the board's connector, then push the probe into contact with the demo board.



■ Figure 7-1. Installing the demo circuit board.

Starting the System. To start the system, perform these steps:

1. Install a DOS diskette (version 2.00 or higher) into drive A of your personal computer.
2. Power up both the μ Analyst mainframe and the personal computer.
3. Remove the DOS diskette from Drive A and replace it with the μ Analyst's HELP DISK.
4. Insert the μ Analyst's SYSTEM DISK into drive B of the personal computer.
5. Enter drive B, then type the word ANALYZE and press the return key.

In a few moments you'll see the Configuration Menu on the screen. You're ready to start the demonstration.

NOTE

If you're using a hard-disk computer, load the μ Analyst software as specified in Section 3, *Getting Started*.

THE CONFIGURATION MENU

If you've followed the instructions in the preceding subsection, you should now be looking at the Configuration Menu. Your screen should be similar to the one shown in Figure 7-2, although there may be some differences in the number and depth of memory cards, and perhaps the location of the controller and memory cards.

If your screen looks like the one shown in Figure 7-3, one of three things is probably wrong:

1. The power to the μ Analyst is not on.
2. The cable between the computer and the μ Analyst is not connected.
3. The PC interface board (the small board that plugs into the personal computer I/O bus) is set to a different address range than the address range shown on the Configuration Menu.

```
Northwest Instrument Systems, Inc.  
Beaverton, Oregon  
Software version: 1.00  
----- Configuration Menu -----  
ANALYST hardware available  
Options                Slot #    Board type  
-> State Analyzer      1.    Interface  
   Help information   2.    State Analyzer Controller 4K  
   Enter new ANALYST address [DE] 3.    State Memory - 32 ch. x 4K  
   Return to user level program 4.    -  
   Return to DOS      5.    -  
   ANALYST Selftest  6.    -  
                          7.    -  
-----  
Command: Cursor keys move the pointer, (RET) selects the option, ?=help
```

■ Figure 7-2. The Configuration Menu.

```
Northwest Instrument Systems, Inc.  
Beaverton, Oregon  
Software version: 1.00  
----- Configuration Menu -----  
ANALYST hardware available  
Options                Slot #    Board type  
-> Help information   1.    ?  
   Enter new ANALYST address [E0] 2.    ?  
   Return to user level program 3.    ?  
   Return to DOS      4.    ?  
   ANALYST Selftest  5.    ?  
                          6.    ?  
                          7.    ?  
-----  
Error: ANALYST not available  
Command: Cursor keys move the pointer, (RET) selects the option, ?=help
```

■ Figure 7-3. The Configuration Menu, without proper connections.

Take appropriate action to correct problems (1) or (2). If the problem is (3), first determine the address programmed on your PC interface board. Now, using the down cursor key, move the screen pointer to the menu's Enter New μ Analyst Address option, as shown in Figure 7-4. Press the return key. The address field in the option should immediately start to blink. In the field, enter the two hexadecimal characters which correspond to the eight most significant bits of the address programmed on the PC interface board.

NOTE

If the above procedures fail to take care of the problem, refer to Section 3 of this manual for instructions on how to handle power-up error conditions.

00842-058

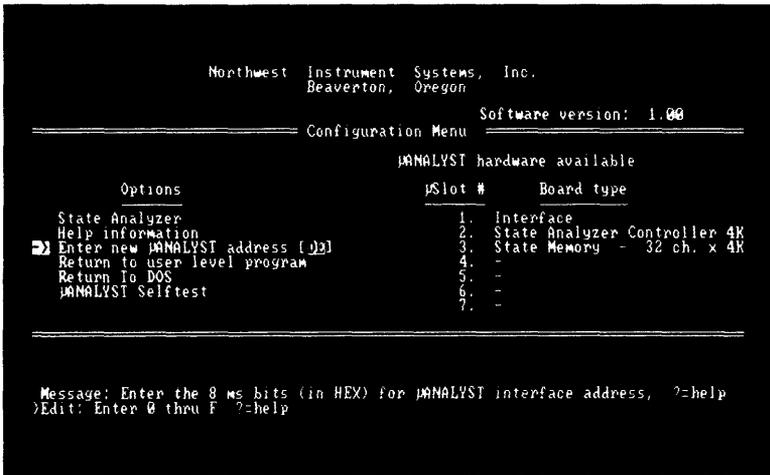


Figure 7-4. Changing the PC interface board's address in the Configuration Menu.

Now that your system is up and running, take a few minutes to read the on-line Help information.

This Help file gives basic information about how to move the cursor through the menus, select commands, and enter and leave the edit mode within a menu.

7 Demonstration

MODEL 2100

Help also explains the command and message lines at the bottom of the screen. These lines are very important in using the system. The command line provides supplemental information about the command you have selected or, if you've made a mistake, gives you an error message. Any time you are unsure of what to do next, read the command and message lines. In most cases this will provide you with the information you need to proceed.

To read the Help information, move the screen pointer to the Help Information option of the Configuration Menu and press the return key. The bottom line of the screen will now show three commands:

- <PgUp> Press this key to move backward through the Help file.
- <PgDn> Press this key to move forward through the Help file.
- <Esc> Press this key to escape the Help file and return to the Configuration Menu.

Now that you have read the Help information, we can proceed with the demonstration. In this demonstration we will be monitoring and controlling the demo board that you have connected to the clock and data probes.

The demo board consists of a 16-bit up/down counter. The state analyzer can be programmed to control the up/down function of the counter, its load initial count function, and its counter enable input. Of course, the state analyzer also monitors the counter's 16 output lines.

As we proceed through the demonstration, we will discuss the operation of the demo board in more detail, and we'll clarify exactly how to program the state analyzer to control and/or monitor the board.

First let's go to the I/O Menu and load a setup file, which will automatically program the entire operation of the state analyzer. Move the screen pointer to the State Analyzer option in the Configuration Menu, and press the return key.

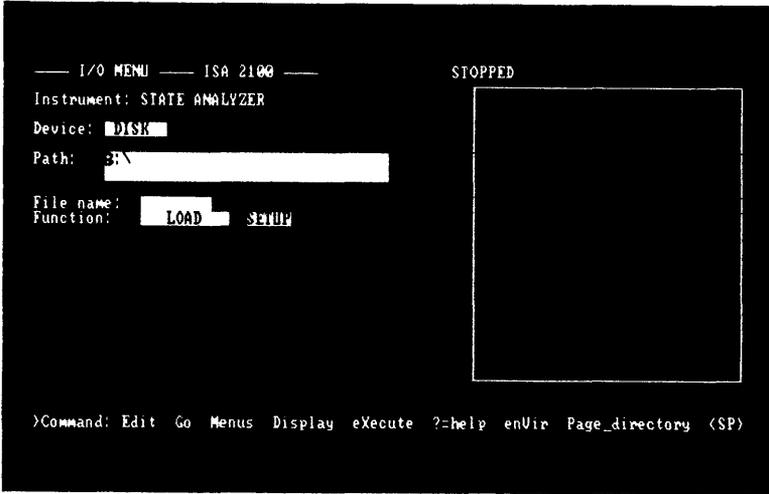
The state analyzer will display its Format Menu first. To move from the Format Menu to the I/O Menu, use the Menu command on the command line at the bottom of the screen. Press M. The command line now lists all of the available menus, including the I/O Menu. Press I to select the I/O Menu.

THE I/O MENU

In the I/O Menu, you should see a screen like the one in Figure 7-5.

There are five programmable fields in this menu. The Device field allows you to select either disk or printer as the I/O device. Disk is the currently selected device.

00842-059



■ Figure 7-5. The I/O Menu.

The Path field refers to the current drive-directory in use. The state analyzer files contained at the path location are displayed in the directory window on the right-hand side of the screen.

The File Name field is used to indicate the name of the file you wish to act on.

The Function field allows you to describe what you want to do with the indicated file.

7 Demonstration

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In this demonstration we want to use the I/O Menu to load the State Analyzer Demo Program, which is contained on the μ Analyst's HELP DISK. The following steps show you how to do this.

1. Press E to enter the edit mode.
2. Move the screen cursor to the Path field and enter:

A: \

Now press the return key. The directory window should immediately show you the files on the HELP DISK.

3. Move the screen cursor to the File Name field, then enter the name of the DEMOXX file that matches the total number of channels in your state analyzer. For example, if your state analyzer has a total of 32 channels, enter DEMO32.
4. Move the screen cursor to the Function field, then, using the space bar, set the field to:

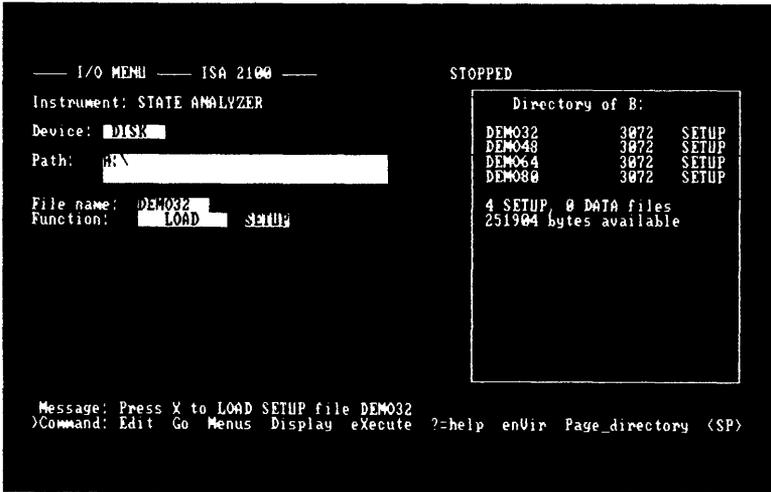
LOAD SETUP

5. Finally, press the escape key to leave the edit mode and return to the command mode.

Your I/O Menu should now look similar to the one shown in Figure 7-6.

 **NOTE**

In this example, we used the DEMO32 file because our state analyzer is configured with a total of 32 channels. If your state analyzer contains more channels, you should be using the appropriate file. Otherwise, the demonstration example will not work properly.



■ Figure 7-6. Setting up the I/O Menu to load the demo file.

7 Demonstration

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You can now load the demo file by pressing X for eXecute. Your screen should now look like Figure 7-7.

The file description reminds you that the data probe connected to the demo board must be attached to the memory board farthest from the controller board, and it tells you how many channels this demo file is set up for.

If the number of channels in the file description matches the number in your system, enter Y for Yes when the μ Analyst asks you to confirm the loading operation.

00842-061

```
----- I/O MENU ----- ISA 2100 -----                STOPPED
Instrument: STATE ANALYZER
Device:  DISK
Path:  C:\
File name:  DEM032
Function:  LOAD  SETUP

File Description:
32 Channel Demo. Connect Data Probe to the
last Memory Board. If using a 32 channel card
use the upper probe connector.

Directory of B:
DEM032      3072  SETUP
DEM048      3072  SETUP
DEM064      3072  SETUP
DEM080      3072  SETUP
4 SETUP, 0 DATA files
251904 bytes available

)Warning: Please confirm: LOAD SETUP from file DEM032 (y/N/?)
```

■ Figure 7-7. Loading the demo file.

During the few moments the setup is loading, your screen will look like Figure 7-8.

00842-062

```
----- I/O MENU ----- Demo00 -----                STOPPED
Instrument: STATE ANALYZER
Device:  DISK
Path:    A:\
File name: DEMO32
Function:  LOAD  SETUP

File Description:
32 Channel Demo. Connect Data Probe to the
last Memory Board. If using a 32 channel card
use the upper probe connector.

Directory of B:\
DEMO32      3072  SETUP
DEMO48      3072  SETUP
DEMO64      3072  SETUP
DEMO80      3072  SETUP
4 SETUP, 0 DATA files
251904 bytes available

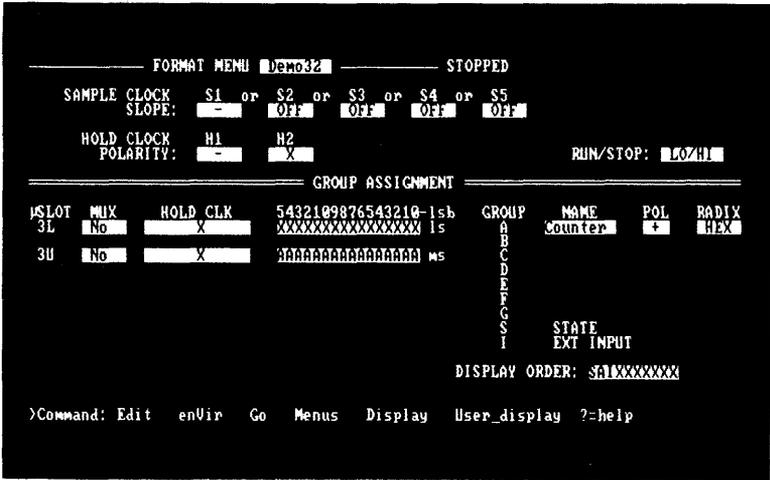
>Message: Reading SETUP file DEMO32
```

■ **Figure 7-8. Reading the setup file.**

When the command line reappears, move to the Format Menu: first select the Menu command by pressing M, and then select the Format Menu by pressing F.

Your screen should now look like Figure 7-9.

00842-063



■ Figure 7-9. The Format Menu.

THE FORMAT MENU

The Format menu is used to describe how you have connected the state analyzer to the device under test, and how this set of connections should be grouped, named and displayed. It also allows you to name the setup (just as we named the demo setup DEMOXX).

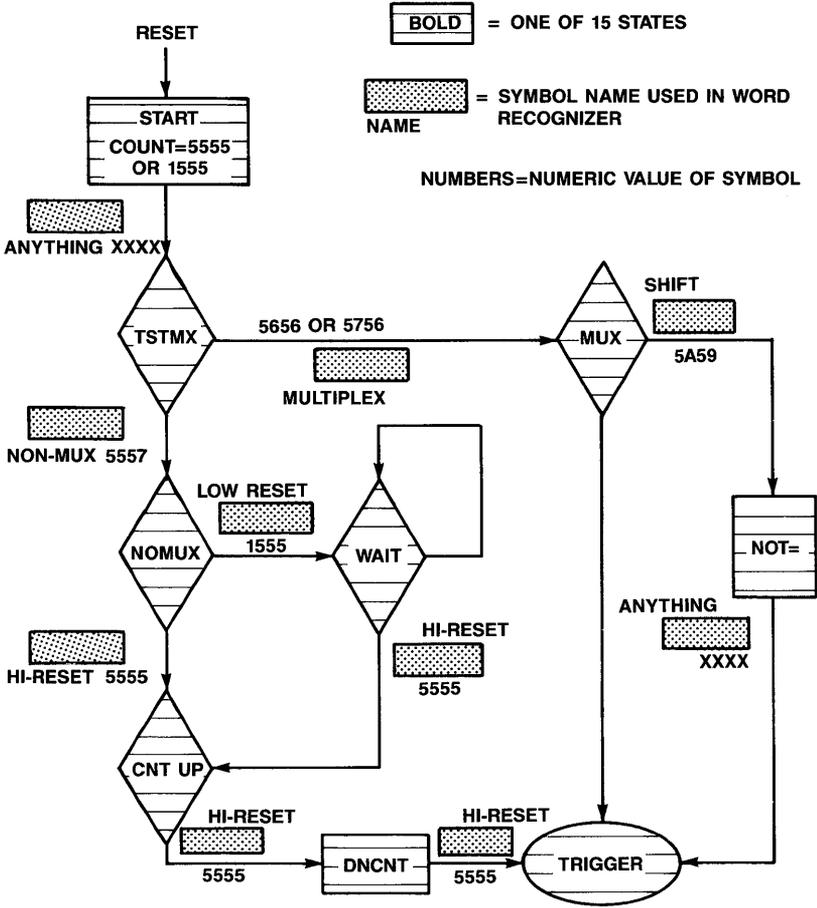
The demo board counter outputs are connected to the channels marked A in Figure 7-9 and on your screen. For the configuration shown in Figure 7-9, you can see that the data probe connected to the demo board is received by the upper probe connector of the 32-Channel Memory Board in slot number 3.

This group of lines has been named Counter on the right-hand side of the screen under the NAME column. They are to be displayed in positive logic (POL=+) and in hexadecimal notation (RADIX=HEX). In the Display Menu, the data acquired from these lines will be in a column that is titled Counter.

We're going to defer further explanation of the Format Menu until we've run the state analyzer a few times and have learned a little more about how the demo is constructed.

The *Trigger-Trace Flowchart* in Figure 7-10 is a flowchart of the trigger and trace program that was loaded into the demo with the DEMOXX setup file. It is a graphical representation of how the triggering is currently programmed. We will get to know how this is done a little later.

For now, notice that there are three different paths to the TRIGGER oval in the lower right-hand corner of the chart. We will cause the data presented to the state analyzer to be different each time we run the machine, by making changes in the Format Menu. (How, we will explain later. For now, our object is to learn to start the state analyzer, follow the flowchart, and manipulate the Format Menu.)



■ Figure 7-10. Demonstration Setup. Trigger-Trace Flowchart.

Let's get started. Connect the jumper on the demo board to both pins. Select the Go command by pressing G. Your screen should now look like Figure 7-11.

00842-065

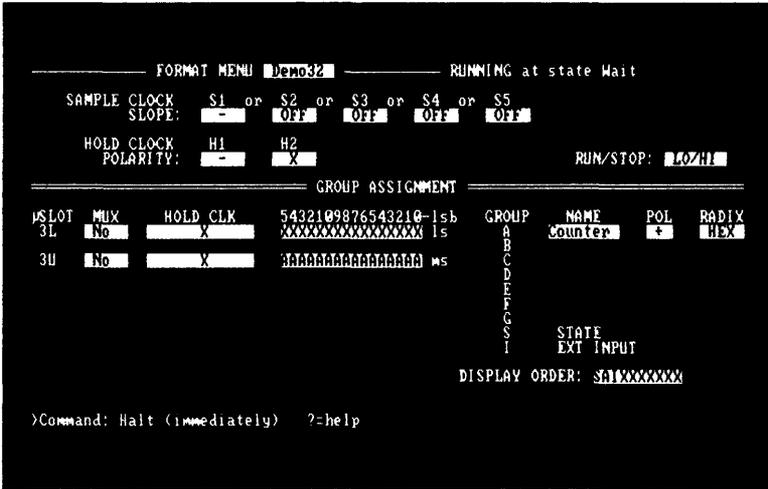


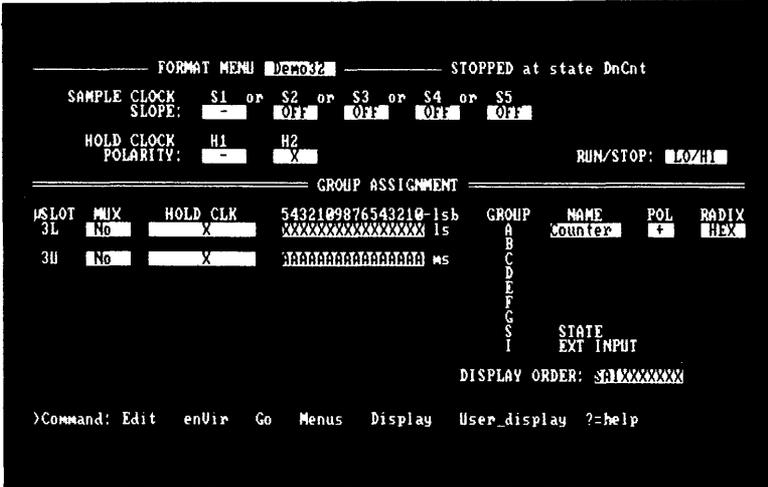
Figure 7-11. Running at state WAIT.

The message in the upper right-hand corner tells you that the state analyzer is running at the state WAIT. Find the box labeled WAIT on your flowchart. The trigger sequence is stuck in state WAIT and is waiting for you to remove the jumper from the demo board. Do this now while you watch the "RUNNING..." message. You probably noticed the "RUNNING..." message indicate states CNTUP and DNCNT before changing to "STOPPED at state DNCNT."

(Leave the jumper off for the time being. You might want to attach it to one leg only on the demo board. That's fine, but be sure it's only on one leg, or you will see slightly different displays from the ones we'll be showing you.)

Your screen should now look like the one shown in Figure 7-12.

00842-066



■ Figure 7-12. Trigger stopped at state DNCNT.

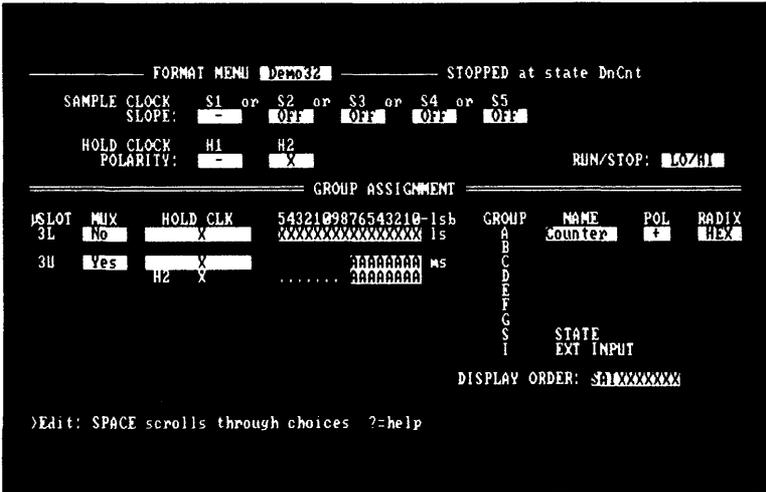
Now let's cause the triggering sequence to trigger in the multiplexed state (state MUX). To do this you must alter the Format Menu programming. First enter the edit mode by pressing E for Edit.

If the blinking screen cursor is not over the MUX field in the row containing the A channels, move it there now. Scroll through your choices in the MUX field by pressing the space bar, as directed on the edit line. Select YES. Your screen should now look like Figure 7-13.

NOTE

If your data probe is not connected to the memory board farthest from the controller board, this MUX operation will not perform as described above. Go back to the beginning of this section and reconnect your data probe as specified. Then, use the I/O Menu to load the DEMOXX file that fits your channel configuration.

00842-067



■ Figure 7-13. Setting up multiplexed mode.

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Escape from the edit mode and select the Go command by pressing G. Your screen should look like Figure 7-14.

00842-068

```
----- FORMAT MENU Demo32 ----- STOPPED at state Mux
SAMPLE CLOCK S1 or S2 or S3 or S4 or S5
SLOPE:      - OFF OFF OFF OFF
HOLD CLOCK  H1  H2
POLARITY:   -  X
RUN/STOP:   LOZHI

----- GROUP ASSIGNMENT -----
MSLOT  MUX  HOLD CLK  5432109876543210-1sb  GROUP  NAME  POL  RADIX
3L     No   X          XXXXXXXXXXXXXXXXXXXX 1s  A B C D E F G S I
3U     Yes  X          AAAAAAAAAA ms  STATE
           H2 X          ..... AAAAAAAAAA  EXT INPUT
                                           DISPLAY ORDER: SA1XXXXXXXXX

>Command: Edit  enVir  Go  Menus  Display  User_display  ?=help
```

■ Figure 7-14. Go in multiplexed mode.

As you can see, we triggered in state MUX, the second path in the flowchart. What has happened here is that the triggering specification has been programmed to detect whether or not data is being treated as multiplexed (MUX=Yes) or non-multiplexed (MUX=No). As you might suspect, this determination was made in state TESTMX on your flowchart.

For the final path in the flowchart, we are going to detect whether or not a hold clock is being used. Enter edit mode. Move the cursor to the Hold Clock column and use the space bar to select H1 LO=PASS. Escape from edit mode. Your screen should look like Figure 7-15.

00842-069

```

----- FORMAT MENU Demo32 ----- STOPPED at state Mux
SAMPLE CLOCK S1 or S2 or S3 or S4 or S5
SLOPE:      - Off Off Off Off
HOLD CLOCK  H1 H2
POLARITY:   - X
RUN/STOP:   LOZH

----- GROUP ASSIGNMENT -----
JSLT MUX HOLD CLK 5432109876543210-1sb GROUP NAME POL RADIX
3L No X ***** 1s A B Counter + Hex
3U Yes H1 LO=PASS ***** ms C D E F G H I STATE
      H2 X ..... 00000000 EXT INPUT
DISPLAY ORDER: 3100000000
>Command: Edit enVir Go Menus Display User_display ?=help
    
```

■ Figure 7-15. Setting up to detect a hold clock.

Now select the Go command. The analyzer will have stopped in the state NOT= and your screen should look like Figure 7-16.

00842-070

```

----- FORMAT MENU Demo32 ----- STOPPED at state Not =
SAMPLE CLOCK S1 or S2 or S3 or S4 or S5
SLOPE:      - OFF OFF OFF OFF
HOLD CLOCK  H1  H2
POLARITY:   -  X
RUN/STOP:   LOZH

----- GROUP ASSIGNMENT -----
PSLOT  MUX  HOLD_CLK  5432109876543210-1sb  GROUP  NAME  POL  RADIX
3L     No   X          XXXXXXXXXXXXXXXXXXXX 1s  B      Counter  +  Hex
3U     Yes  H1 LO=PASS  AAAAAAAAAA  MS  C
              H2 X          ..... AAAAAAAA  D
              E
              F
              G
              H
              I
              STATE
              EXT INPUT
              DISPLAY ORDER: SXXXXXXXXX

>Command: Edit  enVir  Go  Menus  Display  User_display  ?-help
    
```

■ Figure 7-16. Detecting a hold clock.

Before you do anything else, reprogram the Format Menu so that the MUX field is set to NO and the Hold Clock field is X. Your screen should look like Figure 7-9, with a “STOPPED...” message added.

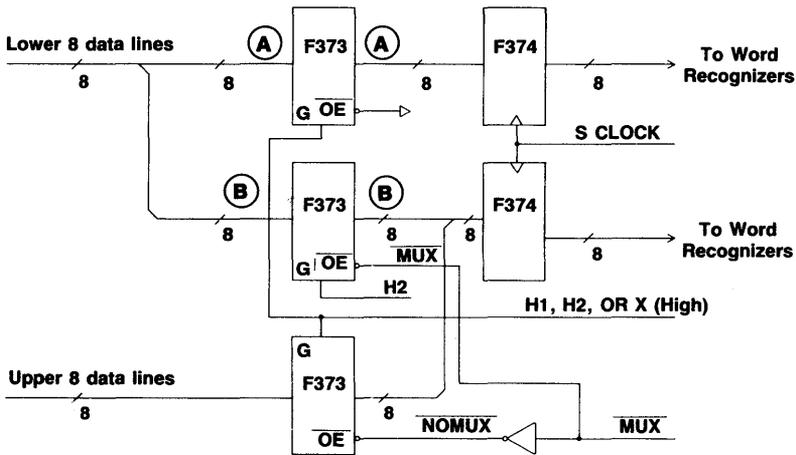
If you are willing to take it on faith that we changed the data by altering the Format Menu, skip ahead a few pages to the material on the Trigger-Store Menu. Whether you do or not, it would be a good idea to read the material on sample and hold clocking provided in Section 4, *Modes of Operation*.

BUS DEMULTIPLEXING

The way you program the Format Menu affects the way data is acquired and displayed. This subsection discusses how the sample and hold clocks work together to capture different kinds of data.

As explained in the material on sample and hold clocking in Section 4, the state analyzer in MUX mode (where MUX=YES) looks at only the lower 8 lines of the data probe. These lines are run through two transparent (or presample) latches in parallel, so that the 8 lines are duplicated and two sets of 8 are presented to the rest of the memory board (shown on paths A and B in Figure 7-17.) Each of these sets of 8 can be presampled with its own hold clock and held until the data is clocked into the state analyzer with the S1-S5 sample clocks.

If both H1 and H2 are high and MUX=YES, then both 8-bit paths will present the same data to the internal logic of the state analyzer's memory board. However, if one or both of the hold clocks are active, and if the phase relationship between the hold clocks is not the same, then different sets of data can be clocked into the internal logic of the memory board.



■ Figure 7-17. Input circuitry of the memory board.

Look at Figure 7-18 and you will see three examples of sample and hold clocks vs data storage for multiplexed systems. The first two examples (shown in Figures 7-18A and 7-18B) are timing diagrams of the demo board. In these diagrams, the sample clock data is the data on path B of Figure 7-17. Likewise, the hold clock data is the data on path A.

In the Format Menu shown in Figure 7-16, path B data is the group associated with H2. Path B is always transparent, because hold clock H2 has been programmed don't care (i.e., pass always).

Path A, the data above path B, is transparent when its hold clock field is programmed to don't care. If path A is programmed to H1 and the current definition of H1 is LO=PASS (HI=HOLD), then the shaded area in Figure 7-18B represents the period when the pre-sample latch is transparent and the white area represents the period when it is holding latched data.

Figure 7-19 shows the schematic for the demo board. As you can see, the counters are clocked on the rising edge of H1, and H1 is delayed relative to S1 by two gate delays. Also, remember that the counters are clocked into the state analyzer on the falling edge of S1.

Starting at the left side of the timing diagram in Figure 7-18B, you can see that shortly after the first rising edge of H1, the sample clock data (the lower 8 bits of the counter) changes to the value 57. The next falling edge of S1 (marked with the vertical line) clocks the sample and hold clock data into the state analyzer so that the displayed value is 5756. (This is the first value displayed in the column just past the far right-hand side of the timing diagram.) The 57 is the sample clock data and the 56 is the hold clock data. Why the hold clock data is 56 will become apparent as we go through the next cycle of the timing diagram.

Immediately after the first falling edge of S1, H1 goes low, causing the hold clock data presample latch to become transparent. Shortly after this latch has been enabled, the data in the latch becomes 57 as indicated. The 57 is the current value of the lower 8 bits of the counter.

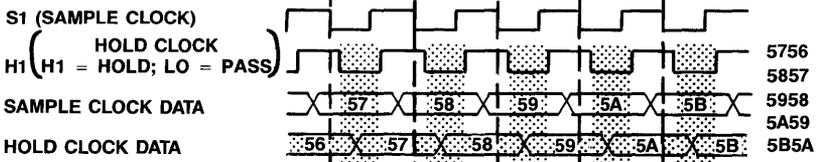
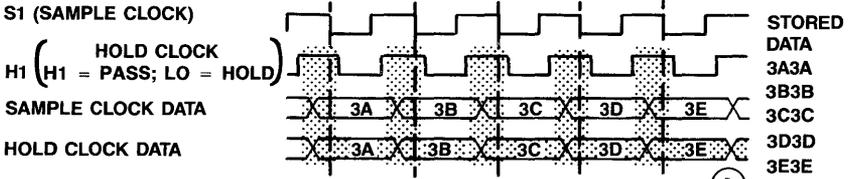
Upon the next rising edge of H1, two things happen: the hold clock data is latched into the presample latch, and the counters are clocked. After a propagation delay from clock to counter is output, the counters increment to the value 58.

At this point the counters (and therefore the sample data path) have the value 58, while the hold clock presample latch has the value 57. The presample latch will hold the value 57 until H1 goes low. However, before this happens S1 goes low, clocking the value 5857 into the state analyzer. (The next four cycles of the timing diagram are left as an exercise for the reader.)

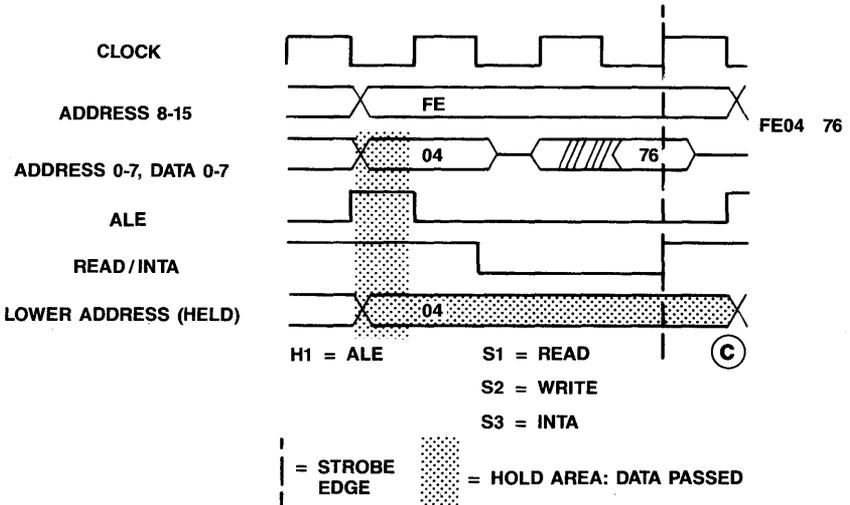
In Figure 7-18A, you can see that if the programmed polarity at H1 is reversed (in relation to Figure 7-18B), sample clock data and hold clock data will be the same at the time S1 clocks the data into the state analyzer. This is because both the sample and hold clock presample latches are transparent (enabled) before and during the S1 falling edge.

Now that you understand how programming the Format Menu in different ways can result in the state analyzer seeing different data, let's go on to the Trigger-Store Menu and learn how trigger specification separates one kind of data from another.

TIMING EXAMPLES OF SAMPLE AND HOLD CLOCKS
VS DATA STORAGE FOR MULTIPLEXED SYSTEMS



EXAMPLE: 8085 READ CYCLE



■ Figure 7-18. Demonstration Timing Diagram.

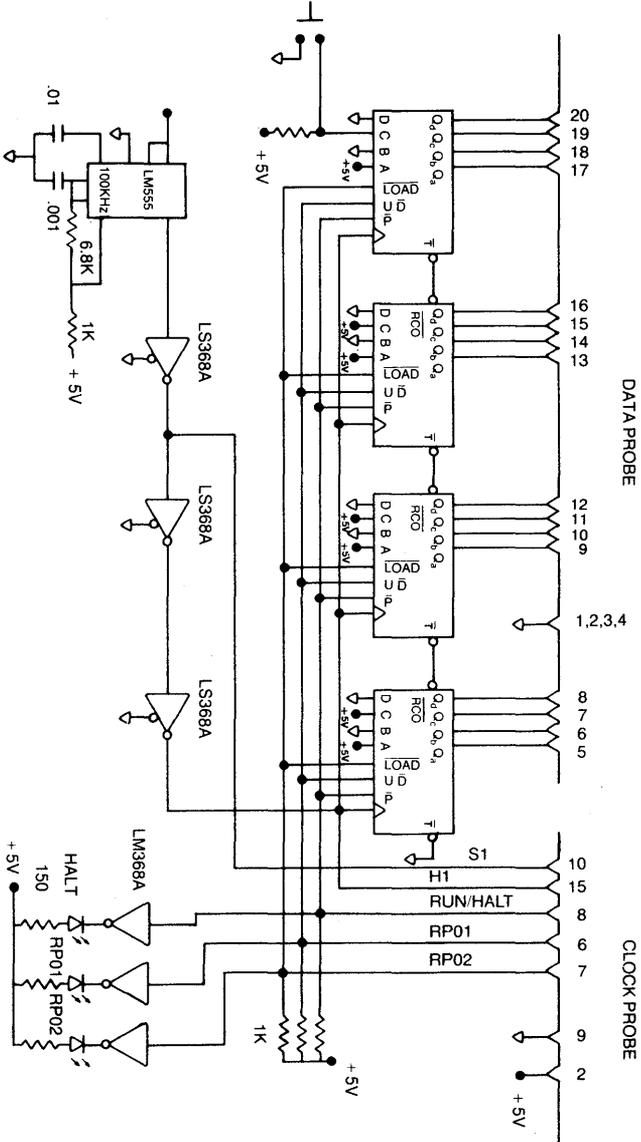


Figure 7-19. Schematic of the demo board.

THE TRIGGER-STORE MENU

In the Trigger-Store Menu the current trigger specification will detect differences in data patterns that result from changing how data is acquired in the Format Menu. (Refer back to the preceding subsection for details.)

You don't need to read over the preceding subsection to follow the demo, but you do need to know the examples of Format Menu programming we used. To summarize, the clocking setup is:

1. MUX = No and hold clock = X.
2. MUX = Yes and hold clock = X.
3. MUX = Yes and hold clock = H1.

The data patterns associated with each mode are as follows:

1. MUX = No and hold clock = X. The data is a straight 16-bit counter that counts up or down, e.g.:

5556
5557
5558
5559

2. MUX = Yes and hold clock = X. The data is 8 bits of the counter, duplicated on both the upper and lower 8 bits of the displayed pattern, e.g.:

3A3A
3B3B
3C3C
3D3D

3. MUX = Yes and hold clock = H1. The data is as in (2), except that the count on the upper 8 bits leads the count on the lower 8 bits by one, e.g.:

5756
5857
5958
5A59

In addition to this information, you will need the Trigger-Trace Flowchart in Figure 7-10 and the information in Section 5 on how to use the Trigger-Store Menu.

Go to the Trigger-Store Menu by pressing M for Menus and T for Trigger-Store.

Your screen should look like Figure 7-20. For convenience, Figure 7-21 shows the entire specification.

00842-074

```

TRIGGER-STORE MENU Demo32 TRIG POS: 014 0000 STOPPED at state Mot =
STATE
Start: IF anything OCCURS 0001 TIMES THEN -----> GOTO IstMx RPO CL
          NEVER -----> STORE 3 1

IstMx: IF Multiplex OCCURS BEFORE 0005 SAMPLE CLKS THEN -> GOTO Mux 3 1
        ELSEIF Non-Mux OCCURS ANYTIME THEN -----> GOTO Nomux 0 1
          NEVER -----> STORE

Mux : IF Shift OCCURS BEFORE 1000 SAMPLE CLKS THEN -> GOTO Mot = 2 1
       ELSE -----> TRIGGER 3 1
          NEVER -----> STORE

Nomux: Hi-Reset OCCURS 0001 TIMES THEN -----> GOTO Shift 0 1
        Hi-Reset OCCURS ANYTIME THEN -----> GOTO Cntup 0 1
          NEVER -----> STORE

----- selected symbol -----
NAME Counter EXT CL
Acq 1234 1234 X X

)Command: Display Edit Go Menus Scrollstates enVir ?=help (SP)
    
```

■ Figure 7-20. The Trigger-Store Menu.

```

TRIGGER-STORE MENU Demo32 TRIG POS: 0001 0001 STOPPED at state Not =
STATE
Start:  IF anything OCCURS 0001 TIMES THEN -----> GOTO TstMx 3 1
        NEVER -----> STORE
TstMx:  IF Multiplex OCCURS BEFORE 0005 SAMPLE CLKS THEN -> GOTO Mux 3 1
        ELSEIF Non-Mux OCCURS ANYTIME THEN -----> GOTO Nomux 0 1
        NEVER -----> STORE
Mux :   IF Shift OCCURS BEFORE 1000 SAMPLE CLKS THEN -> GOTO Not = 2 1
        ELSE -----> TRIGGER 3 1
        NEVER -----> STORE
Nomux:  IF LowReset OCCURS 0001 TIMES THEN -----> GOTO Wait 0 1
        ELSEIF Hi-Reset OCCURS ANYTIME THEN -----> GOTO Cntup 3 1
        NEVER -----> STORE
Not =:  IF anything OCCURS 0001 TIMES THEN -----> TRIGGER 2 1
        NEVER -----> STORE
Wait :  IF Hi-Reset OCCURS 0001 TIMES THEN -----> GOTO Cntup 3 1
        NEVER -----> STORE
Cntup:  IF Hi-Reset OCCURS 0003 TIMES THEN -----> GOTO DnCnt 2 1
        NEVER -----> STORE
DnCnt:  IF Hi-Reset OCCURS 0002 TIMES THEN -----> TRIGGER 3 1
        NEVER -----> STORE
----- selected symbol -----
NAME Counter EXT CL
Hi-Reset 5555 X X

>Command: Display Edit Go Menus Scrollstates enVir ?=help <SP>
    
```

■ Figure 7-21. The Trigger-Store Menu with all the states programmed.

Data values in the trigger-store specification are represented symbolically. Figure 7-22, a listing of the Symbol Menu, gives you a quick reference for the hexadecimal value of any word recognizer.

Perhaps the best way to look at the trigger-store specification is as a small high-level language program consisting of up to 15 procedures. Each procedure corresponds to the labels in the STATE column down the left-hand side of the specification (see Figure 7-21).

Each procedure (or STATE) consists of a number of lower level statements that allow you to jump to (GOTO) other procedures; to halt (TRIGGER); and to execute I/O as a function of the data monitored by the state analyzer's data probes (where Input = STORE and Output = Real-time Programmable Outputs).

At this point the analogy breaks down, because, in the analyzer's state machine, all the lower level instructions within each procedure can be executed in parallel (simultaneously), rather than serially as in a computer program.

On the Trigger-Trace Flowchart (Figure 7-10), the large boxes and diamonds correspond to the STATES in the trigger specification of Figure 7-21. The smaller boxes enclose the symbols used in the trigger specification. The data values next to the smaller boxes are the same as those indicated in the Symbol Menu in Figure 7-22.

00842-076

```

SYMBOL MENU      Demo32      STOPPED at state step

NAME Counter EXT CL
HEX BIN BIN
Any Value XXXX X X
Non-MUX 5555 X X
Multiplex 5656 I I
MASK FFFF 0 0
LowReset 1555 X X
Hi Reset 5555 X X
Shift 5059 X X
Acq 1234 1234 X X
Acq & evn AAAA I I
MASK FFFF 0 0
anything XXXX X X
Any Name FFFF I I

>Command: Display Edit enVir Go MenuS ?=help User_display
    
```

■ Figure 7-22. The Symbol Menu.

One last piece of information before we go through the trigger-store program. On the right-hand side of the screen there is a column labeled RPO. The values in this column determine the levels the two Real-time Programmable Outputs (RPOs) on the clock probe take upon leaving the state they are specified in. These RPOs are connected to the demo board in such a way that they control the up/down function and the load line of the counter. Table 7-1 lists the state the counter will take on for a given RPO programming.

■ **Table 7-1: RPO-Counter Programming**

RPO Value	Counter State
0	Load
1	Load
2	Count Down
3	Count

When you execute the Go command, the initial RPO value will be 0. When the counter is forced to load, the value it loads will be 5555 if the jumper is removed from the demo board, or 1555 if the jumper is installed.

We'll begin with state START in Figure 7-21. (Follow along on Figure 7-21 and your flowchart.) In this state, the first data value clocked into the state analyzer (anything=XXXX) will cause a jump to state TSTMX. It will also set the RPO value to 3, causing the counter to begin counting up from either 1555 or 5555 (depending on whether or not the jumper is installed).

In state TSTMX, the idea is to differentiate between data acquired in MUX mode and data acquired with MUX turned off. We know that in state START the counter was loaded with 1555 or 5555, and will now begin counting up. If (as explained previously) the Format Menu is in MUX mode, the upper and lower 8 bits of data will begin counting up simultaneously from either 5555 or 5655. One clock later their value will be 5656 or 5756.

These values correspond to the symbol Multiplex, and will cause the state machine to jump to the state MUX and continue to count up (RPO=3). If, however, the Format Menu has been used to turn MUX mode off, then the state analyzer will see a 16-bit counter begin to count up from either 1555 or 5555, eventually reaching the value of 5557 (Non-mux) before it counts through the Multiplex values. Non-mux will cause a jump to state NOMUX and will put the counter in a load condition (RPO=0).

We will follow the Multiplex path first and return later to the Non-Mux path.

State MUX will differentiate between data where the upper 8 bits equal the lower 8 bits, and data where the upper 8 bits have a value one greater than the lower 8. The state is looking for the Shift symbol (value 5A59) before 1000 counts have gone by.

We know that upon entering the state MUX, the count was either 5656 or 5756. Three clocks later it will be either 5A59 or 5959. If, on the Format Menu, the H1 hold clock is selected, the count value will be 5A59. The upper data bits and the lower data bits are not equal, and the state machine will jump to the state NOT=. If the hold clock is off (hold clock=X), then the value 5A59 will never occur, because the upper 8 bits will always equal the lower 8 bits. After 1000 clocks, the state analyzer will trigger from state MUX as directed.

State NOT= is being used as a marker. The state analyzer triggers as soon as it enters this state. Without looking at the acquired data, we know something about the sequence of data just by seeing the triggering end point. Marker states like this one are very useful in manufacturing test situations where the end points of tests can be states with labels such as Pass or Fail, depending on the sequence of data acquired.

Returning now to the Non-Mux path, state NOMUX determines whether or not the jumper is installed on the demo board. If the Low Reset symbol (value 1555) is detected, the jumper is installed and the state machine jumps to state WAIT, leaving the counter in load mode (RPO=0). If, however, the jumper is not installed, the Hi-Reset symbol (value 5555) will cause the state machine to jump to state CNTUP. Effectively, the state machine remains in state WAIT until the jumper is removed from the demo board.

In state CNTUP, the counter counts up until it rolls over twice and again reaches the count 5555 (Hi-Reset). Then the state machine jumps to state DNCNT and instructs the counter to count down (RPO=2).

In state DNCNT, the counter counts down until it rolls over once and again reaches the count 5555. At that time the state machine causes the analyzer to trigger.

In each of the states in the trigger specification (shown in Figure 7-21), the state analyzer was directed to NEVER STORE. Even though the data was monitored and the state machine made decisions based upon this data (jumping, setting the RPOs, and triggering), no data was stored. No data, that is except the trigger word. Regardless of the store specification, the trigger word is always stored.

Now, let's enter the Trigger-Store Environment Submenu. Press V for enVIRONMENT, then T for Trigger-Store. Your screen should now look like Figure 7-24.

00842-078



Figure 7-24. The Trigger-Store Environment Submenu.

There are five programmable fields in the Trigger-Store Environment Submenu. The RPO Starting Value field specifies the encoded value that the two RPO lines assume when the Go command is executed. The Starting State field specifies the first state to be entered when the Go command is executed. (We will explain the field labeled COLD later when discussing single-step applications in conjunction with the run/stop line on the clock probe.) We will come back to the Multiple-Preview Acquisition Mode field in a moment. The Store All State Transitions field allows you to see all the states passed through on the way to triggering. Change this field now to YES, then press the escape key to re-enter the Display Menu.

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Execute the Go command. Your screen should look like Figure 7-25. Note that the state sequence matches the flowchart.

00842-079

```
STATE DISPLAY Demo32 ACU DATA STOPPED at state DnCnt
LOC STATE Count EX LOC STATE Count EX LOC STATE Count EX
BEGIN Start 5555 1
-0003 Tstmx 5557 1
-0002 Nowux 5555 1
-0001 Cntup 5555 1
TRIG DnCnt 5555 1

)Command: Edit Go Menus enVir Buffer Find Jump Page ?=help <SP>
```

■ Figure 7-25. All state transitions stored.

Try it again with the jumper on. Install the jumper on the demo board, then execute the Go command. Remove the jumper when you see the "RUNNING at State WAIT" message. Your display should look like Figure 7-26.

00842-080

```
----- STATE DISPLAY Demo32  ACU DATA STOPPED at state DnCnt
LOC STATE Count EX LOC STATE Count EX LOC STATE Count EX
32011 Start 1555 1
-0004 IstMx 5557 1
-0003 NonMx 1555 1
-0002 Wait 5555 1
-0001 Cntup 5555 1
TRIG DnCnt 5555 1

)Command: Edit Go Menus enVir Buffer Find Jump Page ?=help <SP>
```

■ Figure 7-26. With jumper on.

7 Demonstration

MODEL 2100

Now, remove the jumper and try acquiring data after reprogramming the Format Menu to MUX mode with and without the H1 hold clock. After each trial return to the display and compare the state sequence with the flowchart. You should get displays like the ones shown in Figures 7-27 and 7-28.

00842-081

```

----- STATE DISPLAY Demo32 ACQ DATA STOPPED at state Not =
LOC STATE Count EX LOC STATE Count EX LOC STATE Count EX
-BEGIN Start 5555 1
-0002 TrMx 5756 1
-0001 Mux 5A59 1
TRIG Not = 5B5A 1

)Command: Edit Go Menus enVir Buffer Find Jump Page ?=help (SP)
```

■ Figure 7-27. MUX Mode with Hold Clock.

```
STATE DISPLAY Demo32 ACU DATA STOPPED at state Mux
LOC STATE Count EX LOC STATE Count EX LOC STATE Count EX
3301 Start 5555 1
4001 TstMx 5656 1
TRIG Mux 3F3F 1

)Command: Edit Go Menus enVir Buffer Find Jump Page ?=help <SP>
```

■ Figure 7-28. MUX Mode without Hold Clock.

Return now to the Trigger-Store Environment Submenu, and we'll learn about the Multiple-Preview Acquisition (MPA) mode.

MPA allows us to view the seven cycles immediately preceding every qualified acquisition. A qualified acquisition is defined as: any data stored as the result of the store specification within a state; the trigger word; or state transitions, if the Store All State Transitions field is set to YES.

Because the demonstration trigger specification now contains NEVER STORE in all states, the only qualified acquisitions will be the trigger word and state transitions. If we enable MPA mode, we will be able to see the seven unqualified cycles leading up to the trigger and state transitions.

Enable MPA mode now by selecting YES in its field. Exit the Trigger-Store Environment Submenu by pressing escape, and re-enter the Display Menu.

7 Demonstration

MODEL 2100

Before executing the Go command, return the Format Menu to non-mux mode with the hold clock programmed to X. Execute the Go command and re-enter the Display Menu. Your screen should look like the one shown in Figure 7-29.

00842-083



■ Figure 7-29. The MPA Mode.

If you display does not look like Figure 7-29, but the trigger word is in state DNCNT, then enter the edit mode and move the cursor to the programmable field under the LOC column. Press B. Your screen should now look like Figure 7-29.

Note that all qualified acquisitions are marked with a right arrow (see callout 1 in Figure 7-29). The spaces between blocks of data indicate that an indeterminate number of cycles, which were not recorded, occurred between one block and another. (A cycle is the synchronous data presented to the state analyzer by the logical OR of the non-overlapping clocks, S1-S5, depending on which sample clocks you have connected.)

In general, a block of data will consist of one qualified acquisition and its seven preceding cycles (e.g., the block associated with the right arrow). However, if a qualified acquisition occurs before seven unqualified cycles do, the qualified cycle will be marked wherever it occurs within the blocks, and the block will be padded out with cycles occurring immediately after the qualified cycle. This will continue until the block is filled (with a total of eight acquisitions).

If more than one qualified acquisition occurs within a block, all of them will be marked (see callout 2 in Figure 7-29).

In MPA, spaces between lines of data (see callout 3 in Figure 7-29) indicate that some number of unrecorded cycles occurred, and lines of data without spaces represent contiguous cycles.

Now let's see how to use the trigger-position delay counter both in and out of MPA mode.

Enter the Trigger-Store Environment Submenu and turn off MPA mode. Then, enter the Trigger-Store Menu and press E for Edit mode. Move the screen cursor to the Trigger Position (TRIG POS) field at the top of the screen. (If MPA mode were on, the field would not appear in reverse video, and you would not be able to change it.) Once in this field, scroll through your choices. You should see DLY 0000, BEGIN, CENTER, and END as your options.

The trigger-position delay counter—the DLY field—is used to specify how many acquisitions are to occur after the trigger. Thus, DLY 0005 will cause five acquisitions to be stored after the trigger line of the display. For convenience, BEGIN, CENTER, and END are preprogrammed values. For a memory depth of 4096, these have values of 4082, 2047, and 13 respectively.

Program the trigger position to DLY 0002. Then, use the down cursor key to move state DNCNT onto the screen.

7 Demonstration

MODEL 2100

Now move the screen cursor into the NEVER field of state DNCNT. Scroll through your choices, stopping at IF ACQ 1234 or Acq A evn OCCUR THEN. At this point move the cursor into the Acq A evn field. Use the Control (ΛS) command to change the symbol selected in the field to Hi-Reset. The Trigger-Store Menu should now be programmed as indicated in Figure 7-30.

00842-084

```
TRIGGER-STORE MENU Demo32 TRIG POS: DAY 0000 STOPPED at state DnCnt
STATE
Mot :: IF anything OCCURS 0001 TIMES THEN -----> TRIGGER RPO CL
      NEVER -----> STORE 2 1
Wait : IF Hi-Reset OCCURS 0001 TIMES THEN -----> GOTO Cntup 3 1
      NEVER -----> STORE
Cntup: IF Hi-Reset OCCURS 0003 TIMES THEN -----> GOTO DnCnt 2 1
      NEVER -----> STORE
DnCnt: IF Hi-Reset OCCURS 0000 TIMES THEN -----> Hi-Reset 2 1
      IF Acq 1234 OR Hi-Reset OCCUR THEN -----> STORE
----- selected symbol -----
NAME Counter EXT CL
Hi-Reset 5555 X X

>Command: Display Edit Go Menus Scrollstates enVir ?=help <SP>
```

■ Figure 7-30. Programming the delay count.

Execute the Go command and then enter the Display Menu. The data acquired should be as shown in Figure 7-31. Note that all state transitions were recorded and, in the state DNCNT, data values associated with the Acq 1234 and Hi-Reset symbols were acquired. Finally, note that there were exactly two acquisitions after the trigger line, as programmed in the trigger position delay count field.

00842-085

```

STATE DISPLAY Demo32 ACQ DATA STOPPED at state DnCnt
LOC STATE Count EX LOC STATE Count EX LOC STATE Count EX
-0000 Start 5555 1
-0005 TestMx 5557 1
-0004 NowMx 5555 1
-0003 Cntup 5555 1
-0002 DnCnt 5555 1
-0001 DnCnt 1234 1
TRIG DnCnt 5555 1
+0001 DnCnt 5555 1
END DnCnt 1234 1

)Command: Edit Go Menus enVir Buffer Find Jump Page ?=help <SP>

```

■ Figure 7-31. State Display—acquired data with delay count.

THE STATE DISPLAY

By this time you have used the Display Menu repeatedly, but we have not talked about many of the commands, nor about the Display Environment Submenu. If you have not already done so, read the *Display Menu* subsection in Section 5.

Now let's try using the Find command. Enter the Display Environment Submenu by pressing V for enVironment, then D for Display. Move the screen cursor to the Find Pattern field and scroll the Hi-Reset symbol into view. Now press the insert key. This will cause a Followed By field to appear. Again scroll the symbols through this field until the Hi-Reset symbol appears. Your screen should now look like Figure 7-32.

The find specification will look for a 5555, followed by a 5555 within 01 location every time the Find command is executed in the State Display.

00842-086

```

LOC STATE Count EX LOC STATE Count EX LOC STATE Count EX
03011 Start 5555 1
-0005 IstMx 5557 1
-0004 Nomux 5555 1
-0003 Cntup 5555 1
-0002 DnCnt 5555 1
-0001 DnCnt 1234 1
TRIG DnCnt 5555 1

===== STATE Environment Submenu =====
Acquisition mode: GO ONCE Compare ACQ to REF (highlight): NO
Display mode: COMPRESSED FROM: 9999 TO: 9999 OFFSET: 4000
using MASK of: Any Name

Find pattern: Hi-Reset in state
followed by Hi-Reset in state within 0001 locations

----- selected symbol -----
NAME Counter EXT CL
Any Name FFFF 1 1
^MASK FFFF 1 1

>Edit: <enter symbol name>, ^S=scroll thru symbols, ^B=unBuffer
    
```

■ Figure 7-32. The Find Command.

Exit the Display Environment Submenu by pressing the escape key, then enter the Display Menu. In the current display (as shown in Figure 7-31), note that the first occurrence of the data sequence:

```
5555
5555
```

ends on line -0003. Execute the Find command. Note that line -0003 is now at the top of the screen. The next occurrence of the specified sequence ends on line +0001. Execute the Find command again. Now reverse the pattern search direction by pressing the < (less than) key. Try the Find command several times in this direction.

Now let's try using the compare acquisition to reference memory feature. First clean up the display by entering the LOC field and pressing B. Your display should look like the one in Figure 7-31. Select the <-ACQ REF-> option at the top of the display.

Escape from edit mode and execute the Ref<-acq command. Your screen should look like Figure 7-33.

00842-087



Figure 7-33. State Display—Ref<-acq.

Next, re-enter the Display Environment Submenu. Move the cursor to the Compare Acq to Ref field and select YES.

7 Demonstration

MODEL 2100

To acquire data that differs slightly from the current reference data, run the state analyzer again, but this time with the jumper installed on the demo board. (Remember to remove the jumper when the "RUNNING in State WAIT" message appears.) After you execute the Go command, your display should look like the one in Figure 7-34.

00842-088

```
STATE DISPLAY Demo32 <-ACQ [RE]-> STOPPED at state DnCnt
STATE Counter EXT STATE Counter EXT
-0001 Start 1555 1 Start 5555 1
-0000 TstMx 5555 1 TstMx 5557 1
-0005 Nomux 1555 1 Nomux 5555 1
-0004 Wait 5555 1 Cntup 5555 1
-0003 Cntup 5555 1 DnCnt 5555 1
-0002 DnCnt 5555 1 DnCnt 1234 1
-0001 DnCnt 1234 1 DnCnt 5555 1
TRIG DnCnt 5555 1 DnCnt 5555 1
+0001 DnCnt 5555 1 DnCnt 5555 1
END DnCnt 1234 1 DnCnt 1234 1

(Command: Edit Go Menus enVir Buffer Find Jump Page ?=help <SP>)
```

■ Figure 7-34. Data acquired for comparison.

Notice two things about this display. First, the acquisition and reference displays are aligned in relation to their trigger words, unless you've specified an offset in the Display Environment Submenu. (The offset is currently 0.) Second, state labels are never compared. (Note line -0004 where the data is the same but the labels differ.)

Execute the Next_diff command. Note that the first difference (which is highlighted) moves to the top line. Try Next_diff a few more times. Also change direction and try it.

We will now go through an exercise that will teach you a few new things and allow you to practice much of what you have already learned. The objective is to step the counter a few counts at a time. This will illustrate how the state analyzer can be used to single- or multiple-step a microprocessor in your prototype.

First set up the Display Menu. Select the ACQ DATA option at the top of the display.

Now, enter the Display Environment Submenu and change the Acquisition Mode field to GO FOREVER. Change the Display Mode field to STANDARD, and turn off the Compare ACQ to REF field. Your Display Environment Submenu should now be programmed as shown in Figure 7-35.

00842-089

```

STATE DISPLAY Demo32 ACQ DATA STOPPED at state DnCnt
STATE Count EX LOC STATE Count EX LOC STATE Count EX
-0006 TstMx 5555 1
-0005 NomMx 1555 1
-0004 Wait 5555 1
-0003 Cntup 5555 1
-0002 DnCnt 5555 1
-0001 DnCnt 1234 1
TRIG DnCnt 5555 1

STATE Environment Submenu
Acquisition mode: GO FOREVER Compare ACQ to REF (highlight): NO
Display mode: STANDARD FROM: 5555 TO: 5999 OFFSET: +0000
using MASK of: Any Name

Find pattern: ii-Reset in state
followed by ii-Reset in state within 0001 locations

----- selected symbol -----
NAME Counter EXT CL
Any Name FFFF 1 1
^MASK FFFF 1 1

)Edit: (enter symbol name), ^S=scroll thru symbols, ^B=unBuffer

```

Figure 7-35. Setting up the display.

Enter the Trigger-Store Menu. Set the trigger position to DLY 0000. Now move the cursor to the first State field. (This will probably be state START, but it depends on where you left the programming window the last time you were in this menu.)

Press the insert key, and a new State field will appear. Name this state STEP. Move to the OCCURS field and enter 5.

7 Demonstration

MODEL 2100

Now escape from the edit mode and enter the Trigger-Store Environment Submenu. Turn off the MPA mode and the Store All State Transitions mode. Set the RPO Starting Value to 3, and set the Starting State to STEP with a WARM start. The Trigger-Store Environment Submenu should now be programmed as shown in Figure 7-36.

00842-090

```
TRIGGER-STORE MENU Demo32 TRIG POS: DLY 0000 STOPPED at state DnCnt
STATE
Step: 01 any Value OCCURS 0005 TIMES THEN -----> TRIGGER RPO CL
      01 -----> STORE 3 1
TstMx: IF Multiplex OCCURS BEFORE 0005 SAMPLE CLKS THEN -> GOTO Mux 3 1
        ELSEIF Non-Mux OCCURS ANYTIME THEN -----> GOTO Nomux 0 1
        NEVER -----> STORE
Mux : IF Shift OCCURS BEFORE 1000 SAMPLE CLKS THEN -> GOTO Mot = 2 1
        ELSE -----> TRIGGER 3 1
        NEVER -----> STORE
Nomux: IF LowReset OCCURS 0001 TIMES THEN -----> GOTO Wait 0 1
        ELSEIF Hi-Reset OCCURS ANYTIME THEN -----> GOTO Cntup 3 1
        NEVER -----> STORE
===== TRIGGER-STORE Environment Submenu =====
Multiple preview acquisition mode? NO
Store all state transitions? NO
RPO starting value: 3
Starting state: STEP with WARM start

)Edit: SPACE scrolls through choices ?-help
```

■ Figure 7-36. Programming the Trigger-Store Menu.

Because the starting RPO value is 3, these settings will cause the counter to begin counting up when you execute Go. The analyzer will start in state STEP and trigger after five clocks. The counter data associated with all five clocks will be stored, and because the delay counter is set to zero (DLY 0000), the counter will be disabled immediately when the trigger occurs. (Remember that the run/stop line on the clock probe is driving the counter's enable/disable input.)

WARM start will nearly always be the option to select when you want to use the state analyzer to stop a processor. The architecture of the analyzer is pipelined by one clock. This means that when data is displayed there is actually one more piece of data in the pipeline latch. The next time you command the analyzer to go, the first data into the machine is the old data left in the pipeline latch. With COLD start, internal logic causes this first piece of data to be discarded. With WARM start, the data is retained and clocked into the machine. Thus, when you're using the analyzer to single-step a processor, the data is one clock behind the processor.

Return to the Display Menu and execute the Go command. You should see a set of five data values repeated, as illustrated in Figure 7-37. Each element in the set of data is a count of five greater than the corresponding element in the previous set.

You may alternate between the Go and Stop commands to step the counter one block at a time. If you have not already done so, execute the Stop command.

00842-091

```

STATE DISPLAY Demo32 ACC DATA STOPPED at state step
LOC STATE Counter EXT
-0004 step 14FB 1
-0003 step 14FB 1
-0002 step 14FC 1
-0001 step 14FD 1
TRIG step 14FE 1

)Command: Edit Go Menus enVir Buffer Find Jump Page ?=help <SP>

```

■ Figure 7-37. The State Display—counting by 5.

We're just about to move on to the Symbol Menu. First though, execute the Buffer command to save the data we will use in the next menu. Note the message at the bottom of the screen: "data from line -0004 saved in Symbol buffer."

Now go to the Symbol Menu.

THE SYMBOL MENU

Your screen should look like Figure 7-38.

The Symbol Menu is where data values are attached to symbols. There are two ways to do this. The first way is to create a symbol name and explicitly program each data column. The second way is to create a symbol name and then unbuffer the previously saved contents of the symbol buffer.

Let's try the second method now. Enter the edit mode. Move the cursor to any symbol name in the name column (on the far left). Now press the insert key. Type in any name you wish. While still in the name field, execute the unBuffer command, Control-B (^ B).

Now try creating a symbol entirely by hand. This is done in the same way as with the unBuffer method above, except that after you create the name, you will have to move into the data columns and enter the values by hand.

Move back to the name column. The commands available to you at the bottom of the screen include Toggle Mask. Try this command now. At this point you should read the explanation of the mask in the *Symbol Menu* subsection of Section 5.

The mask technique will allow you to specify bits within a digit (i.e., a hexadecimal or octal digit) as don't care, without having to expand the group to binary.

As a final exercise (especially if you still find the concept of the mask difficult) go to the Format Menu and change the radix of the Counter group to binary. Now return to the Symbol Menu and enter the edit mode.

Move the screen cursor to the Multiplex symbol's Name field. If a mask is not displayed below Multiplex, execute the Toggle Mask command to bring it into view. Note that there is only one zero in the mask. Now toggle the mask on and off slowly while you watch the relationship between the zero in the mask and the don't care bit in the Multiplex symbol. Note that only one don't care bit appears.

Now turn off the mask and translate the binary value of the Multiplex symbol into hexadecimal by hand. You should get 5656 or 5756.

Return to the Format Menu and change the Counter group's radix back to HEX. Return to the Symbol Menu. Note that the value displayed for the Multiplex symbol is 5?56. Enter edit mode and toggle the mask. Note that the question mark becomes a 6 and the mask digit below this 6 is E. The position at the zero bit value within the E marks the position of the don't care bit in the 6 above it.

00842-092

```

SYMBOL MENU Demo32 STOPPED
NAME Counter EXT CL
          HEX  BIN  BIN
Any Value XXXX X X
Non-Any 5555 X X
Multiplex 5656 1 1
 ^MASK FFFF 0 0
Low-Reset 1555 X X
Hi-Reset 5555 X X
Shift 5A59 X X
Acq 1234 1234 X X
Acq A evn AAAA 1 1
 ^MASK FFFF 0 0
anything XXXX X X
Any Name FFFF 1 1

)Command: Display Edit enVir Go Menus ?=help User_display

```

■ Figure 7-38. The Symbol Menu using a mask.

ASCII CHARACTERS

0	NUL	32	(blank space)	64	@	96	'
1	SOH	33	!	65	A	97	a
2	STX	34	"	66	B	98	b
3	ETX	35	#	67	C	99	c
4	EOT	36	\$	68	D	100	d
5	ENQ	37	%	69	E	101	e
6	ACK	38	&	70	F	102	f
7	BEL	39	'	71	G	103	g
8	BS	40	(	72	H	104	h
9	HT	41	)	73	I	105	i
10	LF	42	*	74	J	106	j
11	VT	43	+	75	K	107	k
12	FF	44	,	76	L	108	l
13	CR	45	-	77	M	109	m
14	SO	46	.	78	N	110	n
15	SI	47	/	79	O	111	o
16	DLE	48	0	80	P	112	p
17	DC1	49	1	81	Q	113	q
18	DC2	50	2	82	R	114	r
19	DC3	51	3	83	S	115	s
20	DC4	52	4	84	T	116	t
21	NAK	53	5	85	U	117	u
22	SYN	54	6	86	V	118	v
23	ETB	55	7	87	W	119	w
24	CAN	56	8	88	X	120	x
25	EM	57	9	89	Y	121	y
26	SUB	58	:	90	Z	122	z
27	ESC	59	;	91	[	123	{
28	FS	60	<	92	~	124	|
29	GS	61	=	93	]	125	}
30	RS	62	>	94	^	126	~
31	US	63	?	95	_	127	DEL

DATA FILE FORMATS

This appendix explains the data structures and formats used in the I/O Menu's DATA files. These files are created whenever you save the contents of reference memory on disk.

Pascal Declaration of State Acquisition/Reference Data Type

```

Acq_Word = RECORD CASE INTEGER OF {type of 80 bit word
of acq data}
    1: (int : ARRAY [0..4] of INTEGER); {5 words of
data}
    2: (bite : ARRAY [0..9] of BYTE); {in byte form}
Acq_Data = RECORD {type of 96 bit-word read from acq
hardware}
    misc      : WORD; {1 word of flag bits}
    data      : Acq_Word; {5 words of acq data
(80 channels)}
    time_tag  : INTEGER 4; {reserved for Time
Stamp data}

```

Data File Formats

Bytes 0 to 511 are reserved for use by Northwest Instrument Systems, Inc.

All bytes between 512 and the end of the file, inclusive, are available to the user. The contents of these bytes are shown below.

■ Table B-1: Byte Definitions

Public Name	Byte	Contents
ref_beg	512	Low byte of beginning reference location.
	513	High byte of beginning reference location. Integer number from -4096 to +4096. This number tells where the start of state data is with respect to the trigger location (0).
ref_end	514	Low byte of ending reference location.
	515	High byte of ending reference location. Integer number from -1 to +8192. This number tells where the end of state data is with respect to the trigger location (0).
ref_mpa	516	MPA mode flag. Value for MPA mode: 1 = on, 0 = off.
saved_pod_count	517	Low byte of saved_pod_count.
	518	High byte of saved_pod_count. An integer from 1 to 5, which records the number of 16 channel pods available in the state analyzer system.
first_mux	519	Low byte of first_mux.
	520	High byte of first_mux. First_mux is an integer from 0 to 10. It indicates which byte of the data marks the boundary between non-mux and mux data bytes.
ref_has_time	521	A Boolean variable that indicates whether or not the saved reference data contains time data from the Time Stamp (Option 003). 0 = no time data present, 1 = time data present.
ref_ts_flg	522	T_overflow. A Boolean variable that indicates whether or not the Time Stamp counter overflowed while reference data was acquired. 0 = no overflow, 1 = overflow.
	523	T_base_mode. Time Stamp timebase clock source used while reference data was acquired. 0 = internal 20 MHz clock, 1 = external clock, 2 = ISA sample clock.
	524	Ext_period. Time Stamp external timebase clock period. An integer from 2 to 14 indicates the external clock period used while reference data was acquired. 2 = 50 ns, 3 = 100 ns, 4 = 200 ns, 5 = 500 ns...14 = 500 μns.
	525	Reserved for future use by Northwest Instrument Systems, Inc.

Continued

■ Table B-1 (cont): Byte Definitions

Public Name	Byte	Contents
sla_ref_mode	526	An integer which records the time-alignment format that is used for aligning the state data with the data from the Model 2200 Interactive Timing Analyzer.
r_align_loc	527	Low byte of the reference alignment location.
	528	High byte of the reference alignment location. An integer which records the reference alignment location for aligning the state data with the data from the Model 2200 Interactive Timing Analyzer.
st_ref_name[0]	529	State 1 name header. This is the first of 15 groups of 6 bytes each. The first byte in each group is the header and tells how long the string will be. The next 5 bytes represent the letters that compose the state in ASCII.
	530	First letter of state name.
	531	Second letter of state name.
	532	Third letter of state name.
	533	Fourth letter of state name.
	534	Fifth letter of state name.
st_ref_name[14]	.	
	.	
	.	
	613	State 15 name header.
	614	First letter of state name.
	615	Second letter of state name.
616	Third letter of state name.	
617	Fourth letter of state name.	
618	Fifth letter of state name.	

Physical Data Structure

Starting with byte 619, the words of reference data are stored in the format shown below. The first word of this format corresponds to the data stored at location ref_beg.

Flag Byte	} The number of data bytes is determined by the following formula: saved_pod_count * 2 where saved_pod_count equals the number of pods that were available when reference data was saved.
Data Byte 0	
Data Byte 1	
Data Byte 2	
Data Byte 3	
Data Byte 4	
Data Byte 5	
Data Byte 6	
Data Byte 7	
Data Byte 8	
Data Byte 9	} The time bytes are reserved for time data acquired via the Time Stamp.
Time Byte 0	
Time Byte 1	
Time Byte 2	
Time Byte 3	

As shown above, each word of the stored reference data is comprised of the flag byte and the (saved_pod_count * 2) data bytes. Each word may also contain four time bytes, depending on whether or not the Time Stamp (Option 003) was used to acquire time data. The ref_has_time flag indicates whether or not the time bytes are present.

Physical Data Structure for Non-Multiplexed Probes. The following table shows the bit structure used for reference data that has been acquired with non-multiplexed probes.

■ **Table B-2: Bit Structure for Non-Multiplexed Probes**

Byte Number	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Flag Byte	Qual Acq	Ring Full	Cross Link	Ext Input	State Bit 3	State Bit 2	State Bits 1	State Bits 0
Probe 1:								
Data Byte 0	CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0
Data Byte 1	CH15	CH14	CH13	CH12	CH11	CH10	CH9	CH8
Probe 2:								
Data Byte 2	CH23	CH22	CH21	CH20	CH19	CH18	CH17	CH16
Data Byte 3	CH31	CH30	CH29	CH28	CH27	CH26	CH25	CH24

Continued

■ **Table B-2 (cont): Bit Structure for Non-Multiplexed Probes**

Byte Number	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Probe 3:								
Data Byte 4	CH39	CH38	CH37	CH36	CH35	CH34	CH33	CH32
Data Byte 5	CH47	CH46	CH45	CH44	CH43	CH42	CH41	CH40
Probe 4:								
Data Byte 6	CH55	CH54	CH53	CH52	CH51	CH50	CH49	CH48
Data Byte 7	CH63	CH62	CH61	CH60	CH59	CH58	CH57	CH56
Probe 5:								
Data Byte 8	CH71	CH70	CH69	CH68	CH67	CH66	CH65	CH64
Data Byte 9	CH79	CH78	CH77	CH76	CH75	CH74	CH73	CH72

Physical Data Structures for Multiplexed Probes. For multiplexed probes, data is organized as a list of bytes from the non-multiplexed pods, followed by a list of bytes from multiplexed pods. The first_mux variable defines the first byte of the multiplexed part.

The following example shows the relationship between multiplexed probes in the Format Menu and the position of the data bytes within the reference data structures:

uSLOT	MUX	HOLD	CLK	5	4	3	2	1	0
3	NO	X		byte 1	byte 0				non-mux
4	YES	X				byte 2			non-mux
						byte 6			mux ← first_mux
5	YES	X				byte 3			non-mux
						byte 7			mux
6	NO	X		byte 5	byte 4				non-mux

CLOCKING EXAMPLES

This appendix provides several examples of how to use the state analyzer's clocking to acquire data from a microprocessor under test. Each example shows how to connect the data and clock channels to the microprocessor pins, and how to set up the Format Menu.

The microprocessors used for the examples include:

Z80
8085
8086
8088
68000

If you are attempting to acquire data from a microprocessor that is not discussed here, use the following examples as a guide.

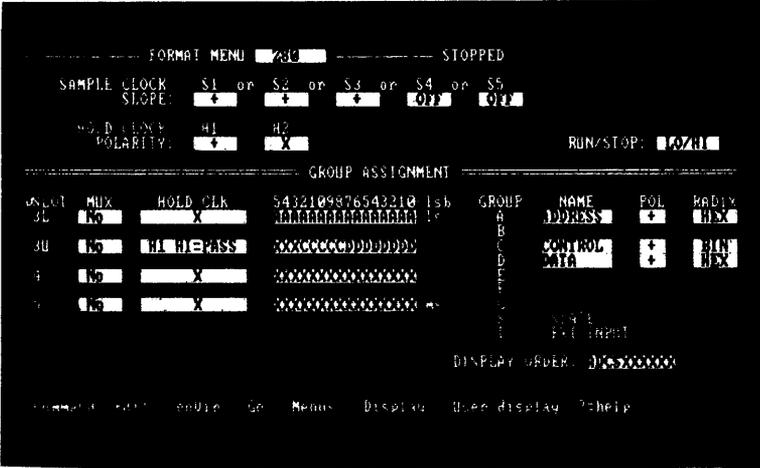
All of the above microprocessors are also supported by the state analyzer's Mnemonic Disassembler kits. These kits provide a single-plug probe connector, as well as preprogrammed disassembler software. For details, see *Related Products and Options* at the front of this manual.

Z80 CLOCKING CONNECTIONS
(using 32 channels)

μ Slot	ISA LEAD	Z80	PIN#
3	D0	A0	30
	D1	A1	31
	D2	A2	32
	D3	A3	33
	D4	A4	34
	D5	A5	35
	D6	A6	36
	D7	A7	37
	D8	A8	38
	D9	A9	39
	D10	A10	40
	D11	A11	1
	D12	A12	2
	D13	A13	3
	D14	A14	4
D15	A15	5	
4	D0	D0	14
	D1	D1	15
	D2	D2	12
	D3	D3	8
	D4	D4	7
	D5	D5	9
	D6	D6	10
	D7	D7	13
	D8	<u>BUSACK</u>	23
	D9	<u>WR</u>	22
	D10	<u>IORQ</u>	20
D11	M1	27	
CLOCK	S1	<u>RD</u>	21
	S2	<u>WR</u>	22
	S3	<u>IORQ</u>	20
	S4		
	S5		
	H1	CLK	6
H2	LEAVE UNCONNECTED		

Z80 FORMAT MENU SETUP (using 32 channels)

00842-093



8085 CLOCKING CONNECTIONS
(using 32 channels)

μ Slot	ISA LEAD	8085	PIN#
1	D0	AD0	12
	D1	AD1	13
	D2	AD2	14
	D3	AD3	15
	D4	AD4	16
	D5	AD5	17
	D6	AD6	18
	D7	AD7	19
2	D0	A8	21
	D1	A9	22
	D2	A10	23
	D3	A11	24
	D4	A12	25
	D5	A13	26
	D6	A14	27
	D7	A15	28
	D8	S0	29
	D9	S1	33
	D10	$\overline{IO/\overline{M}}$	34
	D11	\overline{WR}	31
D12	HLDA	38	
CLOCK	S1	\overline{RD}	32
	S2	\overline{WR}	31
	S3	INTA	11
	S4		
	S5		
	H1	ALE	30
H2	LEAVE UNCONNECTED		

8086, MIN MODE, CLOCKING
CONNECTIONS
(using 48 channels)

μ Slot	ISA LEAD	8086	PIN#
1	D0	AD0	16
	D1	AD1	15
	D2	AD2	14
	D3	AD3	13
	D4	AD4	12
	D5	AD5	11
	D6	AD6	10
	D7	AD7	9
2	D0	AD8	8
	D1	AD9	7
	D2	AD10	6
	D3	AD11	5
	D4	AD12	4
	D5	AD13	3
	D6	AD14	2
	D7	AD15	39
3	D0	A16/S3	38
	D1	A17/S4	37
	D2	A18/S5	36
	D3	A19/S6	35
	D4	$\overline{\text{BHE}}/\text{S7}$	34
	D5	$\overline{\text{DEN}}$	26
	D6	$\overline{\text{DT}}/\overline{\text{R}}$	27
	D7	M/IO	28
CLOCK	S1	$\overline{\text{RD}}$	32
	S2	$\overline{\text{WR}}$	29
	S3	$\overline{\text{INTA}}$	24
	S4		
	S5		
	H1	ALE	25
H2	LEAVE UNCONNECTED		

8086, MIN MODE, FORMAT MENU SETUP (using 48 channels)

00842-095

```

----- FORMAT MENU 3/35/7/11 ----- STOPPED
SAMPLE CLOCK S1 or S2 or S3 or S4 or S5
SLOPE:      +      +      +      0/1  0/1
HOLD CLOCK  H1      H2
POLARITY:   +      X
RUN/STOP:   0/1/1

----- GROUP ASSIGNMENT -----
USLOT  MUX  HOLD CLK  5432109876543210-15b  GROUP  NAME  POL  RADIX
3L     Yes  H1 H1-PASS  . . . . . 00000000 1s  A  ADDRESS  +  HEX
        H2  X      . . . . . 00000000 1s  B  BHE      +  BIN
3U     Yes  H1 H1-PASS  . . . . . 00000000 1s  C  /DEN     +  BIN
        H2  X      . . . . . 00000000 1s  D  DATA    +  HEX
4      Yes  H1 H1-PASS  . . . . . 00000000 1s  E  13 - S7  +  BIN
        H2  X      . . . . . 00000000 1s  F  DT/R     +  BIN
5      No   H2  X      . . . . . 00000000 1s  G  /IO      +  BIN
        H1  X      . . . . . 00000000 1s  H  STATE    +  BIN
        X      . . . . . 00000000 1s  I  EXT INPUT +  BIN

DISPLAY ORDER: 0000000000

>Command: Edit  enBin  Go  Menu  Display  Use Arrow  ?help
    
```

**8086, MAX MODE, CLOCKING
CONNECTIONS**
(using 48 channels)

μ Slot	ISA LEAD	8086	PIN#	8288	PIN#	
1	D0	AD0	16			
	D1	AD1	15			
	D2	AD2	14			
	D3	AD3	13			
	D4	AD4	12			
	D5	AD5	11			
	AD6	10				
		D7	AD7	9		
2	D0	AD8	8			
	D1	AD9	7			
	D2	AD10	6			
	D3	AD11	5			
	D4	AD12	4			
	D5	AD13	3			
	D6	AD14	2			
	D7	AD15	39			
3	D0	A16/S3	38			
	D1	A17/S4	37			
	D2	A18/S5	36			
	D3	A19/S6	35			
	D4	<u>BHE</u> /S7	34			
	D5	<u>S0</u>	26			
	D6	<u>S1</u>	27			
	D7	S2	28			
CLOCK	S1			<u>MRDC</u>	7	
	S2			<u>MWTC</u>	9	
	S3			<u>IORC</u>	13	
	S4			<u>IOWC</u>	11	
	S5			INTA	14	
	H1			ALE	5	
	H2			LEAVE UNCONNECTED		

8086, MAX MODE, FORMAT MENU SETUP (using 48 channels)

00842-096

```

----- FORMAT MENU 8086/MAX ----- STOPPED
SAMPLE CLOCK S1 or S2 or S3 or S4 or S5
SLOPE:      +      +      +      +      +
HOLD CLOCK  H1      H2
POLARITY:   +      X
RUN/STOP:   LOZH

----- GROUP ASSIGNMENT -----
µSLOT  MUX  HOLD CLK  5432109876543210-1sb  GROUP  NAME  POL  RADIX
3L  Yes  H1 HI-PASS  AAAAAAAAAA 1s  A  ADDRESS  +  HEX
      H2  X          B  BME          +  BIN
3U  Yes  H1 HI-PASS  CCCCCCCC  C  S0-S1-S2  +  BIN
      H2  X          D  DATA          +  HEX
4   Yes  H1 HI-PASS  CCCCCAAA  E  S3 - S7    +  BIN
      H2  X          F  STATE          +
5   No   H2  X          G  EXT INPUT  +

XXXXXXXXXXXXXXXXXXXXX MS
STATE
EXT INPUT
DISPLAY ORDER: AXXXXXXXXX
)Command: Edit  enVir  Go  Menus  Display  User display  ?=help
    
```

8088, MAX MODE, CLOCKING
CONNECTIONS
(using 48 channels)

μSLOT	ISA LEAD	8088	PIN#	8288	PIN#
3	D0	AD0	16		
	D1	AD1	15		
	D2	AD2	14		
	D3	AD3	13		
	D4	AD4	12		
	D5	AD5	11		
	D6	AD6	10		
	D7	AD7	9		
4	D0	A8	8		
	D1	A9	7		
	D2	A10	6		
	D3	A11	5		
	D4	A12	4		
	D5	A13	3		
	D6	A14	2		
	D7	A15	39		
	D8	A16	38		
	D9	A17	37		
	D10	A18	36		
	D11	A19	35		
	D12	$\overline{S0}$	26		
	D13	$\overline{S1}$	27		
	D14	$\overline{S2}$	28		
CLOCK	S1			\overline{MRDC}	7
	S2			\overline{MWTC}	9
	S3			\overline{IORC}	13
	S4			\overline{IOWC}	11
	S5			\overline{INTA}	14
	H1			ALE	5
	H2			LEAVE UNCONNECTED	

8088, MAX MODE, FORMAT MENU SETUP (using 48 channels)

00842-097

```

----- FORMAT MENU 8088/MAX ----- STOPPED
SAMPLE CLOCK S1 or S2 or S3 or S4 or S5
SLOPE:      +      +      +      +      +

HOLD CLOCK  H1  H2
POLARITY:   +   X

===== GROUP ASSIGNMENT =====
μSLOT  MIX  HOLD CLK  5432109876543210-1sb  GROUP  NAME  POL  RADIX
3L     Yes  H1 H1=PASS  .....AAAAAAAA 1s  A      ADDRESS +    HEX
        Yes  H2 X      .....DDDDDDDD  B      S6 - S3 +    BIN
3H     Yes  H1 H1=PASS  .....AAAAAAAA  C      CONTROL +    BIN
        Yes  H2 X      .....XXXXXXXX  D      DATA  +    HEX
4      Yes  H1 H1=PASS  .....XCCCCAAA  STATE
        Yes  H2 X      .....XXXXBBBB  EXT INPUT
5      No   X      .....XXXXXXXXXX 1ms  I

DISPLAY ORDER: 10005XXXXX

>Command: Edit  enVie  Go  Menus  Display  User_display  /-help
    
```

8088, MAX MODE CLOCKING
CONNECTIONS
(using 32 channels)

μ Slot	ISA LEAD	8088	PIN#	8288	PIN#
1	D0	AD0	16		
	D1	AD1	15		
	D2	AD2	14		
	D3	AD3	13		
	D4	AD4	12		
	D5	AD5	11		
	D6	AD6	10		
2	D7	AD7	9		
	D0	A8	8		
	D1	A9	7		
	D2	A10	6		
	D3	A11	5		
	D4	A12	4		
	D5	A13	3		
3	D6	A14	2		
	D7	A15	39		
	D0	A16/S3	38		
	D1	A17/S4	37		
	D2	A18/S5	36		
	D3	A19/S6	35		
	D4	$\overline{S0}$	26		
D5	$\overline{S1}$	27			
CLOCK	D6	$\overline{S2}$	28		
	S1			\overline{MRDC}	7
	S2			\overline{MWTC}	9
	S3			\overline{IORC}	13
	S4			\overline{IOWC}	11
	S5			INTA	14
	H1			ALE	5
H2		LEAVE UNCONNECTED			

68000 CLOCKING CONNECTIONS
(using 48 channels)

μ SLOT	ISA LEAD	68000	PIN#
3	D0	GND	53
	D1	A1	29
	D2	A2	30
	D3	A3	31
	D4	A4	32
	D5	A5	33
	D6	A6	34
	D7	A7	35
	D8	A8	36
	D9	A9	37
	D10	A10	38
	D11	A11	39
	D12	A12	40
	D13	A13	41
	D14	A14	42
D15	A15	43	
4	D0	A16	44
	D1	A17	45
	D2	A18	46
	D3	A19	47
	D4	A20	48
	D5	A21	50
	D6	A22	51
	D7	A23	52
	D8	$\overline{\text{BERR}}$	22
	D9	$\overline{\text{BGACK}}$	12
	D10	$\overline{\text{UDS}}$	7
	D11	$\overline{\text{LDS}}$	8
	D12	R/W	9
	D13	FC0	28
	D14	FC1	27
D15	FC2	26	
5	D0	D0	5
	D1	D1	4
	D2	D2	3
	D3	D3	2
	D4	D4	1
	D5	D5	64
	D6	D6	63
	D7	D7	62
D8	D8	61	

68000 CLOCKING CONNECTIONS (cont.)

μ SLOT	ISA LEAD	68000	PIN #
5 (cont)	D9	D9	60
	D10	D10	59
	D11	D11	58
	D12	D12	57
	D13	D13	56
	D14	D14	55
CLOCK	D15	D15	54
	S1	LDS	8
	S2	UDS	7
	S3	NOT CONNECTED	
	S4	NOT CONNECTED	
	S5	NOT CONNECTED	
	H1	NOT CONNECTED	
H2	NOT CONNECTED		

68000 FORMAT MENU SETUP (using 48 channels)

00842-099

```

----- FORMAT MENU 68000 ----- STOPPED
SAMPLE CLOCK S1 or S2 or S3 or S4 or S5
SLOPE:      +   +   0?  0?  0?
HOLD CLOCK  H1   H2
POLARITY:   X   X
RUN/STOP:  RUN

----- GROUP ASSIGNMENT -----
ISLOT  MUX  HOLD CLK  5432109876543210-1sb  GROUP  NAME  POL  RADIX
3L    No   X       11111111111111111111 1s  ADDRESS +  HEX
3U    No   X       00000000000000000000  STATUS +  BIN
4     No   X       00000000000000000000  DATA  +  HEX
5     No   X       00000000000000000000  MS
STATE
EXT INPUT
DISPLAY ORDER: 10CSXXXXXXXXX

)Command: Edit  enVir  Go  Menus  Display  User_display  ?=help
    
```


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